



Neutron Engineering Inc.

FCC Radio Test Report

FCC ID: PKNCM-190

This report concerns (check one) : ☒ Original Grant ☐ Class II Change

Issued Date : Nov. 16, 2012
Project No. : 1211C022
Equipment : Optical Wireless Mouse
Model Name : OM4000W; CM-190; CM-168; CM-193; CM-170;
CM-183; CM-184; CM-186; CM-192
Applicant : Zhuoheng Electronics Co., Limited
Address : No.8. Lane5. ShangNan Road, the 5Th Industrial
Area, NanCe, HuMen Town, DongGuan City, China.
Manufacturer : Zhuoheng Electronics Co., Limited
Address : No.8. Lane5. ShangNan Road, the 5Th Industrial
Area, NanCe, HuMen Town, DongGuan City, China.

Tested by:

Neutron Engineering Inc. EMC Laboratory

Date of Receipt: Nov. 01, 2012

Date of Test:

Nov. 01, 2012 ~ Nov. 15, 2012

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Declaration

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1. CERTIFICATION

Equipment : Optical Wireless Mouse
Brand Name : N/A
Model Name : OM4000W; CM-190; CM-168; CM-193; CM-170; CM-183; CM-184; CM-186;
CM-192
Applicant : Zhuoheng Electronics Co., Limited
Factory : Dongguan Yibang Electronic Technology Co., Ltd.
Address : No.8. Lane5. ShangNan Road, the 5Th Industrial Area, NanCe, HuMen Town,
DongGuan City, China.
Date of Test : Nov. 01, 2012 ~ Nov. 15, 2012
Test Item : ENGINEERING SAMPLE
Standards : FCC Part15, Subpart C(15.247) / ANSI C63.4 : 2009
FCC Public Notice DA 00-705, March 30, 2000.

The above equipment has been tested and found compliance with the requirement of the relative standards by Neutron Engineering Inc. EMC Laboratory.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. NEI-FCCP-1-1211C022) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of NVLAP and TAF according to the ISO-17025 quality assessment standard and technical standard(s).



2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

APPLIED STANDARD: 47 CFR Part 15, Subpart C			
Standard Section	Test Item	Judgment	Remark
47 CFR Part 15			
15.207	Conducted Emission	-	N/A
15.247(d)	Antenna conducted Spurious Emission	PASS	
15.247 (a)(1)	Hopping Channel Separation	PASS	
15.247 (b)(1)	Peak Output Power	PASS	
15.247(d) 15.209	Radiated Spurious Emission	PASS	
15.247 (a)(1)(iii)	Number of Hopping Frequency	PASS	
15.247 (a)(1)(iii)	Dwell Time	PASS	
15.205	Restricted Bands	PASS	
15.203	Antenna Requirement	PASS	

NOTE:

(1) "N/A" denotes test is not applicable in this test report.

(2) According to FCC Public Notice DA 00-705, March 30, 2000.



2.1 TEST FACILITY

The test facilities used to collect the test data in this report is **DG-CB03** at the location of No.3,Jinshagang 1st Road, ShiXia, Dalang Town, Dong Guan, China.523792
Neutron's test firm number for FCC 319330

2.2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately **95 %**.

A. Conducted Measurement :

Test Site	Method	Measurement Frequency Range	U , (dB)	NOTE
DG-C02	CISPR	150 KHz ~ 30MHz	1.94	

B. Radiated Measurement :

Test Site	Method	Measurement Frequency Range	Ant. H / V	U , (dB)	NOTE
DG-CB03	CISPR	30MHz ~ 200MHz	V	3.82	
		30MHz ~ 200MHz	H	3.60	
		200MHz ~ 1,000MHz	V	3.86	
		200MHz ~ 1,000MHz	H	3.94	
		1GHz~18GHz	V	4.23	
		18GHz~40GHz	V	4.15	
		1GHz~18GHz	H	4.15	
		18GHz~40GHz	H	4.14	



3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	Optical Wireless Mouse	
Brand Name	N/A	
Model Name	OM4000W; CM-190; CM-168; CM-193; CM-170; CM-183; CM-184; CM-186; CM-192	
Model Difference	Only difference is model name.	
Product Description	The EUT is a Optical Wireless Mouse.	
	Operation Frequency:	2402~2480 MHz
	Modulation Type:	GFSK
	Bit Rate of Transmitter	1Mbps
	Number of Channel	79CH
	Antenna Designation:	Please see note 3.(Page 10)
	Antenna Gain(Peak)	
	Output Power:	-9.44 dBm
	Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.	
Power Source	DC voltage supplied from 2*AAA battery.	
Power Rating	DC 3V	
Connecting I/O Port(s)	Please refer to the User's Manual	

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.



2.

Channel List					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2402	28	2429	55	2456
02	2403	29	2430	56	2457
03	2404	30	2431	57	2458
04	2405	31	2432	58	2459
05	2406	32	2433	59	2460
06	2407	33	2434	60	2461
07	2408	34	2435	61	2462
08	2409	35	2436	62	2463
09	2410	36	2437	63	2464
10	2411	37	2438	64	2465
11	2412	38	2439	65	2466
12	2413	39	2440	66	2467
13	2414	40	2441	67	2468
14	2415	41	2442	68	2469
15	2416	42	2443	69	2470
16	2417	43	2444	70	2471
17	2418	44	2445	71	2472
18	2419	45	2446	72	2473
19	2420	46	2447	73	2474
20	2421	47	2448	74	2475
21	2422	48	2449	75	2476
22	2423	49	2450	76	2477
23	2424	50	2451	77	2478
24	2425	51	2452	78	2479
25	2426	52	2453	79	2480
26	2427	53	2454		
27	2428	54	2455		

Note: Hopping mode: choose at most 16 channels for use from the 79 channels.

3.

Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	N/A	N/A	Printed	N/A	2



3.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possibly have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	Wireless
Mode 2	TX Mode NOTE (1)
Mode 3	RX Mode NOTE (1)

The EUT system operated these modes were found to be the worst case during the pre-scanning test as following:

For Conducted Emission	
Final Test Mode	Description
N/A	" N/A " denotes test is not applicable in this test report

For Radiated Emission	
Final Test Mode	Description
Mode 2	TX Mode NOTE (1)
Mode 3	RX Mode NOTE (1)

Note:

(1) The measurements are performed at the high, middle, low available channels.

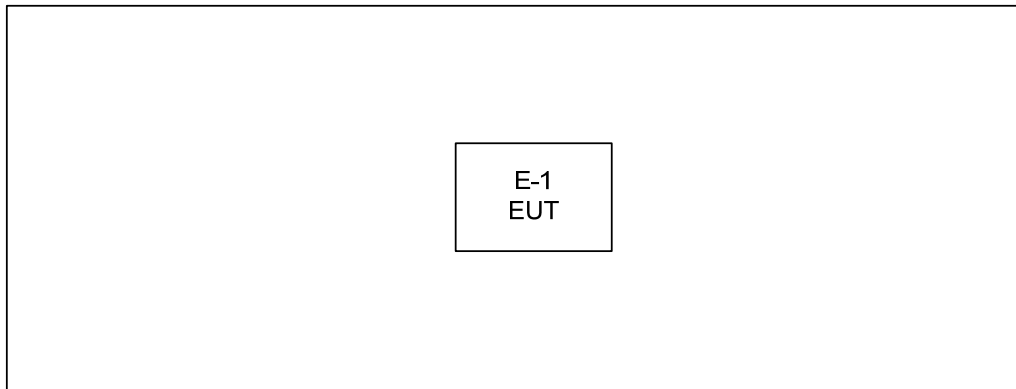
3.3 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS

Test software Version	N/A		
Frequency	2402MHz	2442MHz	2480MHz
Parameters-1Mbps	N/A	N/A	N/A



3.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED





3.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.	Note
E-1	Optical Wireless Mouse	N/A	OM4000W	PKNCM-190	N/A	EUT

Item	Shielded Type	Ferrite Core	Length	Note
-	-	-	-	-

Note:

- (1) For detachable type I/O cable should be specified the length in m in 『Length』 column.



4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 POWER LINE CONDUCTED EMISSION Limits (Frequency Range 150KHz-30MHz)

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)		Standard
	Quasi-peak	Average	Quasi-peak	Average	
0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *	CISPR
0.50 -5.0	73.00	60.00	56.00	46.00	CISPR
5.0 -30.0	73.00	60.00	60.00	50.00	CISPR

0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	73.00	60.00	56.00	46.00	FCC
5.0 -30.0	73.00	60.00	60.00	50.00	FCC

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

4.1.2 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	LISN	EMCO	3816/2SH	00052766	May.04.2013
2	LISN	R&S	ENV216	100526	Nov.25.2012
3	Test Cable	N/A	RG400 12m	N/A	Mar.16.2013
4	EMI TEST RECEIVER	R&S	ESCI	100895	May.04.2013
5	50Ω Terminator	SHX	TF2-3G-A	08122901	May.04.2013

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

The following table is the setting of the receiver

OM4000W Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

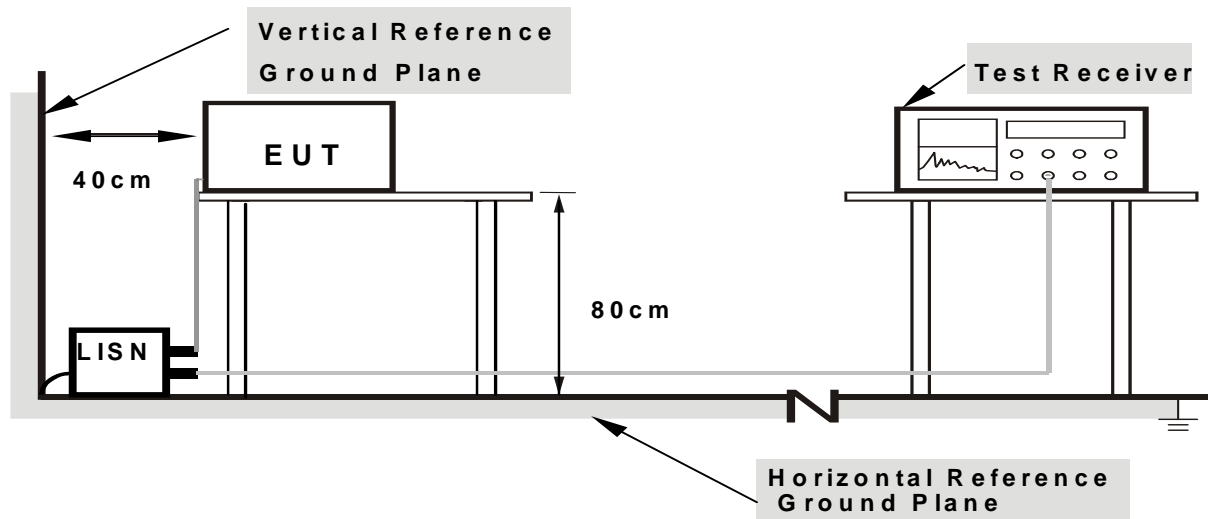
4.1.3 TEST PROCEDURE

- The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation

4.1.5 TEST SETUP



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

4.1.6 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

The EUT is continue Transmitter/Receive data or Hopping on mode.



4.1.7 TEST RESULTS

EUT :	Optical Wireless Mouse	Model Name. :	OM4000W
Temperature :	-	Relative Humidity :	-
Test Voltage :	-		
Test Mode :	N/A		

Note: "N/A" denotes test is not applicable in this test report

Remark

- (1) All readings are QP Mode value unless otherwise stated AVG in column of Note. If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only QP Mode was measured, but AVG Mode didn't perform. In this case, a " * " marked in AVG Mode column of Interference Voltage Measured.
- (2) Measuring frequency range from 150KHz to 30MHz.



4.2 RADIATED EMISSION MEASUREMENT

4.2.1 RADIATED EMISSION LIMITS (Frequency Range 9kHz-1000MHz)

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	(dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

FREQUENCY RANGE OF RADIATED MEASUREMENT (For unintentional radiators)

Highest frequency generated or Upper frequency of measurement used in the device or on which the device operates or tunes (MHz)	Range (MHz)
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower



4.2.2 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Antenna	Schwarbeck	VULB9160	9160-3232	May.25.2013
2	Amplifier	HP	8447D	2944A09673	May.04.2013
3	Test OM4000W	R&S	ESCI	100382	May.04.2013
4	Test Cable	N/A	C-01_CB03	N/A	Jul.01.2013
5	Antenna	ETS	3115	00075789	May.25.2013
6	Amplifier	Agilent	8449B	3008A02274	May.04.2013
7	Spectrum	Agilent	E4408B	US39240143	Nov.25.2012
8	Test Cable	HUBER+SUHNER	C-45	N/A	May.02.2013
9	Controller	CT	SC100	N/A	N/A
10	Horn Antenna	EMCO	3115	9605-4803	May.25.2013
11	Active Loop Antenna	R&S	HFH2-Z2	830749/020	May.04.2013
12	Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170319	Oct.13.2013

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

OM4000W Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz for PK/AVG detector
Start ~ Stop Frequency	90kHz~110kHz for QP detector
Start ~ Stop Frequency	110kHz~490kHz for PK/AVG detector
Start ~ Stop Frequency	490kHz~30MHz for QP detector
Start ~ Stop Frequency	30MHz~1000MHz for QP detector



4.2.3 TEST PROCEDURE

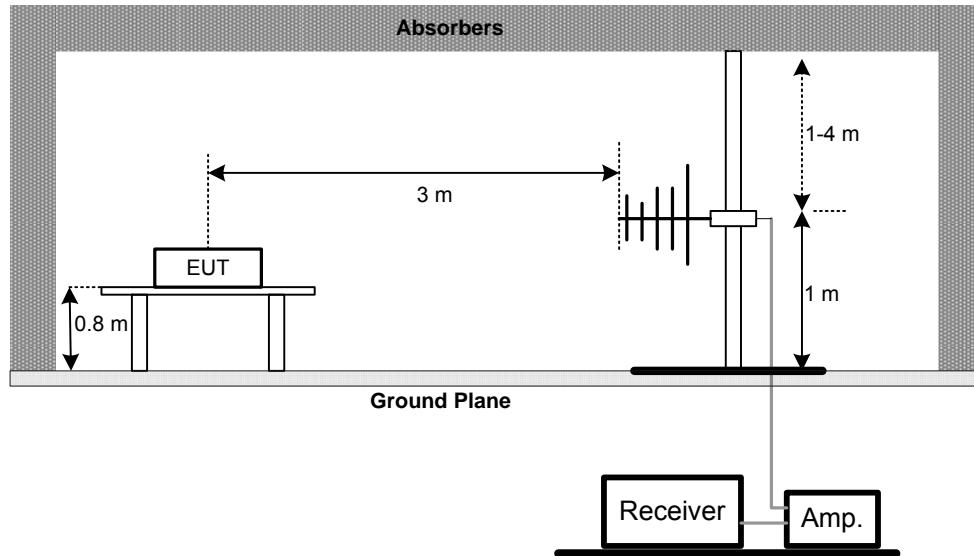
- a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.2.4 DEVIATION FROM TEST STANDARD

