



FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

Wireless Pocket 2D Imager Scanner

Model: MS920

Trade Name: unitech

Issued to

Unitech electronics co., ltd.

5F, No. 136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist., New Taipei City, Taiwan

Issued by

Compliance Certification Services Inc.

No.11, Wugong 6th Rd., Wugu Dist.,

New Taipei City 24891, Taiwan. (R.O.C.)

<http://www.ccsrf.com>

service@ccsrf.com

Issued Date: October 9, 2013



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Revision History

Rev.		Issue Date		Revisions	Effect Page	Revised By
00		October 9, 2013		Initial Issue	ALL	Rachel Wu



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1. TEST RESULT CERTIFICATION

Applicant: Unitech electronics co., ltd.
5F, No. 136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist.,
New Taipei City, Taiwan

Equipment Under Test: Wireless Pocket 2D Imager Scanner

Trade Name: unitech

Model: MS920

Date of Test: September 14~16, 2013

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: 2009** and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements set forth in the above standards. The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:

Reviewed by:

Miller Lee
Section Manager
Compliance Certification Services Inc.

Angel Cheng
Section Manager
Compliance Certification Services Inc.



2. EUT DESCRIPTION

Product	Wireless Pocket 2D Imager Scanner
Trade Name	unitech
Model Number	MS920
Model Discrepancy	N/A
Received Date	June 16, 2013
Power Supply	1. Power form host PC. 2. Power from Li-ion Battery Model: 1400-900020G Rating: 3.7Vdc, 3.14WH
Frequency Range	2402 ~ 2480 MHz
Transmit Power	2.85 dBm
Modulation Technique	GFSK for 1Mbps; $\pi/4$ -DQPSK for 2Mbps; 8DPSK for 3Mbps
Number of Channels	79 Channels
Antenna Specification	Gain: 1.59 dBi
Antenna Specification	Monopole Antenna Brand: SINBON/ Model: A9701424

Remark:

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **HLEMS920BT** 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, 15.247 and DA00-705.

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: 2009.



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: MS920) is a BT module.

Test program 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.

Channel Low (2402MHz), Mid (2441MHz) and High (2480MHz) with 1Mbps and 3Mbps data rate was chosen for full testing.

During the preliminary test, GFSK, $\pi/4$ -QPSK & 8DPSK with DH1 were pre-tested and found that GFSK emits the highest output power. Then the tests were carried on with DH1 compare to DH3 & DH5 and found that GFSK with DH5 emit the highest output power, and therefore had been tested under operating condition.

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

Tested Channel	Modulation Type	Packet Type	Data 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	03/20/2014
Power Meter	Anritsu	ML2495A	1012009	06/04/2014
Power Sensor	Anritsu	MA2411A	0917072	06/04/2014

3M Chamber Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510268	11/06/2013
EMI Test Receiver	R&S	ESCI	100064	02/28/2014
Pre-Amplifier	Mini-Circuits	ZFL-1000LN	SF350700823	01/12/2014
Pre-Amplifier	MITEQ	AFS44-00102650-42-10P-44	1415367	11/19/2013
Bilog Antenna	Sunol Sciences	JB3	A030105	10/01/2014
Horn Antenna	EMCO	3117	00055165	02/13/2014
Horn Antenna	EMCO	3116	2487	10/09/2014
Loop Antenna	EMCO	6502	8905/2356	06/12/2014
Turn Table	CCS	CC-T-1F	N/A	N.C.R
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R
Site NSA	CCS	N/A	N/A	12/22/2013
Test S/W	EZ-EMC (CCS-3A1RE)			

Conducted Emission Room				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESCI	101073	07/30/2014
LISN	R&S	ESH3-Z5	848773/014	10/12/2013
LISN	EMCO	3825/2	9106-1809	07/02/2014
ISN	FCC	FCC-TLISN-T2-02-09	100105	07/29/2014
ISN	FCC	FCC-TLISN-T8-02-09	100106	07/30/2014
Capacitive Voltage Probe	FCC	F-CVP-1	100185	03/24/2014
Test S/W	EZ-EMC			



4.3 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
Powerline Conducted Emission	+/- 1.2575
3M Semi Anechoic Chamber / <200M	+/- 4.0138
3M Semi Anechoic Chamber / 200M~1000M	+/- 3.9483
3M Semi Anechoic Chamber / 1G~8G	+/- 2.5975
3M Semi Anechoic Chamber / 8G~18G	+/- 2.6112
3M Semi Anechoic Chamber / 18G~26G	+/- 2.7389
3M Semi Anechoic Chamber / 26G~40G	+/- 2.9683

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



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 Dist., New Taipei City 24891, Taiwan. (R.O.C.)

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

☐ No.81-1, Lane 210, Bade 2nd Rd., Lujhu Township, Taoyuan County 33841, TAIWAN, R.O.C.

Tel: 886-3-324-0332 / Fax: 886-3-324-5235

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	FCC	3M Semi Anechoic Chamber (FCC MRA: TW1039) to perform FCC Part 15 measurements	 FCC MRA: TW1039
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 2324G-1 / IC 2324G-2) to perform	 IC 2324G-1 IC 2324G-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

For Radiated Emission

No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
	N/A						

For Conducted Emission

No.	Equipment	Model No.	Serial No.	FCC/ BSMI ID	Trade Name	Data Cable	Power Cord
1.	PC	DCTA	8ZS8VBX	R33002	DELL	N/A	Non-shd, 1.8m
2.	HDD	9ZA2AG-500	2GE3NHH2	N/A	Seagate	Shd, 1.8m	N/A
3.	LCD Monitor	LS2421pwA	V116998	N14608	Lenovo	N/A	Non-shd, 1.8m
4.	Printer	Stylus-C63	FAPY150360	R33126	EPSON	Shd, 1.8m	Non-shd, 1.8m
5.	Mouse	N889	MS111-P	R41108	DELL	Shd, 1.8m	N/A
6	Keyboard	KB-2880	BAUEL0HCPZ3AXH	T3A002	HP	Shd, 1.8m	N/A

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.



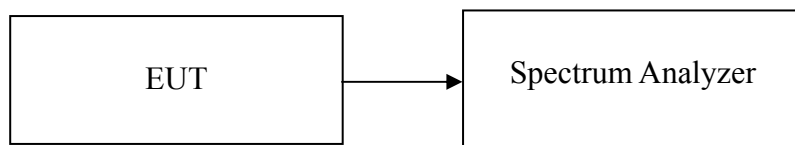
7. FCC PART 15.247 REQUIREMENTS

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=30 kHz, VBW = 100 kHz, Sweep = 3.2 ms.
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.

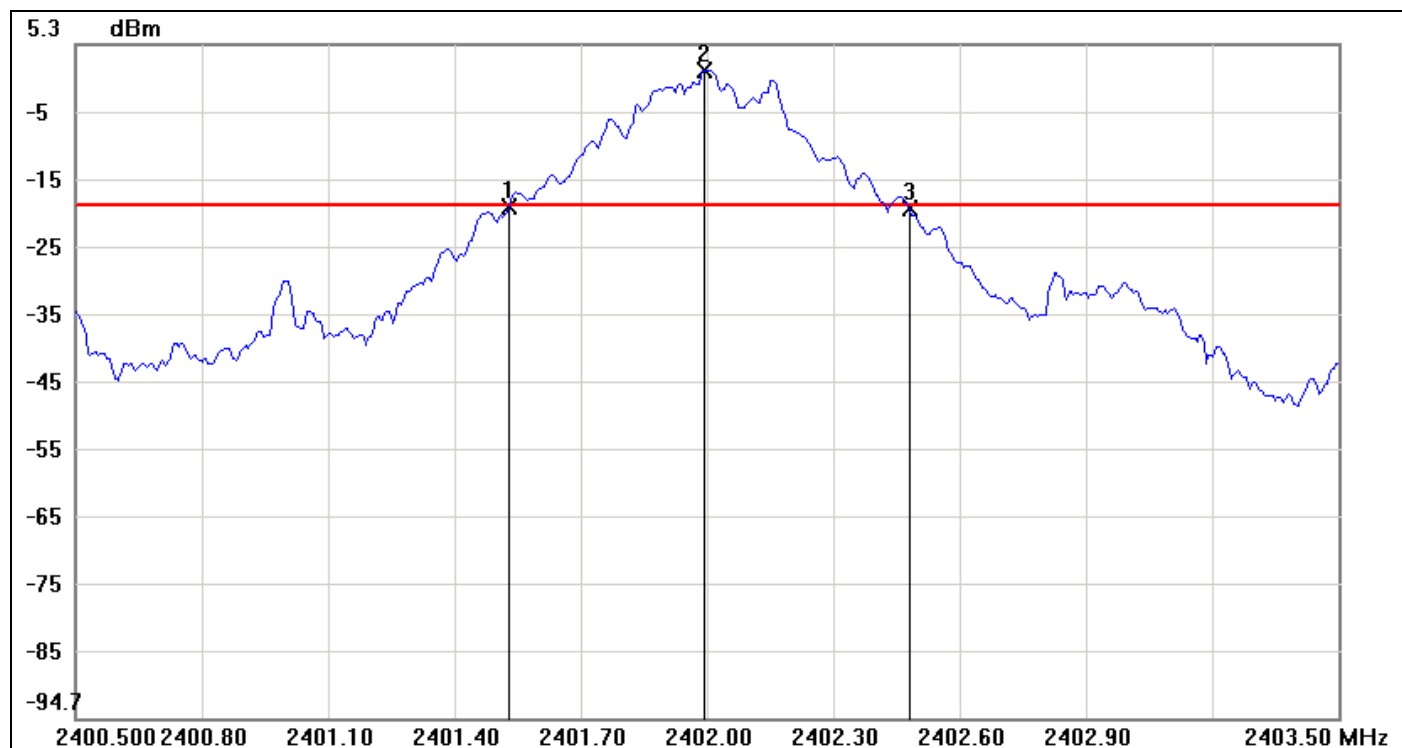
Test Data

For GFSK / DH5

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	0.95
Mid	2441	0.95
High	2480	0.935

For 8DPSK / DH5

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	1.275
Mid	2441	1.305
High	2480	1.345

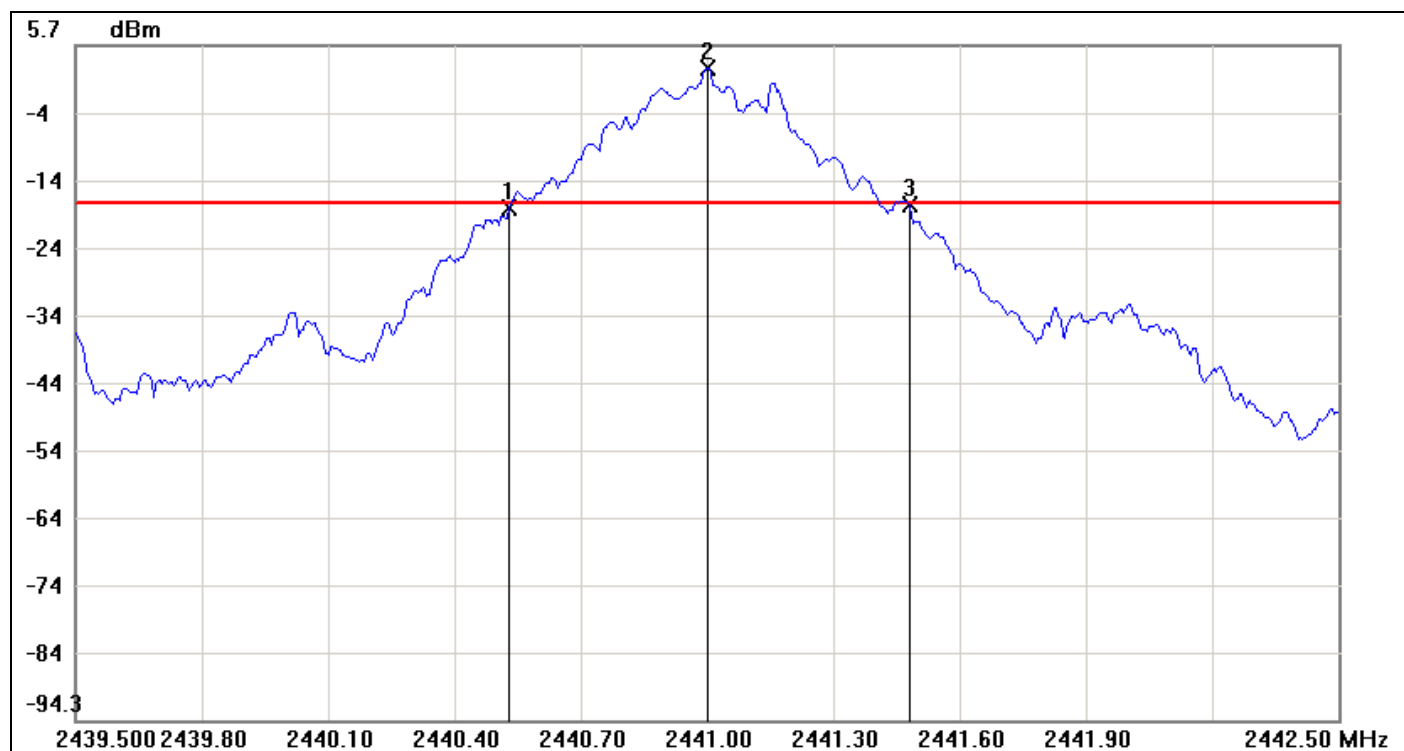
**Test Plot****For GFSK / DH5****20dB Bandwidth (CH Low)**

No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2401.5300	-18.77	-18.55	-0.22
2	2401.9950	1.45	-18.55	20.00
3	2402.4800	-19.15	-18.55	-0.60

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	0.95	-0.38



20dB Bandwidth (CH Mid)

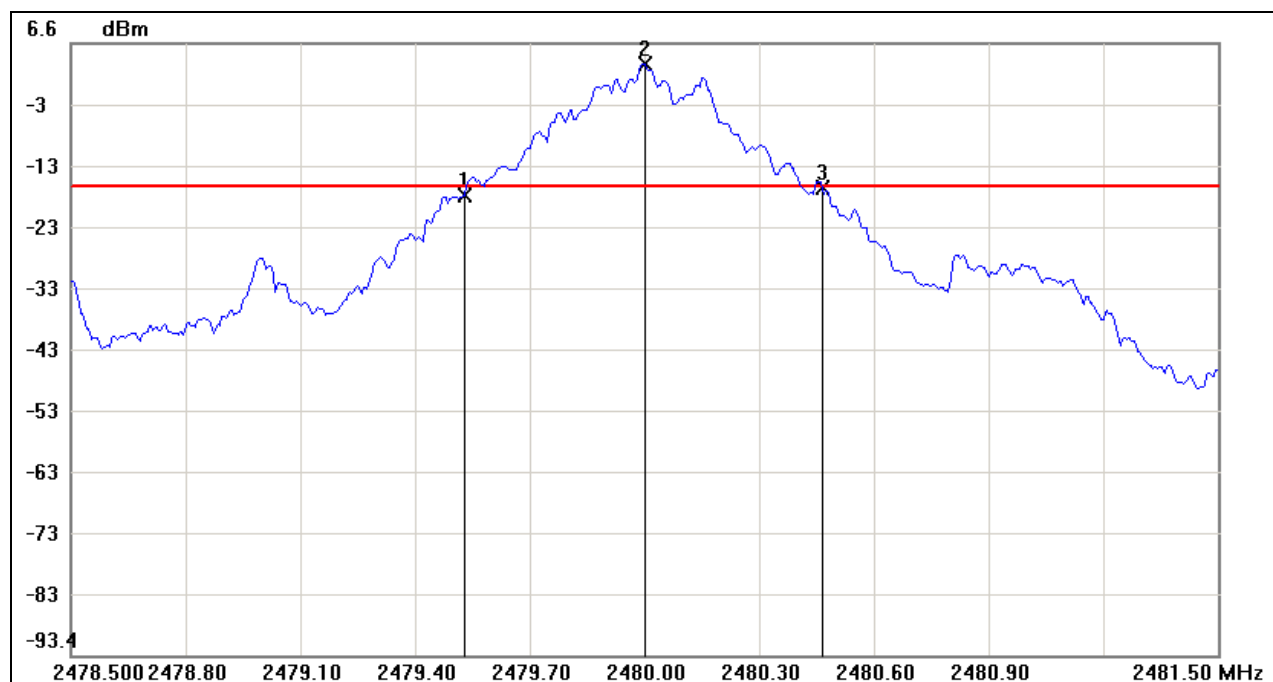


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2440.5300	-18.50	-17.68	-0.82
2	2441.0000	2.32	-17.68	20.00
3	2441.4800	-17.79	-17.68	-0.11

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	0.95	0.71



20dB Bandwidth (CH High)



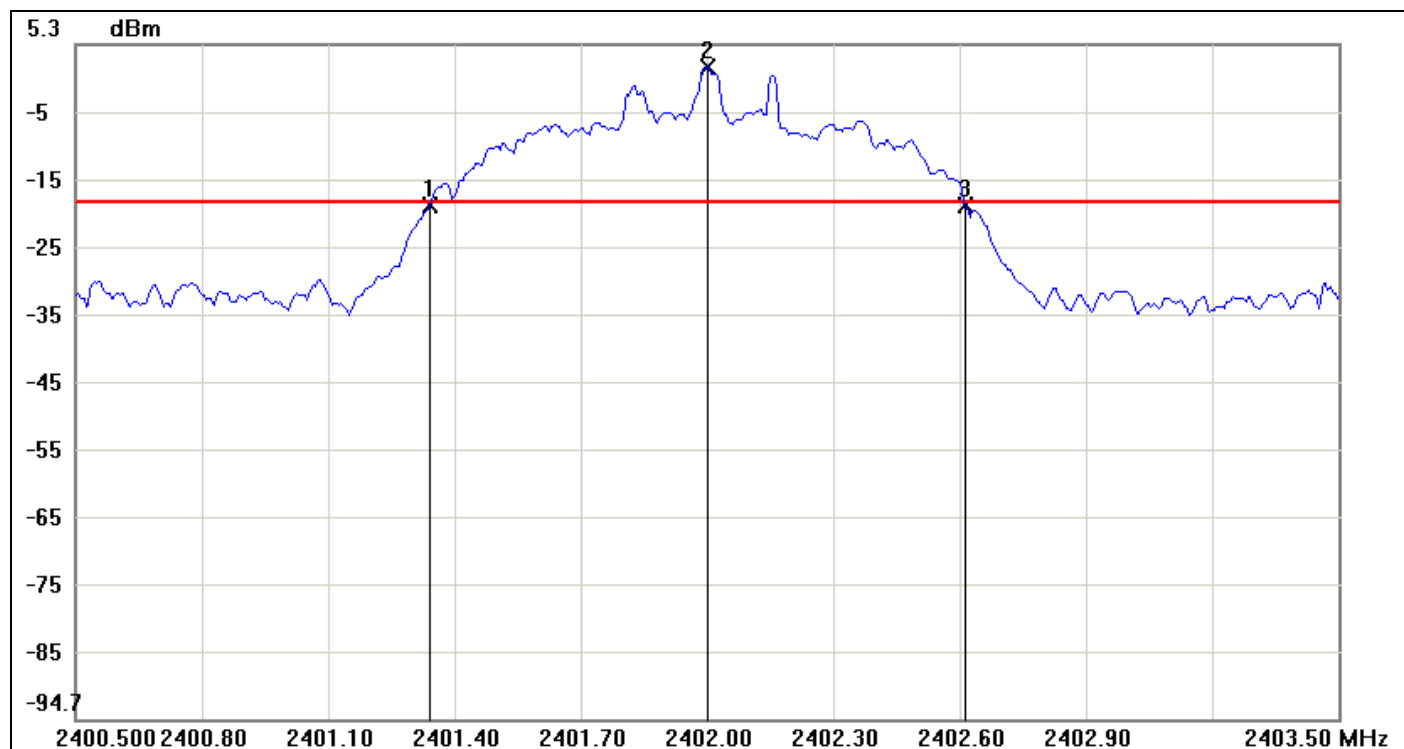
No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2479.5300	-18.25	-16.84	-1.41
2	2480.0000	3.16	-16.84	20.00
3	2480.4650	-16.95	-16.84	-0.11

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	0.935	1.3



For 8DPSK / DH5

20dB Bandwidth (CH Low)

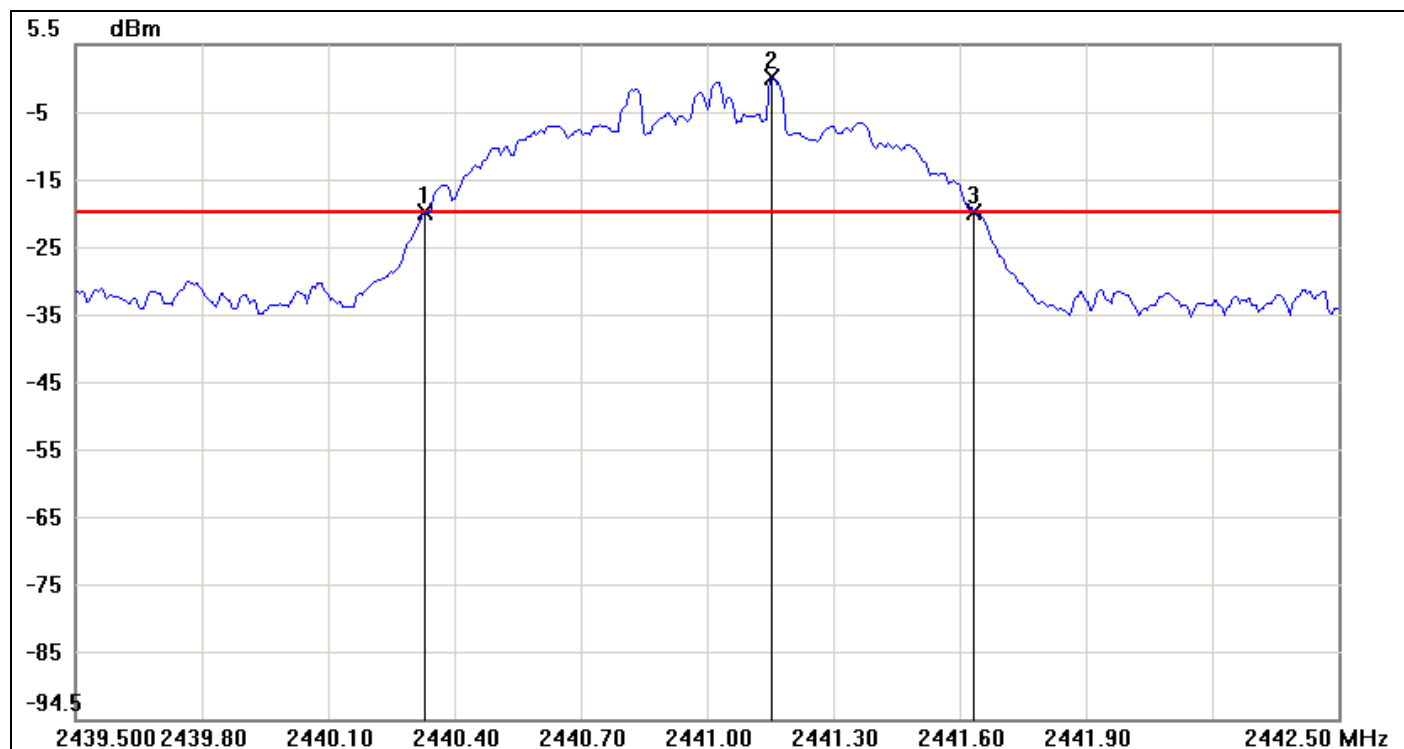


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2401.3400	-18.59	-18.12	-0.47
2	2402.0000	1.88	-18.12	20.00
3	2402.6150	-18.48	-18.12	-0.36

