FCC RADIO TEST REPORT

Applicant's company	**Abocom Systems, Inc.**
Applicant Address	No.77, Yu-Yih Rd., Chu-Nan, Miao-Lih County 35059, Taiwan R.O.C.
FCC ID	**MQ4AMB7220**
Manufacturer's company	**Abocom Systems, Inc.**
Manufacturer Address	No.77, Yu-Yih Rd., Chu-Nan, Miao-Lih County 35059, Taiwan R.O.C.

Product Name	2x2 11ac+BT4.0 Wi-Fi Module
Brand Name	AboCom
Model Name	AMB7220
Test Rule	47 CFR FCC Part 15 Subpart C § 15.247
Test Freq. Range	2402 ~ 2480MHz
Received Date	Jan. 15, 2016
Final Test Date	Jan. 30, 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, DA-00705** and **47 CFR FCC Part 15 Subpart C**.

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

Testing Laboratory
1190

Table of Contents

1. VERIFICATION OF COMPLIANCE 1
2. SUMMARY OF THE TEST RESULT 2
3. GENERAL INFORMATION 3
3.1. Product Details 3
3.2. Accessories 3
3.3. Table for Filed Antenna 4
3.4. Table for Carrier Frequencies 5
3.5. Table for Test Modes 6
3.6. Table for Testing Locations 7
3.7. Table for Supporting Units 8
3.8. Table for Parameters of Test Software Setting 9
3.9. EUT Operation during Test 9
3.10. Duty Cycle 9
3.11. Test Configurations 10
4. TEST RESULT 13
4.1. AC Power Line Conducted Emissions Measurement 13
4.2. Maximum Conducted Output Power Measurement 17
4.3. Hopping Channel Separation Measurement 19
4.4. Number of Hopping Frequency Measurement 30
4.5. Dwell Time Measurement 32
4.6. Radiated Emissions Measurement 39
4.7. Emissions Measurement 51
4.8. Antenna Requirements 65
5. LIST OF MEASURING EQUIPMENTS 66
6. MEASUREMENT UNCERTAINTY 67
APPENDIX A. TEST PHOTOS ..... A1 ~ A8
APPENDIX B. RADIATED EMISSION CO-LOCATION REPORT ..... B1 ~ B5

History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR611516AC	Rev. 01	Initial issue of report	Mar. 09, 2016

1. VERIFICATION OF COMPLIANCE

Product Name	:	2x2 11ac+BT4.0 Wi-Fi Module
Brand Name	:	AboCom
Model No.	:	AMB7220
Applicant	:	Abocom Systems, Inc.
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 Jan. 15, 2016 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

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	12.42 dB
4.2	15.247(b)(1)	Maximum Conducted Output Power	Complies	13.69 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	3.06 dB
4.7	15.247(d)	Band Edge Emissions	Complies	17.32 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 / π/4-DQPSK / 8DPSK)
Data Rate (Mbps)	GFSK: 1 ; π/4-DQPSK: 2 ; 8DPSK: 3
Frequency Range	2402 ~ 2480MHz
Channel Number	79
Channel Band Width (99%)	BR (GFSK) 1 Mbps: 0.9088 MHz EDR (π/4-DQPSK) 2 Mbps: 1.1838 MHz EDR (8DPSK) 3 Mbps: 1.1838 MHz
Maximum Conducted Peak Output Power	BR (GFSK) 1 Mbps: 7.31 dBm EDR (π/4-DQPSK) 2 Mbps: 6.08 dBm EDR (8DPSK) 3 Mbps: 6.33 dBm
Maximum Conducted Average Output Power	BR (GFSK) 1 Mbps: 6.52 dBm EDR (π/4-DQPSK) 2 Mbps: 5.29 dBm EDR (8DPSK) 3 Mbps: 5.54 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 π/4-DQPSK (2Mbps) and 8DPSK (3Mbps).	

3.2. Accessories

N/A

3.3. Table for Filed Antenna

For WiFi Antenna:

Ant.	Brand	P/NO	Antenna Type	Connector	Gain (dBi)		
					2.4GHz	5GHz	
						Band1	Band4
1	WHA YU	-	Printed Antenna	I-PEX	3.8	1.4	1.9
2	WHA YU	-	Printed Antenna	I-PEX	2.6	1.1	1.2

For Bluetooth Antenna:

Ant.	Brand	P/NO	Antenna Type	Connector	Gain (dBi)
3	WHA YU	C068-510500-A	PCB Antenna	MHF	3.84

Note: The EUT has three antennas.

For WiFi Antenna:

For IEEE 802.11a/b/g mode (1TX, 1RX):

Only Ant. 1 can be used as transmitting antenna and receiving antenna.

For IEEE 802.11n/ac mode (2TX, 2RX):

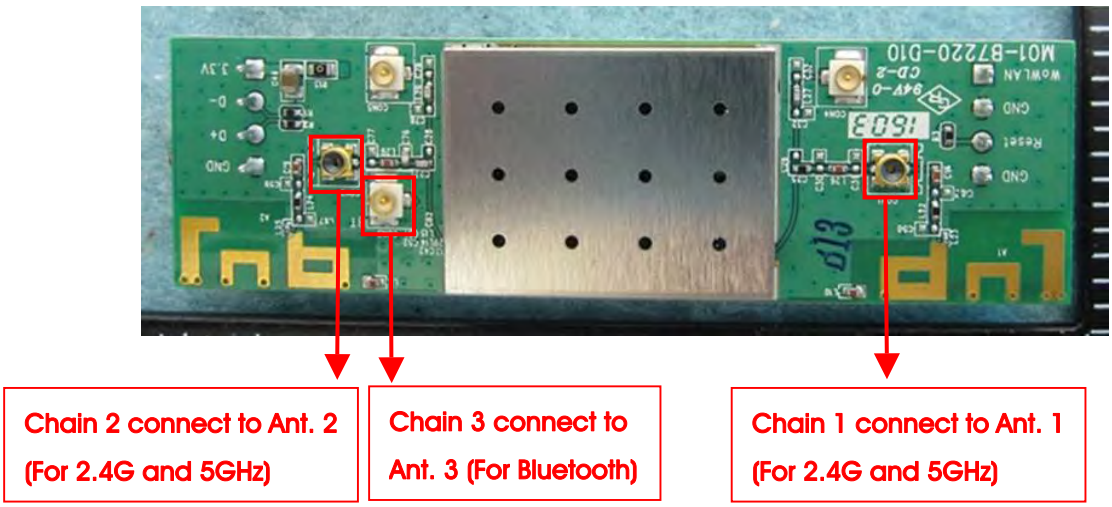
Ant. 1 and Ant. 2 will transmit/receive the same signal simultaneously.

Ant. 1 and Ant. 2 can be used as transmitting/receiving antennas.

For Bluetooth Antenna:

For Bluetooth mode (1TX, 1RX):

Only Ant. 3 can be used as transmitting antenna and receiving antenna.



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	Ant.
AC Power Conducted Emissions	Normal Link	-	-	-
Maximum Conducted Output Power	BR (GFSK)	1 Mbps	0/39/78	3
	EDR (π/4-DQPSK)	2 Mbps	0/39/78	3
	EDR (8DPSK)	3 Mbps	0/39/78	3
Hopping Channel Separation	BR (GFSK)	1 Mbps	0~1 39~40 77~78	3
	EDR (π/4-DQPSK)	2 Mbps	0~1 39~40 77~78	3
	EDR (8DPSK)	3 Mbps	0~1 39~40 77~78	3
Number of Hopping Frequency	EDR (8DPSK)	3 Mbps	0~78	3
Dwell Time	BR (GFSK) (DH1, DH3, DH5)	1 Mbps	0/39/78	3
Radiated Emissions Below 1GHz	Normal Link	-	-	-
Radiated Emissions Above 1GHz	BR (GFSK)	1 Mbps	0/39/78	3
	EDR (8DPSK)	3 Mbps	0/39/78	3
Band Edge Emissions	BR (GFSK)	1 Mbps	0/39/78	3
	EDR (8DPSK)	3 Mbps	0/39/78	3

The following test modes were performed for all tests:

For Conducted Emission test:

Mode 1. EUT + 2.4G + BT with Ant.

Mode 2. EUT + 5G + BT with Ant.

Mode 1 is the worst case, so it was selected to record in this test report.

For Radiated Emission test (Below 1GHz):

Mode 1. EUT in X-axis + 2.4G + BT with Ant.

Mode 2. EUT in Y-axis + 2.4G + BT with Ant.

Mode 3. EUT in Z-axis + 2.4G + BT with Ant.

Mode 3 has been evaluated to be the worst case among Mode 1~3, thus measurement for Mode 4 will follow this same test mode.

Mode 4. EUT in Z-axis + 5G + BT with Ant.

Mode 3 is the worst case, so it was selected to record in this test report.

For Radiated Emission test (Above 1GHz):

The EUT was performed at X axis, Y axis and Z axis position, and the worst case was found at Y axis. So the measurement will follow this same test configuration.

Mode 1. CTX - EUT in Y-axis

For Radiated Emission Co-location Test:

Mode 1. 2.4GHz WLAN Function + Bluetooth Function

Mode 2. 5GHz WLAN Function + Bluetooth Function

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

The EUT could be applied with 2.4GHz WLAN function, 5GHz WLAN function and Bluetooth function; therefore Co-location Maximum Permissible Exposure (Please refer to FA611516) and Radiated Emission Co-location (please refer to Appendix B) tests are added for simultaneously transmit between 2.4GHz WLAN function, 5GHz WLAN function and 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	-
CO02-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 Supporting Units

For Test Site No: CO02-CB

Support Unit	Brand	Model	FCC ID
AP Router	Planex	GW-AP54SGX	KA220030603014-1
Bluetooth keyboard	Microsoft	1390	C3K1390
NB	DELL	E6430	DoC
Mouse	Logitech	M-U0026	DoC
Earphone	SHYARO CHI	MIC-04	N/A
Fixture	Abocom	AM7221T-X10	N/A

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

Support Unit	Brand	Model	FCC ID
AP Router	Netgear	R6300V2	PY313200227
Bluetooth keyboard	iCooky	SK068	DoC
NB	DELL	E4300	DoC
Mouse	Logitech	M-U0026	DoC
Earphone	e-Power	S90W	N/A
Fixture	Abocom	AM7221T-X10	N/A

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

Support Unit	Brand	Model	FCC ID
NB	DELL	E4300	DoC
Fixture	Abocom	AM7221T-X10	N/A

For Test Site No: TH01-CB

Support Unit	Brand	Model	FCC ID
NB	DELL	E4300	DoC
Fixture	Abocom	AM7221T-X10	N/A

3.8. 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	Media Tek BT Tool		
Frequency	2402 MHz	2441 MHz	2480 MHz
Power Parameters	7	7	7

For EDR (π/4-DQPSK) 2 Mbps:

Test Software Version	Media Tek BT Tool		
Frequency	2402 MHz	2441 MHz	2480 MHz
Power Parameters	7	7	7

For EDR (8DPSK) 3 Mbps:

Test Software Version	Media Tek BT Tool		
Frequency	2402 MHz	2441 MHz	2480 MHz
Power Parameters	7	7	7

3.9. EUT Operation during Test

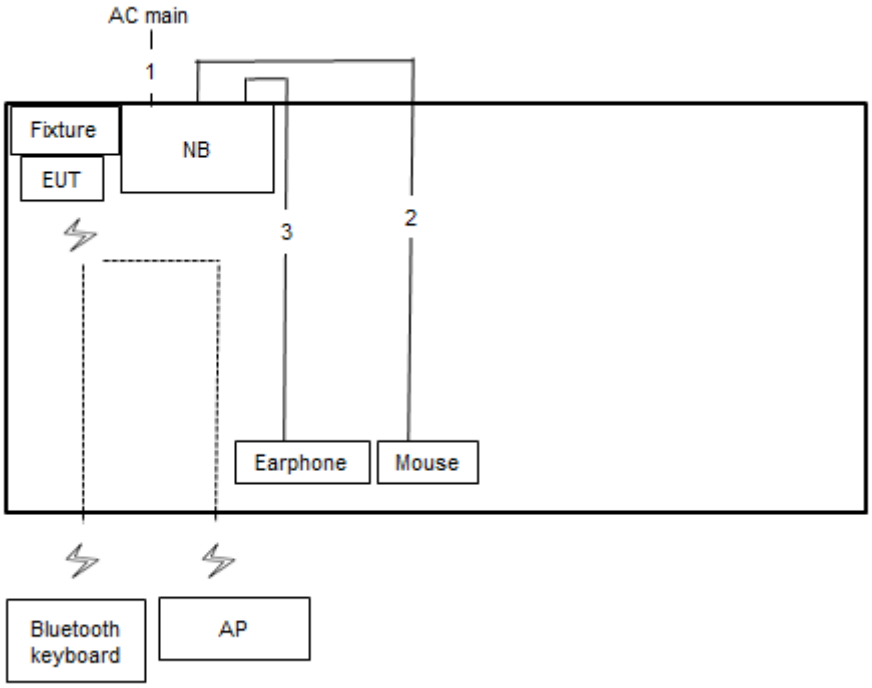
The EUT was programmed to be in continuously transmitting mode.

3.10. Duty Cycle

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
BR (GFSK)	2.870	4.966	57.79	2.38	0.35
EDR (π/4-DQPSK)	2.887	4.983	57.93	2.37	0.35
EDR (8DPSK)	2.887	4.983	57.93	2.37	0.35

3.11. Test Configurations

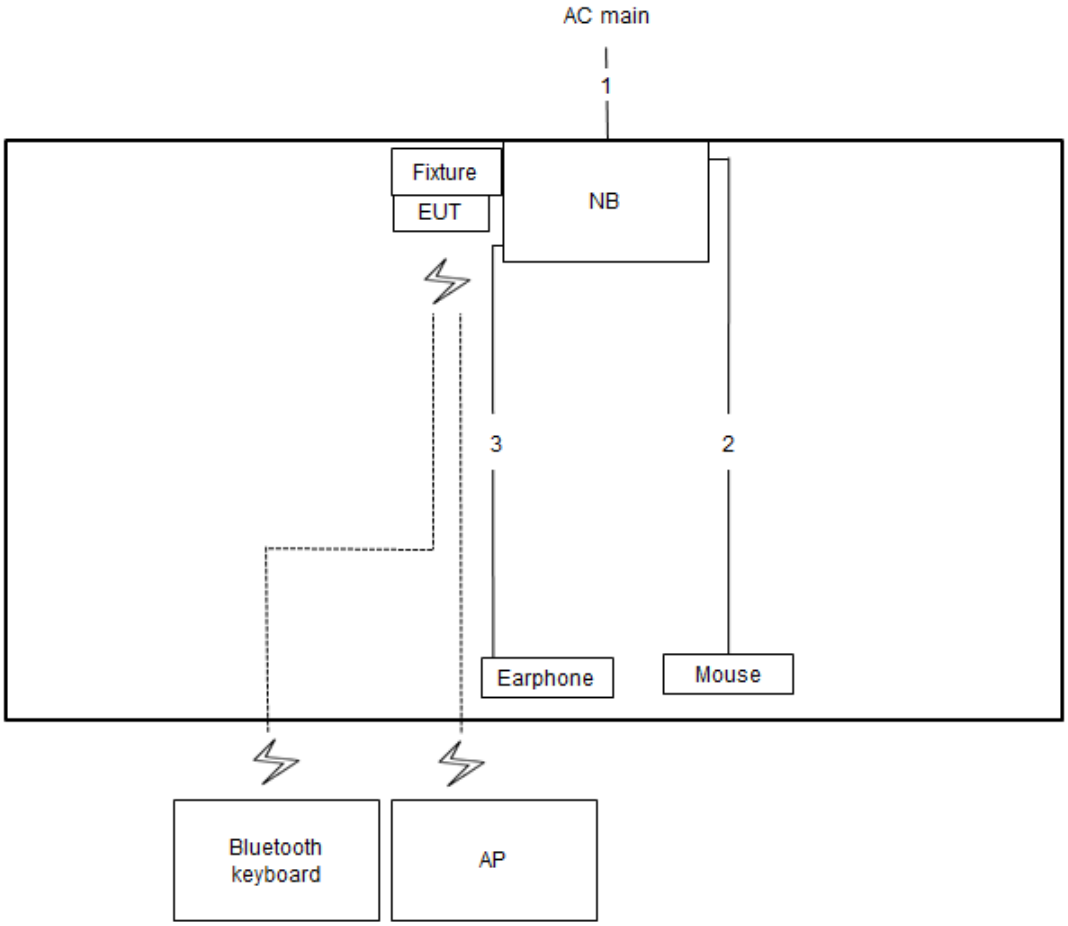
3.11.1. AC Power Line Conduction Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	USB cable	Yes	1.8m
3	Audio cable	No	1.5m

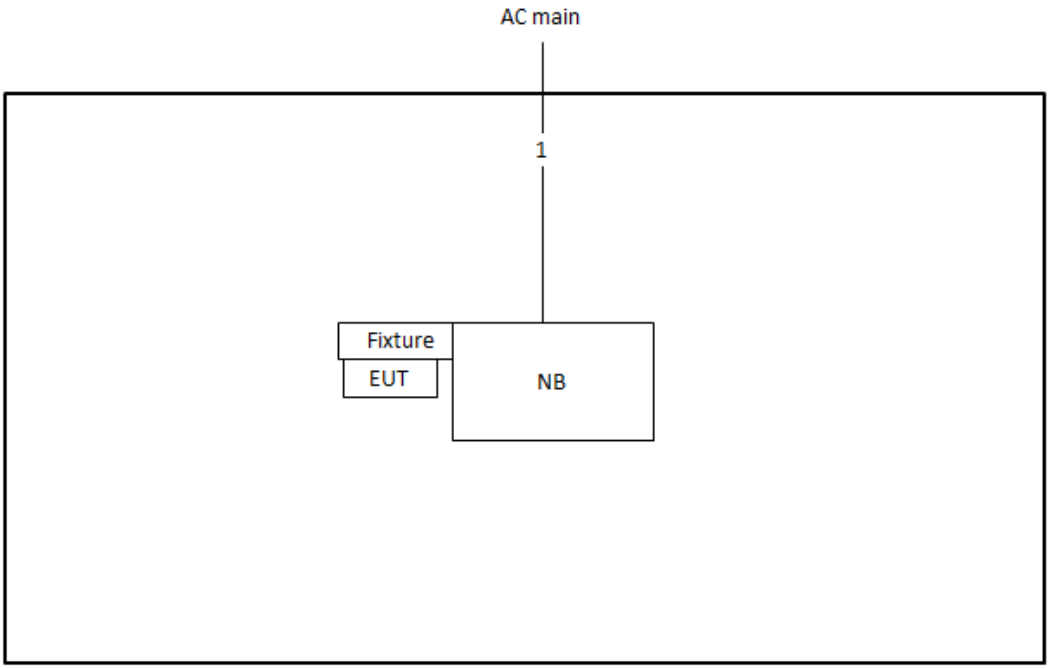
3.11.2. Radiation Emissions Test Configuration

