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

OF

Porsche Classic radio navigation system

Model No.: PCRN2, RN7388A

Trade Mark: PORSCHE

FCC ID: 2AD6S-PCRN2

Report No.: KAD141222064E

Issue Date: February 02, 2015

Prepared for

Kraemer Automotive Systems GmbH
Obere Waessere 6-8, Reutlingen, Germany

Prepared by

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VERIFICATION OF COMPLIANCE

Applicant:	Kraemer Automotive Systems GmbH Obere Waessere 6-8, Reutlingen, Germany
Manufacturer:	HUIZHOU FORYOU GENERAL ELECTRONICS CO., LTD. Building 2, A Zone, Foryou Industrial Park, 1# North Shangxia Road, Dongjiang Hi-tech Industry Park, Huizhou, Guangdong, China
Product Description:	Porsche Classic radio navigation system
Trade Mark:	PORSCHE
Model Number:	PCRN2, RN7388A (Note: The samples are the same except model number. So we prepare PCRN2 for full test.)
Kind of Device:	Bluetooth Ver.3.0+EDR
File Number:	KAD141222064E
Date of Test:	December 22, 2014 to January 12, 2015

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 (2014) 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).

Approved By

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

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD141222064E

Table of Contents

1. GENERAL INFORMATION

1.1 Product Description

The Kraemer Automotive Systems GmbH, Model: PCRN2 (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). Modulation: GFSK, π/4-DQPSK, 8DPSK
C). Number of Channel: 79
D). Channel space: 1MHz
E). Measure RF Output Power: 2.40dBm(0.001738W)
F). Antenna Type: Internal PCB antenna
G). Antenna GAIN: 0dBi
H). Power Supply: DC 11-16V

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 π/4-DQPSK modulation is used.

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: 2AD6S-PCRN2 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 (2014). 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 C63.4-2014. 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 transmitter(EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4-2014.

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)	LIMIT(rms) 20dB bandwidth <250KHz(50Channel)	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	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 μV/m	Distance(m)	Field strength at 3m dBμV/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 dBuV/m=20 log (uV/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(dBμV/m)(at 3m)		Class B(dBμV/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.	Porsche Classic radio navigation system	PORSCHE	PCRN2	2AD6S-PCRN2	***EUT***

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	N/A
§15.247(d),§15.209	Radiated Emission	Compliant
§15.203	Antenna Requirement	Compliant
§1.1310	RF Exposure	Compliant

Remark: The EUT is supplied by Battery, there is no need for AC Power Conducted Emission test to be performed on this product.

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,Π/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. 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 were complete.
5. For range 9KHz~30MHz, The measured value is really too low to be recorded.

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:

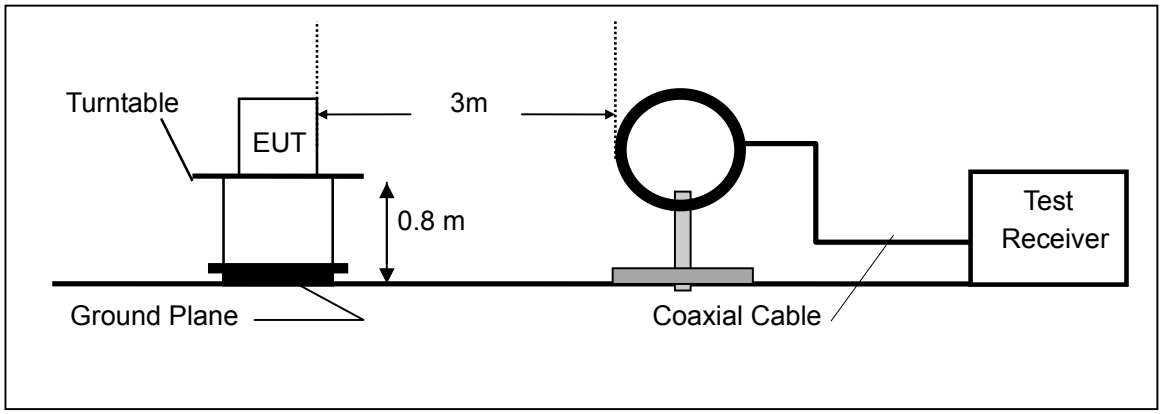
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

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

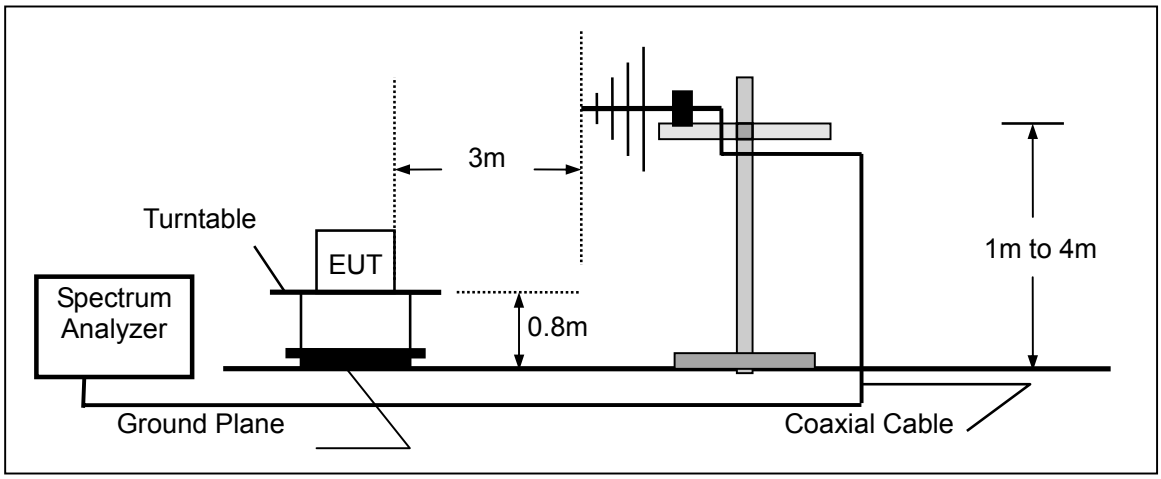
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

5.2 Test SET-UP (Block Diagram of Configuration)

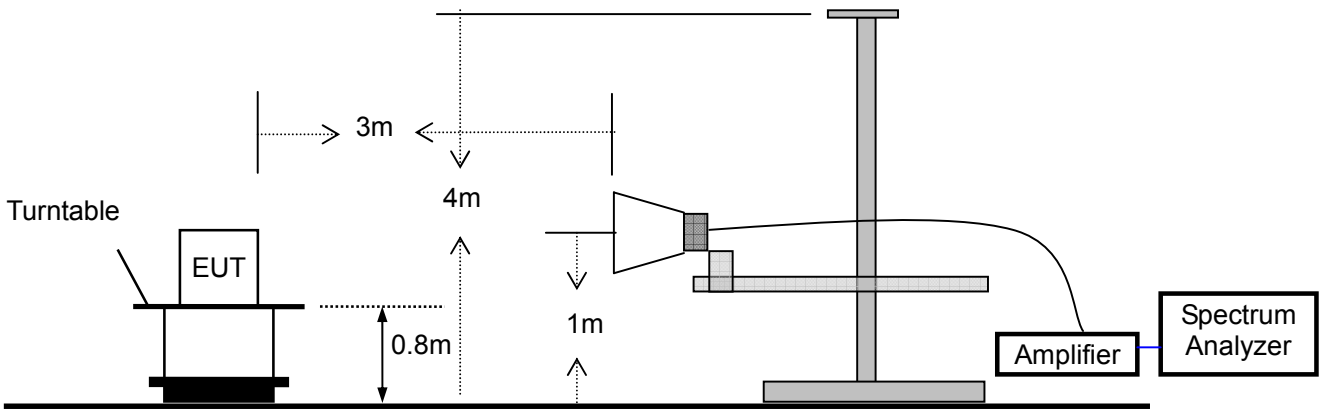
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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	FSV30	1321.3008K	May 16, 2014	May 15, 2015
Spectrum Analyzer	HP	E4407B	839840481	May 16, 2014	May 15, 2015
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	May 16, 2014	May 15, 2015
Pre-Amplifier	HP	8447D	2944A07999	May 16, 2014	May 15, 2015
Bilog Antenna	Schwarzbeck	VULB9163	142	May 19, 2014	May 18, 2015
Loop Antenna	ARA	PLA-1030/B	1029	May 19, 2014	May 18, 2015
Horn Antenna	Electro-Metrics	EM-6961	103314	May 19, 2014	May 18, 2015
Horn Antenna	Schwarzbeck	BBHA 9120	D143	May 19, 2014	May 18, 2015

5.4 Measurement Result

Below 30MHz:

All the modulation modes were tested the data of the test mode are recorded in the following pages.

Operation Mode:	TX Mode	Test Date :	December 26, 2014
Frequency Range:	9KHz~30MHz	Temperature :	28℃
Test Result:	PASS	Humidity :	60 %
Measured Distance:	3m	Test By:	Andy

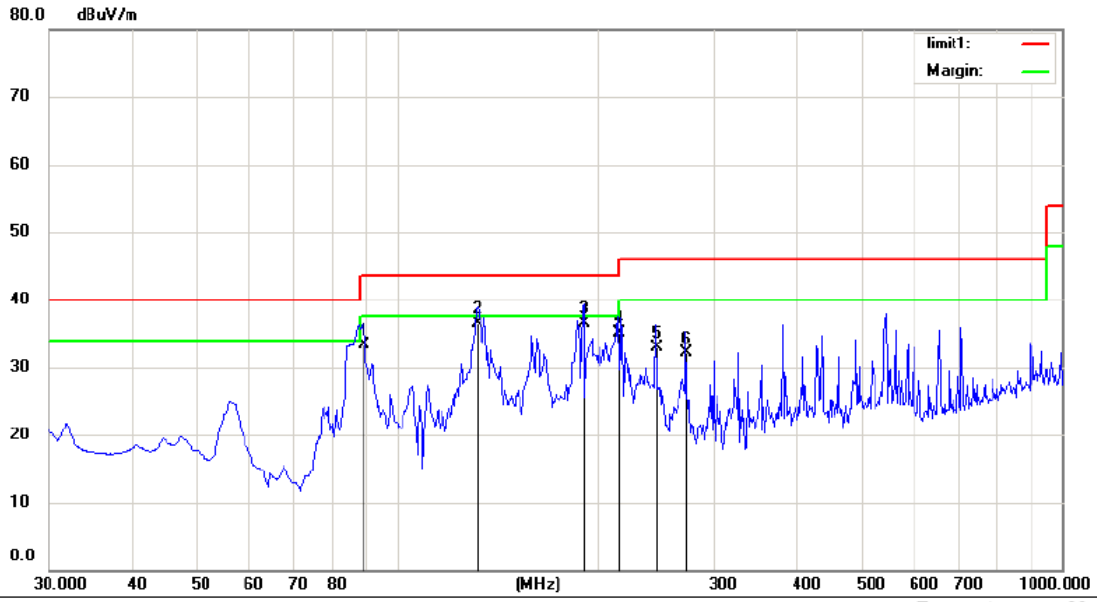
Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.
Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

Below 1000MHz:

Pass.

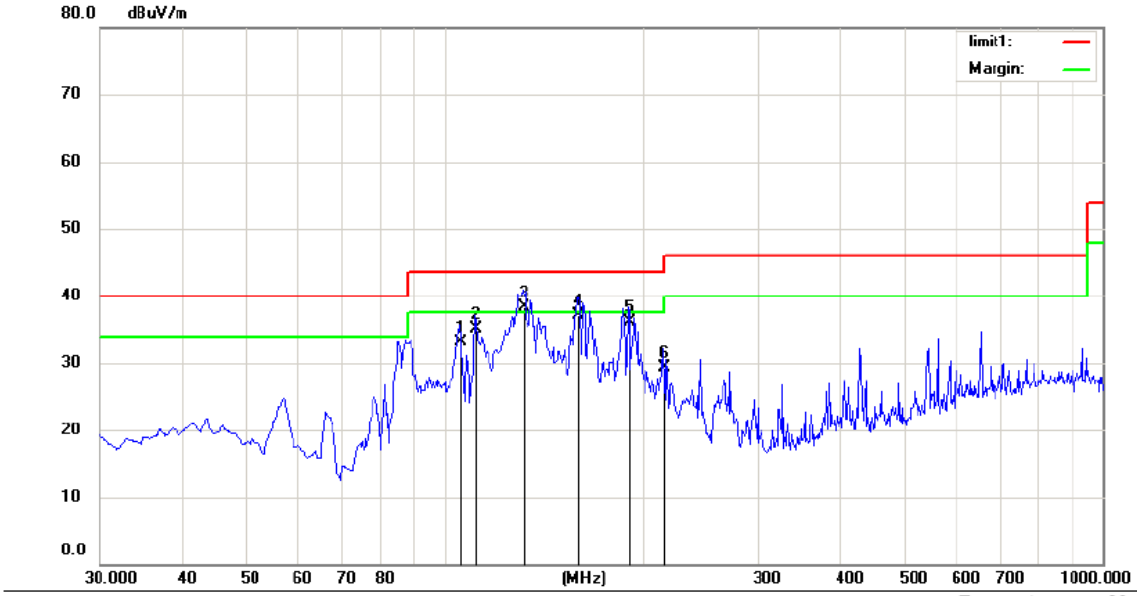
Please refer to the following data.



Site Chamber #1 Polarization: **Horizontal** Temperature: 26
Limit: (RE)FCC PART 15 class C 3m Power: DC 12V Humidity: 55 %
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	Comment
1		89.1700	54.30	-21.04	33.26	43.50	-10.24	QP			
2	*	132.2204	52.90	-16.35	36.55	43.50	-6.95	QP			
3		191.0738	54.70	-18.23	36.47	43.50	-7.03	QP			
4		215.2700	51.50	-16.46	35.04	43.50	-8.46	QP			
5		245.3400	48.60	-15.60	33.00	46.00	-13.00	QP			
6		272.5000	47.30	-15.12	32.18	46.00	-13.82	QP			

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



Site Chamber #1 Polarization: **Vertical** Temperature: 26

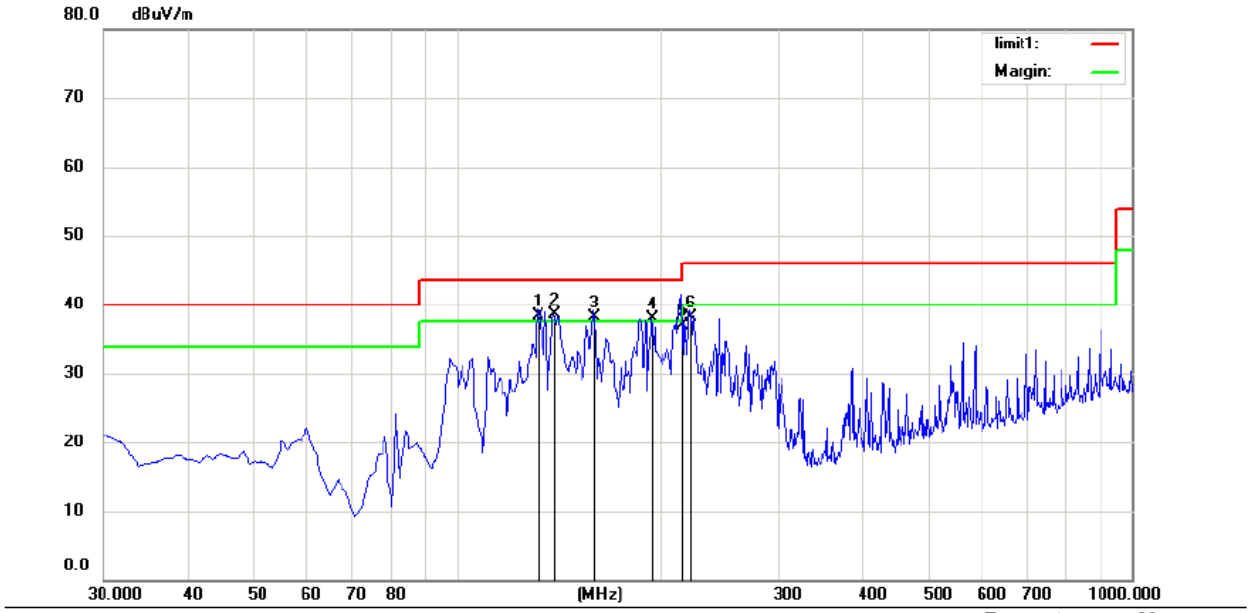
Limit: (RE)FCC PART 15 class C 3m Power: DC 12V Humidity: 55 %

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	Comment
1		105.6600	51.30	-18.12	33.18	43.50	-10.32	QP			
2		111.4800	52.50	-17.48	35.02	43.50	-8.48	QP			
3	*	131.8500	54.70	-16.40	38.30	43.50	-5.20	QP			
4		159.9800	55.60	-18.44	37.16	43.50	-6.34	QP			
5		191.0200	54.30	-18.24	36.06	43.50	-7.44	QP			
6		215.2700	45.80	-16.46	29.34	43.50	-14.16	QP			