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	1.275	0.11



20dB Bandwidth (CH Mid)

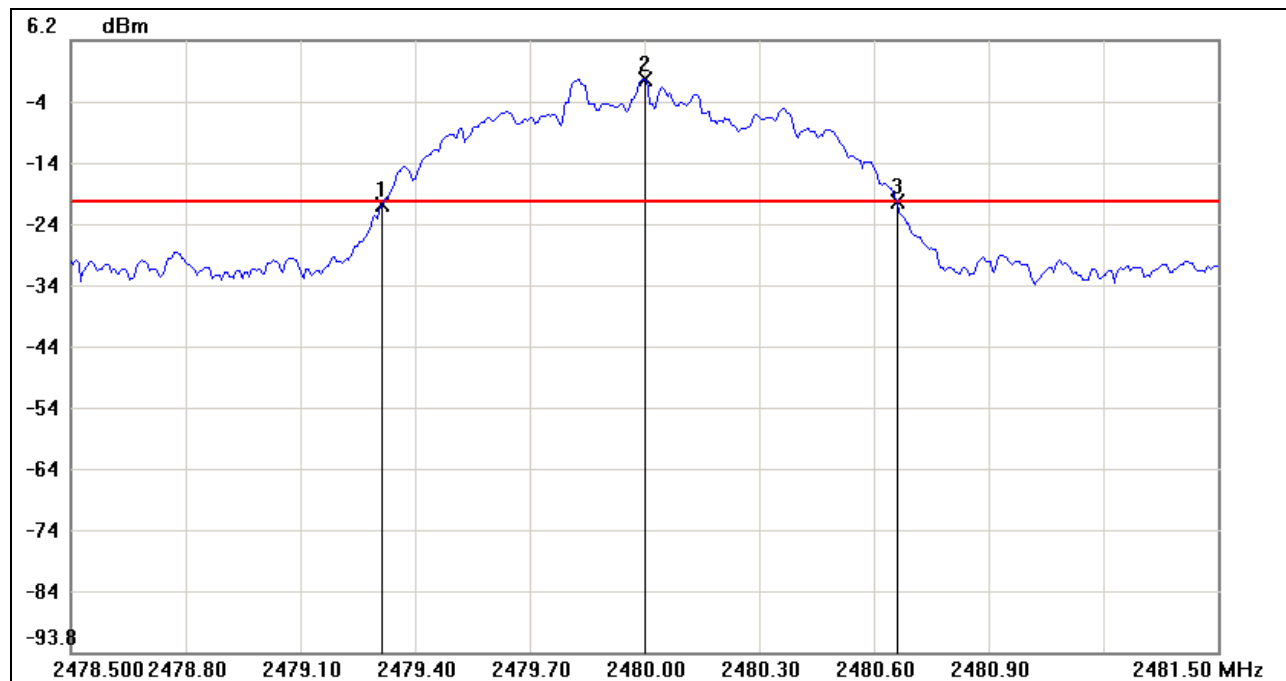


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2440.3300	-19.47	-19.44	-0.03
2	2441.1550	0.56	-19.44	20.00
3	2441.6350	-19.49	-19.44	-0.05

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	1.305	-0.02



20dB Bandwidth (CH High)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2479.3150	-20.72	-20.14	-0.58
2	2480.0000	-0.14	-20.14	20.00
3	2480.6600	-20.19	-20.14	-0.05

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	1.345	0.53



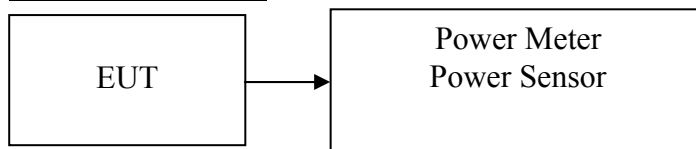
7.2 PEAK POWER

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.

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 / DH5

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2402	2.23	0.0017	0.125	PASS
Mid	2441	2.02	0.0016		PASS
High	2480	2.85	0.0019		PASS

For 8DPSK / DH5

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2402	2.21	0.0017	0.125	PASS
Mid	2441	1.92	0.0016		PASS
High	2480	2.71	0.0019		PASS



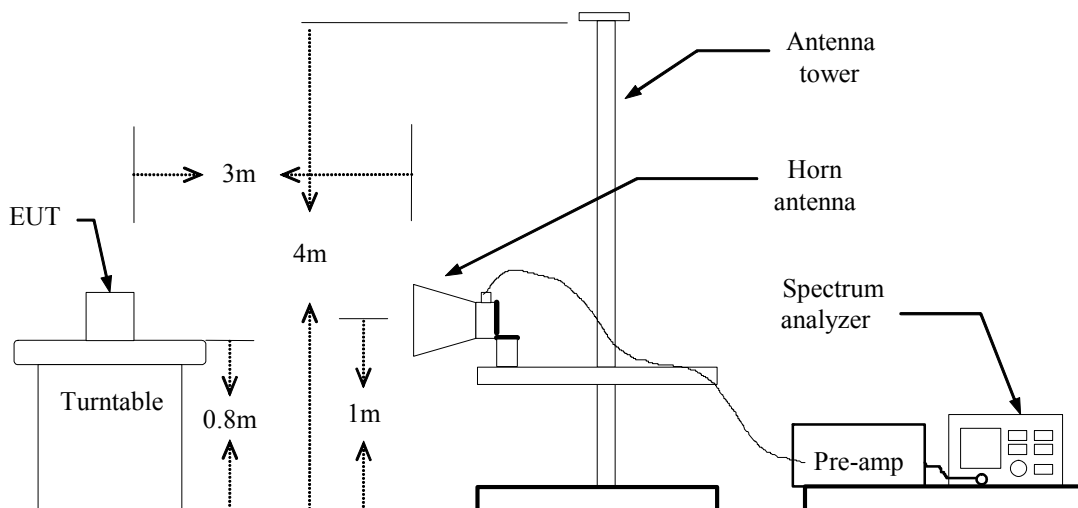
7.3 BAND EDGES MEASUREMENT

LIMIT

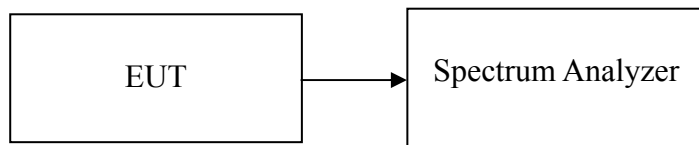
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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 §15.205(c)).

Test Configuration

For Radiated



For Conducted





TEST PROCEDURE

For Radiated

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=1MHz / VBW=3MHz / Sweep=AUTO
 - (b) AVERAGE: RBW=1MHz / VBW=300Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

For Conducted

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 300 kHz. The video bandwidth is set to 300 kHz.

TEST RESULTS

Refer to attach spectrum analyzer data chart.

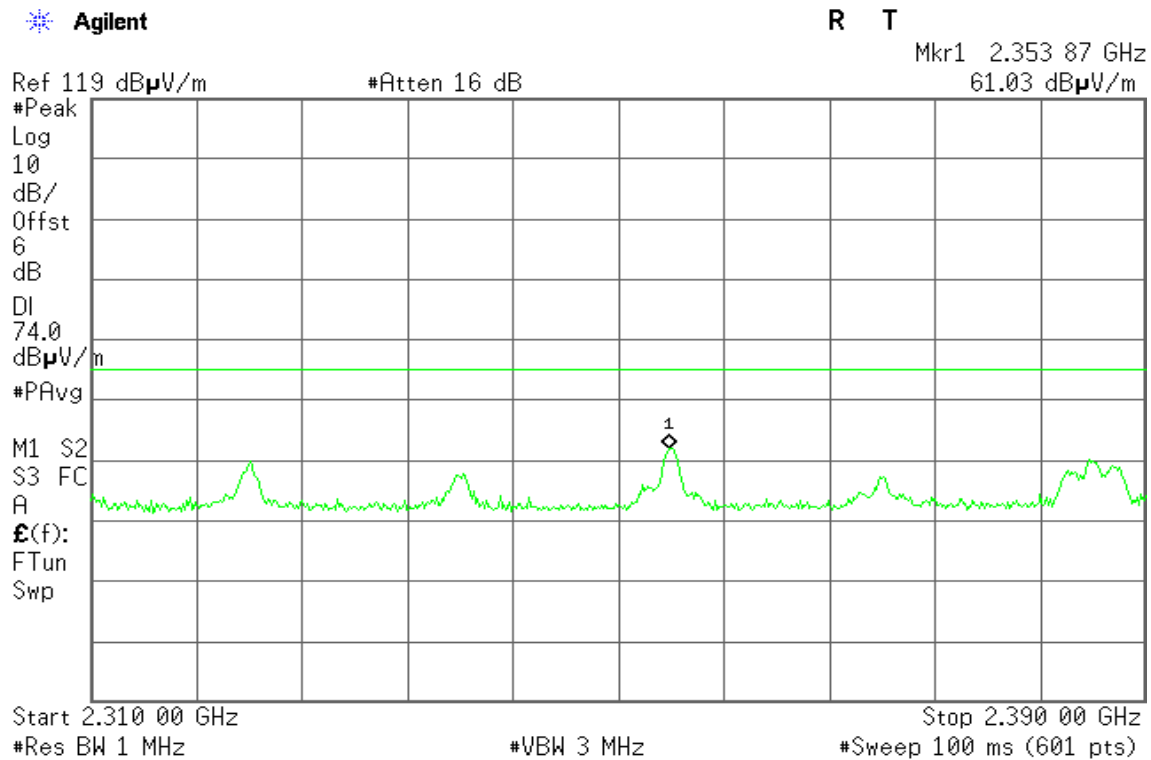


For GFSK / DH5

Band Edges (CH Low)

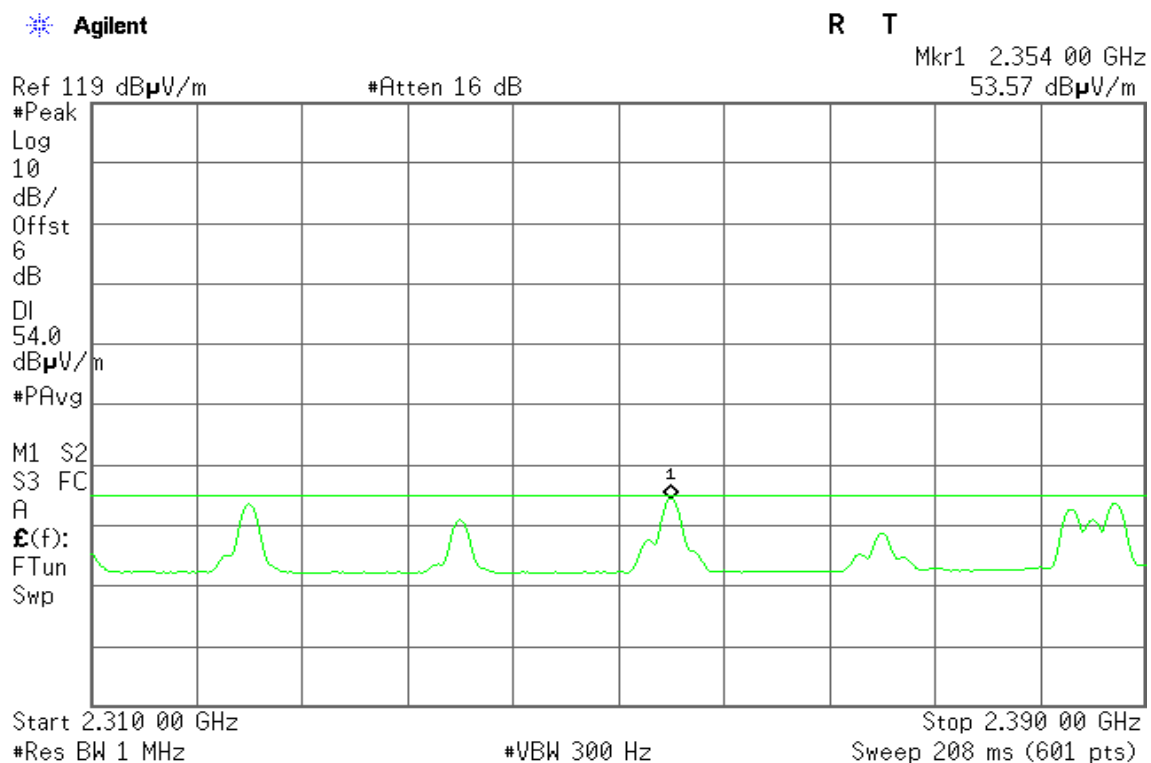
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical





Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.353 87 GHz

61.02 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

#PAvg

V1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.390 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.354 00 GHz

53.32 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

#PAvg

M1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 300 Hz

Stop 2.390 00 GHz

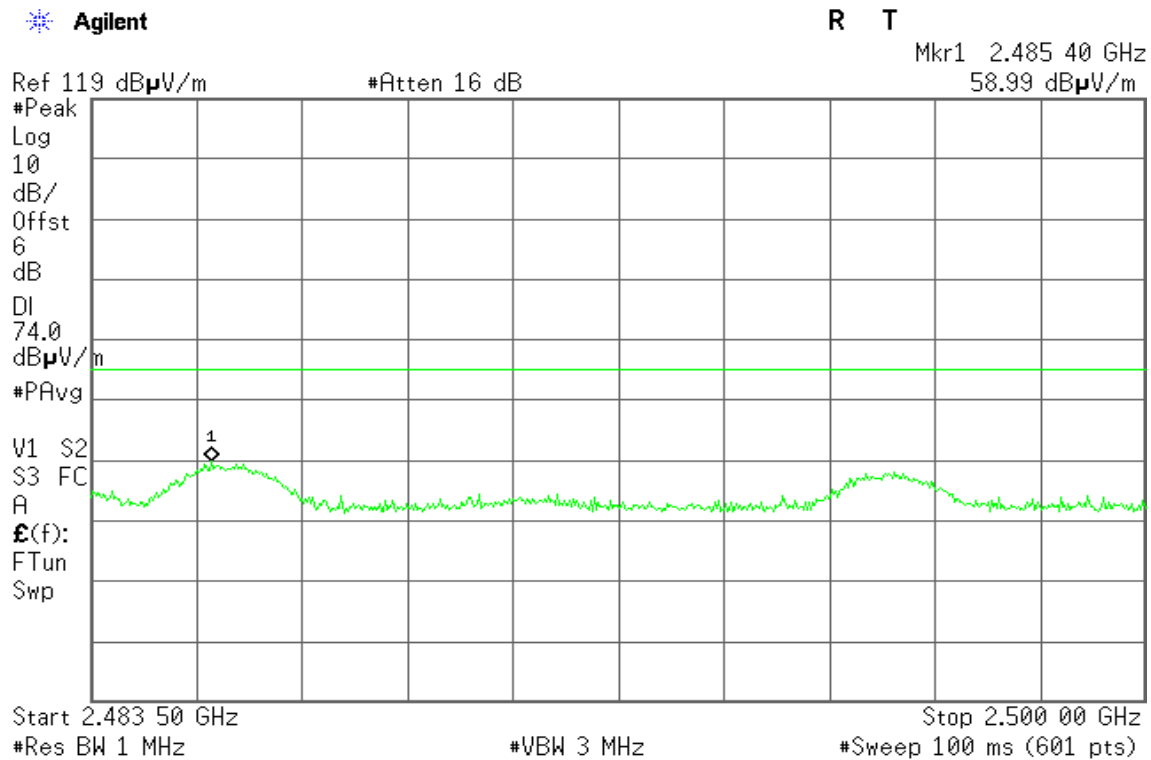
Sweep 208 ms (601 pts)



Band Edges (CH High)

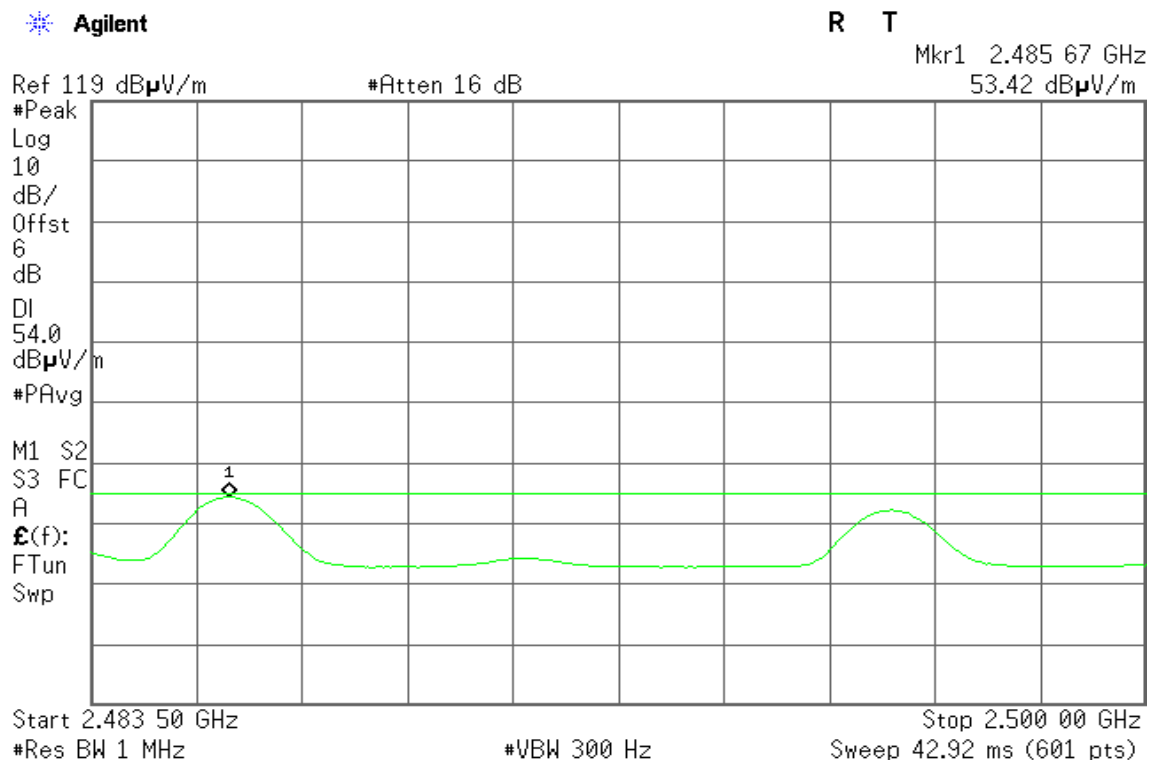
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical





Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.485 67 GHz

58.27 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

#PAvg

V1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.500 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.485 70 GHz

53.29 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

#PAvg

M1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 300 Hz

Stop 2.500 00 GHz

Sweep 42.92 ms (601 pts)

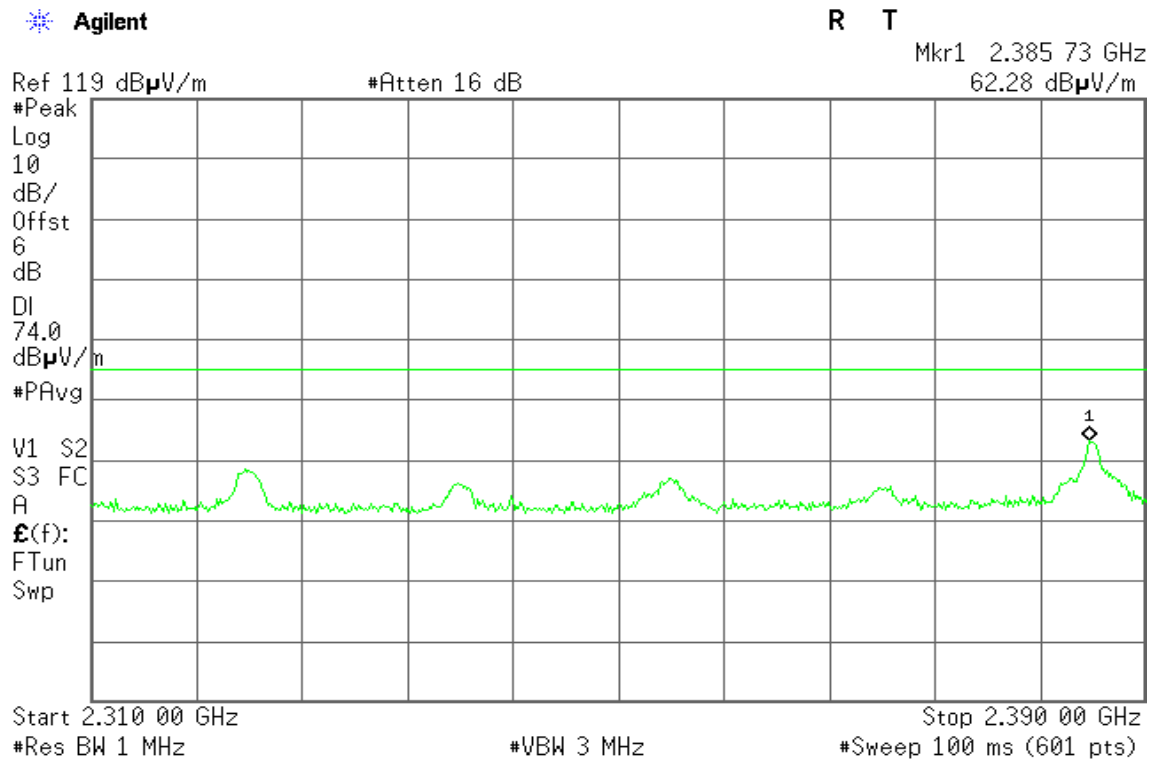


For 8DPSK / DH5

Band Edges (CH Low)

