



# SPORTON International Inc.

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## FCC RADIO TEST REPORT

Applicant's company	Broadcom Corporation
Applicant Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.
FCC ID	QDS-BRCM1090
Manufacturer's company	Broadcom Corporation
Manufacturer Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.

Product Name	Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E/SDIO NGFF 2230 Card
Brand Name	Broadcom
Model No.	BCM94371ZAE
Part No.	BCM94371ZAE, BCM94371Z
Test Rule	47 CFR FCC Part 15 Subpart C § 15.247
Test Freq. Range	2402 ~ 2480MHz
Received Date	Jul. 31, 2014
Final Test Date	Jan. 07, 2016
Submission Type	Original Equipment

### Statement

**Test result included is only for the Bluetooth BR/EDR of the product.**

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.10-2013** and **47 CFR FCC Part 15 Subpart C**.

The test equipment used to perform the test is calibrated and traceable to NML/ROC.



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## History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR473142-07AC	Rev. 01	Initial issue of report	Jan. 12, 2016



## 1. VERIFICATION OF COMPLIANCE

**Product Name** : Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E/SDIO NGFF 2230 Card  
**Brand Name** : Broadcom  
**Model No.** : BCM94371ZAE  
**Part No.** : BCM94371ZAE, BCM94371Z  
**Applicant** : Broadcom Corporation  
**Test Rule Part(s)** : 47 CFR FCC Part 15 Subpart C § 15.247

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on Jul. 31, 2014 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.



Sam Chen

SPORTON INTERNATIONAL INC.

## 2. SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C				
Part	Rule Section	Description of Test	Result	Under Limit
4.1	15.207	AC Power Line Conducted Emissions	Complies	12.12 dB
4.2	15.247(b)(1)	Maximum Conducted Output Power	Complies	8.41 dB
4.3	15.247(a)(1)	Hopping Channel Separation	Complies	-
4.4	15.247(b)(1)	Number of Hopping Frequency	Complies	-
4.5	15.247(a)(1)	Dwell Time	Complies	-
4.6	15.247(d)	Radiated Emissions	Complies	1.89 dB
4.7	15.247(d)	Band Edge Emissions	Complies	4.50 dB
4.8	15.203	Antenna Requirements	Complies	-

### 3. GENERAL INFORMATION

#### 3.1. Product Details

Items	Description
Power Type	From host system
Modulation	FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK)
Data Rate (Mbps)	GFSK: 1 ; $\pi/4$ -DQPSK: 2 ; 8DPSK: 3
Frequency Range	2402 ~ 2480MHz
Channel Number	79
Channel Band Width (99%)	BR (GFSK) 1 Mbps: 0.8880 MHz EDR ( $\pi/4$ -DQPSK) 2 Mbps: 1.2080 MHz EDR (8DPSK) 3 Mbps: 1.2040 MHz
Maximum Conducted Peak Output Power	BR (GFSK) 1 Mbps: 12.59 dBm EDR ( $\pi/4$ -DQPSK) 2 Mbps: 11.97 dBm EDR (8DPSK) 3 Mbps: 12.06 dBm
Maximum Conducted Average Output Power	BR (GFSK) 1 Mbps: 11.48 dBm EDR ( $\pi/4$ -DQPSK) 2 Mbps: 7.96 dBm EDR (8DPSK) 3 Mbps: 8.01 dBm
Carrier Frequencies	Please refer to section 3.4
Antenna	Please refer to section 3.3
Note 1: Bluetooth BR uses a combination of GFSK (1Mbps).	
Note 2: Bluetooth EDR uses a combination of $\pi/4$ -DQPSK (2Mbps) and 8DPSK (3Mbps).	

#### 3.2. Accessories

N/A

### 3.3. Table for Filed Antenna

Set	Ant.	Brand	Part No.	Antenna Type	Connector	Gain (dBi)				
						2.4G/ BT	5G B1	5G B2	5G B3	5G B4
1	1	MAG.LAYERS	PCA-4077-25GC1-A1-RT	WLAN/BT antenna	I-PEX A13	3.33	5.85	5.85	6.21	6.21
	2	MAG.LAYERS	PCA-4077-25GC1-A1-RT	WLAN/BT antenna	I-PEX A13	3.33	5.85	5.85	6.21	6.21

Note: The EUT has one set of antenna, and each set contains two antennas.

Chain 1: Connect to Ant. 1, Chain 2: Connect to Ant. 2.

**For 2.4 GHz WLAN function (2TX/2RX):**

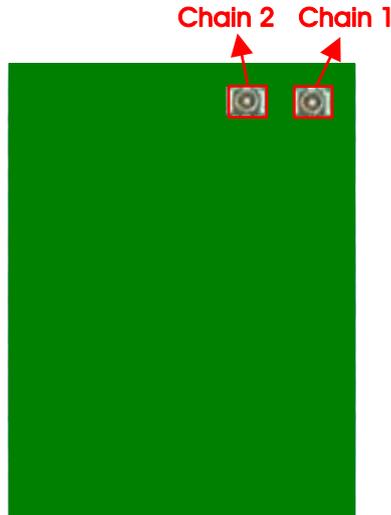
Chain 1 and Chain 2 could transmit/receive simultaneously.

**For Bluetooth function (1TX/1RX):**

Only Chain 1 could transmit/receive simultaneously.

**For 5 GHz WLAN function (2TX/2RX):**

Chain 1 and Chain 2 could transmit/receive simultaneously.



### 3.4. Table for Carrier Frequencies

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
2400~2483.5MHz	0	2402 MHz	40	2442 MHz
	1	2403 MHz	:	:
	:	:	77	2479 MHz
	38	2440 MHz	78	2480 MHz
	39	2441 MHz	-	-

### 3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel	Chain
AC Power Conducted Emissions	Normal Link	-	-	-
Maximum Conducted Output Power	BR (GFSK)	1 Mbps	0/39/78	1
	EDR ( $\pi/4$ -DQPSK)	2 Mbps	0/39/78	1
	EDR (8DPSK)	3 Mbps	0/39/78	1
Hopping Channel Separation	BR (GFSK)	1 Mbps	0~1 39~40 77~78	1
	EDR ( $\pi/4$ -DQPSK)	2 Mbps	0~1 39~40 77~78	1
	EDR (8DPSK)	3 Mbps	0~1 39~40 77~78	1
Number of Hopping Frequency	BR (GFSK)	1 Mbps	0~78	1
Dwell Time	BR (GFSK) (DH1, DH3, DH5)	1 Mbps	0/39/78	1
Radiated Emissions Below 1GHz	Normal Link	-	-	-
Radiated Emissions Above 1GHz	BR (GFSK)	1 Mbps	0/39/78	1
	EDR (8DPSK)	3 Mbps	0/39/78	1
Band Edge Emissions	BR (GFSK)	1 Mbps	0/39/78	1
	EDR (8DPSK)	3 Mbps	0/39/78	1

The following test modes were performed for all tests:

**For AC Power Line Conducted Emissions test:**

Mode 1. EUT 1 + 2.4GHz WLAN function + Bluetooth function

Mode 2. EUT 1 + 5GHz WLAN function + Bluetooth function

Mode 3. EUT 2 + 2.4GHz WLAN function

Mode 4. EUT 2 + 5GHz WLAN function

Mode 5. EUT 2 + Bluetooth function

Mode 5 is the worst case, so it was selected to record in this test report.

**For Radiated Emissions 9kHz~1GHz test:**

Mode 1. Place EUT 1 in X axis + 2.4GHz WLAN function + Bluetooth function

Mode 2. Place EUT 1 in Y axis + 2.4GHz WLAN function + Bluetooth function

Mode 3. Place EUT 1 in Z axis + 2.4GHz WLAN function + Bluetooth function

Mode 4. Place EUT 1 in X axis + 5GHz WLAN function + Bluetooth function

Mode 5. Place EUT 1 in Y axis + 5GHz WLAN function + Bluetooth function

Mode 6. Place EUT 1 in Z axis + 5GHz WLAN function + Bluetooth function

Mode 7. Place EUT 2 in X axis + 2.4GHz WLAN function

Mode 8. Place EUT 2 in Y axis + 2.4GHz WLAN function

Mode 9. Place EUT 2 in Z axis + 2.4GHz WLAN function

Mode 10. Place EUT 2 in X axis + 5GHz WLAN function

Mode 11. Place EUT 2 in Y axis + 5GHz WLAN function

Mode 12. Place EUT 2 in Z axis + 5GHz WLAN function

Mode 9 has been evaluated to be the worst case among Mode 7~9, thus measurement for Mode 13 will follow this same test mode.

Mode 13. Place EUT 2 in Z axis + Bluetooth function

Mode 9 is the worst case, so it was selected to record in this test report.

**For Radiated Emissions above 1GHz test:**

Radiated Emissions above 1GHz test was performed at its 3-axis (X-axis, Y-axis and Z-axis). Z-axis was the worst case, so it's recorded in this test report.

**For Co-location MPE and Radiated Emission Co-location Test:**

The EUT could be applied with 2.4GHz WLAN function and 5GHz WLAN function; therefore Co-location Maximum Permissible Exposure (Please refer to FA473142-07AA) and Radiated Emission Co-location (please refer to Appendix B) tests are added for simultaneously transmit between 2.4GHz WLAN function and 5GHz WLAN function.

Mode 1. EUT 1 + 2.4GHz WLAN function + Bluetooth function

Mode 2. EUT 1 + 5GHz WLAN function + Bluetooth function

### 3.6. Table for Testing Locations

Test Site Location					
Address:	No.8, Lane 724, Bo-ai St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.				
TEL:	886-3-656-9065				
FAX:	886-3-656-9085				
Test Site No.	Site Category	Location	FCC Reg. No.	IC File No.	VCCI Reg. No
03CH01-CB	SAC	Hsin Chu	262045	IC 4086D	-
CO01-CB	Conduction	Hsin Chu	262045	IC 4086D	-
TH01-CB	OVEN Room	Hsin Chu	-	-	-

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

### 3.7. Table for Multiple Listing

The EUT has three part numbers which are identical to each other in all aspects except for the following table:

EUT	Model No.	Part No.	Description
EUT 1	BCM94371ZAE	BCM94371Z	M.2 E Key connector which support PCIe/USB interface.
EUT 2		BCM94371Z	M.2 E Key connector which support SDIO/UART/Pcie/USB interface.
EUT 3		BCM94371ZAE	M.2 A key + E Key connector which support PCIe/USB interface.

From the above models, part number: EUT 1 and EUT 2 were selected as representative models for AC Power Line Conducted Emissions and Radiated Emissions <below 1GHz> tests and EUT 1 was selected as representative model for other tests.

### 3.8. Table for Supporting Units

For Test Site No: CO01-CB

Support Unit	Brand	Model	FCC ID
NB	DELL	E6430	DoC
Fixture*2	Broadcom	BCM9MC2EC_1	N/A
Mouse	Logitech	M-U0026	N/A
Earphone	SHYARO CHI	MIC-04	N/A
NB	DELL	E4300	N/A
Broadcom 802.11 a/b/g/n/ac WLAN + Bluetooth PCI-E NGFF 2230 Card (Device)	Broadcom	BCM94371ZAE	QDS-BRCM1090

For Test Site No: 03CH01-CB (below 1GHz)

Support Unit	Brand	Model	FCC ID
NB	DELL	E4300	DoC
Wireless ac AP	Netgear	R6300V2	PY313200227
Fixture	Broadcom	BCM9MC2EC_1	N/A
Mouse	Logitech	M-U0026	DoC
Earphone	SHYARO CHI	MIC-04	N/A
Adapter	Moso	MSA-C2000IC5	N/A

For Test Site No: 03CH01-CB (above 1GHz)

Support Unit	Brand	Model	FCC ID
NB	DELL	E4300	RSE-TG233
Test fixture	Broadcom	BCM9NGFF2EC_1	N/A

For Test Site No: TH01-CB

Support Unit	Brand	Model	FCC ID
NB	DELL	E6430	DoC
Test fixture	Broadcom	BCM9NGFF2EC_1	N/A

### 3.9. Table for Parameters of Test Software Setting

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

#### Power Parameters of Bluetooth

##### For BR (GFSK) 1 Mbps:

Test Software Version	Broadcom BlueTool V1.8.7.9		
Frequency	2402 MHz	2441 MHz	2480 MHz
Power Parameters	0	0	0

##### For EDR ( $\pi/4$ -DQPSK) 2 Mbps:

Test Software Version	Broadcom BlueTool V1.8.7.9		
Frequency	2402 MHz	2441 MHz	2480 MHz
Power Parameters	0	0	0

##### For EDR (8DPSK) 3 Mbps:

Test Software Version	Broadcom BlueTool V1.8.7.9		
Frequency	2402 MHz	2441 MHz	2480 MHz
Power Parameters	0	0	0

### 3.10. EUT Operation during Test

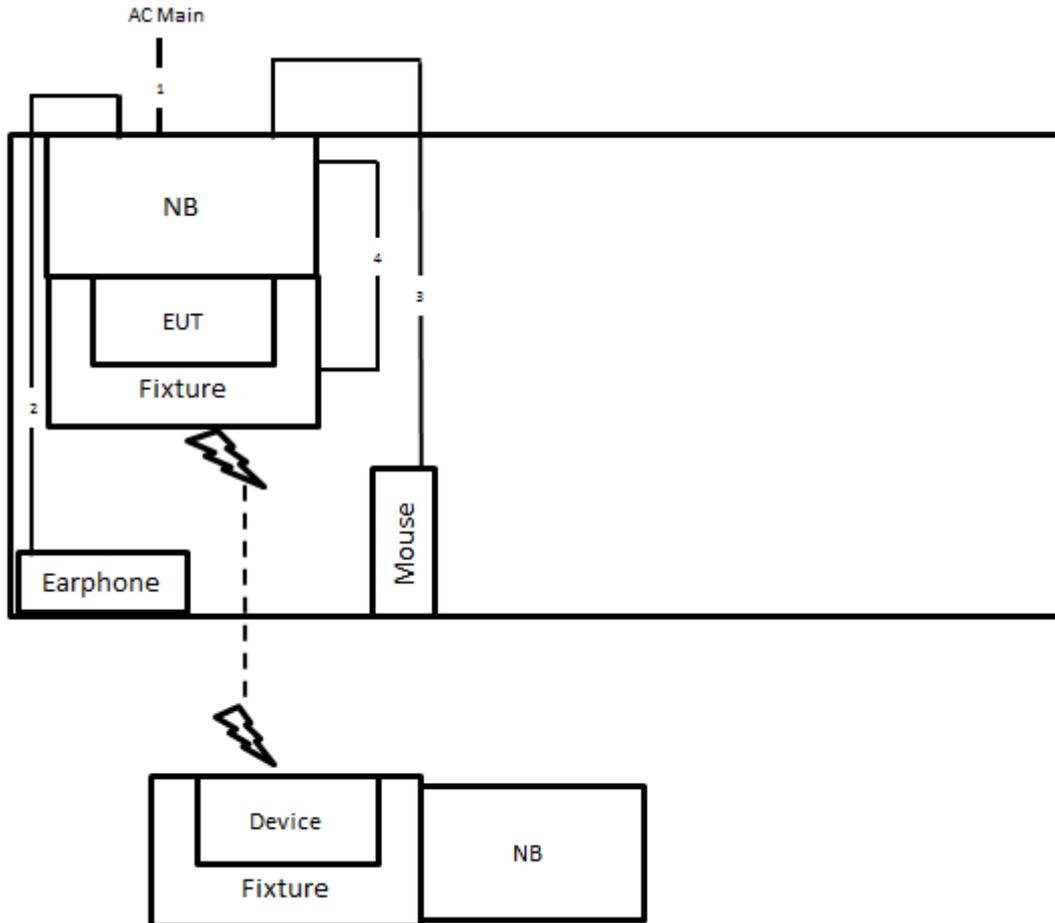
The EUT was programmed to be in continuously transmitting mode.

### 3.11. Duty Cycle

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
BR (GFSK)	2.900	3.669	79.04	1.02	0.34
EDR ( $\pi/4$ -DQPSK)	2.900	3.685	78.70	1.04	0.34
EDR (8DPSK)	2.900	3.717	78.02	1.08	0.34

### 3.12. Test Configurations

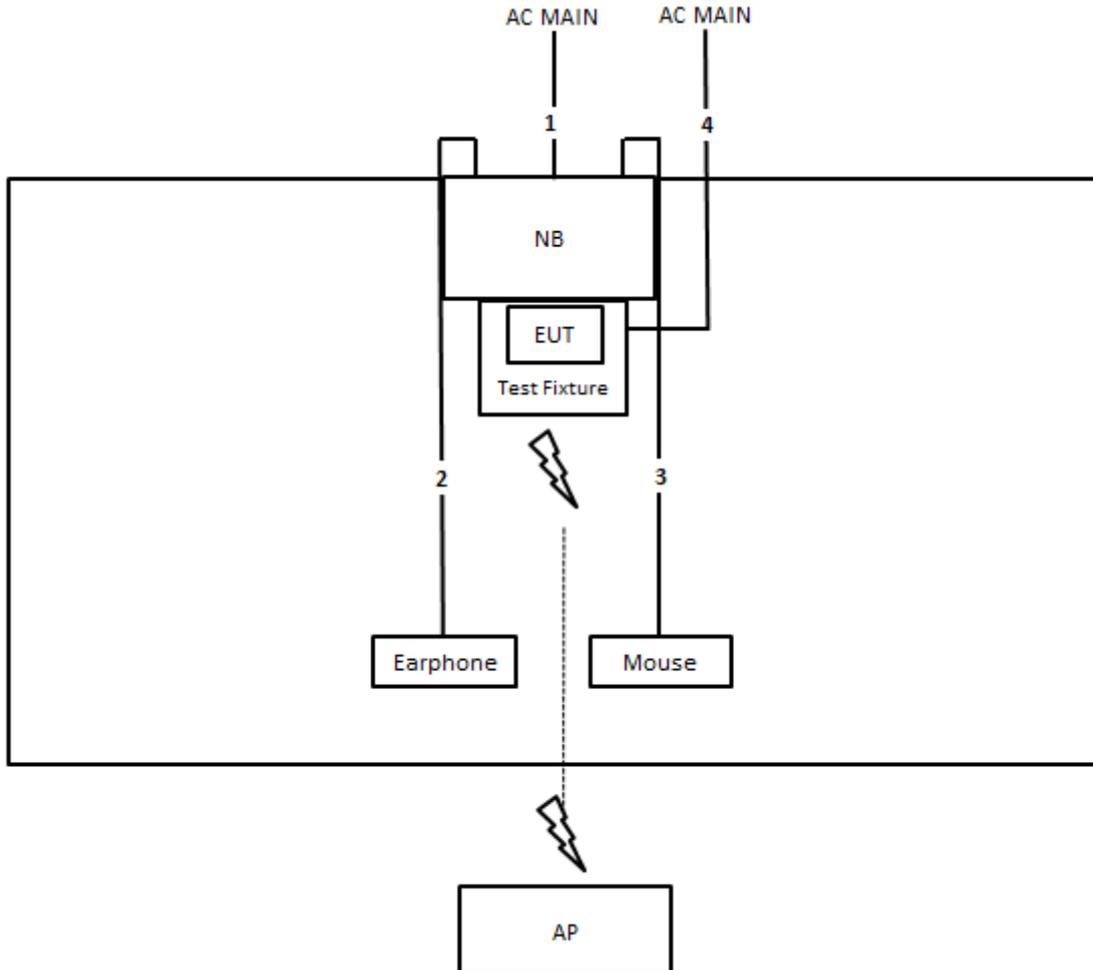
#### 3.12.1. AC Power Line Conduction Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	Audio cable	No	1.1m
3	USB cable	Yes	1.8m
4	USB cable	Yes	1.2m

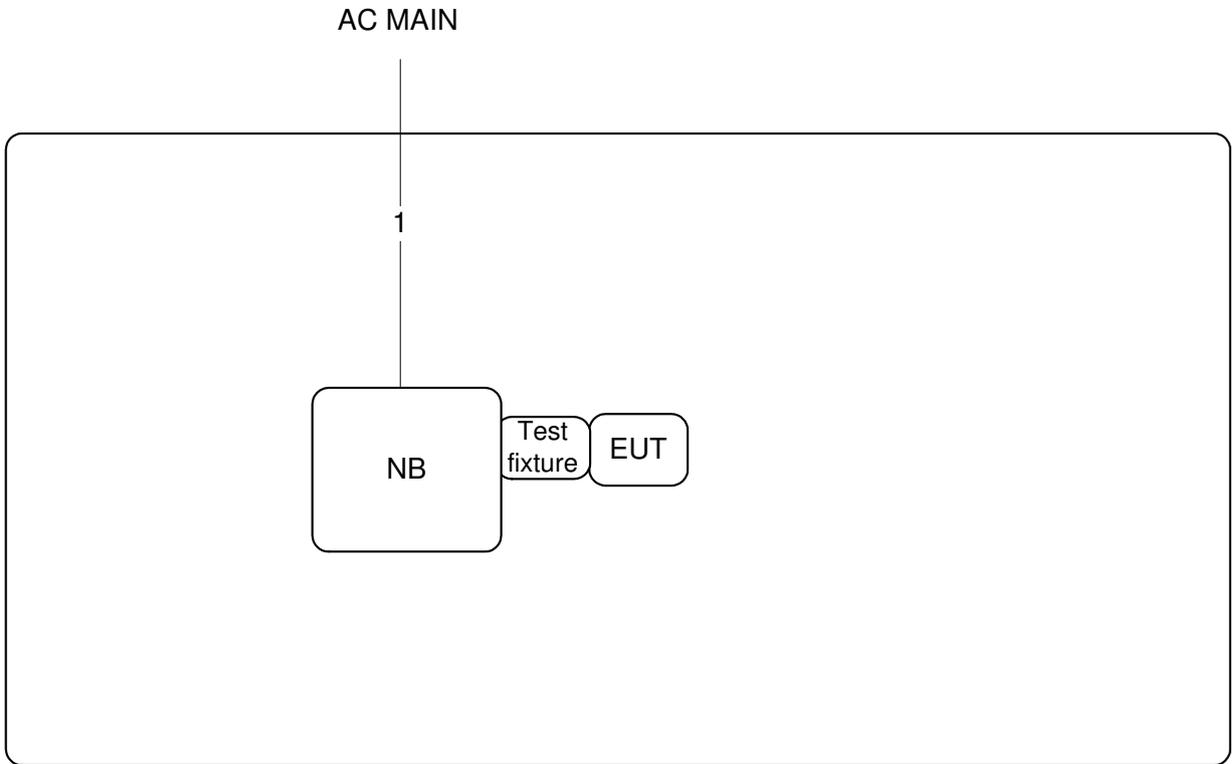
### 3.12.2. Radiation Emissions Test Configuration

Test Configuration: 30MHz~1GHz



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	Audio Cable	No	1.1m
3	USB Cable	Yes	1.8m
4	Power cable	No	1.8m

Test Configuration: above 1GHz



Item	Connection	Shielded	Length
1	Power cable	No	1.8m

## 4. TEST RESULT

### 4.1. AC Power Line Conducted Emissions Measurement

#### 4.1.1. Limit

For a Low-power Radio-frequency Device which is designed to be connected to the AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed below limits table.

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

#### 4.1.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the receiver.

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

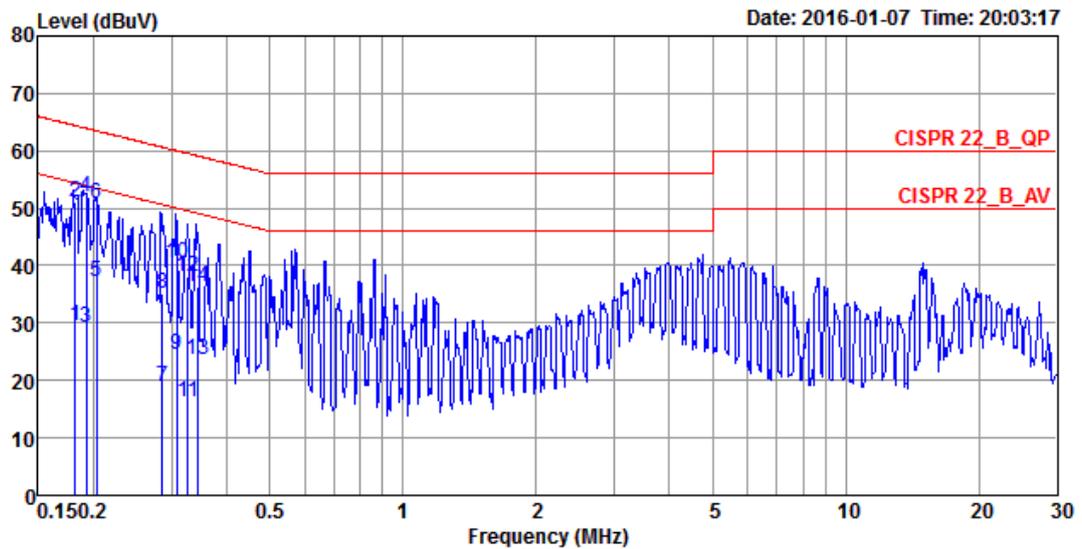
#### 4.1.3. Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 kHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.



