



TEST REPORT

Application No.: SZEM1911019878CR
Applicant: Wintop Electronics Co., Limited
Address of Applicant: Flat 2,8/F Workingport Com'L Bldg,3 Hau Fook ST, Tsim Sha Tsui, Kln, Hong Kong
Manufacturer: Shenzhen Wintop Electronics Co., Ltd
Address of Manufacturer: Room 402 Building 1 No.34 XinHe Road, No. 46, Xinhe Road, Floor 4 No.50 XinHe Road ShangMuGu Community, PingHu Street, LongGang District, ShenZhen City, GuangDong Province, China
Equipment Under Test (EUT):
EUT Name: Wireless Mouse
Model No.: WM-101
FCC ID: 2AB75-TLSR8516
Standard(s) : 47 CFR Part 15, Subpart C 15.249
Date of Receipt: 2019-11-05
Date of Test: 2019-11-19 to 2019-12-10
Date of Issue: 2019-12-12

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

Keny Xu

Keny Xu
EMC Laboratory Manager



Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2019-12-12		Original

Authorized for issue by:			
		 <hr/> Bill Chen /Project Engineer	
		 <hr/> Eric Fu /Reviewer	

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
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
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

3 Contents

	Page
1 COVER PAGE	1
2 TEST SUMMARY	3
3 CONTENTS	4
4 GENERAL INFORMATION	5
4.1 DETAILS OF E.U.T.	5
4.2 DESCRIPTION OF SUPPORT UNITS	6
4.3 MEASUREMENT UNCERTAINTY	6
4.4 TEST LOCATION	7
4.5 TEST FACILITY	7
4.6 DEVIATION FROM STANDARDS	7
4.7 ABNORMALITIES FROM STANDARD CONDITIONS	7
5 EQUIPMENT LIST	8
6 RADIO SPECTRUM TECHNICAL REQUIREMENT	11
6.1 ANTENNA REQUIREMENT	11
6.1.1 Test Requirement:	11
6.1.2 Conclusion	11
7 RADIO SPECTRUM MATTER TEST RESULTS	12
7.1 CONDUCTED EMISSIONS AT AC POWER LINE (150kHz-30MHz)	12
7.1.1 E.U.T. Operation	12
7.1.2 Measurement Procedure and Data	12
7.2 20dB BANDWIDTH	15
7.2.1 E.U.T. Operation	15
7.2.2 Test Setup Diagram	15
7.2.3 Measurement Procedure and Data	15
7.3 FIELD STRENGTH OF THE FUNDAMENTAL SIGNAL (15.249(A))	18
7.3.1 E.U.T. Operation	19
7.3.2 Test Setup Diagram	19
7.3.3 Measurement Procedure and Data	19
7.4 RESTRICTED BAND AROUND FUNDAMENTAL FREQUENCY	26
7.4.1 E.U.T. Operation	27
7.4.2 Test Setup Diagram	27
7.4.3 Measurement Procedure and Data	27
7.5 RADIATED EMISSIONS	34
7.5.1 E.U.T. Operation	35
7.5.2 Test Setup Diagram	35
7.5.3 Measurement Procedure and Data	36
8 PHOTOGRAPHS	47
8.1 TEST SETUP	47
8.2 EUT CONSTRUCTIONAL DETAILS (EUT PHOTOS)	47

4 General Information

4.1 Details of E.U.T.

Power Supply:	Dongle: DC input 5V
Operation Frequency:	2405MHz-2475MHz
Modulation Type:	GFSK
Number of Channels:	8
Antenna Type:	PCB Antenna
Antenna Gain:	1.6dBi

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2405MHz	3	2417MHz	5	2457MHz	7	2469MHz
2	2411MHz	4	2451MHz	6	2463MHz	8	2475MHz

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(CH5)	2451MHz
The Highest channel(CH8)	2475MHz



4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	Lenovo	L480	PF-1N6C1C

4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Conduction emission	$\pm 3.0\text{dB}$ (150kHz to 30MHz)
2	Duty cycle	$\pm 0.37\%$
3	20dB Bandwidth	$\pm 3\%$
4	E-Field	$\pm 4.5\text{dB}$ (Below 1GHz)
5	Radiated Spurious emission test	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
6	Temperature test	$\pm 1^\circ\text{C}$
7	Humidity test	$\pm 3\%$
8	Supply voltages	$\pm 1.5\%$
9	Time	$\pm 3\%$



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4.4 Test Location

All tests were performed at:

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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:

- **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

Conducted Emissions at AC Power Line (150kHz-30MHz)					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	ZhongYu Electron	GB-88	SEM001-06	2019-06-13	2022-06-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM024-01	2019-07-11	2020-07-10
LISN	Rohde & Schwarz	ENV216	SEM007-01	2019-09-24	2020-09-23
LISN	ETS-LINDGREN	3816/2	SEM007-02	2019-04-01	2020-03-31
EMI Test Receiver	Rohde & Schwarz	ESCI	SEM004-02	2019-04-01	2020-03-31

20dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2022-06-12
DC Power Supply	Zhao Xin	KXN-6020D	SEM011-08	2019-09-24	2020-09-23
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2019-09-24	2020-09-23
Measurement Software	JS Tonscend	JS1120-2 BT/WIFI V2.	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-02	2019-07-11	2020-07-10
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2019-09-24	2020-09-23
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2019-09-24	2020-09-23
Electric and Magnetic Field Analyzer	Narda	NBM-550/EHP-50F	EMC2143	2018-02-07	2020-02-06
Electric Field Probe (100KHz-3GHz)	WANDEL & GOLTERMANN	EMR-20	EMC0907	2019-05-21	2020-05-20
EMF Tester	Narda	ELT-400	SZE039-4	2019-07-08	2020-07-07

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	2019-07-11	2020-07-10
EXA Spectrum Analyzer	Agilent Technologies 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



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Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2019-09-24	2020-09-23
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	KXN-6020D	SEM011-08	2019-09-24	2020-09-23
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21

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	2019-07-11	2020-07-10
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	2019-09-24	2020-09-23
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	KXN-6020D	SEM011-08	2019-09-24	2020-09-23
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	2019-07-11	2020-07-10
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



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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	2019-09-24	2020-09-23
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	KXN-6020D	SEM011-08	2019-09-24	2020-09-23
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	2019-09-24	2020-09-23
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	2019-07-11	2020-07-10

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	2019-09-26	2020-09-25
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-04	2019-09-26	2020-09-25
Humidity/ Temperature Indicator	Mingle	N/A	SEM002-08	2019-09-26	2020-09-25
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

Limit:

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 1.6dBi.

Antenna location: Refer to Appendix (Internal photos)



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7 Radio Spectrum Matter Test Results

7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207
Test Method: ANSI C63.10 (2013) Section 6.2
Limit:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

7.1.1 E.U.T. Operation

Operating Environment:

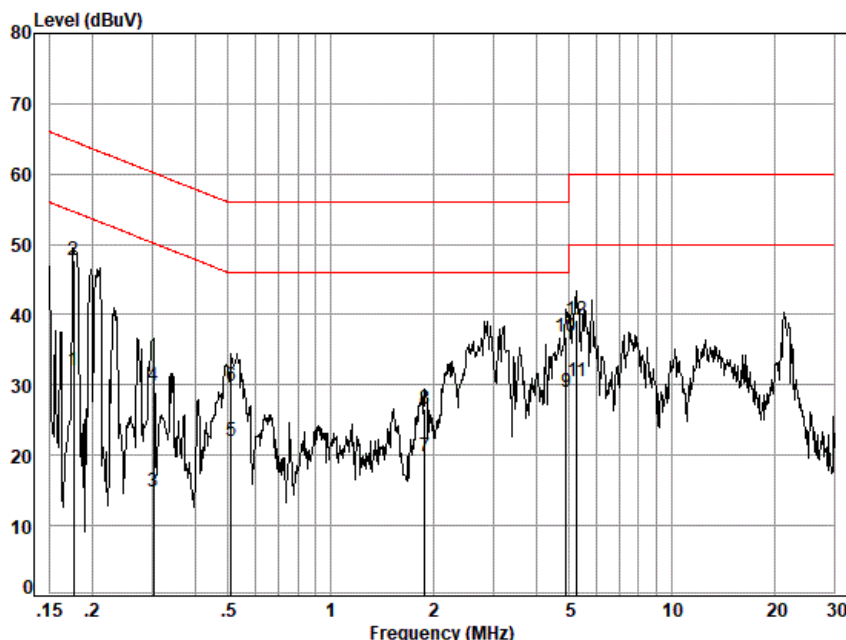
Temperature: 23.2 °C Humidity: 52 % RH Atmospheric Pressure: 1015 mbar
Test mode b:TX mode(Dongle) _Keep the EUT in transmitting with modulation mode.

7.1.2 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 50hm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: LISN=Read Level+ Cable Loss+ LISN Factor

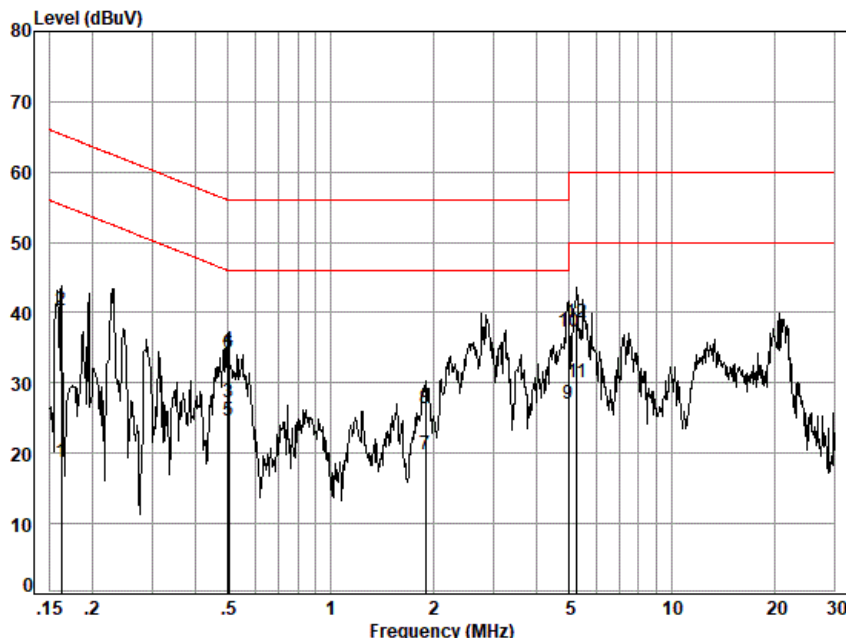
Mode:b Line:Live Line



Site : Shielding Room
Condition: Line
Job No. : 19878CR
Test mode: b

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.18	0.02	9.49	22.43	31.94	54.68	-22.74	Average
2	0.18	0.02	9.49	38.28	47.79	64.68	-16.89	QP
3	0.30	0.04	9.55	5.18	14.77	50.19	-35.42	Average
4	0.30	0.04	9.55	20.17	29.76	60.19	-30.43	QP
5	0.51	0.06	9.59	12.39	22.04	46.00	-23.96	Average
6	0.51	0.06	9.59	20.27	29.92	56.00	-26.08	QP
7	1.89	0.15	9.64	10.05	19.84	46.00	-26.16	Average
8	1.89	0.15	9.64	16.77	26.56	56.00	-29.44	QP
9	4.90	0.17	9.69	19.04	28.90	46.00	-17.10	Average
10	4.90	0.17	9.69	27.08	36.94	56.00	-19.06	QP
11	5.28	0.17	9.69	20.64	30.50	50.00	-19.50	Average
12	5.28	0.17	9.69	29.35	39.21	60.00	-20.79	QP

