FCC RADIO TEST REPORT
FCC 47 CFR PART 15 SUBPART C

Test Standard	**FCC Part 15.247**
FCC ID	**C53WWS110SBR**
Product name	**Mini Wireless Barcode Reader**
Brand name	**Wasp**
Model name	**WWS110SBR**
Test Result	**Pass**

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory)

Testing Laboratory
1309

Approved by:

Sam Chuang
Manager
Compliance Certification Services Inc.

Tested by:

Kevin Kuo
Engineer
Compliance Certification Services Inc.

Revision History

Rev.	Issue Date	Revisions	Revised By
00	December 22, 2017	Initial Issue	Allison Chen
01	December 28, 2017	1. Revised section 3.2 in the P.11	Angel Cheng

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1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	Wasp Barcode Technologies
Applicant Address	1400, 10th Street, Plano, TX 75074 United States
Equipment	Mini Wireless Barcode Reader
Model Name	WWS110SBR
Model Discrepancy	N/A
EUT Functions	BT2.1+EDR
Received Date	September 25, 2017
Date of Test	December 19 ~ December 20, 2017
Output Power(W)	GFSK : 0.0034 W π/4-DQPSK :0.0023 W 8DPSK : 0.0025 W
Power Operation	☐ AC 120V/60Hz ☐ Adapter ☐ PoE ☒ Host system : ☐ DC Type : ☒ Battery ☐ DC Power Supply ☐ External DC adapter

1.2 EUT CHANNEL INFORMATION

Frequency Range	2402MHz-2480MHz
Modulation Type	1. GFSK for BR-1Mbps 2. π/4-DQPSK for EDR-2Mbps 3. 8DPSK for EDR-3Mbps
Number of channel	79 Channels

Remark:
Refer as ANSI 63.10:2013 clause 5.6.1 Table 4 for test channels

Number of frequencies to be tested		
Frequency range in which device operates	**Number of frequencies**	**Location in frequency range of operation**
☐ 1 MHz or less	1	Middle
☐ 1 MHz to 10 MHz	2	1 near top and 1 near bottom
☒ More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

1.3 ANTENNA INFORMATION

Antenna Type	☐ PIFA(Printed) ☐ PCB ☐ Dipole ☒ Chip ☐ Coils
Antenna Gain	2.66 dBi

1.4 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 30 to 1000 MHz	+/- 3.97
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 1 to 18GHz	+/- 3.58
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 18 to 26 GHz	+/- 3.59
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 26 to 40 GHz	+/- 3.81
Conducted Emission (Mains Terminals), 9kHz to 30MHz	+/- 2.48

Remark:
1.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

1.5 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at

No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)

Test site	Test Engineer	Remark
AC Conduction Room	Eric Lee	-
Radiation	Kevin Kuo	-
RF Conducted	Kevin Kuo	-

Remark: *The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.*

1.6 INSTRUMENT CALIBRATION

RF Conducted Test Site					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal Date**	**Cal Due**
Power Meter	Anritsu	ML2495A	1033009	04/11/2017	04/10/2018
Power Sensor	Anritsu	MA2411B	917072	07/03/2017	07/02/2018
Spectrum Analyzer	R&S	FSV 40	101073	10/02/2017	10/01/2018
Thermostatic/Hrgrosatic Chamber	GWINSTEK	GTC-288MH-CC	TH160402	05/23/2017	05/22/2018
Directional Coupler	Agilent	87301D	MY44350252	07/25/2017	07/24/2018
SUCOFLEX Cable	HUBER SUHNER	SUCOFLEX 104PEA	25157	07/31/2017	07/30/2018
Divider	Solvang Technology	2-18GHz 4Way	STI08-0015	07/26/2017	07/25/2018

3M 966 Chamber Test Site					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal Date**	**Cal Due**
Bilog Antenna	Sunol Sciences	JB3	A030105	06/20/2017	06/19/2018
Pre-Amplifier	EMEC	EM330	060609	06/07/2017	06/06/2018
Spectrum Analyzer	Agilent	E4446A	US42510252	11/27/2017	11/26/2018
Loop Ant	COM-POWER	AL-130	121051	03/02/2017	03/01/2018
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R

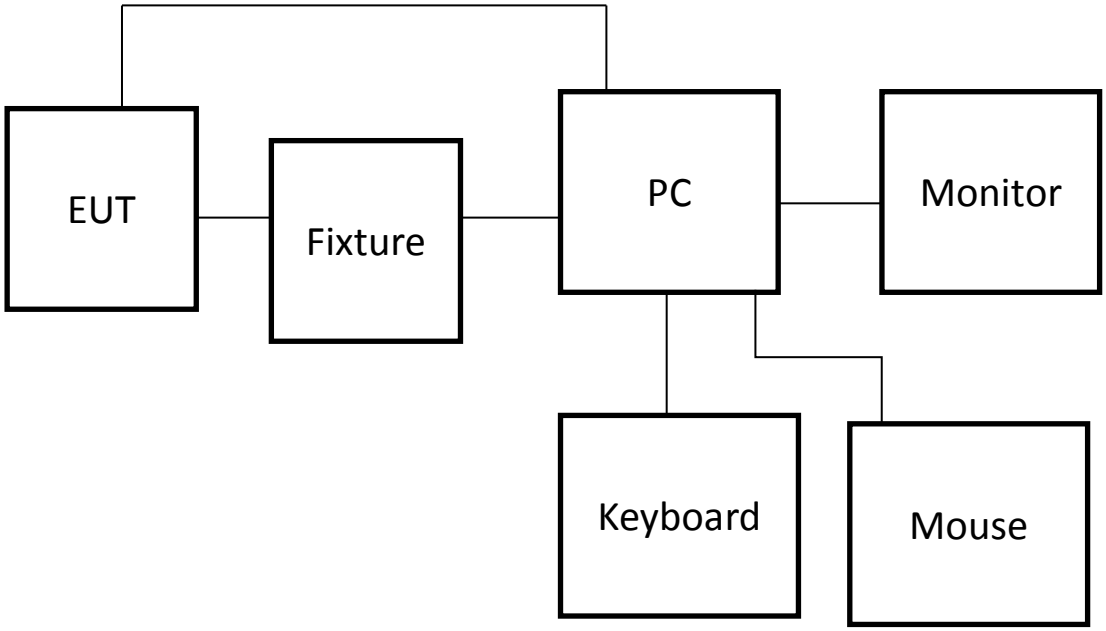
AC Conducted Emissions Test Site					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal Date**	**Cal Due**
LISN	R&S	ENV216	101054	05/18/2017	05/17/2018
LISN	SCHWARZBECK	NSLK 8127	8127-541	02/14/2017	02/13/2018
EMI Test Receiver	R&S	ESCI	100064	05/17/2017	05/16/2018

Remark: *Each piece of equipment is scheduled for calibration once a year.*

1.7 SUPPORT AND EUT ACCESSORIES EQUIPMENT

EUT Accessories Equipment					
No.	**Equipment**	**Brand**	**Model**	**Series No.**	**FCC ID**
	N/A				

Support Equipment					
No.	**Equipment**	**Brand**	**Model**	**Series No.**	**FCC ID**
1	PC	HP	HP Compag dc5850	N/A	DoC
2	Monitor	Samsung	713N	N/A	DoC
3	KeyBoard	DELL	SK-8115	N/A	DoC
4	Mouse	DELL	M-UAL-96	N/A	DoC



1.8 Test methodology and applied standards

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247

2. TEST SUMMERY

FCC Standard Sec.	Report Sec.	Test Item	Result
15.203	1.2	Antenna Requirement	Pass
15.207	4.1	AC Conducted Emission	Pass
15.247(a)(1)	4.2	20 dB Bandwidth	Pass
-	4.2	Occupied Bandwidth (99%)	-
15.247(a)(1)	4.3	Output Power Measurement	Pass
15.247(a)(1)	4.4	Frequency Separation	Pass
15.247(a)(1)(iii)	4.5	Number of Hopping	Pass
15.247(d)	4.6	Conducted Band Edge	Pass
15.247(d)	4.6	Conducted Emission	Pass
15.247(a)(1)(iii)	4.7	Time of Occupancy (Dwell time)	Pass
15.247(d)	4.8	Radiation Band Edge	Pass

3. DESCRIPTION OF TEST MODES

3.1 THE WORST MODE OF OPERATING CONDITION

Operation mode	GFSK for BR-1Mbps (DH5) π/4-DQPSK for EDR-2Mbps (DH5) 8DPSK for EDR-3Mbps (DH5)
Test Channel Frequencies	**GFSK for BR-1Mbps:** 1.Lowest Channel : 2402MHz 2.Middle Channel : 2441MHz 3.Highest Channel : 2480MHz **π/4-DQPSK for EDR-2Mbps:** 1.Lowest Channel : 2402MHz 2.Middle Channel : 2441MHz 3.Highest Channel : 2480MHz **8DPSK for EDR-3Mbps:** 1.Lowest Channel : 2402MHz 2.Middle Channel : 2441MHz 3.Highest Channel : 2480MHz

Remark:

1. *EUT pre-scanned data rate of output power for each mode, the worst data rate were recorded in this report.*

3.2 THE WORST MODE OF MEASUREMENT

Worst Mode			
Mode	**Data Rate**	**Maximum Peak Conducted Output Power (dBm)**	**Worst Mode**
BR(GFSK)	1 Mbps	5.36	V
EDR(DQPSK)	2 Mbps	3.64	-
EDR(8PSK)	3 Mbps	3.93	V

AC Power Line Conducted Emission	
Test Condition	**AC Power line conducted emission for line and neutral**
Voltage/Hz	**120V/60Hz**
Test Mode	**Mode 1:EUT power by host system**
Worst Mode	**☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4**

Radiated Emission Measurement Above 1G	
Test Condition	**Band edge, Emission for Unwanted and Fundamental**
Voltage/Hz	**120V/60Hz**
Test Mode	**Mode 1:EUT power by host system**
Worst Mode	**☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4**
Worst Position	**☐ Placed in fixed position.** **☒ Placed in fixed position at X-Plane (E2-Plane)** **☐ Placed in fixed position at Y-Plane (E1-Plane)** **☐ Placed in fixed position at Z-Plane (H-Plane)**
Worst Polarity	**☒ Horizontal ☐ Vertical**

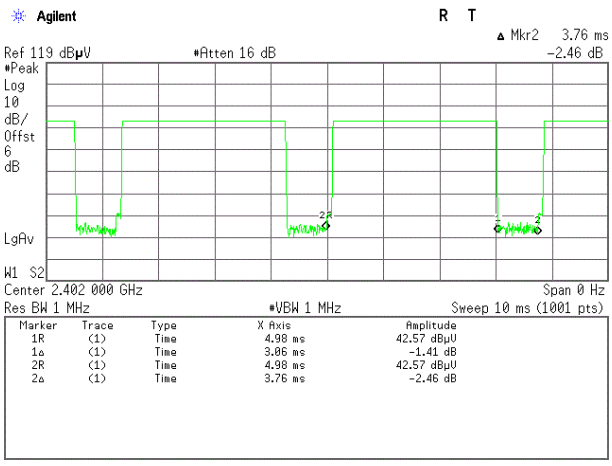
Radiated Emission Measurement Below 1G	
Test Condition	**Radiated Emission Below 1G**
Voltage/Hz	**120V/60Hz**
Test Mode	**Mode 1:EUT power by host system** **Mode 2:EUT power by Battery**
Worst Mode	**☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4**

Remark:
1. The worst mode was record in this test report.
2. EUT pre-scanned in three axis ,X, Y, Z and two polarity, Horizontal and Vertical for radiated measurement. The worst case(Y-Plane and Horizontal) were recorded in this report.
3. For AC power line conducted emission and below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.

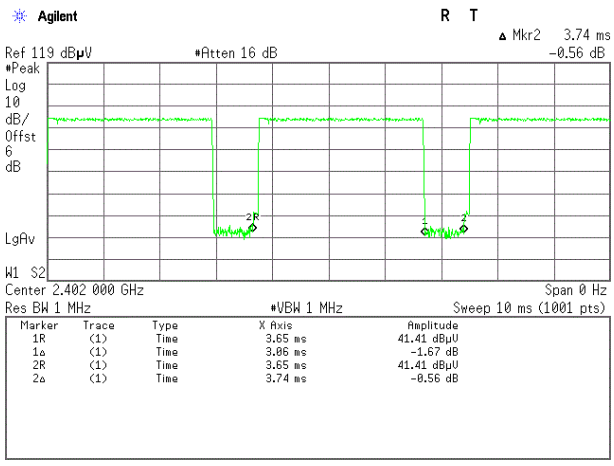
3.3 EUT DUTY CYCLE

Duty Cycle				
Configuration	TX ON (ms)	TX ALL (ms)	Duty Cycle (%)	Duty Factor(dB)
BR-1Mbps	3.06	3.76	81.38%	0.89
EDR-3Mbps	3.06	3.74	81.82%	0.87

BR-1Mbps



EDR-3Mbps



4. TEST RESULT

4.1 AC POWER LINE CONDUCTED EMISSION

4.1.1 Test Limit

According to §15.207(a),

Frequency Range (MHz)	Limits(dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

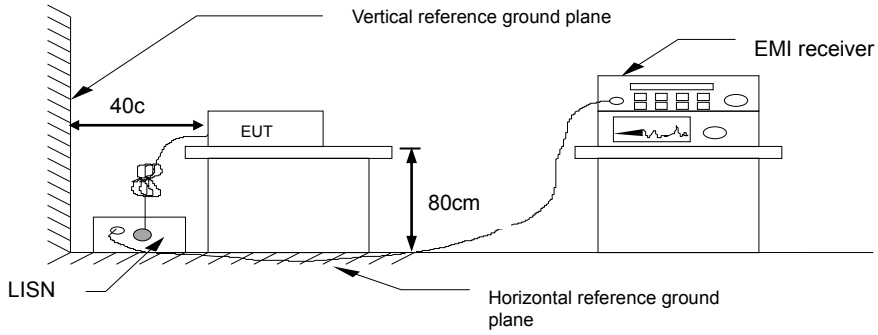
* Decreases with the logarithm of the frequency.

4.1.2 Test Procedure

Test method Refer as ANSI 63.10:2013 clause 6.2,

1. The EUT was placed on a non-conducted table, which is 0.8m above horizontal ground plane and 0.4m above vertical ground plane.
2. EUT connected to the line impedance stabilization network (LISN)
3. Receiver set RBW of 9kHz and Detector Peak, and note as quasi-peak and average.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Recorded Line for Neutral and Line.

4.1.3 Test Setup

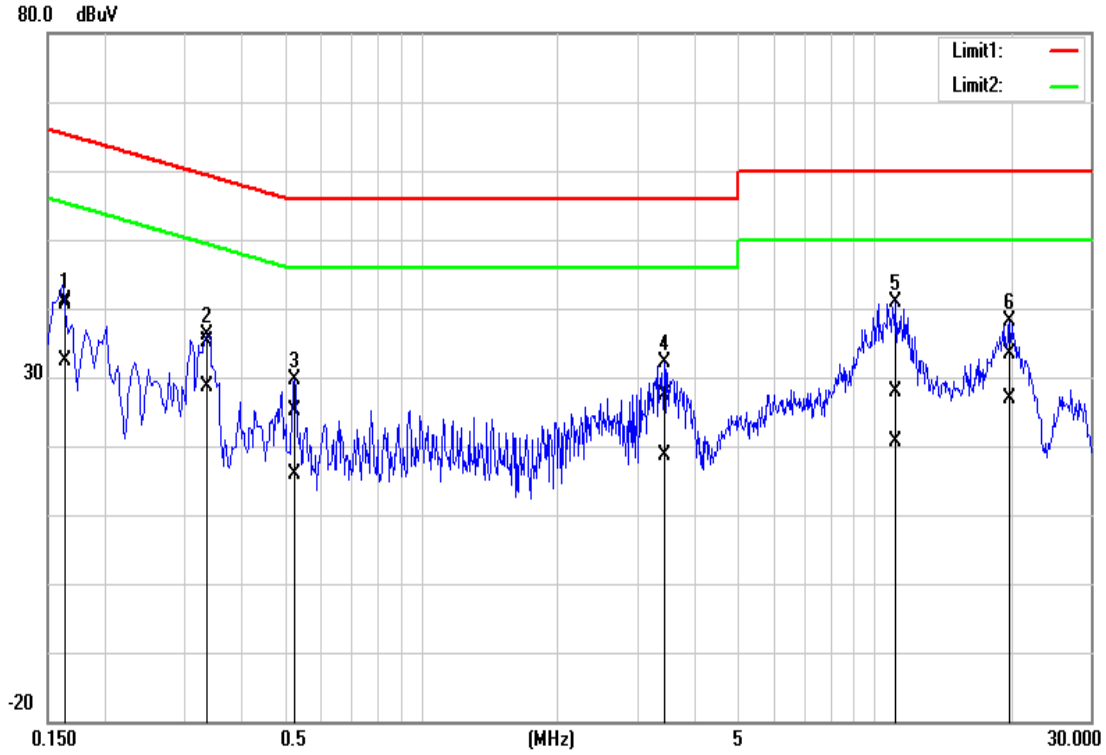


4.1.4 Test Result

Pass.