Test Configuration: 30MHz~1GHz



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	USB cable	Yes	1.8m
3	Audio cable	No	1.4m

Test Configuration: above 1GHz



Item	Connection	Shielded	Length
1	Power cable	No	2.6m

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

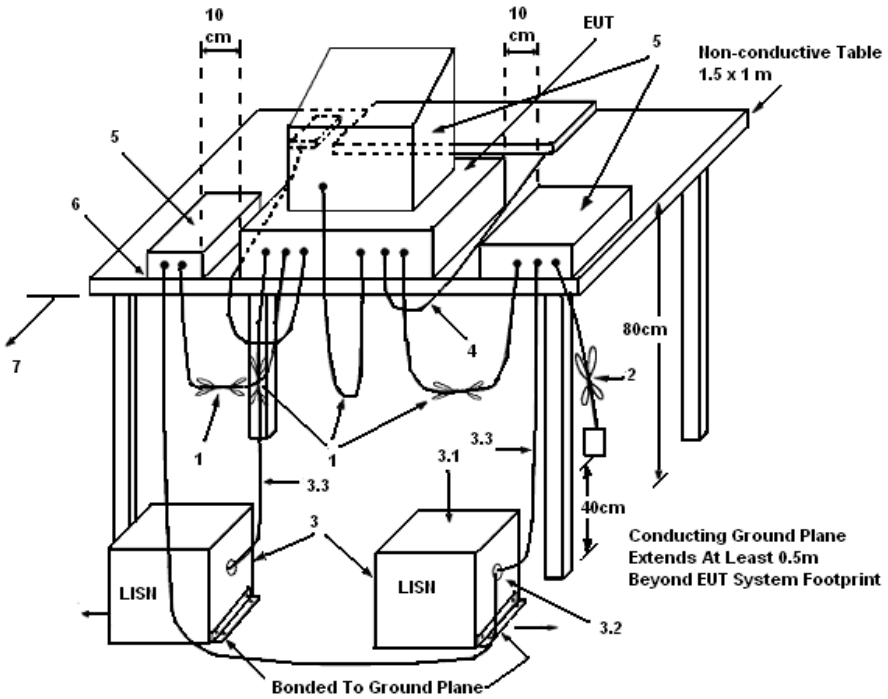
Please refer to section 5 of equipments list in this report. The following table is the setting of the receiver.

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.

4.1.4. Test Setup Layout



LEGEND:

(1) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

(2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

(3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference ground plane.

(3.1) All other equipment powered from additional LISN(s).

(3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

(3.3) LISN at least 80 cm from nearest part of EUT chassis.

(4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

(5) Non-EUT components of EUT system being tested.

(6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

(7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.

4.1.5. Test Deviation

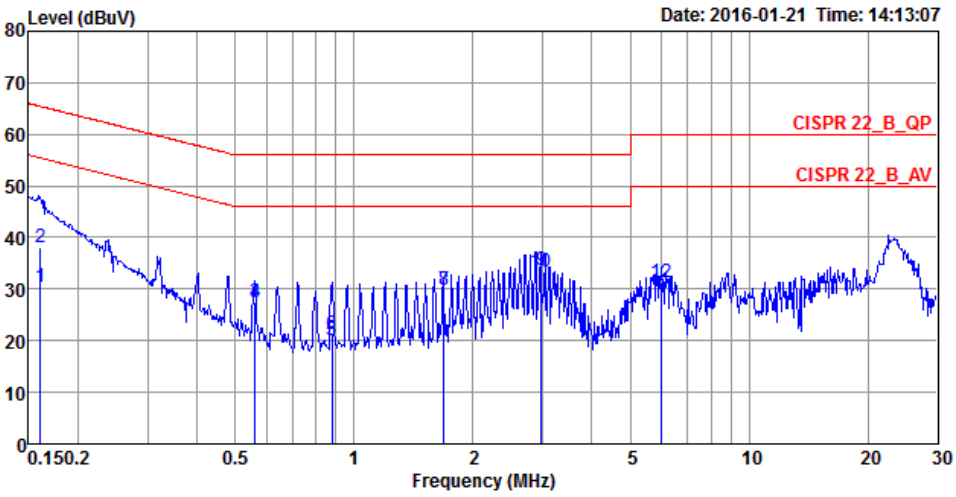
There is no deviation with the original standard.

4.1.6. EUT Operation during Test

The EUT was placed on the test table and programmed in normal function.

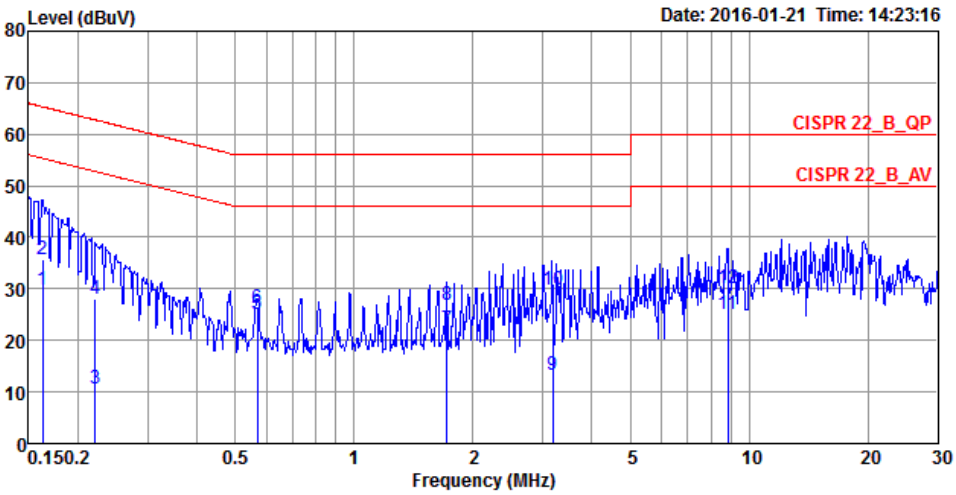
4.1.7. Results of AC Power Line Conducted Emissions Measurement

Temperature	24°C	Humidity	55%
Test Engineer	Da Deng	Phase	Line
Configuration	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1607	30.55	-24.88	55.43	20.43	9.96	0.16	Average	LINE
2	0.1607	38.18	-27.25	65.43	28.06	9.96	0.16	QP	LINE
3	0.5611	27.54	-18.46	46.00	17.32	10.02	0.20	Average	LINE
4	0.5611	27.55	-28.45	56.00	17.33	10.02	0.20	QP	LINE
5	0.8803	20.19	-25.81	46.00	9.96	10.04	0.19	Average	LINE
6	0.8803	21.37	-34.63	56.00	11.14	10.04	0.19	QP	LINE
7	1.6905	29.76	-16.24	46.00	19.45	10.07	0.24	Average	LINE
8	1.6905	29.92	-26.08	56.00	19.61	10.07	0.24	QP	LINE
9	2.9790	33.58	-12.42	46.00	23.19	10.10	0.29	Average	LINE
10	2.9790	33.30	-22.70	56.00	22.91	10.10	0.29	QP	LINE
11	5.9685	29.44	-20.56	50.00	18.96	10.13	0.35	Average	LINE
12	5.9685	31.35	-28.65	60.00	20.87	10.13	0.35	QP	LINE

Temperature	24°C	Humidity	55%
Test Engineer	Da Deng	Phase	Neutral
Configuration	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1624	29.96	-25.38	55.34	19.84	9.96	0.16	Average	NEUTRAL
2	0.1624	35.77	-29.57	65.34	25.65	9.96	0.16	QP	NEUTRAL
3	0.2208	10.57	-42.22	52.79	0.43	9.96	0.18	Average	NEUTRAL
4	0.2208	28.02	-34.77	62.79	17.88	9.96	0.18	QP	NEUTRAL
5	0.5701	25.15	-20.85	46.00	14.98	9.97	0.20	Average	NEUTRAL
6	0.5701	26.18	-29.82	56.00	16.01	9.97	0.20	QP	NEUTRAL
7	1.7162	22.03	-23.97	46.00	11.80	9.99	0.24	Average	NEUTRAL
8	1.7162	26.95	-29.05	56.00	16.72	9.99	0.24	QP	NEUTRAL
9	3.1816	13.36	-32.64	46.00	3.05	10.01	0.30	Average	NEUTRAL
10	3.1816	29.68	-26.32	56.00	19.37	10.01	0.30	QP	NEUTRAL
11	8.8223	24.96	-25.04	50.00	14.46	10.13	0.37	Average	NEUTRAL
12	8.8223	30.02	-29.98	60.00	19.52	10.13	0.37	QP	NEUTRAL

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).

4.2.2. Measuring Instruments and Setting

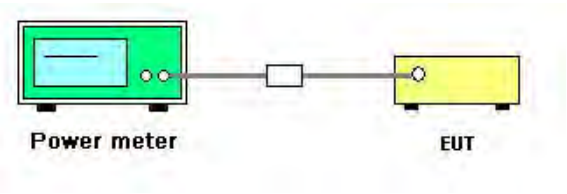
Please refer to section 5 of equipments list in this report. The following table is the setting of the power meter.

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	25°C	Humidity	58%
Test Engineer	Serway Li / Peter Wu	Configurations	GFSK, π/4-DQPSK, 8DPSK
Test Date	Jan. 28, 2016		

For BR (GFSK) 1 Mbps:

Channel	Frequency	Conducted Peak Power (dBm)	Conducted Average Power (dBm)	Max. Limit (dBm)	Result
0	2402 MHz	7.31	6.52	21.00	Complies
39	2441 MHz	7.26	6.47	21.00	Complies
78	2480 MHz	7.17	6.38	21.00	Complies

For EDR (π/4-DQPSK) 2 Mbps:

Channel	Frequency	Conducted Peak Power (dBm)	Conducted Average Power (dBm)	Max. Limit (dBm)	Result
0	2402 MHz	6.02	5.23	21.00	Complies
39	2441 MHz	5.98	5.19	21.00	Complies
78	2480 MHz	6.08	5.29	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	6.26	5.47	21.00	Complies
39	2441 MHz	6.33	5.54	21.00	Complies
78	2480 MHz	6.31	5.52	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

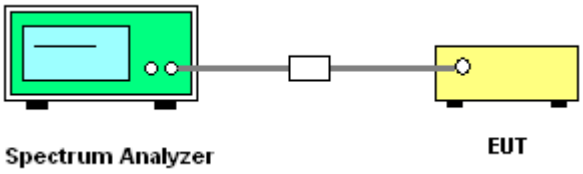
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

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	25°C	Humidity	58%
Test Engineer	Serway Li / Peter Wu	Configurations	GFSK, π/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	0.9681	0.9030	1.00	0.645	Complies
2441 MHz	0.9768	0.9088	1.00	0.651	Complies
2480 MHz	1.0290	0.9059	1.00	0.686	Complies

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

For EDR (π/4-DQPSK) 2 Mbps:

Frequency	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Ch. Separation (MHz)	Two-Thirds of 20dB Bandwidth (MHz)	Result
2402 MHz	1.2812	1.1722	1.00	0.854	Complies
2441 MHz	1.2841	1.1838	1.00	0.856	Complies
2480 MHz	1.2812	1.1751	1.00	0.854	Complies

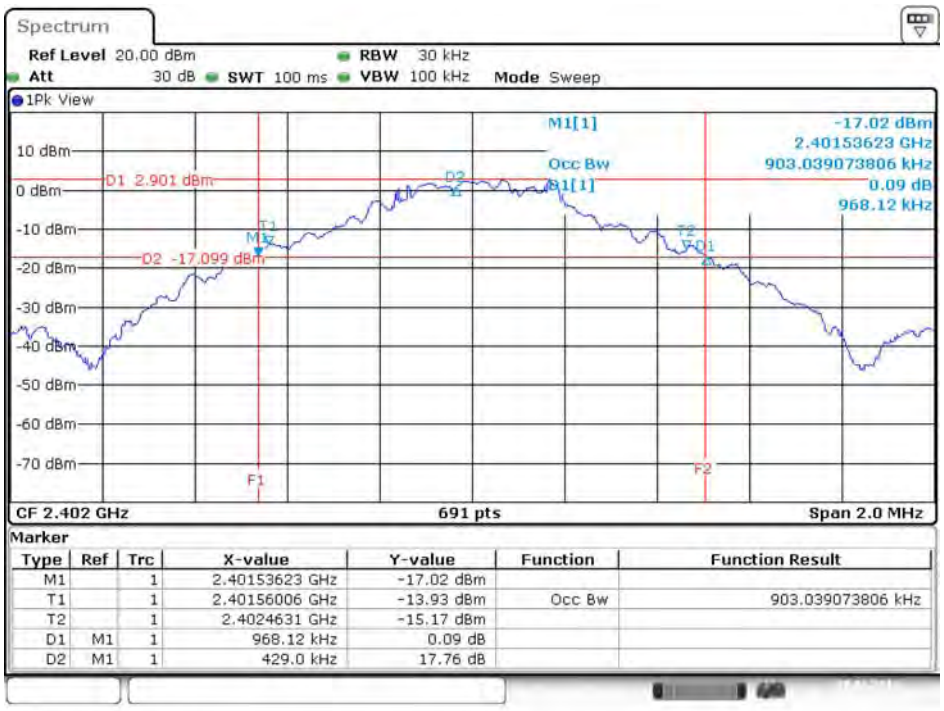
Ch. Separation Limits: >20dB bandwidth or > Two-Thirds of 20dB bandwidth

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	1.2841	1.1838	1.00	0.856	Complies
2441 MHz	1.2841	1.1780	1.00	0.856	Complies
2480 MHz	1.2841	1.1780	1.00	0.856	Complies

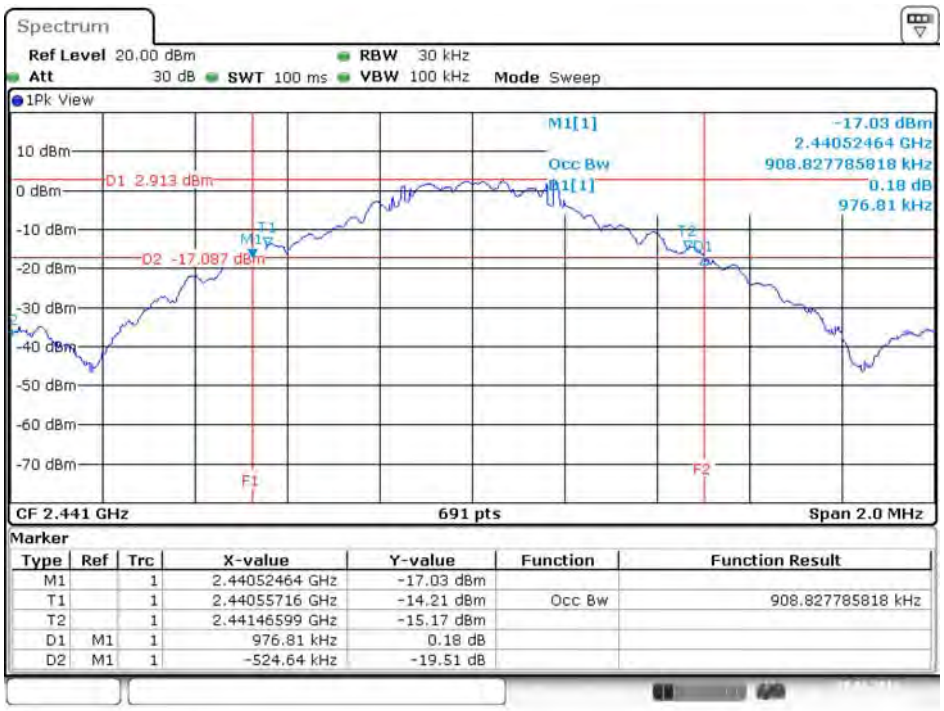
Ch. Separation Limits: >20dB bandwidth or > Two-Thirds of 20dB bandwidth

