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Report No.: SZEM120200052201

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FCC REPORT

Application No. : SZEM1202000522RF
Applicant: HAIBOXING TOYS FACTORY
Product Name: LS-113-2.4G Digital Radio control System
Operation Frequency: 2408MHz to 2445MHz
FCC ID: SX2LS-113-24GT
Standards: FCC CFR Title 47 Part 15 Subpart C Section 15.249: 2010
Date of Receipt 2012-02-17
Date of Test 2012-03-20 to 2012-03-29
Date of Issue 2012-04-02

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

Authorized Signature:



Jack Zhang
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

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3 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203	Pass
Field strength of the fundamental signal	15.249 (a)	Pass
Spurious emissions	15.249 (a)/15.209	Pass
Band edge (Radiated Emission)	15.249(a)/15.205	Pass
20dB Occupied Bandwidth	15.215 (c)	Pass

Remark: Pass: The EUT complies with the essential requirements in the standard.

Fail: The EUT does not comply with the essential requirements in the standard.



4 General Information

4.1 Client Information

Applicant:	HAIBOXING TOYS FACTORY
Address of Applicant:	GUANGTOU INDUSTRIAL AREA, LONGTIAN GUANGYI STREET, CHENGHAI TOWN, SHANTOU CITY, GUANGDONG PROVINCE, CHINA

4.2 General Description of E.U.T.

Product Name:	LS-113-2.4G Digital Radio control System
Model No.:	LS-113-2.4GT, LS-207R, LS-3104-2.4GR Only the model LS-113-2.4GT was tested, since the electrical circuit design, layout, components used and internal wiring were identical for the above models, the differences were the model name, colour and appearance.
Operation Frequency:	2408MHz to 2445MHz
Modulation type:	GFSK
Antenna Type:	Integral
Antenna gain:	0dBi
Power supply:	4.5V DC (1.5V x 3 "AA" Size Batteries)

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	2408MHz
The middle channel	2423MHz
The highest channel	2445MHz





4.3 E.U.T Operation mode

Operating Environment:

Temperature:	24.0 °C
Humidity:	51 % RH
Atmospheric Pressure:	1015 mbar

Test mode:

Transmitting mode:	Keep the EUT in transmitting mode.
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4.4 Description of Support Units

The EUT has been tested as an independent unit.



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.
- **VCCI**
The 3m Semi-anechoic chamber, Full-anechoic Chamber and Shielded Room (7.5m x 4.0m x 3.0m) of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2197, G-416, T-1153 and C-2383 respectively.
- **FCC – Registration No.: 556682**
SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.: 556682.
- **Industry Canada (IC)**
The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1.

4.6 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch E&E Lab

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

Telephone: +86 (0) 755 2601 2053 Fax: +86 (0) 755 2671 0594

No tests were sub-contracted.

4.7 Other Information Requested by the Customer

None.



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4.8 Test Instruments list:

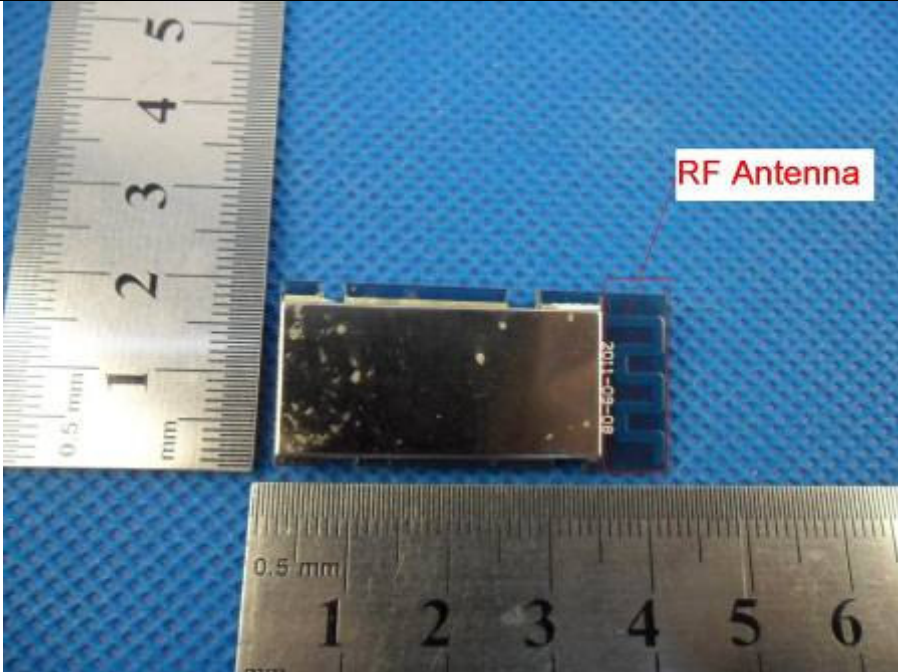
RE in Chamber					
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Due date (yyyy-mm-dd)
1	3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEL0017	2012-06-10
2	EMI Test Receiver	Rohde & Schwarz	ESIB26	SEL0023	2012-05-26
3	EMI Test software	AUDIX	E3	SEL0050	N/A
4	Coaxial cable	SGS	N/A	SEL0028	2012-05-29
5	BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEL0015	2012-10-29
6	Double-ridged horn (1-18GHz)	ETS-LINDGREN	3117	SEL0006	2012-10-29
7	Horn Antenna (18-26GHz)	ETS-LINDGREN	3160	SEL0076	2012-10-29
8	Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEL0053	2012-05-26
9	Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEL0168	2012-10-26
11	Band filter	Amindeon	82346	SEL0094	2012-05-26

General used equipment					
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Due date (yyyy-mm-dd)
1	Humidity/ Temperature Indicator	Shanghai	ZJ1-2B	SEL0102 to SEL0103	2012-10-27
2	Humidity/ Temperature Indicator	Shanghai	ZJ1-2B	SEL0101	2012-10-27
3	Barometer	ChangChun	DYM3	SEL0088	2012-05-18

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5 Test results and Measurement Data

5.1 Antenna requirement:

Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: <i>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.</i>	
E.U.T Antenna:	
The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.	
	