Mode:b; Line:Neutral Line



Site : Shielding Room
Condition: Neutral
Job No. : 19878CR
Test mode: b

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.16	0.01	9.43	9.21	18.65	55.34	-36.69	Average
2	0.16	0.01	9.43	30.97	40.41	65.34	-24.93	QP
3	0.50	0.06	9.58	17.64	27.28	46.01	-18.73	Average
4	0.50	0.06	9.58	24.94	34.58	56.01	-21.43	QP
5	0.50	0.06	9.58	15.06	24.70	46.00	-21.30	Average
6	0.50	0.06	9.58	24.56	34.20	56.00	-21.80	QP
7	1.90	0.15	9.70	9.91	19.76	46.00	-26.24	Average
8	1.90	0.15	9.70	16.62	26.47	56.00	-29.53	QP
9	4.98	0.17	9.76	17.00	26.93	46.00	-19.07	Average
10	4.98	0.17	9.76	27.24	37.17	56.00	-18.83	QP
11	5.28	0.17	9.77	20.04	29.98	50.00	-20.02	Average
12	5.28	0.17	9.77	28.72	38.66	60.00	-21.34	QP

7.2 20dB Bandwidth

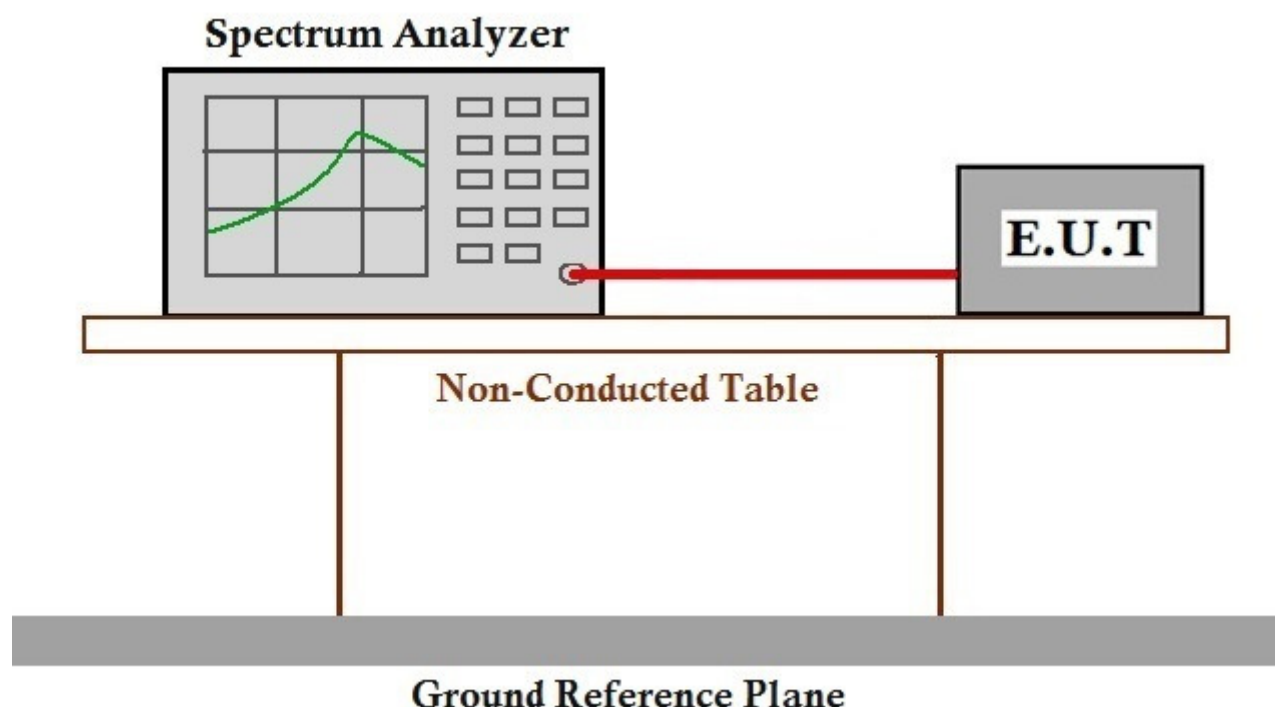
Test Requirement 47 CFR Part 15, Subpart C 15.215
Test Method: ANSI C63.10 (2013) Section 6.9
Limit: N/A

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 21.5 °C Humidity: 52.4 % RH Atmospheric Pressure: 1015 mbar
Test Mode: b:TX mode(Dongle) _Keep the EUT in transmitting with modulation mode.

7.2.2 Test Setup Diagram

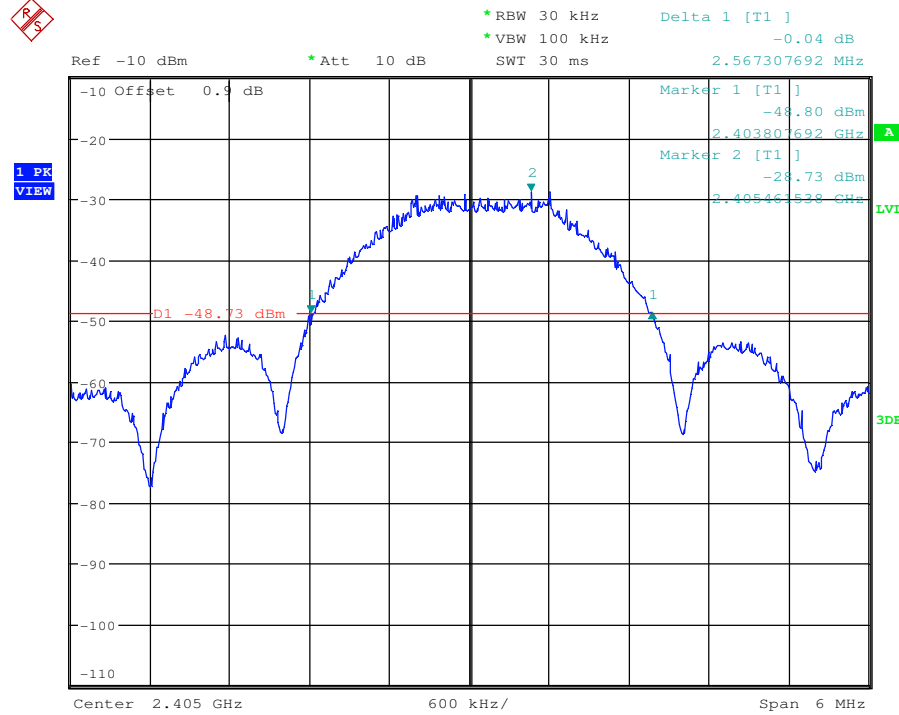


7.2.3 Measurement Procedure and Data

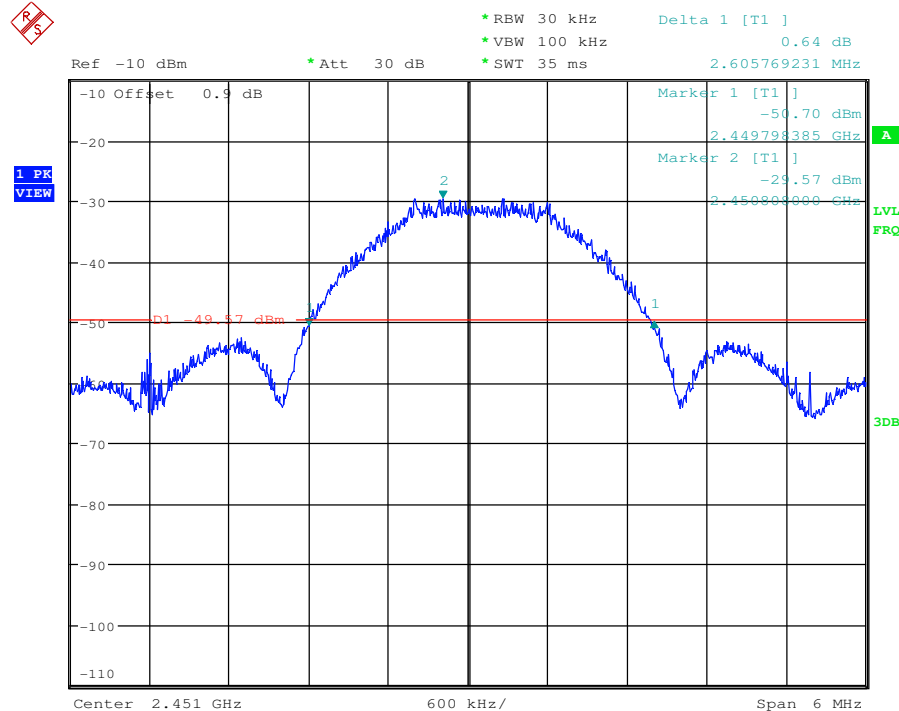
Test channel	20dB bandwidth (MHz)	Results
Lowest	2.567	Pass
Middle	2.406	Pass
Highest	2.635	Pass



