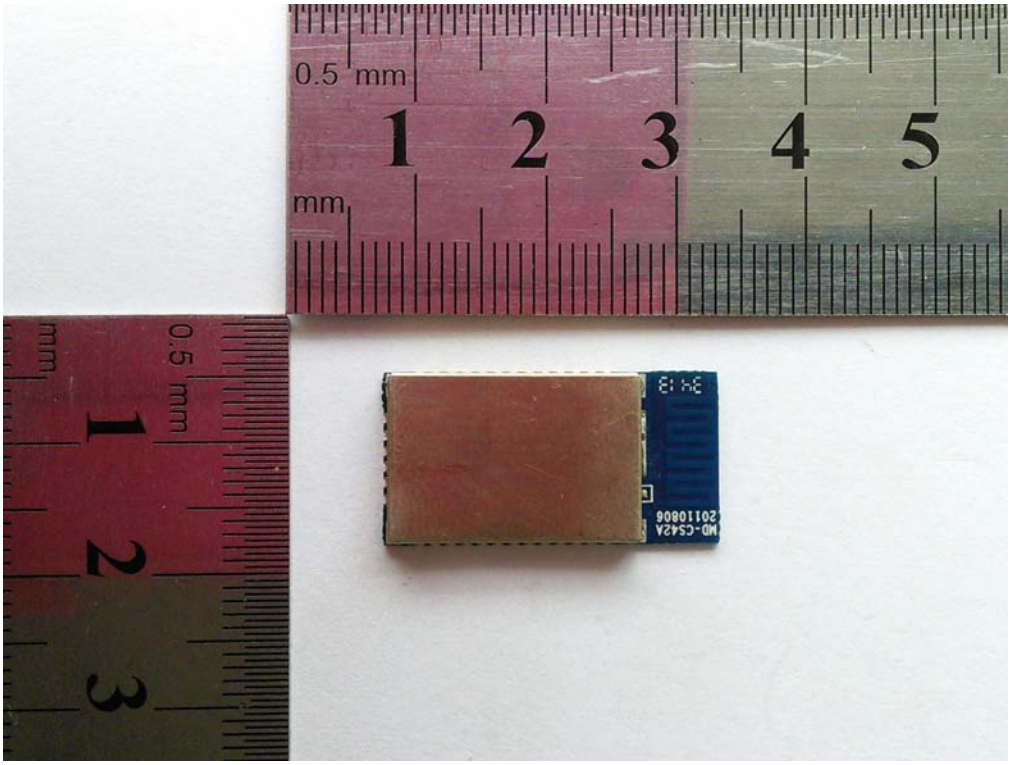
NovaComm Technologies Inc

Bluetooth module

Main Model: NVC-MDCS42
Serial Model: N/A

February 09, 2014
Report No.: 14020065-FCC-R1
(This report supersedes NONE)



Modifications made to the product : None

This Test Report is Issued Under the Authority of:

Amos. Xia	Alex Liu	
Amos Xia Compliance Engineer	Alex Liu Technical Manager	

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Test result presented in this test report is applicable to the representative sample only.

Laboratory Introduction

RF Test Report

To: FCC Part 15.247: 2013, ANSI C63.4 :2003

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Taiwan	EMC, RF, Telecom , Safety
Hong Kong	RF/Wireless ,Telecom
Australia	EMC, RF, Telecom , Safety
Korea	EMI, EMS, RF , Telecom, Safety
Japan	EMI, RF/Wireless, Telecom
Singapore	EMC , RF , Telecom
Europe	EMC, RF, Telecom , Safety

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1 EXECUTIVE SUMMARY & EUT INFORMATION

The purpose of this test programme was to demonstrate compliance of the NovaComm Technologies Inc, Bluetooth module and model: NVC-MDCS42 against the current Stipulated Standards. The Bluetooth module has demonstrated compliance with the FCC 15.247: 2013, ANSI C63.4 :2003.

EUT Information

EUT Description	:	**Bluetooth module**
Main Model	:	**NVC-MDCS42**
Serial Model	:	**N/A**
Antenna Gain	:	**Bluetooth: 1 dBi**
Input Power	:	**The control board power supply： DC 2.7V-3.7V**
Temperature Range	:	**-40℃~80℃**
Classification Per Stipulated Test Standard	:	**FCC 15.247: 2013, ANSI C63.4 :2003**

2 TECHNICAL DETAILS

Purpose	**Compliance testing of Bluetooth module with stipulated standard**
Applicant / Client	**NovaComm Technologies Inc 902A, #560 Shengxia Rd. , ZJ Inno Park, Shanghai 201203, China**
Manufacturer	**NovaComm Technologies Inc 902A, #560 Shengxia Rd， ZJ Inno Park, Shanghai 201203, China**
Laboratory performing the tests	**SIEMIC (Nanjing-China) Laboratories NO.2-1,Longcang Dadao, Yuhua Economic Development Zone, Nanjing, China Tel: +86(25)86730128/86730129 Fax: +86(25)86730127 Email: China@siemic.com**
Test report reference number	**14020065-FCC-R1**
Date EUT received	**January 23, 2014**
Standard applied	**FCC 15.247: 2013, ANSI C63.4 :2003**
Dates of test (from – to)	**January 27, 2014**
No of Units	**#1**
Equipment Category	**DSS**
Trade Name	**NOVA**
RF Operating Frequency (ies)	**Bluetooth: 2402-2480MHz**
Number of Channels	**Bluetooth: 79 CH**
Modulation	**Bluetooth: GFSK/8DPSK/ π /4-DQPSK**
FCC ID	**OC3BM1842**

3 MODIFICATION

NONE

4 TEST SUMMARY

The product was tested in accordance with the following specifications.
All testing has been performed according to below product classification:

Spread Spectrum System/Device

Test Results Summary

Test Standard	Description	Product Class	Pass / Fail
§15.203	Antenna Requirement	See Above	Pass
§15.207(a)	AC Line Conducted Emissions	See Above	Pass
§15.205, §15.209, §15.247(d)	Radiated Emissions	See Above	Pass
§15.247(a)(1)	20 dB Bandwidth	See Above	Pass
§15.247(a)(1)	Channel Separation	See Above	Pass
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	See Above	Pass
§15.247(a)(1)(iii)	Quantity of Hopping Channel	See Above	Pass
§15.247(b)(1)	Peak Output Power	See Above	Pass
§15.247(d)	Band Edge	See Above	Pass

5 MEASUREMENTS, EXAMINATION AND DERIVED RESULTS

5.1 §15.203 – Antenna Requirement

Standard Requirement:

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.
c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

EUT antenna is integrated on PCB; It is in accordance to section 15.203(a); please refer to the internal photos.

Test Result: Pass

5.2 §15.207 (a) – AC Line Conducted Emissions

Standard Requirement:

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

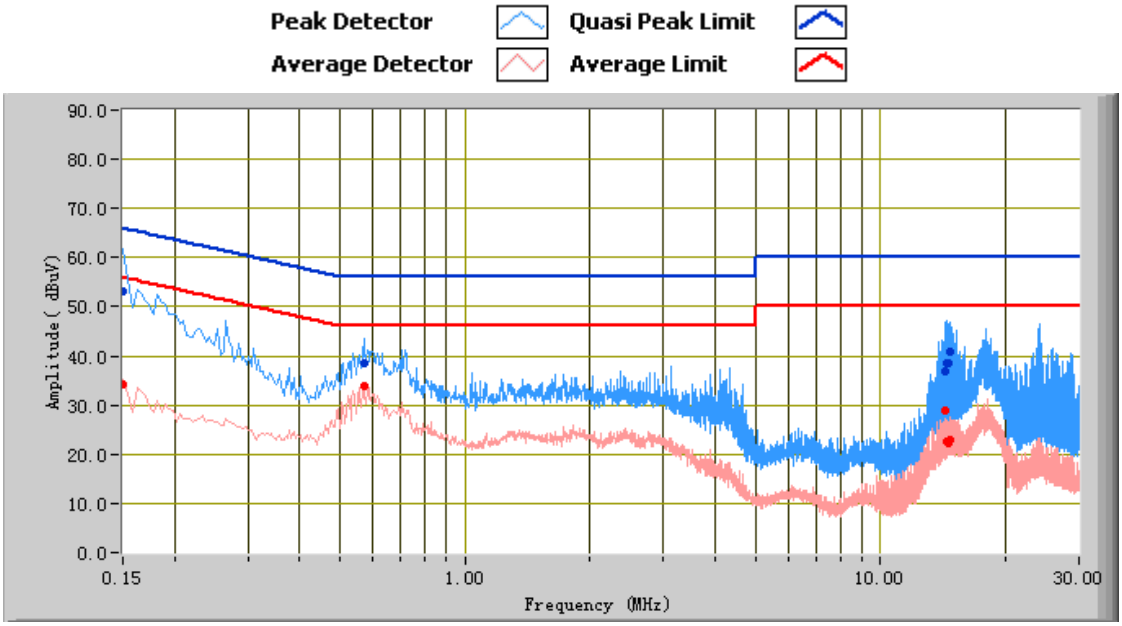
*Decreases with the logarithm of the frequency.

Procedures:

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR and Average detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is ±3.5dB.
4. Environmental Conditions
   Temperature 22°C
   Relative Humidity 50%
   Atmospheric Pressure 1019mbar
5. Test date : January 27, 2014
   Tested By : Amos Xia

Test Result: Pass

Test Mode:	GFSK Transmitting Power-- Line

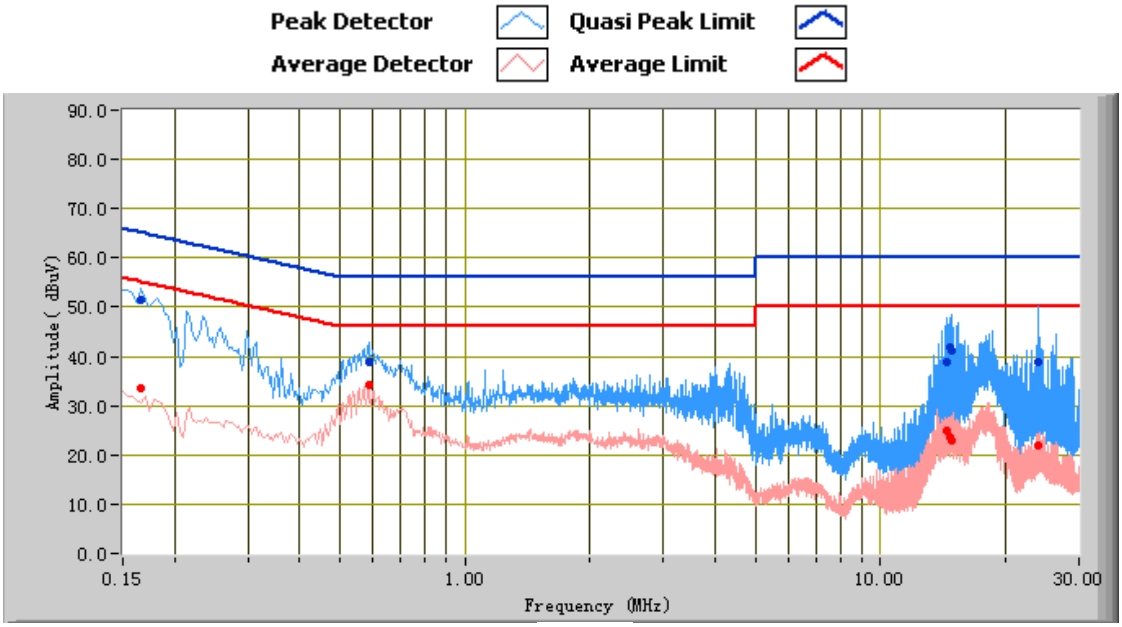


Test Data

Phase Line Plot at 120Vac, 60Hz

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Factors (dB)
0.15	53.06	66.00	-12.94	34.06	56.00	-21.94	12.22
0.57	38.60	56.00	-17.40	33.96	46.00	-12.04	11.03
14.46	38.62	60.00	-21.38	22.48	50.00	-27.52	11.38
14.70	40.71	60.00	-19.29	22.82	50.00	-27.18	11.39
14.23	36.72	60.00	-23.28	28.77	50.00	-21.23	11.36
14.58	38.43	60.00	-21.57	22.15	50.00	-27.85	11.38

Test Mode:	GFSK Transmitting Power-- Neutral



Test Data

Phase Neutral Plot at 120Vac, 60Hz

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Factors (dB)
23.94	38.94	60.00	-21.06	22.02	50.00	-27.98	11.70
14.82	41.27	60.00	-18.73	23.02	50.00	-26.98	11.38
0.17	51.40	65.16	-13.76	33.56	55.16	-21.60	11.99
14.70	41.70	60.00	-18.30	23.64	50.00	-26.36	11.38
14.46	38.70	60.00	-21.30	24.95	50.00	-25.05	11.37
0.59	38.84	56.00	-17.16	34.09	46.00	-11.91	11.00

5.3 §15.209, §15.205 & §15.247(d) - Spurious Emissions

1. All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 1GHz (3m & 10m) & 1GHz above (3m) is +5.6/-4.5dB.
4. Environmental Conditions

Temperature	22°C
Relative Humidity	50%
Atmospheric Pressure	1019mbar

5. Test date : January 24, 2014
   Tested By : Amos Xia

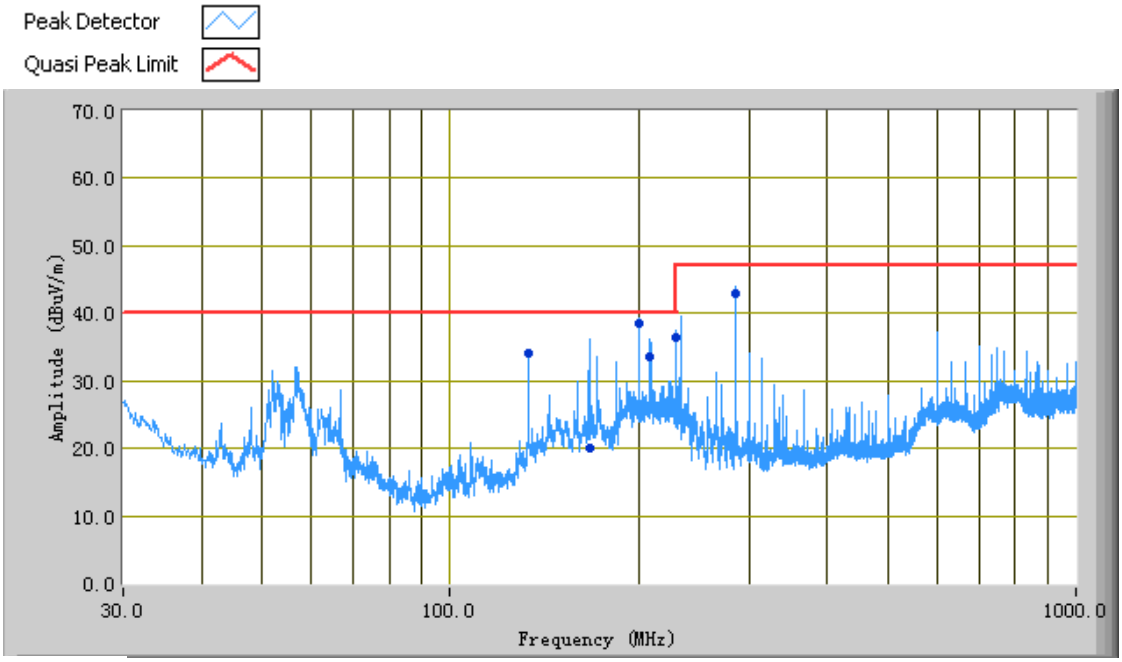
Standard Requirement:

The emissions from the Low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Test Result: Pass

Test Mode:	**GFSK Transmitting**

Below 1GHz



Test Data

@3m

Frequency (MHz)	Quasi Peak (dBµV/m)	Azimuth	Polarity (H/V)	Height (cm)	Factors (dB)	Limit (dBµV/m)	Margin (dB)
199.99	38.58	45.00	V	101.00	-33.24	40.00	-1.42
229.08	36.40	19.00	V	100.00	-32.93	40.00	-3.60
286.34	42.94	293.00	V	100.00	-30.64	47.00	-4.06
166.67	20.00	0.00	V	99.00	-31.75	40.00	-20.00
208.85	33.67	353.00	V	104.00	-33.30	40.00	-6.33
133.35	34.09	29.00	H	253.00	-32.17	40.00	-5.91

Test Mode:	**GFSK Transmitting**

Above 1 GHz

Note: Other Bluetooth modes were verified; only the result of worst case DH5 mode was presented.

Low Channel (2402 MHz)

Frequency (MHz)	S.A. Reading (dBµV)	Detector (PK/AV)	Direction (degree)	Height (cm)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4804	38.96	AV	152	126	V	34	2.6	26.79	48.77	54	-5.23
4804	38.65	AV	320	210	H	33.8	2.6	26.79	48.26	54	-5.74
4804	52.58	PK	96	124	V	34	2.6	26.79	62.39	74	-11.61
4804	51.99	PK	120	210	H	33.8	2.6	26.79	61.6	74	-12.4
7206	42.06	AV	186	132	V	25.3	1.3	26.51	42.15	54	-11.85
7206	41.85	AV	249	143	H	23.8	1.3	26.51	40.44	54	-13.56
7206	56.81	PK	263	52	V	25.3	1.3	26.51	56.9	74	-17.1
7206	57.49	PK	176	68	H	23.8	1.3	26.51	56.08	74	-17.92

Middle Channel (2441 MHz)

Frequency (MHz)	S.A. Reading (dBµV)	Detector (PK/AV)	Direction (degree)	Height (cm)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4882	4882	38.56	AV	281	96	V	33.6	2.6	26.78	47.98	54
4882	4882	38.22	AV	156	125	H	33.8	2.6	26.78	47.84	54
4882	4882	55.32	PK	175	175	V	33.6	2.6	26.78	64.74	74
4882	4882	56.48	PK	194	183	H	33.8	2.6	26.78	66.1	74
7323	7323	39.65	AV	126	142	V	25.3	1.3	26.65	39.6	54
7323	7323	39.15	AV	118	164	H	25.1	1.3	26.65	38.9	54
7323	7323	48.67	PK	255	201	V	25.3	1.3	26.65	48.62	74
7323	7323	49.01	PK	271	145	H	25.1	1.3	26.65	48.76	74

High Channel (2480 MHz)

Frequency (MHz)	S.A. Reading (dBµV)	Detector (PK/AV)	Direction (degree)	Height (cm)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4960	4960	35.64	AV	329	143	V	34.6	2.7	26.75	46.19	54
4960	4960	36.21	AV	284	187	H	34.7	2.7	26.75	46.86	54
4960	4960	51.85	PK	169	182	V	34.6	2.7	26.75	62.4	74
4960	4960	52.36	PK	149	193	H	34.7	2.7	26.75	63.01	74
7440	7440	37.36	AV	172	209	V	25.3	1.4	26.65	37.41	54
7440	7440	38.12	AV	251	255	H	25.5	1.4	26.65	38.37	54
7440	7440	53.25	PK	181	263	V	25.3	1.4	26.65	53.3	74
7440	7440	52.92	PK	86	180	H	25.5	1.4	26.65	53.17	74

Spurious emissions in restricted band

Frequency (MHz)	S.A. Reading (dBµV)	Detector (PK/AV)	Direction (degree)	Height (cm)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2379.55	36.51	AV	196	152	V	30.1	1.8	26.83	41.58	54	-12.42
2484.27	36.82	AV	172	183	V	30.6	1.8	26.83	42.39	54	-11.61
2484.27	40.21	AV	205	199	H	30.6	1.8	26.83	45.78	54	-8.22
2379.55	39.95	AV	32	208	H	30.1	1.8	26.83	45.02	54	-8.98
2484.27	47.25	PK	143	174	V	30.6	1.8	26.83	52.82	74	-21.18
2379.55	47.65	PK	263	229	V	30.1	1.8	26.83	52.72	74	-21.28
2484.27	45.36	PK	207	91	H	30.6	1.8	26.83	50.93	74	-23.07
2379.55	46.31	PK	92	108	H	30.1	1.8	26.83	51.38	74	-22.62

5.4 §15.247(a) (1)-Channel Separation

1. Conducted Measurement
   EUT was set for low, mid, high channel with modulated mode and highest RF output power.
   The spectrum analyzer was connected to the antenna terminal.
2. Environmental Conditions

Temperature	22°C
Relative Humidity	50%
Atmospheric Pressure	1019mbar

3. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is ±1.5dB.
4. Test date : January 27, 2014
   Tested By : Amos Xia

Standard Requirement:

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20dB 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.