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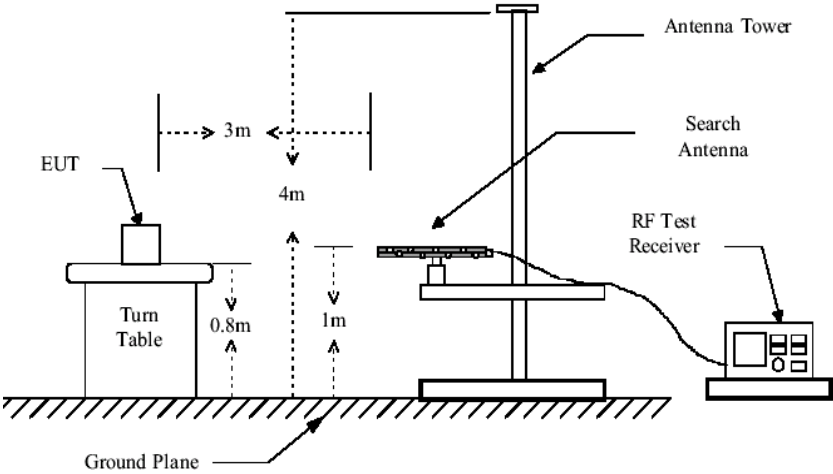
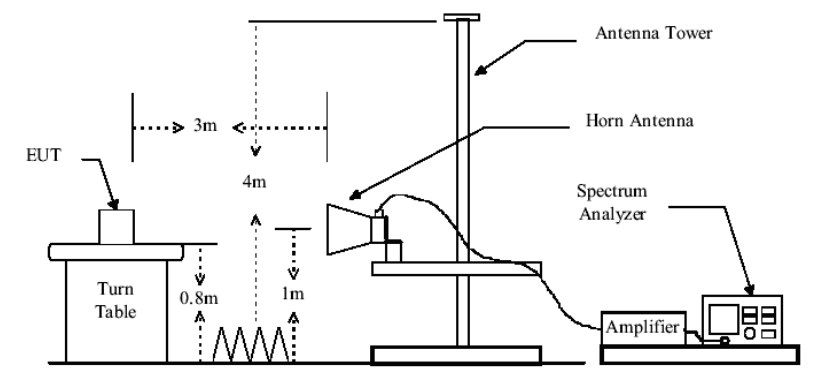
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5.2 Radiated Emission

Test Requirement:	FCC Part15 C Section 15.249 and 15.209				
Test Method:	ANSI C63.10: 2009				
Test Frequency Range:	30MHz to 25000MHz				
Test site:	Measurement Distance: 3m (Semi-Anechoic Chamber)				
Receiver setup:					
	Frequency	Detector	RBW	VBW	Remark
	30MHz-1GHz	Quasi-peak	100kHz	300kHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
Limit: (Field strength of the fundamental signal)					
	Frequency		Limit (dBuV/m @3m)		Remark
	2400MHz-2483.5MHz		94.0		Average Value
			114.0		Peak Value
Limit: (Spurious Emissions)					
	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
74.0			Peak Value		
Limit: (band edge)	Emissions 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.				
Test Procedure:	<div>a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.</div> <div>b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.</div> <div>c. 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.</div> <div>d. 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 and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.</div> <div>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</div> <div>f. 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.</div>				

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	g. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.
Test Instruments:	Refer to section 4.8 for details
Test setup:	<p>Below 1GHz</p>  <p>Above 1GHz</p> 
Test mode:	Transmitting mode
Test results:	Pass

Note:

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

$$\text{Final Test Level} = \text{Receiver Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Preamplifier Factor}$$



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Measurement Data

5.2.1 Field Strength Of The Fundamental Signal

Peak value:

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamplifier Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2408.000	2.99	32.54	39.86	103.61	99.28	114.00	-14.72	Horizontal
2408.000	2.99	32.54	39.86	105.68	101.35	114.00	-12.65	Vertical
2423.000	3.00	32.58	39.88	103.54	99.24	114.00	-14.76	Horizontal
2423.000	3.00	32.58	39.88	103.63	99.33	114.00	-14.67	Vertical
2445.000	3.01	32.61	39.89	103.49	99.22	114.00	-14.78	Horizontal
2445.000	3.01	32.61	39.89	104.66	100.39	114.00	-13.61	Vertical

Average value:

Frequency (MHz)	PDCF	Peak value (dBuV/m)	Average value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2408.000	-23.56	99.28	75.72	94.00	-18.28	Horizontal
2408.000	-23.56	101.35	77.79	94.00	-16.21	Vertical
2423.000	-23.56	99.24	75.68	94.00	-18.32	Horizontal
2423.000	-23.56	99.33	75.77	94.00	-18.23	Vertical
2445.000	-23.56	99.22	75.66	94.00	-18.34	Horizontal
2445.000	-23.56	100.39	76.83	94.00	-17.17	Vertical

Note:

Peak Level (Final Level)= Reading Level + Antenna Factor + Cable Loss - Preamplifier Factor

