

10. Maximum Conducted Output Power

10.1 Block Diagram Of Test Setup



10.2 Limit

According to FCC §15.407

The maximum conducted output power should not exceed:

Frequency Band(MHz)	Limit
5150~5250	250mW
5725~5850	1W

10.3 Test Procedure

Maximum conducted output power may be measured using a spectrum analyzer/EMI receiver or an RF power meter.

1. Device Configuration

If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level (see section II.B.).

a) The intent is to test at 100 percent duty cycle; however a small reduction in duty cycle (to no lower than 98 percent) is permitted if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

b) If continuous transmission (or at least 98 percent duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level with the transmit duration as long as possible and the duty cycle as high as possible.

2. Measurement using a Spectrum Analyzer or EMI Receiver (SA)

Measurement of maximum conducted output power using a spectrum analyzer requires integrating the spectrum across a frequency span that encompasses, at a minimum, either the EBW or the 99-percent occupied bandwidth of the signal.¹ However, the EBW must be used to determine bandwidth dependent limits on maximum conducted output power in accordance with § 15.407(a).

a) The test method shall be selected as follows: (i) Method SA-1 or SA-1 Alternative (averaging with the EUT transmitting at full power throughout each sweep) shall be applied if either of the following conditions can be satisfied:

- The EUT transmits continuously (or with a duty cycle \geq 98 percent).
- Sweep triggering or gating can be implemented in a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep (with the analyzer configured as in Method SA-1, below) is equal to or shorter than the duration T of each transmission from the EUT and if those transmissions exhibit full power throughout their durations.

(ii) Method SA-2 or SA-2 Alternative (averaging across on and off times of the EUT transmissions, followed by duty cycle correction) shall be applied if the conditions of (i) cannot be achieved and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than \pm 2 percent.

(iii) Method SA-3 (RMS detection with max hold) or SA-3 Alternative (reduced VBW with max hold) shall be applied if the conditions of (i) and (ii) cannot be achieved.

b) Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep): (i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(ii) Set RBW = 1 MHz.

(iii) Set VBW \geq 3 MHz.

(iv) Number of points in sweep \geq 2 Span / RBW. (This ensures that bin-to-bin spacing is \leq RBW/2, so that narrowband signals are not lost between frequency bins.)

(v) Sweep time = auto.

(vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.

(vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle \geq 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run".

(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.

(ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum

10.4 EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

10.5 Test Result

Temperature :	26 °C	Relative Humidity :	54%
Pressure :	101kPa	Test Voltage :	DC 5V
Test Mode :	TX (5G) Mode Frequency U-NII-1 (5180-5240MHz)		

Test Mode	Test Channel	Frequency (MHz)	Maximum output power. Antenna port (AV)			Limit dBm	Result
			ANT A(dBm)	ANT B(dBm)	Total(dBm)		
TX 802.11a Mode	CH36	5180	5.08	4.9	/	24	Pass
	CH40	5200	4.89	5.04	/	24	Pass
	CH48	5240	4.43	3.93	/	24	Pass
TX 802.11 n20M Mode	CH36	5180	3.49	3.74	6.63	24	Pass
	CH40	5200	3.32	3.06	6.20	24	Pass
	CH48	5240	3.02	2.51	5.78	24	Pass
TX 802.11 n40M Mode	CH38	5190	3.04	2.96	6.01	24	Pass
	CH46	5230	2.87	2.36	5.63	24	Pass
TX 802.11 ac20M Mode	CH36	5180	3.65	3.61	6.64	24	Pass
	CH40	5200	2.44	2.27	5.37	24	Pass
	CH48	5240	3.51	3.39	6.46	24	Pass
TX 802.11 ac40M Mode	CH38	5190	1.39	2.21	4.83	24	Pass
	CH46	5230	1.4	1.52	4.47	24	Pass
TX 802.11 ac80M Mode	CH42	5210	-0.57	-0.22	2.62	24	Pass
TX 802.11 ax20M Mode	CH36	5180	2.59	2.02	5.32	24	Pass
	CH40	5200	2.38	1.83	5.12	24	Pass
	CH48	5240	1.4	1.79	4.61	24	Pass
TX 802.11 ax40M Mode	CH38	5190	1.29	1.06	4.19	24	Pass
	CH46	5230	0.68	1.45	4.09	24	Pass
TX 802.11 ax80M Mode	CH42	5210	0.22	0.18	3.21	24	Pass

Temperature :	26 °C	Relative Humidity :	54%
Pressure :	101kPa	Test Voltage :	DC 5V
Test Mode :	TX (5G) Mode Frequency U-NII-3 (5745-5825MHz)		

Test Mode	Test Channel	Frequency	Maximum output power. Antenna port (AV)			Limit	Result
		(MHz)	ANT A(dBm)	ANT B(dBm)	Total(dBm)		
TX 802.11a Mode	CH 149	5745	5.29	5.66	/	30	Pass
	CH 157	5785	4.93	5.24	/	30	Pass
	CH 165	5825	4.36	4.17	/	30	Pass
TX 802.11 n20M Mode	CH 149	5745	3.9	3.58	6.75	30	Pass
	CH 157	5785	3.21	3.03	6.13	30	Pass
	CH 165	5825	2.02	1.72	4.88	30	Pass
TX 802.11 n40M Mode	CH 151	5755	3.12	3.07	6.11	30	Pass
	CH 159	5795	3.52	1.51	5.64	30	Pass
TX 802.11 ac20M Mode	CH 151	5755	4.04	3.6	6.84	30	Pass
	CH 159	5795	2.67	2.57	5.63	30	Pass
	CH 151	5755	2.14	1.78	4.97	30	Pass
TX 802.11 ac40M Mode	CH 151	5755	3.3	3.35	6.34	30	Pass
	CH 159	5795	3.01	3.36	6.20	30	Pass
TX 802.11 ac80M Mode	CH 155	5775	0.6	0.32	3.47	30	Pass
TX 802.11 ax20M Mode	CH 151	5755	2.54	2.2	5.38	30	Pass
	CH 159	5795	2.85	2.66	5.77	30	Pass
	CH 151	5755	2.35	2.9	5.64	30	Pass
TX 802.11 ax40M Mode	CH 151	5755	1.57	0.94	4.28	30	Pass
	CH 159	5795	1.54	1.26	4.41	30	Pass
TX 802.11 ax80M Mode	CH 155	5775	0.39	0.03	3.22	30	Pass

11. Out Of Band Emissions

11.1 Block Diagram Of Test Setup



11.2 Limit

According to FCC §15.407(b)

Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

11.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz with a convenient frequency span.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

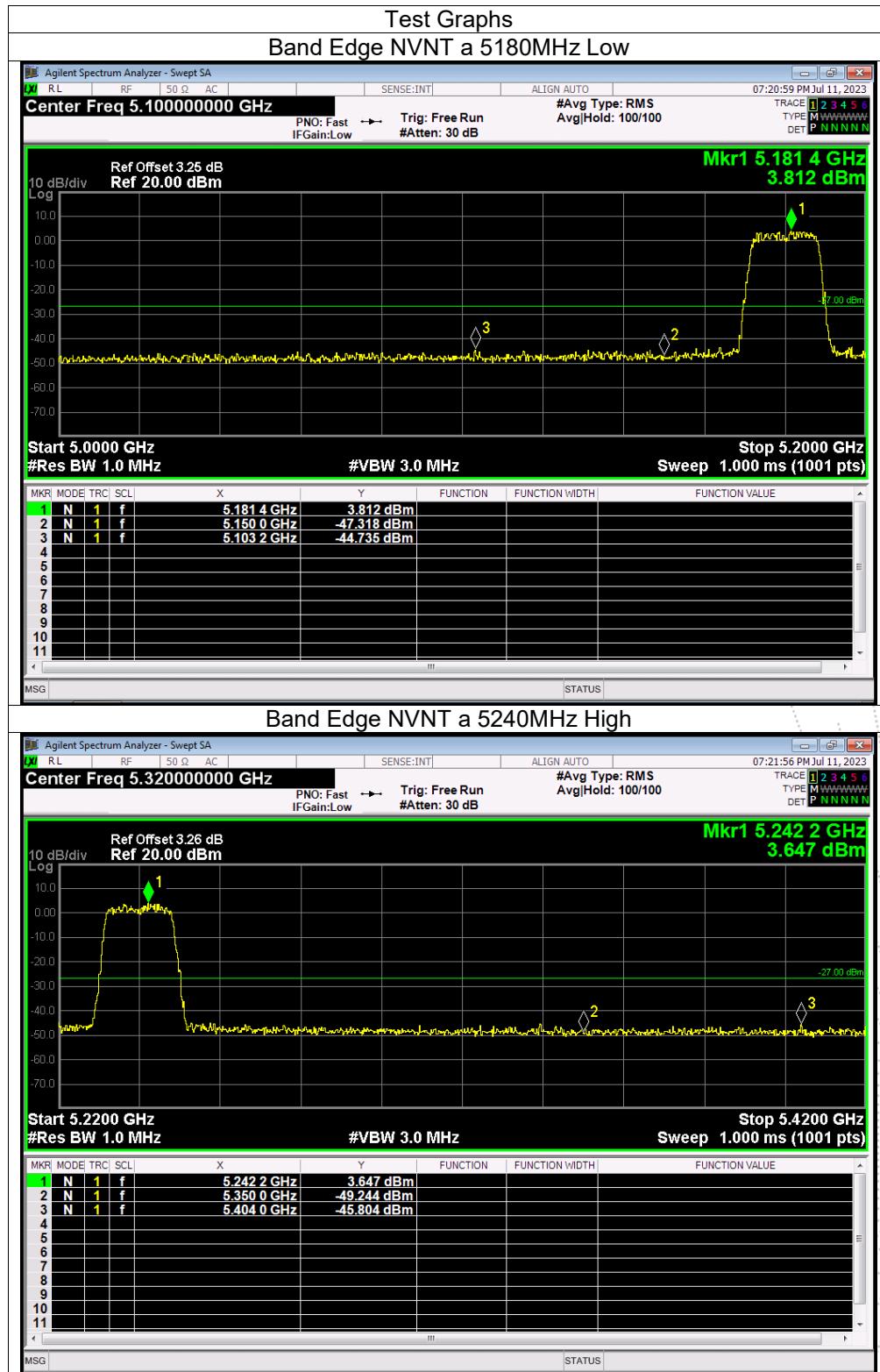
11.4 EUT Operating Conditions

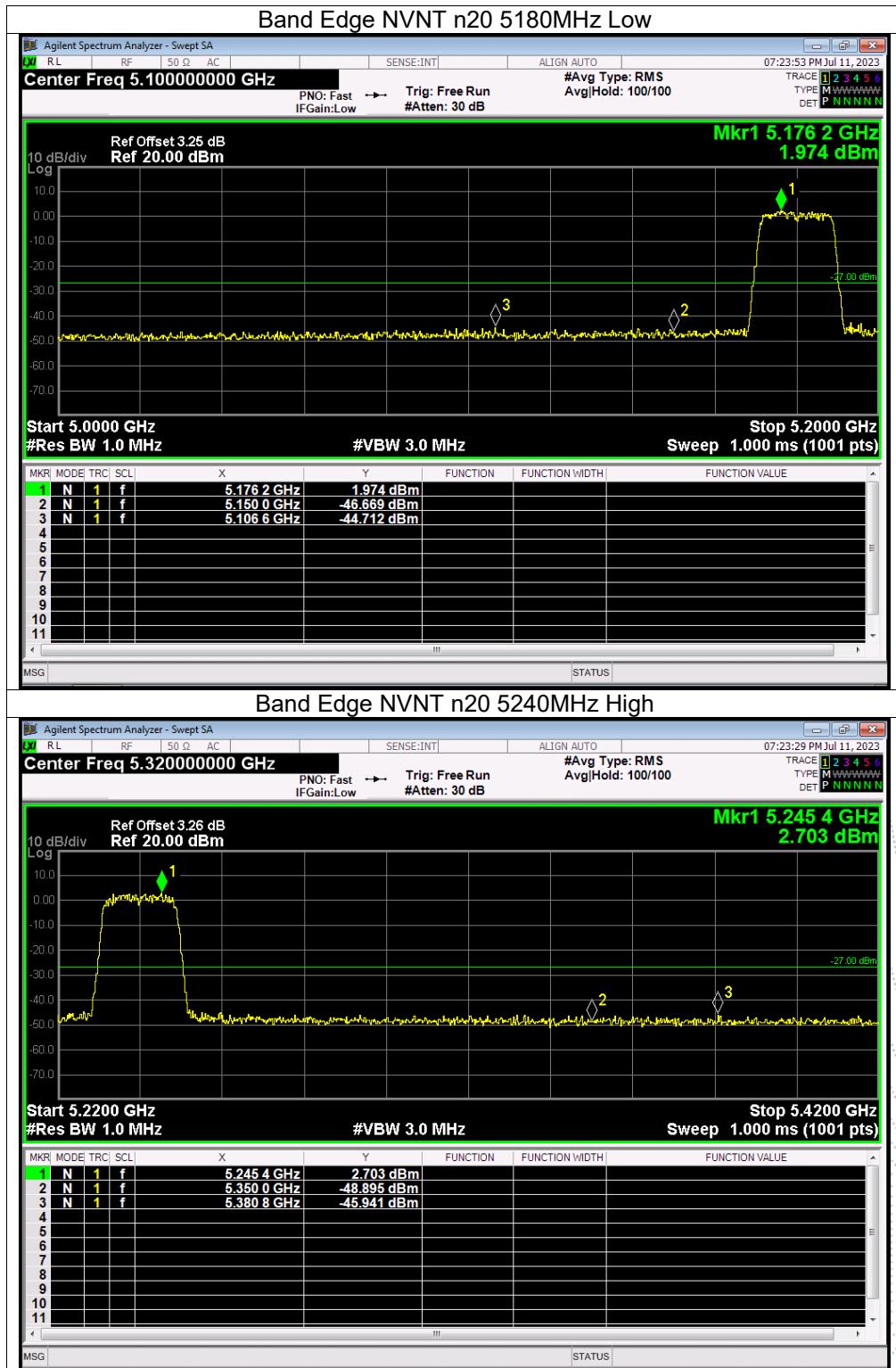
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data

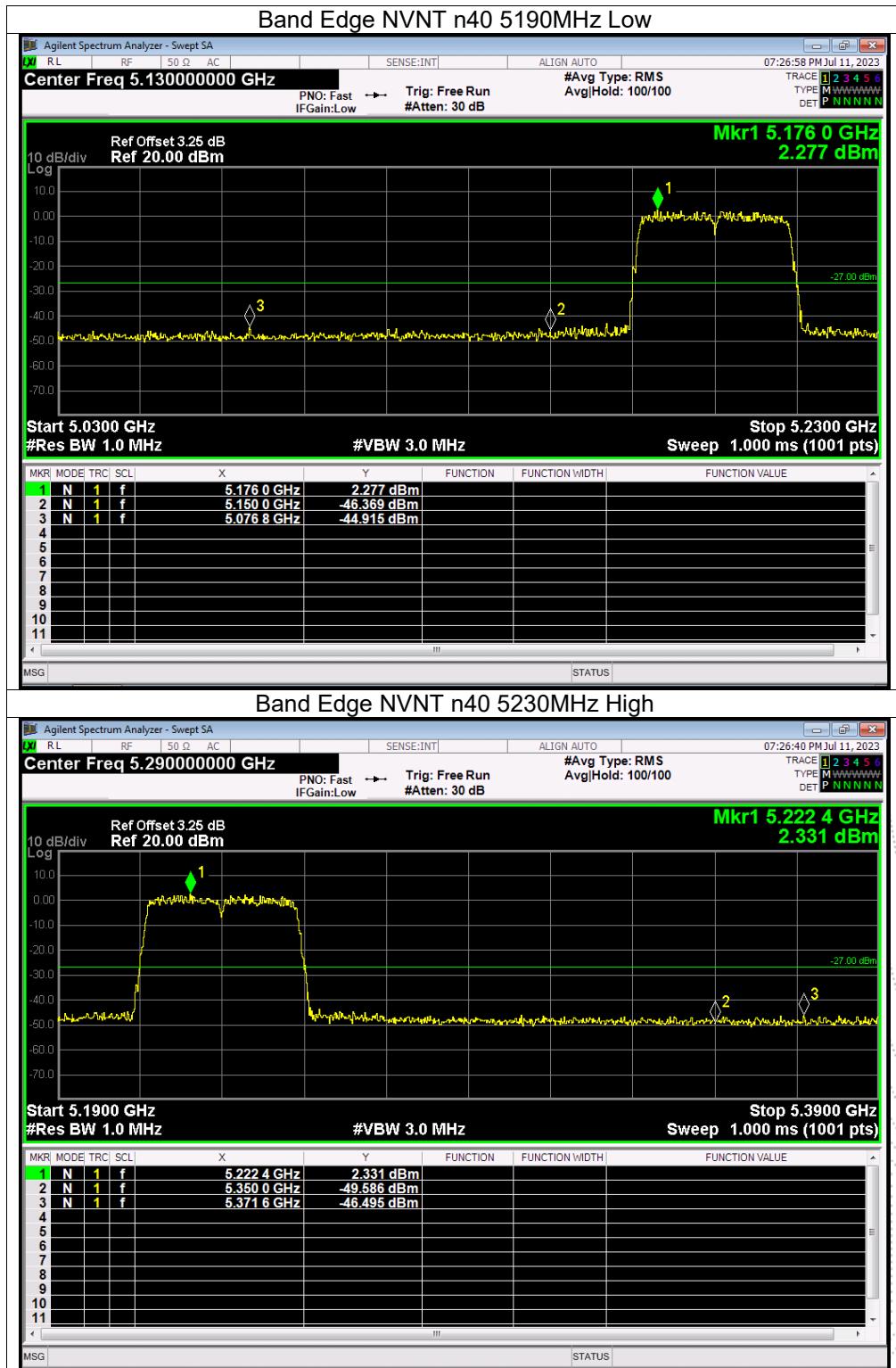
11.5 Test Result

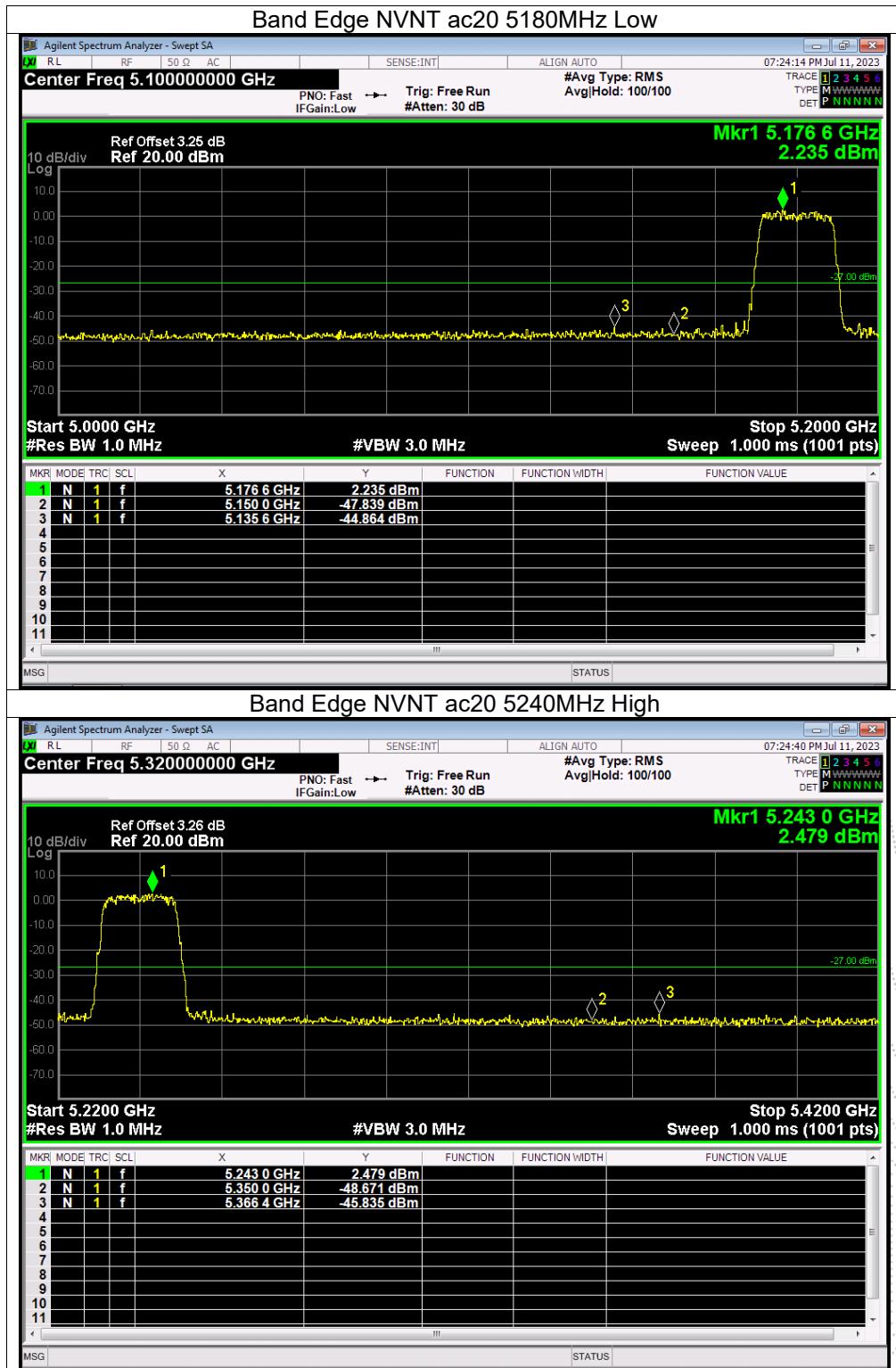
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	101kPa	Test Voltage :	DC 5V

