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检测
TESTING
CNAS L6791

TEST REPORT

Applicant:	Ugreen Group Limited
Address:	URGEEN Building, Longcheng Industrial Park, Longguanxi Road, Longhua, ShenZhen, China
Equipment Type:	Wireless Vertical Mouse
Model Name:	M571
Brand Name:	UGREEN
FCC ID:	2AQI5-M571
Test Standard:	47 CFR Part 15, Subpart C (refer to section 3.1)
Sample Arrival Date:	Oct. 29, 2024
Test Date:	Oct. 29, 2024 - Nov. 15, 2024
Date of Issue:	Nov. 28, 2024

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Julie Zhu

Checked by: Ye Hongji

Approved by: Sunny Zou
(Technical Director)

Revision History

Version	Issue Date	Revisions
Rev. 01	Nov. 28, 2024	Initial Issue

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1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☑ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Ugreen Group Limited
Address	UGREEN Building, Longcheng Industrial Park Longguanxi Road, Longhua, ShenZhen, China

2.2 Manufacturer Information

Manufacturer	Ugreen Group Limited
Address	UGREEN Building, Longcheng Industrial Park Longguanxi Road, Longhua, ShenZhen, China

2.3 Factory Information

Factory	Shenzhen Newidea Technology Co.,Ltd
Address	Building31, No5, Cuigang Industria Zone, Fuyong Town, Bao'an Shenzhen

2.4 General Description for Equipment under Test (EUT)

EUT Name	Wireless Vertical Mouse
Model Name Under Test	M571
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	A2
Software Version	3F13
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

- Product Number (P/N) code in the below table, for marketing purpose, will be marked on the marking plate.

55916	55916A	55916B	55916C	55916U	55916P	55916X	55916JP	55916EU	55916UK	55916US
55917	55917A	55917B	55917C	55917U	55917P	55917X	55917JP	55917EU	55917UK	55917US

2.5 Technical Information

Network and Wireless connectivity	2.4G ISM Band

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	FHSS
Modulation Type	GFSK
Product Type	☐ Mobile ☒ Portable ☐ Fix Location
Transfer Rate	1 Mbps
Frequency Range	The frequency range used is 2402 MHz – 2480 MHz; The frequency block is 2400 MHz to 2483.5 MHz.
Number of Channel	40
Tested Channel	Low channel (2402 MHz), Middle channel (2440 MHz), High channel (2480 MHz)
Antenna Type	PCB Antenna
Antenna Gain	-1.05 dBi
Adaptive or non-adaptive	Non-Adaptive
The Max RF Output power	-6.13 dBm

Channel List

Number	Frequency (MHz)	Number	Frequency (MHz)	Number	Frequency (MHz)
1	2402(Low)	15	2430	29	2458
2	2404	16	2432	30	2460
3	2406	17	2434	31	2462
4	2408	18	2436	32	2464
5	2410	19	2438	33	2466
6	2412	20	2440(Middle)	34	2468
7	2414	21	2442	35	2470
8	2416	22	2444	36	2472
9	2418	23	2446	37	2474
10	2420	24	2448	38	2476
11	2422	25	2450	39	2478
12	2424	26	2452	40	2480(High)
13	2426	27	2454	--	--
14	2428	28	2456	--	--

Note: The modulation is GFSK with FHSS, there are total 40 channels (frequency range is 2402-2480MHz, channel step is 2MHz, totally 40 channels). In this report, the equipment select the lowest, middle and highest channel from 40 channels, Which are 2402 MHz, 2440 MHz and 2480 MHz. The more information please refer to the manufacturer's instructions.

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Intentional radiators of radio frequency equipment
2	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
3 ☆	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules

3.2 Verdict

No.	Description	FCC Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	--	Pass Note 1
2	Number of Hopping Frequency	15.247(a)	5.2.4	Pass
3	Peak Output Power	15.247(b)	5.3.4	Pass
4	Occupied Bandwidth	15.247(a)	5.4.4	Pass
5	Hopping Frequency Separation	15.247(a)	5.5.4	Pass
6	Time of Occupancy (Dwell time)	15.247(a)	5.6.4	Pass
7	Conducted Spurious Emission& Authorized-band band-edge	15.247(d)	5.7.4	Pass
8	Conducted Emission	15.207	5.8.4	N/A Note 2
9	Radiated Spurious Emission	15.209 15.247(d)	5.9.4	Pass
10	Band Edge (Restricted-band band-edge)	15.209 15.247(d)	5.10.4	Pass

Note [1]: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note [2]: The EUT only powered by Dry Cell, so the Conducted Emission test is not applicable.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	41% to 62%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+20.2℃ to +26.3℃
Working Voltage of the EUT	NV (Normal Voltage)	1.5 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY56060183	2024.08.01	2025.07.31
Spectrum Analyzer	KEYSIGHT	N9020A	MY52510065	2024.08.01	2025.07.31
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	01631	2022.02.23	2025.02.22
Test Antenna-Horn	A-INFO	LB-180400KF	J211060273	2024.06.15	2027.06.14
Anechoic Chamber	RAINFORD	9m*6m*6m	144	2022.02.19	2025.09.03
Amplifier	COM-MV	LSCX_LNA1-12G-01	180602	2024.08.01	2025.07.31
Amplifier	COM-MV	XKu_LNA7-18G-01	180601	2024.08.01	2025.07.31
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2024.08.01	2025.07.31
Test Antenna-Loop	SCHWARZBECK	FMZB 1519	1519-037	2024.01.23	2025.01.22
Amplifier	COM-MV	ZT30-1000M	B2018054558	2023.12.05	2024.12.04
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60*7.35m	130	2024.07.13	2027.07.12
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2024.08.01	2025.07.31
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-624	2024.07.06	2027.07.05
Amplifier	COM-MV	ZT30-1000M	B2017119082	2023.12.05	2024.12.04
Anechoic Chamber	RAINFORD	9m*6m*6m	101	2023.03.04	2026.03.03

4.3 Test Software List

Description	Manufacturer	Software Version	Serial No.	Applicable test Setup
BL410R	BALUN	V2.1.1.488	N/A	The section 4.5.1
BL410E	BALUN	V22.930	N/A	The section 4.5.2&4.5.3&4.5.4&4.5.5

4.4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Parameters	Uncertainty
Occupied Channel Bandwidth	2.8%
RF output power, conducted	1.28 dB
Power Spectral Density, conducted	1.30 dB
Unwanted Emissions, conducted	1.84 dB
All emissions, radiated	5.36 dB
Temperature	0.8℃
Humidity	4%

4.5 Description of Test Setup

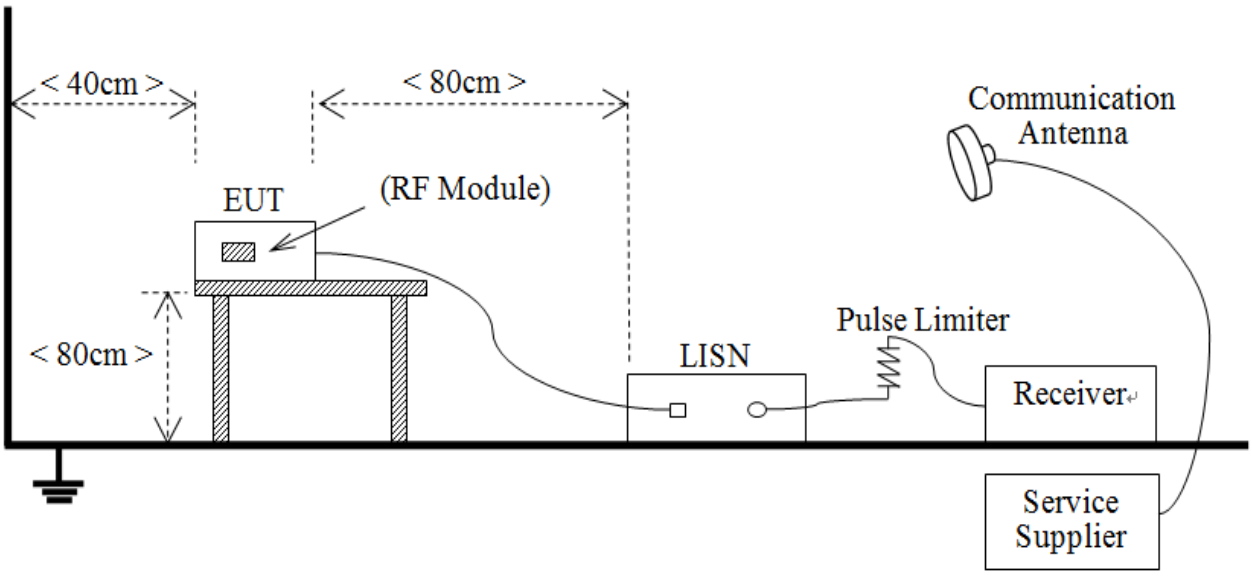
4.5.1. For Antenna Port Test

Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm

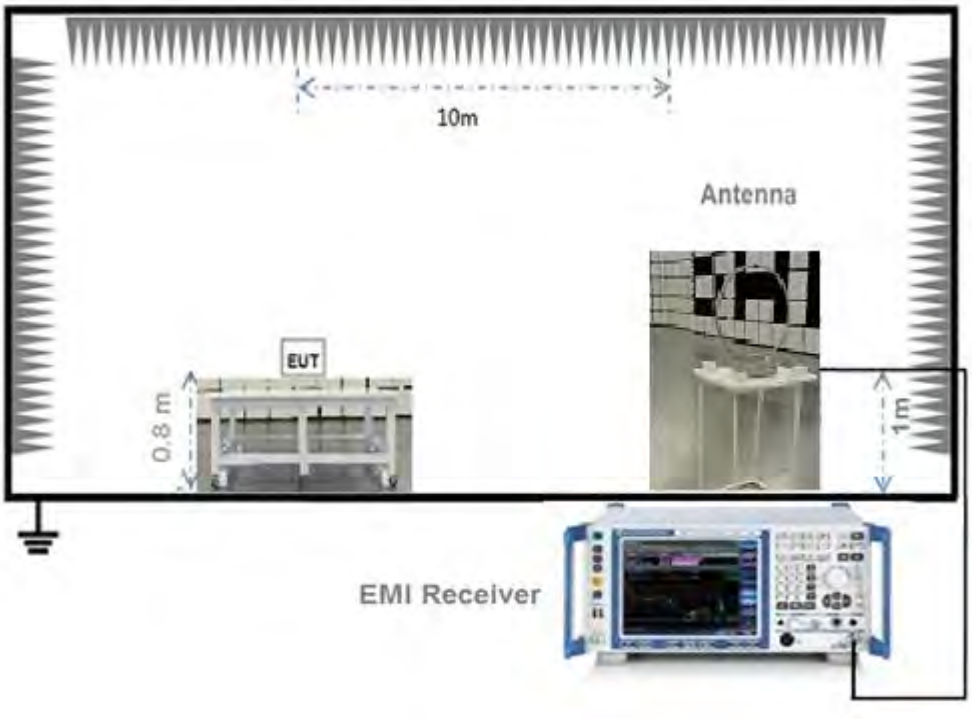
(Diagram 1)

