FCC TEST REPORT

for

Dongguan Lingjie Electronics Co., Ltd.

Wireless gaming mouse

Model Number: C20S,EDGE

FCC ID: 2AC3KC20S

Prepared for	:	Dongguan Lingjie Electronics Co., Ltd.
Address	:	No. A4-201 Hongye North Road 99, Tangxia Lin village, Dongguan 523711 P.R.C.
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Report No.	:	16KWE013448F
Date of Test	:	Apr. 08~11, 2016
Date of Report	:	Apr. 12, 2016

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Keyway Testing Technology Co., Ltd.

Applicant: **Address:**	Dongguan Lingjie Electronics Co., Ltd. No. A4-201 Hongye North Road 99, Tangxia Lin village, Dongguan 523711 P.R.C.		
Manufacturer: **Address:**	Dongguan Lingjie Electronics Co., Ltd. No. A4-201 Hongye North Road 99, Tangxia Lin village, Dongguan 523711 P.R.C.		
E.U.T:	Wireless gaming mouse		
Model Number:	C20S,EDGE		
Trade Name:	ID or 富德	**Serial No.:**	------
Date of Receipt:	Apr. 07, 2016	**Date of Test:**	Apr. 08~11, 2016
Test Specification:	FCC Part 15, Subpart C Section 15.249: 2015 ANSI C63.10-2013		
Test Result:	The equipment under test was found to be compliance with the requirements of the standards applied.		

Issue Date: Apr. 12, 2016

Tested by:	Reviewed by:	Approved by:
Keven Wu / Engineer	Mike Xu / Supervisor	Andy Gao / Supervisor

Other Aspects:

None.

Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested

1. TEST SUMMARY

Test Items	Test Requirement	Result
Conducted Emissions	15.207	N/A
Radiated Emissions	15.205(a)/15.209/15.249(d)	PASS
Bandwidth	15.249	PASS
Emissions from out of band	15.249	PASS
Antenna Requirement	15.203	PASS

2. GENERAL PRODUCT INFORMATION

2.1. Product Function

Refer to Technical Construction Form and User Manual.

2.2. Description of Device (EUT)

Product Name:	Wireless gaming mouse
Model No.:	C20S,EDGE
Model Difference	All the models are the same circuit and RF module, except the model names and colours.
Operation Frequency:	2402MHz-2480MHz
Channel numbers:	16
Modulation technology:	GFSK
Data speed (IEEE 802.11b):	1Mbps
Antenna Type:	PCB
Antenna gain:	-4.26dBi
Power supply:	DC 3.0V (1.5V AA battery*2)

2.3. Independent Operation Modes

The basic operation modes are:

Test mode	Frequency
Mode 1	2402MHz
Mode 2	2441MHz
Mode 3	2480MHz

2.4. Channel List

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	10	2441MHz				
2	2407MHz	11	2445MHz				
3	2414MHz	12	2459MHz				
4	2414MHz	13	2463MHz				
5	2419MHz	14	2466MHz				
6	2422MHz	15	2473MHz				
7	2426MHz	16	2480MHz				
8	2436MHz						
9	2439MHz						

2.5. TEST SITES

Lab Qualifications : 944 Shielded Room built by ETS-Lindgren, USA
Date of completion: March 28, 2011

966 Chamber built by ETS-Lindgren, USA
Date of completion: March 28, 2011

Certificated by TUV Rheinland, Germany.
Registration No.: UA 50207153
Date of registration: July 13, 2011

Certificated by UL, USA
Registration No.: 100567-237
Date of registration: December 1, 2011

Certificated by Intertek
Registration No.: 2011-RTL-L1-31
Date of registration: October 11, 2011

Certificated by Industry Canada
Registration No.: 9868A
Date of registration: December 8, 2011

Certificated by FCC, USA
Registration No.: 370994
Date of registration: February 21, 2012

Certificated by CNAS China
Registration No.: CNAS L5783
Date of registration: August 8, 2012

Name of Firm : Keyway Testing Technology Co., Ltd.

Site Location : Baishun Industrial Zone, Zhangmutou Town,
Dongguan, Guangdong, China

2.6. List of Test and Measurement Instruments

2.6.1. For conducted emission at the mains terminals test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,15	Apr. 27,16
Artificial Mains Network	Rohde&Schwarz	ENV216	101315	Apr. 27,15	Apr. 27,16
Artificial Mains Network (AUX)	Rohde&Schwarz	ENV216	101314	Apr. 27,15	Apr. 27,16
RF Cable	FUJIKURA	3D-2W	944 Cable	Apr. 27,15	Apr. 27,16

2.6.2. For radiated emission test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,15	Apr. 27,16
System Simulator	Agilent	E5515C	GB43130245	Apr. 27,15	Apr. 27,16
Power Splitter	Weinschel	1506A	NW425	Apr. 27,15	Apr. 27,16
Bilog Antenna	ETS-LINDGREEN	3142D	135452	Apr. 27,15	Apr. 27,16
Spectrum Analyzer	Agilent	E4411B	MY4511304	Apr. 27,15	Apr. 27,16
Spectrum Analyzer	R&S	FSV40	132.1.3008K39 -100967	Apr. 27,15	Apr. 27,16
3m Semi-anechoic Chamber	ETS-LINDGREEN	966	KW01	Apr. 27,15	Apr. 27,16
Signal Amplifier	SONOMA	310	187016	Apr. 27,15	Apr. 27,16
Signal Amplifier	Agilent	8449B	3008A00251	Apr. 27,15	Apr. 27,16
RF Cable	IMRO	IMRO-400	966 Cable 1#	N/A	N/A
MULTI-DEVICE Controller	ETS-LINDGREEN	2090	126913	N/A	N/A
Horn Antenna	DAZE	ZN30701	11003	Apr. 27,15	Apr. 27,16
Horn Antenna	SCHWARZBECK	BBHA9170	9170-068	Apr. 27,15	Apr. 27,16
Spectrum Analyzer	Agilent	8593E	3911A04271	Apr. 27,15	Apr. 27,16
Spectrum Analyzer	Agilent	E4408B	MY44211125	Apr. 27,15	Apr. 27,16
Signal Amplifier	DAZE	ZN3380C	11001	Apr. 27,15	Apr. 27,16
High Pass filter	Micro	HPM50111	324216	Apr. 27,15	Apr. 27,16
Filter	COM-MW	ZBSF-C836.5-25-X	KW032	Apr. 27,15	Apr. 27,16
Filter	COM-MW	ZBSF-C1747.5-75-X2	KW035	Apr. 27,15	Apr. 27,16
Filter	COM-MW	ZBSF-C1880-60-X2	KW037	Apr. 27,15	Apr. 27,16
DC Power Supply	LongWei	PS-305D	010964729	Apr. 27,15	Apr. 27,16
Constant temperature and humidity box	GF	GTH-800-40-1P	MAA9906-005	Apr. 27,15	Apr. 27,16
Universal radio communication tester	Rohde&Schwarz	CMU200	3215420	Apr. 27,15	Apr. 27,16
Splitter	Agilent	11636B	0025164	Apr. 27,15	Apr. 27,16
Loop Antenna	ARA	PLA-1030/B	1029	Apr. 22,15	Apr. 22,16

3. TEST SET-UP AND OPERATION MODES

3.1. Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the Operating Instructions.