Procedures:

1. Place the EUT on the table and set it in hopping function 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 Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span, Video (or Average) Bandwidth (VBW) ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
5. Max hold, mark 2 peaks of hopping channel and record the 2 peaks frequency.

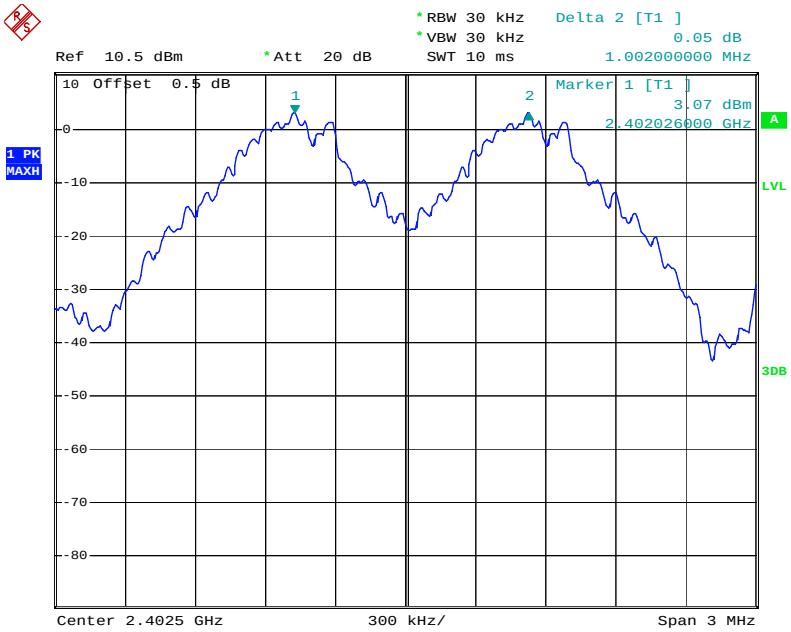
Test Result: Pass

Test Mode:	**GFSK Transmitting**

Channel	**Channel Frequency (MHz)**	**Channel Separation (MHz)**	**Limit (MHz)**	**Result**
Low Channel	2402	1.002	0.888	Pass
Adjacency Channel	2403			
Mid Channel	2440	1.002	0.864	Pass
Adjacency Channel	2441			
High Channel	2480	1.002	0.852	Pass
Adjacency Channel	2479			

Please refer to the following plots.

Low Channel



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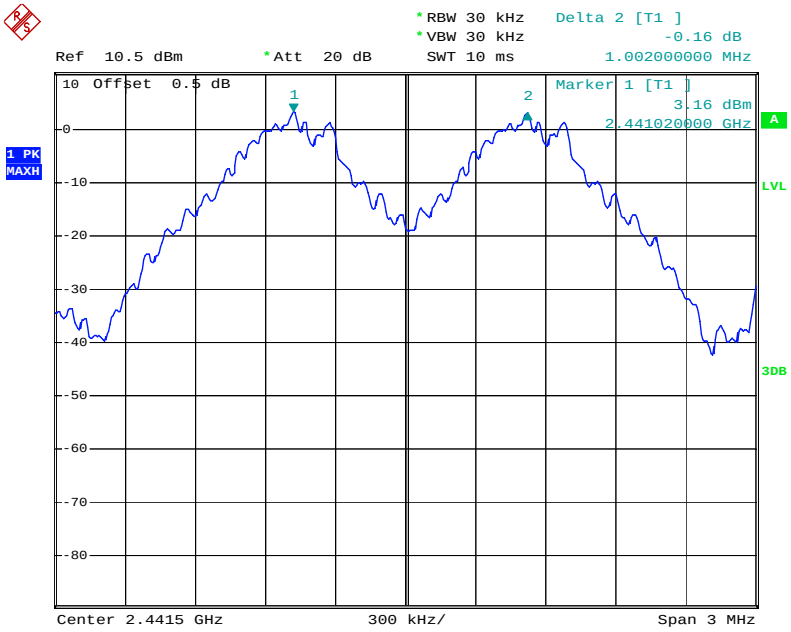
Middle Channel



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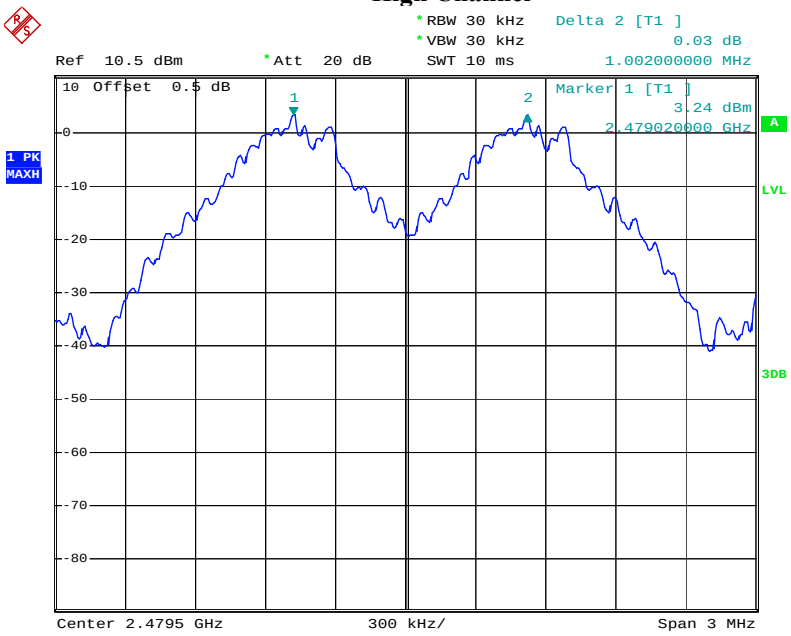
High Channel



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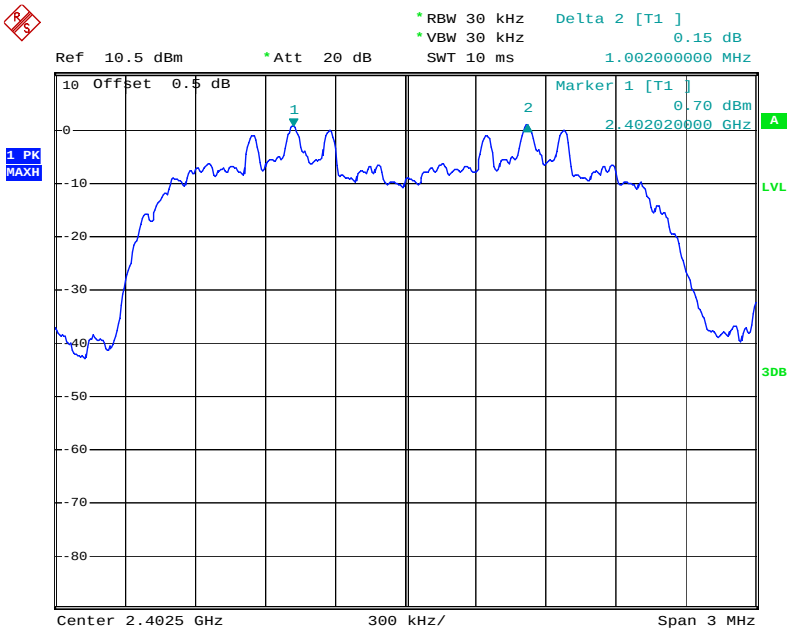
Test Mode:	**8DPSK Transmitting**

Channel	**Channel Frequency (MHz)**	**Channel Separation (MHz)**	**Limit (MHz)**	**Result**
Low Channel	2402	1.002	0.668	Pass
Adjacency Channel	2403			
Mid Channel	2440	1.002	0.668	Pass
Adjacency Channel	2441			
High Channel	2480	1.002	0.668	Pass
Adjacency Channel	2479			

Please refer to the following plots.

Low Channel



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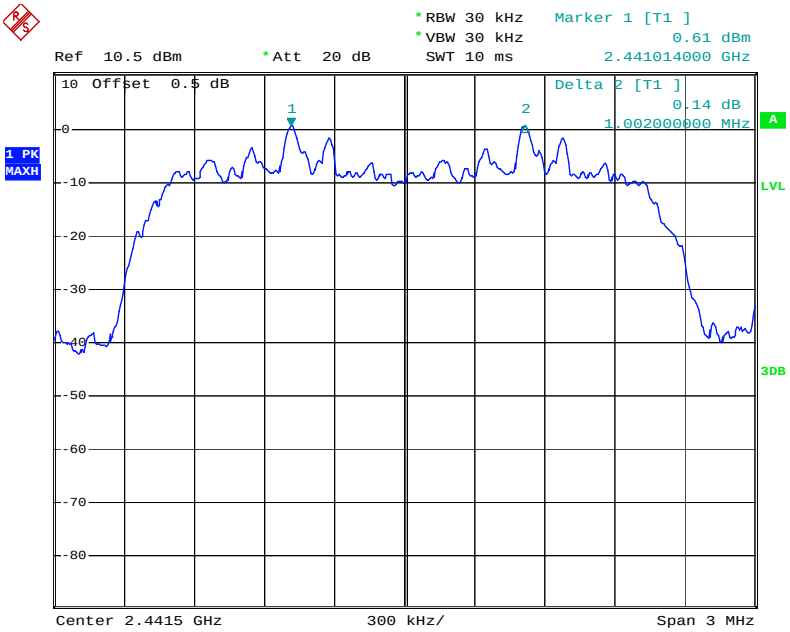
Middle Channel



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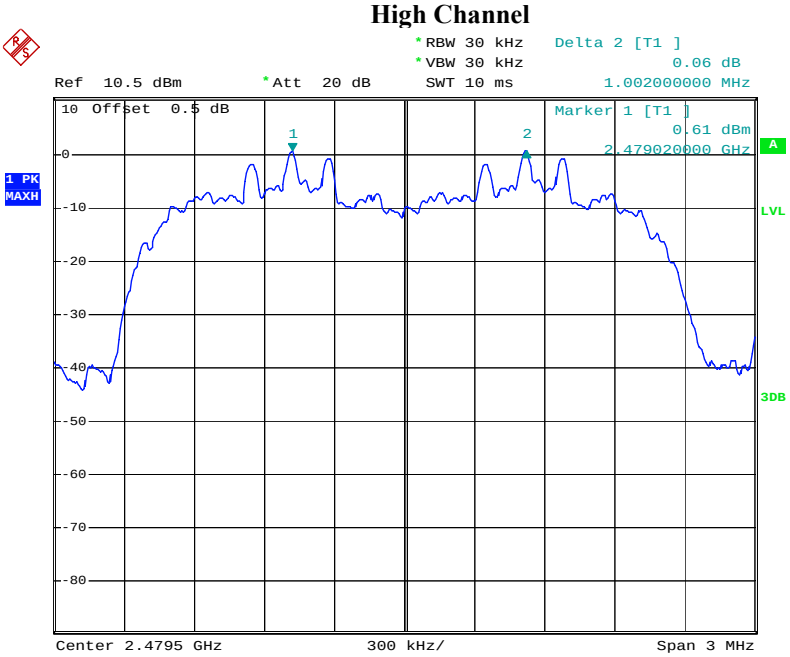
High Channel



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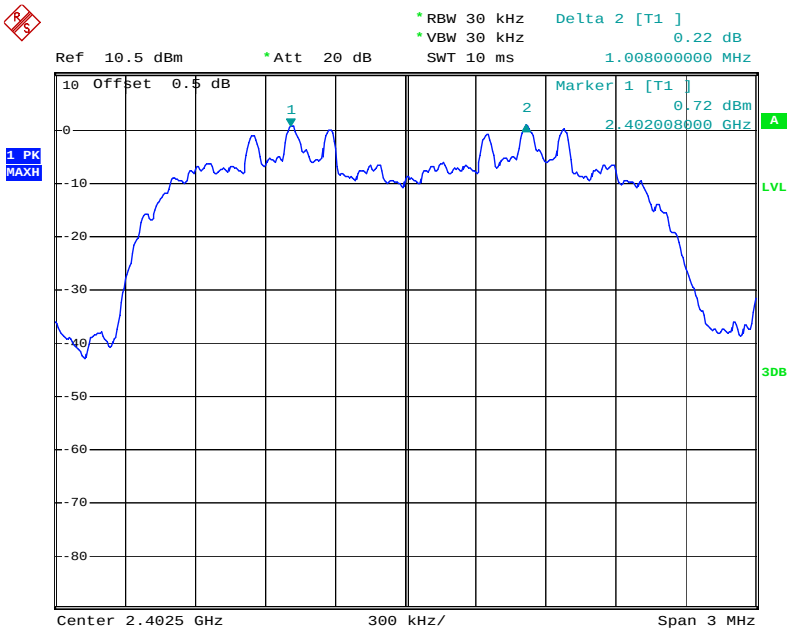
Test Mode:	**π /4-DQPSK Transmitting**

Channel	**Channel Frequency (MHz)**	**Channel Separation (MHz)**	**Limit (MHz)**	**Result**
Low Channel	2402	1.008	0.672	Pass
Adjacency Channel	2403			
Mid Channel	2440	1.002	0.668	Pass
Adjacency Channel	2441			
High Channel	2480	1.002	0.668	Pass
Adjacency Channel	2479			

Please refer to the following plots.

Low Channel



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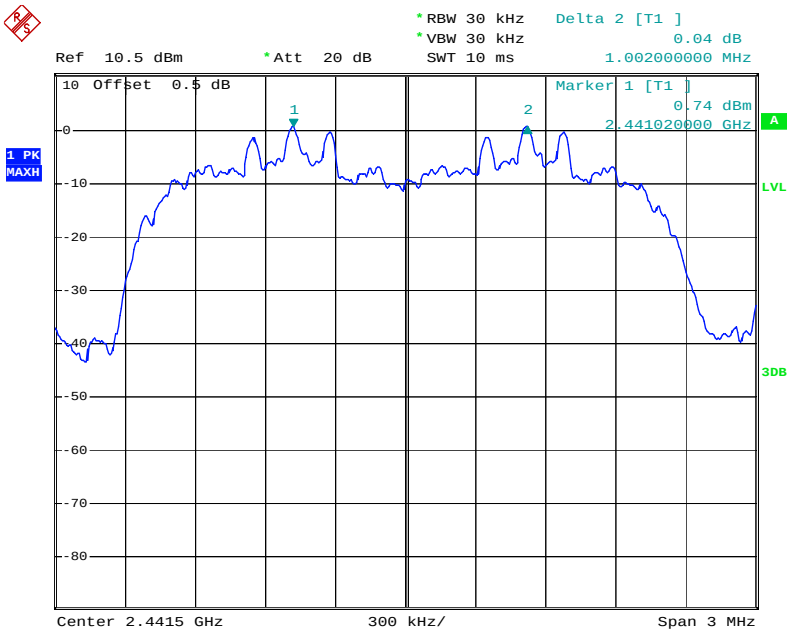
Middle Channel



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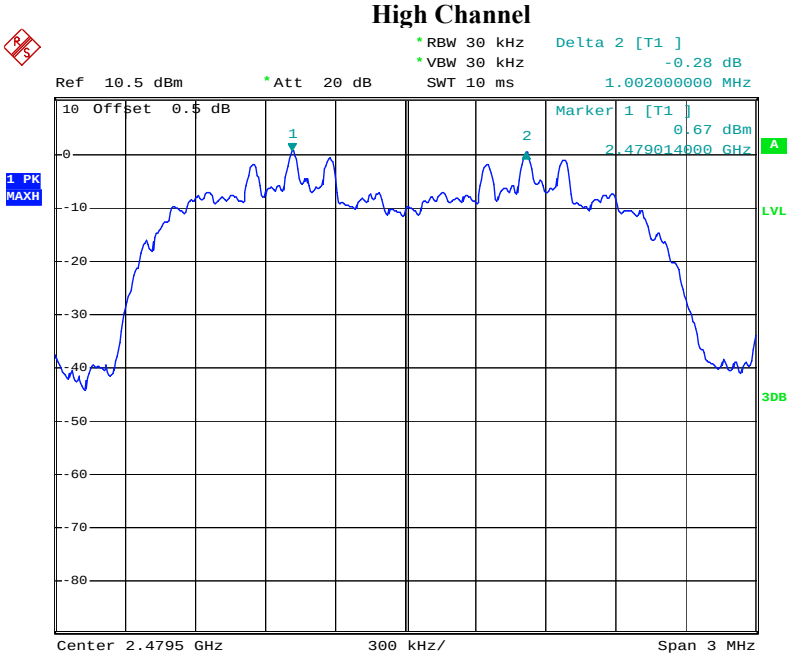
High Channel



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§15.247(a) (1) – 20dB Bandwidth

1. Conducted Measurement
   EUT was set for low, mid, high channel with modulated mode and highest RF output power.
   The spectrum analyzer was connected to the antenna terminal.
2. Environmental Conditions

Temperature	22°C
Relative Humidity	50%
Atmospheric Pressure	1019mbar

3. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is ±1.5dB.
4. Test date : January 27, 2014
   Tested By : Amos Xia

Standard Requirement:

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.

Procedures:

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 Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel, RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
4. Set the measured low, middle and high frequency and test 20dB bandwidth with spectrum analyzer.