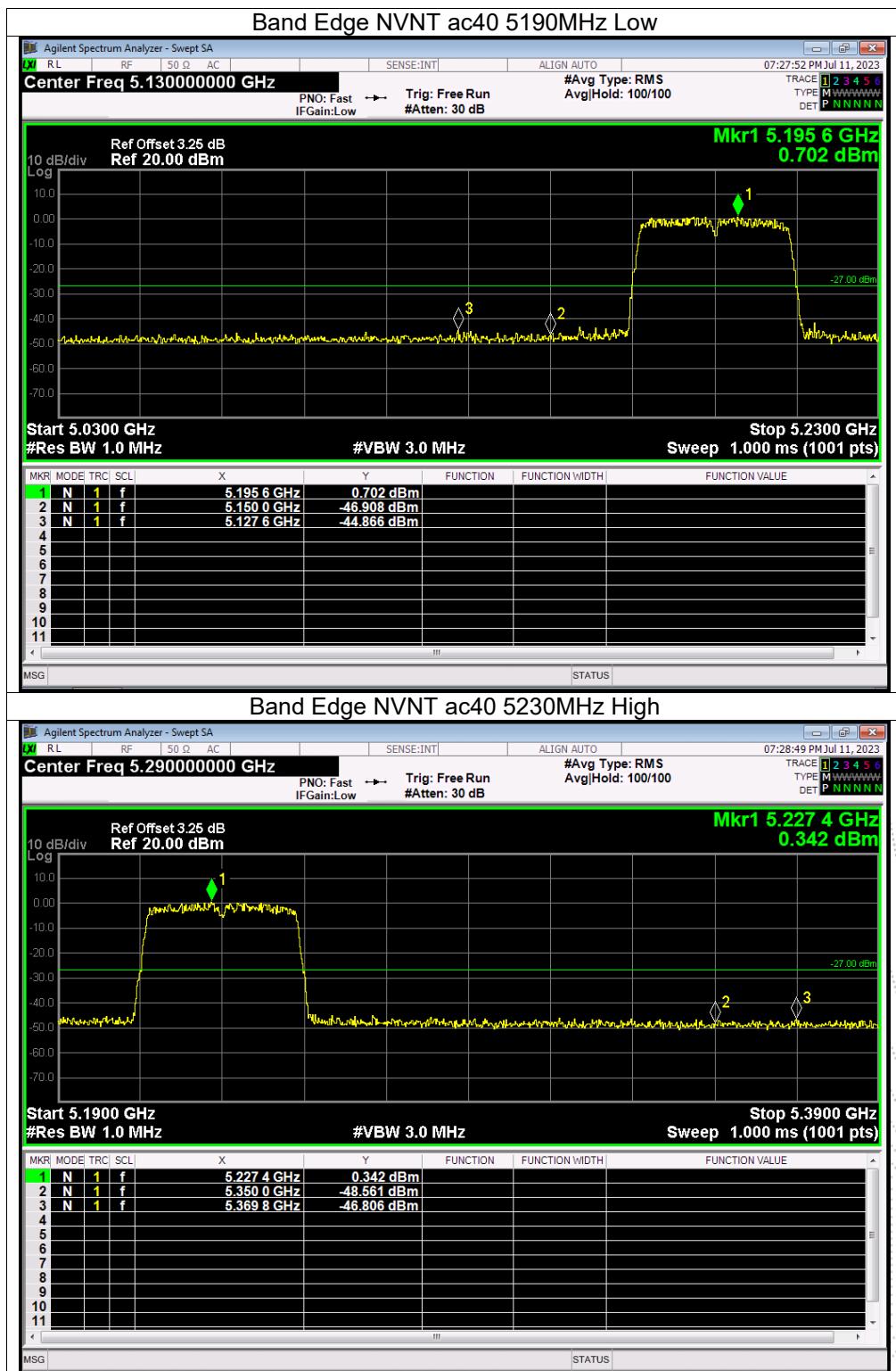
Note: A(B) Represent the value of antenna A and B, The worst data is Antenna A, only shown Antenna A .
 Plot. Antenna A: 5180-5240MHz

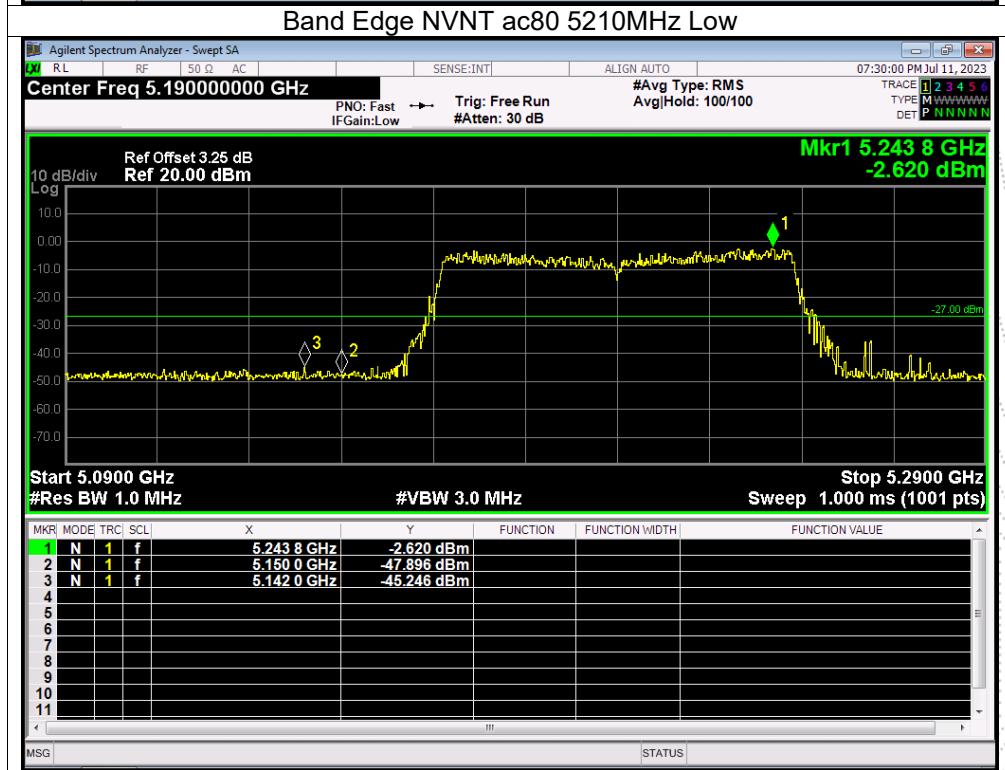
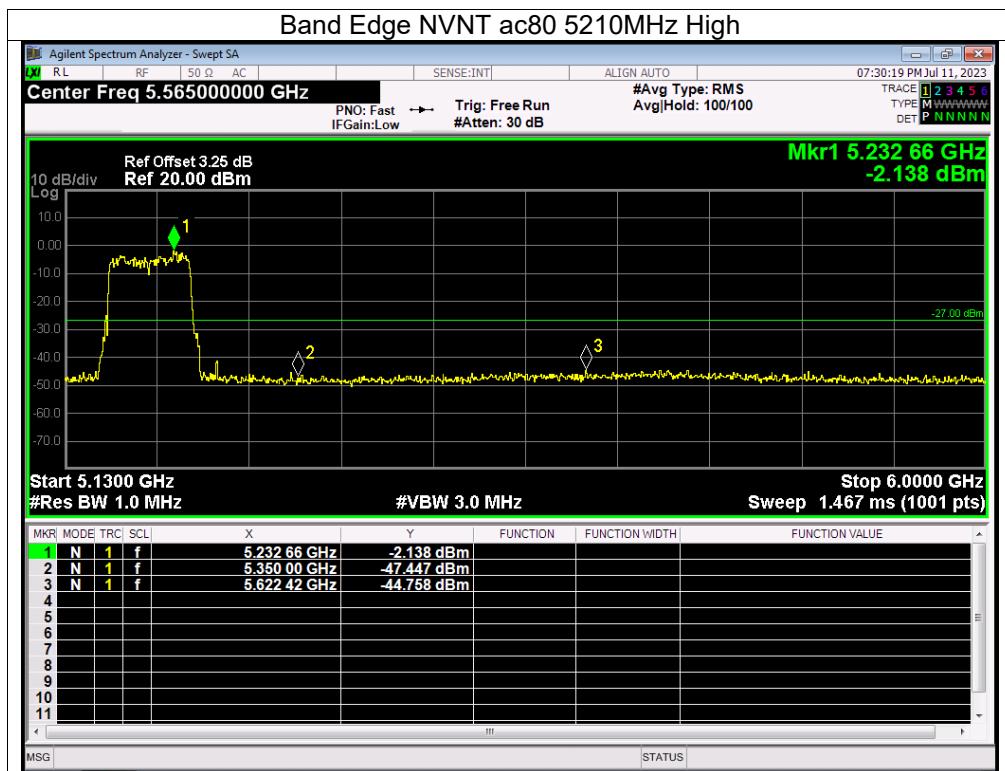