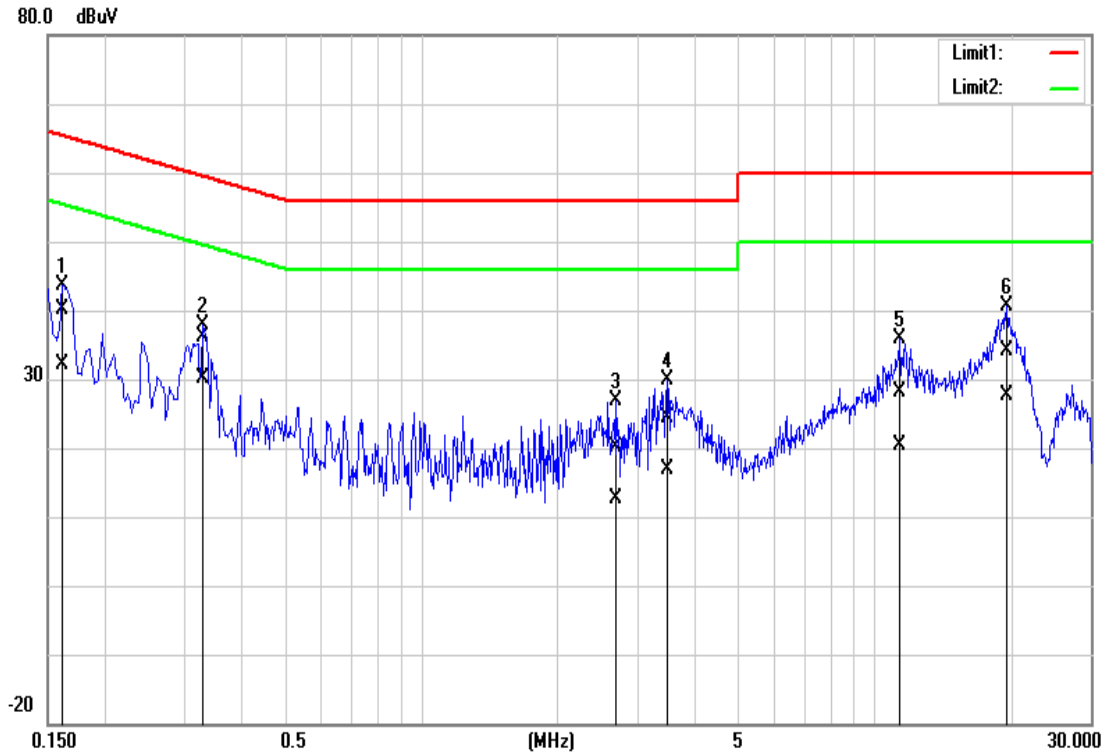
Test Data

Test Mode	Mode 1	Temp/Hum	24(℃)/ 50%RH
Test Voltage	120Vac / 60Hz	Test Date	December 19, 2017
Phase	Line	Test Engineer	Eric Lee



Frequency (MHz)	Quasi Peak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	Quasi Peak result (dBuV)	Average result (dBuV)	Quasi Peak limit (dBuV)	Average limit (dBuV)	Quasi Peak margin (dB)	Average margin (dB)	Remark
0.1649	30.75	22.64	9.71	40.46	32.35	65.21	55.21	-24.75	-22.86	Pass
0.3355	25.41	18.92	9.70	35.11	28.62	59.31	49.31	-24.2	-20.69	Pass
0.5218	15.32	6.02	9.70	25.02	15.72	56.00	46.00	-30.98	-30.28	Pass
3.4346	17.49	8.87	9.74	27.23	18.61	56.00	46.00	-28.77	-27.39	Pass
11.1270	17.91	10.78	9.80	27.71	20.58	60.00	50.00	-32.29	-29.42	Pass
19.9318	23.54	16.81	9.88	33.42	26.69	60.00	50.00	-26.58	-23.31	Pass

Test Mode	Mode 1	Temp/Hum	24(℃)/ 50%RH
Test Voltage	120Vac / 60Hz	Test Date	December 19, 2017
Phase	Neutral	Test Engineer	Eric Lee



Frequency (MHz)	Quasi Peak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	Quasi Peak result (dBuV)	Average result (dBuV)	Quasi Peak limit (dBuV)	Average limit (dBuV)	Quasi Peak margin (dB)	Average margin (dB)	Remark
0.1620	30.35	22.17	9.78	40.13	31.95	65.36	55.36	-25.23	-23.41	Pass
0.3300	26.36	20.25	9.76	36.12	30.01	59.45	49.45	-23.33	-19.44	Pass
2.6860	10.21	2.84	9.80	20.01	12.64	56.00	46.00	-35.99	-33.36	Pass
3.5060	14.56	6.8	9.82	24.38	16.62	56.00	46.00	-31.62	-29.38	Pass
11.4180	18.05	10.29	10.06	28.11	20.35	60.00	50.00	-31.89	-29.65	Pass
19.5419	23.88	17.32	10.26	34.14	27.58	60.00	50.00	-25.86	-22.42	Pass

4.2 20DB BANDWIDTH AND OCCUPIED BANDWIDTH (99%)

4.2.1 Test Limit

According to §15.247(a)(1)

20 dB Bandwidth ：For reporting purposes only.

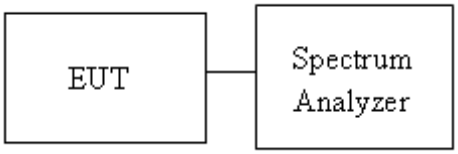
Occupied Bandwidth(99%) ：For reporting purposes only.

4.2.2 Test Procedure

Test method Refer as ANSI 63.10:2013 clause 6.9.2,

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 30kHz, VBW = 100kHz and Detector = Peak, to measurement 20 dB Bandwidth and 99% Bandwidth.
4. Measure and record the result of 20 dB Bandwidth and 99% Bandwidth. in the test report.

4.2.3 Test Setup



4.2.4 Test Result

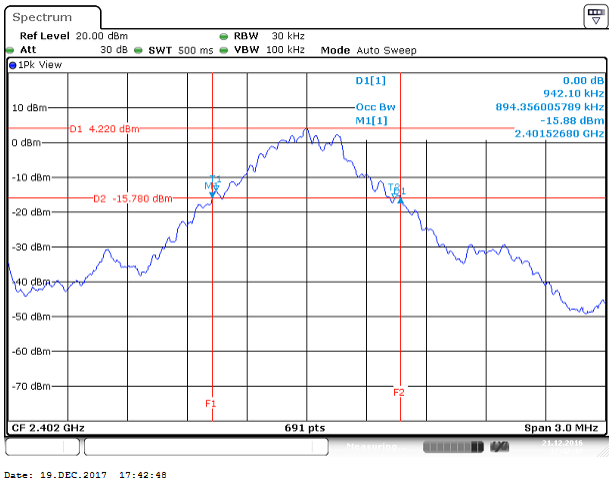
Test mode: GFSK_BR-1Mbps mode / 2402-2480 MHz			
Channel	**Frequency (MHz)**	**OBW (99%) (MHz)**	**20dB BW (MHz)**
Low	2402	0.8943	0.9421
Mid	2440	0.8769	0.9378
High	2480	0.8726	0.9378

Test mode: 8DPSK_EDR-3Mbps mode / 2402-2480 MHz			
Channel	**Frequency (MHz)**	**OBW (99%) (MHz)**	**20dB BW (MHz)**
Low	2402	1.1678	1.2634
Mid	2440	1.1591	1.2590
High	2480	1.1591	1.2590

Test Data

GFSK_BR-1Mbps mode

Low CH



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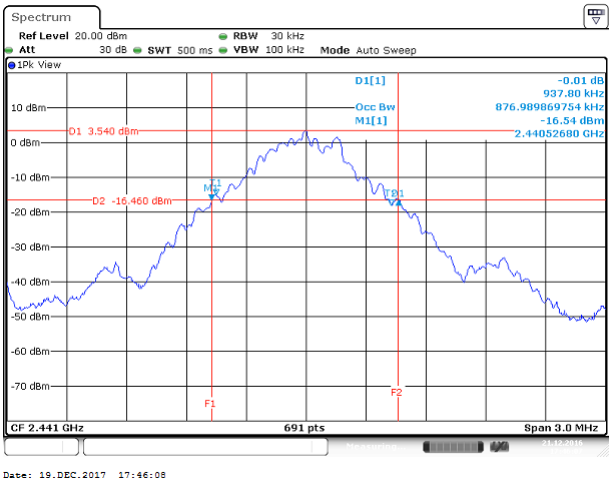
Mid CH



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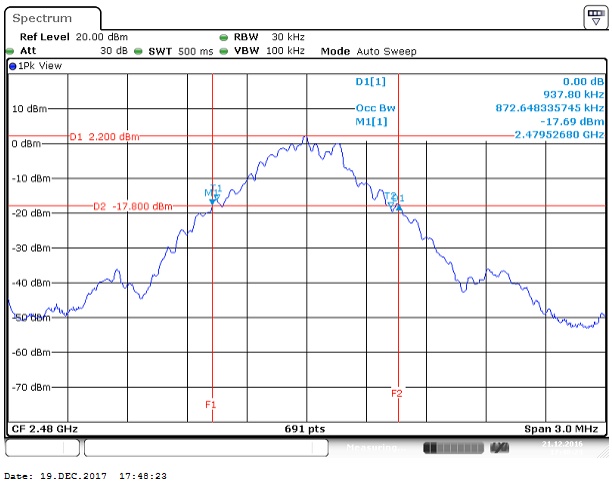
High CH



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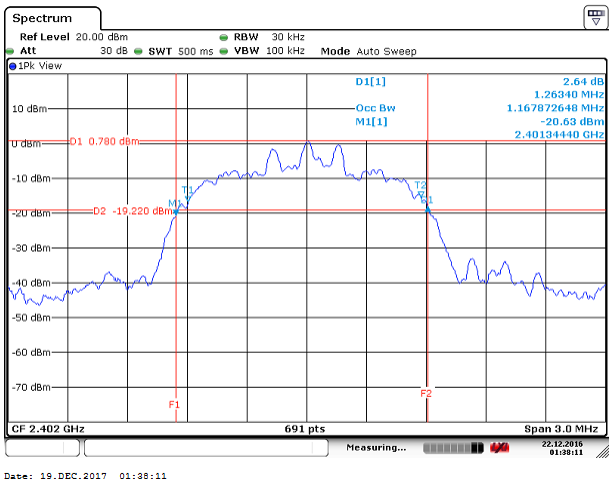
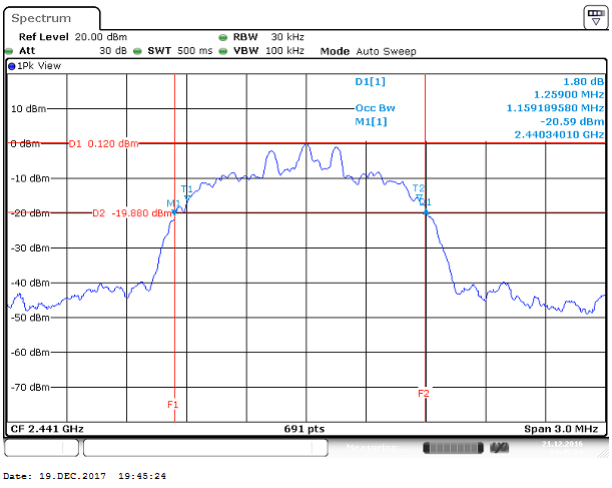
8DPSK _EDR-3Mbps mode

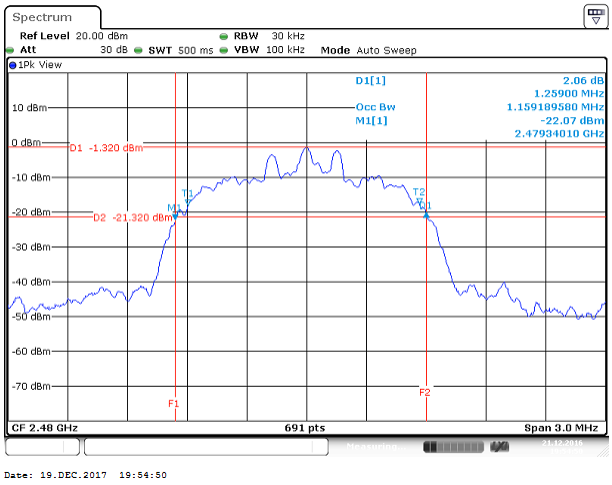
Low CH



Mid CH



High CH



4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.247(a)(1),

Peak output power：

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, provided the systems operate with an output power no greater than 125 mW..

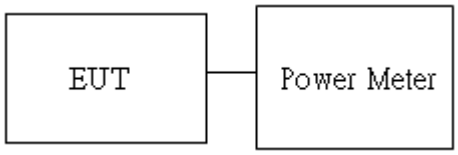
Limit	☒ Antenna not exceed 6 dBi：21dBm ☐ Antenna with DG greater than 6 dBi： [Limit = 30 – (DG – 6)]

Average output power：For reporting purposes only.

4.3.2 Test Procedure

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power. in the test report.

4.3.3 Test Setup



4.3.4 Test Result

Peak output power：

BT					
Config.	CH	Freq. (MHz)	PK Power (dBm)	PK Power (W)	Limit (dBm)
GFSK BR-1Mbps (DH5)	0	2402	3.56	0.0023	21
	39	2441	5.36	0.0034	
	78	2480	4.86	0.0031	
π/4-DQPSK EDR-2Mbps (DH5)	0	2402	1.54	0.0014	
	39	2441	2.65	0.0018	
	78	2480	3.64	0.0023	
8DPSK EDR-3Mbps (DH5)	0	2402	1.76	0.0015	
	39	2441	2.73	0.0019	
	78	2480	3.93	0.0025	

Average output power：

BT			
Config.	CH	Freq. (MHz)	AV Power (dBm)
GFSK BR-1Mbps (DH5)	0	2402	3.21
	39	2441	5.04
	78	2480	3.51
π/4-DQPSK EDR-2Mbps (DH5)	0	2402	1.00
	39	2441	1.31
	78	2480	2.94
8DPSK EDR-3Mbps (DH5)	0	2402	1.11
	39	2441	1.58
	78	2480	3.08

4.4 FREQUENCY SEPARATION

4.4.1 Test Limit

According to §15.247(a)(1)

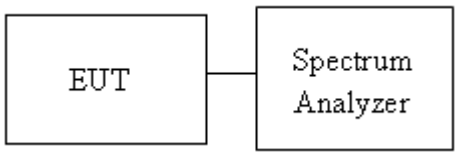
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Limit	> two-thirds of the 20 dB bandwidth

4.4.2 Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set the spectrum analyzer as RBW = 100kHz, VBW = 300kHz, Sweep = auto. Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency

4.4.3 Test Setup

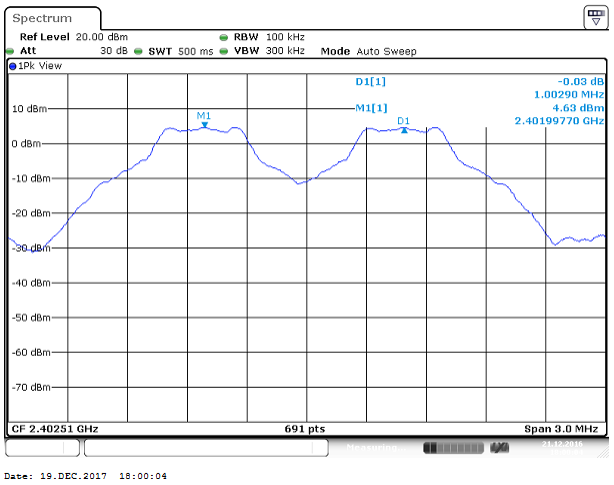
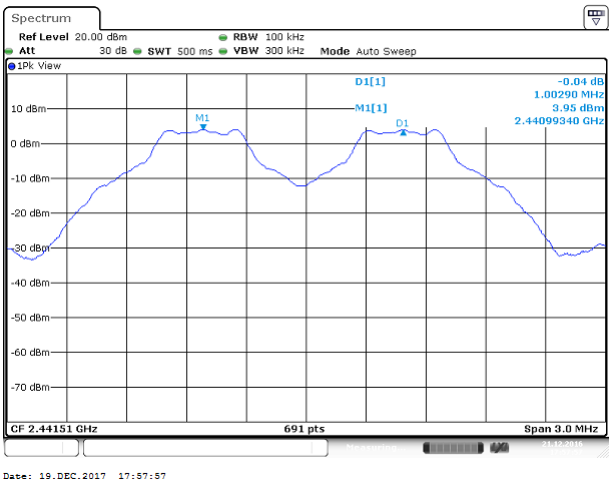
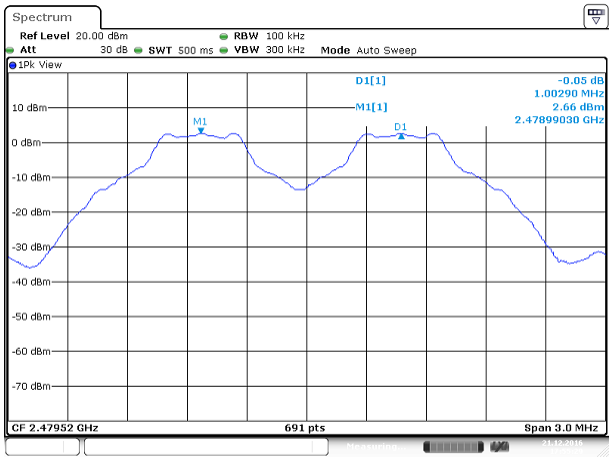


