



**FCC 47 CFR PART 15 SUBPART C**

**TEST REPORT**

**For**

**Rocketfish RF-QX5 Bluetooth Mono Headset**

**Model: RF-QX5**

**Brand Name: Rocketfish**

*Prepared for*

**Primax Electronics Ltd.**

**No. 669, Ruey Kuang Road, Neihu 114 Taipei, Taiwan. R.O.C.**

*Prepared by*

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# 1. TEST RESULT CERTIFICATION

**Applicant:** Primax Electronics Ltd.  
 No. 669, Ruey Kuang Road, Neihu 114 Taipei, Taiwan. R.O.C.

**Equipment Under Test:** Rocketfish RF-QX5 Bluetooth Mono Headset

**Brand Name:** Rocketfish

**Model:** RF-QX5

**Date of Test:** August 28 - September 08, 2009

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

### We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.207, 15.209 and 15.247.

The test results of this report relate only to the tested sample EUT identified in this report.

*Approved by:*

*Reviewed by:*

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**Clinton Kao**  
**Manager**  
**Compliance Certification Service Inc.**

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**Vincent Yao**  
**Assistant manager**  
**Compliance Certification Service Inc.**



## 2. EUT DESCRIPTION

<b>Product</b>	Rocketfish RF-QX5 Bluetooth Mono Headset
<b>Brand Name</b>	Rocketfish
<b>Model Number</b>	RF-QX5
<b>Model Discrepancy</b>	N/A
<b>Power Supply</b>	DC3.7V Powered by the lithium battery Adapter Model name/ Manufacturer YJS005A-0500500U/ I.T.E AC input: AC100~240V, 50/60Hz,180mA DC output: DC5V, 500mA DC output cable: Un-shielded, 1.25m
<b>Frequency Range</b>	2402 ~ 2480 MHz
<b>Transmit Power</b>	3.28dBm
<b>Modulation Technique</b>	FHSS(GFSK, $\pi/4$ -DQPSK, 8DPSK)
<b>Number of Channels</b>	79 Channels
<b>Antenna Specification</b>	Ceramic Antenna with 7.91 dBi gain(Max)

*Note: This submittal(s) (test report) is intended for FCC ID: EMJTRFQX5 filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.*



### **3. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance 3 meters.

#### **3.1 EUT CONFIGURATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

#### **3.2 EUT EXERCISE**

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

#### **3.3 GENERAL TEST PROCEDURES**

##### **Conducted Emissions**

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4: 2003. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

##### **Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4: 2003.

### 3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	( <sup>2</sup> )
13.36 - 13.41	322 - 335.4		

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

### 3.5 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

The following test mode(s) were scanned during the preliminary test below 1G:

Test Item	Test mode	Worse mode
Conducted Emission	Mode 1: Charge with the adapter	■
	Mode 2: Charge with PC	□
Radiated Emission	Mode 1: Charge with the adapter	□
	Mode 2: Charge with PC	□
	Mode 3: Normal link	■

Above 1G, Channel Low (2402MHz) 、Mid (2441MHz) and High (2480MHz) were chosen for full testing for GFSK and 8DPSK.



#### **4. INSTRUMENT CALIBRATION**

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.



## 5. FACILITIES AND ACCREDITATIONS

### 5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

**No10-1, Mingkeda Logistics Park, No.18 Huanguan South RD. Guan lan Town, Baoan District, Shenzhen China**

The sites are constructed in conformance with the requirements of ANSI C63.4:2003, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

### 5.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following accreditation body according to ISO/IEC 17025.

<b>USA</b>	<b>A2LA</b>
<b>Taiwan</b>	<b>TAF</b>

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

<b>USA</b>	<b>FCC</b>
<b>Japan</b>	<b>VCCI</b>
<b>Canada</b>	<b>INDUSTRY CANADA</b>
<b>Taiwan</b>	<b>BSMI</b>
<b>Norway</b>	<b>Nemko</b>

Copies of granted accreditation certificates are available for downloading from our web site, <http://www.ccsrf.com>

### 5.3 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

<b>Measurement</b>	<b>Frequency</b>	<b>Uncertainty</b>
Conducted emissions	9kHz~30MHz	+/- 3.18dB
Radiated emissions	30MHz ~ 200MHz	+/- 3.79dB
	200MHz ~1000MHz	+/- 3.62dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

The measured result is above (below) the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance (non-compliance) is more probable than non-compliance) with the specification limit.





## 6. SETUP OF EQUIPMENT UNDER TEST

### 6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

### 6.2 SUPPORT EQUIPMENT

No.	Equipment	Model No.	Serial No.	FCC ID	Trade Name	Data Cable	Power Cord
1	Mobile phone	E50	N/A	N/A	NOKIA	N/A	N/A
2	Notebook	2672	992F2VG	N/A	IBM	N/A	Unshielded 1.80m

**Notes:**

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.



## 7. FCC PART 15.247 REQUIREMENTS

### 7.1 20DB BANDWIDTH

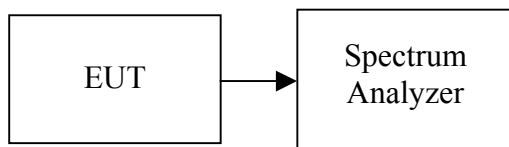
None; for reporting purpose only.

### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010

*Remark: Each piece of equipment is scheduled for calibration once a year.*

### TEST CONFIGURATION



### TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT, then connect a low loss RF cable from antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=30kHz, VBW=100kHz, Span=3MHz, Sweep = auto.
4. Mark the peak frequency and 20dB (upper and lower) frequency.
5. Repeat until all the test channels are investigated.

### TEST RESULTS

No non-compliance noted



**Test plot**

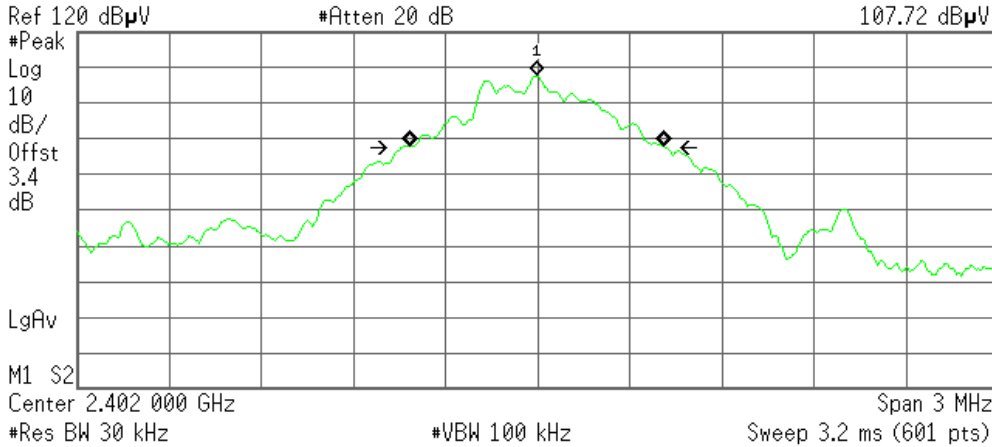
**GFSK**

**20dB Bandwidth (CH Low)**

Agilent 15:23:07 2 Sep 2009

R T

Mkr1 2.401 995 GHz  
107.72 dBμV



**Occupied Bandwidth**  
826.8514 kHz

**Occ BW % Pwr** 99.00 %  
**x dB** -20.00 dB

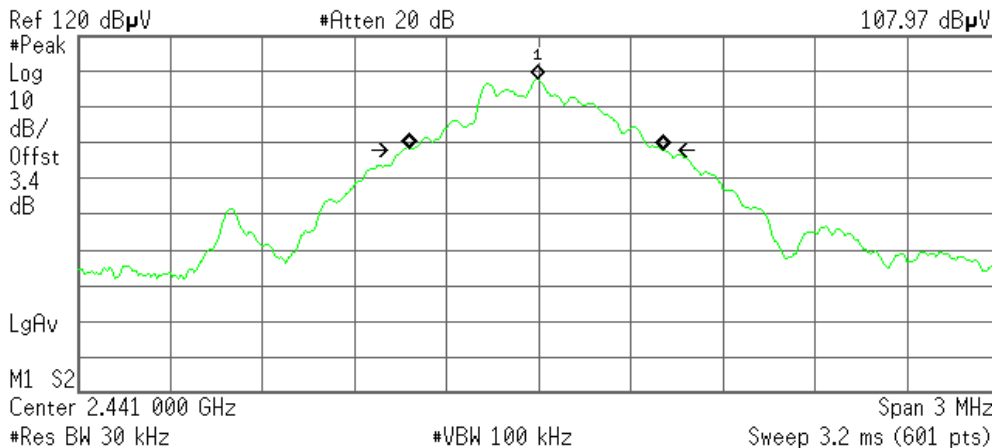
**Transmit Freq Error** -3.097 kHz  
**x dB Bandwidth** 855.833 kHz

**20dB Bandwidth (CH Mid)**

Agilent 15:24:04 2 Sep 2009

R T

Mkr1 2.440 995 GHz  
107.97 dBμV



**Occupied Bandwidth**  
826.2921 kHz

**Occ BW % Pwr** 99.00 %  
**x dB** -20.00 dB

**Transmit Freq Error** -5.743 kHz  
**x dB Bandwidth** 845.826 kHz



### 20dB Bandwidth (CH High)

Agilent 15:25:18 2 Sep 2009

R T

Mkr1 2.479 995 GHz

108.39 dBμV

Ref 120 dBμV

#Atten 20 dB

#Peak

Log

10

dB/

Offst

3.4

dB

LgAv

M1 S2

Center 2.480 000 GHz

Span 3 MHz

#Res BW 30 kHz

#VBW 100 kHz

Sweep 3.2 ms (601 pts)

Occupied Bandwidth

822.8337 kHz

Occ BW % Pwr 99.00 %

x dB -20.00 dB

Transmit Freq Error -5.447 kHz

x dB Bandwidth 845.869 kHz

### 8DPSK

### 20dB Bandwidth (CH Low)

Agilent 16:55:20 2 Sep 2009

R T

Mkr1 2.401 995 GHz

108.27 dBμV

Ref 120 dBμV

#Atten 20 dB

#Peak

Log

10

dB/

Offst

3.4

dB

LgAv

M1 S2

Center 2.402 000 GHz

Span 3 MHz

#Res BW 30 kHz

#VBW 100 kHz

Sweep 3.2 ms (601 pts)

Occupied Bandwidth

1.1302 MHz

Occ BW % Pwr 99.00 %

x dB -20.00 dB

Transmit Freq Error 8.585 kHz

x dB Bandwidth 1.195 MHz



### 20dB Bandwidth (CH Mid)

Agilent 16:54:37 2 Sep 2009

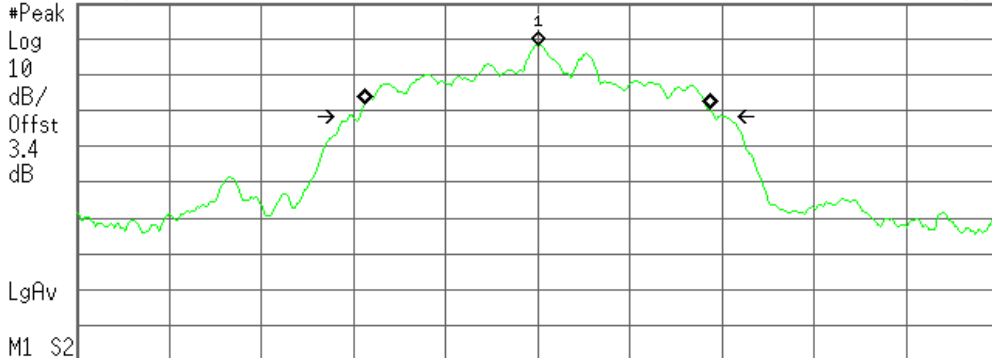
R T

Mkr1 2.441 005 GHz

108.51 dBμV

Ref 120 dBμV

#Atten 20 dB



Center 2.441 000 GHz

Span 3 MHz

#Res BW 30 kHz

#VBW 100 kHz

Sweep 3.2 ms (601 pts)

Occupied Bandwidth

1.1204 MHz

Occ BW % Pwr 99.00 %

x dB -20.00 dB

Transmit Freq Error -1.426 kHz

x dB Bandwidth 1.222 MHz

### 20dB Bandwidth (CH High)

Agilent 16:53:52 2 Sep 2009

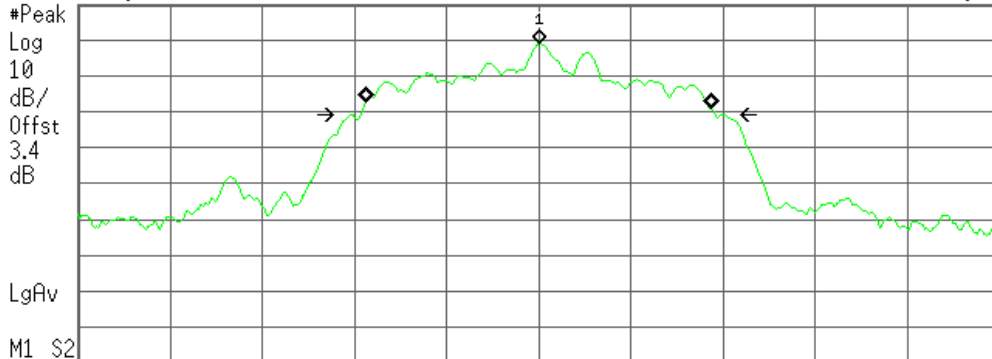
R T

Mkr1 2.480 005 GHz

109.16 dBμV

Ref 120 dBμV

#Atten 20 dB



Center 2.480 000 GHz

Span 3 MHz

#Res BW 30 kHz

#VBW 100 kHz

Sweep 3.2 ms (601 pts)

Occupied Bandwidth

1.1210 MHz

Occ BW % Pwr 99.00 %

x dB -20.00 dB

Transmit Freq Error -1.591 kHz

x dB Bandwidth 1.226 MHz

## 7.2 PEAK POWER

### LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

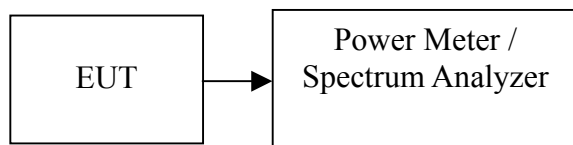
1. For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
2. Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6dBi.
3. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
RF Power Meter & Sensor	Anritsu	ML2487A	6K00001491	02/23/2010
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010

*Remark: Each piece of equipment is scheduled for calibration once a year.*

### Test Configuration



### TEST PROCEDURE

The transmitter output is connected to the RF Power Meter. The RF Power Meter is set to the peak power detection.



**TEST RESULTS**

*No non-compliance noted*

**Test Data**

**GFSK**

Channel	Frequency (MHz)	Reading Power (dBm)	Factor (dB)	Output Power (dBm)	Output Power (W)	Limit (mW)	Result
Low	2402	-1.12	3.40	2.28	0.00169	81	PASS
Md	2441	-0.49	3.40	2.91	0.00195		PASS
Hgh	2480	-0.42	3.40	2.98	0.00199		PASS

**8DPSK**

Channel	Frequency (MHz)	Reading Power (dBm)	Factor (dB)	Output Power (dBm)	Output Power (W)	Limit (mW)	Result
Low	2402	-0.43	3.40	2.97	0.00198	81	PASS
Md	2441	-0.32	3.40	3.08	0.00203		PASS
Hgh	2480	-0.12	3.40	3.28	0.00213		PASS

Note: Since the antenna gain exceeds 6dBi, the power limit is lowered from 125mW to 81mW.

### 7.3 PEAK POWER SPECTRAL DENSITY

#### LIMIT

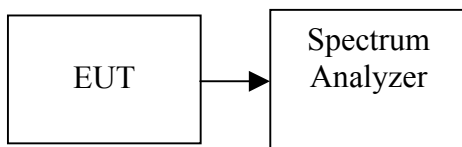
1. For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.
2. The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

#### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010

*Remark: Each piece of equipment is scheduled for calibration once a year.*

#### Test Configuration



#### TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 300kHz, Sweep=100s
4. Record the max. reading.
5. Repeat the above procedure until the measurements for all frequencies are completed.

#### TEST RESULTS

*Not applicable. Since EUT is the Bluetooth device.*



## 7.4 BAND EDGES MEASUREMENT

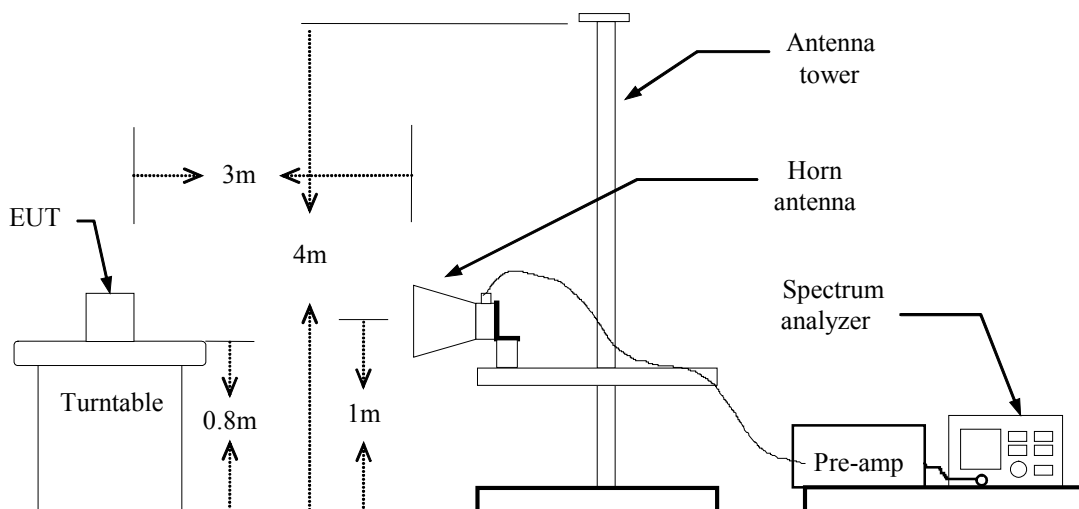
### LIMIT

According to §15.247(c), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010
EMI Test Receiver	R&S	ESCI	1166.5950 03	01/13/2010
Low Noise Amplifier	MITEQ	AM-1604-3000	1123808	02/14/2010
Bilog Antenna	SCHWAZBECK	CBL6143	5082	06/09/2010
Turn Table	EMCO	2081-1.21	N/A	N.C.R
Antenna Tower	CT	N/A	N/A	N.C.R
Controller	CT	N/A	N/A	N.C.R
High Noise Amplifier	Agilent	89842	N/A	06/09/2010
Site NSA	C&C	N/A	N/A	06/09/2010
Horn Antenna	TRC	N/A	N/A	03/04/2010
Signal Generator	Anritsu	MG3694A	#050125	02/24/2010

### Test Configuration





## **TEST PROCEDURE**

1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
  - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

## **TEST RESULTS**

Refer to attach spectrum analyzer data chart.