3.2. Block Diagram of Test Set-up

System Diagram of Connections between EUT and Simulators

(EUT: Wireless gaming mouse)

3.3. Test Operation Mode and Test Software

None.

3.4. Special Accessories and Auxiliary Equipment

None.

3.5. Countermeasures to Achieve EMC Compliance

None.

4. EMISSION TEST RESULTS

4.1. Conducted Emission at the Mains Terminals Test

4.1.1. Limit 15.207 limits

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15-0.5 0.5-5 5-30	66 to 56 56 60	56 to 46 46 50

4.1.2. Test Setup

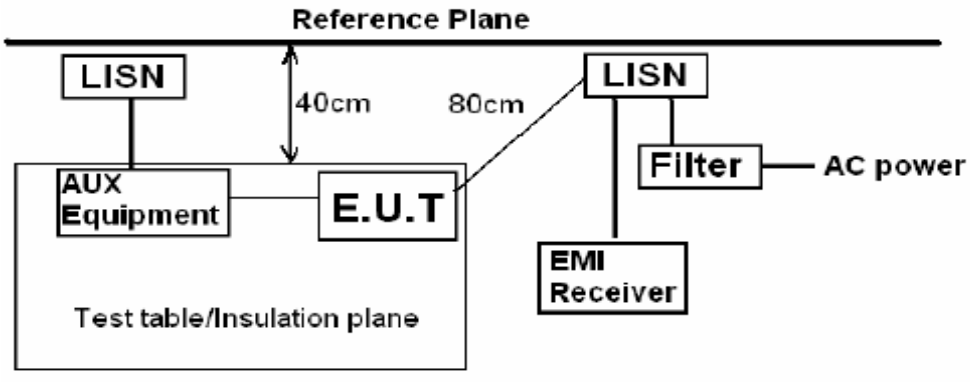
The EUT was put on a wooden table which was 0.8 m high above the ground and connected to the AC mains through the Artificial Mains Network (AMN). Where the mains cable supplied by the manufacture was longer than 0.8 m, the excess was folded back and forth parallel to the cable at the centre so as to form a bundle no longer than 0.4 m.

The EUT was kept 0.4 m from any other earthed conducting surface. Both sides of AC line were checked to find out the maximum conducted emission levels according to the test procedure during the conducted emission test.

The frequency range from 150 kHz to 30 MHz was investigated.

The bandwidth of the test receiver was set at 9 kHz.

Pretest for all mode, The test data of the worst case condition(s) was reported on the following page.



Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m

EUT：	Wireless gaming mouse	Model Name ：	C20S
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Phase：	N/A
Test Voltage ：	N/A	Test Mode：	N/A

4.2. Radiated Emission Test

4.2.1. Limit 15.209 limits

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/m
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

4.2.2. Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

4.2.3. Test setup

The EUT was placed on a turn table which was 0.8 m(above 1GHz, the table was 1.5m) above the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

The EUT was tested in the Chamber Site. It was pre-scanned with a Peak detector from the spectrum, and all the final readings from the test receiver were measured with the Quasi-Peak detector.

The bandwidth of the EMI test receiver is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz.

The frequency range from 30MHz to 10^{th} harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

Notes: 1. Emission Level = Antenna Factor + Cable Loss + Meter Reading-Preamp Factor.

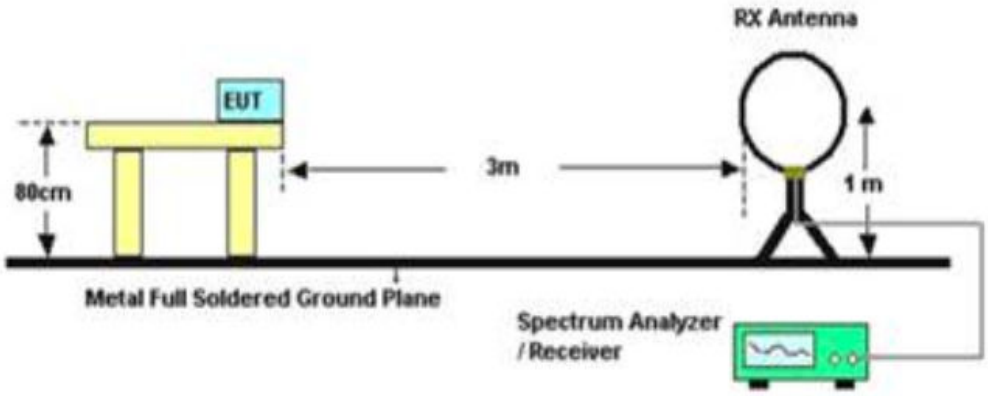
2. Measurement Uncertainty: ±3.2 dB at a level of confidence of 95%.

3. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

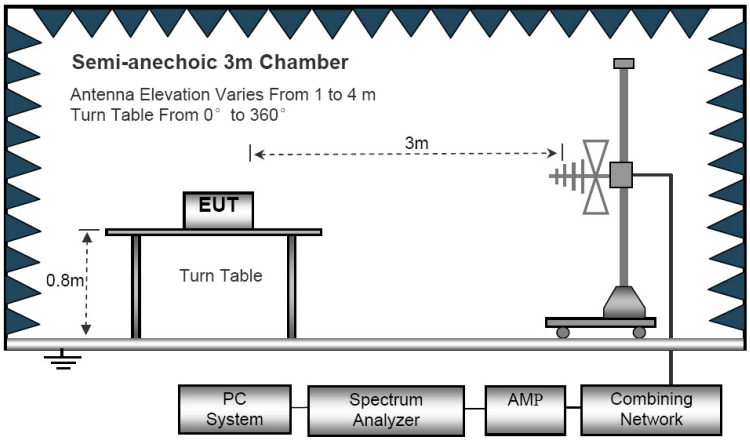
4. For emissions below 1GHz, pretest for all mode, The test data of the worst case condition(s) was reported on the following pages.

5. 5.EUT Pre-scan X/Y/Z orientation, only worst case is presented in the report (Z orientation).