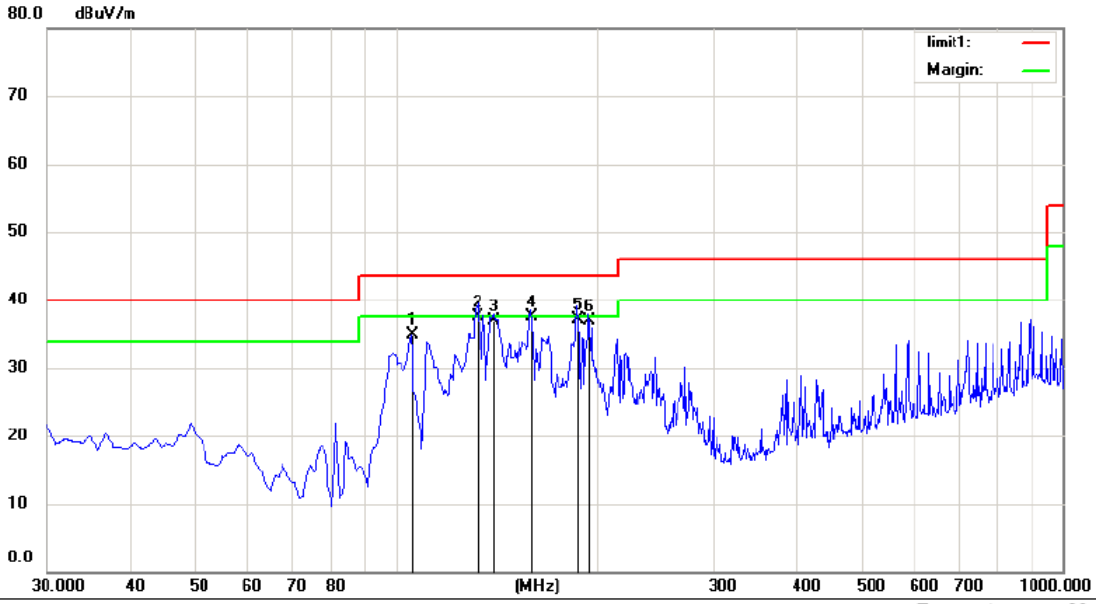
*:Maximum data x:Over limit !:over margin Operator: Snake



Site Chamber #1 Polarization: **Horizontal** Temperature: 26
Limit: (RE)FCC PART 15 class C 3m Power: DC 12V Humidity: 55 %
Mode:TX2441
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	Comment
1	!	131.8500	54.59	-16.34	38.25	43.50	-5.25	QP			
2	*	139.6100	55.42	-17.00	38.42	43.50	-5.08	QP			
3	!	159.9800	56.54	-18.44	38.10	43.50	-5.40	QP			
4	!	194.9000	55.85	-17.88	37.97	43.50	-5.53	QP			
5		215.2700	53.45	-16.46	36.99	43.50	-6.51	QP			
6		222.0600	54.21	-16.16	38.05	46.00	-7.95	QP			

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



Site Chamber #1 Polarization: **Vertical** Temperature: 26

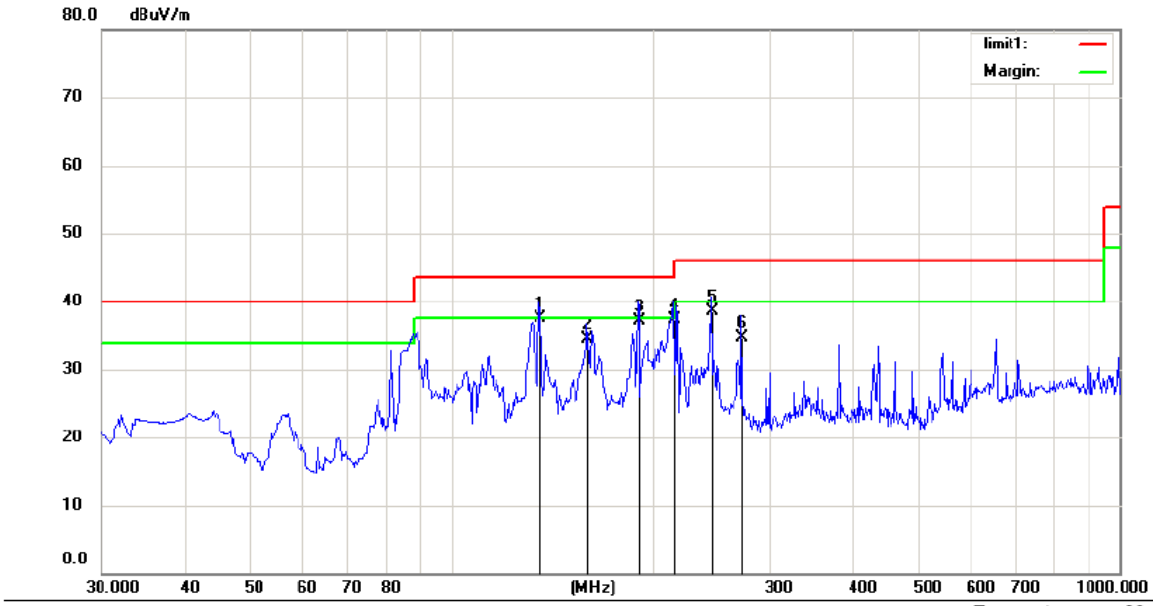
Limit: (RE)FCC PART 15 class C 3m Power: DC 12V Humidity: 55 %

Mode:TX2441

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	Comment
1		105.6600	53.08	-18.12	34.96	43.50	-8.54	QP			
2	*	132.8200	53.97	-16.43	37.54	43.50	-5.96	QP			
3		140.5800	53.90	-17.09	36.81	43.50	-6.69	QP			
4		159.9800	55.85	-18.44	37.41	43.50	-6.09	QP			
5		187.1400	55.44	-18.41	37.03	43.50	-6.47	QP			
6		194.9000	54.81	-17.88	36.93	43.50	-6.57	QP			

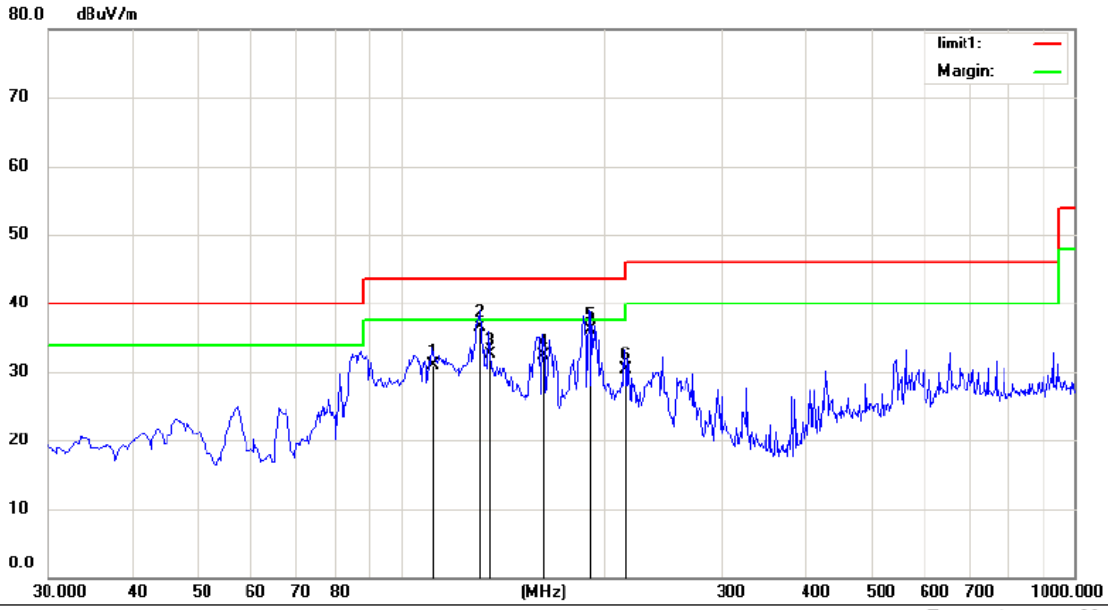
*:Maximum data x:Over limit !:over margin Operator: Snake



Site Chamber #1 Polarization: **Horizontal** Temperature: 26
Limit: (RE)FCC PART 15 class C 3m Power: DC 12V Humidity: 55 %
Mode:TX2480
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	Comment
1	*	135.7300	54.10	-16.58	37.52	43.50	-5.98	QP			
2		159.9800	52.90	-18.44	34.46	43.50	-9.04	QP			
3		191.0200	55.30	-18.24	37.06	43.50	-6.44	QP			
4		215.2700	53.70	-16.46	37.24	43.50	-6.26	QP			
5		245.3400	54.20	-15.60	38.60	46.00	-7.40	QP			
6		272.5000	49.80	-15.12	34.68	46.00	-11.32	QP			

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



Site Chamber #1 Polarization: **Vertical** Temperature: 26

Limit: (RE)FCC PART 15 class C 3m Power: DC 12V Humidity: 55 %

Mode:TX2480

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	Comment
1		111.4800	48.30	-17.48	30.82	43.50	-12.68	QP			
2	*	131.2965	52.90	-16.38	36.52	43.50	-6.98	QP			
3		135.7300	49.10	-16.58	32.52	43.50	-10.98	QP			
4		162.8900	50.70	-18.41	32.29	43.50	-11.21	QP			
5		191.0200	54.40	-18.24	36.16	43.50	-7.34	QP			
6		215.2700	46.80	-16.46	30.34	43.50	-13.16	QP			

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

Operation Mode:	TX Mode (CH1: 2402MHz)	Test Date :	December 26, 2014
Frequency Range:	1-25GHz	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Measured Distance:	3m	Test By:	Andy

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4804	V	65.38	44.11	74	54	-8.62	-9.89
7206	V	64.08	43.08	74	54	-9.92	-10.92
9608	V	63.91	42.19	74	54	-10.09	-11.81
12010	V	62.72	41.04	74	54	-11.28	-12.96
14412	V	61.04	40.39	74	54	-12.96	-13.61
16814	V	60.95	39.56	74	54	-13.05	-14.44
4804	H	65.33	45.72	74	54	-8.67	-8.28
7206	H	64.19	44.19	74	54	-9.81	-9.81
9608	H	63.79	43.37	74	54	-10.21	-10.63
12010	H	62.05	42.55	74	54	-11.95	-11.45
14412	H	61.79	41.19	74	54	-12.21	-12.81
16814	H	60.95	40.65	74	54	-13.05	-13.35

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.
(4) The results of worst cased was recorded.

Operation Mode:	TX Mode (CH40: 2441MHz)	Test Date :	December 26, 2014
Frequency Range:	1-25GHz	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Measured Distance:	3m	Test By:	Andy

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4882	V	66.35	44.08	74	54	-7.65	-9.92
7323	V	64.75	43.18	74	54	-9.25	-10.82
9764	V	63.04	42.37	74	54	-10.96	-11.63
12205	V	62.95	41.42	74	54	-11.05	-12.58
14646	V	61.72	40.95	74	54	-12.28	-13.05
17087	V	60.35	39.56	74	54	-13.65	-14.44
4882	H	59.28	45.16	74	54	-14.72	-8.84
7323	H	65.72	44.37	74	54	-8.28	-9.63
9764	H	64.39	43.08	74	54	-9.61	-10.92
12205	H	63.89	42.92	74	54	-10.11	-11.08
14646	H	62.28	41.72	74	54	-11.72	-12.28
17087	H	61.06	38.79	74	54	-12.94	-15.21

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.
(4) The results of worst cased was recorded.

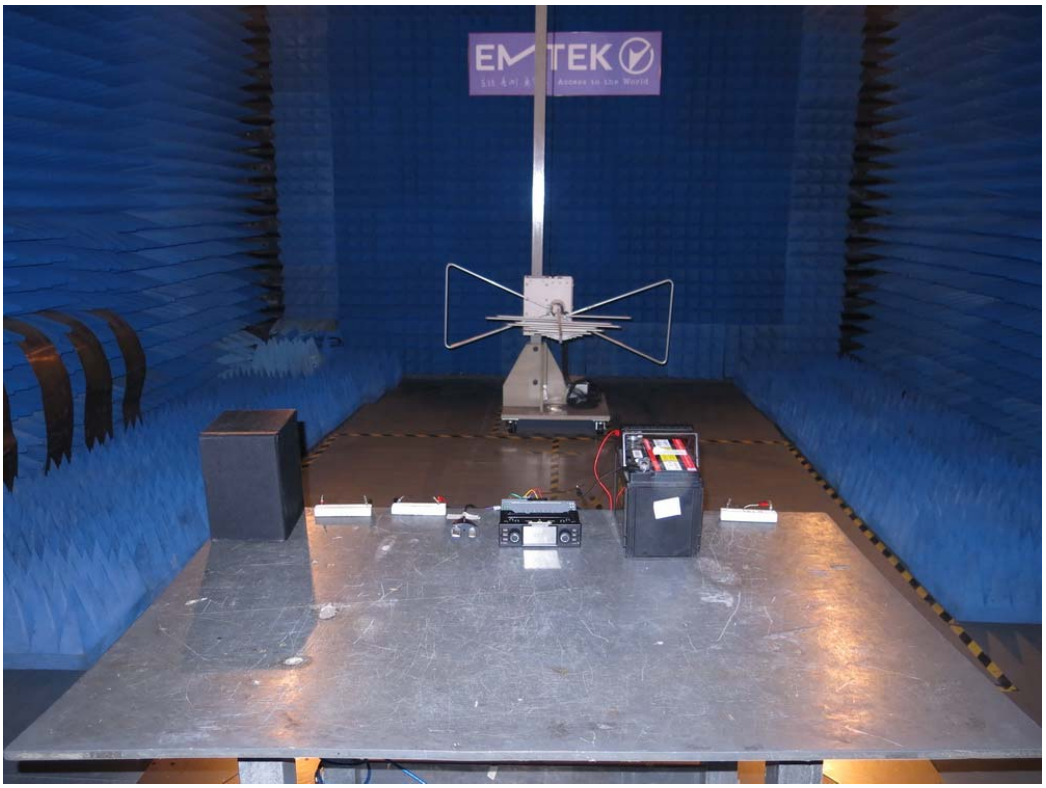
Operation Mode:	TX Mode (CH79: 2480MHz)	Test Date :	December 26, 2014
Frequency Range:	1-25GHz	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Measured Distance:	3m	Test By:	Andy

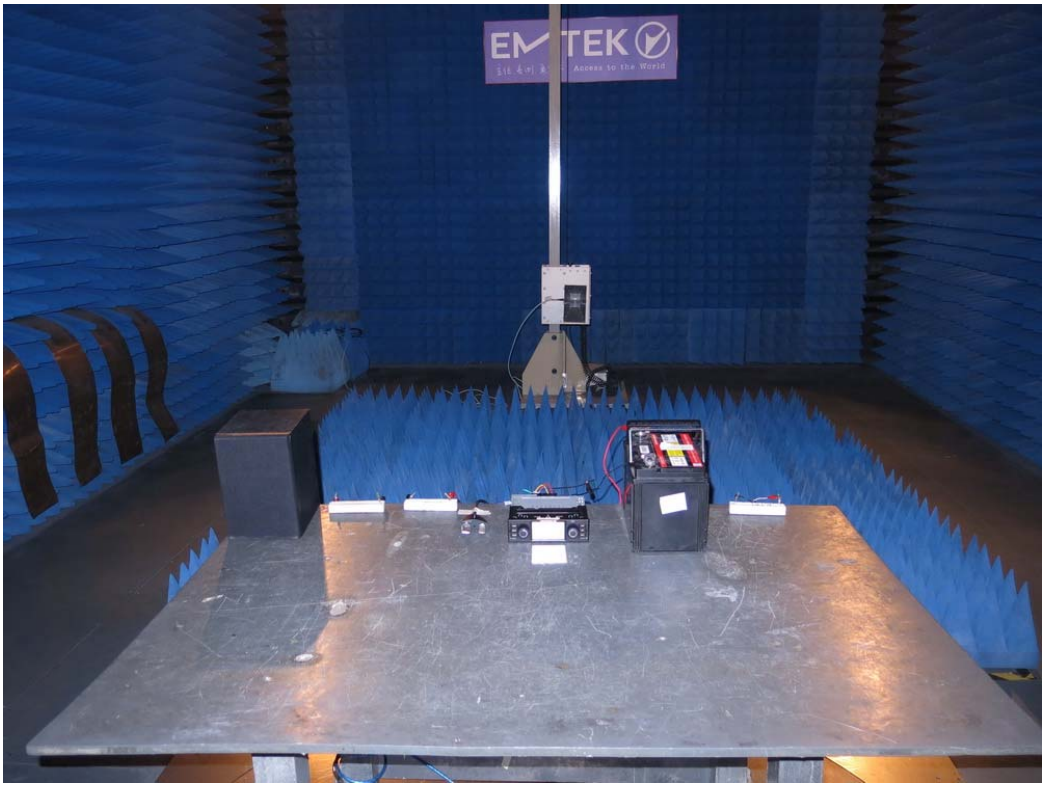
Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4960	V	65.13	46.08	74	54	-8.87	-7.92
7440	V	64.72	45.13	74	54	-9.28	-8.87
9920	V	63.18	44.72	74	54	-10.82	-9.28
12400	V	62.08	43.69	74	54	-11.92	-10.31
14880	V	61.75	42.18	74	54	-12.25	-11.82
17360	V	60.39	41.08	74	54	-13.61	-12.92
4960	H	64.82	45.39	74	54	-9.18	-8.61
7440	H	63.79	44.72	74	54	-10.21	-9.28
9920	H	62.19	43.38	74	54	-11.81	-10.62
12400	H	61.03	42.18	74	54	-12.97	-11.82
14880	H	60.79	41.05	74	54	-13.21	-12.95
17360	H	59.43	40.95	74	54	-14.57	-13.05

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.
(4) The results of worst cased was recorded.

