

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

OF

Express Speaker

Model No.: HL2507

Trade Mark:  **bēm**
WIRELESS

FCC ID: P XK-HL2507

Report No.: KAD140627144E2

Issue Date: December 18, 2014

Prepared for

ECORE TECHNOLOGY COMPANY LIMITED

**North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei
Province, China**

Prepared by

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DONGGUAN EMTEK CO., LTD.**

VERIFICATION OF COMPLIANCE

Applicant:	ECORE TECHNOLOGY COMPANY LIMITED North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei Province, China
Manufacturer:	ECORE TECHNOLOGY COMPANY LIMITED North of Bingang East Road, Huahu Development Zone, Ezhou city, Hubei Province, China
Product Description:	Express Speaker
Trade Mark:	
Model Number:	HL2507
Kind of Device:	Bluetooth Ver. 2.1+EDR
File Number:	KAD140627144E2
Date of Test:	June 27, 2014 to November 28, 2014

We hereby certify that:

The above equipment was tested by DONGGUAN 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(2014).

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

Approved By



**Sam Lv / Q.A. Manager
DONGGUAN EMTEK CO., LTD.**

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD140627144E2

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Appendix I (Photos of EUT) (4 pages)

1. GENERAL INFORMATION

1.1 Product Description

The ECORE TECHNOLOGY COMPANY LIMITED, Model: HL2507 (referred to as the EUT in this report) The EUT is an short range, lower power transmitter. It is designed by way of utilizing the following modulation achieves the system operating.

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: 2402-2480MHz
- B). Kind of device: Bluetooth 4.0&Bluetooth 2.1+EDR
- C). Modulation: GFSK(For Bluetooth 4.0 and Bluetooth 2.1+EDR), $\pi/4$ -DQPSK, 8DPSK(For Bluetooth 2.1+EDR)
- D). Number of Channel: 40(For Bluetooth 4.0) OR 79(For Bluetooth 2.1+EDR)
- E). Channel space: 2MHz(For Bluetooth 4.0) OR 1MHz(For Bluetooth 2.1+EDR)
- F). Rated RF Output Power: -2.08dBm (0.000619W) (For Bluetooth 2.1+EDR)
- G). Antenna Type: Internal PCB antenna
- H). Antenna GAIN: 0 dBi
- I). Input Rating: DC 5V, 2A come from Adapter
- J). Information of Adapter:
Model:YN12W-0500200UZ
Input: AC 100-240V, 50/60Hz, 0.3A
Output: DC 5V, 2A

Remark:

The basic data rate of 1Mbps uses GFSK modulation and the enhanced data rate uses PSK modulation. For the enhanced data rate of 3Mbps 8DPSK modulation and of 2Mbps $\pi/4$ -DQPSK modulation is used.

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: PXX-HL2507 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and FCC Public Notice DA 00-705.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (2009). 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 FCC, June 18, 2014
The Certificate Number is 247565.

Accredited by Industry Canada, February 19, 2014
The Certificate Number is 9444A

Name of Firm : DONGGUAN EMTEK CO., LTD.

Site Location : No.281, Guantai Road, Nancheng District,
Dongguan, 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 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

(2) 20dB Bandwidth

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

(4) Time of Occupancy(Dwell Time)

FCC Part 15, Subpart C Section 15.247

Frequency Range (MHz)	20dB bandwidth <250kHz(50Channel)	LIMIT(rms)	
		20dB bandwidth >250kHz(25Channel)	20dB bandwidth <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 Range (MHz)	Quantity of Hopping Channel	LIMIT(W)			
		50	25	15	75
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	Peak power ration to emission(dBc)	Limit 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 1000MHz. 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	/
0.490-1.705	24000/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 ($\mu\text{V/m}$)

: 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

FCC Part 15, Section 15.35(b) limit of radiated emission for frequency above 1000MHz

Frequency(MHz)	Class A(dB $\mu\text{V/m}$)(at 3m)		Class B(dB $\mu\text{V/m}$)(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
Above 1000	80.0	60.0	74.0	54.0

FCC Part 15, Subpart C Section 15.249. The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency(MHz)	Filed Strength of Fundamental(at 3m)		Filed Strength of Harmonics(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
902-928	114	94	74.0	54.0
2400-2483.5	114	94	74.0	54.0
5725-5875	114	94	74.0	54.0
24000-24250	128	108	88.0	68.0

2.5 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

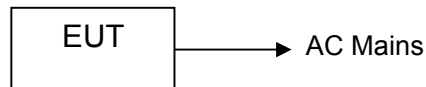


Table 2-1 Equipment Used in Tested System

Item	Equipment	Trade Mark	Model No.	FCC ID	Note
1.	Express Speaker		HL2507	PXK-HL2507	<i>EUT</i>

Note:

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

3. Summary of Test Results

FCC Rules	Description Of Test	Result
§15.247(a)(1)	Channel Separation test	Compliant
§15.247(a)(1)	20dB Bandwidth	Compliant
§15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§15.247(a)(1)(iii)	Time of Occupancy(Dwell Time)	Compliant
§15.247(b)	Max Peak output Power test	Compliant
§15.247(d)	Band edge test	Compliant
§15.207	AC Power Conducted Emission	Compliant
§15.247(d),§15.209	Radiated Emission	Compliant
§15.203	Antenna Requirement	Compliant

4. 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.

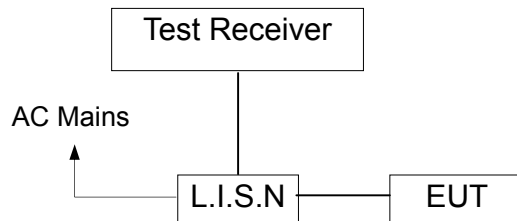
Channel	Frequency(MHz)
1	2402
40	2441
79	2480

5. Conducted Emissions Test

5.1 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 was complete.

5.2 Test SET-UP (Block Diagram of Configuration)



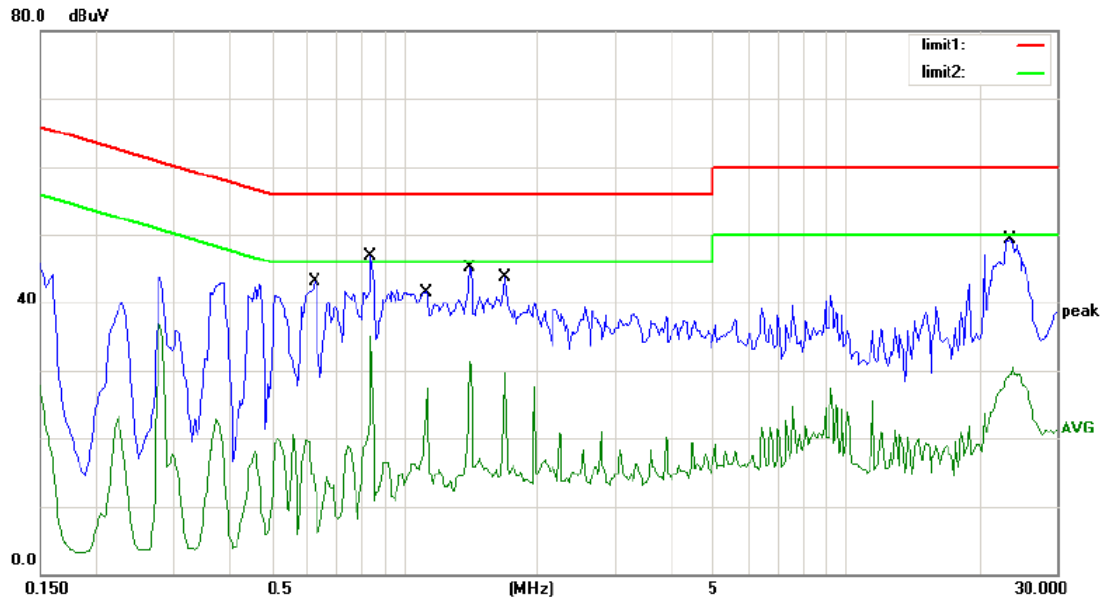
5.3 Measurement Equipment Used:

Conducted Emission Test Site # 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Receiver	Rohde & Schwarz	ESCS30	100018	05/16/2014	05/15/2015
L.I.S.N	Rohde & Schwarz	ENV216	100017	05/16/2014	05/15/2015
RF Switching Unit	CDS	RSU-M2	38401	05/16/2014	05/15/2015

5.4 Measurement Result:

Pass.

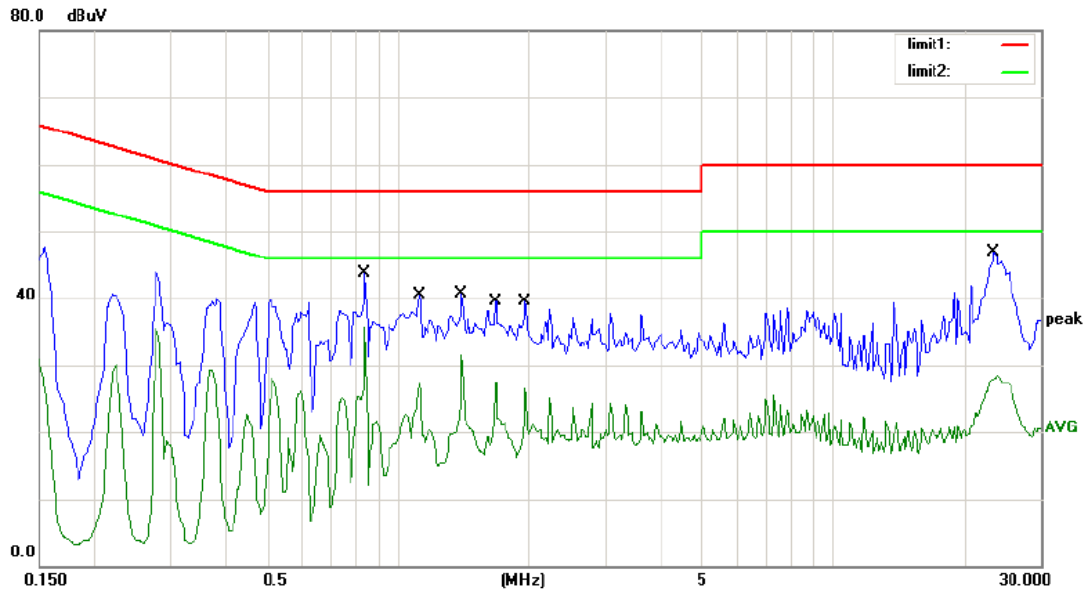
Please refer to the following data.



Site site #1 Phase: **L1** Temperature: 24
Limit: (CE)FCC PART 15 class C_QP Power: AC 120V/60Hz Humidity: 55 %
Mode: BT Link
Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.6300	40.10	0.00	40.10	56.00	-15.90	QP	
2		0.6300	14.70	0.00	14.70	46.00	-31.30	AVG	
3		0.8400	44.10	0.00	44.10	56.00	-11.90	QP	
4	*	0.8400	35.11	0.00	35.11	46.00	-10.89	AVG	
5		1.1200	38.50	0.00	38.50	56.00	-17.50	QP	
6		1.1200	27.47	0.00	27.47	46.00	-18.53	AVG	
7		1.4100	42.30	0.00	42.30	56.00	-13.70	QP	
8		1.4100	31.33	0.00	31.33	46.00	-14.67	AVG	
9		1.6850	40.70	0.00	40.70	56.00	-15.30	QP	
10		1.6850	29.76	0.00	29.76	46.00	-16.24	AVG	
11		23.6000	46.20	0.00	46.20	60.00	-13.80	QP	
12		23.6000	30.37	0.00	30.37	50.00	-19.63	AVG	

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



Site site #1 Phase: **N** Temperature: 24
Limit: (CE)FCC PART 15 class C_QP Power: AC 120V/60Hz Humidity: 55 %
Mode: BT Link
Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.8400	40.90	0.00	40.90	56.00	-15.10	QP	
2	*	0.8400	35.62	0.00	35.62	46.00	-10.38	AVG	
3		1.1200	37.50	0.00	37.50	56.00	-18.50	QP	
4		1.1200	27.24	0.00	27.24	46.00	-18.76	AVG	
5		1.4000	37.80	0.00	37.80	56.00	-18.20	QP	
6		1.4000	31.50	0.00	31.50	46.00	-14.50	AVG	
7		1.6800	36.50	0.00	36.50	56.00	-19.50	QP	
8		1.6800	27.58	0.00	27.58	46.00	-18.42	AVG	
9		1.9650	37.10	0.00	37.10	56.00	-18.90	QP	
10		1.9650	26.48	0.00	26.48	46.00	-19.52	AVG	
11		23.4000	44.60	0.00	44.60	60.00	-15.40	QP	
12		23.4000	28.46	0.00	28.46	50.00	-21.54	AVG	

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

5.5 Conducted Measurement Photos:



6. Radiated Emission Test

6.1 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 were complete.
5. The following table is the setting of spectrum analyzer:

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz 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:

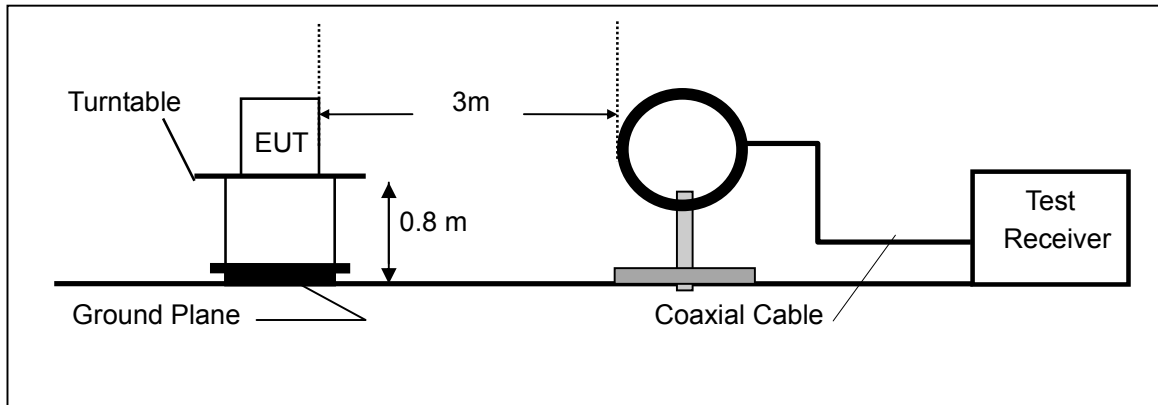
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