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



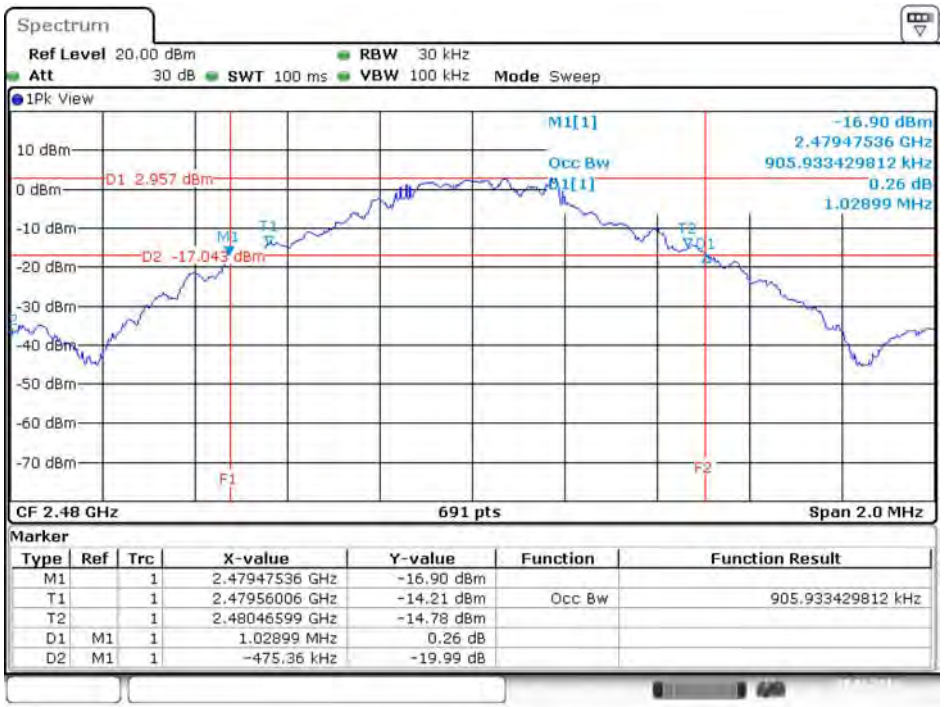
Date: 28.JAN.2016 15:53:24

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



Date: 28.JAN.2016 15:56:19

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



Marker

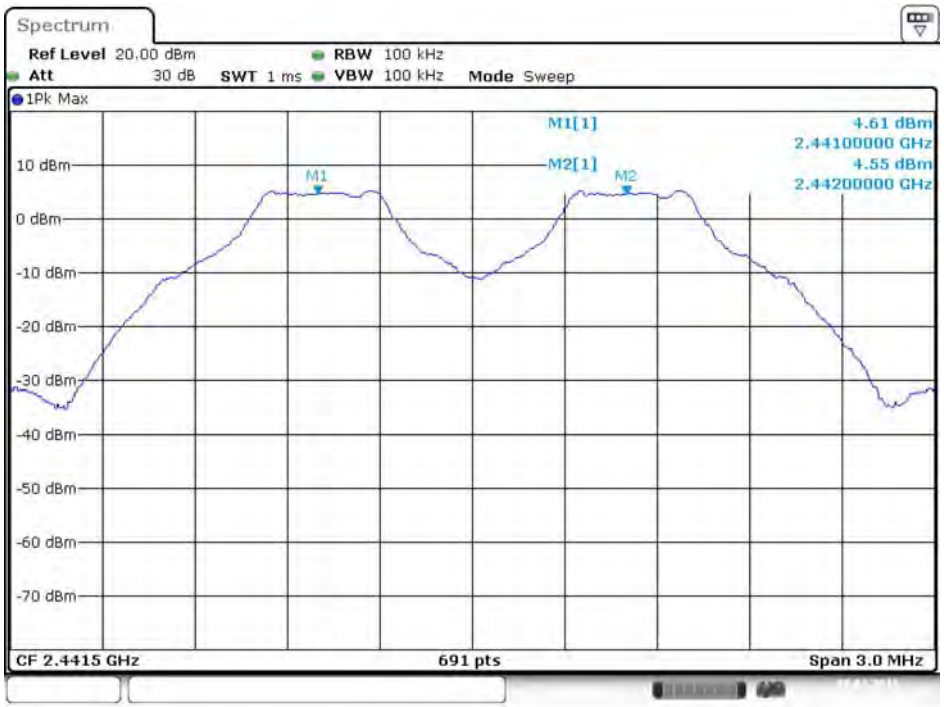
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47947536 GHz	-16.90 dBm		
T1		1	2.47956006 GHz	-14.21 dBm	Occ Bw	905.933429812 kHz
T2		1	2.48046599 GHz	-14.78 dBm		
D1	M1	1	1.02899 MHz	0.26 dB		
D2	M1	1	-475.36 kHz	-19.99 dB		

Date: 28.JAN.2016 16:02:05

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

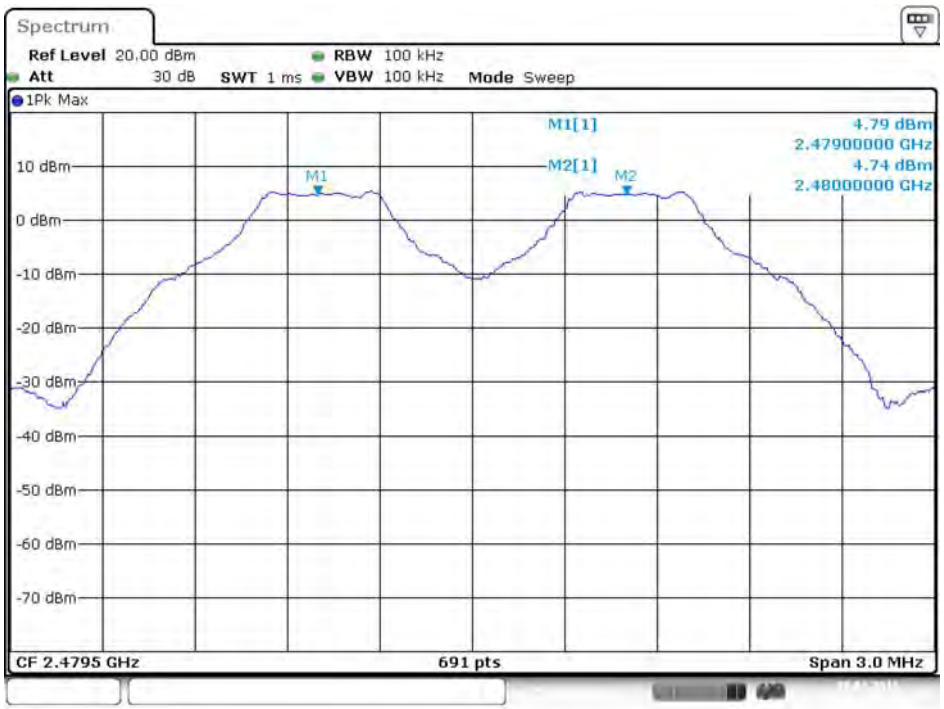
Date: 28.JAN.2016 17:21:48

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



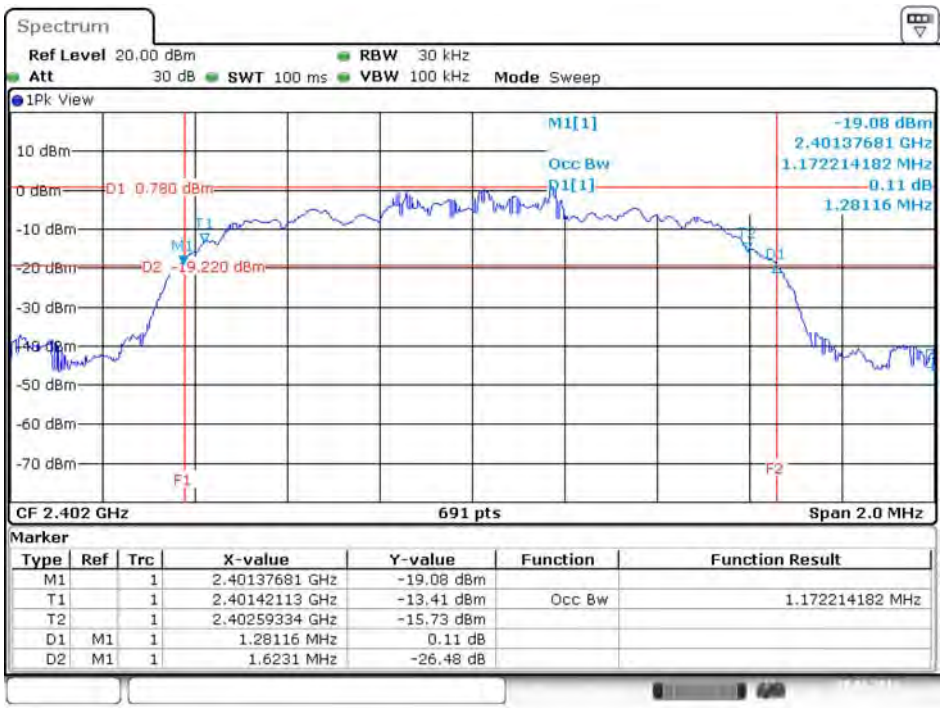
Date: 28.JAN.2016 17:16:11

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



Date: 28.JAN.2016 17:13:50

20 dB Bandwidth Plot on EDR (π/4-DQPSK) 2 Mbps / Channel 0 / 2402 MHz

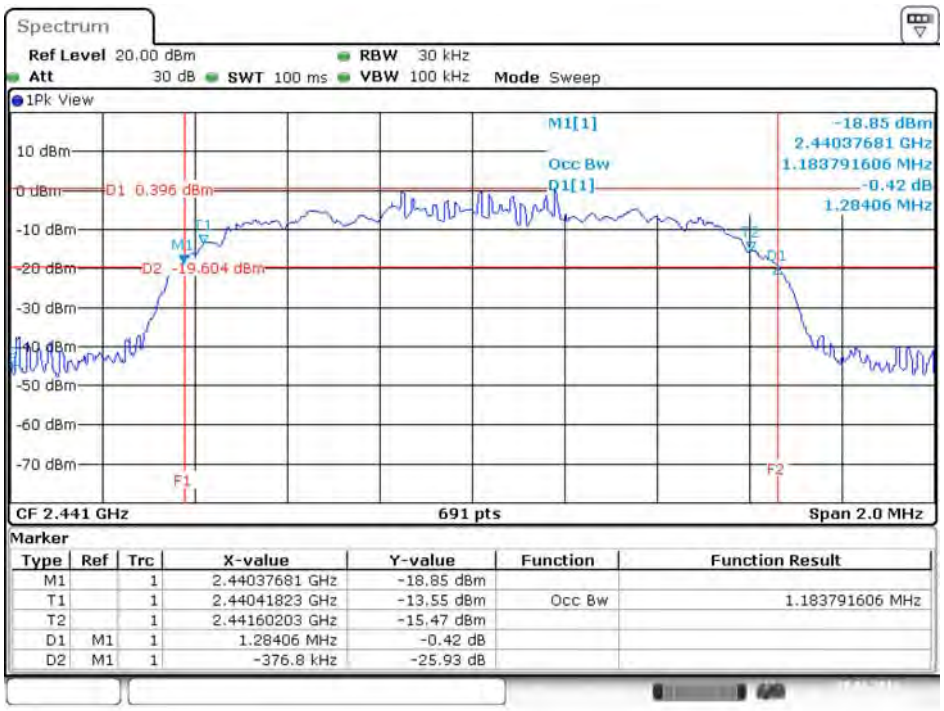


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40137681 GHz	-19.08 dBm		
T1		1	2.40142113 GHz	-13.41 dBm	Occ Bw	1.172214182 MHz
T2		1	2.40259334 GHz	-15.73 dBm		
D1	M1	1	1.28116 MHz	0.11 dB		
D2	M1	1	1.6231 MHz	-26.48 dB		

Date: 28.JAN.2016 16:08:04

20 dB Bandwidth Plot on EDR (π/4-DQPSK) 2 Mbps / Channel 39 / 2441 MHz

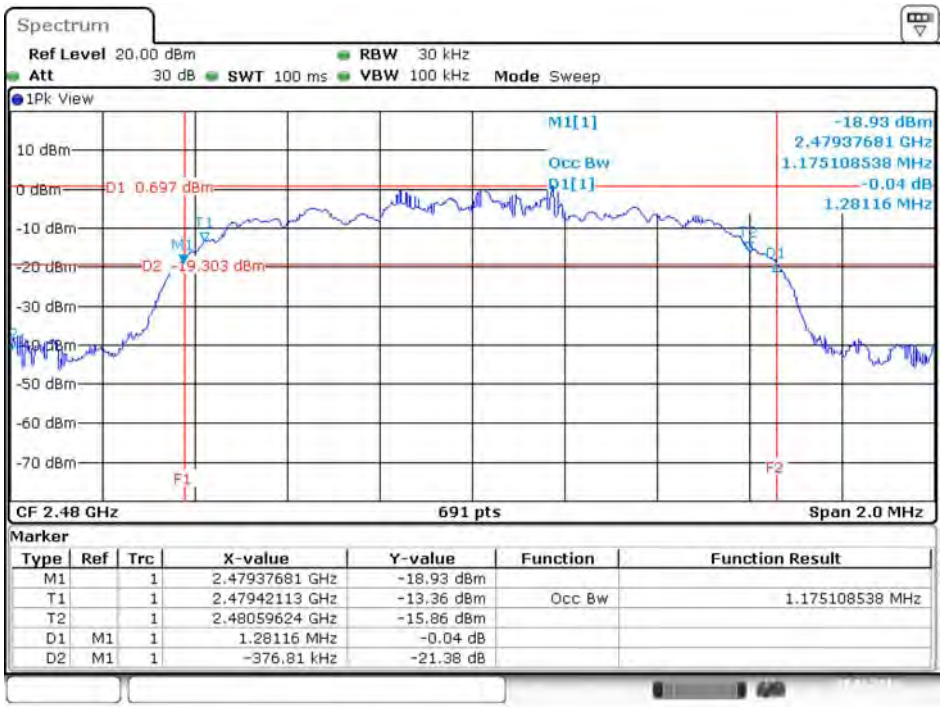


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44037681 GHz	-18.85 dBm		
T1		1	2.44041823 GHz	-13.55 dBm	Occ Bw	1.183791606 MHz
T2		1	2.44160203 GHz	-15.47 dBm		
D1	M1	1	1.28406 MHz	-0.42 dB		
D2	M1	1	-376.8 kHz	-25.93 dB		

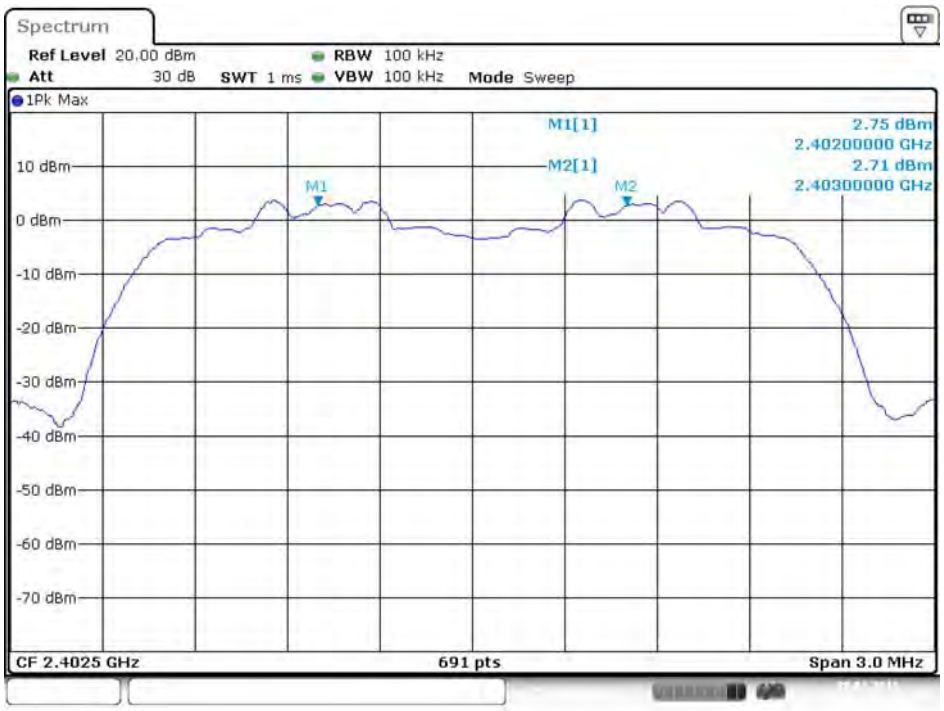
Date: 28.JAN.2016 16:07:31

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



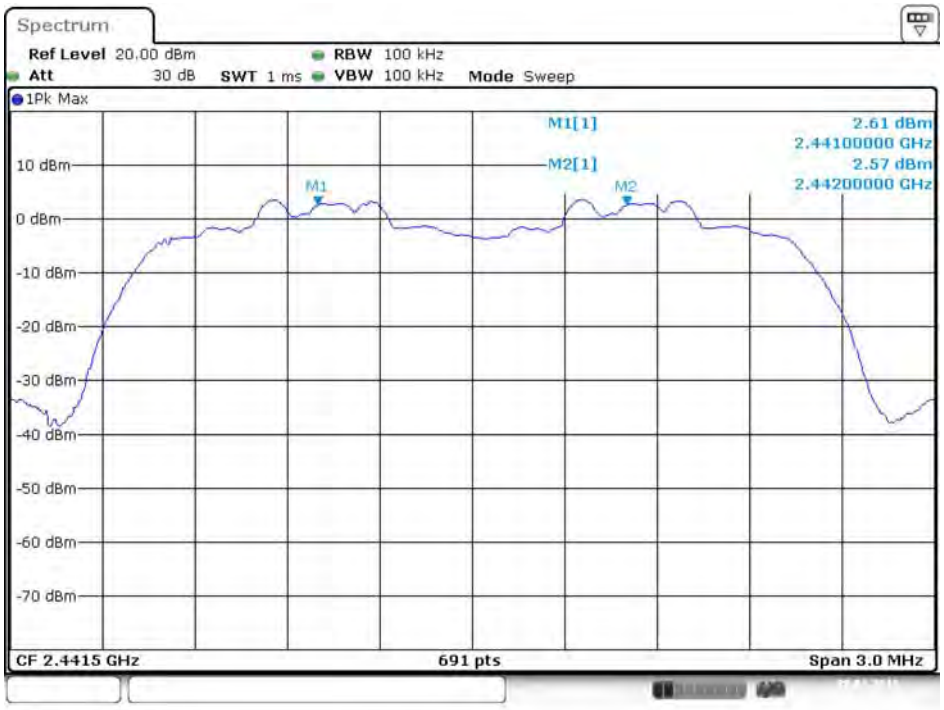
Date: 28.JAN.2016 16:06:52

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



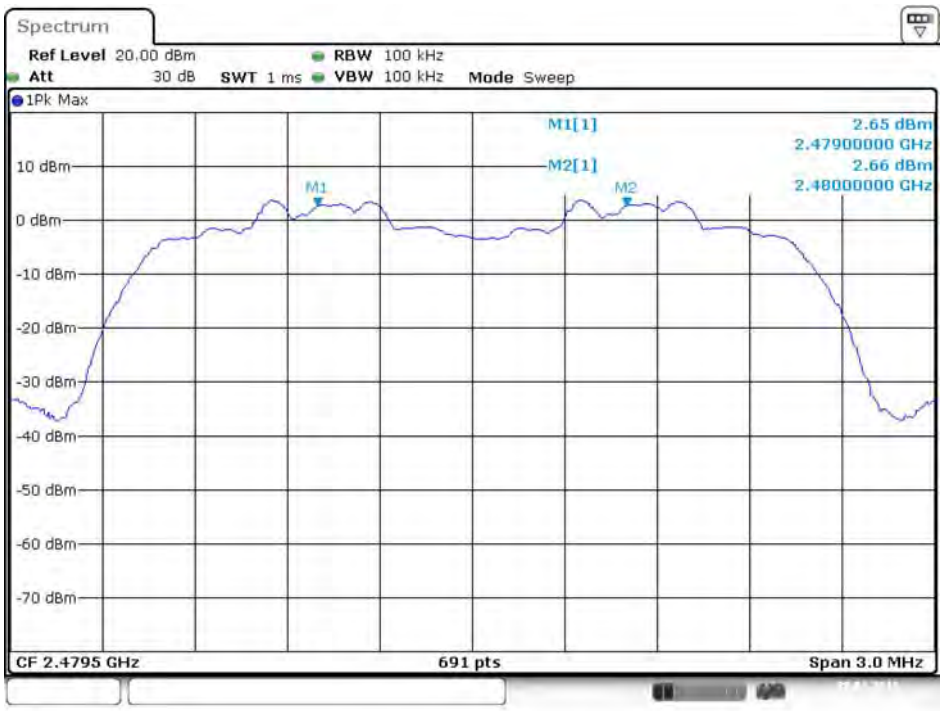
Date: 28.JAN.2016 17:21:00

Channel Separation Plot on EDR (π/4-DQPSK) 2 Mbps / Channel 39~40 / 2441 MHz ~ 2442 MHz



