



FCC TEST REPORT

FCC ID: L73-MTR

On Behalf of

Sanwa Electronic Instrument Co Ltd

2.4GHz Radio Control System

Model No.: MT-R

Prepared for : Sanwa Electronic Instrument Co Ltd
Address : 1-2-50, Honmachi, Yoshida, Higashi-Osaka, Osaka 578, Japan

Prepared By : Shenzhen Alpha Product Testing Co., Ltd.
Address : Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103,
Shenzhen, Guangdong, China

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Date of Receipt : June 29, 2022
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Date of Report : July 14, 2022
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TEST REPORT DECLARATION

Applicant : Sanwa Electronic Instrument Co Ltd
 Address : 1-2-50, Honmachi, Yoshida, Higashi-Osaka, Osaka 578, Japan
 Manufacturer : Dongguan Fountain Electronics
 Address : Qiaolian Industrial District, Erhuan St., Dongkeng Town, Dongguan City,
 Guangdong, P.R. China
 EUT Description : 2.4GHz Radio Control System
 (A) Model No. : MT-R
 (B) Trademark : SANWA

Measurement Standard Used:

FCC Rules and Regulations Part 15 Subpart C Section 15.247


ANSI C63.10:2013

The device described above is tested by Shenzhen Alpha Product Testing Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C limits both conducted and radiated emissions. The test results are contained in this test report and Shenzhen Alpha Product Testing Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

After the test, our opinion is that EUT compliance with the requirement of the above standards.

This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Shenzhen Alpha Product Testing Co., Ltd.

Tested by (name + signature).....: Yannis Wen
 Project Engineer



Approved by (name + signature).....: Simple Guan
 Project Manager



Date of issue..... : July 14, 2022

Revision History

Revision	Issue Date	Revisions	Revised By
V0	July 14, 2022	Initial released Issue	Yannis Wen

1. Summary Of Standards And Results

1.1. Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

Test Item	Standards Paragraph	Result
Maximum Peak Output Power	FCC Part 15: 15.247(b)(1) ANSI C63.10 :2013	P
Bandwidth	FCC Part 15: 15.215 ANSI C63.10 :2013	P
Carrier Frequency Separation	FCC Part 15: 15.247(a)(1) ANSI C63.10 :2013	P
Number Of Hopping Channel	FCC Part 15: 15.247(a)(1)(iii) ANSI C63.10 :2013	P
Dwell Time	FCC Part 15: 15.247(a)(1)(iii) ANSI C63.10 :2013	P
Radiated Emission	FCC Part 15: 15.209 FCC Part 15: 15.247(d) ANSI C63.10 :2013	P
Band Edge Compliance	FCC Part 15: 15.247(d) ANSI C63.10 :2013	P
Power Line Conducted Emissions	FCC Part 15: 15.207 ANSI C63.10 :2013	N/A
Antenna requirement	FCC Part 15: 15.203	P
Note:	1. P is an abbreviation for Pass. 2. F is an abbreviation for Fail. 3. N/A is an abbreviation for Not Applicable.	

2. General Information

2.1. Description of Device (EUT)

EUT Name	:	2.4GHz Radio Control System
Model No.	:	MT-R
DIFF	:	N/A
Trademark	:	SANWA
Power rate	:	DC 6V from battery
Test Power supply	:	4*DC 1.5V by AAA battery
Radio Technology	:	2.4G
Operation frequency	:	1) 2404-2470 MHz 2) 2405-2471 MHz 3) 2412-2478 MHz 4) 2413-2479MHz
Channel No.	:	34Channels
Channel Separation	:	2MHz
Modulation	:	GFSK
Antenna Type	:	Integrated Antenna, max gain 2.0dBi.
Software version	:	ver.0.16
Hardware version	:	311A21041A

Channel list:

2404-2470MHz:

Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)
1CH	2404	10CH	2422	19CH	2440	28CH	2458
2CH	2406	11CH	2424	20CH	2442	29CH	2460
3CH	2408	12CH	2426	21CH	2444	30CH	2462
4CH	2410	13CH	2428	22CH	2446	31CH	2464
5CH	2412	14CH	2430	23CH	2448	32CH	2466
6CH	2414	15CH	2432	24CH	2450	33CH	2468
7CH	2416	16CH	2434	25CH	2452	34CH	2470
8CH	2418	17CH	2436	26CH	2454		
9CH	2420	18CH	2438	27CH	2456		

2405-2471MHz:

Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)
1CH	2405	10CH	2423	19CH	2441	28CH	2459
2CH	2407	11CH	2425	20CH	2443	29CH	2461
3CH	2409	12CH	2427	21CH	2445	30CH	2463
4CH	2411	13CH	2429	22CH	2447	31CH	2465
5CH	2413	14CH	2431	23CH	2449	32CH	2467
6CH	2415	15CH	2433	24CH	2451	33CH	2469
7CH	2417	16CH	2435	25CH	2453	34CH	2471
8CH	2419	17CH	2437	26CH	2455		
9CH	2421	18CH	2439	27CH	2457		

2412-2478MHz:

Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)
1CH	2412	10CH	2430	19CH	2448	28CH	2466
2CH	2414	11CH	2432	20CH	2450	29CH	2468
3CH	2416	12CH	2434	21CH	2452	30CH	2470
4CH	2418	13CH	2436	22CH	2454	31CH	2472
5CH	2420	14CH	2438	23CH	2456	32CH	2474
6CH	2422	15CH	2440	24CH	2458	33CH	2476
7CH	2424	16CH	2442	25CH	2460	34CH	2478
8CH	2426	17CH	2444	26CH	2462		
9CH	2428	18CH	2446	27CH	2464		

2413-2479MHz:

Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)	Channel	Freq (MHz)
1CH	2413	10CH	2431	19CH	2449	28CH	2467
2CH	2415	11CH	2433	20CH	2451	29CH	2469
3CH	2417	12CH	2435	21CH	2453	30CH	2471
4CH	2419	13CH	2437	22CH	2455	31CH	2473
5CH	2421	14CH	2439	23CH	2457	32CH	2475
6CH	2423	15CH	2441	24CH	2459	33CH	2477
7CH	2425	16CH	2443	25CH	2461	34CH	2479
8CH	2427	17CH	2445	26CH	2463		
9CH	2429	18CH	2447	27CH	2465		

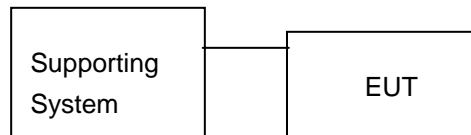
2.2. Accessories of Device (EUT)

Accessories1 : /
 Manufacturer : /
 Model : /
 Ratings : /

2.3. Tested Supporting System Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDOC
1	AAA Battery case	/	/	/	/

2.4. Block Diagram of connection between EUT and simulators



2.5. Test Mode Description

Tested mode, channel, and data rate information	
Mode	Channel
GFSK	Low
	Middle
	High

2.6. Test Conditions

Items	Required	Actual
Temperature range:	15-35°C	24°C
Humidity range:	25-75%	56%
Pressure range:	86-106kPa	98kPa

2.7. Test Facility

Shenzhen Alpha Product Testing Co., Ltd
 Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103,
 Shenzhen, Guangdong, China

June 21, 2018 File on Federal Communication Commission
 Registration Number: 293961

July 15, 2019 Certificated by IC
 Registration Number: CN0085

2.8. Measurement Uncertainty

(95% confidence levels, k=2)

Item	Uncertainty
Uncertainty for Power point Conducted Emissions Test	1.63dB
Uncertainty for Radiation Emission test in 3m chamber (below 30MHz)	3.5dB
Uncertainty for Radiation Emission test in 3m chamber (30MHz to 1GHz)	3.74dB(Polarize: V)
	3.76dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber (1GHz to 25GHz)	3.77dB(Polarize: V)
	3.80dB(Polarize: H)
Uncertainty for radio frequency	5.06×10^{-8} GHz
Uncertainty for conducted RF Power	0.40dB
Uncertainty for temperature	0.2°C
Uncertainty for humidity	1%
Uncertainty for DC and low frequency voltages	0.06%

2.9. Test Equipment List

Equipment	Manufacture	Model No.	Firmware version	Serial No.	Last cal.	Cal Interval
9*6*6 anechoic chamber	CHENYU	9*6*6	/	N/A	2020.09.02	3Year
Spectrum analyzer	ROHDE&SCHWARZ	FSV40-N	2.3	102137	2021.08.25	1Year
Spectrum analyzer	Agilent	N9020A	A.14.16	MY499100060	2021.08.25	1Year
Receiver	ROHDE&SCHWARZ	ESR	2.28 SP1	1316.3003K03-102082-Wa	2021.08.25	1Year
Receiver	R&S	ESCI	4.42 SP1	101165	2021.08.25	1Year
Bilog Antenna	Schwarzbeck	VULB 9168	/	VULB 9168#627	2021.08.30	2Year
Horn Antenna	SCHWARZBECK	BBHA 9120 D	/	2106	2021.08.30	2Year
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	/	00059	2021.08.30	2Year
RF Cable	Resenberger	Cable 1	/	RE1	2021.08.25	1Year
RF Cable	Resenberger	Cable 2	/	RE2	2021.08.25	1Year
RF Cable	Resenberger	Cable 3	/	CE1	2021.08.25	1Year
Pre-amplifier	HP	HP8347A	/	2834A00455	2021.08.25	1Year
Pre-amplifier	Agilent	8449B	/	3008A02664	2021.08.25	1Year
L.I.S.N.#1	Schwarzbeck	NSLK8126	/	8126-466	2021.08.25	1Year
L.I.S.N.#2	ROHDE&SCHWARZ	ENV216	/	101043	2021.08.25	1 Year
Horn Antenna	SCHWARZBECK	BBHA9170	/	00946	2021.08.30	2 Year
Preamplifier	SKET	LNPA_1840-50	/	SK2018101801	2021.08.25	1 Year
Power Meter	Agilent	E9300A	/	MY41496628	2021.08.25	1 Year
Power Sensor	DARE	RPR3006W	/	15100041SNO91	2021.08.25	1 Year
Temp. & Humid. Chamber	Weihuang	WHTH-100 0-40-880	/	100631	2022.04.22	1 Year
Switching Mode Power Supply	JUNKE	JK12010S	/	20140927-6	2021.08.25	1 Year

Adjustable attenuator	MWRFtest	N/A	/	N/A	N/A	N/A
10dB Attenuator	Mini-Circuits	DC-6G	/	N/A	N/A	N/A

Software Information			
Test Item	Software Name	Manufacturer	Version
RE	EZ-EMC	farad	Alpha-3A1
CE	EZ-EMC	farad	Alpha-3A1
RF-CE	MTS 8310	MWRFtest	2.0.0.0

3. Maximum Peak Output Power

3.1. Limit

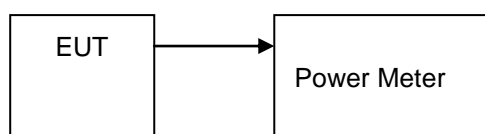
Please refer section 15.247.

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts, the e.i.r.p shall not exceed 4W

3.2. Test Procedure

The transmitter output is connected to the RF Power Meter. The RF Power Meter is set to the peak power detection.

3.3. Test Setup



3.4. Test Result

2404-2470 MHz:

Mode	Freq (MHz)	PK Output Power (dBm)	Limit (dBm)	Result
GFSK	2404	8.388	21	Pass
	2436	7.933	21	Pass
	2470	7.23	21	Pass
Conclusion: PASS				

2405-2471 MHz:

Mode	Freq (MHz)	PK Output Power (dBm)	Limit (dBm)	Result
GFSK	2405	8.403	21	Pass
	2438	7.986	21	Pass
	2471	7.459	21	Pass
Conclusion: PASS				

2412-2478 MHz:

Mode	Freq (MHz)	PK Output Power (dBm)	Limit (dBm)	Result
GFSK	2412	8.293	21	Pass
	2444	7.54	21	Pass
	2478	6.684	21	Pass
Conclusion: PASS				

2413-2479 MHz:

Mode	Freq (MHz)	PK Output Power (dBm)	Limit (dBm)	Result
GFSK	2413	8.438	21	Pass
	2446	7.732	21	Pass
	2479	7.405	21	Pass
Conclusion: PASS				

4. Bandwidth

4.1. Limit

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

4.2. Test Procedure

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30kHz RBW and 100kHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

4.3. Test Result

2404-2470 MHz:

Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Limit -20 dB Bandwidth (MHz)	Verdict
2404	Ant 1	1.67	1.776	-	Pass
2436	Ant 1	1.618	1.804	-	Pass
2470	Ant 1	1.622	1.752	-	Pass

OBW NVNT user 2404MHz Ant1



Date: 5.JUL.2022 12:12:03

-20 dB BW NVNT user 2404MHz Ant1



Date: 5.JUL.2022 12:57:05

OBW NVNT user 2436MHz Ant1



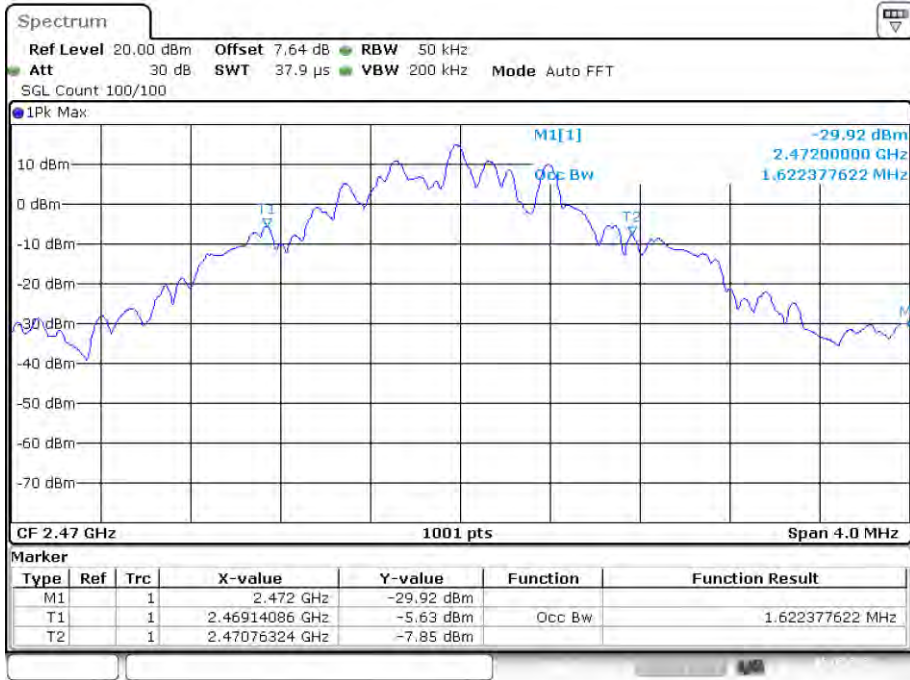
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-20 dB BW NVNT user 2436MHz Ant1



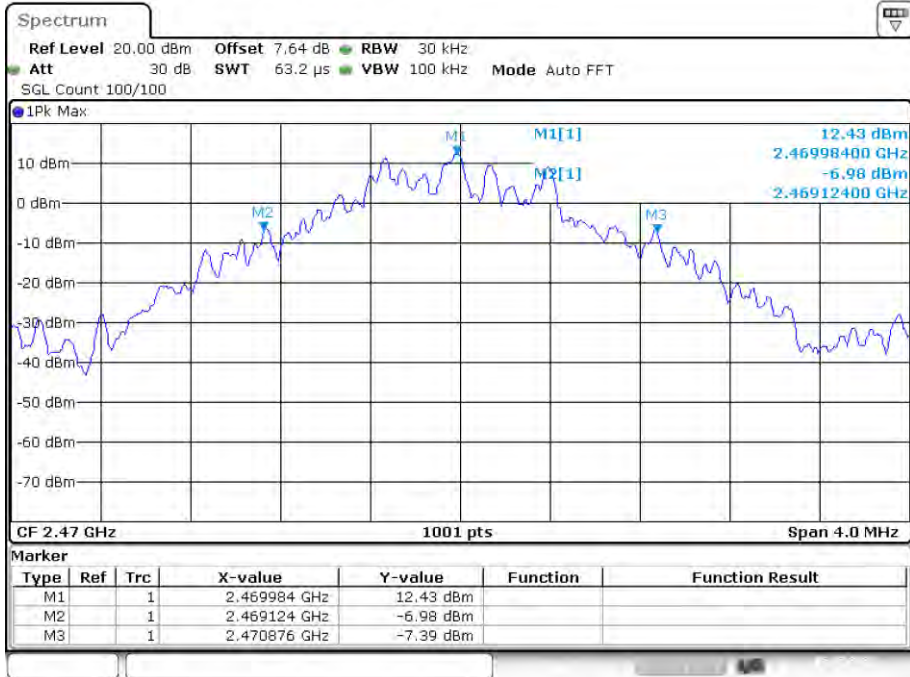
Date: 5.JUL.2022 12:27:05

OBW NVNT user 2470MHz Ant1



Date: 5.JUL.2022 12:22:00

-20 dB BW NVNT user 2470MHz Ant1



Date: 5.JUL.2022 12:22:10

2405-2471 MHz:

Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Limit -20 dB Bandwidth (MHz)	Verdict
2405	Ant 1	1.53	1.864	-	Pass
2438	Ant 1	1.614	1.852	-	Pass
2471	Ant 1	1.698	1.744	-	Pass

OBW NVNT user 2405MHz Ant1



Date: 6.JUL.2022 11:09:36

-20 dB BW NVNT user 2405MHz Ant1



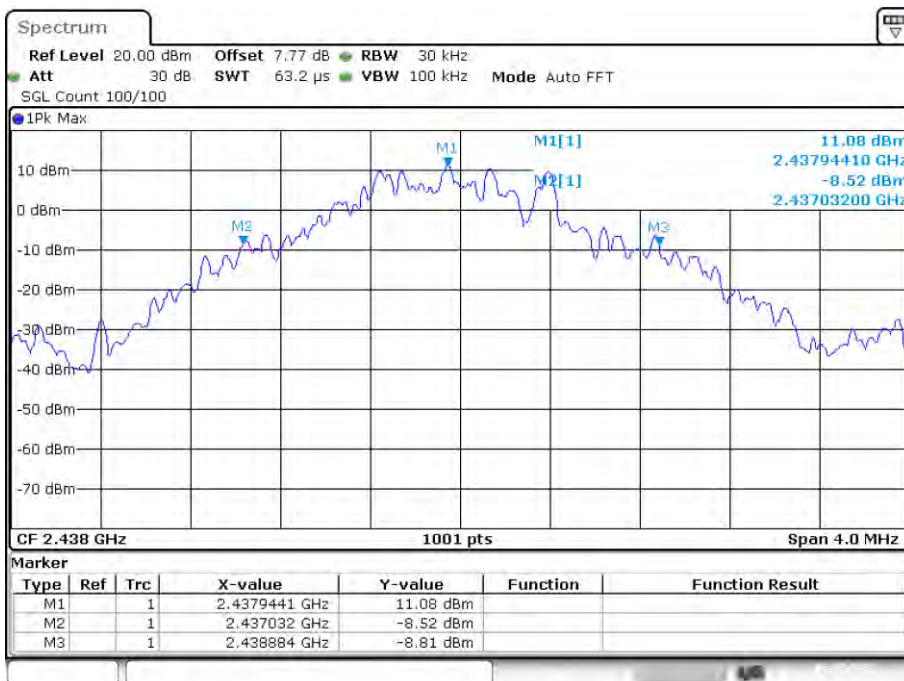
Date: 6.JUL.2022 11:09:45

OBW NVNT user 2438MHz Ant1



Date: 6.JUL.2022 11:05:49

-20 dB BW NVNT user 2438MHz Ant1



Date: 6.JUL.2022 11:05:58

OBW NVNT user 2471MHz Ant1



Date: 6.JUL.2022 11:04:06

-20 dB BW NVNT user 2471MHz Ant1



Date: 6.JUL.2022 11:04:15

2412-2478 MHz:

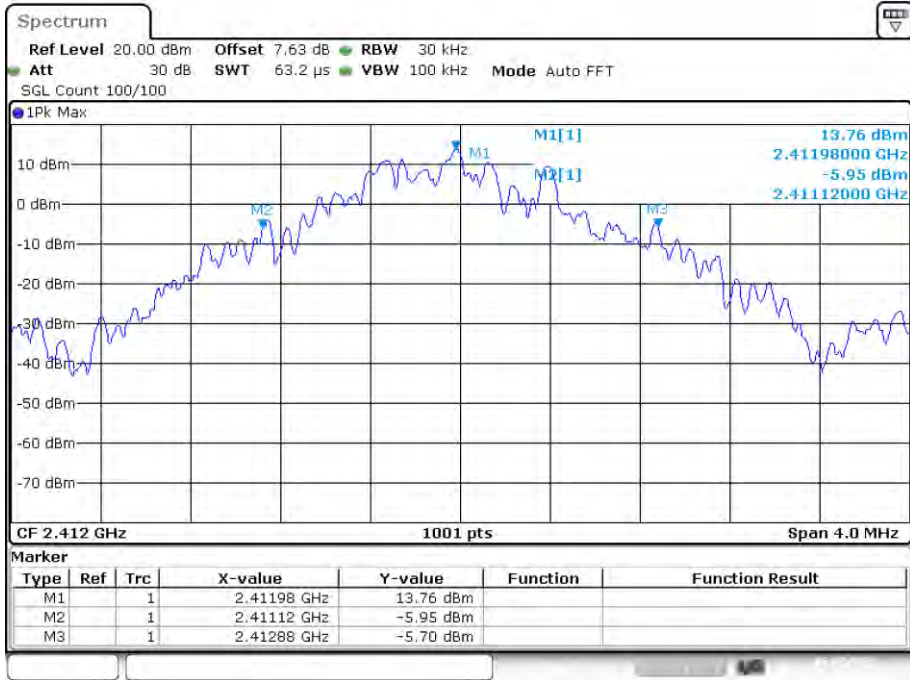
Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Limit -20 dB Bandwidth (MHz)	Verdict
2412	Ant 1	1.63	1.76	-	Pass
2446	Ant 1	1.542	1.584	-	Pass
2478	Ant 1	1.626	1.584	-	Pass

OBW NVNT user 2412MHz Ant1



Date: 6.JUL.2022 10:54:31

-20 dB BW NVNT user 2412MHz Ant1



Date: 6.JUL.2022 10:55:02

OBW NVNT user 2444MHz Ant1



Date: 6.JUL.2022 10:56:32

-20 dB BW NVNT user 2444MHz Ant1



Date: 6.JUL.2022 10:56:41

OBW NVNT user 2478MHz Ant1



Date: 6.JUL.2022 10:58:58

-20 dB BW NVNT user 2478MHz Ant1



Date: 6.JUL.2022 10:59:07

2413-2479MHz:

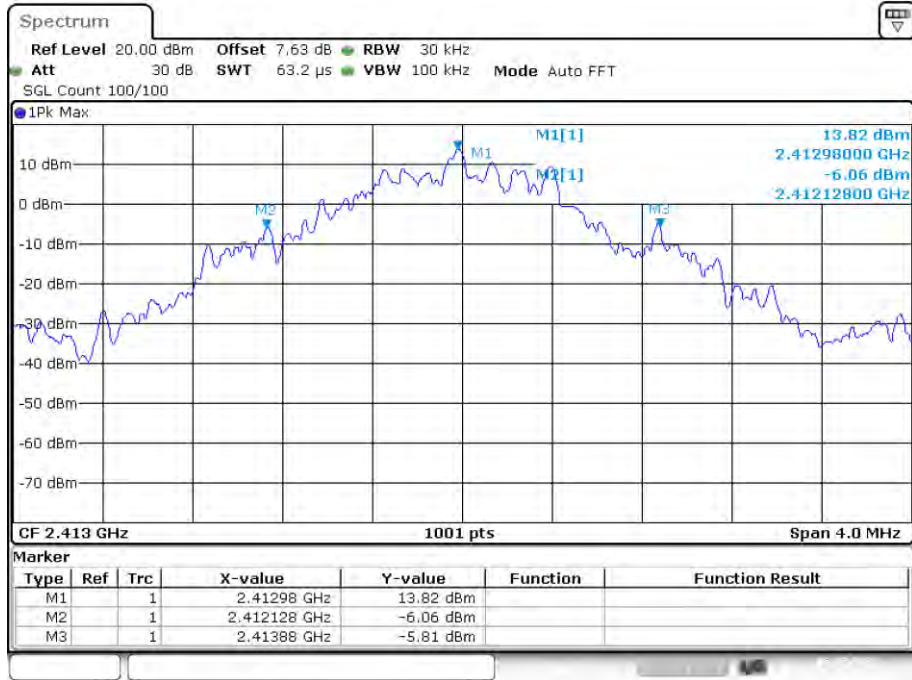
Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Limit -20 dB Bandwidth (MHz)	Verdict
2413	Ant 1	1.61	1.752	-	Pass
2446	Ant 1	1.71	1.804	-	Pass
2479	Ant 1	1.618	1.752	-	Pass

OBW NVNT user 2413MHz Ant1



Date: 6.JUL.2022 11:53:30

-20 dB BW NVNT user 2413MHz Ant1



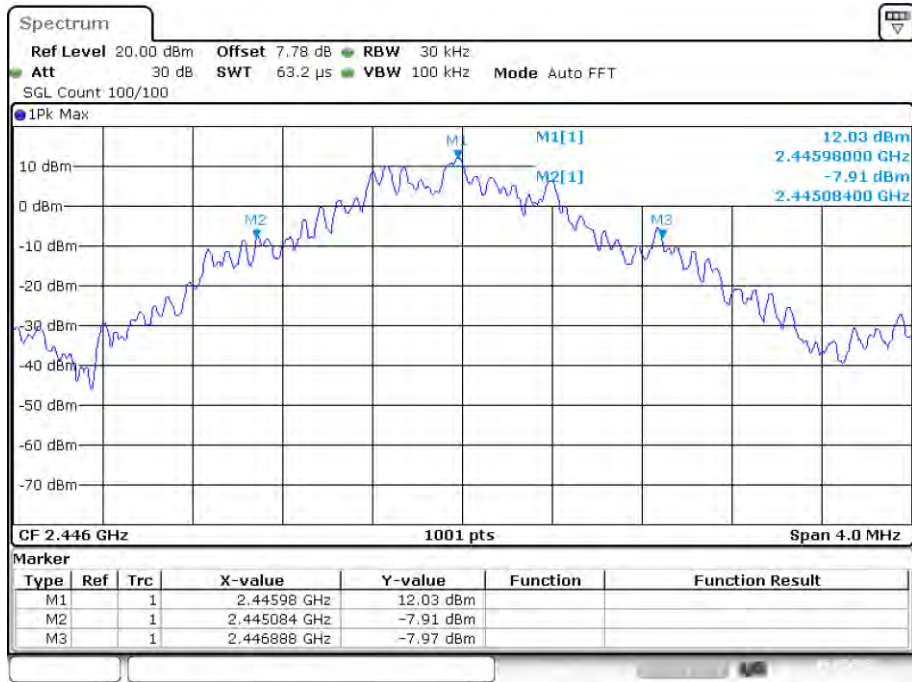
Date: 6.JUL.2022 11:53:39

OBW NVNT user 2446MHz Ant1



Date: 6.JUL.2022 11:56:39

-20 dB BW NVNT user 2446MHz Ant1



Date: 6.JUL.2022 11:56:48

OBW NVNT user 2479MHz Ant1



Date: 6.JUL.2022 11:58:36

-20 dB BW NVNT user 2479MHz Ant1



Date: 6.JUL.2022 11:58:46

5. 5. Carrier Frequency Separation

5.1. Limit

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 operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 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

5.2. Test Procedure

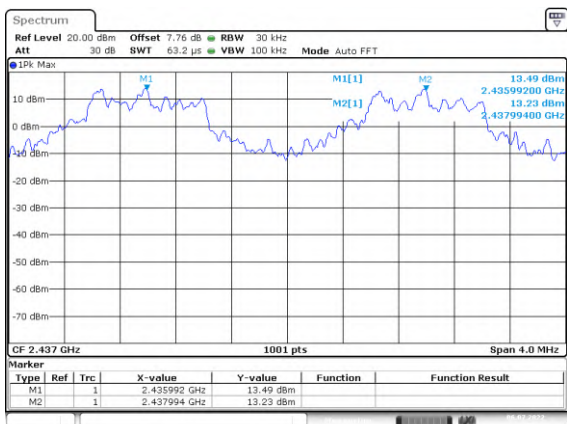
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The carrier frequency was measured by spectrum analyzer with 100kHz RBW and 300kHz VBW.

5.3. Test Result

Mode	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
GFSK (2404-2470MHz)	2435.992	2437.994	2.002	1.203	Pass
GFSK (2405-2471MHz)	2438.64	2440.984	2.344	1.243	Pass
GFSK (2412-2478MHz)	2443.988	2445.994	2.006	1.173	Pass
GFSK (2413-2479MHz)	2446.98	2448.644	1.664	1.203	Pass

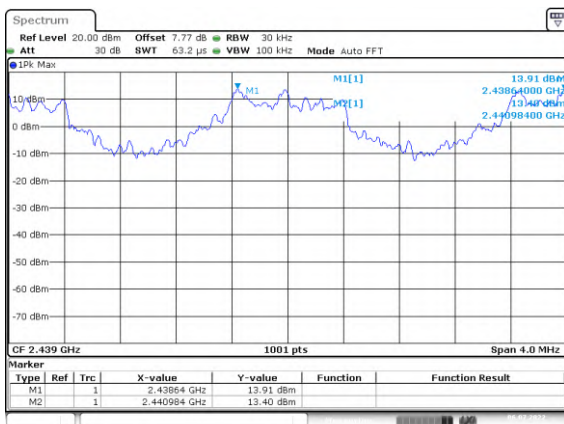
Original test data for channel separation

2404-2470 MHz



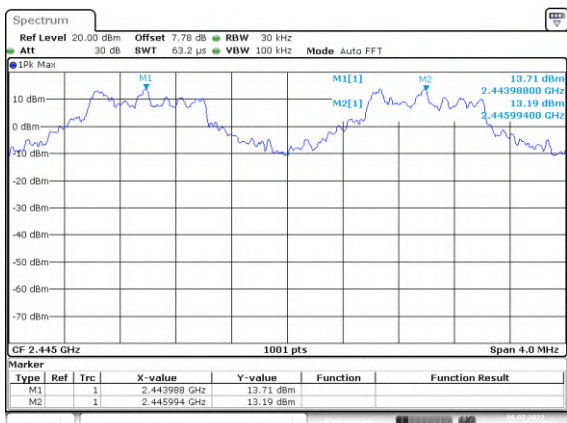
Date: 6.JUL.2022 09:39:59

2405-2471 MHz



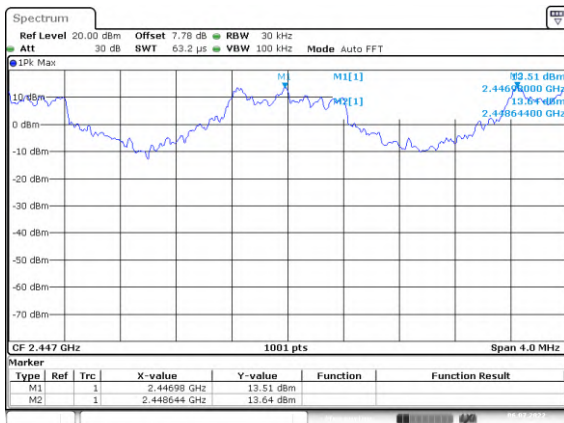
Date: 6.JUL.2022 11:16:06

2412-2478 MHz



Date: 6.JUL.2022 11:30:47

2413-2479MHz



Date: 6.JUL.2022 11:30:47

6. Number Of Hopping Channel

6.1. Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels

6.2. Test Procedure

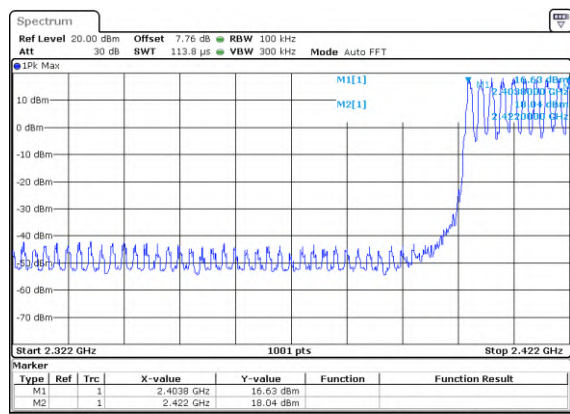
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The number of hopping channel was measured by spectrum analyzer with 100kHz RBW and 300KHz VBW.

6.3. Test Result

Mode	Number of hopping channel	Limit	Conclusion
GFSK	34	>15	PASS

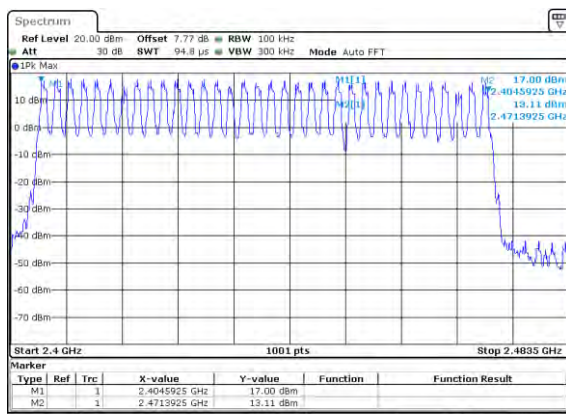
Original test data for hopping channel number

2404-2470 MHz



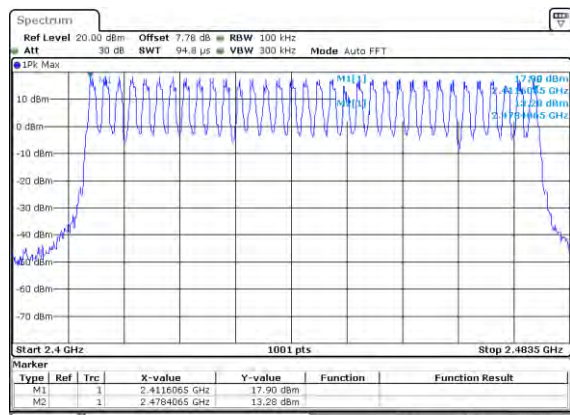
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2405-2471 MHz



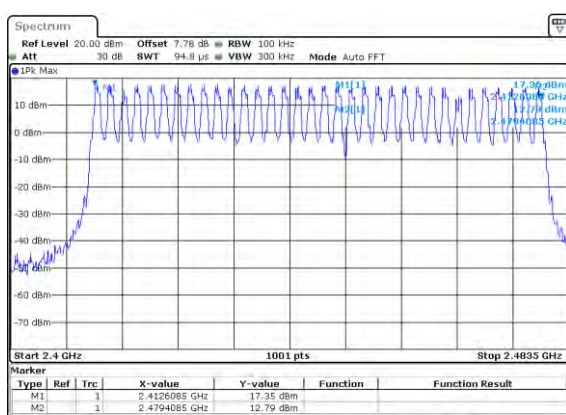
Date: 6.JUL.2022 11:13:35

2412-2478 MHz



Date: 6.JUL.2022 10:47:11

2413-2479MHz



Date: 6.JUL.2022 11:24:13

7. Dwell Time

7.1. Test limit

Please refer section 15.247

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

7.2. Test Procedure

7.2.1. Place the EUT on the table and set it in transmitting mode.

7.2.2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

7.2.3. Set center frequency of spectrum analyzer = operating frequency.

7.2.4. Set the spectrum analyzer as RBW=1MHz, VBW=1MHz, Span = 0Hz, Sweep = auto.

7.2.5. Repeat above procedures until all frequency measured were complete.

7.3. Test Result

PASS.

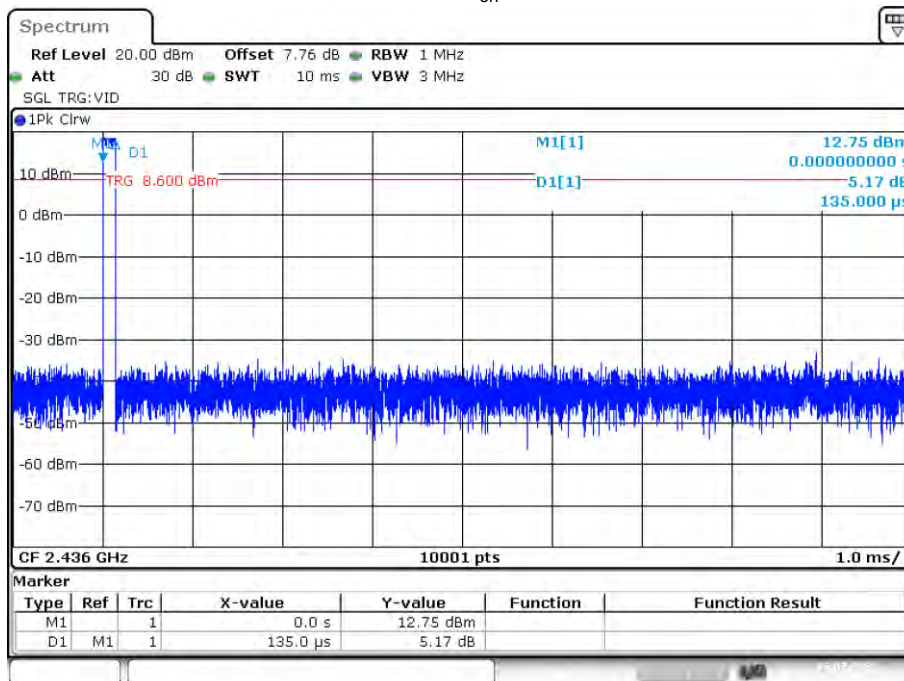
Detailed information please see the following page.

