




# TEST REPORT

FCC ID. .... :	2AUARTK689	
Test Report No..... :	TCT240712E023	
Date of issue..... :	Jul. 24, 2024	
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..... :	THINKCAR TECH CO., LTD.	
Address..... :	2606, building 4, phase II, TiananYungu, Gangtou community, Bantian, Longgang District, Shenzhen, China	
Manufacturer's name ... :	THINKCAR TECH CO., LTD.	
Address..... :	2606, building 4, phase II, TiananYungu, Gangtou community, Bantian, Longgang District, Shenzhen, China	
Standard(s) .....	FCC CFR Title 47 Part 15 Subpart C Section 15.247 FCC KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013	
Product Name..... :	Automotive Diagnostic Tool	
Trade Mark .....	THINKCAR, XHINKCAR, MUCAR	
Model/Type reference..... :	TK689	
Rating(s)..... :	Rechargeable Li-ion Battery DC 3.8V	
Date of receipt of test item .....	Jul. 12, 2024	
Date (s) of performance of test..... :	Jul. 12, 2024 ~ Jul. 24, 2024	
Tested by (+signature) ... :	Ronaldo LUO	
Check by (+signature).... :	Beryl ZHAO	
Approved by (+signature):	Tomsin	

**General disclaimer:**

This report shall not be reproduced except in full, without the written approval of SHENZHEN TONGCE TESTING LAB. This document may be altered or revised by SHENZHEN TONGCE TESTING LAB personnel only, and shall be noted in the revision section of the document. The test results in the report only apply to the tested sample.

## Table of Contents

<b>1. General Product Information .....</b>	<b>3</b>
1.1. EUT description .....	3
1.2. Model(s) list.....	3
1.3. Operation Frequency .....	3
<b>2. Test Result Summary .....</b>	<b>4</b>
<b>3. General Information.....</b>	<b>5</b>
3.1. Test environment and mode.....	5
3.2. Description of Support Units.....	5
<b>4. Facilities and Accreditations .....</b>	<b>6</b>
4.1. Facilities .....	6
4.2. Location .....	6
4.3. Measurement Uncertainty.....	6
<b>5. Test Results and Measurement Data .....</b>	<b>7</b>
5.1. Antenna requirement .....	7
5.2. Conducted Emission.....	8
5.3. Conducted Output Power .....	12
5.4. Emission Bandwidth .....	13
5.5. Power Spectral Density.....	14
5.6. Conducted Band Edge and Spurious Emission Measurement .....	15
5.7. Radiated Spurious Emission Measurement.....	17
<b>Appendix A: Test Result of Conducted Test</b>	
<b>Appendix B: Photographs of Test Setup</b>	
<b>Appendix C: Photographs of EUT</b>	

## 1. General Product Information

### 1.1. EUT description

Product Name.....:	Automotive Diagnostic Tool
Model/Type reference.....:	TK689
Sample Number.....:	TCT240712E022-0101
Bluetooth Version .....	V5.1(This report is for BLE)
Operation Frequency .....	2402MHz~2480MHz
Channel Separation.....:	2MHz
Data Rate.....:	LE 1M PHY, LE 2M PHY
Number of Channel .....	40
Modulation Type .....	GFSK
Antenna Type.....:	FPC Antenna
Antenna Gain.....:	5dBi
Rating(s).....:	Rechargeable Li-ion Battery DC 3.8V

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

None.

### 1.3. Operation Frequency

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	10	2422MHz	20	2442MHz	30	2462MHz
1	2404MHz	11	2424MHz	21	2444MHz	31	2464MHz
...	...	...	...	...	...	...	...
8	2418MHz	18	2438MHz	28	2458MHz	38	2478MHz
9	2420MHz	19	2440MHz	29	2460MHz	39	2480MHz

Remark: Channel 0, 19 & 39 have been tested.

## 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)(3)	PASS
6dB Emission Bandwidth	§15.247 (a)(2)	PASS
Power Spectral Density	§15.247 (e)	PASS
Band Edge	§15.247(d)	PASS
Spurious Emission	§15.205/§15.209	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:	22.7 °C	22.8 °C
Humidity:	52 % RH	51 % RH
Atmospheric Pressure:	1010 mbar	1010 mbar
Test Software:		
Software Information:	Engineering mode	
Power Level:	Default	
Test Mode:		
Engineer mode:	Keep the EUT in continuous transmitting by select channel and modulations with Fully-charged battery.	
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.		

#### 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
Adapter	EP-TA200	R37R55T6KL2SE3	/	SAMSUNG

**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, 6dB Emission Bandwidth, Power Spectral Density, 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-1

SHENZHEN TONGCE TESTING LAB

CAB identifier: CN0031

The testing lab has been registered by Certification and Engineering Bureau of Industry 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	$\pm 3.10$ dB
2	RF power, conducted	$\pm 0.12$ dB
3	Spurious emissions, conducted	$\pm 0.11$ dB
4	All emissions, radiated(<1 GHz)	$\pm 4.56$ dB
5	All emissions, radiated(1 GHz - 18 GHz)	$\pm 4.22$ dB
6	All emissions, radiated(18 GHz- 40 GHz)	$\pm 4.36$ dB



## 5. Test Results and Measurement Data

### 5.1. Antenna requirement

#### Standard requirement:

FCC Part15 C Section 15.203 /247(c)

#### 15.203 requirement:

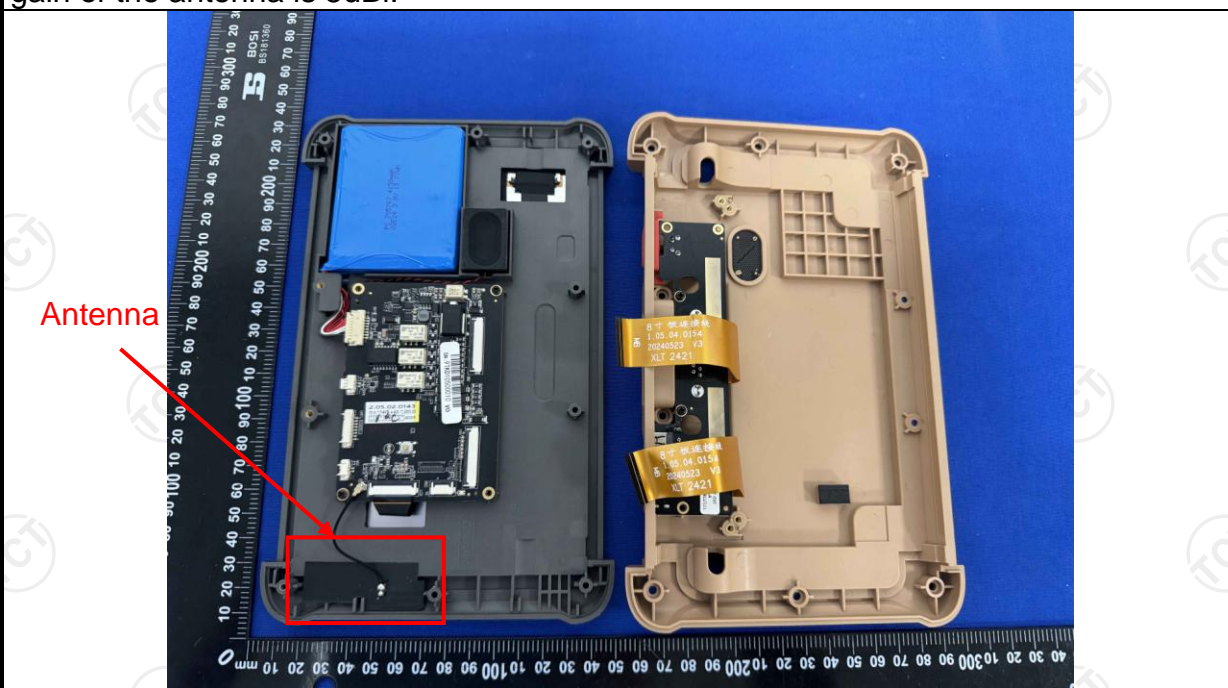
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit 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 Bluetooth antenna is FPC antenna which permanently attached, and the best case gain of the antenna is 5dBi.



## 5.2. Conducted Emission

### 5.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207														
Test Method:	ANSI C63.10:2013														
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:	<div><p>Reference Plane</p><p>40cm</p><p>Test table/Insulation plane</p><p>80cm</p><p>EMI Receiver</p><p>Filter</p><p>AC power</p><p>AC power</p><p>Remark E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p></div>														
Test Mode:	Charging + Transmitting Mode														
Test Procedure:	<ol style="list-style-type: none"><li>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.</li><li>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).</li><li>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 C63.10:2013 on conducted measurement.</li></ol>														
Test Result:	PASS														



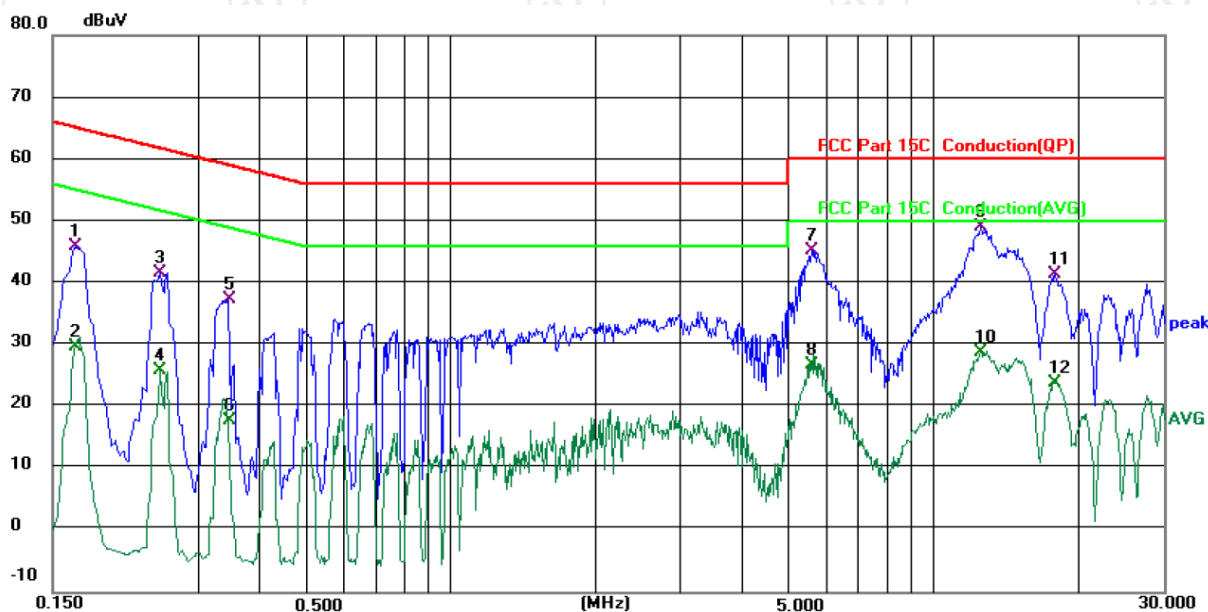
**5.2.2. Test Instruments**

Conducted Emission Shielding Room Test Site (843)				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESCI3	100898	Jun. 26, 2025
LISN	Schwarzbeck	NSLK 8126	8126453	Jan. 31, 2025
Attenuator	N/A	10dB	164080	Jun. 26, 2025
Line-5	TCT	CE-05	/	Jun. 26, 2025
EMI Test Software	EZ EMC	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: 22.7 (°C)

Humidity: 52 %

Limit: FCC Part 15C Conduction(QP)

Power: DC 5 V(Adapter 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		0.1660	36.15	9.66	45.81	65.16	-19.35	QP	
2		0.1660	19.99	9.66	29.65	55.16	-25.51	AVG	
3		0.2500	31.91	9.66	41.57	61.76	-20.19	QP	
4		0.2500	16.18	9.66	25.84	51.76	-25.92	AVG	
5		0.3459	27.32	10.01	37.33	59.06	-21.73	QP	
6		0.3459	7.74	10.01	17.75	49.06	-31.31	AVG	
7		5.5979	35.01	10.22	45.23	60.00	-14.77	QP	
8		5.5979	16.53	10.22	26.75	50.00	-23.25	AVG	
9	*	12.5579	38.81	10.30	49.11	60.00	-10.89	QP	
10		12.5579	18.47	10.30	28.77	50.00	-21.23	AVG	
11		17.8700	31.11	10.30	41.41	60.00	-18.59	QP	
12		17.8700	13.48	10.30	23.78	50.00	-26.22	AVG	

#### Note:

Freq. = Emission frequency in MHz

Reading level (dBuV) = Receiver reading

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

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

Limit (dBuV) = Limit stated in standard

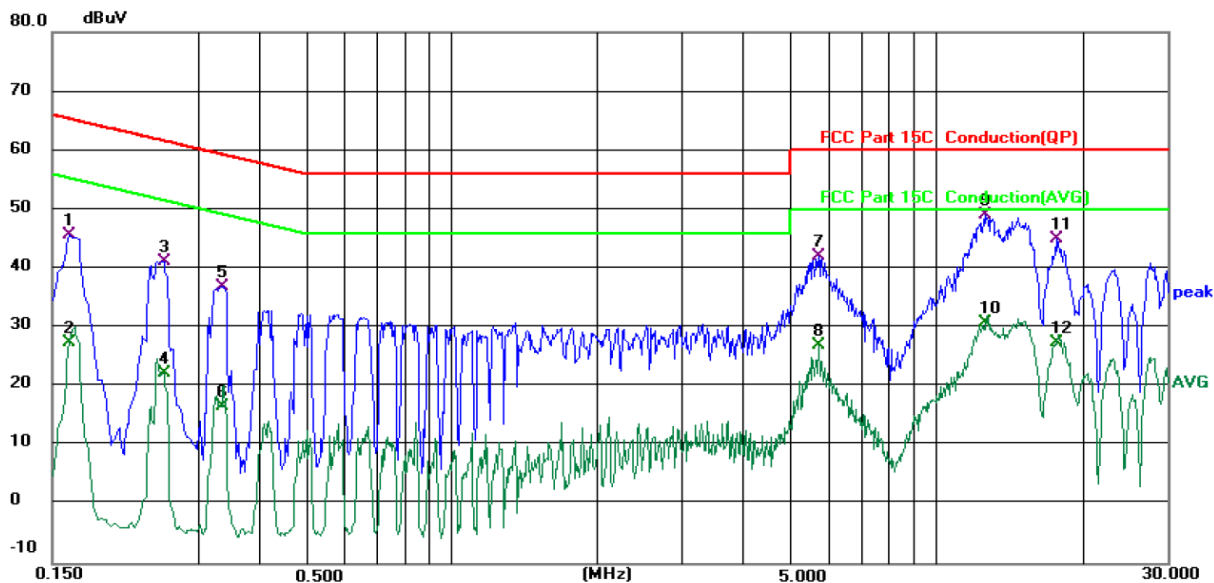
Margin (dB) = Measurement (dBuV) – Limits (dBuV)

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: 22.7 (°C)

Humidity: 52 %

Limit: FCC Part 15C Conduction(QP)

Power: DC 5 V(Adapter 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		0.1620	35.94	9.65	45.59	65.36	-19.77	QP	
2		0.1620	17.82	9.65	27.47	55.36	-27.89	AVG	
3		0.2540	31.46	9.64	41.10	61.63	-20.53	QP	
4		0.2540	12.64	9.64	22.28	51.63	-29.35	AVG	
5		0.3339	26.99	9.97	36.96	59.35	-22.39	QP	
6		0.3339	6.80	9.97	16.77	49.35	-32.58	AVG	
7		5.7419	32.03	10.15	42.18	60.00	-17.82	QP	
8		5.7419	16.87	10.15	27.02	50.00	-22.98	AVG	
9	*	12.6419	38.88	10.28	49.16	60.00	-10.84	QP	
10		12.6419	20.46	10.28	30.74	50.00	-19.26	AVG	
11		17.7340	34.70	10.23	44.93	60.00	-15.07	QP	
12		17.7340	17.15	10.23	27.38	50.00	-22.62	AVG	

### Note1:

Freq. = Emission frequency in MHz

Reading level (dBuV) = Receiver reading

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

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

Limit (dBuV) = Limit stated in standard

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

Q.P. =Quasi-Peak

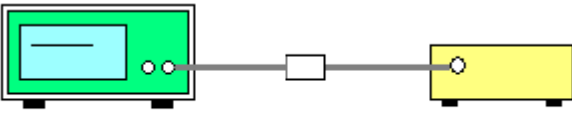
AVG =average

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

**Note2:** Speed for 1M and 2M modulations of EUT have been tested, but the test data only show the worst case in this report, and we found the worst case is 2M speed modulation. Measurements were conducted in all three channels (high, middle, low), and the worst case Mode (Highest channel) was submitted only.

### 5.3. Conducted Output Power

#### 5.3.1. Test Specification

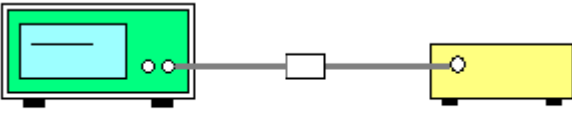
<b>Test Requirement:</b>	FCC Part15 C Section 15.247 (b)(3)
<b>Test Method:</b>	KDB 558074 D01 v05r02
<b>Limit:</b>	30dBm
<b>Test Setup:</b>	 <p style="text-align: center;">Spectrum Analyzer                      EUT</p>
<b>Test Mode:</b>	Refer to item 3.1
<b>Test Procedure:</b>	<p>Set spectrum analyzer as following:</p> <ul style="list-style-type: none"> <li>a) Set the RBW <math>\geq</math> DTS bandwidth.</li> <li>b) Set VBW <math>\geq 3 \times</math> RBW.</li> <li>c) Set span <math>\geq 3 \times</math> RBW</li> <li>d) Sweep time = auto couple.</li> <li>e) Detector = peak.</li> <li>f) Trace mode = max hold.</li> <li>g) Allow trace to fully stabilize.</li> <li>h) Use peak marker function to determine the peak amplitude level.</li> </ul>
<b>Test Result:</b>	PASS

#### 5.3.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 26, 2025
Combiner Box	Ascentest	AT890-RFB	/	/

## 5.4. Emission Bandwidth

### 5.4.1. Test Specification

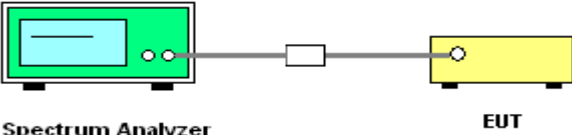
<b>Test Requirement:</b>	FCC Part15 C Section 15.247 (a)(2)
<b>Test Method:</b>	KDB 558074 D01 v05r02
<b>Limit:</b>	>500kHz
<b>Test Setup:</b>	 <p style="text-align: center;">Spectrum Analyzer                      EUT</p>
<b>Test Mode:</b>	Refer to item 3.1
<b>Test Procedure:</b>	<ol style="list-style-type: none"> <li>1. Set to the maximum power setting and enable the EUT transmit continuously.</li> <li>2. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.</li> <li>3. Measure and record the results in the test report.</li> </ol>
<b>Test Result:</b>	PASS

### 5.4.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 26, 2025
Combiner Box	Ascentest	AT890-RFB	/	/

## 5.5. Power Spectral Density

### 5.5.1. Test Specification

<b>Test Requirement:</b>	FCC Part15 C Section 15.247 (e)
<b>Test Method:</b>	KDB 558074 D01 v05r02
<b>Limit:</b>	The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.
<b>Test Setup:</b>	 <p style="text-align: center;">Spectrum Analyzer                      EUT</p>
<b>Test Mode:</b>	Refer to item 3.1
<b>Test Procedure:</b>	<ol style="list-style-type: none"> <li>1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.</li> <li>2. Set to the maximum power setting and enable the EUT transmit continuously.</li> <li>3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW): <math>3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}</math>. Video bandwidth VBW <math>\geq 3 \times \text{RBW}</math>. In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)</li> <li>4. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.</li> <li>5. Measure and record the results in the test report.</li> </ol>
<b>Test Result:</b>	PASS