4.5.2. For AC Power Supply Port Test



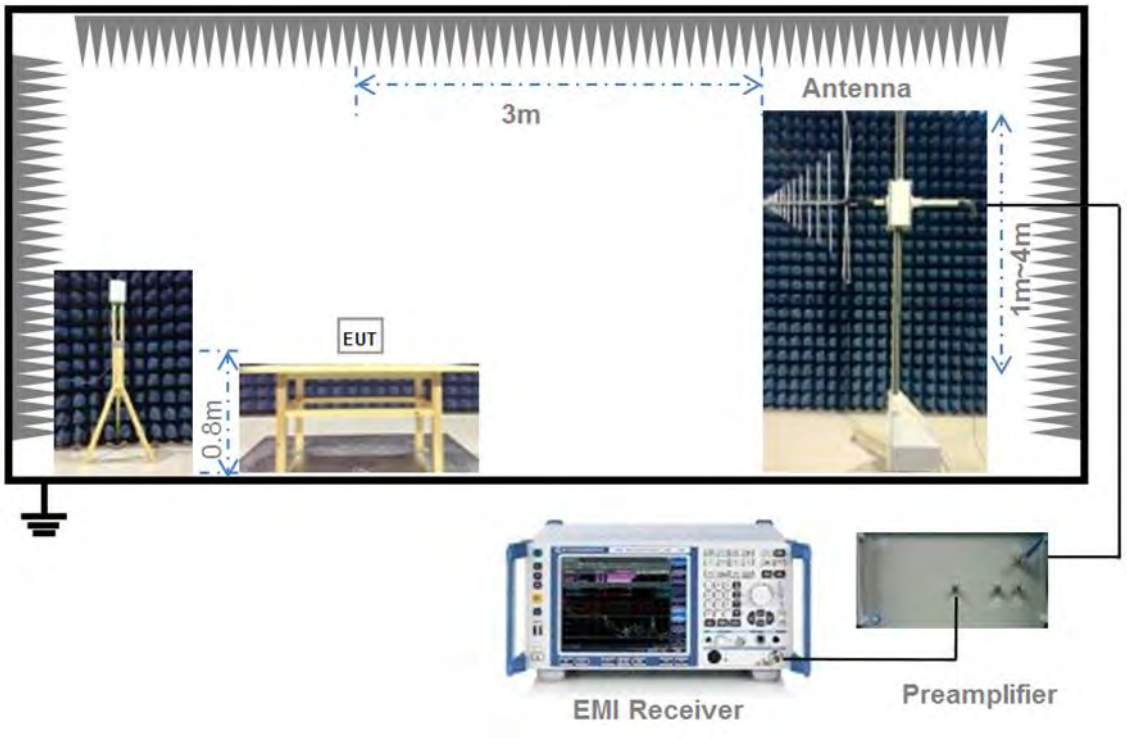
(Diagram 2)

4.5.3. For Radiated Test (Below 30 MHz)



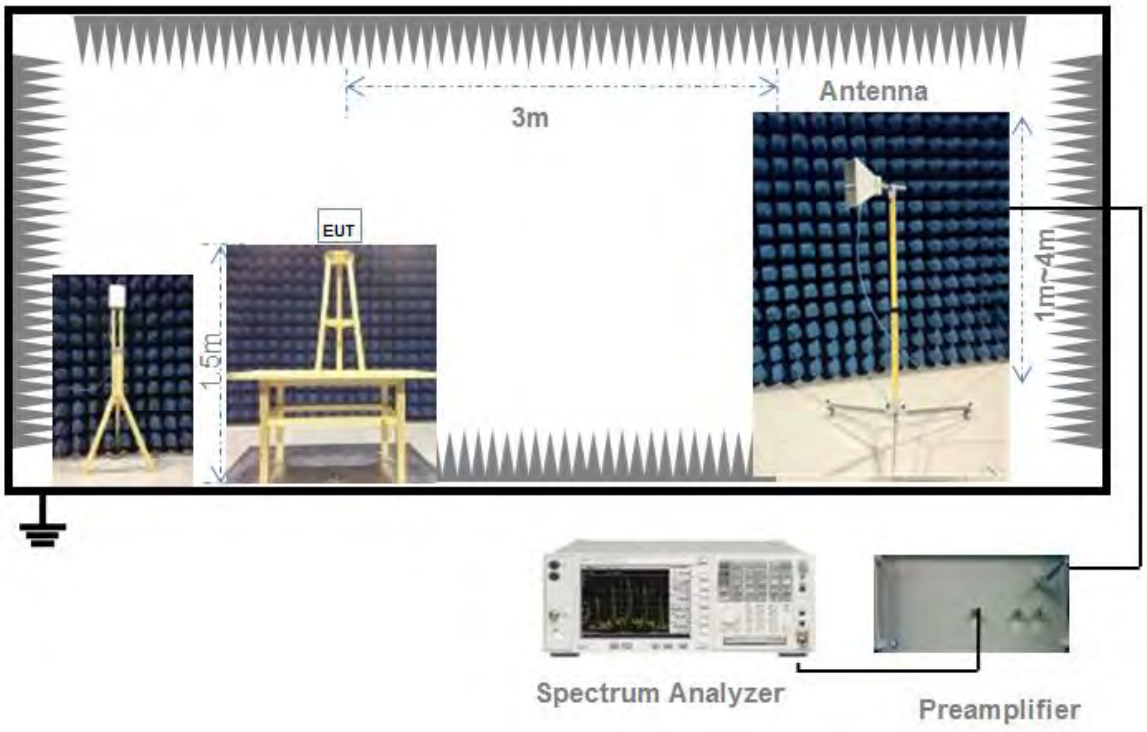
(Diagram 3)

4.5.4. For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.5.5. For Radiated Test (Above 1 GHz)



(Diagram 5)

4.6 Measurement Results Explanation Example

4.6.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

4.6.2 For radiated band edges and spurious emission test:

Per part 15.35(c), the EUT Bluetooth average emission level could be determined by the peak emission level applying duty cycle correction factor, to represent averaging over the whole pulse train.

The average level is derived from the peak level corrected with “Duty cycle correction factor”.

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + Duty cycle correction factor (dB)

Duty cycle correction factor (dB) = 20 * log (Duty cycle).

Duty cycle = on time / 100 milliseconds

On time = dwell time * hopping number in 100 ms

For example: bluetooth with dwell time 2.9 ms and 3 hops in 100 ms, then

Duty cycle correction factor (dB) = 20 * log ((2.9 * 3) / 100) = -21.21 dB

Following shows an average computation example with duty cycle correction factor = -21.21 dB, and the peak emission level is 45.61 dBuV/m.

Example:

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + duty cycle correction factor (dB)

= 45.61 + (-21.21) = 24.4 (dBuV/m)

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203 & 15.247(b)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product.	An embedded-in antenna design is used.

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Number of Hopping Frequency

5.2.1 Limit

FCC §15.247(a) (1) (iii)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

5.2.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.2.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

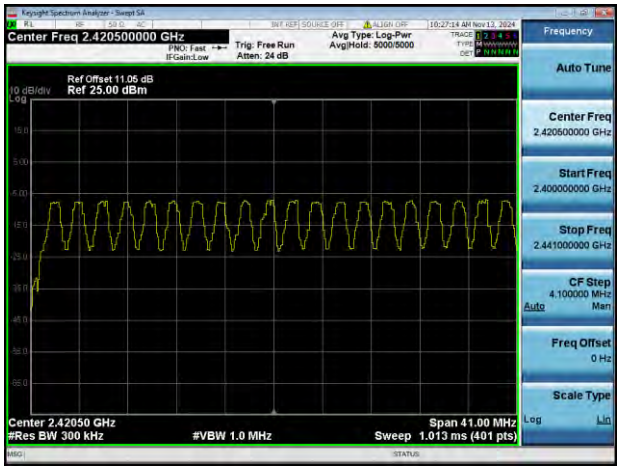
5.2.4 Test Result

Test Data

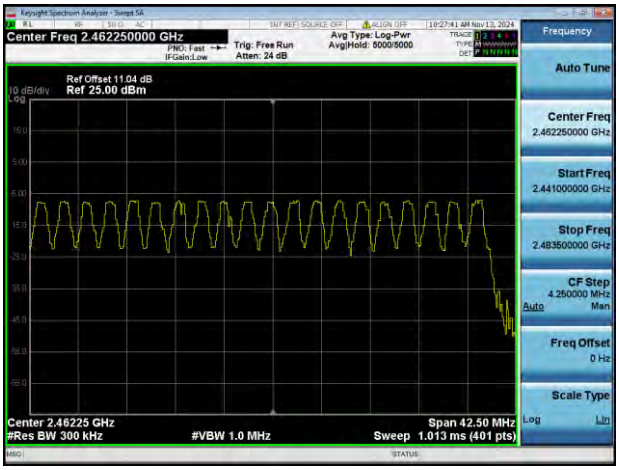
Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
GFSK	2400 - 2483.5	40	15	Pass

Test Plot

GFSK 2.4 GHz ~ 2.4415 GHz



GFSK 2.4415 GHz ~ 2.4835 GHz



5.3 Peak Output Power

5.3.1 Test Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

5.3.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.3.3 Test Procedure

The Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

5.3.4 Test Result

Peak Power Test Data

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
Low	-6.44	0.23	21	125	Pass
Middle	-6.36	0.23			Pass
High	-6.13	0.24			Pass

Test Plots

GFSK LOW CHANNEL

GFSK MIDDLE CHANNEL

GFSK HIGH CHANNEL

5.4 Occupied Bandwidth

5.4.1 Limit

FCC §15.247(a)

Measurement of the 20dB bandwidth of the modulated signal.

