



FCC TEST REPORT

FCC ID: 2A3MU-C5

On Behalf of

Shanghai EFIX Geomatics Co.,Ltd

Geodetic GNSS Receiver

Model No.: C5

Prepared for : Shanghai EFIX Geomatics Co.,Ltd
Address : Building 1, 158 Shuanglian Road, Qingpu District, Shanghai

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

Report Number : A2206032-C02-R03
Date of Receipt : June 6, 2022
Date of Test : June 6, 2022 - June 27, 2022
Date of Report : June 29, 2022
Version Number : V0

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TEST REPORT DECLARATION

Applicant : Shanghai EFIX Geomatics Co.,Ltd
Address : Building 1, 158 Shuanglian Road, Qingpu District, Shanghai
Manufacturer : Shanghai EFIX Geomatics Co.,Ltd
Address : Building 1, 158 Shuanglian Road, Qingpu District, Shanghai
EUT Description : Geodetic GNSS Receiver
(A) Model No. : C5
(B) Trademark : 

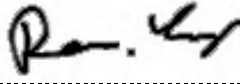
Measurement Standard Used:

**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 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).....: Reak Yang
Project Engineer 

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

Date of issue.....: June 29, 2022

Revision History

Revision	Issue Date	Revisions	Revised By
V0	June 29, 2022	Initial released Issue	Reak Yang

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)	P
Bandwidth	FCC Part 15: 15.215	P
Carrier Frequency Separation	FCC Part 15: 15.247(a)(1)	P
Number Of Hopping Channel	FCC Part 15: 15.247(a)(1)	P
Dwell Time	FCC Part 15: 15.247(a)(1)	P
Radiated Emission	FCC Part 15: 15.209 FCC Part 15: 15.247(d)	P
Band Edge Compliance	FCC Part 15: 15.247(d)	P
Power Line Conducted Emissions	FCC Part 15: 15.207	P
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. 4. The conclusion of this test report is judged by actual test data without considering measurement uncertainty.	

2. General Information

2.1. Description of Device (EUT)

Description/PMN : Geodetic GNSS Receiver

Model : C5

Number/HVIN(s)

Diff. : N/A

Trademark



Test Voltage : DC 8.4V From Battery, DC 5V From Adapter

Radio Technology : Bluetooth EDR

Operation : 2402MHz-2480MHz
frequency

Modulation : GFSK, $\pi/4$ -DQPSK, 8DPSK

Channel No. : 79 Channels

Channel Separation : 1MHz

Antenna Type : Internal Antenna, max gain 1.56dBi. (Antenna information is provided by applicant.)

Software version : V1.0

Hardware version : V1.7.2

Remark:

1. The worst-case simultaneous transmission configuration was evaluated with no non-compliance found. Results in this report are only for Bluetooth EDR function, and there is no other transmitter involved.

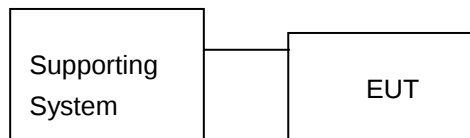
2.2. Accessories of Device (EUT)

Accessories : AC Adapter
 Manufacturer : Yisheng Electronics Co., Ltd.
 Model : EA1012AVRU-050
 Rating : Input: AC 100-240V, 1.0A, 50-60Hz
 Output: DC 5V,2.4A

2.3. Tested Supporting System Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDOC
1.	Notebook PC	Lenovo	ThinkPad E14	N/A	SDOC

2.4. Block Diagram of connection between EUT and simulators



2.5. Test Mode Description

The test software “RFTTestTool.app” was used to control EUT work in Continuous TX mode, and select test channel, wireless mode

Tested mode, channel, and data rate information		
Mode	Channel	Frequency (MHz)
Carrier Tx Mode	CH0	2402
	CH39	2441
	CH78	2480
GFSK / Pi/4-DQPSK/8DPSK hopping on Tx Mode	CH0 to CH78	2402 to 2480
GFSK / Pi/4-DQPSK/8DPSK hopping off Tx Mode	CH0	2402
	CH39	2441
	CH78	2480

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

Designation Number: CN1236

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	1316.3003K03-10 2082-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-1000 -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	V2.0.0.0

3. Maximum Peak Output Power

3.1. Limit

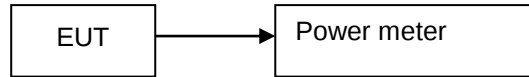
Please refer FCC part 15.247 & RSS-247..

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 Power meter is set to the peak power detection.

3.3. Test Setup



3.4. Test Result

Mode	Freq (MHz)	PK Output Power (dBm)	Limit (dBm)	Result
GFSK	2402	3.482	30	Pass
	2441	3.982	30	Pass
	2480	3.556	30	Pass
$\pi/4$ DQPSK	2402	2.888	21	Pass
	2441	3.512	21	Pass
	2480	3.514	21	Pass
8DPSK	2402	2.82	21	Pass
	2441	3.433	21	Pass
	2480	3.151	21	Pass
Conclusion: PASS				

4. Bandwidth

4.1. Limit

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in RSS-GEN, FCC Section 15.247(a)(1), 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.

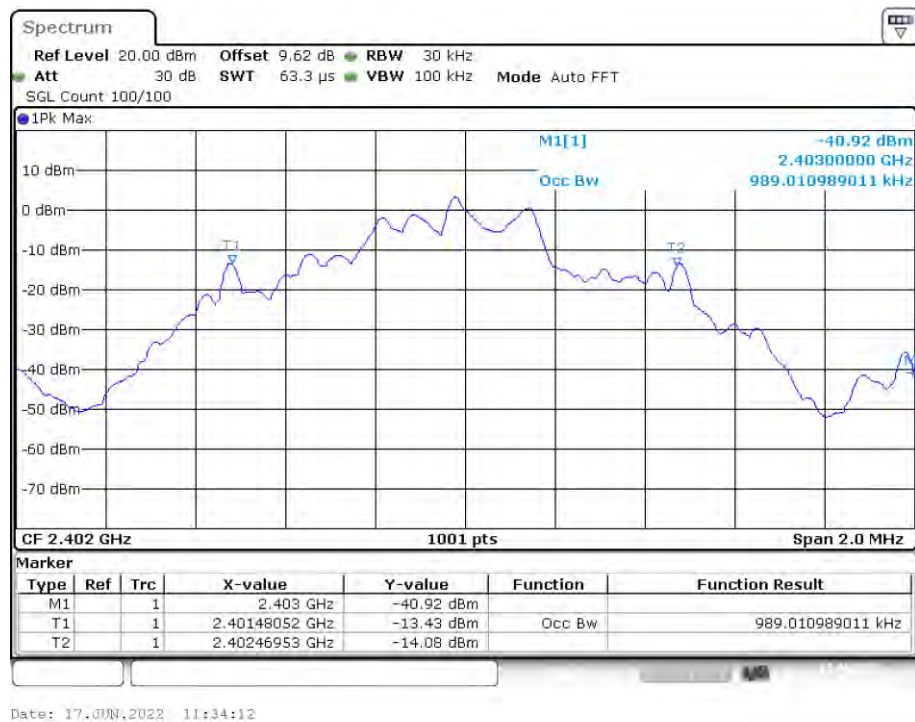
4.2. Test Procedure

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.

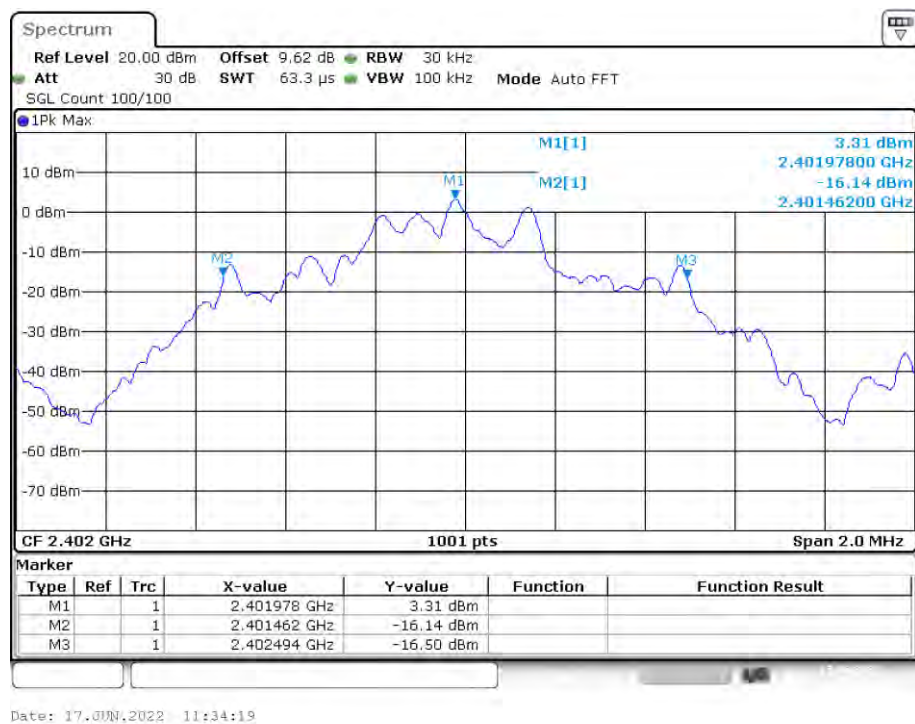
4.3. Test Result

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-20 dB Bandwidth (MHz)	Limit -20 dB Bandwidth (MHz)	Verdict
NVNT	1-DH1	2402	Ant 1	0.989	1.032	/	Pass
NVNT	1-DH1	2441	Ant 1	0.989	1.032	/	Pass
NVNT	1-DH1	2480	Ant 1	0.993	1.032	/	Pass
NVNT	2-DH1	2402	Ant 1	1.171	1.224	/	Pass
NVNT	2-DH1	2441	Ant 1	1.157	1.226	/	Pass
NVNT	2-DH1	2480	Ant 1	1.171	1.214	/	Pass
NVNT	3-DH1	2402	Ant1	1.115	1.15	/	Pass
NVNT	3-DH1	2441	Ant1	1.111	1.16	/	Pass
NVNT	3-DH1	2480	Ant1	1.115	1.162	/	Pass