2404-2470 MHz:

Frequency (MHz)	Pulse Duration (ms)	Dwell Time (ms)	Limit (ms)	Conclusion
2436	0.135	42.228	400	Pass

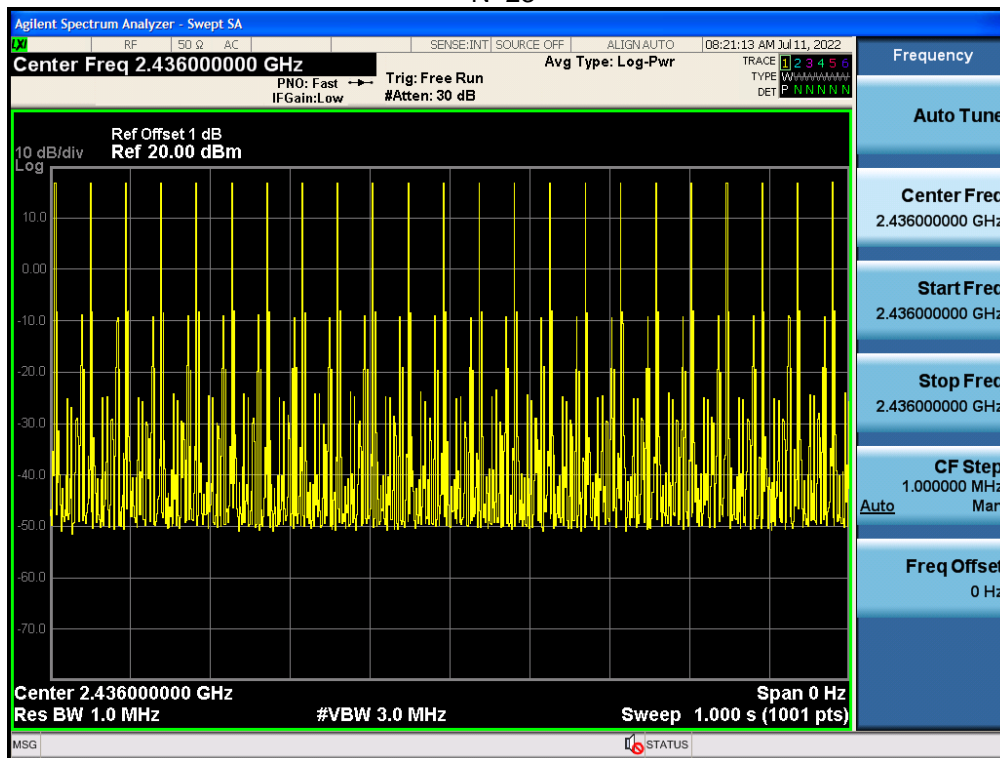
Note: Dwell time= $23 \times 34 \times 0.4 \times 0.135 = 42.228\text{ms}$

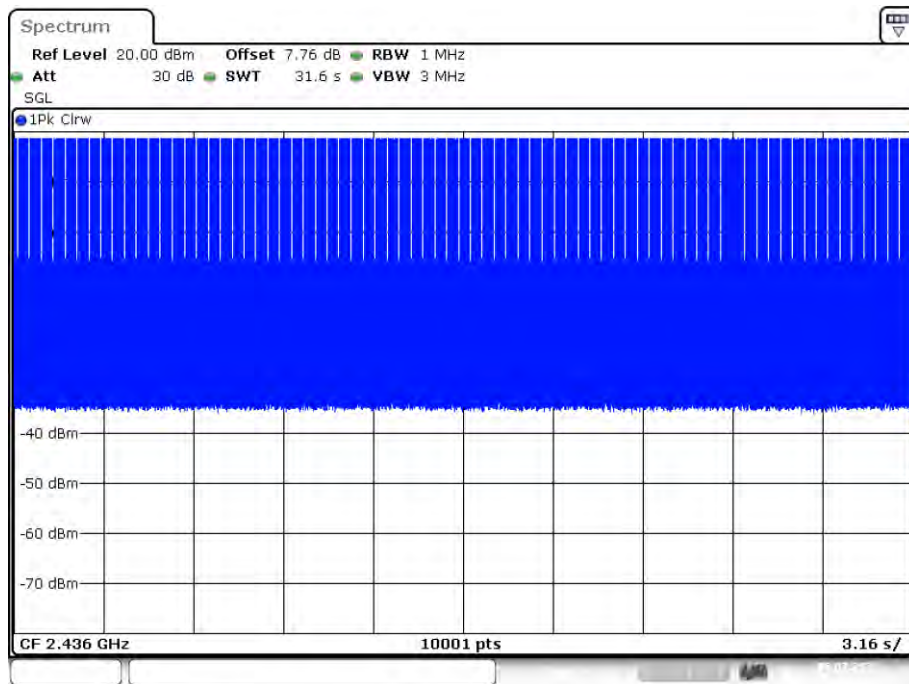
2436MHz: $T_{on} = 0.135\text{ms}$



Date: 6.JUL.2022 09:43:34

N=23





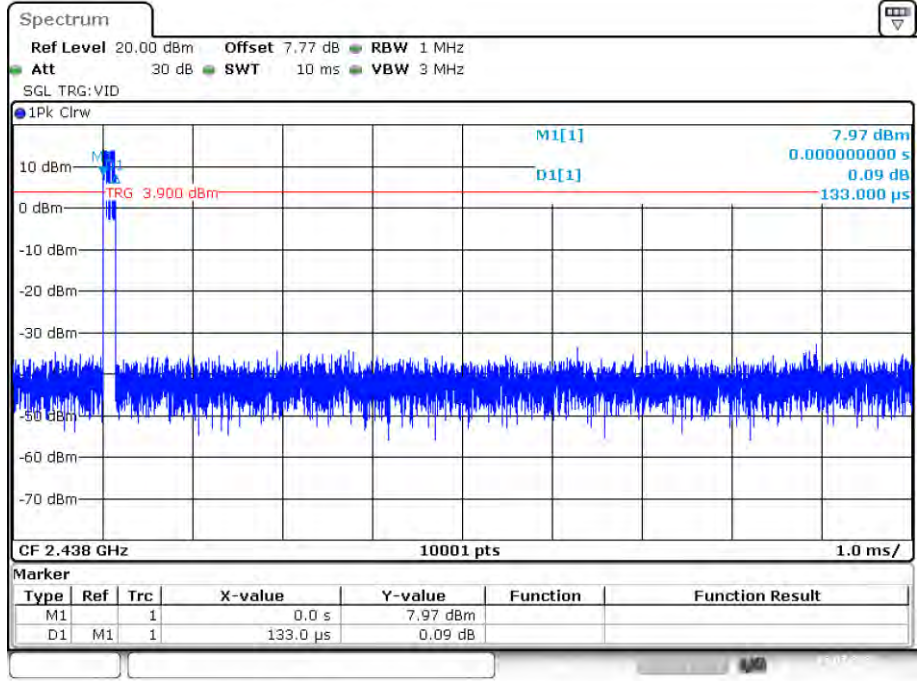
Date: 6.JUL.2022 09:44:08

2405-2471 MHz:

Frequency (MHz)	Pulse Duration (ms)	Dwell Time (ms)	Limit (ms)	Conclusion
2438	0.133	39.7936	400	Pass

Note: Dwell time= $22 \times 34 \times 0.4 \times 0.133 = 39.7936$ ms

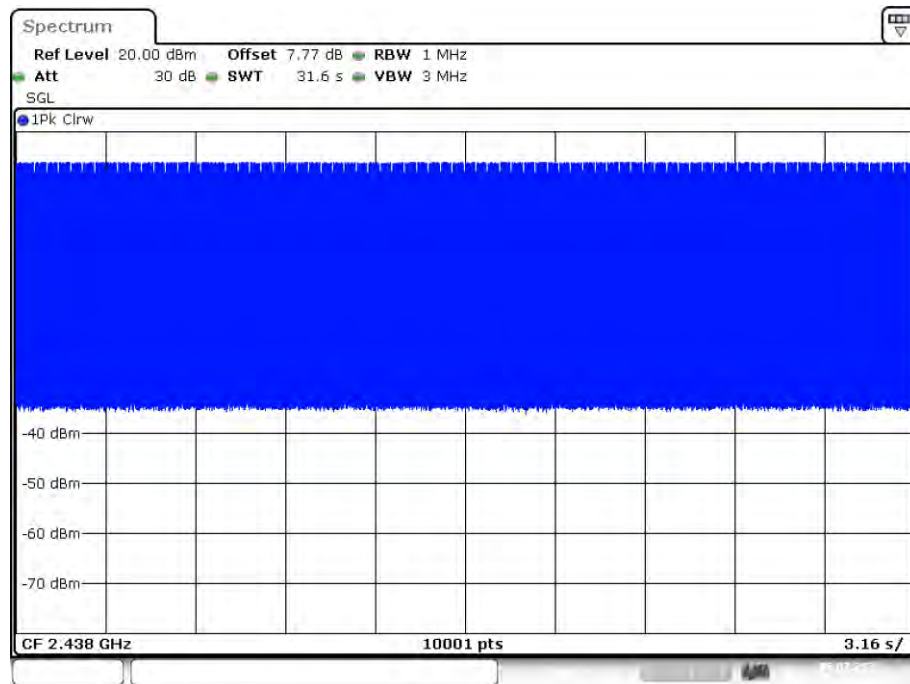
2438MHz: $T_{on} = 0.133$ ms



Date: 6.JUL.2022 11:19:44

N=22





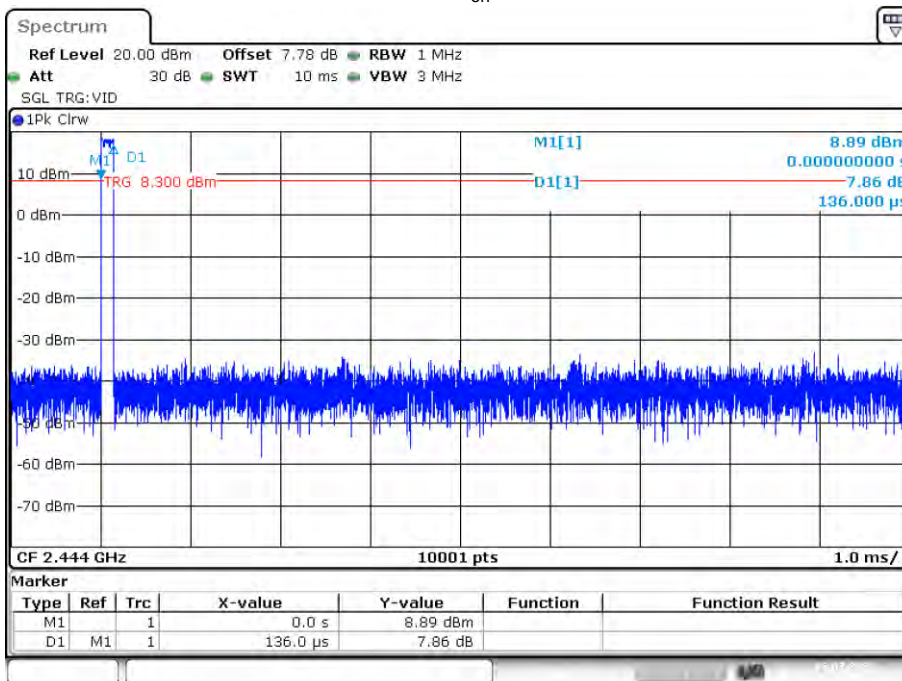
Date: 6.JUL.2022 11:20:19

2412-2478 MHz:

Frequency (MHz)	Pulse Duration (ms)	Dwell Time (ms)	Limit (ms)	Conclusion
2444	0.136	42.5408	400	Pass

Note: Dwell time= $23 \times 34 \times 0.4 \times 0.136 = 42.5408\text{ms}$

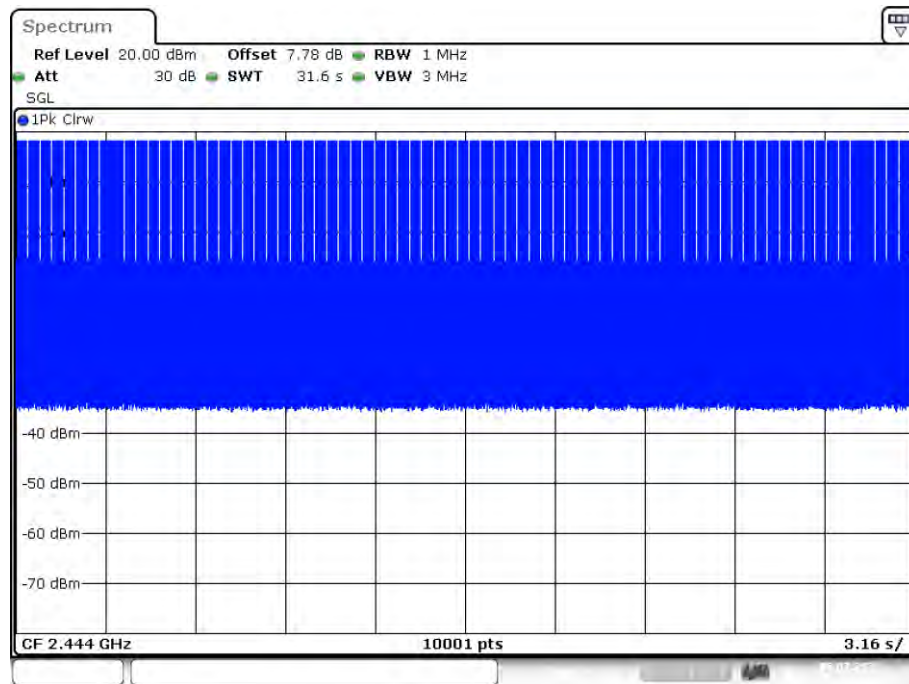
2444MHz: $T_{on} = 0.136\text{ms}$



Date: 6.JUL.2022 10:47:39

N=23





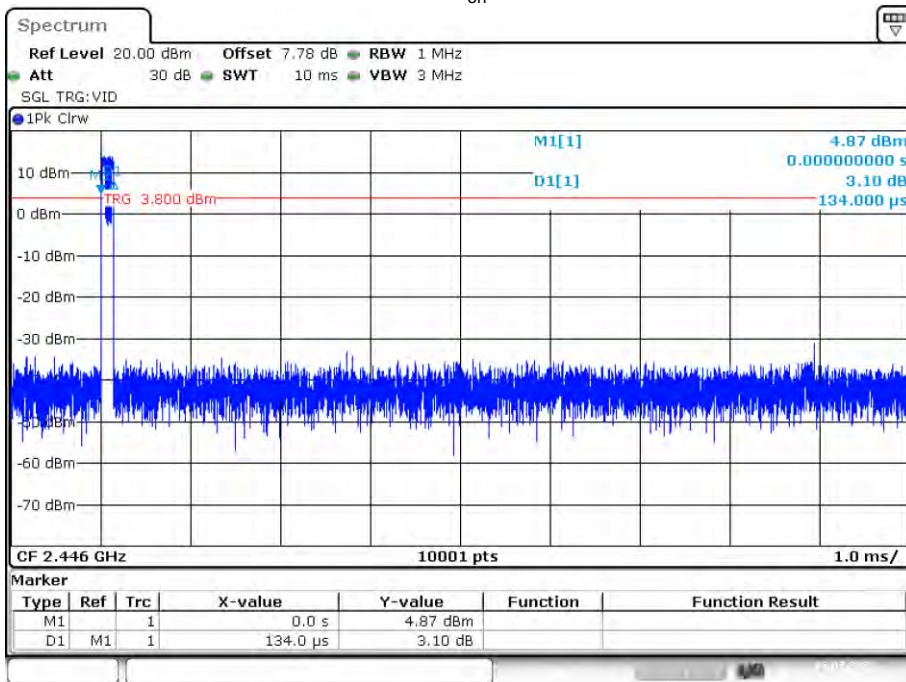
Date: 6.JUL.2022 10:48:13

2413-2479MHz:

Frequency (MHz)	Pulse Duration (ms)	Dwell Time (ms)	Limit (ms)	Conclusion
2446	0.134	40.0928	400	Pass

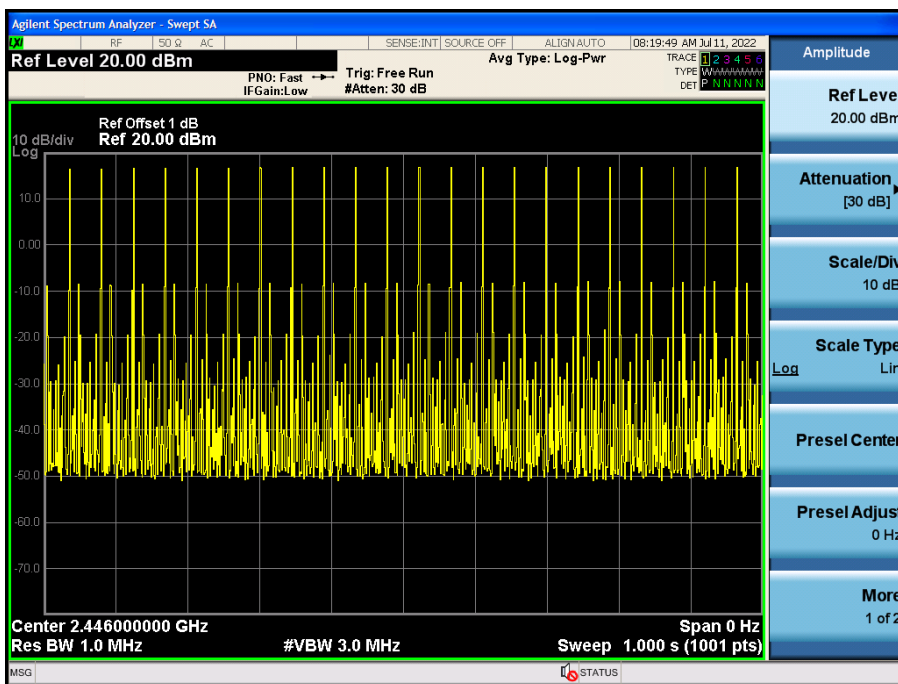
Note: Dwell time= $22 \times 34 \times 0.4 \times 0.134 = 40.0928\text{ms}$

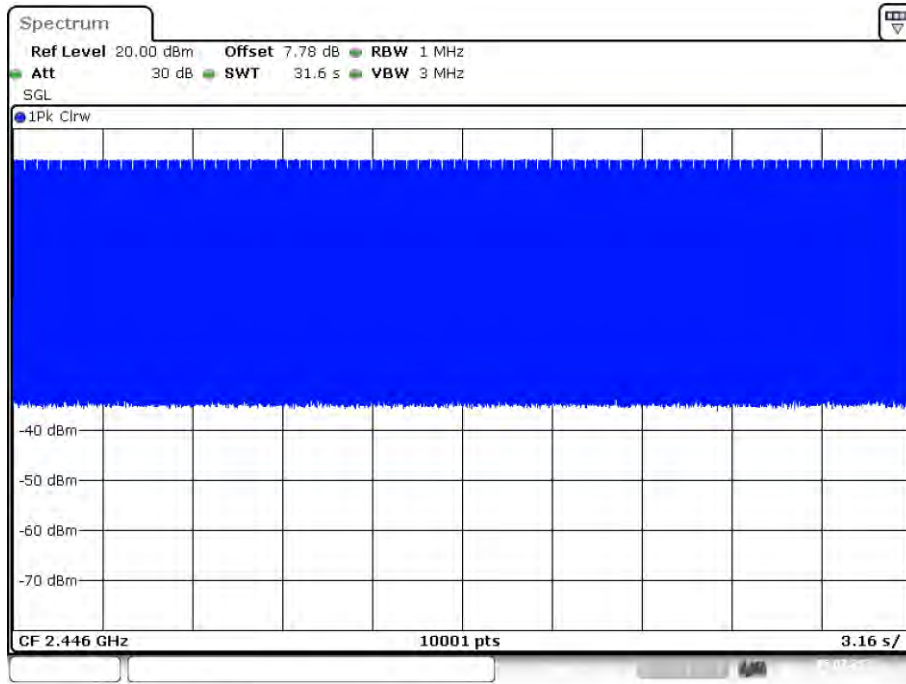
2446MHz $T_{on} = 0.134\text{ms}$



Date: 6.JUL.2022 11:34:23

N=22





Date: 6.JUL.2022 11:34:58

8. Radiated Emissions

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

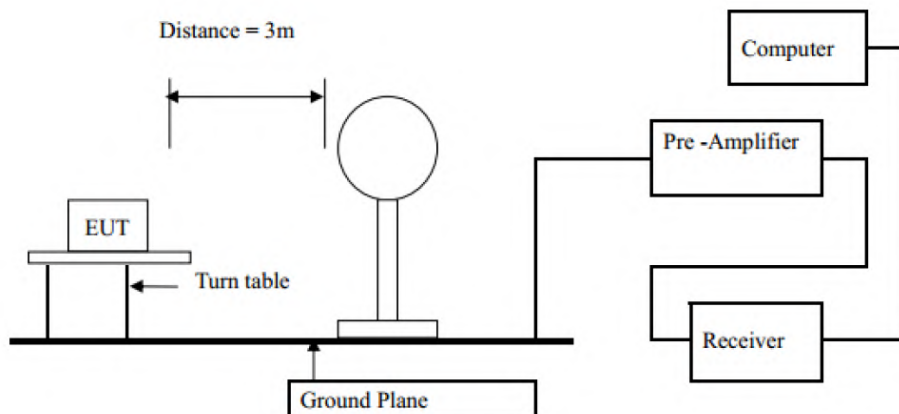
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 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