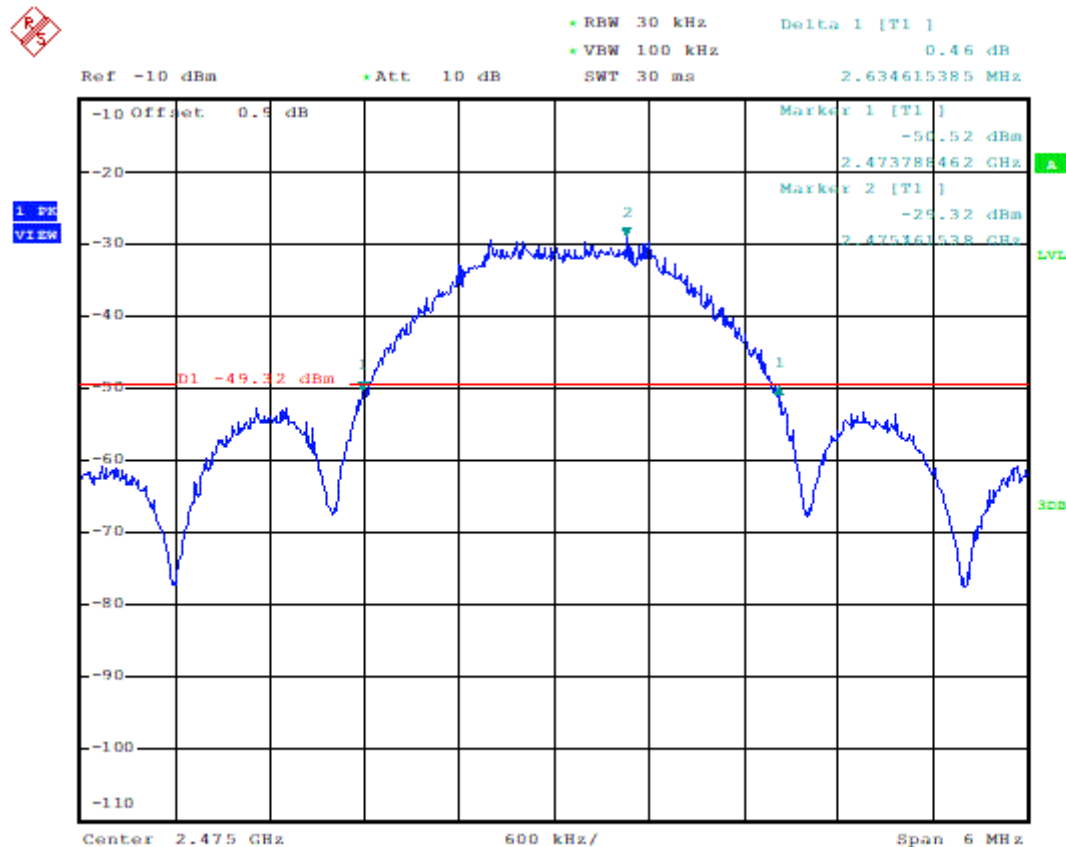
Mode:b; Channel:Low



Mode:b; Channel:middle



Mode:b; Channel:High



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7.3 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.



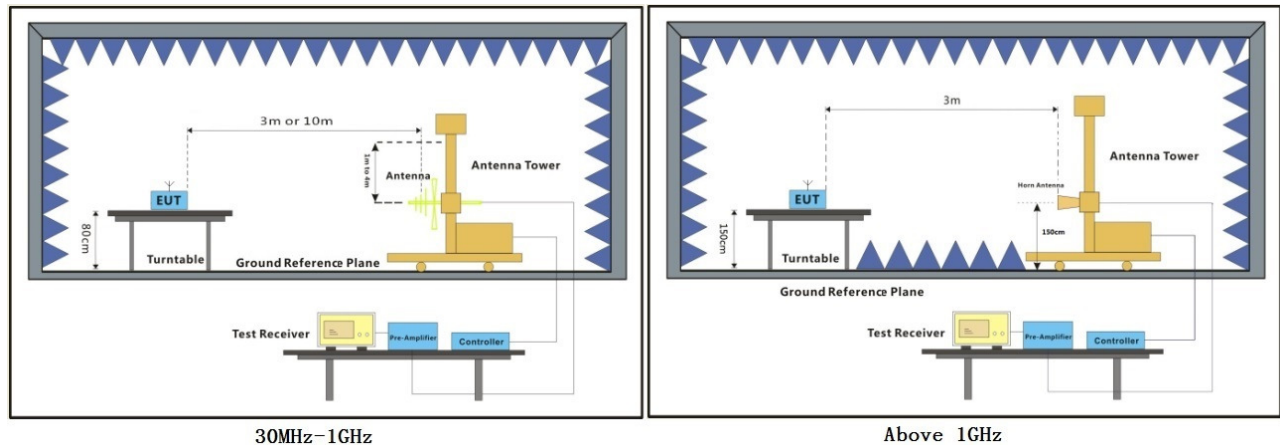
7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 25 °C Humidity: 51 % RH Atmospheric Pressure: 1015 mbar

Test Mode: b:TX mode(Dongle) _Keep the EUT in transmitting with modulation mode.

7.3.2 Test Setup Diagram

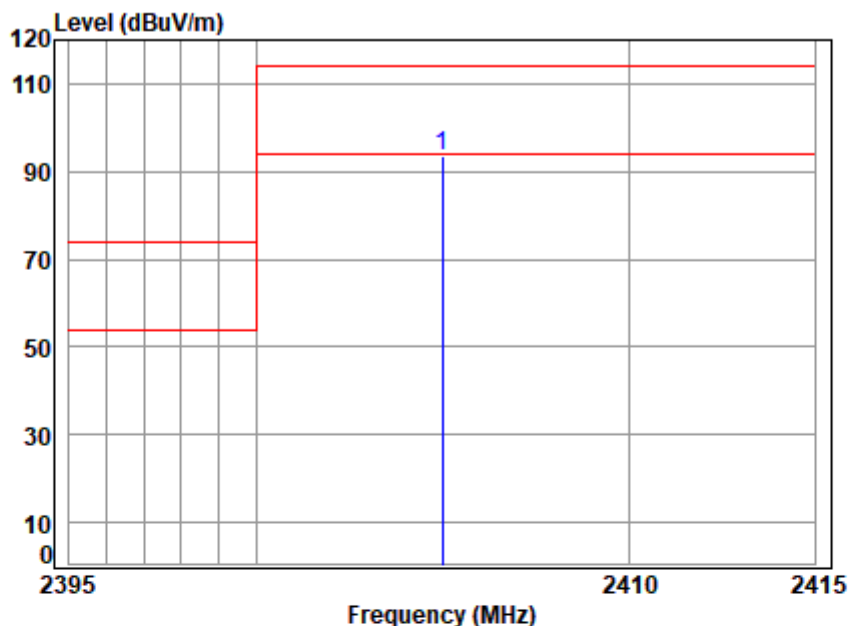


7.3.3 Measurement Procedure and Data

- 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.
- 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.
- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.
- Test the EUT in the lowest channel, the middle channel, the Highest channel.
- 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.
- Repeat above procedures until all frequencies measured was complete.

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

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



Site : chamber

Condition: 3m HORIZONTAL

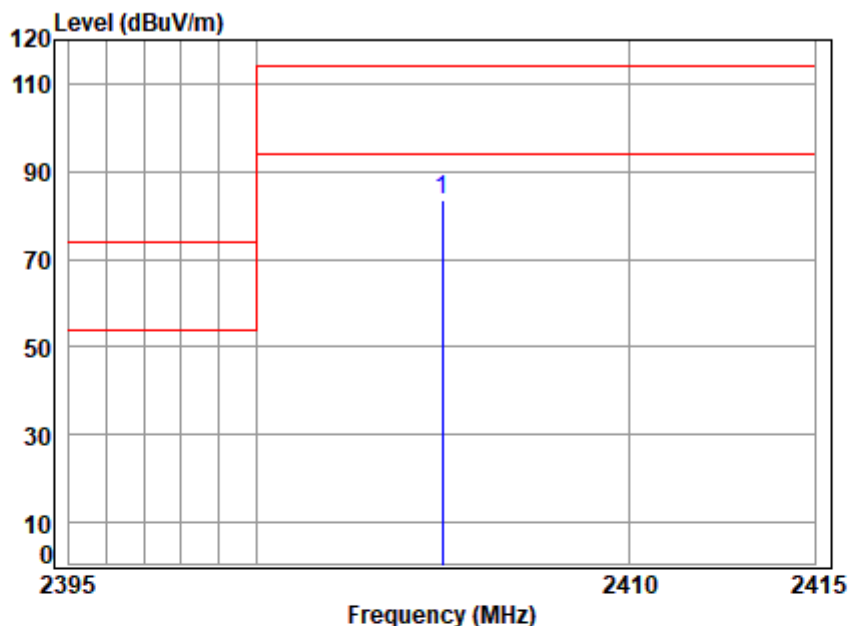
Job No : 19878CR

Mode : 2405 Field strength

		Cable	Ant	Preamp	Read	Limit	Over	
Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz	dB		dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2405.000	5.49	28.54	40.98	100.49	93.54	114.00	-20.46 peak



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

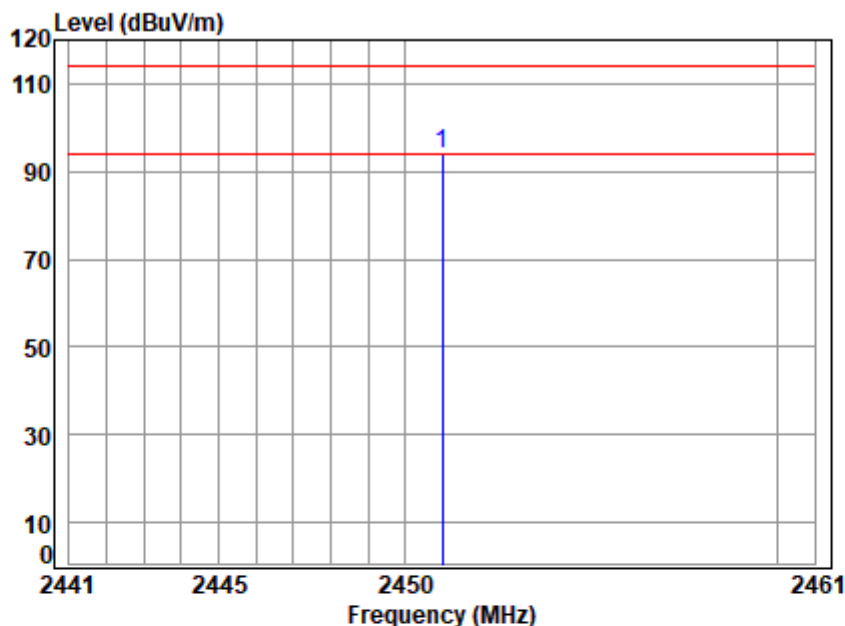


Site : chamber
Condition: 3m VERTICAL
Job No : 19878CR
Mode : 2405 Field strength

		Cable	Ant	Preamp	Read	Limit	Over	
Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz	dB		dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2405.000	5.49	28.54	40.98	90.22	83.27	114.00	-30.73 peak