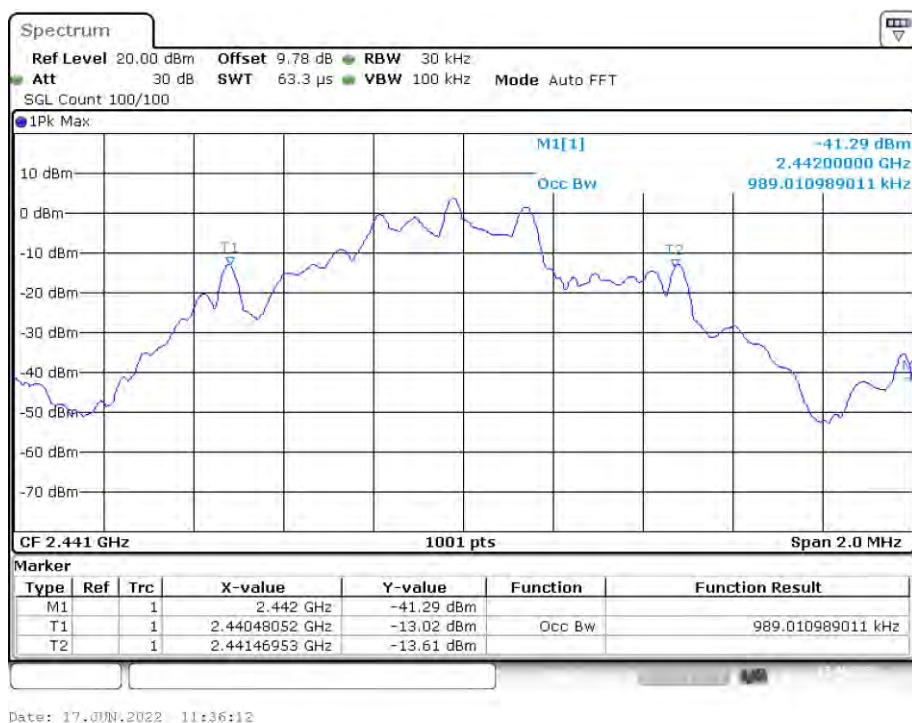
OBW NVNT 1-DH1 2402MHz Ant1



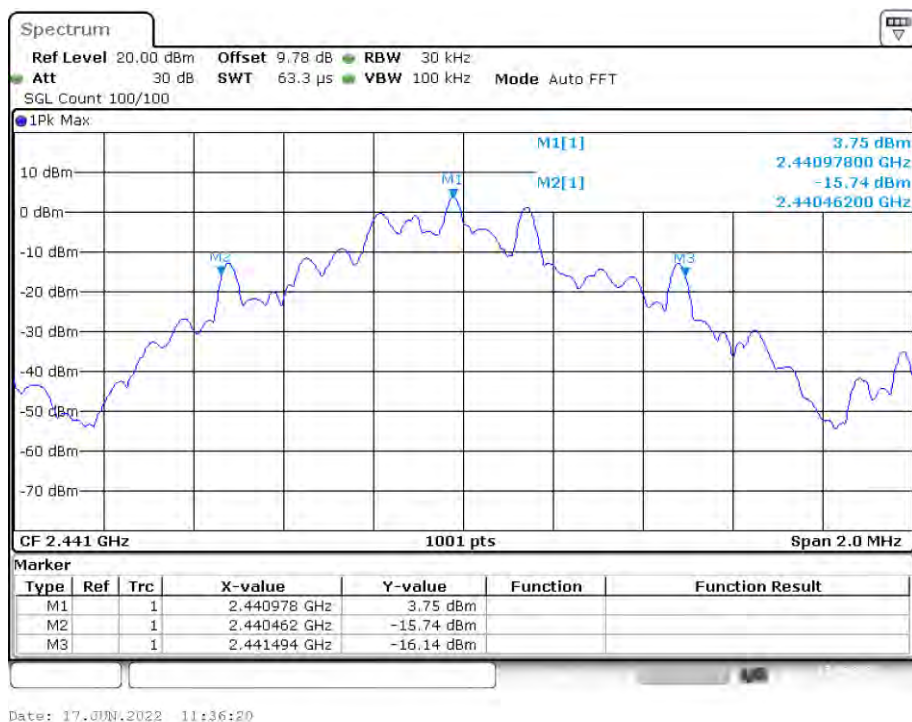
-20 dB BW NVNT 1-DH1 2402MHz Ant1



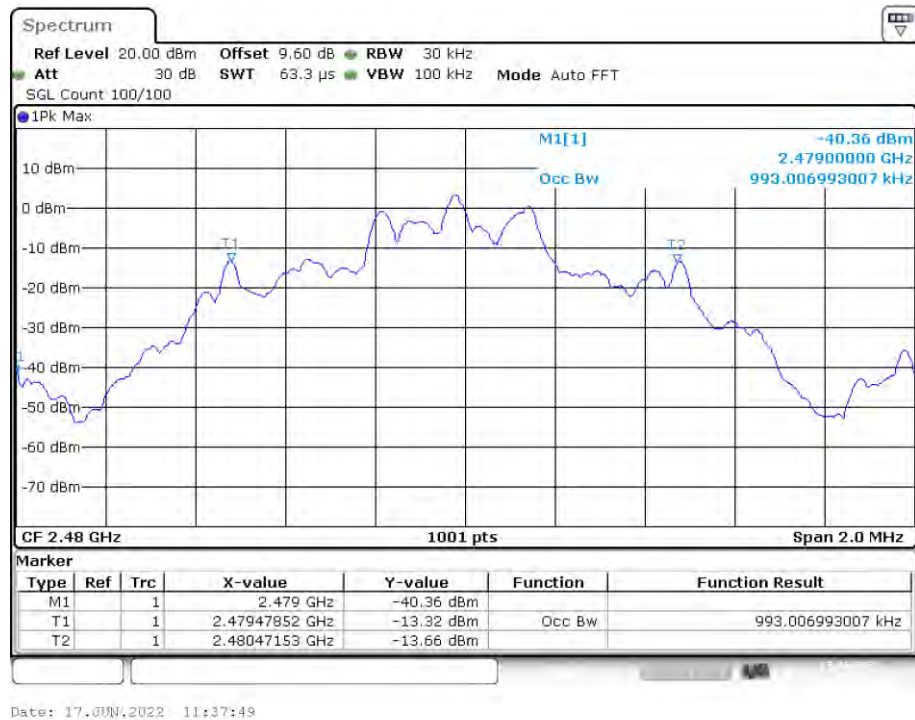
OBW NVNT 1-DH1 2441MHz Ant1



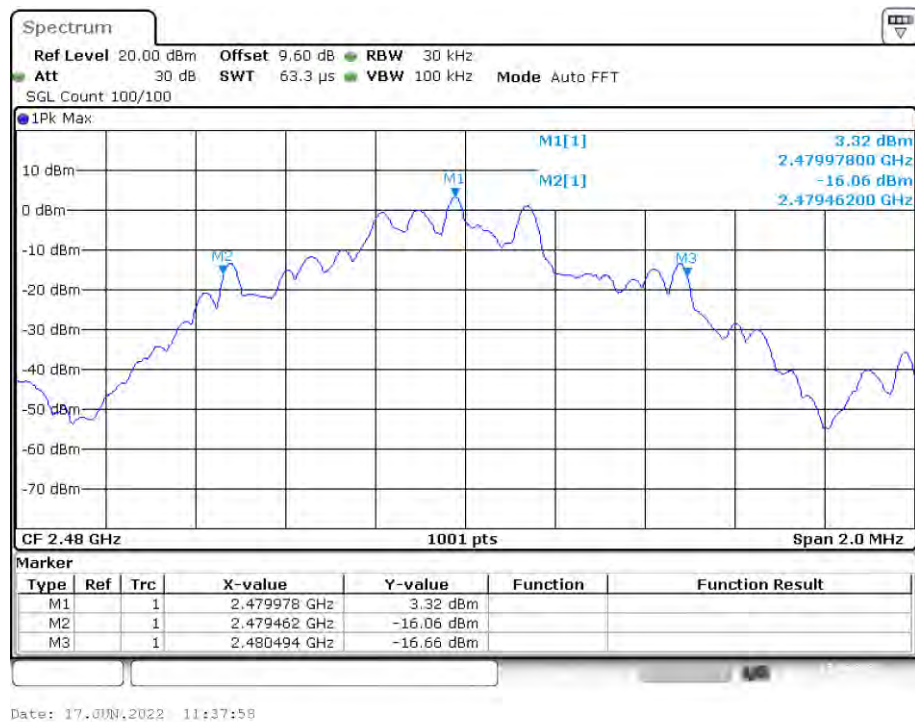
-20 dB BW NVNT 1-DH1 2441MHz Ant1



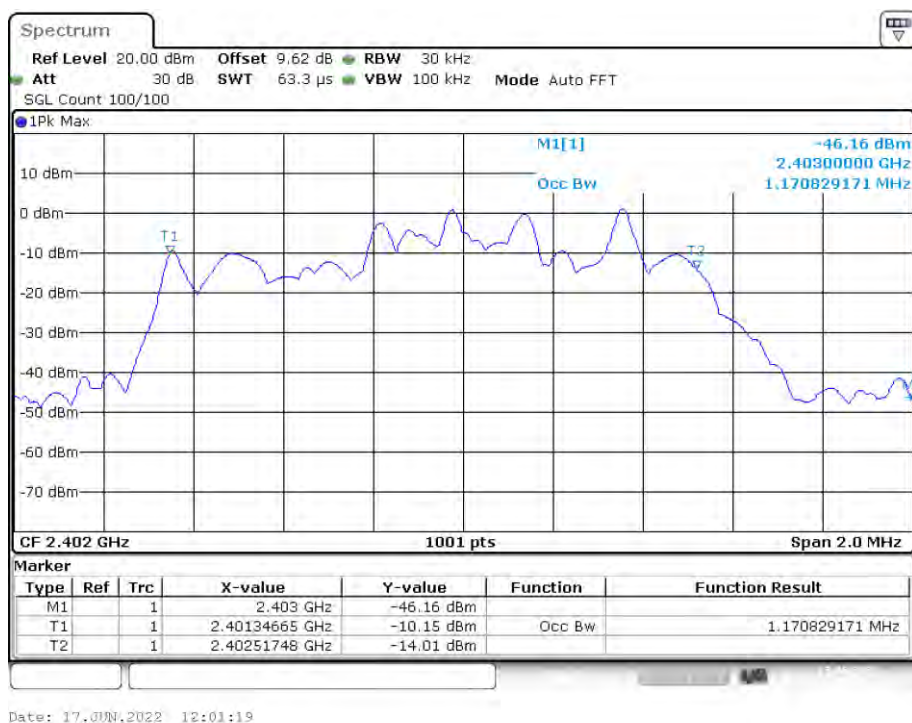
OBW NVNT 1-DH1 2480MHz Ant1



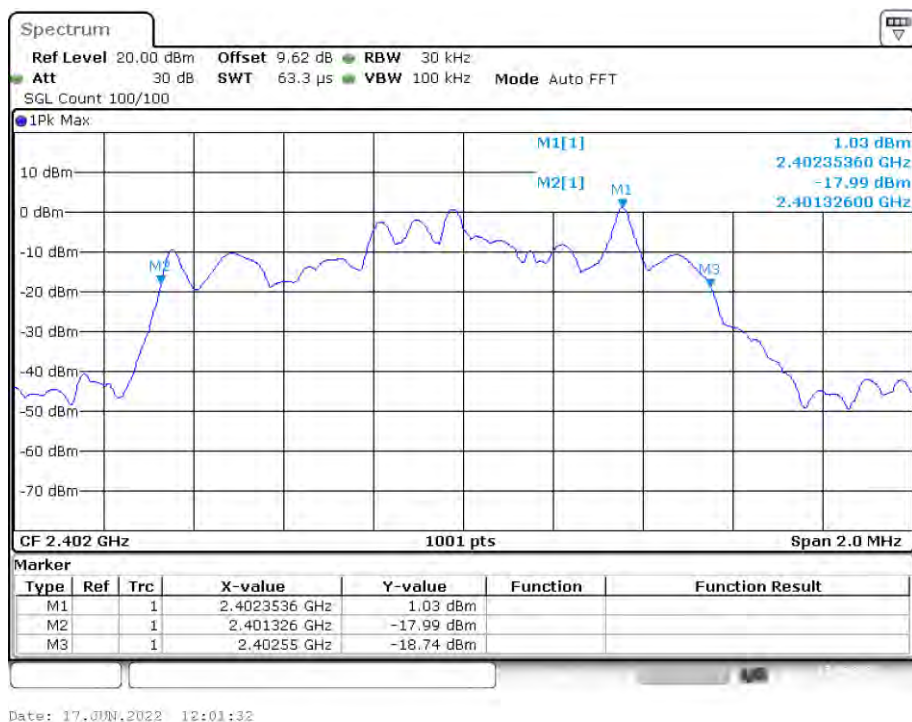
-20 dB BW NVNT 1-DH1 2480MHz Ant1



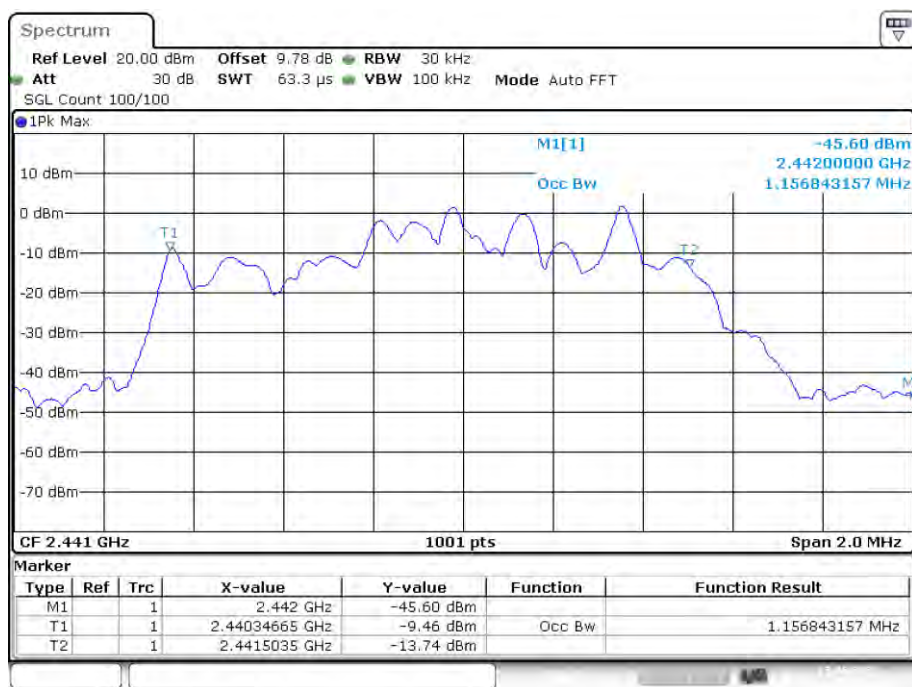
OBW NVNT 2-DH1 2402MHz Ant1



-20 dB BW NVNT 2-DH1 2402MHz Ant1

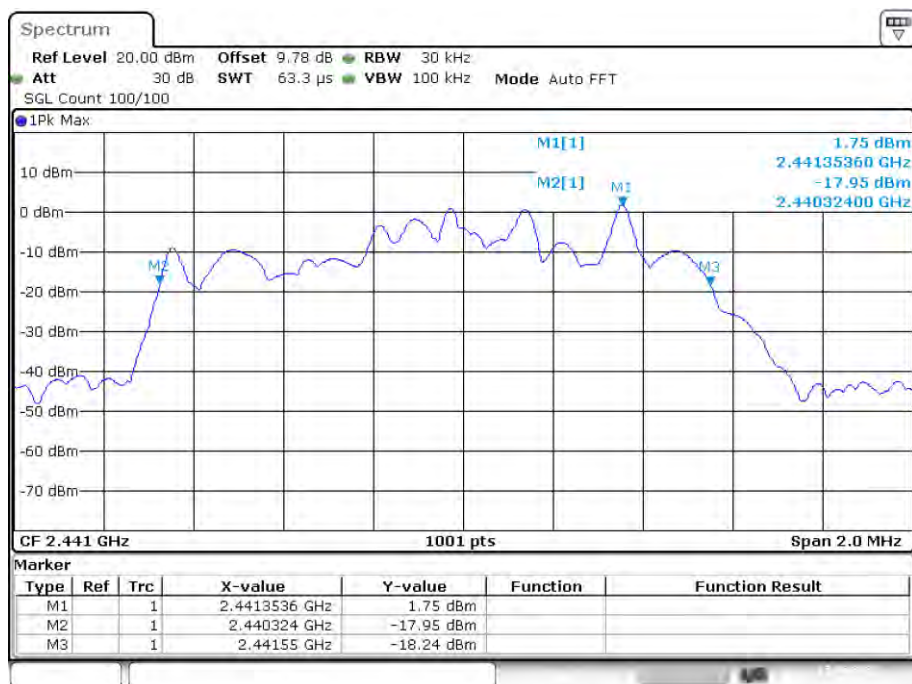


OBW NVNT 2-DH1 2441MHz Ant1



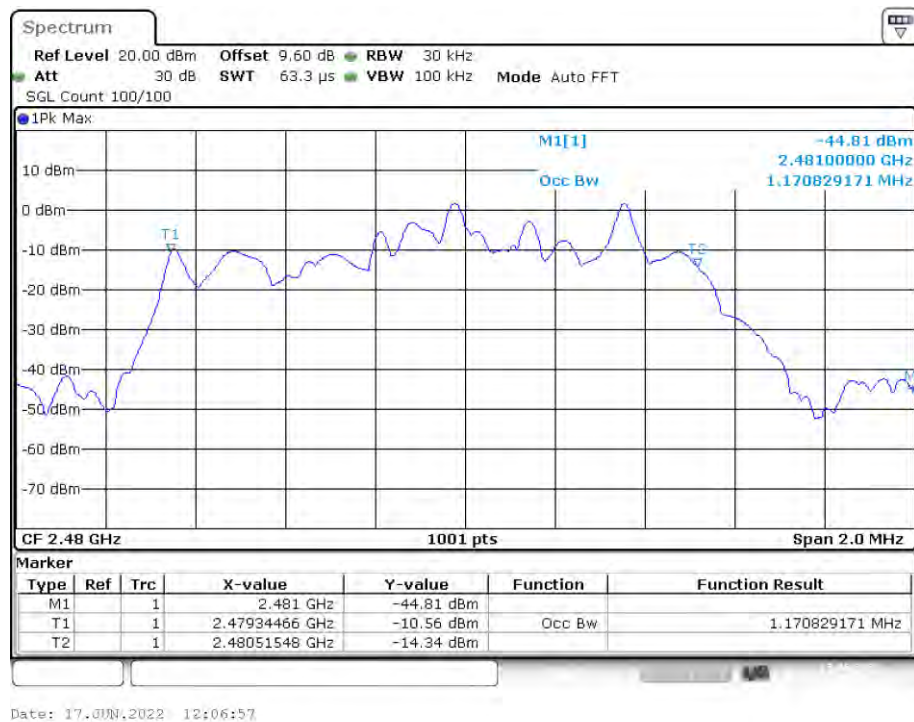
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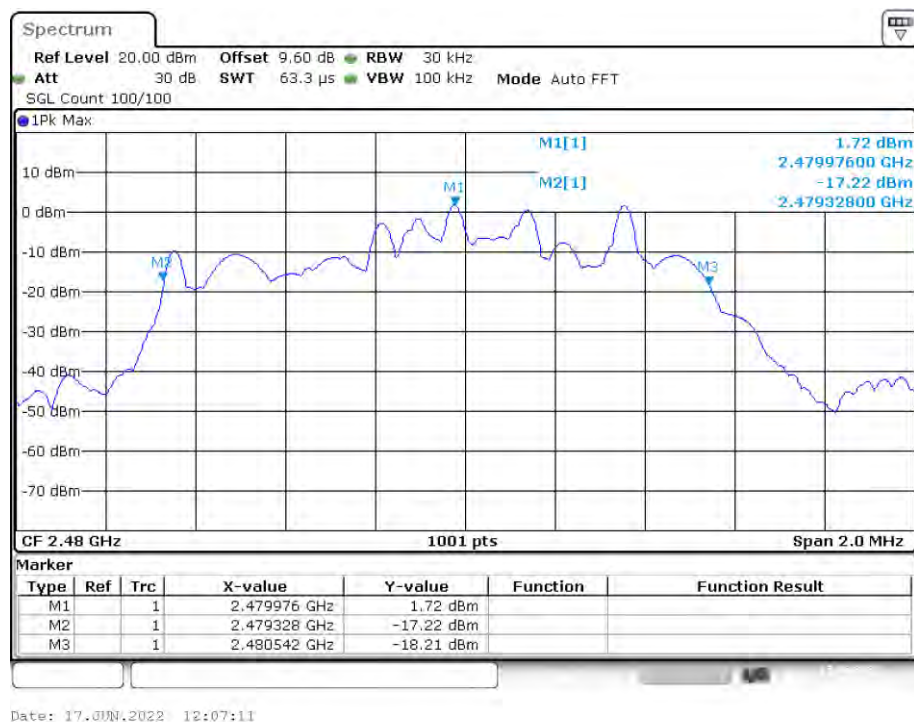


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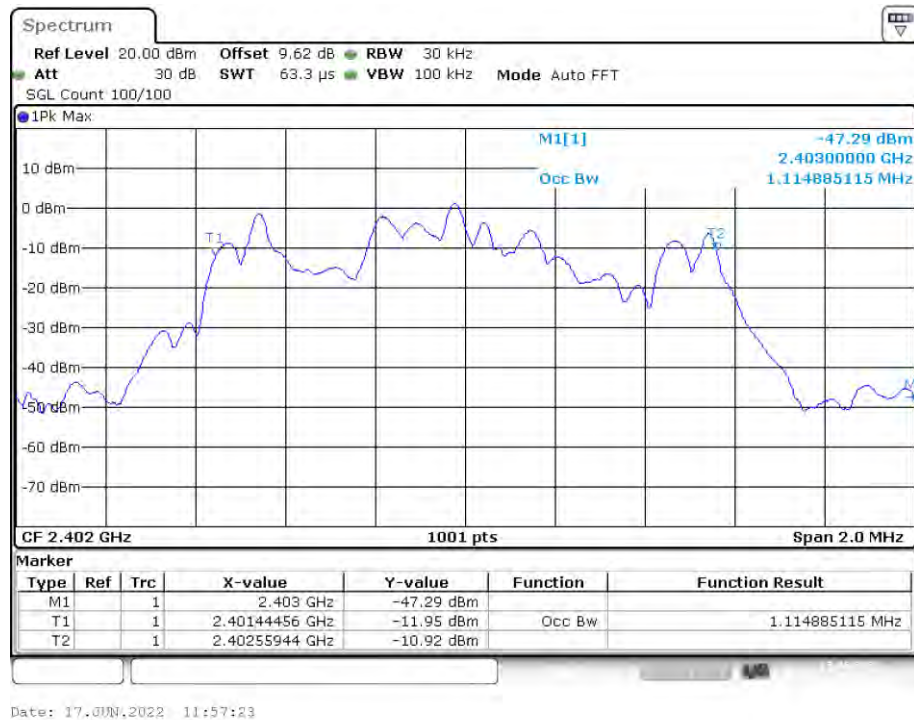
OBW NVNT 2-DH1 2480MHz Ant1



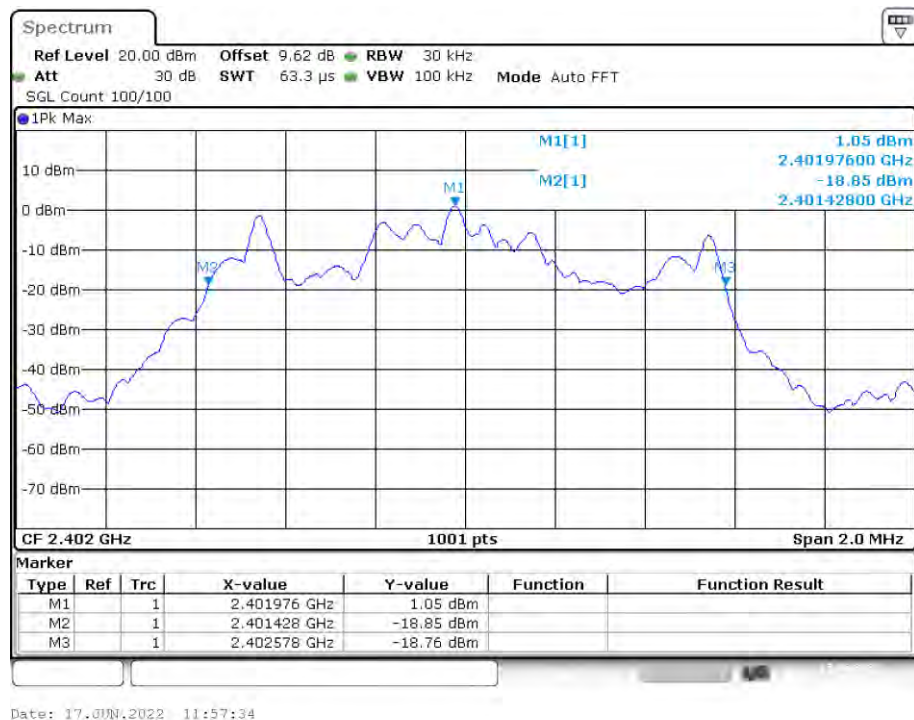
-20 dB BW NVNT 2-DH1 2480MHz Ant1



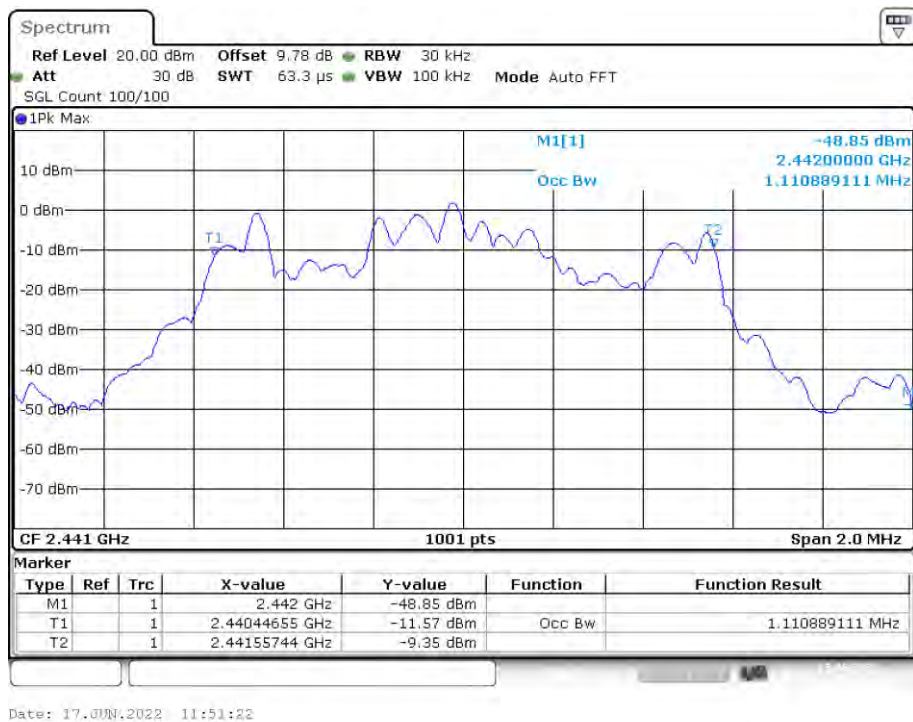
OBW NVNT 3-DH1 2402MHz Ant1



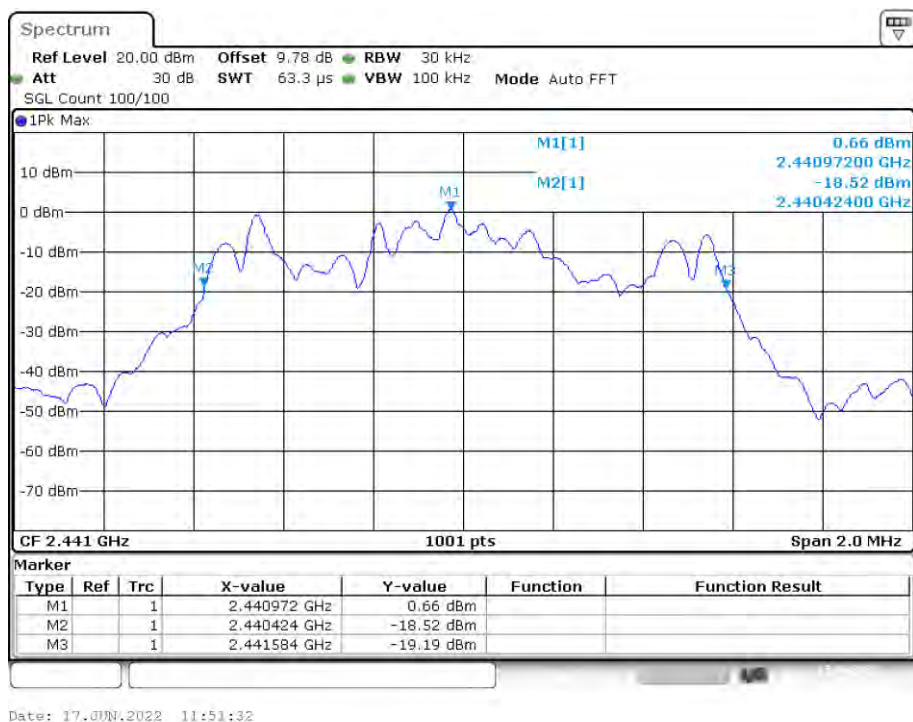
-20 dB BW NVNT 3-DH1 2402MHz Ant1



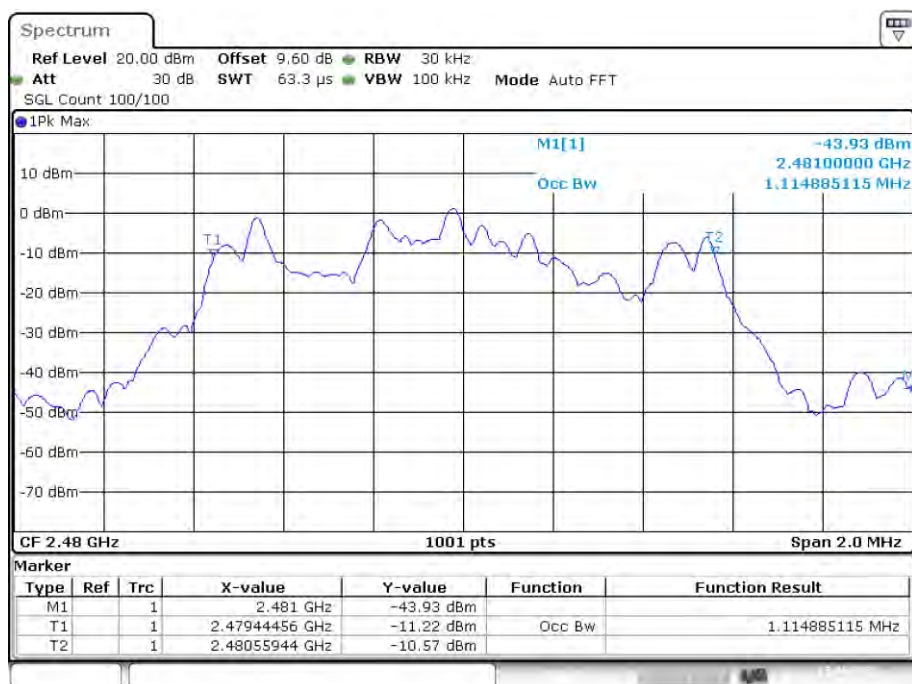
OBW NVNT 3-DH1 2441MHz Ant1



-20 dB BW NVNT 3-DH1 2441MHz Ant1

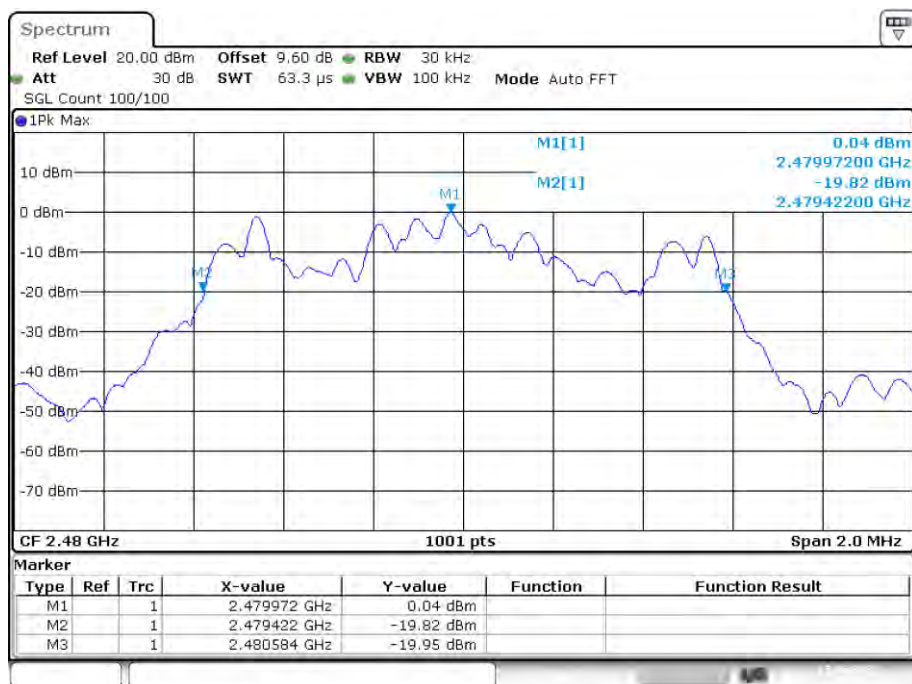


OBW NVNT 3-DH1 2480MHz Ant1



Date: 17.09.2022 11:55:05

-20 dB BW NVNT 3-DH1 2480MHz Ant1



Date: 17.09.2022 11:55:16

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

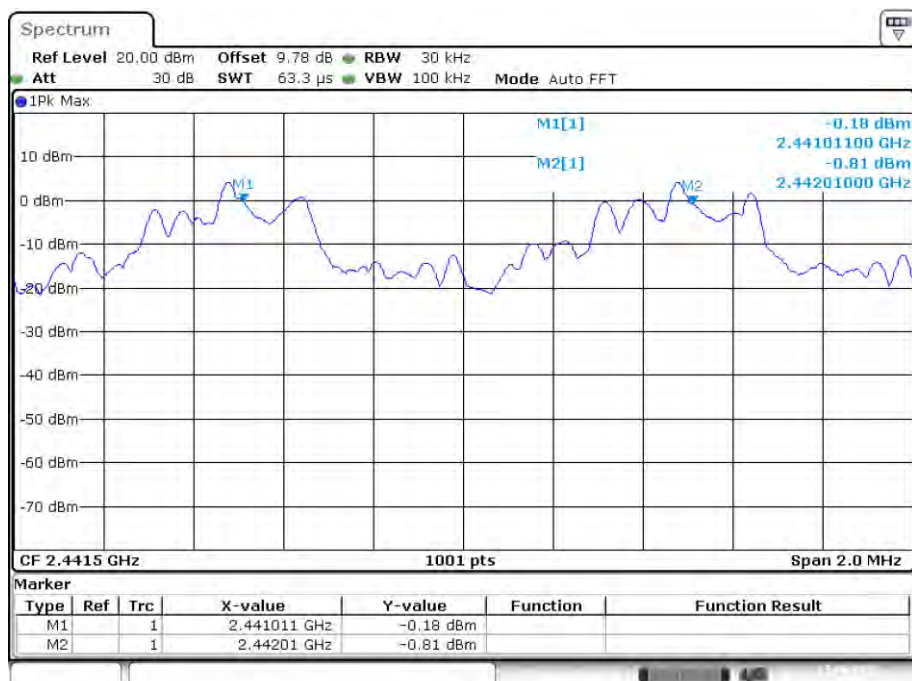
5.2. Test Procedure

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 30kHz RBW and 100kHz VBW.

5.3. Test Result

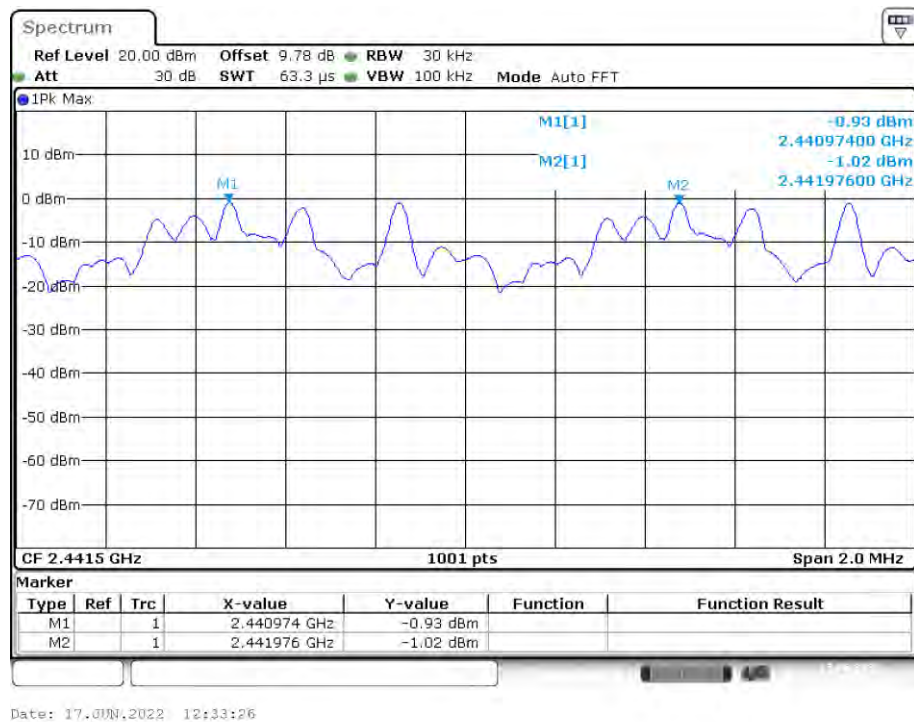
Condition	Mode	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
NVNT	1-DH1	2441.011	2442.01	0.999	0.87	Pass
NVNT	2-DH1	2440.974	2441.976	1.002	0.817	Pass
NVNT	3-DH1	2440.976	2441.976	1	0.773	Pass

CFS NVNT 1-DH1 2441MHz Ant1

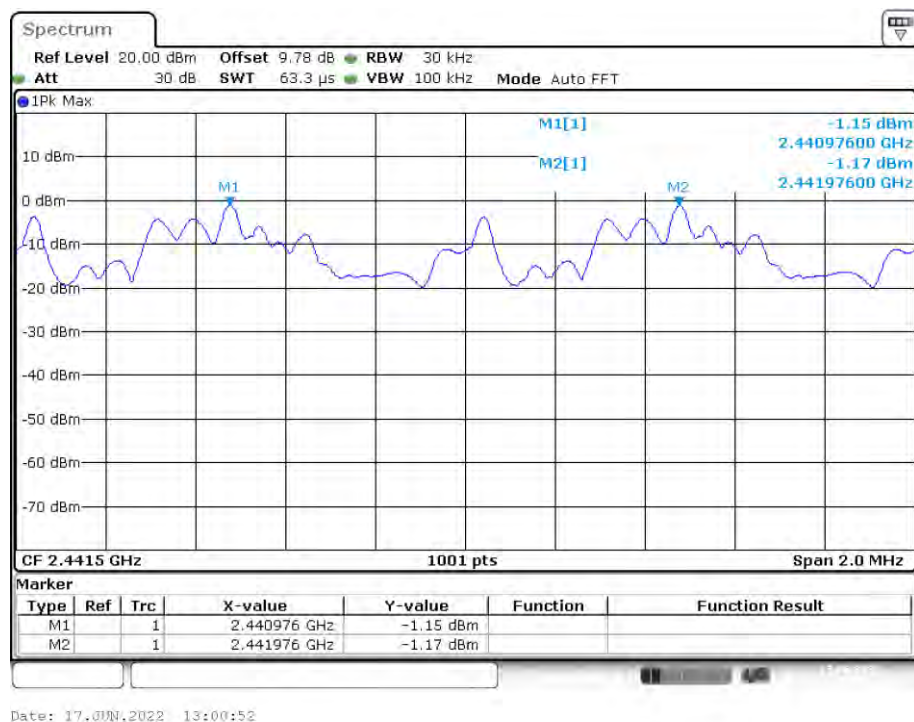


Date: 17.07.2022 12:25:36

CFS NVNT 2-DH1 2441MHz Ant1



CFS NVNT 3-DH1 2441MHz Ant1



6. Number Of Hopping Channel

6.1. Limit

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

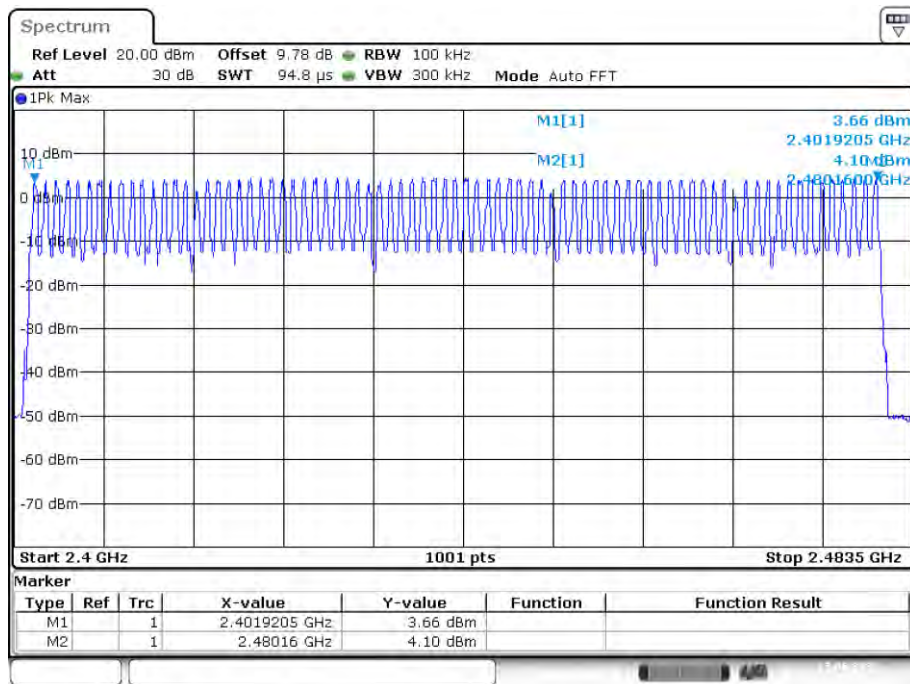
6.2. Test Procedure

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

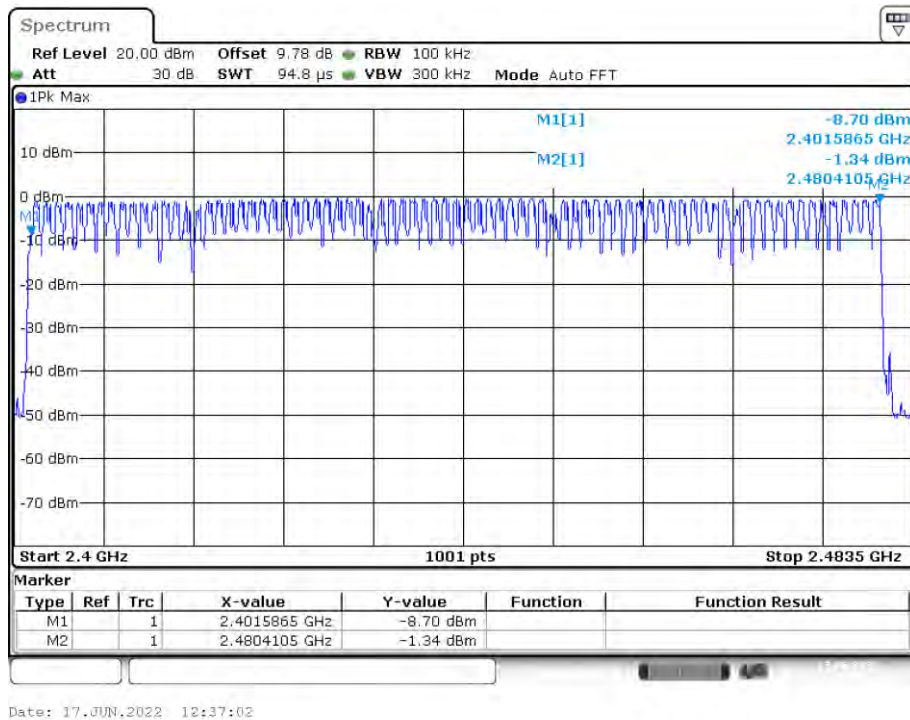
Condition	Mode	Hopping Number	Limit	Verdict
NVNT	1-DH1	79	15	Pass
NVNT	2-DH1	79	15	Pass
NVNT	3-DH1	79	15	Pass

