RADIO TEST REPORT

FCC 47 CFR PART 15 SUBPART C

Test Standard	**FCC Part 15.247**
Product name	**NearSky 360**
Brand name	**CIMCON**
Model No.	**NS360V2**
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)

Approved by: *Reviewed by:*

Kevin Tsai
Deputy Manager

Dally Hong
Engineer

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.
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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	April 9, 2019	Initial Issue	ALL	Becca Chen

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1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	**CIMCON Lighting, Inc.** 35 Crosby Drive, Bedford, MA 01730, USA
Manufacturer	**CIMCON Lighting, Inc.** 35 Crosby Drive, Bedford, MA 01730, USA
Equipment	NearSky 360
Model Name	NS360V2
Model Discrepancy	N/A
Trade Name	CIMCON
Received Date	October 16, 2018
Date of Test	November 23, 2018 ~ March 27, 2019
Output Power (W)	GFSK : 0.0068 8DPSK : 0.0076
Power Supply	AC 120V

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1.2 INFORMATION ABOUT THE FHSS CHARACTERISTICS

1.2.1 Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

1.2.2 Equal Hopping Frequency Use

The channels of this system will be used equally over the long-term distribution of the hopsets.

1.2.3 Example of a 79 hopping sequence in data mode:

02, 05, 31, 24, 20, 10, 43, 36, 30, 23, 40, 06, 21, 50, 44, 09, 71, 78, 01, 13, 73, 07, 70, 72, 35, 62, 42, 11, 41, 08, 29, 60, 15, 34, 61, 58, 04, 67, 12, 22, 53, 57, 18, 27, 76, 39, 32, 17, 77, 52, 33, 56, 46, 37, 47, 64, 49, 45, 38, 69, 14, 51, 26, 79, 19, 28, 65, 75, 54, 48, 03, 25, 66, 16, 68, 74, 59, 63, 55

1.2.4 System Receiver Input Bandwidth

Each channel bandwidth is 1MHz.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

1.2.5 Equipment Description

15.247(a)(1) that the Rx input bandwidths shift frequencies in synchronization with the transmitted signals.
15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

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1.3 EUT CHANNEL INFORMATION

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

Remark:
Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 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

1.4 ANTENNA INFORMATION

Antenna Type	☐ PIFA ☐ PCB ☒ Dipole ☐ Coils
Antenna Gain	3.32 dBi
Antenna Connector	Ipex MHF

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1.5 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575
Emission bandwidth, 20dB bandwidth	+/- 0.0014
RF output power, conducted	+/- 1.14
Power density, conducted	+/- 1.40
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12
3M Semi Anechoic Chamber / 200M~1000M	+/- 4.68
3M Semi Anechoic Chamber / 1G~8G	+/- 5.18
3M Semi Anechoic Chamber / 8G~18G	+/- 5.47
3M Semi Anechoic Chamber / 18G~26G	+/- 3.81
3M Semi Anechoic Chamber / 26G~40G	+/- 3.87

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.*

1.6 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	Dally Hong	-
Radiation	Kane Tseng	-
RF Conducted	Dally Hong	-

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

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1.7 INSTRUMENT CALIBRATION

RF Conducted Test Site					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal Date**	**Cal Due**
Power Meter	Anritsu	ML2495A	1149001	02/12/2019	02/11/2020
Power Seneor	Anritsu	MA2491A	030982	02/12/2019	02/11/2020
Signal Analyzer	R&S	FSV 40	101073	09/27/2018	09/26/2019
Software	N/A				

3M 966 Chamber Test Site					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal Date**	**Cal Due**
Band Reject Filters	MICRO TRONICS	BRM 50702	120	02/26/2019	02/25/2020
Bilog Antenna	Sunol Sciences	JB3	A030105	07/13/2018	07/12/2019
Cable	HUBER SUHNER	SUCOFLEX 104PEA	25157	02/26/2019	02/25/2020
Cable	HUBER SUHNER	SUCOFLEX 104PEA	20995	02/26/2019	02/25/2020
Digital Thermo-Hygro Meter	WISEWIND	1206	D07	01/30/2019	01/29/2020
double Ridged Guide Horn Antenna	ETC	MCTD 1209	DRH13M020 03	08/20/2018	08/19/2019
Loop Antenna	ETS.LINDGREN	6502	00148045	10/08/2018	10/07/2019
Pre-Amplifier	EMEC	EM330	060609	02/26/2019	02/25/2020
Pre-Amplifier	HP	8449B	3008A00965	02/26/2019	02/25/2020
PSA Series Spectrum Analyzer	Agilent	E4446A	MY46180323	05/31/2018	05/30/2019
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
Software	e3 6.11-20180413				

AC Conducted Emissions Test Site					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal Date**	**Cal Due**
CABLE	EMCI	CFD300-NL	CERF	06/29/2018	06/28/2019
EMI Test Receiver	R&S	ESCI	100064	07/24/2018	07/23/2019
LISN	SCHWARZBECK	NSLK 8127	8127-541	02/09/2018	02/08/2019
LISN	SCHAFFNER	NNB41	03/10013	02/06/2018	02/05/2019
Software	EZ-EMC(CCS-3A1-CE)				

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

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1.8 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	NB(B)	Toshiba	PORTEGE R30-A	N/A	PD97260H

1.9 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.

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2. TEST SUMMERY

FCC Standard Section	Report Section	Test Item	Result
15.203	1.3	Antenna Requirement	Pass
15.207(a)	5.1	AC Conducted Emission	Pass
15.247(a)(1)	5.2	20 dB Bandwidth	Pass
-	5.2	Occupied Bandwidth (99%)	Pass
15.247(b)(1)	5.3	Output Power Measurement	Pass
15.247(a)(1)	5.4	Frequency Separation	Pass
15.247(a)(1)(iii)	5.5	Number of Hopping	Pass
15.247(d)	5.6	Conducted Band Edge	Pass
15.247(d)	5.6	Conducted Emission	Pass
15.247(a)(1)(iii)	5.7	Time of Occupancy	Pass
15.247(d)	5.8	Radiation Band Edge	Pass
15.247(d)	5.8	Radiation Spurious Emission	Pass

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3. DESCRIPTION OF TEST MODES

3.1 THE WORST MODE OF OPERATING CONDITION

Operation mode	GFSK for BDR-1Mbps (DH5) 8DPSK for EDR-3Mbps (3DH5)
Test Channel Frequencies	**GFSK for BDR-1Mbps:** 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

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3.2 THE WORST MODE OF MEASUREMENT

AC Power Line Conducted Emission	
Test Condition	AC Power line conducted emission for line and neutral
Power supply Mode	Mode 1: AC 120V.
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement Above 1G	
Test Condition	Band edge, Emission for Unwanted and Fundamental
Power supply Mode	Mode 1: AC 120V.
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
Power supply Mode	Mode 1: AC 120V.
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 (X-Plane and Vertical) were recorded in this report

3. AC power line conducted emission and for below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.

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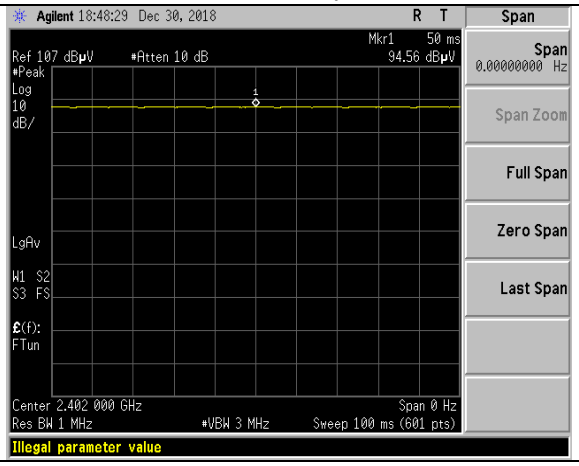
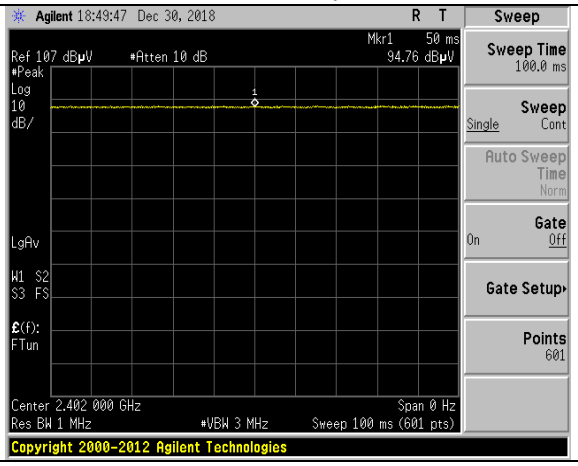
4. EUT DUTY CYCLE

Duty Cycle			
Configuration	TX ON (ms)	TX ALL (ms)	Duty Cycle (%)
BDR-1Mbps	1.0000	1.0000	100.00%
EDR-3Mbps	1.0000	1.0000	100.00%

BDR-1Mbps



EDR-3Mbps



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5. TEST RESULT

5.1 AC POWER LINE CONDUCTED EMISSION

5.1.1 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

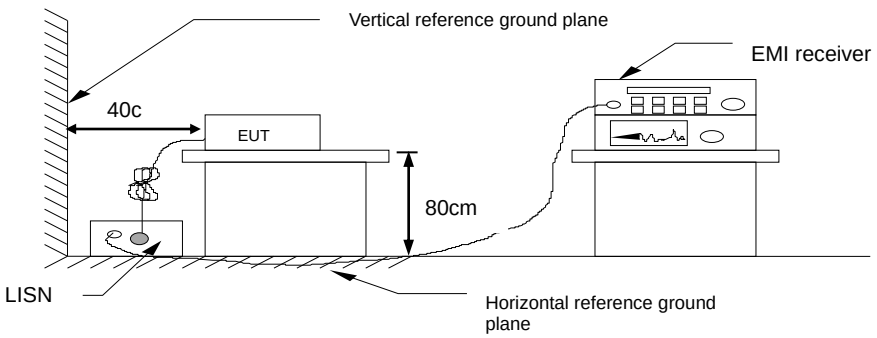
* Decreases with the logarithm of the frequency.

5.1.2 Test Procedure

Test method Refer as ANSI C63.10: 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.

5.1.3 Test Setup



5.1.4 Test Result

PASS

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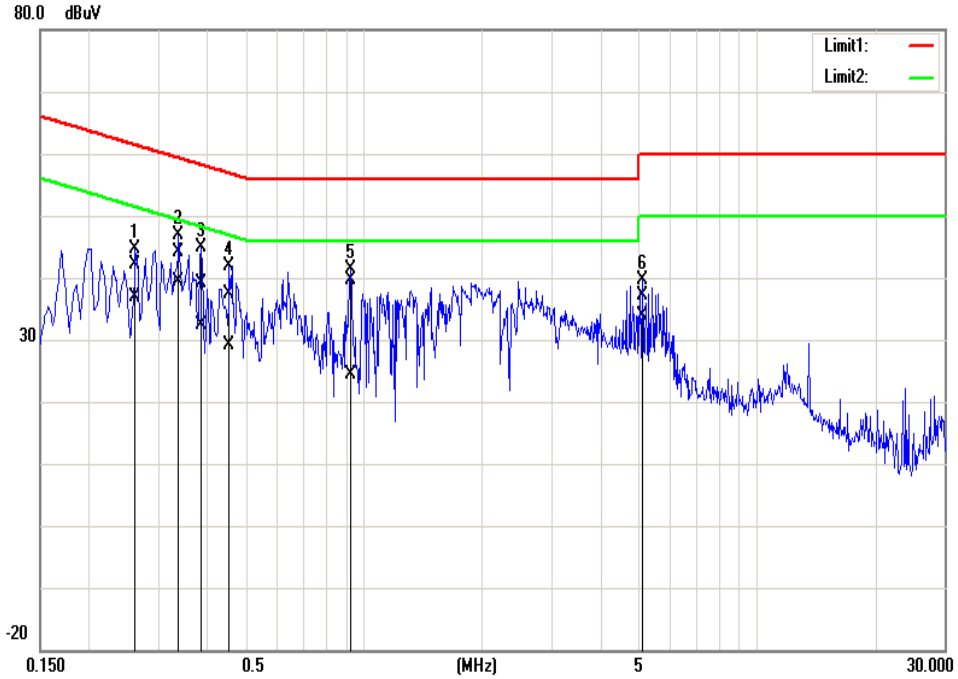
Test Data

Test Mode:	Mode 1	Temp/Hum	24(℃) / 50%RH
Phase:	Line	Test Date	November 23, 2018
		Test Engineer	Dally Hong



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
0.2620	41.86	36.72	0.16	42.02	36.88	61.37	51.37	-19.35	-14.49	Pass
0.3380	43.93	39.17	0.18	44.11	39.35	59.25	49.25	-15.14	-9.90	Pass
0.3860	39.05	32.16	0.18	39.23	32.34	58.15	48.15	-18.92	-15.81	Pass
0.4540	37.21	29.05	0.18	37.39	29.23	56.80	46.80	-19.41	-17.57	Pass
0.9260	39.52	24.24	0.20	39.72	24.44	56.00	46.00	-16.28	-21.56	Pass
5.1340	36.88	33.55	0.32	37.20	33.87	60.00	50.00	-22.80	-16.13	Pass

