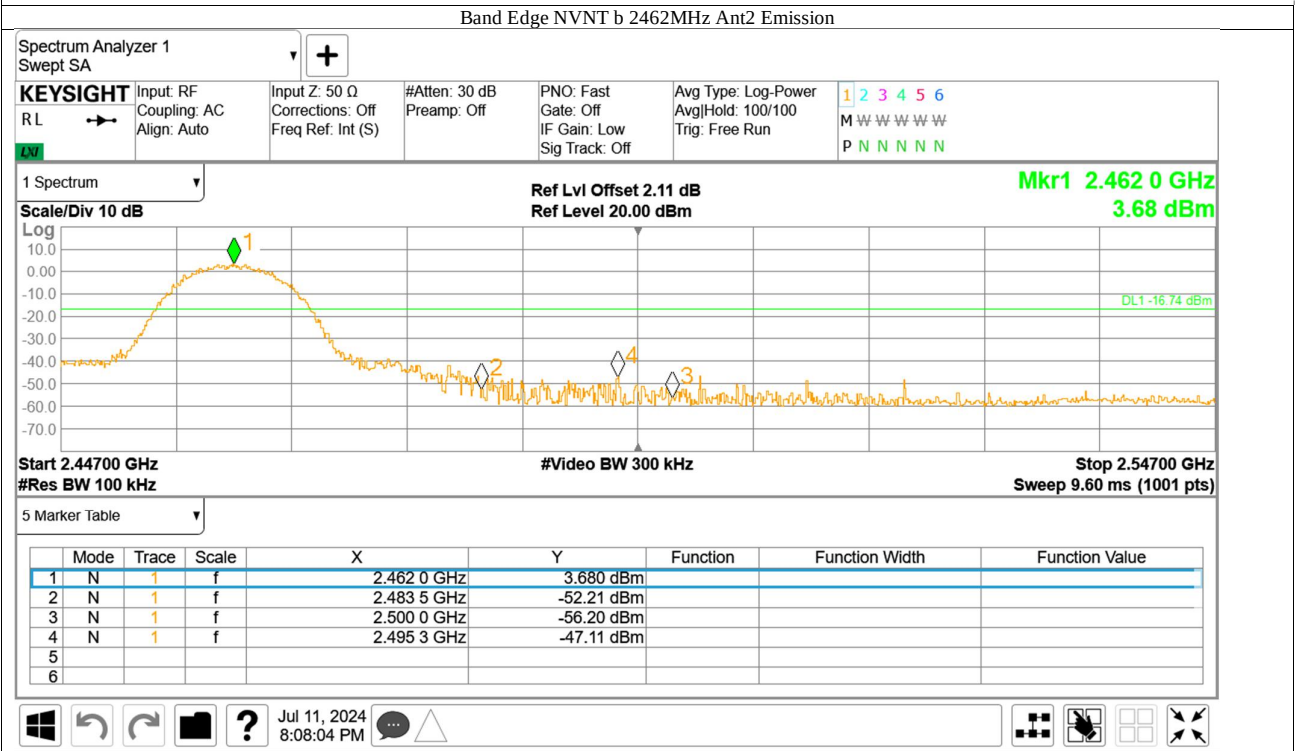
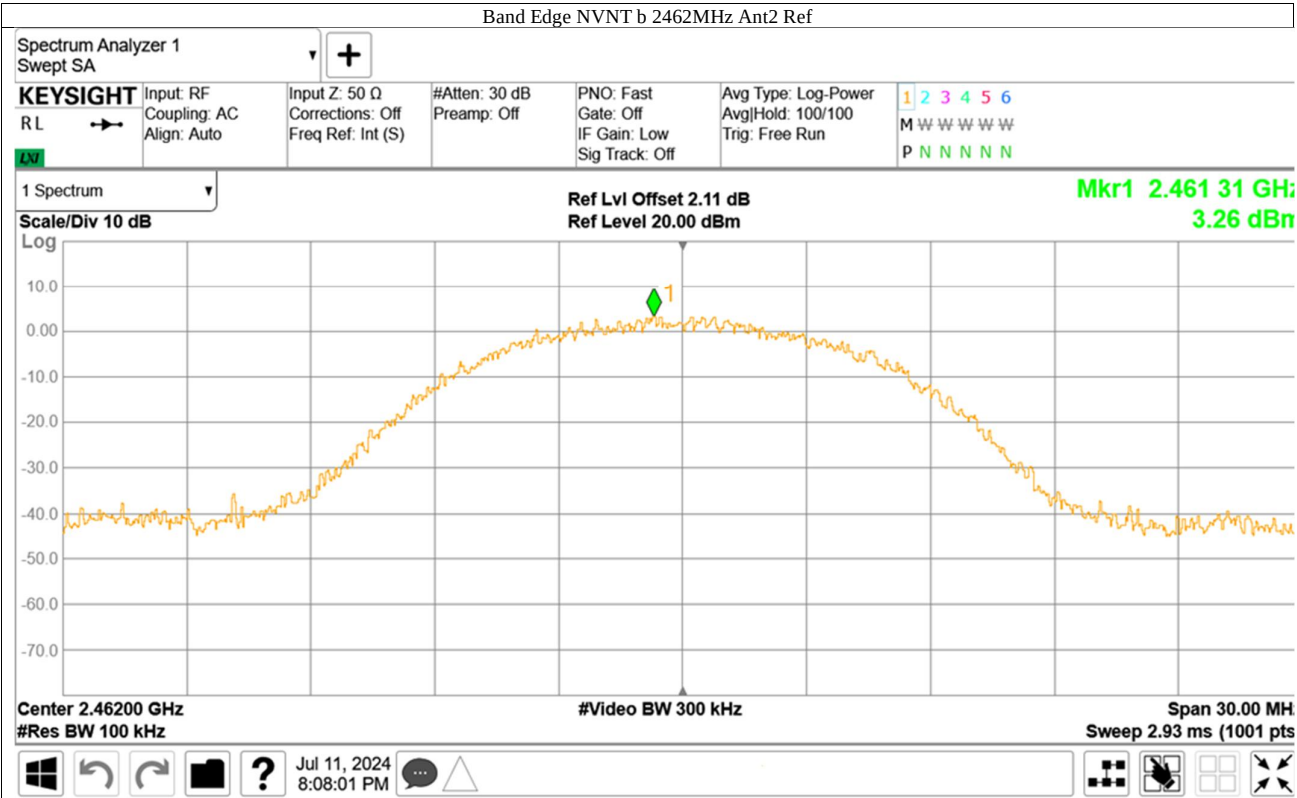
