FCC Test Report

Product Name	ThinkPad TrackPoint Keyboard II
Machine Type / Model No.	KC-1957
FCC ID	A5MKC-1957

Applicant	Lenovo（Beijing）Limited
Address	201-H2-6, Floor 2, Building 2, No.6 Shangdi West Road, Haidian District, Beijing, China 100085

Date of Receipt	Dec. 26, 2019
Issued Date	Jan. 21, 2020
Report No.	19C0439R-RFUSP15V00
Report Version	V1.0

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.

This report must not be used to claim product endorsement by TAF or any agency of the government.

Test Report

Issued Date: Jan. 21, 2020
Report No.: 19C0439R-RFUSP15V00

Product Name	ThinkPad TrackPoint Keyboard II
Applicant	Lenovo（Beijing）Limited
Address	201-H2-6, Floor 2, Building 2, No.6 Shangdi West Road, Haidian District, Beijing, China 100085
Manufacturer	Chicony Electronics Co., Ltd.
Machine Type / Model No.	KC-1957
FCC ID.	A5MKC-1957
EUT Rated Voltage	DC 3.7V by Battery, DC 5V by USB
EUT Test Voltage	DC 5V by USB
Trade Name	Lenovo
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

Documented By : Leven Huang

(Senior Adm. Specialist / Leven Huang)

Tested By : Boris HSU

(Engineer / Boris Hsu)

Approved By :

(Director / Vincent Lin)

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name	ThinkPad TrackPoint Keyboard II
Trade Name	Lenovo
Machine Type / Model No.	KC-1957
FCC ID	A5MKC-1957
Frequency Range	2402~2479MHz
Channel Number	78CH
Channel Separation	1MHz
Type of Modulation	GFSK
Antenna Type	Chip Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”
USB Type C Cable	Shielded, 1.1m

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	MAGIC	MTCA321608002G4E	Chip Antenna	2dBi for 2.4 GHz

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 00:	2402 MHz	Channel 21:	2423 MHz	Channel 42:	2444 MHz	Channel 63:	2465 MHz
Channel 01:	2403 MHz	Channel 22:	2424 MHz	Channel 43:	2445 MHz	Channel 64:	2466 MHz
Channel 02:	2404 MHz	Channel 23:	2425 MHz	Channel 44:	2446 MHz	Channel 65:	2467 MHz
Channel 03:	2405 MHz	Channel 24:	2426 MHz	Channel 45:	2447 MHz	Channel 66:	2468 MHz
Channel 04:	2406 MHz	Channel 25:	2427 MHz	Channel 46:	2448 MHz	Channel 67:	2469 MHz
Channel 05:	2407 MHz	Channel 26:	2428 MHz	Channel 47:	2449 MHz	Channel 68:	2470 MHz
Channel 06:	2408 MHz	Channel 27:	2429 MHz	Channel 48:	2450 MHz	Channel 69:	2471 MHz
Channel 07:	2409 MHz	Channel 28:	2430 MHz	Channel 49:	2451 MHz	Channel 70:	2472 MHz
Channel 08:	2410 MHz	Channel 29:	2431 MHz	Channel 50:	2452 MHz	Channel 71:	2473 MHz
Channel 09:	2411 MHz	Channel 30:	2432 MHz	Channel 51:	2453 MHz	Channel 72:	2474 MHz
Channel 10:	2412 MHz	Channel 31:	2433 MHz	Channel 52:	2454 MHz	Channel 73:	2475 MHz
Channel 11:	2413 MHz	Channel 32:	2434 MHz	Channel 53:	2455 MHz	Channel 74:	2476 MHz
Channel 12:	2414 MHz	Channel 33:	2435 MHz	Channel 54:	2456 MHz	Channel 75:	2477 MHz
Channel 13:	2415 MHz	Channel 34:	2436 MHz	Channel 55:	2457 MHz	Channel 76:	2478 MHz
Channel 14:	2416 MHz	Channel 35:	2437 MHz	Channel 56:	2458 MHz	Channel 77:	2479 MHz
Channel 15:	2417 MHz	Channel 36:	2438 MHz	Channel 57:	2459 MHz		
Channel 16:	2418 MHz	Channel 37:	2439 MHz	Channel 58:	2460 MHz		
Channel 17:	2419 MHz	Channel 38:	2440 MHz	Channel 59:	2461 MHz		
Channel 18:	2420 MHz	Channel 39:	2441 MHz	Channel 60:	2462 MHz		
Channel 19:	2421 MHz	Channel 40:	2442 MHz	Channel 61:	2463 MHz		
Channel 20:	2422 MHz	Channel 41:	2443 MHz	Channel 62:	2464 MHz		

Note:

1. The EUT is a ThinkPad TrackPoint Keyboard II with a built-in 2.4GHz GFSK transceiver.
2. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
3. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.
4. These tests are conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15 Subpart C Paragraph 15.249 for spread spectrum devices.

Test Mode	Mode 1: Transmit

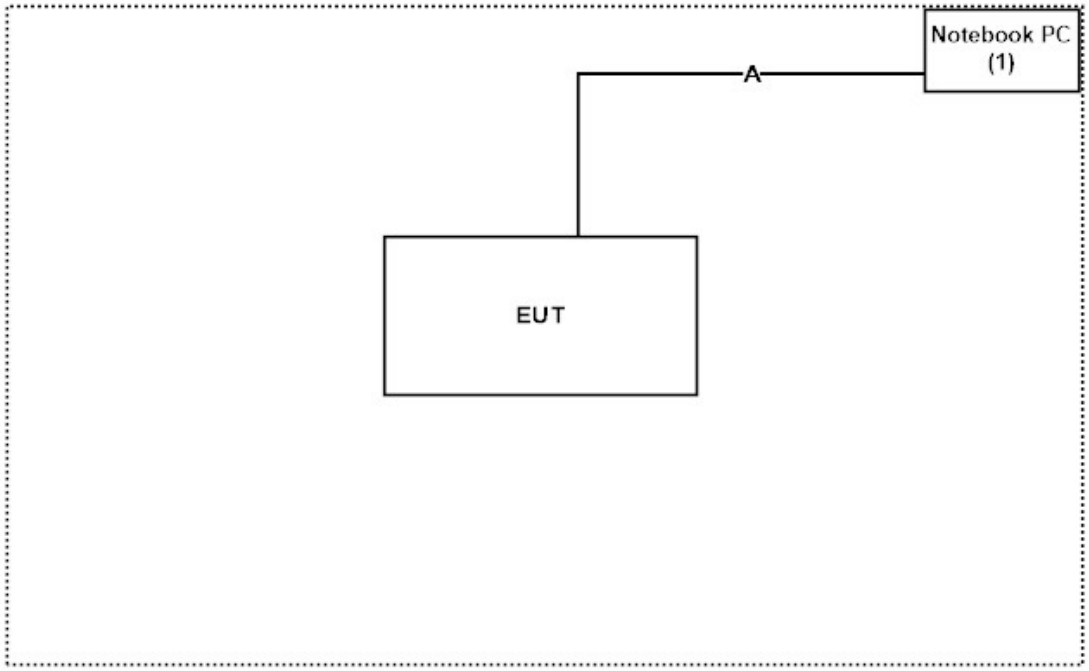
1.3. Tested System Datails

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

Product		Brand Name	Model No.	Serial No.	Power Cord
1.	Notebook PC	DELL	Latitude 5580	2HRD7H2	Non-Shielded, 0.8m

Signal Cable Type		Signal cable Description
A	USB Type C Cable	Shielded, 1.1m

1.4. Configuration of Test System



1.5. EUT Exercise Software

1. Setup the EUT as shown in Section 1.4.
2. Press the button on the EUT.
3. Configure the test mode, the test channel, and the data rate.
4. Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Performed Item	Items	Required	Actual
Conducted Emission	Temperature (°C)	10~40 °C	24.1 °C
	Humidity (%RH)	10~90 %	50 %
Radiated Emission	Temperature (°C)	10~40 °C	20 °C
	Humidity (%RH)	10~90 %	74 %
Conductive	Temperature (°C)	10~40 °C	22.3 °C
	Humidity (%RH)	10~90 %	64.7 %

USA : FCC Registration Number: TW3023

Canada : IC Registration Number: 4075A

Site Description: Accredited by TAF
Accredited Number: 3023

Test Laboratory: DEKRA Testing and Certification Co., Ltd
Address: No.5-22, Ruishukeng, Linkou Dist., New Taipei City 24451, Taiwan.
Phone number: 886-2-8601-3788
Fax number: 886-2-8601-3789
Email address: info.tw@dekra.com
Website: http://www.dekra.com.tw

1.7. List of Test Equipment

For Conducted measurements /CB3/SR8

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
	Temperature Chamber	WIT GROUP	TH-1S-B	EQ-201-00146	2019/02/26	2020/02/25
X	Spectrum Analyzer	Agilent	N9010A	MY53470892	2019/09/25	2020/09/24
X	Peak Power Analyzer	Keysight	8990B	MY51000410	2019/07/30	2020/07/29
X	Wideband Power Sensor	Keysight	N1923A	MY56080003	2019/07/30	2020/07/29
X	Wideband Power Sensor	Keysight	N1923A	MY56080004	2019/07/30	2020/07/29
X	EMI Test Receiver	R&S	ESCS 30	100369	2019/11/19	2020/11/18
X	LISN	R&S	ENV216	101105	2019/04/10	2020/04/09
X	LISN	R&S	ESH3-Z5	836679/014	2019/04/10	2020/04/09
X	Coaxial Cable	DEKRA	RG 400	LC018-RG	2019/06/20	2020/06/19

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 SystemV9.0.5.