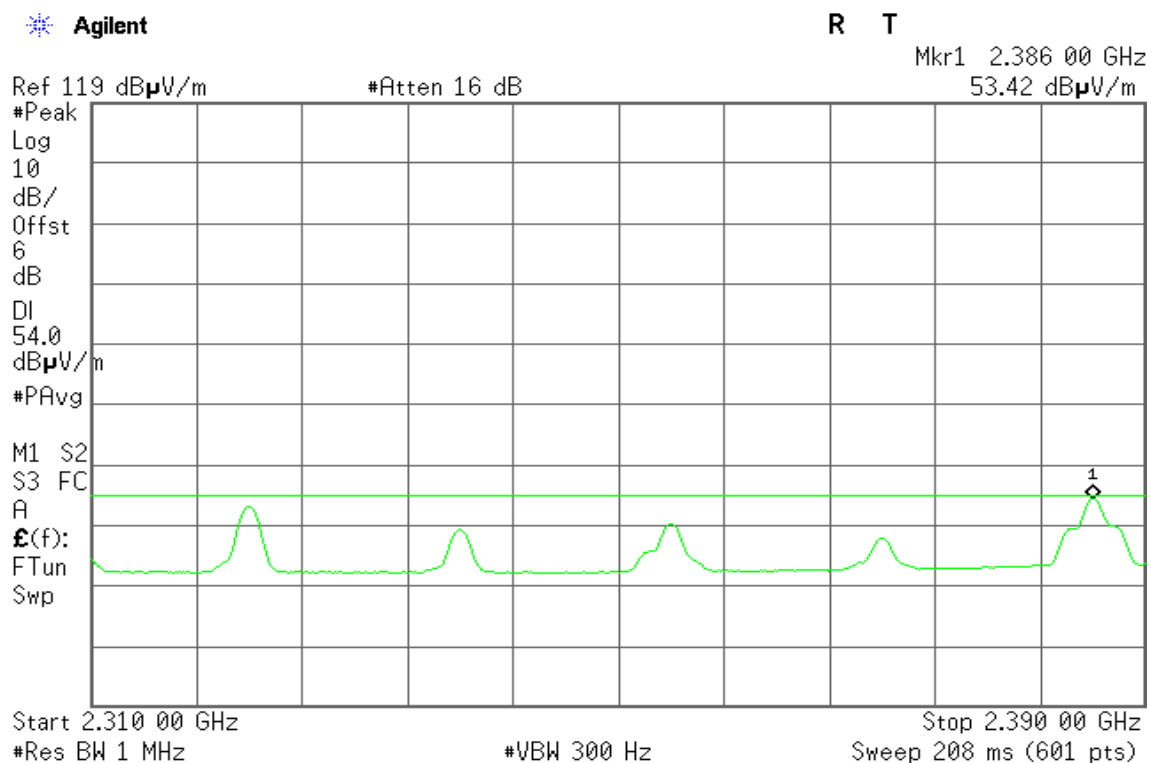
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical





Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.385 87 GHz

61.55 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

#PAvg

V1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.390 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.386 13 GHz

53.10 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

#PAvg

M1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 300 Hz

Stop 2.390 00 GHz

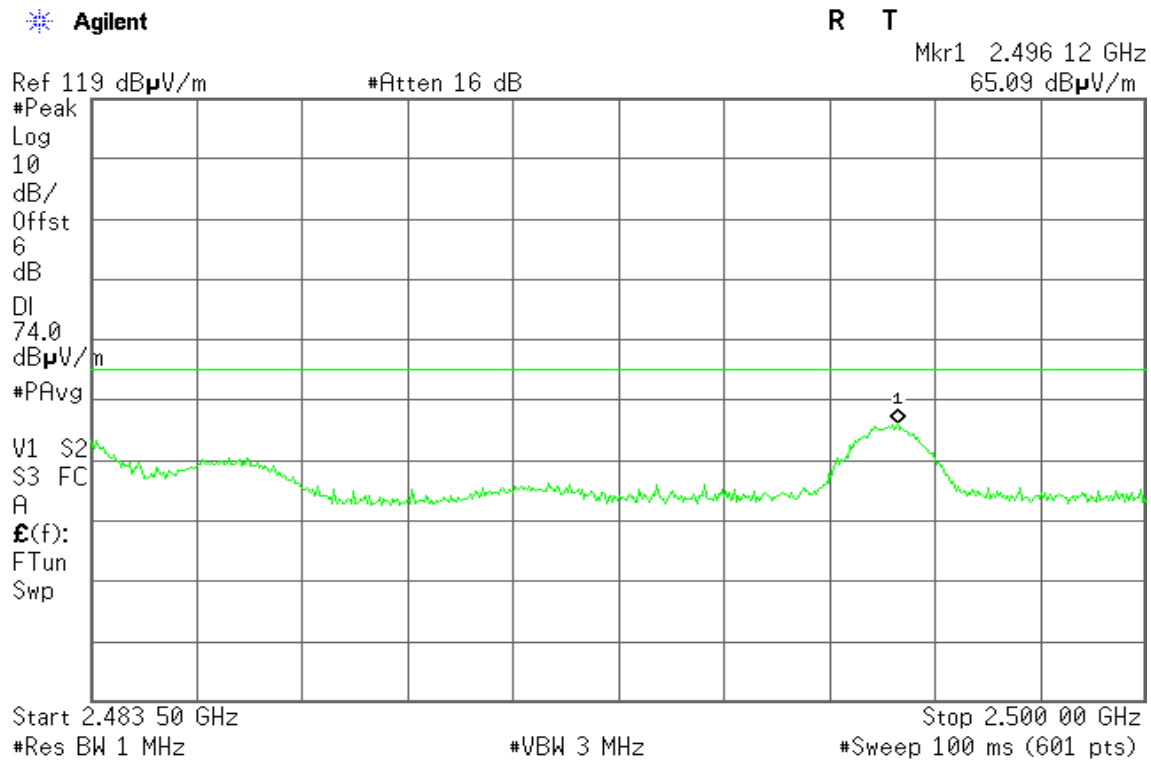
Sweep 208 ms (601 pts)



Band Edges (CH High)

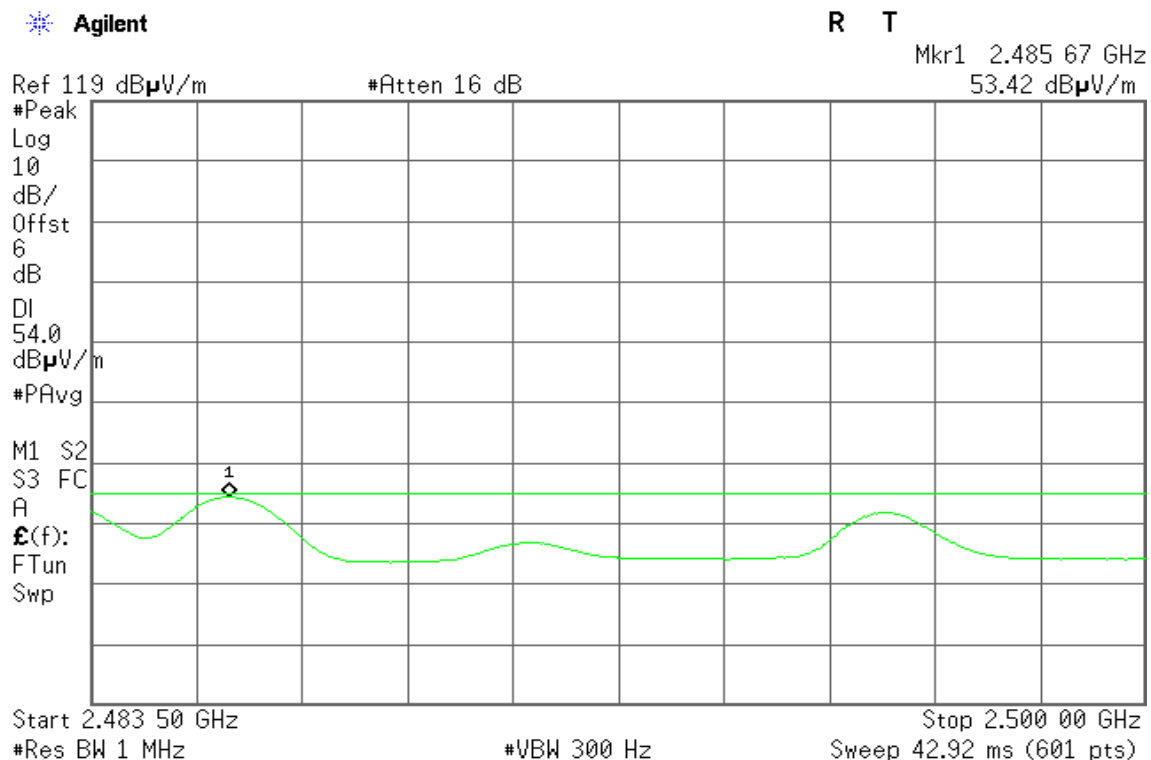
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical





Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.483 53 GHz
63.13 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

#PAvg

1

V1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.500 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.485 67 GHz
53.73 dB μ V/mRef 119 dB μ V/m

#Atten 16 dB

#Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

#PAvg

M1 S2

S3 FC

A

E(f):

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 300 Hz

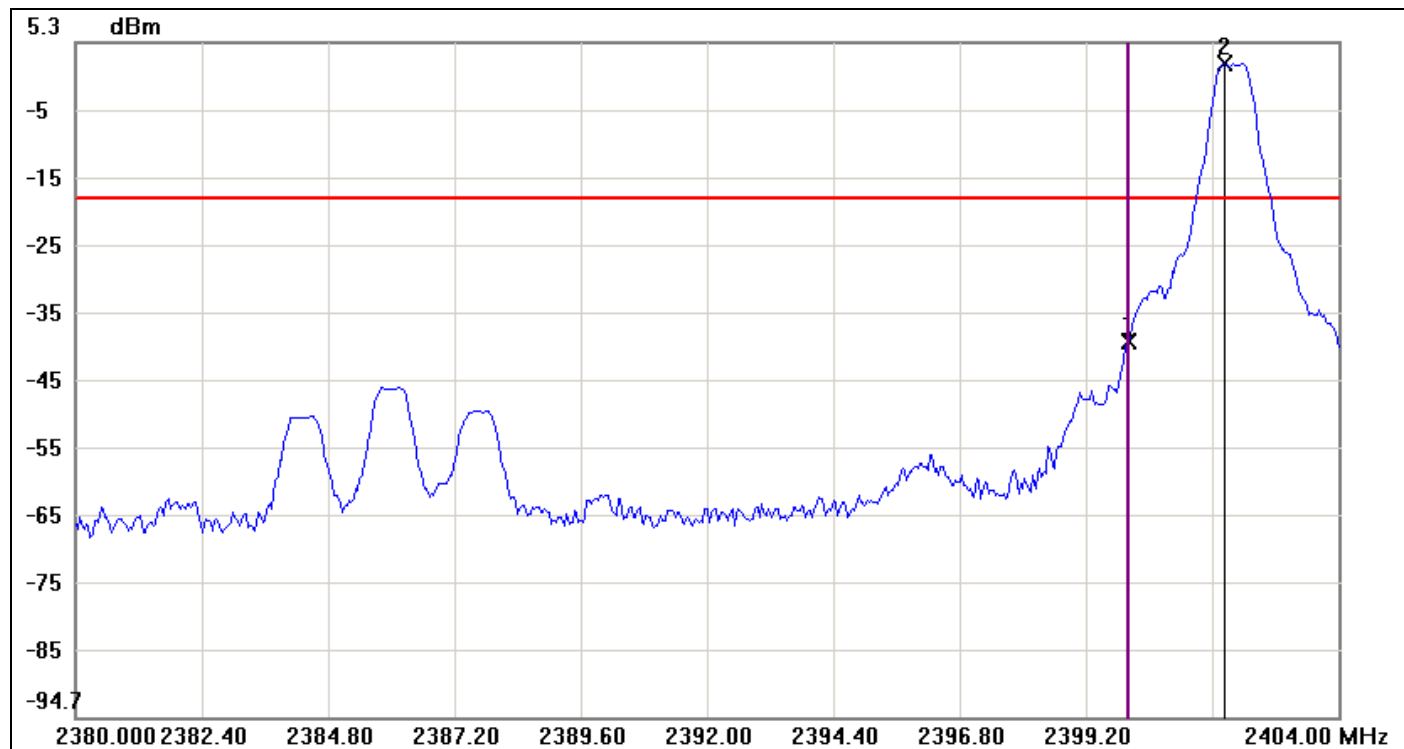
Stop 2.500 00 GHz

Sweep 42.92 ms (601 pts)



GFSK

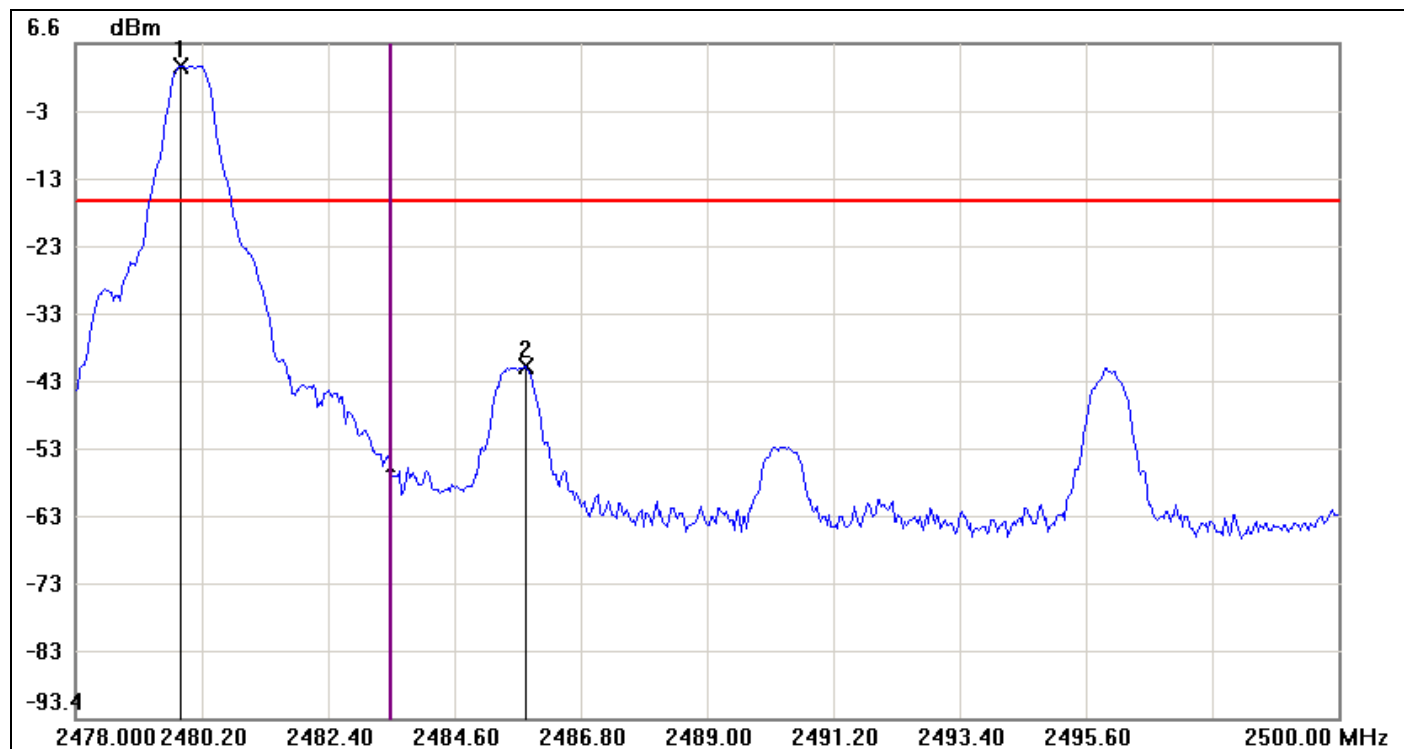
Band Edges (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2400.0000	-38.95	-17.87	-21.08
2	2401.8400	2.13	-17.87	20.00



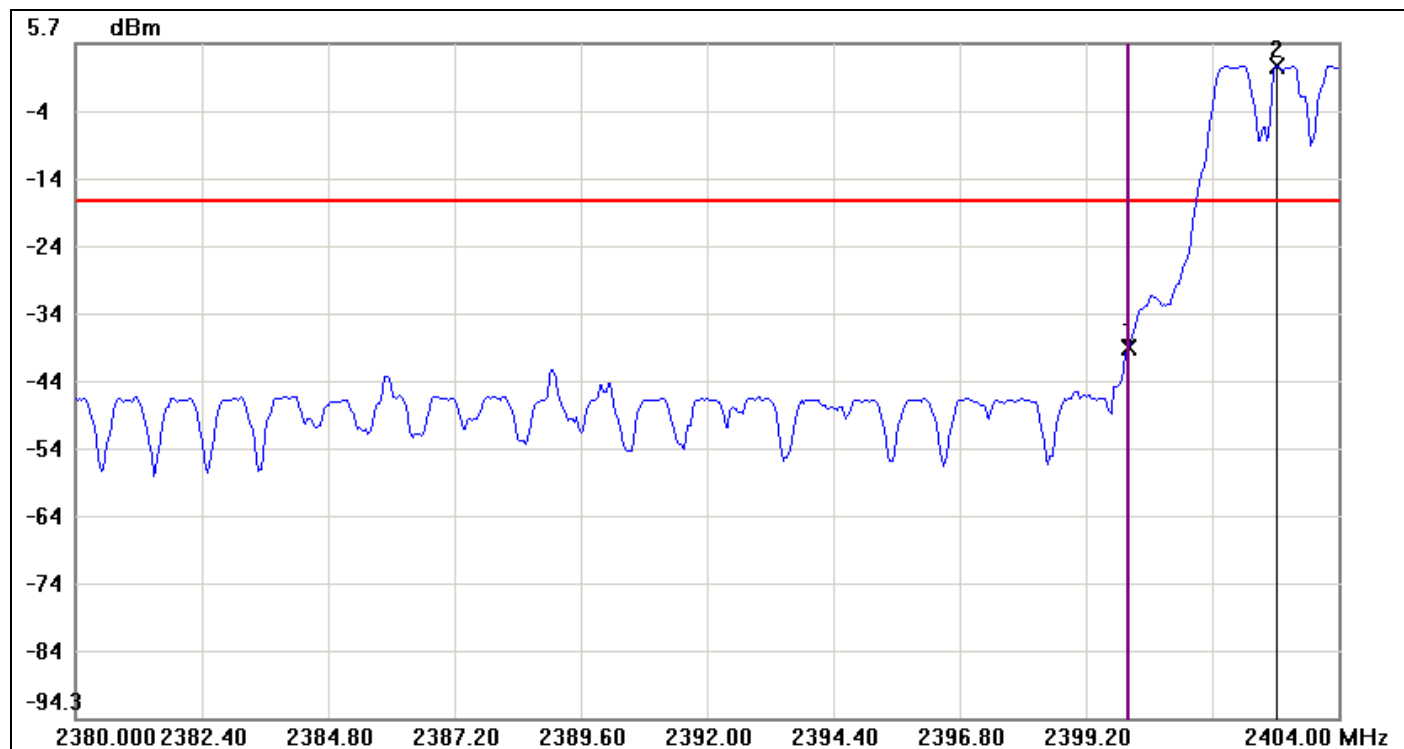
Band Edges (CH High)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2479.8333	3.19	-16.81	20.00
2	2485.8467	-41.27	-16.81	-24.46



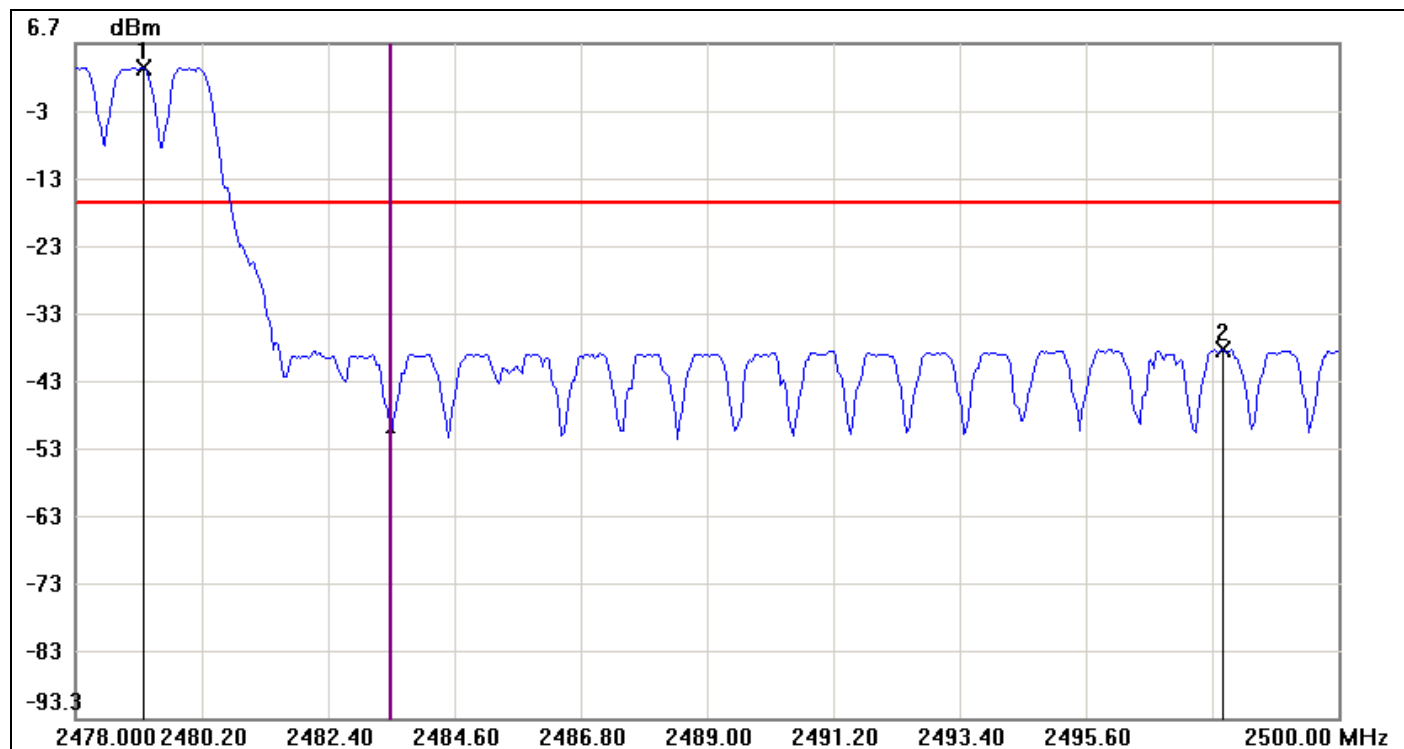
Hopping Mode (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2400.0000	-39.32	-17.58	-21.74
2	2402.8400	2.42	-17.58	20.00