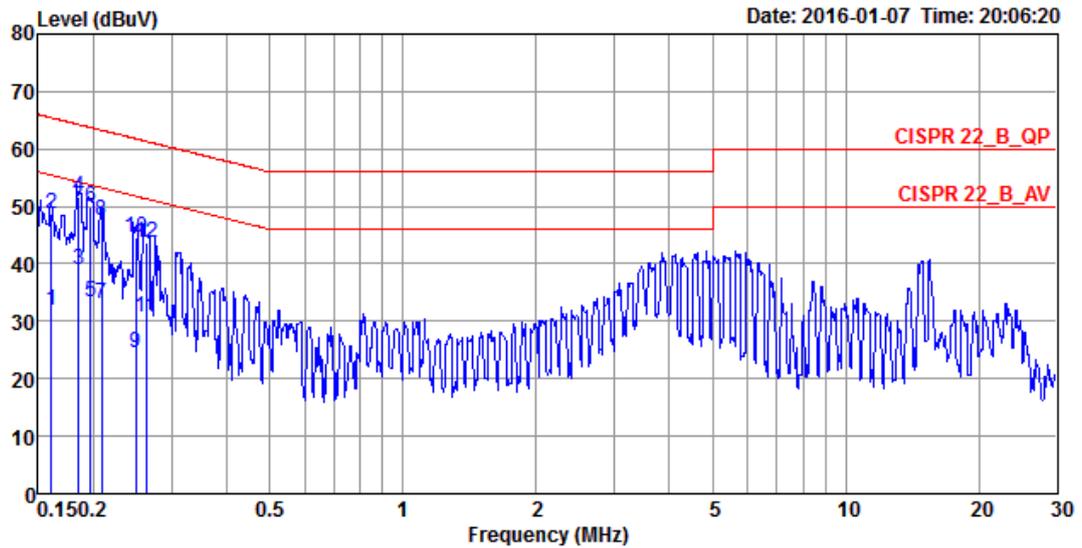
4.1.7. Results of AC Power Line Conducted Emissions Measurement

Temperature	25°C	Humidity	62%
Test Engineer	Kane Liu	Phase	Line
Configuration	Normal Link	Test Mode	Mode 5



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1815	29.48	-24.94	54.42	19.53	9.93	0.02	LINE	Average
2	0.1815	50.94	-13.48	64.42	40.99	9.93	0.02	LINE	QP
3	0.1924	29.14	-24.79	53.93	19.19	9.93	0.02	LINE	Average
4	0.1924	51.81	-12.12	63.93	41.86	9.93	0.02	LINE	QP
5	0.2029	37.31	-16.18	53.49	27.36	9.93	0.02	LINE	Average
6	0.2029	50.65	-12.84	63.49	40.70	9.93	0.02	LINE	QP
7	0.2863	18.97	-31.66	50.63	9.00	9.93	0.04	LINE	Average
8	0.2863	35.00	-25.63	60.63	25.03	9.93	0.04	LINE	QP
9	0.3083	24.54	-25.48	50.02	14.57	9.93	0.04	LINE	Average
10	0.3083	40.39	-19.63	60.02	30.42	9.93	0.04	LINE	QP
11	0.3268	16.17	-33.36	49.53	6.20	9.93	0.04	LINE	Average
12	0.3268	38.13	-21.40	59.53	28.16	9.93	0.04	LINE	QP
13	0.3428	23.59	-25.54	49.13	13.62	9.93	0.04	LINE	Average
14	0.3428	36.30	-22.83	59.13	26.33	9.93	0.04	LINE	QP

Temperature	25°C	Humidity	62%
Test Engineer	Kane Liu	Phase	Neutral
Configuration	Normal Link	Test Mode	Mode 5



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1607	31.76	-23.67	55.43	21.96	9.78	0.02	NEUTRAL	Average
2	0.1607	48.74	-16.69	65.43	38.94	9.78	0.02	NEUTRAL	QP
3	0.1854	38.93	-15.31	54.24	29.12	9.79	0.02	NEUTRAL	Average
4	0.1854	51.52	-12.72	64.24	41.71	9.79	0.02	NEUTRAL	QP
5	0.1965	33.34	-20.42	53.76	23.53	9.79	0.02	NEUTRAL	Average
6	0.1965	49.79	-13.97	63.76	39.98	9.79	0.02	NEUTRAL	QP
7	0.2083	33.19	-20.08	53.27	23.38	9.79	0.02	NEUTRAL	Average
8	0.2083	47.39	-15.88	63.27	37.58	9.79	0.02	NEUTRAL	QP
9	0.2495	24.40	-27.38	51.78	14.58	9.79	0.03	NEUTRAL	Average
10	0.2495	44.48	-17.30	61.78	34.66	9.79	0.03	NEUTRAL	QP
11	0.2630	30.57	-20.77	51.34	20.75	9.79	0.03	NEUTRAL	Average
12	0.2630	43.56	-17.78	61.34	33.74	9.79	0.03	NEUTRAL	QP

Note:

Level = Read Level + LISN Factor + Cable Loss.

## 4.2. Maximum Conducted Output Power Measurement

### 4.2.1. Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, the limit for peak output power is 1Watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts (21dBm). The limited has to be reduced by the amount in dB that the gain of the antenna exceed 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### 4.2.2. Measuring Instruments and Setting

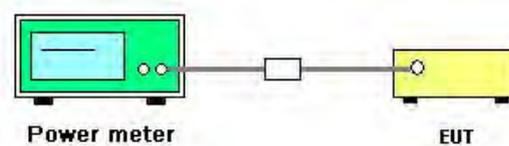
Please refer to section 5 of equipments list in this report. The following table is the setting of the power meter.

Power Meter Parameter	Setting
Bandwidth	50MHz bandwidth is greater than the EUT emission bandwidth
Detector	Peak and Average

### 4.2.3. Test Procedures

This procedure provides an alternative for determining the RMS output power using a broadband RF average power meter with a thermocouple detector.

### 4.2.4. Test Setup Layout



### 4.2.5. Test Deviation

There is no deviation with the original standard.

### 4.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

#### 4.2.7. Test Result of Maximum Conducted Output Power

Temperature	20°C	Humidity	52%
Test Engineer	Kenneth Huang	Configurations	GFSK, $\pi/4$ -DQPSK, 8DPSK
Test Date	Oct. 08, 2014		

##### For BR (GFSK) 1 Mbps:

Channel	Frequency	Conducted Peak Power (dBm)	Conducted Average Power (dBm)	Max. Limit (dBm)	Result
0	2402 MHz	11.34	10.01	21.00	Complies
39	2441 MHz	12.42	11.26	21.00	Complies
78	2480 MHz	12.59	11.48	21.00	Complies

##### For EDR ( $\pi/4$ -DQPSK) 2 Mbps:

Channel	Frequency	Conducted Peak Power (dBm)	Conducted Average Power (dBm)	Max. Limit (dBm)	Result
0	2402 MHz	10.62	6.71	21.00	Complies
39	2441 MHz	11.54	7.75	21.00	Complies
78	2480 MHz	11.97	7.96	21.00	Complies

##### For EDR (8DPSK) 3 Mbps:

Channel	Frequency	Conducted Peak Power (dBm)	Conducted Average Power (dBm)	Max. Limit (dBm)	Result
0	2402 MHz	10.61	6.74	21.00	Complies
39	2441 MHz	11.69	7.78	21.00	Complies
78	2480 MHz	12.06	8.01	21.00	Complies

### 4.3. Hopping Channel Separation Measurement

#### 4.3.1. Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

#### 4.3.2. Measuring Instruments and Setting

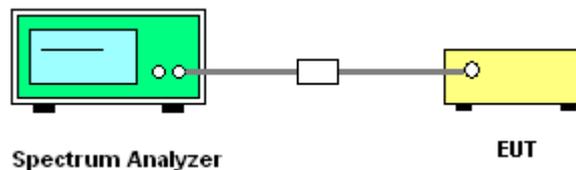
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RBW	30 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
VBW	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

#### 4.3.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilized for 20 dB bandwidth measurement.
3. The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were utilized for channel separation measurement.

#### 4.3.4. Test Setup Layout



#### 4.3.5. Test Deviation

There is no deviation with the original standard.

#### 4.3.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

#### 4.3.7. Test Result of Hopping Channel Separation

Temperature	20°C	Humidity	52%
Test Engineer	Kenneth Huang	Configurations	GFSK, $\pi/4$ -DQPSK, 8DPSK

For BR (GFSK) 1 Mbps:

Frequency	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Ch. Separation (MHz)	Two-Thirds of 20dB Bandwidth (MHz)	Result
2402 MHz	1.0300	0.8880	1.00	0.643	Complies
2441 MHz	0.9680	0.8880	1.00	0.632	Complies
2480 MHz	0.9680	0.8880	1.00	0.637	Complies

Ch. Separation Limits: >20dB bandwidth or > Two-Thirds of 20dB bandwidth

For EDR ( $\pi/4$ -DQPSK) 2 Mbps:

Frequency	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Ch. Separation (MHz)	Two-Thirds of 20dB Bandwidth (MHz)	Result
2402 MHz	1.3320	1.2080	1.00	0.888	Complies
2441 MHz	1.3240	1.2080	1.00	0.891	Complies
2480 MHz	1.3240	1.2040	1.00	0.883	Complies

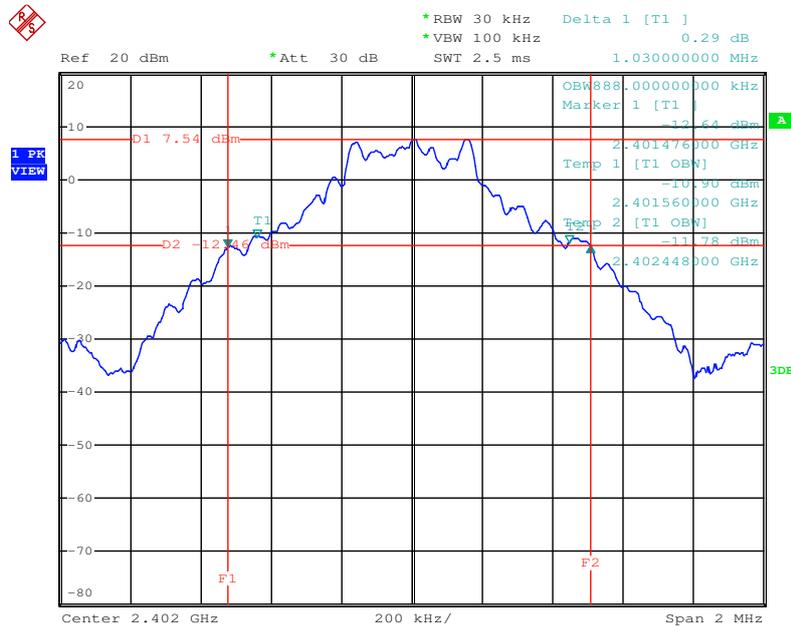
Ch. Separation Limits: >20dB bandwidth or > Two-Thirds of 20dB bandwidth

For EDR (8DPSK) 3 Mbps:

Frequency	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Ch. Separation (MHz)	Two-Thirds of 20dB Bandwidth (MHz)	Result
2402 MHz	1.3120	1.2040	1.00	0.869	Complies
2441 MHz	1.3120	1.2040	1.00	0.875	Complies
2480 MHz	1.3080	1.2000	1.00	0.877	Complies

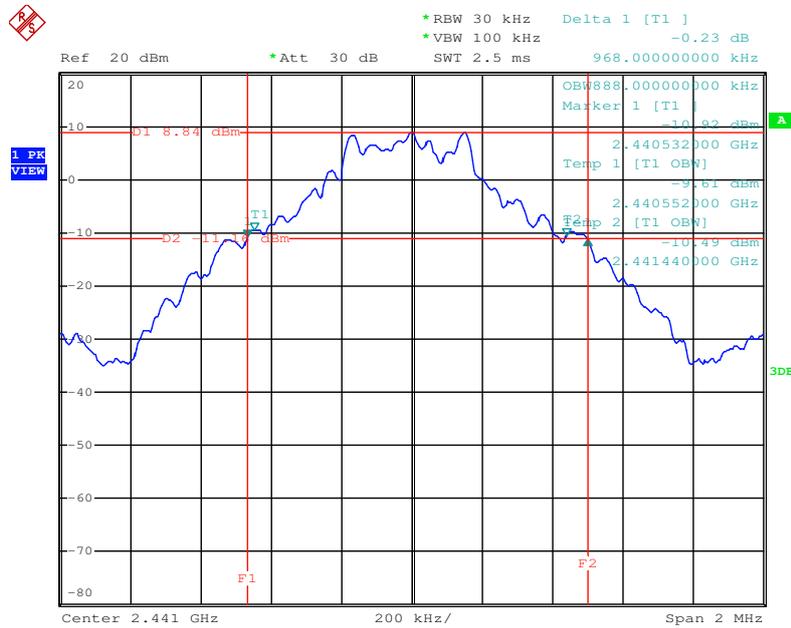
Ch. Separation Limits: >20dB bandwidth or > Two-Thirds of 20dB bandwidth

20 dB Bandwidth Plot on BR (GFSK) 1 Mbps / Channel 0 / 2402 MHz



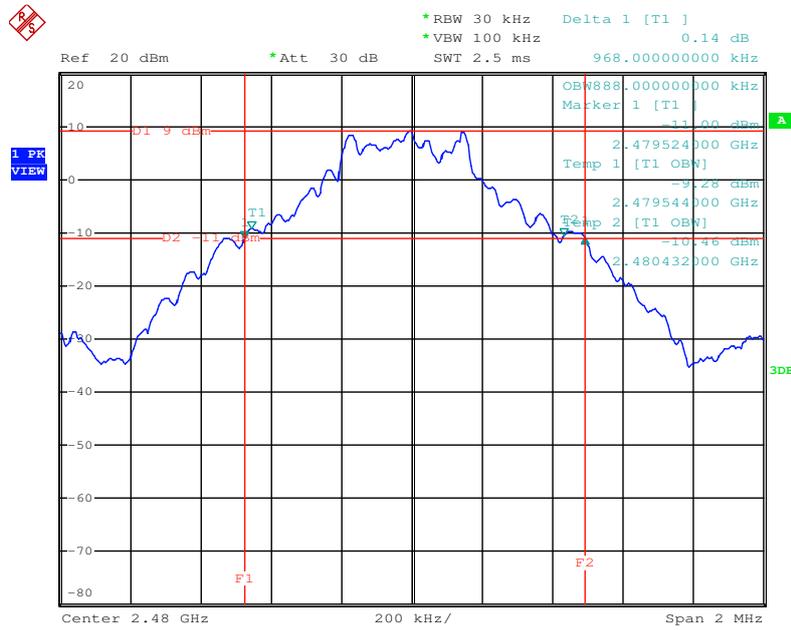
Date: 8.OCT.2014 20:41:56

20 dB Bandwidth Plot on BR (GFSK) 1 Mbps / Channel 39 / 2441 MHz



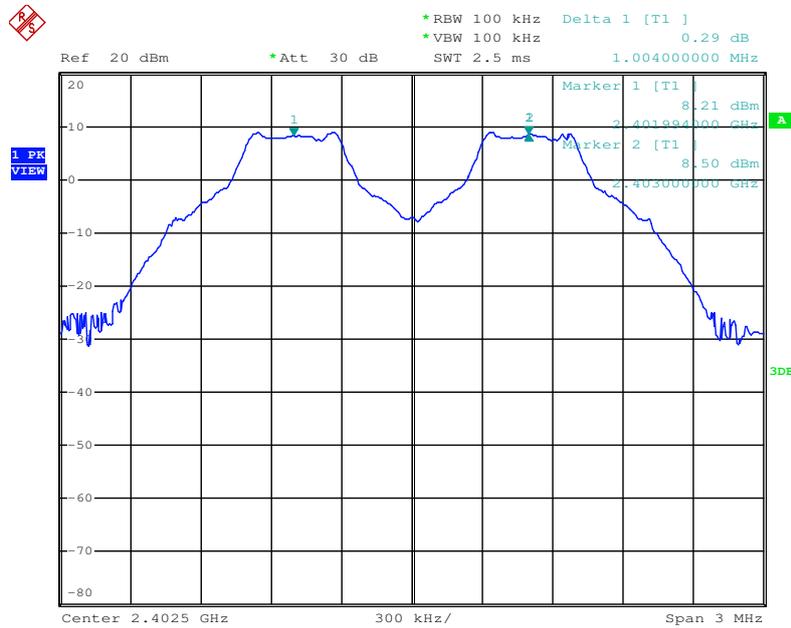
Date: 8.OCT.2014 20:48:20

**20 dB Bandwidth Plot on BR (GFSK) 1 Mbps / Channel 78 / 2480 MHz**



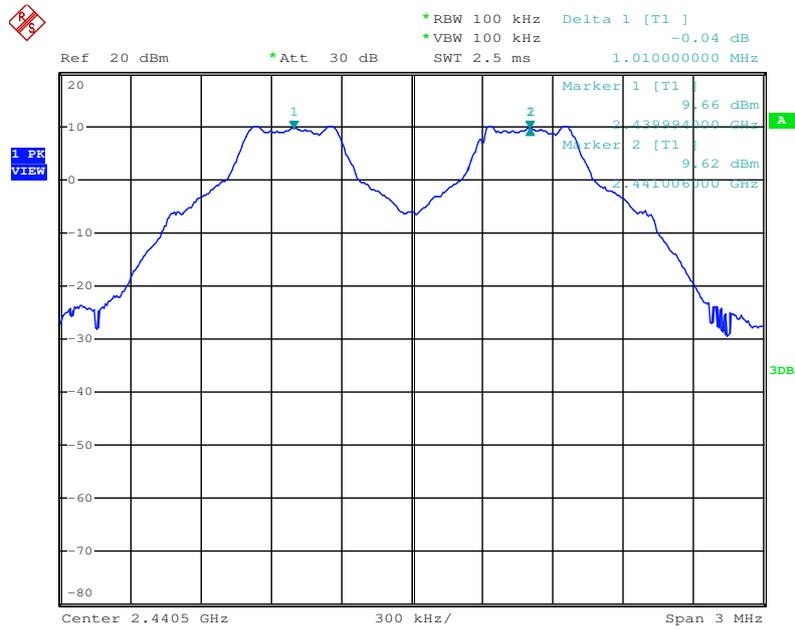
Date: 8.OCT.2014 20:53:34

**Channel Separation Plot on BR (GFSK) 1 Mbps / Channel 0~1 / 2402 MHz ~ 2403 MHz**



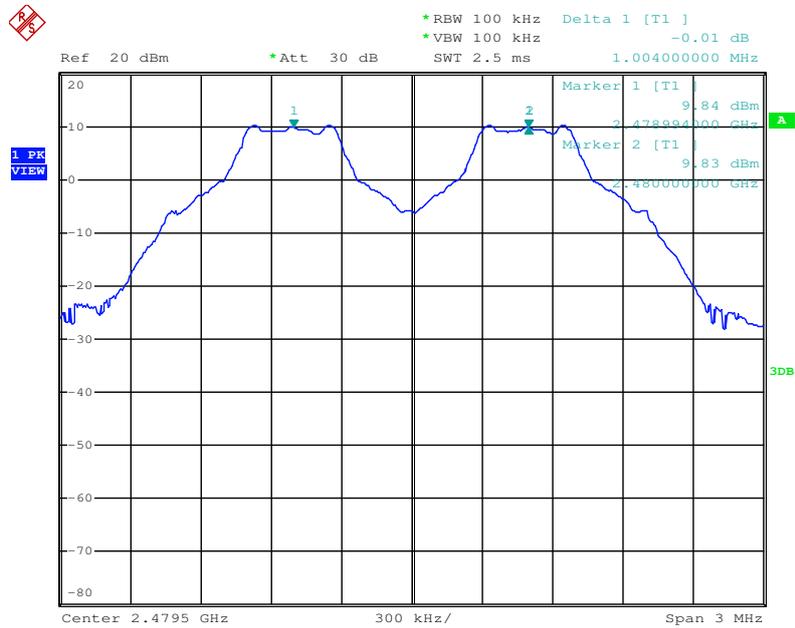
Date: 8.OCT.2014 21:30:53

**Channel Separation Plot on BR (GFSK) 1 Mbps / Channel 39~40 / 2441 MHz ~ 2442 MHz**



Date: 8.OCT.2014 21:29:49

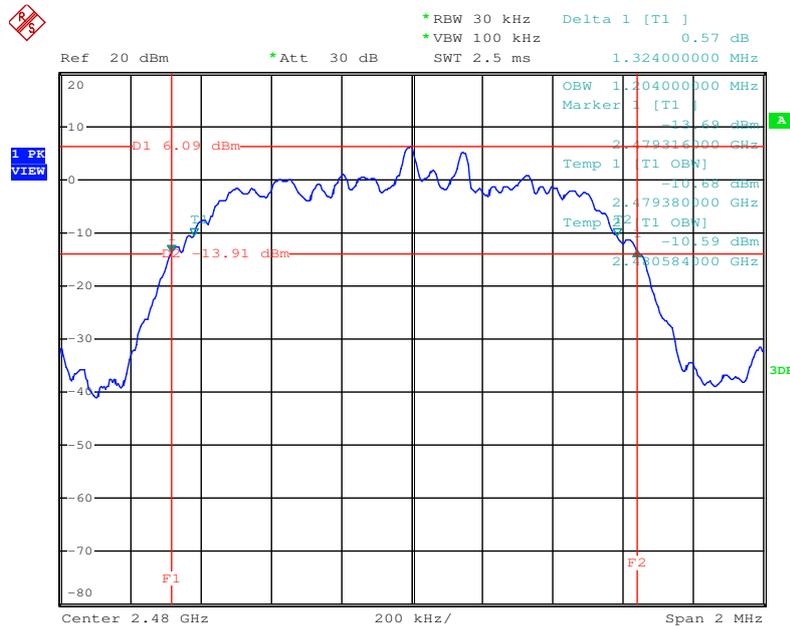
**Channel Separation Plot on BR (GFSK) 1 Mbps / Channel 77~78 / 2479 MHz ~ 2480 MHz**



Date: 8.OCT.2014 21:28:36

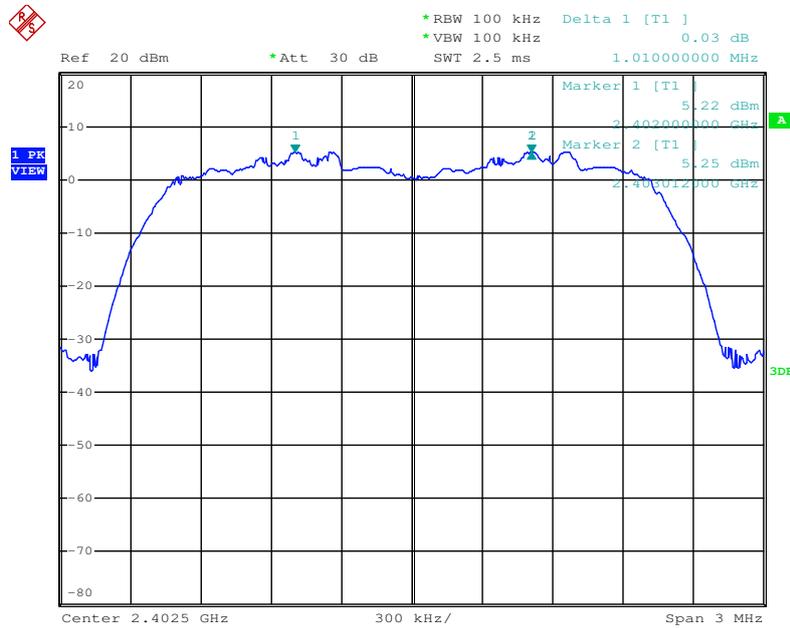


20 dB Bandwidth Plot on EDR ( $\pi/4$ -DQPSK) 2 Mbps / Channel 78 / 2480 MHz



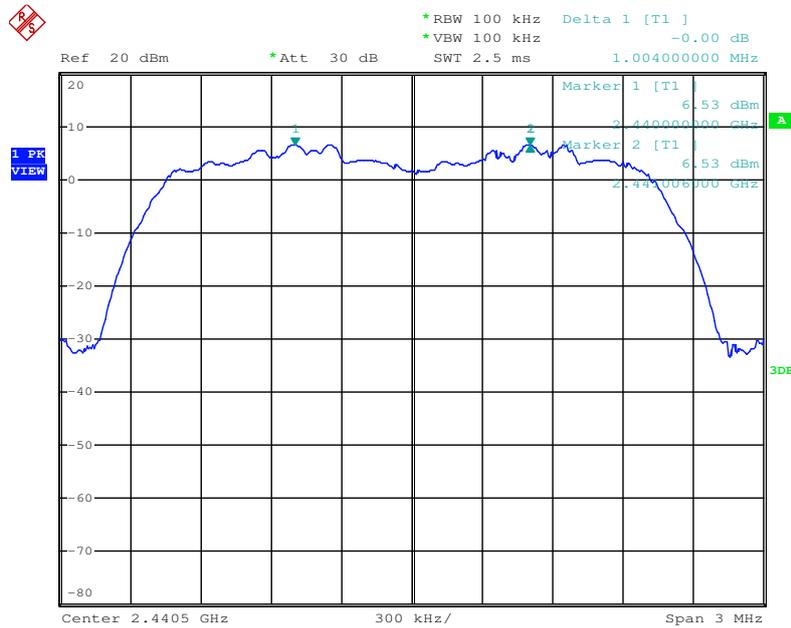
Date: 8.OCT.2014 20:58:20

Channel Separation Plot on EDR ( $\pi/4$ -DQPSK) 2 Mbps / Channel 0~1 / 2402 MHz ~ 2403 MHz