**Test Data**

**GFSK**

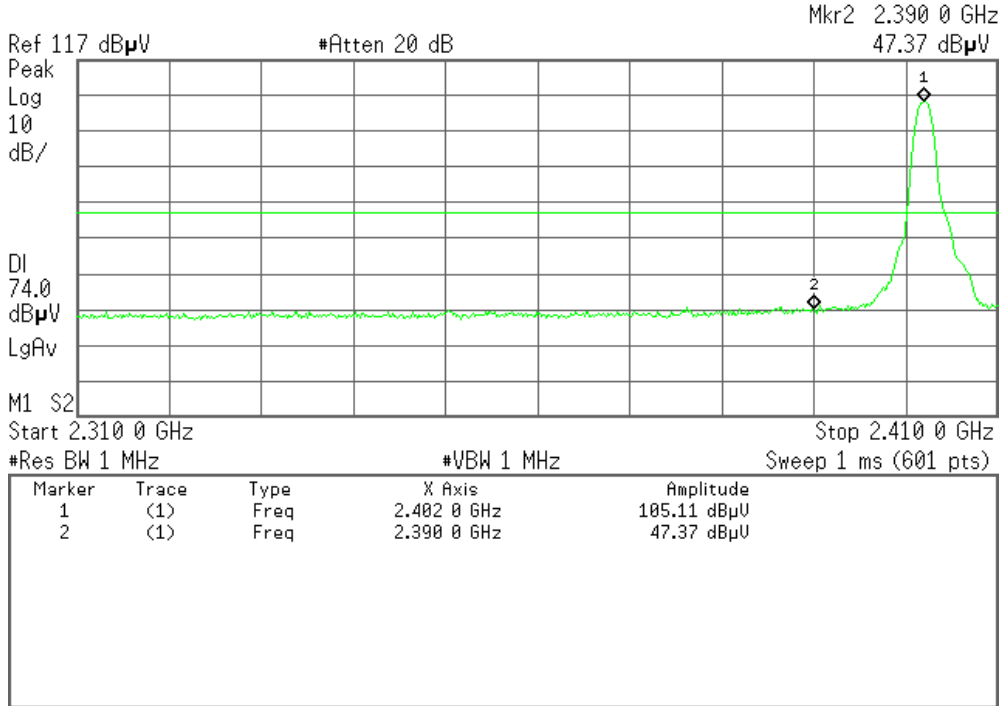
**Band Edges (CH-Low)**

**Detector mode: Peak**

**Polarity: Vertical**

Agilent 14:58:30 28 Aug 2009

R T

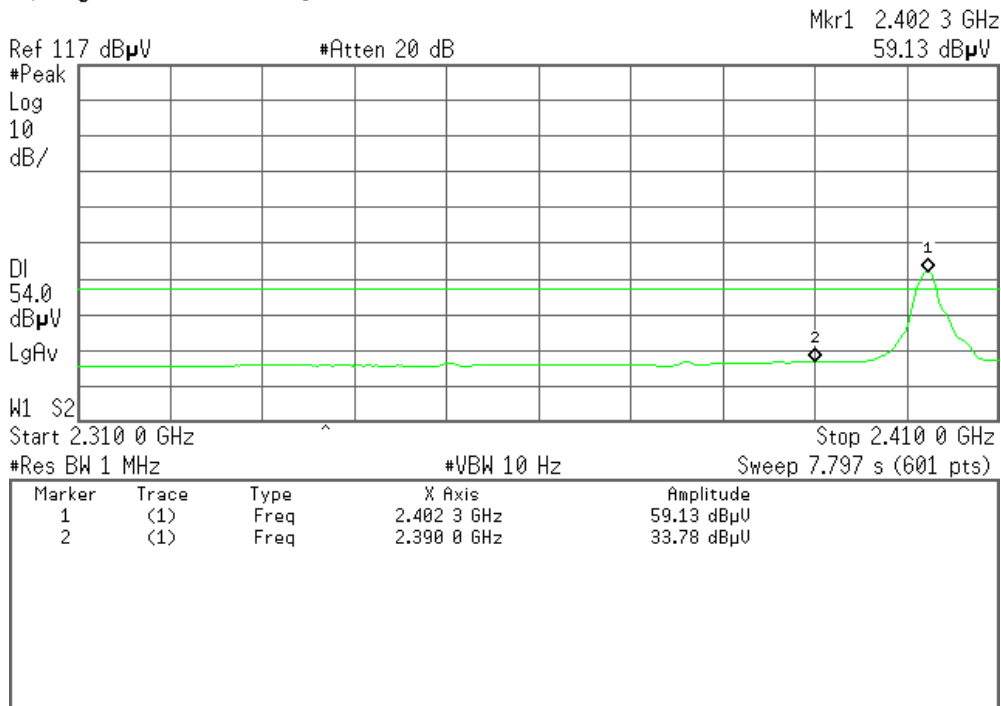


**Detector mode: Average**

**Polarity: Vertical**

Agilent 15:00:00 28 Aug 2009

R T



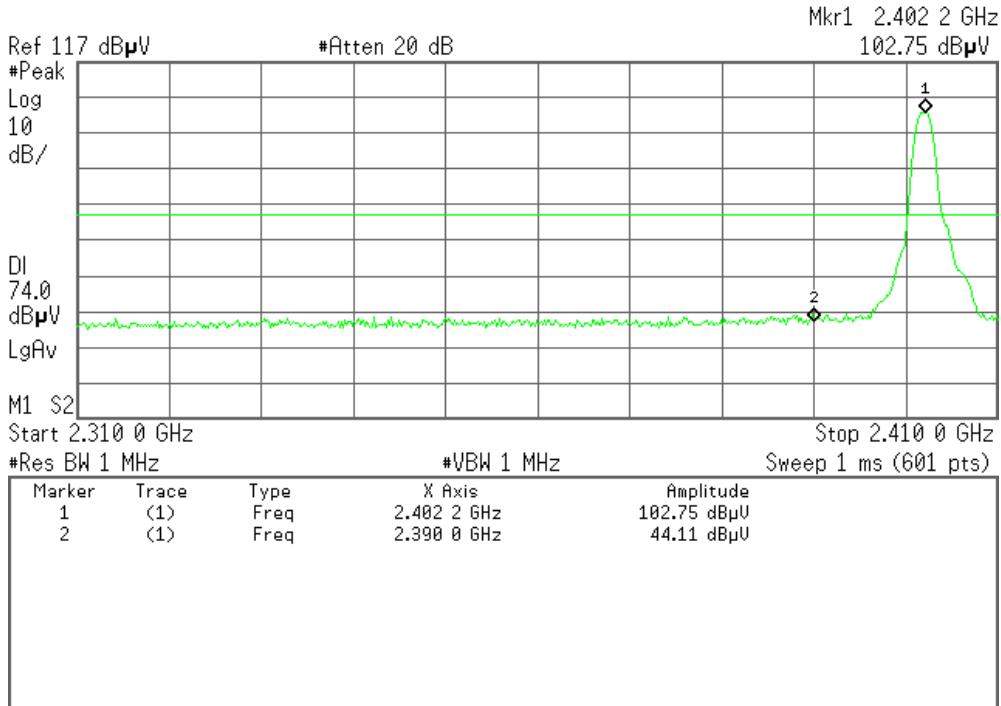


Detector mode: Peak

Polarity: Horizontal

Agilent 15:46:41 28 Aug 2009

R T

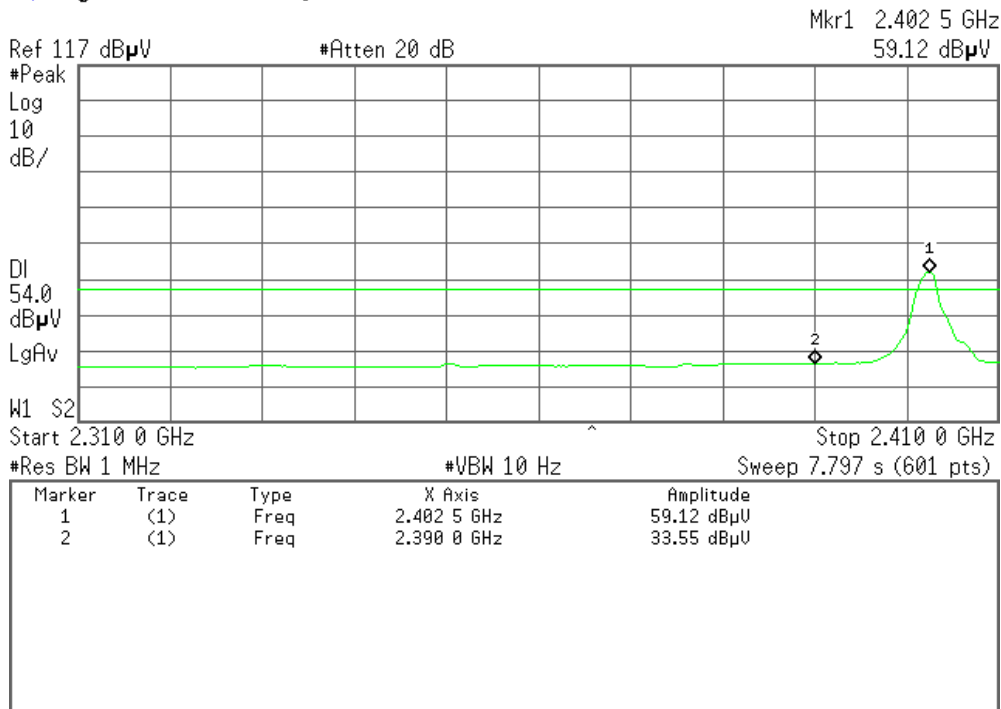


Detector mode: Average

Polarity: Horizontal

Agilent 15:45:55 28 Aug 2009

R T





### Band Edges (CH-High)

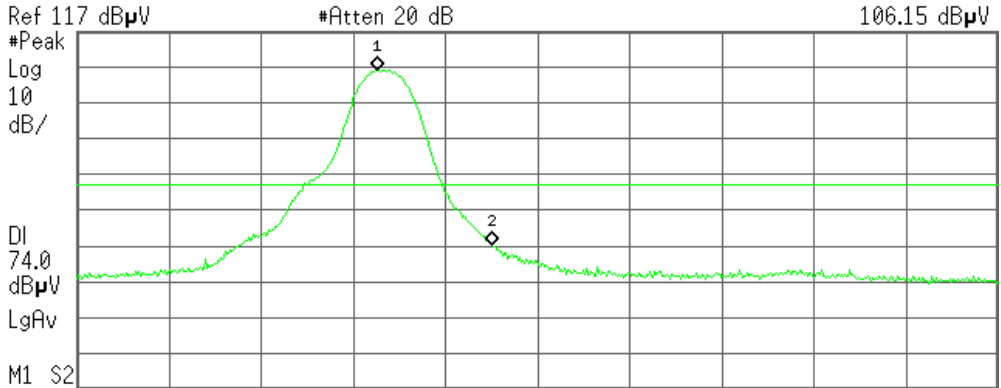
Detector mode: Peak

Polarity: Vertical

Agilent 15:56:46 28 Aug 2009

R T

Mkr1 2.479 80 GHz  
106.15 dBμV



Start 2.470 00 GHz #Res BW 1 MHz #Atten 20 dB #VBW 1 MHz Stop 2.500 00 GHz Sweep 1 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.479 80 GHz	106.15 dBμV
2	(1)	Freq	2.483 50 GHz	57.17 dBμV

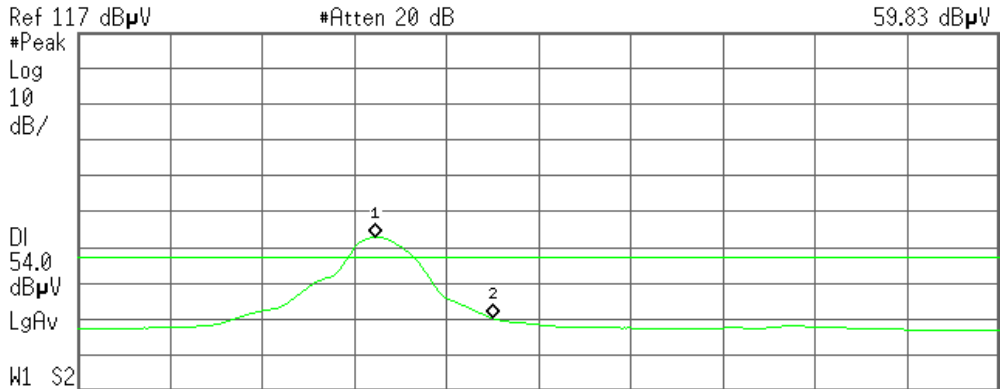
Detector mode: Average

Polarity: Vertical

Agilent 15:57:22 28 Aug 2009

R T

Mkr1 2.479 70 GHz  
59.83 dBμV



Start 2.470 00 GHz #Res BW 1 MHz #Atten 20 dB #VBW 10 Hz Stop 2.500 00 GHz Sweep 2.339 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.479 70 GHz	59.83 dBμV
2	(1)	Freq	2.483 50 GHz	37.21 dBμV



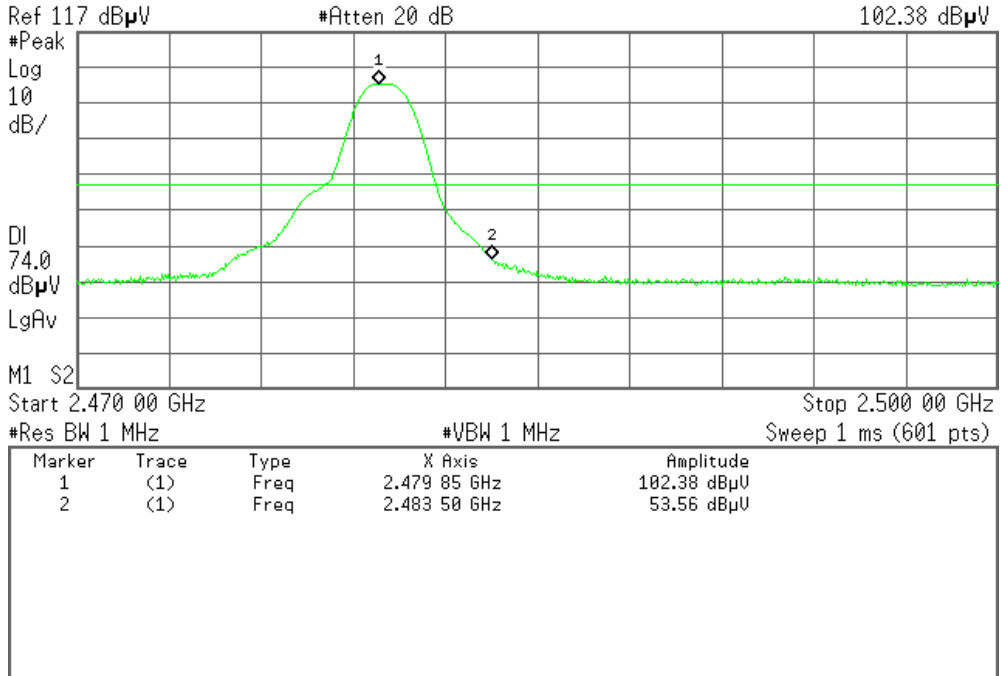
Detector mode: Peak

Polarity: Horizontal

Agilent 15:51:26 28 Aug 2009

R T

Mkr1 2.479 85 GHz  
102.38 dBµV



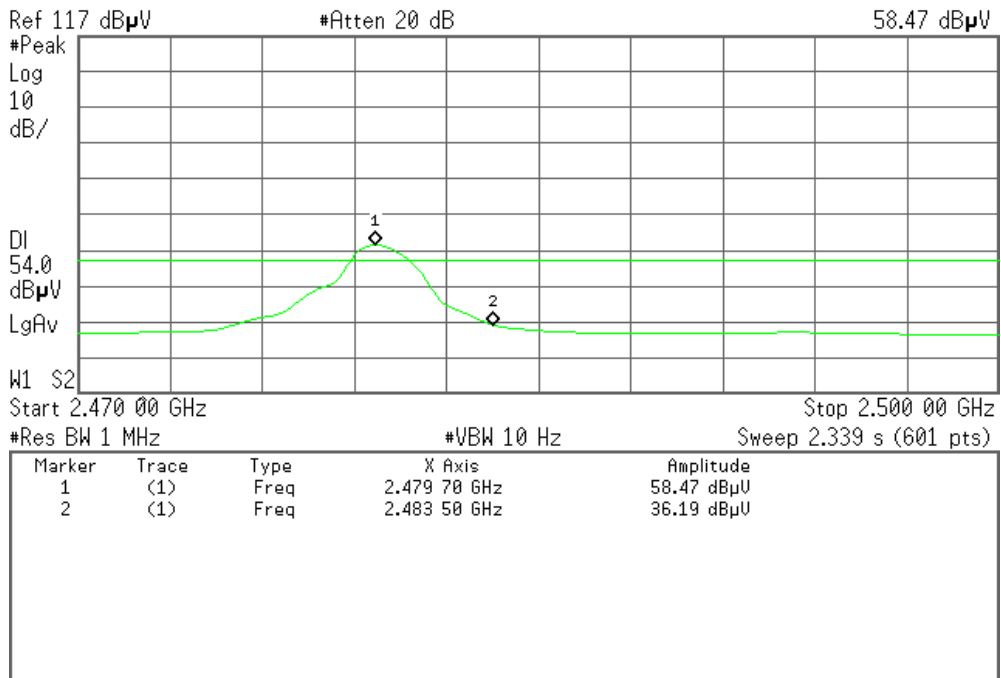
Detector mode: Average

Polarity: Horizontal

Agilent 15:52:23 28 Aug 2009

R T

Mkr1 2.479 70 GHz  
58.47 dBµV





### 8DPSK

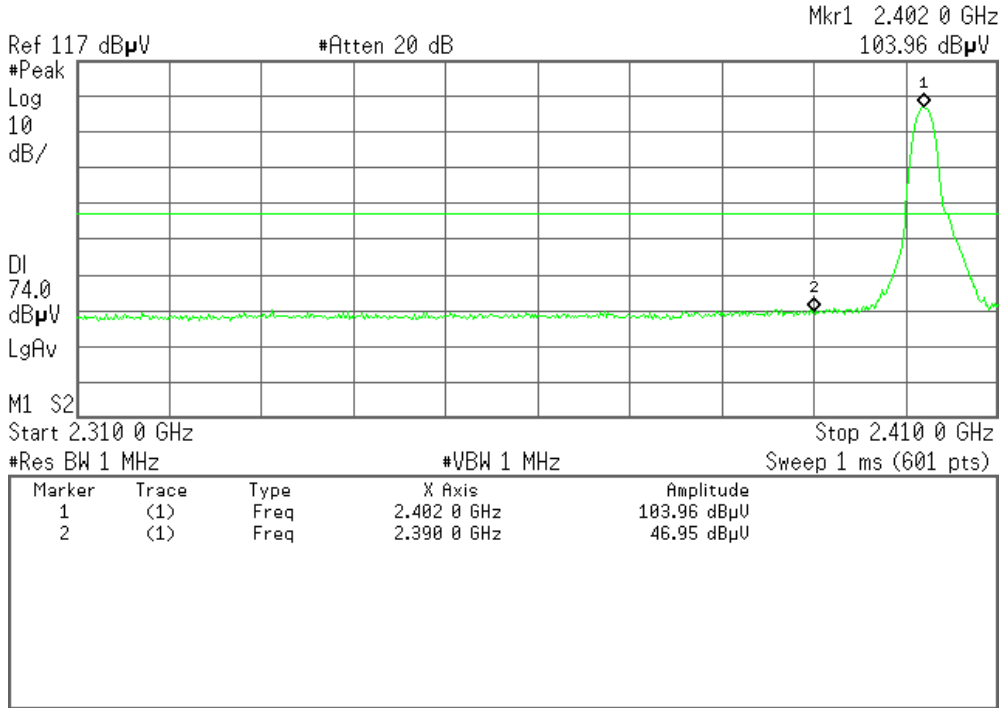
#### Band Edges (CH-Low)