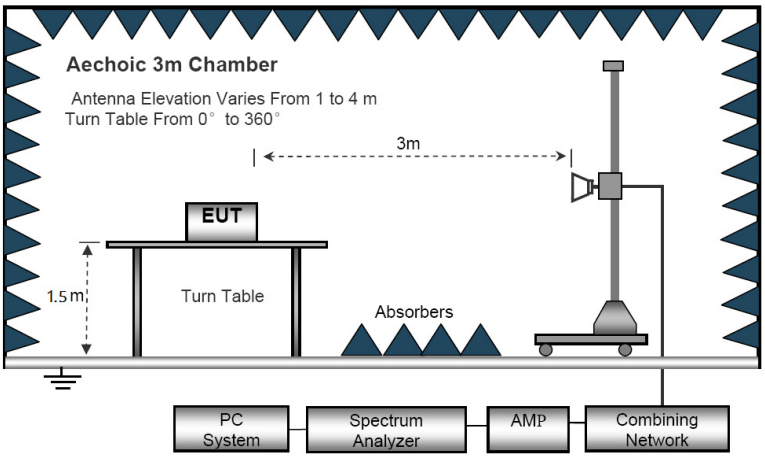
Radiated Emission Test-Up Frequency Below 30MHz



30MHz- 1GHz



Above 1GHz



Below 30MHz

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	P
--	--	--	--	P

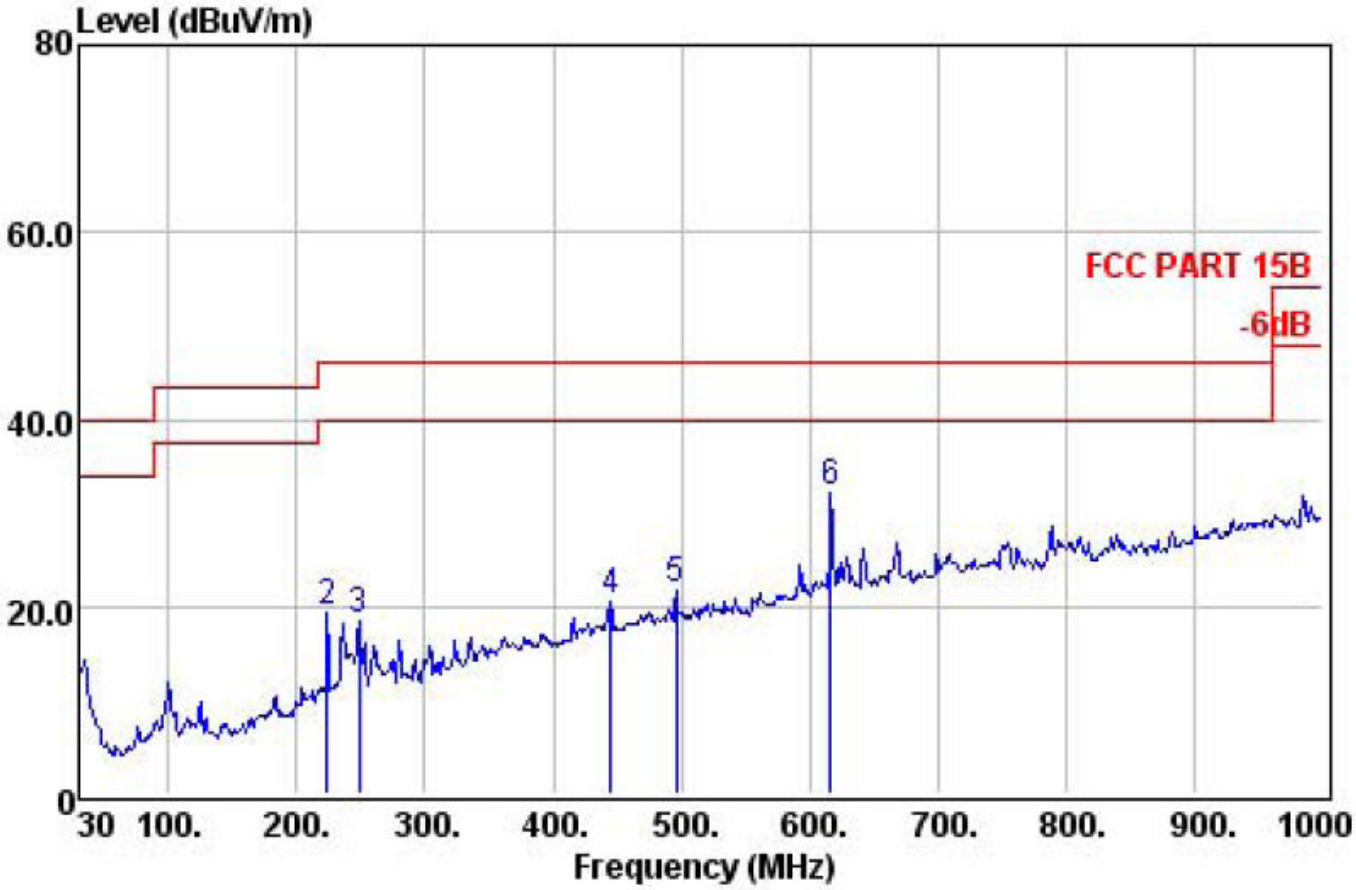
Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB);

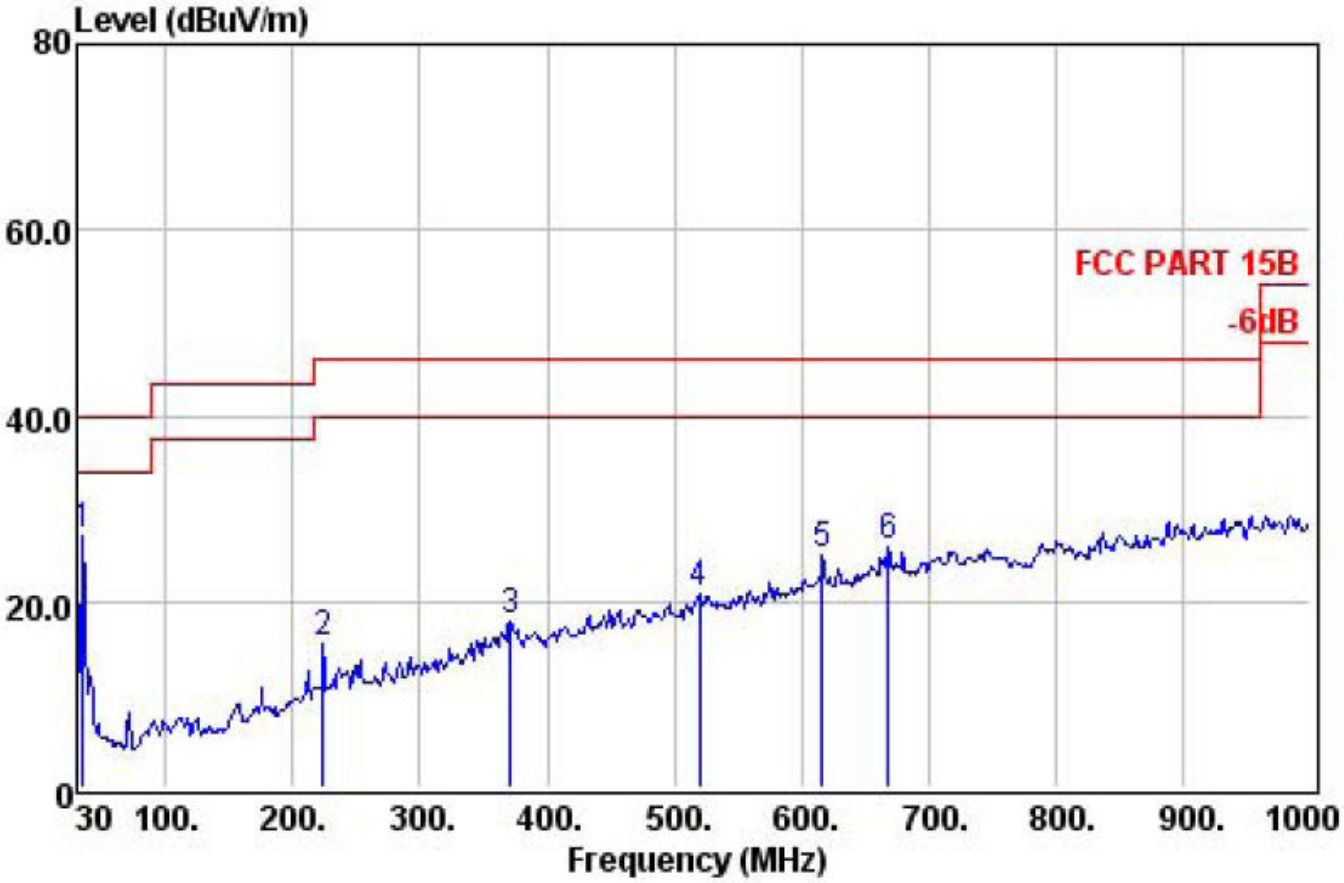
Limit line = specific limits(dBuv) + distance extrapolation factor.