5.5 Radiated Measurement Photos:



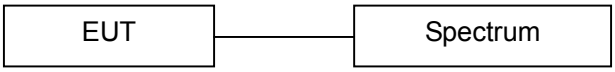


6. Channel Separation test

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:

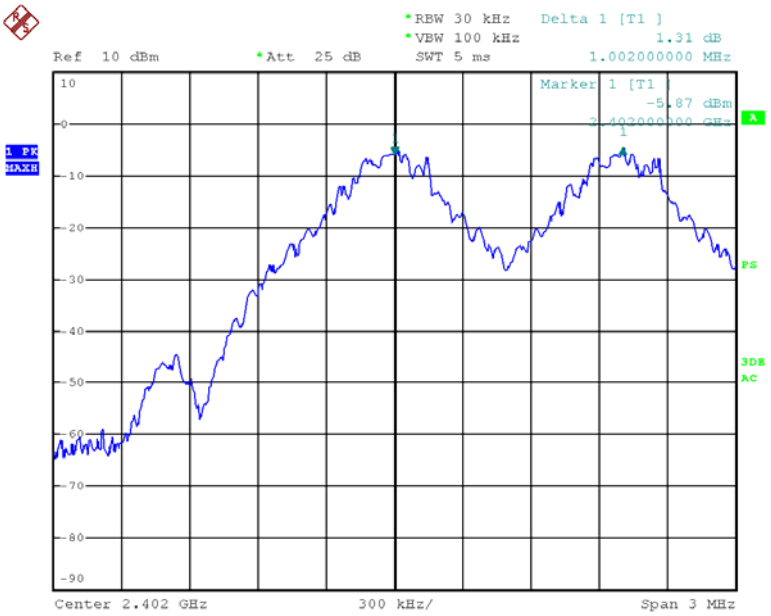
Same as 5.3 Radiated Emission Measurement.

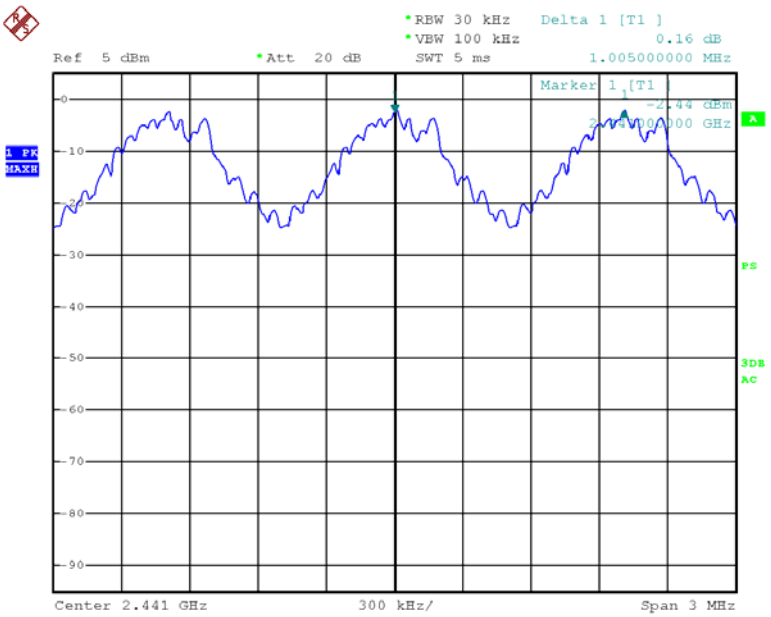
6.4 Measurement Results:

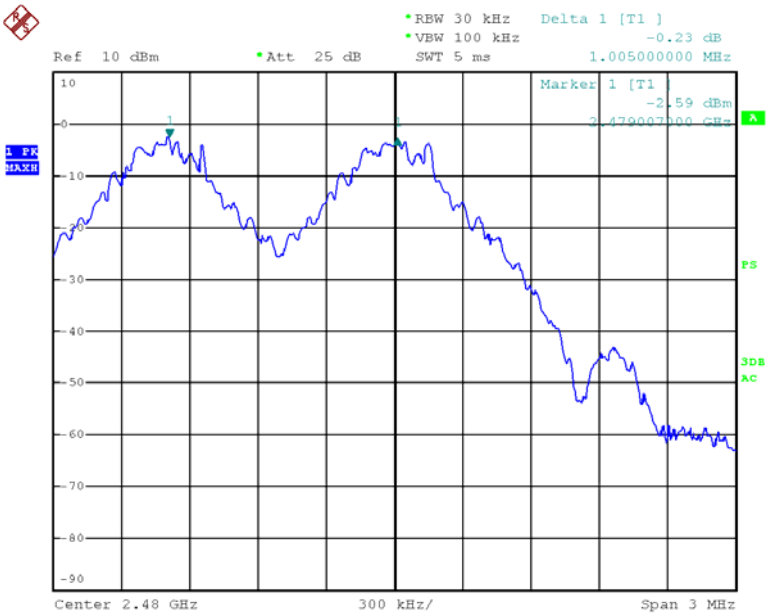
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit 20dB Down BW(KHz)
1	2402	1002	>891
40	2441	1005	>891
79	2480	1002	>891

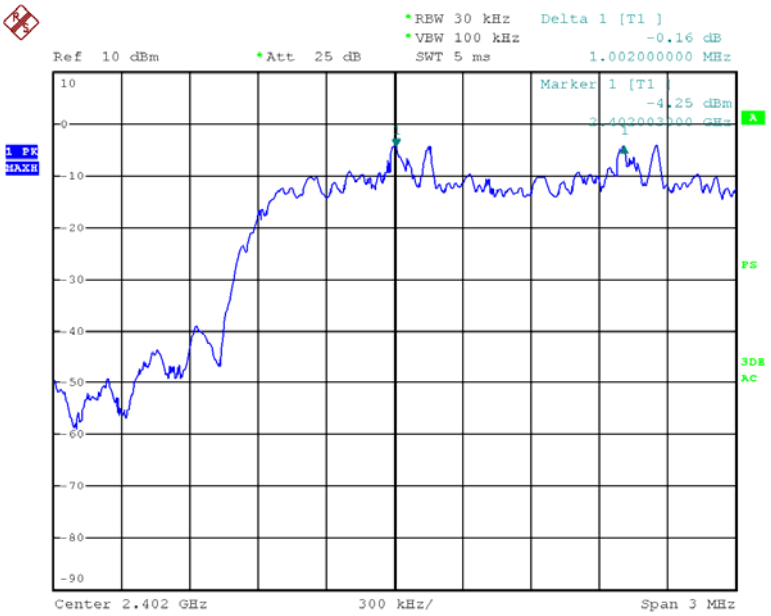

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
1.31 dB
1.002000000 MHz
Ref 10 dBm
Att 25 dB
Marker 1 [T1]
-5.87 dBm
2.402000000 GHz
Center 2.402 GHz
300 kHz/
Span 3 MHz

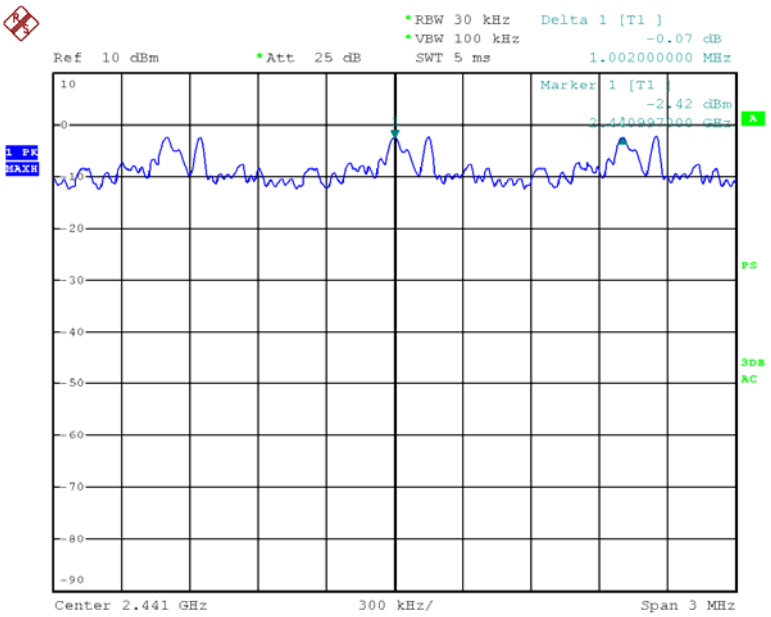

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
0.16 dB
1.005000000 MHz
Ref 5 dBm
Att 20 dB
Marker 1 [T1]
-2.44 dBm
Center 2.441 GHz
300 kHz/
Span 3 MHz

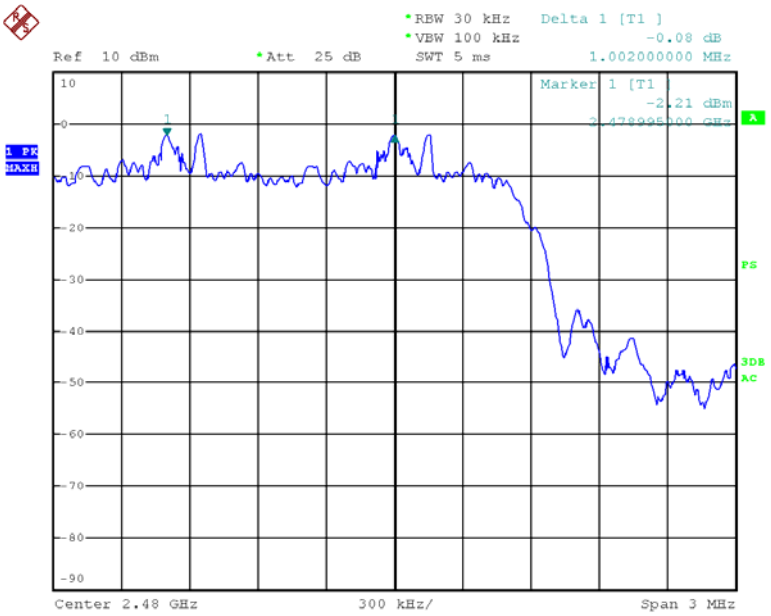


Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	1/4Π-DQPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit 2/3 20dB Down BW(KHz)
1	2402	1002	>814
40	2441	1002	>840
79	2480	1002	>822

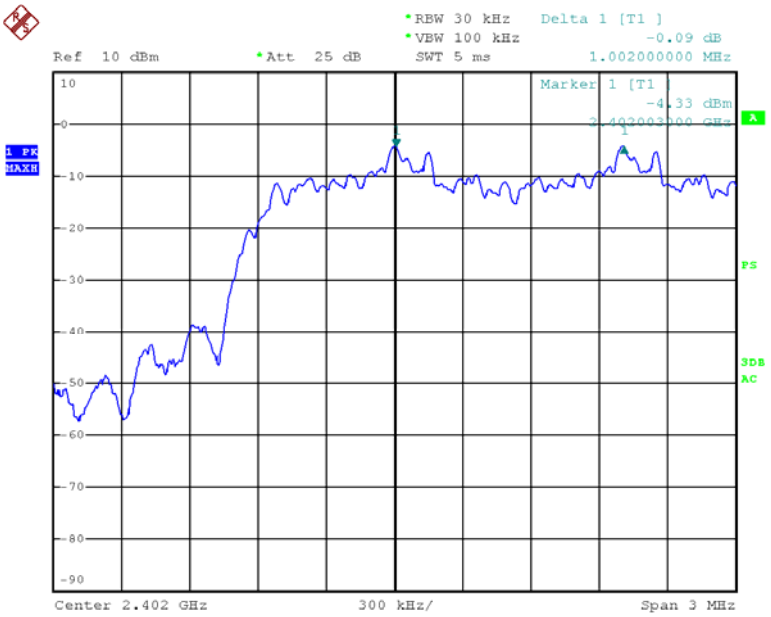

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
-0.16 dB
1.002000000 MHz
Ref 10 dBm
Att 25 dB
Marker 1 [T1]
-4.25 dBm
2.402003000 GHz
1 PK MAXH
A
PS
3DB
AC
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.402 GHz
300 kHz/
Span 3 MHz

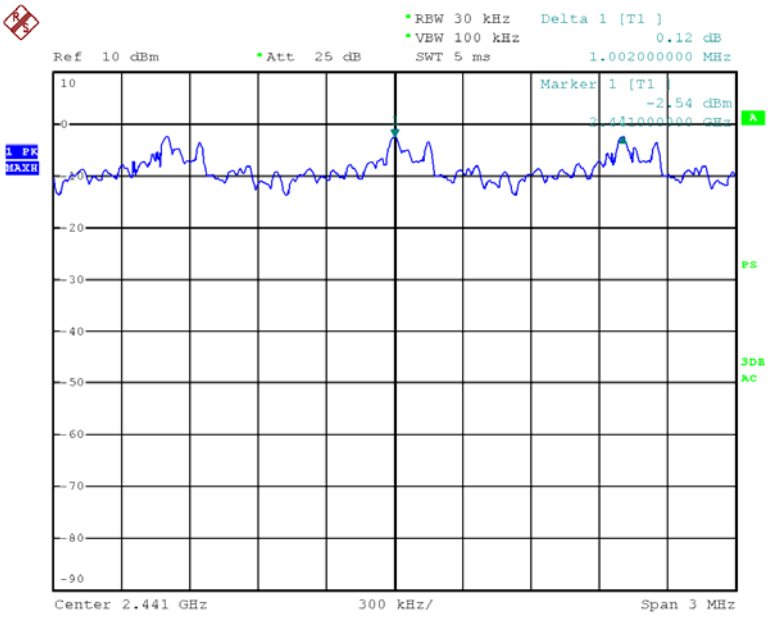

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
-0.07 dB
1.002000000 MHz
Ref 10 dBm
Att 25 dB
Marker 1 [T1]
-2.42 dBm
2.440997000 GHz
1 PK MAXH
A
PS
3DB
AC
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.441 GHz
300 kHz/
Span 3 MHz

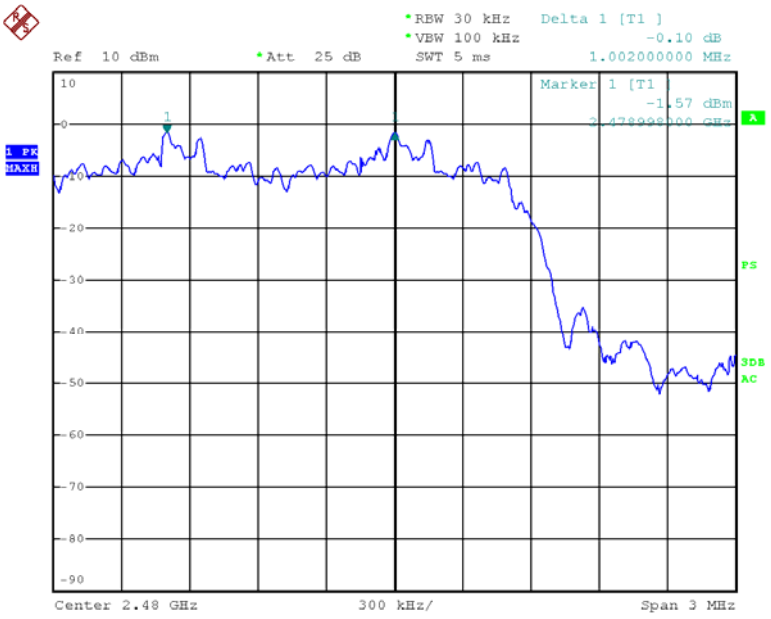


Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit 2/3 20dB Down BW(KHz)
1	2402	1002	>814
40	2441	1002	> 840
79	2480	1002	>840


RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
-0.09 dB
1.002000000 MHz
Ref 10 dBm
Att 25 dB
Marker 1 [T1]
-4.33 dBm
2.402003000 GHz
1 PK
MAXH
PS
3DB
AC
Center 2.402 GHz
300 kHz/
Span 3 MHz


RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
0.12 dB
1.002000000 MHz
Ref 10 dBm
Att 25 dB
Marker 1 [T1]
-2.54 dBm
2.441000000 GHz
1 PK
MAXH
PS
3DB
AC
Center 2.441 GHz
300 kHz/
Span 3 MHz

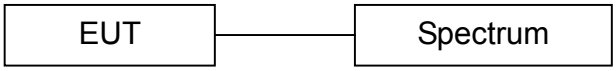

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Delta 1 [T1]
-0.10 dB
1.002000000 MHz
Ref 10 dBm
Att 25 dB
Marker 1 [T1]
-1.57 dBm
2.478999000 GHz
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1 PK
MAXH
A
PS
3DB
AC
Center 2.48 GHz
300 kHz/
Span 3 MHz

7. 20dB Bandwidth 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:

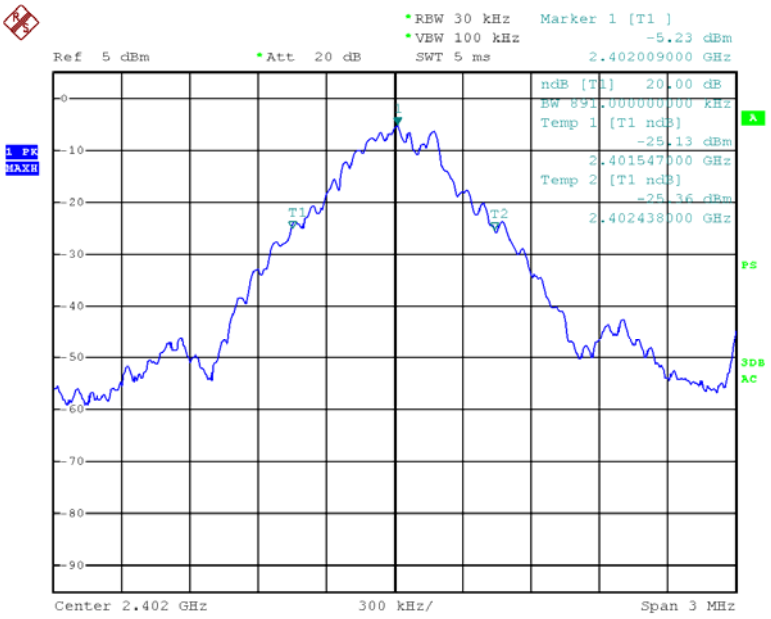
Same as 5.3 Radiated Emission Measurement.

