

2.4GHz Wideband Low Power Data Communication System Test Report

Product Name	Wireless Gaming Keyboard
Model No.	M601

Applicant	ASUSTeK COMPUTER INC.
Address	1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan

Date of Receipt	Jun. 20, 2020
Issued Date	Aug. 18, 2020
Report No.	2060790R-E3032140408
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.

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 : Aug. 18, 2020

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Product Name	Wireless Gaming Keyboard
Applicant	ASUSTeK COMPUTER INC.
Address	1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan
Manufacturer	ASUSTeK COMPUTER INC.
Model No.	M601
EUT Rated Voltage	DC 3.85V(Power by battery) or DC 5V (Power by USB)
EUT Test Voltage	DC 3.85V(Power by battery) and DC 5V (Power by USB)
Trade Name	ASUS
Test Method	Public notice of MIC No.88 test method of specified radio equipment (January 26, 2004) Annex43. Article 2 paragraph 1 item 19
Test Result	Complied

Documented By

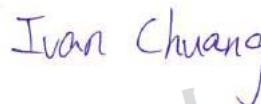
:



(Senior Adm. Specialist / Joanne Lin)

Tested By

:



(Senior Engineer / Ivan Chuang)

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
2060790R-E3032140408	V1.0	Initial issue of report.	2020-08-18

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Wireless Gaming Keyboard
Trade Name	ASUS
Model No.	M601
SERIAL NUMBER	N/A
Frequency Range	2403-2480MHz
Number of Channels	78CH
Type of Modulation	GFSK
Antenna Type	PIFA Antenna
Antenna Gain	Refer to the table "Antenna List"
Channel Control	Auto
Declared Output Power	1.5mW
USB Cable	Shielded, 1.9m

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	Shenzhen Shuodian Electronic Technology Co.,Ltd	SD623-PCB-2.4G WIFI-20200610	PIFA Antenna	2dBi for 2.4GHz

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: The EUT is an Wireless Gaming Keyboard with built-in 2.4G wireless transceiver.

Test Mode	Mode 1: Transmit
	Mode 2: Receive

1.2. Operation Description

The EUT is an Wireless Gaming Keyboard with built-in 2.4G transceiver. , It uses the latest 2.4GHz wireless technology along with specially designed dual-antenna and auto interference avoidance mechanism, ensure stable connection even in complicate Wi-Fi indoor environment.

Total numbers of channels supported by this device are 78 channels operating from 2403 to 2480MHz with 1MHz channel spacing. The antenna type is PIFA and the modulation type is GFSK. The device can receive wireless signal and transmit signal for associate device.

1.3. EUT Exercise Software

- (1) Provide DC power to EUT.
- (2) Execute software “usb_hid_cmd 1.07” on the Notebook PC.
- (3) Configure the test mode, the test channel, and the data rate.
- (4) Press “OK” to start the continuous Transmit.
- (5) Verify that the EUT works properly.

1.4. Parament of test software setting

The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Test Software	usb_hid_cmd		
Frequency	2403MHz	2440MHz	2480MHz
2.4G wireless	5	5	5

1.5. Test Conditions

Voltage Test Item	Test Voltage	Voltage meter reading value (RF Chip U9 (CC2640R2F) pin 44)
Nominal Voltage	DC 3.85V	2.02V DC
Highest Voltage	DC 4.23V	2.02V DC
Lowest Voltage	DC 3.46V	2.02V DC

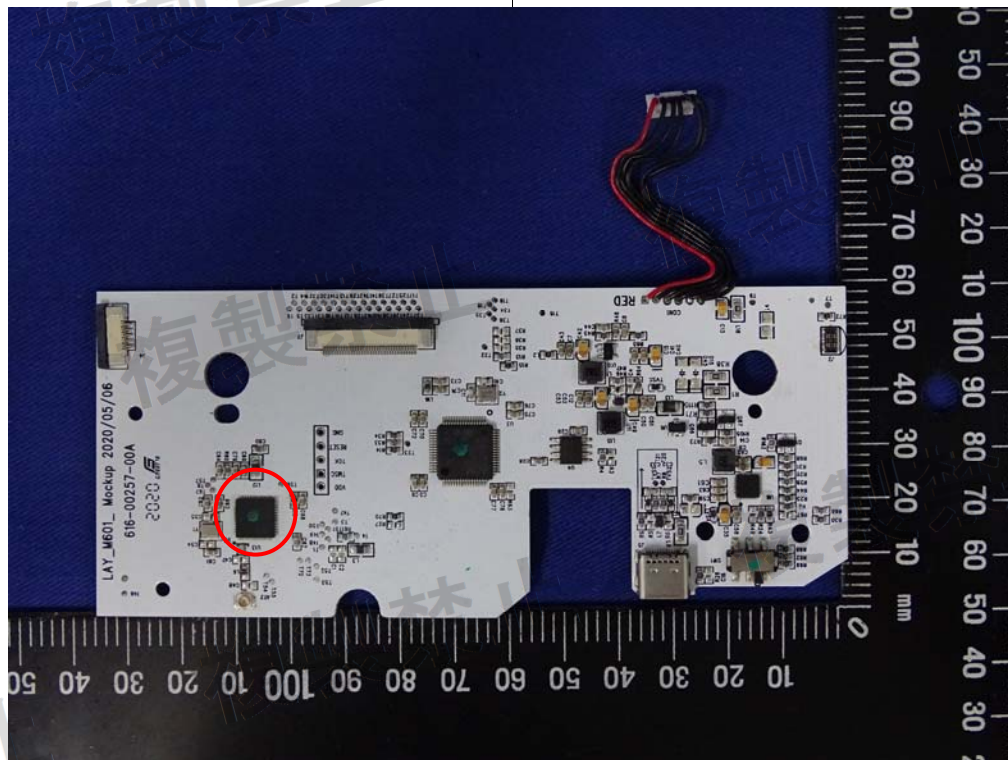
Note:

The Voltage supply for RF Chip U9 (CC2640R2F) pin 44 is 2.02VDC.

The internal supply gives a fluctuation value less than 1 % (Around 0% from max. to min.)

1.6. RF and IF section must be tamper requirement

Requirement	Comments	Result
RF, IF and Modulation section must be tamper	<input type="checkbox"/> Use Special Screw <input type="checkbox"/> Metal Shielding is Soldered <input type="checkbox"/> Use Ball Grid Array (BGA) (Please see Attachment: EUT Detailed Photographs)	Complete
	<input checked="" type="checkbox"/> RF module/Chip pin >10 <input checked="" type="checkbox"/> RF module/Chip pins distance <1.5mm (Please see Attachment: EUT Detailed Photographs)	Complete



1.7. Test Facility

Ambient conditions in the laboratory:

Performed Item	Items	Required	Actual
Conductive	Temperature (°C)	15~35 °C	25.6°C
	Humidity (%RH)	20~75 %	61.3%

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>

1.8. List of Test Item and Equipment

For Conducted measurements /ASR2

	Equipment	Manufacturer	Model No.	Serial No.	Calibrated	Cal. Method	Cali. Data	Due. Data
X	Spectrum Analyzer	R&S	FSV30	103466	ETC	*(c)	2019.12.16	2020.12.15
X	Power Meter	Anritsu	ML2496A	MY51000539	ETC	*(c)	2020.05.13	2021.05.12
X	Power Sensor	Anritsu	MA2411B	MY59240002	ETC	*(c)	2020.05.22	2021.05.21
X	Power Sensor	Anritsu	MA2411B	MY59240003	ETC	*(c)	2020.05.22	2021.05.21

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
4.
 - a) Calibration conducted by the National Institute of Information and Communications Technology(NICT) (hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1)
 - b) Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992)
 - c) Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated agency under Article 102-18 paragraph (1).
 - d) Calibration conducted by using other equipment that listed above from a) to c).

1.9. 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
Output Power and Output Power Tolerance	$\pm 0.91 \text{ dB}$
Occupied Bandwidth	$\pm 682.83 \text{ Hz}$
Frequency Tolerance	$\pm 682.83 \text{ Hz}$
Transmitter Spurious Emissions	$\pm 2.53 \text{ dB}$
Receiver Spurious Emissions	$\pm 2.53 \text{ dB}$

2. Output Power and Output Power Tolerance

2.1. Test Setup



2.2. Limits

10mW (10dBm)

2.3. Test Procedure

Output power is measured using the power meter and record the value.

2.4. Test Result of Output Power and Output Power Tolerance

Product : Wireless Gaming Keyboard
Test Item : Output Power
Test Date : 2020/07/21
Test Mode : Mode 1: Transmit

Maximum Antenna Gain= 2dBi				
Frequency (MHz)	Real Value (dBm)	Limit (dBm)	Real Value (EIRP) (dBm)	Limit (EIRP) (dBm)
2403	1.56	1.56	10	3.56
2440	1.57	1.57	10	3.57
2480	1.69	1.69	10	3.69

Real Value (EIRP) = Real Value + Antenna Gain

Test Result	PASS
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Product : Wireless Gaming Keyboard
Test Item : Output Power Tolerance
Test Date : 2020/07/21
Test Mode : Mode 1: Transmit

Frequency (MHz)	Declared Output Power (mW)	Output Power (mW)	Tolerance (%)	Limit (%)
2403	1.500	1.432	-4.52	+20% to -80%
2440	1.500	1.435	-4.30	+20% to -80%
2480	1.500	1.476	-1.62	+20% to -80%

Note: Deviation = (Output Power - Declared Output Power) / Declared Output Power * 100%

Test Result	PASS
--------------------	------

3. Occupied Bandwidth

3.1. Test Setup



3.2. Test Procedure

A spectrum analyzer or similar device shall be used to observe a sample of the modulated transmitter's radio frequency power output.

- (a) A positive peak detector function must be used.
- (b) A measurement instrument with an integrated 99% power bandwidth function may be used to automate the test process.
- (c) The measurement instrument bandwidth and span must be set sufficiently with, and, the scan time set sufficiently slow, to ensure all major modulation products are captured. Note that the measurement bandwidth should also be set sufficiently narrow to avoid adding significant error to the test result.
- (d) 'Maximum Hold' mode may be used to accumulate the measurement result over several scans provided the emission is repetitive in nature.

3.3. Limits

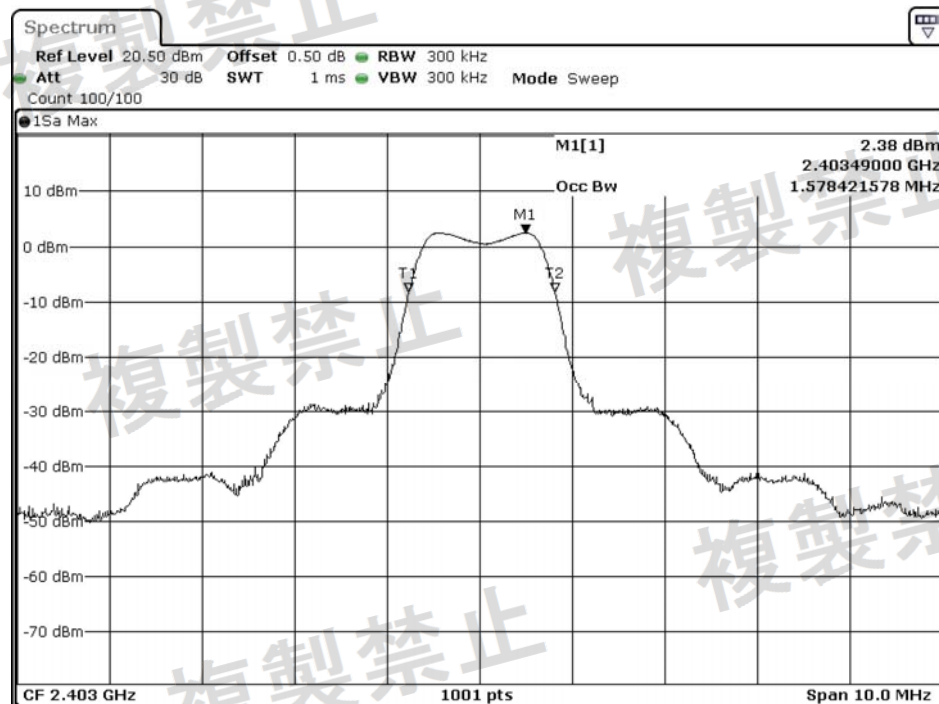
≤ 26 MHz for DSSS&OFDM, ≤ 83.5 MHz for FHSS,
 ≤ 38 MHz for OFDM(Wide-band)