Detector mode: Peak

Polarity: Vertical

Agilent 16:23:28 28 Aug 2009

R T

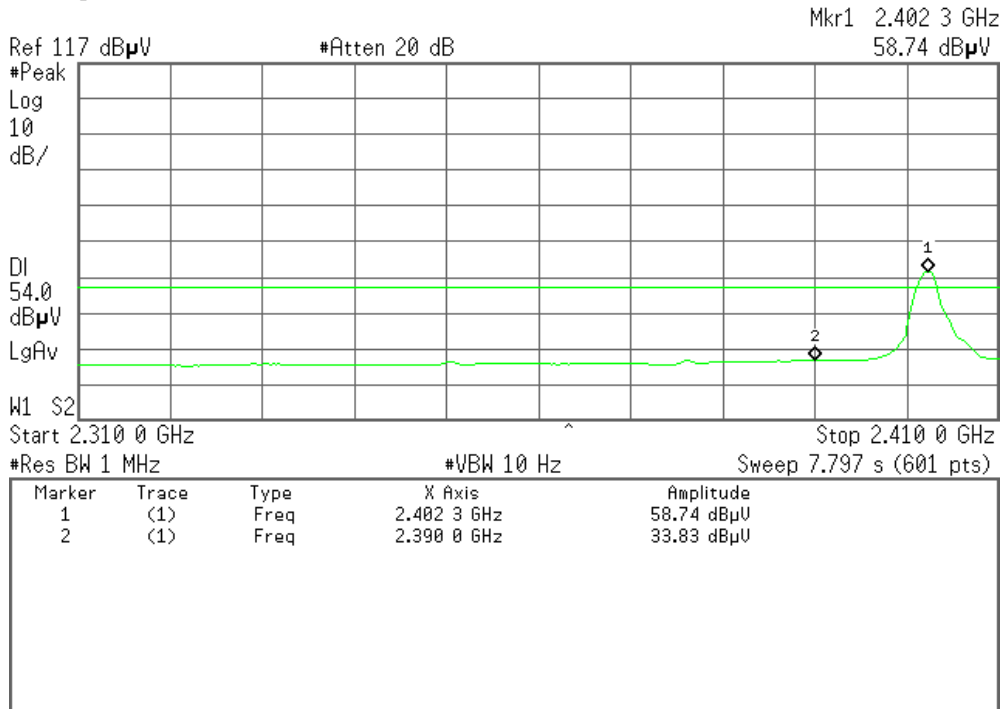


Detector mode: Average

Polarity: Vertical

Agilent 16:24:20 28 Aug 2009

R T



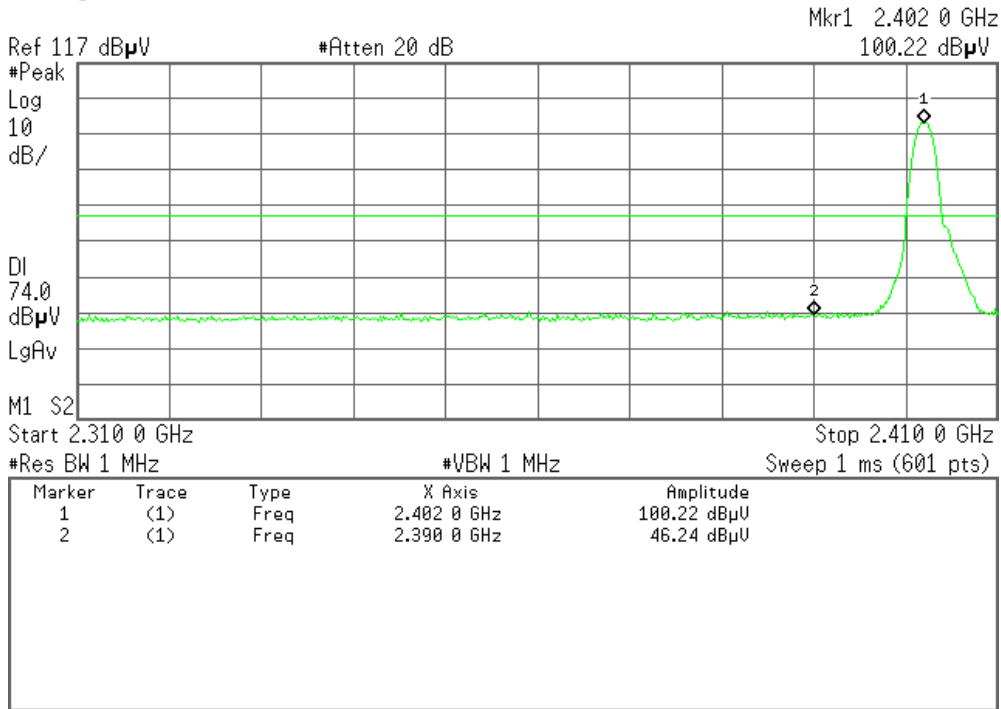


Detector mode: Peak

Polarity: Horizontal

Agilent 16:18:57 28 Aug 2009

R T

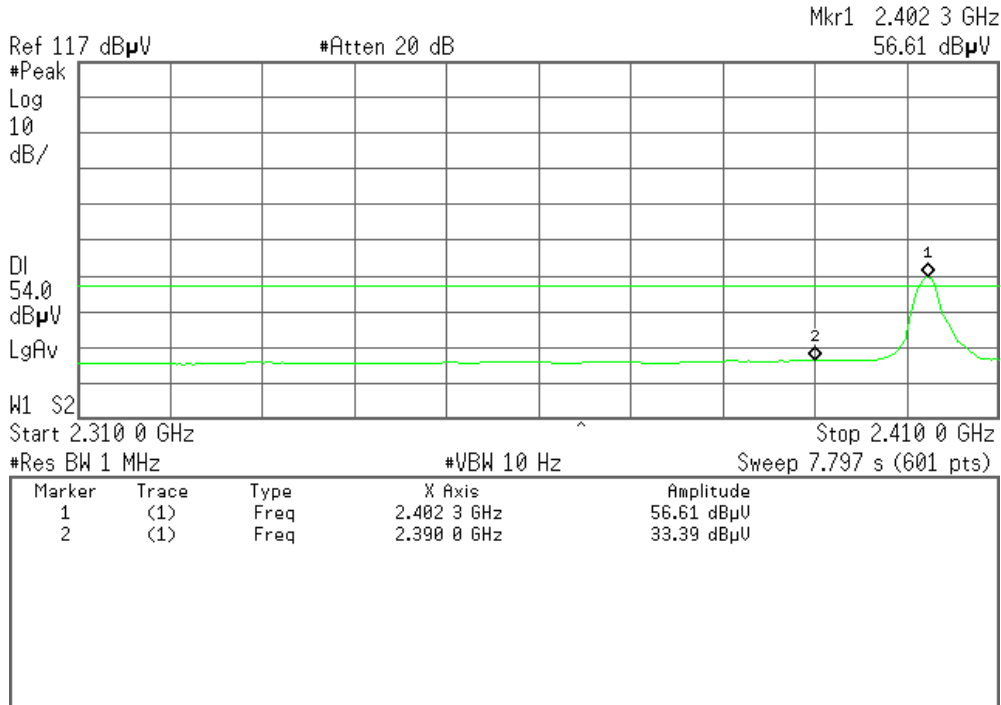


Detector mode: Average

Polarity: Horizontal

Agilent 16:19:36 28 Aug 2009

R T







### Band Edges (CH-High)

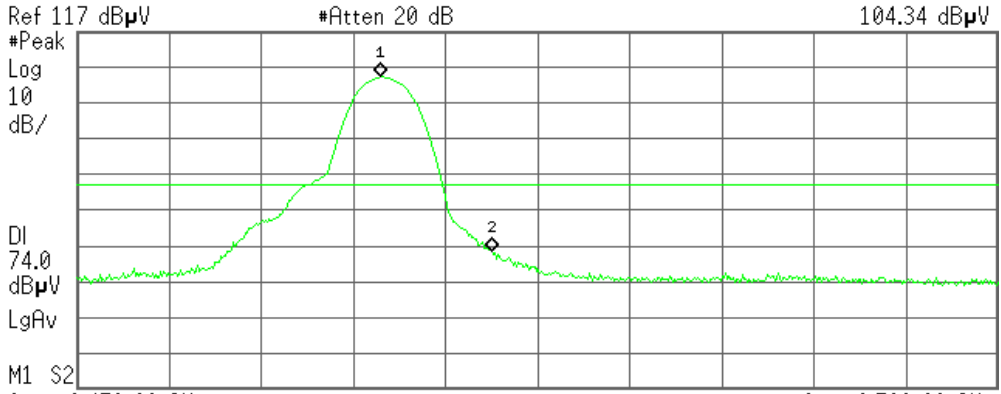
Detector mode: Peak

Polarity: Vertical

Agilent 16:03:54 28 Aug 2009

R T

Mkr1 2.479 90 GHz  
104.34 dBμV



#Res BW 1 MHz #VBW 1 MHz Sweep 1 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.479 90 GHz	104.34 dBμV
2	(1)	Freq	2.483 50 GHz	55.35 dBμV

Detector mode: Average

Polarity: Vertical

Agilent 16:09:15 28 Aug 2009

T

Mkr1 2.479 95 GHz  
99.42 dBμV



#Res BW 1 MHz #VBW 1 MHz Sweep 1 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.479 95 GHz	99.42 dBμV
2	(1)	Freq	2.483 50 GHz	50.60 dBμV



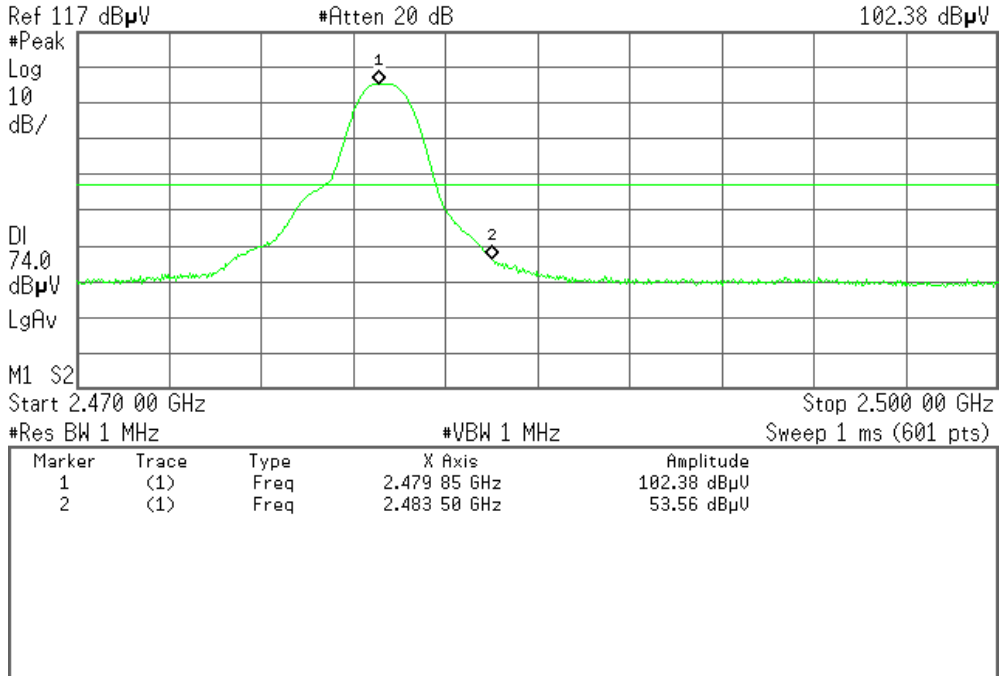
Detector mode: Peak

Polarity: Horizontal

Agilent 15:51:26 28 Aug 2009

R T

Mkr1 2.479 85 GHz  
102.38 dBµV



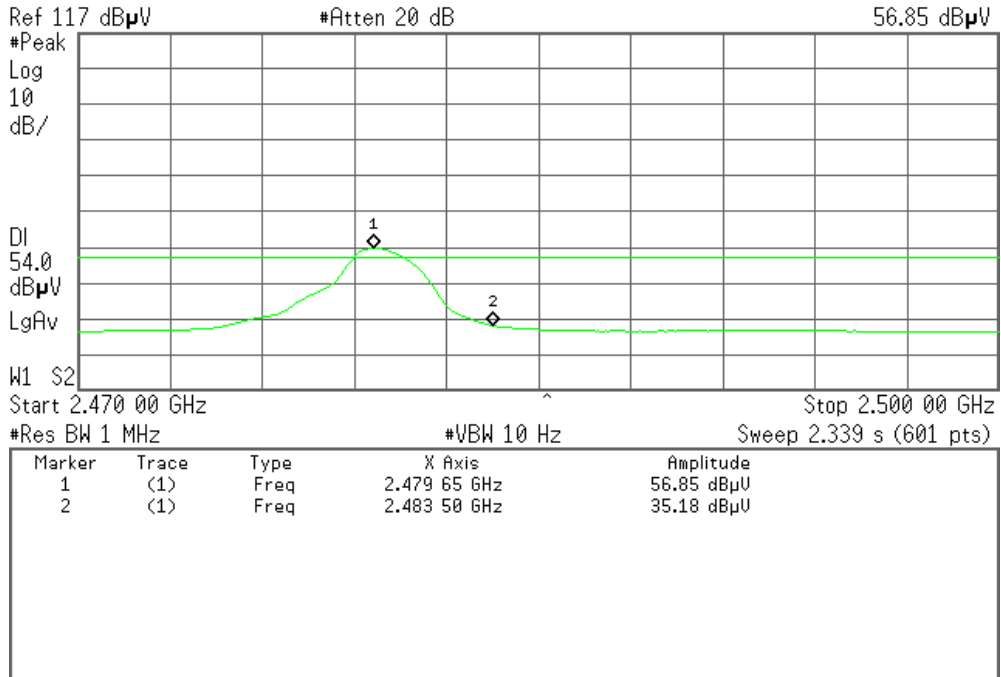
Detector mode: Average

Polarity: Horizontal

Agilent 16:13:02 28 Aug 2009

R T

Mkr1 2.479 65 GHz  
56.85 dBµV



## 7.5 FREQUENCY SEPARATION

### LIMIT

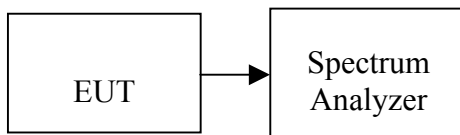
According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/22/2010

*Remark: Each piece of equipment is scheduled for calibration once a year.*

### Test Configuration



### TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW=30kHz, VBW=100kHz, Adjust Span to 3 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

### TEST RESULTS

*No non-compliance noted*

#### Test Data

##### GFSK

Channel Separation (MHz)	Two-thirds of the 20 dB Bandwidth (kHz)	Channel Separation Limit	Result
1.0	571	> Two-thirds of the 20 dB Bandwidth	Pass

##### 8DPSK

Channel Separation (MHz)	Two-thirds of the 20 dB Bandwidth (kHz)	Channel Separation Limit	Result
1.0	817	> Two-thirds of the 20 dB Bandwidth	Pass



**GFSK**

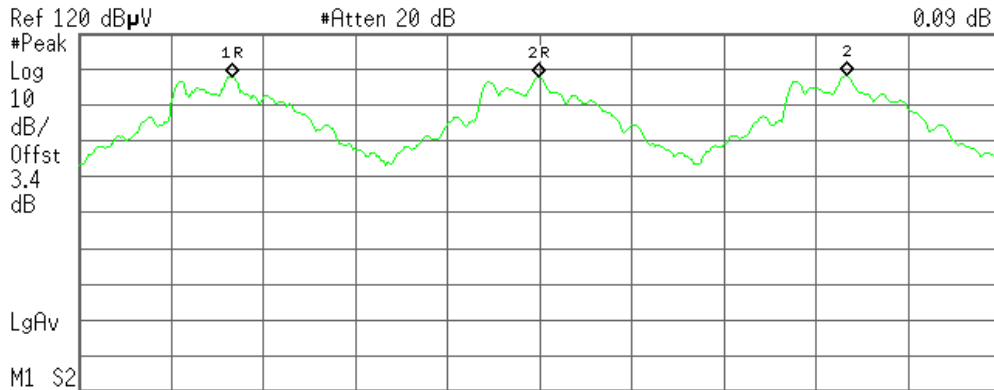
**Test Plot**

**Measurement of Channel Separation**

Agilent 15:36:58 2 Sep 2009

R T

Mkr2 1.000 MHz  
0.09 dB



Ref 120 dBμV #Atten 20 dB  
Center 2.441 000 GHz Span 3 MHz  
#Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms (601 pts)

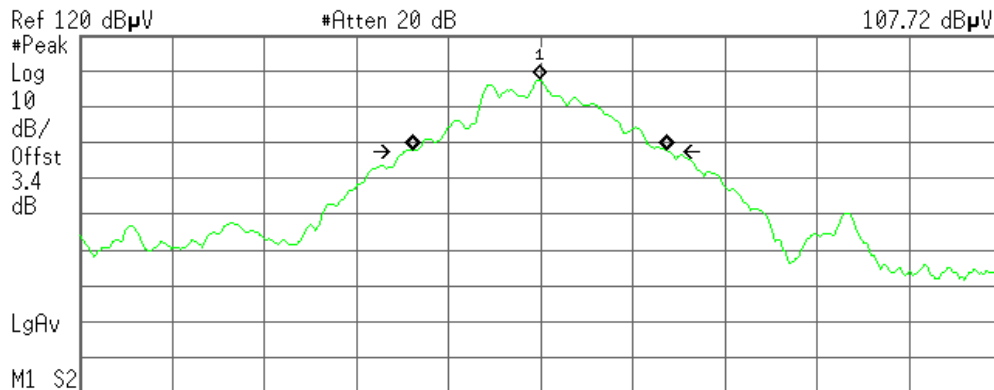
Marker	Trace	Type	X Axis	Amplitude
1R	(1)	Freq	2.440 001 GHz	107.90 dBμV
1Δ	(1)	Freq	1.000 MHz	0.18 dB
2R	(1)	Freq	2.441 000 GHz	108.00 dBμV
2Δ	(1)	Freq	1.000 MHz	0.09 dB

**20 dB bandwidth(CH Low)**

Agilent 15:23:07 2 Sep 2009

R T

Mkr1 2.401 995 GHz  
107.72 dBμV



Ref 120 dBμV #Atten 20 dB  
Center 2.402 000 GHz Span 3 MHz  
#Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms (601 pts)

**Occupied Bandwidth**  
826.8514 kHz

**Occ BW % Pwr** 99.00 %  
**x dB** -20.00 dB

**Transmit Freq Error** -3.097 kHz  
**x dB Bandwidth** 855.833 kHz



### 8DPSK

#### Test Plot

#### Measurement of Channel Separation

Agilent 16:51:10 2 Sep 2009

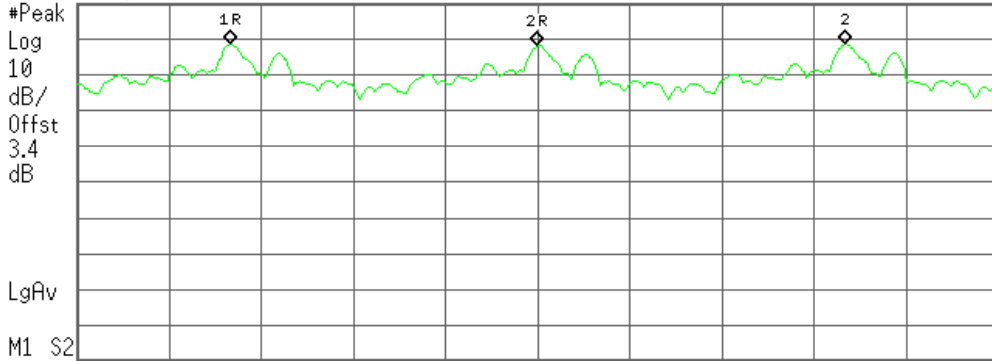
R T

Mkr2 1.000 MHz

0.10 dB

Ref 120 dBμV

#Atten 20 dB



Center 2.441 000 GHz

Span 3 MHz

#Res BW 30 kHz

#VBW 100 kHz

Sweep 3.2 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1R	(1)	Freq	2.440 000 GHz	108.58 dBμV
1Δ	(1)	Freq	1.000 MHz	-0.11 dB
2R	(1)	Freq	2.441 000 GHz	108.47 dBμV
2Δ	(1)	Freq	1.000 MHz	0.10 dB

#### 20 dB bandwidth(CH High)

Agilent 16:53:52 2 Sep 2009

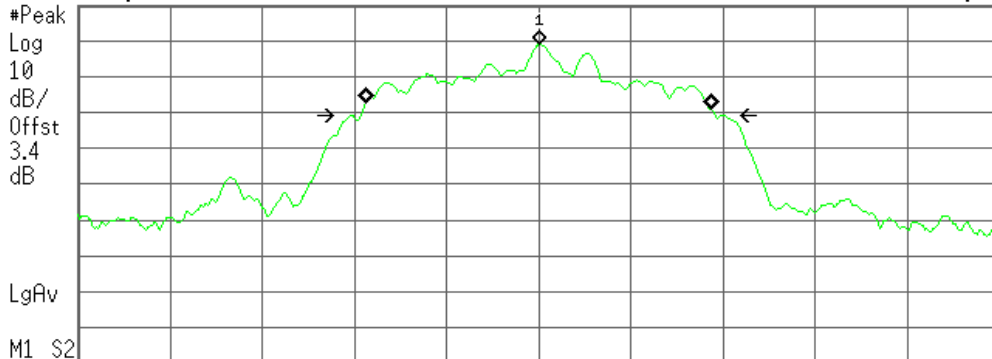
R T

Mkr1 2.480 005 GHz

109.16 dBμV

Ref 120 dBμV

#Atten 20 dB



Center 2.480 000 GHz

Span 3 MHz

#Res BW 30 kHz

#VBW 100 kHz

Sweep 3.2 ms (601 pts)

Occupied Bandwidth

1.1210 MHz

Occ BW % Pwr 99.00 %

x dB -20.00 dB

Transmit Freq Error -1.591 kHz

x dB Bandwidth 1.226 MHz

## 7.6 NUMBER OF HOPPING FREQUENCY

### LIMIT

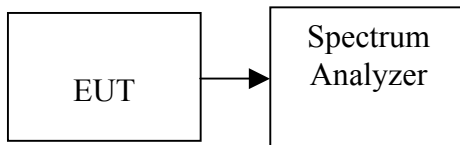
According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010

*Remark: Each piece of equipment is scheduled for calibration once a year.*

### Test Configuration



### TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2441.5MHz, Sweep = 5.04ms and Start=2441.5MHz, Stop = 2483.5MHz, Sweep = 5.08ms.
4. Set the spectrum analyzer as RBW, VBW=100kHz,
5. Max hold, view and count how many channel in the band.