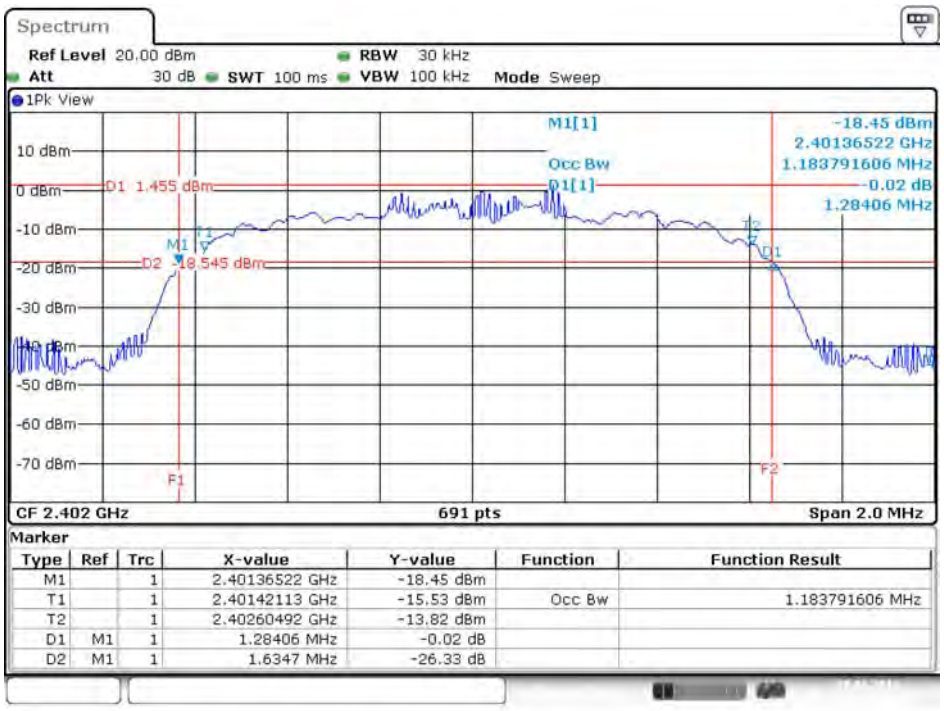
Date: 28.JAN.2016 17:17:03

Channel Separation Plot on EDR (π/4-DQPSK) 2 Mbps / Channel 77~78 / 2479 MHz ~ 2480 MHz



Date: 28.JAN.2016 17:13:05

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

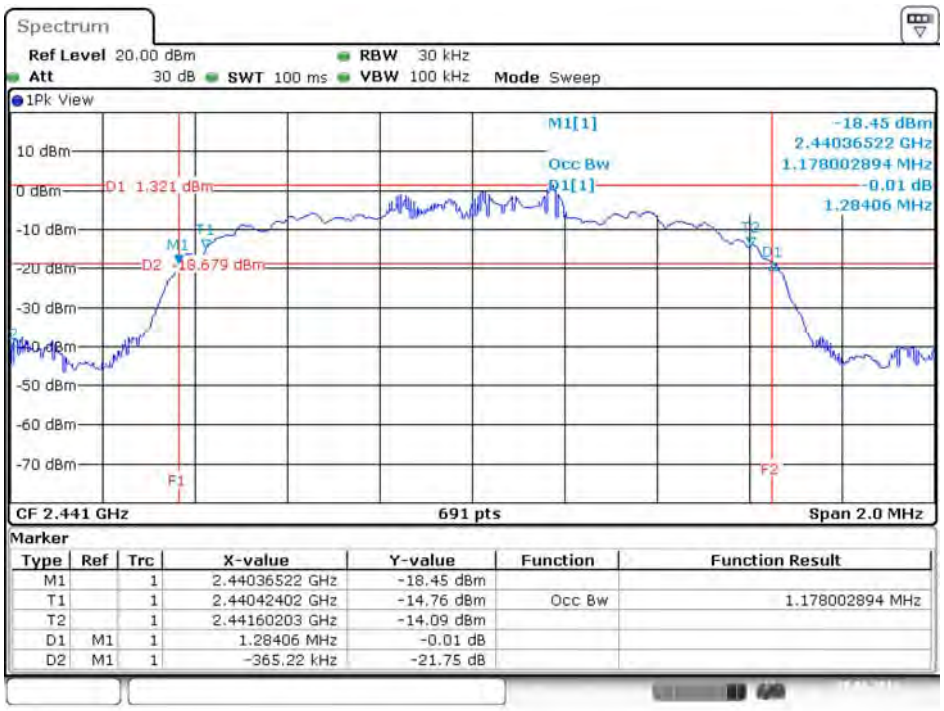


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40136522 GHz	-18.45 dBm		
T1		1	2.40142113 GHz	-15.53 dBm	Occ Bw	1.183791606 MHz
T2		1	2.40260492 GHz	-13.82 dBm		
D1	M1	1	1.28406 MHz	-0.02 dB		
D2	M1	1	1.6347 MHz	-26.33 dB		

Date: 28.JAN.2016 16:09:50

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

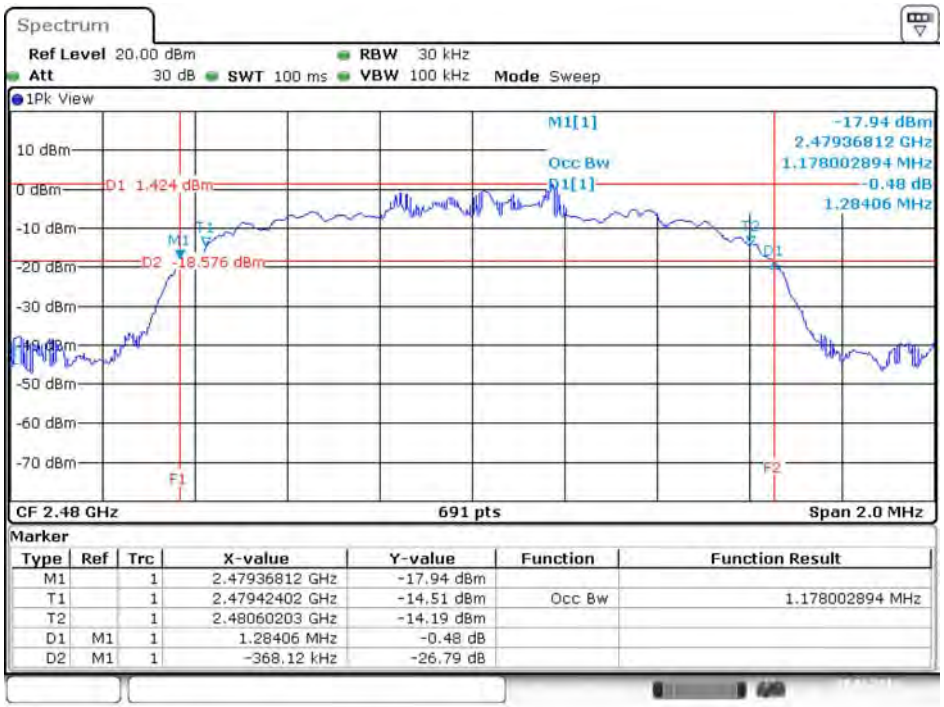


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44036522 GHz	-18.45 dBm		
T1		1	2.44042402 GHz	-14.76 dBm	Occ Bw	1.178002894 MHz
T2		1	2.44160203 GHz	-14.09 dBm		
D1	M1	1	1.28406 MHz	-0.01 dB		
D2	M1	1	-365.22 kHz	-21.75 dB		

Date: 28.JAN.2016 16:10:38

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

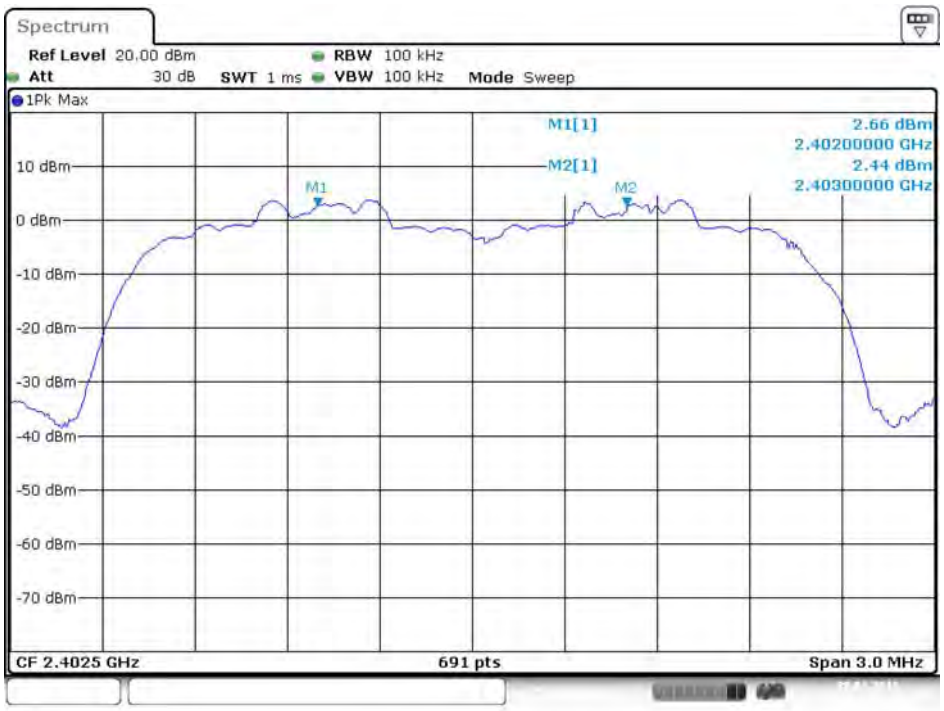


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47936812 GHz	-17.94 dBm		
T1		1	2.47942402 GHz	-14.51 dBm	Occ Bw	1.178002894 MHz
T2		1	2.48060203 GHz	-14.19 dBm		
D1	M1	1	1.28406 MHz	-0.48 dB		
D2	M1	1	-368.12 kHz	-26.79 dB		

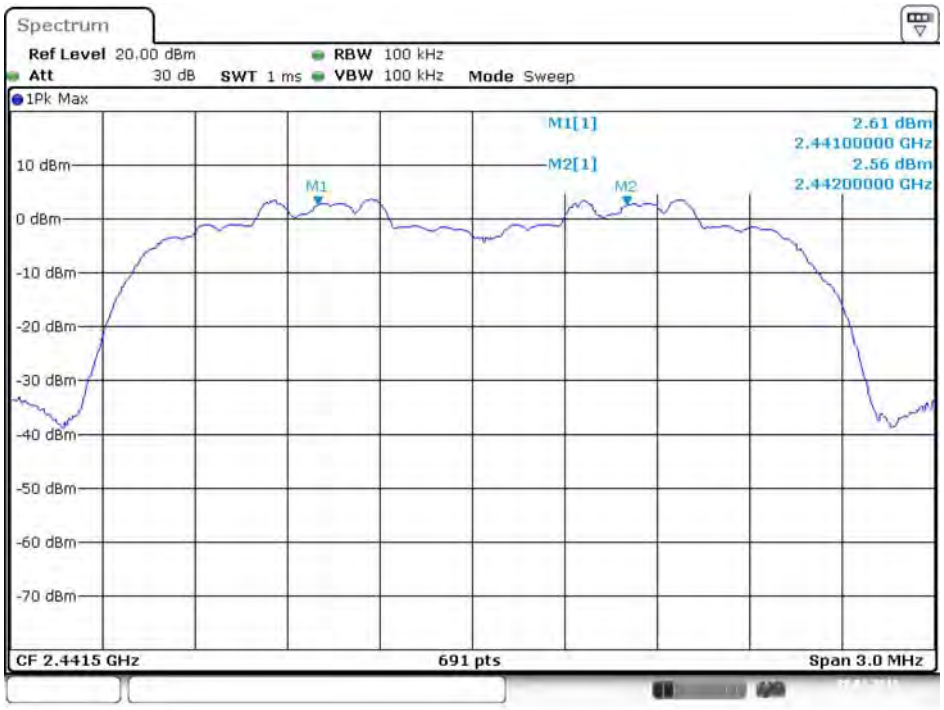
Date: 28.JAN.2016 16:11:15

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



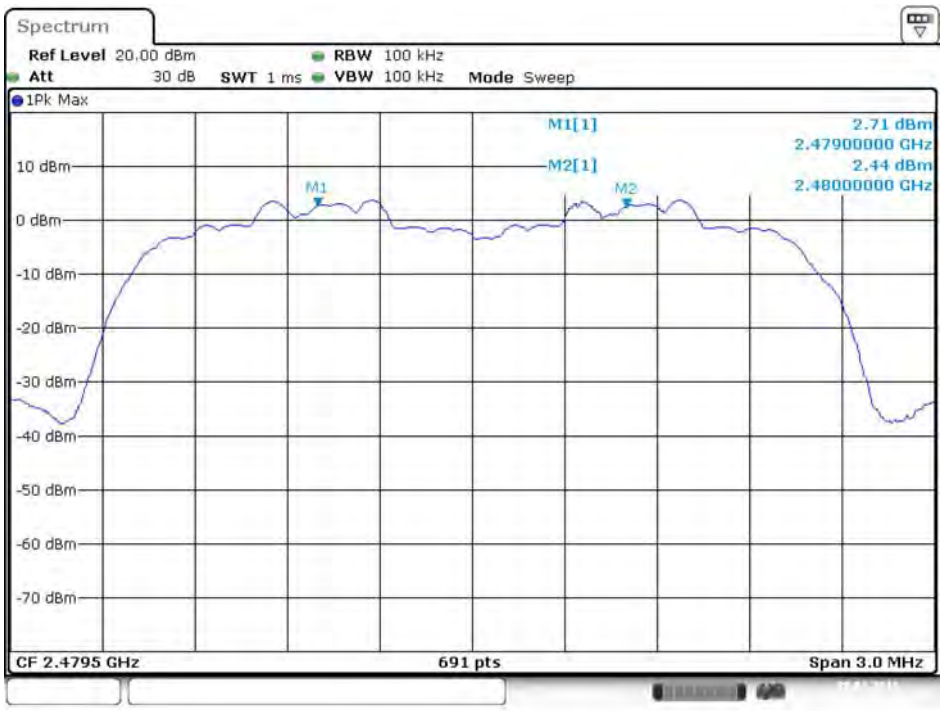
Date: 28.JAN.2016 17:19:24

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



Date: 28.JAN.2016 17:18:03

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



Date: 28.JAN.2016 17:12:14

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

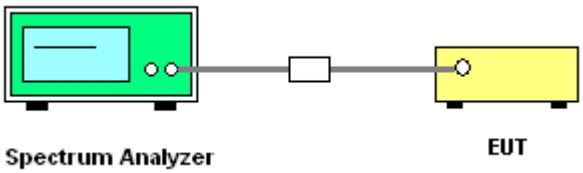
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

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

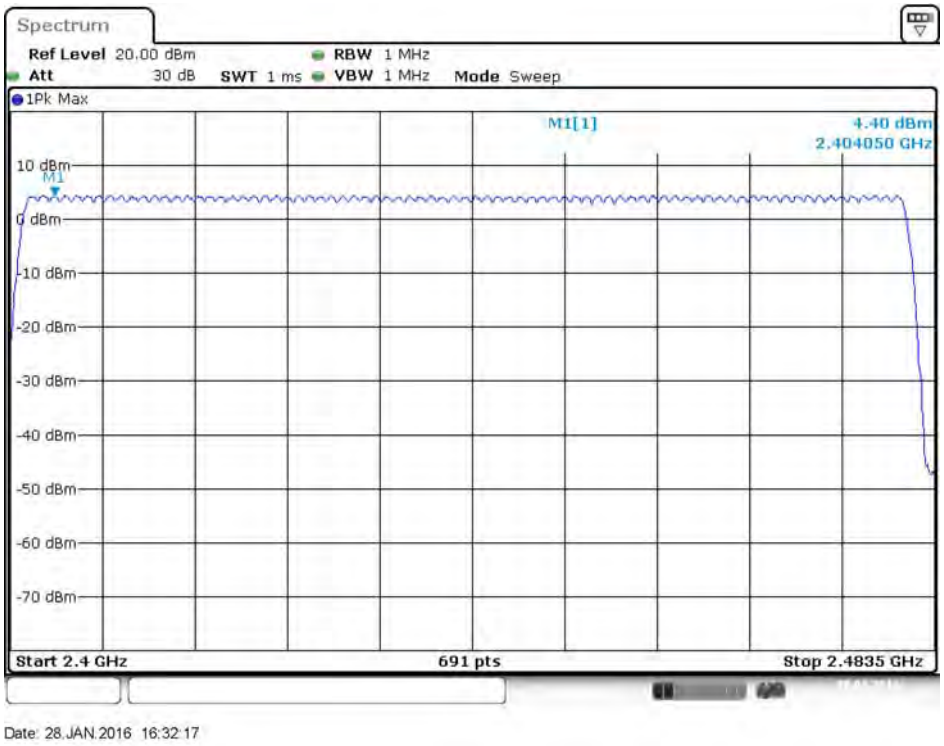
The EUT was programmed to be in continuously transmitting mode.