Hopping No. NVNT 1-DH1 2441MHz Ant1

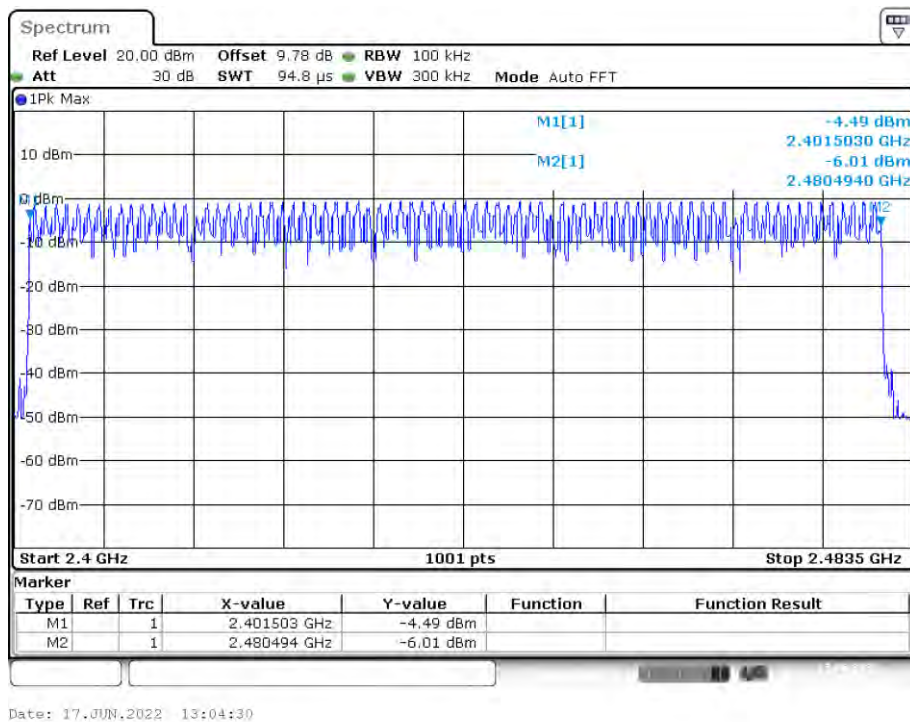


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Hopping No. NVNT 2-DH1 2441MHz Ant1



Hopping No. NVNT 3-DH1 2441MHz Ant1



7. Dwell Time

7.1. Test limit

Please refer FCC part 15.247 & RSS-247.

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, VBW=1MHz, Span = 0Hz, Sweep = auto.

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

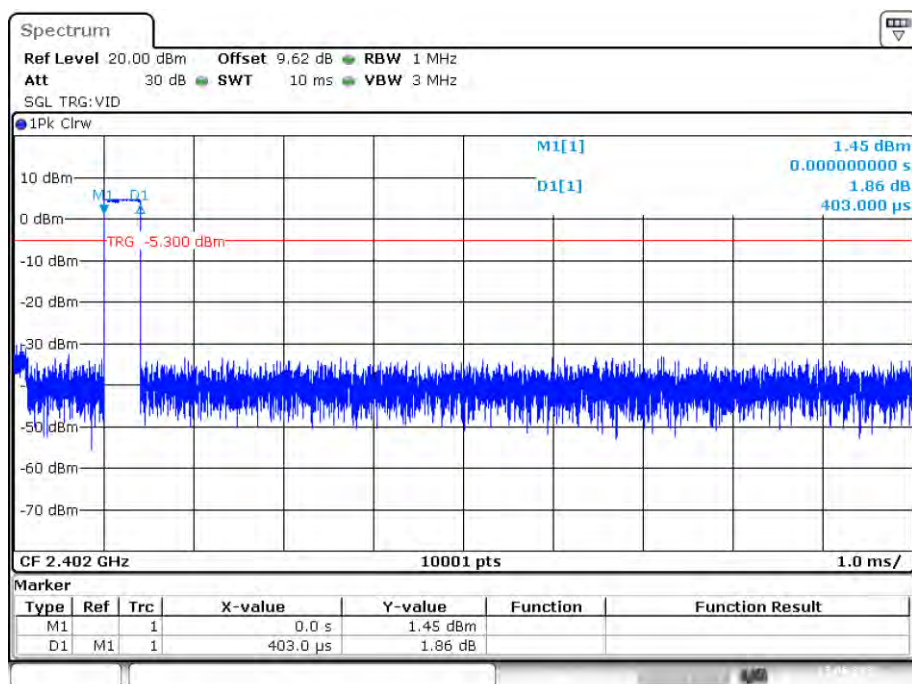
7.3. Test Result

PASS.

Detailed information please see the following page.

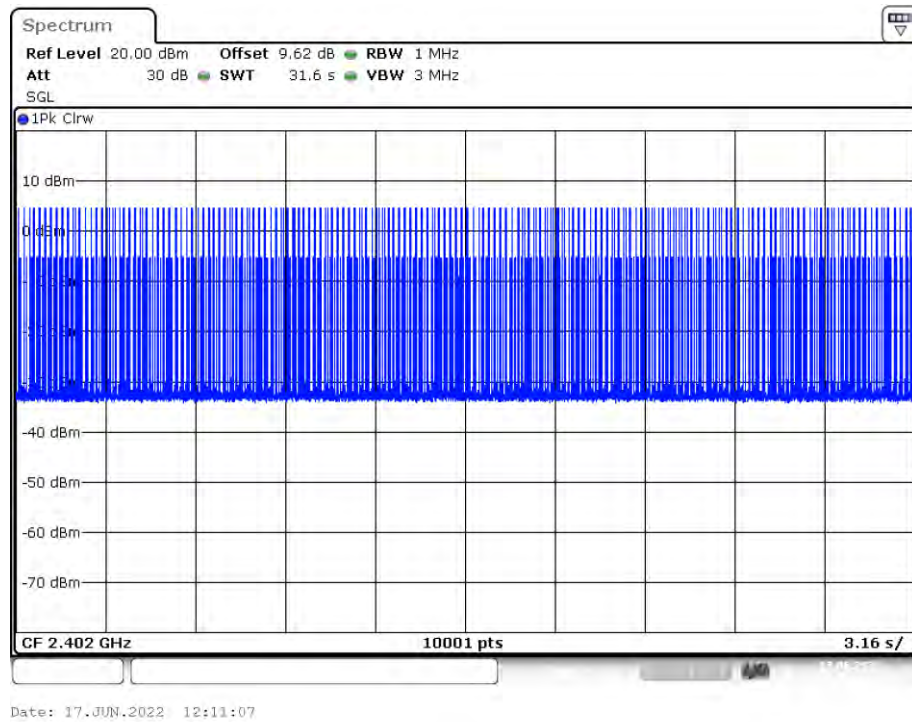
Condition	Mode	Frequency (MHz)	Antenna	Pulse Time (ms)	Total Dwell Time (ms)	Burst Count	Period Time (ms)	Limit (ms)	Verdict
NVNT	1-DH1	2402	Ant1	0.403	128.154	318	31600	400	Pass
NVNT	1-DH1	2441	Ant1	0.403	128.557	319	31600	400	Pass
NVNT	1-DH1	2480	Ant1	0.404	128.876	319	31600	400	Pass
NVNT	1-DH3	2441	Ant1	1.659	262.122	158	31600	400	Pass
NVNT	1-DH5	2441	Ant1	2.907	331.398	114	31600	400	Pass
NVNT	2-DH1	2402	Ant1	0.402	128.238	319	31600	400	Pass
NVNT	2-DH1	2441	Ant1	0.407	131.054	322	31600	400	Pass
NVNT	2-DH1	2480	Ant1	0.408	129.336	317	31600	400	Pass
NVNT	2-DH3	2441	Ant1	1.659	275.394	166	31600	400	Pass
NVNT	2-DH5	2441	Ant1	2.908	322.788	111	31600	400	Pass
NVNT	3-DH1	2402	Ant1	0.407	128.612	316	31600	400	Pass
NVNT	3-DH1	2441	Ant1	0.408	128.52	315	31600	400	Pass
NVNT	3-DH1	2480	Ant1	0.407	129.019	317	31600	400	Pass
NVNT	3-DH3	2441	Ant1	1.658	266.938	161	31600	400	Pass
NVNT	3-DH5	2441	Ant1	2.901	298.803	103	31600	400	Pass

Dwell NVNT 1-DH1 2402MHz Ant1 One Burst

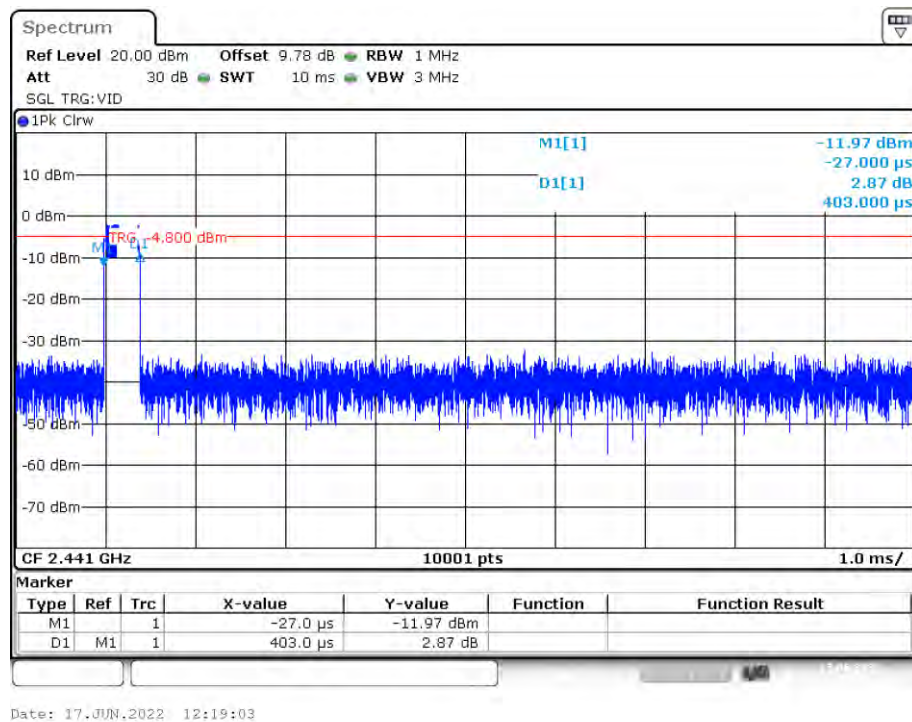


Date: 17.JUN.2022 12:10:33

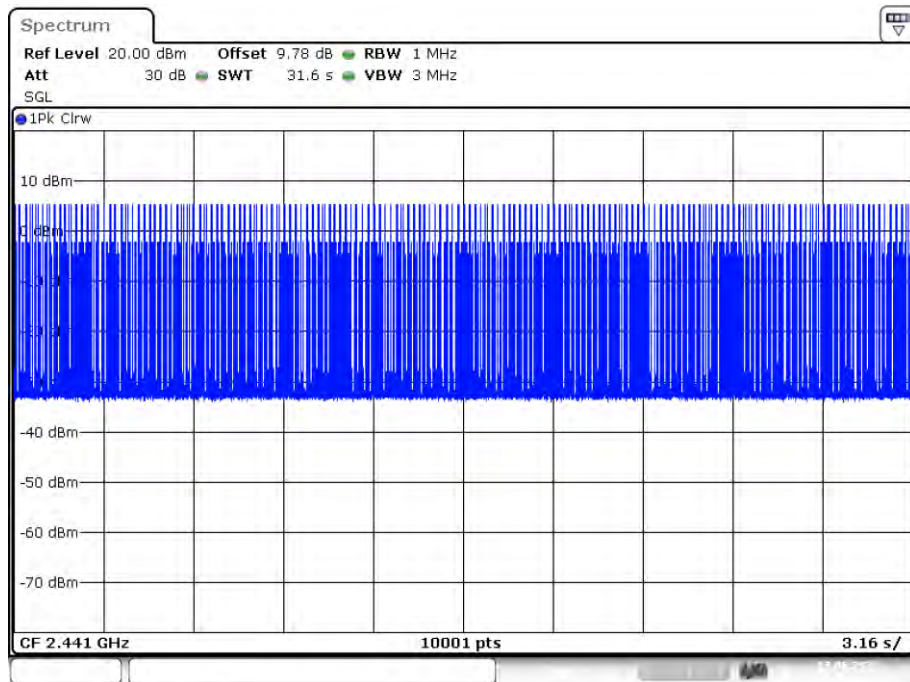
Dwell NVNT 1-DH1 2402MHz Ant1 Accumulated



Dwell NVNT 1-DH1 2441MHz Ant1 One Burst

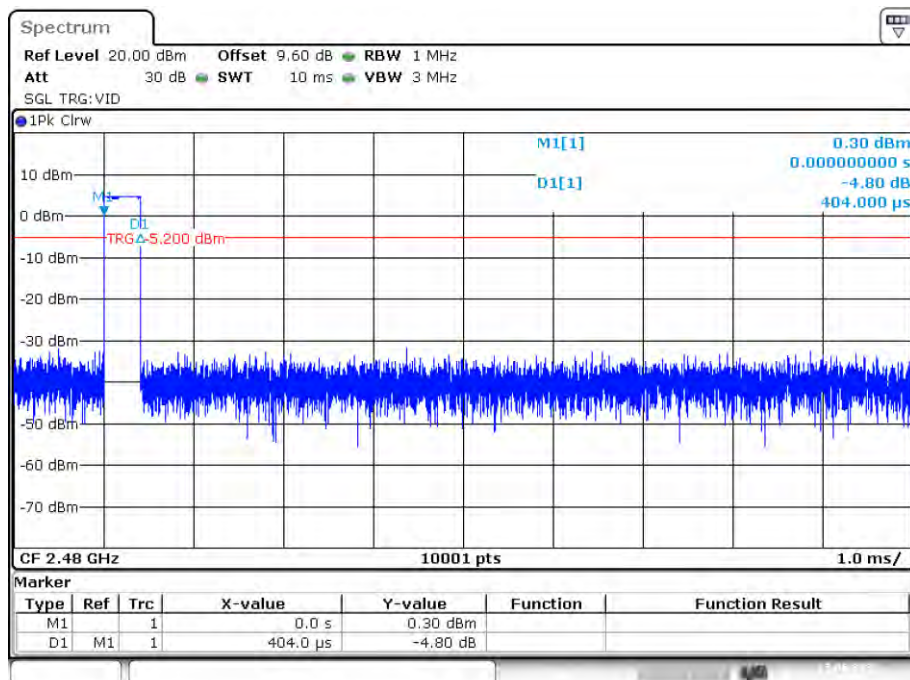


Dwell NVNT 1-DH1 2441MHz Ant1 Accumulated



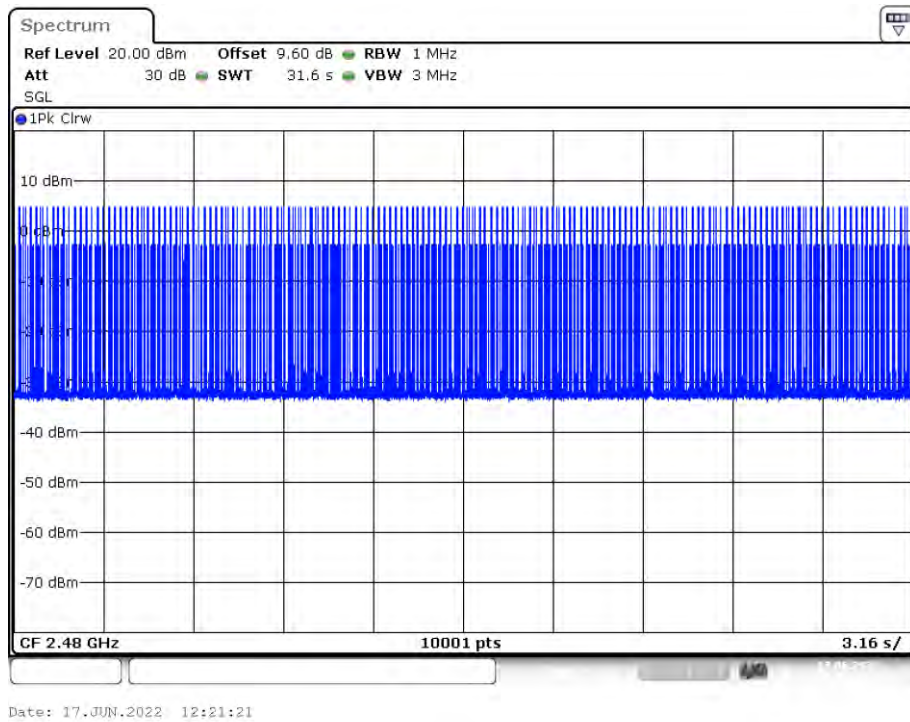
Date: 17.JUN.2022 12:19:37

Dwell NVNT 1-DH1 2480MHz Ant1 One Burst

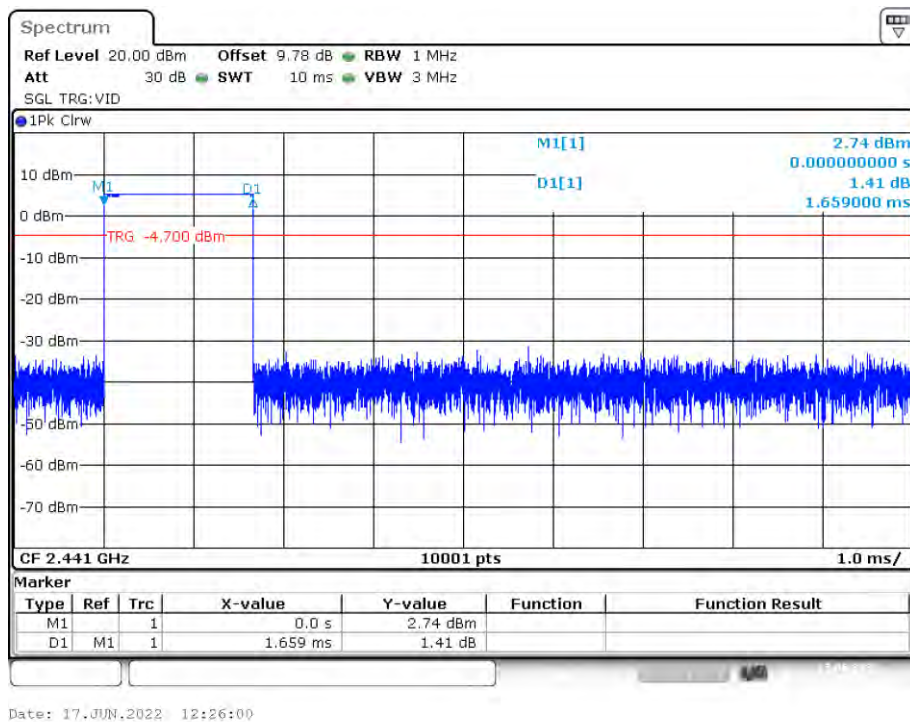


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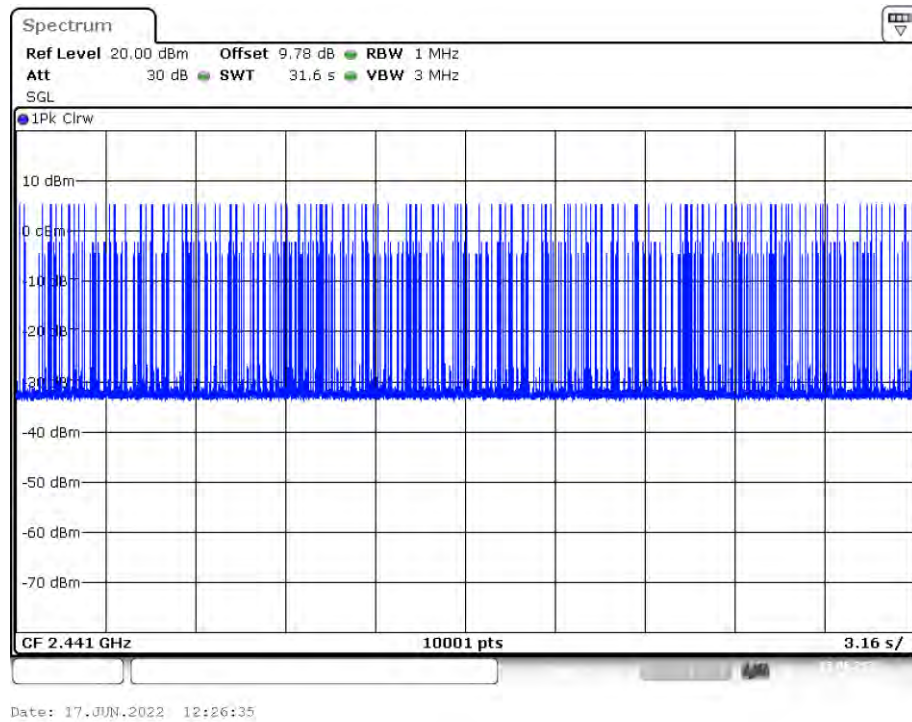
Dwell NVNT 1-DH1 2480MHz Ant1 Accumulated



