FCC Test Report

Product Name	Wireless Gaming Keyboard
Model No.	MA02
FCC ID	EMJKMA02

Applicant	Primax Electronics Ltd
Address	669 Ruey Kuang Road Neihu 114, Taipei, Taiwan

Date of Receipt	Nov. 28, 2020
Issued Date	Jan. 12, 2021
Report No.	20B0995R-E3032110120
Report Version	V1.0

Testing Laboratory
3023

The test results relate only to the samples tested.
The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.
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The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Test Report

Issued Date: Jan. 12, 2021
Report No.: 20B0995R-E3032110120

Product Name	Wireless Gaming Keyboard
Applicant	Primax Electronics Ltd
Address	669 Ruey Kuang Road Neihu 114, Taipei, Taiwan
Manufacturer	Primax Electronics Ltd
Model No.	MA02
EUT Rated Voltage	DC 3.85V (Power by Battery) / DC 5V (Power by USB)
EUT Test Voltage	DC 5V (Power by USB)
Trade Name	ASUS
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

Documented By : Rita Huang

(Senior Adm. Specialist / Rita Huang)

Tested By : Bill Lin

(Senior Engineer / Bill Lin)

Approved By :

(Director / Vincent Lin)

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Attachment 1: EUT Test Photographs

Attachment 2: EUT Detailed Photographs

Revision History

Report No.	Version	Description	Issued Date
20B0995R-E3032110120	V1.0	Initial issue of report.	2021-01-12

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Wireless Gaming Keyboard
Trade Name	ASUS
Model No.	MA02
FCC ID	EMJKMA02
Frequency Range	2403-2480MHz
Number of Channels	78CH
Type of Modulation	GFSK
Antenna Type	PCB Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”
USB to Type-C Cable	MFR: ASUS, M/N: MA02 Shielded, 2.0m
USB to Type-C transfer	MFR: ASUS, M/N: MA02
USB Dongle	MFR: ASUS, M/N: P510DONGLE, FCC ID: EMJDP510DONGLE
Numeric Keyboard	MFR: ASUS, M/N: MA02
USB TO Type-C Extender	MFR: ASUS, M/N: MA02

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	ASUS	MA02	PCB Antenna	5.732 dBi for 2.4GHz

Note: The antenna of EUT is conform to FCC 15.203

Center Frequency of Each Channel:

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

Note:

1. The EUT is a Wireless Gaming Keyboard with a built-in 2.4GHz wireless transceiver.
2. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
3. These tests are conducted on a sample of the equipment for the purpose of demonstrating compliance of transmitter with Part 15 Subpart C Paragraph 15.249 for spread spectrum devices.

Test Mode	Mode 1: Transmit

1.2. Tested System Datails

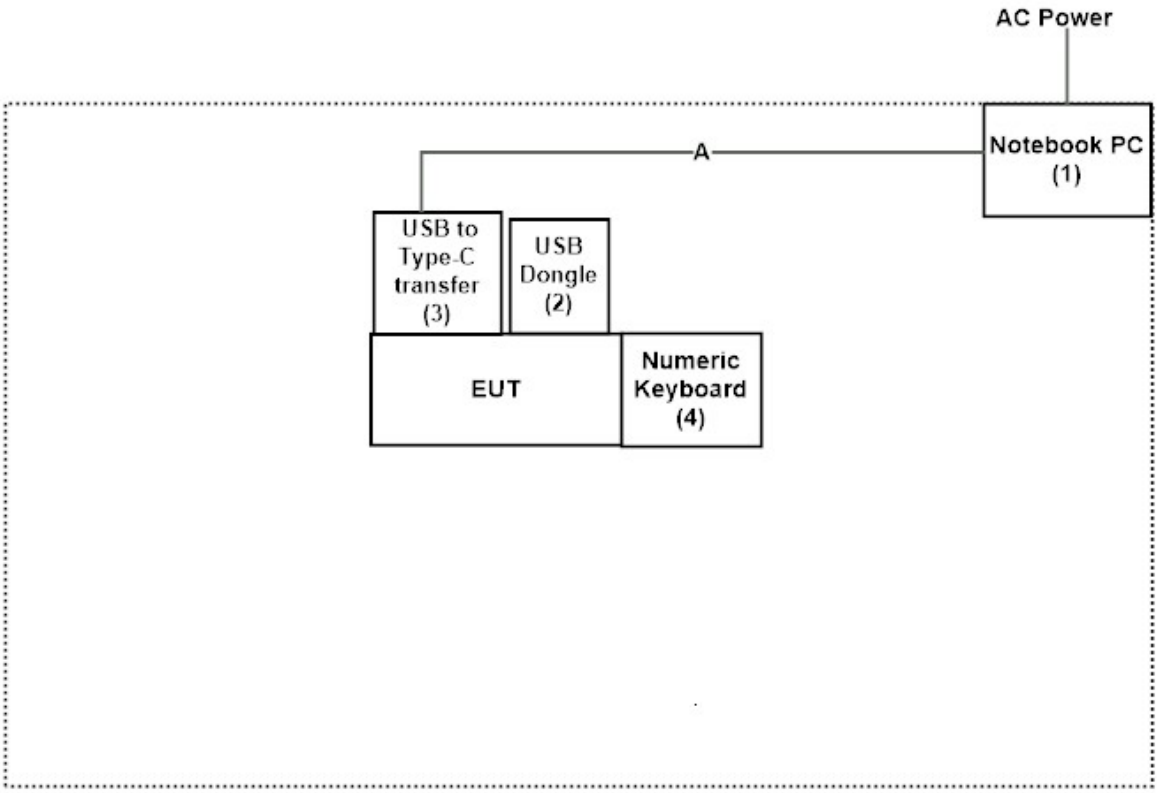
The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	Notebook PC	DELL	Latitude 5580	GDZN7H2	Non-Shielded, 0.8m
2	USB Dongle	Transcend	USB 3.0 / 16GB	N/A	N/A
3	USB to Type-C transfer	ASUS	MA02	N/A	N/A
4	Numeric Keyboard	ASUS	MA02	N/A	N/A

Note:The USB Dongle(M/N: USB 3.0 / 16GB) is not USB Dongle(M/N: P510DONGLE).

Signal Cable Type		Signal cable Description
A	USB to Type-C Cable	Shielded, 2.0m

1.3. Configuration of Test System



1.4. EUT Exercise Software

(1) Setup the EUT as shown in Section 1.3.

(2) Execute software “Cmd v10.0.19042.685” on the EUT.

(3) Configure the test mode and the test channel

(4) Start the continuous Transmit.

(5) Verify that the EUT works properly.

1.5. Test Facility

Ambient conditions in the laboratory:

Performed Item	Items	Required	Actual
Conducted Emission	Temperature (°C)	15~35 °C	23.6 °C
	Humidity (%RH)	20~75 %	51.2 %
Radiated Emission	Temperature (°C)	15~35 °C	22.1 °C
	Humidity (%RH)	20~75 %	69.0 %

USA : FCC Registration Number: TW0023

Canada : IC Registration Number: 25880

Site Description : Accredited by TAF
Accredited Number: 3023

Test Laboratory : DEKRA Testing and Certification Co., Ltd
Address : No.159, Sec. 2, Wenhua 1st Rd., Linkou Dist.,
New Taipei City 24457, Taiwan, R.O.C.
Phone number : 886-2-2602-7968
Fax number : 866-2-2602-3286
Email address : info.tw@dekra.com
Website : http://www.dekra.com.tw

USA : FCC Registration Number: TW0031

Canada : IC Registration Number: 26443

Site Description : Accredited by TAF
Accredited Number: 3023

Test Laboratory : DEKRA Testing and Certification Co., Ltd
Address : No. 6, Lane 75, Wenlin St., Linkou Dist.,
New Taipei City 24457, Taiwan, R.O.C.
Phone number : 886-2-2602-7968
Fax number : 866-2-2602-3286
Email address : info.tw@dekra.com
Website : http://www.dekra.com.tw

1.6. List of Test Equipment

For Conduction measurements /ASR1

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	EMI Test Receiver	R&S	ESR7	101601	2020.05.28	2021.05.27
X	Two-Line V-Network	R&S	ENV216	101306	2020.03.25	2021.03.24
X	Two-Line V-Network	R&S	ENV216	101307	2020.04.17	2021.04.16
X	Coaxial Cable	DEKRA	RG400_BNC	RF001	2020.05.24	2021.05.23

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with “X” are used to measure the final test results.
3. Test Software version : DEKRA Testing System V2.0.

For Conducted measurements /ASR2

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
	Spectrum Analyzer	R&S	FSV30	103464	2020.02.11	2021.02.10
X	Spectrum Analyzer	Keysight	N9030B	MY56320509	2020.08.10	2021.08.09
	Power Meter	Anritsu	ML2496A	1548003	2019.12.17	2020.12.16
	Power Sensor	Anritsu	MA2411B	1531024	2019.12.17	2020.12.16
	Power Sensor	Anritsu	MA2411B	1531025	2019.12.17	2020.12.16

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with “X” are used to measure the final test results.
3. Test Software version : DEKRA Conduction Test System V9.0.5.

For Radiated measurements / AC3

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	Loop Antenna	AMETEK	HLA6121	49611	2020.03.16	2021.03.15
X	Bi-Log Antenna	SCHWARZBECK	VULB9168	01125	2020.07.31	2021.07.30
X	Horn Antenna	ETS-Lindgren	3117	00227709	2020.11.03	2021.11.02
	Horn Antenna	Com-Power	AH-840	101087	2020.06.08	2021.06.07
X	Pre-Amplifier	EMCI	EMC330	060736	2020.08.03	2021.08.02
X	Pre-Amplifier	EMCI	PRAMP118	20200701	2020.08.03	2021.08.02
X	Pre-Amplifier	EMCI	PRAMP0510	20200703	2020.08.03	2021.08.02
X	Filter	MICRO TRONICS	BRM50702	G251	2020.09.17	2021.09.16
	Filter	MICRO TRONICS	BRM50716	G188	2020.09.17	2021.09.16
X	EMI Test Receiver	R&S	ESR7	101601	2020.05.21	2021.05.20
X	Spectrum Analyzer	R&S	FSV40	101148	2020.03.16	2021.03.15
X	Coaxial Cable	SUHNER	SUCOFLEX 106	RF003	2020.09.18	2021.09.17
X	Mircoflex Cable	HUBER SUHNER	SUCOFLEX 102	MY3381/2	2020.06.10	2021.06.09

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with “X” are used to measure the final test results.
3. Test Software version : DEKRA Testing System V2.0.

