TEST REPORT

Application No.:	SZEM1905014538CR
Applicant / Manufacturer:	WEILONG TOYS FACTORY
Address of Applicant / Manufacturer:	LANE 1, FENGXIANG DONGHU AVENUE, CHENGHAI DISTRICT, SHANTOU CITY, CHINA
Equipment Under Test (EUT):	
EUT Name:	Remote controlled rotary motorcycle
Model No.:	2388M, 300, 007, 399, 810, 605, 678, 998, 322, 260, 533, 860, 955 ♣
♣	Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.
FCC ID:	2ATNK-WL3007810399
Standard(s) :	47 CFR Part 15, Subpart C 15.249
Date of Receipt:	2019-05-28
Date of Test:	2019-06-05 to 2019-06-11
Date of Issue:	2019-07-04
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Keny Xu
EMC Laboratory Manager

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Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
01		2019-07-04		Original

Authorized for issue by:				
		Bill Chen **Bill Chen /Project Engineer**		
		Eric Fu **Eric Fu /Reviewer**		

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2 Test Summary

Radio Spectrum Technical Requirement				
Item	**Standard**	**Method**	**Requirement**	**Result**
Antenna Requirement	47 CFR Part 15, Subpart C 15.249	N/A	47 CFR Part 15, Subpart C 15.203	Pass

Radio Spectrum Matter Part				
Item	**Standard**	**Method**	**Requirement**	**Result**
20dB Bandwidth	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.9	47 CFR Part 15, Subpart C 15.215	Pass
Field Strength of the Fundamental Signal (15.249(a))	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.5&6.6	47 CFR Part 15, Subpart C 15.249(a)	Pass
Restricted Band Around Fundamental Frequency	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.205 & 15.249(d) & 15.209	Pass
Radiated Emissions	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)	Pass

Remark:

Model No.: 2388M, 300, 007, 399, 810, 605, 678, 998, 322, 260, 533, 860, 955

Only the model 007 was tested, since the electrical circuit design, layout, components used, internal wiring and functions were identical for the above models, with only difference on color, appearance and packaging.

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4 General Information

4.1 Details of E.U.T.

Power supply:	TX:DC 3.0V by 1.5V x 2"AA" batteries
Frequency Range	2405MHz to 2475MHz
Number of Channels:	71
Channel Spacing:	1MHz
Modulation Type:	GFSK
Antenna Type:	Integral Antenna
Antenna Gain:	0dBi

Operation Frequency each of channel							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2405.00	19	2423.00	37	2441.00	55	2459.00
2	2406.00	20	2424.00	38	2442.00	56	2460.00
3	2407.00	21	2425.00	39	2443.00	57	2461.00
4	2408.00	22	2426.00	40	2444.00	58	2462.00
5	2409.00	23	2427.00	41	2445.00	59	2463.00
6	2410.00	24	2428.00	42	2446.00	60	2464.00
7	2411.00	25	2429.00	43	2447.00	61	2465.00
8	2412.00	26	2430.00	44	2448.00	62	2466.00
9	2413.00	27	2431.00	45	2449.00	63	2467.00
10	2414.00	28	2432.00	46	2450.00	64	2468.00
11	2415.00	29	2433.00	47	2451.00	65	2469.00
12	2416.00	30	2434.00	48	2452.00	66	2470.00
13	2417.00	31	2435.00	49	2453.00	67	2471.00
14	2418.00	32	2436.00	50	2454.00	68	2472.00
15	2419.00	33	2437.00	51	2455.00	69	2473.00
16	2420.00	34	2438.00	52	2456.00	70	2474.00
17	2421.00	35	2439.00	53	2457.00	71	2475.00
18	2422.00	36	2440.00	54	2458.00		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel(CH1)	2405MHz
The Middle channel(CH36)	2440MHz
The Highest channel(CH71)	2475MHz

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4.2 Description of Support Units

The EUT has been tested as an independent unit.

4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	± 7.25 x 10^{-8}
2	Duty cycle	± 0.37%
3	-20dB Bandwidth	± 3%
4	E-Filed	± 4.8dB (Above 1GHz)
5	Radiated Spurious emission test	± 4.5dB (Below 1GHz)
		± 4.8dB (Above 1GHz)
6	Temperature test	± 1℃
7	Humidity test	± 3%
8	Supply voltages	± 1.5%
9	Time	± 3%

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4.4 Test Location

All tests were performed at:

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No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

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5 Equipment List

20dB Bandwidth					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2018-09-27	2019-09-26
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2018-07-12	2019-07-11
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018-09-27	2019-09-26
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018-09-25	2019-09-24

Field Strength of the Fundamental Signal (15.249(a))					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2018-07-12	2019-07-11
EXA Spectrum Analyzer	AgilentTechnologies Inc	N9010A	SEM004-12	2019-04-12	2020-04-11
BiConiLog Antenna (26-3000MHz)	ETS-Lindgren	3142C	SEM003-01	2017-06-27	2020-06-26
Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna (15GHz-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017-10-17	2020-10-16
Pre-amplifier (0.1-1300MHz)	HP	8447D	SEM005-02	2018-09-25	2019-09-24
Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2018-11-12	2019-11-11
Pre-amplifier (18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2019-04-01	2020-03-31
Pre-amplifier (26GHz-40GHz)	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2019-04-01	2020-03-31
DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21

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Restricted Band Around Fundamental Frequency					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2018-07-12	2019-07-11
EXA Spectrum Analyzer	AgilentTechnologies Inc	N9010A	SEM004-12	2019-04-12	2020-04-11
Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna (15GHz-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017-10-17	2020-10-16
Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2018-11-12	2019-11-11
Pre-amplifier(18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2019-04-01	2020-03-31
Pre-amplifier (26GHz-40GHz)	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2019-04-01	2020-03-31
DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21

Radiated Emissions					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2018-07-12	2019-07-11
EXA Spectrum Analyzer	AgilentTechnologies Inc	N9010A	SEM004-12	2019-04-12	2020-04-11
Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna (15GHz-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017-10-17	2020-10-16
Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2018-11-12	2019-11-11
Pre-amplifier (18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2019-04-01	2020-03-31

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Pre-amplifier (26GHz-40GHz)	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2019-04-01	2020-03-31
DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2018-09-25	2019-09-24
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21

RE in Chamber					
Test Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. Date**	**Cal. Due date**
3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEM001-01	2017-08-05	2020-08-04
MXE EMI Receiver (20Hz-8.4GHz)	Agilent Technologies	N9038A	SEM004-05	2018-09-25	2019-09-24
BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEM003-01	2017-06-27	2020-06-26
Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEM005-01	2019-04-01	2020-03-31
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM025-01	2018-07-12	2019-07-11

General used equipment					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-03	2018-09-27	2019-09-26
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-04	2018-09-27	2019-09-26
Humidity/ Temperature Indicator	Mingle	N/A	SEM002-08	2018-09-27	2019-09-26
Barometer	Changchun Meteorological Industry Factory	DYM3	SEM002-01	2019-04-04	2020-04-03

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6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203

6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently

attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.

Antenna location: Refer to Appendix(Internal photos)

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7 Radio Spectrum Matter Test Results

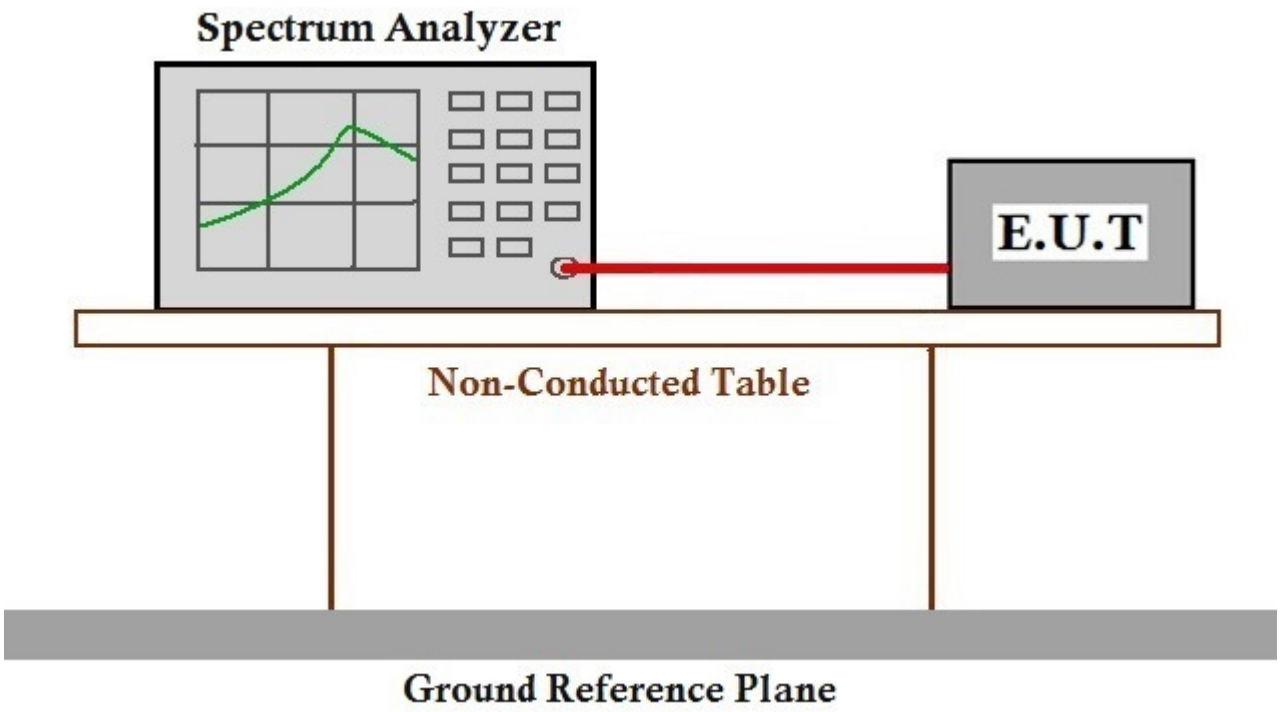
7.1 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.215
Test Method: ANSI C63.10 (2013) Section 6.9
Limit: N/A

7.1.1 E.U.T. Operation

Operating Environment:
Temperature: 23.2 °C Humidity: 55 % RH Atmospheric Pressure: 1005 mbar
Test mode a:TX mode_Keep the EUT in transmitting with modulation mode.