### TEST RESULTS

*No non-compliance noted*

### Test Data

#### GFSK / 8DPSK

Result (No. of CH)	Limit (No. of CH)	Result
79	>15	PASS



**Test Plot**

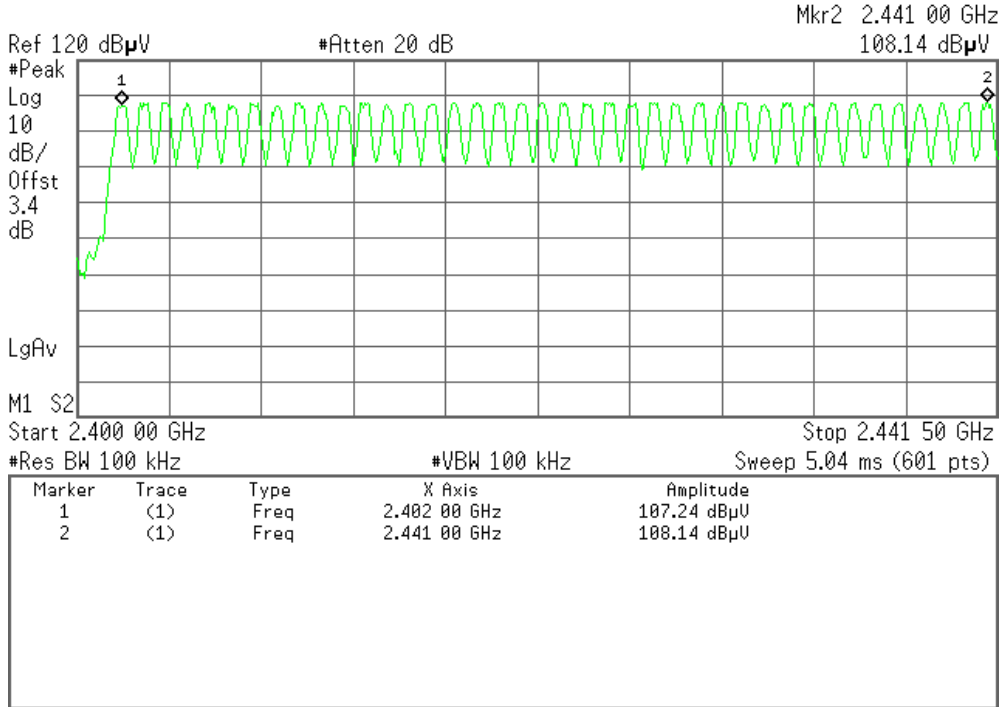
**Channel Number**

**GFSK**

**2.4 GHz – 2.441 GHz**

Agilent 15:28:34 2 Sep 2009

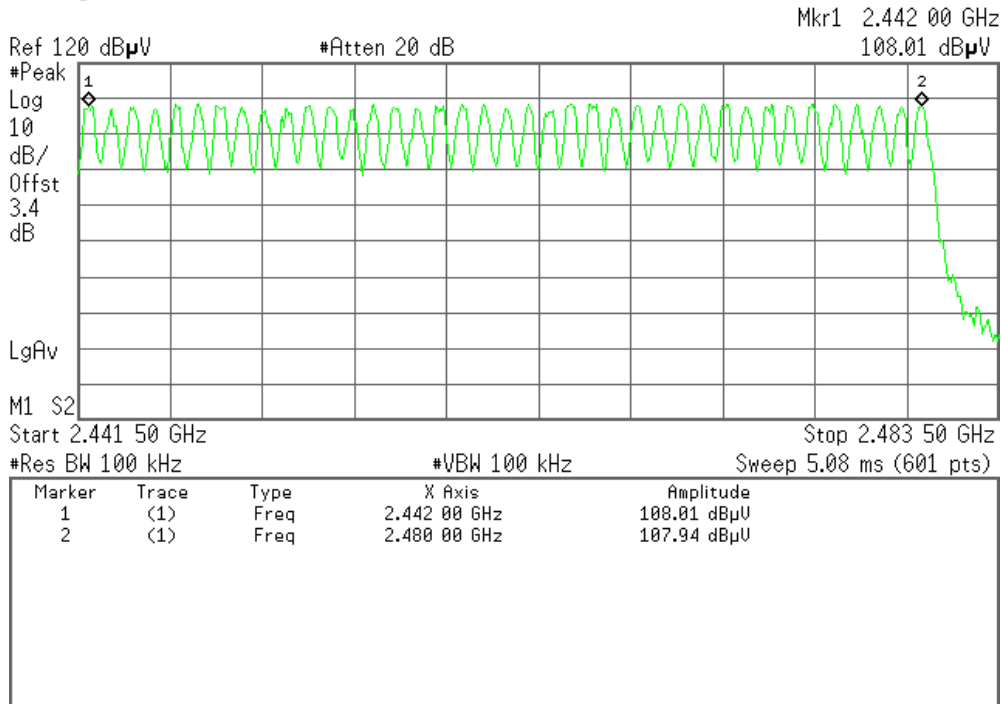
R T



**2.441 GHz – 2.4835 GHz**

Agilent 15:30:37 2 Sep 2009

R T





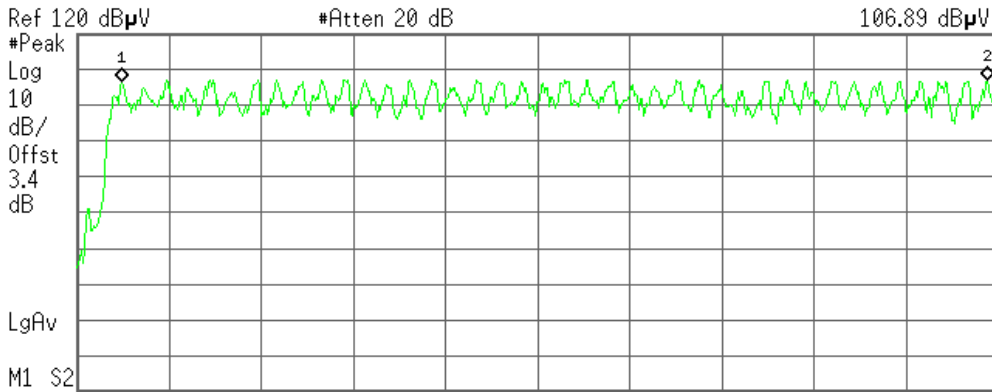
### 8DPSK

#### 2.4 GHz – 2.441 GHz

Agilent 16:43:09 2 Sep 2009

R T

Mkr2 2.441 00 GHz  
106.89 dBμV



Ref 120 dBμV #Atten 20 dB  
Start 2.400 00 GHz Stop 2.441 50 GHz  
#Res BW 100 kHz #VBW 100 kHz Sweep 5.04 ms (601 pts)

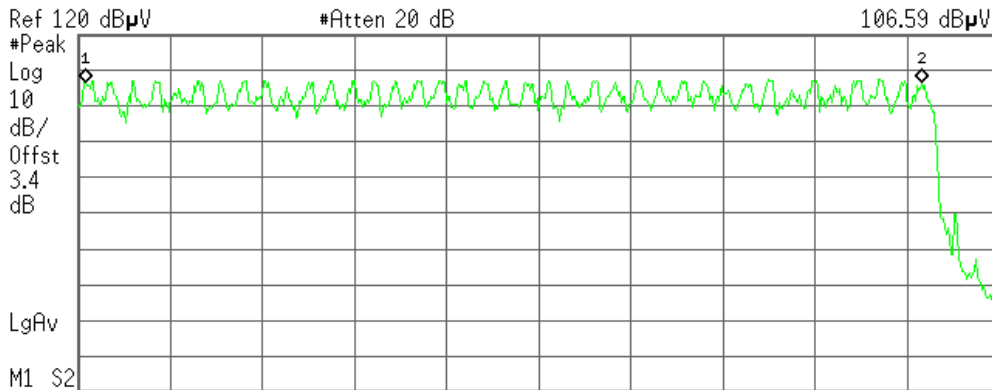
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.402 00 GHz	106.66 dBμV
2	(1)	Freq	2.441 00 GHz	106.89 dBμV

#### 2.441 GHz – 2.4835 GHz

Agilent 16:46:59 2 Sep 2009

R T

Mkr1 2.441 86 GHz  
106.59 dBμV



Ref 120 dBμV #Atten 20 dB  
Start 2.441 50 GHz Stop 2.483 50 GHz  
#Res BW 100 kHz #VBW 100 kHz Sweep 5.08 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.441 86 GHz	106.59 dBμV
2	(1)	Freq	2.480 00 GHz	106.37 dBμV



## 7.7 TIME OF OCCUPANCY (DWELL TIME)

### LIMIT

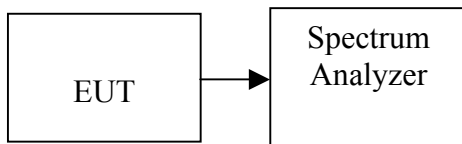
According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010

*Remark: Each piece of equipment is scheduled for calibration once a year.*

### Test Configuration



### TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, Span = 0Hz, Sweep = auto.
5. Repeat above procedures until all frequency measured were complete.



### TEST RESULTS

No non-compliance noted

#### Test Data

#### GFSK

#### DH 1

CH Low:  $0.40 * (1600/2)/79 * 31.6 = 128.0(\text{ms})$

CH Mid:  $0.40 * (1600/2)/79 * 31.6 = 128.0(\text{ms})$

CH High:  $0.40 * (1600/2)/79 * 31.6 = 128.0(\text{ms})$

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	0.40	128.0	31.60	400.00	PASS
Mid	0.40	128.0	31.60		PASS
High	0.40	128.0	31.60		PASS

#### DH 3

CH Low:  $1.65 * (1600/4)/79 * 31.6 = 264.0(\text{ms})$

CH Mid:  $1.65 * (1600/4)/79 * 31.6 = 264.0(\text{ms})$

CH High:  $1.65 * (1600/4)/79 * 31.6 = 264.0(\text{ms})$

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	1.65	264.0	31.60	400.00	PASS
Mid	1.65	264.0	31.60		PASS
High	1.65	264.0	31.60		PASS

#### DH 5

CH Low:  $2.90 * (1600/6)/79 * 31.6 = 309.3(\text{ms})$

CH Mid:  $2.90 * (1600/6)/79 * 31.6 = 309.3(\text{ms})$

CH High:  $2.90 * (1600/6)/79 * 31.6 = 309.3(\text{ms})$

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	2.90	309.3	31.60	400.00	PASS
Mid	2.90	309.3	31.60		PASS
High	2.90	309.3	31.60		PASS



**8DPSK**

**DH 1**

CH Low:  $0.41 * (1600/2)/79 * 31.6 = 131.2(\text{ms})$

CH Mid:  $0.41 * (1600/2)/79 * 31.6 = 131.2(\text{ms})$

CH High:  $0.41 * (1600/2)/79 * 31.6 = 131.2(\text{ms})$

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	0.41	131.2	31.60	400.00	PASS
Mid	0.41	131.2	31.60		PASS
High	0.41	131.2	31.60		PASS

**DH 3**

CH Low:  $1.67 * (1600/4)/79 * 31.6 = 267.2(\text{ms})$

CH Mid:  $1.67 * (1600/4)/79 * 31.6 = 267.2(\text{ms})$

CH High:  $1.66 * (1600/4)/79 * 31.6 = 265.6(\text{ms})$

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	1.67	267.2	31.60	400.00	PASS
Mid	1.67	267.2	31.60		PASS
High	1.66	265.6	31.60		PASS

**DH 5**

CH Low:  $2.91 * (1600/6)/79 * 31.6 = 310.4(\text{ms})$

CH Mid:  $2.91 * (1600/6)/79 * 31.6 = 310.4(\text{ms})$

CH High:  $2.91 * (1600/6)/79 * 31.6 = 310.4(\text{ms})$

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	2.91	310.4	31.60	400.00	PASS
Mid	2.91	310.4	31.60		PASS
High	2.91	310.4	31.60		PASS