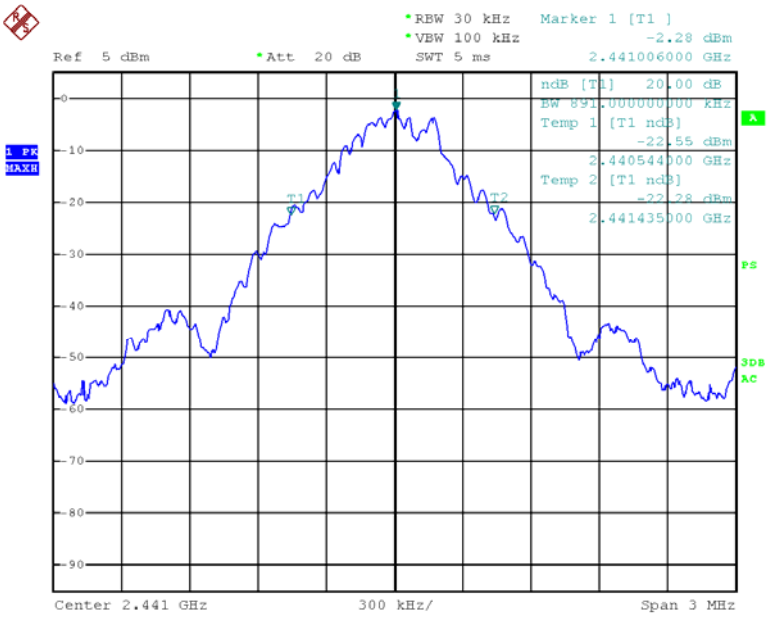
7.4 Measurement Results:

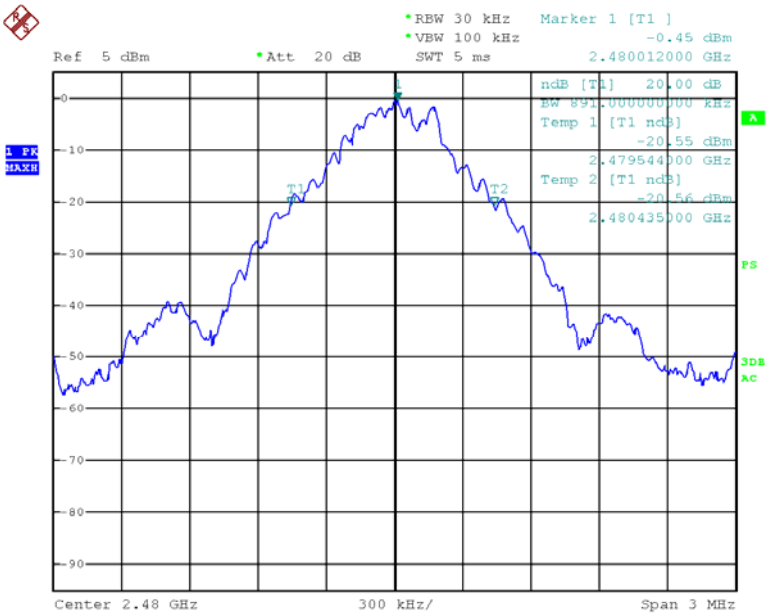
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	20dB Down BW(KHz)
1	2402	891
40	2441	891
79	2480	891

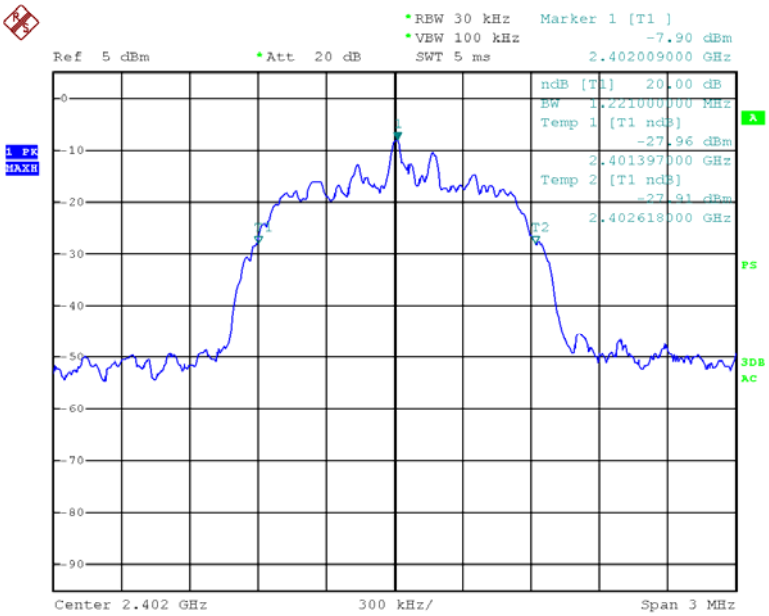

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Marker 1 [T1]
-5.23 dBm
2.402009000 GHz
Ref 5 dBm
Att 20 dB
ndB [T1] 20.00 dB
BW 891.000000000 kHz
Temp 1 [T1 ndB]
-25.13 dBm
2.401547000 GHz
Temp 2 [T1 ndB]
-25.36 dBm
2.402438000 GHz
1 PK MAXH
T1
T2
PS
3DB
AC
Center 2.402 GHz
300 kHz/
Span 3 MHz

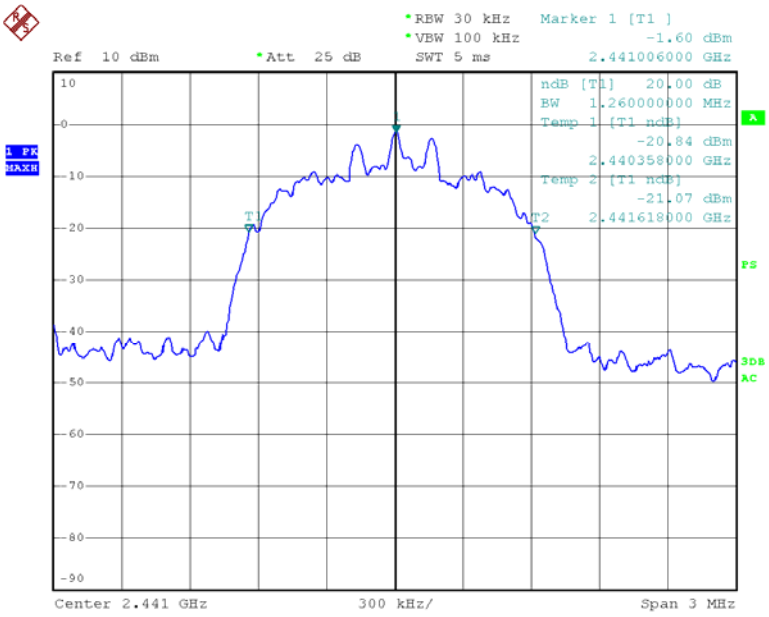

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Marker 1 [T1]
-2.28 dBm
2.441006000 GHz
Ref 5 dBm
Att 20 dB
ndB [T1] 20.00 dB
BW 891.000000000 kHz
Temp 1 [T1 ndB]
-22.55 dBm
2.440544000 GHz
Temp 2 [T1 ndB]
-22.28 dBm
2.441435000 GHz
1 PK MAXH
T1
T2
PS
3DB
AC
Center 2.441 GHz
300 kHz/
Span 3 MHz

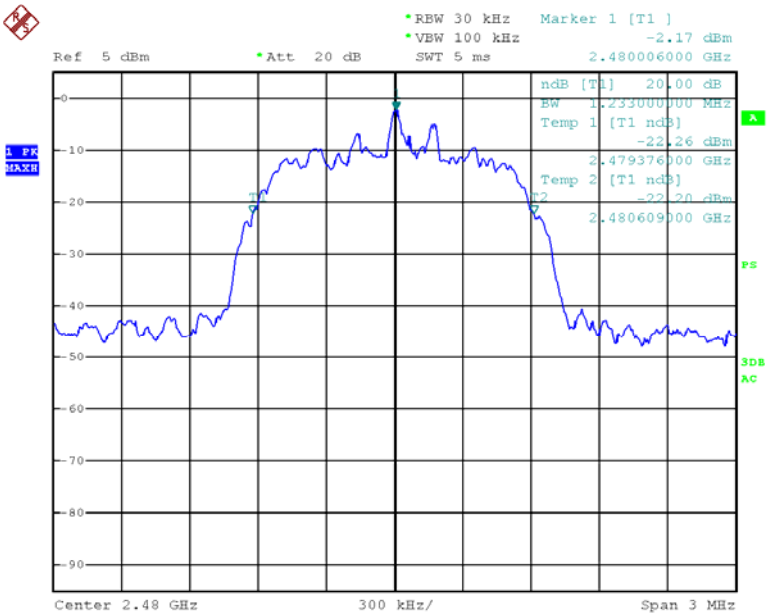


Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(KHz)
1	2402	1221
40	2441	1260
79	2480	1233

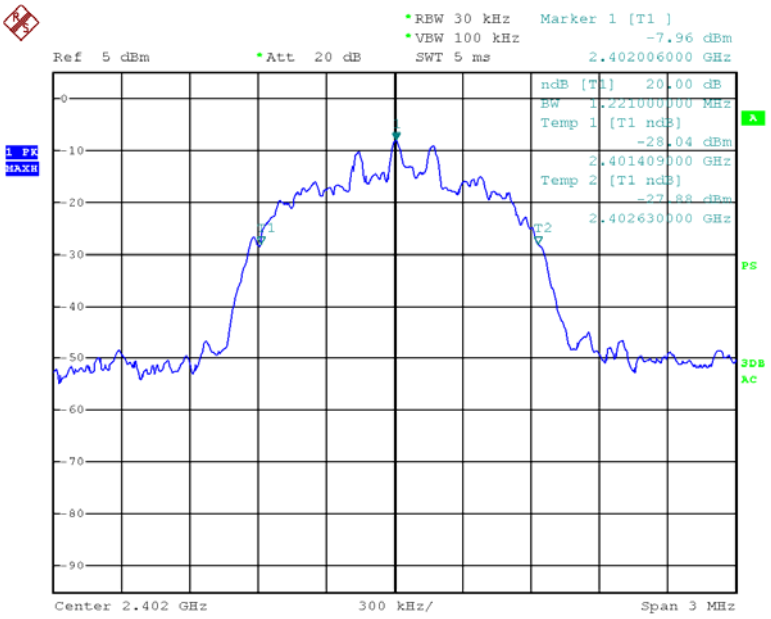

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Marker 1 [T1]
-7.90 dBm
2.402009000 GHz
Ref 5 dBm
Att 20 dB
ndB [T1] 20.00 dB
BW 1.221000000 MHz
Temp 1 [T1 ndB]
-27.96 dBm
2.401397000 GHz
Temp 2 [T1 ndB]
-27.91 dBm
2.402618000 GHz
1 PK MAXH
PS
3DB AC
Center 2.402 GHz
300 kHz/
Span 3 MHz

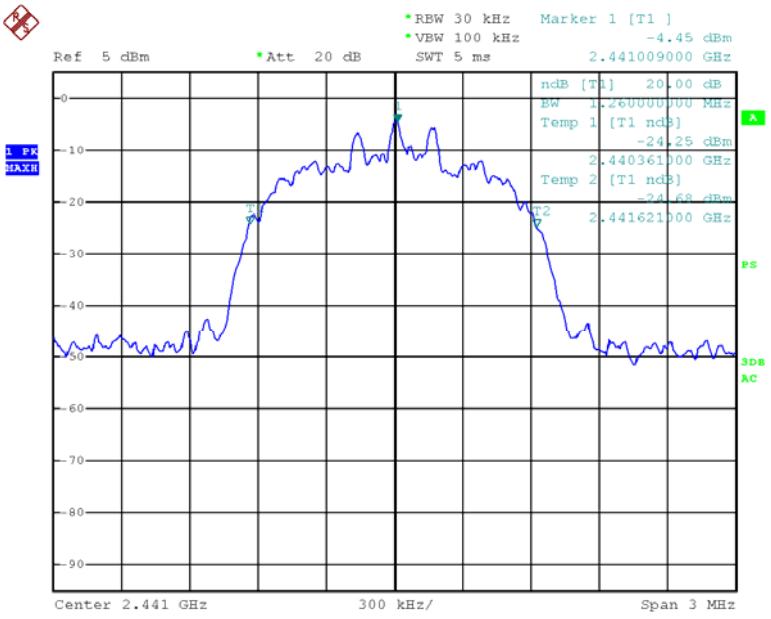

RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Marker 1 [T1]
-1.60 dBm
2.441006000 GHz
Ref 10 dBm
Att 25 dB
ndB [T1] 20.00 dB
BW 1.260000000 MHz
Temp 1 [T1 ndB]
-20.84 dBm
2.440358000 GHz
Temp 2 [T1 ndB]
-21.07 dBm
2.441618000 GHz
1 PK MAXH
PS
3DB AC
Center 2.441 GHz
300 kHz/
Span 3 MHz

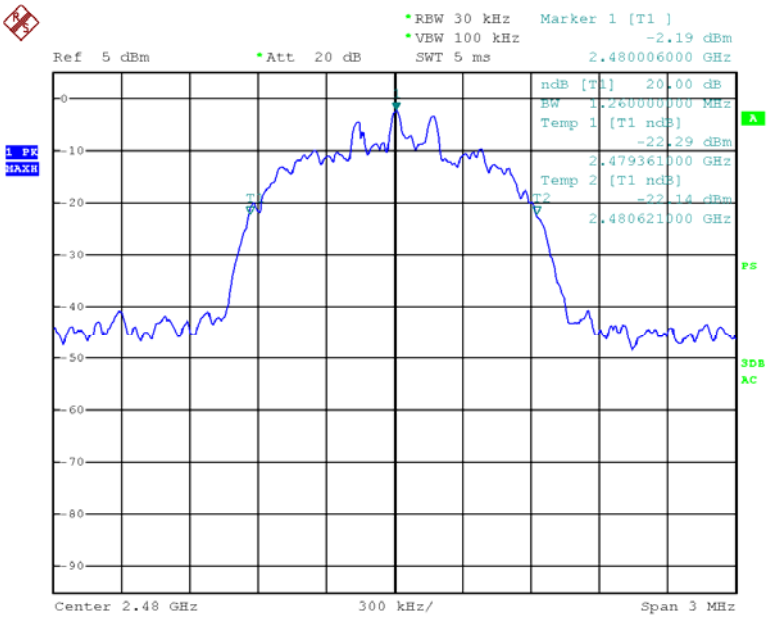


Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(KHz)
1	2402	1221
40	2441	1260
79	2480	1260


RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Marker 1 [T1]
-7.96 dBm
2.402006000 GHz
Ref 5 dBm
Att 20 dB
ndB [T1] 20.00 dB
BW 1.221000000 MHz
Temp 1 [T1 ndB]
-28.04 dBm
2.401409000 GHz
Temp 2 [T1 ndB]
-27.88 dBm
2.402630000 GHz
Center 2.402 GHz
300 kHz/
Span 3 MHz


RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Marker 1 [T1]
-4.45 dBm
2.441009000 GHz
Ref 5 dBm
Att 20 dB
ndB [T1] 20.00 dB
BW 1.260000000 MHz
Temp 1 [T1 ndB]
-24.25 dBm
2.440361000 GHz
Temp 2 [T1 ndB]
-24.68 dBm
2.441621000 GHz
Center 2.441 GHz
300 kHz/
Span 3 MHz


RBW 30 kHz
VBW 100 kHz
SWT 5 ms
Marker 1 [T1]
-2.19 dBm
2.480006000 GHz
Ref 5 dBm
Att 20 dB
ndB [T1] 20.00 dB
BW 1.260000000 MHz
Temp 1 [T1 ndB]
-22.29 dBm
2.479361000 GHz
Temp 2 [T1 ndB]
-22.14 dBm
2.480621000 GHz
T1
T2
Center 2.48 GHz
300 kHz/
Span 3 MHz

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)

8.3 Measurement Equipment Used:

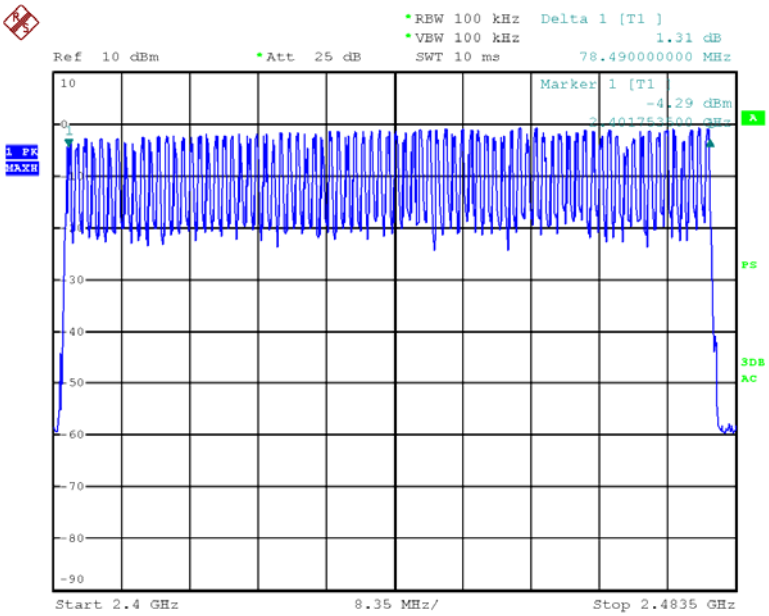
Same as 5.3 Radiated Emission Measurement.

8.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

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



9. Time of Occupancy (Dwell Time) test

9.1 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:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6s

with:
- hop rate = 1600/2 * 1/s for DH1 packets = 1600 s^{-1}
- hop rate = 1600/4 * 1/s for DH3 packets = 533.33 s^{-1}
- hop rate = 1600/6 * 1/s for DH5 packets = 320 s^{-1}
- number of hopping channels = 79
- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

9.2 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.

9.3 Test Protocol

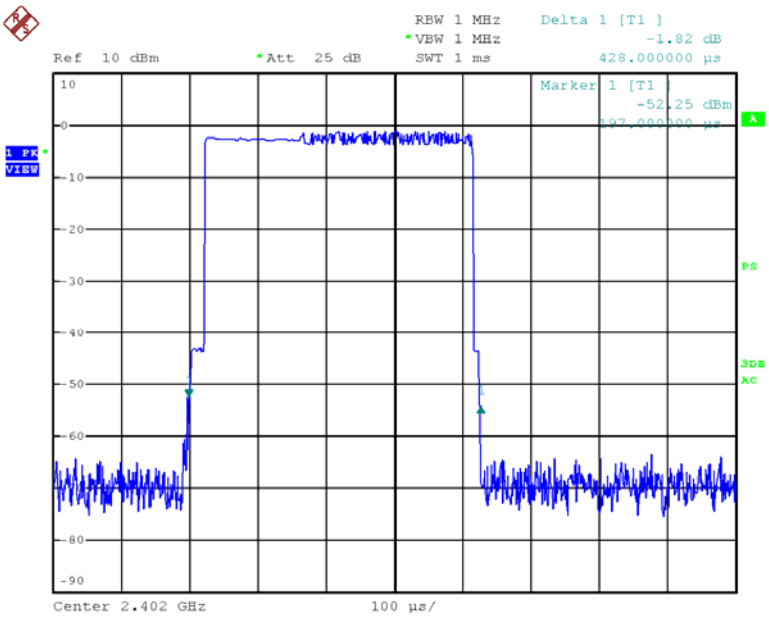
Packet type	Time slot length(ms)	Dwell time	Dwell time(ms)
DH1	0.428	time slot length *1600/2 /79 * 31.6	136.96
DH3	1.674	time slot length *1600/4 /79 * 31.6	267.84
DH5	2.940	time slot length *1600/6 /79 * 31.6	313.60
2DH1	0.430	time slot length *1600/2 /79 * 31.6	137.60
2DH3	1.696	time slot length *1600/4 /79 * 31.6	271.36
2DH5	2.940	time slot length *1600/6 /79 * 31.6	313.60
3DH1	0.432	time slot length *1600/2 /79 * 31.6	138.24
3DH3	1.689	time slot length *1600/4 /79 * 31.6	270.24
3DH5	2.940	time slot length *1600/6 /79 * 31.6	313.60

Remark:
1. The test plot of worst cased was recorded.

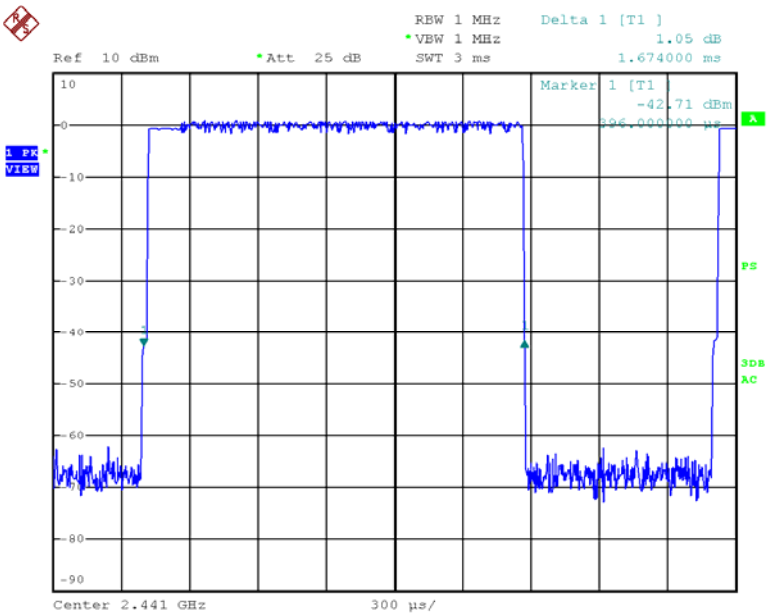
9.4 Test result: Dwell time

PASS.

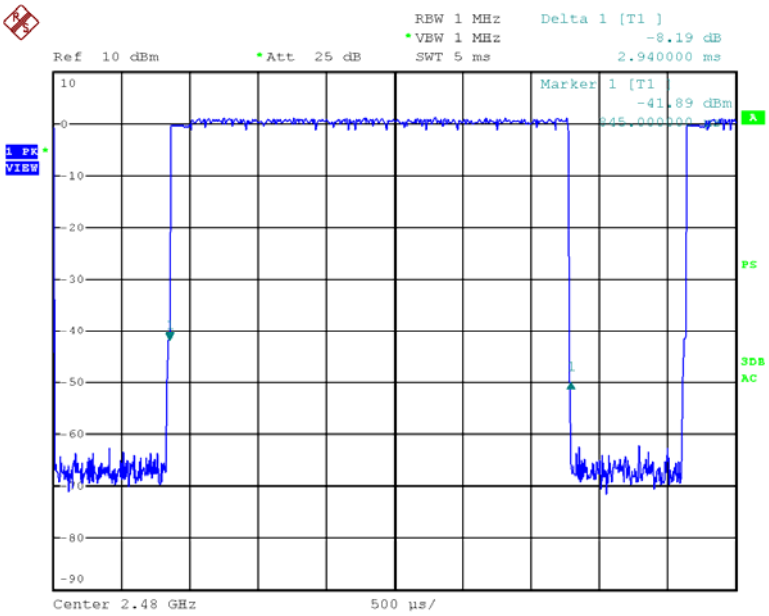
DH1:



DH3:



DH5:


RBW 1 MHz
VBW 1 MHz
SWT 5 ms
Delta 1 [T1]
-8.19 dB
2.940000 ms
Ref 10 dBm
Att 25 dB
Marker 1 [T1]
-41.89 dBm
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.48 GHz
500 µs/

10. MAXIMUM PEAK OUTPUT POWER TEST

10.1 Measurement Procedure

a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.

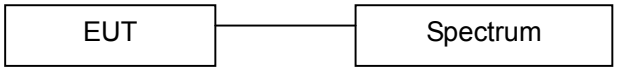
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.

d. Measure the captured power within the band and recording the plot.

e. Repeat above procedures until all frequencies required were complete.

10.2 Test SET-UP (Block Diagram of Configuration)



10.3 Measurement Equipment Used:

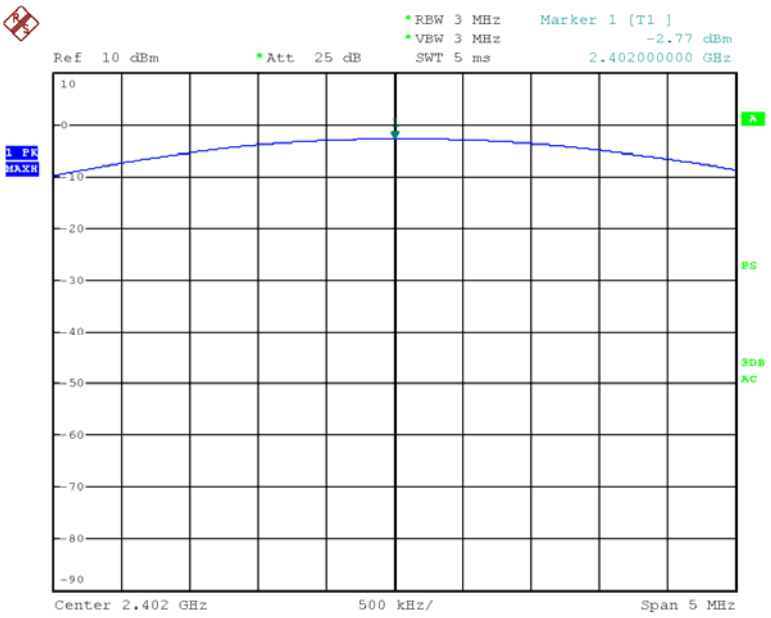
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	05/18/2014	05/17/2015

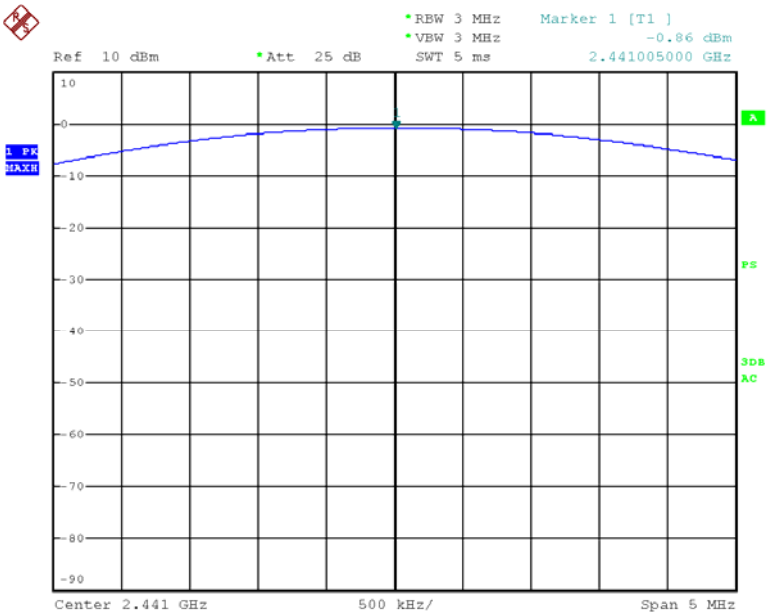
10.4Measurement Results:

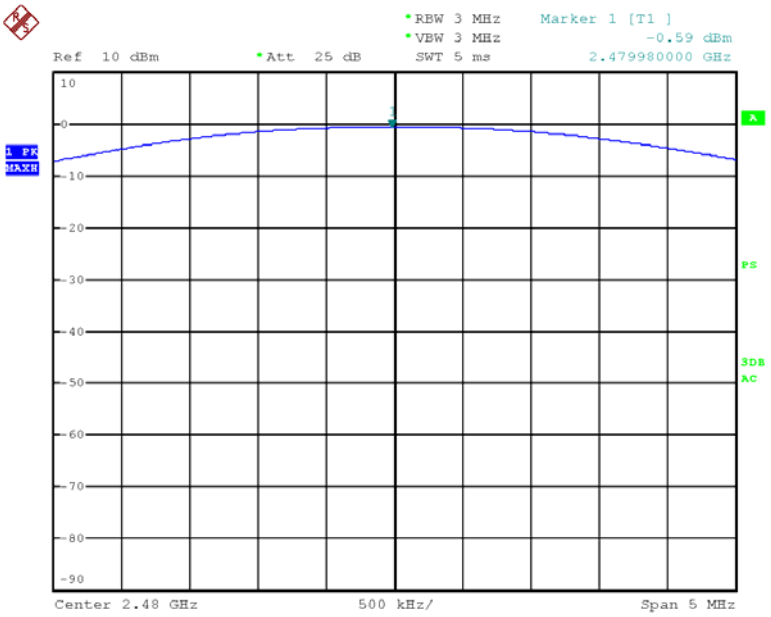
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	25 ℃
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
01	2402	-2.77	0.528	1000	PASS
40	2441	-0.86	0.820	1000	PASS
79	2480	-0.59	0.873	1000	PASS

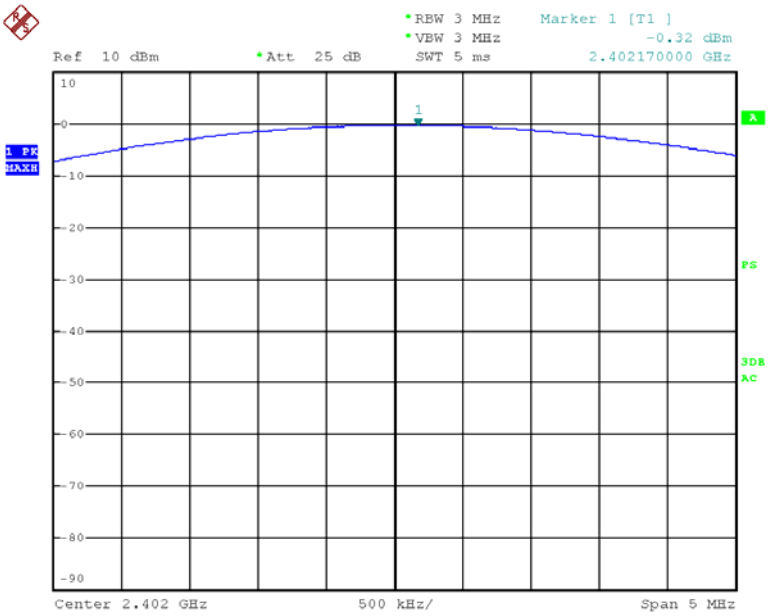


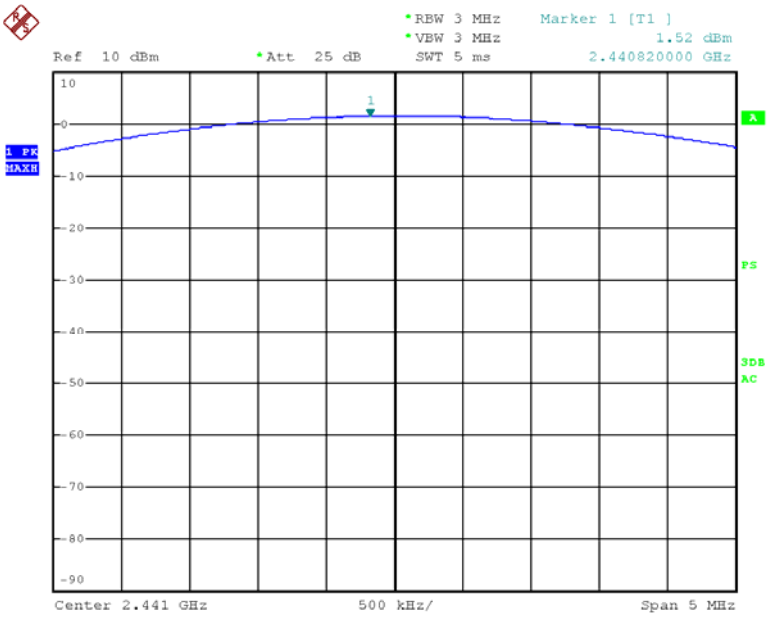

RBW 3 MHz
VBW 3 MHz
SWT 5 ms
Marker 1 [T1]
-0.86 dBm
2.441005000 GHz
Ref 10 dBm
Att 25 dB
1 PK
MAXH
A
PS
3DB
AC
Center 2.441 GHz
500 kHz/
Span 5 MHz