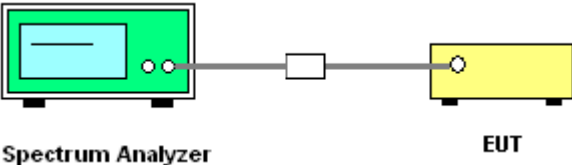
### 5.5.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 26, 2025
Combiner Box	Ascentest	AT890-RFB	/	/



## 5.6. Conducted Band Edge and Spurious Emission Measurement

### 5.6.1. Test Specification

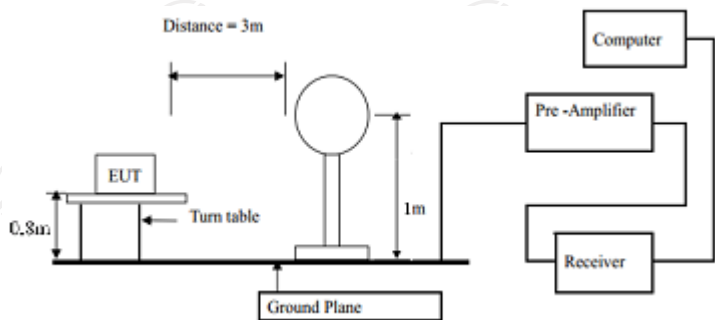
<b>Test Requirement:</b>	FCC Part15 C Section 15.247 (d)
<b>Test Method:</b>	KDB 558074 D01 v05r02
<b>Limit:</b>	In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement and radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).
<b>Test Setup:</b>	 <p>The diagram illustrates the test setup. On the left is a Spectrum Analyzer, represented by a green rectangle with a blue screen and two red dots indicating ports. A black line representing an RF cable connects the Spectrum Analyzer to a small white square, which represents an attenuator. Another black line connects the attenuator to a yellow rectangle representing the EUT (Equipment Under Test), which has a single red dot indicating a port. Below the Spectrum Analyzer is the label 'Spectrum Analyzer', and below the EUT is the label 'EUT'.</p>
<b>Test Mode:</b>	Refer to item 3.1
<b>Test Procedure:</b>	<ol style="list-style-type: none"> <li>1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.</li> <li>2. Set to the maximum power setting and enable the EUT transmit continuously.</li> <li>3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).</li> <li>4. Measure and record the results in the test report.</li> <li>5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.</li> </ol>
<b>Test Result:</b>	PASS

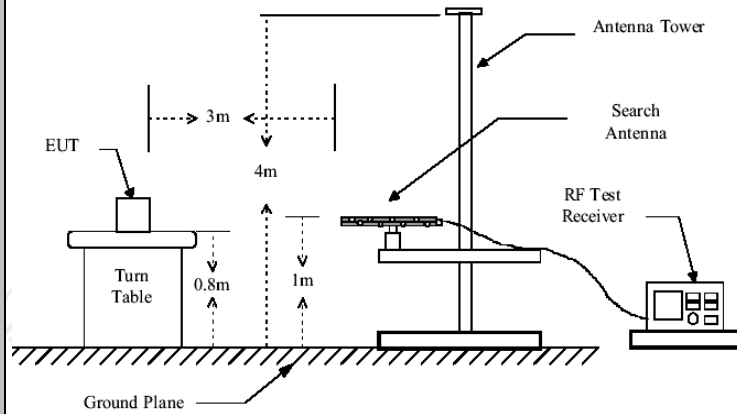
### 5.6.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Jun. 26, 2025
Combiner Box	Ascentest	AT890-RFB	/	/

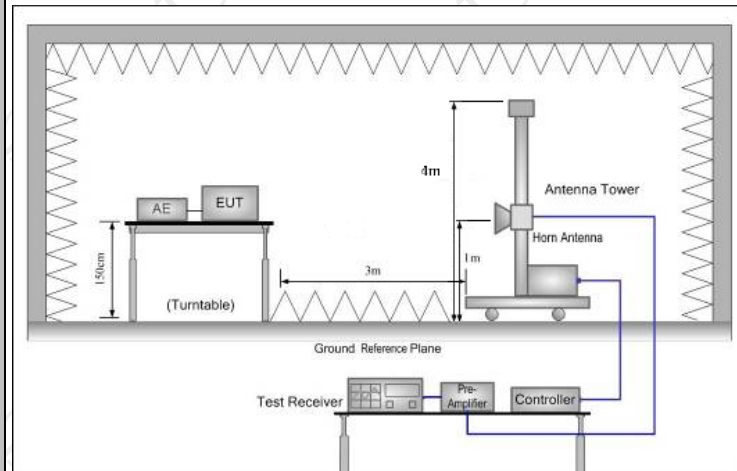
## 5.7. Radiated Spurious Emission Measurement

### 5.7.1. Test Specification

<b>Test Requirement:</b>	FCC Part15 C Section 15.209			
<b>Test Method:</b>	ANSI C63.10:2013			
<b>Frequency Range:</b>	9 kHz to 25 GHz			
<b>Measurement Distance:</b>	3 m			
<b>Antenna Polarization:</b>	Horizontal & Vertical			
<b>Operation mode:</b>	Refer to item 3.1			
<b>Receiver Setup:</b>	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
<b>Limit:</b>	Remark			
	Quasi-peak Value			
	Quasi-peak Value			
	Quasi-peak Value			
	Peak Value			
<b>Test setup:</b>	Average Value			
<b>Test setup:</b>	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	
	30-88	100	3	
<b>Test setup:</b>	88-216	150	3	
	216-960	200	3	
	Above 960	500	3	
<b>Test setup:</b>	Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector
	Above 1GHz	500	3	Average
		5000	3	Peak
<b>Test setup:</b>	For radiated emissions below 30MHz			
				
	30MHz to 1GHz			



Above 1GHz



### Test Procedure:

1. 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

	<p>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.</p> <p>2. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level</p> <p>3. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.</p> <p>4. Use the following spectrum analyzer settings:</p> <p>(1) Span shall wide enough to fully capture the emission being measured;</p> <p>(2) Set RBW=120 kHz for <math>f &lt; 1</math> GHz; VBW <math>\geq</math> RBW; Sweep = auto; Detector function = peak; Trace = max hold;</p> <p>(3) Set RBW = 1 MHz, VBW= 3MHz for <math>f &gt; 1</math> GHz for peak measurement.</p> <p>For average measurement: VBW = 10 Hz, when duty cycle is no less than 98 percent. VBW <math>\geq 1/T</math>, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.</p>
<b>Test mode:</b>	Refer to section 3.1 for details
<b>Test results:</b>	PASS

## 5.7.2. Test Instruments

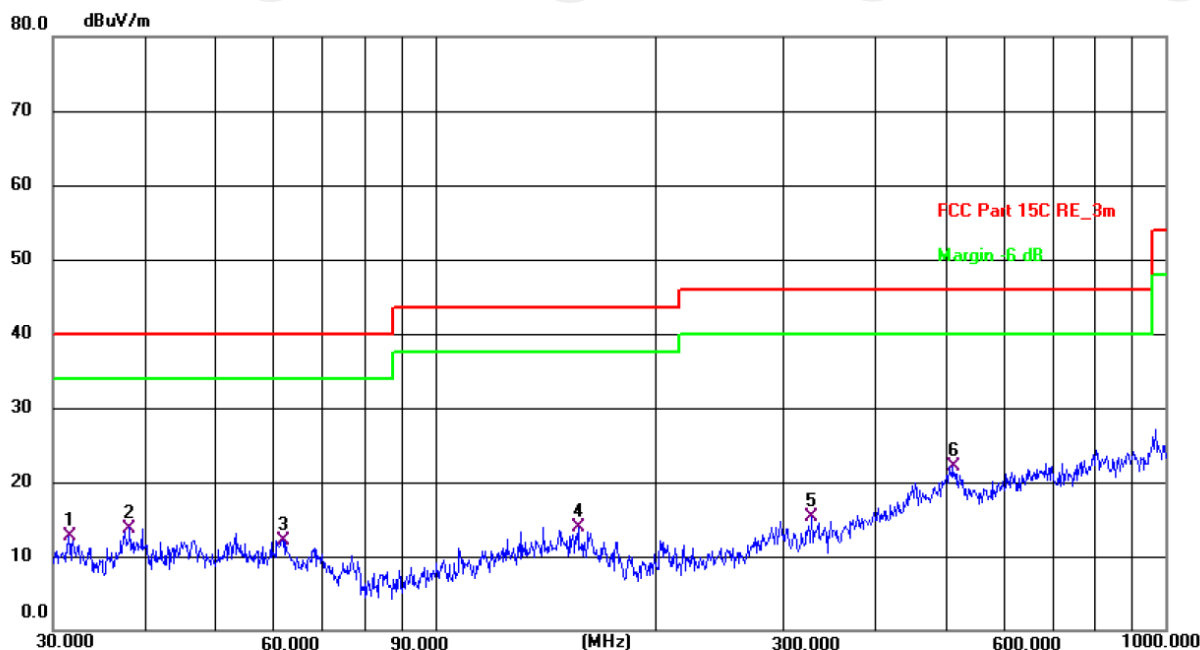
Radiated Emission Test Site (966)				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESCI7	100529	Jan. 31, 2025
Spectrum Analyzer	R&S	FSQ40	200061	Jun. 26, 2025
Pre-amplifier	HP	8447D	2727A05017	Jun. 26, 2025
Pre-amplifier	SKET	LNPA_0118G-45	SK2021012102	Jan. 31, 2025
Pre-amplifier	SKET	LNPA_1840G-50	SK202109203500	Jan. 31, 2025
Loop antenna	Schwarzbeck	FMZB1519B	00191	Jun. 26, 2025
Broadband Antenna	Schwarzbeck	VULB9163	340	Jun. 28, 2025
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Jun. 28, 2025
Horn Antenna	Schwarzbeck	BBHA 9170	00956	Feb. 02, 2025
Coaxial cable	SKET	RE-03-D	/	Jun. 26, 2025
Coaxial cable	SKET	RE-03-M	/	Jun. 26, 2025
Coaxial cable	SKET	RE-03-L	/	Jun. 26, 2025
Coaxial cable	SKET	RE-04-D	/	Jun. 26, 2025
Coaxial cable	SKET	RE-04-M	/	Jun. 26, 2025
Coaxial cable	SKET	RE-04-L	/	Jun. 26, 2025
Antenna Mast	Keleto	RE-AM	/	/
EMI Test Software	EZ EMC	FA-03A2 RE+	1.1.4.2	/



### 5.7.3. Test Data

Please refer to following diagram for individual  
Below 1GHz

Horizontal:



Site 3m Anechoic Chamber2

Polarization: **Horizontal**

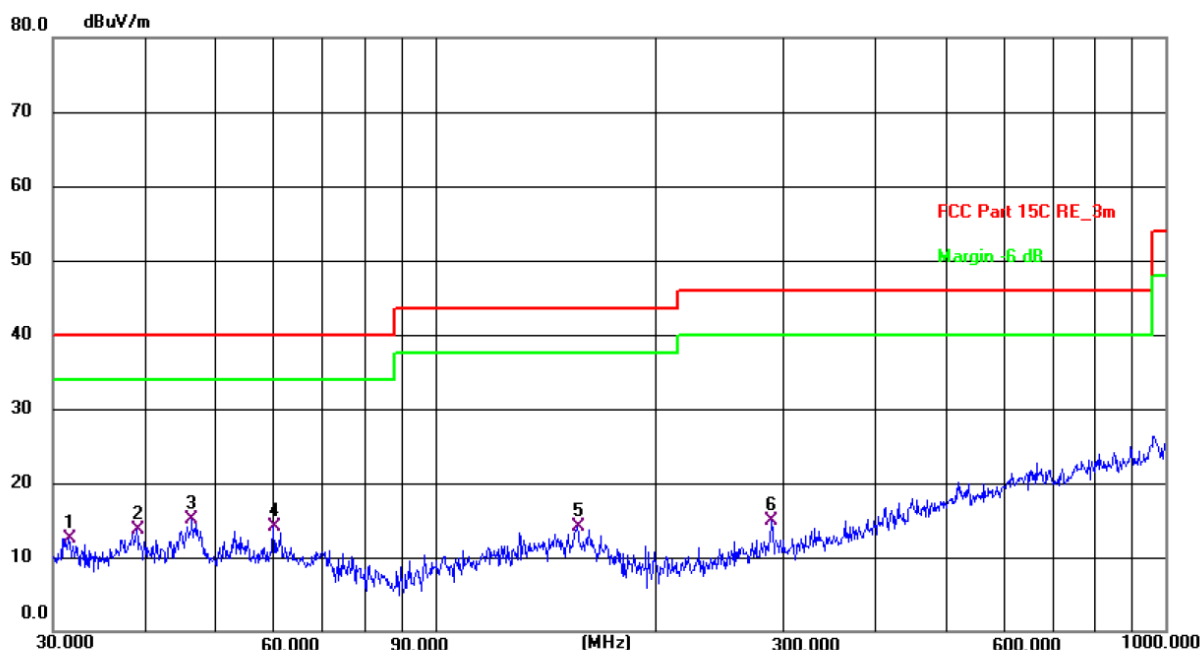
Temperature: 22.8(C) Humidity: 51 %

Limit: FCC Part 15C RE\_3m

Power: DC 3.8 V

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	31.5095	32.16	-19.44	12.72	40.00	-27.28	QP	P	
2	38.2120	32.45	-18.65	13.80	40.00	-26.20	QP	P	
3	61.7780	31.14	-19.01	12.13	40.00	-27.87	QP	P	
4	157.0073	31.03	-17.08	13.95	43.50	-29.55	QP	P	
5	327.8872	32.76	-17.48	15.28	46.00	-30.72	QP	P	
6 *	511.8352	34.09	-11.98	22.11	46.00	-23.89	QP	P	

Vertical:



Site 3m Anechoic Chamber2 Polarization: **Vertical** Temperature: 22.8(C) Humidity: 51 %

Limit: FCC Part 15C RE\_3m

Power: DC 3.8 V

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	31.5095	32.04	-19.44	12.60	40.00	-27.40	QP	P	
2	39.0244	32.27	-18.48	13.79	40.00	-26.21	QP	P	
3 *	46.5030	33.79	-18.66	15.13	40.00	-24.87	QP	P	
4	60.0691	32.95	-18.94	14.01	40.00	-25.99	QP	P	
5	156.4577	31.05	-16.97	14.08	43.50	-29.42	QP	P	
6	289.0020	32.45	-17.51	14.94	46.00	-31.06	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. Speed for 1M and 2M modulations of EUT have been tested, but the test data only show the worst case in this report, and we found the worst case is 2M speed modulation. Measurements were conducted in all three channels (high, middle, low), and the worst case Mode (Highest channel) was submitted only.

3. Freq. = Emission frequency in MHz

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

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

Limit (dBuV/m) = Limit stated in standard

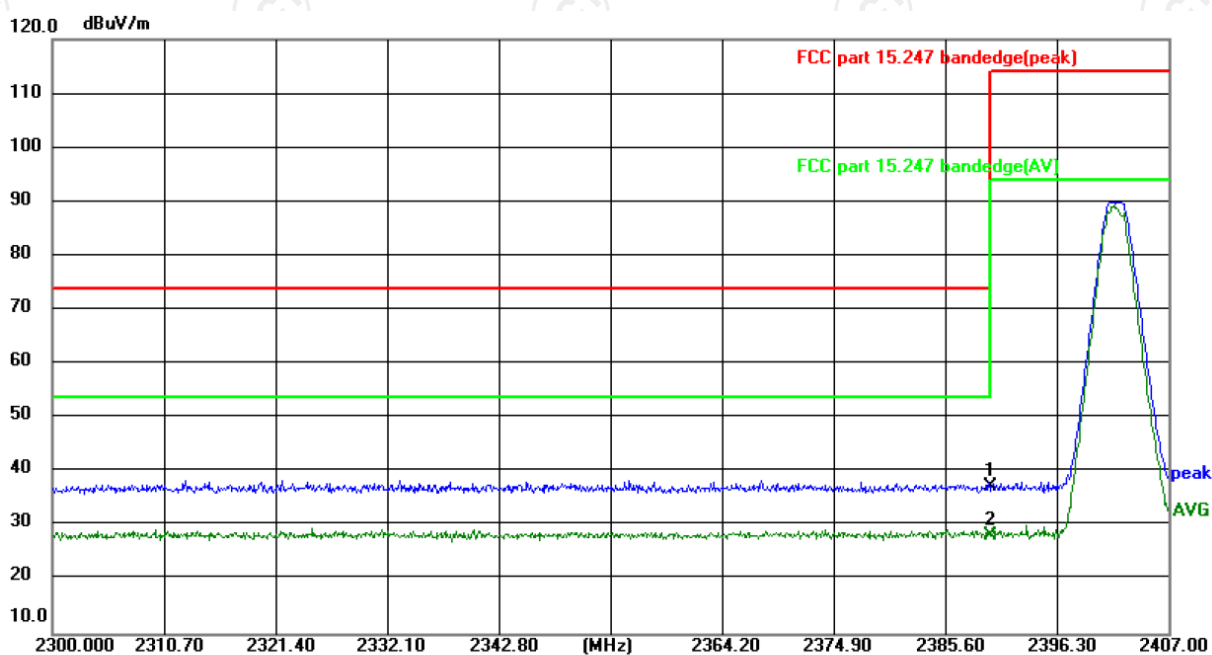
Margin (dB) = Measurement (dBuV/m) – Limits (dBuV/m)

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

## Test Result of Radiated Spurious at Band edges

Lowest channel 2402:

Horizontal:



Site: 3m Anechoic Chamber

Polarization: **Horizontal**

Temperature: 24.8(°C)

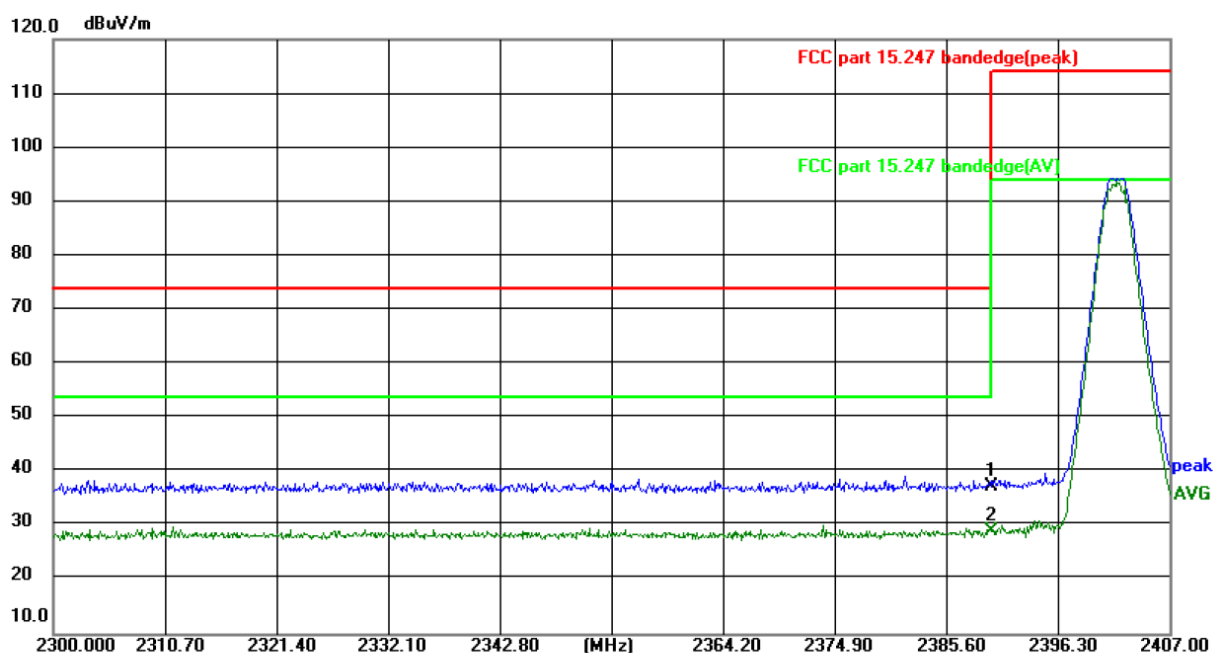
Humidity: 51 %

Limit: FCC part 15.247 bandedge(peak)