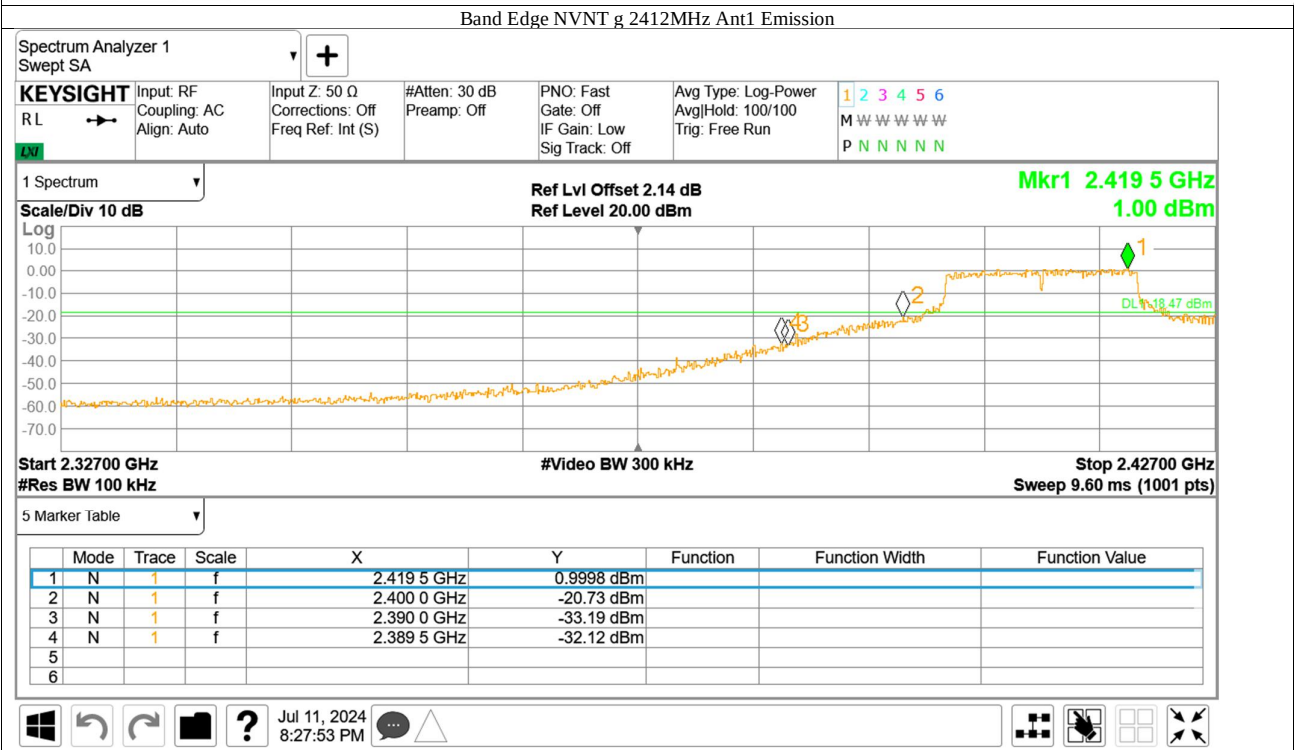
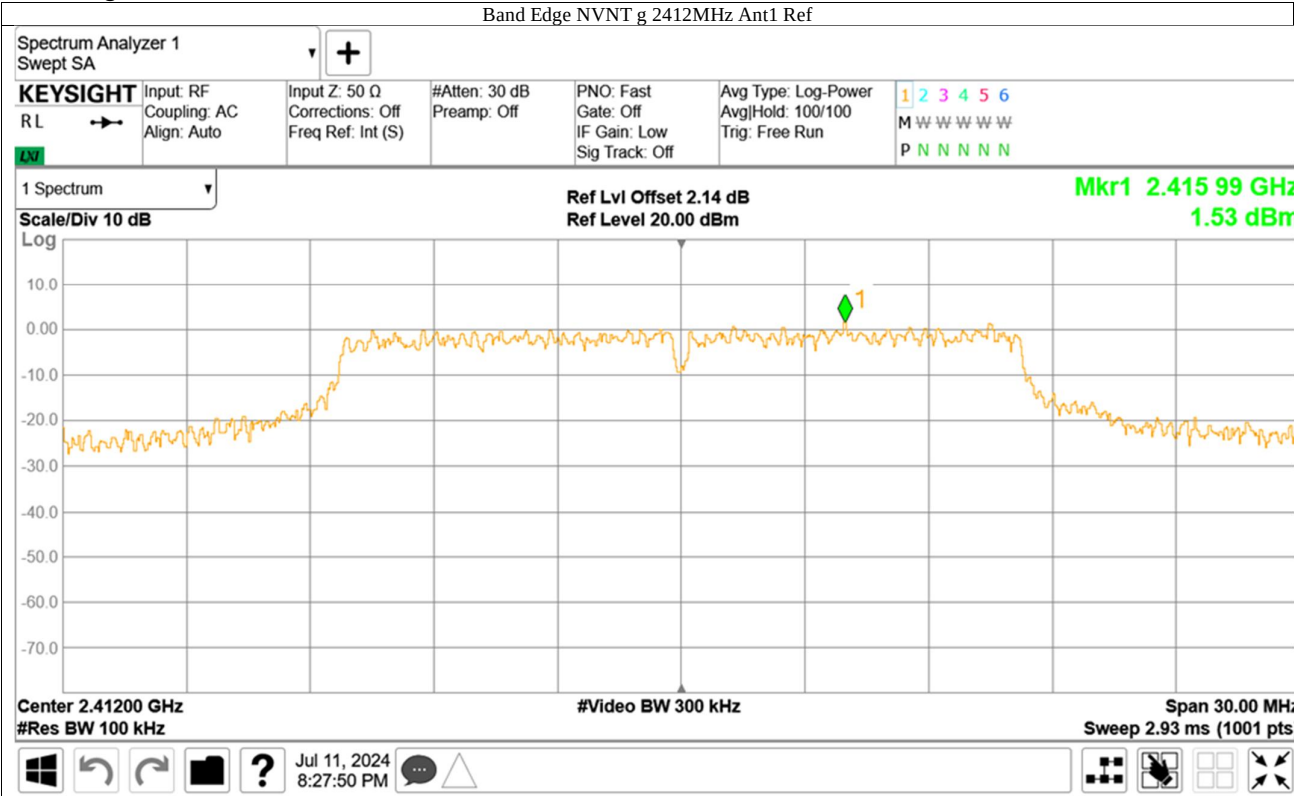
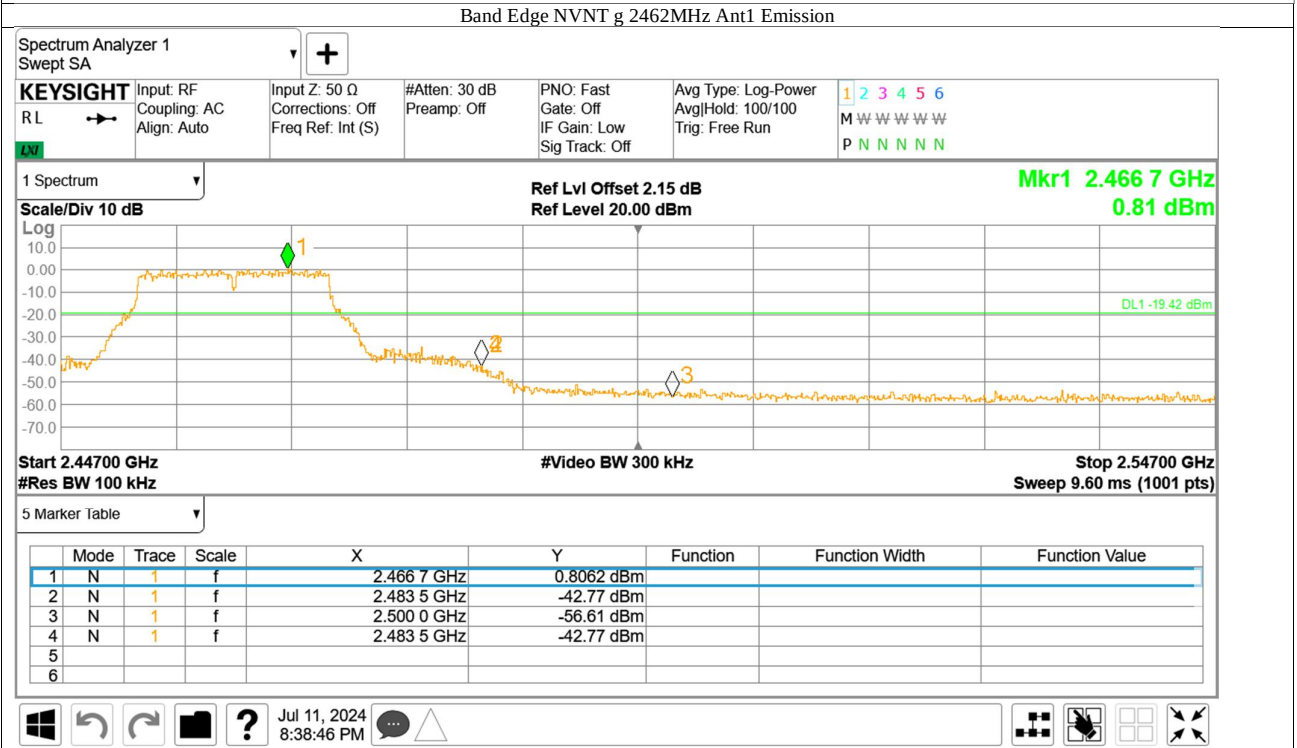