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

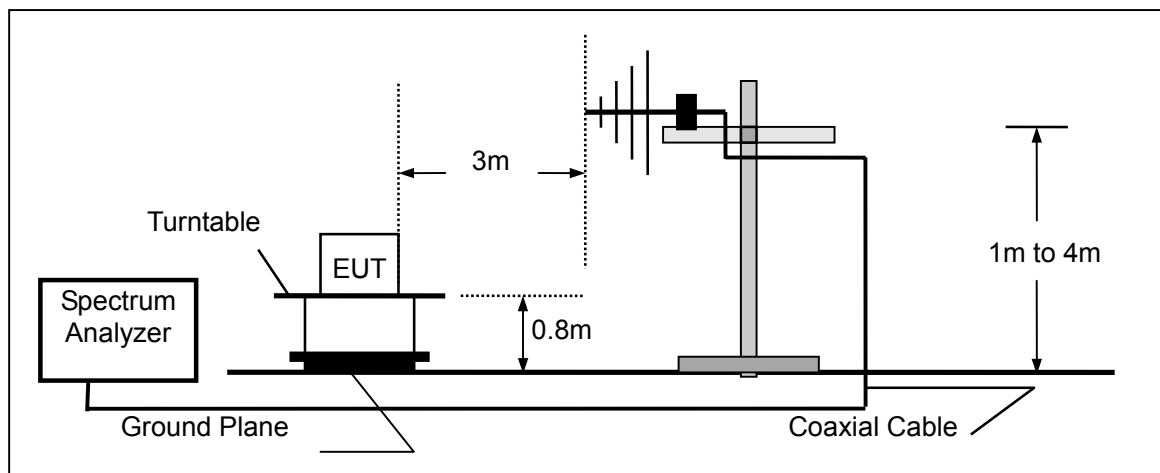
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

6.2 Test SET-UP (Block Diagram of Configuration)

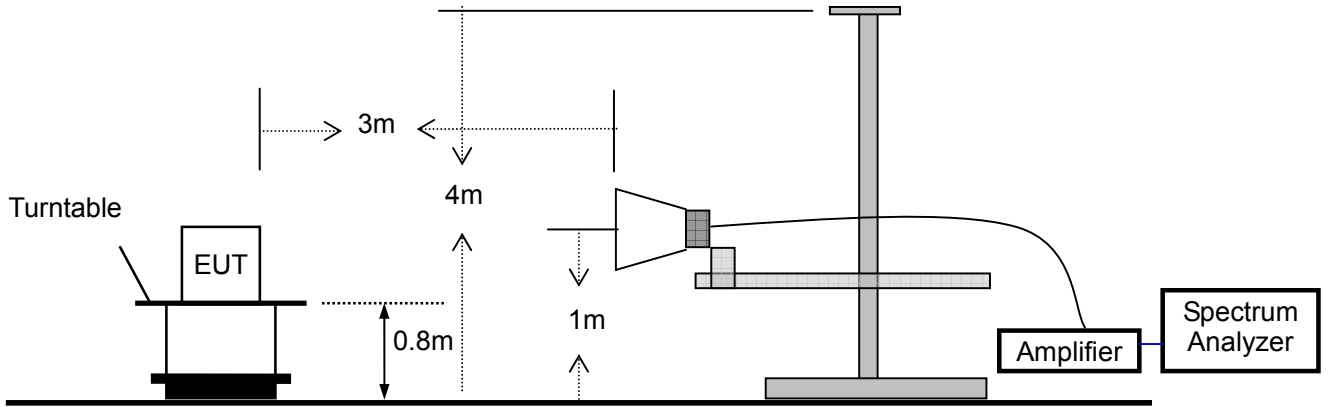
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



6.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	05/16/2014	05/15/2015
Spectrum Analyzer	HP	E4407B	839840481	05/16/2014	05/15/2015
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	05/16/2014	05/15/2015
Pre-Amplifier	HP	8447D	2944A07999	05/16/2014	05/15/2015
Bilog Antenna	Schwarzbeck	VULB9163	142	05/19/2014	05/18/2015
Loop Antenna	Schwarzbeck	FMZB 1519	012	05/19/2014	05/18/2015
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	05/19/2014	05/18/2015
Horn Antenna	Schwarzbeck	BBHA 9120	D143	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4446A	US44300399	05/16/2014	05/15/2015

6.4 Measurement Result

Below 30MHz:

Operation Mode:	TX	Test Date :	November 11, 2014
Frequency Range:	9KHz~30MHz	Temperature :	28℃
Test Result:	PASS	Humidity :	65 %
Measured Distance:	3m	Test By:	Andy

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

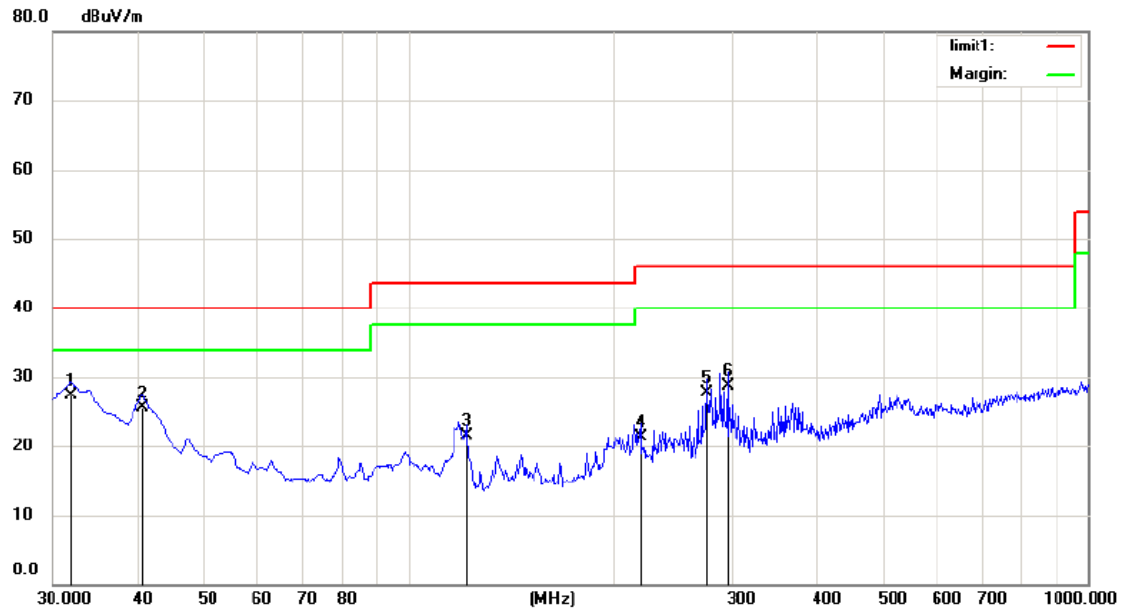
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Below 1000MHz:

Pass.

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

Please refer to the following data.



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

Limit: (RE)FCC PART 15 class C 3m

Power: AC 120V/60Hz

Humidity: 55 %

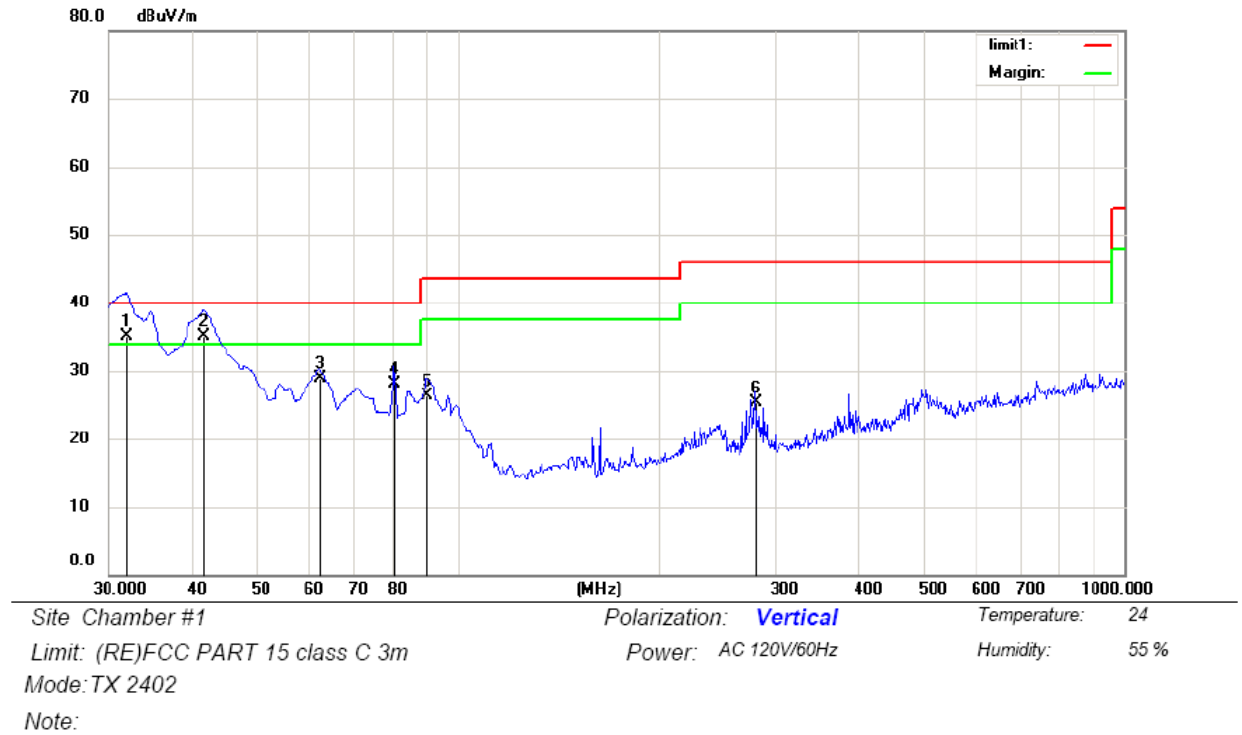
Mode: TX 2402

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	*	31.9400	44.28	-16.95	27.33	40.00	-12.67	QP		
2		40.6700	41.67	-16.13	25.54	40.00	-14.46	QP		
3		122.1500	40.76	-19.26	21.50	43.50	-22.00	QP		
4		220.1200	35.44	-14.08	21.36	46.00	-24.64	QP		
5		275.4100	40.22	-12.45	27.77	46.00	-18.23	QP		
6		295.7800	40.49	-11.81	28.68	46.00	-17.32	QP		

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

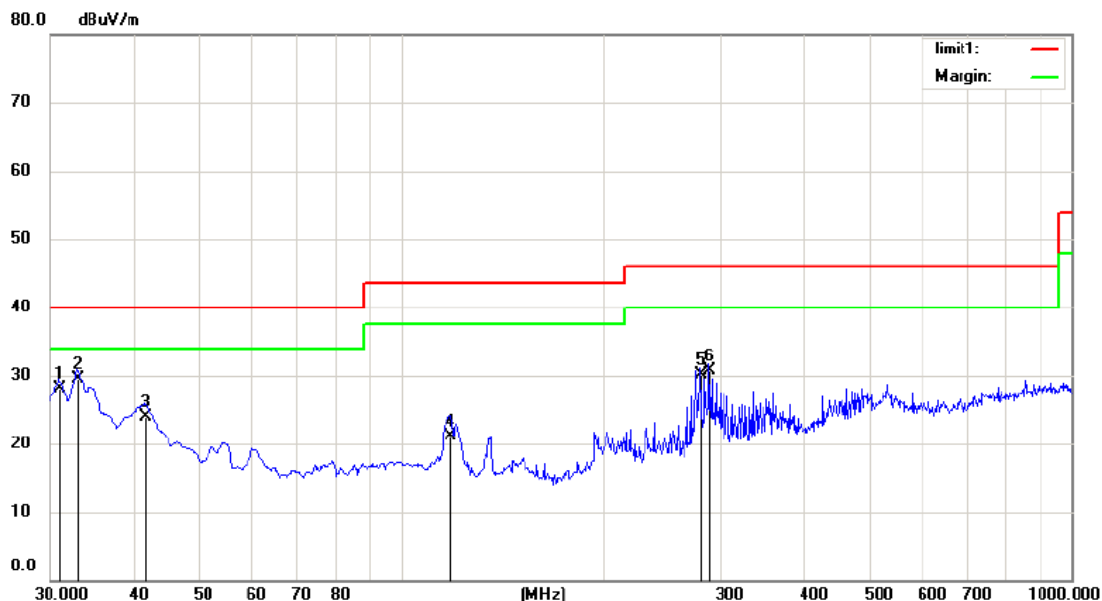
Operator: Snake



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	!	31.9400	52.10	-16.95	35.15	40.00	-4.85	QP		
2	*	41.6400	51.30	-16.12	35.18	40.00	-4.82	QP		
3		62.0100	46.58	-17.72	28.86	40.00	-11.14	QP		
4		80.4400	49.03	-20.86	28.17	40.00	-11.83	QP		
5		90.2202	43.96	-17.57	26.39	43.50	-17.11	QP		
6		280.2600	37.64	-12.24	25.40	46.00	-20.60	QP		

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

Operator: Snake



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

Limit: (RE)FCC PART 15 class C 3m

Power: AC 120V/60Hz

Humidity: 55 %

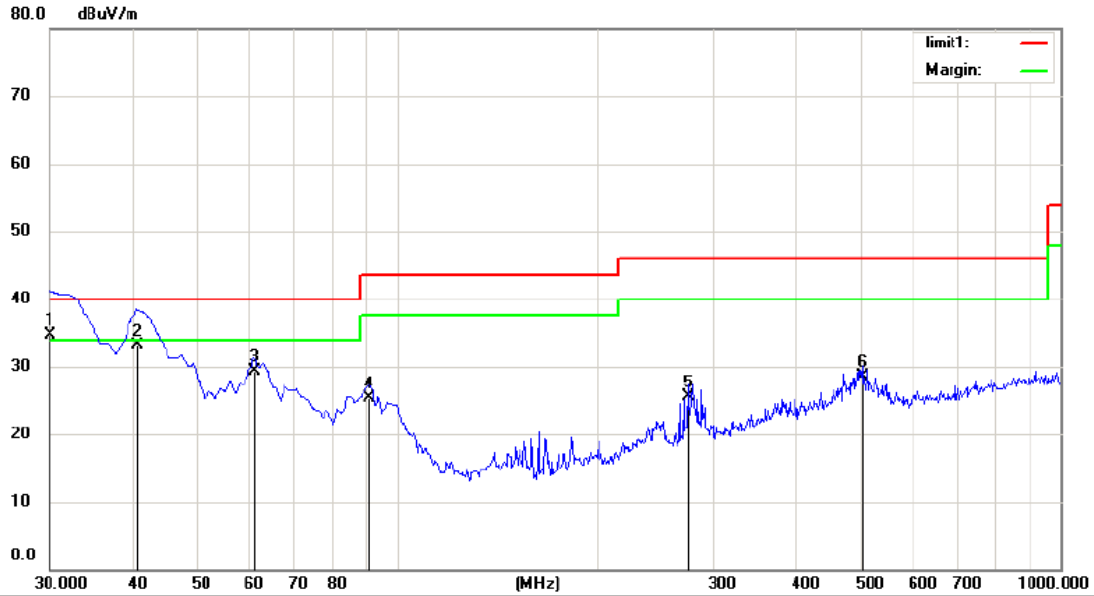
Mode: TX 2441

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		30.9700	45.06	-17.05	28.01	40.00	-11.99	QP		
2	*	32.9100	46.30	-16.85	29.45	40.00	-10.55	QP		
3		41.6400	39.94	-16.12	23.82	40.00	-16.18	QP		
4		118.2700	39.77	-18.66	21.11	43.50	-22.39	QP		
5		280.2600	42.35	-12.24	30.11	46.00	-15.89	QP		
6		288.0200	42.60	-11.96	30.64	46.00	-15.36	QP		