Power:DC 3.8V

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2390.000	54.18	-16.70	37.48	74.00	-36.52	peak	P	
2 *	2390.000	44.90	-16.70	28.20	54.00	-25.80	AVG	P	

Vertical:



Site: 3m Anechoic Chamber

Polarization: **Vertical**

Temperature: 24.8(°C)

Humidity: 51 %

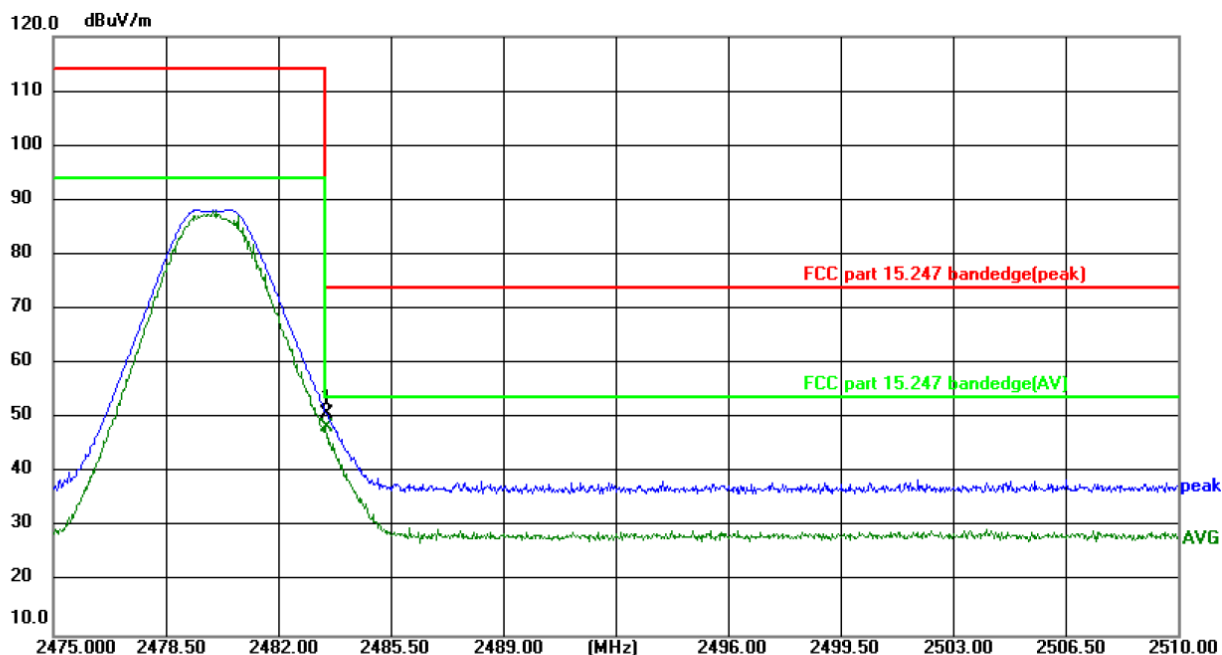
Limit: FCC part 15.247 bandedge(peak)

Power:DC 3.8V

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2390.000	54.17	-16.70	37.47	74.00	-36.53	peak	P	
2 *	2390.000	45.75	-16.70	29.05	54.00	-24.95	AVG	P	

Highest channel 2480:

Horizontal:



Site: 3m Anechoic Chamber

Polarization: **Horizontal**

Temperature: 24.8(°C)

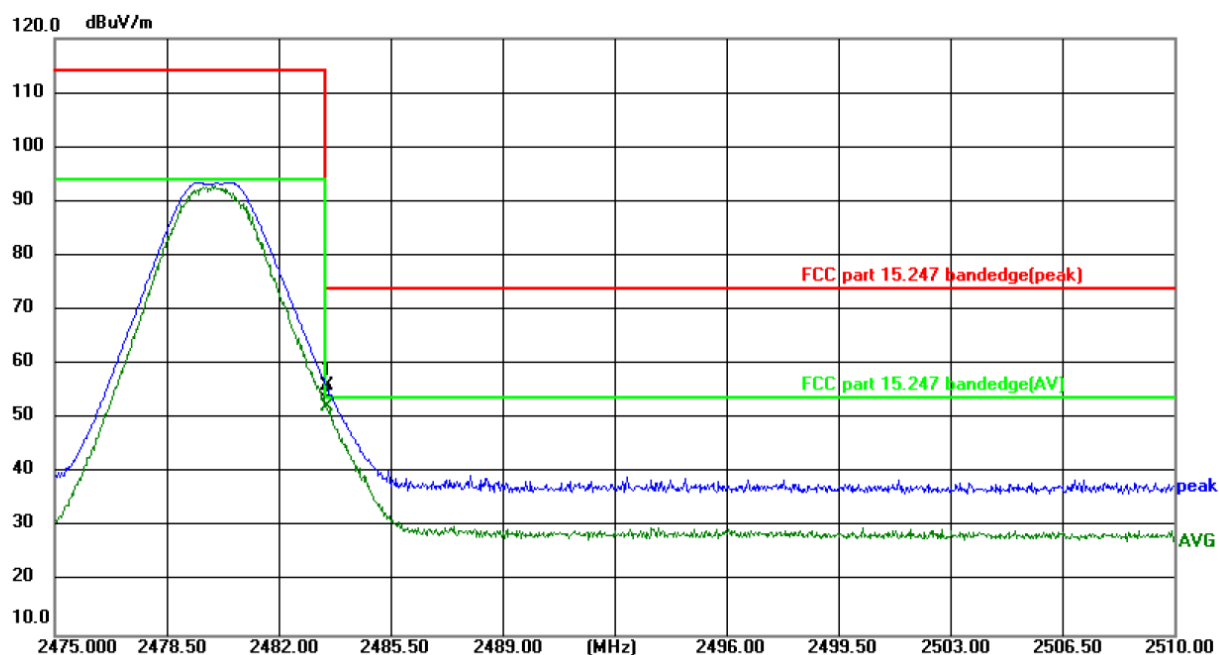
Humidity: 51 %

Limit: FCC part 15.247 bandedge(peak)

Power:DC 3.8V

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2483.500	67.45	-16.65	50.80	74.00	-23.20	peak	P	
2 *	2483.500	65.14	-16.65	48.49	54.00	-5.51	AVG	P	

Vertical:



Site: 3m Anechoic Chamber

Polarization: **Vertical**

Temperature: 24.8(°C)

Humidity: 51 %

Limit: FCC part 15.247 bandedge(peak)

Power:DC 3.8V

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	2483.500	72.63	-16.65	55.98	74.00	-18.02	peak	P	
2 *	2483.500	68.75	-16.65	52.10	54.00	-1.90	AVG	P	

**Note:** Speed for 1M and 2M modulations of EUT have been tested, but the test data only show the worst case in this report, and we found the worst case is 2M speed modulation.



## Above 1GHz

### Low channel: 2402 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)			
4804	H	45.69	---	0.66	46.35	---	74	54	-7.65
7206	H	34.52	---	9.50	44.02	---	74	54	-9.98
---	H	---	---	---	---	---	---	---	---
4804	V	45.75	---	0.66	46.41	---	74	54	-7.59
7206	V	34.43	---	9.50	43.93	---	74	54	-10.07
---	V	---	---	---	---	---	---	---	---

### Middle channel: 2440 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)			
4880	H	44.25	---	0.99	45.24	---	74	54	-8.76
7320	H	34.89	---	9.87	44.76	---	74	54	-9.24
---	H	---	---	---	---	---	---	---	---
4880	V	46.43	---	0.99	47.42	---	74	54	-6.58
7320	V	35.58	---	9.87	45.45	---	74	54	-8.55
---	V	---	---	---	---	---	---	---	---

### High channel: 2480 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)			
4960	H	45.74	---	1.33	47.07	---	74	54	-6.93
7440	H	34.10	---	10.22	44.32	---	74	54	-9.68
---	H	---	---	---	---	---	---	---	---
4960	V	46.14	---	1.33	47.47	---	74	54	-6.53
7440	V	35.08	---	10.22	45.30	---	74	54	-8.70
---	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. Speed for 1M and 2M modulations of EUT have been tested, but the test data only show the worst case in this report, and we found the worst case is 2M speed modulation.
7. All the restriction bands are compliance with the limit of 15.209.

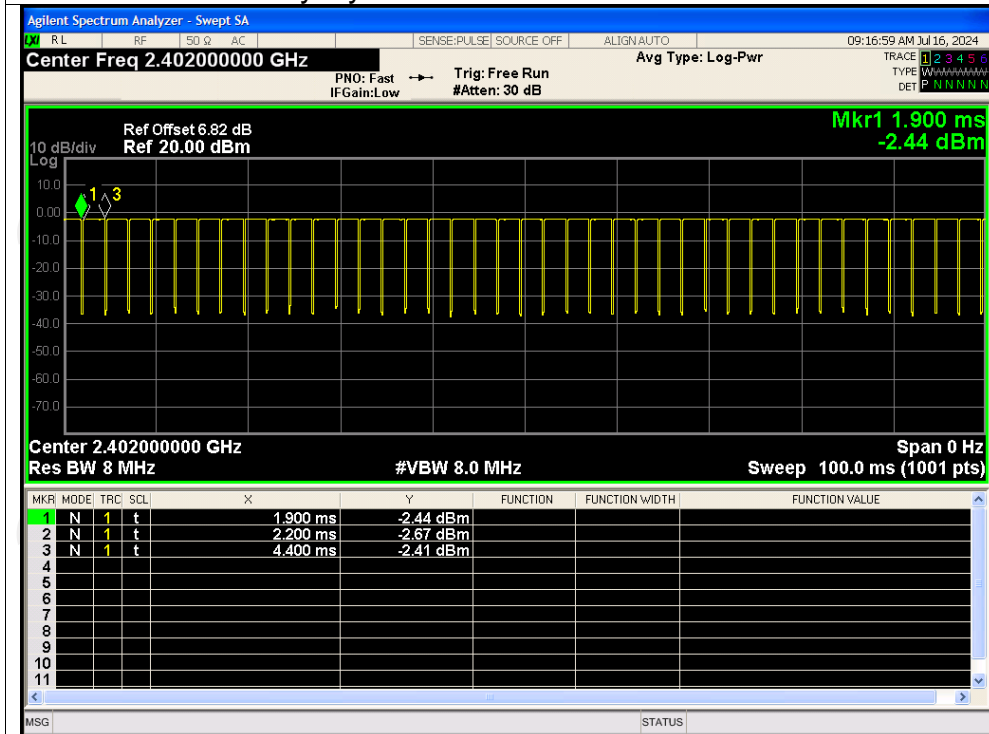
## Appendix A: Test Result of Conducted Test

### Duty Cycle

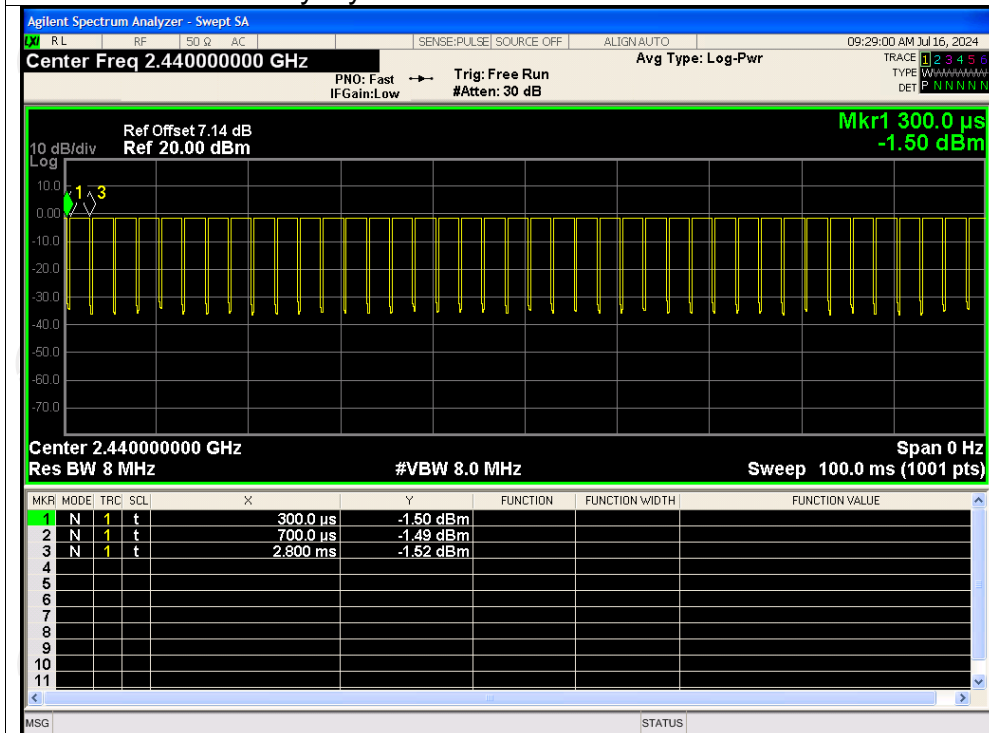
Condition	Mode	Frequency (MHz)	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	BLE 1M	2402	92.01	0.36	0.45
NVNT	BLE 1M	2440	88.01	0.55	0.48
NVNT	BLE 1M	2480	88.01	0.55	0.48
NVNT	BLE 2M	2402	61.14	2.14	0.91
NVNT	BLE 2M	2440	62.64	2.03	0.91
NVNT	BLE 2M	2480	62.64	2.03	0.91