Hopping Mode (CH High)

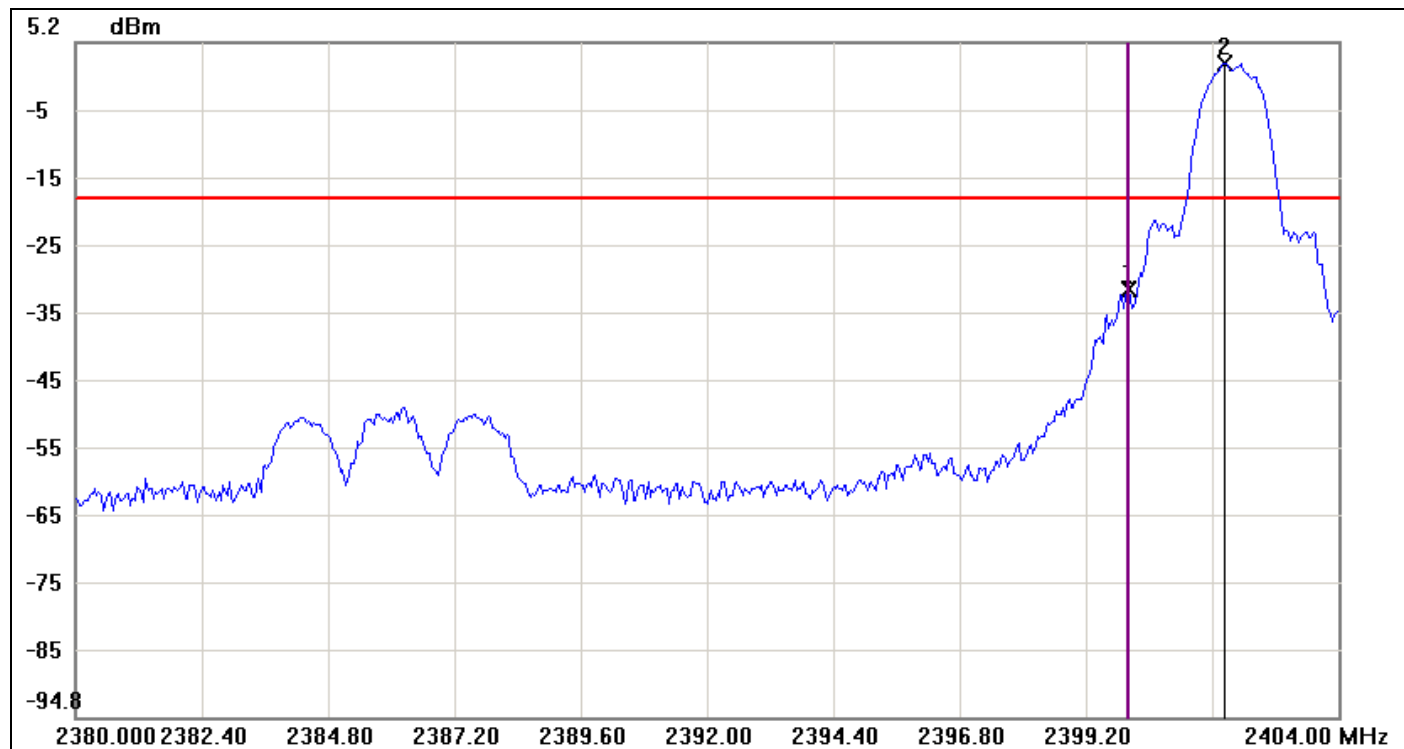


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2479.1733	3.15	-16.85	20.00
2	2497.9833	-38.62	-16.85	-21.77



8DPSK

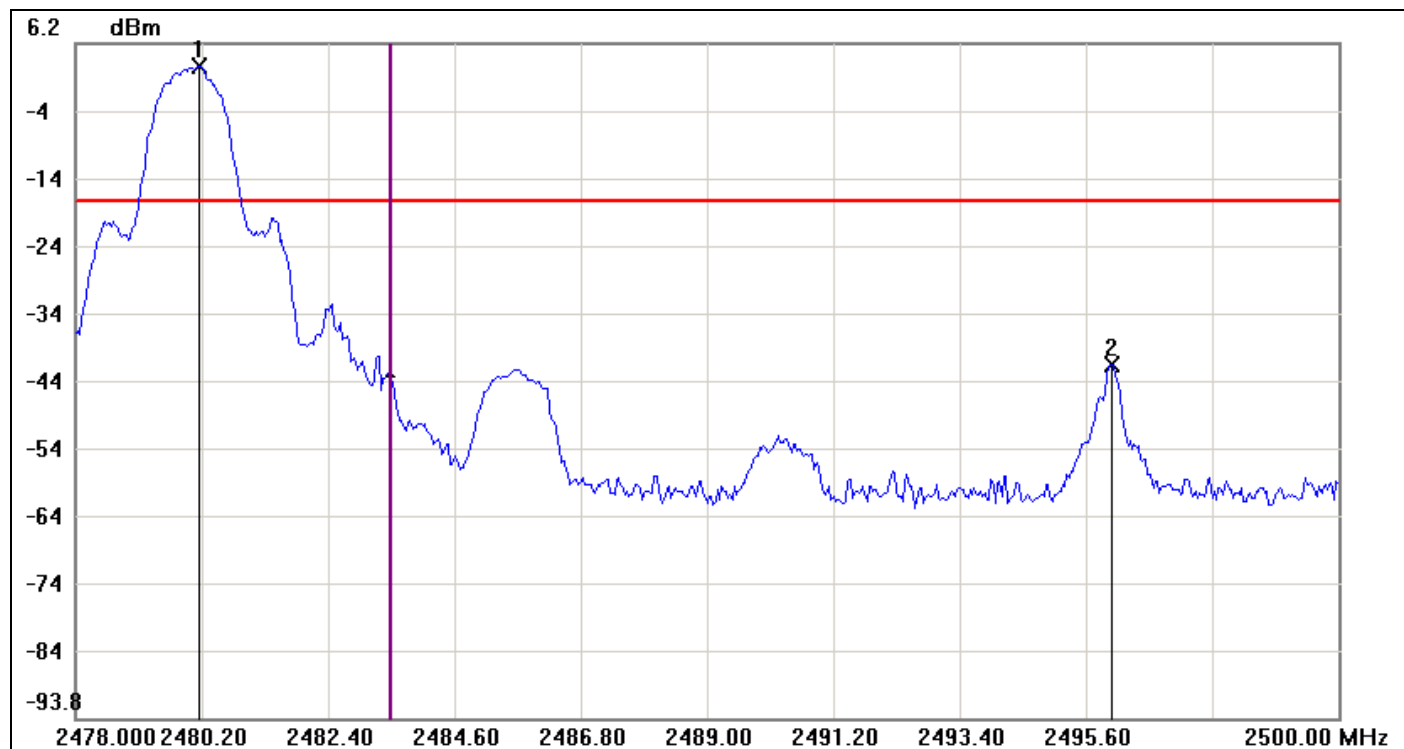
Band Edges (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2400.0000	-31.47	-17.89	-13.58
2	2401.8400	2.11	-17.89	20.00



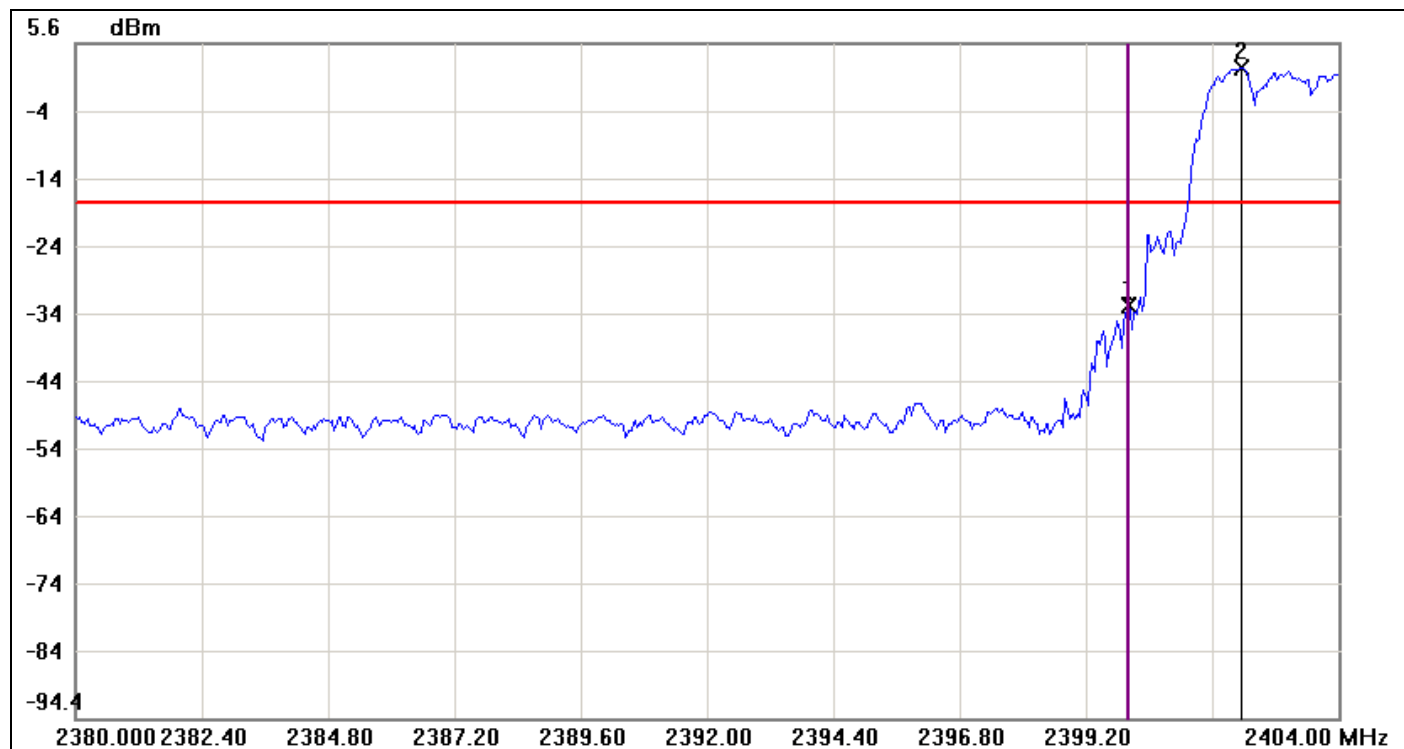
Band Edges (CH High)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2480.1633	2.71	-17.29	20.00
2	2496.0400	-41.45	-17.29	-24.16



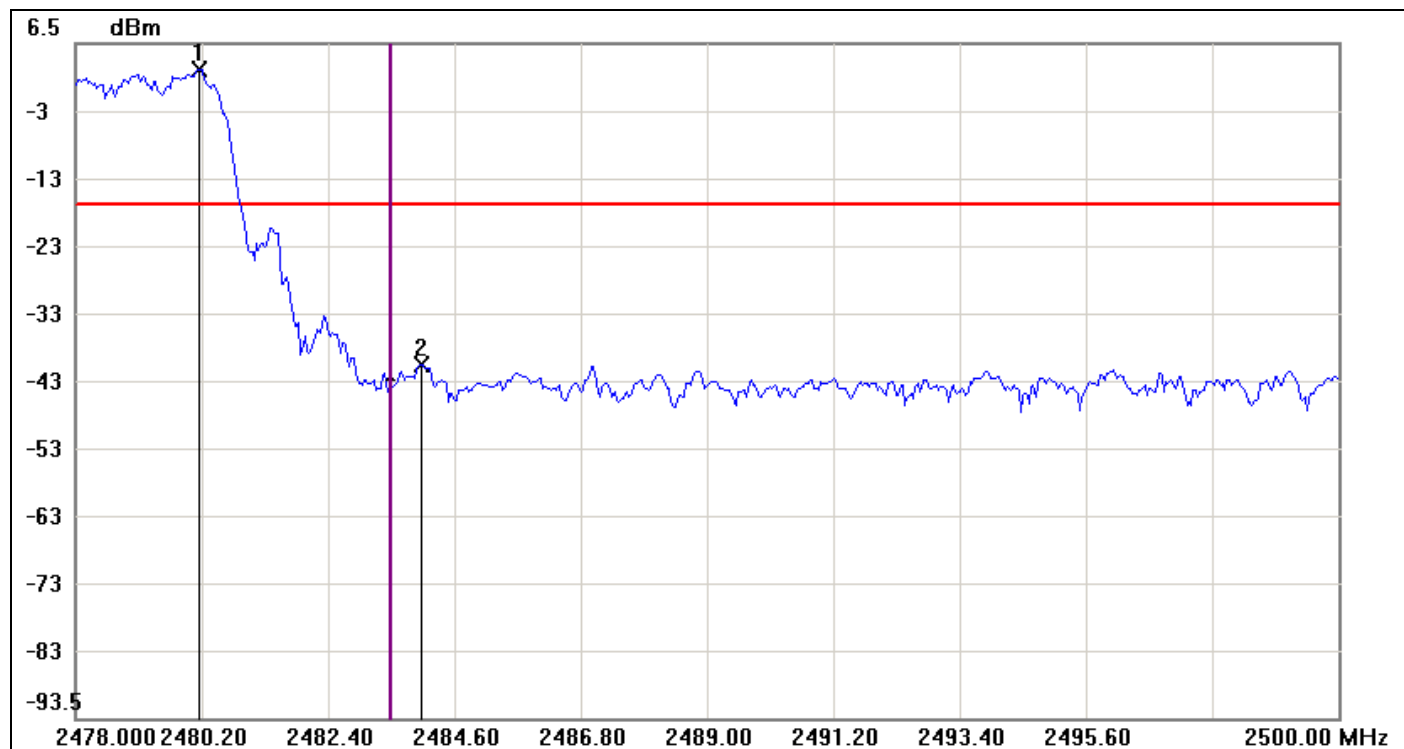
Hopping Mode (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2400.0000	-33.20	-17.92	-15.28
2	2402.1600	2.08	-17.92	20.00



Hopping Mode (CH High)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2480.1633	2.73	-17.27	20.00
2	2484.0133	-41.01	-17.27	-23.74

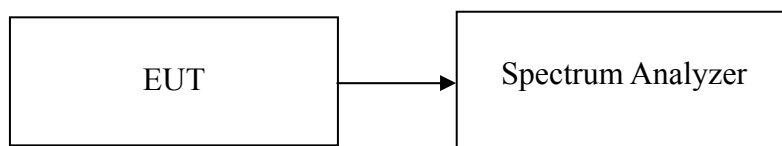


7.4 FREQUENCY SEPARATION

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, Sweep = 3.2 ms.
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 / DH5

Channel Separation (MHz)	two-thirds of the 20 dB bandwidth	Channel Separation Limit	Result
1.085	0.63	> two-thirds of the 20 dB bandwidth	Pass

For 8DPSK / DH5

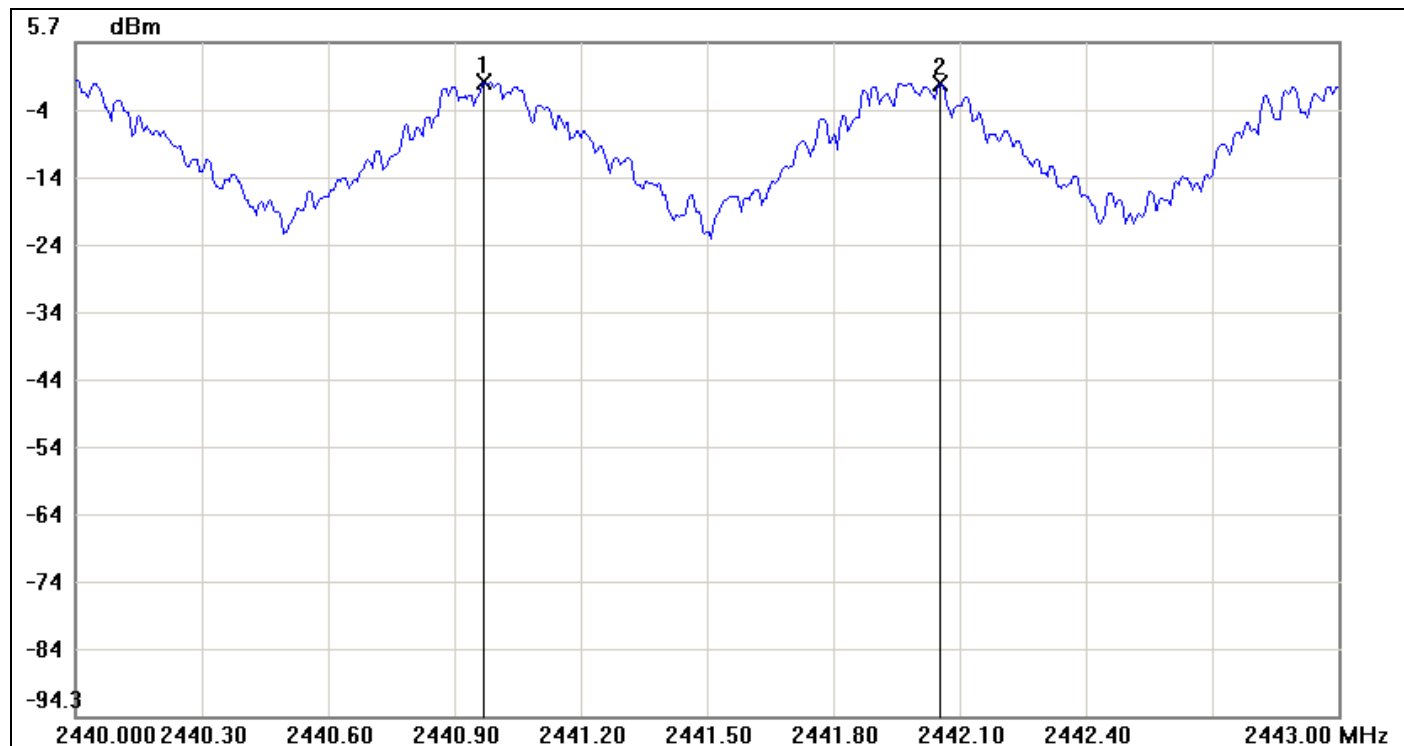
Channel Separation (MHz)	two-thirds of the 20 dB bandwidth	Channel Separation Limit	Result
1.145	0.90	> two-thirds of the 20 dB bandwidth	Pass



Test Plot

For GFSK / DH5

Measurement of Channel Separation

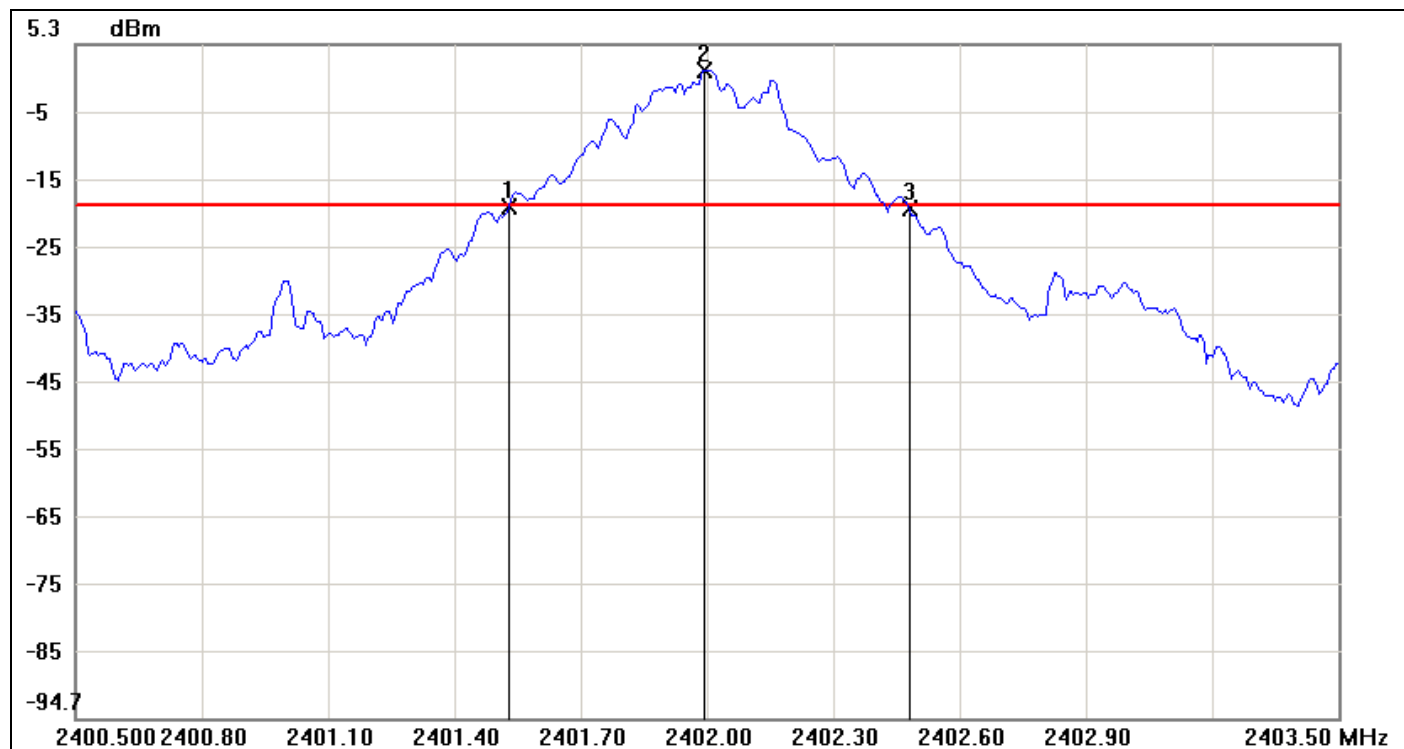


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2440.9700	-0.26		
2	2442.0550	-0.52		