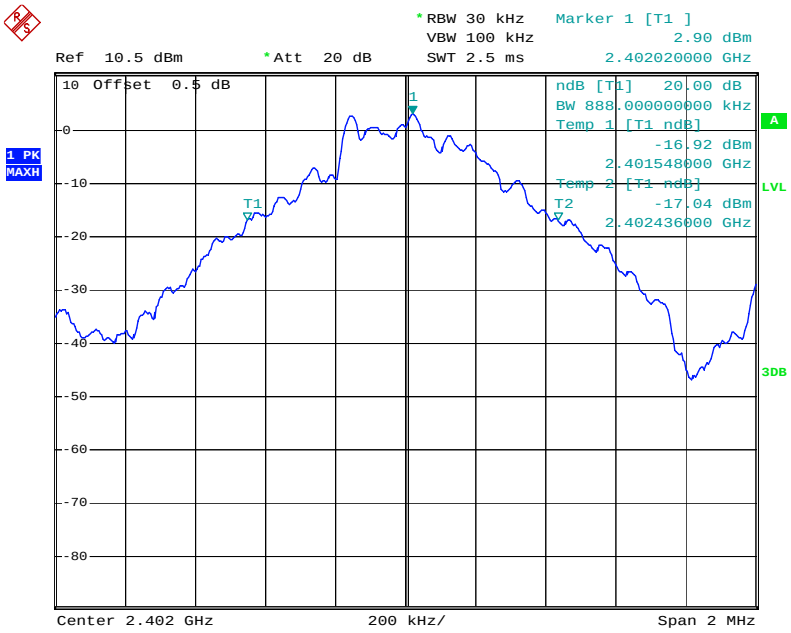
Test Result: Pass

Test Mode:	**GFSK Transmitting**

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	0.888
Middle	2441	0.864
High	2480	0.852

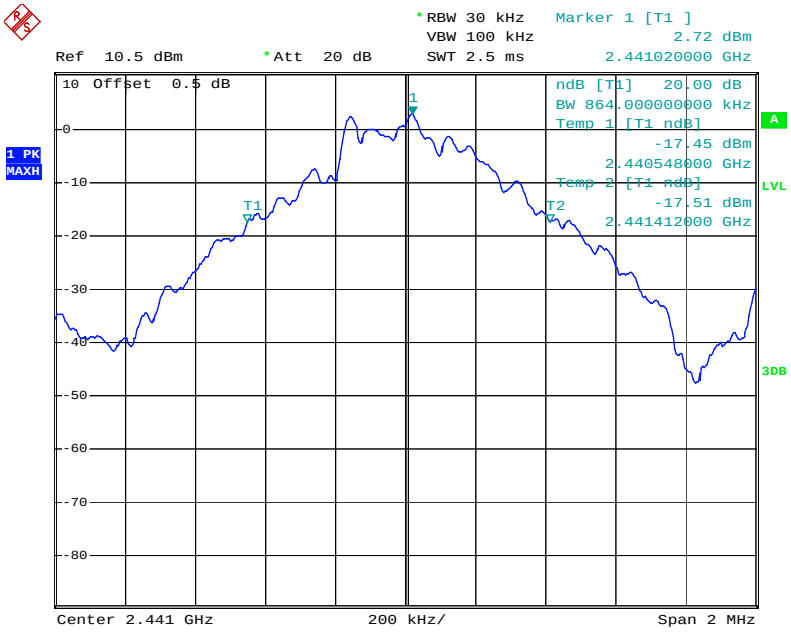
Please refer to the following plots.

Low Channel



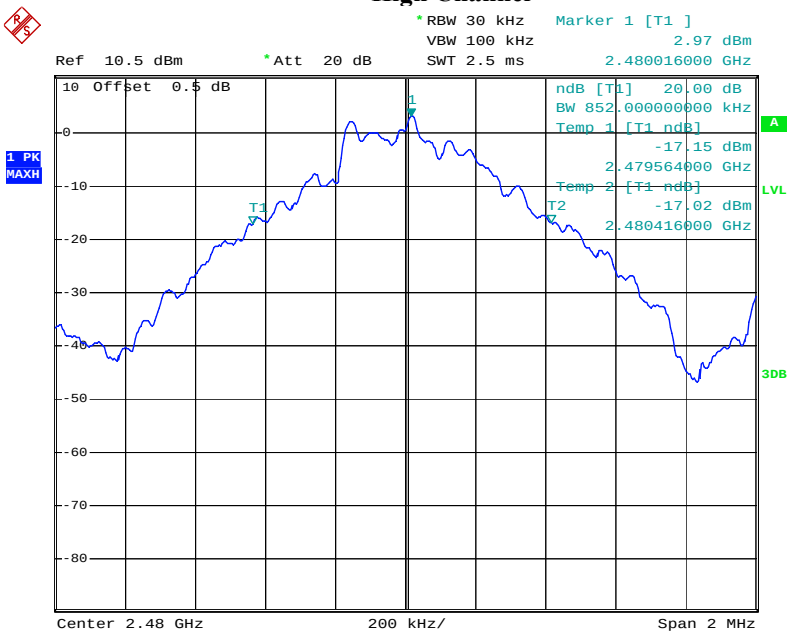
Date: 26.JAN.2014 17:41:54

Middle Channel



Date: 26.JAN.2014 17:43:56

High Channel



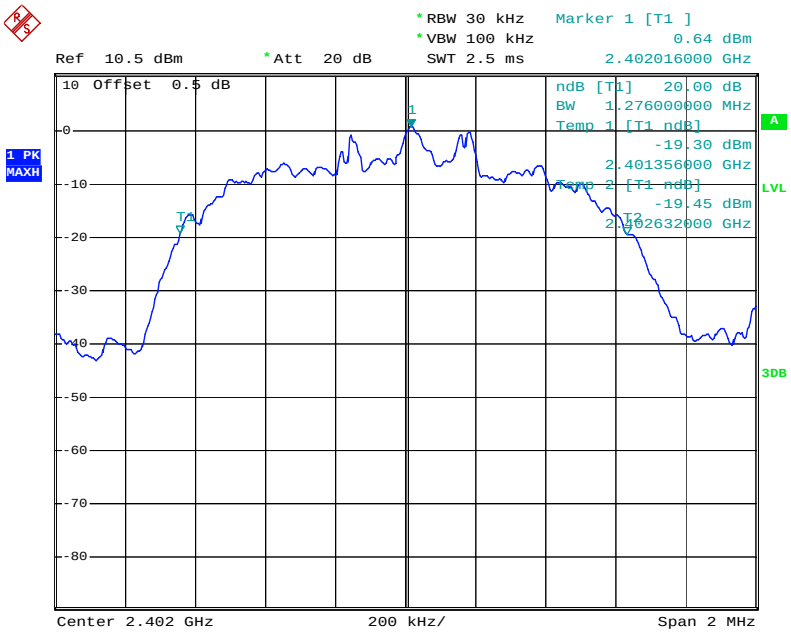
Date: 26.JAN.2014 17:44:32

Test Mode:	**8DPSK Transmitting**

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	1.276
Middle	2441	1.276
High	2480	1.268

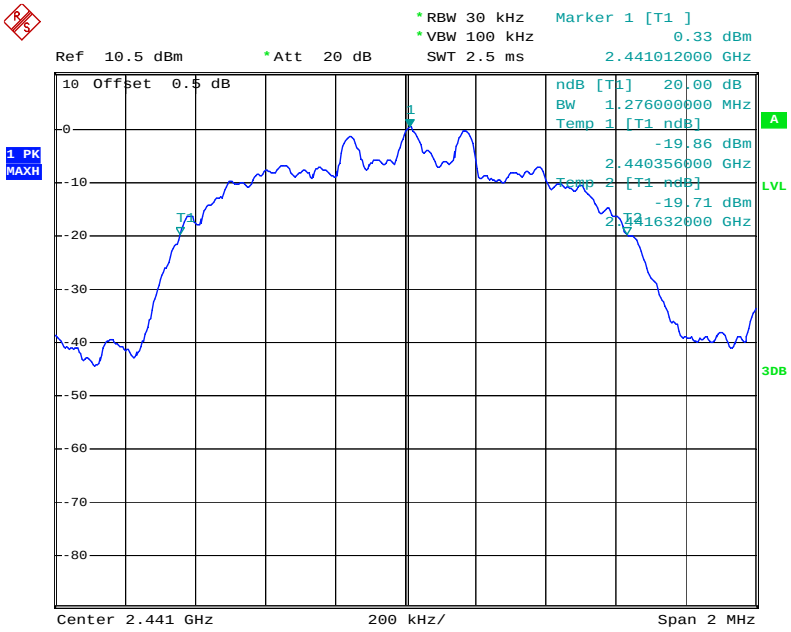
Please refer to the following plots.

Low Channel



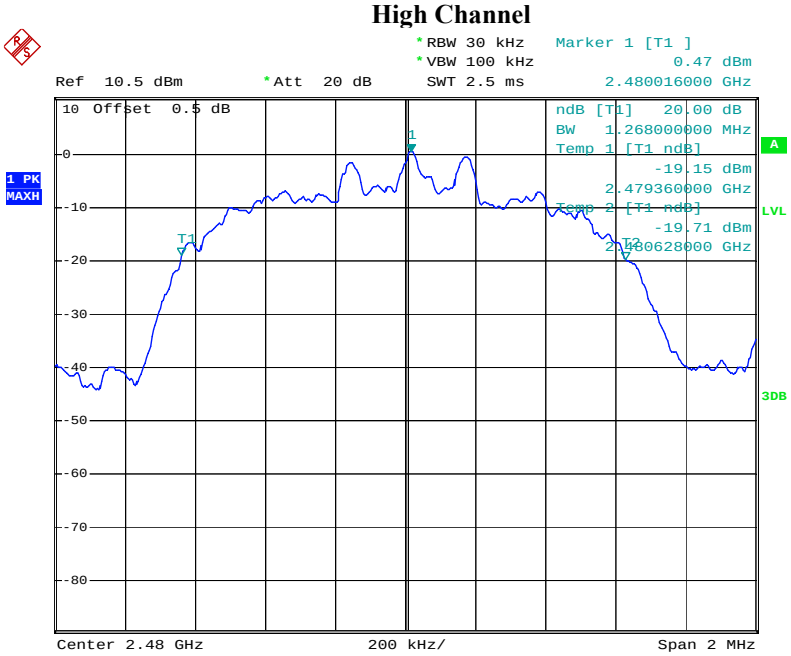
Date: 26.JAN.2014 17:50:22

Middle Channel



Date: 26.JAN.2014 17:52:15

High Channel



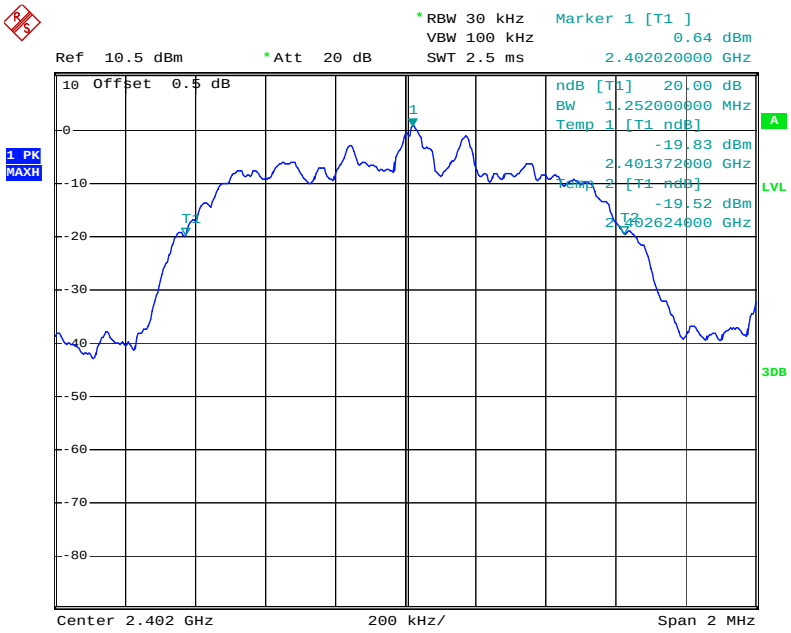
Date: 26.JAN.2014 17:53:19

Test Mode:	**4-DQPSK Transmitting**

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	1.252
Middle	2441	1.248
High	2480	1.24

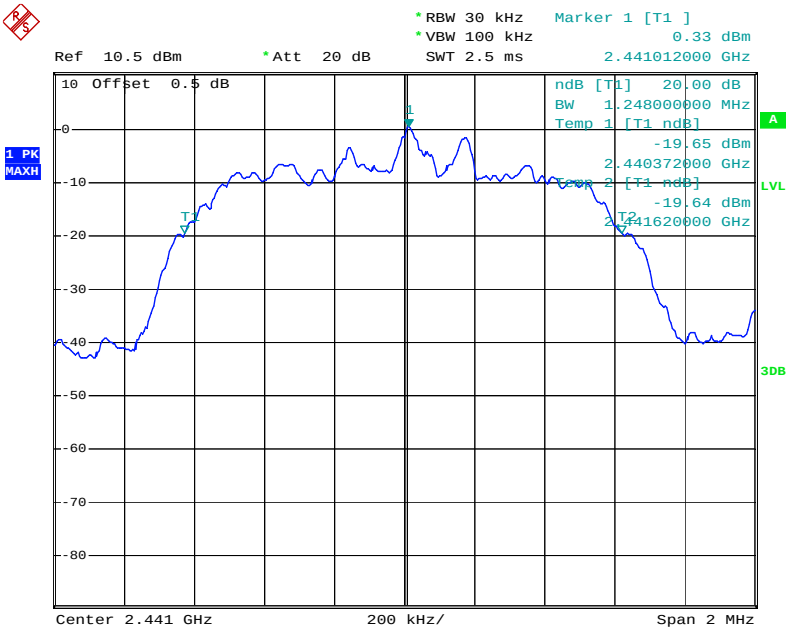
Please refer to the following plots.

Low Channel



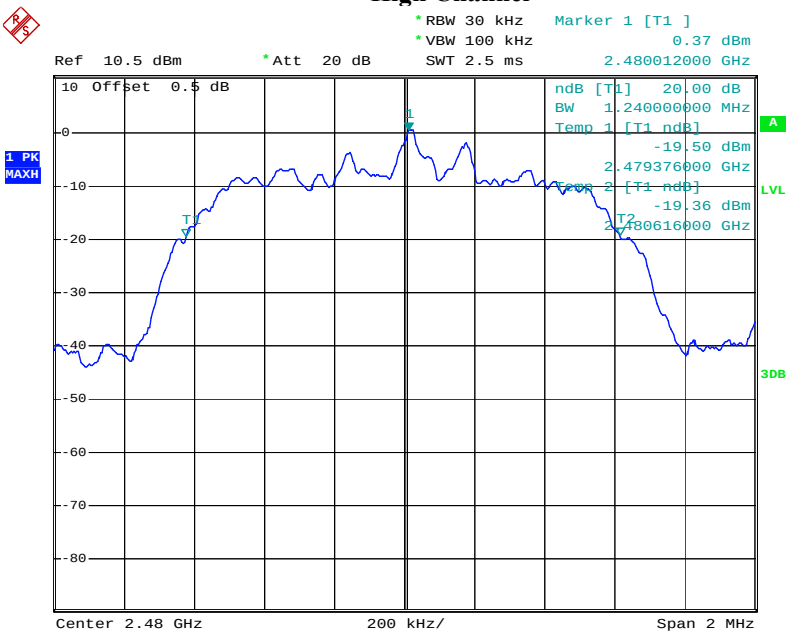
Date: 26.JAN.2014 17:45:57

Middle Channel



Date: 26.JAN.2014 17:47:04

High Channel



Date: 26.JAN.2014 17:48:03

5.5 §15.247(a) (1) (iii)-Number of Hopping Channels

1. Conducted Measurement
   EUT was set for low, mid, high channel with modulated mode and highest RF output power.
   The spectrum analyzer was connected to the antenna terminal.
2. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is ±1.5dB.
3. Environmental Conditions

Temperature	22°C
Relative Humidity	50%
Atmospheric Pressure	1019mbar

4. Test date : January 27, 2014
   Tested By : Amos Xia

Standard Requirement:

According to §15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Procedures:

1. Place the EUT on the table and set it in hopping function 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 Start=2400MHz, Stop = 2483.5MHz, Span = the frequency band of operation, RBW ≥1% of the span, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
4. Count the quantity of peaks to get the number of hopping channels.