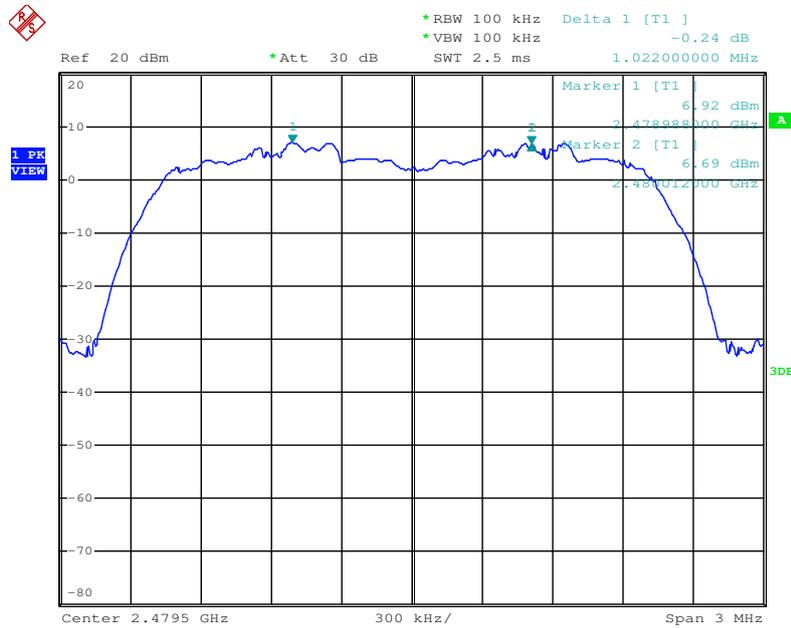
Date: 8.OCT.2014 21:24:29

**Channel Separation Plot on EDR ( $\pi/4$ -DQPSK) 2 Mbps / Channel 39~40 / 2441 MHz ~ 2442 MHz**



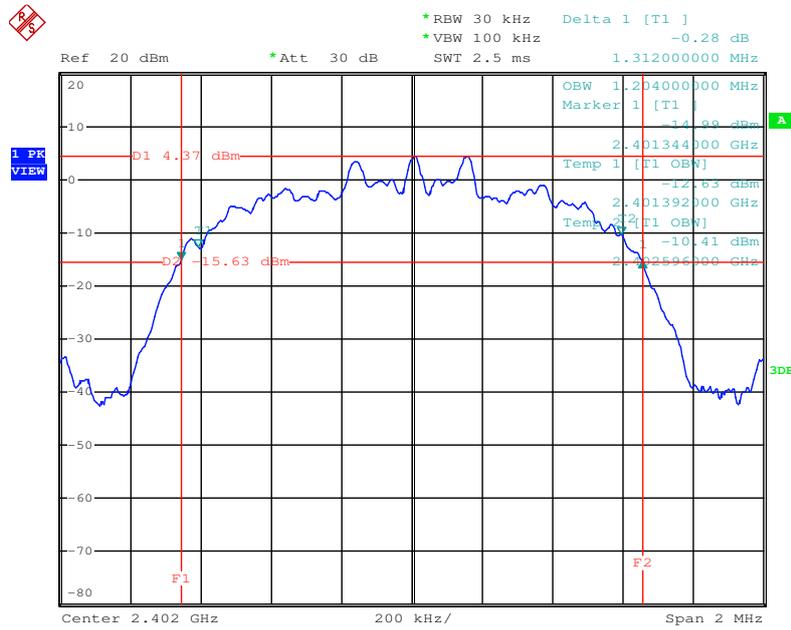
Date: 8.OCT.2014 21:25:57

**Channel Separation Plot on EDR ( $\pi/4$ -DQPSK) 2 Mbps / Channel 77~78 / 2479 MHz ~ 2480 MHz**



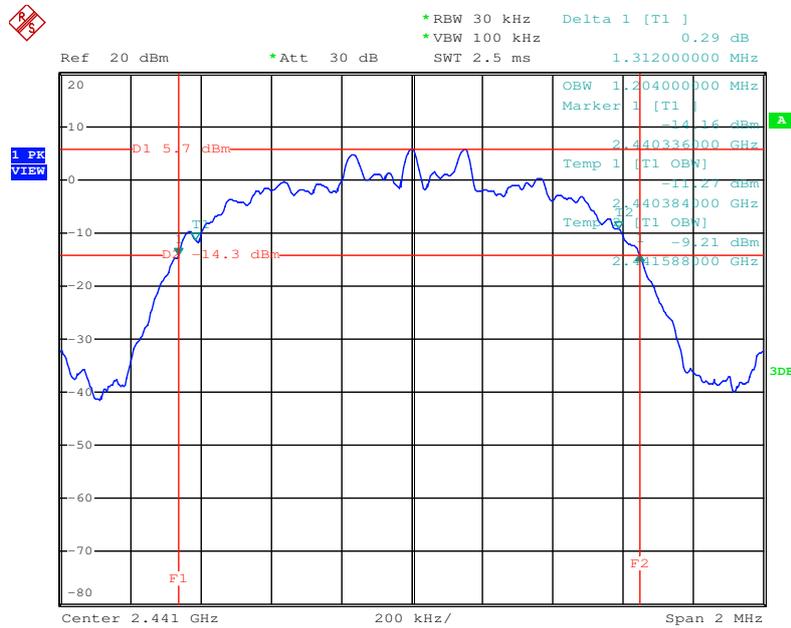
Date: 8.OCT.2014 21:27:06

**20 dB Bandwidth Plot on EDR (8DPSK) 3 Mbps / Channel 0 / 2402 MHz**



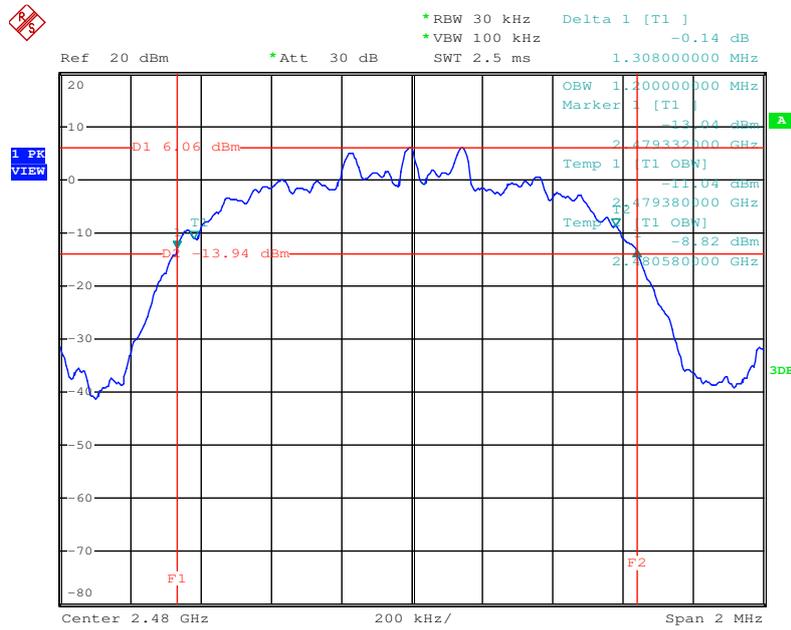
Date: 8.OCT.2014 21:06:45

**20 dB Bandwidth Plot on EDR (8DPSK) 3 Mbps / Channel 39 / 2441 MHz**



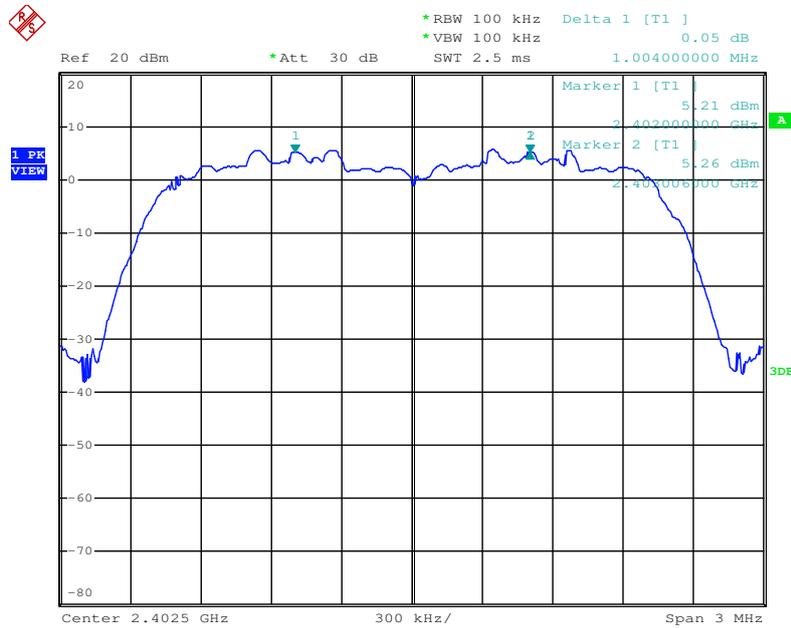
Date: 8.OCT.2014 21:09:10

**20 dB Bandwidth Plot on EDR (8DPSK) 3 Mbps / Channel 78 / 2480 MHz**



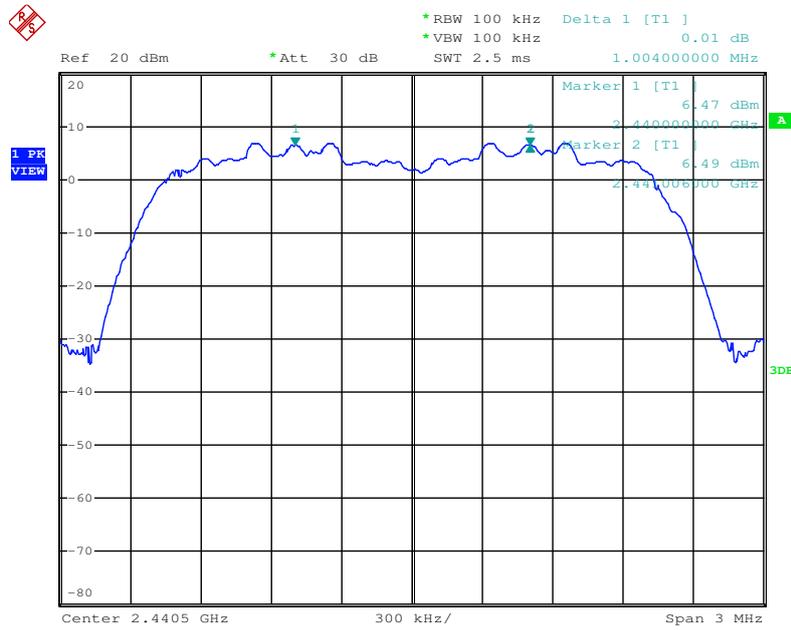
Date: 8.OCT.2014 21:14:03

**Channel Separation Plot on EDR (8DPSK) 3 Mbps / Channel 0~1 / 2402 MHz ~ 2403 MHz**



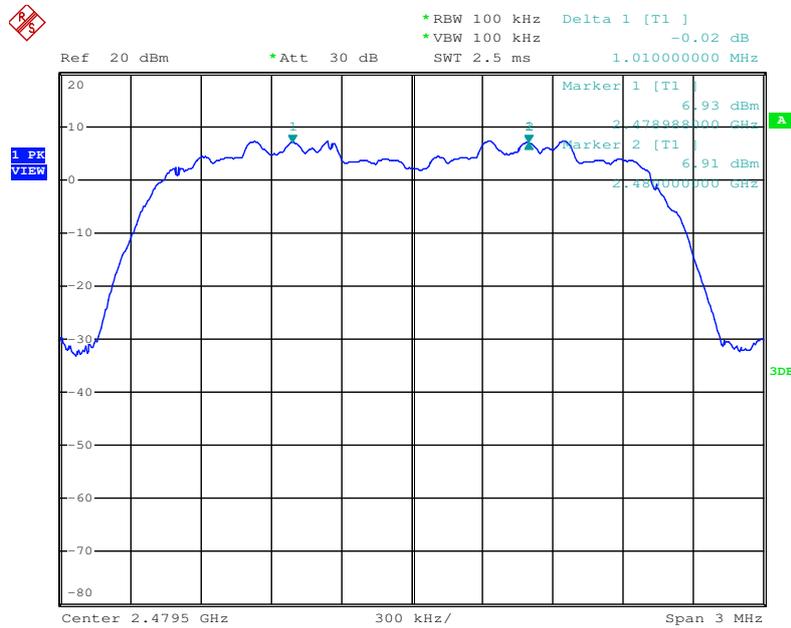
Date: 8.OCT.2014 21:23:04

**Channel Separation Plot on EDR (8DPSK) 3 Mbps / Channel 39~40 / 2441 MHz ~ 2442 MHz**



Date: 8.OCT.2014 21:21:36

**Channel Separation Plot on EDR (8DPSK) 3 Mbps / Channel 77~78 / 2479 MHz ~ 2480 MHz**



Date: 8.OCT.2014 21:19:42

#### 4.4. Number of Hopping Frequency Measurement

##### 4.4.1. Limit

At least 15 hopping frequencies, and should be equally spaced.

##### 4.4.2. Measuring Instruments and Setting

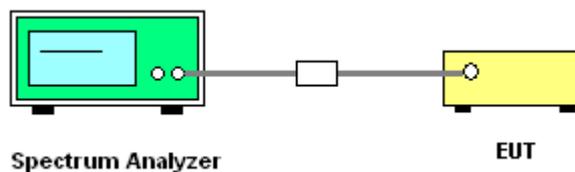
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating Frequency Range
RBW	1000 kHz
VBW	1000 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

##### 4.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth of 1000 kHz and the video bandwidth of 1000 kHz were utilized.
3. Observe frequency hopping in 2400MHz~2483.5MHz, there are at least 75 non-overlapping channels.

##### 4.4.4. Test Setup Layout



##### 4.4.5. Test Deviation

There is no deviation with the original standard.

##### 4.4.6. EUT Operation during Test

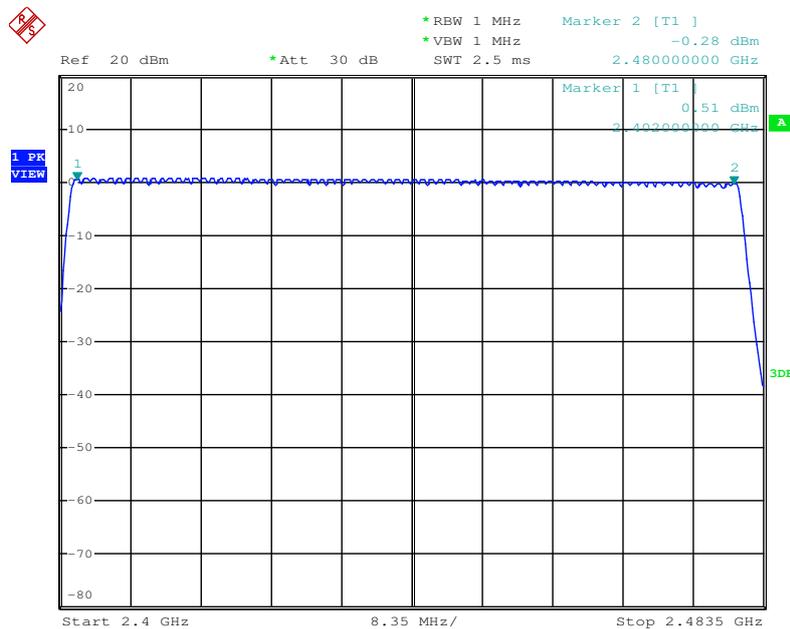
The EUT was programmed to be in continuously transmitting mode.

4.4.7. Test Result of Number of Hopping Frequency

Temperature	20°C	Humidity	52%
Test Engineer	Robert Chang	Configurations	BR (GFSK)

Modulation Type	Channel No.	Frequency (MHz)	Hopping Ch. (Channels)		Min. Limit (Channels)	Test Result
			Max.	Min. (Note)		
BR (GFSK)	0 ~ 78	2402 ~ 2480MHz	79	20	15	Complies

Number of Hopping Channel Plot on BR (GFSK) / Channel 0~78 / 2402 MHz ~ 2480 MHz



Date: 11.SEP.2014 18:00:35

Note: When Adaptive Frequency Hopping (AFH) function is employed, the minimum number of hopping channels is 20 channels.

## 4.5. Dwell Time Measurement

### 4.5.1. Limit

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.

### 4.5.2. Measuring Instruments and Setting

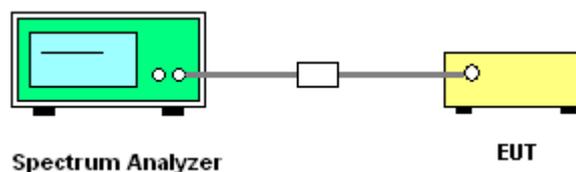
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	0 MHz
RBW	1000 kHz
VBW	1000 kHz
Detector	Peak
Trace	Single Trigger

### 4.5.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer
2. Set RBW of spectrum analyzer to 1000kHz and VBW to 1000kHz.
3. Use a video trigger with the trigger level set to enable triggering only on full pulses.
4. Sweep Time is more than once pulse time.
5. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
6. Measure the maximum time duration of one single pulse.
7. Set the EUT for DH1, DH3, DH5 packet transmitting.
8. Measure the maximum time duration of one single pulse.

### 4.5.4. Test Setup Layout



### 4.5.5. Test Deviation

There is no deviation with the original standard.

### 4.5.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

#### 4.5.7. Test Result of Dwell Time

Temperature	20°C	Humidity	52%
Test Engineer	Kenneth Huang	Configurations	BR (GFSK) / DH1, DH3, DH5

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Result
DH5	2402 MHz	2.8900	0.3083	0.4000	Complies
DH3	2402 MHz	1.6400	0.2624	0.4000	Complies
DH1	2402 MHz	0.3800	0.1216	0.4000	Complies
DH5	2441 MHz	2.8900	0.3083	0.4000	Complies
DH3	2441 MHz	1.6400	0.2624	0.4000	Complies
DH1	2441 MHz	0.3900	0.1248	0.4000	Complies
DH5	2480 MHz	2.9000	0.3093	0.4000	Complies
DH3	2480 MHz	1.6500	0.2640	0.4000	Complies
DH1	2480 MHz	0.3900	0.1248	0.4000	Complies

**Remark:**

Dwell Time = Channels x 0.4(s) x Average Hopping Channel x Package transfer time (us)

Channels come from the Hopping Channel number.

Average Hopping Channel = hops / sweep time

The limit of maximum Hopping channels (79 channels)

DH5:  $1600 / \text{Hopping Channel number (79)} / 6 \times (\text{Hopping Channel number (79)} \times 0.4\text{s}) \times \text{pulse on time} / 1000 = 0.4000$

DH3:  $1600 / \text{Hopping Channel number (79)} / 4 \times (\text{Hopping Channel number (79)} \times 0.4\text{s}) \times \text{pulse on time} / 1000$

DH1:  $1600 / \text{Hopping Channel number (79)} / 2 \times (\text{Hopping Channel number (79)} \times 0.4\text{s}) \times \text{pulse on time} / 1000$

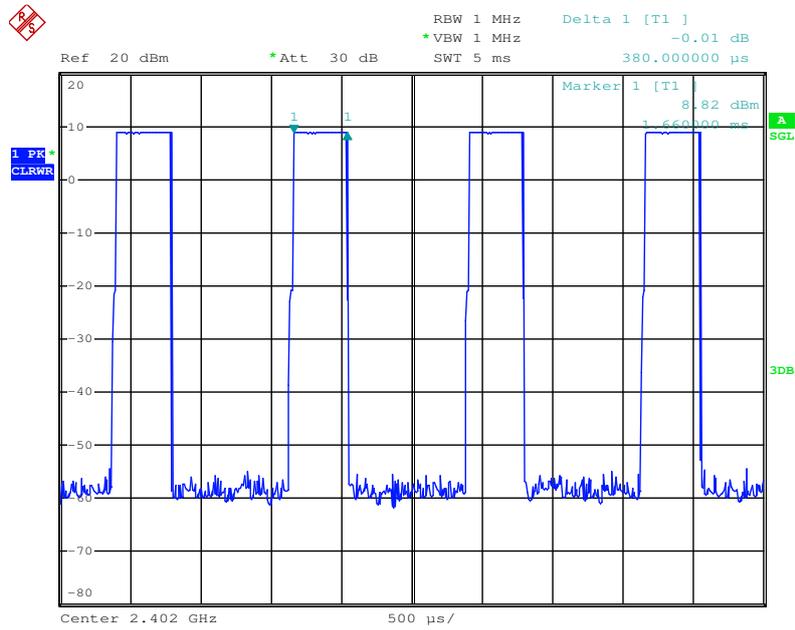
The limit of minimum Hopping channels (20 channels) (AFH)

DH5:  $1600 / \text{Hopping Channel number (20)} / 6 \times (\text{Hopping Channel number (20)} \times 0.4\text{s}) \times \text{pulse on time} / 1000$

DH3:  $1600 / \text{Hopping Channel number (20)} / 4 \times (\text{Hopping Channel number (20)} \times 0.4\text{s}) \times \text{pulse on time} / 1000$

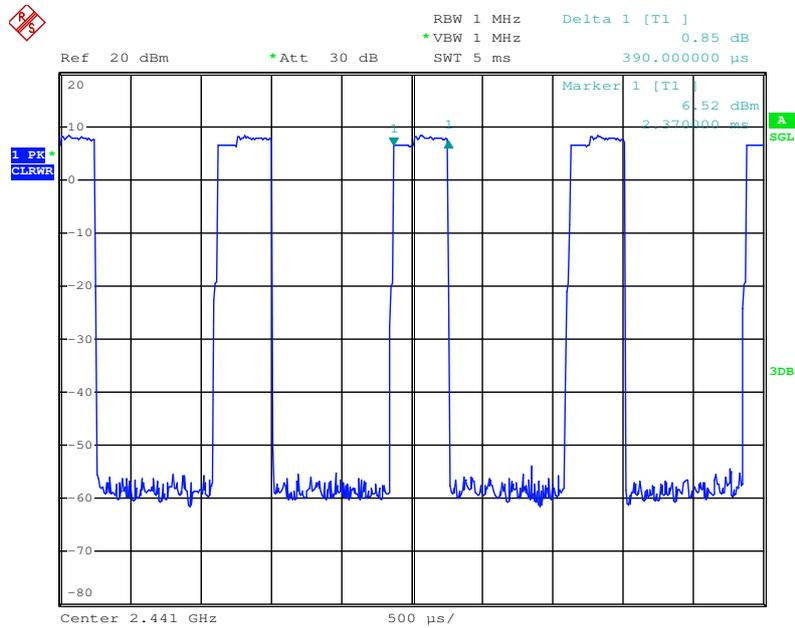
DH1:  $1600 / \text{Hopping Channel number (20)} / 2 \times (\text{Hopping Channel number (20)} \times 0.4\text{s}) \times \text{pulse on time} / 1000$