3.4. Test Result of Occupied Bandwidth

Product : Wireless Gaming Keyboard
 Test Item : Occupied Bandwidth
 Test Mode : Mode 1: Transmit

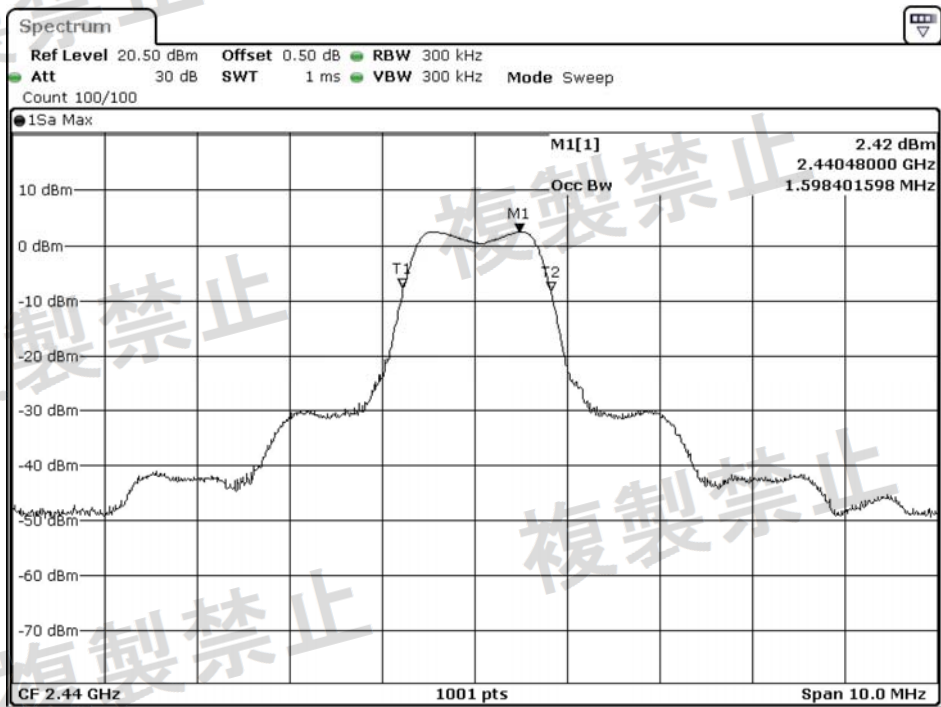
Frequency (MHz)	Reading Value (MHz)	Limit (MHz)
2403	1.578	≤ 26
2440	1.598	≤ 26
2480	1.608	≤ 26

2403MHz



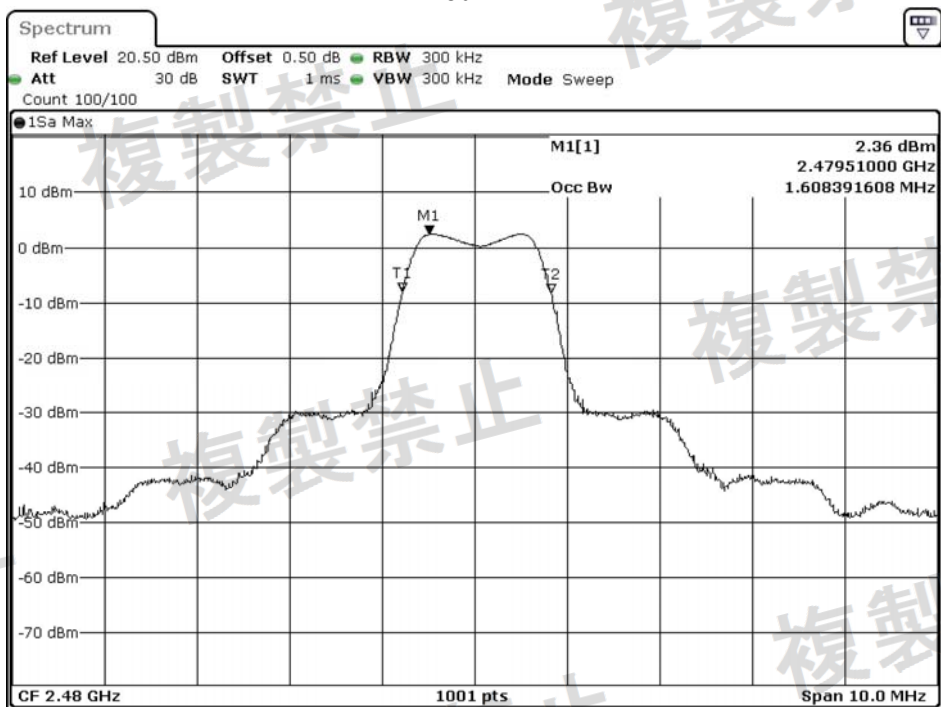
Date: 21.JUL.2020 15:51:11

2440MHz



Date: 21.JUL.2020 16:01:03

2480MHz



Date: 21.JUL.2020 16:12:20

Test Result	PASS
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4. Frequency Tolerance

4.1. Test Setup



4.2. Test Procedure

A spectrum analyzer or similar device shall be used to observe a sample of the modulated transmitter's radio frequency power output.

- (a) A positive peak detector function must be used.
- (b) The measurement instrument bandwidth and span must be set sufficiently with, and, the scan time set sufficiently slow, to ensure all major modulation products are captured. Note that the measurement bandwidth should also be set sufficiently narrow to avoid adding significant error to the test result.
- (c) 'Maximum Hold' mode may be used to accumulate the measurement result over several scans provided the emission is repetitive in nature.

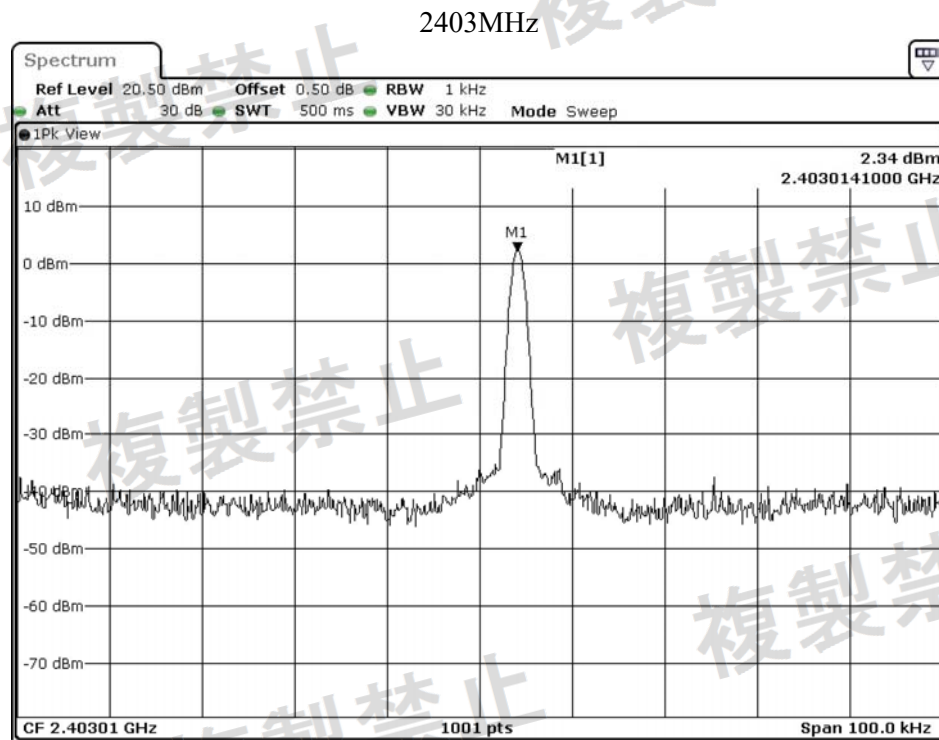
4.3. Limits

± 50 ppm

4.4. Test Result of Frequency Tolerance

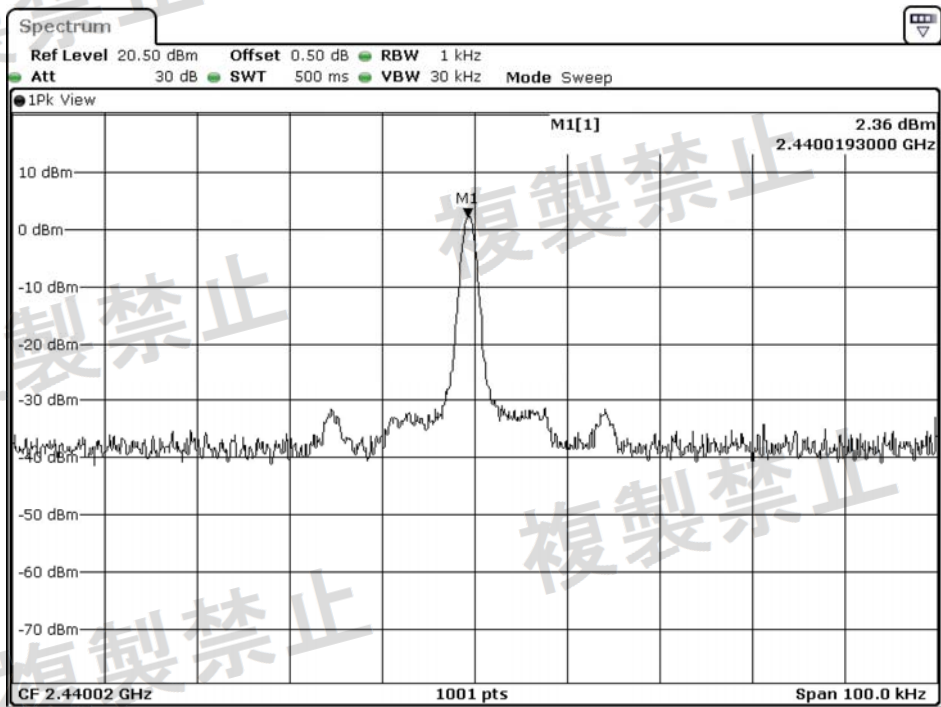
Product : Wireless Gaming Keyboard
 Test Item : Frequency Tolerance
 Test Mode : Mode 1: Transmit

Frequency (MHz)	Reading Value (MHz)	Tolerance (ppm)	Limit (ppm)
2403	2403.0141	5.86767	± 50
2440	2440.0193	7.90984	± 50
2480	2480.0197	7.94355	± 50

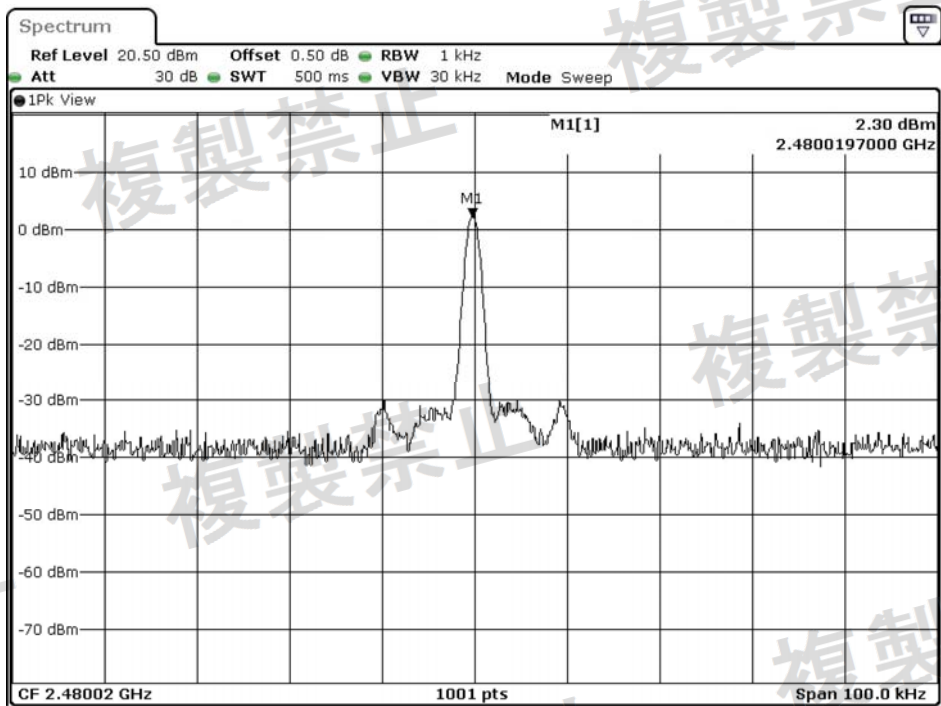


Date: 21.JUL.2020 15:49:48

2440MHz



2480MHz



Test Result

PASS

5. Transmitter Spurious Emissions

5.1. Test Setup



5.2. Test Procedure

A spectrum analyzer or similar device shall be used to observe a sample of the modulated transmitter's radio frequency power output.

