



FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

Handheld Image Reader(Linear / 2D Scanner)

Model: THIR-6000B-(W), THIR-6000HB-(W), THIR-6000DM-B-(W)

Trade Name: TOHKEN

Issued to

**TOHKEN CO., LTD.
2-16-20 Tamagawa, Chofu-shi,
Tokyo 182-0025, Japan**

Issued by

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TABLE OF CONTENTS

1. TEST RESULT CERTIFICATION.....	3
2. EUT DESCRIPTION	4
3. TEST METHODOLOGY	5
3.1 EUT CONFIGURATION	5
3.2 EUT EXERCISE.....	5
3.3 GENERAL TEST PROCEDURES.....	5
3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS.....	6
3.5 DESCRIPTION OF TEST MODES	7
4. INSTRUMENT CALIBRATION.....	8
4.1 MEASURING INSTRUMENT CALIBRATION.....	8
4.2 MEASUREMENT EQUIPMENT USED.....	8
5. FACILITIES AND ACCREDITATIONS	9
5.1 FACILITIES	9
5.2 EQUIPMENT.....	9
5.3 TABLE OF ACCREDITATIONS AND LISTINGS.....	10
6. SETUP OF EQUIPMENT UNDER TEST	11
6.1 SETUP CONFIGURATION OF EUT.....	11
6.2 SUPPORT EQUIPMENT	11
7. FCC PART 15.247 REQUIREMENTS.....	12
7.1 20 DB BANDWIDTH	12
7.2 PEAK POWER.....	16
7.3 AVERAGE POWER	18
7.4 BAND EDGES MEASUREMENT	19
7.5 PEAK POWER SPECTRAL DENSITY	28
7.6 FREQUENCY SEPARATION.....	34
7.7 NUMBER OF HOPPING FREQUENCY	37
7.8 TIME OF OCCUPANCY (DWELL TIME).....	40
7.9 SPURIOUS EMISSIONS	53
7.10 POWERLINE CONDUCTED EMISSIONS.....	68
APPENDIX I RADIO FREQUENCY EXPOSURE	71
APPENDIX II PHOTOGRAPHS OF TEST SETUP	73



1. TEST RESULT CERTIFICATION

Applicant: TOHKEN CO., LTD.
2-16-20 Tamagawa, Chofu-shi,
Tokyo 182-0025, Japan

Equipment Under Test: Handheld Image Reader(Linear / 2D Scanner)

Trade Name: TOHKEN

Model: THIR-6000B-(W), THIR-6000HB-(W), THIR-6000DM-B-(W)

Date of Test: June 17 ~ 19, 2008

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 the requirements of FCC Rules Part 15.207, 15.209, 15.247.

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

Approved by:

Rex Lai
Section Manager
Compliance Certification Services Inc.

Reviewed by:

Amanda Wu
Section Manager
Compliance Certification Services Inc.



2. EUT DESCRIPTION

Product	Handheld Image Reader(Linear / 2D Scanner)			
Trade Name	TOHKEN			
Model Number	THIR-6000B-(W), THIR-6000HB-(W), THIR-6000DM-B-(W)			
Model Discrepancy	1. All the specification and layout are identical except they come with different model numbers just for marketing purpose only. 2.			
	Model	THIR-6000B-(W)	THIR-6000HB-(W)	THIR-6000DM-B-(W)
	Means	Normal Type(Standard-density)	High-density	DPM (Direct Part Marking) FUNCTION
Power Supply	1. Model number: 3A-181WP05A I/P: AC 100-240V, 0.6A, 50-60Hz O/P: DC 5V, 3.0A 2. Rechargeable Lithium Battery: Rating: 3.7VDC, 2200mAh			
Frequency Range	2402 ~ 2480 MHz			
Transmit Power	13.17 dBm			
Modulation Technique	GFSK for 1Mbps; $\pi/4$ -DQPSK for 2Mbps; 8DPSK for 3Mbps			
Transmit Data Rate	1, 2, 3Mbps			
Number of Channels	79 Channels			
Antenna Specification	Gain: 2 dBi			
Antenna Designation	Chip Antenna			

Remark:

1. The sample selected for test was production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **WK4-THIR-6000B** 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 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

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 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 maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.



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
¹ 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	(²)
13.36 - 13.41	322 - 335.4		

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² 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 (model: THIR-6000B-(W)) had been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting mode was programmed.

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

Following channels were selected for the for radiated emission testing only as listed below:

Tested Channel	Modulation Type	Packet Type	Date Rate
Low, Mid, High	GFSK	DH 5	1
Low, Mid, High	8DPSK	DH 5	3



4. INSTRUMENT CALIBRATION

4.1 MEASURING 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.

4.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

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

Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY43360131	02/24/2009
Power Meter	Agilent	E4416A	GB41291611	04/06/2009
Power Sensor	Agilent	E9327A	US40441097	06/19/2009

3M Semi Anechoic Chamber				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	09/11/2008
Test Receiver	Rohde&Schwarz	ESCI	100064	11/30/2008
Switch Controller	TRC	Switch Controller	SC94050010	05/03/2009
4 Port Switch	TRC	4 Port Switch	SC94050020	05/03/2009
Horn-Antenna	TRC	HA-0502	06	06/04/2009
Horn-Antenna	TRC	HA-0801	04	06/19/2009
Horn-Antenna	TRC	HA-1201A	01	08/12/2008
Horn-Antenna	TRC	HA-1301A	01	08/12/2008
Bilog- Antenna	Sunol Sciences	JB3	A030205	03/28/2009
Turn Table	Max-Full	MFT-120S	T120S940302	N.C.R.
Antenna Tower	Max-Full	MFA-430	A440940302	N.C.R.
Controller	Max-Full	MF-CM886	CC-C-1F-13	N.C.R.
Site NSA	CCS	N/A	FCC: 965860 IC: IC 6106	09/25/2008
Test S/W	LABVIEW (V 6.1)			

Remark: The measurement uncertainty is less than $\pm 3.7046\text{dB}$ (30MHz ~ 1GHz), $\pm 3.0958\text{dB}$ (Above 1GHz) which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.

Powerline Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver 9kHz-30MHz	Rohde & Schwarz	ESHS30	828144/003	10/30/2008
Two-Line V-Network 9kHz-30MHz	Schaffner	NNB41	03/10013	06/11/2009
LISN 10kHz-100MHz	EMCO	3825/2	9106-1809	04/09/2009
ISN 9kHz-30MHz	FCC	FCC-TLISN-T4	20167	09/21/2008
Test S/W	LABVIEW (V 6.1)			

Remark: The measurement uncertainty is less than $\pm 2.81\text{dB}$, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.



5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

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

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No.11, Wugong 6th Rd., Wugu Industrial Park, Taipei Hsien 248, Taiwan

Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT





Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5.3 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	A2LA	EN 55011, EN 55014-1/2, CISPR 11, CISPR 14-1/2, EN 55022, EN 55015, CISPR 22, CISPR 15, AS/NZS 3548, VCCI V3 (2001), CFR 47, FCC Part 15/18, CNS 13783-1, CNS 13439, CNS 13438, CNS 13803, CNS 14115, EN 55024, IEC 801-2, IEC 801-3, IEC 801-4, IEC/EN 61000-3-2, EIC/EN 61000-3-3, IEC/EN 61000-4-2/3/4/5/6/8/11, EN 50081-1/ EN 61000-6-3, EN 50081-2/EN 61000-6-4, EN 50081-2/EN 61000-6-1: 2001	 ACCREDITED TESTING CERT #0824.01
USA	FCC	3M Semi Anechoic Chamber (965860 and 898658) to perform FCC Part 15/18 measurements	 965860, 898658
Taiwan	TAF	LP0002, RTTE01, FCC Method-47 CFR Part 15 Subpart C, D, E, RSS-210, RSS-310 IDA TS SRD, AS/NZS 4268, AS/NZS 4771, TS 12.1 & 12.2, ETSI EN 300 440-1, ETSI EN 300 440-2, ETSI EN 300 328, ETSI EN 300 220-1, ETSI EN 300 220-2, ETSI EN 301 893, ETSI EN 301 489-1/3/7/17 FCC OET Bulletin 65 + Supplement C, EN 50360, EN 50361, EN 50371, RSS 102, EN 50383, EN 50385, EN 50392, IEC 62209, CNS 14958-1, CNS 14959 FCC Method -47 CFR Part 15 Subpart B IEC / EN 61000-3-2, IEC / EN 61000-3-3, IEC / EN 61000-4-2/3/4/5/6/8/11	 Testing Laboratory 1309
Canada	Industry Canada	3M Semi Anechoic Chamber (IC 6106 & IC 6106A-2) to perform RSS 212 Issue 1	 IC 6106 IC 6106A-2

* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.



6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

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

6.2 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	Notebook PC	DELL	PP05L	7T390 A03	E2K5HCKT	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core
2.	Power Supply	Agilent	E3640A	N/A	FCC DoC	N/A	Unshielded, 1.8m
3.	Test kit	N/A	N/A	N/A	N/A	N/A	N/A
4.	WIRELESS UNIT CASE	TOHKEN	TMU-6000	N/A	N/A	N/A	Unshielded, 2.05m

Remark:

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.*



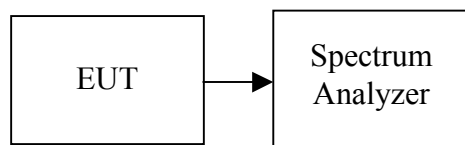
7. FCC PART 15.247 REQUIREMENTS

7.1 20 DB BANDWIDTH

LIMIT

None; for reporting purposes only.

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 and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW= 10kHz, VBW = 30kHz, Span = 1.5MHz, Sweep = auto.
4. Mark the peak frequency and 20dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

TEST RESULTS

No non-compliance noted.

**Test Plot****For GFSK****20dB Bandwidth (CH Low)**

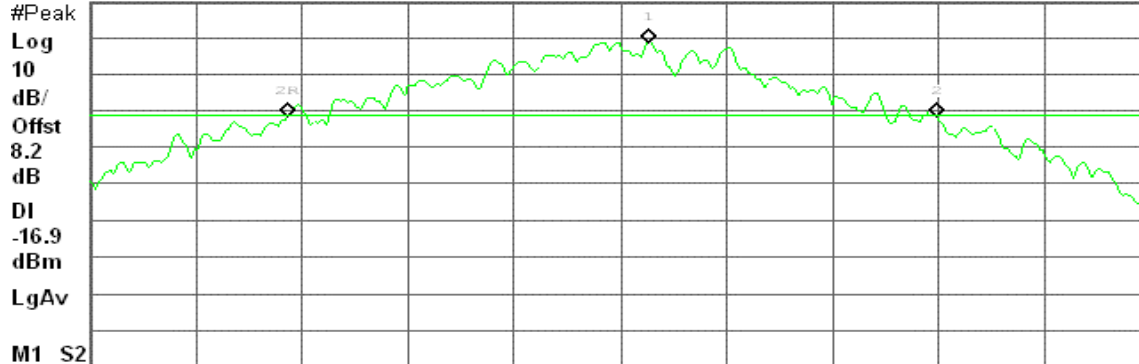
✱ Agilent 22:22:57 Jun 18, 2008

R T

Δ Mkr2 935 kHz
-0.37 dB

Ref 14.2 dBm

#Atten 16 dB



Center 2.402 000 GHz

Span 1.5 MHz

#Res BW 10 kHz

#VBW 30 kHz

Sweep 14.36 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.402 041 GHz	3.16 dBm
2R	(1)	Freq	2.401 527 GHz	-17.23 dBm
2Δ	(1)	Freq	935 kHz	-0.37 dB

20dB Bandwidth (CH Mid)

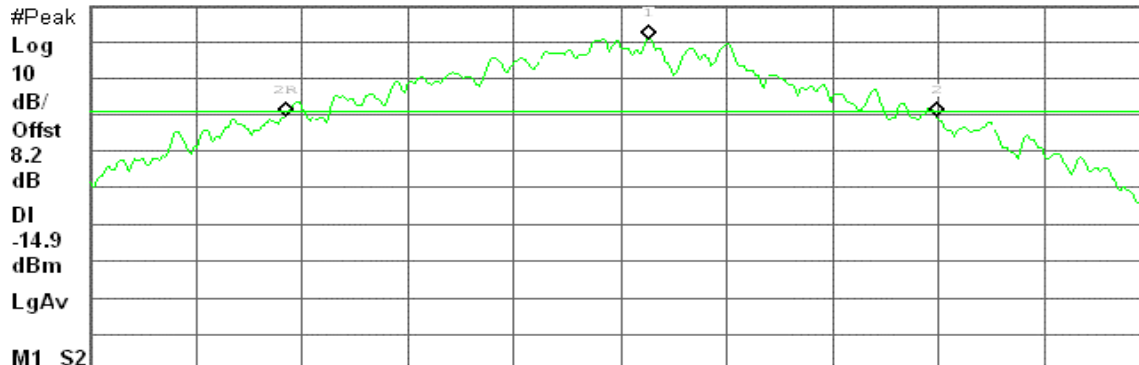
✱ Agilent 22:25:46 Jun 18, 2008

R T

Δ Mkr2 938 kHz
-0.10 dB

Ref 14.2 dBm

#Atten 16 dB



Center 2.441 000 GHz

Span 1.5 MHz

#Res BW 10 kHz

#VBW 30 kHz

Sweep 14.36 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.441 041 GHz	5.15 dBm
2R	(1)	Freq	2.440 524 GHz	-16.10 dBm
2Δ	(1)	Freq	938 kHz	-0.10 dB

**20dB Bandwidth (CH High)**

* Agilent 22:35:10 Jun 18, 2008

R T

 Δ Mkr2 932 kHz
-0.58 dB

Ref 14.2 dBm

#Atten 16 dB

#Peak

Log

10

dB/

Offst

8.2

dB

DI

-13.8

dBm

LgAv

M1 S2

Center 2.480 000 GHz

Span 1.5 MHz

#Res BW 10 kHz

#VBW 30 kHz

Sweep 14.36 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.480 041 GHz	6.19 dBm
2R	(1)	Freq	2.479 527 GHz	-13.83 dBm
2Δ	(1)	Freq	932 kHz	-0.58 dB

For 8DPSK**20dB Bandwidth (CH Low)**

* Agilent 10:50:49 Jun 18, 2008

R T

 Δ Mkr2 1.287 MHz
-0.29 dB

Ref 17.5 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

7.5

dB

DI

-12.7

dBm

LgAv

V1 S2

Center 2.402 000 GHz

Span 1.5 MHz

#Res BW 10 kHz

#VBW 30 kHz

Sweep 14.36 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.402 000 GHz	7.29 dBm
2R	(1)	Freq	2.401 326 GHz	-12.70 dBm
2Δ	(1)	Freq	1.287 MHz	-0.29 dB

**20dB Bandwidth (CH Mid)**

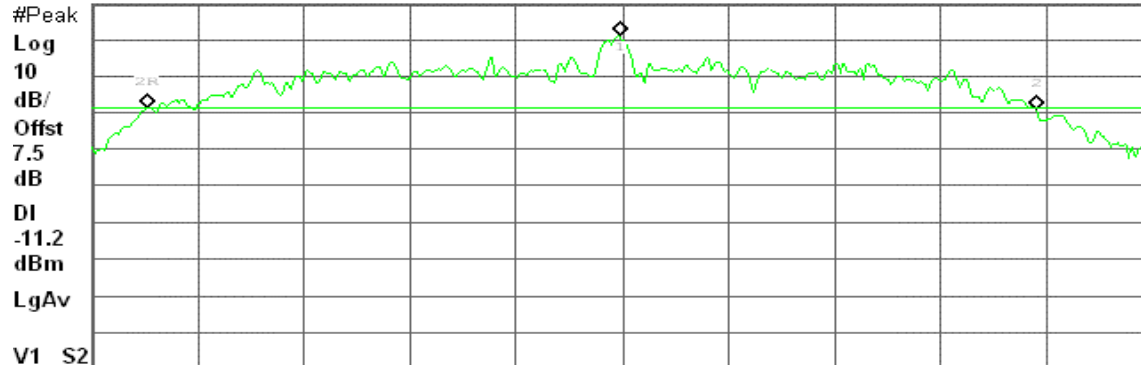
* Agilent 10:52:32 Jun 18, 2008

R T

 Δ Mkr2 1.280 MHz
-0.43 dB

Ref 17.5 dBm

#Atten 20 dB

V1 S2
Center 2.441 000 GHz

Span 1.5 MHz

#Res BW 10 kHz

#VBW 30 kHz

Sweep 14.36 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.440 995 GHz	8.81 dBm
2R	(1)	Freq	2.440 326 GHz	-11.00 dBm
2Δ	(1)	Freq	1.280 MHz	-0.43 dB

20dB Bandwidth (CH High)

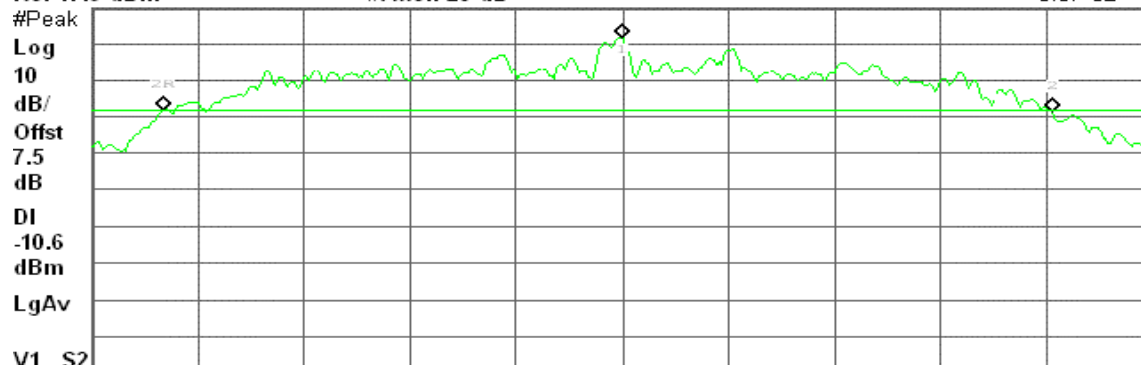
* Agilent 10:53:29 Jun 18, 2008

R T

 Δ Mkr2 1.288 MHz
-0.37 dB

Ref 17.5 dBm

#Atten 20 dB

V1 S2
Center 2.480 000 GHz

Span 1.5 MHz

#Res BW 10 kHz

#VBW 30 kHz

Sweep 14.36 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.479 997 GHz	9.41 dBm
2R	(1)	Freq	2.479 324 GHz	-10.51 dBm
2Δ	(1)	Freq	1.288 MHz	-0.37 dB



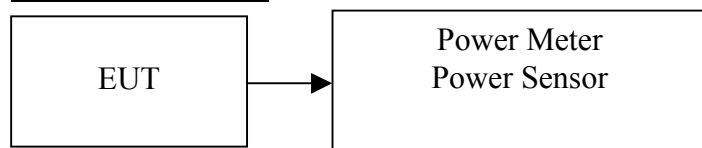
7.2 PEAK POWER

LIMIT

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

1. 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.
2. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.
3. According to §15.247(b)(4), 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.

Test Configuration



TEST PROCEDURE

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

**TEST RESULTS***No non-compliance noted***Test Data****For GFSK**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2402	9.74	0.0094	0.125	PASS
Mid	2441	11.29	0.0135		PASS
High	2480	12.09	0.0162		PASS

For 8DPSK

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2402	11.63	0.0146	0.125	PASS
Mid	2441	12.29	0.0169		PASS
High	2480	13.17	0.0207		PASS

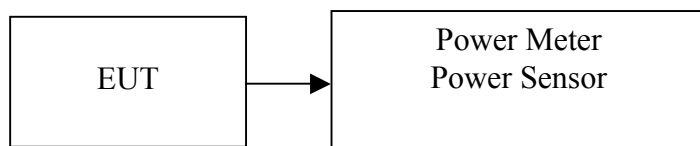


7.3 AVERAGE POWER

LIMIT

None; for reporting purposes only.

Test Configuration



TEST PROCEDURE

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

TEST RESULTS

No non-compliance noted.

Test Data

For GFSK

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2402	7.18	0.0052
Mid	2441	9.05	0.0080
High	2480	10.21	0.0105

For 8DPSK

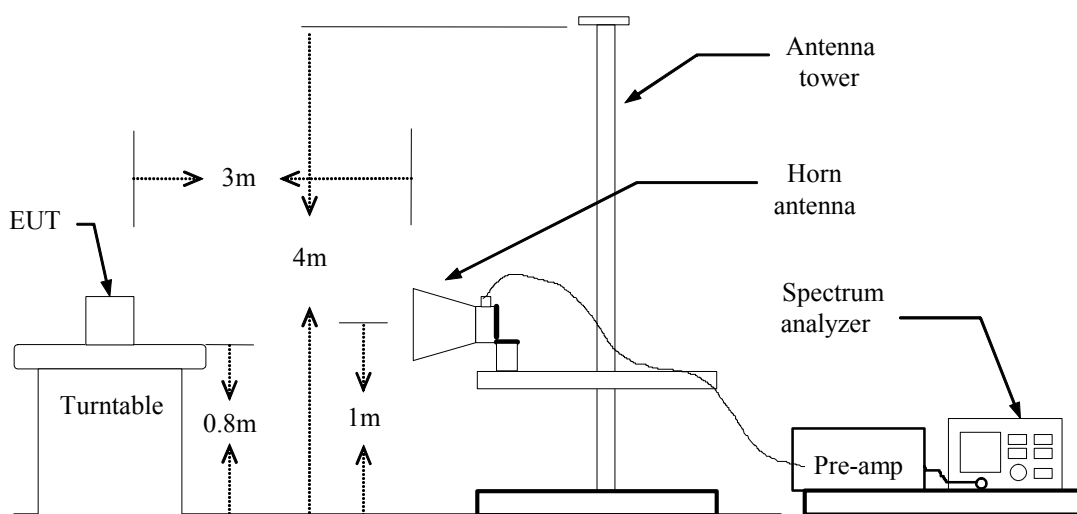
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2402	9.01	0.0080
Mid	2441	10.67	0.0117
High	2480	11.46	0.0140

7.4 BAND EDGES MEASUREMENT

LIMIT

According to §15.247(d), 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 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, provided the transmitter demonstrates compliance with the peak conducted power limits. 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) (see Section 15.205(c)).