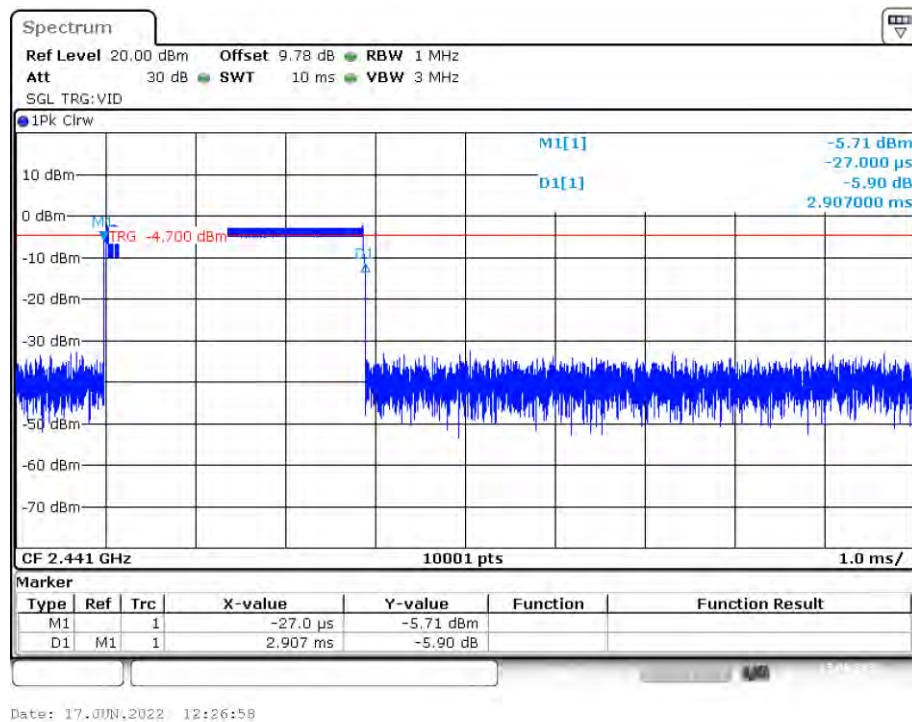
Dwell NVNT 1-DH3 2441MHz Ant1 One Burst



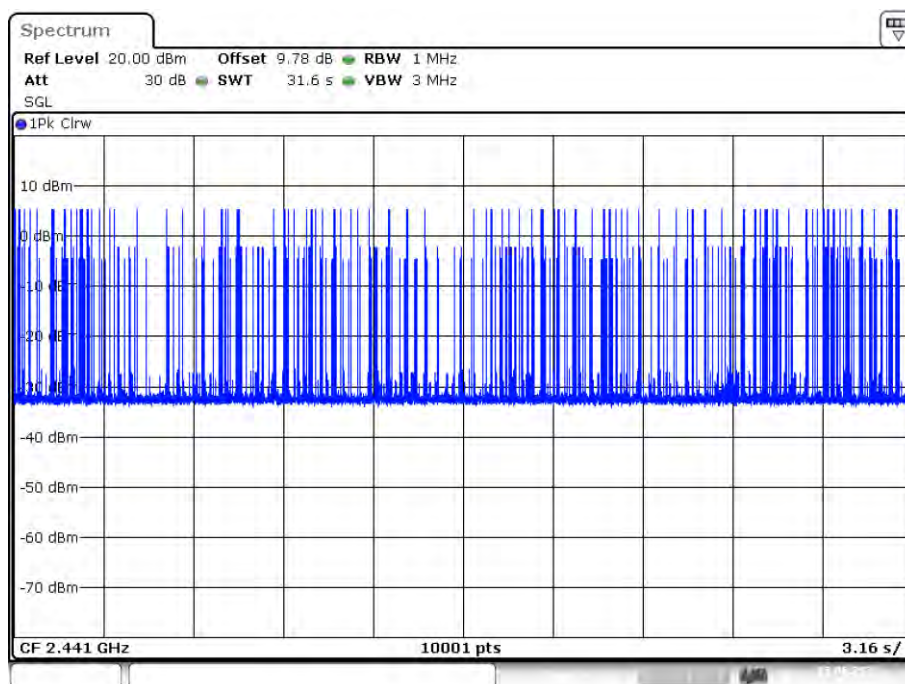
Dwell NVNT 1-DH3 2441MHz Ant1 Accumulated



Dwell NVNT 1-DH5 2441MHz Ant1 One Burst

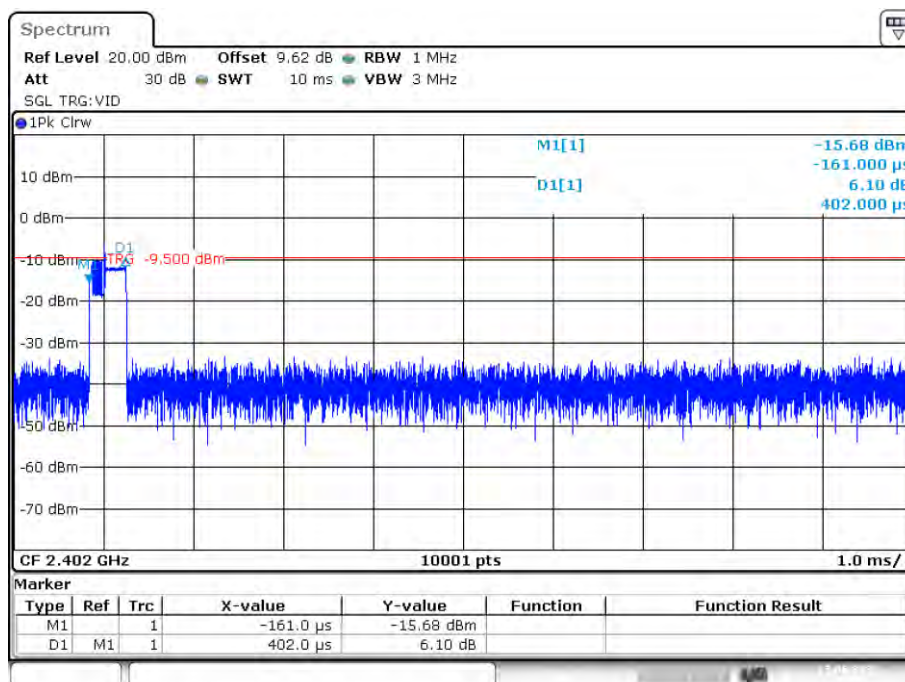


Dwell NVNT 1-DH5 2441MHz Ant1 Accumulated



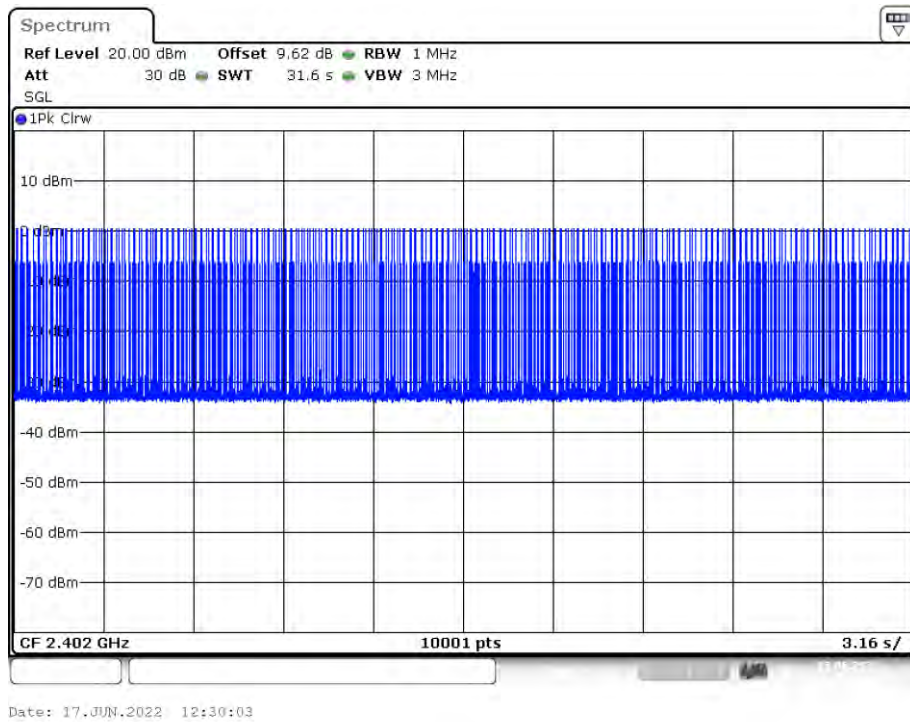
Date: 17.JUN.2022 12:27:33

Dwell NVNT 2-DH1 2402MHz Ant1 One Burst

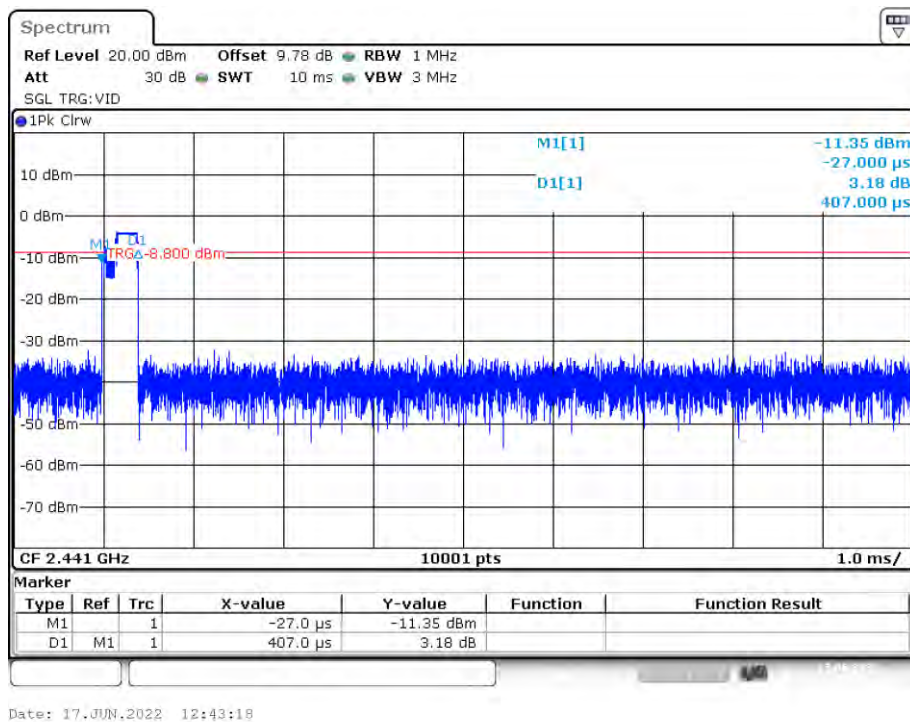


Date: 17.JUN.2022 12:29:29

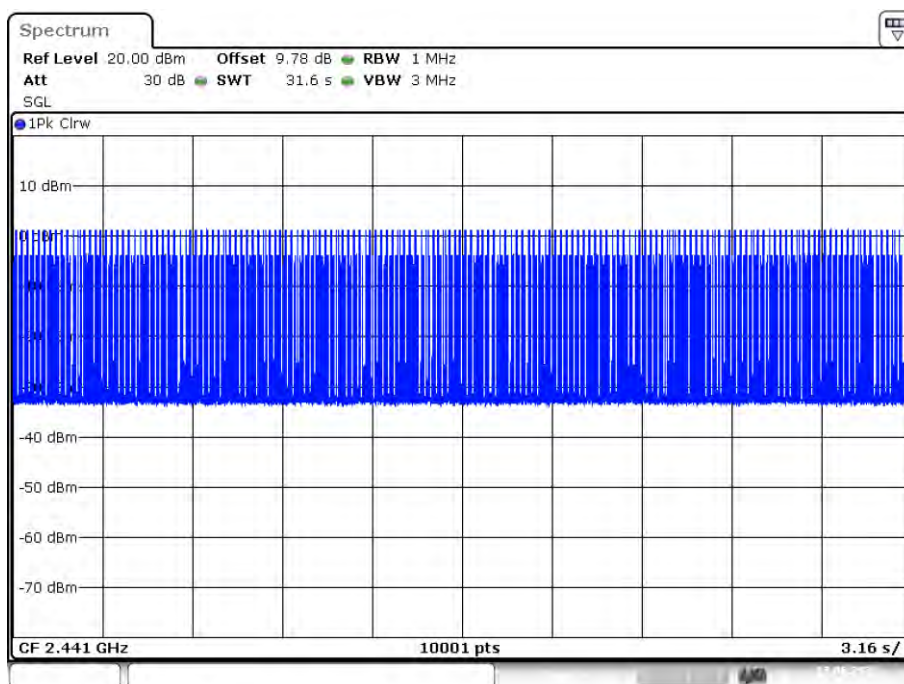
Dwell NVNT 2-DH1 2402MHz Ant1 Accumulated



Dwell NVNT 2-DH1 2441MHz Ant1 One Burst

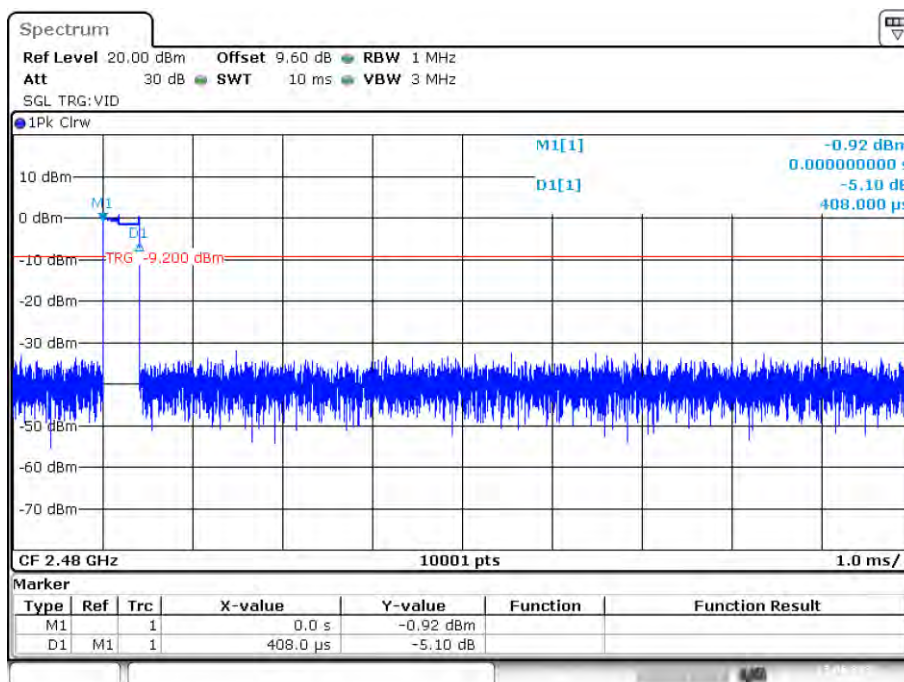


Dwell NVNT 2-DH1 2441MHz Ant1 Accumulated



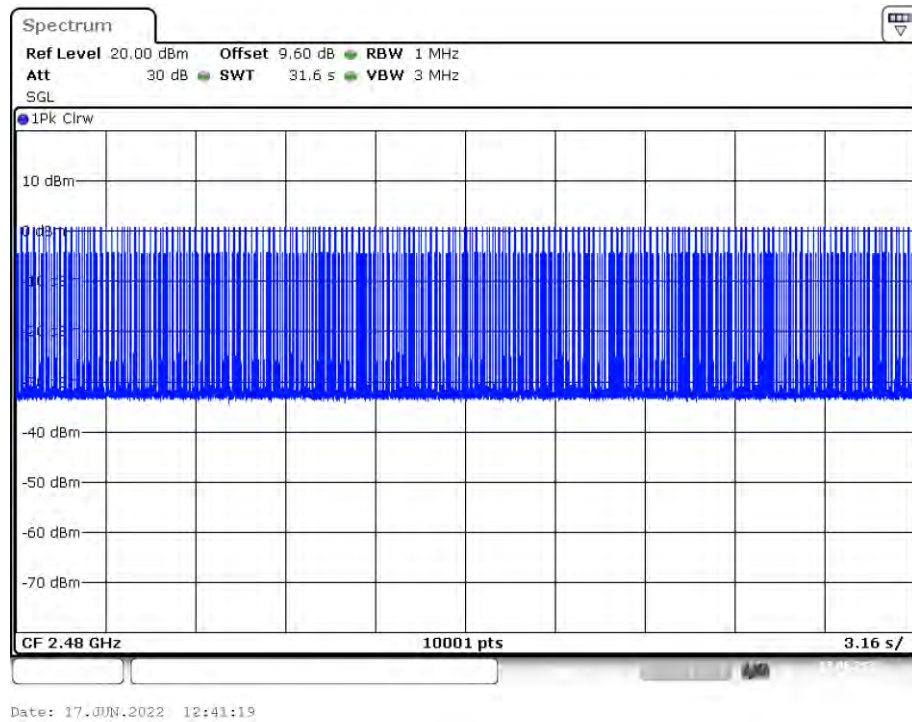
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Dwell NVNT 2-DH1 2480MHz Ant1 One Burst

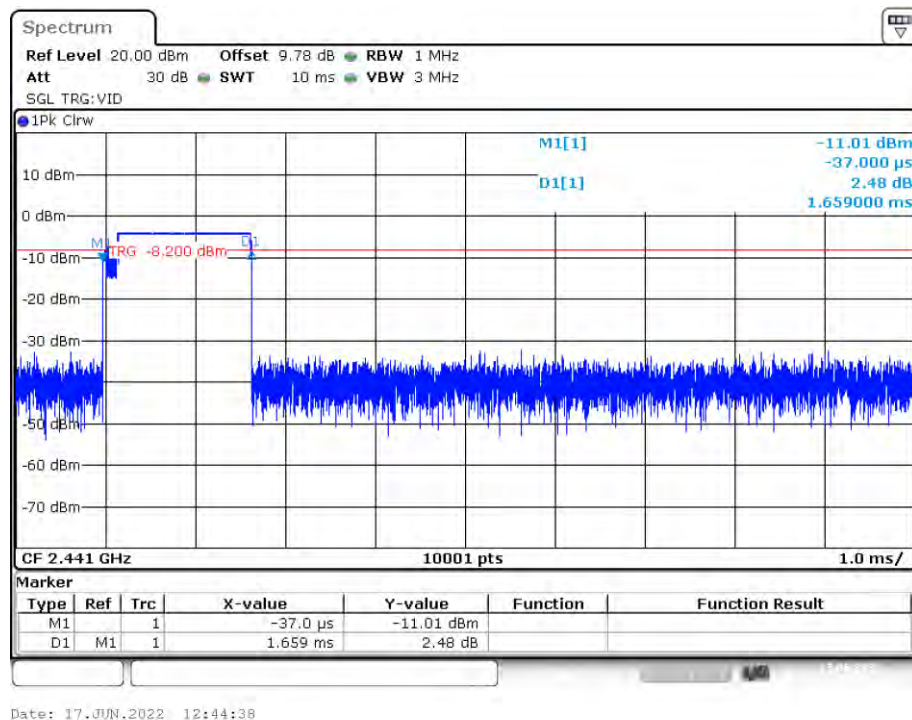


Date: 17.JUN.2022 12:40:44

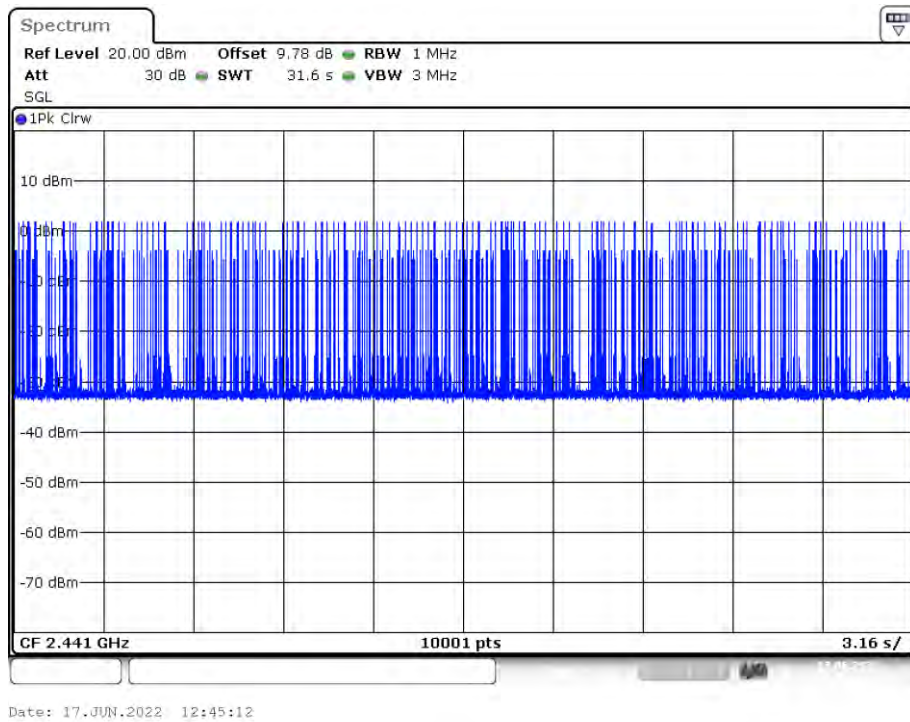
Dwell NVNT 2-DH1 2480MHz Ant1 Accumulated



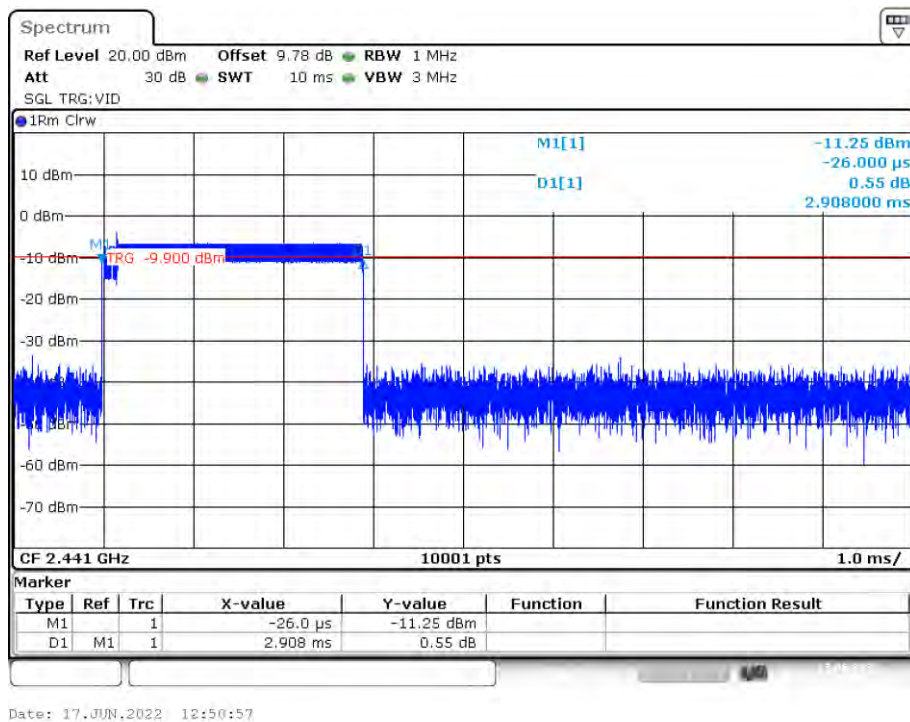
Dwell NVNT 2-DH3 2441MHz Ant1 One Burst



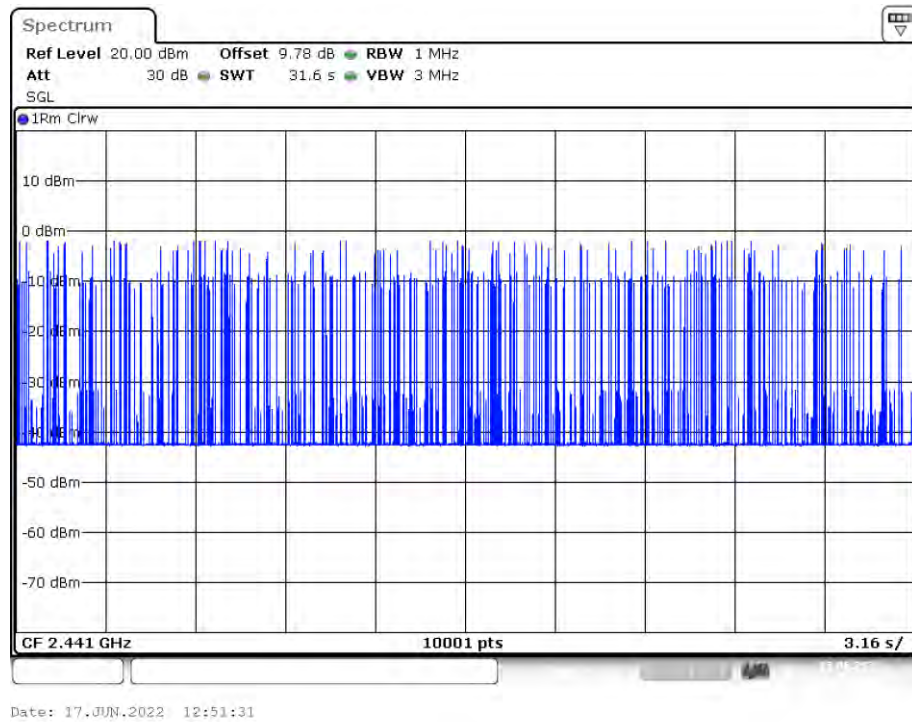
Dwell NVNT 2-DH3 2441MHz Ant1 Accumulated



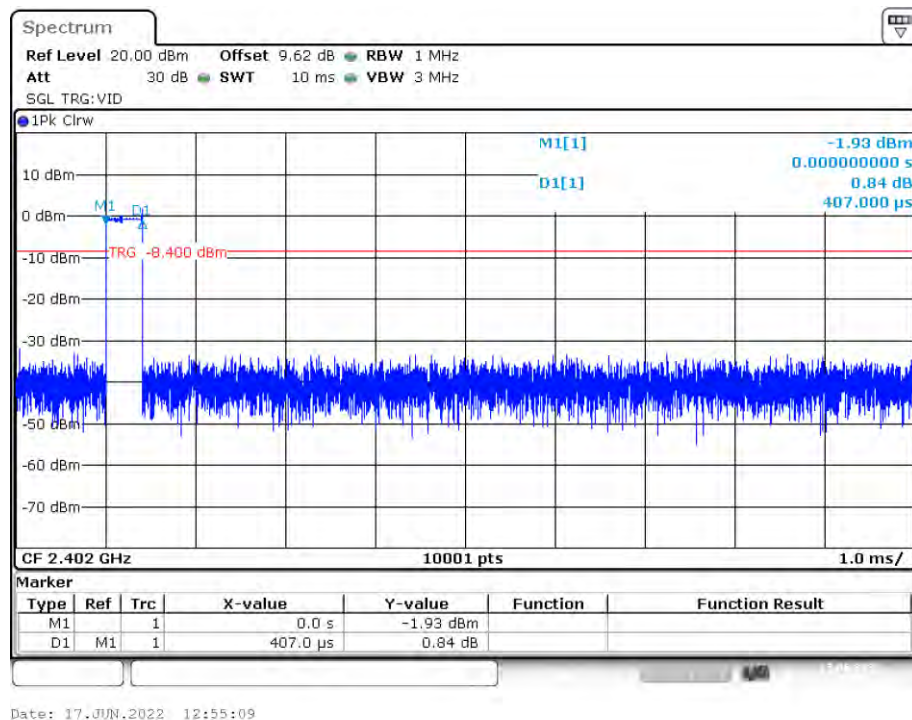
Dwell NVNT 2-DH5 2441MHz Ant1 One Burst



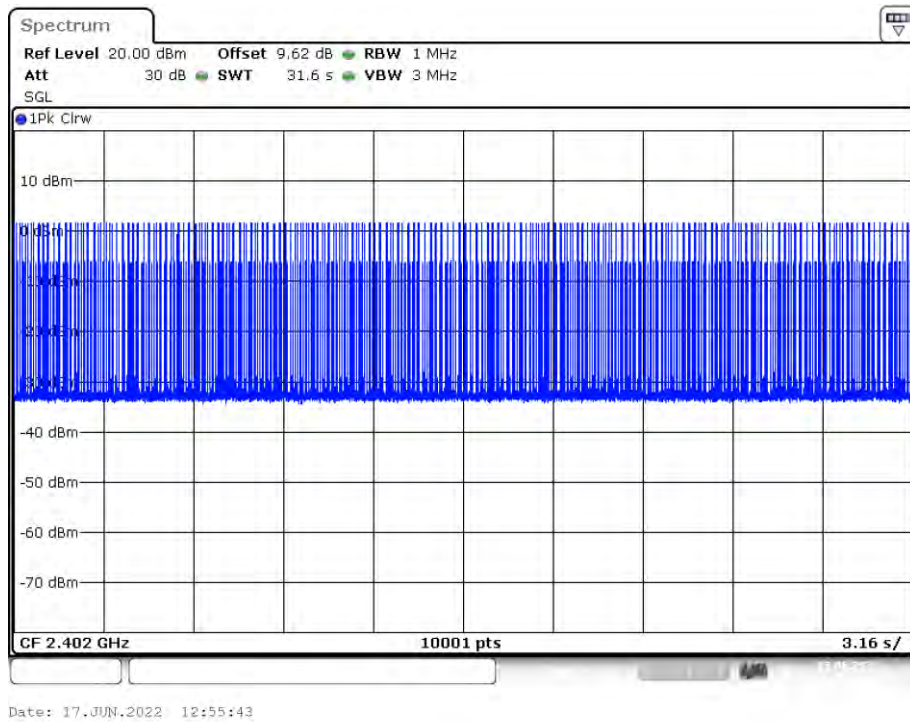
Dwell NVNT 2-DH5 2441MHz Ant1 Accumulated



