

**ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
INTENTIONAL RADIATOR CERTIFICATION TO
FCC PART 15 SUBPART C REQUIREMENT**

OF

Ohm

MODEL No.: Ohm

FCC ID: 2AAAH-OHM001

Trademark: Quirky

REPORT NO: ES141017109E1

ISSUE DATE: November 07, 2014

Prepared for
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VERIFICATION OF COMPLIANCE

Applicant:	Quirky, Inc. 606 W 28th St Floor 7 New York, NY 10001 United States
Manufacturer:	Quirky, Inc. 606 W 28th St Floor 7 New York, NY 10001 United States
Product Name:	Ohm
Model Number:	Ohm
Serial Number:	0000000000000000
File Number:	ES141017109E1

We hereby certify that:

The above equipment was tested by SHENZHEN EMTEK CO., LTD. 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 conducted and radiated emission limits of FCC Rules Part 15.247.

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

Date of Test : October 17, 2014 to November 07, 2014

Yaping Shen

Prepared by : Yaping Shen/Editor

Jack Li

Reviewer : Jack Li/Supervisor

Lisa Wang

Approve & Authorized Signer : Lisa Wang/Manager

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1. GENERAL INFORMATION

1.1 Product Description

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: Bluetooth: 2402-2480MHz,
- B). Modulation: BT DSS: GFSK, $\pi/4$ -DQPSK, 8DPSK; DTS:GFSK
- C). Number of Channel: DSS:79 Channels; DTS: 40 Channels;
- D).Conducted Power: DSS: 2.582dBm; DTS:-0.593dBm
- E) Antenna Gain: -1.72dBi
- F). Antenna Type: Integral Antenna
- G). Power Supply: AC 100-240V~50/60Hz 1.2A

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: 2AAAH-OHM001 filing to comply with Section 15.247 of the FCC Part 15 Subpart C Rules.

1.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4 (2009) and FCC Public Notice DA 00-705. Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4 Special Accessories

Not available for this EUT intended for grant.

1.5 Equipment Modifications

Not available for this EUT intended for grant.

1.6 Test Facility

Site Description

EMC Lab.

: Accredited by CNAS, 2013.10.29
The certificate is valid until 2016.10.28
The Laboratory has been assessed and proved to be in compliance with CNAS/CL01:2006(identical to ISO/IEC17025: 2005)
The Certificate Registration Number is L2291

Accredited by TUV Rheinland Shenzhen 2010.5.25
The Laboratory has been assessed according to the requirements ISO/IEC 17025

Accredited by FCC, April 17, 2013
The Certificate Registration Number is 406365.

Accredited by Industry Canada, March 5, 2010
The Certificate Registration Number is 4480A-2.

Name of Firm

: SHENZHEN EMTEK CO., LTD

Site Location

: Bldg 69, Majialong Industry Zone,
Nanshan District, Shenzhen, Guangdong, China

2. System Test Configuration

2.1 EUT Configuration

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

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4-2009 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter(EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4-2009.

2.4 Limitation

(1) Channel Separation test

FCC Part 15, Subpart C Section 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 Bandwidth of the hopping channel, whichever is greater.

Frequency Range (MHz)	Limit(kHz)
902-928	>25kHz
2400-2483.5	>25kHz
5725-5850	>25kHz

		20dB Bandwidth			
Frequency	Limit(kHz)				
Range(MHz)	Quantity of Hopping Channel	50	25	15	75
	902-928	<250	>250	NA	NA
	2400-2483.5	NA	NA	>1000	<1000

(3) Quantity of Hopping Channel

FCC Part 15, Subpart C Section 15.247

Frequency	Limit(Quantity of Hopping Channel)			
	20dB	20dB	20dB	20dB
Range (MHz)	bandwidth	bandwidth	bandwidth	bandwidth
	<250kHz	>250 kHz	<1MHz	>1M Hz
902-928	50	25	NA	NA
2400-2483.5	NA	NA	75	15
5725-5850	NA	NA	75	NA

(4) Time of Occupancy(Dwell Time)

FCC Part 15, Subpart C Section 15.247

Frequency Range	LIMIT(rms)		
	20dB bandwidth	20dB	20dB bandwidth
(MHz)	<250kHz(50Channel)	bandwidth >250kHz(25Channel)	<1MHz(75Channel)
902-928	400(20S)	400(10S)	NA
2400-2483.5	NA	NA	400(30S)
5725-5850	NA	NA	400(30S)

Note: The “()” is all channel’s average time of occupancy.

(5) Maximum Peak Output Power

FCC Part 15, Subpart C Section 15.247

Frequency	Quantity of	LIMIT(W)			
		50	25	15	75
Range (MHz)	Hopping Channel				
902-928		1(30dBm)	0.125(21dBm)	NA	NA
2400-2483.5		NA	NA	0.125(21dBm)	1(30dBm)
5725-5850		NA	NA	NA	1(30dBm)

(6) Band edge

FCC Part15, Subpart C Section 15.247, In any 100kHz bandwidth outside the frequency band in with the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Operating Frequency Range(MHz)	Spurious emission frequency	Limit Peak power ration to emission(dBc)	Emission level(dBuV/m)
902-928	<902	>20	NA
	>928	>20	NA
	960-1240	NA	54
2400-2483.5	<2400	>20	NA
	>2483.5-2500	NA	54
5725-5850	<5350-5460	NA	54
	<5725	>20	NA
	>5850	>20	NA

(7) Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

(8) Radiated Emission

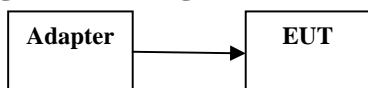
FCC Part 15, Subpart C Section 15.209 limit of radiated emission for frequency below 1000GHz. The emissions from an intentional radiator shall not exceed the field strength level specified in the following table:

Frequency (MHz)	Field strength $\mu\text{V/m}$	Distance(m)	Field strength at 3m dB $\mu\text{V/m}$
0.009~0.490	2400/F(KHz)	300	See the remark
0.490~1.705	2400/F(KHz)	30	
1.705~30.0	30	30	
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

Remark: 1. Emission level in dB $\mu\text{V/m}$ =20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dB μV) + distance extrapolation factor.

2.5 Configuration of Tested System

Fig. 2-1 Configuration of Tested System



2.6 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.	Note
1.	Ohm	Quirky	Ohm	2AAAH-OHM001	N/A	EUT
2.	iPhone 5C	Apple	A1387	BCG-E2430A	N/A	Support equipment

Note:

- (1) Unless otherwise denoted as EUT in 『Remark』 column , device(s) used in tested system is a support equipment.

2.7 Description of test modes

The EUT has been tested under TX operating condition.

This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, All the modes GFSK, $\pi/4$ -DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel	Frequency(MHz)
1	2402
40	2441
79	2480

3. Summary of Test Results

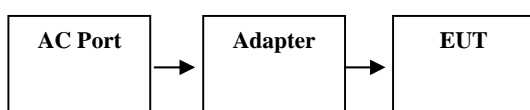
FCC Rule	Description Of Test	Result
15.247(a)(1)	Channel Separation test	Pass
15.247(a)(1)	20dB Bandwidth	Pass
15.247(a)(1)	Quantity of Hopping Channel	Pass
15.247(a)(1)	Time of Occupancy (Dwell Time)	Pass
15.247(b)(1)	Max Peak output Power test	Pass
15.247(d)	Band edge test	Pass
15.207	AC Power Conducted Emission	Pass
15.247(d)	Radiated Emission	Pass
§15.247(d)	Antenna Port Emission	Pass
15.203&15.247(b)	Antenna Application	Pass

4. Conducted Emissions Test

4.1 Measurement 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.

4.2 Test SET-UP (Block Diagram of Configuration)



4.3 Measurement Equipment Used:

Conducted Emission Test Site # 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Receiver	Rohde & Schwarz	ESCS30	828985/018	05/17/2014	05/16/2015
L.I.S.N	Rohde & Schwarz	ESH2-Z5	834549/005	05/17/2014	05/16/2015
50ΩCoaxial Switch	Anritsu	MP59B	M20531	05/17/2014	05/16/2015

4.4 Conducted Emission Limit

(7) Conducted Emission

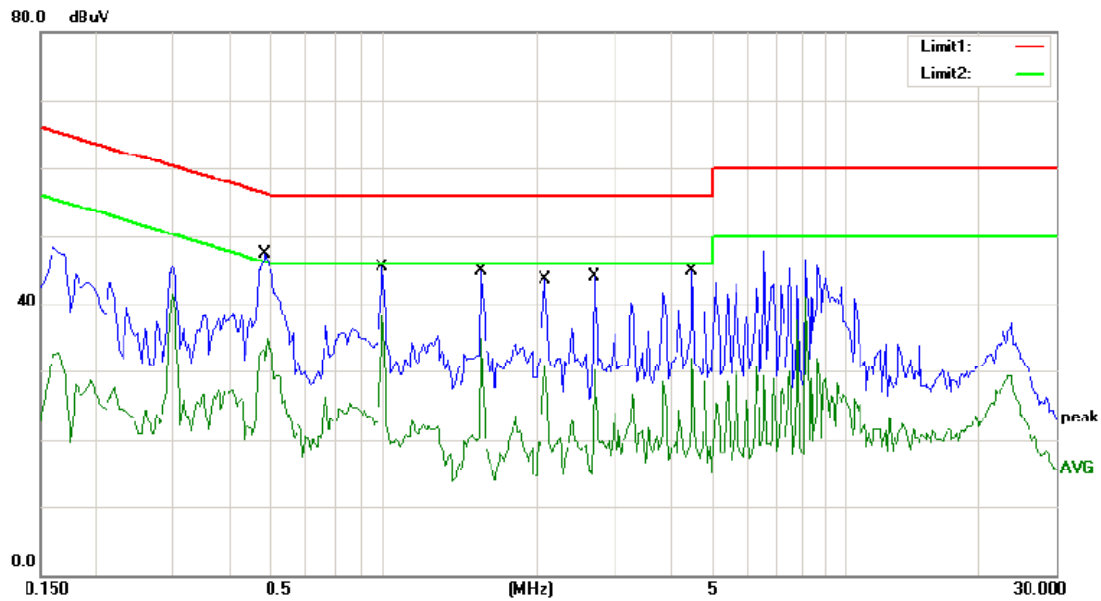
Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.5 Measurement Result:

PASS



Site Conduction #1

Phase: **L1**

Temperature: 26

Limit: (CE)FCC PART 15 C

Power: AC 120V/60Hz

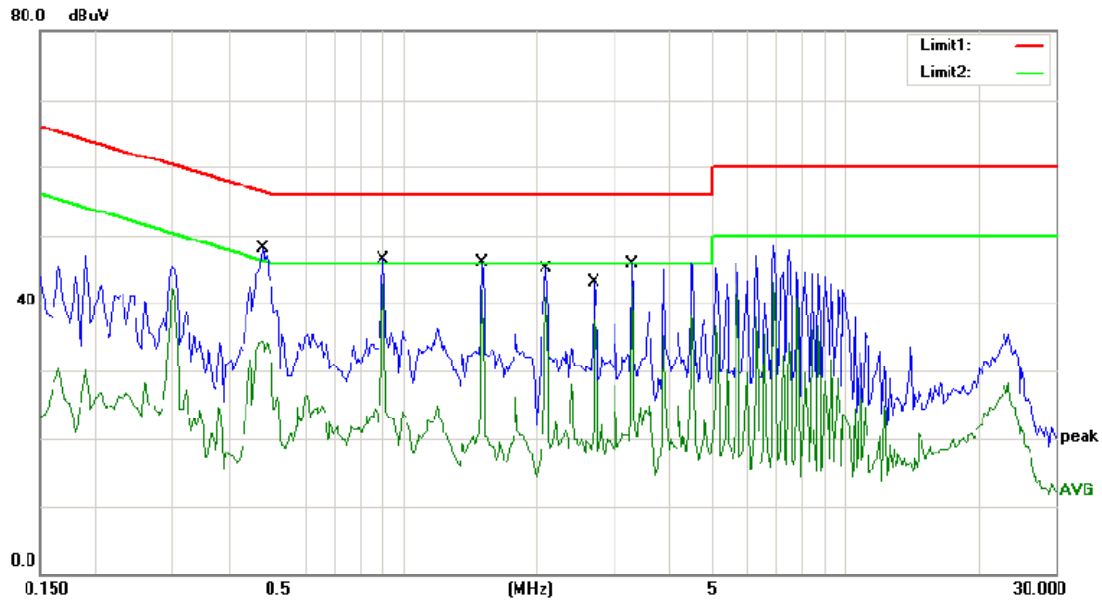
Humidity: 60 %

Mode: Bluetooth ON

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.4850	47.48	0.00	47.48	56.25	-8.77	QP	
2		0.4850	34.91	0.00	34.91	46.25	-11.34	AVG	
3		0.8950	45.51	0.00	45.51	56.00	-10.49	QP	
4	*	0.8950	38.06	0.00	38.06	46.00	-7.94	AVG	
5		1.4850	44.93	0.00	44.93	56.00	-11.07	QP	
6		1.4850	34.99	0.00	34.99	46.00	-11.01	AVG	
7		2.0800	43.79	0.00	43.79	56.00	-12.21	QP	
8		2.0800	30.81	0.00	30.81	46.00	-15.19	AVG	
9		2.6900	44.02	0.00	44.02	56.00	-11.98	QP	
10		2.6900	30.04	0.00	30.04	46.00	-15.96	AVG	
11		4.4900	44.82	0.00	44.82	56.00	-11.18	QP	
12		4.4900	31.85	0.00	31.85	46.00	-14.15	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver. Operator: csl



Site Conduction #1

Phase: **N**

Temperature: 26

Limit: (CE)FCC PART 15 C

Power: AC 120V/60Hz

Humidity: 60 %

Mode: Bluetooth ON

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.4800	48.10	0.00	48.10	56.34	-8.24	QP	
2		0.4800	34.36	0.00	34.36	46.34	-11.98	AVG	
3		0.9000	46.60	0.00	46.60	56.00	-9.40	QP	
4	*	0.9000	42.87	0.00	42.87	46.00	-3.13	AVG	
5		1.5000	46.17	0.00	46.17	56.00	-9.83	QP	
6		1.5000	42.08	0.00	42.08	46.00	-3.92	AVG	
7		2.1000	45.03	0.00	45.03	56.00	-10.97	QP	
8		2.1000	40.99	0.00	40.99	46.00	-5.01	AVG	
9		2.7000	43.04	0.00	43.04	56.00	-12.96	QP	
10		2.7000	37.43	0.00	37.43	46.00	-8.57	AVG	
11		3.3000	45.99	0.00	45.99	56.00	-10.01	QP	
12		3.3000	42.42	0.00	42.42	46.00	-3.58	AVG	

*:Maximum data x:Over limit l:over margin Comment: Factor build in receiver. Operator: csl

5. Radiated Emission Test

5.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured was complete.