- (a) A positive peak detector function must be used.
- (b) The measurement instrument bandwidth and span must be set sufficiently with, and, the scan time set sufficiently slow, to ensure all major modulation products are captured. Note that the measurement bandwidth should also be set sufficiently narrow to avoid adding significant error to the test result.
- (c) 'Maximum Hold' mode may be used to accumulate the measurement result over several scans provided the emission is repetitive in nature.

5.3. Limits

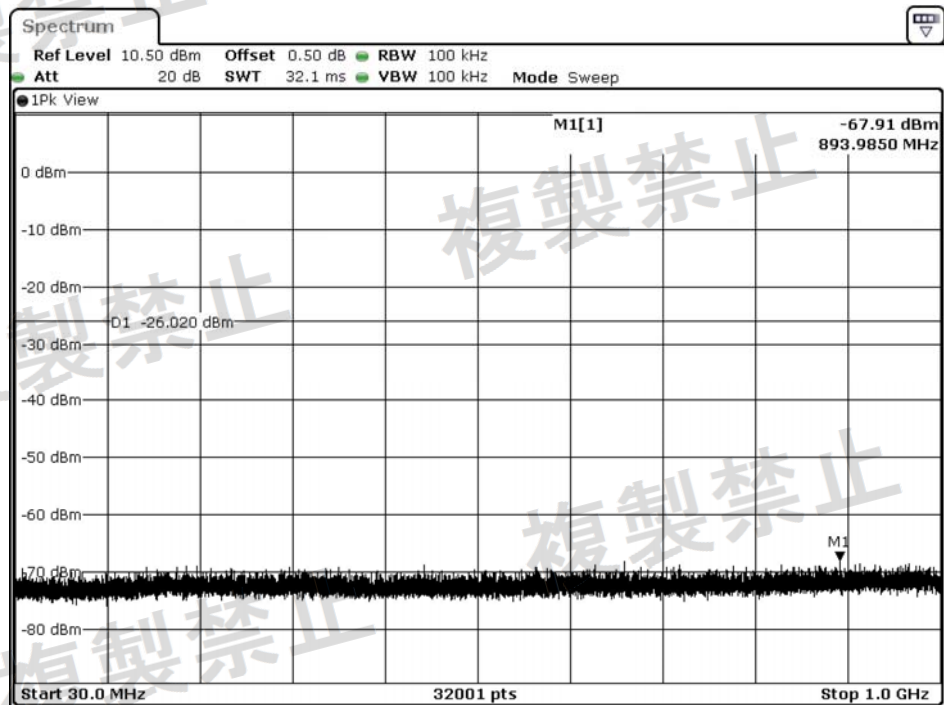
- $\leq 2.5\mu\text{W}$ for 30 – 2387 MHz
- $\leq 25\mu\text{W}$ for 2387 – 2400 MHz
- $\leq 25\mu\text{W}$ for 2483.5 – 2496.5 MHz
- $\leq 2.5\mu\text{W}$ for 2496.5 – 12500 MHz

5.4. Test Result of Transmitter Spurious Emissions

Product : Wireless Gaming Keyboard
Test Item : Transmitter Spurious Emissions
Test Mode : Mode 1: Transmit (2403MHz)

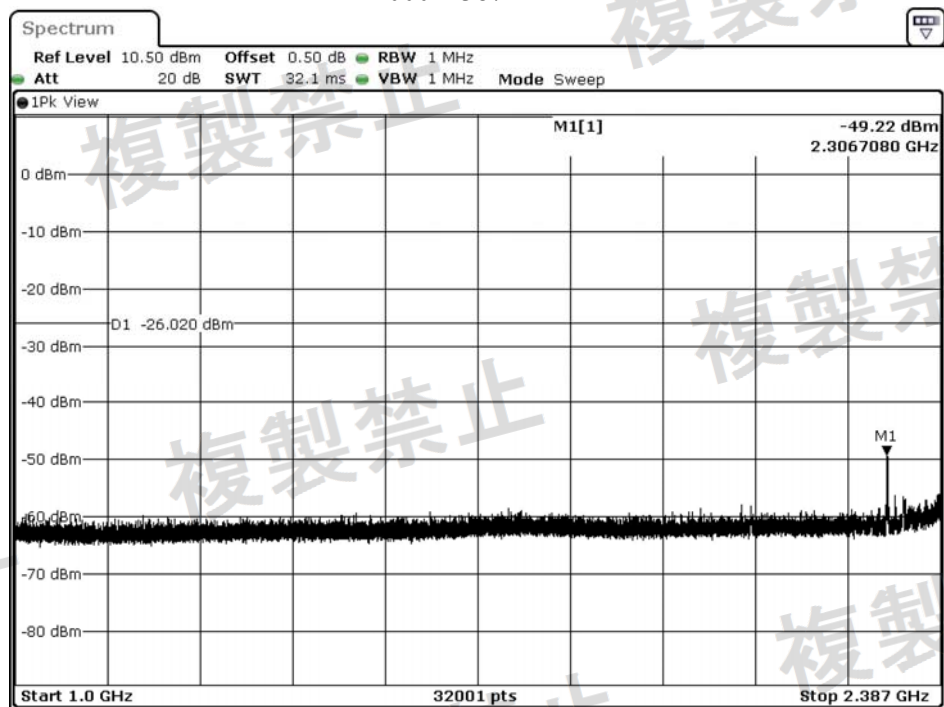
Frequency Range (MHz)	Reading Value (dBm)	Limit (dBm)
30 – 1000	-67.91	-26 (2.5uW)
1000 – 2387	-49.22	-26 (2.5uW)
2387 – 2400	-38.34	-16 (25uW)
2483.5 – 2496.5	-55.85	-16 (25uW)
2496.5 – 8000	-49.33	-26 (2.5uW)
8000 – 12750	-56.29	-26 (2.5uW)

30–1000MHz



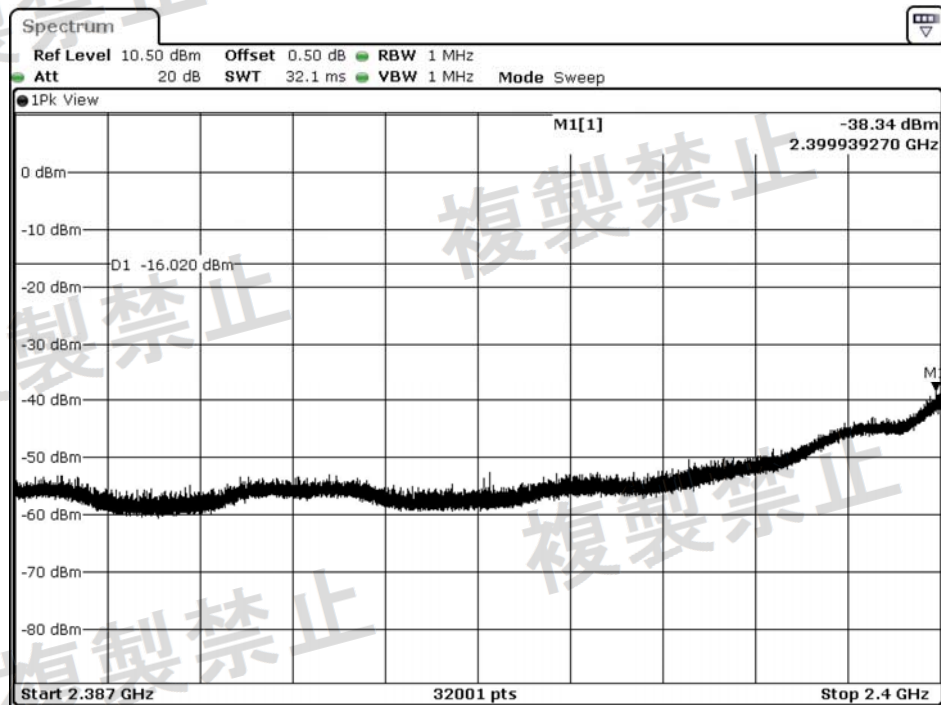
Date: 21.JUL.2020 15:56:48

1000–2387MHz



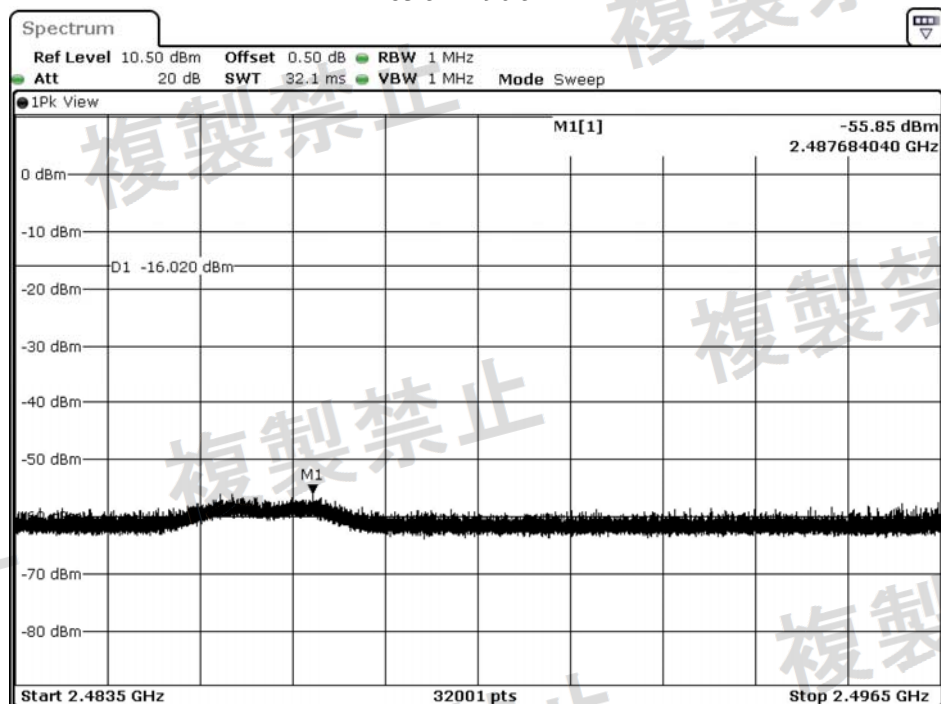
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2387–2400 MHz