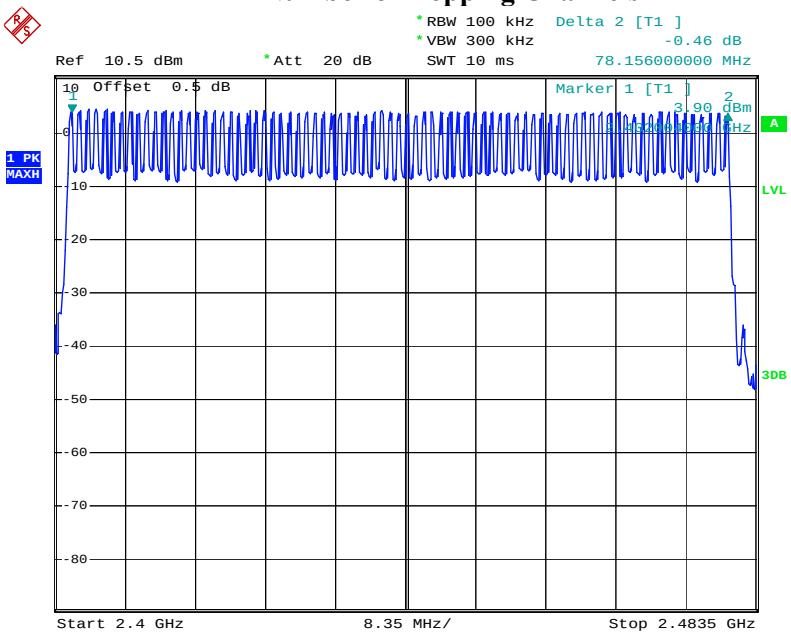
Test Result: Pass

Test Mode:	**Hopping Mode With GFSK Modulation**

Frequency Range (MHz)	Number of Hopping Channels	Limit
2400-2483.5	79	≥15

Please refer to following tables and plots

Number of Hopping Channels



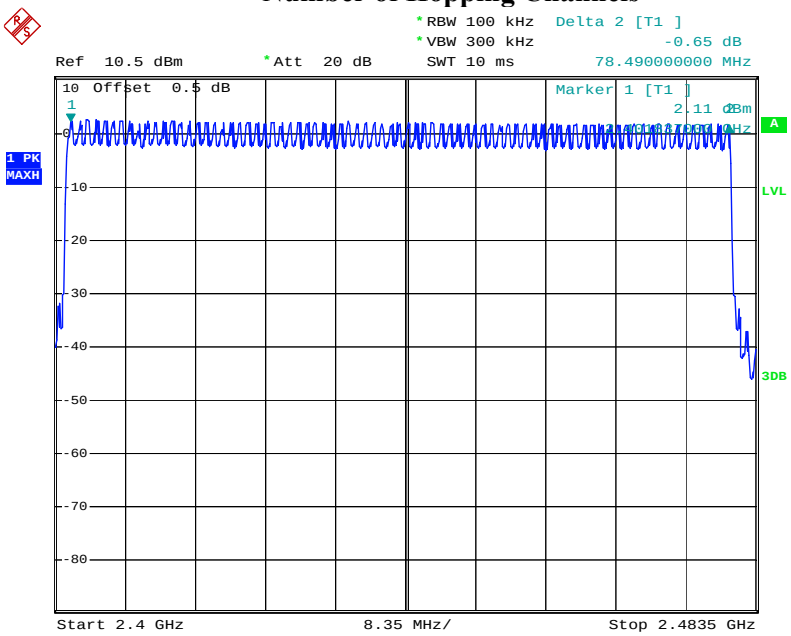
Date: 27.JAN.2014 11:59:32

Test Mode:	**Hopping Mode With 8DPSK Modulation**

Frequency Range (MHz)	Number of Hopping Channels	Limit
2400-2483.5	79	≥15

Please refer to following tables and plots

Number of Hopping Channels



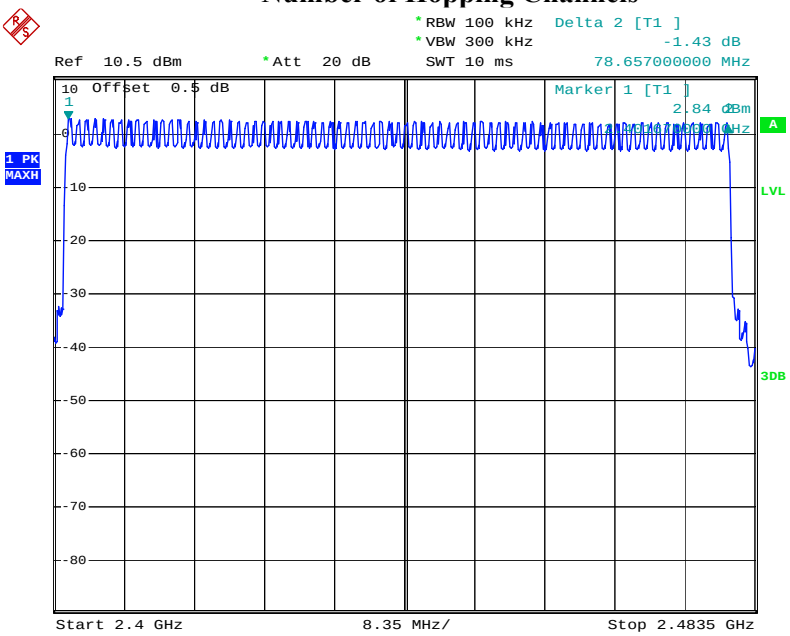
Date: 27.JAN.2014 13:17:45

Test Mode:	**Hopping Mode With π /4-DQPSK Modulation**

Frequency Range (MHz)	Number of Hopping Channels	Limit
2400-2483.5	79	≥15

Please refer to following tables and plots

Number of Hopping Channels



Date: 27.JAN.2014 13:00:26

5.6 §15.247(a) (1) (iii) -Time of Occupancy (Dwell Time)

1. Conducted Measurement
   EUT was set for low, mid, high channel with modulated mode and highest RF output power.
   The spectrum analyzer was connected to the antenna terminal.
2. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is ±1.5dB.
3. Environmental Conditions

Temperature	22°C
Relative Humidity	50%
Atmospheric Pressure	1019mbar

4. Test date : January 27, 2014
   Tested By : Amos Xia

Standard Requirement:

According to §15.247(a)(1)(iii), The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Procedures:

1. Place the EUT on the table and set it in transmitting mode and switch on frequency hopping function.
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 Span = zero span, centered on a hopping channel,
   RBW=1MHz, VBW ≥ RBW, Sweep = as necessary to capture the entire dwell time per hopping channel, Detector function = peak, Trace = max hold.
4. Calculate the time of occupancy in a period with time occupancy of a burst and quantity of bursts.

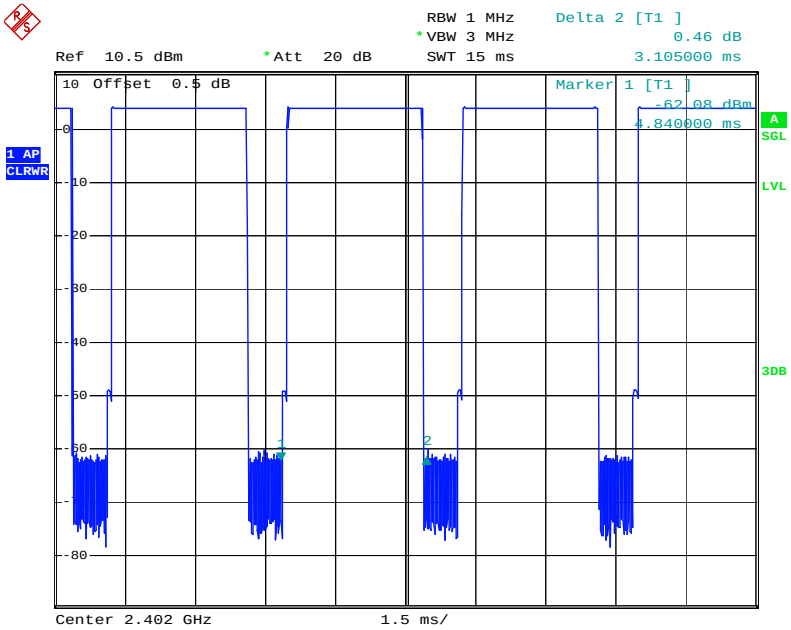
Test Result: Pass

Test Mode:	**Hopping Mode With GFSK Modulation**

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
DH 5	Low	3.105	0.33120	0.4	Pass
	Middle	3.075	0.32800	0.4	Pass
	High	3.075	0.32800	0.4	Pass
	Note: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second				

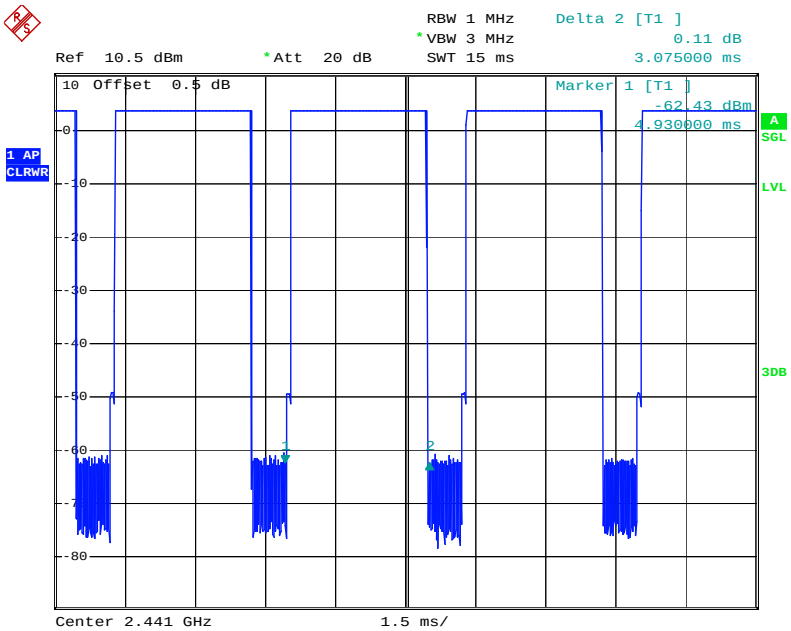
Please refer to the following plots.

Low Channel for DH5



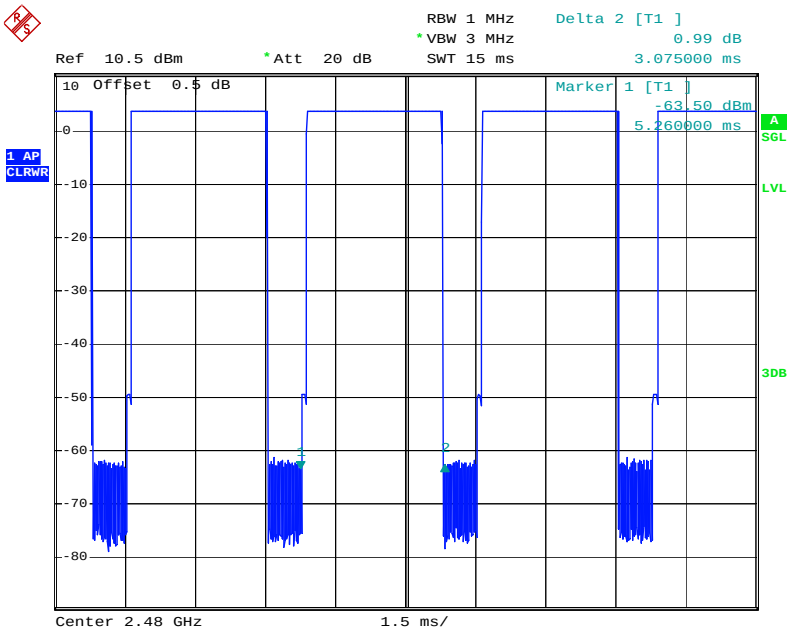
Date: 27.JAN.2014 17:31:56

Middle Channel for DH5



Date: 27.JAN.2014 17:32:15

High Channel for DH5



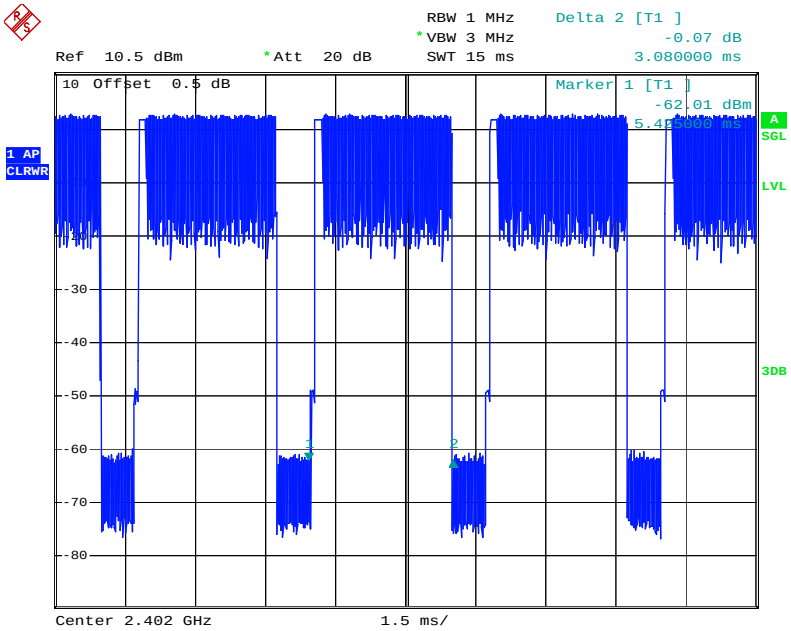
Date: 27.JAN.2014 17:32:43

Test Mode:	**Hopping Mode With 8DPSK Modulation**

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
DH 5	Low	3.080	0.32853	0.4	Pass
	Middle	3.110	0.33173	0.4	Pass
	High	3.110	0.33173	0.4	Pass
	Note: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second				

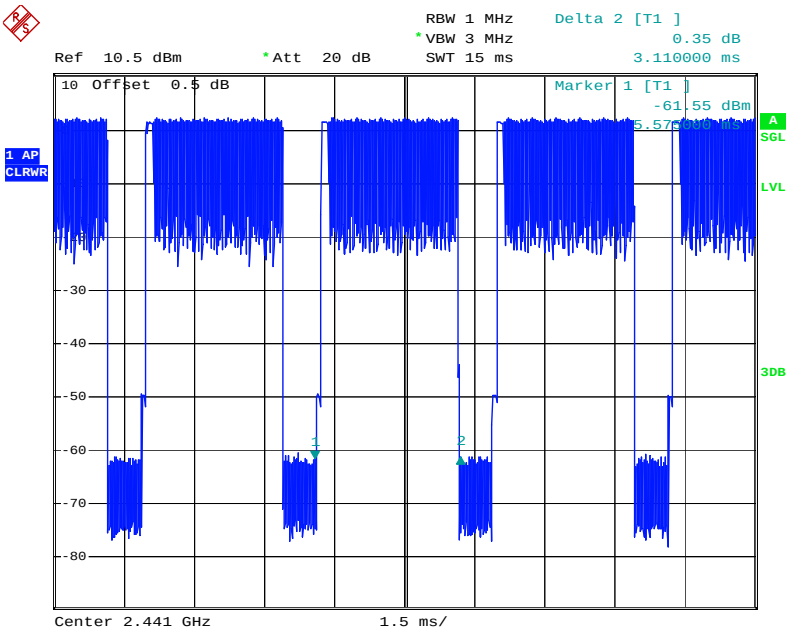
Please refer to the following plots.

Low Channel for DH5



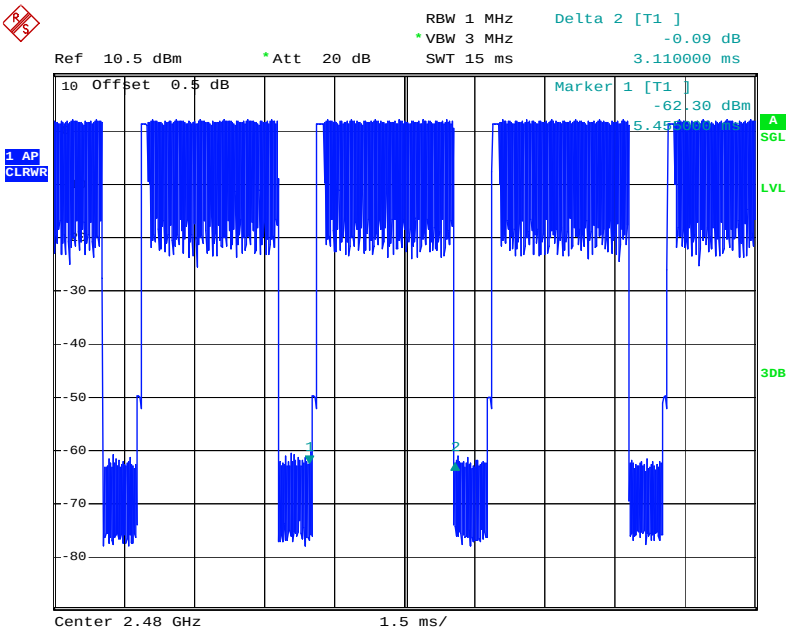
Date: 27.JAN.2014 17:43:51

Middle Channel for DH5



Date: 27.JAN.2014 17:44:12

High Channel for DH5



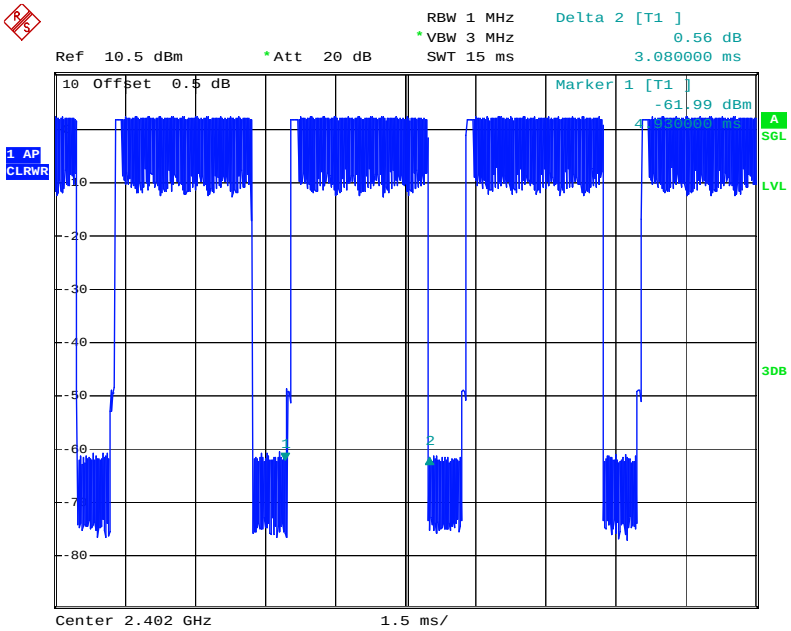
Date: 27.JAN.2014 17:44:34

Test Mode:	**Hopping Mode With π /4-DQPSK Modulation**

Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
DH 5	Low	3.080	0.32853	0.4	Pass
	Middle	3.080	0.32853	0.4	Pass
	High	3.110	0.33173	0.4	Pass
	Note: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second				

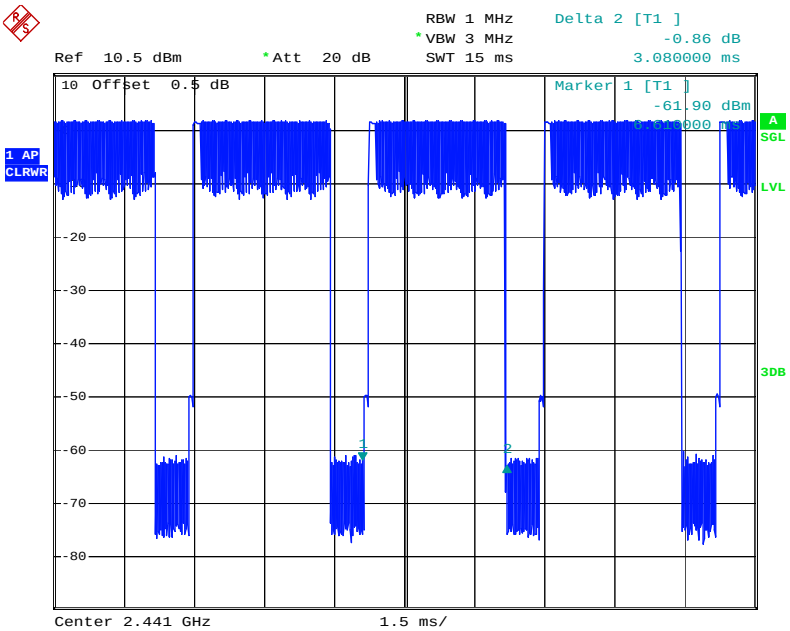
Please refer to the following plots.