4.4.4 Test Result

Test mode: GFSK_BR-1Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	1.0029	0.628	PASS
Mid	2441	1.0029	0.625	PASS
High	2480	1.0029	0.625	PASS

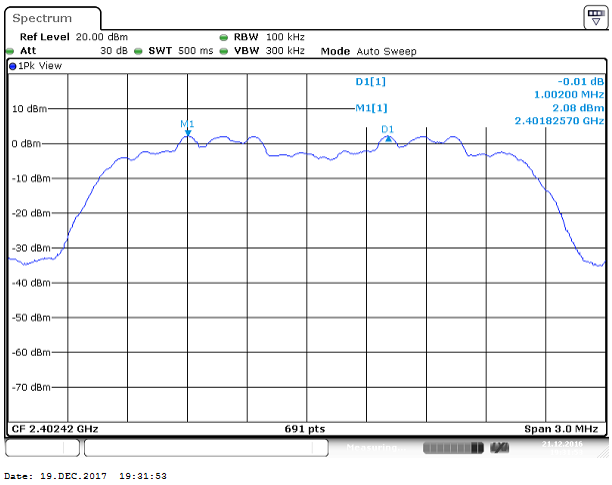
Test mode: 8DPSK_EDR-3Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	1.0029	0.842	PASS
Mid	2441	1.0029	0.773	PASS
High	2480	1.0029	0.773	PASS

Test Data

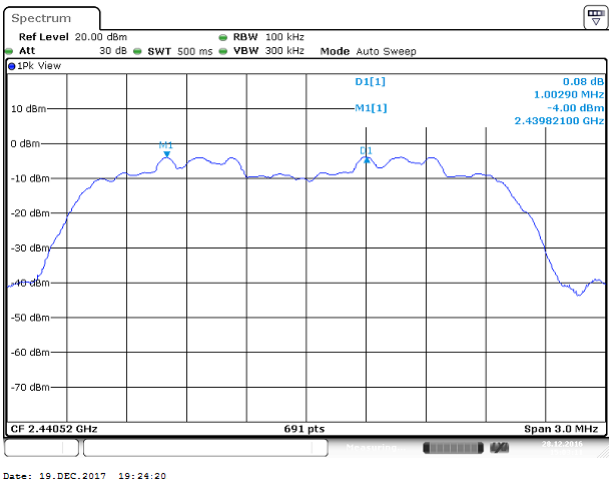
GFSK_BR-1Mbps mode	
Low CH	**Mid CH**
	
High CH	
	

8DPSK_EDR-3Mbps mode

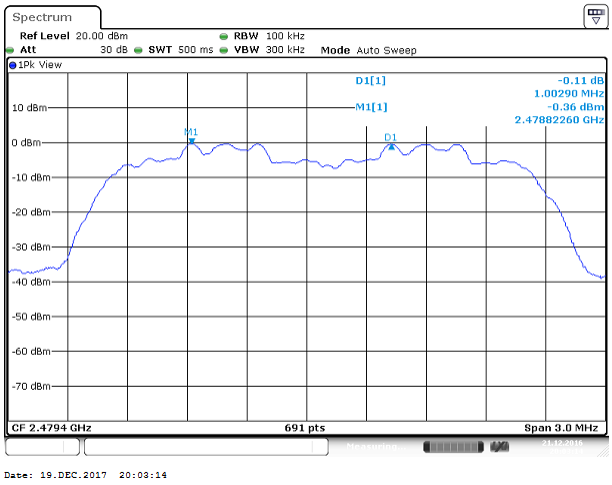
Low CH



Mid CH



High CH



4.5 NUMBER OF HOPPING

4.5.1 Test Limit

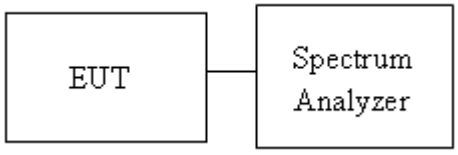
According to §15.247(a)(1)(iii),

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

4.5.2 Test Procedure

Test method Refer as ANSI 63.10:2013 clause 7.8.3,
1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set spectrum analyzer Start Freq. = 2400 MHz, Stop Freq. = 2483.5 MHz, RBW=100KHz, VBW = 300KHz.Sweep Time = 1s
4. Max hold, view and count how many channel in the band.

4.5.3 Test Setup

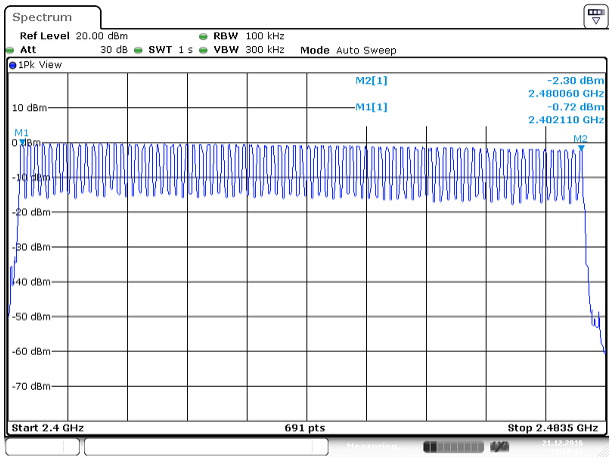
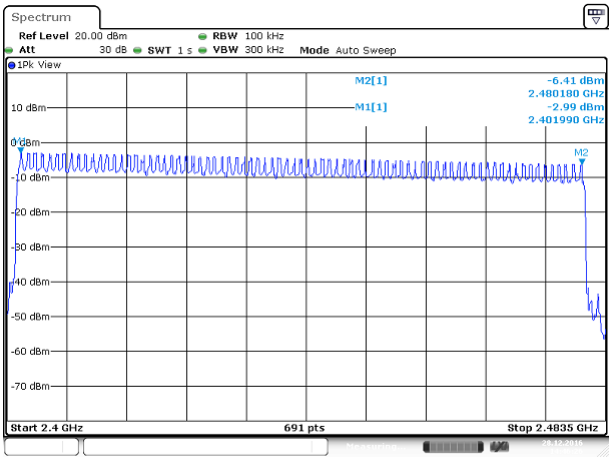


4.5.4 Test Result

Number of Hopping				
Mode	**Frequency (MHz)**	**Hopping Channel Number**	**Hopping Channel Number Limits**	**Result**
BR-1Mbps	2402-2480	79	15	Pass
EDR-3Mbps	2402-2480	79	15	

REMARK:
The frequency spectrum was broken up in to two sub-range to clearly show all of the hopping frequencies. In the AFH mode, this device operation was using 20 channels, so the requirement for minimum number of hopping channels is satisfied

Test Data

Number of Hopping	
GFSK_BR-1Mbps mode	8DPSK_EDR-3Mbps mode
	

4.6 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

4.6.1 Test Limit

According to §15.247(d),

Limit	-20 dBc

.

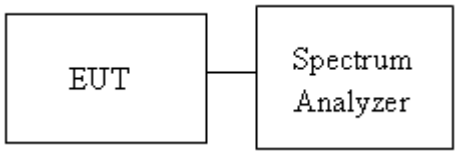
4.6.2 Test Procedure

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.

2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

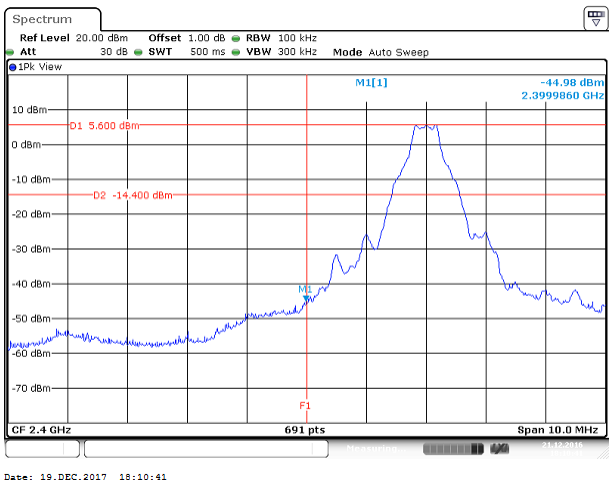
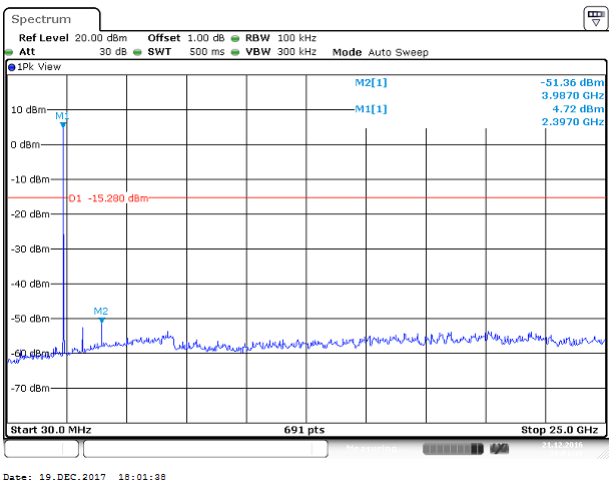
3. The Band Edge at 2.4GHz and 2.4835GHz are investigated with normal hopping mode.

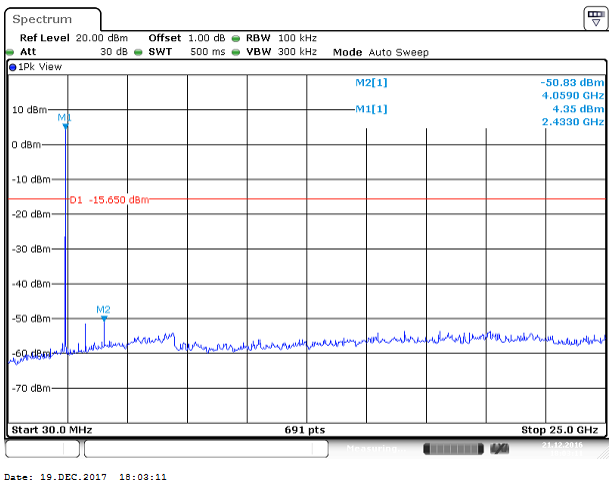
4.6.3 Test Setup

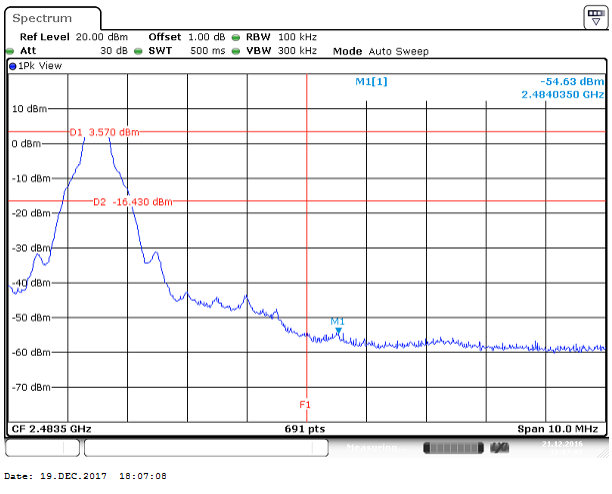
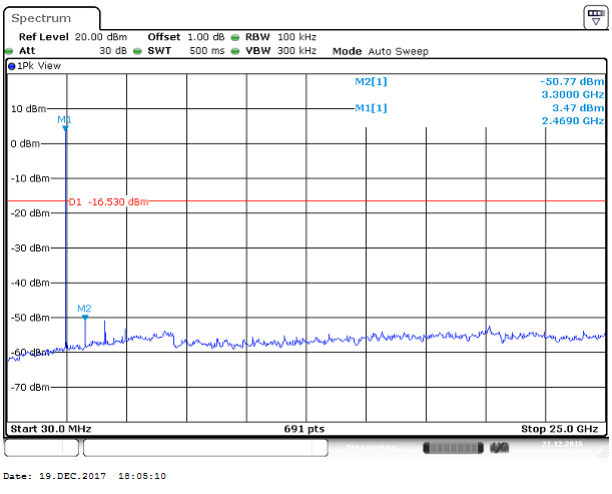


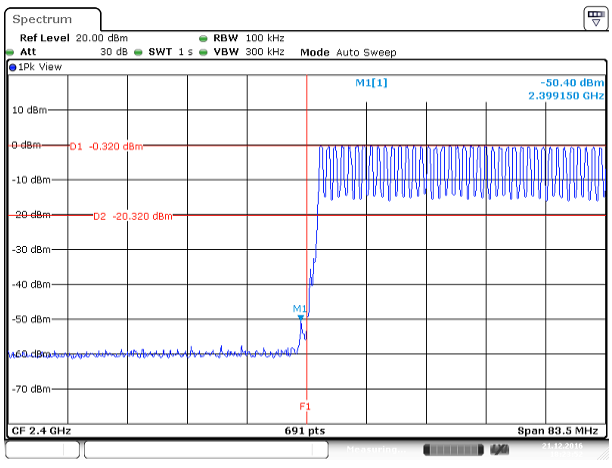
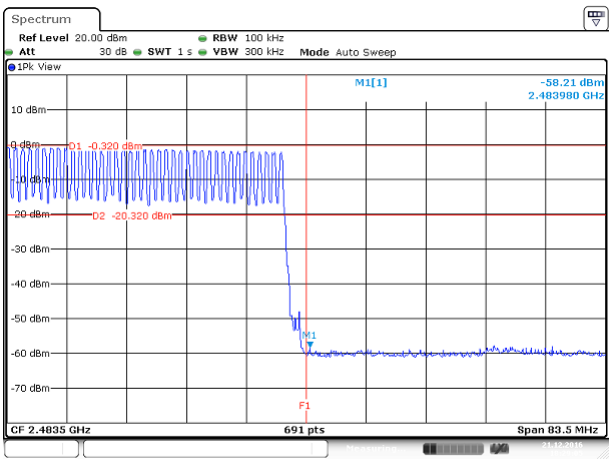
4.6.4 Test Result

Test Data

GFSK_BR-1Mbps mode Low CH	
Band Edge	**Spurious Emission 30MHz-25GHz**
	

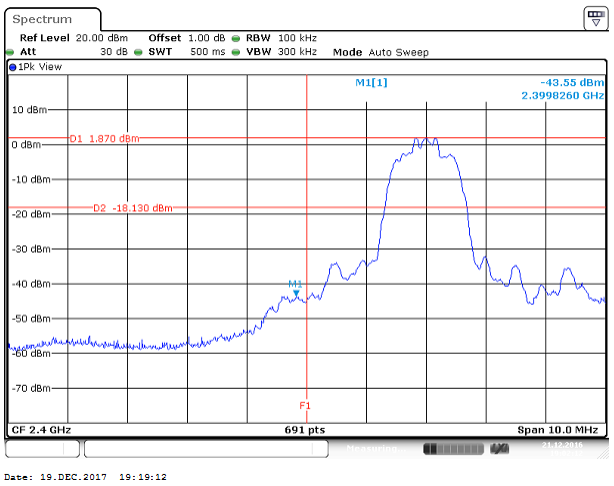
GFSK_BR-1Mbps mode Mid CH
Spurious Emission 30MHz-25GHz


GFSK_BR-1Mbps mode High CH	
Band Edge	**Spurious Emission 30MHz-25GHz**
	

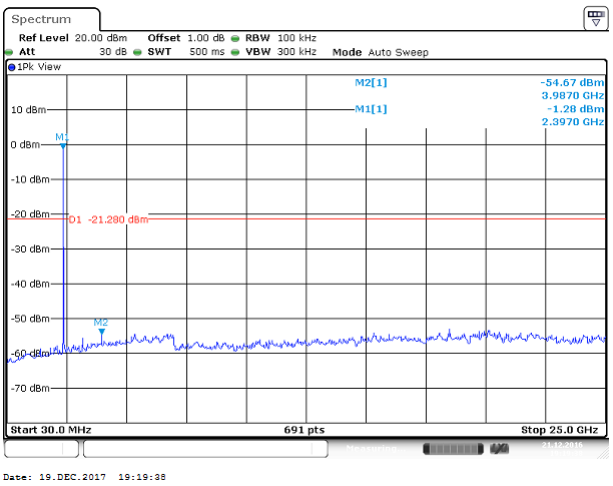
GFSK_BR-1Mbps Hopping mode	
Low Band Edge	**High Band Edge**
	