### Test Graphs

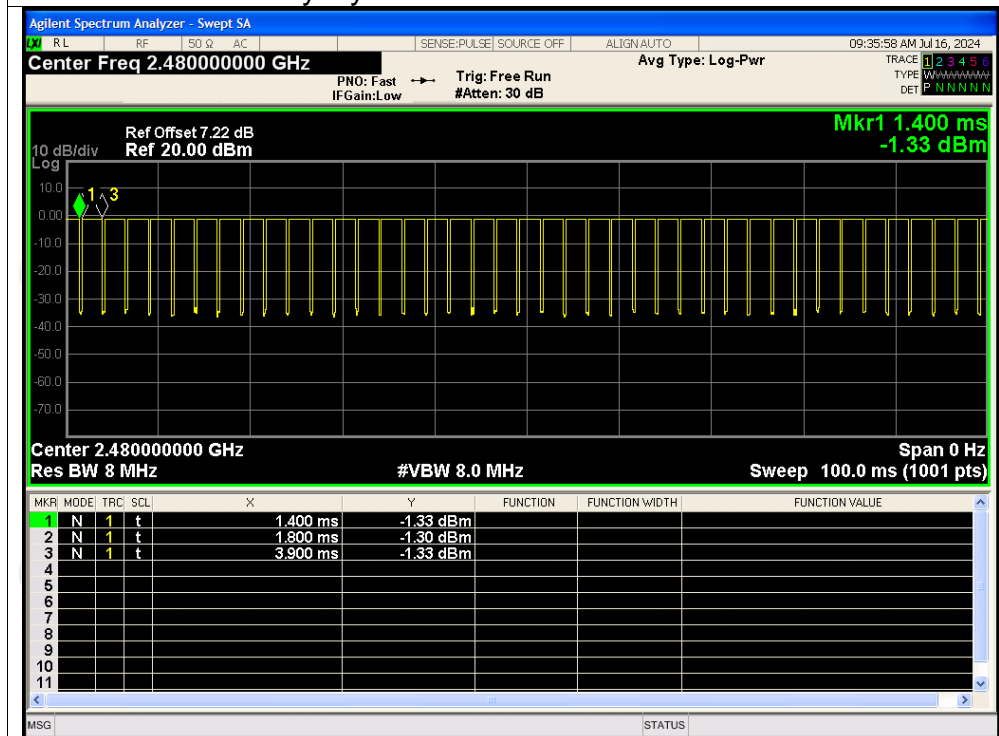
#### Duty Cycle NVNT BLE 1M 2402MHz



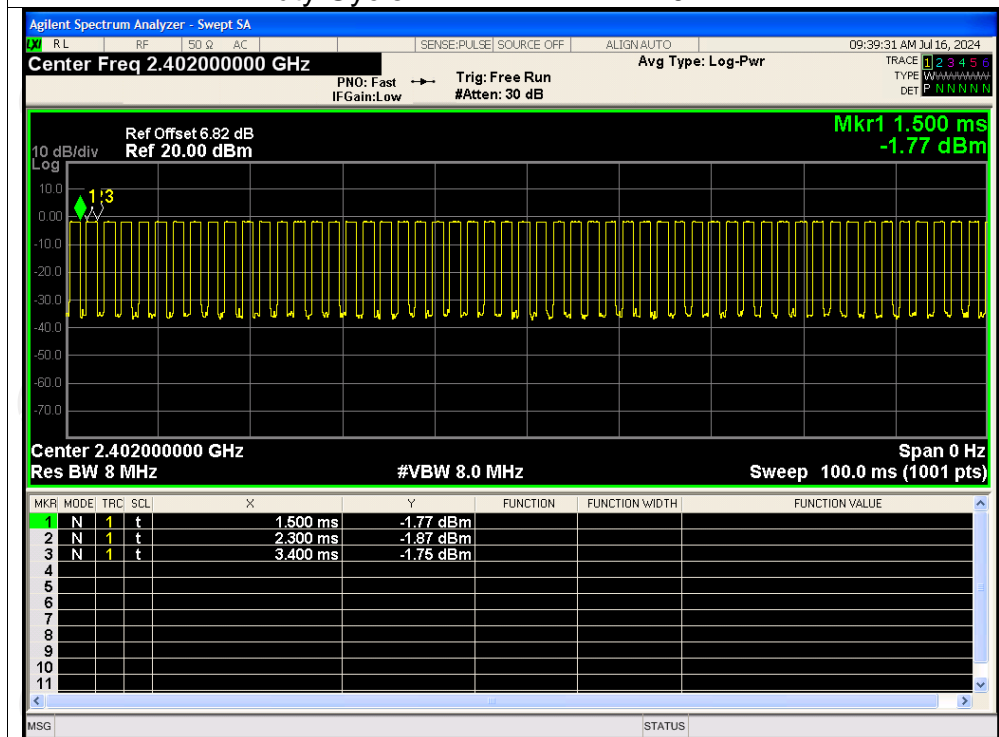
#### Duty Cycle NVNT BLE 1M 2440MHz



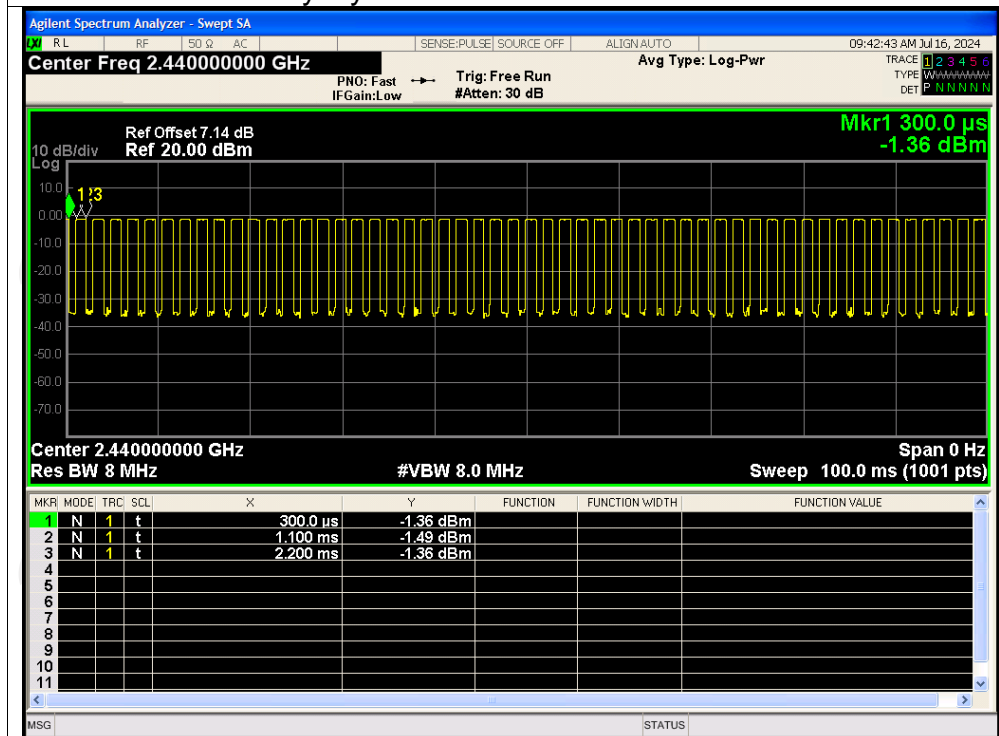
### Duty Cycle NVNT BLE 1M 2480MHz



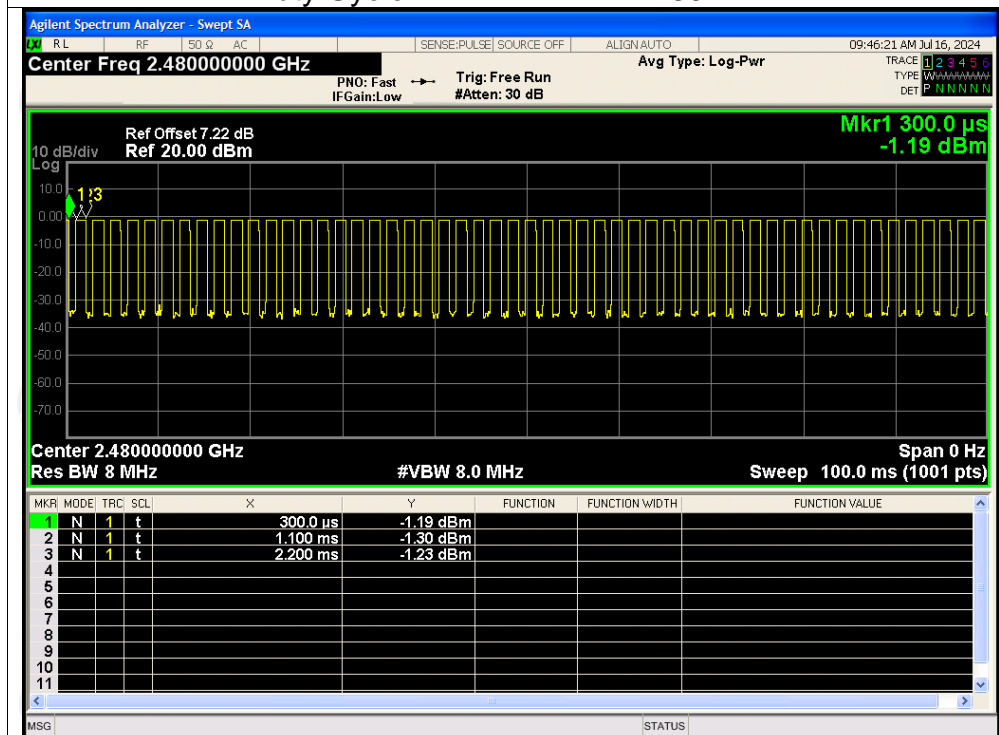
### Duty Cycle NVNT BLE 2M 2402MHz



## Duty Cycle NVNT BLE 2M 2440MHz



## Duty Cycle NVNT BLE 2M 2480MHz



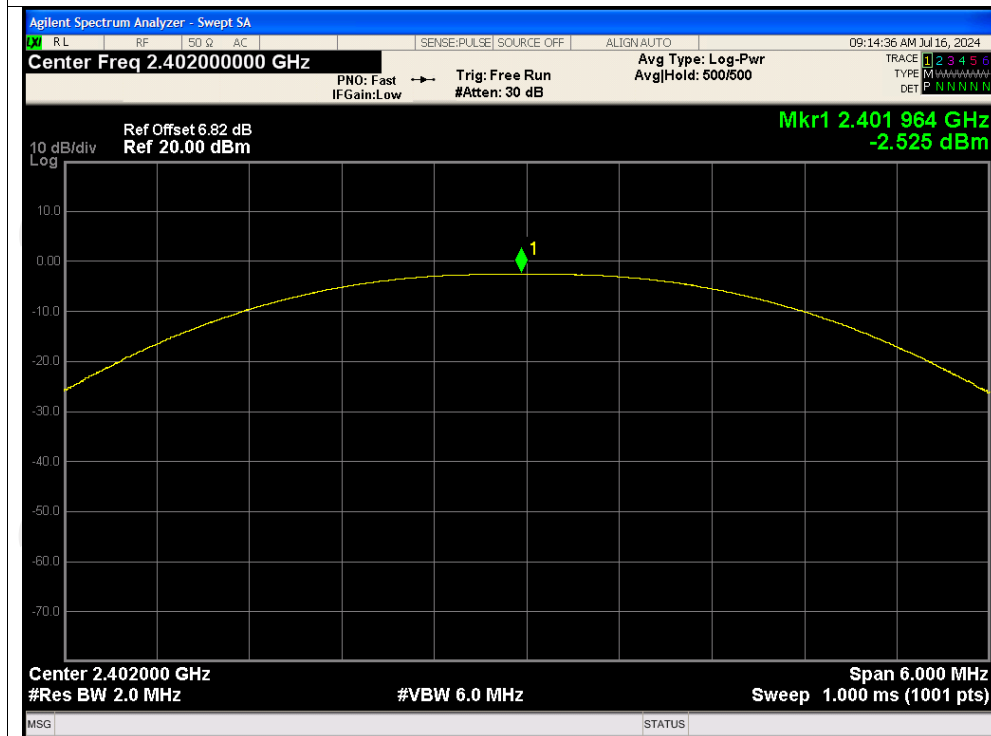
### Maximum Conducted Output Power

Condition	Mode	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	-2.53	30	Pass
NVNT	BLE 1M	2440	-2.02	30	Pass
NVNT	BLE 1M	2480	-1.43	30	Pass
NVNT	BLE 2M	2402	-1.94	30	Pass
NVNT	BLE 2M	2440	-1.56	30	Pass
NVNT	BLE 2M	2480	-1.40	30	Pass