Below 1GHz
Horizontal



	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	30.00	31.41	27.18	0.56	15.13	40.00	-24.87	QP
2	224.00	30.95	36.50	1.53	19.23	46.00	-26.77	QP
3	248.25	30.96	34.94	1.70	18.53	46.00	-27.47	QP
4	445.16	30.61	31.01	2.62	20.52	46.00	-25.48	QP
5	495.60	30.59	30.81	2.77	21.62	46.00	-24.38	QP
6	616.85	30.64	38.37	3.38	32.18	46.00	-13.82	QP

Vertical



	Freq	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	34.85	31.38	41.80	0.56	26.92	40.00	-13.08	QP
2	224.00	30.95	32.85	1.53	15.58	46.00	-30.42	QP
3	371.44	30.62	30.02	2.27	17.84	46.00	-28.16	QP
4	519.85	30.67	29.45	2.94	20.82	46.00	-25.18	QP
5	616.85	30.64	31.11	3.38	24.92	46.00	-21.08	QP
6	668.26	30.79	31.13	3.69	25.87	46.00	-20.13	QP

Mode 1 is the worst mode. only worst case is presented in the report

Above 1GHz

Frequency (MHz)	Reading (dB μ V)	Factor (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Remark	Polar (H/V)
low channel(2402MHz)							
2402.000	78.98	13.02	92.00	114	-22.00	Pk	Vertical
2402.000	69.75	13.02	82.77	94	-11.23	AV	Vertical
4804.000	47.85	10.12	57.97	74	-16.03	Pk	Vertical
4804.000	35.67	10.12	45.79	54	-8.21	AV	Vertical
7206.000	44.12	12.05	56.17	74	-17.83	Pk	Vertical
7206.000	34.78	12.05	46.83	54	-7.17	AV	Vertical
2402.000	73.56	13.02	86.58	114	-27.42	Pk	Horizontal
2402.000	63.02	13.02	76.04	94	-17.96	AV	Horizontal
4804.000	45.63	10.12	55.75	74	-18.25	Pk	Horizontal
4804.000	33.23	10.12	43.35	54	-10.65	AV	Horizontal
7206.000	43.23	12.05	55.28	74	-18.72	Pk	Horizontal
7206.000	32.12	12.05	44.17	54	-9.83	AV	Horizontal
Middle channel(2441MHz)							
2441.000	75.45	12.96	88.41	114	-25.59	Pk	Vertical
2441.000	65.34	12.96	78.3	94	-15.70	AV	Vertical
4882.000	52.12	10.42	62.54	74	-11.46	Pk	Vertical
4882.000	37.34	10.42	47.76	54	-6.24	AV	Vertical
7323.000	47.42	12.81	60.23	74	-13.77	Pk	Vertical
7323.000	35.35	12.81	48.16	54	-5.84	AV	Vertical
2441.000	74.12	12.96	87.08	114	-26.92	Pk	Horizontal
2441.000	64.12	12.96	77.08	94	-16.92	AV	Horizontal
4882.000	54.62	10.42	65.04	74	-8.96	Pk	Horizontal
4882.000	35.62	10.42	46.04	54	-7.96	AV	Horizontal
7323.000	48.63	12.81	61.44	74	-12.56	Pk	Horizontal
7323.000	36.42	12.81	49.23	54	-4.77	AV	Horizontal
High channel(2480MHz)							
2480.000	78.45	12.93	91.38	114	-22.62	Pk	Vertical
2480.000	65.09	12.93	78.02	94	-15.98	AV	Vertical
4960.000	48.56	10.48	59.04	74	-14.96	Pk	Vertical
4960.000	35.34	10.48	45.82	54	-8.18	AV	Vertical
7440.000	45.12	12.87	57.99	74	-16.01	Pk	Vertical
7440.000	35.09	12.87	47.96	54	-6.04	AV	Vertical
2480.000	74.12	12.93	87.05	114	-26.95	Pk	Horizontal
2480.000	62.31	12.93	75.24	94	-18.76	AV	Horizontal
4960.000	45.22	10.48	55.7	74	-18.3	Pk	Horizontal
4960.000	35.12	10.48	45.6	54	-8.4	AV	Horizontal
7440.000	49.12	12.87	61.99	74	-12.01	Pk	Horizontal
7440.000	34.62	12.87	47.49	54	-6.51	AV	Horizontal

NOTE:

Factor= Antenna Factor+cable loss-Preamp factor,

Corrected Amplitude=Reading+ Factor

Margin= Absolute Level – Limit

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has not to be reported.

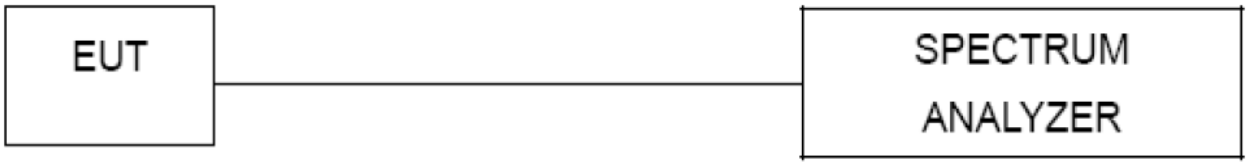
5. BANDWIDTH TEST

5.1. TEST PROCEDURE

a. The EUT was directly connected to the spectru analyzer and antenna output port as show in the block diagram below.

b.Spectrum Setting:RBW=100KHz, VBW ≥ RBW, Sweep=Auto.

