

TEST REPORT

FCC ID. :	Z2G-PERIMICERCVR	
Test Report No..... :	TCT240828E033	
Date of issue..... :	May 28, 2025	
Testing laboratory	SHENZHEN TONGCE TESTING LAB	
Testing location/ address:	2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, 518103, People's Republic of China	
Applicant's name..... :	Perixx Computer GmbH	
Address..... :	Heerdter Landstrasse 189e 40549 Dusseldorf, Germany	
Manufacturer's name ... :	Perixx Computer GmbH	
Address..... :	Heerdter Landstrasse 189e 40549 Dusseldorf, Germany	
Standard(s)	FCC CFR Title 47 Part 15 Subpart C Section 15.247 FCC KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2020	
Product Name..... :	Wireless Ergonomic Vertical Mouse	
Trade Mark	N/A	
Model/Type reference..... :	PERIMICE-713 R, PERIMICE-713 RX	
Rating(s)..... :	DC 5V	
Date of receipt of test item	Aug. 28, 2024	
Date (s) of performance of test..... :	Aug. 28, 2024 ~ May 28, 2025	
Tested by (+signature) ... :	Ronaldo LUO	
Check by (+signature).... :	Beryl ZHAO	
Approved by (+signature):	Tomsin	

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Table of Contents

1. General Product Information	3
1.1. EUT description	3
1.2. Model(s) list.....	3
1.3. Operation Frequency	3
2. Test Result Summary	5
3. General Information.....	6
3.1. Test environment and mode.....	6
3.2. Description of Support Units.....	7
4. Facilities and Accreditations	8
4.1. Facilities	8
4.2. Location	8
4.3. Measurement Uncertainty.....	8
5. Test Results and Measurement Data	9
5.1. Antenna requirement	9
5.2. Conducted Emission.....	10
5.3. Conducted Output Power	14
5.4. 20dB Occupy Bandwidth	15
5.5. Carrier Frequencies Separation	16
5.6. Hopping Channel Number	17
5.7. Dwell Time.....	18
5.8. Pseudorandom Frequency Hopping Sequence	19
5.9. Conducted Band Edge Measurement	20
5.10. Conducted Spurious Emission Measurement.....	21
5.11. Radiated Spurious Emission Measurement	22
Appendix A: Test Result of Conducted Test	
Appendix B: Photographs of Test Setup	
Appendix C: Photographs of EUT	

1. General Product Information

1.1. EUT description

Product Name.....:	Wireless Ergonomic Vertical Mouse
Model/Type reference.....:	PERIMICE-713 R
Sample Number.....:	TCT240828E033-0101
Operation Frequency	2403MHz~2479MHz
Number of Channel	16
Modulation Type	GFSK
Modulation Technology	FHSS
Antenna Type.....:	PCB Antenna
Antenna Gain.....:	-1.31dBi
Rating(s).....:	DC 5V

Note: The antenna gain listed in this report is provided by applicant, and the test laboratory is not responsible for this parameter.

1.2. Model(s) list

No.	Model No.	Tested with
1	PERIMICE-713 R	☒
Other models	PERIMICE-713 RX	☐

Note: PERIMICE-713 R is tested model, other models are derivative models. The models are identical in circuit and PCB layout, only different on the model names. So the test data of PERIMICE-713 R can represent the remaining models.

1.3. Operation Frequency

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2403MHz	4	2422MHz	8	2441MHz	12	2463MHz
1	2407MHz	5	2426MHz	9	2445MHz	13	2466MHz
2	2414MHz	6	2436MHz	10	2453MHz	14	2473MHz
3	2419MHz	7	2439MHz	11	2459MHz	15	2479MHz

Remark: Channel 0, 8 & 15 have been tested for GFSK modulation mode.

2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna Requirement	§15.203/§15.247 (c)	PASS
AC Power Line Conducted Emission	§15.207	PASS
Conducted Peak Output Power	§15.247 (b)(1)	PASS
20dB Occupied Bandwidth	§15.247 (a)(1)	PASS
Carrier Frequencies Separation	§15.247 (a)(1)	PASS
Hopping Channel Number	§15.247 (a)(1)	PASS
Dwell Time	§15.247 (a)(1)	PASS
Radiated Emission	§15.205/§15.209	PASS
Band Edge	§15.247(d)	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

3. General Information

3.1. Test environment and mode

Operating Environment:		
Condition	Conducted Emission	Radiated Emission
Temperature:	25.3 °C	24.4 °C
Humidity:	54 % RH	51 % RH
Atmospheric Pressure:	1010 mbar	1010 mbar
Test Software:		
Software Information:	CompXTest V1.1	
Power Level:	Default	
Test Mode:		
Engineer mode:	Keep the EUT in continuous transmitting by select channel and modulations	
The sample was placed 0.8m & 1.5m for the measurement below & above 1GHz above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case(Z axis) are shown in Test Results of the following pages. DH1 DH3 DH5 all have been tested, only worse case DH1 is reported.		

3.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
Notebook Computer	G3 3500	00342-36088-99832-AAOEM	/	DELL
Power Supply	HA130PM190	CN-0CY0JM-CH200-0B6-7405-A01	/	DELL

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. For conducted measurements (Output Power, 20dB Occupied Bandwidth, Carrier Frequencies Separation, Hopping Channel Number, Dwell Time, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

4. Facilities and Accreditations

4.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 645098

SHENZHEN TONGCE TESTING LAB

Designation Number: CN1205

The testing lab has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A

SHENZHEN TONGCE TESTING LAB

CAB identifier: CN0031

The testing lab has been registered by Innovation, Science and Economic Development Canada for radio equipment testing.

4.2. Location

SHENZHEN TONGCE TESTING LAB

Address: 2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, 518103, People's Republic of China

TEL: +86-755-27673339

4.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	± 3.10 dB
2	RF power, conducted	± 0.12 dB
3	Spurious emissions, conducted	± 0.11 dB
4	All emissions, radiated(<1 GHz)	± 4.56 dB
5	All emissions, radiated(1 GHz - 18 GHz)	± 4.22 dB
6	All emissions, radiated(18 GHz- 40 GHz)	± 4.36 dB

5. Test Results and Measurement Data

5.1. Antenna requirement

Standard requirement:

FCC Part15 C Section 15.203 /247(c)

15.203 requirement:

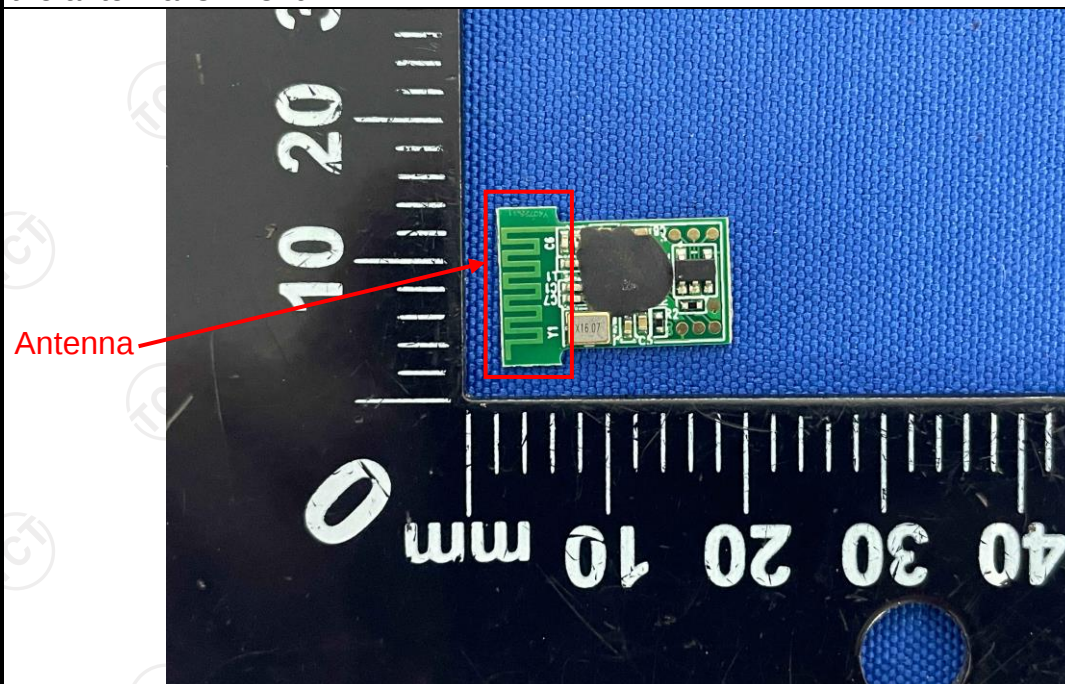
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

E.U.T Antenna:

The antenna is PCB antenna which permanently attached, and the best case gain of the antenna is -1.31dBi.



5.2. Conducted Emission

5.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207														
Test Method:	ANSI C63.10:2020														
Frequency Range:	150 kHz to 30 MHz														
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto														
Limits:	<table><tr><th rowspan="2">Frequency range (MHz)</th><th colspan="2">Limit (dBuV)</th></tr><tr><th>Quasi-peak</th><th>Average</th></tr><tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr><tr><td>0.5-5</td><td>56</td><td>46</td></tr><tr><td>5-30</td><td>60</td><td>50</td></tr></table>	Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)														
	Quasi-peak	Average													
0.15-0.5	66 to 56*	56 to 46*													
0.5-5	56	46													
5-30	60	50													
Test Setup:	Reference Plane 40cm Test table/Insulation plane Remark E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m														
Test Mode:	Transmitting Mode														
Test Procedure:	1. The E.U.T is connected to an adapter through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2020 on conducted measurement.														
Test Result:	PASS														

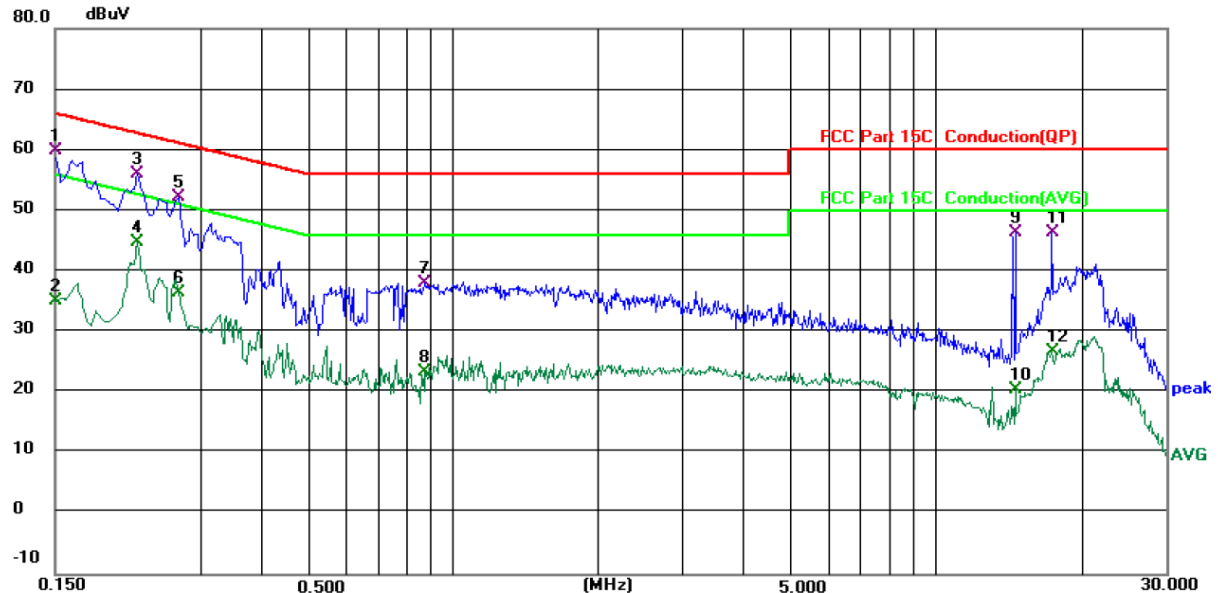
5.2.2. Test Instruments

Conducted Emission Shielding Room Test Site (843)					
Equipment	Manufacturer	Model	Serial Number	Date of Cal.	Due Date
EMI Test Receiver	R&S	ESCI3	100898	Jun. 27, 2024	Jun. 26, 2025
LISN	Schwarzbeck	NSLK 8126	8126453	Jan. 21, 2025	Jan. 20, 2026
Attenuator	N/A	10dB	164080	Jun. 27, 2024	Jun. 26, 2025
Line-5	TCT	CE-05	/	Jun. 27, 2024	Jun. 26, 2025
EMI Test Software	EZ_EMG	EMEC-3A1	1.1.4.2	/	/

