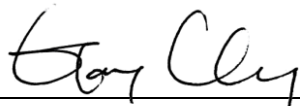


FCC Test Report

FCC ID : ZHK-62250-01
Equipment : SENSEI WIRELESS LASER MOUSE
Model No. : 62250-01
Brand Name : STEELSERIES
Applicant : SteelSeries ApS
Address : Suite 2E, 656 West Randolph Street, , IL.
Chicago,IL 60661
Standard : 47 CFR FCC Part 15.249
Received Date : Jan. 24, 2014
Tested Date : Jan. 27 ~ Jan. 28, 2014

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Approved & Reviewed by:



Gary Chang / Manager



Testing Laboratory
2732

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Release Record

Report No.	Version	Description	Issued Date
FR412403	Rev. 01	Initial issue	Feb. 24, 2014

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emissions	N/A	N/A
15.249(a)	Field Strength of Fundamental	Meet the requirement of limit	Pass
15.249(a)(d)	Field Strength of Harmonics and Emissions Radiated outside of the Specified Frequency Bands	Meet the requirement of limit	Pass
15.215(c)	20dB bandwidth	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass
Note: AC power line conducted emissions test is not performed since the EUT consumes DC power from battery.			

1 General Description

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Modulation	Ch. Freq. (MHz)	Channel Number	Channel Bandwidth (MHz)
2400-2483.5	GFSK	2404-2479	1-26 [26]	1

1.1.2 Antenna Details

Ant. No.	Type	Gain (dBi)	Connector
1	Printed	-2.37	N/A

1.1.3 EUT Operational Condition

Power Supply Type	3.7Vdc from battery.
--------------------------	----------------------

Note: The equipment tests are performed using a new battery.

1.1.4 Accessories

Accessories		
No.	Equipment	Description
1	Lithium Ion Polymer Rechargeable Battery	Brand Name: RPC Corporation Model Name: AE1102338P8HS Power Rating: 3.7Vdc, 950mAh

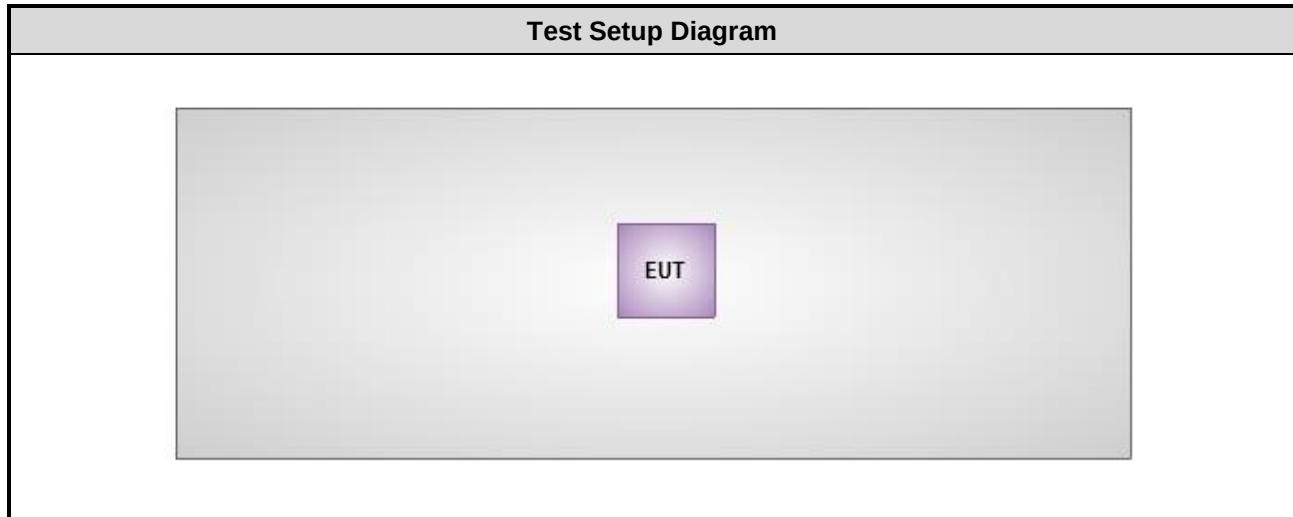
1.1.5 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2404	8	2425	15	2446	22	2467
2	2407	9	2428	16	2449	23	2470
3	2410	10	2431	17	2452	24	2473
4	2413	11	2434	18	2455	25	2476
5	2416	12	2437	19	2458	26	2479
6	2419	13	2440	20	2461	-	-
7	2422	14	2443	21	2464	-	-