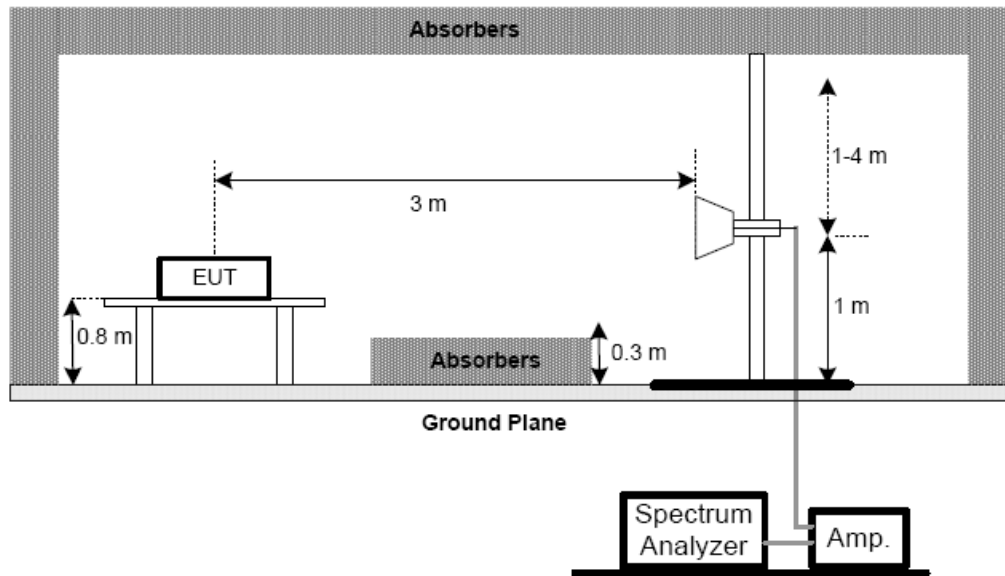
No deviation

4.2.5 TEST SETUP

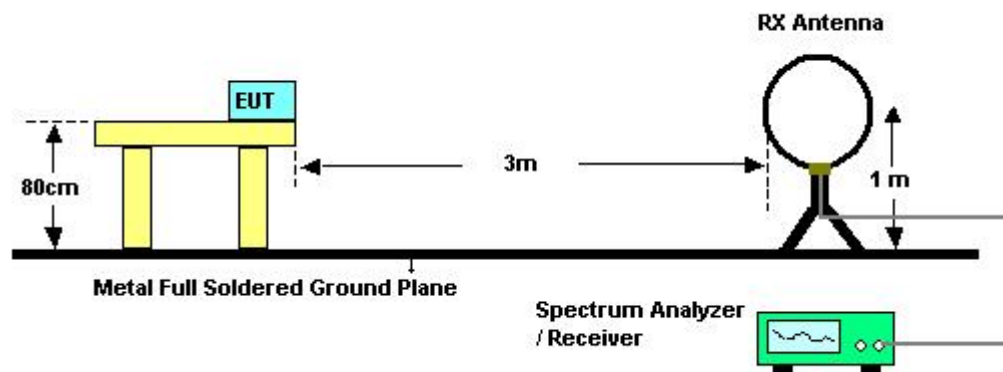
(A) Radiated Emission Test Set-Up Frequency Below 1 GHz



(B) Radiated Emission Test Set-Up Frequency Above 1 GHz



(C) For radiated emissions below 30MHz



4.2.6 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



4.2.7 TEST RESULTS (BELOW 30MHZ)

EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010 hPa	Test Voltage :	DC 3V
Test Mode :	TX Mode		

Freq. (MHz)	Ant. 0°/90°	Reading(RA) (dBuV)	Corr.Factor(CF) (dB)	Measured(FS) (dBuV/m)	Limits(QP) (dBuV/m)	Margin (dB)	Note
0.0095	0°	19.65	24.30	43.95	128.07	-84.12	AVG
0.0095	0°	21.68	24.30	45.98	148.07	-102.09	PK
0.0237	0°	19.57	24.07	43.64	120.12	-76.48	AVG
0.0237	0°	20.48	24.07	44.55	140.12	-95.57	PK
0.0363	0°	18.27	23.27	41.54	116.42	-74.88	AVG
0.0363	0°	21.67	23.27	44.94	136.42	-91.48	PK
0.0653	0°	19.36	22.09	41.45	111.31	-69.85	AVG
0.0653	0°	23.87	22.09	45.96	131.31	-85.34	PK
0.2517	0°	20.94	20.40	41.34	99.59	-58.25	AVG
0.2517	0°	23.14	20.40	43.54	119.59	-76.05	PK
1.2538	0°	24.46	19.57	44.03	65.64	-21.60	QP

Freq. (MHz)	Ant. 0°/90°	Reading(RA) (dBuV)	Corr.Factor(CF) (dB)	Measured(FS) (dBuV/m)	Limits(QP) (dBuV/m)	Margin (dB)	Note
0.0096	90°	17.36	24.30	41.66	127.93	-86.27	AVG
0.0096	90°	20.68	24.30	44.98	147.93	-102.95	PK
0.0254	90°	14.39	23.96	38.35	119.52	-81.17	AVG
0.0254	90°	19.12	23.96	43.08	139.52	-96.44	PK
0.0344	90°	19.58	23.39	42.97	116.87	-73.90	AVG
0.0344	90°	21.58	23.39	44.97	136.87	-91.90	PK
0.0653	90°	20.35	22.09	42.44	111.30	-68.86	AVG
0.0653	90°	23.68	22.09	45.77	131.30	-85.53	PK
0.2422	90°	20.67	20.42	41.09	99.92	-58.83	AVG
0.2422	90°	22.78	20.42	43.20	119.92	-76.72	PK
1.2513	90°	23.12	19.57	42.69	65.66	-22.97	QP

Remark :

- (1) The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported °
- (2) Distance extrapolation factor = 40 log (specific distance / test distance) (dB); °
- (3) Limit line = specific limits (dBuV) + distance extrapolation factor. °



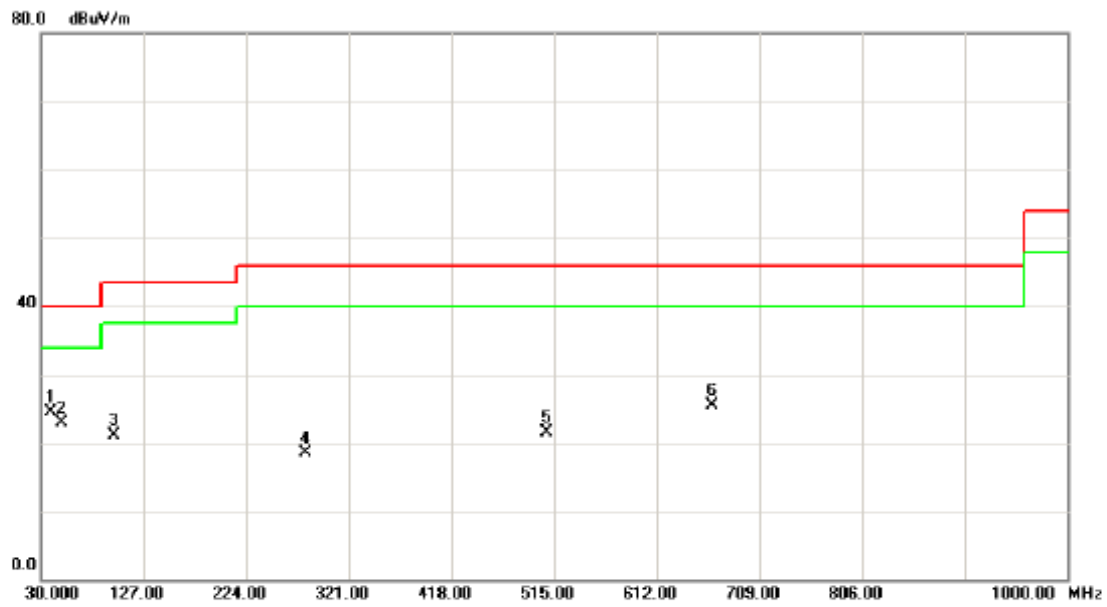
4.2.8 TEST RESULTS (BETWEEN 30 – 1000 MHZ)

Remark :

- (1) Reading in which marked as QP or Peak means measurements by using are Quasi-Peak Mode or Peak Mode with Detector BW=120KHz ; SPA setting in RBW=120KHz, VBW =120KHz, Swp. Time = 0.3 sec./MHz .
- (2) All readings are Peak unless otherwise stated QP in column of 『Note 』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform .
- (3) Measuring frequency range from 30MHz to 1000MHz .
- (4) If the peak scan value lower limit more than 20dB, then this signal data does not show in table .



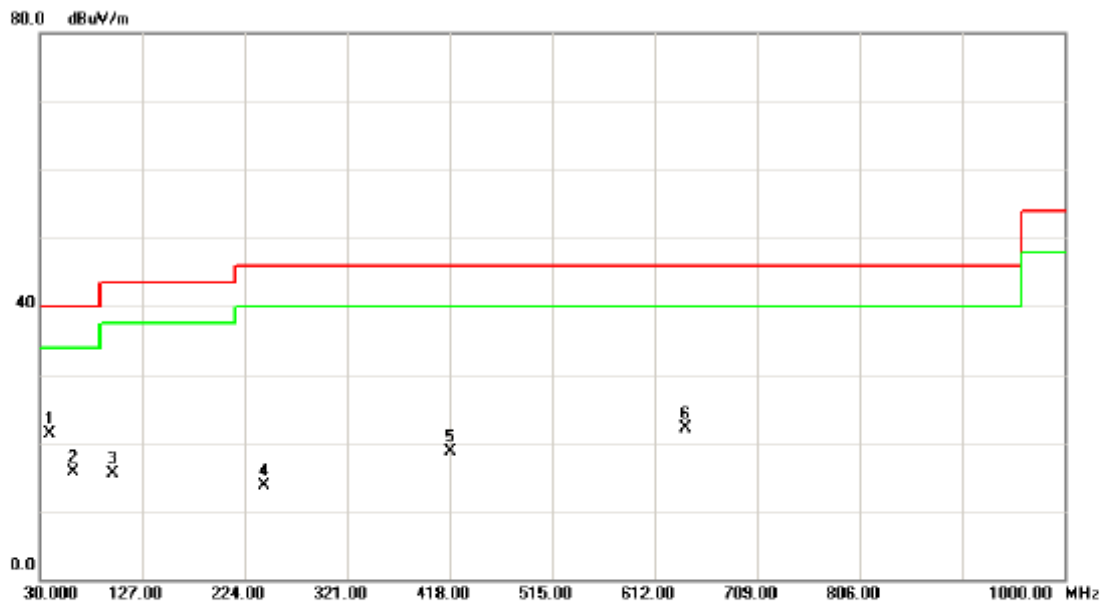
EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010 hPa	Test Voltage :	DC 3V
Test Mode :	TX 2402MHz	Phase:	Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	*	39.7000	38.41	-13.90	24.51	40.00	-15.49	peak	
2		50.3700	47.60	-24.69	22.91	40.00	-17.09	peak	
3		98.8700	42.66	-21.54	21.12	43.50	-22.38	peak	
4		280.2600	33.63	-15.16	18.47	46.00	-27.53	peak	
5		507.2400	31.69	-10.21	21.48	46.00	-24.52	peak	
6		664.3800	32.42	-6.92	25.50	46.00	-20.50	peak	



EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010 hPa	Test Voltage :	DC 3V
Test Mode :	TX 2402MHz	Phase:	Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	*	39.7000	35.11	-13.90	21.21	40.00	-18.79	peak	
2		62.0100	39.57	-23.95	15.62	40.00	-24.38	peak	
3		98.8700	37.03	-21.54	15.49	43.50	-28.01	peak	
4		242.4300	30.80	-17.14	13.66	46.00	-32.34	peak	
5		418.0000	30.73	-12.09	18.64	46.00	-27.36	peak	
6		641.1000	29.88	-7.82	22.06	46.00	-23.94	peak	



4.2.9 TEST RESULTS (ABOVE 1000 MHZ)

EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010 hPa	Test Voltage :	DC 3V
Test Mode :	TX 2402MHz		

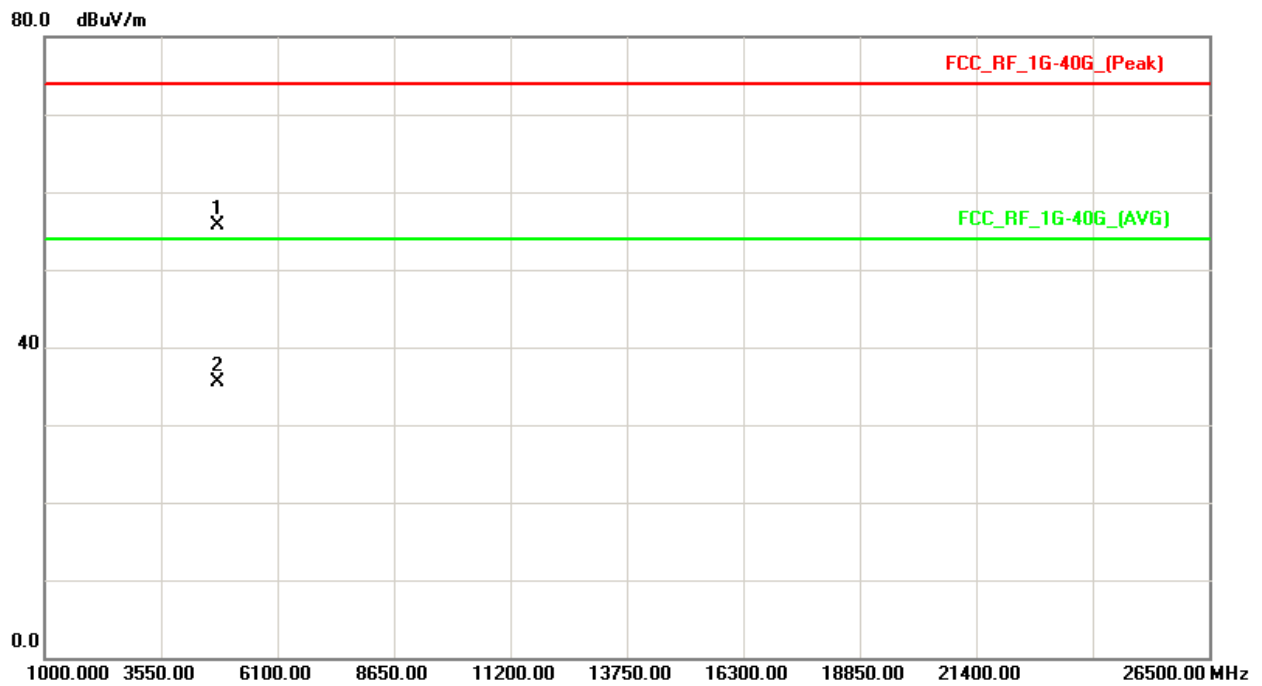
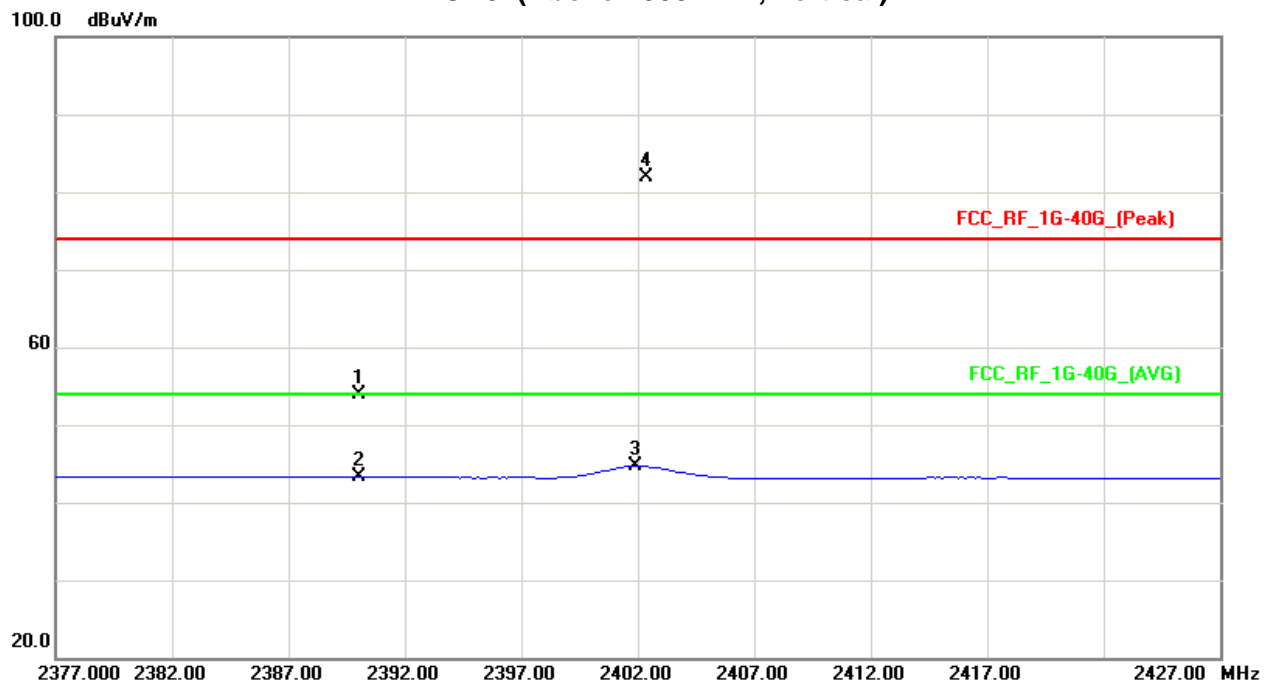
Freq. (MHz)	Ant.Pol. H/V	Reading		Ant./CF CF(dB)	Act.		Limit		Note
		Peak (dBuV)	AV (dBuV)		Peak (dBuV/m)	AV (dBuV/m)	Peak (dBuV/m)	AV (dBuV/m)	
2390.00	V	21.59	10.99	32.28	53.87	43.27	74.00	54.00	X/E
2402.38	V	49.66	12.46	32.27	81.93	44.73			X/F
4803.28	V	49.67	29.30	6.11	55.78	35.41	74.00	54.00	X/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform.
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency. "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission.
- (4) Data of measurement within this frequency range shown " * " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna



TX CH01(Above 1000 MHz, Vertical)





EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010hPa	Test Voltage :	DC 3V
Test Mode :	TX 2402MHz		

Freq. (MHz)	Ant.Pol. H/V	Reading		Ant./CF CF(dB)	Act.		Limit		Note
		Peak (dBuV)	AV (dBuV)		Peak (dBuV/m)	AV (dBuV/m)	Peak (dBuV/m)	AV (dBuV/m)	
2390.00	H	22.14	10.96	32.28	54.42	43.24	74.00	54.00	X/E
2401.75	H	55.21	12.84	32.27	87.48	45.11			X/F
4803.43	H	45.21	28.89	6.11	51.32	35.00	74.00	54.00	X/H

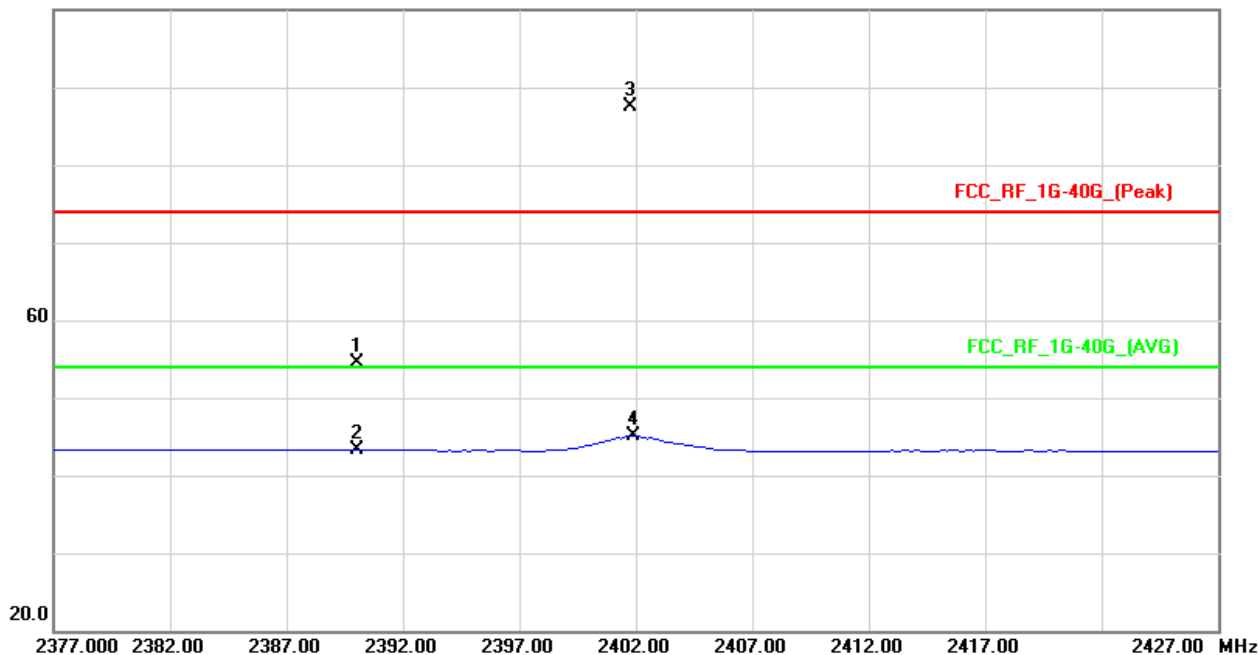
Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform .
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency. "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission .
- (4) Data of measurement within this frequency range shown " * " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna

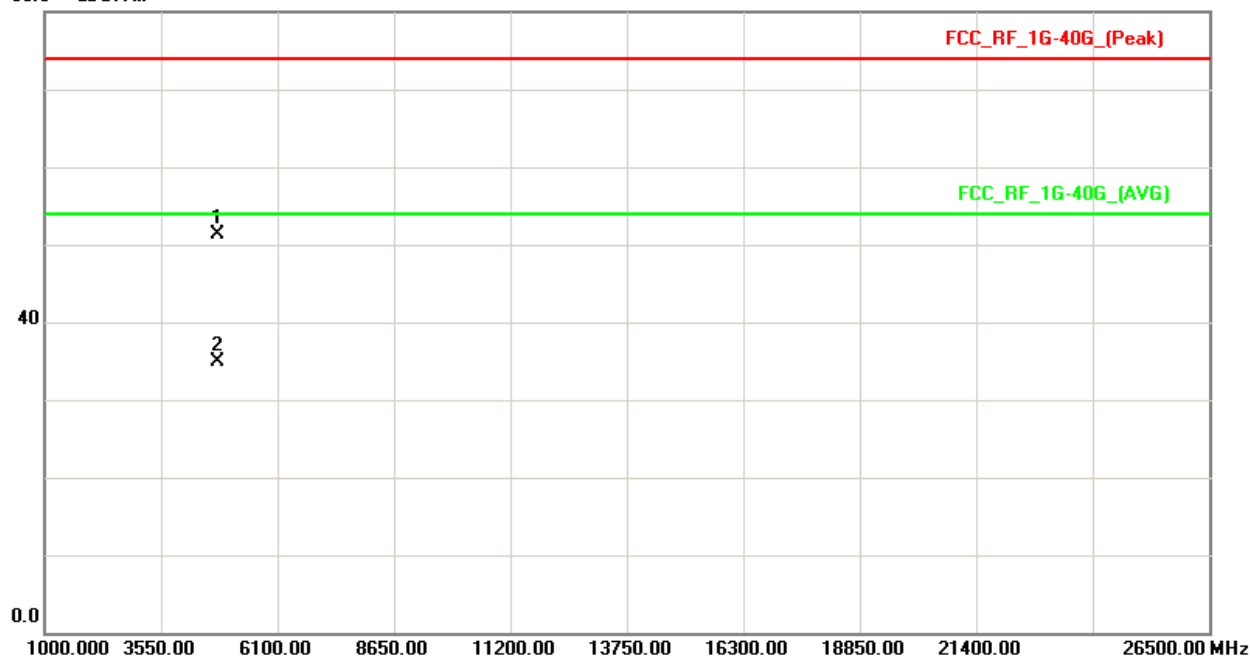


TX CH01(Above 1000 MHz, Horizontal)

100.0 dBuV/m



80.0 dBuV/m





EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010 hPa	Test Voltage :	DC 3V
Test Mode :	TX 2442MHz		

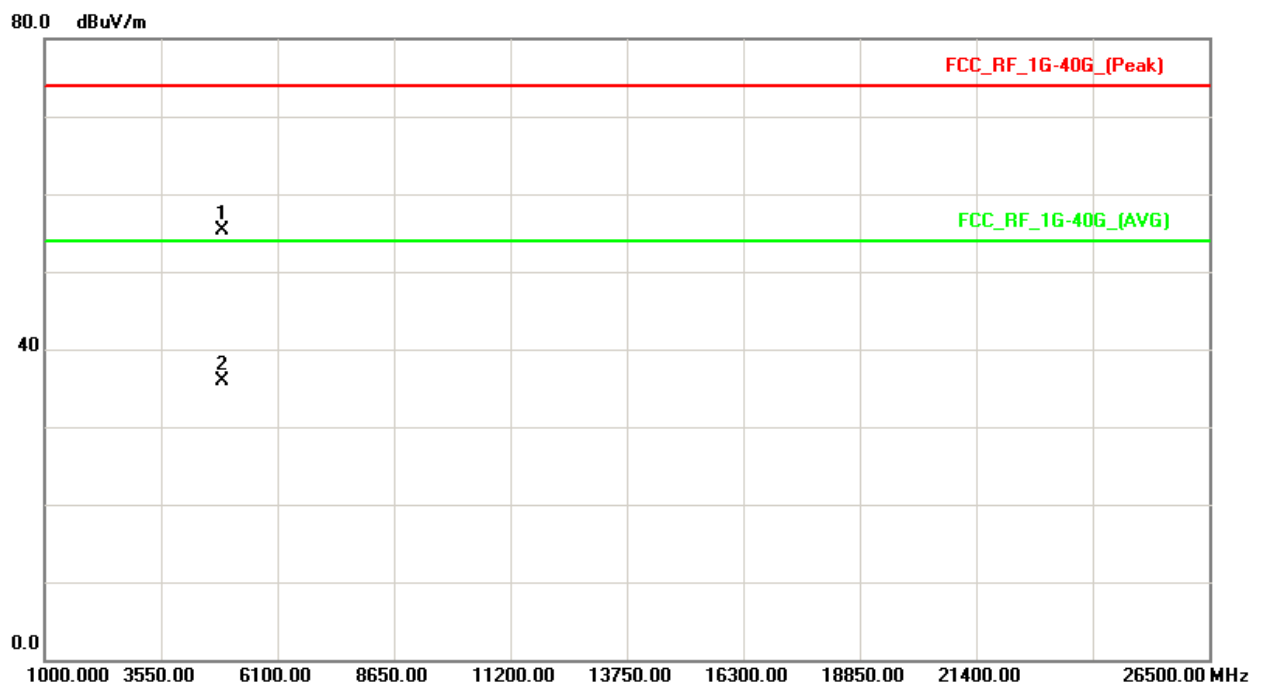
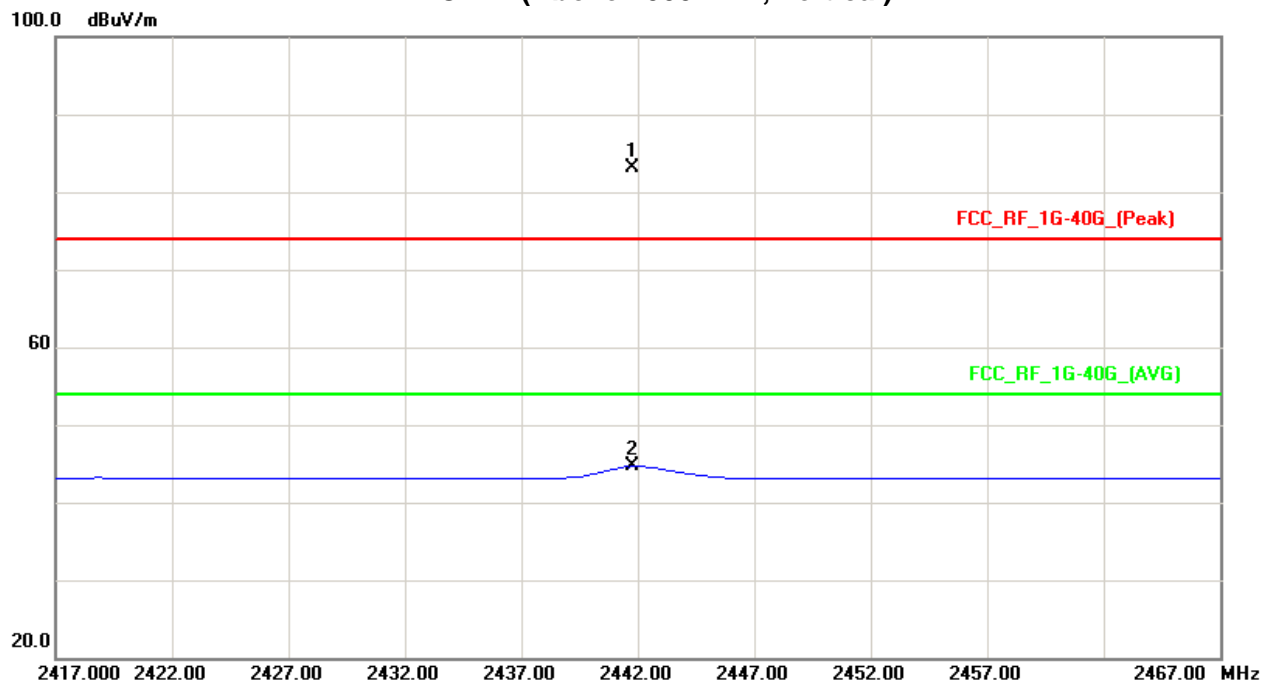
Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2441.75	V	50.91	12.50	32.23	83.14	44.73			X/F
4884.26	V	48.96	29.38	6.43	55.39	35.81	74.00	54.00	X/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform .
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency . "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission .
- (4) Data of measurement within this frequency range shown " * " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna



TX CH41 (Above 1000 MHz, Vertical)





Neutron Engineering Inc.

EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010 hPa	Test Voltage :	DC 3V
Test Mode :	TX 2442MHz		

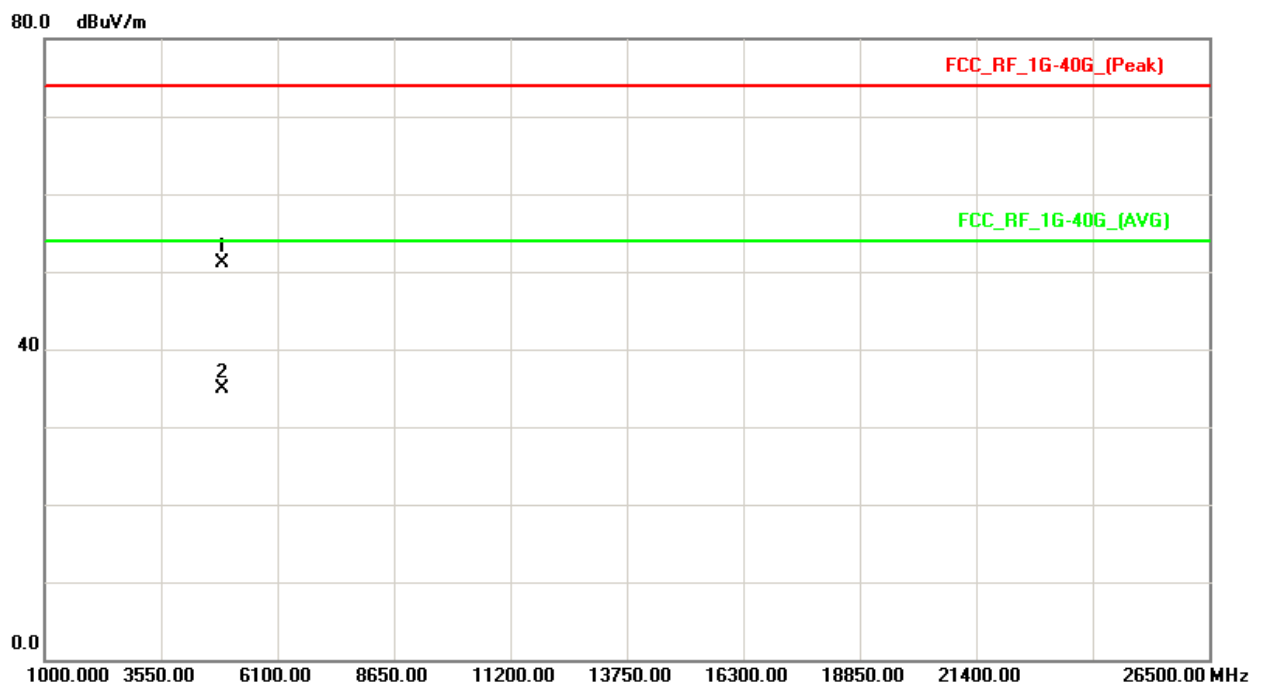
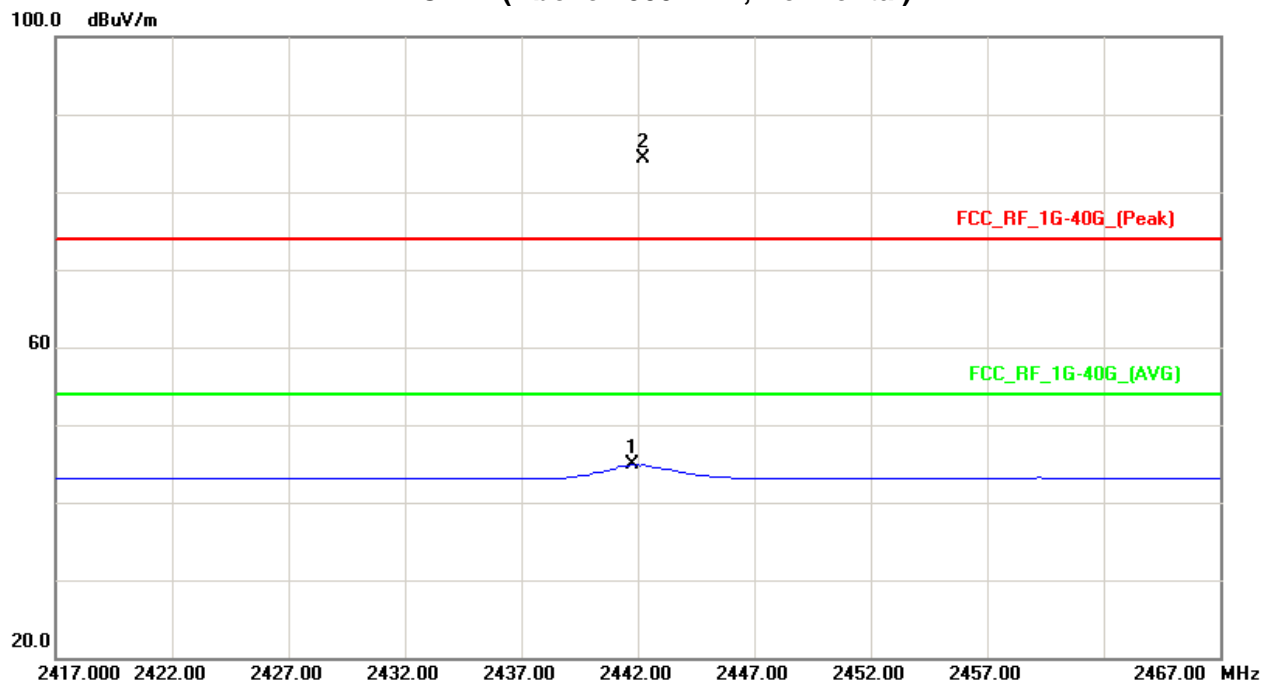
Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2442.25	H	52.06	12.62	32.23	84.29	44.85			X/F
4883.89	H	44.58	28.57	6.43	51.01	35.00	74.00	54.00	X/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform .
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency . "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission .
- (4) Data of measurement within this frequency range shown " * " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna



TX CH41 (Above 1000 MHz, Horizontal)





EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010hPa	Test Voltage :	DC 3V
Test Mode :	TX 2480MHz		

Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2479.75	V	50.41	12.48	32.18	82.59	44.66			X/F
2483.50	V	21.36	10.99	32.17	53.53	43.16	74.00	54.00	X/E
4960.25	V	49.28	28.38	6.74	56.02	35.12	74.00	54.00	X/H

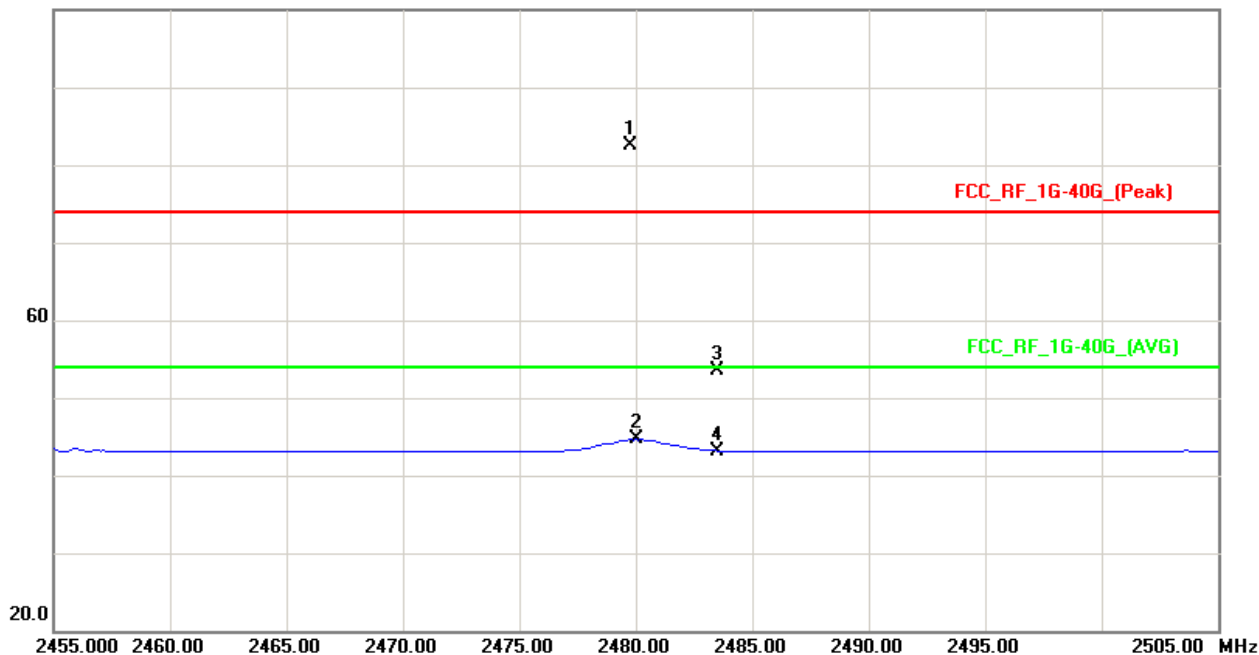
Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform .
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency. "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission .
- (4) Data of measurement within this frequency range shown " * " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna

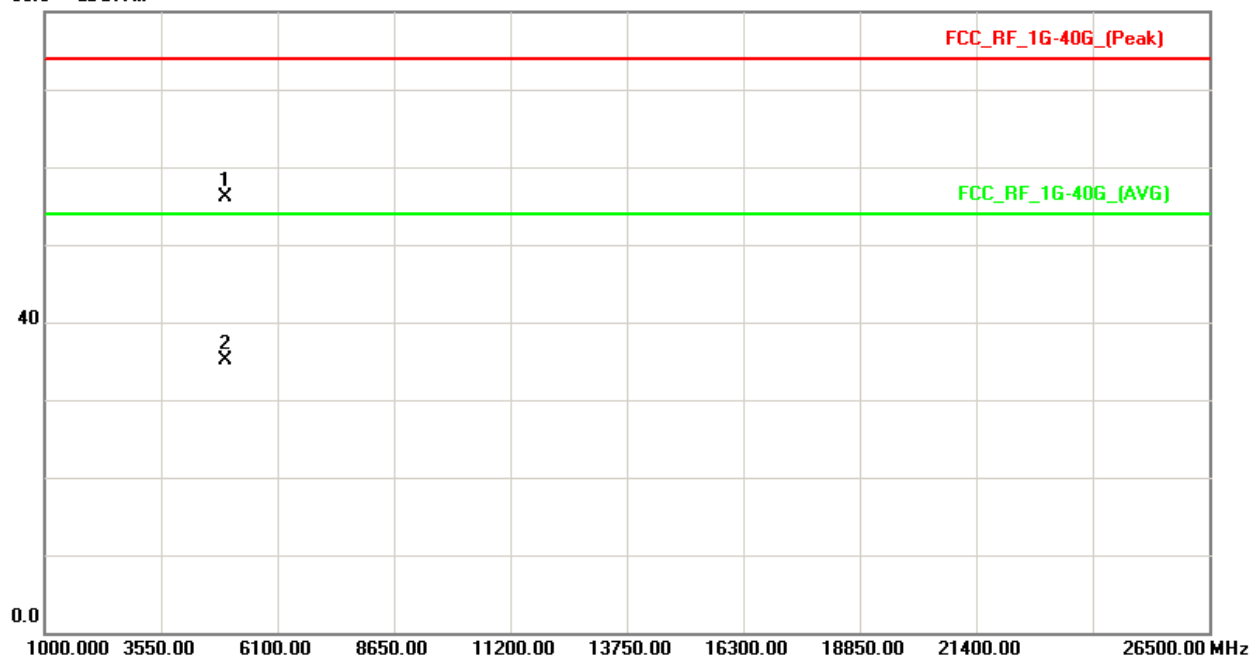


TX CH79 (Above 1000 MHz, Vertical)

100.0 dBuV/m



80.0 dBuV/m





EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1010 hPa	Test Voltage :	DC 3V
Test Mode :	TX 2480MHz		

Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2479.75	H	53.96	12.84	32.18	86.14	45.02			X/F
2483.50	H	22.00	11.05	32.17	54.17	43.22	74.00	54.00	X/E
4960.30	H	43.76	28.55	6.74	50.50	35.29	74.00	54.00	X/H

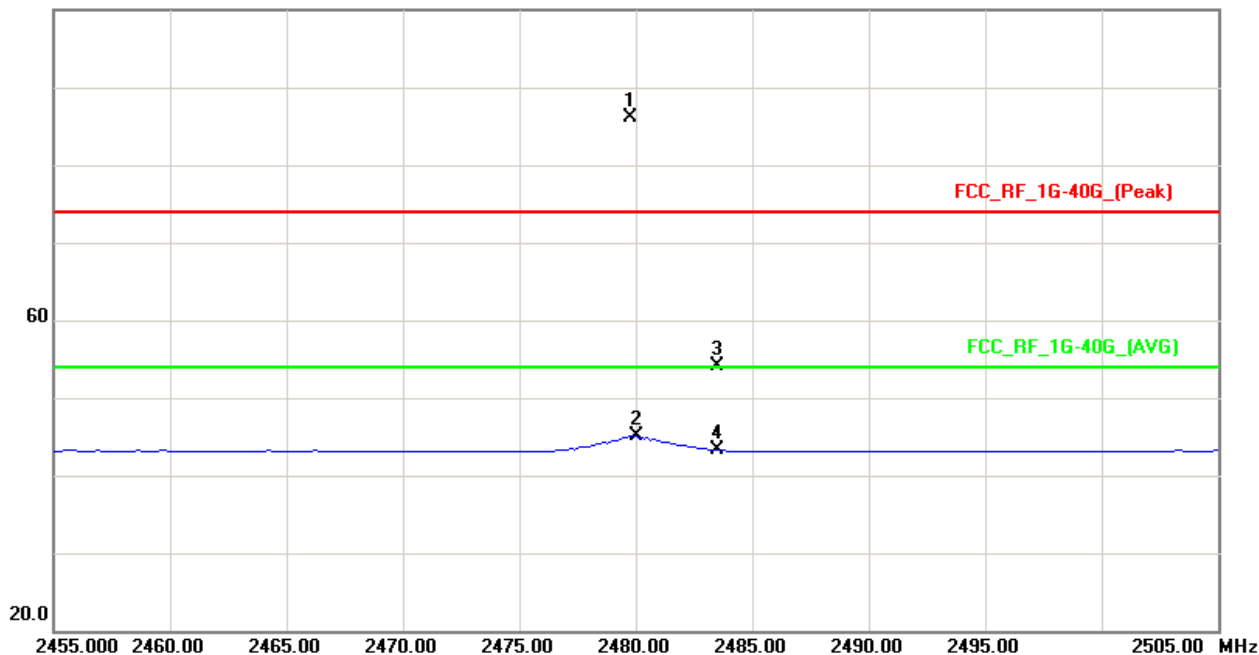
Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform.
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency. "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission.
- (4) Data of measurement within this frequency range shown " * " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna

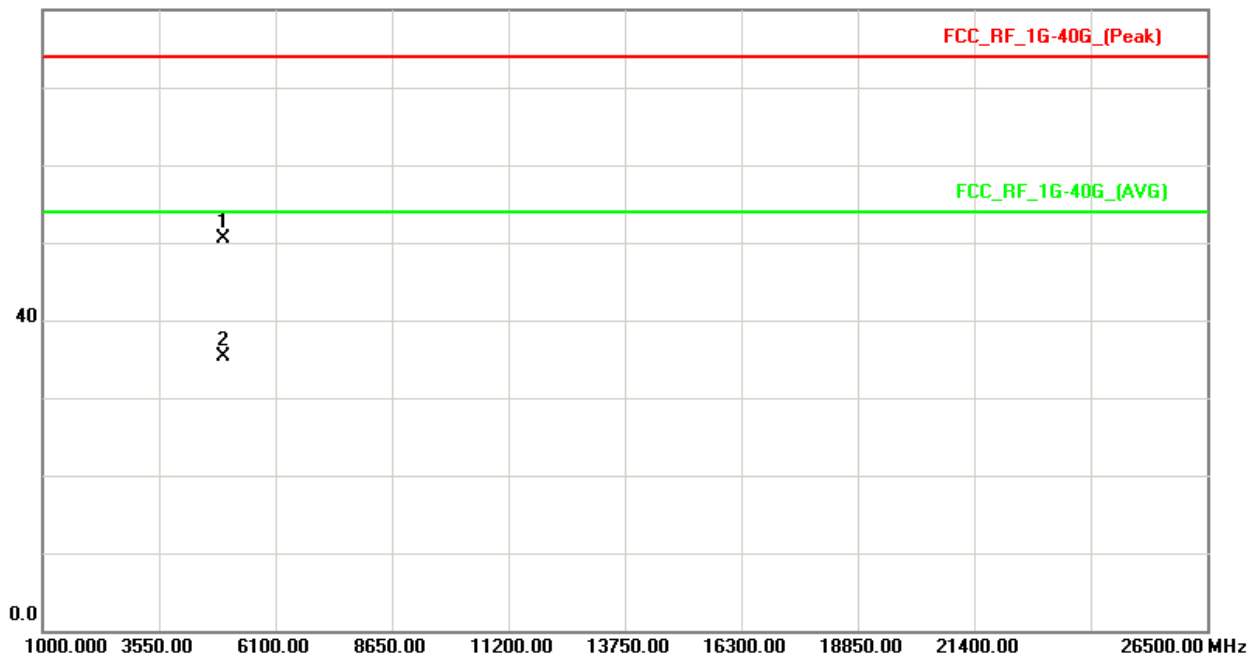


TX CH79 (Above 1000 MHz, Horizontal)

100.0 dBuV/m



80.0 dBuV/m





5. NUMBER OF HOPPING CHANNEL

5.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Frequency Range (MHz)	Result
15.247 (a)(1)(iii)	Number of Hopping Channel	2400-2483.5	PASS

5.1.1 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP 40	100185	Nov.25.2012

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating Frequency Range
RB	100 kHz
VB	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.1.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW= 100KHz, VBW=100KHz, Sweep time = Auto.

5.1.3 DEVIATION FROM STANDARD

No deviation.

5.1.4 TEST SETUP



5.1.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.





6. AVERAGE TIME OF OCCUPANCY

6.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)(iii)	Average Time of Occupancy	0.4sec	2400-2483.5	PASS

6.1.1 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP 40	100185	Nov.25.2012

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

6.1.2 TEST PROCEDURE

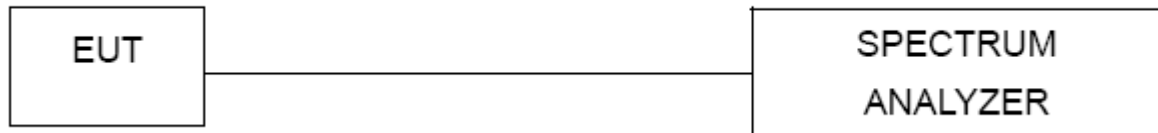
- The transmitter output (antenna port) was connected to the spectrum analyzer
- Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz.
- Use a video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for DH5, DH3 and DH1 packet transmitting.
- Measure the maximum time duration of one single pulse.

6.1.3 DEVIATION FROM STANDARD

No deviation.



6.1.4 TEST SETUP



6.1.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



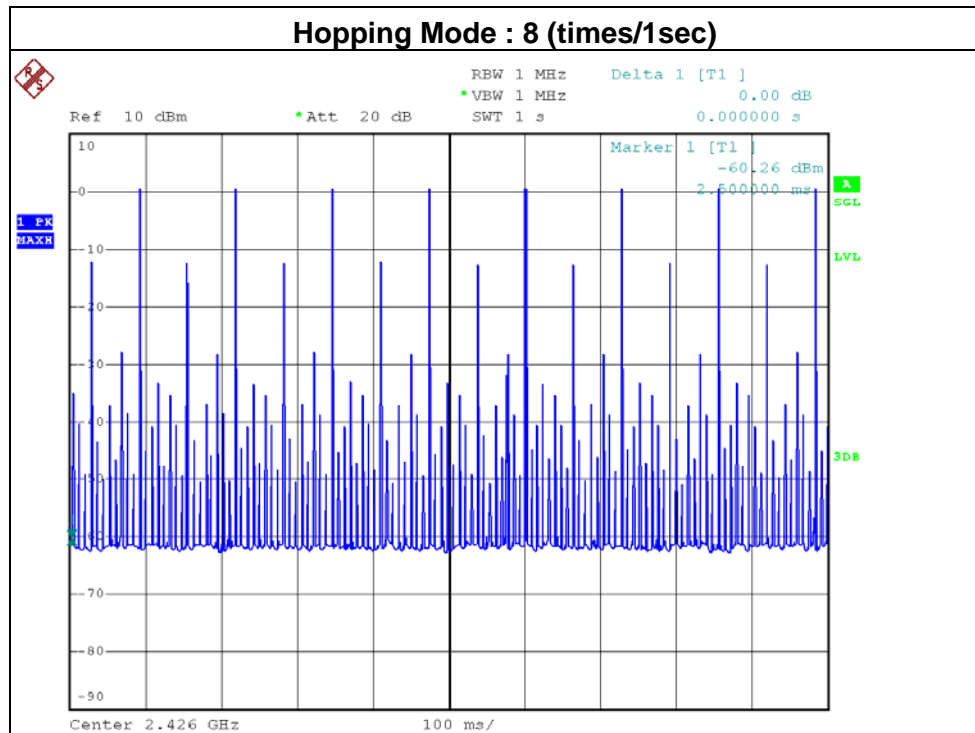
6.1.6 TEST RESULTS

EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1009 hPa	Test Voltage :	DC 3V
Test Mode :	Hopping Mode		

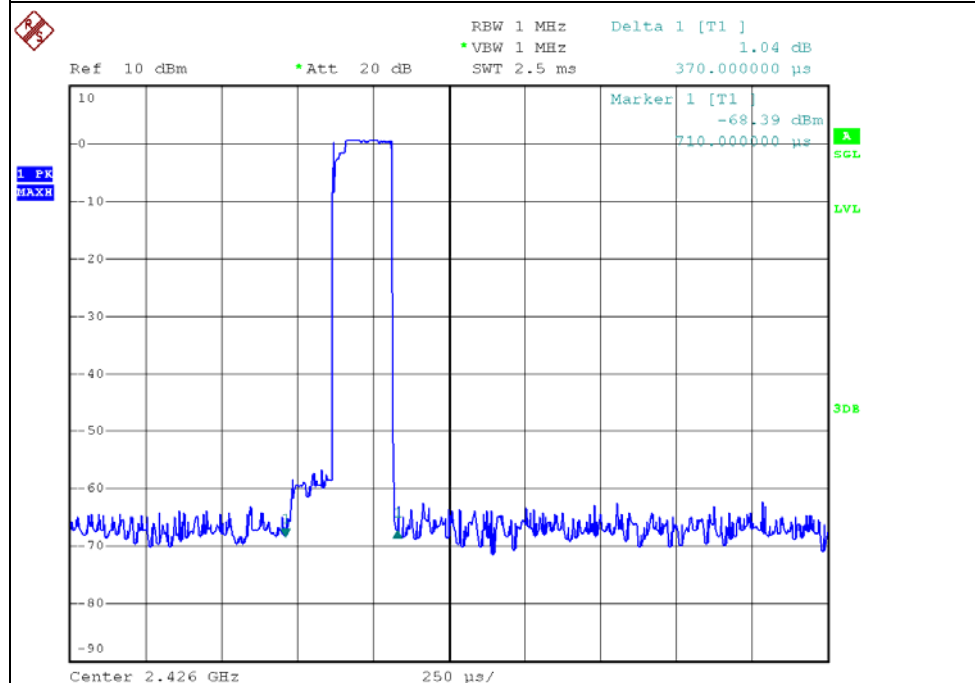
Mode	Number of transmission in a 6.4(16Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
2426MHz	(8/1) *6.4=51.2 times Note1	0.37	18.944	400

Note1: 7 times of occupied channels per 1 second

	Results
Measured cycle (sec)	16CH*0.4=6.4
The total number of frequency-hopping per second	((8/1)*16)=128
The number of occupied channels per second	128/16=8(number/sec)
occupied time for each channel(1)	0.37ms
The total number of channels occupied within one cycle (2)	(8/1) *6.4=51.2 times
The average time of occupancy within one cycle(1)*(2)	18.944msec
LIMIT (msec)	400msec



Date: 13.NOV.2012 15:39:45



Date: 13.NOV.2012 15:40:56



7. HOPPING CHANNEL SEPARATION MEASUREMENT

7.1 APPLIED PROCEDURES / LIMIT

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

7.1.1 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP 40	100185	Nov.25.2012

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30 kHz
VB	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

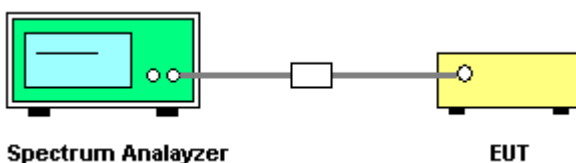
7.1.2 TEST PROCEDURE

- a. The EUT must have its hopping function enabled
- b. Span = wide enough to capture the peaks of two adjacent channels
 - Resolution (or IF) Bandwidth (RBW) \geq 1% of the span
 - Video (or Average) Bandwidth (VBW) \geq RBW
 - Sweep = auto
 - Detector function = peak
 - Trace = max hold

7.1.3 DEVIATION FROM STANDARD

No deviation.

7.1.4 TEST SETUP



7.1.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in hopping mode.

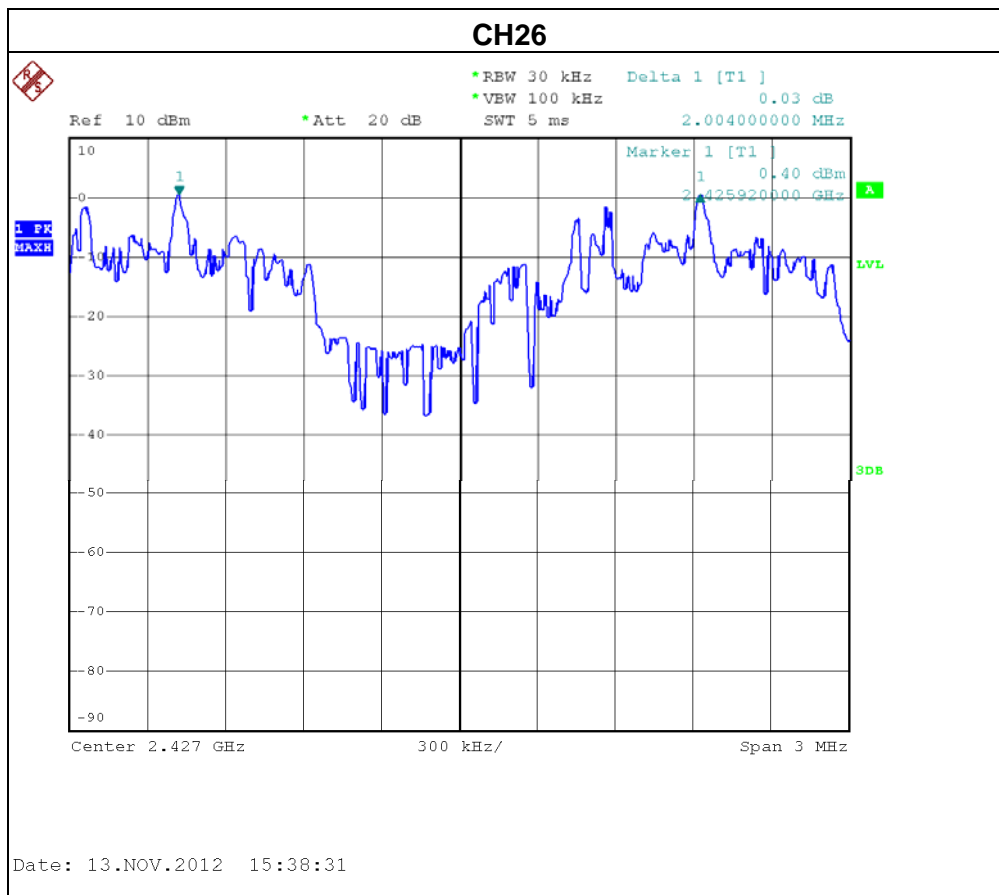


7.1.6 TEST RESULTS

EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1009 hPa	Test Voltage :	DC 3V
Test Mode :	CH26		

Frequency	Ch. Separation (MHz)	20dB Bandwidth (MHz)	Result
2427MHz	2.004	1.307	Complies

Ch. Separation Limits: >20dB bandwidth or >2/3 of 20dB bandwidth





8. BANDWIDTH TEST

8.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(2)	Bandwidth	≤ 1 MHz (20dB bandwidth)	2400-2483.5	PASS

8.1.1 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP 40	100185	Nov.25.2012

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	$>$ Measurement Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

8.1.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW= 30KHz, VBW=100KHz, Sweep time = Auto.

8.1.3 DEVIATION FROM STANDARD

No deviation.