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.

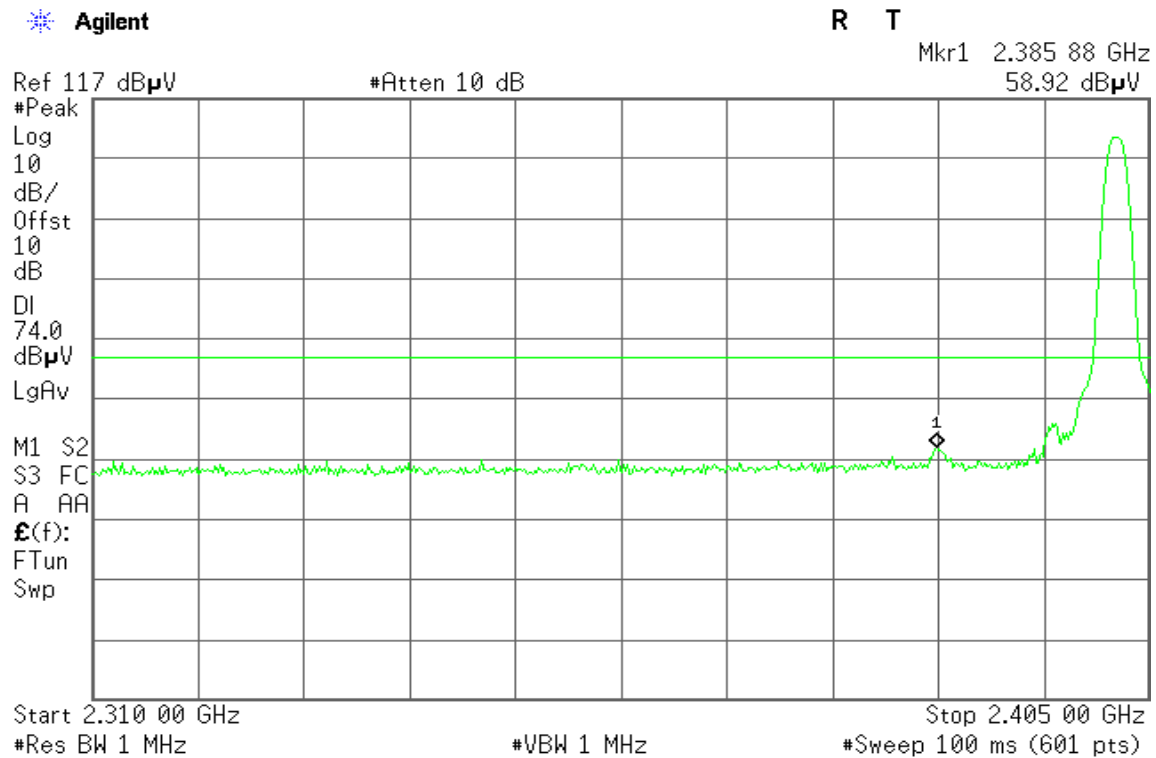


For GFSK

Band Edges (CH Low)

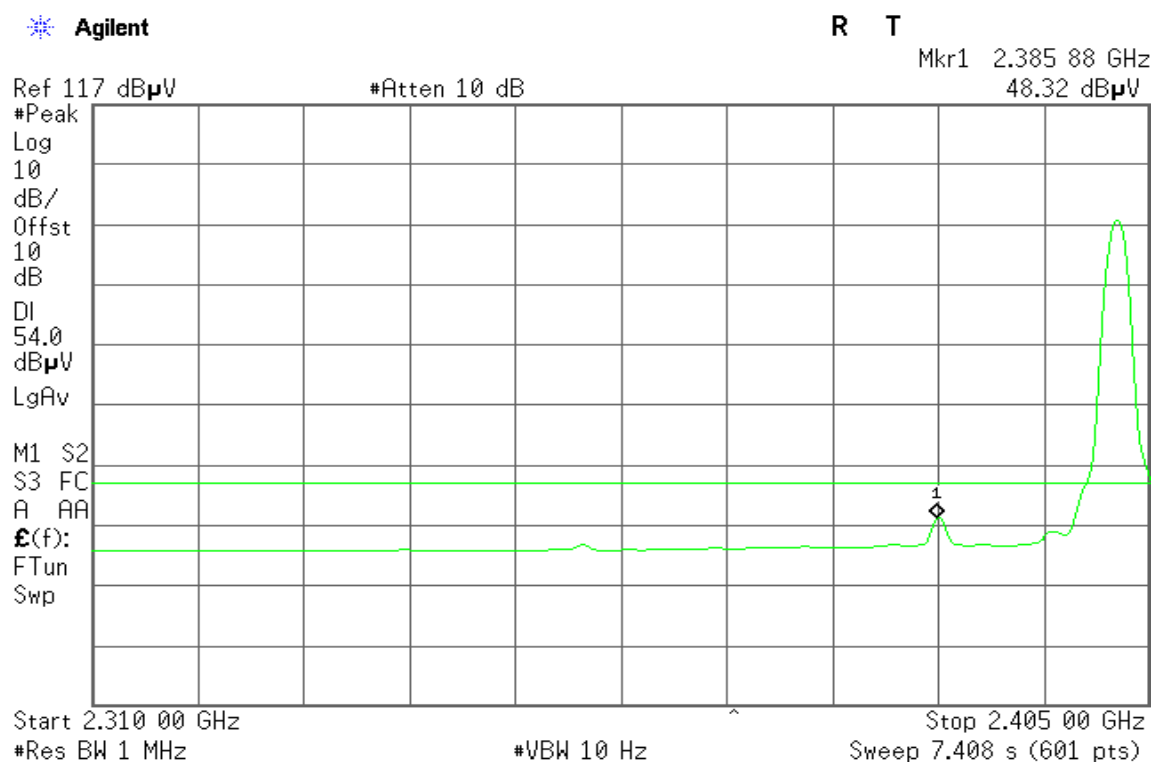
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

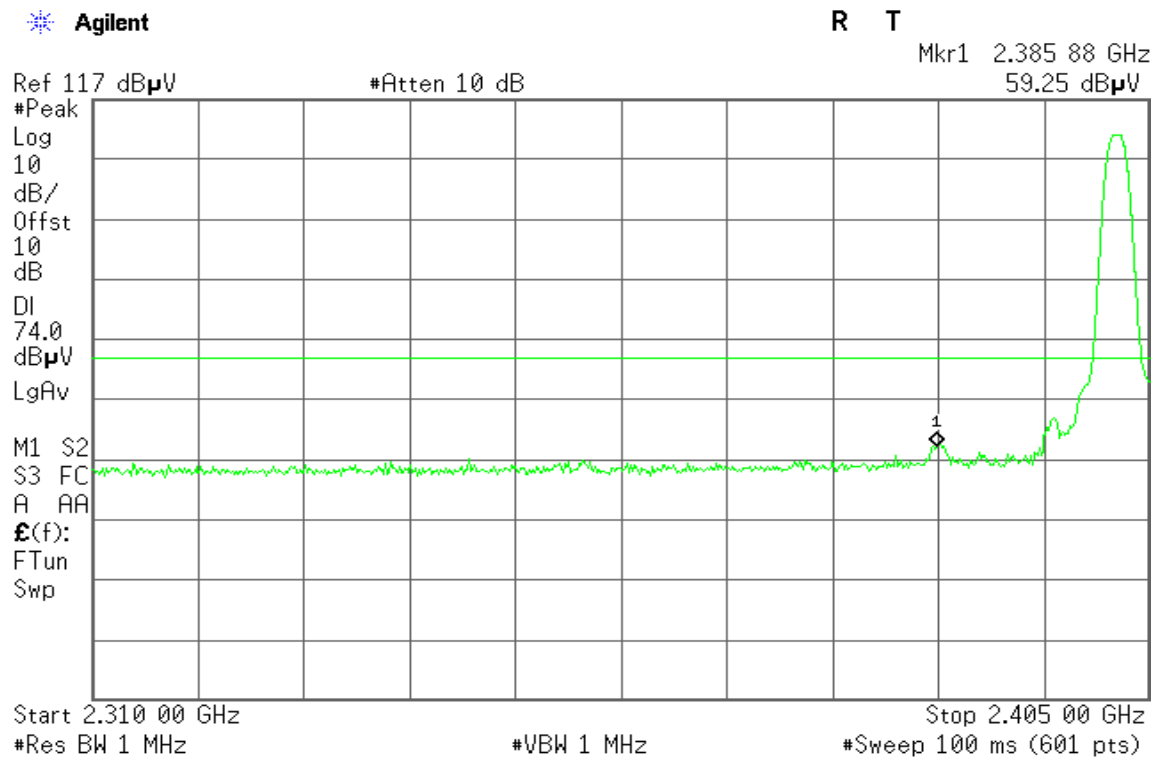
Polarity: Vertical





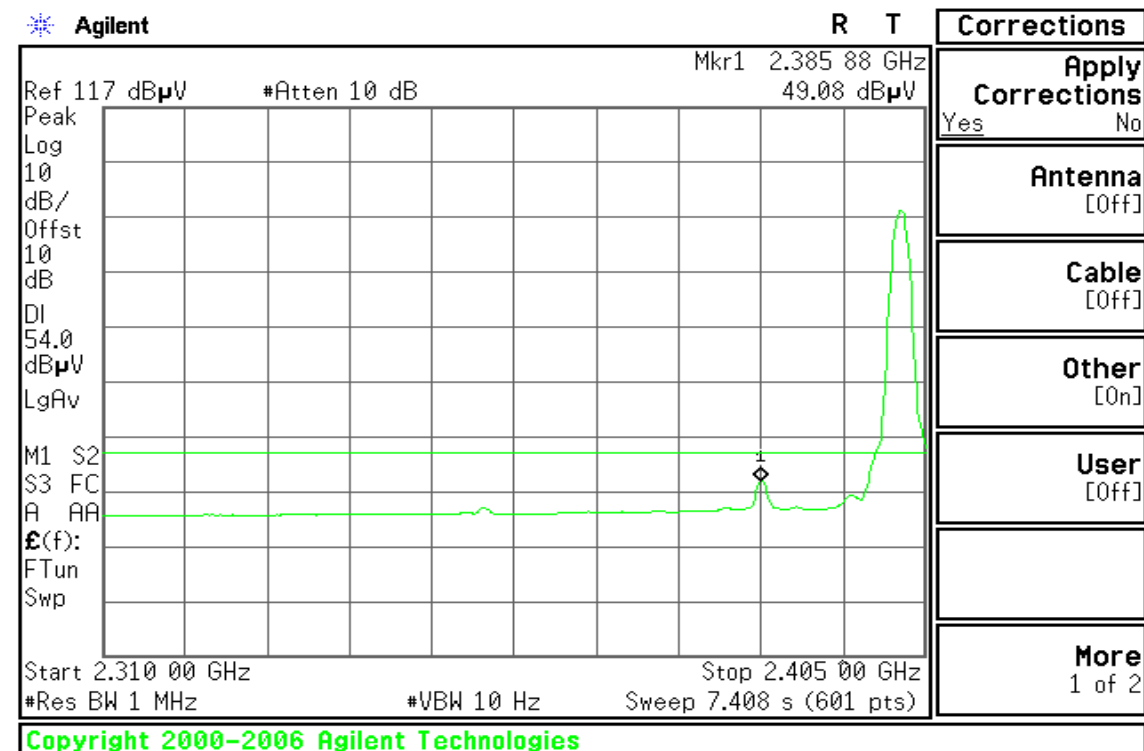
Detector mode: Peak

Polarity: Horizontal



Detector mode: Average

Polarity: Horizontal

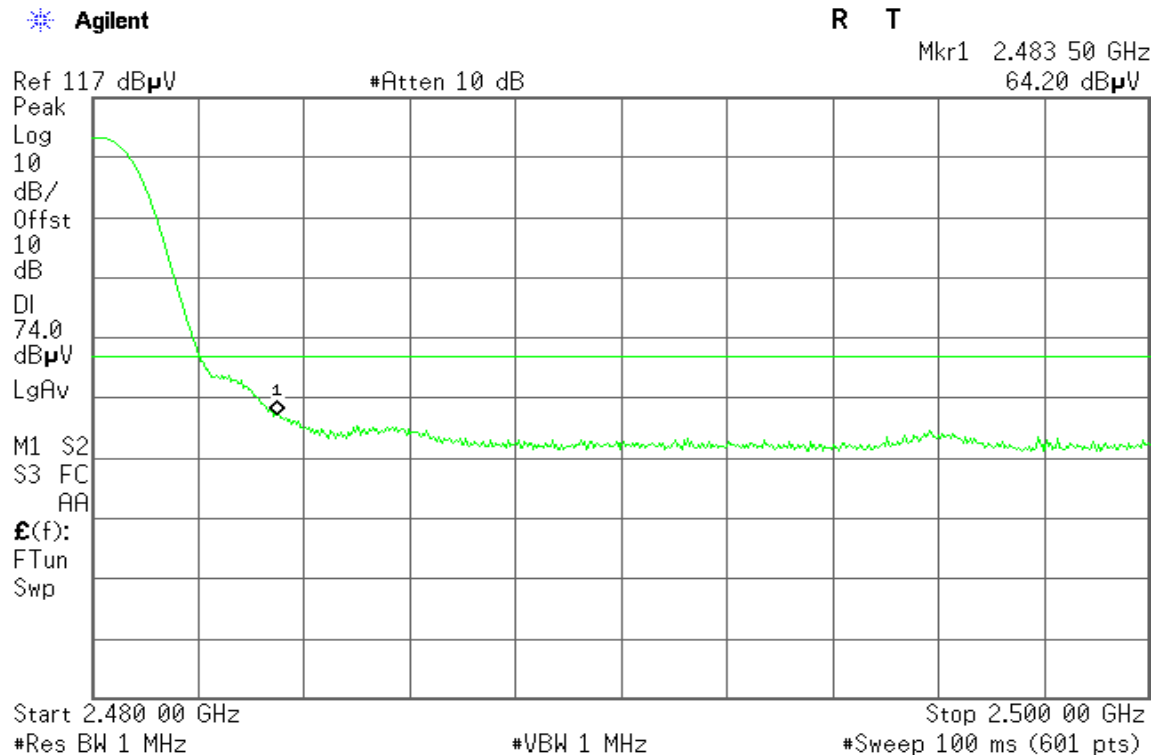




Band Edges (CH High)

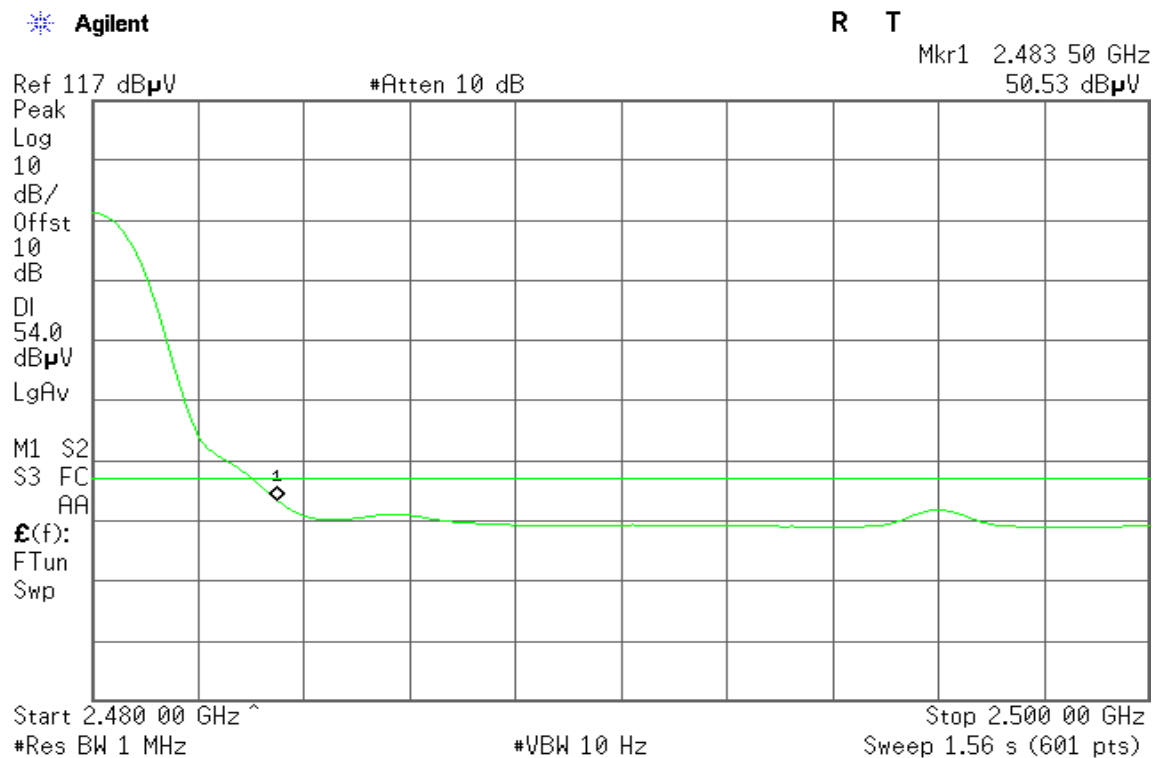
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