For Radiated measurements /Site3/CB8

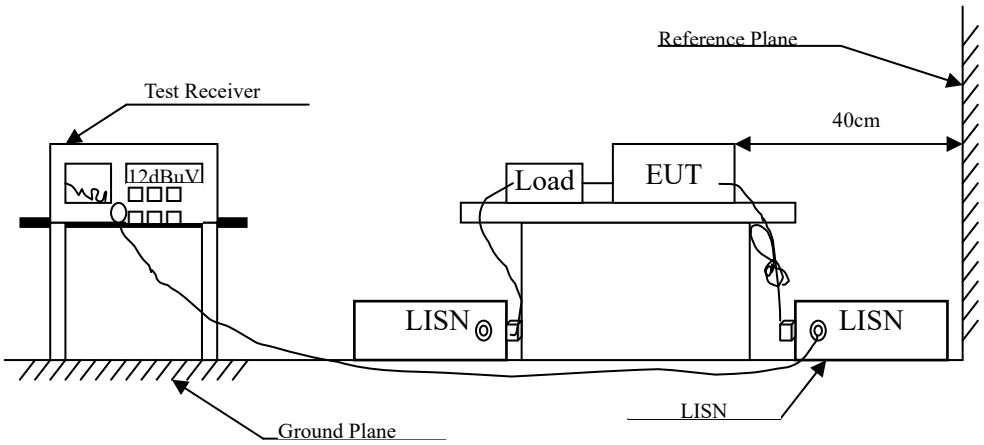
	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
X	Spectrum Analyzer	R&S	FSP40	100170	2019/03/11	2020/03/10
X	Loop Antenna	Teseq	HLA6121	37133	2019/10/15	2021/10/14
X	Bilog Antenna	Schaffner Chase	CBL6112B	2794	2019/06/23	2020/06/22
X	Coaxial Cable	DEKRA	L1907-001C	280280.F141.1000D	2019/07/10	2020/07/09
X	Amplifier	EMCI	EMC001330	980254	2019/08/22	2020/08/21
X	Horn Antenna	ETS-LINDGREN	3117	00228113	2019/05/02	2020/05/01
X	Coaxial Cable	DEKRA	L1907-002C	280280.F141.1000D	2019/07/10	2020/07/09
X	Amplifier	EMCI	EMC05820SE	980362	2019/06/26	2020/06/25
X	Amplifier	EMCI	EMC051845SE	SN980632	2019/08/08	2020/08/07
	Horn Antenna	Com-Power	AH-1840	101101	2019/10/31	2020/10/30
	Amplifier + Cable	EMCI	EMC184045SE	980369	2019/04/16	2020/04/15
	Bilog Antenna	Schaffner Chase	CBL6112B	2916	2019/06/23	2020/06/22
	Coaxial Cable	DEKRA	L1907-003C	00100A1B3A120M	2019/07/10	2020/07/09
	Amplifier	EMCI	EMC001330	980255	2019/06/28	2020/06/27
X	Filter	MICRO-TRONICS	BRM50702	G270	2019/08/08	2020/08/07
	Filter	MICRO-TRONICS	BRM50716	G196	2019/08/08	2020/08/07

Note:

1. Loop Antenna is calibrated every two years, the other 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 Test SystemV1.1.

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBuV) 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.

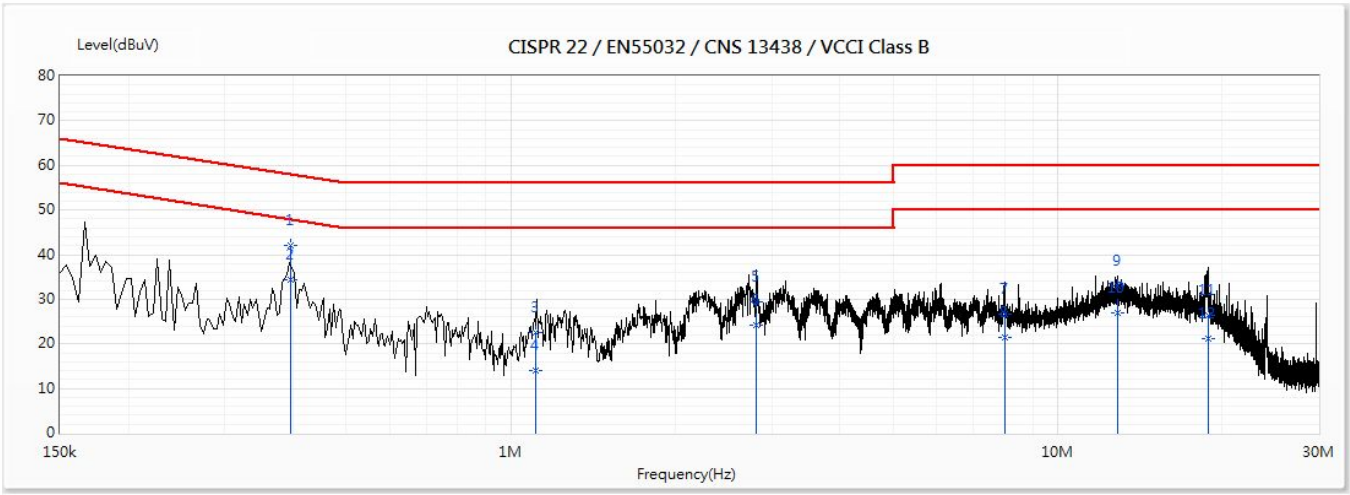
2.4. Uncertainty

± 2.26 dB

2.5. Test Result of Conducted Emission

Product : ThinkPad TrackPoint Keyboard II
Test Item : Conducted Emission Test
Test Date : 2020/01/16
Test Mode : Mode 1: Transmit (2440MHz)

L1



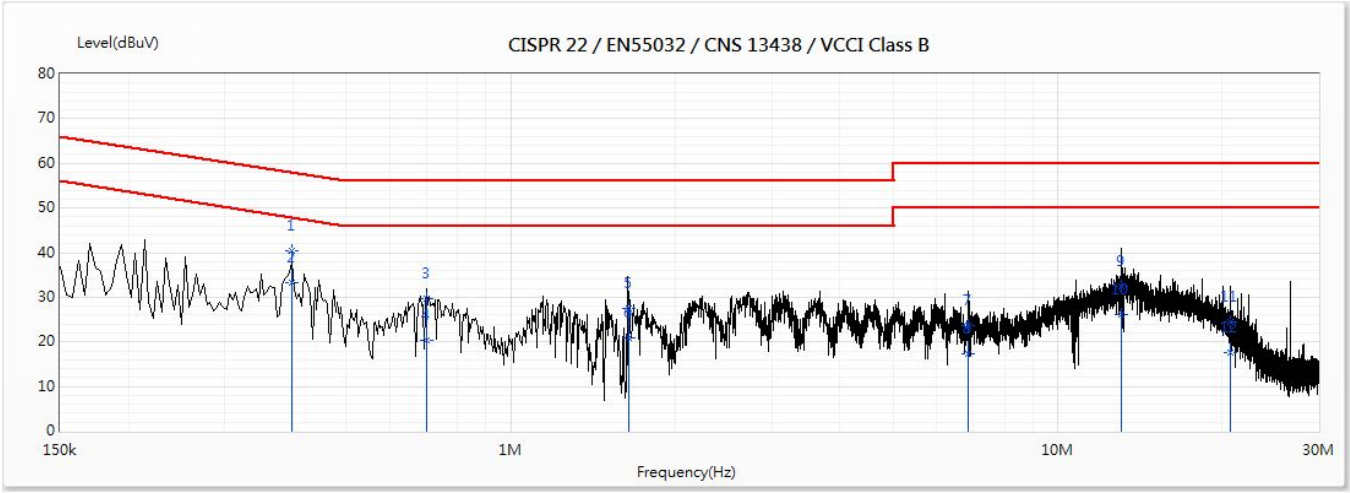
No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.396	42.11	57.93	-15.82	32.42	9.70	QP
*2	0.396	34.34	47.93	-13.59	24.64	9.70	AV
3	1.113	22.58	56.00	-33.42	12.84	9.73	QP
4	1.113	14.00	46.00	-32.00	4.26	9.73	AV
5	2.811	29.31	56.00	-26.69	19.51	9.80	QP
6	2.811	24.06	46.00	-21.94	14.25	9.80	AV
7	7.998	26.66	60.00	-33.34	16.70	9.96	QP
8	7.998	21.49	50.00	-28.51	11.52	9.96	AV
9	12.862	32.88	60.00	-27.12	22.81	10.07	QP
10	12.862	26.96	50.00	-23.04	16.90	10.07	AV
11	18.822	26.51	60.00	-33.49	16.35	10.16	QP
12	18.822	21.12	50.00	-28.88	10.96	10.16	AV

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " * ", means this data is the worst emission level.

Product : ThinkPad TrackPoint Keyboard II
Test Item : Conducted Emission Test
Test Date : 2020/01/16
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	0.397	40.53	57.92	-17.39	30.81	9.73	QP
*2	0.397	33.23	47.92	-14.69	23.51	9.73	AV
3	0.701	29.72	56.00	-26.28	19.97	9.75	QP
4	0.701	20.23	46.00	-25.77	10.48	9.75	AV
5	1.641	27.53	56.00	-28.47	17.73	9.81	QP
6	1.641	21.01	46.00	-24.99	11.21	9.81	AV
7	6.874	23.64	60.00	-36.36	13.65	9.99	QP
8	6.874	17.26	50.00	-32.74	7.27	9.99	AV
9	13.065	32.43	60.00	-27.57	22.26	10.17	QP
10	13.065	26.20	50.00	-23.80	16.03	10.17	AV
11	20.715	24.37	60.00	-35.63	14.00	10.37	QP
12	20.715	17.57	50.00	-32.43	7.20	10.37	AV

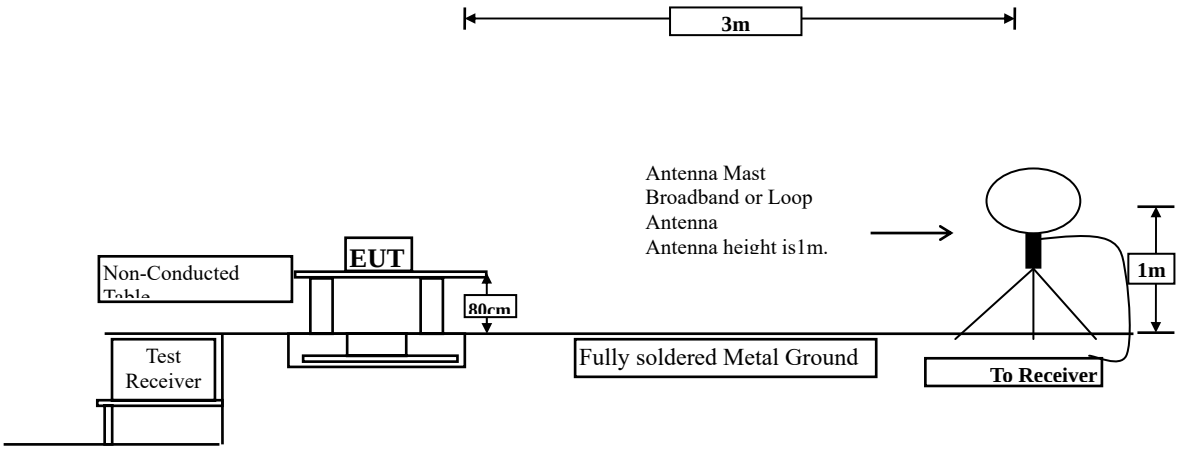
Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " * ", means this data is the worst emission level.