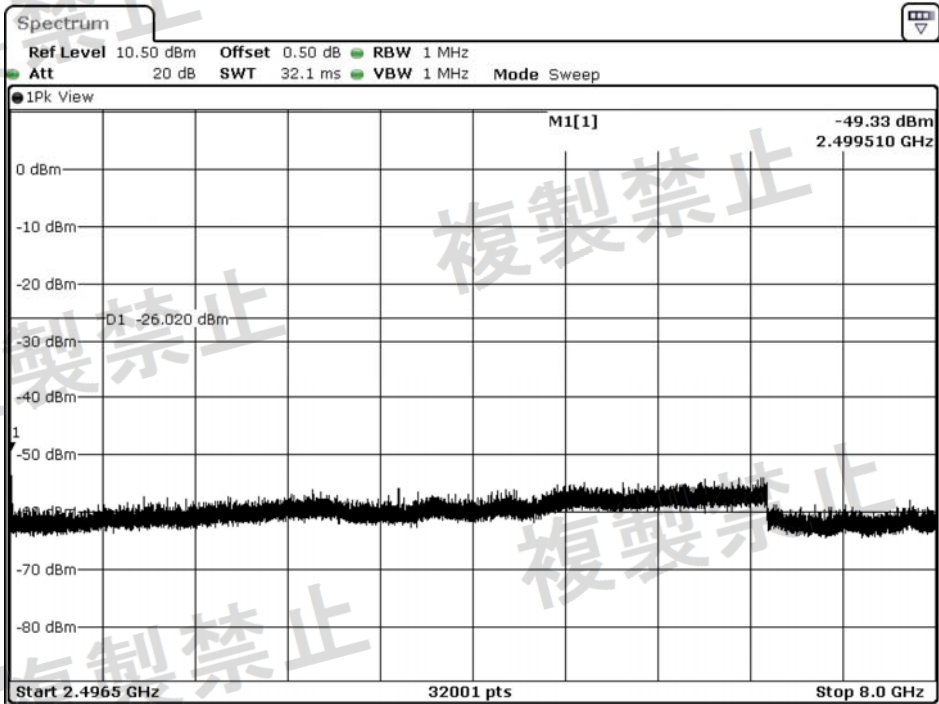
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2483.5–2496.5MHz



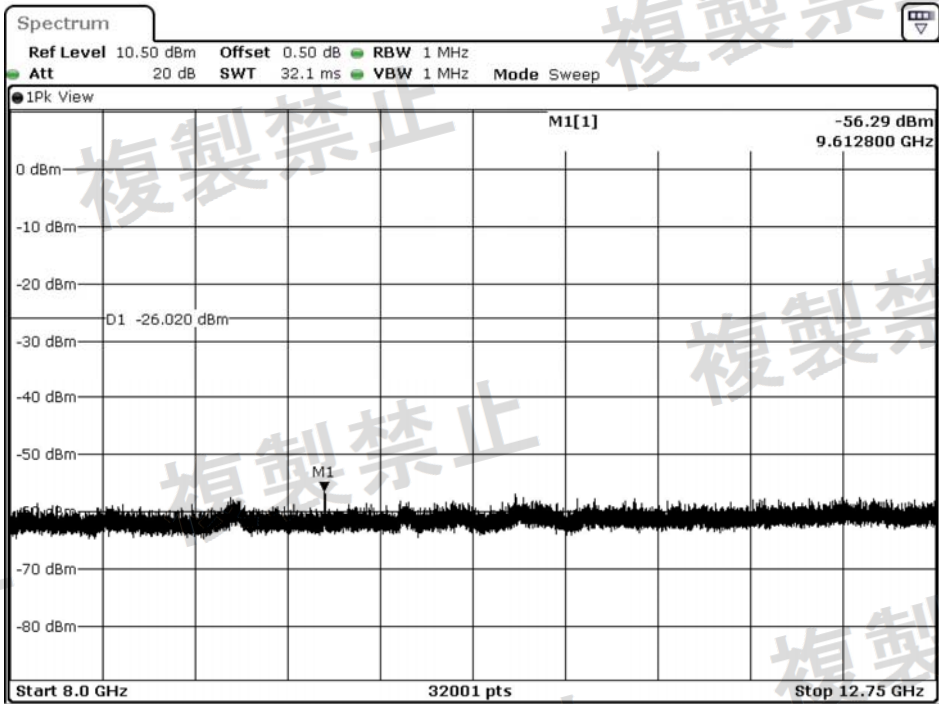
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2496.5–8000MHz



Date: 21.JUL.2020 15:58:17

8000–12750MHz

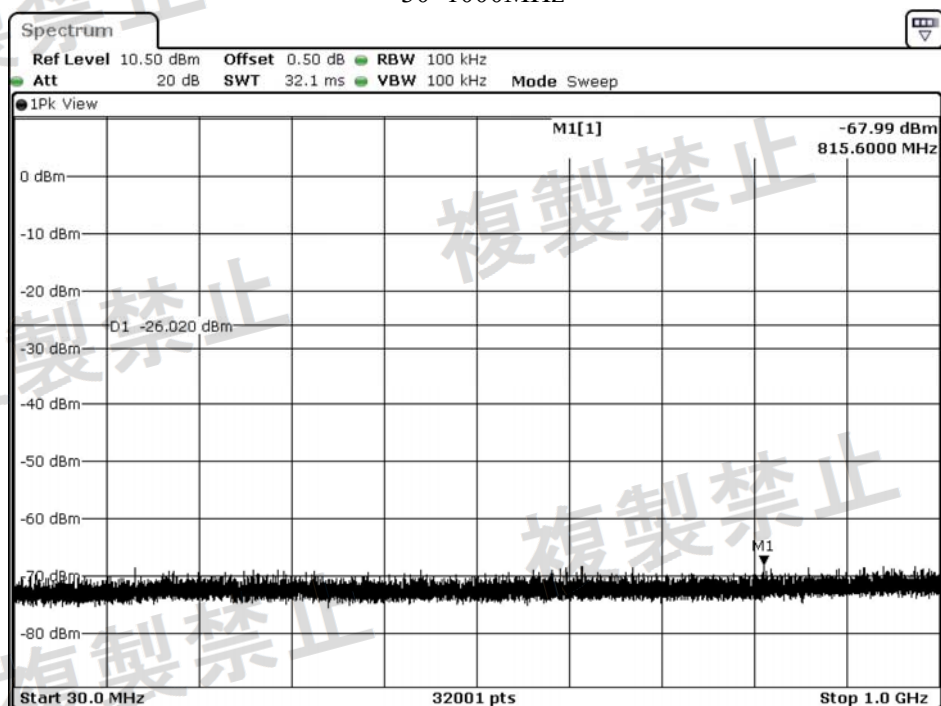


Date: 21.JUL.2020 15:58:39

Product : Wireless Gaming Keyboard
Test Item : Transmitter Spurious Emissions
Test Mode : Mode 1: Transmit (2440MHz)

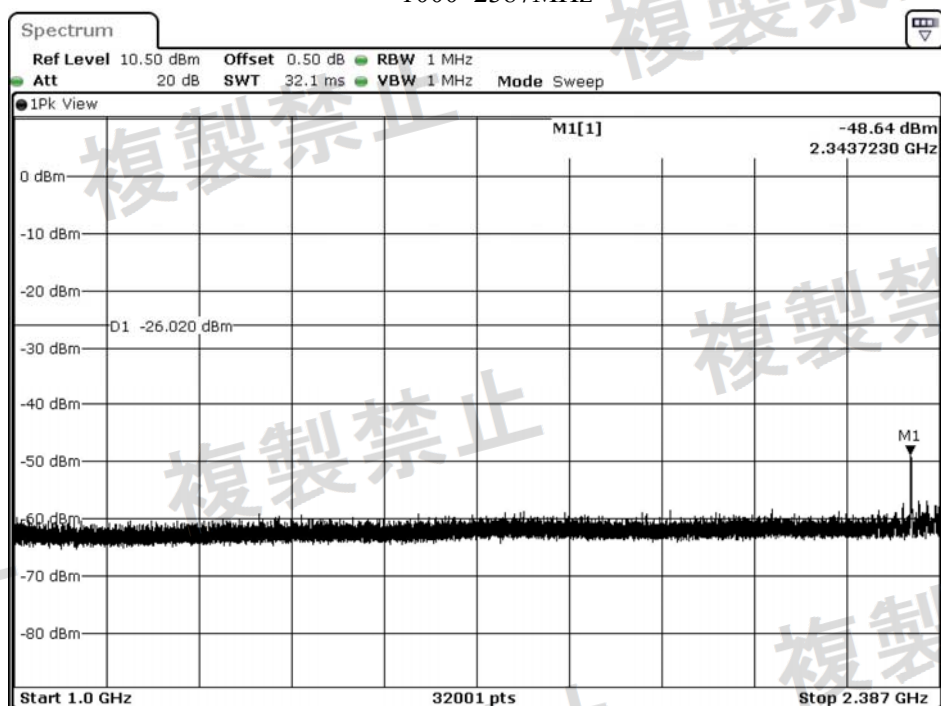
Frequency Range (MHz)	Reading Value (dBm)	Limit (dBm)
30 – 1000	-67.99	-26 (2.5uW)
1000 – 2387	-48.64	-26 (2.5uW)
2387 – 2400	-56.38	-16 (25uW)
2483.5 – 2496.5	-55.26	-16 (25uW)
2496.5 – 8000	-49.47	-26 (2.5uW)
8000 – 12750	-55.58	-26 (2.5uW)

30–1000MHz



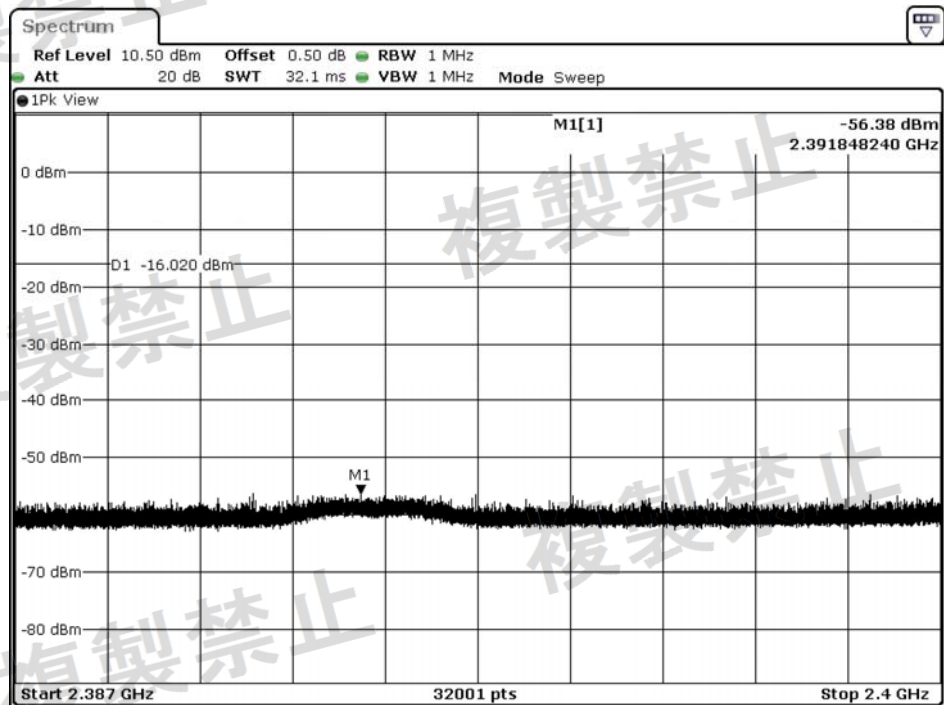
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1000–2387MHz



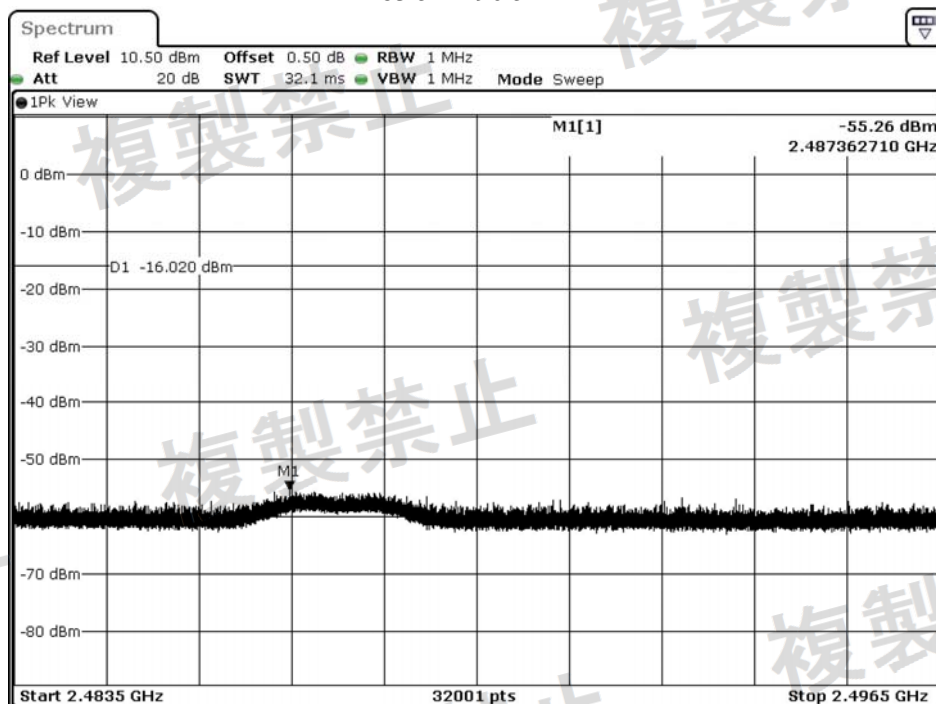
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2387–2400 MHz