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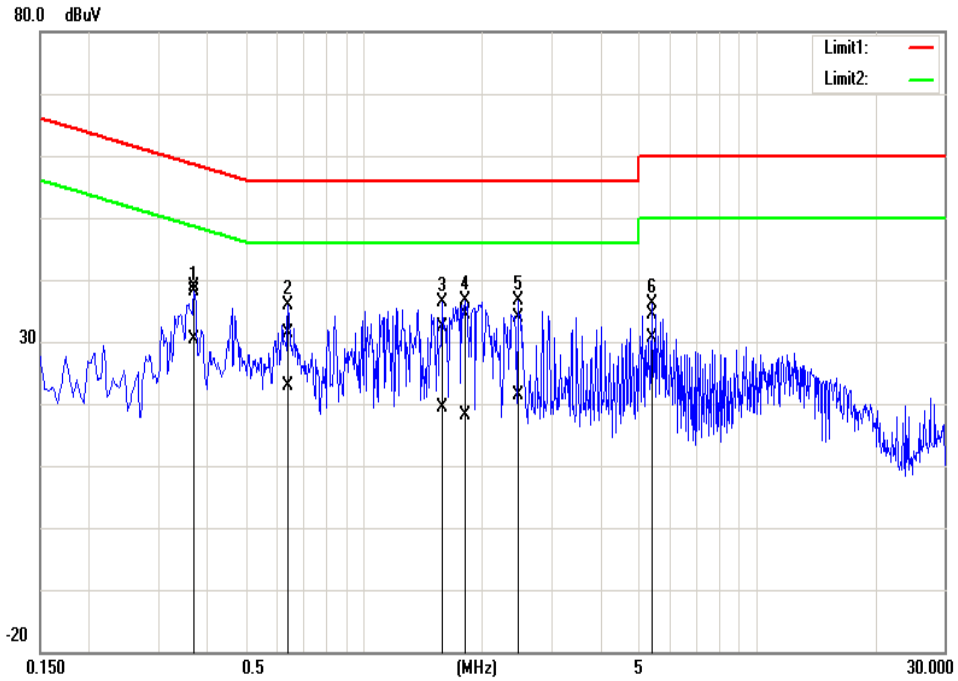
Test Mode:	Mode 1	Temp/Hum	24(℃) / 50%RH
Phase:	Neutral	Test Date	November 23, 2018
		Test Engineer	Dally Hong



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
0.3700	38.70	30.14	0.19	38.89	30.33	58.50	48.50	-19.61	-18.17	Pass
0.6420	31.22	22.79	0.19	31.41	22.98	56.00	46.00	-24.59	-23.02	Pass
1.5820	32.07	19.20	0.23	32.30	19.43	56.00	46.00	-23.70	-26.57	Pass
1.8100	34.12	17.88	0.24	34.36	18.12	56.00	46.00	-21.64	-27.88	Pass
2.4660	33.58	21.02	0.25	33.83	21.27	56.00	46.00	-22.17	-24.73	Pass
5.4180	34.10	30.33	0.33	34.43	30.66	60.00	50.00	-25.57	-19.34	Pass

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5.2 20dB BANDWIDTH AND OCCUPIED BANDWIDTH (99%)

5.2.1 Test Limit

According to §15.247(a) (1),

20 dB Bandwidth ：For reporting purposes only.

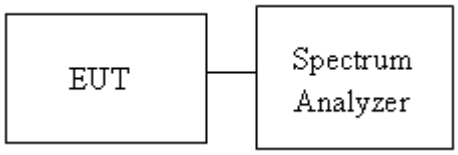
Occupied Bandwidth(99%) ：For reporting purposes only.

5.2.2 Test Procedure

Test method Refer as Section 8.1 and ANSI C63.10: 2013 clause 7.8.7,

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 20dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth.
5. Measure and record the result of 20 dB Bandwidth and 99% Bandwidth. in the test report.

5.2.3 Test Setup



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5.2.4 Test Result

Test mode: GFSK_BDR-1Mbps mode / 2402-2480 MHz			
Channel	**Frequency (MHz)**	**OBW (99%) (MHz)**	**20dB BW (MHz)**
Low	2402	0.8423	0.9465
Mid	2441	0.8857	0.9551
High	2480	0.8726	0.9551

Test mode: 8DPSK_EDR-3Mbps mode / 2402-2480 MHz			
Channel	**Frequency (MHz)**	**OBW (99%) (MHz)**	**20dB BW (MHz)**
Low	2402	1.2243	1.3589
Mid	2441	1.2243	1.3632
High	2480	1.2330	1.3589

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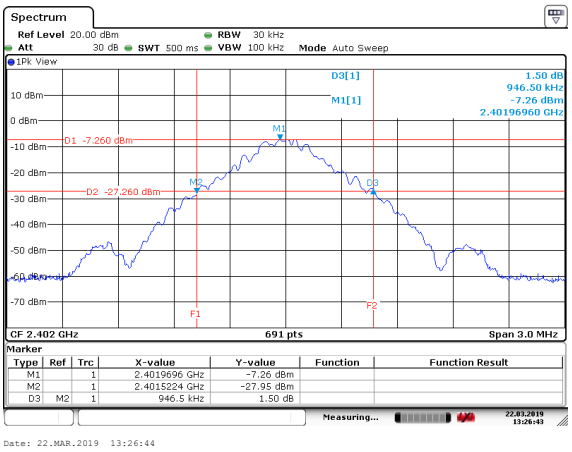
Test Data

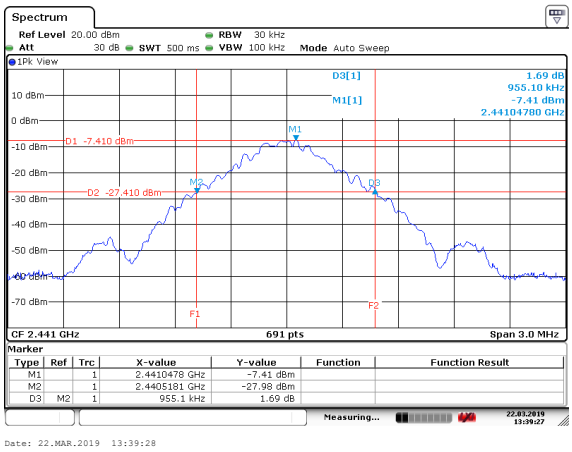
20 dB Bandwidth

GFSK_BDR-1Mbps mode

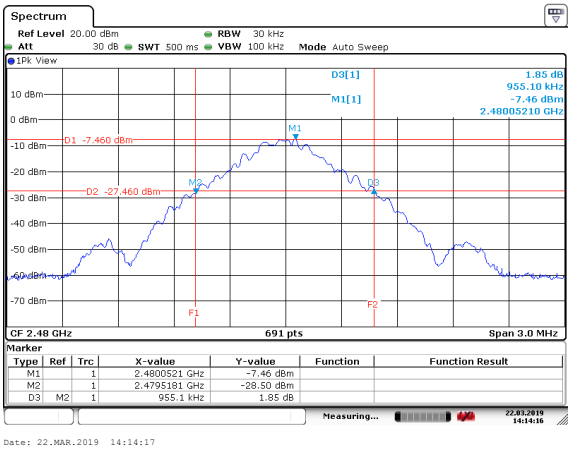
Low CH



Mid CH



High CH



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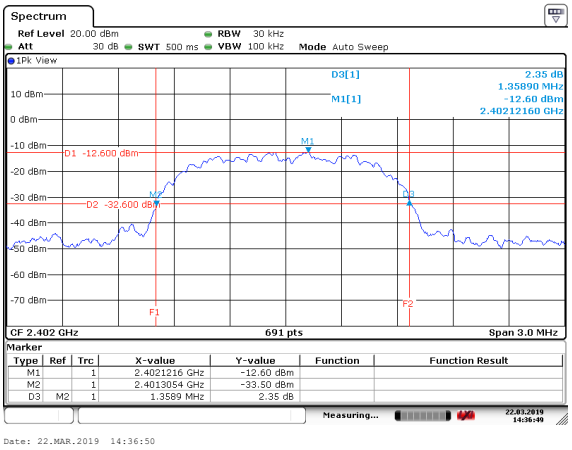
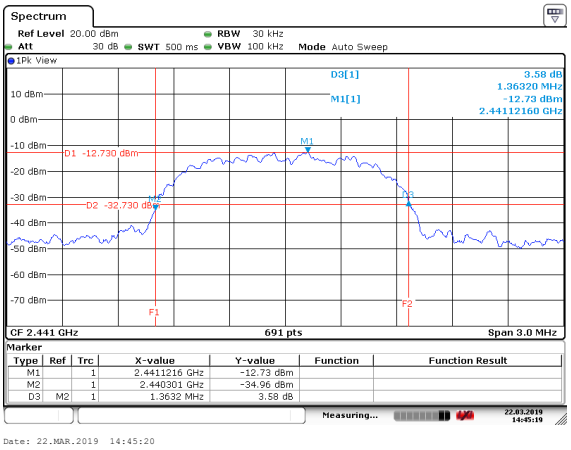
8DPSK_EDR-3Mbps mode

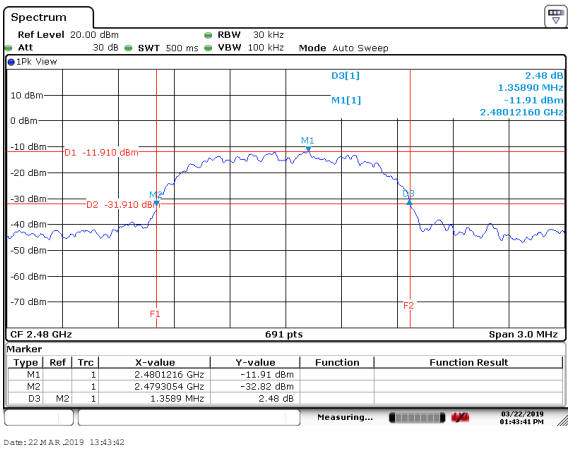
Low CH



Mid CH



High CH



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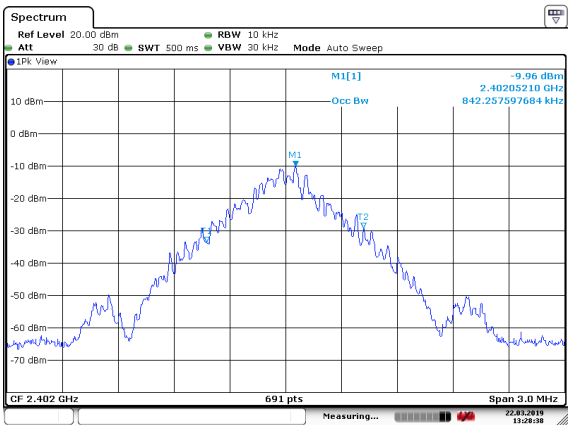
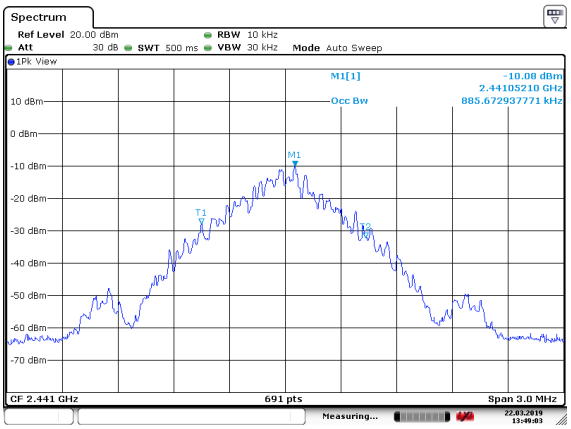
99% Bandwidth

GFSK_BR-1Mbps mode

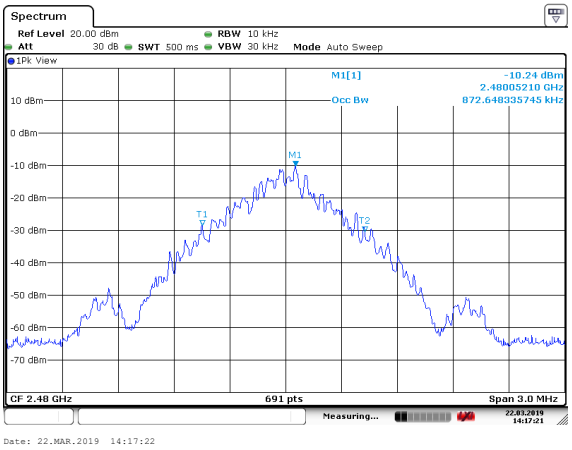
Low CH



Mid CH



High CH



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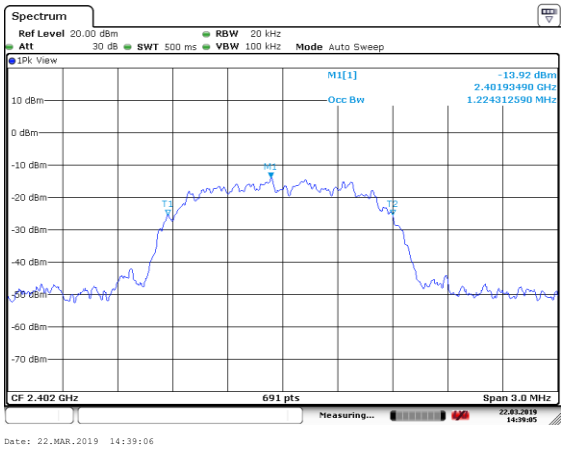
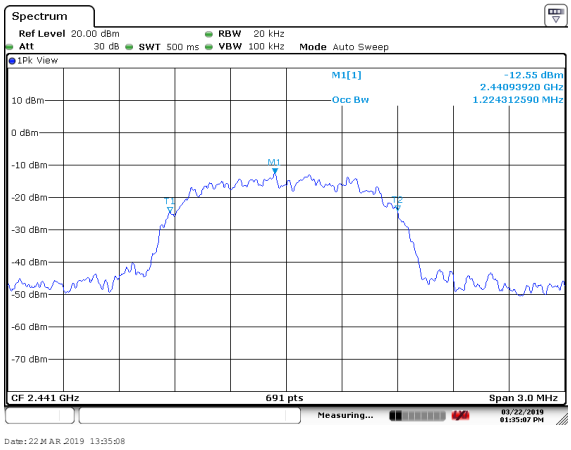
8DPSK_EDR-3Mbps mode