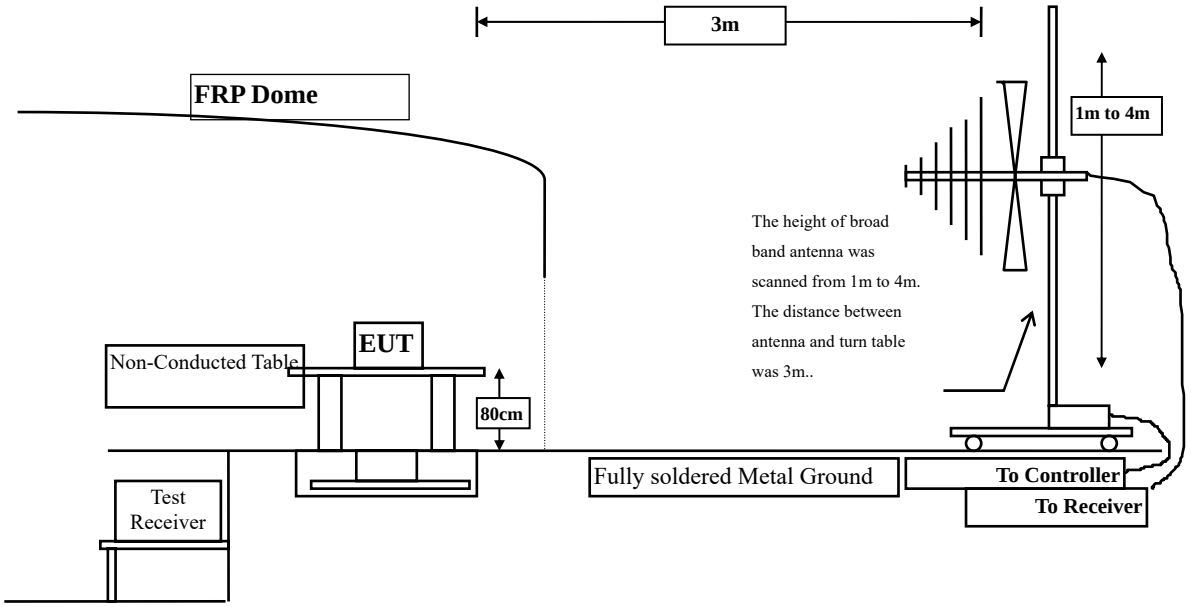
3. Radiated Emission

3.1. Test Setup

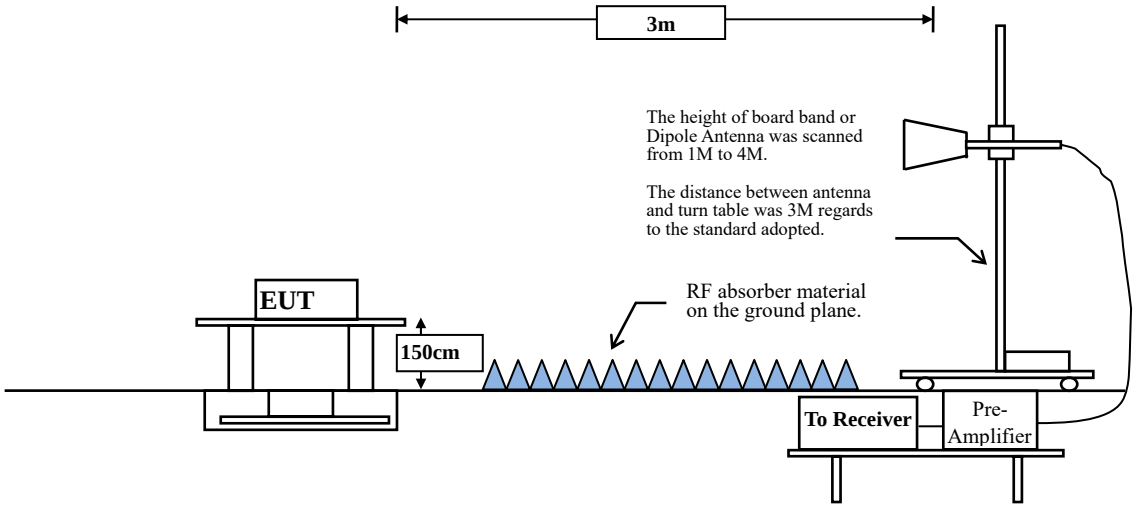
Radiated Emission Under 30MHz



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)	(dBuV/m @3m)	(uV/m @3m)	(dBuV/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 (dBuV/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 (dBuV/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 worst radiated emission is measured in the Open Area Test Site on the Final Measurement.

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

3.4. Uncertainty

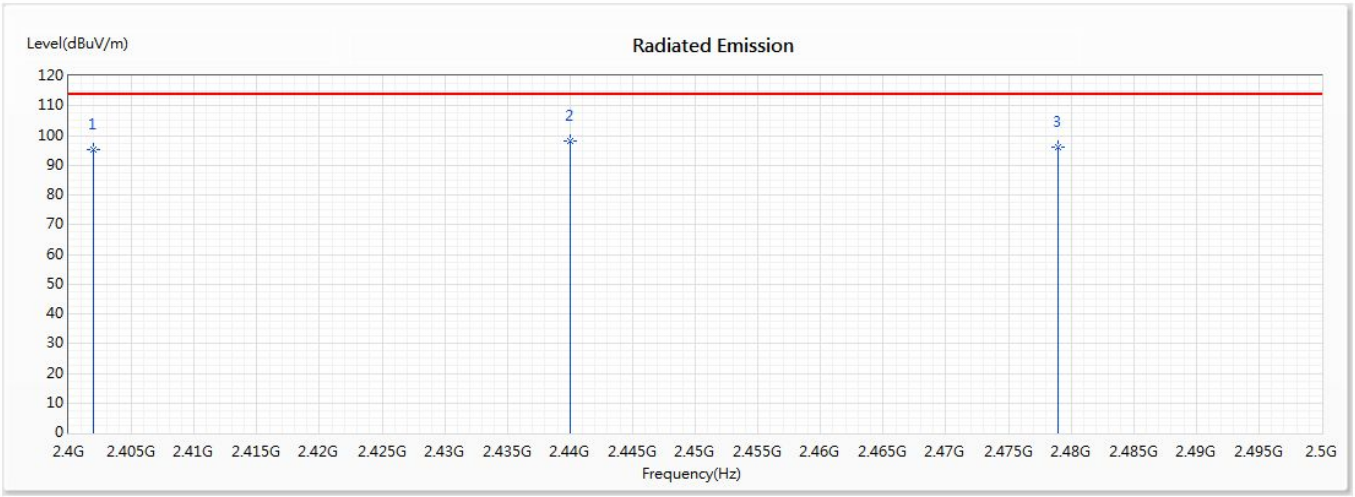
± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

3.5. Test Result of Radiated Emission

Product : ThinkPad TrackPoint Keyboard II
Test Item : Fundamental Radiated Emission
Test Date : 2020/01/10
Test Mode : Mode 1: Transmit (X-Axis)

Horizontal



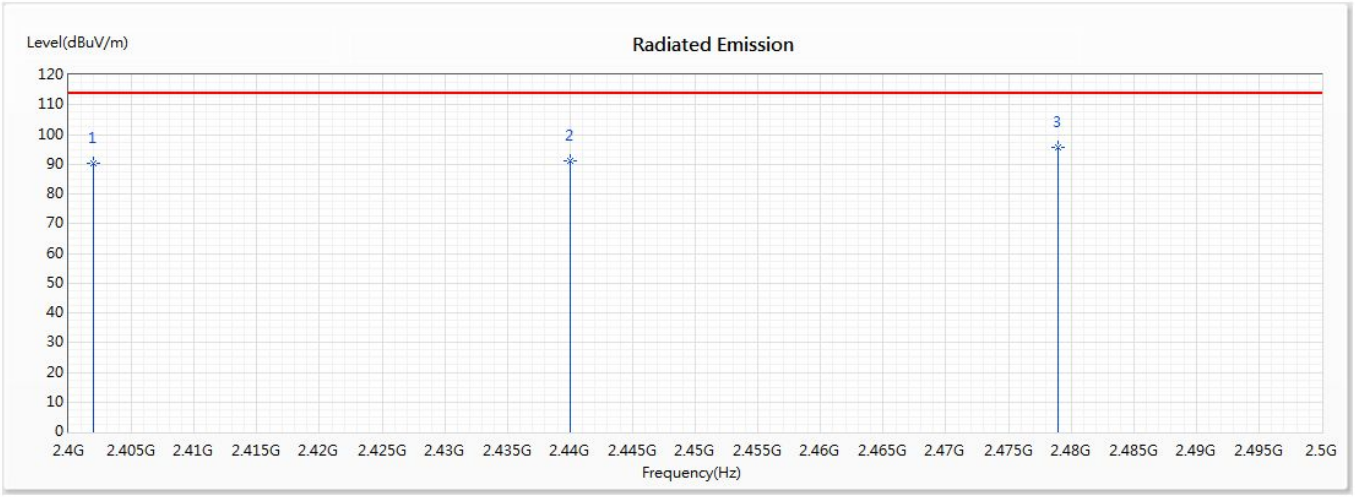
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	2402	95.25	114.00	-18.75	82.28	12.97	PK
* 2	2440	98.22	114.00	-15.78	84.96	13.26	PK
3	2479	96.05	114.00	-17.95	82.69	13.36	PK

Note:

1. Emission Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna Factor + Cable Loss – PreAMP.
3. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Product : ThinkPad TrackPoint Keyboard II
Test Item : Fundamental Radiated Emission
Test Date : 2020/01/10
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/m)	Detector Type
1	2402	90.50	114.00	-23.50	77.53	12.97	PK
2	2440	91.19	114.00	-22.81	77.93	13.26	PK
* 3	2479	95.81	114.00	-18.19	82.45	13.36	PK

Note:

1. Emission Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna Factor + Cable Loss – PreAMP.
3. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Average Detector:

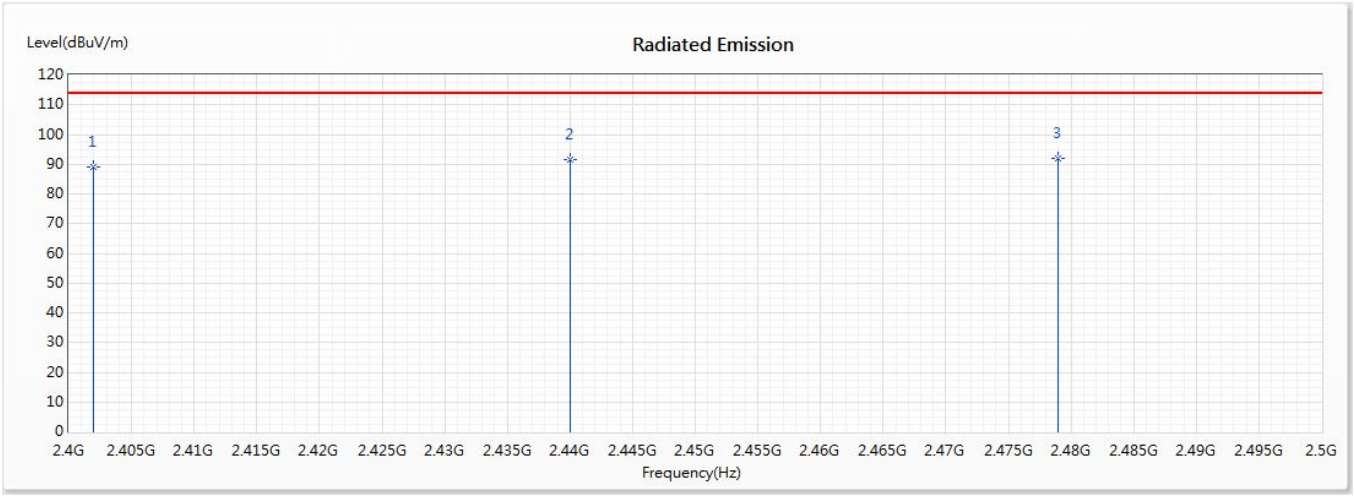
Frequency	Peak Measurement	Duty Cycle Correct Factor	Measurement Level	Margin	Limit
MHz	dBuV/m	dB	dBuV/m	dB	dBuV/m
Horizontal Average Detector:					
2402	95.25	-20.127	75.123	-18.877	94.000
2440	98.22	-20.127	78.093	-15.907	94.000
2479	96.05	-20.127	75.923	-18.077	94.000
Vertical Average Detector:					
2402	90.50	-20.127	70.373	-23.627	94.000
2440	91.19	-20.127	71.063	-22.937	94.000
2479	95.81	-20.127	75.683	-18.317	94.000

Note:

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

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/01/10
Test Mode	:	Mode 1: Transmit (Y-Axis)

Horizontal



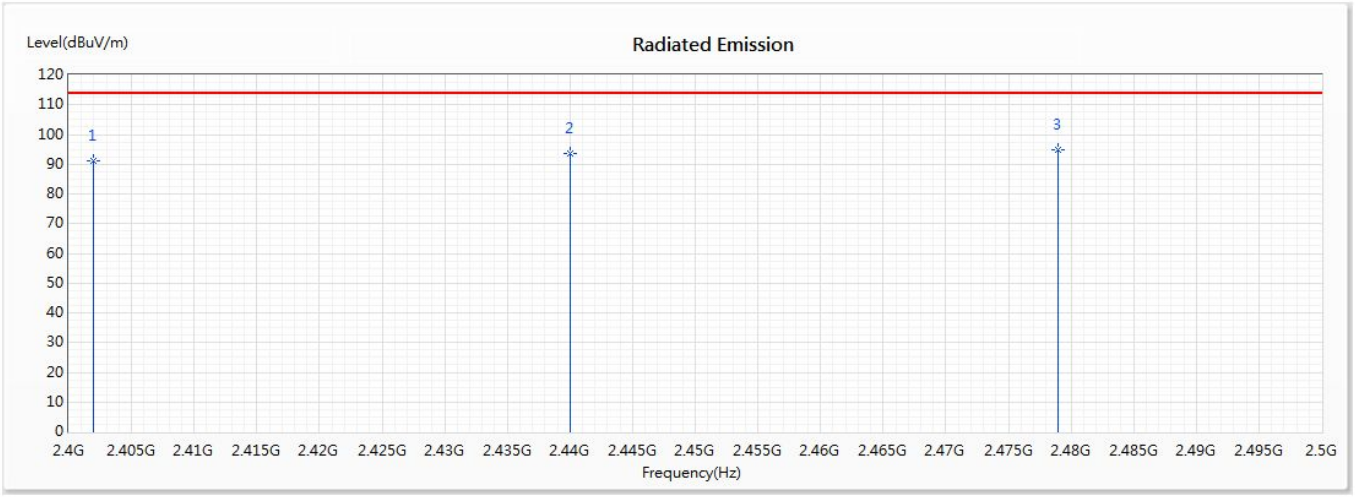
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	2402	88.98	114.00	-25.02	76.01	12.97	PK
2	2440	91.39	114.00	-22.61	78.13	13.26	PK
* 3	2479	91.76	114.00	-22.24	78.40	13.36	PK

Note:

1. Emission Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna Factor + Cable Loss – PreAMP.
3. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Product : ThinkPad TrackPoint Keyboard II
Test Item : Fundamental Radiated Emission
Test Date : 2020/01/13
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/m)	Detector Type
1	2402	91.19	114.00	-22.81	78.22	12.97	PK
2	2440	93.56	114.00	-20.44	80.30	13.26	PK
* 3	2479	94.64	114.00	-19.36	81.28	13.36	PK

Note:

1. Emission Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna Factor + Cable Loss – PreAMP.
3. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Average Detector:

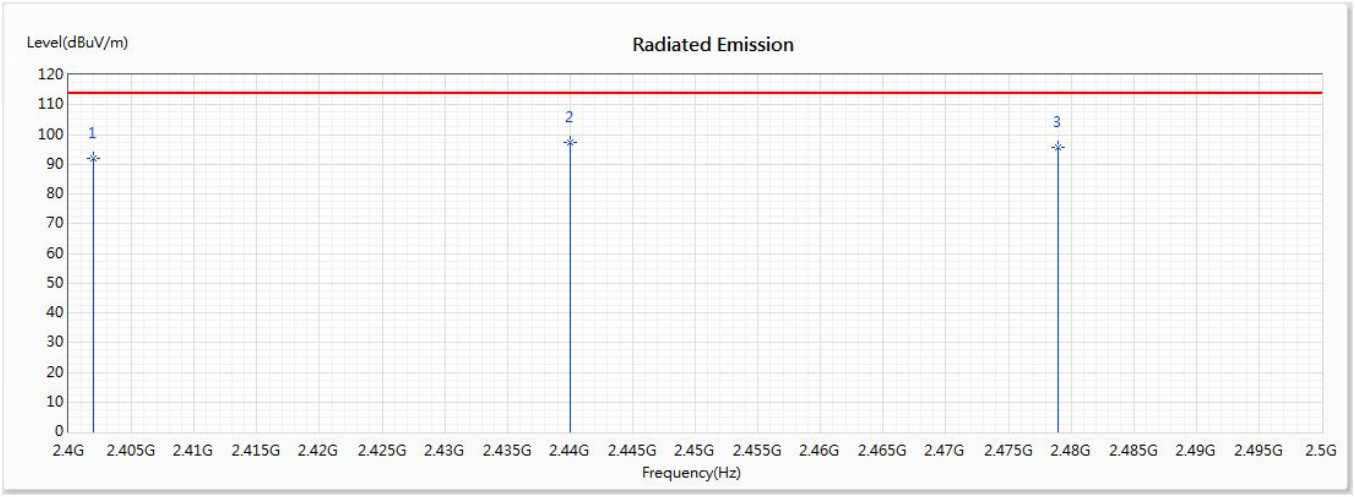
Frequency	Peak Measurement	Duty Cycle Correct Factor	Measurement Level	Margin	Limit
MHz	dBuV/m	dB	dBuV/m	dB	dBuV/m
Horizontal Average Detector:					
2402	88.98	-20.127	68.853	-25.147	94.000
2440	91.39	-20.127	71.263	-22.737	94.000
2479	91.76	-20.127	71.633	-22.367	94.000
Vertical Average Detector:					
2402	91.19	-20.127	71.063	-22.937	94.000
2440	93.56	-20.127	73.433	-20.567	94.000
2479	94.64	-20.127	74.513	-19.487	94.000

Note:

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

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/01/13
Test Mode	:	Mode 1: Transmit (Z-Axis)