5.2.3. Test data

Please refer to following diagram for individual

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Site 844 Shielding Room

Phase: **L1**

Temperature: 25.3 (°C)

Humidity: 54 %

Limit: FCC Part 15C Conduction(QP)

Power: DC 5 V(Notebook Computer Input AC 120 V/60 Hz)

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1500	50.10	9.67	59.77	66.00	-6.23	QP	
2		0.1500	25.37	9.67	35.04	56.00	-20.96	AVG	
3		0.2220	46.38	9.65	56.03	62.74	-6.71	QP	
4		0.2220	35.12	9.65	44.77	52.74	-7.97	AVG	
5		0.2700	42.49	9.66	52.15	61.12	-8.97	QP	
6		0.2700	26.89	9.66	36.55	51.12	-14.57	AVG	
7		0.8780	27.42	10.60	38.02	56.00	-17.98	QP	
8		0.8780	12.79	10.60	23.39	46.00	-22.61	AVG	
9		14.6100	36.12	10.27	46.39	60.00	-13.61	QP	
10		14.6100	10.22	10.27	20.49	50.00	-29.51	AVG	
11		17.3979	36.00	10.28	46.28	60.00	-13.72	QP	
12		17.3979	16.61	10.28	26.89	50.00	-23.11	AVG	

Note:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = LISN factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

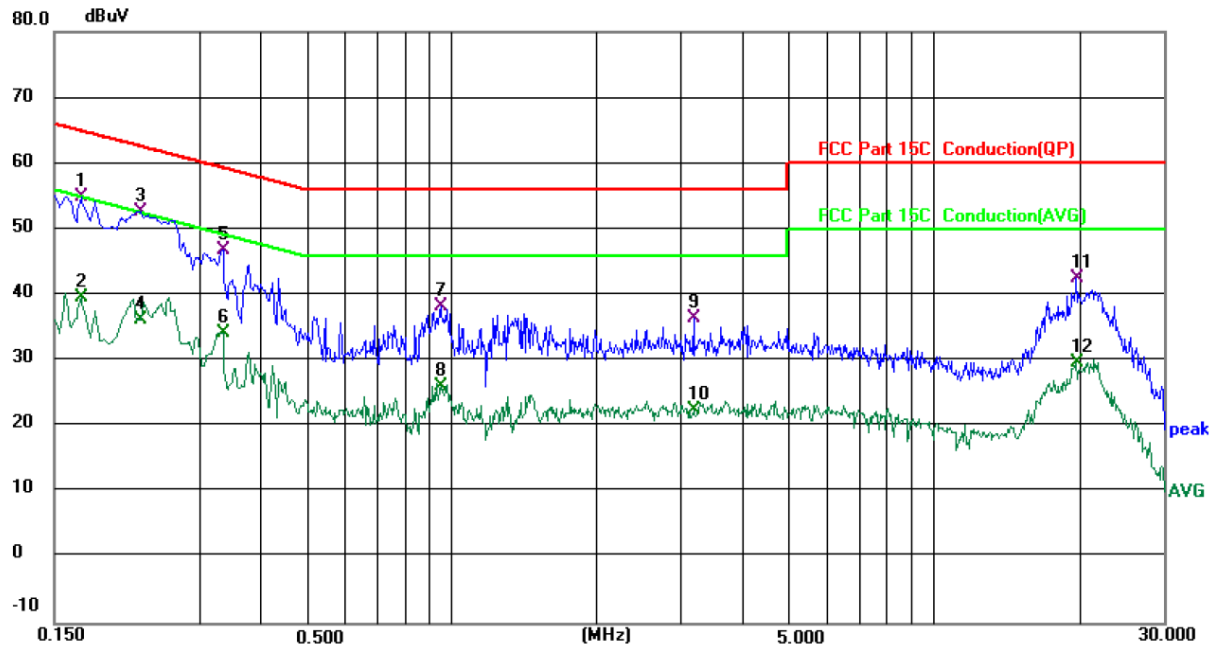
Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak

AVG =average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site 844 Shielding Room

Phase: **N**

Temperature: 25.3 (°C)

Humidity: 54 %

Limit: FCC Part 15C Conduction(QP)

Power: DC 5 V(Notebook Computer Input AC 120 V/60 Hz)

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1700	45.20	9.64	54.84	64.96	-10.12	QP	
2		0.1700	29.91	9.64	39.55	54.96	-15.41	AVG	
3	*	0.2260	43.06	9.63	52.69	62.60	-9.91	QP	
4		0.2260	26.62	9.63	36.25	52.60	-16.35	AVG	
5		0.3339	36.90	9.97	46.87	59.35	-12.48	QP	
6		0.3339	24.19	9.97	34.16	49.35	-15.19	AVG	
7		0.9500	27.57	10.65	38.22	56.00	-17.78	QP	
8		0.9500	15.37	10.65	26.02	46.00	-19.98	AVG	
9		3.1780	26.58	9.92	36.50	56.00	-19.50	QP	
10		3.1780	12.63	9.92	22.55	46.00	-23.45	AVG	
11		19.7580	32.19	10.24	42.43	60.00	-17.57	QP	
12		19.7580	19.44	10.24	29.68	50.00	-20.32	AVG	

Note:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = LISN factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak AVG =average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

5.3. Conducted Output Power

5.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (b)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) 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.
Test Setup:	 The diagram illustrates the test setup. On the left is a green rectangular box labeled 'Spectrum Analyzer'. A black cable connects it to a yellow rectangular box on the right labeled 'EUT'.
Test Mode:	Transmitting mode with modulation
Test Procedure:	Use the following spectrum analyzer settings: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.
Test Result:	PASS

5.3.2. Test Instruments

Equipment	Manufacturer	Model No.	Serial Number	Date of Cal.	Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 27, 2024	Jun. 26, 2025
Power detector box	MWRFTest	MW100-RFCB	MW210531TCT	Jan. 21, 2025	Jan. 20, 2026

5.4. 20dB Occupy Bandwidth

5.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	N/A
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; $1\% \leq RBW \leq 5\%$ of the 20 dB bandwidth; $VBW \geq 3RBW$; Sweep = auto; Detector function = peak; Trace = max hold. 4. Measure and record the results in the test report.
Test Result:	PASS

5.4.2. Test Instruments

Equipment	Manufacturer	Model No.	Serial Number	Date of Cal.	Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 27, 2024	Jun. 26, 2025
Power detector box	MWRFTest	MW100-RFCB	MW210531TCT	Jan. 21, 2025	Jan. 20, 2026

5.5. Carrier Frequencies Separation

5.5.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	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.
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Hopping mode
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = wide enough to capture the peaks of two adjacent channels; RBW is set to approximately 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 5. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Record the value in report.
Test Result:	PASS

5.5.2. Test Instruments

Equipment	Manufacturer	Model No.	Serial Number	Date of Cal.	Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 27, 2024	Jun. 26, 2025
Power detector box	MWRFTest	MW100-RFCB	MW210531TCT	Jan. 21, 2025	Jan. 20, 2026

5.6. Hopping Channel Number

5.6.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Hopping mode
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = the frequency band of operation; set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 5. The number of hopping frequency used is defined as the number of total channel. 6. Record the measurement data in report.
Test Result:	PASS

5.6.2. Test Instruments

Equipment	Manufacturer	Model No.	Serial Number	Date of Cal.	Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 27, 2024	Jun. 26, 2025
Power detector box	MWRFTest	MW100-RFCB	MW210531TCT	Jan. 21, 2025	Jan. 20, 2026

5.7. Dwell Time

5.7.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Hopping mode
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected dwell time per channel; VBW $\geq$ RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold. 5. Measure and record the results in the test report.
Test Result:	PASS

5.7.2. Test Instruments

Equipment	Manufacturer	Model No.	Serial Number	Date of Cal.	Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 27, 2024	Jun. 26, 2025
Power detector box	MWRFTest	MW100-RFCB	MW210531TCT	Jan. 21, 2025	Jan. 20, 2026

5.8. Pseudorandom Frequency Hopping Sequence

Test Requirement:	FCC Part15 C Section 15.247 (a)(1) requirement:
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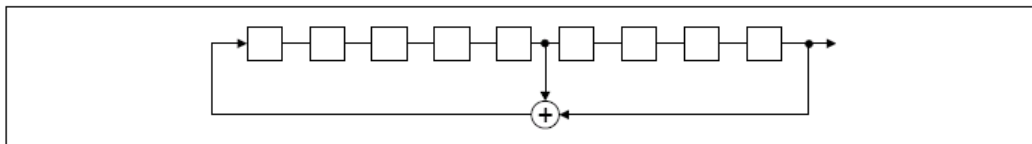
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence

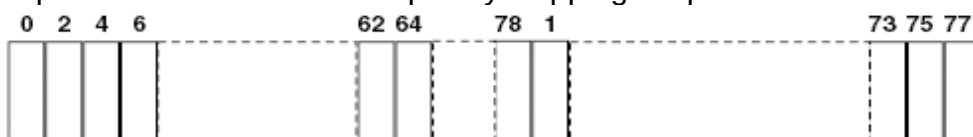
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: $2^9 - 1 = 511$ bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

5.9. Conducted Band Edge Measurement

5.9.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB 558074 D01 v05r02
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. Set to the maximum power setting and enable the EUT transmit continuously. 2. Set RBW = 100 kHz ($\geq 1\%$ span=10MHz), VBW = 300 kHz ($\geq$RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used. 3. Enable hopping function of the EUT and then repeat step 2 and 3. 4. Measure and record the results in the test report.
Test Result:	PASS

5.9.2. Test Instruments

Equipment	Manufacturer	Model No.	Serial Number	Date of Cal.	Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 27, 2024	Jun. 26, 2025
Power detector box	MWRFtest	MW100-RFCB	MW210531TCT	Jan. 21, 2025	Jan. 20, 2026