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



Site : chamber

Condition: 3m HORIZONTAL

Job No : 19878CR

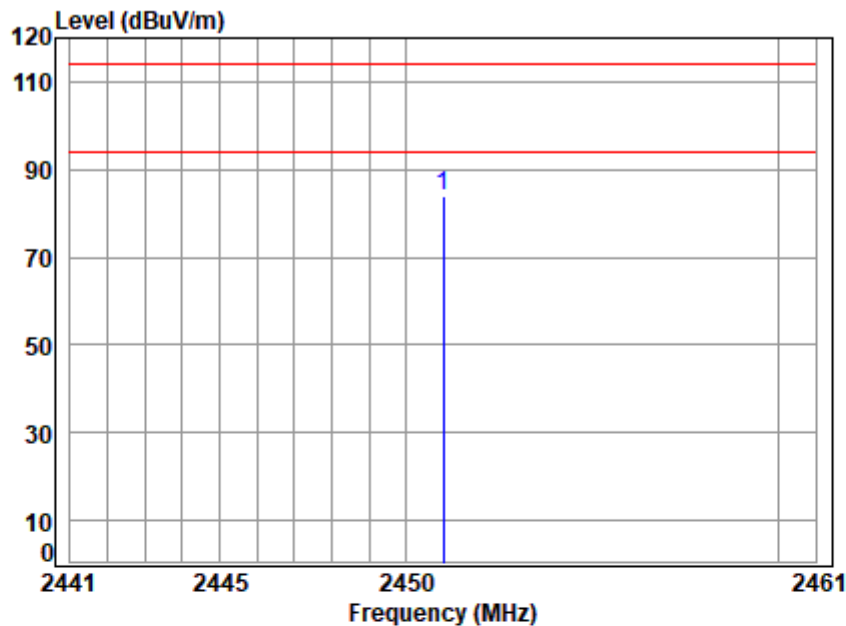
Mode : 2451 Field strength

		Cable	Ant	Preamp	Read	Limit	Over	
Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 2451.000	5.56	28.62	41.00	100.81	93.99	114.00	-20.01	peak





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



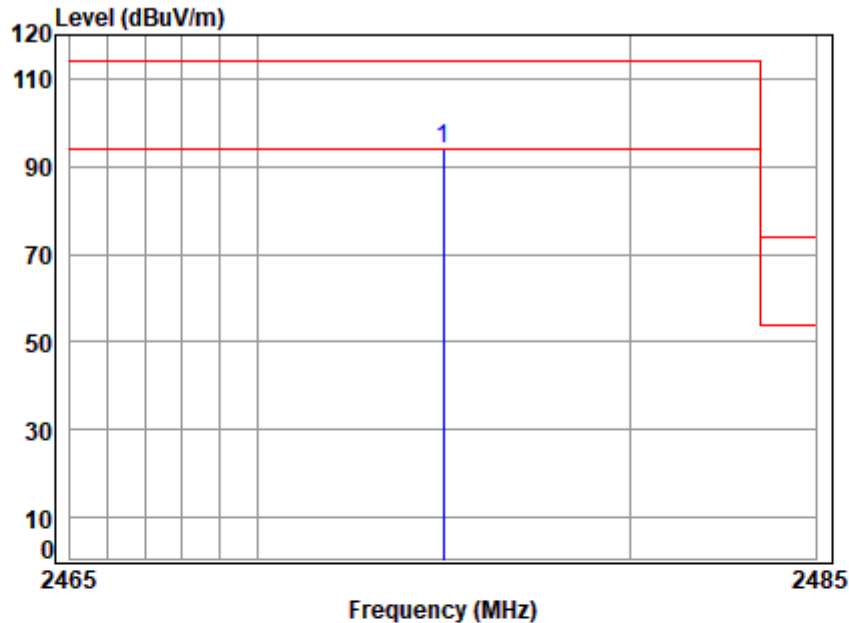
Site : chamber
Condition: 3m VERTICAL
Job No : 19878CR
Mode : 2451 Field strength

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2451.000	5.56	28.62	41.00	90.66	83.84	114.00	-30.16 peak





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



Site : chamber

Condition: 3m HORIZONTAL

Job No : 19878CR

Mode : 2475 Field strength

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2475.000	5.59	28.66	41.01	100.67	93.91	114.00	-20.09 peak



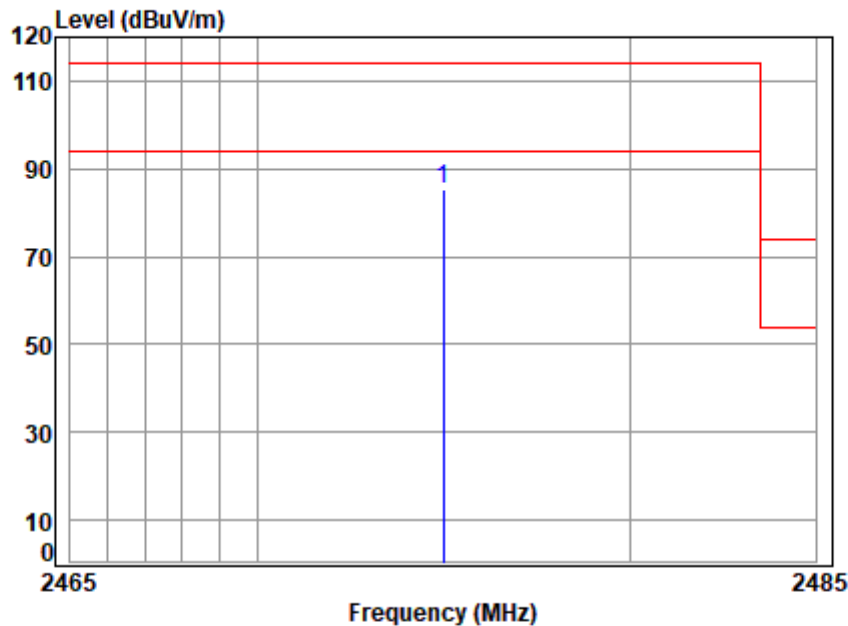
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Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Site : chamber
Condition: 3m VERTICAL
Job No : 19878CR
Mode : 2475 Field strength

		Cable	Ant	Preamp	Read	Limit	Over	
Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2475.000	5.59	28.66	41.01	91.94	85.18	114.00	-28.82 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.





7.4 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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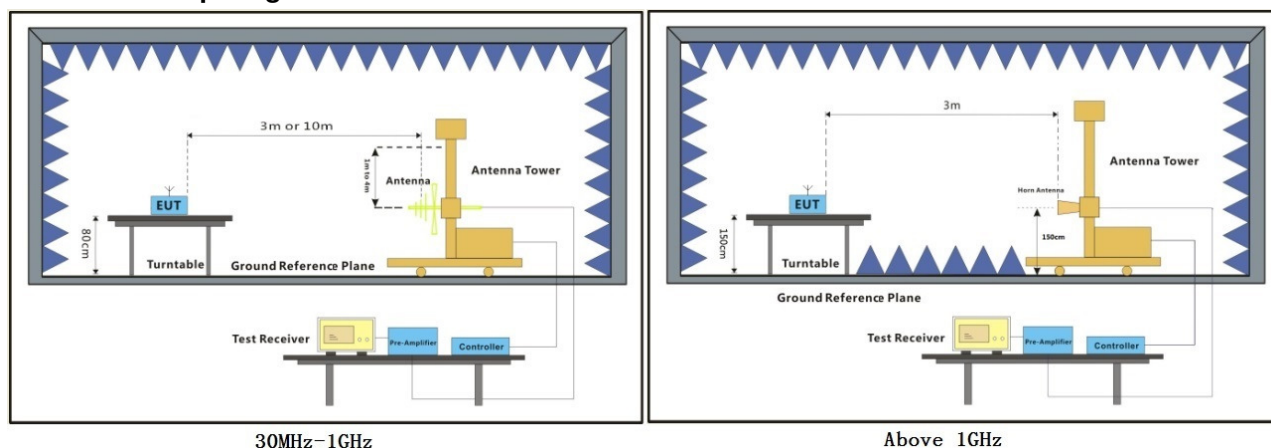
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7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 21.9 °C Humidity: 43.6 % RH Atmospheric Pressure: 1020 mbar
Test Mode: b:TX mode(Dongle) _Keep the EUT in transmitting with modulation mode.

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

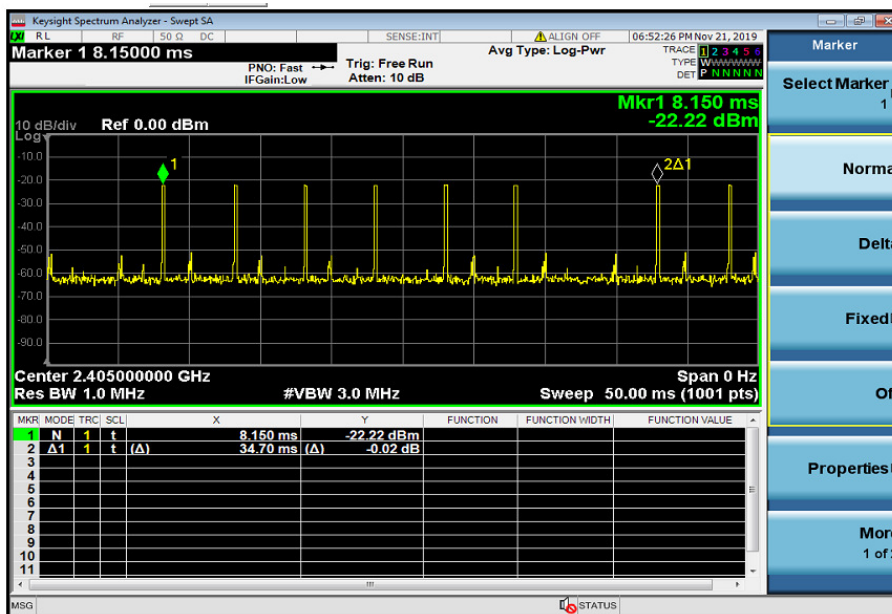
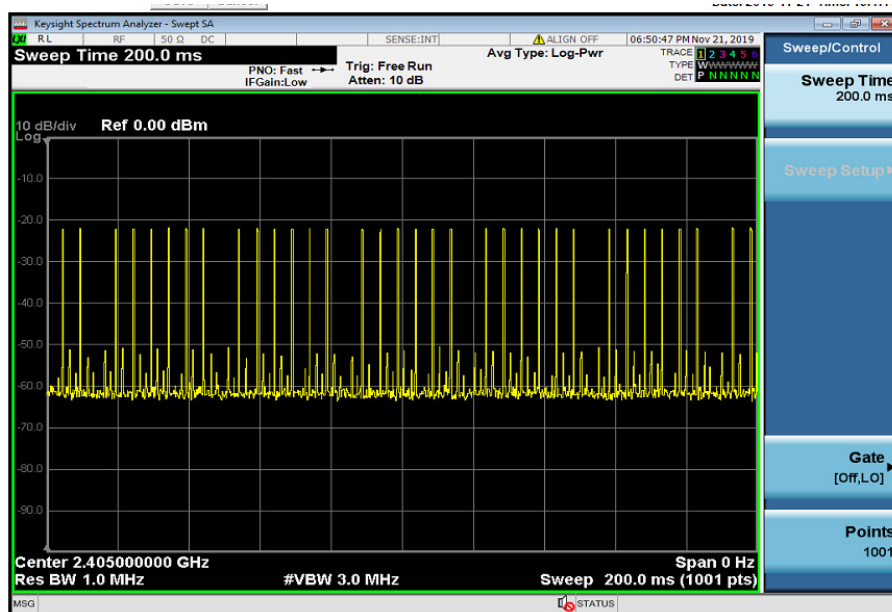
- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.
- Test the EUT in the lowest channel, the middle channel, the Highest channel.
- 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.
- Repeat above procedures until all frequencies measured was complete.