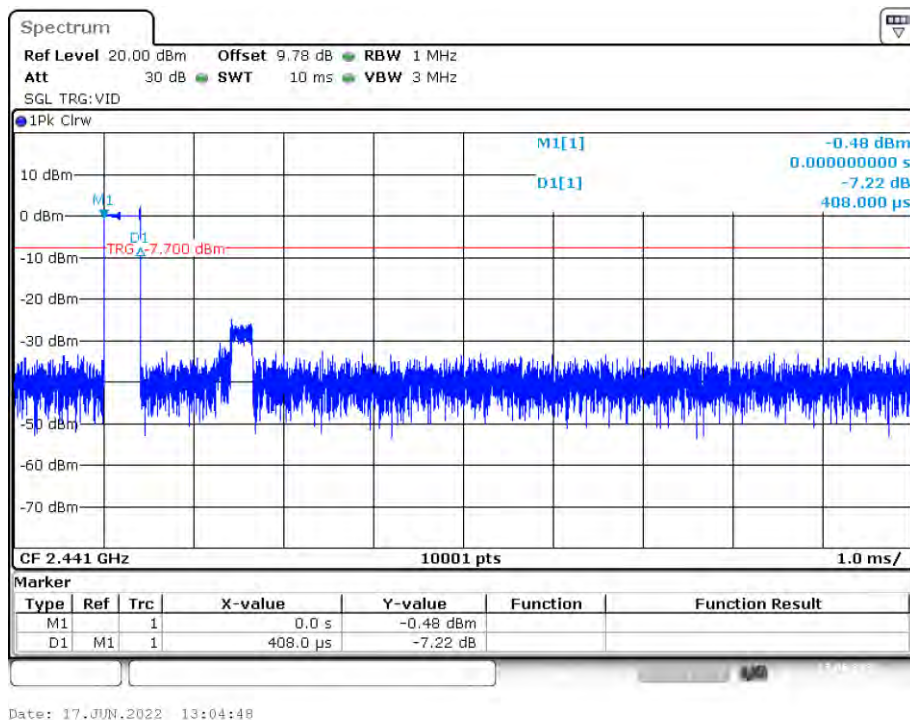
Dwell NVNT 3-DH1 2402MHz Ant1 One Burst



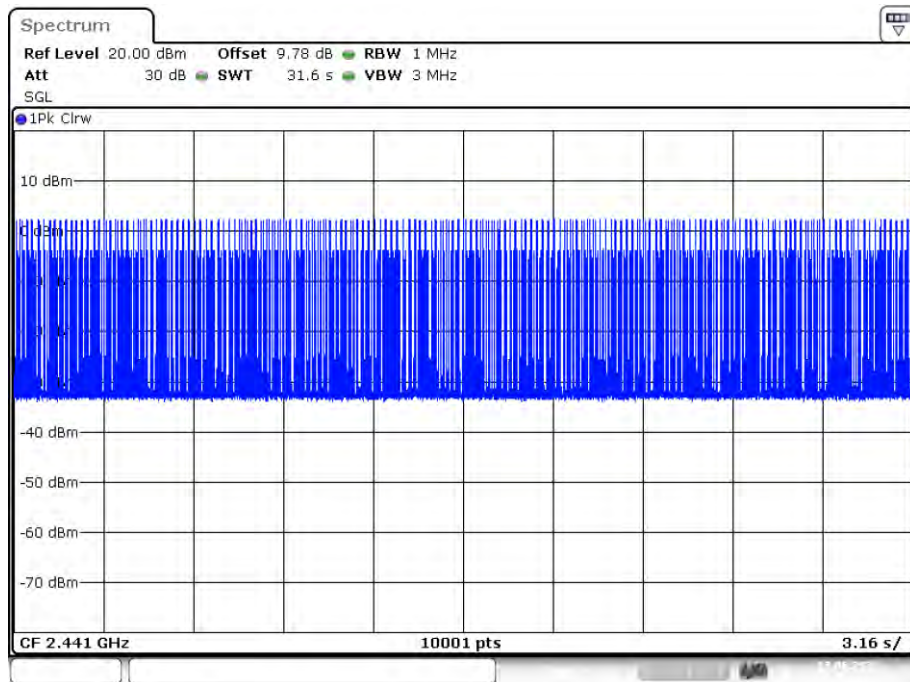
Dwell NVNT 3-DH1 2402MHz Ant1 Accumulated



Dwell NVNT 3-DH1 2441MHz Ant1 One Burst

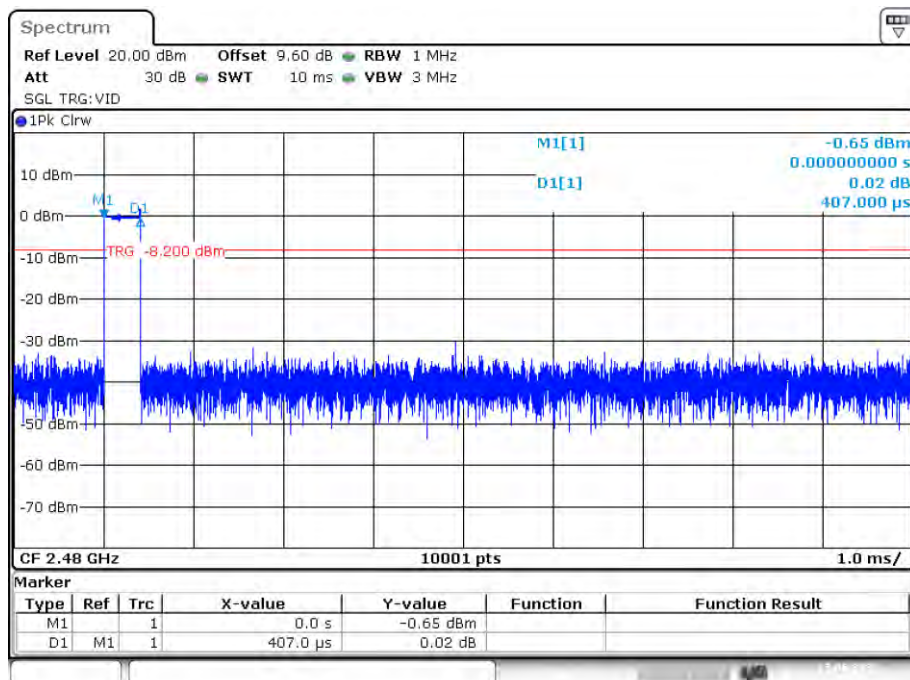


Dwell NVNT 3-DH1 2441MHz Ant1 Accumulated



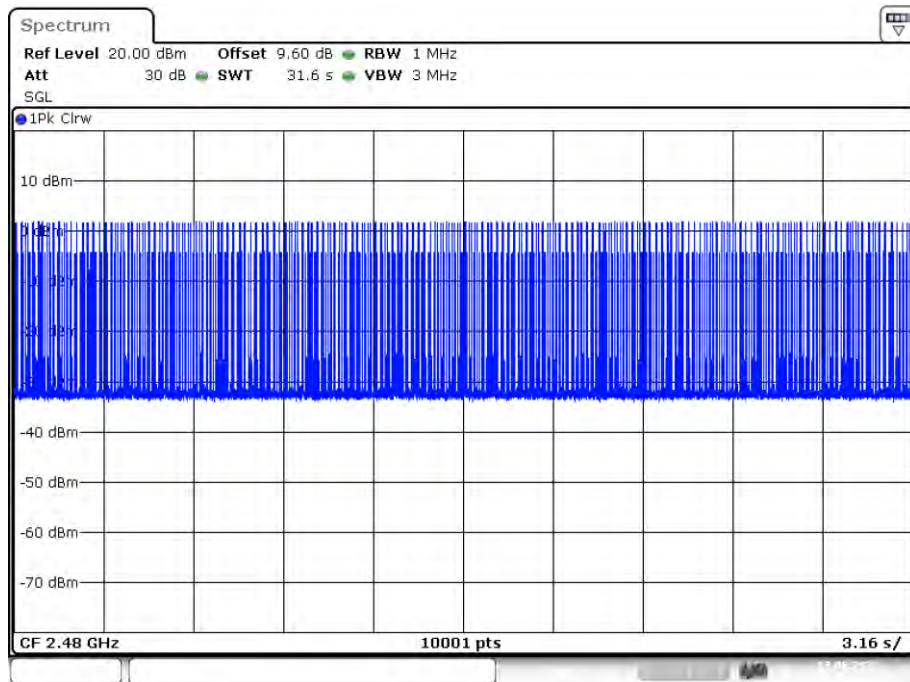
Date: 17.JUN.2022 13:05:23

Dwell NVNT 3-DH1 2480MHz Ant1 One Burst



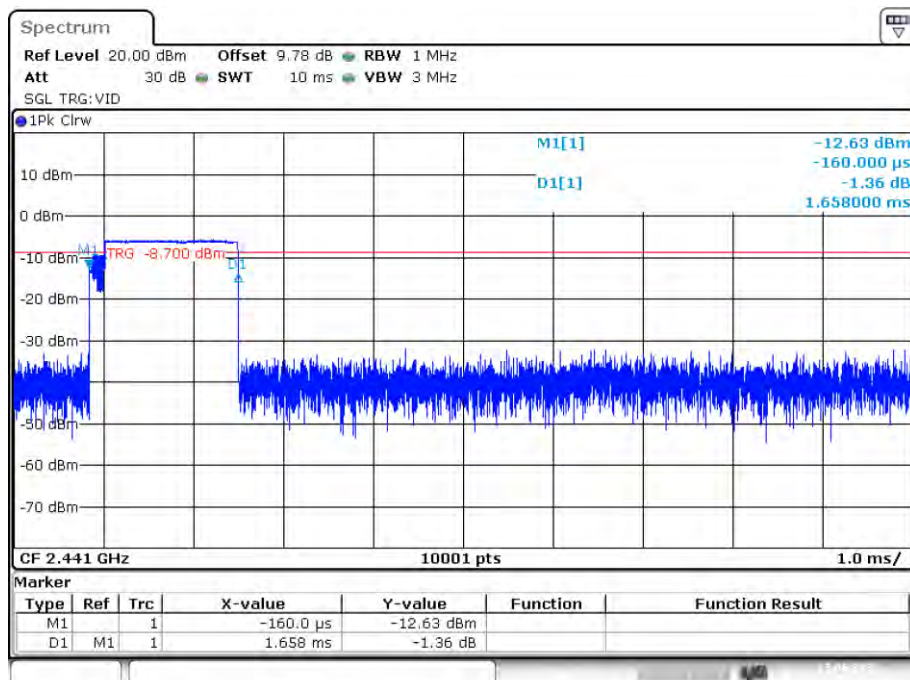
Date: 17.JUN.2022 13:06:24

Dwell NVNT 3-DH1 2480MHz Ant1 Accumulated



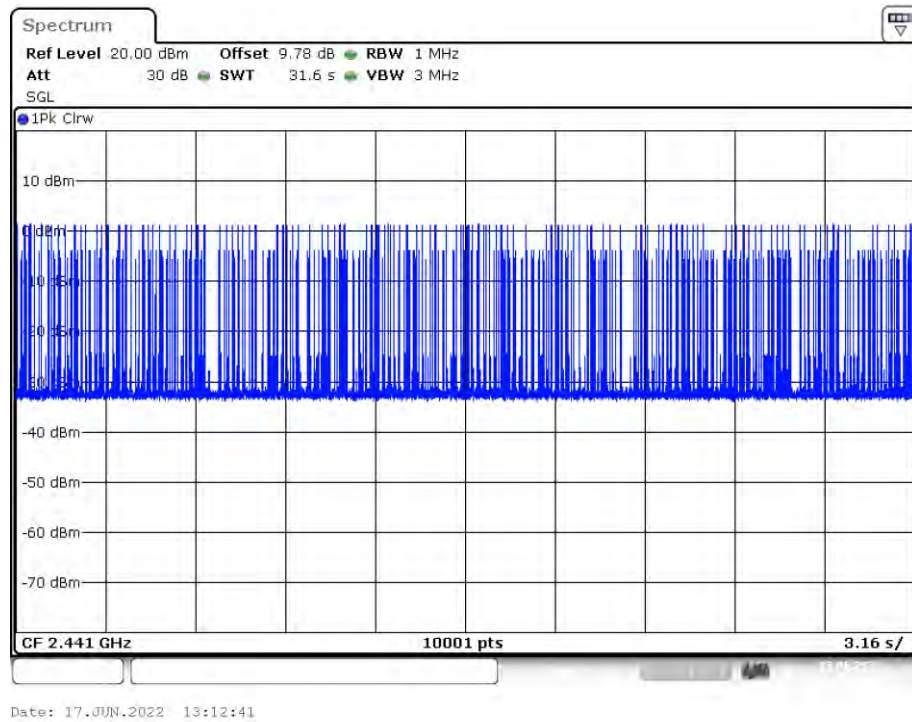
Date: 17.JUN.2022 13:06:58

Dwell NVNT 3-DH3 2441MHz Ant1 One Burst

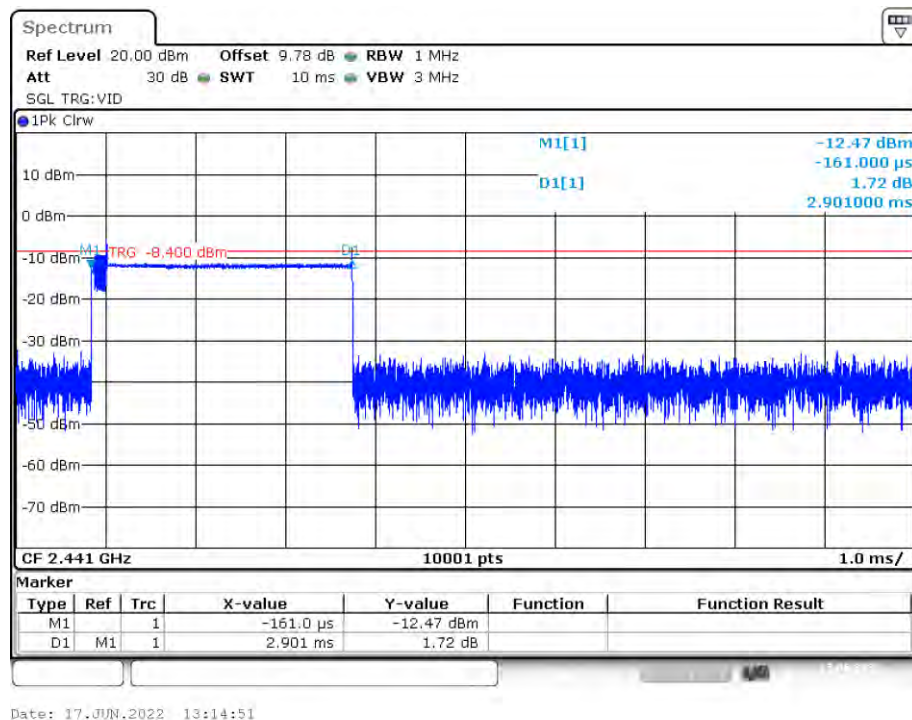


Date: 17.JUN.2022 13:12:07

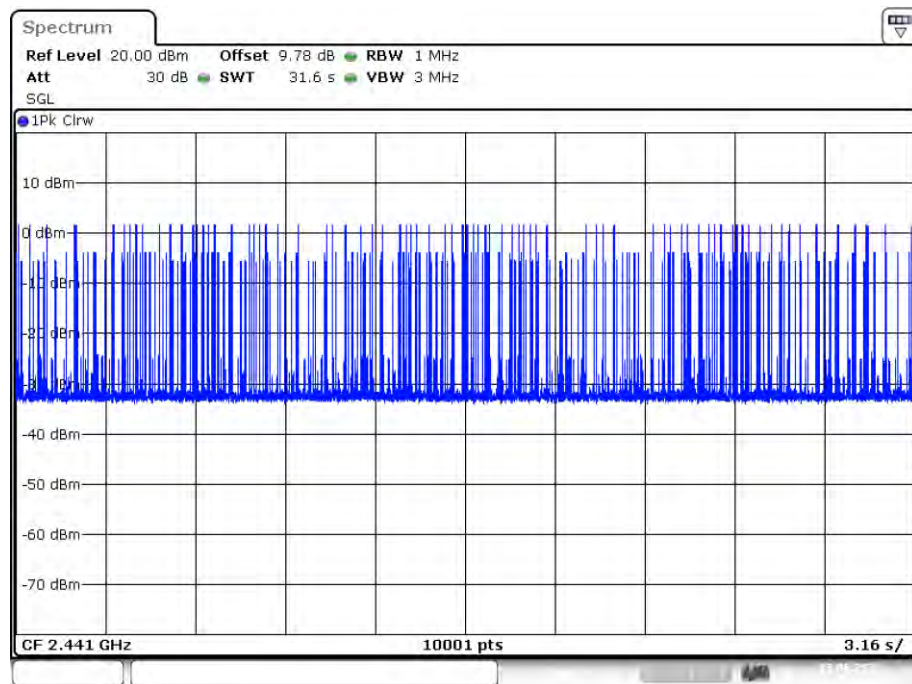
Dwell NVNT 3-DH3 2441MHz Ant1 Accumulated



Dwell NVNT 3-DH5 2441MHz Ant1 One Burst



Dwell NVNT 3-DH5 2441MHz Ant1 Accumulated



Date: 17.JUN.2022 13:15:25

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)

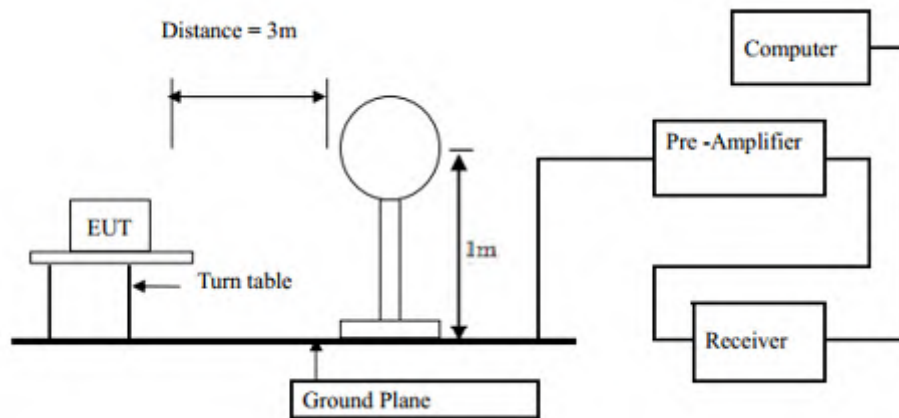
15.209 Limit

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/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)	

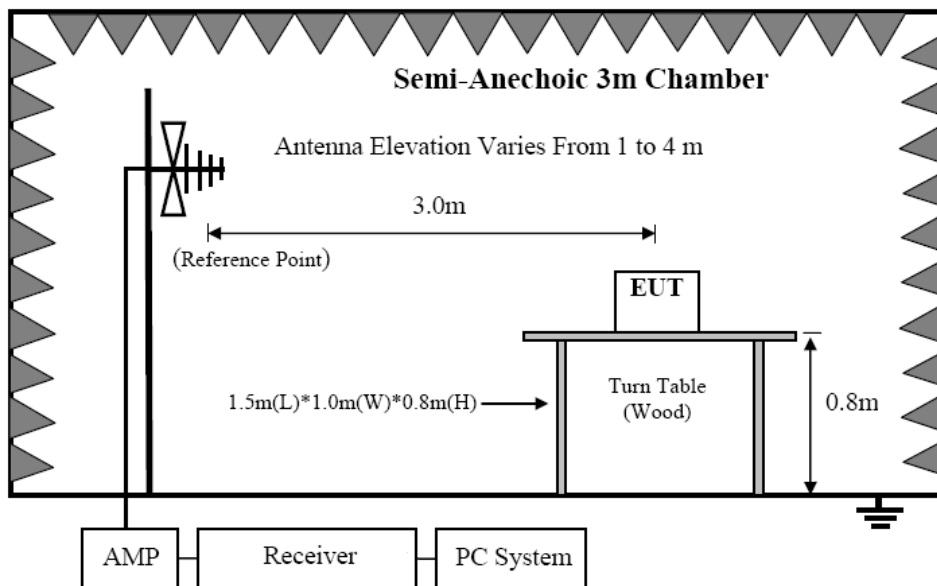
Note: The peak limit is 20 dB higher than the average limit

8.2. Block Diagram of Test setup

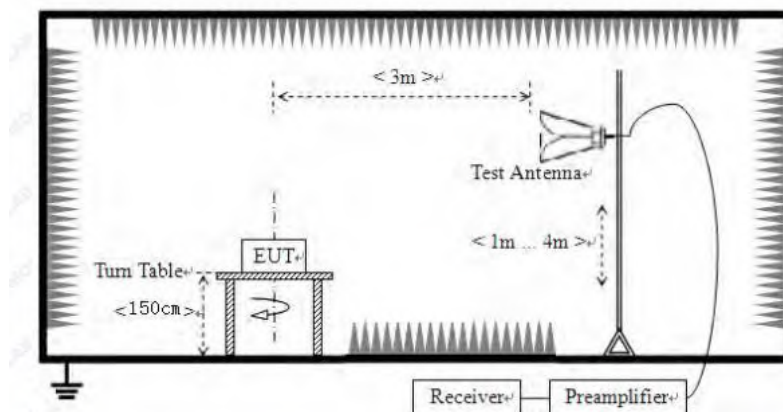
8.2.1 In 3m Anechoic Chamber Test Setup Diagram for below 30MHz



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) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber.
- (2) Setup EUT and simulator
- (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 :2013on 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

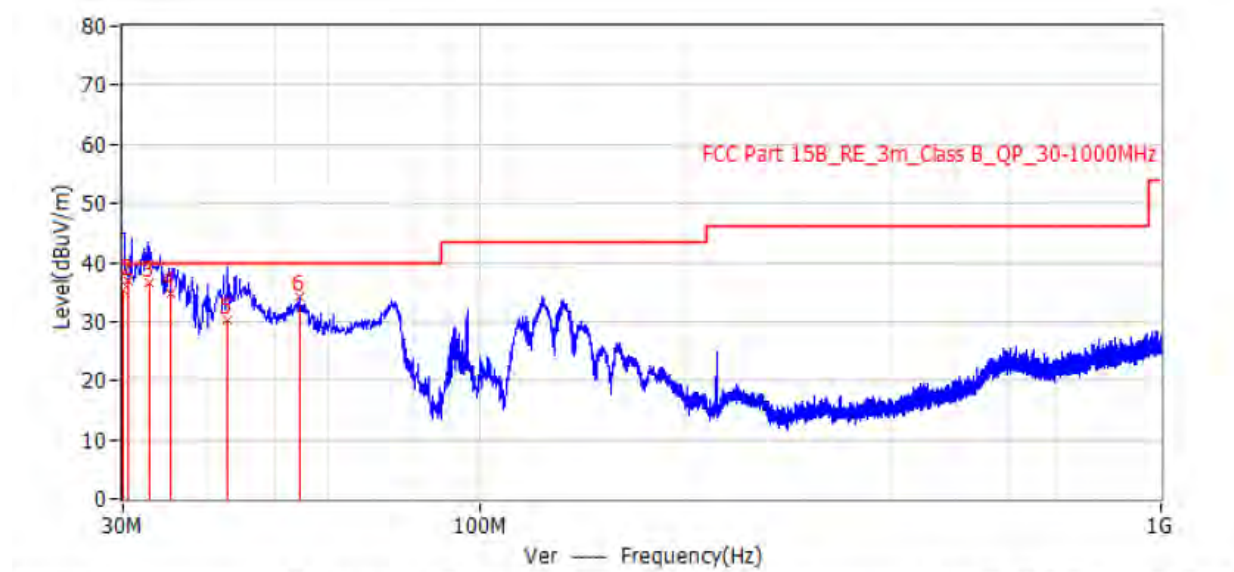
We have scanned from 9kHz to the 10th harmonic of the EUT's highest frequency.
Detailed information please see the following page.