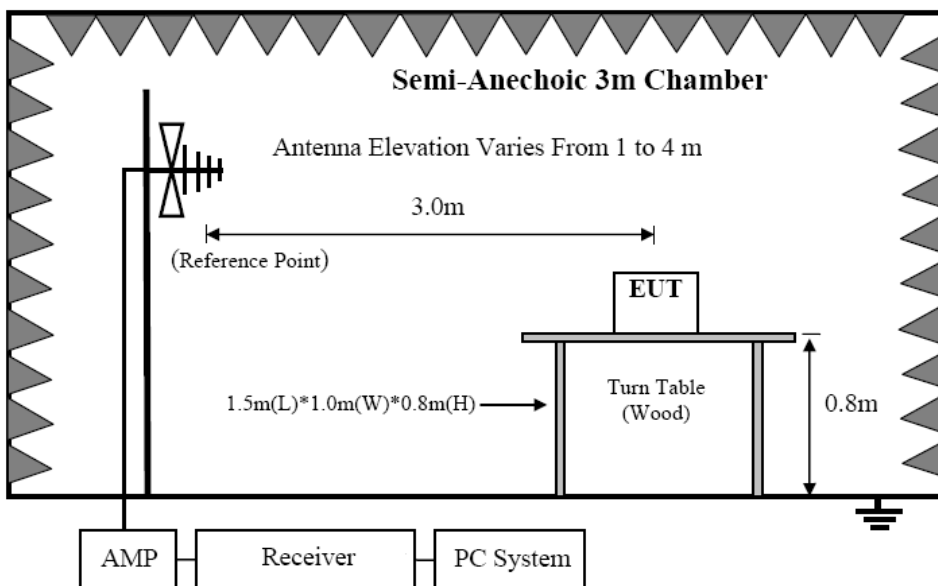
FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V}/\text{m}$	$\text{dB}(\mu\text{V})/\text{m}$
0.009-0.490	300	2400/F(KHz)	/
0.490-1.705	30	24000/F(KHz)	/
1.705-30	30	30	29.5
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

8.2. Block Diagram of Test setup

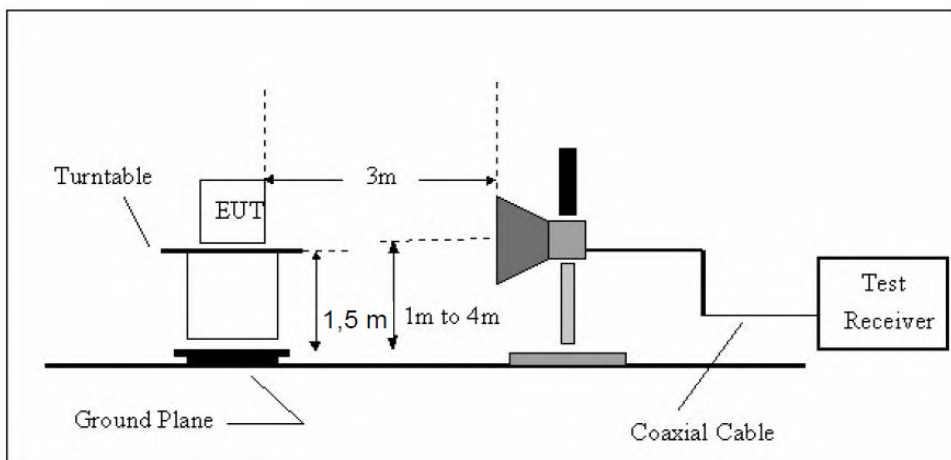
8.2.1 In 3m Anechoic Chamber Test Setup Diagram for below 30MHz



8.2.1 In 3m Anechoic Chamber Test Setup Diagram for below 1GHz



8.2.2 In 3m Anechoic Chamber Test Setup Diagram for frequency above 1GHz



Note: For harmonic emissions test a appropriate high pass filter was inserted in the input port of AMP.

8.3. Test Procedure

- (1) The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber for below 1GHz and 150 cm above the ground plane inside a semi-anechoic chamber for above 1GHz.
- (2) Setup EUT and simulator as shown in section 1.4 and 6.1
- (3) Test antenna was located 3m from the EUT on an adjustable mast. Below pre-scan procedure was first performed in order to find prominent radiated emissions.
 - (a) Change work frequency or channel of device if practicable.
 - (b) Change modulation type of device if practicable.
 - (c) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions
- (4) Spectrum frequency from 9KHz to 25GHz (tenth harmonic of fundamental frequency) was investigated
- (5) For final emissions measurements at each frequency of interest, the EUT were rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10:2013 on Radiated Emission test.
- (6) For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure; RBW is set at 1MHz, VBW is set at 10Hz for Average measure.

8.4. Test Result

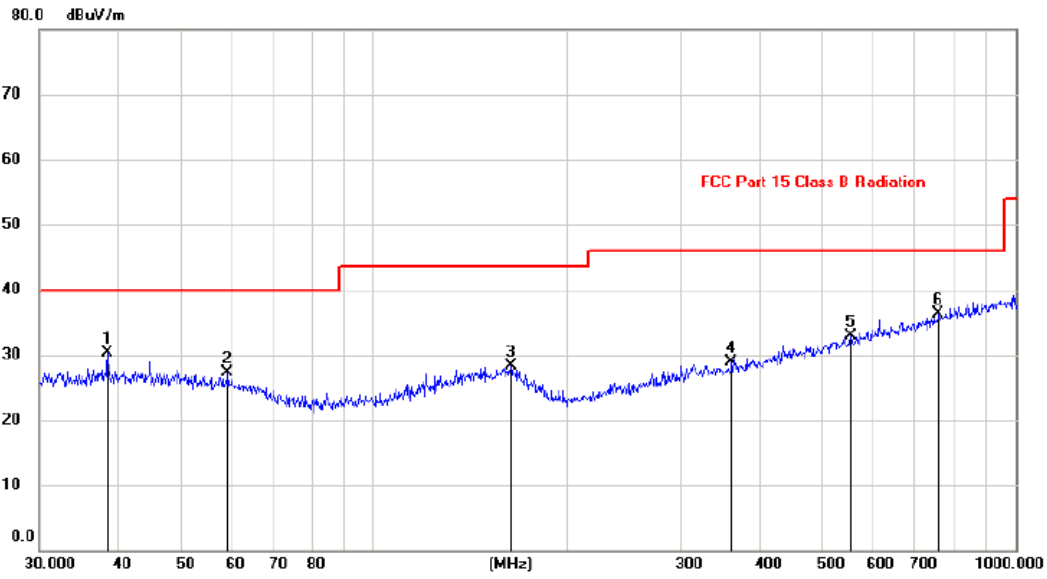
We have scanned the 10th harmonic from 9KHz to the EUT's highest frequency..
Detailed information please see the following page.

From 9KHz to 30MHz: Conclusion: PASS

Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

From 30MHz to 1000MHz: Conclusion: PASS

Vertical:

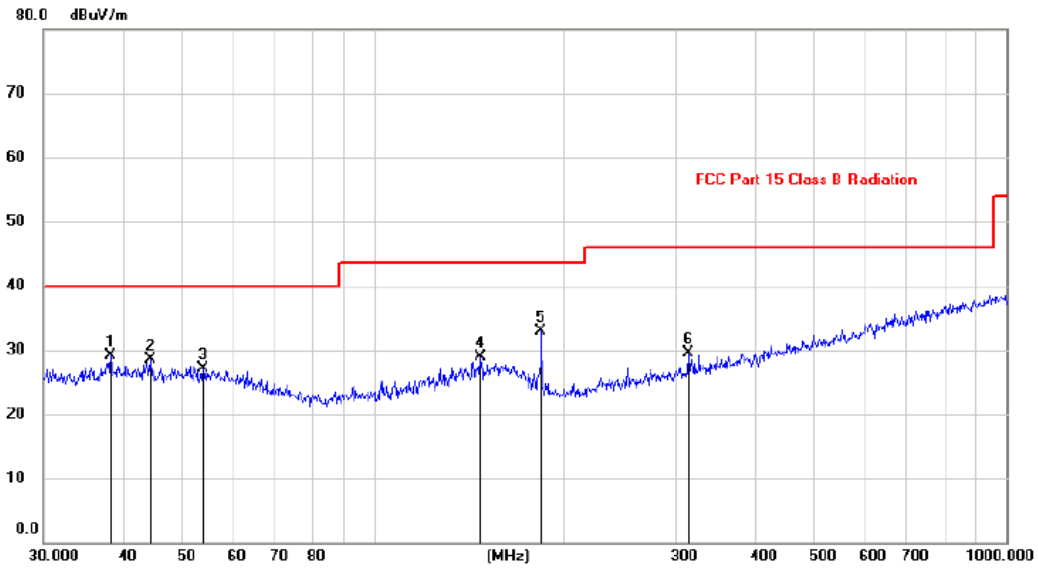


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	38.3967	15.95	14.26	30.21	40.00	-9.79			peak
2		59.1546	14.00	13.25	27.25	40.00	-12.75			peak
3		163.3249	13.68	14.69	28.37	43.50	-15.13			peak
4		360.6056	13.39	15.42	28.81	46.00	-17.19			peak
5		552.8832	13.72	19.24	32.96	46.00	-13.04			peak
6		758.7056	13.60	22.61	36.21	46.00	-9.79			peak

Note: 1. *:Maximum data; x:Over limit; !:over margin.

2.Measurement=Reading Level+Correct Factor; Correct Factor=Antenna Factor+Cable Loss.

Horizontal:



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		38.3967	14.85	14.26	29.11	40.00	-10.89			peak
2		44.3528	14.39	14.17	28.56	40.00	-11.44			peak
3		53.8582	13.36	13.69	27.05	40.00	-12.95			peak
4		147.4682	14.08	14.82	28.90	43.50	-14.60			peak
5	*	183.9246	20.73	12.14	32.87	43.50	-10.63			peak
6		314.9281	15.10	14.46	29.56	46.00	-16.44			peak

Note: 1. *-Maximum data; x:Over limit; !:over margin.

2.Measurement=Reading Level+Correct Factor; Correct Factor=Antenna Factor+Cable Loss.

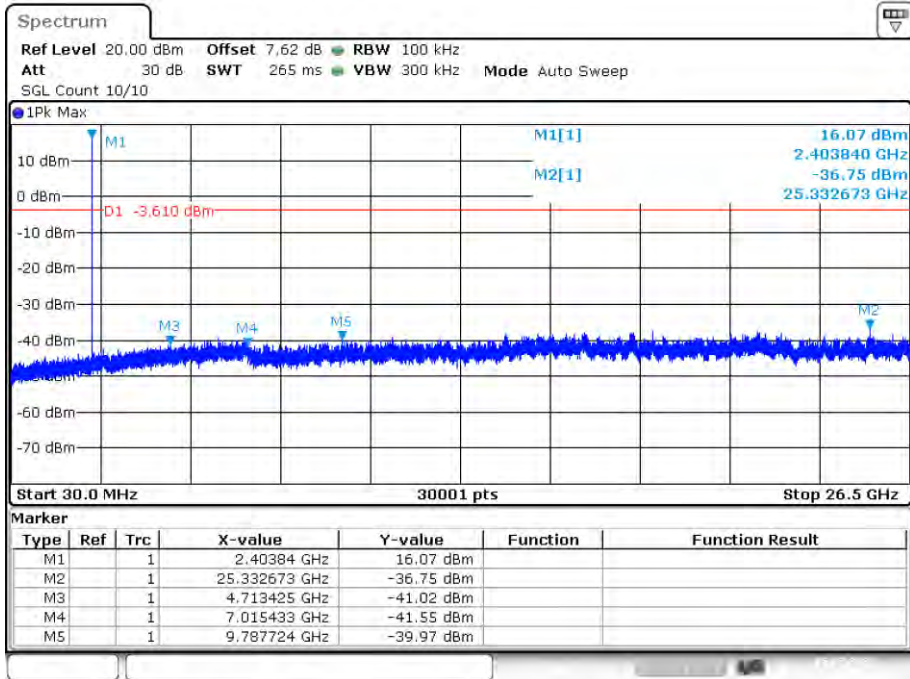
Remark: All modes have been tested, and only worst data of GFSK mode, Channel 2446MHz (2413-2479MHz, DC 4.5V) was listed in this report.

From 1G-25GHz

Test Mode: GFSK TX Low									
Freq (MHz)	Read Level (dBuV/m)	Polar (H/V)	Antenna Factor (dB/m)	Cable loss(dB)	Amp Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
4802	47.46	V	33.95	10.18	34.26	57.33	74	-16.67	PK
4802	37.11	V	33.95	10.18	34.26	46.98	54	-7.02	AV
7203	/	/	/	/	/	/	/	/	/
9604	/	/	/	/	/	/	/	/	/
4802	46.98	H	33.95	10.18	34.26	56.85	74	-17.15	PK
4802	37.11	H	33.95	10.18	34.26	46.98	54	-7.02	AV
7203	/	/	/	/	/	/	/	/	/
9604	/	/	/	/	/	/	/	/	/
Test Mode: GFSK TX Mid									
4888	42.84	V	33.93	10.2	34.29	52.68	74	-21.32	PK
4888	35.89	V	33.93	10.2	34.29	45.73	54	-8.27	AV
7332	/	/	/	/	/	/	/	/	/
9776	/	/	/	/	/	/	/	/	/
4888	44.22	H	33.93	10.2	34.29	54.06	74	-19.94	PK
4888	34.99	H	33.93	10.2	34.29	44.83	54	-9.17	AV
7332	/	/	/	/	/	/	/	/	/
9776	/	/	/	/	/	/	/	/	/
Test Mode: GFSK TX High									
4958	44.36	V	33.98	10.22	34.25	54.31	74	-19.69	PK
4958	35.42	V	33.98	10.22	34.25	45.37	54	-8.63	AV
7437	/	/	/	/	/	/	/	/	/
9916	/	/	/	/	/	/	/	/	/
4958	44.69	H	33.98	10.22	34.25	54.64	74	-19.36	PK
4958	34.45	H	33.98	10.22	34.25	44.40	54	-9.60	AV
7437	/	/	/	/	/	/	/	/	/
9916	/	/	/	/	/	/	/	/	/
Note:									
1, Result = Read level + Antenna factor + cable loss-Amp factor									
2, All the other emissions not reported were too low to read and deemed to comply with FCC limit.									

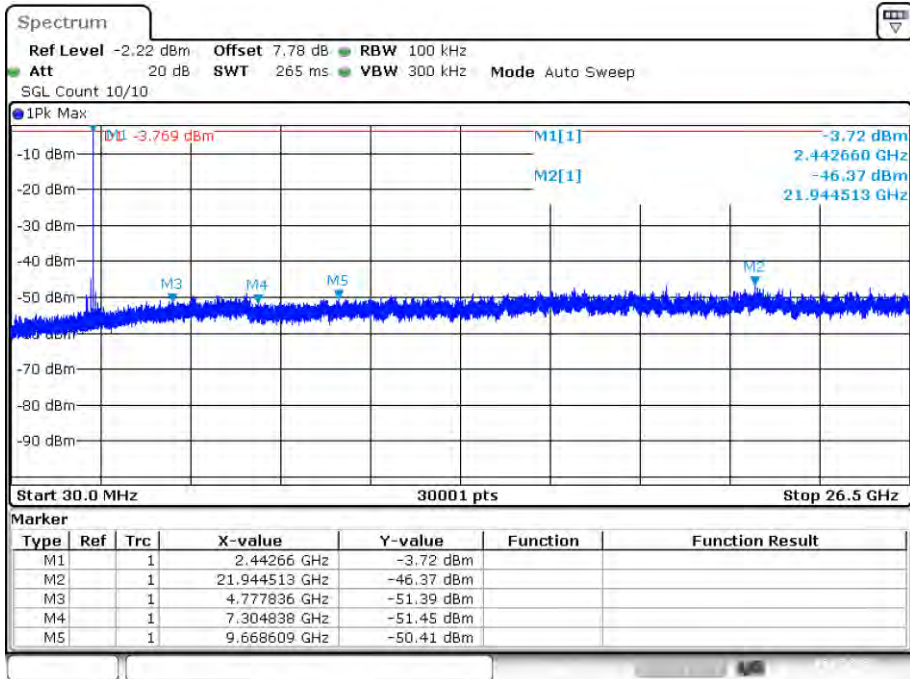
Conducted RF Spurious Emission:

Tx. Spurious NVNT user 2404MHz Ant1 Emission



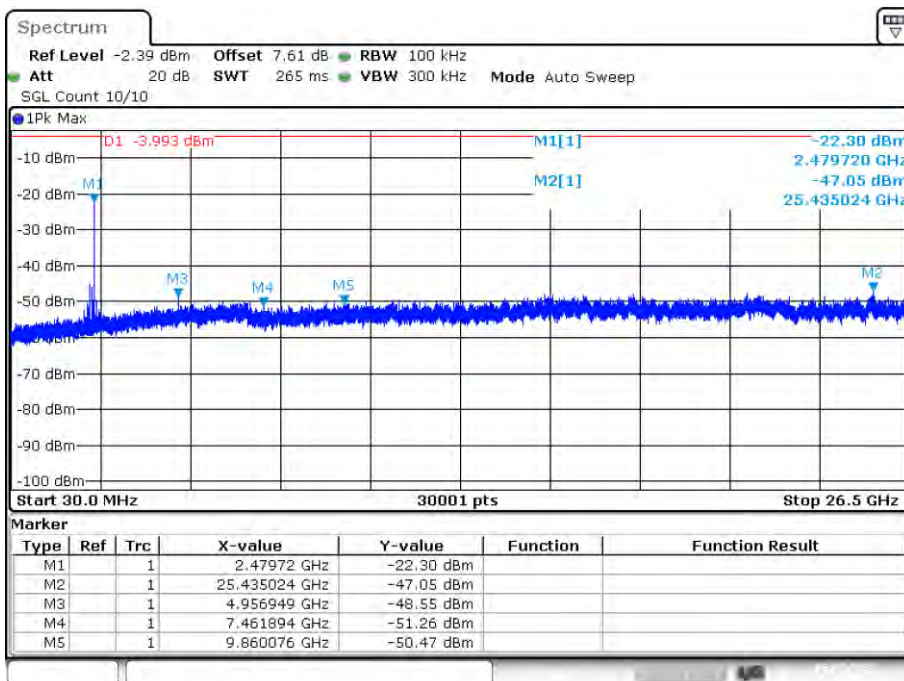
Date: 5.JUL.2022 12:30:36

Tx. Spurious NVNT user 2444MHz Ant1 Emission



Date: 6.JUL.2022 10:57:05

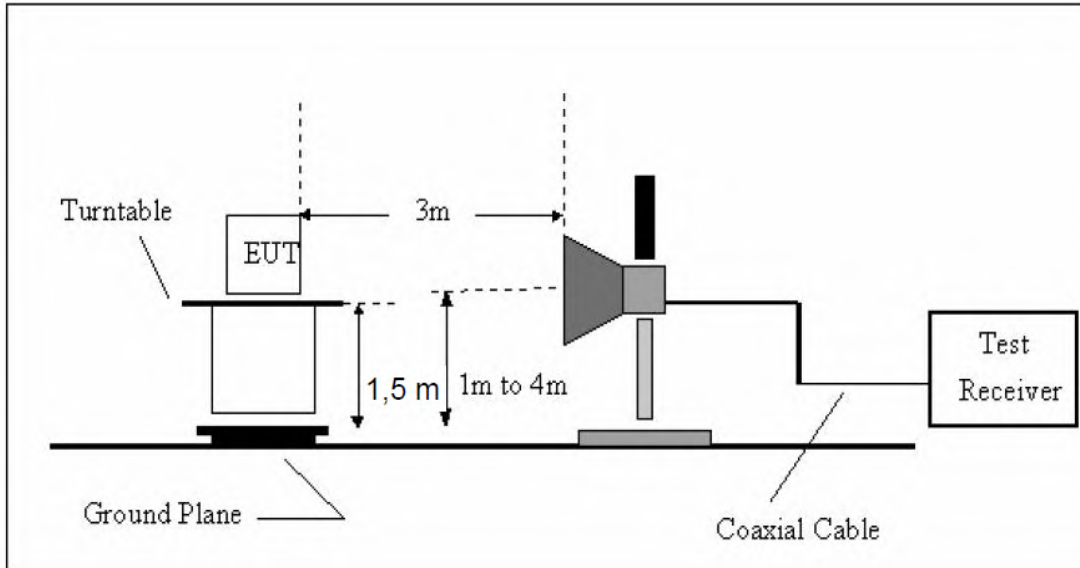
Tx. Spurious NVNT user 2479MHz Ant1 Emission



Date: 6.JUL.2022 11:59:24

9. Band Edge Compliance

9.1. Block Diagram of Test Setup



9.2. Limit

All the lower and upper band-edges emissions appearing within restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions outside operation shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

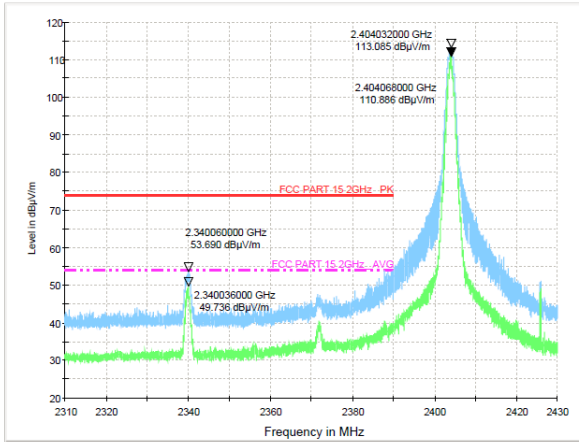
9.3. Test Procedure

All restriction band and non- restriction band have been tested , only worse case is reported.