1.2 Local Support Equipment List

Support Equipment List						
No.	Equipment	Brand	Model	S/N	FCC ID	Signal cable / Length (m)
1	---	---	---	---	---	---

1.3 Test Setup Chart



1.4 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber 2 / (03CH02-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101498	Jan. 25, 2014	Jan. 24, 2015
Receiver	R&S	ESR3	101657	Jan. 18, 2014	Jan. 17, 2015
Bilog Antenna	Schwarzbeck	VULB9168	VULB9168-524	Jan. 08, 2014	Jan. 07, 2015
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120D	BBHA 9120 D 1095	Jan. 07, 2014	Jan. 06, 2015
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Dec. 27, 2013	Dec. 26, 2014
Amplifier	Burgeon	BPA-530	100218	Dec. 09, 2013	Dec. 08, 2014
Amplifier	Agilent	83017A	MY39501309	Dec. 09, 2013	Dec. 08, 2014
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16140/4	Dec. 17, 2013	Dec. 16, 2014
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Dec. 17, 2013	Dec. 16, 2014
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16015/4	Dec. 17, 2013	Dec. 16, 2014
RF Cable-R03m	Woken	CFD400NL-LW	CFD400NL-003	Dec. 17, 2013	Dec. 16, 2014
RF Cable-R10m	Woken	CFD400NL-LW	CFD400NL-004	Dec. 17, 2013	Dec. 16, 2014
control	EM Electronics	EM1000	060608	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

Loop Antenna	R&S	HFH2-Z2	100330	Nov. 15, 2012	Nov. 14, 2014
Amplifier	EM	EM18G40G	060572	Jun. 20, 2013	Jun. 19, 2015
Note: Calibration Interval of instruments listed above is two year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV 40	101063	Feb. 18, 2013	Feb. 17, 2014
Power Meter	Anritsu	ML2495A	1241002	Oct. 24, 2013	Oct. 23, 2014
Power Sensor	Anritsu	MA2411B	1027366	Oct. 24, 2013	Oct. 23, 2014
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.249

ANSI C63.10-2009

Note: The EUT has been tested and complied with FCC part 15B requirement. FCC Part 15B test results are issued to another report.

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ($k=2$))

Measurement Uncertainty	
Parameters	Uncertainty
AC conducted emission	± 2.43 dB
Radiated emission	± 2.49 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH02-WS	25°C / 65%	Anderson Hong
RF Conducted	TH01-WS	25°C / 65%	Anderson Hong

➤ FCC site registration No.: 657002

➤ IC site registration No.: 10807A-2

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Test Configuration
Field Strength of Fundamental	GFSK	2404, 2440, 2479	---
Radiated Emissions (below 1GHz)	GFSK	2440	---
Radiated Emissions (Above 1GHz)	GFSK	2404, 2440, 2479	---
20dB bandwidth	GFSK	2404, 2440, 2479	---

3 Transmitter Test Results

3.1 Radiated Emission

This section includes field strength of fundamental, field strength of harmonics and emissions radiated outside of the operating frequency bands.

3.1.1 Limit of field strength of fundamental and field strength of harmonics

Fundamental Frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	50
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

3.1.2 Limit of Unwanted Emissions

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 §15.209, whichever is the lesser attenuation.