5.2. Test setup

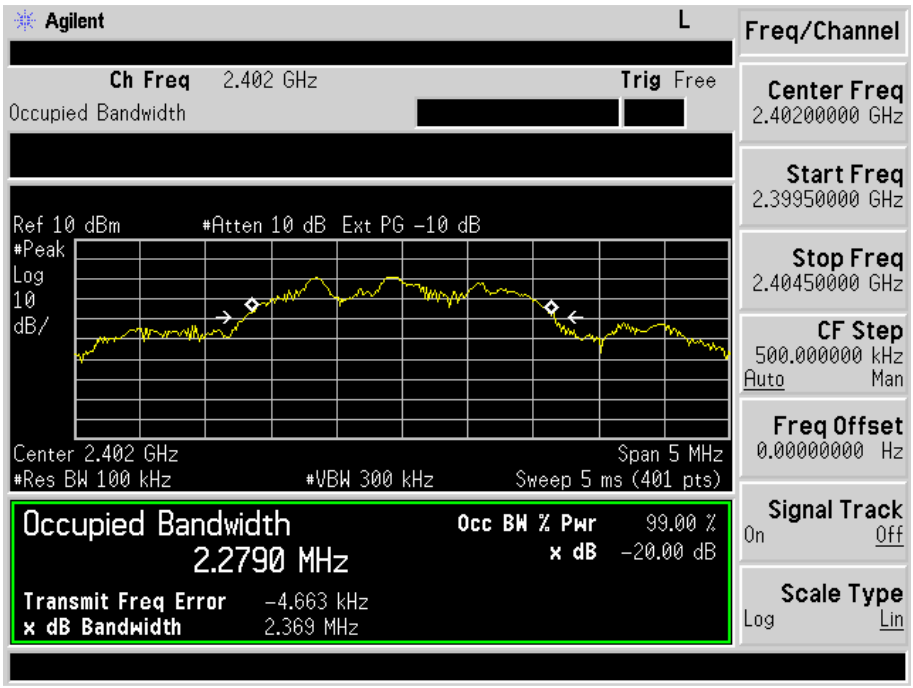


Test data:

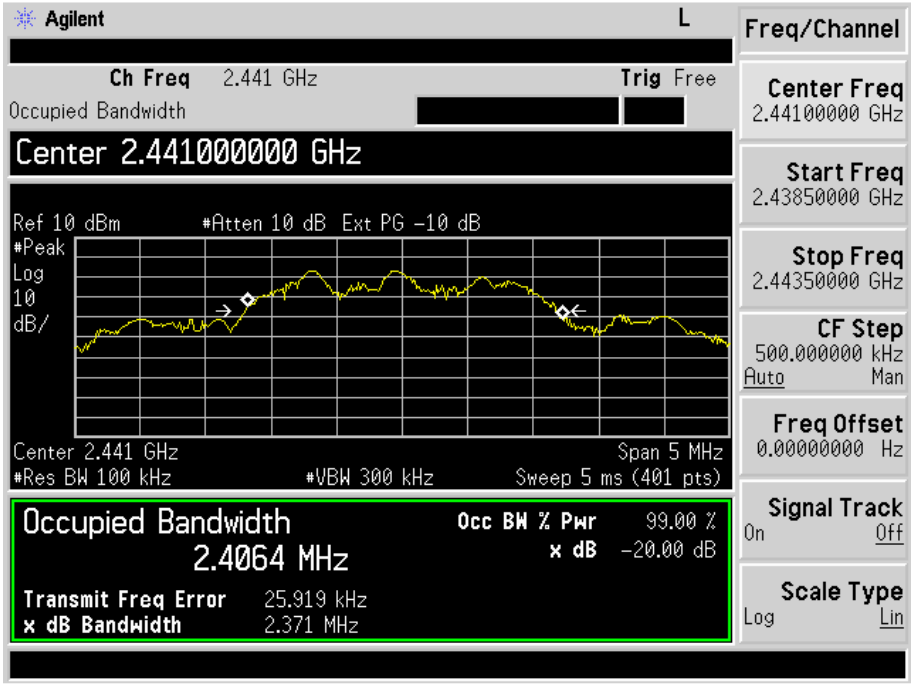
Channel Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402	2.369	2.279	Pass
2441	2.371	2.406	Pass
2480	2.405	2.764	Pass

Test plot as follows:

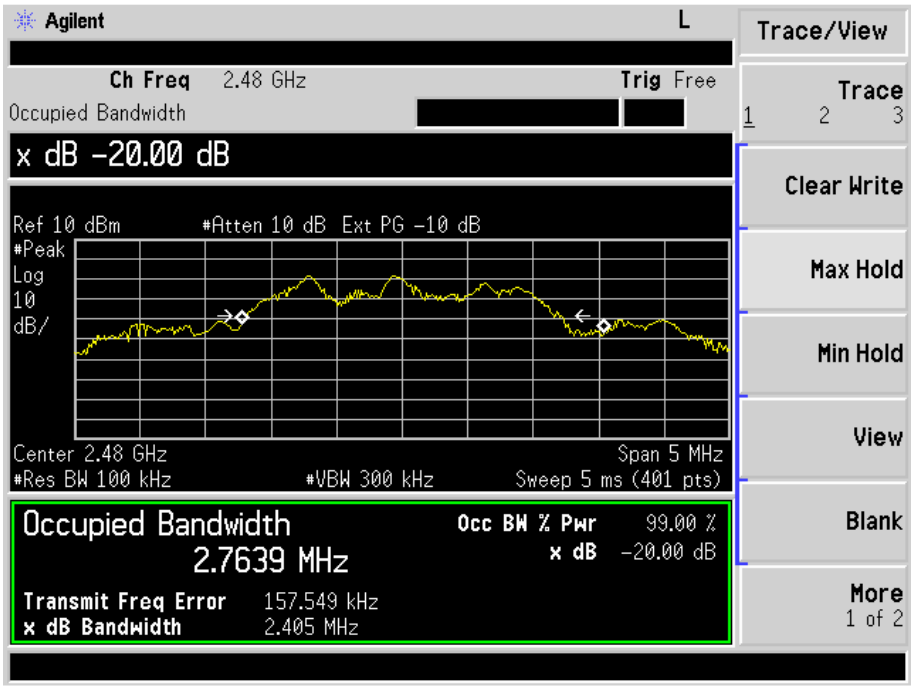
2402MHz



2441MHz



2480 MHz


Agilent
L
Trace/View
Ch Freq 2.48 GHz
Trig Free
Occupied Bandwidth
Trace
1 2 3
x dB -20.00 dB
Clear Write
Ref 10 dBm
#Atten 10 dB Ext PG -10 dB
Max Hold
#Peak
Log
10
dB/
Min Hold
View
Center 2.48 GHz
Span 5 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 5 ms (401 pts)
Blank
Occupied Bandwidth
2.7639 MHz
Occ BW % Pwr 99.00 %
x dB -20.00 dB
More
1 of 2
Transmit Freq Error 157.549 kHz
x dB Bandwidth 2.405 MHz

6. BAND EDGE COMPLIANCE TEST

6.1. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF con-ducted or a radiated measurement.

6.2. Test setup

The EUT was placed on a turn table which was 1.5 m above the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

Set to span from the lowest frequency generated in the device up to and including the tenth harmonic of the highest fundamental frequency

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure. For all test, used peak detector.