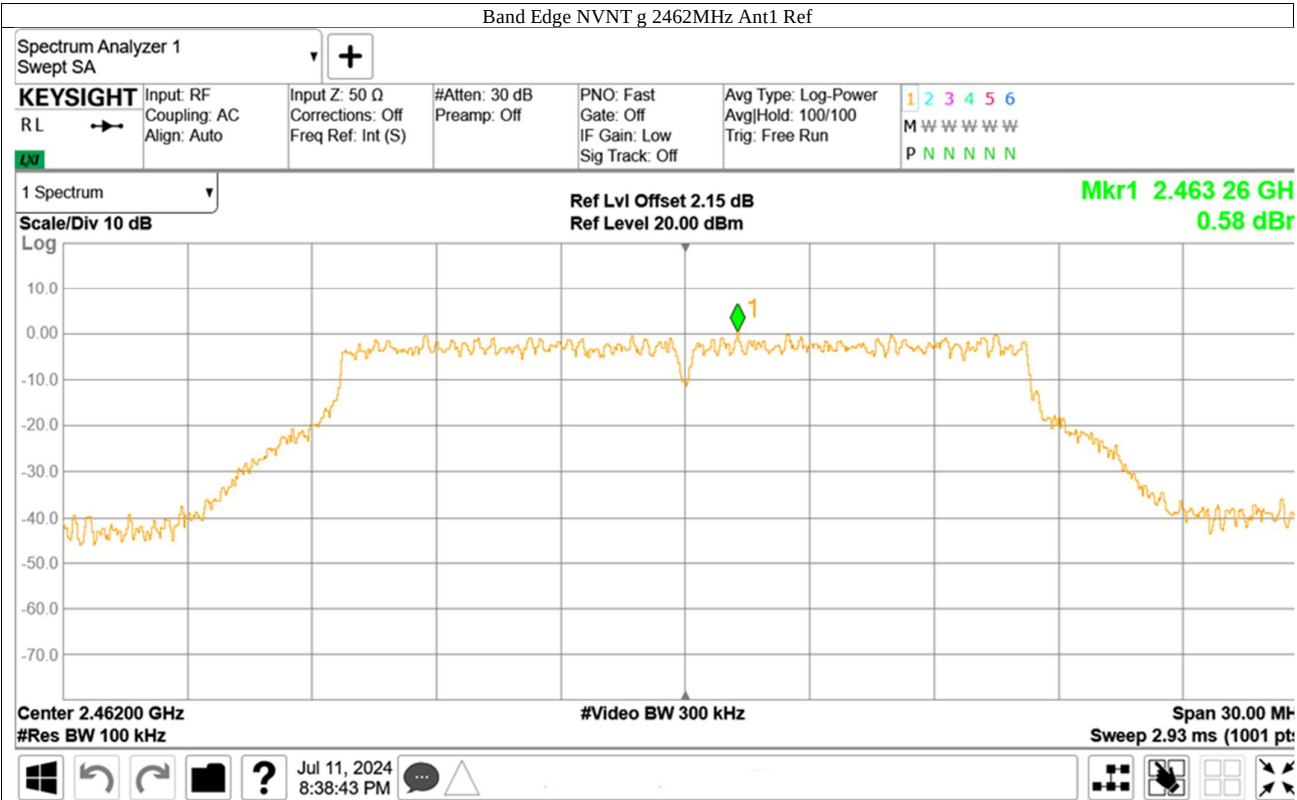


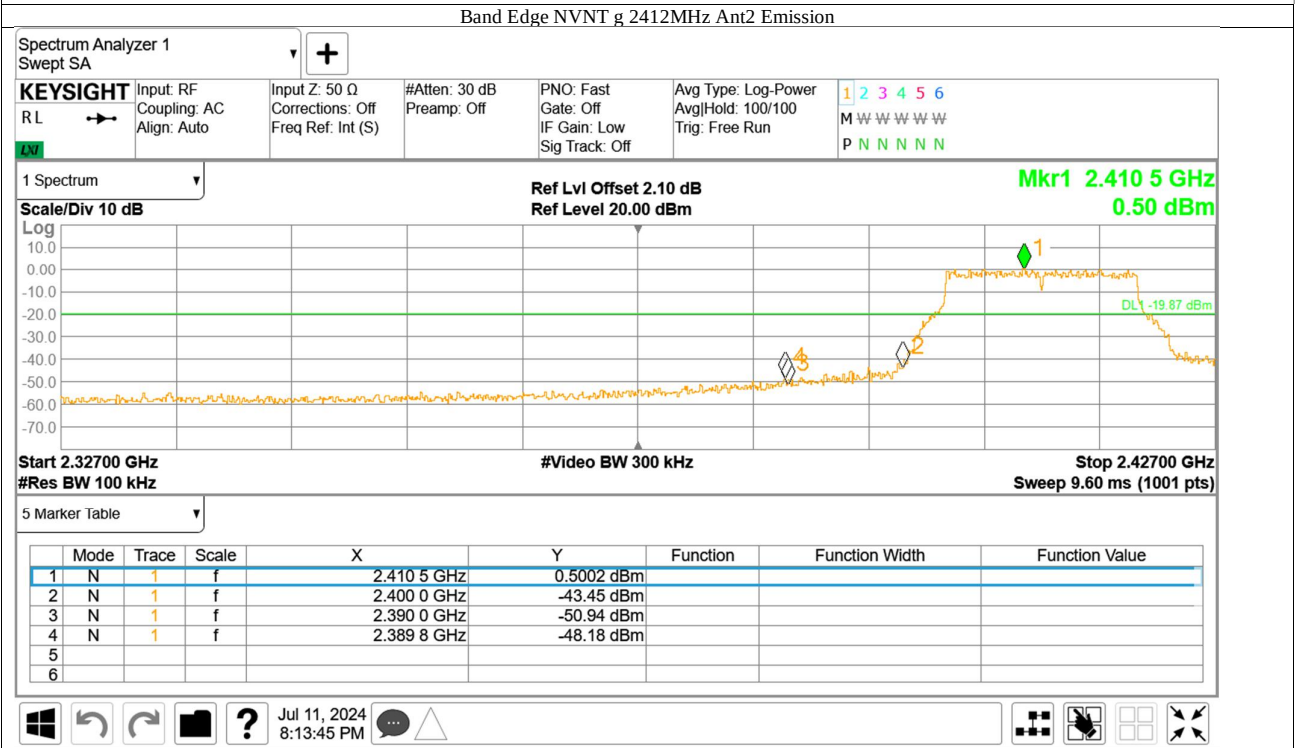