8DPSK_EDR-3Mbps mode Low CH

Band Edge

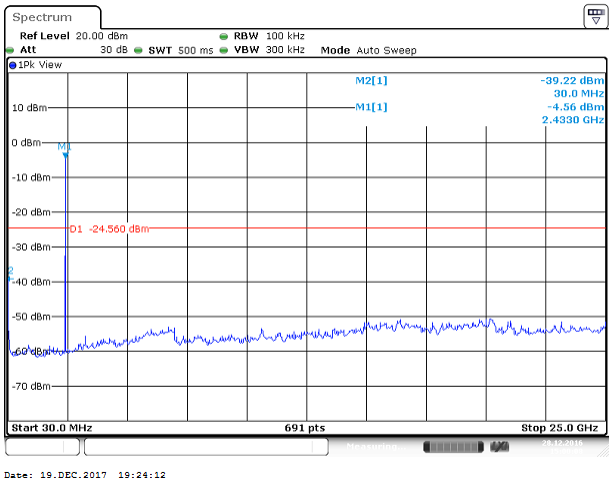


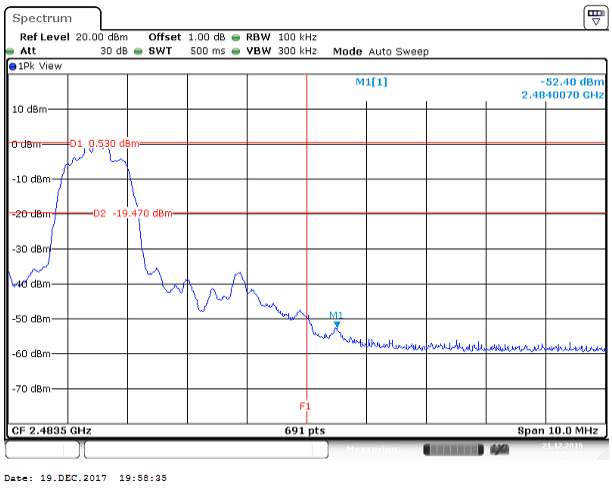
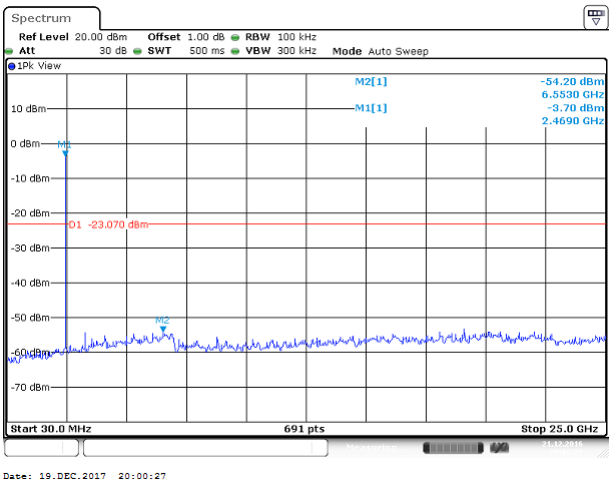
Spurious Emission 30MHz-25GHz

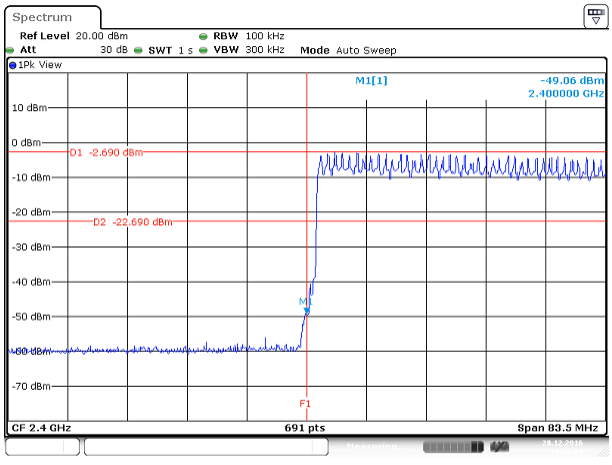
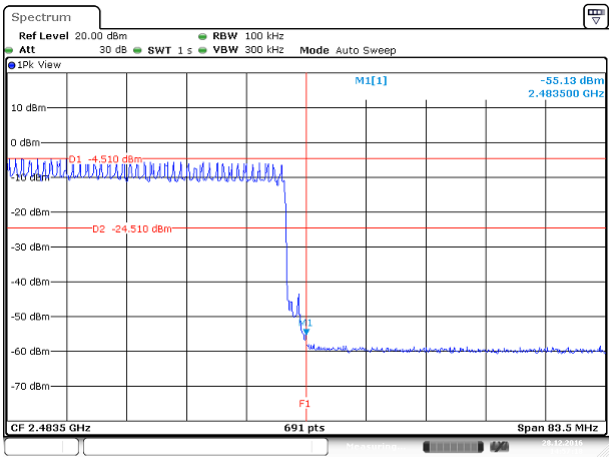


8DPSK_EDR-3Mbps mode Mid CH

Spurious Emission 30MHz-25GHz



8DPSK_EDR-3Mbps mode High CH	
Band Edge	**Spurious Emission 30MHz-25GHz**
	

8DPSK_EDR-3Mbps Hopping mode	
Low Band Edge	**High Band Edge**
	

4.7 TIME OF OCCUPANCY (DWELL TIME)

4.7.1 Test Limit

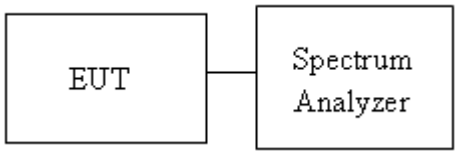
According to §15.247(a)(1)(iii),

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.

4.7.2 Test Procedure

1. EUT RF output port connected to the SA by RF cable.
2. Set center frequency of spectrum analyzer = operating frequency.
3. Set the spectrum analyzer as RBW, VBW=1MHz, Sweep = 1 ms

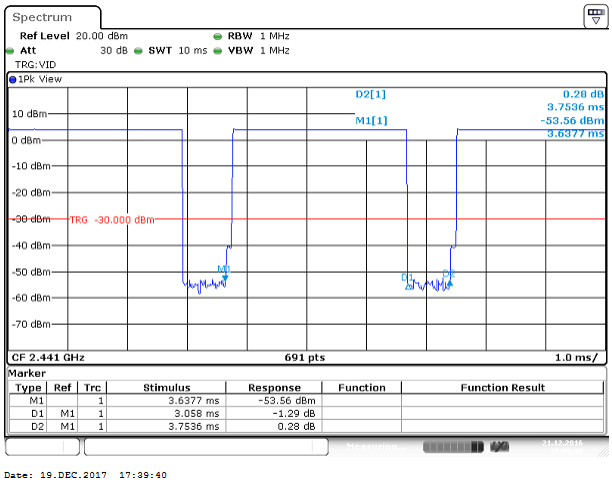
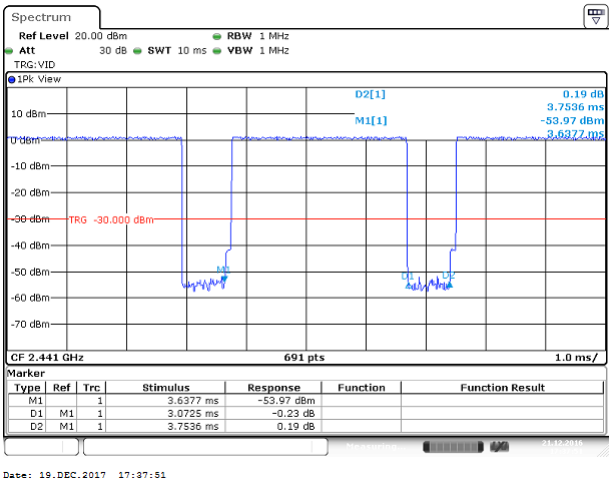
4.7.3 Test Setup



4.7.4 Test Result

Time of Occupancy (Dwell Time)							
Mode	**Frequency (MHz)**	**Pulse Time Per Hopping (ms)**	**Minimum Number of Hopping Freq.**	**Number of pulse in (0.4 * N sec)**	**Dwell Time IN (0.4 * N sec)**	**Dwell Time Limits (s)**	**Result**
BR-1Mbps	2441	3.058	79	106.67	0.3262	0.4	Pass
EDR-3Mbps	2441	3.0725	79	106.67	0.3277	0.4	
AFH: DH5	2441	3.058	20	53.33	0.1631	0.4	
Non-AFH: DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 3.37 * 0.4 *79 = 106.6							
AFH: DH5 Packet permit maximum 800/ 20 / 6 = 6.666 hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 6.666*0.4*20 = 53.33							

Test Data

Time of Occupancy (Dwell Time)	
GFSK_BR-1Mbps mode	**8DPSK_EDR-3Mbps mode**
	

4.8 RADIATION BANDEDGE AND SPURIOUS EMISSION

4.8.1 Test Limit

According to §15.247(d), §15.209 and §15.205,

In any 100 kHz bandwidth outside the authorized frequency band, all harmonic and spurious must be least 20 dB below the highest emission level with the authorized frequency band. Radiation emission which fall in the restricted bands must also follow the FCC section 15.209 as below limit in table.

Below 30 MHz

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Above 30 MHz

Frequency (MHz)	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

4.8.2 Test Procedure

Test method Refer as ANSI C63.10:2013.

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10, and the EUT set in a continuous mode.

2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.

3. Span shall wide enough to full capture the emission measured. The SA from 30MHz to 26.5GHz set to the low, Mid and High channels with the EUT transmit.

4. For harmonic, the worst case of output power was BR-1Mbps. Therefore only BR-1Mbps record in the report.

5. The SA setting following：

(1) Below 1G：RBW = 100kHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.

(2) Above 1G：

(2.1) For Peak measurement：RBW = 1MHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.

(2.2) For Average measurement：RBW = 1MHz, VBW

- If Duty Cycle ≥ 98%, VBW=10Hz.
- If Duty Cycle < 98%, VBW=1/T.

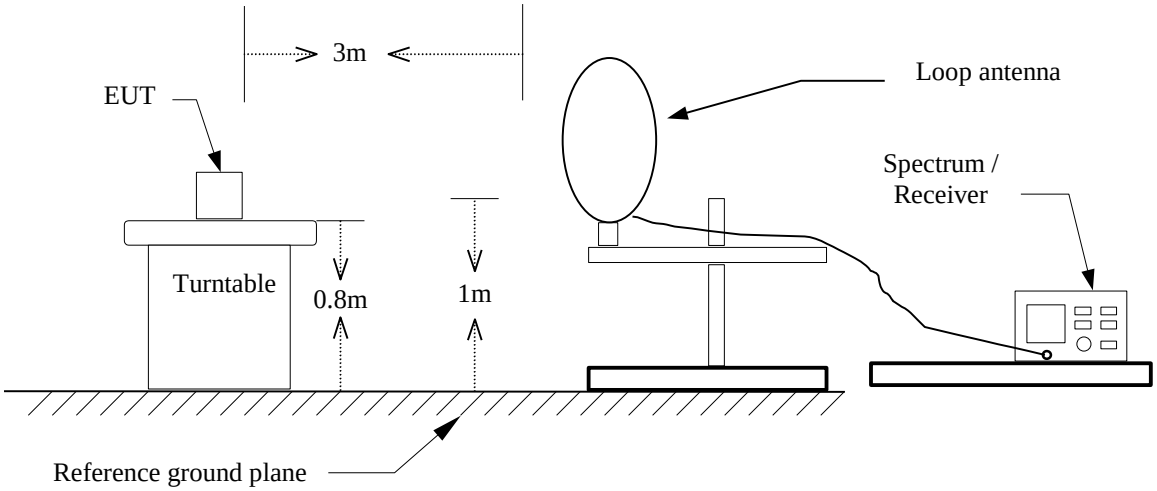
Configuration	Duty Cycle (%)	VBW
GFSK_BR-1Mbps	81.38%	360 Hz
8DPSK_EDR-3Mbps	81.82%	360 Hz

Remark:

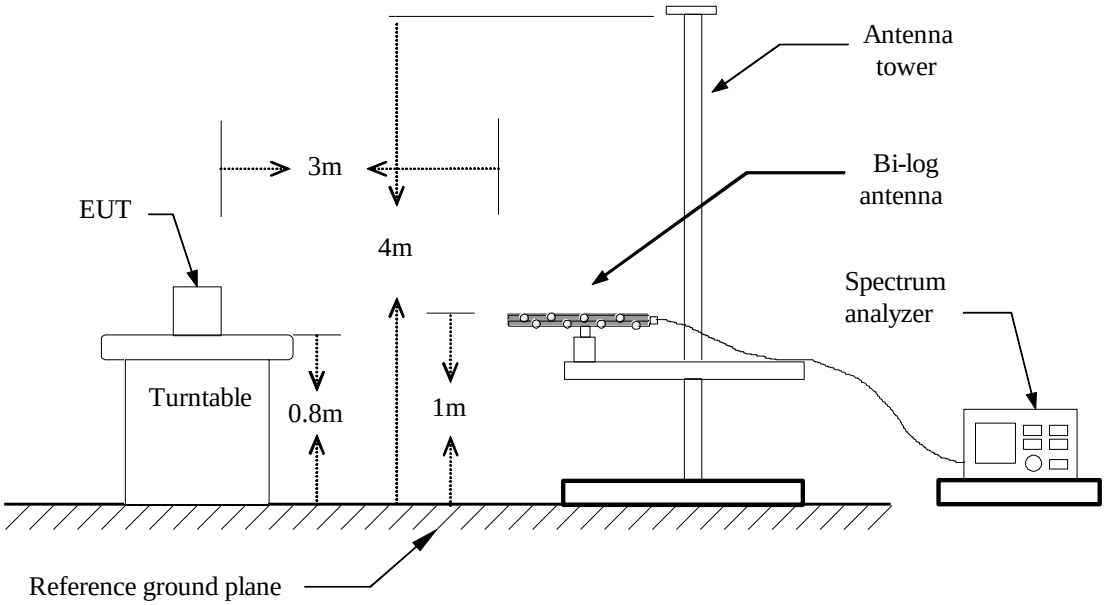
Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