8.1.4 TEST SETUP



8.1.5 EUT OPERATION CONDITIONS

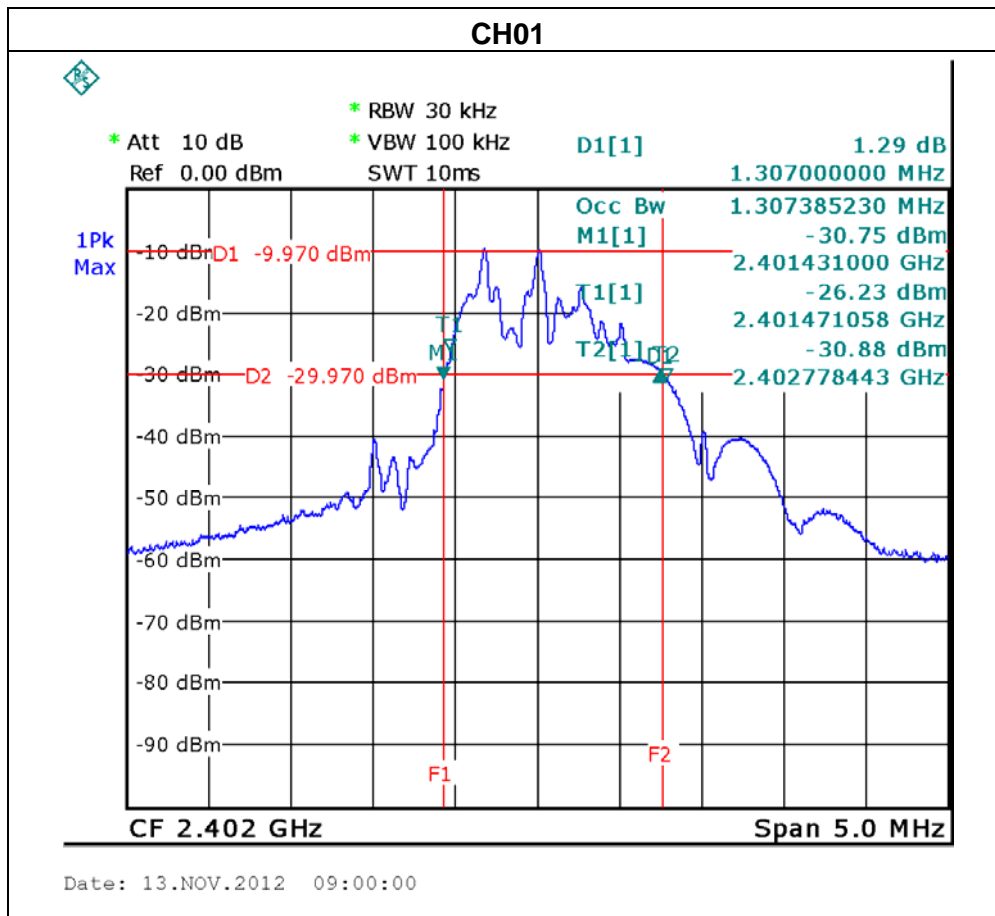
The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.

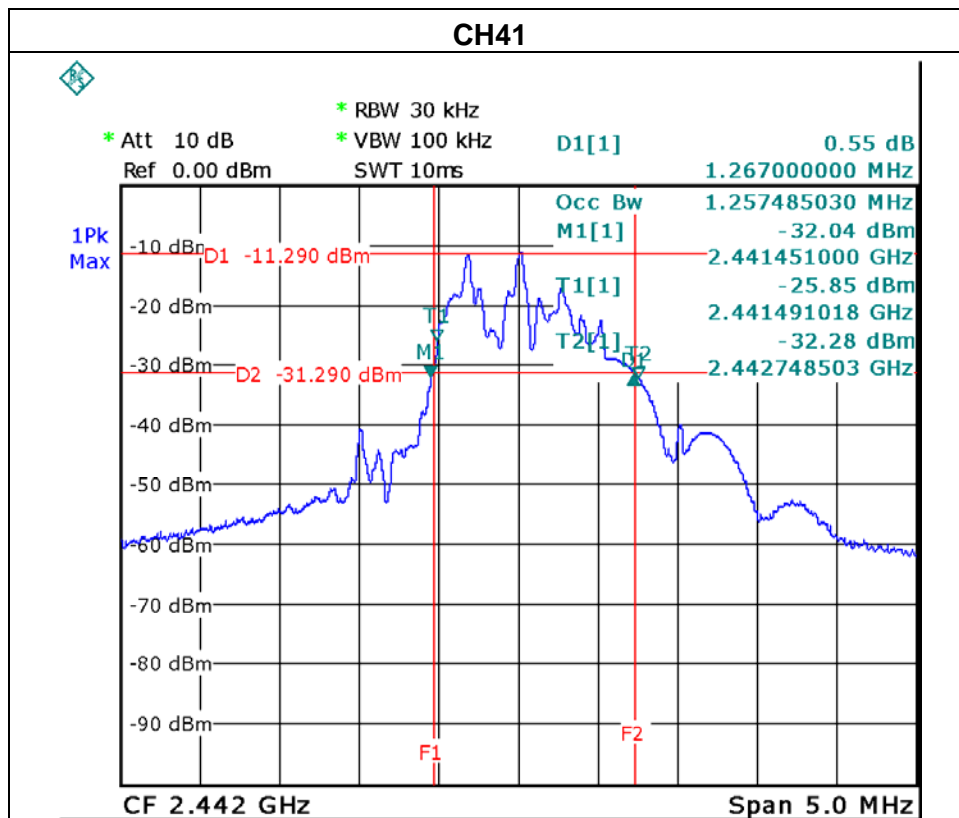


8.1.6 TEST RESULTS

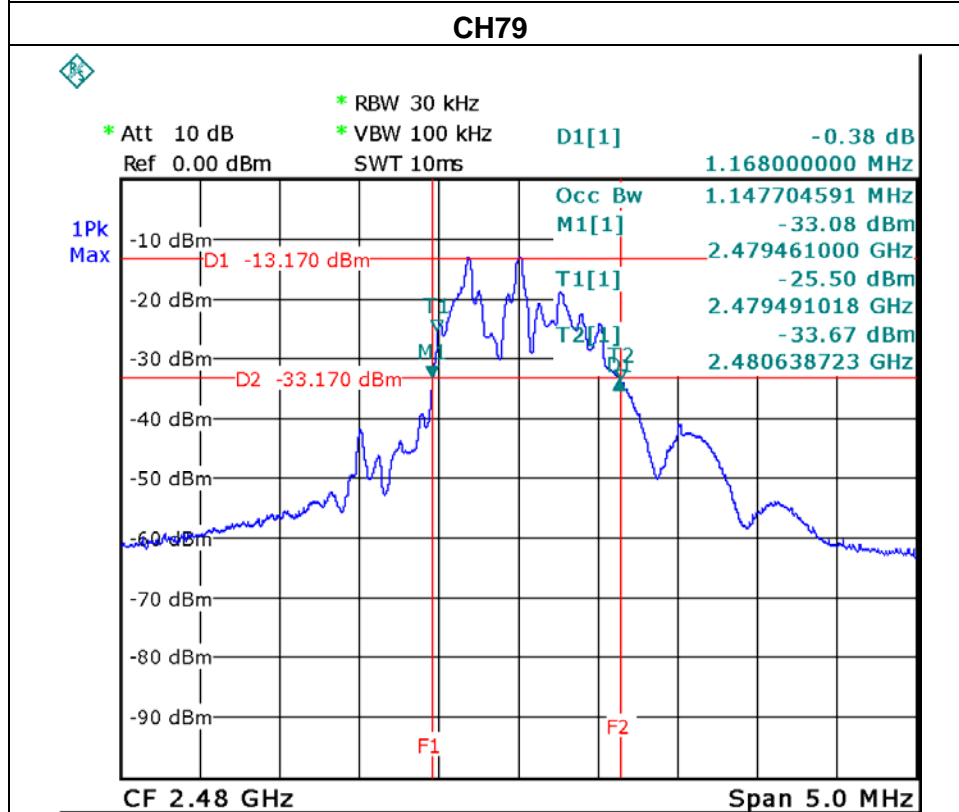
EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1009 hPa	Test Voltage :	DC 3V
Test Mode :	CH01 / CH41 / CH79		

Frequency	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Result
2402MHz	1.307	1.307	PASS
2442MHz	1.267	1.257	PASS
2480MHz	1.168	1.148	PASS





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9. PEAK OUTPUT POWER TEST

9.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (b)(1)	Peak Output Power	0.125 watt or 21dBm	2400-2483.5	PASS

9.1.1 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP 40	100185	Nov.25.2012

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

9.1.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW= 3MHz, VBW= 3MHz, Sweep time = Auto.

9.1.3 DEVIATION FROM STANDARD

No deviation.

9.1.4 TEST SETUP



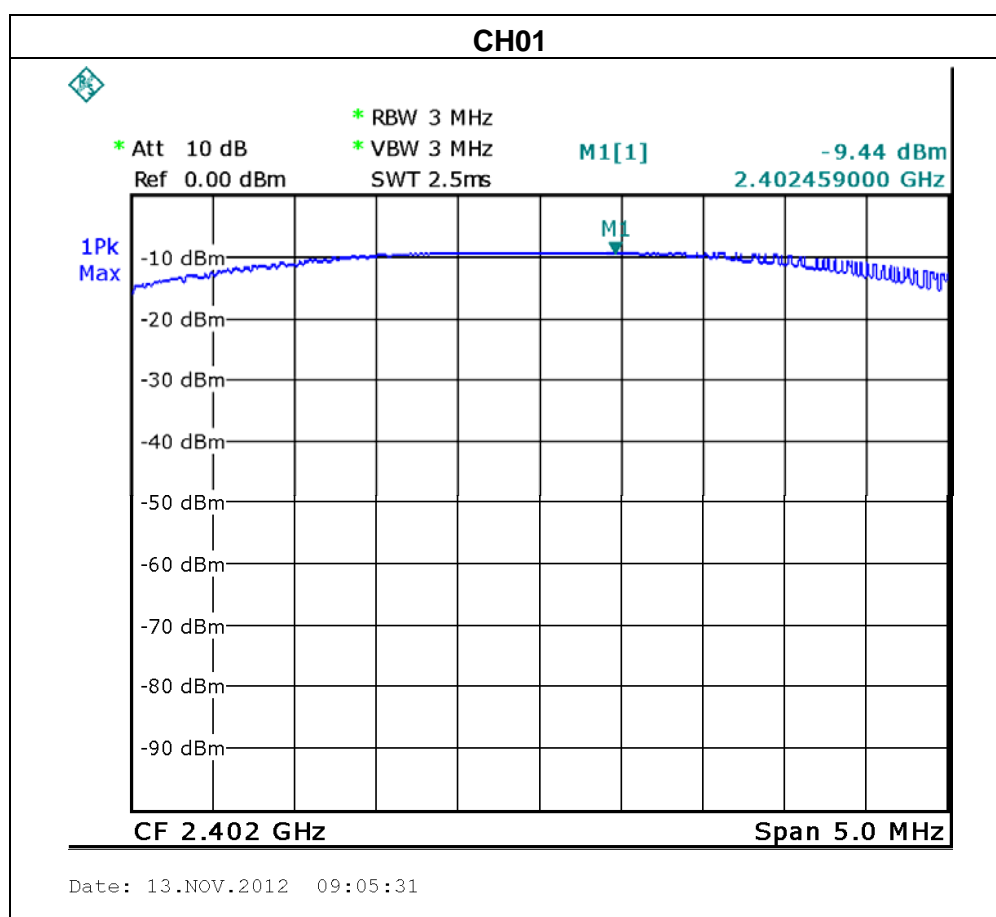
9.1.5 EUT OPERATION CONDITIONS

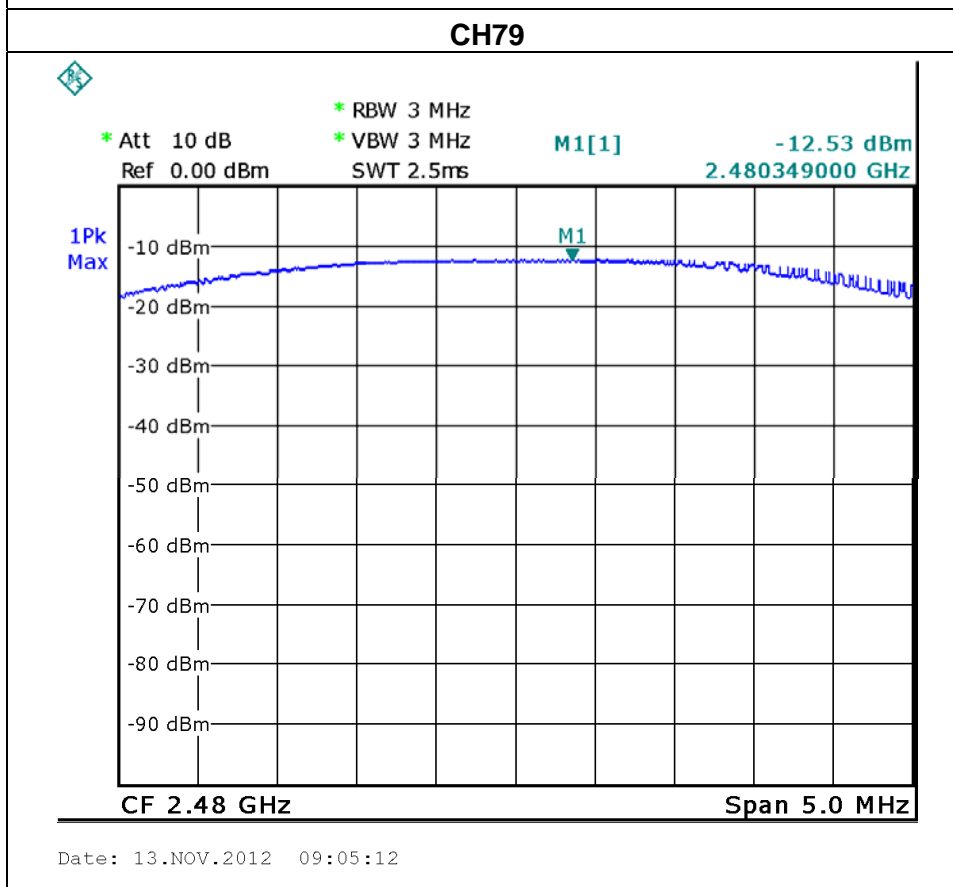
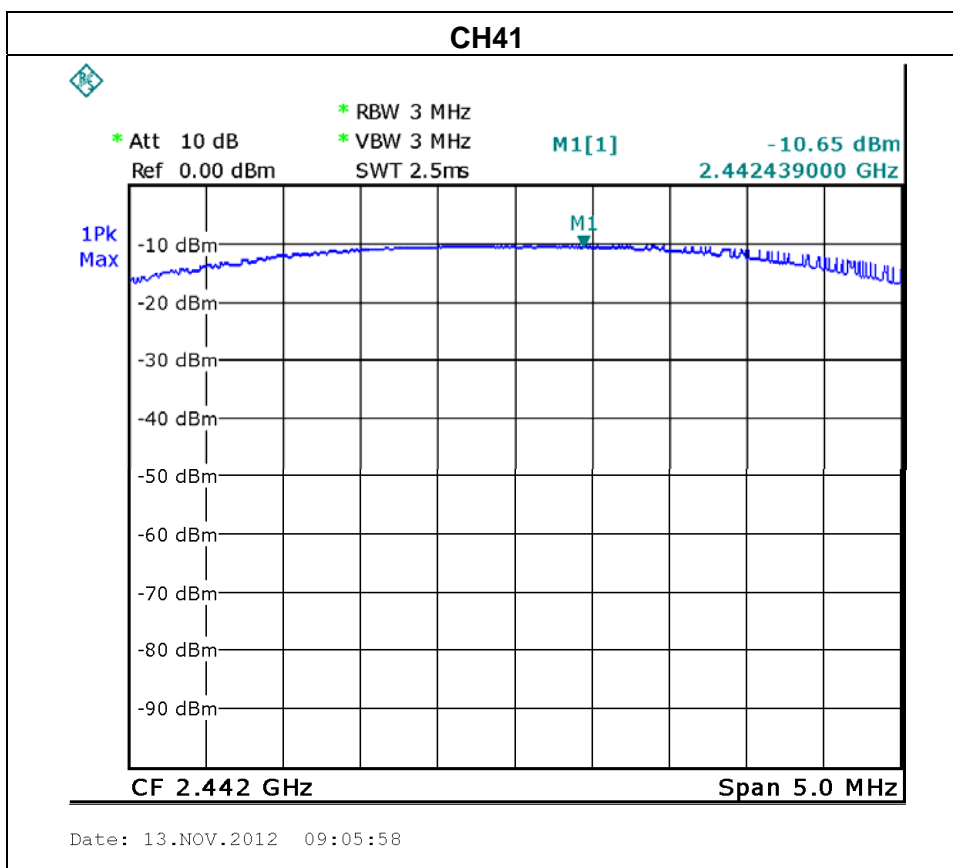
The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 ℃	Relative Humidity :	58 %
Pressure :	1009 hPa	Test Voltage :	DC 3V
Test Mode :	CH01 / CH41 / CH79		

Test Channel	Frequency (MHz)	Peak Output Power (dBm)	LIMIT (dBm)	LIMIT (W)
CH01	2402MHz	-9.44	21	0.125
CH41	2442MHz	-10.65	21	0.125
CH79	2480MHz	-12.53	21	0.125







10. ANTENNA CONDUCTED SPURIOUS EMISSION

10.1 APPLIED PROCEDURES / LIMIT

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

10.1.1 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP 40	100185	Nov.25.2012

Remark: "N/A" denotes no model name, serial no., or calibration specified.

