FCC PART 15C TEST REPORT FOR CERTIFICATION
On Behalf of

Tivo Technologies Pte Ltd

Mechanical Keyboard

Model Number: Phantom+ ELITE

Additional Model: K85, K19

FCC ID: 2BMK5-PHANTOMELITE

Applicant:	Tivo Technologies Pte Ltd
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	Chilingxiang, Qishantou, Santun, Houjie, Dongguan, Guangdong, China
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Report Number:	ESTE-R2412152
Date of Test:	Dec. 04, 2024~ Dec. 20, 2024
Date of Report:	Dec. 23, 2024

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Applicant: **Address:**	Tivo Technologies Pte Ltd #05-15, 514 Chai Chee Ln, Singapore 469029, Singapore
Manufacturer: **Address:**	Sisun Electronics Technology (DG) CO., LTD Sisun industrial park, xikeng Rd, puxin village, Shipai town, Dongguan, Guangdong, China
Factory: **Address:**	Sisun Electronics Technology (DG) CO., LTD Sisun industrial park, xikeng Rd, puxin village, Shipai town, Dongguan, Guangdong, China
E.U.T:	Mechanical Keyboard
Model Number:	Phantom+ ELITE
Additional Model:	K85, K19 Note: They are identical except model name.
Power Supply:	DC 5V/300mA; DC 3.7V From Battery
Trade Name:	TECWARE Serial No.: ------
Date of Receipt:	Dec. 04, 2024 Date of Test: Dec. 04, 2024~ Dec. 20, 2024
Test Specification:	FCC Part 15 Subpart C (15.247) ANSI C63.10:2013 FCC KDB 558074 D01 15.247 Meas Guidance v05r02
Test Result:	The device described above is tested by EST Technology Co., Ltd. The measurement results were contained in this test report and EST Technology Co., Ltd. was assumed full responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT to be technically compliance with the FCC Rules and Regulations Part 15 Subpart C requirements. This report applies to above tested sample only and shall not be reproduced in part without written approval of EST Technology Co., Ltd. **Date:** Dec. 23, 2024

Prepared by:	Reviewed by:	Approved by:
Ring Yang / Assistant	Seven Wang / Engineer	Iceman Hu / Manager

Other Aspects:

None.

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

This test report is based on a single evaluation of one sample of above mentioned products ,It is not permitted to be duplicated in extracts without written approval of EST Technology Co., Ltd.

1.GENERAL INFORMATION

1.1.Description of Device (EUT)

Product Name	:	Mechanical Keyboard
Model Number	:	Phantom+ ELITE
Software Version	:	N/A
Hardware Version	:	N/A
Operation frequency	:	2402MHz~2480MHz
Number of channel	:	40
Max Output Power (PEAK)	:	3.55dBm
Modulation Type	:	GFSK
Sample Type	:	Prototype production

Note: For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

1.2.Antenna Information

Ant No.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	-	-	Internal	-	2.34

Note:
1.The antenna gain is declared by the customer and the laboratory is not responsible for the accuracy of the antenna gain.
2.The test results of this report only apply to the sample as received

1.3.Information of RF Cable

Cable Loss(dB)	Provided by
1.0	Tivo Technologies Pte Ltd

Note:
1.The customer declared the loss value of the RF Cable. and the test results of this report only apply to the sample as received.
2.The laboratory is not responsible for the accuracy of the cable loss.

2.SUMMARY OF TEST

2.1.Summary of test result

No.	Description of Test Item	FCC Standard Section	Results
1	6dB Bandwidth	15.247(a)(2)	PASS
2	Maximum Peak Output Power	15.247(b)(3)	PASS
3	Power Spectral Density	15.247(e)	PASS
4	Conducted Band Edge	15.247(d)	PASS
5	Conducted Spurious Emissions	15.247(d)	PASS
6	Radiated Spurious Emissions and Band Edge	15.205 15.209 15.247(d)	PASS
7	AC Power Line Conducted Emissions	15.207	PASS
8	Antenna Requirement	15.203	PASS

Note:“N/A” denotes test is not applicable in this test report.

2.2.Test Facilities

EMC Lab	:	Accredited by CNAS, CHINA Registration No.: L5288 This Accreditation is valid until: November 12, 2029 Recognized by FCC, USA Designation Number: CN1215 This Recognition is valid until: January 31, 2026 Accredited by A2LA, USA Registration No.: 4366.01 This Accreditation is valid until: January 31, 2026 Recognized by Industry Canada CAB identifier No.: CN0035 This Recognition is valid until: January 31, 2026 Recognized by VCCI, Japan Registration No.:C-14103; T-20073; R-13663; R-20103; G-20097 Date of registration: Apr. 20, 2020 This Recognition is valid until: Apr. 19, 2026 Recognized by TUV Rheinland, Germany Registration No.: UA 50413872 0001 Date of registration: July 31, 2018 Recognized by Intertek Registration No.: 2011-RTL-L2-64 Date of registration: November 08, 2018
Name of Firm	:	EST Technology Co., Ltd.
Site Location	:	Chilingxiang, Qishantou, Santun, Houjie, Dongguan, Guangdong, China

2.3.Measurement uncertainty

Test Item	Uncertainty
Uncertainty for Conduction emission test	±3.48dB
Uncertainty for spurious emissions test (Below 30MHz)	±1.62 dB
Uncertainty for spurious emissions test (30MHz-1GHz)	±4.60 dB(Polarize: H)
	±4.68 dB(Polarize: V)
Uncertainty for spurious emissions test (1GHz to 25GHz)	±4.96dB
Uncertainty for radio frequency	7×10^{-8}
Uncertainty for conducted RF Power	1.08dB
Uncertainty for Power density test	0.26dB

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

2.4.Assistant equipment used for test

Item	Equipment	Brand	Model Name/Type No.	FCC ID	Series No.
-	-	-	-	-	-

Item	Shielded Type	Ferrite Core	Length	Note
-	-	-	-	-

2.5.Block Diagram

For radiated emissions test: EUT was placed on a turn table, which is 0.8 (or 1.5) meter high above ground. EUT was beset into BLE test mode by software before test.

EUT

DC 3.7V From Battery

(EUT: Mechanical Keyboard)

2.6.Test Mode

The test mode was selected for the final test as listed below.

Test Item	Modulation Type	Test Channel
6dB Bandwidth	GFSK	Low/Middle/High
Maximum Peak Output Power	GFSK	Low/Middle/High
Power Spectral Density	GFSK	Low/Middle/High
Conducted Band Edge	GFSK	Low/ High
Conducted Spurious Emissions	GFSK	Low/Middle/High
Radiated Spurious Emissions(Below 1GHz)	GFSK	Low/Middle/High
Radiated Spurious Emissions(Above 1GHz)	GFSK	Low/Middle/High
Radiated Band Edge	GFSK	Low/High
AC Power Line Conducted Emissions	GFSK	Low/Middle/High

Note:In radiated measurement,the EUT had been pre-scan on the positioned of each 3 axis(X,Y,Z), the worst case was found when positioned on **X-plane.**

2.7.Power Setting of Test Software

Software Name	BK32xx RF Test_V1.9.1.exe		
Frequency(MHz)	2402	2440	2480
Setting	3	3	3

Note: This information is provided by the applicant.

2.8.Duty Cycle

Refer to section 11: Appendix G

Note:

1. If duty cycle <98 %, the conducted average output power and average power spectral density should be add duty factor.
2. If duty cycle≥98 %,the EUT is consider to be transmitting continuously,the conducted average output power and average power spectral density no need to add duty factor(consider to be zero).
3. The conducted peak output power and peak power spectral density no need to consider duty factor.
4. The on-time time is transmission duration(T).

2.9.Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	1	2404
2	2406	3	2408
4	2410	5	2412
6	2414	7	2416
8	2418	9	2420
10	2422	11	2424
12	2426	13	2428
14	2430	15	2432
16	2434	17	2436
18	2438	19	2440
20	2442	21	2444
22	2446	23	2448
24	2450	25	2452
26	2454	27	2456
28	2458	29	2460
30	2462	31	2464
32	2466	33	2468
34	2470	35	2472
36	2474	37	2476
38	2478	39	2480

2.10. Test Equipment List

For conducted emission test						
Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
EMI Test Receiver	Rohde & Schwarz	ESRP3	EST-E070	LISAI	June 11,24	June 10,25
Artificial Mains Network	Rohde & Schwarz	ENV216	EST-E048	LISAI	June 11,24	June 10,25
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	EST-E078	LISAI	June 11,24	June 10,25
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A

For radiated emission test(9kHz-30MHz)						
Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
EMI Test Receiver	Rohde & Schwarz	ESR7	EST-E047	LISAI	June 11,24	June 10,25
Active Loop Antenna	SCHWAREBECK	FMZB 1519B	EST-E054	LISAI	June 11,24	June 10,25
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A
9kHz-30MHz Cable	N/A	EST-001	N/A	N/A	N/A	N/A

For radiated emissions test (30MHz-1000MHz)						
Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
EMI Test Receiver	Rohde & Schwarz	ESR7	EST-E047	LISAI	June 11,24	June 10,25
Bilog Antenna	Teseq	CBL 6111D	EST-E034	LISAI	June 11,24	June 10,25
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A
30-1000MHz Cable	N/A	EST-002	N/A	N/A	N/A	N/A

For radiated emission test(Above 1000MHz)						
Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
Horn Antenna	SCHWARZBECK	BBHA9120D	EST-E144	LISAI	June 11,24	June 10,25
Horn Antenna	Com-Power	AHA-840	EST-E133	LISAI	June 11,24	June 10,25
Low Noise Amplifier	RF	TRLA-010180G45N	EST-E142	LISAI	June 11,24	June 10,25
Spectrum Analyzer	Rohde &Schwarz	FSV40	EST-E069	LISAI	June 11,24	June 10,25
Test Software	Audix	e3-6.111221a	N/A	N/A	N/A	N/A
Above 1GHz Cable	N/A	EST-003	N/A	N/A	N/A	N/A

For connect EUT antenna terminal test						
Equipment	Manufacturer	Model No.	Serial No.	Calibration Body	Last Cal.	Next Cal.
TS 1120	Tonscend	/	/	/	/	/
Test Software	Tonscend	TS1120-3	3.3.38	/	/	/
RF Control Unit	Tonscend	JS0806-2	EST-E134	LISAI	June 11,24	June 10,25
Signal and Spectrum Analyzer	Keysight	N9010B	EST-E141	LISAI	June 11,24	June 10,25

3.6dB Bandwidth

3.1.Limit

Systems using digital modulation techniques operate in the 2400-2483.5 MHz,the minimum 6 dB bandwidth shall be at least 500 kHz.

3.2.Test Setup

3.3.Spectrum Analyzer Setting

Spectrum Parameters	Setting
RBW	100KHz
VBW	300KHz
Span	3MHz
Sweep Time	Auto
Detector	Peak
Trace Mode	Max Hold

3.4.Test Procedure

a. Connect EUT antenna terminal to the spectrum analyzer with RF cable.
b. Spectrum analyzer setting parameters in accordance with section 3.3.
c. Set the EUT transmit continuously with maximum output power.
d. Allow trace to stabilize, use the ndB down function to measure 6dB Bandwidth.
e. Repeat above procedures until all channels were measured.
f. Record the results in the test report.

3.5.Test Result

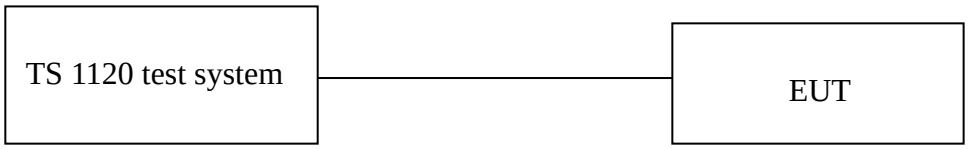
Refer to section 11: Appendix A

4.MAXIMUM PEAK OUTPUT POWER

4.1.Limit

For systems using digital modulation in 2400-2483.5 MHz,the maximum peak output power is 1 Watt(30dBm).

4.2.Test Setup



4.3.Spectrum Analyzer Setting

Spectrum Parameters	Setting
RBW	≥DTS Bandwidth
VBW	3*RBW
Span	≥3*DTS Bandwidth
Sweep Time	Auto
Detector	Peak
Trace Mode	Max Hold

4.4.Test Procedure

a. Connect EUT antenna terminal to the spectrum analyzer with RF cable.
b. Spectrum analyzer setting parameters in accordance with section 4.3.
c. Set the EUT transmit continuously with maximum output power.
d. Allow trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission.
e. Repeat above procedures until all channels were measured.
f. Record the results in the test report.

4.5.Test Result

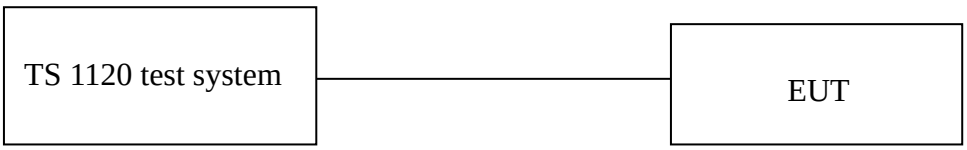
Refer to section 11: Appendix B

5.POWER SPECTRAL DENSITY

5.1.Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2.Test Setup



5.3.Spectrum Analyzer Setting

Spectrum Parameters	Setting
RBW	3KHz
VBW	10KHz
Span	2MHz
Sweep Time	Auto
Detector	Peak
Trace Mode	Max Hold

5.4.Test Procedure

a. Connect EUT antenna terminal to the spectrum analyzer with RF cable.
b. Spectrum analyzer setting parameters in accordance with section 5.3.
c. Set the EUT transmit continuously with maximum output power.
d. Allow trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission.
e. Repeat above procedures until all channels were measured.
f. Record the results in the test report.

5.5.Test Result

Refer to section 11: Appendix C

6.CONDUCTED BAND EDGE

6.1.Limit

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

6.2.Test Setup

6.3.Spectrum Analyzer Setting

Spectrum Parameters	Setting
RBW	100KHz
VBW	300KHz
Span	100MHz
Sweep Time	Auto
Detector	Peak
Trace Mode	Max Hold

6.4.Test Procedure

a. Connect EUT antenna terminal to the spectrum analyzer with RF cable.
b. Spectrum analyzer setting parameters in accordance with section 6.3.
c. Set the EUT transmit continuously with maximum output power.
d. Allow trace to stabilize, use the marker function to mark the highest emission level outside the authorized band.
e. Repeat above procedures until all channels were measured.
f. Record the results in the test report.