1.7. Uncertainty

Uncertainties have been calculated according to the DEKRA internal document, and is described in each test chapter of this report.

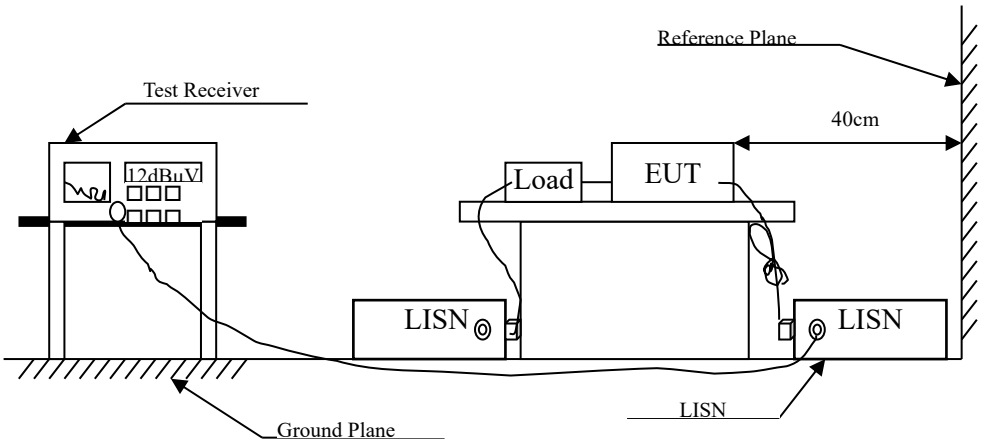
The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Test item	**Uncertainty**	
Conducted Emission	±3.42 dB	
Radiated Emission	Under 1GHz ±4.06 dB	Above 1GHz ±3.73 dB
Band Edge	±2.53 dB	
Duty Cycle	±2.31 ms	

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBµV) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.3. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

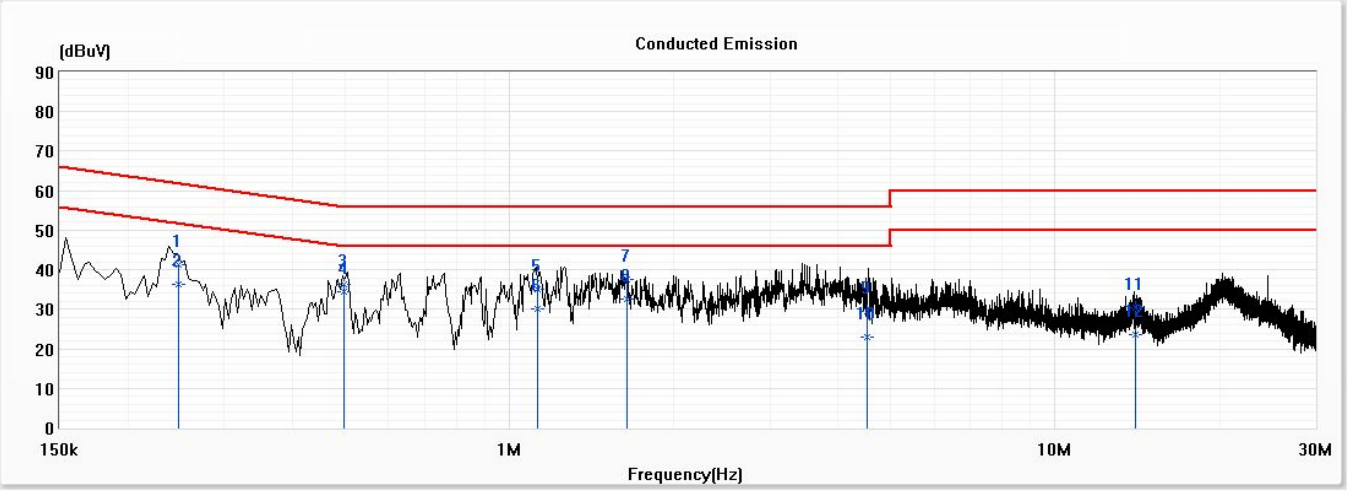
Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

2.4. Test Result of Conducted Emission

Product	:	Wireless Gaming Keyboard
Test Item	:	Conducted Emission Test
Test date	:	2021/01/08
Test Mode	:	Mode 1: Transmit (2440MHz)

Line1

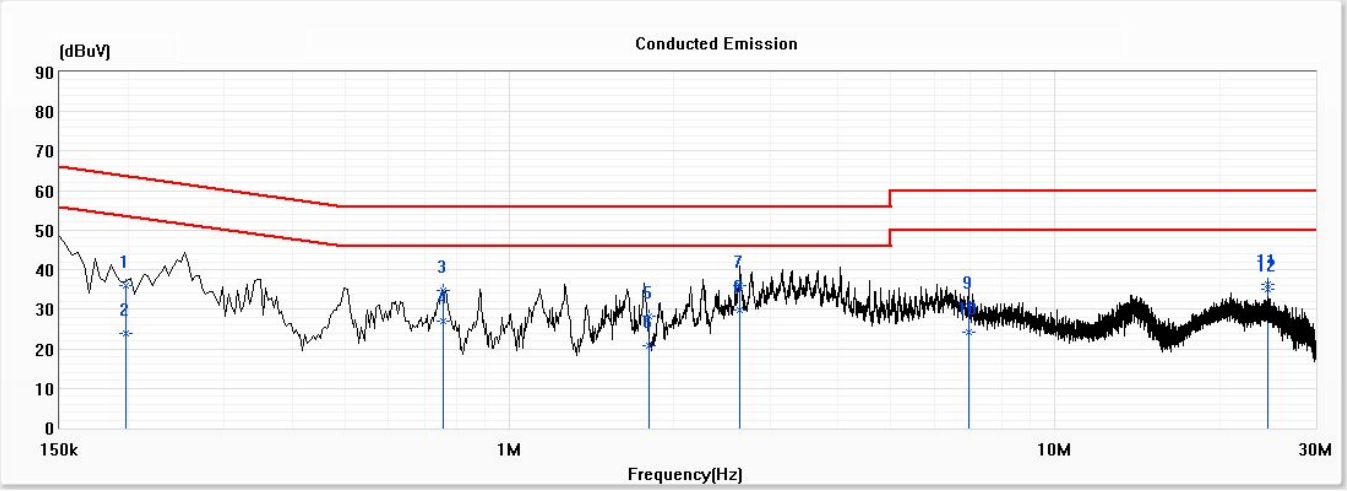


No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.247	41.37	61.85	-20.48	31.72	9.65	QP
2	0.247	36.41	51.85	-15.44	26.76	9.65	AV
3	0.498	36.27	56.03	-19.76	26.61	9.66	QP
*4	0.498	34.43	46.03	-11.60	24.77	9.66	AV
5	1.124	35.01	56.00	-20.99	25.32	9.69	QP
6	1.124	30.13	46.00	-15.87	20.44	9.69	AV
7	1.646	37.54	56.00	-18.46	27.83	9.71	QP
8	1.646	32.51	46.00	-13.49	22.80	9.71	AV
9	4.522	29.45	56.00	-26.55	19.67	9.78	QP
10	4.522	23.00	46.00	-23.00	13.22	9.78	AV
11	14.015	30.32	60.00	-29.68	20.39	9.94	QP
12	14.015	23.46	50.00	-26.54	13.53	9.94	AV

Remark:
1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=LISN Factor+Cable Loss).
3. Margin=Emission Level-Limit

Product	:	Wireless Gaming Keyboard
Test Item	:	Conducted Emission Test
Test date	:	2021/01/08
Test Mode	:	Mode 1: Transmit (2440MHz)

N



No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.198	35.99	63.70	-27.71	26.31	9.67	QP
2	0.198	23.87	53.70	-29.83	14.19	9.67	AV
3	0.758	34.63	56.00	-21.37	24.95	9.68	QP
4	0.758	27.03	46.00	-18.97	17.35	9.68	AV
5	1.802	28.25	56.00	-27.75	18.52	9.72	QP
6	1.802	20.69	46.00	-25.31	10.97	9.72	AV
7	2.649	36.08	56.00	-19.92	26.34	9.74	QP
8	2.649	29.84	46.00	-16.16	20.09	9.74	AV
9	6.946	30.78	60.00	-29.22	20.93	9.85	QP
10	6.946	24.15	50.00	-25.85	14.30	9.85	AV
11	24.577	36.40	60.00	-23.60	26.33	10.08	QP
*12	24.577	34.94	50.00	-15.06	24.86	10.08	AV

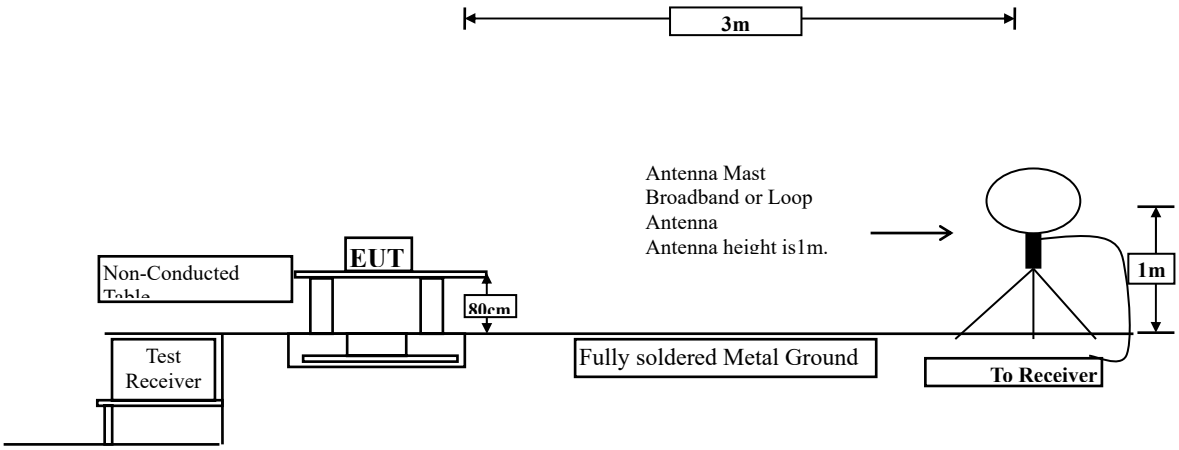
Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=LISN Factor+Cable Loss).
3. Margin=Emission Level-Limit