Radiated emission limits in §15.209			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:

Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:

Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.1.3 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at a height of 0.8 m test table above the ground plane.
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

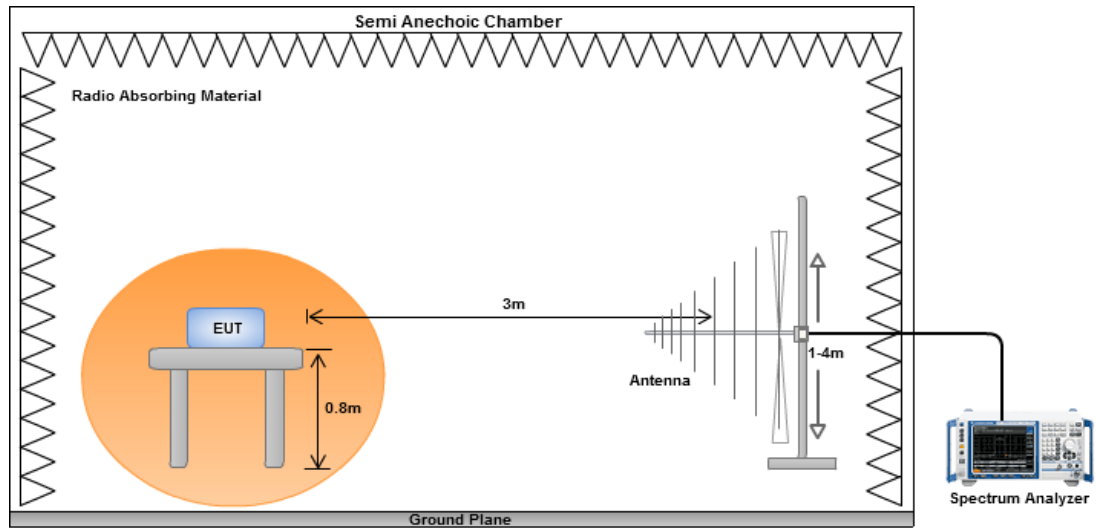
Note:

1. Radiated emission below 1GHz
120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission
2. Radiated emission above 1GHz / Peak value except fundamental
RBW=1MHz, VBW=3MHz and Peak detector
Radiated emission above 1GHz / Average value
The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula:
3.
$$20\log (\text{Duty cycle}) = 20\log \frac{25 * 0.23478 \text{ ms}}{100 \text{ ms}} = -24.63\text{dB}$$

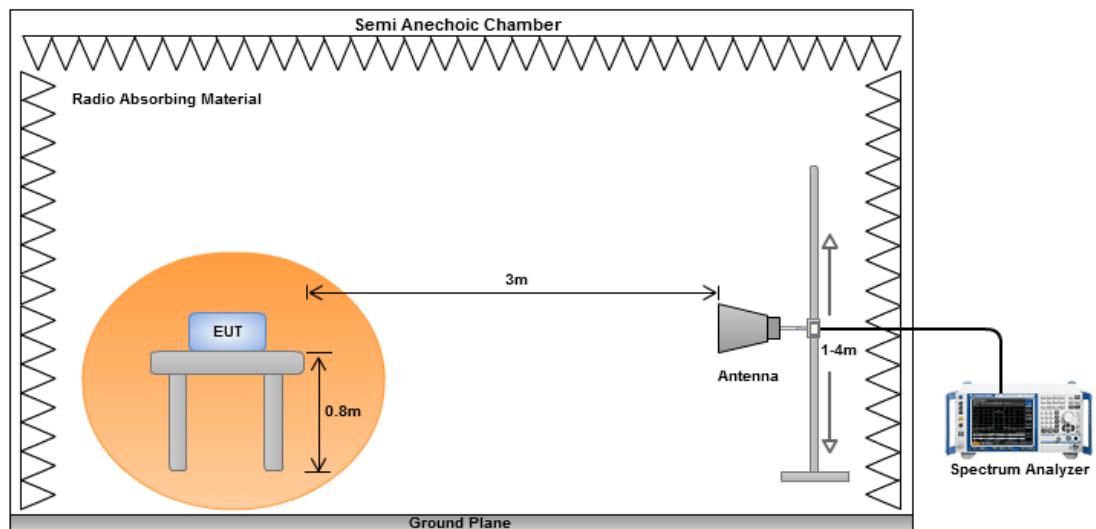
Please see page 21 for plotted duty
4. Radiated emission above 1GHz / Average value for other emissions
RBW=1MHz, VBW=10Hz and Peak detector
5. Radiated emission Peak value for fundamental
RBW=3MHz, VBW=10MHz and Peak detector