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk2-mk1	1.085	-0.26



Measurement of 20dB Bandwidth



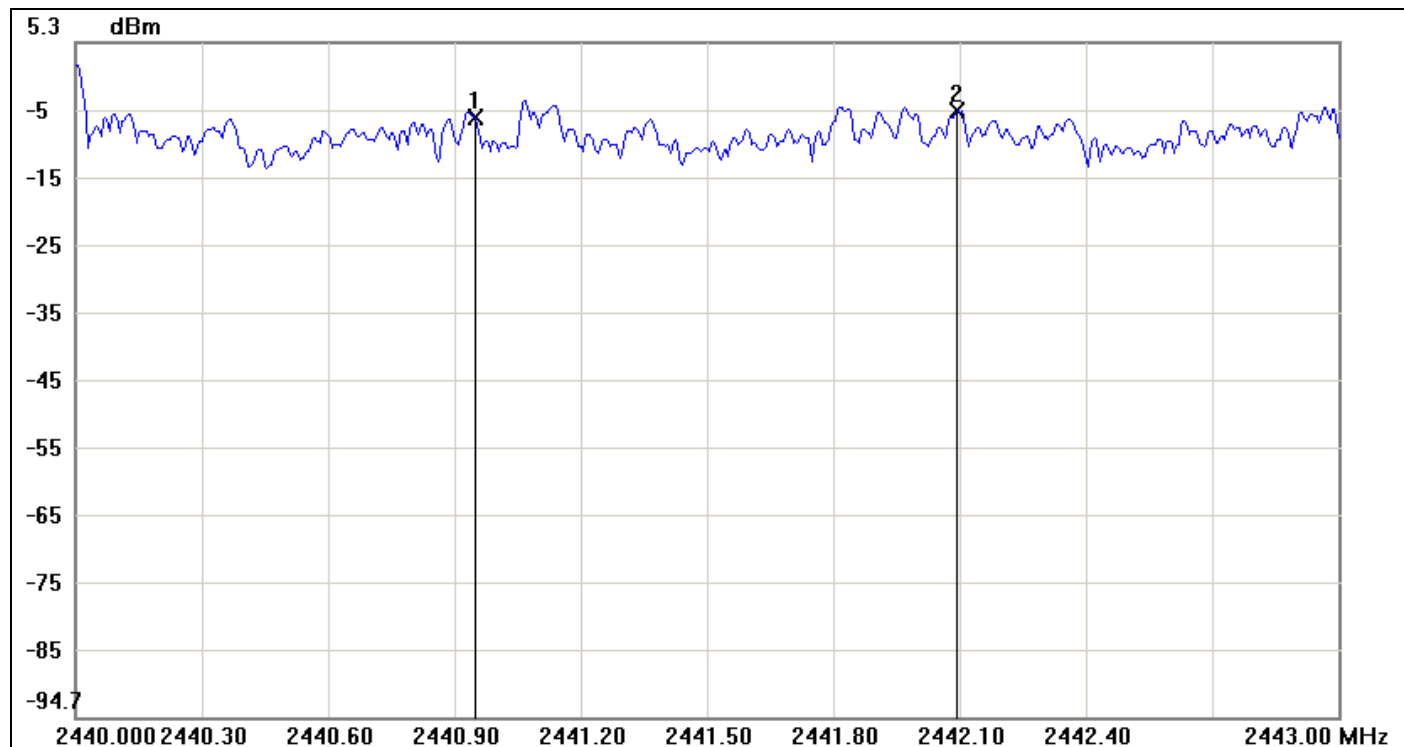
No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2401.5300	-18.77	-18.55	-0.22
2	2401.9950	1.45	-18.55	20.00
3	2402.4800	-19.15	-18.55	-0.60

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	0.95	-0.38



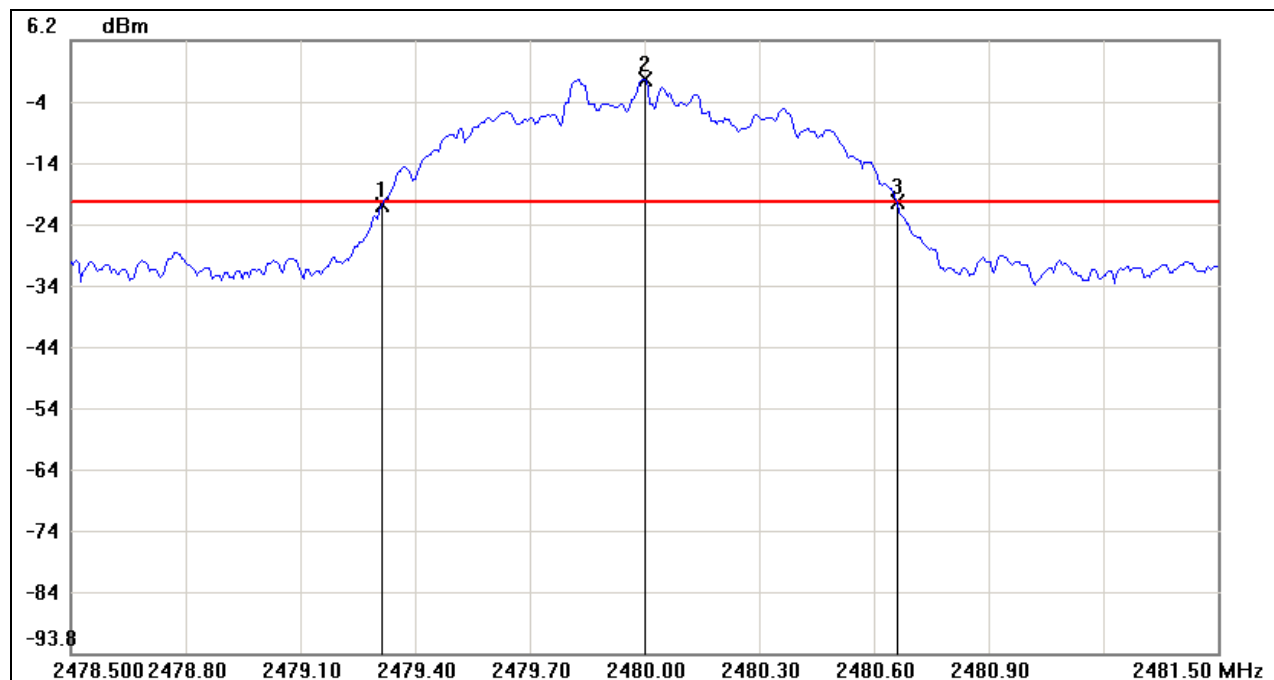
For 8DPSK / DH5

Measurement of Channel Separation



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2440.9500	-5.70		
2	2442.0950	-4.82		

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk2-mk1	1.145	0.88

**Measurement of 20dB Bandwidth**

No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2479.3150	-20.72	-20.14	-0.58
2	2480.0000	-0.14	-20.14	20.00
3	2480.6600	-20.19	-20.14	-0.05

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	1.345	0.53



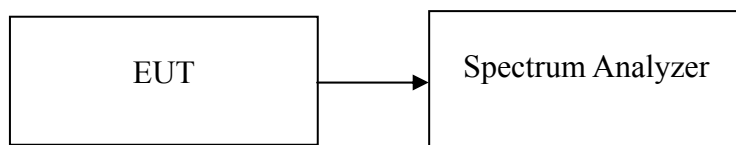
7.5 NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 75 hopping frequencies.

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 = 2430.5MHz, Sweep = auto
Start=2430.5MHz, Stop = 2460.5MHz, Sweep = auto and Start=2460.5MHz, Stop = 2485.5MHz, 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

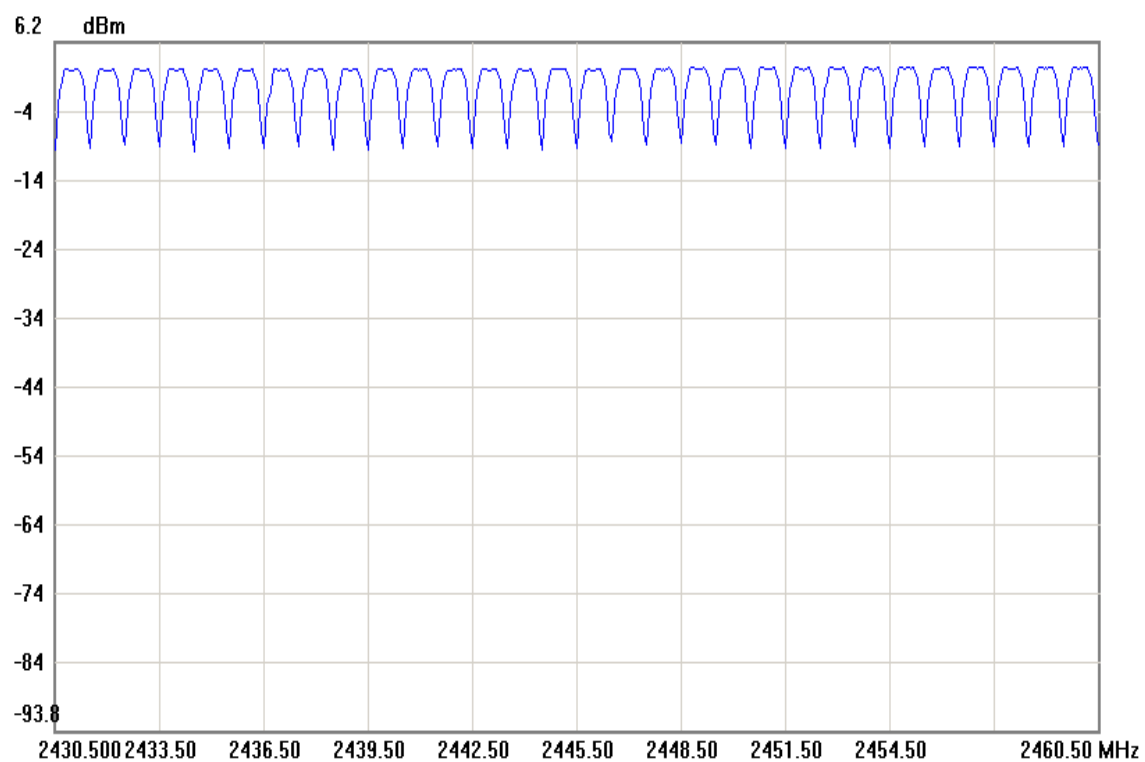
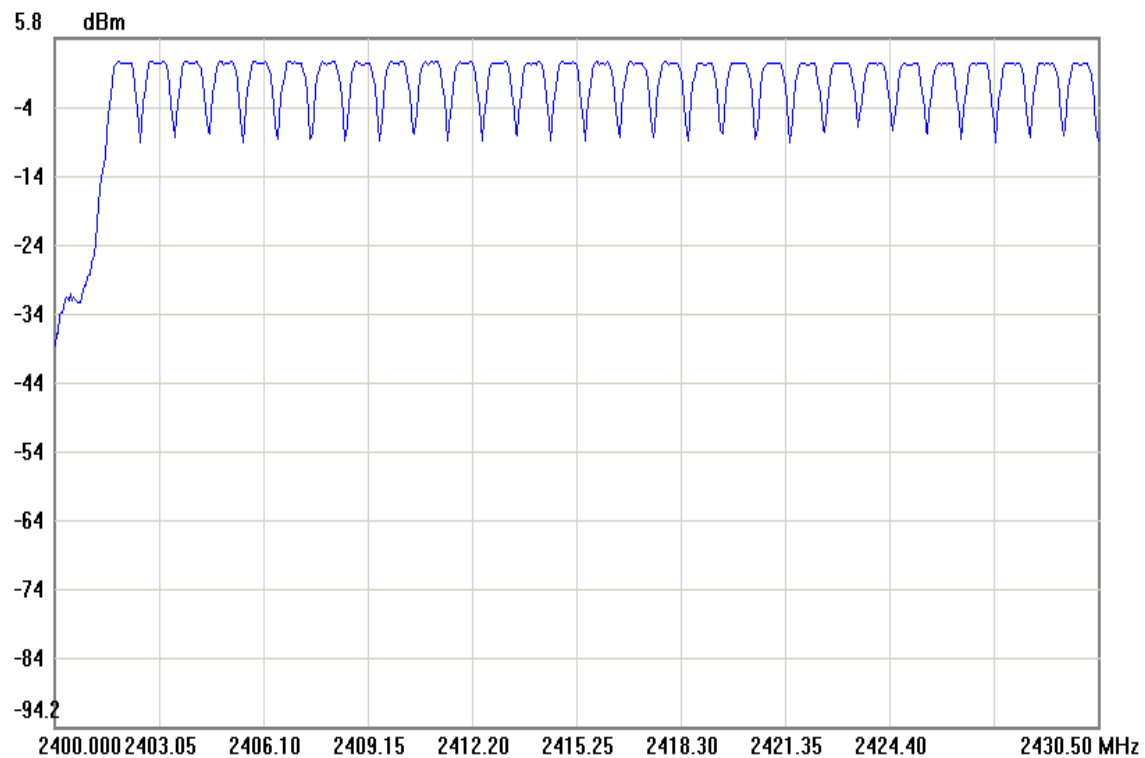
Result (No. of CH)	Limit (No. of CH)	Result
79	>15	PASS

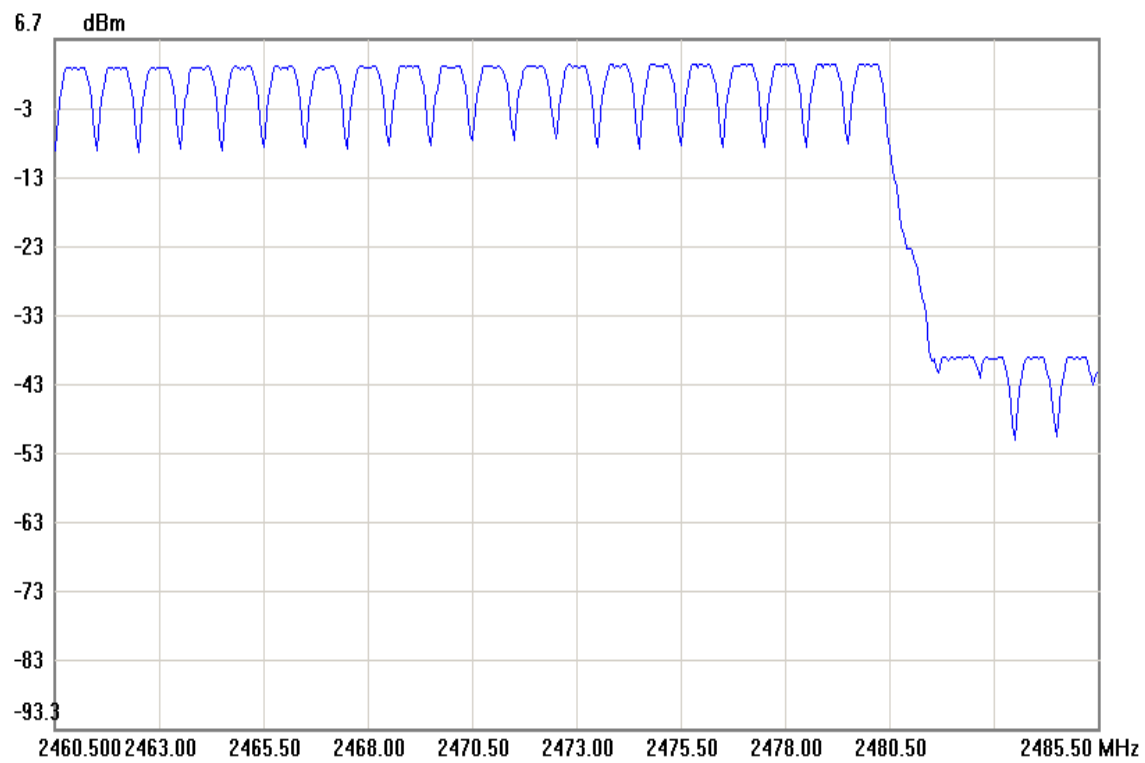


Test Plot

For GFSK

Channel Number

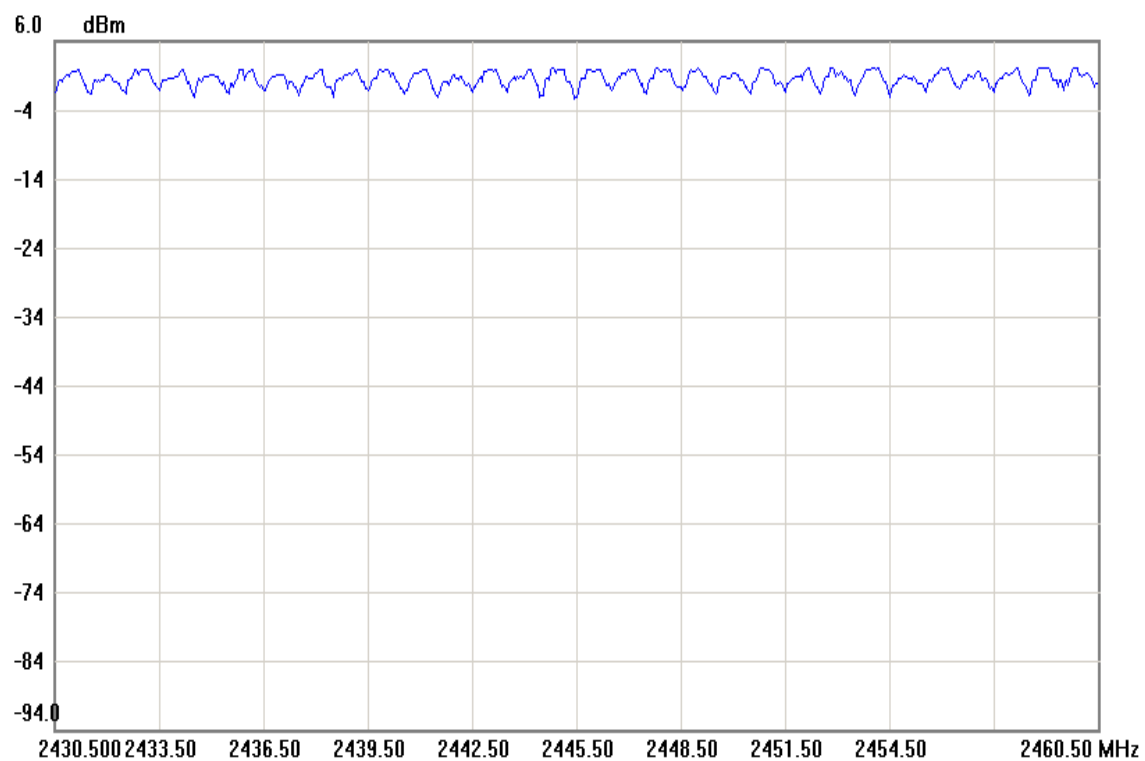
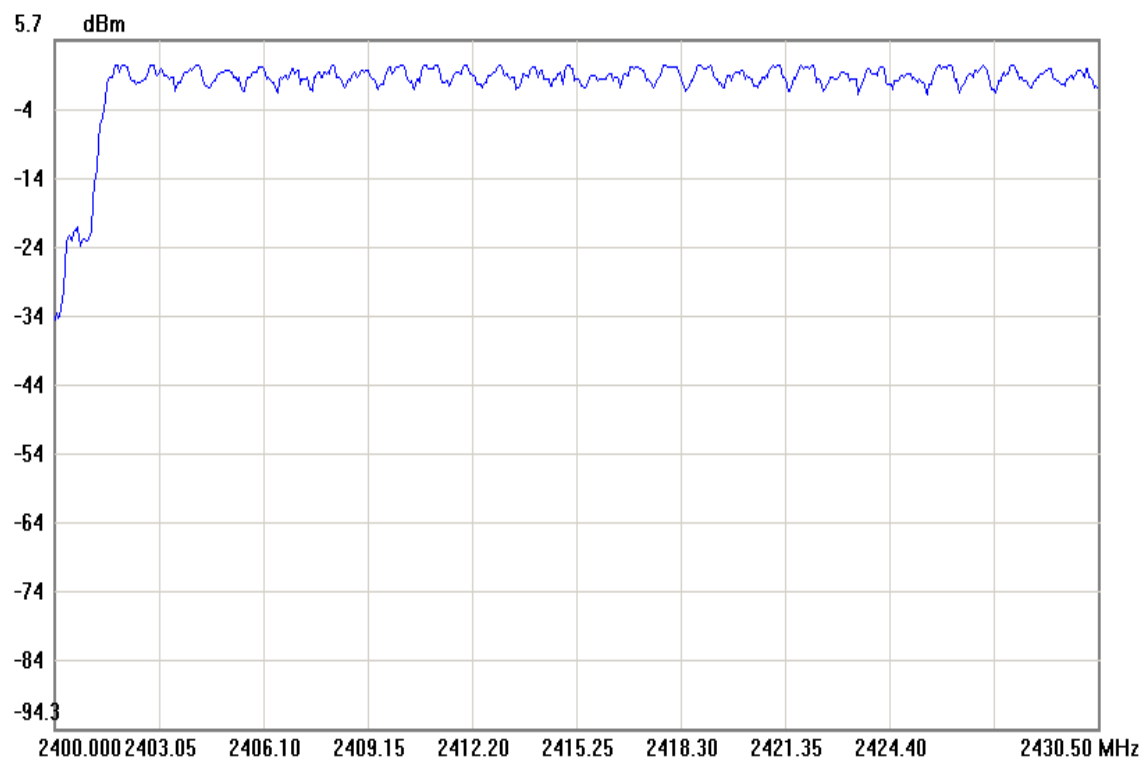


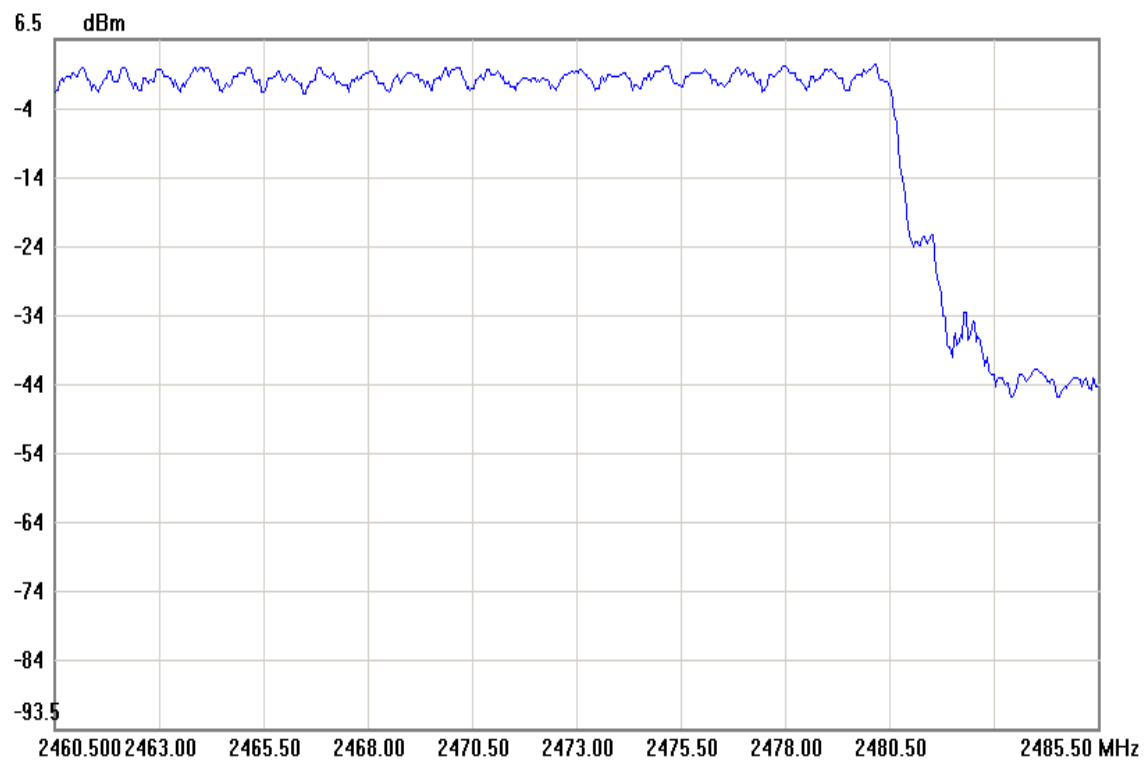




For 8DPSK

Channel Number





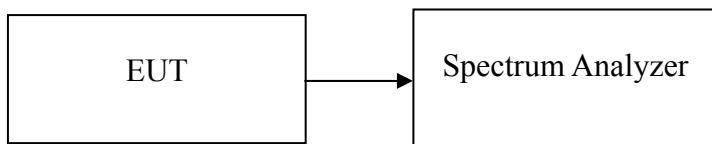


7.6 TIME OF OCCUPANCY (DWELL TIME)

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, Sweep = 1 ms.
5. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