When spectrum scanned from 30 MHz to 1GHz setting resolution bandwidth 120 kHz and video bandwidth 300kHz.

EMI Test Receiver	Setting
Attenuation	Auto
RB	120kHz
VB	300kHz
Detector	QP
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz.

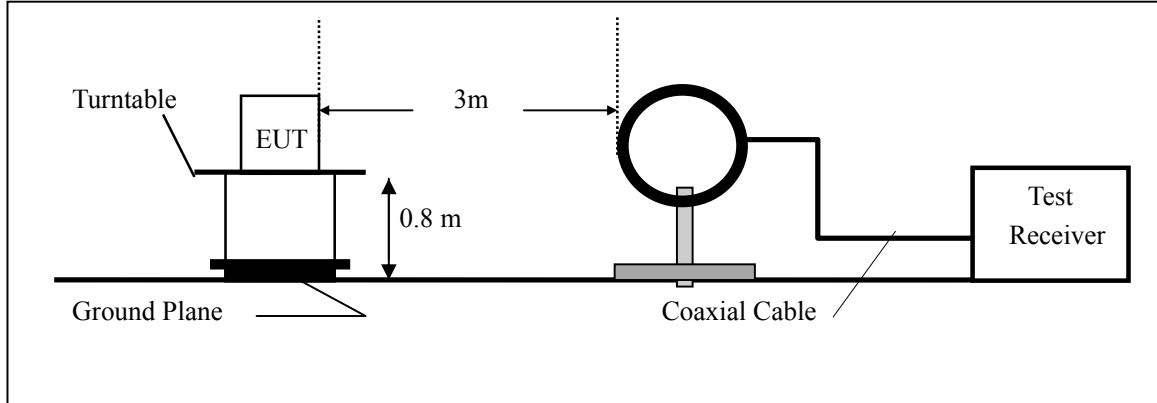
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz.

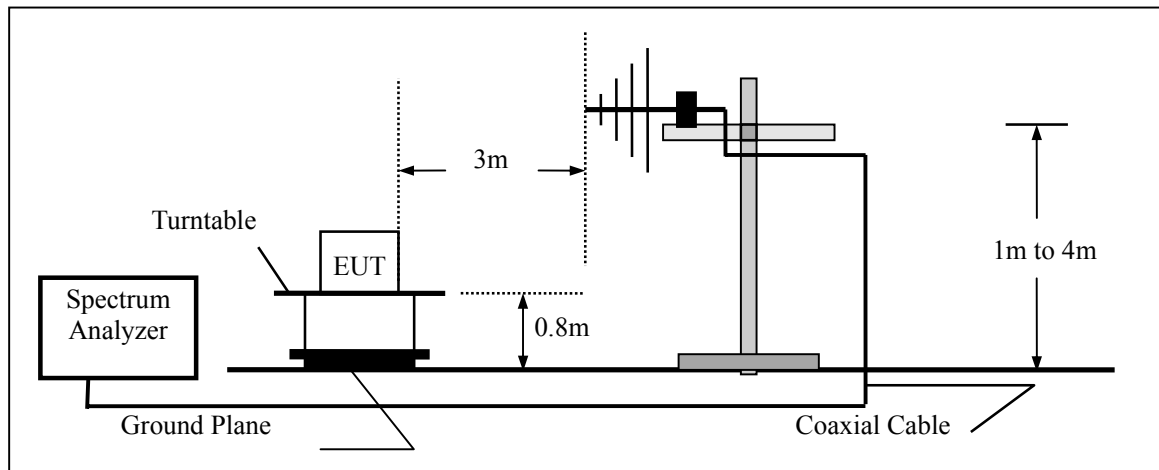
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

5.2 Test SET-UP (Block Diagram of Configuration)

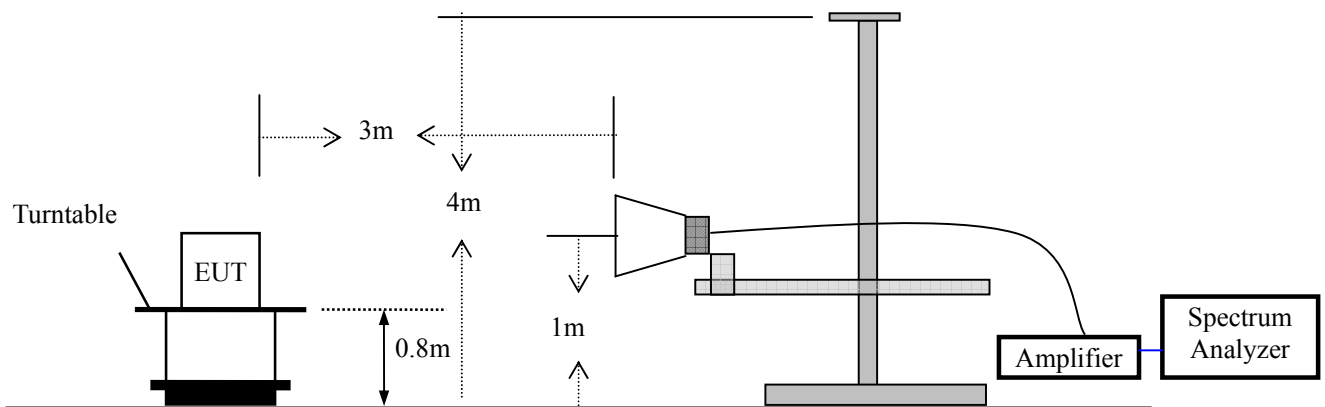
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



5.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSP7	839511/010	05/17/2014	05/16/2015
Spectrum Analyzer	HP	E4407B	839840481	05/17/2014	05/16/2015
EMI Test Receiver	Rohde & Schwarz	ESCS30	828985/018	05/17/2014	05/16/2015
Pre-Amplifier	HP	8447D	2944A07999	05/17/2014	05/16/2015
Bilog Antenna	Schwarzbeck	VULB9163	142	05/17/2014	05/16/2015
Loop Antenna	ARA	PLA-1030/B	1029	05/17/2014	05/16/2015
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	05/17/2014	05/16/2015
Horn Antenna	Schwarzbeck	BBHA 9120	D143	05/17/2014	05/16/2015

5.4 Measurement Result

All the modulation modes were tested the data of the worst mode (GFSK) are recorded in the following pages and all modulation methods do not exceed the above mentioned limits.

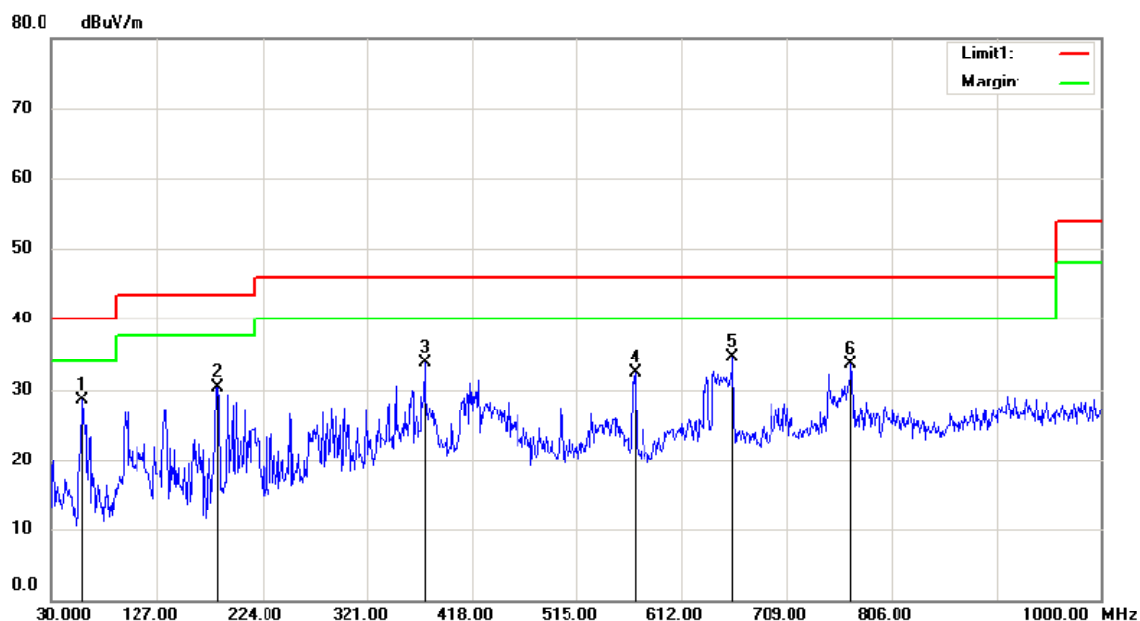
Operation Mode: Bluetooth Mode Test Date : October 21, 2014
Frequency Range: 9KHz~30MHz Temperature : 24°C
Test Result: PASS Humidity : 53 %
Measured Distance: 3m Test By: KK

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Operation Mode: 2402MHz
Frequency Range: 30~1000MHz
Test Result: PASS
Measured Distance: 3m
Test mode: GFSK

Test Date : October 21, 2014
Temperature : 24℃
Humidity : 53 %
Test By: KK



Site 3m Chamber #1

Polarization: **Horizontal**

Temperature: 24 C

Limit: (RE)FCC Part 15 C

Power: AC 120V 60Hz

Humidity: 53 %

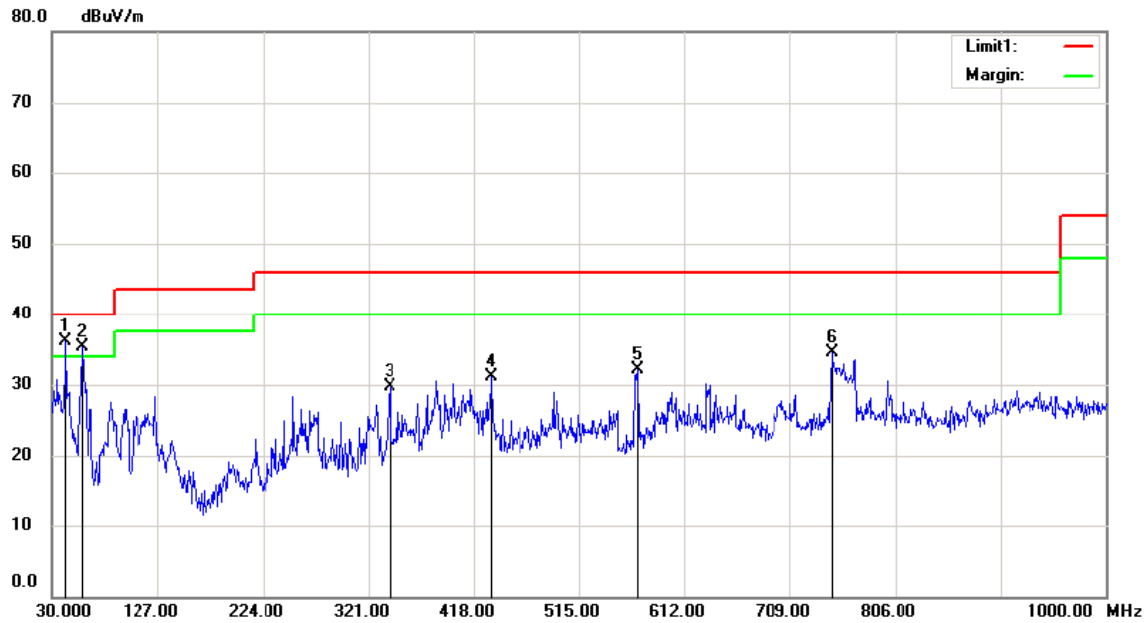
Mode:TX2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1	*	58.1300	43.07	-14.50	28.57	40.00	-11.43	QP		
2		183.2600	47.38	-17.01	30.37	43.50	-13.13	QP		
3		375.3200	42.63	-8.93	33.70	46.00	-12.30	QP		
4		568.3500	39.76	-7.45	32.31	46.00	-13.69	QP		
5		659.5300	38.64	-4.12	34.52	46.00	-11.48	QP		
6		768.1700	36.03	-2.58	33.45	46.00	-12.55	QP		

*:Maximum data x:Over limit !:over margin

Operator: SYP



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 24 C

Limit: (RE)FCC Part 15 C

Power: AC 120V 60Hz

Humidity: 53 %

Mode:TX2402

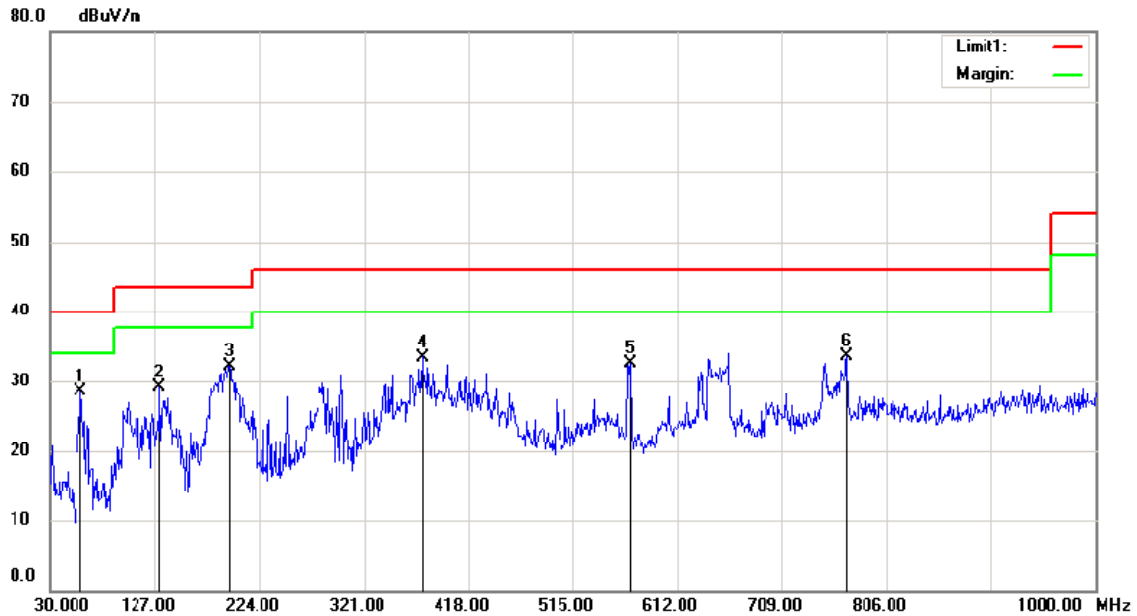
Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	42.6100	47.61	-11.42	36.19	40.00	-3.81	QP		
2	!	58.1300	49.78	-14.50	35.28	40.00	-4.72	QP		
3		340.4000	40.21	-10.47	29.74	45.00	-16.26	QP		
4		434.4900	40.24	-9.05	31.19	45.00	-14.81	QP		
5		568.3500	39.47	-7.45	32.02	45.00	-13.98	QP		
6		747.8000	37.89	-3.34	34.55	45.00	-11.45	QP		