5.4.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.4.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW ≥ 1% of the 20 dB bandwidth

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.4.4 Test Result

Test Data

Test Mode	GFSK	
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low Channel	2.040000	1.877300
Middle Channel	2.044000	1.914800
High Channel	2.092000	1.925700

Test Plots

20 dB Bandwidth

GFSK LOW CHANNEL

GFSK MIDDLE CHANNEL

GFSK HIGH CHANNEL

99% Bandwidth

GFSK LOW CHANNEL

GFSK MIDDLE CHANNEL

GFSK HIGH CHANNEL

5.5 Carrier Frequency Separation

5.5.1 Limit

FCC §15.247(a)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

5.5.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.5.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.5.4 Test Result

Test Data

Mode	Frequency separation (MHz)	2/3 of the 20 dB Bandwidth (MHz)	Verdict
GFSK	2.000	1.395	Pass

Test Plot

GFSK

5.6 Time of Occupancy (Dwell time)

5.6.1 Limit

FCC §15.247(a)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.6.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.6.3 Test Procedure

The average time of occupancy on any channel within the Period can be calculated with formulas:

{Total of Dwell} = {Pulse Time} * {Number of Hopping Frequency in Period}

{Period} = 0.4s * {Number of Hopping Frequency}

The middle channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

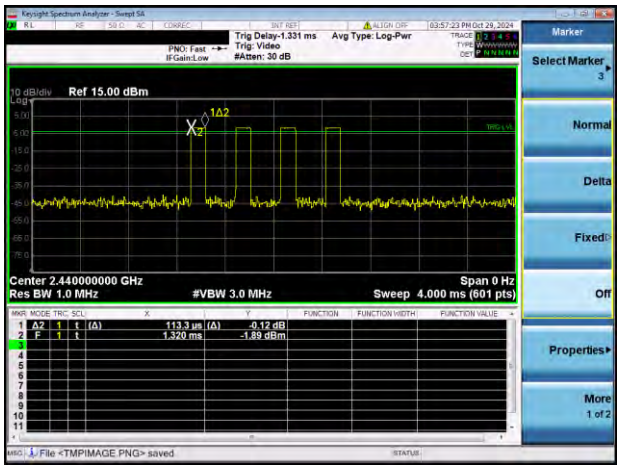
5.6.4 Test Result

Test Data

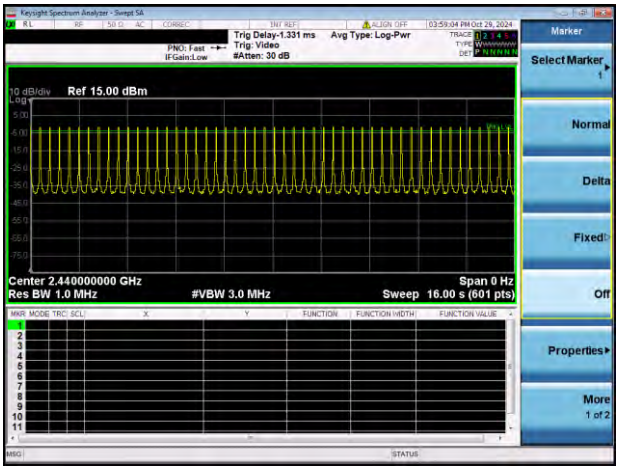
GFSK			
Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
0.452	22.600	0.4	Pass

Test Plots

On Time



Total of Dwell



5.7 Conducted Spurious Emission & Authorized-band band-edge

5.7.1 Limit

FCC §15.247(d)

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

5.7.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.7.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.7.4 Test Result

Test Data

GFSK Mode:

GFSK				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-35.64	-7.91	-27.91	Pass
Middle	-35.97	-7.76	-27.76	Pass
High	-36.51	-7.44	-27.44	Pass

Hopping Mode:

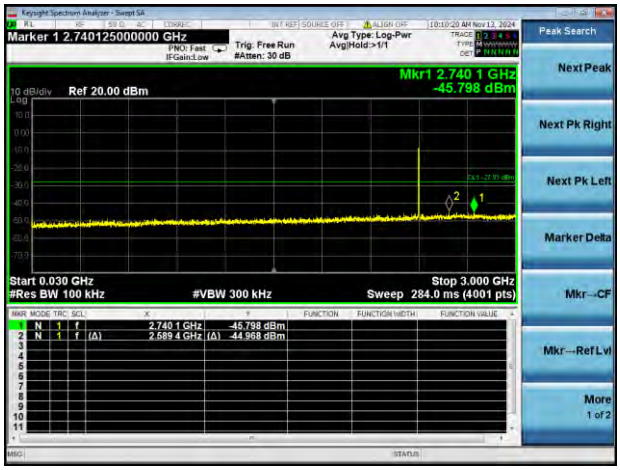
GFSK				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
GFSK	-35.15	-7.71	-27.71	Pass

Test Plots

GFSK LOW CHANNEL, CARRIER LEVEL

GFSK LOW CHANNEL, BAND EDGE

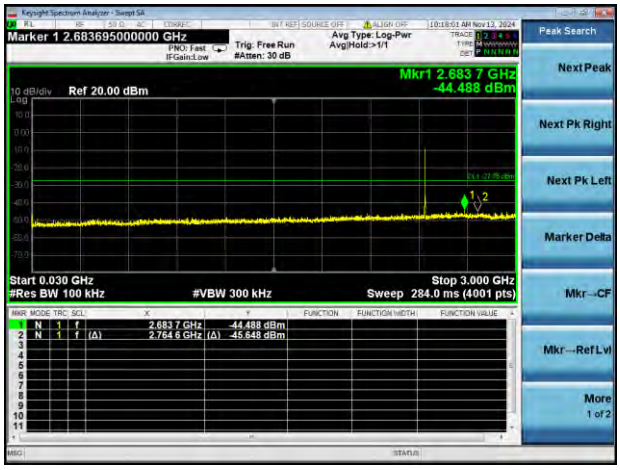
GFSK LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



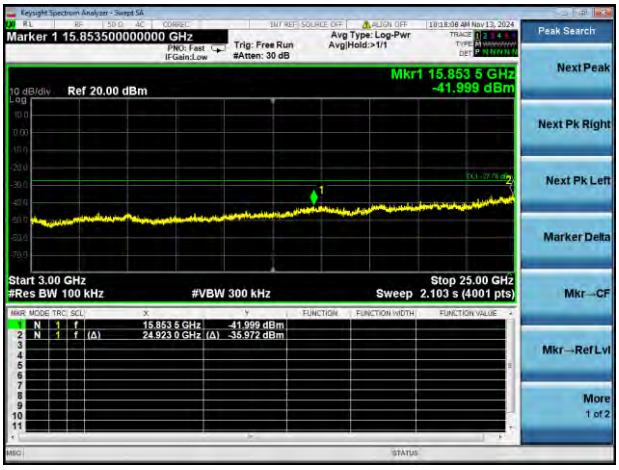
GFSK LOW CHANNEL, SPURIOUS 3 GHz ~ 25 GHz

GFSK MIDDLE CHANNEL, CARRIER LEVEL

GFSK MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

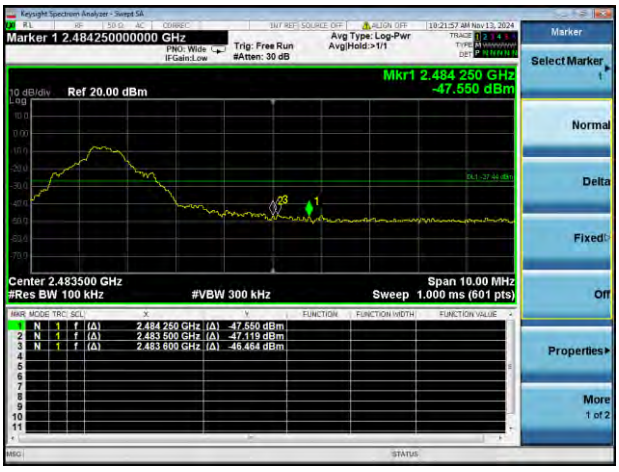


GFSK MIDDLE CHANNEL, SPURIOUS 3 GHz ~ 25 GHz

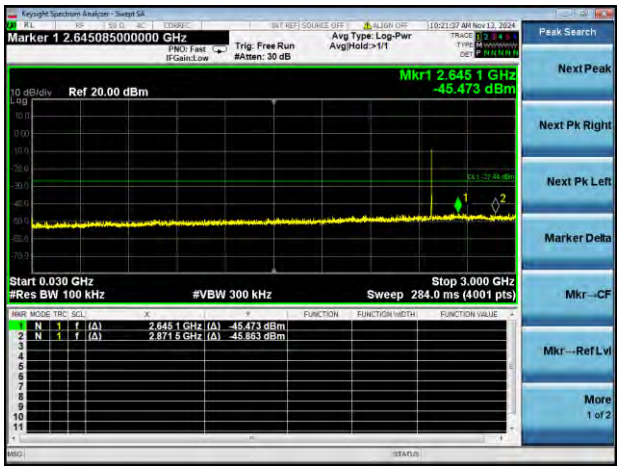


GFSK HIGH CHANNEL, CARRIER LEVEL

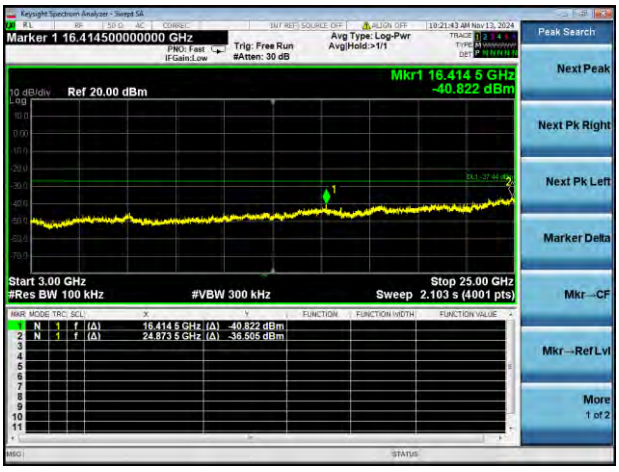
GFSK HIGH CHANNEL, BAND EDGE



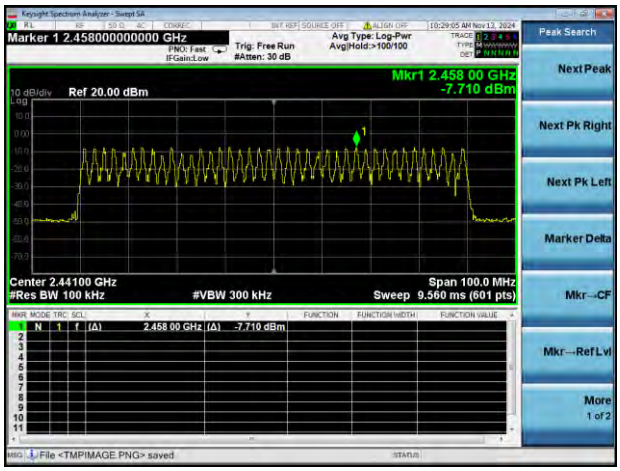
GFSK HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