Horizontal



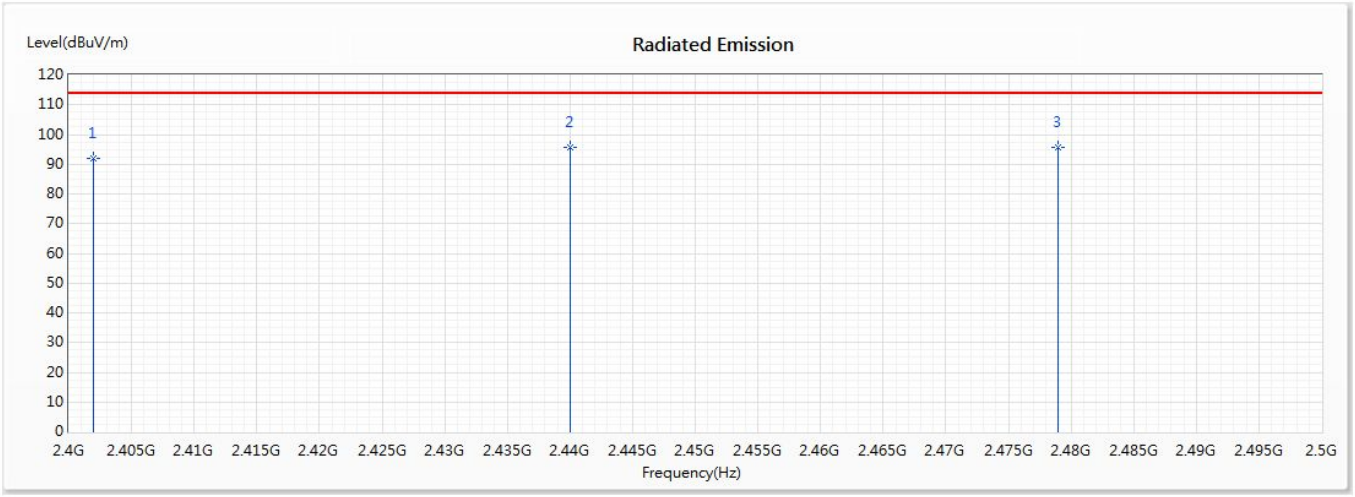
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	2402	91.90	114.00	-22.10	78.93	12.97	PK
* 2	2440	97.18	114.00	-16.82	83.92	13.26	PK
3	2479	95.60	114.00	-18.40	82.24	13.36	PK

Note:

1. Emission Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna Factor + Cable Loss – PreAMP.
3. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Fundamental Radiated Emission
Test Date	:	2020/01/13
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/m)	Detector Type
1	2402	91.90	114.00	-22.10	78.93	12.97	PK
2	2440	95.50	114.00	-18.50	82.24	13.26	PK
* 3	2479	95.51	114.00	-18.49	82.15	13.36	PK

Note:

1. Emission Level = Reading Level + Correct Factor.
2. Correct Factor = Antenna Factor + Cable Loss – PreAMP.
3. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Average Detector:

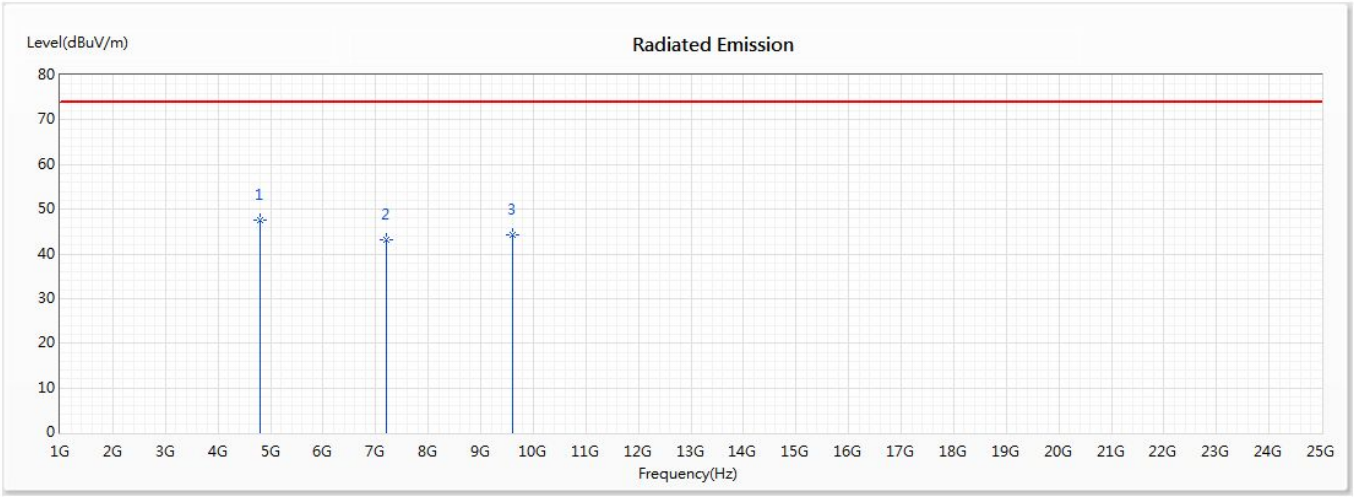
Frequency	Peak Measurement	Duty Cycle Correct Factor	Measurement Level	Margin	Limit
MHz	dBuV/m	dB	dBuV/m	dB	dBuV/m
Horizontal Average Detector:					
2402	91.90	-20.127	71.773	-22.227	94.000
2440	97.18	-20.127	77.053	-16.947	94.000
2479	95.60	-20.127	75.473	-18.527	94.000
Vertical Average Detector:					
2402	91.90	-20.127	71.773	-22.227	94.000
2440	95.50	-20.127	75.373	-18.627	94.000
2479	95.51	-20.127	75.383	-18.617	94.000

Note:

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

Product : ThinkPad TrackPoint Keyboard II
Test Item : Harmonic Radiated Emission Data
Test Date : 2020/01/13
Test Mode : Mode 1: Transmit (2402MHz)

Horizontal



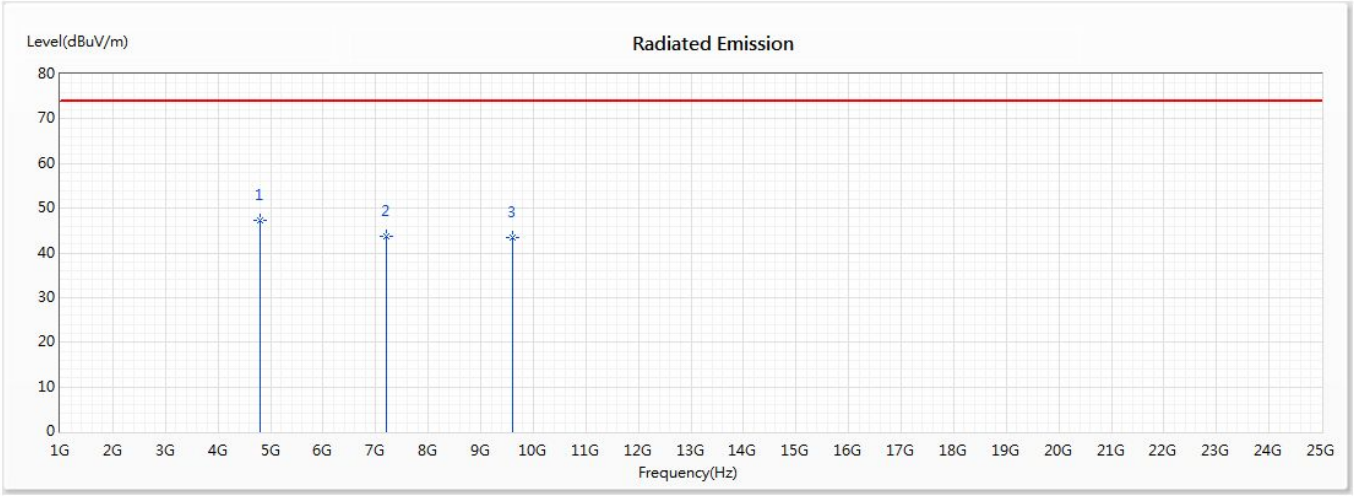
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4804	47.56	74.00	-26.44	59.71	-12.15	PK
2	7206	43.14	74.00	-30.86	56.28	-13.14	PK
3	9608	44.14	74.00	-29.86	57.56	-13.42	PK

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/01/13
Test Mode	:	Mode 1: Transmit (2402MHz)

Vertical



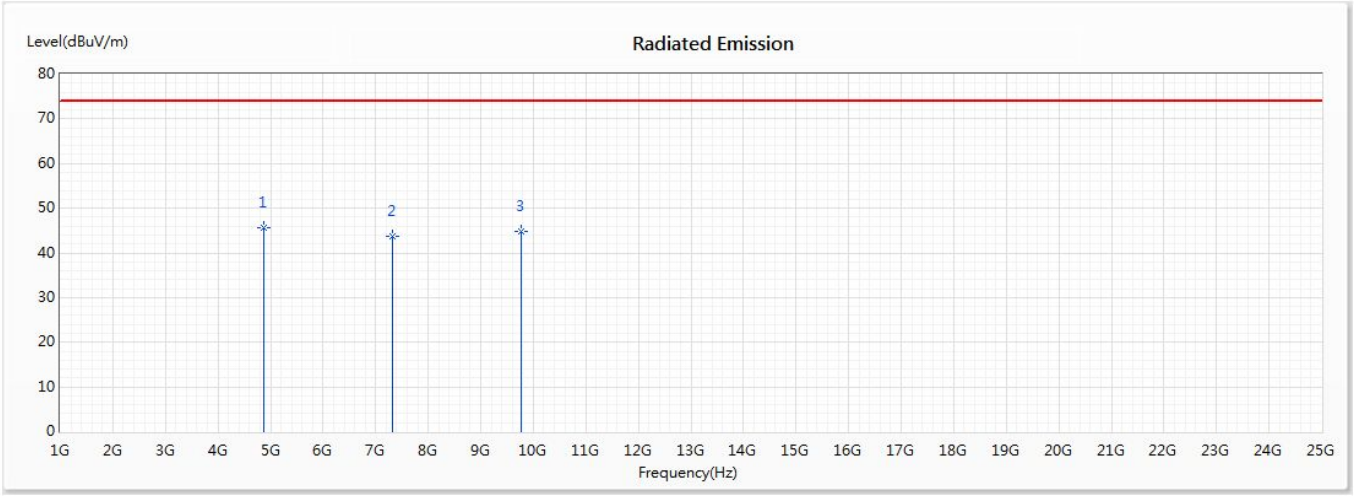
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4804	47.18	74.00	-26.82	59.33	-12.15	PK
2	7206	43.68	74.00	-30.32	56.82	-13.14	PK
3	9608	43.55	74.00	-30.45	56.97	-13.42	PK

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : ThinkPad TrackPoint Keyboard II
Test Item : Harmonic Radiated Emission Data
Test Date : 2020/01/13
Test Mode : Mode 1: Transmit (2440MHz)