Low Channel for DH5



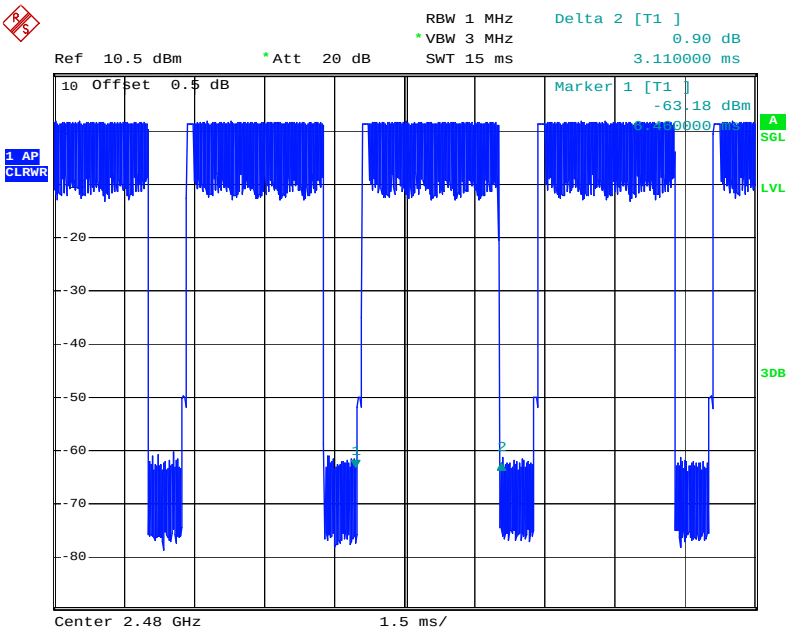
Date: 27.JAN.2014 17:38:10

Middle Channel for DH5



Date: 27.JAN.2014 17:38:55

High Channel for DH5



Date: 27.JAN.2014 17:39:27

5.7 §15.247(b) (1) - Peak Output Power

1. Conducted Measurement
   EUT was set for low, mid, high channel with modulated mode and highest RF output power.
   The spectrum analyzer was connected to the antenna terminal.
2. Conducted Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2, in the range 30MHz – 40GHz is ±1.5dB.
3. Environmental Conditions

Temperature	22°C
Relative Humidity	50%
Atmospheric Pressure	1019mbar

4. Test date : January 27, 2014
   Tested By : Amos Xia

Standard Requirement:

According to §15.247(b)(2), For frequency hopping systems in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5MHz band: 0.125watts.

Procedures:

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 Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel, RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW, Sweep=auto, Detector function=peak, Trace = max hold.
4. Then set the EUT to transmit at low, middle and high channel and measure the conducted output power separately.

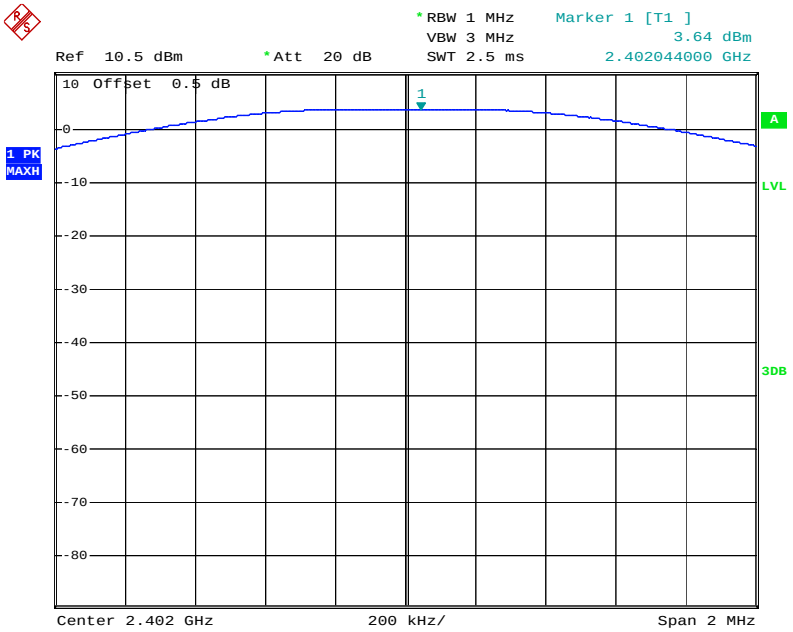
Test Result: Pass

Test Mode:	**GFSK Transmitting**

Channel	Channel frequency (MHz)	Peak output power (dBm)	Power output (mW)	Limit (mW)
Low channel	2402	3.64	2.31	1000
Middle channel	2441	3.27	2.12	1000
High channel	2480	3.19	2.08	1000

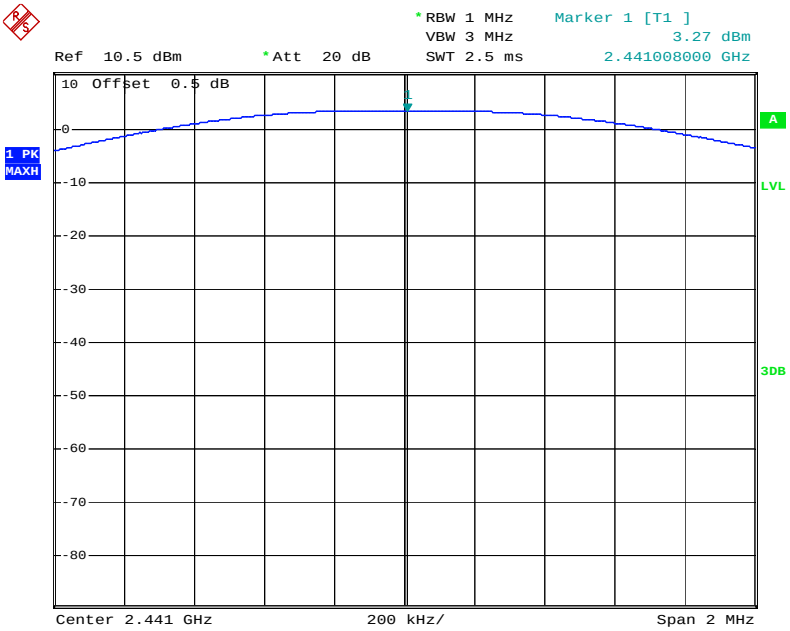
Please refer to the following plots.
Note: The data above was tested in conducted mode.

Low Channel



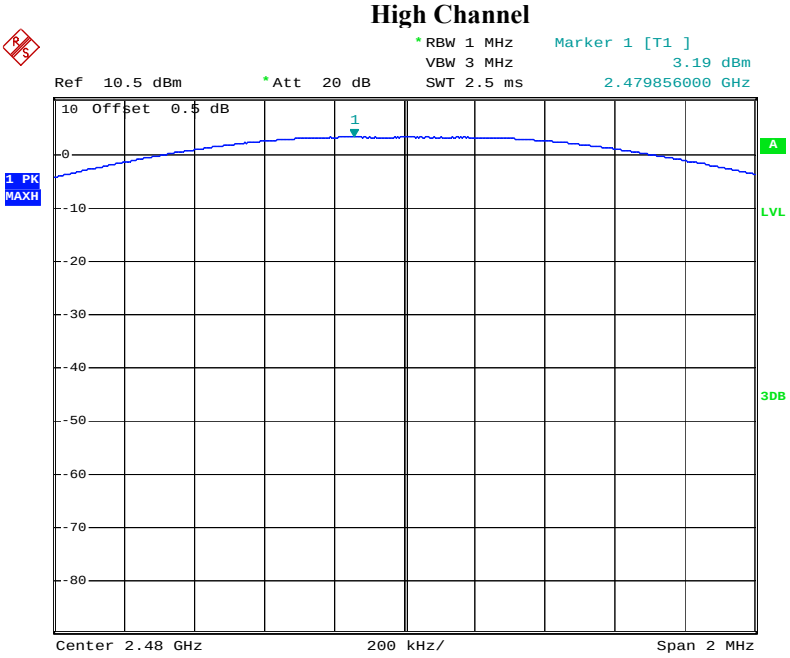
Date: 26.JAN.2014 17:43:29

Middle Channel



Date: 26.JAN.2014 17:44:08

High Channel



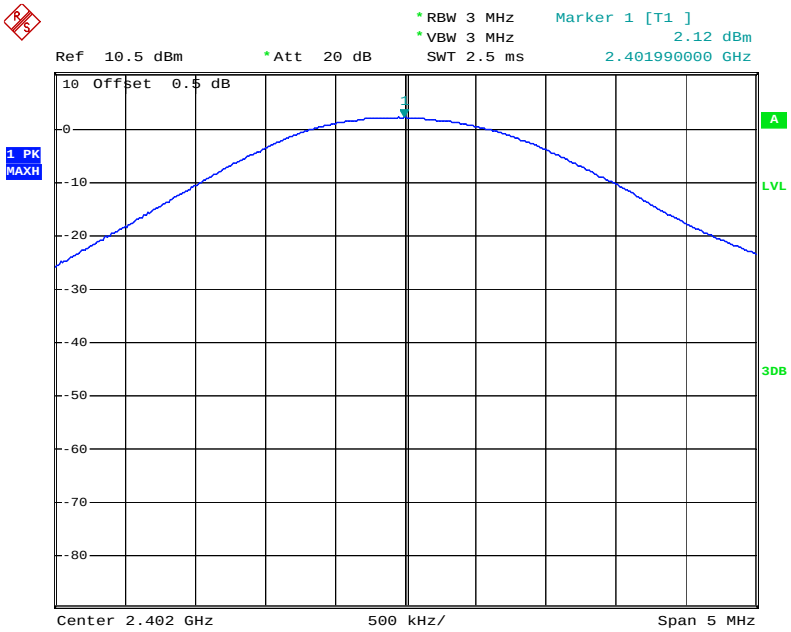
Date: 26.JAN.2014 17:44:45

Test Mode:	**8DPSK Transmitting**

Channel	Channel frequency (MHz)	Peak output power (dBm)	Power output (mW)	Limit (mW)
Low channel	2402	2.12	1.63	125
Middle channel	2441	2.05	1.60	125
High channel	2480	1.82	1.52	125

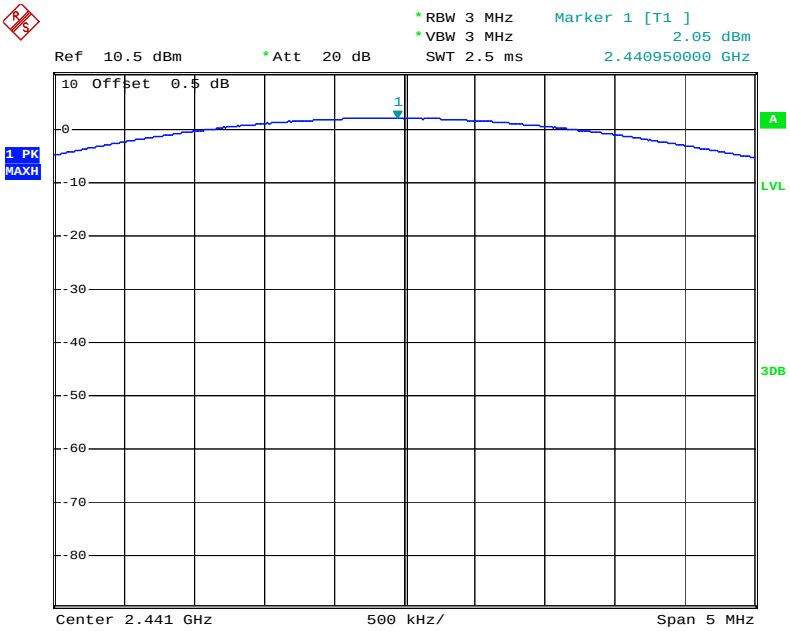
Please refer to the following plots.
Note: The data above was tested in conducted mode.

Low Channel



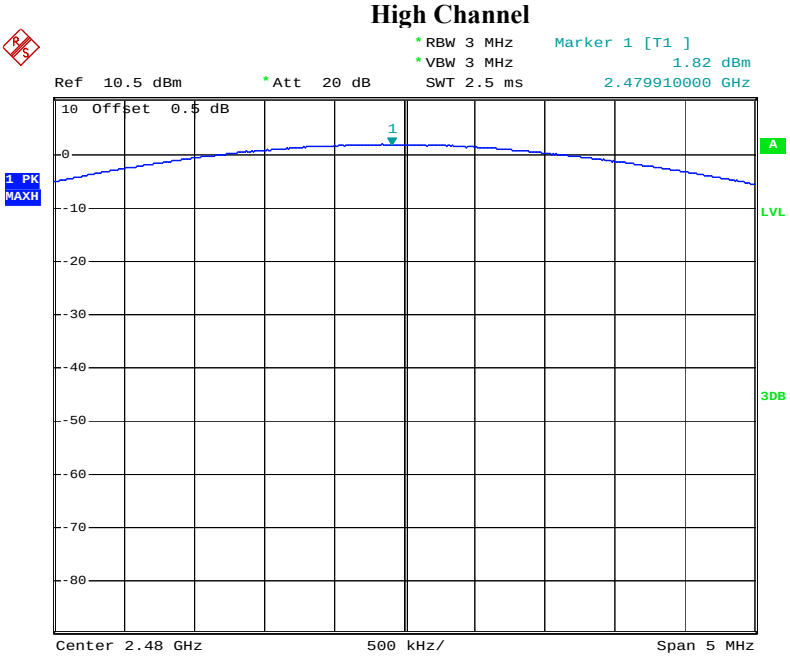
Date: 26.JAN.2014 17:51:35

Middle Channel



Date: 26.JAN.2014 17:52:43

High Channel



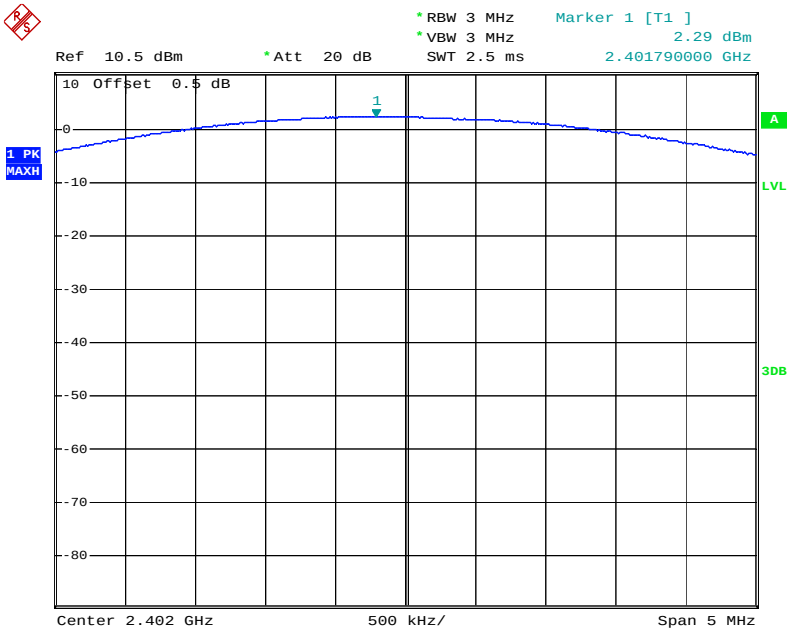
Date: 26.JAN.2014 17:53:42

Test Mode:	**π /4-DQPSK Transmitting**

Channel	Channel frequency (MHz)	Peak output power (dBm)	Power output (mW)	Limit (mW)
Low channel	2402	2.29	1.69	125
Middle channel	2441	1.73	1.49	125
High channel	2480	1.54	1.43	125

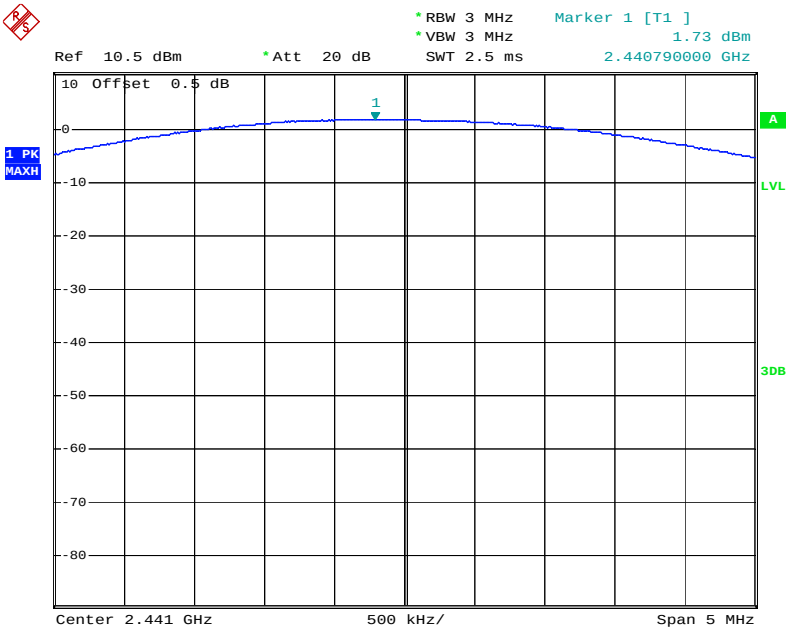
Please refer to the following plots.
Note: The data above was tested in conducted mode.

Low Channel



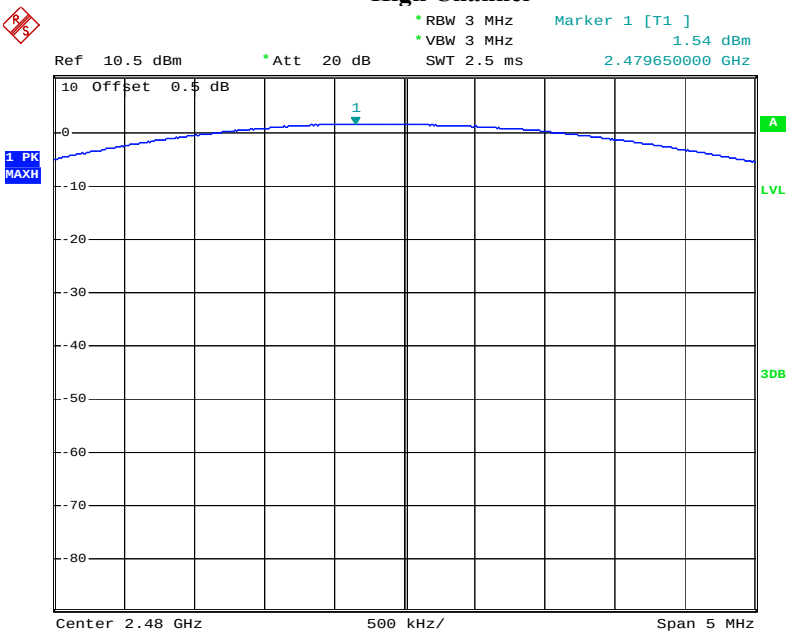
Date: 26.JAN.2014 17:46:15

Middle Channel



Date: 26.JAN.2014 17:47:21

High Channel



Date: 26.JAN.2014 17:48:22

5.8 §15.247(d) - Band Edge

Standard Requirement:

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)).