**Test Plot**

**GFSK**

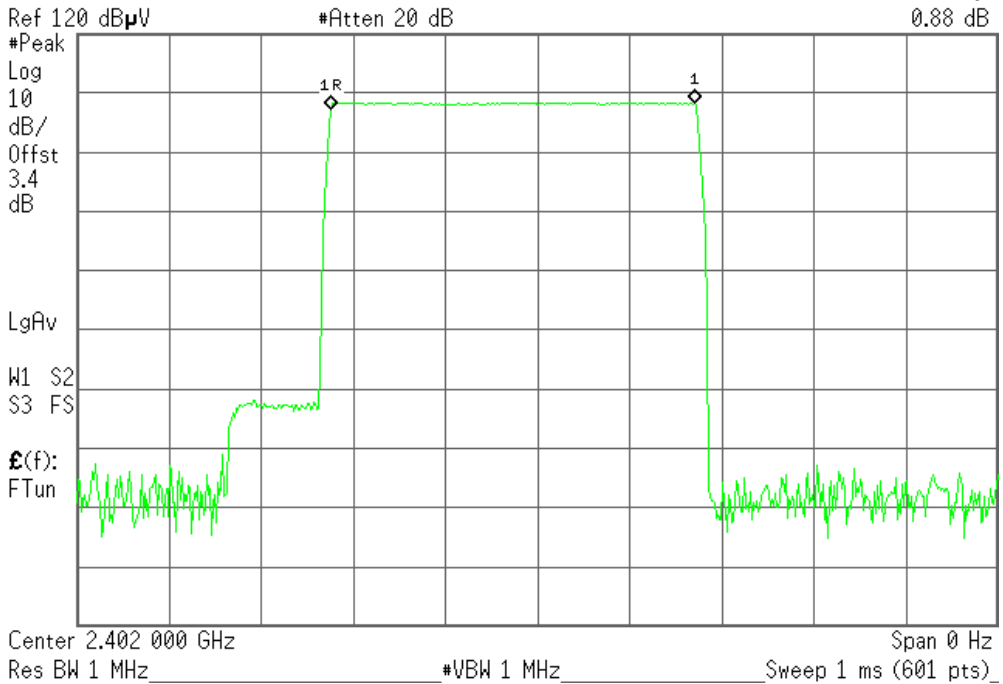
**DH 1**

**(CH Low)**

Agilent 16:07:52 2 Sep 2009

R T

Mkr1 395  $\mu$ s  
0.88 dB

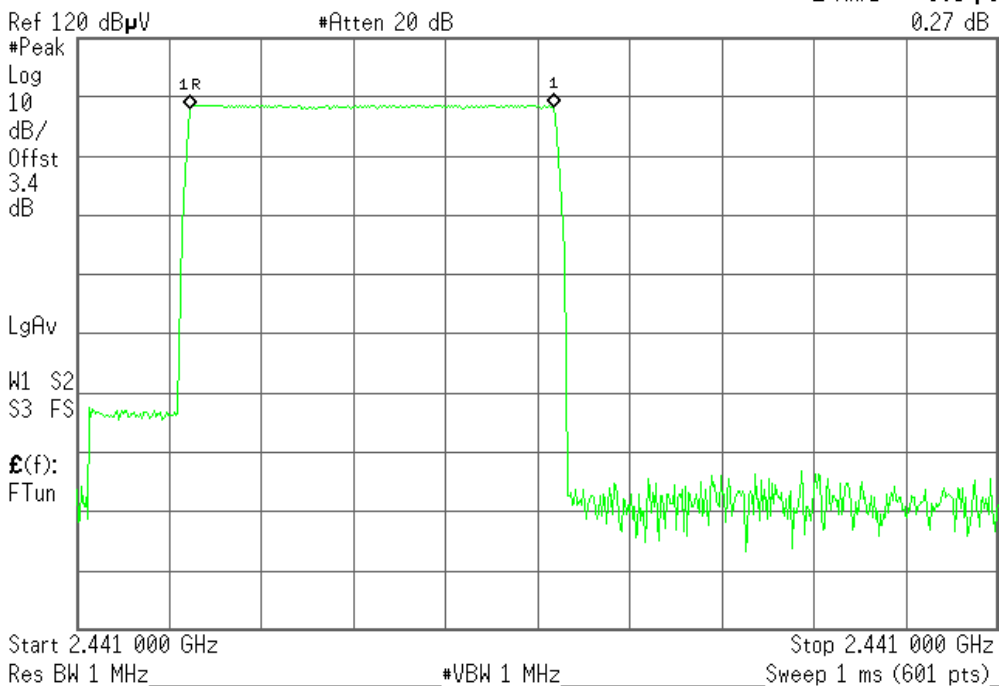


**(CH Mid)**

Agilent 16:06:39 2 Sep 2009

R T

Mkr1 395  $\mu$ s  
0.27 dB



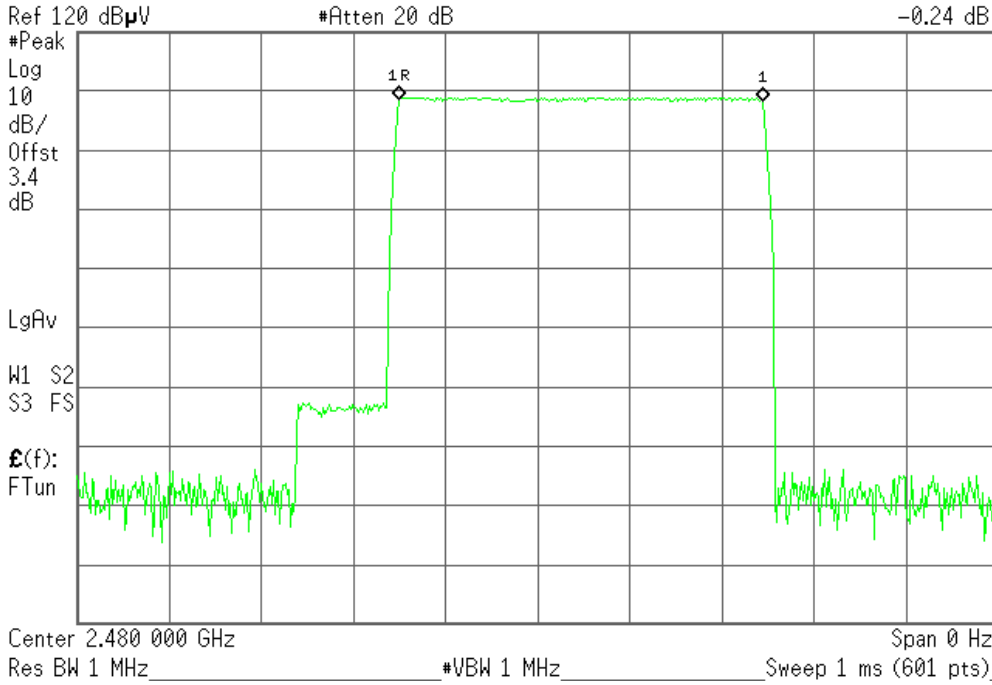


**(CH High)**

Agilent 15:53:06 2 Sep 2009

R T

Mkr1 395  $\mu$ s  
-0.24 dB



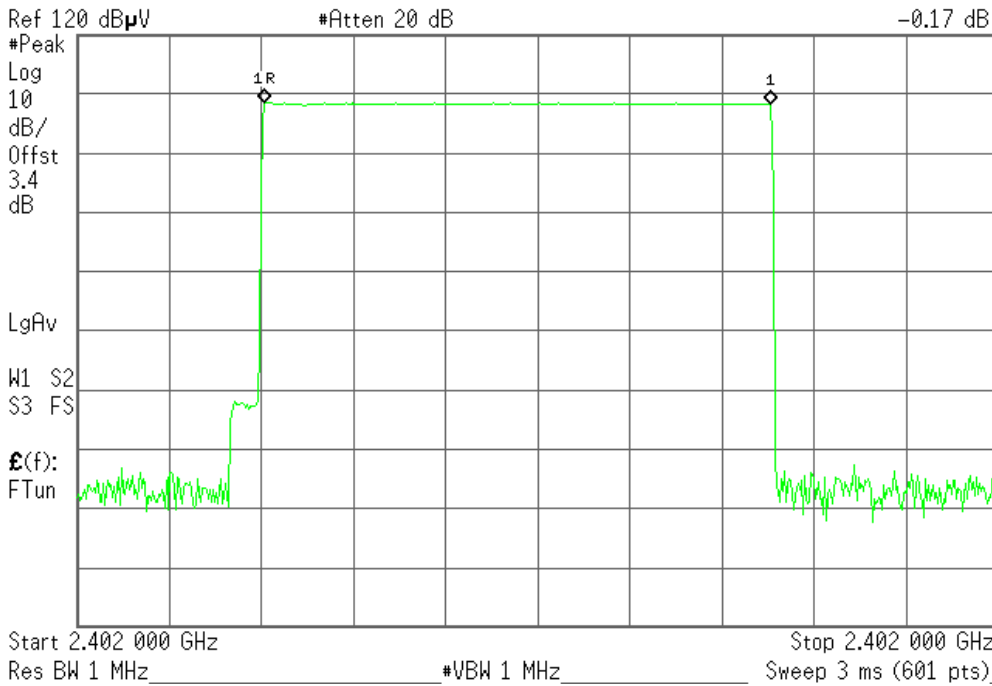
**DH 3**

**(CH Low)**

Agilent 16:14:24 2 Sep 2009

R T

Mkr1 1.65 ms  
-0.17 dB



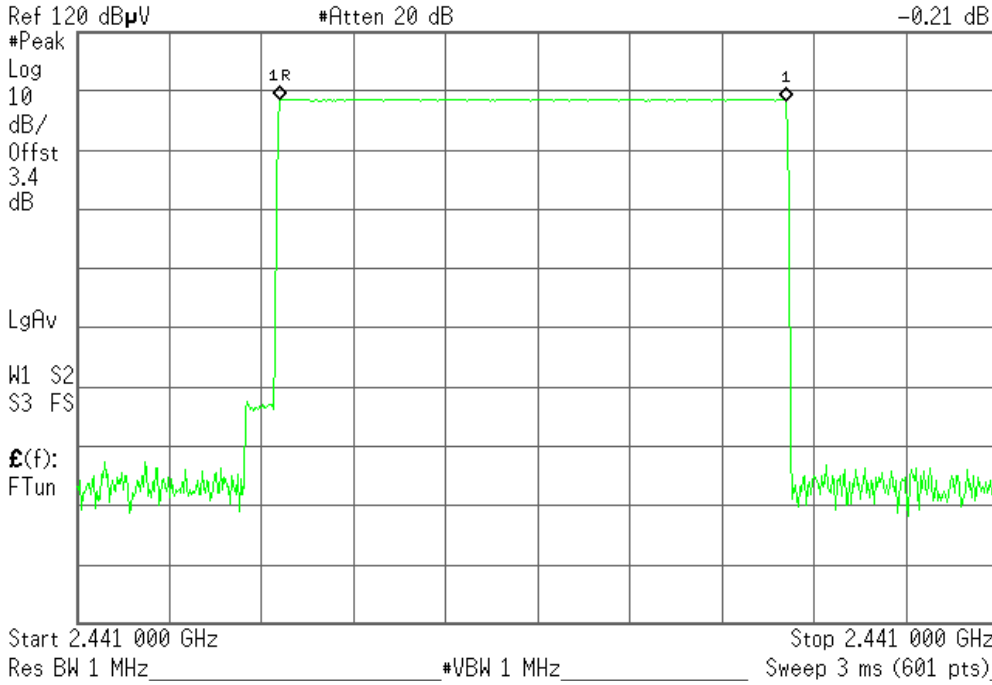


**(CH Mid)**

Agilent 16:15:17 2 Sep 2009

R T

Mkr1 1.65 ms  
-0.21 dB

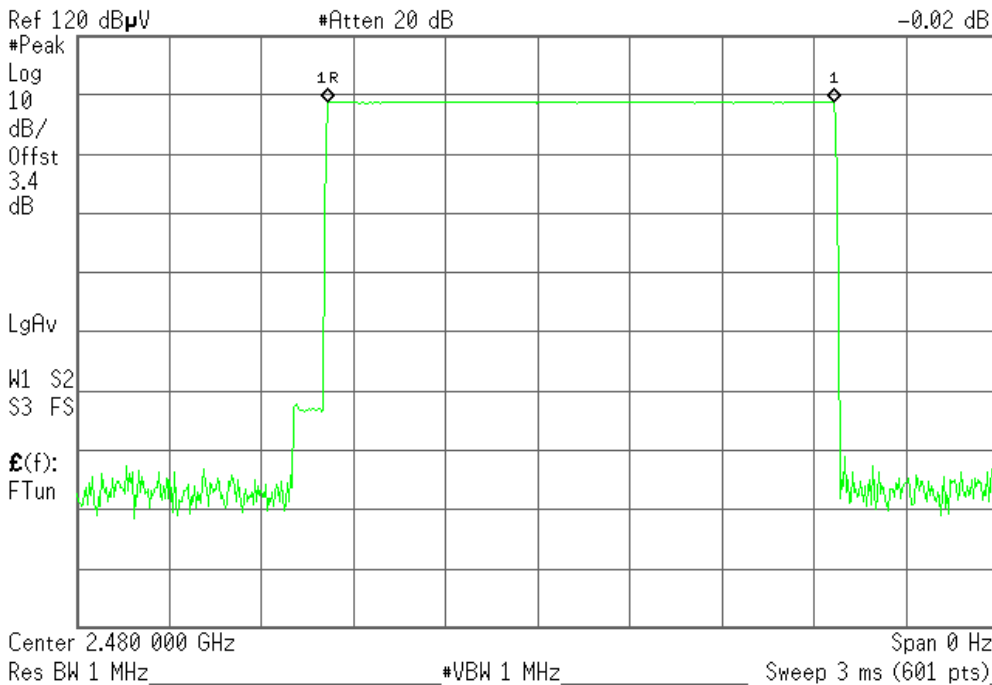


**(CH High)**

Agilent 16:16:44 2 Sep 2009

R T

Mkr1 1.65 ms  
-0.02 dB





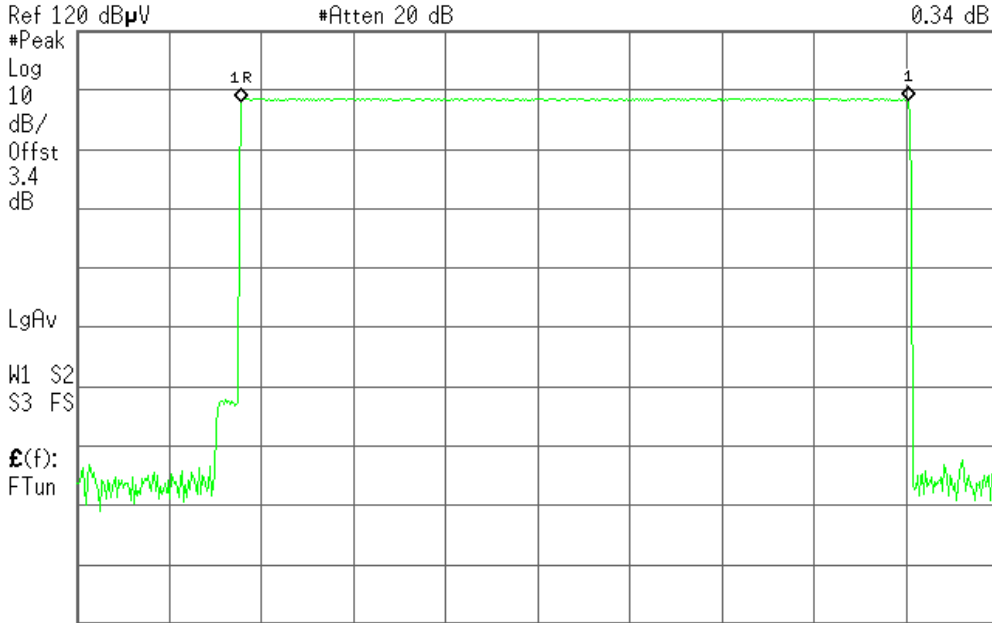
**DH 5**

**(CH Low)**

Agilent 16:20:26 2 Sep 2009

R T

Mkr1 2.9 ms  
0.34 dB



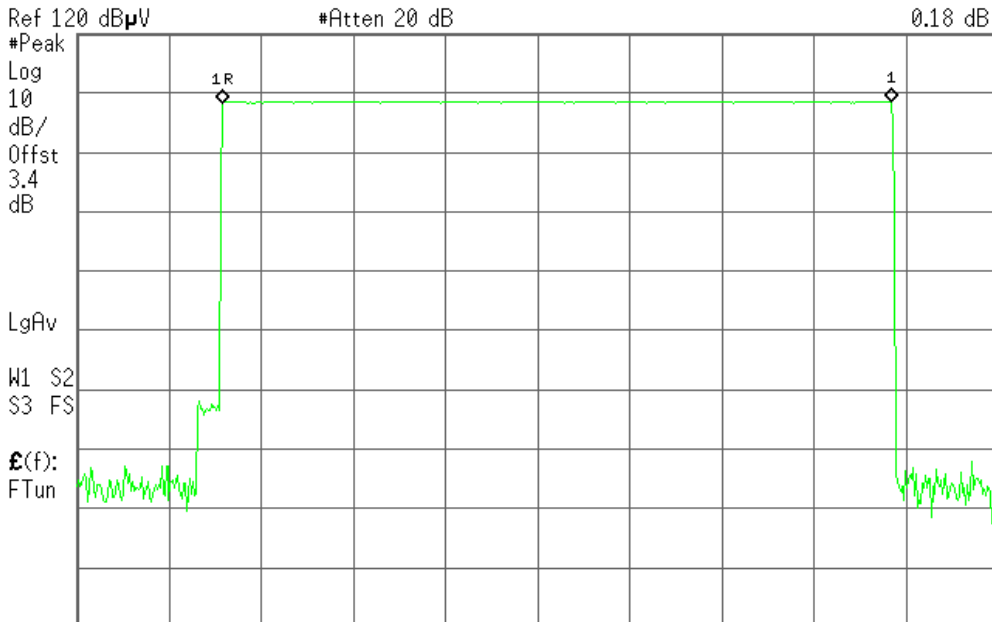
Center 2.402 000 GHz Span 0 Hz  
Res BW 1 MHz #VBW 1 MHz Sweep 4 ms (601 pts)

**(CH Mid)**

Agilent 16:19:20 2 Sep 2009

R T

Mkr1 2.9 ms  
0.18 dB



Center 2.441 000 GHz Span 0 Hz  
Res BW 1 MHz #VBW 1 MHz Sweep 4 ms (601 pts)