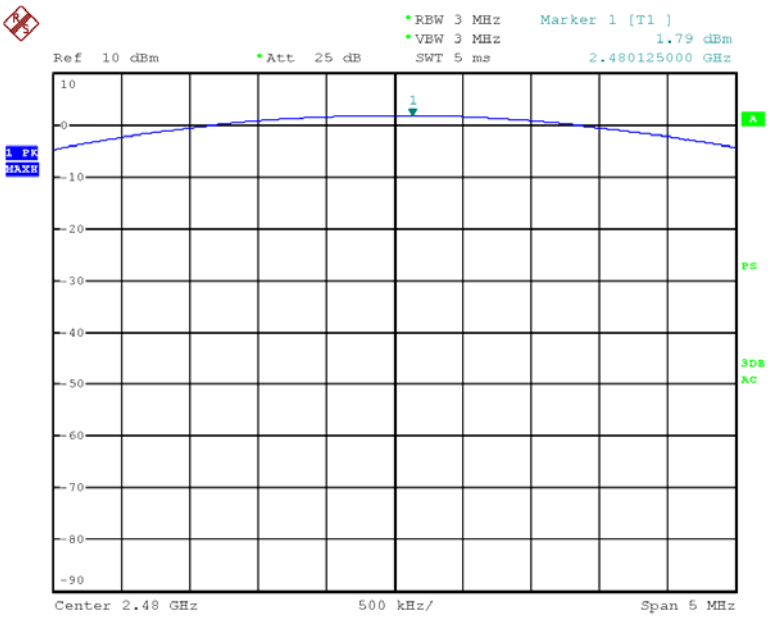

RBW 3 MHz
VBW 3 MHz
SWT 5 ms
Marker 1 [T1]
-0.59 dBm
2.479980000 GHz
Ref 10 dBm
Att 25 dB
1 PK
MAXH
A
PS
3DB
AC
Center 2.48 GHz
500 kHz/
Span 5 MHz

Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	25 ℃
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
01	2402	-0.32	0.929	125	PASS
40	2441	1.52	1.419	125	PASS
79	2480	1.79	1.510	125	PASS

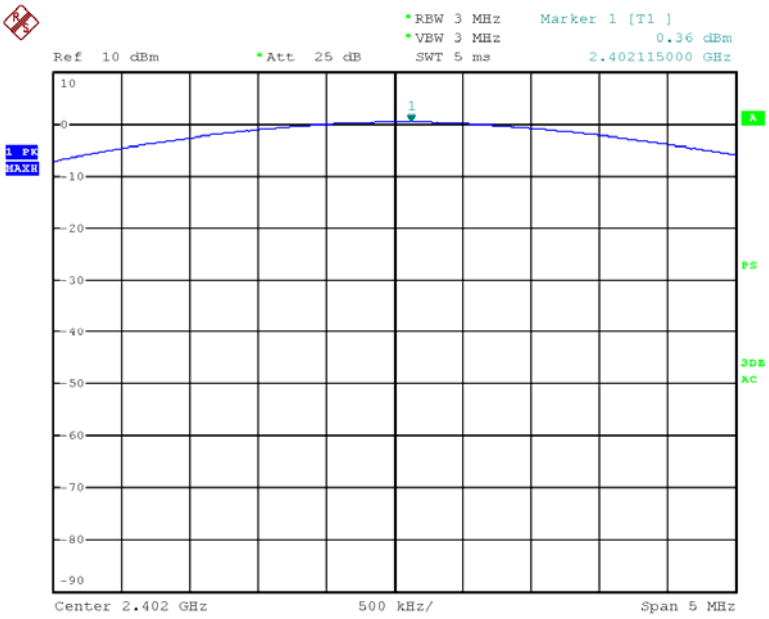


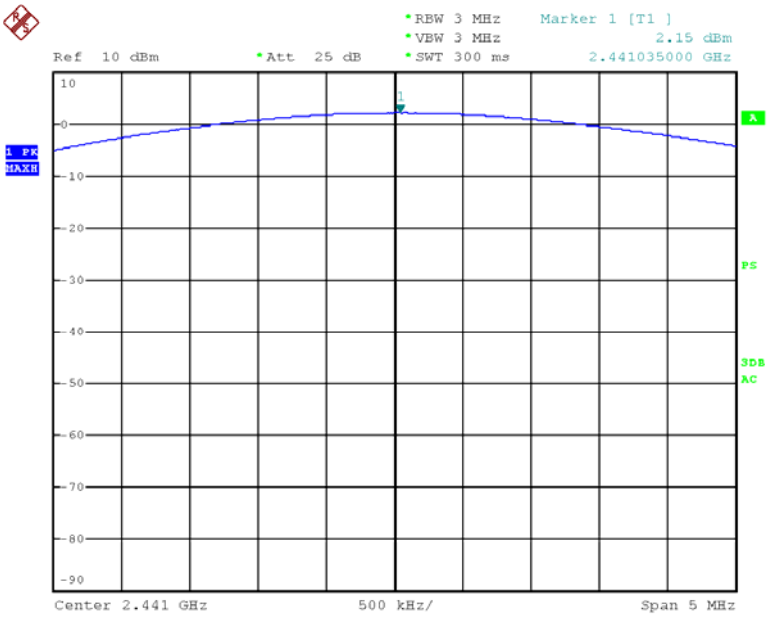

RBW 3 MHz
VBW 3 MHz
SWT 5 ms
Marker 1 [T1]
1.52 dBm
2.440820000 GHz
Ref 10 dBm
Att 25 dB
1 PK MAXH
A
PS
3DB AC
Center 2.441 GHz
500 kHz/
Span 5 MHz

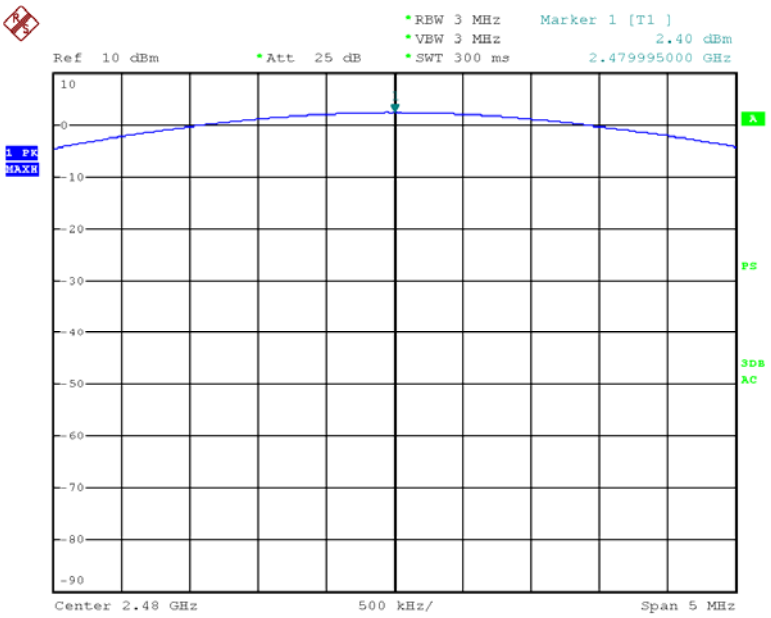

RBW 3 MHz
VBW 3 MHz
SWT 5 ms
Marker 1 [T1]
1.79 dBm
2.480125000 GHz
Ref 10 dBm
Att 25 dB
1 PK MAXH
A
PS
3DB AC
Center 2.48 GHz
500 kHz/
Span 5 MHz

Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	25 ℃
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
01	2402	0.36	1.086	125	PASS
40	2441	2.15	1.641	125	PASS
79	2480	**2.40**	**1.738**	125	PASS




RBW 3 MHz
VBW 3 MHz
SWT 300 ms
Marker 1 [T1]
2.15 dBm
2.441035000 GHz
Ref 10 dBm
Att 25 dB
1 PK MAXH
A
PS
3DB AC
Center 2.441 GHz
500 kHz/
Span 5 MHz


RBW 3 MHz
VBW 3 MHz
SWT 300 ms
Marker 1 [T1]
2.40 dBm
2.479995000 GHz
Ref 10 dBm
Att 25 dB
1 PK MAXH
A
PS
3DB AC
Center 2.48 GHz
500 kHz/
Span 5 MHz

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.

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

11.2 Test SET-UP (Block Diagram of Configuration)

Same as 5.2 Radiated Emission Set-up.

11.3 Measurement Equipment Used:

Same as 5.3 Radiated Emission Measurement.

11.4Measurement Results:

Refer to attached data chart.

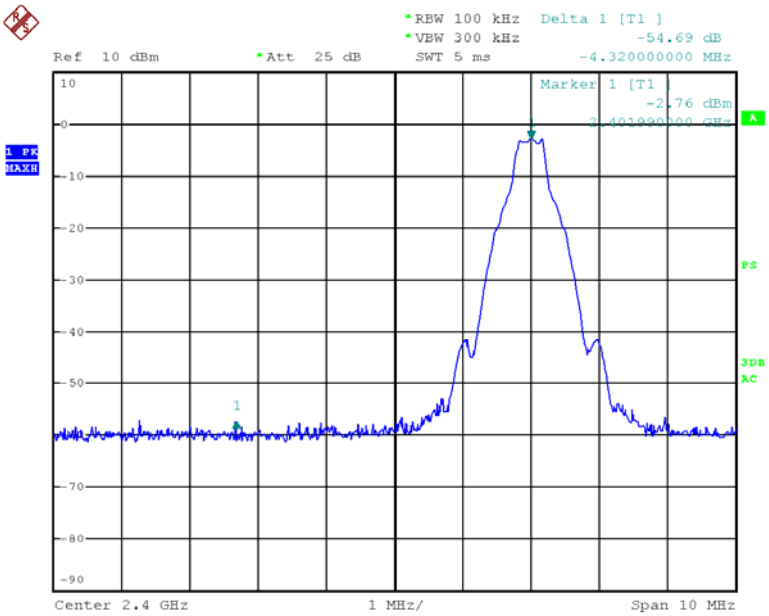
Spectrum Detector:	PK	Test Date :	December 26, 2014
Test By:	Andy	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

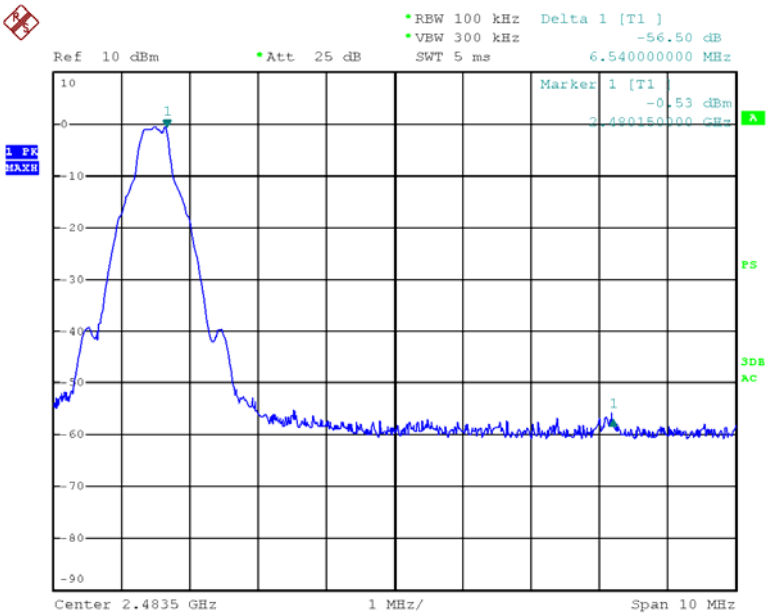
1. Conducted Test

For Non-Hopping mode:

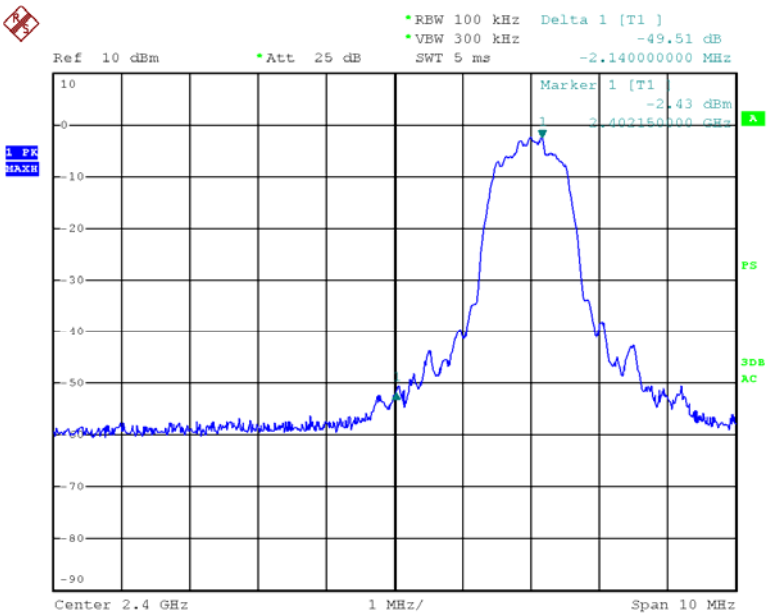
Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)
<2400	GFSK	-2.76	-57.45	54.69
	pi/4-DQPSK	-2.43	-51.94	49.51
	8DPSK	-2.46	-52.42	49.96
>2483.5	GFSK	-0.53	-57.03	56.5
	pi/4-DQPSK	-0.69	-53.30	52.61
	8DPSK	-0.2	-53.01	52.81