Horizontal



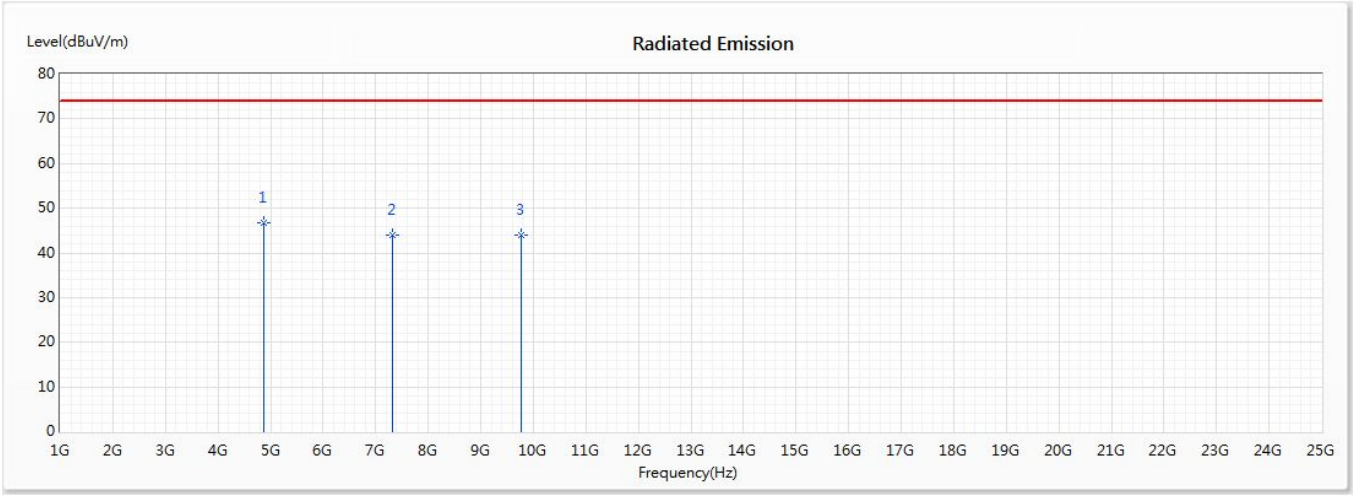
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4880	45.59	74.00	-28.41	57.19	-11.60	PK
2	7320	43.63	74.00	-30.37	57.18	-13.55	PK
3	9760	44.76	74.00	-29.24	57.24	-12.48	PK

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : ThinkPad TrackPoint Keyboard II
Test Item : Harmonic Radiated Emission Data
Test Date : 2020/01/13
Test Mode : Mode 1: Transmit (2440MHz)

Vertical



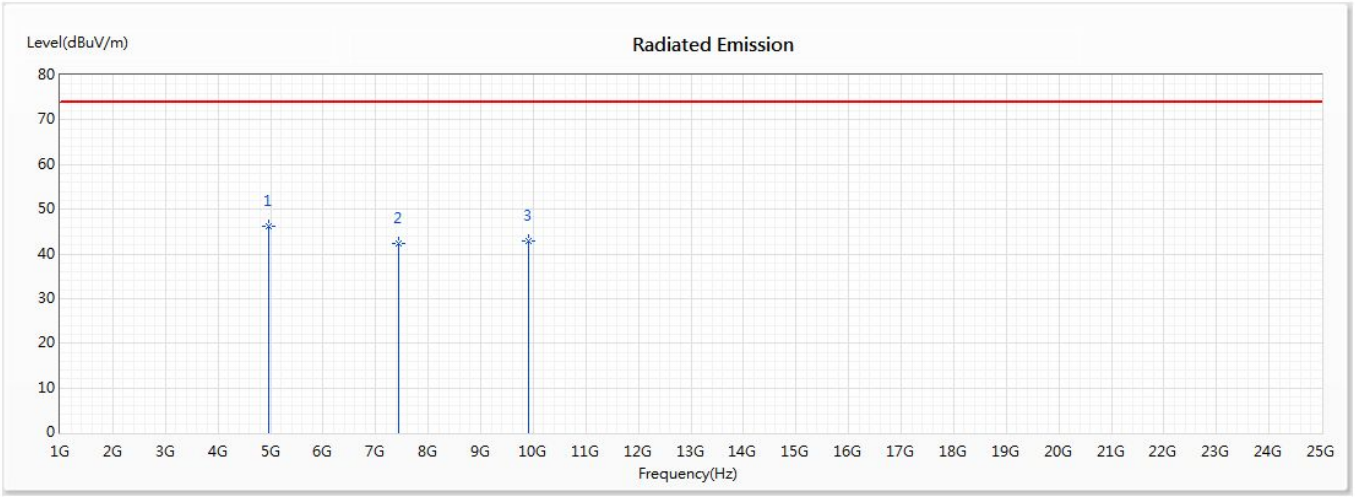
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4880	46.75	74.00	-27.25	58.35	-11.60	PK
2	7320	43.91	74.00	-30.09	57.46	-13.55	PK
3	9760	43.97	74.00	-30.03	56.45	-12.48	PK

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/01/13
Test Mode	:	Mode 1: Transmit (2479 MHz)

Horizontal



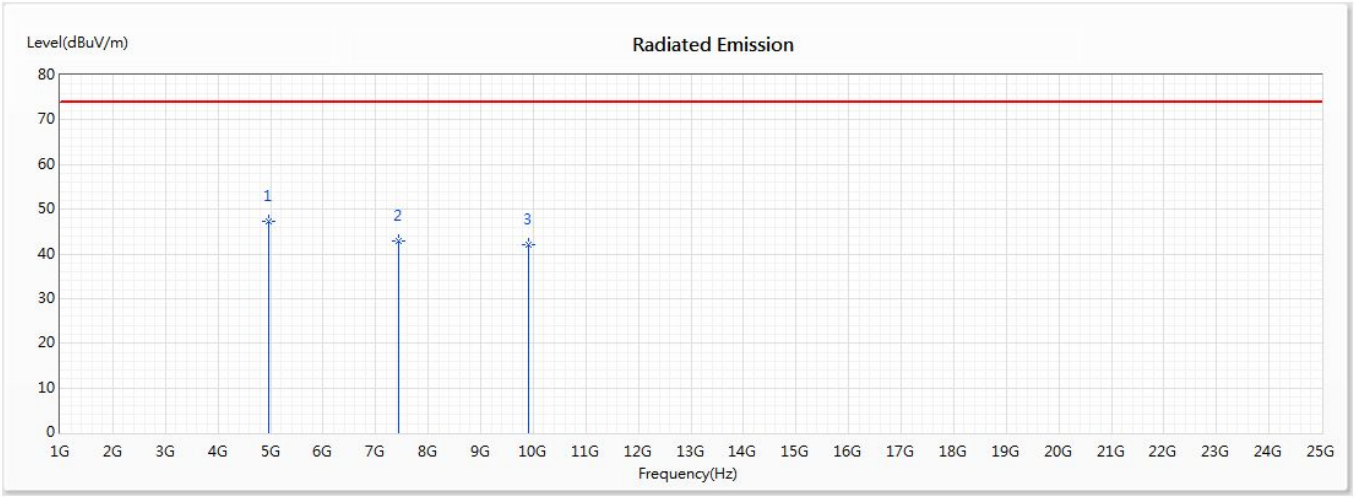
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4958	46.26	74.00	-27.74	57.16	-10.90	PK
2	7437	42.25	74.00	-31.75	56.84	-14.59	PK
3	9916	42.92	74.00	-31.08	57.11	-14.19	PK

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Harmonic Radiated Emission Data
Test Date	:	2020/01/13
Test Mode	:	Mode 1: Transmit (2479 MHz)

Vertical



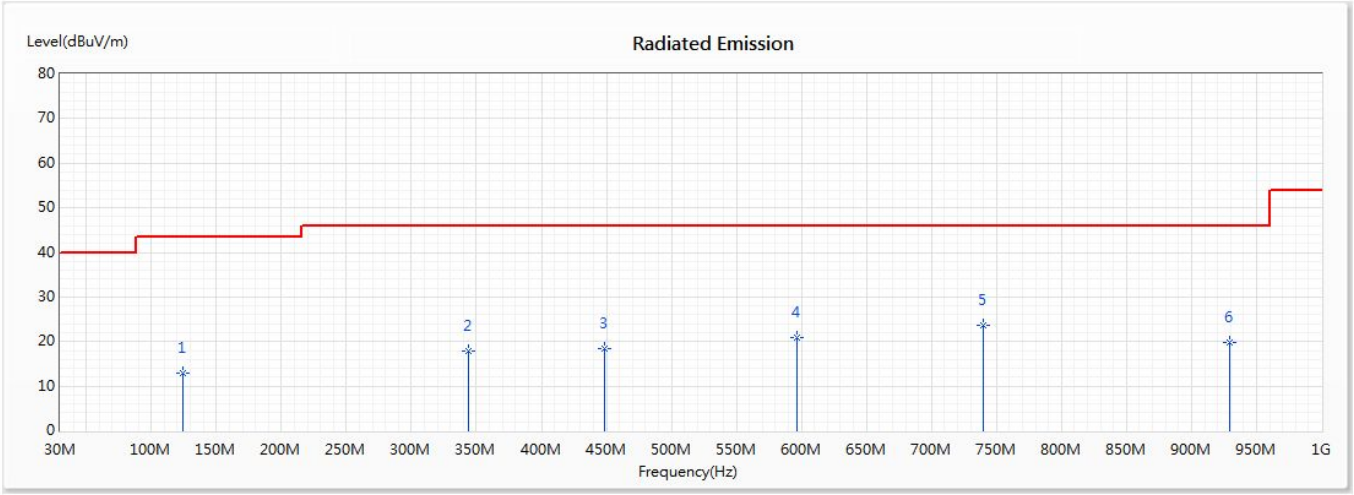
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4958	47.19	74.00	-26.81	58.09	-10.90	PK
2	7437	43.01	74.00	-30.99	57.60	-14.59	PK
3	9916	42.13	74.00	-31.87	56.32	-14.19	PK

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	General Radiated Emission Data
Test Date	:	2020/01/16
Test Mode	:	Mode 1: Transmit (2440 MHz)