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

Operator: Snake



Site Chamber #1

Polarization: **Vertical**

Temperature: 24

Limit: (RE)FCC PART 15 class C 3m

Power: AC 120V/60Hz

Humidity: 55 %

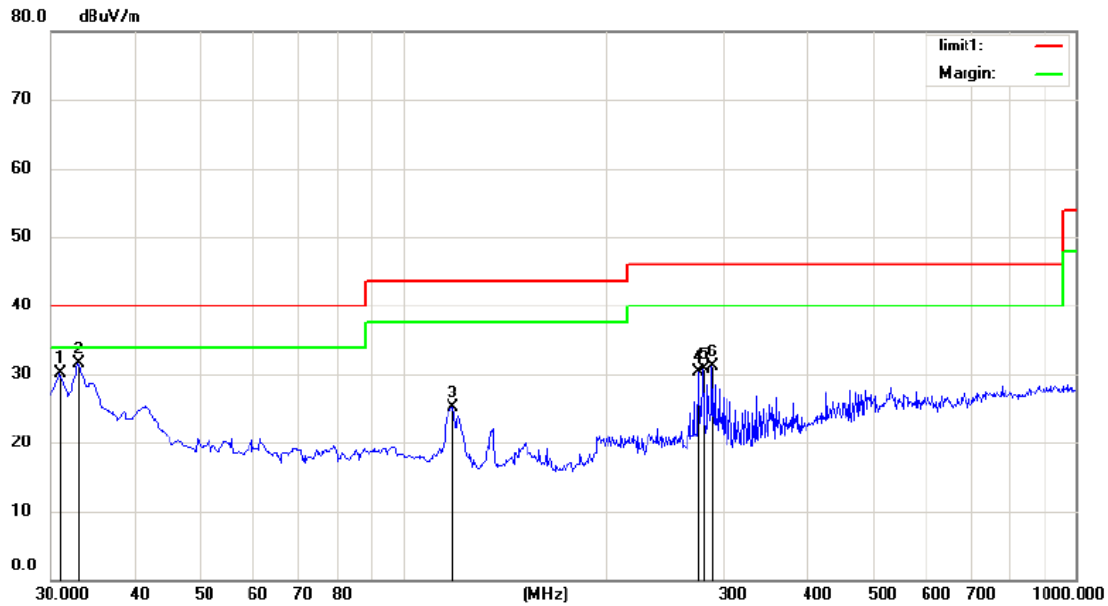
Mode: TX 2441

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	*	30.0000	51.80	-17.15	34.65	40.00	-5.35	QP		
2		40.6700	49.20	-16.13	33.07	40.00	-6.93	QP		
3		61.0400	46.65	-17.33	29.32	40.00	-10.68	QP		
4		91.1744	42.74	-17.38	25.36	43.50	-18.14	QP		
5		275.4100	37.90	-12.45	25.45	46.00	-20.55	QP		
6		504.3300	35.60	-7.07	28.53	46.00	-17.47	QP		

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

Operator: Snake



Site Chamber #1

Polarization: **Horizontal**

Temperature: 24

Limit: (RE)FCC PART 15 class C 3m

Power: AC 120V/60Hz

Humidity: 55 %

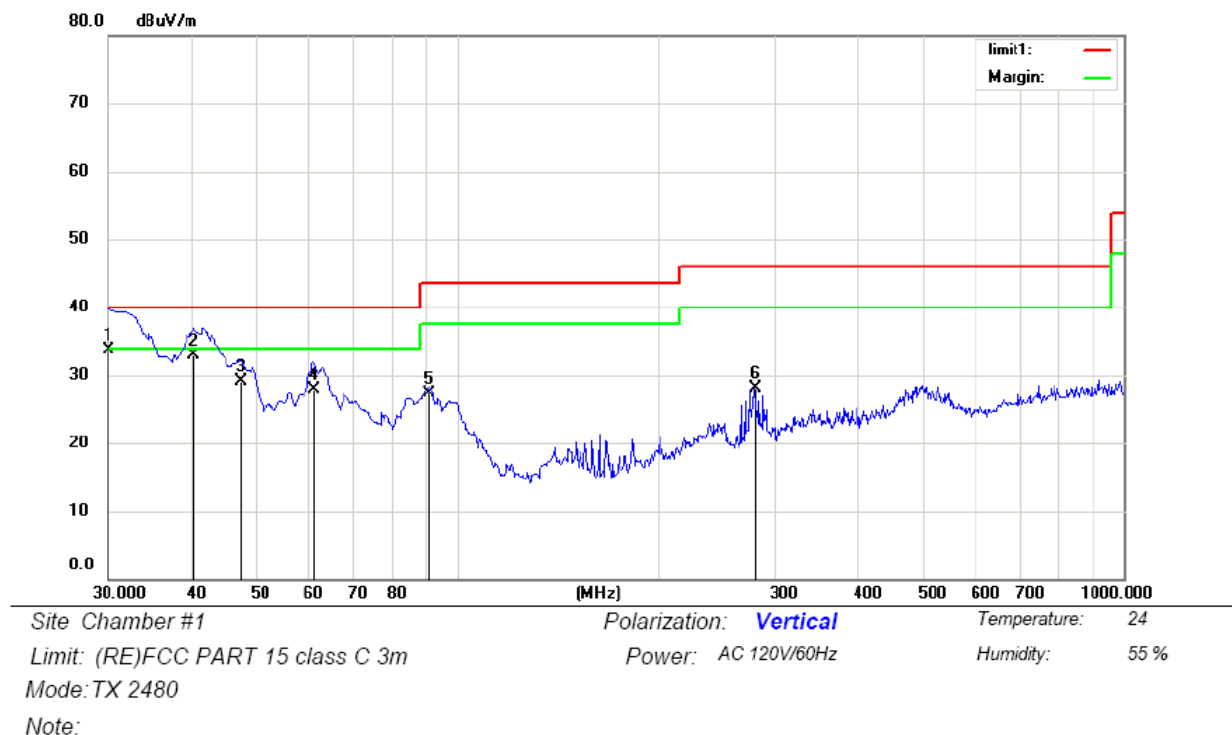
Mode: TX 2480

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		30.9700	47.06	-17.05	30.01	40.00	-9.99	QP			
2	*	32.9100	48.30	-16.85	31.45	40.00	-8.55	QP			
3		118.2700	43.77	-18.66	25.11	43.50	-18.39	QP			
4		275.4100	42.67	-12.45	30.22	46.00	-15.78	QP			
5		280.2600	42.85	-12.24	30.61	46.00	-15.39	QP			
6		288.0200	43.10	-11.96	31.14	46.00	-14.86	QP			

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

Operator: Snake



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Comment
1	*	30.0000	50.86	-17.15	33.71	40.00	-6.29	QP		
2		40.4170	49.11	-16.12	32.99	40.00	-7.01	QP		
3		47.4600	45.43	-16.26	29.17	40.00	-10.83	QP		
4		61.0400	45.15	-17.33	27.82	40.00	-12.18	QP		
5		91.1744	44.74	-17.38	27.36	43.50	-16.14	QP		
6		280.2600	40.28	-12.24	28.04	46.00	-17.96	QP		

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

Operator: Snake

Above 1000MHz

Operation Mode: TX Mode (CH1: 2402MHz) Test Date : November 11, 2014
Frequency Range: 1-25GHz Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4804	V	68.15	45.22	74	54	-5.85	-8.78
7206	V	67.05	44.72	74	54	-6.95	-9.28
9608	V	66.23	43.82	74	54	-7.77	-10.18
12010	V	65.13	42.13	74	54	-8.87	-11.87
14412	V	64.08	41.08	74	54	-9.92	-12.92
16814	V	63.82	40.82	74	54	-10.18	-13.18
4804	H	67.22	46.52	74	54	-6.78	-7.48
7206	H	66.82	45.72	74	54	-7.18	-8.28
9608	H	65.35	44.13	74	54	-8.65	-9.87
12010	H	64.13	43.38	74	54	-9.87	-10.62
14412	H	63.82	42.43	74	54	-10.18	-11.57
16814	H	62.72	41.82	74	54	-11.28	-12.18

Other harmonics emissions are lower than 20dB below the allowable limit.

Note: (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.

Operation Mode: TX Mode (CH40: 2441MHz) Test Date : November 11, 2014
Frequency Range: 1-25GHz Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4882	V	67.23	45.13	74	54	-6.77	-8.87
7323	V	66.55	44.85	74	54	-7.45	-9.15
9764	V	65.12	43.59	74	54	-8.88	-10.41
12205	V	64.05	42.71	74	54	-9.95	-11.29
14646	V	63.29	41.08	74	54	-10.71	-12.92
17087	V	62.75	40.85	74	54	-11.25	-13.15
4882	H	66.85	45.39	74	54	-7.15	-8.61
7323	H	65.28	44.17	74	54	-8.72	-9.83
9764	H	64.13	43.28	74	54	-9.87	-10.72
12205	H	63.85	42.85	74	54	-10.15	-11.15
14646	H	62.85	41.01	74	54	-11.15	-12.99
17087	H	61.07	40.38	74	54	-12.93	-13.62

Other harmonics emissions are lower than 20dB below the allowable limit.

Note: (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.

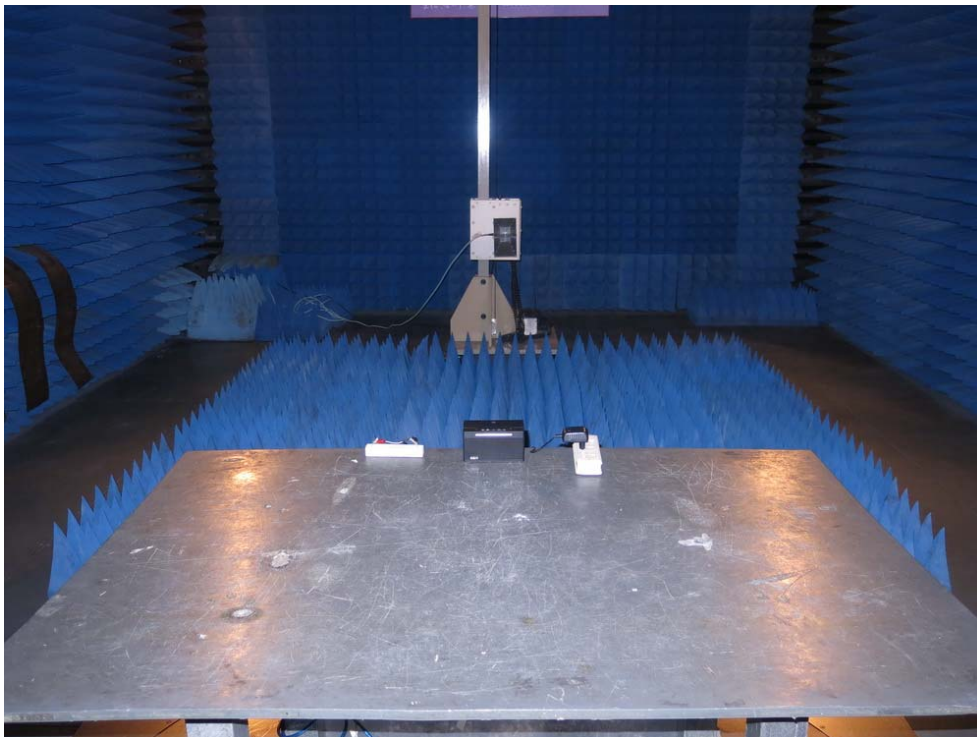
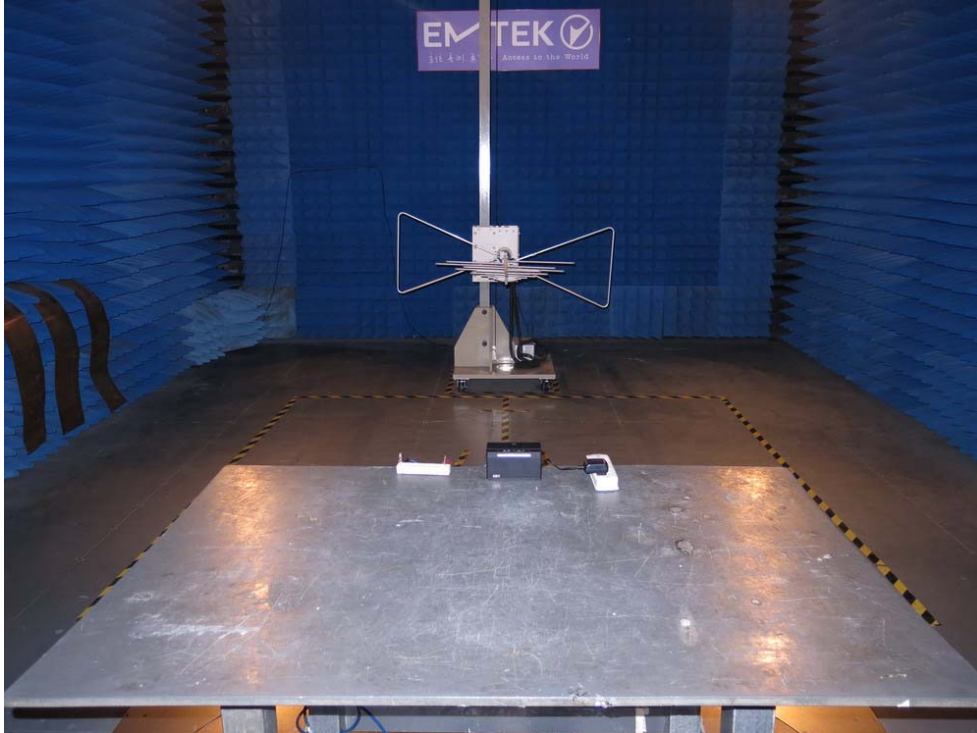
Operation Mode: TX Mode (CH79: 2480MHz) Test Date : November 11, 2014
Frequency Range: 1-25GHz Temperature : 25 °C
Test Result: PASS Humidity : 50 %
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4960	V	66.23	46.85	74	54	-7.77	-7.15
7440	V	65.42	45.13	74	54	-8.58	-8.87
9920	V	64.05	44.28	74	54	-9.95	-9.72
12400	V	63.85	43.59	74	54	-10.15	-10.41
14880	V	62.49	42.13	74	54	-11.51	-11.87
17360	V	61.35	41.08	74	54	-12.65	-12.92
4960	H	65.22	45.95	74	54	-8.78	-8.05
7440	H	64.13	44.13	74	54	-9.87	-9.87
9920	H	63.85	43.95	74	54	-10.15	-10.05
12400	H	62.75	42.18	74	54	-11.25	-11.82
14880	H	61.07	41.08	74	54	-12.93	-12.92
17360	H	60.22	40.33	74	54	-13.78	-13.67

Other harmonics emissions are lower than 20dB below the allowable limit.

Note: (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.

6.5 Radiated Measurement Photos:

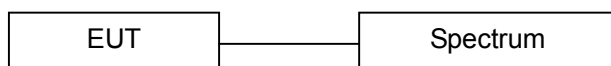


7. Channel Separation test

7.1 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.