Note: If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

For radiated test as follows:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type	Comment
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		
2390	36.85	13.06	49.91	74.00	-24.09	peak	Vertical
2390	35.78	13.06	48.84	74.00	-25.16	peak	Horizontal
2483.5	37.23	12.78	50.01	74.00	-23.99	peak	Vertical
2483.5	38.56	12.78	51.34	74.00	-22.66	peak	Horizontal
hopping							
2390	36.23	13.06	49.29	74.00	-24.71	peak	Vertical
2390	35.15	13.06	48.21	74.00	-25.79	peak	Horizontal
2483.5	37.56	12.78	50.34	74.00	-23.66	peak	Vertical
2483.5	38.36	12.78	51.14	74.00	-22.86	peak	Horizontal

If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

7. ANTENNA REQUIREMENTS

7.1. Limits

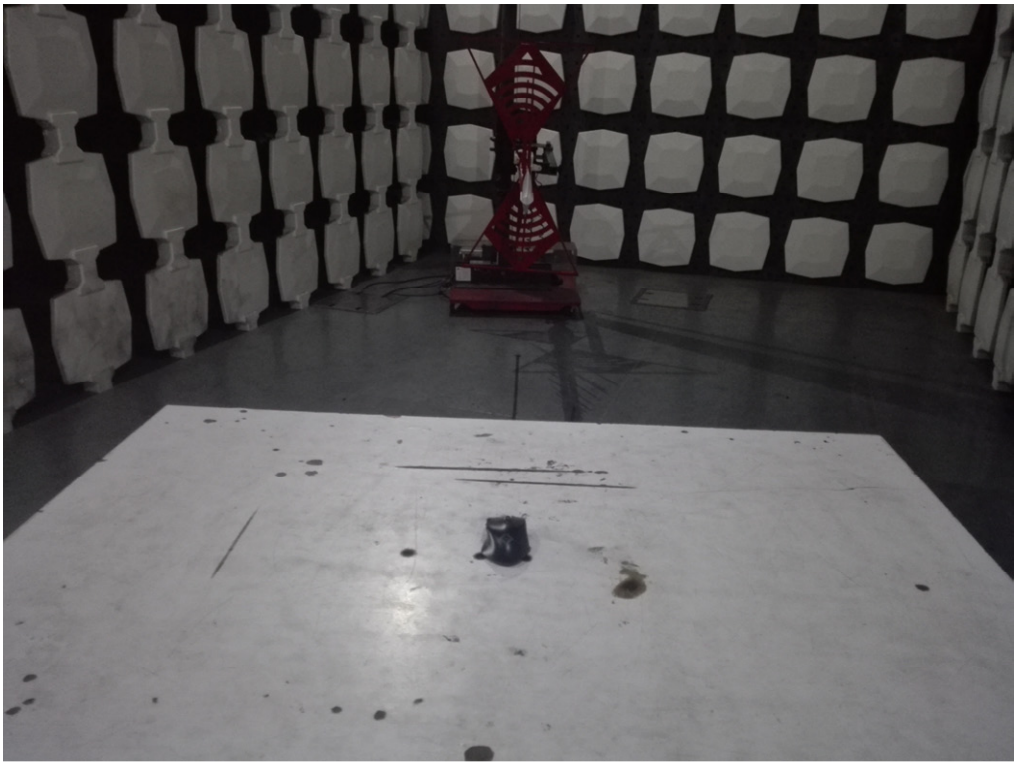
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

7.2. Result

The antennas used for this product are permanent attached antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only -4.26dBi.

8. PHOTOGRAPHS OF TEST SET-UP

Radiated Emission Test



9. PHOTOGRAPHS OF THE EUT


cm 1 2 3 4 5 6 7 8 9 10 11
32 INCH 1 2 3 64 4 16


cm 1 2 3 4 5 6 7 8 9 10 11 12 13
32 INCH 1 2 3 64 4 16 5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Made in China
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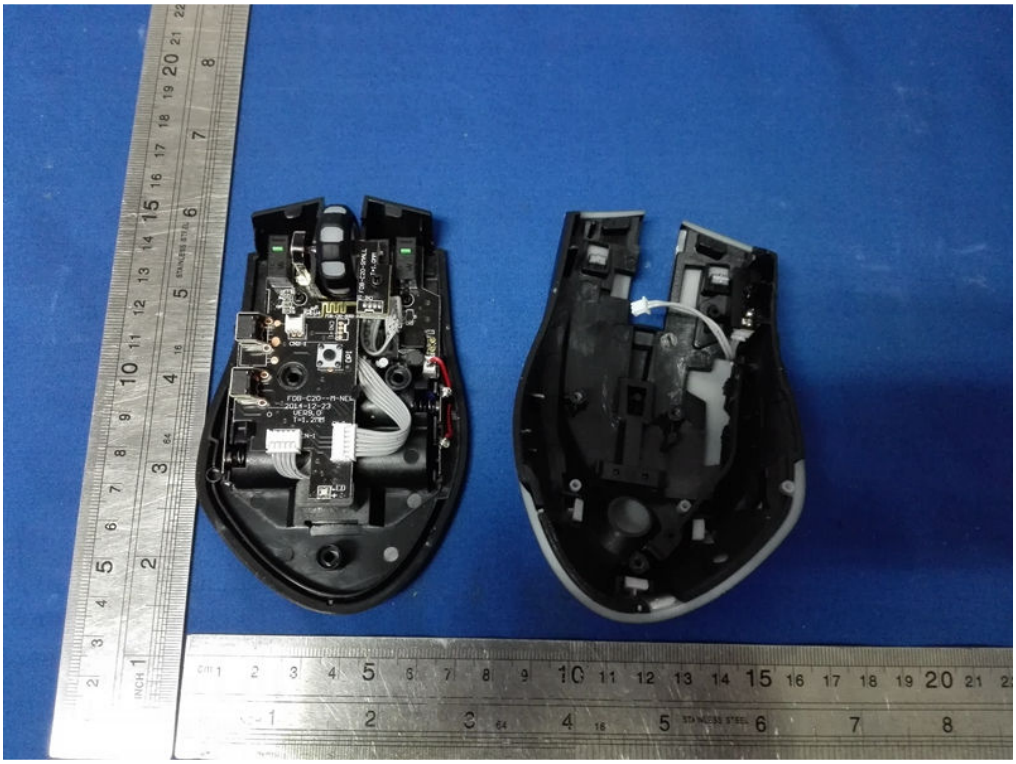