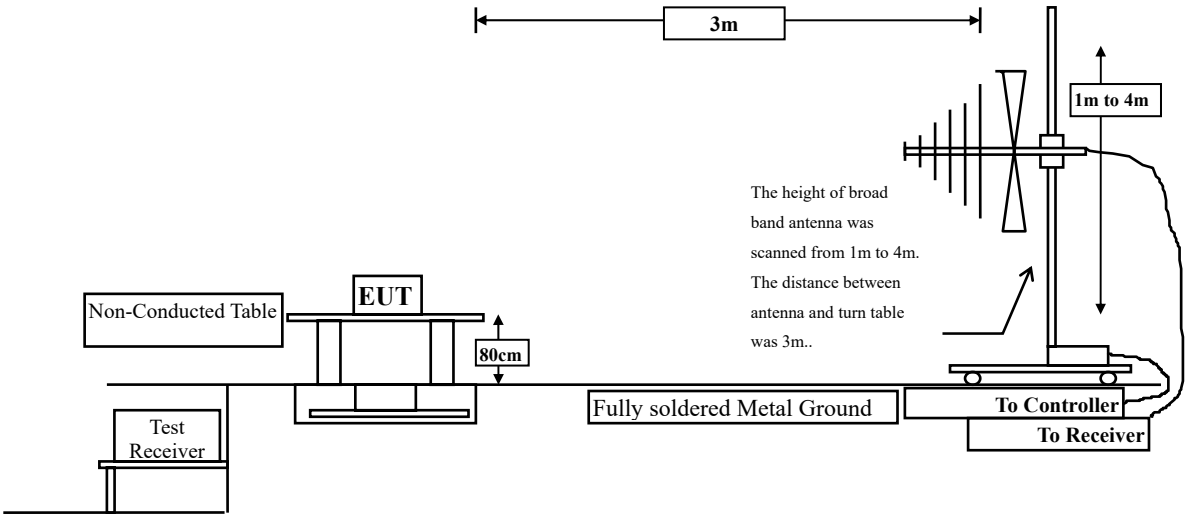
3. Radiated Emission

3.1. Test Setup

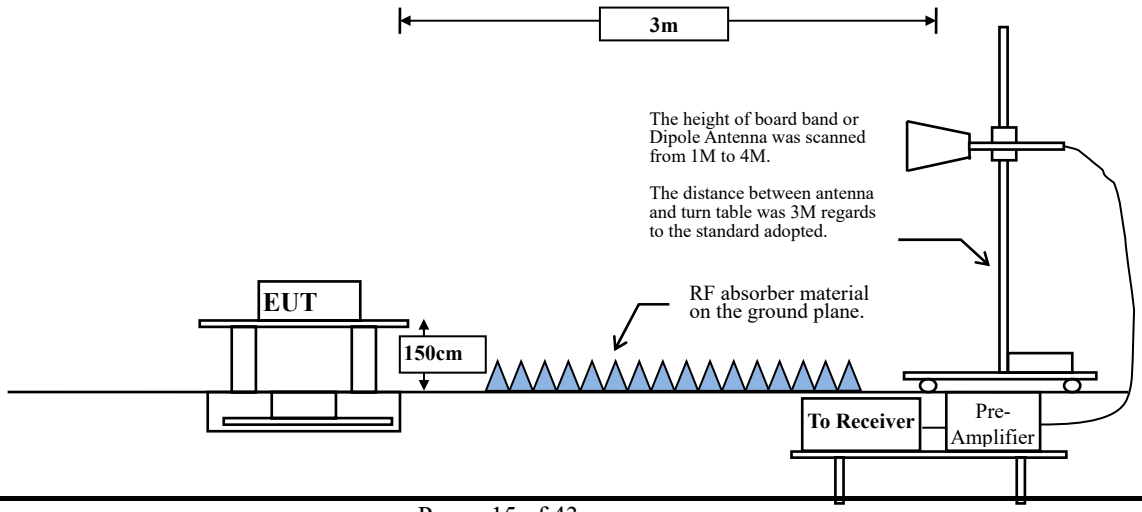
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



3.2. Limits

➢ **Fundamental and Harmonics Emission Limits**

FCC Part 15 Subpart C Paragraph 15.249 Limits				
Frequency MHz	Field Strength of Fundamental		Field Strength of Harmonics	
	(mV/m @3m)	(dBμV /m @3m)	(uV/m @3m)	(dBμV /m @3m)
902-928	50	94	500	54
2400-2483.5	50	94	500	54
5725-5875	50	94	500	54

Remarks : 1. RF Voltage (dBμV /m) = 20 log RF Voltage (uV/m)

2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

➢ **General Radiated Emission Limits**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBμV /m) = 20 log E field strength (uV/m)

3.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested compliance to FCC 47CFR 15.249 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground,when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level.

This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

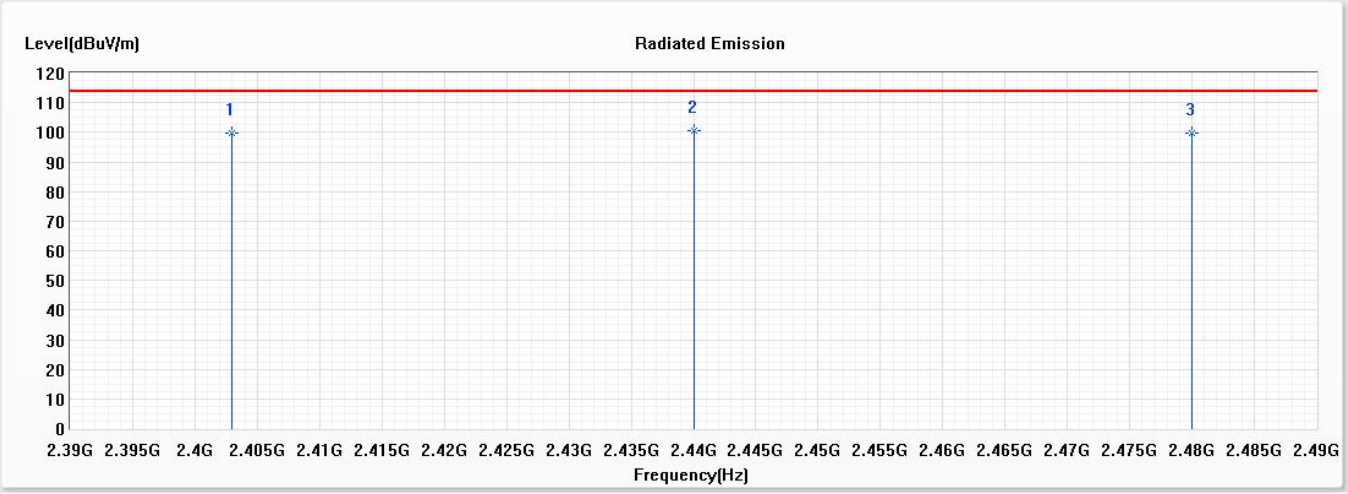
The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The measurement frequency range form 9kHz - 10th Harmonic of fundamental was investigated.

3.4. Test Result of Radiated Emission

Product : Wireless Gaming Keyboard
Test Item : Fundamental Radiated Emission
Test Date : 2020/12/28
Test Mode : Mode 1: Transmit (X-Axis)

Horizontal



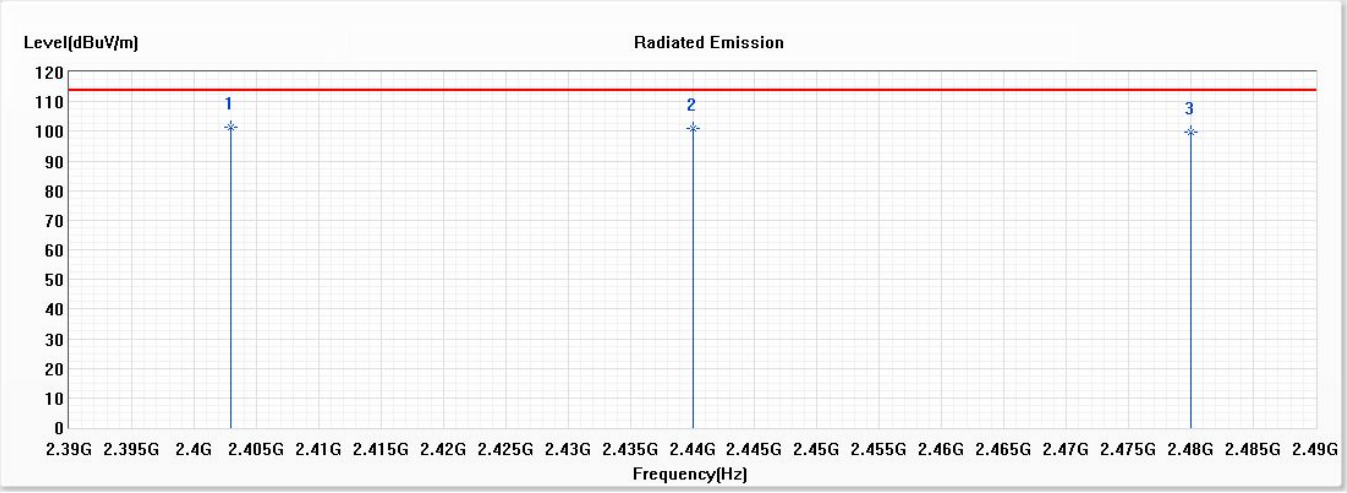
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2403.000	99.90	114.00	-14.10	87.35	12.55	PK
* 2	2440.000	100.74	114.00	-13.26	87.86	12.88	PK
3	2480.000	99.69	114.00	-14.31	86.87	12.82	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

Product	:	Wireless Gaming Keyboard
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (X-Axis)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	2403.000	101.57	114.00	-12.43	89.02	12.55	PK
2	2440.000	101.14	114.00	-12.86	88.26	12.88	PK
3	2480.000	99.76	114.00	-14.24	86.94	12.82	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