5.10. Conducted Spurious Emission Measurement

5.10.1. Test Specification

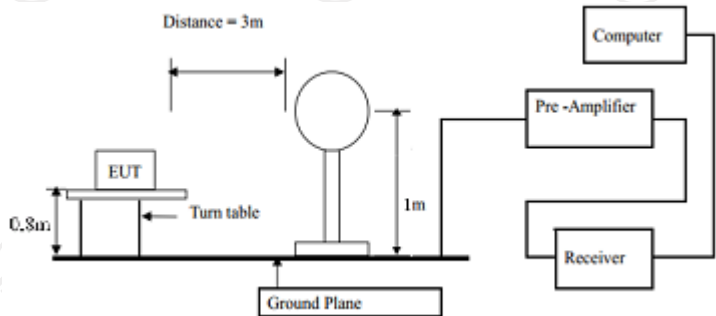
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB 558074 D01 v05r02
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	 The diagram illustrates the test setup. On the left is a green Spectrum Analyzer with a blue screen and two red input ports. A black RF cable connects these ports to a yellow rectangular box on the right, labeled 'EUT' (Equipment Under Test).
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. 4. Measure and record the results in the test report. 5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
Test Result:	PASS

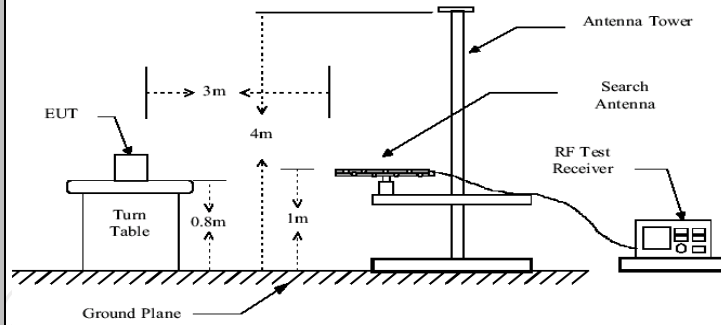
5.10.2. Test Instruments

Equipment	Manufacturer	Model No.	Serial Number	Date of Cal.	Due Date
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 27, 2024	Jun. 26, 2025
Power detector box	MWRFTest	MW100-RFCB	MW210531TCT	Jan. 21, 2025	Jan. 20, 2026

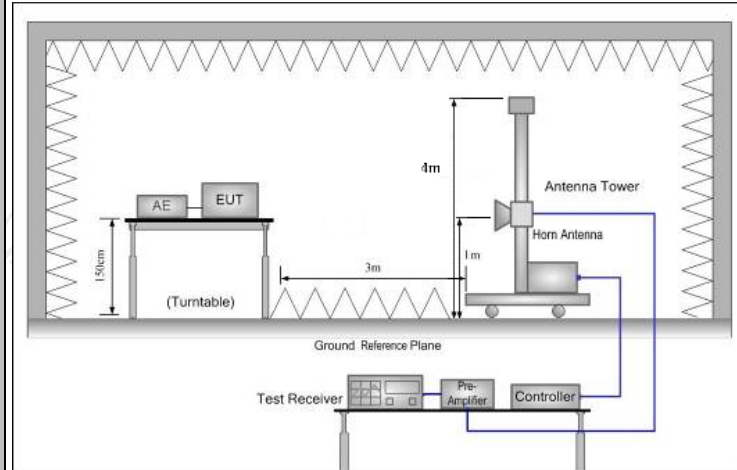
5.11. Radiated Spurious Emission Measurement

5.11.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.209			
Test Method:	ANSI C63.10:2020			
Frequency Range:	9 kHz to 25 GHz			
Measurement Distance:	3 m			
Antenna Polarization:	Horizontal & Vertical			
Receiver Setup:	Frequency	Detector	RBW	VBW
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz
	30MHz-1GHz	Quasi-peak	120KHz	300KHz
	Above 1GHz	Peak	1MHz	3MHz
Limit:				Remark
				Quasi-peak Value
				Quasi-peak Value
				Quasi-peak Value
				Peak Value
Test setup:				Average Value
	Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	
	0.009-0.490	2400/F(KHz)	300	
	0.490-1.705	24000/F(KHz)	30	
	1.705-30	30	30	
Test setup:				
	30-88	100	3	
	88-216	150	3	
	216-960	200	3	
	Above 960	500	3	
Test setup:	Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector
	Above 1GHz	500	3	Average
		5000	3	Peak
	For radiated emissions below 30MHz			
	 Distance = 3m 0.8m Turn table 1m Ground Plane Computer Pre-Amplifier Receiver			
	30MHz to 1GHz			



Above 1GHz



Test Mode:

Transmitting mode with modulation

Test Procedure:

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10:2020 Measurement Guidelines.
2. For the radiated emission test below 1GHz:
The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high PASS filter are used for the test in order to get better signal level.
For the radiated emission test above 1GHz:
Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission

	and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Use the following spectrum analyzer settings: (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=120 kHz for $f < 1$ GHz, RBW=1MHz for $f > 1$GHz ; VBW$\geq$RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak (3) For average measurement: use duty cycle correction factor method per 15.35(c). Duty cycle = On time/100 milliseconds On time = $N_1 \cdot L_1 + N_2 \cdot L_2 + \dots + N_{n-1} \cdot L_{n-1} + N_n \cdot L_n$ Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc. Average Emission Level = Peak Emission Level + $20 \cdot \log(\text{Duty cycle})$ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
Test results:	PASS

5.11.2. Test Instruments

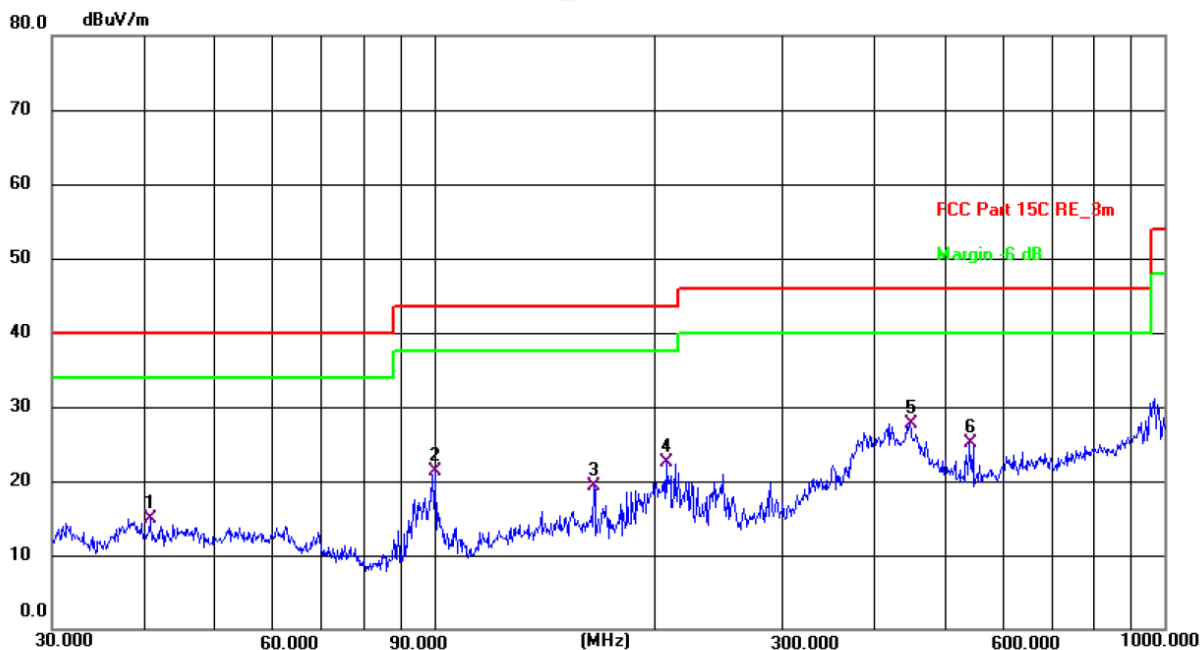
Radiated Emission Test Site (966)					
Name of Equipment	Manufacturer	Model	Serial Number	Date of Cal.	Due Date
EMI Test Receiver	R&S	ESCI7	100529	Jan. 21, 2025	Jan. 20, 2026
Spectrum Analyzer	R&S	FSQ40	200061	Jun. 27, 2024	Jun. 26, 2025
Pre-amplifier	HP	8447D	2727A05017	Jun. 27, 2024	Jun. 26, 2025
Pre-amplifier	SKET	LNPA_0118G-45	SK2021012102	Jan. 21, 2025	Jan. 20, 2026
Pre-amplifier	SKET	LNPA_1840G-50	SK202109203500	Jan. 21, 2025	Jan. 20, 2026
Loop antenna	Schwarzbeck	FMZB1519B	00191	Jun. 27, 2024	Jun. 26, 2025
Broadband Antenna	Schwarzbeck	VULB9163	340	Jun. 29, 2024	Jun. 28, 2025
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Jun. 29, 2024	Jun. 28, 2025
Horn Antenna	Schwarzbeck	BBHA 9170	00956	Jan. 23, 2025	Jan. 22, 2026
Coaxial cable	SKET	RE-03-D	/	Jun. 27, 2024	Jun. 26, 2025
Coaxial cable	SKET	RE-03-M	/	Jun. 27, 2024	Jun. 26, 2025
Coaxial cable	SKET	RE-03-L	/	Jun. 27, 2024	Jun. 26, 2025
Coaxial cable	SKET	RE-04-D	/	Jun. 27, 2024	Jun. 26, 2025
Coaxial cable	SKET	RE-04-M	/	Jun. 27, 2024	Jun. 26, 2025
Coaxial cable	SKET	RE-04-L	/	Jun. 27, 2024	Jun. 26, 2025
Antenna Mast	Keleto	RE-AM	/	/	/
EMI Test Software	EZ EMC	FA-03A2 RE+	1.1.4.2	/	/

5.11.3. Test Data

Please refer to following diagram for individual

Below 1GHz

Horizontal:



Site 3m Anechoic Chamber2

Polarization: **Horizontal**

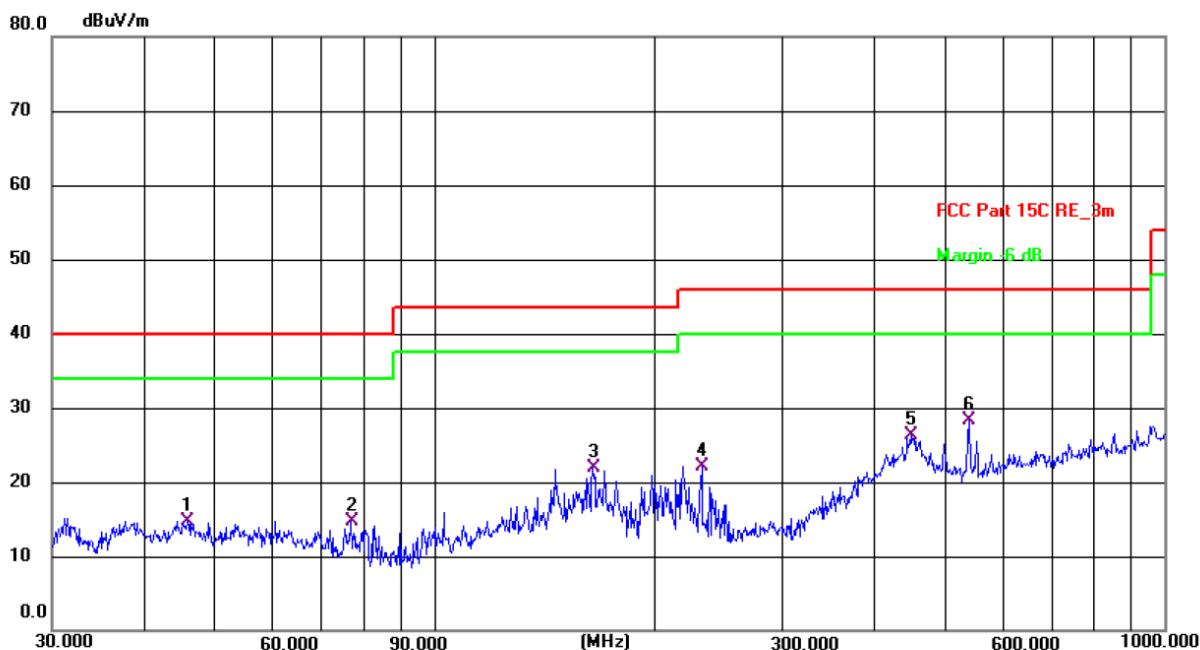
Temperature: 24.4(C) Humidity: 51 %

Limit: FCC Part 15C RE_3m

Power: DC 5V(Notebook Computer Input AC 120V/60Hz)