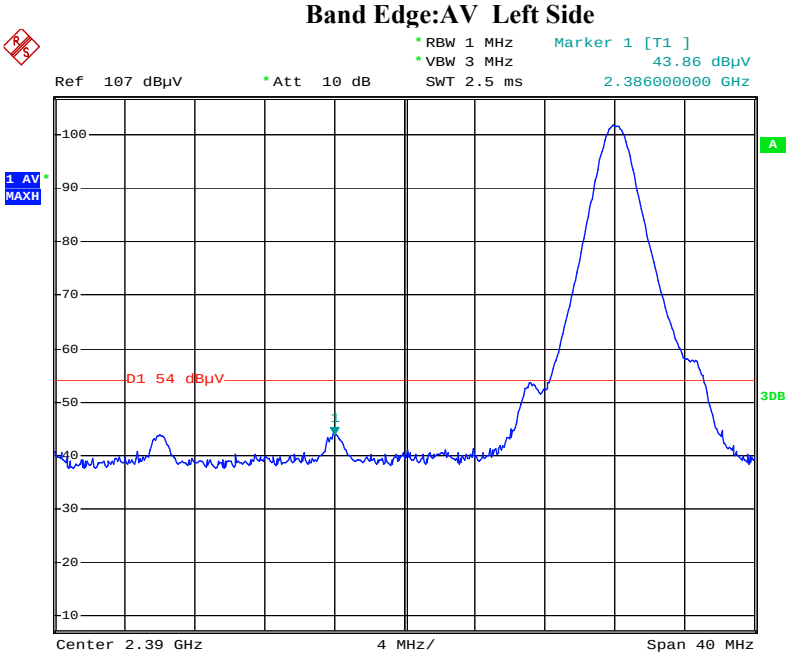
Procedures:

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Put it on the Rotated table and turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Result: Pass