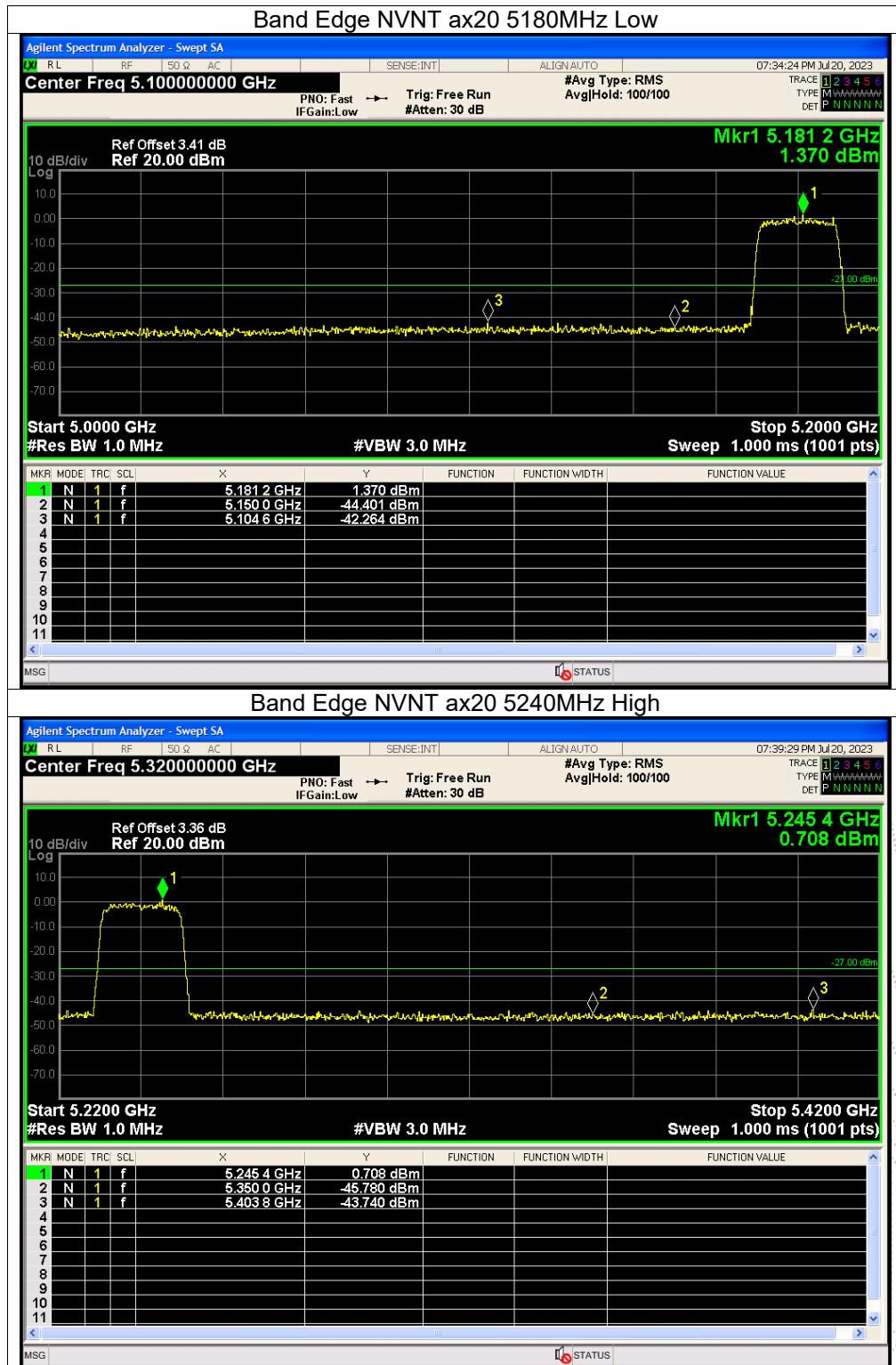


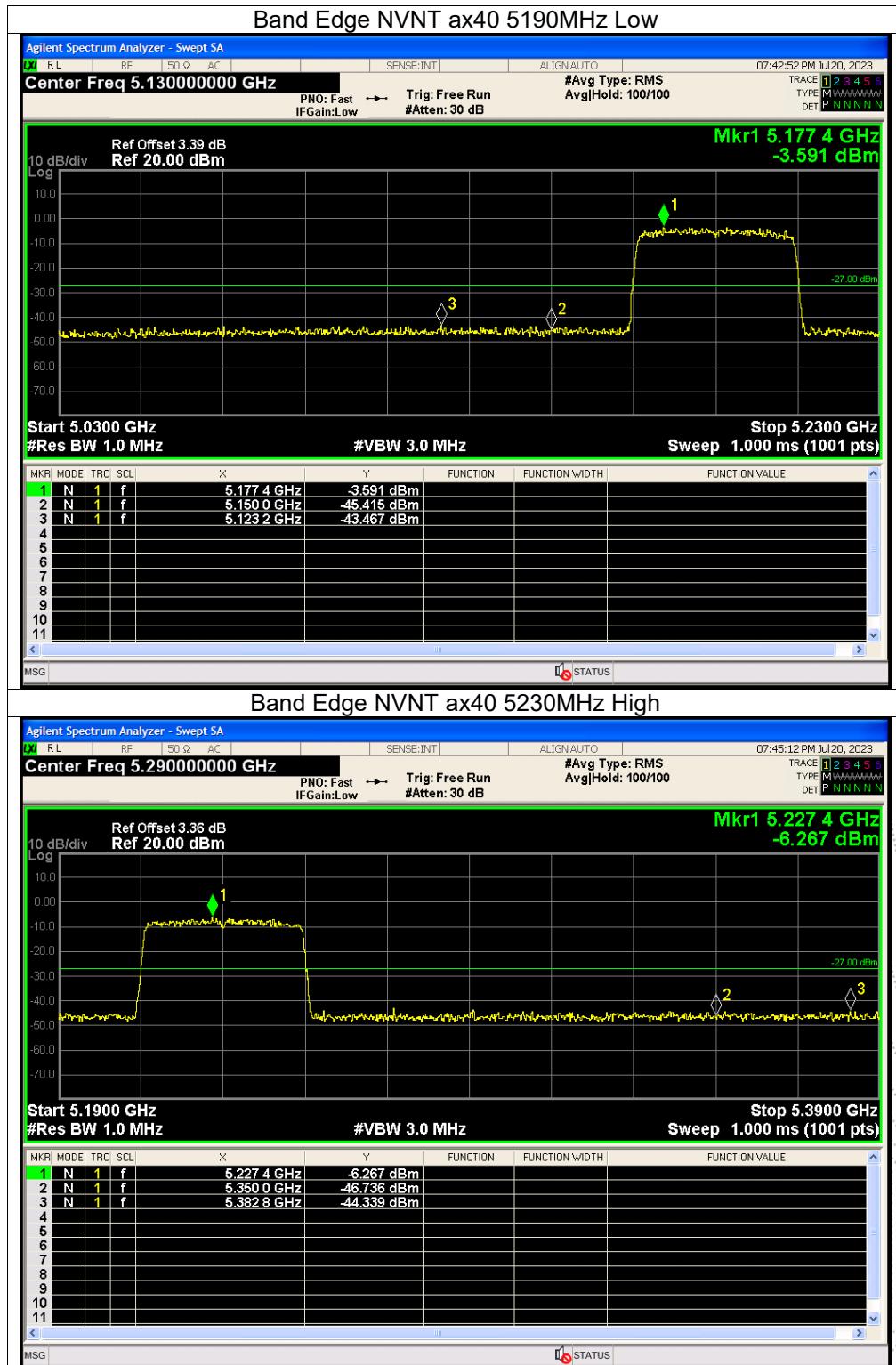


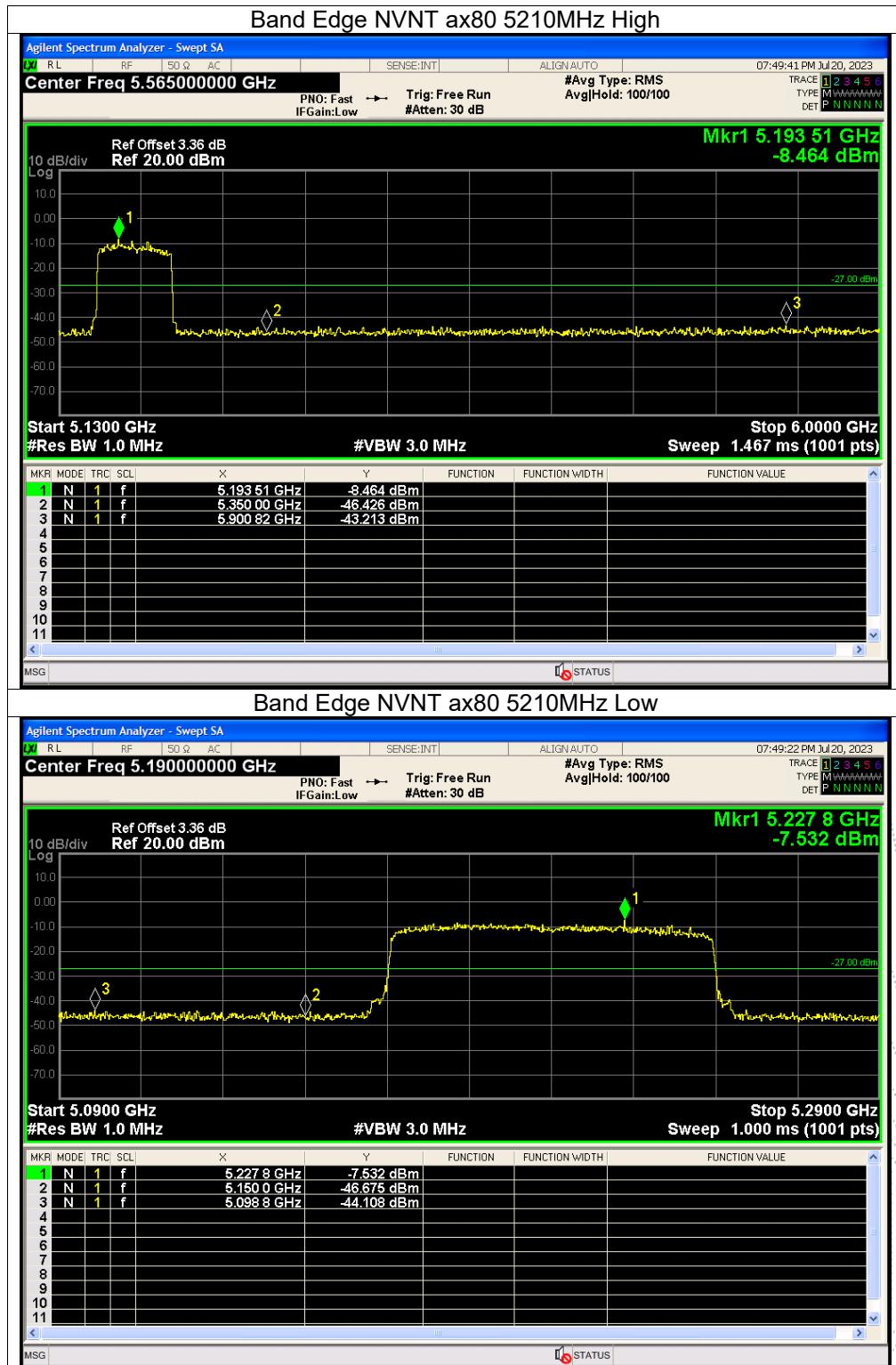




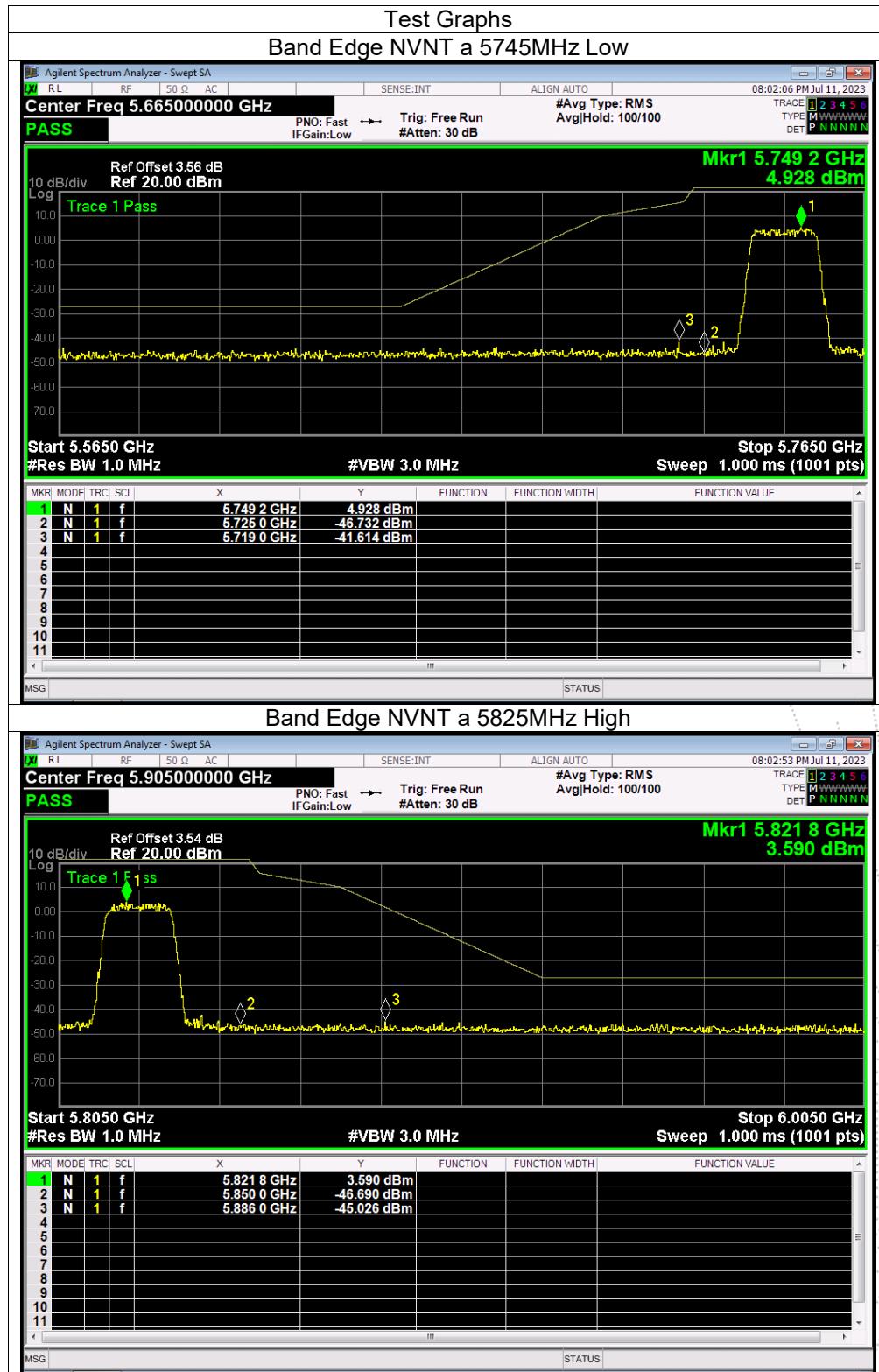


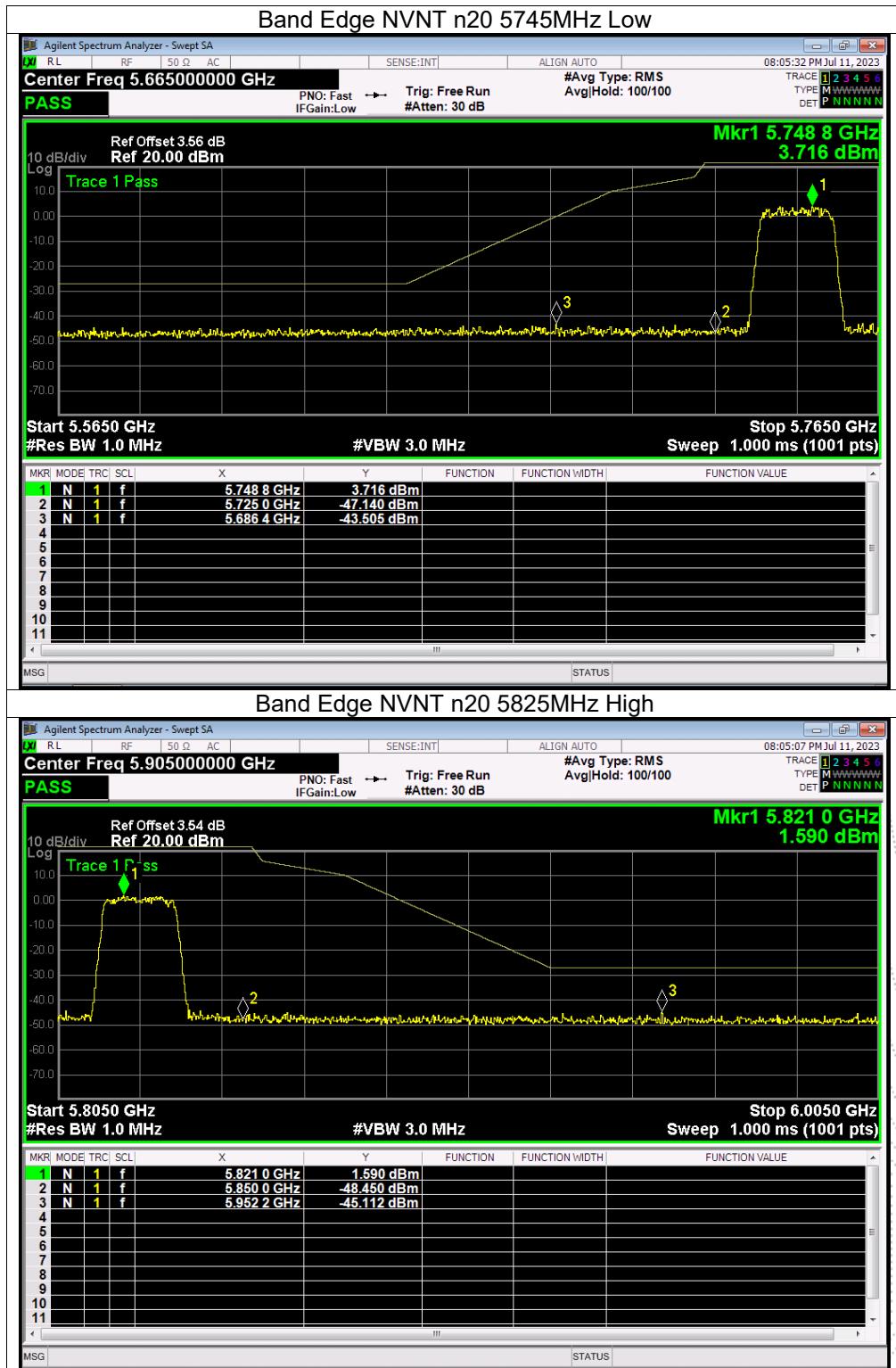


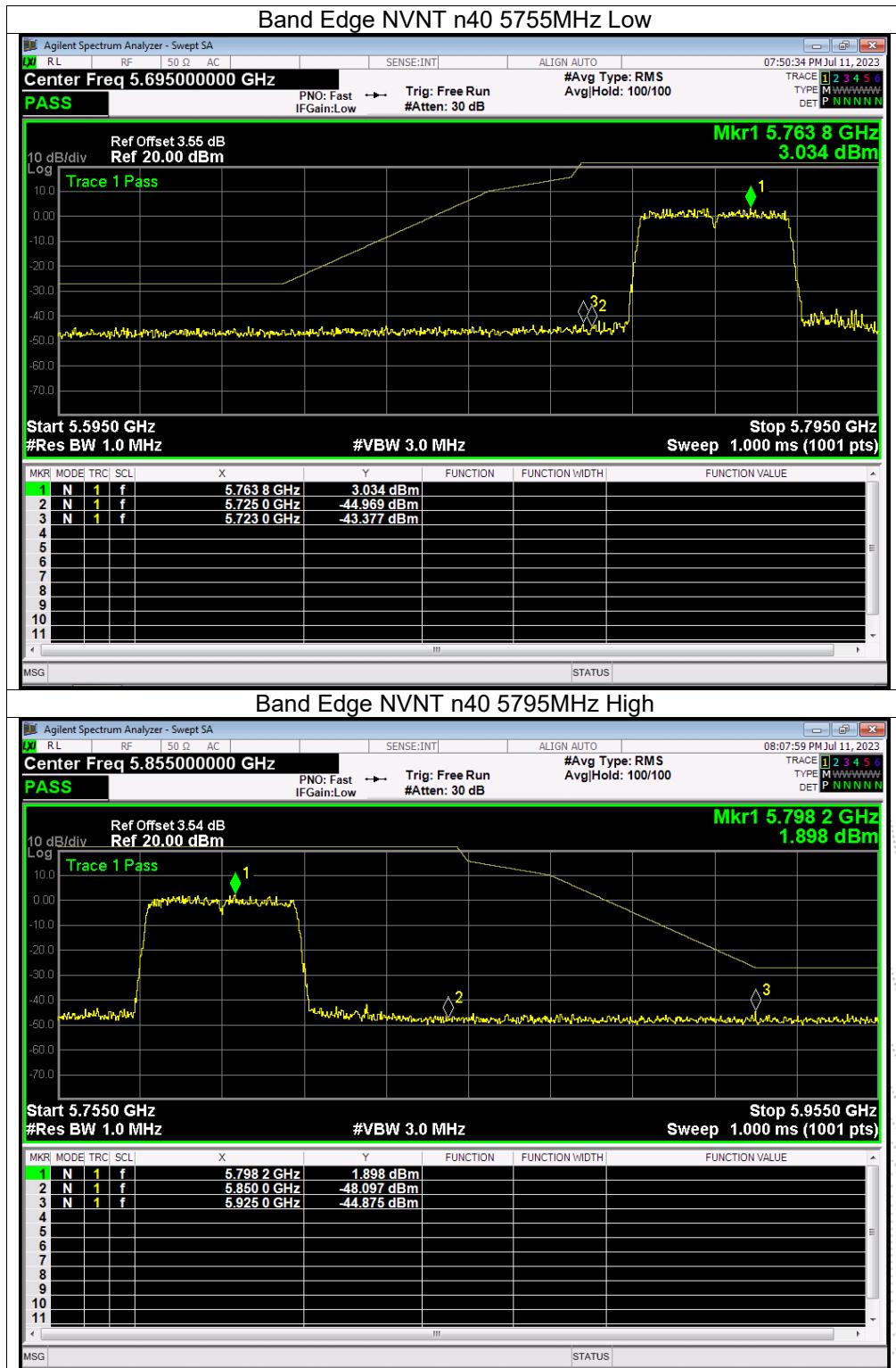


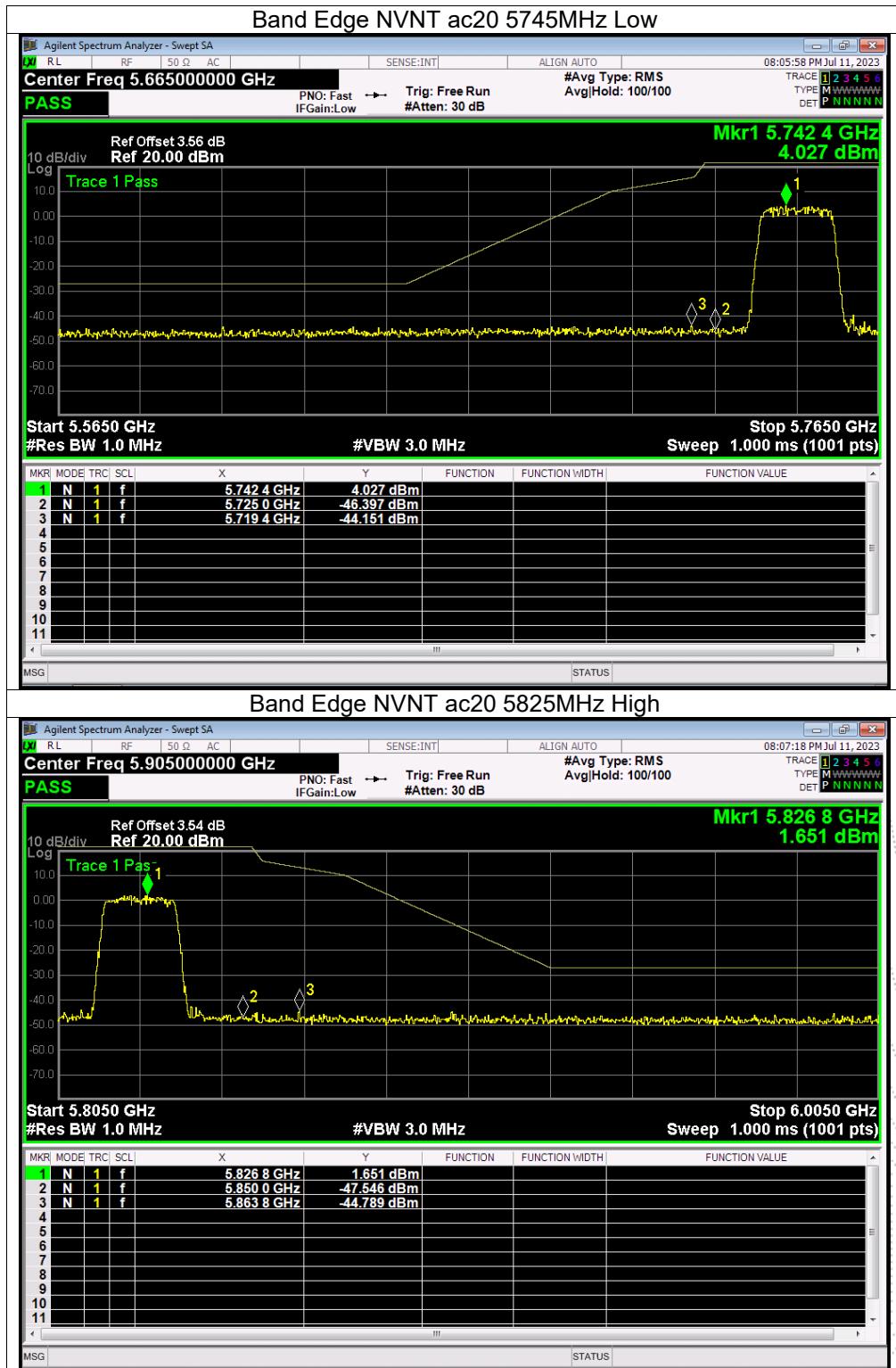


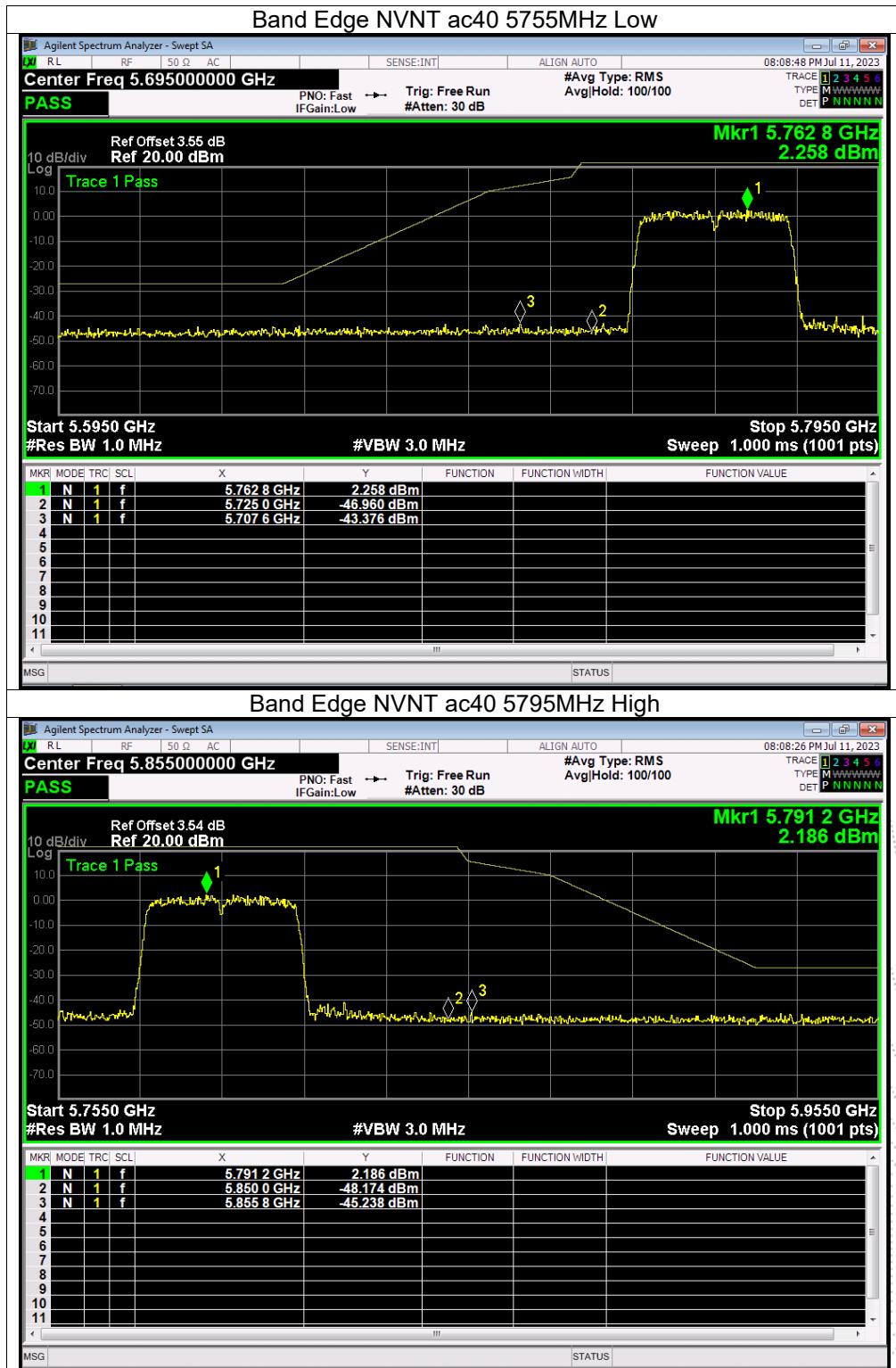
Note: A(B) Represent the value of antenna A and B. The worst data is Antenna A, only shown Antenna A.
 Antenna A: 5745-58250MHz