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	40.8445	33.23	-18.35	14.88	40.00	-25.12	QP	P	
2	100.2285	42.45	-21.24	21.21	43.50	-22.29	QP	P	
3	165.4866	37.04	-17.64	19.40	43.50	-24.10	QP	P	
4	207.8501	43.68	-21.08	22.60	43.50	-20.90	QP	P	
5 *	447.9822	41.24	-13.58	27.66	46.00	-18.34	QP	P	
6	541.3725	36.67	-11.57	25.10	46.00	-20.90	QP	P	

Vertical:



Site 3m Anechoic Chamber2

Polarization: **Vertical**

Temperature: 24.4(C) Humidity: 51 %

Limit: FCC Part 15C RE_3m

Power: DC 5V(Notebook Computer Input AC 120V/60Hz)

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	46.0162	33.46	-18.67	14.79	40.00	-25.21	QP	P	
2	77.0505	36.14	-21.51	14.63	40.00	-25.37	QP	P	
3	164.9074	39.45	-17.64	21.81	43.50	-21.69	QP	P	
4	232.5318	42.39	-20.21	22.18	46.00	-23.82	QP	P	
5	449.5558	39.77	-13.54	26.23	46.00	-19.77	QP	P	
6 *	539.4775	39.96	-11.60	28.36	46.00	-17.64	QP	P	

Note: 1. The low frequency, which started from 9KHz~30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

2. Measurements were conducted in all three channels (high, middle, low) and the worst case Mode (Lowest channel) was submitted only.

3. Freq. = Emission frequency in MHz

Measurement (dBμV/m) = Reading level (dBμV) + Corr. Factor (dB)

Correction Factor= Antenna Factor + Cable loss – Pre-amplifier

Limit (dBμV/m) = Limit stated in standard

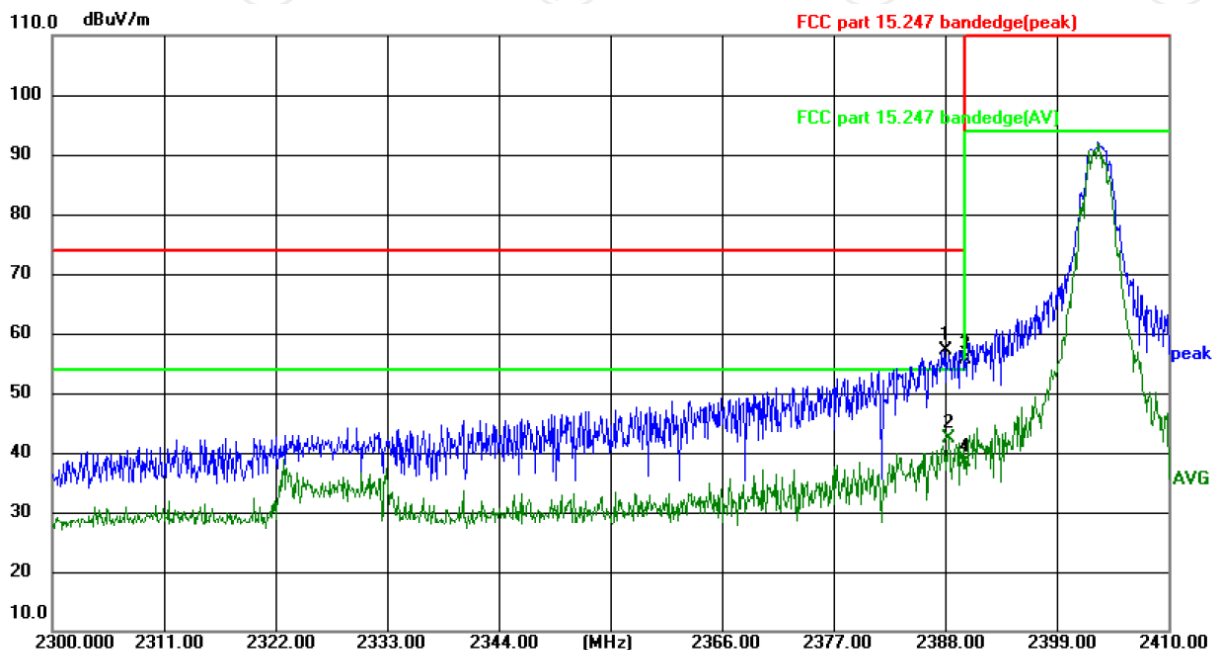
Over (dB) = Measurement (dBμV/m) – Limits (dBμV/m)

* is meaning the worst frequency has been tested in the test frequency range.

Test Result of Radiated Spurious at Band edges

Lowest channel 2403:

Horizontal:



Site: 3m Anechoic Chamber

Polarization: **Horizontal**

Temperature: 24.8(°C)

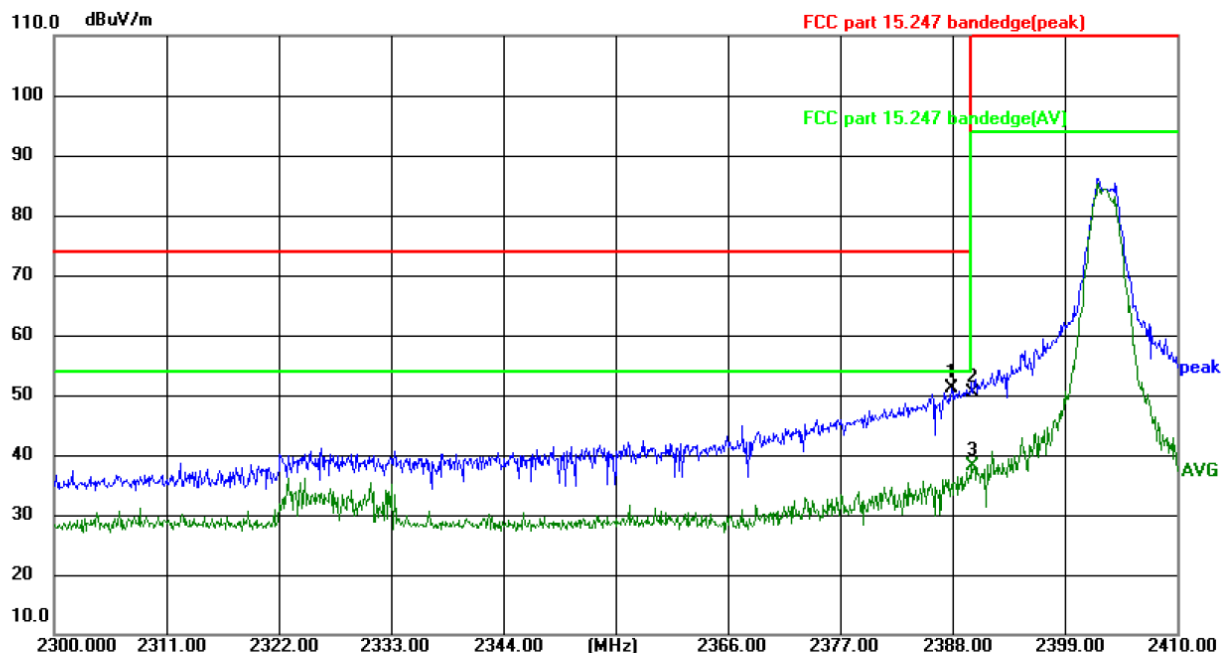
Humidity: 51 %

Limit: FCC part 15.247 bandedge(peak)

Power:DC 5V From Notebook computer

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2387.901	73.88	-16.70	57.18	74.00	-16.82	peak	P	
2 *	2388.407	59.18	-16.70	42.48	54.00	-11.52	AVG	P	
3	2390.000	72.26	-16.70	55.56	74.00	-18.44	peak	P	
4	2390.000	55.15	-16.70	38.45	54.00	-15.55	AVG	P	

Vertical:



Site: 3m Anechoic Chamber

Polarization: **Vertical**

Temperature: 24.8(°C)

Humidity: 51 %

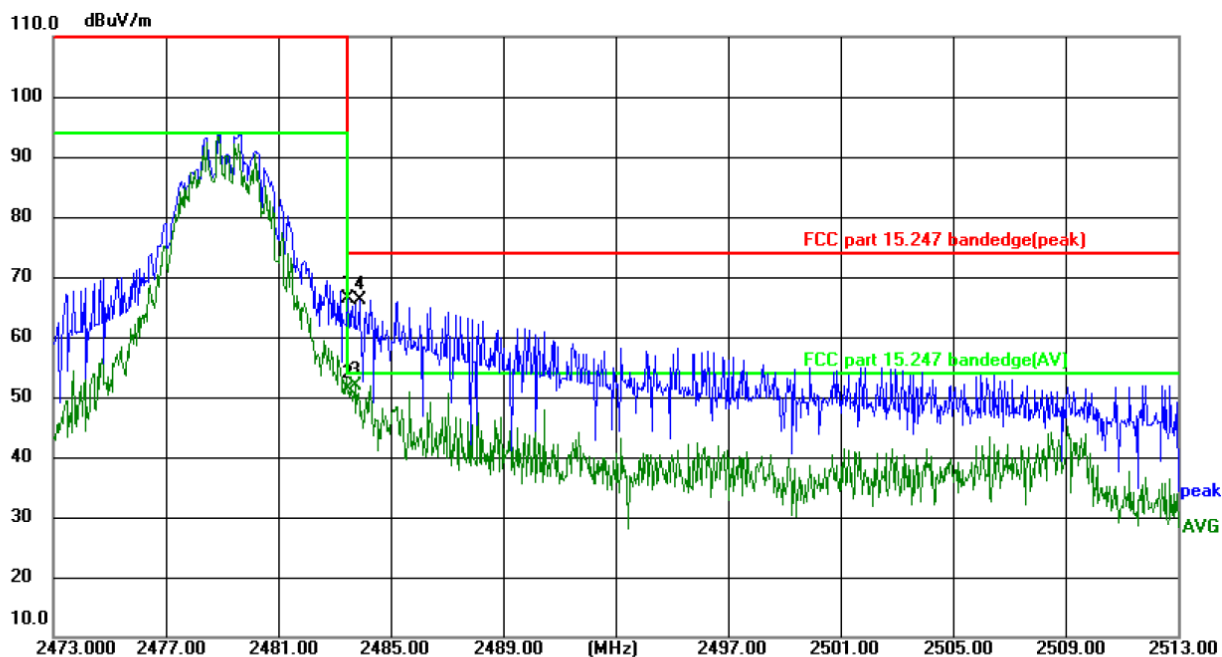
Limit: FCC part 15.247 bandedge(peak)