Horizontal



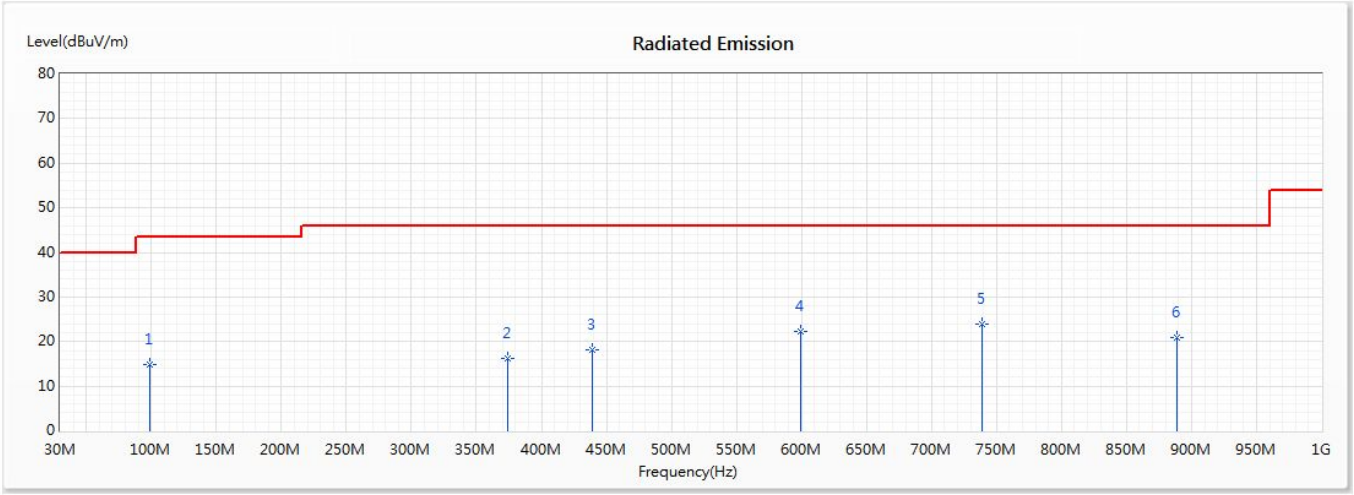
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	124.188	13.04	43.50	-30.46	29.60	-16.56	QP
2	343.493	17.89	46.00	-28.11	31.63	-13.74	QP
3	448.928	18.44	46.00	-27.56	28.54	-10.10	QP
4	596.536	20.90	46.00	-25.10	27.66	-6.76	QP
* 5	739.928	23.64	46.00	-22.36	29.16	-5.52	QP
6	929.71	19.89	46.00	-26.11	29.44	-9.55	QP

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : ThinkPad TrackPoint Keyboard II
Test Item : General Radiated Emission Data
Test Date : 2020/01/16
Test Mode : Mode 1: Transmit (2440 MHz)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	98.884	14.91	43.50	-28.59	31.17	-16.26	QP
2	374.42	16.09	46.00	-29.91	28.32	-12.23	QP
3	439.087	18.24	46.00	-27.76	28.11	-9.87	QP
4	599.348	22.30	46.00	-23.70	28.93	-6.63	QP
* 5	738.522	23.92	46.00	-20.08	29.67	-5.75	QP
6	888.942	20.92	46.00	-25.08	29.95	-9.03	QP

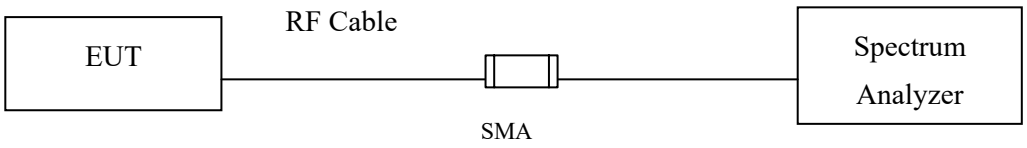
Note:

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.
4. Emission Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

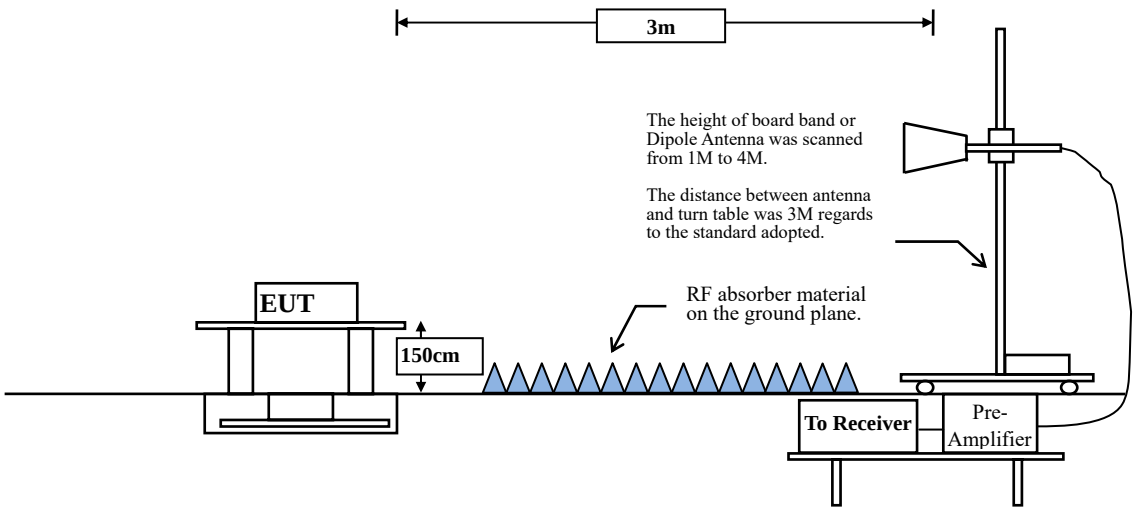
4. Band Edge

4.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement:



4.2. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 50 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 conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

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.

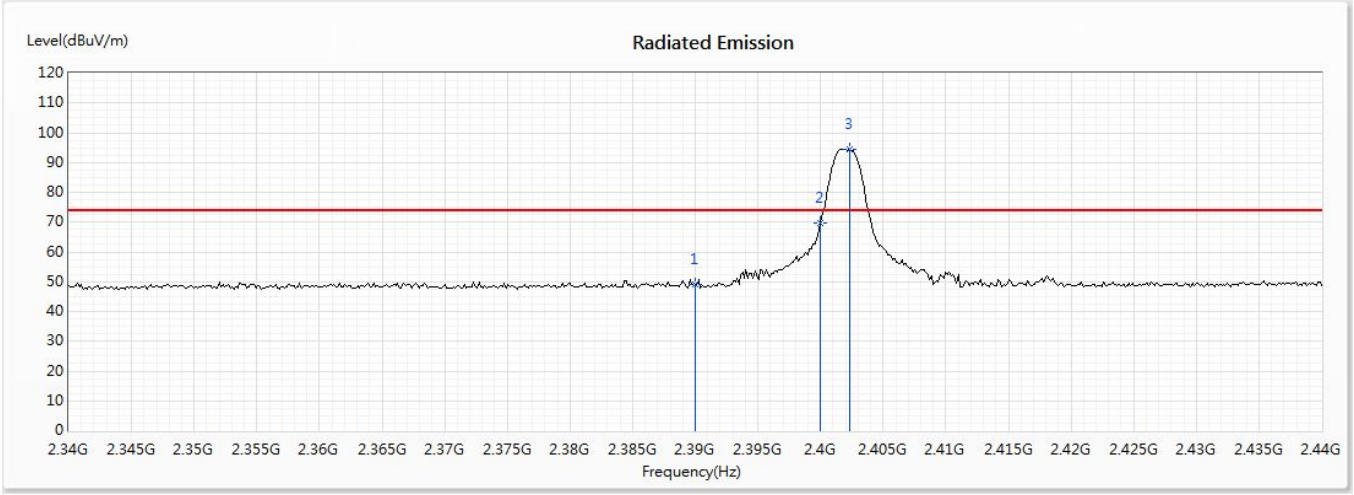
4.4. Uncertainty

± 4.08 dB above 1GHz
± 4.22 dB below 1GHz

4.5. Test Result of Band Edge

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Band Edge Data
Test Date	:	2020/01/13
Test Mode	:	Mode 1: Transmit (2402MHz)

Horizontal



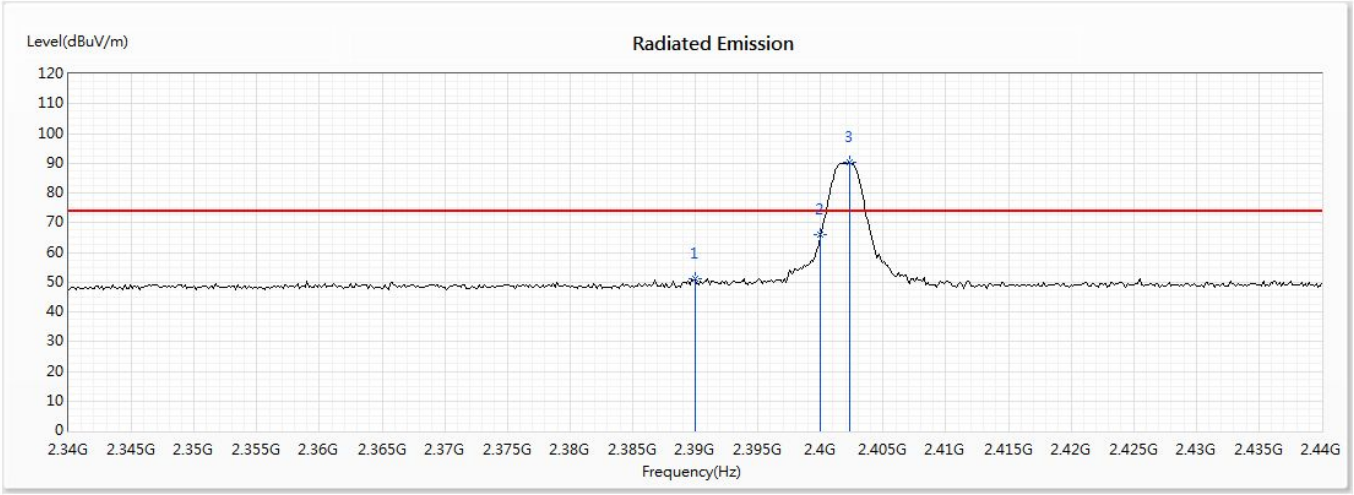
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	2390	48.95	74.00	-25.05	36.06	12.89	PK
2	2400	69.84	--	--	56.88	12.96	PK
! 3	2402.319	94.39	--	--	81.42	12.97	PK

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.