4.8.3 Test Setup

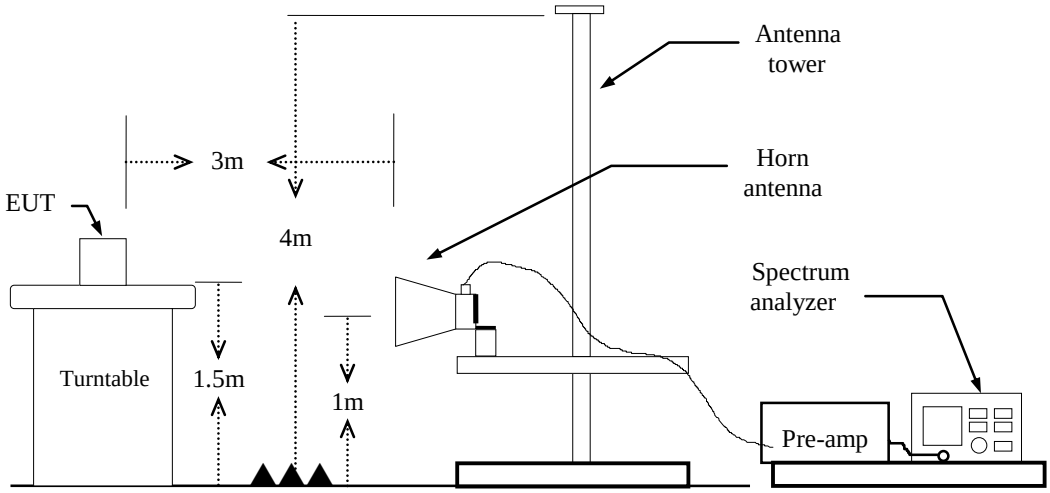
9kHz ~ 30MHz



30MHz ~ 1GHz



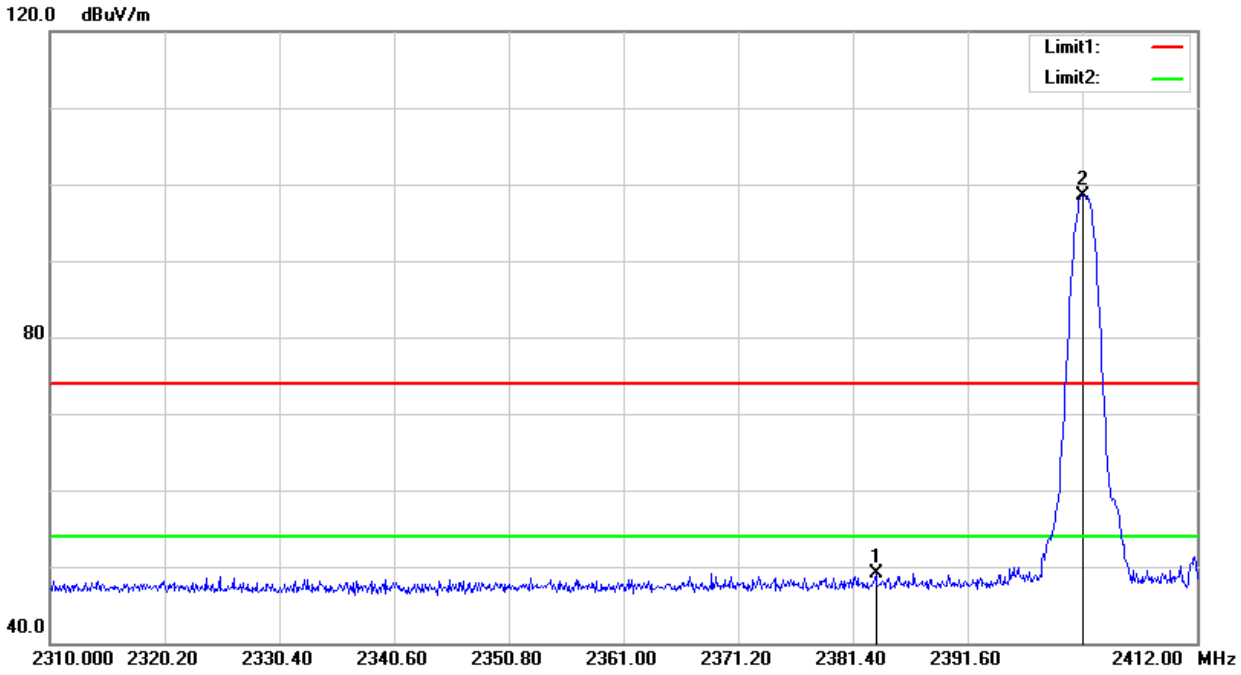
Above 1 GHz



4.8.4 Test Result

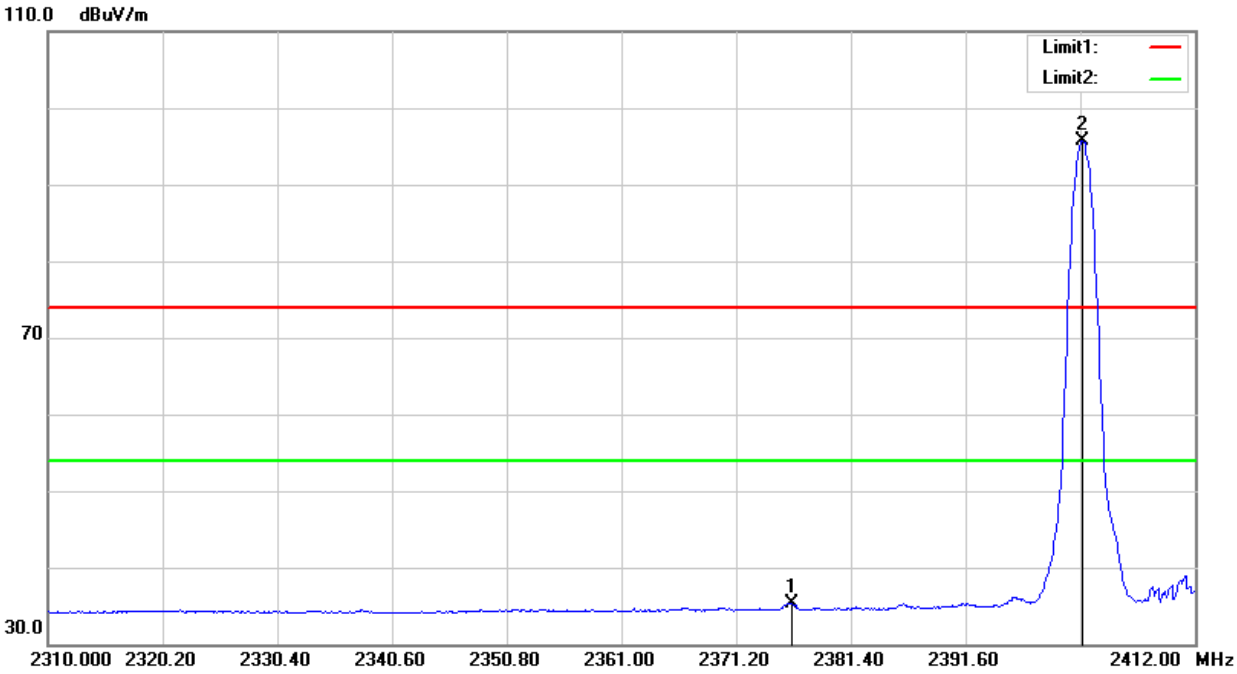
Band Edge Test Data

Test Mode	GFSK_BR-1Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak	Test Voltage	120Vac / 60Hz



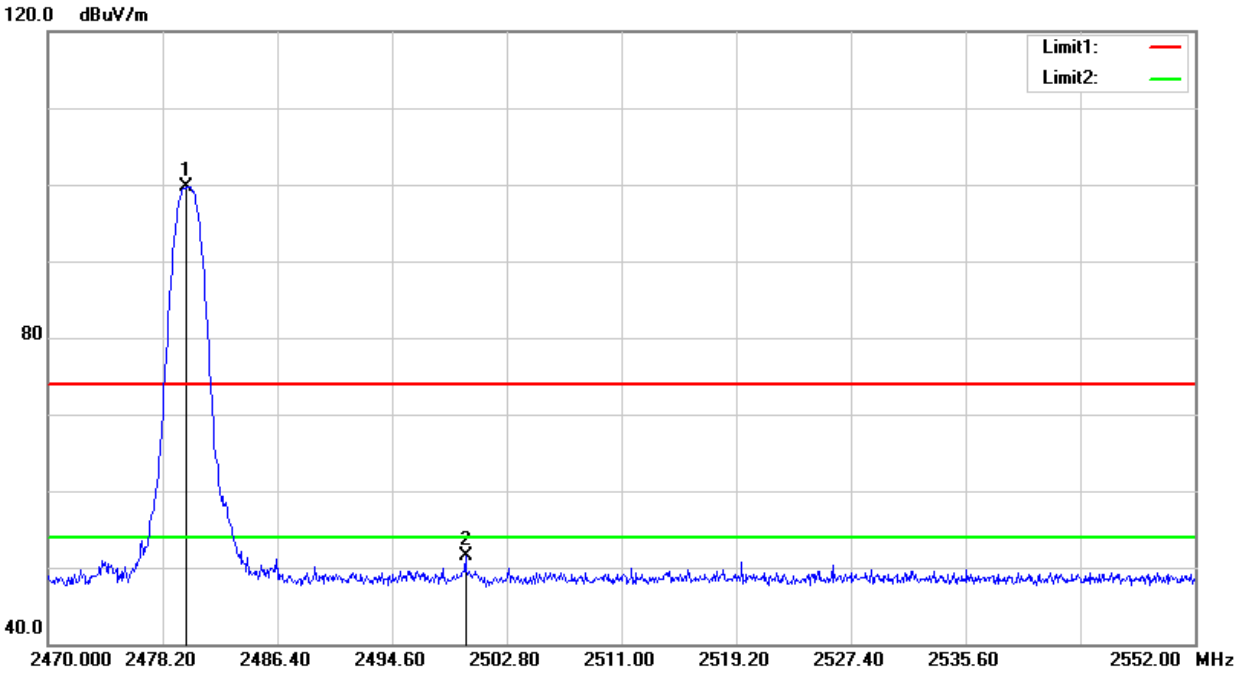
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2383.440	52.09	-2.55	49.54	74.00	-24.46	Peak
2401.800	101.14	-2.41	98.73	-	-	Peak

Test Mode	GFSK_BR-1Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Average	Test Voltage	120Vac / 60Hz



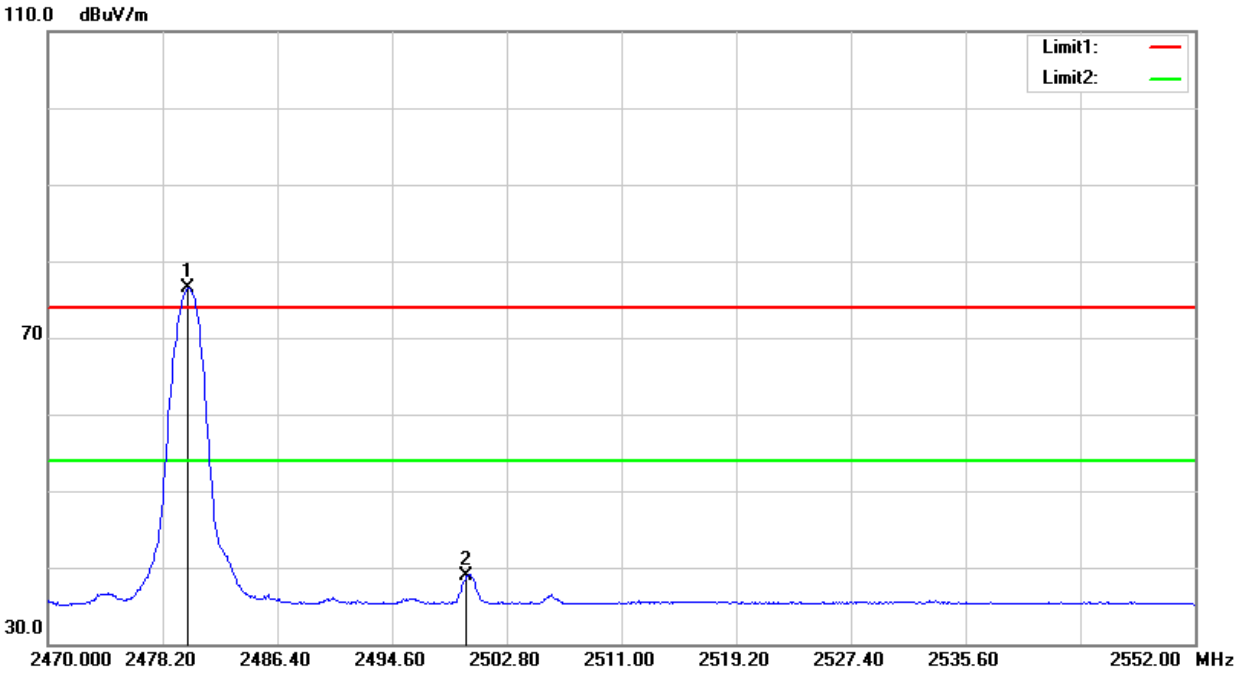
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2376.096	37.78	-2.61	35.17	54.00	-18.83	AVG
2402.004	98.14	-2.41	95.73	-	-	AVG

Test Mode	GFSK_BR-1Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak	Test Voltage	120Vac / 60Hz



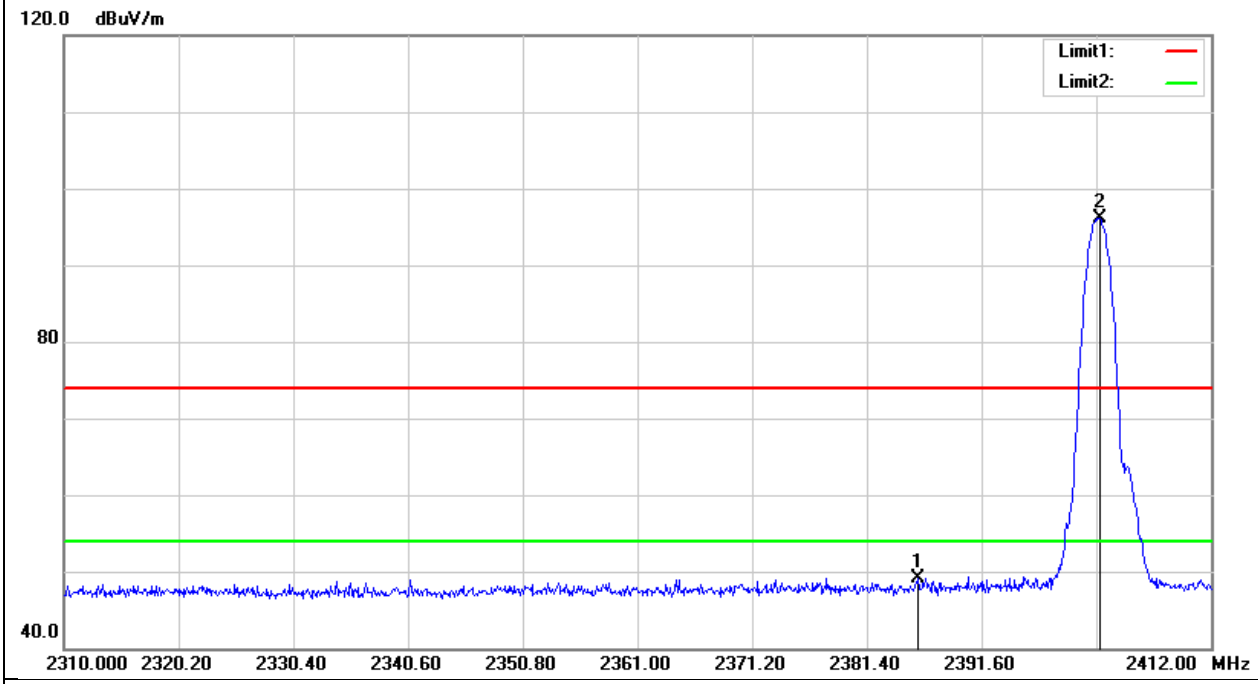
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2479.840	101.58	-2.03	99.55	-	-	Peak
2499.848	53.00	-1.86	51.14	74.00	-22.86	Peak

Test Mode	GFSK_BR-1Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Average	Test Voltage	120Vac / 60Hz



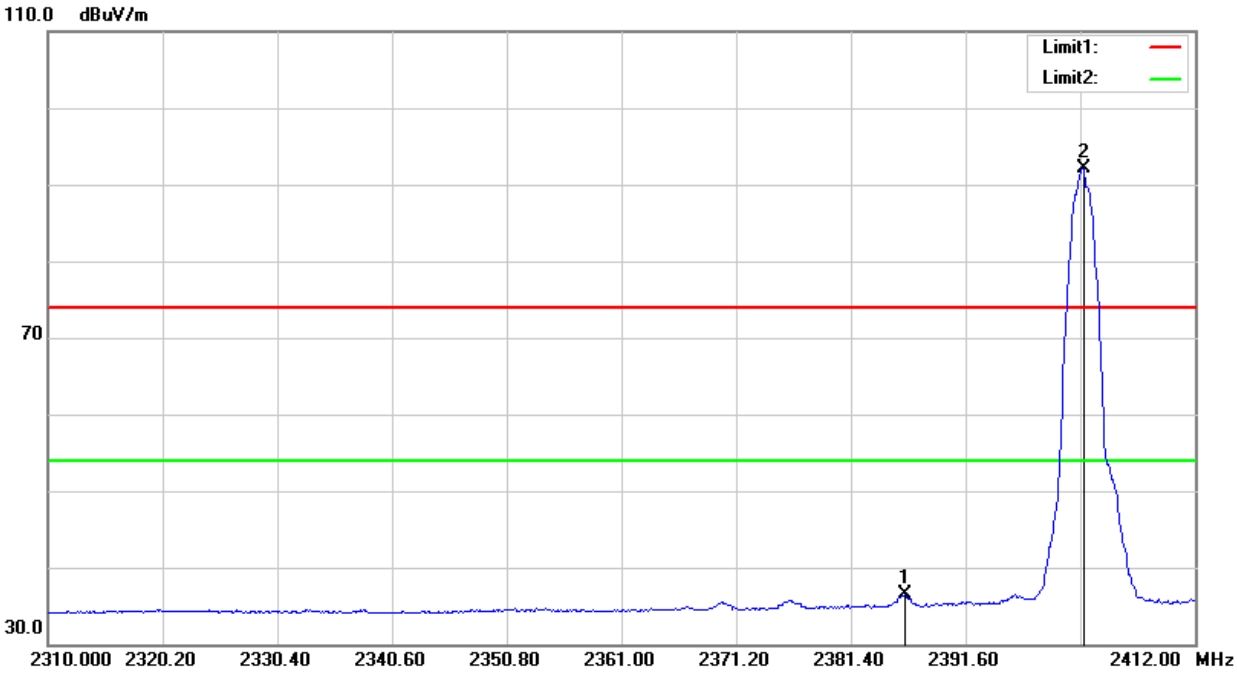
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2480.004	78.70	-2.03	76.67	-	-	AVG
2499.930	40.67	-1.86	38.81	54.00	-15.19	AVG

Test Mode	8DPSK_EDR-3Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak	Test Voltage	120Vac / 60Hz