All calibration period of Equipment List is One Year.

10.1.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW= 100KHz, VBW=100KHz, Sweep time = Auto.

10.1.3 DEVIATION FROM STANDARD

No deviation.

10.1.4 TEST SETUP



10.1.5 EUT OPERATION CONDITIONS

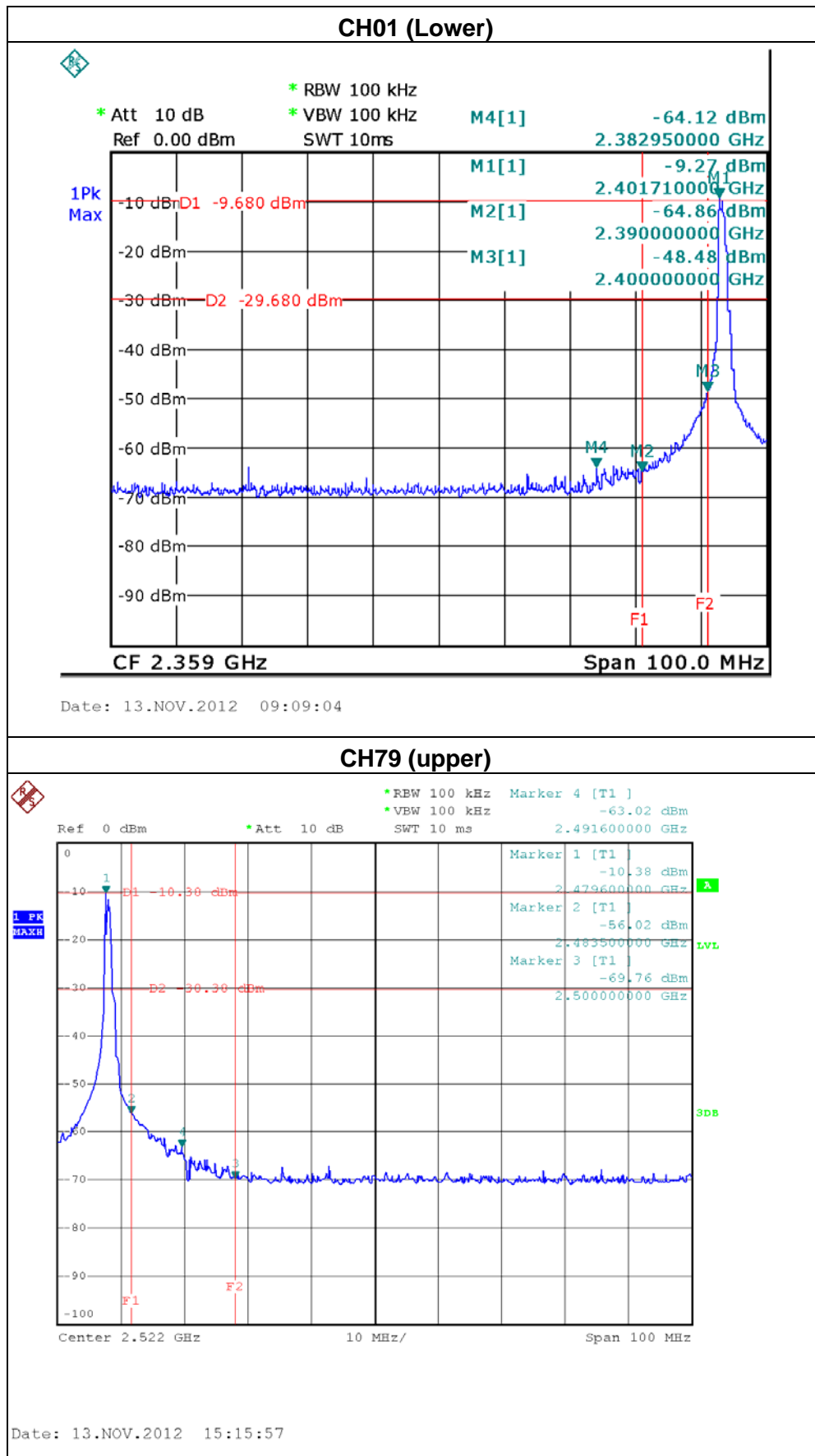
The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



10.1.6 TEST RESULTS

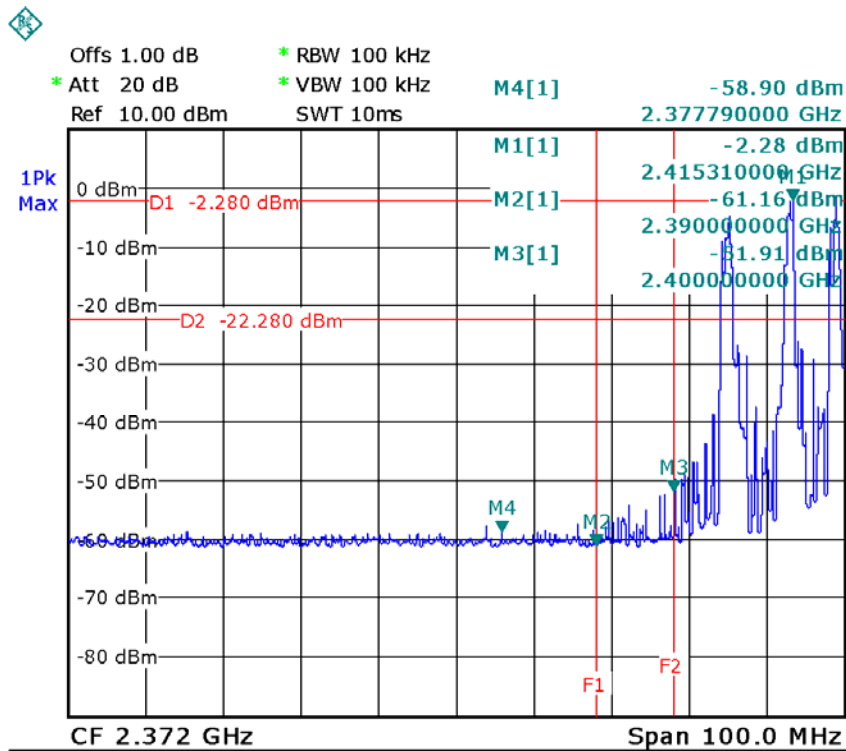
EUT :	Optical Wireless Mouse	Model Name :	OM4000W
Temperature :	25 °C	Relative Humidity :	58 %
Pressure :	1009 hPa	Test Voltage :	DC 3V
Test Mode :	CH01 / CH41 / CH79 & Hopping on mode		

The max. radio frequency power in any 100kHz bandwidth within the frequency band		The max. radio frequency power in any 100 kHz bandwidth within the frequency band.	
FREQUENCY(MHz)	POWER(dBm)	FREQUENCY(MHz)	POWER(dBm)
2400.00	-48.48	2483.50	-56.02
Result			
In any 100kHz bandwidth outside the frequency band, the radio frequency power is at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.			



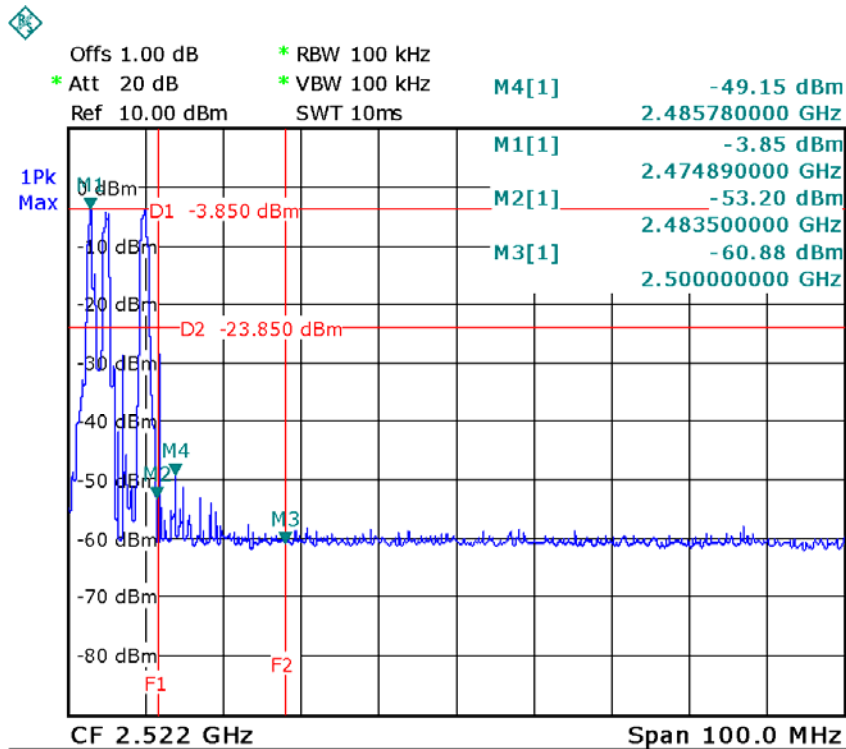


Hopping on mode (Lower)

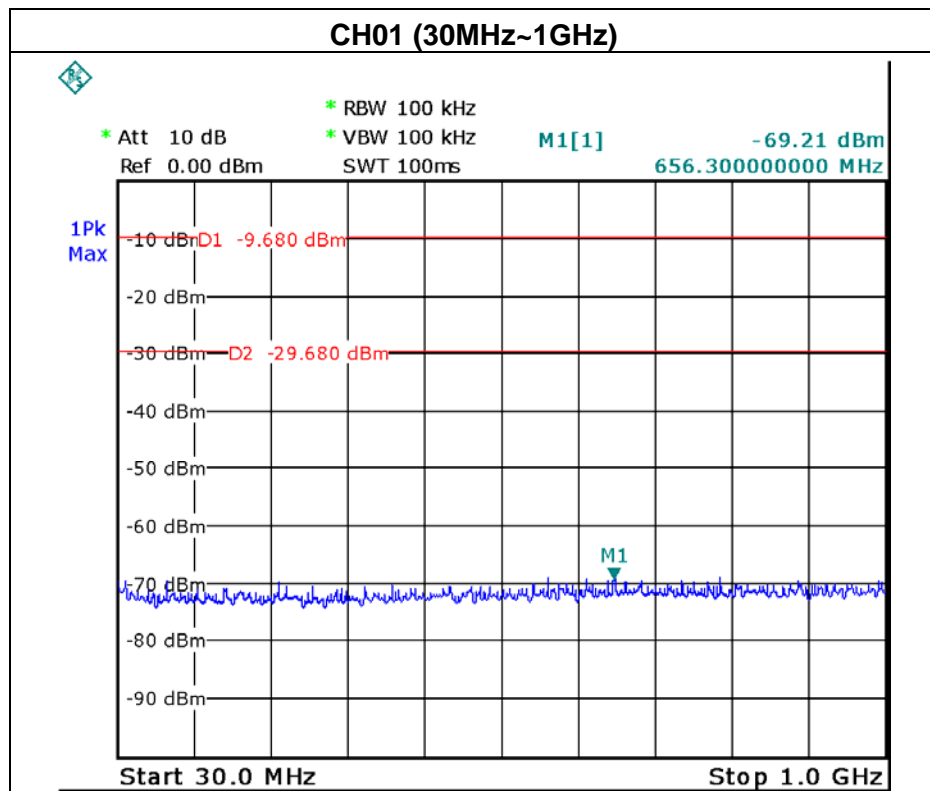


Date: 13.NOV.2012 14:13:34

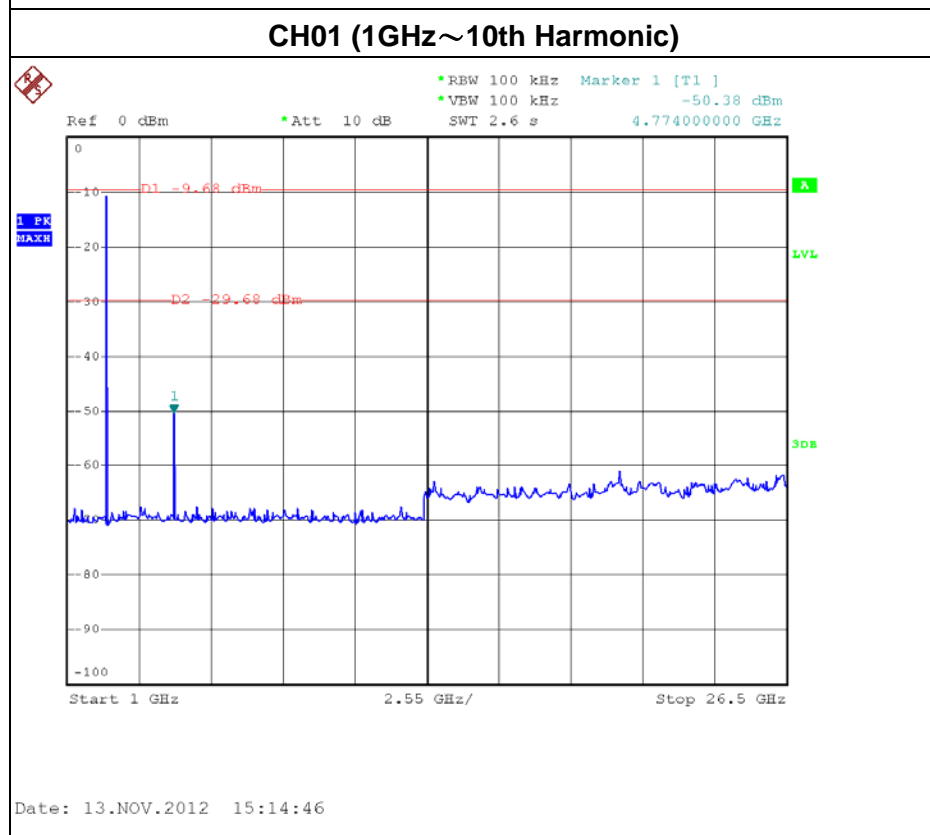
Hopping on mode (upper)