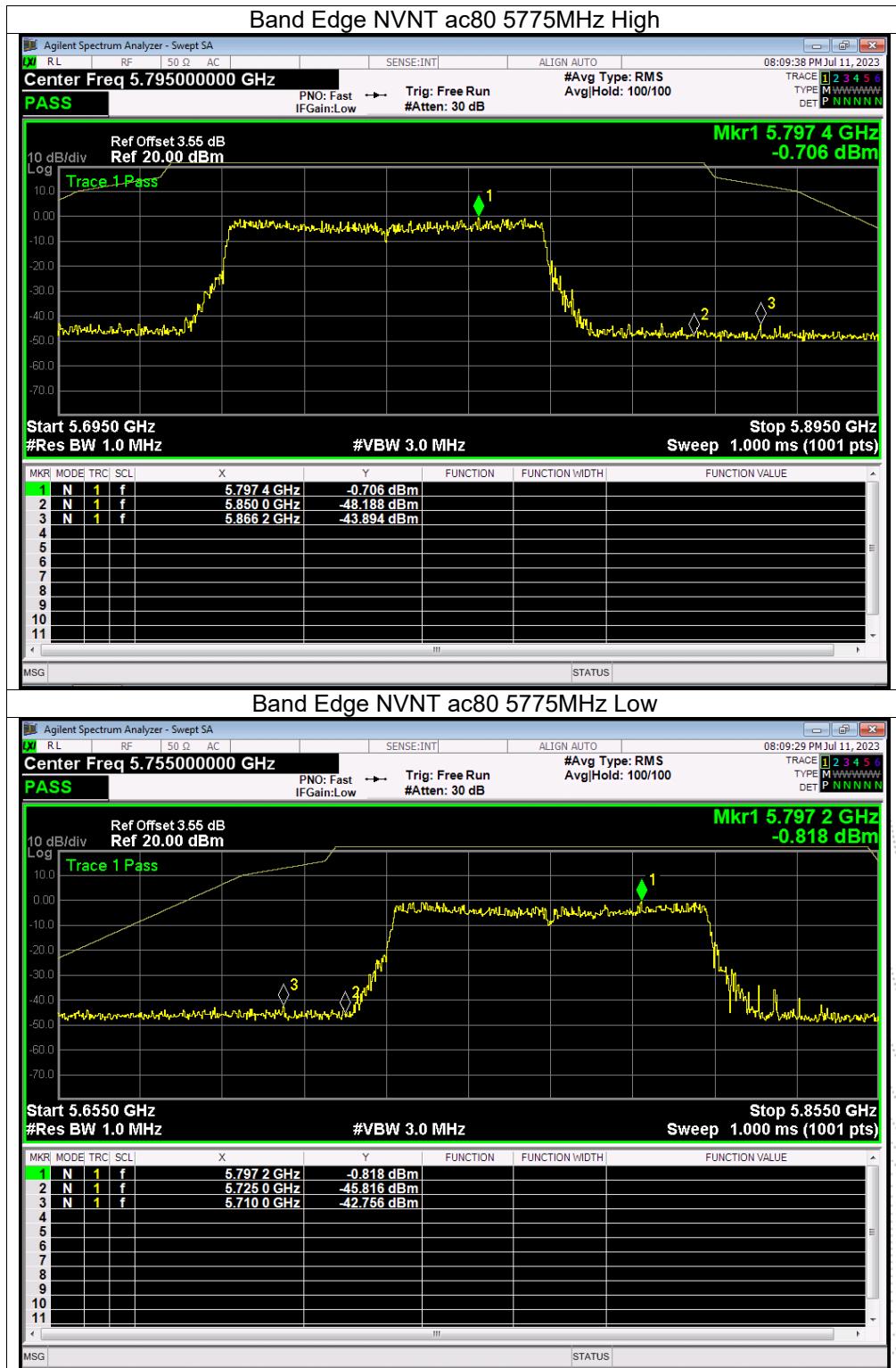


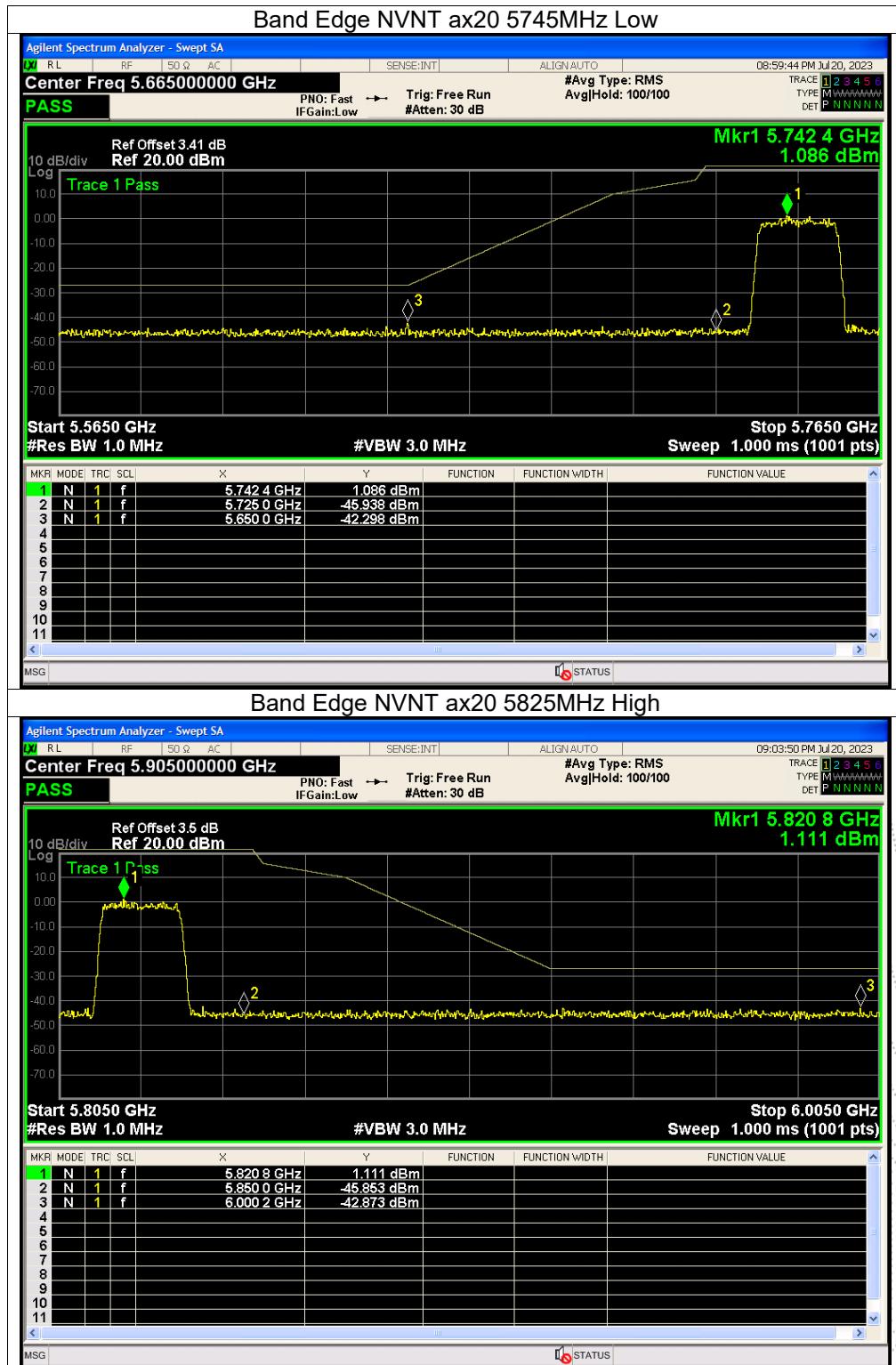


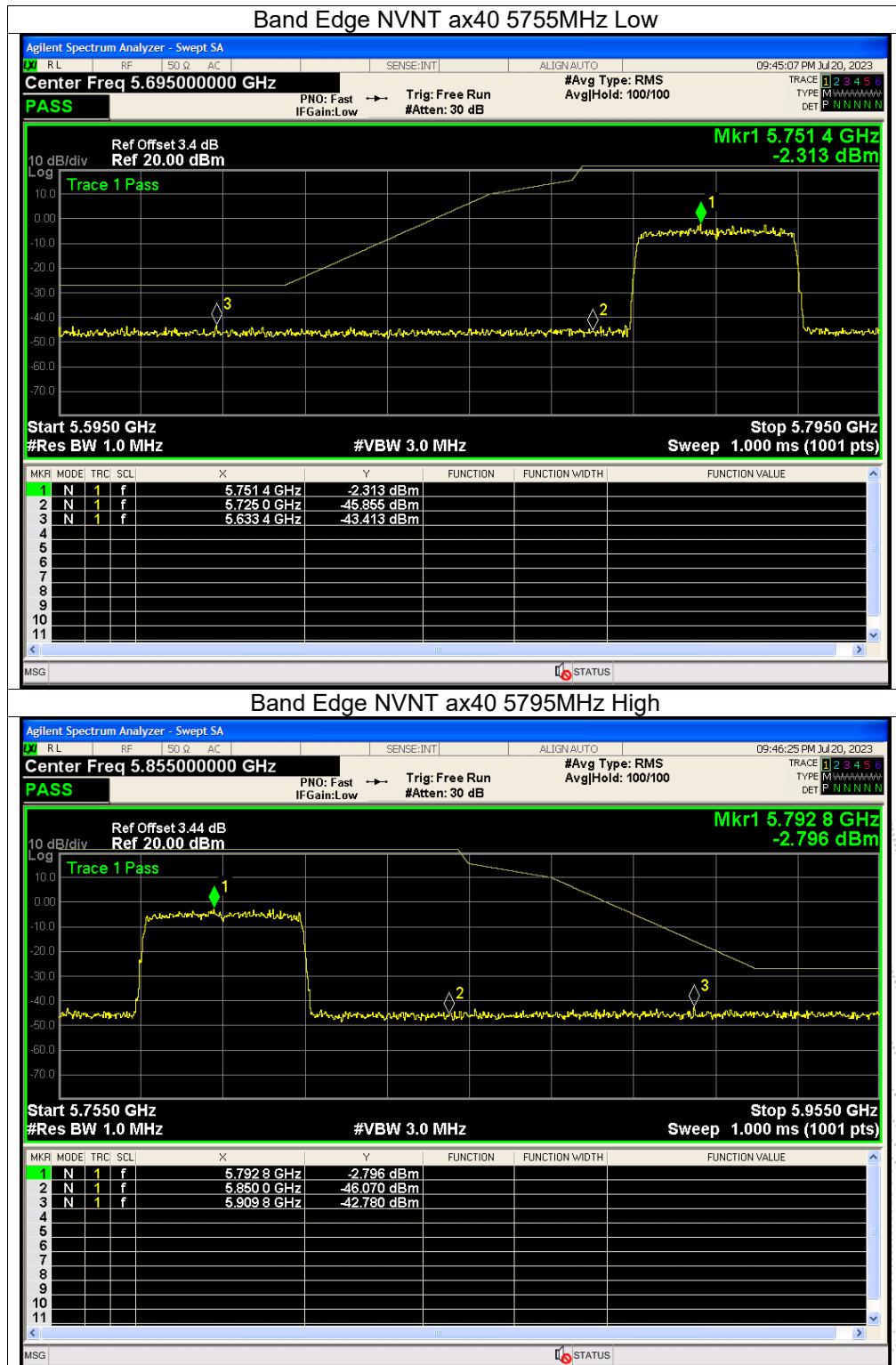


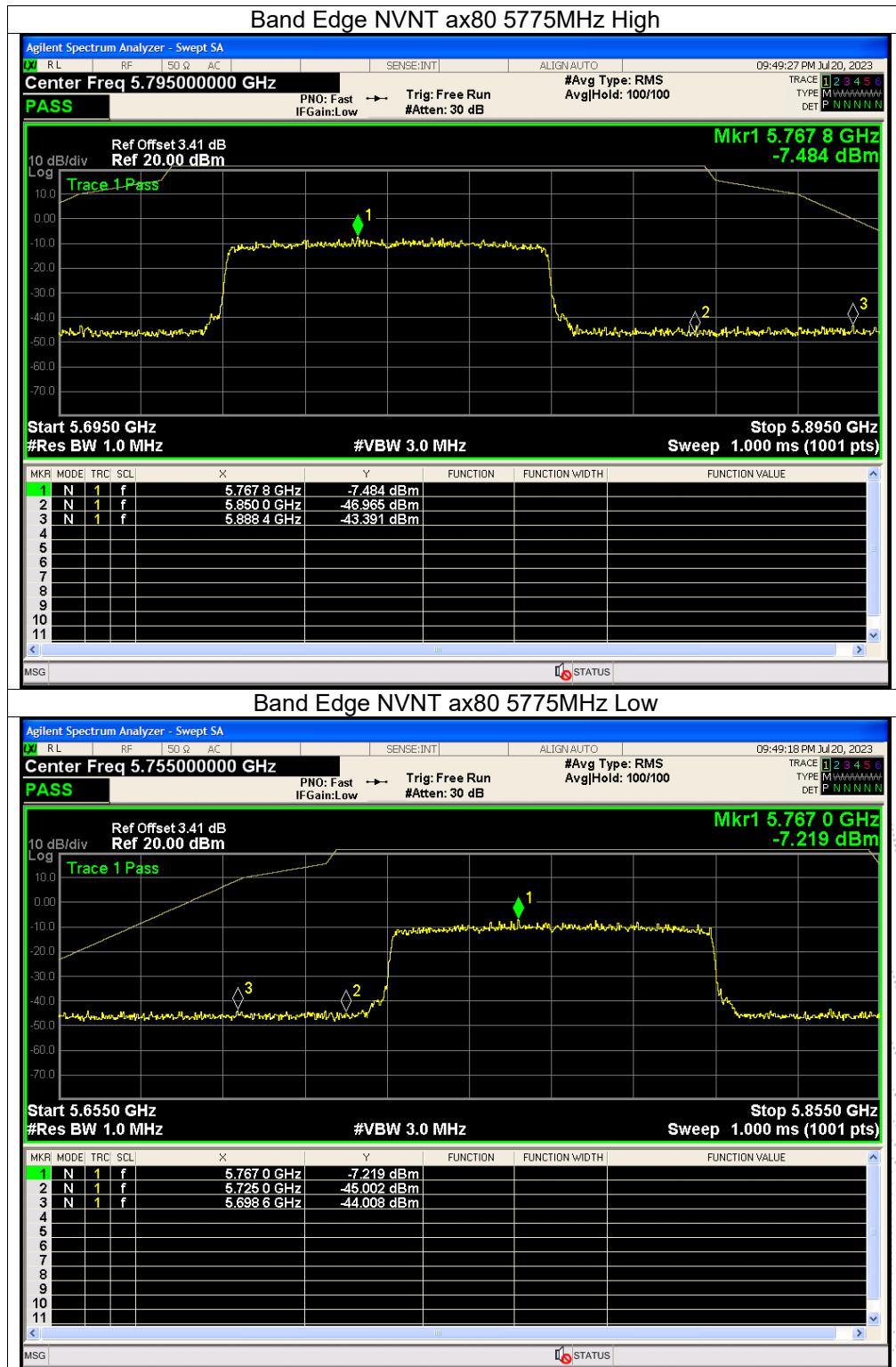












12. Spurious RF Conducted Emissions

12.1 Block Diagram Of Test Setup



12.2 Limit

Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) For transmitters operating in the 5.725-5.85 GHz band:
 - (i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge..

12.3 Test Procedure

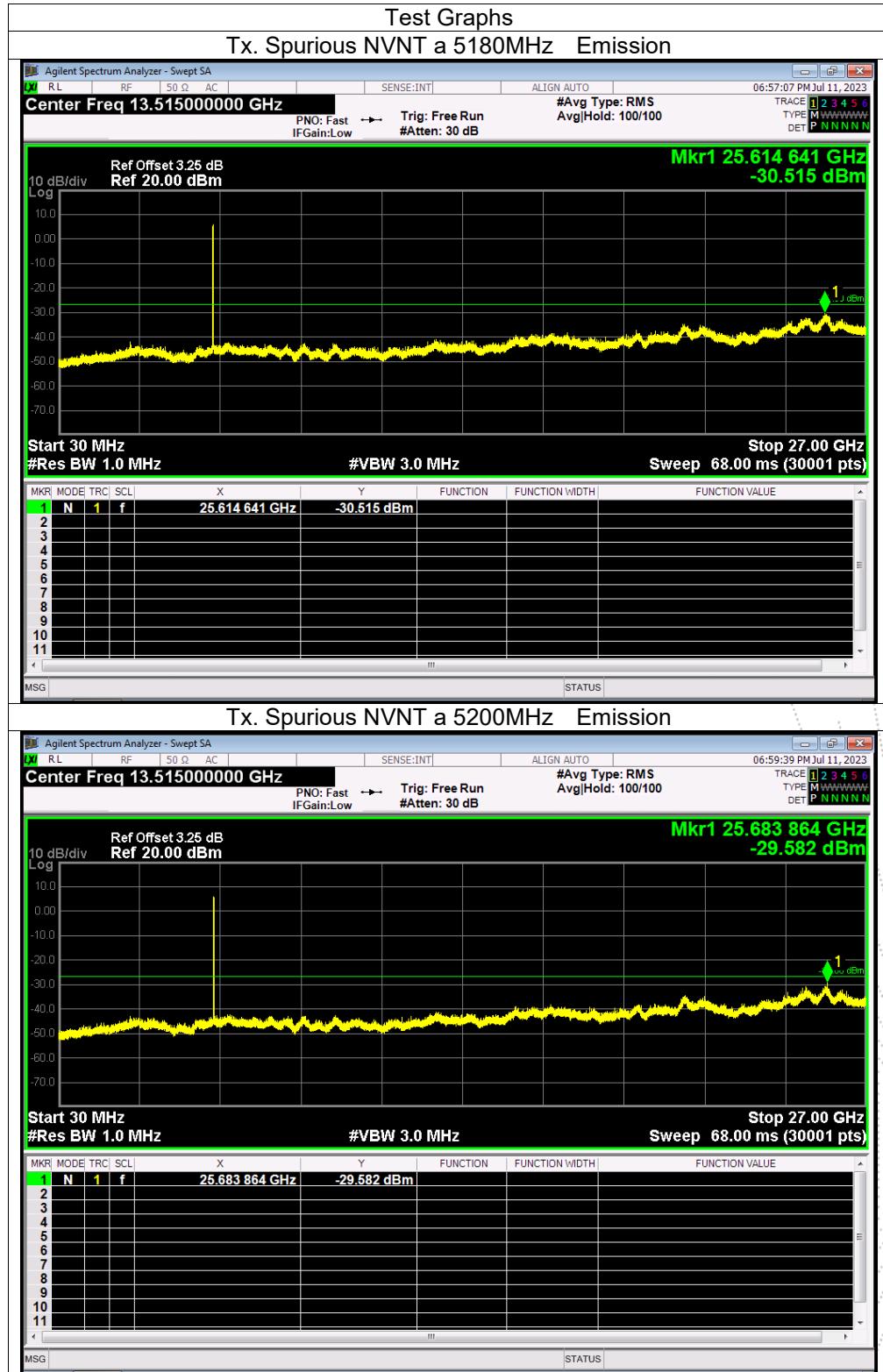
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz with a convenient frequency span.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