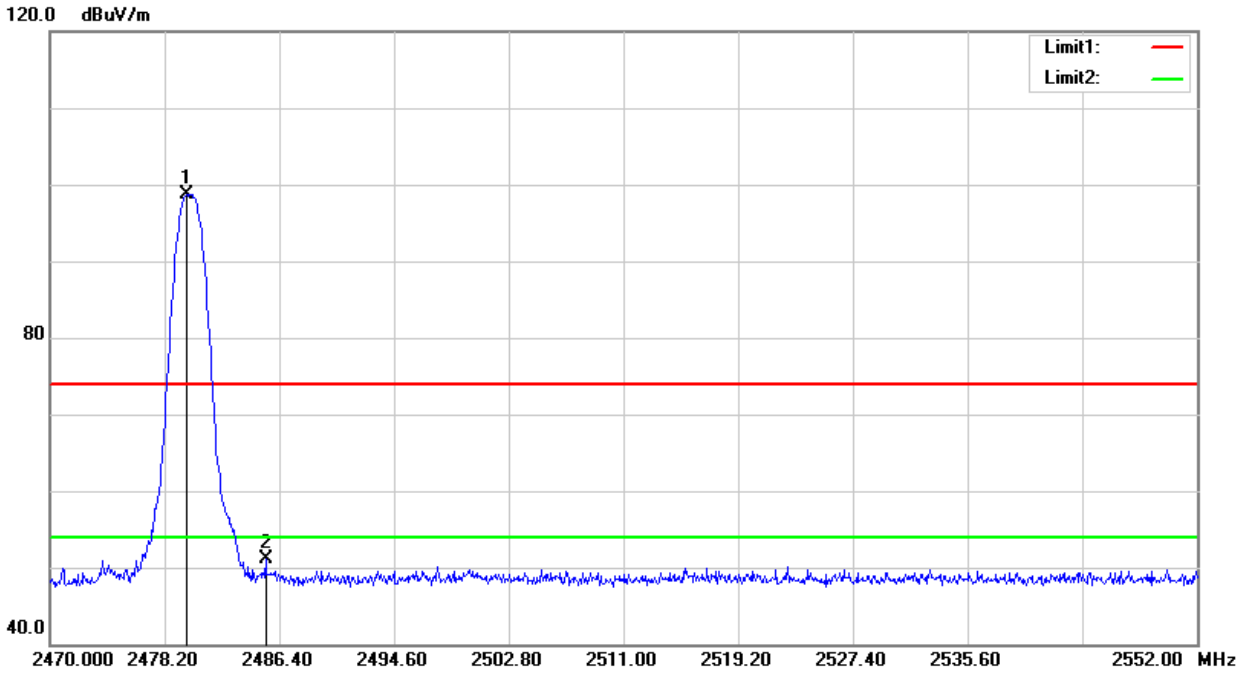
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2385.990	51.64	-2.53	49.11	74.00	-24.89	Peak
2402.106	98.74	-2.41	96.33	-	-	Peak

Test Mode	8DPSK_EDR-3Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Average	Test Voltage	120Vac / 60Hz



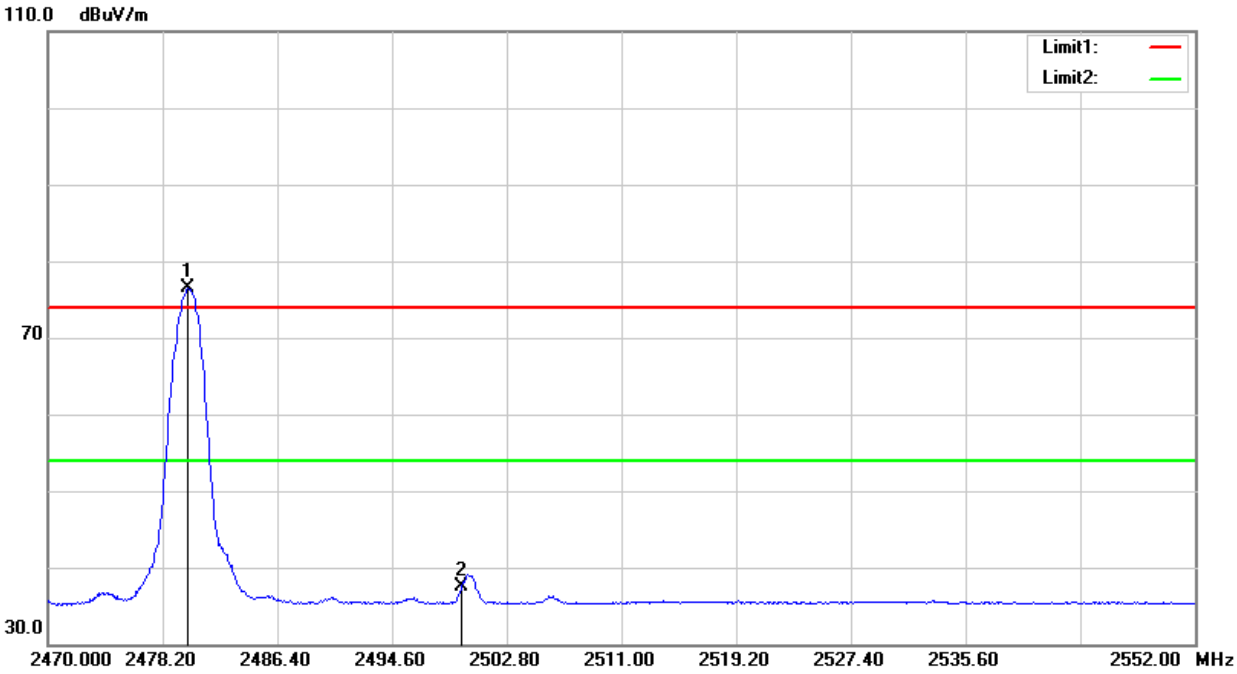
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2386.194	39.09	-2.52	36.57	54.00	-17.43	AVG
2402.106	95.39	-2.41	92.98	-	-	AVG

Test Mode	8DPSK_EDR-3Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak	Test Voltage	120Vac / 60Hz



Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2479.758	100.82	-2.03	98.79	-	-	Peak
2485.416	53.07	-1.98	51.09	74.00	-22.91	Peak

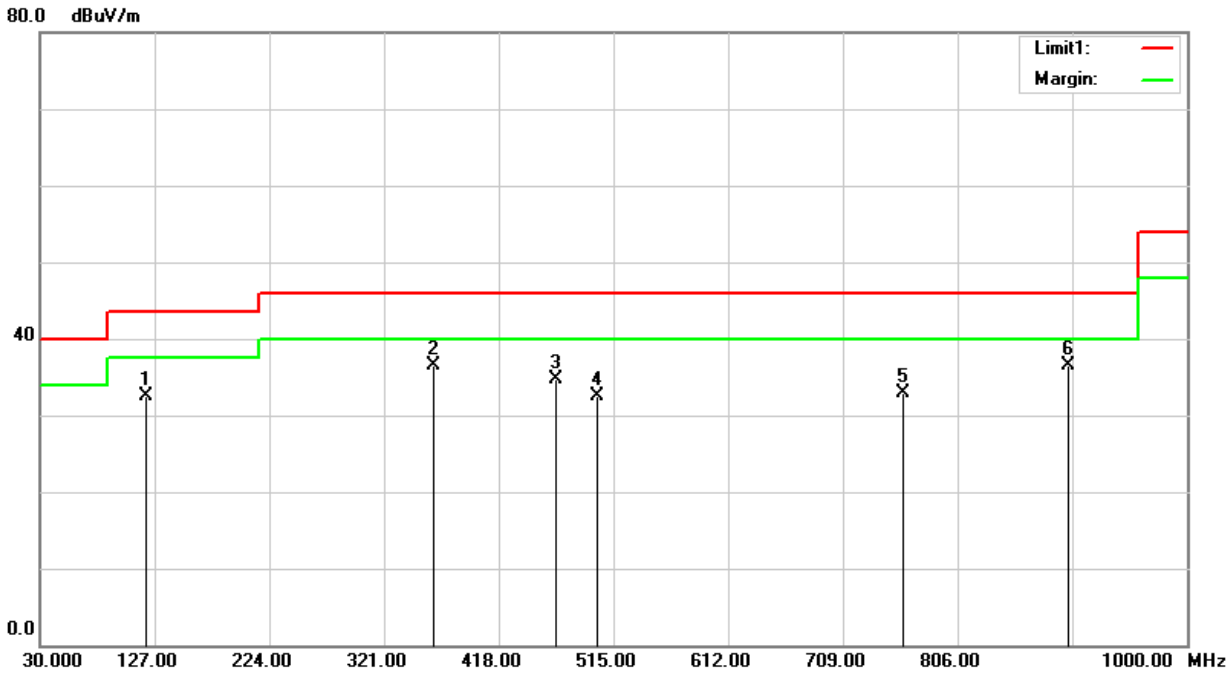
Test Mode	8DPSK_EDR-3Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Band Edge	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Average	Test Voltage	120Vac / 60Hz



Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2480.004	78.38	-2.03	76.35	-	-	AVG
2499.602	39.04	-1.86	37.18	54.00	-16.82	AVG

Below 1G Test Data

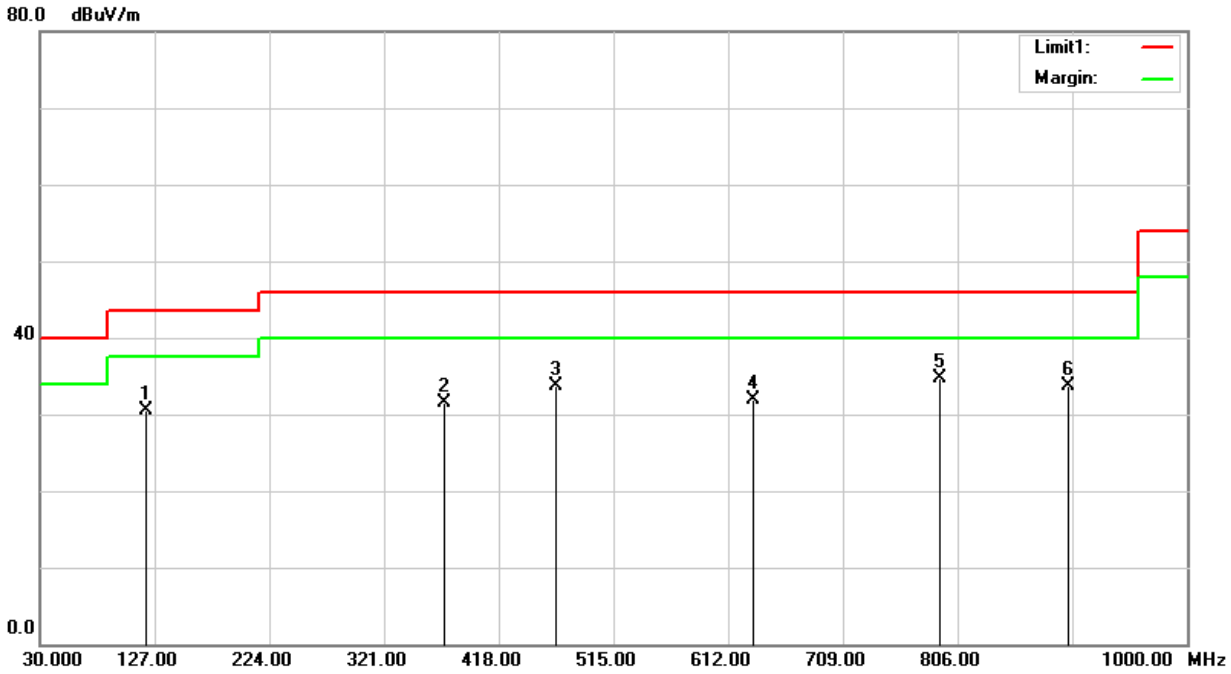
Test Mode	Mode 1	Temp/Hum	21(℃)/ 58%RH
Test Item	30MHz-1GHz	Test Date	December 20, 2017
Polarize	Vertical	Test Engineer	Kevio Kuo
Detector	Peak	Test Voltage	120Vac / 60Hz



Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
120.1800	47.97	-15.50	32.47	43.50	-11.03	peak
362.5400	49.17	-12.59	36.58	46.00	-9.42	peak
466.5800	44.65	-9.87	34.78	46.00	-11.22	peak
500.9100	41.72	-9.23	32.49	46.00	-13.51	peak
759.4600	37.65	-4.84	32.81	46.00	-13.19	peak
900.2200	39.82	-3.19	36.63	46.00	-9.37	peak

Note: No emission found between lowest internal used/generated frequency to 30MHz(9KHz~30MHz)

Test Mode	Mode 1	Temp/Hum	21(℃)/ 58%RH
Test Item	30MHz-1GHz	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevio Kuo
Detector	Peak	Test Voltage	120Vac / 60Hz

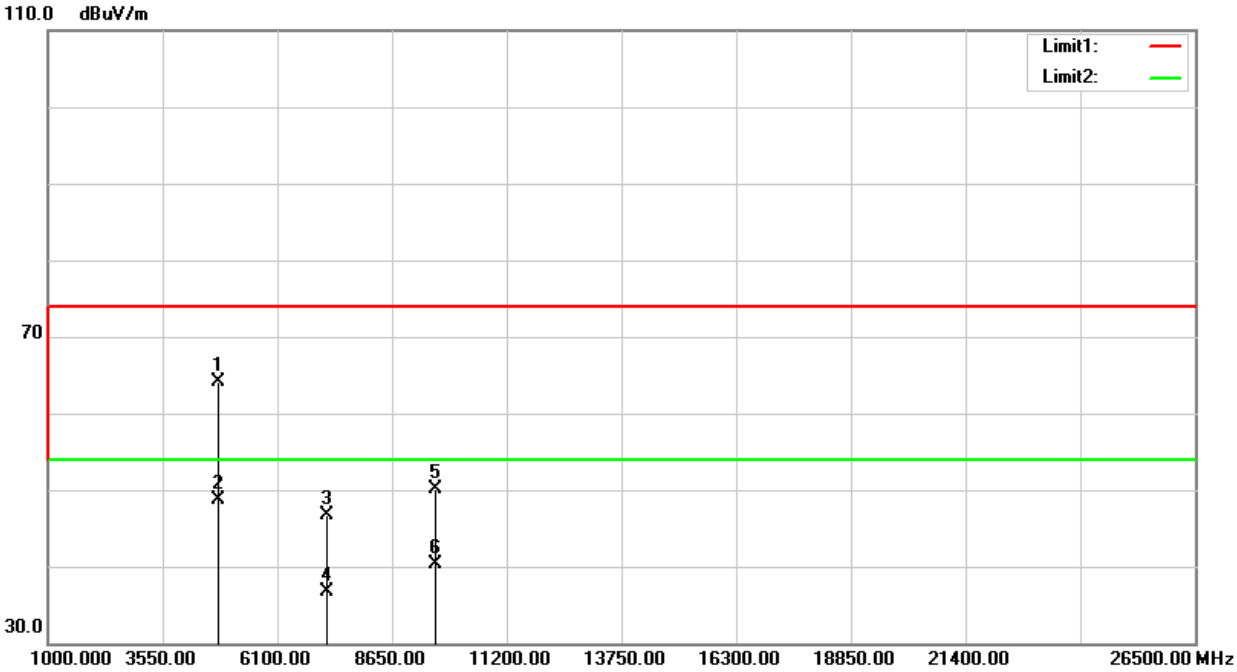


Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
120.1500	46.17	-15.50	30.67	43.50	-12.83	peak
372.5400	43.93	-12.35	31.58	46.00	-14.42	peak
466.5500	43.30	-9.88	33.42	46.00	-12.58	peak
633.3400	38.74	-6.97	31.77	46.00	-14.23	peak
790.5200	39.41	-4.58	34.83	46.00	-11.17	peak
900.0900	37.13	-3.19	33.94	46.00	-12.06	peak

Note: No emission found between lowest internal used/generated frequency to 30MHz(9KHz~30MHz)

Above 1G Test Data

Test Mode	GFSK_BR-1Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Vertical	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

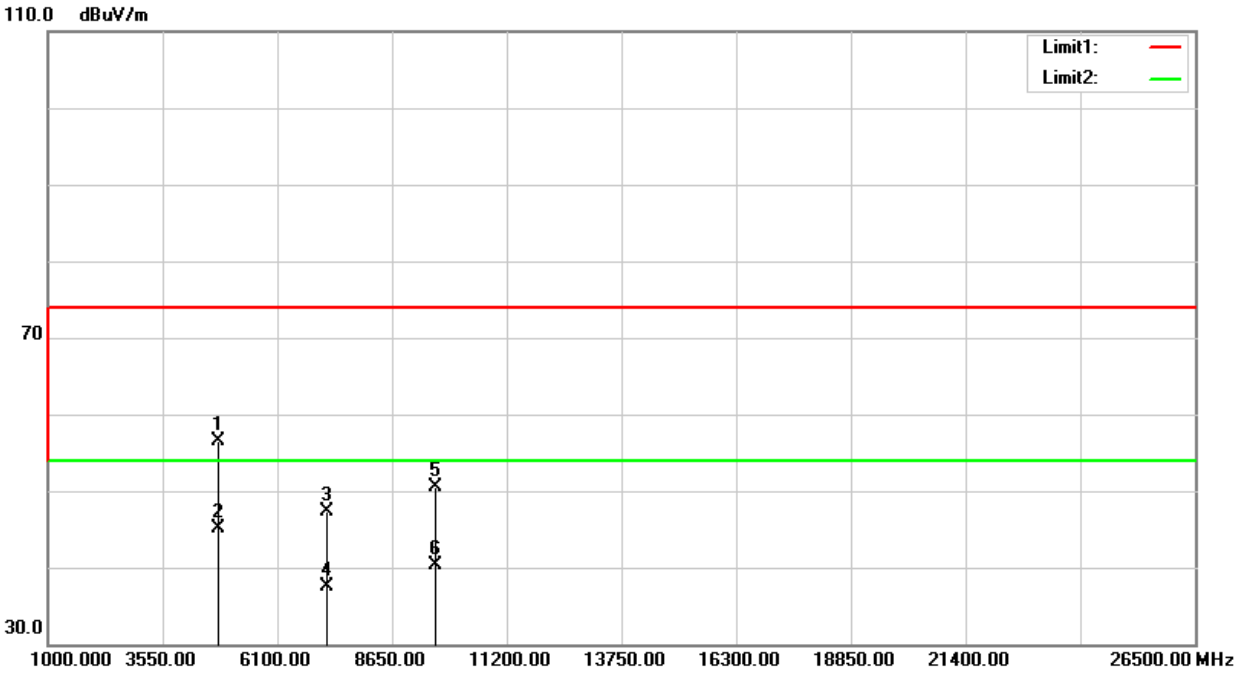


Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4804.000	59.17	5.04	64.21	74.00	-9.79	Peak
4804.000	43.70	5.04	48.74	54.00	-5.26	AVG
7206.000	34.19	12.62	46.81	74.00	-27.19	Peak
7206.000	24.02	12.62	36.64	54.00	-17.36	AVG
9608.000	32.92	17.60	50.52	74.00	-23.48	Peak
9608.000	22.97	17.60	40.57	54.00	-13.43	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	GFSK_BR-1Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