Product : ThinkPad TrackPoint Keyboard II
Test Item : Band Edge Data
Test Date : 2020/01/13
Test Mode : Mode 1: Transmit (2402MHz)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	2390	51.04	74.00	-22.96	38.15	12.89	PK
2	2400	66.12	--	--	53.16	12.96	PK
! 3	2402.319	90.12	--	--	77.15	12.97	PK

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.

Average Detector:

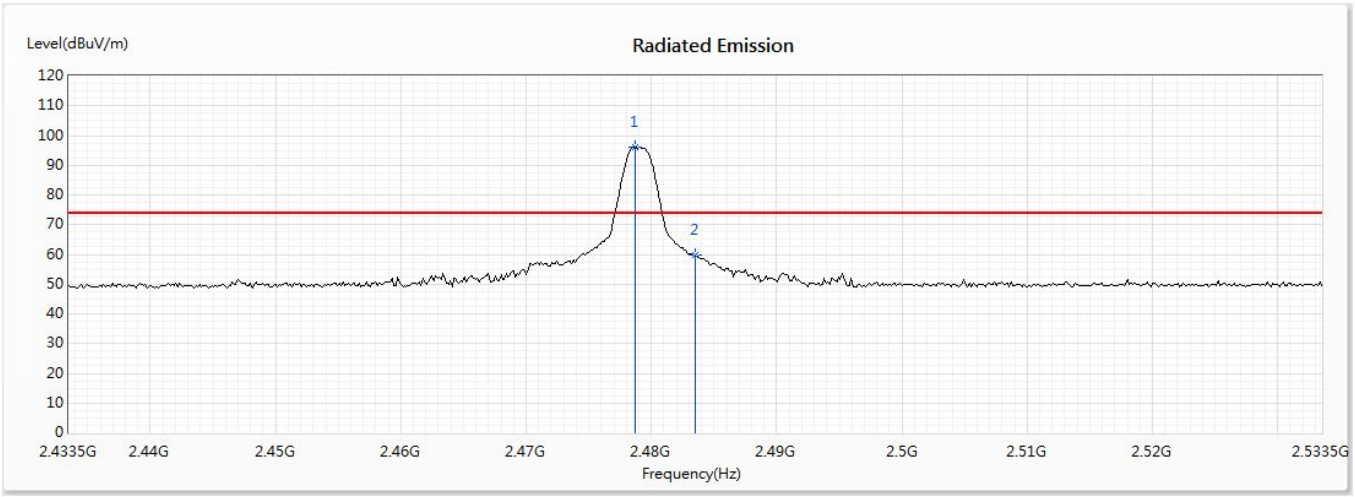
Frequency	Peak Measurement	Duty Cycle Factor	Measurement Level	Margin	Limit	Result Pass
MHz	dBµV/m	dB	dBµV/m	dB	dBµV/m	
Horizontal						
Average Detector:						
2390	48.95	-20.127	28.823	-25.177	54.000	Pass
2400	69.84	-20.127	49.713	--	--	Pass
2402.319	94.39	-20.127	74.263	--	--	Pass
Vertical						
Average Detector:						
2390	51.04	-20.127	30.913	-23.087	54.000	Pass
2400	66.12	-20.127	45.993	--	--	Pass
2402.319	90.12	-20.127	69.993	--	--	Pass

Note:

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

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Band Edge Data
Test Site	:	No.3 OATS
Test Date	:	2020/01/13
Test Mode	:	Mode 1: Transmit (2479MHz)

Horizontal



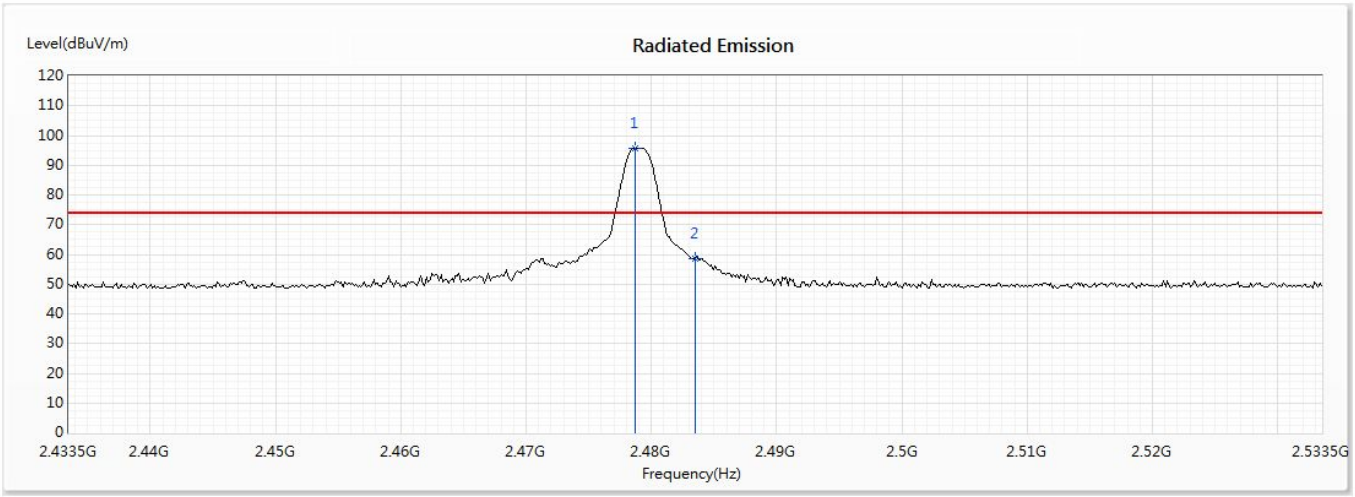
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
! 1	2478.717	95.95	--	--	82.58	13.37	PK
2	2483.5	59.61	74.00	-14.39	46.23	13.38	PK

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.

Product	:	ThinkPad TrackPoint Keyboard II
Test Item	:	Band Edge Data
Test Site	:	No.3 OATS
Test Date	:	2020/01/13
Test Mode	:	Mode 1: Transmit (2479MHz)

Vertical



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
! 1	2478.717	95.62	--	--	82.25	13.37	PK
2	2483.5	58.39	74.00	-15.61	45.01	13.38	PK

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.

Average Detector:

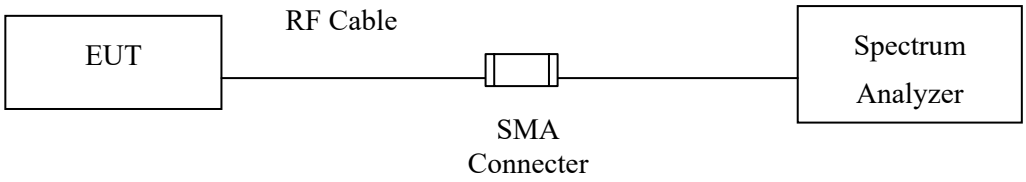
Frequency	Peak Measurement	Duty Cycle Factor	Measurement Level	Margin	Limit	Result Pass
MHz	dBµV/m	dB	dBµV/m	dB	dBµV/m	
Horizontal						
Average Detector:						
2478.717	95.95	-20.127	75.823	--	--	Pass
2483.5	59.61	-20.127	39.483	-14.517	54.000	Pass
Vertical						
Average Detector:						
2478.717	95.62	-20.127	75.493	--	--	Pass
2483.5	58.39	-20.127	38.263	-15.737	54.000	Pass

Note:

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

5. Duty Cycle

5.1. Test Setup

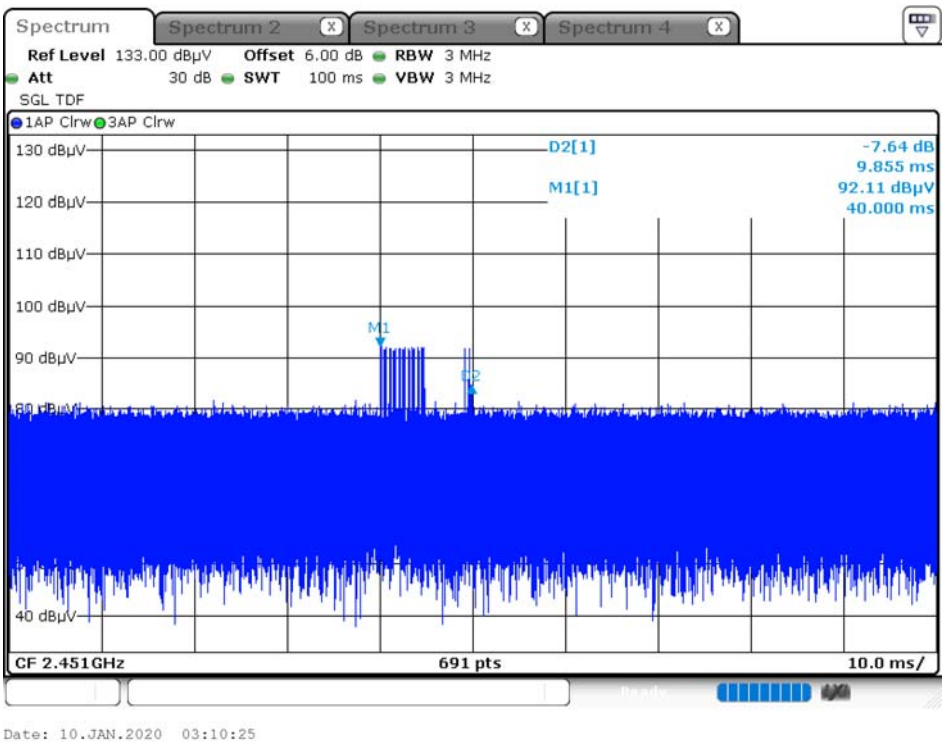


5.2. Uncertainty

± 2.31ms

5.3. Test Result of Duty Cycle

Product : ThinkPad TrackPoint Keyboard II
Test Item : Duty Cycle Data
Test Date : 2020/01/20
Test Mode : Mode 1: Transmit



Time on of 100ms=9.855ms

Duty Cycle= 9.855ms / 100ms= 0.09855

Duty Cycle correction factor= 20 LOG 0.09855= -20.127 dB

Duty Cycle correction factor	**-20.127**	**dB**

6. EMI Reduction Method During Compliance Testing

No modification was made during testing.