GFSK HIGH CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



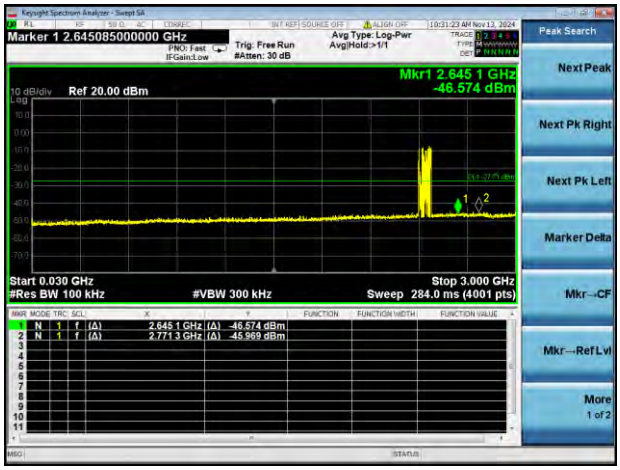
GFSK HOPPING, CARRIER LEVEL



GFSK HOPPING BAND EDGE (LOW)

GFSK HOPPING BAND EDGE (HIGH)

GFSK Hopping Mode, SPURIOUS
30 MHz ~ 3 GHz



GFSK Hopping Mode, SPURIOUS
3GHz ~ 25 GHz

5.8 Conducted Emission

5.8.1 Limit

FCC §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.8.2 Test Setup

See section 4.5.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX A.

5.8.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

5.8.4 Test Result

Note: Not applicable.

5.9 Radiated Spurious Emission

5.9.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.9.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.9.4 Test Result

Note [1]: The symbol of "--" in the table which means not application.

Note [2]: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

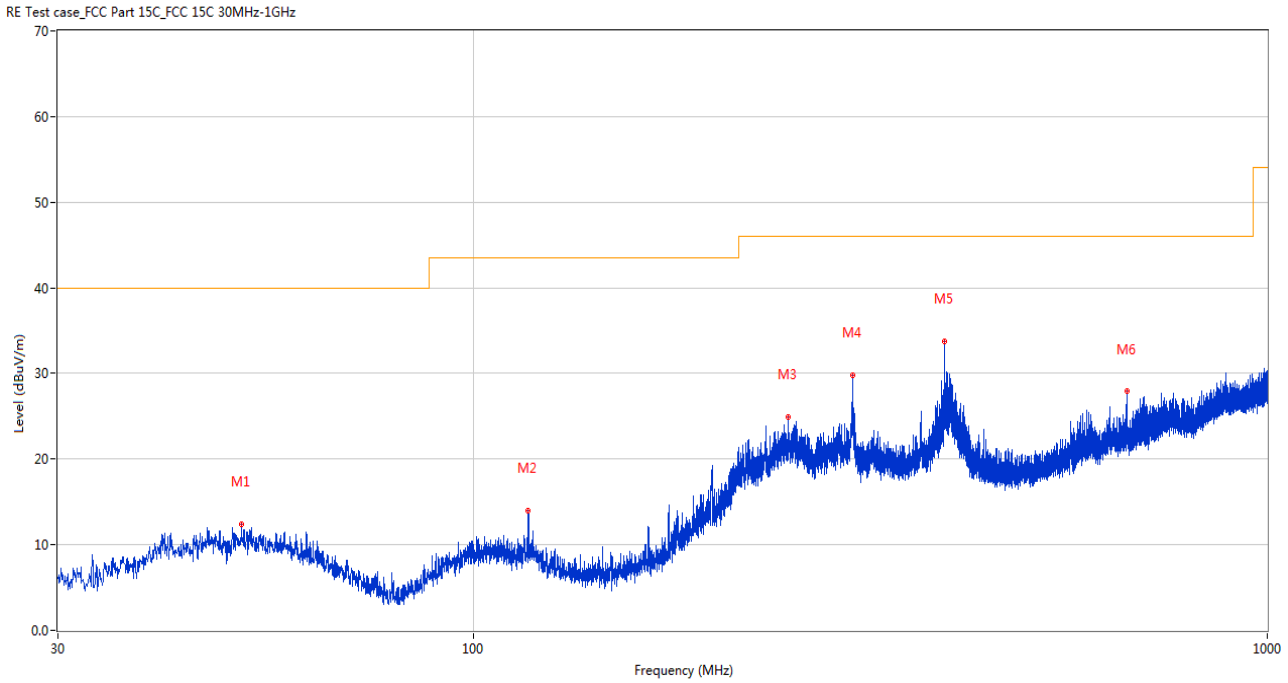
Note [3]: The EUT was tested in connected the laptop and dongle test mode.

Note [4]: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

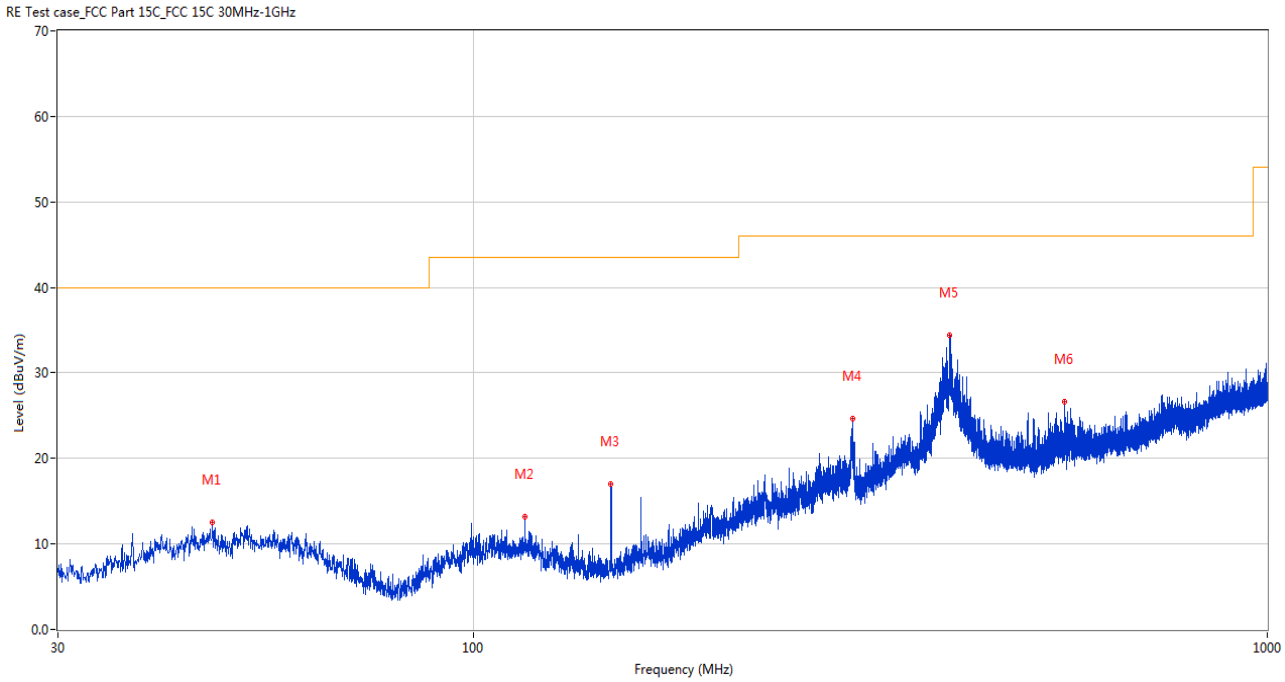
Test Data and Plots

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	51.097	12.45	-24.81	40.0	27.55	Peak	121.20	100	Horizontal	Pass
2	117.349	13.96	-27.43	43.5	29.54	Peak	283.20	100	Horizontal	Pass
3	249.414	24.98	-24.54	46.0	21.02	Peak	263.30	100	Horizontal	Pass
4	300.582	29.78	-23.11	46.0	16.22	Peak	137.50	100	Horizontal	Pass
5	392.392	33.81	-20.49	46.0	12.19	Peak	123.40	100	Horizontal	Pass
6	666.514	27.89	-14.18	46.0	18.11	Peak	185.00	100	Horizontal	Pass

30 MHz to 1 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	46.975	12.57	-24.82	40.0	27.43	Peak	1.50	100	Vertical	Pass
2	116.282	13.16	-27.46	43.5	30.34	Peak	359.50	100	Vertical	Pass
3	149.165	17.05	-29.83	43.5	26.45	Peak	297.00	100	Vertical	Pass
4	300.388	24.61	-23.09	46.0	21.39	Peak	149.50	100	Vertical	Pass
5	398.600	34.47	-20.39	46.0	11.53	Peak	186.60	100	Vertical	Pass
6	556.080	26.61	-16.76	46.0	19.39	Peak	117.50	100	Vertical	Pass

Test Data and Plots

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious from 18GHz-25GHz is noise only, do not show on the report.

GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1322.800	42.54	74.0	31.46	Peak	319.00	100	Horizontal	Pass
1**	1322.800	33.11	54.0	20.89	AV	319.00	100	Horizontal	Pass
2	2402.300	82.36	74.0	-8.36	Peak	355.00	100	Horizontal	N/A
2**	2402.300	81.65	54.0	-27.65	AV	355.00	100	Horizontal	N/A
3	4799.800	51.58	74.0	22.42	Peak	59.00	100	Horizontal	Pass
3**	4799.800	46.87	54.0	7.13	AV	59.00	100	Horizontal	Pass
4	4814.200	50.46	74.0	23.54	Peak	213.00	150	Horizontal	Pass
4**	4814.200	47.58	54.0	6.42	AV	213.00	150	Horizontal	Pass
5	12862.088	54.09	74.0	19.91	Peak	360.00	400	Horizontal	Pass
5**	12862.088	44.24	54.0	9.76	AV	360.00	400	Horizontal	Pass
6	17413.313	56.41	74.0	17.59	Peak	134.00	200	Horizontal	Pass
6**	17413.313	47.66	54.0	6.34	AV	134.00	200	Horizontal	Pass

GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1264.900	42.72	74.0	31.28	Peak	197.00	200	Vertical	Pass
1**	1264.900	32.69	54.0	21.31	AV	197.00	200	Vertical	Pass
2	2402.300	75.59	74.0	-1.59	Peak	16.00	100	Vertical	N/A
2**	2402.300	73.87	54.0	-19.87	AV	16.00	100	Vertical	N/A
3	2900.400	51.45	74.0	22.55	Peak	260.00	200	Vertical	Pass
3**	2900.400	43.04	54.0	10.96	AV	260.00	200	Vertical	Pass
4	4765.200	49.33	74.0	24.67	Peak	311.00	150	Vertical	Pass
4**	4765.200	47.51	54.0	6.49	AV	311.00	150	Vertical	Pass
5	13360.838	56.08	74.0	17.92	Peak	151.00	150	Vertical	Pass
5**	13360.838	46.14	54.0	7.86	AV	151.00	150	Vertical	Pass
6	17416.462	55.83	74.0	18.17	Peak	193.00	300	Vertical	Pass
6**	17416.462	47.62	54.0	6.38	AV	193.00	300	Vertical	Pass

GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1554.400	43.03	74.0	30.97	Peak	152.00	100	Horizontal	Pass
1**	1554.400	33.51	54.0	20.49	AV	152.00	100	Horizontal	Pass
2	2440.200	81.91	74.0	-7.91	Peak	40.00	200	Horizontal	N/A
2**	2440.200	81.08	54.0	-27.08	AV	40.00	200	Horizontal	N/A
3	4876.200	51.83	74.0	22.17	Peak	233.00	150	Horizontal	Pass
3**	4876.200	48.40	54.0	5.60	AV	233.00	150	Horizontal	Pass
4	4879.600	51.97	74.0	22.03	Peak	200.00	200	Horizontal	Pass
4**	4879.600	46.51	54.0	7.49	AV	200.00	200	Horizontal	Pass
5	13307.288	55.13	74.0	18.87	Peak	118.00	150	Horizontal	Pass
5**	13307.288	46.53	54.0	7.47	AV	118.00	150	Horizontal	Pass
6	17428.802	56.28	74.0	17.72	Peak	0.00	400	Horizontal	Pass
6**	17428.802	47.51	54.0	6.49	AV	0.00	400	Horizontal	Pass

GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1416.200	43.12	74.0	30.88	Peak	310.00	400	Vertical	Pass
1**	1416.200	32.69	54.0	21.31	AV	310.00	400	Vertical	Pass
2	2440.400	77.09	74.0	-3.09	Peak	20.00	200	Vertical	N/A
2**	2440.400	75.91	54.0	-21.91	AV	20.00	200	Vertical	N/A
3	4863.200	49.48	74.0	24.52	Peak	304.00	150	Vertical	Pass
3**	4863.200	46.84	54.0	7.16	AV	304.00	150	Vertical	Pass
4	6805.800	54.49	74.0	19.51	Peak	341.00	300	Vertical	Pass
4**	6805.800	45.89	54.0	8.11	AV	341.00	300	Vertical	Pass
5	13438.012	55.90	74.0	18.10	Peak	34.00	150	Vertical	Pass
5**	13438.012	46.60	54.0	7.40	AV	34.00	150	Vertical	Pass
6	17413.575	56.36	74.0	17.64	Peak	274.00	300	Vertical	Pass
6**	17413.575	46.59	54.0	7.41	AV	274.00	300	Vertical	Pass

GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1541.300	42.72	74.0	31.28	Peak	141.00	200	Horizontal	Pass
1**	1541.300	33.40	54.0	20.60	AV	141.00	200	Horizontal	Pass
2	2480.300	83.18	74.0	-9.18	Peak	59.00	150	Horizontal	N/A
2**	2480.300	82.57	54.0	-28.57	AV	59.00	150	Horizontal	N/A
3	4956.200	52.48	74.0	21.52	Peak	223.00	150	Horizontal	Pass
3**	4956.200	50.48	54.0	3.52	AV	223.00	150	Horizontal	Pass
4	4959.800	53.45	74.0	20.55	Peak	223.00	150	Horizontal	Pass
4**	4959.800	49.09	54.0	4.91	AV	223.00	150	Horizontal	Pass
5	13400.212	55.17	74.0	18.83	Peak	66.00	150	Horizontal	Pass
5**	13400.212	47.00	54.0	7.00	AV	66.00	150	Horizontal	Pass
6	17397.563	56.13	74.0	17.87	Peak	46.00	150	Horizontal	Pass
6**	17397.563	46.77	54.0	7.23	AV	46.00	150	Horizontal	Pass

GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1337.500	42.90	74.0	31.10	Peak	237.00	300	Vertical	Pass
1**	1337.500	33.49	54.0	20.51	AV	237.00	300	Vertical	Pass
2	2479.700	78.01	74.0	-4.01	Peak	0.00	150	Vertical	N/A
2**	2479.700	75.07	54.0	-21.07	AV	0.00	150	Vertical	N/A
3	4959.600	50.81	74.0	23.19	Peak	321.00	150	Vertical	Pass
3**	4959.600	45.86	54.0	8.14	AV	321.00	150	Vertical	Pass
4	6792.000	54.41	74.0	19.59	Peak	285.00	200	Vertical	Pass
4**	6792.000	45.81	54.0	8.19	AV	285.00	200	Vertical	Pass
5	13352.700	56.46	74.0	17.54	Peak	160.00	150	Vertical	Pass
5**	13352.700	47.18	54.0	6.82	AV	160.00	150	Vertical	Pass
6	17423.813	57.35	74.0	16.65	Peak	56.00	150	Vertical	Pass
6**	17423.813	46.97	54.0	7.03	AV	56.00	150	Vertical	Pass

5.10 Band Edge (Restricted-band band-edge)

5.10.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.10.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.10.4 Test Result

Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note [2]: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

Note [3]: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note [4]: The Level (dBuV/m) has been corrected by factor.

Test Data

GFSK LOW CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2320.400	58.11	74.0	15.89	Peak	216.00	200	Horizontal	Pass
1**	2320.400	46.38	54.0	7.62	AV	216.00	200	Horizontal	Pass
2	2389.950	55.80	74.0	18.20	Peak	200.00	150	Horizontal	Pass
2**	2389.950	45.98	54.0	8.02	AV	200.00	150	Horizontal	Pass

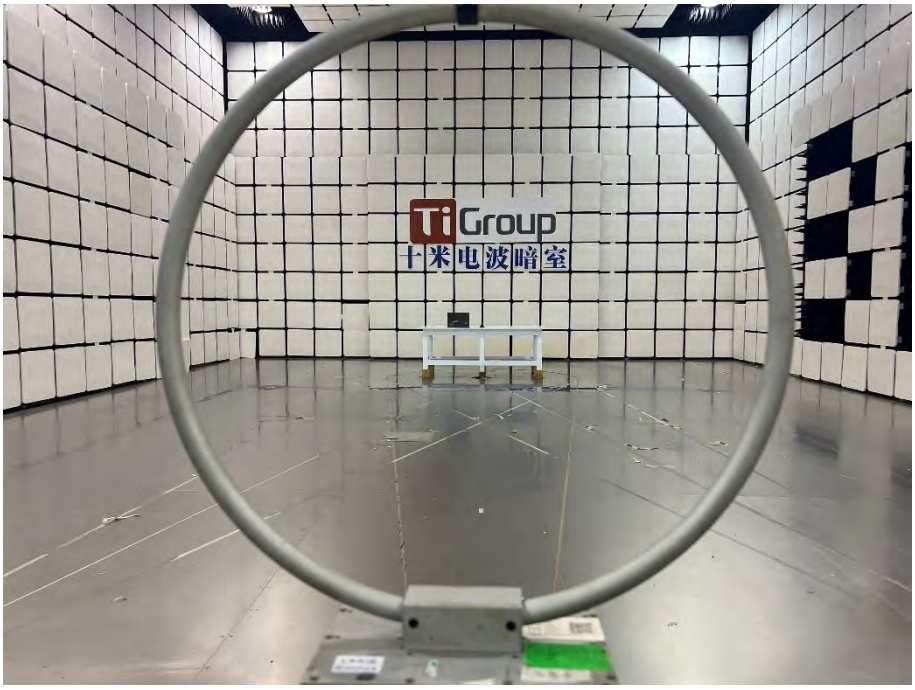
GFSK HIGH CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.545	60.52	74.0	13.48	Peak	76.00	100	Horizontal	Pass
1**	2483.545	46.76	54.0	7.24	AV	76.00	100	Horizontal	Pass
2	2484.175	60.69	74.0	13.31	Peak	63.00	200	Horizontal	Pass
2**	2484.175	46.51	54.0	7.49	AV	63.00	200	Horizontal	Pass