**Dwell Time Plot on BR (GFSK) / Channel 0 / DH1 / 2402 MHz**



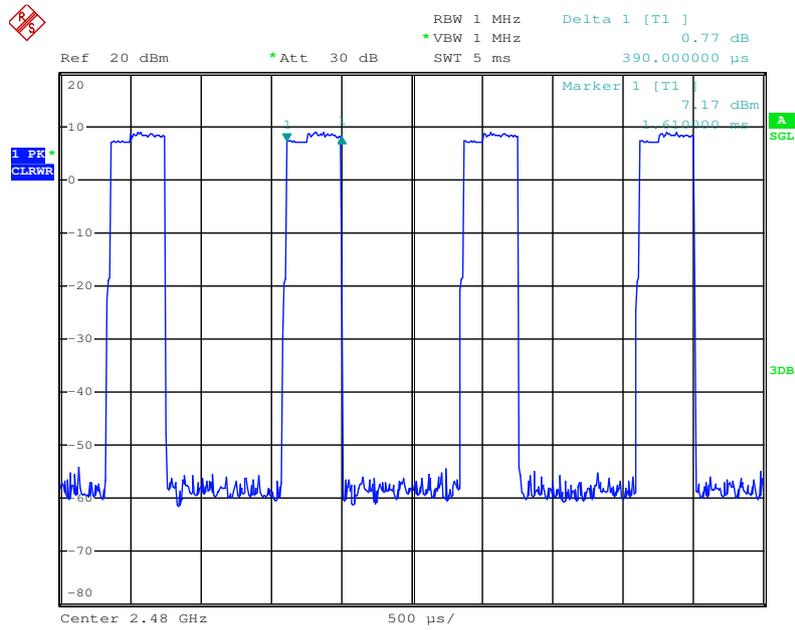
Date: 8.OCT.2014 21:39:31

**Dwell Time Plot on BR (GFSK) / Channel 39 / DH1 / 2441 MHz**



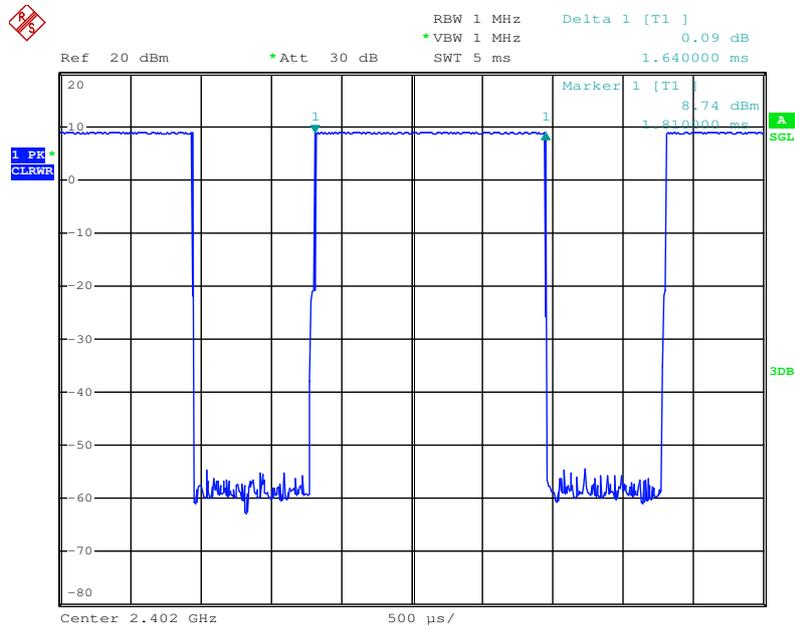
Date: 8.OCT.2014 21:41:52

**Dwell Time Plot on BR (GFSK) / Channel 78 / DH1 / 2480 MHz**



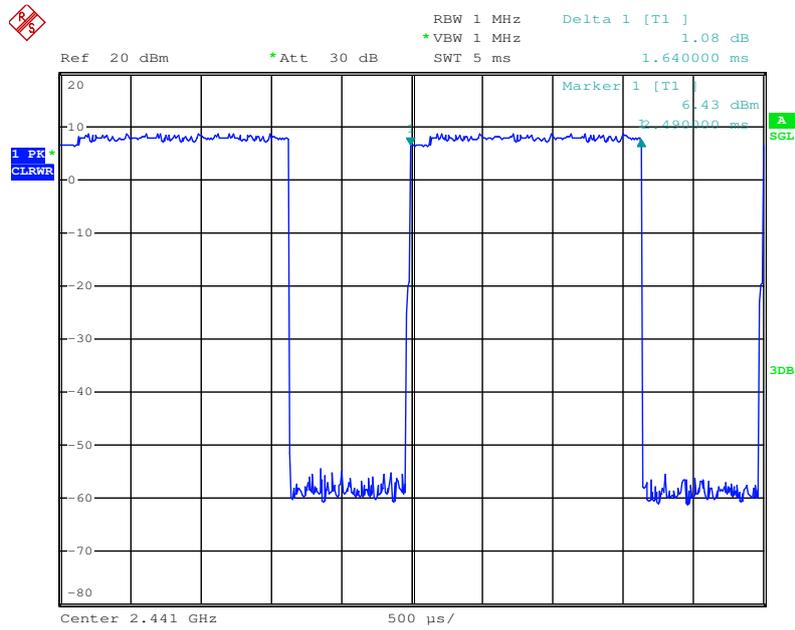
Date: 8.OCT.2014 21:45:21

**Dwell Time Plot on BR (GFSK) / Channel 0 / DH3 / 2402 MHz**



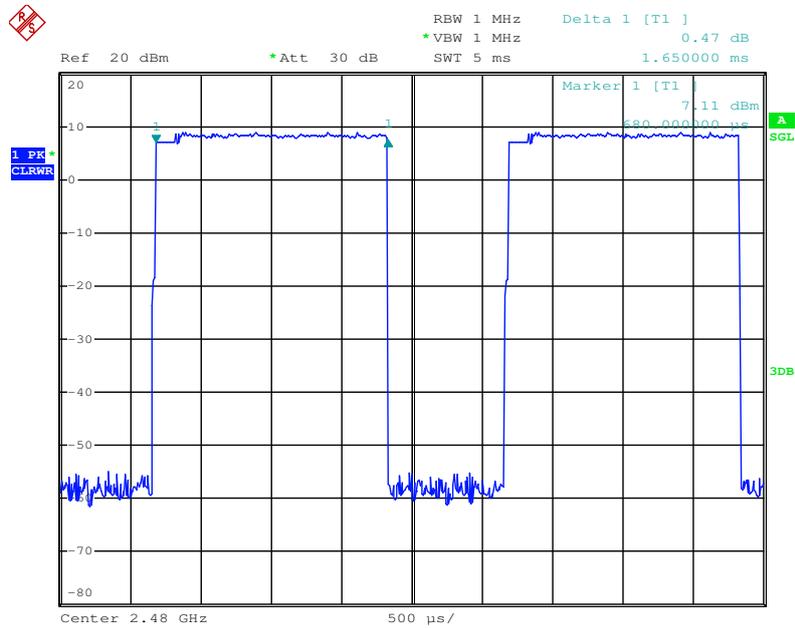
Date: 8.OCT.2014 21:38:24

Dwell Time Plot on BR (GFSK) / Channel 39 / DH3 / 2441 MHz



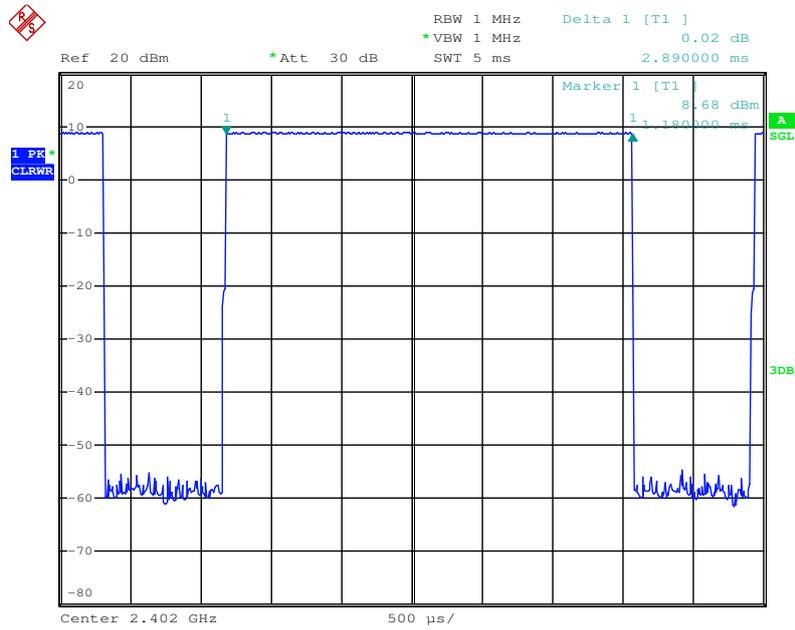
Date: 8.OCT.2014 21:42:31

Dwell Time Plot on BR (GFSK) / Channel 78 / DH3 / 2480 MHz



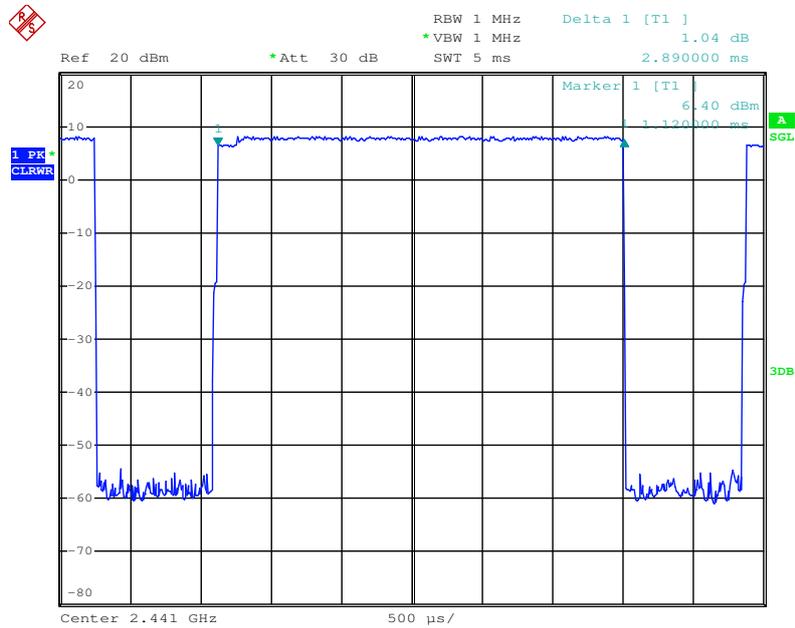
Date: 8.OCT.2014 21:44:41

**Dwell Time Plot on BR (GFSK) / Channel 0 / DH5 / 2402 MHz**



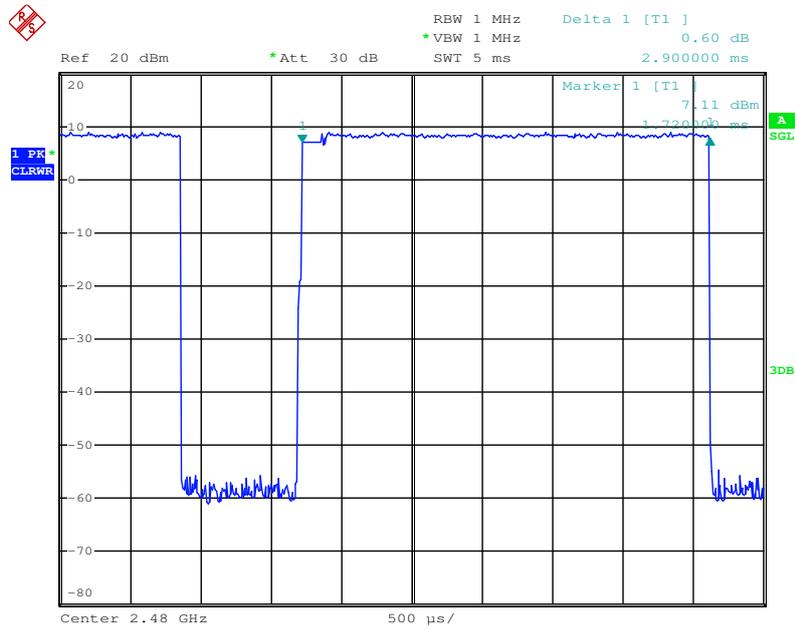
Date: 8.OCT.2014 21:37:06

**Dwell Time Plot on BR (GFSK) / Channel 39 / DH5 / 2441 MHz**



Date: 8.OCT.2014 21:43:14

Dwell Time Plot on BR (GFSK) / Channel 78 / DH5 / 2480 MHz



Date: 8.OCT.2014 21:43:58

## 4.6. Radiated Emissions Measurement

### 4.6.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
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
88~216	150	3
216~960	200	3
Above 960	500	3

### 4.6.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW (Emission in restricted band)	1 MHz / 3MHz for Peak, 1 MHz / 1/T for Average
RBW / VBW (Emission in non-restricted band)	100kHz, 300kHz for peak

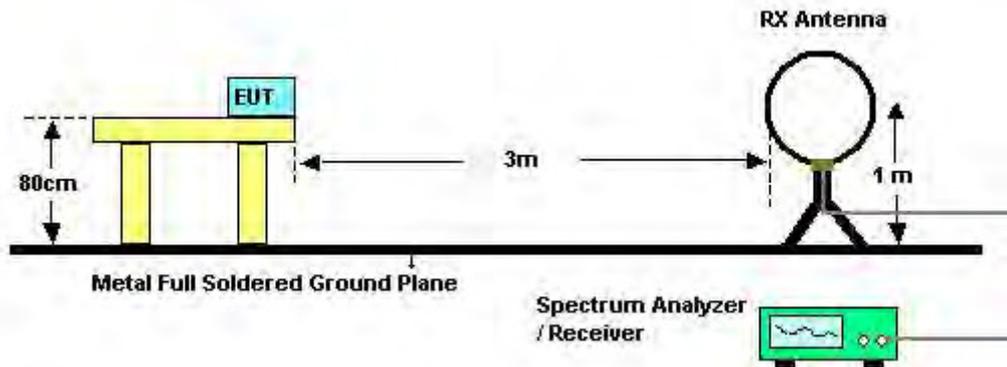
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz, RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz, RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz, RBW 120kHz for QP

#### 4.6.3. Test Procedures

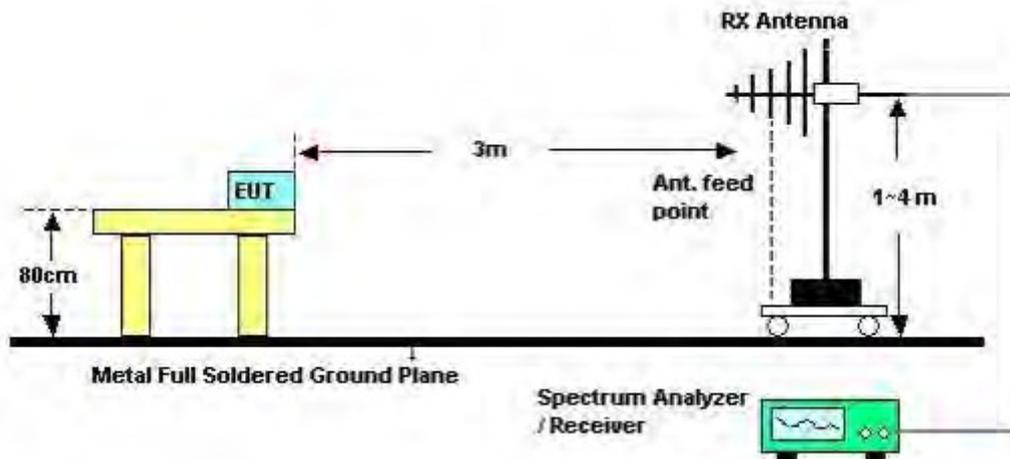
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

#### 4.6.4. Test Setup Layout

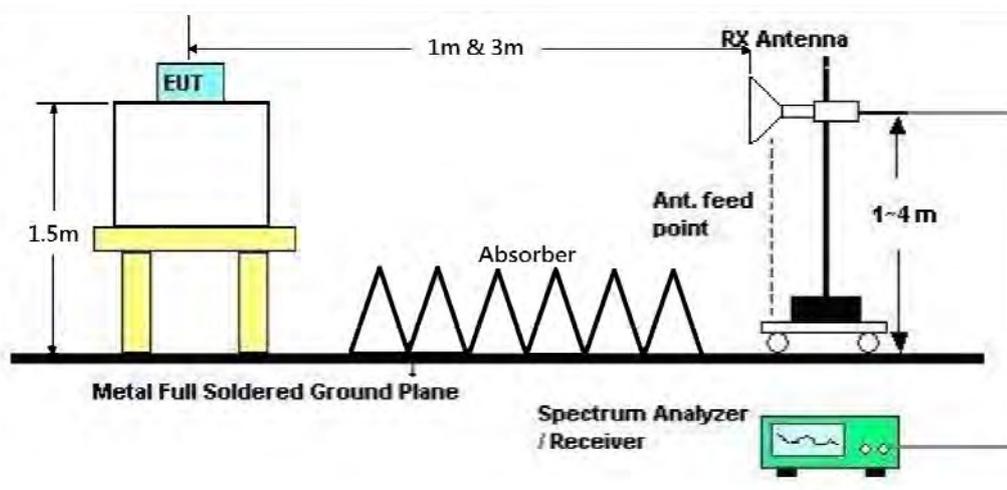
For Radiated Emissions: 9kHz ~30MHz



For Radiated Emissions: 30MHz~1GHz



For Radiated Emissions: Above 1GHz



#### **4.6.5. Test Deviation**

There is no deviation with the original standard.

#### **4.6.6. EUT Operation during Test**

The EUT was programmed to be in continuously transmitting mode.

#### 4.6.7. Results of Radiated Emissions (9kHz~30MHz)

Temperature	24°C	Humidity	52%
Test Engineer	Luke Hsieh / Stim Song	Configurations	Normal Link
Test Date	Jan. 07, 2016	Test Mode	Mode 9

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

**Note:**

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

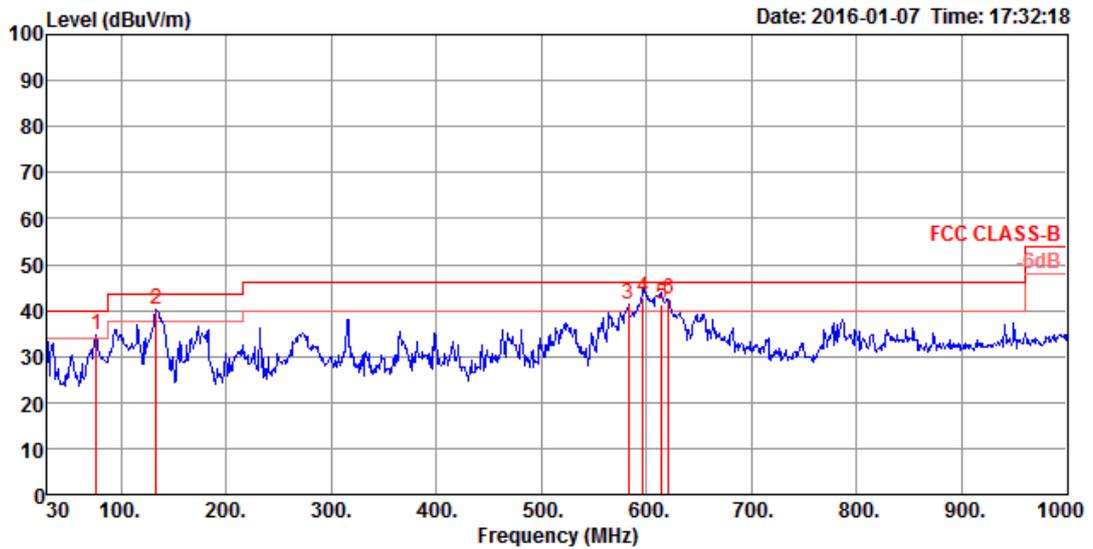
Distance extrapolation factor =  $40 \log(\text{specific distance} / \text{test distance})$  (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

4.6.8. Results of Radiated Emissions (30MHz~1GHz)

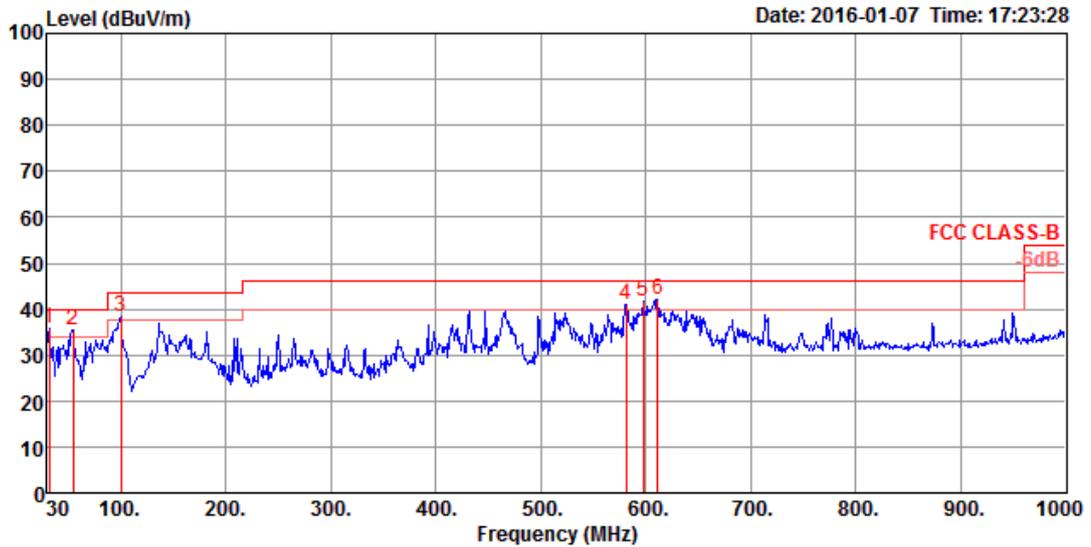
Temperature	24°C	Humidity	52%
Test Engineer	Luke Hsieh / Stim Song	Configurations	Normal Link
Test Mode	Mode 9		

Horizontal



	Freq	Level	Limit	Over	Read	CableAntenna	Preamp	A/Pos	T/Pos	Remark	PoI/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg	
1	76.56	34.65	40.00	-5.35	52.93	0.76	13.36	32.40	125	169 Peak	HORIZONTAL
2	133.79	40.16	43.50	-3.34	52.96	0.99	18.57	32.36	125	292 Peak	HORIZONTAL
3	582.90	41.20	46.00	-4.80	46.31	2.09	25.20	32.40	100	304 Peak	HORIZONTAL
4	596.48	42.96	46.00	-3.04	47.87	2.12	25.38	32.41	114	174 QP	HORIZONTAL
5	614.91	41.24	46.00	-4.76	45.89	2.14	25.61	32.40	123	166 QP	HORIZONTAL
6	620.73	42.39	46.00	-3.61	46.94	2.15	25.70	32.40	100	319 Peak	HORIZONTAL

**Vertical**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg	
1	31.94	35.78	40.00	-4.22	43.02	0.50	24.66	32.40	100	266 Peak	VERTICAL
2	54.25	35.49	40.00	-4.51	52.89	0.64	14.37	32.41	100	234 Peak	VERTICAL
3	99.84	38.33	43.50	-5.17	52.26	0.86	17.60	32.39	100	3 Peak	VERTICAL
4	580.96	41.07	46.00	-4.93	46.21	2.09	25.17	32.40	125	291 Peak	VERTICAL
5	597.45	41.60	46.00	-4.40	46.51	2.12	25.38	32.41	100	164 Peak	VERTICAL
6	611.03	42.18	46.00	-3.82	46.86	2.14	25.58	32.40	100	164 Peak	VERTICAL

**Note:**

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

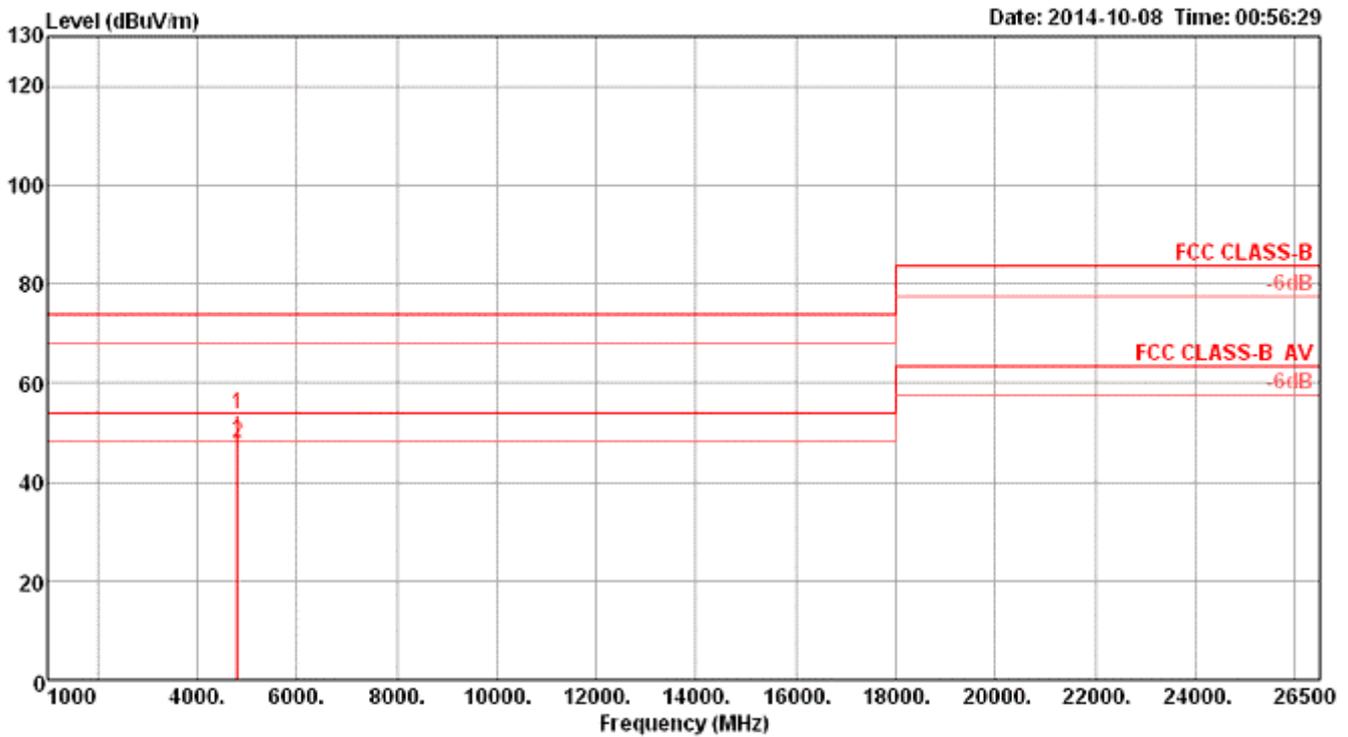
Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.6.9. Results for Radiated Emissions (1GHz~10<sup>th</sup> Harmonic)

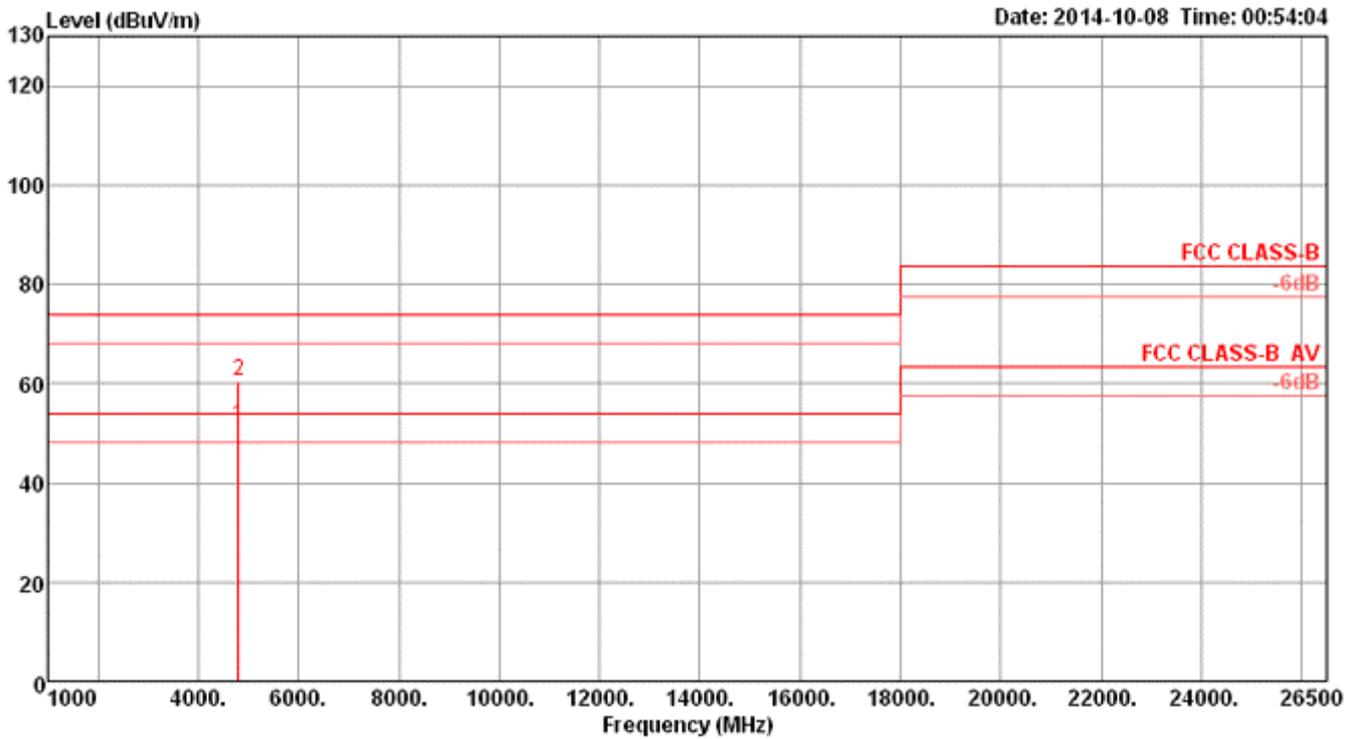
Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	BR (GFSK) / Channel 0