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

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 =0.84ms
	T period =34.7ms
	PDCF value= -32.32dB

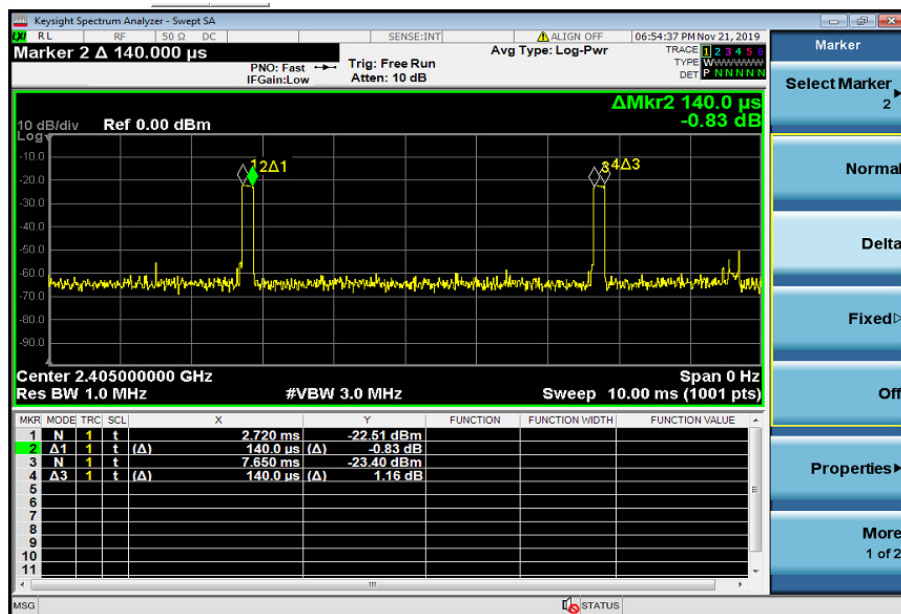
Duty cycle test plots:



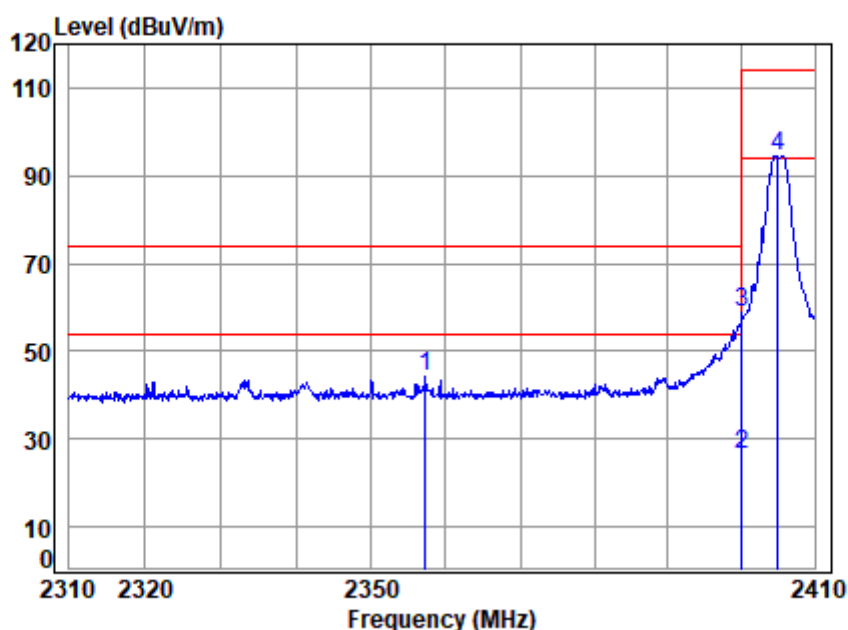
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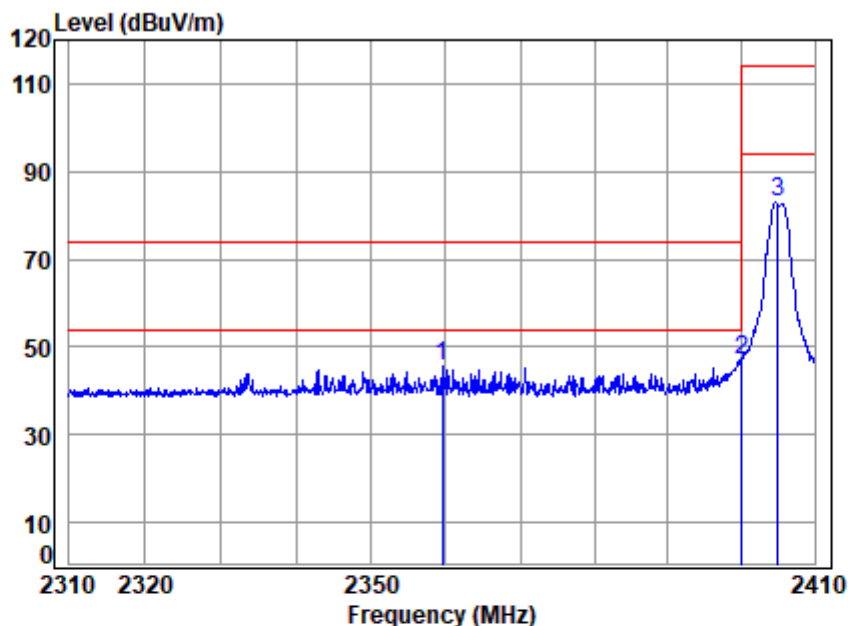
Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low



Site : chamber
Condition: 3m HORIZONTAL
Job No : 19878CR
Mode : 2405 Band edge

		Cable	Ant	Preamp	Read	Limit	Over	
Freq		Loss	Factor	Factor	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2357.271	5.43	28.46	40.96	51.30	44.23	74.00	-29.77 Peak
2	2400.000	5.49	28.54	40.98	33.46	26.51	54.00	-27.49 Average
3	2400.000	5.49	28.54	40.98	65.78	58.83	74.00	-15.17 peak
4	2405.000	5.49	28.54	40.98	101.58	94.63	114.00	-19.37 peak

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

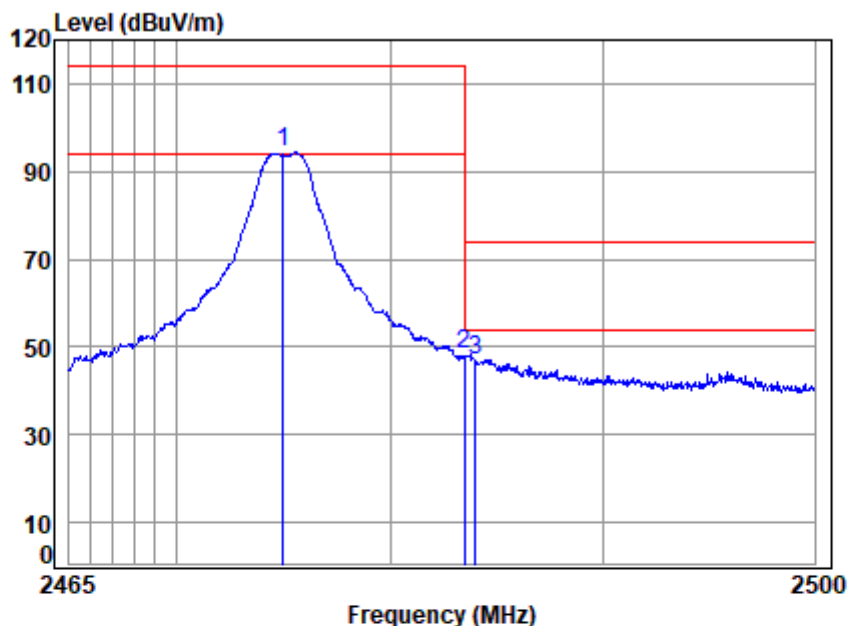


Site : chamber
Condition: 3m VERTICAL
Job No : 19878CR
Mode : 2405 Band edge

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2359.570	5.43	28.47	40.96	52.68	45.62	74.00	-28.38	Peak
2	2400.000	5.49	28.53	40.98	53.88	46.92	74.00	-27.08	peak
3	2405.000	5.49	28.54	40.98	89.89	82.94	114.00	-31.06	peak



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



Site : chamber
Condition: 3m HORIZONTAL
Job No : 19878CR
Mode : 2475 Band edge

		Cable	Ant	Preamp	Read	Limit	Over	
Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz	dB		dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2475.000	5.59	28.66	41.01	101.02	94.26	114.00	-19.74 peak
2	2483.500	5.60	28.67	41.01	55.06	48.32	74.00	-25.68 peak
3	2484.014	5.60	28.67	41.01	53.93	47.19	74.00	-26.81 Peak

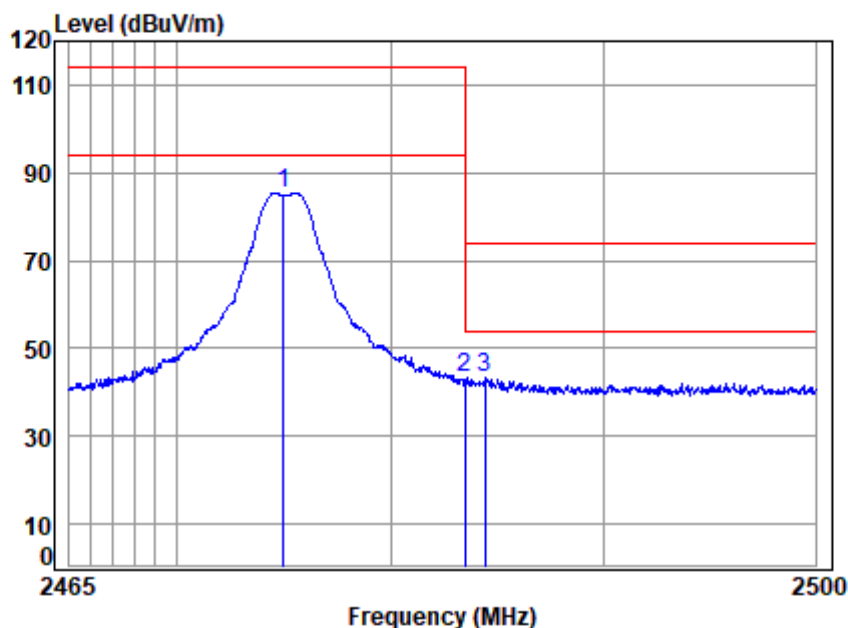


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Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Site : chamber

Condition: 3m VERTICAL

Job No : 19878CR

Mode : 2475 Band edge

		Cable	Ant	Preamp	Read	Limit	Over	
Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz	dB		dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2475.000	5.59	28.66	41.01	92.19	85.43	114.00	-28.57 peak
2	2483.500	5.60	28.67	41.01	50.13	43.39	74.00	-30.61 peak
3	2484.434	5.60	28.67	41.01	50.12	43.38	74.00	-30.62 Peak

Remark:

- 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
- 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.