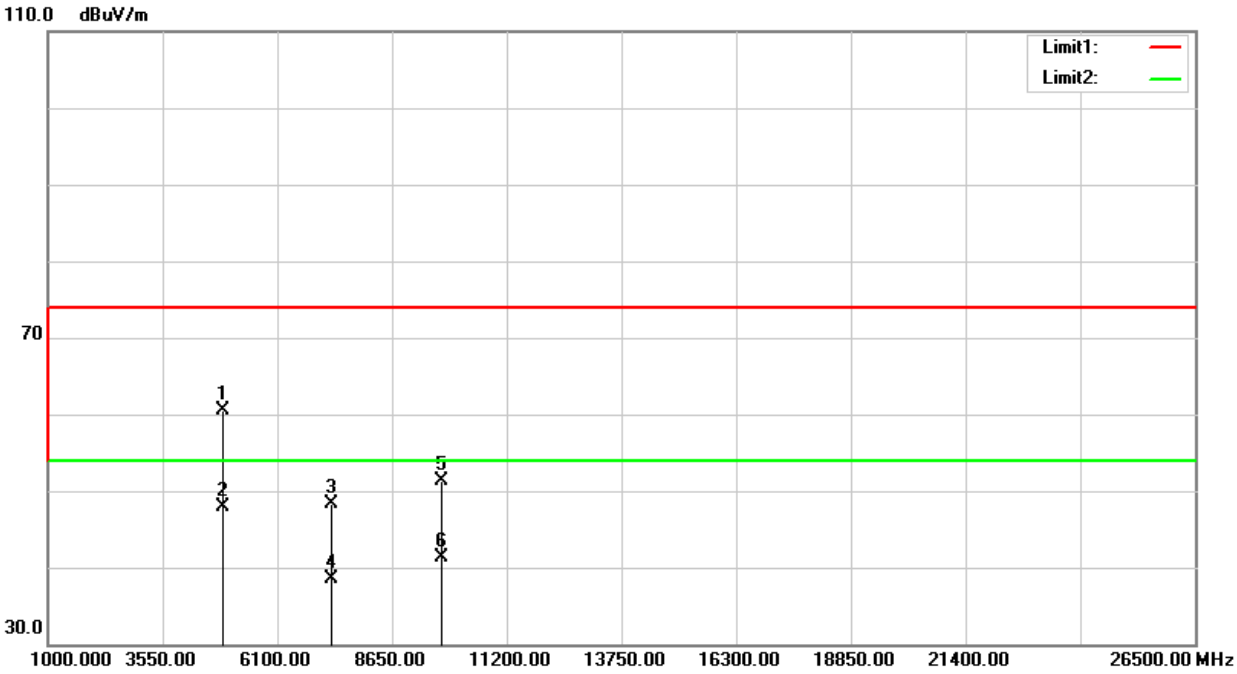


Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4804.000	51.13	5.04	56.17	74.00	-17.83	Peak
4804.000	40.23	5.04	45.27	54.00	-8.73	AVG
7206.000	34.72	12.62	47.34	74.00	-26.66	Peak
7206.000	24.65	12.62	37.27	54.00	-16.73	AVG
9608.000	32.59	17.60	50.19	74.00	-23.81	Peak
9608.000	23.27	17.60	40.87	54.00	-13.13	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	GFSK_BR-1Mbps Mid CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Vertical	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

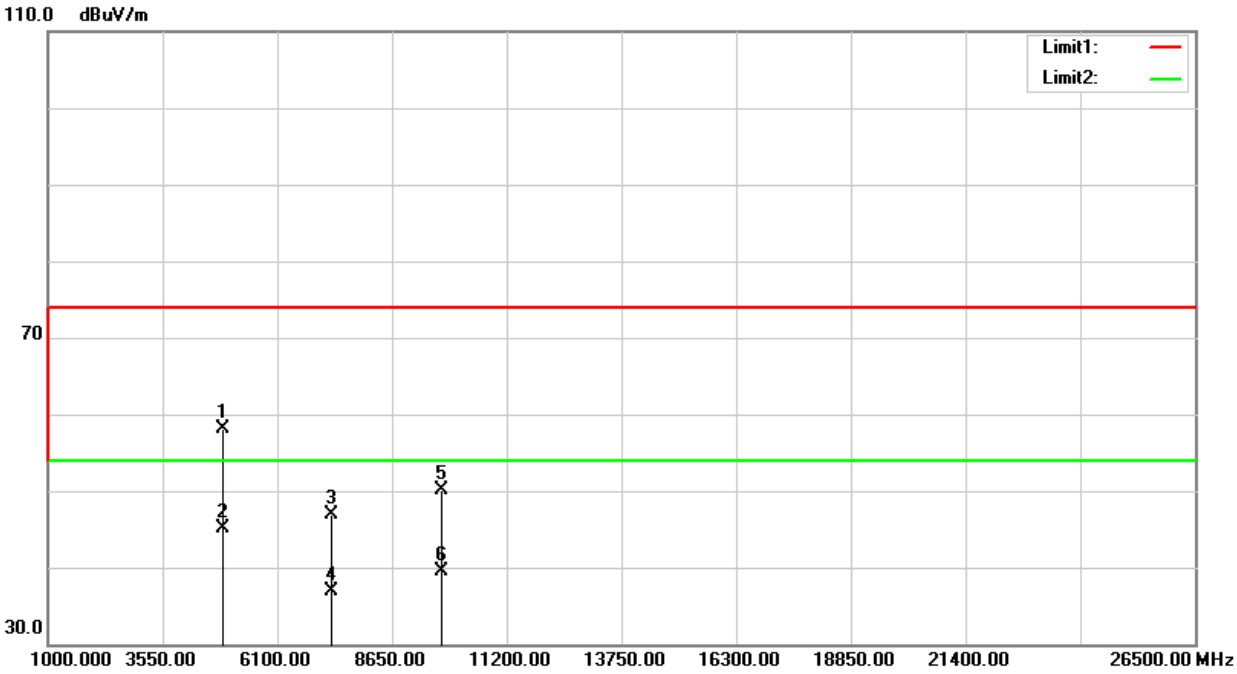


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4882.000	55.60	5.25	60.85	74.00	-13.15	Peak
4882.000	42.56	5.25	47.81	54.00	-6.19	AVG
7323.000	35.36	12.98	48.34	74.00	-25.66	Peak
7323.000	25.47	12.98	38.45	54.00	-15.55	AVG
9764.000	33.57	17.60	51.17	74.00	-22.83	Peak
9764.000	23.72	17.60	41.32	54.00	-12.68	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	GFSK_BR-1Mbps Mid CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

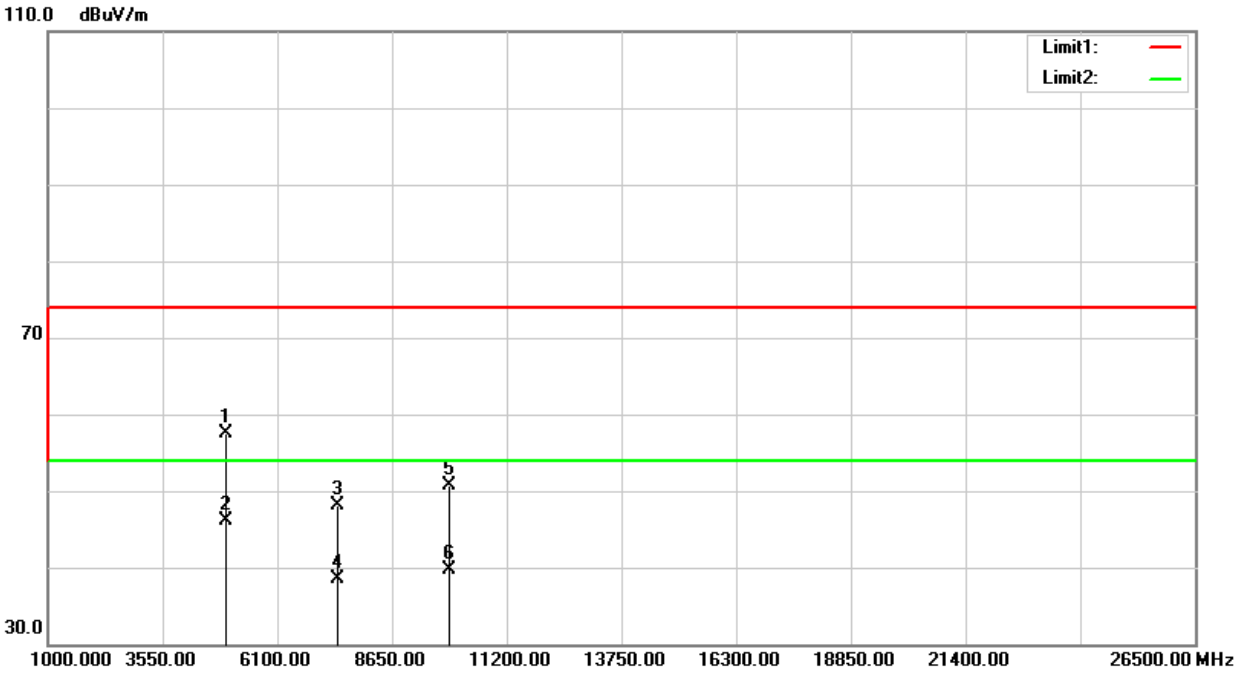


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4882.000	53.09	5.25	58.34	74.00	-15.66	peak
4882.000	40.37	5.25	45.62	54.00	-8.38	AVG
7323.000	33.79	12.98	46.77	74.00	-27.23	peak
7323.000	23.42	12.98	36.40	54.00	-17.6	AVG
9764.000	32.57	17.60	50.17	74.00	-23.83	peak
9764.000	21.76	17.60	39.36	54.00	-14.64	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	GFSK_BR-1Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Vertical	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

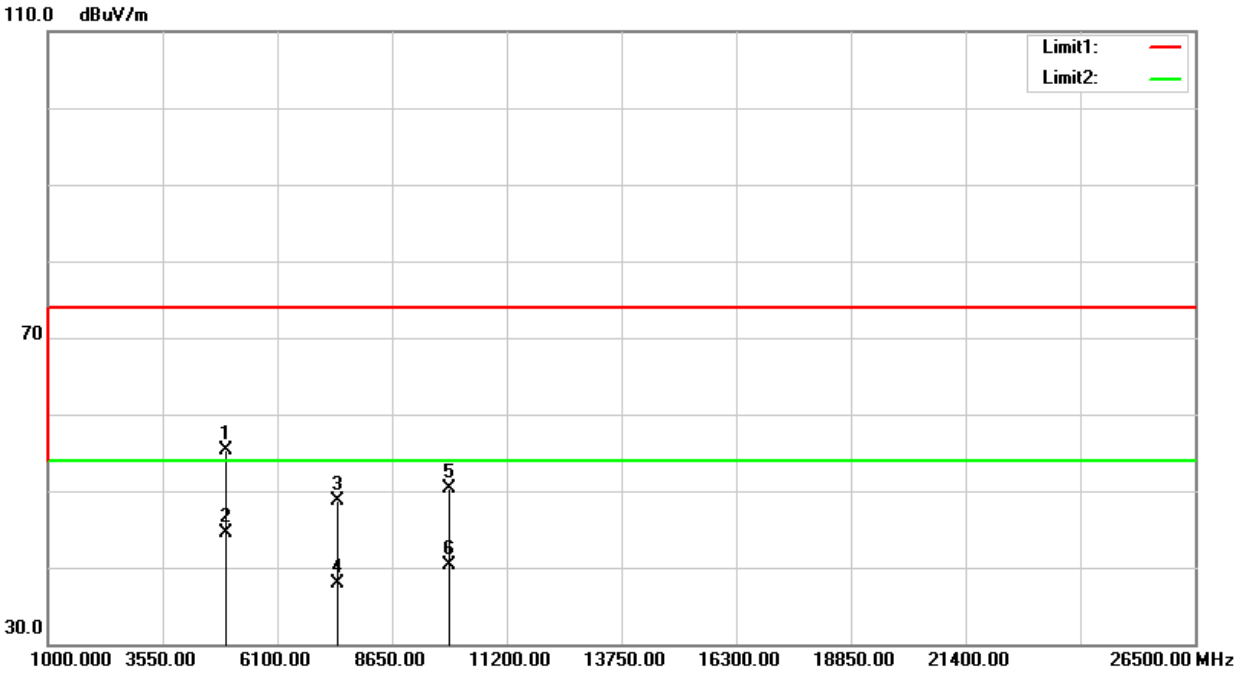


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4960.000	51.88	5.46	57.34	74.00	-16.66	Peak
4960.000	40.76	5.46	46.22	54.00	-7.78	AVG
7440.000	34.75	13.33	48.08	74.00	-25.92	Peak
7440.000	25.08	13.33	38.41	54.00	-15.59	AVG
9920.000	33.03	17.60	50.63	74.00	-23.37	Peak
9920.000	22.25	17.60	39.85	54.00	-14.15	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	GFSK_BR-1Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

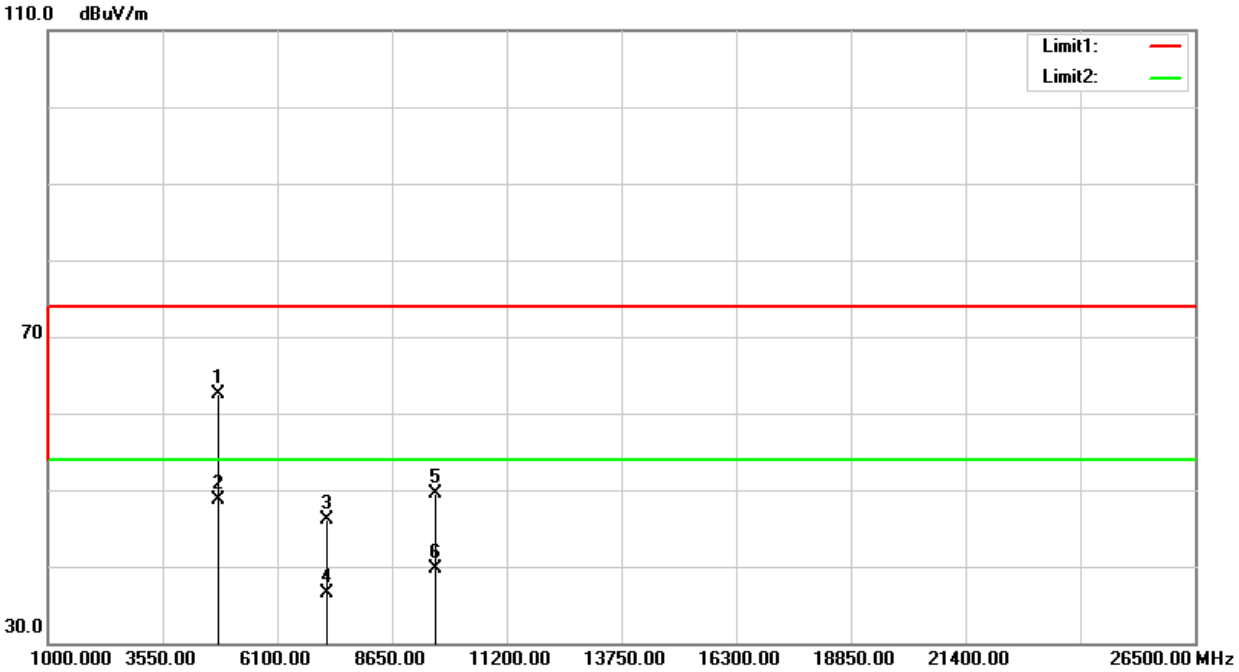


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4960.000	49.88	5.46	55.34	74.00	-18.66	Peak
4960.000	39.08	5.46	44.54	54.00	-9.46	AVG
7440.000	35.14	13.33	48.47	74.00	-25.53	Peak
7440.000	24.46	13.33	37.79	54.00	-16.21	AVG
9920.000	32.81	17.60	50.41	74.00	-23.59	Peak
9920.000	22.43	17.60	40.03	54.00	-13.97	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	8DPSK_EDR-3Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Vertical	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