7.1.2 Test Setup Diagram



7.1.3 Measurement Procedure and Data

Test channel	20dB bandwidth (MHz)	Results
Lowest	1.2229	Pass
Middle	1.1939	Pass
Highest	1.2156	Pass

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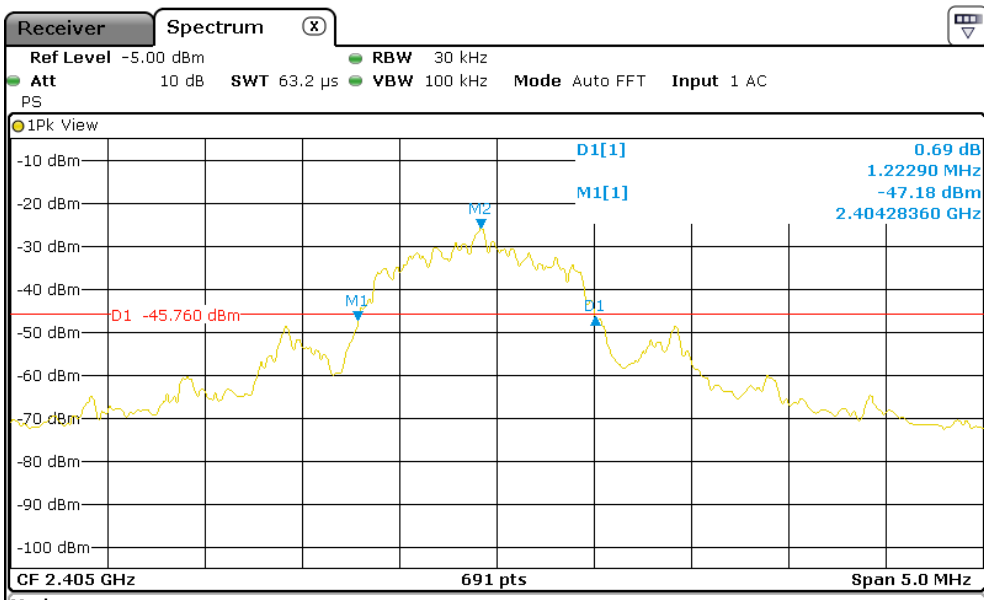
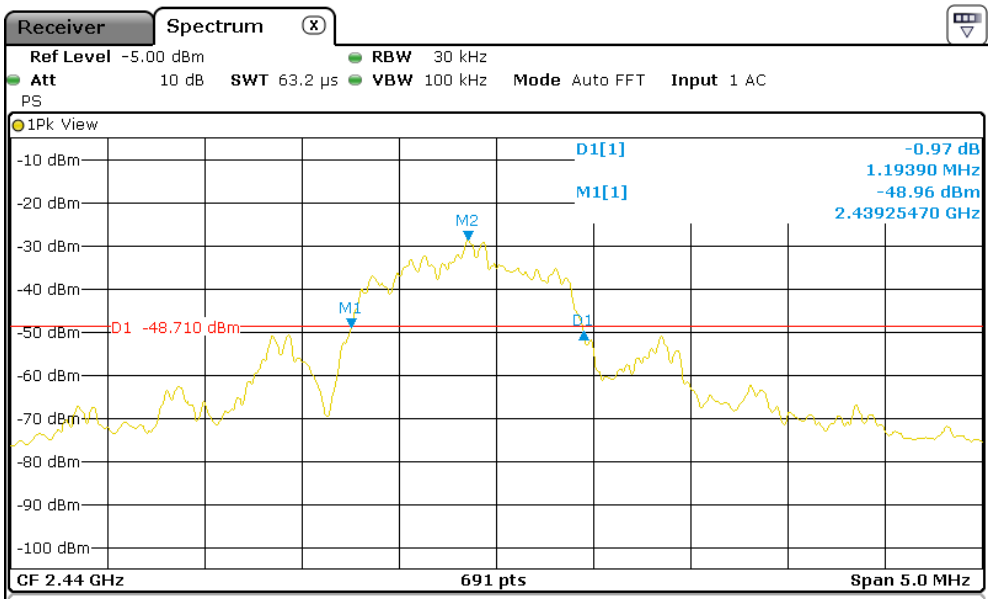


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4042836 GHz	-47.18 dBm		
D1	M1	1	1.2229 MHz	0.69 dB		
M2		1	2.4049204 GHz	-25.76 dBm		



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4392547 GHz	-48.96 dBm		
D1	M1	1	1.1939 MHz	-0.97 dB		
M2		1	2.4398553 GHz	-28.71 dBm		

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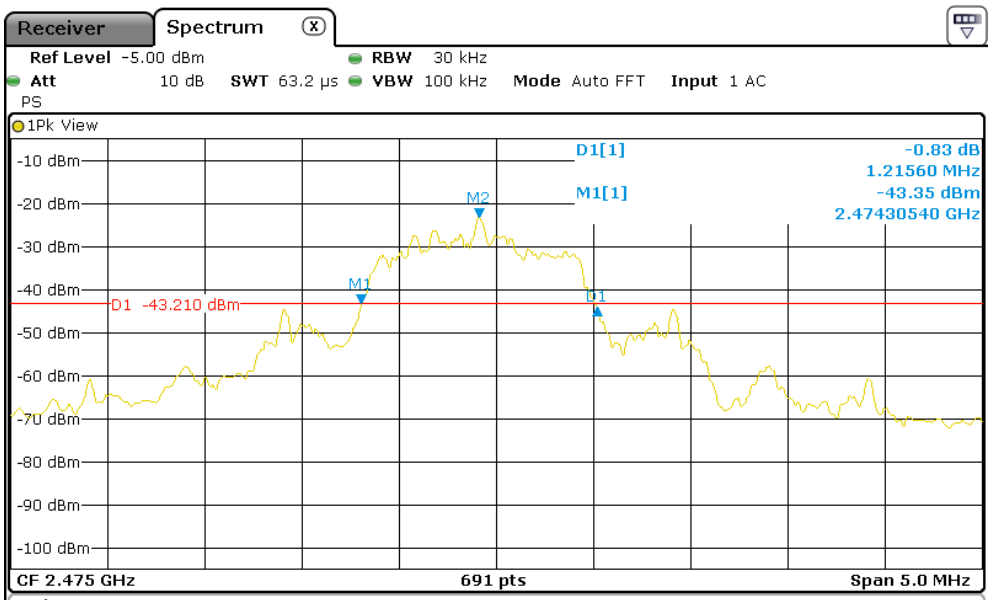

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4743054 GHz	-43.35 dBm		
D1	M1	1	1.2156 MHz	-0.83 dB		
M2		1	2.4749132 GHz	-23.21 dBm		

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7.2 Field Strength of the Fundamental Signal (15.249(a))

Test Requirement 47 CFR Part 15, Subpart C 15.249(a)
Test Method: ANSI C63.10 (2013) Section 6.5&6.6
Measurement Distance: 3m
Limit:

Fundamental frequency(MHz)	Field strength of fundamental(millivolts/meter)	Field strength of harmonics(microvolts/meter)
902-928	50	500
2400-2483.5	50	500
5725-5875	50	500
24000-24250	250	2500
Remark: The frequencies above 1000MHz are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For fundamental frequency in “902-928MHz”, the field strength of fundamental is based on Quasi-Peak.		

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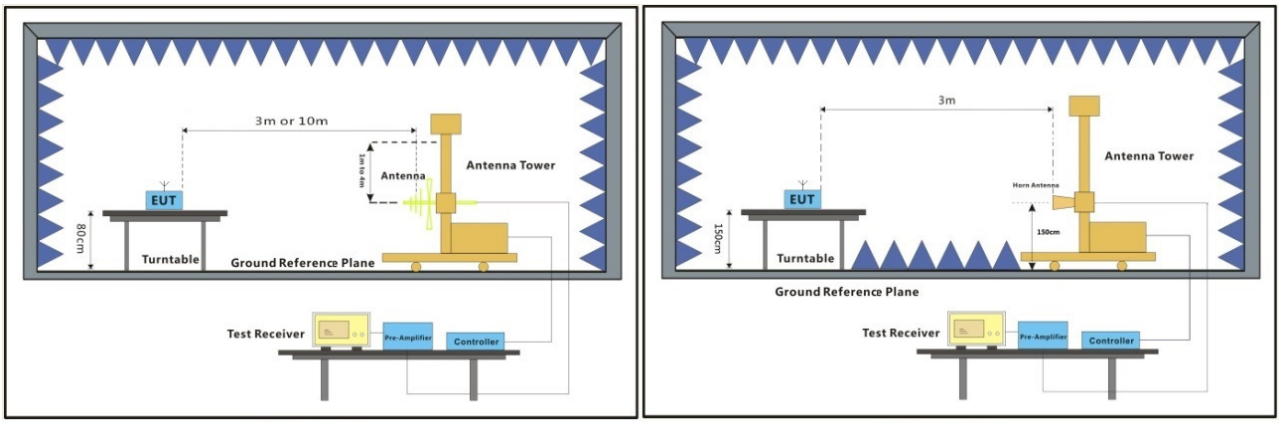
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 23.2 °C Humidity: 55 % RH Atmospheric Pressure: 1005 mbar

Test mode a:TX mode_Keep the EUT in transmitting with modulation mode.