Horizontal



	Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4803.64	53.64	74.00	-20.36	49.63	5.85	33.36	35.20	Peak	181	312	HORIZONTAL
2	4804.01	47.77	54.00	-6.23	43.76	5.85	33.36	35.20	Average	181	312	HORIZONTAL

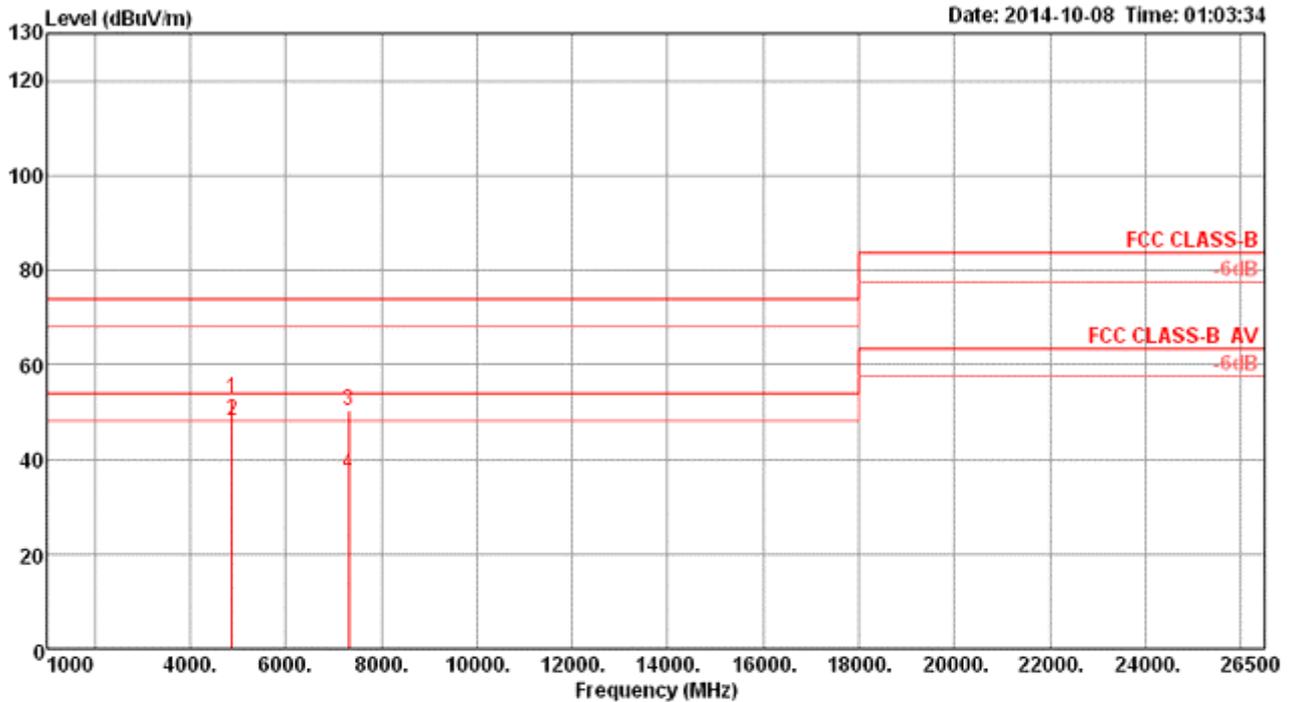
**Vertical**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Preamp Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4803.98	51.31	54.00	-2.69	47.30	5.85	33.36	35.20	Average	234	0	VERTICAL
2	4804.33	60.42	74.00	-13.58	56.41	5.85	33.36	35.20	Peak	234	0	VERTICAL

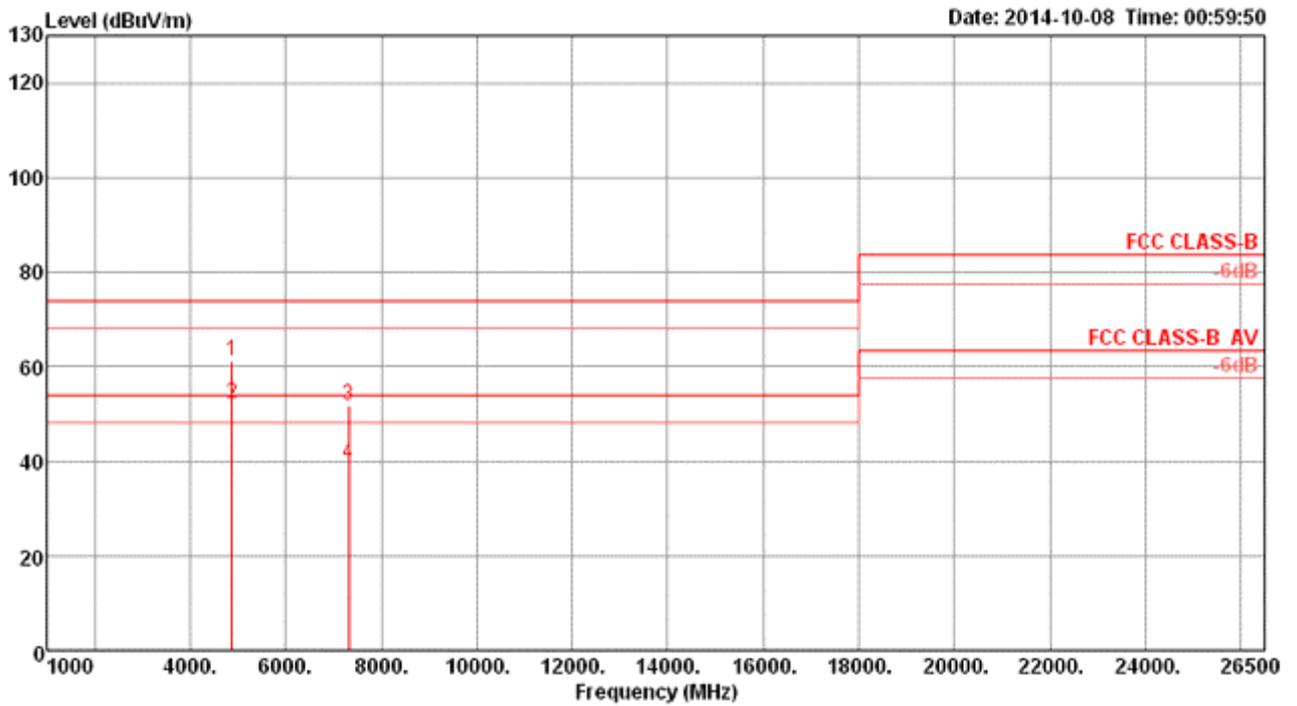
Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	BR (GFSK) / Channel 39

**Horizontal**



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4881.71	52.92	74.00	-21.08	48.72	5.92	33.48	35.20	Peak	261	280	HORIZONTAL
2	4881.99	48.33	54.00	-5.67	44.13	5.92	33.48	35.20	Average	261	280	HORIZONTAL
3	7323.22	50.49	74.00	-23.51	42.27	7.14	36.51	35.43	Peak	168	288	HORIZONTAL
4	7323.43	37.06	54.00	-16.94	28.84	7.14	36.51	35.43	Average	168	288	HORIZONTAL

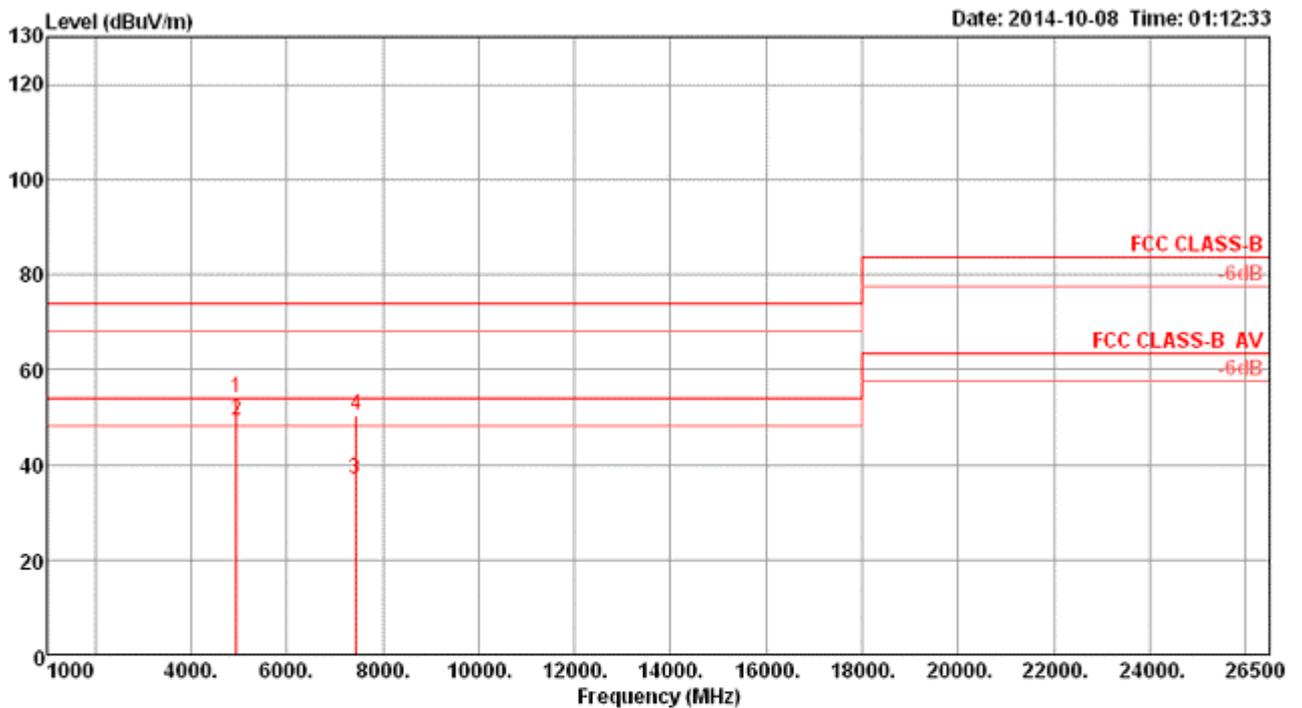
**Vertical**



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4881.65	61.18	74.00	-12.82	56.98	5.92	33.48	35.20	Peak	215	333	VERTICAL
2	4882.01	52.11	54.00	-1.89	47.91	5.92	33.48	35.20	Average	215	333	VERTICAL
3	7322.33	51.79	74.00	-22.21	43.57	7.14	36.51	35.43	Peak	189	8	VERTICAL
4	7323.06	39.38	54.00	-14.62	31.16	7.14	36.51	35.43	Average	189	8	VERTICAL

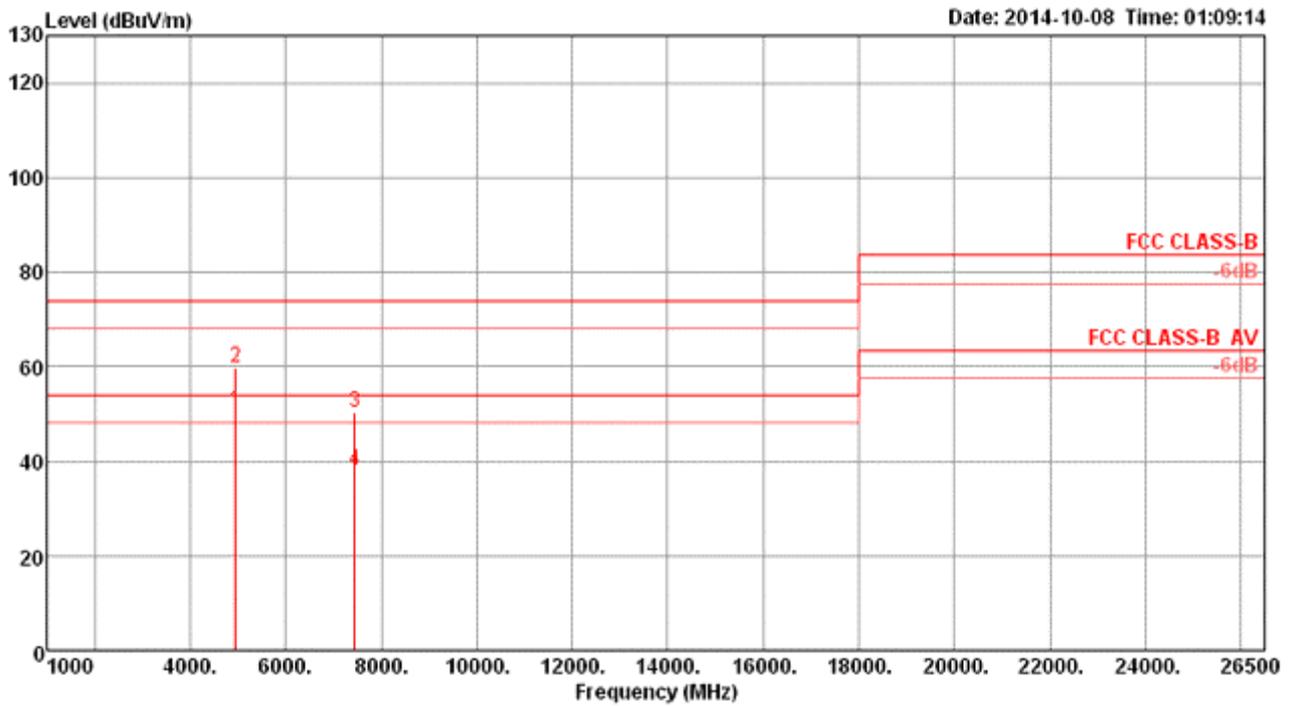
Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	BR (GFSK) / Channel 78

**Horizontal**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4959.69	54.10	74.00	-19.90	49.66	6.00	33.64	35.20	Peak	210	309	HORIZONTAL
2	4959.95	49.39	54.00	-4.61	44.95	6.00	33.64	35.20	Average	210	309	HORIZONTAL
3	7437.79	37.02	54.00	-16.98	28.61	7.20	36.69	35.48	Average	151	328	HORIZONTAL
4	7440.38	50.37	74.00	-23.63	41.96	7.20	36.69	35.48	Peak	151	328	HORIZONTAL

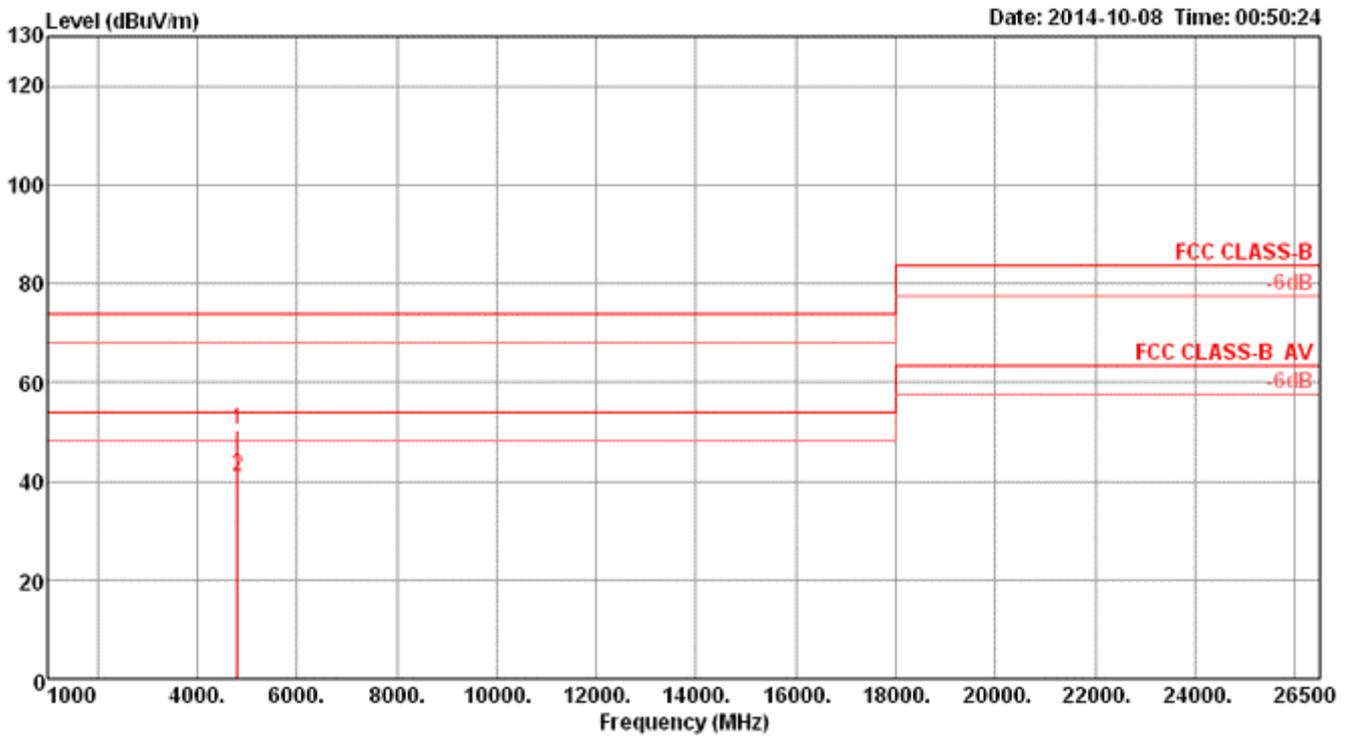
**Vertical**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Preamp Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4959.95	50.73	54.00	-3.27	46.29	6.00	33.64	35.20	Average	188	346	VERTICAL
2	4960.24	59.67	74.00	-14.33	55.23	6.00	33.64	35.20	Peak	188	346	VERTICAL
3	7439.47	50.50	74.00	-23.50	42.09	7.20	36.69	35.48	Peak	196	2	VERTICAL
4	7440.21	38.13	54.00	-15.87	29.72	7.20	36.69	35.48	Average	196	2	VERTICAL

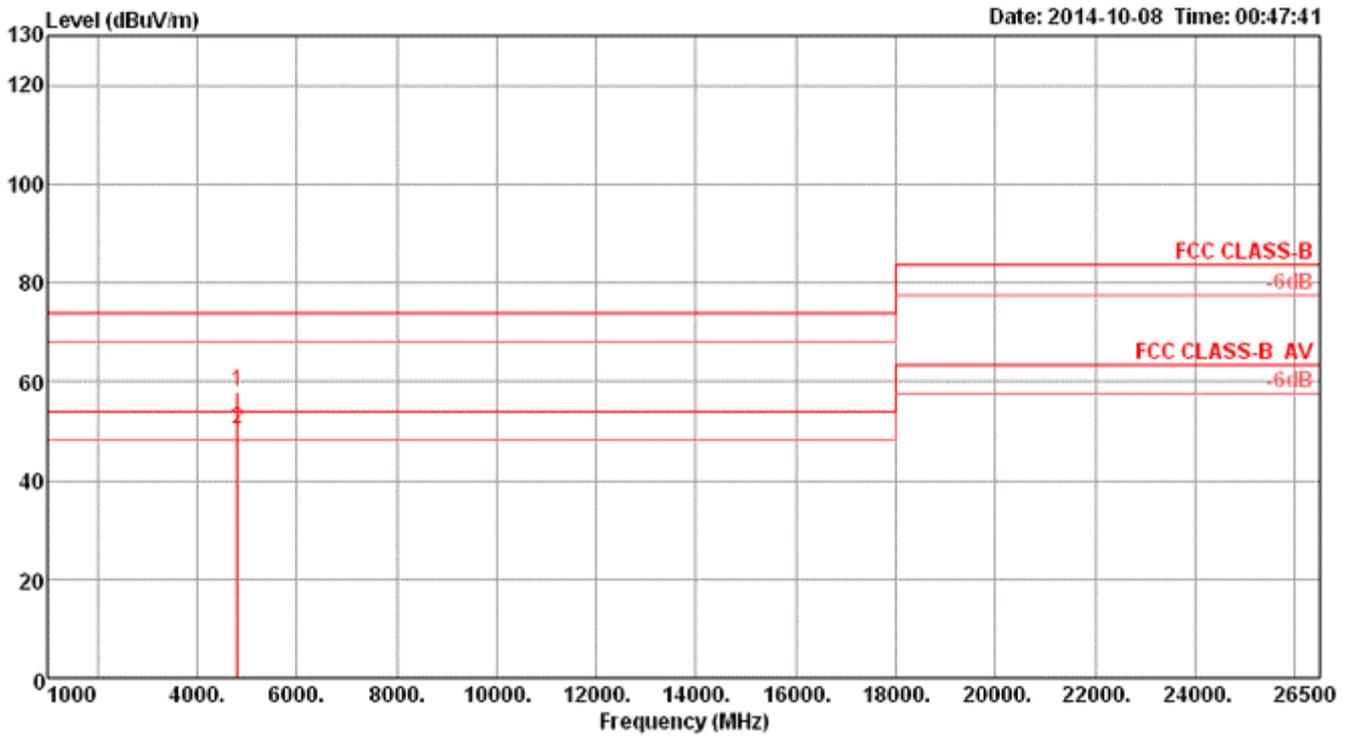
Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	EDR (8DPSK) / Channel 0

**Horizontal**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Preamp Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4803.73	50.41	74.00	-23.59	46.40	5.85	33.36	35.20	Peak	209	312	HORIZONTAL
2	4803.99	40.88	54.00	-13.12	36.87	5.85	33.36	35.20	Average	209	312	HORIZONTAL

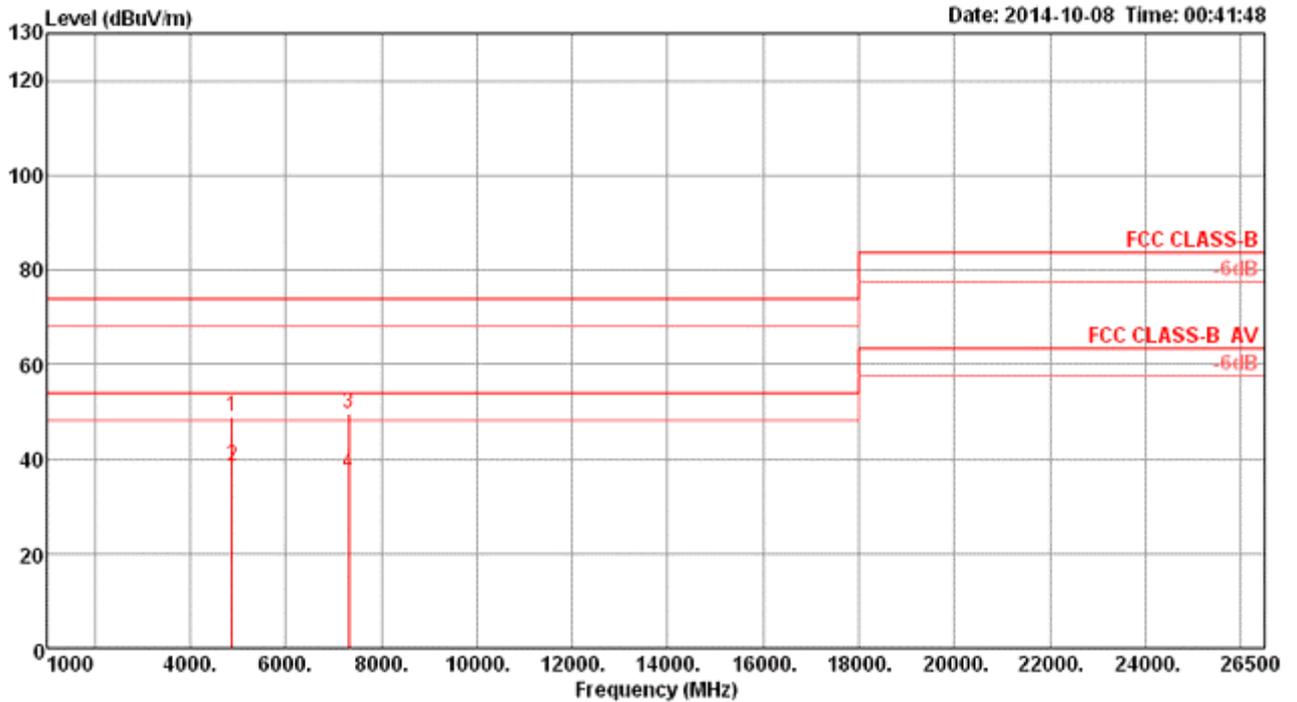
**Vertical**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Preamp Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4803.91	57.91	74.00	-16.09	53.90	5.85	33.36	35.20	Peak	234	360	VERTICAL
2	4804.01	50.33	54.00	-3.67	46.32	5.85	33.36	35.20	Average	234	360	VERTICAL