7.2 Test SET-UP (Block Diagram of Configuration)



7.3 Measurement Equipment Used:

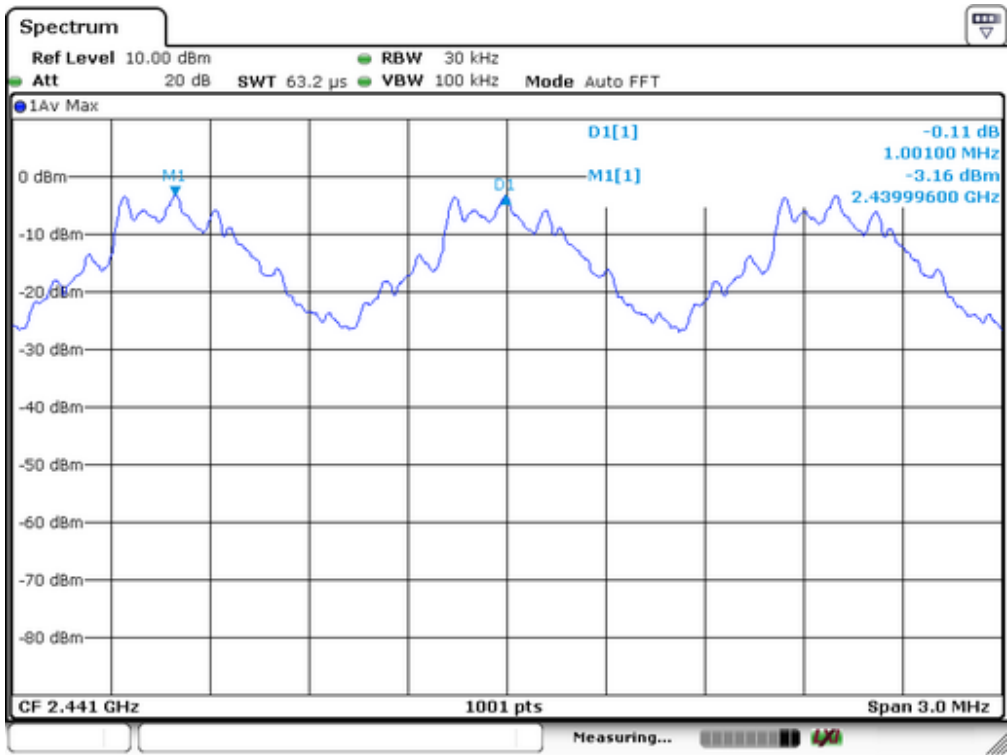
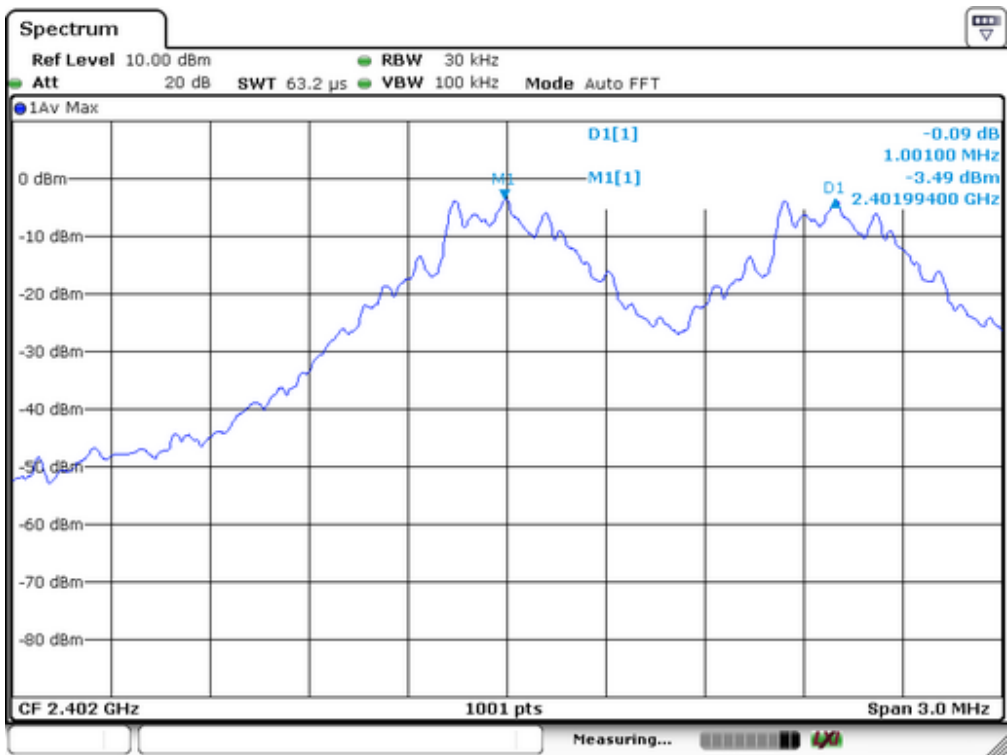
Same as 6.3 Radiated Emission Measurement.

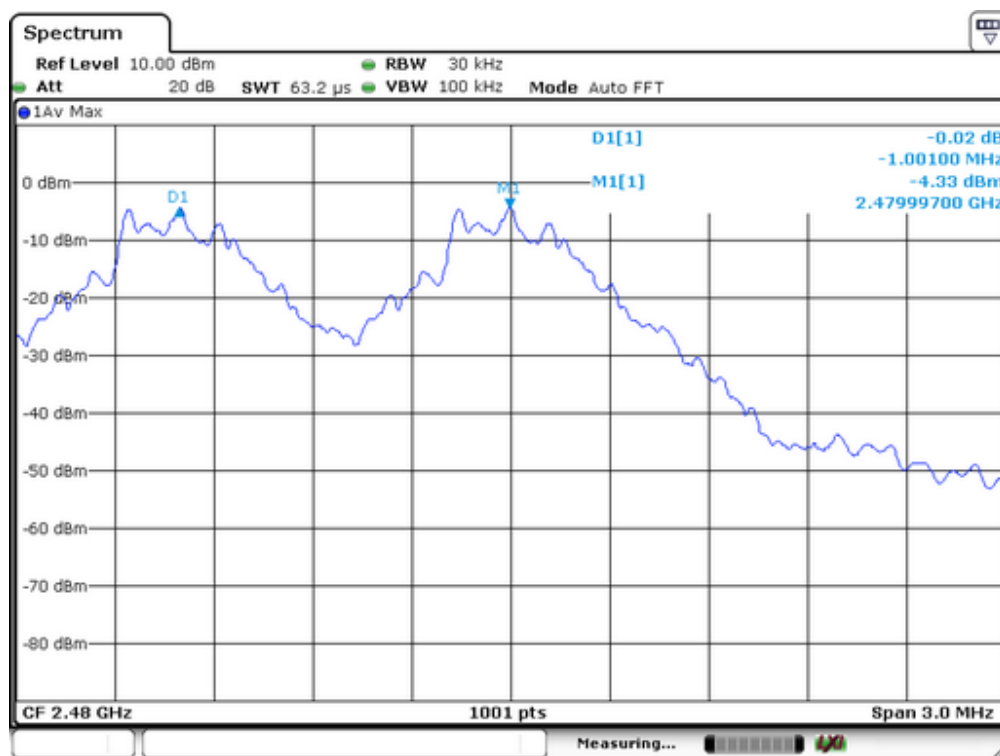
7.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 11, 2014
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

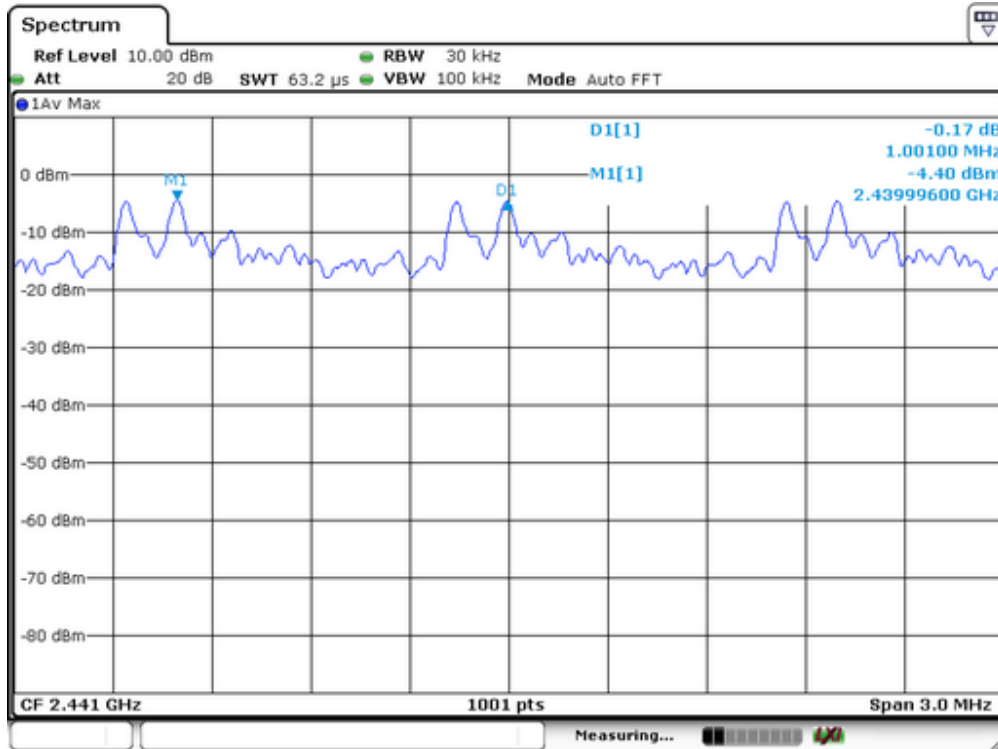
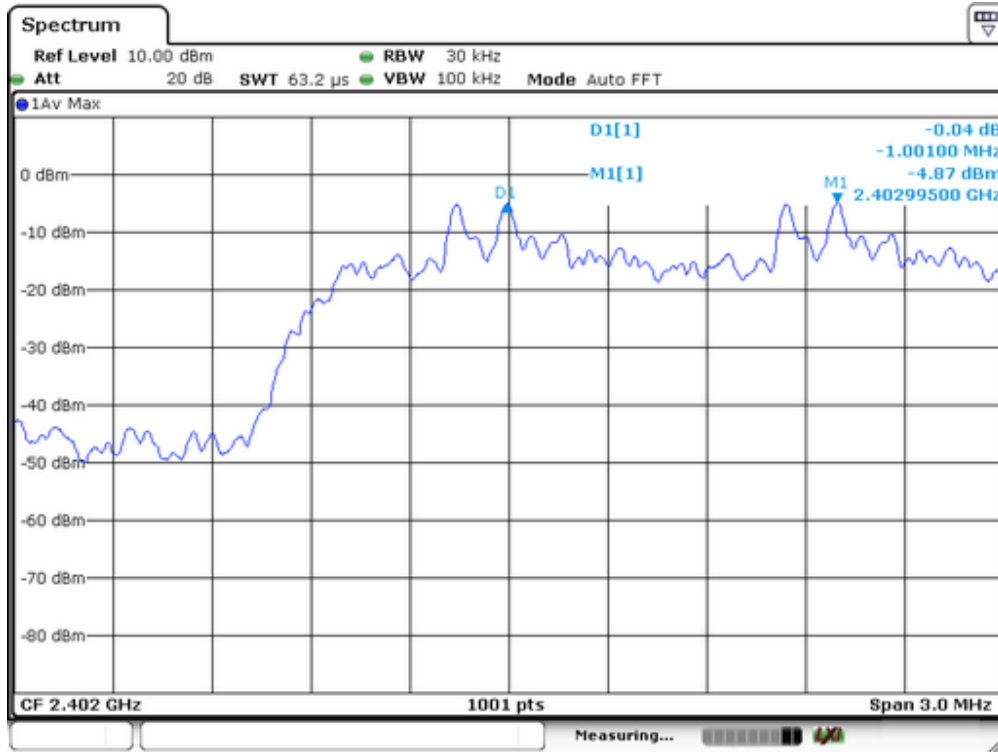
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
1	2402	1001	>836
40	2441	1001	>830
79	2480	1001	>824

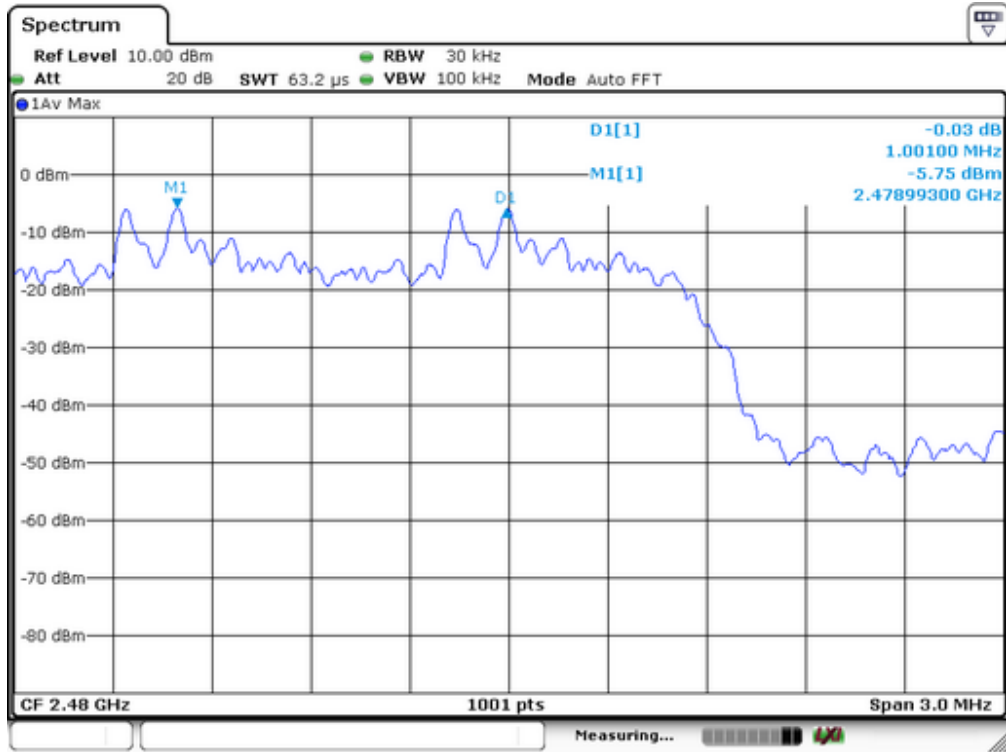




Spectrum Detector:	PK	Test Date :	November 11, 2014
Test By:	Andy	Temperature :	24°C
Test Result:	PASS	Humidity :	53 %
Modulation:	$\Pi/4$ -DQPSK		