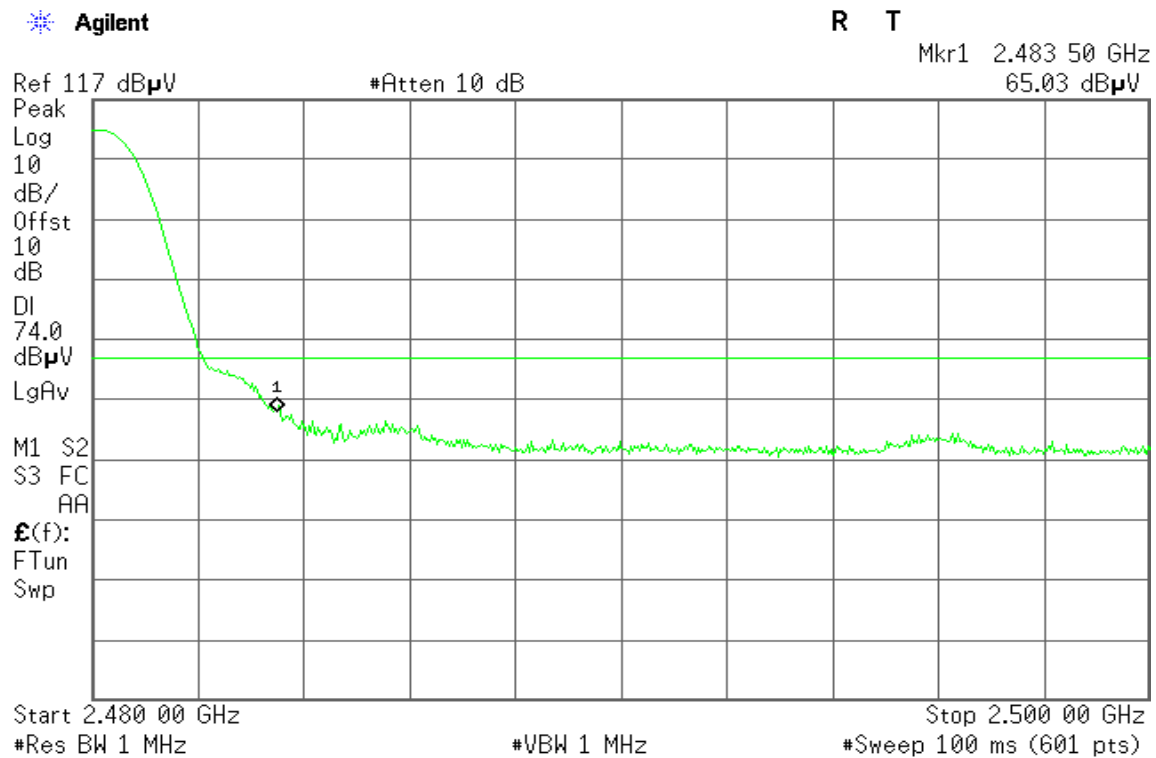
Polarity: Vertical





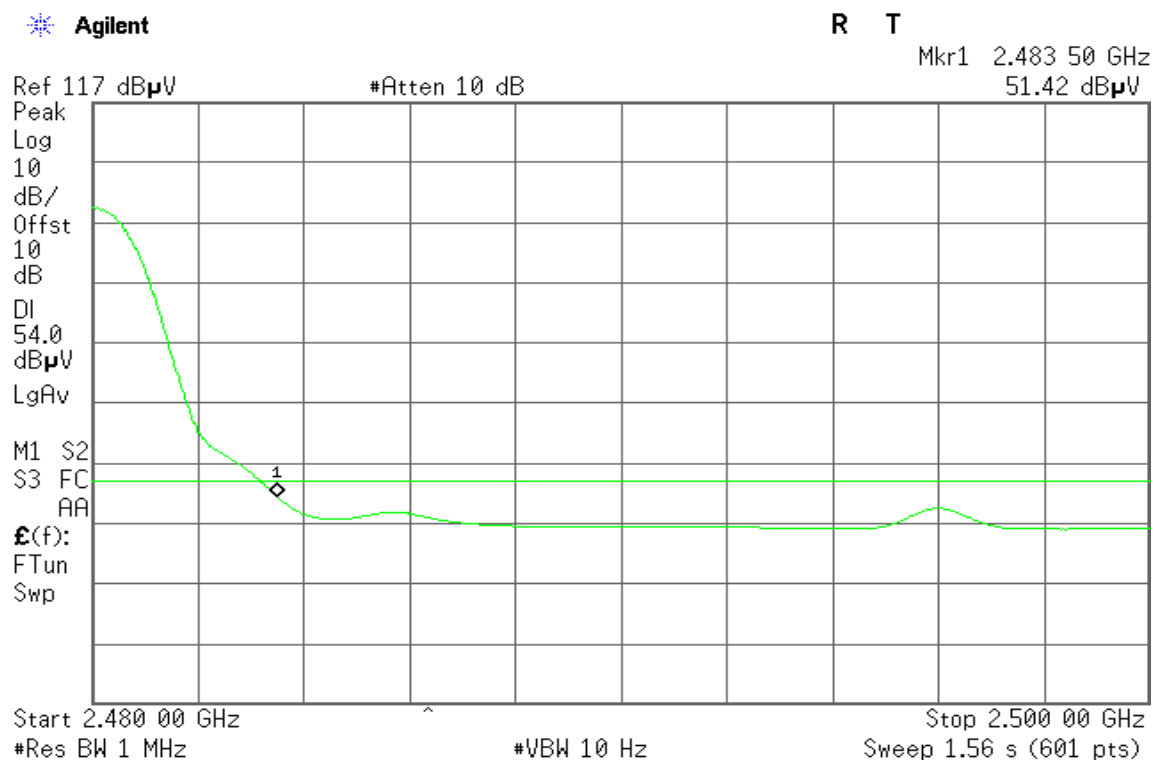
Detector mode: Peak

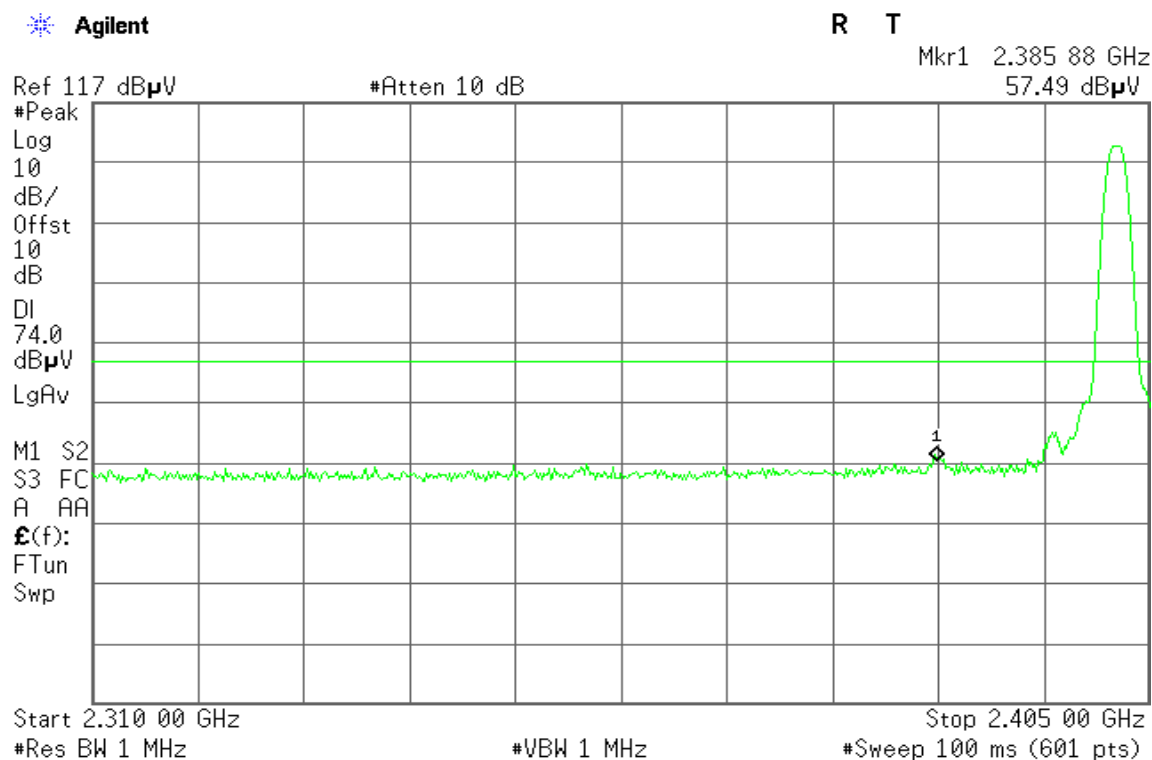
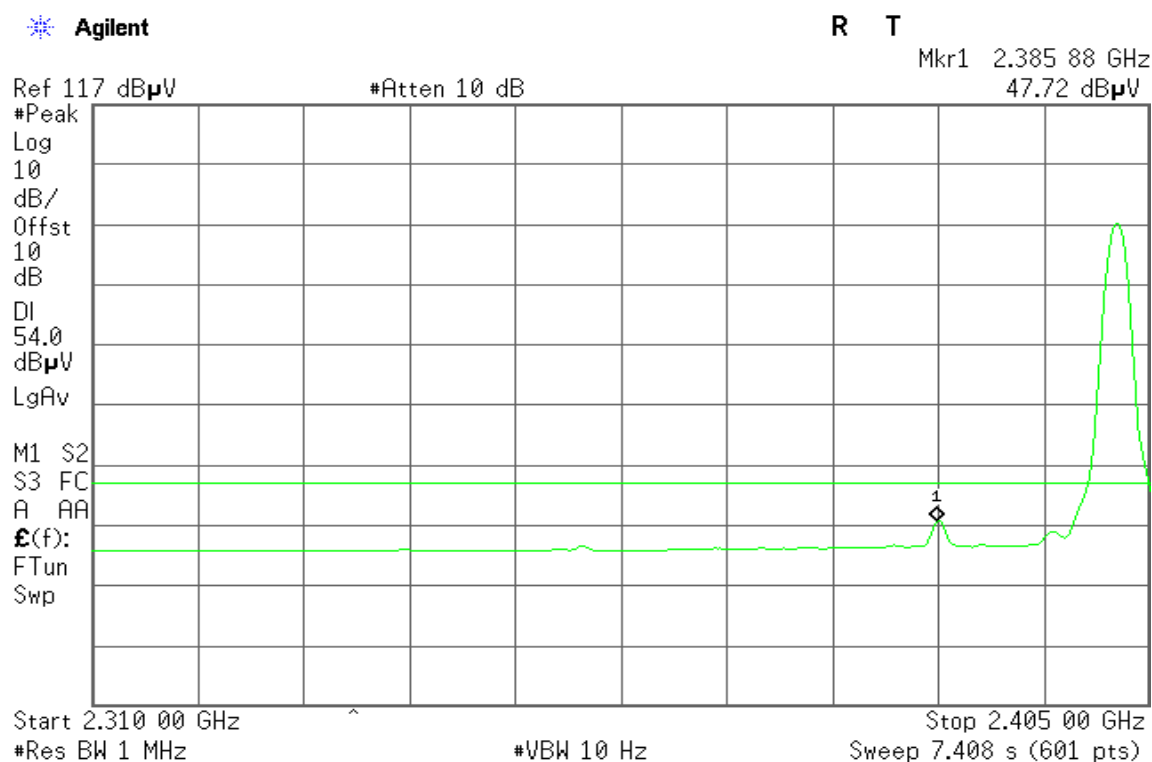
Polarity: Horizontal



Detector mode: Average

Polarity: Horizontal

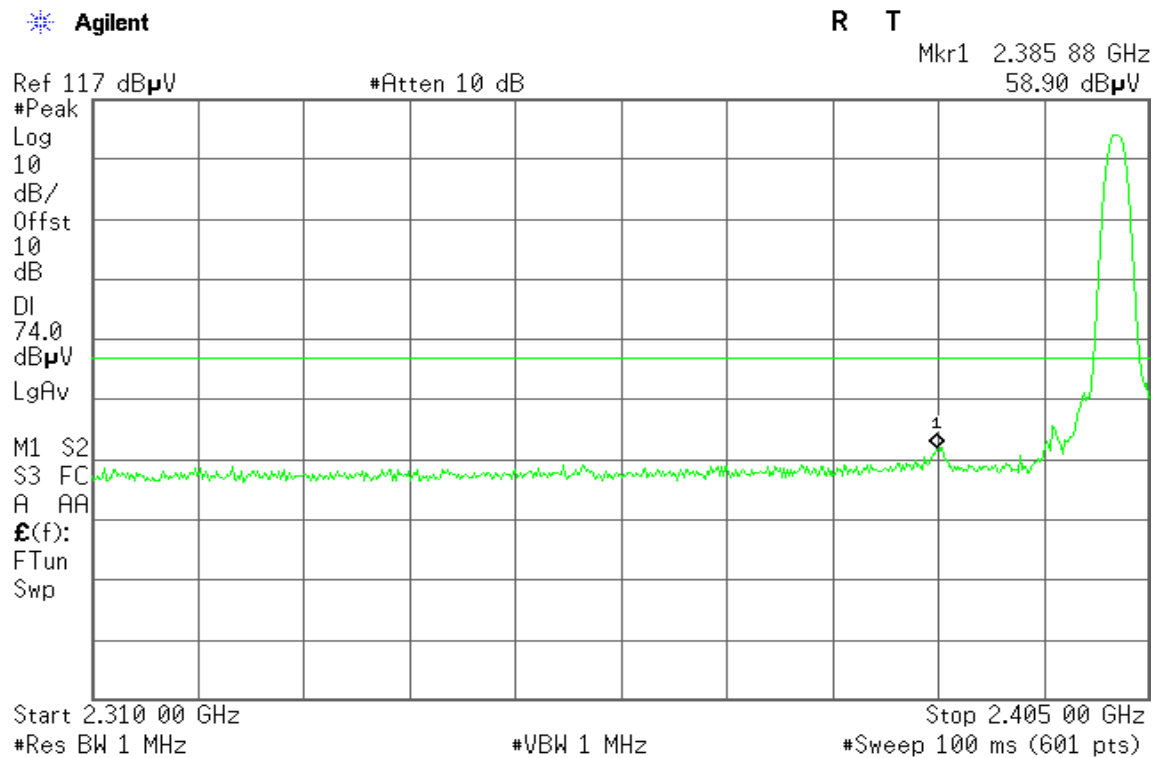


**For 8DPSK****Band Edges (CH Low)****Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**



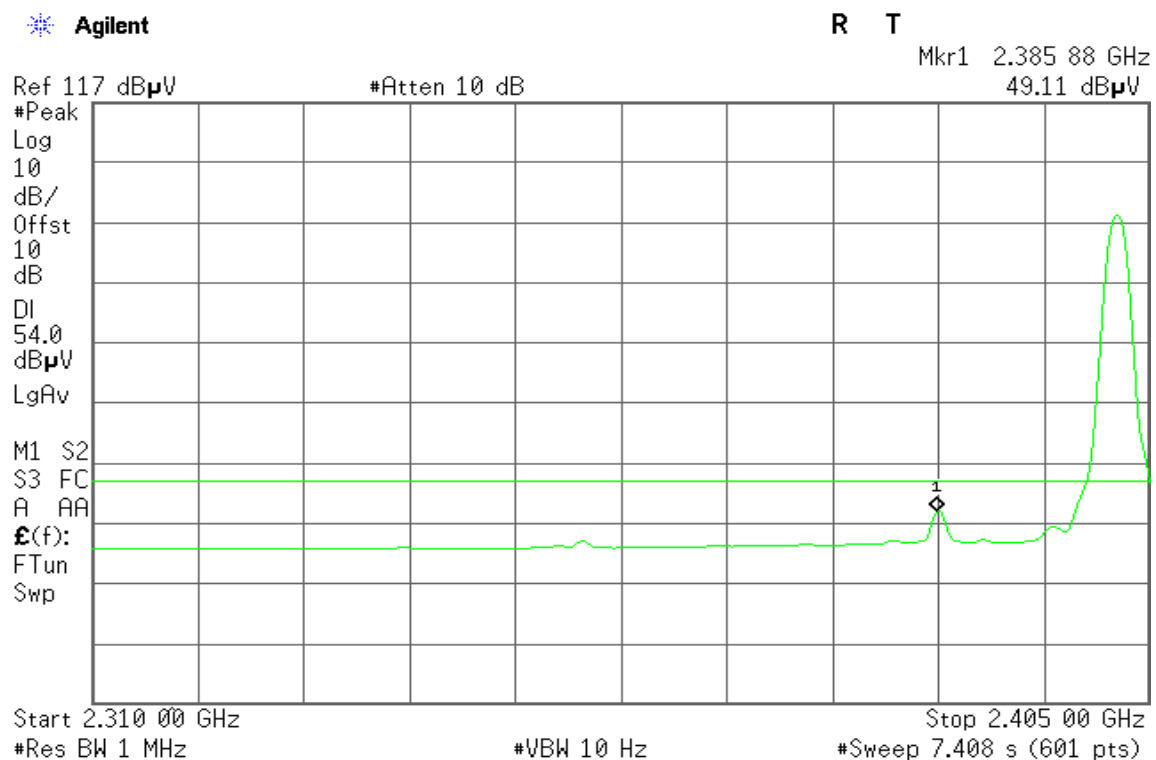
Detector mode: Peak

Polarity: Horizontal



Detector mode: Average

Polarity: Horizontal

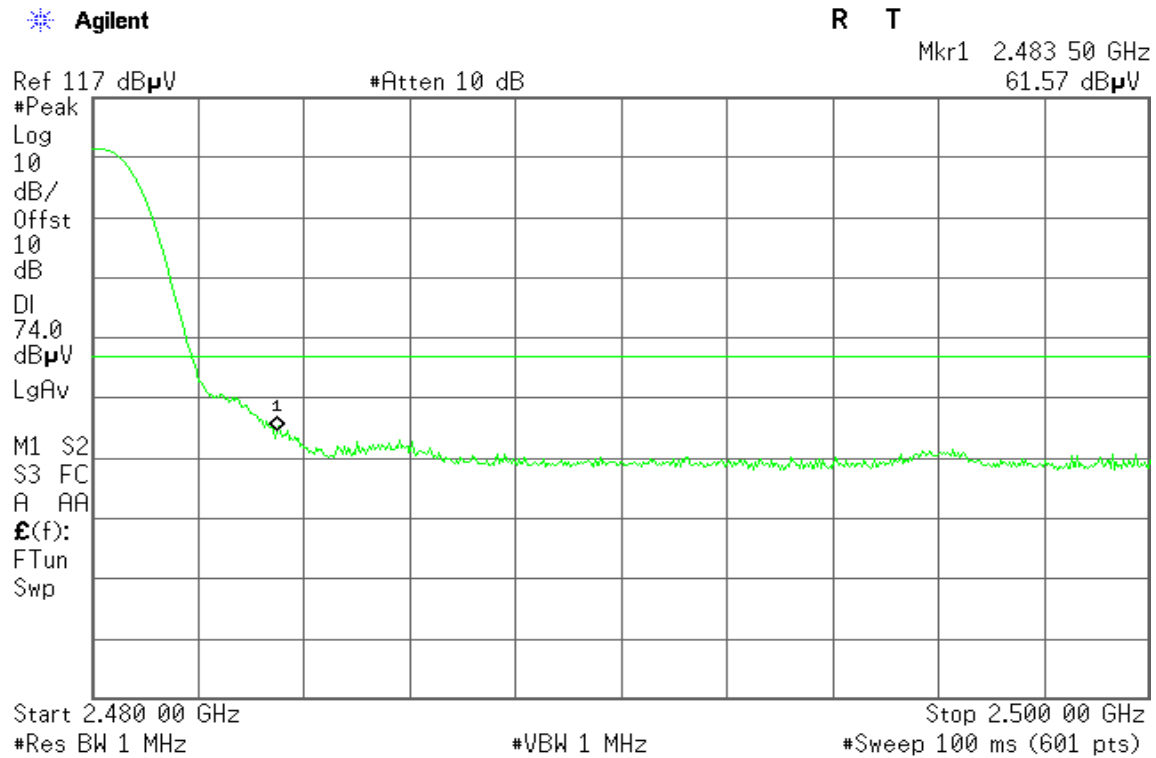




Band Edges (CH High)

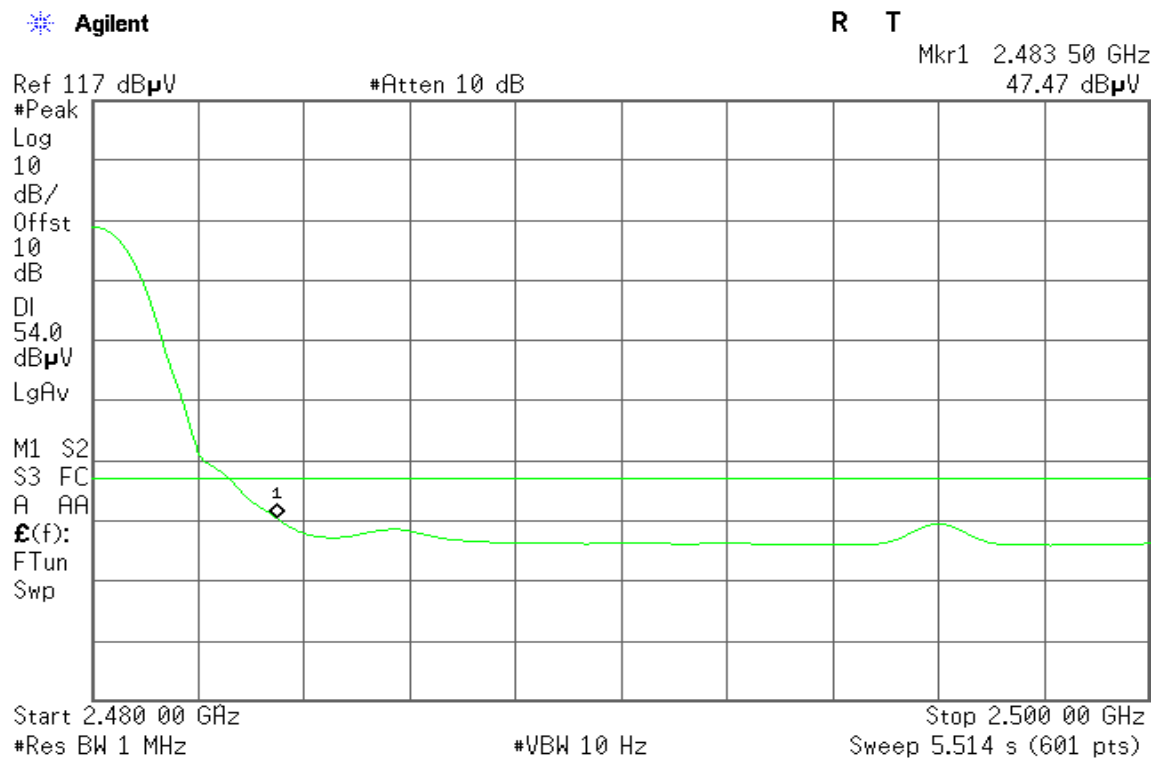
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

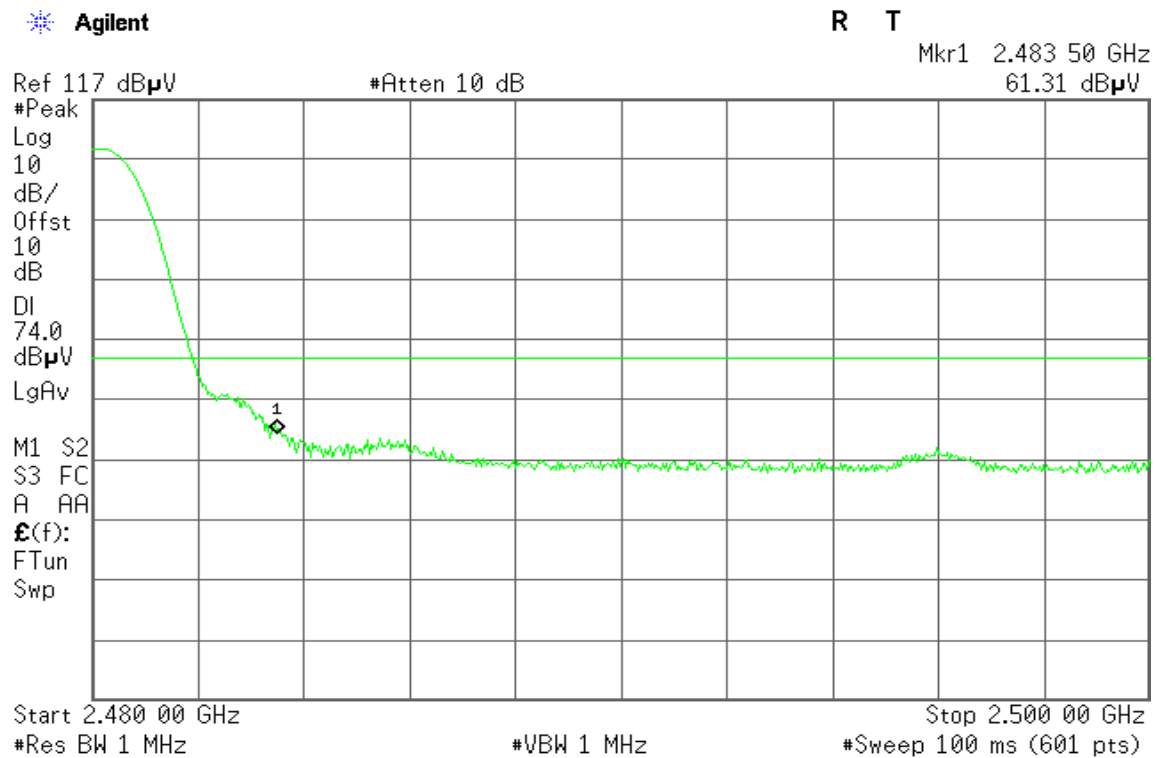
Polarity: Vertical





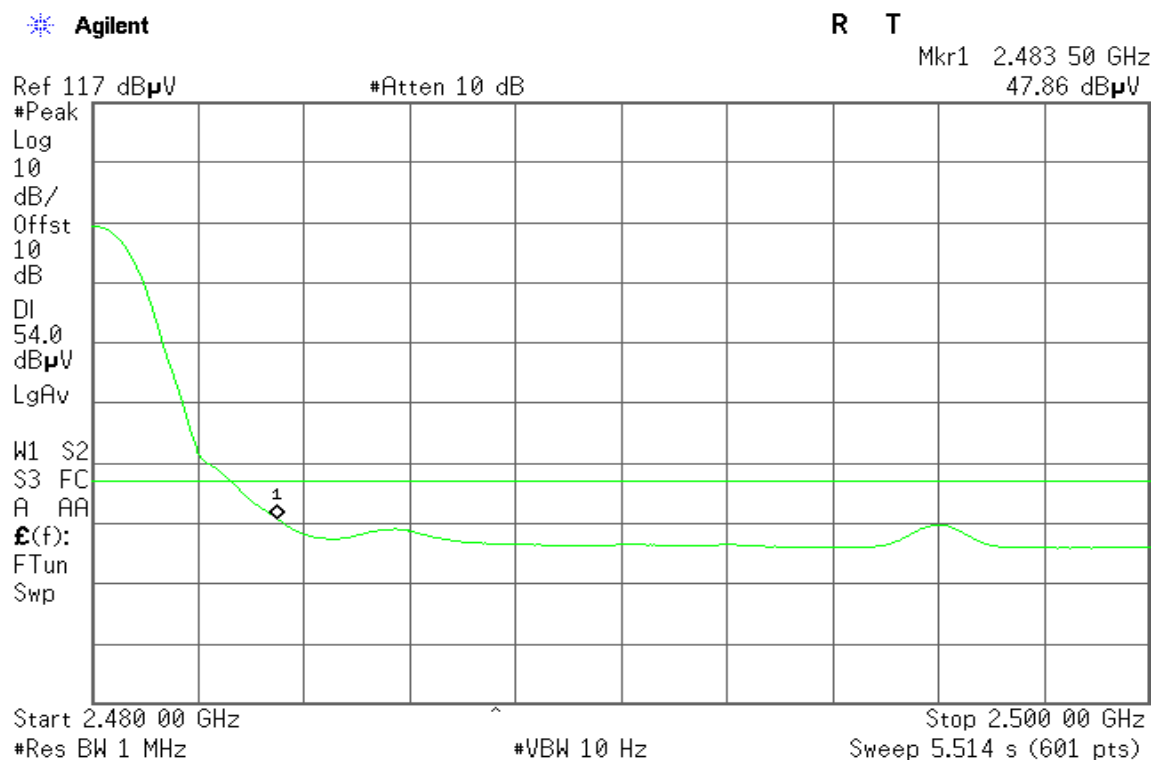
Detector mode: Peak

Polarity: Horizontal



Detector mode: Average

Polarity: Horizontal



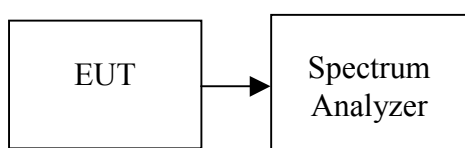


7.5 PEAK POWER SPECTRAL DENSITY

LIMIT

1. According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
2. According to §15.247(f), the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

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

No non-compliance noted.