7.2.2 Test Setup Diagram



30MHz-1GHz Above 1GHz

7.2.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

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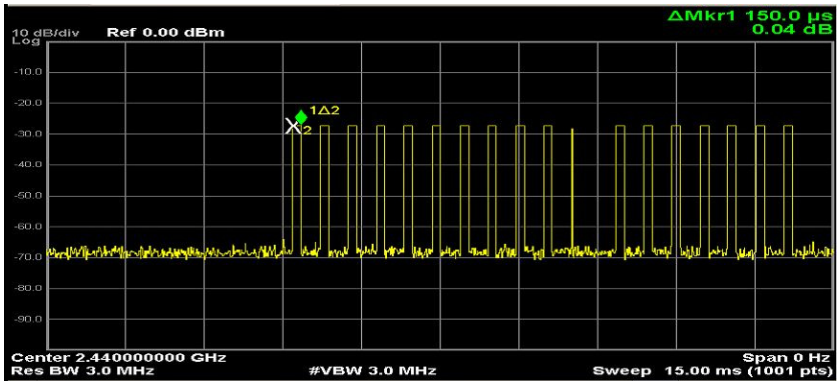
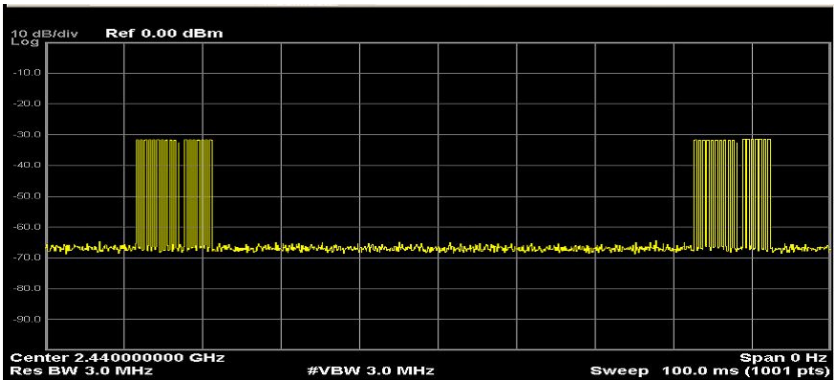
Average value:

Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)
	Duty cycle= T on time / T period
Test data:	Ton time =5.1ms
	T period =100ms
	PDCF value= -25.85dB

Duty cycle test plots:





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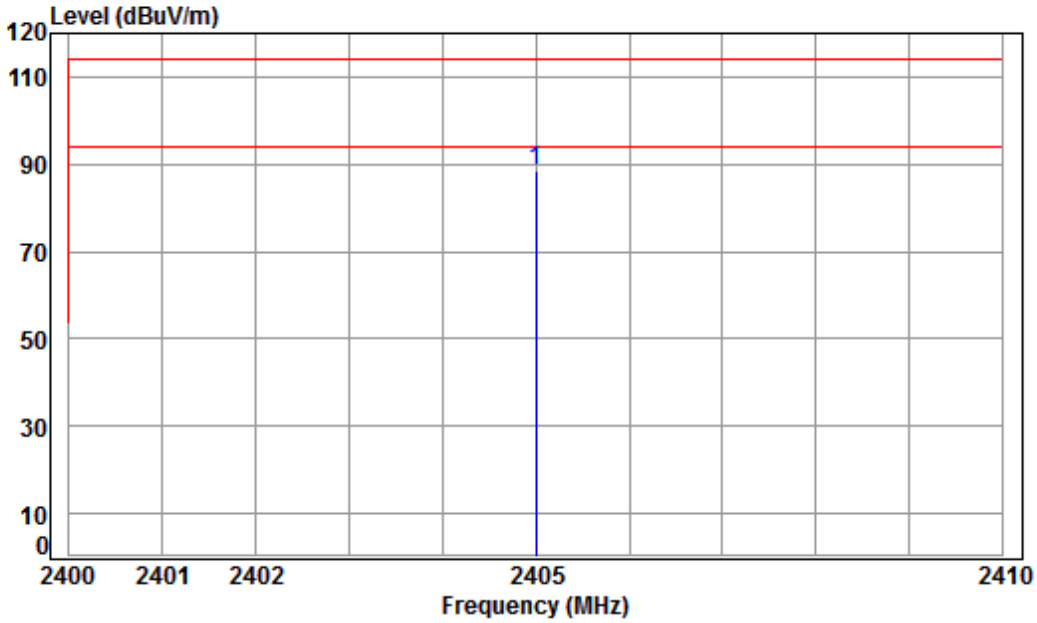
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low



Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2405 Field Strength

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2405.000	5.49	29.12	41.88	95.76	88.49	114.00	-25.51	peak

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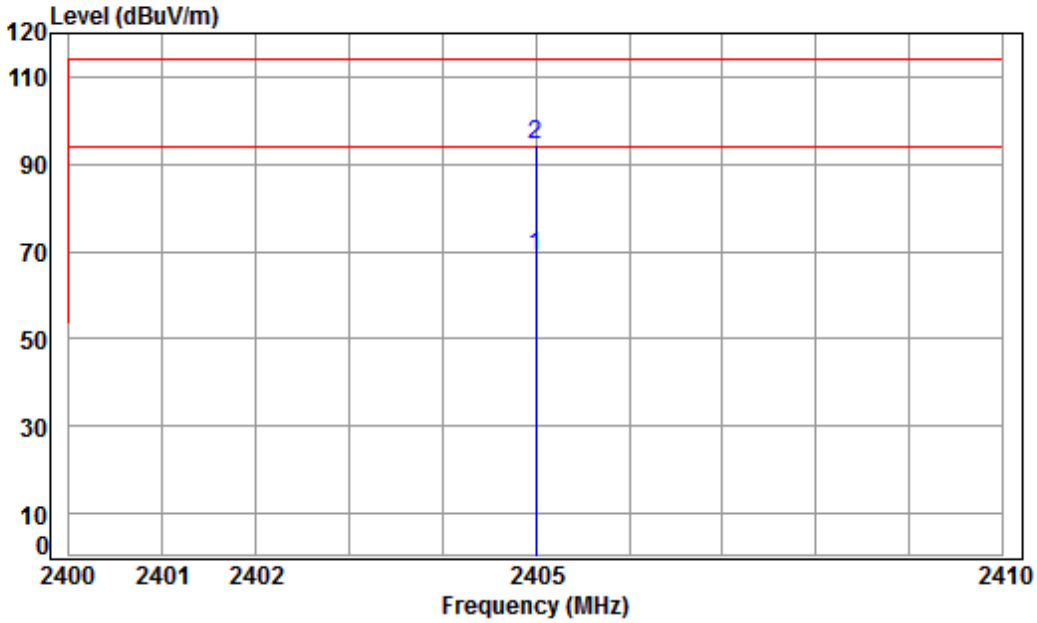
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2405 Field Strength

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 av	2405.000	5.49	29.12	41.88	76.09	68.82	94.00	-25.18	Average
2 pp	2405.000	5.49	29.12	41.88	101.94	94.67	114.00	-19.33	peak

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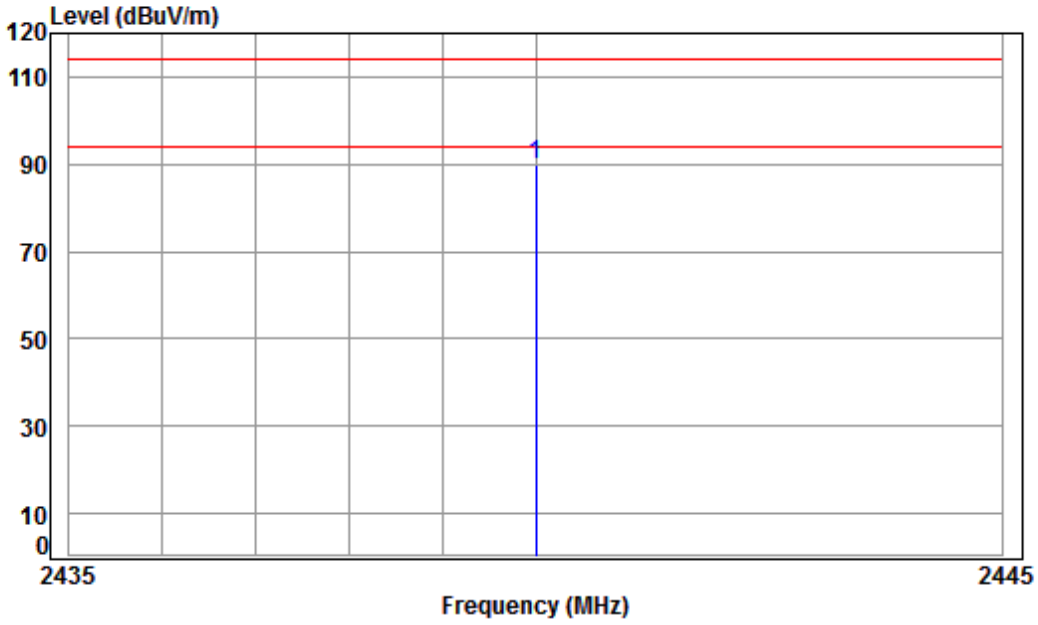
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle



Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2440 Field Strength

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2440.000	5.54	29.23	41.89	96.92	89.80	114.00	-24.20	Peak

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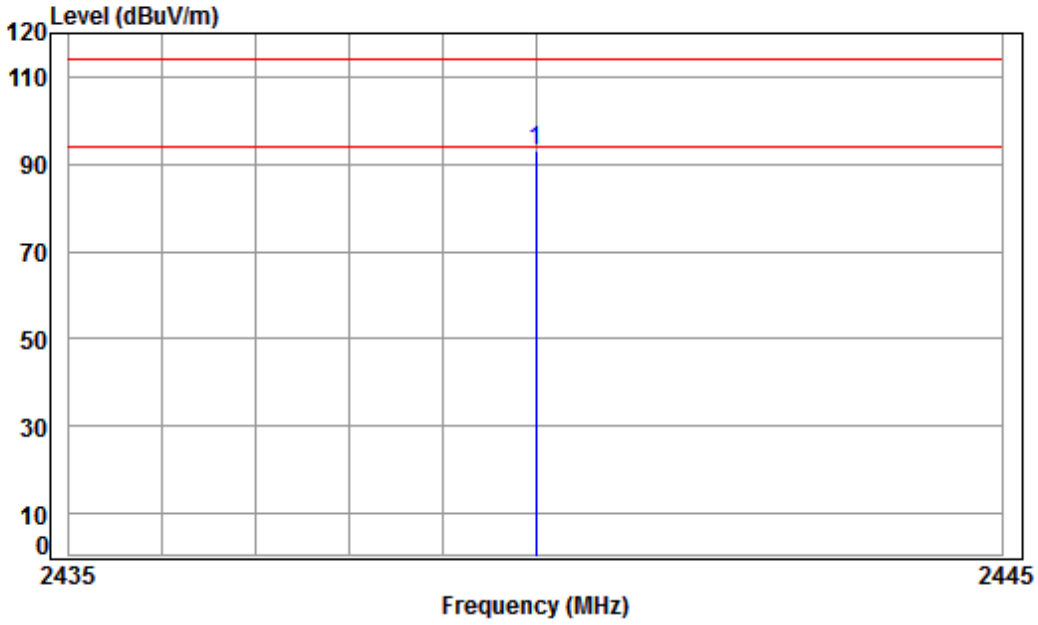
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:middle