6.5.Test Result

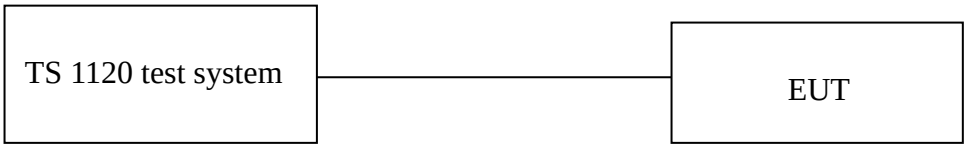
Refer to section 11: Appendix D & E

7.CONDUCTED SPURIOUS EMISSIONS

7.1.Limit

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

7.2.Test Setup



7.3.Spectrum Analyzer Setting

Spectrum Parameters	Setting
RBW	100KHz
VBW	300KHz
Start frequency	30MHz
Stop frequency	26.5GHz
Sweep Time	Auto
Detector	Peak
Trace Mode	Max Hold

7.4.Test Procedure

a. Connect EUT antenna terminal to the spectrum analyzer with RF cable.
b. Spectrum analyzer setting parameters in accordance with section 7.3.
c. Set the EUT transmit continuously with maximum output power.
d. Allow trace to stabilize, use the marker function to mark the highest emission level outside the authorized band.
e. Repeat above procedures until all channels were measured.
f. Record the results in the test report.

7.5.Test Result

Refer to section 11: Appendix D & F

8.RADIATED SPURIOUS EMISSIONS AND BAND EDGE

8.1.Limit

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

15.205 Restricted frequency band

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

15.209 Limit

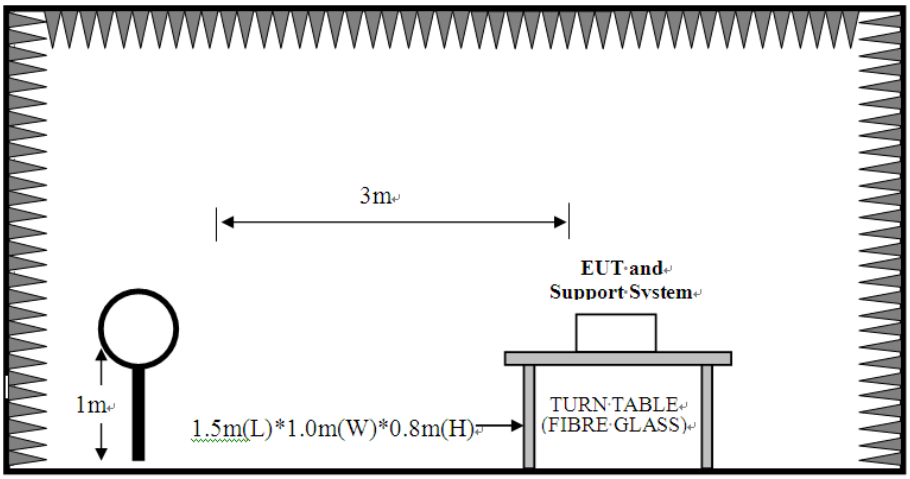
Frequency (MHz)	Field Strength(μV/m)	Distance(m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

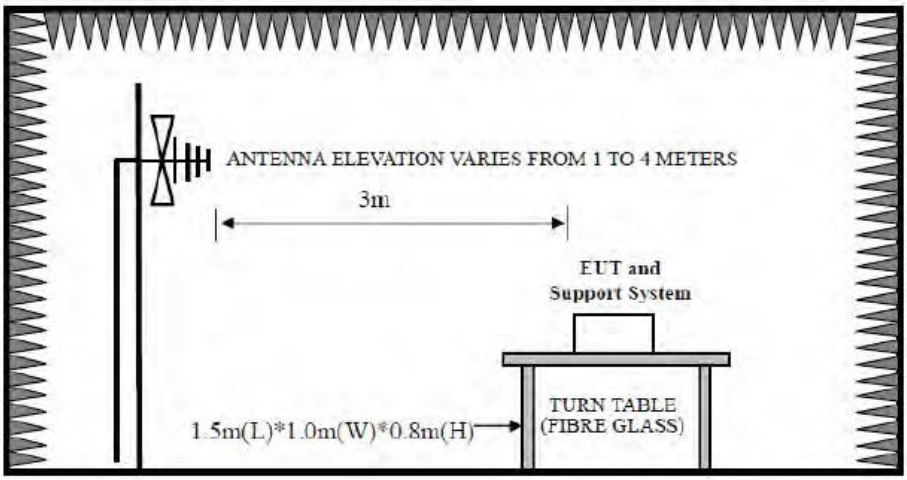
(1) Emission level dBμV = 20 log Emission level μV/m.
(2) The smaller limit shall apply at the cross point between two frequency bands.
(3) Distance is the distance in meters between the measuring instrument,antenna and the closest point of any part of the device or system.

8.2.Test Setup

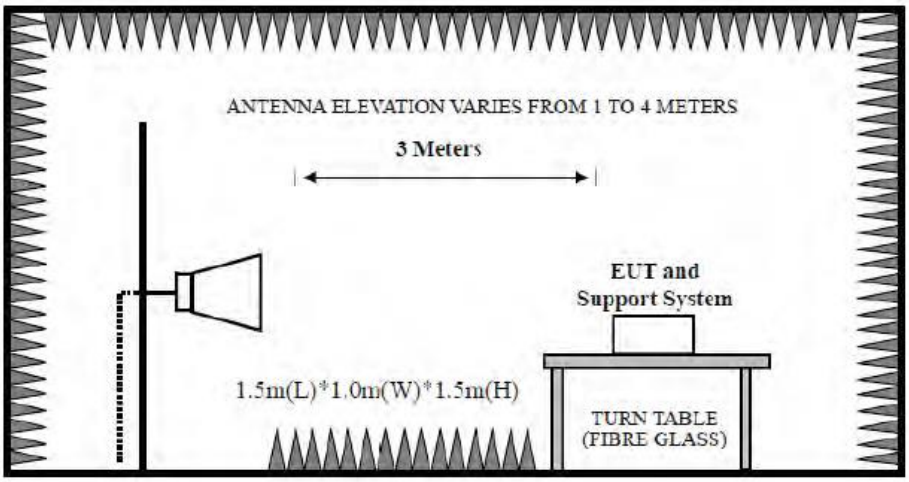
9kHz~30MHz



30~1000MHz



Above 1GHz



8.3.Spectrum Analyzer Setting

For 9KHz-150KHz

Spectrum Parameters	Setting
RBW	300Hz(for Peak&AVG)/CISPR 200Hz(for QP)
VBW	300Hz(for Peak&AVG)/CISPR 200Hz(for QP)
Start frequency	9KHz
Stop frequency	150KHz
Sweep Time	Auto
Detector	PEAK/QP/AVG
Trace Mode	Max Hold

For 150KHz-30MHz

Spectrum Parameters	Setting
RBW	9KHz
VBW	9KHz
Start frequency	150KHz
Stop frequency	30MHz
Sweep Time	Auto
Detector	QP
Trace Mode	Max Hold

For 30MHz-1GHz

Spectrum Parameters	Setting
RBW	120KHz
VBW	300KHz
Start frequency	30MHz
Stop frequency	1GHz
Sweep Time	Auto
Detector	QP
Trace Mode	Max Hold

For Above 1GHz

Spectrum Parameters	Setting	
RBW	1MHz	
VBW	PEAK Measurement	AVG Measurement
	3MHz	Duty cycle≥98%,VBW=10Hz
		Duty cycle＜98%,VBW≥1/T
Start frequency	1GHz	
Stop frequency	25GHz	
Sweep Time	Auto	
Detector	PEAK	
Trace Mode	Max Hold	

Note :T is the on-time time of the duty cycle,when EUT transmit continuously with maximum output power,unit is seconds. reference section 2.8 for the on-time time.

8.4.Test Procedure

a. EUT was placed on a turn table, which is 0.8 meter high above ground for below 1GHz test, and which is 1.5 meter high above ground for above 1GHz test.
b. EUT is set 3 meters away from the receiving antenna, which is mounted on a antenna tower.
c. Set the EUT transmit continuously with maximum output power.
d. The turn table can rotate 360 degrees to determine the position of the maximum emission level.
e. The antenna can be moved 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 test.
f. Spectrum analyzer setting parameters in accordance with section 8.3.
g. Repeat above procedures until all channels were measured.
h. Record the results in the test report.

Note:

1. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.
2. The frequency 2402MHz ,2440MHz and 2480MHz is fundamental frequency which no limit, the limit on plots is automatically generated by the software, it's not fundamental limit, we can't remove it.

8.5.Test Result

Radiated Emissions Below 1GHz

EST Technology

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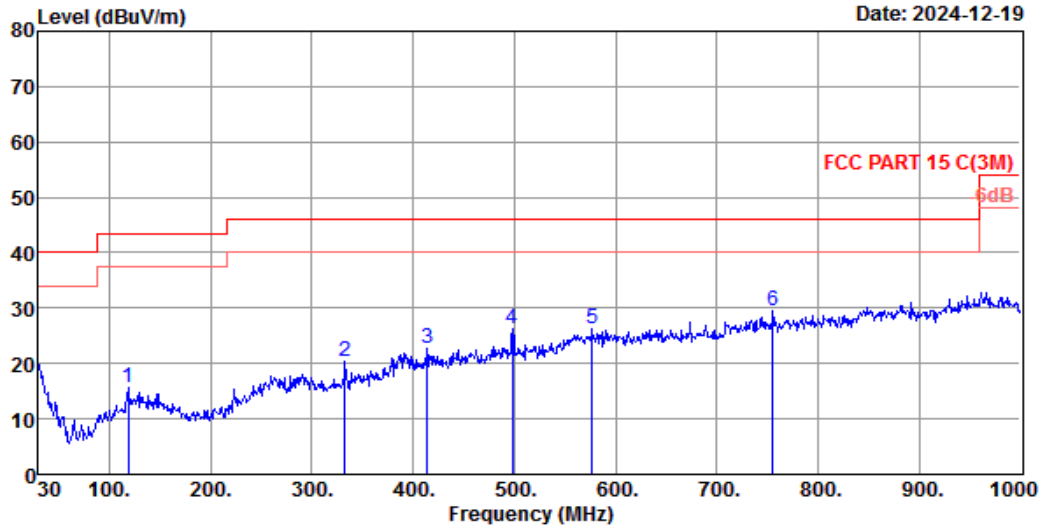
Data: 57 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 57
Dis. / Ant. : 3m 54681 Ant. pol. : VERTICAL
Limit : FCC PART 15 C(3M)
Env. / Ins. : Temp:23'℃:Humi:54%: Prwss:101.1kPa
Engineer : Luke Zhu
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : TX Mode

	Freq. (MHz)	ANT Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	118.27	12.40	1.40	1.73	15.53	43.50	27.97	QP
2	332.64	13.86	3.19	3.42	20.47	46.00	25.53	QP
3	414.12	16.62	3.59	2.63	22.84	46.00	23.16	QP
4	498.51	17.87	3.99	4.29	26.15	46.00	19.85	QP
5	577.08	20.10	4.30	1.91	26.31	46.00	19.69	QP
6	755.56	21.98	4.98	2.69	29.65	46.00	16.35	QP

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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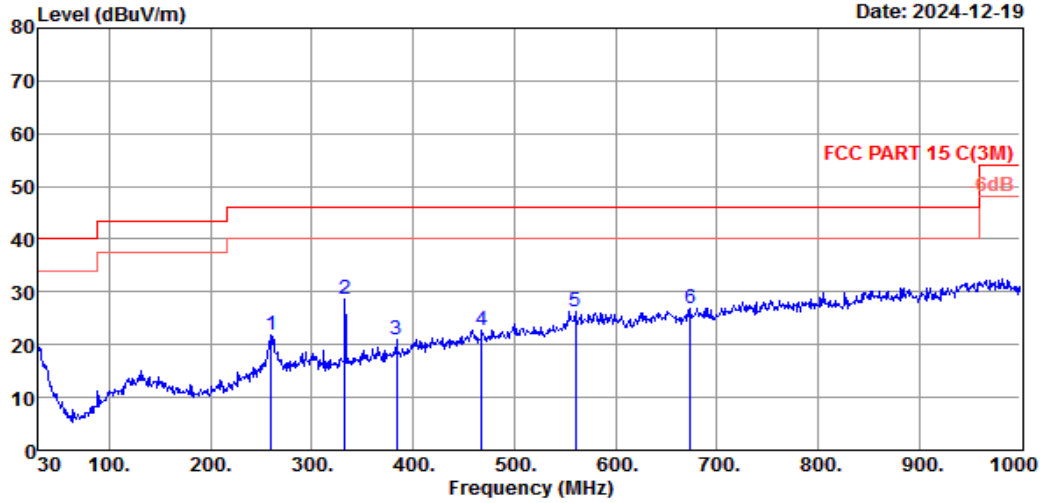
Data: 58 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 58
Dis. / Ant. : 3m 54681 Ant. pol. : HORIZONTAL
Limit : FCC PART 15 C(3M)
Env. / Ins. : Temp:23'℃:Humi:54%: Prwss:101.1kPa
Engineer : Luke Zhu
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : TX Mode

	Freq. (MHz)	ANT Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	259.89	14.40	2.80	4.51	21.71	46.00	24.29	QP
2	332.64	13.86	3.19	11.55	28.60	46.00	17.40	QP
3	384.05	15.36	3.45	2.18	20.99	46.00	25.01	QP
4	467.47	17.35	3.84	1.67	22.86	46.00	23.14	QP
5	560.59	20.35	4.23	1.69	26.27	46.00	19.73	QP
6	674.08	20.36	4.67	1.95	26.98	46.00	19.02	QP

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

Note:

1. The amplitude of 9KHz to 30MHz spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.
2. All channels had been pre-test,only the worst case was reported.