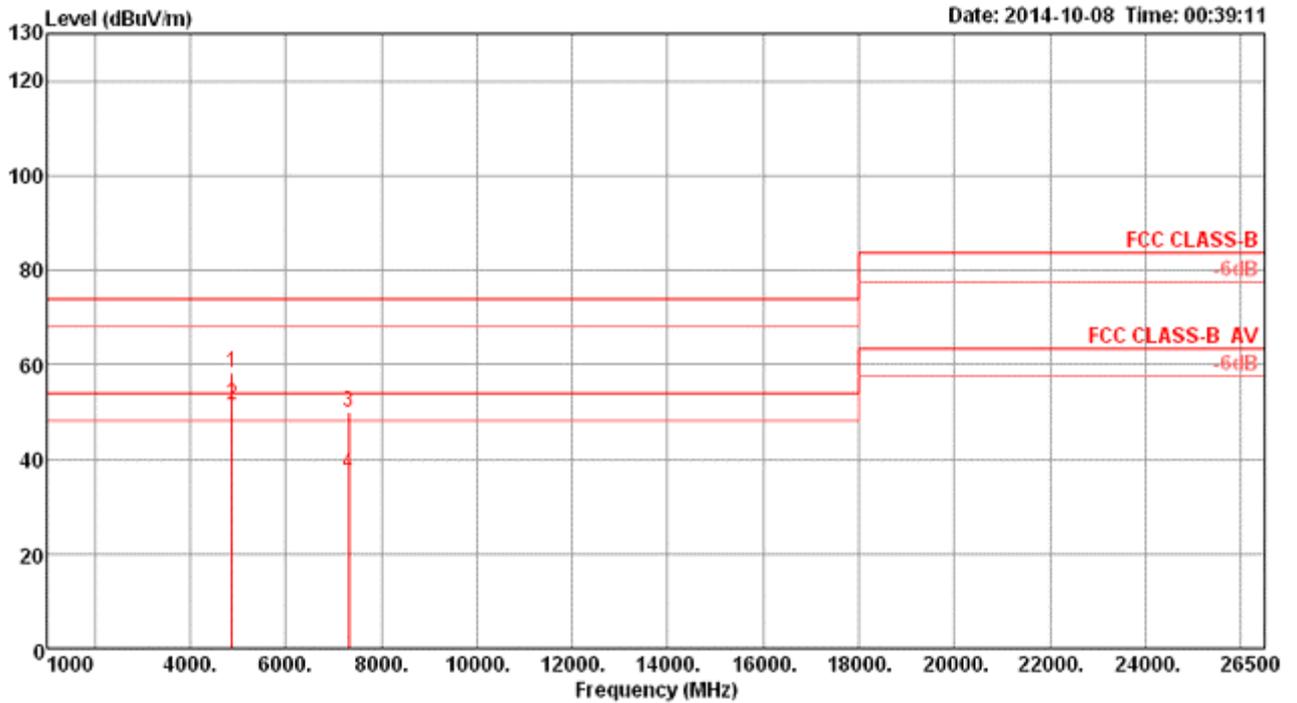
Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	EDR (8DPSK) / Channel 39

**Horizontal**



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4881.87	48.84	74.00	-25.16	44.64	5.92	33.48	35.20	Peak	100	281	HORIZONTAL
2	4882.02	38.42	54.00	-15.58	34.22	5.92	33.48	35.20	Average	100	281	HORIZONTAL
3	7318.16	49.73	74.00	-24.27	41.51	7.14	36.51	35.43	Peak	168	249	HORIZONTAL
4	7318.29	36.81	54.00	-17.19	28.59	7.14	36.51	35.43	Average	168	249	HORIZONTAL

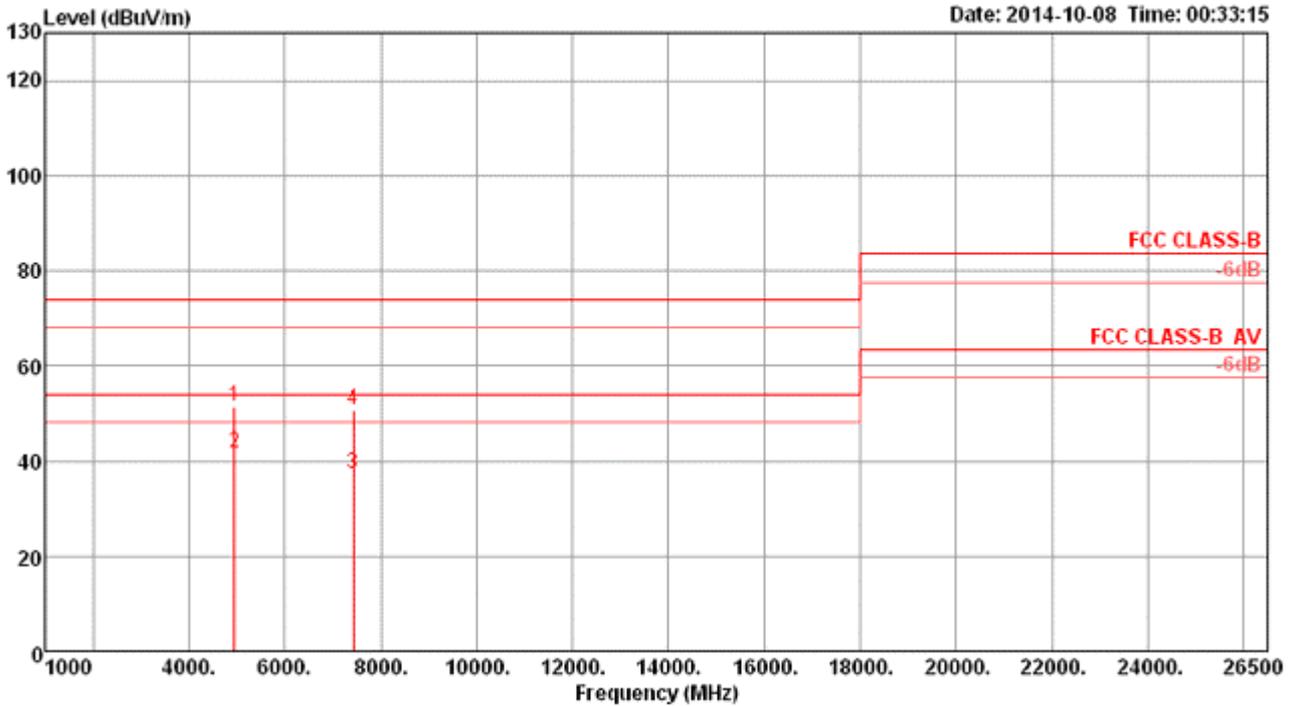
**Vertical**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Preamp Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4881.91	58.20	74.00	-15.80	54.00	5.92	33.48	35.20	Peak	187	333	VERTICAL
2	4881.95	51.45	54.00	-2.55	47.25	5.92	33.48	35.20	Average	187	333	VERTICAL
3	7315.15	50.02	74.00	-23.98	41.81	7.13	36.51	35.43	Peak	145	68	VERTICAL
4	7316.11	36.94	54.00	-17.06	28.72	7.14	36.51	35.43	Average	144	68	VERTICAL

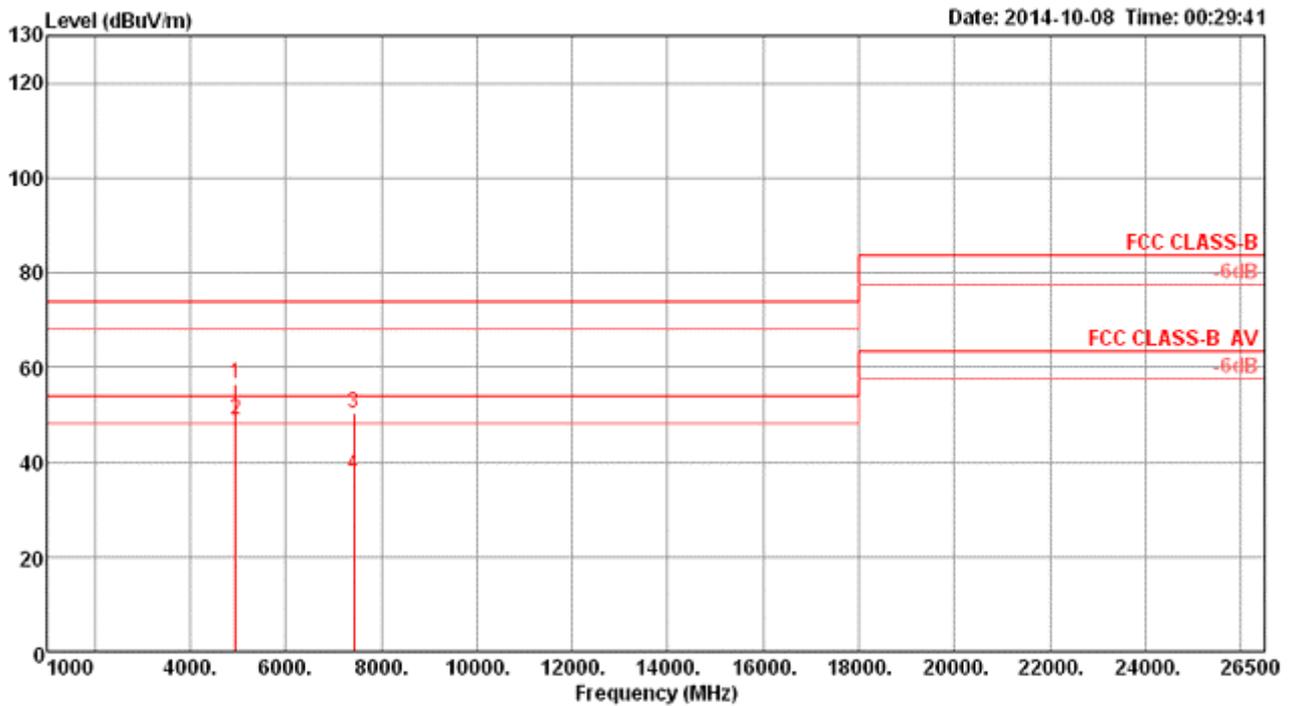
Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	EDR (8DPSK) / Channel 78

**Horizontal**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4959.34	51.45	74.00	-22.55	47.01	6.00	33.64	35.20	Peak	210	309	HORIZONTAL
2	4959.94	41.77	54.00	-12.23	37.33	6.00	33.64	35.20	Average	210	309	HORIZONTAL
3	7432.12	37.14	54.00	-16.86	28.73	7.19	36.69	35.47	Average	199	291	HORIZONTAL
4	7437.08	50.84	74.00	-23.16	42.43	7.20	36.69	35.48	Peak	199	291	HORIZONTAL

**Vertical**



	Freq	Level	Limit Line	Over Limit	Read Level	CableAntenna Loss	Preamp Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4959.96	56.42	74.00	-17.58	51.98	6.00	33.64	35.20	Peak	228	352	VERTICAL
2	4959.99	48.78	54.00	-5.22	44.34	6.00	33.64	35.20	Average	228	352	VERTICAL
3	7432.95	50.48	74.00	-23.52	42.07	7.19	36.69	35.47	Peak	192	25	VERTICAL
4	7436.35	37.22	54.00	-16.78	28.81	7.20	36.69	35.48	Average	192	25	VERTICAL

**Note:**

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

## 4.7. Emissions Measurement

### 4.7.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micovolts/meter)	Measurement Distance (meters)
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
88~216	150	3
216~960	200	3
Above 960	500	3

### 4.7.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RBW / VBW (Emission in restricted band)	1MHz / 3MHz for Peak, 1MHz / 1/T for Average
RBW / VBW (20dBc in any 100 kHz bandwidth emission)	100 kHz / 100 kHz for Peak

### 4.7.3. Test Procedures

#### For Radiated band edges Measurement:

1. The test procedure is the same as section 4.6.3, only the frequency range investigated is limited to 100MHz around band edges.

#### For Radiated Out of Band Emission Measurement:

1. The radiated emission test is performed on each TX port of operating mode without summing or adding  $10\log(N)$  since the limit is relative emission limit.  
Only worst data of each operating mode is presented.

#### **4.7.4. Test Setup Layout**

For Radiated band edges Measurement:

This test setup layout is the same as that shown in section 4.6.4.

For Radiated Out of Band Emission Measurement:

This test setup layout is the same as that shown in section 4.6.4.

#### **4.7.5. Test Deviation**

There is no deviation with the original standard.

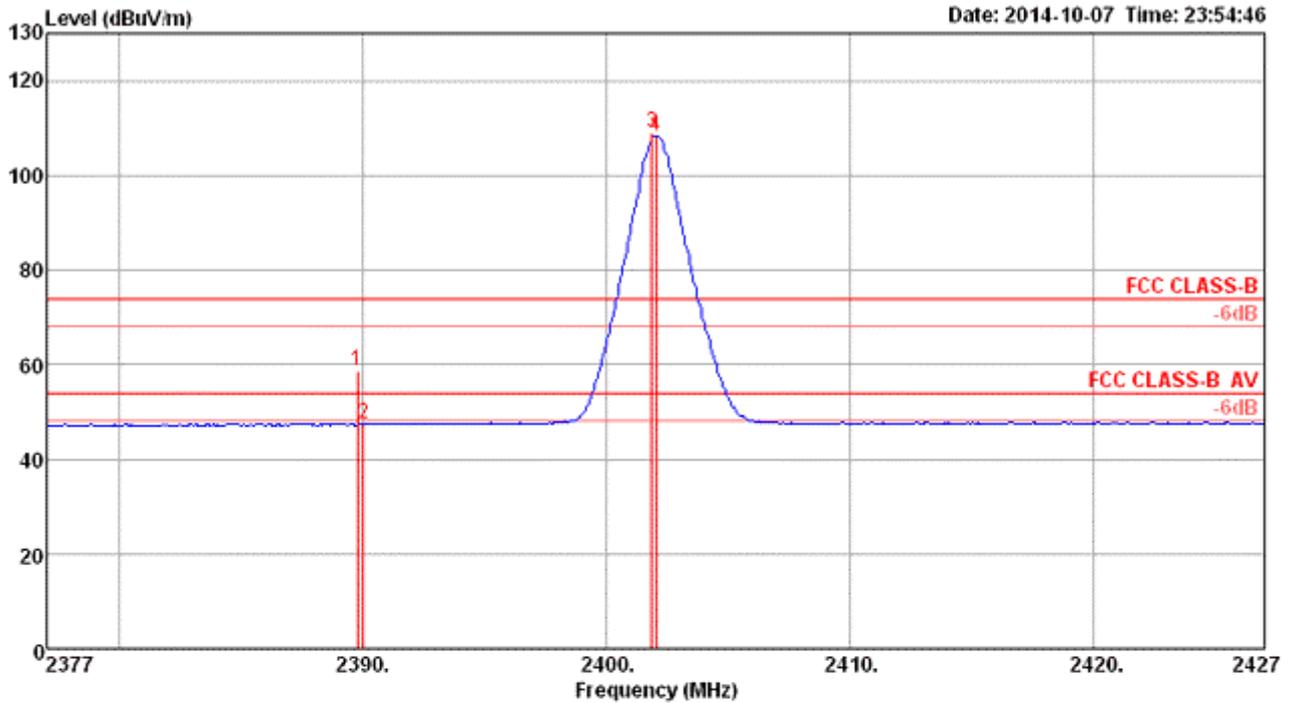
#### **4.7.6. EUT Operation during Test**

The EUT was programmed to be in continuously transmitting mode.

4.7.7. Test Result of Band Edge and Fundamental Emissions

Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	BR (GFSK) / Channel 0, 39, 78

Channel 0

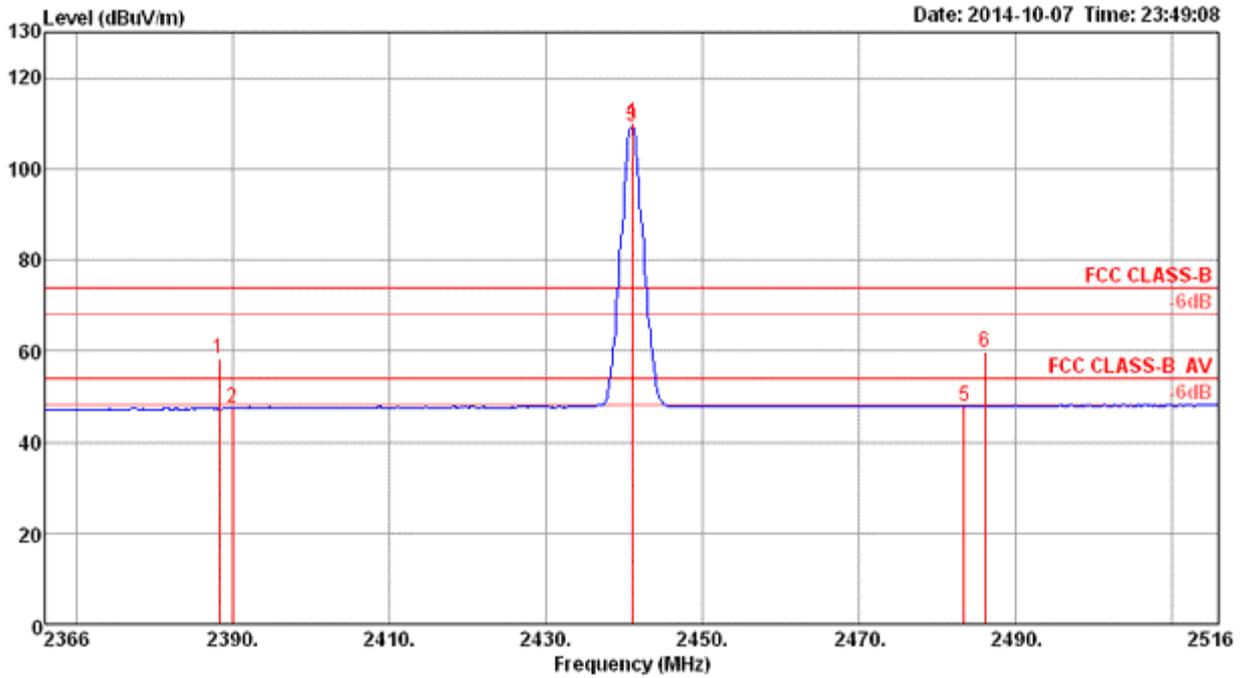


	Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2389.76	58.74	74.00	-15.26	26.60	4.09	28.05	0.00	Peak	182	314	VERTICAL
2	2390.00	47.26	54.00	-6.74	15.12	4.09	28.05	0.00	Average	182	314	VERTICAL
3	2401.84	109.13			76.95	4.09	28.09	0.00	Peak	182	314	VERTICAL
4	2402.00	108.24			76.06	4.09	28.09	0.00	Average	182	314	VERTICAL

Item 3, 4 are the fundamental frequency at 2402 MHz.

Note: Both antenna polarizations have been tested and only the worst case was recorded in test report.

Channel 39

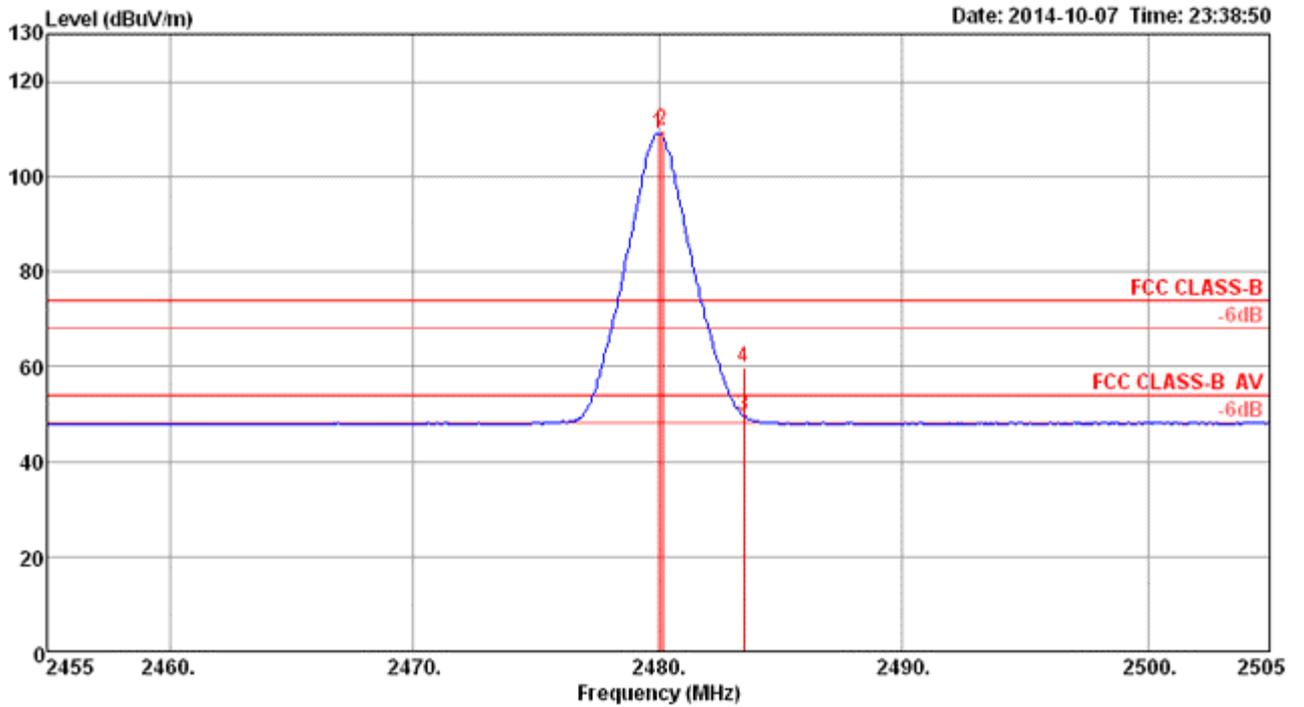


	Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2388.32	58.24	74.00	-15.76	26.10	4.09	28.05	0.00	Peak	146	316	VERTICAL
2	2390.00	47.52	54.00	-6.48	15.38	4.09	28.05	0.00	Average	146	316	VERTICAL
3	2441.00	109.30			76.99	4.13	28.18	0.00	Average	146	316	VERTICAL
4	2441.00	110.23			77.92	4.13	28.18	0.00	Peak	146	316	VERTICAL
5	2483.50	47.80	54.00	-6.20	15.38	4.16	28.26	0.00	Average	146	316	VERTICAL
6	2486.14	59.91	74.00	-14.09	27.45	4.16	28.30	0.00	Peak	146	316	VERTICAL

Item 3, 4 are the fundamental frequency at 2441 MHz.

Note: Both antenna polarizations have been tested and only the worst case was recorded in test report.

Channel 78



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	PoI/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2480.00	108.92			76.50	4.16	28.26	0.00	Average	143	316	VERTICAL
2	2480.16	109.79			77.37	4.16	28.26	0.00	Peak	143	316	VERTICAL
3	2483.50	49.50	54.00	-4.50	17.08	4.16	28.26	0.00	Average	143	316	VERTICAL
4	2483.50	59.78	74.00	-14.22	27.36	4.16	28.26	0.00	Peak	143	316	VERTICAL

Item 1, 2 are the fundamental frequency at 2480 MHz.

Note: Both antenna polarizations have been tested and only the worst case was recorded in test report.