Date: 13.NOV.2012 14:17:28



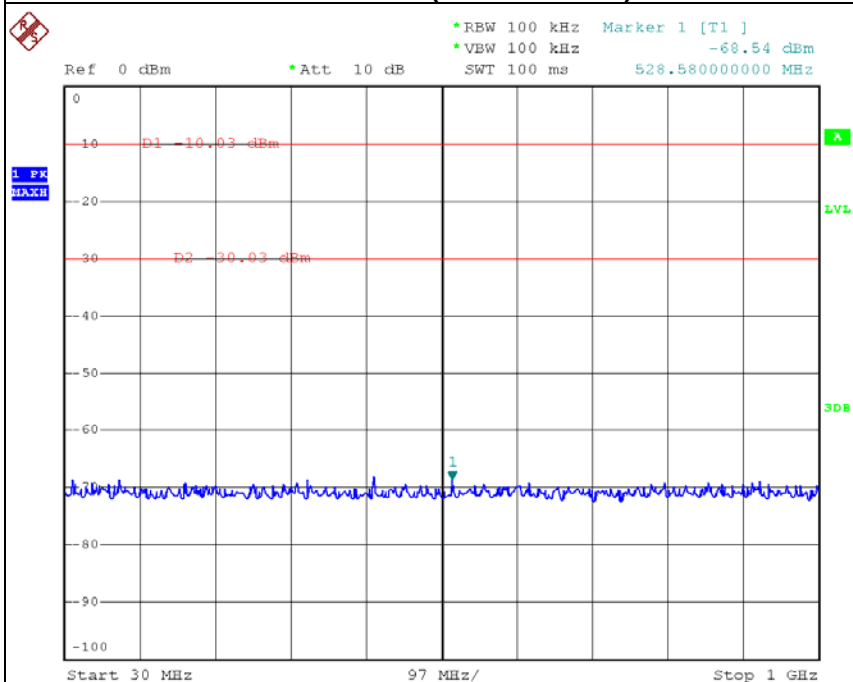
Date: 13.NOV.2012 09:09:26



Date: 13.NOV.2012 15:14:46

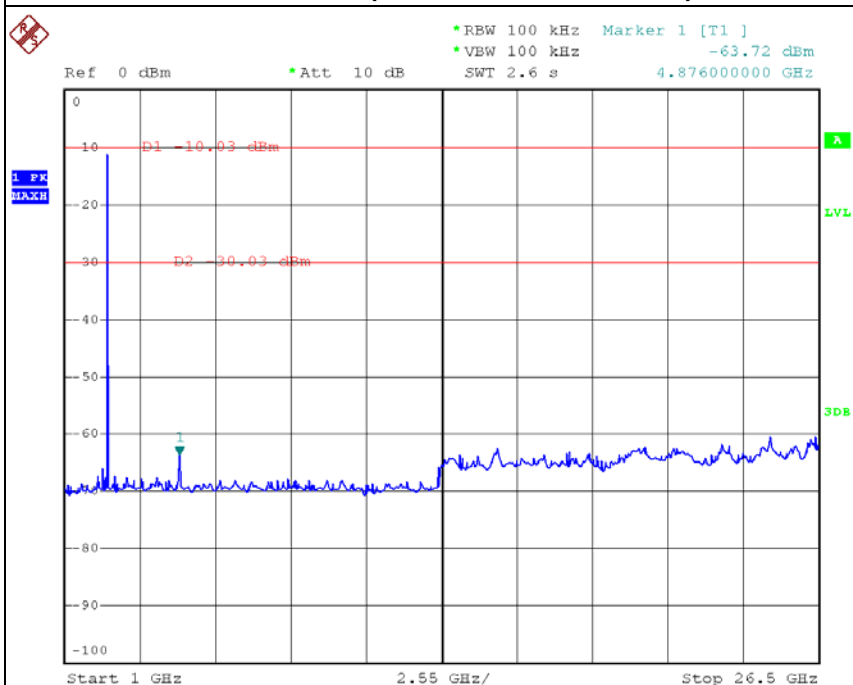


CH41 (30MHz~1GHz)



Date: 13.NOV.2012 15:17:46

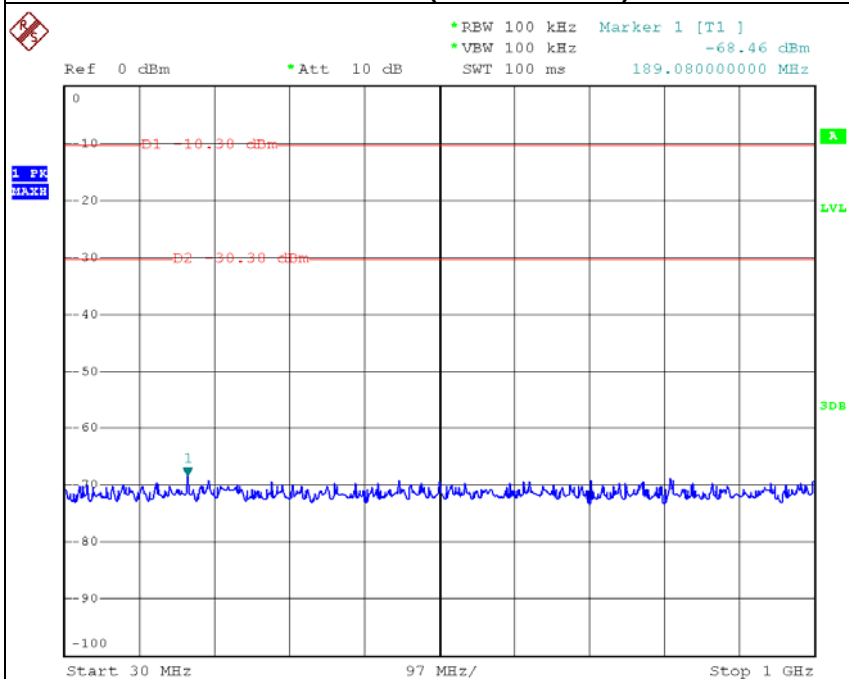
CH41 (1GHz~10th Harmonic)



Date: 13.NOV.2012 15:18:18

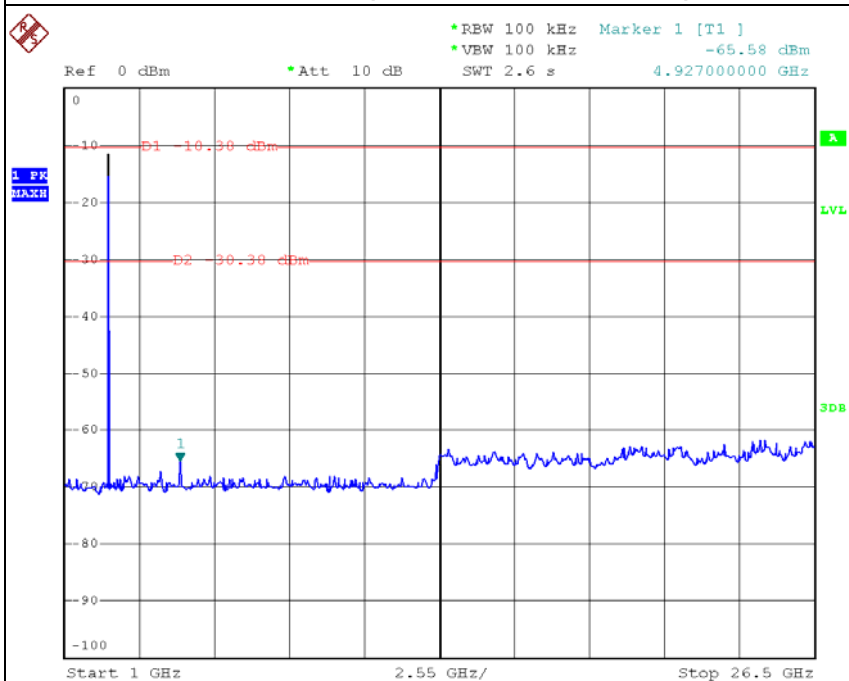


CH79 (30MHz~1GHz)



Date: 13.NOV.2012 15:16:09

CH79 (1GHz~10th Harmonic)

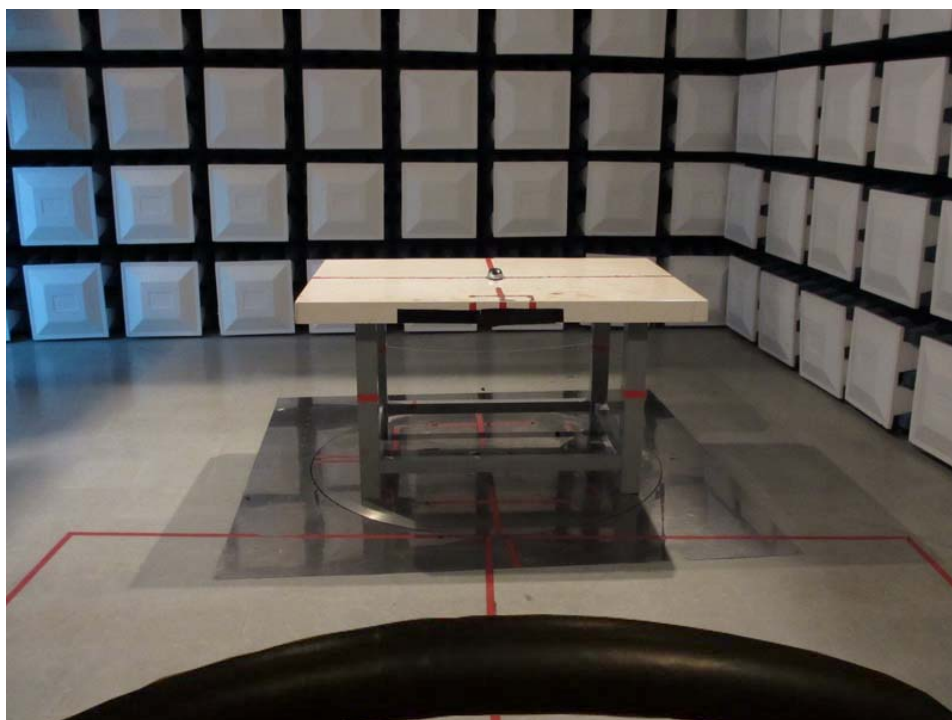
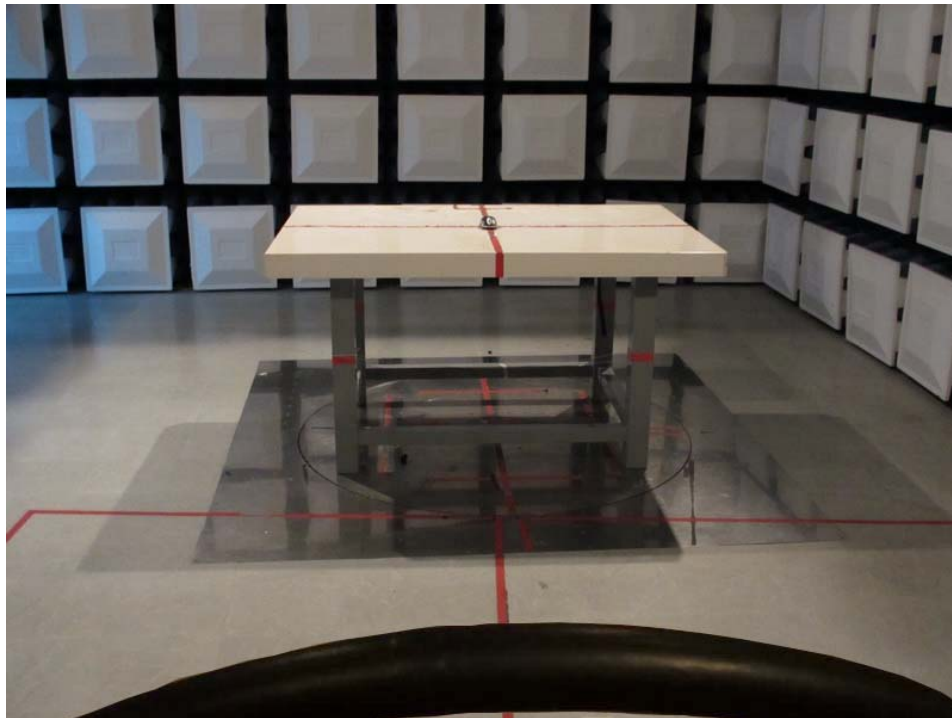


Date: 13.NOV.2012 15:16:29

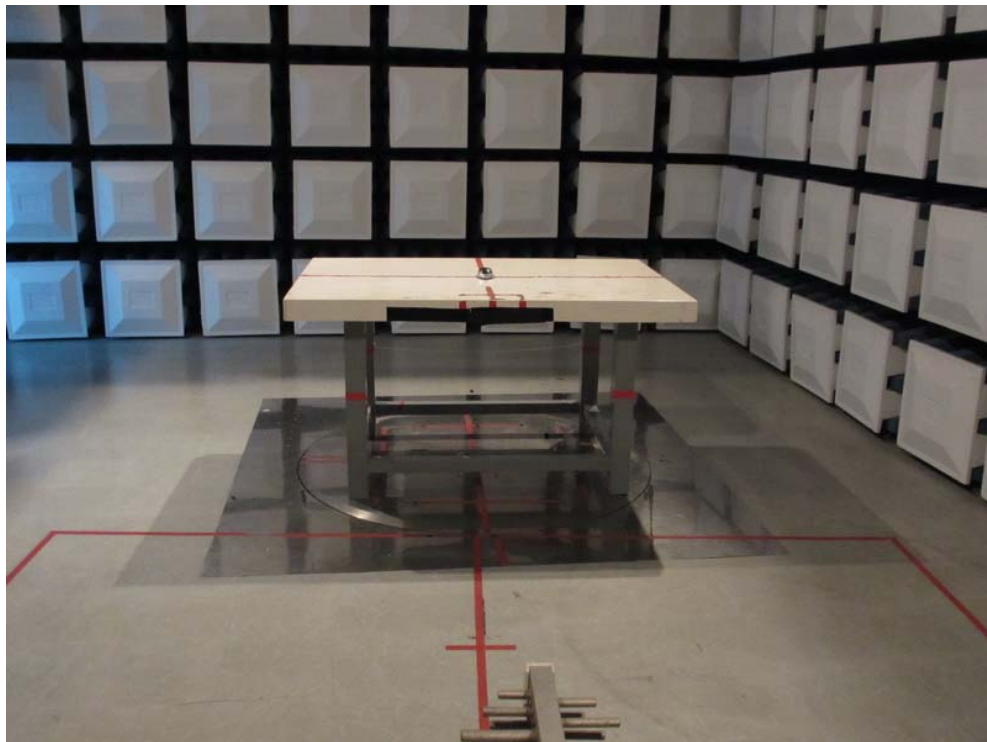


11. EUT TEST PHOTO

**Radiated Measurement Photos
9K-30MHz**



**Radiated Measurement Photos
30MHz-1GHz**



**Radiated Measurement Photos
Above 1GHz**