No non-compliance noted



Test Data

For GFSK

DH 1: $0.4050 * (1600/2)/79 * 31.6 = 129.600$ (ms)

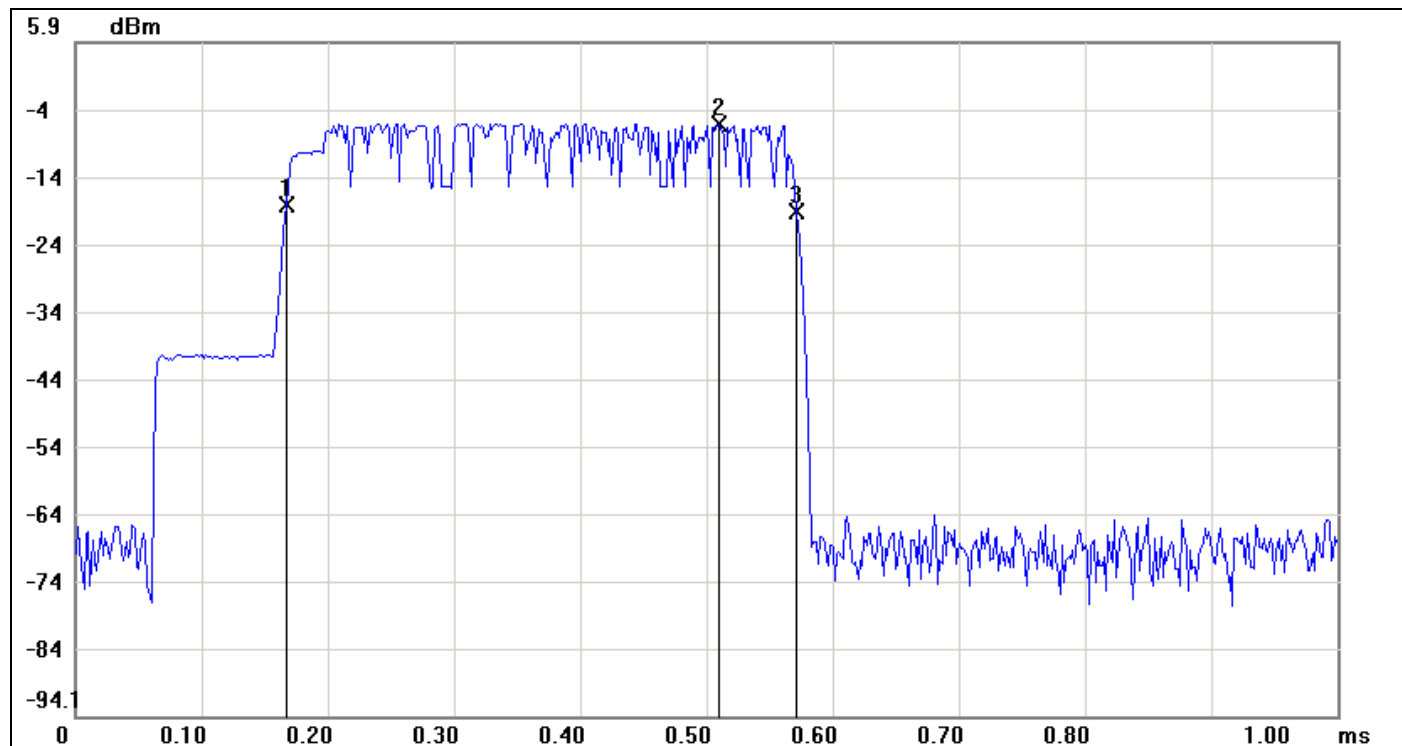
DH 3: $1.6700 * (1600/4)/79 * 31.6 = 267.200$ (ms)

DH 5: $2.9250 * (1600/6)/79 * 31.6 = 312.000$ (ms)

	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
DH 1	0.4050	129.600	31.60	400.00	PASS
DH 3	1.6700	267.200	31.60		PASS
DH 5	2.9250	312.000	31.60		PASS



Test Plot
For GFSK
DH 1

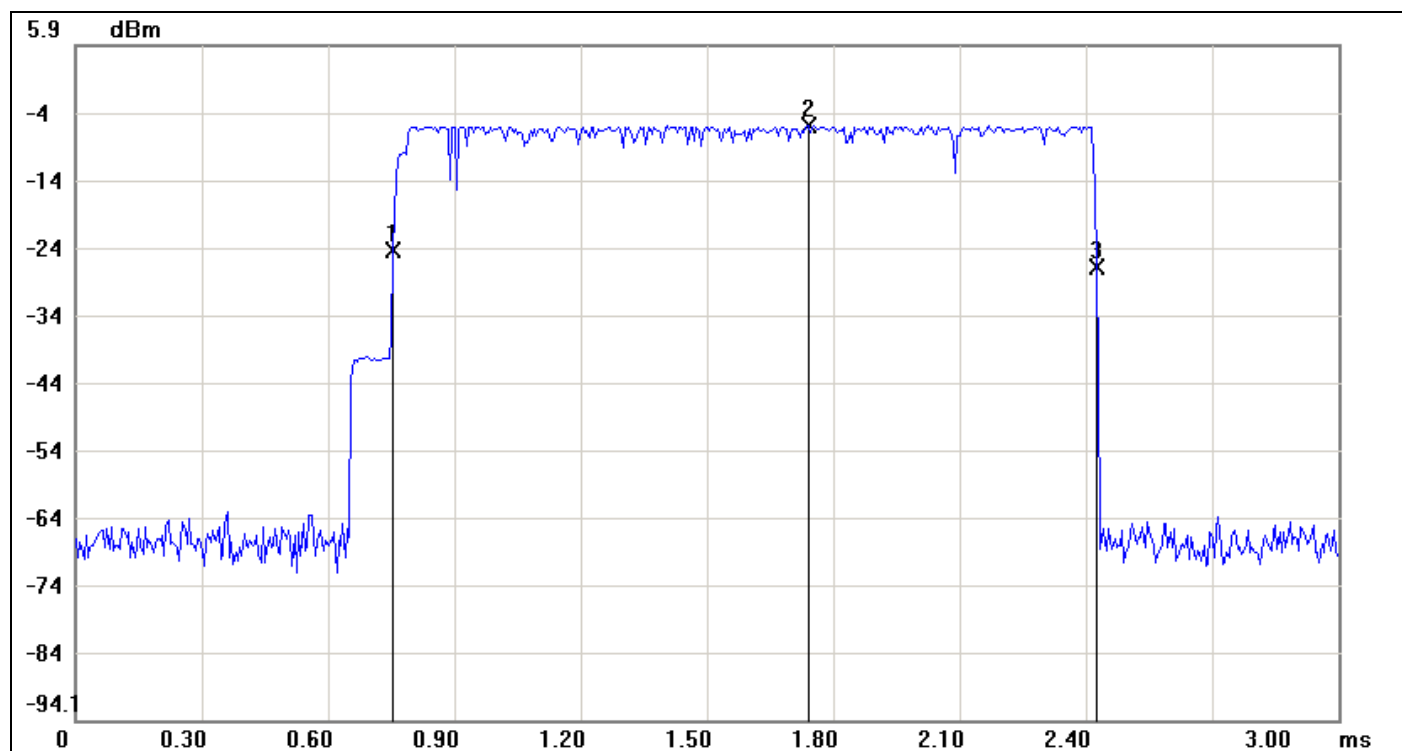


No.	Sweep time(ms)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	0.1667	-18.21		
2	0.5100	-6.21		
3	0.5717	-19.35		

No.		Δ Time(ms)	Δ Level(dB)
1	mk3-mk1	0.405	-1.14



DH 3

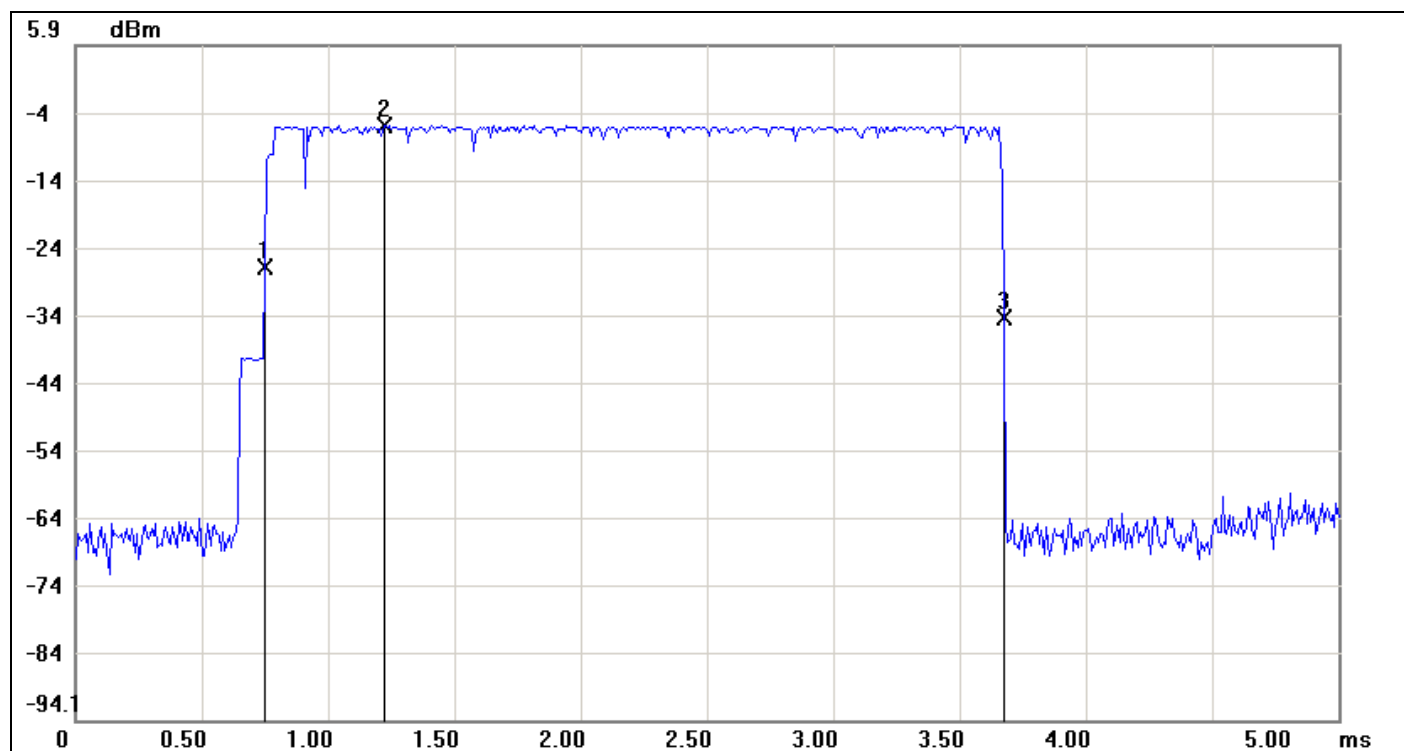


No.	Sweep time(ms)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	0.7550	-24.52		
2	1.7400	-6.07		
3	2.4250	-27.03		

No.		Δ Time(ms)	Δ Level(dB)
1	mk3-mk1	1.67	-2.51



DH 5



No.	Sweep time(ms)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	0.7500	-27.08		
2	1.2250	-5.98		
3	3.6750	-34.55		

No.		Δ Time(ms)	Δ Level(dB)
1	mk3-mk1	2.925	-7.47



Test Data

For 8DPSK

DH 1: $0.4133 * (1600/2)/79 * 31.6 = 132.256$ (ms)

DH 3: $1.6700 * (1600/4)/79 * 31.6 = 267.200$ (ms)

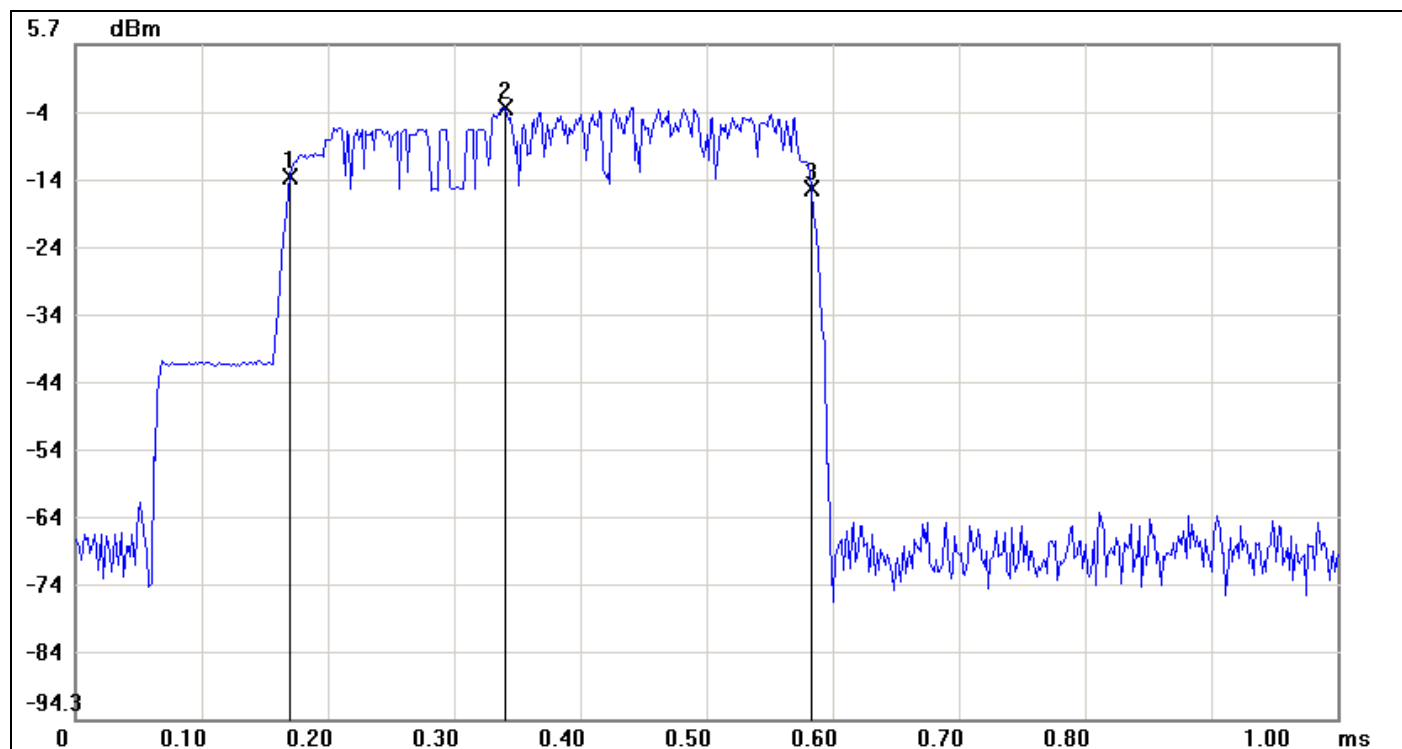
DH 5: $2.9250 * (1600/6)/79 * 31.6 = 312.000$ (ms)

	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
DH 1	0.4133	132.256	31.60	400.00	PASS
DH 3	1.6700	267.200	31.60		PASS
DH 5	2.9250	321.000	31.60		PASS



For 8DPSK

DH 1

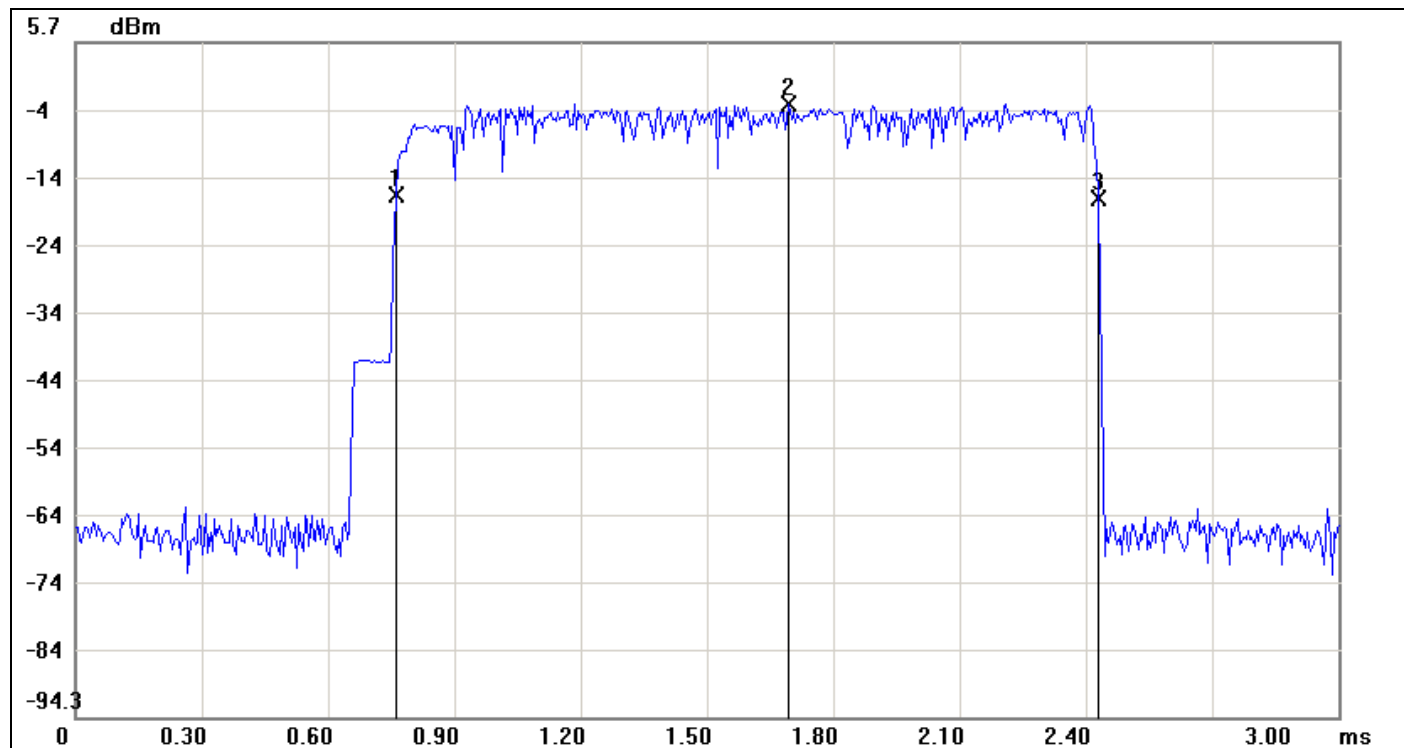


No.	Sweep time(ms)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	0.1700	-13.89		
2	0.3400	-3.56		
3	0.5833	-15.63		

No.		Δ Time(ms)	Δ Level(dB)
1	mk3-mk1	0.4133	-1.74



DH 3

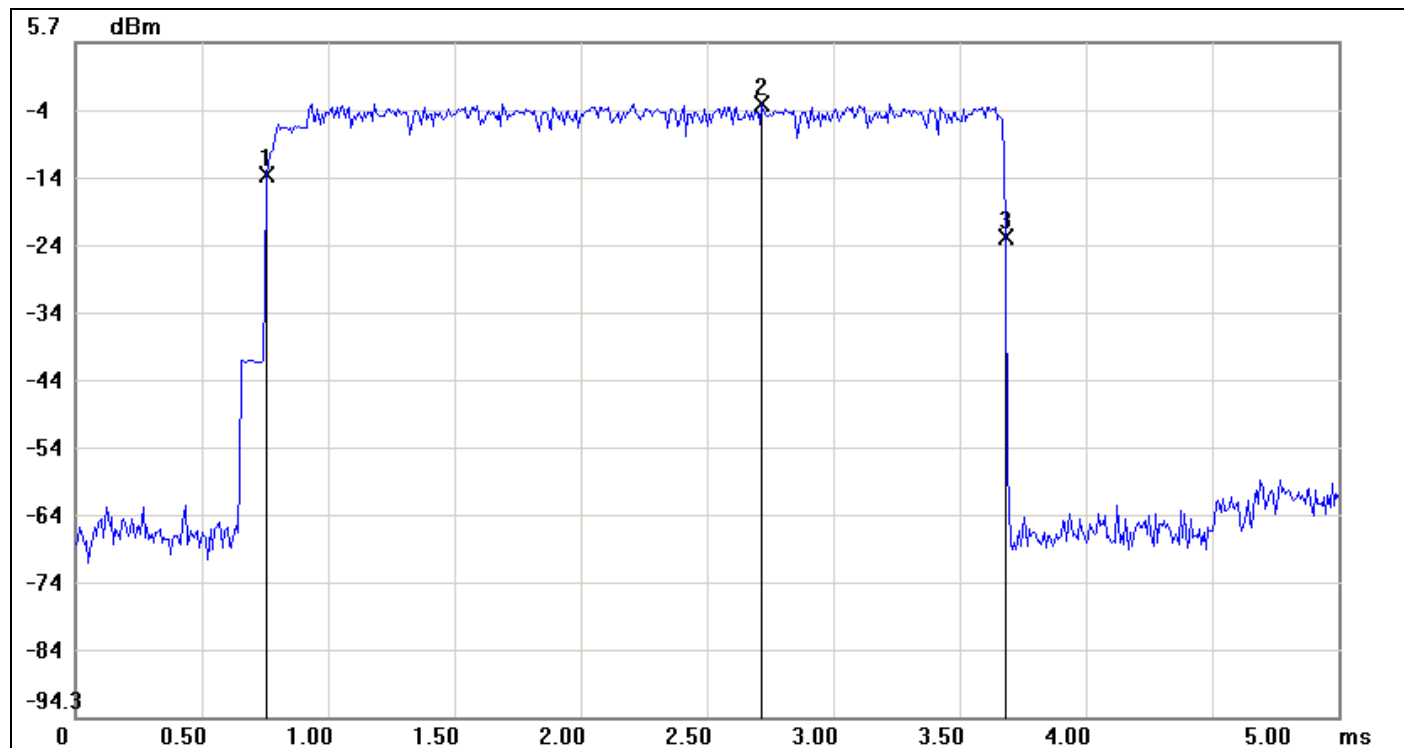


No.	Sweep time(ms)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	0.7600	-16.86		
2	1.6950	-3.33		
3	2.4300	-17.50		