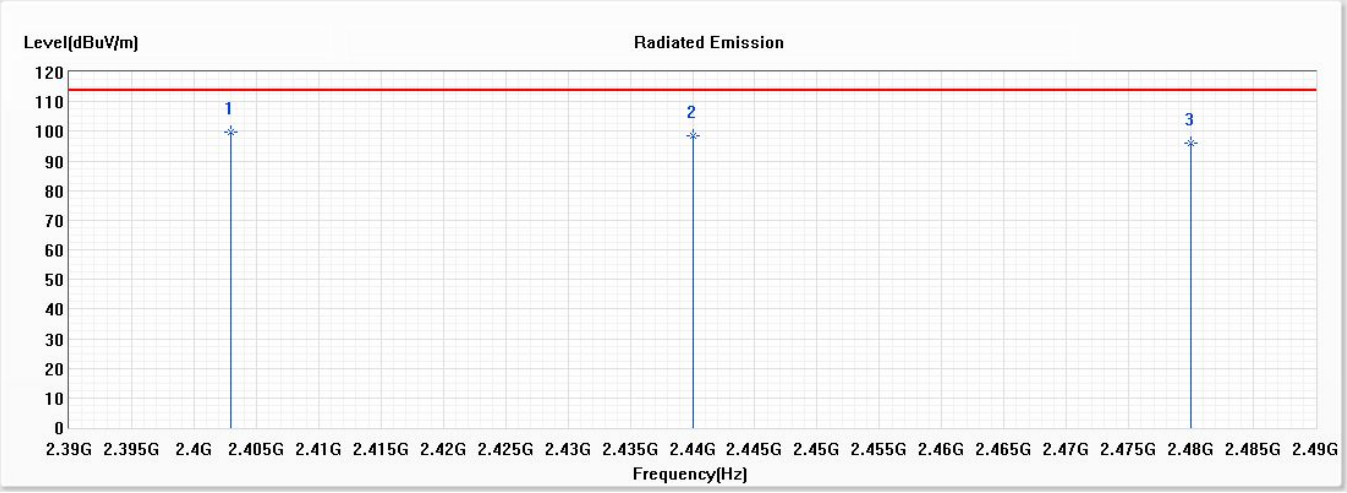
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Horizontal **Average Detector:**					
2403.000	99.900	-16.478	83.422	-10.578	94.000
2440.000	100.740	-16.478	84.262	-9.738	94.000
2480.000	99.690	-16.478	83.212	-10.788	94.000
Vertical **Average Detector:**					
2403.000	101.570	-16.478	85.092	-8.908	94.000
2440.000	101.140	-16.478	84.662	-9.338	94.000
2480.000	99.760	-16.478	83.282	-10.718	94.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (Y-Axis)

Horizontal



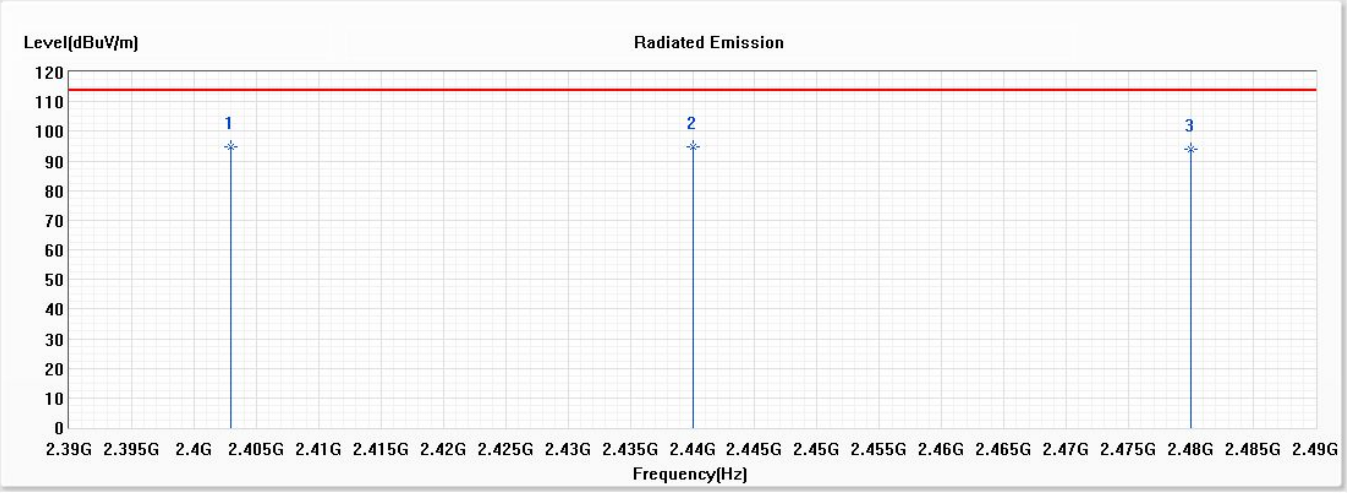
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	2403.000	99.57	114.00	-14.43	87.02	12.55	PK
2	2440.000	98.60	114.00	-15.40	85.72	12.88	PK
3	2480.000	95.99	114.00	-18.01	83.17	12.82	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

Product	:	Wireless Gaming Keyboard
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (Y-Axis)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	2403.000	94.86	114.00	-19.14	82.31	12.55	PK
2	2440.000	94.79	114.00	-19.21	81.91	12.88	PK
3	2480.000	93.91	114.00	-20.09	81.09	12.82	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

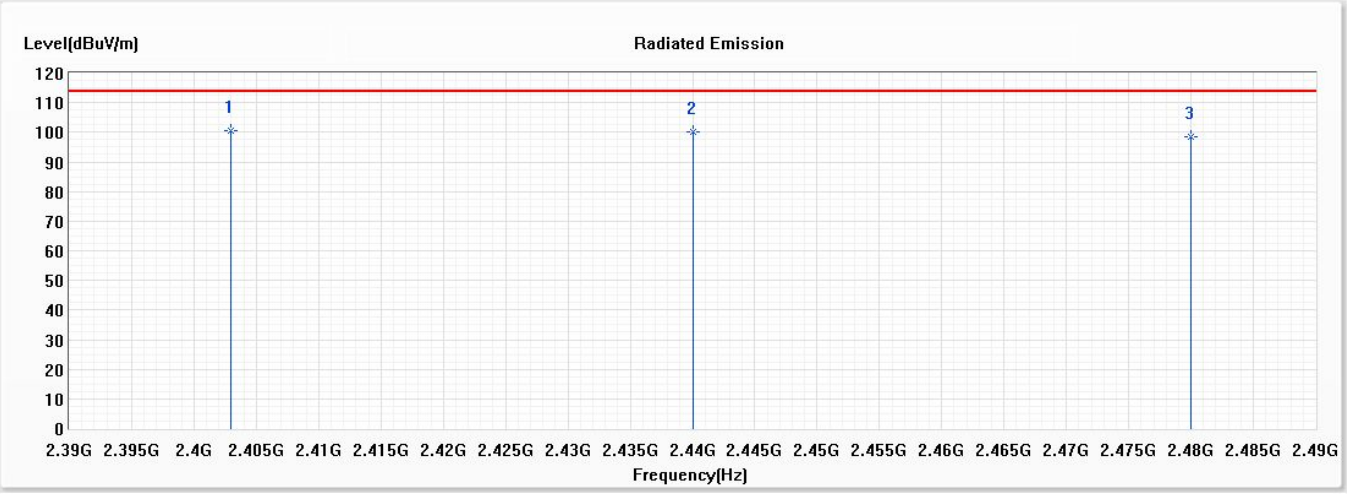
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Horizontal Average Detector:					
2403.000	99.570	-16.478	83.092	-10.908	94.000
2440.000	98.600	-16.478	82.122	-11.878	94.000
2480.000	95.990	-16.478	79.512	-14.488	94.000
Vertical Average Detector:					
2403.000	94.860	-16.478	78.382	-15.618	94.000
2440.000	94.790	-16.478	78.312	-15.688	94.000
2480.000	93.910	-16.478	77.432	-16.568	94.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (Z-Axis)

Horizontal



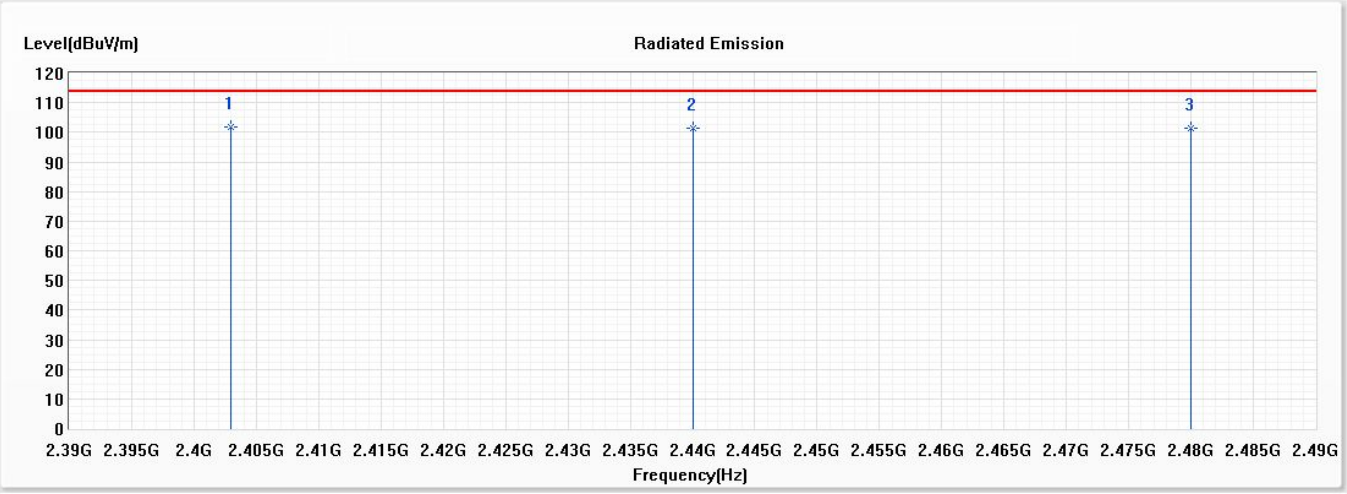
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	2403.000	100.70	114.00	-13.30	88.15	12.55	PK
2	2440.000	100.14	114.00	-13.86	87.26	12.88	PK
3	2480.000	99.57	114.00	-15.43	86.75	12.82	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

Product	:	Wireless Gaming Keyboard
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (Z-Axis)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	2403.000	101.68	114.00	-12.32	89.13	12.55	PK
2	2440.000	101.38	114.00	-12.62	88.50	12.88	PK
3	2480.000	101.31	114.00	-12.69	88.49	12.82	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. Correct Factor = Antenna factor + Cable loss –Amplifier gain.