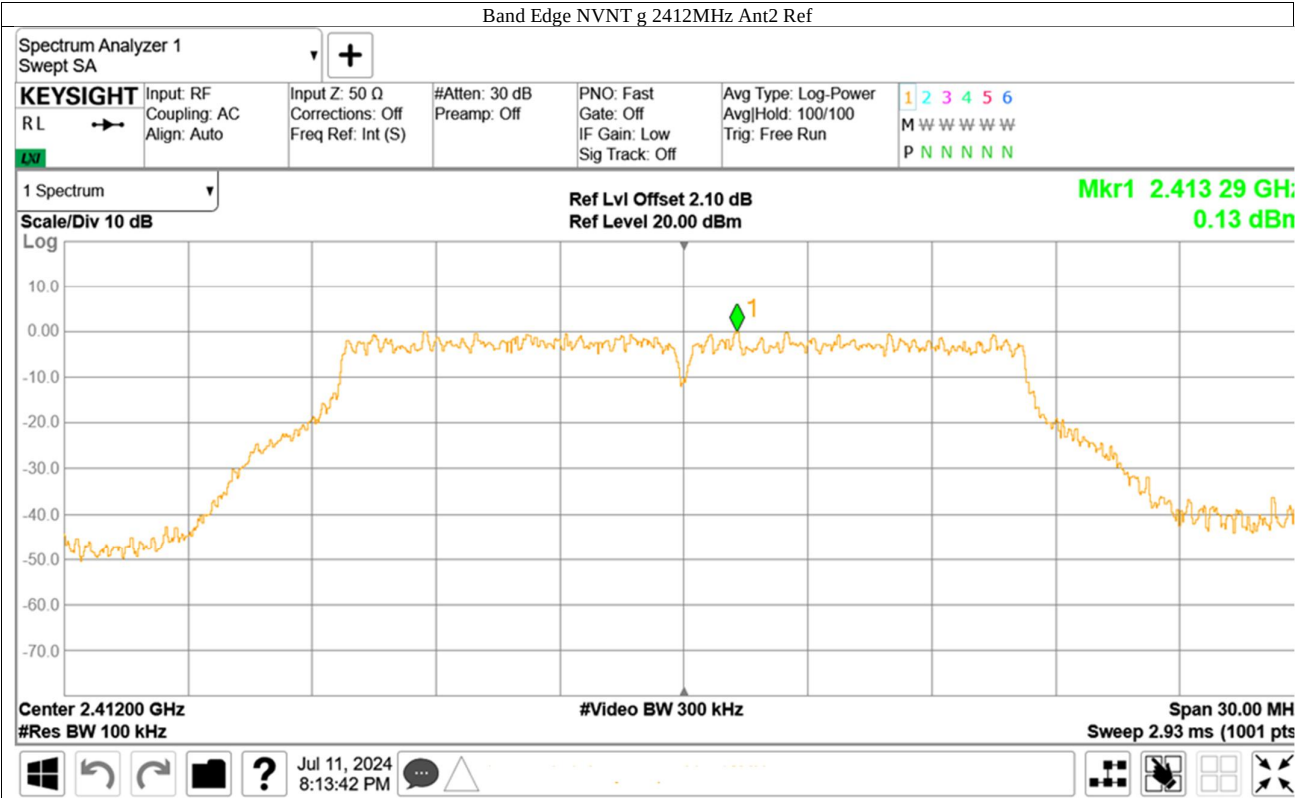


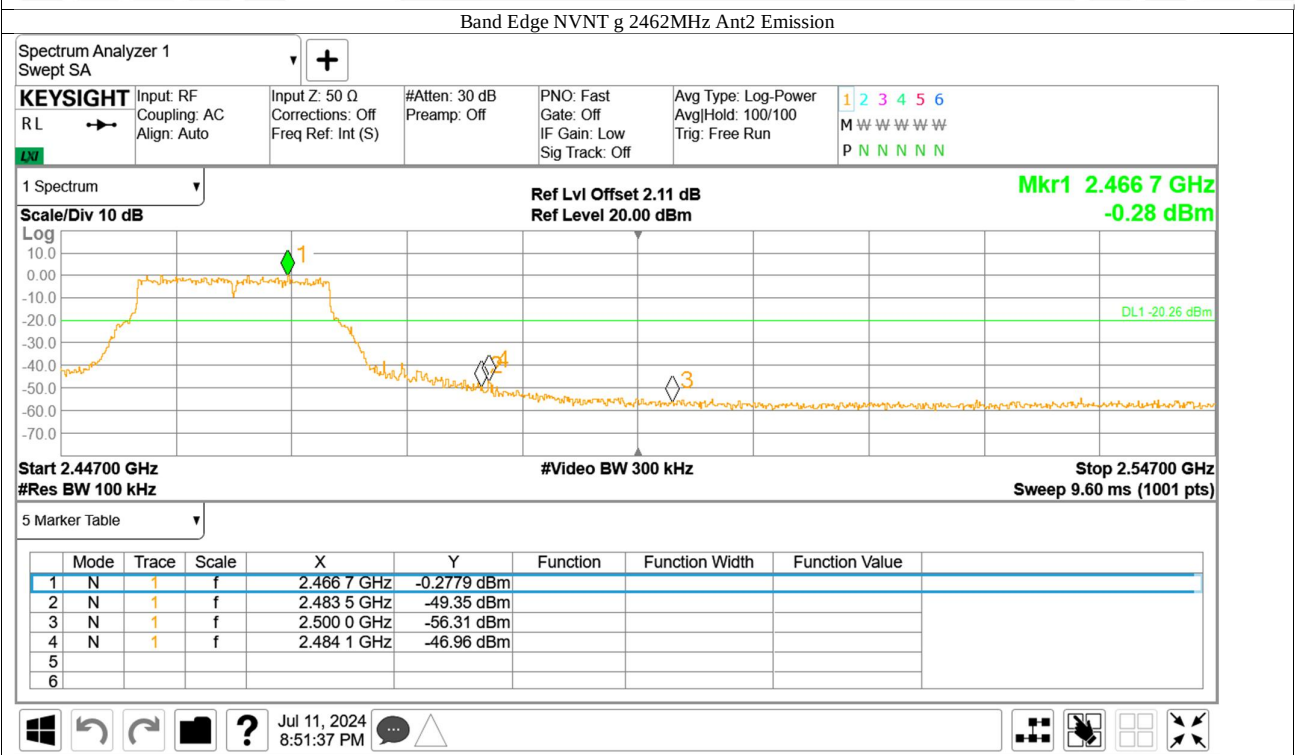