7.5 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

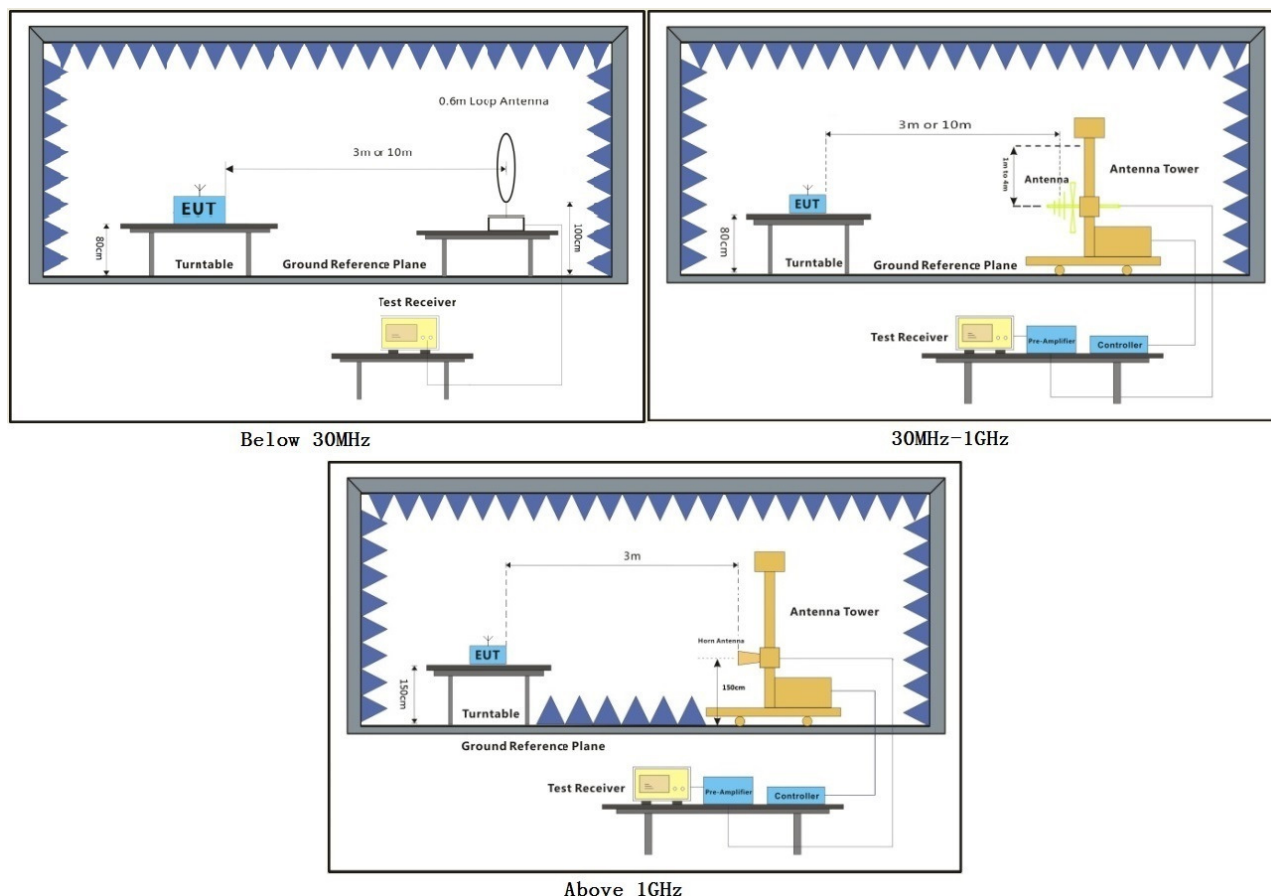
7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 25 °C Humidity: 51 % RH Atmospheric Pressure: 1015 mbar

Test Mode: b:TX mode(Dongle) _Keep the EUT in transmitting with modulation mode.

7.5.2 Test Setup Diagram



7.5.3 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.

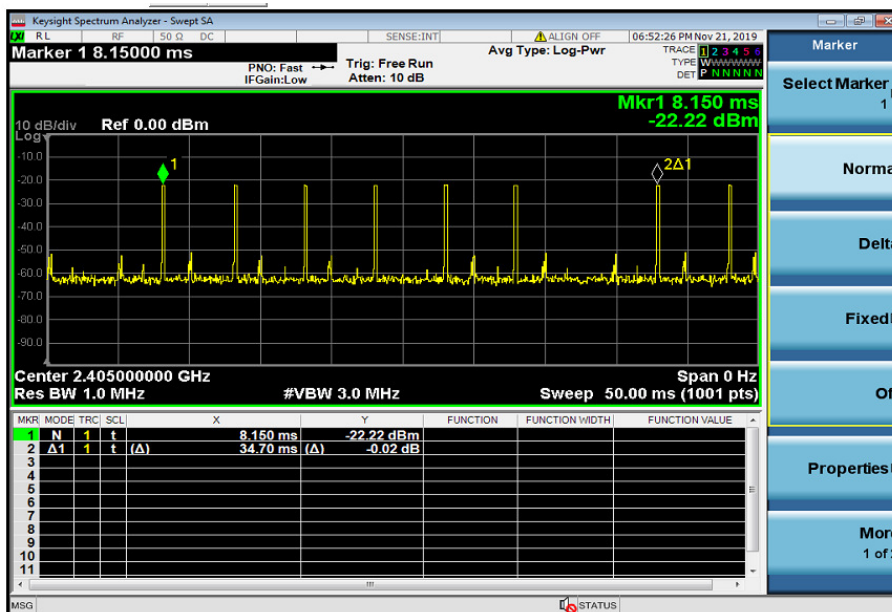
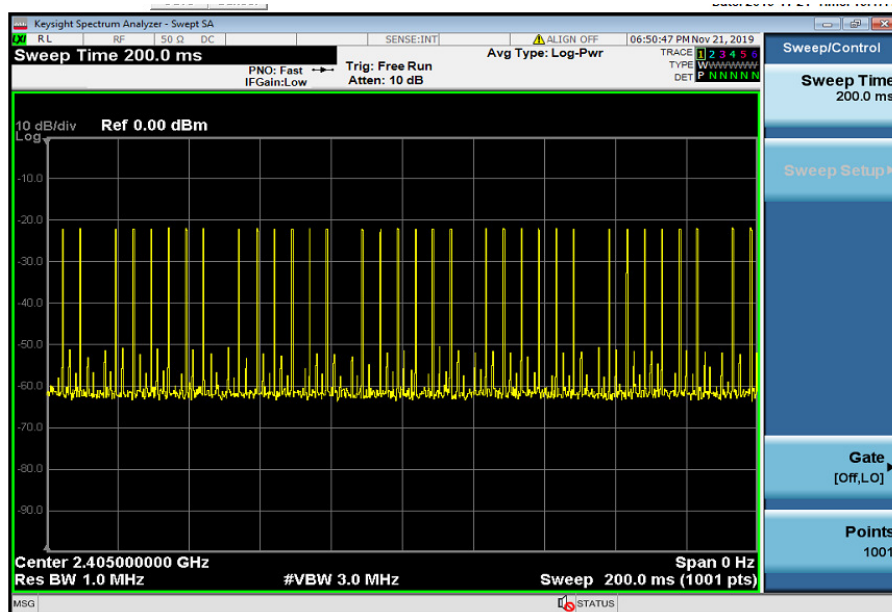
Remark:

- 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.

Average value:

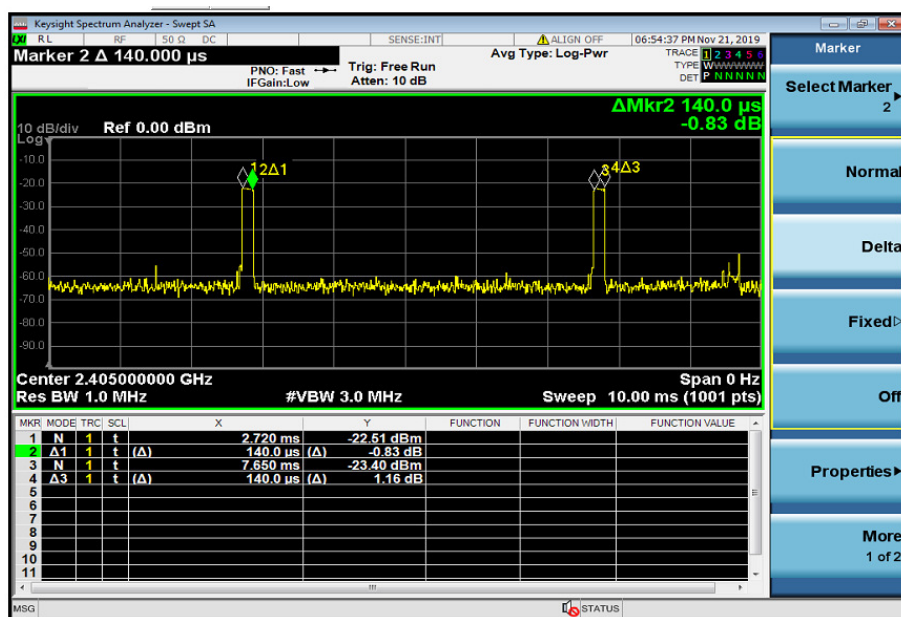
Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)
	Duty cycle= T on time / T period
Test data:	Ton time =0.84ms
	T period =34.7ms
	PDCF value= -32.32dB

Duty cycle test plots:



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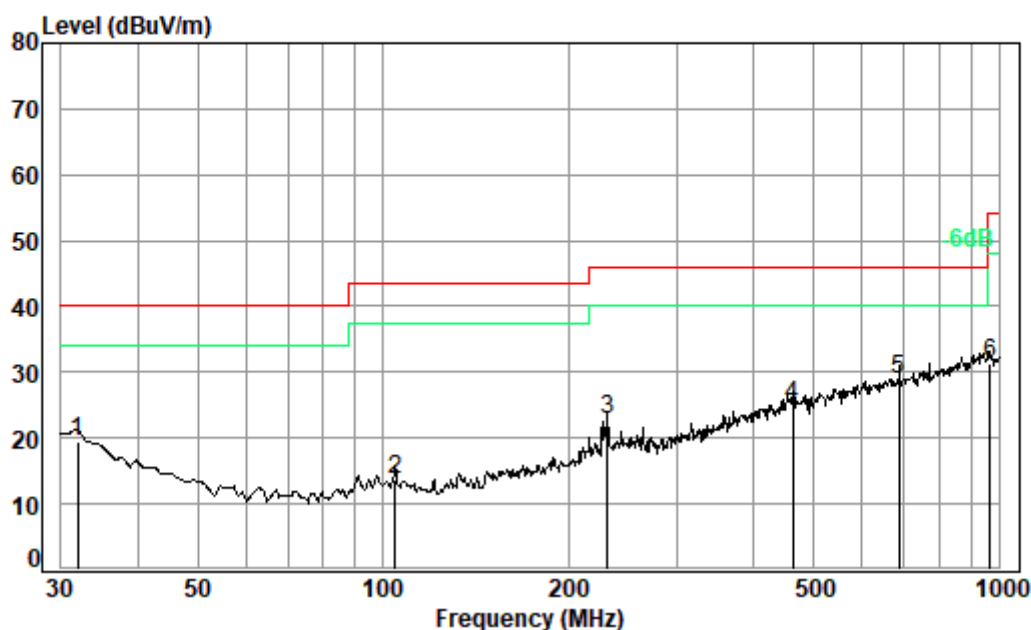
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30MHz~1GHz

QP value:

Mode: b; Polarization: Horizontal;



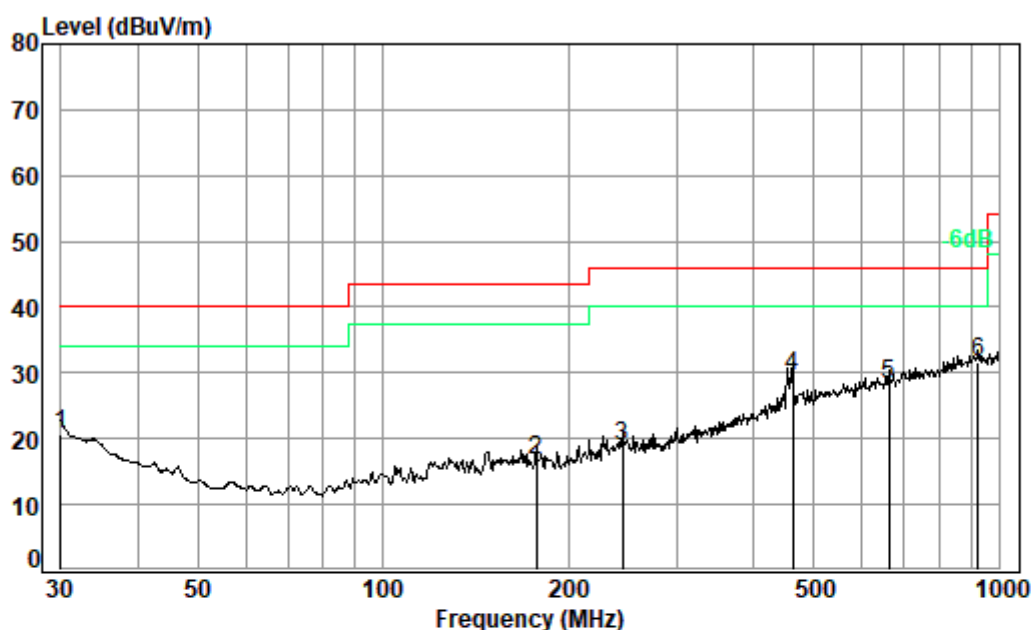
Condition: 3m HORIZONTAL

Job No. : 19878CR

Test mode: b

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB		dB/m	dB	dBuV	dBuV/m	dB
1	31.95	0.60	21.40	27.72	25.15	19.43	40.00	-20.57
2	104.54	1.21	13.78	27.61	26.29	13.67	43.50	-29.83
3	231.72	1.58	18.15	27.07	30.14	22.80	46.00	-23.20
4	462.35	2.46	23.83	27.69	26.35	24.95	46.00	-21.05
5 pp	689.56	2.88	27.77	27.95	26.24	28.94	46.00	-17.06
6	968.93	3.67	30.15	27.02	24.38	31.18	54.00	-22.82

Mode :b; Polarization: Vertical



Condition: 3m VERTICAL

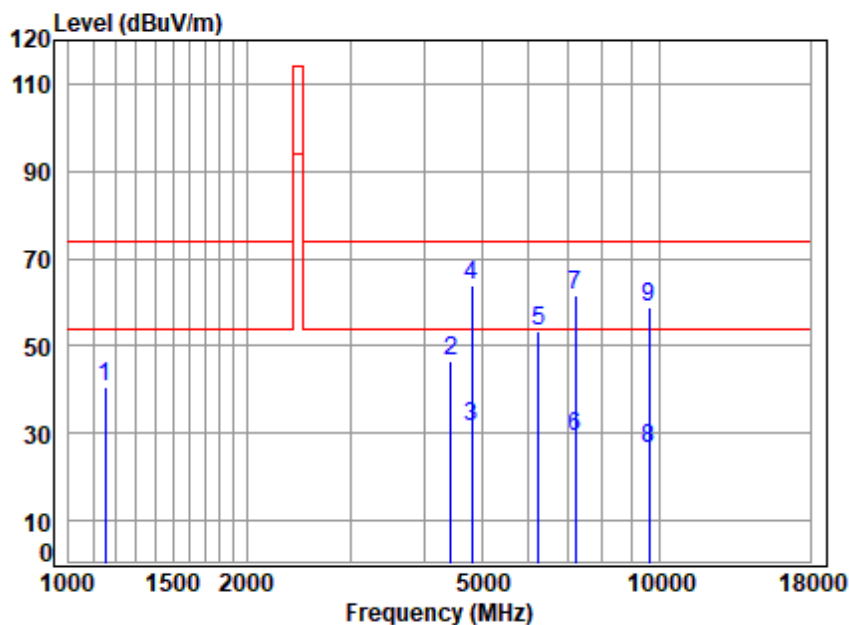
Job No. : 19878CR

Test mode: b

	Freq	Cable	Ant	Preamp	Read	Limit	Over
	MHz	Loss	Factor	Factor	Level	Line	Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m
1	30.00	0.60	22.50	27.73	25.46	20.83	40.00
2	177.51	1.37	15.85	27.25	26.74	16.71	43.50
3	245.09	1.65	18.88	27.03	25.43	18.93	46.00
4	462.35	2.46	23.83	27.69	30.98	29.58	46.00
5	663.47	2.83	27.45	28.01	26.04	28.31	46.00
6 pp	925.76	3.63	29.93	27.19	25.12	31.49	46.00

Above 1GHz

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



Site : chamber

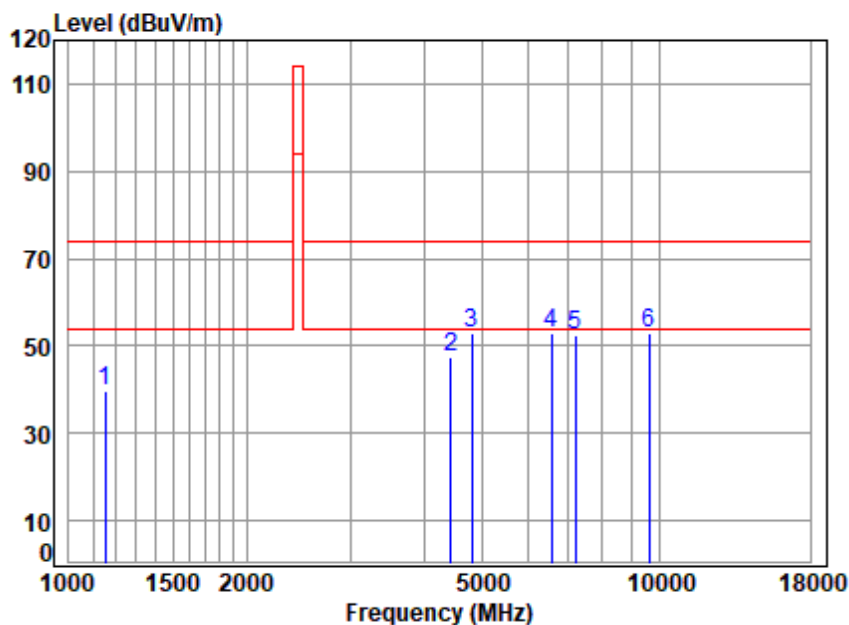
Condition: 3m HORIZONTAL

Job No : 19878CR

Mode : 2405 TX RSE

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1152.148	4.22	24.37	40.24	52.48	40.83	74.00	-33.17	peak
2	4430.628	7.48	33.48	42.50	48.13	46.59	74.00	-27.41	peak
3	4810.000	7.90	33.98	42.77	32.40	31.51	54.00	-22.49	Average
4	4810.000	7.90	33.98	42.77	64.72	63.83	74.00	-10.17	peak
5	6249.464	11.06	35.35	42.09	48.84	53.16	74.00	-20.84	peak
6	7215.000	10.07	36.08	41.57	24.68	29.26	54.00	-24.74	Average
7	7215.000	10.07	36.08	41.57	57.00	61.58	74.00	-12.42	peak
8	9620.000	10.75	37.67	38.56	16.64	26.50	54.00	-27.50	Average
9	9620.000	10.75	37.67	38.56	48.96	58.82	74.00	-15.18	peak