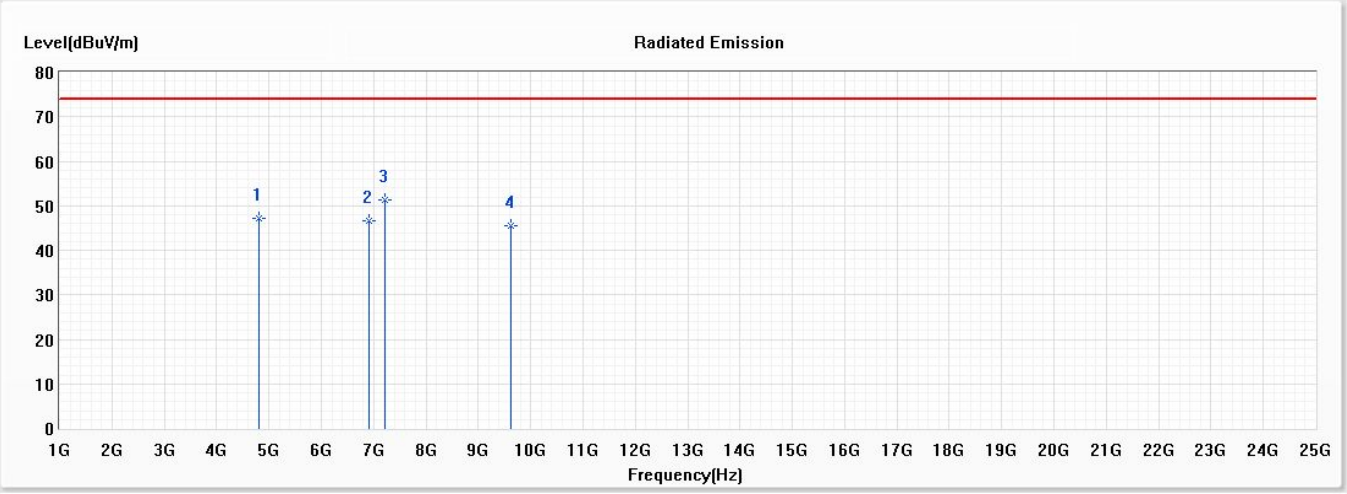
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Horizontal Average Detector:					
2403.000	100.700	-16.478	84.222	-9.778	94.000
2440.000	100.140	-16.478	83.662	-10.338	94.000
2480.000	99.570	-16.478	83.092	-10.908	94.000
Vertical Average Detector:					
2403.000	101.680	-16.478	85.202	-8.798	94.000
2440.000	101.380	-16.478	84.902	-9.098	94.000
2480.000	101.310	-16.478	84.832	-9.168	94.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2403MHz)

Horizontal



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4806.000	47.30	74.00	-26.70	58.98	-11.68	PK
2	6917.000	46.61	74.00	-27.39	53.37	-6.76	PK
* 3	7209.000	51.41	74.00	-22.59	58.06	-6.65	PK
4	9612.000	45.42	74.00	-28.58	50.15	-4.73	PK

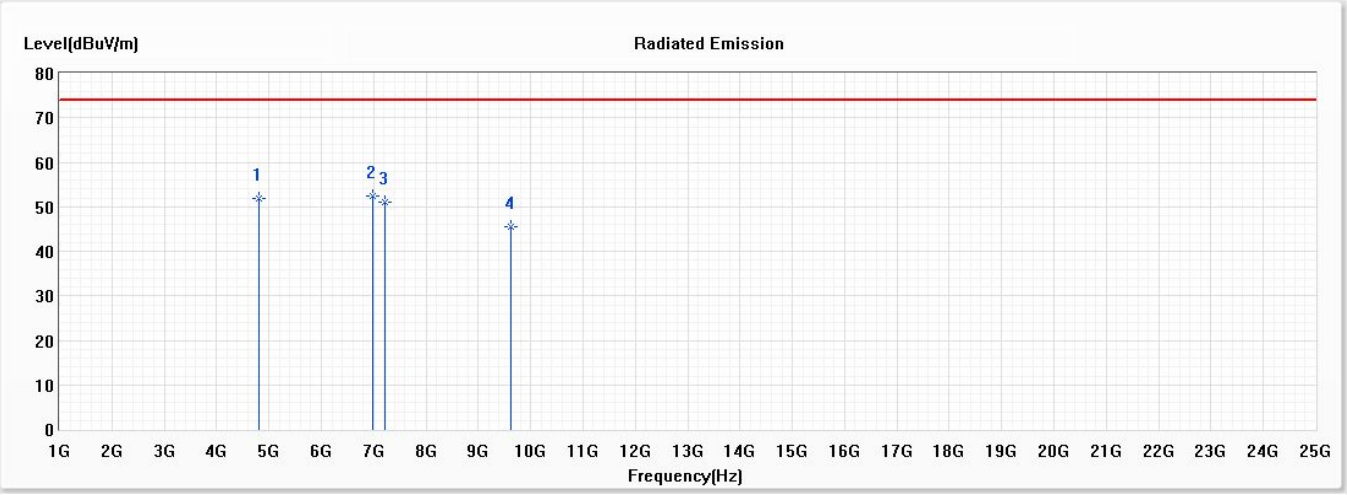
Note:
1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Horizontal Average Detector:					
--					54.000

Note:
1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2403MHz)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4806.000	51.81	74.00	-22.19	63.49	-11.68	PK
* 2	6991.000	52.36	74.00	-21.64	59.06	-6.70	PK
3	7206.000	50.91	74.00	-23.09	57.56	-6.65	PK
4	9612.000	45.51	74.00	-28.49	50.24	-4.73	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

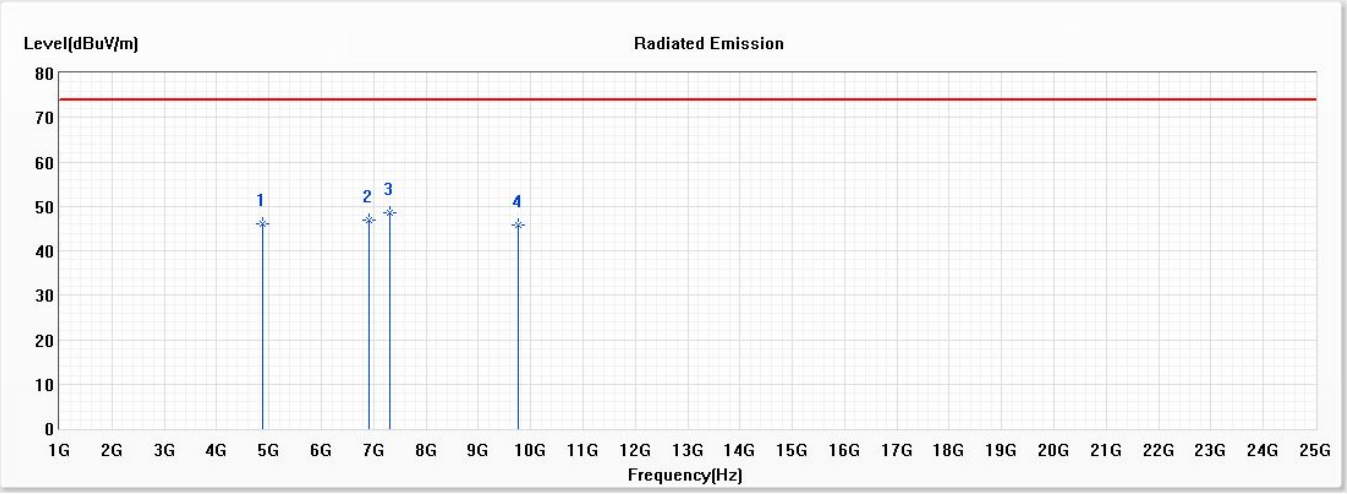
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Vertical Average Detector:					
--					54.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2440MHz)

Horizontal



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4880.000	46.05	74.00	-27.95	57.46	-11.41	PK
2	6922.000	46.90	74.00	-27.10	53.65	-6.75	PK
* 3	7320.000	48.44	74.00	-25.56	55.14	-6.70	PK
4	9760.000	45.74	74.00	-28.26	50.04	-4.30	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

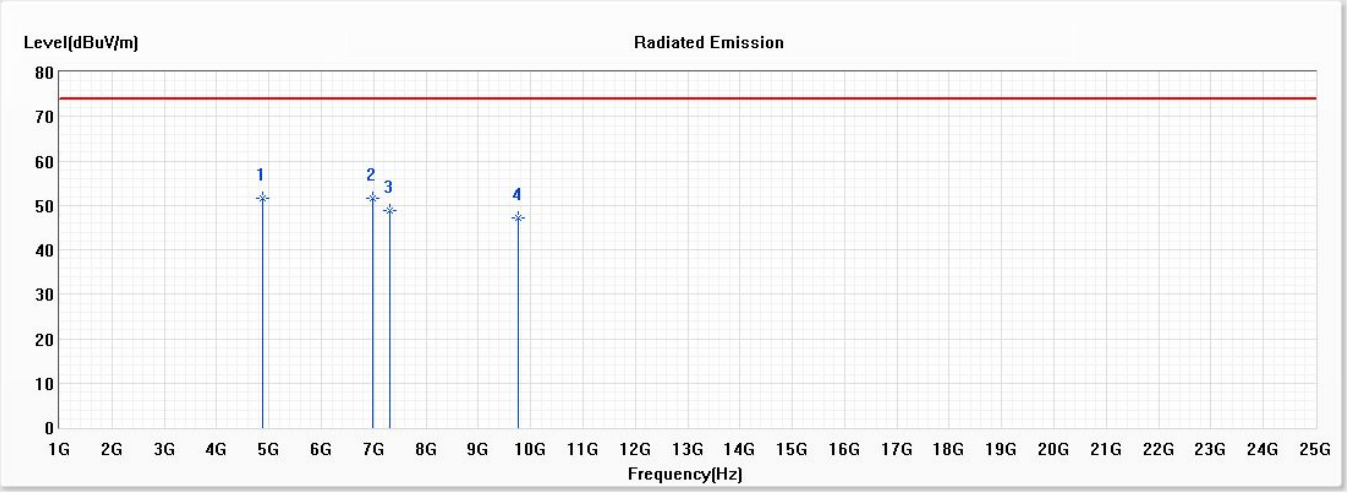
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Horizontal Average Detector:					
--					54.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2440MHz)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4880.000	51.55	74.00	-22.45	62.96	-11.41	PK
* 2	6991.000	51.61	74.00	-22.39	58.31	-6.70	PK
3	7320.000	48.94	74.00	-25.06	55.64	-6.70	PK
4	9760.000	47.22	74.00	-26.78	51.52	-4.30	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