Power:DC 5V From Notebook computer

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2387.989	67.87	-16.70	51.17	74.00	-22.83	peak	P	
2	2390.000	67.16	-16.70	50.46	74.00	-23.54	peak	P	
3 *	2390.000	54.92	-16.70	38.22	54.00	-15.78	AVG	P	

Highest channel 2479:

Horizontal:



Site: 3m Anechoic Chamber

Polarization: **Horizontal**

Temperature: 24.8(°C)

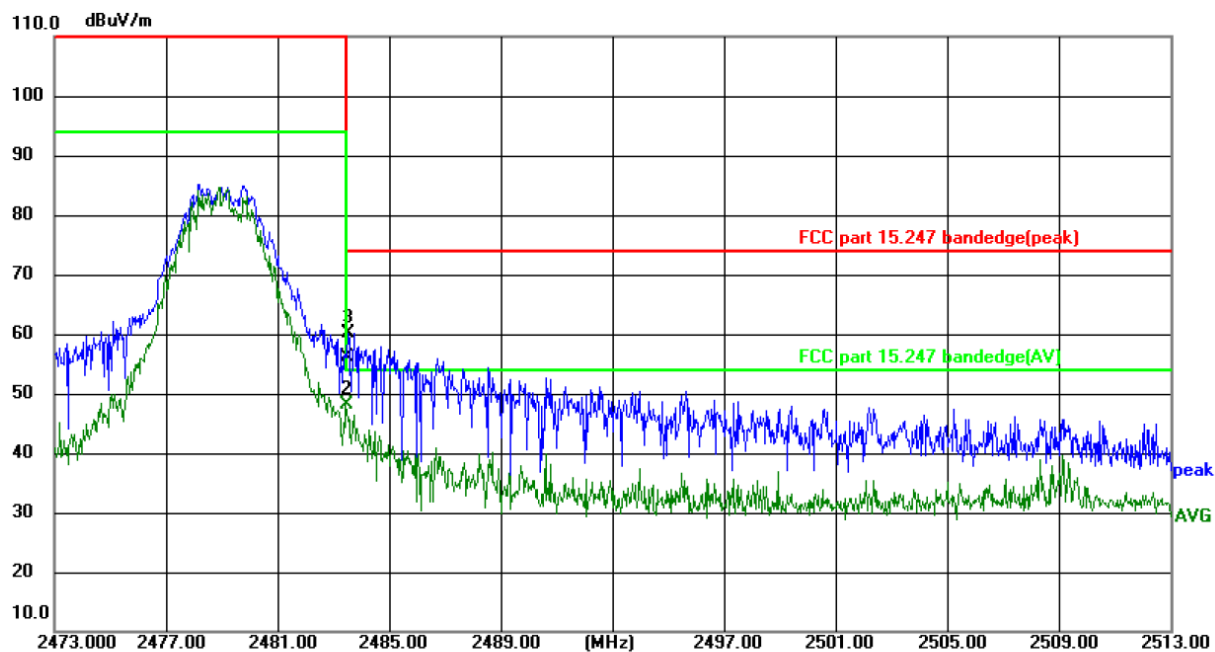
Humidity: 51 %

Limit: FCC part 15.247 bandedge(peak)

Power:DC 5V From Notebook computer

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2483.500	82.94	-16.65	66.29	74.00	-7.71	peak	P	
2	2483.500	68.01	-16.65	51.36	54.00	-2.64	AVG	P	
3 *	2483.720	68.53	-16.65	51.88	54.00	-2.12	AVG	P	
4	2483.916	82.90	-16.65	66.25	74.00	-7.75	peak	P	

Vertical:



Site: 3m Anechoic Chamber

Polarization: **Vertical**

Temperature: 24.8(°C)

Humidity: 51 %

Limit: FCC part 15.247 bandedge(peak)

Power:DC 5V From Notebook computer

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2483.500	72.86	-16.65	56.21	74.00	-17.79	peak	P	
2 *	2483.500	64.83	-16.65	48.18	54.00	-5.82	AVG	P	
3	2483.540	76.85	-16.65	60.20	74.00	-13.80	peak	P	

Above 1GHz

Modulation Type: GFSK									
Low channel: 2403 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4806	H	54.77	---	-9.52	45.25	---	74	54	-8.75
7209	H	45.54	---	-1.42	44.12	---	74	54	-9.88
---	H	---	---	---	---	---	---	---	---
4806	V	56.98	---	-9.52	47.46	---	74	54	-6.54
7209	V	47.44	---	-1.42	46.02	---	74	54	-7.98
---	V	---	---	---	---	---	---	---	---

Middle channel: 2441 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4882	H	55.03	---	-9.36	45.67	---	74	54	-8.33
7323	H	46.28	---	-1.14	45.14	---	74	54	-8.86
---	H	---	---	---	---	---	---	---	---
4882	V	56.12	---	-9.36	46.76	---	74	54	-7.24
7323	V	46.09	---	-1.14	44.95	---	74	54	-9.05
---	V	---	---	---	---	---	---	---	---

High channel: 2479 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4958	H	54.66	---	-9.21	45.45	---	74	54	-8.55
7437	H	45.74	---	-0.97	44.77	---	74	54	-9.23
---	H	---	---	---	---	---	---	---	---
4958	V	54.33	---	-9.21	45.12	---	74	54	-8.88
7437	V	45.70	---	-0.97	44.73	---	74	54	-9.27
---	V	---	---	---	---	---	---	---	---

Note:

1. Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier
2. Margin (dB) = Emission Level (Peak) (dBμV/m)-Average limit (dBμV/m)
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.
5. Data of measurement shown “---“in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.
6. All the restriction bands are compliance with the limit of 15.209.

Appendix A: Test Result of Conducted Test

Maximum Conducted Output Power

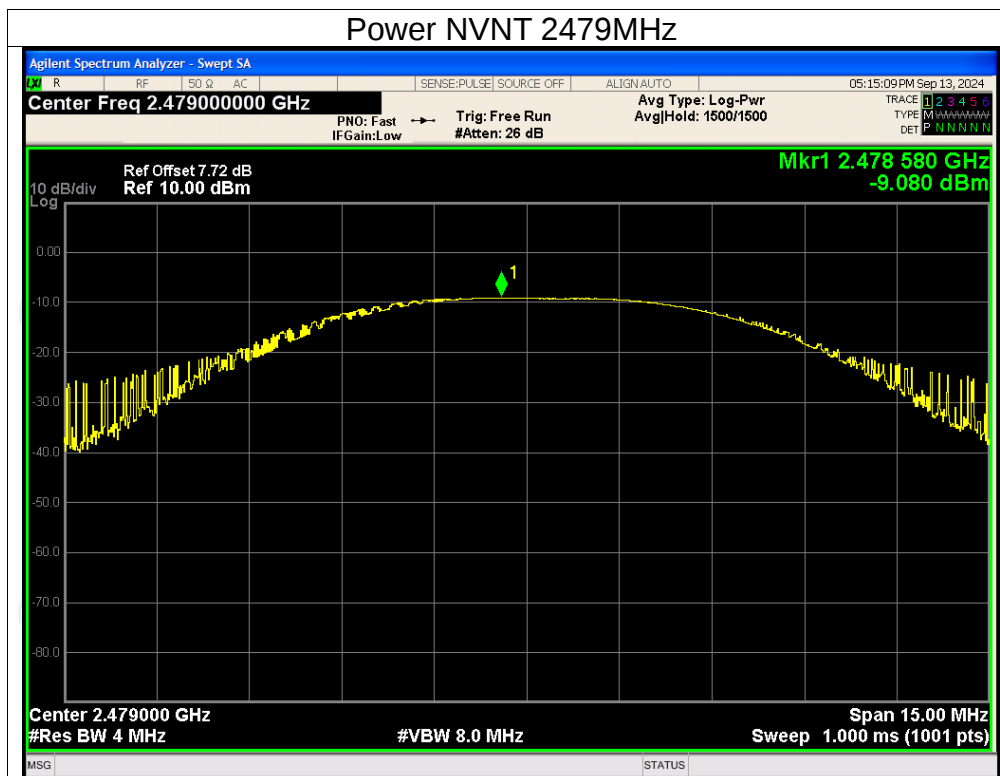
Condition	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	2403	-7.20	21	Pass
NVNT	2441	-7.94	21	Pass
NVNT	2479	-9.08	21	Pass

Test Graphs Power NVNT 2403MHz



Power NVNT 2441MHz





-20dB Bandwidth

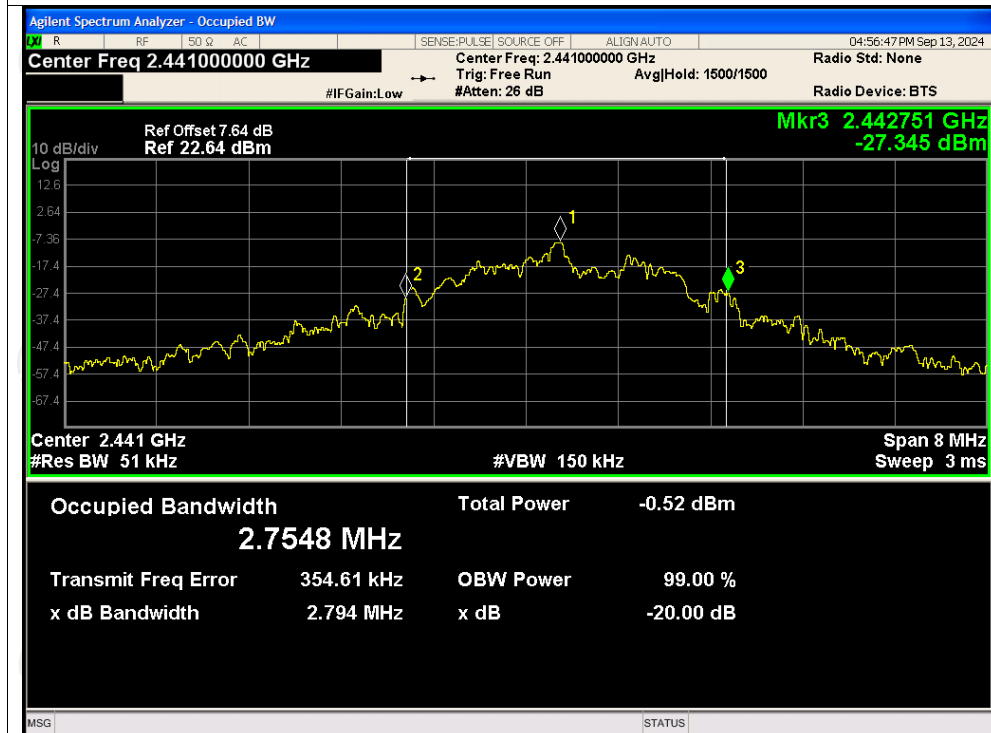
Condition	Frequency (MHz)	-20 dB Bandwidth (MHz)	Verdict
NVNT	2403	3.035	Pass
NVNT	2441	2.794	Pass
NVNT	2479	2.573	Pass