ANNEX A TEST SETUP PHOTOS

1 Radiated Test Photo

Below 30MHz

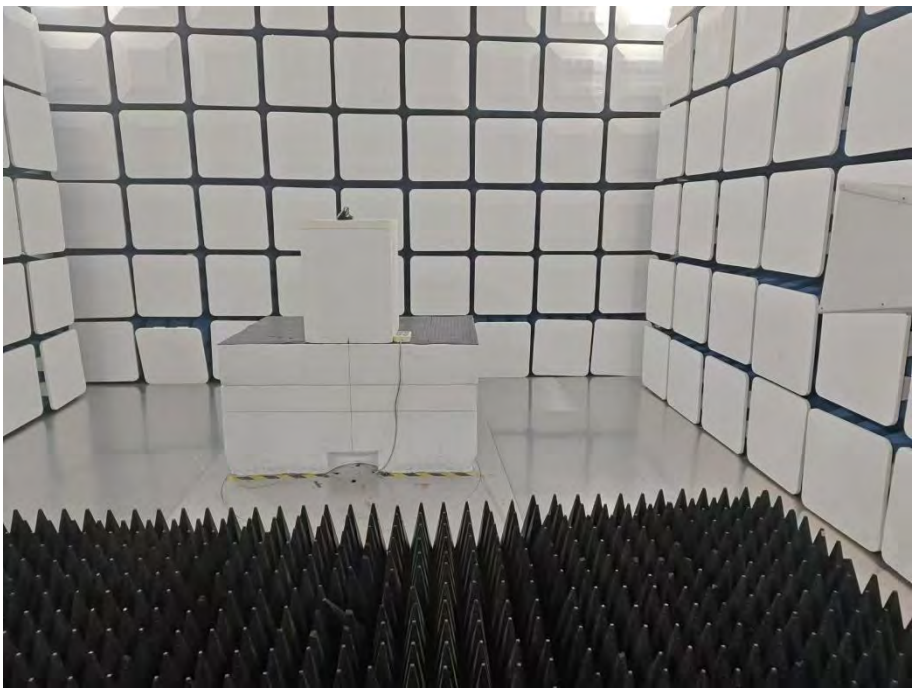


Close-up

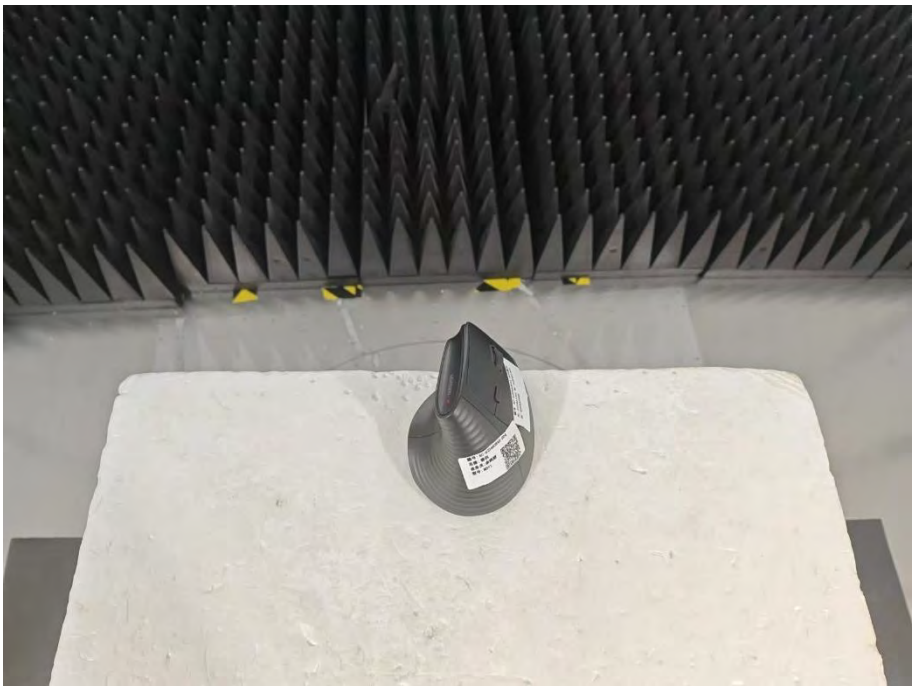
30MHz-1GHz

Close-up

Above 1GHz

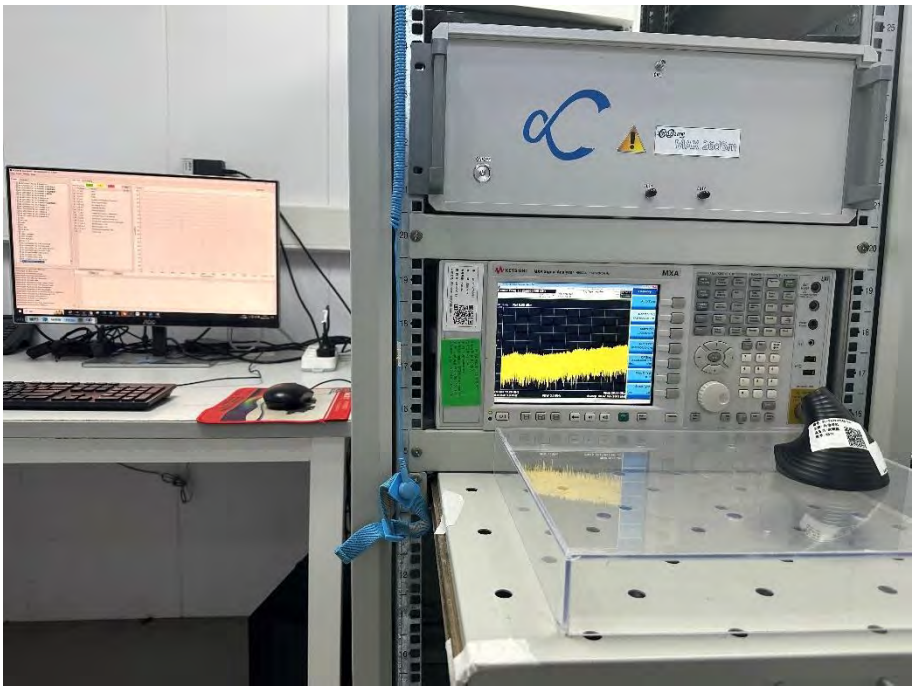


Close-up



2 Conducted Test Photo

Conducted Test

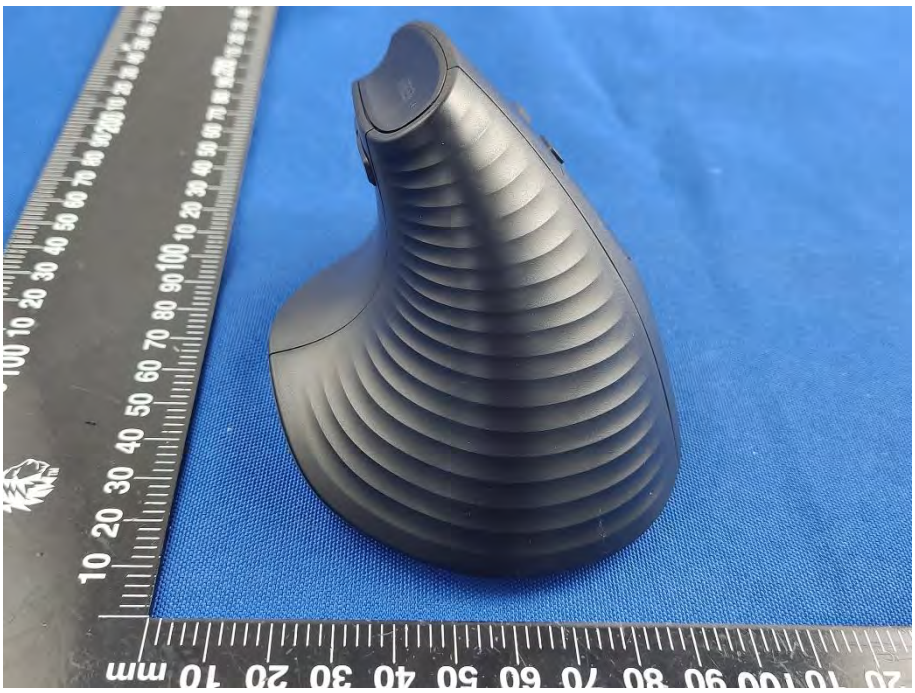


ANNEX B EUT EXTERNAL PHOTOS

FRONT VIEW OF EUT

REAR VIEW OF EUT

LEFT VIEW OF EUT

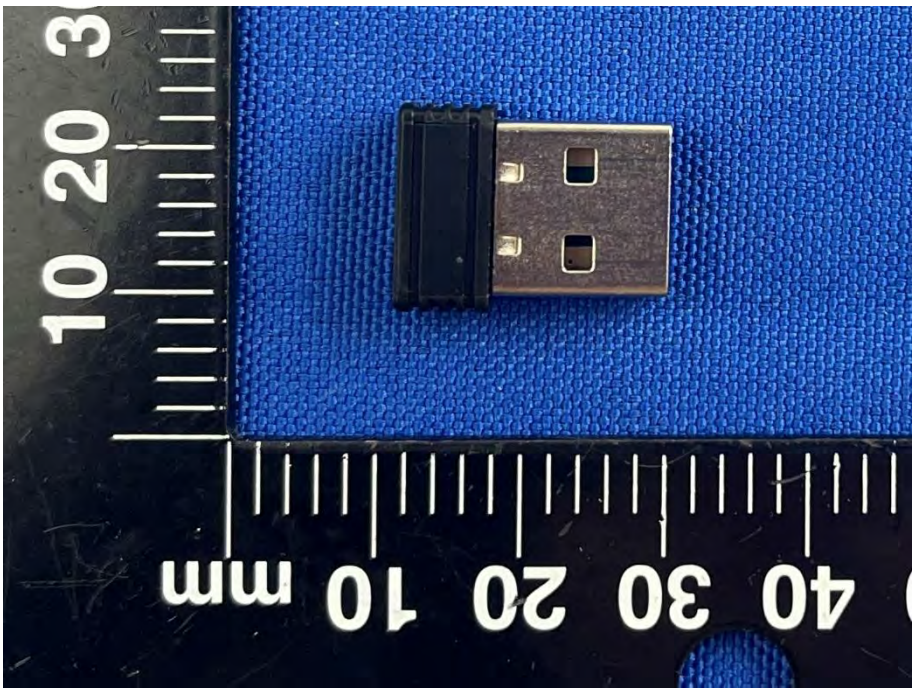