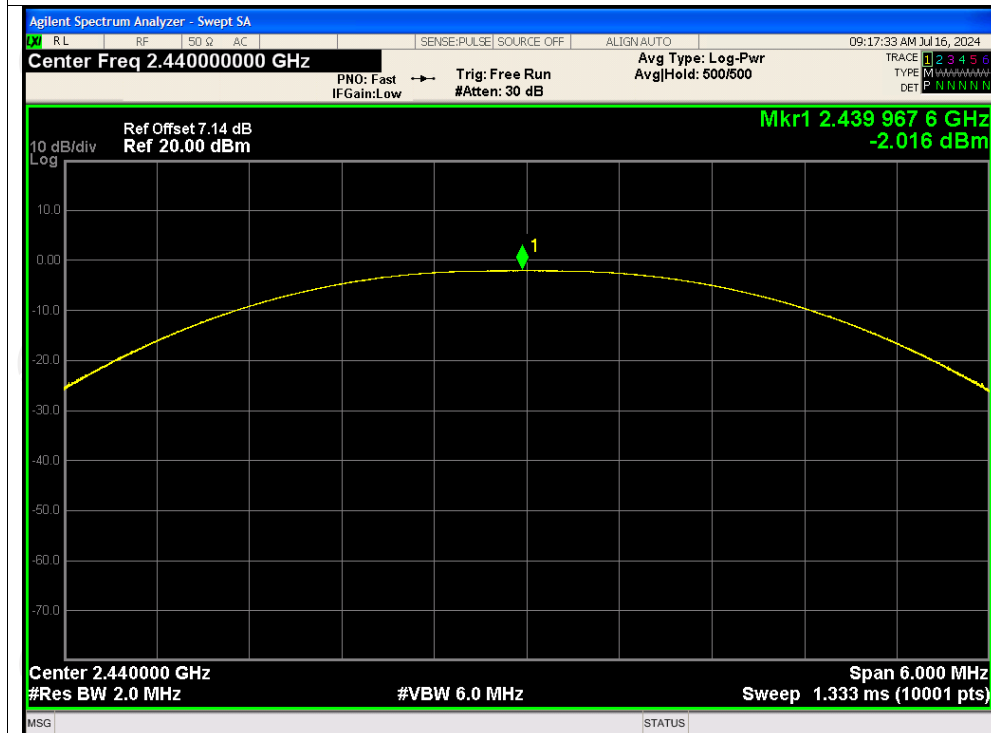


### Test Graphs

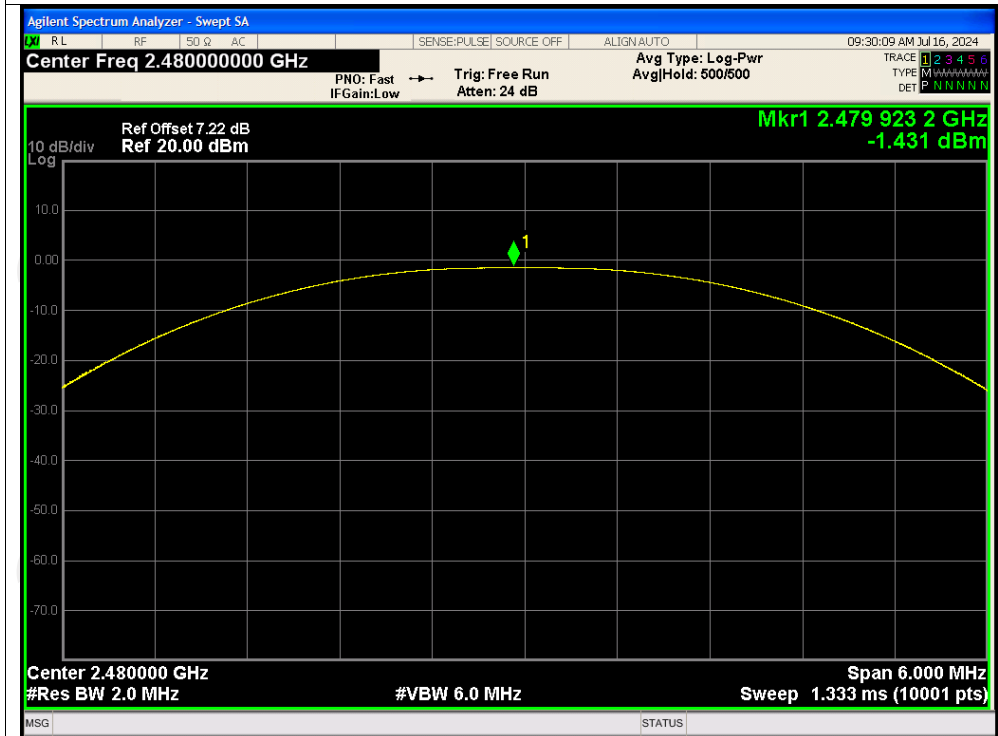
#### Power NVNT BLE 1M 2402MHz



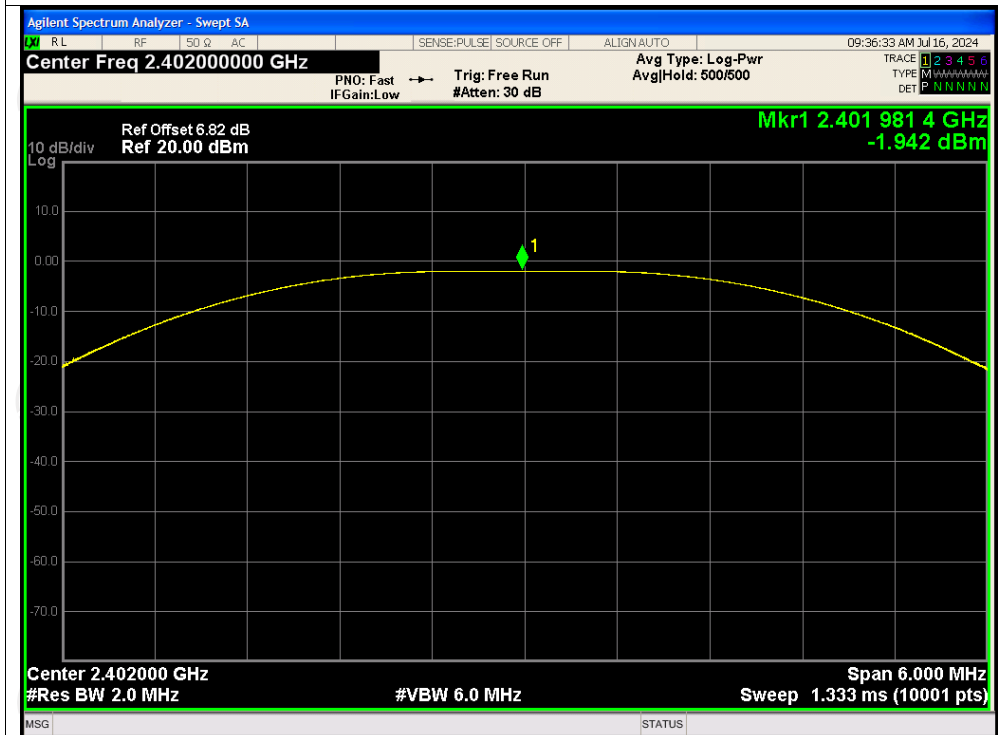
#### Power NVNT BLE 1M 2440MHz



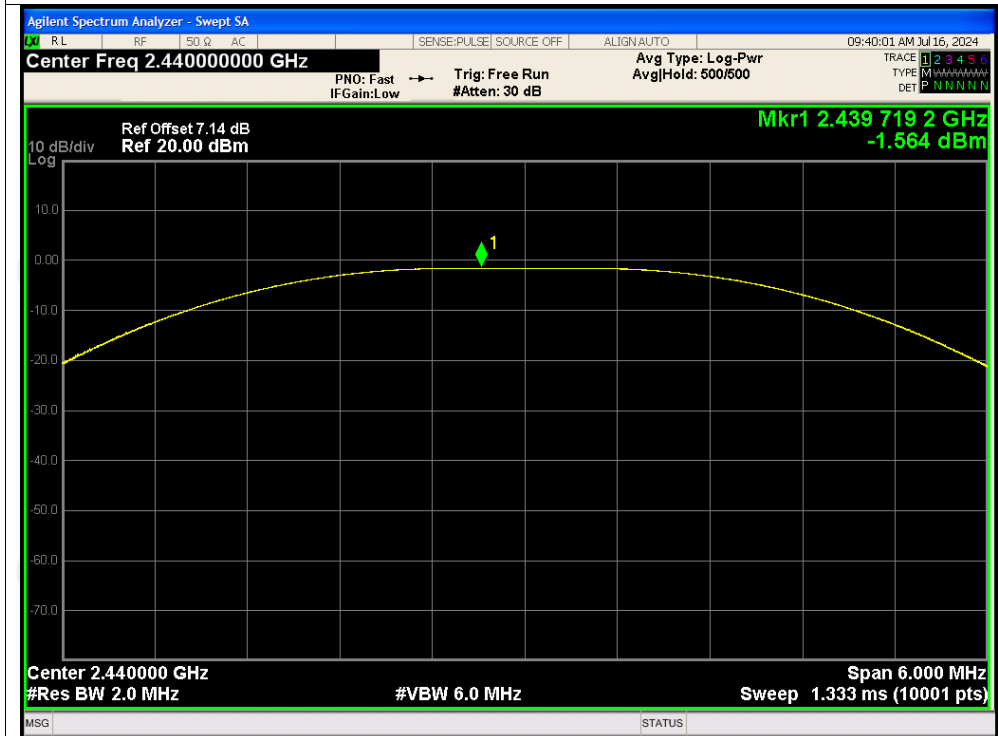
### Power NVNT BLE 1M 2480MHz



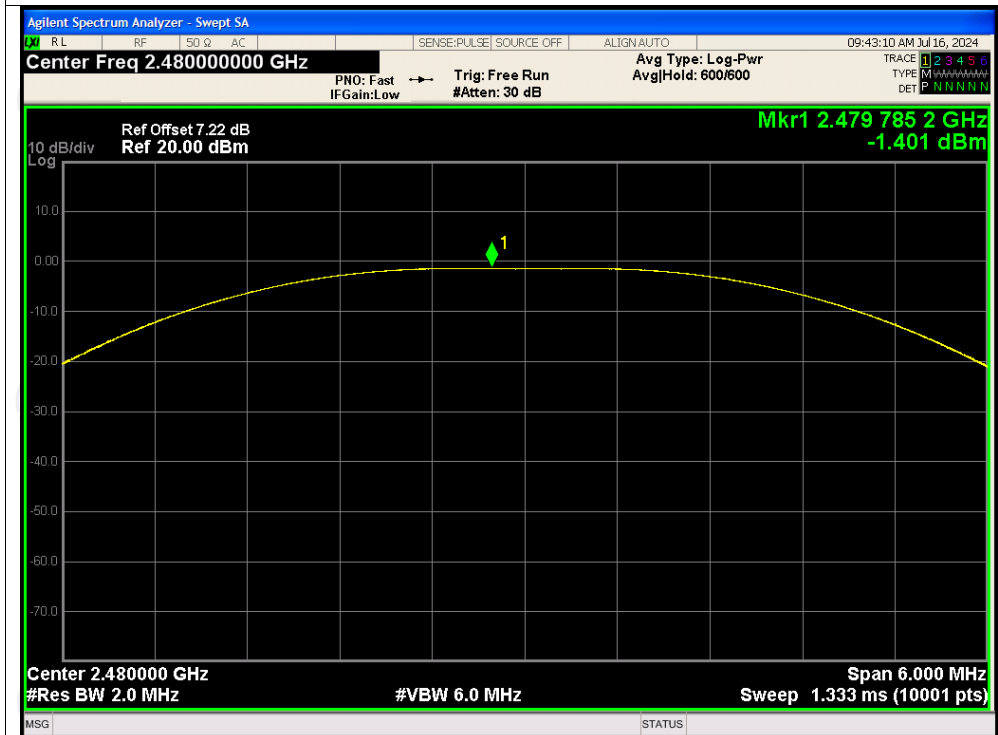
### Power NVNT BLE 2M 2402MHz



## Power NVNT BLE 2M 2440MHz



## Power NVNT BLE 2M 2480MHz

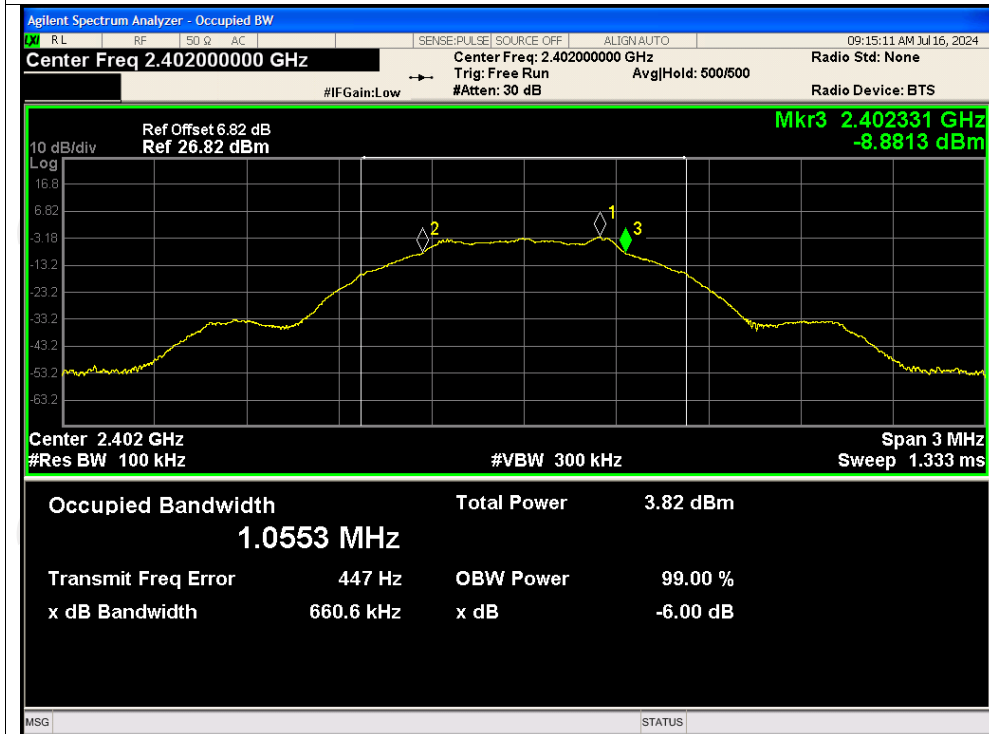


**-6dB Bandwidth**

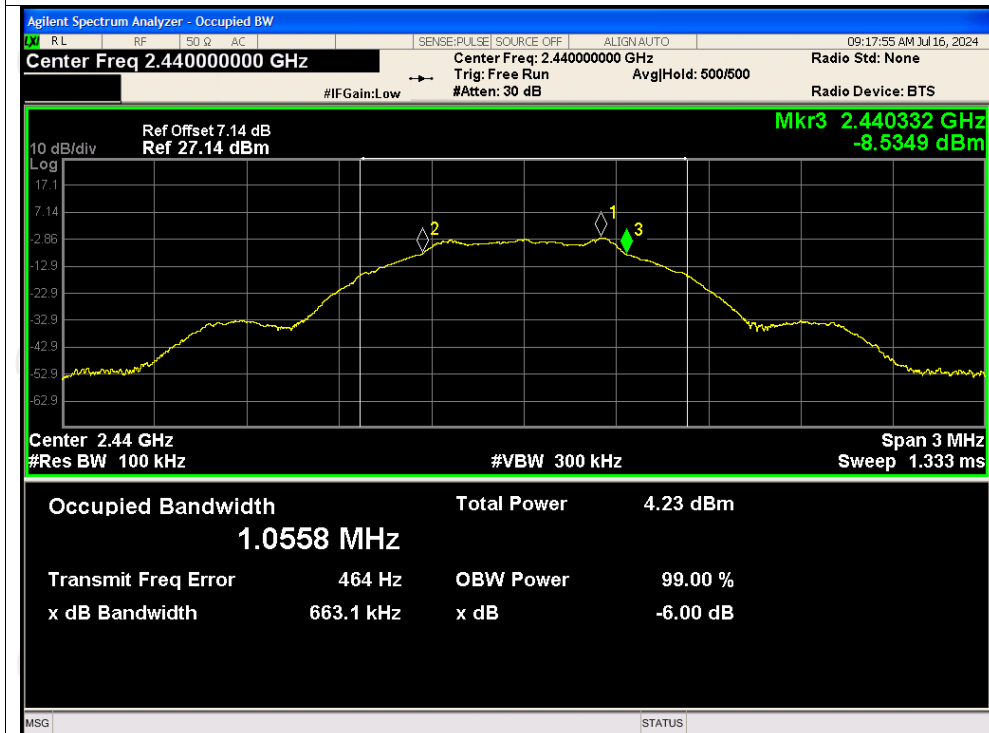
Condition	Mode	Frequency (MHz)	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE 1M	2402	0.661	0.5	Pass
NVNT	BLE 1M	2440	0.663	0.5	Pass
NVNT	BLE 1M	2480	0.682	0.5	Pass
NVNT	BLE 2M	2402	1.166	0.5	Pass
NVNT	BLE 2M	2440	1.160	0.5	Pass
NVNT	BLE 2M	2480	1.161	0.5	Pass

## Test Graphs

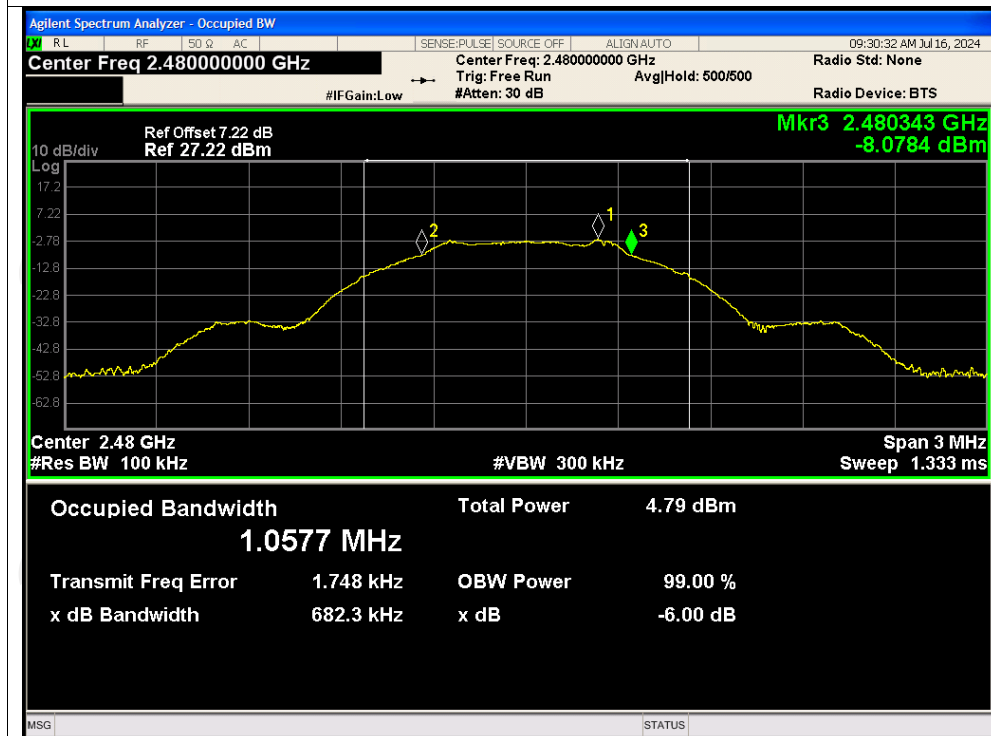
### -6dB Bandwidth NVNT BLE 1M 2402MHz



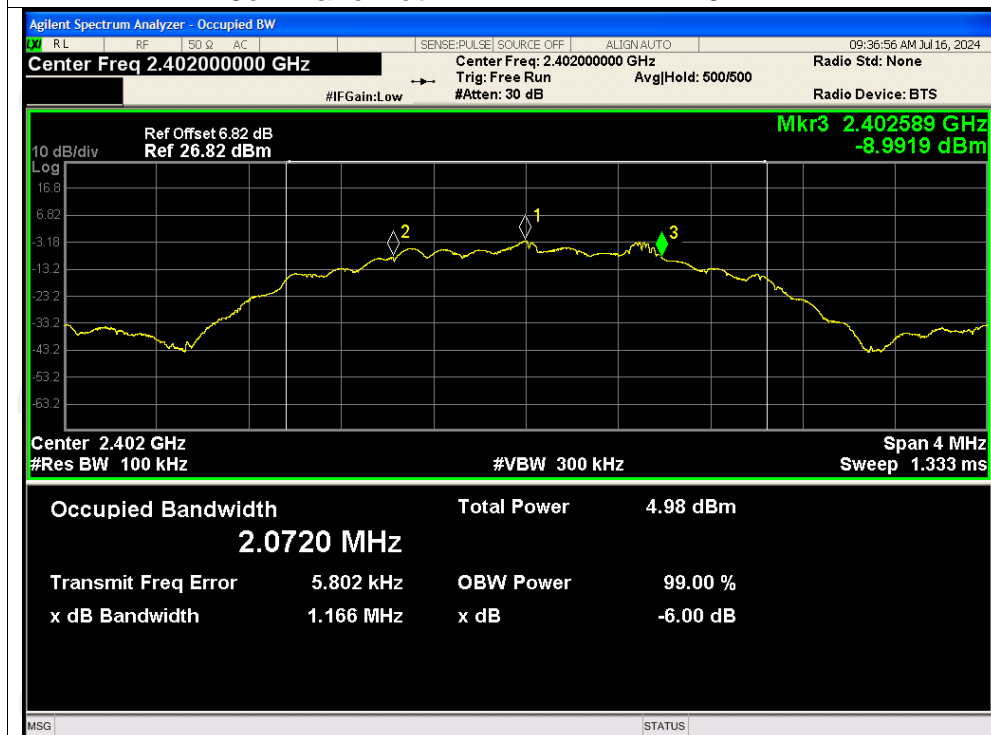
### -6dB Bandwidth NVNT BLE 1M 2440MHz

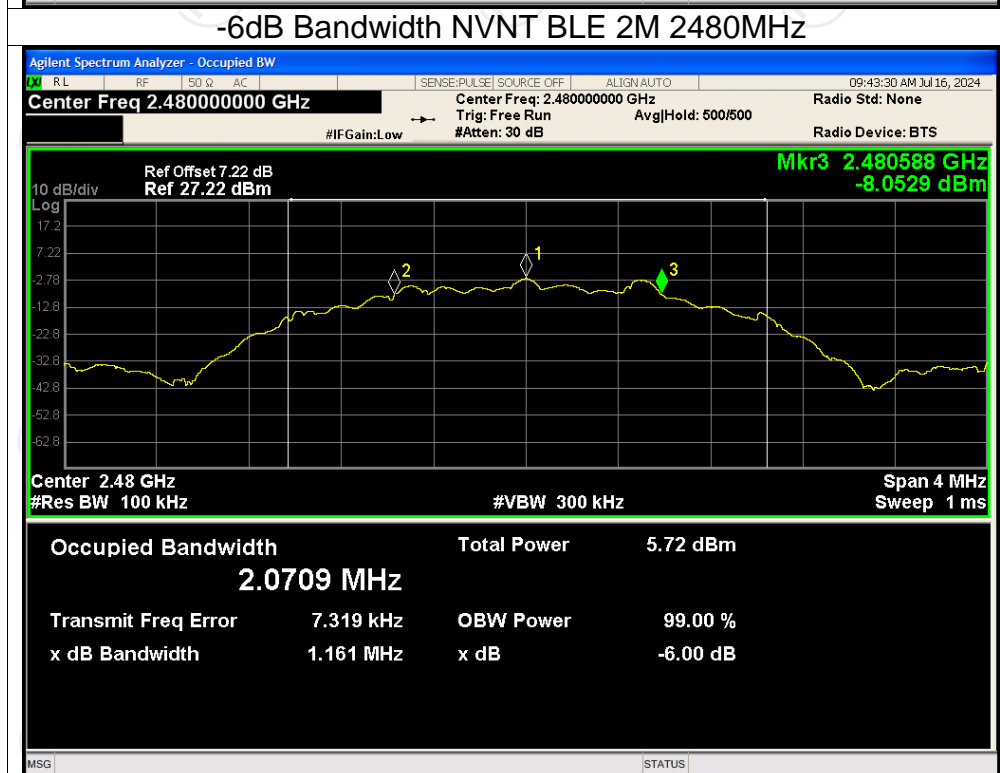
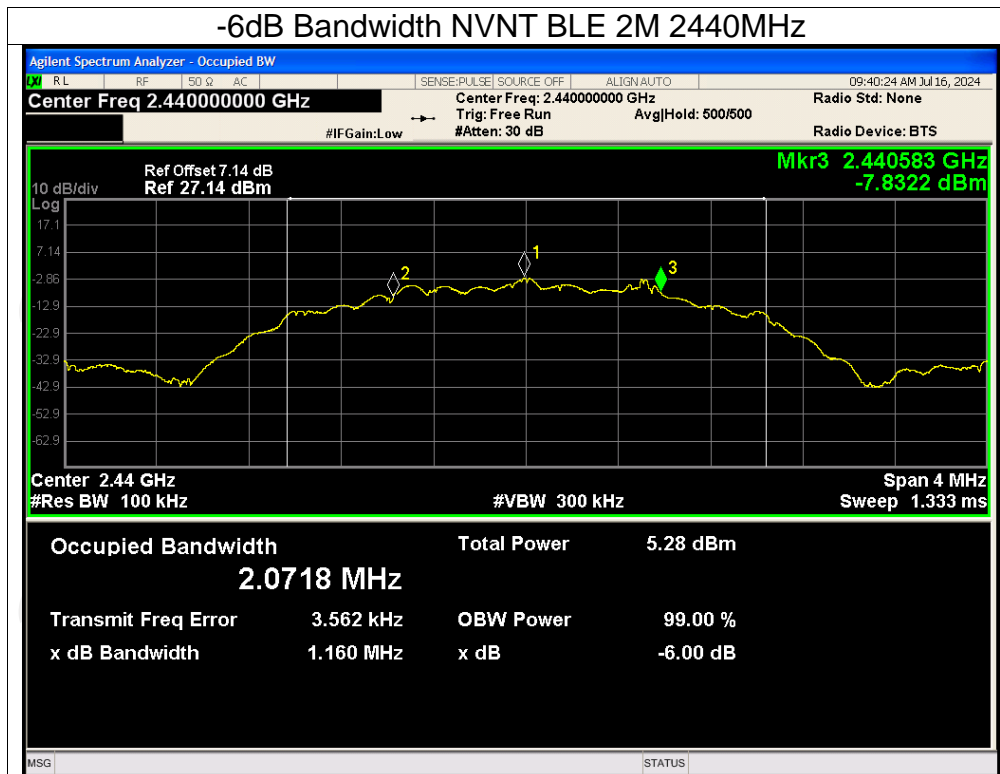


## -6dB Bandwidth NVNT BLE 1M 2480MHz



## -6dB Bandwidth NVNT BLE 2M 2402MHz





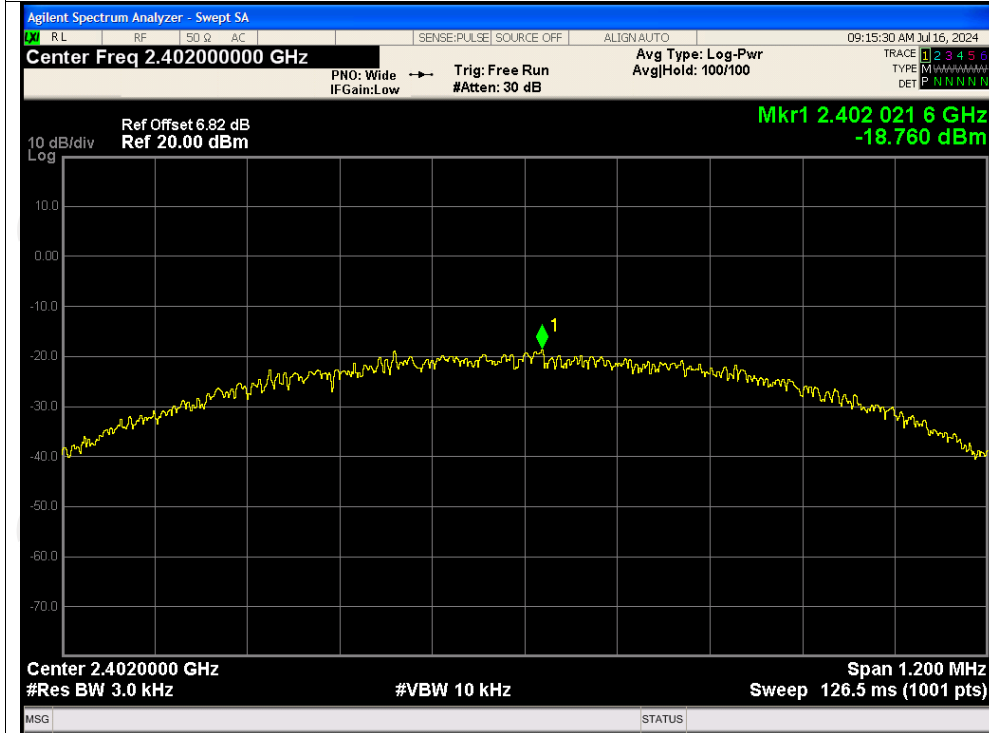
### Maximum Power Spectral Density Level

Condition	Mode	Frequency (MHz)	Conducted PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE 1M	2402	-18.76	8	Pass
NVNT	BLE 1M	2440	-18.37	8	Pass
NVNT	BLE 1M	2480	-17.68	8	Pass
NVNT	BLE 2M	2402	-20.66	8	Pass
NVNT	BLE 2M	2440	-20.28	8	Pass
NVNT	BLE 2M	2480	-20.15	8	Pass