*:Maximum data x:Over limit !:over margin

Operator: SYP

Operation Mode: 2441MHz Test Date : October 21, 2014
Frequency Range: 30~1000MHz Temperature : 24°C
Test Result: PASS Humidity : 53 %
Measured Distance: 3m Test By: KK
Test mode: GFSK

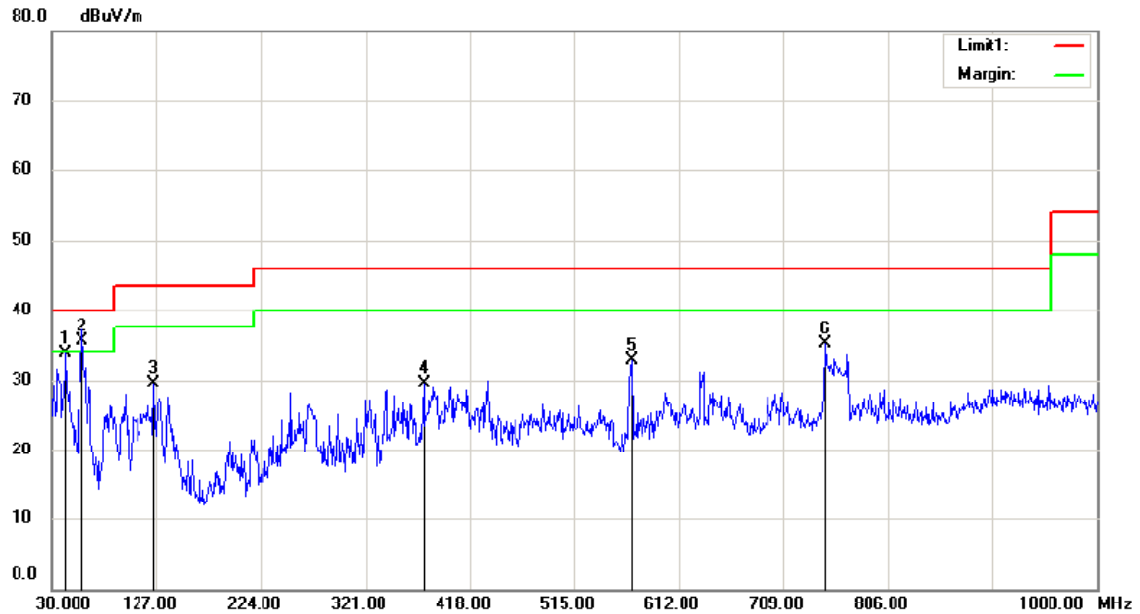


Site 3m Chamber #1 Polarization: **Horizontal** Temperature: 24 C
Limit: (RE)FCC Part 15 C Power: AC 120V 60Hz Humidity: 53 %
Mode: IX2441
Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		58.1300	42.91	-14.50	28.41	40.00	-11.59	QP		
2		131.8500	45.53	-16.50	29.03	43.50	-14.47	QP		
3	*	195.8700	47.56	-15.36	32.20	43.50	-11.30	QP		
4		375.3200	42.33	-8.93	33.40	46.00	-12.60	QP		
5		568.3500	40.04	-7.45	32.59	46.00	-13.41	QP		
6		769.1400	35.96	-2.54	33.42	46.00	-12.58	QP		

*:Maximum data x:Over limit !:over margin

Operator: SYP



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 24 C

Limit: (RE)FCC Part 15 C

Power: AC 120V 60Hz

Humidity: 53 %

Mode:TX2441

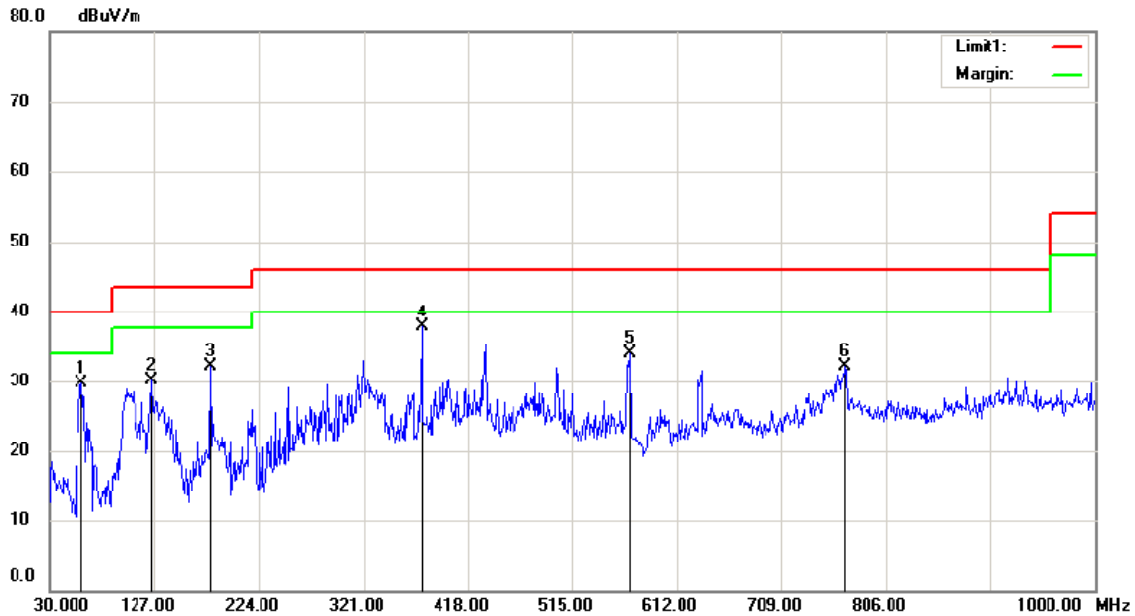
Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		42.6100	45.18	-11.42	33.76	40.00	-6.24	QP		
2	*	58.1300	50.10	-14.50	35.60	40.00	-4.40	QP		
3		125.0600	45.85	-16.39	29.46	43.50	-14.04	QP		
4		375.3200	38.50	-8.93	29.57	46.00	-16.43	QP		
5		568.3500	40.08	-7.45	32.63	46.00	-13.37	QP		
6		748.7700	38.41	-3.25	35.16	46.00	-10.84	QP		

*:Maximum data x:Over limit l:over margin

Operator: SYP

Operation Mode: 2480MHz Test Date : October 21, 2014
Frequency Range: 30~1000MHz Temperature : 24℃
Test Result: PASS Humidity : 53 %
Measured Distance: 3m Test By: KK
Test mode: GFSK

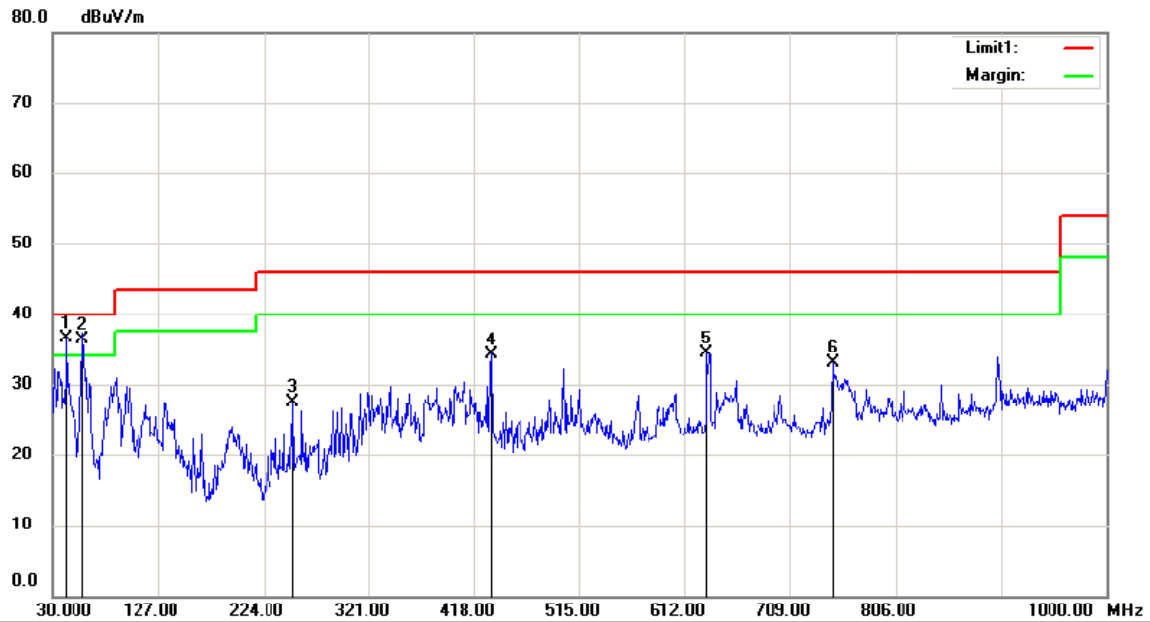


Site 3m Chamber #1 Polarization: **Horizontal** Temperature: 24 C
Limit: (RE)FCC Part 15 C Power: AC 120V 60Hz Humidity: 53 %
Mode:TX 2480
Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		59.1000	43.58	-13.91	29.67	40.00	-10.33	QP		
2		125.0600	46.50	-16.39	30.11	43.50	-13.39	QP		
3		179.3800	49.77	-17.68	32.09	43.50	-11.41	QP		
4	*	375.3200	46.60	-8.93	37.67	46.00	-8.33	QP		
5		568.3500	41.28	-7.45	33.83	46.00	-12.17	QP		
6		768.1700	34.62	-2.58	32.04	46.00	-13.96	QP		

*:Maximum data x:Over limit !:over margin

Operator: SYP



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	42.6100	47.98	-11.42	36.56	40.00	-3.44	QP		
2	!	58.1300	50.90	-14.50	36.40	40.00	-3.60	QP		
3		252.1300	39.38	-11.87	27.51	46.00	-18.49	QP		
4		434.4900	43.25	-9.05	34.20	46.00	-11.80	QP		
5		632.3700	39.09	-4.71	34.38	46.00	-11.62	QP		
6		747.8000	36.32	-3.34	32.98	46.00	-13.02	QP		

*:Maximum data x:Over limit !:over margin

Operator: SYP

Operation Mode: CH1: 2402MHz Test Date : October 21, 2014
Frequency Range: 1-25GHz Temperature : 24℃
Test Result: PASS Humidity : 53 %
Measured Distance: 3m Test By: KK
Test mode: GFSK

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4808.00	V	46.15	35.90	74.00	54.00	-27.85	-18.10
7018.00	V	47.64	36.50	74.00	54.00	-26.36	-17.50
8225.00	V	47.97	36.40	74.00	54.00	-26.03	-17.60
9500.00	V	50.22	36.80	74.00	54.00	-23.78	-17.20
12169.00	V	48.43	37.90	74.00	54.00	-25.57	-16.10
14430.00	V	50.48	38.50	74.00	54.00	-23.52	-15.50
4808.00	H	47.63	35.40	74.00	54.00	-26.37	-18.60
7120.00	H	47.14	36.50	74.00	54.00	-26.86	-17.50
8480.00	H	49.34	36.90	74.00	54.00	-24.66	-17.10
9602.00	H	49.85	37.40	74.00	54.00	-24.15	-16.60
12101.00	H	49.40	37.50	74.00	54.00	-24.60	-16.50
14549.00	H	51.54	38.50	74.00	54.00	-22.46	-15.50

No others harmonics emissions are higher than 20dB below the limits of 47 CFR Part 15.247.

- Note:**
- (1) All Readings are Peak Value and AV.
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss.
 - (3) Data of measurement within this frequency range shown “ -- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

Operation Mode: CH40: 2441MHz Test Date : October 21, 2014
Frequency Range: 1-25GHz Temperature : 24°C
Test Result: PASS Humidity : 53 %
Measured Distance: 3m Test By: KK
Test mode: GFSK

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4876.00	V	50.50	35.80	74.00	54.00	-23.50	-18.20
7035.00	V	47.54	36.20	74.00	54.00	-26.46	-17.80
8480.00	V	48.33	36.20	74.00	54.00	-25.67	-17.80
9500.00	V	50.49	36.20	74.00	54.00	-23.51	-17.80
11540.00	V	49.44	37.40	74.00	54.00	-24.56	-16.60
14345.00	V	50.85	38.50	74.00	54.00	-23.15	-15.50
2428.00	H	42.56	36.80	74.00	54.00	-31.44	-17.20
4876.00	H	50.17	36.40	74.00	54.00	-23.83	-17.60
7256.00	H	47.78	37.10	74.00	54.00	-26.22	-16.90
9704.00	H	50.15	37.60	74.00	54.00	-23.85	-16.40
12050.00	H	49.18	38.20	74.00	54.00	-24.82	-15.80
13648.00	H	50.71	38.90	74.00	54.00	-23.29	-15.10

No others harmonics emissions are higher than 20dB below the limits of 47 CFR Part 15.247.

- Note:**
- (1) All Readings are Peak Value and AV.
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss.
 - (3) Data of measurement within this frequency range shown “ -- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

Operation Mode: CH79: 2480MHz Test Date : October 21, 2014
Frequency Range: 1-25GHz Temperature : 24℃
Test Result: PASS Humidity : 53 %
Measured Distance: 3m Test By: KK
Test mode: GFSK

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4468.00	V	45.58	35.70	74.00	54.00	-28.42	-18.30
4961.00	V	46.93	36.80	74.00	54.00	-27.07	-17.20
7749.00	V	48.32	36.50	74.00	54.00	-25.68	-17.50
9619.00	V	51.05	36.90	74.00	54.00	-22.95	-17.10
14566.00	V	51.85	37.40	74.00	54.00	-22.15	-16.60
16487.00	V	51.46	38.50	74.00	54.00	-22.54	-15.50
4961.00	H	45.94	35.40	74.00	54.00	-28.06	-18.60
8514.00	H	48.67	36.90	74.00	54.00	-25.33	-17.10
9551.00	H	49.44	37.10	74.00	54.00	-24.56	-16.90
13835.00	H	50.62	36.40	74.00	54.00	-23.38	-17.60
14498.00	H	51.40	37.50	74.00	54.00	-22.60	-16.50
17813.00	H	53.09	38.60	74.00	54.00	-20.91	-15.40

No others harmonics emissions are higher than 20dB below the limits of 47 CFR Part 15.247.