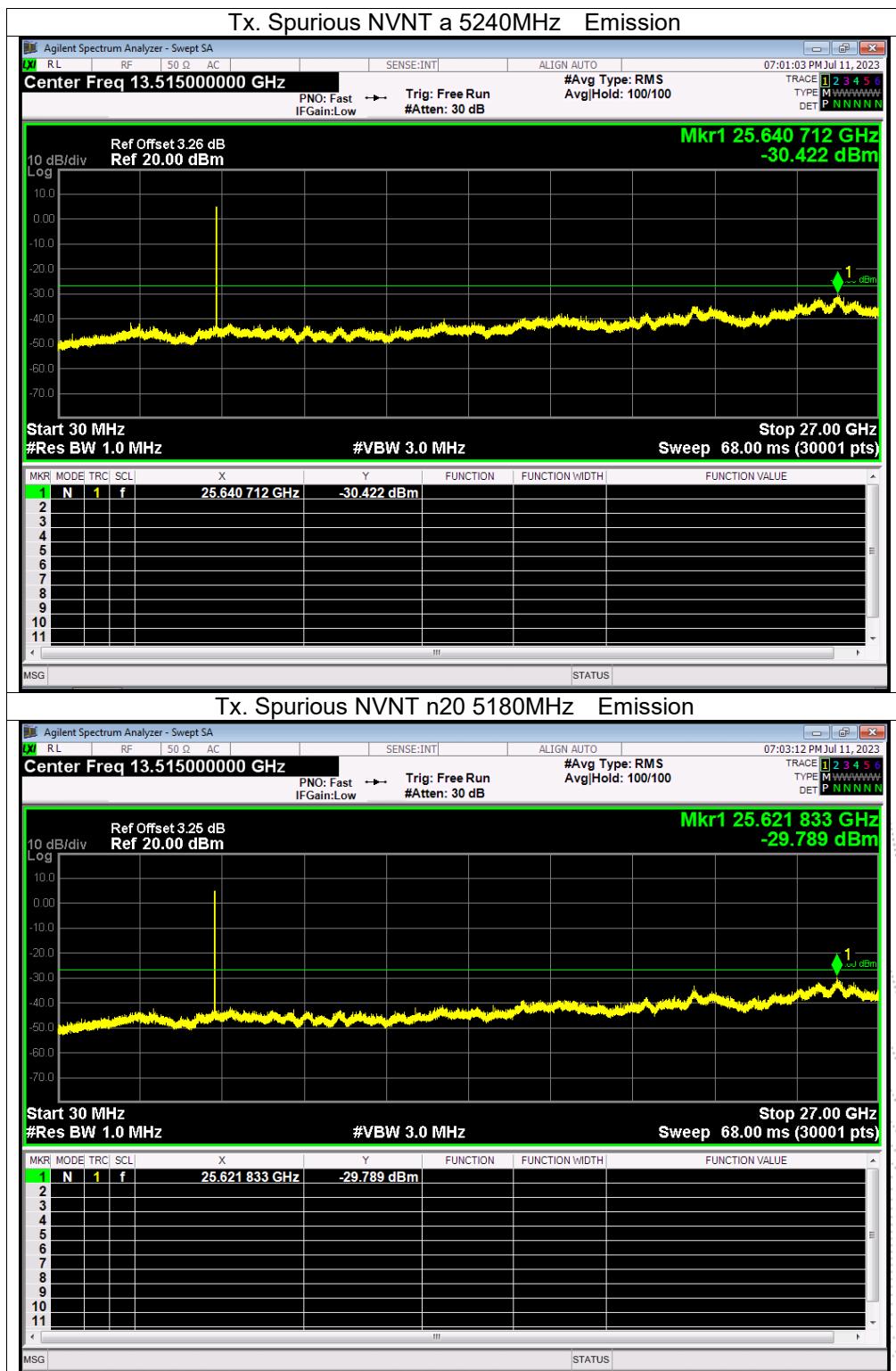
12.4 Test Result

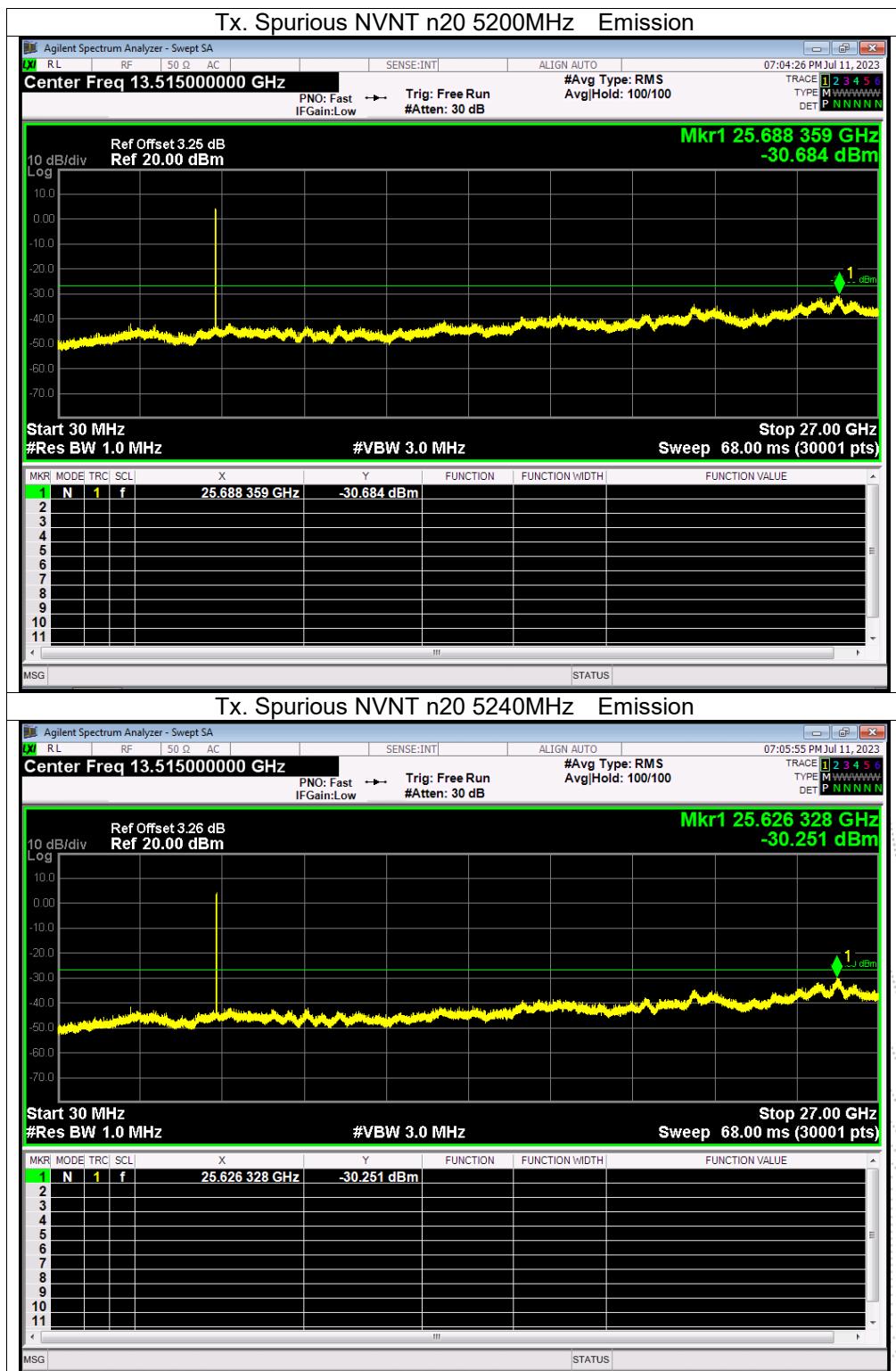
Remark: The measurement frequency range is from 9KHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandege measurement data.

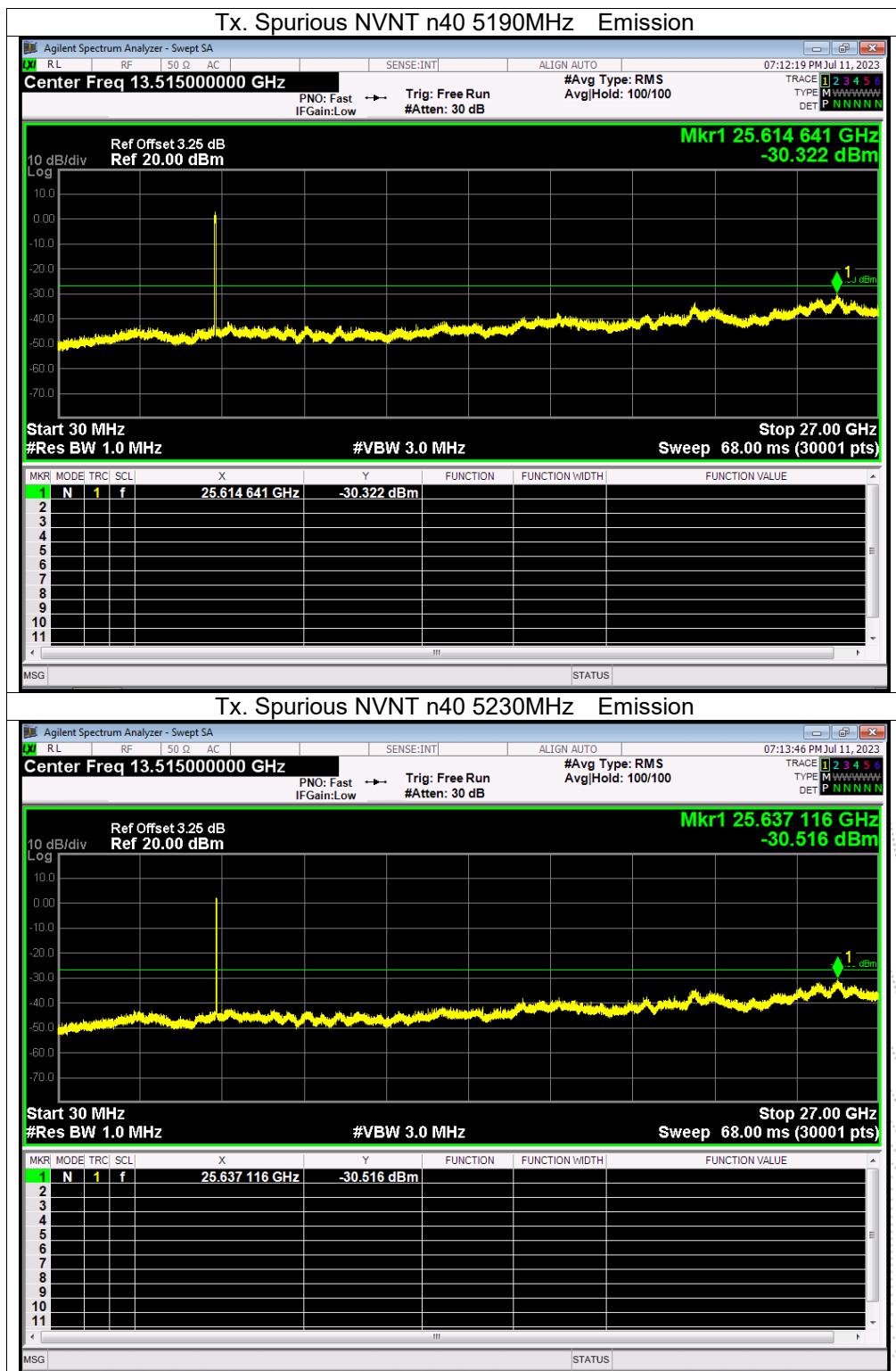
About:26.5GHz-40GHz, The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

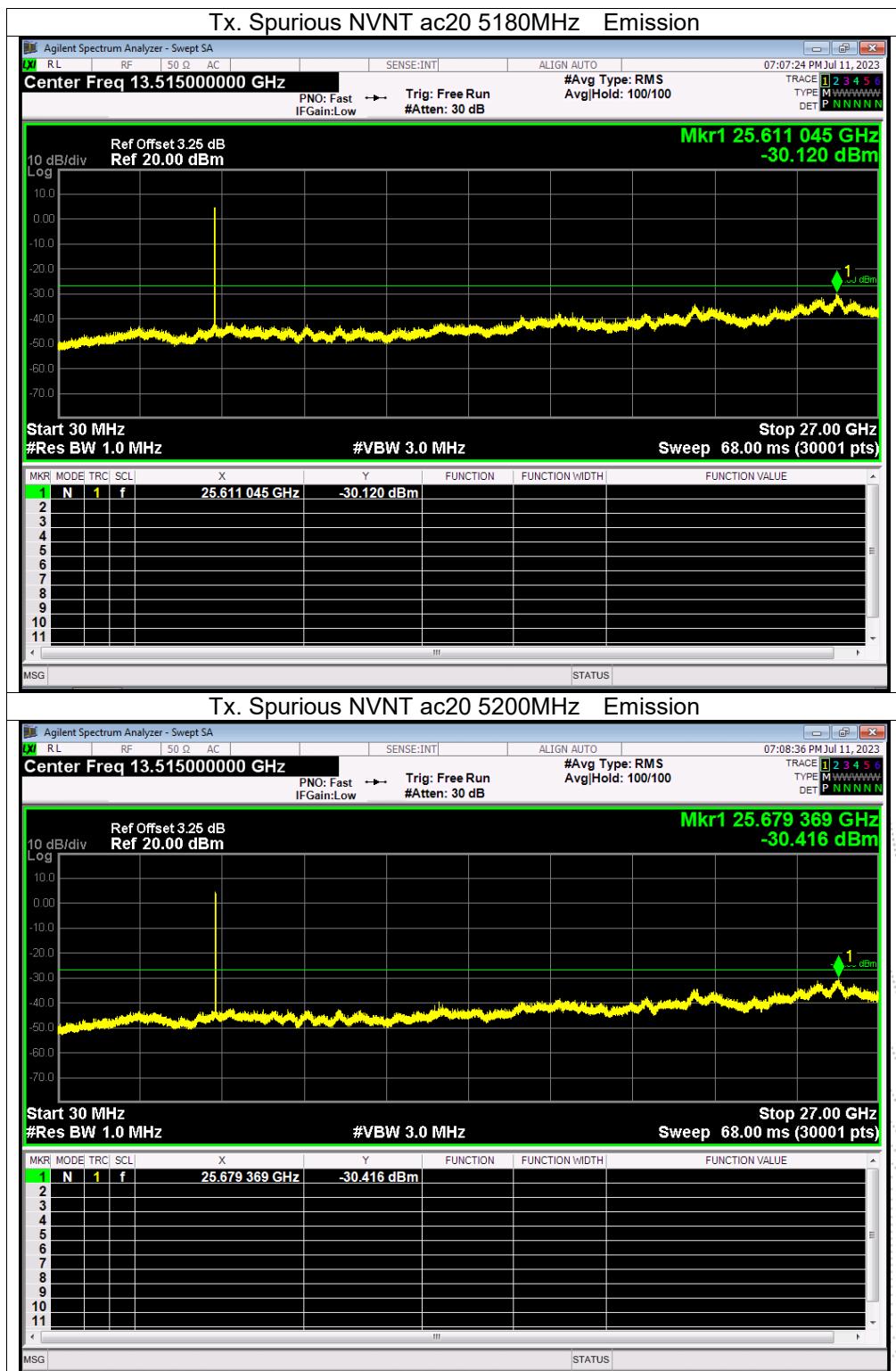
Note: A(B) Represent the value of antenna A and B, The worst data is Antenna A, only shown Antenna A.
Plot. Antenna A: 5180-5240MHz