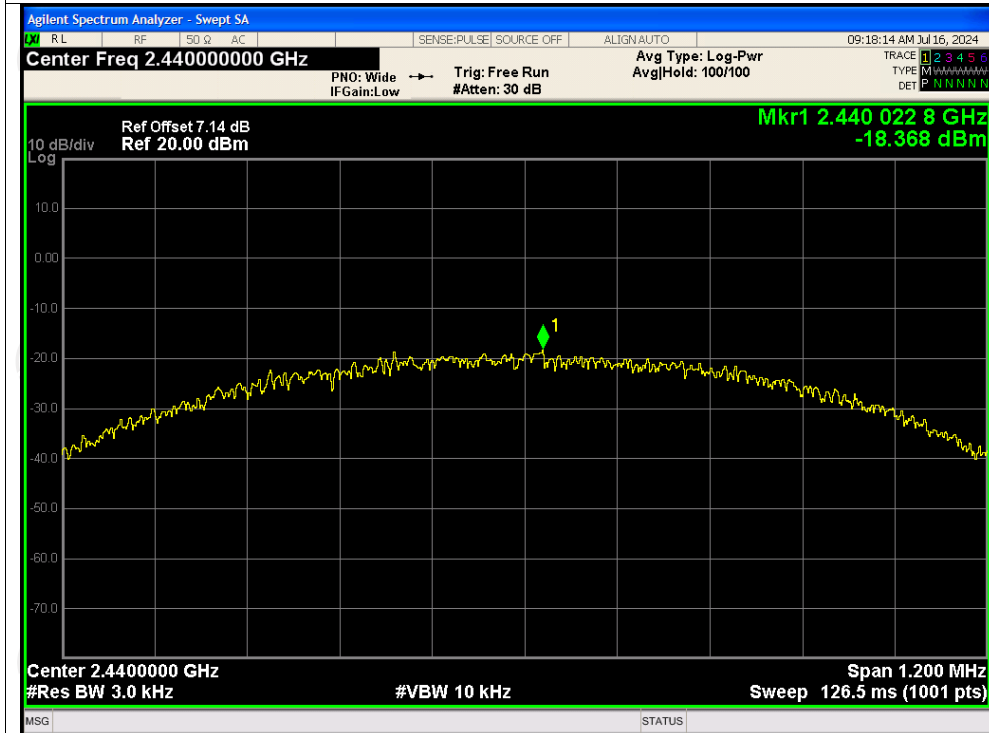


### Test Graphs

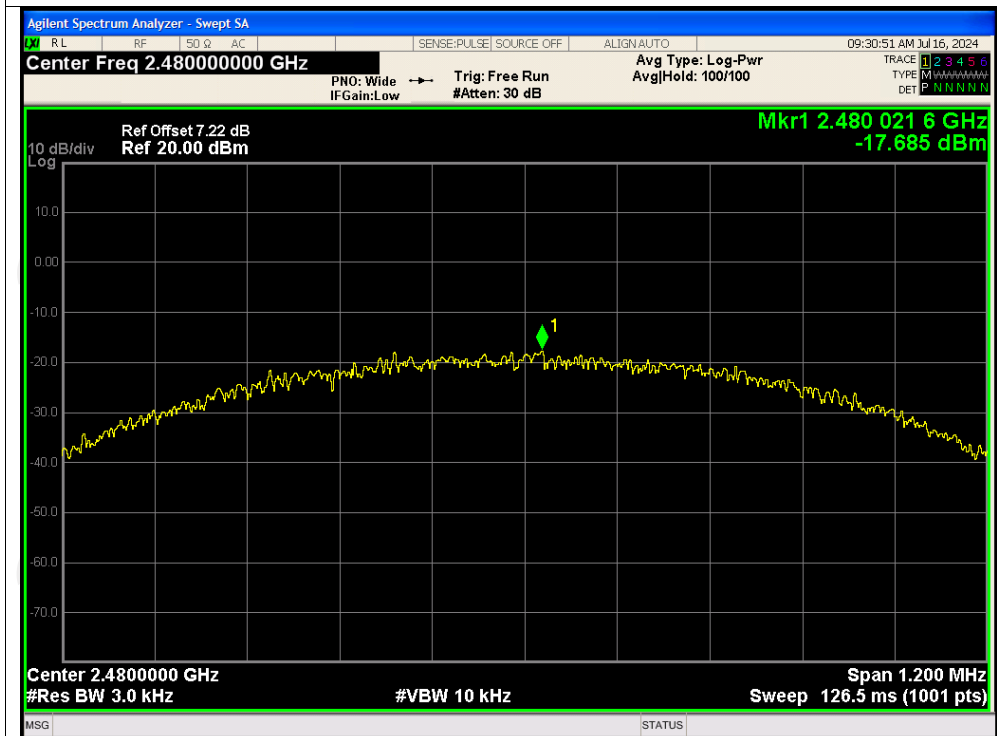
#### PSD NVNT BLE 1M 2402MHz



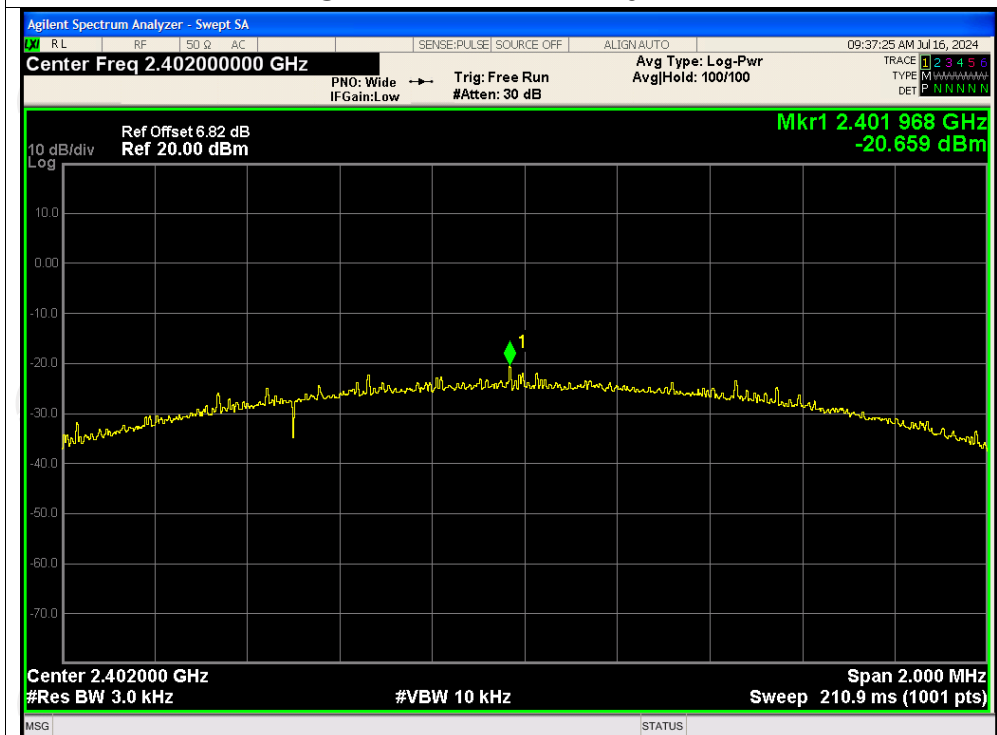
#### PSD NVNT BLE 1M 2440MHz

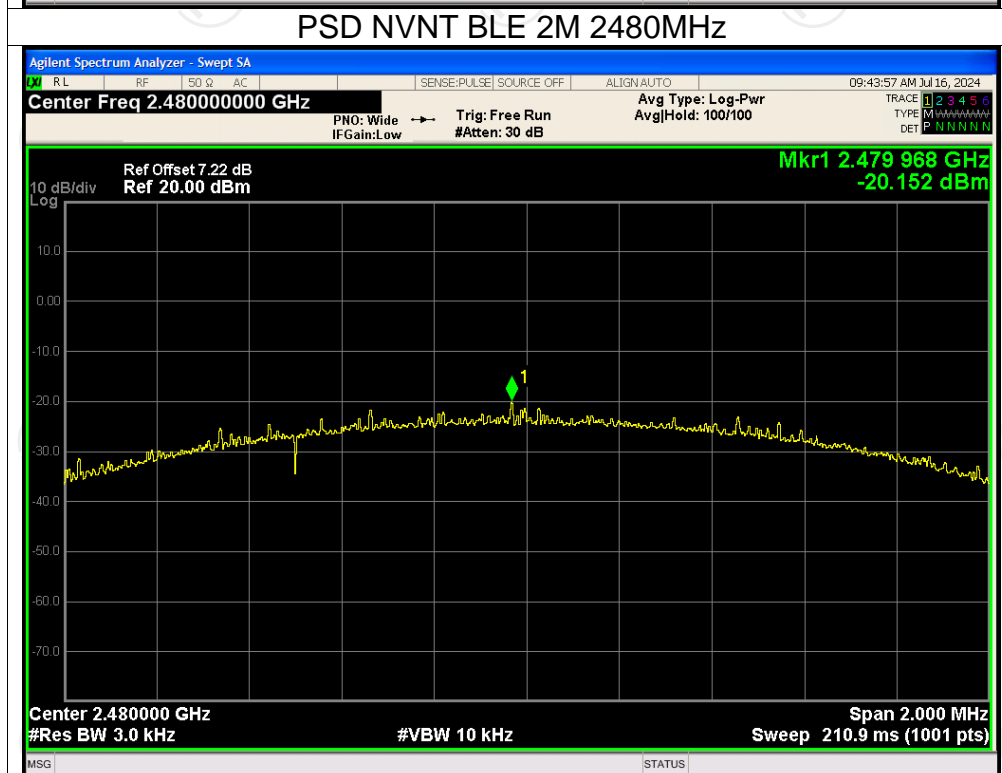
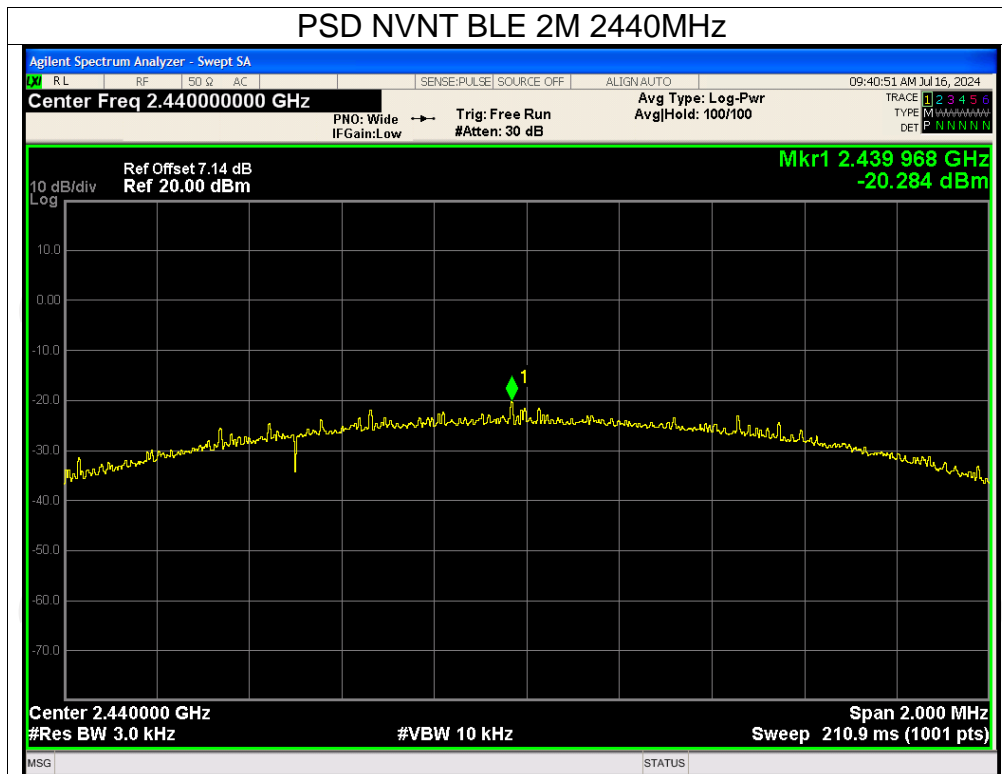


## PSD NVNT BLE 1M 2480MHz



## PSD NVNT BLE 2M 2402MHz



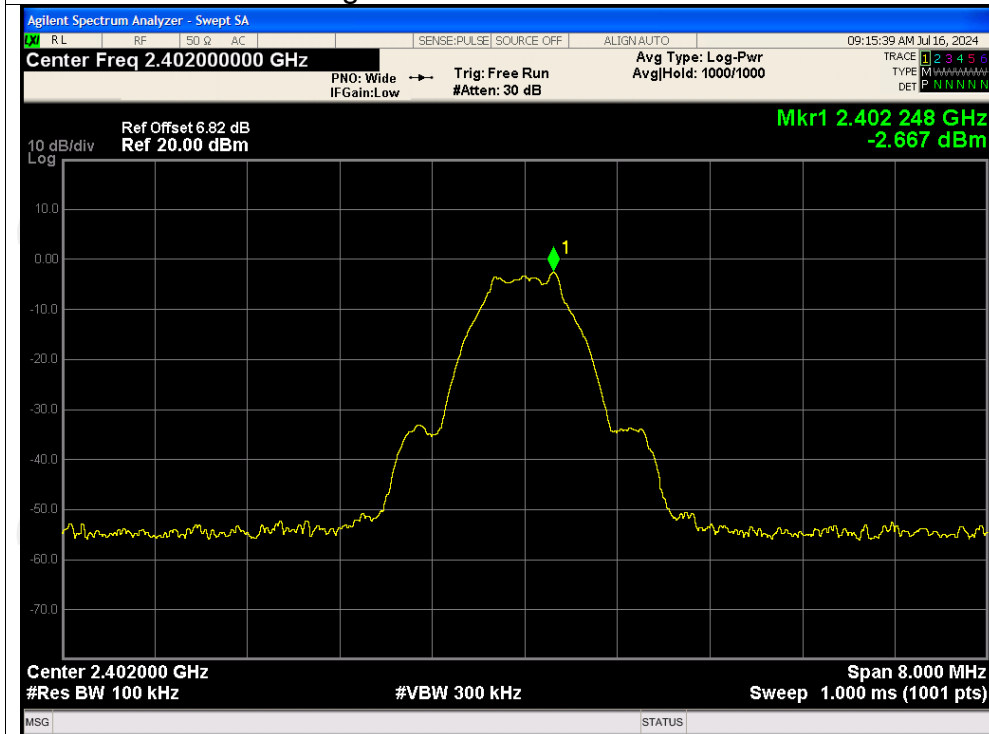


### Band Edge

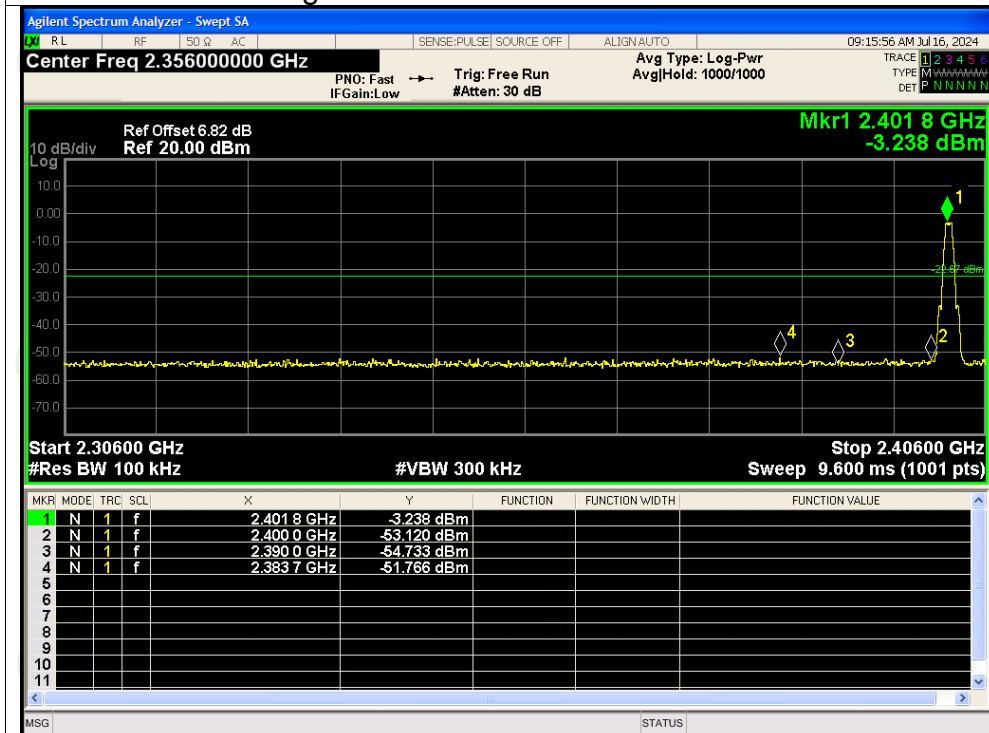
Condition	Mode	Frequency (MHz)	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	-49.09	-20	Pass
NVNT	BLE 1M	2480	-49.19	-20	Pass
NVNT	BLE 2M	2402	-48.05	-20	Pass
NVNT	BLE 2M	2480	-49.14	-20	Pass

### Test Graphs

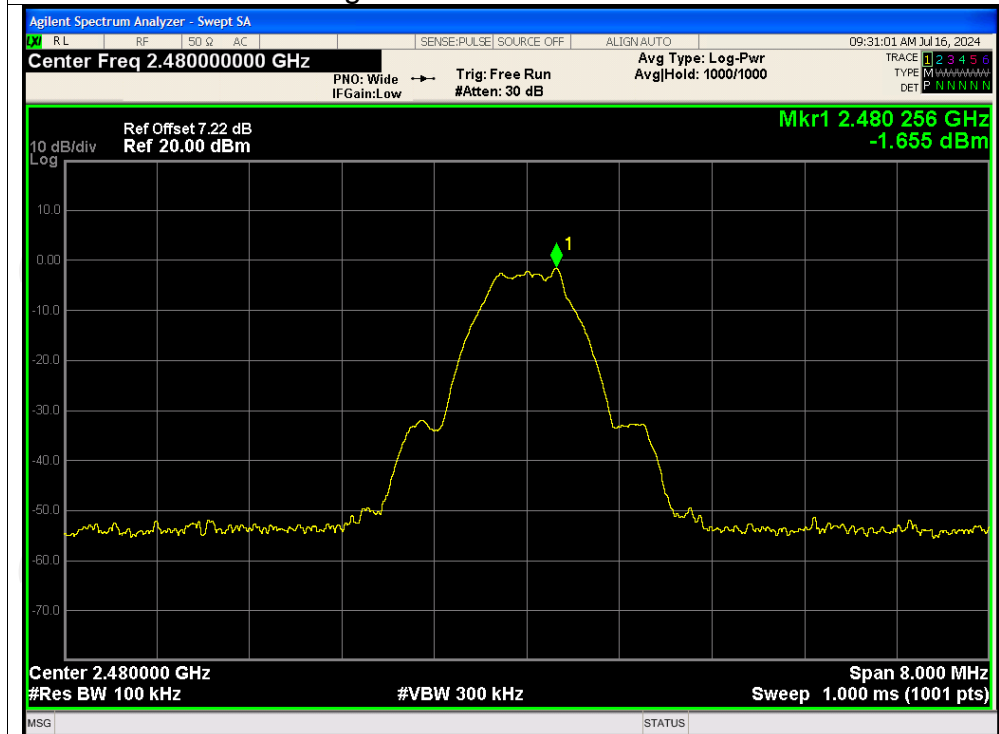
#### Band Edge NVNT BLE 1M 2402MHz Ref



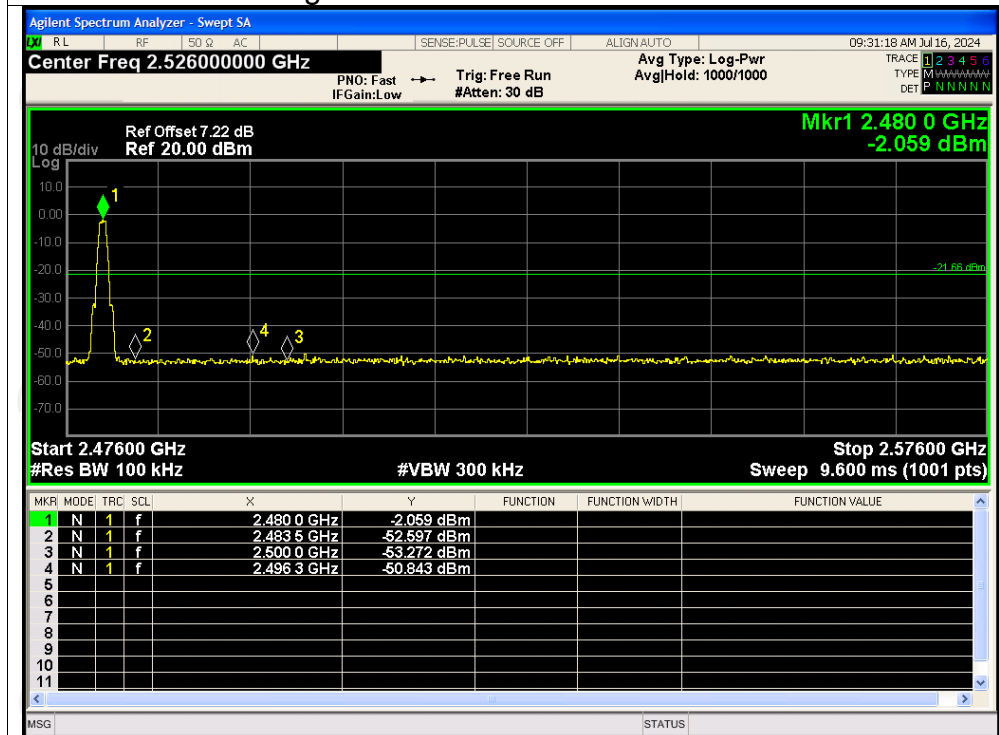
#### Band Edge NVNT BLE 1M 2402MHz Emission