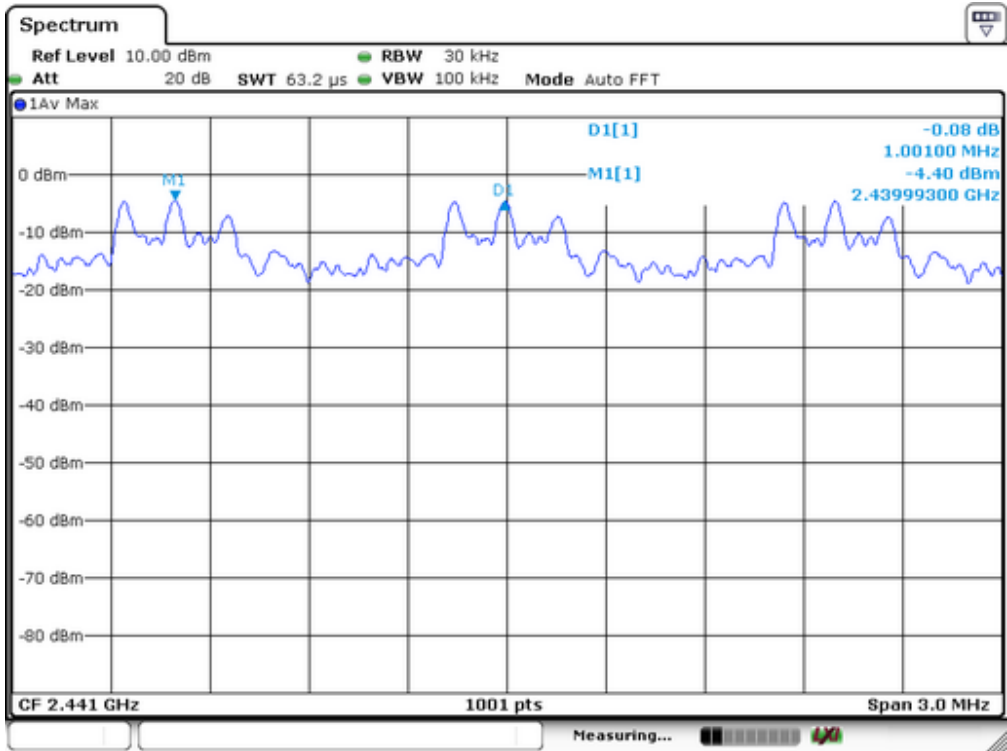
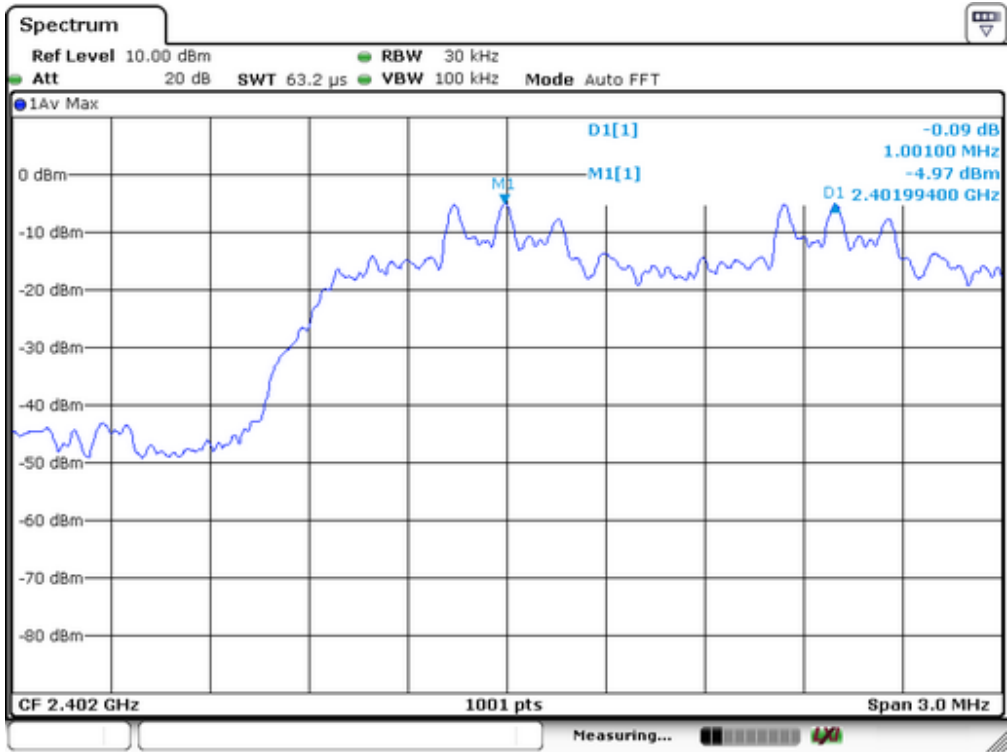
Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>810
40	2441	1001	>808
79	2480	1001	>808

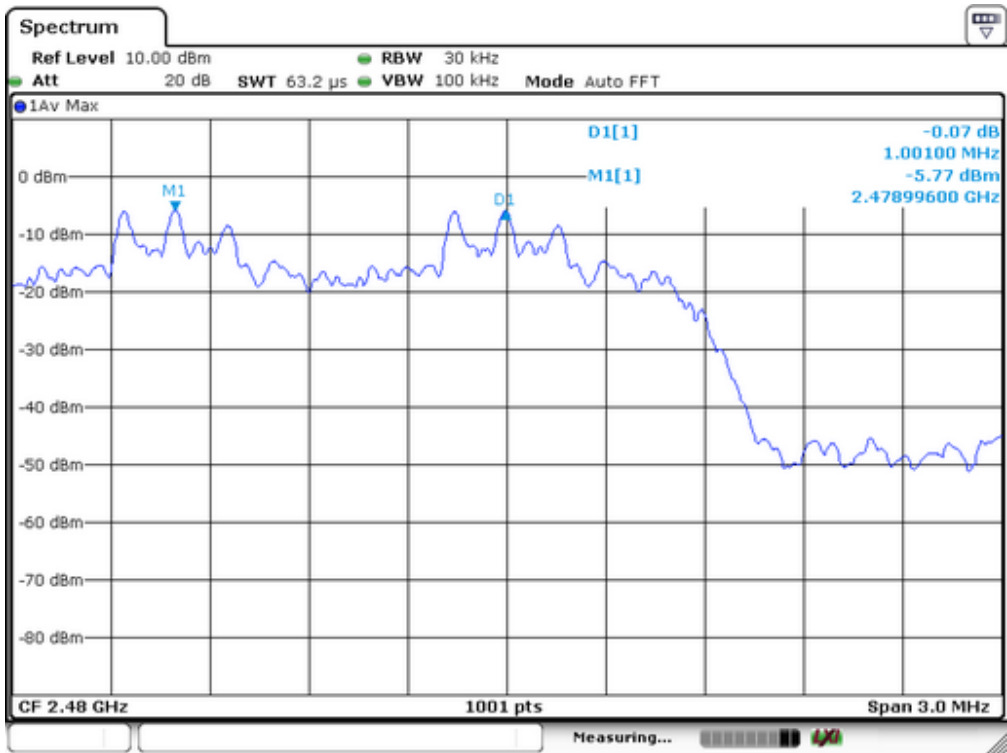




Spectrum Detector:	PK	Test Date :	November 11, 2014
Test By:	Andy	Temperature :	24 °C
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
1	2402	1001	>804
40	2441	1001	>802
79	2480	1001	>808



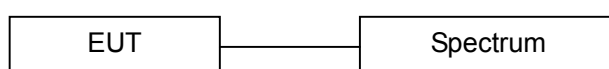


8. 20dB Bandwidth test

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)



8.3 Measurement Equipment Used:

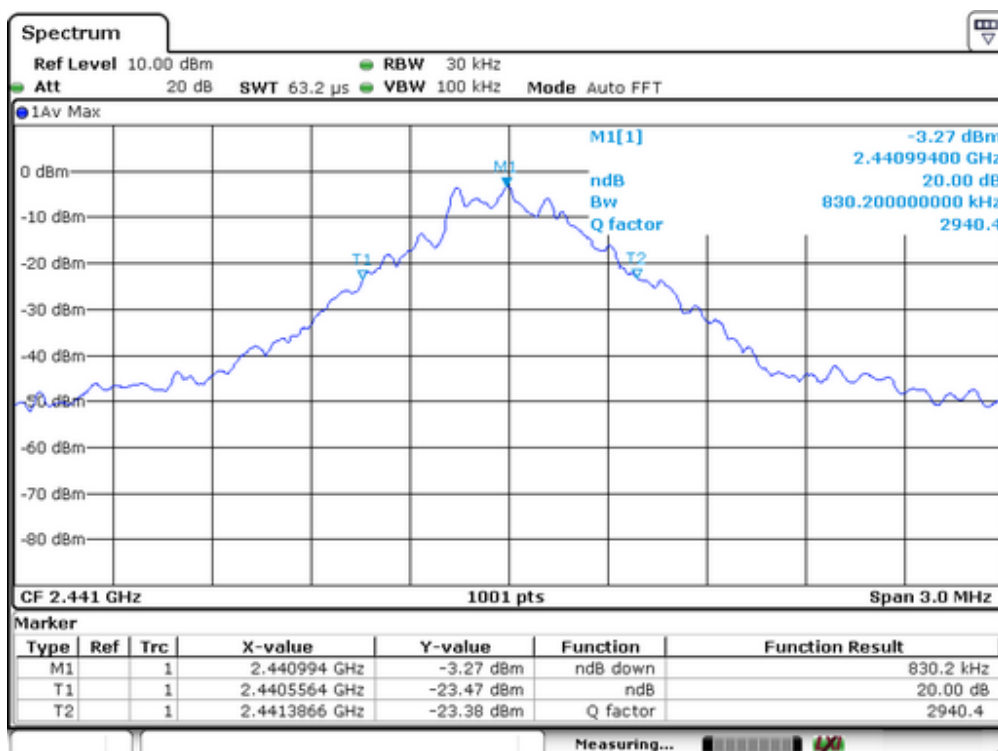
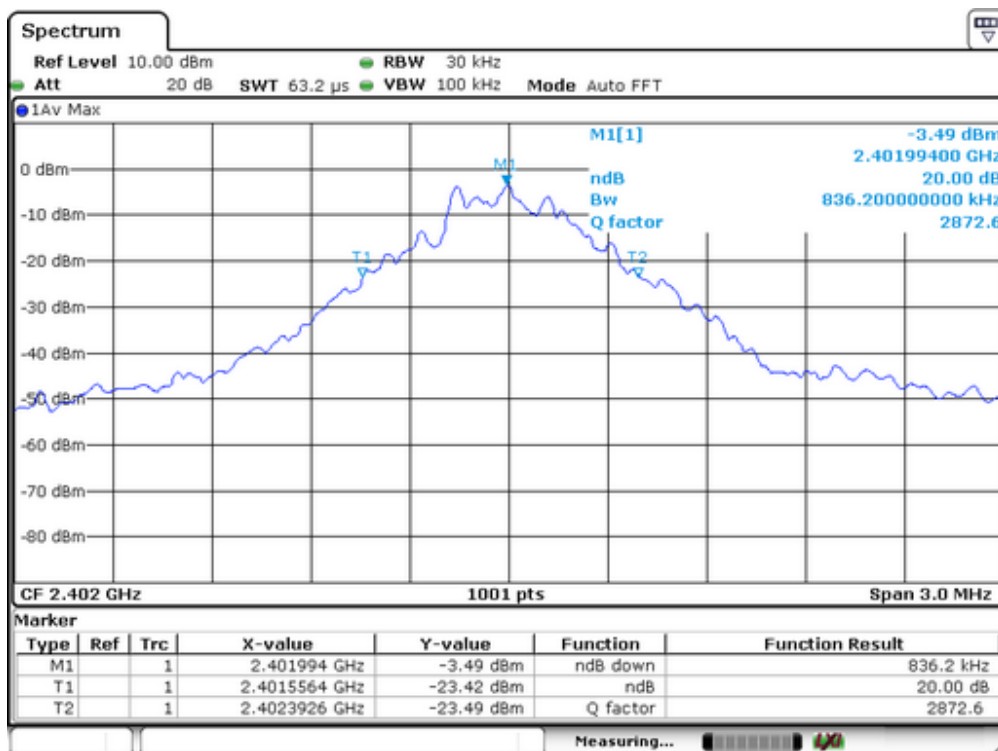
Same as 6.3 Radiated Emission Measurement.

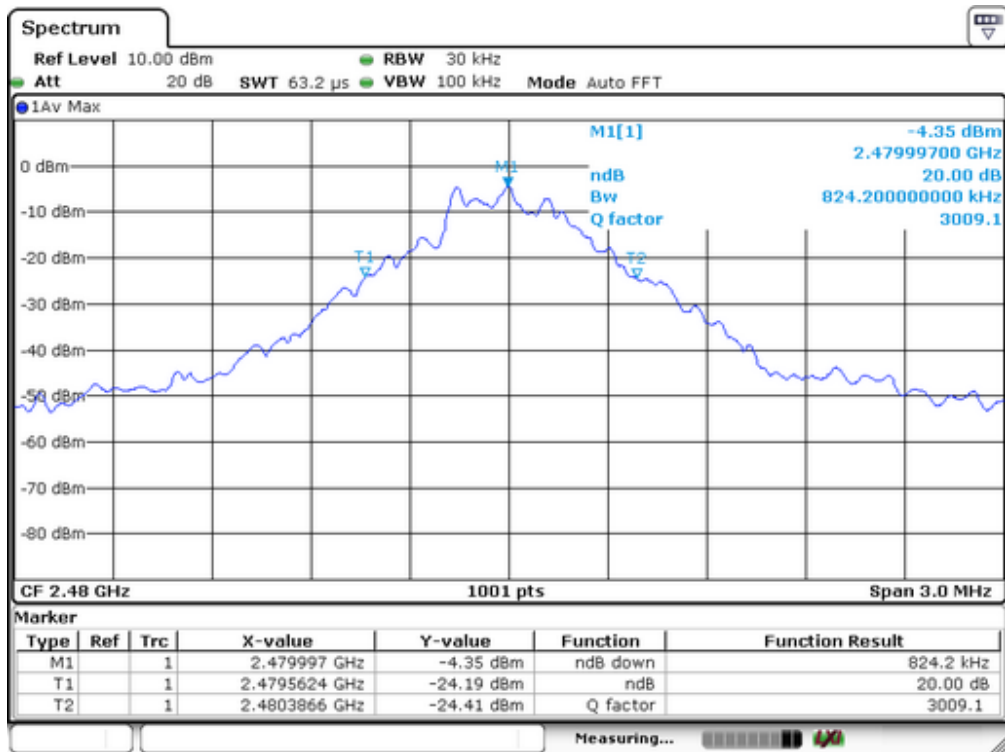
8.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 11, 2014
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