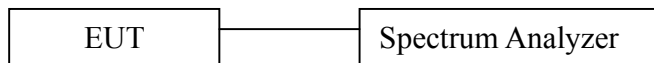
- Note:**
- (1) All Readings are Peak Value and AV.
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss.
 - (3) Data of measurement within this frequency range shown “ -- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

6. Channel Separation test

6.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

6.2 Test SET-UP (Block Diagram of Configuration)



6.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4407B	88156318	05/17/2014	05/16/2015

6.4 Measurement Results:

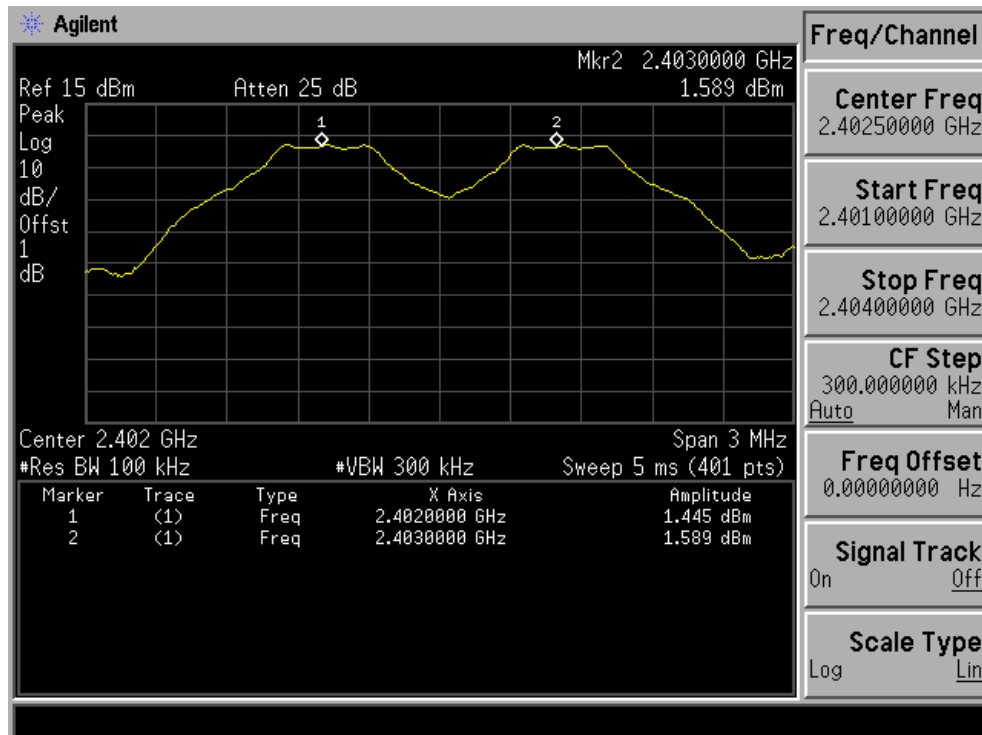
The following table is the setting of spectrum analyzer.

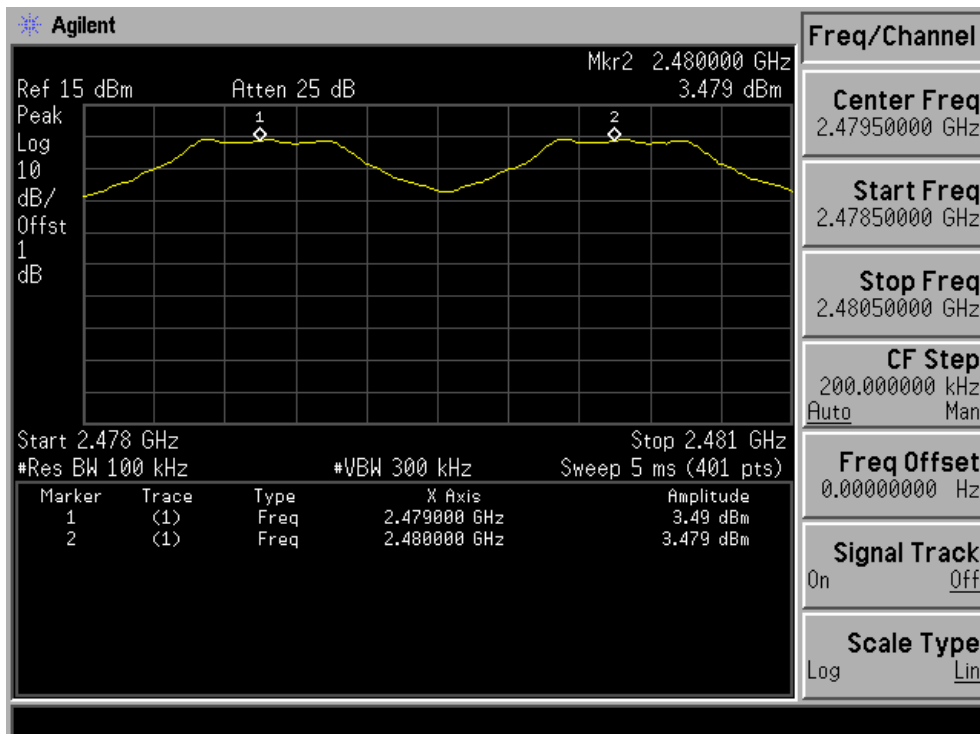
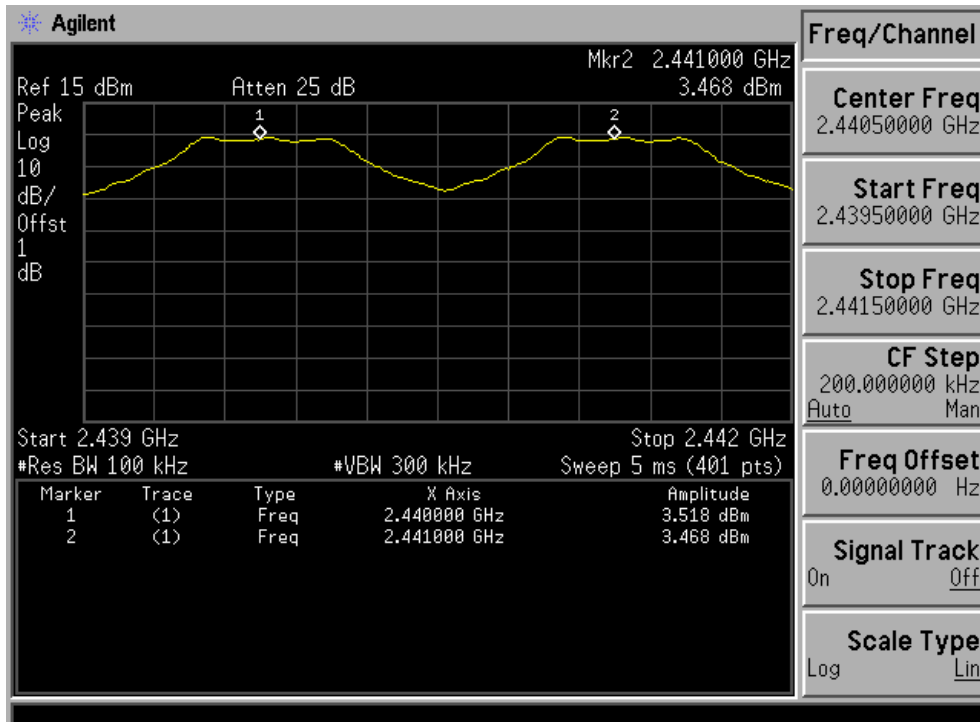
EMI Test Receiver	Setting
Attenuation	Auto
RB	100kHz
VB	300kHz
Detector	Peak
Trace	Max hold

All the modes GFSK, $\pi/4$ -DQPSK, 8DPSK have been tested and the result were recorded in the following pages and the others modulation methods do not exceed the limits.
Refer to attached data chart.

Spectrum Detector: PK Test Date : October 21, 2014
 Test By: SYP Temperature : 24°C
 Test Result: PASS Humidity : 53 %
 Modulation: GFSK

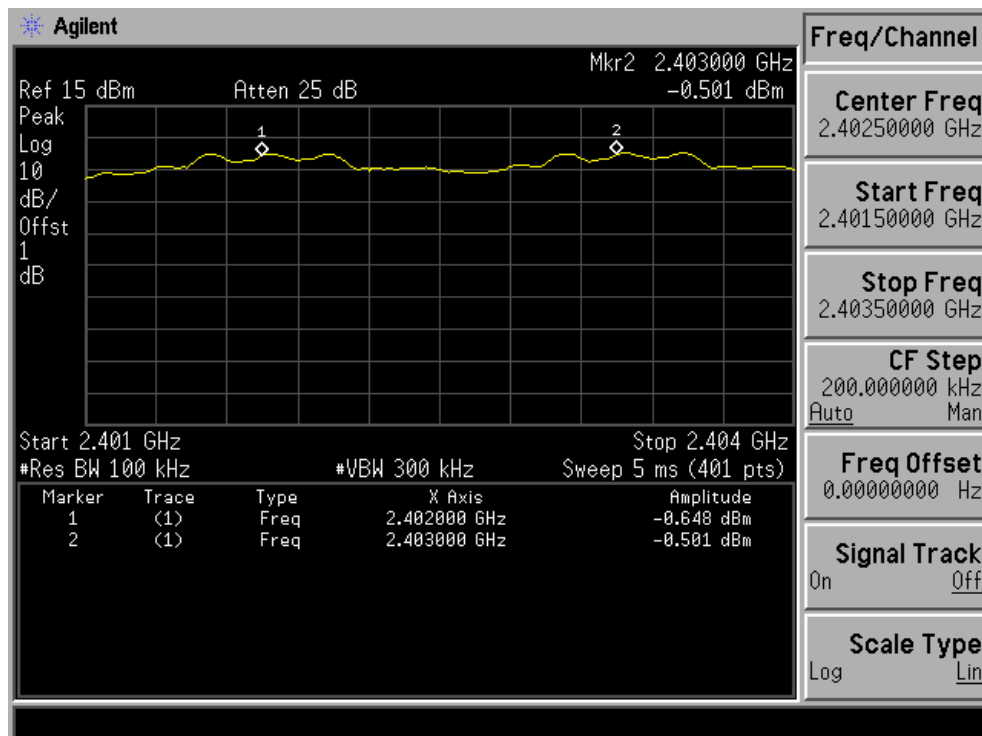
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 20dB Down BW(kHz)
1	2402	1000.00	>892.214
40	2441	1000.00	>866.841
79	2480	1000.00	>851.567

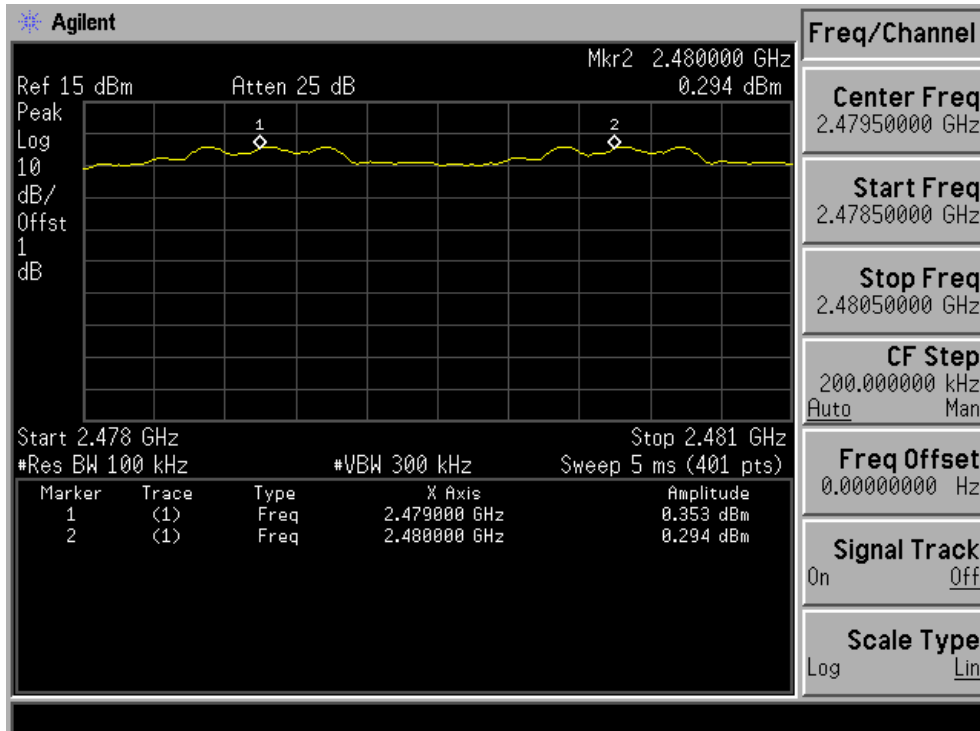
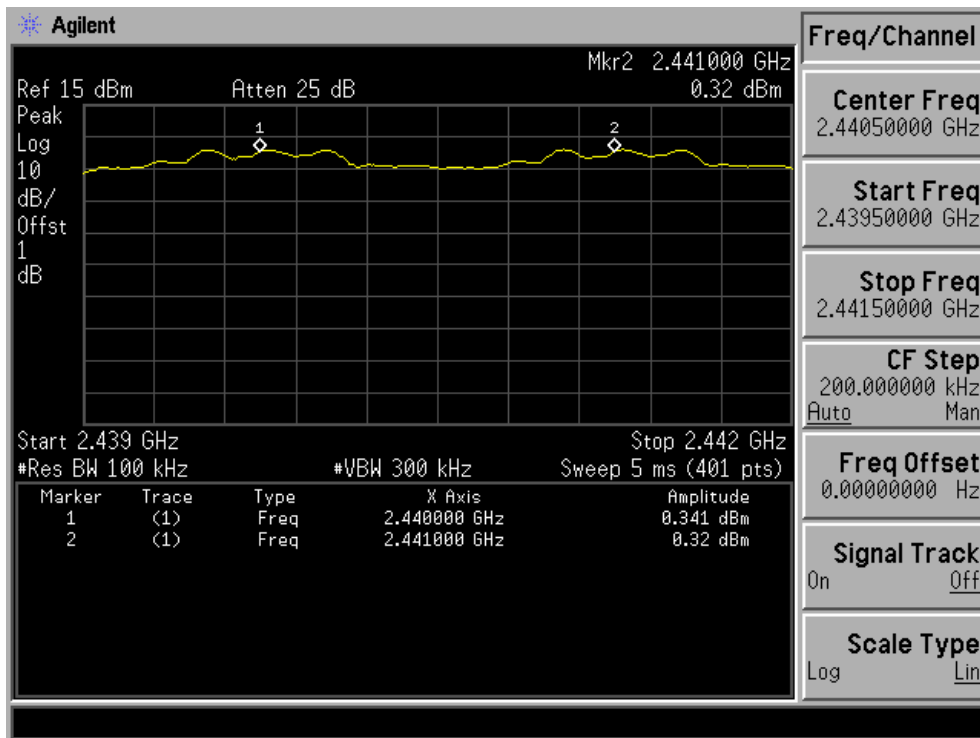