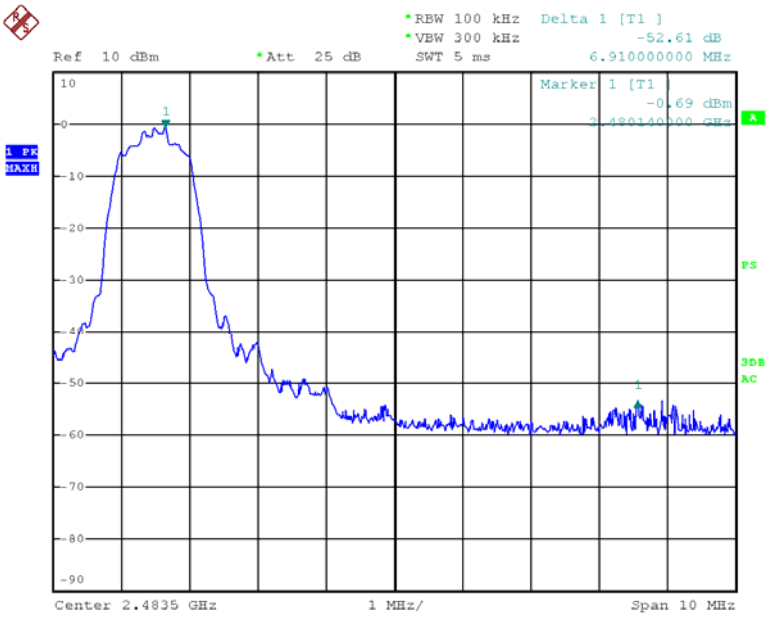
Test Mode: GFSK



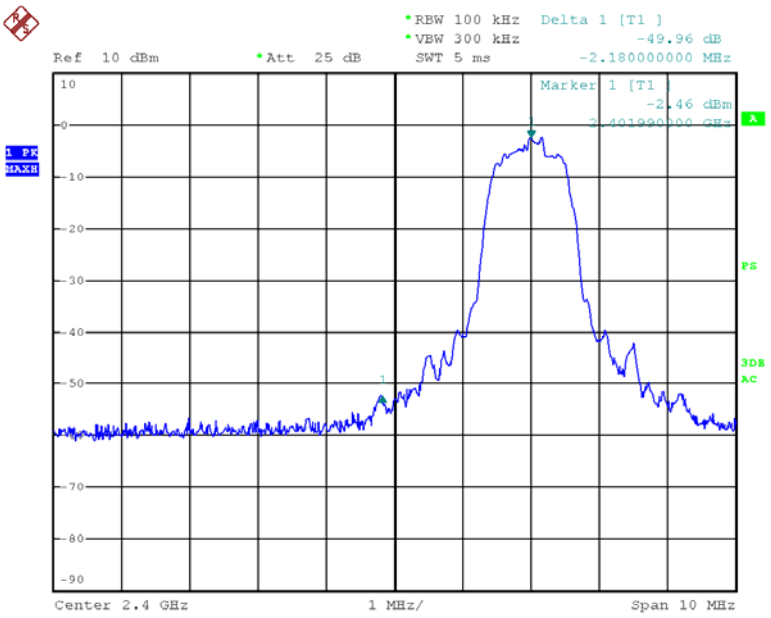


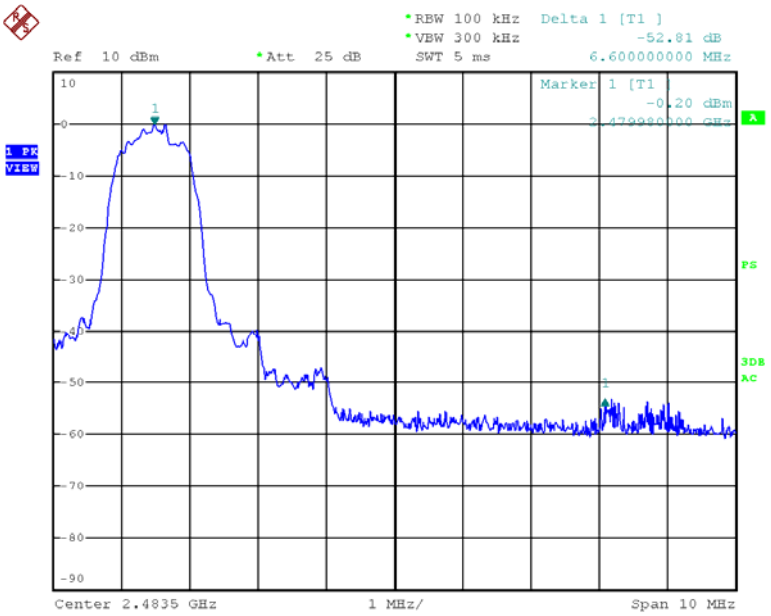
Test Mode: Pi/4-DQPSK





Test Mode: 8DPSK

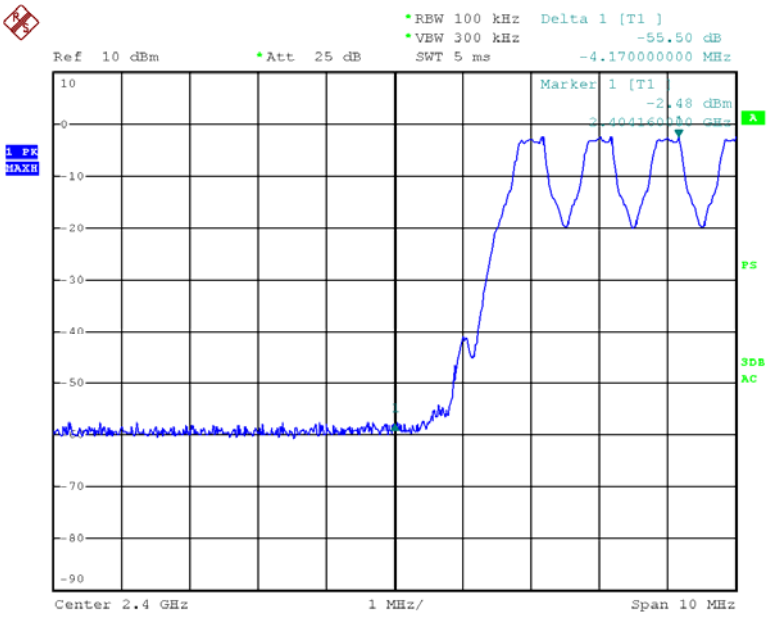


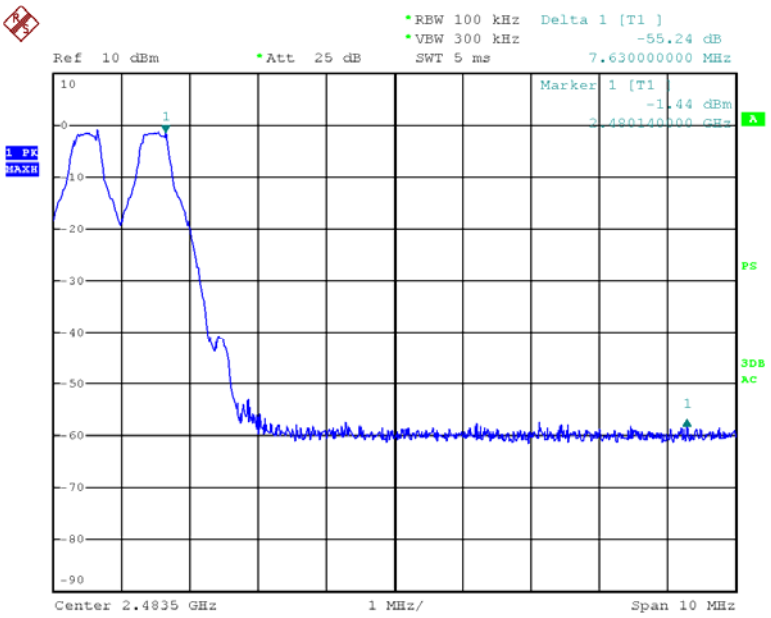


For Hopping mode:

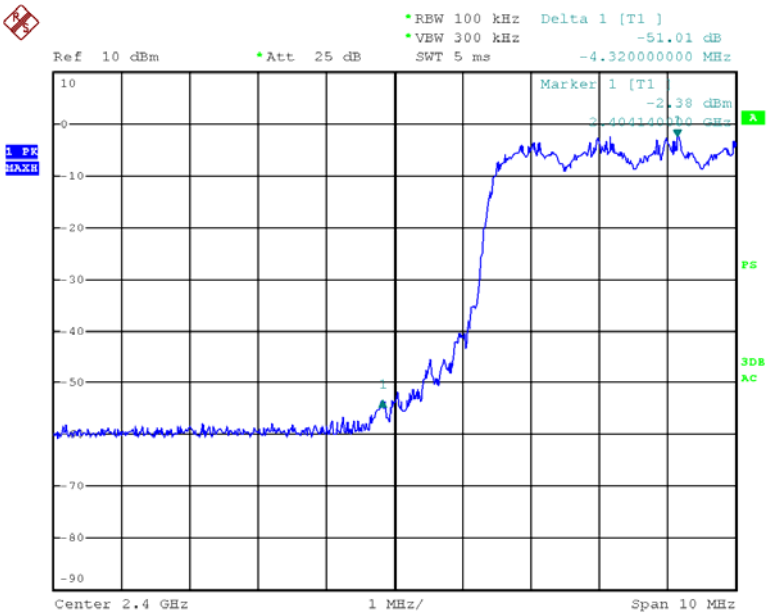
Frequency (MHz)	Modulation	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)
<2400	GFSK	-2.48	-54.98	52.5
	pi/4-DQPSK	-2.38	-53.39	51.01
	8DPSK	-2.31	-53.64	51.33
>2483.5	GFSK	-1.44	-56.68	55.24
	pi/4-DQPSK	-0.7	-54.63	53.93
	8DPSK	-0.86	-55.63	54.77

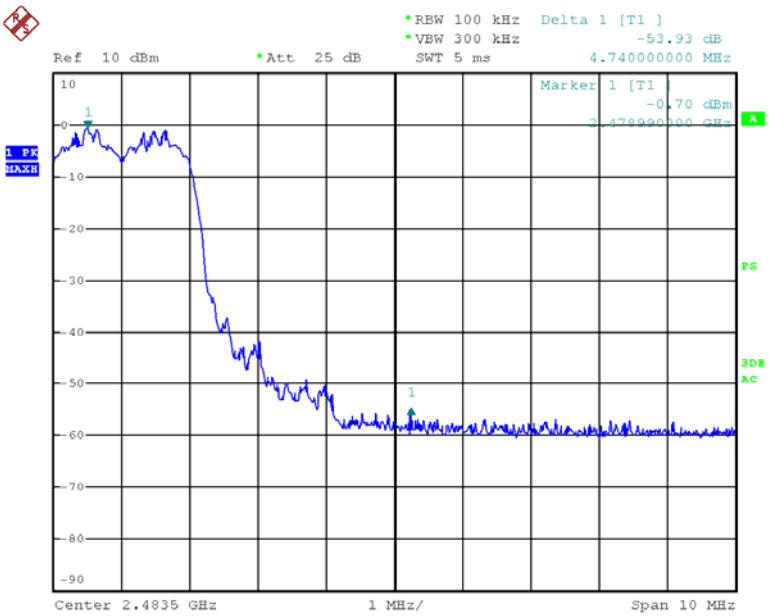
Test Mode: GFSK



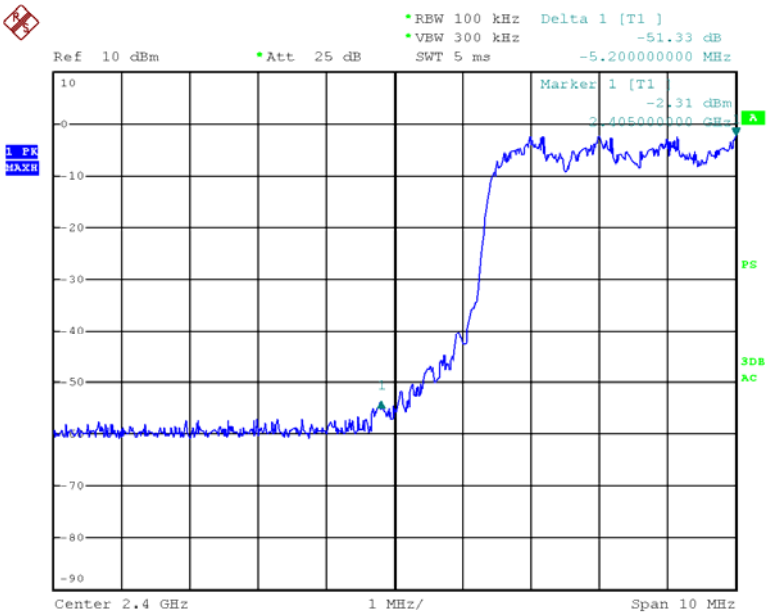


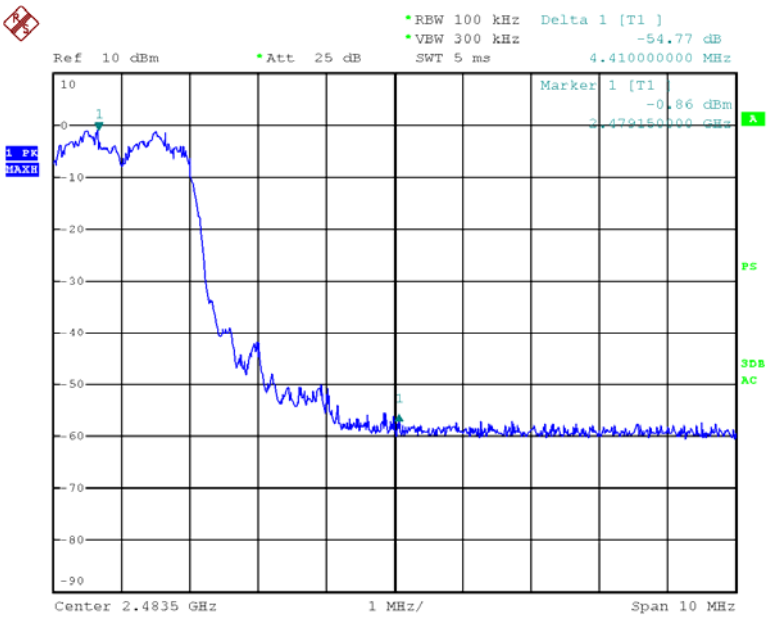
Test Mode: Pi/4-DQPSK





Test Mode: 8DPSK





2. Radiated emission Test

For Non-Hopping mode:

Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
<2400	H	65.08	44.08	74	54	-8.92	-9.92
<2400	V	61.82	40.38	74	54	-12.18	-13.62
>2483.5	H	66.04	43.15	74	54	-7.96	-10.85
>2483.5	V	62.42	38.95	74	54	-11.58	-15.05

For Hopping mode:

Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
<2400	H	64.03	45.12	74	54	-9.97	-8.88
<2400	V	57.59	40.72	74	54	-16.41	-13.28
>2483.5	H	65.05	44.08	74	54	-8.95	-9.92
>2483.5	V	59.48	38.72	74	54	-14.52	-15.28

12. Antenna Application

12.1 Antenna requirement

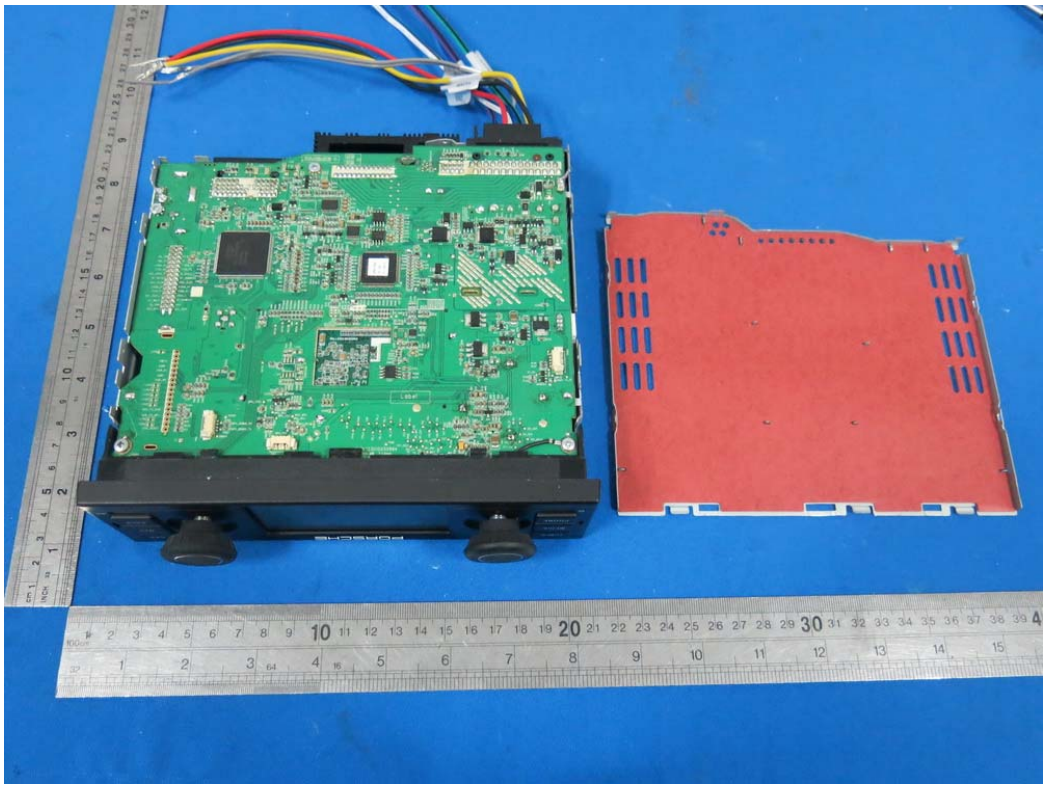
The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

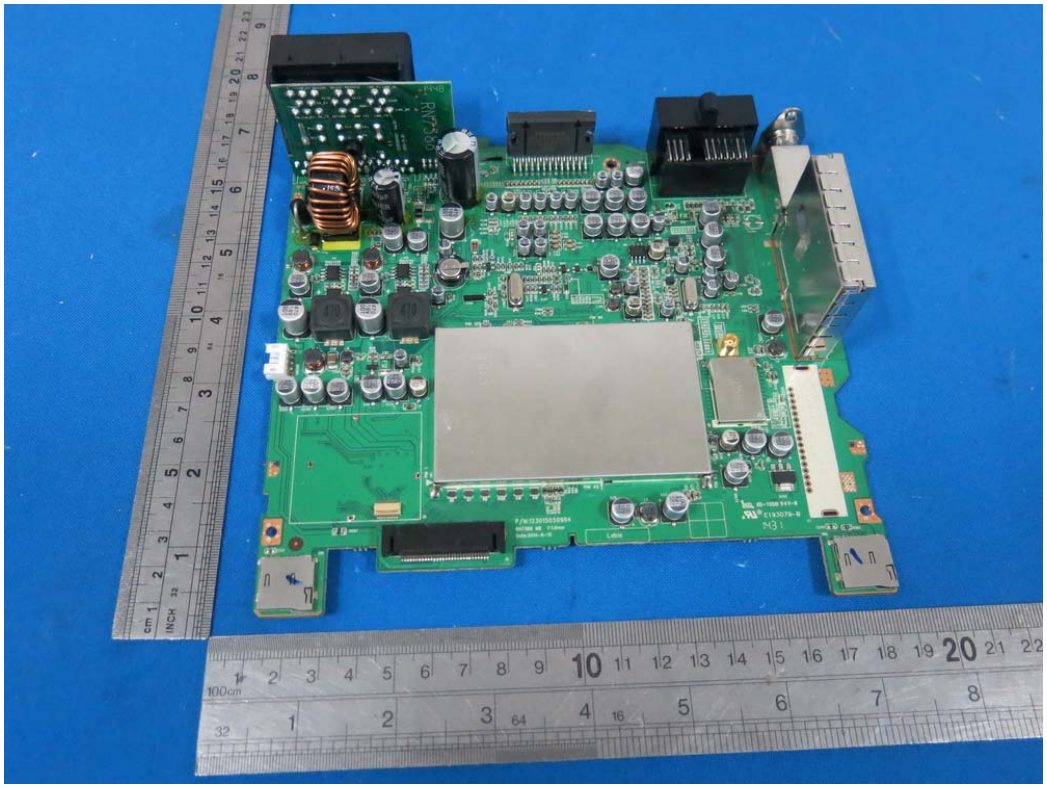
FCC part 15C section 15.247 requirements:
Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