3.1.4 Test Setup

Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



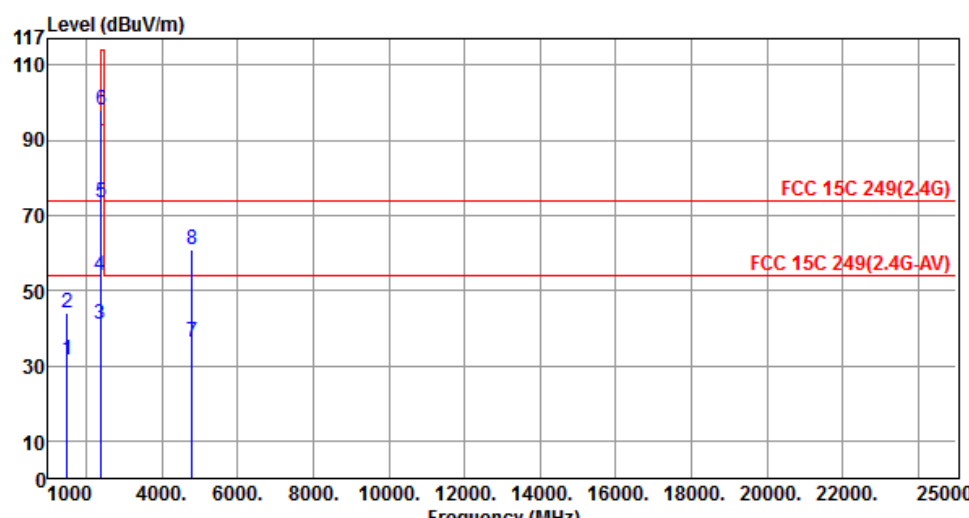
3.1.5 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Horizontal		
Level (dBuV/m) </			

Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Vertical		
Level (dBuV/m)			

3.1.1 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation	GFSK	Test Freq. (MHz)	2404
Polarization	Horizontal		