RIGHT VIEW OF EUT

TOP VIEW OF EUT

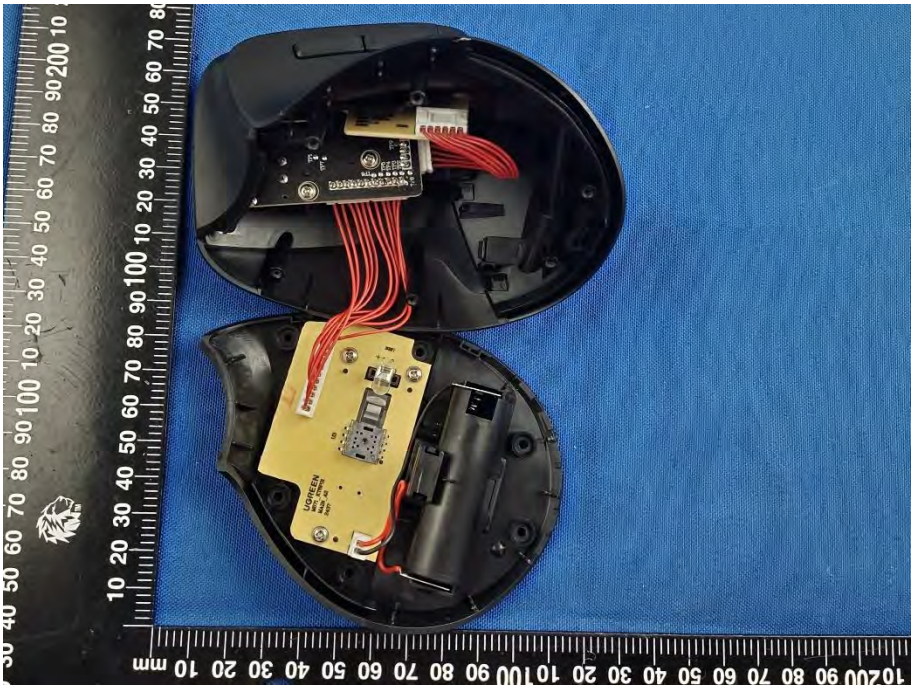
BOTTOM VIEW OF EUT

Accessory-Dongle

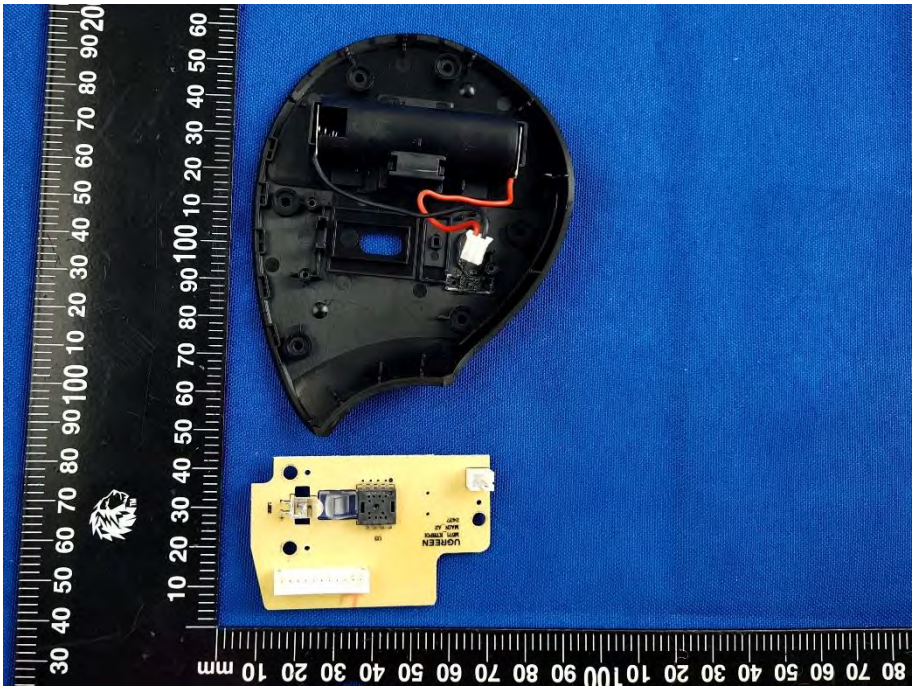


ANNEX C EUT INTERNAL PHOTOS

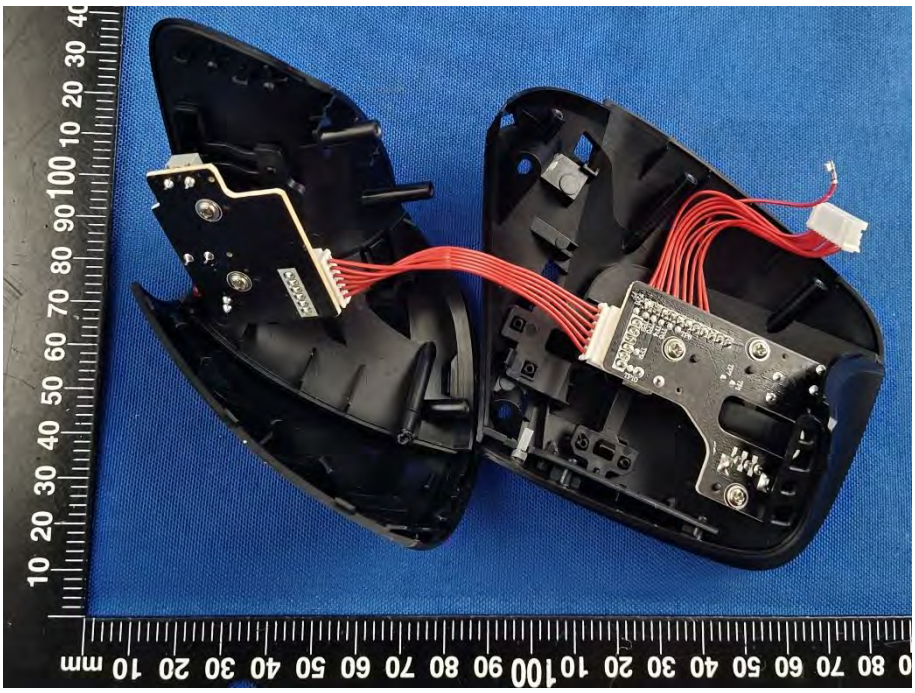
EUT UNCOVER VIEW 1



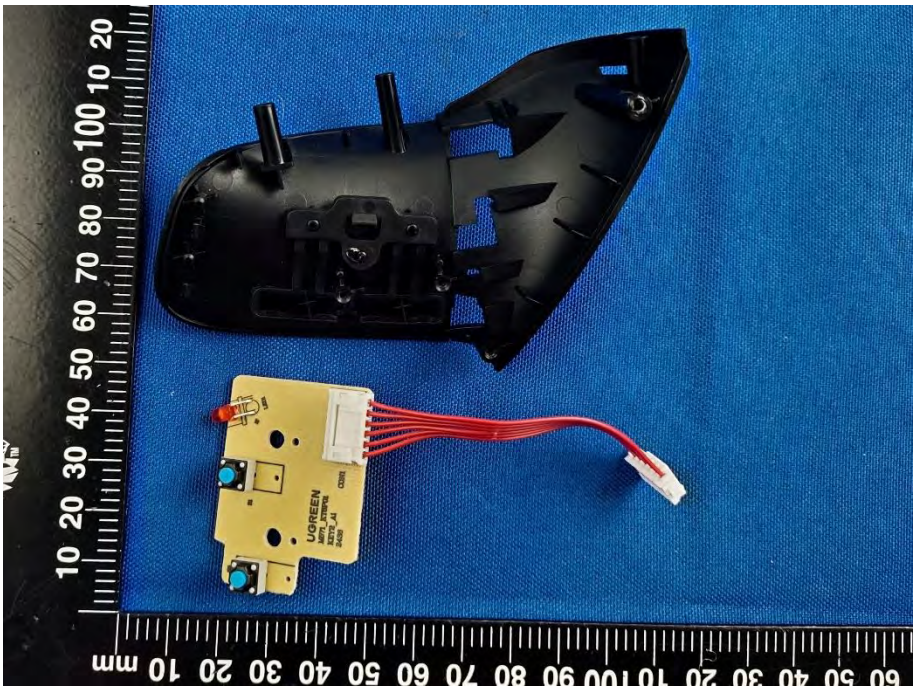
EUT UNCOVER VIEW 2



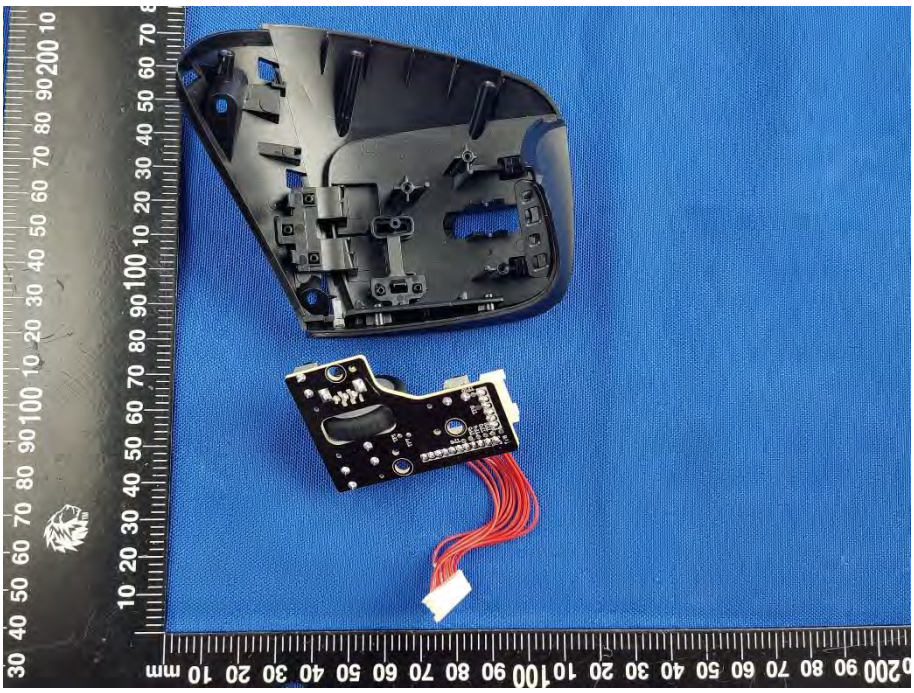
EUT UNCOVER VIEW 3



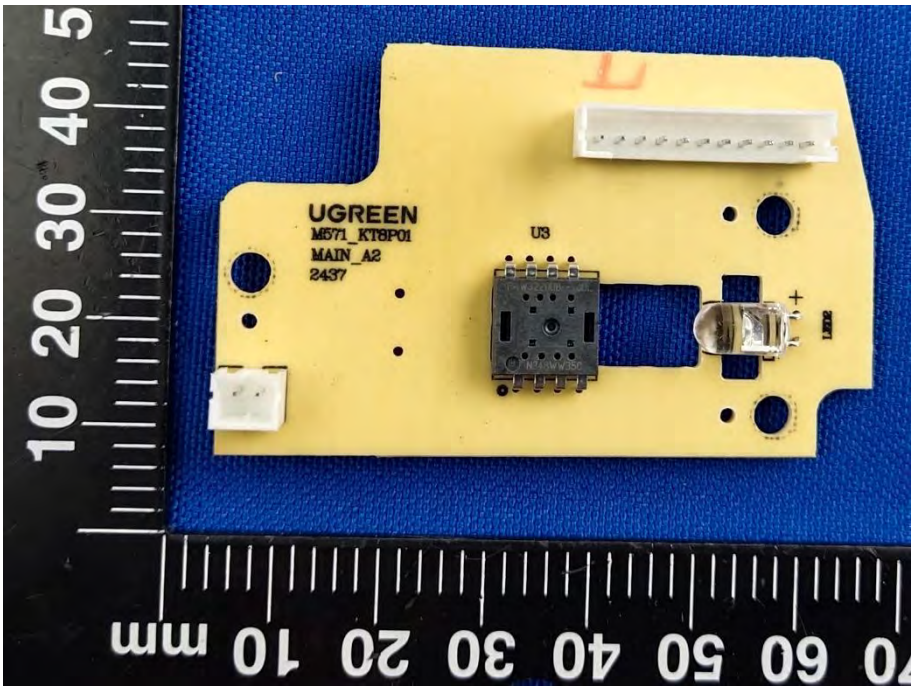
EUT UNCOVER VIEW 4