No.		Δ Time(ms)	Δ Level(dB)
1	mk3-mk1	1.67	-0.64



DH 5



No.	Sweep time(ms)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	0.7583	-13.81		
2	2.7167	-3.41		
3	3.6833	-23.29		

No.		Δ Time(ms)	Δ Level(dB)
1	mk3-mk1	2.925	-9.48



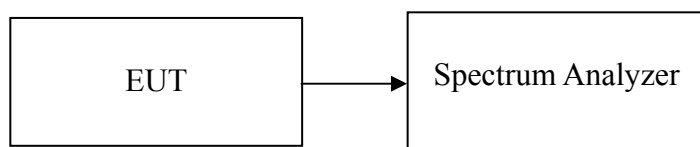
7.7 SPURIOUS EMISSIONS

7.7.1 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

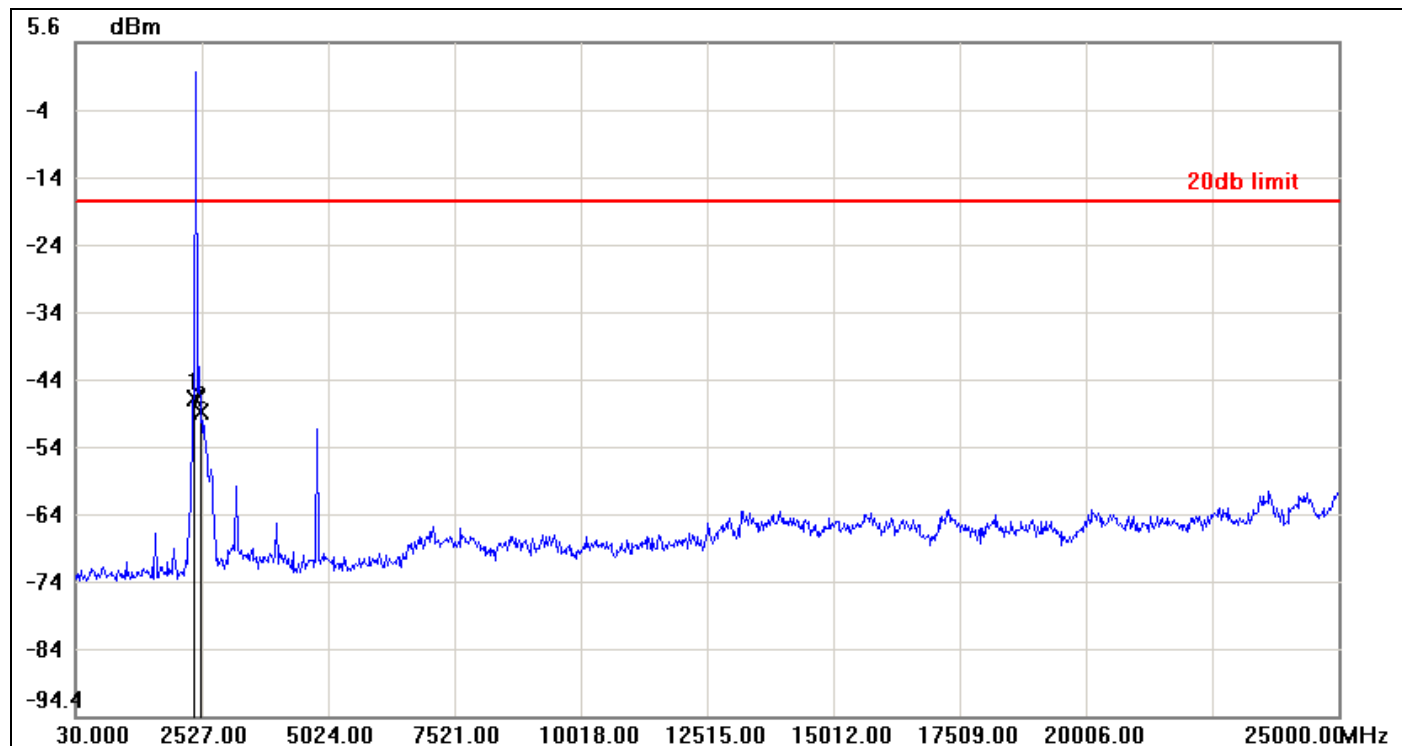
No non-compliance noted



Test Plot

For GFSK / DH5

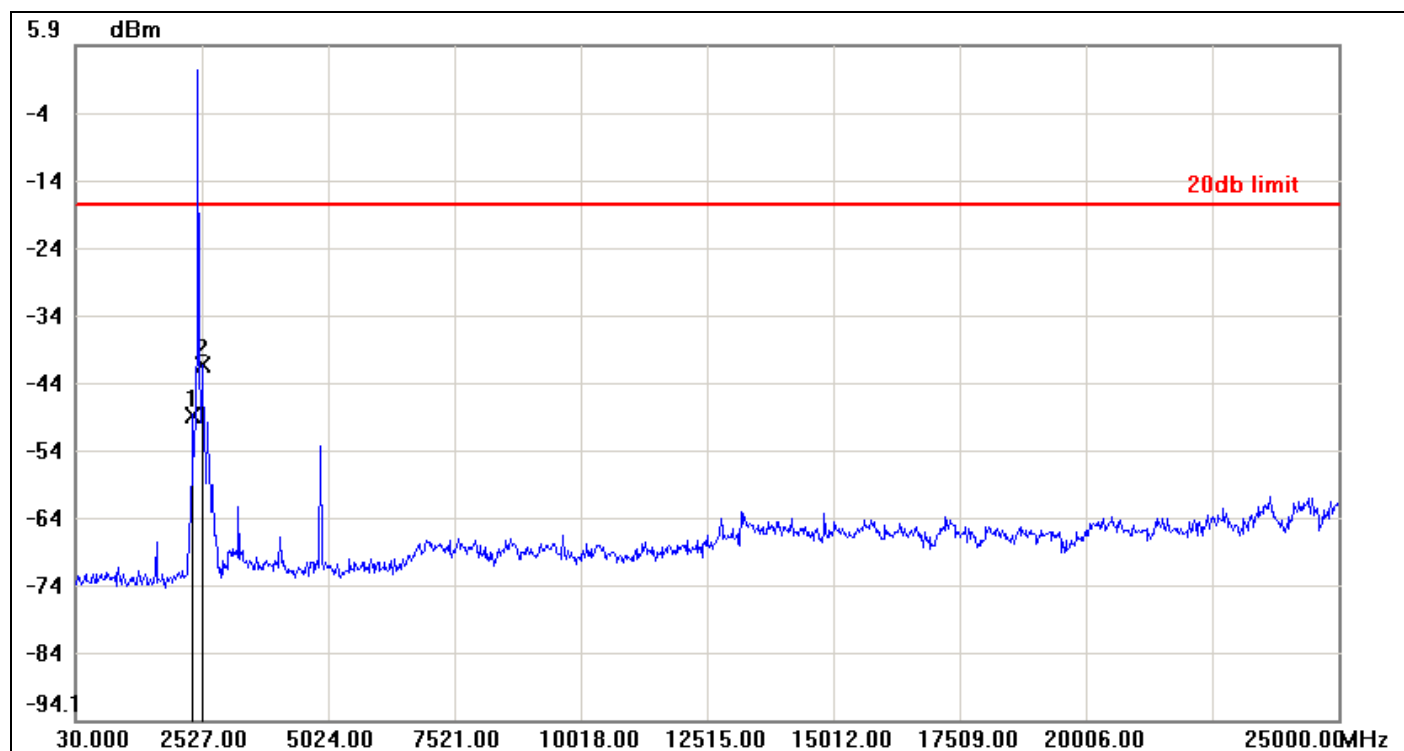
CH Low



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-47.27	-18.13	-29.14
2	2502.0300	-49.29	-18.13	-31.16



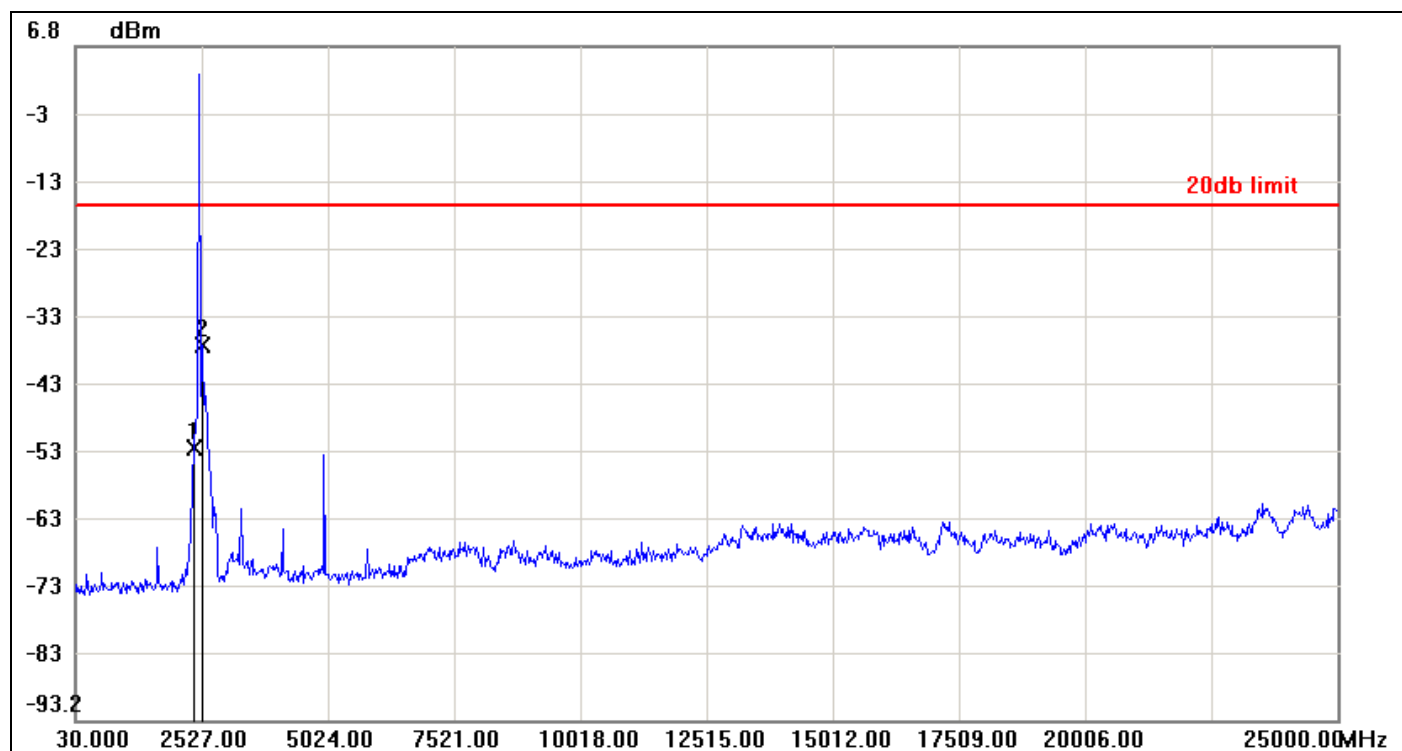
CH Mid



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2352.2100	-48.81	-17.60	-31.21
2	2527.0000	-41.32	-17.60	-23.72



CH High

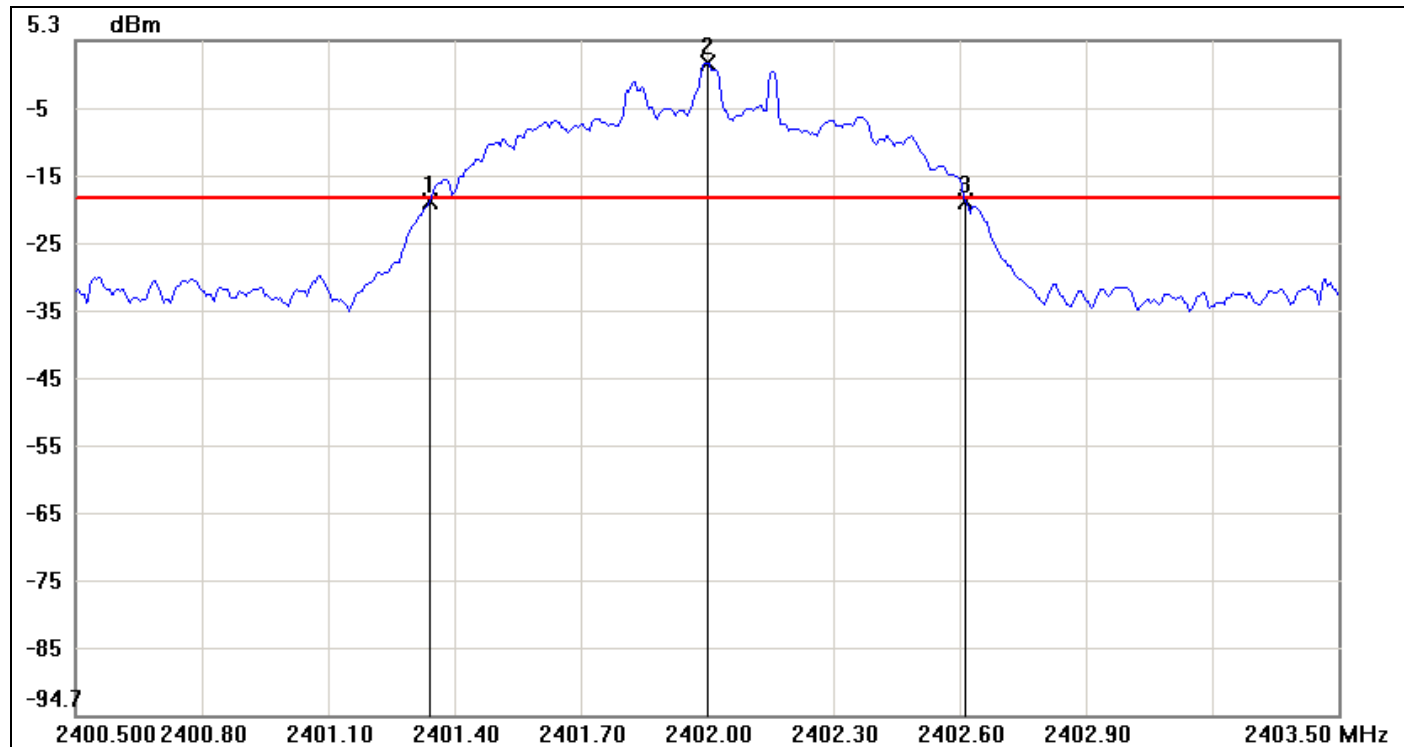


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-52.89	-16.72	-36.17
2	2527.0000	-37.61	-16.72	-20.89



For 8DPSK / DH5

CH Low

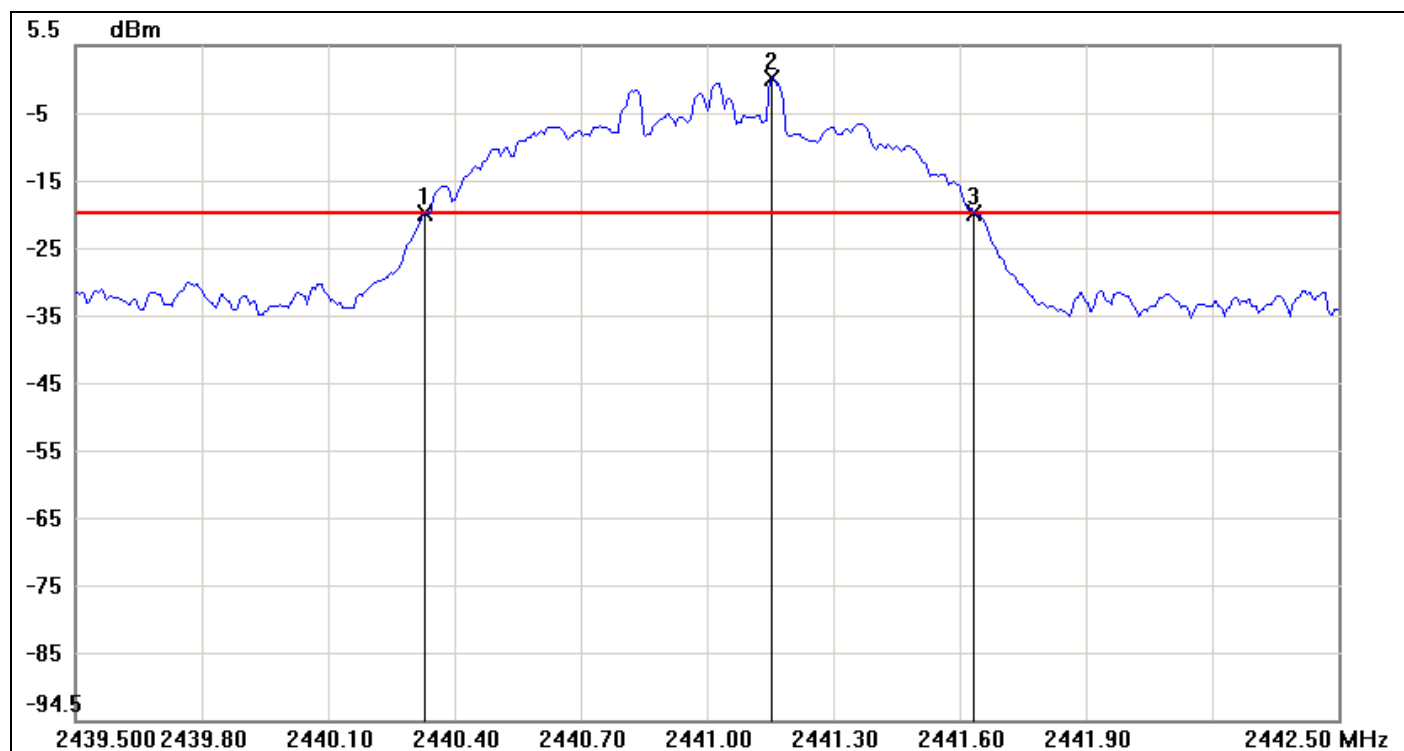


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2401.3400	-18.59	-18.12	-0.47
2	2402.0000	1.88	-18.12	20.00
3	2402.6150	-18.48	-18.12	-0.36

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	1.275	0.11



CH Mid

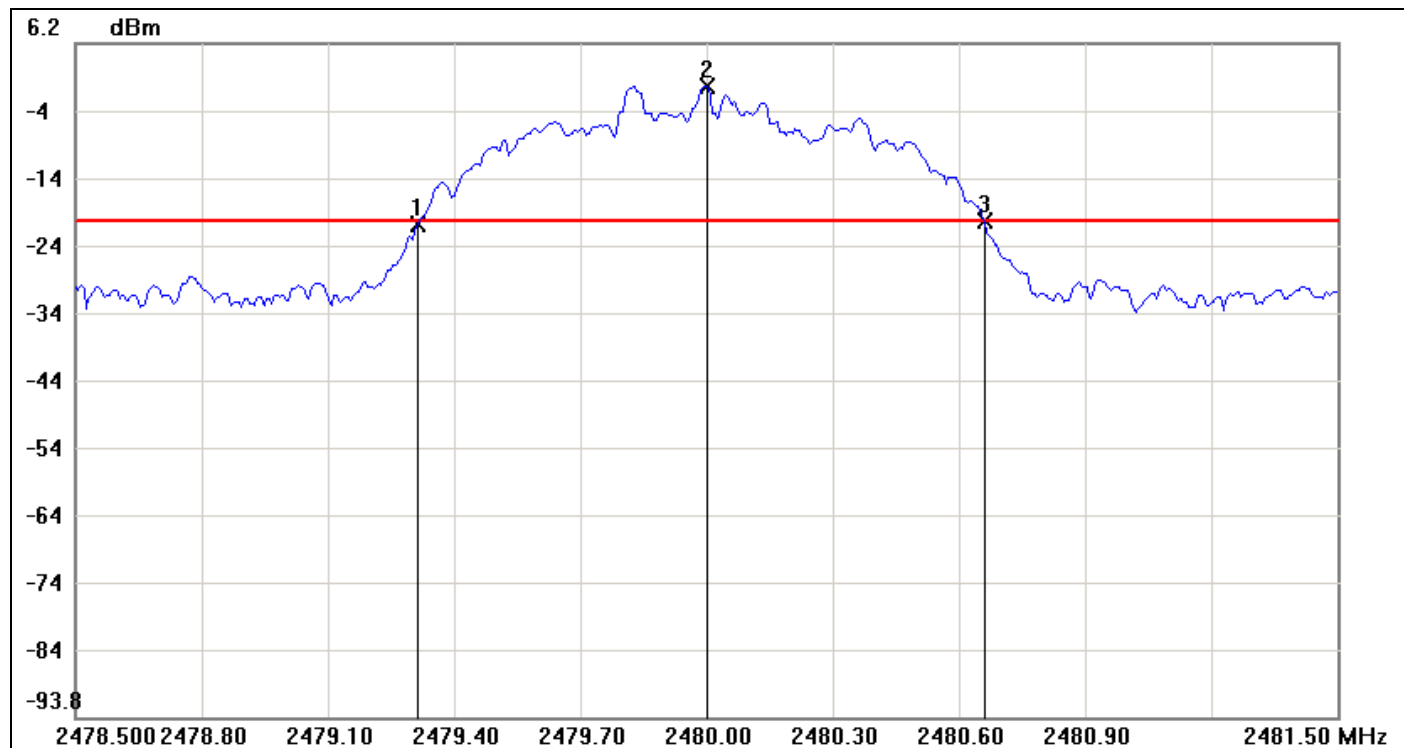


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2440.3300	-19.47	-19.44	-0.03
2	2441.1550	0.56	-19.44	20.00
3	2441.6350	-19.49	-19.44	-0.05

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	1.305	-0.02



CH High



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2479.3150	-20.72	-20.14	-0.58
2	2480.0000	-0.14	-20.14	20.00
3	2480.6600	-20.19	-20.14	-0.05

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	1.345	0.53



7.7.2 Radiated Emissions

LIMIT

All spurious emissions shall comply with the limits of §15.209(a) and RSS-Gen Table 2 & Table 5.