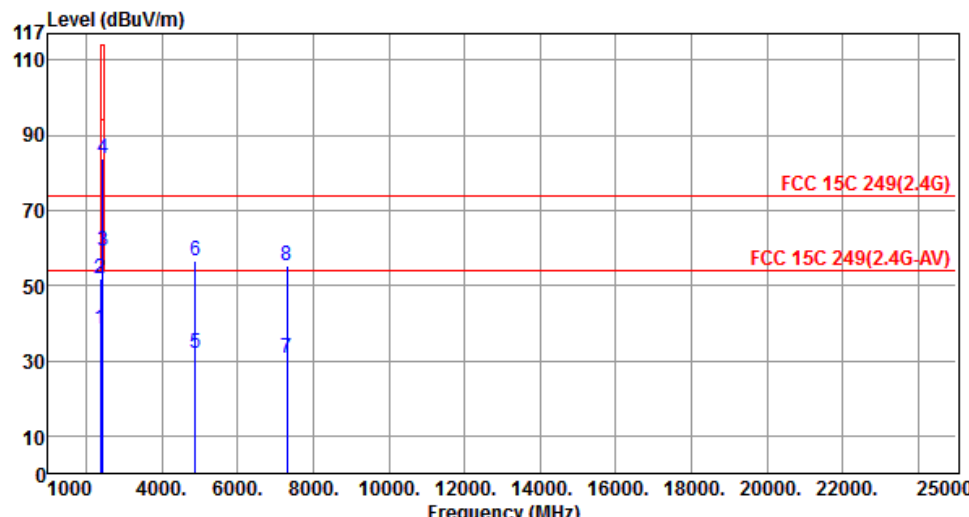
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1500.00	31.35	54.00	-22.65	37.82	-6.47	Average	---	---
2	1500.00	44.17	74.00	-29.83	50.64	-6.47	Peak	---	---
3	2390.00	40.92	54.00	-13.08	43.74	-2.82	Average	---	---
4	2390.00	54.09	74.00	-19.91	56.91	-2.82	Peak	---	---
5	2404.00	73.41	94.00	-20.59	76.16	-2.75	Average	---	---
6	2404.00	98.04	114.00	-15.96	100.79	-2.75	Peak	---	---
7	4808.00	36.16	54.00	-17.84	31.11	5.05	Average	---	---
8	4808.00	60.79	74.00	-13.21	55.74	5.05	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	GFSK	Test Freq. (MHz)	2404																																																																																										
Polarization	Vertical																																																																																												
Level (dBuV/m) 117 110 90 70 50 30 10 0 1000 2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 25000 Frequency (MHz) 1 2 3 4 5 6 7 8 1500.00 2390.00 2404.00 4808.00 28.14 40.55 38.74 52.17 58.54 83.17 32.35 56.98 54.00 74.00 74.00 54.00 94.00 114.00 54.00 74.00 -25.86 -33.45 -15.26 -21.83 -35.46 -30.83 -21.65 -17.02 34.61 47.02 41.56 54.99 61.29 85.92 27.30 51.93 -6.47 -6.47 -2.82 -2.82 -2.75 -2.75 5.05 5.05 Average Peak Average Peak Average Peak Average Peak --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- FCC 15C 249(2.4G) FCC 15C 249(2.4G-AV) <table><tr><th></th><th>Freq. MHz</th><th>Emission level dBuV/m</th><th>Limit dBuV/m</th><th>Margin dB</th><th>SA reading dBuV</th><th>Factor dB</th><th>Remark</th><th>ANT High cm</th><th>Turn Table deg</th></tr><tr><td>1</td><td>1500.00</td><td>28.14</td><td>54.00</td><td>-25.86</td><td>34.61</td><td>-6.47</td><td>Average</td><td>---</td><td>---</td></tr><tr><td>2</td><td>1500.00</td><td>40.55</td><td>74.00</td><td>-33.45</td><td>47.02</td><td>-6.47</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>3</td><td>2390.00</td><td>38.74</td><td>54.00</td><td>-15.26</td><td>41.56</td><td>-2.82</td><td>Average</td><td>---</td><td>---</td></tr><tr><td>4</td><td>2390.00</td><td>52.17</td><td>74.00</td><td>-21.83</td><td>54.99</td><td>-2.82</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>5</td><td>2404.00</td