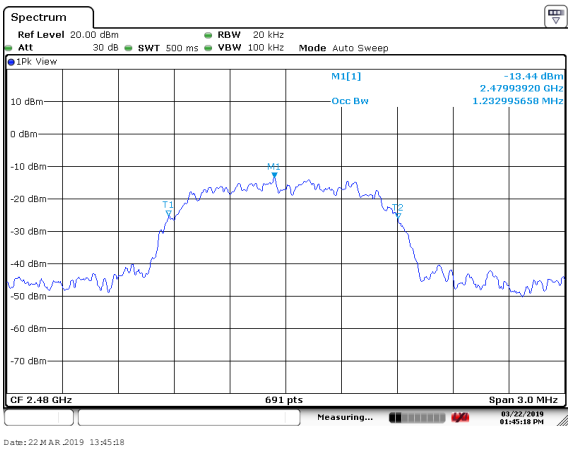
Low CH



Mid CH



High CH



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5.3 OUTPUT POWER MEASUREMENT

5.3.1 Test Limit

According to §15.247(b)(1).

Peak output power：

FCC

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.

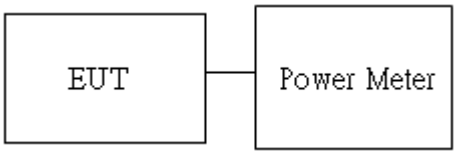
Limit	☒ Antenna not exceed 6 dBi：21dBm ☐ Antenna with DG greater than 6 dBi：21dBm [Limit = 30 – (DG – 6)]

Average output power：For reporting purposes only.

5.3.2 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.

5.3.3 Test Setup



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5.3.4 Test Result

Peak output power：

BT					
Config.	CH	Freq. (MHz)	PK Power (dBm)	PK Power (W)	Limit (dBm)
GFSK BR-1Mbps (DH5)	0	2402	8.33	0.0068	21
	39	2441	8.1	0.0065	
	78	2480	7.86	0.0061	
8DPSK EDR-3Mbps (DH5)	0	2402	8.52	0.0071	
	39	2441	8.79	0.0076	
	78	2480	8.4	0.0069	

Average output power：

BT			
Config.	CH	Freq. (MHz)	AV Power (dBm)
GFSK BR-1Mbps (DH5)	0	2402	8.25
	39	2441	8.01
	78	2480	7.78
8DPSK EDR-3Mbps (DH5)	0	2402	6.16
	39	2441	5.83
	78	2480	5.34

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5.4 FREQUENCY SEPARATION

5.4.1 Test Limit

According to §15.247(a)(1),

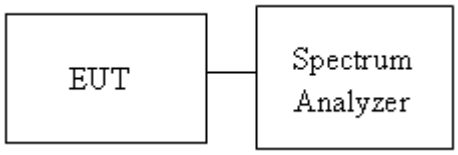
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

Limit	> two-thirds of the 20 dB bandwidth

5.4.2 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

5.4.3 Test Setup



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5.4.4 Test Result

Test mode: GFSK_BDR-1Mbps mode / 2402-2480 MHz				
Channel	**Frequency (MHz)**	**Channel Separation (MHz)**	**Channel Separation Limits (MHz)**	**Result**
Low	2402	0.9942	0.631	PASS
Mid	2441	0.9942	0.637	PASS
High	2480	0.9942	0.637	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	0.906	PASS
Mid	2441	1.0029	0.909	PASS
High	2480	1.0029	0.906	PASS

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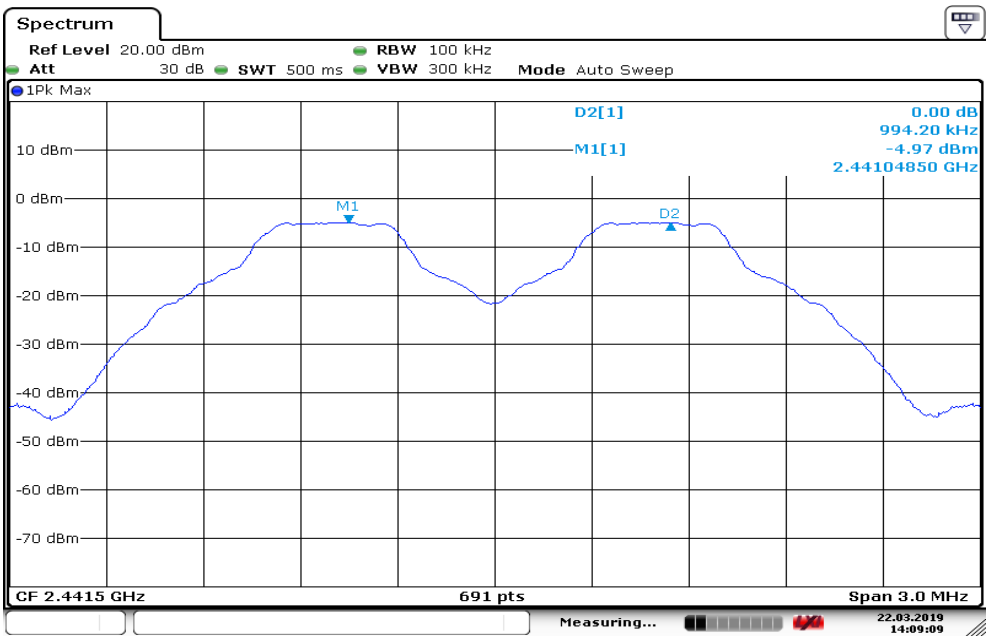
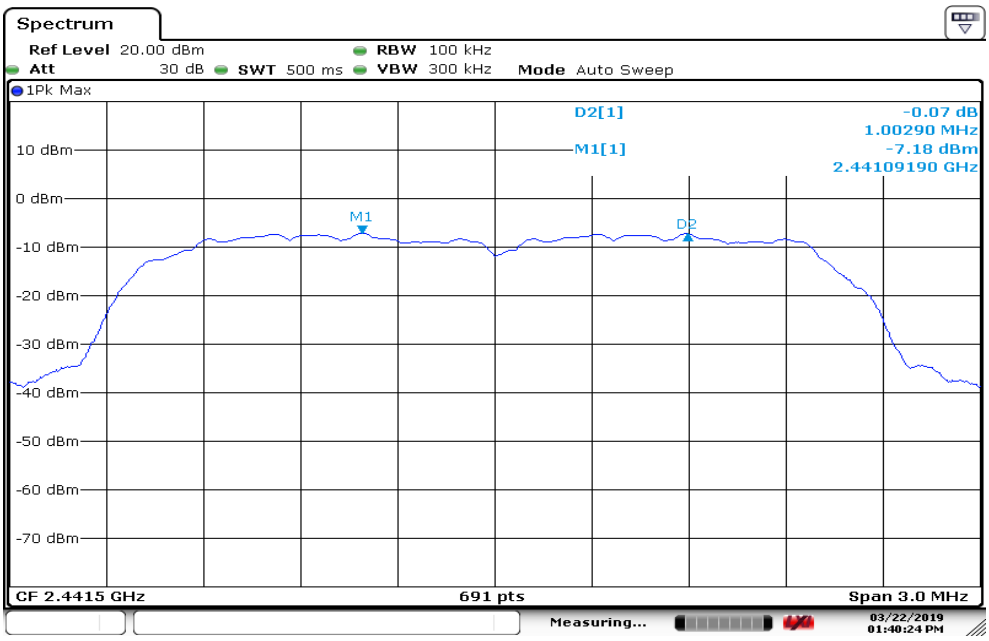
Test Data

GFSK_BDR-1Mbps mode



Date: 22.MAR.2019 14:09:10

8DPSK_EDR-3Mbps mode



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5.5 NUMBER OF HOPPING

5.5.1 Test Limit

According to §15.247(a)(1)(iii)

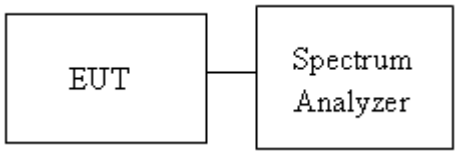
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

5.5.2 Test Procedure

Test method Refer as ANSI C63.10: 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.
4. Max hold, view and count how many channels in the band.

5.5.3 Test Setup



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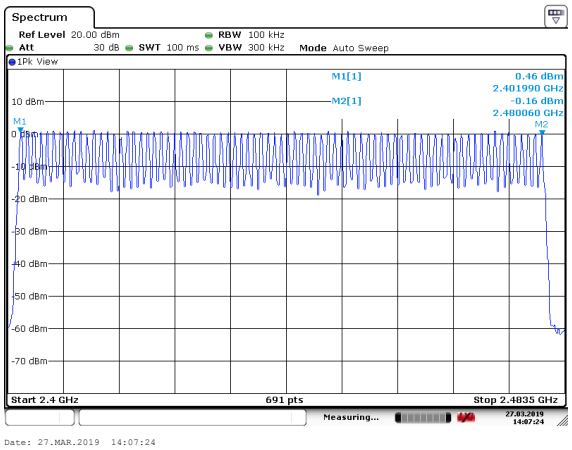
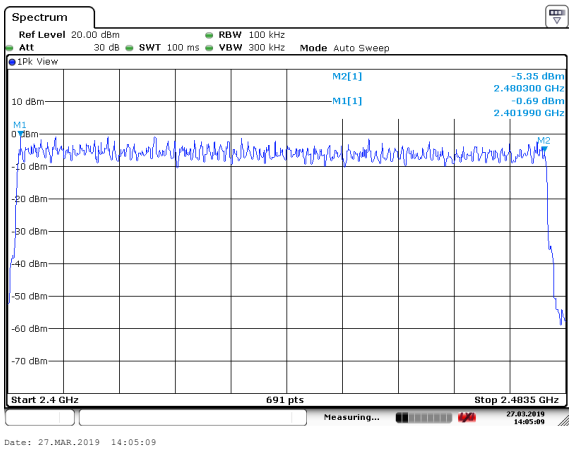
5.5.4 Test Result

Number of Hopping				
Mode	**Frequency (MHz)**	**Hopping Channel Number**	**Hopping Channel Number Limits**	**Result**
BDR-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_BDR-1Mbps mode	**8DPSK_EDR-3Mbps mode**
	

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5.6 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

5.6.1 Test Limit

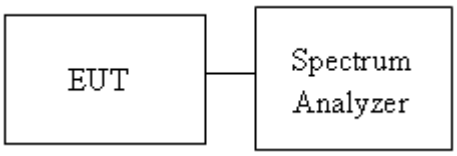
According to §15.247(d),

Limit	-20 dBc

5.6.2 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.