Radiated Emissions Above 1G

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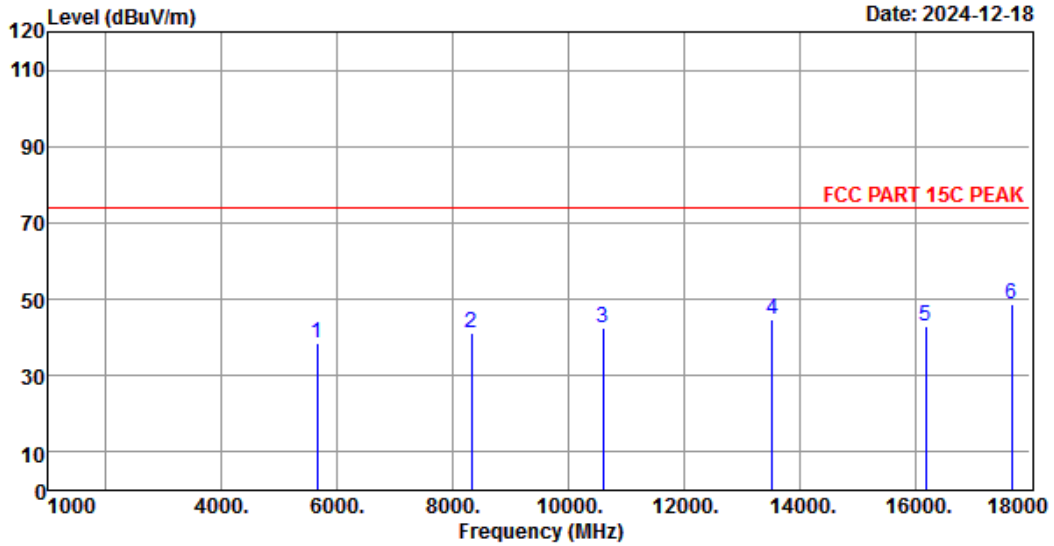
Data: 43 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 43
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : HORIZONTAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	5658.00	34.20	7.56	42.90	39.53	38.39	74.00	35.61	Peak
2	8327.00	37.37	8.82	42.71	37.62	41.10	74.00	32.90	Peak
3	10605.00	38.70	10.27	41.33	34.98	42.62	74.00	31.38	Peak
4	13529.00	41.03	11.29	39.87	32.13	44.58	74.00	29.42	Peak
5	16181.00	38.73	12.54	42.76	34.36	42.87	74.00	31.13	Peak
6	17677.00	41.62	14.14	41.72	34.76	48.80	74.00	25.20	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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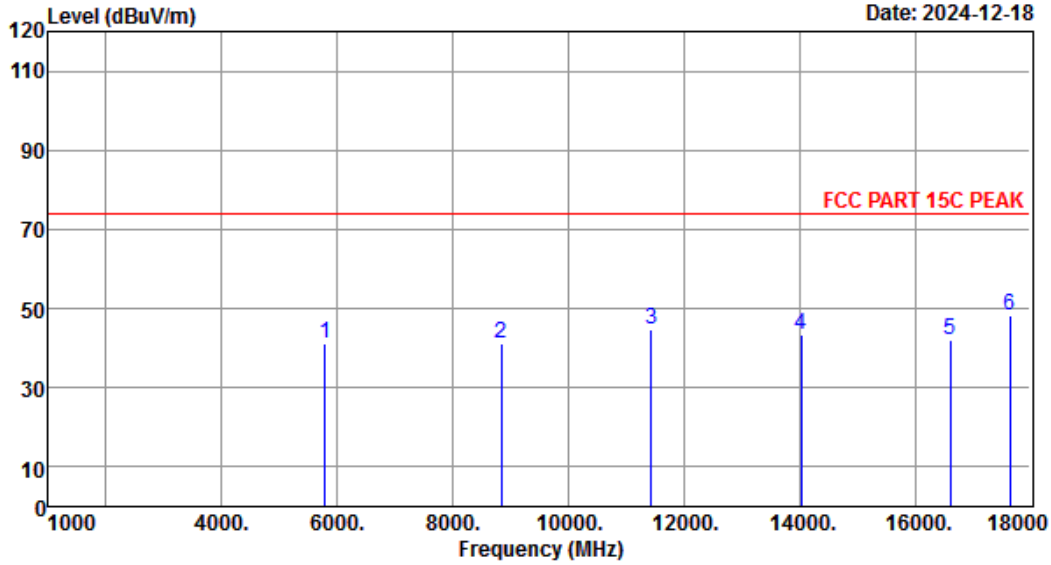
Data: 44 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 44
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	5794.00	34.70	7.69	42.86	41.57	41.10	74.00	32.90	Peak
2	8837.00	38.03	9.10	42.40	36.28	41.01	74.00	32.99	Peak
3	11438.00	40.30	10.80	40.97	34.45	44.58	74.00	29.42	Peak
4	14039.00	40.00	11.26	40.37	32.49	43.38	74.00	30.62	Peak
5	16606.00	39.90	13.10	42.68	31.86	42.18	74.00	31.82	Peak
6	17643.00	41.65	14.11	41.76	34.19	48.19	74.00	25.81	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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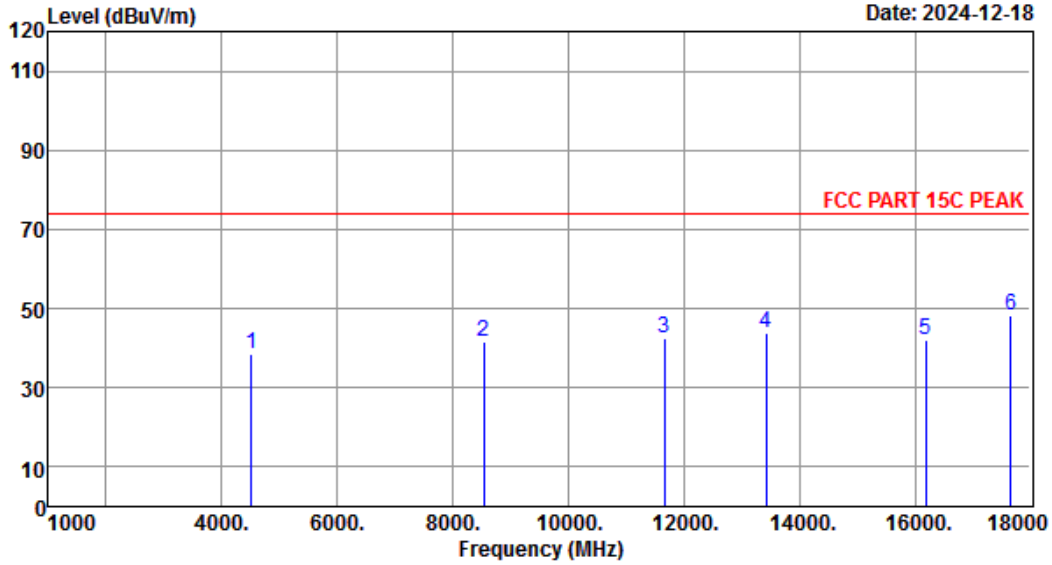
Data: 45 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 45
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2440MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	4519.00	32.27	6.58	43.29	43.07	38.63	74.00	35.37	Peak
2	8531.00	37.73	8.93	42.58	37.65	41.73	74.00	32.27	Peak
3	11659.00	39.54	10.90	40.90	32.97	42.51	74.00	31.49	Peak
4	13427.00	40.83	11.30	39.78	31.58	43.93	74.00	30.07	Peak
5	16181.00	38.73	12.54	42.76	33.70	42.21	74.00	31.79	Peak
6	17660.00	41.63	14.12	41.74	34.32	48.33	74.00	25.67	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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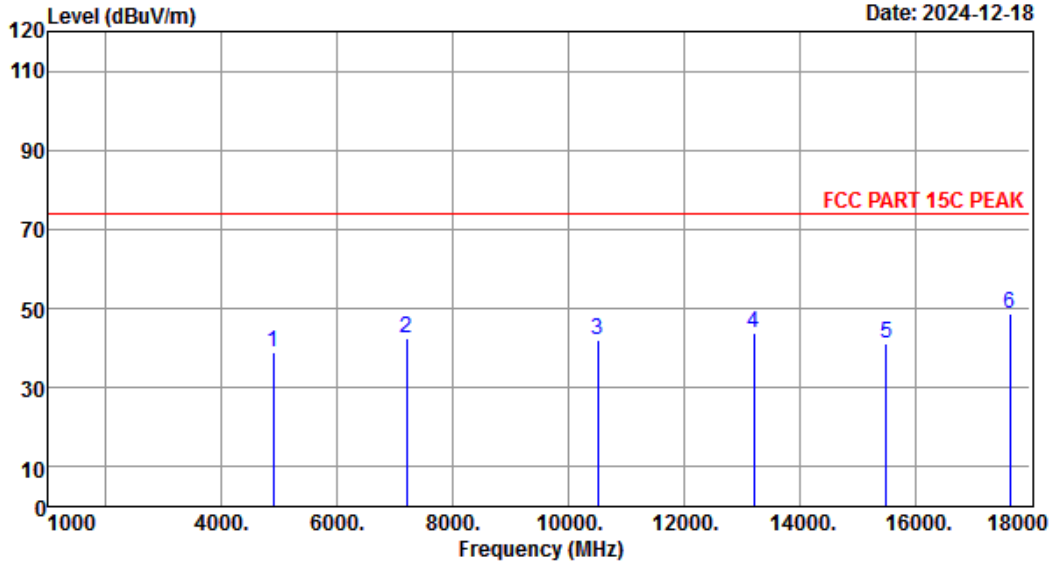
Data: 46 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 46
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : HORIZONTAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2440MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	4893.00	33.60	6.87	43.14	41.45	38.78	74.00	35.22	Peak
2	7205.00	37.80	8.41	42.90	39.27	42.58	74.00	31.42	Peak
3	10503.00	38.50	10.19	41.39	34.73	42.03	74.00	31.97	Peak
4	13206.00	40.70	11.32	39.58	31.53	43.97	74.00	30.03	Peak
5	15501.00	37.20	11.72	42.60	34.89	41.21	74.00	32.79	Peak
6	17643.00	41.65	14.11	41.76	34.86	48.86	74.00	25.14	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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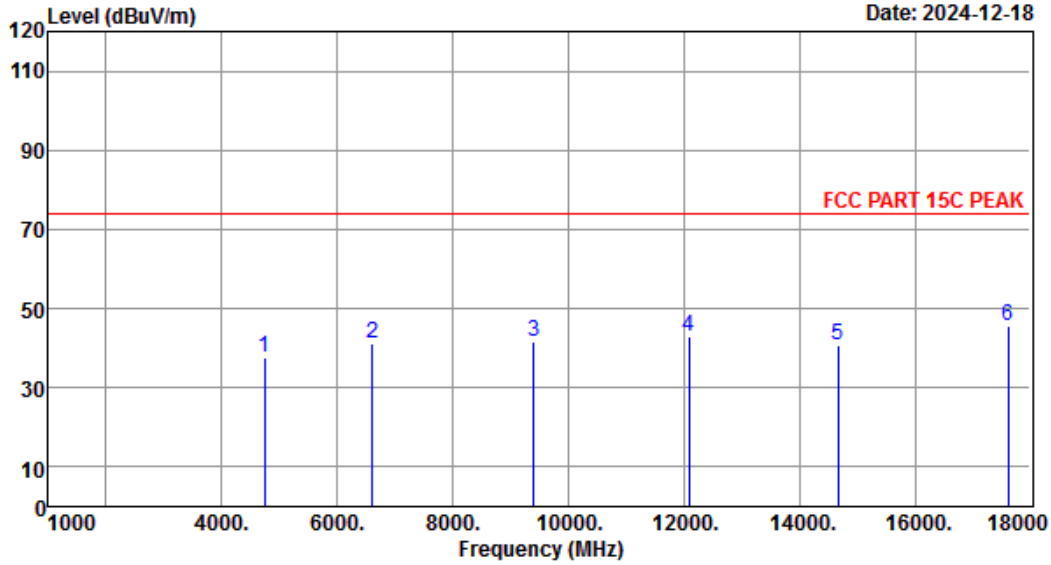
Data: 47 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 47
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : HORIZONTAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	4740.00	33.10	6.75	43.20	40.95	37.60	74.00	36.40	Peak
2	6610.00	36.47	8.17	42.86	39.46	41.24	74.00	32.76	Peak
3	9398.00	38.70	9.43	42.06	35.74	41.81	74.00	32.19	Peak
4	12084.00	39.33	11.09	40.68	33.22	42.96	74.00	31.04	Peak
5	14668.00	38.93	11.18	41.69	32.45	40.87	74.00	33.13	Peak
6	17609.00	41.68	14.08	41.81	31.55	45.50	74.00	28.50	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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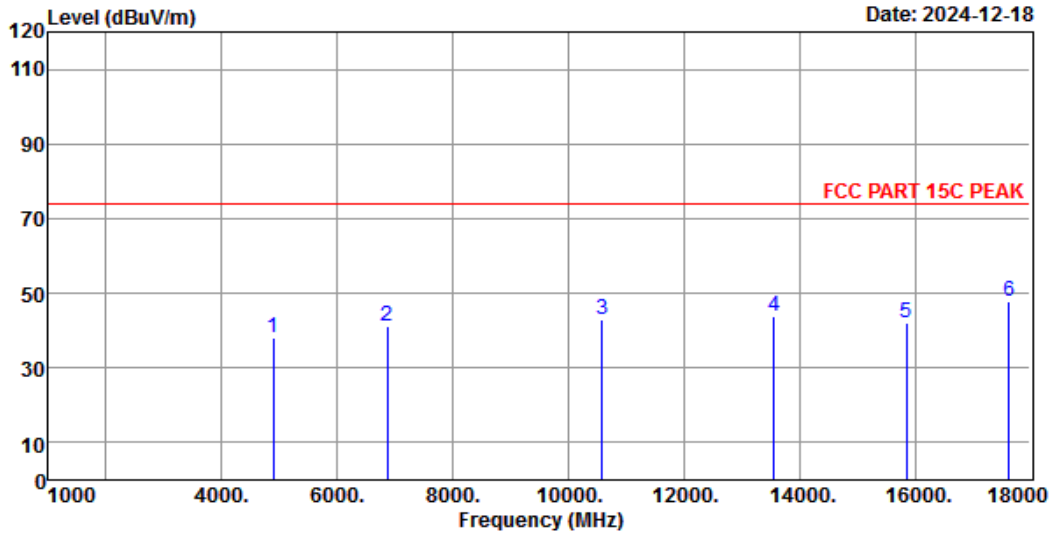
Data: 48 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 48
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	4893.00	33.60	6.87	43.14	40.87	38.20	74.00	35.80	Peak
2	6865.00	35.93	8.29	42.89	39.74	41.07	74.00	32.93	Peak
3	10588.00	38.67	10.26	41.34	35.45	43.04	74.00	30.96	Peak
4	13563.00	40.97	11.29	39.90	31.59	43.95	74.00	30.05	Peak
5	15858.00	36.58	12.13	42.74	36.28	42.25	74.00	31.75	Peak
6	17626.00	41.67	14.10	41.78	33.90	47.89	74.00	26.11	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