><td>58.54</td><td>94.00</td><td>-35.46</td><td>61.29</td><td>-2.75</td><td>Average</td><td>---</td><td>---</td></tr><tr><td>6</td><td>2404.00</td><td>83.17</td><td>114.00</td><td>-30.83</td><td>85.92</td><td>-2.75</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>7</td><td>4808.00</td><td>32.35</td><td>54.00</td><td>-21.65</td><td>27.30</td><td>5.05</td><td>Average</td><td>---</td><td>---</td></tr><tr><td>8</td><td>4808.00</td><td>56.98</td><td>74.00</td><td>-17.02</td><td>51.93</td><td>5.05</td><td>Peak</td><td>---</td><td>---</td></tr></table>					Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg	1	1500.00	28.14	54.00	-25.86	34.61	-6.47	Average	---	---	2	1500.00	40.55	74.00	-33.45	47.02	-6.47	Peak	---	---	3	2390.00	38.74	54.00	-15.26	41.56	-2.82	Average	---	---	4	2390.00	52.17	74.00	-21.83	54.99	-2.82	Peak	---	---	5	2404.00	58.54	94.00	-35.46	61.29	-2.75	Average	---	---	6	2404.00	83.17	114.00	-30.83	85.92	-2.75	Peak	---	---	7	4808.00	32.35	54.00	-21.65	27.30	5.05	Average	---	---	8	4808.00	56.98	74.00	-17.02	51.93	5.05	Peak	---	---
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Modulation	GFSK	Test Freq. (MHz)	2440																																																																																																														
Polarization	Horizontal																																																																																																																
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	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn																																																																																																								
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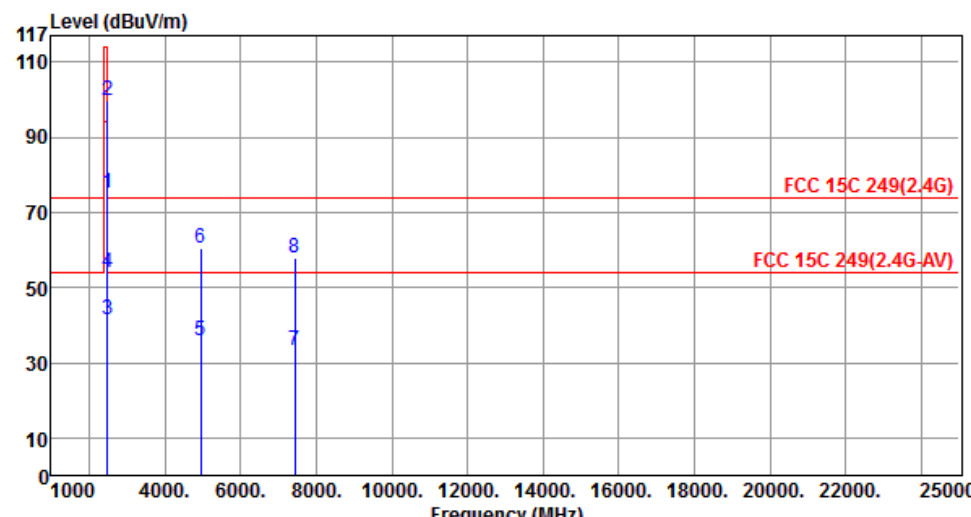
Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	38.33	54.00	-15.67	41.15	-2.82	Average	---	---
2	2390.00	51.62	74.00	-22.38	54.44	-2.82	Peak	---	---
3	2440.00	59.20	94.00	-34.80	61.80	-2.60	Average	---	---
4	2440.00	83.83	114.00	-30.17	86.43	-2.60	Peak	---	---
5	4880.00	31.80	54.00	-22.20	26.61	5.19	Average	---	---
6	4880.00	56.43	74.00	-17.57	51.24	5.19	Peak	---	---
7	7320.00	30.53	54.00	-23.47	19.79	10.74	Average	---	---
8	7320.00	55.16	74.00	-18.84	44.42	10.74	Peak	---	---