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2440 Field Strength

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2440.000	5.54	29.23	41.89	100.24	93.12	114.00	-20.88	Peak

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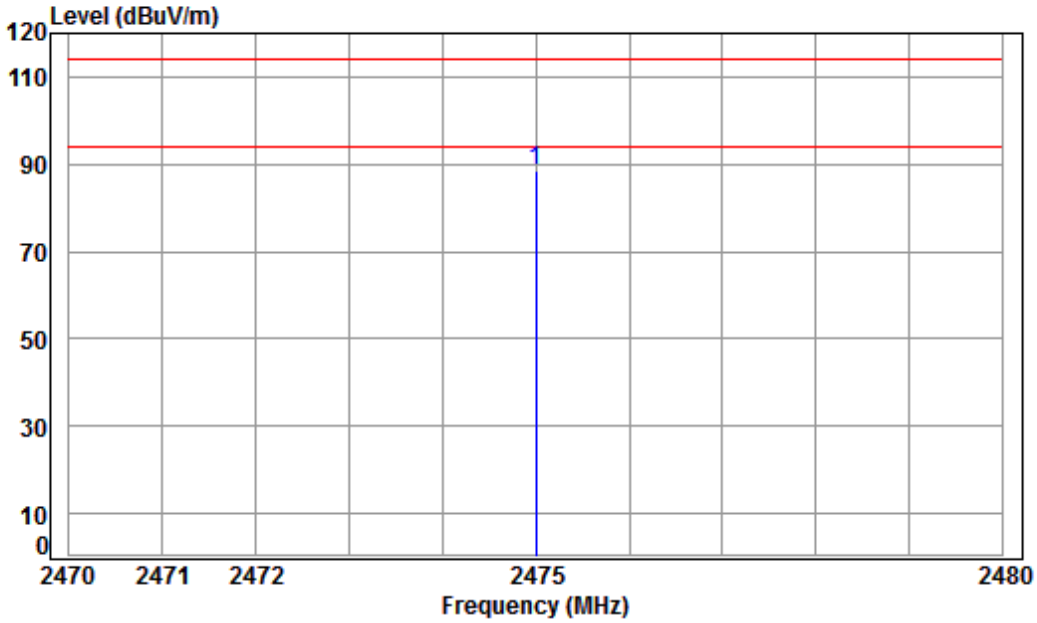
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2475 Field Strength

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2475.000	5.59	29.33	41.91	95.54	88.55	114.00	-25.45	peak

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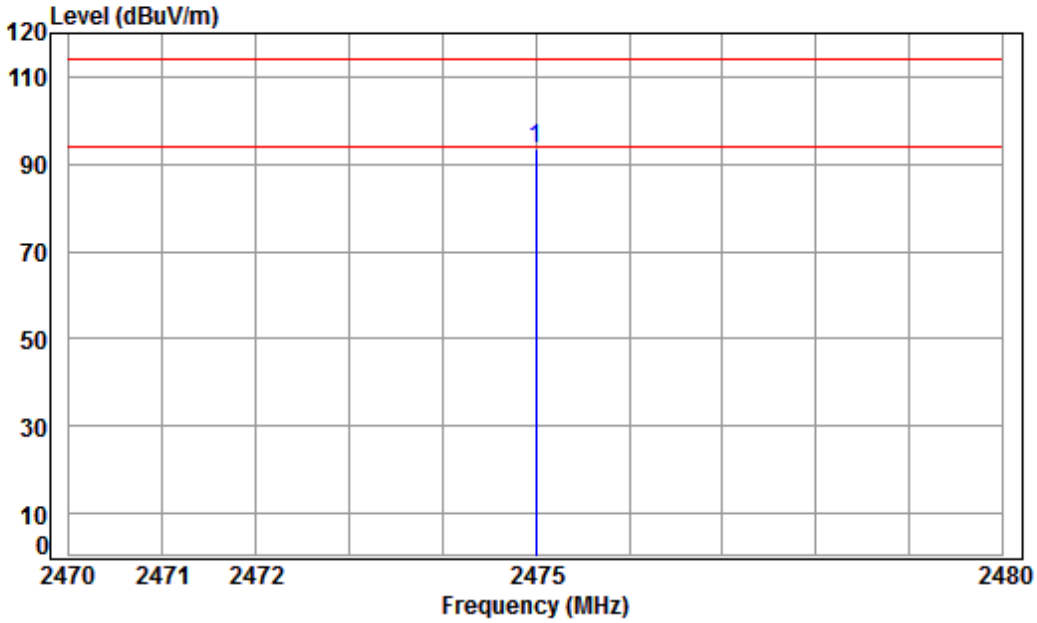
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2475 Field Strength

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2475.000	5.59	29.33	41.91	100.72	93.73	114.00	-20.27	peak

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
2) The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the above measurement data were shown in the report.

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7.3 Restricted Band Around Fundamental Frequency

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.249(d) & 15.209
Test Method: ANSI C63.10 (2013) Section 6.4&6.5&6.6
Measurement Distance: 3m
Limit:

Frequency	Limit (dBuV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
Above 1GHz	74.0	Peak Value
Emission radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209,whichever is the lesser attenuation.		

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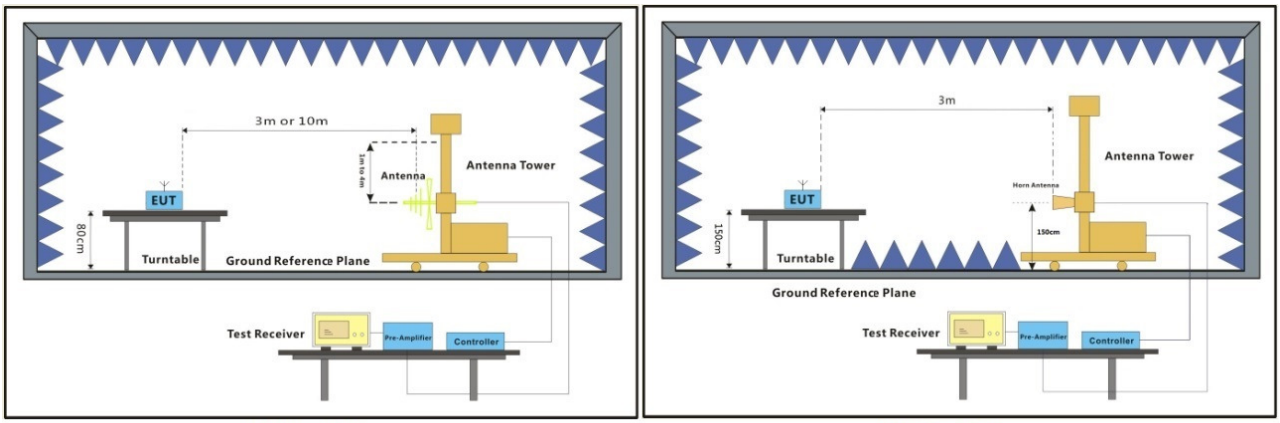
7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 21.5 °C Humidity: 70.6 % RH Atmospheric Pressure: 1005 mbar

Test mode a:TX mode_Keep the EUT in transmitting with modulation mode.

7.3.2 Test Setup Diagram



30MHz-1GHz Above 1GHz

7.3.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

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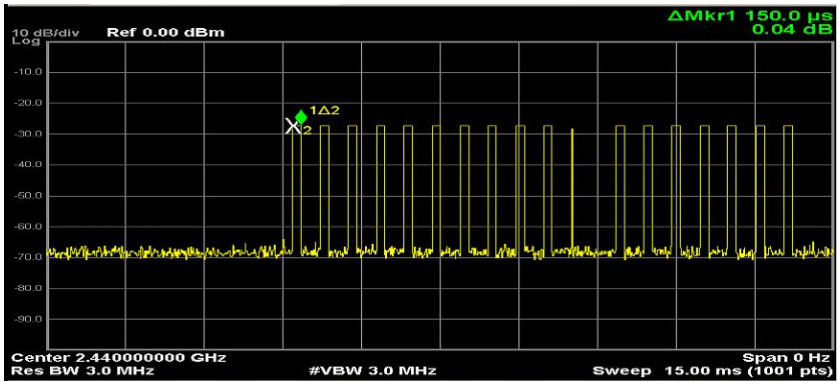
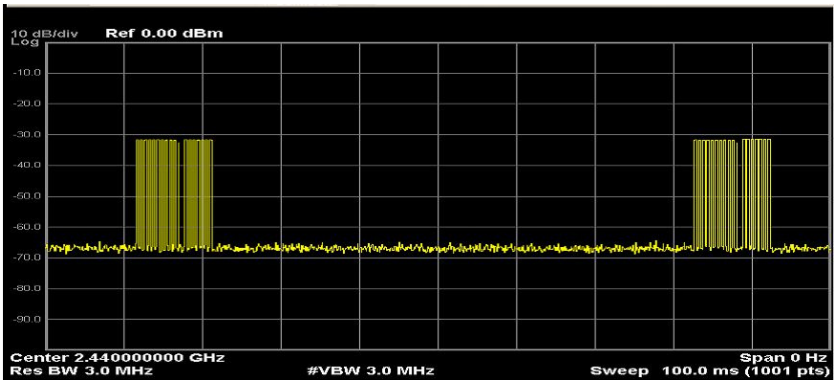
Average value:

Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)
	Duty cycle= T on time / T period
Test data:	Ton time =5.1ms
	T period =100ms
	PDCF value= -25.85dB

Duty cycle test plots:





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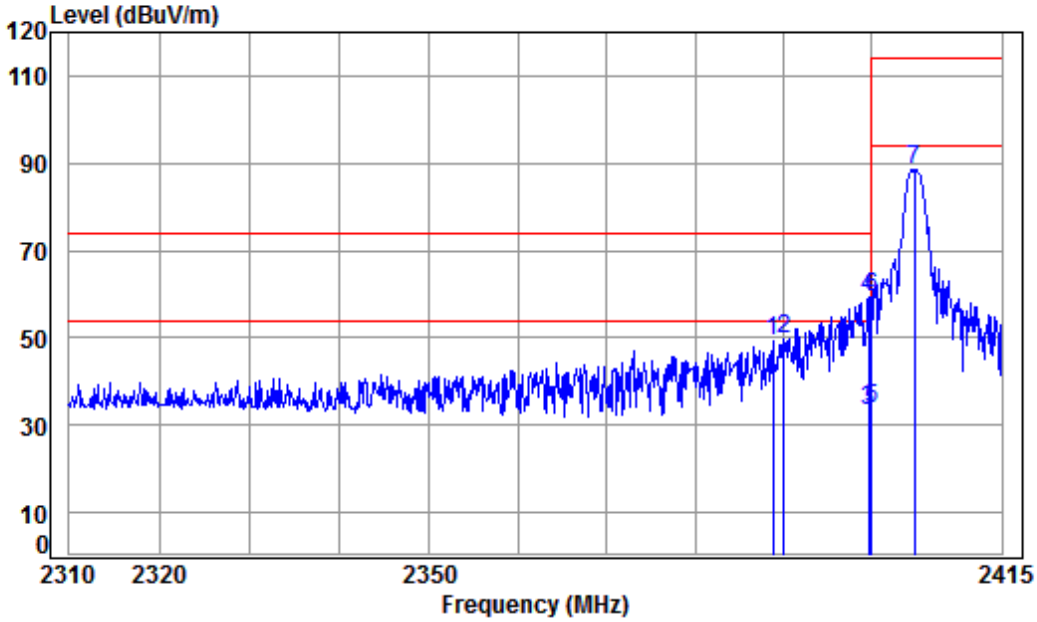

Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2405 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2388.842	5.47	29.07	41.87	56.77	49.44	74.00	-24.56	peak
2	2390.000	5.47	29.08	41.87	56.88	49.56	74.00	-24.44	peak
3	2399.698	5.49	29.11	41.88	40.76	33.48	54.00	-20.52	Average
4	2399.698	5.49	29.11	41.88	66.61	59.33	74.00	-14.67	peak
5 av	2400.000	5.49	29.11	41.88	40.82	33.54	54.00	-20.46	Average
6 pp	2400.000	5.49	29.11	41.88	66.67	59.39	74.00	-14.61	peak
7	2405.000	5.49	29.12	41.88	95.76	88.49	114.00	-25.51	peak

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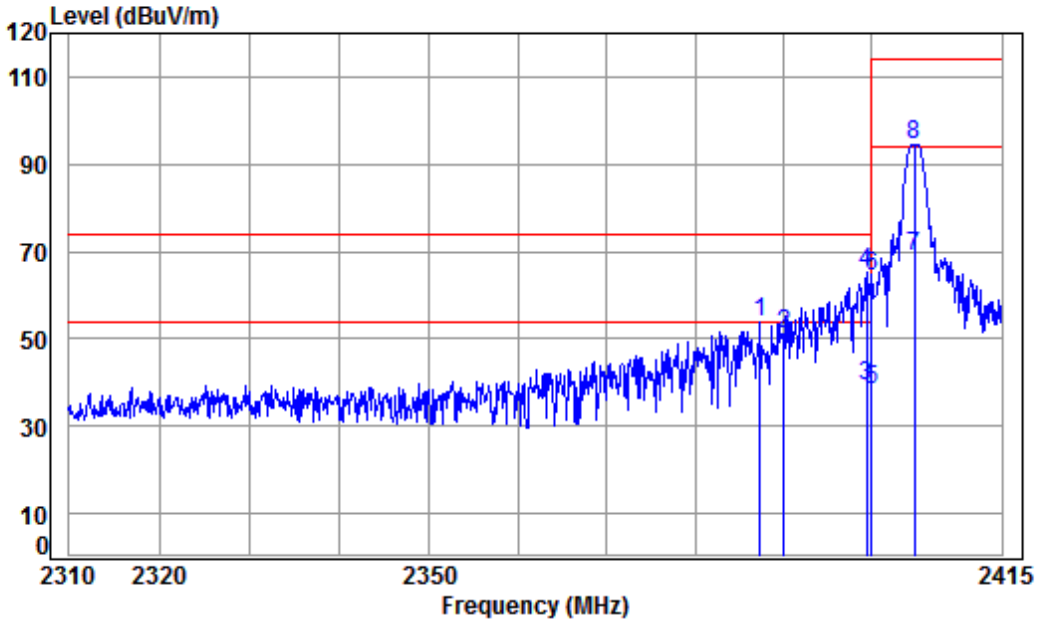
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2405 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2387.355	5.47	29.07	41.87	61.01	53.68	74.00	-20.32	peak
2	2390.000	5.47	29.08	41.87	58.45	51.13	74.00	-22.87	peak
3 av	2399.484	5.49	29.11	41.88	46.71	39.43	54.00	-14.57	Average
4 pp	2399.484	5.49	29.11	41.88	72.56	65.28	74.00	-8.72	peak
5	2400.000	5.49	29.11	41.88	45.66	38.38	54.00	-15.62	Average
6	2400.000	5.49	29.11	41.88	71.51	64.23	74.00	-9.77	peak
7	2405.000	5.49	29.12	41.88	76.09	68.82	94.00	-25.18	Average
8	2405.000	5.49	29.12	41.88	101.94	94.67	114.00	-19.33	peak

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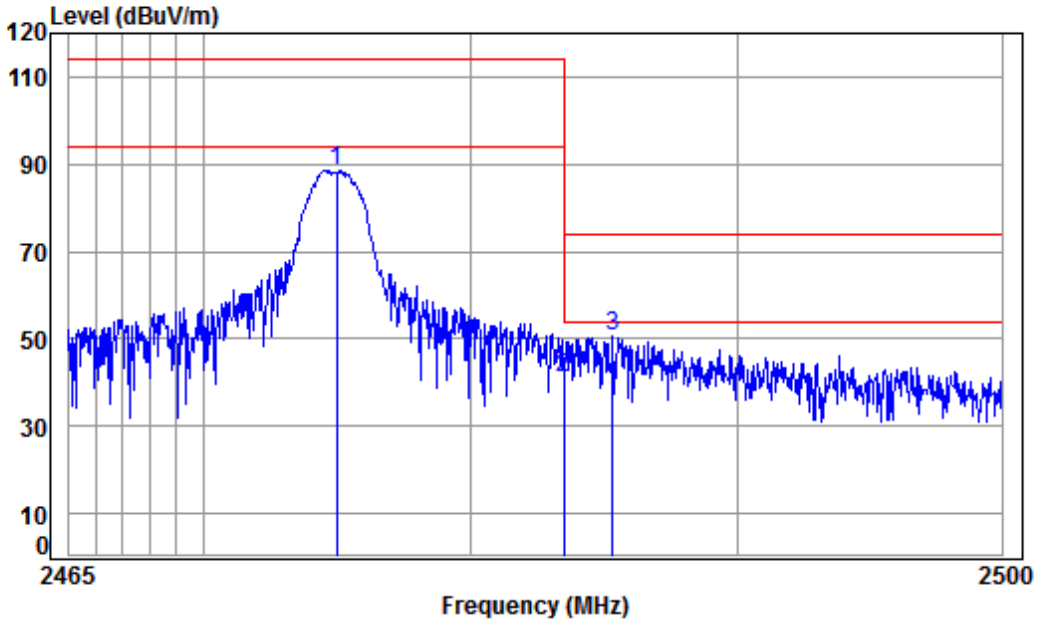
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2475 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2475.000	5.59	29.33	41.91	95.54	88.55	114.00	-25.45	peak
2	2483.500	5.60	29.35	41.91	48.22	41.26	74.00	-32.74	peak
3 pp	2485.345	5.60	29.36	41.91	57.42	50.47	74.00	-23.53	peak

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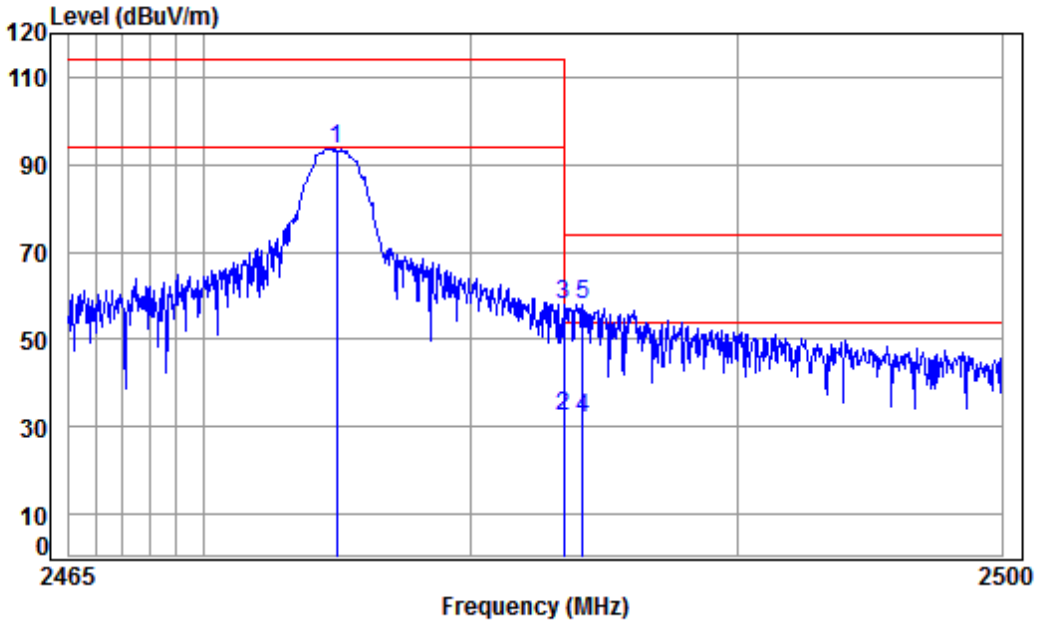
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2475 Band edge

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2475.000	5.59	29.33	41.91	100.72	93.73	114.00	-20.27	peak
2 av	2483.500	5.60	29.35	41.91	39.14	32.18	54.00	-21.82	Average
3 pp	2483.500	5.60	29.35	41.91	64.99	58.03	74.00	-15.97	peak
4	2484.224	5.60	29.35	41.91	39.00	32.04	54.00	-21.96	Average
5	2484.224	5.60	29.35	41.91	64.85	57.89	74.00	-16.11	peak

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

2) The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the above measurement data were shown in the report.