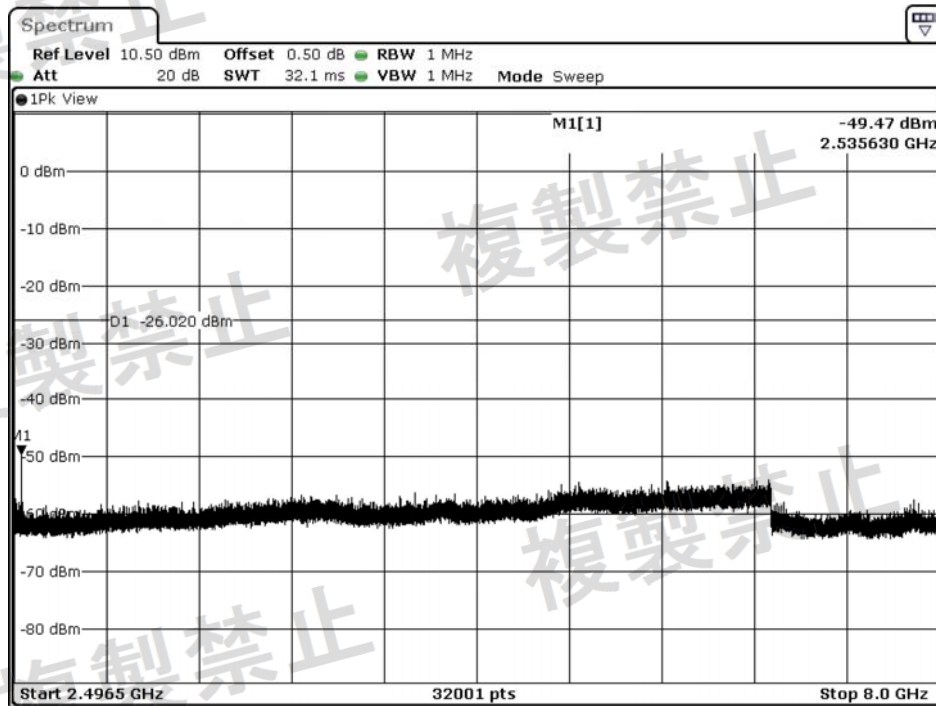
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2483.5–2496.5MHz



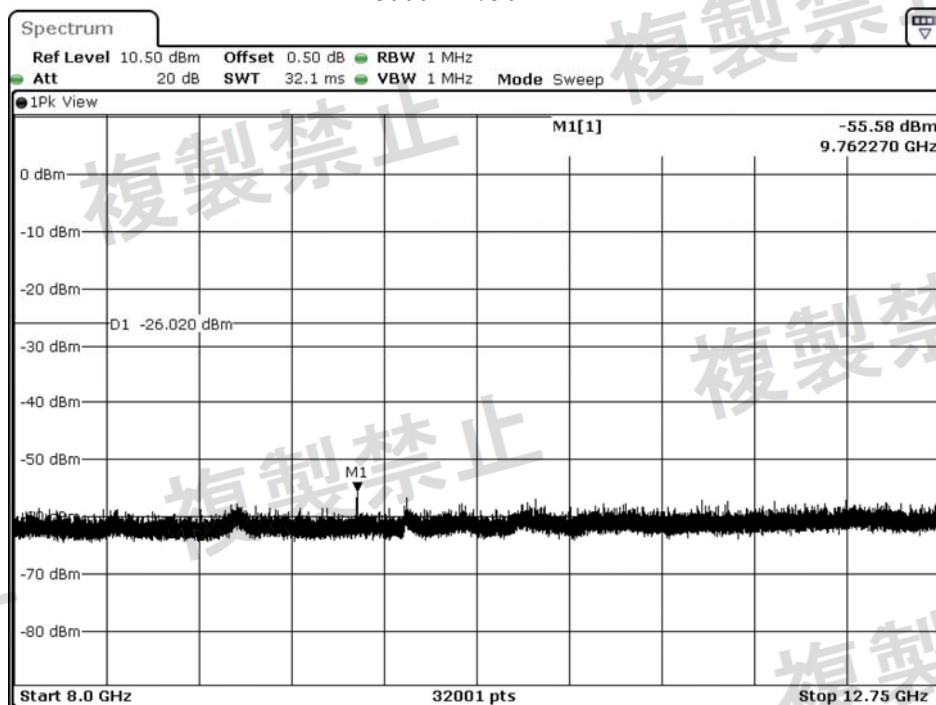
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2496.5–8000MHz



Date: 21.JUL.2020 16:07:03

8000–12750MHz

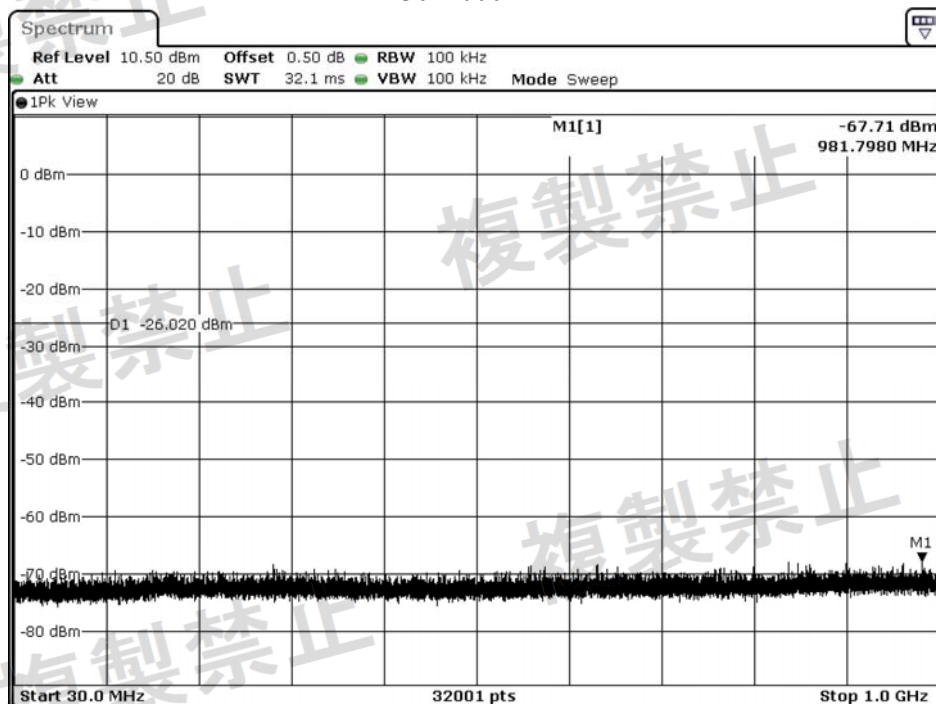


Date: 21.JUL.2020 16:07:26

Product : Wireless Gaming Keyboard
Test Item : Transmitter Spurious Emissions
Test Mode : Mode 1: Transmit (2480MHz)

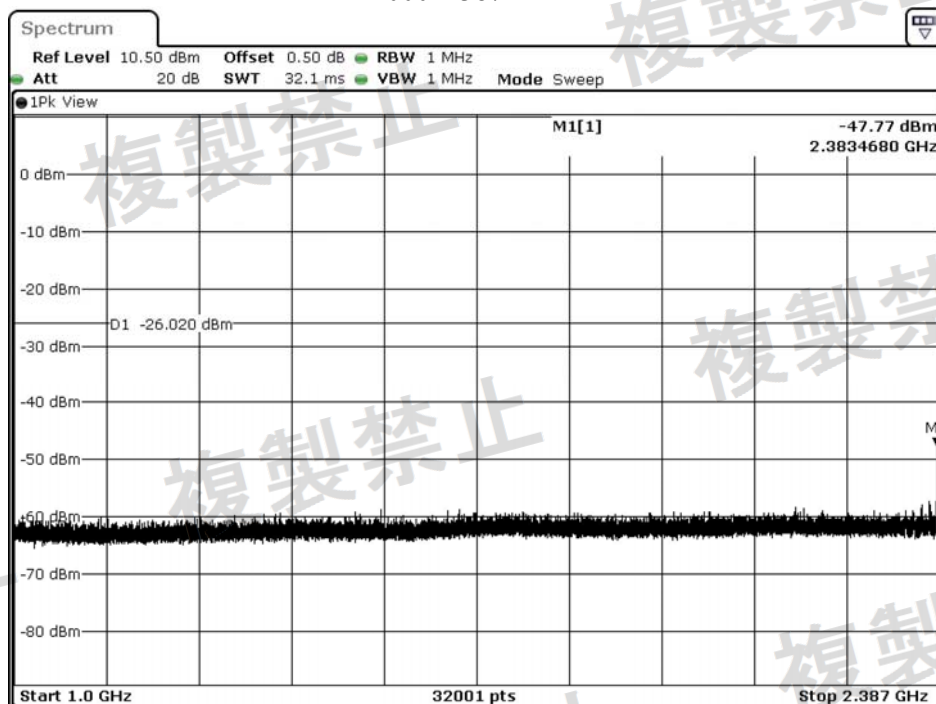
Frequency Range (MHz)	Reading Value (dBm)	Limit (dBm)
30 – 1000	-67.71	-26 (2.5uW)
1000 – 2387	-47.77	-26 (2.5uW)
2387 – 2400	-55.7	-16 (25uW)
2483.5 – 2496.5	-36.99	-16 (25uW)
2496.5 – 8000	-50.47	-26 (2.5uW)
8000 – 12750	-56.61	-26 (2.5uW)