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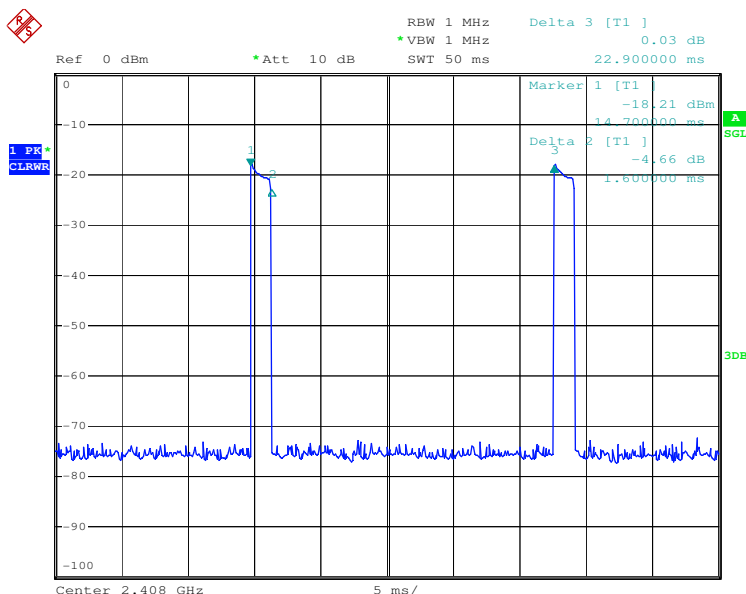
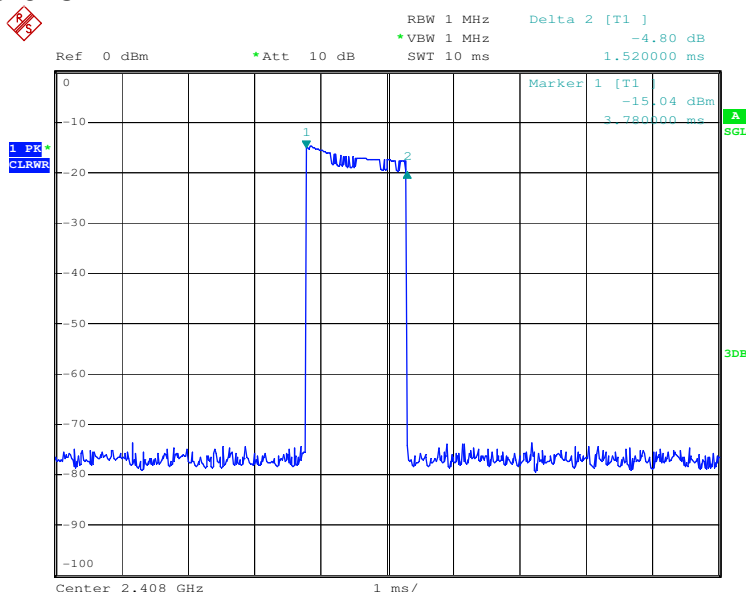
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Average value:	
Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)=-23.56
	Duty cycle= T on time/ T period
Test data:	Ton time =1.52ms
	T period =22.9ms

Test plot as follows:



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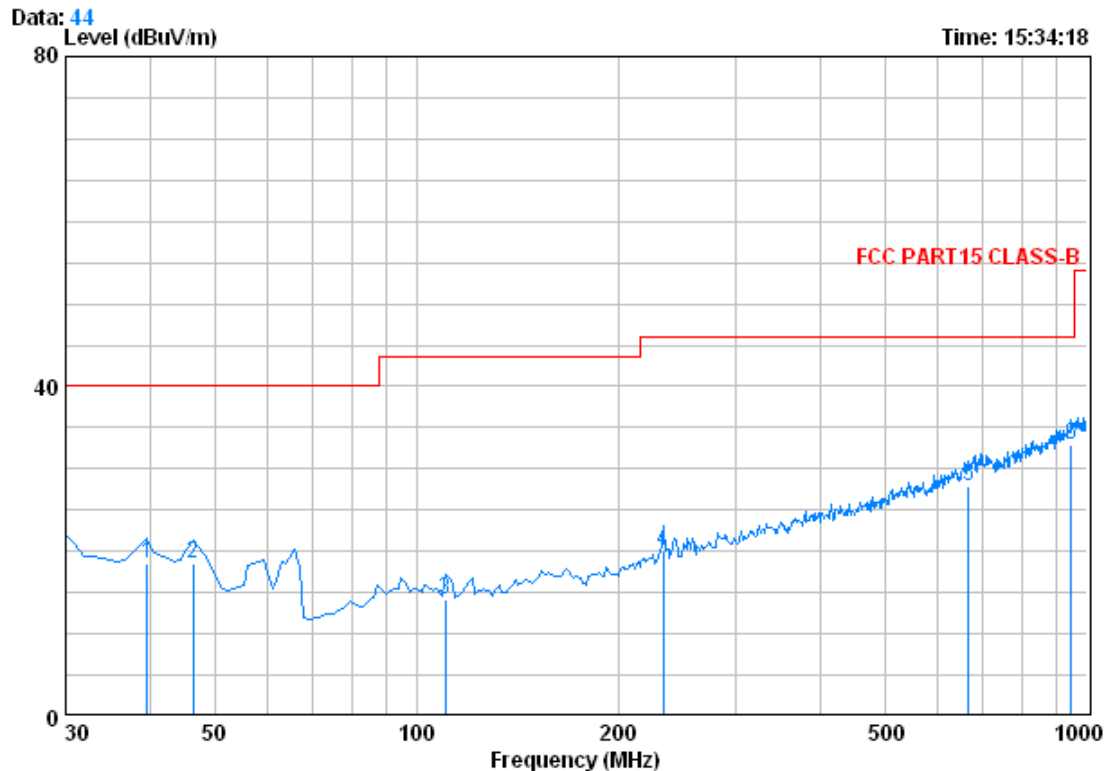
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5.2.2 Spurious Emissions

30MHz~1GHz

Vertical:

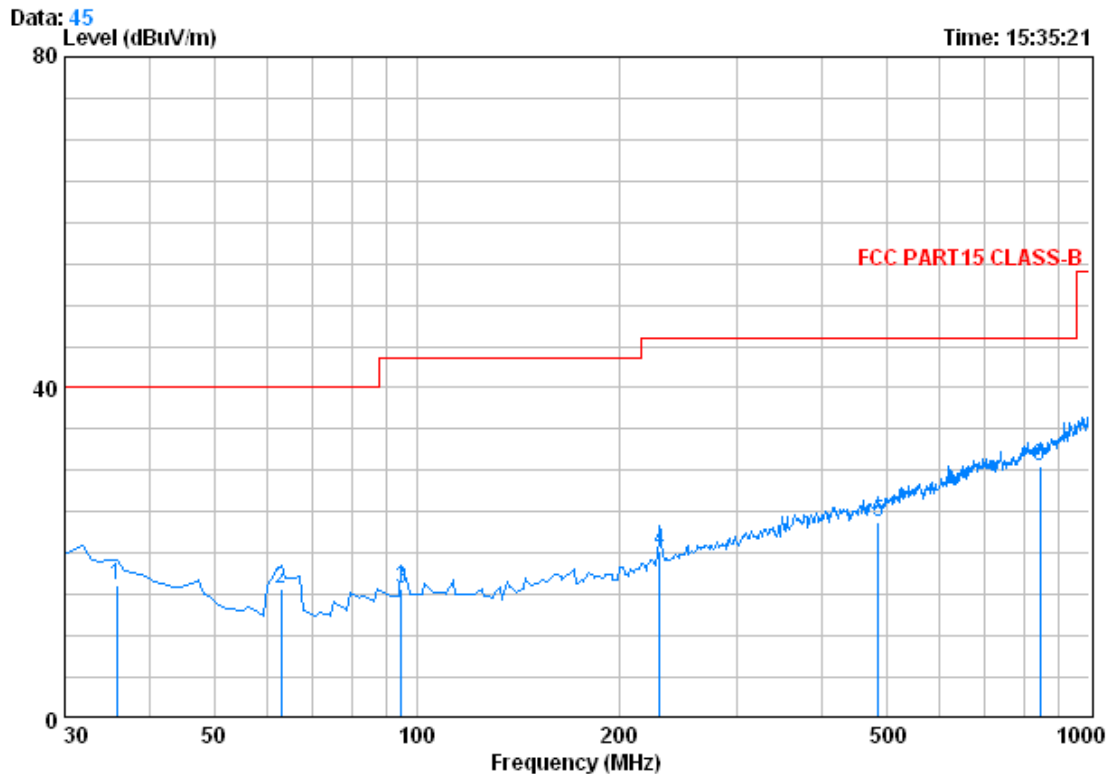


Condition : FCC PART15 CLASS-B 3m 0042673 VERTICAL
Job No. : 0522RF
Mode : TX SE

	Freq	Cable Loss	Antenna Factor	Preamplifier Factor	Read Level	Level	Limit	Over
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	39.700	0.60	11.30	27.32	34.00	18.58	40.00	-21.42
2	46.490	0.73	9.03	27.30	35.96	18.43	40.00	-21.57
3	110.510	1.23	8.57	27.13	31.59	14.26	43.50	-29.24
4	233.700	1.59	11.79	26.58	33.29	20.08	46.00	-25.92
5	665.350	2.84	21.16	27.45	31.35	27.89	46.00	-18.11
6 @	948.590	3.65	23.30	26.54	32.50	32.91	46.00	-13.09

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Horizontal:



Condition : FCC PART15 CLASS-B 3m 0042673 HORIZONTAL

Job No. : 0522RF

Mode : TX SE

	Freq	Cable Loss	Antenna Factor	Preamplifier Factor	Read Level	Level	Limit	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	35.820	0.60	12.80	27.33	30.05	16.12	40.00	-23.88
2	62.980	0.80	7.11	27.26	34.94	15.59	40.00	-24.41
3	94.990	1.15	8.91	27.21	32.74	15.59	43.50	-27.91
4	229.820	1.57	11.64	26.59	33.66	20.28	46.00	-25.72
5	485.900	2.55	17.80	27.64	31.01	23.72	46.00	-22.28
6	843.830	3.39	22.40	27.06	31.68	30.41	46.00	-15.59



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Above 1GHz								
Test mode:		Transmitting	Test channel:		Lowest	Remark:		Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
1514.252	2.52	28.22	39.36	50.14	41.52	74.00	-32.48	Vertical
3200.502	3.49	33.32	40.45	48.92	45.28	74.00	-28.72	Vertical
4821.757	4.70	34.68	41.64	63.72	61.46	74.00	-12.54	Vertical
5850.919	5.07	35.45	41.06	50.62	50.08	74.00	-23.92	Vertical
6974.358	5.50	35.83	40.08	50.39	51.64	74.00	-22.36	Vertical
10480.590	6.09	38.28	37.65	48.08	54.80	74.00	-19.20	Vertical
1257.465	2.36	27.67	39.25	47.52	38.30	74.00	-35.70	Horizontal
1993.395	2.84	31.68	39.56	49.69	44.65	74.00	-29.35	Horizontal
3561.636	3.79	33.28	40.72	48.77	45.12	74.00	-28.88	Horizontal
4821.757	4.70	34.68	41.64	60.44	58.18	74.00	-15.82	Horizontal
7880.772	6.21	36.00	39.29	49.77	52.69	74.00	-21.31	Horizontal
11027.980	6.23	38.49	37.88	46.84	53.68	74.00	-20.32	Horizontal