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7.4 Radiated Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)
Test Method: ANSI C63.10 (2013) Section 6.4&6.5&6.6
Measurement Distance: 3m
Limit:

Frequency(MHz)	Field strength (microvolts/meter)	Limit (dBuV/m)	Detector	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	-	300
0.490-1.705	24000/F(kHz)	-	-	30
1.705-30	30	-	-	30
30-88	100	40.0	QP	3
88-216	150	43.5	QP	3
216-960	200	46.0	QP	3
960-1000	500	54.0	QP	3
Above 1000	500	54.0	AV	3

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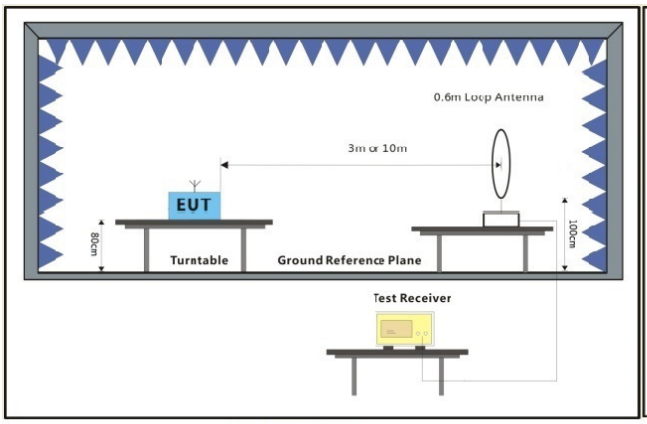
7.4.1 E.U.T. Operation

Operating Environment:

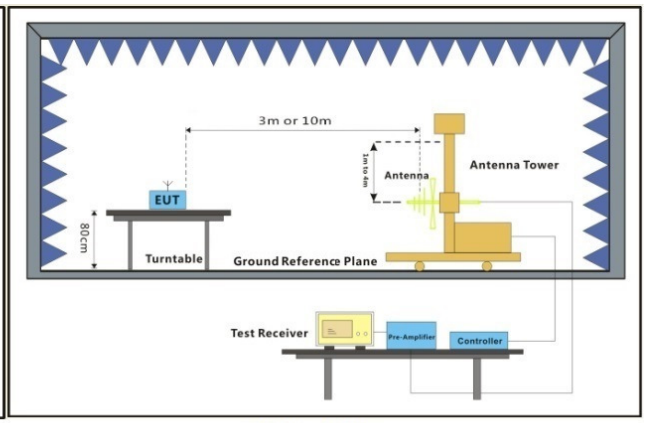
Temperature: 23.2 °C Humidity: 55 % RH Atmospheric Pressure: 1005 mbar

Test mode a:TX mode_Keep the EUT in transmitting with modulation mode.

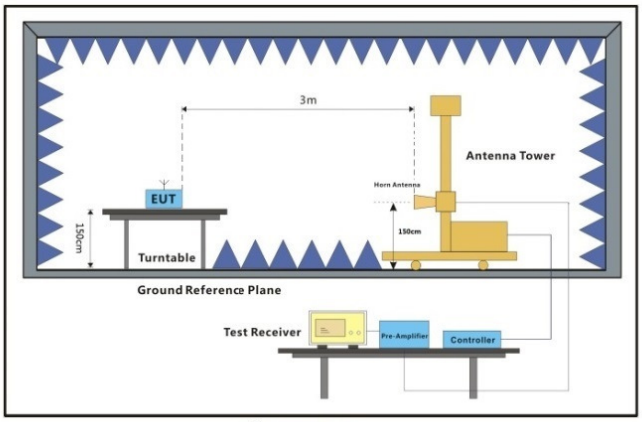
7.4.2 Test Setup Diagram



Below 30MHz



30MHz-1GHz



Above 1GHz

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7.4.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark:

1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.

2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

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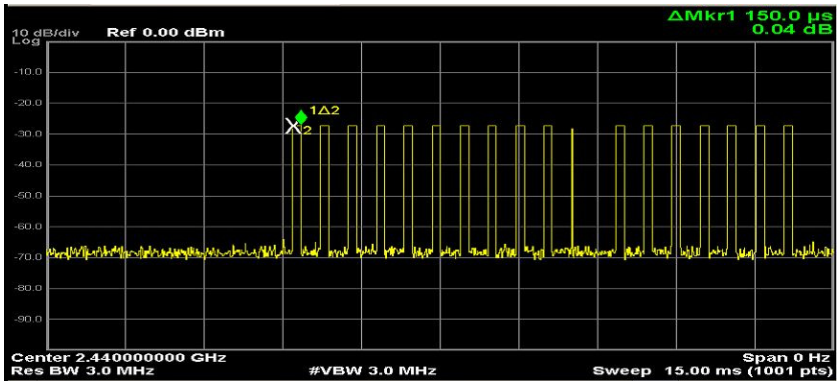
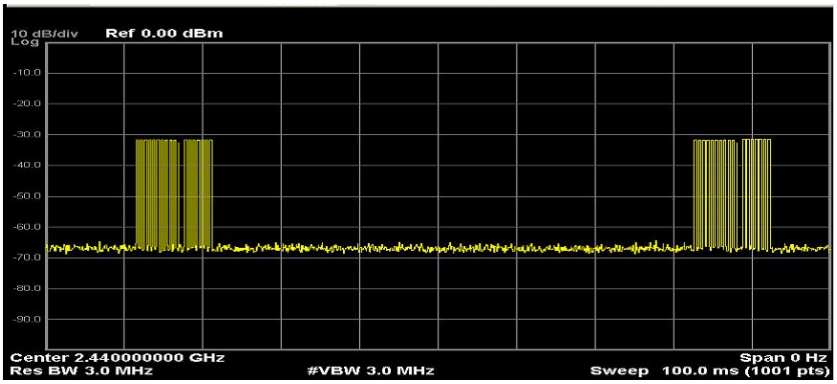
Average value:

Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)
	Duty cycle= T on time / T period
Test data:	Ton time =5.1ms
	T period =100ms
	PDCF value= -25.85dB

Duty cycle test plots:





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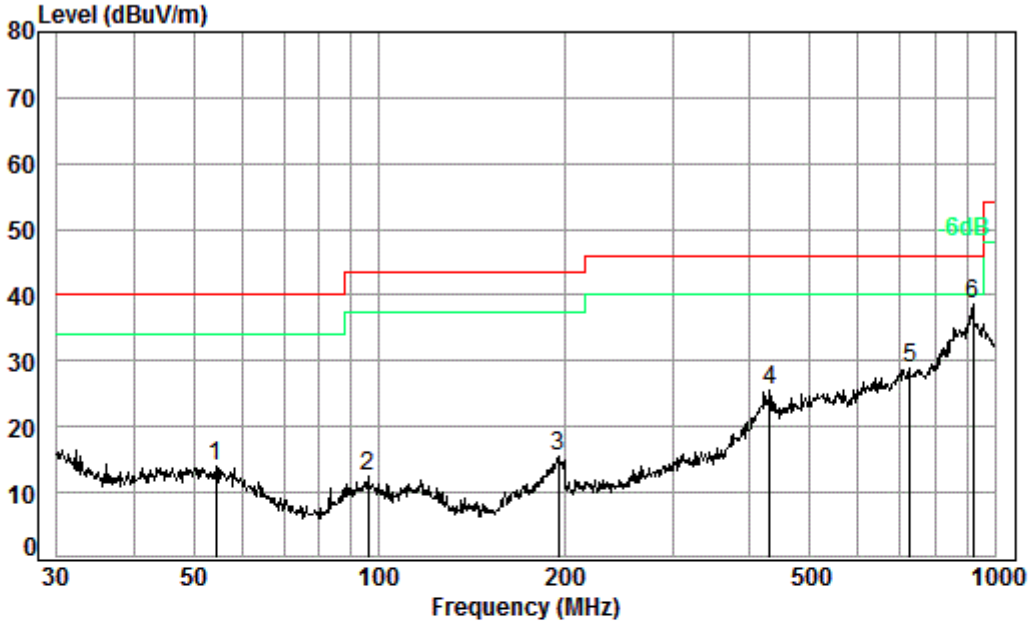
30MHz~1GHz

QP value:

Mode: a; Polarization: Horizontal;



Condition: 3m HORIZONTAL
Job No. : 14538CR
Test mode: a

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	54.26	0.80	13.75	27.58	26.90	13.87	40.00	-26.13
2	96.10	1.16	13.66	27.51	25.05	12.36	43.50	-31.14
3	195.82	1.39	16.38	27.53	25.15	15.39	43.50	-28.11
4	431.03	2.33	23.14	27.78	27.74	25.43	46.00	-20.57
5	726.81	2.98	28.07	27.51	25.42	28.96	46.00	-17.04
6 pp	922.52	3.62	29.92	27.00	31.96	38.50	46.00	-7.50