**Test Data****For GFSK**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2402	-3.41	8.00	PASS
Mid	2441	-1.29		PASS
High	2480	-0.22		PASS

For 8DPSK

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2402	-0.47	8.00	PASS
Mid	2441	0.87		PASS
High	2480	1.85		PASS



Test Plot

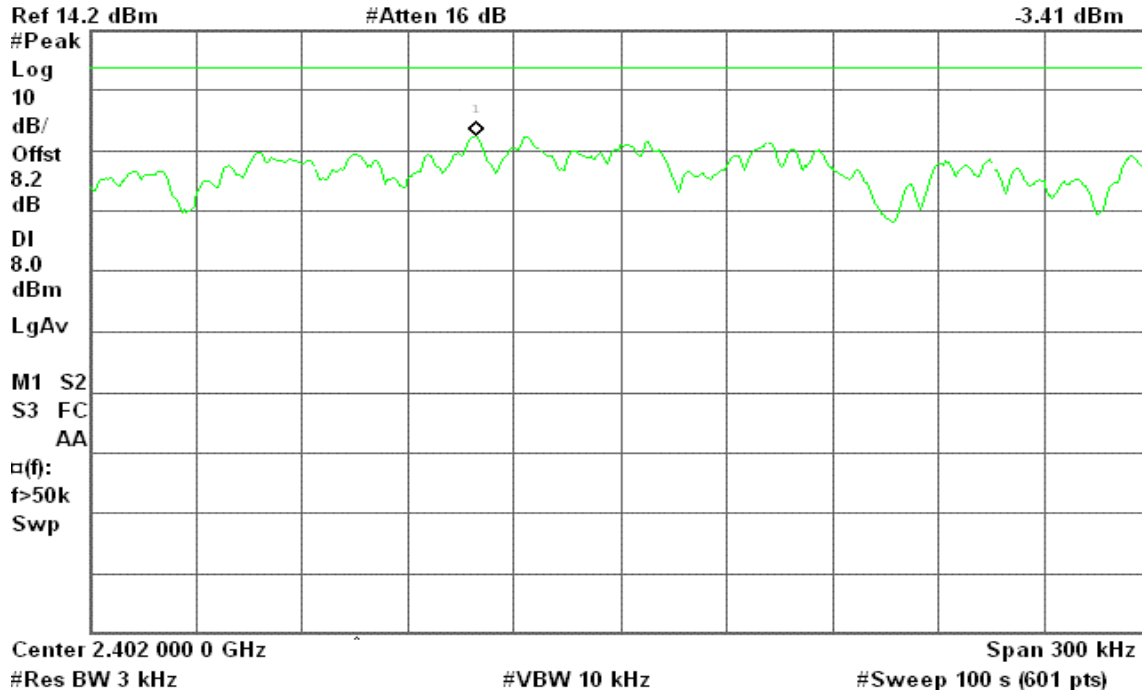
For GFSK

PPSD (CH Low)

Agilent 22:50:17 Jun 18, 2008

R T

Mkr1 2.401 959 4 GHz
-3.41 dBm

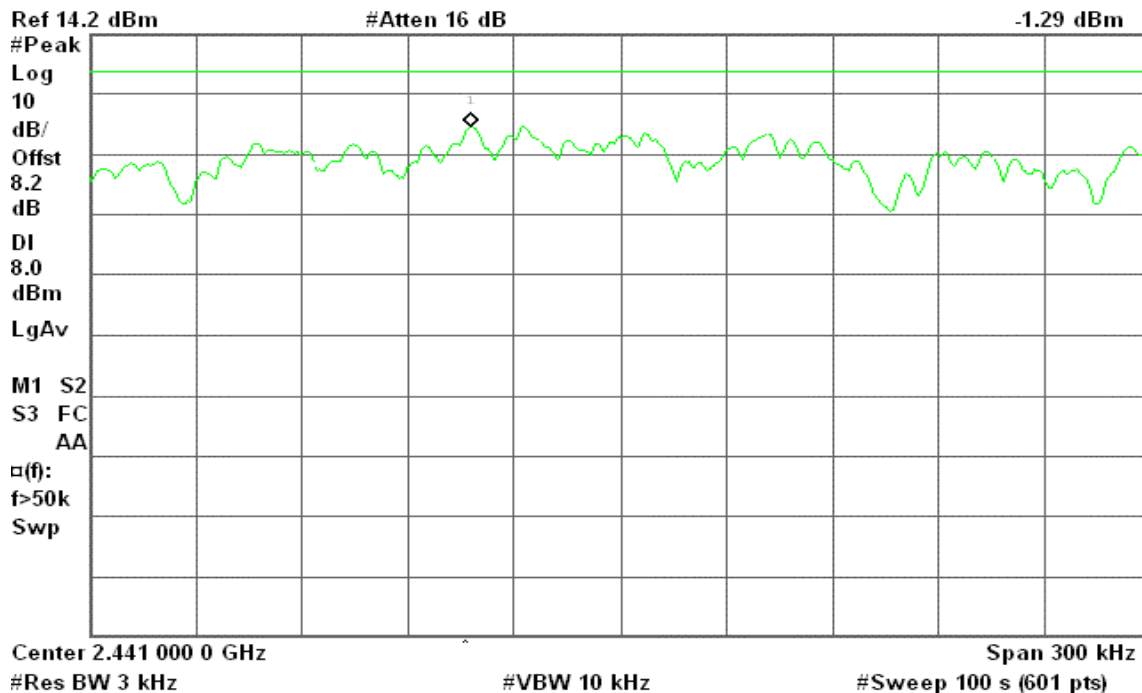


PPSD (CH Mid)

Agilent 22:56:31 Jun 18, 2008

R T

Mkr1 2.440 957 9 GHz
-1.29 dBm





PPSD (CH High)

Agilent 22:59:31 Jun 18, 2008

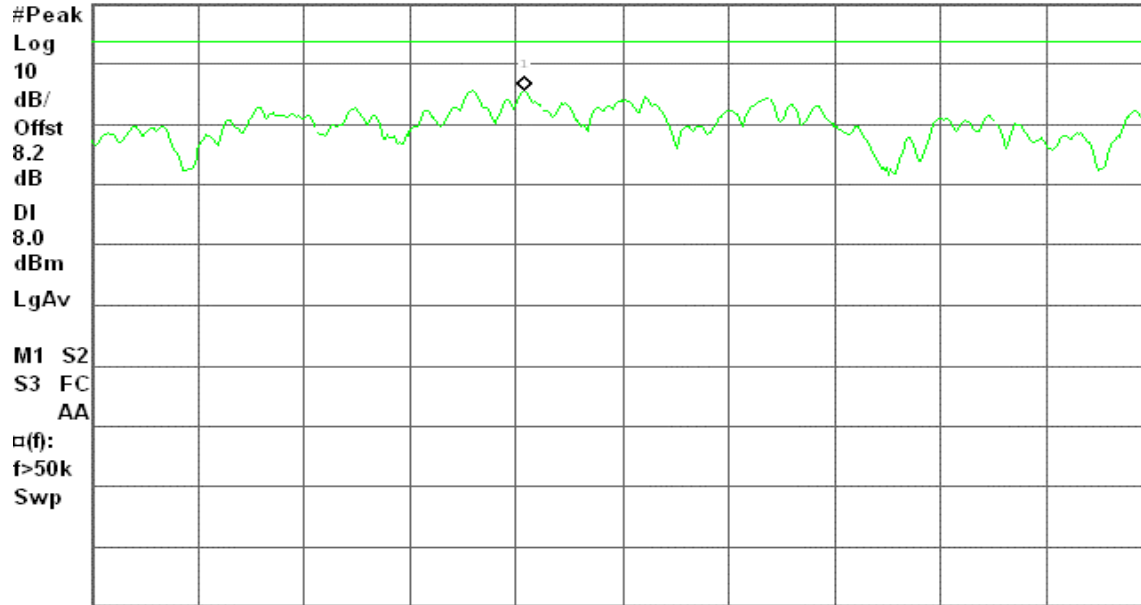
R T

Mkr1 2.479 972 4 GHz

-0.22 dBm

Ref 14.2 dBm

#Atten 16 dB



Center 2.480 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)



For 8DPSK

PPSD (CH Low)

Agilent 11:13:14 Jun 18, 2008

R T

Mkr1 2.401 978 9 GHz

-0.47 dBm

Ref 17.5 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

7.5

dB

DI

8.0

dBm

LgAv

M1 S2

S3 FC

AA

□(f):

f>50k

Swp

Center 2.402 000 0 GHz

#Res BW 3 kHz

#VBW 10 kHz

Span 300 kHz

#Sweep 100 s (601 pts)

PPSD (CH Mid)

Agilent 11:16:22 Jun 18, 2008

R T

Mkr1 2.440 975 9 GHz

0.87 dBm

Ref 17.5 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

7.5

dB

DI

8.0

dBm

LgAv

M1 S2

S3 FC

AA

□(f):

f>50k

Swp

Center 2.441 000 0 GHz

#Res BW 3 kHz

#VBW 10 kHz

Span 300 kHz

#Sweep 100 s (601 pts)



PPSD (CH High)

Agilent 11:18:17 Jun 18, 2008

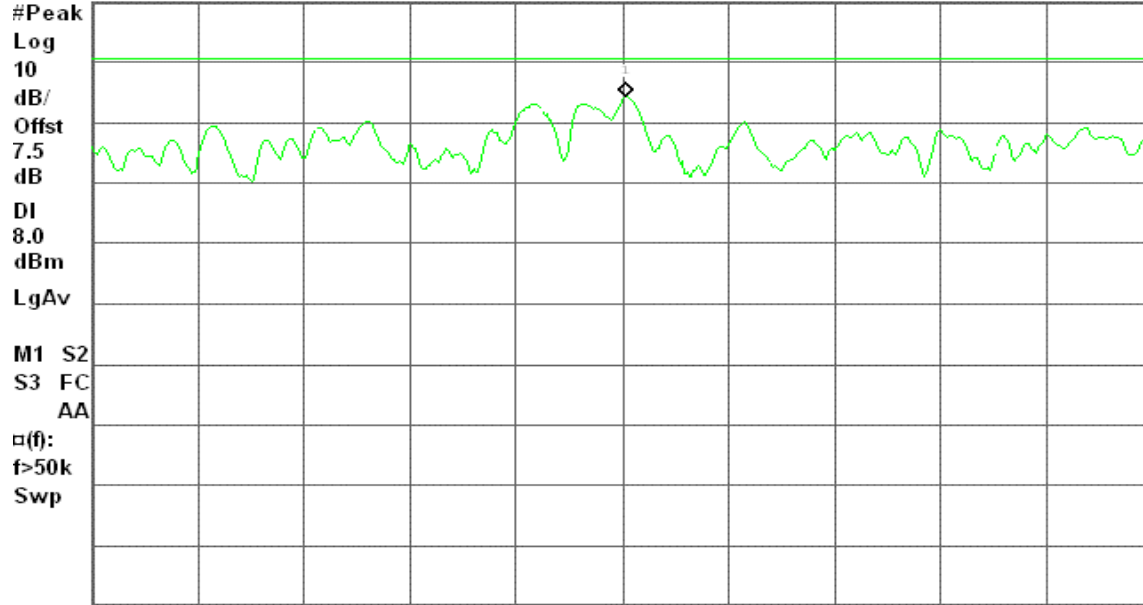
R T

Mkr1 2.480 001 0 GHz

Ref 17.5 dBm

#Atten 20 dB

1.85 dBm



Center 2.480 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)

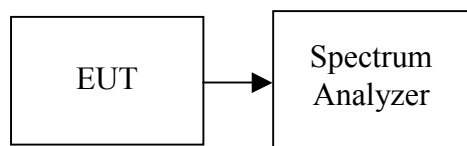


7.6 FREQUENCY SEPARATION

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.

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, Span = 3MHz, 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

For GFSK

Channel Separation (MHz)	two-thirds of the 20 dB bandwidth (kHz)	Channel Separation Limit	Result
1.00	625	> two-thirds of the 20 dB bandwidth	Pass

For 8DPSK

Channel Separation (MHz)	two-thirds of the 20 dB bandwidth (kHz)	Channel Separation Limit	Result
1.00	859	> two-thirds of the 20 dB bandwidth	Pass



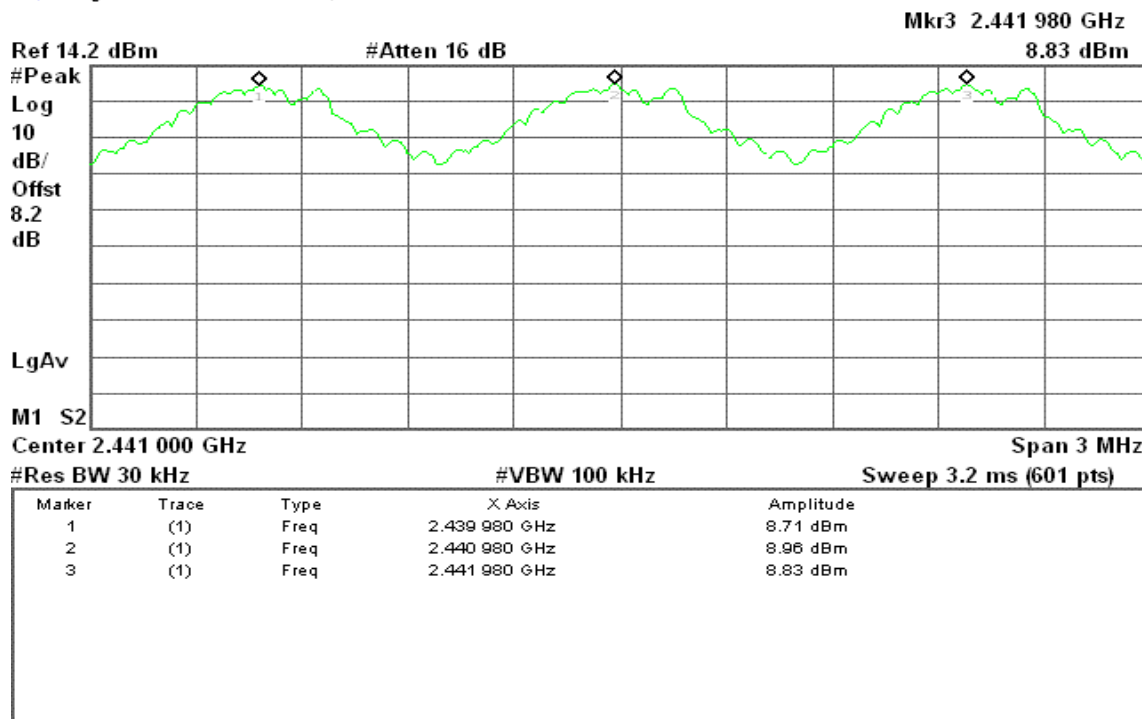
Test Plot

For GFSK

Measurement of Channel Separation

* Agilent 23:11:45 Jun 18, 2008

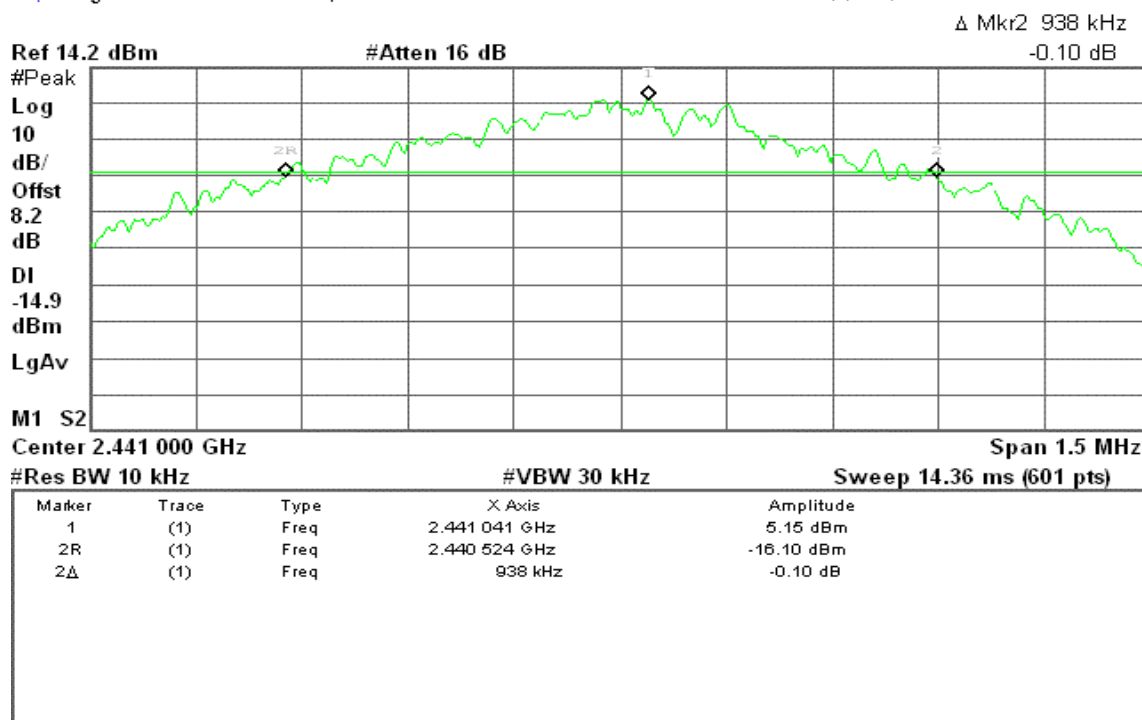
R T



Measurement of 20dB Bandwidth

* Agilent 22:25:46 Jun 18, 2008

R T



**For 8DPSK****Measurement of Channel Separation**

✱ Agilent 11:29:04 Jun 18, 2008

R T

Mkr3 2.441 990 GHz

Ref 17.5 dBm

#Atten 20 dB

13.44 dBm

#Peak

Log

10

dB/

Offst

7.5

dB

LgAv

V1 S2

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
1	(1)	Freq	2.439 995 GHz	13.53 dBm
2	(1)	Freq	2.440 990 GHz	13.33 dBm
3	(1)	Freq	2.441 990 GHz	13.44 dBm

Measurement of 20dB Bandwidth

✱ Agilent 10:53:29 Jun 18, 2008

R T

Δ Mkr2 1.288 MHz

-0.37 dB

Ref 17.5 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

7.5

dB

DI

-10.6

dBm

LgAv

V1 S2

Center 2.480 000 GHz

Span 1.5 MHz

#Res BW 10 kHz

#VBW 30 kHz

Sweep 14.36 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.479 997 GHz	9.41 dBm
2R	(1)	Freq	2.479 324 GHz	-10.51 dBm
2Δ	(1)	Freq	1.288 MHz	-0.37 dB

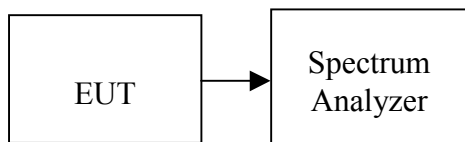


7.7 NUMBER OF HOPPING FREQUENCY

LIMIT

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

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 = auto and Start=2441.5MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW=510kHz.
5. Max hold, view and count how many channel in the band.