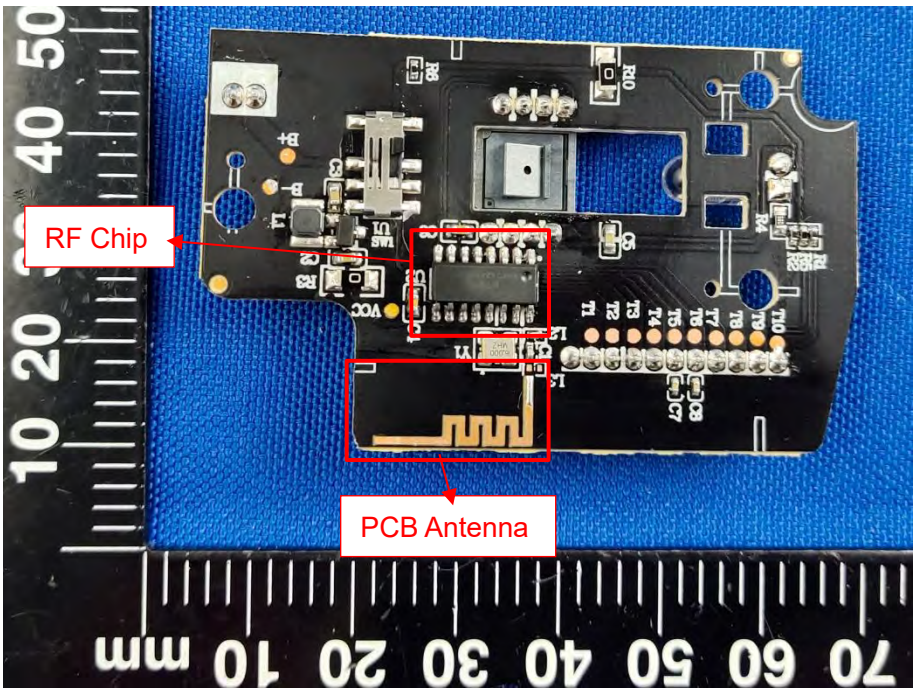
EUT UNCOVER VIEW 5



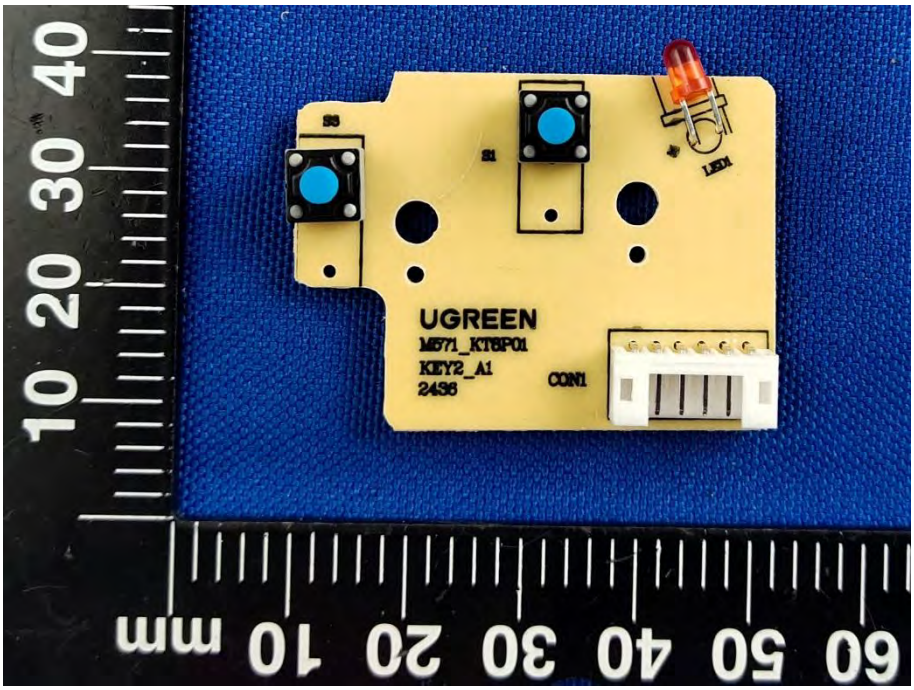
MAIN BOARD TOP VIEW



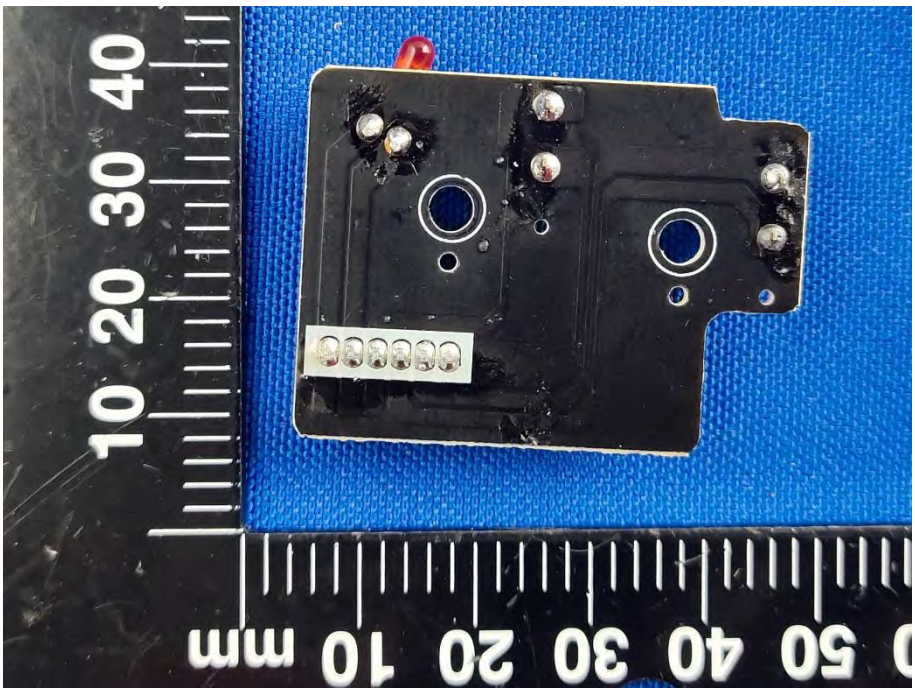
MAIN BOARD REAR VIEW



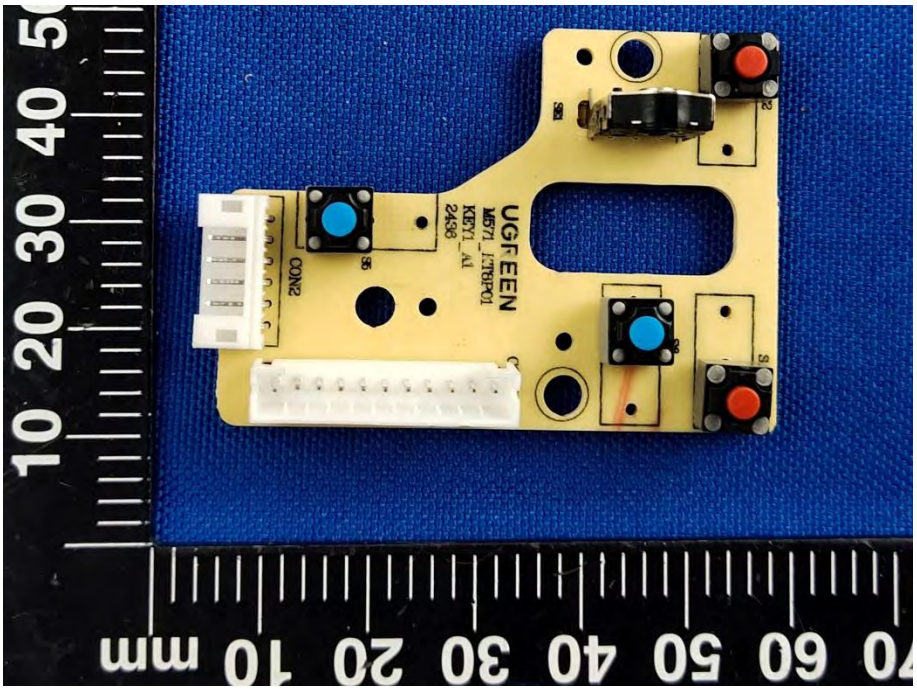
SECONDARY BOARD 1 TOP VIEW



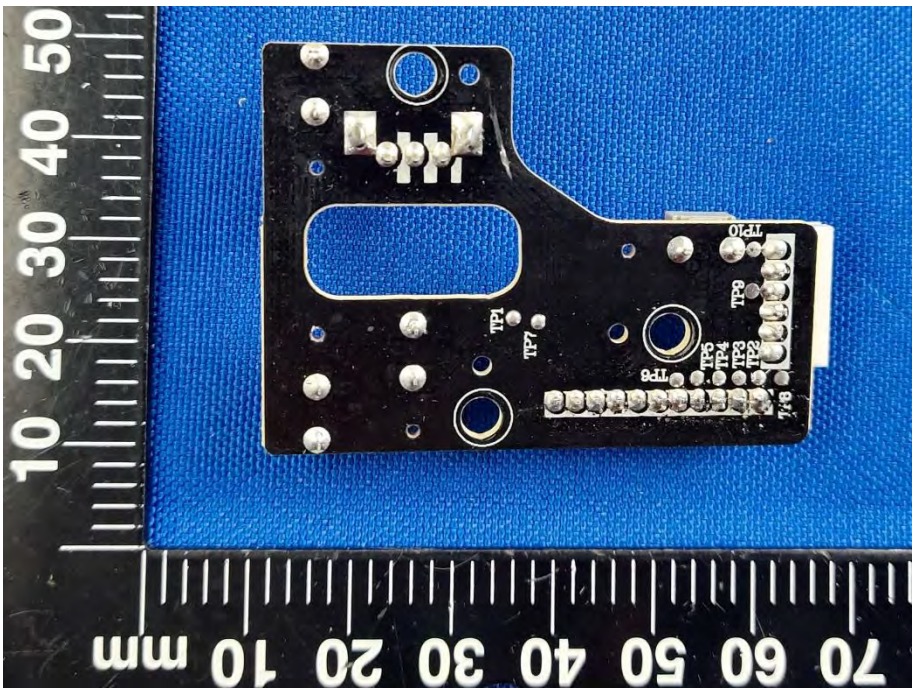
SECONDARY BOARD 1 REAR VIEW



SECONDARY BOARD 2 TOP VIEW



SECONDARY BOARD 2 REAR VIEW



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