Test mode:		Transmitting	Test channel:		Middle	Remark:		Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
1672.296	2.63	29.46	39.42	46.65	39.32	74.00	-34.68	Vertical
3445.704	3.69	33.22	40.63	48.55	44.83	74.00	-29.17	Vertical
4834.046	4.71	34.65	41.65	58.94	56.65	74.00	-17.35	Vertical
6478.053	5.25	36.26	40.51	49.56	50.56	74.00	-23.44	Vertical
8792.365	6.17	36.43	38.50	47.03	51.13	74.00	-22.87	Vertical
11692.920	6.39	38.59	38.15	46.91	53.74	74.00	-20.26	Vertical
1273.572	2.37	27.70	39.25	46.51	37.33	74.00	-36.67	Horizontal
1764.123	2.69	30.07	39.46	47.93	41.23	74.00	-32.77	Horizontal
4834.046	4.71	34.65	41.65	56.52	54.23	74.00	-19.77	Horizontal
6956.627	5.48	35.85	40.08	49.21	50.46	74.00	-23.54	Horizontal
9370.083	6.05	37.03	37.99	46.99	52.08	74.00	-21.92	Horizontal
11963.890	6.46	38.87	38.26	48.05	55.12	74.00	-18.88	Horizontal

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Test mode:		Transmitting		Test channel:		Highest		Remark:	Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization	
1364.182	2.43	27.85	39.29	47.39	38.38	74.00	-35.62	Vertical	
3184.250	3.47	33.33	40.44	49.11	45.47	74.00	-28.53	Vertical	
4883.519	4.72	34.59	41.68	62.20	59.83	74.00	-14.17	Vertical	
7394.878	6.00	35.96	39.71	49.08	51.33	74.00	-22.67	Vertical	
10113.670	6.00	37.84	37.50	46.22	52.56	74.00	-21.44	Vertical	
11933.470	6.45	38.83	38.24	48.83	55.87	74.00	-18.13	Vertical	
1173.943	2.30	27.51	39.21	47.04	37.64	74.00	-36.36	Horizontal	
3216.838	3.50	33.32	40.47	49.54	45.89	74.00	-28.11	Horizontal	
4883.519	4.72	34.59	41.68	63.06	60.69	74.00	-13.31	Horizontal	
6283.164	5.20	36.04	40.68	49.78	50.34	74.00	-23.66	Horizontal	
7470.558	6.08	35.99	39.64	49.53	51.96	74.00	-22.04	Horizontal	
9935.053	5.98	37.65	37.52	47.21	53.32	74.00	-20.68	Horizontal	

Remark:

As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits.

For harmonic emissions (pulse signal) , Average value=Peak value + PDCF

PDCF < Average limte-Peak limit = -20dB,and the peak value complies with the peak limit, so deems to the Average value complies with the average limit.



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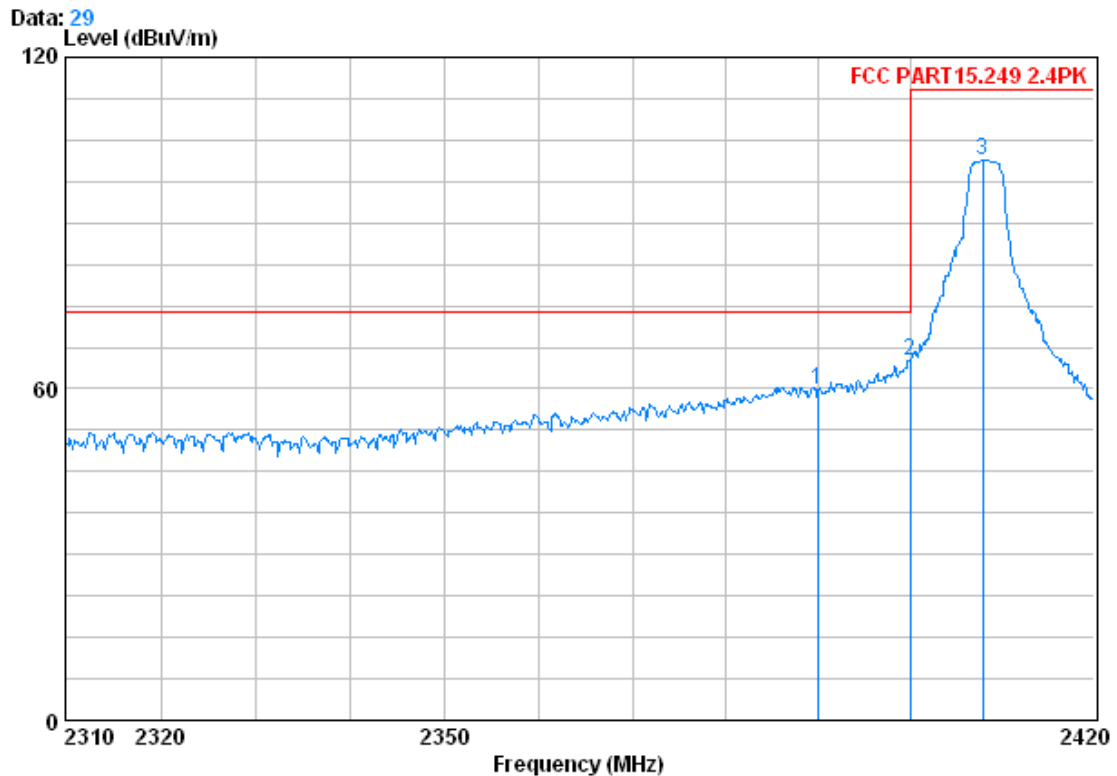
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5.2.3 Band edge (Radiated Emission)

Test mode:	Transmitting	Test channel:	Lowest	Remark:	Peak
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Vertical:

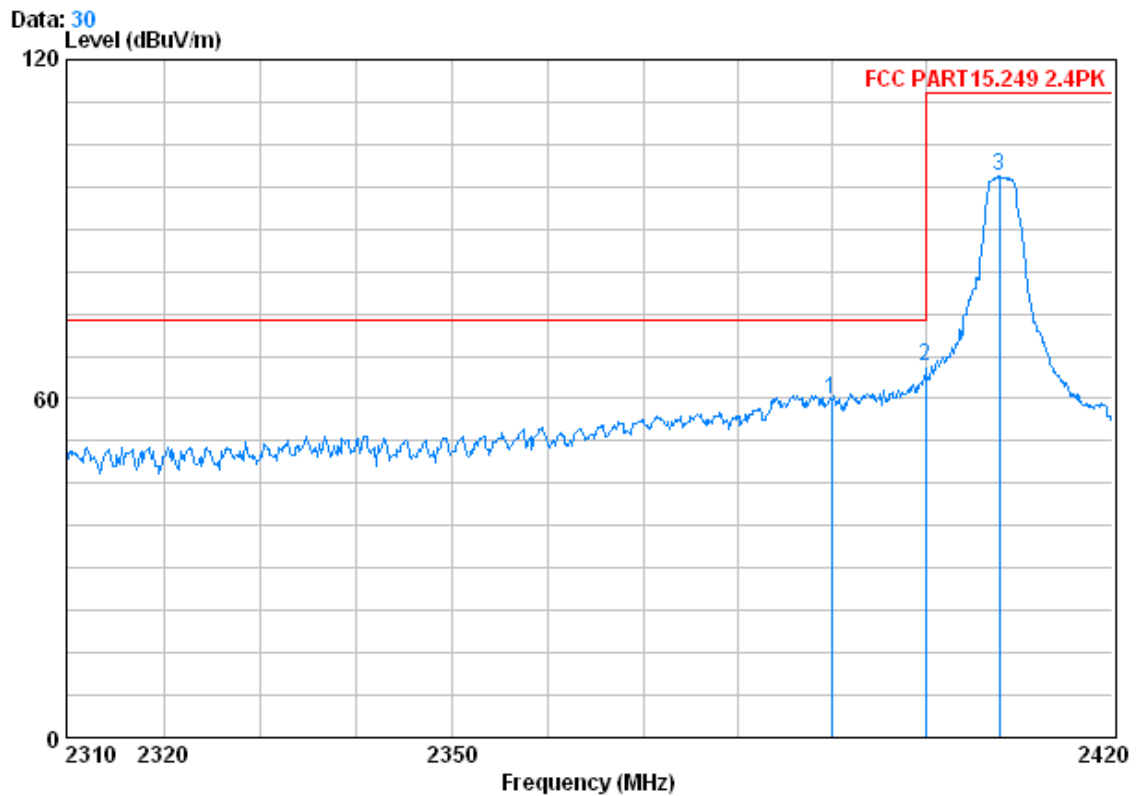


Condition : FCC PART15.249 2.4PK 3m VERTICAL
Job No. : 0522RF
test mode : low channel

		CableAntenna	Preamplifier	Read	Limit	Over
	Freq	Loss Factor	Factor	Level	Line	Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m
1	2390.000	2.98	32.51	39.85	64.17	59.82
2	2400.000	2.98	32.51	39.86	69.57	65.20
3	2407.900	2.99	32.54	39.86	105.68	101.35

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Horizontal:



Condition : FCC PART15.249 2.4PK 3m HORIZONTAL
Job No. : 0522RF
test mode : low channel

		Cable&Antenna		Preamplifier	Read		Limit	Over
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2390.000	2.98	32.51	39.85	64.10	59.75	74.00	-14.25
2	2400.000	2.98	32.51	39.86	70.17	65.80	74.00	-8.20
3	2407.900	2.99	32.54	39.86	103.61	99.28	114.00	-14.72



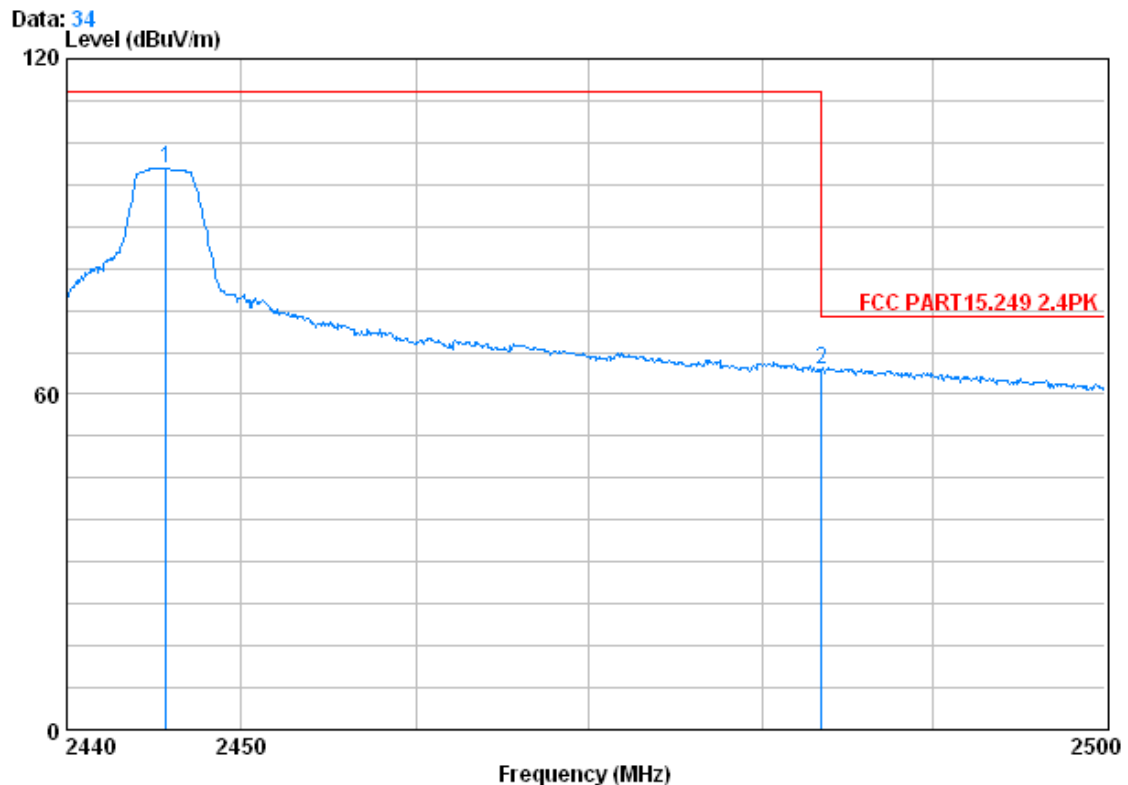
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Test mode:	Transmitting	Test channel:	Highest	Remark:	Peak
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Vertical:



Condition : FCC PART 15.249 2.4PK 3m VERTICAL

Job No. : 0522RF

test mode : high channel

		CableAntenna Preamp			Read		Limit	Over
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2445.700	3.01	32.61	39.89	104.66	100.39	114.00	-13.61
2	2483.500	3.03	32.67	39.92	68.70	64.48	74.00	-9.52

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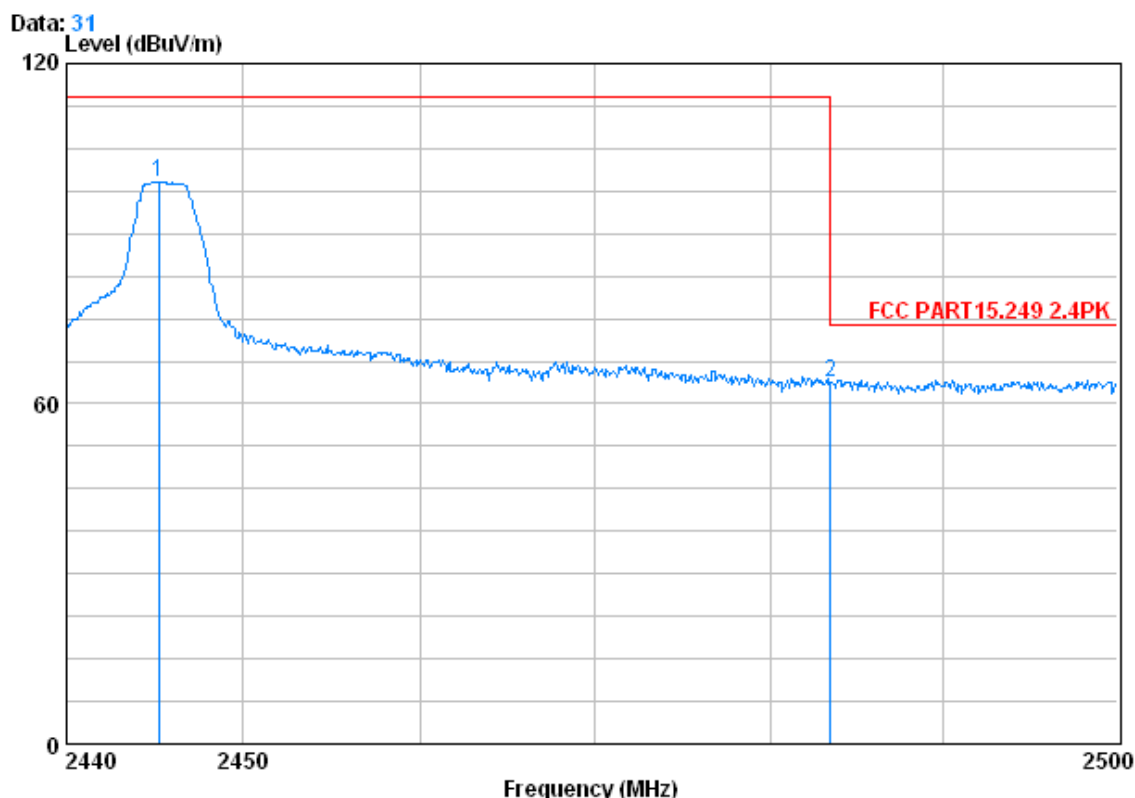


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Horizontal:



Condition : FCC PART15.249 2.4PK 3m HORIZONTAL

Job No. : 0522RF

test mode : high channel

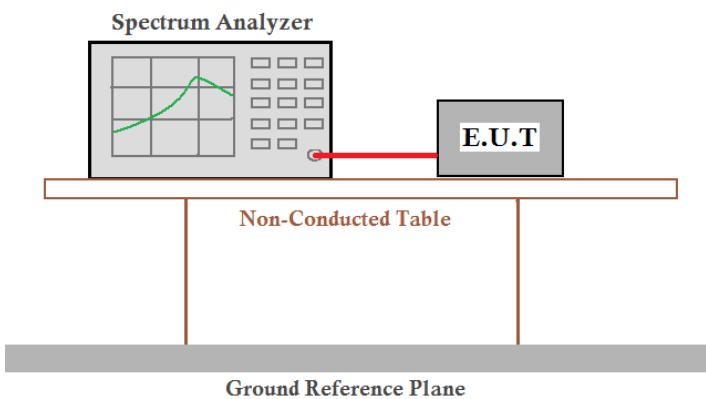
		CableAntenna		Preamp	Read		Limit	Over
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2445.220	3.01	32.61	39.89	103.49	99.22	114.00	-14.78
2	2483.500	3.03	32.67	39.92	67.92	63.70	74.00	-10.30

For band-edge radiated emissions (pulse signal) , Average value=Peak value + PDCF

PDCF < Average limte-Peak limit = -20dB,and the peak value complies with the peak limit, so deems to the Average value complies with the average limit.