TEST RESULTS

No non-compliance noted

Test Data

For GFSK / 8DPSK

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



Test Plot

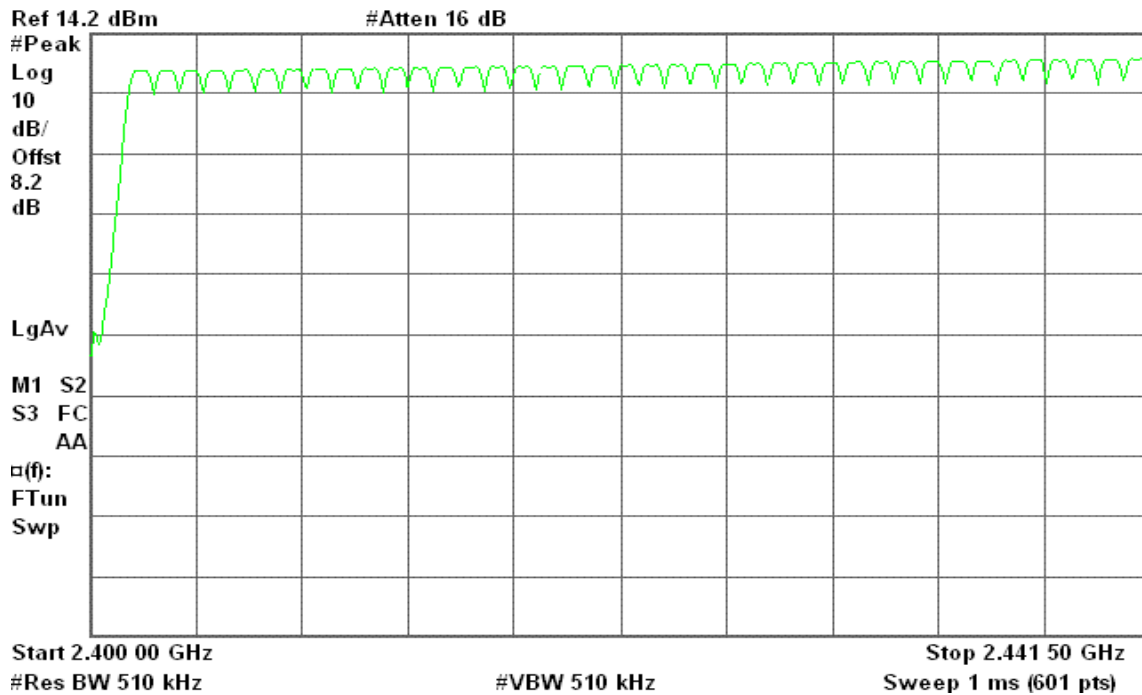
For GFSK

Channel Number

2.4 GHz – 2.4415 GHz

* Agilent 22:38:00 Jun 18, 2008

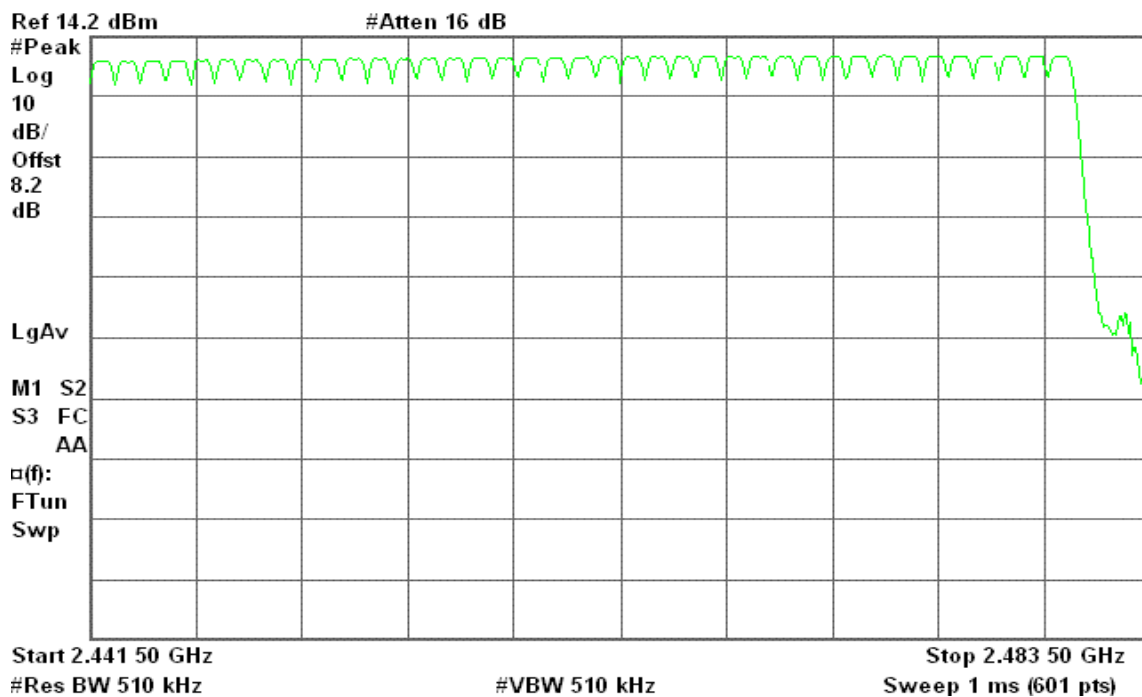
R T



2.4415 GHz – 2.4835 GHz

* Agilent 22:38:53 Jun 18, 2008

R T





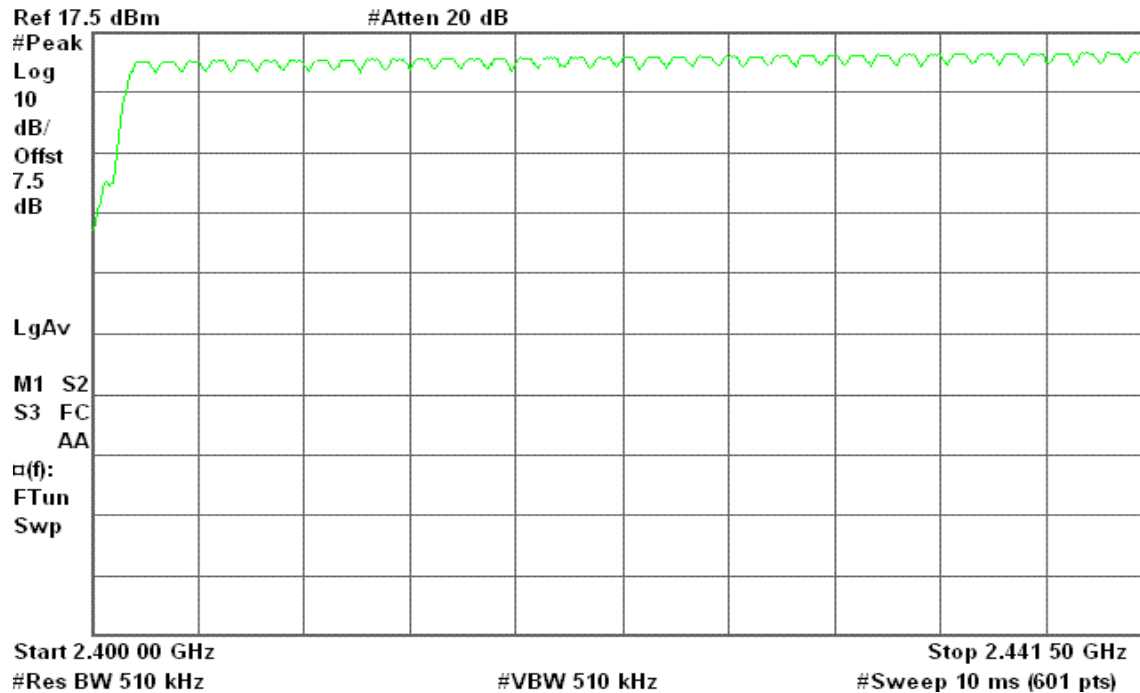
For 8DPSK

Channel Number

2.4 GHz – 2.4415 GHz

* Agilent 11:08:44 Jun 18, 2008

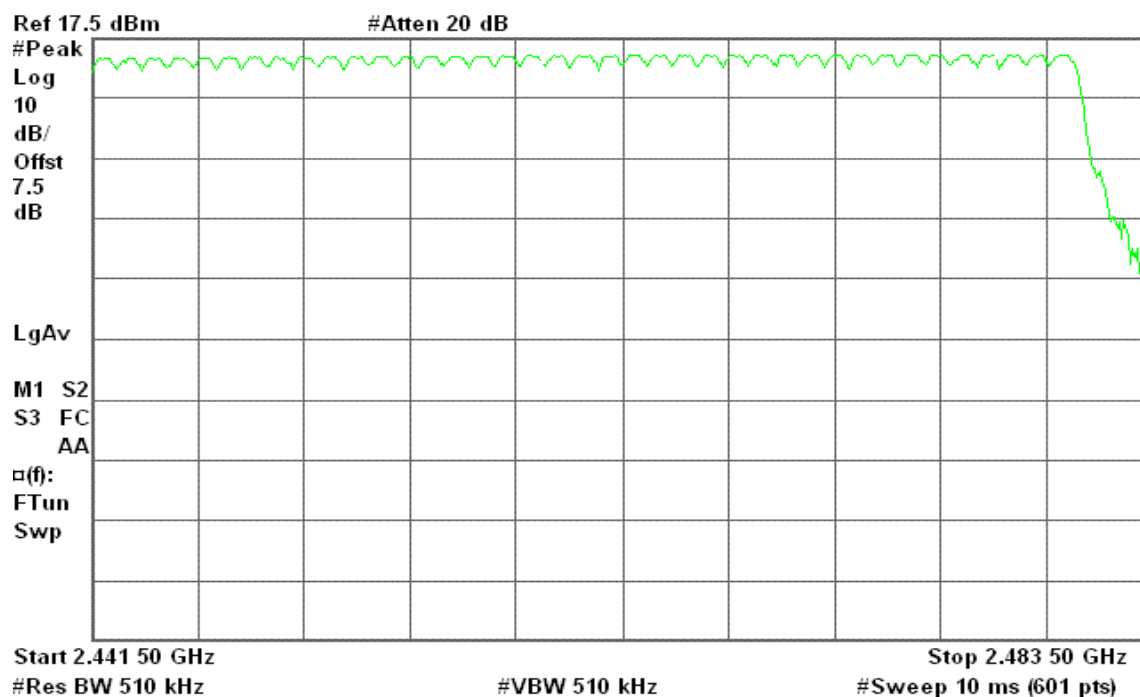
R T



2.4415 GHz – 2.4835 GHz

* Agilent 11:09:52 Jun 18, 2008

R T



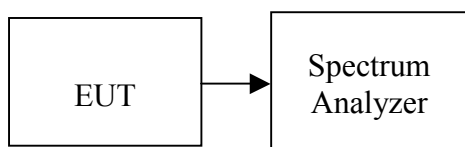


7.8 TIME OF OCCUPANCY (DWELL TIME)

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.

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

For GFSK

DH 1

CH Low: $0.3968 * (1600/2)/79 * 31.6 = 126.9760$ (ms)

CH Mid: $0.4012 * (1600/2)/79 * 31.6 = 128.3840$ (ms)

CH High: $0.4012 * (1600/2)/79 * 31.6 = 128.3840$ (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	0.3968	126.9760	31.60	400.00	PASS
Mid	0.4012	128.3840	31.60		PASS
High	0.4012	128.3840	31.60		PASS

DH 3

CH Low: $1.6490 * (1600/4)/79 * 31.6 = 263.8400$ (ms)

CH Mid: $1.6650 * (1600/4)/79 * 31.6 = 266.4000$ (ms)

CH High: $1.6480 * (1600/4)/79 * 31.6 = 263.6800$ (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	1.6490	263.8400	31.60	400.00	PASS
Mid	1.6650	266.4000	31.60		PASS
High	1.6480	263.6800	31.60		PASS

DH 5

CH Low: $2.9080 * (1600/6)/79 * 31.6 = 310.1867$ (ms)

CH Mid: $2.8890 * (1600/6)/79 * 31.6 = 308.1600$ (ms)

CH High: $2.9160 * (1600/6)/79 * 31.6 = 311.0400$ (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	2.9080	310.1867	31.60	400.00	PASS
Mid	2.8890	308.1600	31.60		PASS
High	2.9160	311.0400	31.60		PASS

**For 8DPSK****DH 1**CH Low: $0.4167 * (1600/2)/79 * 31.60 = 133.3440$ (ms)CH Mid: $0.4167 * (1600/2)/79 * 31.60 = 133.3440$ (ms)CH High: $0.4167 * (1600/2)/79 * 31.60 = 133.3440$ (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	0.4167	133.3440	31.60	400.00	PASS
Mid	0.4167	133.3440	31.60		PASS
High	0.4167	133.3440	31.60		PASS

DH 3CH Low: $1.6670 * (1600/4)/79 * 31.60 = 266.7200$ (ms)CH Mid: $1.6670 * (1600/4)/79 * 31.60 = 266.7200$ (ms)CH High: $1.6830 * (1600/4)/79 * 31.60 = 269.2800$ (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	1.6670	266.7200	31.60	400.00	PASS
Mid	1.6670	266.7200	31.60		PASS
High	1.6830	269.2800	31.60		PASS

DH 5CH Low: $2.9170 * (1600/6)/79 * 31.60 = 311.1467$ (ms)CH Mid: $2.9170 * (1600/6)/79 * 31.60 = 311.1467$ (ms)CH High: $2.9170 * (1600/6)/79 * 31.60 = 311.1467$ (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	2.9170	311.1467	31.60	400.00	PASS
Mid	2.9170	311.1467	31.60		PASS
High	2.9170	311.1467	31.60		PASS

Test Plot

For GFSK

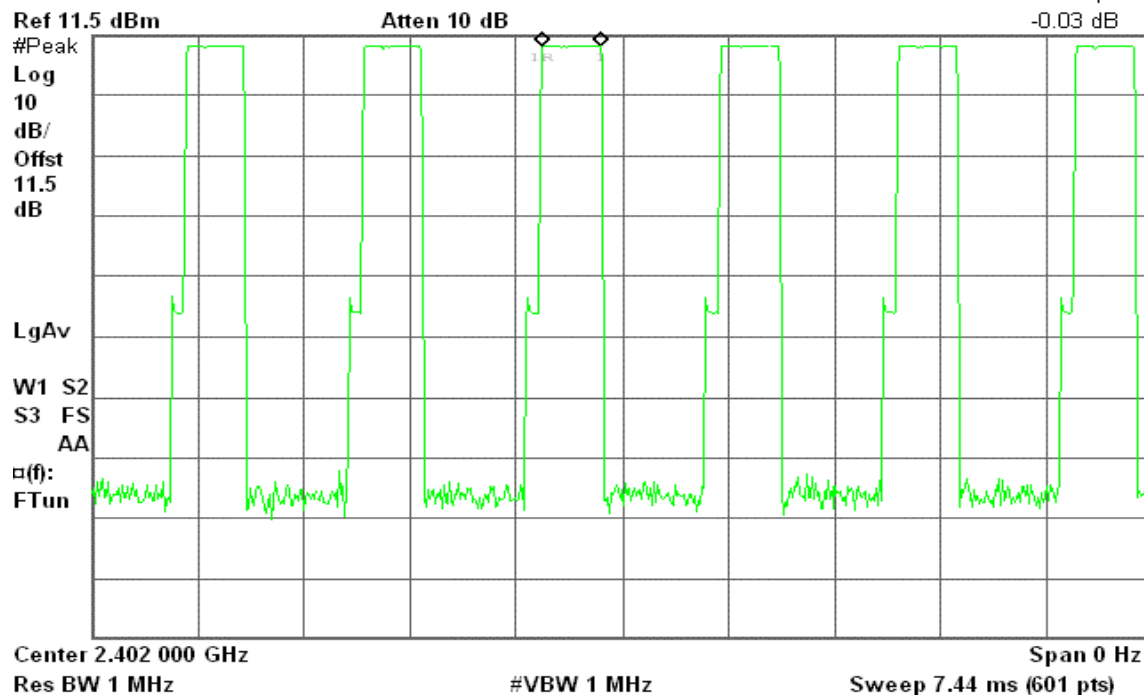
DH 1

(CH Low)

Agilent 02:37:31 Jun 18, 2008

R T

Δ Mkr1 396.8 μ s
-0.03 dB

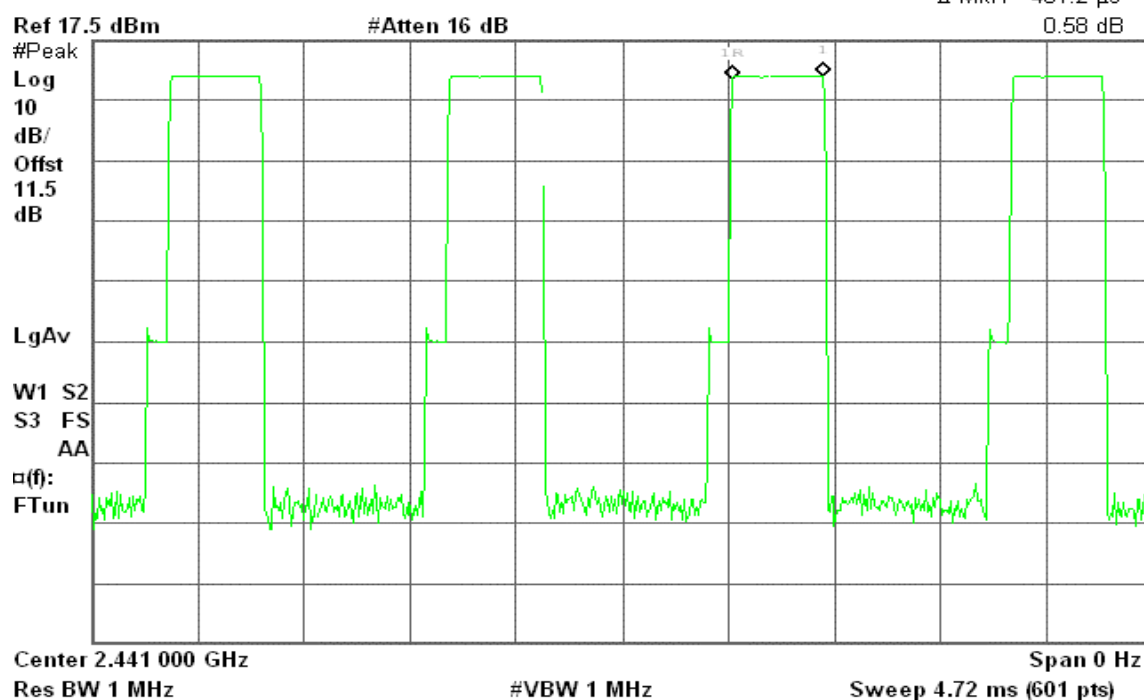


(CH Mid)

Agilent 02:43:29 Jun 18, 2008

R T

Δ Mkr1 401.2 μ s
0.58 dB



**(CH High)**

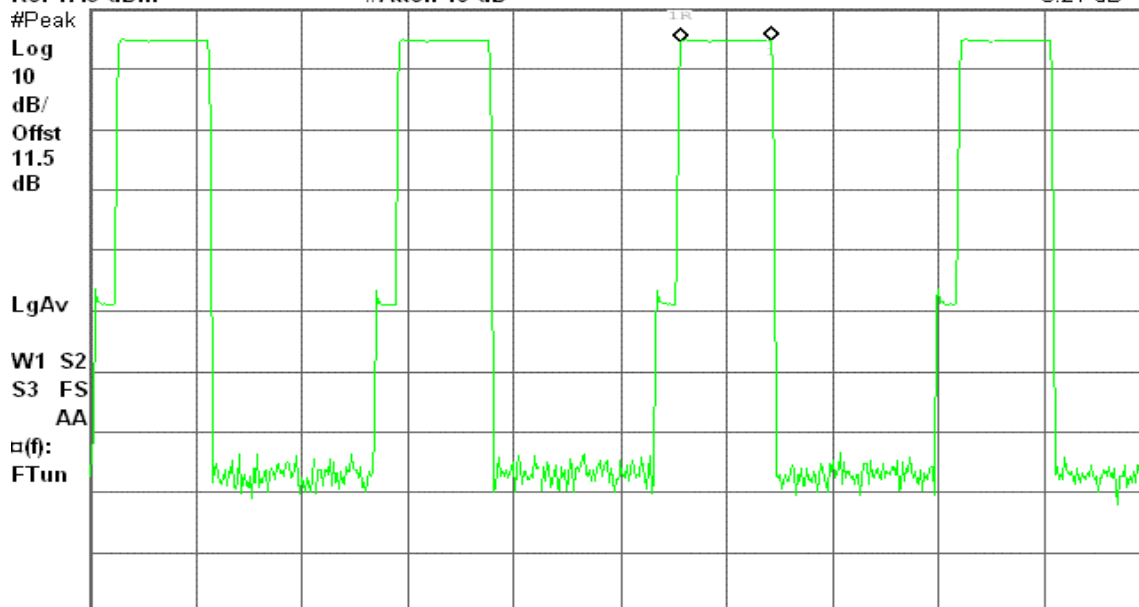
* Agilent 02:44:20 Jun 18, 2008

R T

 Δ Mkr1 401.2 μ s
0.21 dB

Ref 17.5 dBm

#Atten 16 dB



Center 2.480 000 GHz

Span 0 Hz

Res BW 1 MHz

#VBW 1 MHz

Sweep 4.72 ms (601 pts)

DH3**(CH Low)**

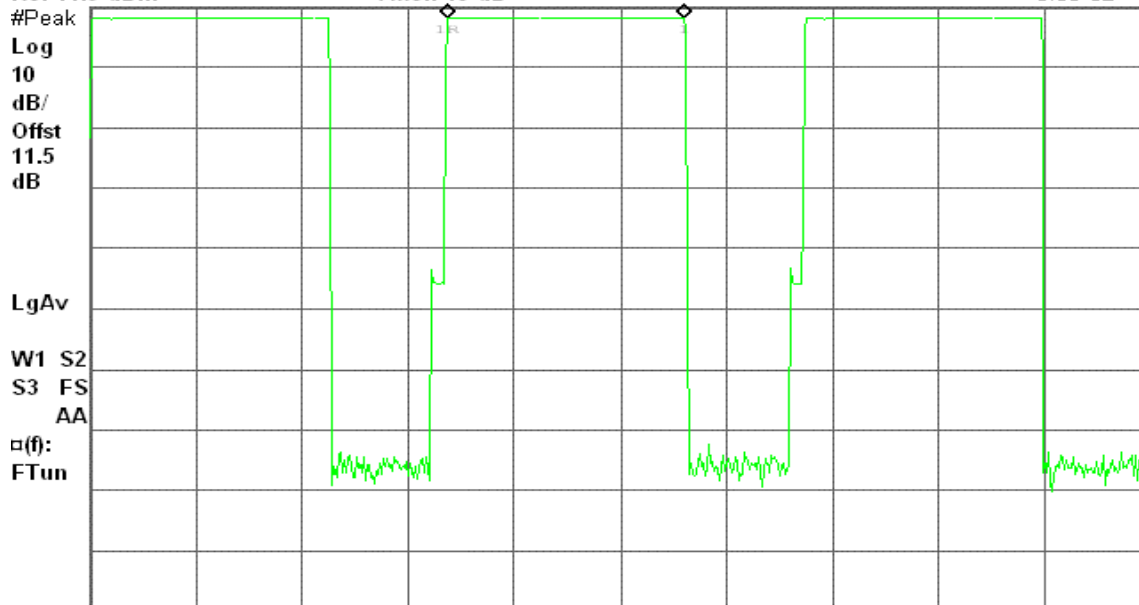
* Agilent 02:38:19 Jun 18, 2008

R T

 Δ Mkr1 1.649 ms
-0.05 dB

Ref 11.5 dBm

Atten 10 dB



Center 2.402 000 GHz

Span 0 Hz

Res BW 1 MHz

#VBW 1 MHz

Sweep 7.44 ms (601 pts)