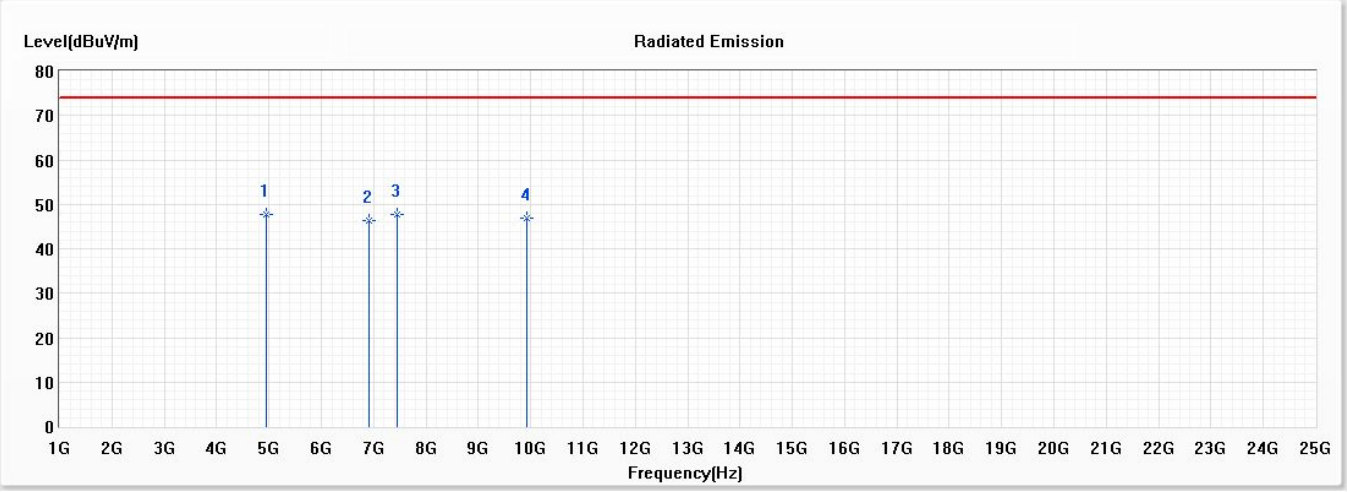
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Vertical					
Average Detector:					
--					54.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2480MHz)

Horizontal



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4960.000	47.65	74.00	-26.35	58.90	-11.25	PK
2	6917.000	46.43	74.00	-27.57	53.19	-6.76	PK
* 3	7440.000	47.83	74.00	-26.17	54.42	-6.59	PK
4	9920.000	46.82	74.00	-27.18	50.76	-3.94	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

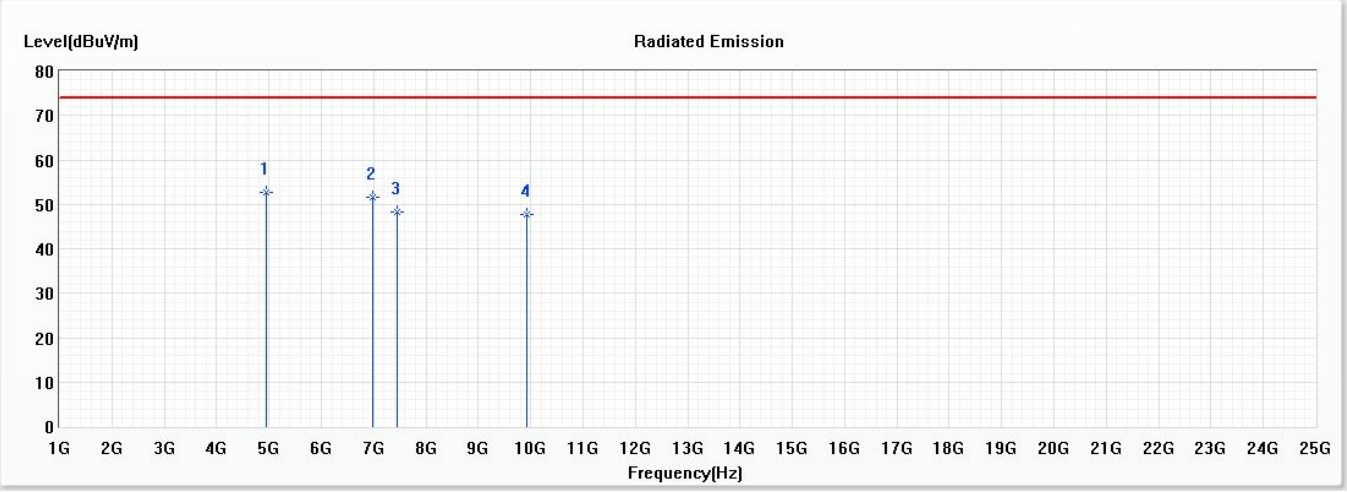
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Horizontal Average Detector:					
--					54.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2480MHz)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	4960.000	52.61	74.00	-21.39	63.86	-11.25	PK
2	6991.000	51.53	74.00	-22.47	58.23	-6.70	PK
3	7440.000	48.22	74.00	-25.78	54.81	-6.59	PK
4	9920.000	47.80	74.00	-26.20	51.74	-3.94	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

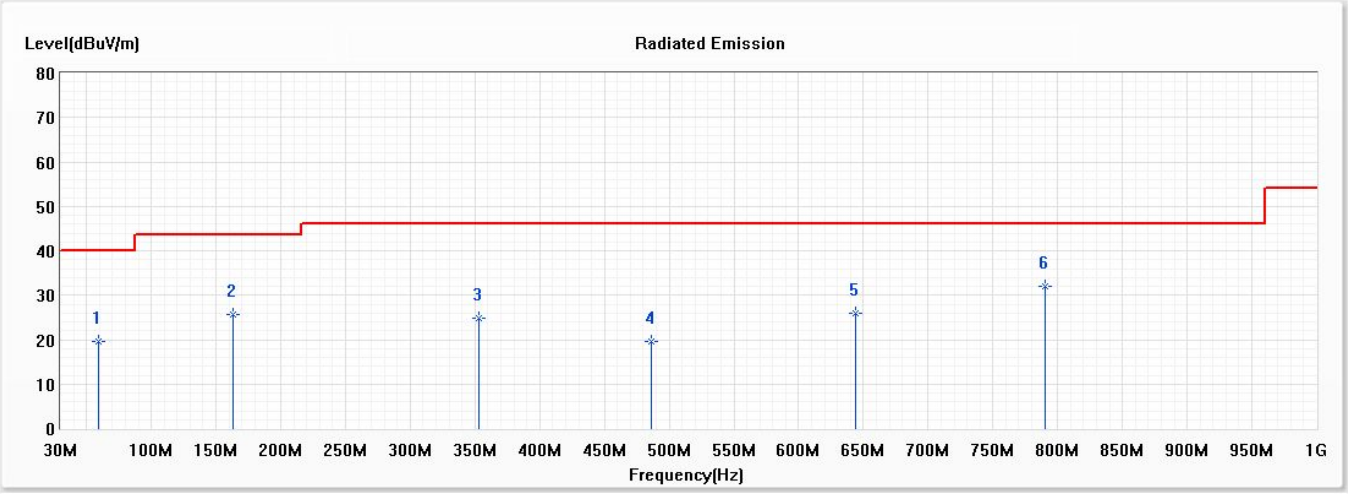
Frequency MHz	Peak Measurement dBμV /m	Duty Cycle Correct Factor dB	Measurement Level dBμV /m	Margin dB	Limit dBμV /m
Vertical					
Average Detector:					
--					54.000

Note:

1. AVG Measurement=Peak Measurement + Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 5.

Product : Wireless Gaming Keyboard
Test Item : General Radiated Emission Data
Test Date : 2020/12/31
Test Mode : Mode 1: Transmit (2440MHz)

Horizontal



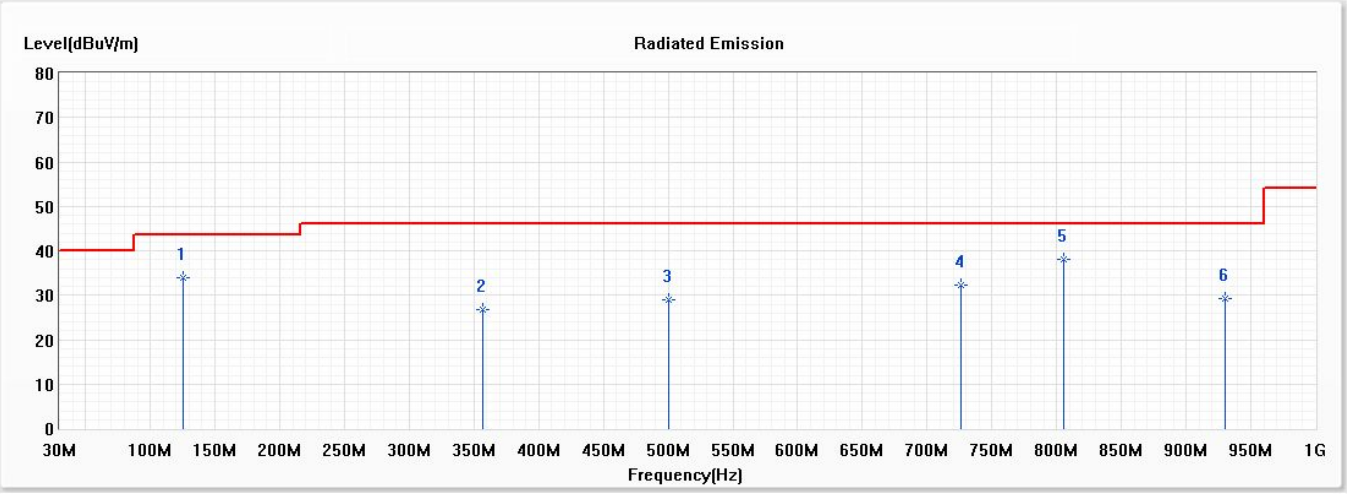
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	59.100	19.47	40.00	-20.53	39.38	-19.91	QP
2	162.890	25.59	43.50	-17.91	44.40	-18.81	QP
3	353.010	24.94	46.00	-21.06	41.82	-16.88	QP
4	485.900	19.52	46.00	-26.48	33.30	-13.78	QP
5	644.010	26.02	46.00	-19.98	36.67	-10.65	QP
* 6	790.480	31.93	46.00	-14.07	31.47	0.46	QP

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.
6. Each mode through the pretest, only the worst case is shown in the report.