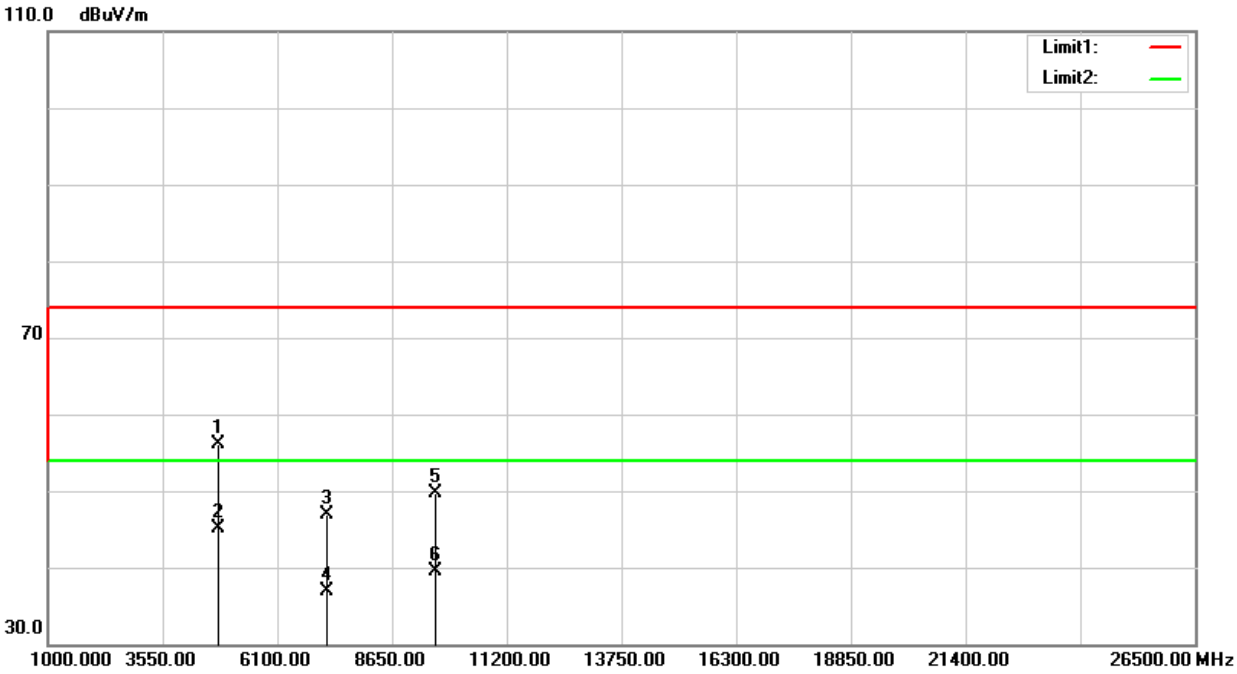


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4804.000	57.49	5.04	62.53	74.00	-11.47	Peak
4804.000	43.57	5.04	48.61	54.00	-5.39	AVG
7206.000	33.66	12.62	46.28	74.00	-27.72	Peak
7206.000	23.85	12.62	36.47	54.00	-17.53	AVG
9608.000	31.92	17.60	49.52	74.00	-24.48	Peak
9608.000	22.03	17.60	39.63	54.00	-14.37	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	8DPSK_EDR-3Mbps Low CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

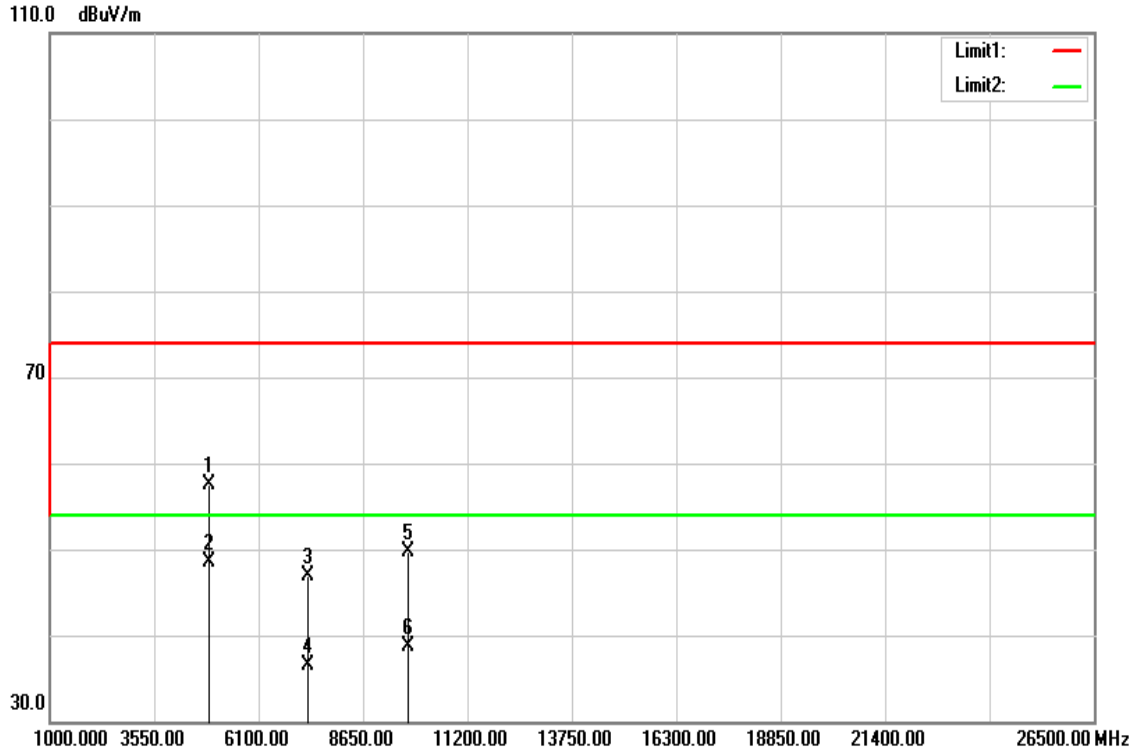


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4804.000	51.27	5.04	56.31	74.00	-17.69	Peak
4804.000	40.14	5.04	45.18	54.00	-8.82	AVG
7206.000	34.09	12.62	46.71	74.00	-27.29	Peak
7206.000	24.23	12.62	36.85	54.00	-17.15	AVG
9608.000	32.02	17.60	49.62	74.00	-24.38	Peak
9608.000	21.97	17.60	39.57	54.00	-14.43	AVG

Remark:

3. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
4. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	8DPSK_EDR-3Mbps Mid CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Vertical	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

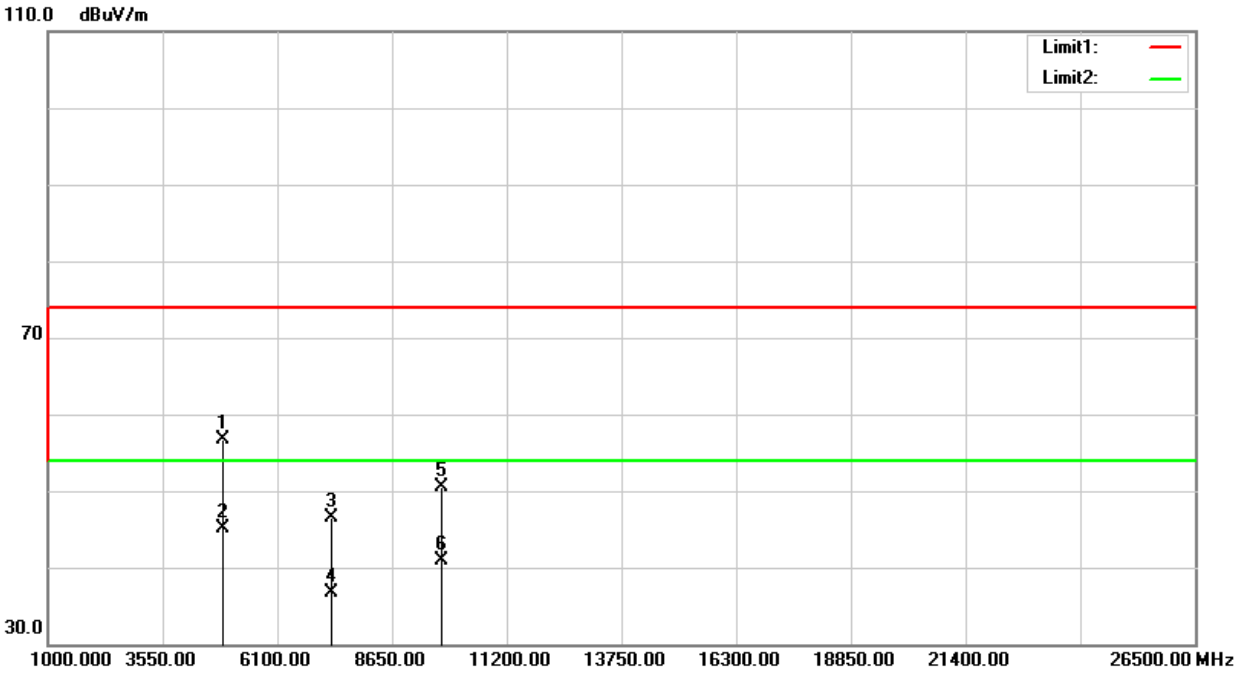


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4882.000	55.92	5.25	61.17	74.00	-12.83	Peak
4882.000	42.46	5.25	47.71	54.00	-6.29	AVG
7323.000	35.55	12.98	48.53	74.00	-25.47	Peak
7323.000	25.43	12.98	38.41	54.00	-15.59	AVG
9764.000	33.22	17.60	50.82	74.00	-23.18	Peak
9764.000	22.93	17.60	40.53	54.00	-13.47	AVG

Remark:

3. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
4. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	8DPSK_EDR-3Mbps Mid CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

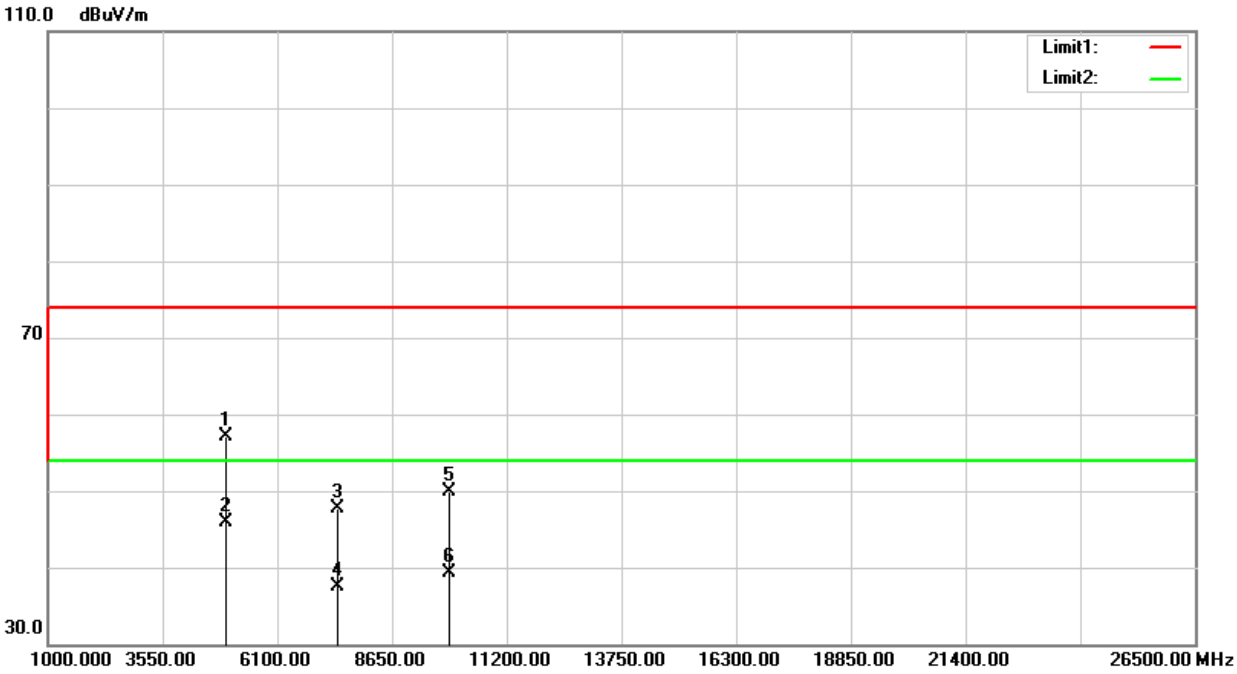


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4882.000	51.26	5.25	56.51	74.00	-17.49	Peak
4882.000	39.99	5.25	45.24	54.00	-8.76	AVG
7323.000	33.45	12.98	46.43	74.00	-27.57	Peak
7323.000	23.67	12.98	36.65	54.00	-17.35	AVG
9764.000	32.88	17.60	50.48	74.00	-23.52	Peak
9764.000	23.12	17.60	40.72	54.00	-13.28	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	8DPSK_EDR-3Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Vertical	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz

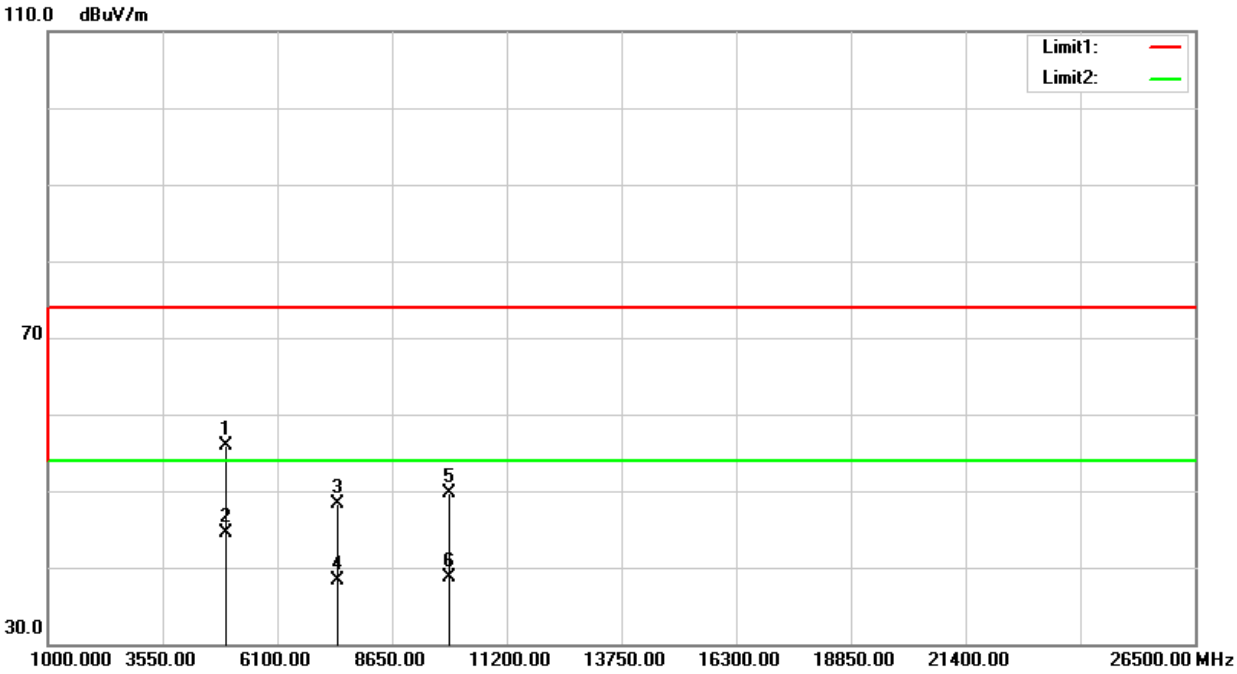


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4960.000	51.76	5.46	57.22	74.00	-16.78	Peak
4960.000	40.71	5.46	46.17	54.00	-7.83	AVG
7440.000	34.40	13.33	47.73	74.00	-26.27	Peak
7440.000	24.35	13.33	37.68	54.00	-16.32	AVG
9920.000	32.18	17.60	49.78	74.00	-24.22	Peak
9920.000	21.78	17.60	39.38	54.00	-14.62	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*

Test Mode	8DPSK_EDR-3Mbps High CH	Temp/Hum	27(℃)/ 53%RH
Test Item	Harmonic	Test Date	December 20, 2017
Polarize	Horizontal	Test Engineer	Kevin Kuo
Detector	Peak and Average	Test Voltage	120Vac / 60Hz



Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4960.000	50.65	5.46	56.11	74.00	-17.89	Peak
4960.000	38.88	5.46	44.34	54.00	-9.66	AVG
7440.000	34.92	13.33	48.25	74.00	-25.75	Peak
7440.000	25.04	13.33	38.37	54.00	-15.63	AVG
9920.000	32.19	17.60	49.79	74.00	-24.21	Peak
9920.000	21.21	17.60	38.81	54.00	-15.19	AVG

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *For above 1GHz,the EUT peak value was under average limit, therefore the Average value compliance with the average limit*