(CH Mid)

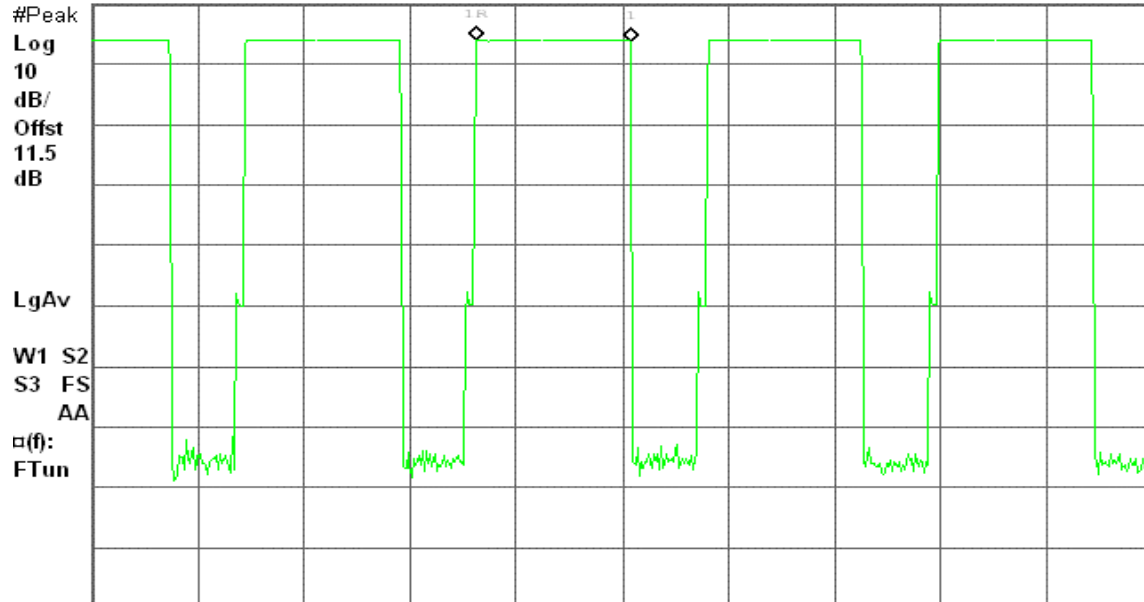
Agilent 02:42:36 Jun 18, 2008

R T

Δ Mkr1 1.665 ms
-0.17 dB

Ref 17.5 dBm

#Atten 16 dB



Center 2.441 000 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz
Sweep 11.48 ms (601 pts)

(CH High)

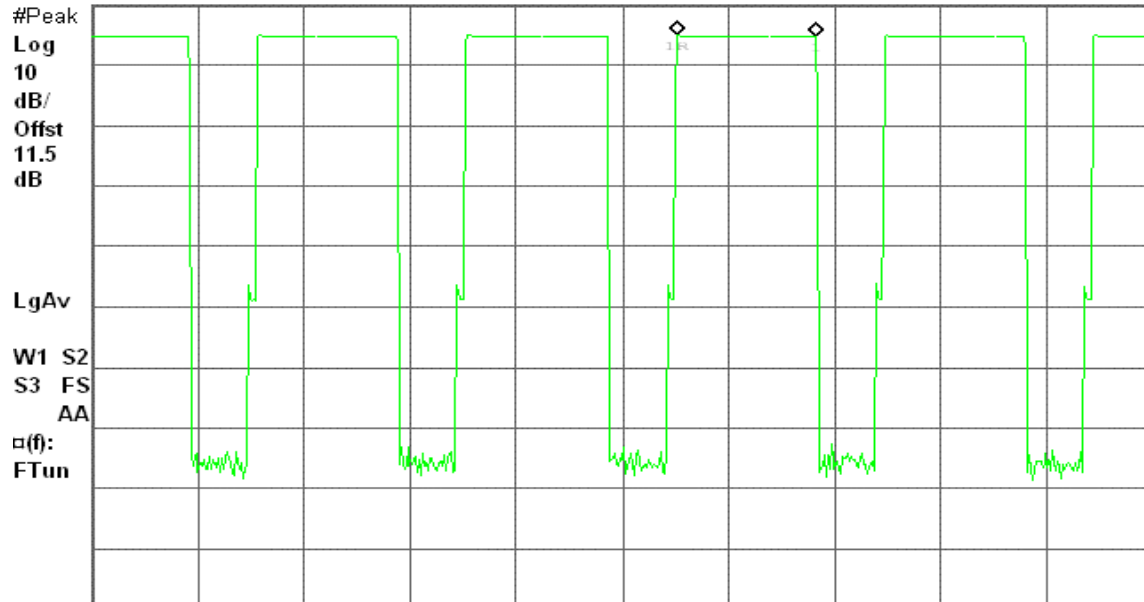
Agilent 02:45:26 Jun 18, 2008

R T

Δ Mkr1 1.648 ms
-0.10 dB

Ref 17.5 dBm

#Atten 16 dB



Center 2.480 000 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz
Sweep 12.68 ms (601 pts)



DH 5

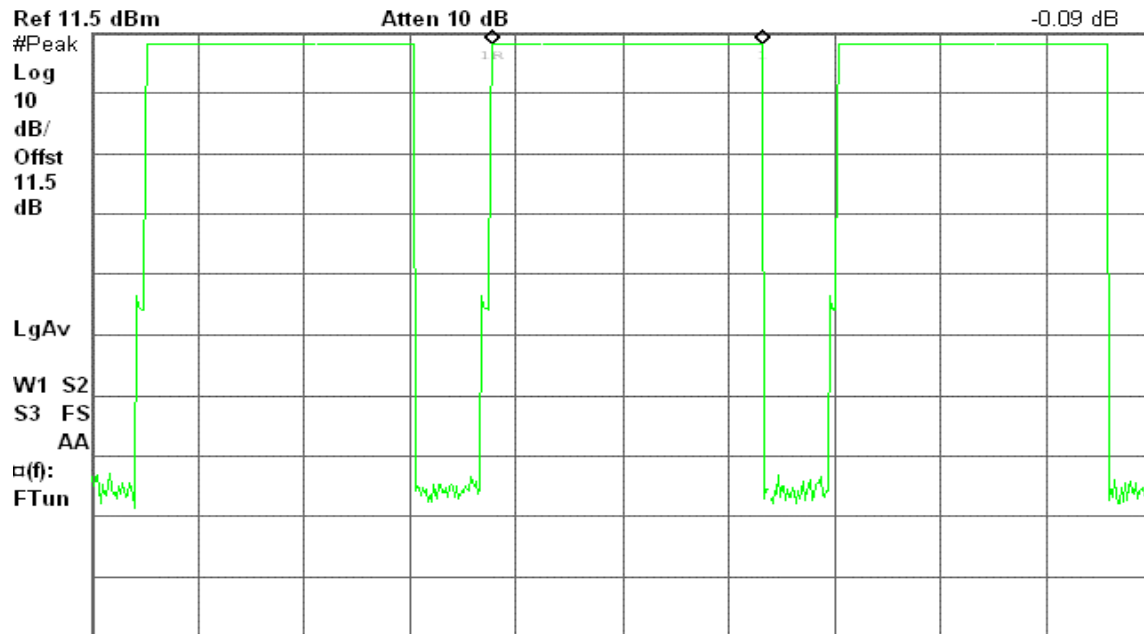
(CH Low)

Agilent 02:39:59 Jun 18, 2008

R T

Δ Mkr1 2.908 ms

-0.09 dB



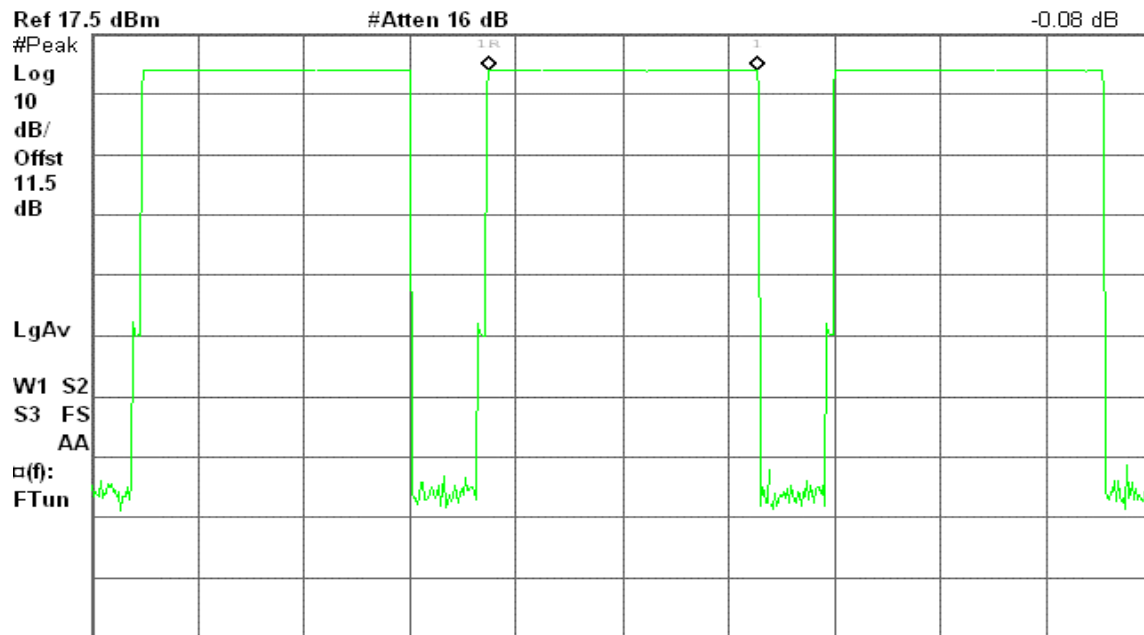
(CH Mid)

Agilent 02:41:54 Jun 18, 2008

R T

Δ Mkr1 2.889 ms

-0.08 dB





(CH High)

Agilent 02:47:24 Jun 18, 2008

R T

Δ Mkr1 2.916 ms
0.68 dB

Ref 17.5 dBm

#Atten 16 dB

#Peak

Log

10

dB/

Offst

11.5

dB

LgAv

W1 S2

S3 FS

AA

□(f):

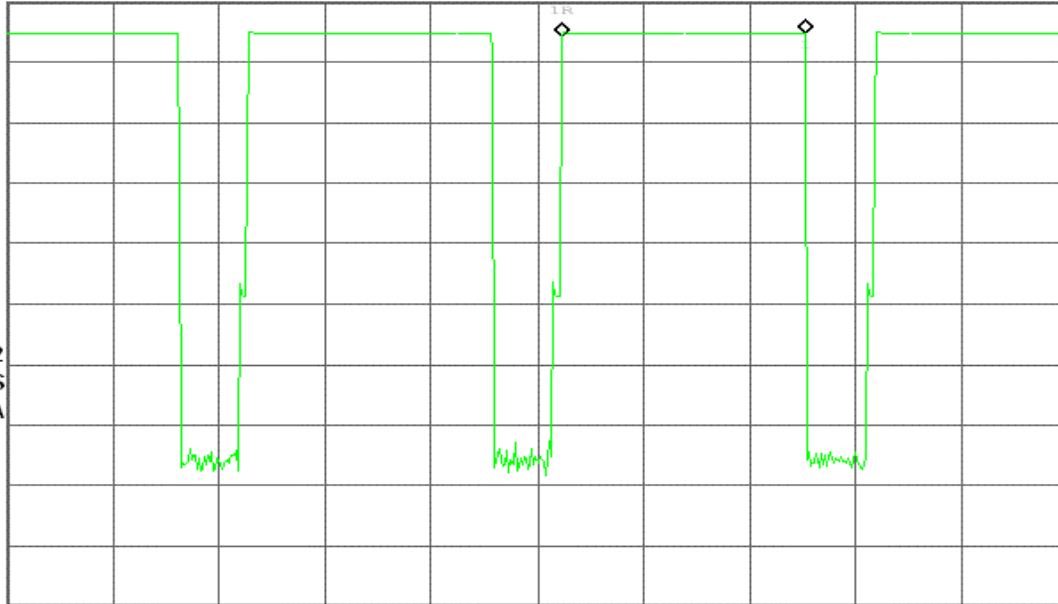
FTun

Center 2.480 000 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz
Sweep 12.68 ms (601 pts)





For 8DPSK

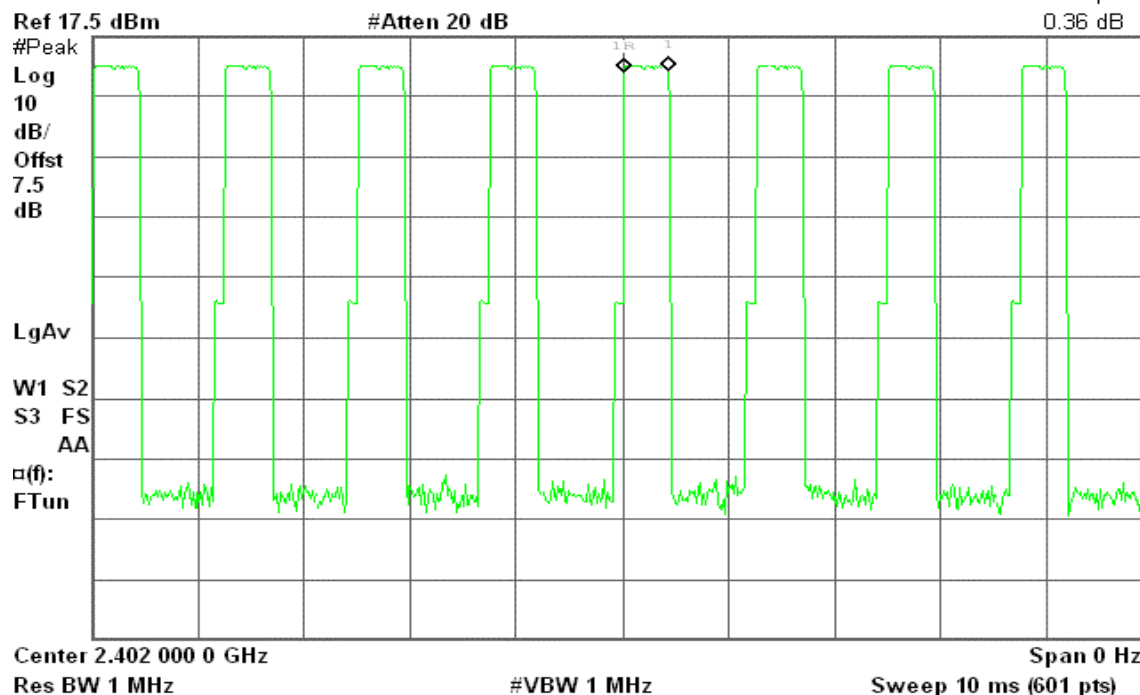
DH 1

(CH Low)

Agilent 11:00:12 Jun 18, 2008

R T

Δ Mkr1 416.7 μ s
0.36 dB

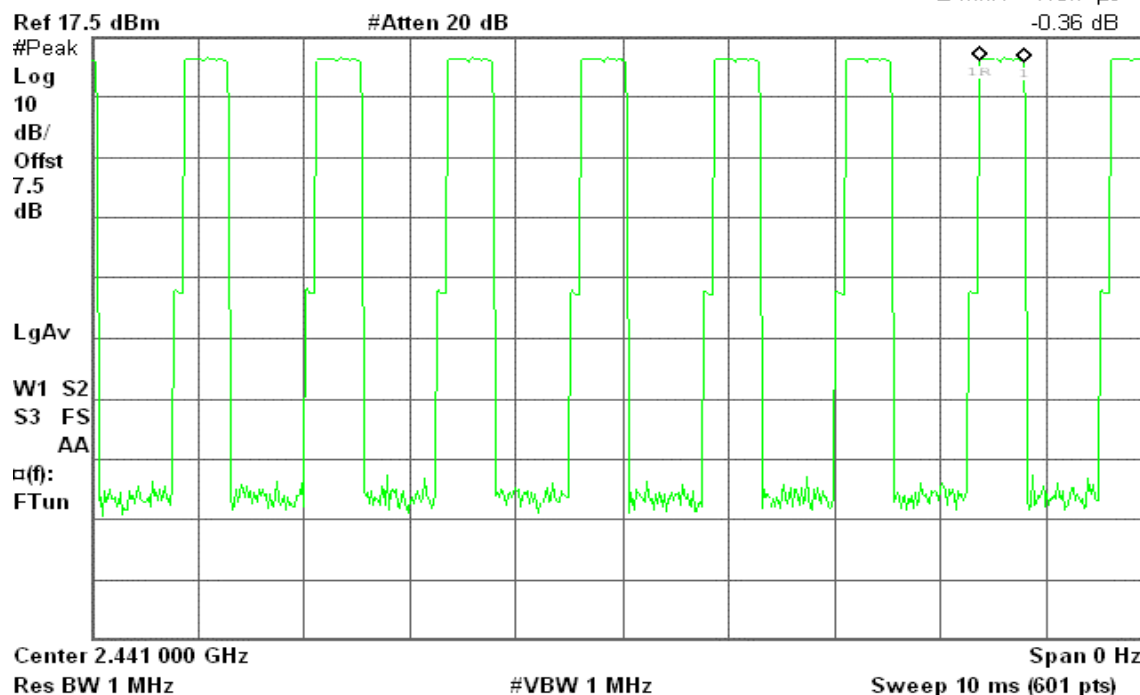


(CH Mid)

Agilent 11:02:18 Jun 18, 2008

R T

Δ Mkr1 416.7 μ s
-0.36 dB



**(CH High)**

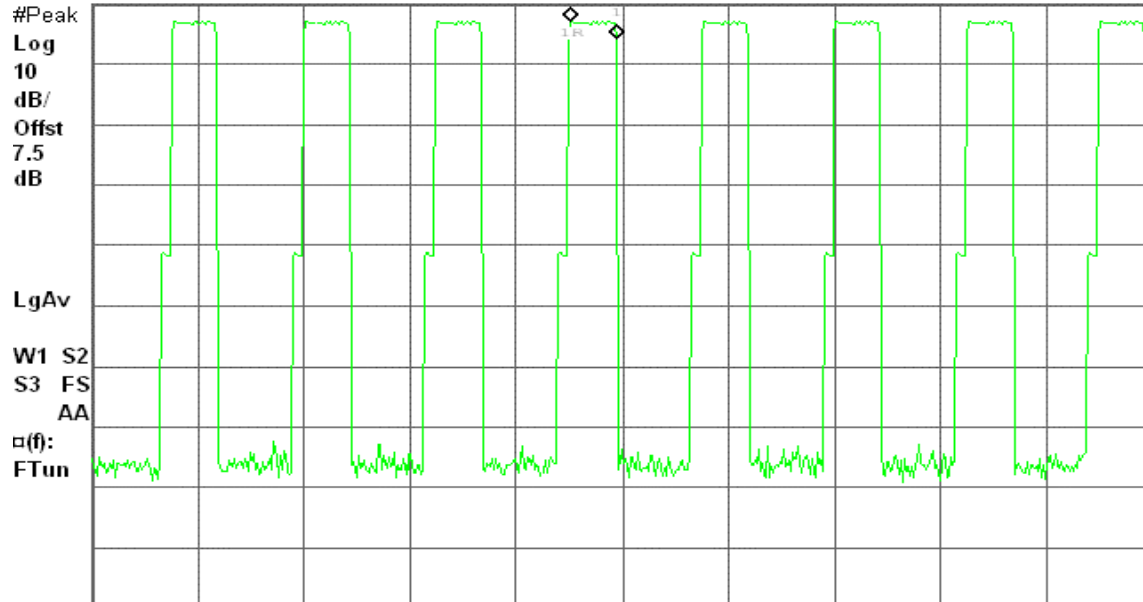
Agilent 11:04:08 Jun 18, 2008

R T

 Δ Mkr1 416.7 μ s
-2.88 dB

Ref 17.5 dBm

#Atten 20 dB



Center 2.480 000 GHz

Span 0 Hz

Res BW 1 MHz

#VBW 1 MHz

Sweep 10 ms (601 pts)