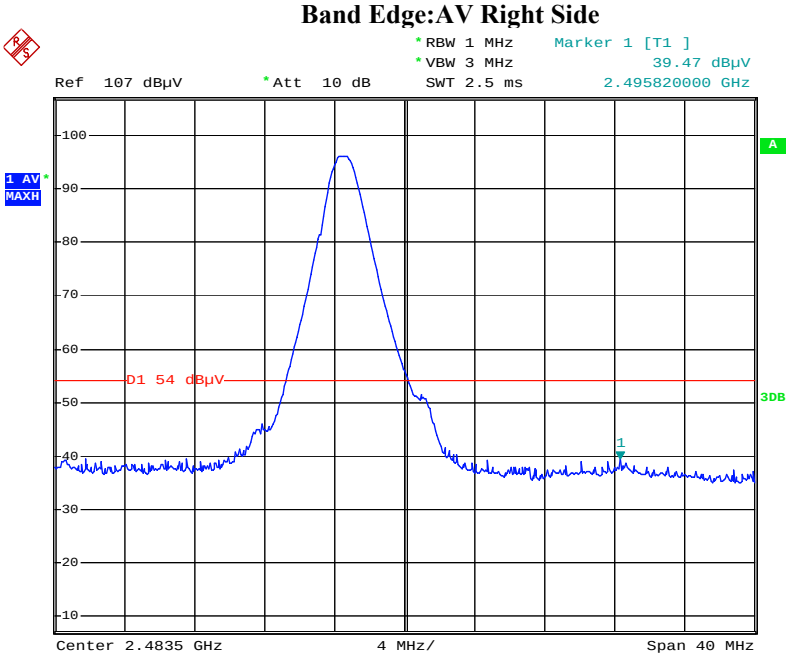
Test Mode:	GFSK Transmitting

Band Edge:AV Left Side



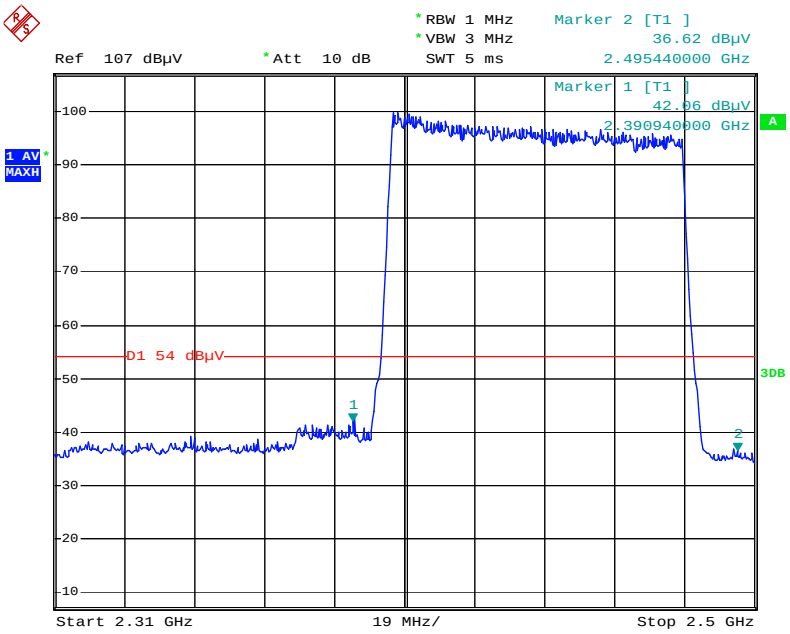
Date: 28.JAN.2014 14:16:09

Band Edge:AV Right Side



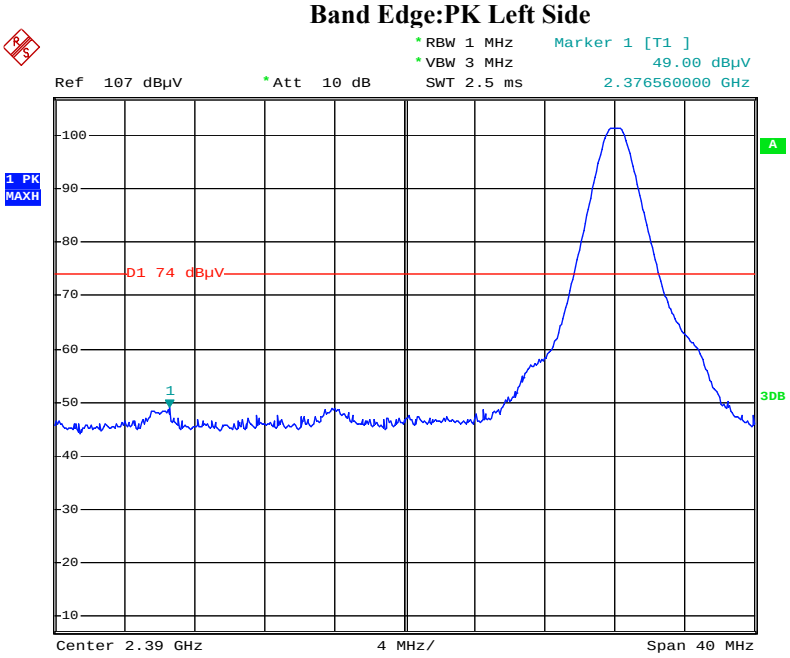
Date: 28.JAN.2014 14:27:26

Band Edge: AV Hopping



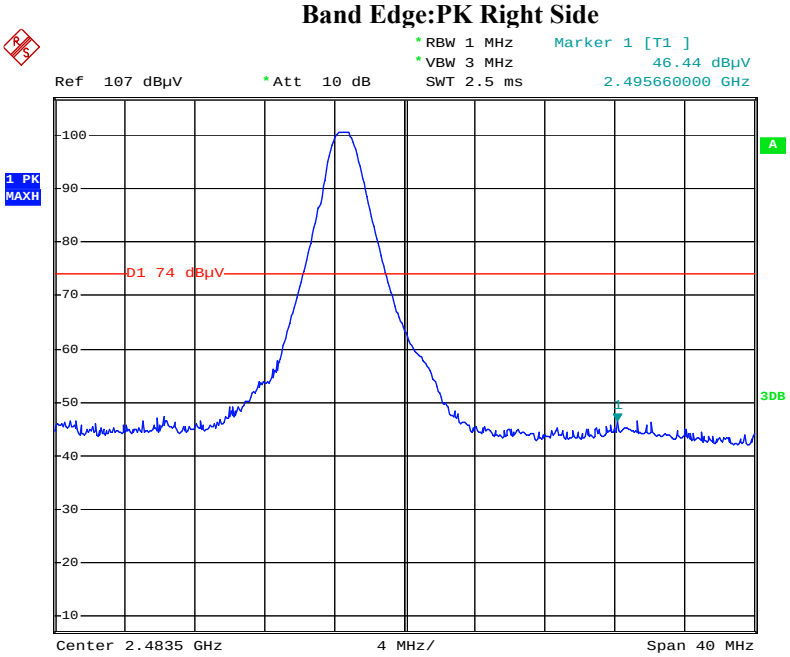
Date: 28.JAN.2014 14:31:50

Band Edge:PK Left Side



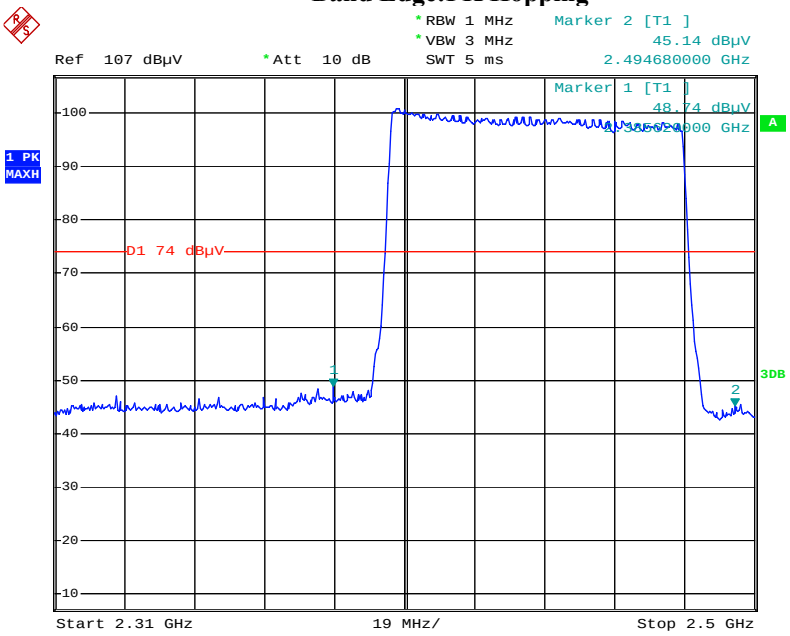
Date: 28.JAN.2014 14:20:00

Band Edge:PK Right Side



Date: 28.JAN.2014 14:23:50

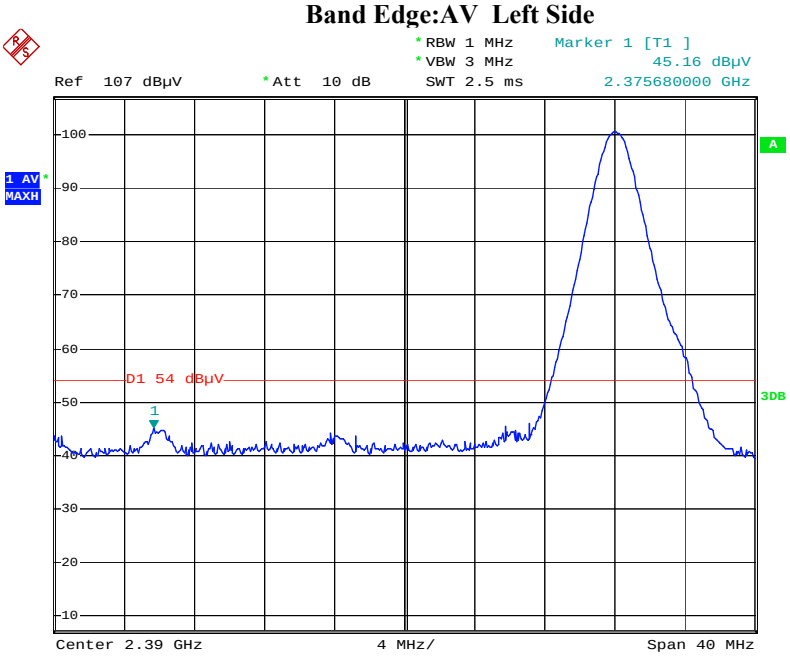
Band Edge:PK Hopping



Date: 28.JAN.2014 14:35:45

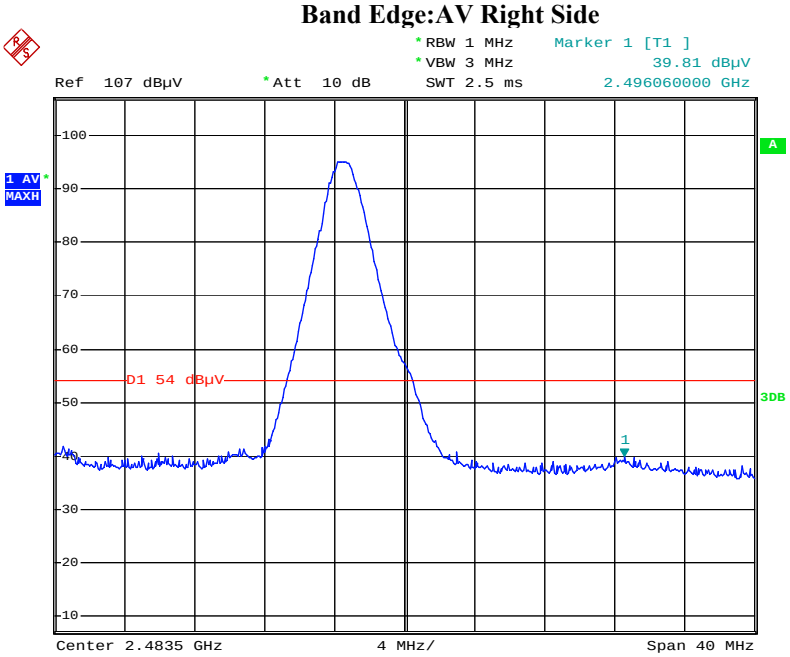
Test Mode:	8DPSK Transmitting

Band Edge:AV Left Side



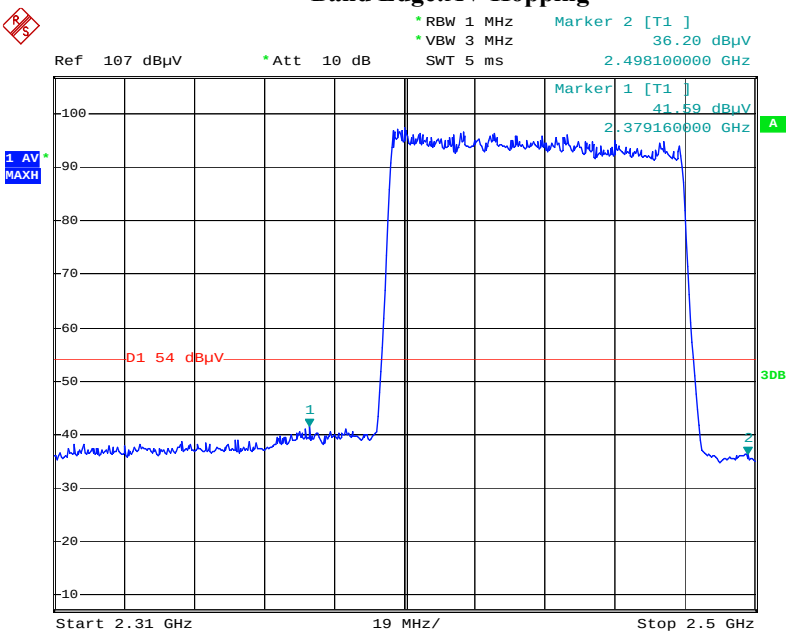
Date: 28.JAN.2014 13:57:02

Band Edge:AV Right Side



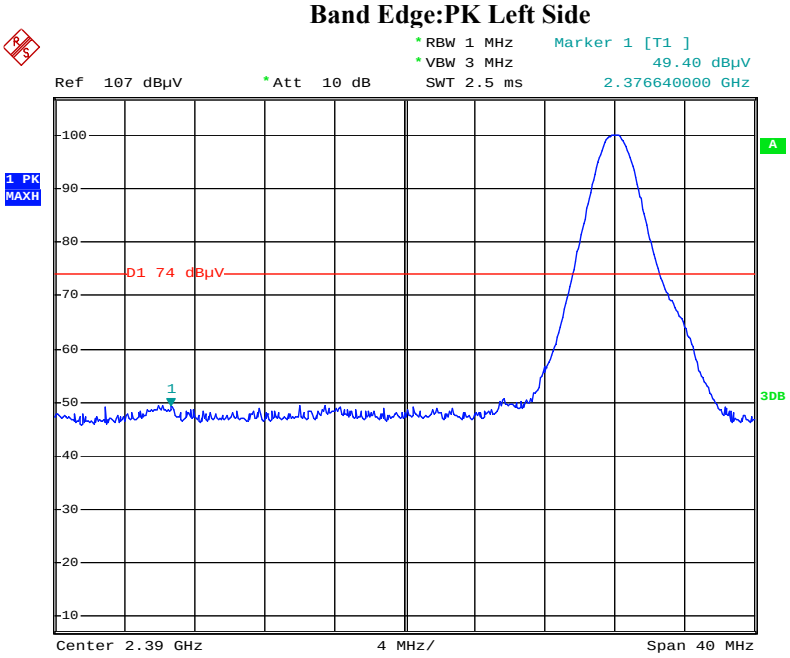
Date: 28.JAN.2014 14:00:11

Band Edge:AV Hopping



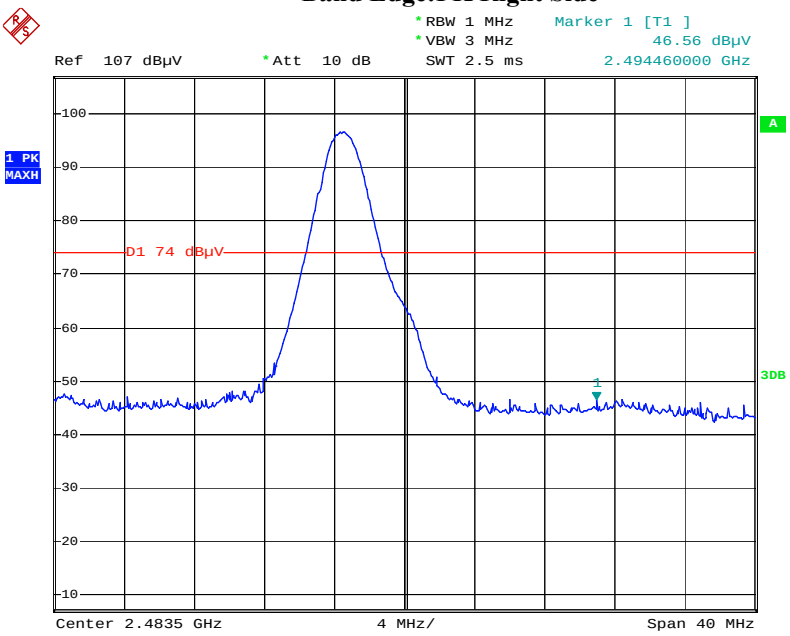
Date: 28.JAN.2014 14:46:47

Band Edge:PK Left Side



Date: 28.JAN.2014 13:57:59

Band Edge:PK Right Side



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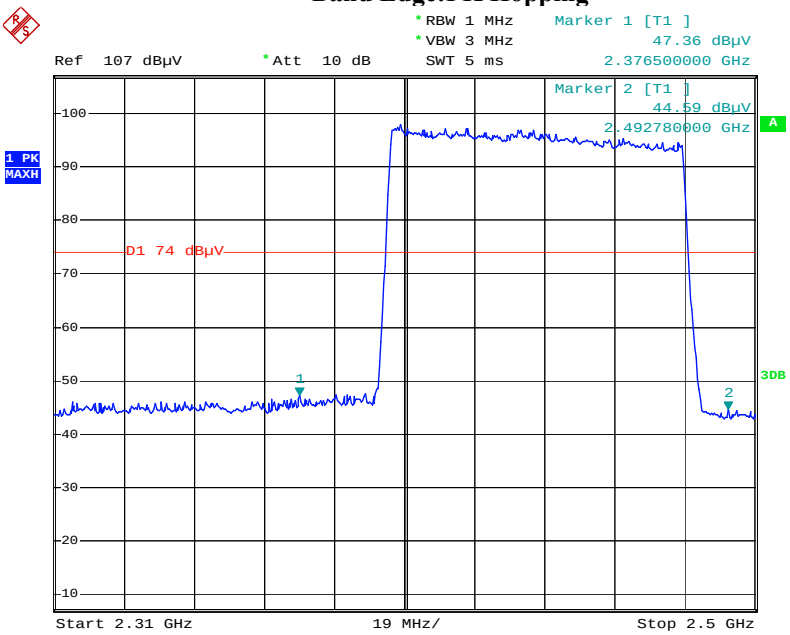
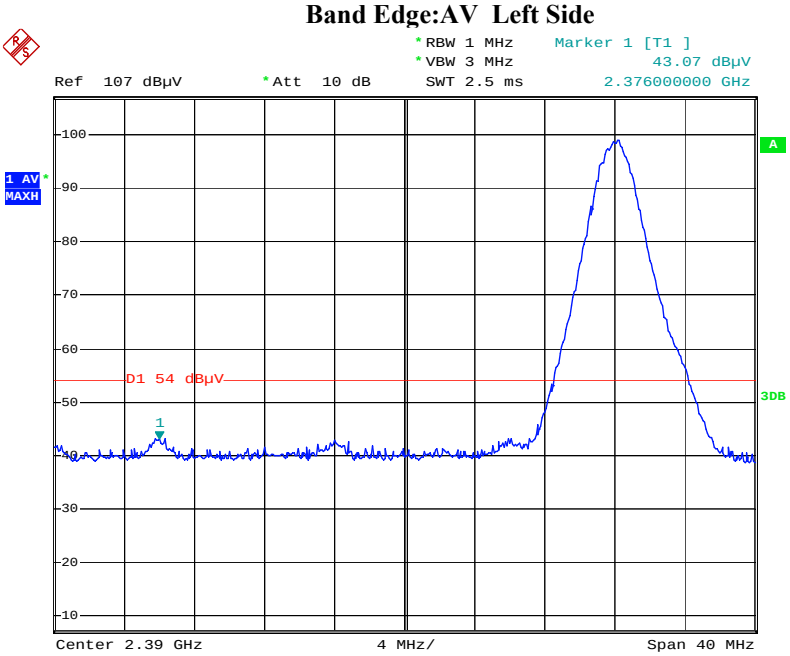
Band Edge:PK Hopping



Date: 28.JAN.2014 14:50:30

Test Mode:	π /4-DQPSK Transmitting

Band Edge:AV Left Side



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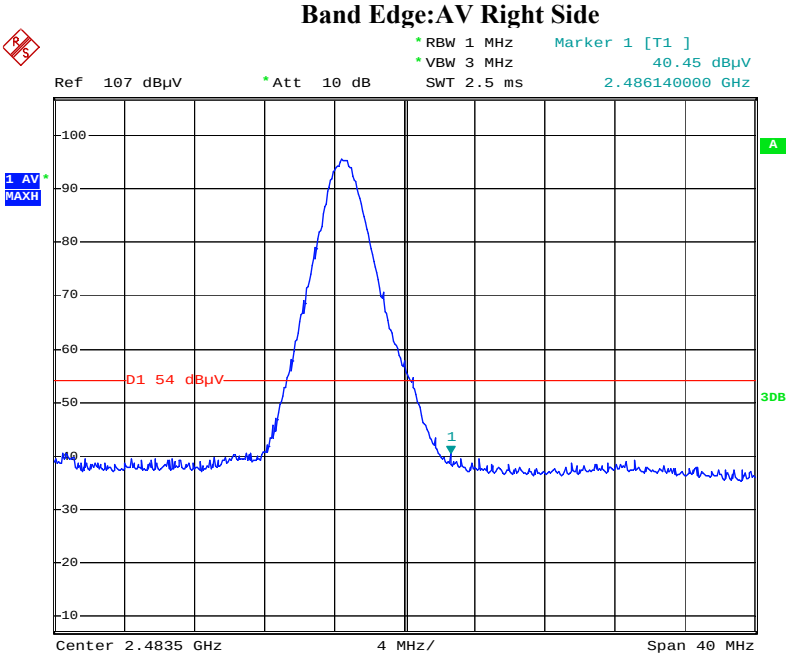
Band Edge:AV Right Side



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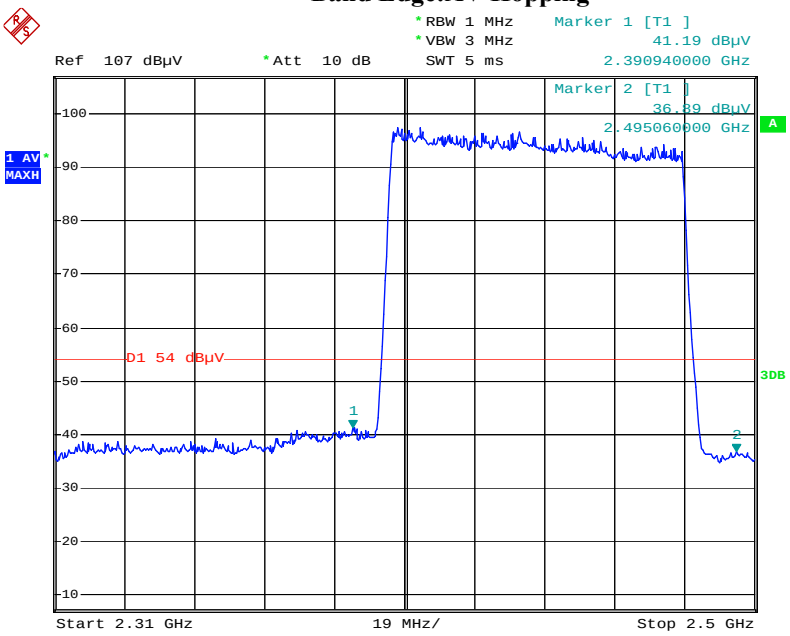
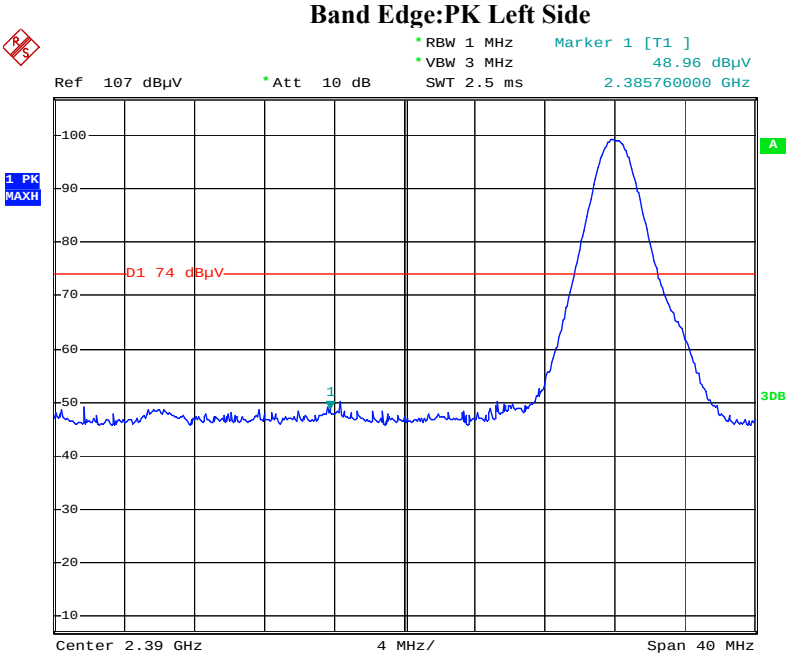
Band Edge:AV Hopping



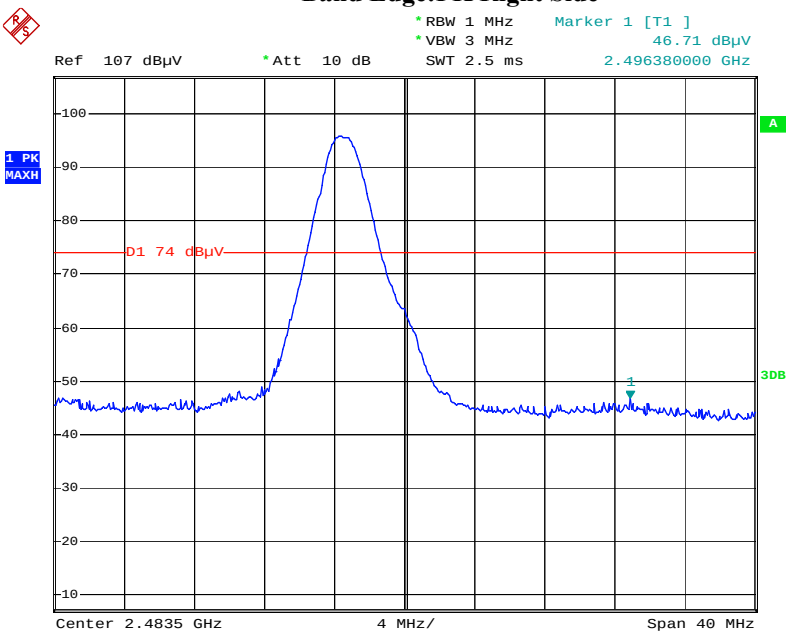
Date: 28.JAN.2014 14:42:42

Band Edge:PK Left Side



Date: 28.JAN.2014 14:08:37

Band Edge:PK Right Side



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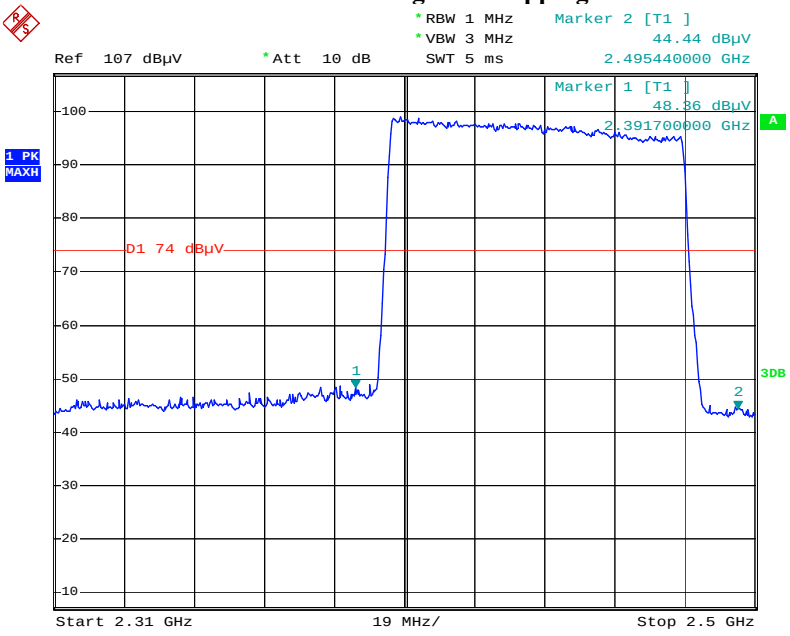
Band Edge:PK Hopping



Date: 28.JAN.2014 14:39:43

Annex A. TEST INSTRUMENT & METHOD

Annex A.i. TEST INSTRUMENTATION & GENERAL PROCEDURES

Instrument	Model	Calibration Date	Calibration Due Date
Conducted Emissions			
R&S EMI Test Receiver	ESPI3	09/27/2013	09/26/2014
Com-Power LISN	LI-115	05/25/2013	05/25/2014
Radiated Emissions			
Hp Spectrum Analyzer	8563E	09/27/2013	09/26/2014
R&S EMI Receiver	ESPI3	09/27/2013	09/26/2014
Antenna (30MHz~6GHz)	JB6	03/27/2013	03/26/2014
ETS-Lindgren Antenna(1 ~18GHz)	3115	10/09/2013	10/08/2014
A-INFOMW Antenna(1 ~18GHz)	JXTXLB-10180	10/09/2013	10/08/2014
Horn Antenna (18~40GHz)	AH-840	04/22/2013	04/22/2014
Microwave Pre-Amp (18~40GHz)	PA-840	05/30/2013	05/29/2014
Hp Agilent Pre-Amplifier	8447F	10/27/2013	10/26/2014
MITEQ Pre-Amplifier(0.1 ~ 18GHz)	AMF-7D-00101800-30-10P	10/27/2013	10/26/2014
Chamber	3m	04/13/2013	04/12/2014

Sample Calculation Example

At 20 MHz limit = 250 μV = 47.96 dBμV

Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.20 dB

Q-P reading obtained directly from EMI Receiver = 40.00 dBμV
(Calibrated for system losses)

Therefore, Q-P margin = 47.96 – 40.00 = 7.96 i.e. **7.96 dB below limit**

Annex A. iii. RADIATED EMISSIONS TEST DESCRIPTION

Limit

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

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

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

Frequency (Hz)	Field Strength (µV/m at 3-meter)	Field Strength (dBµV/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

EUT Characterisation

EUT characterisation, over the frequency range from 30MHz to 10th Harmonic, was done in order to minimise radiated emissions testing time while still maintaining high confidence in the test results.

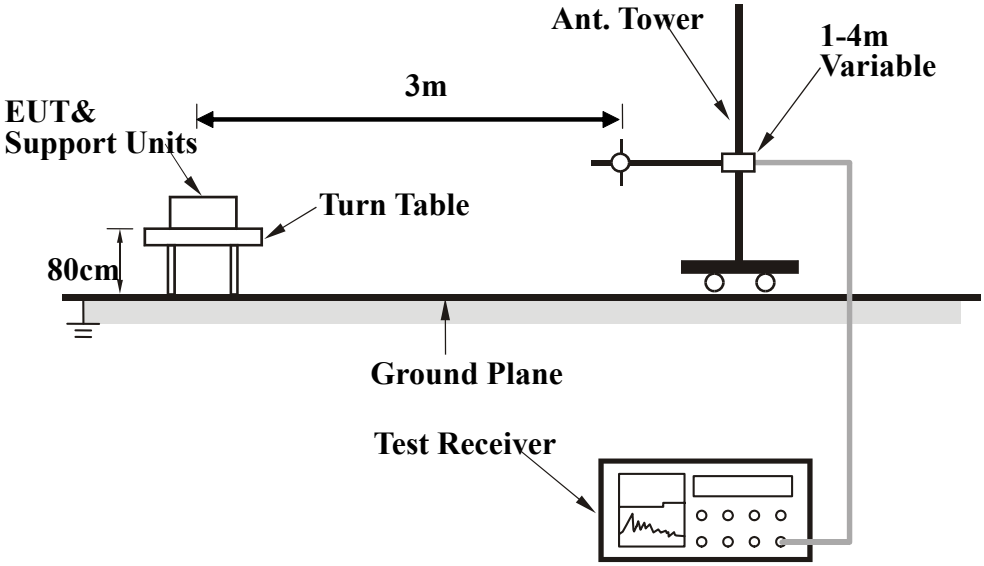
The EUT was placed in the chamber, at a height of about 0.8m on a turntable. Its radiated emissions frequency profile was observed, using a spectrum analyzer /receiver with the appropriate broadband antenna placed 3m away from the EUT. Radiated emissions from the EUT were maximised by rotating the turntable manually, changing the antenna polarisation and manipulating the EUT cables while observing the frequency profile on the spectrum analyzer / receiver. Frequency points at which maximum emissions occurred, clock frequencies and operating frequencies were then noted for the formal radiated emissions test at the Open Area Test Site (OATS) or 3m EMC chamber.

Test Set-up

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.

2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.

3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.



Test Method

The following procedure was performed to determine the maximum emission axis of EUT:
1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

Final Radiated Emission Measurement
1. Setup the configuration according to figure 1. Turn on EUT and make sure that it is in normal function.

2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on an open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.

3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.

4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ◦ to 360 ◦ with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading.

5. Repeat step 4 until all frequencies need to be measured was complete.

6. Repeat step 5 with search antenna in vertical polarized orientations.

During the radiated emission test, the Spectrum Analyzer was set with the following configurations:

Frequency Band (MHz)	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	Peak	100 kHz	100 kHz
Above 1000	Peak	1 MHz	1 MHz
	Average	1 MHz	10 Hz

Description of Radiated Emissions Program

This EMC Measurement software run LabView automation software and offers a common user interface for electromagnetic interference (EMI) measurements. This software is a modern and powerful tool for controlling and monitoring EMI test receivers and EMC test systems. It guarantees reliable collection, evaluation, and documentation of measurement results. Basically, this program will run a pre-scan measurement before it proceeds with the final measurement. The pre-scan routine will run the scan on four different antenna heights, 2 antenna polarity, and 360 degrees table rotation. For example, the program was set to run 30 MHz to 1 GHz scan; the program will first start from a meter antenna height and divide the 30 MHz to 1 GHz into 10 separate parts of maximum hold sweeps. Each parts of maximum hold sweep, the program will collect the data from 0 degree to 360 degrees table rotation. After the program complete the 1m scan, the antenna continues to rise to 2m and continue the scan. The step will repeated for all specified antenna height and polarity. This program will perform the Quasi Peak measurement after the signal maximization process and pre-scan routine. The final measurement will be base on the pre-scan data reduction result.