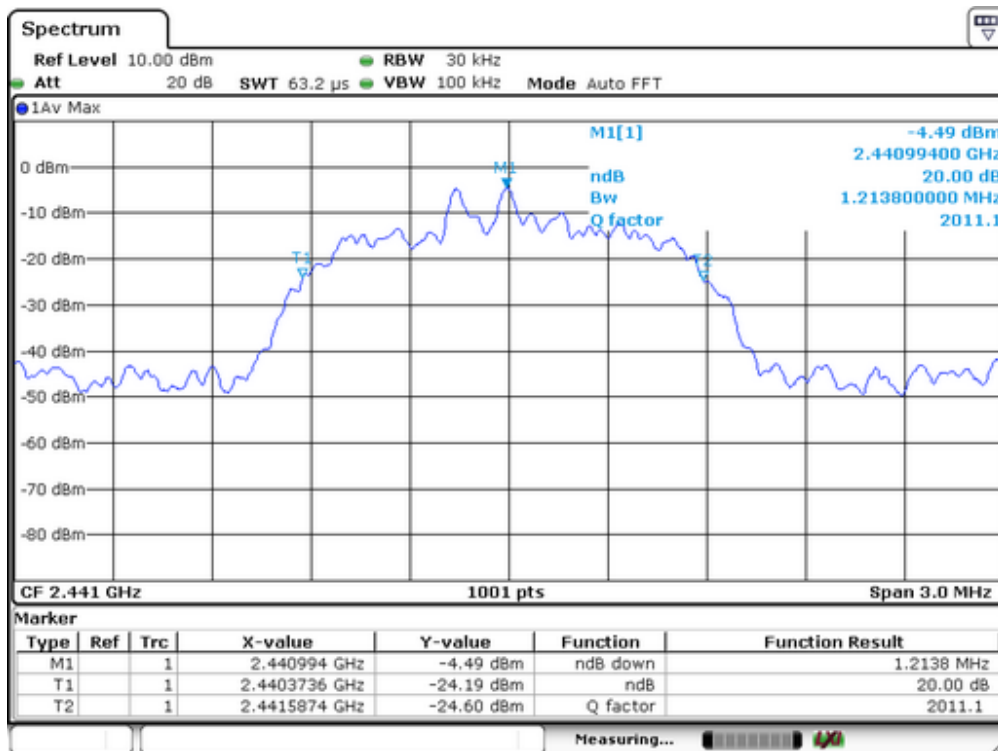
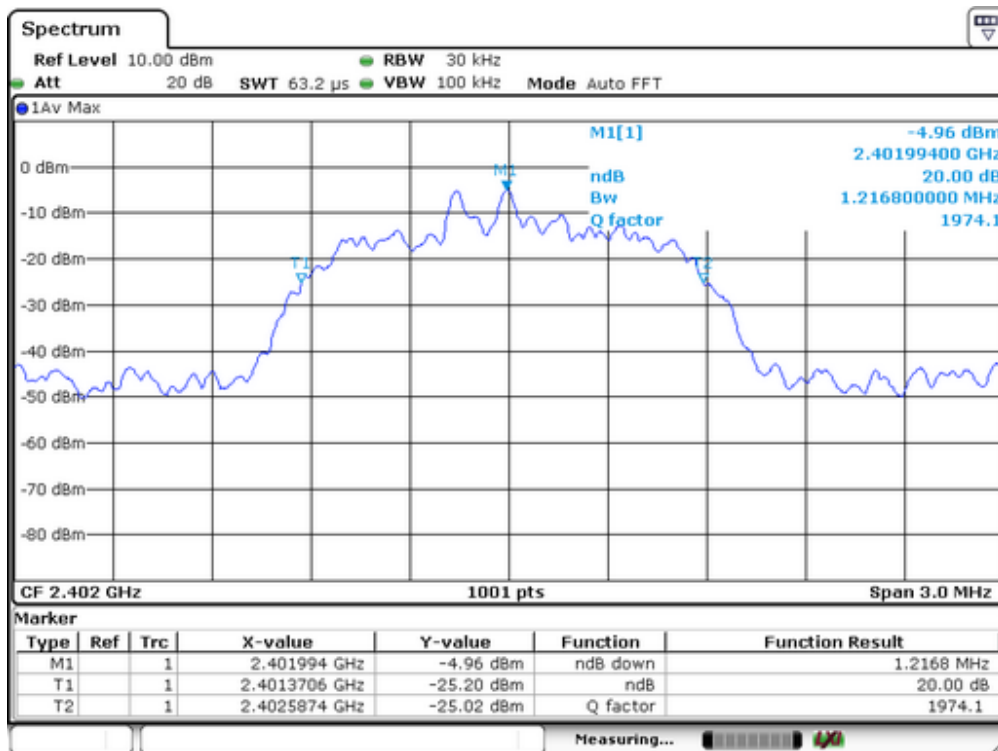
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	836
40	2441	830
79	2480	824

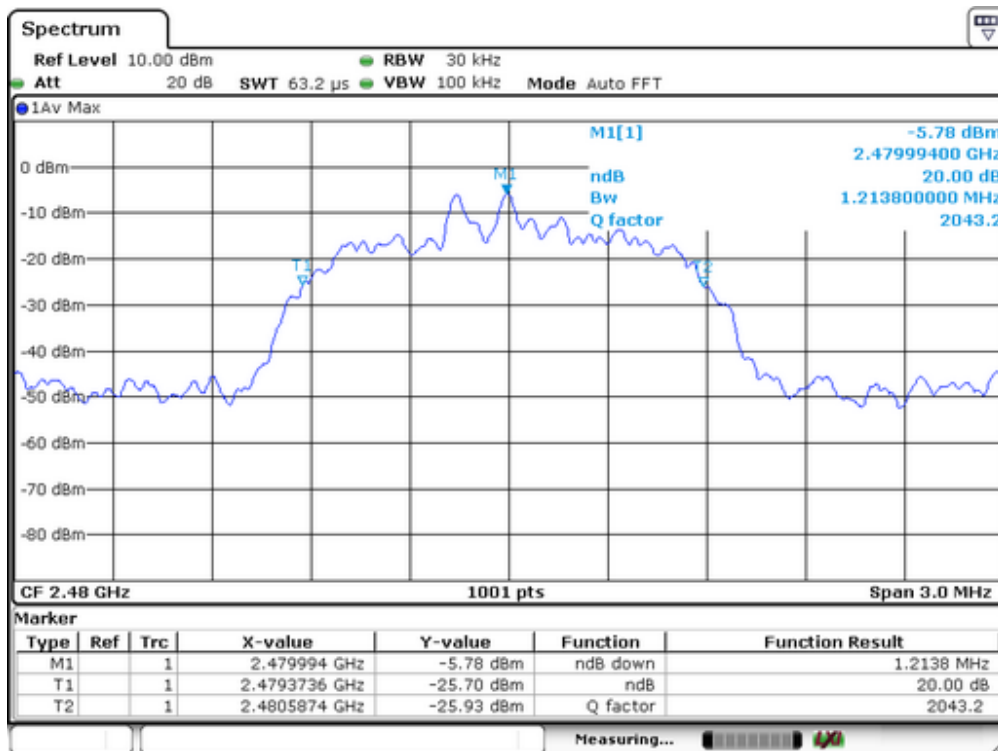




Spectrum Detector: PK Test Date : November 11, 2014
Test By: Andy Temperature : 24°C
Test Result: PASS Humidity : 53 %
Modulation: $\pi/4$ -DQPSK

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1216
40	2441	1213
79	2480	1213

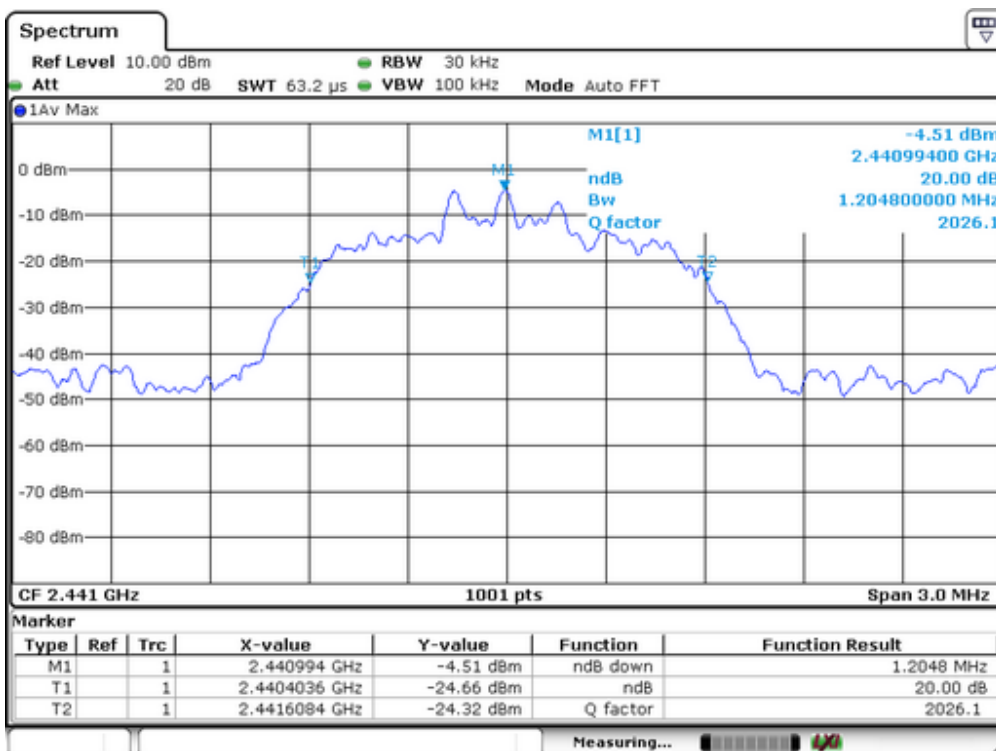
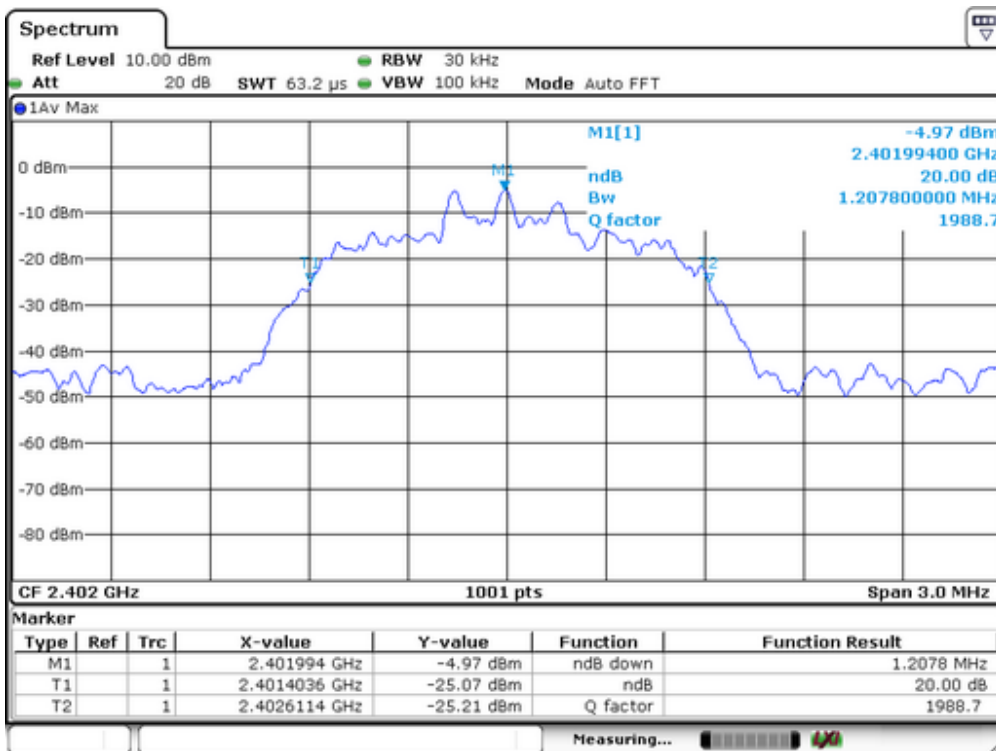


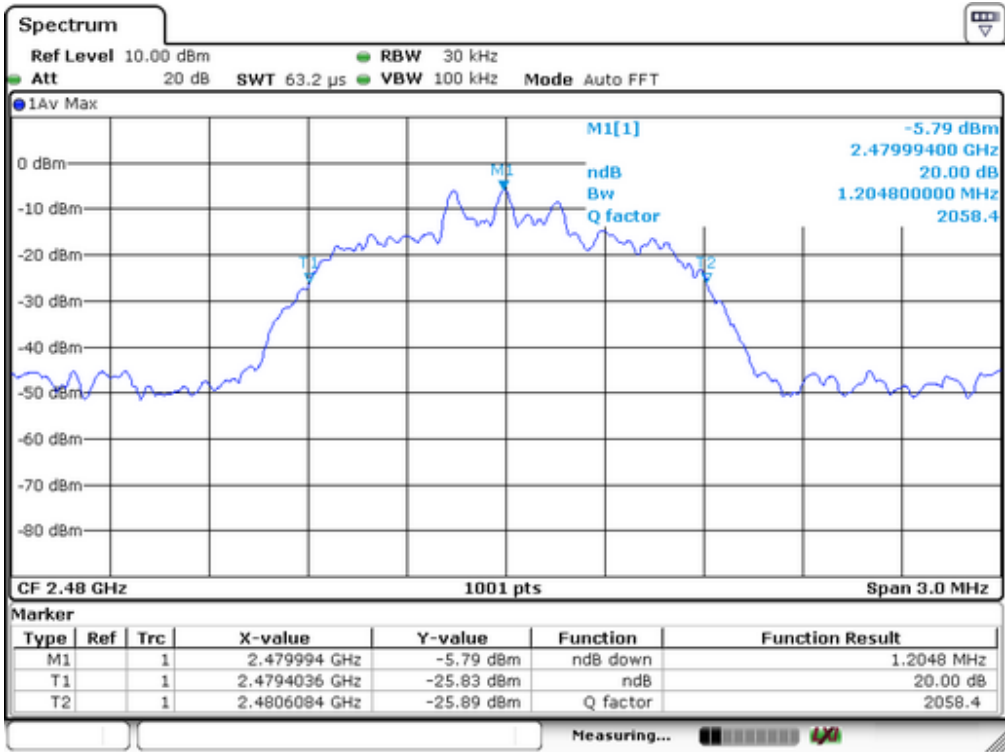


Spectrum Detector: PK
Test By: Andy
Test Result: PASS
Modulation: 8DPSK

Test Date : November 11, 2014
Temperature : 24°C
Humidity : 53 %

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
1	2402	1207
40	2441	1204
79	2480	1204





10. Time of Occupancy (Dwell Time) test

10.1 Test Description

The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

$$\text{Dwell time} = \text{time slot length} * \text{hop rate} / \text{number of hopping channels} * 31.6\text{s}$$

with:

- hop rate = $1600 * 1/\text{s}$ for DH1 packets = 1600 s^{-1}
- hop rate = $1600/3 * 1/\text{s}$ for DH3 packets = 533.33 s^{-1}
- number of hopping channels = 79
- $31.6 \text{ s} = 0.4 \text{ seconds}$ multiplied by the number of hopping channels = $0.4 \text{ s} * 79$

The highest value of the dwell time is reported.

10.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6seconds. Refer to attached data chart.