4.4.7. Test Result of Number of Hopping Frequency

Temperature	25°C	Humidity	58%
Test Engineer	Serway Li / Peter Wu	Configurations	EDR (8DPSK)

Modulation Type	Channel No.	Frequency (MHz)	Hopping Ch. (Channels)	Min. Limit (Channels)	Test Result
EDR (8DPSK)	0 ~ 78	2402 ~ 2480MHz	79	15	Complies

Number of Hopping Channel Plot on EDR (8DPSK) / Channel 0~78 / 2402 MHz ~ 2480 MHz



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

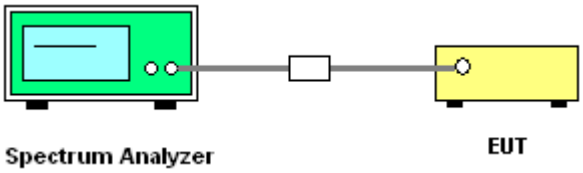
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

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	25°C	Humidity	58%
Test Engineer	Serway Li / Peter Wu	Configurations	BR (GFSK) / DH1, DH3, DH5

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Result
DH1	2402 MHz	0.3739	0.1197	0.4000	Complies
DH3	2402 MHz	1.6261	0.2602	0.4000	Complies
DH5	2402 MHz	2.8870	0.3079	0.4000	Complies
DH1	2441 MHz	0.3652	0.1169	0.4000	Complies
DH3	2441 MHz	1.6261	0.2602	0.4000	Complies
DH5	2441 MHz	2.8696	0.3061	0.4000	Complies
DH1	2480 MHz	0.3739	0.1197	0.4000	Complies
DH3	2480 MHz	1.6261	0.2602	0.4000	Complies
DH5	2480 MHz	2.8870	0.3079	0.4000	Complies

Note: Pulse Duration * Number of Pulses*(Dwell time / measure time)

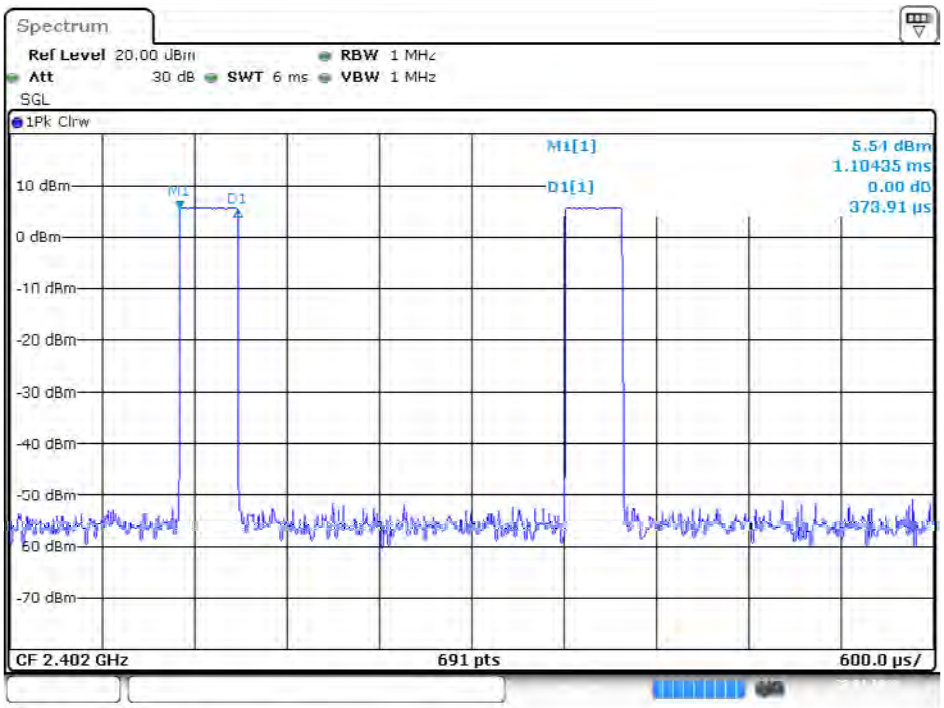
Remark:

Dwell Time=79(channels) x 0.4(s) x average hopping channel x package transfer time (us)

79 channels come from the Hopping Channel number.

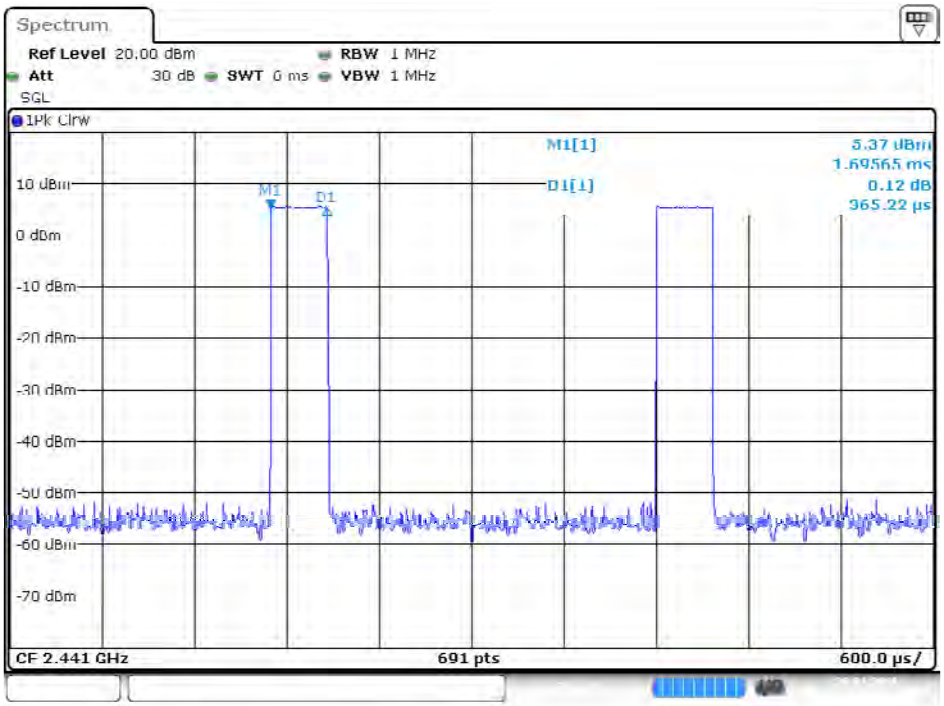
Average Hopping Channel = hops / sweep time