From 9KHz to 30MHz: Conclusion: PASS

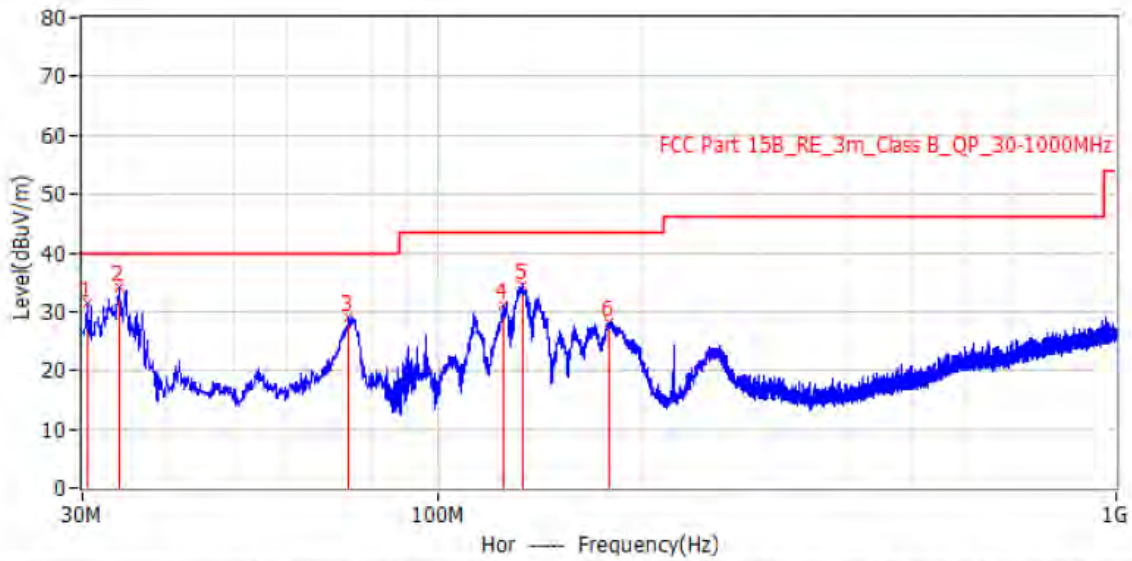
Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

From 30MHz to 1000MHz: Conclusion: PASS

Vertical:



No.	Frequency	Level dBuV/m	Factor dB/m	Limit dBuV/m	Margin dB	Detector	Height cm	Height cm	Angle deg
1	30.065MHz	35.5	16.6	40.0	-4.5	QP	Ver	100.0	41.0
2	30.628MHz	37.0	16.6	40.0	-3.0	QP	Ver	100.0	0.0
3	32.795MHz	36.6	16.7	40.0	-3.4	QP	Ver	100.0	0.0
4	35.339MHz	34.8	16.9	40.0	-5.2	QP	Ver	100.0	263.0
5	42.671MHz	30.3	17.4	40.0	-9.7	QP	Ver	100.0	0.0
6*	54.493MHz	34.1	16.9	40.0	-5.9	PK	Ver	100.0	0.0

Horizontal:

No.	Frequency	Level dBuV/m	Factor dB/m	Limit dBuV/m	Margin dB	Detector	Height cm	Height cm	Angle deg
1*	30.485MHz	31.6	16.6	40.0	-8.4	PK	Hor	100.0	284.0
2*	34.001MHz	34.2	16.8	40.0	-5.8	PK	Hor	100.0	344.0
3*	74.135MHz	29.1	14.1	40.0	-10.9	PK	Hor	200.0	139.0
4*	125.181MHz	31.2	15.7	43.5	-12.3	PK	Hor	200.0	265.0
5*	133.426MHz	34.6	16.1	43.5	-8.9	PK	Hor	200.0	258.0
6*	179.259MHz	28.3	15.5	43.5	-15.2	PK	Hor	100.0	260.0

Remark: All modes have been tested, and only worst data of GFSK mode, Channel 2441MHz (AC 120V/ 60Hz) 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
4804	43.74	V	33.95	10.18	34.26	53.61	74	-20.39	PK
4804	35.47	V	33.95	10.18	34.26	45.34	54	-8.66	AV
7206	/	/	/	/	/	/	/	/	/
9608	/	/	/	/	/	/	/	/	/
4804	42.27	H	33.95	10.18	34.26	52.14	74	-21.86	PK
4804	34.86	H	33.95	10.18	34.26	44.73	54	-9.27	AV
7206	/	/	/	/	/	/	/	/	/
9608	/	/	/	/	/	/	/	/	/
Test Mode: GFSK TX Mid									
4882	45.93	V	33.93	10.2	34.29	55.77	74	-18.23	PK
4882	35.22	V	33.93	10.2	34.29	45.06	54	-8.94	AV
7323	/	/	/	/	/	/	/	/	/
9764	/	/	/	/	/	/	/	/	/
4882	44.78	H	33.93	10.2	34.29	54.62	74	-19.38	PK
4882	33.29	H	33.93	10.2	34.29	43.13	54	-10.87	AV
7323	/	/	/	/	/	/	/	/	/
9764	/	/	/	/	/	/	/	/	/
Test Mode: GFSK TX High									
4960	43.40	V	33.98	10.22	34.25	53.35	74	-20.65	PK
4960	35.28	V	33.98	10.22	34.25	45.23	54	-8.77	AV
7440	/	/	/	/	/	/	/	/	/
9920	/	/	/	/	/	/	/	/	/
4960	46.60	H	33.98	10.22	34.25	56.55	74	-17.45	PK
4960	35.80	H	33.98	10.22	34.25	45.75	54	-8.25	AV
7440	/	/	/	/	/	/	/	/	/
9920	/	/	/	/	/	/	/	/	/

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.

From 1G-25GHz

Test Mode: $\pi/4$ DQPSK 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
4804	44.40	V	33.95	10.18	34.26	54.27	74	-19.73	PK
4804	35.20	V	33.95	10.18	34.26	45.07	54	-8.93	AV
7206	/	/	/	/	/	/	/	/	/
9608	/	/	/	/	/	/	/	/	/
4804	42.72	H	33.95	10.18	34.26	52.59	74	-21.41	PK
4804	35.13	H	33.95	10.18	34.26	45.00	54	-9.00	AV
7206	/	/	/	/	/	/	/	/	/
9608	/	/	/	/	/	/	/	/	/
Test Mode: $\pi/4$ DQPSK TX Mid									
4882	45.49	V	33.93	10.2	34.25	55.37	74	-18.63	PK
4882	35.99	V	33.93	10.2	34.25	45.87	54	-8.13	AV
7323	/	/	/	/	/	/	/	/	/
9764	/	/	/	/	/	/	/	/	/
4882	44.34	H	33.93	10.2	34.29	54.18	74	-19.82	PK
4882	33.33	H	33.93	10.2	34.29	43.17	54	-10.83	AV
7323	/	/	/	/	/	/	/	/	/
9764	/	/	/	/	/	/	/	/	/
Test Mode: $\pi/4$ DQPSK TX High									
4960	43.89	V	33.98	10.22	34.25	53.84	74	-20.16	PK
4960	35.23	V	33.98	10.22	34.25	45.18	54	-8.82	AV
7440	/	/	/	/	/	/	/	/	/
9920	/	/	/	/	/	/	/	/	/
4960	46.64	H	33.98	10.22	34.25	56.59	74	-17.41	PK
4960	35.79	H	33.98	10.22	34.25	45.74	54	-8.26	AV
7440	/	/	/	/	/	/	/	/	/
9920	/	/	/	/	/	/	/	/	/

Note:

1, Result = Read level + Antenna factor + cable loss-Amp factor

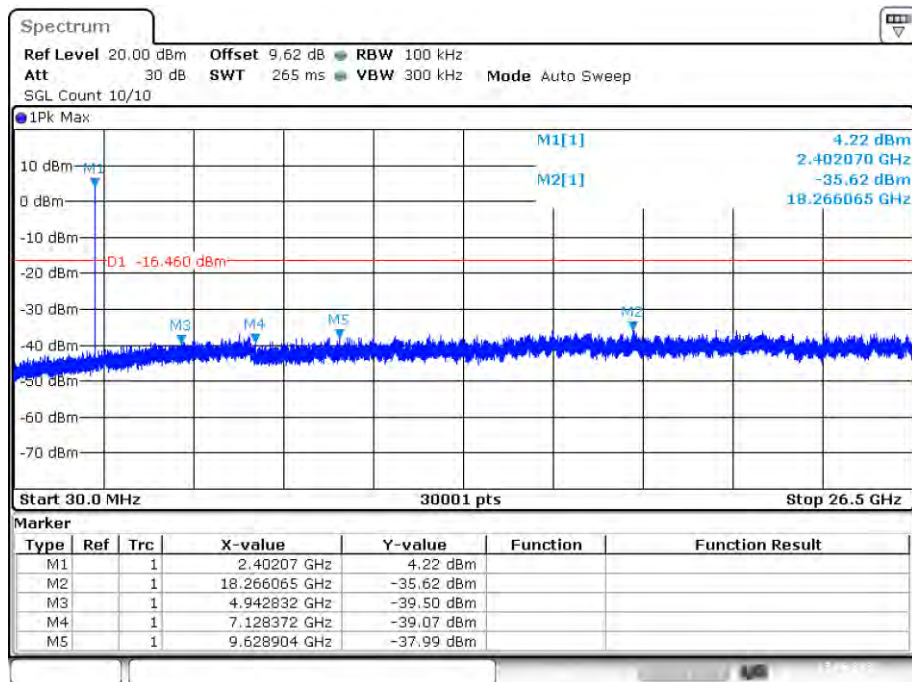
2, All the other emissions not reported were too low to read and deemed to comply with FCC limit.

Test Mode: $\pi/4$ DQPSK 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
4804	43.72	V	33.95	10.18	34.26	53.59	74	-20.41	PK
4804	35.01	V	33.95	10.18	34.26	44.88	54	-9.12	AV
7206	/	/	/	/	/	/	/	/	/
9608	/	/	/	/	/	/	/	/	/
4804	43.06	H	33.95	10.18	34.26	52.93	74	-21.07	PK
4804	35.18	H	33.95	10.18	34.26	45.05	54	-8.95	AV
7206	/	/	/	/	/	/	/	/	/
9608	/	/	/	/	/	/	/	/	/
Test Mode: $\pi/4$ DQPSK TX Mid									
4882	45.95	V	33.93	10.2	34.29	55.79	74	-18.21	PK
4882	35.38	V	33.93	10.2	34.29	45.22	54	-8.78	AV
7323	/	/	/	/	/	/	/	/	/
9764	/	/	/	/	/	/	/	/	/
4882	45.07	H	33.93	10.2	34.29	54.91	74	-19.09	PK
4882	34.07	H	33.93	10.2	34.29	43.91	54	-10.09	AV
7323	/	/	/	/	/	/	/	/	/
9764	/	/	/	/	/	/	/	/	/
Test Mode: $\pi/4$ DQPSK TX High									
4960	43.91	V	33.98	10.22	34.25	53.86	74	-20.14	PK
4960	34.94	V	33.98	10.22	34.25	44.89	54	-9.11	AV
7440	/	/	/	/	/	/	/	/	/
9920	/	/	/	/	/	/	/	/	/
4960	47.25	H	33.98	10.22	34.25	57.20	74	-16.80	PK
4960	36.64	H	33.98	10.22	34.25	46.59	54	-7.41	AV
7440	/	/	/	/	/	/	/	/	/
9920	/	/	/	/	/	/	/	/	/

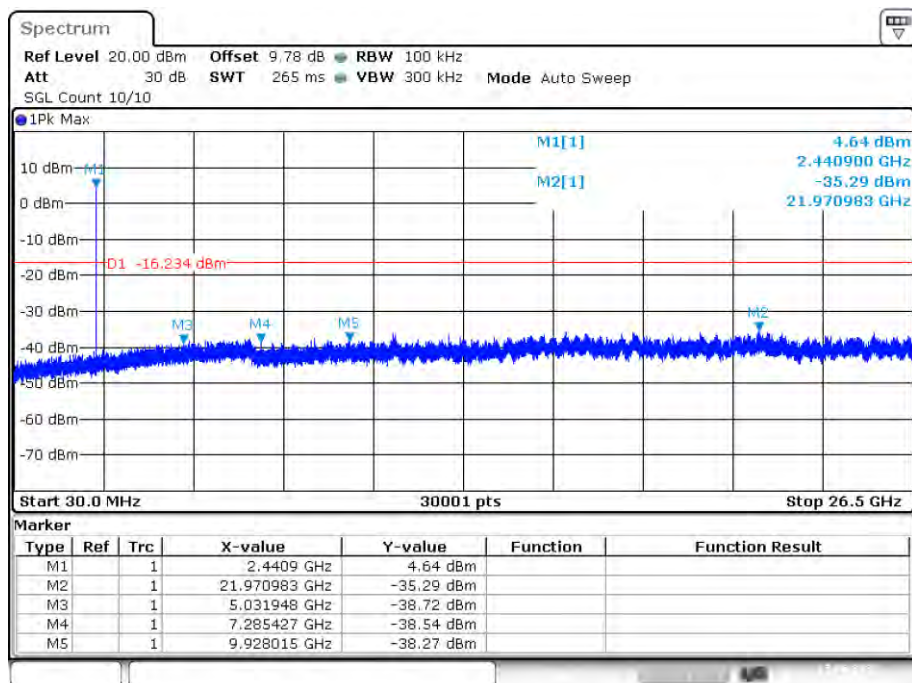
Note:

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.

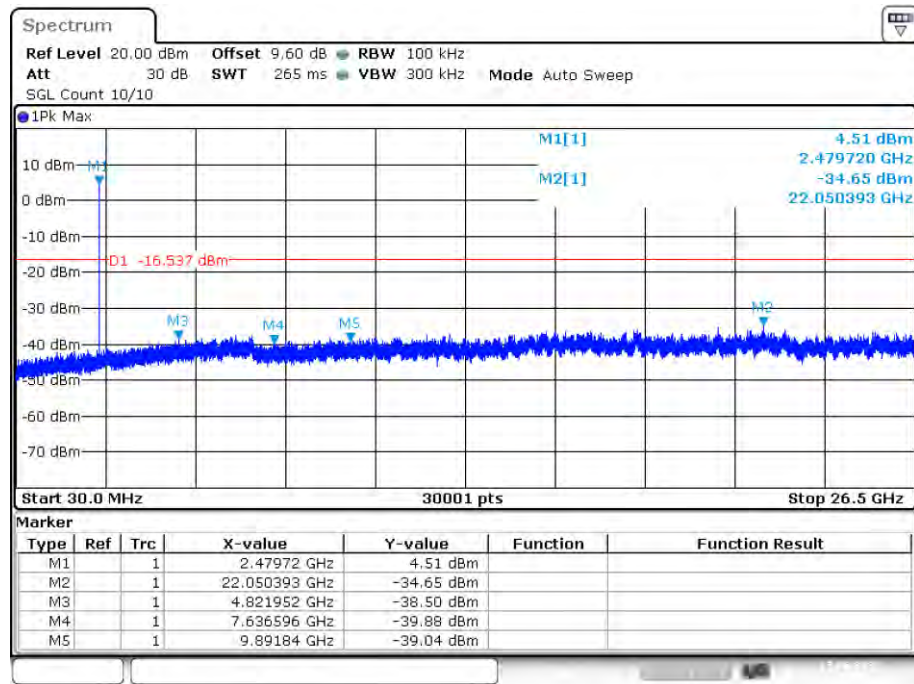
Conducted RF Spurious Emission**Tx. Spurious NVNT 1-DH1 2402MHz Ant1 Emission**

Date: 17.JUN.2022 11:34:54

Tx. Spurious NVNT 1-DH1 2441MHz Ant1 Emission

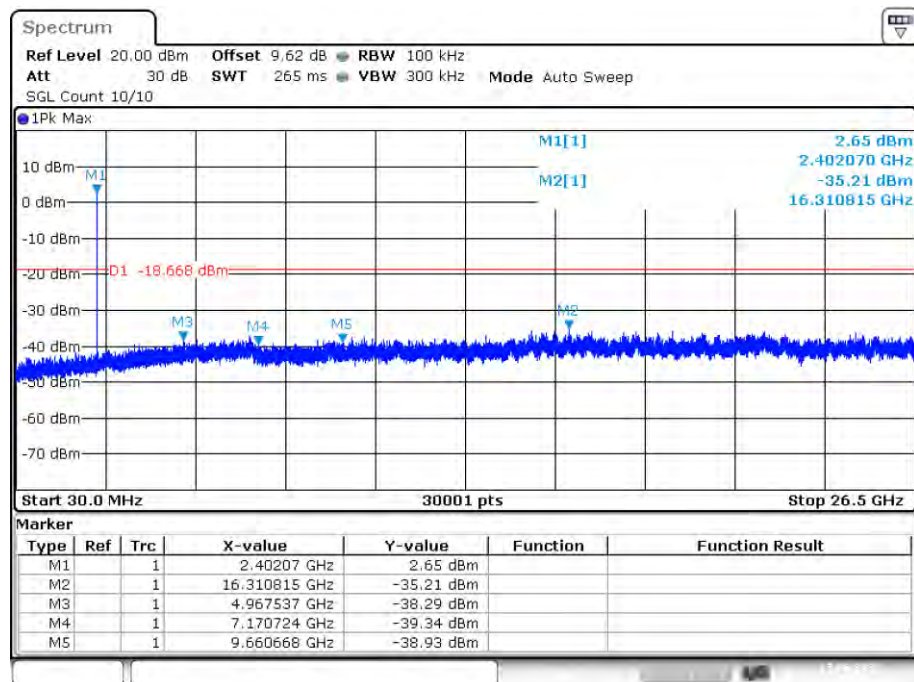
Date: 17.JUN.2022 11:36:43

Tx. Spurious NVNT 1-DH1 2480MHz Ant1 Emission



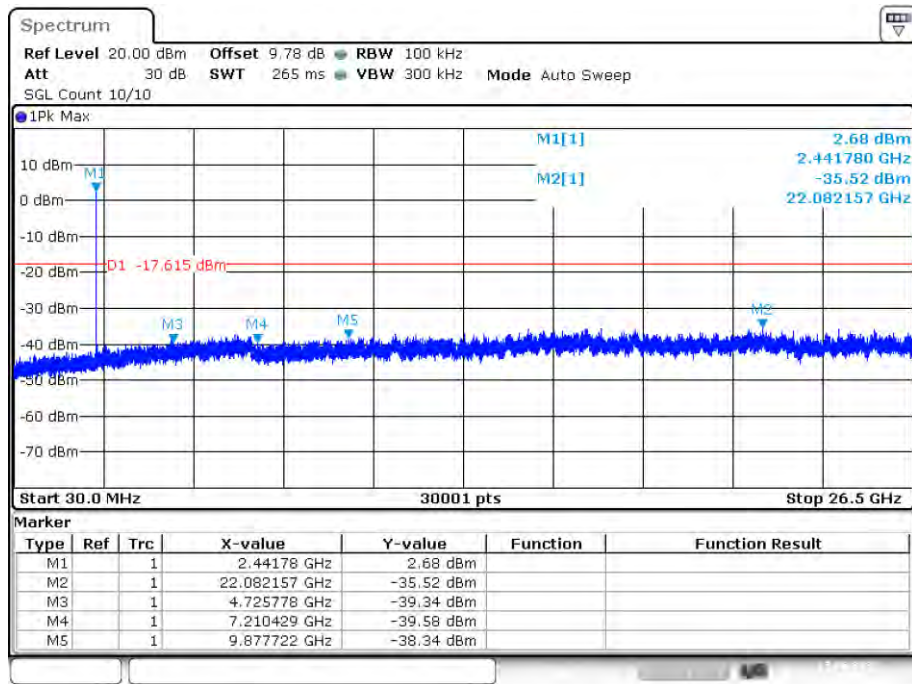
Date: 17.JUN.2022 11:38:35

Tx. Spurious NVNT 2-DH1 2402MHz Ant1 Emission



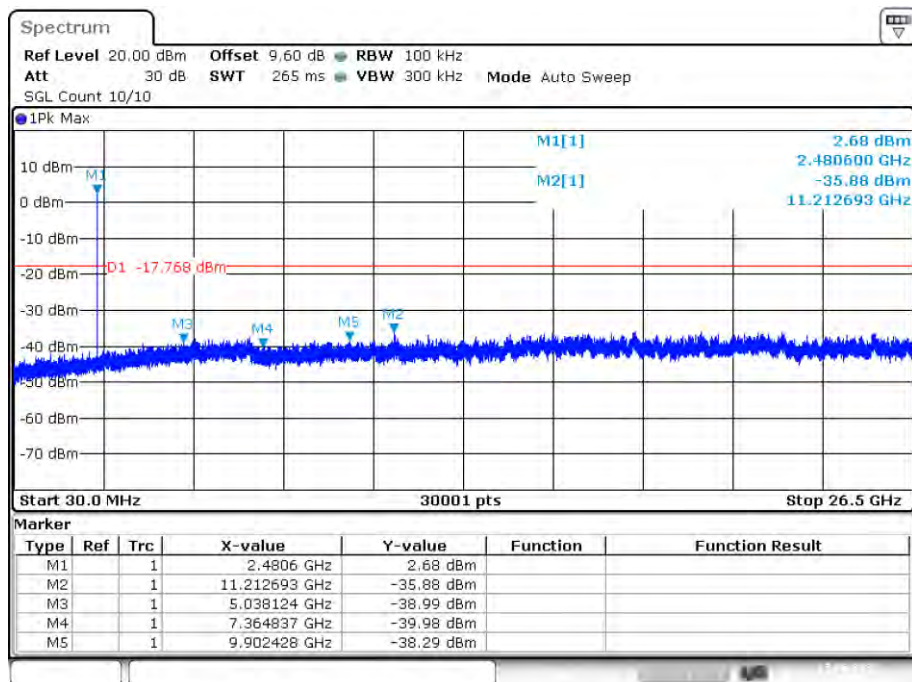
Date: 17.JUN.2022 12:02:16

Tx. Spurious NVNT 2-DH1 2441MHz Ant1 Emission



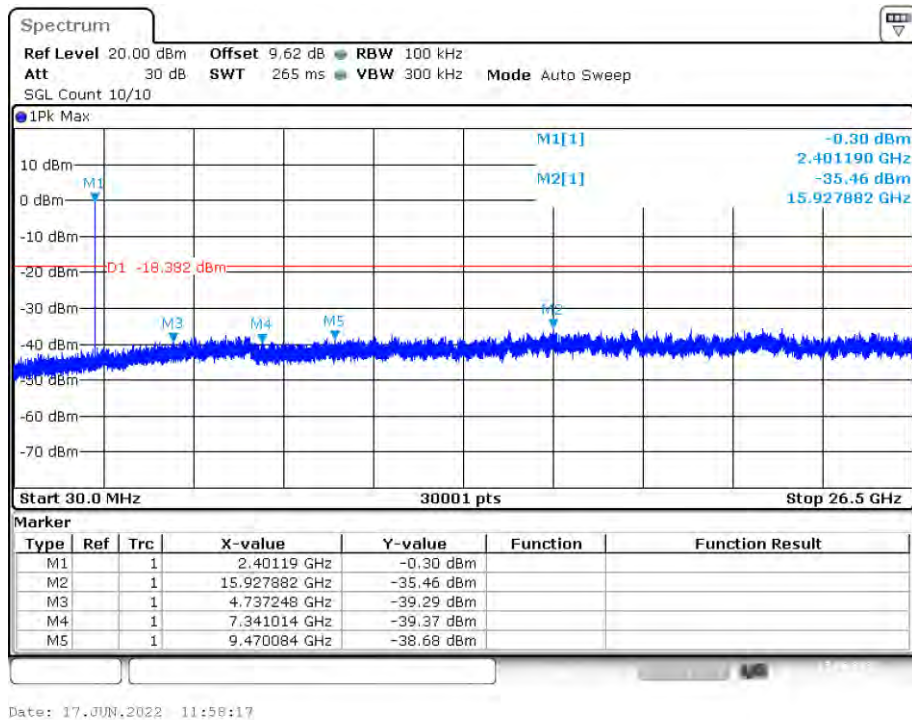
Date: 17/JUN/2022 11:49:32

Tx. Spurious NVNT 2-DH1 2480MHz Ant1 Emission

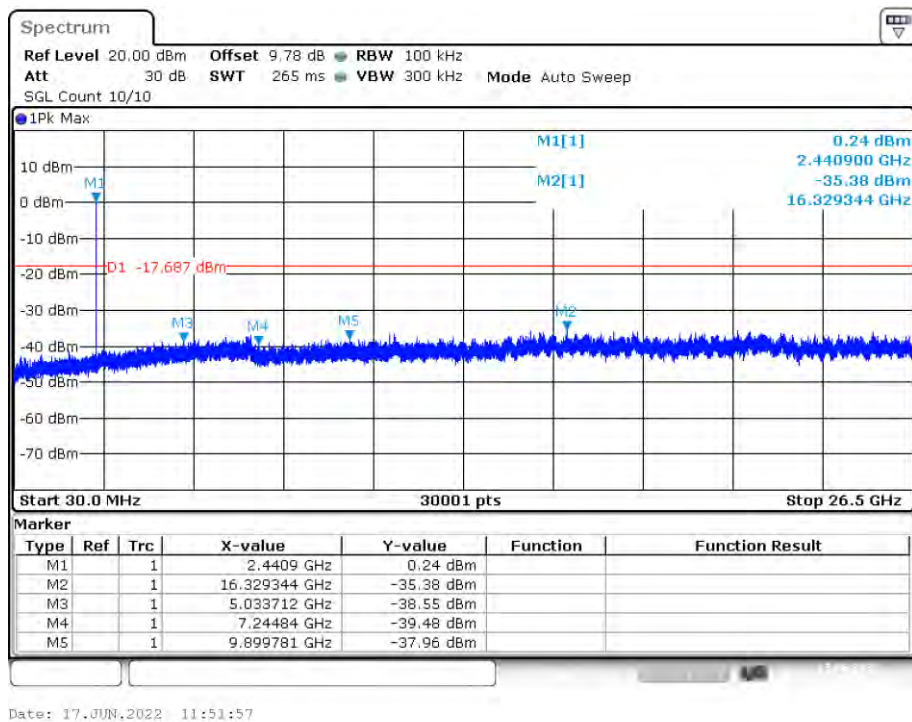


Date: 17/JUN/2022 12:07:56

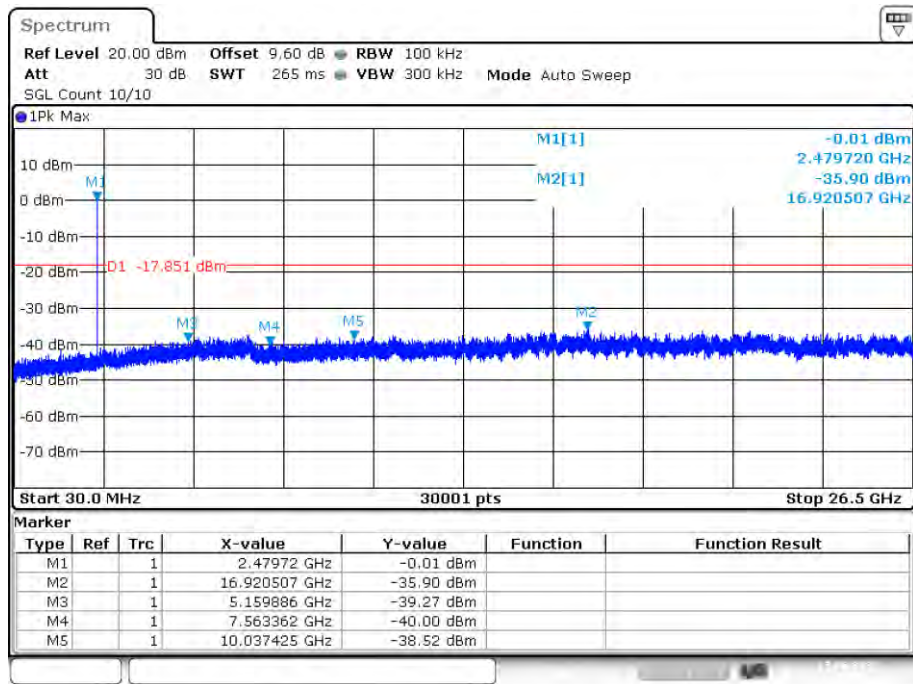
Tx. Spurious NVNT 3-DH1 2402MHz Ant1 Emission



Tx. Spurious NVNT 3-DH1 2441MHz Ant1 Emission



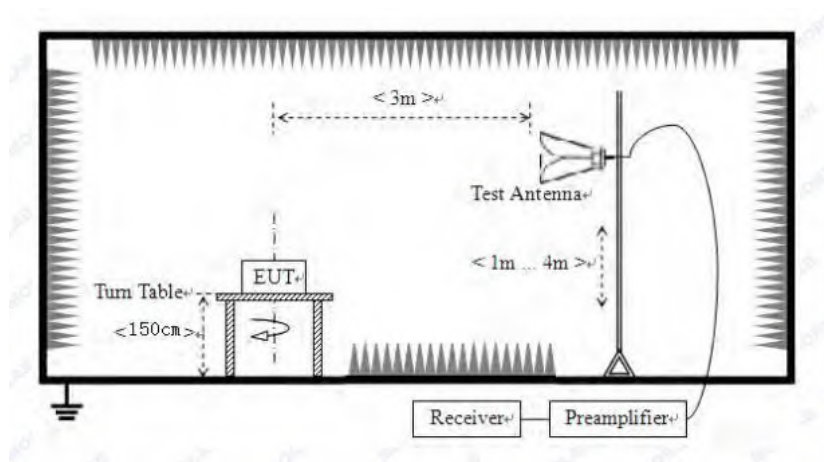
Tx. Spurious NVNT 3-DH1 2480MHz Ant1 Emission



Date: 17.JUN.2022 11:55:58

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 FCC part 15.209 and RSS-GEN, all the other emissions outside operation shall be at least 20dB below the fundamental emissions, or comply with FCC part 15.209 and RSS-GEN limits.