Note: The amplitude of 18GHz to 25GHz spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Radiated Band Edge

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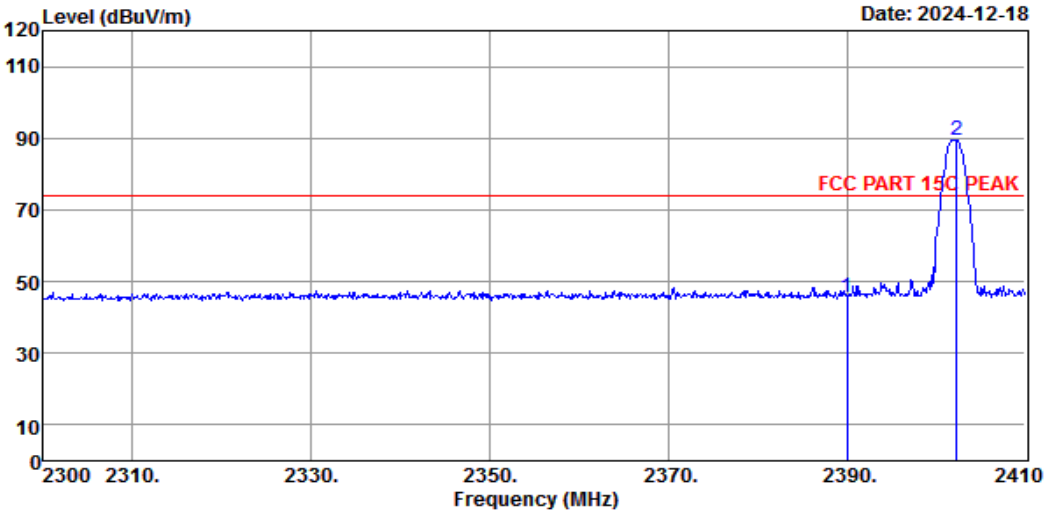
Data: 11 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 11
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : HORIZONTAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2390.00	27.60	4.88	44.15	57.40	45.73	74.00	28.27	Peak
2	2402.30	27.60	4.88	44.15	101.10	89.43	74.00	-15.43	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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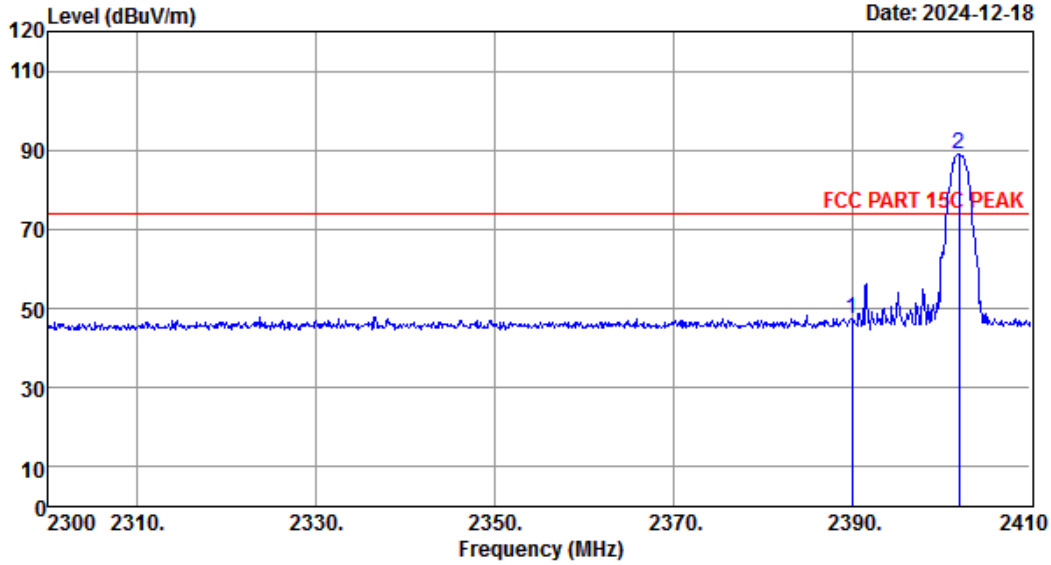
Data: 12 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 12
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2402MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2390.00	27.60	4.88	44.15	58.95	47.28	74.00	26.72	Peak
2	2401.97	27.60	4.88	44.15	100.52	88.85	74.00	-14.85	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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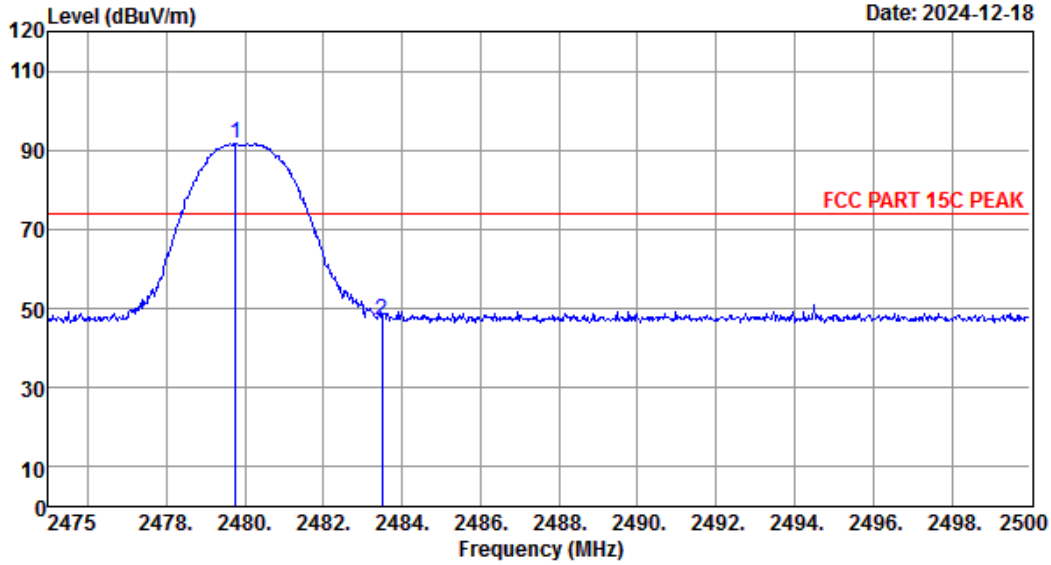
Data: 13 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 13
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2479.78	28.20	4.99	44.04	102.31	91.46	74.00	-17.46	Peak
2	2483.50	28.20	4.99	44.04	57.67	46.82	74.00	27.18	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

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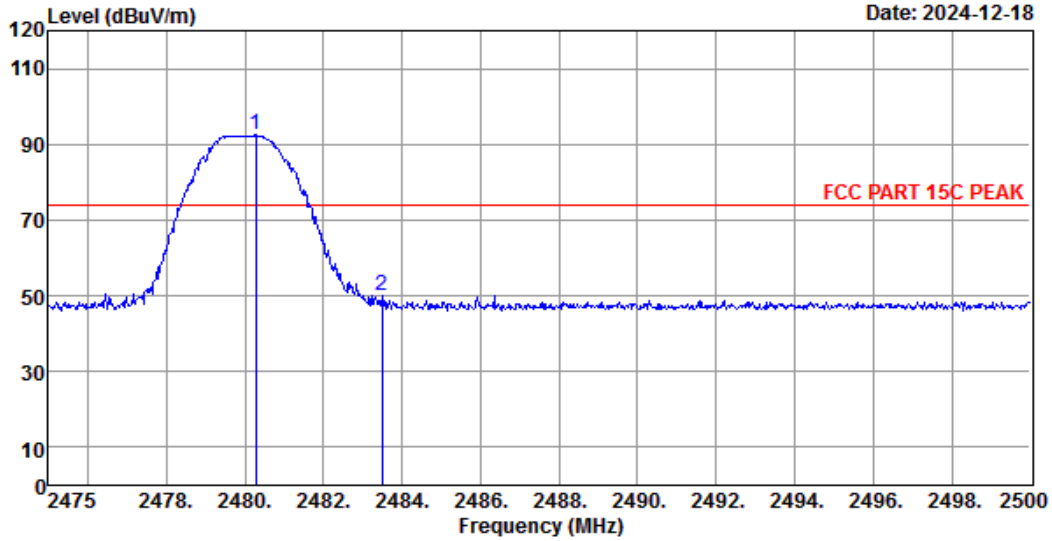
Data: 14 File: \\EMC-966-5\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE-1.EM6 (60)



Site no. : 5# 966 Chamber Data no. : 14
Dis. / Ant. : 3m BBHA9120D-2667 Ant. pol. : HORIZONTAL
Limit : FCC PART 15C PEAK
Env. / Ins. : Temp:19.5℃;Humi:50%;Press:101.55kPa
Engineer : Aron Zhang
EUT : Mechanical Keyboard
Power : DC 3.7V From Battery
M/N : Phantom+ ELITE
Test Mode : GFSK 1Mbps TX 2480MHz

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp Factor (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2480.28	28.20	4.99	44.04	103.20	92.35	74.00	-18.35	Peak
2	2483.50	28.20	4.99	44.04	60.94	50.09	74.00	23.91	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss - Amp Factor + Reading.
2. Margin= Limit - Emission Level.
3. The emission levels that are 20dB below the official limit are not reported.

Note: All channels had been pre-test,only of the worst case channels were reported.

9.AC POWER LINE CONDUCTED EMISSIONS

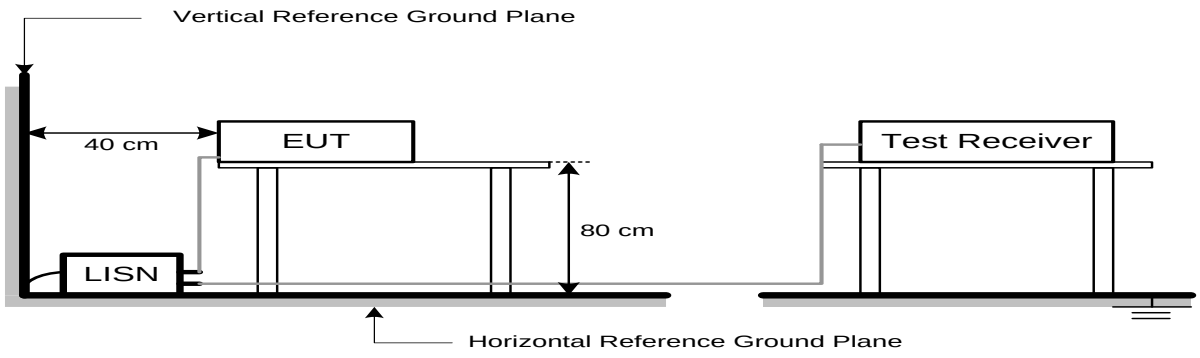
9.1.Limit

Frequency			Maximum RF Line Voltage	
			Quasi-Peak Level dB(μV)	Average Level dB(μV)
150kHz	~	500kHz	66 ~ 56*	56 ~ 46*
500kHz	~	5MHz	56	46
5MHz	~	30MHz	60	50

Note:

1. * Decreasing linearly with logarithm of frequency.
2. The lower limit shall apply at the transition frequencies.

9.2.Test Setup



9.3.Spectrum Analyzer Setting

Spectrum Parameters	Setting
RBW	9KHz
VBW	9KHz
Start frequency	150KHz
Stop frequency	30MHz
Sweep Time	Auto
Detector	QP/AVG
Trace Mode	Max Hold

9.4.Test Procedure

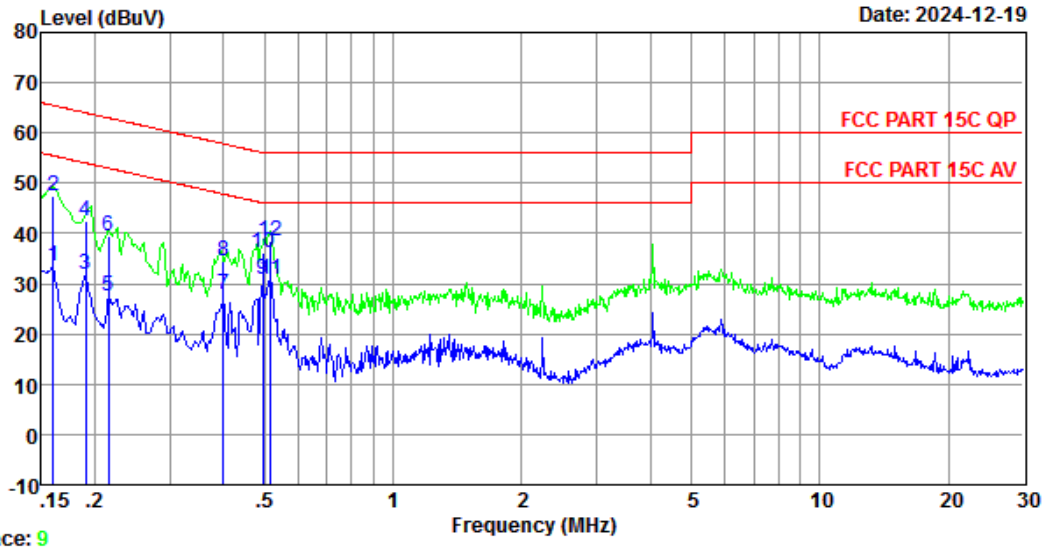
a. The EUT was placed on a non-metallic table, 80cm above the ground plane.
b. The EUT Power connected to the power mains through a line impedance stabilization network.
c. Provides a 50 ohm coupling impedance for the EUT (Please refer the block diagram of the test setup and photographs).
d. Set the EUT transmit continuously with maximum output power.
e. Spectrum analyzer setting parameters in accordance with section 9.3.
f. The AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to ANSI C63.10: 2013 on Conducted Emission Test.
g. Record the results in the test report.