5.6.3 Test Setup



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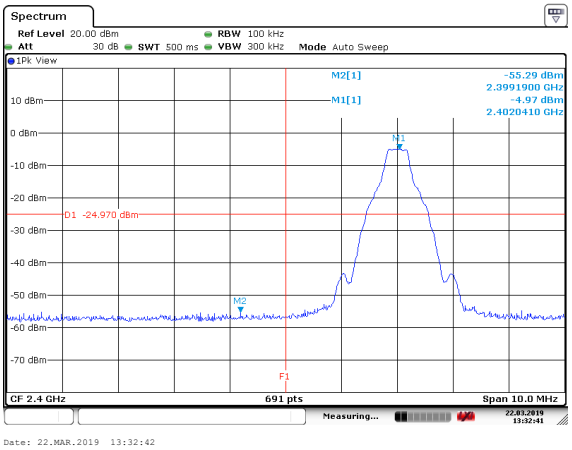
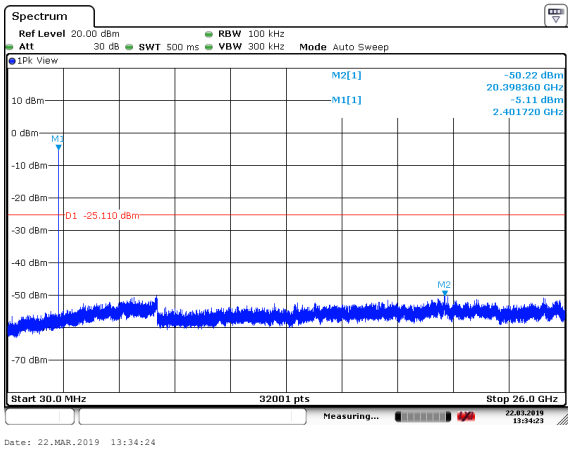
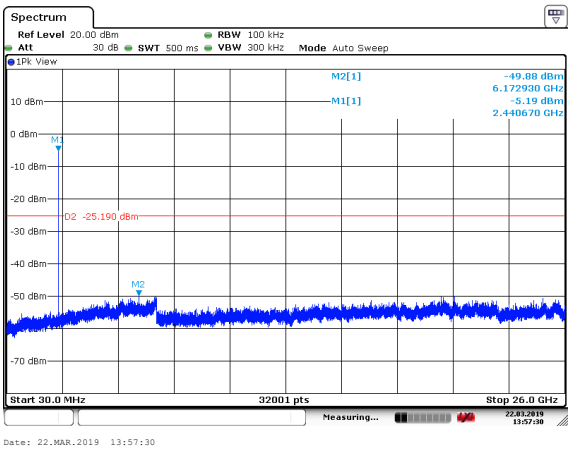
5.6.4 Test Result

Test Data

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

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


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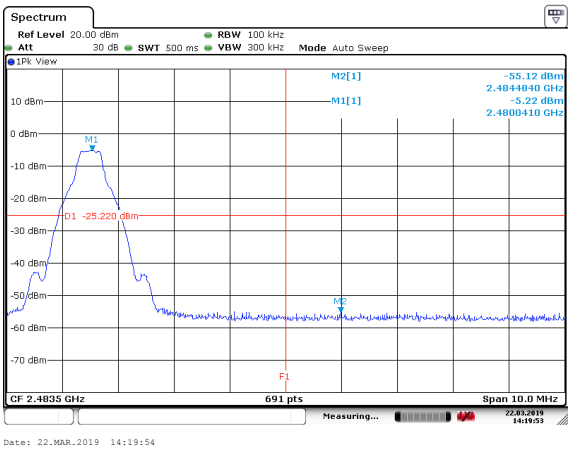
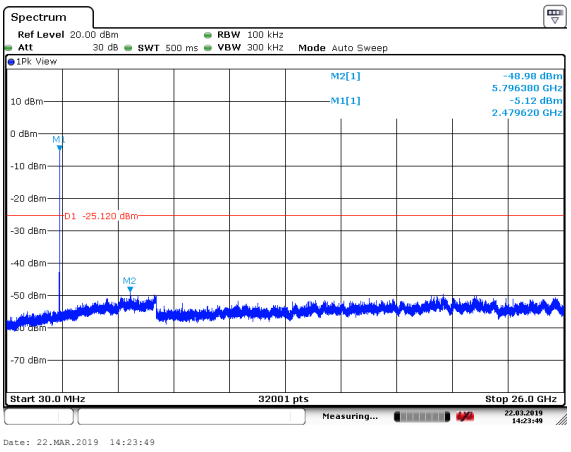
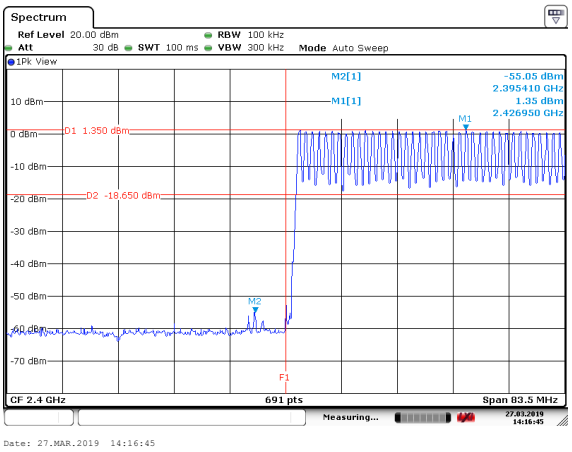
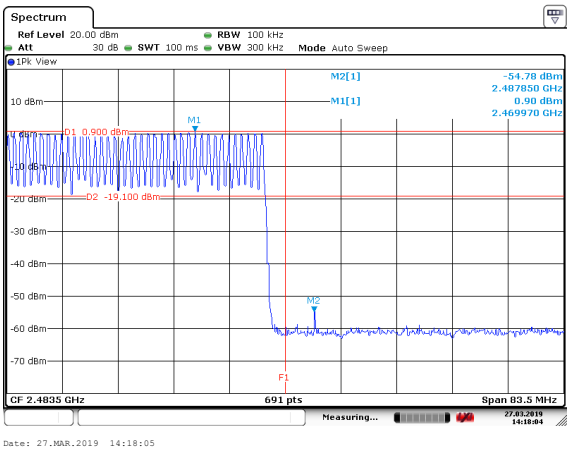
GFSK_BDR-1Mbps mode High CH	
Band Edge	**Spurious Emission 30MHz-25GHz**
	
GFSK_BDR-1Mbps Hopping mode	
Low Band Edge	**High Band Edge**
	

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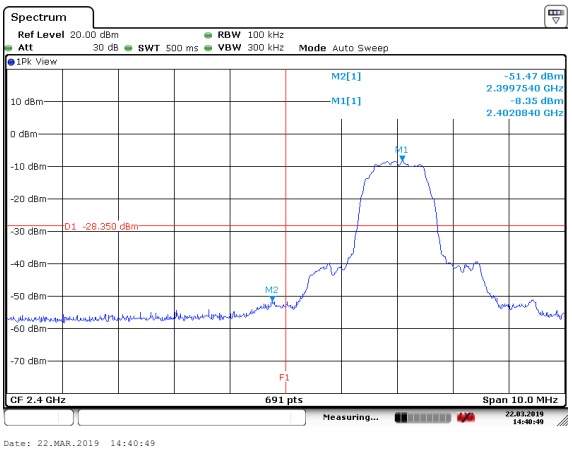
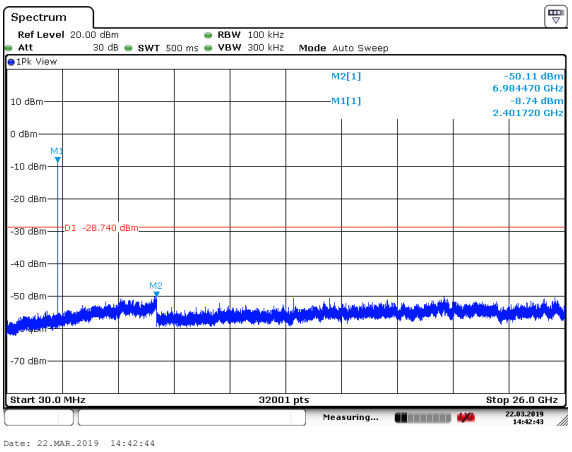
8DPSK_EDR-3Mbps mode Low CH

Band Edge

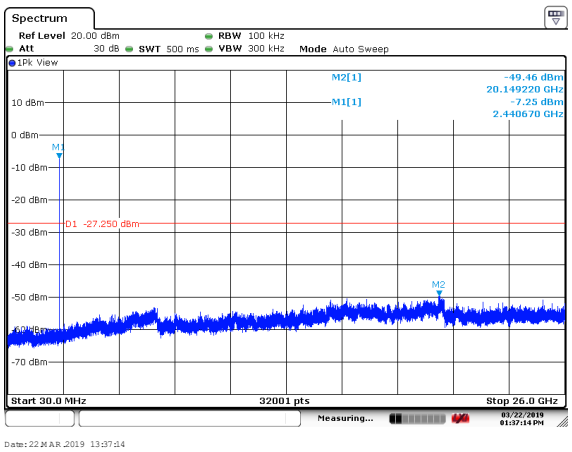


Spurious Emission 30MHz-25GHz



8DPSK_EDR-3Mbps mode Mid CH

Spurious Emission 30MHz-25GHz



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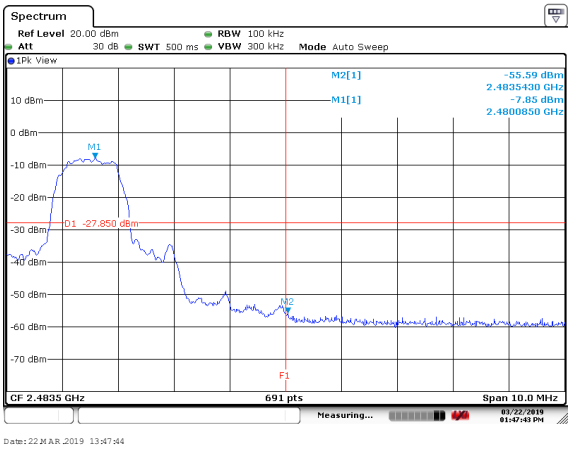
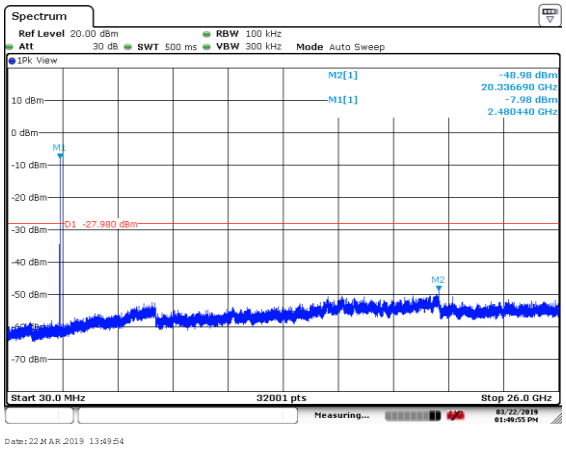
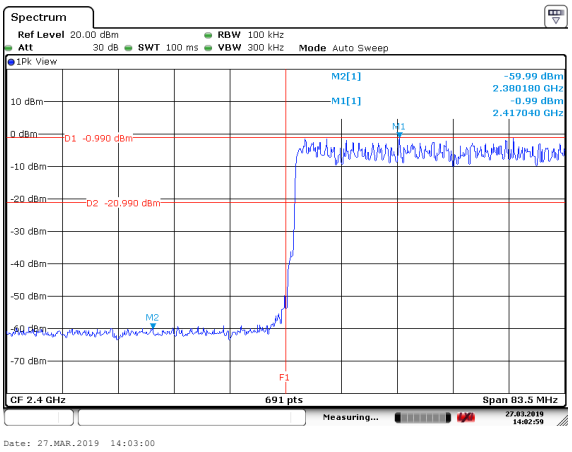
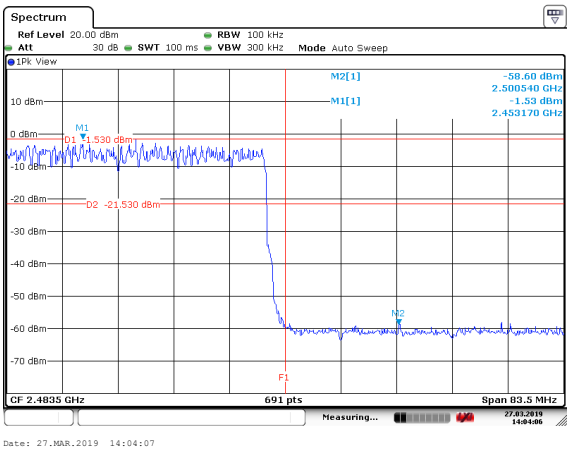
8DPSK_EDR-3Mbps mode High CH	
Band Edge	**Spurious Emission 30MHz-25GHz**
	
8DPSK_EDR-3Mbps Hopping mode	
Low Band Edge	**High Band Edge**
	

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5.7 TIME OF OCCUPANCY (DWELL TIME)

5.7.1 Test Limit

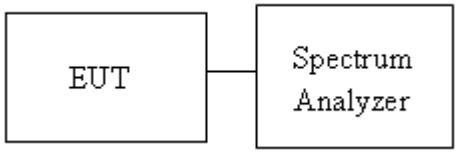
According to §15.247(a)(1)(iii),

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.