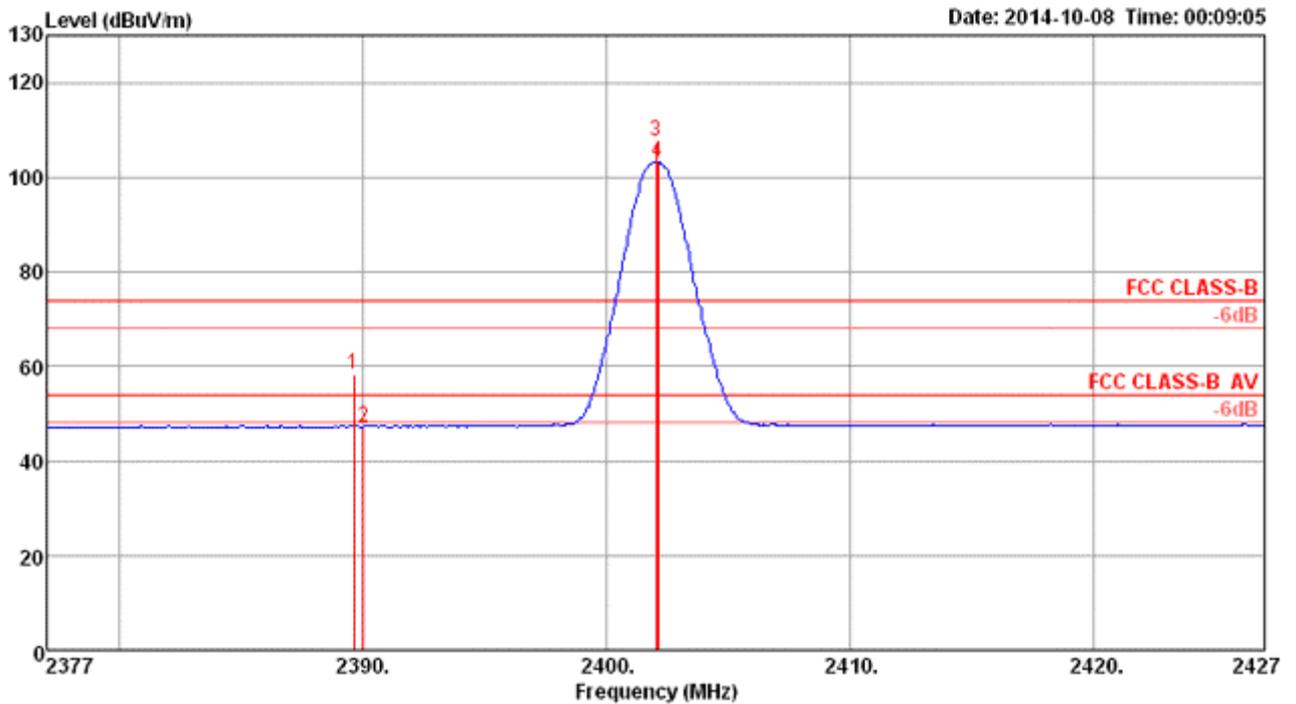
Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Configurations	EDR (8DPSK) / Channel 0, 39, 78

Channel 0

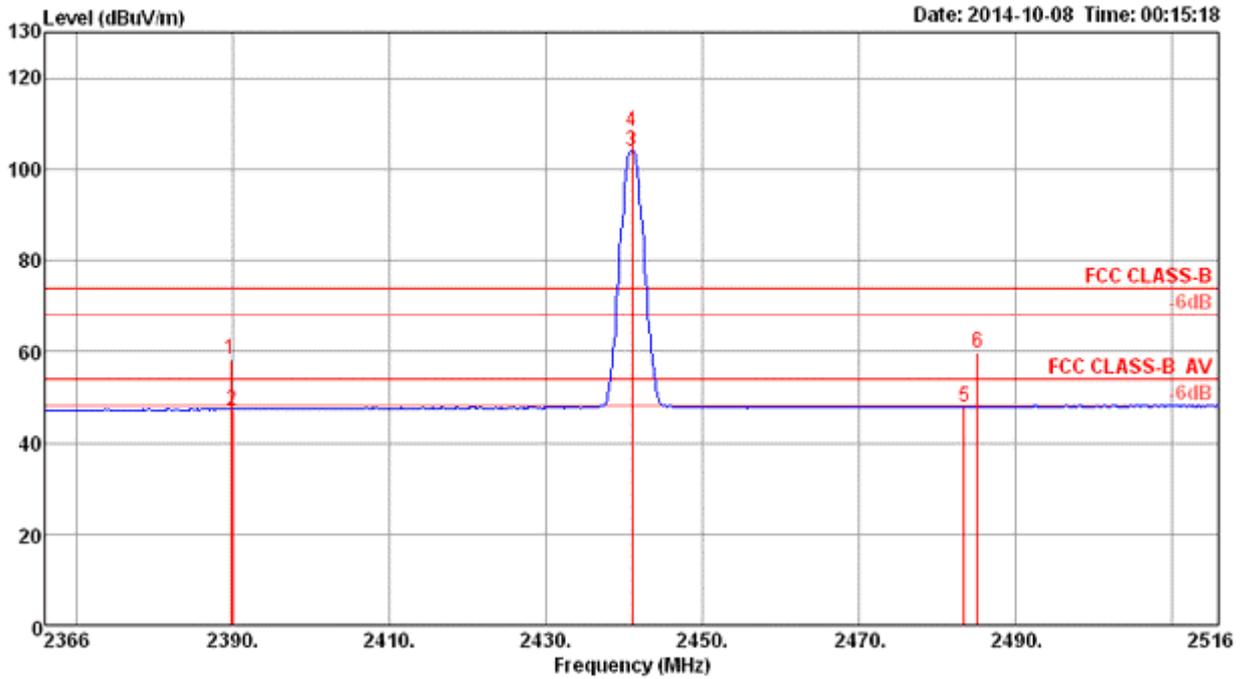


	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2389.60	58.14	74.00	-15.86	26.00	4.09	28.05	0.00	Peak	155	315	VERTICAL
2	2390.00	47.17	54.00	-6.83	15.03	4.09	28.05	0.00	Average	155	315	VERTICAL
3	2402.00	107.41			75.23	4.09	28.09	0.00	Peak	155	315	VERTICAL
4	2402.08	103.21			71.03	4.09	28.09	0.00	Average	155	315	VERTICAL

Item 3, 4 are the fundamental frequency at 2402 MHz.

Note: Both antenna polarizations have been tested and only the worst case was recorded in test report.

Channel 39

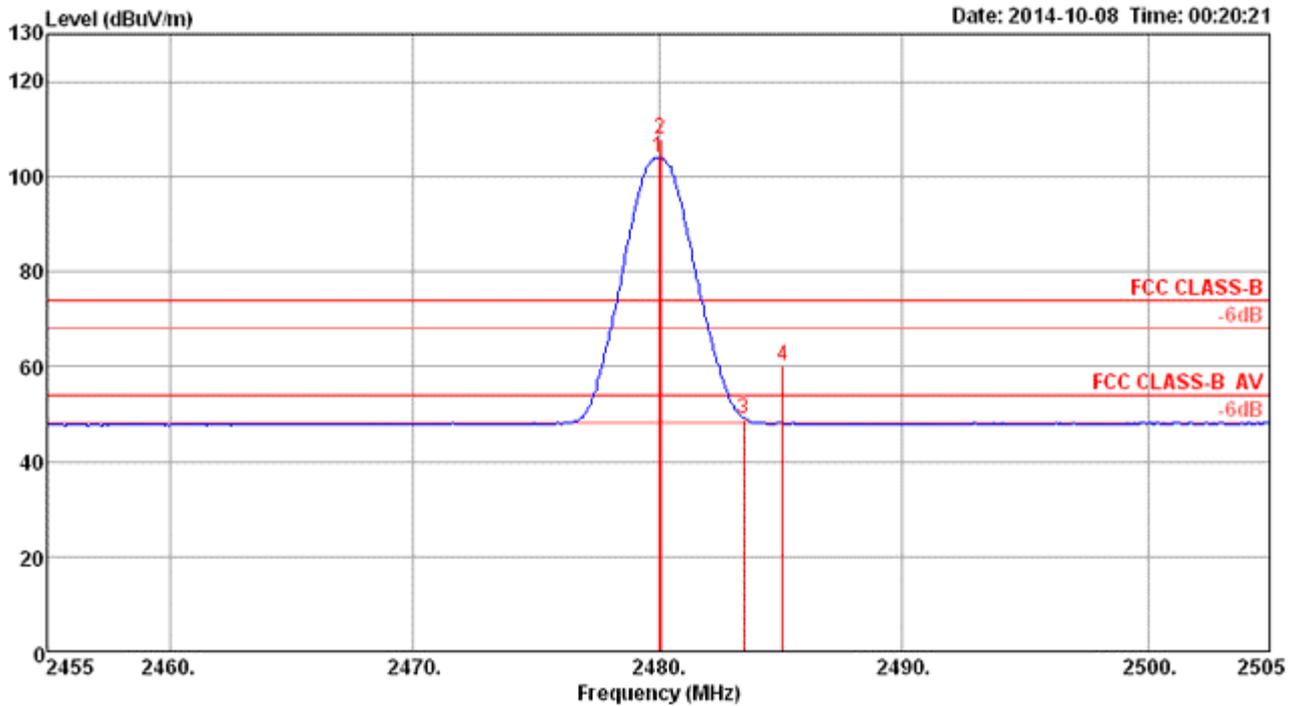


	Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2389.76	58.35	74.00	-15.65	26.21	4.09	28.05	0.00	Peak	158	315	VERTICAL
2	2390.00	47.25	54.00	-6.75	15.11	4.09	28.05	0.00	Average	158	315	VERTICAL
3	2441.00	104.01			71.70	4.13	28.18	0.00	Average	158	315	VERTICAL
4	2441.00	108.15			75.84	4.13	28.18	0.00	Peak	158	315	VERTICAL
5	2483.50	47.74	54.00	-6.26	15.32	4.16	28.26	0.00	Average	158	315	VERTICAL
6	2485.18	59.62	74.00	-14.38	27.16	4.16	28.30	0.00	Peak	158	315	VERTICAL

Item 3, 4 are the fundamental frequency at 2441 MHz.

Note: Both antenna polarizations have been tested and only the worst case was recorded in test report.

Channel 78



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2480.00	103.91			71.49	4.16	28.26	0.00	Average	142	315	VERTICAL
2	2480.08	108.07			75.65	4.16	28.26	0.00	Peak	142	315	VERTICAL
3	2483.50	48.90	54.00	-5.10	16.48	4.16	28.26	0.00	Average	142	315	VERTICAL
4	2485.10	60.08	74.00	-13.92	27.62	4.16	28.30	0.00	Peak	142	315	VERTICAL

Item 1, 2 are the fundamental frequency at 2480 MHz.

Note: Both antenna polarizations have been tested and only the worst case was recorded in test report.

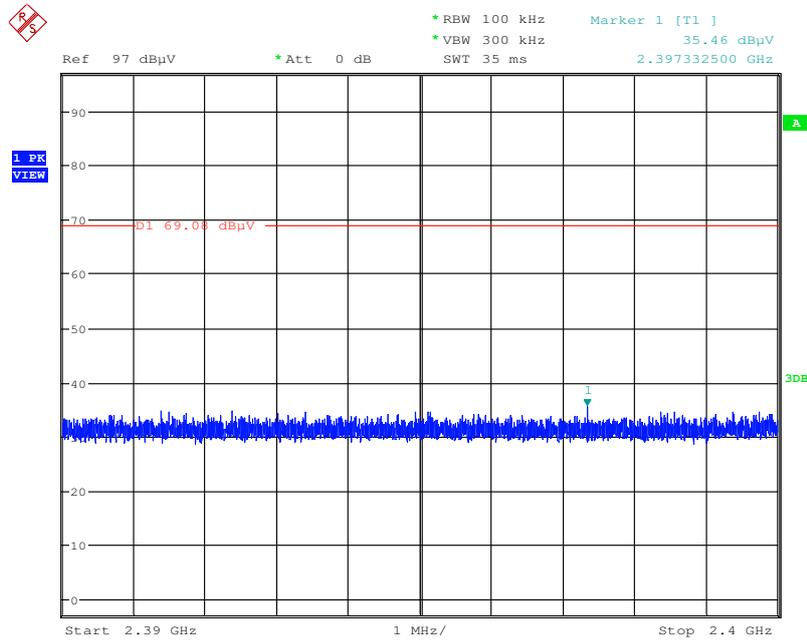
Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

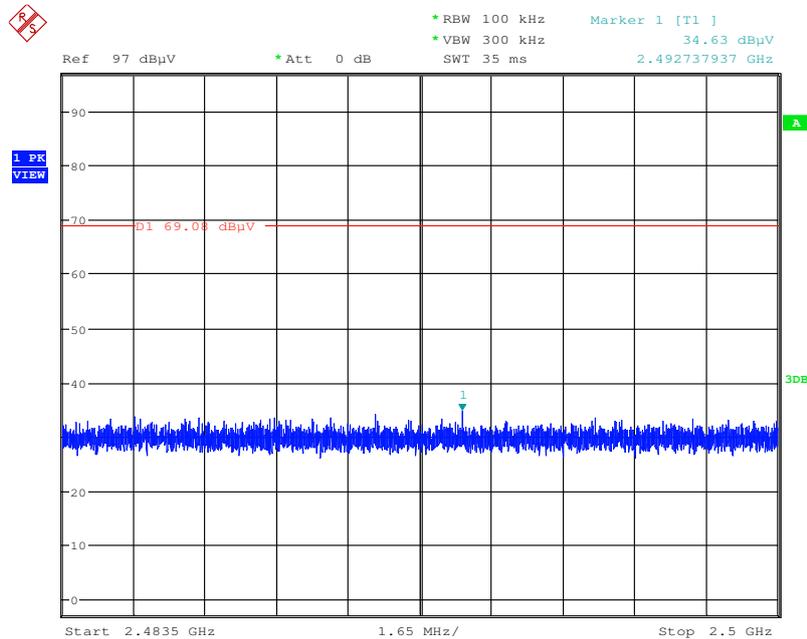


Plot on Configuration For BR (GFSK) / Channel 0 / 2390MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:25:19

Plot on Configuration For BR (GFSK) / Channel 0 / 2483.5MHz~2500MHz (down 20dBc) (Vertical)

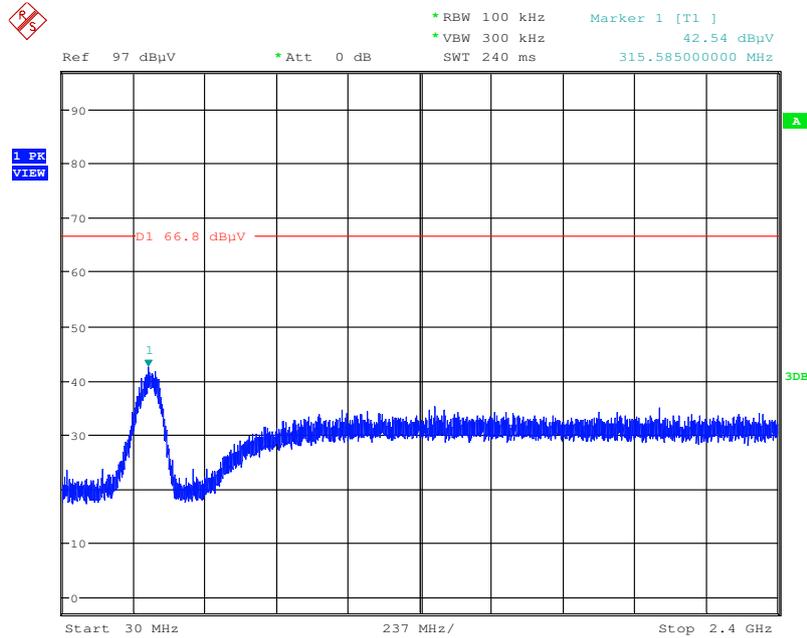


Date: 8.OCT.2014 03:25:51

Note: Only the worse polarization (Vertical) is tested and recorded in test report.

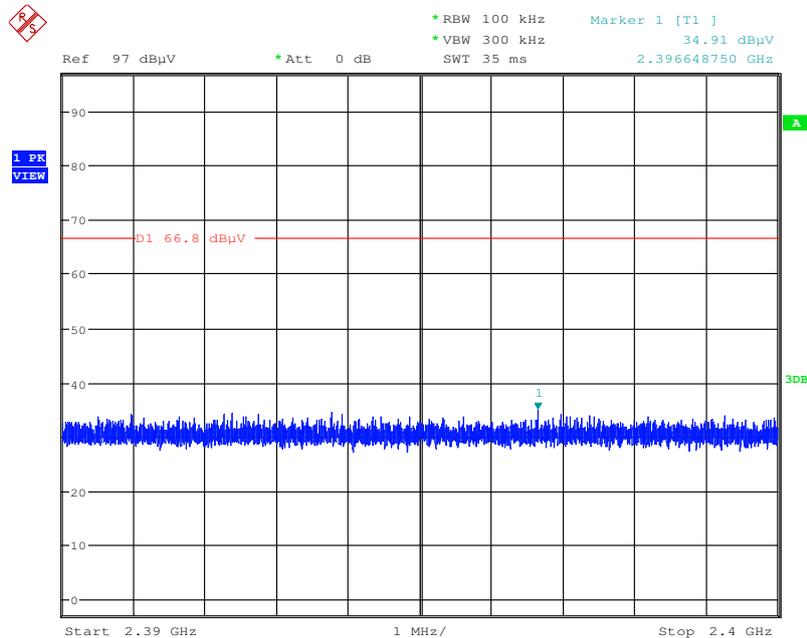


Plot on Configuration For BR (GFSK) / Channel 78 / 30MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:29:50

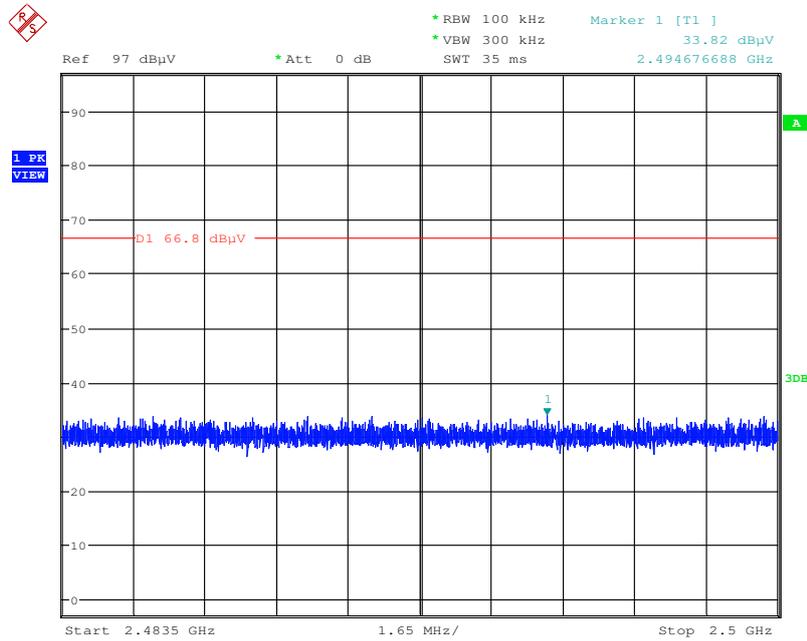
Plot on Configuration For BR (GFSK) / Channel 78 / 2390MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:30:26

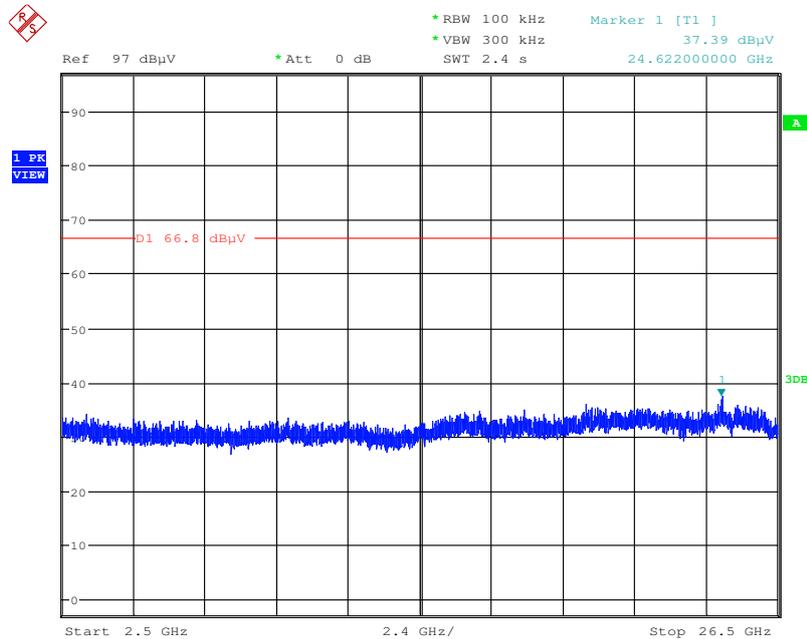
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For BR (GFSK) / Channel 78 / 2483.5MHz~2500MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:31:12

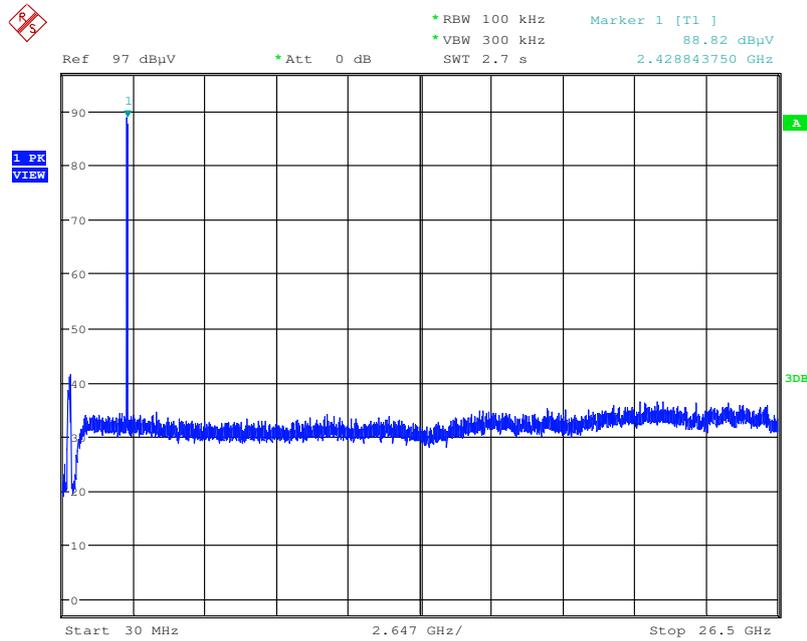
Plot on Configuration For BR (GFSK) / Channel 78 / 2500MHz~2650MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:31:47

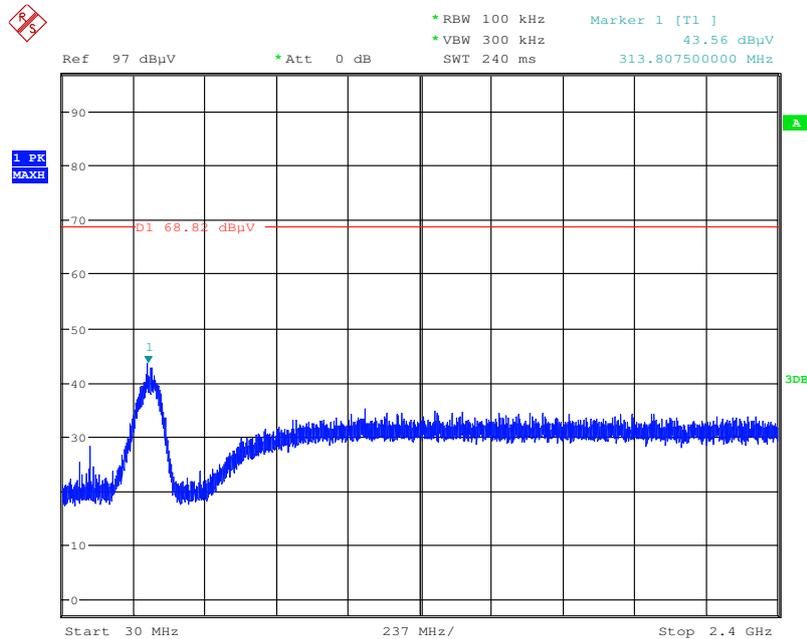
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

**Plot on Configuration For BR (GFSK) / Hopping / Reference Level (Vertical)**



Date: 8.OCT.2014 03:39:57

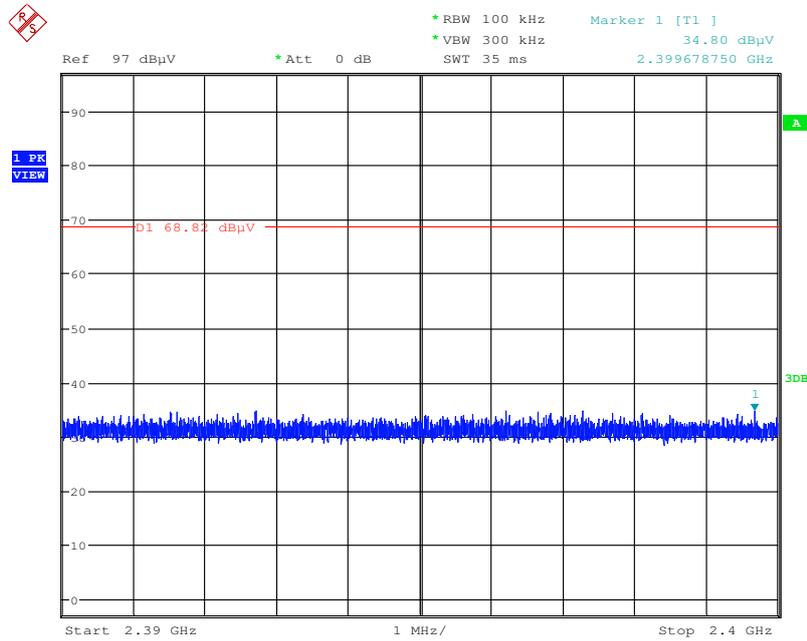
**Plot on Configuration For BR (GFSK) / Hopping / 30MHz~2400MHz (down 20dBc) (Vertical)**



Date: 8.OCT.2014 03:40:47

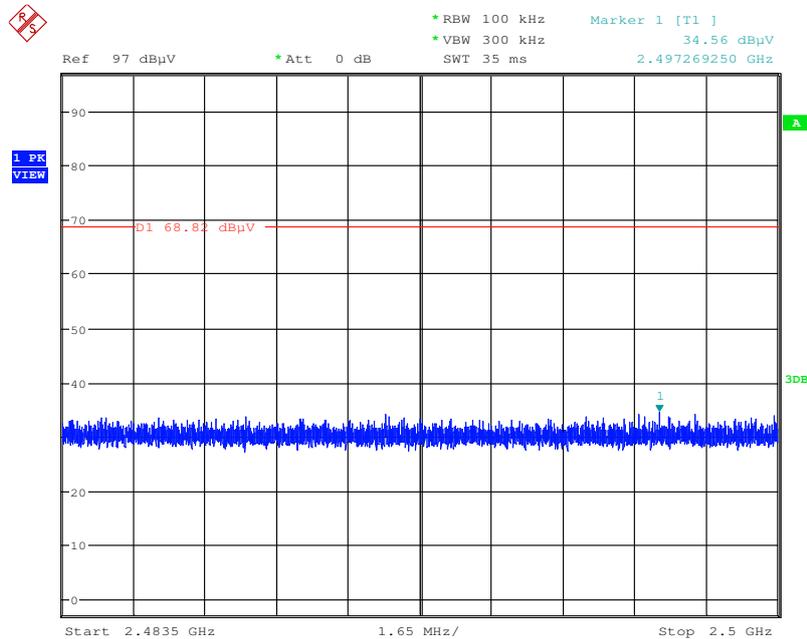
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For BR (GFSK) / Hopping / 2390MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:41:28

Plot on Configuration For BR (GFSK) / Hopping / 2483.5MHz~2500MHz (down 20dBc) (Vertical)

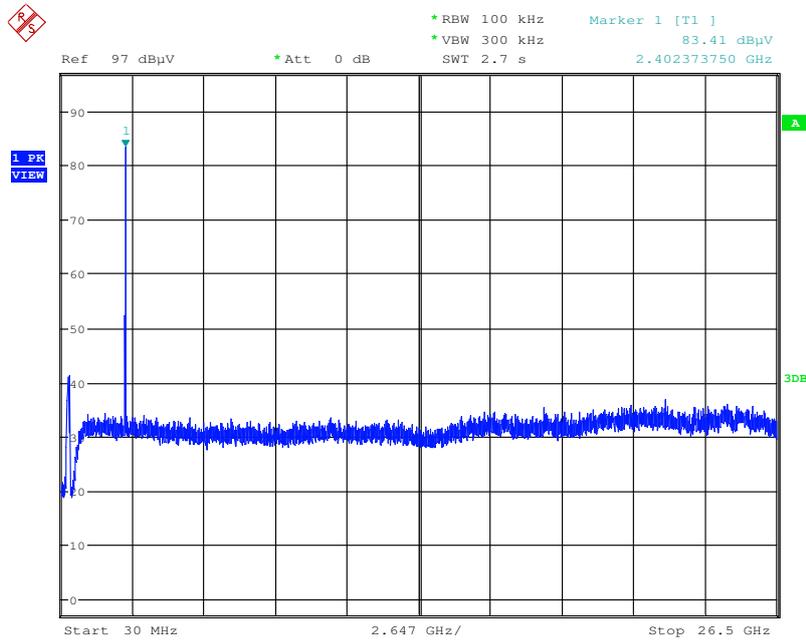


Date: 8.OCT.2014 03:42:02

Note: Only the worse polarization (Vertical) is tested and recorded in test report.