9.3. Test Procedure

Refer to ANSI C 63.10, Clause 6.10.

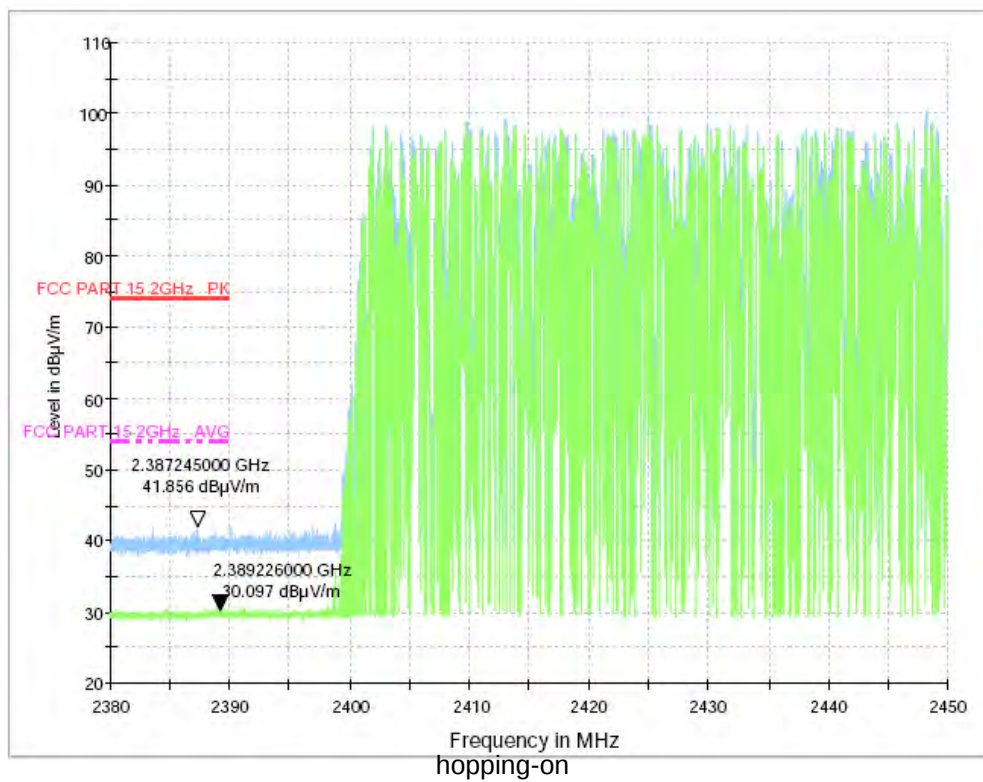
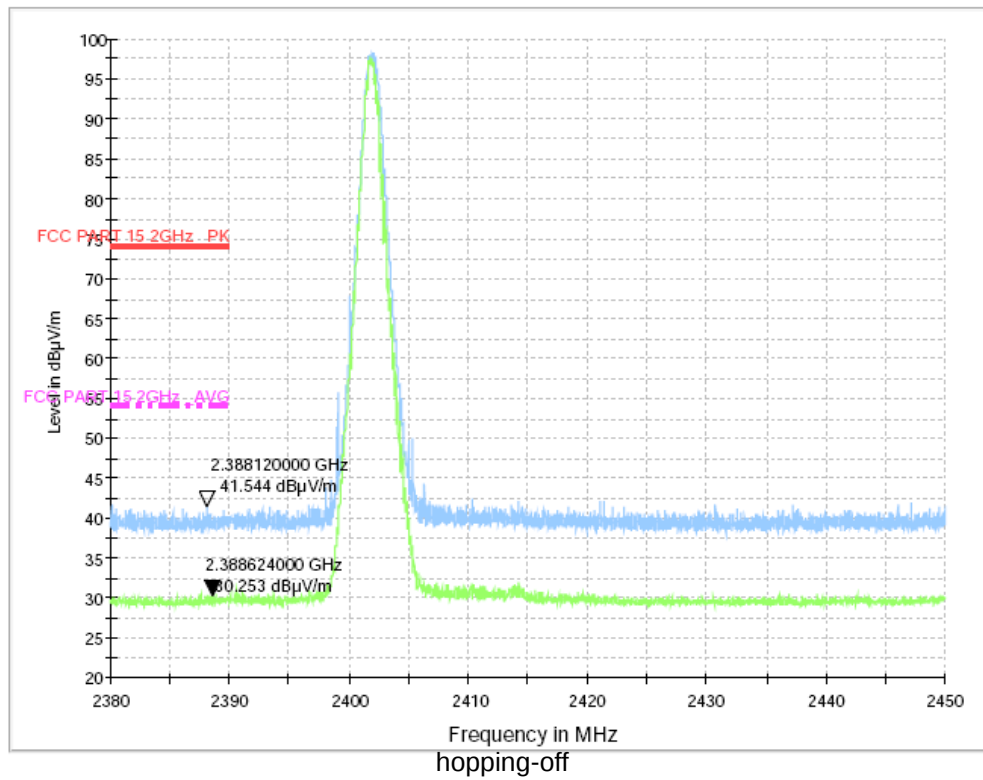
All restriction band and non- restriction band have been tested, only worse case is reported.

9.4. Test Result

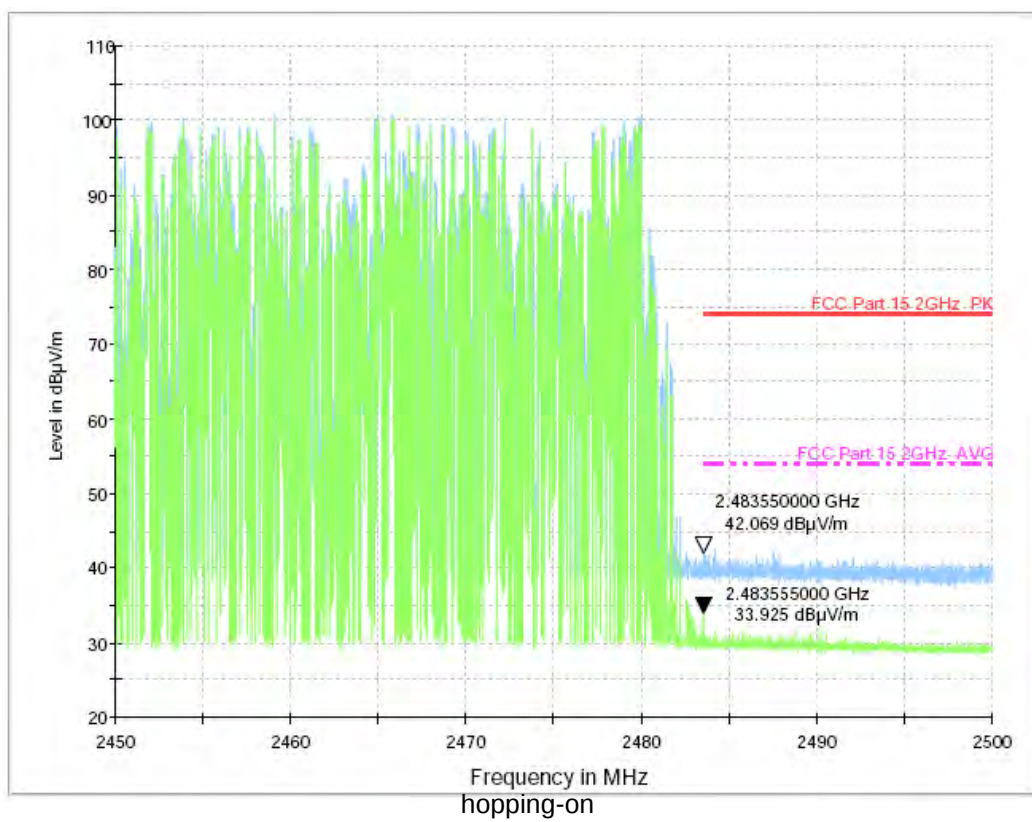
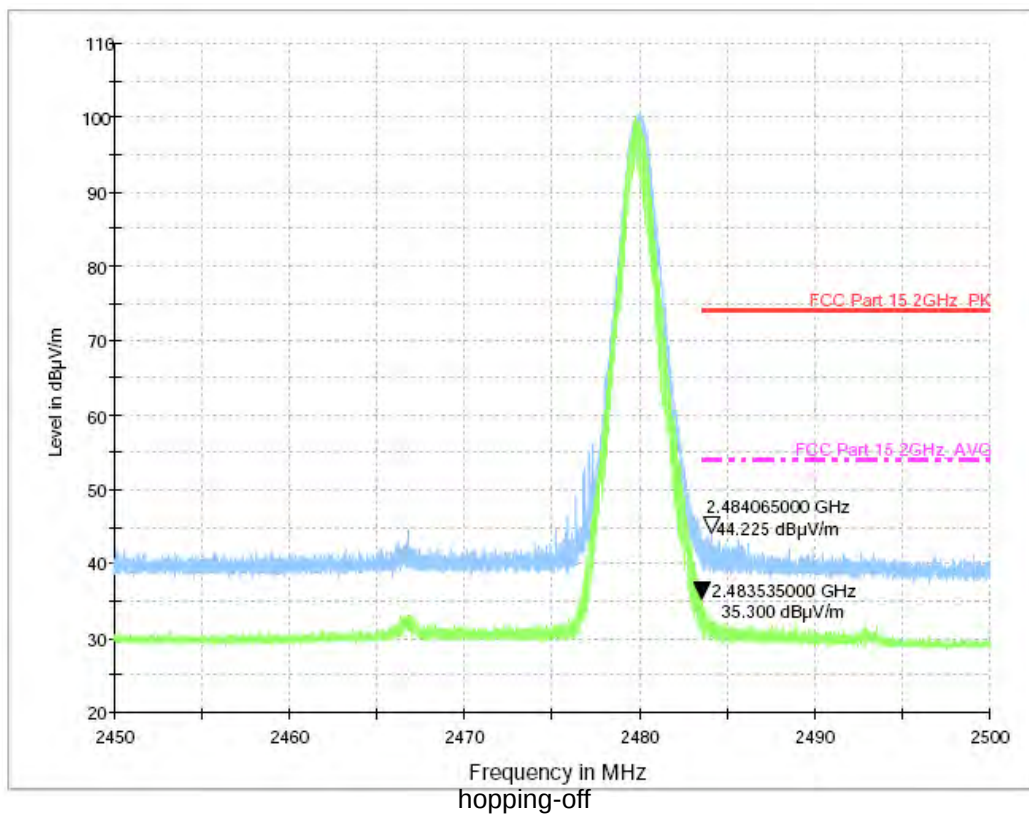
PASS. (See below detailed test data)

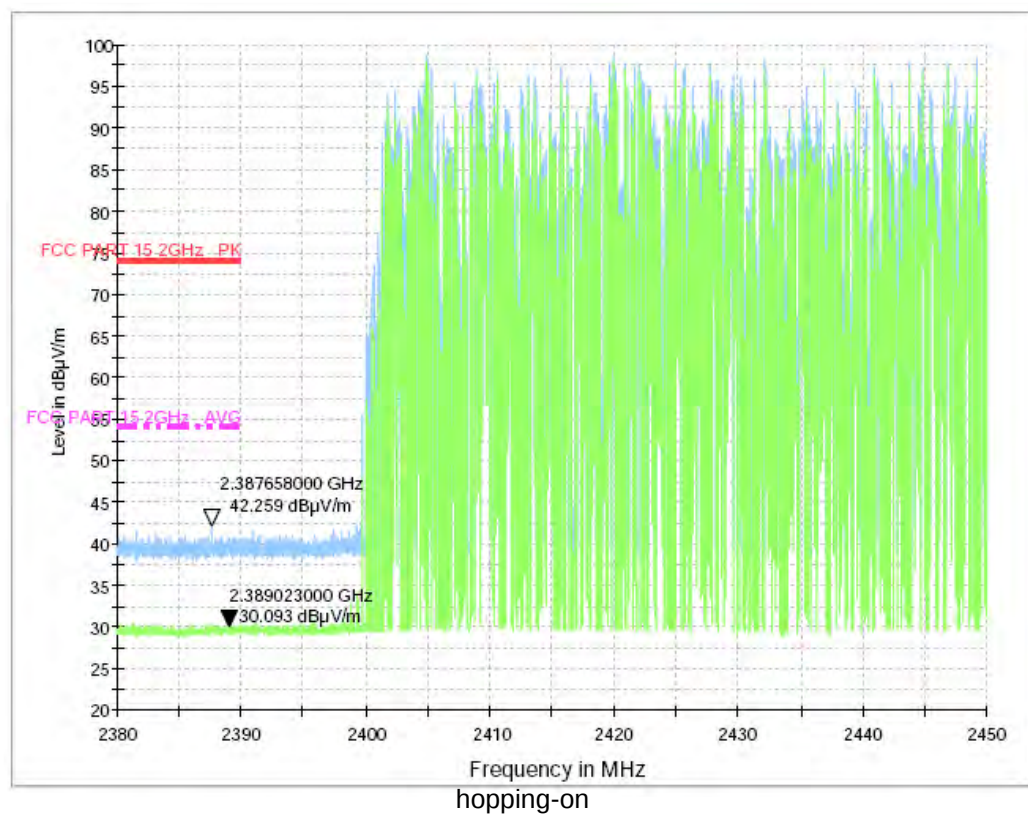
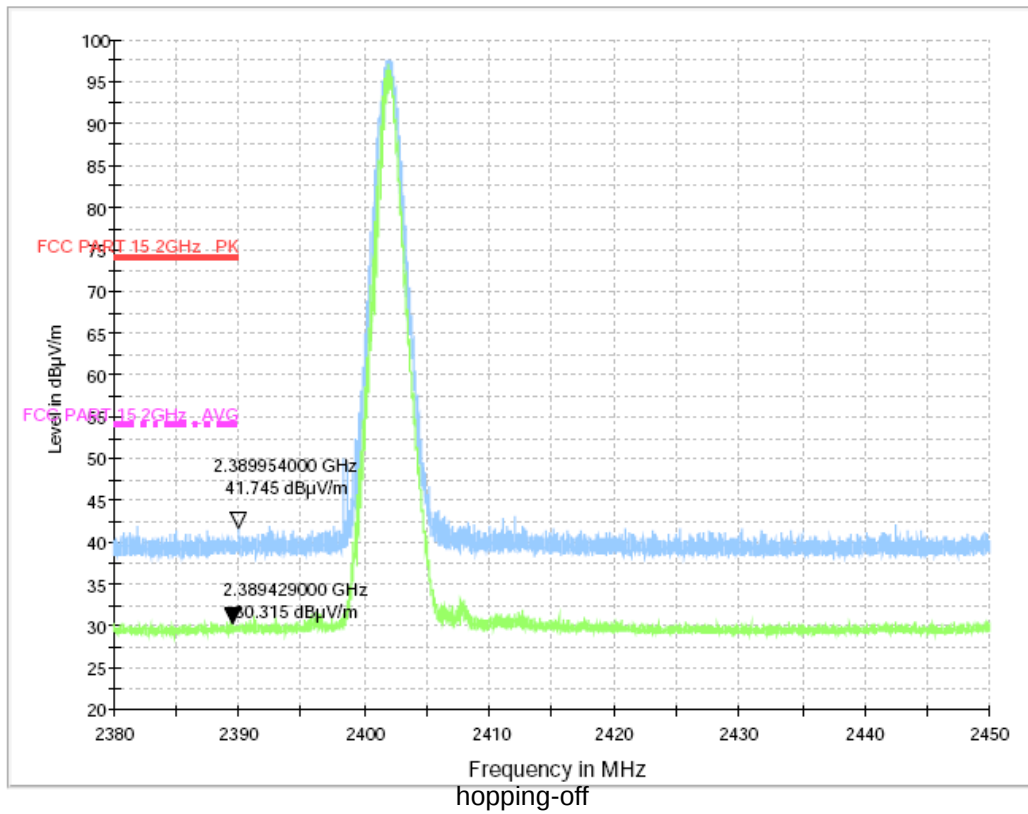
Radiated Method:

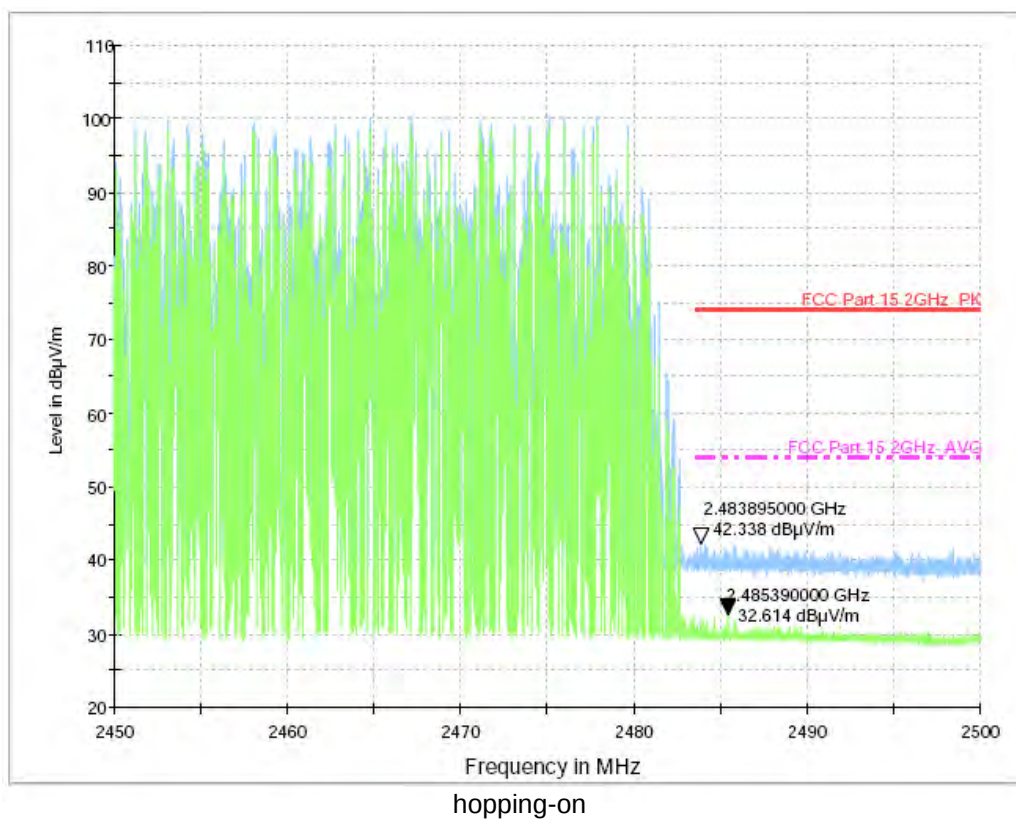
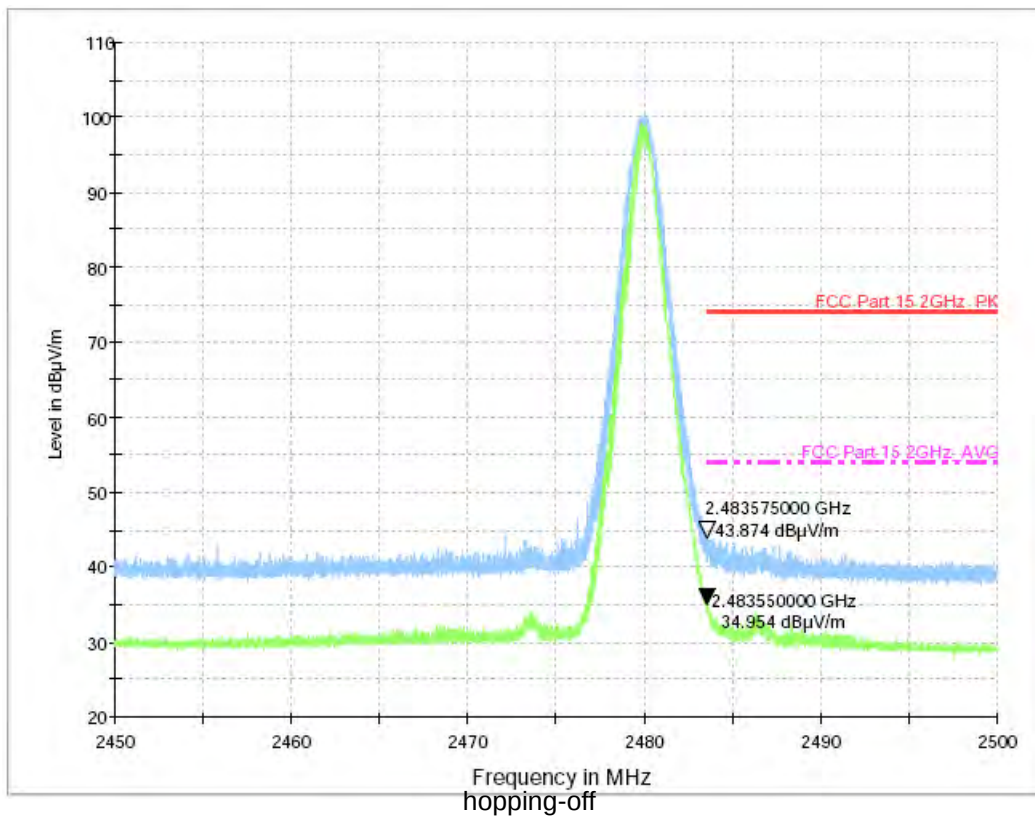
Test Mode: GFSK-Low