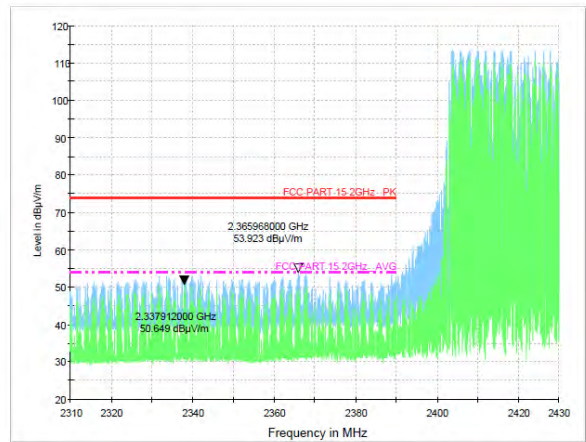
9.4. Test Result

PASS. (See below detailed test data)

Test Mode: GFSK-Low (2404MHz)

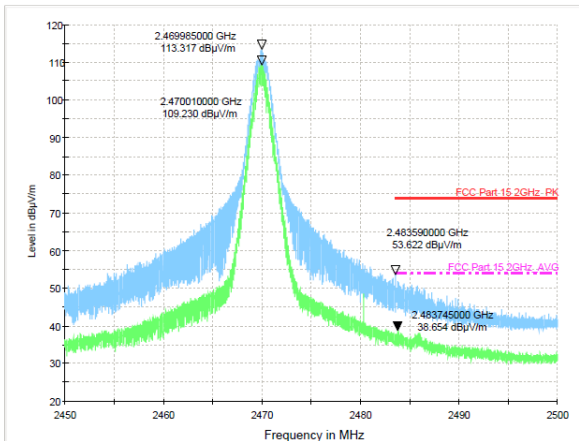


hopping-off

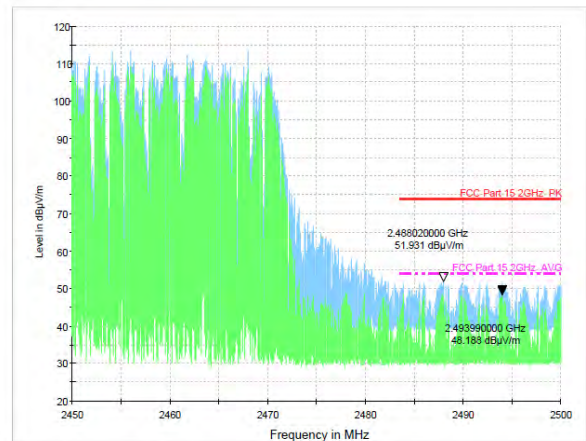


hopping-on

Test Mode: GFSK-Low (2470MHz)

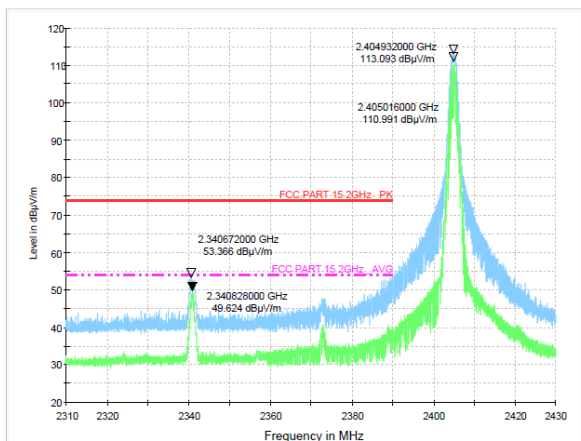


hopping-off

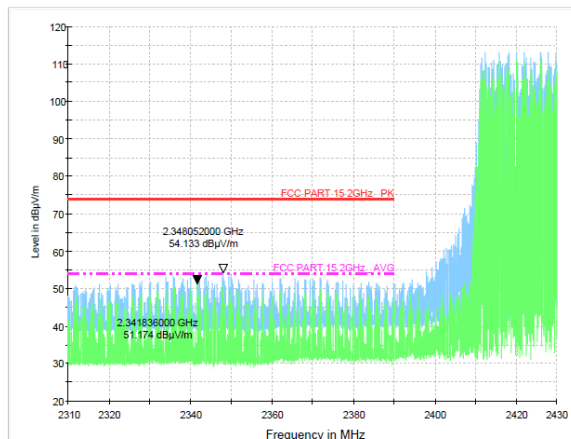


hopping-on

Test Mode: GFSK-High (2405MHz)

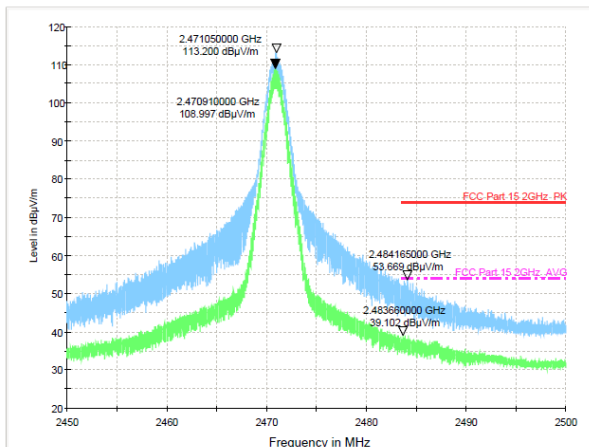


hopping-off

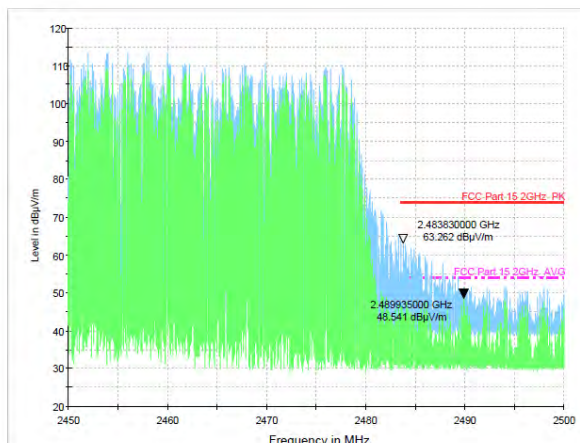


hopping-on

Test Mode: GFSK-High (2471MHz)

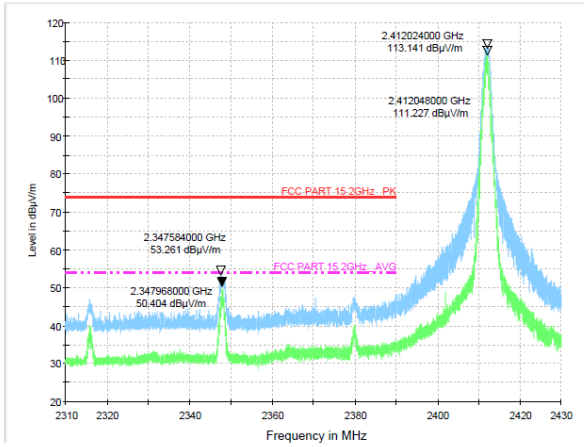


hopping-off

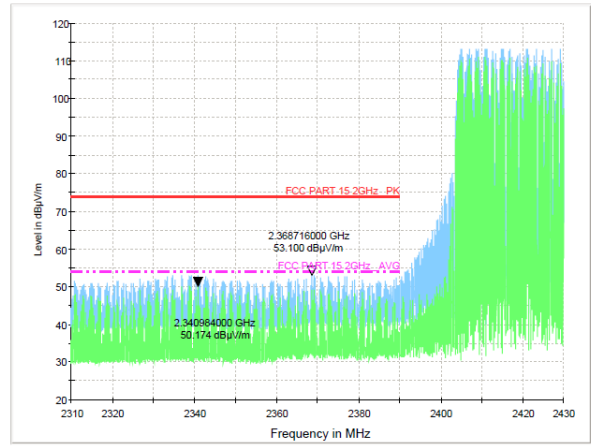


hopping-on

Test Mode: GFSK-Low (2412MHz)

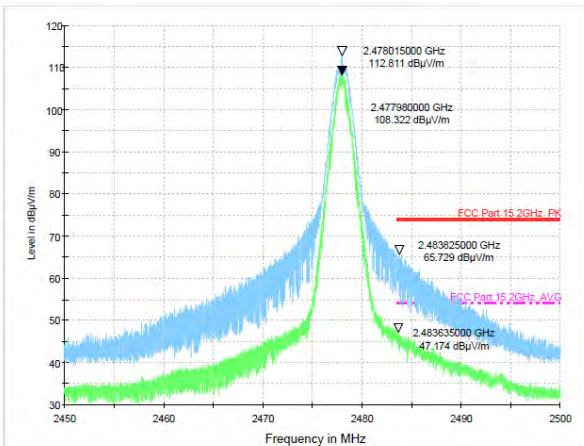


hopping-off

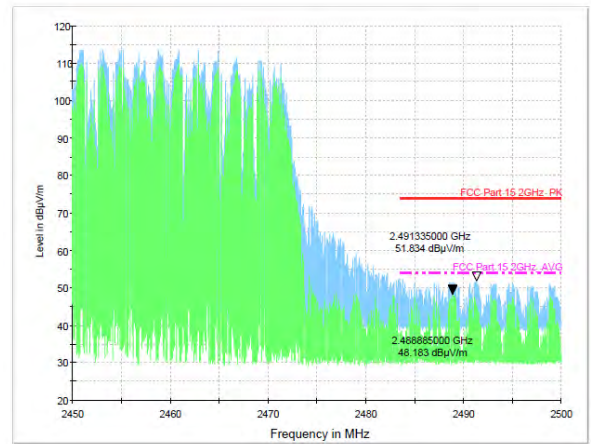


hopping-on

Test Mode: GFSK-Low (2478MHz)

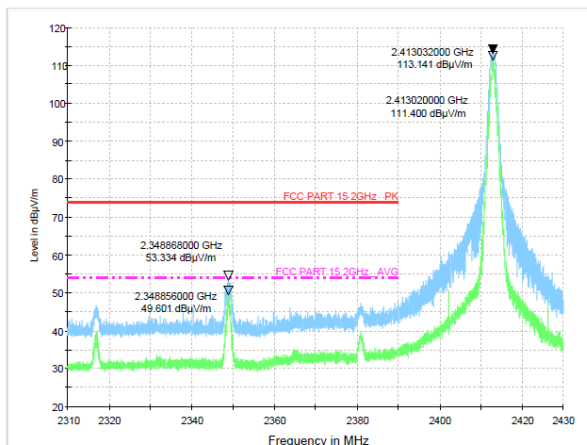


hopping-off

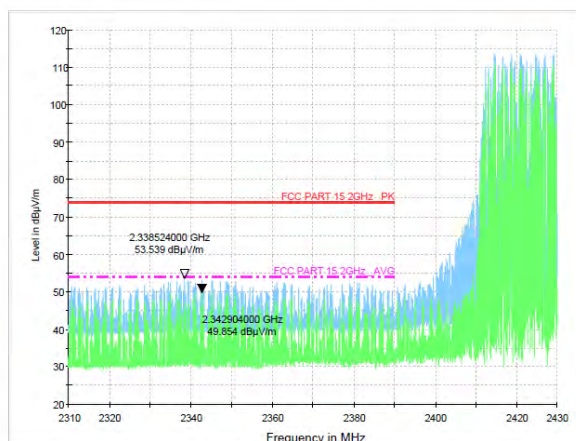


hopping-on

Test Mode: GFSK-High (2413MHz)

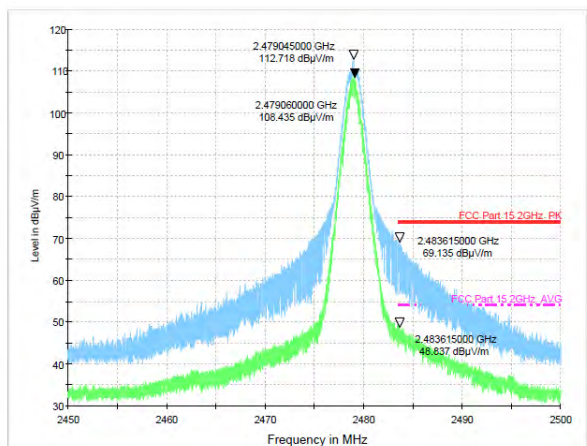


hopping-off

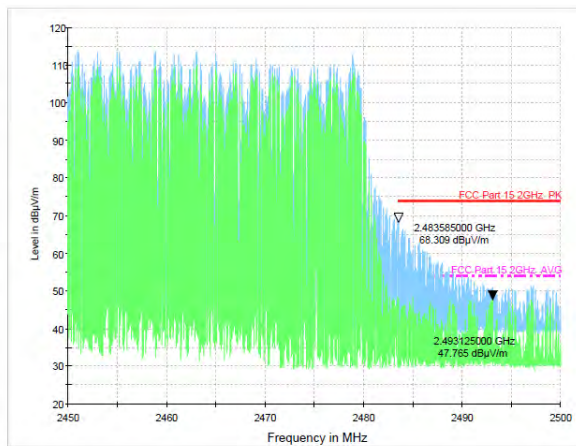


hopping-on

Test Mode: GFSK-High (2479MHz)



hopping-off



hopping-on

Note: 1. *:Maximum data; x:Over limit; !:over margin.

2. Measurement=Reading Level+Correct Factor; Correct Factor=Antenna Factor+Cable Loss.

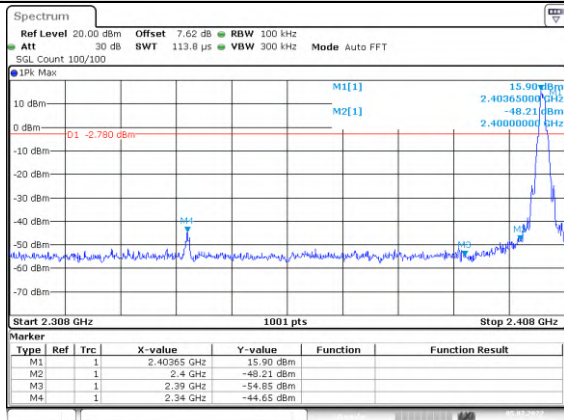
Conducted Method

GFSK Mode:

2404-2470 MHz:

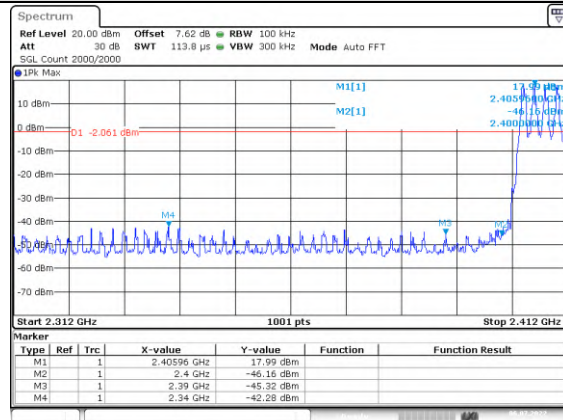
Test channel:

Lowest channel



Date: 5.JUL.2022 12:12:27

Hopping-off mode

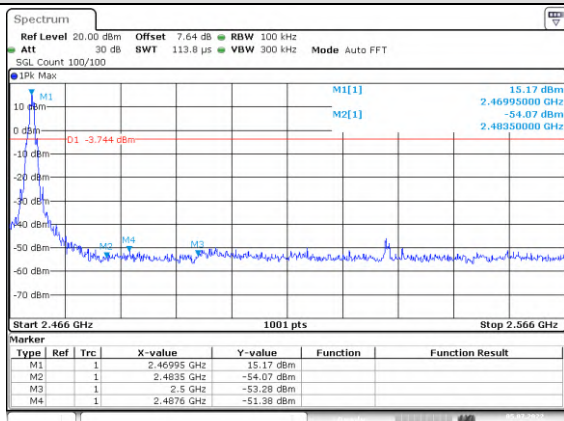


Date: 6.JUL.2022 09:39:09

Hopping-on mode

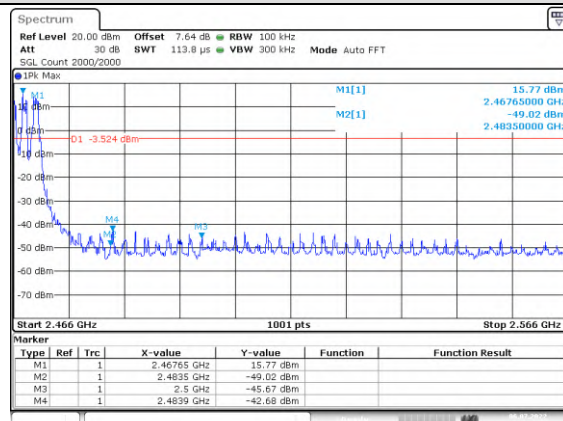
Test channel:

Highest channel



Date: 5.JUL.2022 12:22:24

Hopping-off mode

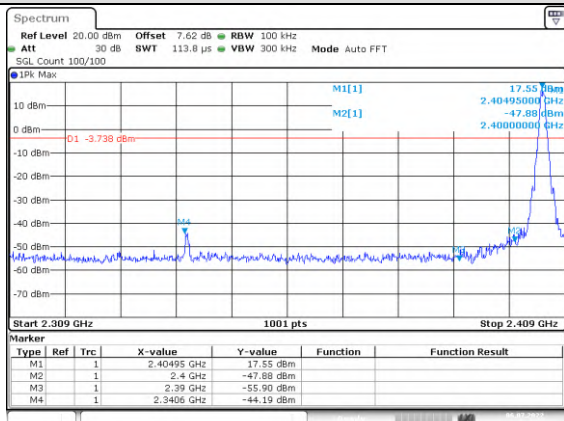


Date: 6.JUL.2022 09:46:05

Hopping-on mode

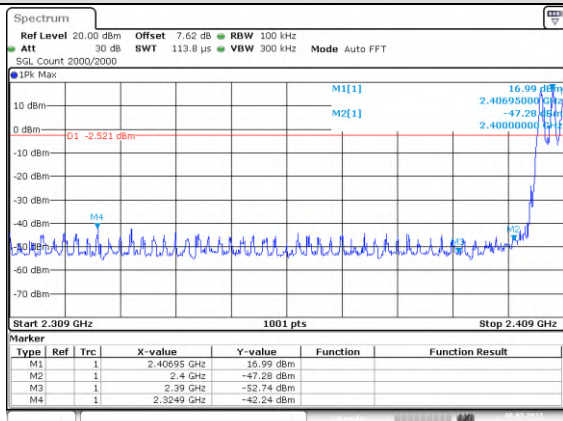
2405-2471 MHz:

Test channel: Lowest channel



Date: 6.JUL.2022 11:09:58

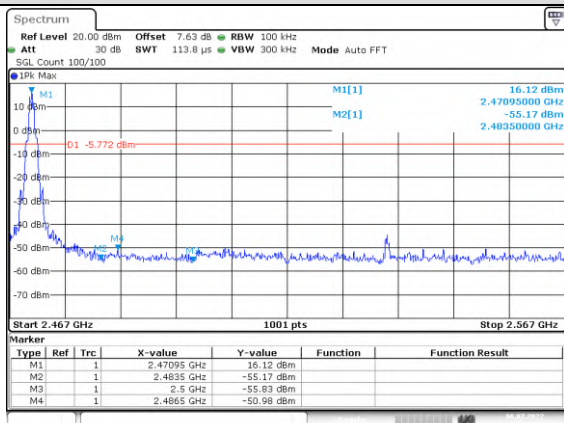
Hopping-off mode



Date: 6.JUL.2022 11:14:16

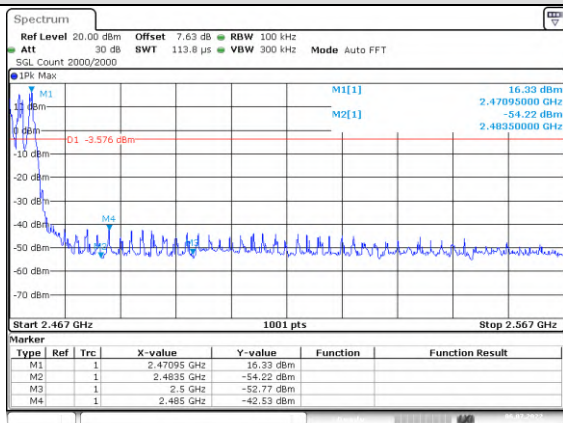
Hopping-on mode

Test channel: Highest channel



Date: 6.JUL.2022 11:04:28

Hopping-off mode

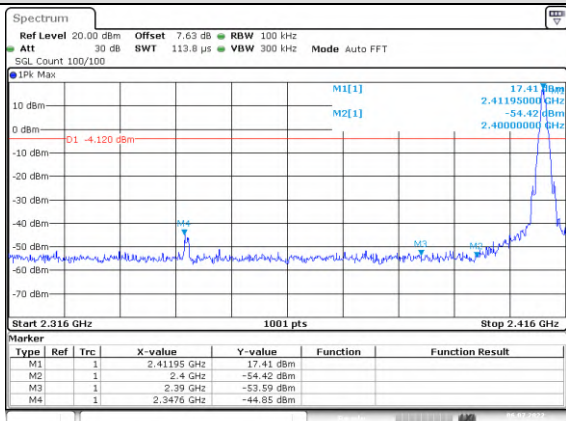


Date: 6.JUL.2022 11:21:35

Hopping-on mode

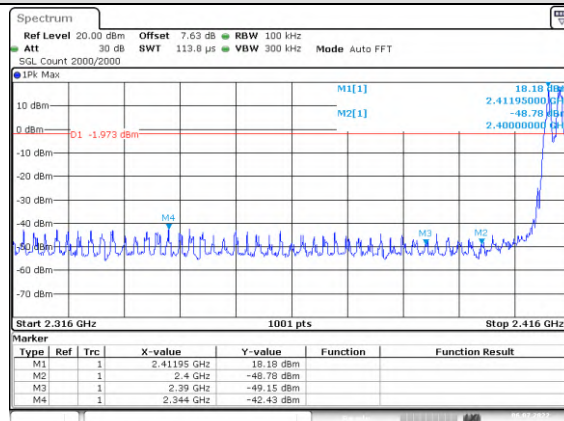
2412-2478 MHz:

Test channel: Lowest channel



Date: 6.JUL.2022 10:53:21

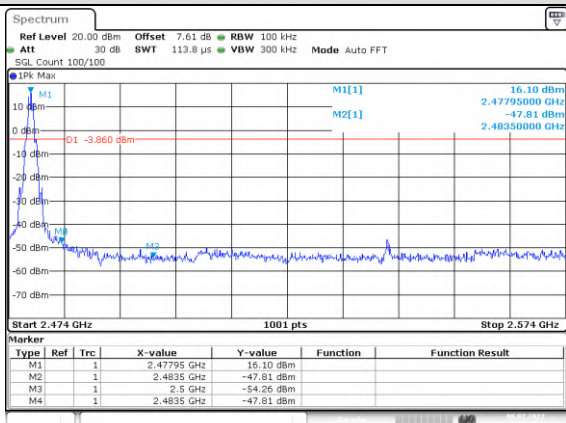
Hopping-off mode



Date: 6.JUL.2022 10:40:19

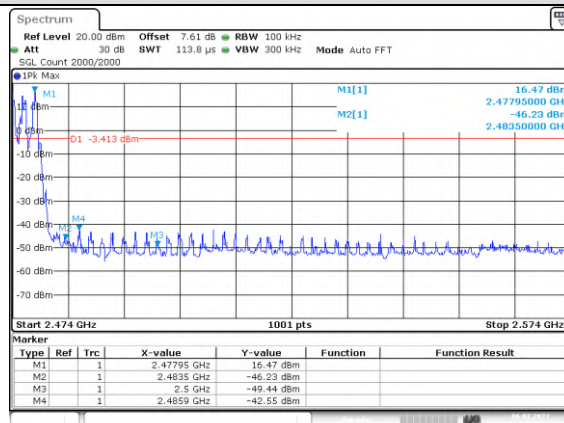
Hopping-on mode

Test channel: Highest channel



Date: 6.JUL.2022 10:59:22

Hopping-off mode

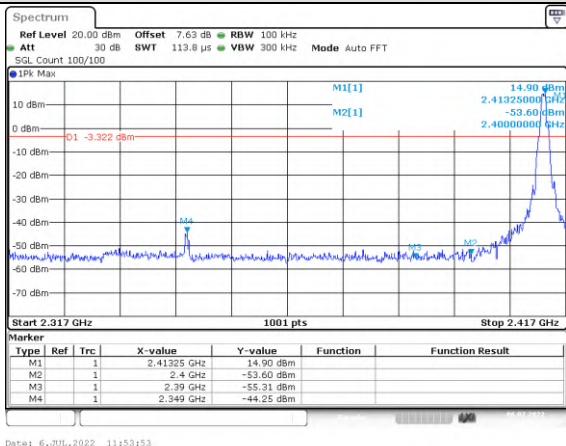


Date: 6.JUL.2022 10:51:49

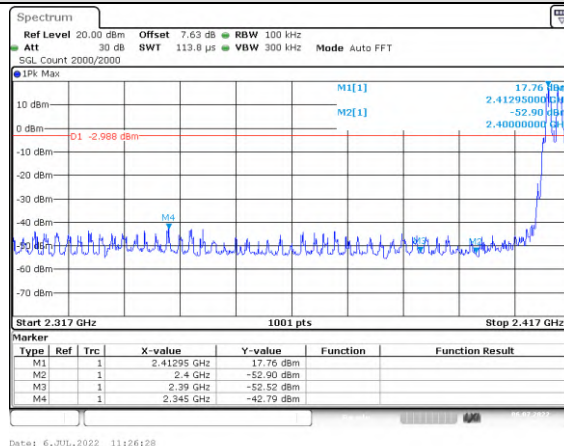
Hopping-on mode

2413-2479 MHz:

Test channel: Lowest channel

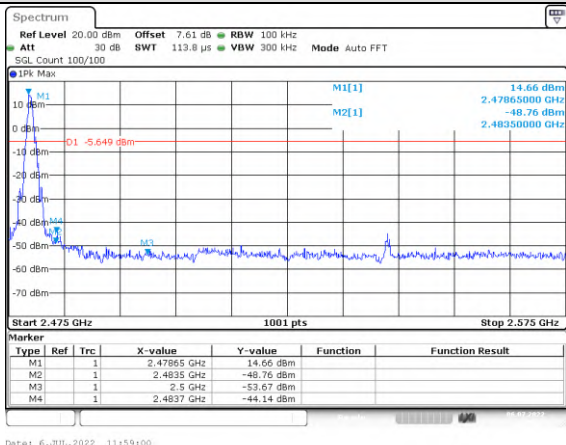


Hopping-off mode

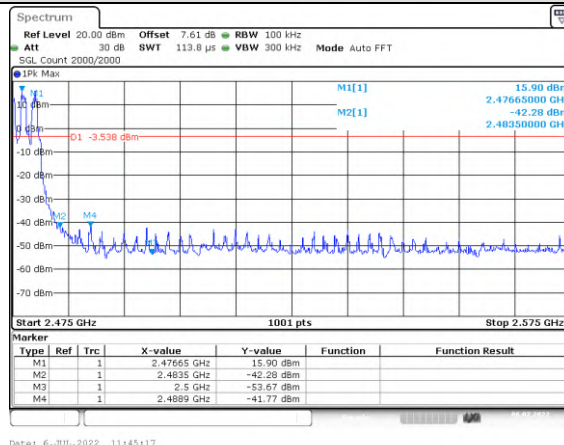


Hopping-on mode

Test channel: Highest channel



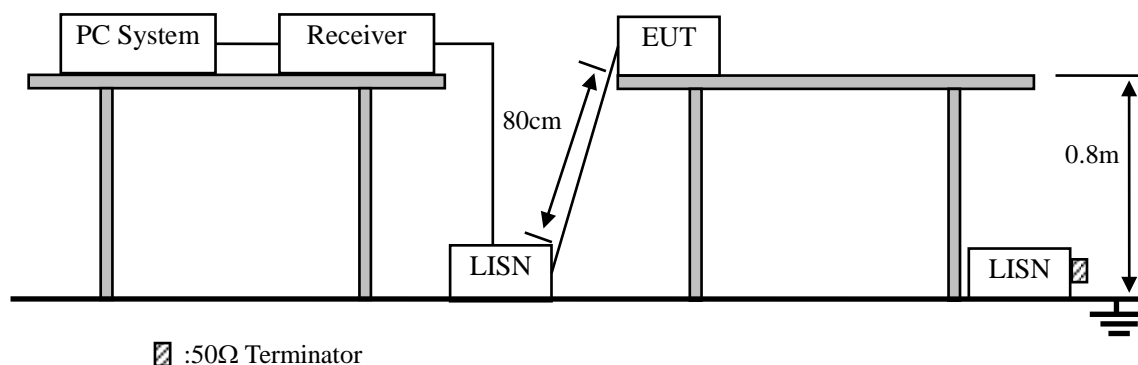
Hopping-off mode



Hopping-on mode

10. Power Line Conducted Emissions

10.1. Block Diagram of Test Setup



10.2. Limit

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

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

10.3. Test Procedure

- (1) The EUT was placed on a non-metallic table, 80cm above the ground plane.
- (2) Setup the EUT and simulator as shown in 10.1
- (3) The EUT Power connected to the power mains through a power adapter and a line impedance stabilization network (L.I.S.N1). The other peripheral devices power cord connected to the power mains through a line impedance stabilization network (L.I.S.N2), this provided a 50-ohm coupling impedance for the EUT (Please refer to the block diagram of the test setup and photographs). Both sides of power line were checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10:2013 on conducted Emission test.
- (4) The bandwidth of test receiver is set at 10kHz.
- (5) The frequency range from 150 KHz to 30MHz is checked.

10.4. Test Result

Not applicable for equipment operated with AAA battery power supply.

11. Antenna Requirements

11.1. Limit

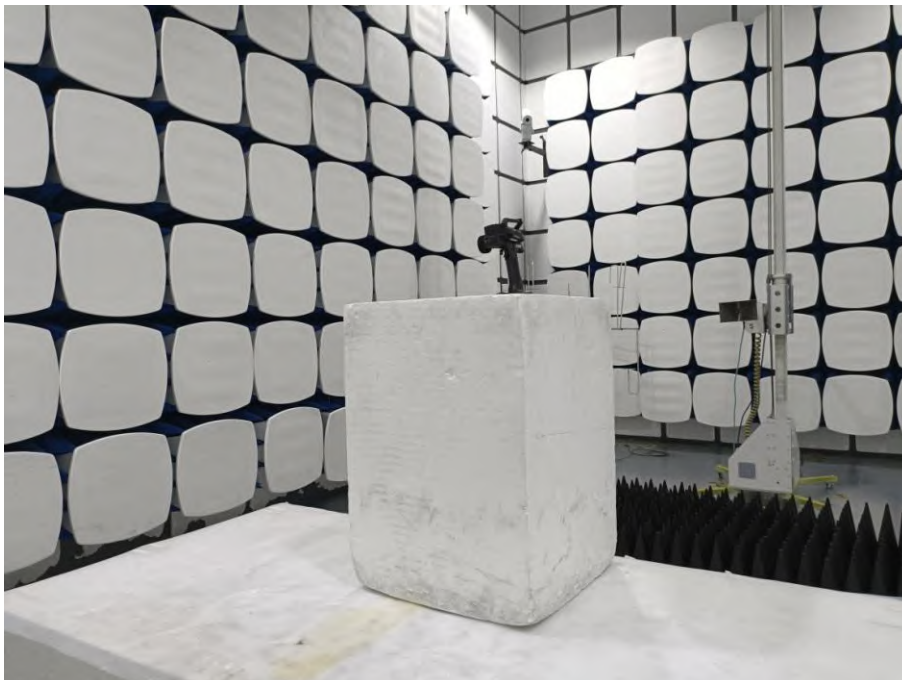
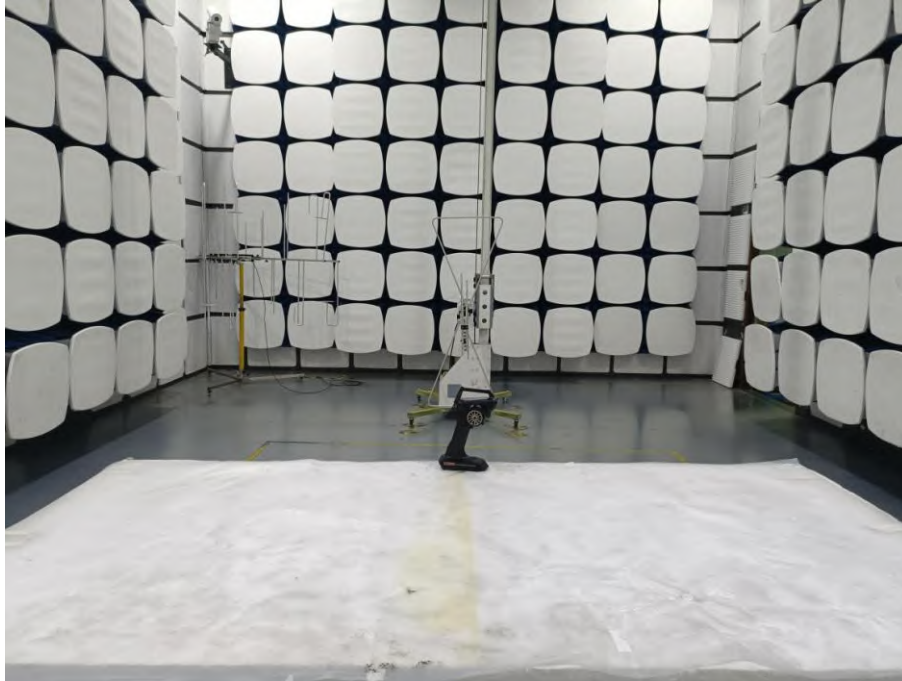
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

11.2. Result

The EUT antenna is internal antenna. It complies with the standard requirement.