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



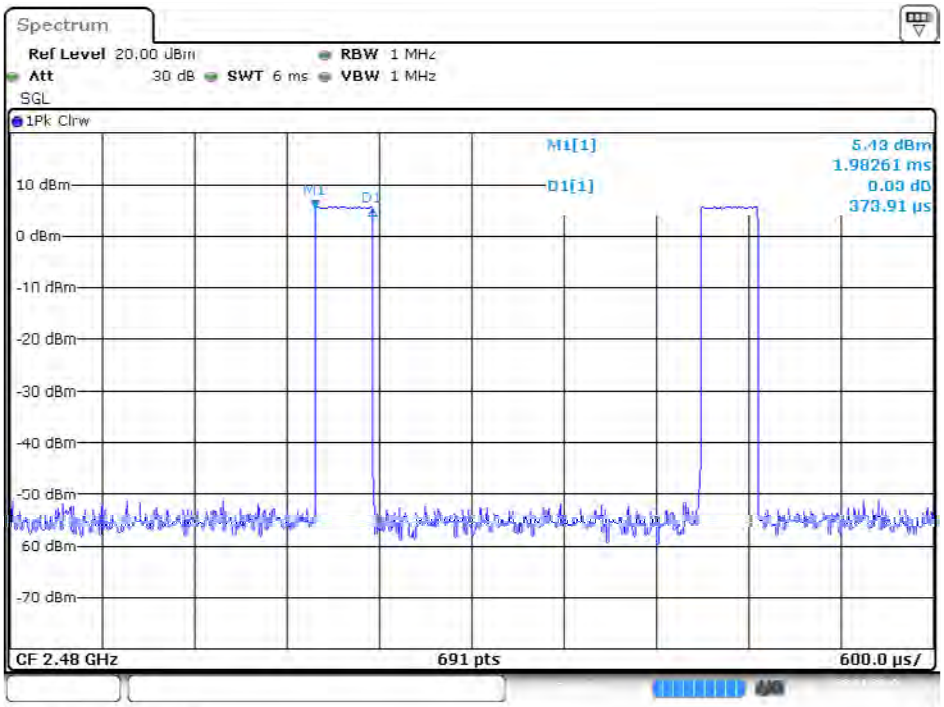
Date: 28.JAN.2016 18:26:40

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



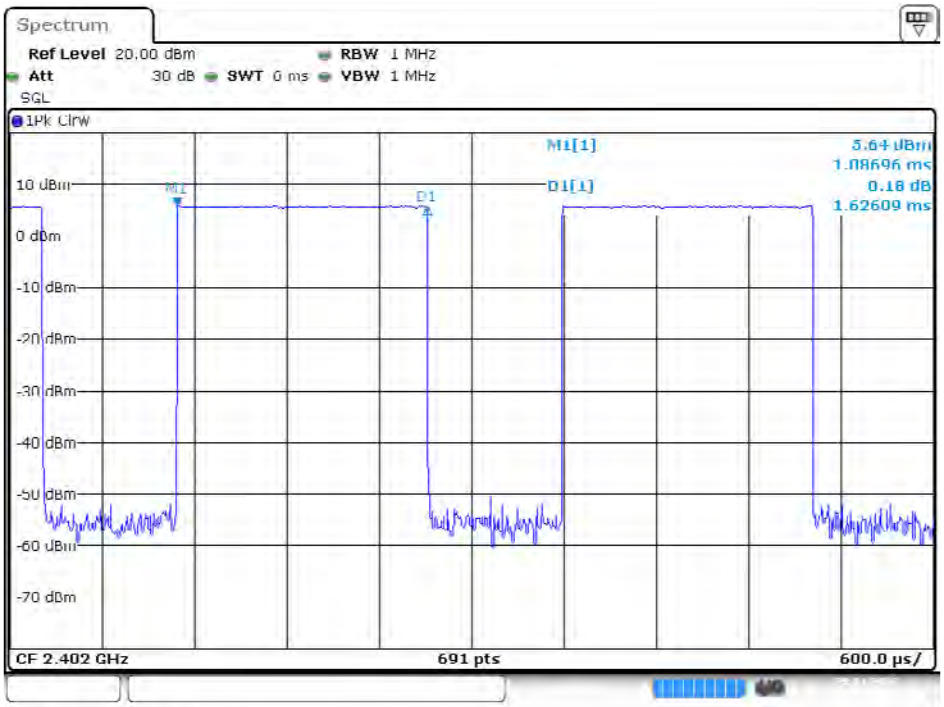
Date: 28.JAN.2016 18:30:49

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



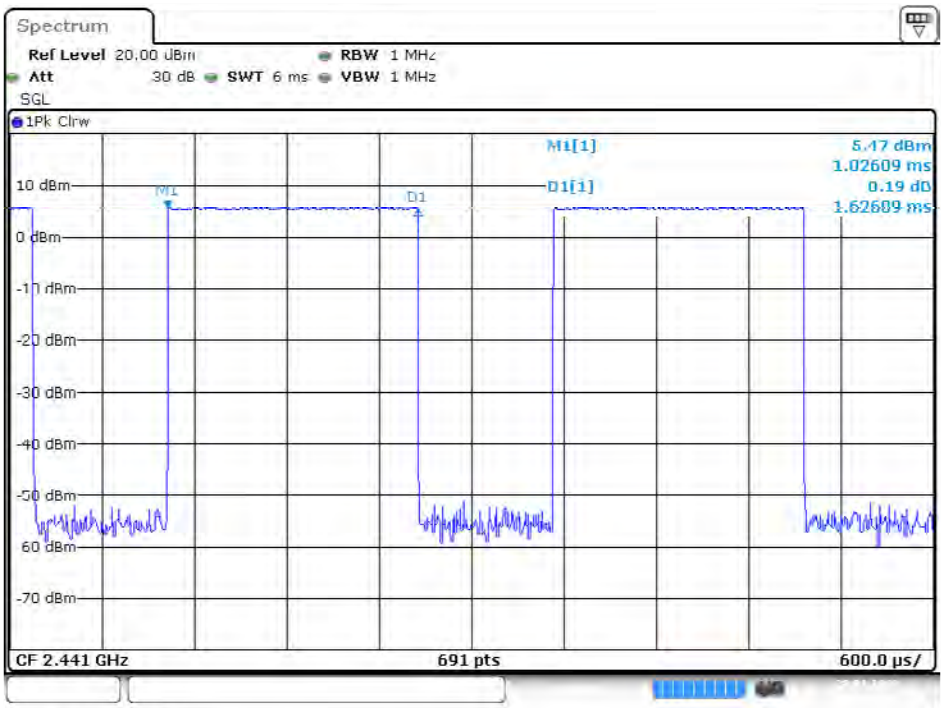
Date: 28.JAN.2016 18:31:54

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



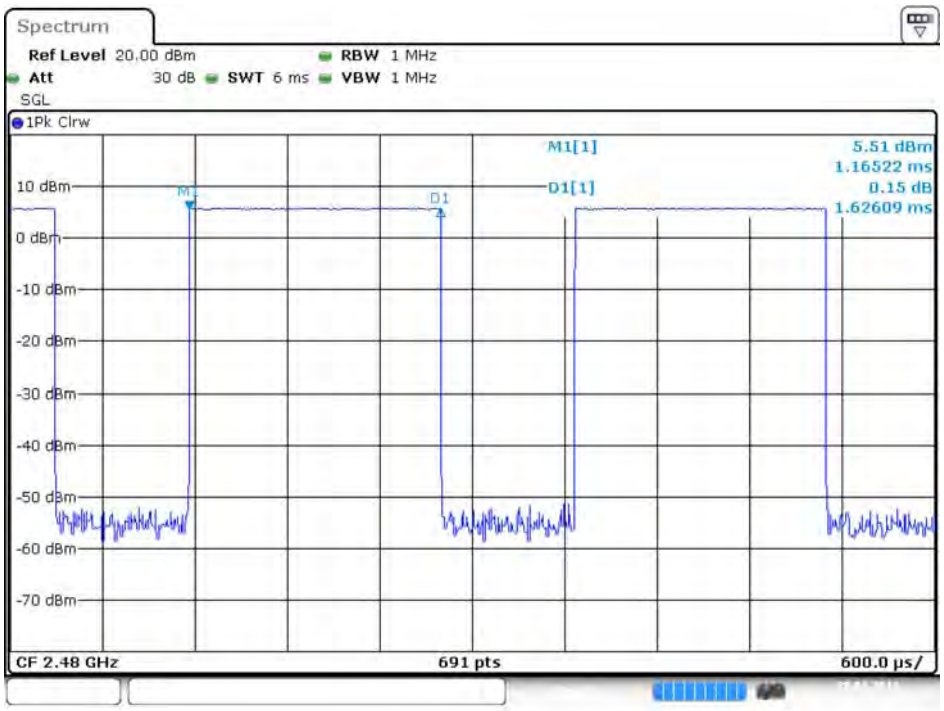
Date: 28.JAN.2016 18:24:06

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



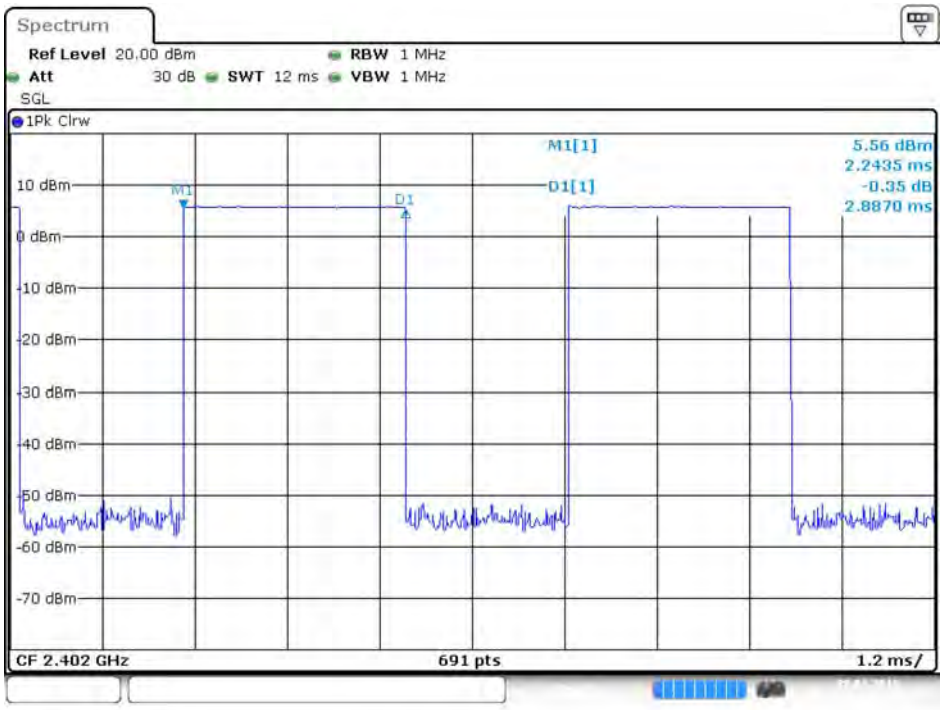
Date: 28.JAN.2016 18:25:10

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



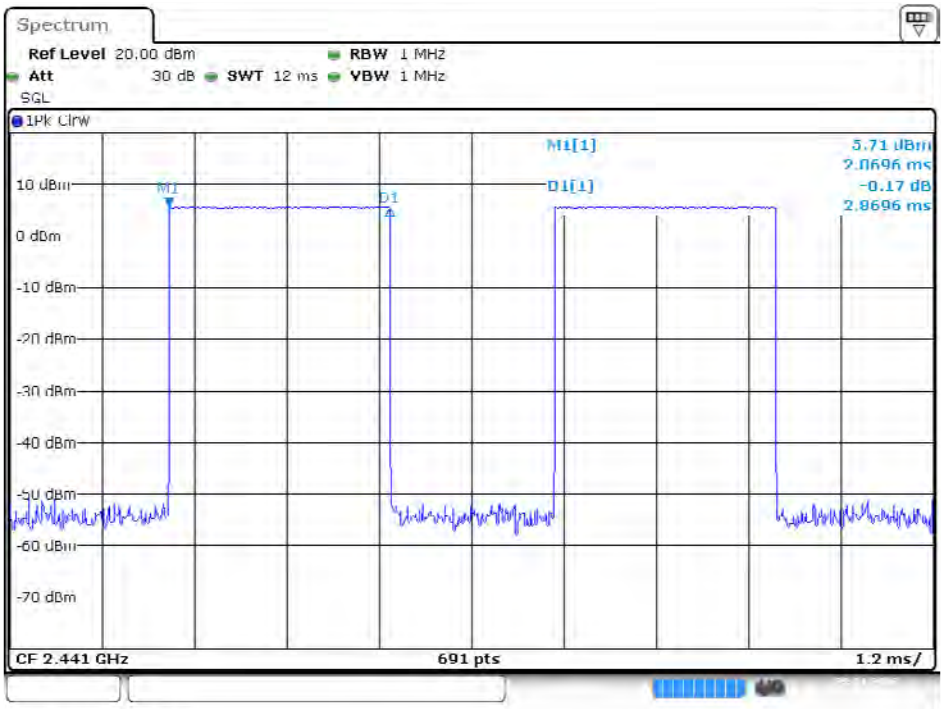
Date: 28.JAN.2016 18:20:03

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



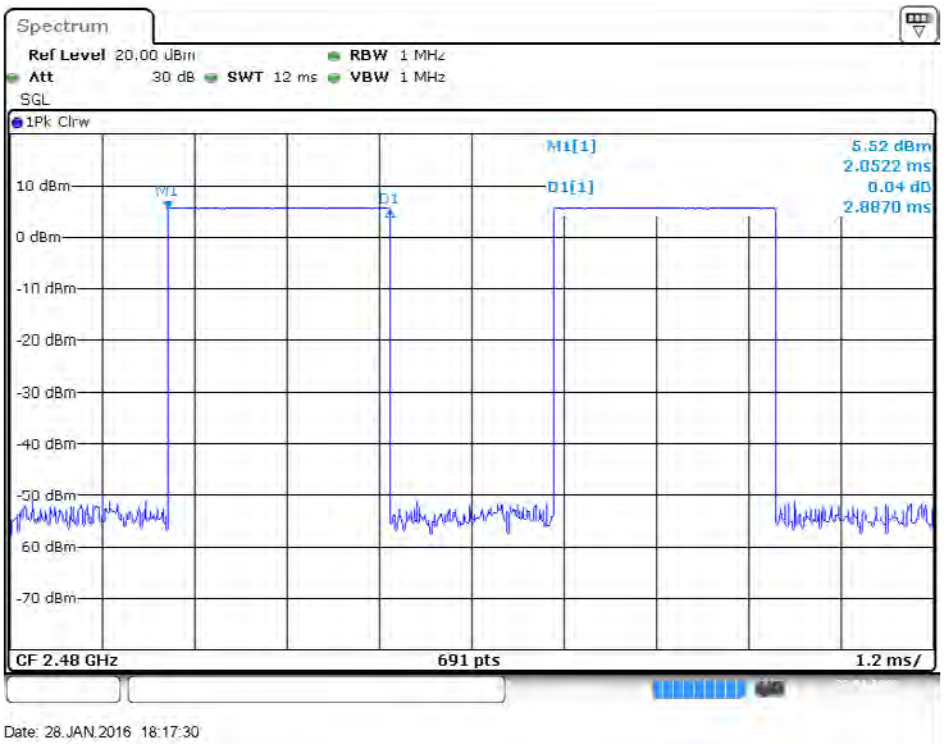
Date: 28.JAN.2016 18:11:05

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



Date: 28.JAN.2016 18:15:45

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



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)	1MHz / 3MHz for Peak, 1MHz / 1/T for Average
RBW / VBW (Emission in non-restricted band)	100kHz, 300kHz for peak

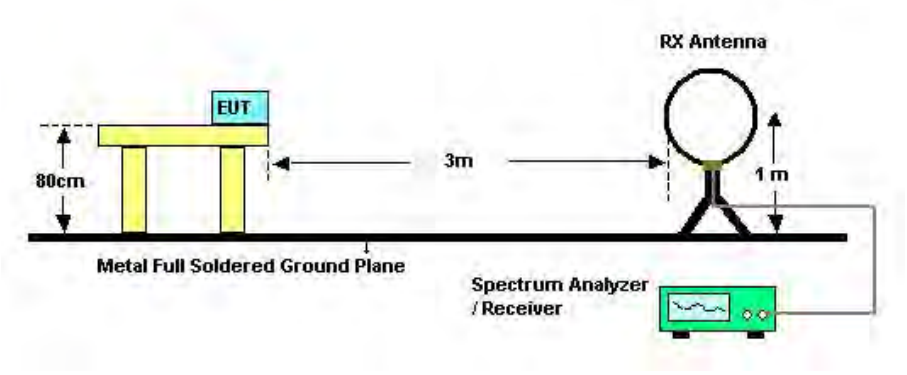
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz, RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz, RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz, RBW 120kHz for QP

4.6.3. Test Procedures

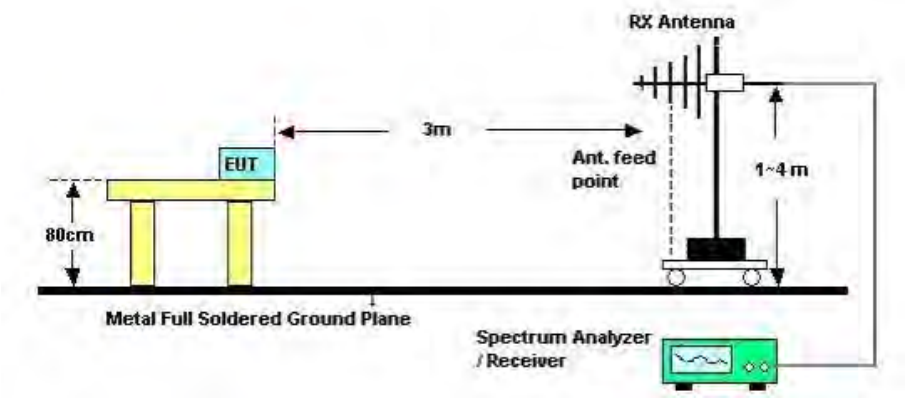
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 1m & 3m far away from the turntable.
2. Power on the EUT and all the supporting 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

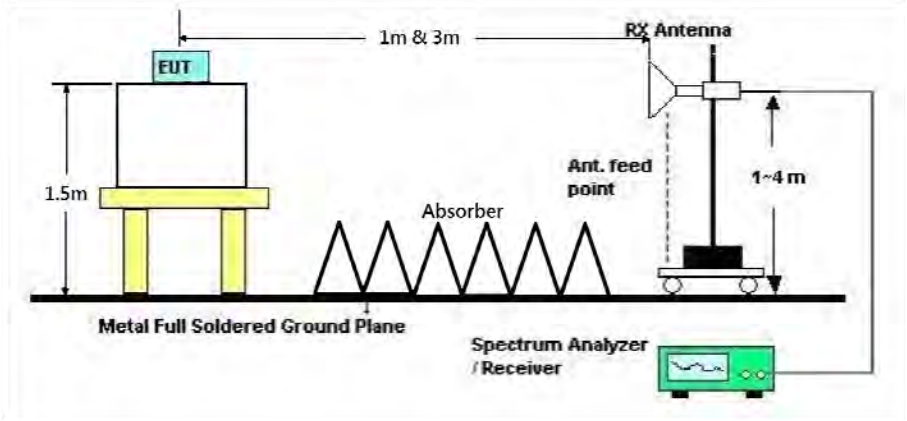
For Radiated Emissions: 9kHz ~30MHz



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	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	Normal Link
Test Date	Jan. 22, 2016	Test Mode	Mode 3

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 20dB below the permissible value has no need to be reported.

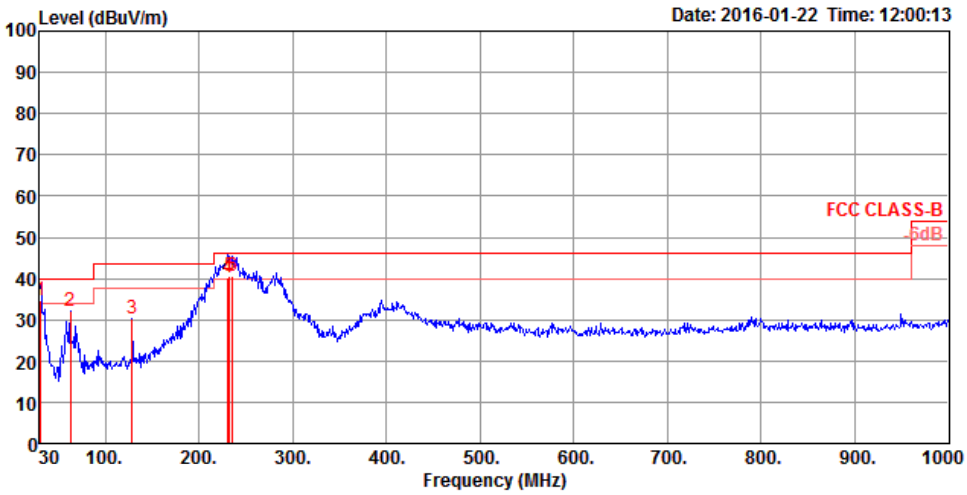
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

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

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

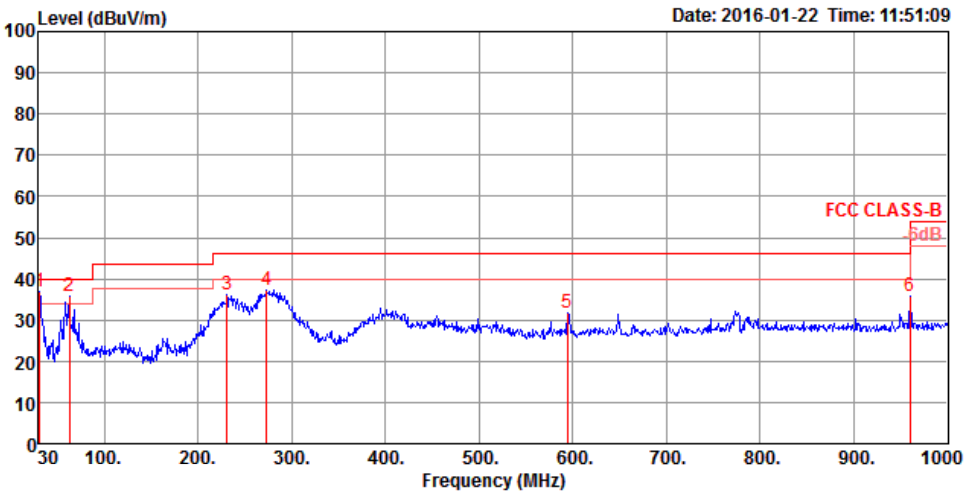
Temperature	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	Normal Link
Test Mode	Mode 3		

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	30.97	34.75	40.00	-5.25	41.52	0.50	25.13	32.40	100	62	QP	HORIZONTAL
2	62.98	32.11	40.00	-7.89	50.35	0.70	13.46	32.40	200	187	Peak	HORIZONTAL
3	128.94	30.43	43.50	-13.07	42.99	0.98	18.83	32.37	150	236	Peak	HORIZONTAL
4	230.79	40.13	46.00	-5.87	53.56	1.30	17.58	32.31	150	80	QP	HORIZONTAL
5	232.73	40.59	46.00	-5.41	53.87	1.30	17.73	32.31	150	230	QP	HORIZONTAL
6	235.64	40.55	46.00	-5.45	53.53	1.31	18.02	32.31	200	207	QP	HORIZONTAL

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	30.97	36.94	40.00	-3.06	43.71	0.50	25.13	32.40	100	257	Peak	VERTICAL
2	62.98	35.71	40.00	-4.29	53.95	0.70	13.46	32.40	150	266	Peak	VERTICAL
3	230.79	36.21	46.00	-9.79	49.64	1.30	17.58	32.31	200	140	Peak	VERTICAL
4	273.47	37.43	46.00	-8.57	48.68	1.41	19.63	32.29	200	2	Peak	VERTICAL
5	594.54	31.55	46.00	-14.45	36.50	2.11	25.35	32.41	100	359	Peak	VERTICAL
6	960.23	35.79	54.00	-18.21	36.09	2.69	28.20	31.19	100	126	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~10th Harmonic)

Temperature	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	BR (GFSK) / Channel 0
Test Date	Jan. 30, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4804.30	21.54	54.00	-32.46	18.33	7.19	32.56	36.54	150	58	HORIZONTAL	Average
2	4804.30	45.98	74.00	-28.02	42.77	7.19	32.56	36.54	150	58	HORIZONTAL	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4804.69	21.13	54.00	-32.87	17.92	7.19	32.56	36.54	150	77	VERTICAL	Average
2	4804.69	45.57	74.00	-28.43	42.36	7.19	32.56	36.54	150	77	VERTICAL	Peak

Temperature	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	BR (GFSK) / Channel 39
Test Date	Jan. 30, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4882.58	21.06	54.00	-32.94	17.78	7.10	32.71	36.53	150	94	HORIZONTAL	Average
2	4882.58	45.50	74.00	-28.50	42.22	7.10	32.71	36.53	150	94	HORIZONTAL	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4882.43	21.33	54.00	-32.67	18.05	7.10	32.71	36.53	150	116	VERTICAL	Average
2	4882.43	45.77	74.00	-28.23	42.49	7.10	32.71	36.53	150	116	VERTICAL	Peak

Temperature	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	BR (GFSK) / Channel 78
Test Date	Jan. 30, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4959.07	21.11	54.00	-32.89	17.77	7.03	32.83	36.52	150	140	HORIZONTAL	Average
2	4959.07	45.55	74.00	-28.45	42.21	7.03	32.83	36.52	150	140	HORIZONTAL	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4959.60	21.59	54.00	-32.41	18.25	7.03	32.83	36.52	150	232	VERTICAL	Average
2	4959.60	46.03	74.00	-27.97	42.69	7.03	32.83	36.52	150	232	VERTICAL	Peak

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.

Temperature	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	EDR (8DPSK) / Channel 0
Test Date	Jan. 30, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4803.38	21.00	54.00	-33.00	17.79	7.19	32.56	36.54	150	282	HORIZONTAL	Average
2	4803.38	45.44	74.00	-28.56	42.23	7.19	32.56	36.54	150	282	HORIZONTAL	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4804.74	21.46	54.00	-32.54	18.25	7.19	32.56	36.54	150	304	VERTICAL	Average
2	4804.74	45.90	74.00	-28.10	42.69	7.19	32.56	36.54	150	304	VERTICAL	Peak

Temperature	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	EDR (8DPSK) / Channel 39
Test Date	Jan. 30, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4882.30	20.40	54.00	-33.60	17.12	7.10	32.71	36.53	150	269	HORIZONTAL	Average
2	4882.30	44.84	74.00	-29.16	41.56	7.10	32.71	36.53	150	269	HORIZONTAL	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4882.59	21.35	54.00	-32.65	18.07	7.10	32.71	36.53	150	220	VERTICAL	Average
2	4882.59	45.79	74.00	-28.21	42.51	7.10	32.71	36.53	150	220	VERTICAL	Peak

Temperature	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	EDR (8DPSK) / Channel 78
Test Date	Jan. 30, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4959.78	21.10	54.00	-32.90	17.76	7.03	32.83	36.52	150	191	HORIZONTAL	Average
2	4959.78	45.54	74.00	-28.46	42.20	7.03	32.83	36.52	150	191	HORIZONTAL	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	4959.83	21.21	54.00	-32.79	17.87	7.03	32.83	36.52	150	160	VERTICAL	Average
2	4959.83	45.65	74.00	-28.35	42.31	7.03	32.83	36.52	150	160	VERTICAL	Peak

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 (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

4.7.2. 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

<u>For Radiated band edges Measurement</u>:

1. The test procedure is the same as section 4.6.3.

<u>For Radiated Out of Band Emission Measurement</u>:

1. The test procedure is follow 15.247(d).

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	17°C	Humidity	38%
Test Engineer	Paul Chen	Configurations	BR (GFSK) / Channel 0, 39, 78
Test Date	Jan. 29, 2016		

Channel 0

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	2382.60	31.64	54.00	-22.36	-0.23	3.96	27.91	0.00	241	180	HORIZONTAL	Average
2	2382.60	56.08	74.00	-17.92	24.21	3.96	27.91	0.00	241	180	HORIZONTAL	Peak
3	2402.00	74.55			42.68	3.98	27.89	0.00	241	180	HORIZONTAL	Average
4	2402.00	98.99			67.12	3.98	27.89	0.00	241	180	HORIZONTAL	Peak

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

Channel 39

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	2387.60	31.57	54.00	-22.43	-0.30	3.97	27.90	0.00	193	188	HORIZONTAL	Average
2	2387.60	56.01	74.00	-17.99	24.14	3.97	27.90	0.00	193	188	HORIZONTAL	Peak
3	2441.00	77.62			45.74	4.03	27.85	0.00	193	188	HORIZONTAL	Average
4	2441.00	102.06			70.18	4.03	27.85	0.00	193	188	HORIZONTAL	Peak
5	2491.80	31.24	54.00	-22.76	-0.65	4.08	27.81	0.00	193	188	HORIZONTAL	Average
6	2491.80	55.68	74.00	-18.32	23.79	4.08	27.81	0.00	193	188	HORIZONTAL	Peak