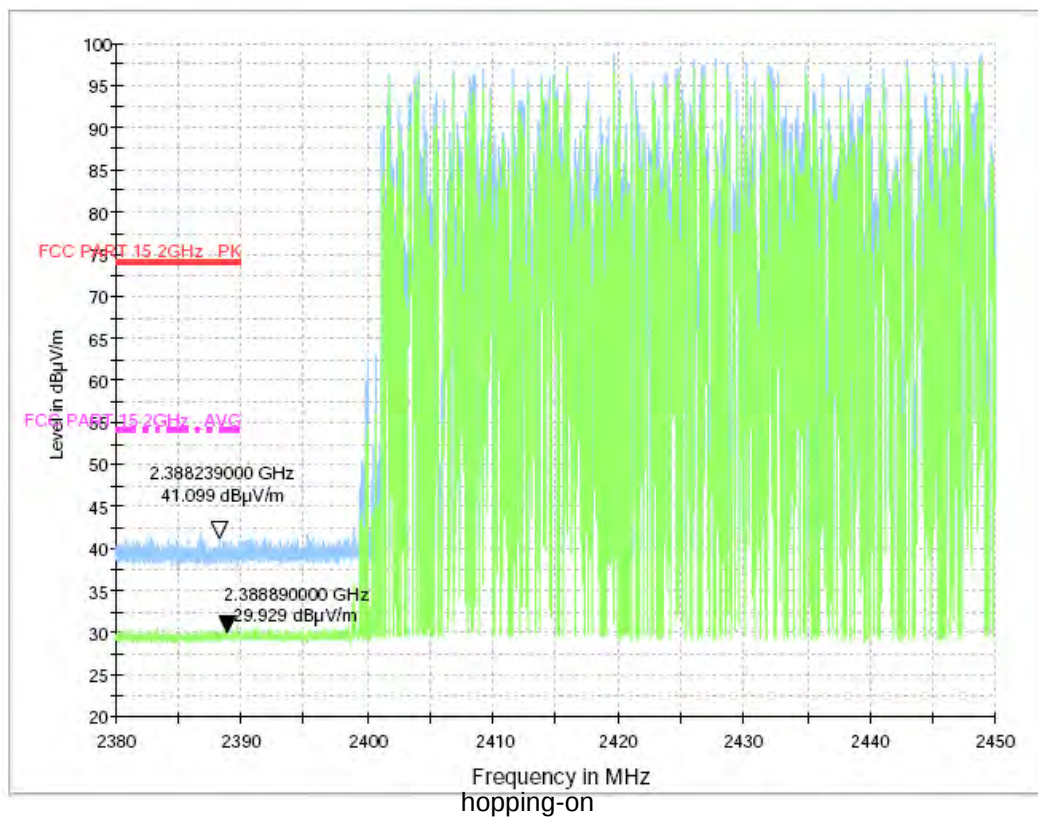
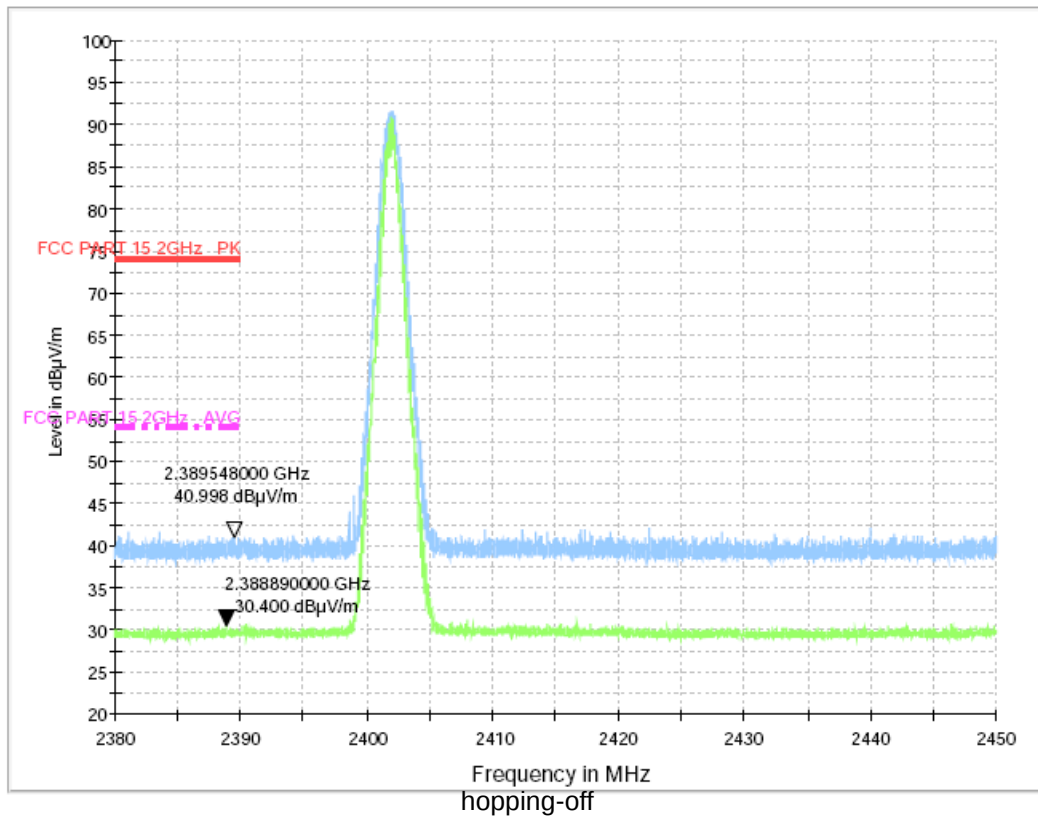
Test Mode: GFSK-High



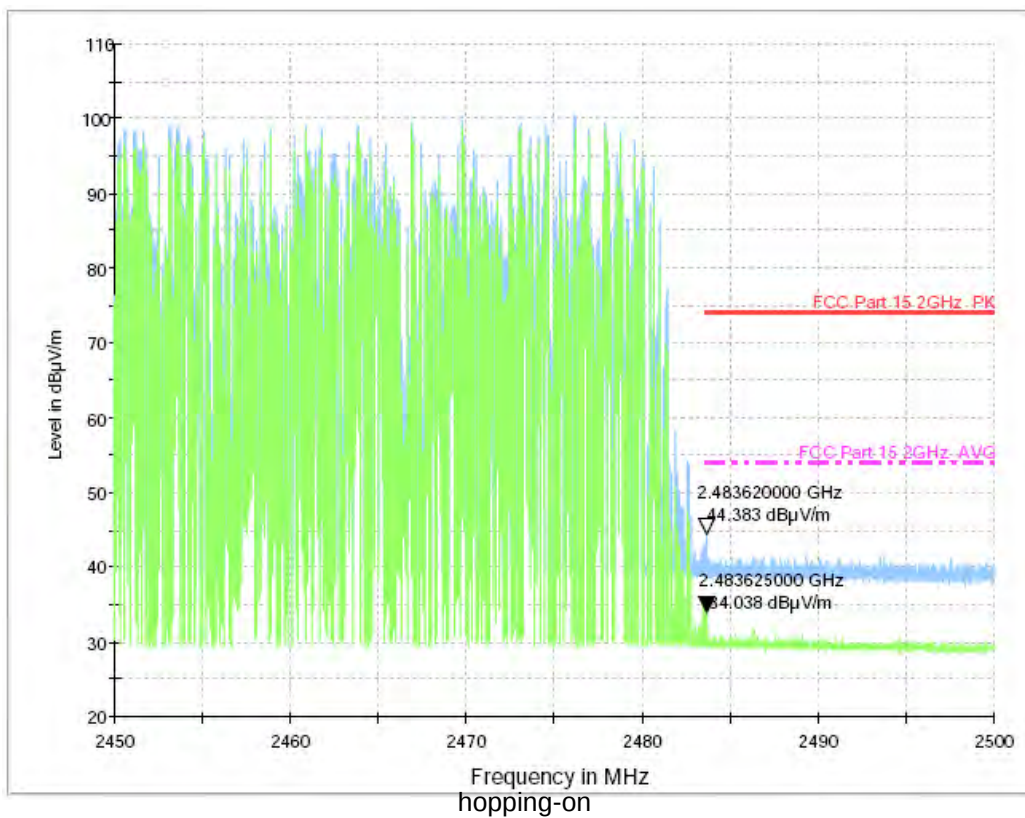
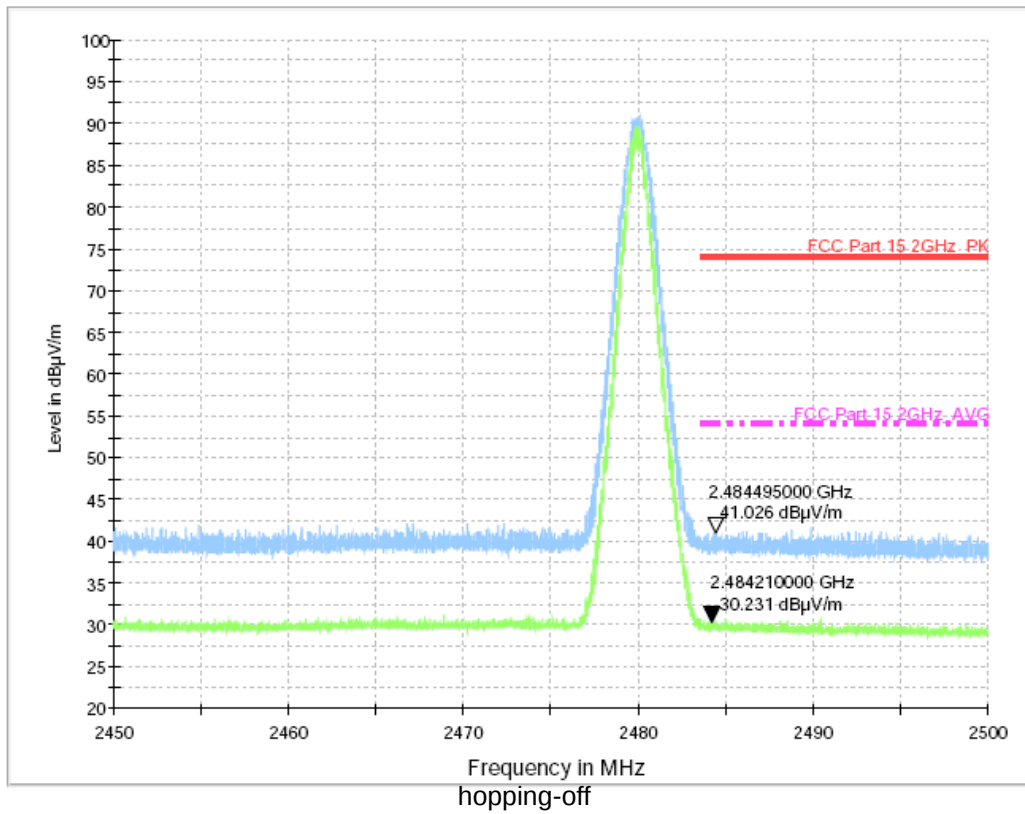
Test Mode: $\pi/4$ DQPSK-Low

Test Mode: $\pi/4$ DQPSK-High

Test Mode: 8DPSK-Low



Test Mode: 8DPSK-High



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

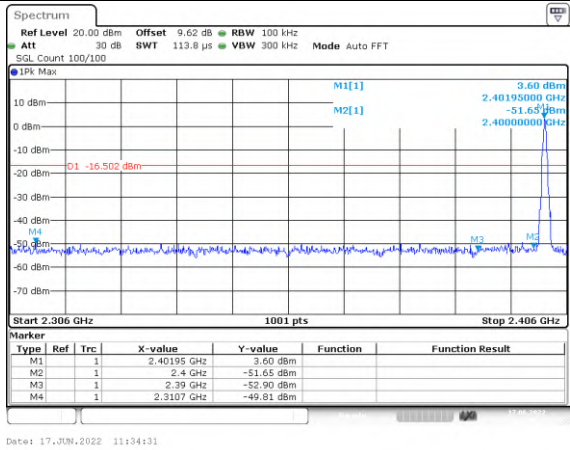
2.Measurement=Reading Level+Correct Factor; Correct Factor=Antenna Factor+Cable Loss.

Conducted Method

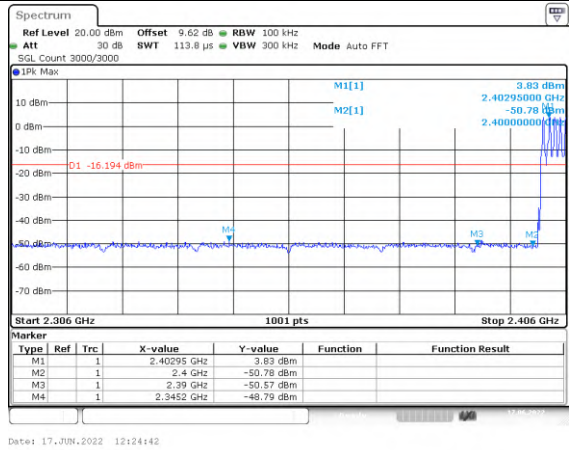
GFSK Mode:

Test channel:

Lowest channel



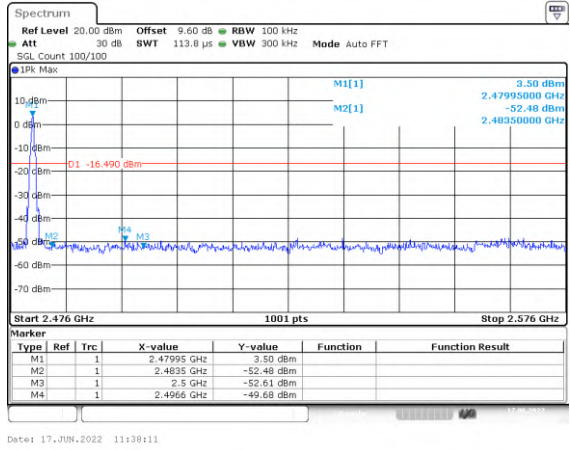
No-hopping mode



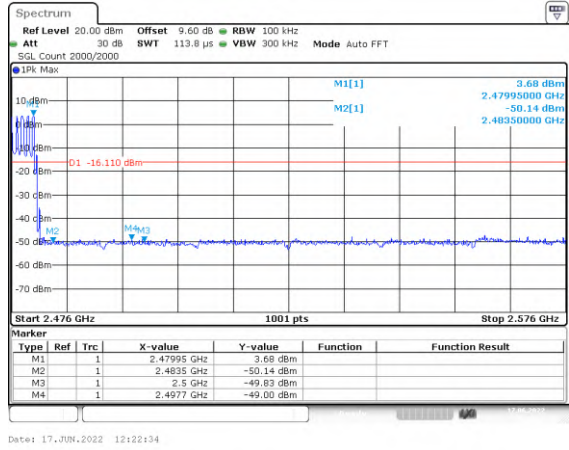
Hopping mode

Test channel:

Highest channel



No-hopping mode

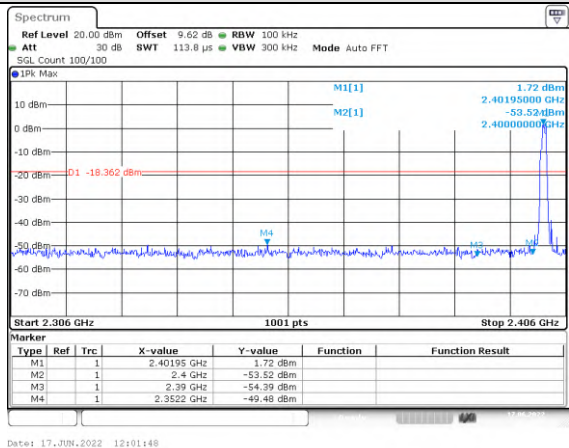


Hopping mode

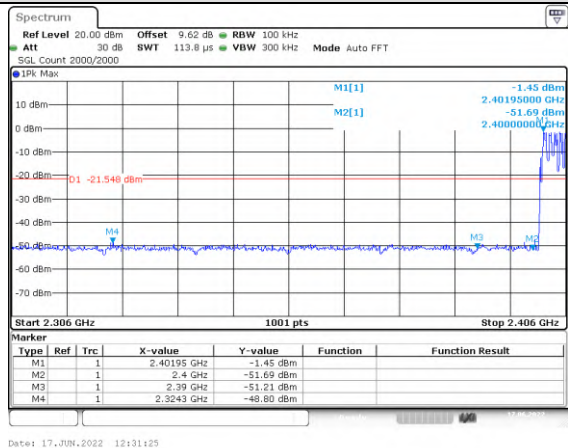
Pi/4QPSK Mode:

Test channel:

Lowest channel



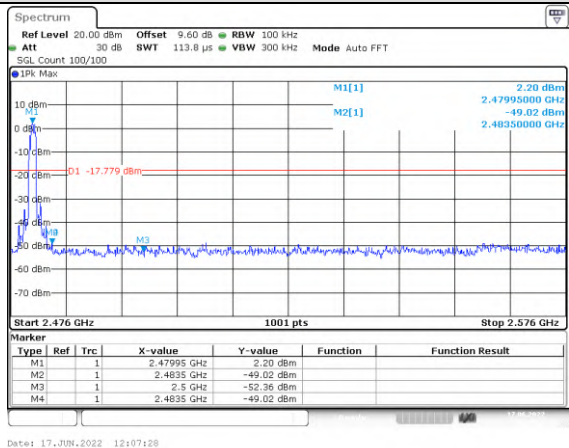
No-hopping mode



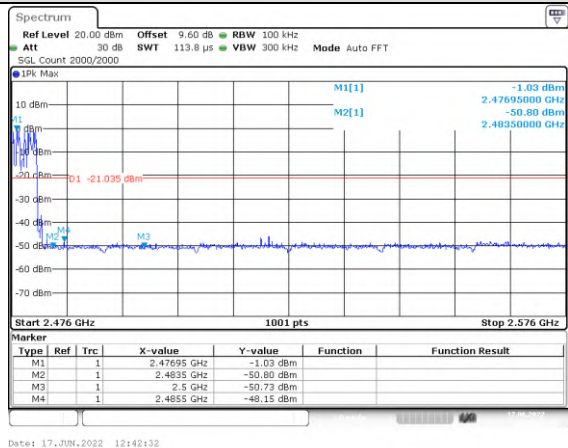
Hopping mode

Test channel:

Highest channel



No-hopping mode



Hopping mode

Test channel:



No-hopping mode

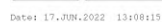
Date: 17.JUN.2022 12:56:58

Hopping mode

Highest channel



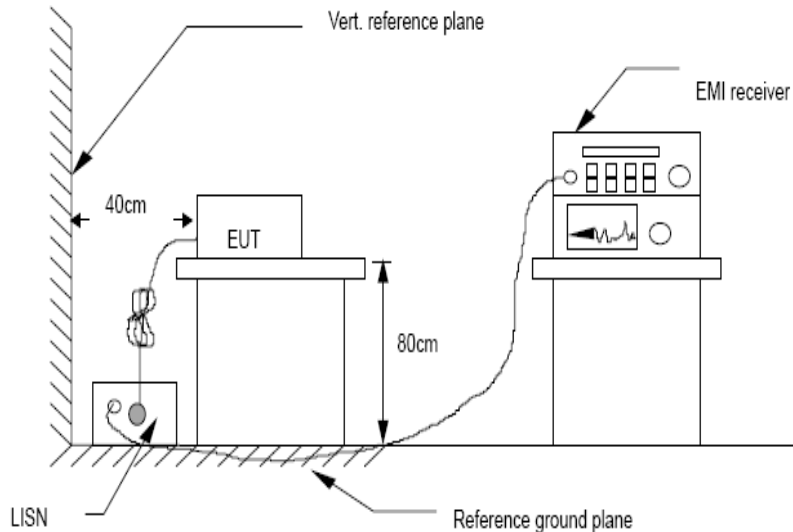
No-hopping mode



Hopping 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 C63.10:2013on conducted Emission test.
- (4) The bandwidth of test receiver is set at 10KHz.

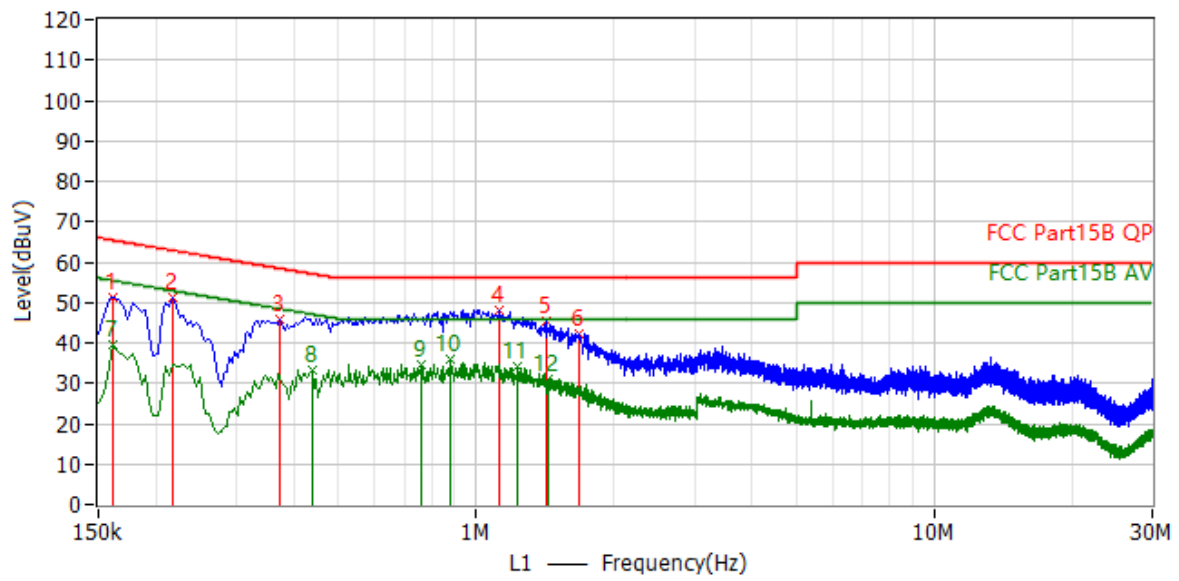
(5) The frequency range from 150 KHz to 30MHz is checked.

10.4.Test Result

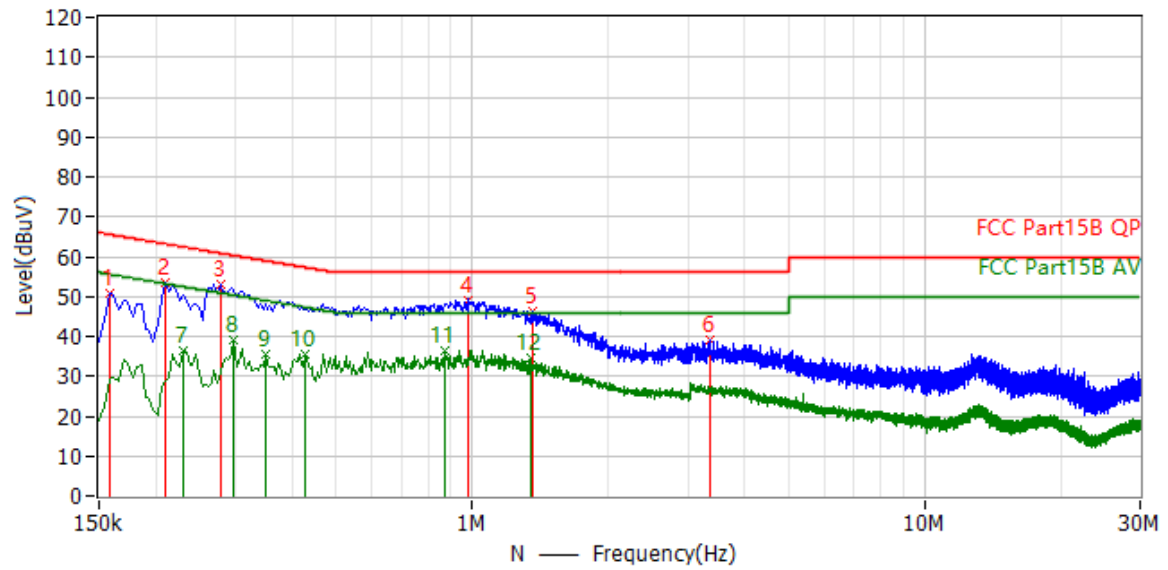
PASS. (See below detailed test data)

Note: If peak Result comply with AV limit, QP and AV Result is deemed to comply with AV limit

Line:



No.	Frequency	Limit dBuV	Level dBuV	Delta dB	Factor dB	Detector	Polar
1*	162.000 kHz	65.4	51.2	-14.1	9.7	PK	L1
2*	218.000 kHz	62.9	51.1	-11.8	9.7	PK	L1
3*	374.000 kHz	58.4	46.0	-12.4	9.7	PK	L1
4*	1.130 MHz	56.0	48.2	-7.8	9.9	PK	L1
5*	1.422 MHz	56.0	45.2	-10.8	9.9	PK	L1
6*	1.674 MHz	56.0	42.4	-13.6	9.9	PK	L1
7*	162.000 kHz	55.4	39.7	-15.7	9.7	AV	L1
8*	438.000 kHz	47.1	33.2	-13.9	9.8	AV	L1
9*	758.000 kHz	46.0	34.8	-11.2	9.8	AV	L1
10*	878.000 kHz	46.0	36.0	-10.0	9.8	AV	L1
11*	1.238 MHz	46.0	34.2	-11.8	9.9	AV	L1
12*	1.438 MHz	46.0	31.2	-14.8	9.9	AV	L1

Neutral:

No.	Frequency	Limit dBuV	Level dBuV	Delta dB	Factor dB	Detector	Polar
1*	158.000 kHz	65.6	50.6	-14.9	9.7	PK	N
2*	210.000 kHz	63.2	53.4	-9.8	9.7	PK	N
3*	278.000 kHz	60.9	53.0	-7.9	9.7	PK	N
4*	978.000 kHz	56.0	49.2	-6.8	9.7	PK	N
5*	1.358 MHz	56.0	46.3	-9.7	9.8	PK	N
6*	3.350 MHz	56.0	39.0	-17.0	9.9	PK	N
7*	230.000 kHz	52.4	36.5	-15.9	9.7	AV	N
8*	298.000 kHz	50.3	39.0	-11.3	9.7	AV	N
9*	350.000 kHz	49.0	35.7	-13.3	9.7	AV	N
10*	430.000 kHz	47.3	35.5	-11.8	9.7	AV	N
11*	870.000 kHz	46.0	36.5	-9.5	9.7	AV	N
12*	1.350 MHz	46.0	34.4	-11.6	9.8	AV	N

Remark: All modes have been tested, and only worst data of GFSK mode, Channel 2441MHz (AC 120V/ 60Hz) was listed in this report.

11. Antenna Requirements

11.1.Limit

For intentional device, according to FCC 47 CFR Section 15.203 and RSS-GEN, 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.

----- END OF REPORT-----