30–1000MHz



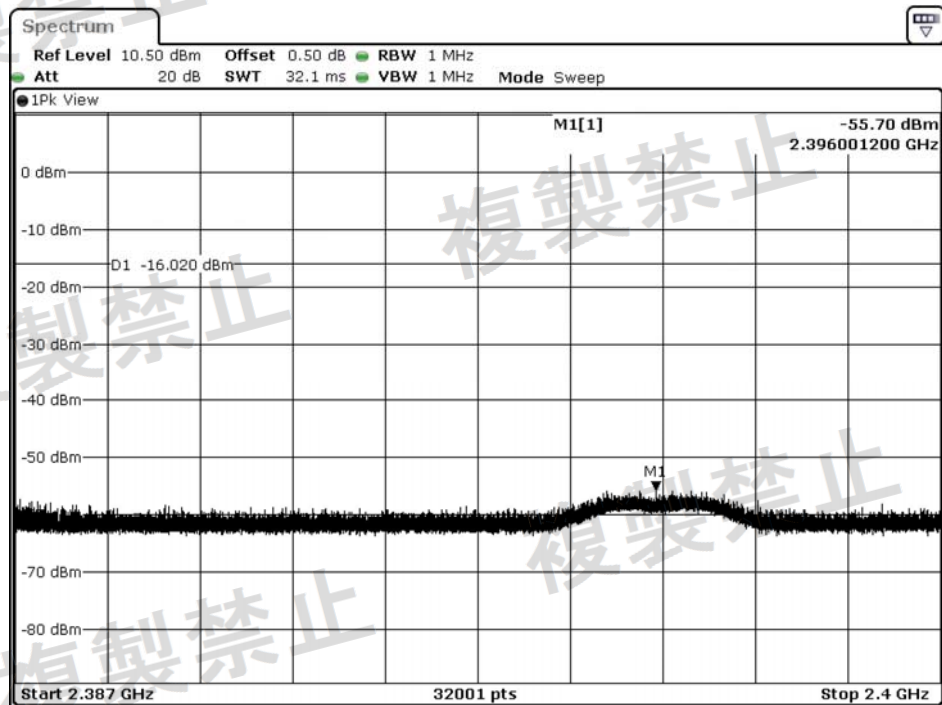
Date: 21.JUL.2020 16:16:28

1000–2387MHz



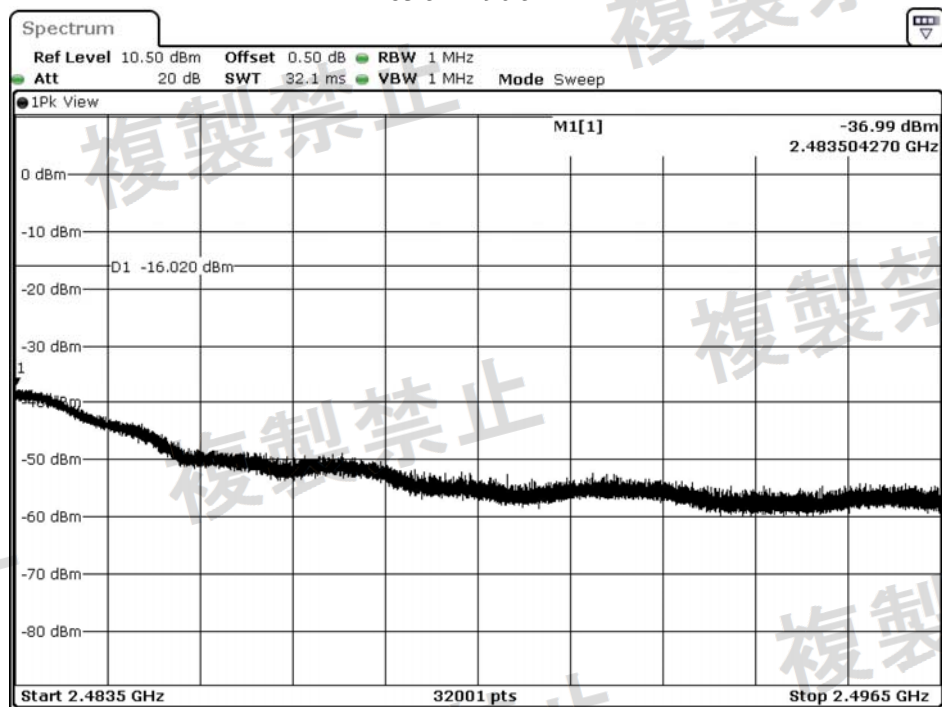
Date: 21.JUL.2020 16:16:49

2387–2400 MHz



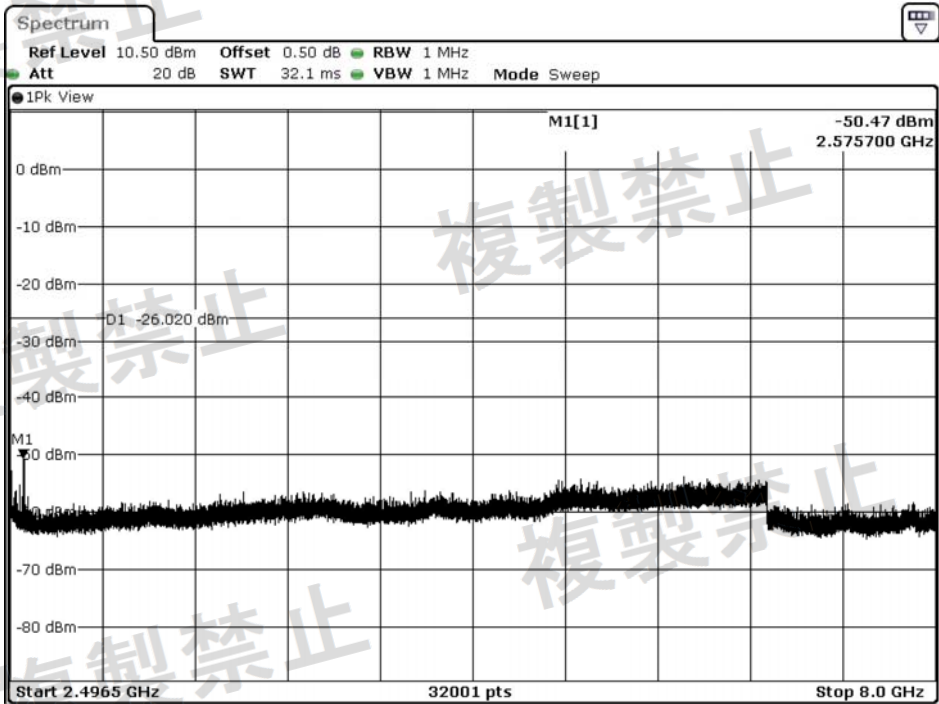
Date: 21.JUL.2020 16:17:12

2483.5–2496.5MHz



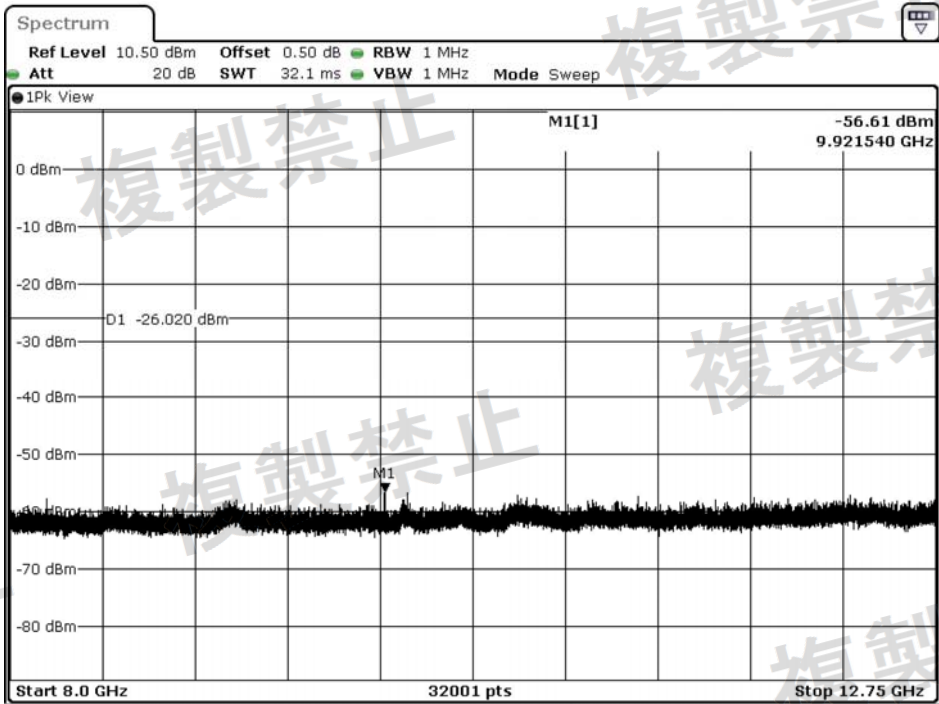
Date: 21.JUL.2020 16:17:35

2496.5–8000MHz



Date: 21.JUL.2020 16:17:58

8000–12750MHz



Date: 21.JUL.2020 16:18:19

Test Result	PASS
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6. Receiver Suprious Emissions

6.1. Test Setup



6.2. Test Procedure

A spectrum analyzer or similar device shall be used to observe a sample of the modulated transmitter's radio frequency power output.

- (a) A positive peak detector function must be used.
- (b) The measurement instrument bandwidth and span must be set sufficiently with, and, the scan time set sufficiently slow, to ensure all major modulation products are captured. Note that the measurement bandwidth should also be set sufficiently narrow to avoid adding significant error to the test result.
- (c) 'Maximum Hold' mode may be used to accumulate the measurement result over several scans provided the emission is repetitive in nature.

6.3. Limits

$\leq 4\text{nW}$ for 30 – 1000 MHz

$\leq 20\text{nW}$ for 1000 – 3000 MHz

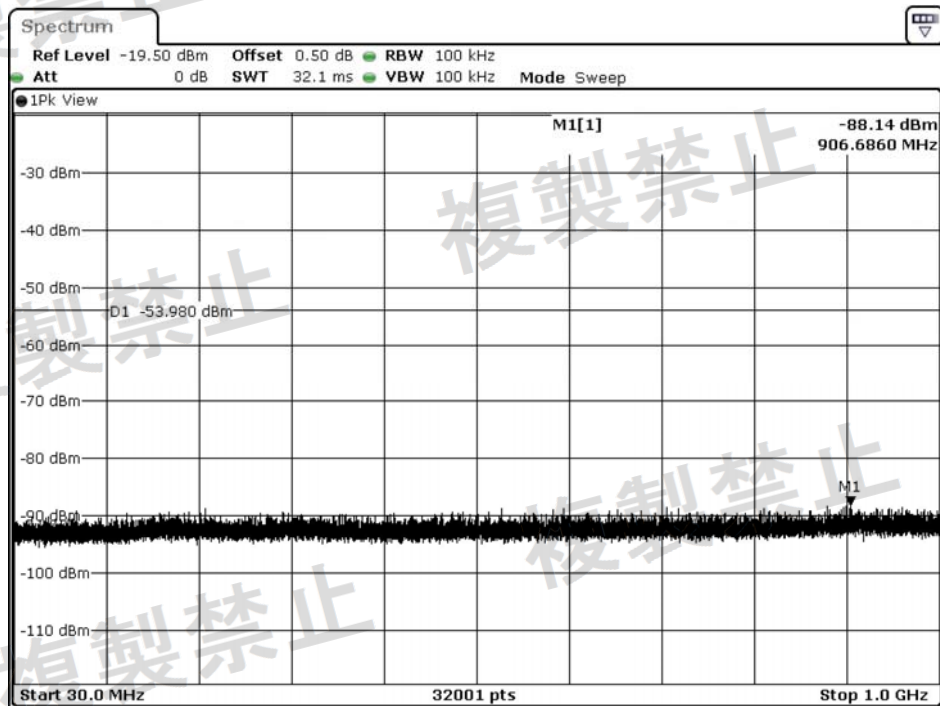
$\leq 20\text{nW}$ for 3000 – 12750 MHz

6.4. Test Result of Receiver Spurious Emissions

Product : Wireless Gaming Keyboard
Test Item : Receiver Spurious Emissions
Test Mode : Mode 2: Receive (2403MHz)

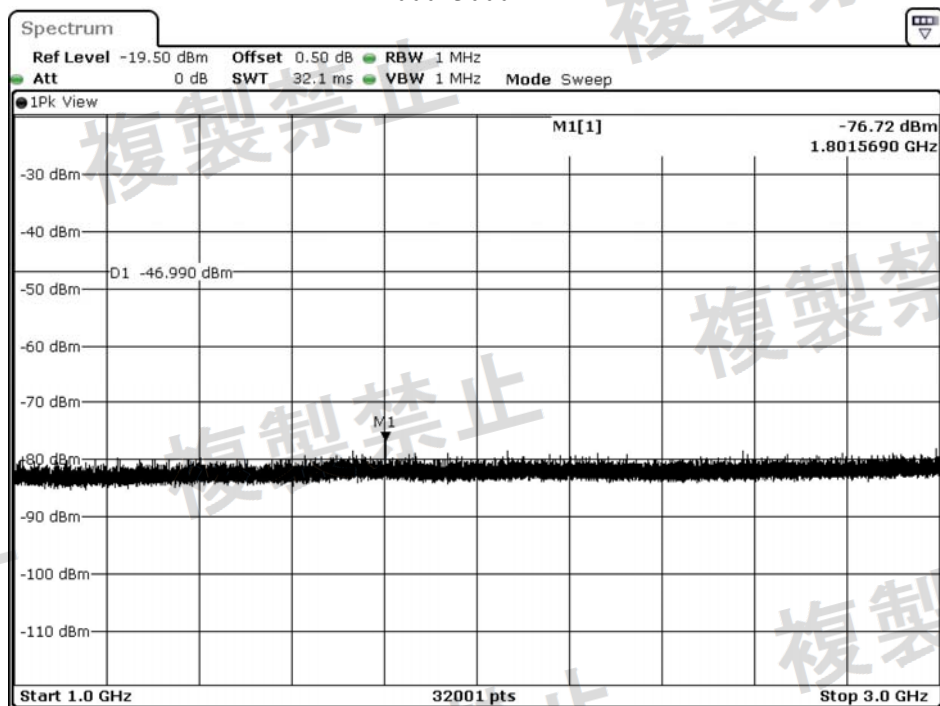
Frequency Range (MHz)	Reading Value (dBm)	Limit (dBm)
30 – 1000	-88.14	-54 (4nW)
1000 – 3000	-76.72	-47 (20nW)
3000 – 8000	-73.54	-47 (20nW)
8000 – 12750	-76.99	-47 (20nW)