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	GFSK	Test Freq. (MHz)	2479
Polarization	Horizontal		



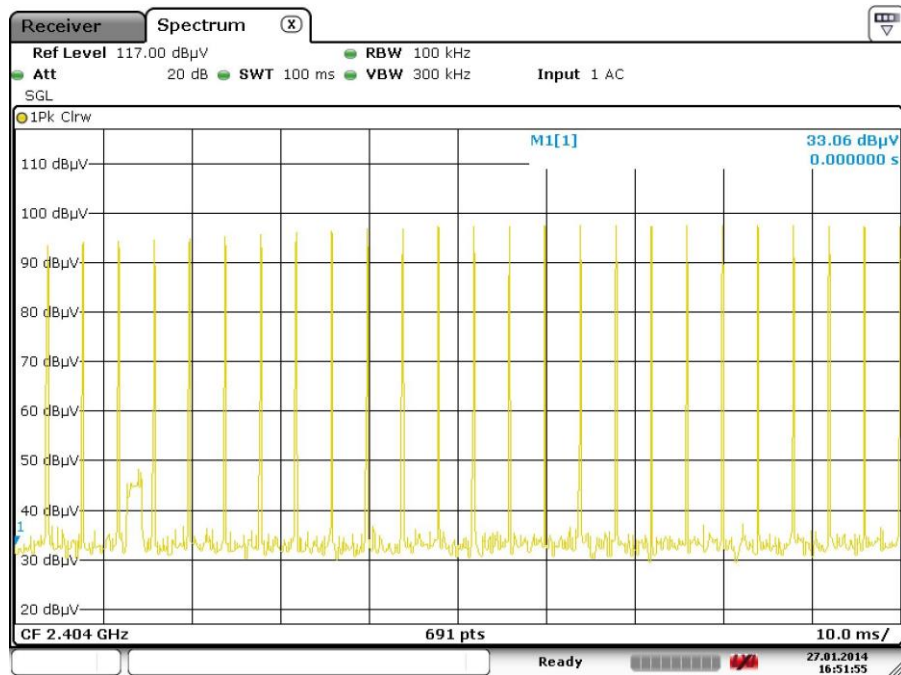
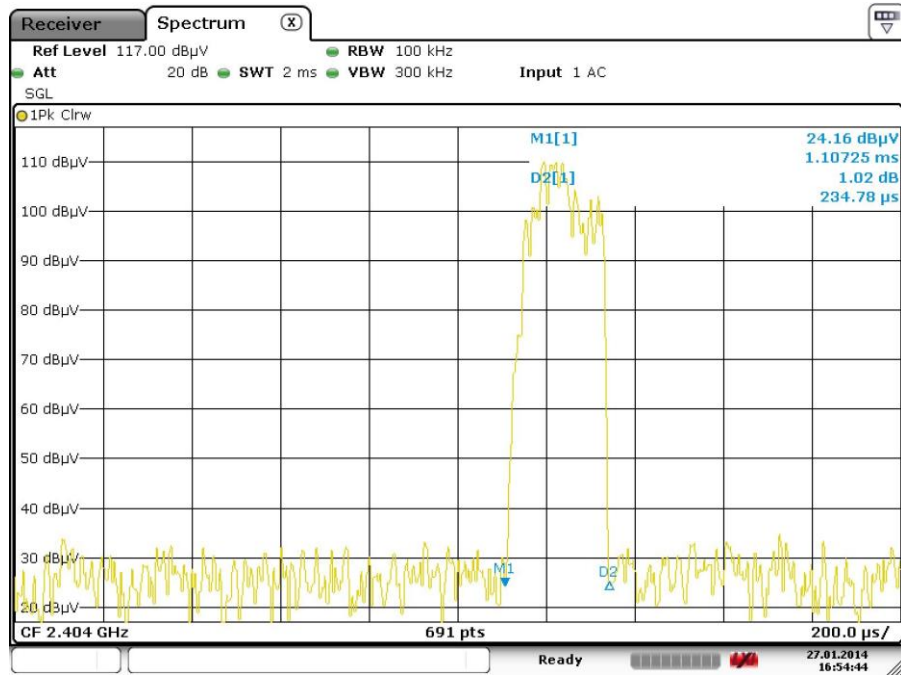
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2479.00	75.04	94.00	-18.96	77.45	-2.41	Average	---	---
2	2479.00	99.67	114.00	-14.33	102.08	-2.41	Peak	---	---
3	2483.50	41.26	54.00	-12.74	43.65	-2.39	Average	---	---
4	2483.50	53.80	74.00	-20.20	56.19	-2.39	Peak	---	---
5	4958.00	35.87	54.00	-18.13	30.54	5.33	Average	---	---
6	4958.00	60.50	74.00	-13.50	55.17	5.33	Peak	---	---
7	7437.00	33.14	54.00	-20.86	22.21	10.93	Average	---	---
8	7437.00	57.77	74.00	-16.23	46.84	10.93	Peak	---	---