5.7.2 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

5.7.3 Test Setup



5.7.4 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
BDR-1Mbps	2441	1.0000	79	106.67	0.1067	0.4	Pass
EDR-3Mbps	2441	1.0000	79	106.67	0.1067	0.4	
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							

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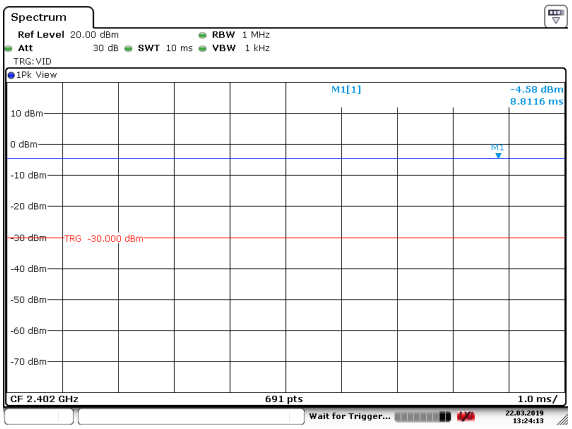
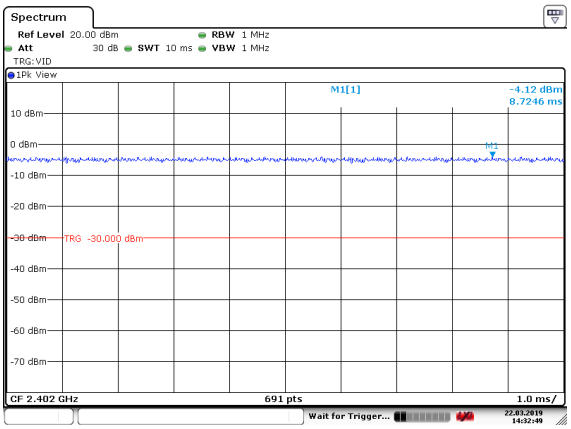
Test Data

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

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5.8 RADIATION BANDEDGE AND SPURIOUS EMISSION

5.8.1 Test Limit

FCC 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)

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 414788.

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5.8.2 Test Procedure

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: 2013, 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 9kHz to 26.5GHz set to the low, Mid and High channels with the EUT transmit.

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

4. For harmonic, the worst case of output power was BDR-1Mbps. Therefore only BDR-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 (%)	T(ms)	1/T (kHz)	VBW setting
GFSK_BDR-1Mbps	100%	1.0000	-	10
8DPSK_EDR-3Mbps	100%	1.0000	-	10

Remark:

1. *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 414788.*
2. *No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).*

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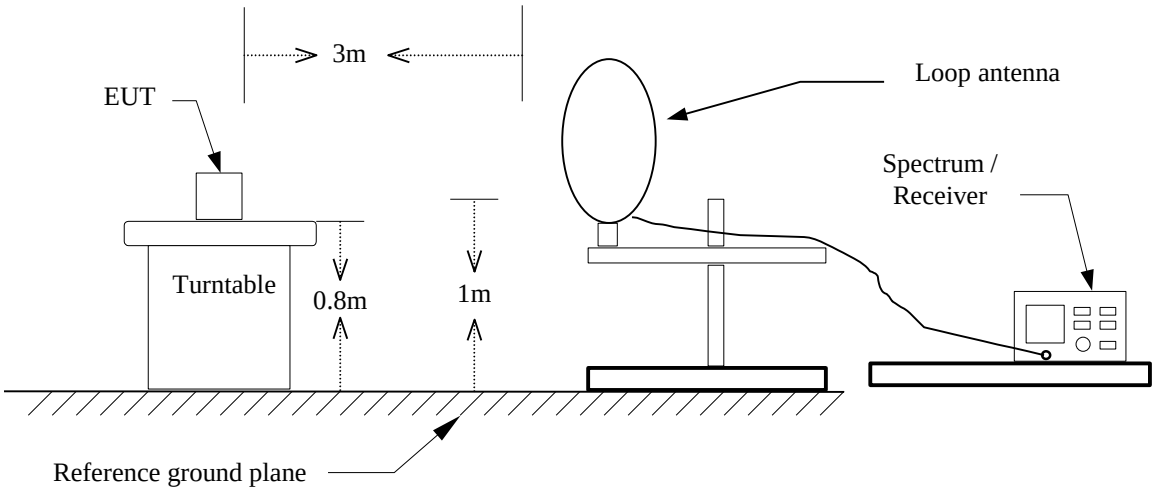
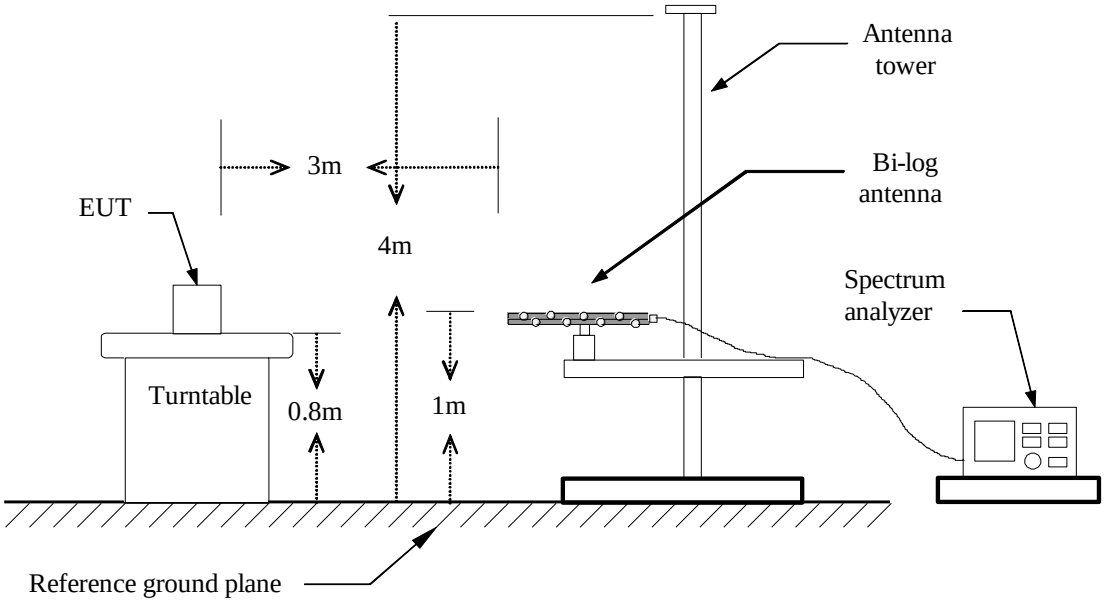
5.8.3 Test Setup

9kHz ~ 30MHz



30MHz ~ 1GHz



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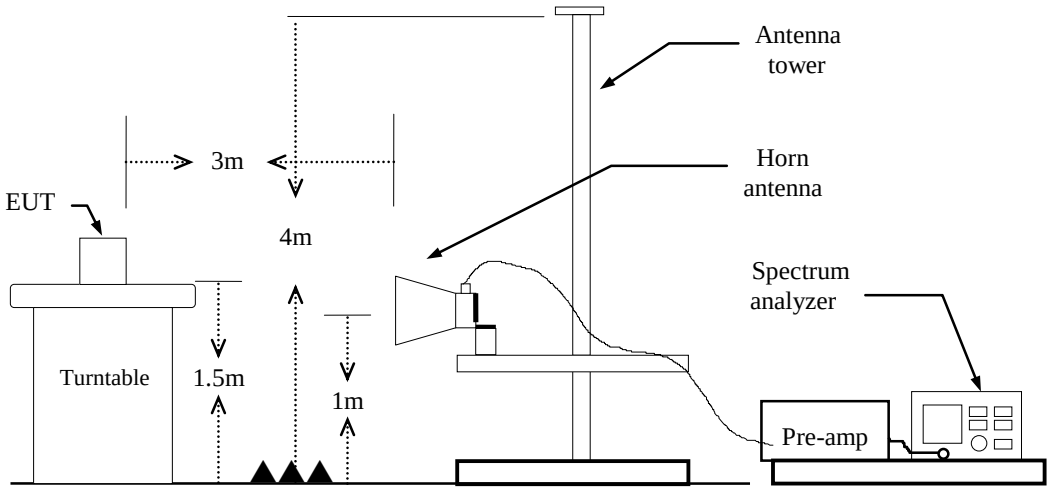
Above 1GHz



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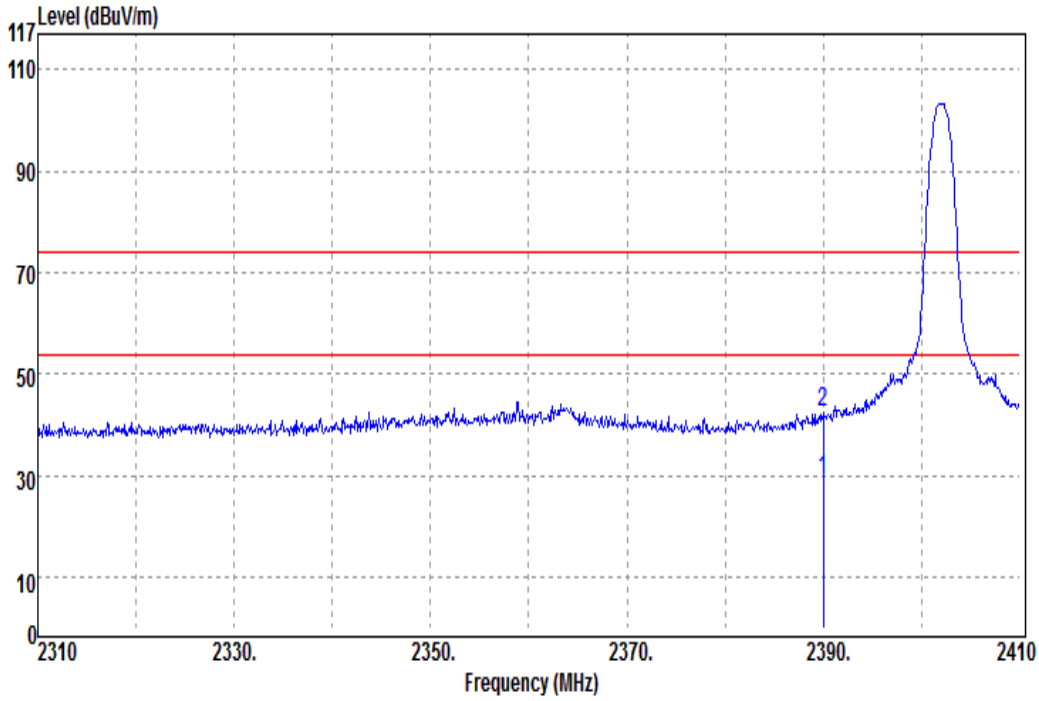
5.8.4 Test Result

Band Edge Test Data

Test Mode:	GFSK_BR-1Mbps Low CH	Temp/Hum	21(℃) / 49%RH
Test Item	Band Edge	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak & Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	32.34	-3.33	29.01	54.00	-24.99
2390.00	Peak	45.92	-3.33	42.59	74.00	-31.41

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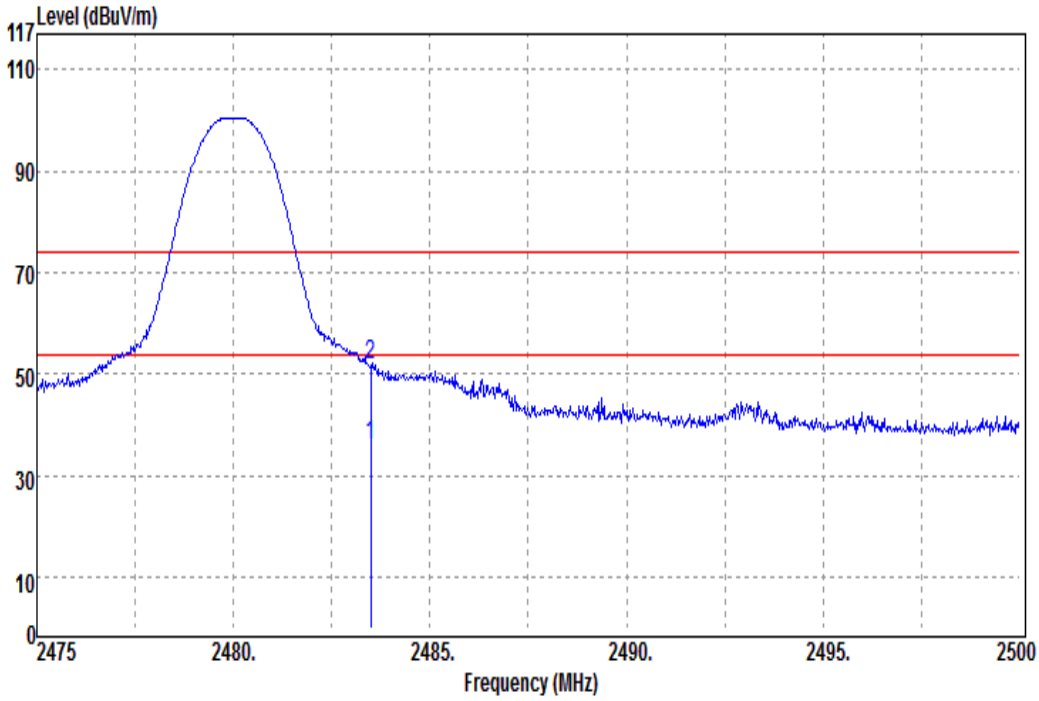
Test Mode:	GFSK_BR-1Mbps High CH	Temp/Hum	21(℃) / 49%RH
Test Item	Band Edge	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak & Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	38.72	-2.72	36.00	54.00	-18.00
2483.50	Peak	54.48	-2.72	51.76	74.00	-22.24