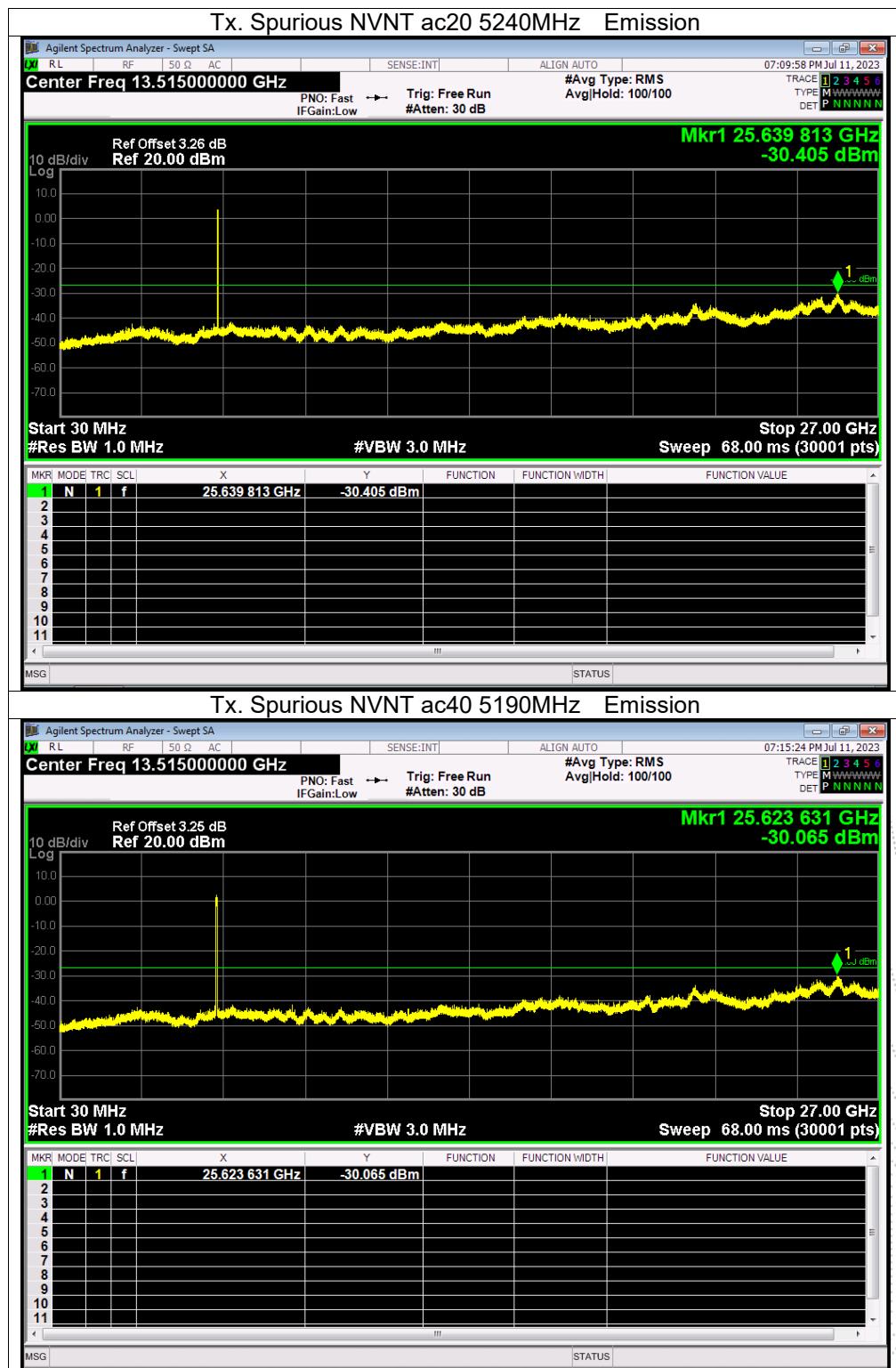


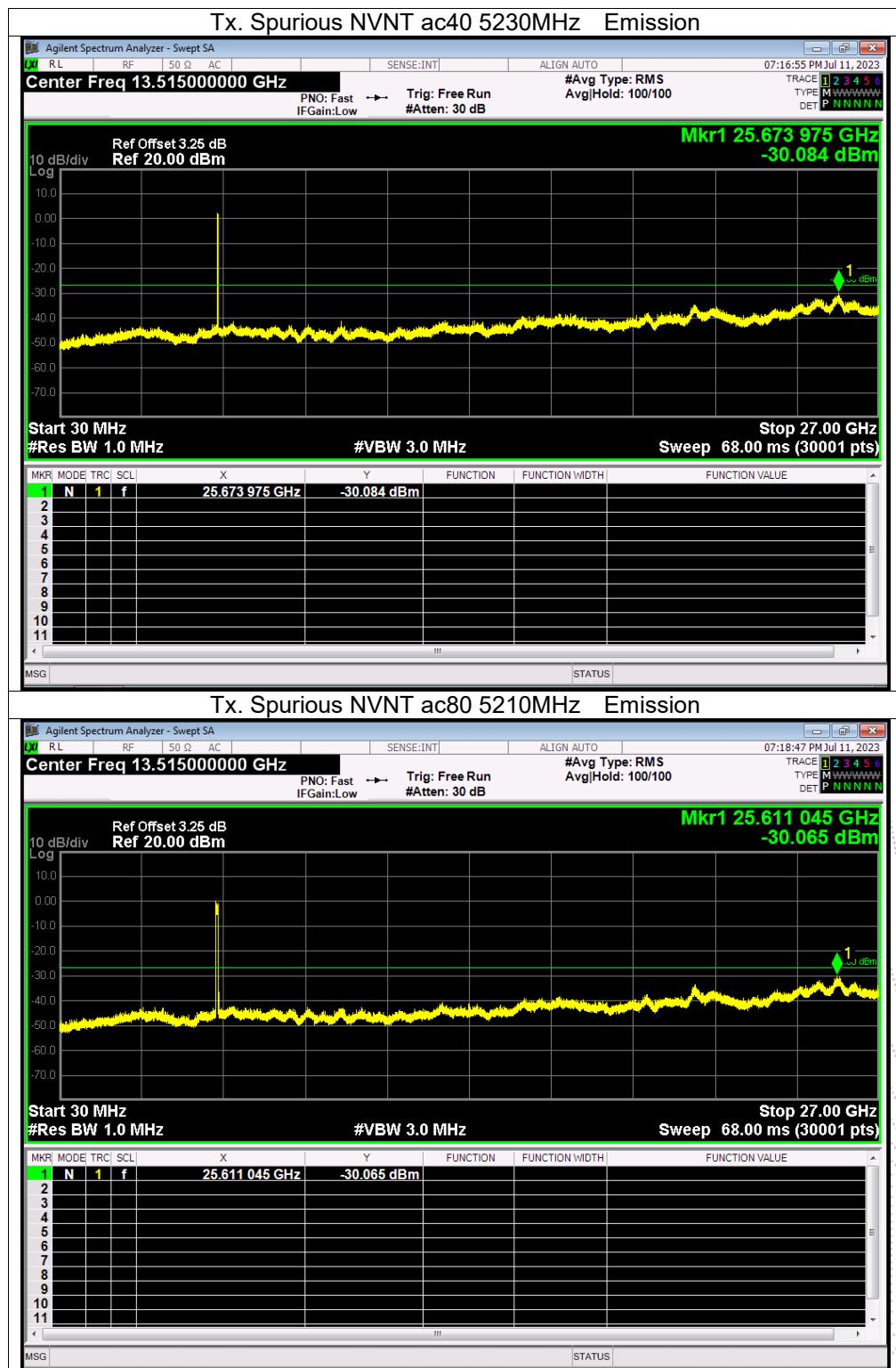


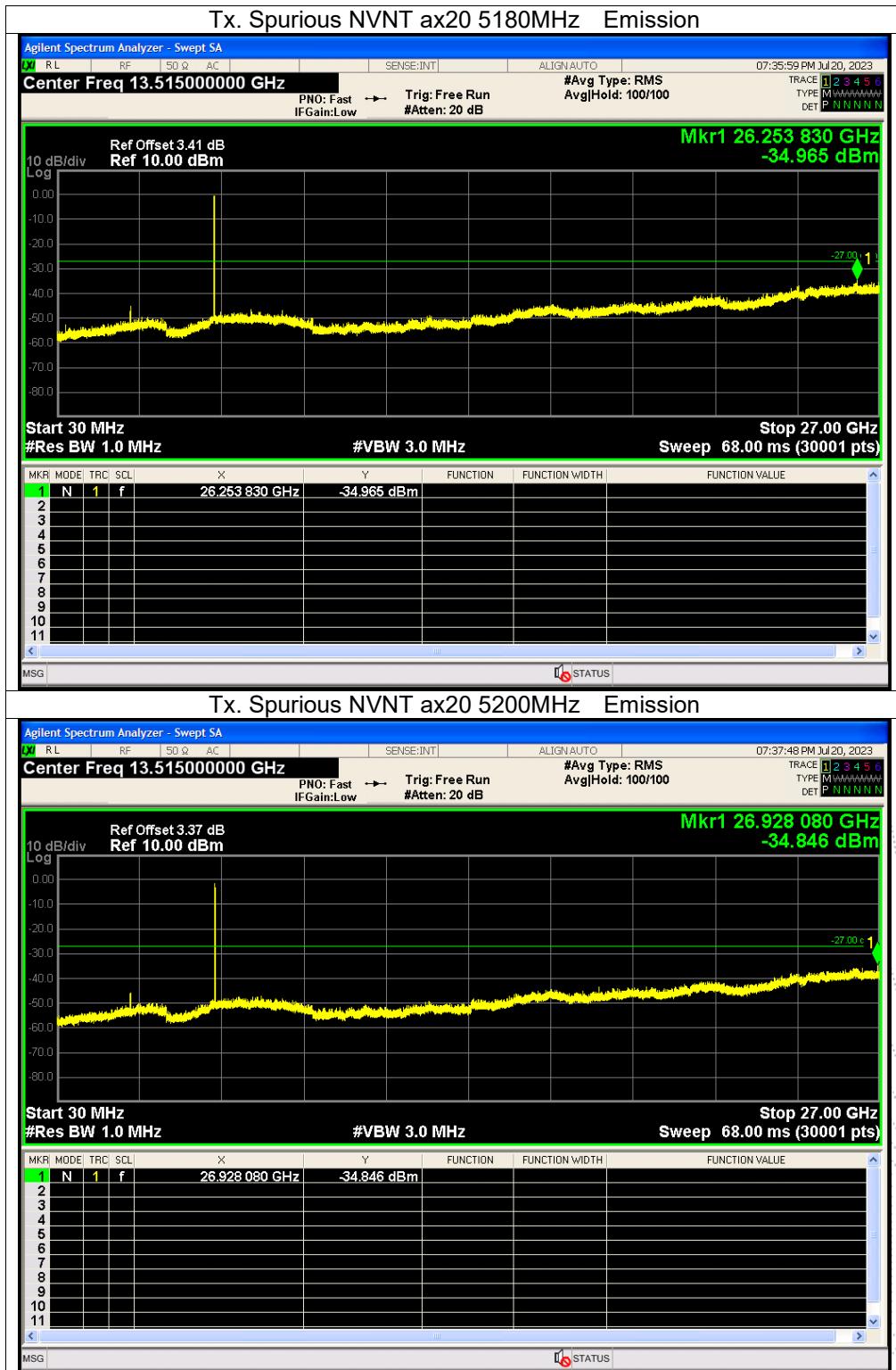


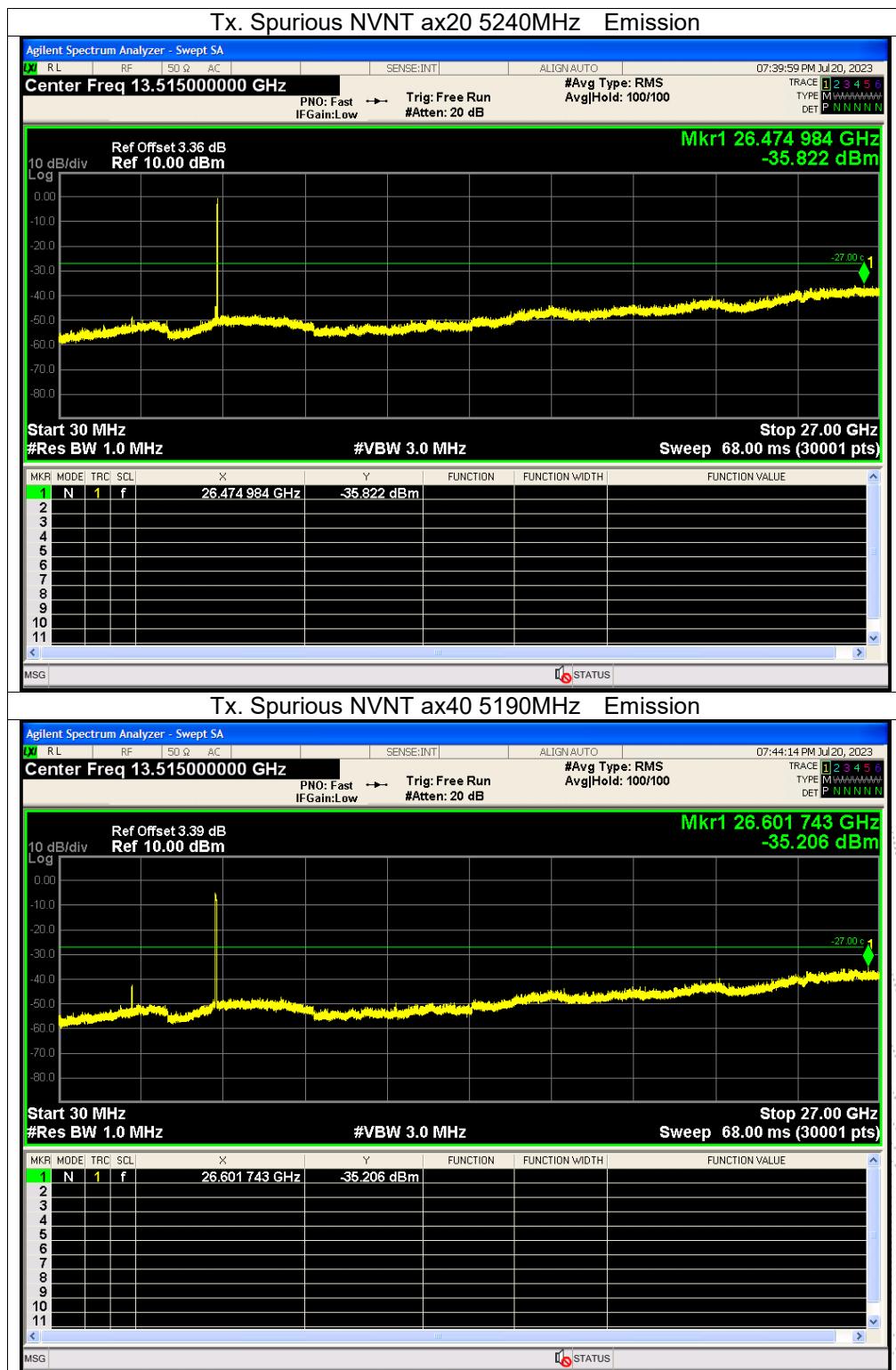


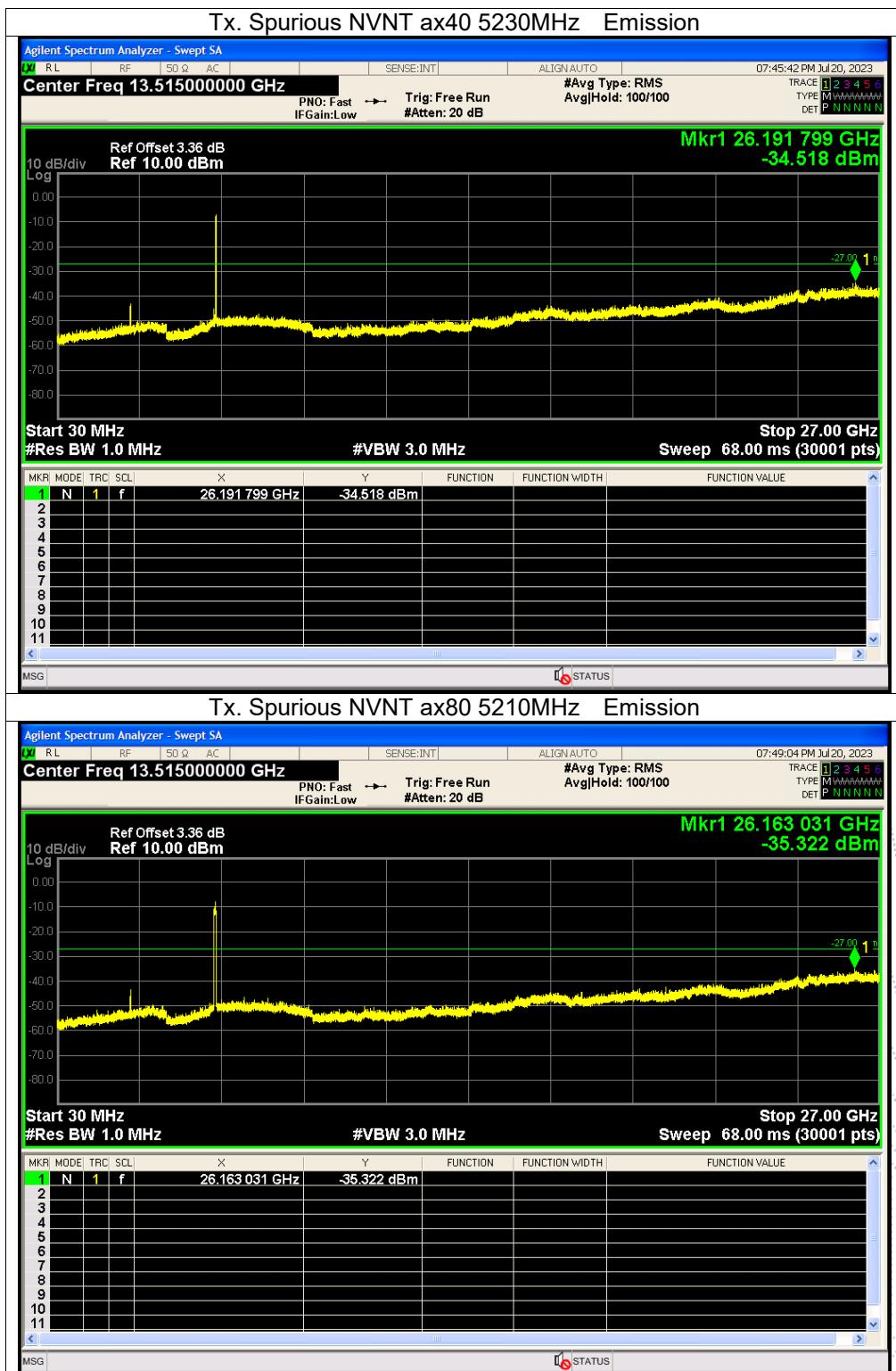




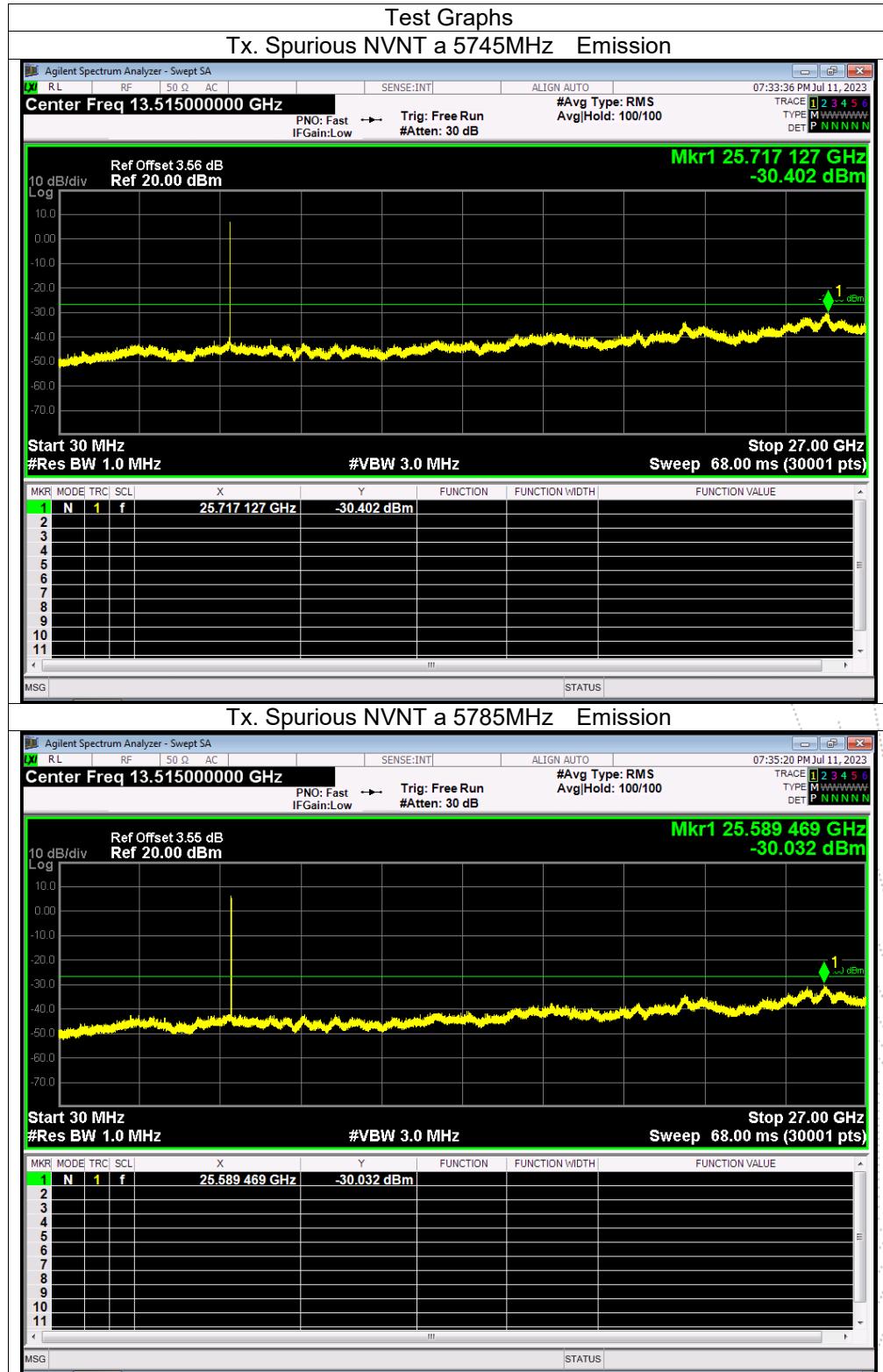