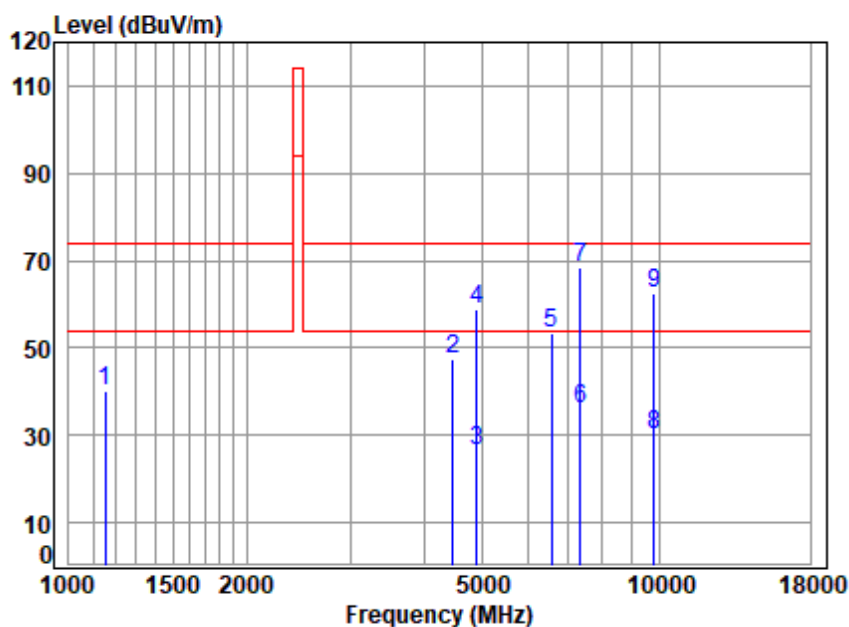
Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Site : chamber
Condition: 3m VERTICAL
Job No : 19878CR
Mode : 2405 TX RSE

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1152.148	4.22	24.37	40.24	51.51	39.86	74.00	-34.14	peak
2	4430.628	7.48	33.48	42.50	49.04	47.50	74.00	-26.50	peak
3	4810.000	7.90	33.98	42.77	54.00	53.11	74.00	-20.89	peak
4	6564.209	11.35	35.64	41.92	47.74	52.81	74.00	-21.19	peak
5	7215.000	10.07	36.08	41.57	48.05	52.63	74.00	-21.37	peak
6	9620.000	10.75	37.67	38.56	43.20	53.06	74.00	-20.94	peak

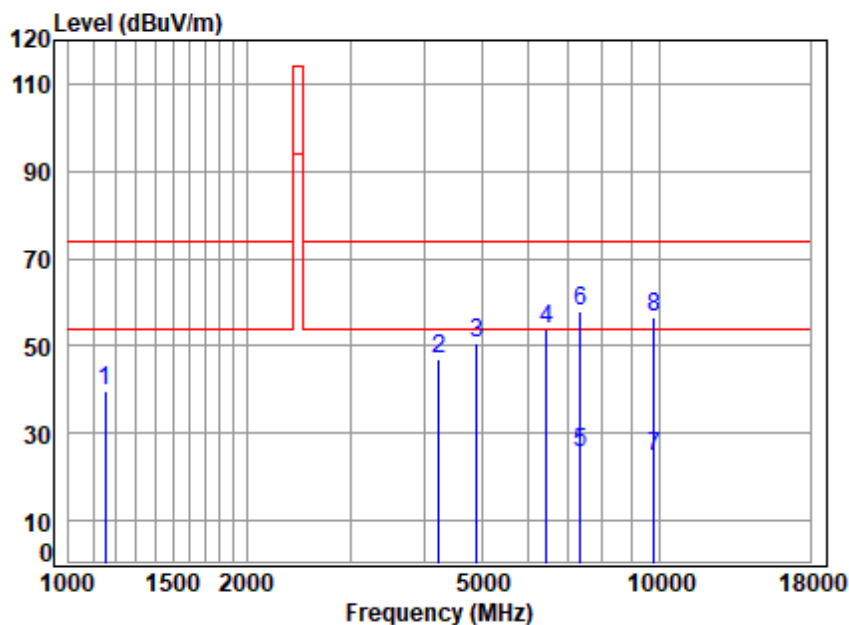
Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle



Site : chamber
Condition: 3m HORIZONTAL
Job No : 19878CR
Mode : 2451 TX RSE

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1152.148	4.22	24.37	40.24	51.93	40.28	74.00	-33.72	peak
2	4469.214	7.53	33.55	42.53	48.88	47.43	74.00	-26.57	peak
3	4902.000	7.99	34.09	42.83	27.44	26.69	54.00	-27.31	Average
4	4902.000	7.99	34.09	42.83	59.76	59.01	74.00	-14.99	peak
5	6564.209	11.35	35.64	41.92	48.40	53.47	74.00	-20.53	peak
6	7353.000	10.04	36.19	41.51	31.20	35.92	54.00	-18.08	Average
7	7353.000	10.04	36.19	41.51	63.52	68.24	74.00	-5.76	peak
8	9804.000	10.84	37.78	38.28	19.99	30.33	54.00	-23.67	Average
9	9804.000	10.84	37.78	38.28	52.31	62.65	74.00	-11.35	peak

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



```
Site      : chamber
Condition: 3m VERTICAL
Job No    : 19878CR
Mode      : 2451 TX RSE
```

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	
1152.148	4.22	24.37	40.24	51.28	39.63	74.00	-34.37	peak
4230.396	7.26	33.13	42.34	48.92	46.97	74.00	-27.03	peak
4902.000	7.99	34.09	42.83	51.34	50.59	74.00	-23.41	peak
6432.732	11.41	35.54	41.99	48.96	53.92	74.00	-20.08	peak
7353.000	10.04	36.19	41.51	20.86	25.58	54.00	-28.42	Average
7353.000	10.04	36.19	41.51	53.18	57.90	74.00	-16.10	peak
9804.000	10.84	37.78	38.28	14.14	24.48	54.00	-29.52	Average
9804.000	10.84	37.78	38.28	46.46	56.80	74.00	-17.20	peak

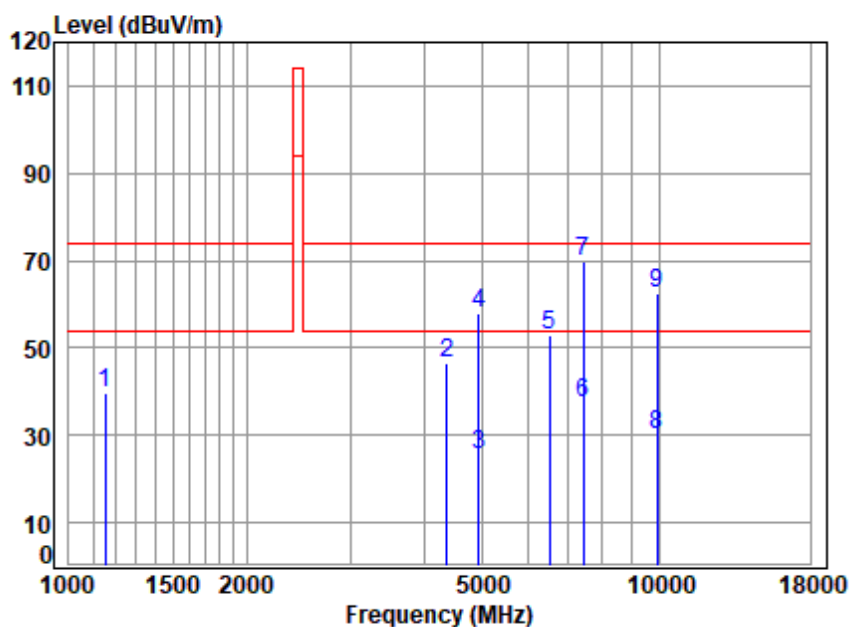


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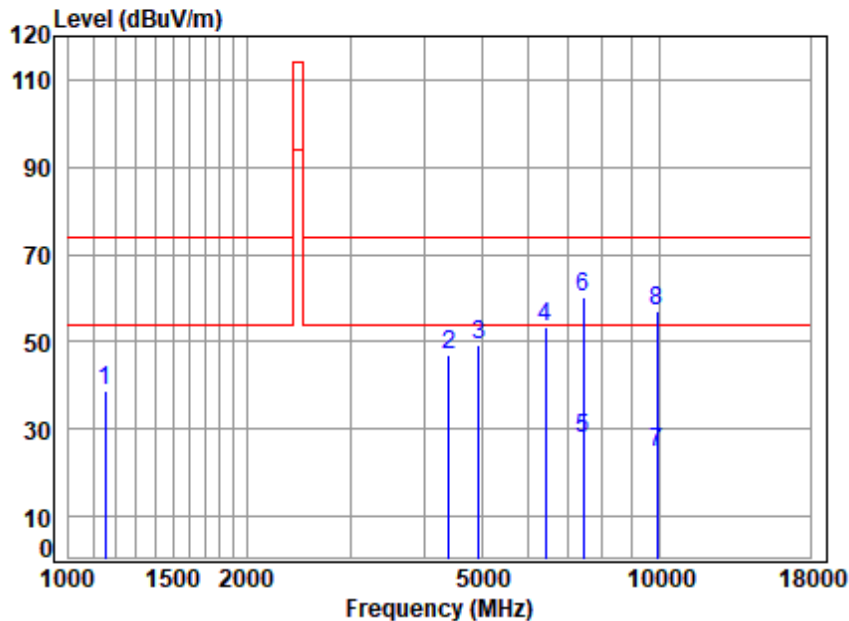
Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Site : chamber
Condition: 3m HORIZONTAL
Job No : 19878CR
Mode : 2475 TX RSE

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1152.148	4.22	24.37	40.24	51.22	39.57	74.00	-34.43	peak
2	4367.058	7.41	33.37	42.45	48.39	46.72	74.00	-27.28	peak
3	4950.000	8.04	34.14	42.87	26.15	25.46	54.00	-28.54	Average
4	4950.000	8.04	34.14	42.87	58.47	57.78	74.00	-16.22	peak
5	6526.373	11.46	35.62	41.94	47.72	52.86	74.00	-21.14	peak
6	7425.000	10.02	36.24	41.47	32.57	37.36	54.00	-16.64	Average
7	7425.000	10.02	36.24	41.47	64.89	69.68	74.00	-4.32	peak
8	9900.000	10.89	37.84	38.14	19.67	30.26	54.00	-23.74	Average
9	9900.000	10.89	37.84	38.14	51.99	62.58	74.00	-11.42	peak

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



Site : chamber

Condition: 3m VERTICAL

Job No : 19878CR

Mode : 2475 TX RSE

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1152.148	4.22	24.37	40.24	50.37	38.72	74.00	-35.28	peak
2	4405.090	7.46	33.44	42.48	48.58	47.00	74.00	-27.00	peak
3	4950.000	8.04	34.14	42.87	49.84	49.15	74.00	-24.85	peak
4	6414.167	11.38	35.52	42.00	48.36	53.26	74.00	-20.74	peak
5	7425.000	10.02	36.24	41.47	23.05	27.84	54.00	-26.16	Average
6	7425.000	10.02	36.24	41.47	55.37	60.16	74.00	-13.84	peak
7	9900.000	10.89	37.84	38.14	14.10	24.69	54.00	-29.31	Average
8	9900.000	10.89	37.84	38.14	46.42	57.01	74.00	-16.99	peak





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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