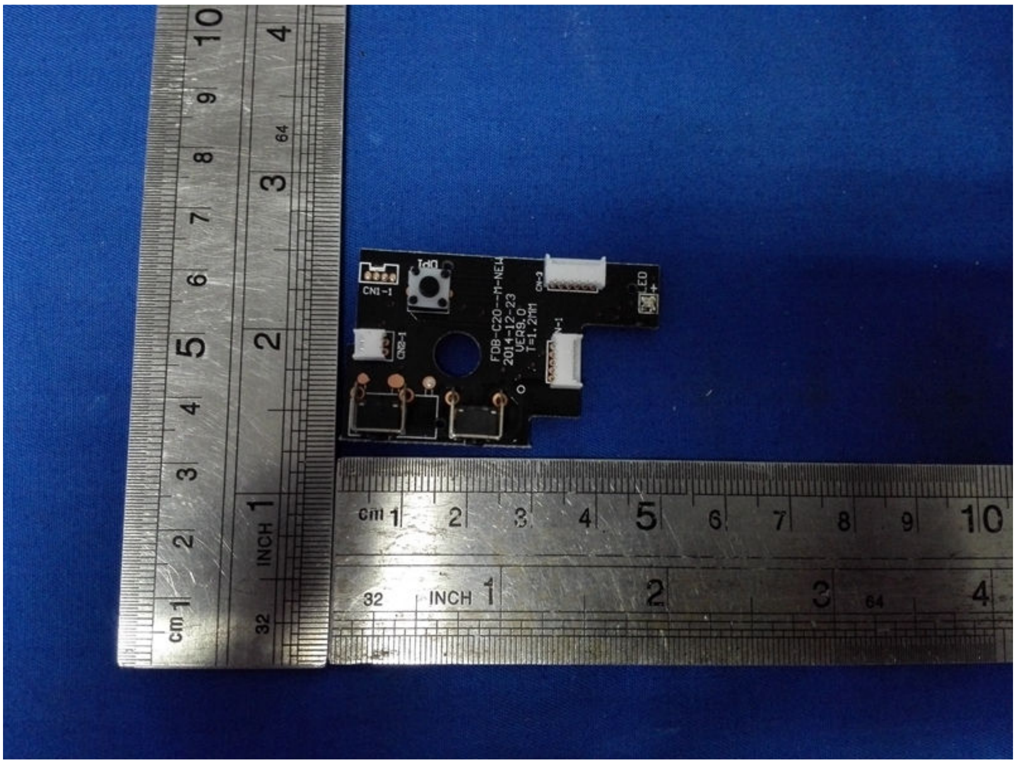
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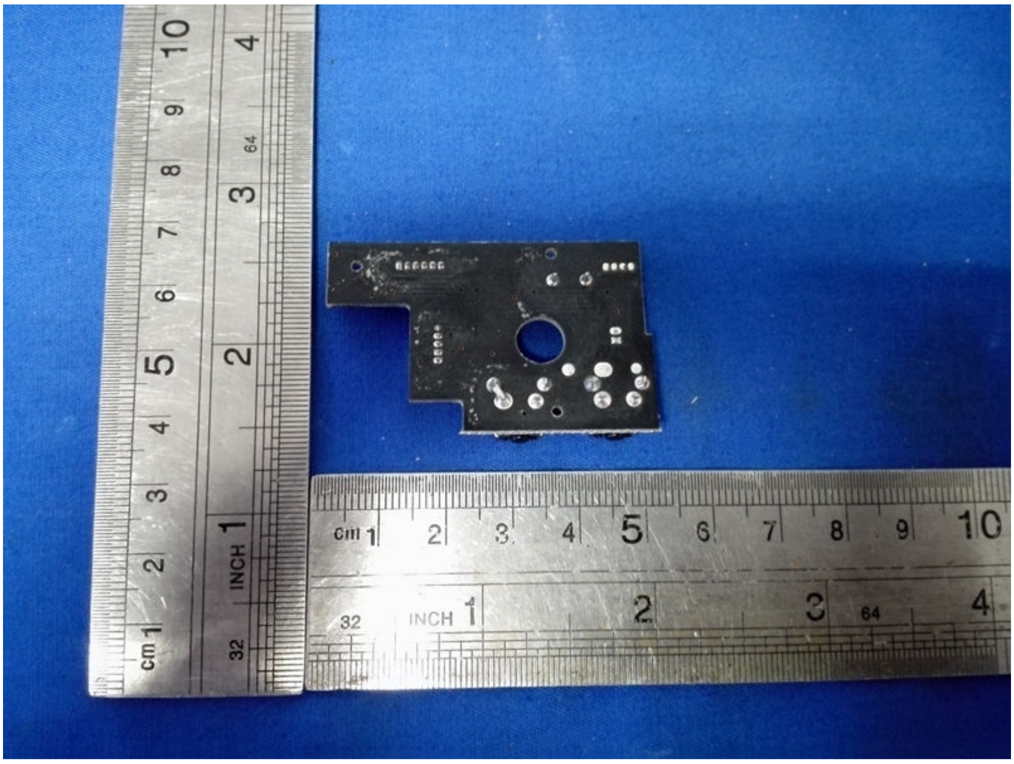
cm
INCH