Spectrum Detector: PK Test Date : October 21, 2014
 Test By: SYP Temperature : 24℃
 Test Result: PASS Humidity : 53 %
 Modulation: $\pi/4$ DQPSK

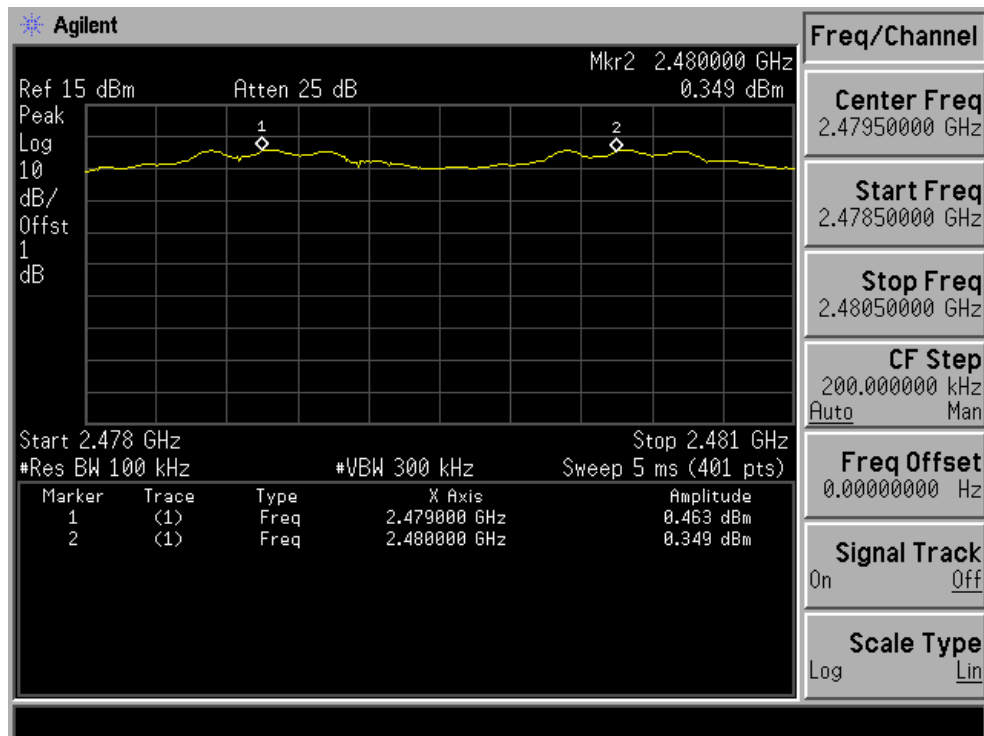
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1000.00	>805
40	2441	1000.00	>812
79	2480	1000.00	>806

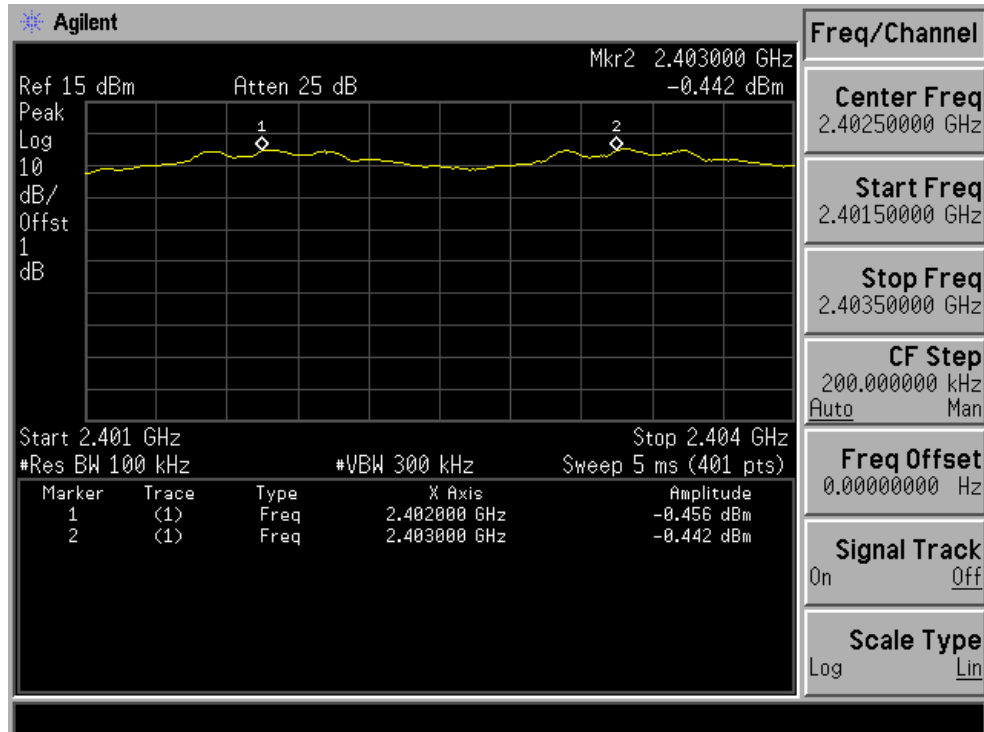
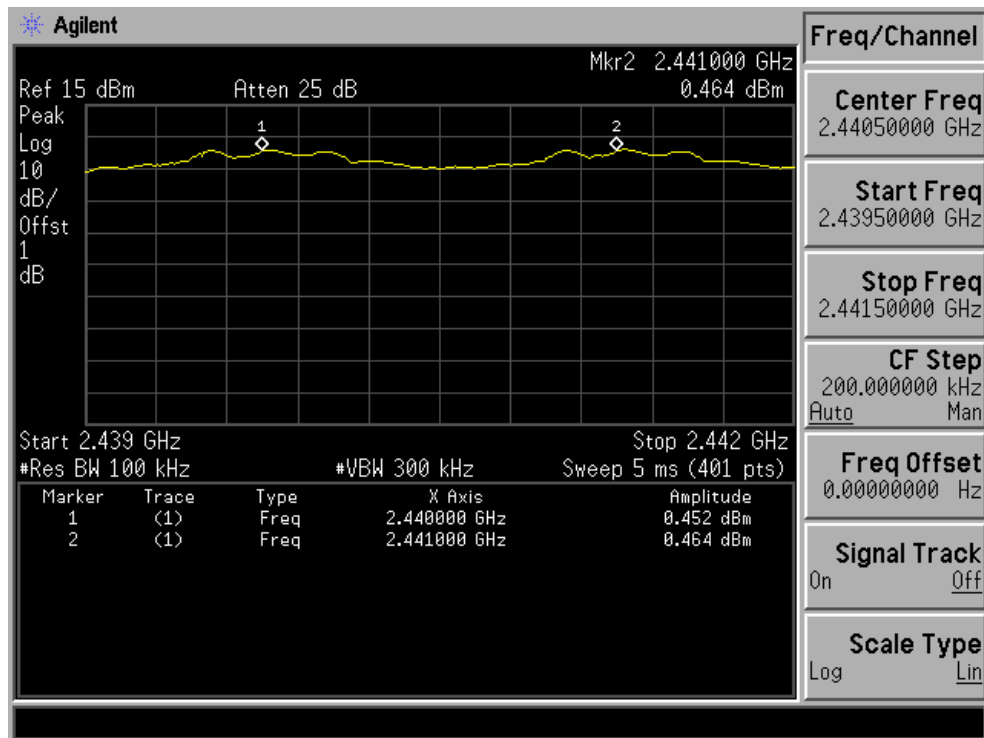




Spectrum Detector: PK Test Date : October 21, 2014
Test By: SYP Temperature : 24℃
Test Result: PASS Humidity : 53 %
Modulation: 8DPSK

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1000.00	>806
40	2441	1000.00	>815
79	2480	1000.00	>812



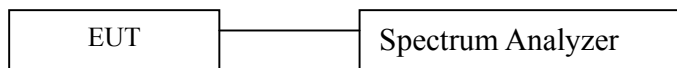


7. 20dB Bandwidth test

7.1 Measurement Procedure

- 1 The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 2 Set to the maximum power setting and enable the EUT transmit continuously
- 3 Make the measurement with the spectrum analyzer 's resolution bandwidth (RBW) = 30KHz.Set the Video bandwidth (VBW) = 100 kHz.
- 4 Measure and record the results in the test report.

7.2 Test SET-UP (Block Diagram of Configuration)

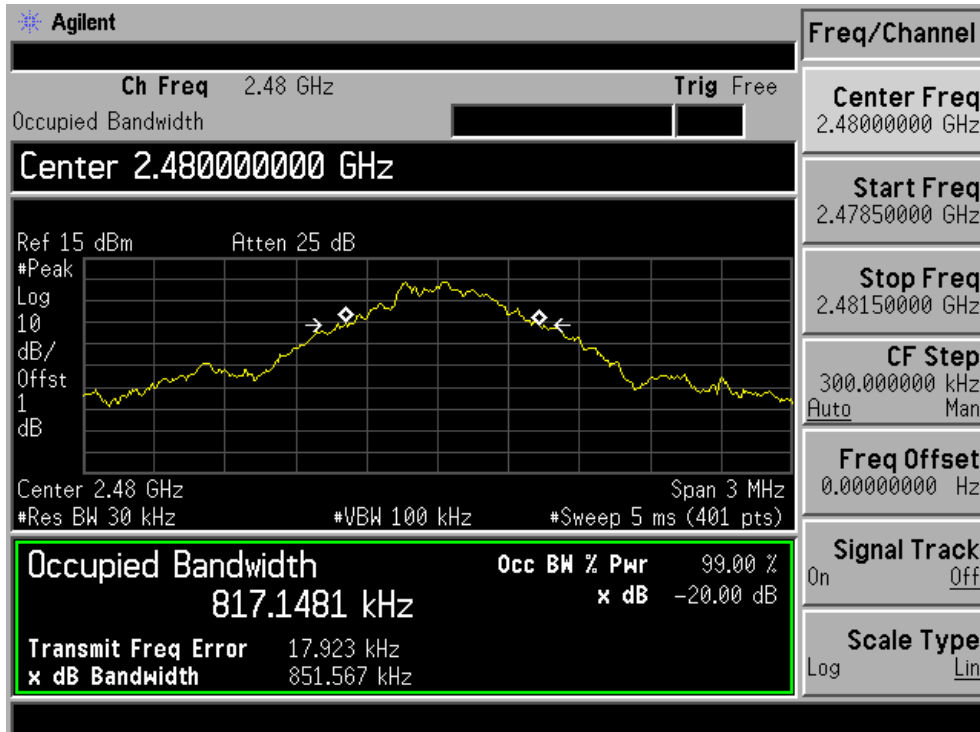
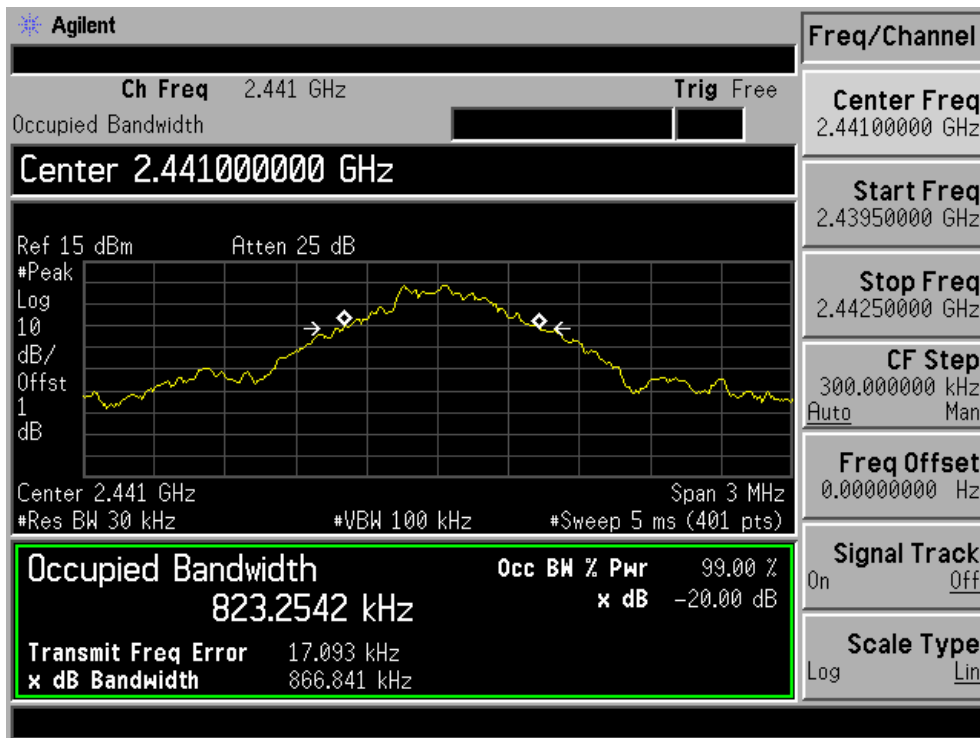


7.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4407B	88156318	05/17/2014	05/16/2015

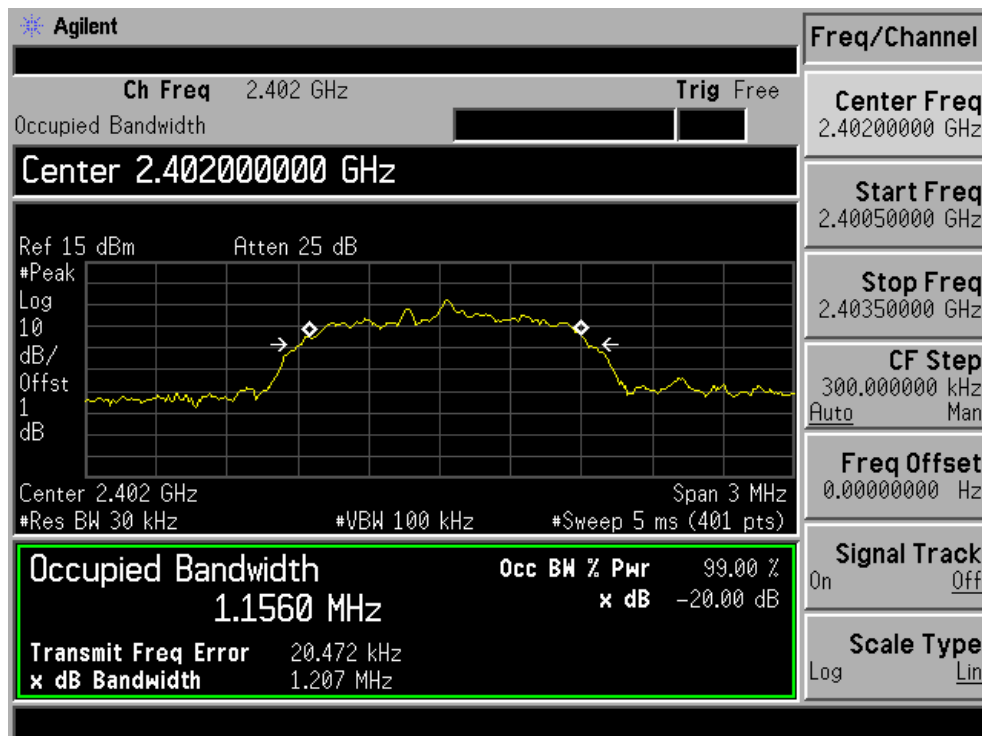
7.4 Measurement Results:

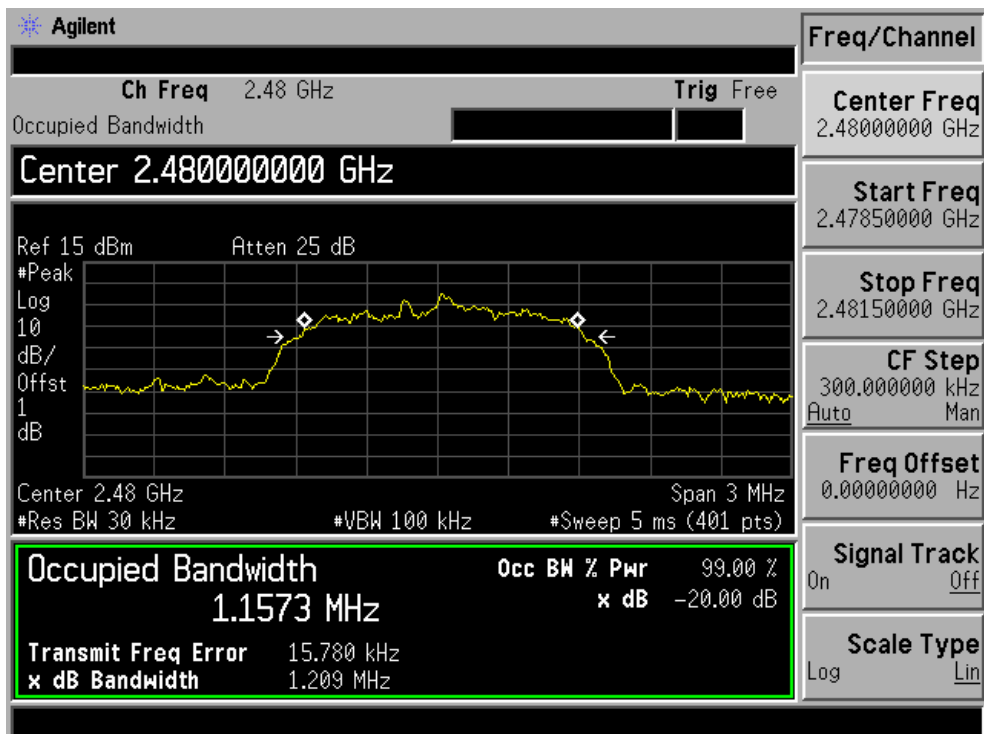
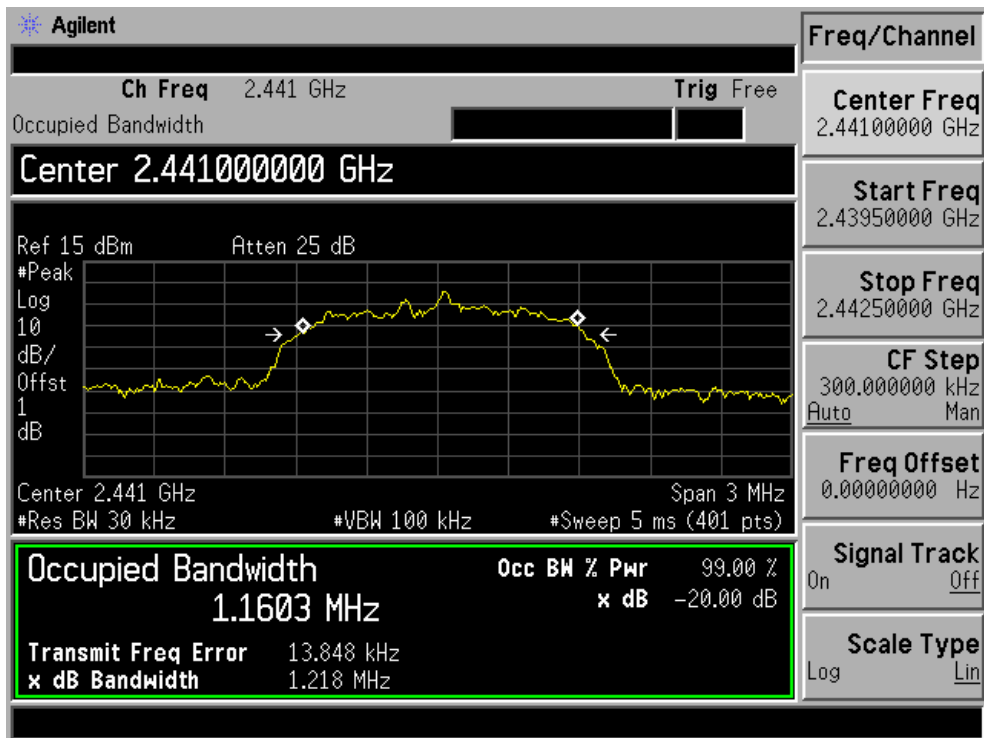
All the modes GFSK, $\pi/4$ -DQPSK,8DPSK have been tested and the result recorded in the following pages.



Spectrum Detector: PK Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test Result: PASS Humidity : 55 %
Modulation: $\pi/4$ -DQPSK

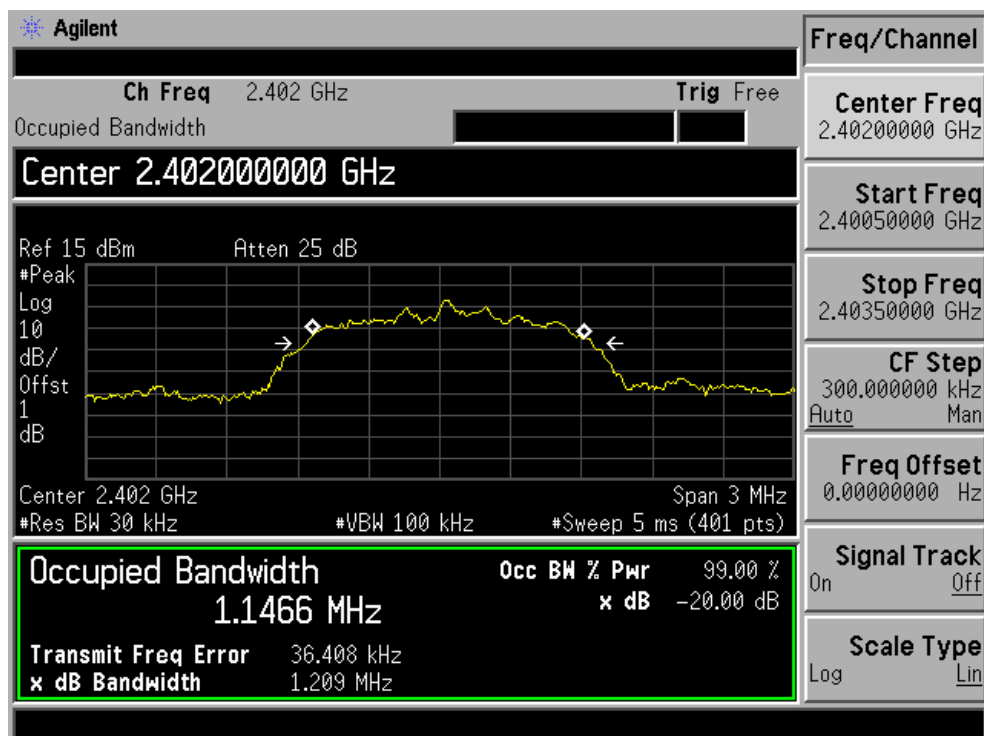
Channel number	Channel frequency (MHz)	20dB Down BW(MHz)
1	2402	1.207
40	2441	1.218
79	2480	1.209

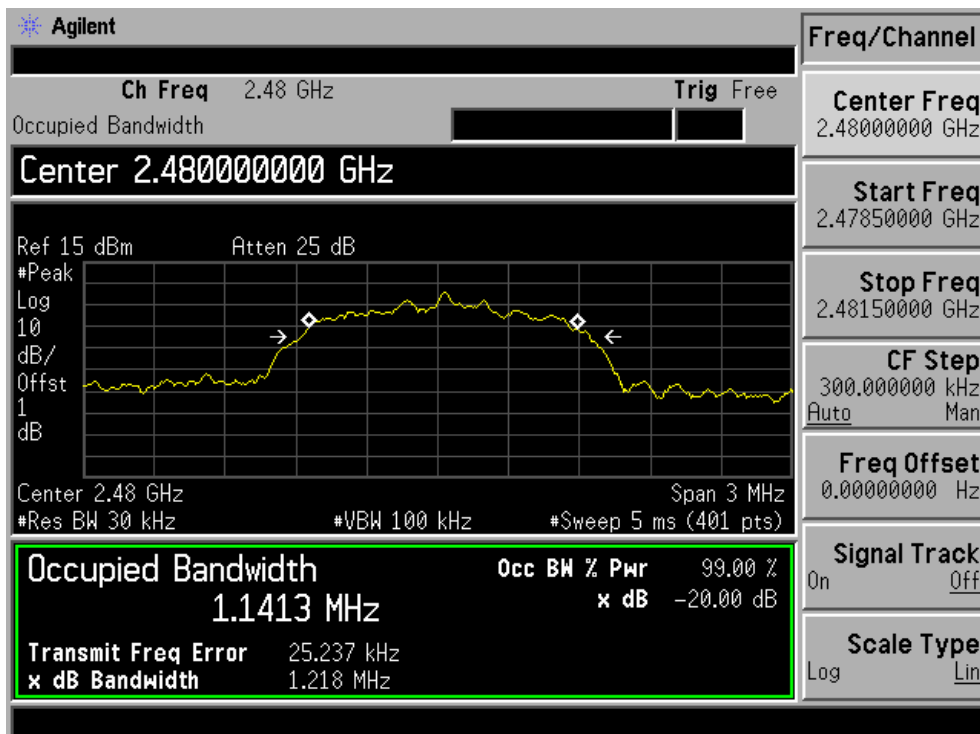
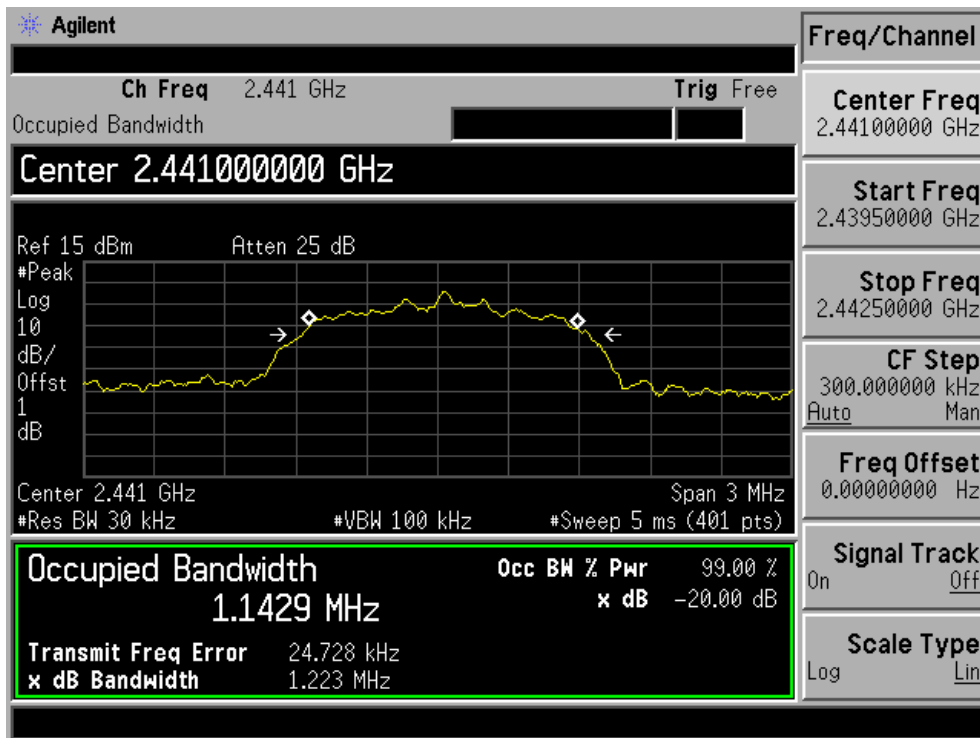




Spectrum Detector:	PK	Test Date :	October 21, 2014
Test By:	SYP	Temperature :	25°C
Test Result:	PASS	Humidity :	55 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1.209
40	2441	1.223
79	2480	1.218





8. Quantity of Hopping Channel Test

8.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

8.2 Test SET-UP (Block Diagram of Configuration)

EUT

Spectrum Analyzer

8.3 Measurement Equipment Used:

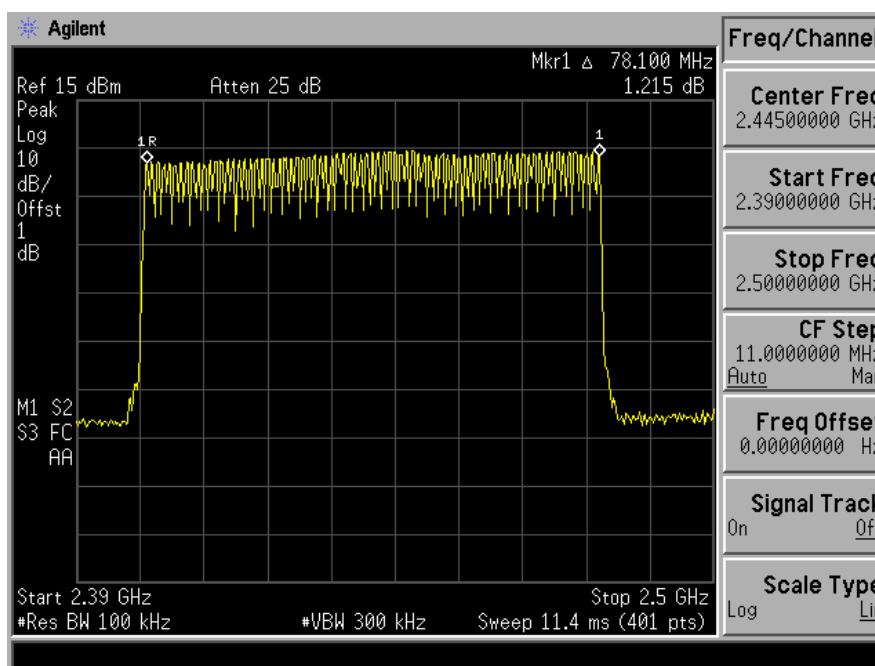
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4407B	88156318	05/17/2014	05/16/2015

8.4 Measurement Results:

All the modulation modes were tested the data of the mode (GFSK) is recorded as below

Spectrum Detector: PK Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test Result: PASS Humidity : 55 %

Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel limit
2402-2480	79	> 15

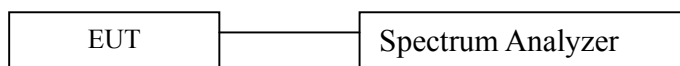


9. Time of Occupancy (Dwell Time) test

9.1 Measurement Procedure

- Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- Repeat above procedures until all different time-slot modes have been completed.