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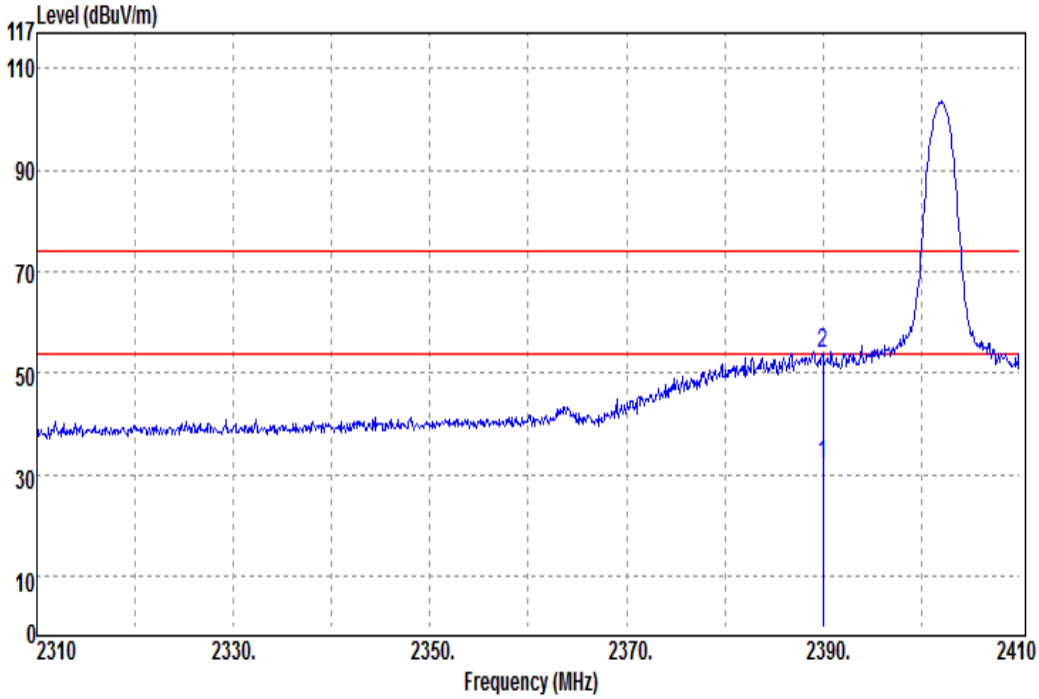
Test Mode:	8DPSK_EDR-3Mbps Low CH	Temp/Hum	21(℃) / 49%RH
Test Item	Band Edge	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak & Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	35.46	-3.33	32.13	54.00	-21.87
2390.00	Peak	57.15	-3.33	53.82	74.00	-20.18

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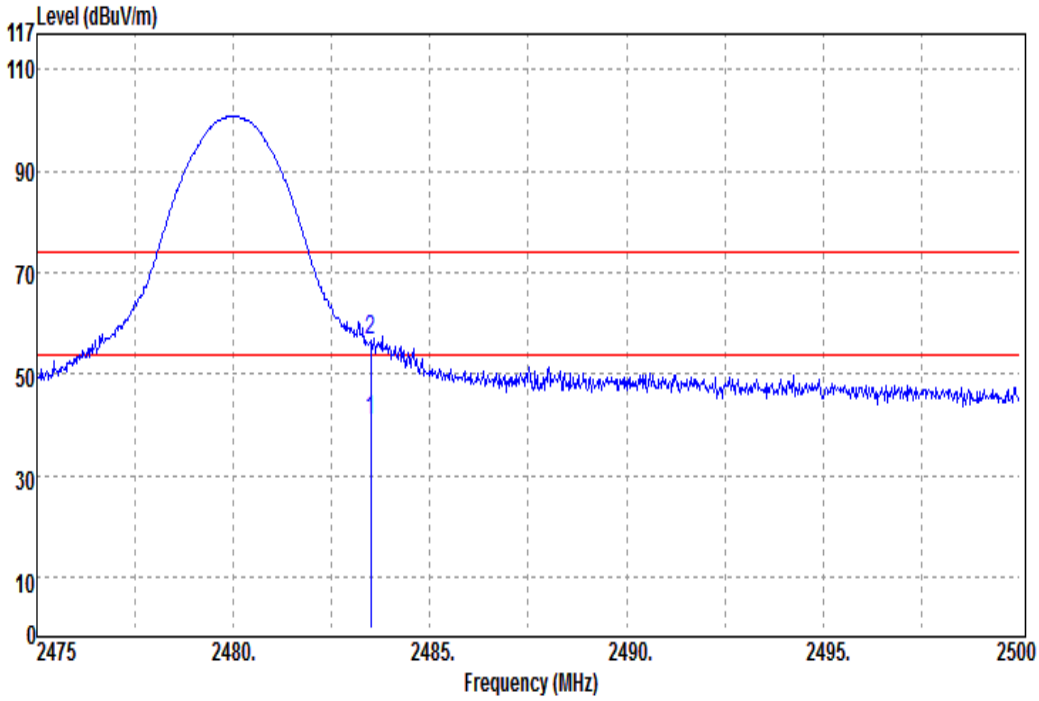
Test Mode:	8DPSK_EDR-3Mbps High CH	Temp/Hum	21(℃) / 49%RH
Test Item	Band Edge	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak & Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	43.74	-2.72	41.02	54.00	-12.98
2483.50	Peak	59.47	-2.72	56.75	74.00	-17.25

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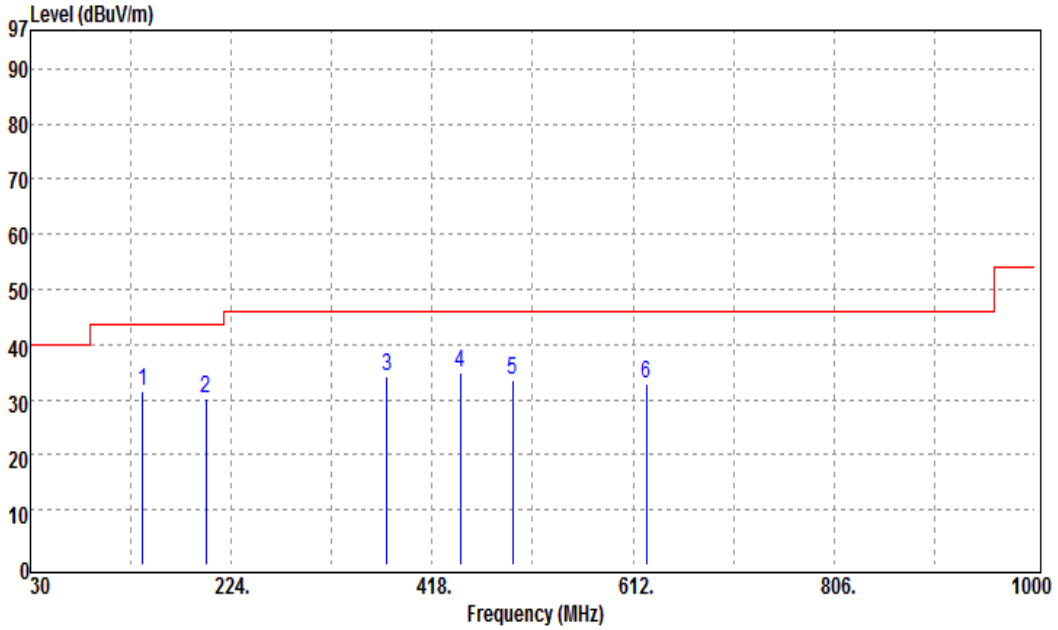
Below 1GHz Test Data

Test Mode:	BT Mode	Temp/Hum	21(℃) / 49%RH
Test Item	30MHz-1GHz	Test Date	March 21, 2019
Polarize	Vertical	Test Engineer	Kane Tseng
Detector	Peak		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
138.64	Peak	40.58	-9.02	31.56	43.50	-11.94
199.75	Peak	38.85	-8.68	30.17	43.50	-13.33
374.35	Peak	39.65	-5.58	34.07	46.00	-11.93
445.16	Peak	38.07	-3.18	34.89	46.00	-11.11
495.60	Peak	35.58	-2.10	33.48	46.00	-12.52
624.61	Peak	32.13	0.62	32.75	46.00	-13.25

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

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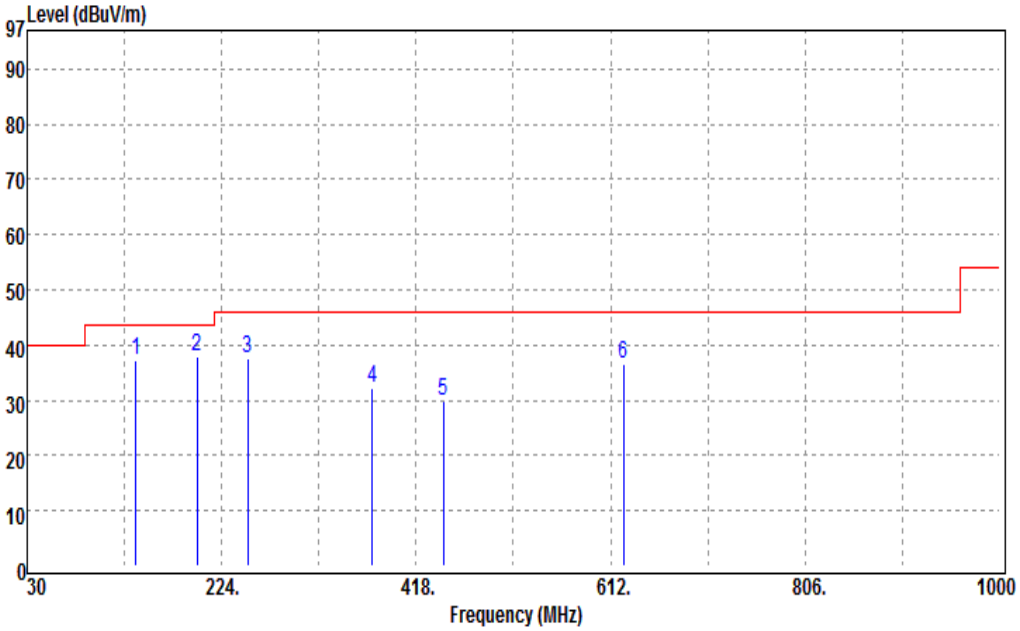
Test Mode:	BT Mode	Temp/Hum	21(℃) / 49%RH
Test Item	30MHz-1GHz	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
138.64	Peak	46.40	-9.02	37.38	43.50	-6.12
199.75	Peak	46.47	-8.68	37.79	43.50	-5.71
250.19	Peak	47.43	-9.82	37.61	46.00	-8.39
374.35	Peak	37.74	-5.58	32.16	46.00	-13.84
445.16	Peak	33.02	-3.18	29.84	46.00	-16.16
624.61	Peak	35.81	0.62	36.43	46.00	-9.57

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

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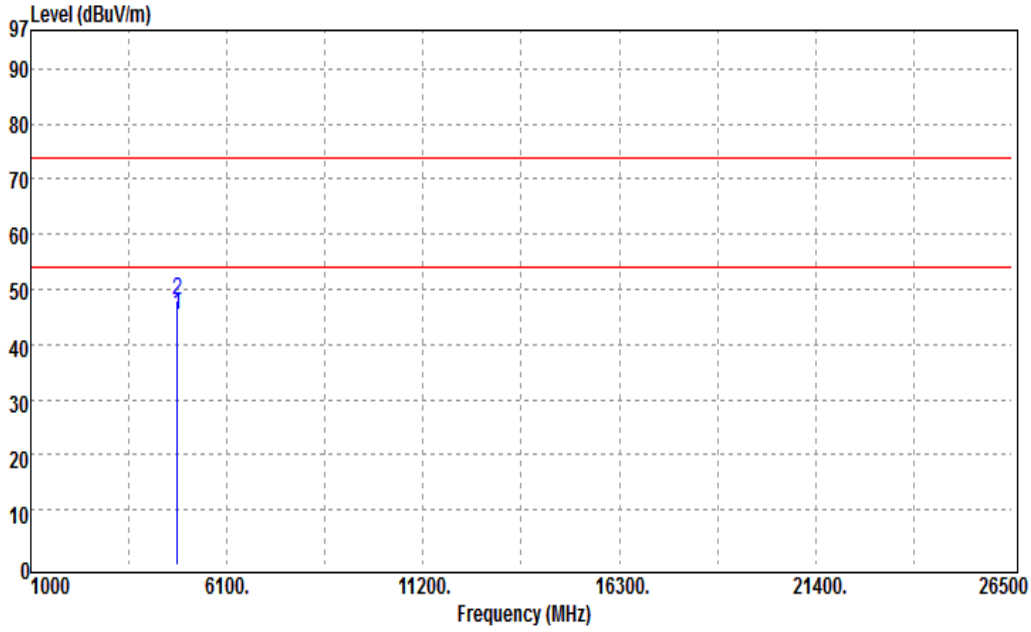
Above 1GHz Test Data

Test Mode:	GFSK_BR-1Mbps Low CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Vertical	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4804.00	Average	42.10	3.11	45.21	54.00	-8.79
4804.00	Peak	44.79	3.11	47.90	74.00	-26.10

Remark:

1. *Measuring frequencies from 1GHz 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*