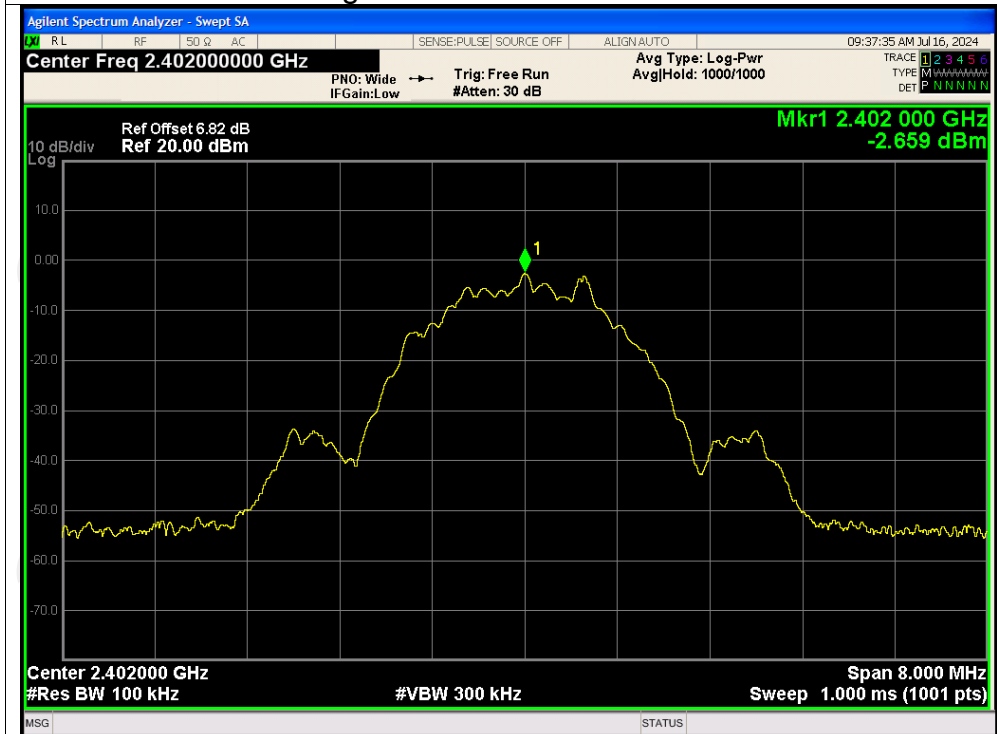
## Band Edge NVNT BLE 1M 2480MHz Ref



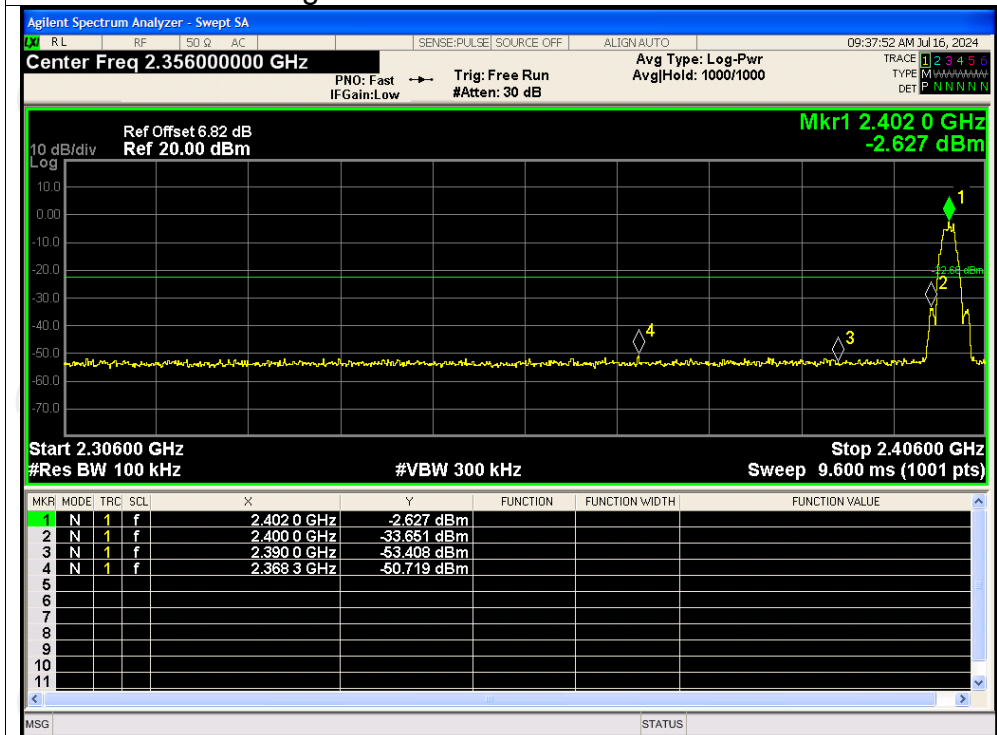
## Band Edge NVNT BLE 1M 2480MHz Emission



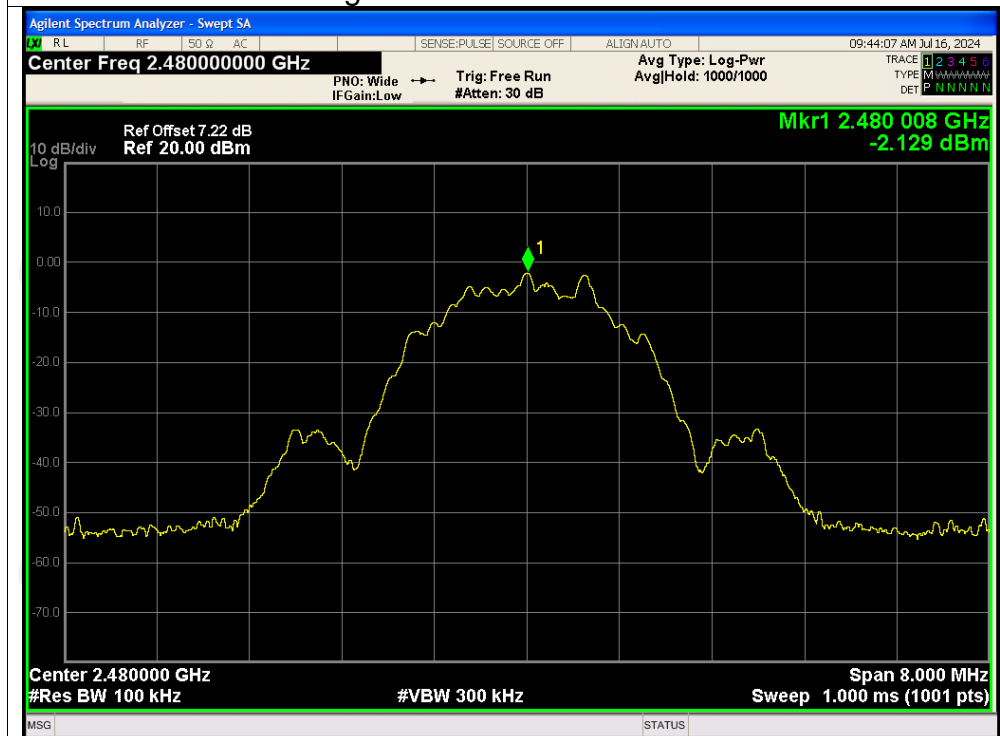
## Band Edge NVNT BLE 2M 2402MHz Ref



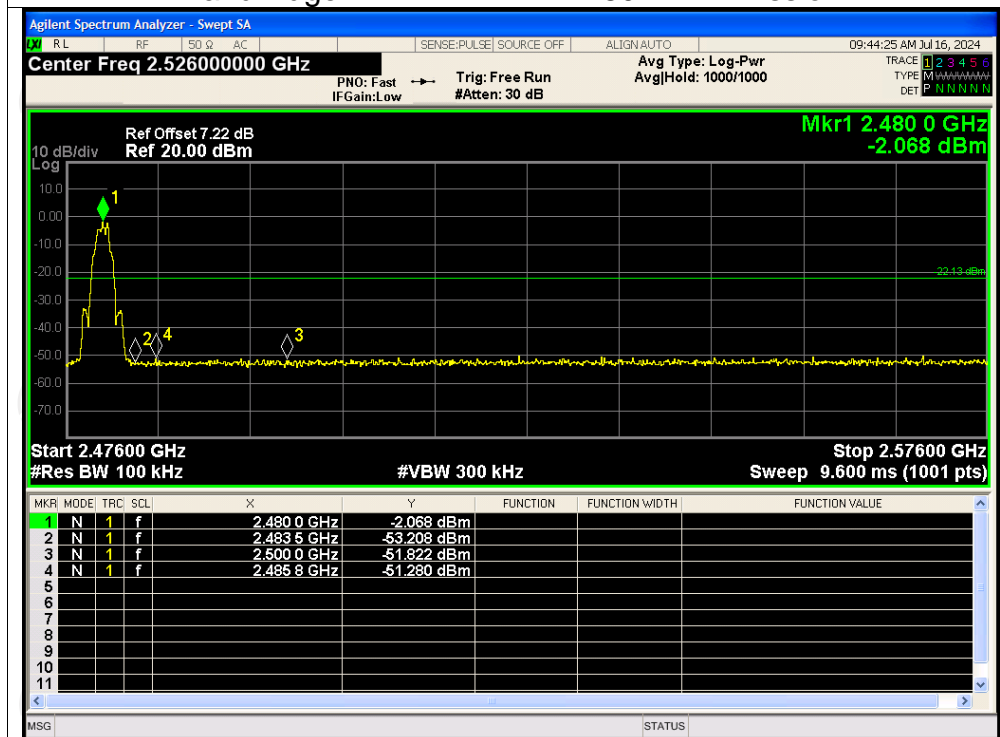
## Band Edge NVNT BLE 2M 2402MHz Emission



### Band Edge NVNT BLE 2M 2480MHz Ref



### Band Edge NVNT BLE 2M 2480MHz Emission



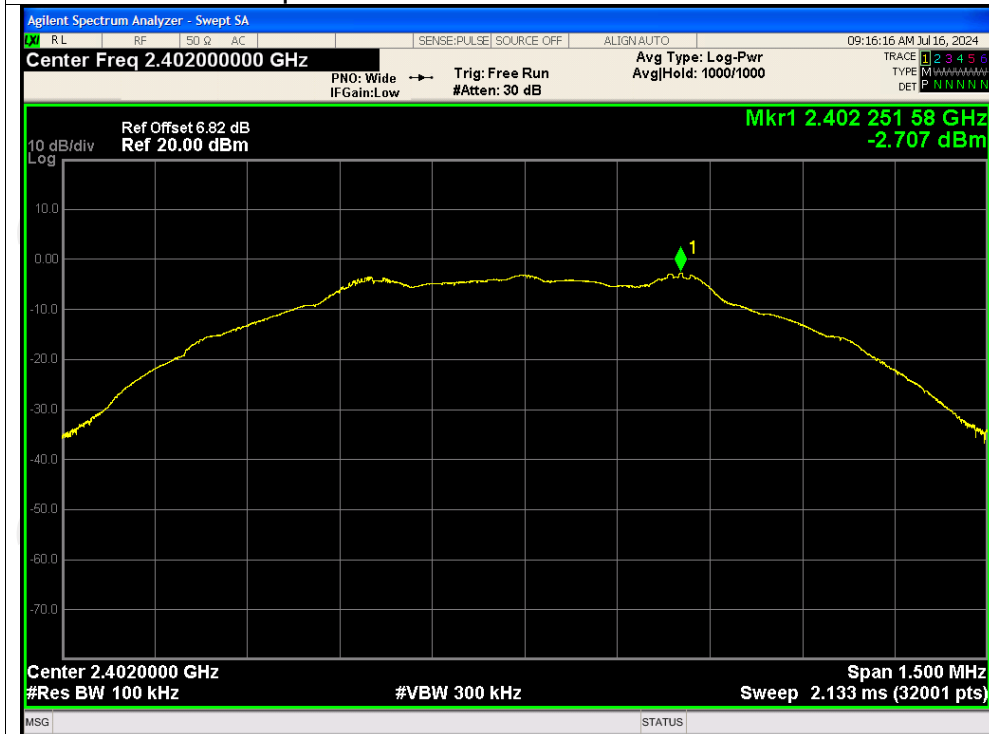


### Conducted RF Spurious Emission

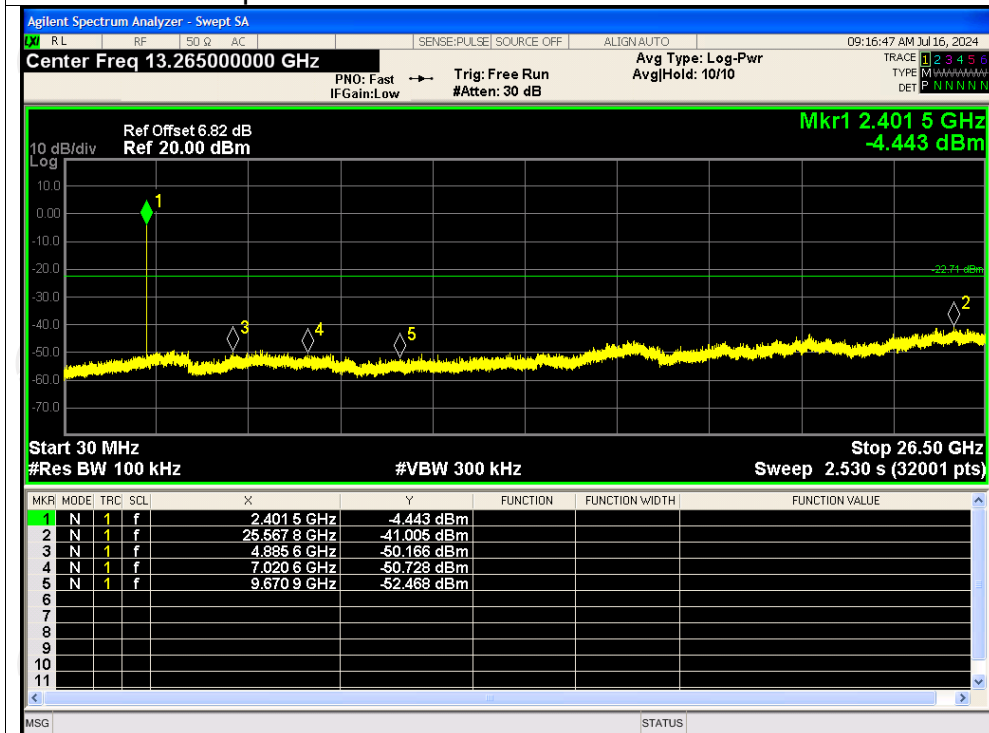
Condition	Mode	Frequency (MHz)	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	-38.29	-20	Pass
NVNT	BLE 1M	2440	-39.00	-20	Pass
NVNT	BLE 1M	2480	-38.44	-20	Pass
NVNT	BLE 2M	2402	-37.84	-20	Pass
NVNT	BLE 2M	2440	-37.97	-20	Pass
NVNT	BLE 2M	2480	-37.60	-20	Pass

## Test Graphs

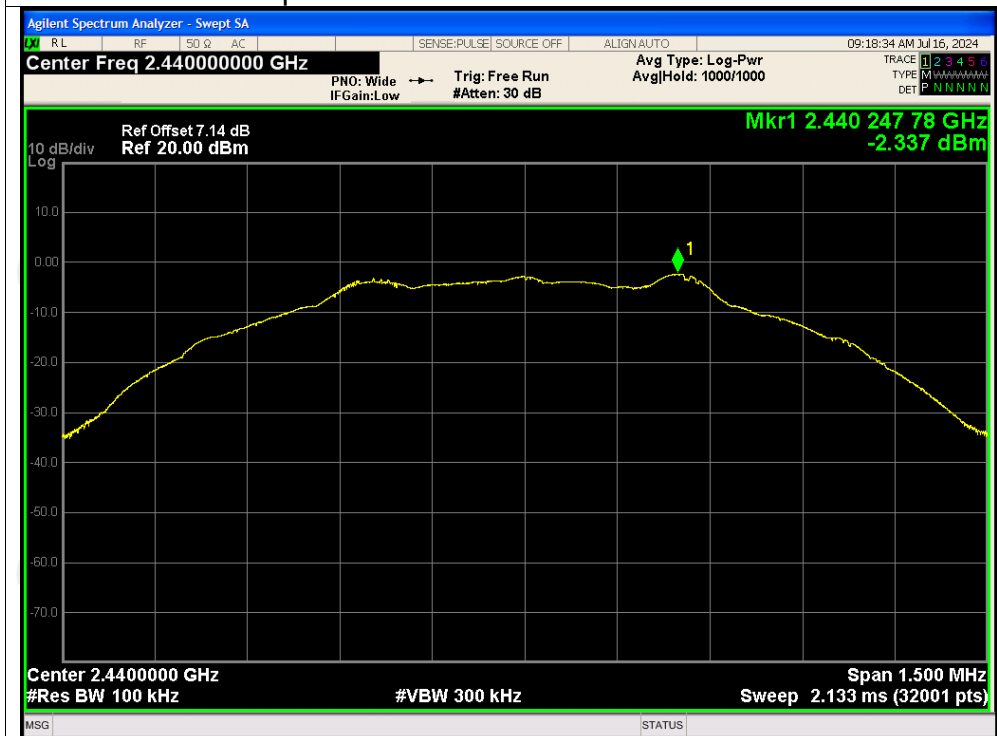
### Tx. Spurious NVNT BLE 1M 2402MHz Ref



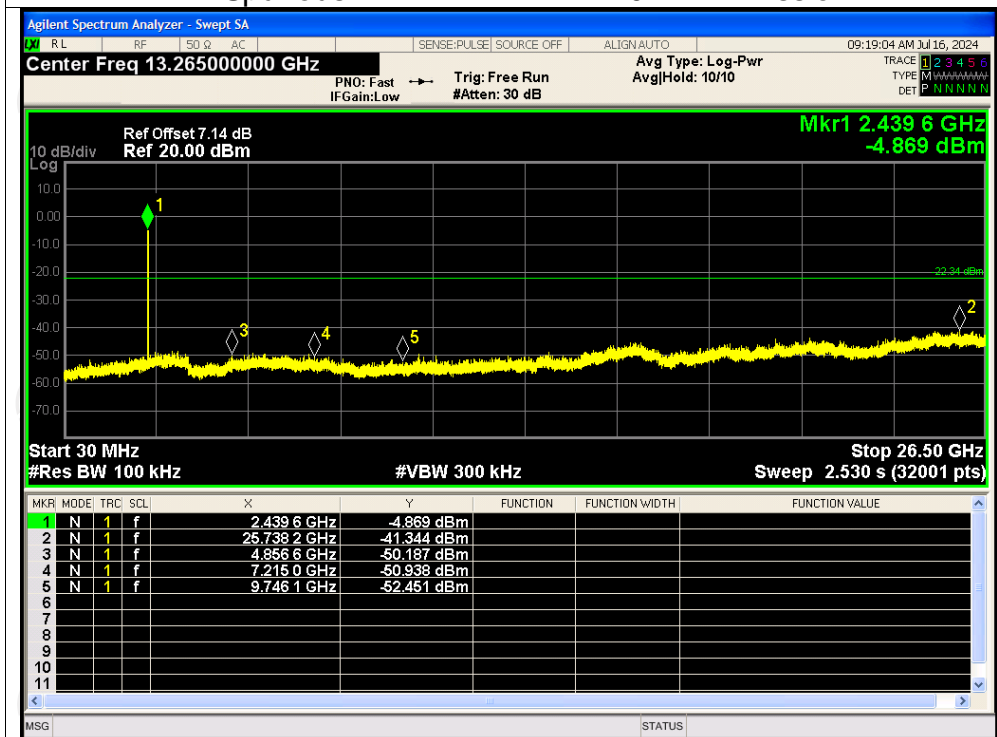
### Tx. Spurious NVNT BLE 1M 2402MHz Emission