RSS-Gen Table 2 & Table 5: General Field Strength Limits for Transmitters and Receivers at Frequencies Above 30 MHz ^(Note)

Frequency (MHz)	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

Note: *Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 7.2.7.

Transmitting devices are not permitted in Table 1 bands or, unless stated otherwise, in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz).

RSS-Gen Table 6: General Field Strength Limits for Transmitters at Frequencies Below 30 MHz (Transmit)

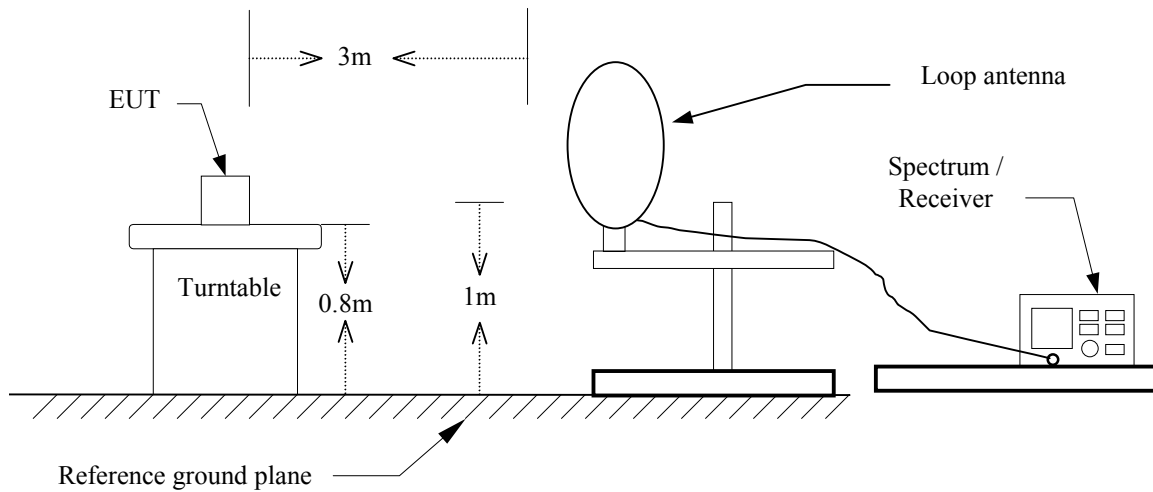
Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	3000
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector.

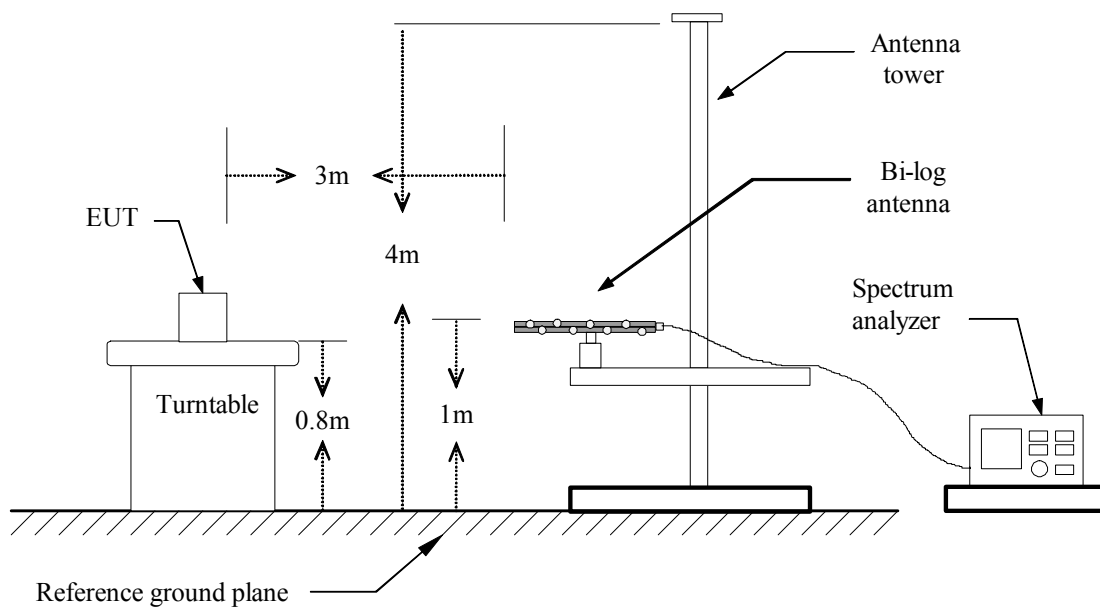


Test Configuration

9kHz ~ 30MHz

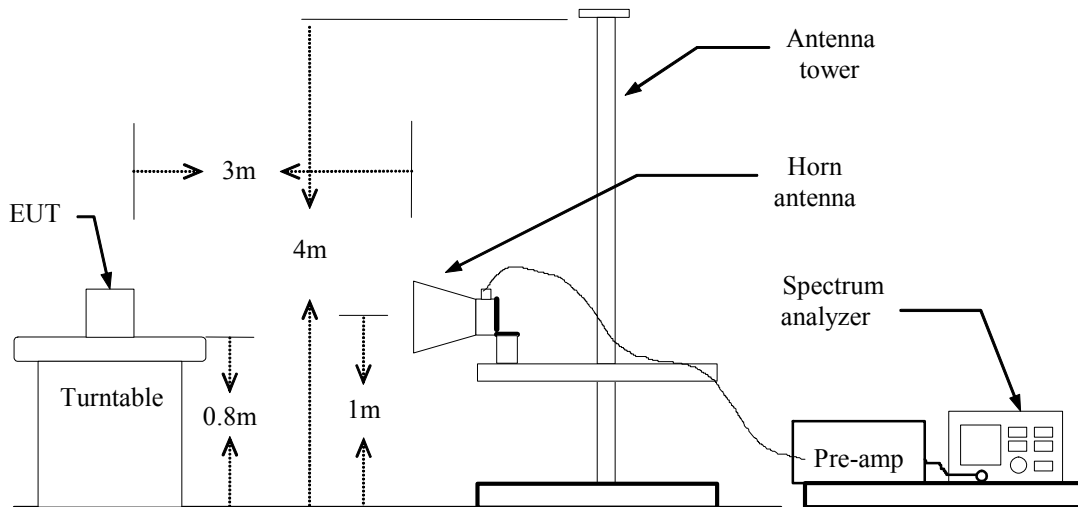


30MHz ~ 1GHz





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=1MHz / VBW=3MHz / Sweep=AUTO
(b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

**Below 1 GHz**

Operation Mode: Normal Link **Test Date:** September 14, 2013
Temperature: 27 °C **Tested by:** Rex Huang
Humidity: 53 % RH **Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
34.8500	58.19	-24.02	34.17	40.00	-5.83	QP	V
47.7833	66.66	-32.59	34.07	40.00	-5.93	QP	V
144.7833	55.20	-28.77	26.43	43.50	-17.07	peak	V
432.5500	59.46	-24.67	34.79	46.00	-11.21	peak	V
463.2667	57.66	-24.01	33.65	46.00	-12.35	peak	V
912.7000	49.44	-17.24	32.20	46.00	-13.80	peak	V
31.6167	49.88	-21.64	28.24	40.00	-11.76	Peak	H
125.3833	58.98	-28.35	30.63	43.50	-12.87	Peak	H
175.5000	62.77	-30.11	32.66	43.50	-10.84	Peak	H
432.5500	62.99	-24.67	38.32	46.00	-7.68	Peak	H
463.2667	60.89	-24.01	36.88	46.00	-9.12	Peak	H
912.7000	53.58	-17.24	36.34	46.00	-9.66	Peak	H

Remark:

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)
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. $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Quasi-peak limit (dBuV/m)}$.

**Above 1 GHz****Operation Mode:** TX / GFSK / DH5 / CH Low**Test Date:** September 14, 2013**Temperature:** 27 °C**Tested by:** Rex Huang**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
2323.333	57.41	-0.17	57.24	74.00	-16.76	peak	V
2323.333	53.78	-0.17	53.61	54.00	-0.39	AVG	V
2353.333	57.72	-0.12	57.60	74.00	-16.40	peak	V
2353.333	53.64	-0.12	53.52	54.00	-0.48	AVG	V
2370.000	56.88	-0.10	56.78	74.00	-17.22	peak	V
2370.000	51.48	-0.10	51.38	54.00	-2.62	AVG	V
2513.333	58.18	0.72	58.90	74.00	-15.10	peak	V
2513.333	52.88	0.72	53.60	54.00	-0.40	AVG	V
4800.000	54.85	5.38	60.23	74.00	-13.77	peak	V
4800.000	48.11	5.38	53.49	54.00	-0.51	AVG	V
7208.333	47.79	9.57	57.36	74.00	-16.64	peak	V
7208.333	43.63	9.57	53.20	54.00	-0.80	AVG	V
2310.000	53.75	-0.18	53.57	74.00	-20.43	peak	H
2310.000	48.39	-0.18	48.21	54.00	-5.79	AVG	H
2353.333	53.78	-0.12	53.66	74.00	-20.34	peak	H
2353.333	49.26	-0.12	49.14	54.00	-4.86	AVG	H
2513.333	54.90	0.72	55.62	74.00	-18.38	peak	H
2513.333	52.69	0.72	53.41	54.00	-0.59	AVG	H
4800.000	53.98	5.38	59.36	74.00	-14.64	peak	H
4800.000	47.61	5.38	52.99	54.00	-1.01	AVG	H
7208.333	46.44	9.57	56.01	74.00	-17.99	peak	H
7208.333	44.16	9.57	53.73	54.00	-0.27	AVG	H

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 / GFSK / DH5 / CH Mid**Test Date:** September 14, 2013**Temperature:** 27 °C**Tested by:** Rex Huang**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
2360.000	58.50	-0.11	58.39	74.00	-15.61	peak	V
2360.000	53.77	-0.11	53.66	54.00	-0.34	AVG	V
2486.667	58.01	0.58	58.59	74.00	-15.41	peak	V
2486.667	53.15	0.58	53.73	54.00	-0.27	AVG	V
2520.000	57.58	0.73	58.31	74.00	-15.69	peak	V
2520.000	52.63	0.73	53.36	54.00	-0.64	AVG	V
4883.333	50.96	5.49	56.45	74.00	-17.55	peak	V
4883.333	47.74	5.49	53.23	54.00	-0.77	AVG	V
7325.000	45.37	9.79	55.16	74.00	-18.84	peak	V
7325.000	43.37	9.79	53.16	54.00	-0.84	AVG	V
2490.000	56.66	0.61	57.27	74.00	-16.73	peak	H
2490.000	52.52	0.61	53.13	54.00	-0.87	AVG	H
2523.333	55.88	0.74	56.62	74.00	-17.38	peak	H
2523.333	52.81	0.74	53.55	54.00	-0.45	AVG	H
4883.333	52.15	5.49	57.64	74.00	-16.36	peak	H
4883.333	48.38	5.49	53.87	54.00	-0.13	AVG	H
7325.000	44.51	9.79	54.30	74.00	-19.70	peak	H
7325.000	43.20	9.79	52.99	54.00	-1.01	AVG	H

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. $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$.

**Operation Mode:** TX / GFSK / DH5 / CH High**Test Date:** September 14, 2013**Temperature:** 27 °C**Tested by:** Rex Huang**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
2366.667	56.69	-0.10	56.59	74.00	-17.41	peak	V
2366.667	53.44	-0.10	53.34	54.00	-0.66	AVG	V
2496.667	60.53	0.66	61.19	74.00	-12.81	peak	V
2496.667	53.21	0.66	53.87	54.00	-0.13	AVG	V
2530.000	57.73	0.76	58.49	74.00	-15.51	peak	V
2530.000	52.72	0.76	53.48	54.00	-0.52	AVG	V
2560.000	57.09	0.84	57.93	74.00	-16.07	peak	V
2560.000	52.05	0.84	52.89	54.00	-1.11	AVG	V
4958.333	52.11	5.59	57.70	74.00	-16.30	peak	V
4958.333	47.20	5.59	52.79	54.00	-1.21	AVG	V
7441.667	49.50	10.00	59.50	74.00	-14.50	peak	V
7441.667	43.46	10.00	53.46	54.00	-0.54	AVG	V
2366.667	54.01	-0.10	53.91	74.00	-20.09	peak	H
2366.667	50.44	-0.10	50.34	54.00	-3.66	AVG	H
2496.667	56.26	0.66	56.92	74.00	-17.08	peak	H
2496.667	52.64	0.66	53.30	54.00	-0.70	AVG	H
2526.667	57.28	0.75	58.03	74.00	-15.97	peak	H
2526.667	52.97	0.75	53.72	54.00	-0.28	AVG	H
2560.000	57.86	0.84	58.70	74.00	-15.30	peak	H
2560.000	53.05	0.84	53.89	54.00	-0.11	AVG	H
2590.000	56.09	0.92	57.01	74.00	-16.99	peak	H
2590.000	52.35	0.92	53.27	54.00	-0.73	AVG	H
4958.333	52.81	5.59	58.40	74.00	-15.60	peak	H
4958.333	47.49	5.59	53.08	54.00	-0.92	AVG	H
7441.667	45.03	10.00	55.03	74.00	-18.97	peak	H
7441.667	40.90	10.00	50.90	54.00	-3.10	AVG	H

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 / 8DPSK / DH5 / CH Low**Test Date:** September 14, 2013**Temperature:** 27 °C**Tested by:** Rex Huang**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
2323.333	56.89	-0.17	56.72	74.00	-17.28	peak	V
2323.333	53.04	-0.17	52.87	54.00	-1.13	AVG	V
2386.667	58.97	-0.07	58.90	74.00	-15.10	peak	V
2386.667	53.83	-0.07	53.76	54.00	-0.24	AVG	V
4800.000	52.43	5.38	57.81	74.00	-16.19	peak	V
4800.000	48.30	5.38	53.68	54.00	-0.32	AVG	V
7208.333	44.80	9.57	54.37	74.00	-19.63	peak	V
7208.333	43.61	9.57	53.18	54.00	-0.82	AVG	V
2323.333	54.50	-0.17	54.33	74.00	-19.67	peak	H
2323.333	51.60	-0.17	51.43	54.00	-2.57	AVG	H
2386.667	56.97	-0.07	56.90	74.00	-17.10	peak	H
2386.667	53.82	-0.07	53.75	54.00	-0.25	AVG	H
4808.333	50.24	5.39	55.63	74.00	-18.37	peak	H
4808.333	47.79	5.39	53.18	54.00	-0.82	AVG	H

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 / 8DPSK / DH5 / CH Mid**Test Date:** September 14, 2013**Temperature:** 27 °C**Tested by:** Rex Huang**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
2360.000	57.08	-0.11	56.97	74.00	-17.03	peak	V
2360.000	53.09	-0.11	52.98	54.00	-1.02	AVG	V
2490.000	57.80	0.61	58.41	74.00	-15.59	peak	V
2490.000	53.19	0.61	53.80	54.00	-0.20	AVG	V
2520.000	57.05	0.73	57.78	74.00	-16.22	peak	V
2520.000	52.92	0.73	53.65	54.00	-0.35	AVG	V
4883.333	51.70	5.49	57.19	74.00	-16.81	peak	V
4883.333	48.08	5.49	53.57	54.00	-0.43	AVG	V
7325.000	46.01	9.79	55.80	74.00	-18.20	peak	V
7325.000	41.73	9.79	51.52	54.00	-2.48	AVG	V
2396.667	55.29	-0.05	55.24	74.00	-18.76	peak	H
2396.667	50.15	-0.05	50.10	54.00	-3.90	AVG	H
2490.000	57.42	0.61	58.03	74.00	-15.97	peak	H
2490.000	53.15	0.61	53.76	54.00	-0.24	AVG	H
2520.000	56.26	0.73	56.99	74.00	-17.01	peak	H
2520.000	51.94	0.73	52.67	54.00	-1.33	AVG	H
4883.333	50.84	5.49	56.33	74.00	-17.67	peak	H
4883.333	47.54	5.49	53.03	54.00	-0.97	AVG	H

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 / 8DPSK / DH5 / CH High**Test Date:** September 14, 2013**Temperature:** 27 °C**Tested by:** Rex Huang**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
2336.667	56.97	-0.14	56.83	74.00	-17.17	Peak	V
2336.667	51.22	-0.14	51.08	54.00	-2.92	AVG	V
2366.667	58.11	-0.10	58.01	74.00	-15.99	Peak	V
2366.667	52.72	-0.10	52.62	54.00	-1.38	AVG	V
2496.667	59.28	0.66	59.94	74.00	-14.06	Peak	V
2496.667	52.84	0.66	53.50	54.00	-0.50	AVG	V
2526.667	58.39	0.75	59.14	74.00	-14.86	Peak	V
2526.667	52.52	0.75	53.27	54.00	-0.73	AVG	V
2560.000	56.00	0.84	56.84	74.00	-17.16	Peak	V
2560.000	52.23	0.84	53.07	54.00	-0.93	AVG	V
4958.333	53.34	5.59	58.93	74.00	-15.07	Peak	V
4958.333	47.95	5.59	53.54	54.00	-0.46	AVG	V
7441.667	47.66	10.00	57.66	74.00	-16.34	Peak	V
7441.667	43.28	10.00	53.28	54.00	-0.72	AVG	V
2496.667	58.30	0.66	58.96	74.00	-15.04	Peak	H
2496.667	51.53	0.66	52.19	54.00	-1.81	AVG	H
2526.667	56.87	0.75	57.62	74.00	-16.38	Peak	H
2526.667	52.66	0.75	53.41	54.00	-0.59	AVG	H
2560.000	56.96	0.84	57.80	74.00	-16.20	Peak	H
2560.000	52.03	0.84	52.87	54.00	-1.13	AVG	H
4958.333	52.60	5.59	58.19	74.00	-15.81	Peak	H
4958.333	47.65	5.59	53.24	54.00	-0.76	AVG	H

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).



7.8 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(a) & RSS-Gen §7.2.4, 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:** September 16, 2013
Temperature: 25.9°C **Tested by:** Moore Cheng
Humidity: 53% RH

Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB/m)	QP Result (dBuV/m)	AV Result (dBuV/m)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
0.1501	36.23	26.56	9.58	45.81	36.14	65.99	55.99	-20.18	-19.85	L1
0.2104	37.53	29.38	9.58	47.11	38.96	63.19	53.19	-16.08	-14.23	L1
0.2855	26.16	18.80	9.58	35.74	28.38	60.65	50.65	-24.91	-22.27	L1
2.8365	13.27	7.52	9.60	22.87	17.12	56.00	46.00	-33.13	-28.88	L1
15.1625	17.08	8.72	9.72	26.80	18.44	60.00	50.00	-33.20	-31.56	L1
28.3481	23.16	18.00	9.68	32.84	27.68	60.00	50.00	-27.16	-22.32	L1
0.1535	32.37	21.60	9.63	42.00	31.23	65.81	55.81	-23.81	-24.58	L2
0.2125	38.71	30.72	9.63	48.34	40.35	63.11	53.11	-14.77	-12.76	L2
0.2823	27.91	20.94	9.63	37.54	30.57	60.75	50.75	-23.21	-20.18	L2
0.3535	20.35	14.51	9.63	29.98	24.14	58.88	48.88	-28.90	-24.74	L2
2.6955	14.97	11.96	9.65	24.62	21.61	56.00	46.00	-31.38	-24.39	L2
28.1697	21.58	12.56	9.81	31.39	22.37	60.00	50.00	-28.61	-27.63	L2

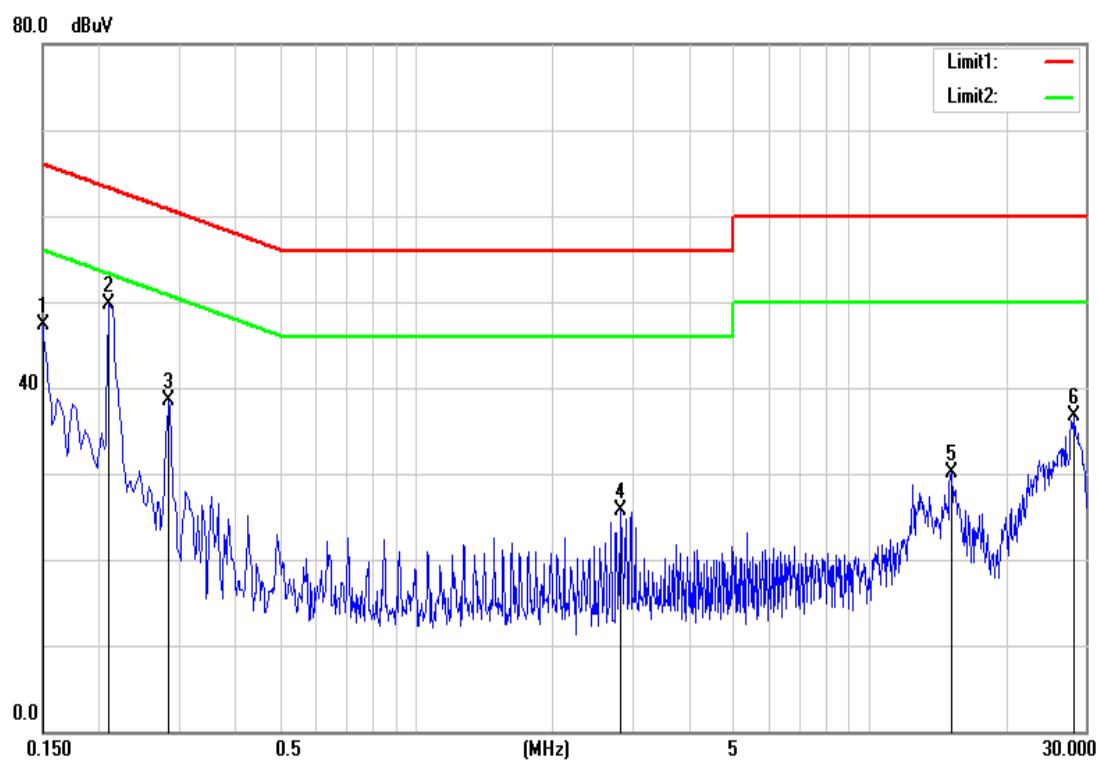
Remark:

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 10 kHz; the IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9 kHz;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)



Test Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)