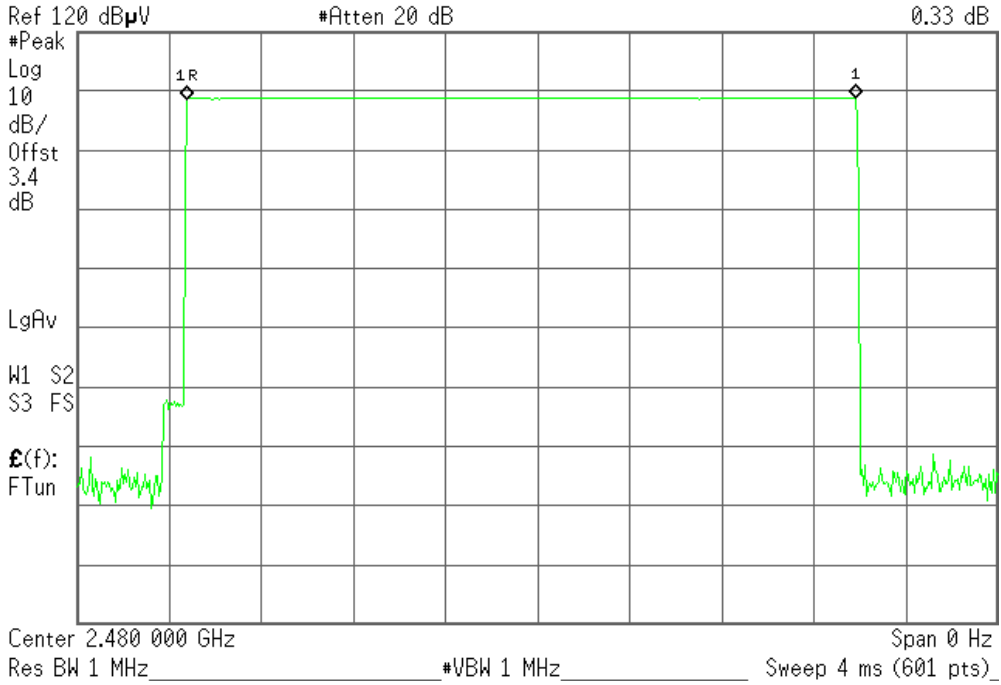


**(CH High)**

Agilent 16:17:59 2 Sep 2009

R T

Mkr1 2.9 ms



**8DPSK**

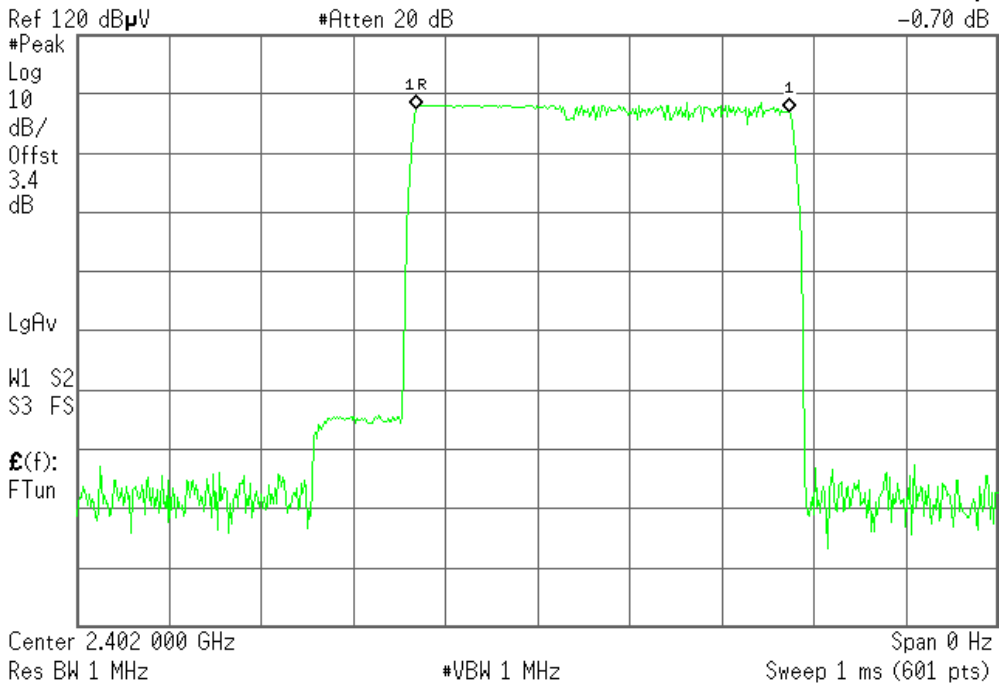
**DH 1**

**(CH Low)**

Agilent 16:39:05 2 Sep 2009

R T

Mkr1 405 µs





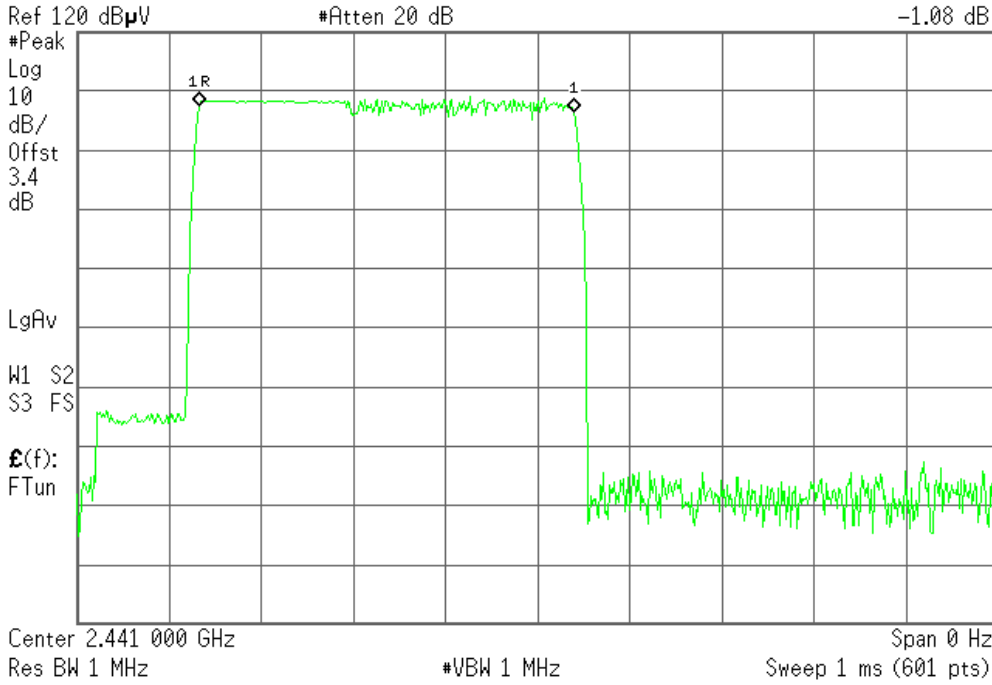


**(CH Mid)**

Agilent 16:39:54 2 Sep 2009

R T

Mkr1 406.7  $\mu$ s  
-1.08 dB

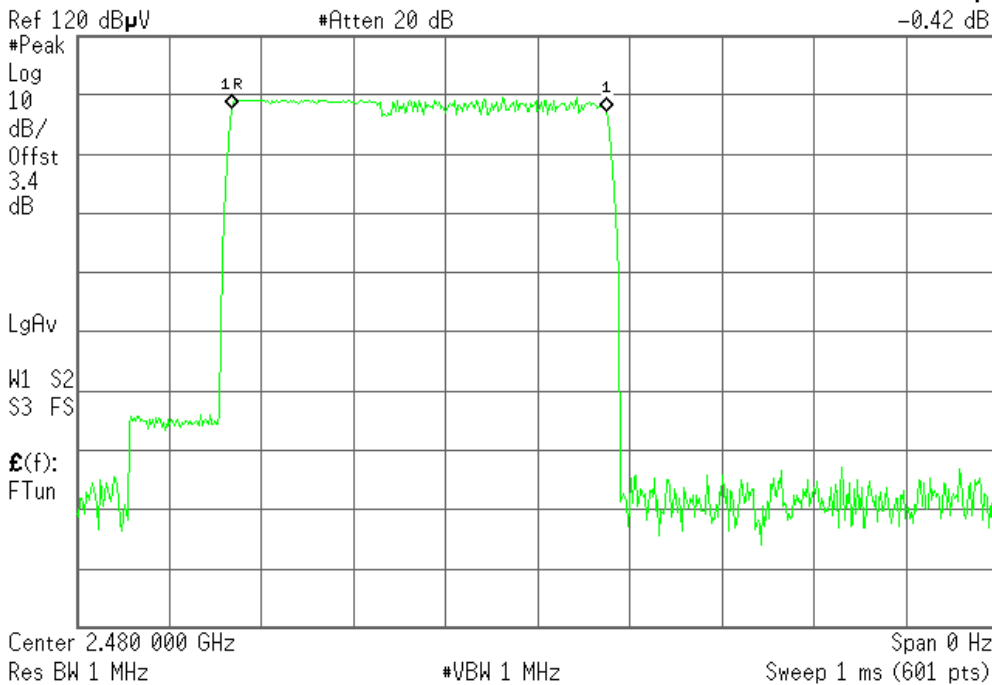


**(CH High)**

Agilent 16:40:43 2 Sep 2009

R T

Mkr1 406.7  $\mu$ s  
-0.42 dB





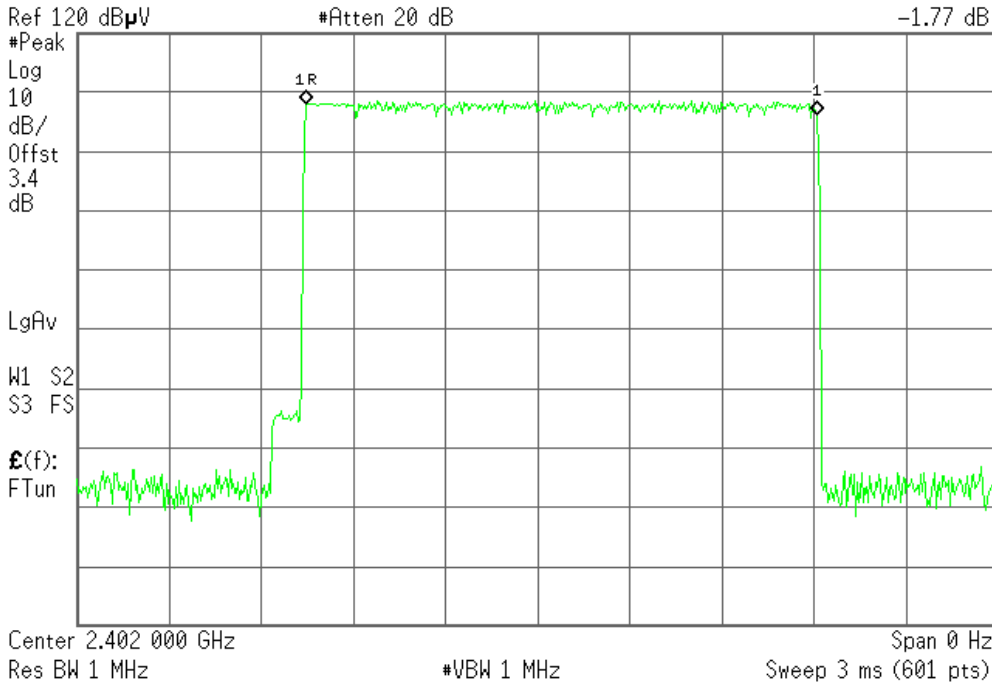
### DH 3

#### (CH Low)

Agilent 16:37:56 2 Sep 2009

R T

Mkr1 1.665 ms  
-1.77 dB

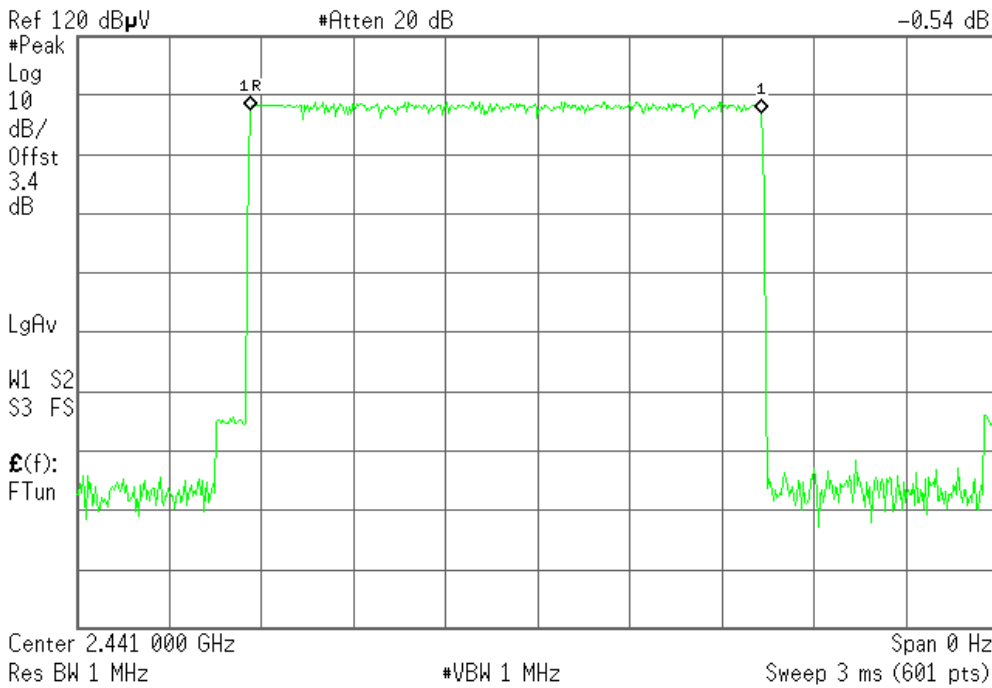


#### (CH Mid)

Agilent 16:37:08 2 Sep 2009

R T

Mkr1 1.665 ms  
-0.54 dB



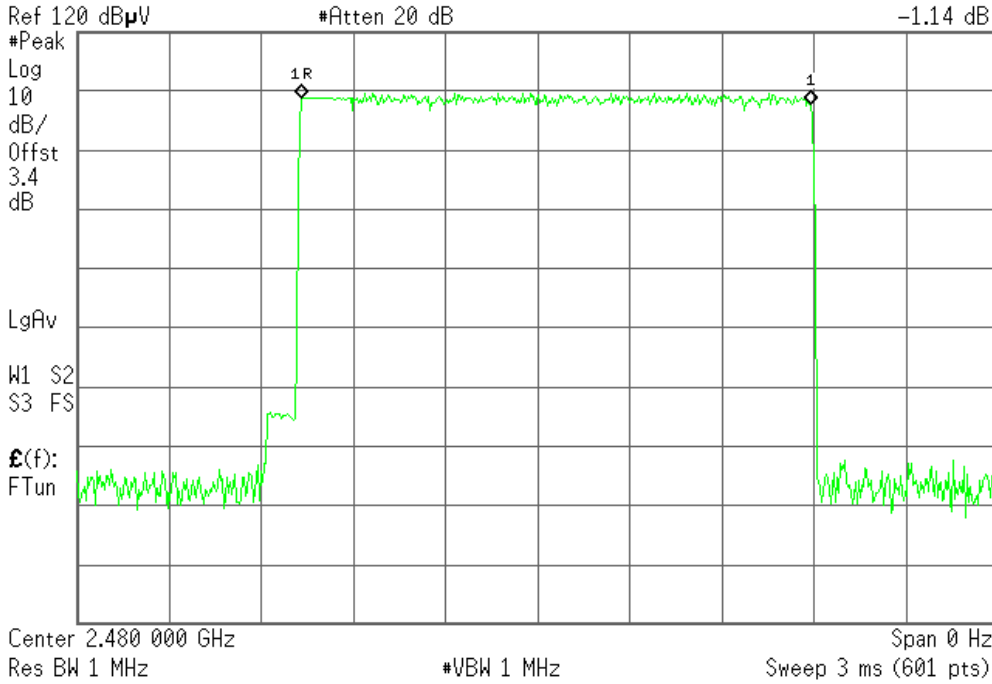


**(CH High)**

Agilent 16:36:00 2 Sep 2009

R T

▲ Mkr1 1.66 ms  
-1.14 dB



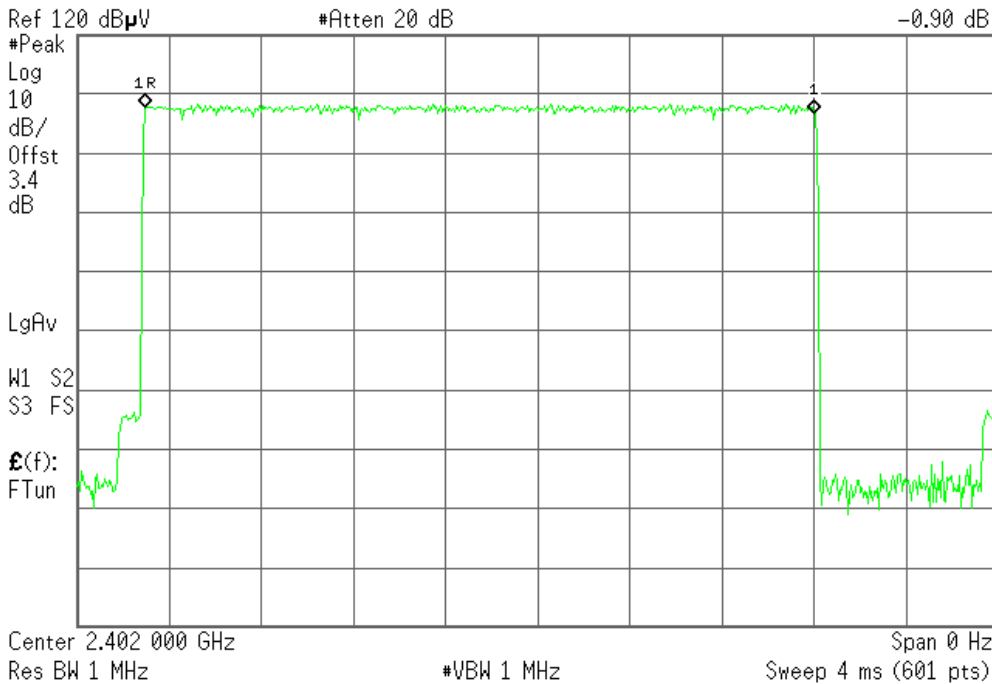
**DH 5**

**(CH Low)**

Agilent 16:32:28 2 Sep 2009

R T

▲ Mkr1 2.907 ms  
-0.90 dB



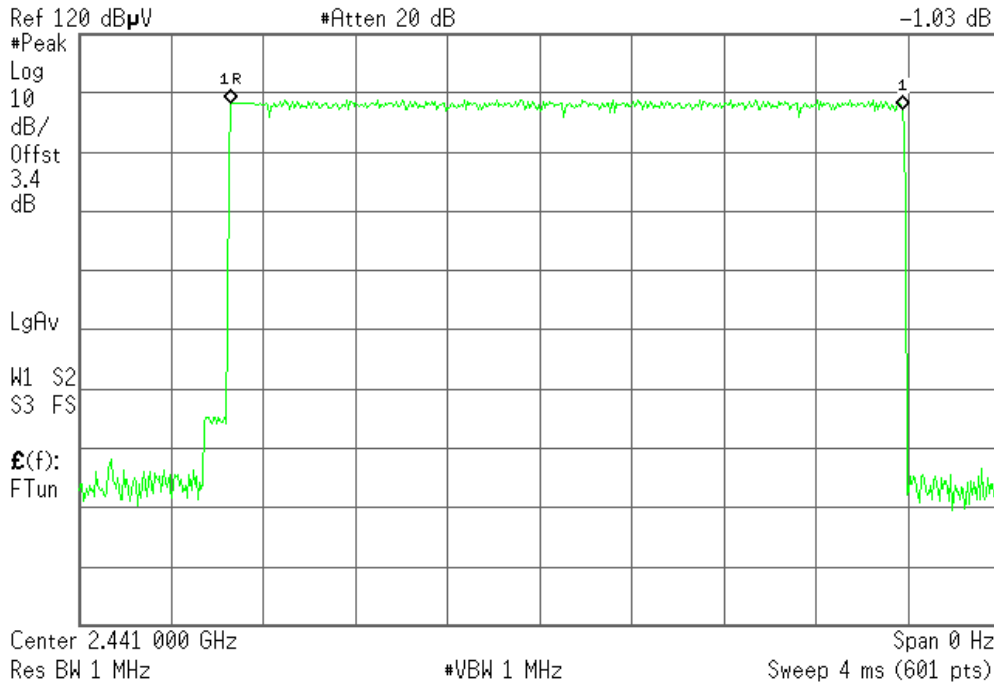


**(CH Mid)**

Agilent 16:33:22 2 Sep 2009

R T

Δ Mkr1 2.913 ms  
-1.03 dB

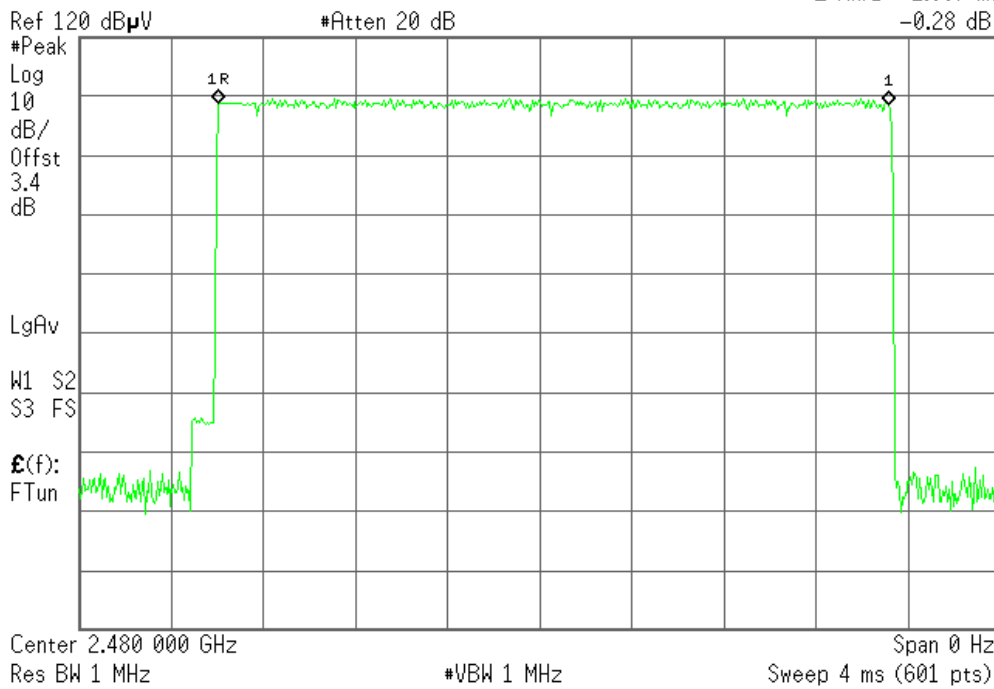


**(CH High)**

Agilent 16:34:28 2 Sep 2009

R T

Δ Mkr1 2.907 ms  
-0.28 dB





## 7.8 SPURIOUS EMISSIONS

### 7.7 Conducted Measurement

#### LIMIT

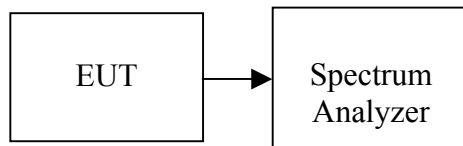
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

#### MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/24/2010

*Remark: Each piece of equipment is scheduled for calibration once a year.*

#### Test Configuration



#### TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 KHz. The video bandwidth is set to 100 KHz.

Measurements are made over the 30MHz to 26GHz range with the transmitter set to the lowest, middle, and highest channels.