12. Test Setup Photo

12.1. Photos of Radiated emission

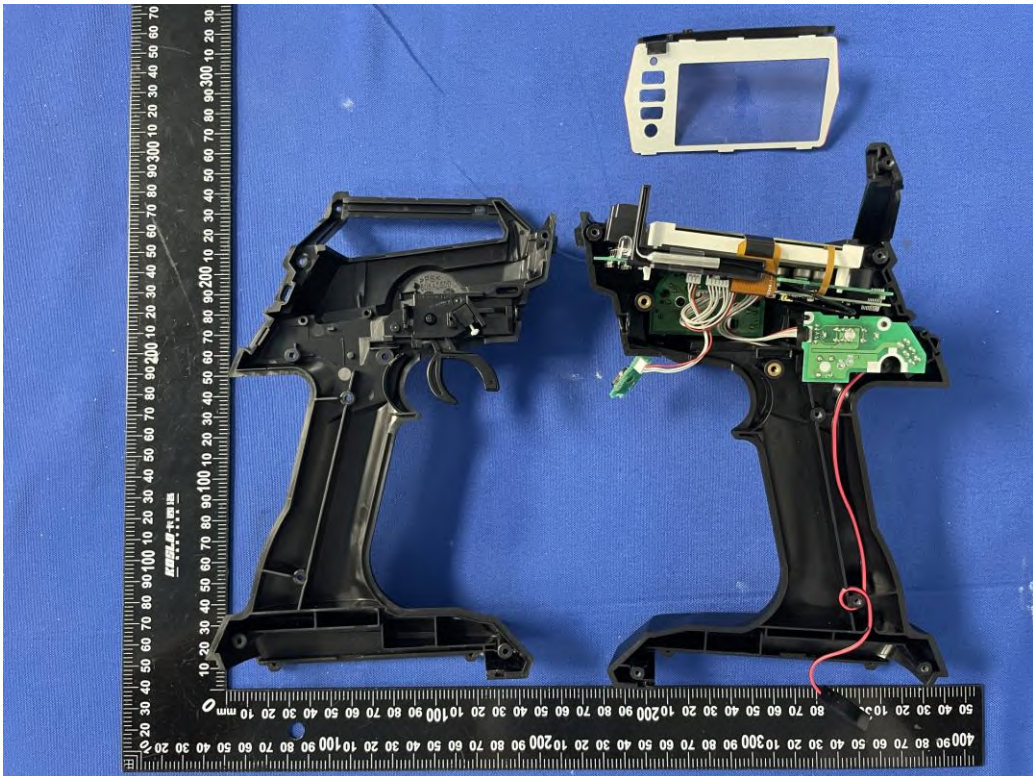


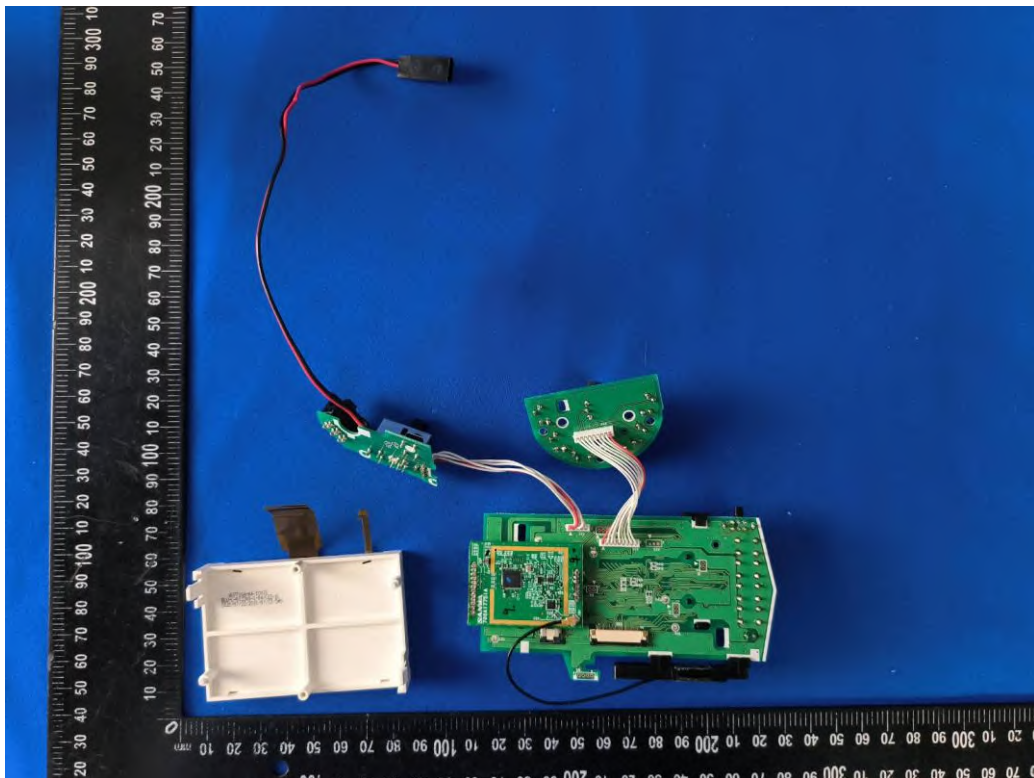
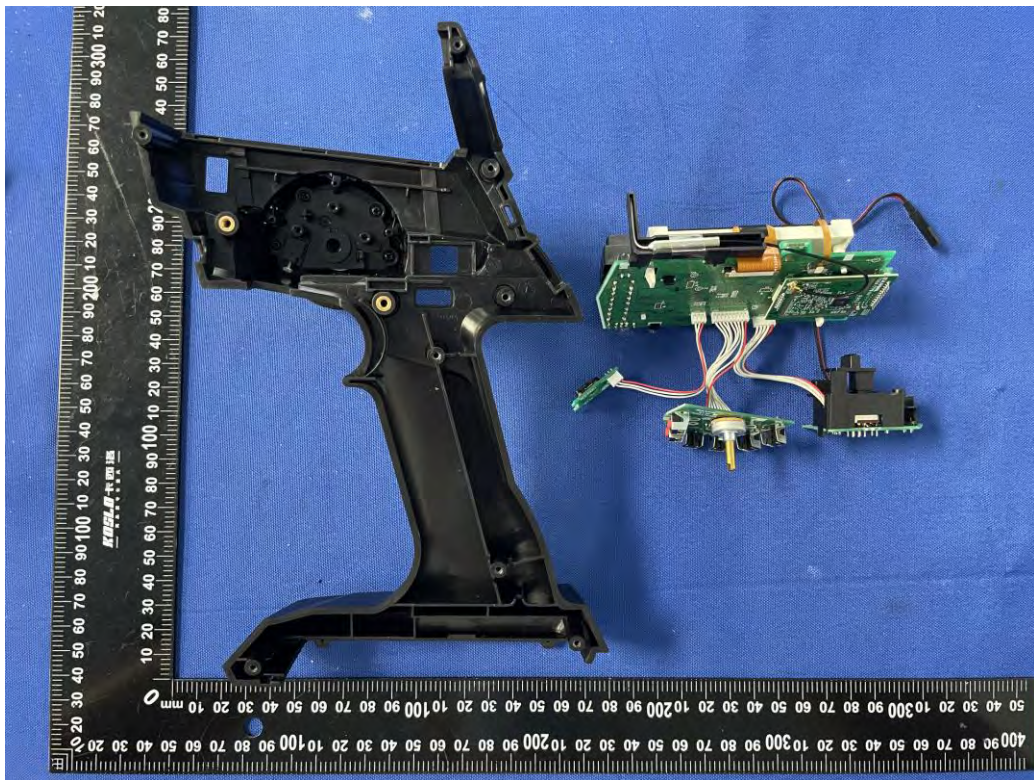
13. Photos Of The EUT

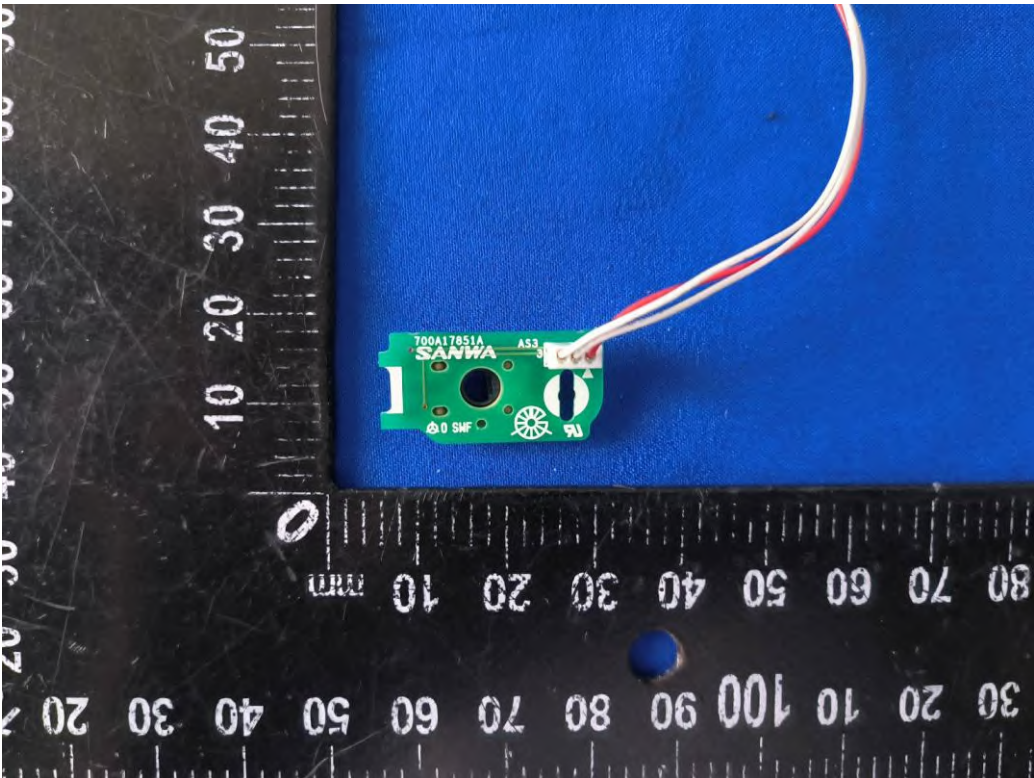
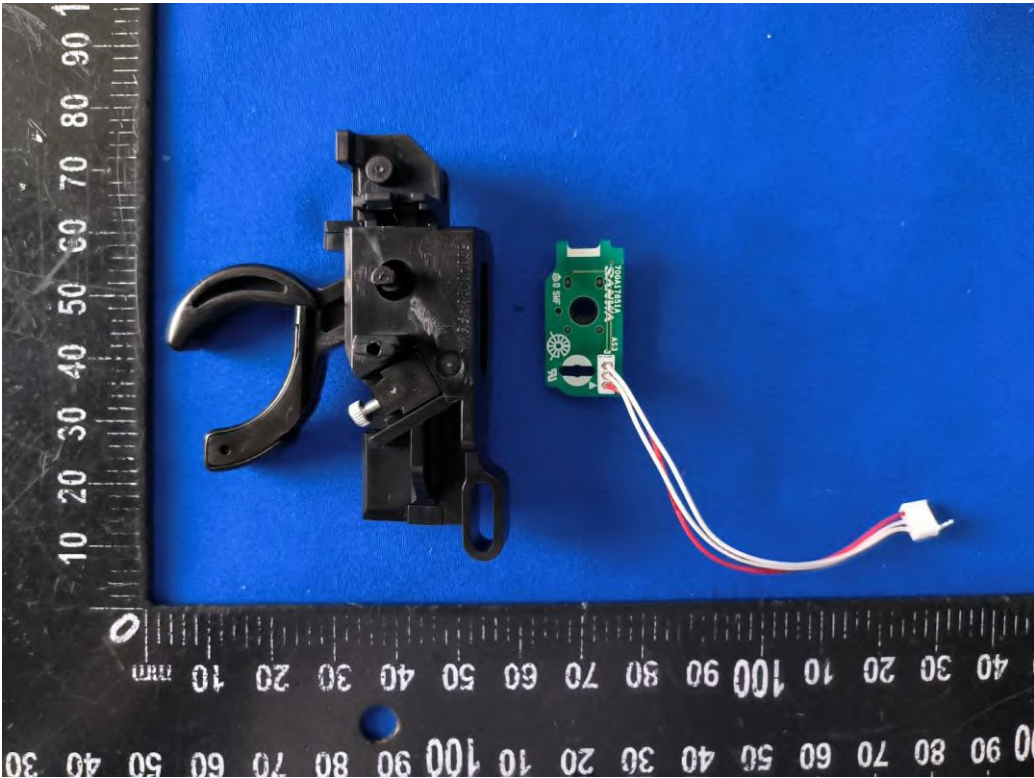


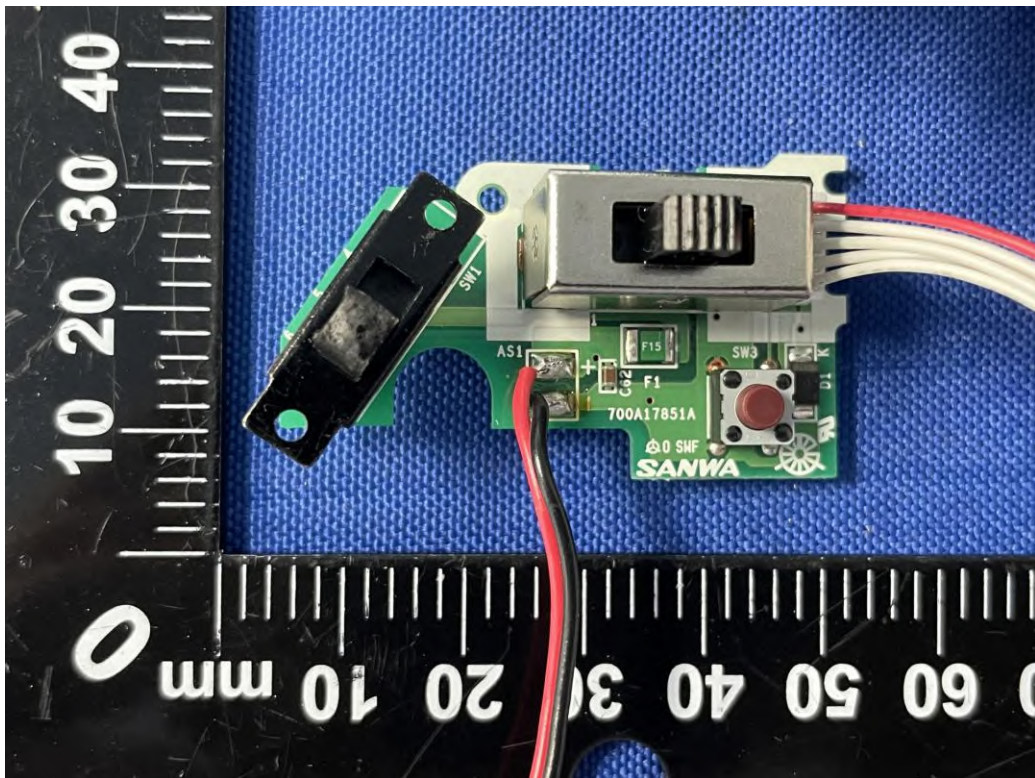
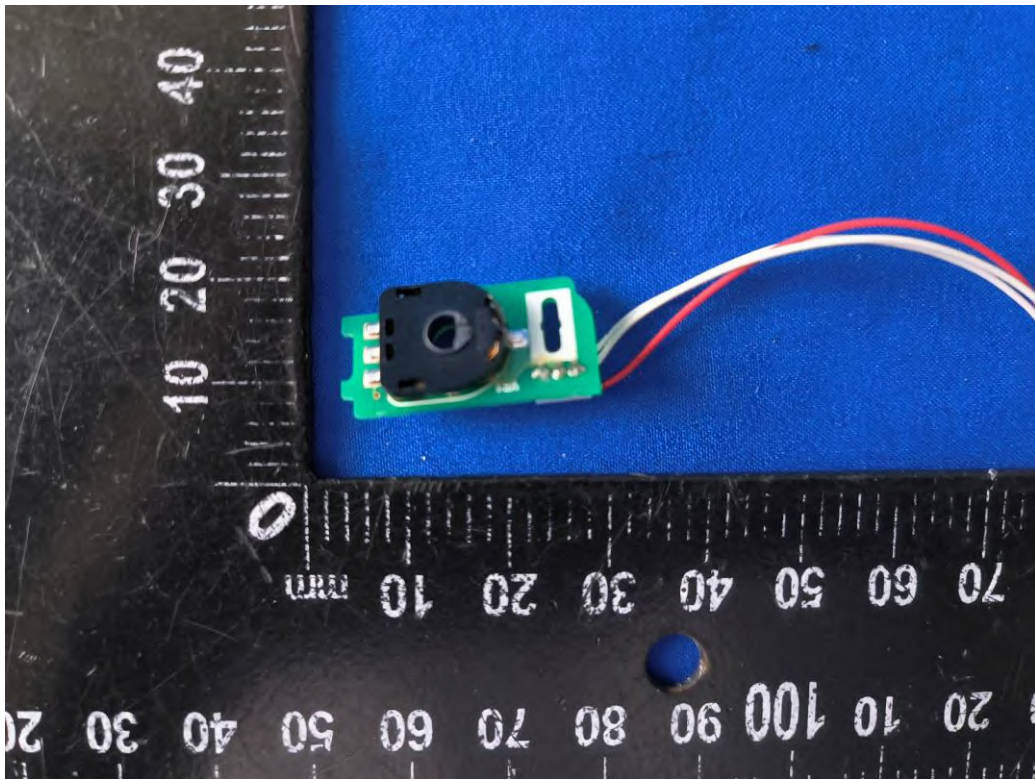


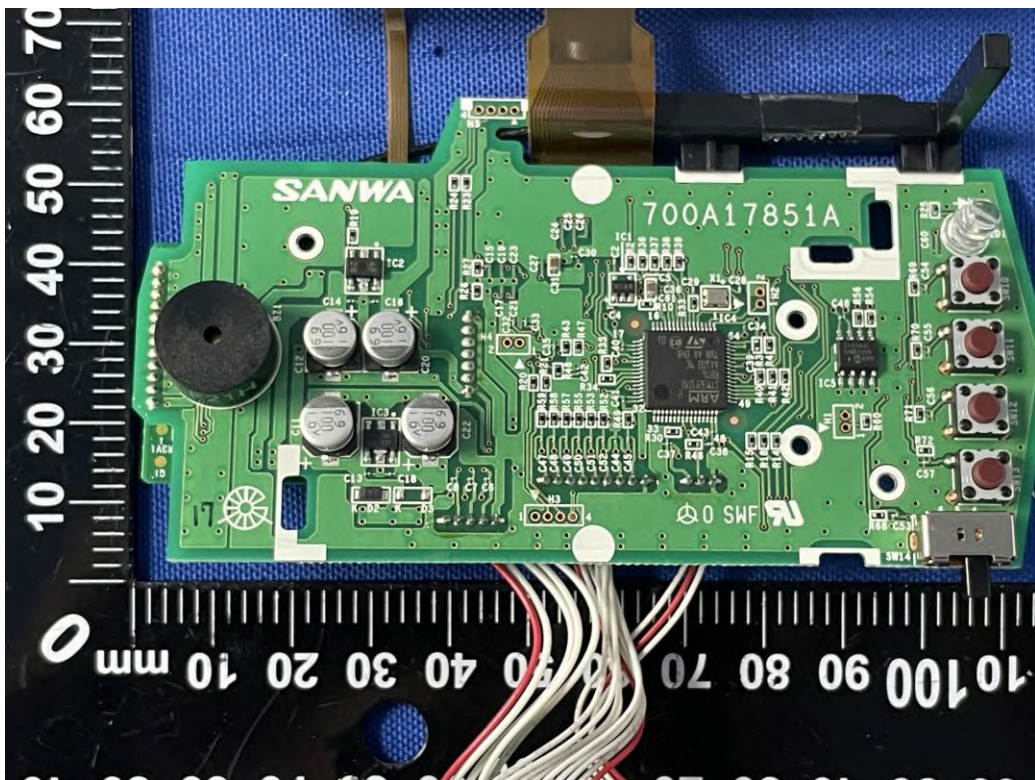
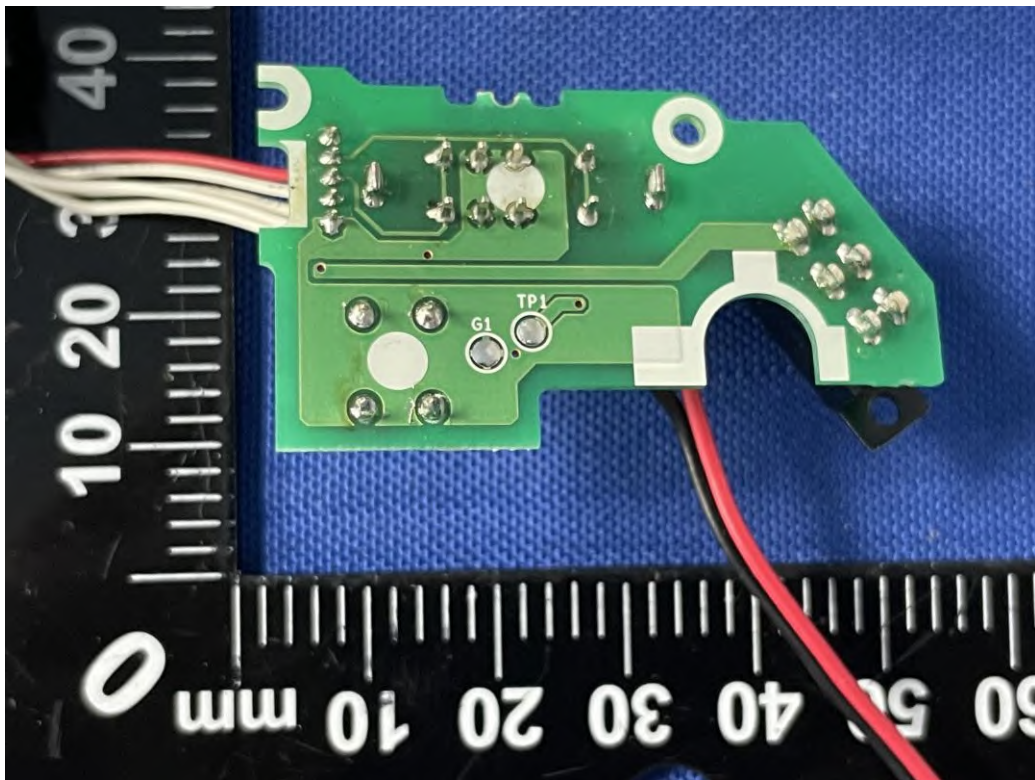