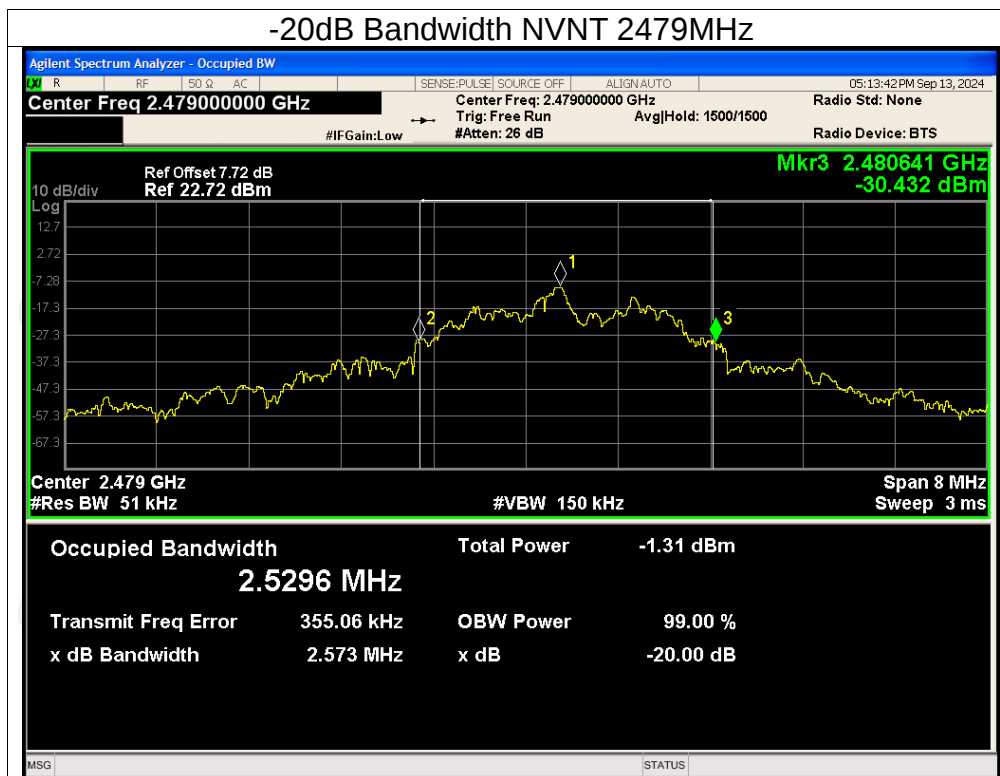
Test Graphs

-20dB Bandwidth NVNT 2403MHz



-20dB Bandwidth NVNT 2441MHz

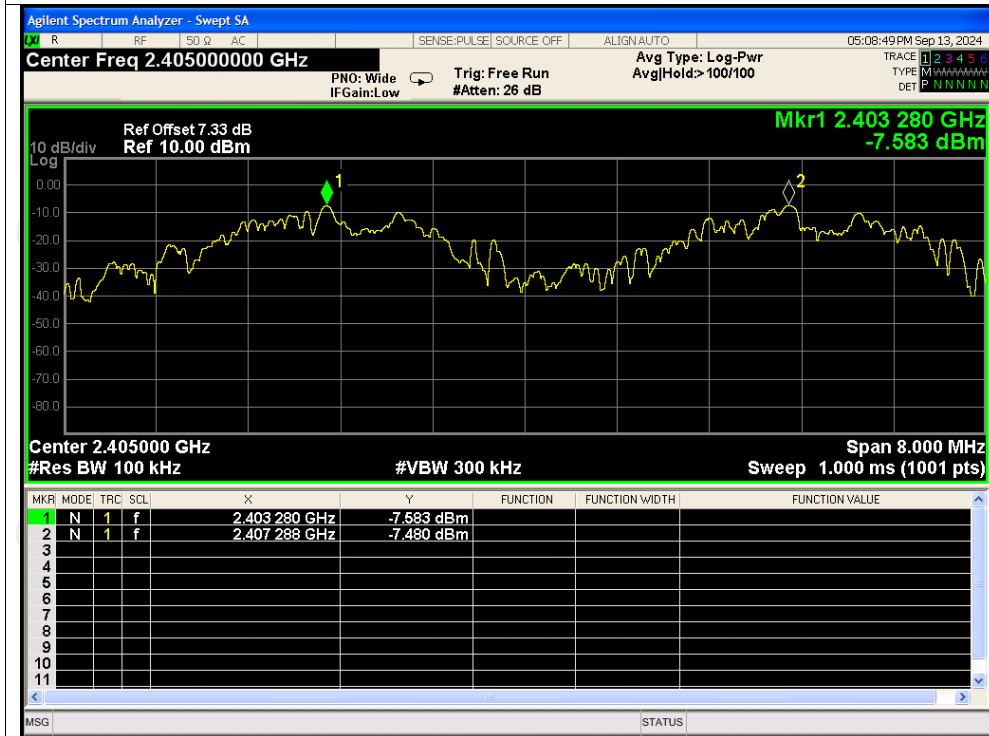




Carrier Frequencies Separation

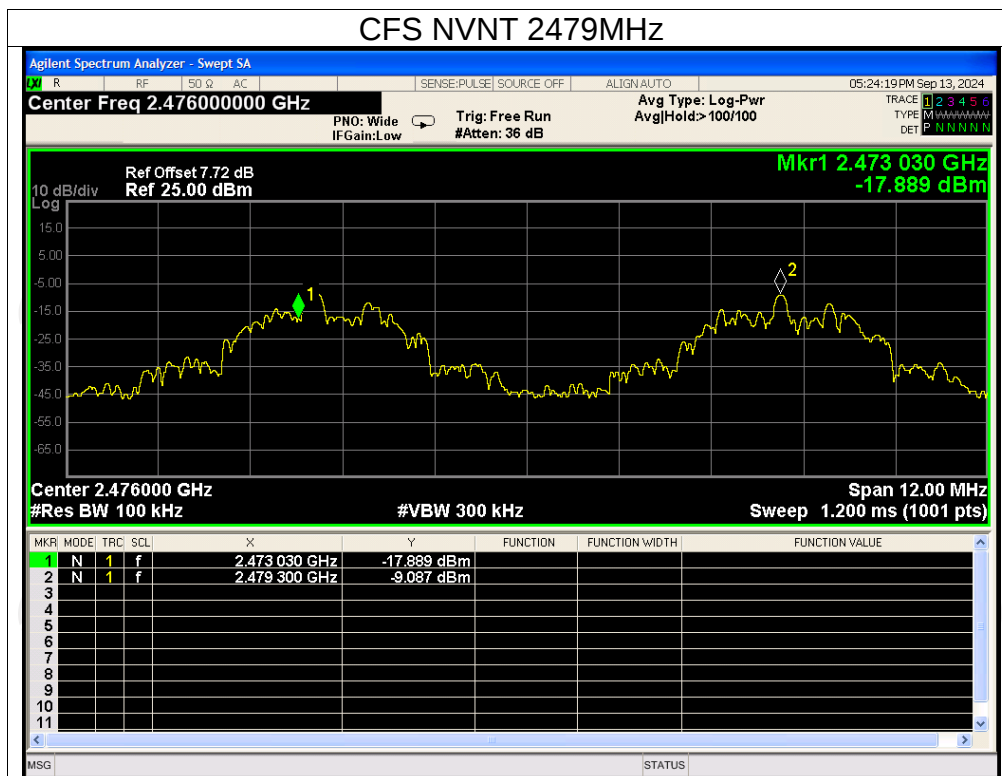
Condition	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
NVNT	2403.28	2407.288	4.008	2.023	Pass
NVNT	2441.30	2445.060	3.760	2.023	Pass
NVNT	2473.03	2479.300	6.270	2.023	Pass

Test Graphs CFS NVNT 2403MHz



CFS NVNT 2441MHz





Band Edge

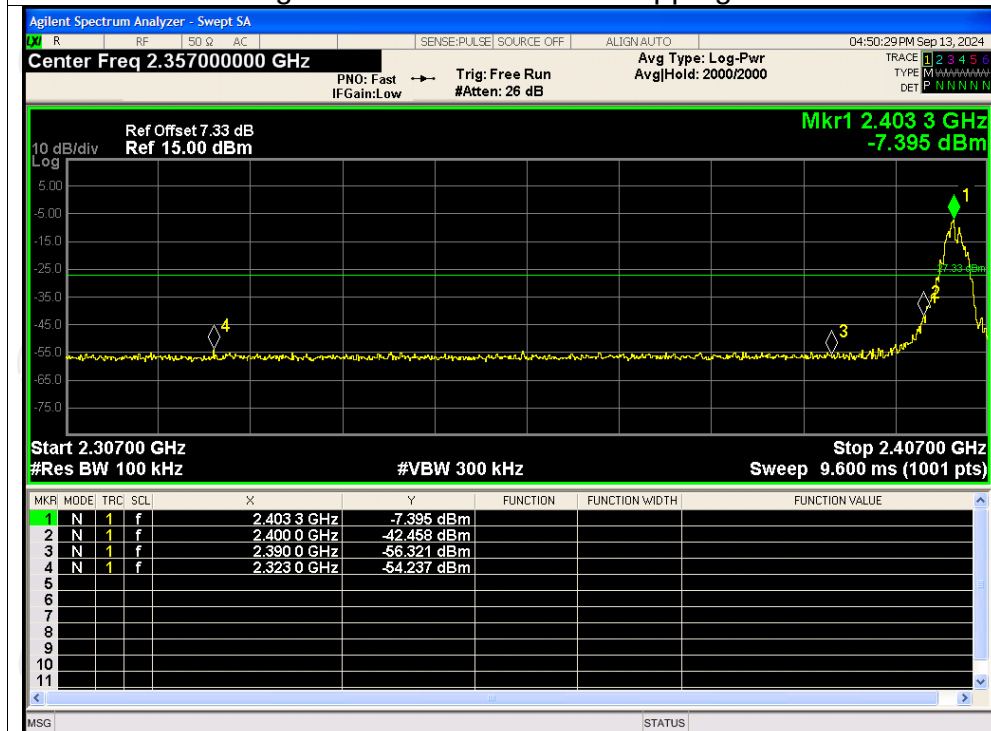
Condition	Frequency (MHz)	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2403	No-Hopping	-46.90	-20	Pass
NVNT	2479	No-Hopping	-40.49	-20	Pass