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	GFSK	Test Freq. (MHz)	2479
Polarization	Vertical		
Level (dBuV/m)			



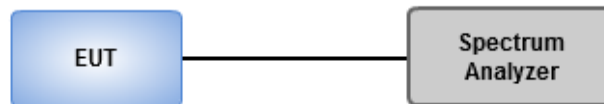
$$20\log(\text{Duty cycle}) = 20\log \frac{25 \times 0.23478 \text{ ms}}{100 \text{ ms}} = -24.63\text{dB}$$

3.2 20dB and Occupied Bandwidth

3.2.1 Test Procedures

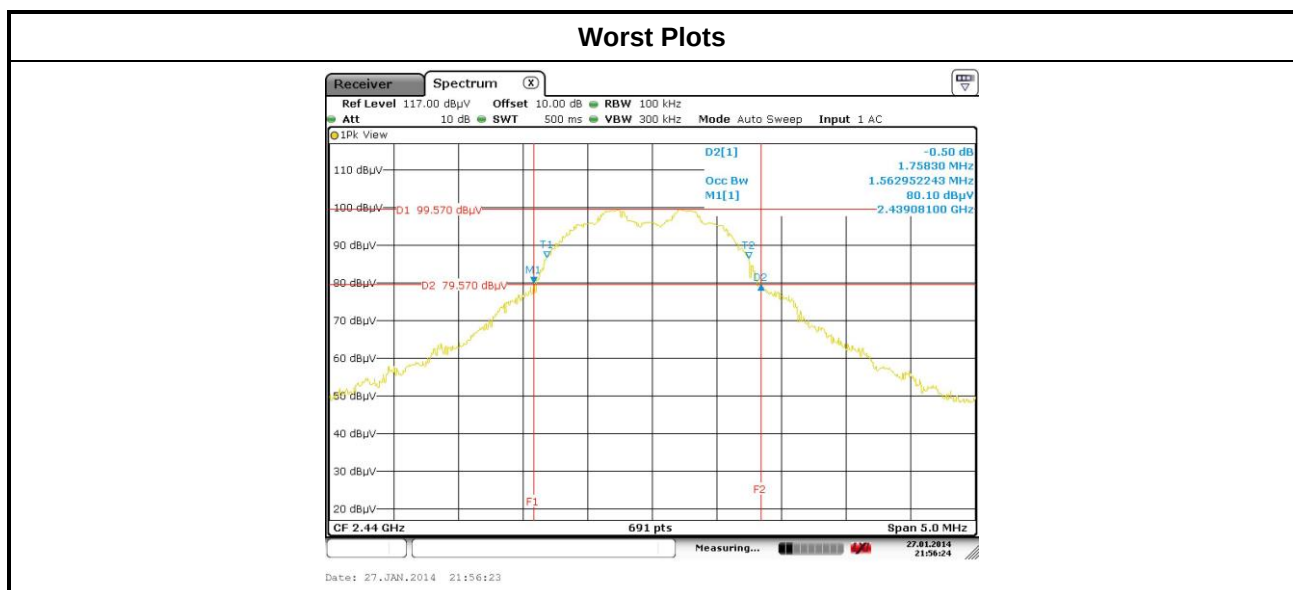
1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20dB relative to the maximum level measured in the fundamental emission.
5. Use the occupied measurement function of spectrum analyzer to measure 99% occupied bandwidth

3.2.2 Test Setup



3.2.3 20dB and Occupied Bandwidth

Freq. (MHz)	20dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
2404	1.621	1.476
2440	1.758	1.563
2479	1.737	1.570



4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp, it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan Hsiang. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

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No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.

Kwei Shan

Tel: 886-3-271-8666

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If you have any suggestion, please feel free to contact us as below information

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