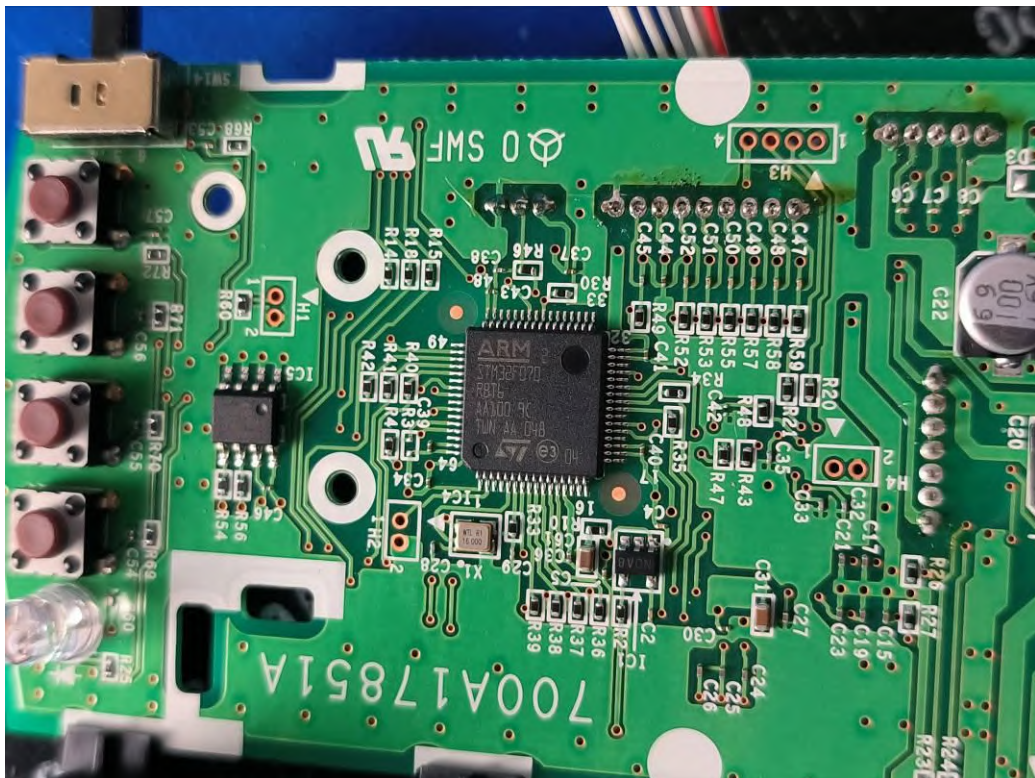
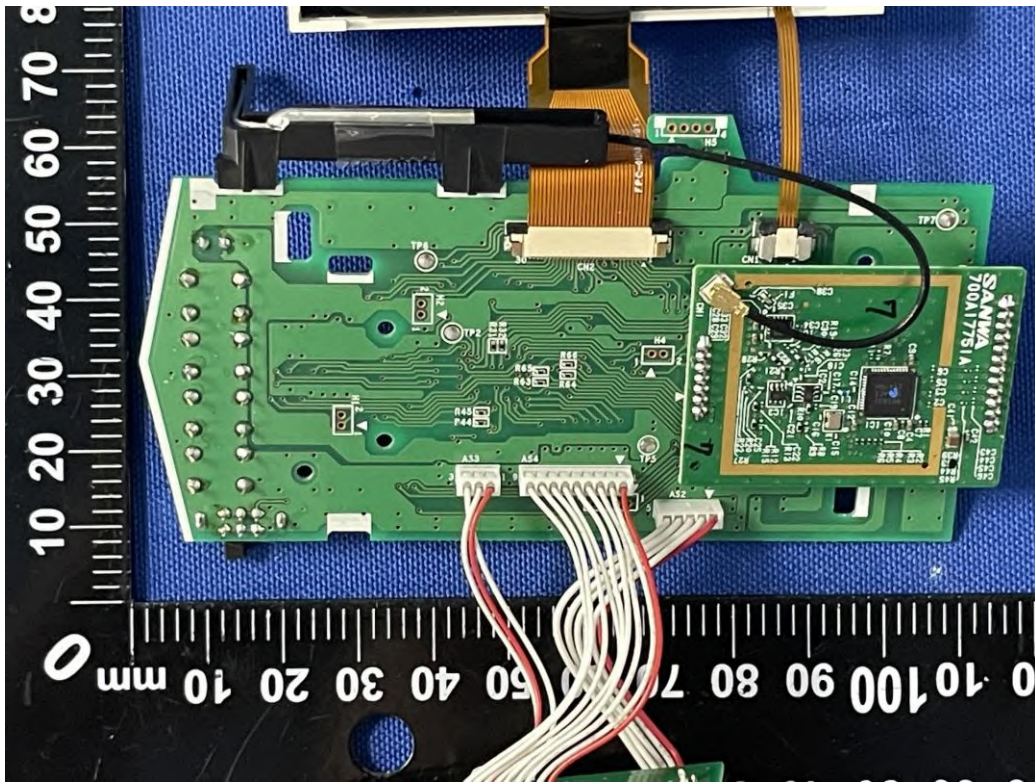


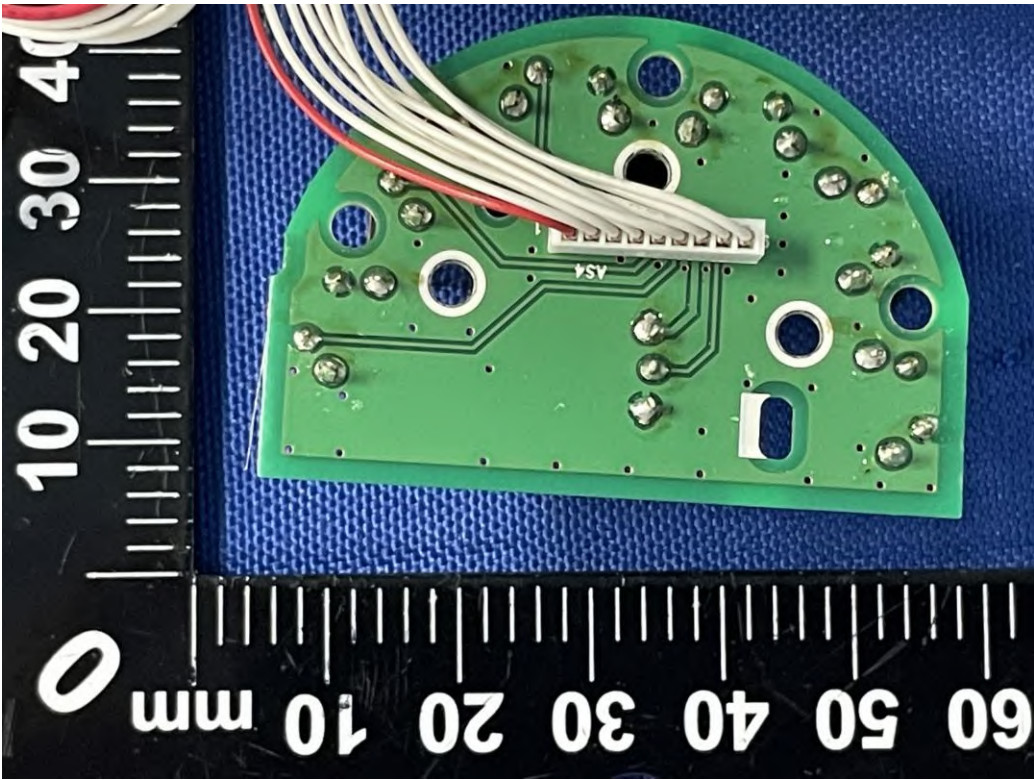
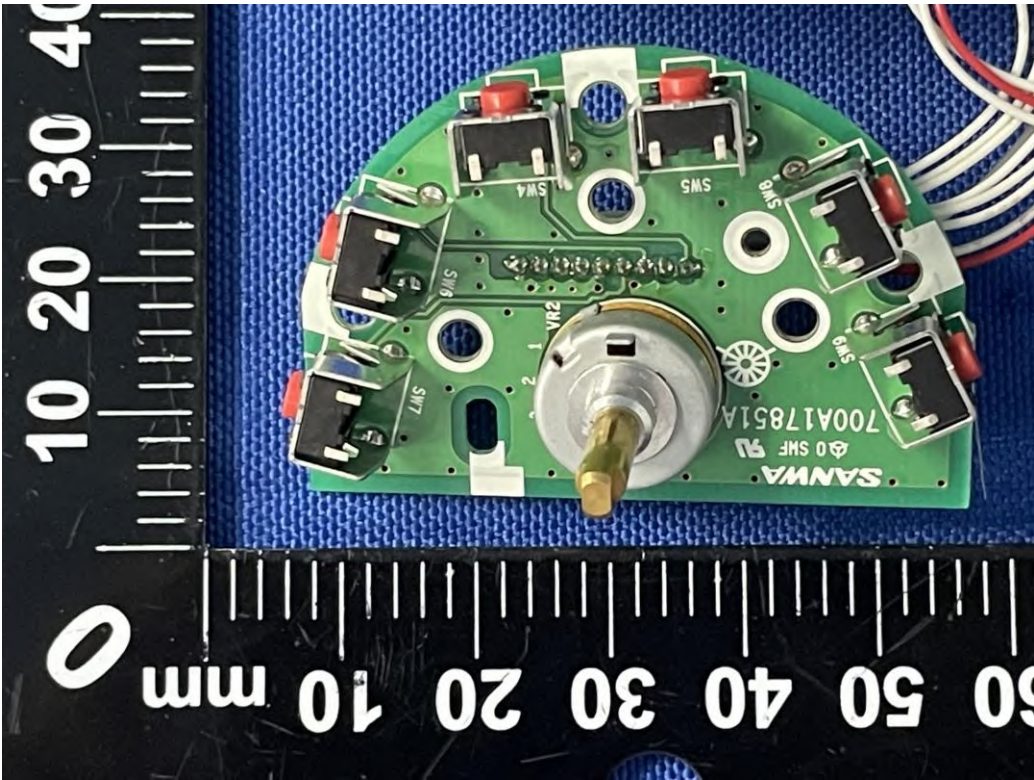


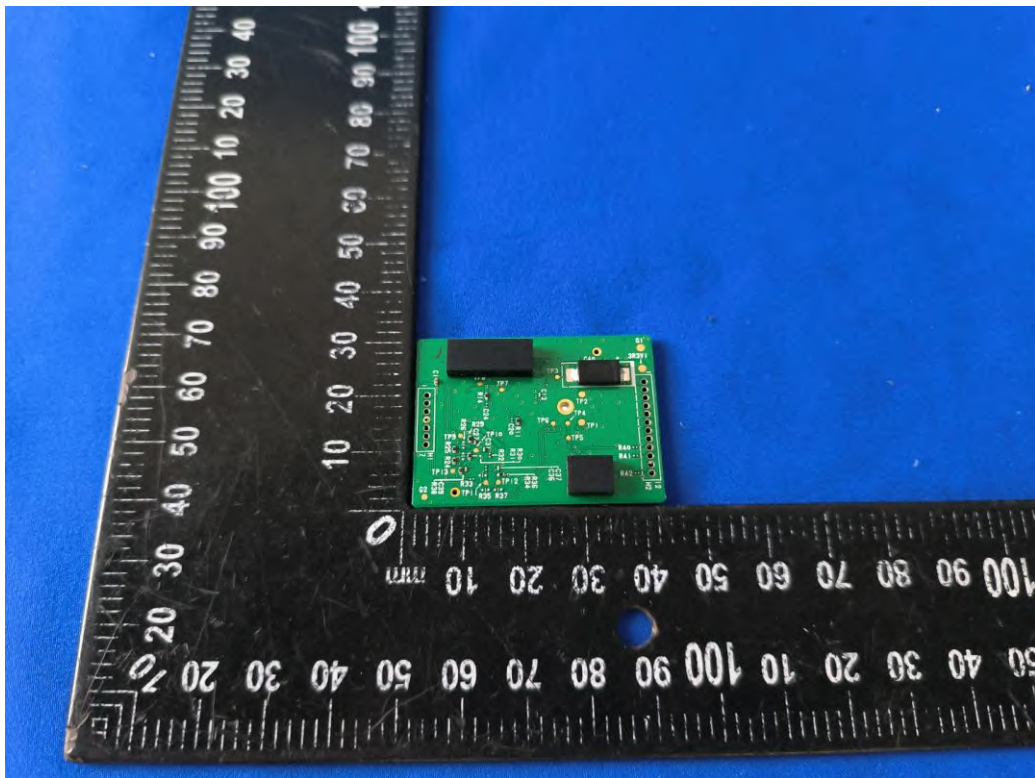
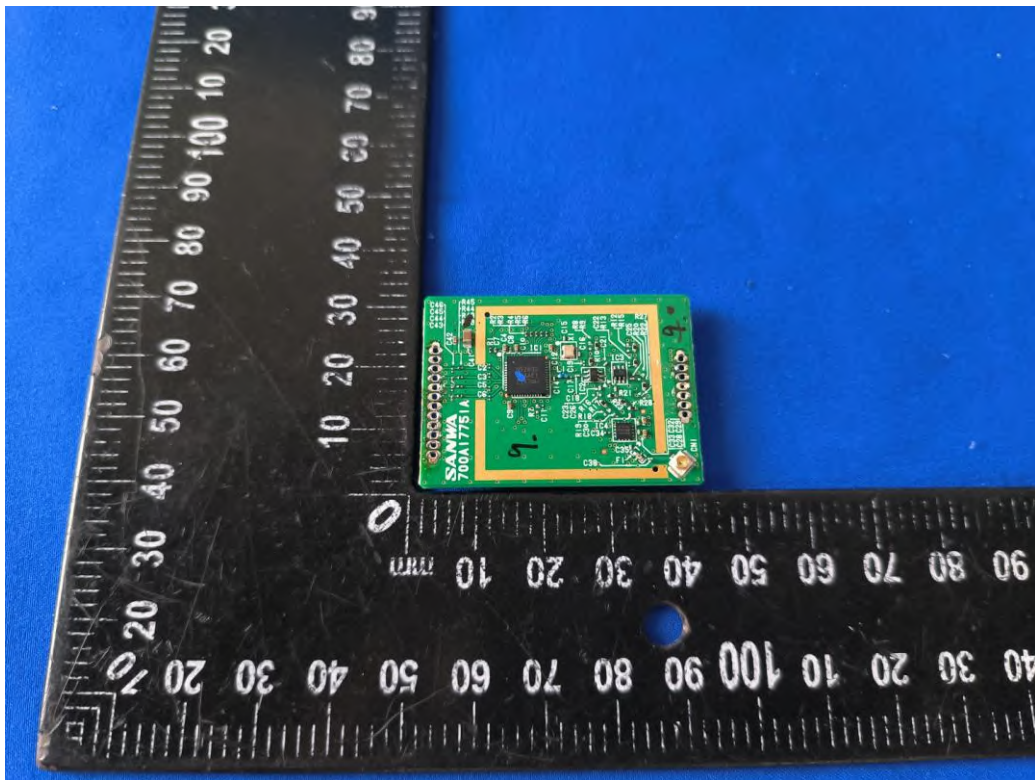


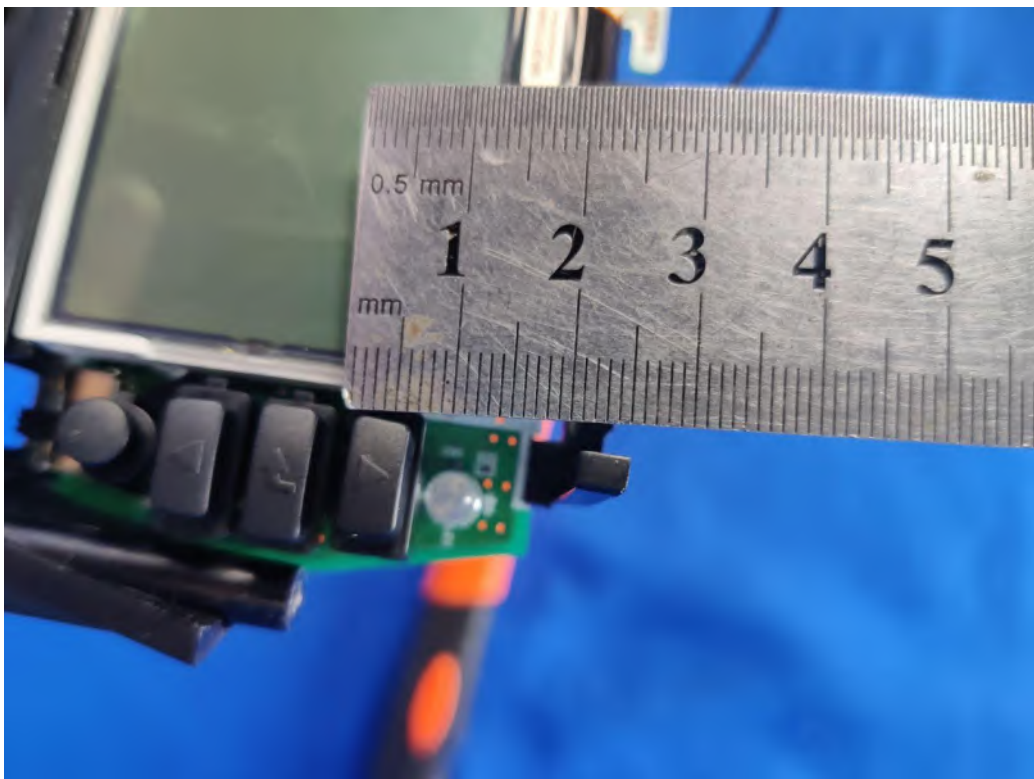
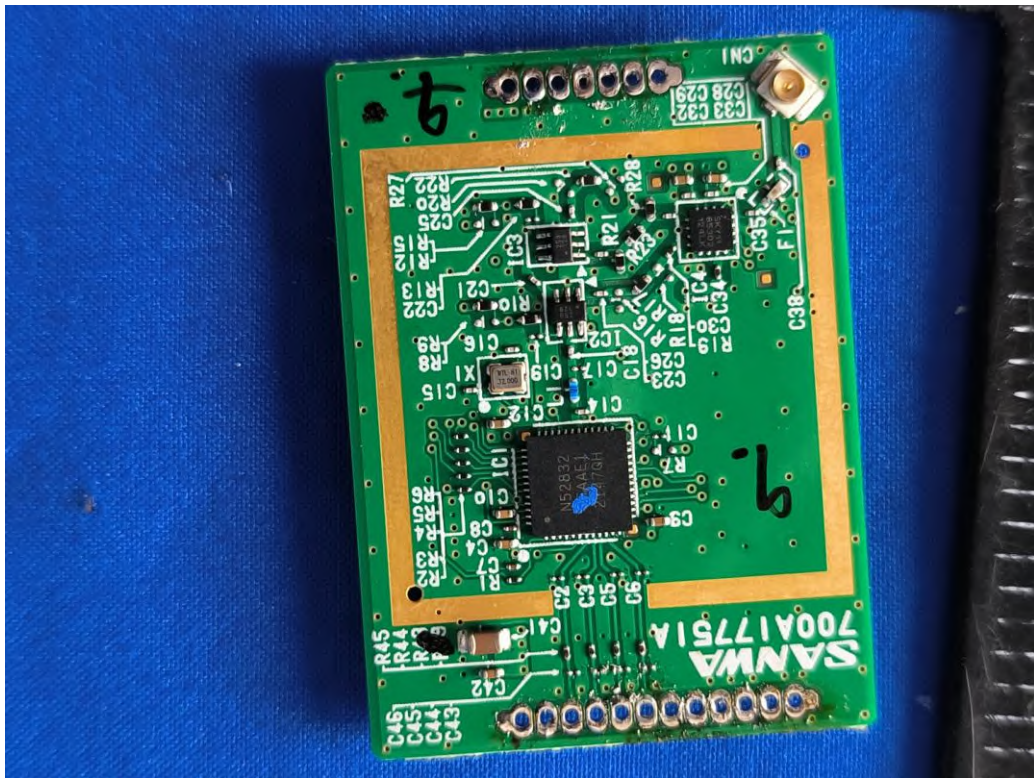












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