Test Graphs

Band Edge NVNT 2403MHz No-Hopping Ref



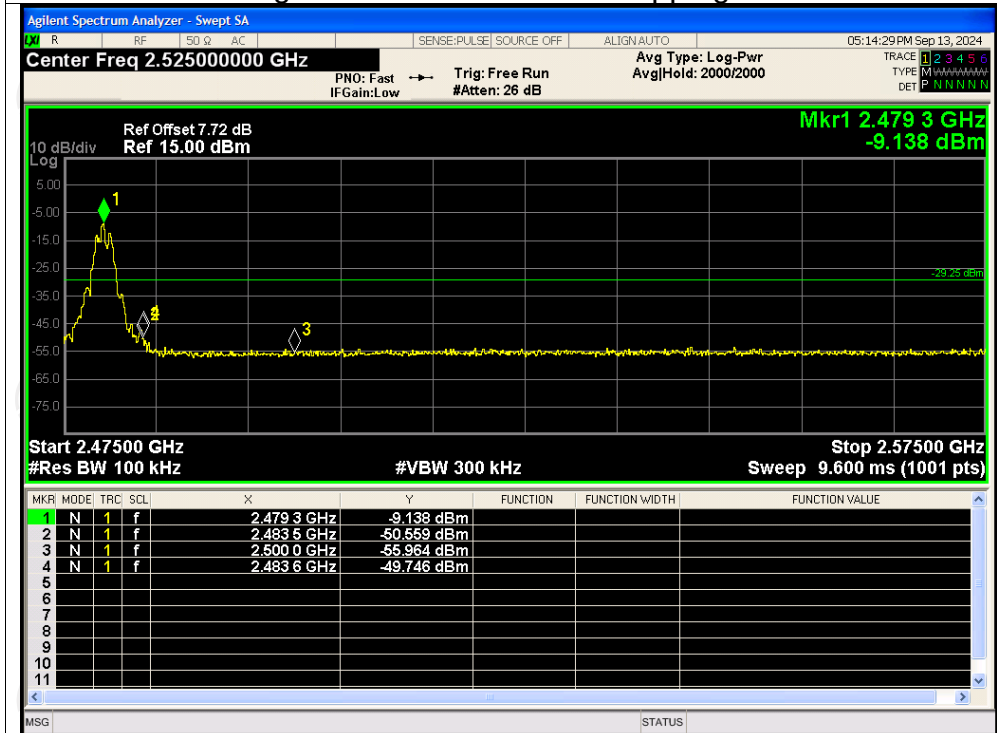
Band Edge NVNT 2403MHz No-Hopping Emission



Band Edge NVNT 2479MHz No-Hopping Ref



Band Edge NVNT 2479MHz No-Hopping Emission



Band Edge(Hopping)

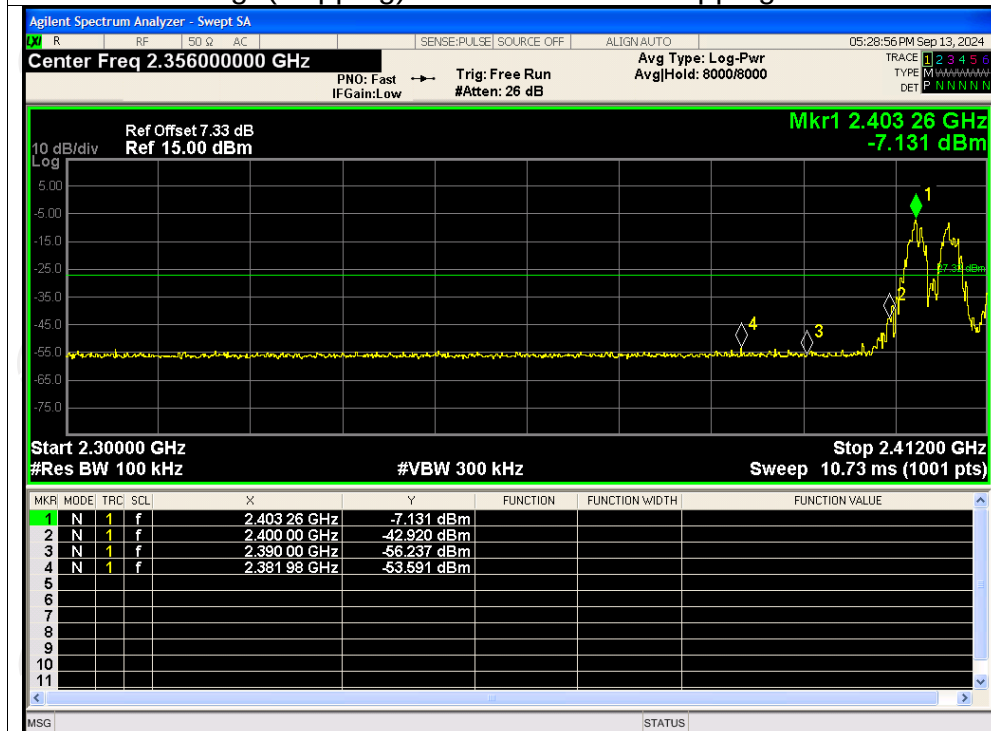
Condition	Frequency (MHz)	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2403	Hopping	-46.28	-20	Pass
NVNT	2479	Hopping	-30.62	-20	Pass

Test Graphs

Band Edge(Hopping) NVNT 2403MHz Hopping Ref



Band Edge(Hopping) NVNT 2403MHz Hopping Emission



Band Edge(Hopping) NVNT 2479MHz Hopping Ref



Band Edge(Hopping) NVNT 2479MHz Hopping Emission



Conducted RF Spurious Emission

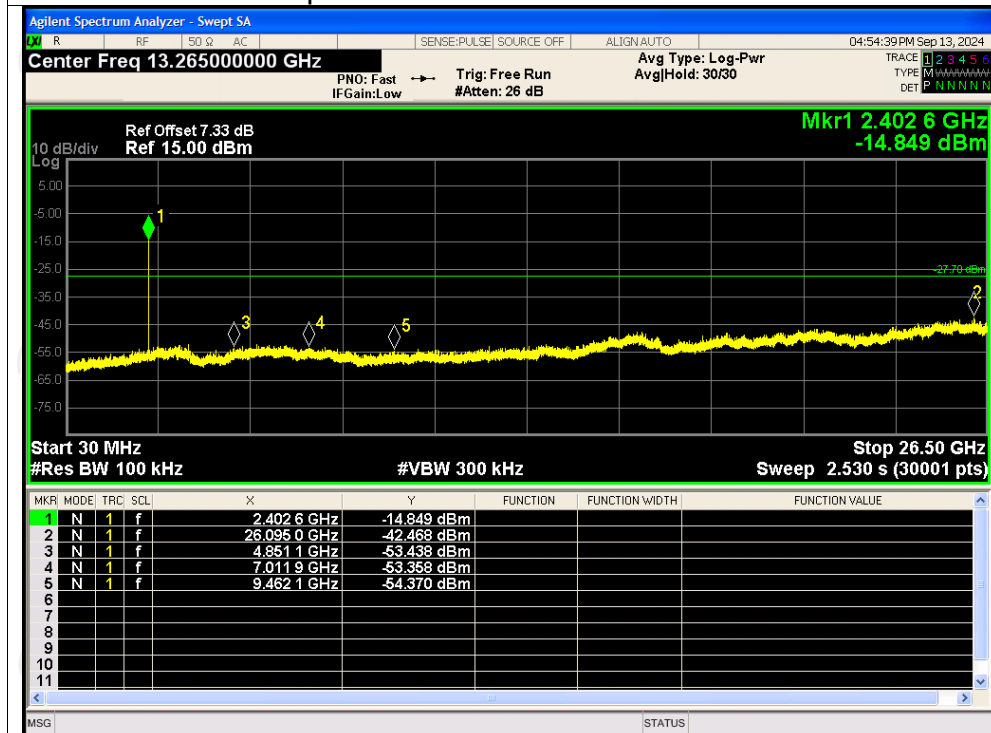
Condition	Frequency (MHz)	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2403	-34.76	-20	Pass
NVNT	2441	-34.60	-20	Pass
NVNT	2479	-28.29	-20	Pass