9.5. Test Result

EST Technology

Chilingxiang, Qishantou, Santun,
Houjie, Dongguan,Guangdong,China
Tel:+86-769-83081888
Fax:+86-769-83081878

Data: 10 File: \\EMC-CE-3\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE.EM6 (16)



Trace: 9

Site no : 3#CE Shield Room Data no. : 10
Env. / Ins. : Temp:25.5℃;Humi:57%;Press:101.1kPa LINE Phase : LINE
Limit : FCC PART 15C QP
Engineer : Wind Li
EUT : Mechanical Keyboard
Power : DC 5V From Adapter Input AC 120V/60Hz
M/N : Phantom+ ELITE
Test Mode : TX Mode

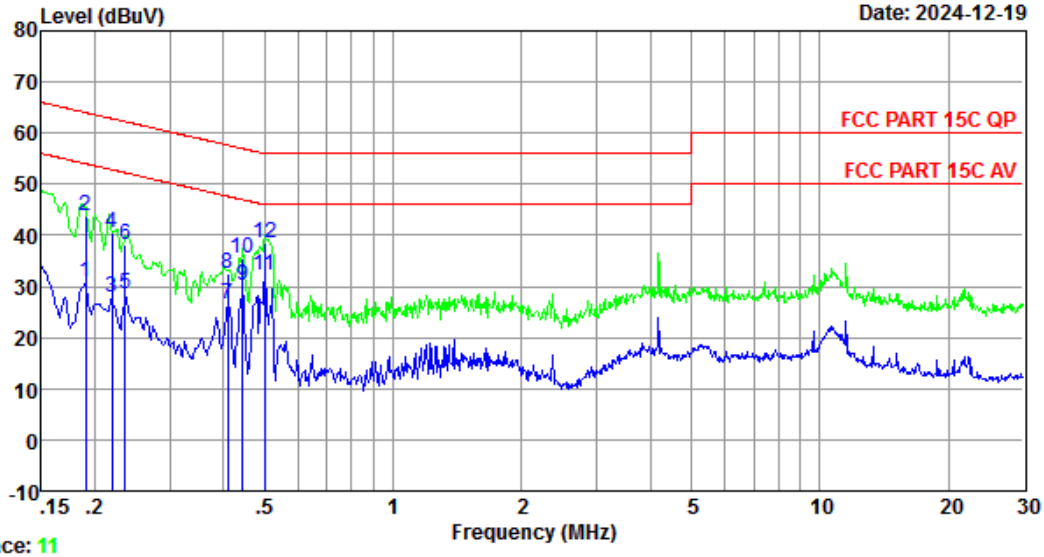
	Freq. (MHz)	LISN Factor (db)	Cable Loss (db)	Reading dBuV)	Emission Level (dBuv)	Limits (dBuv)	Margin (dB)	Remark
1	0.16	10.19	9.82	13.50	33.51	55.47	21.96	Average
2	0.16	10.19	9.82	27.52	47.53	65.47	17.94	QP
3	0.19	10.00	9.82	12.17	31.99	54.02	22.03	Average
4	0.19	10.00	9.82	22.55	42.37	64.02	21.65	QP
5	0.22	10.00	9.82	7.84	27.66	53.01	25.35	Average
6	0.22	10.00	9.82	19.53	39.35	63.01	23.66	QP
7	0.40	10.26	9.83	7.91	28.00	47.86	19.86	Average
8	0.40	10.26	9.83	14.26	34.35	57.86	23.51	QP
9	0.49	10.19	9.83	10.74	30.76	46.10	15.34	Average
10	0.49	10.19	9.83	16.25	36.27	56.10	19.83	QP
11	0.52	10.18	9.83	10.81	30.82	46.00	15.18	Average
12	0.52	10.18	9.83	18.53	38.54	56.00	17.46	QP

Remarks: 1. Emission Level= LISN Factor + Cable Loss + Reading.
2. Margin= Limit - Emission Level.
3. If the average limit is met when useing a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

EST Technology

Chilingxiang, Qishantou, Santun,
Houjie, Dongguan,Guangdong,China
Tel:+86-769-83081888
Fax:+86-769-83081878

Data: 12 File: \\EMC-CE-3\Test Data2\2024\RF\S\Sai Shun\Phantom+ELITE.EM6 (16)



Trace: 11

Site no : 3#CE Shield Room Data no. : 12
Env. / Ins. : Temp:25.5℃;Humi:57%;Press:101.1kPa LINE Phase : NEUTRAL
Limit : FCC PART 15C QP
Engineer : Wind Li
EUT : Mechanical Keyboard
Power : DC 5V From Adapter Input AC 120V/60Hz
M/N : Phantom+ ELITE
Test Mode : TX Mode

	Freq. (MHz)	LISN Factor (db)	Cable Loss (db)	Reading dBuV)	Emission Level (dBuv)	Limits (dBuv)	Margin (dB)	Remark
1	0.19	10.22	9.82	10.70	30.74	54.02	23.28	Average
2	0.19	10.22	9.82	23.65	43.69	64.02	20.33	QP
3	0.22	10.22	9.82	7.79	27.83	52.83	25.00	Average
4	0.22	10.22	9.82	20.29	40.33	62.83	22.50	QP
5	0.24	10.23	9.82	8.54	28.59	52.26	23.67	Average
6	0.24	10.23	9.82	18.25	38.30	62.26	23.96	QP
7	0.41	10.16	9.83	6.64	26.63	47.64	21.01	Average
8	0.41	10.16	9.83	12.52	32.51	57.64	25.13	QP
9	0.44	10.16	9.83	10.27	30.26	46.98	16.72	Average
10	0.44	10.16	9.83	15.53	35.52	56.98	21.46	QP
11	0.50	10.16	9.83	12.28	32.27	46.01	13.74	Average
12	0.50	10.16	9.83	18.63	38.62	56.01	17.39	QP

Remarks: 1. Emission Level= LISN Factor + Cable Loss + Reading.
2. Margin= Limit - Emission Level.
3. If the average limit is met when useing a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

10. ANTENNA REQUIREMENTS

10.1. Limit

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, 15.221, or §15.236. 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.

10.2. Test Result

The antennas used for this product is internal antenna, so compliance with antenna requirements. (Please refer to the EUT photo for details)

11.APPENDIX

Appendix A: DTS Bandwidth

Test Result

Test Mode	Antenna	Frequency[MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.678	2401.652	2402.330	0.5	PASS
BLE_1M	Ant1	2440	0.696	2439.649	2440.345	0.5	PASS
BLE_1M	Ant1	2480	0.702	2479.652	2480.354	0.5	PASS

Test Graphs

BLE_1M-Ant1-2402-PASS

BLE_1M-Ant1-2440-PASS

BLE_1M-Ant1-2480-PASS

Appendix B: Maximum conducted output power

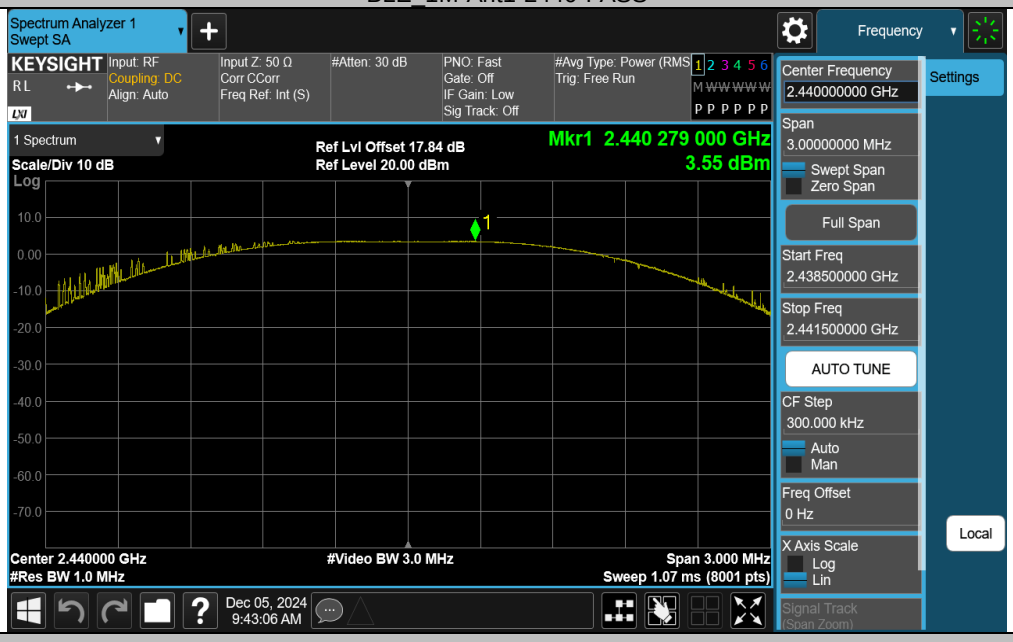
Test Result Peak

TestMode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
BLE_1M	Ant1	2402	3.42	≤30	PASS
BLE_1M	Ant1	2440	3.55	≤30	PASS
BLE_1M	Ant1	2480	3.35	≤30	PASS

Test Graphs Peak

BLE_1M-Ant1-2402-PASS

BLE_1M-Ant1-2440-PASS



BLE_1M-Ant1-2480-PASS

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr
Freq Ref: Int (S)
#Atten: 30 dB
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
#Avg Type: Power (RMS
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 17.84 dB
Ref Level 20.00 dBm
Mkr1 2.480 230 625 GHz
3.35 dBm
Center 2.480000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 3.000 MHz
Sweep 1.07 ms (8001 pts)
Dec 05, 2024
9:45:00 AM
Frequency
Center Frequency
2.480000000 GHz
Span
3.00000000 MHz
Swept Span
Zero Span
Full Span
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
AUTO TUNE
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Local

Appendix C: Maximum power spectral density

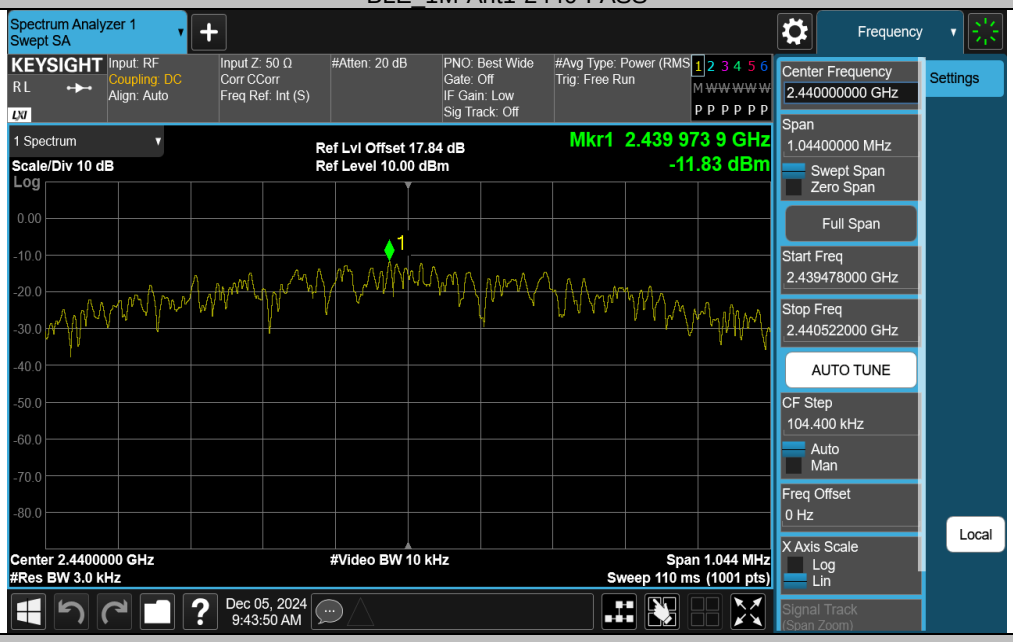
Test Result

TestMode	Antenna	Frequency[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-11.75	≤8.00	PASS
BLE_1M	Ant1	2440	-11.83	≤8.00	PASS
BLE_1M	Ant1	2480	-11.79	≤8.00	PASS

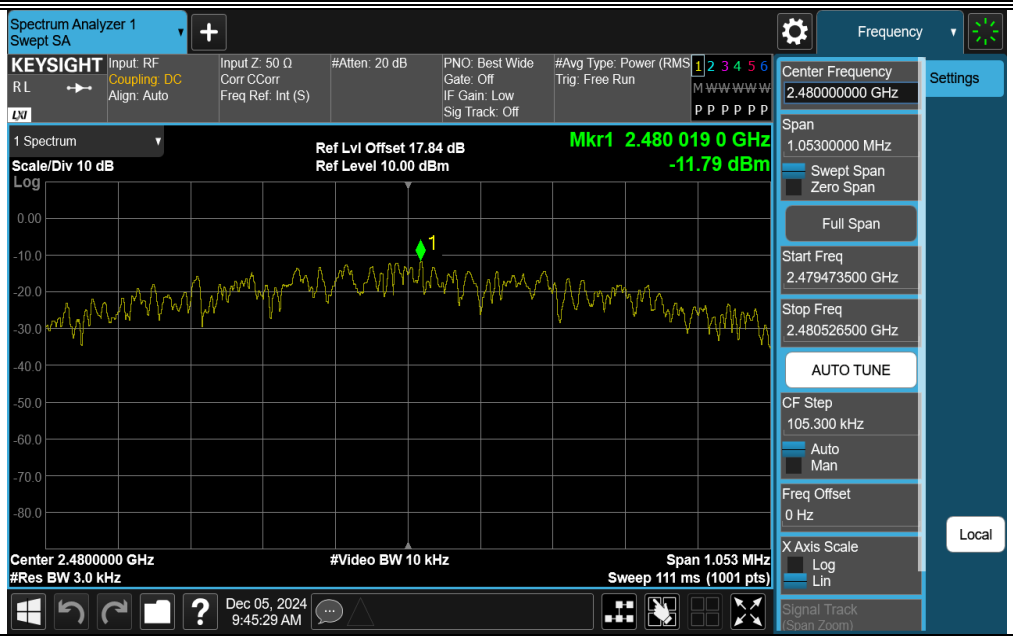
Test Graphs

BLE_1M-Ant1-2402-PASS

BLE_1M-Ant1-2440-PASS



BLE_1M-Ant1-2480-PASS


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr
Freq Ref: Int (S)
#Atten: 20 dB
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
#Avg Type: Power (RMS)
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 17.84 dB
Ref Level 10.00 dBm
Mkr1 2.480 019 0 GHz
-11.79 dBm
Center 2.4800000 GHz
#Res BW 3.0 kHz
#Video BW 10 kHz
Span 1.053 MHz
Sweep 111 ms (1001 pts)
Dec 05, 2024
9:45:29 AM
Frequency
Center Frequency
2.480000000 GHz
Span
1.05300000 MHz
Swept Span
Zero Span
Full Span
Start Freq
2.479473500 GHz
Stop Freq
2.480526500 GHz
AUTO TUNE
CF Step
105.300 kHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Local