9.2 Test SET-UP (Block Diagram of Configuration)



9.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4407B	88156318	05/17/2014	05/16/2015

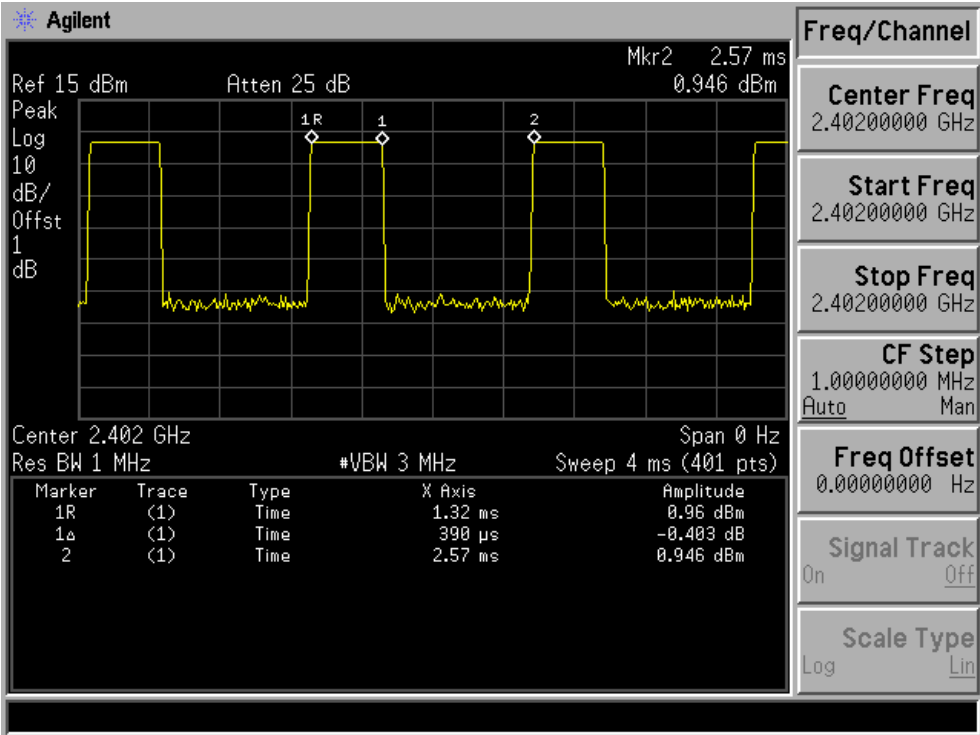
9.4 Measurement Results:

All the modulation modes were tested and the data of the GFSK mode are recorded in the following pages. Low, Middle and Highest channels have been tested, the worst test data channel 2402 were recorded in this report, all modulation methods do not exceed the above mentioned limits.

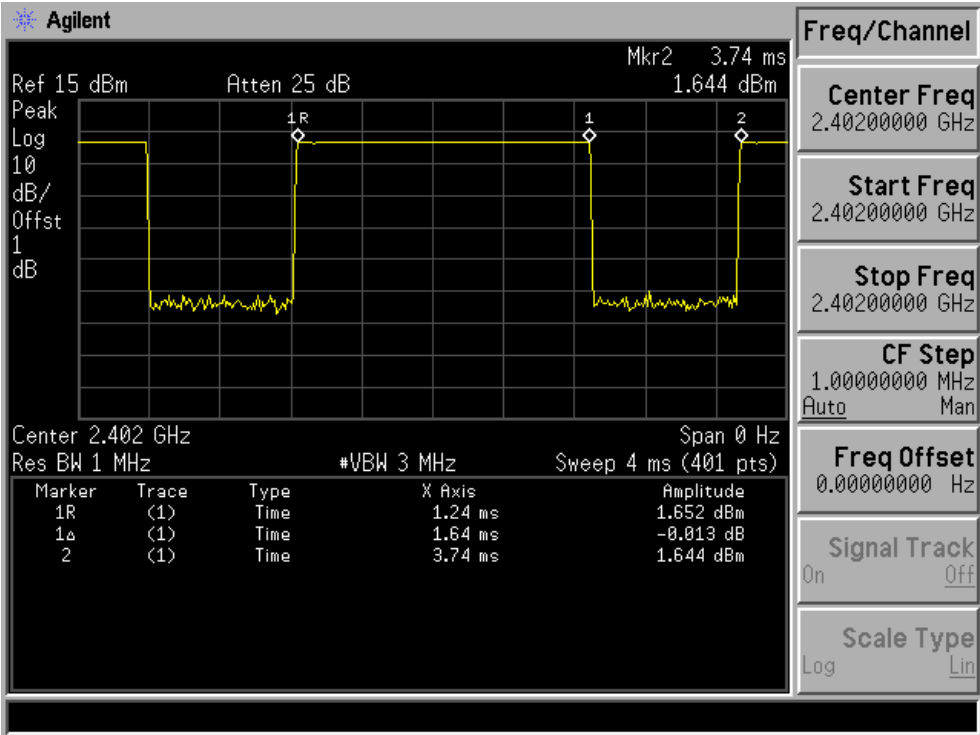
Spectrum Detector:	PK	Test Date :	October 21, 2014
Test By:	SYP	Temperature :	25°C
Test Result:	PASS	Humidity :	55 %

Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(sec)	Result (msec)	Limit (msec)
DH1	$1600/(2*79) \times 31.6 = 320$	0.39	124.0	400
DH3	$1600/(4*79) \times 31.6 = 160$	1.64	262.4	400
DH5	$1600/(6*79) \times 31.6 = 106.67$	2.88	307.2	400

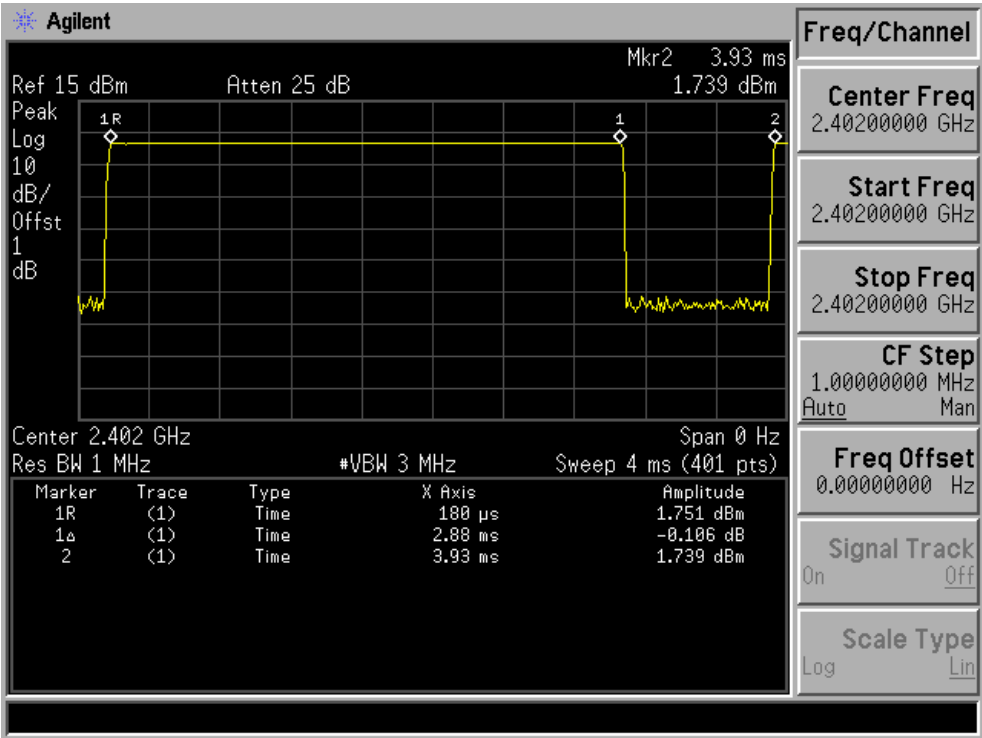
DH1



DH3



DH5

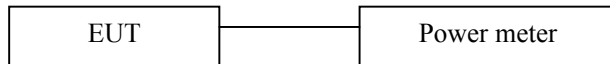


10. MAXIMUM PEAK OUTPUT POWER TEST

10.1 Measurement Procedure

- Check the calibration of the measuring instrument(Power meter) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.
- Measure the captured power within the band and recording the plot.
- Repeat above procedures until all frequencies required were complete.

10.2 Test SET-UP (Block Diagram of Configuration)



10.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power meter	Boonton	4232A	29001	05/17/2014	05/16/2015
Power sensor	Boonton	51011-EMC	31184	05/17/2014	05/16/2015

10.4 Measurement Results:

All the modes GFSK, $\pi/4$ -DQPSK, 8DPSK have been tested and the result recorded in the following pages and the others modulation methods do not exceed the limits.

Spectrum Detector: PK Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test Result: PASS Humidity : 55 %
Modulation: GFSK

Channel number	Channel Frequency (MHz)	conducted power (dBm)	conducted power Limit(mW)	Pass/Fail
1	2402.00	0.189	1000mW	PASS
40	2441.00	2.582	1000mW	PASS
79	2480.00	2.522	1000mW	PASS

Spectrum Detector: PK Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test Result: PASS Humidity : 55 %
Modulation: $\pi/4$ -DQPSK

Channel number	Channel Frequency (MHz)	conducted power (dBm)	conducted power Limit(mW)	Pass/Fail
1	2402.00	-2.102	125mW	PASS
40	2441.00	0.117	125mW	PASS
79	2480.00	0.063	125mW	PASS

Spectrum Detector: PK Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test Result: PASS Humidity : 55 %
Modulation: 8DPSK

Channel number	Channel Frequency (MHz)	conducted power (dBm)	conducted power Limit(mW)	Pass/Fail
1	2402.00	-1.898	125mW	PASS
40	2441.00	0.49	125mW	PASS
79	2480.00	0.408	125mW	PASS

11. Band EDGE test

11.1 Measurement Procedure

1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a turn table which is 0.8m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.

EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

11.2 Test SET-UP (Block Diagram of Configuration)

As 5.2 Test set up (B) and (C)

11.3 Measurement Equipment Used:

Same as 5.3 Radiated Emission Measurement.

11.4 Measurement Results:

All the modes GFSK, $\pi/4$ -DQPSK, 8DPSK and hopping mode have been tested and the result recorded as below.

Spectrum Detector: PK/AV Test Date : October 21, 2014
 Test By: SYP Temperature : 25°C
 Test channel: 1 Humidity : 55 %
 Modulation: GFSK

Frequency (MHz)	Polarity	Level (dBuV/m)		Limited (dBuV/m)	
		PK	AV	PK	AV
2399.55	H	56.31	40.33	74	54
2398.57	V	54.01	38.99	74	54

Spectrum Detector: PK/AV Test Date : October 21, 2014
 Test By: SYP Temperature : 25°C
 Test channel: 79 Humidity : 55 %
 Modulation: GFSK

Frequency (MHz)	Polarity	Level (dBuV/m)		Limited (dBuV/m)	
		PK	AV	PK	AV
2485.66	H	55.75	40.45	74	54
2485.77	V	54.65	42.65	74	54

Spectrum Detector: PK/AV Test Date : October 21, 2014
 Test By: SYP Temperature : 25°C
 Test channel: 1 Humidity : 55 %
 Modulation: $\pi/4$ -DQPSK

Frequency (MHz)	Polarity	Level (dBuV/m)		Limited (dBuV/m)	
		PK	AV	PK	AV
2399.77	H	60.22	47.14	74	54
2399.14	V	52.44	40.32	74	54

Spectrum Detector: PK/AV Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test channel: 79 Humidity : 55 %
Modulation: $\pi/4$ -DQPSK

Frequency (MHz)	Polarity	Level (dBuV/m)		Limited (dBuV/m)	
		PK	AV	PK	AV
2485.44	H	53.46	40.48	74	54
2484.77	V	53.74	39.66	74	54

Spectrum Detector: PK/AV Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test channel: 1 Humidity : 55 %
Modulation: 8DPSK

Frequency (MHz)	Polarity	Level (dBuV/m)		Limited (dBuV/m)	
		PK	AV	PK	AV
2399.45	H	54.62	41.46	74	54
2398.76	V	52.78	44.63	74	54

Spectrum Detector: PK/AV Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test channel: 79 Humidity : 55 %
Modulation: 8DPSK

Frequency (MHz)	Polarity	Level (dBuV/m)		Limited (dBuV/m)	
		PK	AV	PK	AV
2485.66	H	56.44	41.44	74	54
2484.05	V	52.35	40.19	74	54

Spectrum Detector: PK/AV Test Date : October 21, 2014
Test By: SYP Temperature : 25°C
Test channel: Hopping Humidity : 55 %

Frequency (MHz)	Polarity	Level (dBuV/m)		Limited (dBuV/m)	
		PK	AV	PK	AV
2399.54	H	59.61	45.32	74	54
2398.74	V	58.74	44.10	74	54
2485.66	H	56.44	41.44	74	54
2485.05	V	52.35	40.19	74	54

12. Antenna Port Emission

12.1 Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4407B	88156318	05/17/2014	05/16/2015

12.2 Measuring Instruments and setting

All the modulation modes were tested and the data of the GFSK mode are recorded in the following pages and the others modulation methods do not exceed the limits.

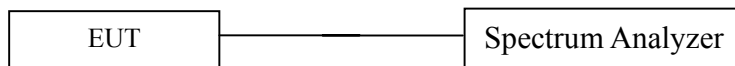
The following table is the setting of spectrum analyzer.

EMI Test Receiver	Setting
Attenuation	Auto
RB	100kHz
VB	300kHz
Detector	Peak
Trace	Max hold

12.3 Test Procedures

The conducted spurious emissions were measured conducted using a spectrum analyzer at low, mid, and hi channels, the limit was determined by attenuation 20dB of the RF peak power output.