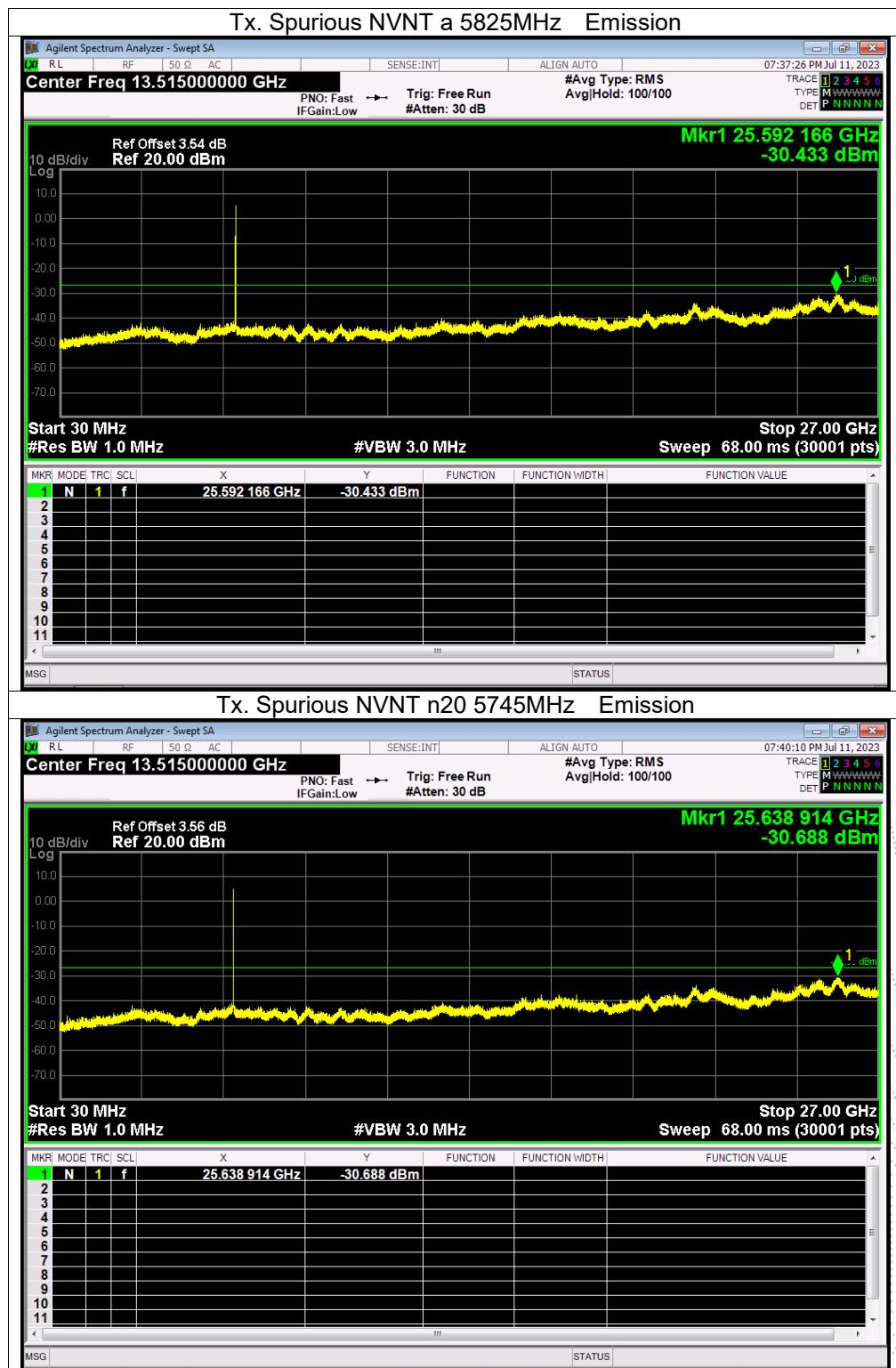


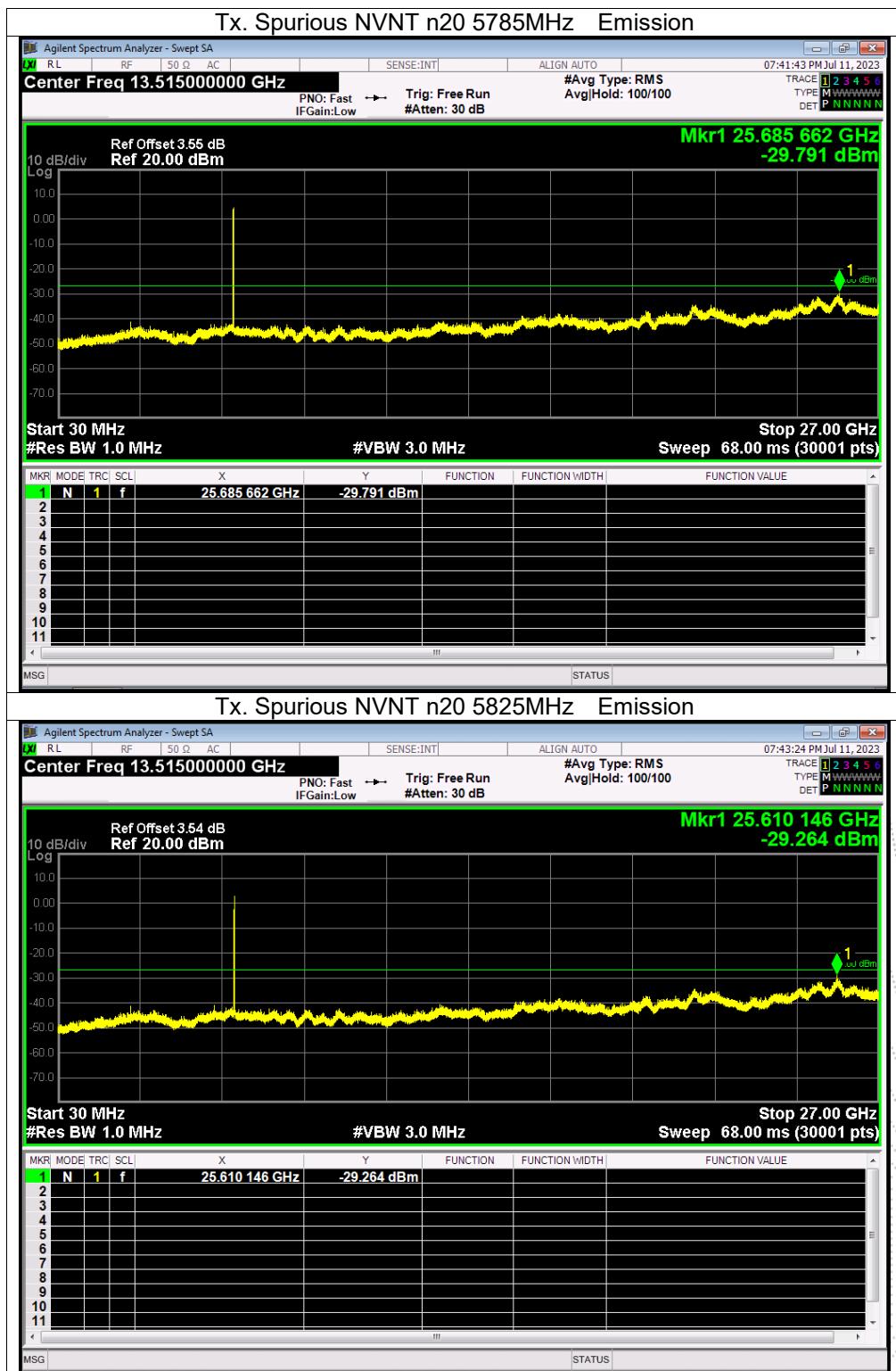


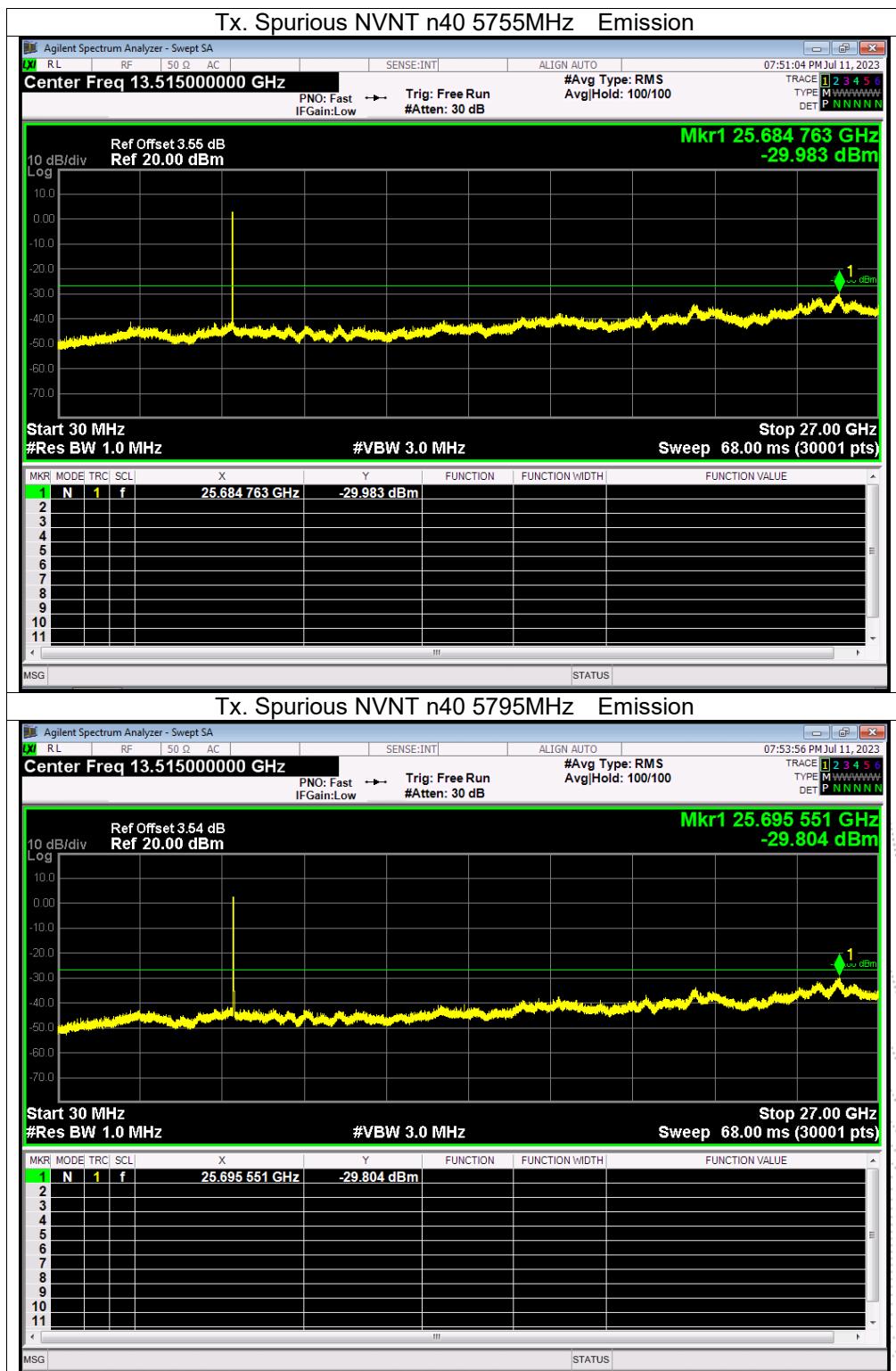


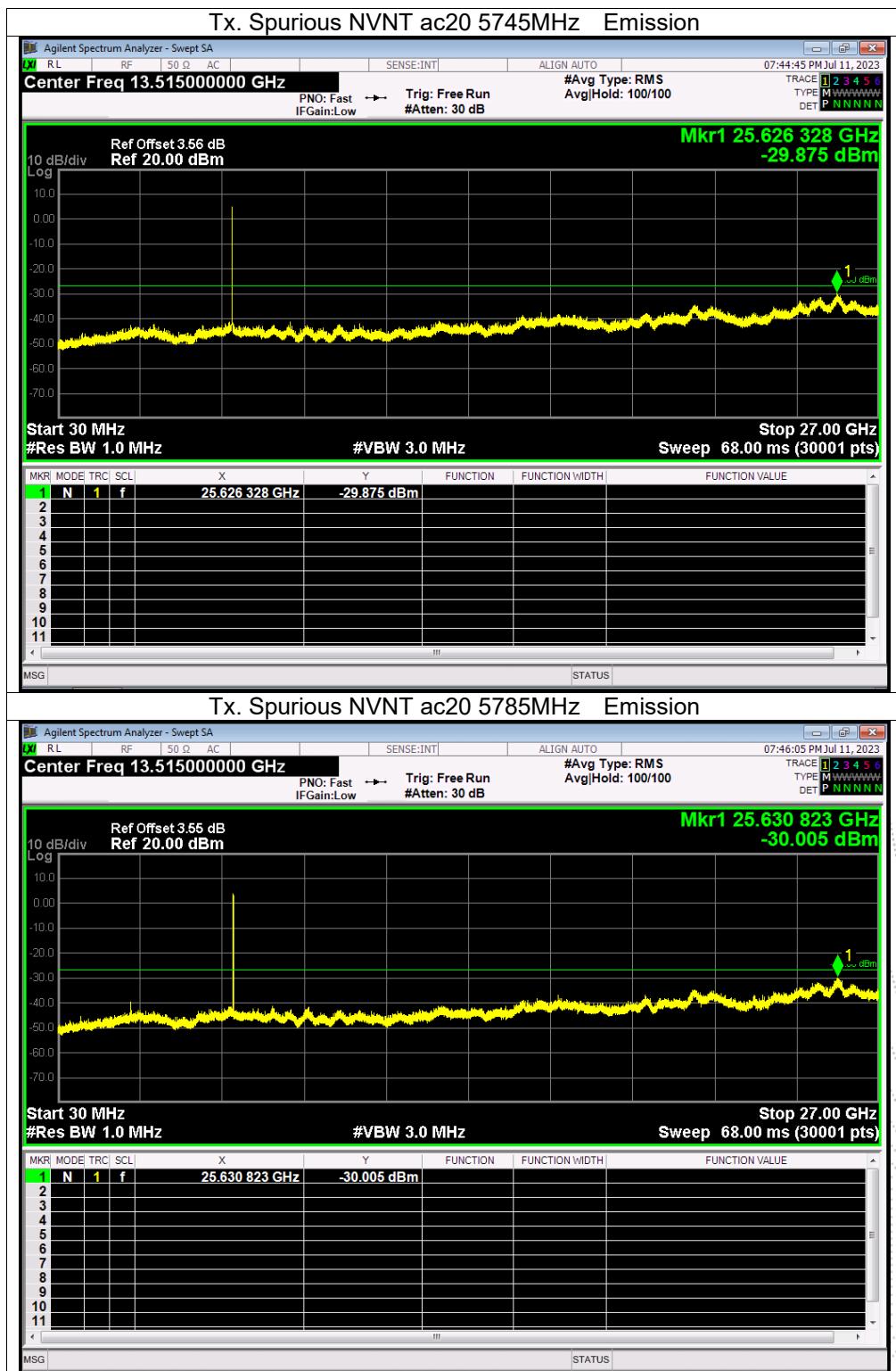
Note: A(B) Represent the value of antenna A and B, The worst data is Antenna A, only shown Antenna A.
Antenna A: 5745-58250MHz