10.3 Test Protocol

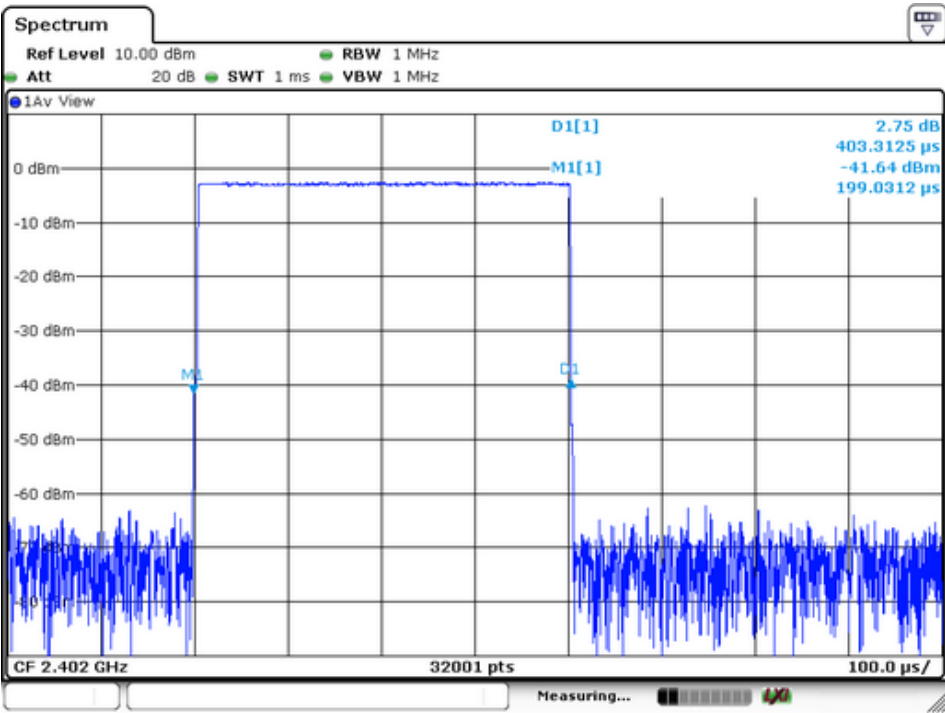
Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	$1600/(2*79) \times 31.6 = 320$	0.403	128.96	400
DH3	$1600/(4*79) \times 31.6 = 160$	1.656	264.96	400
DH5	$1600/(6*79) \times 31.6 = 106.67$	2.906	309.98	400

Remark: The results of worst cased was recorded.

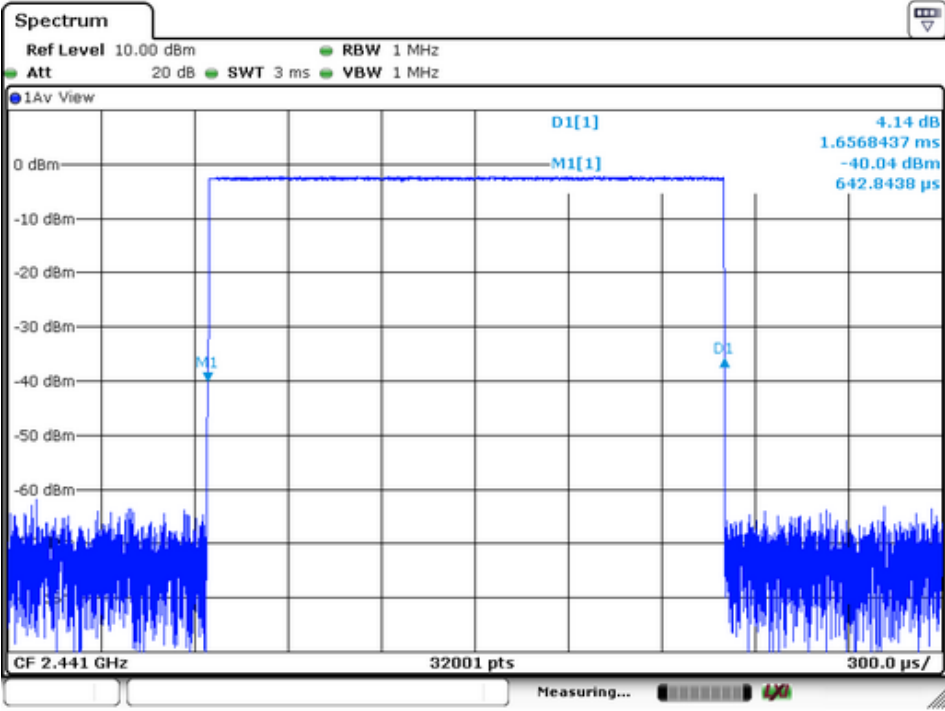
10.4 Test result: Dwell time

PASS.

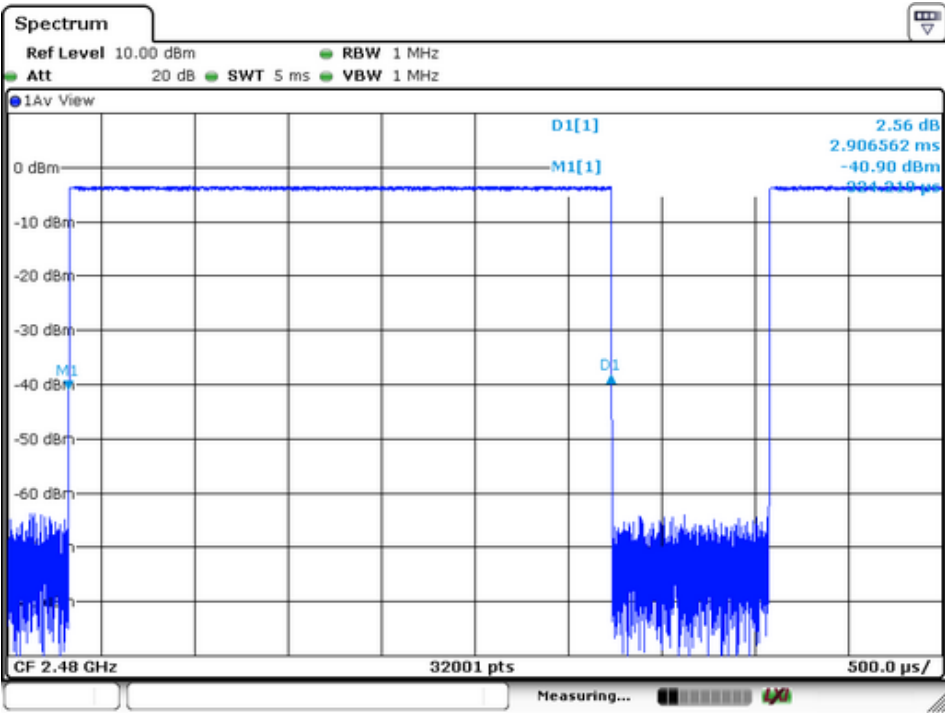
DH1:



DH3:



DH5:

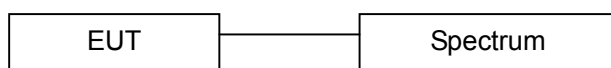


11. MAXIMUM PEAK OUTPUT POWER TEST

11.1 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 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.

11.2 Test SET-UP (Block Diagram of Configuration)



11.3 Measurement Equipment Used:

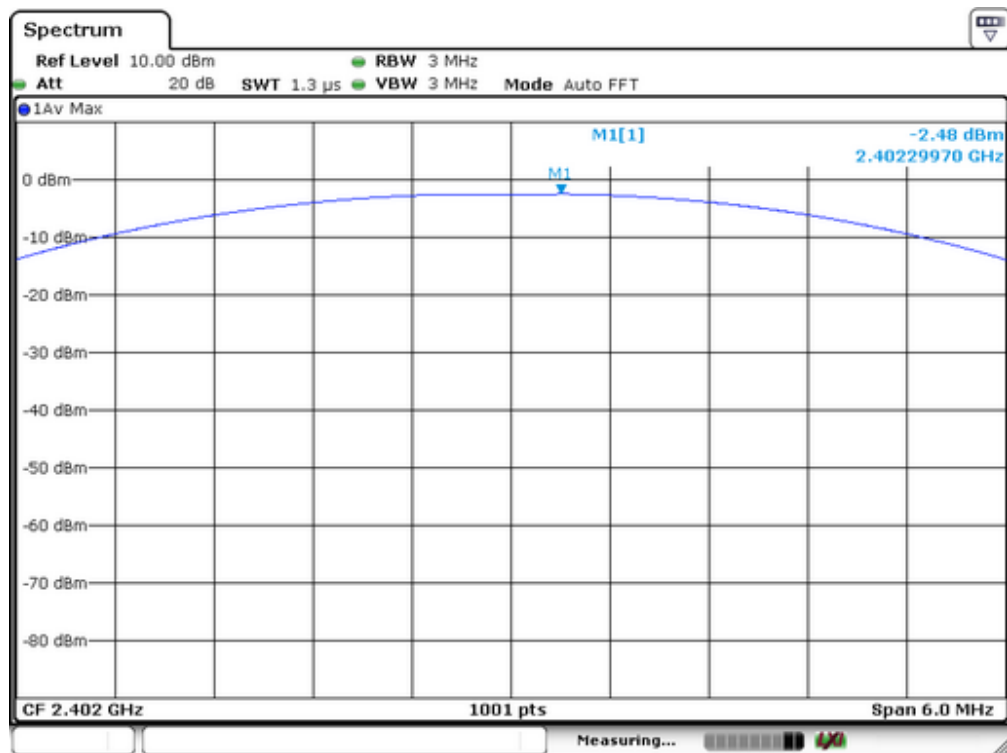
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	05/16/2014	05/15/2015

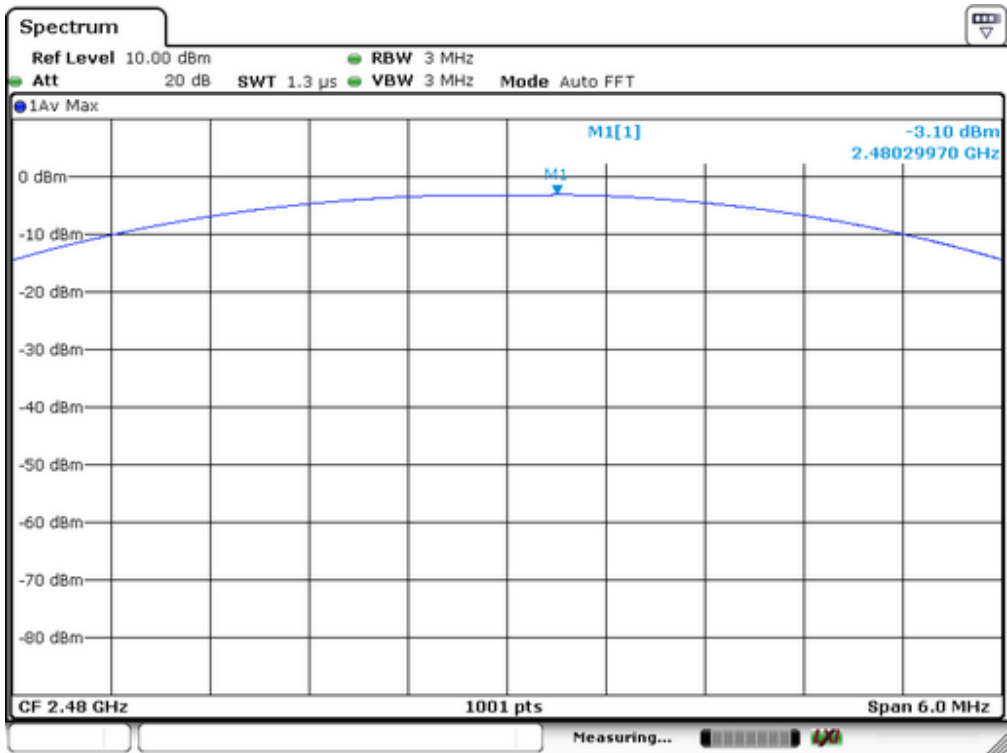
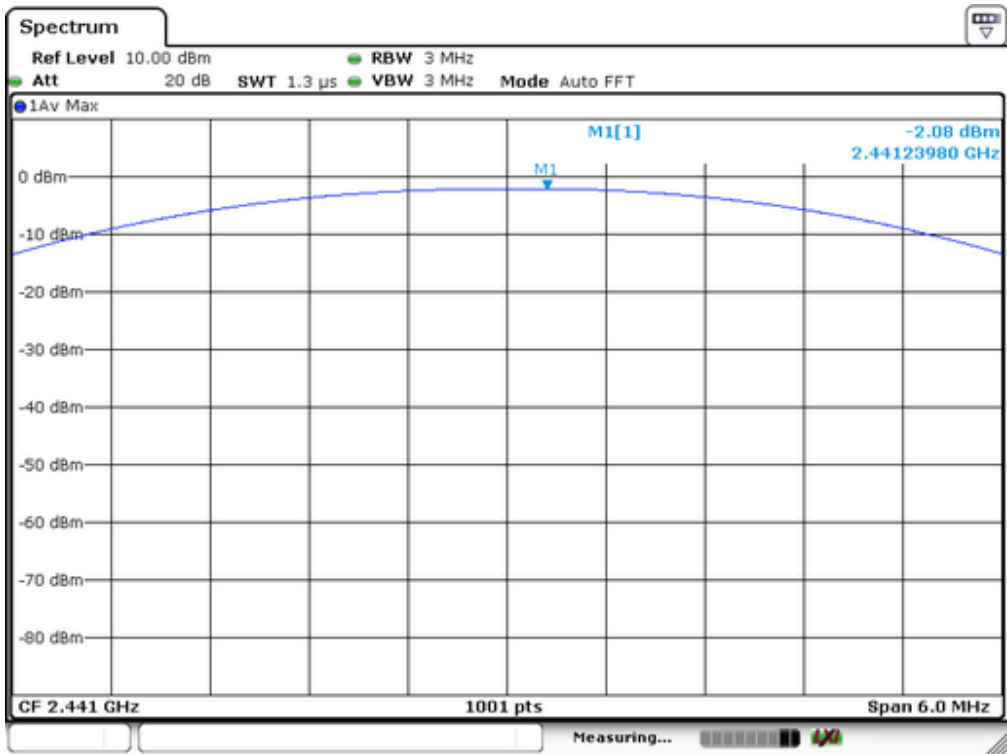
11.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 11, 2014
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

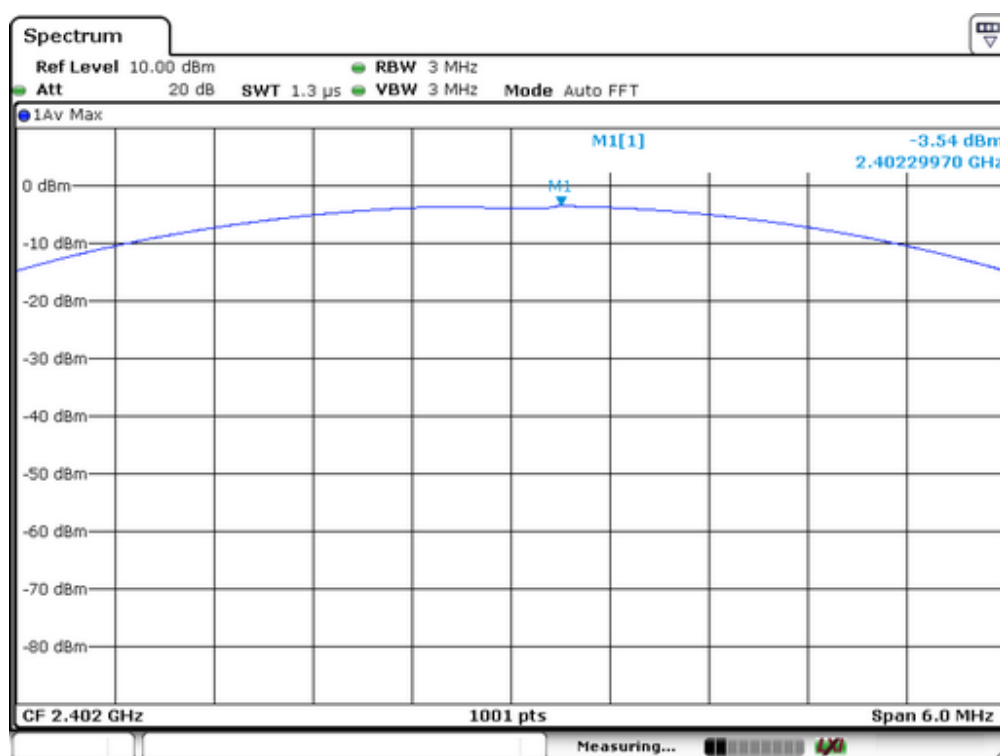
Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-2.48	0.565	1000	PASS
40	2441	-2.08	0.619	1000	PASS
79	2480	-3.10	0.490	1000	PASS