cm
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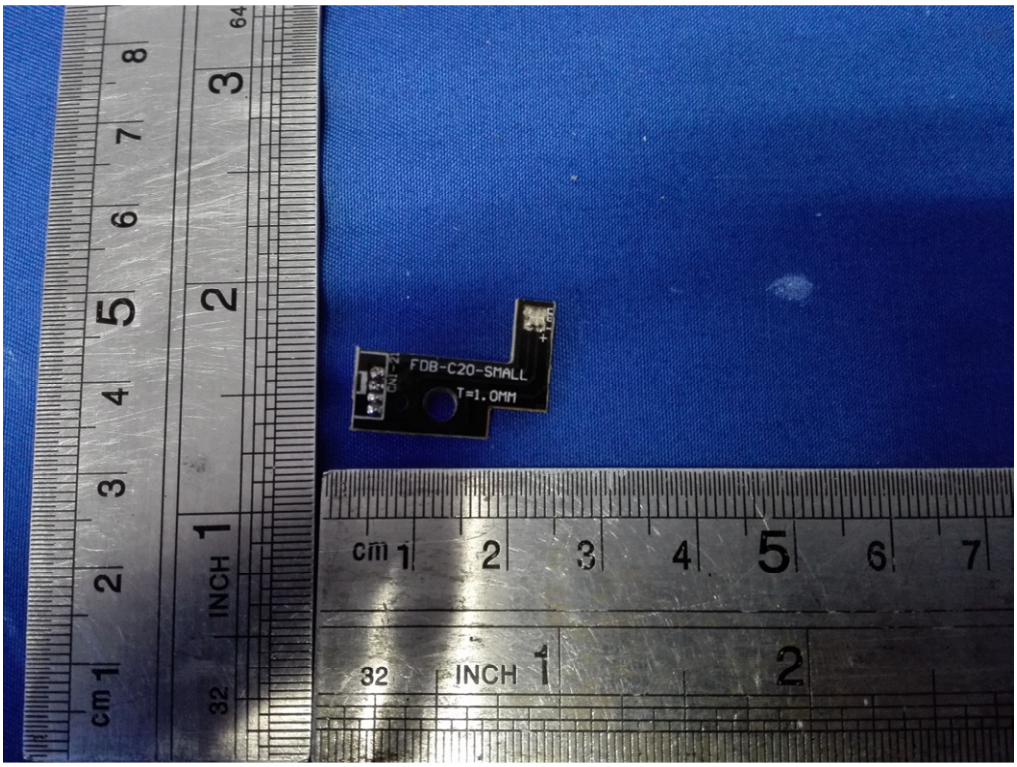
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CN1
cm
INCH
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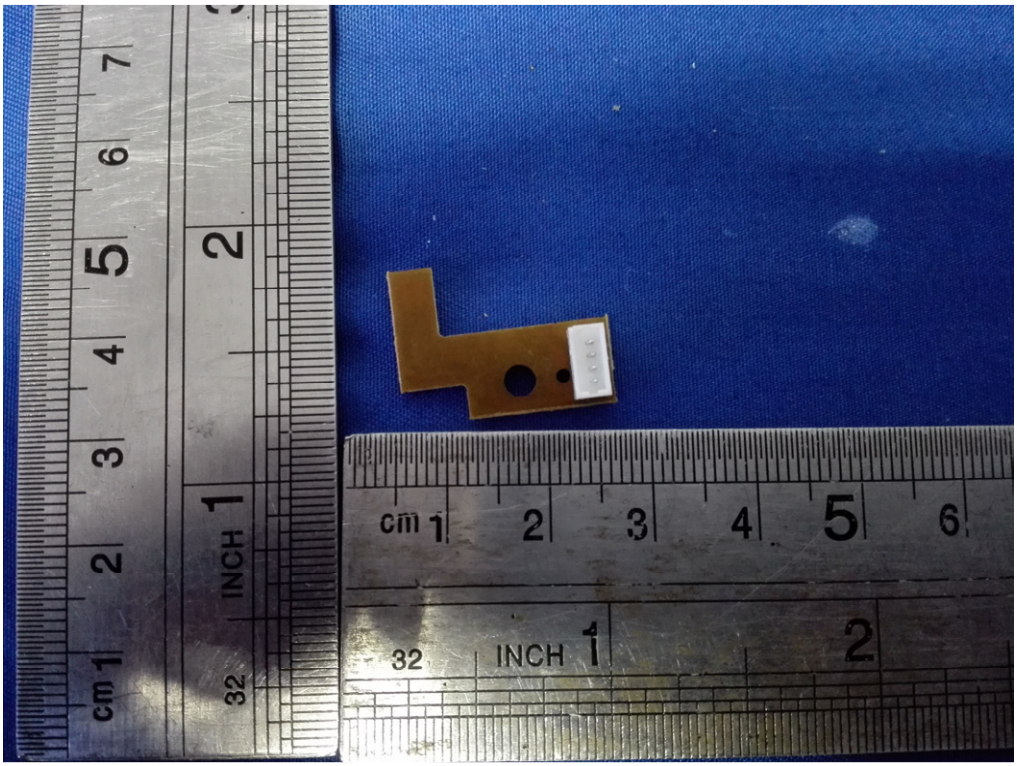
cm
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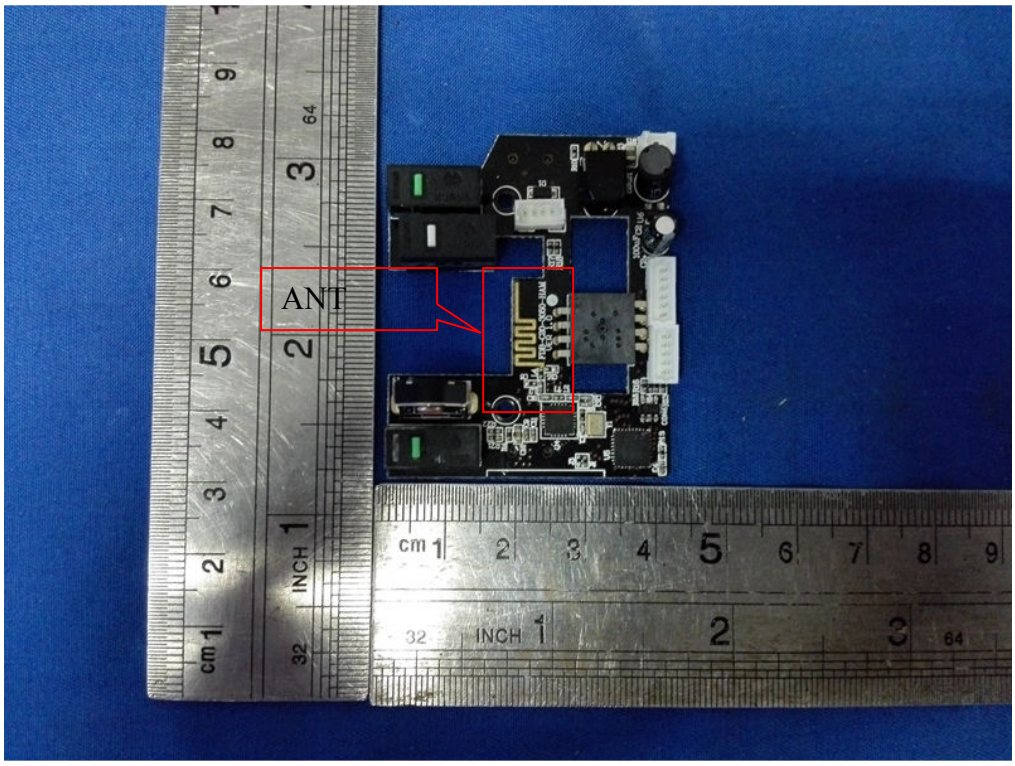

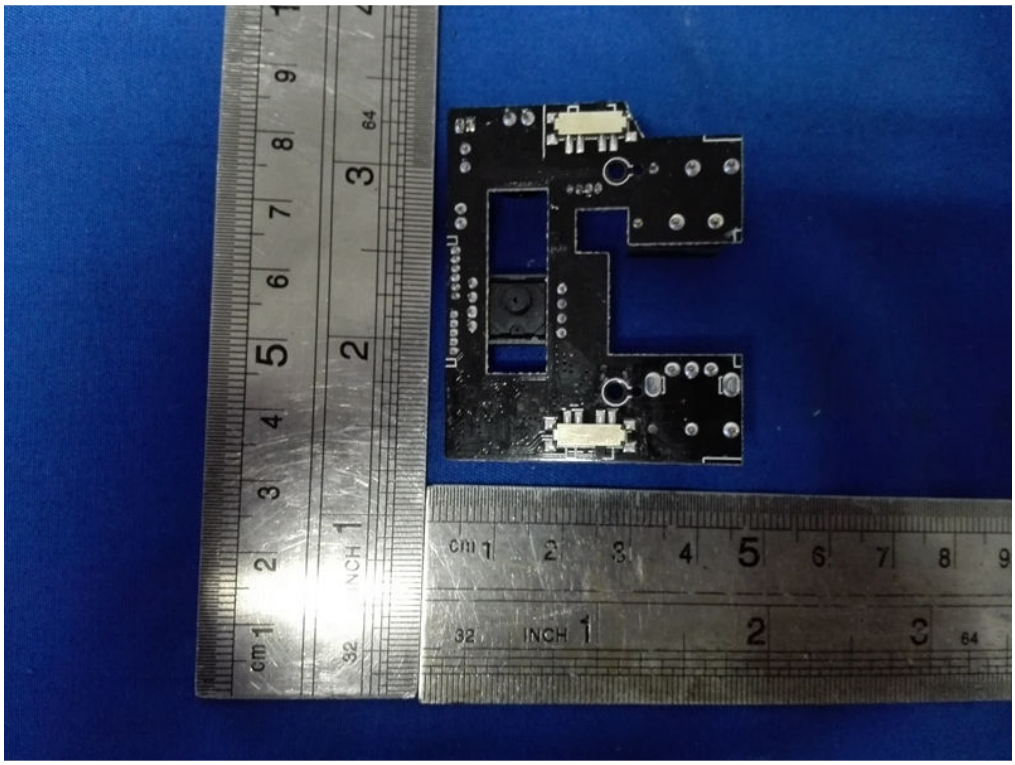

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