12.4 Block Diagram of Test setup

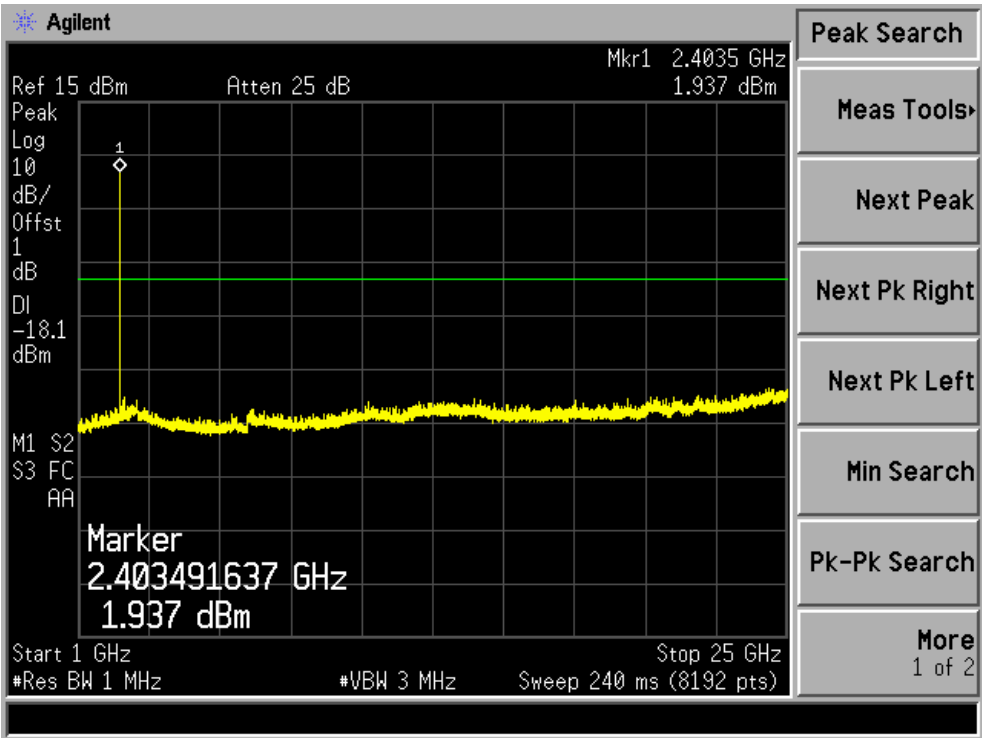
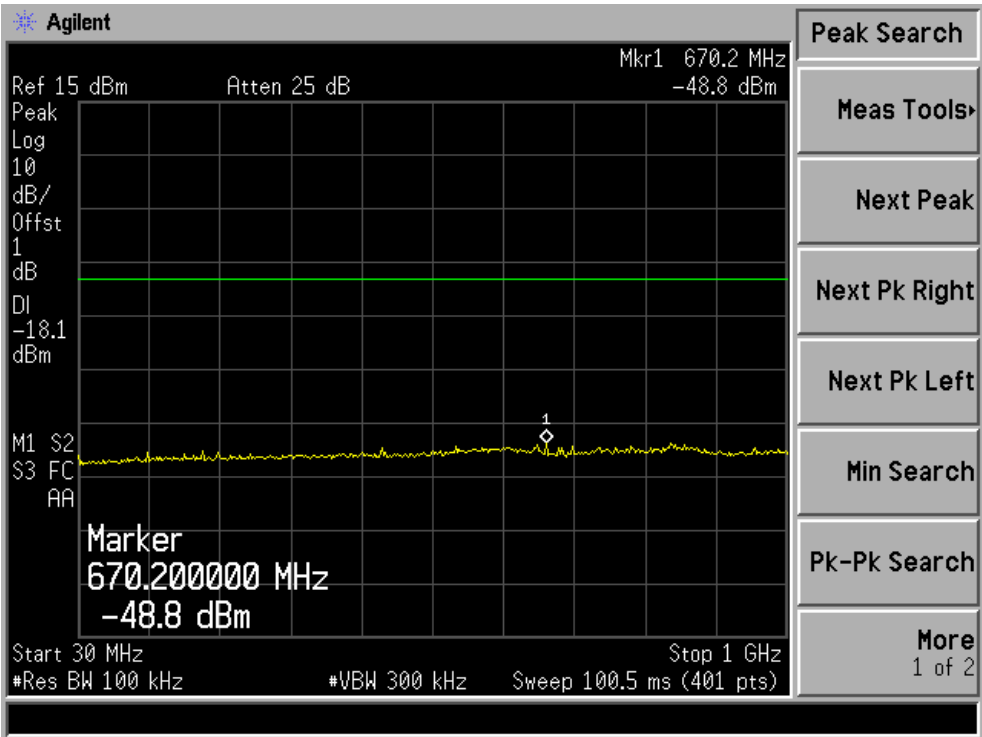


12.5 Test Result

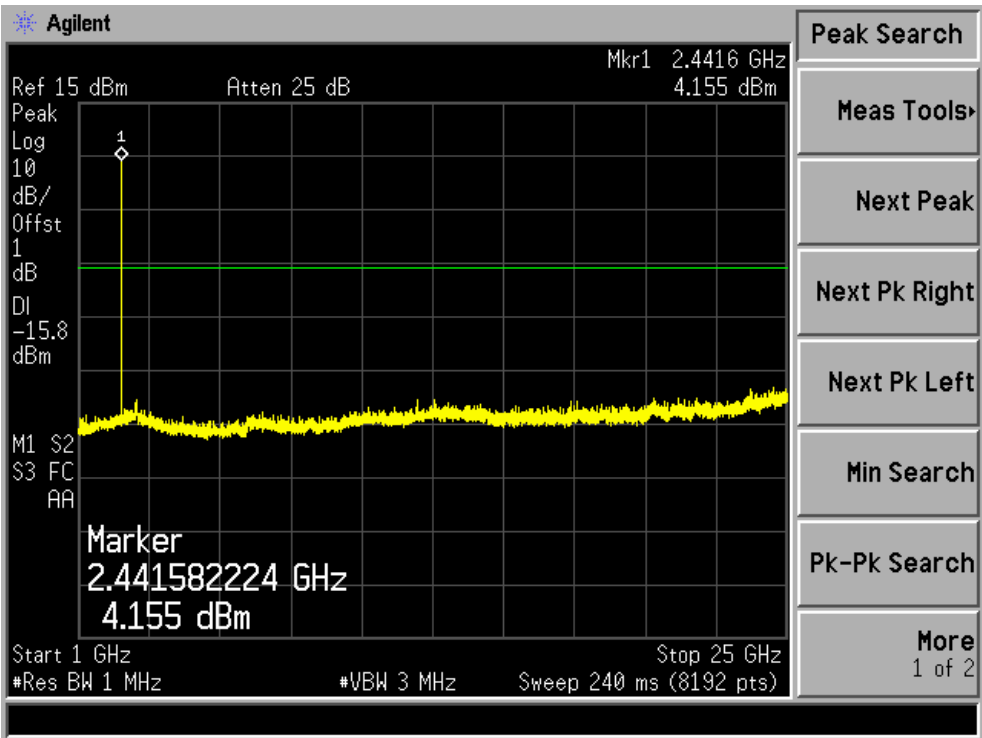
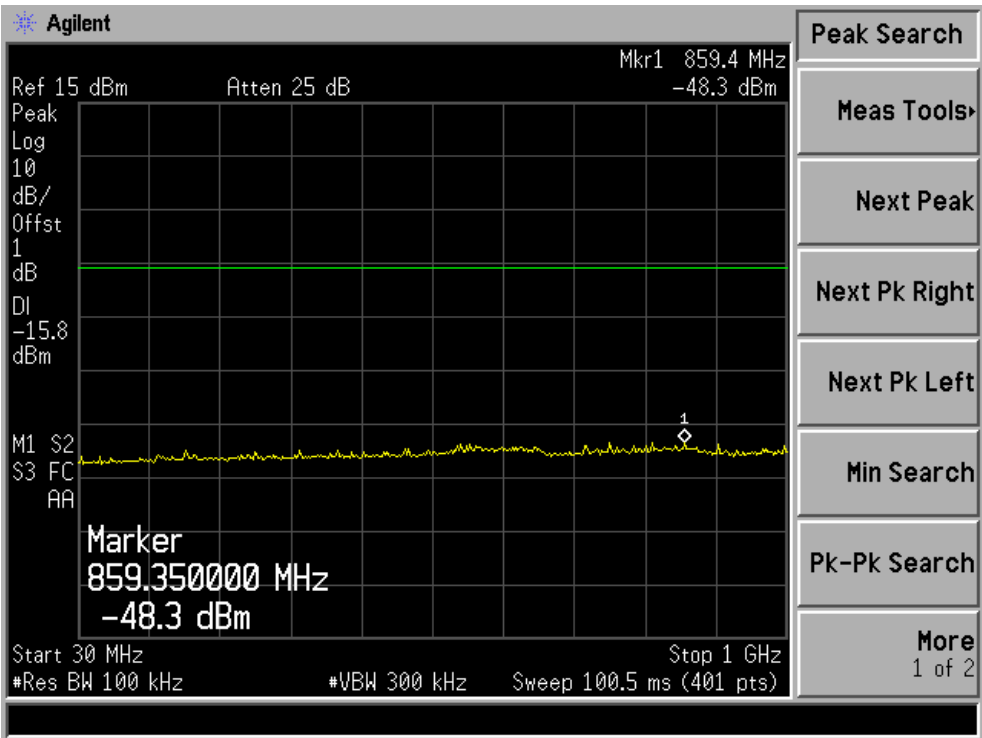
PASS.

All the modes GFSK, $\pi/4$ -DQPSK, 8DPSK have been tested and the worst result recorded in the following pages.

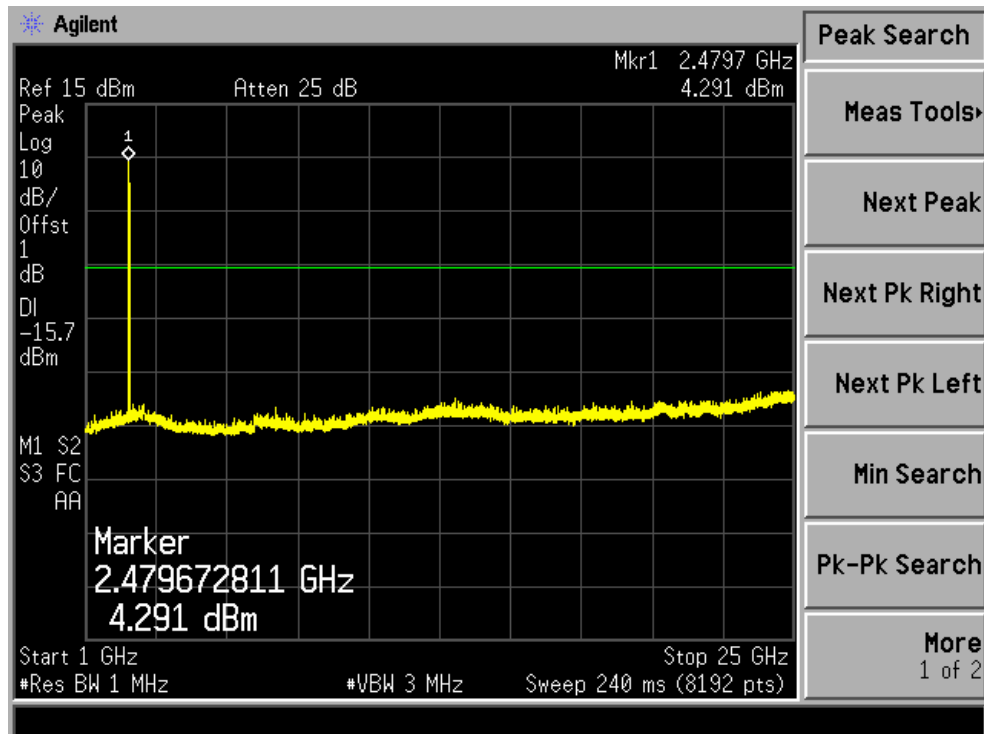
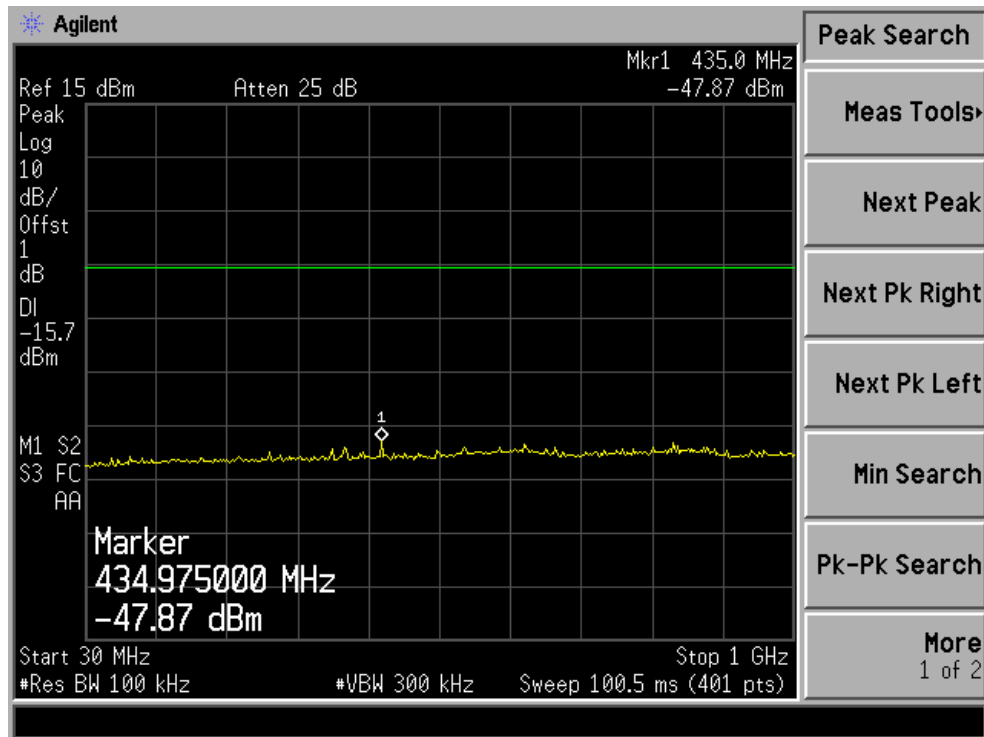
TX 2402MHz



TX 2441MHz



TX 2480MHz



13. Antenna Application

13.1 Antenna requirement

The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247

FCC part 15C section 15.247 requirements:

Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

13.2 Result

The EUT's antenna integrated on PCB, The antenna's gain is -1.72dBi and meets the requirement.