Product	:	Wireless Gaming Keyboard
Test Item	:	General Radiated Emission Data
Test Date	:	2020/12/31
Test Mode	:	Mode 1: Transmit (2440MHz)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	125.060	34.03	43.50	-9.47	54.59	-20.56	QP
2	356.890	26.72	46.00	-19.28	43.51	-16.79	QP
3	500.450	29.00	46.00	-17.00	42.52	-13.52	QP
4	726.460	32.25	46.00	-13.75	39.04	-6.79	QP
* 5	805.030	38.15	46.00	-7.85	37.01	1.14	QP
6	930.160	29.12	46.00	-16.88	35.73	-6.61	QP

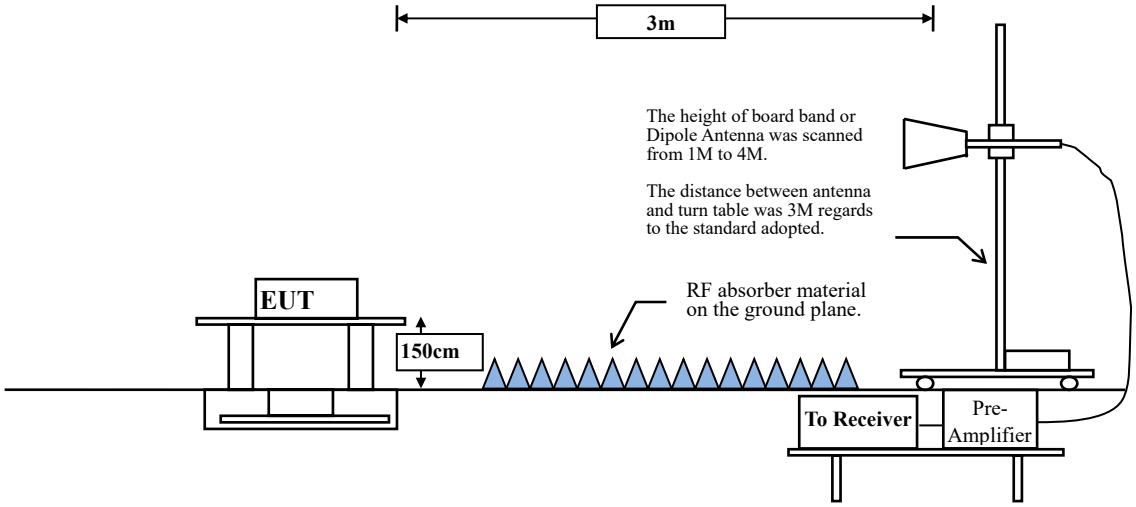
Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.
6. Each mode through the pretest, only the worst case is shown in the report.

4. Band Edge

4.1. Test Setup

RF Radiated Measurement:



4.2. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBμV /m) = 20 log E field strength (uV/m)

4.3. Test Procedure

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.
Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.
The bandwidth setting below 1GHz and above 1GHz on the field strength meter is 120 kHz and 1MHz, respectively.

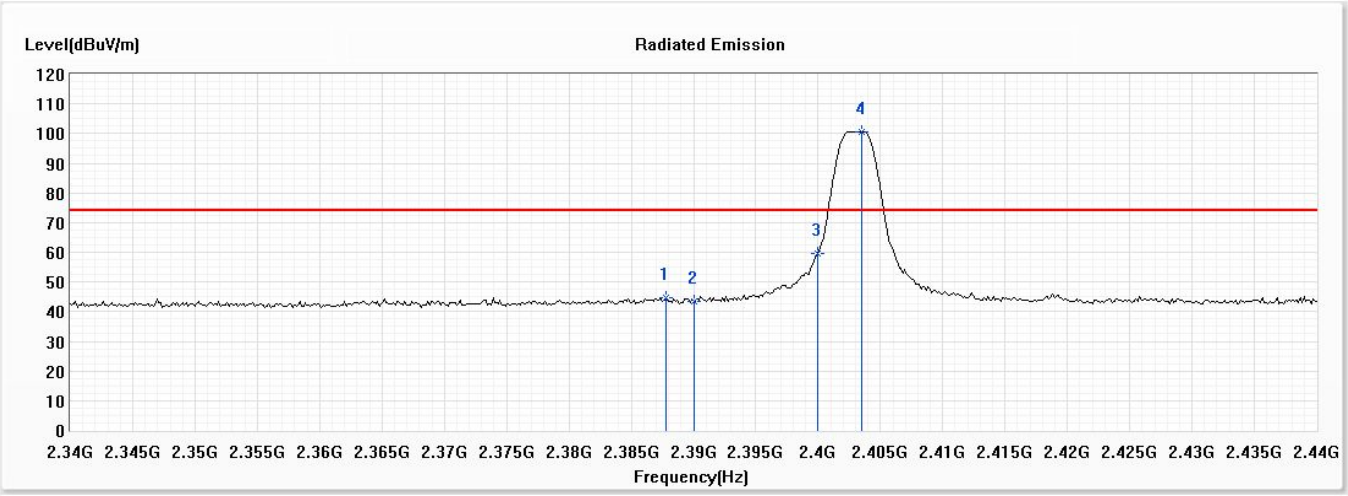
4.4. Test Result of Band Edge

Product : Wireless Gaming Keyboard
Test Item : Band Edge Data
Test Date : 2020/12/28
Test Mode : Mode 1: Transmit (2403MHz)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV /m)	Peak Limit (dBμV /m)	Result
01 (Peak)	2387.826	12.57	32.25	44.82	74.00	Pass
01 (Peak)	2390.000	12.55	30.85	43.40	74.00	Pass
01 (Peak)	2400.000	12.53	47.17	59.70	74.00	Pass
01 (Peak)	2403.478	12.57	88.16	100.73	--	--

Figure Channel 01: Horizontal (Peak)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. The average measurement was not performed when the peak measured data under the limit of average detection.

Channel No.	Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Average Measurement (dBμV/m)	Average Limit (dBμV/m)	Result
01 (Average)	2387.826	44.820	-16.478	28.342	54.000	Pass
01 (Average)	2390.000	43.400	-16.478	26.922	54.000	Pass
01 (Average)	2400.000	59.700	-16.478	43.222	54.000	Pass
01 (Average)	2403.478	100.730	-16.478	84.252	--	--

Note:

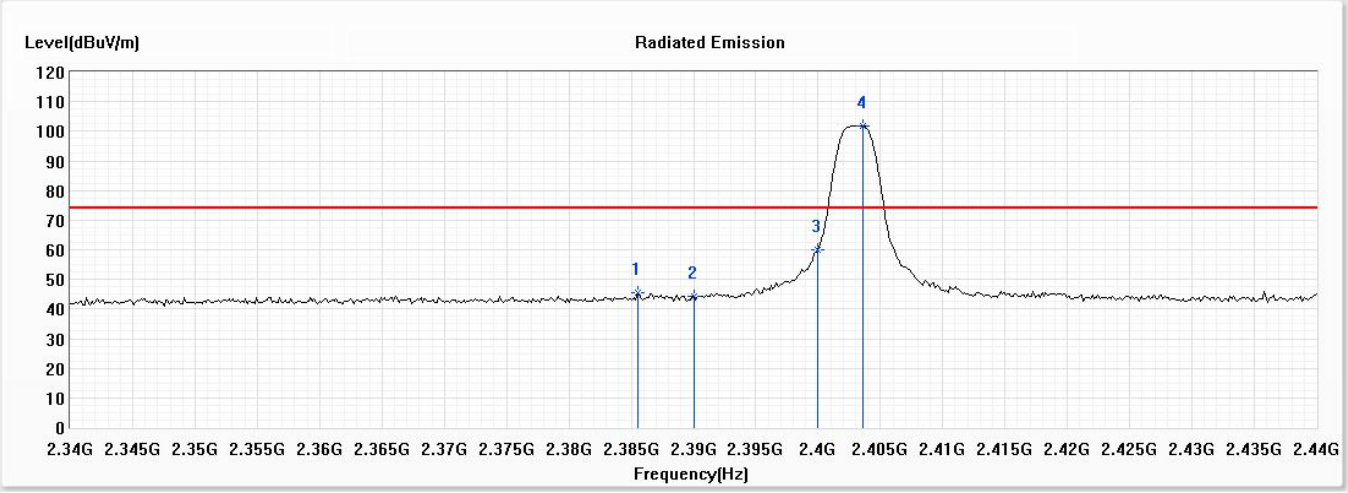
1. Average Measurement=Peak Measurement + Duty Cycle Factor
2. The Duty Cycle is refer to section 5.

Product : Wireless Gaming Keyboard
Test Item : Band Edge Data
Test Date : 2020/12/28
Test Mode : Mode 1: Transmit (2403MHz)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV /m)	Peak Limit (dBμV /m)	Result
01 (Peak)	2385.507	12.57	32.84	45.41	74.00	Pass
01 (Peak)	2390.000	12.55	31.71	44.26	74.00	Pass
01 (Peak)	2400.000	12.53	47.67	60.20	74.00	Pass
01 (Peak)	2403.623	12.57	89.21	101.78	--	--

Figure Channel 01: **Vertical (Peak)**



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. The average measurement was not performed when the peak measured data under the limit of average detection.