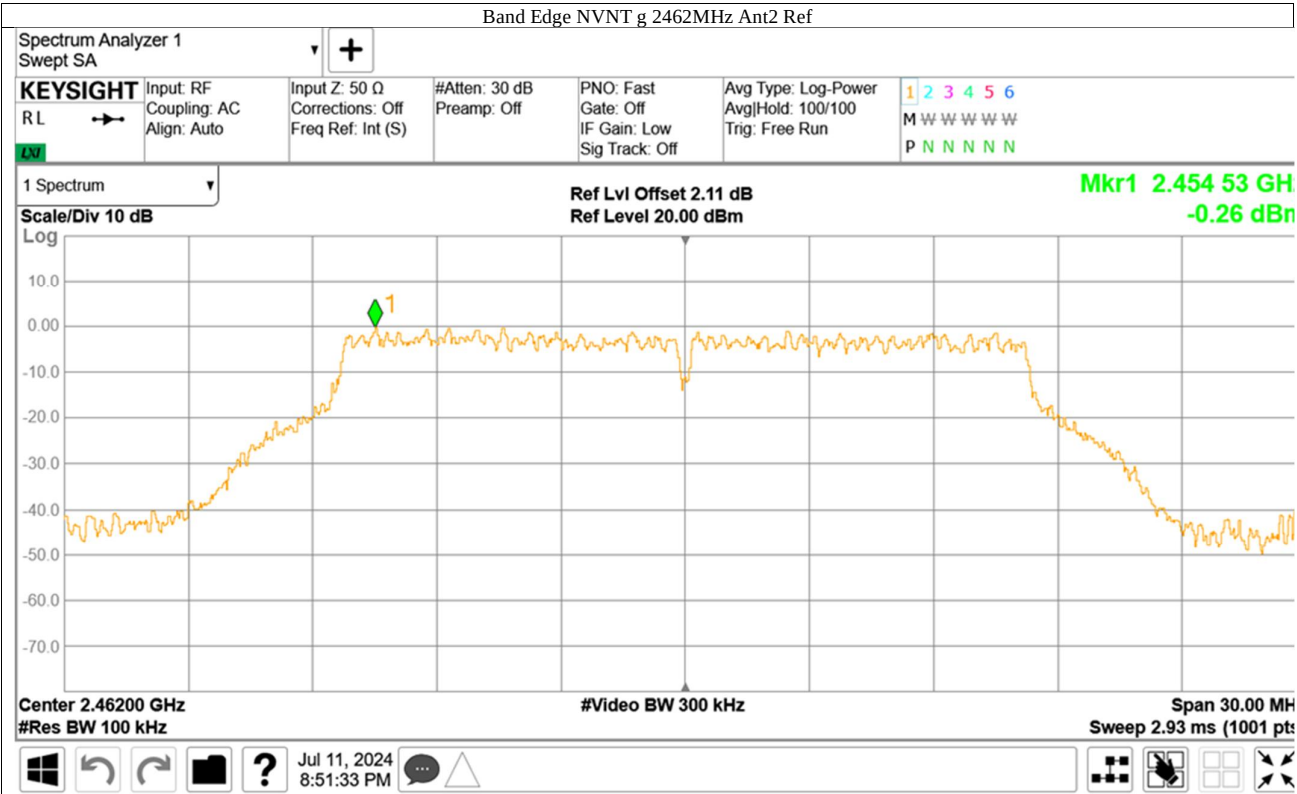


802.11 g



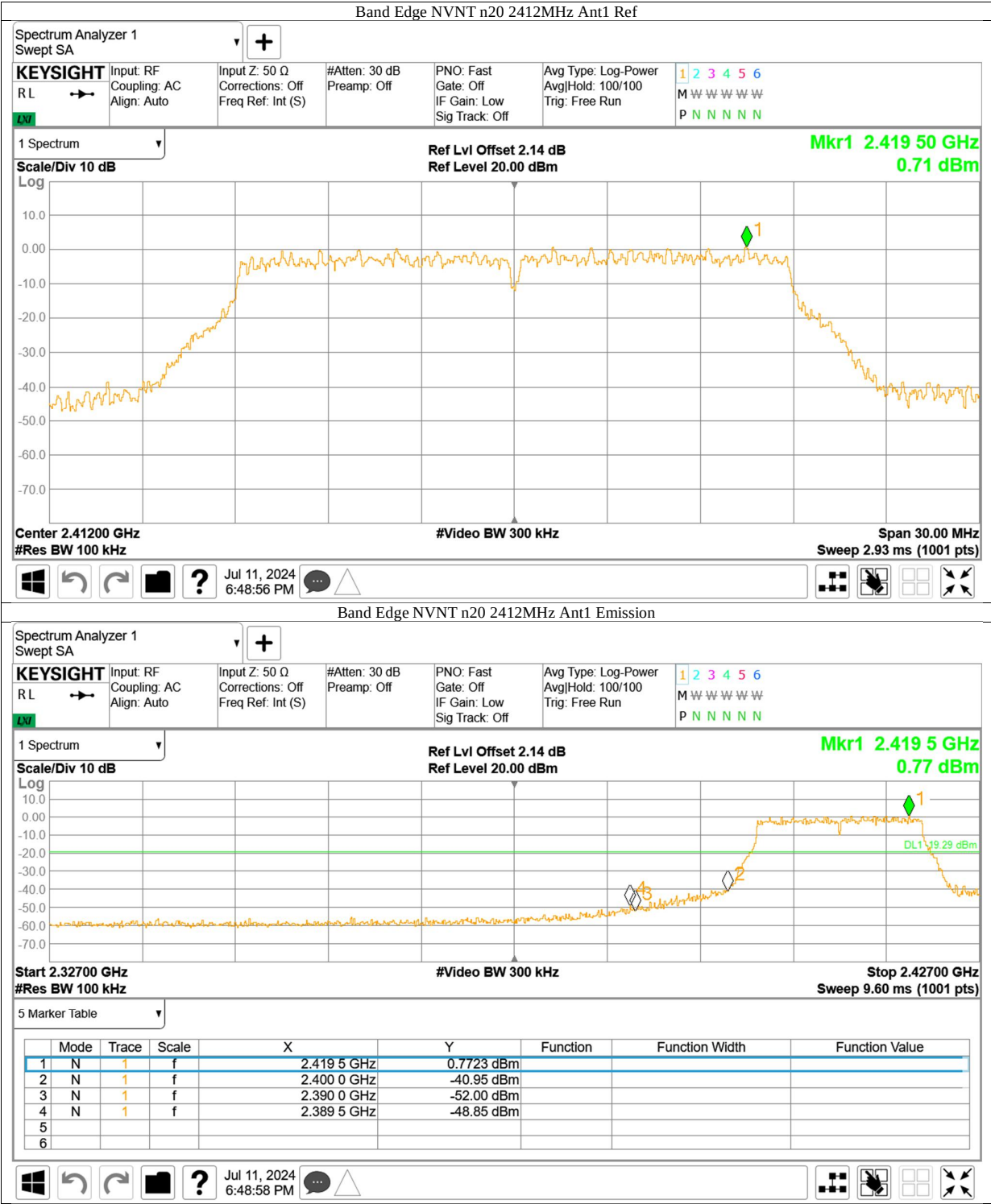