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

Channel 78

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	2480.00	78.52			46.64	4.06	27.82	0.00	208	191	HORIZONTAL	Average
2	2480.00	102.96			71.08	4.06	27.82	0.00	208	191	HORIZONTAL	Peak
3	2487.50	32.12	54.00	-21.88	0.24	4.07	27.81	0.00	208	191	HORIZONTAL	Average
4	2487.50	56.56	74.00	-17.44	24.68	4.07	27.81	0.00	208	191	HORIZONTAL	Peak

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

Note:

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

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

Temperature	17℃	Humidity	38%
Test Engineer	Paul Chen	Configurations	EDR (8DPSK) / Channel 0, 39, 78
Test Date	Jan. 29, 2016~Jan. 30, 2016		

Channel 0

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	2376.60	32.24	54.00	-21.76	0.37	3.96	27.91	0.00	127	243	VERTICAL	Average
2	2376.60	56.68	74.00	-17.32	24.81	3.96	27.91	0.00	127	243	VERTICAL	Peak
3	2402.00	65.63			33.76	3.98	27.89	0.00	127	243	VERTICAL	Average
4	2402.00	90.07			58.20	3.98	27.89	0.00	127	243	VERTICAL	Peak

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

Channel 39

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	2371.00	31.13	54.00	-22.87	-0.75	3.96	27.92	0.00	234	190	HORIZONTAL	Average
2	2371.00	55.57	74.00	-18.43	23.69	3.96	27.92	0.00	234	190	HORIZONTAL	Peak
3	2441.40	76.03			44.15	4.03	27.85	0.00	234	190	HORIZONTAL	Average
4	2441.40	100.47			68.59	4.03	27.85	0.00	234	190	HORIZONTAL	Peak
5	2498.30	31.04	54.00	-22.96	-0.85	4.09	27.80	0.00	234	190	HORIZONTAL	Average
6	2498.30	55.48	74.00	-18.52	23.59	4.09	27.80	0.00	234	190	HORIZONTAL	Peak

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

Channel 78

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	2480.20	70.82			38.94	4.06	27.82	0.00	216	248	VERTICAL	Average
2	2480.20	95.26			63.38	4.06	27.82	0.00	216	248	VERTICAL	Peak
3	2486.60	31.49	54.00	-22.51	-0.39	4.07	27.81	0.00	216	248	VERTICAL	Average
4	2486.60	55.93	74.00	-18.07	24.05	4.07	27.81	0.00	216	248	VERTICAL	Peak

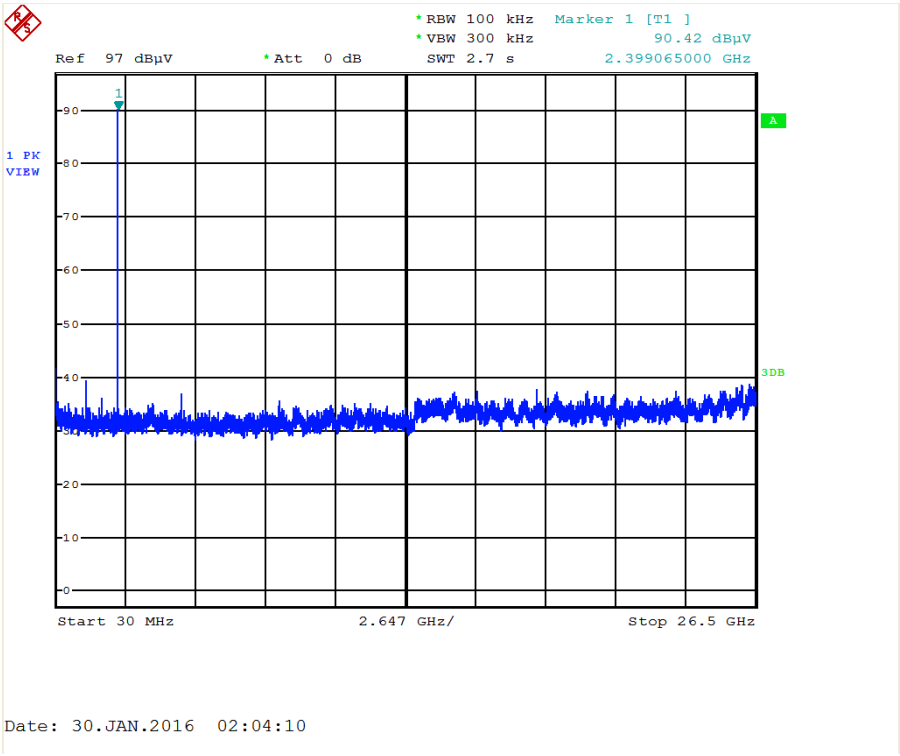
Item 1, 2 are the fundamental frequency at 2480 MHz.

Note:

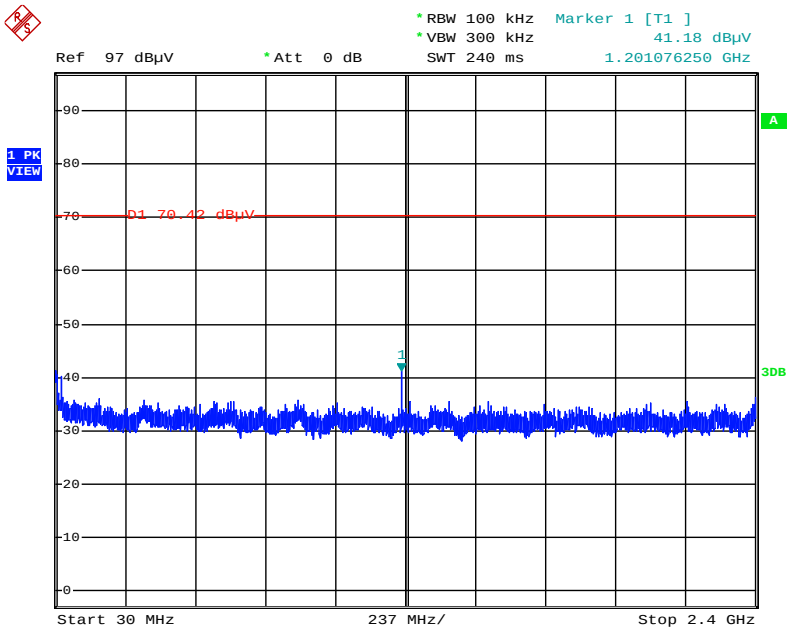
Emission level (dBuV/m) = 20 log Emission level (uV/m).

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

Plot on Configuration For BR (GFSK) / Channel 0 / Reference Level

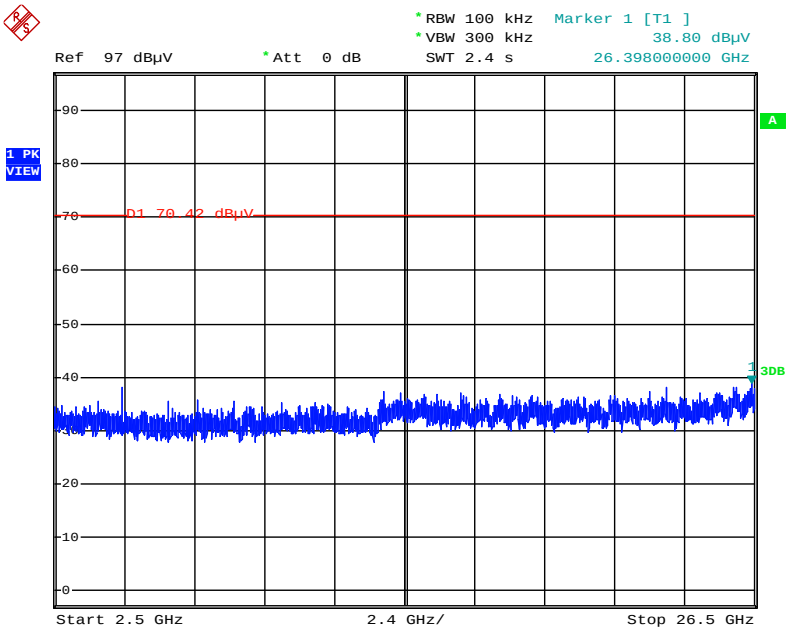


Plot on Configuration For BR (GFSK) / Channel 0 / 30MHz~2400MHz (down 20dBc)



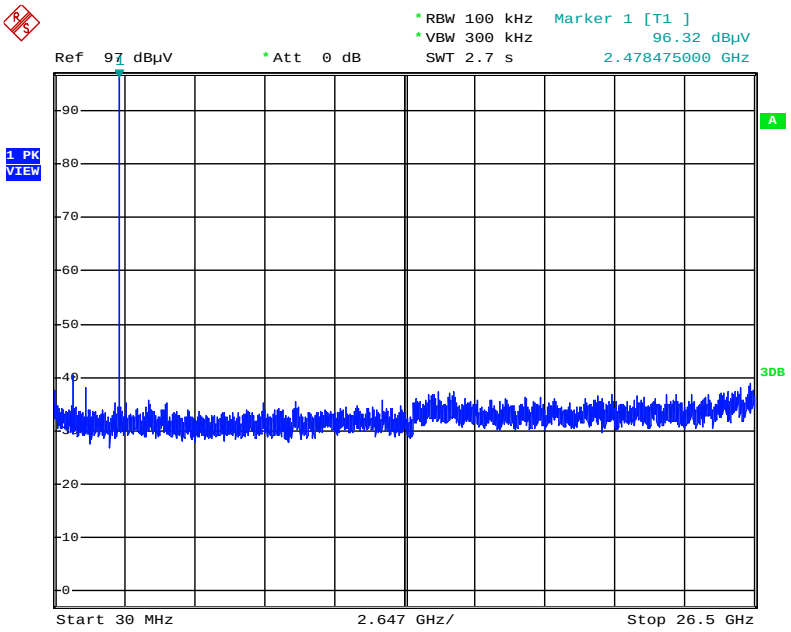
Date: 30.JAN.2016 02:05:30

Plot on Configuration For BR (GFSK) / Channel 0 / 2500MHz~26500MHz (down 20dBc)



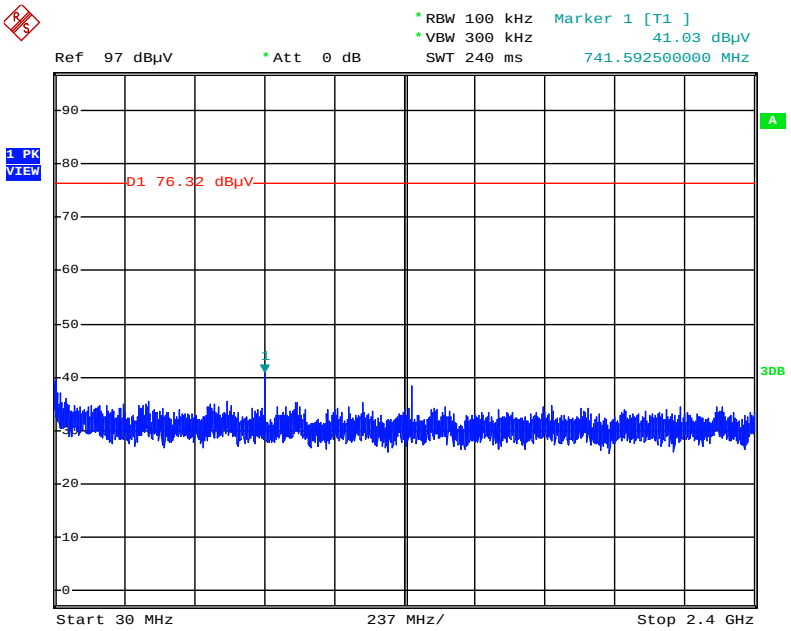
Date: 30.JAN.2016 02:06:22

Plot on Configuration For BR (GFSK) / Channel 78 / Reference Level



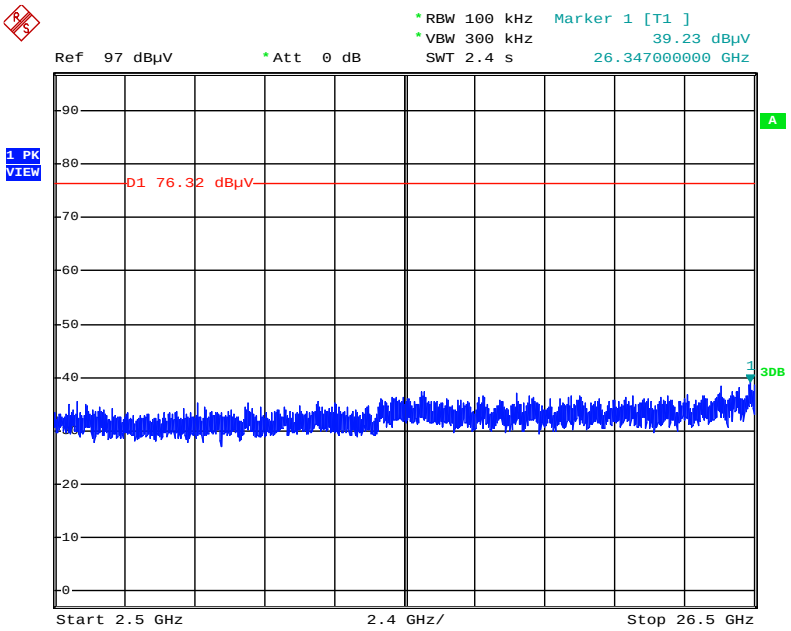
Date: 30.JAN.2016 02:08:50

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



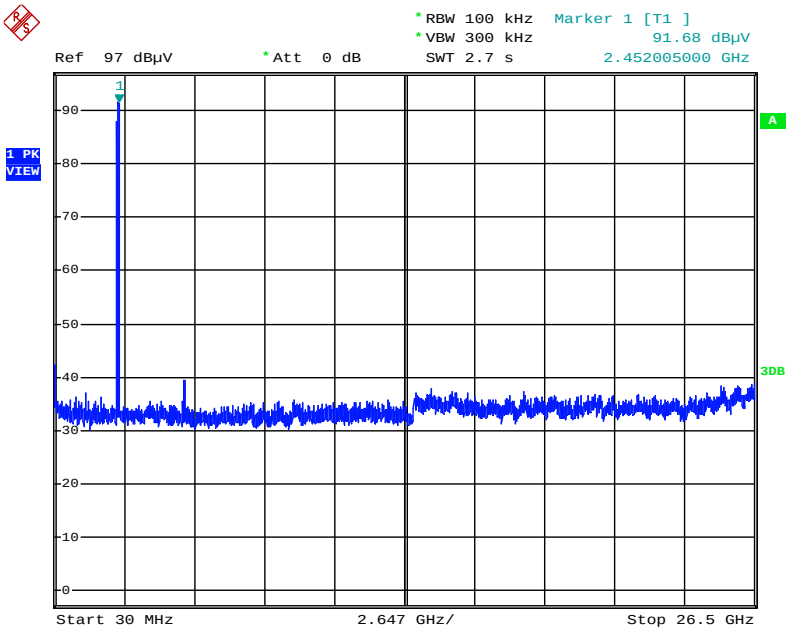
Date: 30.JAN.2016 02:09:26

Plot on Configuration For BR (GFSK) / Channel 78 / 2500MHz~26500MHz (down 20dBc)



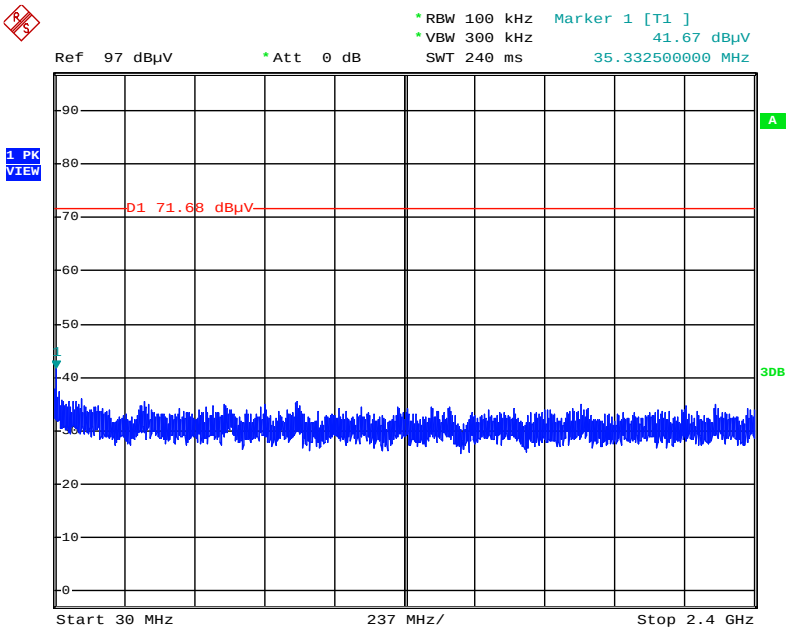
Date: 30.JAN.2016 02:10:01

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



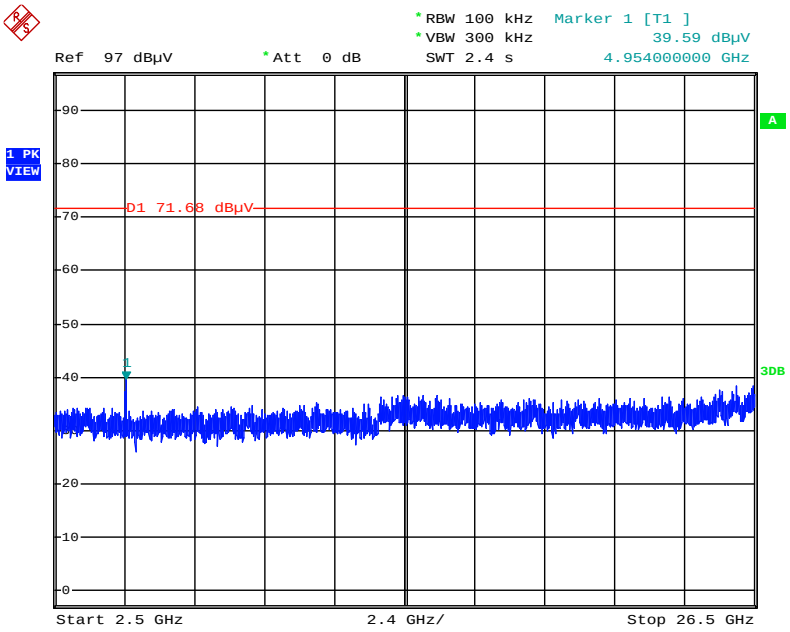
Date: 30.JAN.2016 02:25:59

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



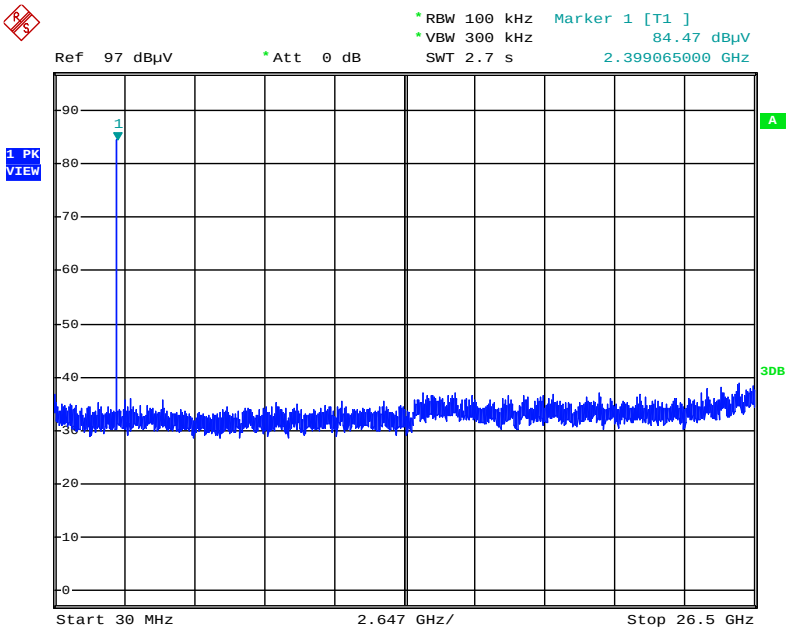
Date: 30.JAN.2016 02:26:47

Plot on Configuration For BR (GFSK) / Hopping / 2500MHz~26500MHz (down 20dBc)