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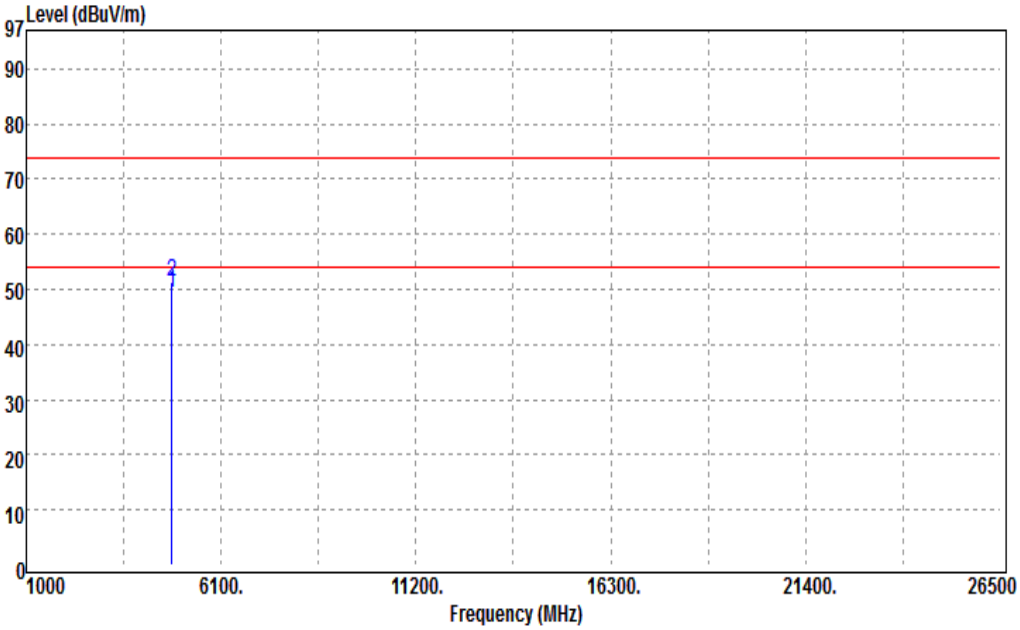
Test Mode:	GFSK_BR-1Mbps Low CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.00	Average	46.35	3.11	49.46	54.00	-4.54
4804.00	Peak	48.08	3.11	51.19	74.00	-22.81

Remark:

1. *Measuring frequencies from 1GHz 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*

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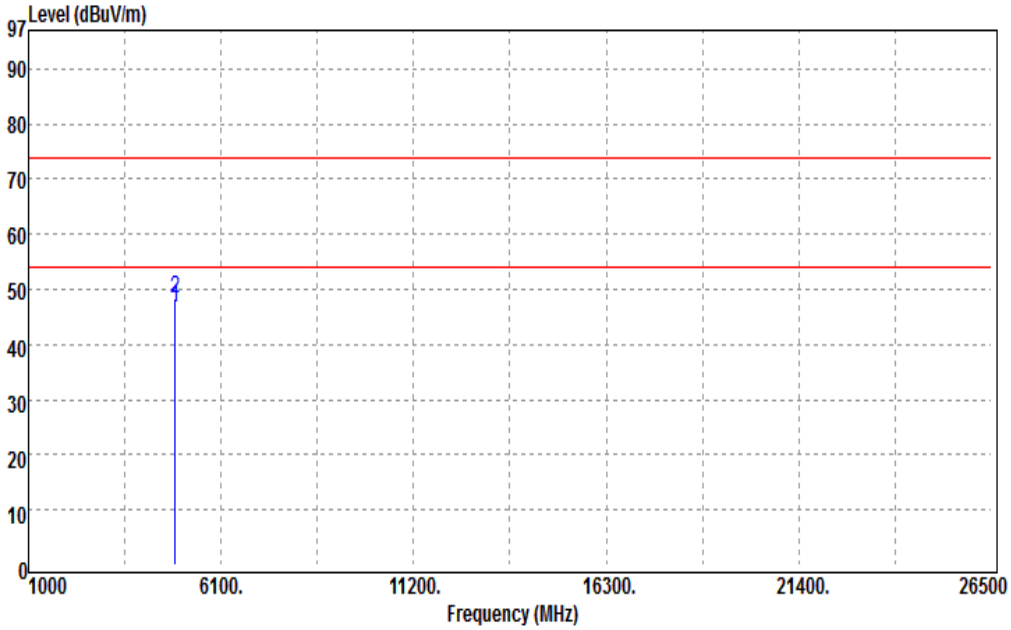
Test Mode:	GFSK_BR-1Mbps Mid CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Vertical	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4882.00	Average	43.08	3.46	46.54	54.00	-7.46
4885.00	Peak	44.83	3.49	48.32	74.00	-25.68

Remark:

1. *Measuring frequencies from 1GHz 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*

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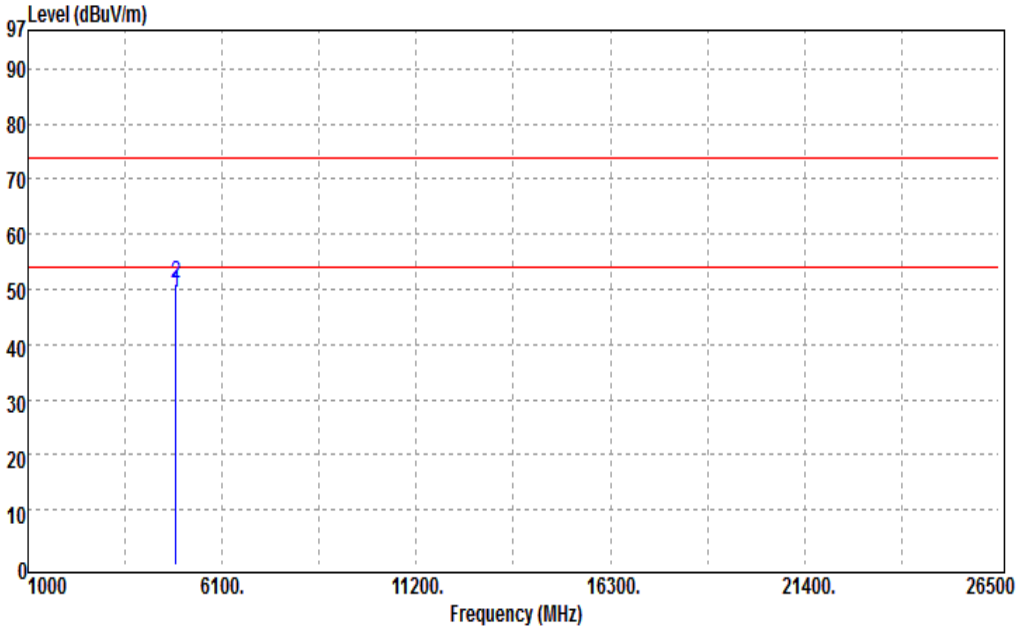
Test Mode:	GFSK_BR-1Mbps Mid CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4882.00	Average	45.95	3.46	49.41	54.00	-4.59
4885.00	Peak	47.40	3.49	50.89	74.00	-23.11

Remark:

1. *Measuring frequencies from 1GHz 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*

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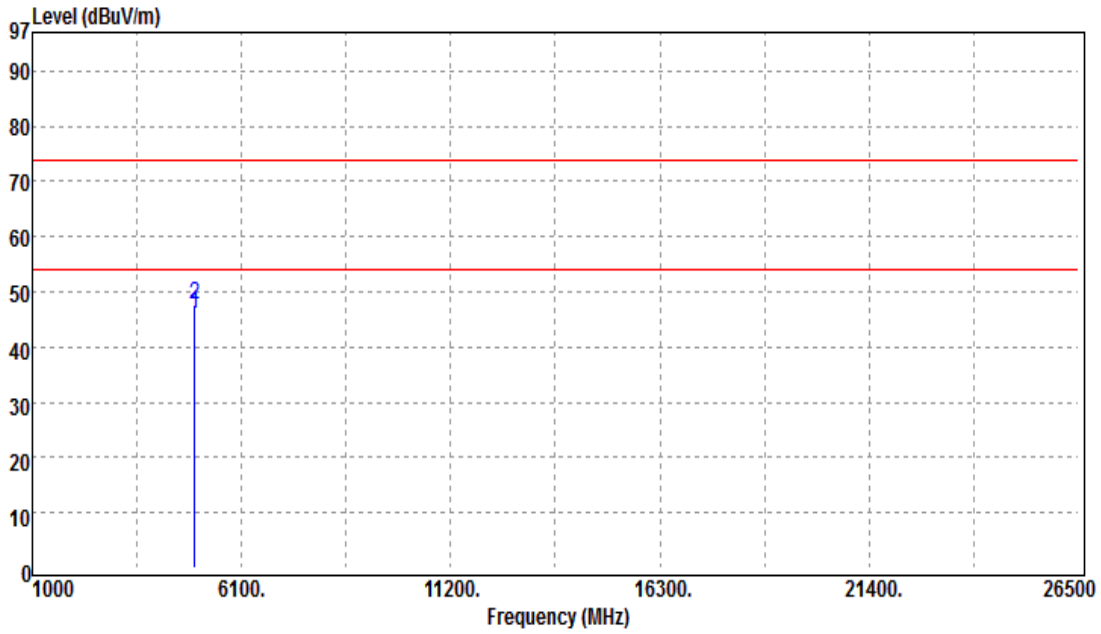
Test Mode:	GFSK_BR-1Mbps High CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Vertical	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	41.63	4.48	46.11	54.00	-7.89
4960.00	Peak	43.08	4.48	47.56	74.00	-26.44

Remark:

1. *Measuring frequencies from 1GHz 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*

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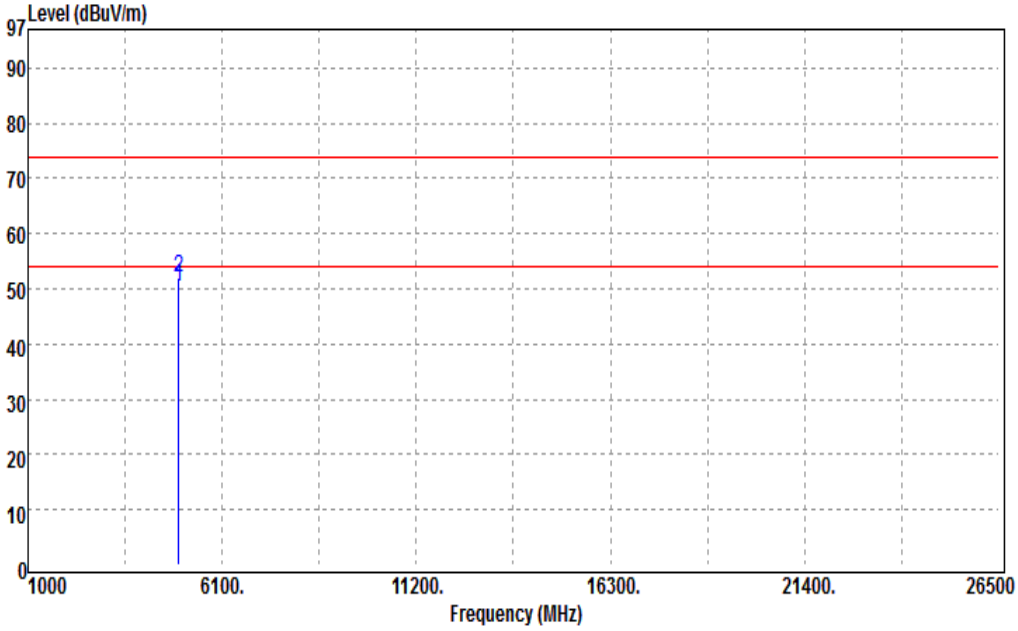
Test Mode:	GFSK_BR-1Mbps High CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	45.97	4.48	50.45	54.00	-3.55
4960.00	Peak	47.66	4.48	52.14	74.00	-21.86

Remark:

1. *Measuring frequencies from 1GHz 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*

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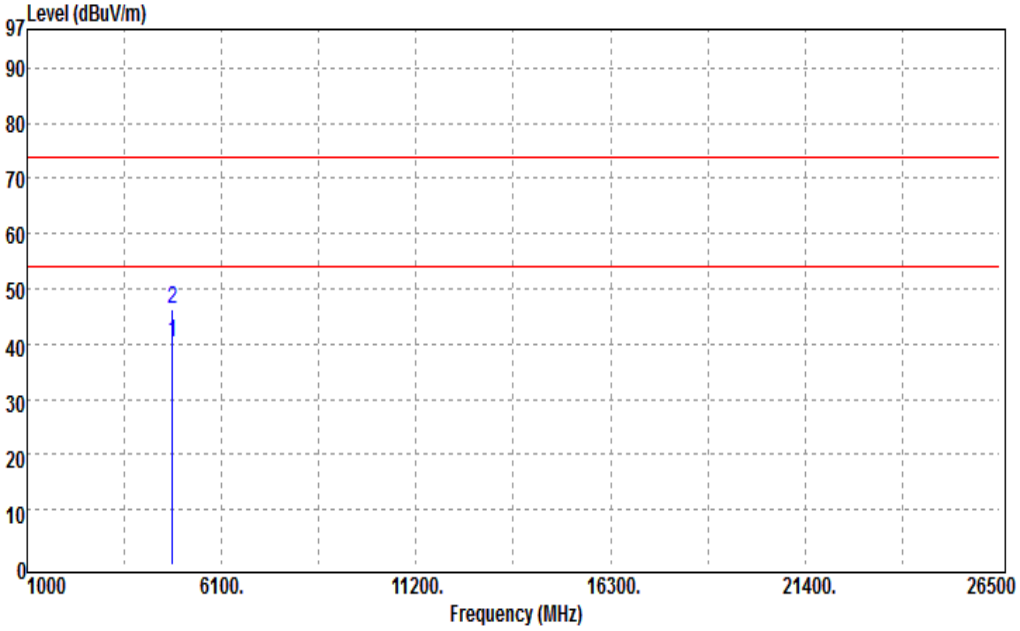
Test Mode:	8DPSK_EDR-3Mbps Low CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Vertical	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.00	Average	37.15	3.11	40.26	54.00	-13.74
4804.00	Peak	43.13	3.11	46.24	74.00	-27.76