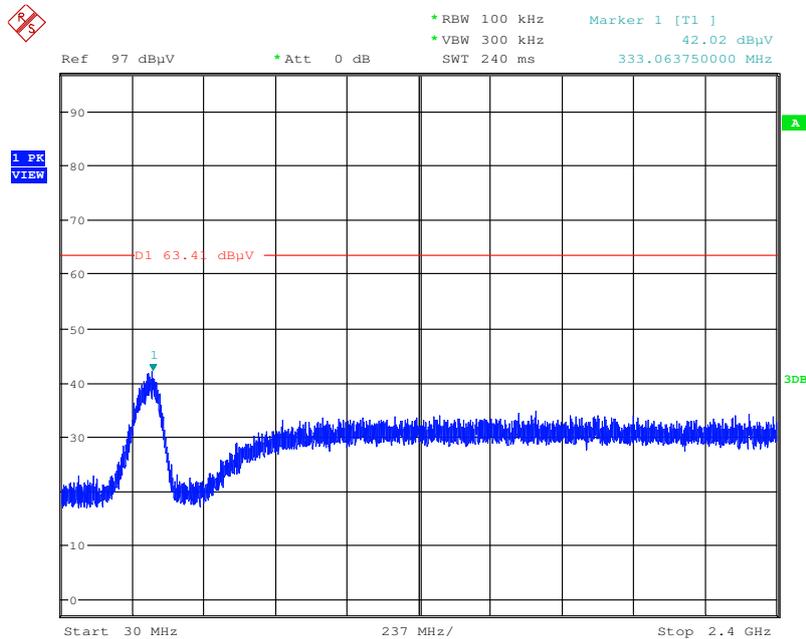


Plot on Configuration For EDR (8DPSK) / Channel 0 / Reference Level (Vertical)



Date: 8.OCT.2014 03:49:22

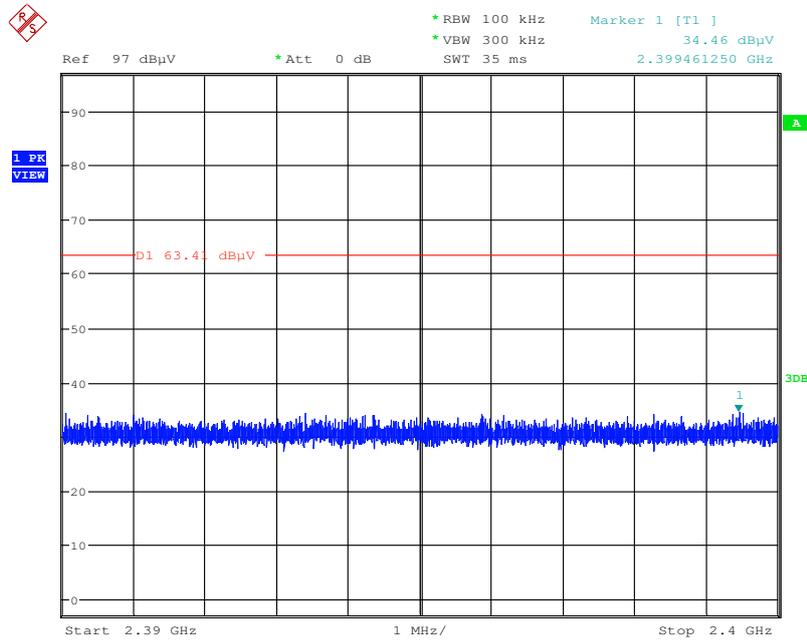
Plot on Configuration For EDR (8DPSK) / Channel 0 / 30MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:50:16

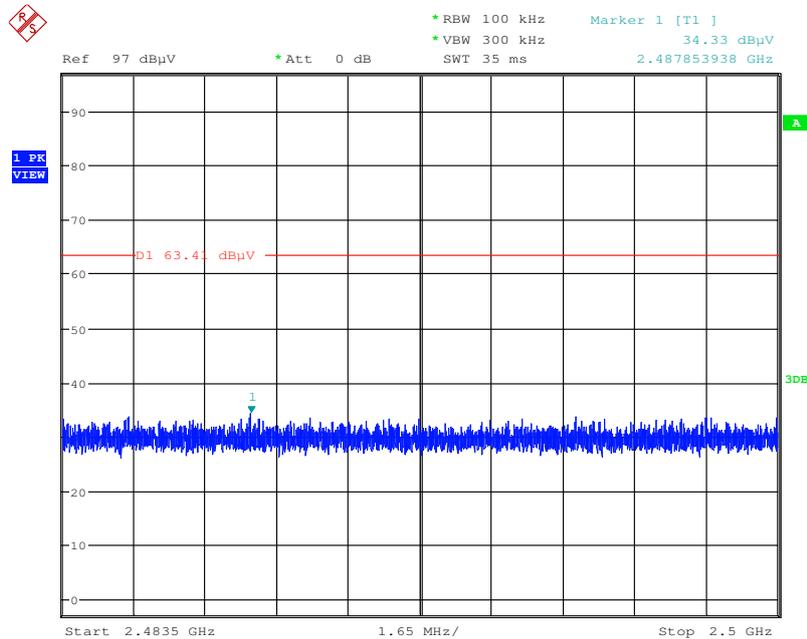
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For EDR (8DPSK) / Channel 0 / 2390MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:50:44

Plot on Configuration For EDR (8DPSK) / Channel 0 / 2483.5MHz~2500MHz (down 20dBc) (Vertical)

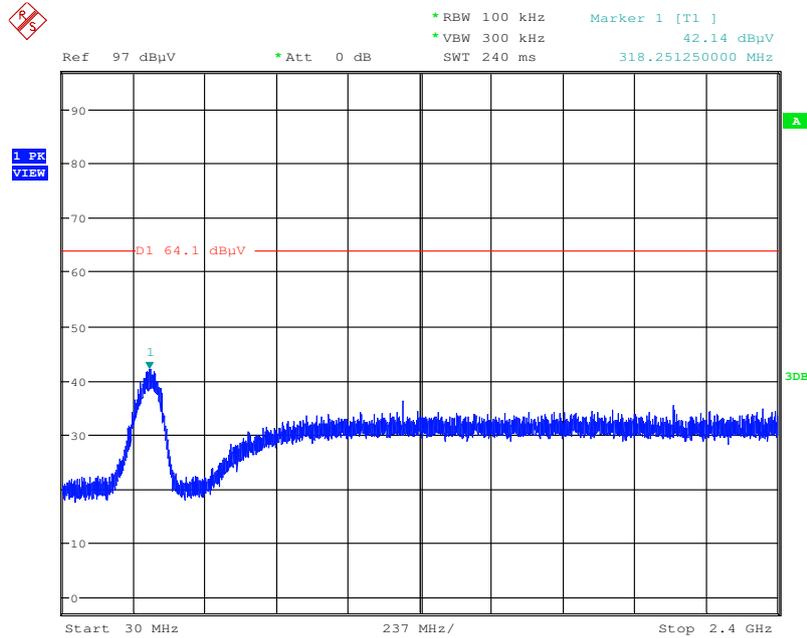


Date: 8.OCT.2014 03:51:15

Note: Only the worse polarization (Vertical) is tested and recorded in test report.

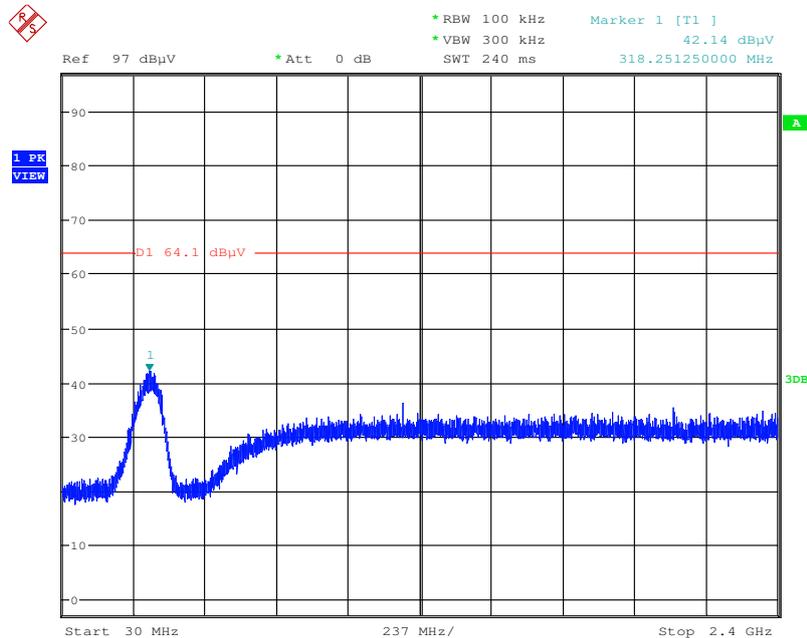


Plot on Configuration For EDR (8DPSK) / Channel 78 / 30MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:54:07

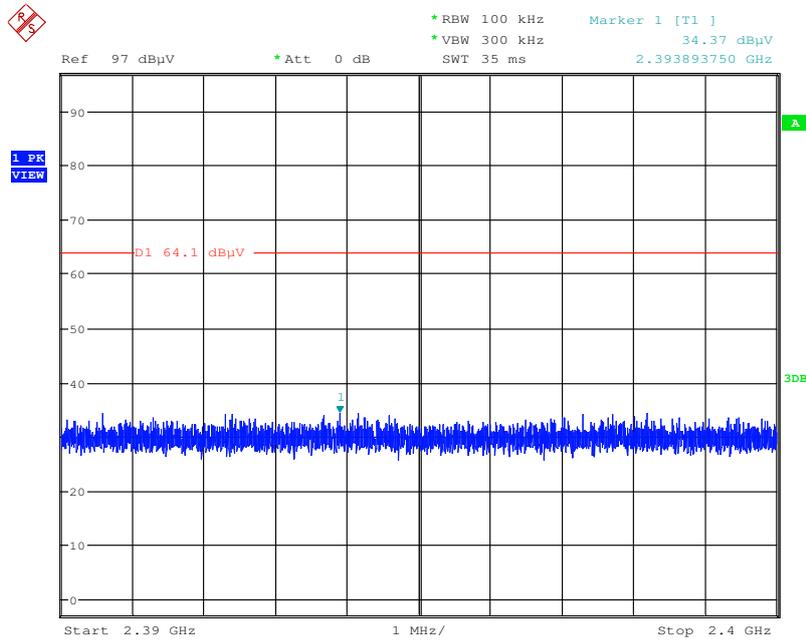
Plot on Configuration For EDR (8DPSK) / Channel 78 / 2390MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:54:07

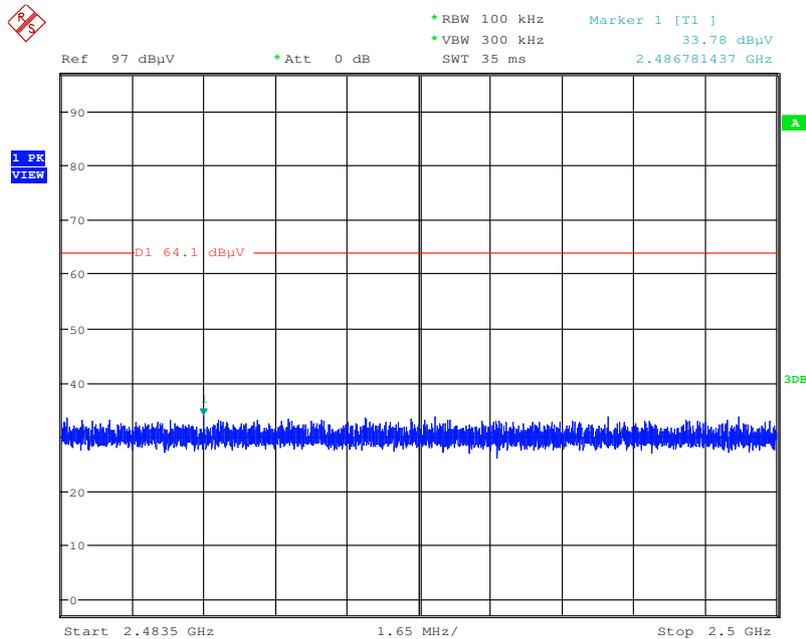
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For EDR (8DPSK) / Channel 78 / 2483.5MHz~2500MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:54:54

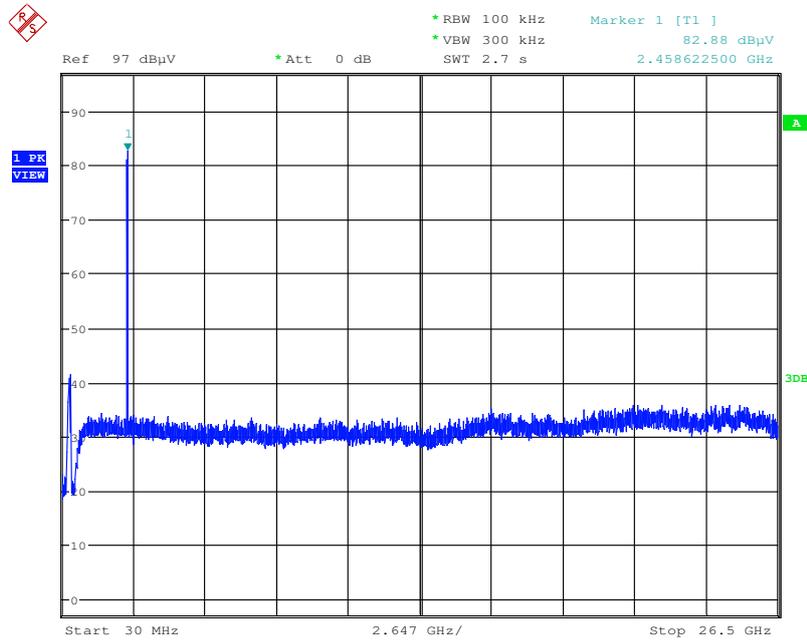
Plot on Configuration For EDR (8DPSK) / Channel 78 / 2500MHz~2650MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:55:22

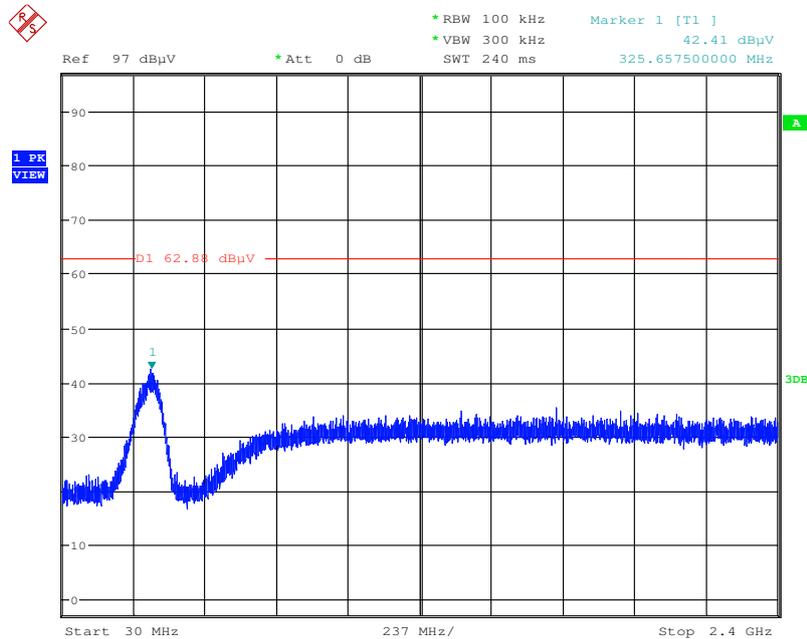
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For EDR (8DPSK) / Hopping / Reference Level (Vertical)



Date: 8.OCT.2014 03:44:34

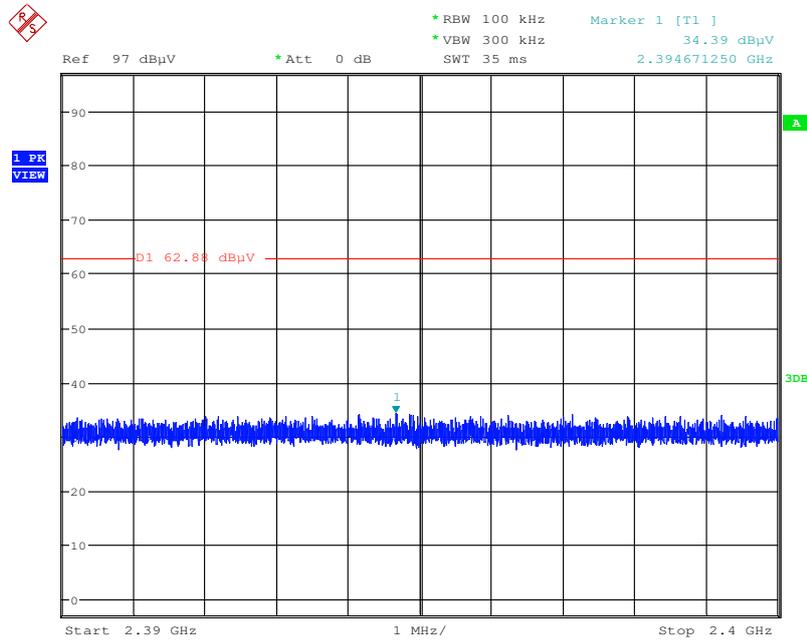
Plot on Configuration For EDR (8DPSK) / Hopping / 30MHz~2400MHz (down 20dBc) (Vertical)



Date: 8.OCT.2014 03:45:37

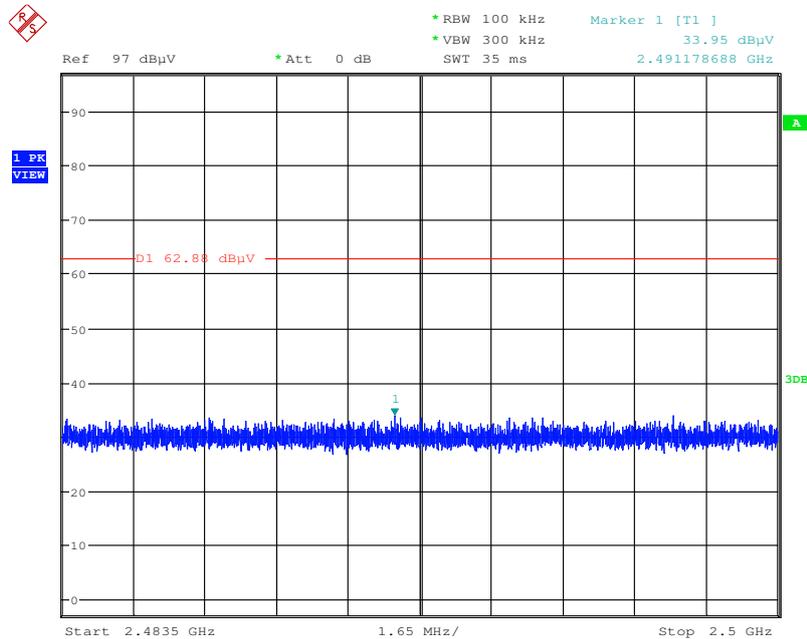
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

**Plot on Configuration For EDR (8DPSK) / Hopping / 2390MHz~2400MHz (down 20dBc) (Vertical)**



Date: 8.OCT.2014 03:46:14

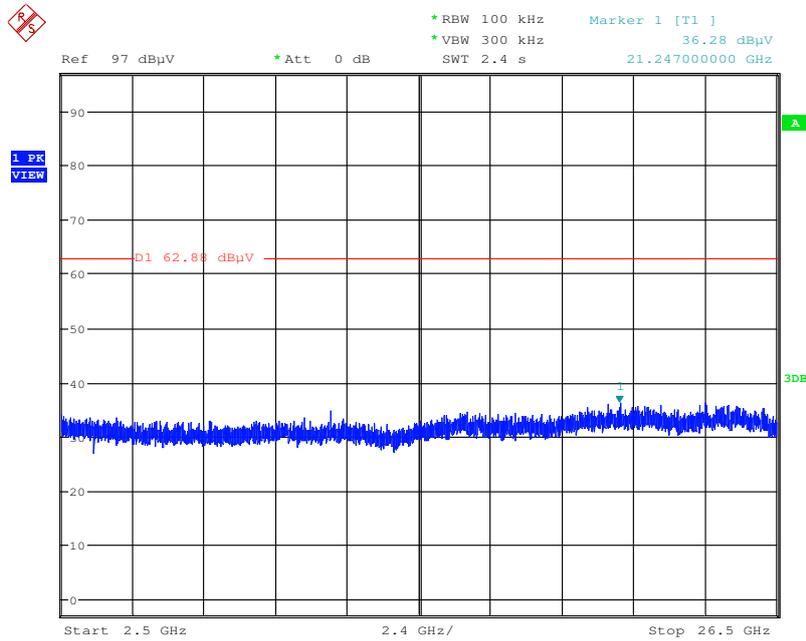
**Plot on Configuration For EDR (8DPSK) / Hopping / 2483.5MHz~2500MHz (down 20dBc) (Vertical)**



Date: 8.OCT.2014 03:46:44

Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For EDR (8DPSK) / Hopping / 2500MHz~26500MHz (down 20dBc)



Date: 8.OCT.2014 03:47:33

Note: Only the worse polarization (Vertical) is tested and recorded in test report.

## **4.8. Antenna Requirements**

### **4.8.1. Limit**

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

### **4.8.2. Antenna Connector Construction**

Please refer to section 3.3 in this test report, antenna connector complied with the requirements.

## 5. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Test Receiver	R&S	ESCS 30	100355	9 kHz ~ 2.75 GHz	Apr. 23, 2014	Conduction (CO01-CB)
EMI Test Receiver	R&S	ESCS 30	100355	9kHz ~ 2.75GHz	Apr. 22, 2015	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150 kHz ~ 100 MHz	Nov. 23, 2013	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 08, 2015	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127478	9kHz ~ 30MHz	Nov. 11, 2013	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Dec. 23, 2015	Conduction (CO01-CB)
Software	Audix	E3	5.410e	-	N.C.R.	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150 kHz ~ 30 MHz	Dec. 04, 2013	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150kHz ~ 30MHz	May 25, 2015	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	Conduction (CO01-CB)
Temp. and Humidity Chamber	Ten Billion	TTH-D3SP	TBN-931011	-30~100 degree	Jun. 03, 2014	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-7	-	1 GHz – 26.5 GHz	Nov. 17, 2013	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-8	-	1 GHz – 26.5 GHz	Nov. 17, 2013	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-9	-	1 GHz – 26.5 GHz	Nov. 17, 2013	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-10	-	1 GHz – 26.5 GHz	Nov. 17, 2013	Conducted (TH01-CB)
RF Cable-high	Woken	High Cable-11	-	1 GHz – 26.5 GHz	Nov. 17, 2013	Conducted (TH01-CB)
Power Sensor	Anritsu	MA2411B	0917223	300MHz~40GHz	Sep. 18, 2013	Conducted (TH01-CB)
Power Meter	Anritsu	ML2495A	1035008	300MHz~40GHz	Sep. 18, 2013	Conducted (TH01-CB)
BILOG ANTENNA	Schaffner	CBL6112D	37880	20MHz ~ 2GHz	Sep. 03, 2015	Radiation (O3CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 12, 2015*	Radiation (O3CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	9170-507	15GHz ~ 40GHz	Feb. 13, 2014	Radiation (O3CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Feb. 24, 2015	Radiation (O3CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Dec. 16, 2013	Radiation (O3CH01-CB)
Pre-Amplifier	WM	TF-130N-R1	923365	26GHz ~ 40GHz	Oct. 23, 2013	Radiation (O3CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Oct. 27, 2015	Radiation (O3CH01-CB)
EMI Receiver	Agilent	N9038A	MY52260123	9kHz ~ 8.4GHz	Jan. 21, 2015	Radiation (O3CH01-CB)



Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Turn Table	INN CO	CO 2000	N/A	0 ~ 360 degree	N.C.R.	Radiation (03CH01-CB)
Antenna Mast	INN CO	CO2000	N/A	1 m - 4 m	N.C.R.	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-1	N/A	30 MHz ~ 1 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-1	N/A	1 GHz - 26.5 GHz	Nov. 17, 2013	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-2	N/A	1 GHz - 26.5 GHz	Nov. 17, 2013	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-3	N/A	1 GHz - 40 GHz	Nov. 17, 2013	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-4	N/A	1 GHz - 40 GHz	Nov. 17, 2013	Radiation (03CH01-CB)

Note: Calibration Interval of instruments listed above is one year.

“\*” Calibration Interval of instruments listed above is two years.

N.C.R. means Non-Calibration required.

## 6. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.2 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	3.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%
Conducted Emission	1.7 dB	Confidence levels of 95%