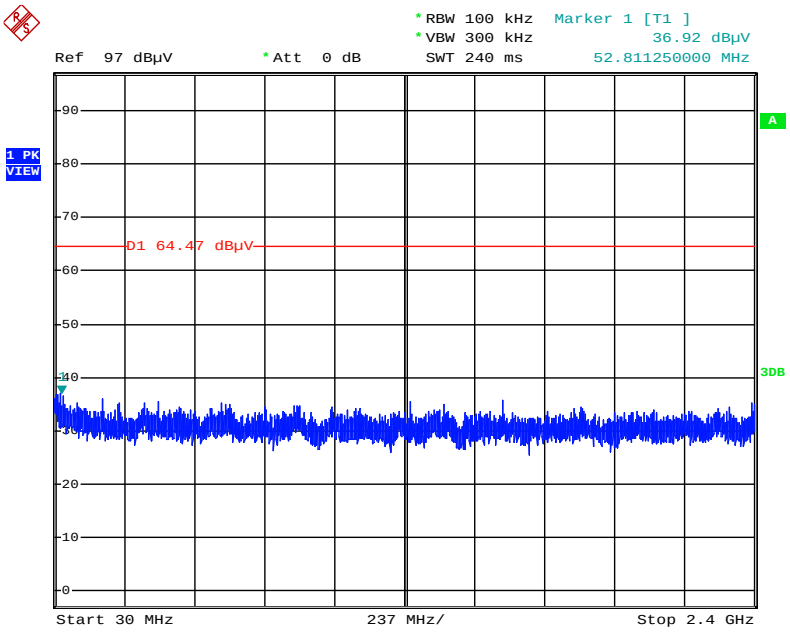
Date: 30.JAN.2016 02:27:15

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



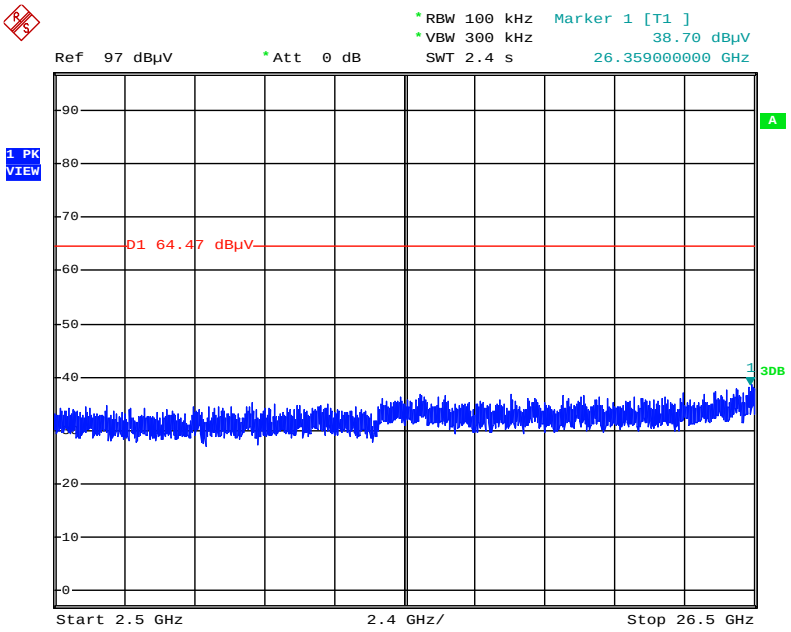
Date: 30.JAN.2016 02:14:36

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



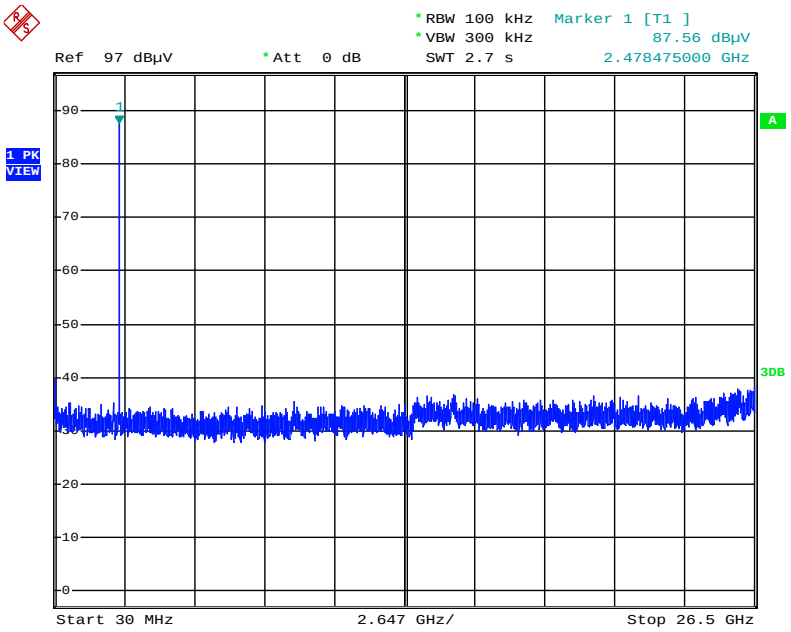
Date: 30.JAN.2016 02:15:28

Plot on Configuration For EDR (8DPSK) / Channel 0 / 2500MHz~26500MHz (down 20dBc)



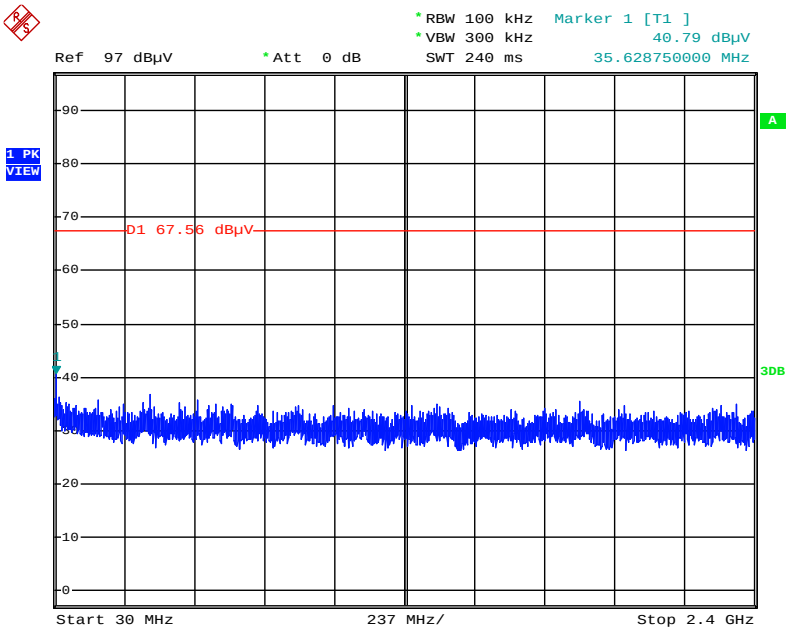
Date: 30.JAN.2016 02:15:52

Plot on Configuration For EDR (8DPSK) / Channel 78 / Reference Level



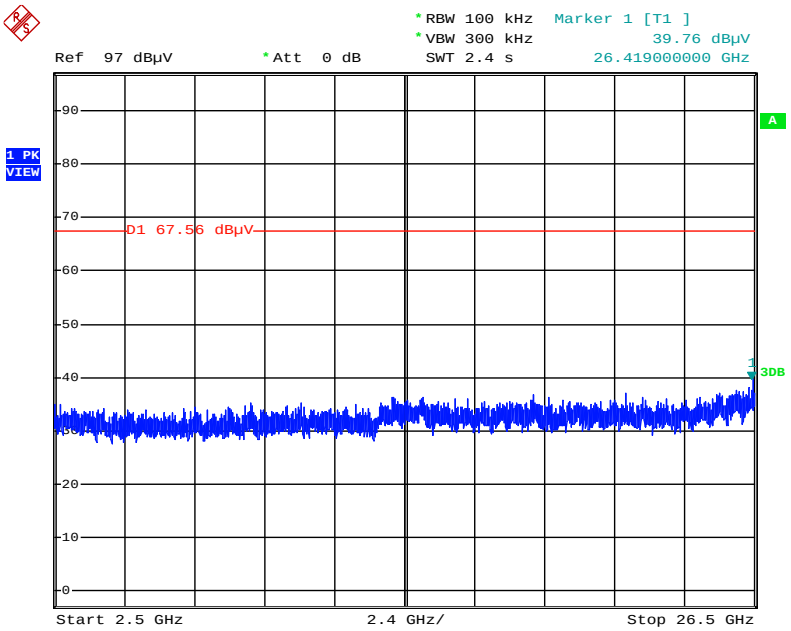
Date: 30.JAN.2016 02:19:53

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



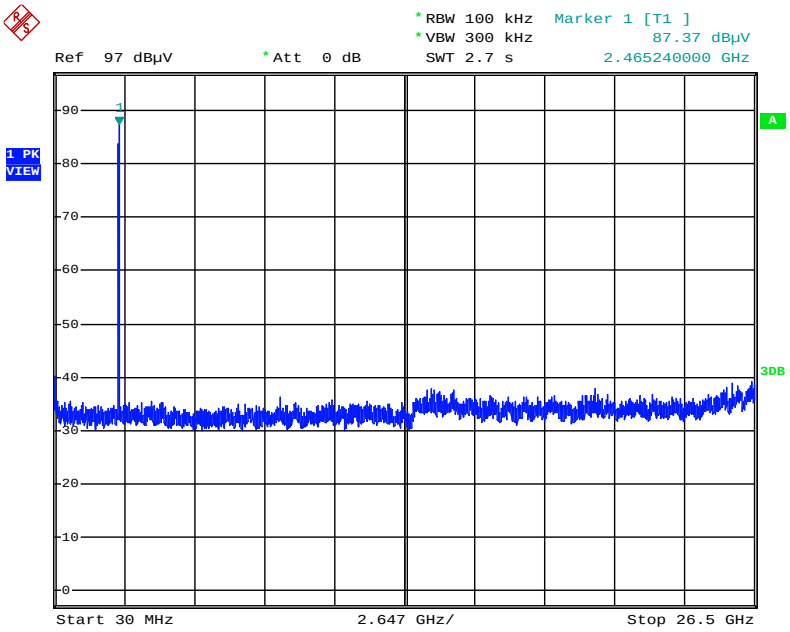
Date: 30.JAN.2016 02:20:28

Plot on Configuration For EDR (8DPSK) / Channel 78 / 2500MHz~26500MHz (down 20dBc)



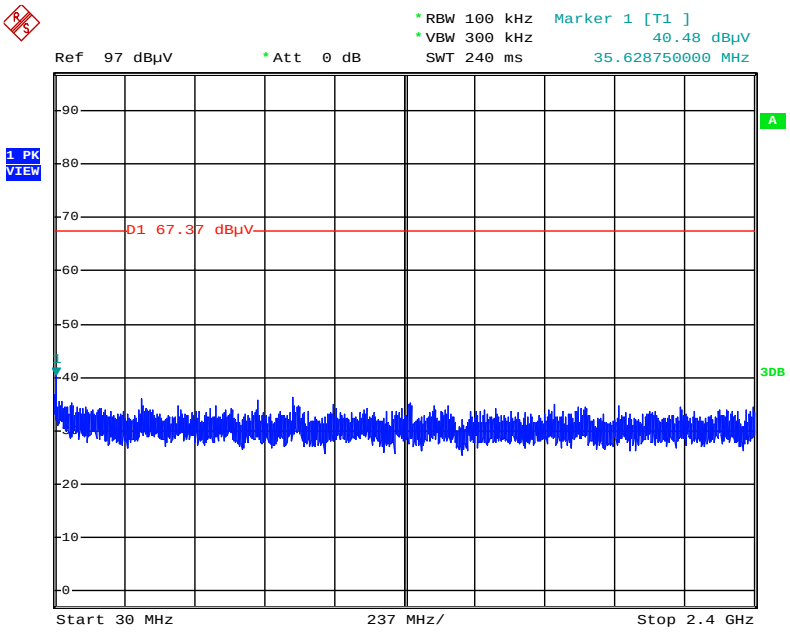
Date: 30.JAN.2016 02:20:55

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



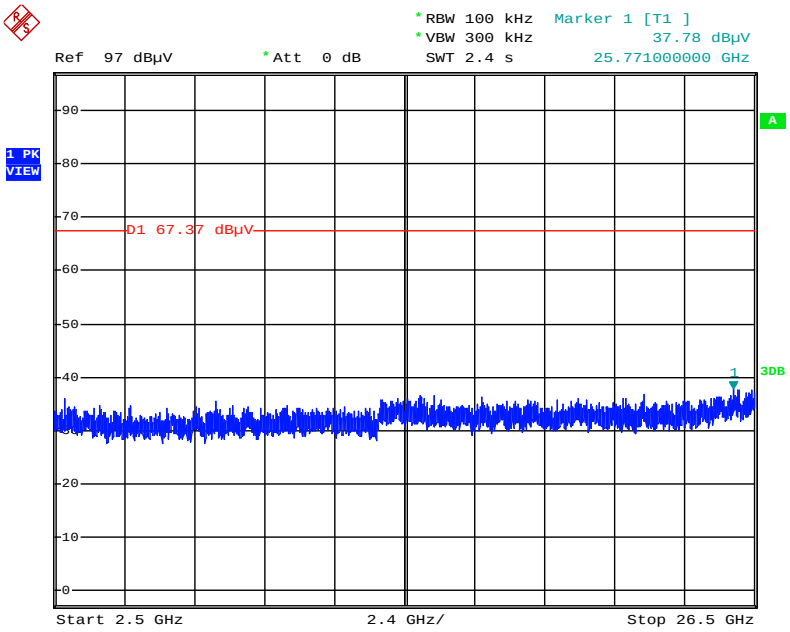
Date: 30.JAN.2016 02:28:56

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



Date: 30.JAN.2016 02:29:22

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



Date: 30.JAN.2016 02:29:45

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
LISN	Schwarzbeck	NSLK 8127	8127650	9kHz ~ 30MHz	Nov. 16, 2015	Conduction (CO02-CB)
LISN	Schwarzbeck	NSLK 8127	8127478	9kHz ~ 30MHz	Nov. 13, 2015	Conduction (CO02-CB)
EMI Receiver	Agilent	N9038A	MY52260140	9kHz ~ 8.4GHz	Jan. 18, 2016	Conduction (CO02-CB)
COND Cable	Woken	Cable	01	0.15MHz ~ 30MHz	Dec. 01, 2015	Conduction (CO02-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	Conduction (CO02-CB)
Pulse Limiter	Schwarzbeck	VTSD 9561F	9561-F073	9kHz ~ 30MHz	Sep. 30, 2015	Conduction (CO02-CB)
BILOG ANTENNA	Schaffner	CBL6112D	37880	20MHz ~ 2GHz	Sep. 03, 2015	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 12, 2015*	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Oct. 22, 2015	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 21, 2015	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Feb. 24, 2015	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 18, 2016	Radiation (03CH01-CB)
Pre-Amplifier	WM	TF-130N-R1	923365	26GHz ~ 40GHz	Feb.10, 2015	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Oct. 27, 2015	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-16	N/A	1 GHz ~ 18 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-17	N/A	1 GHz ~ 18 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-1	N/A	18GHz ~ 40 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-2	N/A	18GHz ~ 40 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
Test Software	Audix	E3	6.2009-I0-7	N/A	N/A	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSV40	100979	9kHz~40GHz	Dec. 09, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-7	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-8	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-9	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-10	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-6	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
Power Sensor	Agilent	U2021XA	MY53410001	50MHz~18GHz	Nov. 02, 2015	Conducted (TH01-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%