30–1000MHz



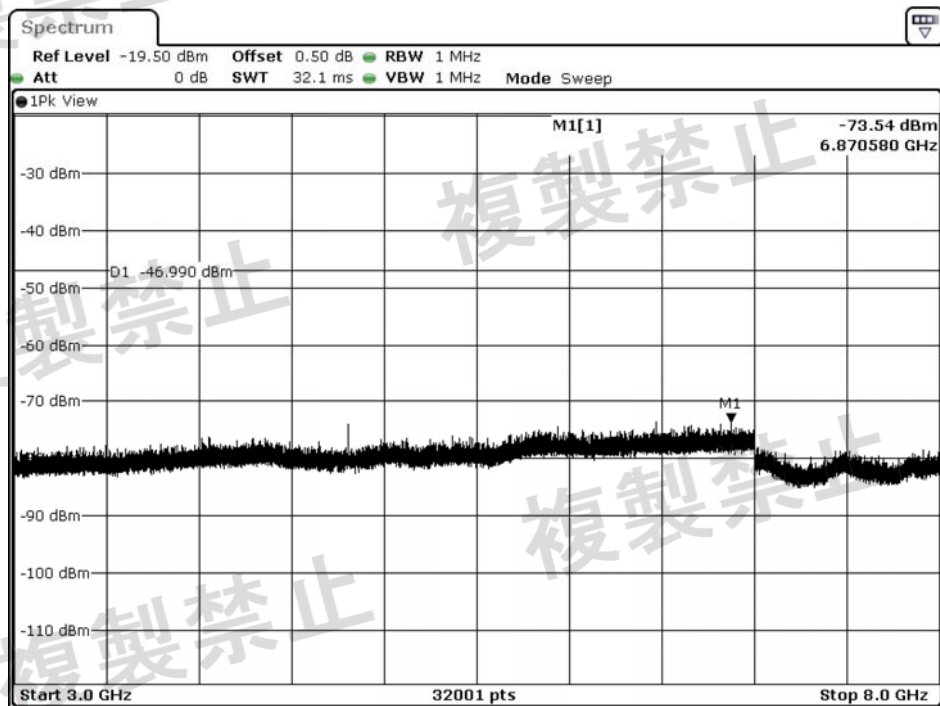
Date: 21.JUL.2020 15:53:36

1000–3000MHz



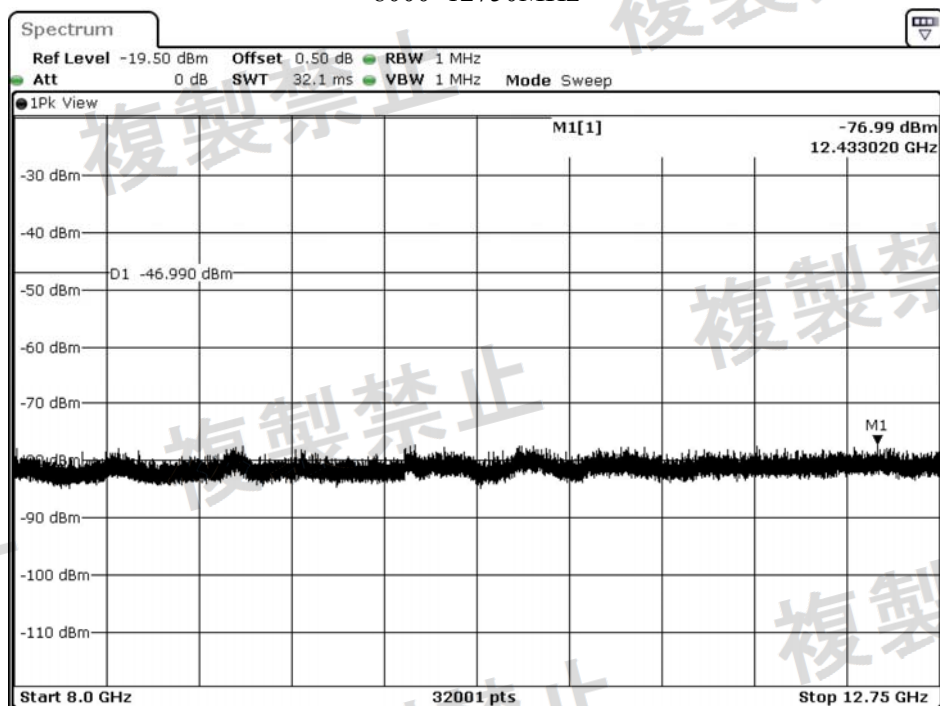
Date: 21.JUL.2020 15:53:58

3000–8000MHz



Date: 21.JUL.2020 15:54:20

8000–12750MHz

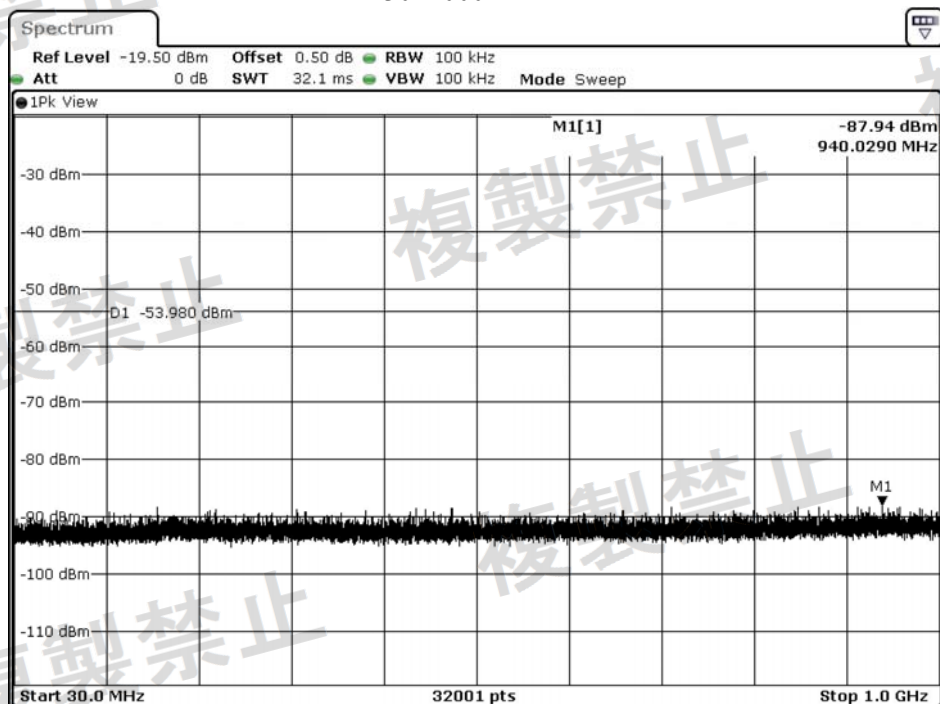


Date: 21.JUL.2020 15:54:43

Product : Wireless Gaming Keyboard
Test Item : Receiver Spurious Emissions
Test Mode : Mode 2: Receive (2440MHz)

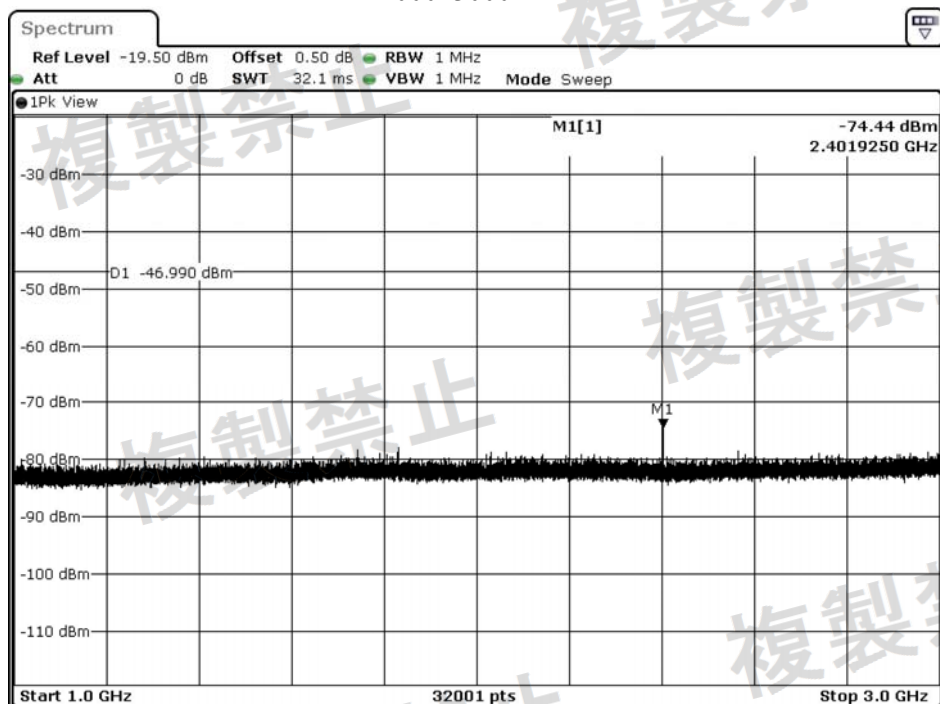
Frequency Range (MHz)	Reading Value (dBm)	Limit (dBm)
30 – 1000	-87.94	-54 (4nW)
1000 – 3000	-74.44	-47 (20nW)
3000 – 8000	-73.62	-47 (20nW)
8000 – 12750	-75.44	-47 (20nW)