Remark:

1. *Measuring frequencies from 1GHz 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*

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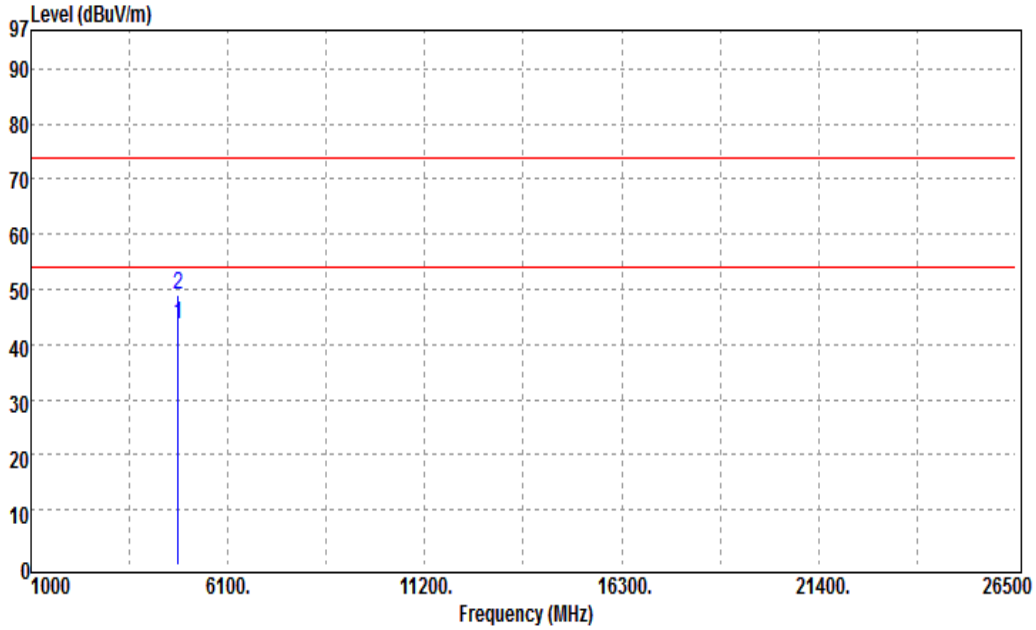
Test Mode:	8DPSK_EDR-3Mbps Low CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4804.00	Average	40.47	3.11	43.58	54.00	-10.42
4804.00	Peak	46.03	3.11	49.14	74.00	-24.86

Remark:

1. *Measuring frequencies from 1GHz 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*

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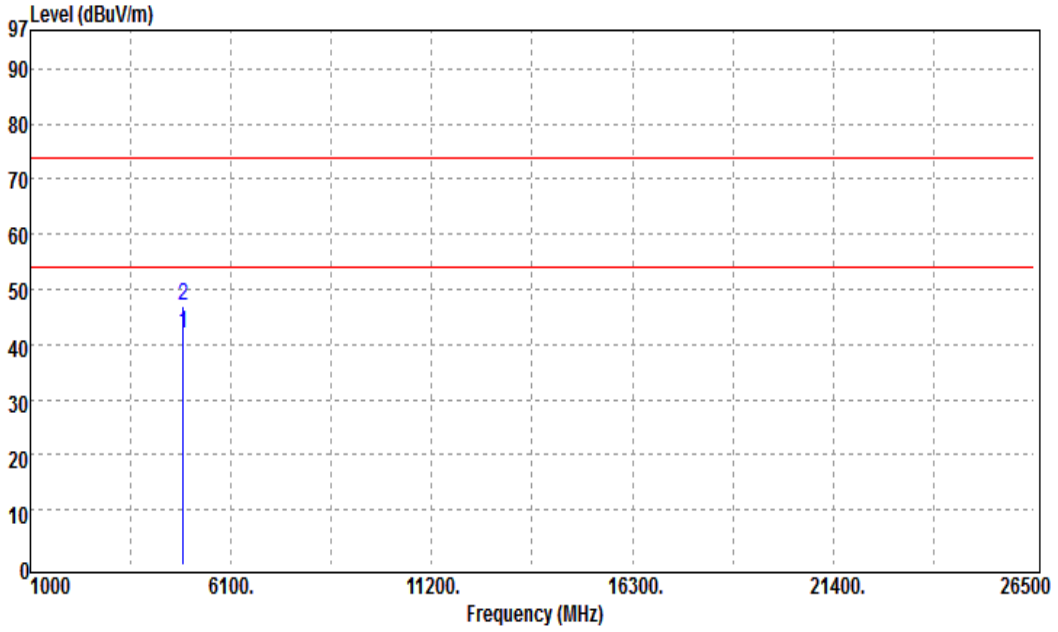
Test Mode:	8DPSK_EDR-3Mbps Mid CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Vertical	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4882.00	Average	38.48	3.46	41.94	54.00	-12.06
4882.00	Peak	43.55	3.46	47.01	74.00	-26.99

Remark:

1. *Measuring frequencies from 1GHz 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*

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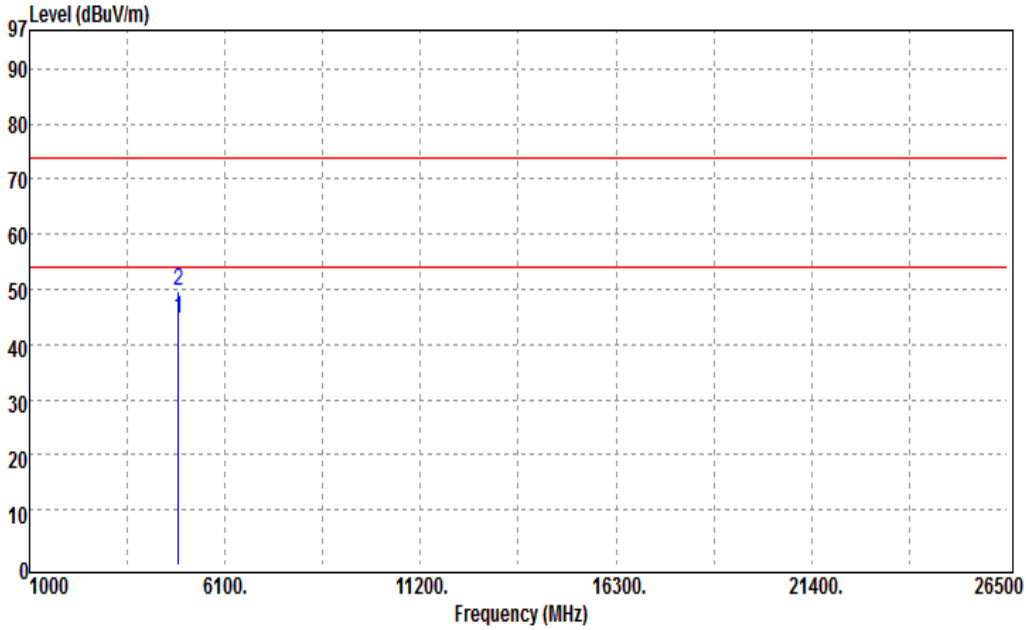
Test Mode:	8DPSK_EDR-3Mbps Mid CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4882.00	Average	41.27	3.46	44.73	54.00	-9.27
4882.00	Peak	46.28	3.46	49.74	74.00	-24.26

Remark:

1. *Measuring frequencies from 1GHz 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*

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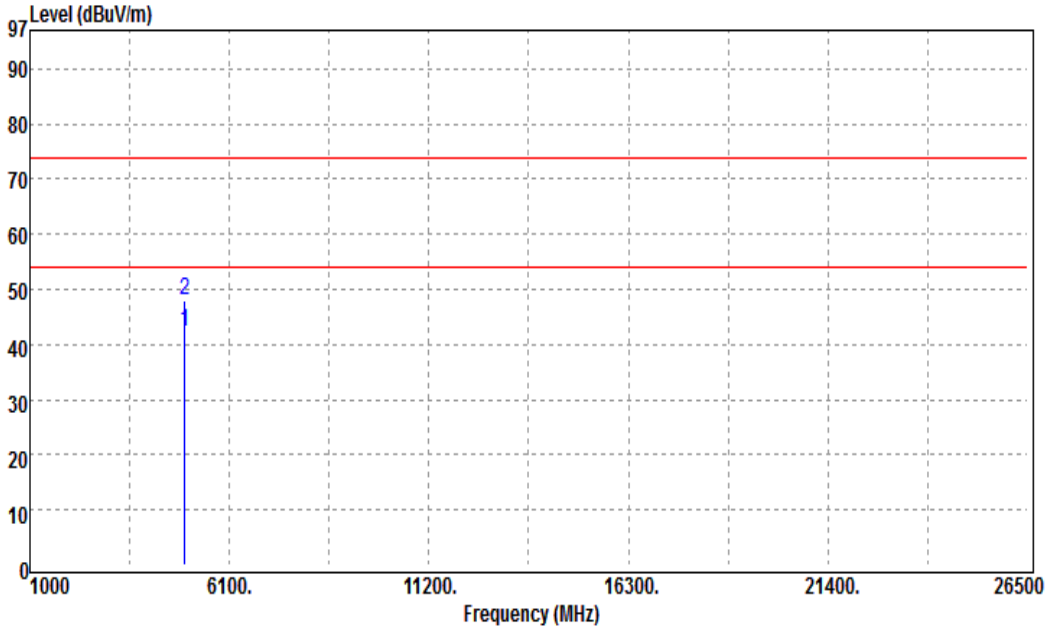
Test Mode:	8DPSK_EDR-3Mbps High CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Vertical	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	37.83	4.48	42.31	54.00	-11.69
4960.00	Peak	43.46	4.48	47.94	74.00	-26.06

Remark:

1. *Measuring frequencies from 1GHz 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*

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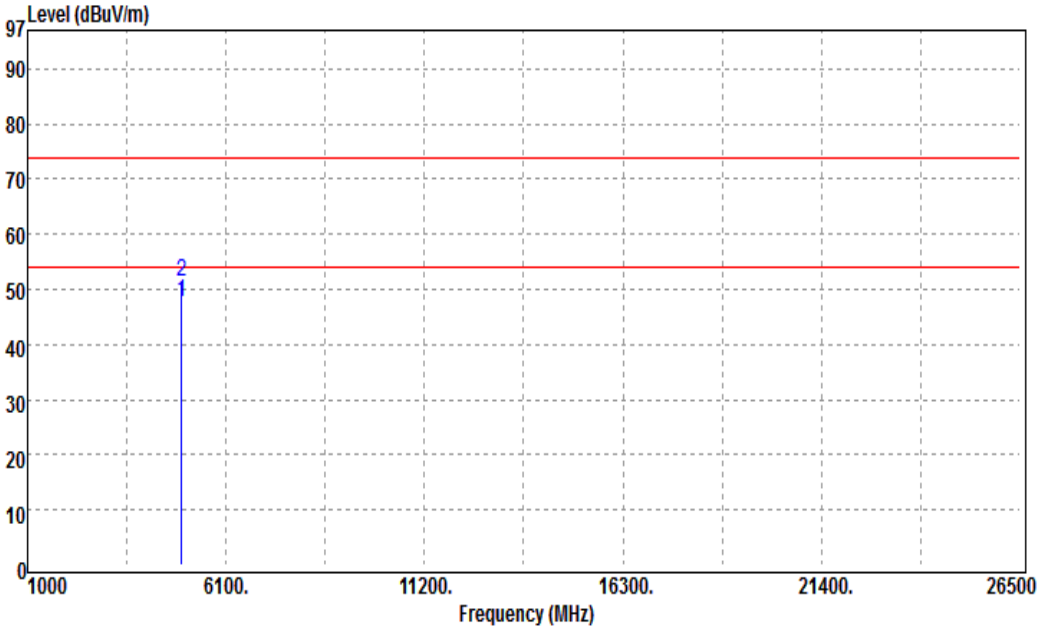
Test Mode:	8DPSK_EDR-3Mbps High CH	Temp/Hum	21(℃) / 49%RH
Test Item	Harmonic	Test Date	March 21, 2019
Polarize	Horizontal	Test Engineer	Kane Tseng
Detector	Peak and Average		



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	43.02	4.48	47.50	54.00	-6.50
4960.00	Peak	46.81	4.48	51.29	74.00	-22.71

Remark:

1. *Measuring frequencies from 1GHz 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*

--End of Test Report--

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