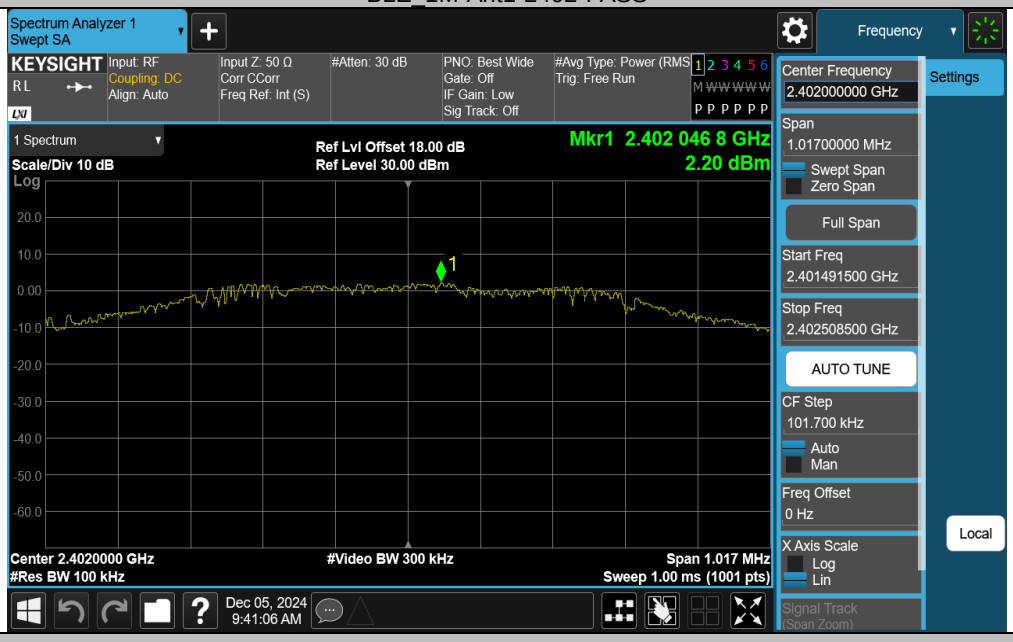
Appendix D: Reference level measurement

Test Result

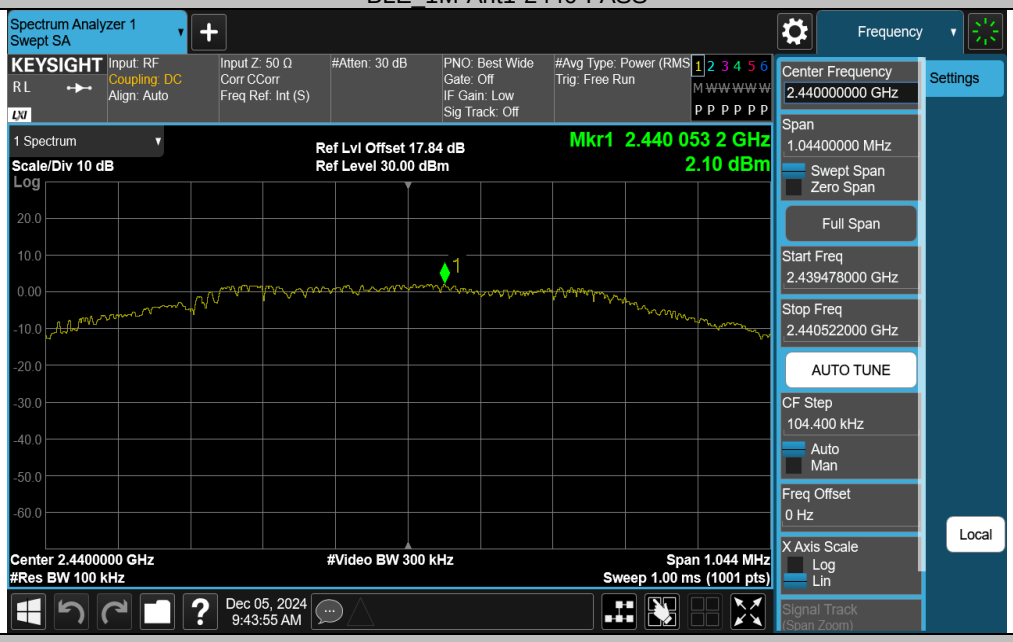
TestMode	Antenna	Freq(MHz)	Max.Point[MHz]	Result[dBm]
BLE_1M	Ant1	2402	2402.05	2.20
BLE_1M	Ant1	2440	2440.05	2.10
BLE_1M	Ant1	2480	2480.03	2.01

Test Graphs

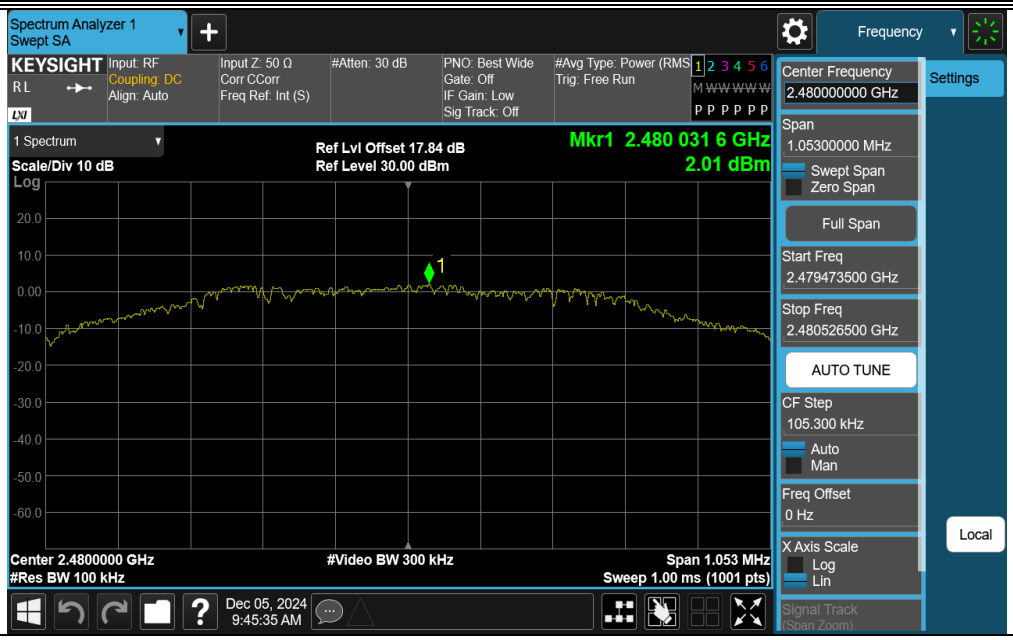
BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2440-PASS



BLE_1M-Ant1-2480-PASS


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr
Freq Ref: Int (S)
#Atten: 30 dB
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
#Avg Type: Power (RMS
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 17.84 dB
Ref Level 30.00 dBm
Mkr1 2.480 031 6 GHz
2.01 dBm
Center 2.4800000 GHz
#Res BW 100 kHz
#Video BW 300 kHz
Span 1.053 MHz
Sweep 1.00 ms (1001 pts)
Dec 05, 2024
9:45:35 AM
Frequency
Center Frequency
2.480000000 GHz
Span
1.05300000 MHz
Swept Span
Zero Span
Full Span
Start Freq
2.479473500 GHz
Stop Freq
2.480526500 GHz
AUTO TUNE
CF Step
105.300 kHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Local

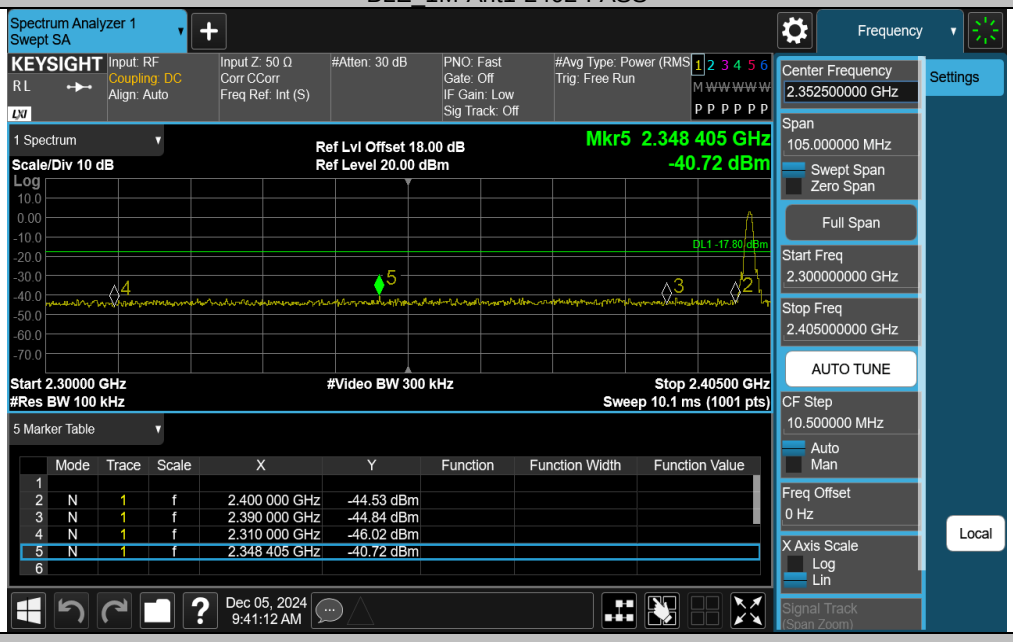
Appendix E: Band edge measurements

Test Result

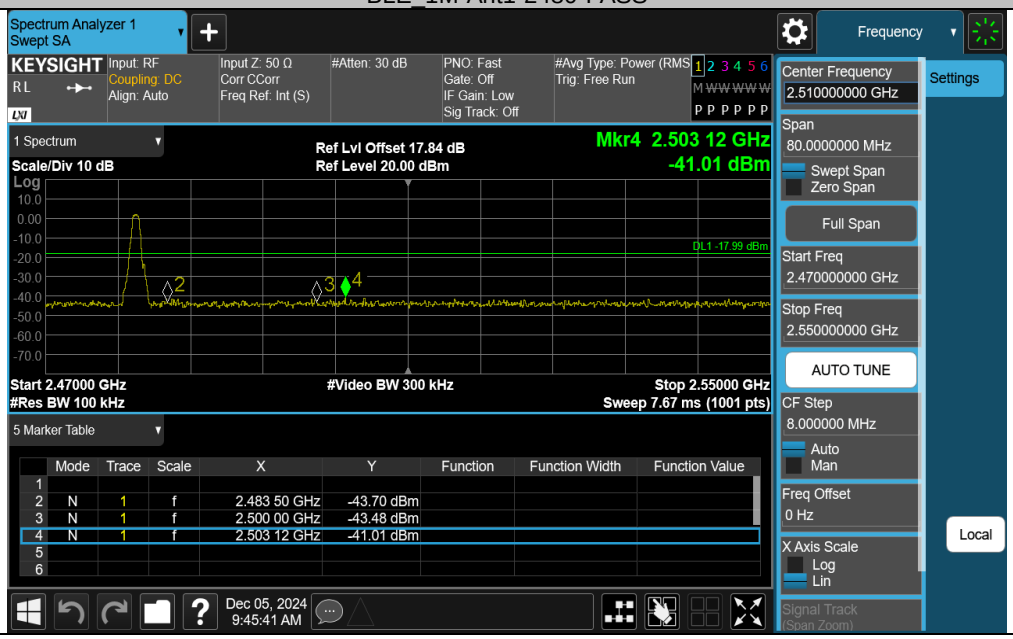
TestMode	Antenna	ChName	Frequency[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	2.20	-40.72	≤-17.8	PASS
BLE_1M	Ant1	High	2480	2.01	-41.01	≤-17.99	PASS