DH 3**(CH Low)**

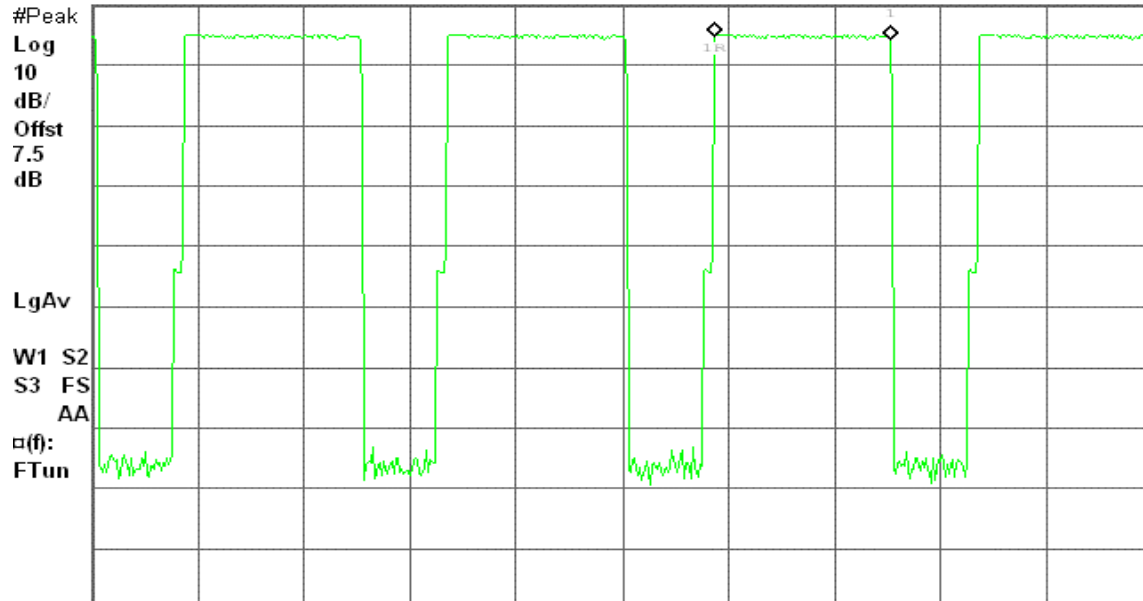
Agilent 11:01:02 Jun 18, 2008

R T

 Δ Mkr1 1.667 ms
-0.64 dB

Ref 17.5 dBm

#Atten 20 dB



Center 2.402 000 0 GHz

Span 0 Hz

Res BW 1 MHz

#VBW 1 MHz

Sweep 10 ms (601 pts)



(CH Mid)

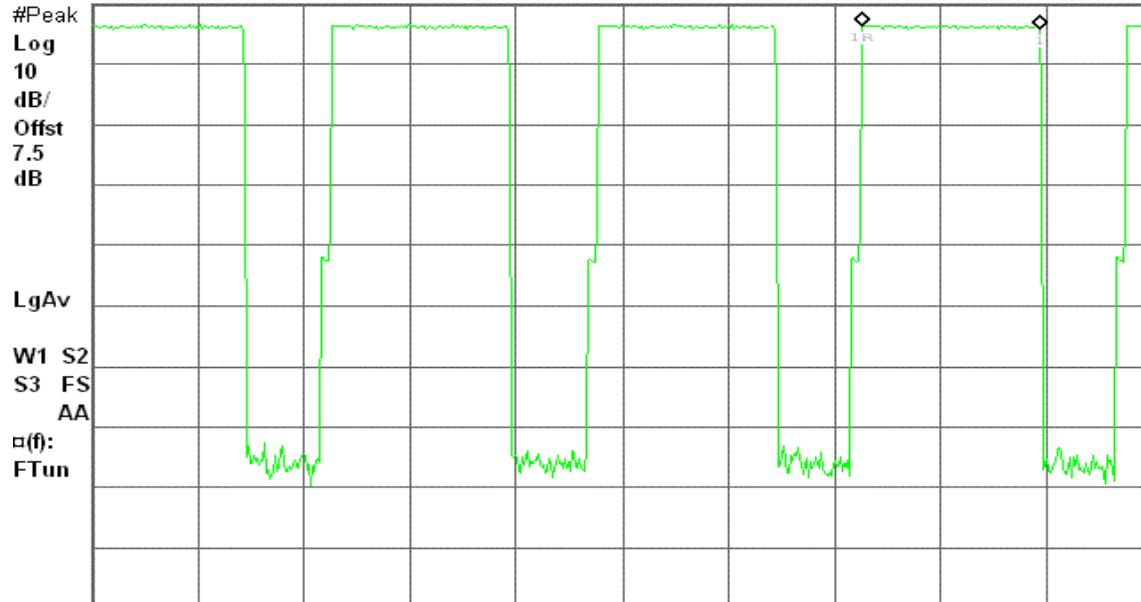
Agilent 11:02:48 Jun 18, 2008

R T

Δ Mkr1 1.667 ms
-0.49 dB

Ref 17.5 dBm

#Atten 20 dB



Center 2.441 000 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz
Sweep 10 ms (601 pts)

(CH High)

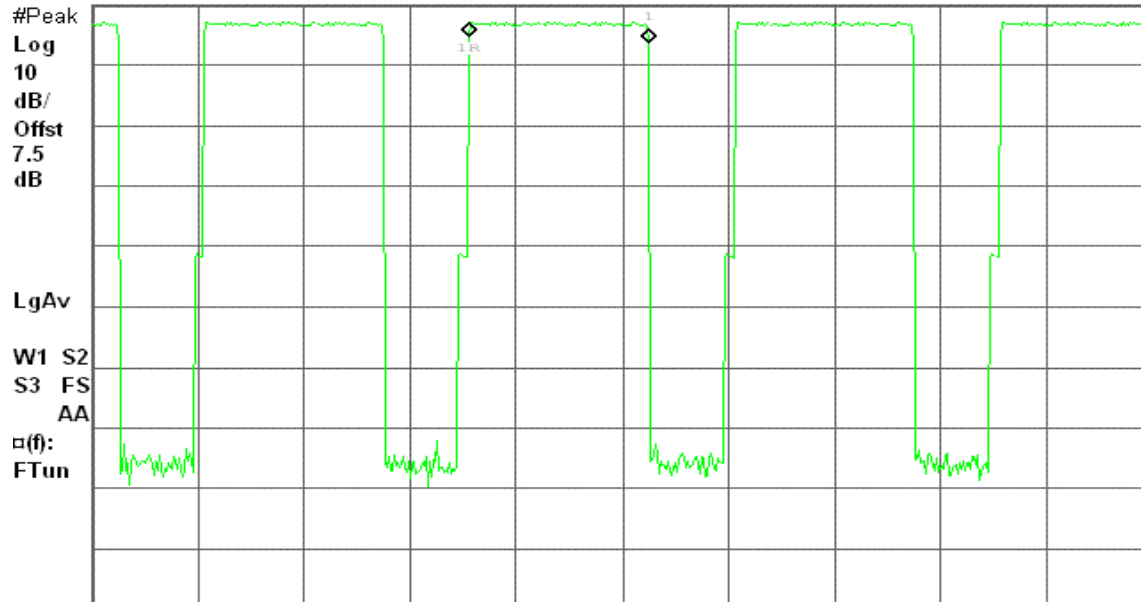
Agilent 11:04:35 Jun 18, 2008

R T

Δ Mkr1 1.683 ms
-1.07 dB

Ref 17.5 dBm

#Atten 20 dB



Center 2.480 000 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz
Sweep 10 ms (601 pts)



DH 5

(CH Low)

Agilent 11:01:32 Jun 18, 2008

R T

Δ Mkr1 2.917 ms

-0.84 dB

Ref 17.5 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

7.5

dB

LgAv

W1 S2

S3 FS

AA

□(f):

FTun

Center 2.402 000 0 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz

Sweep 10 ms (601 pts)

(CH Mid)

Agilent 11:03:20 Jun 18, 2008

R T

Δ Mkr1 2.917 ms

-2.77 dB

Ref 17.5 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

7.5

dB

LgAv

W1 S2

S3 FS

AA

□(f):

FTun

Center 2.441 000 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz

Sweep 10 ms (601 pts)



(CH High)

Agilent 11:05:03 Jun 18, 2008

R T

Δ Mkr1 2.917 ms
-1.40 dB

Ref 17.5 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

7.5

dB

LgAv

W1 S2

S3 FS

AA

□(f):

FTun

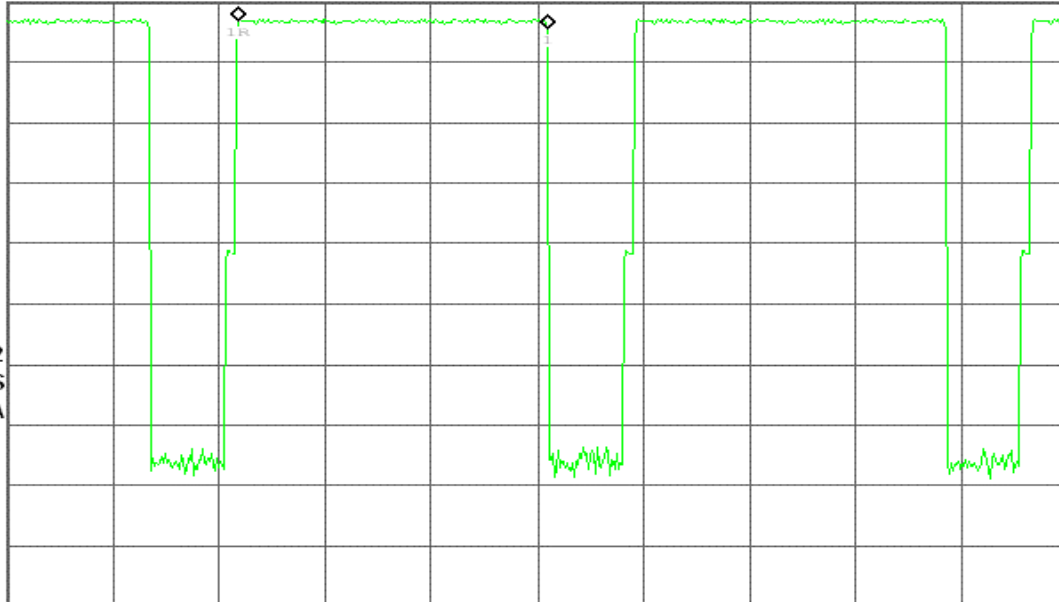
Center 2.480 000 GHz

Res BW 1 MHz

#VBW 1 MHz

Span 0 Hz

Sweep 10 ms (601 pts)





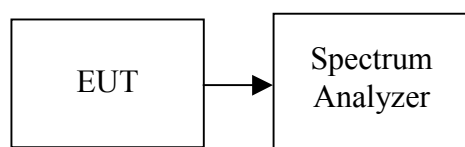
7.9 SPURIOUS EMISSIONS

7.9.1 Conducted Measurement

LIMIT

According to §15.247(d), 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 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, provided the transmitter demonstrates compliance with the peak conducted power limits. 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) (see Section 15.205(c)).