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5.3 20dB Bandwidth

Test Requirement:	FCC Part15 C Section 15.249/15.215
Test Method:	ANSI C63.10:2009
Receiver setup:	RBW=30kHz, VBW=100kHz, detector: Peak
Limit:	Operation Frequency range 2400MHz-2483.5MHz
Test Procedure:	<ol style="list-style-type: none"> 1. According to the follow Test-setup, keep the relative position between the artificial antenna and the EUT. 2. Set the EUT to proper test channel. 3. Max hold the radiated emissions, mark the peak power frequency point and the -20dB upper and lower frequency points. 4. Read 20dB bandwidth.
Test setup:	 <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Electronic Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by two vertical legs. Below the table is a Ground Reference Plane, represented by a thick grey bar.</p>
Test Instruments:	Refer to section 4.8 for details
Test mode:	Transmitting mode
Test results:	Pass

Measurement Data

Test channel	20dB bandwidth (kHz)	Results
Lowest	131	Pass
Middle	137	Pass
Highest	144	Pass



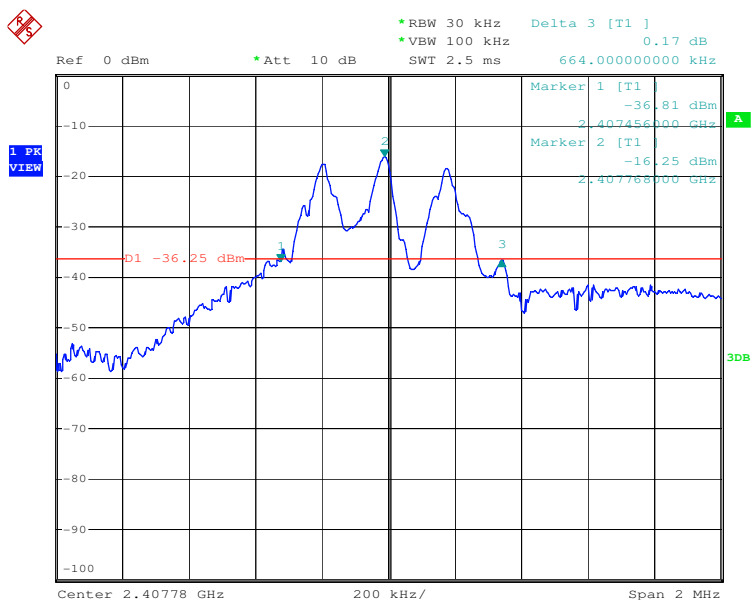
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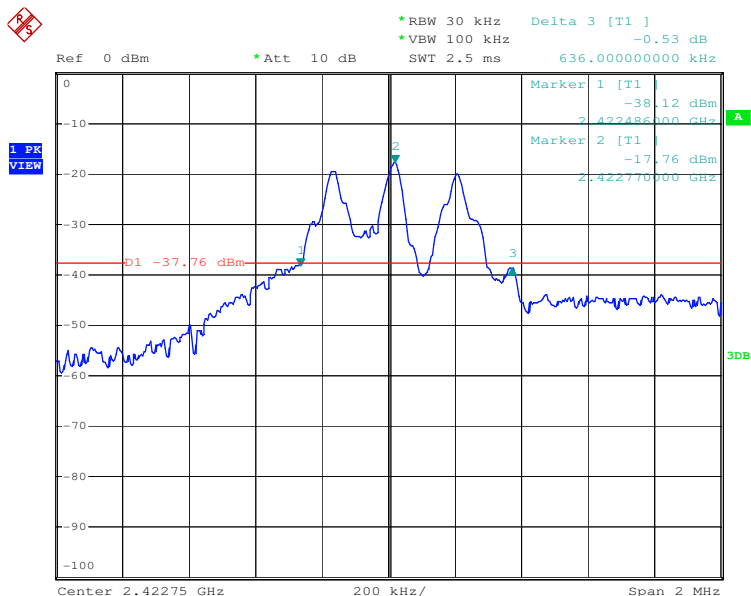
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Test plot as follows:

Test channel:	Lowest	
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Test channel:	Middle	
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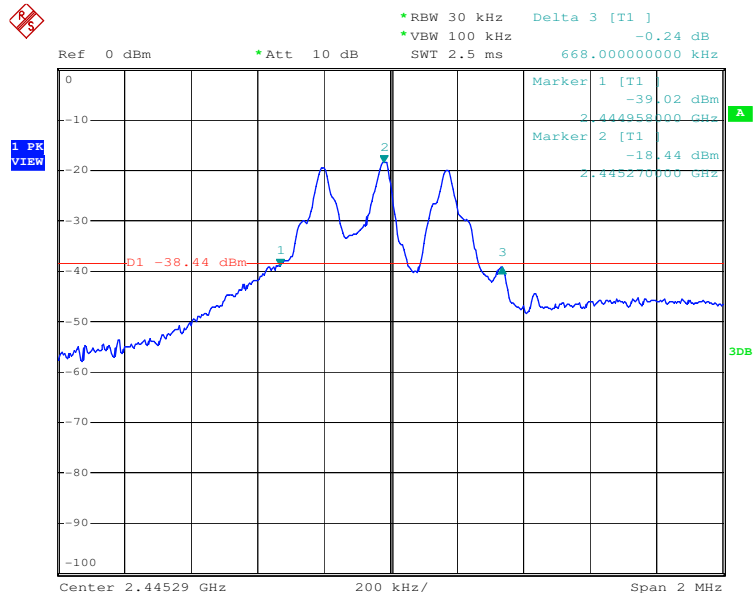


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Test channel:	Highest	
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