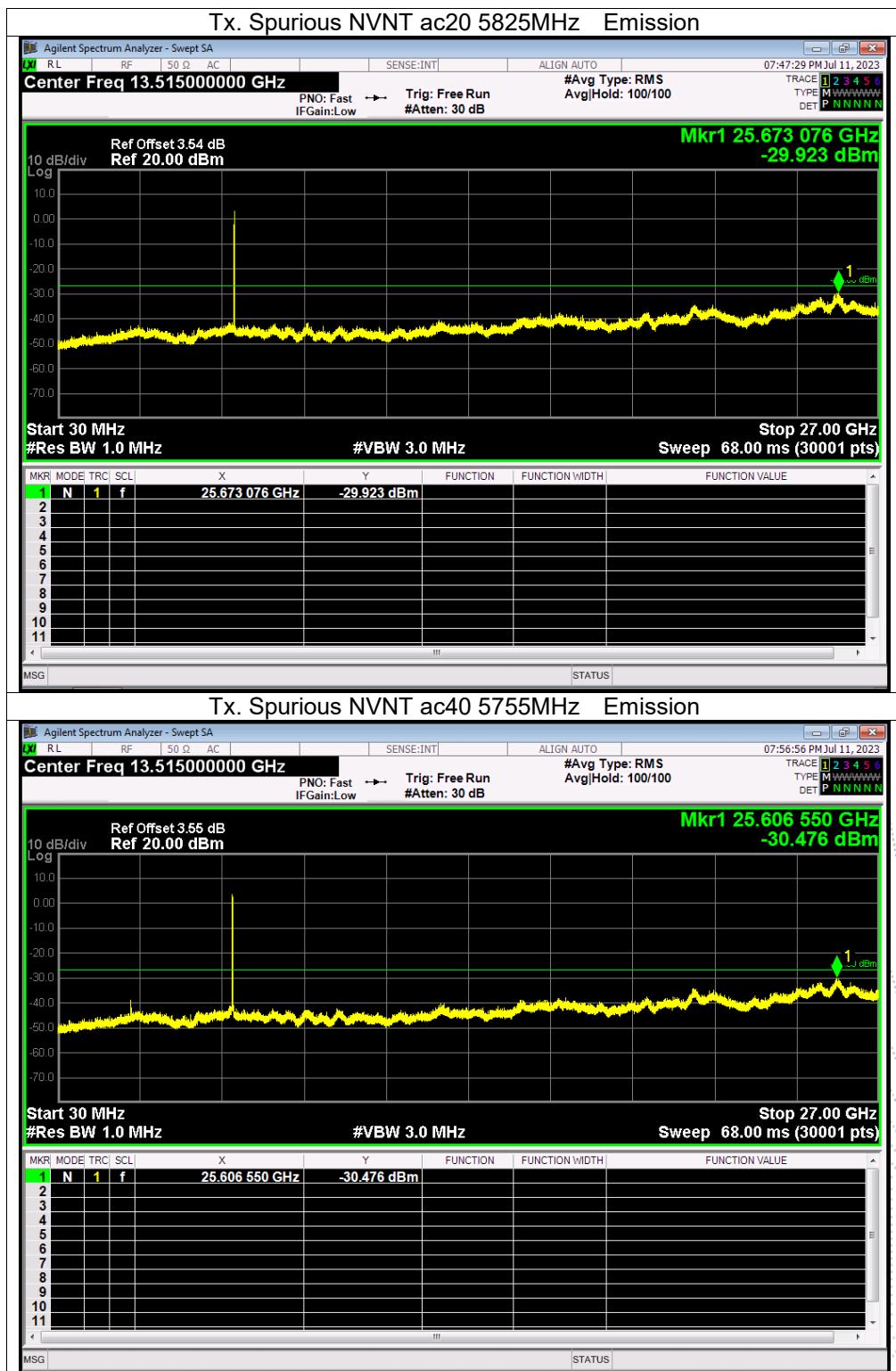


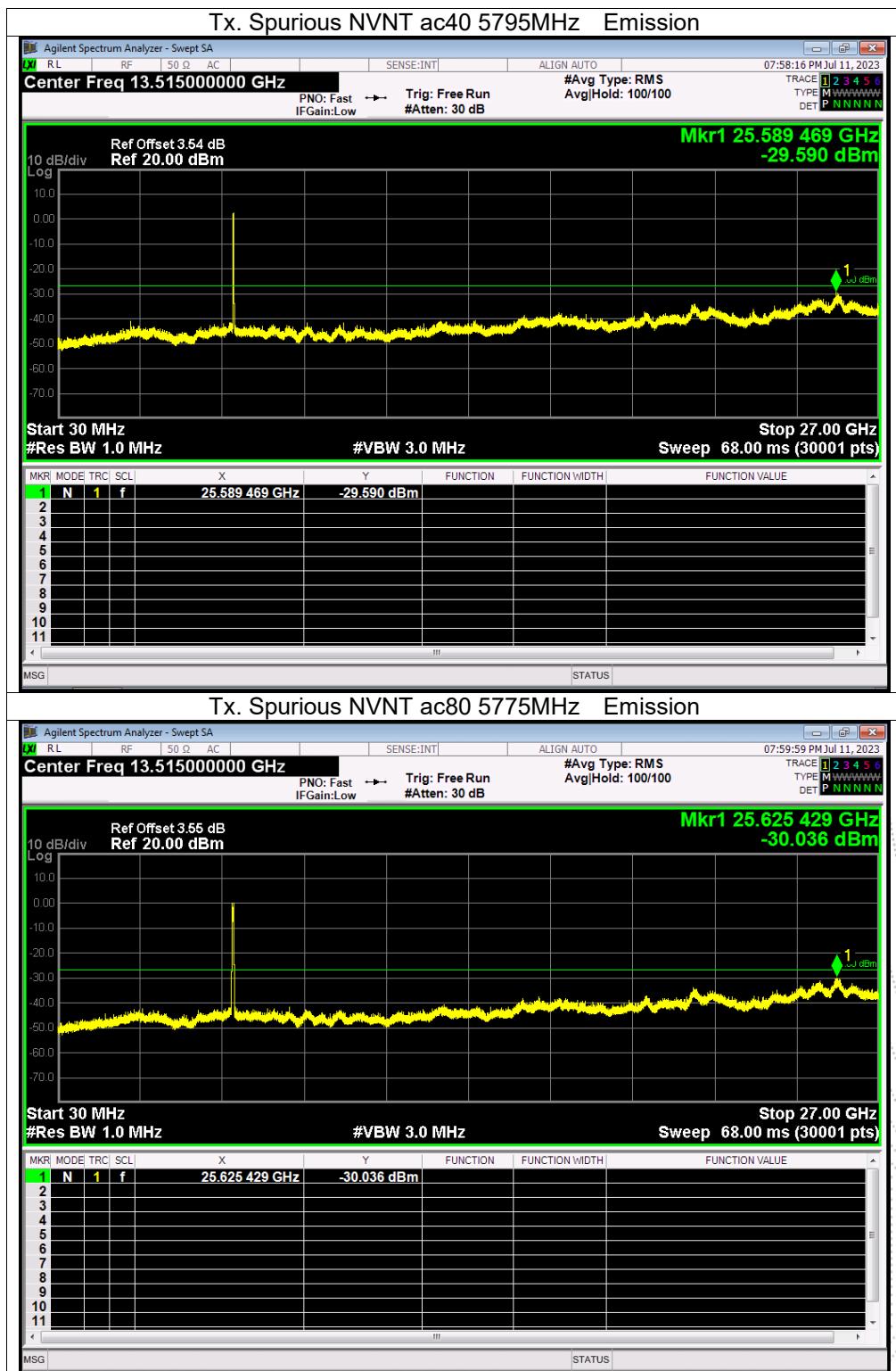


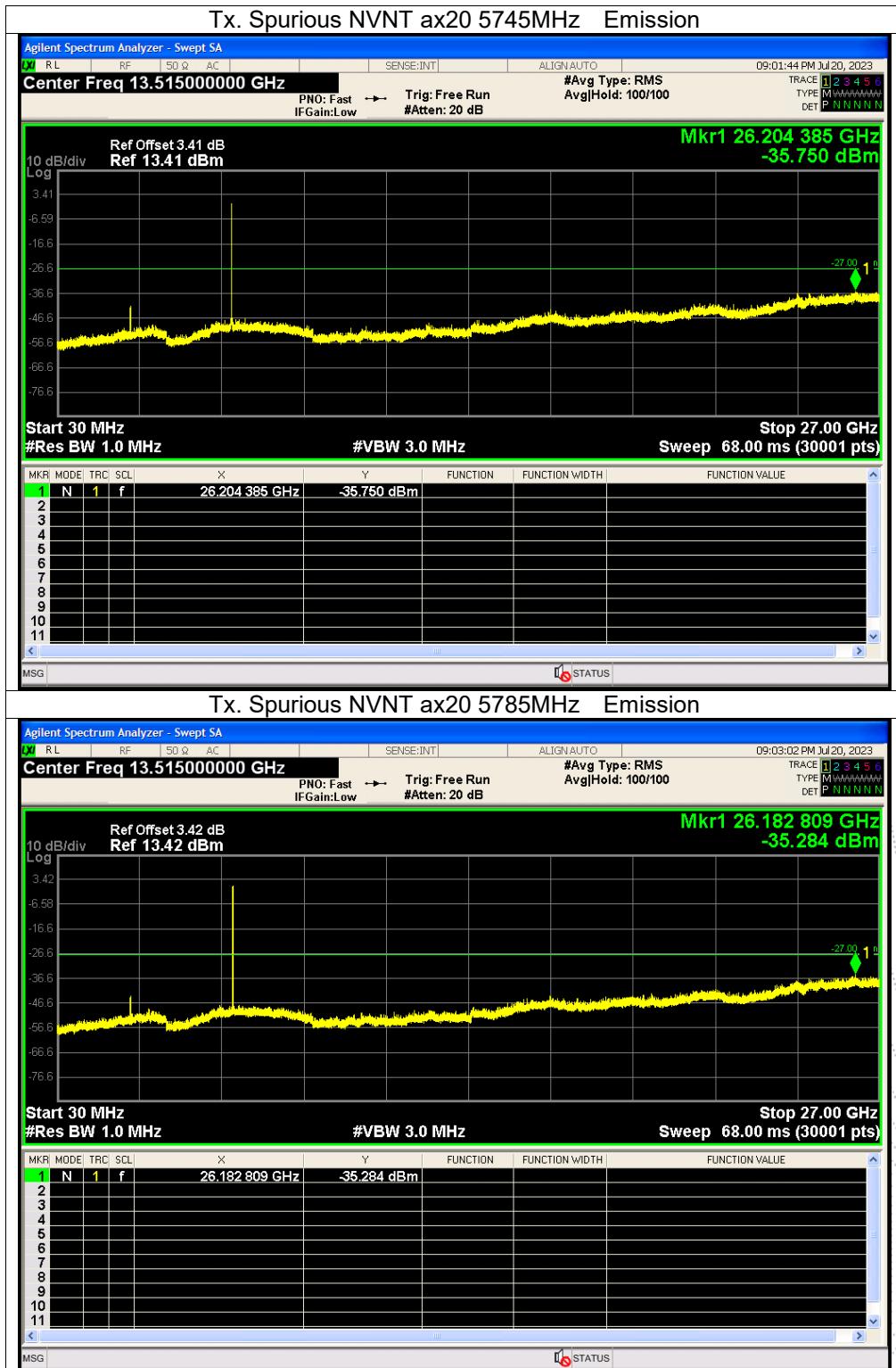








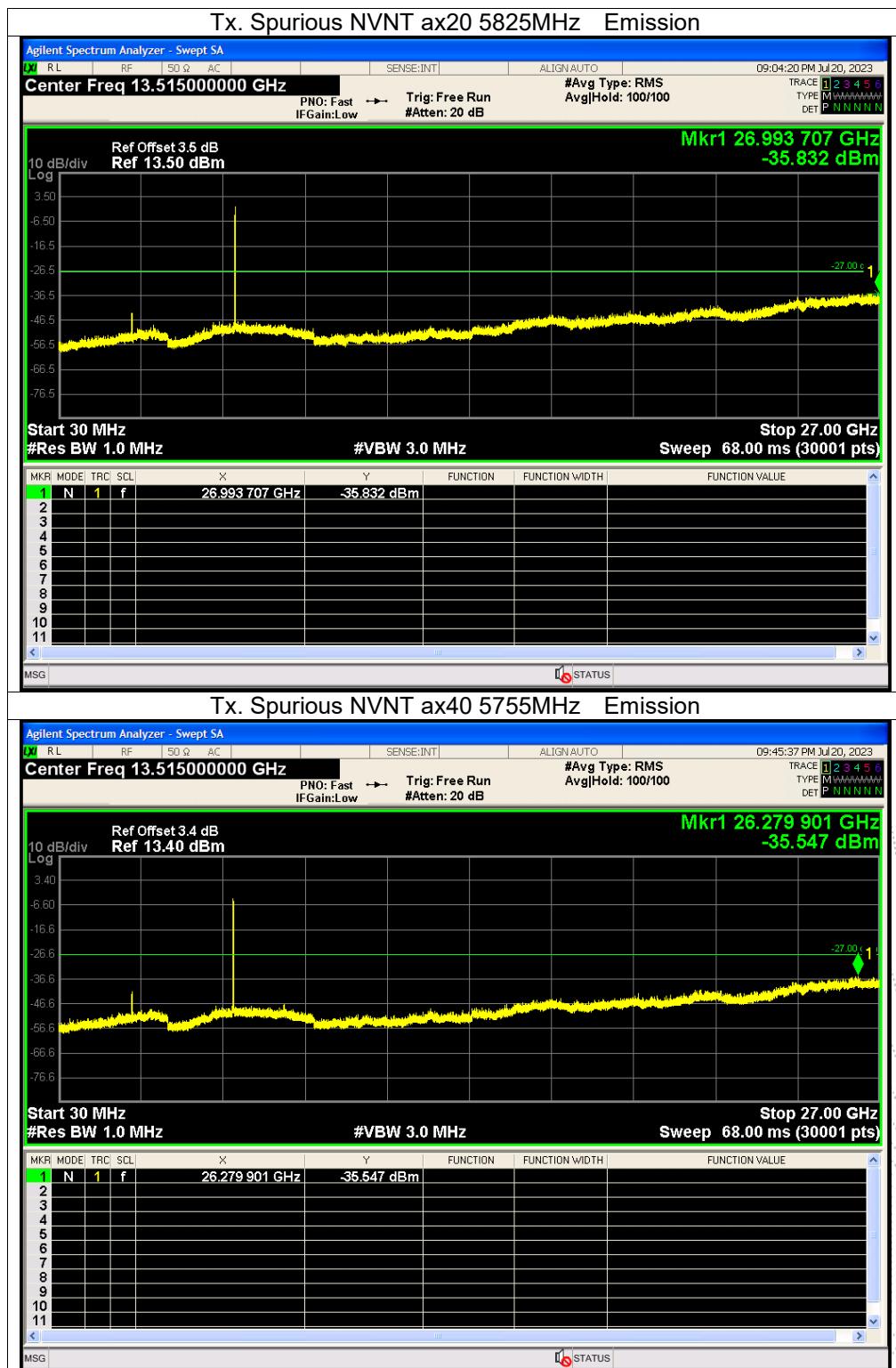


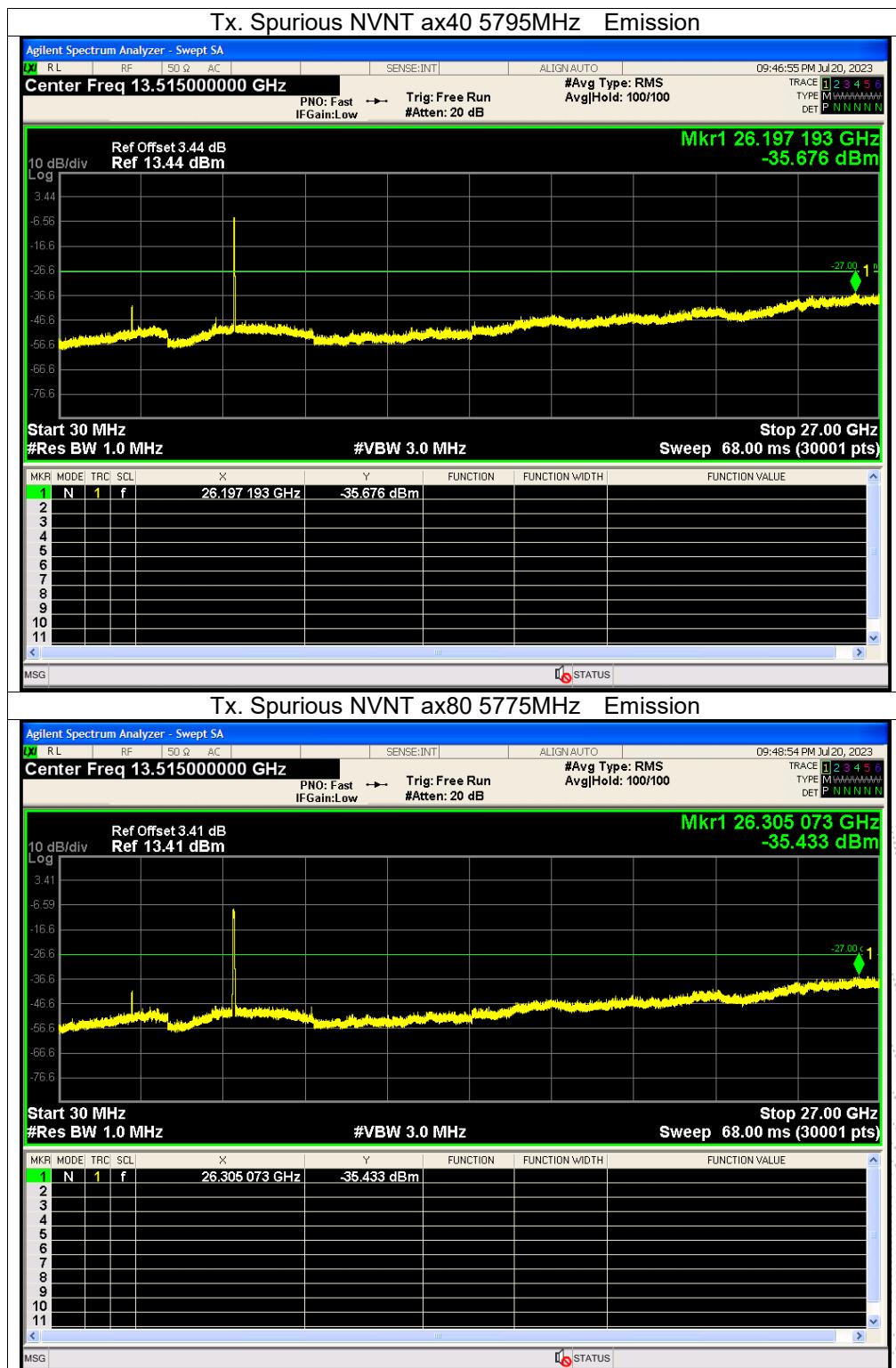




BCTC

Report No.: BCTC2307882250-4E





13. Frequency Stability Measurement

13.1 Block Diagram Of Test Setup



13.2 Limit

Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

The transmitter center frequency tolerance shall be ± 20 ppm maximum for the 5 GHz band (IEEE 802.11n specification)..

13.3 Test Procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. EUT have transmitted absence of modulation signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth.
4. Set RBW = 10 kHz, VBW = 10 kHz with peak detector and maxhold settings.
5. fc is declaring of channel frequency. Then the frequency error formula is $(fc-f)/fc \times 10^6$ ppm and he limit is less than ± 20 ppm (IEEE 802.11n specification).
6. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value
7. Extreme temperature is -20°C~70°C.

13.4 Test Result

Temperature :	26 °C	Relative Humidity :	54%
Pressure :	101kPa	Test Voltage :	DC 5V
Test Mode :	TX Frequency U-NII-1 (5180-5240MHz)		

Voltage vs. Frequency Stability

TEST CONDITIONS			Reference Frequency : 5180MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
T nom (°C)	20	V nom (V)	5.00	5180.0138	5180	0.0138	2.6676
		V max (V)	5.75	5180.0177	5180	0.0177	3.4122
		V min (V)	4.25	5180.0019	5180	0.0019	0.3643
Limits			5150-5250 MHz				
Result			Complies				

Temperature vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5180MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
V nom (V)	5	T (°C)	-20	5180.0097	5180	0.0097	1.8751
		T (°C)	-10	5180.0057	5180	0.0057	1.0957
		T (°C)	0	5180.0003	5180	0.0003	0.0595
		T (°C)	10	5180.0097	5180	0.0097	1.8724
		T (°C)	20	5180.0023	5180	0.0023	0.4532
		T (°C)	30	5180.0024	5180	0.0024	0.4551
		T (°C)	40	5180.0078	5180	0.0078	1.5037
		T (°C)	50	5180.0030	5180	0.0030	0.5864
		T (°C)	60	5180.0127	5180	0.0127	2.4434
		T (°C)	70	5180.0107	5180	0.0107	2.0737
Limits			5150-5250 MHz				
Result			Complies				

Voltage vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5200MHz					
			f	fc	Max. Deviation (MHz)		Max. Deviation (ppm)	
T nom (°C)	20	V nom (V)	5.00	5200.0100	5200	0.0100	1.9176	
		V max (V)	5.75	5200.0085	5200	0.0085	1.6404	
		V min (V)	4.25	5200.0043	5200	0.0043	0.8234	
Limits			5725-5850 MHz					
Result			Complies					

Temperature vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5200MHz					
			f	fc	Max. Deviation (MHz)		Max. Deviation (ppm)	
V nom (V)	5	T (°C)	-20	5200.01337	5200	0.01337	2.5718	
		T (°C)	-10	5200.00363	5200	0.00363	0.6988	
		T (°C)	0	5200.00332	5200	0.00332	0.6385	
		T (°C)	10	5200.00657	5200	0.00657	1.2631	
		T (°C)	20	5200.00687	5200	0.00687	1.3209	
		T (°C)	30	5200.01035	5200	0.01035	1.9898	
		T (°C)	40	5200.01299	5200	0.01299	2.4978	
		T (°C)	50	5200.00264	5200	0.00264	0.5073	
		T (°C)	60	5200.00180	5200	0.00180	0.3467	
		T (°C)	70	5200.00164	5200	0.00164	0.3159	
Limits			5150-5250 MHz					
Result			Complies					

Voltage vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5240MHz					
			f	fc	Max. Deviation (MHz)		Max. Deviation (ppm)	
T nom (°C)	20	V nom (V)	5.00	5240.0099	5240	0.0099	1.8978	
		V max (V)	5.75	5240.0111	5240	0.0111	2.1200	
		V min (V)	4.25	5240.0110	5240	0.0110	2.0959	
Limits			5150-5250 MHz					
Result			Complies					

Temperature vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5240MHz					
			f	fc	Max. Deviation (MHz)		Max. Deviation (ppm)	
V nom (V)	5	T (°C)	-20	5240.0109	5240	0.0109	2.0894	
		T (°C)	-10	5240.0054	5240	0.0054	1.0316	
		T (°C)	0	5240.0064	5240	0.0064	1.2220	
		T (°C)	10	5240.0095	5240	0.0095	1.8168	
		T (°C)	20	5240.0079	5240	0.0079	1.5120	
		T (°C)	30	5240.0131	5240	0.0131	2.4917	
		T (°C)	40	5240.0056	5240	0.0056	1.0677	
		T (°C)	50	5240.0008	5240	0.0008	0.1489	
		T (°C)	60	5240.0012	5240	0.0012	0.2196	
		T (°C)	70	5240.0044	5240	0.0044	0.8339	
Limits			5150-5250 MHz					
Result			Complies					

Temperature :	26 °C	Relative Humidity :	54%
Pressure :	101kPa	Test Voltage :	DC 5V
Test Mode :	TX Frequency(5745-5825MHz)		

Voltage vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5745MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
T nom ("C)	20	V nom (V)	5.00	5745.00452	5745	0.00452	
		V max (V)	5.75	5745.01060	5745	0.01060	
		V min (V)	4.25	5745.00523	5745	0.00523	
Limits			5725-5850 MHz				
Result			Complies				

Temperature vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5745MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
V nom (V)	5	T ("C)	-20	5745.01141	5745	0.01141	
		T ("C)	-10	5745.00199	5745	0.00199	
		T ("C)	0	5745.00697	5745	0.00697	
		T ("C)	10	5745.01352	5745	0.01352	
		T ("C)	20	5745.00268	5745	0.00268	
		T ("C)	30	5745.00266	5745	0.00266	
		T ("C)	40	5745.00106	5745	0.00106	
		T ("C)	50	5745.00293	5745	0.00293	
		T ("C)	60	5745.00923	5745	0.00923	
		T ("C)	70	5745.00639	5745	0.00639	
Limits			5725-5850 MHz				
Result			Complies				

Voltage vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5785MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
T nom (°C)	20	V nom (V)	5.00	5785.01264	5785	0.01264	2.1843
		V max (V)	5.75	5785.00070	5785	0.00070	0.1205
		V min (V)	4.25	5785.00307	5785	0.00307	0.5313
Limits			5725-5850 MHz				
Result			Complies				

Temperature vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5785MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
V nom (V)	5	T (°C)	-20	5785.00242	5785	0.00242	0.4182
		T (°C)	-10	5785.01137	5785	0.01137	1.9663
		T (°C)	0	5785.00627	5785	0.00627	1.0845
		T (°C)	10	5785.00899	5785	0.00899	1.5540
		T (°C)	20	5785.00481	5785	0.00481	0.8308
		T (°C)	30	5785.00017	5785	0.00017	0.0294
		T (°C)	40	5785.01228	5785	0.01228	2.1221
		T (°C)	50	5785.00156	5785	0.00156	0.2697
		T (°C)	60	5785.01035	5785	0.01035	1.7898
		T (°C)	70	5785.00116	5785	0.00116	0.2011
Limits			5725-5850 MHz				
Result			Complies				

Voltage vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5825MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
T nom (°C)	20	V nom (V)	5.00	5825.00433	5825	0.00433	0.7442
		V max (V)	5.75	5825.01203	5825	0.01203	2.0652
		V min (V)	4.25	5825.01173	5825	0.01173	2.0138
Limits			5725-5850 MHz				
Result			Complies				

Temperature vs. Frequency Stability

TEST CONDITIONS			Reference Frequency: 5825MHz				
			f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)	
V nom (V)	5	T (°C)	-20	5825.01035	5825	0.01035	1.7771
		T (°C)	-10	5825.00273	5825	0.00273	0.4691
		T (°C)	0	5825.00832	5825	0.00832	1.4290
		T (°C)	10	5825.01009	5825	0.01009	1.7318
		T (°C)	20	5825.00710	5825	0.00710	1.2190
		T (°C)	30	5825.00482	5825	0.00482	0.8274
		T (°C)	40	5825.00044	5825	0.00044	0.0749
		T (°C)	50	5825.00591	5825	0.00591	1.0146
		T (°C)	60	5825.00183	5825	0.00183	0.3142
		T (°C)	70	5825.00609	5825	0.00609	1.0461
Limits			5725-5850 MHz				
Result			Complies				

14. Antenna Requirement

14.1 Limit

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

14.2 Test Result

The EUT antenna is Internal antenna (antenna gain (A):0.02 dBi; antenna gain (B) : -1.64 dBi). It comply with the standard requirement.