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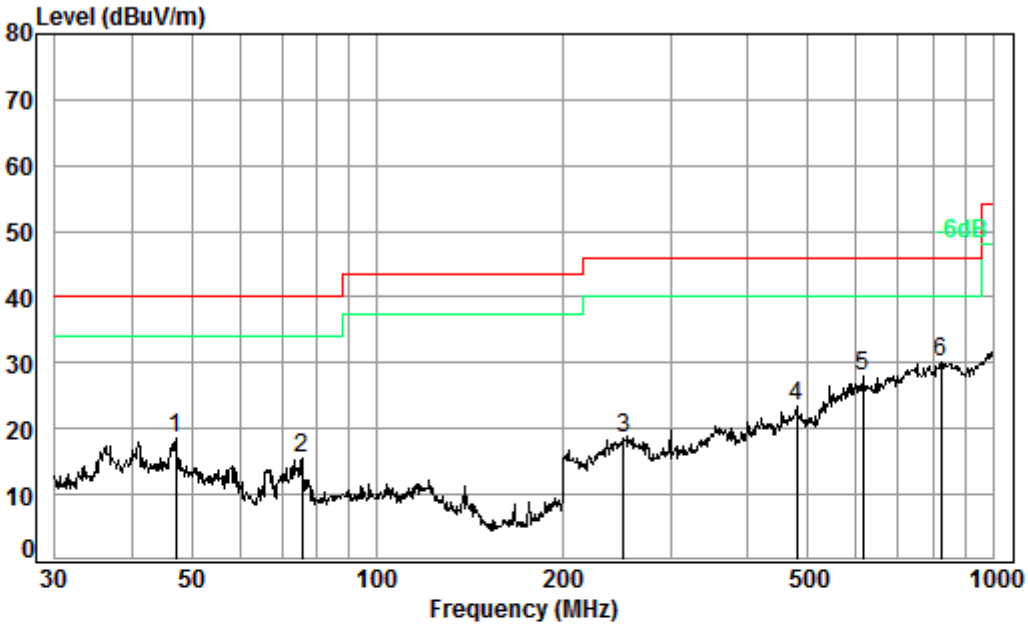
Mode :a; Polarization: Vertical



Condition: 3m VERTICAL
Job No. : 14538CR
Test mode: a

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	47.16	0.75	15.06	27.61	30.24	18.44	40.00	-21.56
2	75.71	0.98	12.33	27.51	29.75	15.55	40.00	-24.45
3	251.18	1.68	18.97	27.54	25.49	18.60	46.00	-27.40
4	480.53	2.53	24.21	27.85	24.43	23.32	46.00	-22.68
5	614.21	2.73	26.80	27.68	26.23	28.08	46.00	-17.92
6 pp	824.60	3.31	28.83	27.33	25.24	30.05	46.00	-15.95

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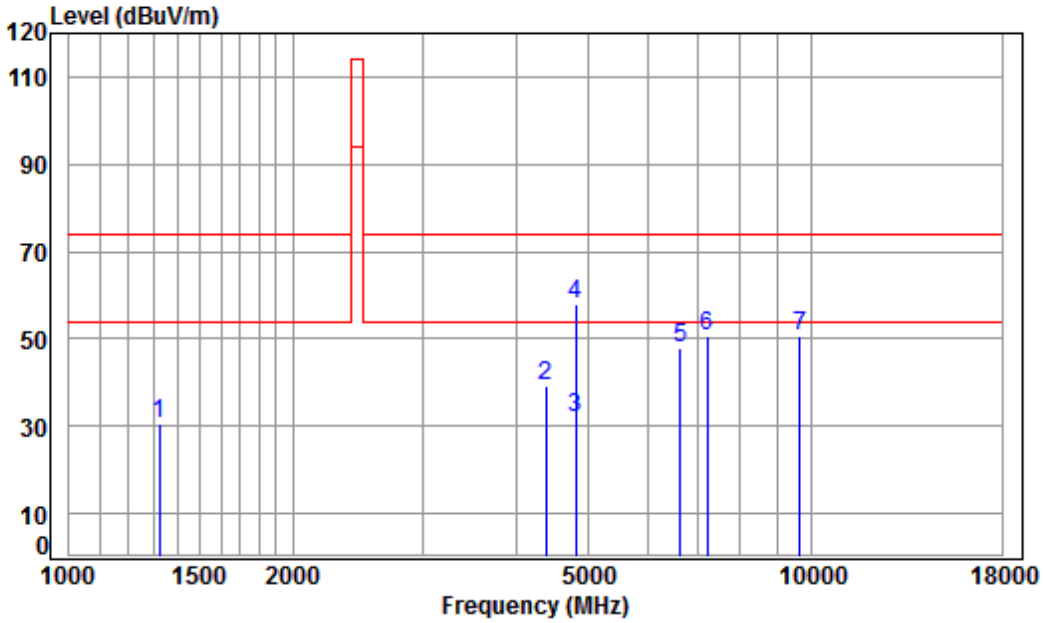
Above 1GHz

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low



Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2405 TX SE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1323.614	4.88	25.06	41.28	41.70	30.36	74.00	-43.64	peak
2	4379.699	7.43	33.60	42.40	40.54	39.17	74.00	-34.83	peak
3 av	4810.000	7.90	34.17	42.47	32.47	32.07	54.00	-21.93	Average
4 pp	4810.000	7.90	34.17	42.47	58.32	57.92	74.00	-16.08	peak
5	6640.542	11.13	35.50	41.11	42.34	47.86	74.00	-26.14	peak
6	7215.000	10.07	36.41	40.71	44.89	50.66	74.00	-23.34	peak
7	9620.000	10.75	37.52	37.72	40.15	50.70	74.00	-23.30	peak

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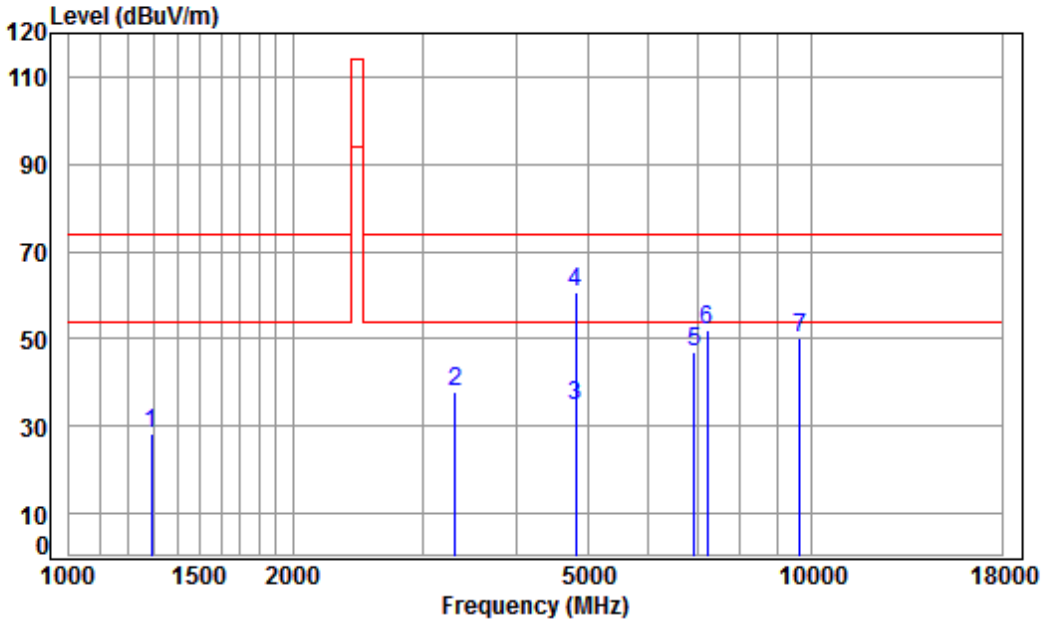
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2405 TX SE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1289.627	4.76	24.91	41.25	39.93	28.35	74.00	-45.65	peak
2	3308.894	6.29	31.87	42.18	41.82	37.80	74.00	-36.20	peak
3 av	4810.000	7.90	34.17	42.47	35.04	34.64	54.00	-19.36	Average
4 pp	4810.000	7.90	34.17	42.47	60.89	60.49	74.00	-13.51	peak
5	6934.778	10.31	36.32	40.90	41.44	47.17	74.00	-26.83	peak
6	7215.000	10.07	36.41	40.71	46.13	51.90	74.00	-22.10	peak
7	9620.000	10.75	37.52	37.72	39.64	50.19	74.00	-23.81	peak

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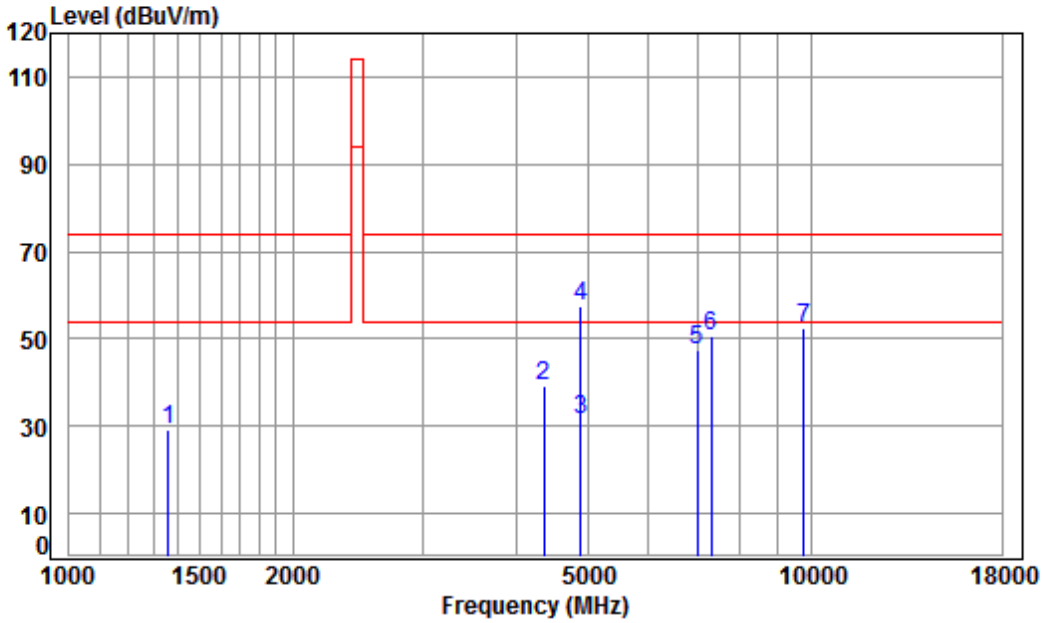
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle



Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2440 TX SE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1358.498	5.01	25.21	41.31	40.49	29.40	74.00	-44.60	peak
2	4354.454	7.40	33.60	42.39	40.59	39.20	74.00	-34.80	peak
3 av	4880.000	7.97	34.29	42.48	31.66	31.44	54.00	-22.56	Average
4 pp	4880.000	7.97	34.29	42.48	57.51	57.29	74.00	-16.71	peak
5	6995.172	10.14	36.49	40.86	41.72	47.49	74.00	-26.51	peak
6	7320.000	10.05	36.37	40.63	44.97	50.76	74.00	-23.24	peak
7	9760.000	10.82	37.55	37.53	41.49	52.33	74.00	-21.67	peak

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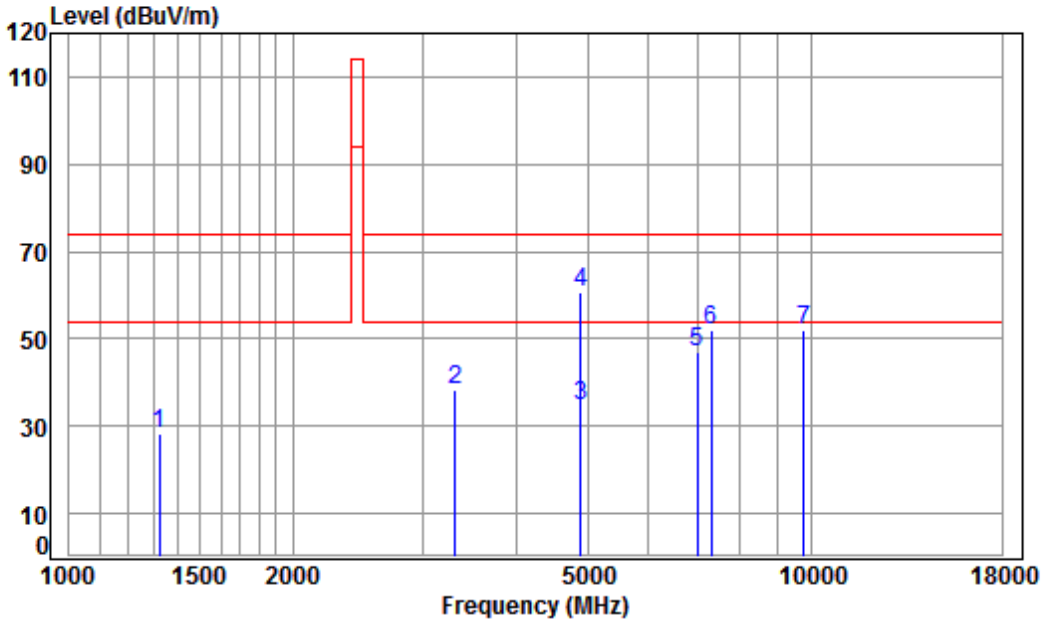
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:middle



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2440 TX SE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1323.614	4.88	25.06	41.28	39.86	28.52	74.00	-45.48	peak
2	3308.894	6.29	31.87	42.18	42.34	38.32	74.00	-35.68	peak
3 av	4880.000	7.97	34.29	42.48	35.07	34.85	54.00	-19.15	Average
4 pp	4880.000	7.97	34.29	42.48	60.92	60.70	74.00	-13.30	peak
5	6995.172	10.14	36.49	40.86	41.14	46.91	74.00	-27.09	peak
6	7320.000	10.05	36.37	40.63	46.12	51.91	74.00	-22.09	peak
7	9760.000	10.82	37.55	37.53	41.26	52.10	74.00	-21.90	peak

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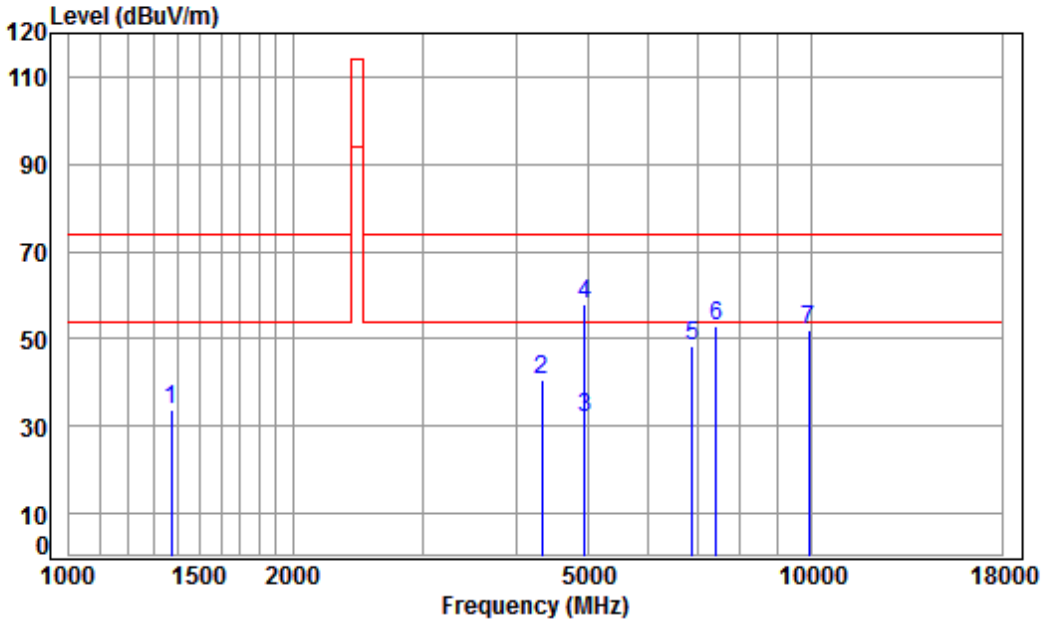
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Condition: 3m HORIZONTAL
Job No : 14538CR
Mode : 2475 TX SE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1374.295	5.06	25.28	41.32	44.95	33.97	74.00	-40.03	peak
2	4329.354	7.37	33.60	42.39	42.08	40.66	74.00	-33.34	peak
3 av	4950.000	8.04	34.41	42.49	32.17	32.13	54.00	-21.87	Average
4 pp	4950.000	8.04	34.41	42.49	58.02	57.98	74.00	-16.02	peak
5	6894.806	10.42	36.21	40.93	42.58	48.28	74.00	-25.72	peak
6	7425.000	10.02	36.33	40.57	47.29	53.07	74.00	-20.93	peak
7	9900.000	10.89	37.58	37.34	40.95	52.08	74.00	-21.92	peak

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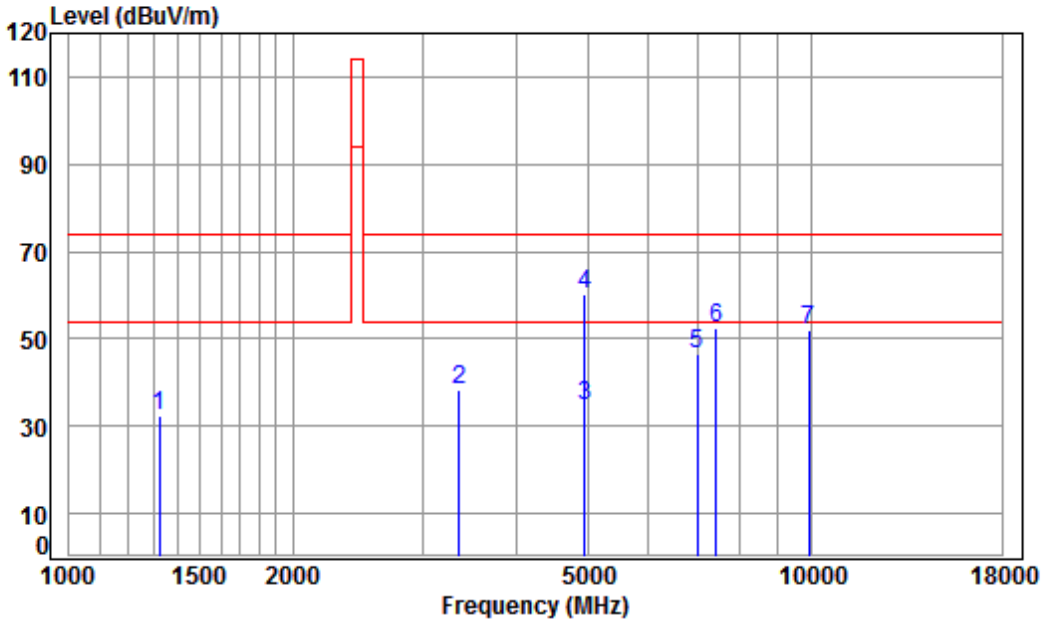
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Condition: 3m VERTICAL
Job No : 14538CR
Mode : 2475 TX SE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1323.614	4.88	25.06	41.28	43.83	32.49	74.00	-41.51	peak
2	3347.371	6.32	31.94	42.19	42.11	38.18	74.00	-35.82	peak
3 av	4950.000	8.04	34.41	42.49	34.64	34.60	54.00	-19.40	Average
4 pp	4950.000	8.04	34.41	42.49	60.49	60.45	74.00	-13.55	peak
5	6995.172	10.14	36.49	40.86	40.85	46.62	74.00	-27.38	peak
6	7425.000	10.02	36.33	40.57	46.91	52.69	74.00	-21.31	peak
7	9900.000	10.89	37.58	37.34	40.88	52.01	74.00	-21.99	peak

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8 Photographs

8.1 Test Setup

Please refer to setup photos.

8.2 EUT Constructional Details (EUT Photos)

Please refer to external and internal photos for details.

- End of the Report -

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