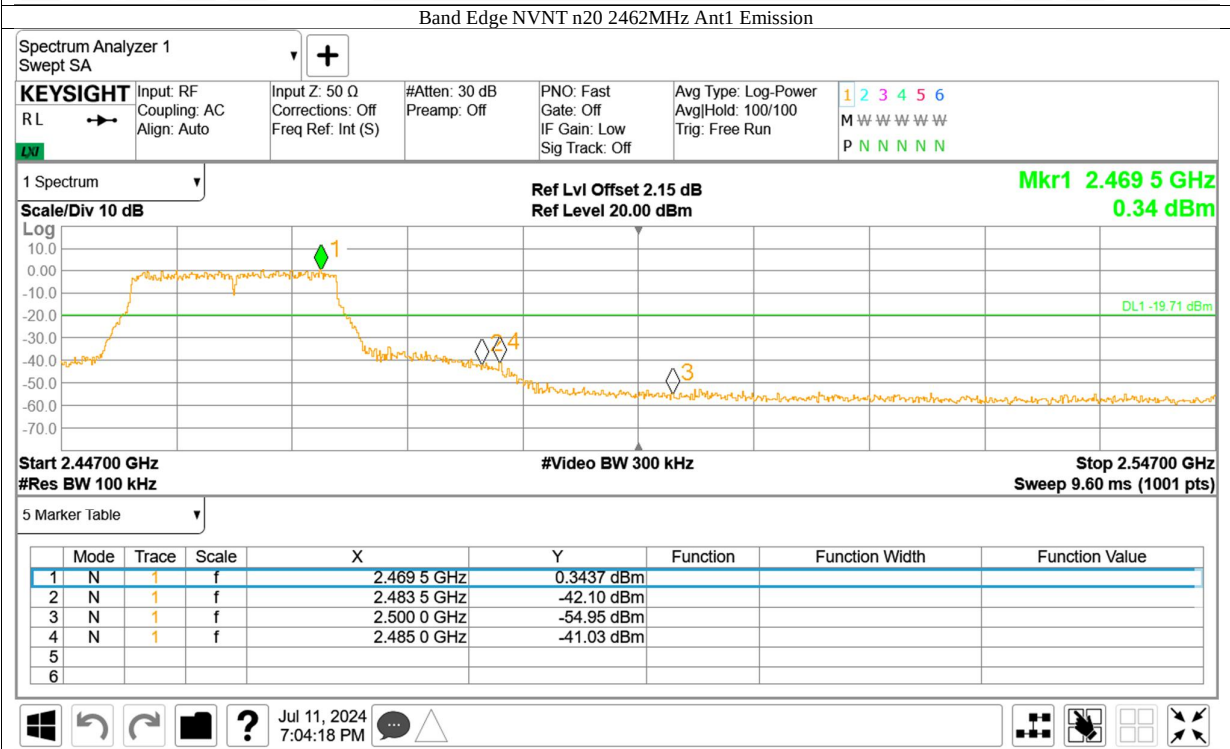
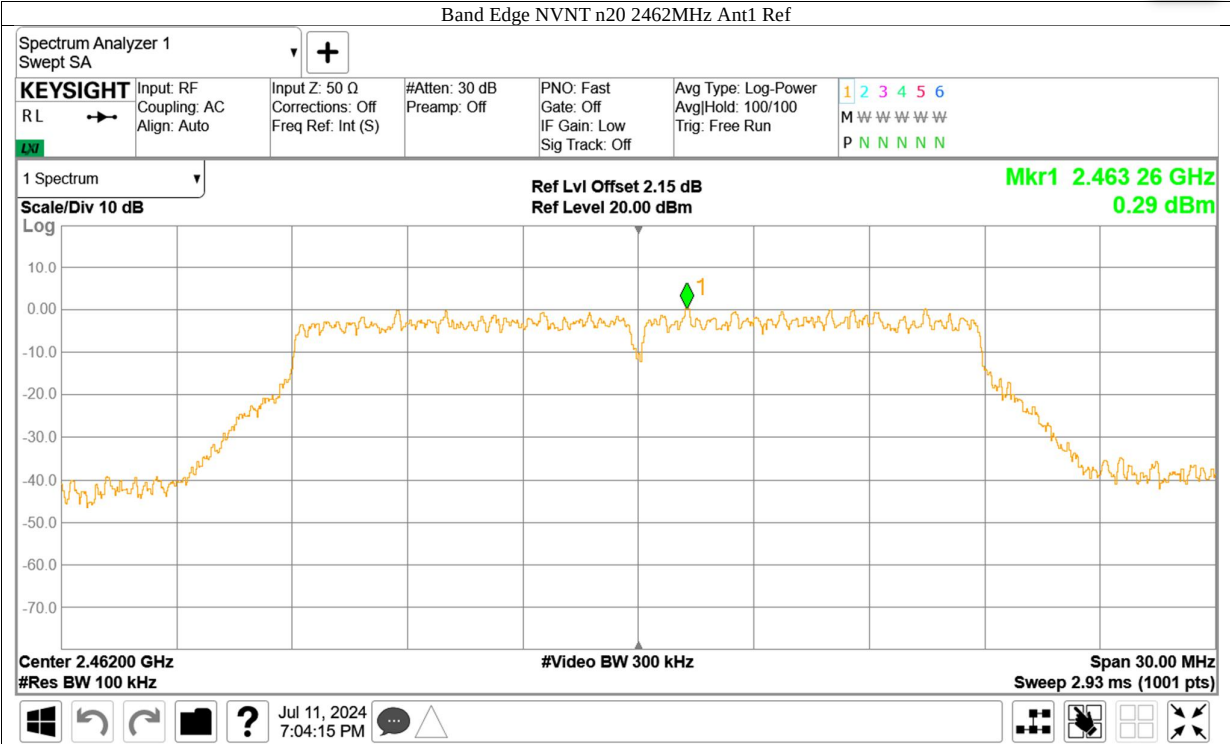


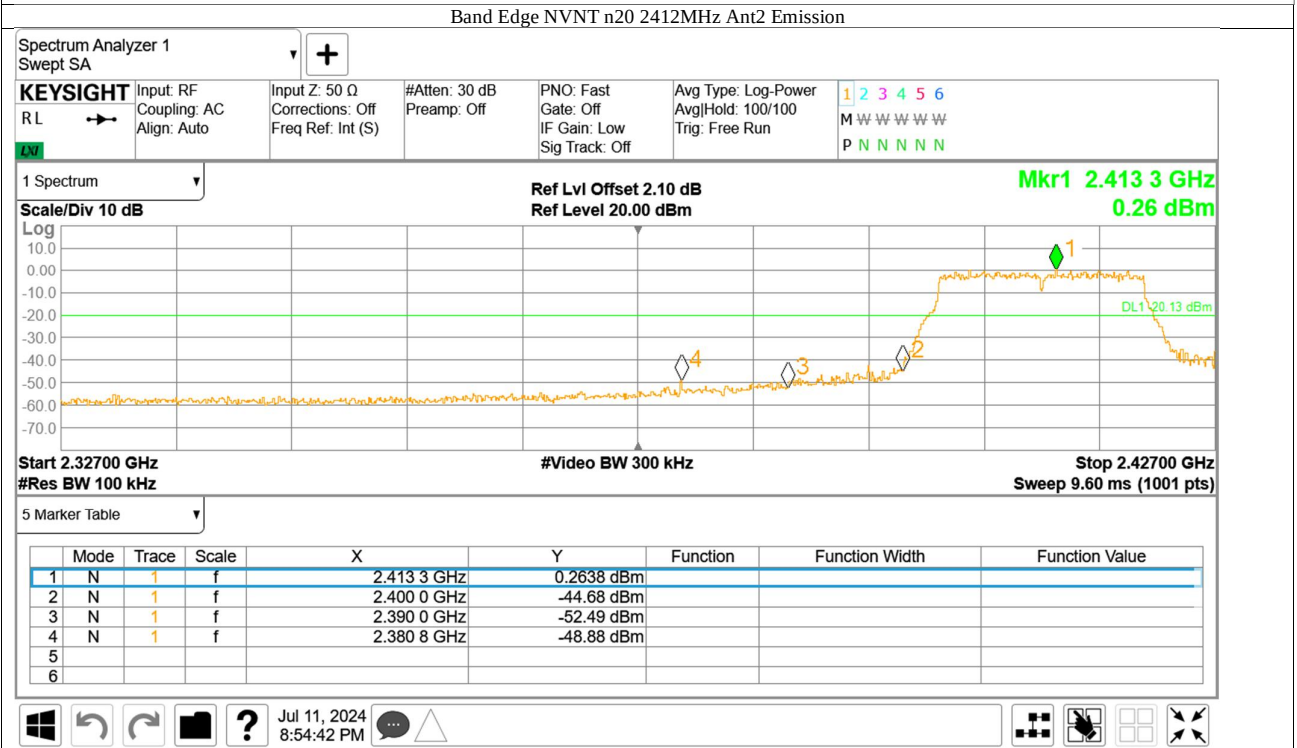