Test Graphs

BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2480-PASS



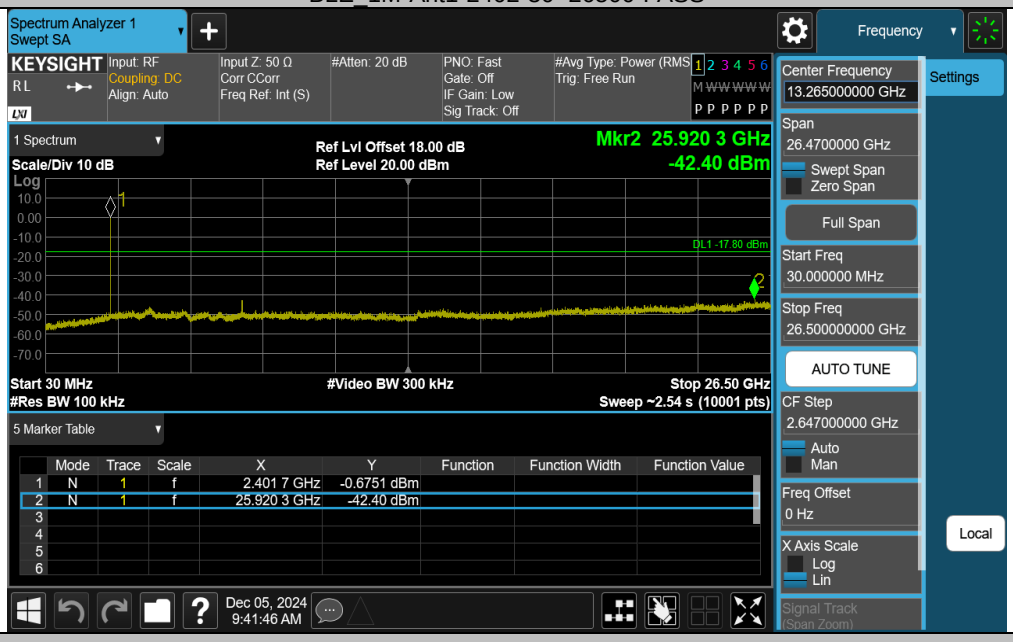
Appendix F: Conducted Spurious Emission

Test Result

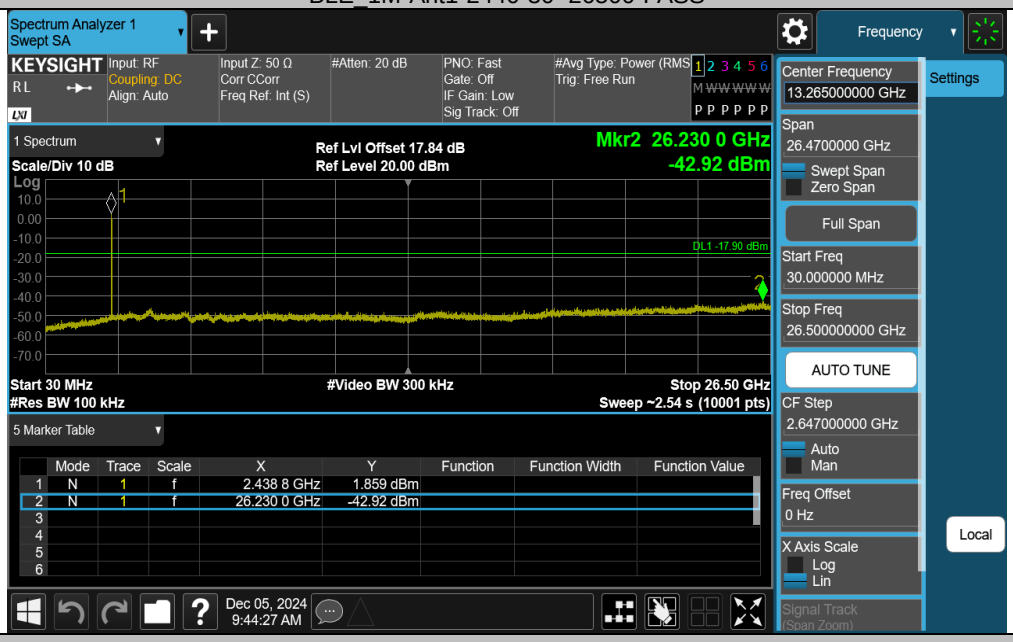
TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	30~26500	2.20	-42.4	≤-17.8	PASS
BLE_1M	Ant1	2440	30~26500	2.10	-42.92	≤-17.9	PASS
BLE_1M	Ant1	2480	30~26500	2.01	-43.18	≤-17.99	PASS

Test Graphs

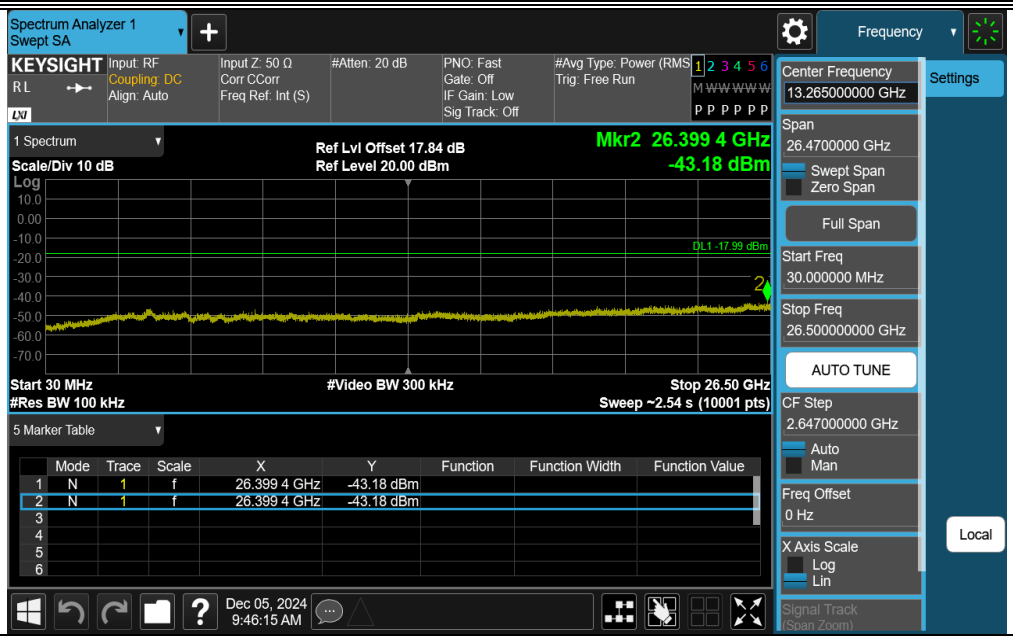
BLE_1M-Ant1-2402-30~26500-PASS



BLE_1M-Ant1-2440-30~26500-PASS



BLE_1M-Ant1-2480-30~26500-PASS


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr
Freq Ref: Int (S)
#Atten: 20 dB
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
#Avg Type: Power (RMS)
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 17.84 dB
Ref Level 20.00 dBm
Mkr2 26.399 4 GHz
-43.18 dBm
DL1 -17.99 dBm
Start 30 MHz
#Res BW 100 kHz
#Video BW 300 kHz
Stop 26.50 GHz
Sweep ~2.54 s (10001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 26.399 4 GHz -43.18 dBm
2 N 1 f 26.399 4 GHz -43.18 dBm
Dec 05, 2024
9:46:15 AM
Frequency
Center Frequency
13.265000000 GHz
Span
26.4700000 GHz
Swept Span
Zero Span
Full Span
Start Freq
30.000000 MHz
Stop Freq
26.500000000 GHz
AUTO TUNE
CF Step
2.647000000 GHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)
Settings
Local

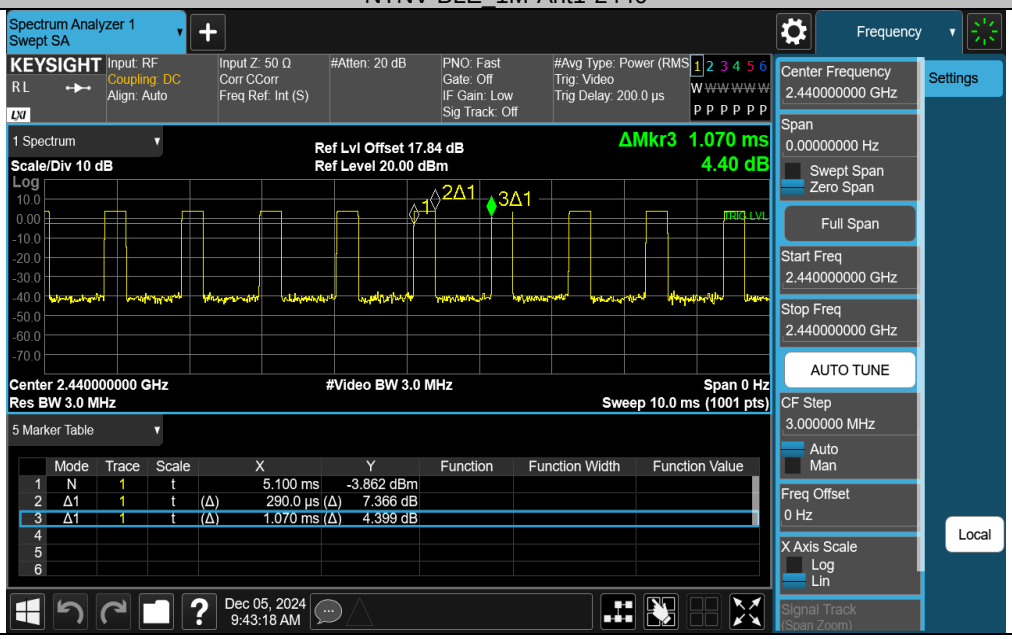
Appendix G: Duty Cycle

Test Result

Test Mode	Antenna	Frequency[MHz]	ON Time [ms]	Period [ms]	Duty Cycle [%]	Duty Cycle Factor[dB]
BLE_1M	Ant1	2440	0.29	1.07	27.10	5.67

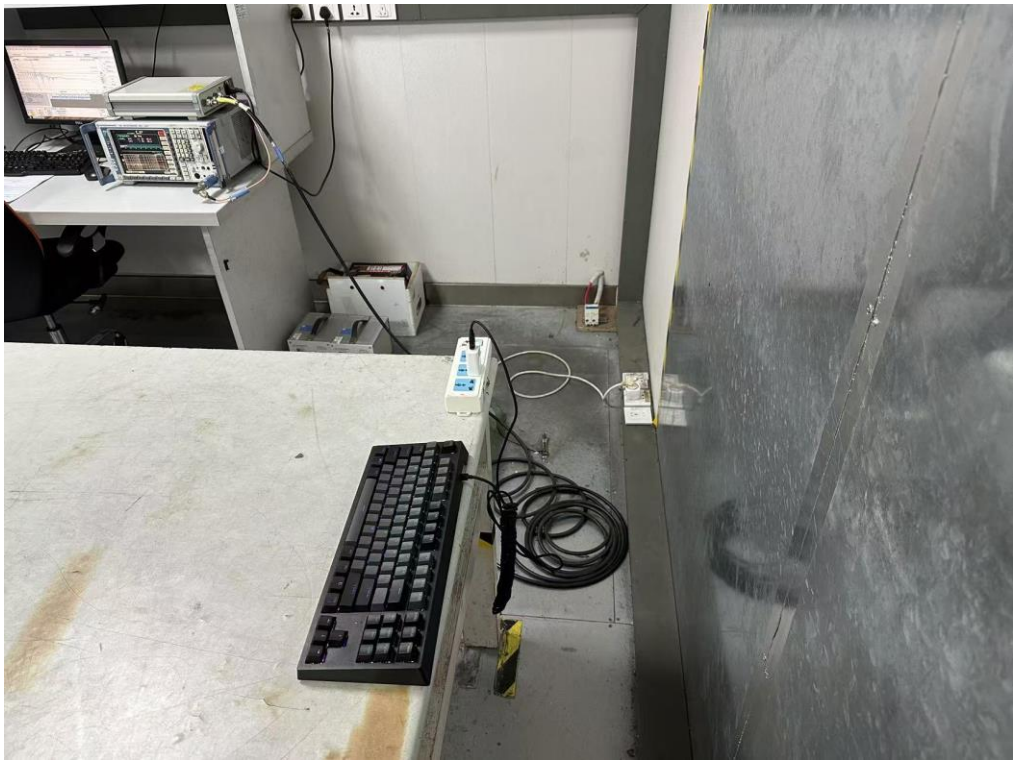
Test Graphs

NTNV-BLE_1M-Ant1-2440

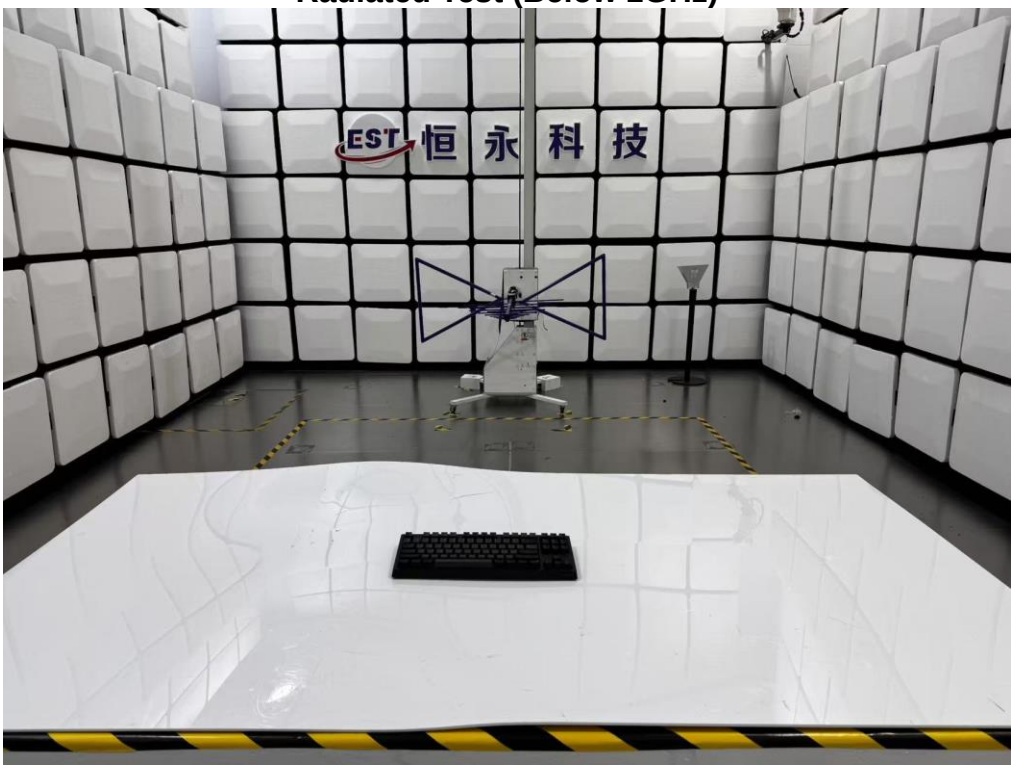


12. TEST SETUP PHOTO

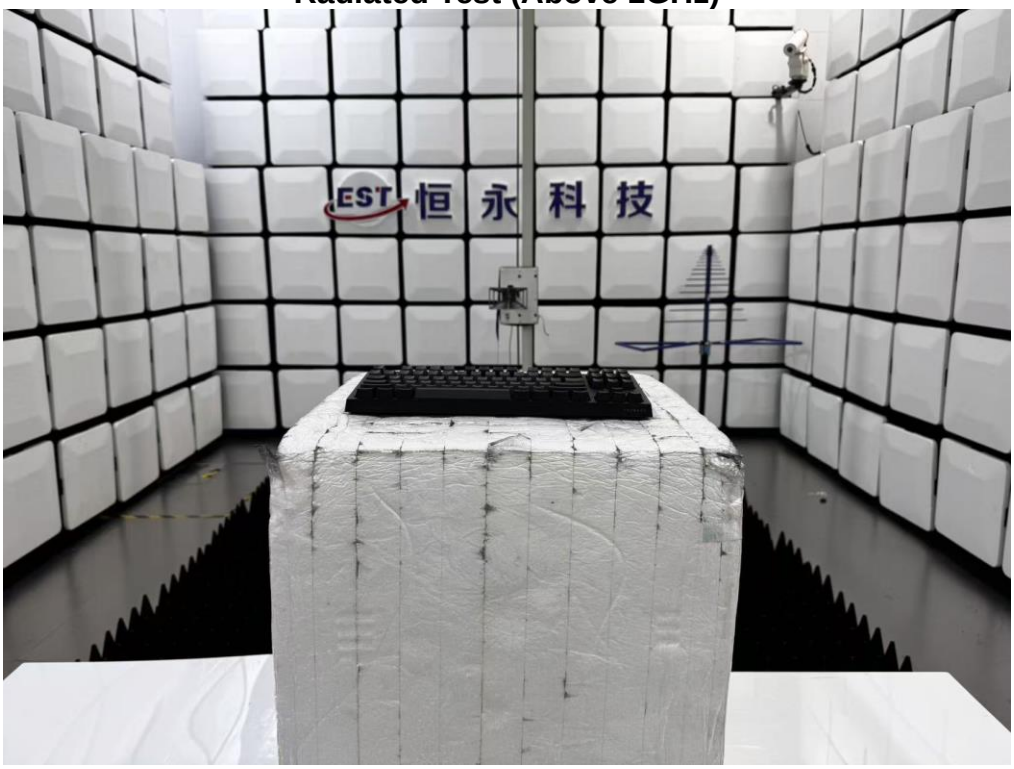
Conducted Test



Radiated Test (Below 1GHz)