Channel No.	Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Average Measurement (dBμV/m)	Average Limit (dBμV/m)	Result
01 (Average)	2385.507	45.410	-16.478	28.932	54.000	Pass
01 (Average)	2390.000	44.260	-16.478	27.782	54.000	Pass
01 (Average)	2400.000	60.200	-16.478	43.722	54.000	Pass
01 (Average)	2403.623	101.780	-16.478	85.302	--	--

Note:

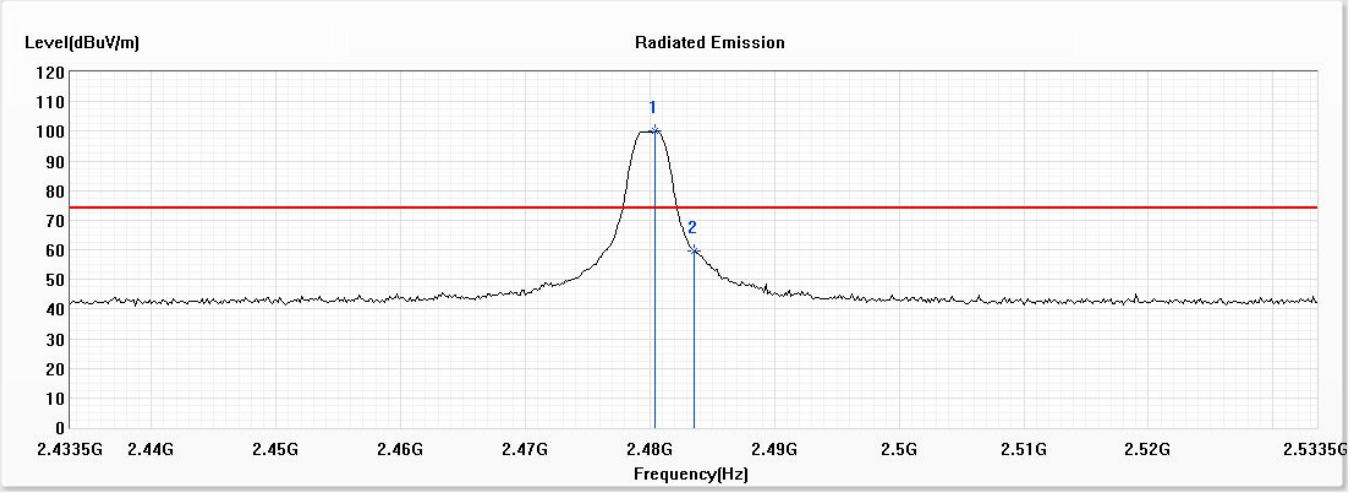
1. Average Measurement=Peak Measurement + Duty Cycle Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Band Edge Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2480MHz)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV /m)	Peak Limit (dBμV /m)	Result
78 (Peak)	2480.457	12.82	87.14	99.96	--	--
78 (Peak)	2483.500	12.80	46.83	59.63	74.00	Pass

Figure Channel 78: Horizontal (Peak)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. The average measurement was not performed when the peak measured data under the limit of average detection.

Channel No.	Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Average Measurement (dBμV/m)	Average Limit (dBμV/m)	Result
78 (Average)	2480.457	99.960	-16.478	83.482	--	--
78 (Average)	2483.500	59.630	-16.478	43.152	54.000	Pass

Note:

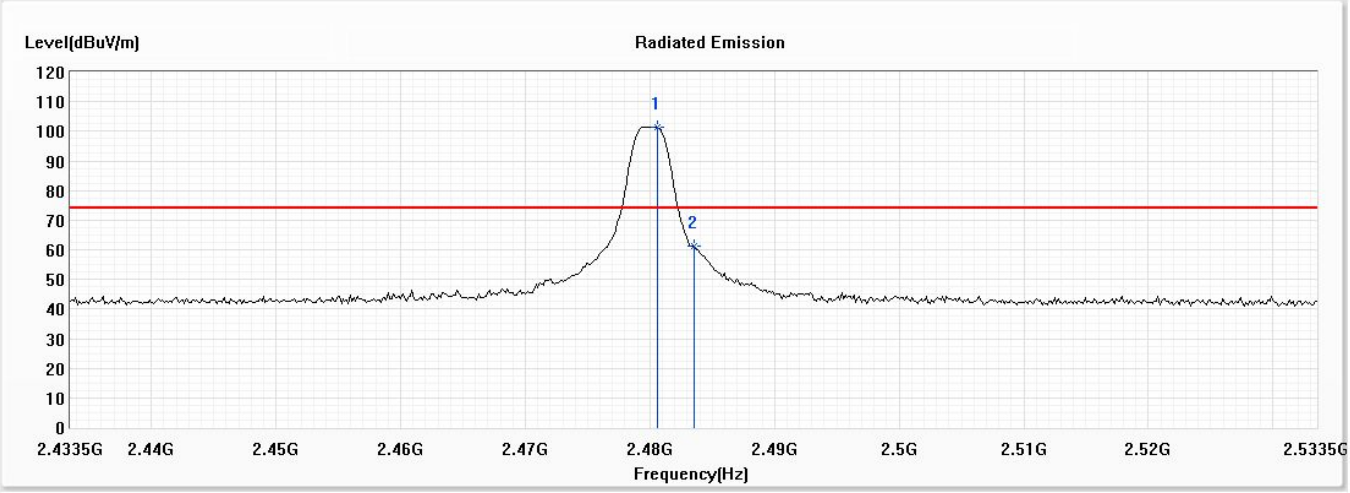
1. Average Measurement=Peak Measurement + Duty Cycle Factor
2. The Duty Cycle is refer to section 5.

Product	:	Wireless Gaming Keyboard
Test Item	:	Band Edge Data
Test Date	:	2020/12/28
Test Mode	:	Mode 1: Transmit (2480MHz)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV /m)	Peak Limit (dBμV /m)	Result
78 (Peak)	2480.601	12.82	88.51	101.33	--	--
78 (Peak)	2483.500	12.80	48.39	61.19	74.00	Pass

Figure Channel 78: **Vertical (Peak)**



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Emission Level = Reading Level + Correct Factor.
4. The average measurement was not performed when the peak measured data under the limit of average detection.

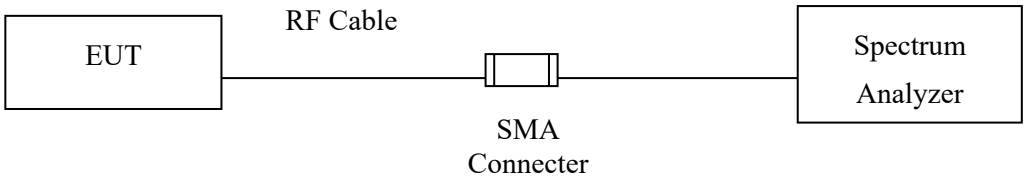
Channel No.	Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Average Measurement (dBμV/m)	Average Limit (dBμV/m)	Result
78 (Average)	2480.601	101.330	-16.478	84.852	--	--
78 (Average)	2483.500	61.190	-16.478	44.712	54.000	Pass

Note:

1. Average Measurement=Peak Measurement + Duty Cycle Factor
2. The Duty Cycle is refer to section 5.

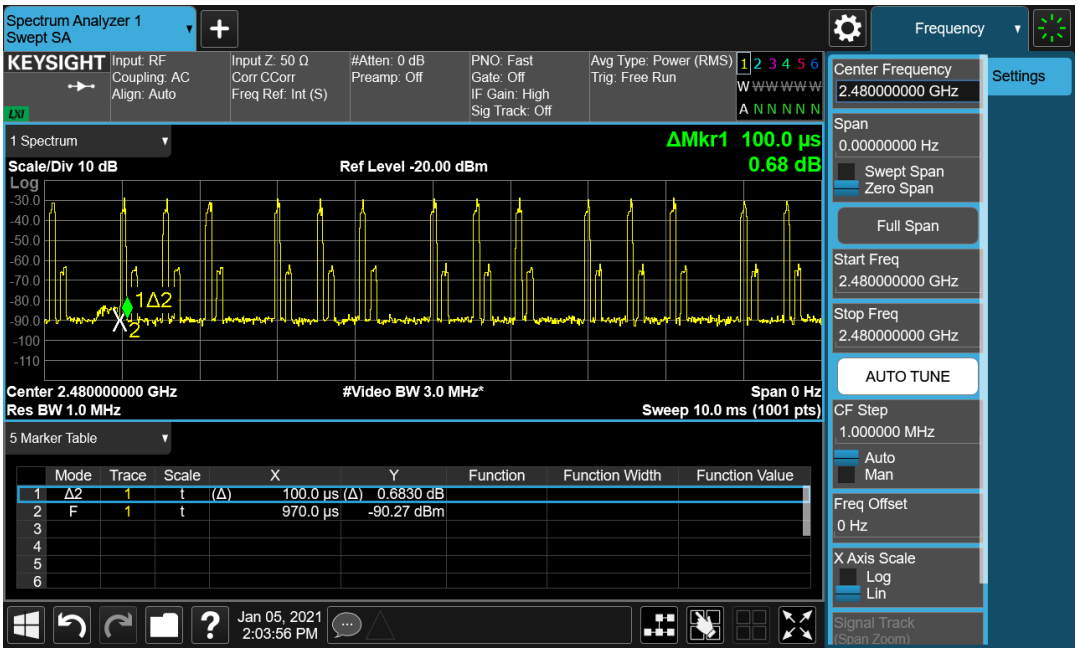
5. Duty Cycle

5.1. Test Setup



5.2. Test Result of Duty Cycle

Product : Wireless Gaming Keyboard
Test Item : Duty Cycle Data
Test Mode : Normal mode



Time on of 100ms= 0.1ms*150= 15ms

Duty Cycle=15ms / 100ms= 0.15

Duty Cycle correction factor= 20 LOG 0.15= -16.478 dB

Duty Cycle correction factor	**-16.478**	**dB**

6. EMI Reduction Method During Compliance Testing

No modification was made during testing.