#### TEST RESULTS

*No non-compliance noted*



**Test Plot**

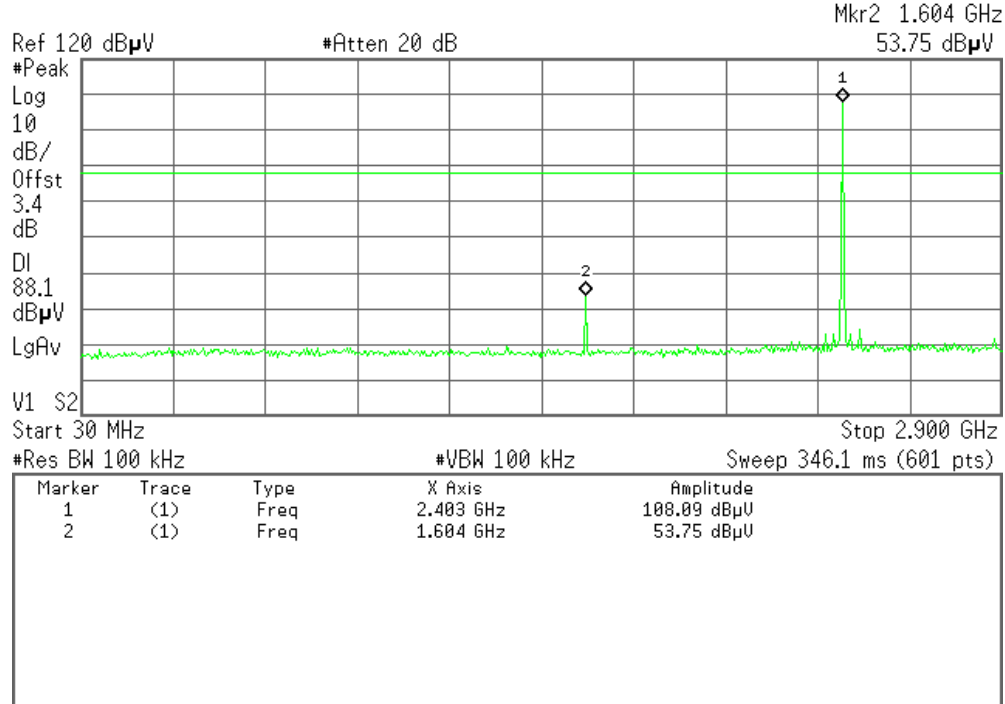
**GFSK**

**CH Low**

**30MHz – 2.9GHz**

Agilent 15:42:52 2 Sep 2009

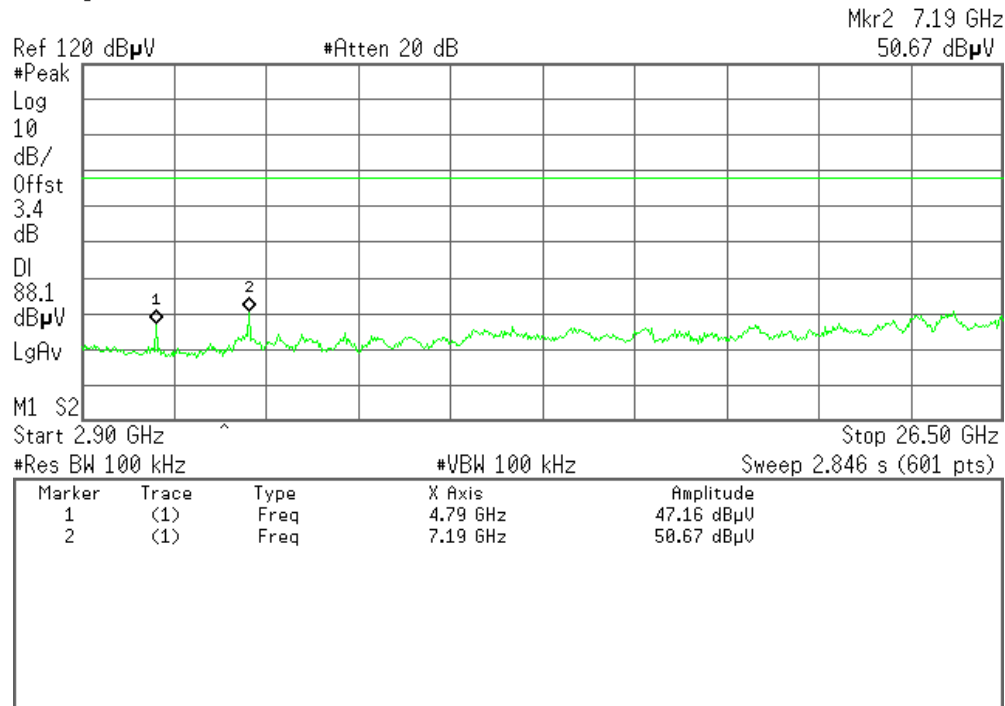
R T



**2.9GHz – 26.5GHz**

Agilent 15:44:00 2 Sep 2009

R T



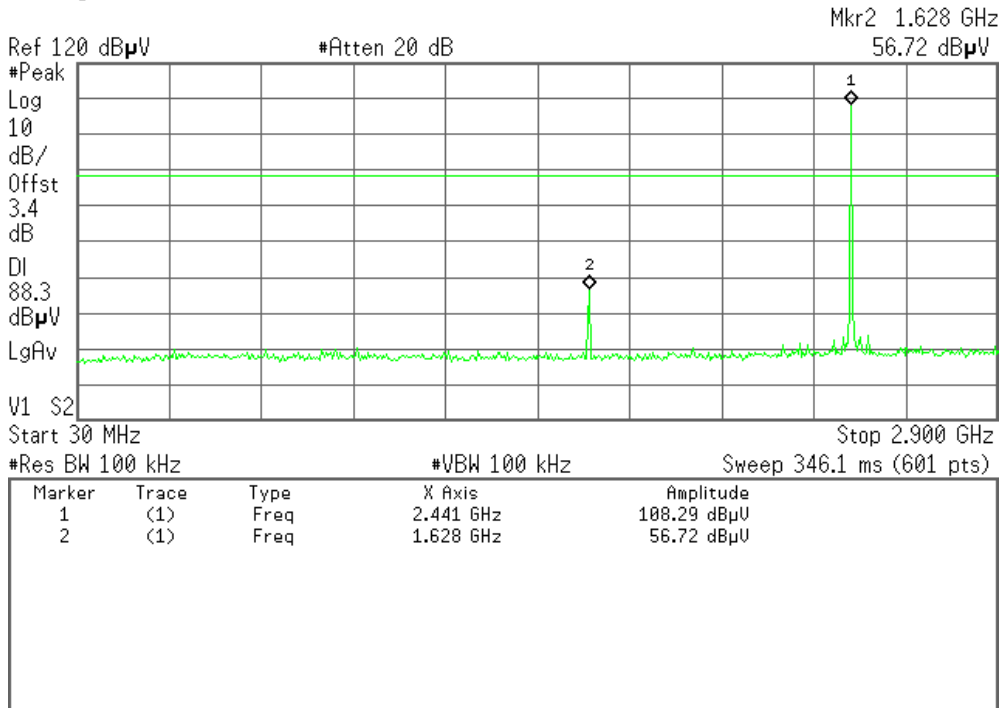


### CH Mid

### 30MHz – 2.9GHz

Agilent 15:45:23 2 Sep 2009

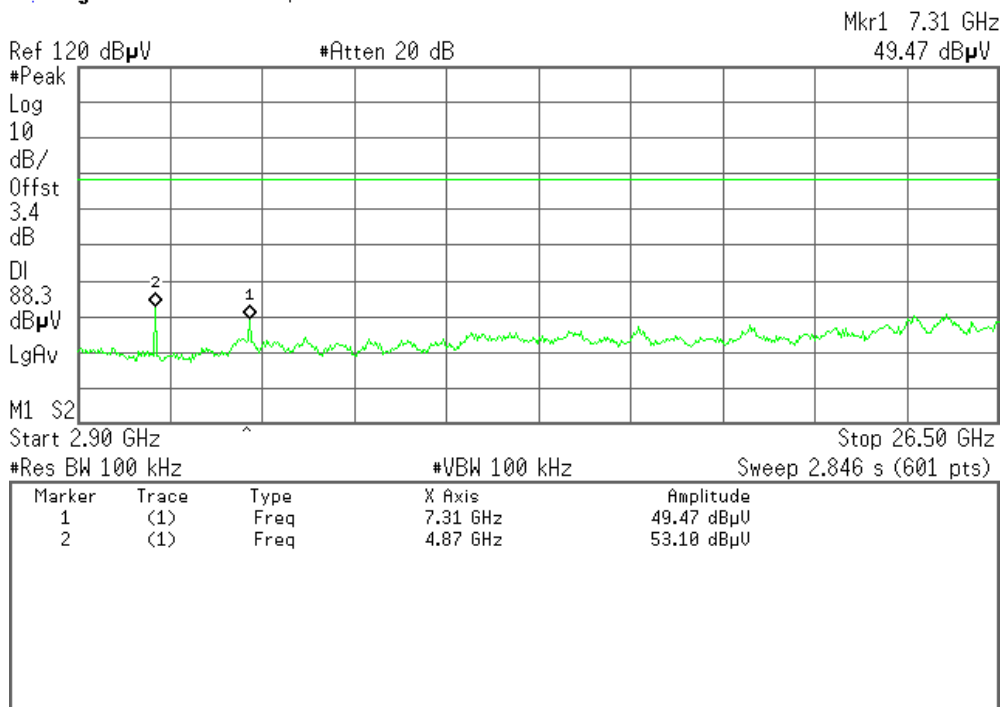
R T



### 2.9GHz – 26.5GHz

Agilent 15:46:27 2 Sep 2009

R T



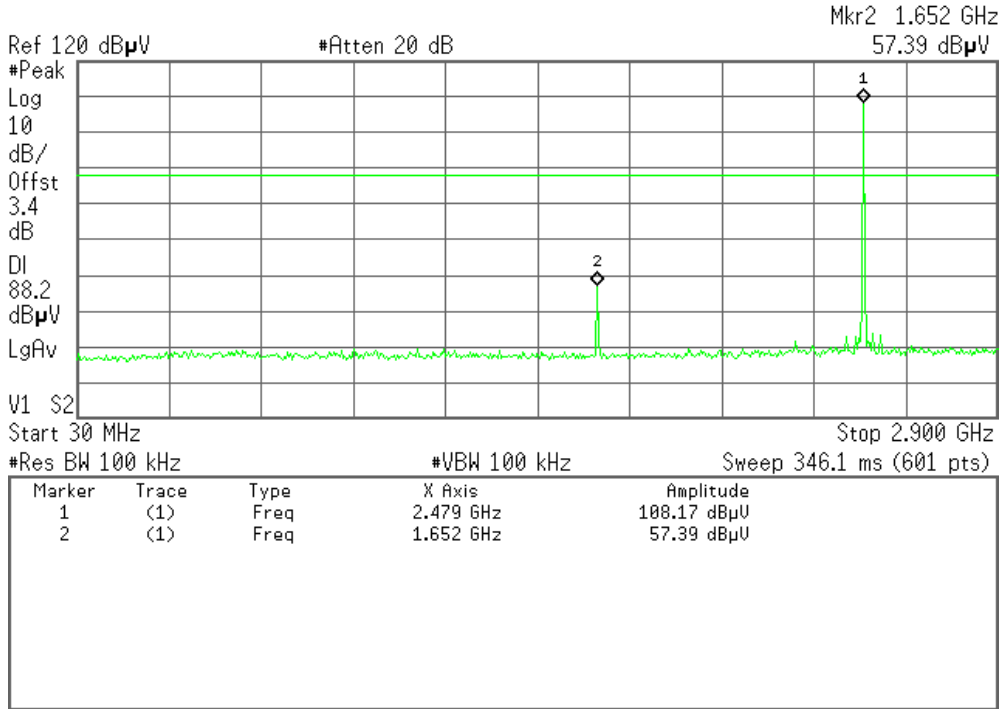


### CH High

### 30MHz – 2.9GHz

Agilent 15:47:59 2 Sep 2009

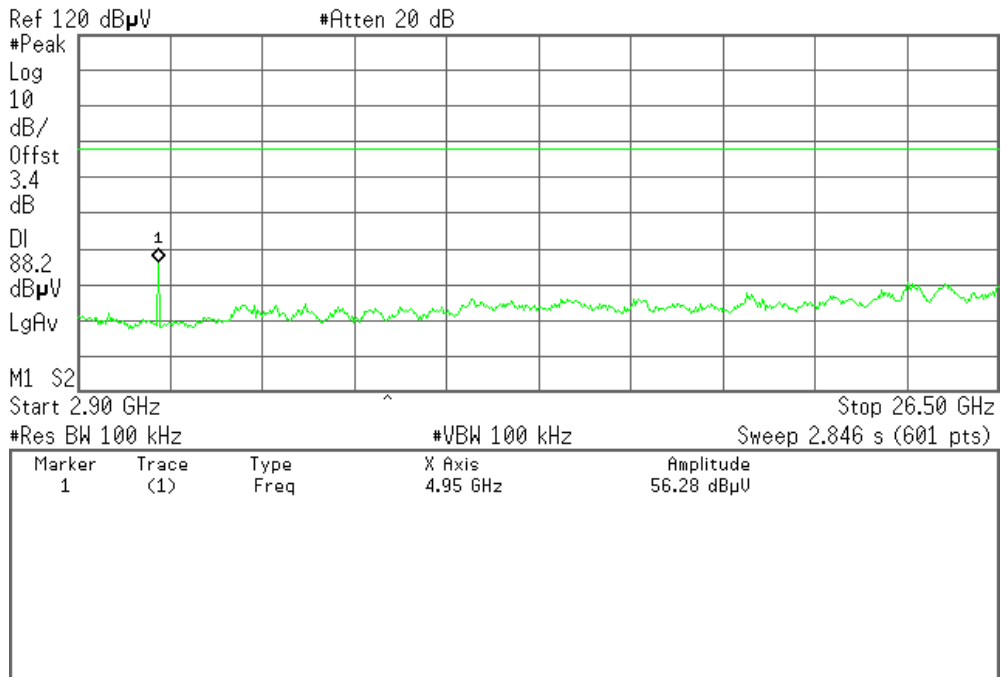
R T



### 2.9GHz – 26.5GHz

Agilent 15:49:19 2 Sep 2009

R T







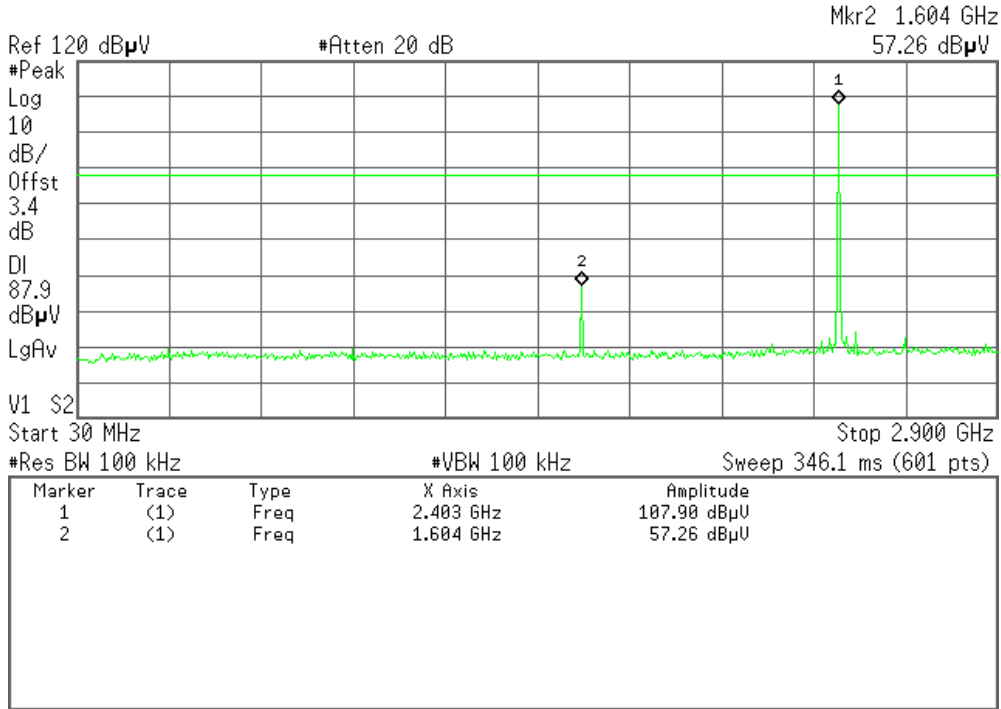
### 8DPSK

#### CH Low

#### 30MHz – 2.9GHz

Agilent 16:57:28 2 Sep 2009

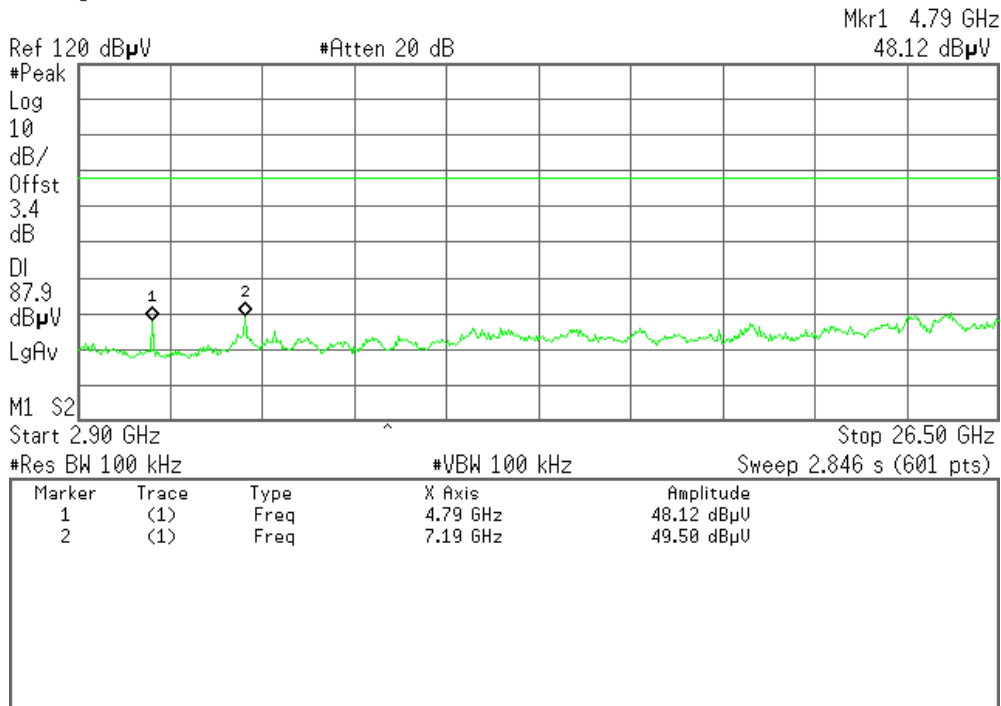
R T



#### 2.9GHz – 26.5GHz

Agilent 16:58:13 2 Sep 2009

R T



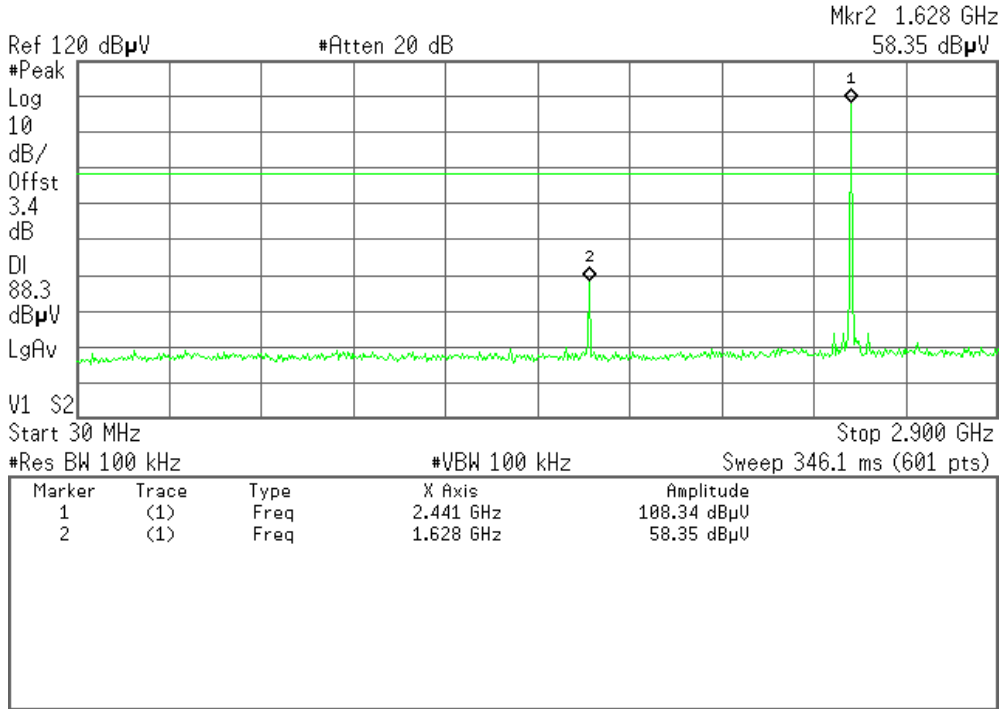


### CH Mid

#### 30MHz – 2.9GHz

Agilent 16:59:16 2 Sep 2009

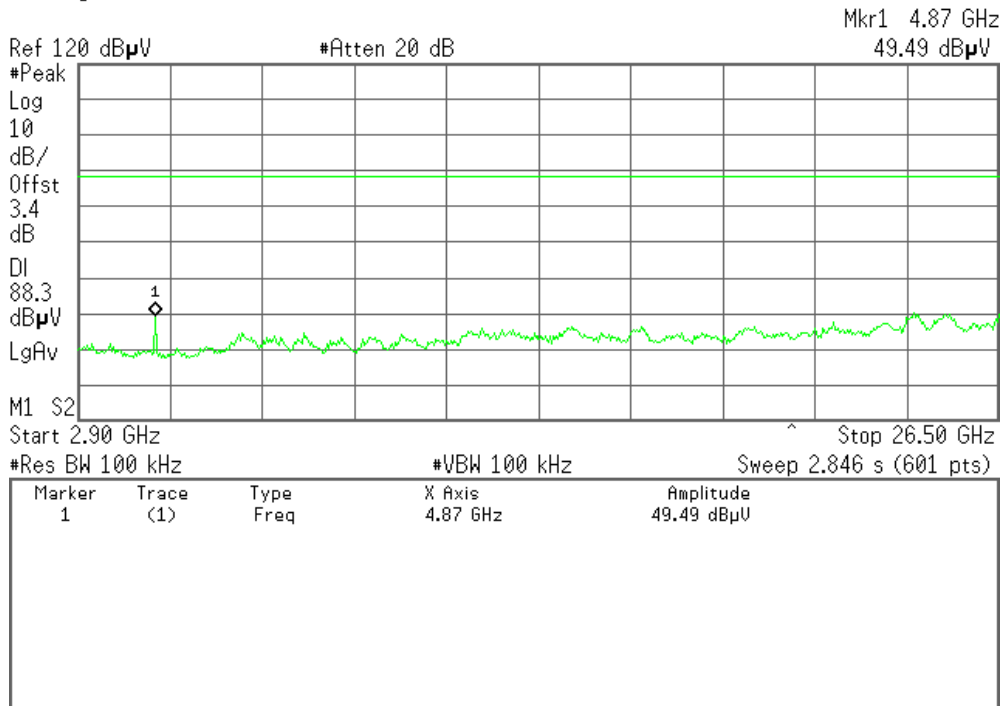
R T



#### 2.9GHz – 26.5GHz

Agilent 17:00:14 2 Sep 2009

R T



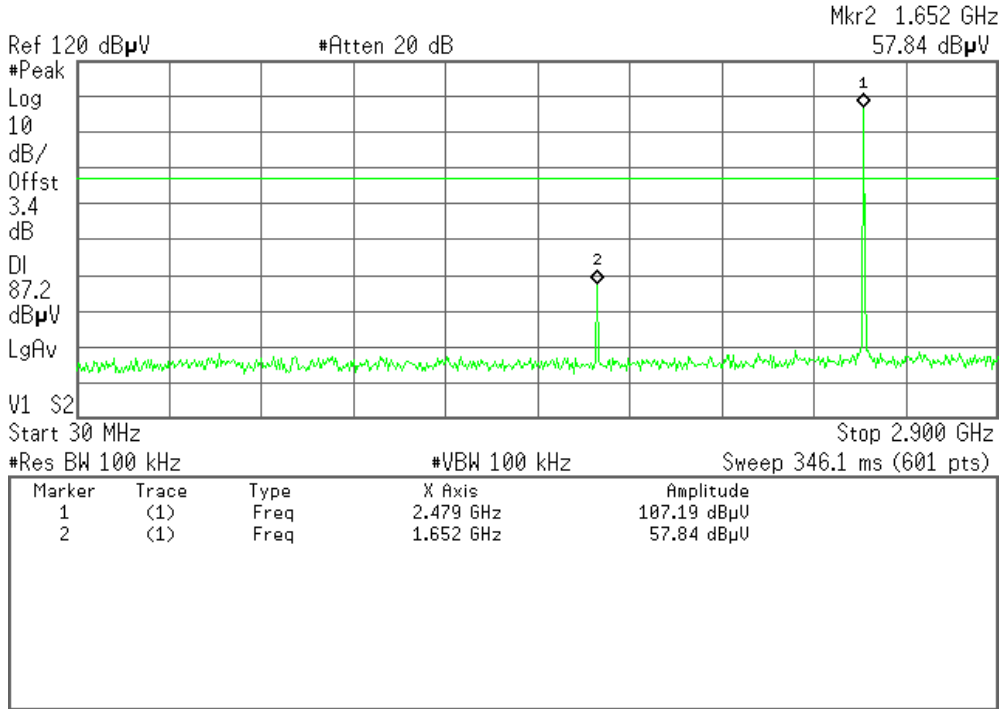


### CH High

#### 30MHz – 2.9GHz

Agilent 17:02:15 2 Sep 2009

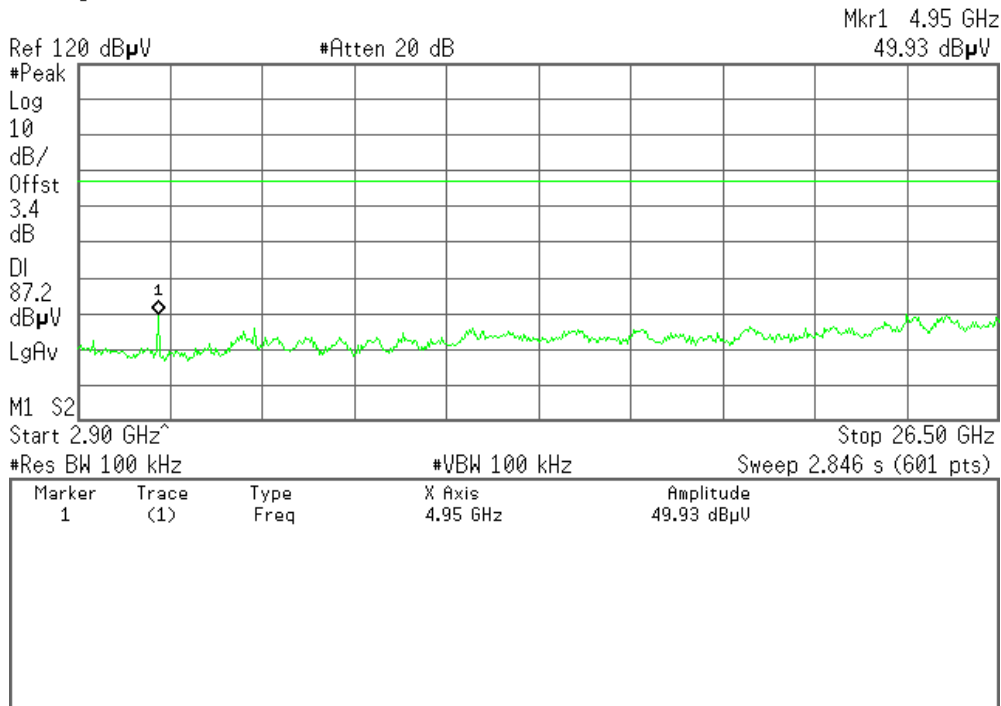
R T



#### 2.9GHz – 26.5GHz

Agilent 17:03:48 2 Sep 2009

R T





### 7.7.2 Radiated Emissions

#### LIMIT

1. Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (mV/m)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

*Note: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

2. In the above emission table, the tighter limit applies at the band edges.

Frequency (Hz)	Field Strength ( $\mu$ V/m at 3-meter)	Field Strength (dB $\mu$ V/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

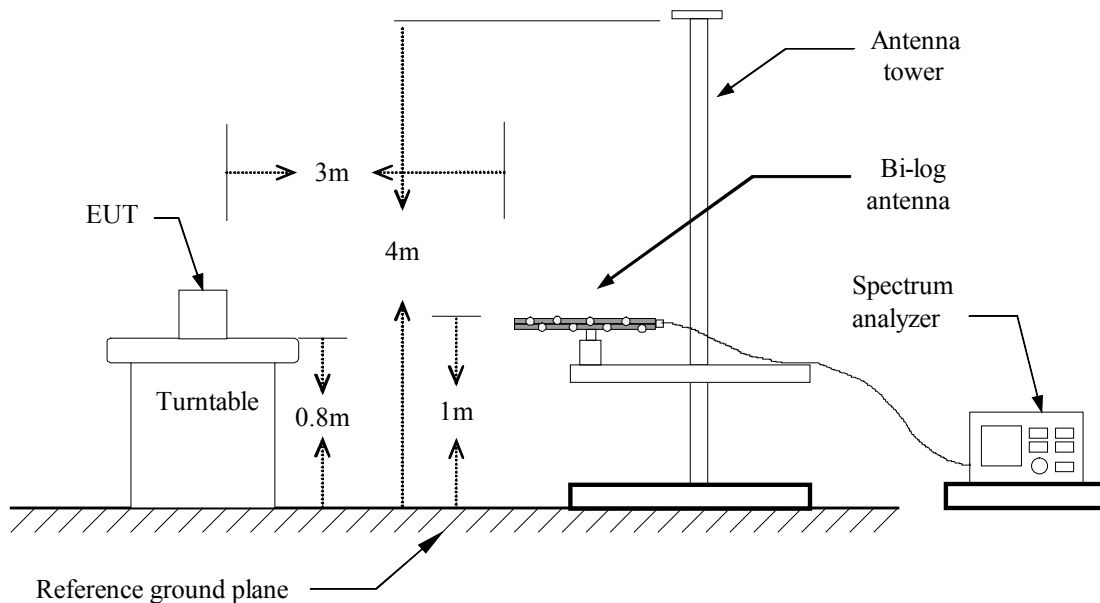
**MEASUREMENT EQUIPMENT USED**

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	CAL. DUE
ESCI EMI TEST RECEIVE.ESCI	ROHDE&SCHWARZ	1166.5950 03	100783	03/20/2010
Spectrum Analyzer	Agilent	E4446A	US44300399	03/01/2010
Low Noise Amplifier	MITEQ	AM-1604-3000	1123808	02/06/2010
Turn Table	EMCO	2081-1.21	N/A	N.C.R
Controller	CT	N/A	N/A	N.C.R
High Noise Amplifier	Agilent	8449B	3008A01838	05/29/2010
Site NSA	C&C	N/A	N/A	N.C.R
BILOG ANTENNA	SCHAFFNER	CBL6143	5082	06/09/2010
Horn Antenna	SCHAFFNER	BBHA9120D	1201	03/19/2010
Signal Generator	Anritsu	MG3694A	#050125	03/01/2010