Radiated Test (Above 1GHz)



13. EUT PHOTO

External Photos

M/N: Phantom+ ELITE

External Photos

M/N: Phantom+ ELITE

External Photos

M/N: Phantom+ ELITE

External Photos

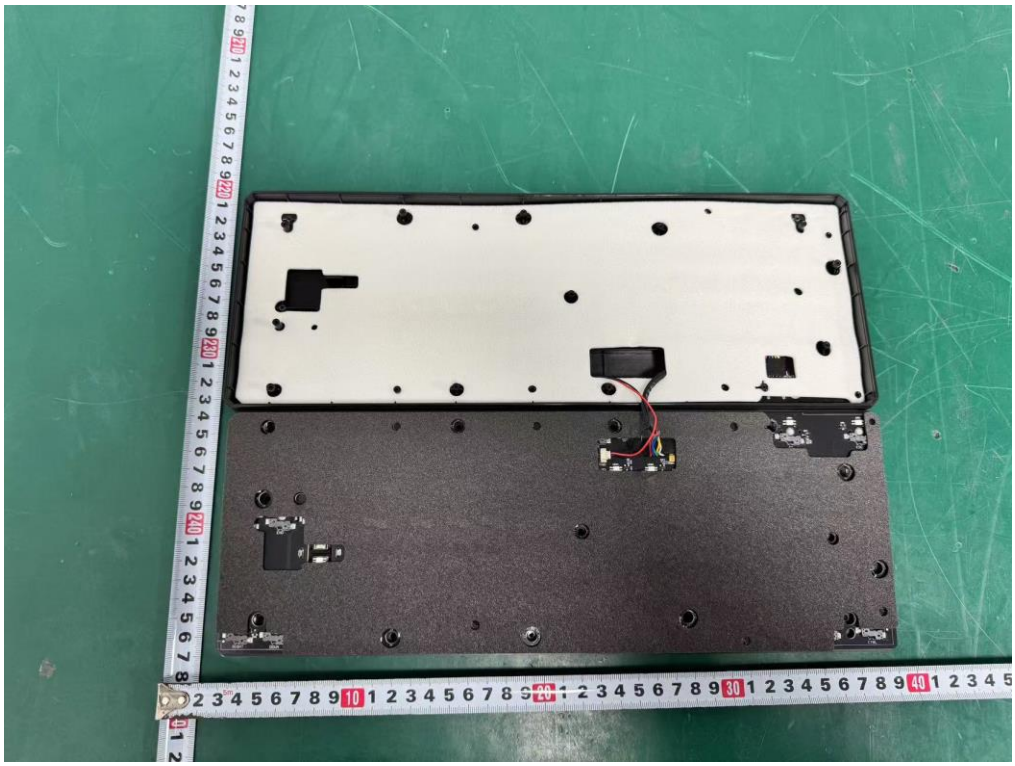
M/N: Phantom+ ELITE

External Photos

M/N: Phantom+ ELITE

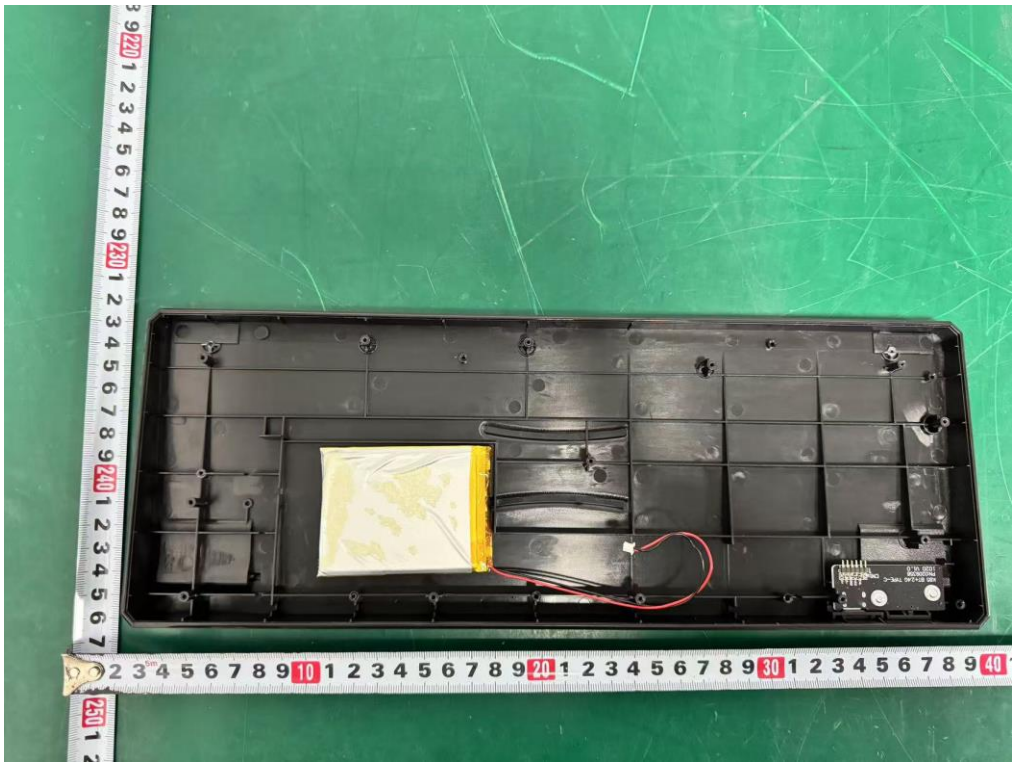
Internal Photos

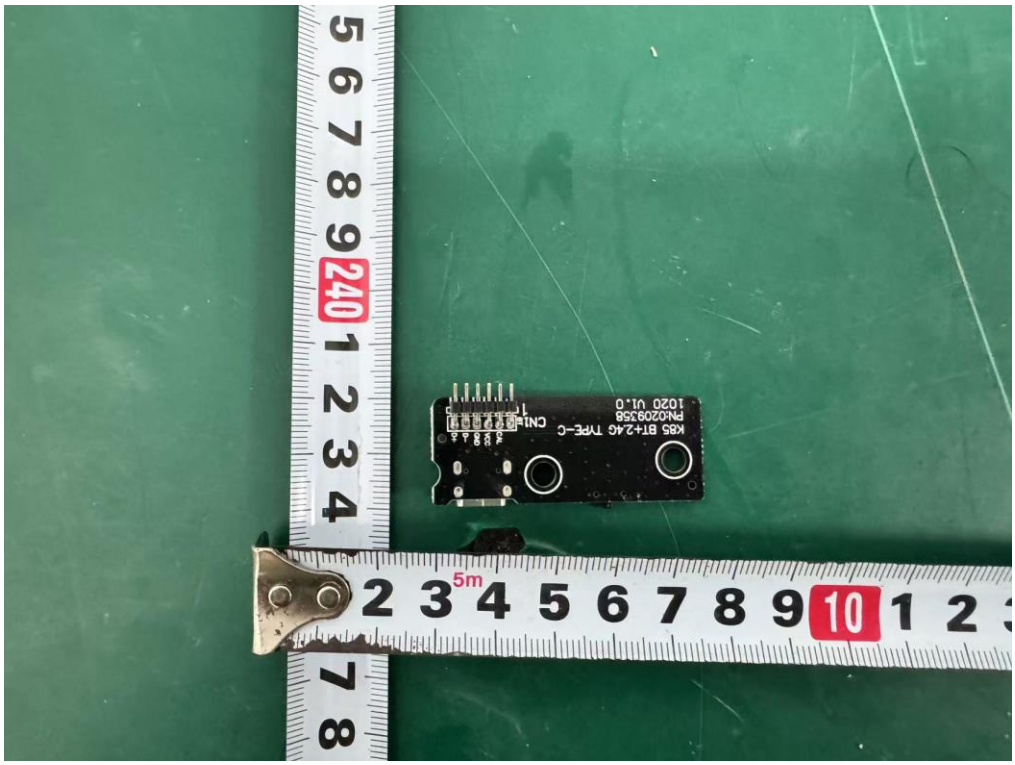
M/N: Phantom+ ELITE



Internal Photos

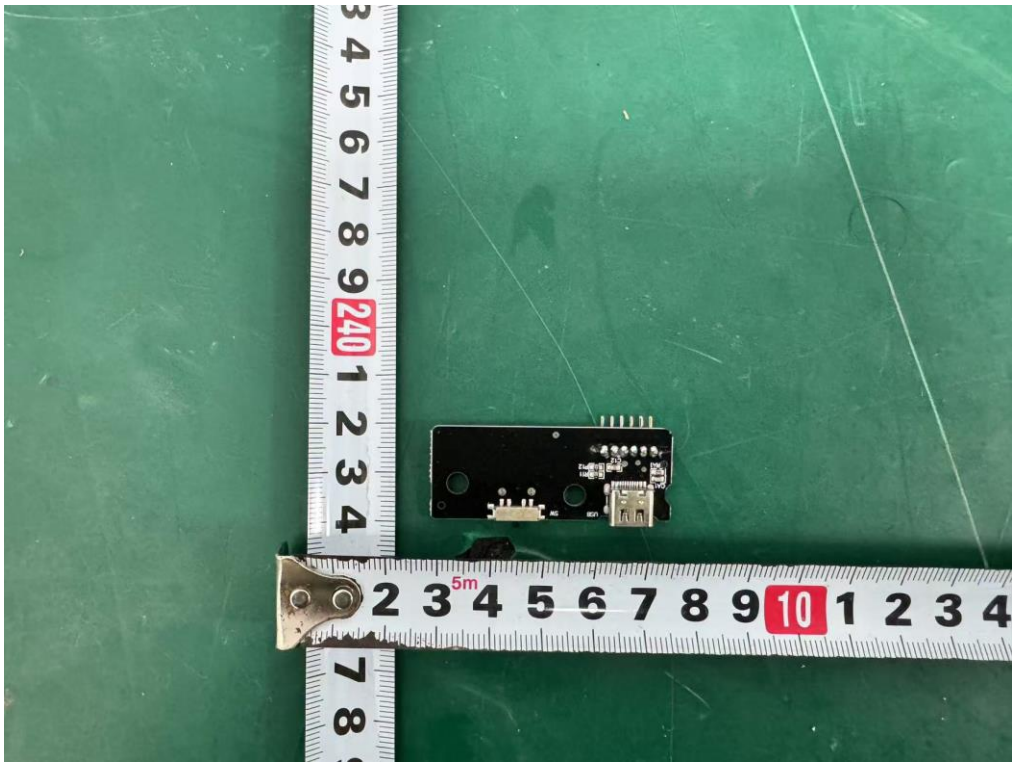
M/N: Phantom+ ELITE





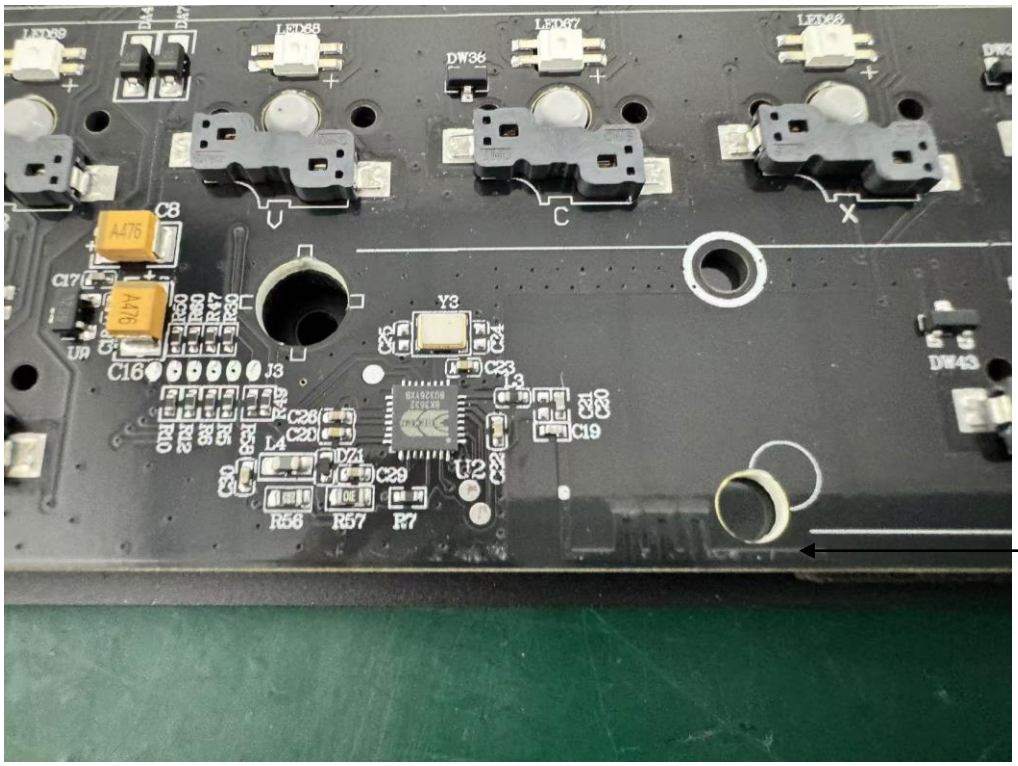
Internal Photos

M/N: Phantom+ ELITE



Internal Photos

M/N: Phantom+ ELITE



End of Test Report