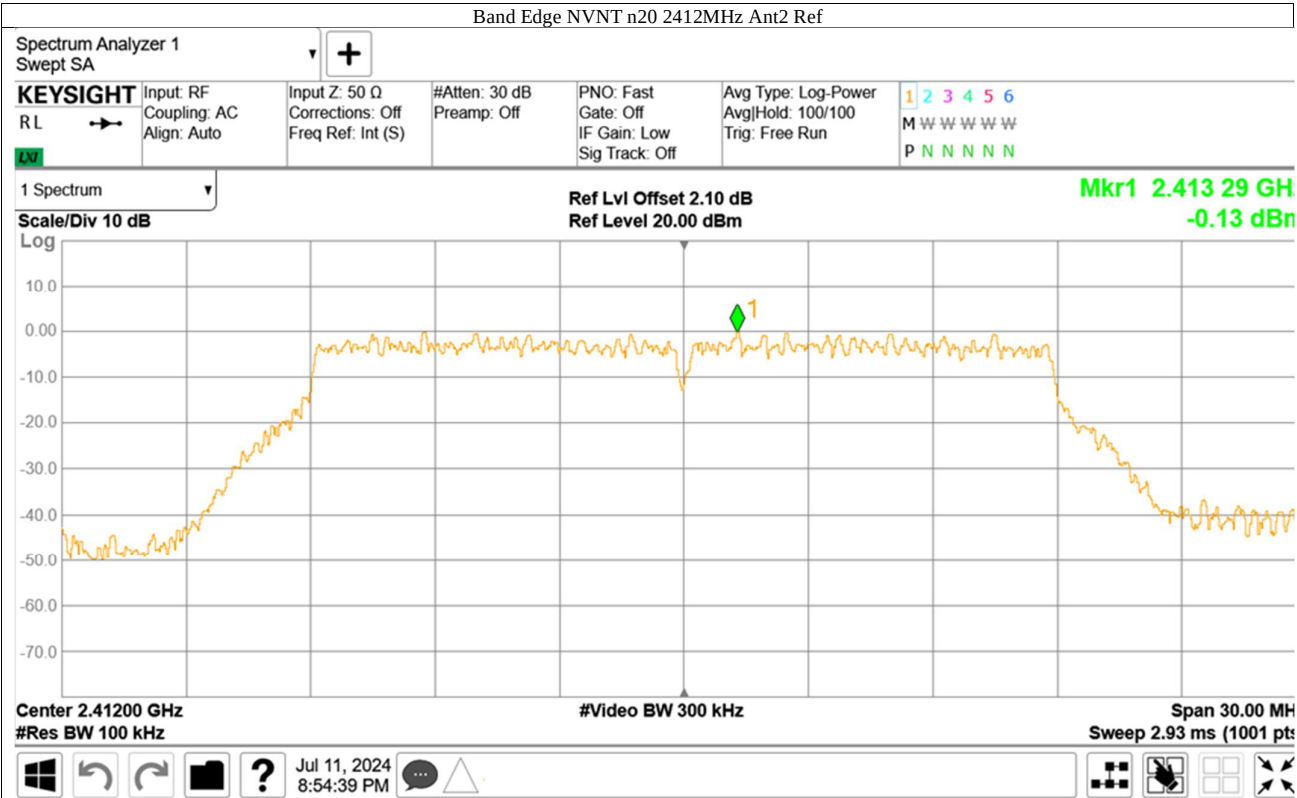


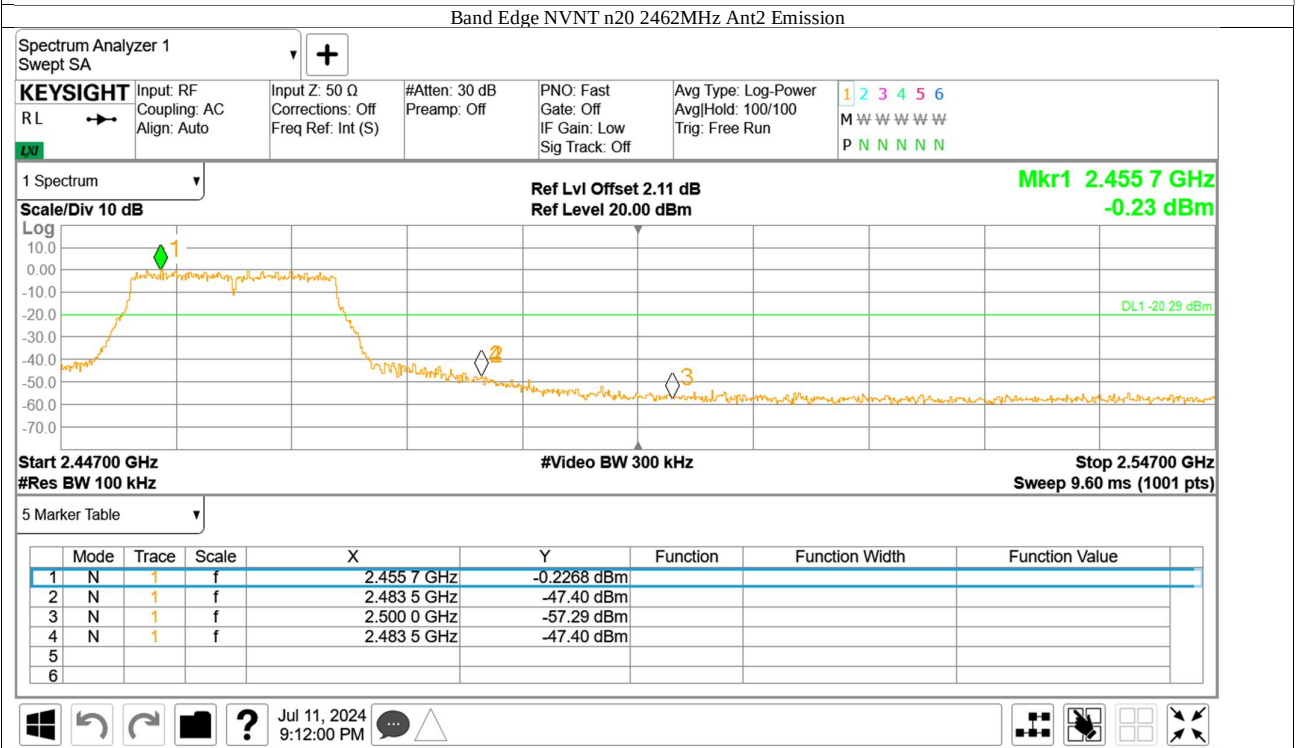