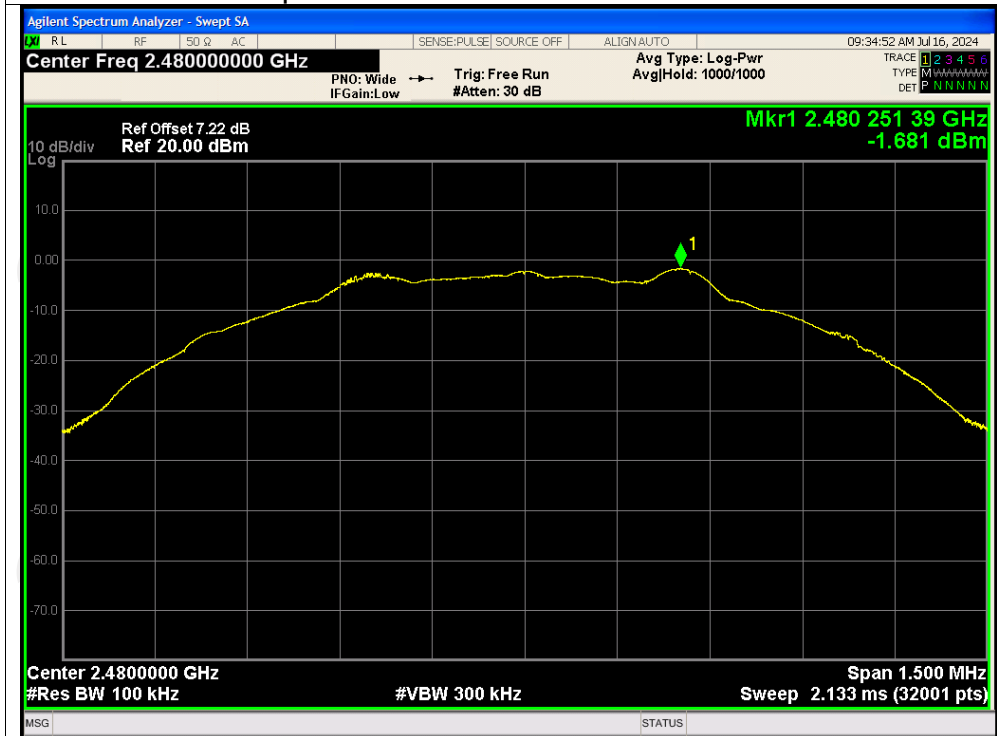
## Tx. Spurious NVNT BLE 1M 2440MHz Ref



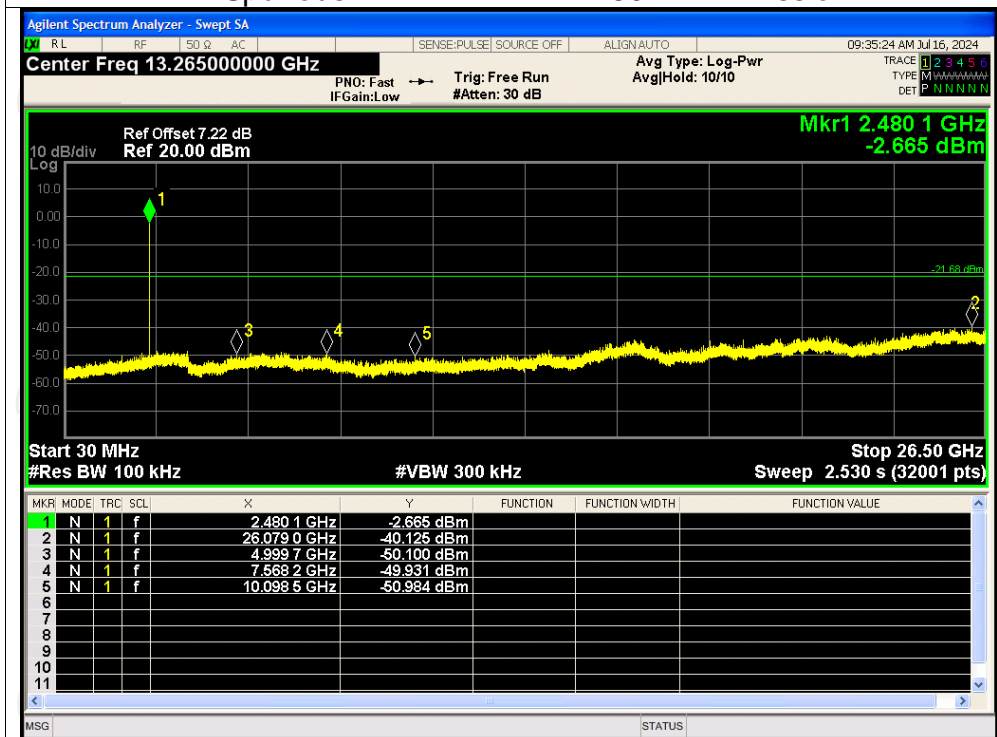
## Tx. Spurious NVNT BLE 1M 2440MHz Emission



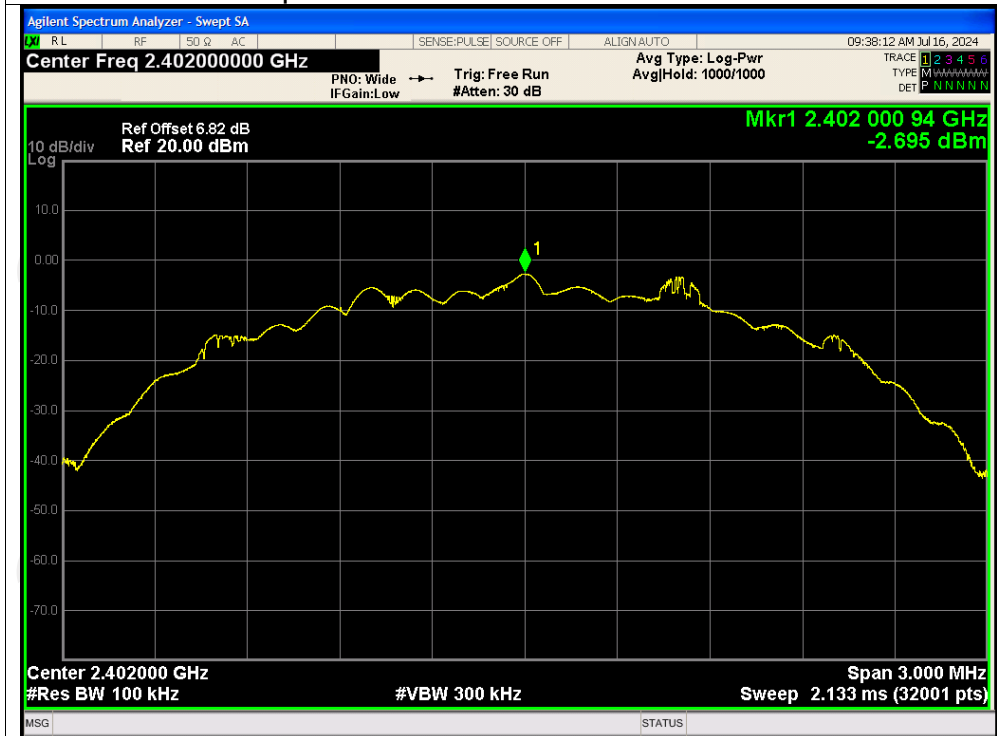
## Tx. Spurious NVNT BLE 1M 2480MHz Ref



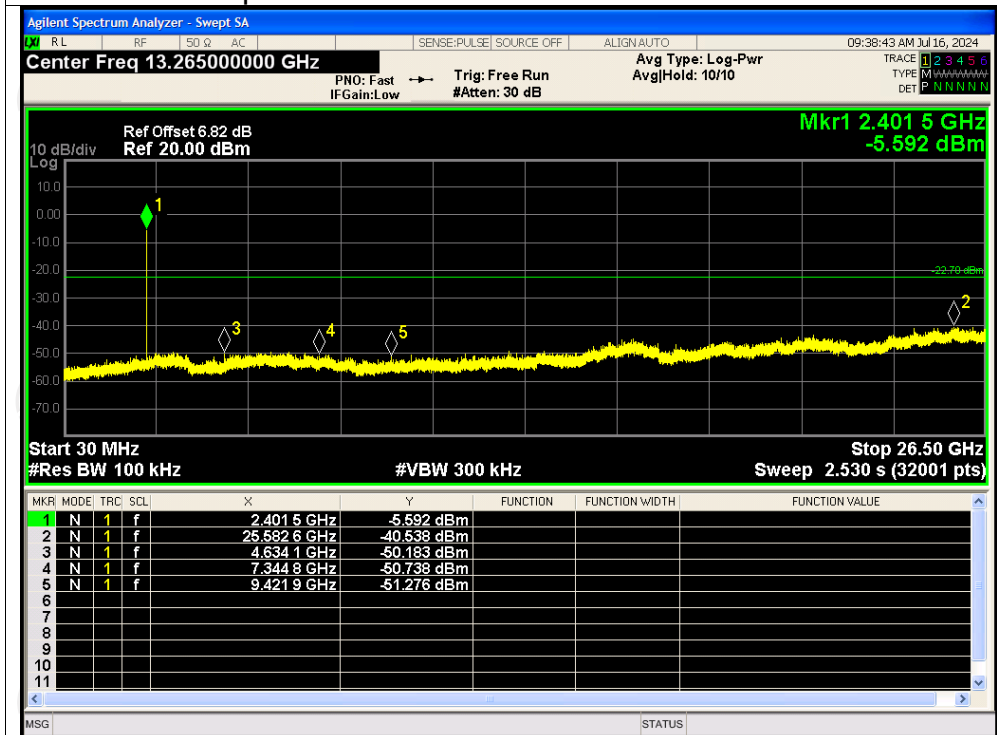
## Tx. Spurious NVNT BLE 1M 2480MHz Emission



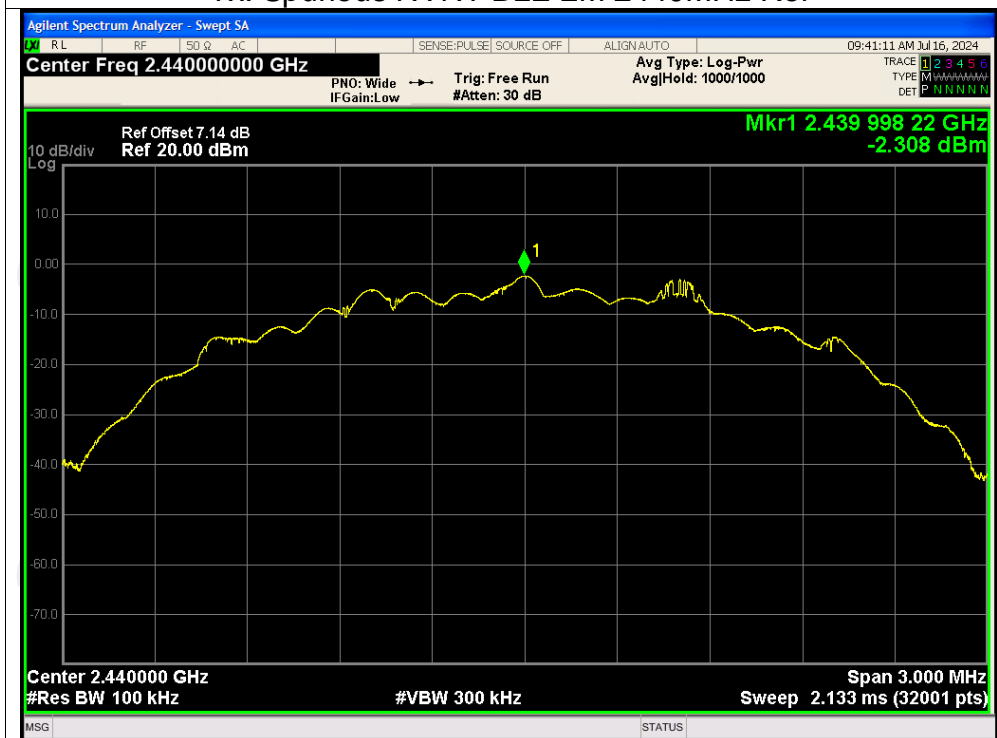
## Tx. Spurious NVNT BLE 2M 2402MHz Ref



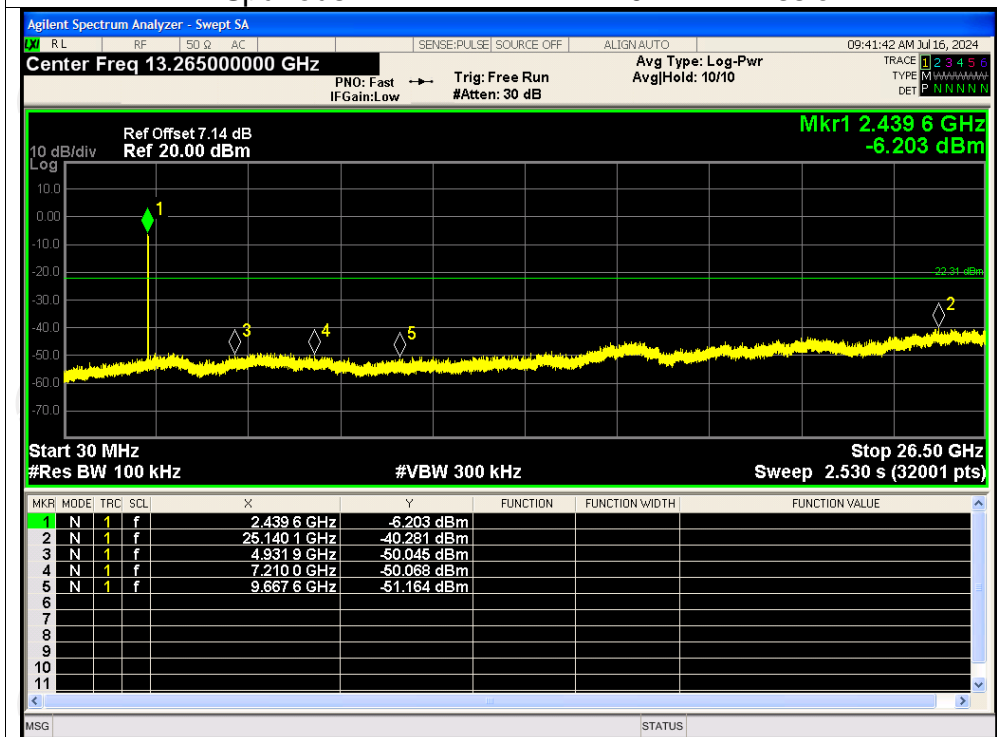
## Tx. Spurious NVNT BLE 2M 2402MHz Emission



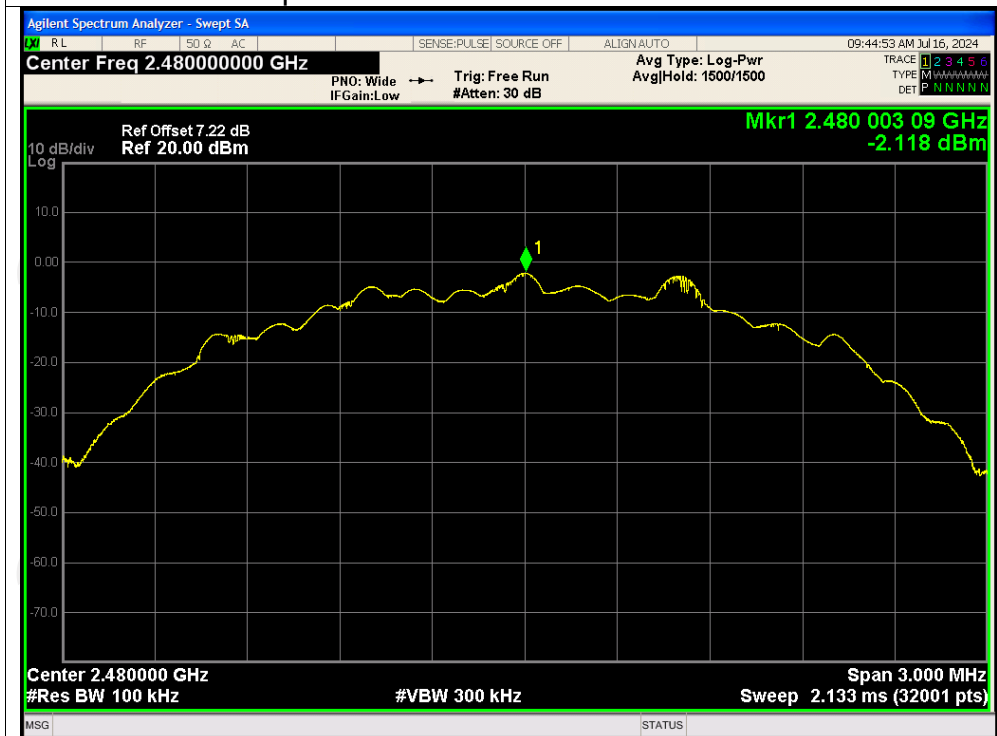
## Tx. Spurious NVNT BLE 2M 2440MHz Ref



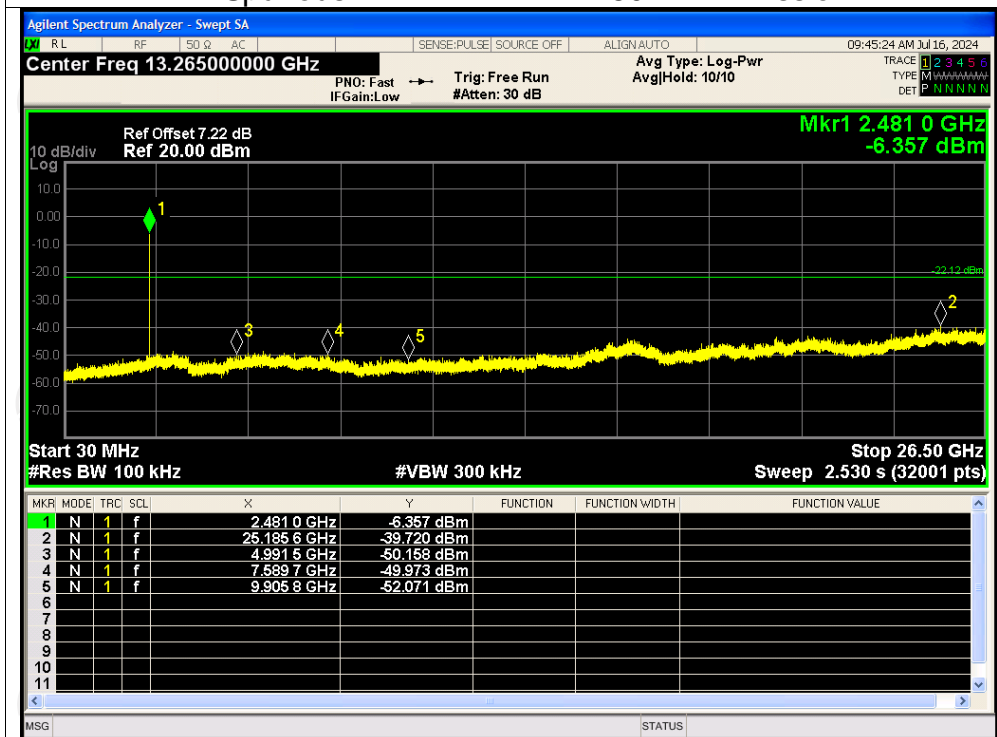
## Tx. Spurious NVNT BLE 2M 2440MHz Emission



## Tx. Spurious NVNT BLE 2M 2480MHz Ref



## Tx. Spurious NVNT BLE 2M 2480MHz Emission



## Appendix B: Photographs of Test Setup

Refer to the test report No. TCT240712E022

## Appendix C: Photographs of EUT

Refer to the test report No. TCT240712E022

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