Test Graphs

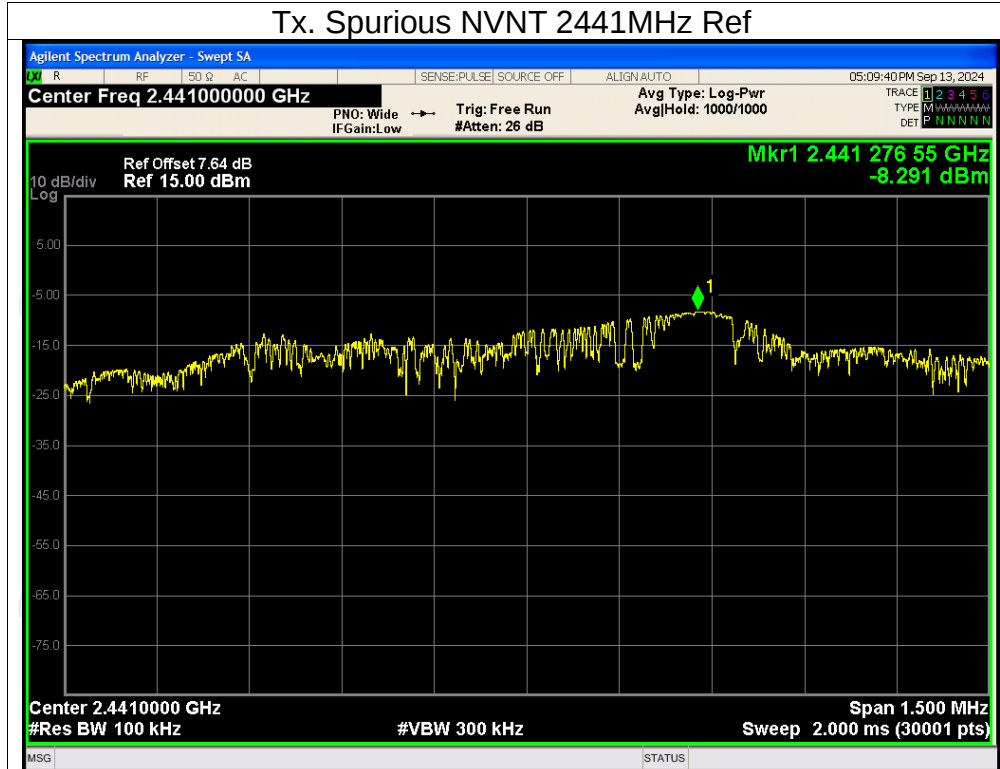
Tx. Spurious NVNT 2403MHz Ref



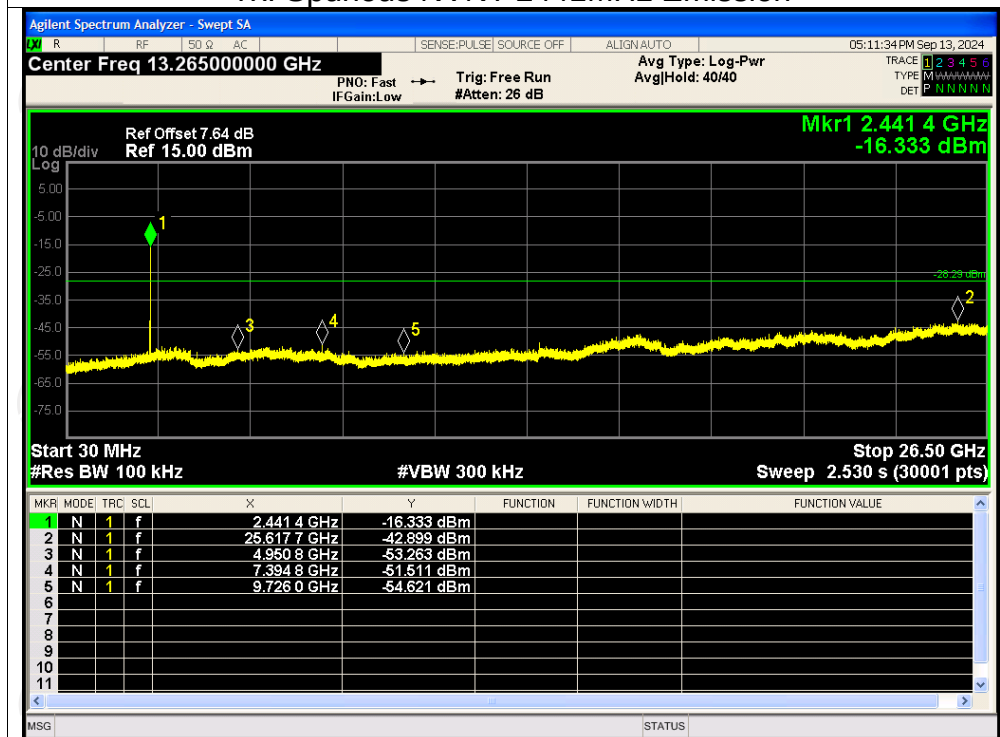
Tx. Spurious NVNT 2403MHz Emission



Tx. Spurious NVNT 2441MHz Ref



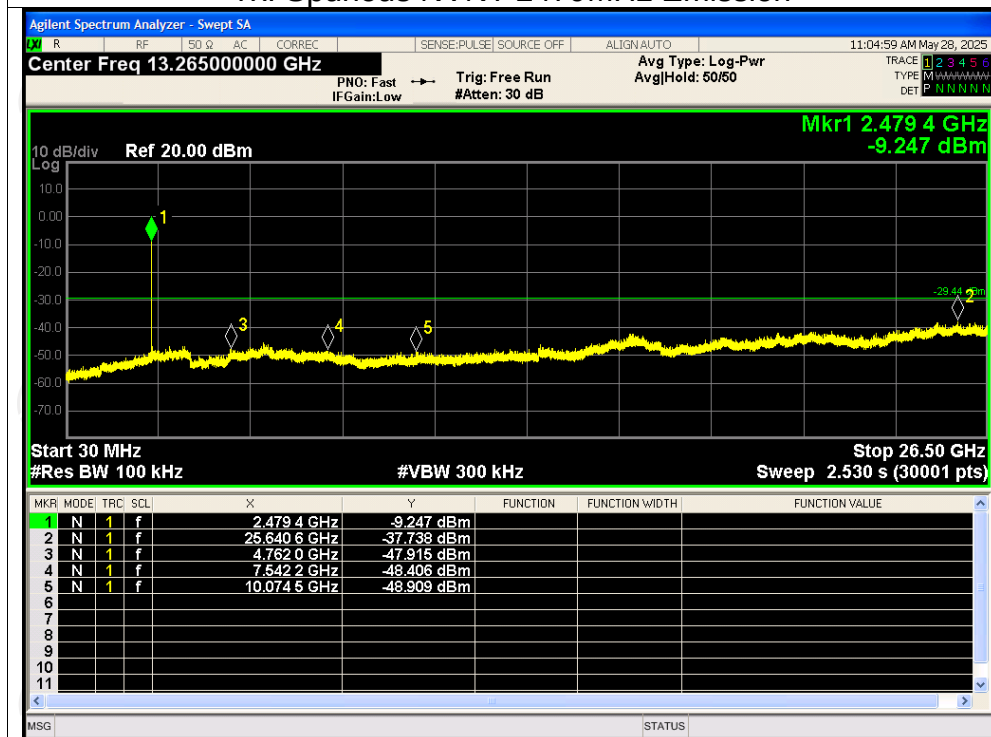
Tx. Spurious NVNT 2441MHz Emission



Tx. Spurious NVNT 2479MHz Ref

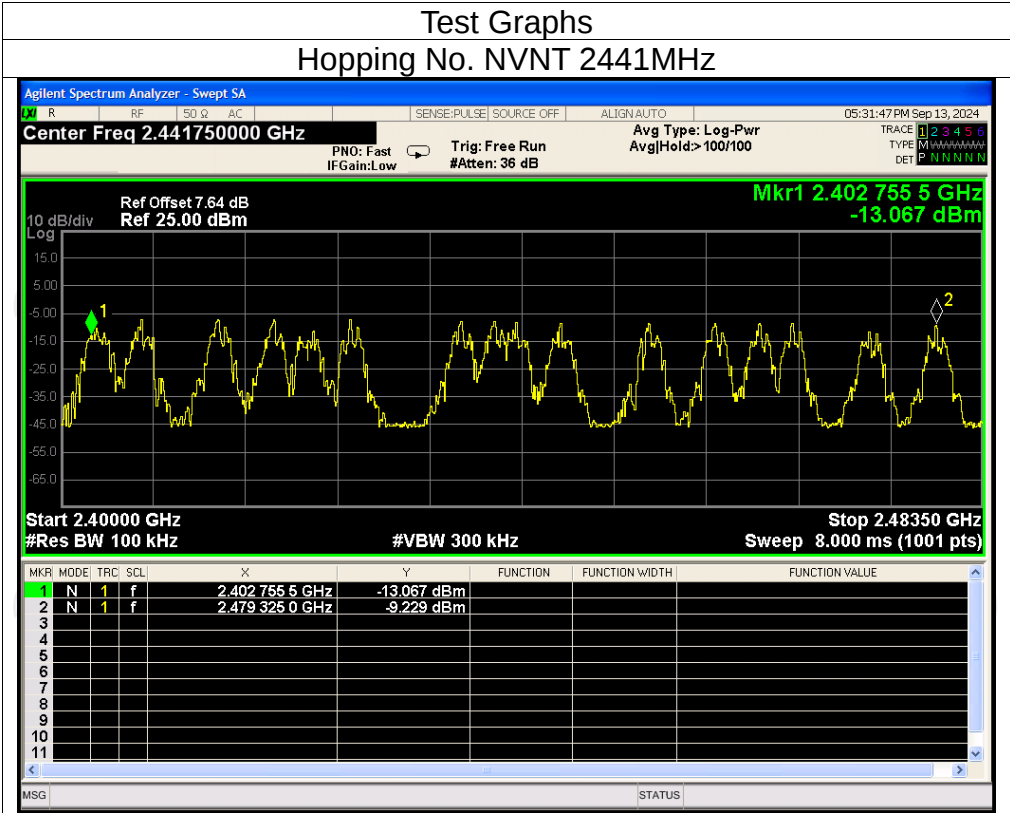


Tx. Spurious NVNT 2479MHz Emission



Number of Hopping Channel

Condition	Hopping Number	Limit	Verdict
NVNT	16	15	Pass

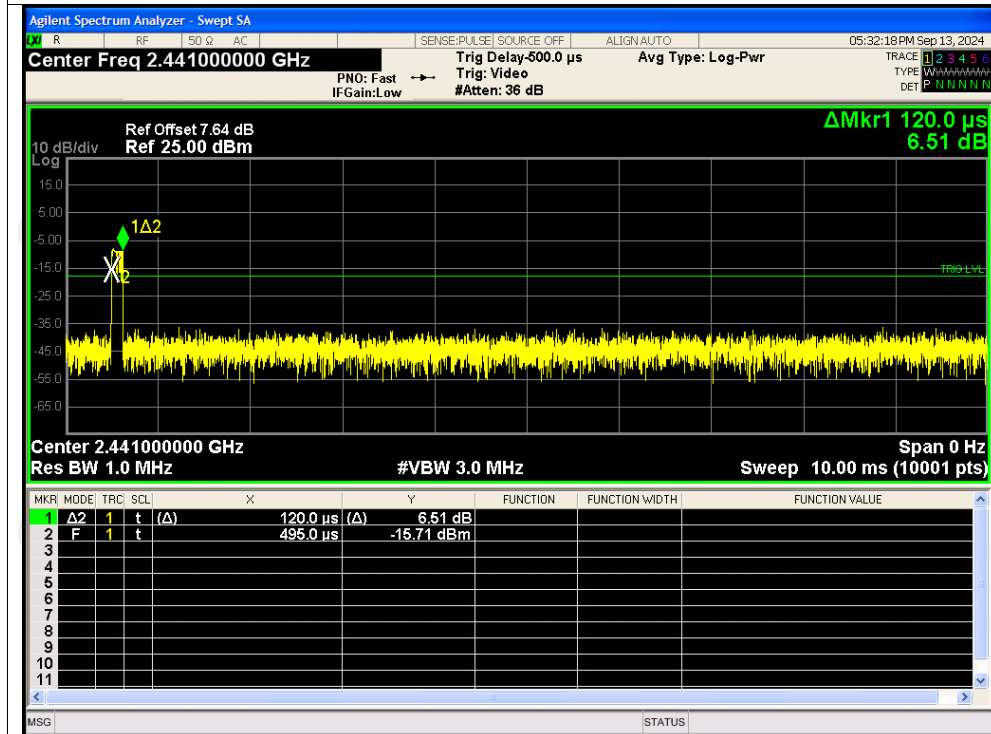


Dwell Time

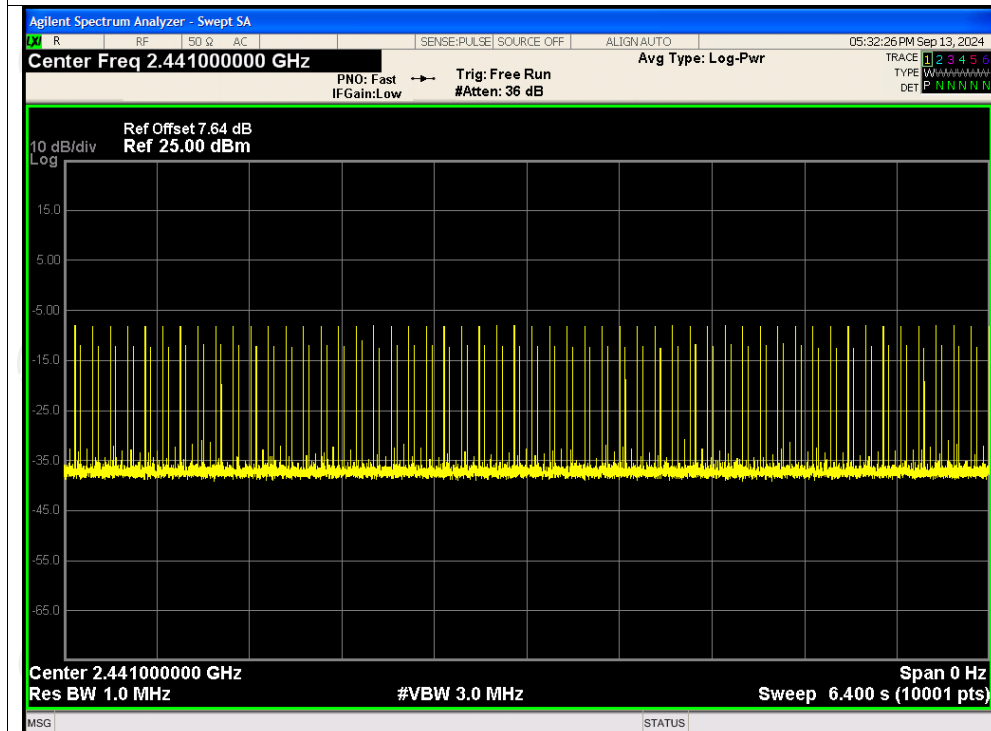
Condition	Frequency (MHz)	Pulse Time (ms)	Total Dwell Time (ms)	Burst Count	Period Time (ms)	Limit (ms)	Verdict
NVNT	2441	0.12	12.48	104	6400	400	Pass

Test Graphs

Dwell NVNT 2441MHz One Burst



Dwell NVNT 2441MHz Accumulated



Appendix B: Photographs of Test Setup

Please refer to document Appendix No.: TCT240828E033-A.

Appendix C: Photographs of EUT

Please refer to document Appendix No.: TCT240828E033-B & TCT240828E033-C.

*******END OF REPORT*******