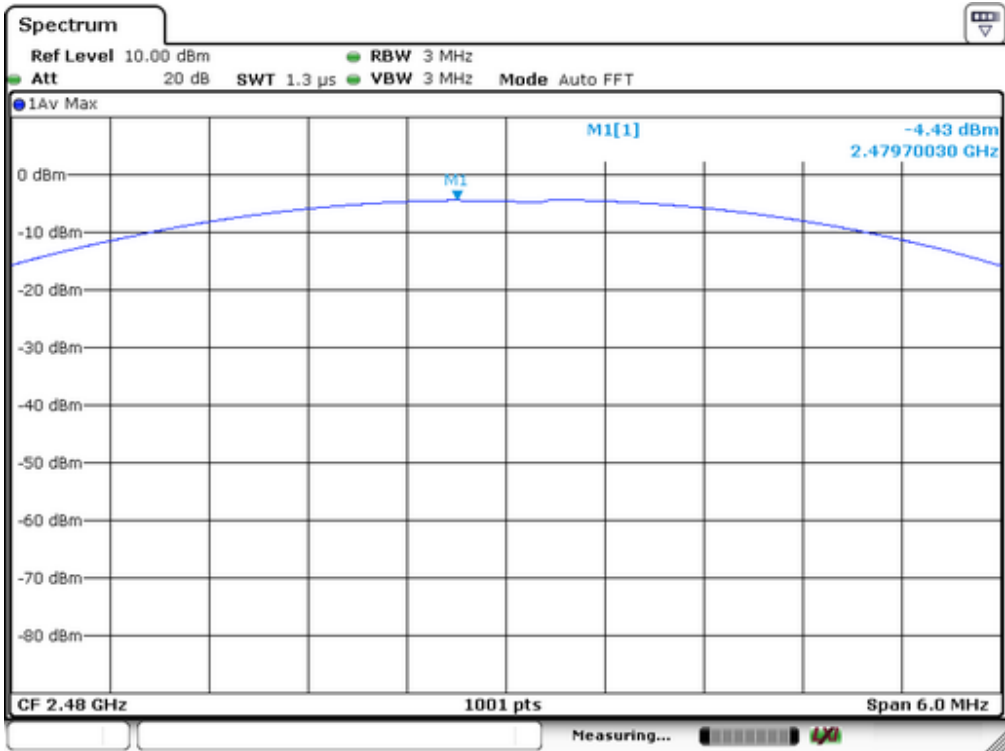
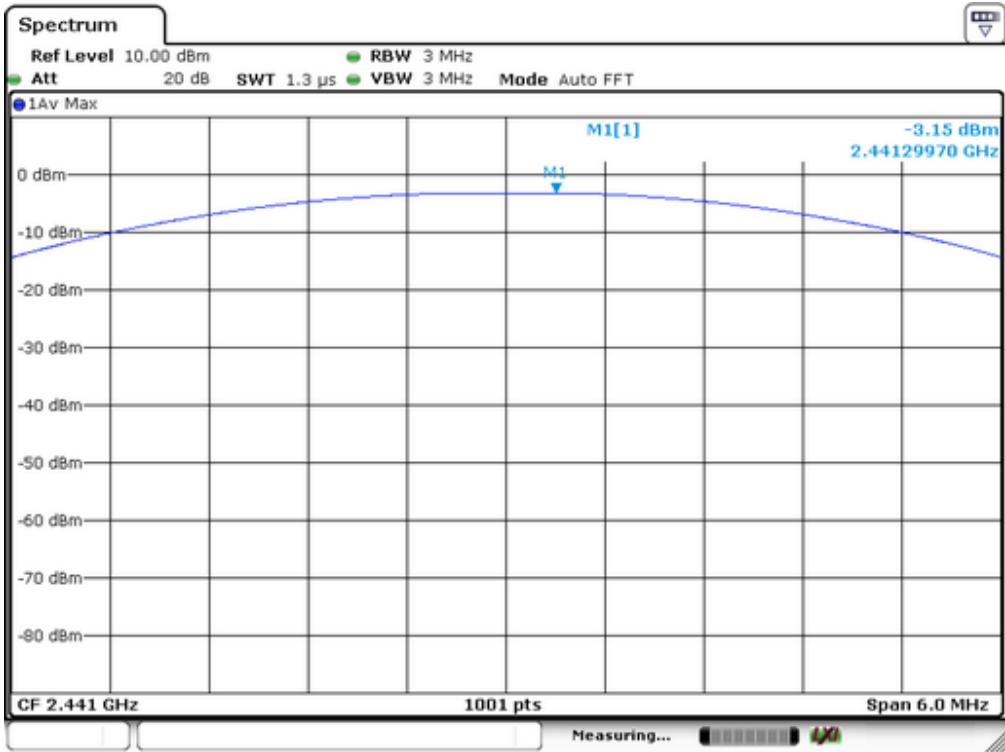




Spectrum Detector:	PK	Test Date :	November 11, 2014
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	Π/4-DQPSK		

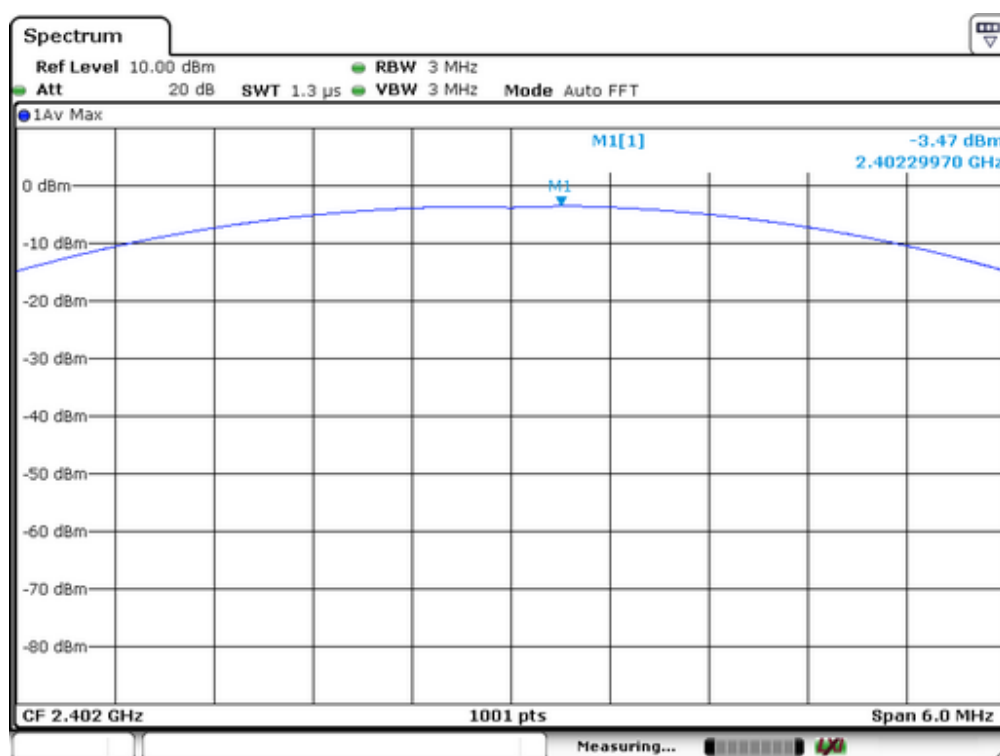
Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-3.54	0.443	125	PASS
40	2441	-3.15	0.484	125	PASS
79	2480	-4.43	0.361	125	PASS

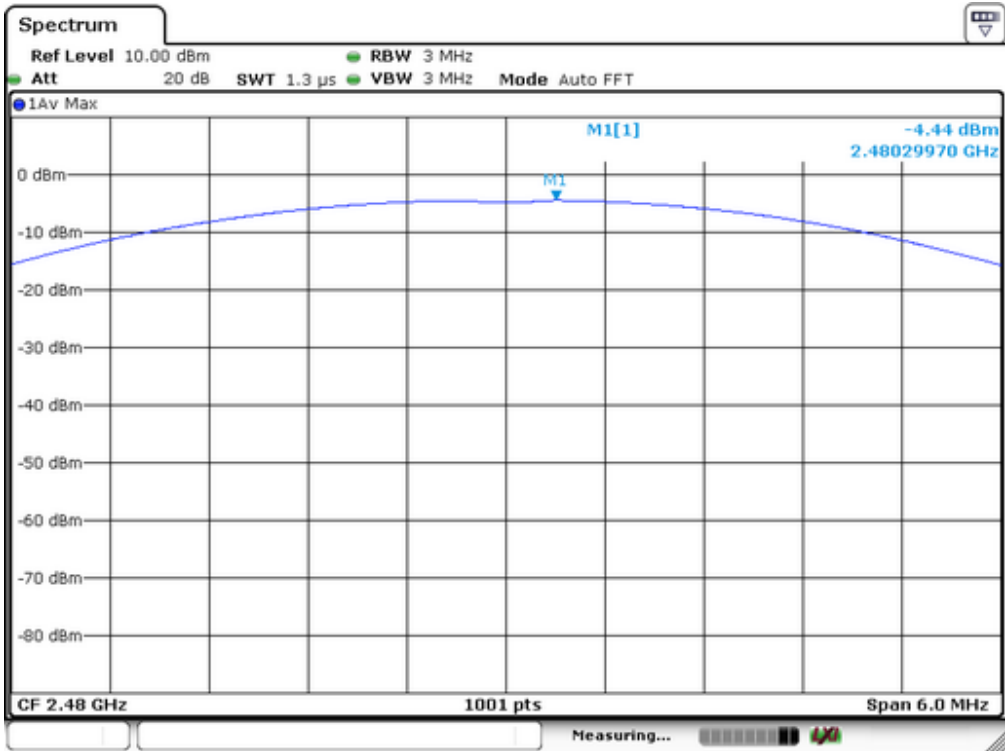
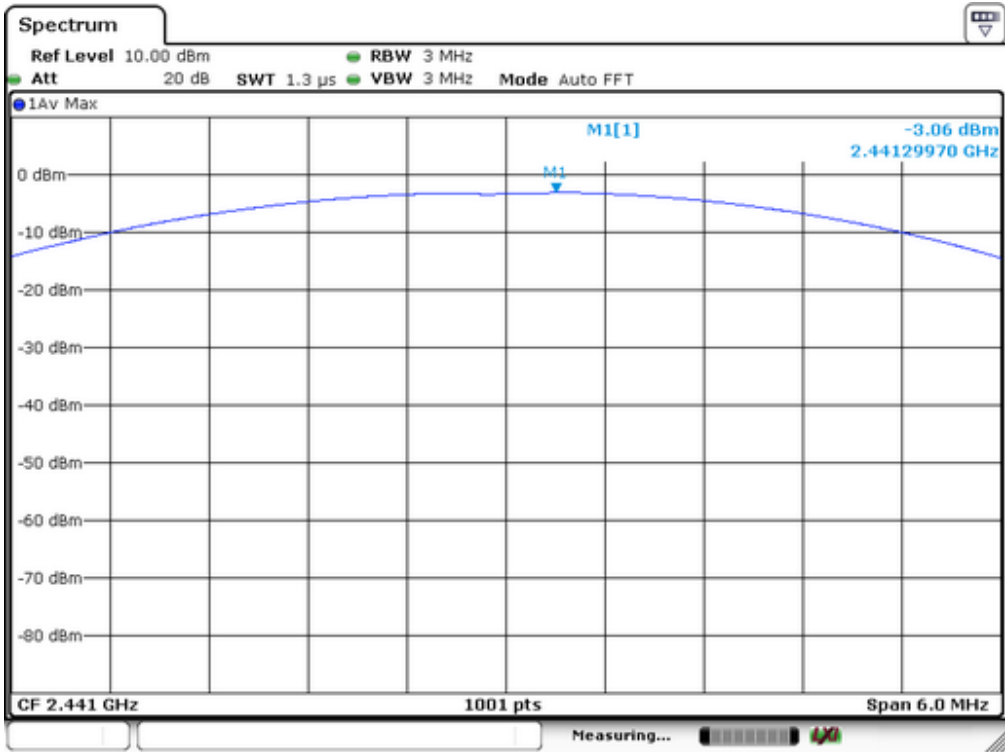




Spectrum Detector:	PK	Test Date :	November 11, 2014
Test By:	Andy	Temperature :	25 °C
Test Result:	PASS	Humidity :	50 %
Modulation:	8DPSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
1	2402	-3.47	0.450	125	PASS
40	2441	-3.06	0.494	125	PASS
79	2480	-4.44	0.360	125	PASS





12. Band EDGE test

12.1 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.
6. Use the following spectrum analyzer settings:

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

12.2 Test SET-UP (Block Diagram of Configuration)

Same as 6.2 Radiated Emission Set-up.

12.3 Measurement Equipment Used:

Same as 6.3 Radiated Emission Measurement.

12.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector: PK Test Date : November 11, 2014
Test By: Andy Temperature : 25 °C
Test Result: PASS Humidity : 50 %

1. Conducted Test

For Non-Hopping Mode:

Frequency (MHz)	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
<2400	-2.76	-43.48	40.72	>20dBc
	-3.89	-49.63	45.74	>20dBc
	-3.91	-50.23	46.32	>20dBc
>2483.5	-3.52	-62.10	58.58	>20dBc
	-4.74	-60.91	56.17	>20dBc
	-4.73	-63.37	58.64	>20dBc

For Hopping Mode:

Frequency (MHz)	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
<2400	-2.69	-49.60	46.91	>20dBc
	-3.83	-51.02	47.19	>20dBc
	-3.84	-51.38	47.54	>20dBc
>2483.5	-3.54	-62.47	58.93	>20dBc
	-4.76	-64.07	59.31	>20dBc
	-4.77	-63.62	58.85	>20dBc

2. Radiated emission Test

For Non-Hopping Mode:

Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)	
		PK	AV	PK	AV
<2400	V	66.13	45.28	74.00	54.00
	H	60.59	40.08	74.00	54.00
>2483.5	V	64.23	44.13	74.00	54.00
	H	59.17	40.52	74.00	54.00

For Hopping Mode:

Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)	
		PK	AV	PK	AV
<2400	V	65.13	44.13	74.00	54.00
	H	60.72	40.59	74.00	54.00
>2483.5	V	64.53	45.18	74.00	54.00
	H	59.72	41.08	74.00	54.00

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 used a PCB antenna and integrated on PCB, The antenna's gain is 0 dBi and meets the requirement.

APPENDIX I (Photos of EUT)