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



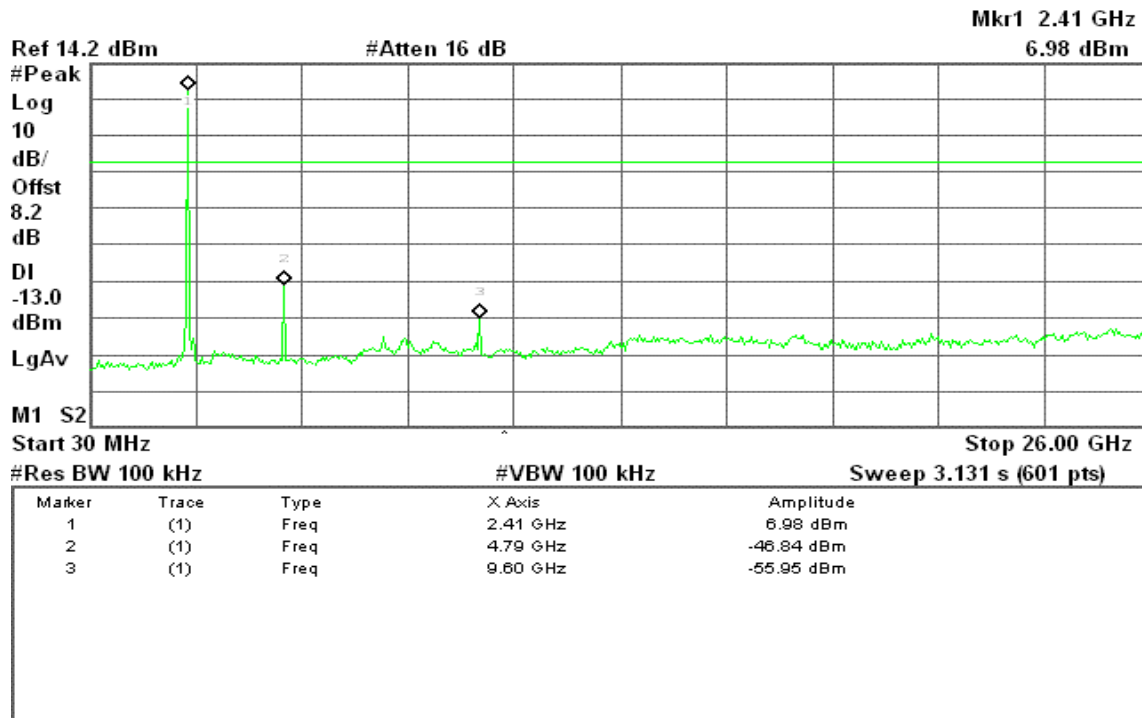
Test Plot

For GFSK

CH Low

* Agilent 23:06:43 Jun 18, 2008

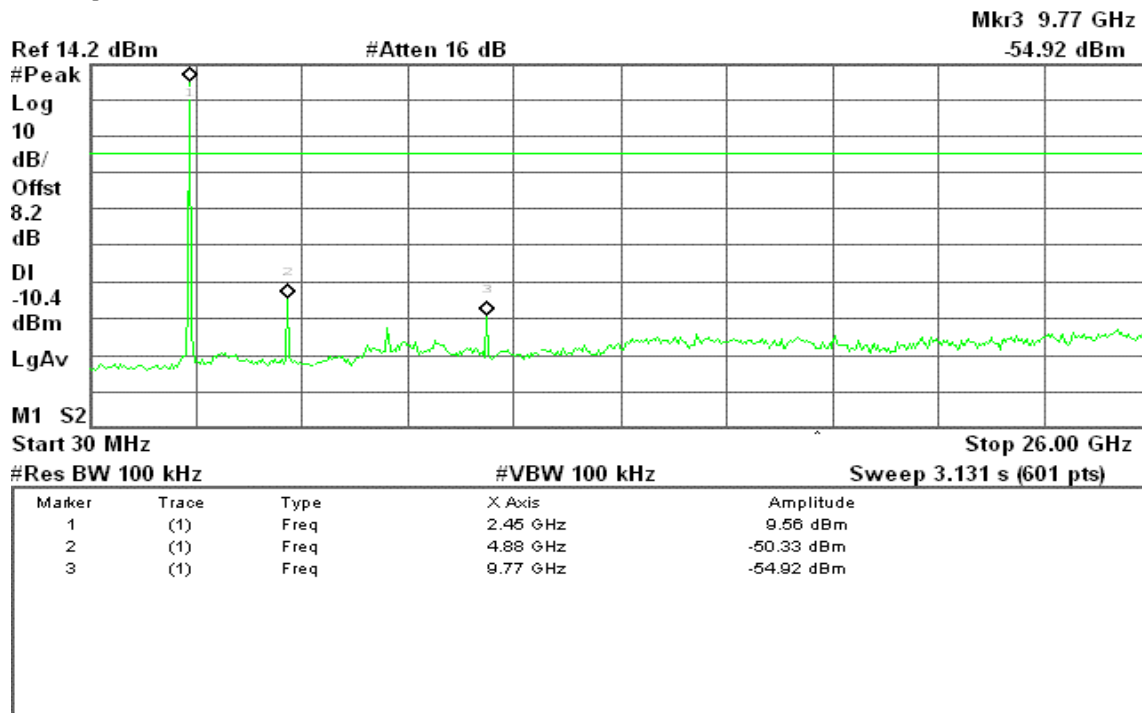
R T



CH Mid

* Agilent 23:08:35 Jun 18, 2008

R T

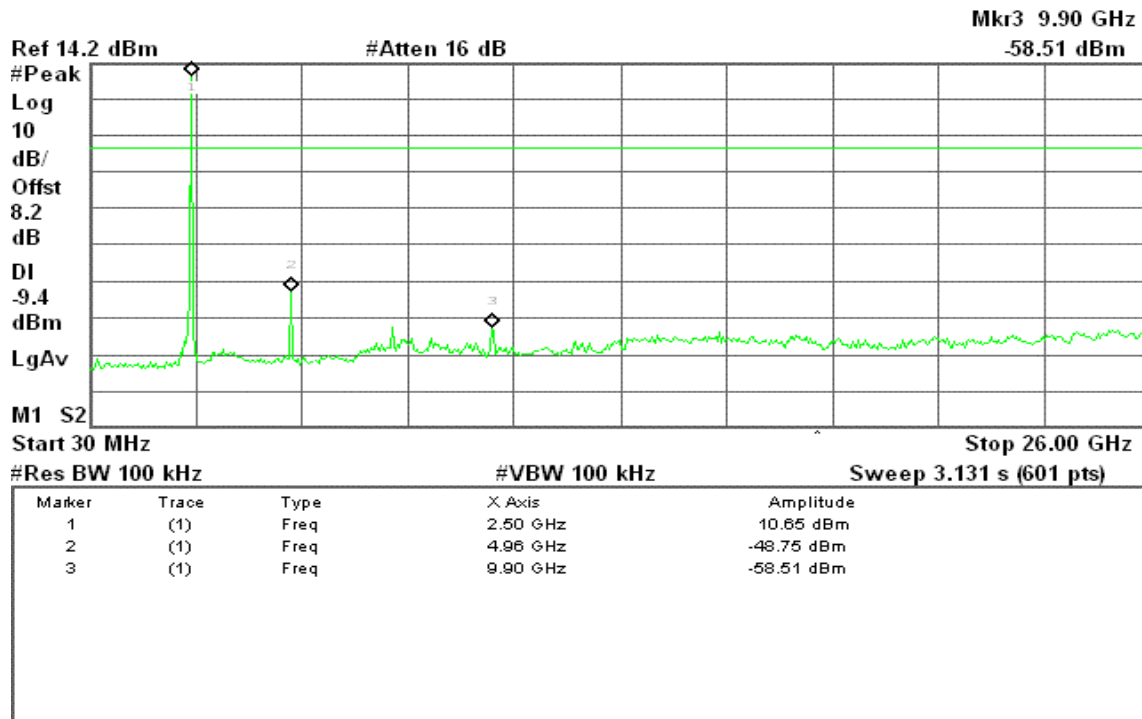




CH High

Agilent 23:03:10 Jun 18, 2008

R T



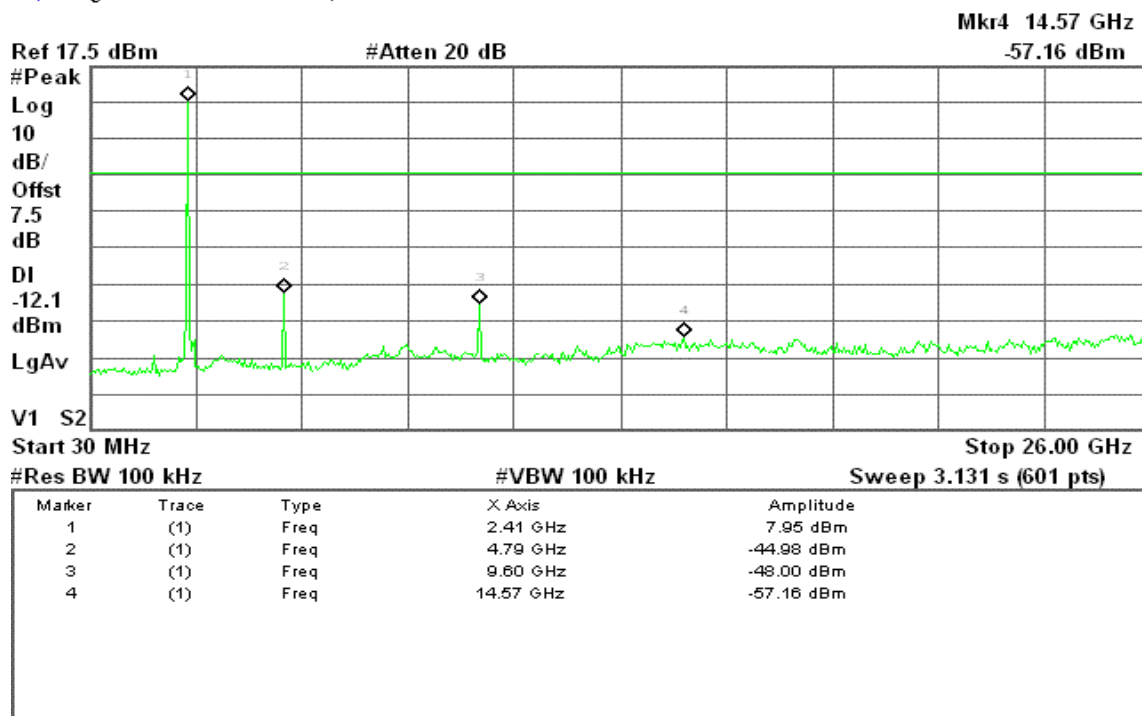


For 8DPSK

CH Low

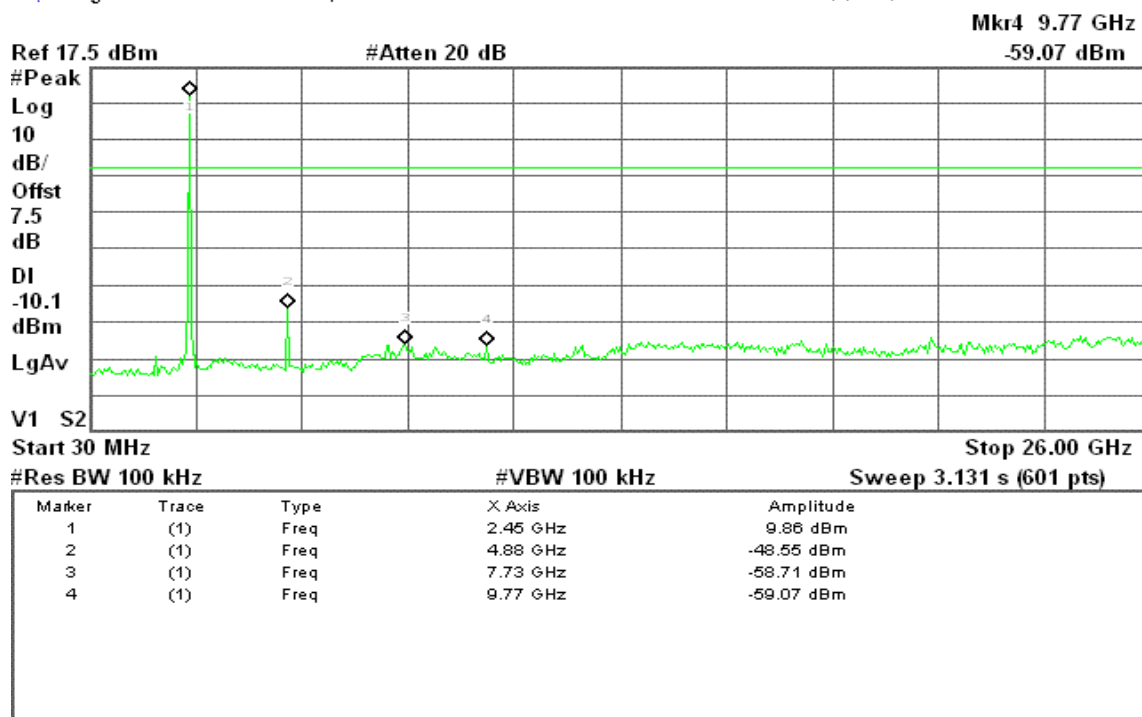
Agilent 11:25:34 Jun 18, 2008

R T

CH Mid

Agilent 11:26:38 Jun 18, 2008

R T

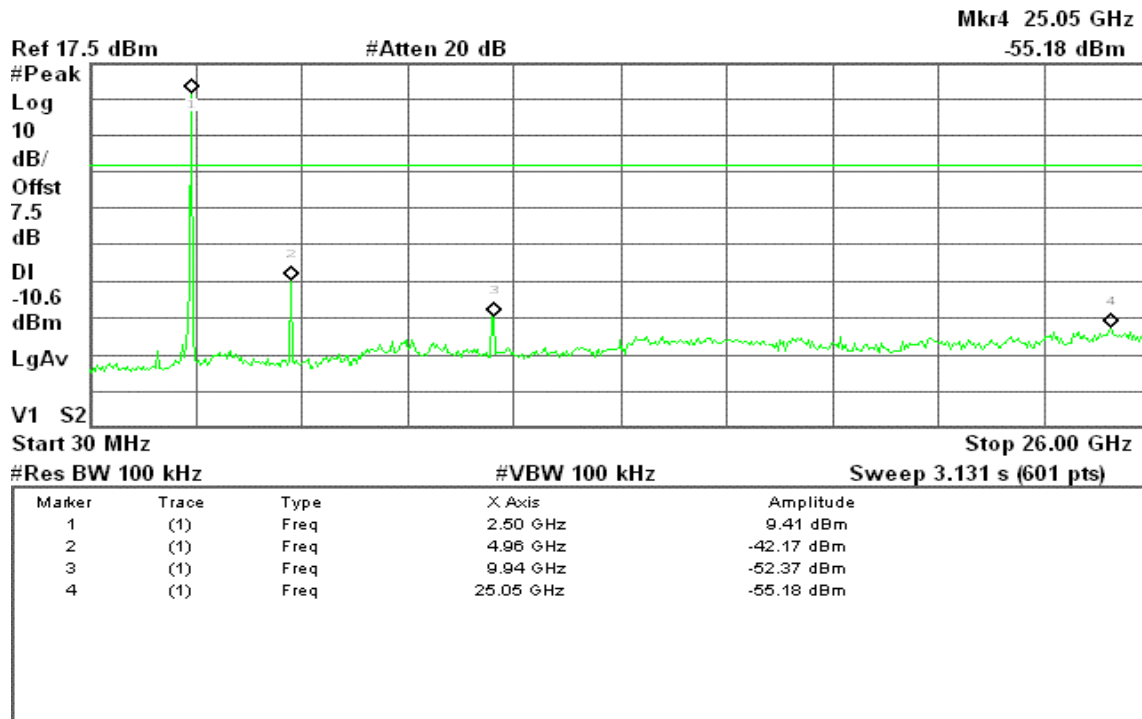




CH High

Agilent 11:21:24 Jun 18, 2008

R T





7.9.2 Radiated Emissions

LIMIT

1. According to §15.209(a), 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 ($\mu\text{V/m}$)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

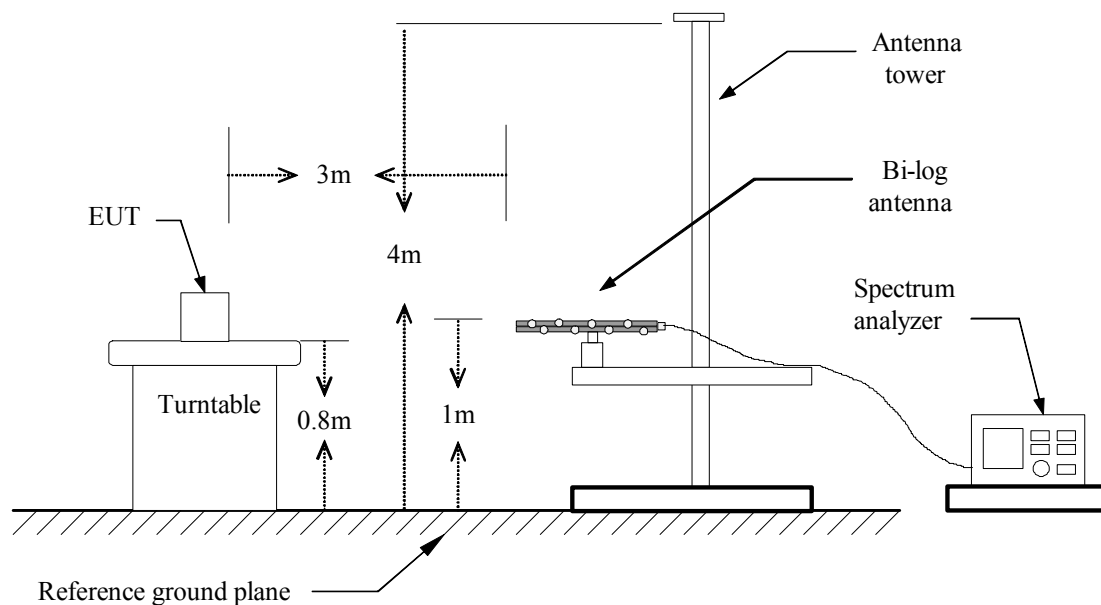
Remark: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of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

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

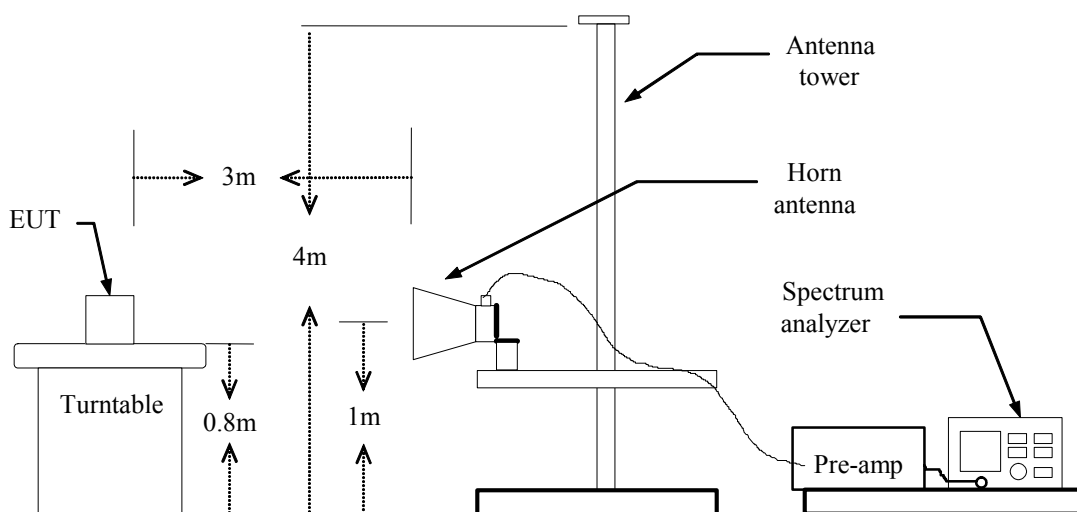
Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

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. Set the spectrum analyzer in the following setting as:
Below 1GHz:
RBW=100kHz / VBW=300kHz / Sweep=AUTO
Above 1GHz:
(a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
(b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.



TEST RESULTS

No non-compliance noted

Below 1 GHz

Operation Mode: Normal Link

Test Date: June 19, 2008

Temperature: 23°C

Tested by: Mimic Young

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
72.03	V	44.41	-14.70	29.71	40.00	-10.29	Peak
107.60	V	39.85	-10.92	28.93	43.50	-14.57	Peak
201.37	V	40.19	-7.63	32.55	43.50	-10.95	Peak
468.12	V	33.49	-1.94	31.55	46.00	-14.45	Peak
749.42	V	29.30	4.25	33.55	46.00	-12.45	Peak
833.48	V	30.81	5.15	35.96	46.00	-10.04	Peak
295.13	H	36.82	-6.60	30.22	46.00	-15.78	Peak
432.55	H	38.05	-2.88	35.17	46.00	-10.83	Peak
468.12	H	38.62	-1.94	36.68	46.00	-9.32	Peak
599.07	H	38.66	1.10	39.76	46.00	-6.24	Peak
666.97	H	35.73	1.89	37.62	46.00	-8.38	Peak
749.42	H	34.79	4.25	39.04	46.00	-6.96	Peak

Remark:

- 1. Measuring frequencies from 30 MHz to the 1GHz.*
- 2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.*
- 3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.*
- 4. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, 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.*
- 5. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).*

**Above 1 GHz****For GFSK****Operation Mode:** TX / CH Low**Test Date:** June 17, 2008**Temperature:** 25°C**Tested by:** Jerry Lin**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
4800.00	V	51.04	---	0.40	51.44	---	74.00	54.00	-2.56	Peak
7208.33	V	46.77	---	2.97	49.74	---	74.00	54.00	-4.26	Peak
9600.00	V	45.06	39.70	9.38	54.43	49.08	74.00	54.00	-4.92	AVG
N/A										
4800.00	H	52.50	---	0.40	52.90	---	74.00	54.00	-1.10	Peak
7208.33	H	45.34	---	2.97	48.31	---	74.00	54.00	-5.69	Peak
9616.67	H	44.31	---	9.41	53.72	---	74.00	54.00	-0.28	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. 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.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, 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.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / CH Mid**Test Date:** June 17, 2008**Temperature:** 25°C**Tested by:** Jerry Lin**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
2176.67	V	54.54	---	-3.63	50.91	---	74.00	54.00	-3.09	Peak
2713.33	V	54.22	---	-2.07	52.15	---	74.00	54.00	-1.85	Peak
4883.33	V	49.08	---	0.22	49.30	---	74.00	54.00	-4.70	Peak
7325.00	V	44.27	---	2.94	47.22	---	74.00	54.00	-6.78	Peak
9766.67	V	44.09	---	9.68	53.77	---	74.00	54.00	-0.23	Peak
N/A										
2083.33	H	54.15	---	-3.92	50.24	---	74.00	54.00	-3.76	Peak
2613.33	H	54.15	---	-2.33	51.82	---	74.00	54.00	-2.18	Peak
4883.33	H	52.78	---	0.22	53.00	---	74.00	54.00	-1.00	Peak
6883.33	H	44.09	---	2.72	46.81	---	74.00	54.00	-7.19	Peak
9766.67	H	45.32	38.53	9.68	55.00	48.21	74.00	54.00	-5.79	AVG
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. 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.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, 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.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / CH High**Test Date:** June 17, 2008**Temperature:** 25°C**Tested by:** Jerry Lin**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
4958.33	V	48.91	---	0.05	48.97	---	74.00	54.00	-5.03	Peak
7441.67	V	46.46	---	2.92	49.38	---	74.00	54.00	-4.62	Peak
9916.67	V	40.90	---	9.95	50.86	---	74.00	54.00	-3.14	Peak
N/A										
4958.33	H	51.83	---	0.05	51.88	---	74.00	54.00	-2.12	Peak
7441.67	H	45.81	---	2.92	48.73	---	74.00	54.00	-5.27	Peak
9916.67	H	41.83	---	9.95	51.79	---	74.00	54.00	-2.21	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. 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.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, 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.
6. $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$.

**For 8DPSK****Operation Mode:** TX / CH Low**Test Date:** June 17, 2008**Temperature:** 25°C**Tested by:** Jerry Lin**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
4800.00	V	50.93	---	0.40	51.33	---	74.00	54.00	-2.67	Peak
7208.33	V	47.35	---	2.97	50.32	---	74.00	54.00	-3.68	Peak
9600.00	V	46.02	40.05	9.38	55.40	49.43	74.00	54.00	-4.57	AVG
N/A										
4800.00	H	52.93	---	0.40	53.33	---	74.00	54.00	-0.67	Peak
9600.00	H	44.38	---	9.38	53.76	---	74.00	54.00	-0.24	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. 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.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, 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.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / CH Mid**Test Date:** June 17, 2008**Temperature:** 25°C**Tested by:** Jerry Lin**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
4883.33	V	48.33	---	0.22	48.55	---	74.00	54.00	-5.45	Peak
9766.67	V	44.71	40.01	9.68	54.39	49.69	74.00	54.00	-4.31	AVG
N/A										
4883.33	H	51.94	---	0.22	52.16	---	74.00	54.00	-1.84	Peak
9766.67	H	44.97	40.06	9.68	54.65	49.74	74.00	54.00	-4.26	AVG
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. 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.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, 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.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / CH High**Test Date:** June 17, 2008**Temperature:** 25°C**Tested by:** Jerry Lin**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
4958.33	V	49.20	---	0.05	49.26	---	74.00	54.00	-4.74	Peak
7441.67	V	46.62	---	2.92	49.54	---	74.00	54.00	-4.46	Peak
9916.67	V	40.88	---	9.95	50.83	---	74.00	54.00	-3.17	Peak
N/A										
4958.33	H	52.02	---	0.05	52.07	---	74.00	54.00	-1.93	Peak
7441.67	H	45.99	---	2.92	48.91	---	74.00	54.00	-5.09	Peak
9916.67	H	41.11	---	9.95	51.06	---	74.00	54.00	-2.94	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. 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.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, 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.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



7.10 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that 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 the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Limits (dB μ V)	
	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

* Decreases with the logarithm of the frequency.

Test Configuration

See test photographs attached in Appendix II 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

Operation Mode: Normal Link

Test Date: May 23, 2008

Temperature: 22°C

Tested by: Leo Shi

Humidity: 45% RH

Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB)	QP Result (dBuV)	AV Result (dBuV)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
0.19	35.84	21.79	9.97	45.81	31.76	64.04	54.04	-18.23	-22.28	L1
1.35	24.35	7.29	9.96	34.31	17.25	56.00	46.00	-21.69	-28.75	L1
17.67	22.07	16.17	10.69	32.76	26.86	60.00	50.00	-27.24	-23.14	L1
19.47	21.72	16.37	10.74	32.46	27.11	60.00	50.00	-27.54	-22.89	L1
20.75	21.78	16.73	10.80	32.58	27.53	60.00	50.00	-27.42	-22.47	L1
21.31	21.65	16.83	10.83	32.48	27.66	60.00	50.00	-27.52	-22.34	L1
0.1600	44.31	24.81	0.19	44.50	25.00	65.46	55.46	-20.96	-30.46	L2
0.2000	38.35	17.85	0.15	38.50	18.00	63.61	53.61	-25.11	-35.61	L2
0.2400	33.17	13.57	0.13	33.30	13.70	62.10	52.10	-28.80	-38.40	L2
0.2750	33.38	16.28	0.12	33.50	16.40	60.97	50.97	-27.47	-34.57	L2
0.4400	33.85	30.85	0.05	33.90	30.90	57.06	47.06	-23.16	-16.16	L2
2.3500	24.65	19.85	0.05	24.70	19.90	56.00	46.00	-31.30	-26.10	L2

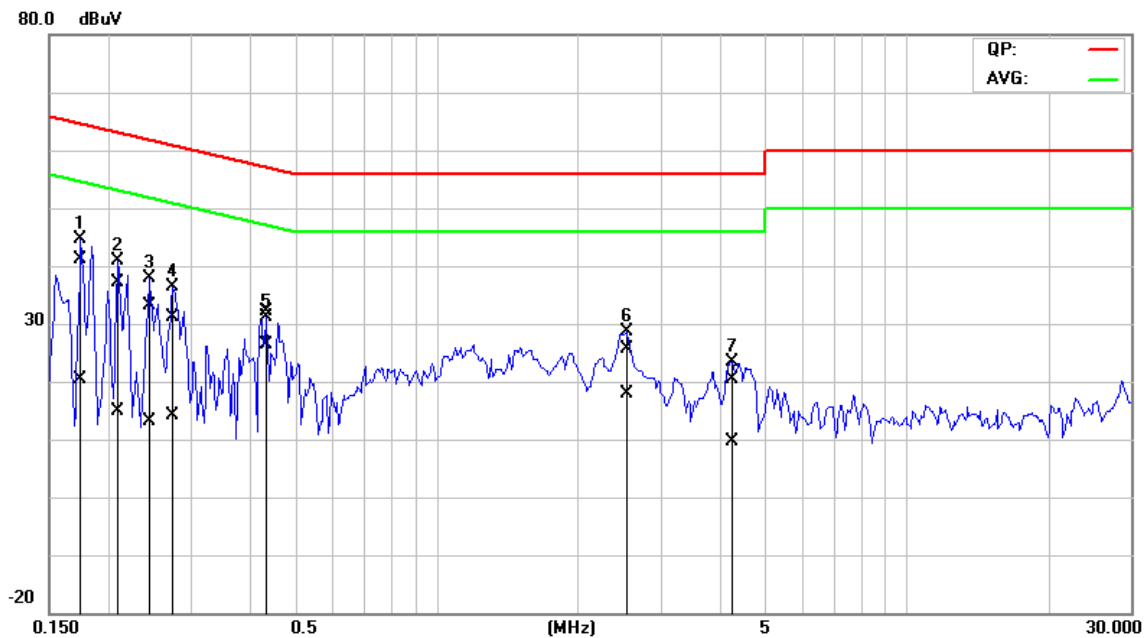
Remark:

1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. 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;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

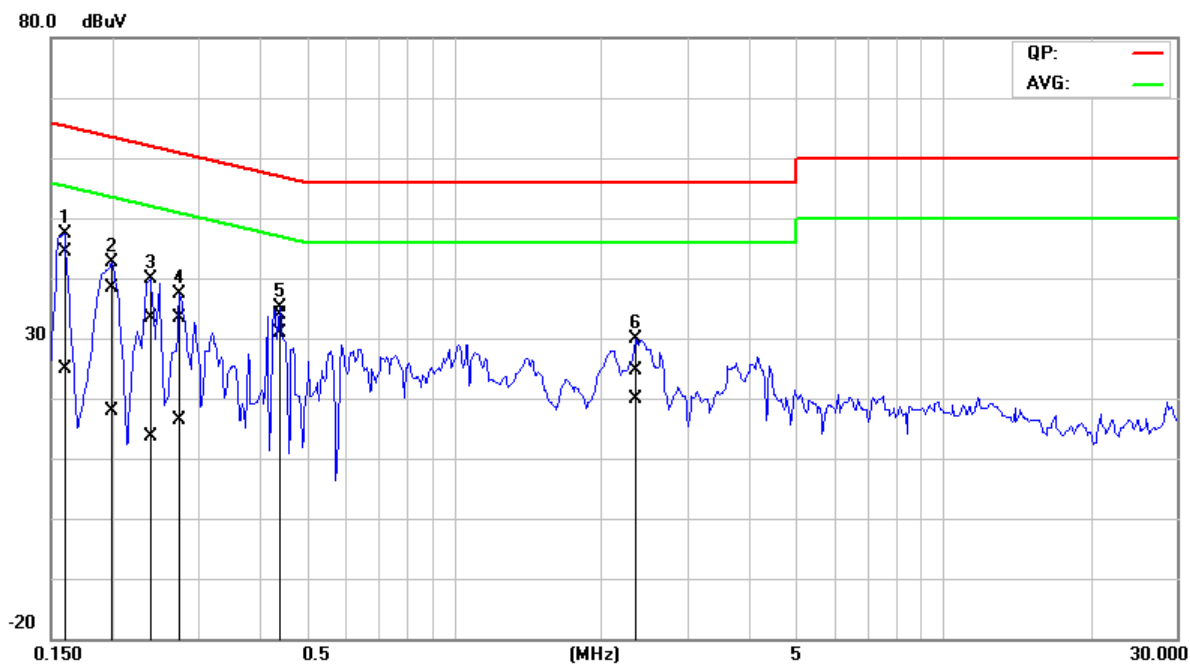


Test Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)





APPENDIX I RADIO FREQUENCY EXPOSURE

LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

EUT Specification

EUT	Handheld Image Reader(Linear / 2D Scanner)
Frequency band (Operating)	<input type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input checked="" type="checkbox"/> Others: <u>Bluetooth: 2.402GHz ~ 2.480GHz</u>
Device category	<input checked="" type="checkbox"/> Portable (<20cm separation) <input type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others _____
Exposure classification	<input type="checkbox"/> Occupational/Controlled exposure ($S = 5mW/cm^2$) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure ($S=1mW/cm^2$)
Antenna diversity	<input checked="" type="checkbox"/> Single antenna <input type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input type="checkbox"/> Tx/Rx diversity
Max. output power	13.17 dBm (20.75mW)
Antenna gain (Max)	2 dBi (Numeric gain: 1.58)
Evaluation applied	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A

Remark:

1. The maximum output power is 13.17dBm (20.75mW) at 2480MHz (with 1.58 numeric antenna gain.)
2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is $1.0 mW/cm^2$ even if the calculation indicates that the power density would be larger.

TEST RESULTS

No non-compliance noted.

**Calculation**

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$

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 and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

Maximum Permissible Exposure

EUT output power = 20.75mW

Numeric Antenna gain = 1.58

Substituting the MPE safe distance using $d = 20$ cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

$$\rightarrow \text{Power density} = 0.0065 \text{ mW / cm}^2$$

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.)