30–1000MHz



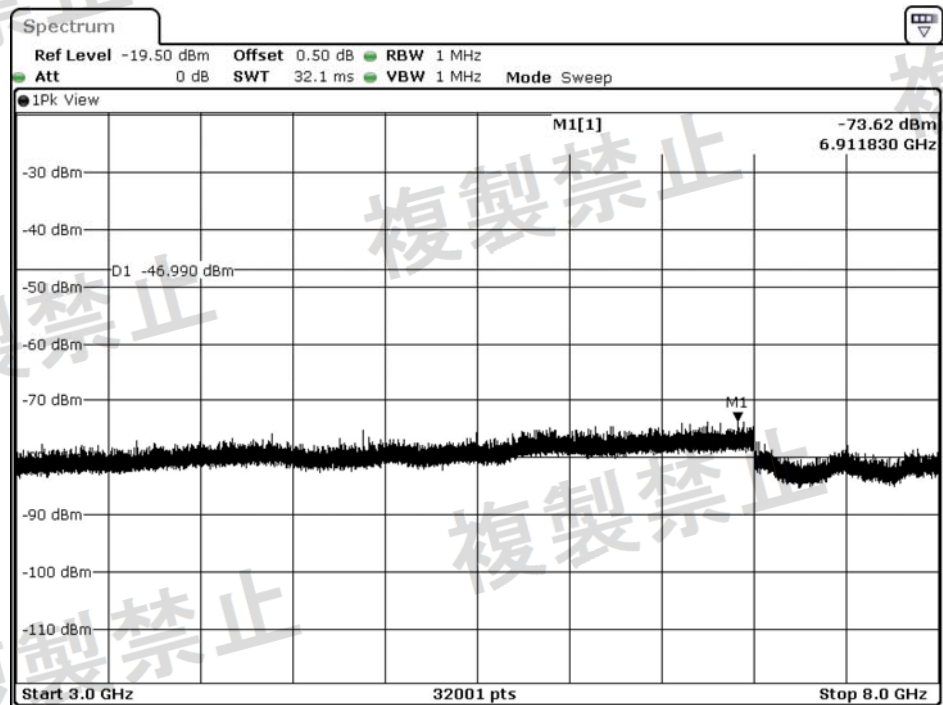
Date: 21.JUL.2020 16:03:11

1000–3000MHz



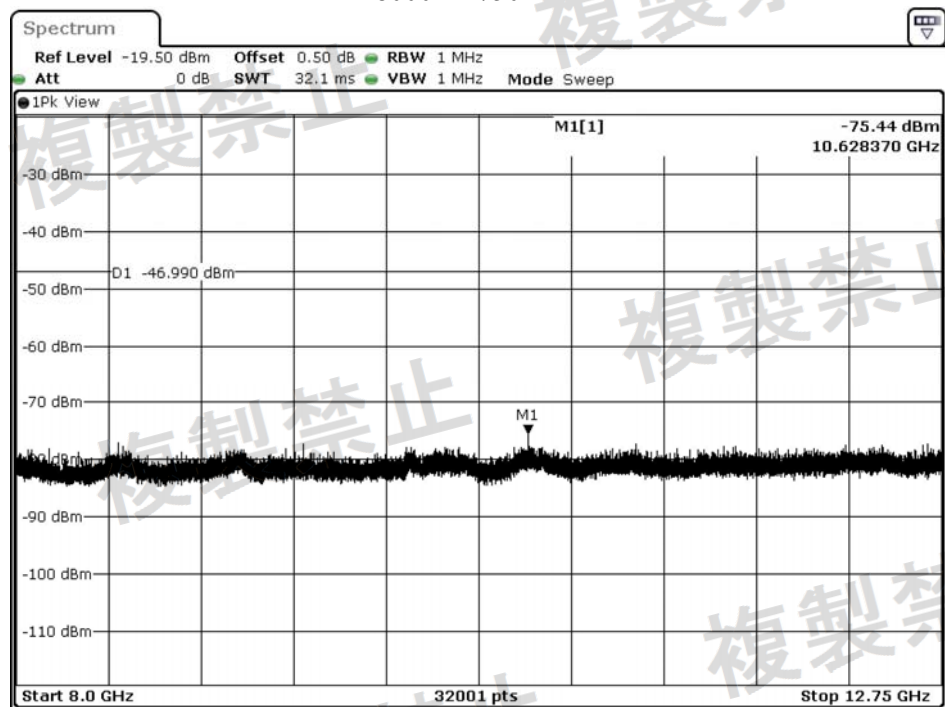
Date: 21.JUL.2020 16:03:32

3000–8000MHz



Date: 21.JUL.2020 16:03:55

8000–12750MHz

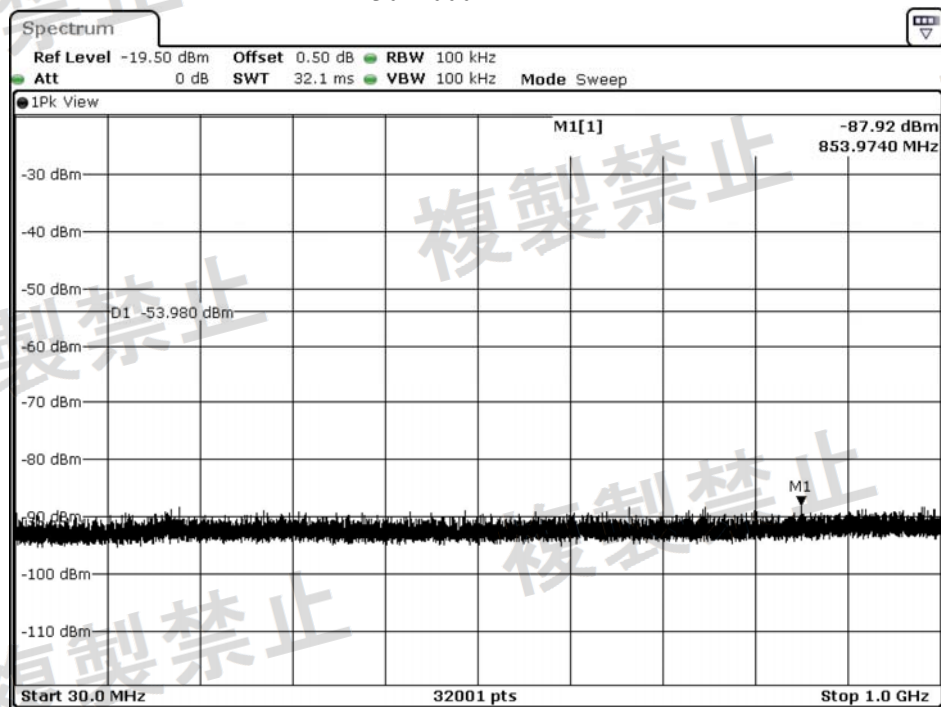


Date: 21.JUL.2020 16:04:18

Product : Wireless Gaming Keyboard
Test Item : Receiver Spurious Emissions
Test Mode : Mode 2: Receive (2480MHz)

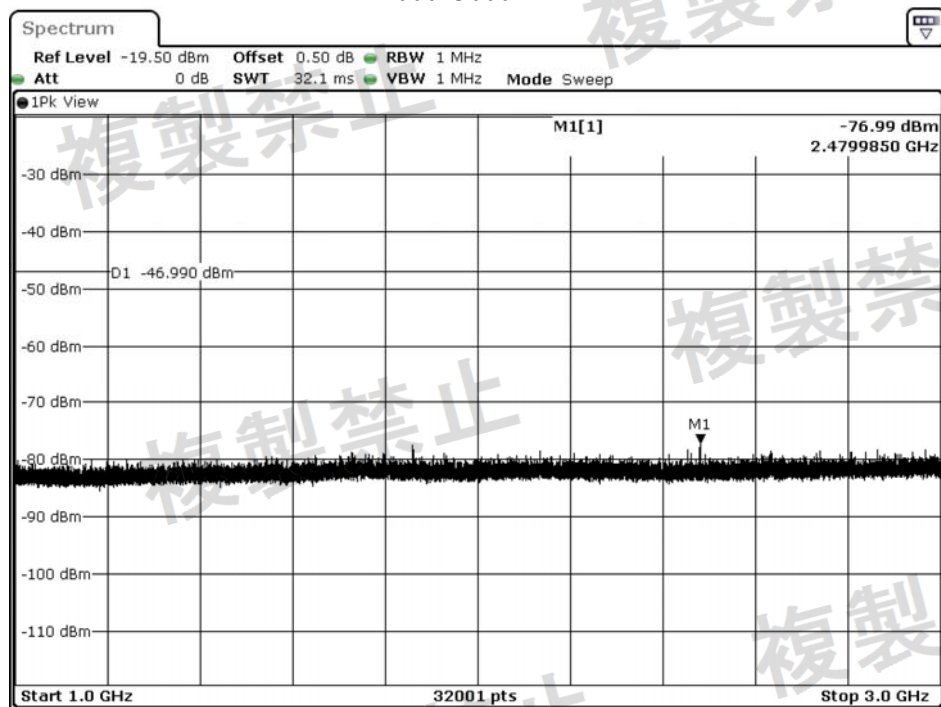
Frequency Range (MHz)	Reading Value (dBm)	Limit (dBm)
30 – 1000	-87.92	-54 (4nW)
1000 – 3000	-76.99	-47 (20nW)
3000 – 8000	-73.85	-47 (20nW)
8000 – 12750	-76.48	-47 (20nW)

30–1000MHz



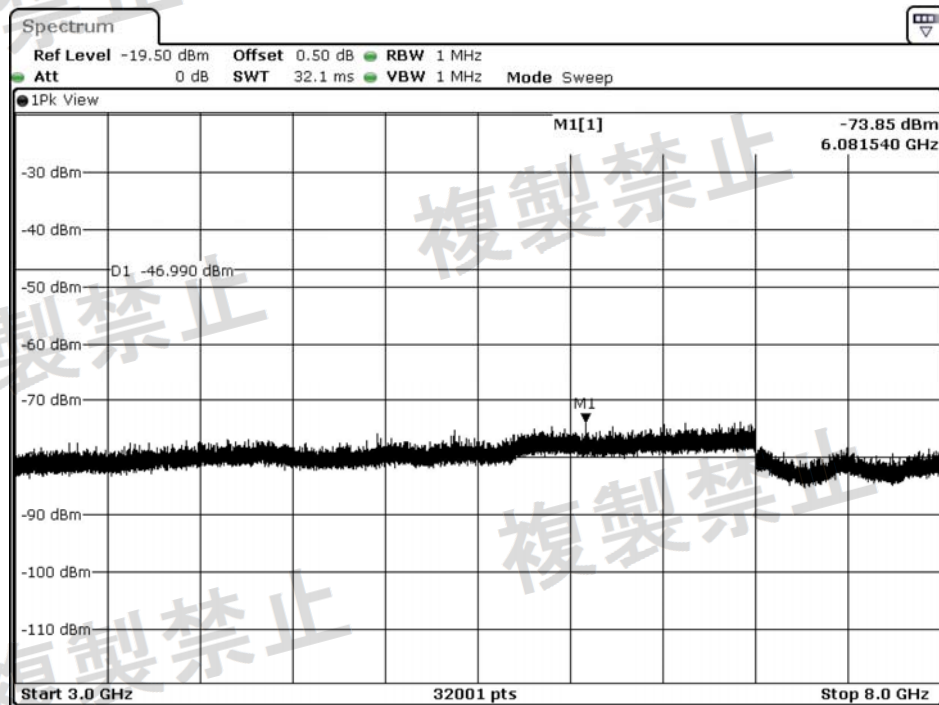
Date: 21.JUL.2020 16:14:15

1000–3000MHz



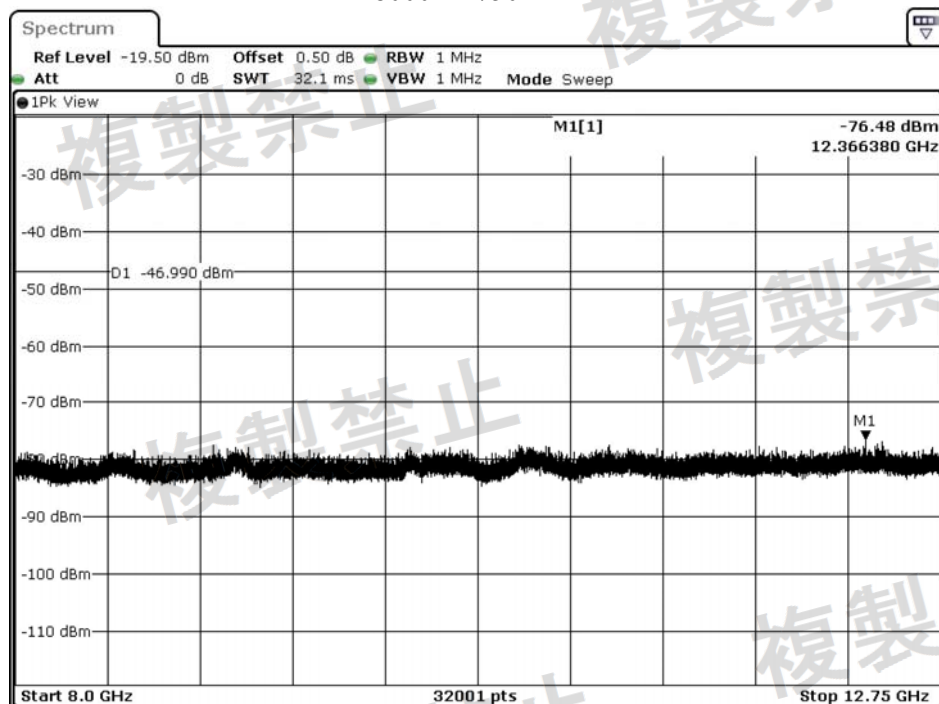
Date: 21.JUL.2020 16:14:38

3000–8000MHz



Date: 21.JUL.2020 16:14:59

8000–12750MHz



Date: 21.JUL.2020 16:15:22

Test Result	PASS
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7. EMI Reduction Method During Compliance Testing

No modification was made during testing.