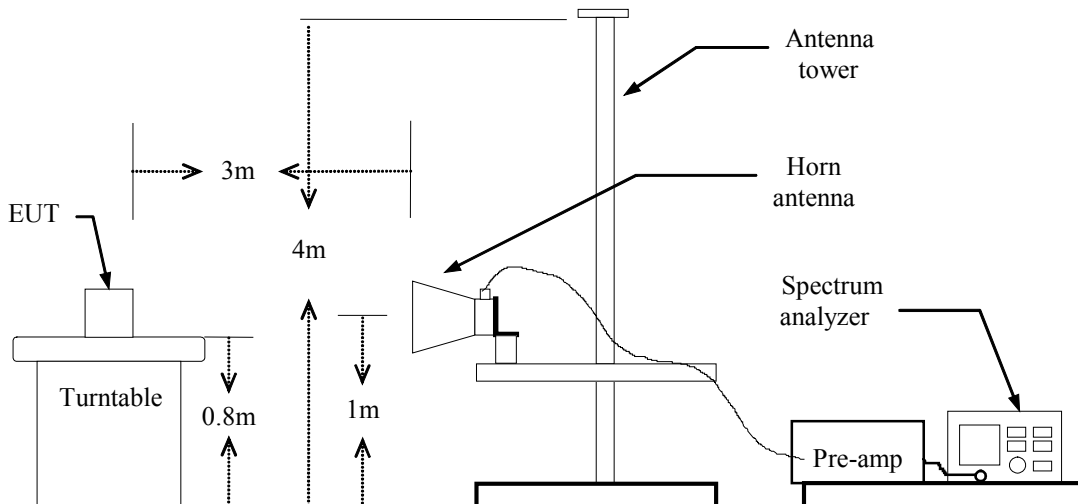
*Remark: Each piece of equipment is scheduled for calibration once a year.*

**Test Configuration**

**Below 1 GHz**



### Above 1 GHz



### TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

**TEST RESULTS****Below 1 GHz****Operation Mode:** Normal**Test Date:** September 04, 2009**Temperature:** 26°C**Tested by:** Tom**Humidity:** 65 % RH**Polarity:** Ver. / Hor.

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/Q.P)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limits 3m (dBuV/m)	Safe Margin (dBuV/m)
75.450	V	Peak	54.24	-20.16	34.08	40.00	-5.92
184.350	V	Peak	55.32	-18.25	37.07	43.50	-6.43
218.100	V	Peak	56.99	-17.28	39.71	46.00	-6.29
455.166	V	Peak	52.50	-10.12	42.38	46.00	-3.62
601.000	V	Peak	47.51	-5.91	41.60	46.00	-4.40
778.333	V	Peak	42.69	-3.77	38.92	46.00	-7.08
76.800	H	Peak	53.71	-20.08	33.63	40.00	-6.37
125.400	H	Peak	53.78	-19.49	34.29	43.50	-9.21
200.550	H	Peak	53.82	-17.33	36.49	43.50	-7.01
265.800	H	Peak	59.36	-15.90	43.46	46.00	-2.54
455.166	H	Peak	52.08	-10.12	41.96	46.00	-4.04
616.166	H	Peak	43.65	-5.70	37.95	46.00	-8.05

**\*\*Remark:** No emission found between lowest internal used/generated frequency to 30 MHz.**Notes:**

1. Measuring frequencies from 9kHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30MHz to 1GHz were made with an instrument using Peak/Quasi-peak detector mode.
3. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.



**Above 1 GHz**

**GFSK**

**Operation Mode:** TX(CH Low)

**Test Date:** September 04, 2009

**Temperature:** 26°C

**Tested by:** Tom

**Humidity:** 65 % RH

**Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1063.33	V	61.48	---	-11.82	49.66	---	74.00	54.00	-4.34	Peak
1600.00	V	58.61	---	-8.63	49.98	---	74.00	54.00	-4.02	Peak
1863.33	V	55.72	---	-6.54	49.18	---	74.00	54.00	-4.82	Peak
4808.33	V	49.41	46.98	2.65	52.06	49.63	74.00	54.00	-4.37	AVG.
N/A										
1063.33	H	58.16	---	-11.82	46.34	---	74.00	54.00	-7.66	Peak
1200.00	H	58.05	---	-11.07	46.98	---	74.00	54.00	-7.02	Peak
1633.33	H	55.17	---	-8.36	46.81	---	74.00	54.00	-7.19	Peak
4808.33	H	45.20	---	2.65	47.85	---	74.00	54.00	-6.15	Peak
N/A										

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum setting:
  - a. Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
  - b. AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.





Operation Mode: TX(CH Mid)

Test Date: September 04, 2009

Temperature: 26°C

Tested by: Tom

Humidity: 65 % RH

Polarity: Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1066.66	V	62.83	---	-11.80	51.03	---	74.00	54.00	-2.97	Peak
1600.00	V	60.52	---	-8.63	51.89	---	74.00	54.00	-2.11	Peak
1863.33	V	56.45	---	-6.54	49.91	---	74.00	54.00	-4.09	Peak
4883.33	V	50.26	45.97	2.78	53.04	48.75	74.00	54.00	-5.25	AVG.
N/A										
1200.00	H	57.88	---	-11.07	46.81	---	74.00	54.00	-7.19	Peak
1626.66	H	53.68	---	-8.42	45.26	---	74.00	54.00	-8.74	Peak
2016.66	H	49.36	---	-5.39	43.97	---	74.00	54.00	-10.03	Peak
4883.33	H	47.46	---	2.78	50.24	---	74.00	54.00	-3.76	Peak
N/A										

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum setting:
  - a. Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
  - b. AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.



Operation Mode: TX(CH High)

Test Date: September 04, 2009

Temperature: 26°C

Tested by: Tom

Humidity: 65 % RH

Polarity: Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1066.66	V	61.32	---	-11.80	49.52	---	74.00	54.00	-4.48	Peak
1600.00	V	60.13	---	-8.63	51.50	---	74.00	54.00	-2.50	Peak
1693.33	V	58.94	---	-7.89	51.05	---	74.00	54.00	-2.95	Peak
4966.66	V	43.90	---	2.92	46.82	---	74.00	54.00	-7.18	Peak
N/A										
1200.00	H	62.72	---	-11.07	51.65	---	74.00	54.00	-2.35	Peak
1653.33	H	55.32	---	-8.21	47.11	---	74.00	54.00	-6.89	Peak
1990.00	H	49.94	---	-5.54	44.40	---	74.00	54.00	-9.60	Peak
4933.33	H	45.13	---	2.87	48.00	---	74.00	54.00	-6.00	Peak
N/A										

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum setting:
  - a. Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
  - b. AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.



**8DPSK**

**Operation Mode:** TX(CH Low)

**Test Date:** September 04, 2009

**Temperature:** 26°C

**Tested by:** Tom

**Humidity:** 65 % RH

**Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1600.00	V	57.99	---	-8.63	49.36	---	74.00	54.00	-4.64	Peak
1866.66	V	56.08	---	-6.52	49.56	---	74.00	54.00	-4.44	Peak
2136.66	V	51.88	---	-4.92	46.96	---	74.00	54.00	-7.04	Peak
4825.00	V	45.43	---	2.68	48.11	---	74.00	54.00	-5.89	Peak
N/A										
1070.00	H	56.14	---	-11.79	44.35	---	74.00	54.00	-9.65	Peak
1200.00	H	58.76	---	-11.07	47.69	---	74.00	54.00	-6.31	Peak
1603.33	H	53.87	---	-8.60	45.27	---	74.00	54.00	-8.73	Peak
4800.00	H	44.77	---	2.64	47.41	---	74.00	54.00	-6.59	Peak
N/A										

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum setting:
  - a. Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
  - b. AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.



Operation Mode: TX(CH Mid)

Test Date: September 04, 2009

Temperature: 26°C

Tested by: Tom

Humidity: 65 % RH

Polarity: Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1330.00	V	55.69	---	-10.36	45.33	---	74.00	54.00	-8.67	Peak
1596.66	V	55.50	---	-8.65	46.85	---	74.00	54.00	-7.15	Peak
1863.33	V	56.11	---	-6.54	49.57	---	74.00	54.00	-4.43	Peak
4883.33	V	46.03	---	2.78	48.81	---	74.00	54.00	-5.19	Peak
N/A										
1200.00	H	56.84	---	-11.07	45.77	---	74.00	54.00	-8.23	Peak
1626.66	H	54.41	---	-8.42	45.99	---	74.00	54.00	-8.01	Peak
2040.00	H	50.52	---	-5.30	45.22	---	74.00	54.00	-8.78	Peak
4858.33	H	45.14	---	2.74	47.88	---	74.00	54.00	-6.12	Peak
N/A										

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum setting:
  - a. Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
  - b. AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.



Operation Mode: TX(CH High)

Test Date: September 04, 2009

Temperature: 26°C

Tested by: Tom

Humidity: 65 % RH

Polarity: Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1066.66	V	62.80	---	-11.80	51.00	---	74.00	54.00	-3.00	Peak
1600.00	V	54.33	---	-8.63	45.70	---	74.00	54.00	-8.30	Peak
1866.66	V	57.04	---	-6.52	50.52	---	74.00	54.00	-3.48	Peak
4958.33	V	43.99	---	2.91	46.90	---	74.00	54.00	-7.10	Peak
N/A										
1200.00	H	58.83	---	-11.07	47.76	---	74.00	54.00	-6.24	Peak
1653.33	H	56.17	---	-8.21	47.96	---	74.00	54.00	-6.04	Peak
2050.00	H	49.76	---	-5.26	44.50	---	74.00	54.00	-9.50	Peak
4958.33	H	44.25	---	2.91	47.16	---	74.00	54.00	-6.84	Peak
N/A										

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum setting:
  - a. Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
  - b. AV Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.



## 7.9 POWERLINE CONDUCTED EMISSIONS

### LIMIT

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

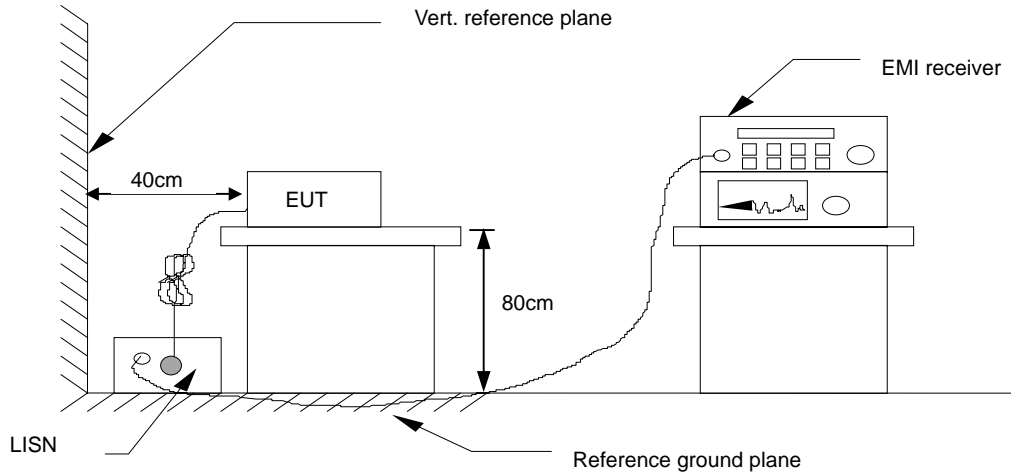
Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

### MEASUREMENT EQUIPMENT USED

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL. DUE
ESCI EMI TEST RECEIVE.ESCI	ROHDE&SCHWARZ	1166.5950 03	100145	03/20/2009	03/20/2010
LISN	FCC	FCC-LISN-50-50-2-M	01068	03/01/2009	03/01/2010
LISN	EMCO	3825/2	8901-1459	03/01/2009	03/01/2010
CDN	FCC	FCC-TILISN-T4	20182	03/01/2009	03/01/2010
CDN	FCC	FCC-TLISN-T8-02	20183	03/01/2009	03/01/2010
CDN	FCC	FCC-TLISN-T4-02	20382	03/01/2009	03/01/2010
CDN	FCC	FCC-TLISN-T4-02	20383	03/01/2009	03/01/2010
CDN	FCC	FCC-801-T8-RJ45	04030	03/01/2009	03/01/2010
Current Probe	STODDART AIRCRAFT	91550-1	345-73	03/01/2009	03/01/2010

**Remark:** Each piece of equipment is scheduled for calibration once a year.

## Test Configuration



See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

## TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

## TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.



**Test Data**

<b>Model No.</b>	RF-QX5	<b>Test Mode</b>	Charge with the adapter
<b>Environmental Conditions</b>	26°C,65% RH, 991 hPa	<b>RBW,VBW</b>	9 KHz
<b>Tested by</b>	Tom		

(The chart below shows the highest readings taken from the final data.)

FREQ MHz	PEAK RAW dBuV	Q.P. RAW dBuV	AVG RAW dBuV	Q.P. Limit dBuV	AVG Limit dBuV	Q.P. Margin dB	AVG Margin dB	NOTE
0.150	51.27	---	---	66.00	56.00	---	-4.73	L1
0.201	41.30	---	---	64.52	54.52	---	-13.22	L1
0.276	38.14	---	---	62.40	52.40	---	-14.26	L1
0.342	33.05	---	---	60.49	50.49	---	-17.44	L1
0.546	24.70	---	---	56.00	46.00	---	-21.30	L1
18.745	27.60	---	---	60.00	50.00	---	-22.40	L1
0.150	55.63	50.23	48.02	66.00	56.00	-15.77	-7.98	L2
0.205	41.17	---	---	64.41	54.41	---	-13.24	L2
0.276	38.92	---	---	62.40	52.40	---	-13.48	L2
0.346	33.05	---	---	60.39	50.39	---	-17.34	L2
5.863	24.92	---	---	60.00	50.00	---	-25.08	L2
19.466	28.31	---	---	60.00	50.00	---	-21.69	L2

**Remark:**

1. The measuring frequencies range between 0.15 MHz and 30 MHz.
2. The emissions measured in the frequency range between 0.15 MHz and 30MHz were made with an instrument using Quasi-peak detector and Average detector.
3. “---” denotes the emission level was or more than 2dB below the Average limit, and no re-check was made.
4. The IF bandwidth of SPA between 0.15MHz and 30MHz was 10KHz. The IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9kHz.
5. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

**Note:**

- Freq. = Emission frequency in MHz
- RAW dBuV = Uncorrected Analyzer/Received Reading +INSERTION LOSS of LISN+CABLE LOSS+pulse limiter loss
- Q.P. Limit dBuV = Limit stated in standard
- AVG Limit dBuV = Limit stated in standard
- Q.P. Margin dB = Q.P. RAW (dBuV) –Q.P. Limit (dBuV)
- AVG Margin dB = AVG RAW (dBuV) –AVG Limit (dBuV)
- Note = Current carrying line of reading
- Q.P.: =Quasi-Peak





## **8. ANNEX DECLARATION FOR BLUETOOTH DEVICE ACC to Part 15.247**

### **1 Output power and channel separation of a Bluetooth device in the different operating modes:**

The different operating modes (data-mode, acquisition-mode) of a Bluetooth device has no influence on the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters. Only a different hopping sequence will be used. For this reason the check of these

RF parameters in one op-mode is sufficient.

### **2 Frequency range of a Bluetooth device:**

Hereby we declare that the maximum frequency of this device is: 2402 – 2480 MHz. This is according to the Bluetooth Core Specification (+ critical errata) for devices which will be operated in the USA. This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04E). Other frequency ranges ( e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

### **3 Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:**

Bluetooth units which want to communicate with other units must be organised in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

### **4 Example of a hopping sequence in data mode:**

Example of a 79 hopping sequence in data mode: 40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

## **5 Equally average use of frequencies in data mode and behaviour for short transmissions:**

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection
2. Internal master clock

The LAP (lower address part) are the 24 LSB's of the 48 BD\_ADDRESS. The BD\_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD\_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronisation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5  $\mu$ s. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviour: The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5  $\mu$ s). The hopping sequence will always differ from the first one.

## **6 Receiver input bandwidth and behaviour for repeated single or multiple packets:**

The input bandwidth of the receiver is 1 MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection (e.g. single or multi slot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings. Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.



## 7 Dwell time in data mode

The dwell time of 0.3797s within a 30 second period in data mode is independent from the packet type (packet length). The calculation for a 30 second period is as follows:

Dwell time = time slot length \* hop rate / number of hopping channels \* 30s

Example for a DH1 packet (with a maximum length of one time slot) Dwell time =  $625 \mu\text{s} * 1600 \text{ 1/s} / 79 * 30\text{s} = 0.3797\text{s}$  (in a 30s period)

For multislot packet the hopping is reduced according to the length of the packet.

Example for a DH5 packet (with a maximum length of five time slots) Dwell time =  $5 * 625 \mu\text{s} * 1600 * 1/5 * 1/s / 79 * 30\text{s} = 0.3797\text{s}$  (in a 30s period).

This is according to the Bluetooth Core Specification V 1.0B (+ critical errata) for all Bluetooth devices. Therefore all Bluetooth devices comply with the FCC dwell time requirement in data mode. This was checked during the Bluetooth Qualification tests. The Dwell time in hybrid mode is measured and stated in the test report.

## 8 Channel Separation in hybrid mode

The nominal channel spacing of the Bluetooth system is 1MHz independent of the operating mode. The maximum "initial carrier frequency tolerance" which is allowed for Bluetooth is  $f_{\text{center}} = 75 \text{ kHz}$ . This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/07E) for three frequencies (2402, 2441, 2480 MHz). Additionally an example for the channel separation is given in the test report

## 9 Derivation and examples for a hopping sequence in hybrid mode

For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used (see chapter 5), but this time with different input vectors:

- For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.
- For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies.

So it is ensured that also in hybrid mode the frequency use is equally averaged.

Example of a hopping sequence in inquiry mode: 48, 50, 09, 13, 52, 54, 41, 45, 56, 58, 11, 15, 60, 62, 43, 47, 00, 02, 64, 68, 04, 06, 17, 21, 08, 10, 66, 70, 12, 14, 19, 23



Example of a hopping sequence in paging mode: 08, 57, 68, 70, 51, 02, 42, 40, 04, 61, 44, 46, 63, 14, 50, 48, 16, 65, 52, 54, 67, 18, 58, 56, 20, 53, 60, 62, 55, 06, 66, 64

#### **10 Receiver input bandwidth and synchronisation in hybrid mode:**

The receiver input bandwidth is the same as in the data mode (1 MHz). When two Bluetooth devices establish contact for the first time, one device sends an inquiry access code, the other device is scanning for this inquiry access code. If two devices have been connected previously and want to start a new transmission, a similar procedure takes place. The only difference is, instead of the inquiry access code, a special access code, derived from the BD\_ADDRESS of the paged device will be, will be sent by the master of this connection. Due to the fact that both units have been connected before (in the inquiry procedure) the paging unit has timing and frequency information about the page scan of the paged unit. For this reason the time to establish the connection is reduced considerably.

#### **11 Spread rate / data rate of the direct sequence signal**

The Spread rate / Data rate in inquiry and paging mode can be defined via the access code. The access code is the only criterion for the system to check if there is a valid transmission or not. If you regard the presence of a valid access code as one bit of information, and compare it with the length of the access code of 68 bits, the Spread rate/ Data rate will be 68/1.

#### **12 Spurious emission in hybrid mode**

The dwell time in hybrid mode is shorter than in data mode. For this reason the spurious emissions average level in data mode is worst case. The spurious emissions peak level is the same for both modes.

#### **13 Peak power spectral density measurement**

Since the transmitter is only active for some milliseconds on one channel you would get a result with many interruptions if using a sweep time of e.g. 1s as stated in the FCC rules. Therefore a fast sweep in maxhold function is used instead and the EUT is activated several times until the measurement curve has stabilized.