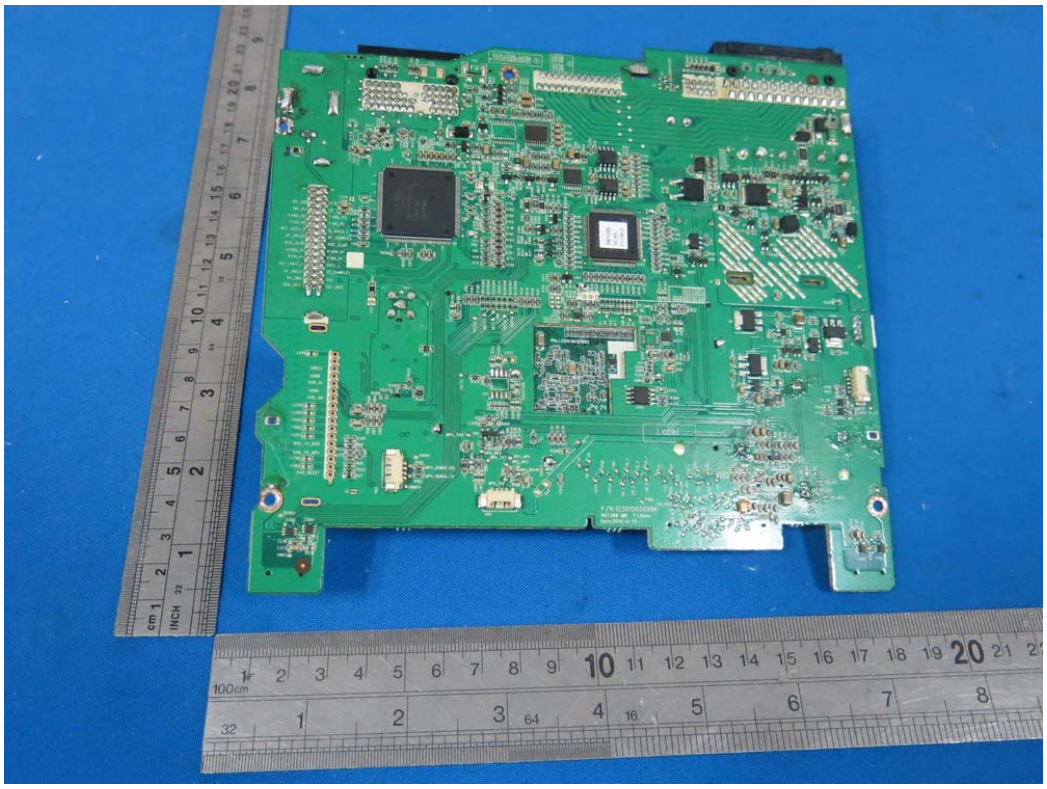
12.2 Result

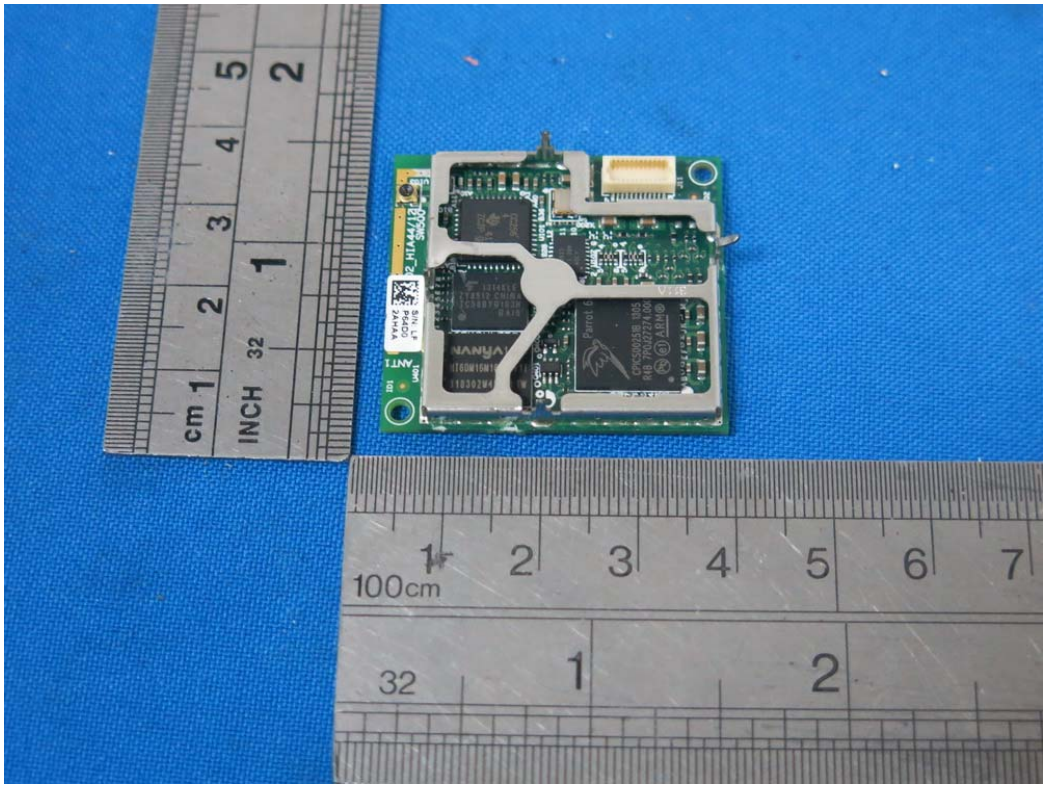
The EUT's antenna used a PCB antenna. The antenna's gain is 0dBi and meets the requirement.

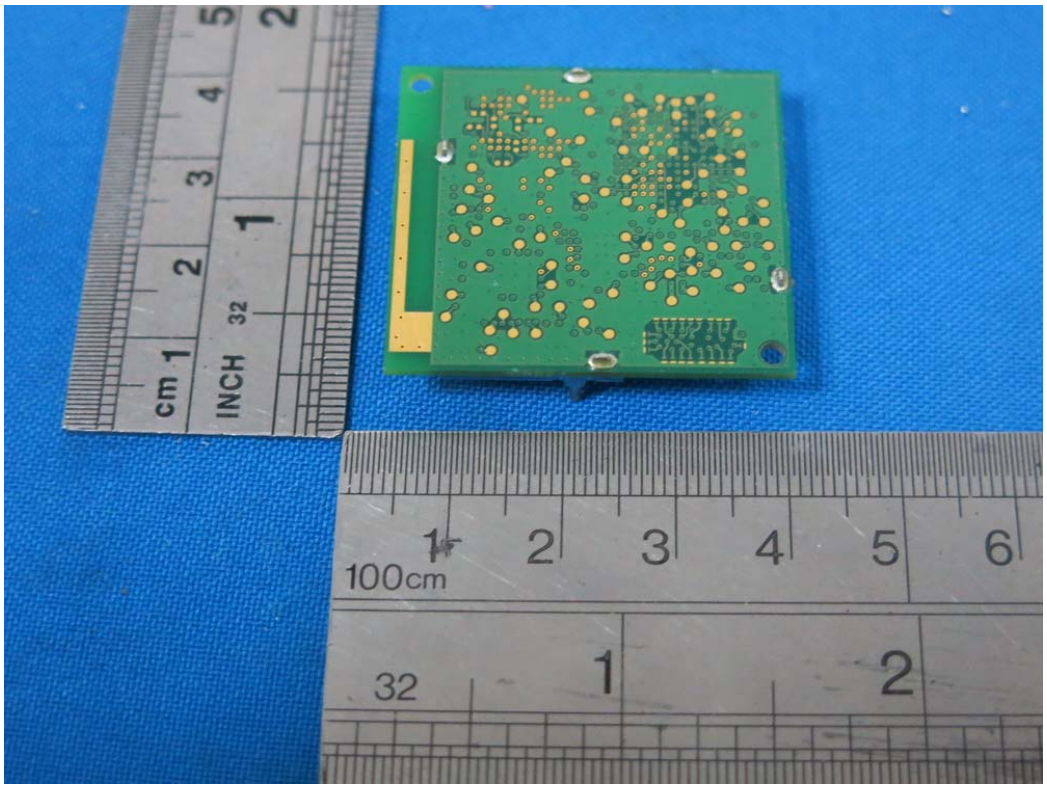
General Appearance of the EUT

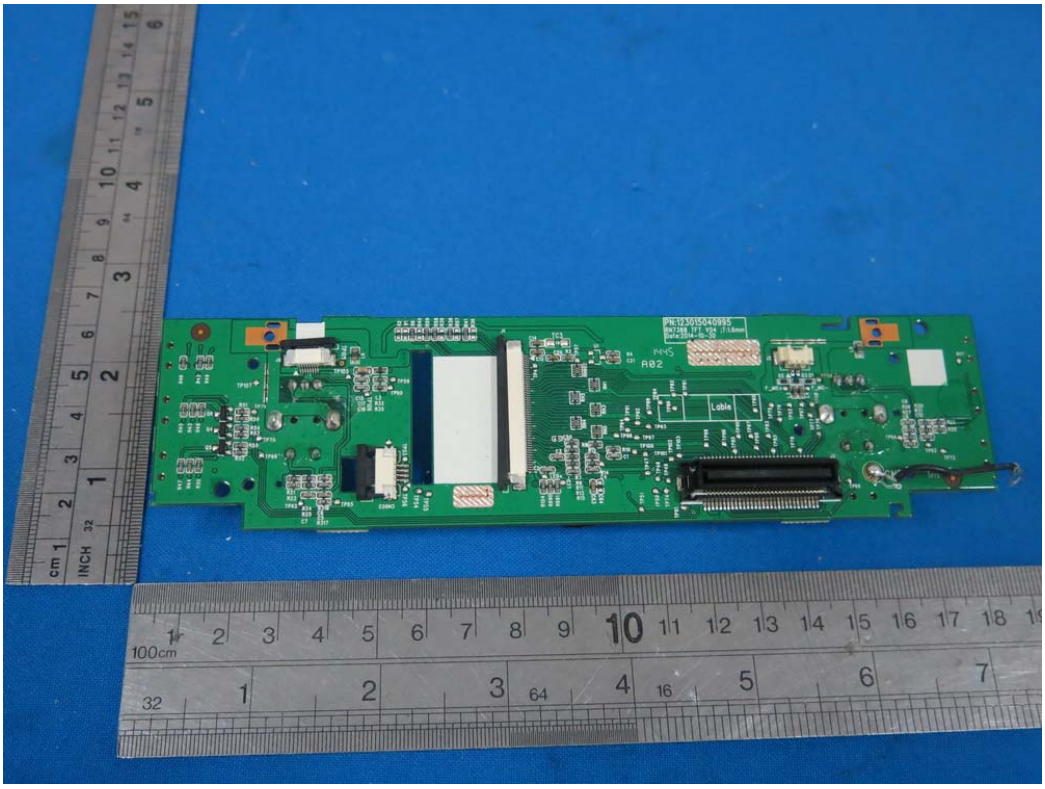


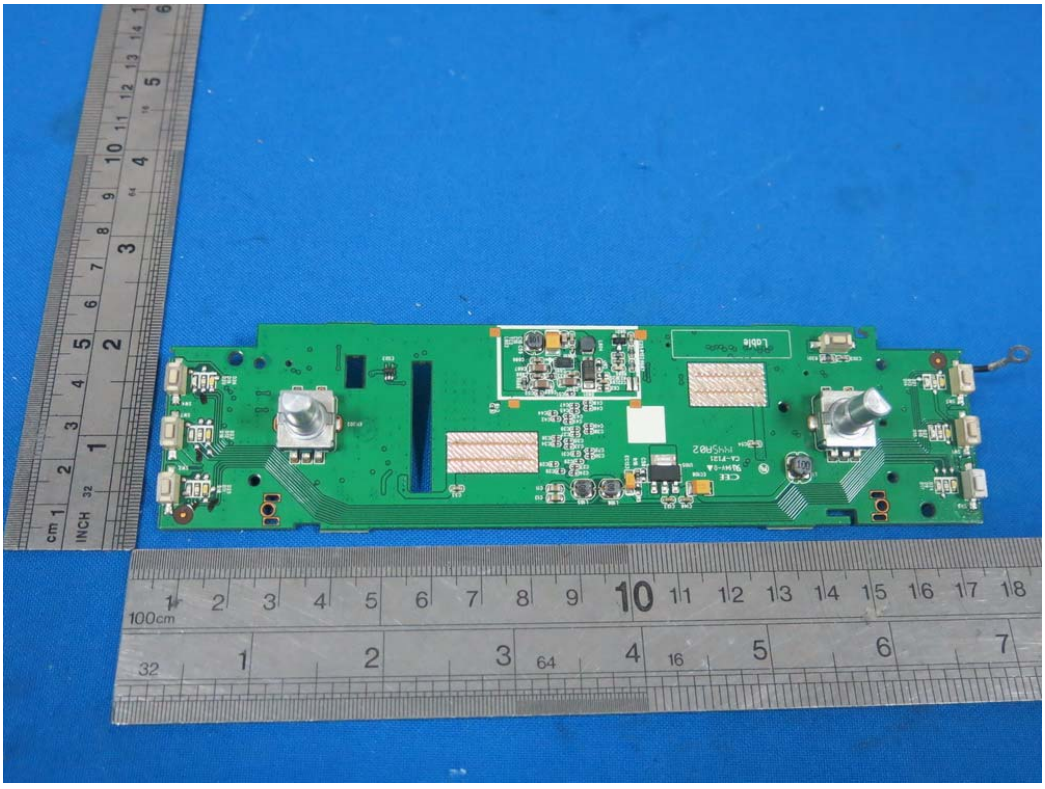


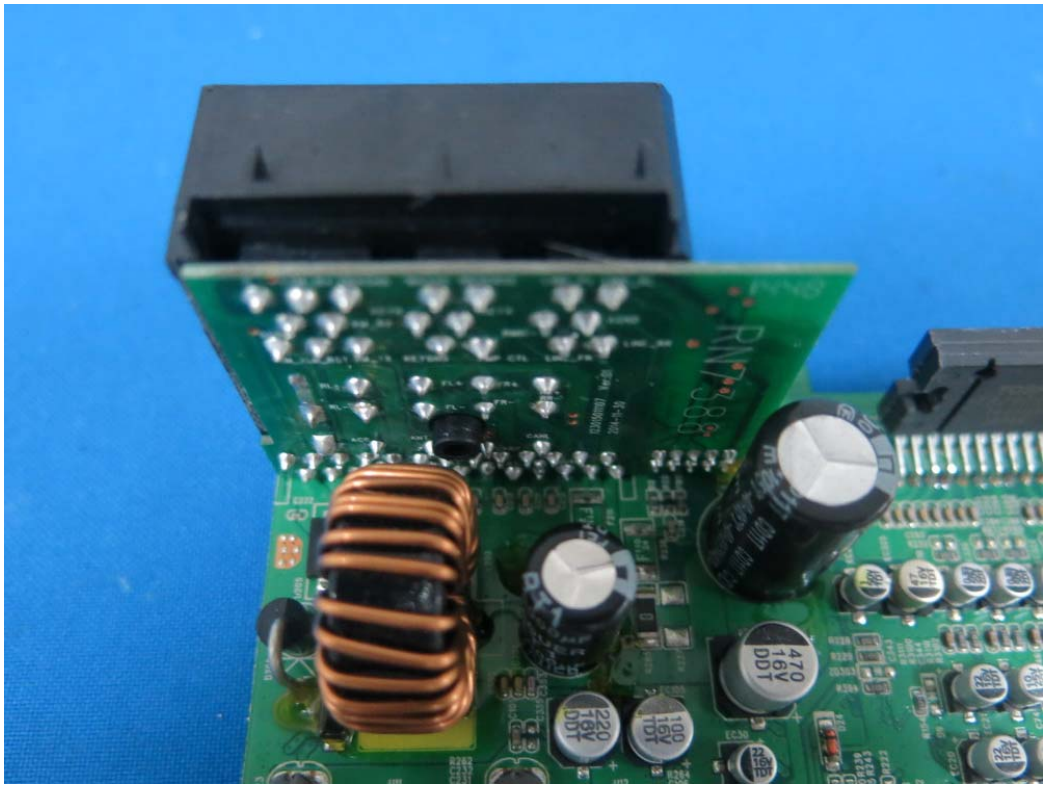



cm 1
INCH 32
100cm
32


cm 1
INCH 32
100cm
32






RNT388
470
16V
DDT
220
16V
DDT
100
16V
DDT