Sample Calculation Example

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

Peak = Reading + Corrected Factor

where

Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

And the average value is

Average = Peak Value + Duty Factor or

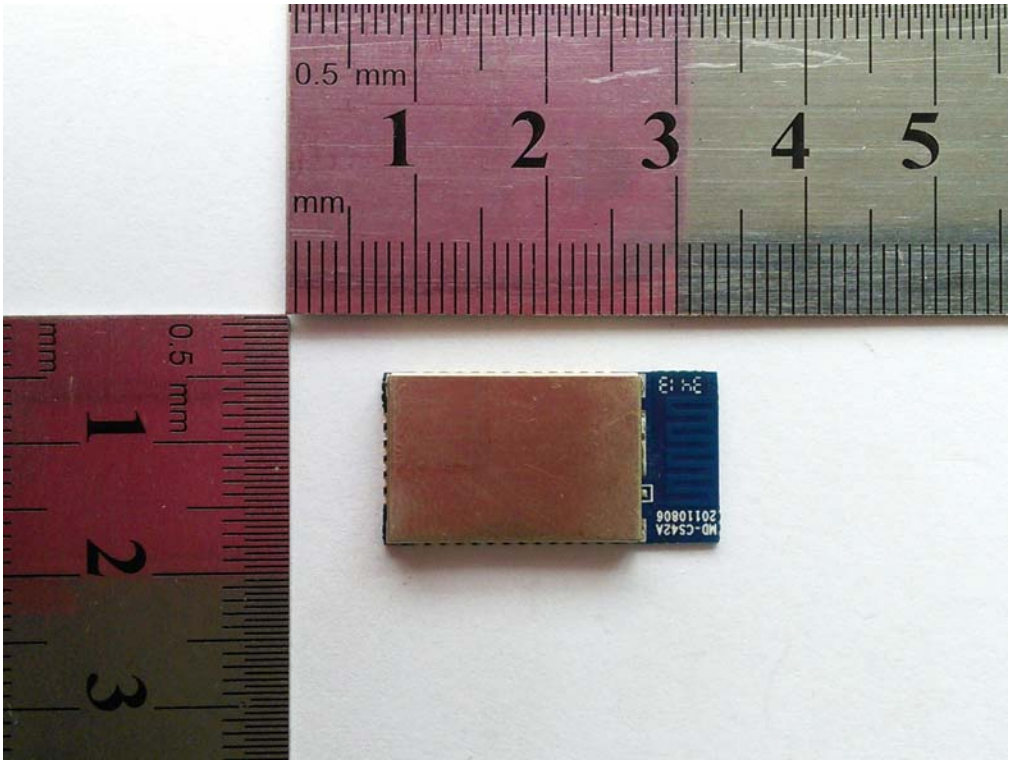
Set RBW = 1MHz, VBW = 10Hz.

Note:

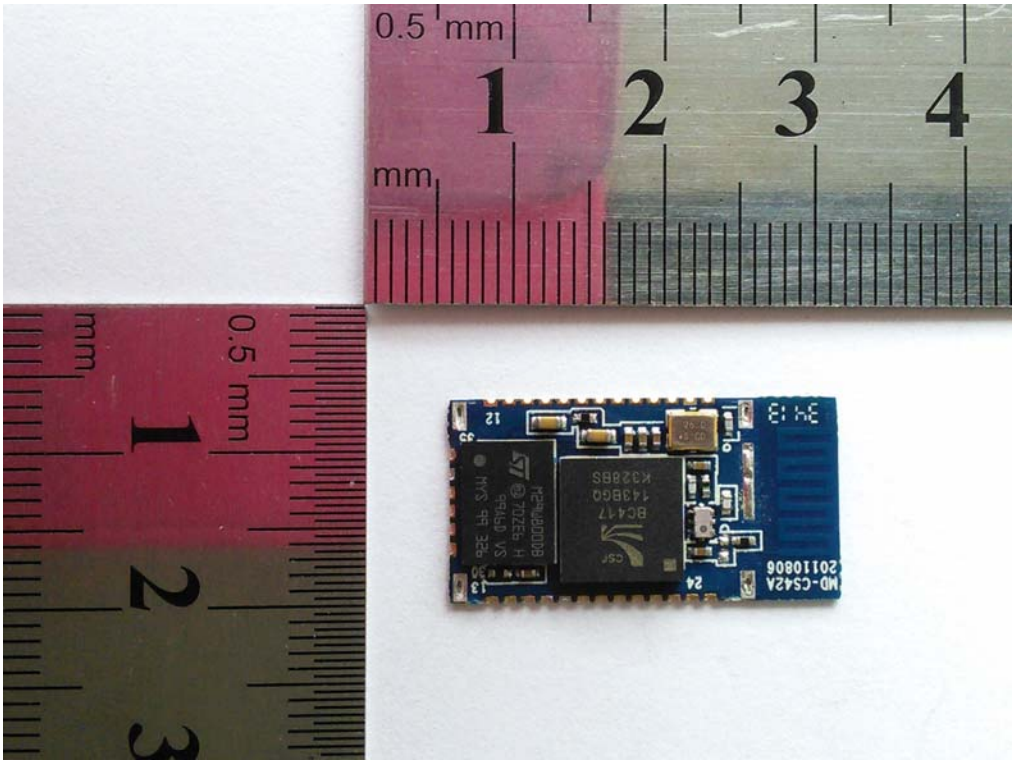
If the measured frequencies are fall in the restricted frequency band, the limit employed must be quasi peak value when frequencies are below or equal to 1 GHz. And the measuring instrument is set to quasi peak detector function.

Annex B. EUT AND TEST SETUP PHOTOGRAPHS

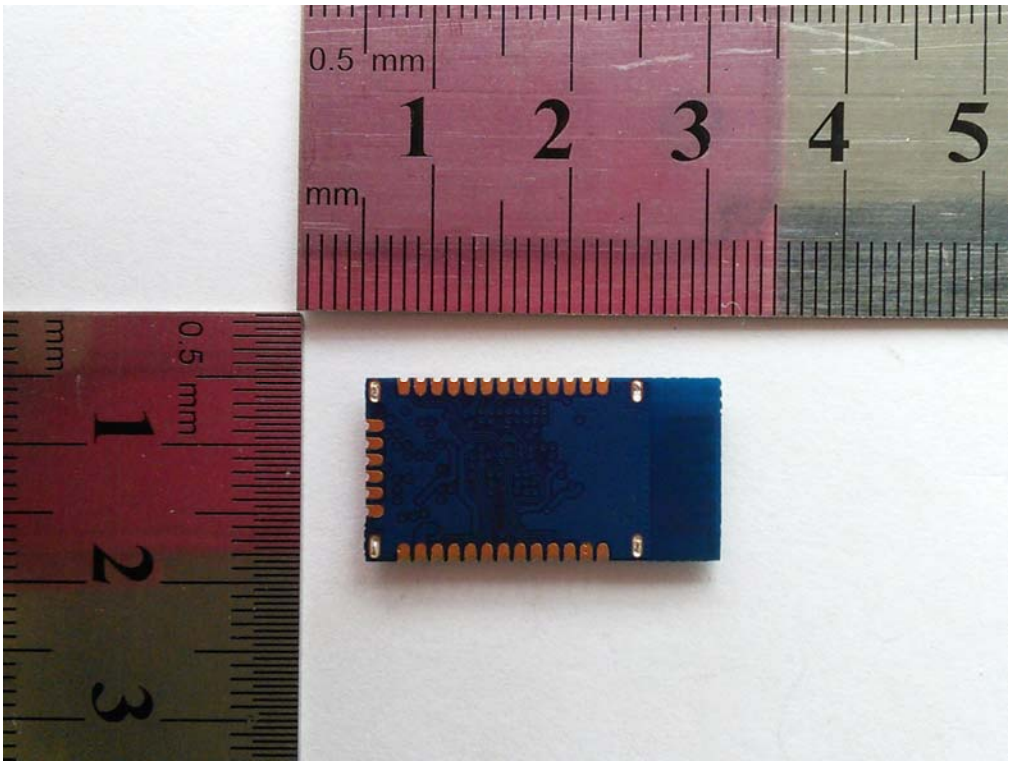
Annex B.i. Photograph 1: EUT External Photo



EUT - Whole View

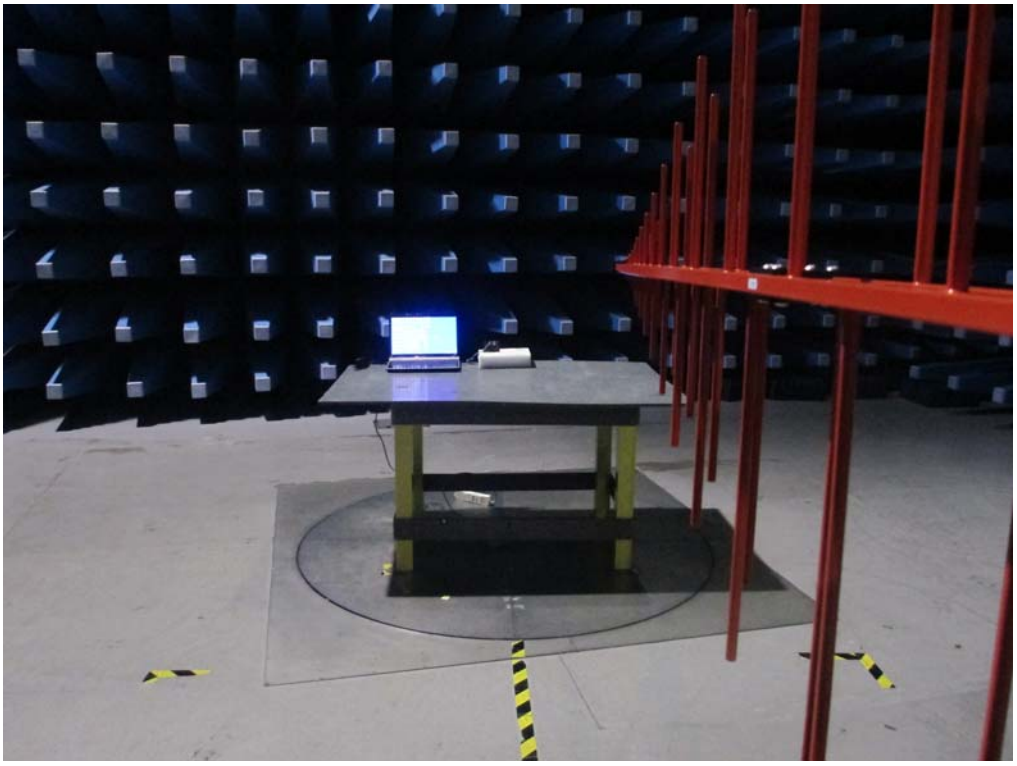


EUT – Front (without shielding) View

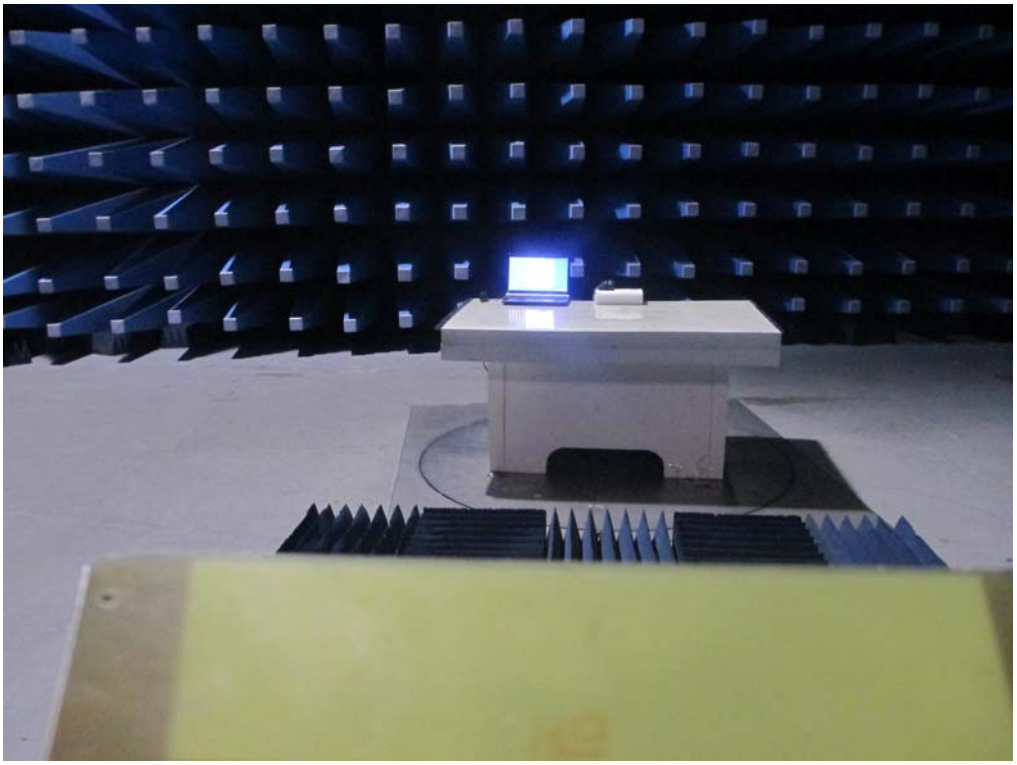


EUT – Rear View

Annex B.ii. Photograph 2: Test Setup Photo



Radiated Emissions Test Setup Below 1GHz - Front View



Radiated Emissions Test Setup Above 1GHz - Front View

Annex C. TEST SETUP AND SUPPORTING EQUIPMENT

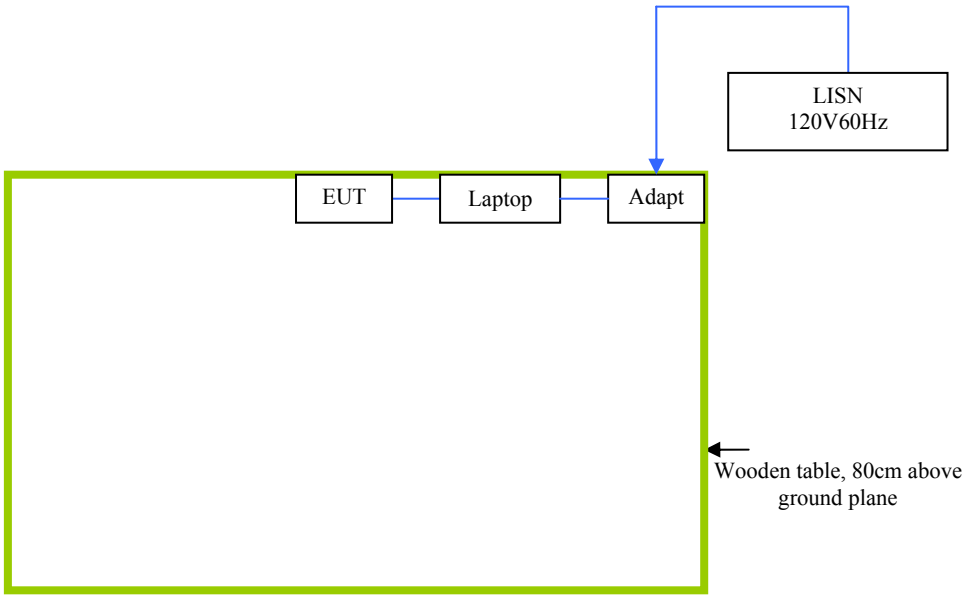
EUT TEST CONDITIONS

Annex C. i. SUPPORTING EQUIPMENT DESCRIPTION

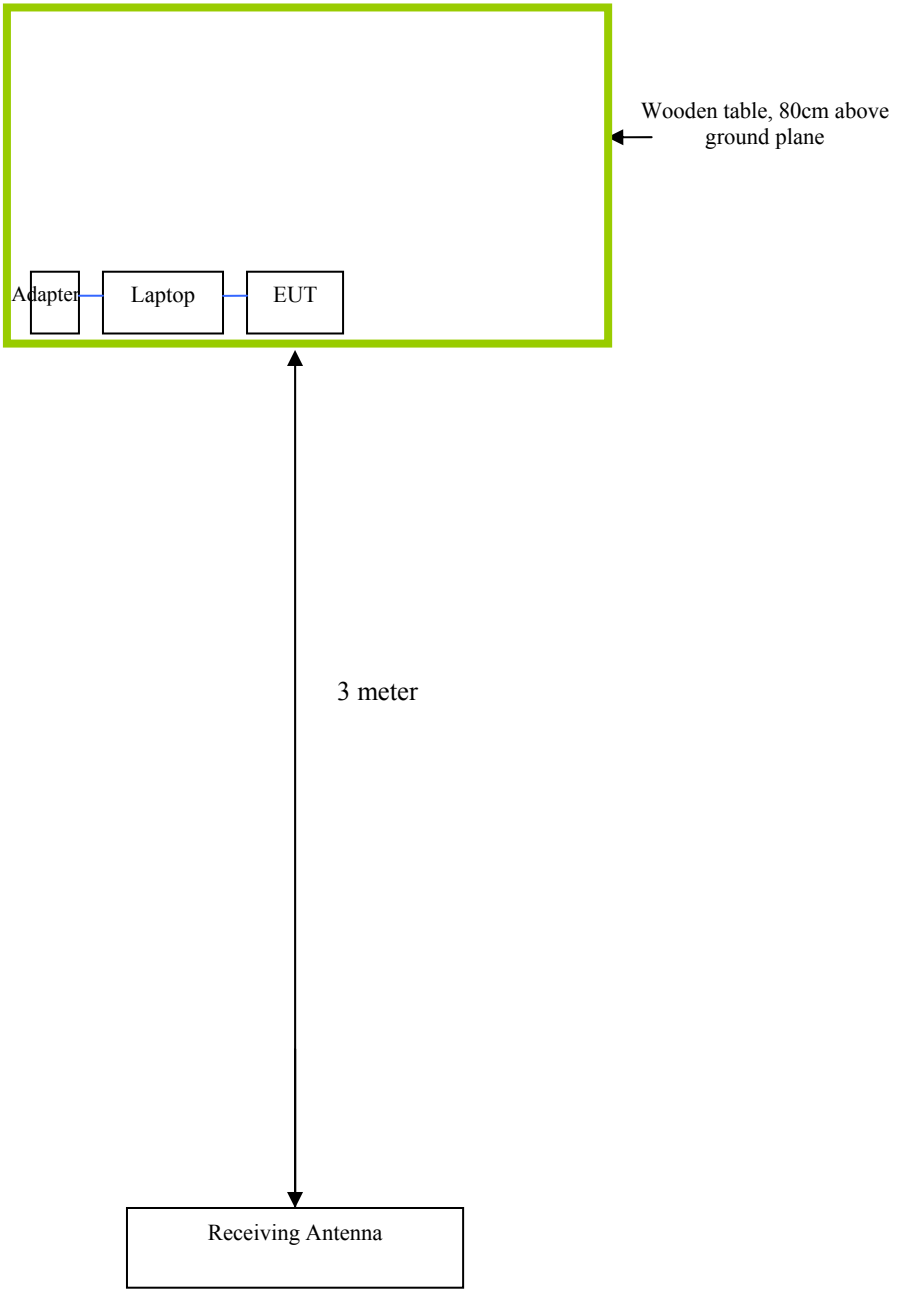
The following is a description of supporting equipment and details of cables used with the EUT.

Manufacturer	Equipment Description (Including Brand Name)	Model	Calibration Date	Calibration Due Date
DELL	PC	MX-01XGM4-74262-097-1L2LX	N/A	N/A

Block Configuration Diagram for Conducted Emissions



Block Configuration Diagram for Radiated Emissions



Annex C.ii. EUT OPERATING CONDITIONS

The following is the description of how the EUT is exercised during testing.

Test	Description Of Operation
Emissions Testing	The EUT was continuously transmitting to stimulate the worst case.

Annex D. USER MANUAL / BLOCK DIAGRAM / SCHEMATICS / PART LIST

Please see attachment

Annex E. DECLARATION OF SIMILARITY

N/A