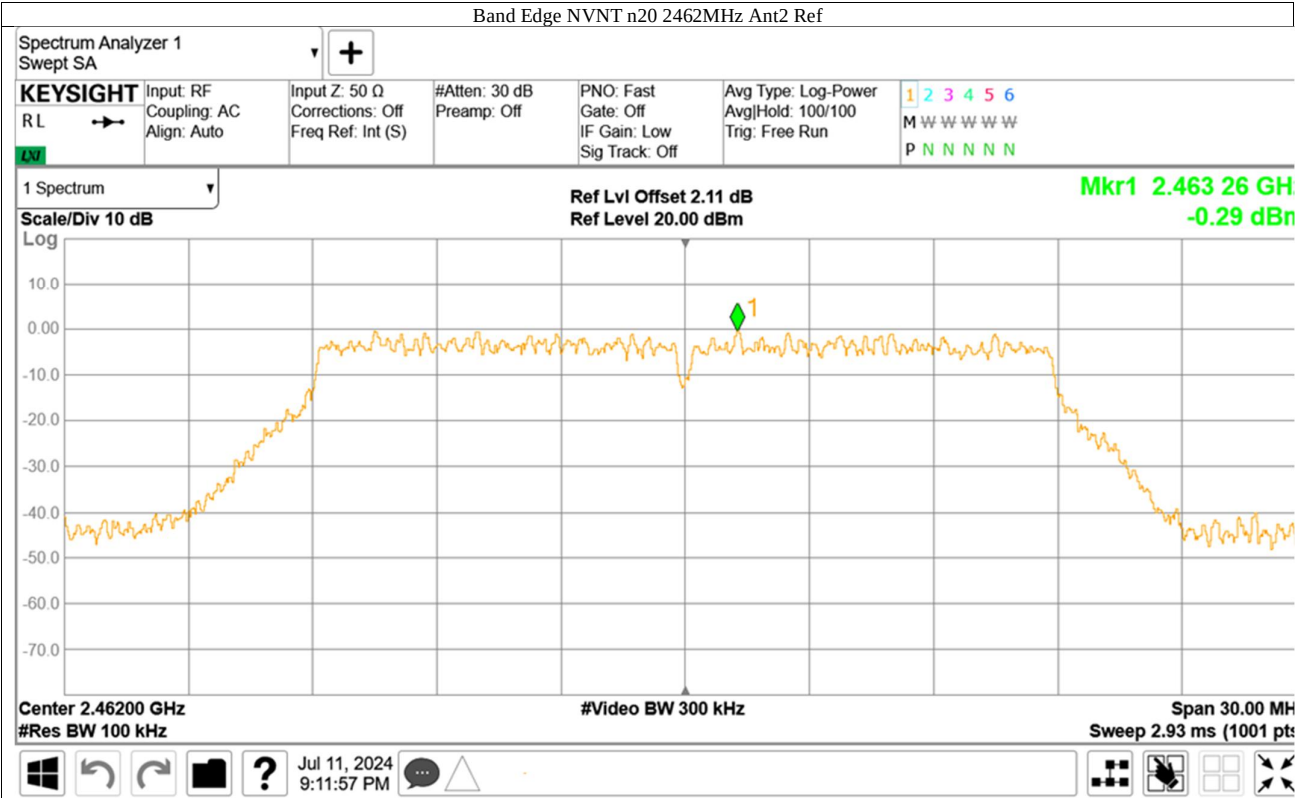


802.11 n20



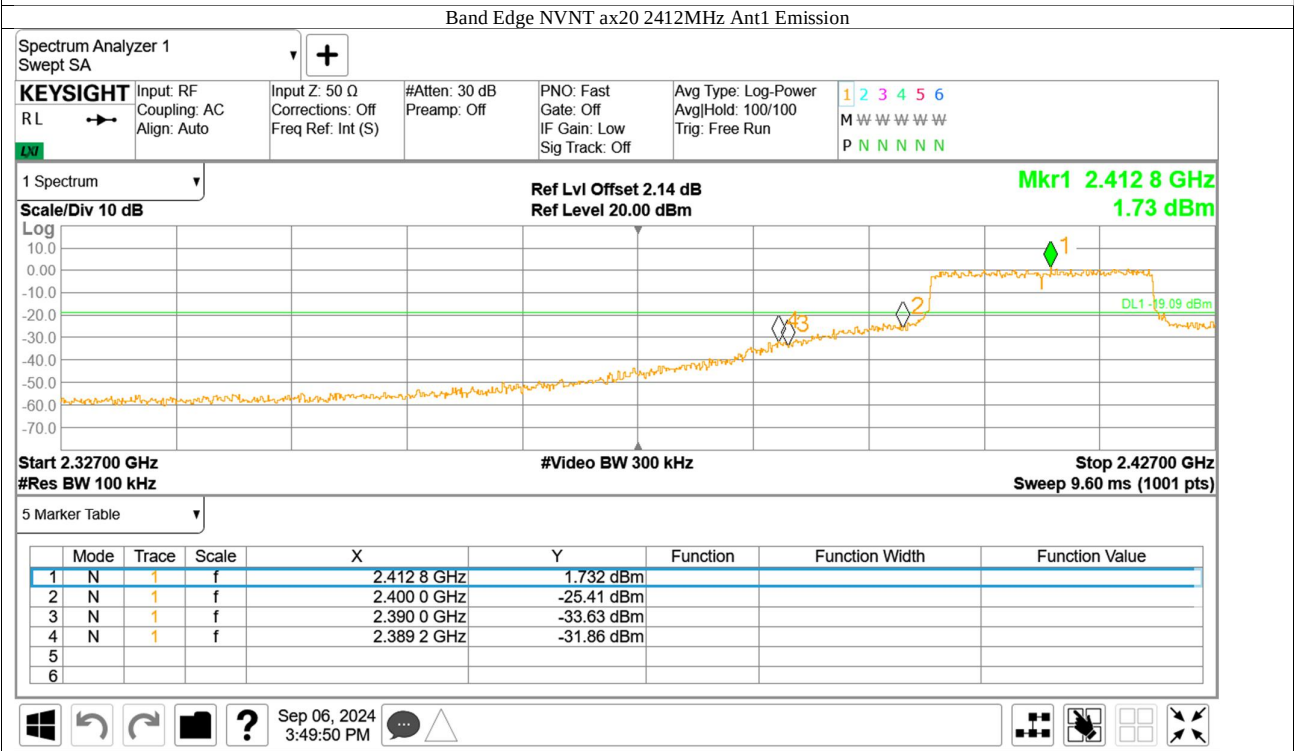
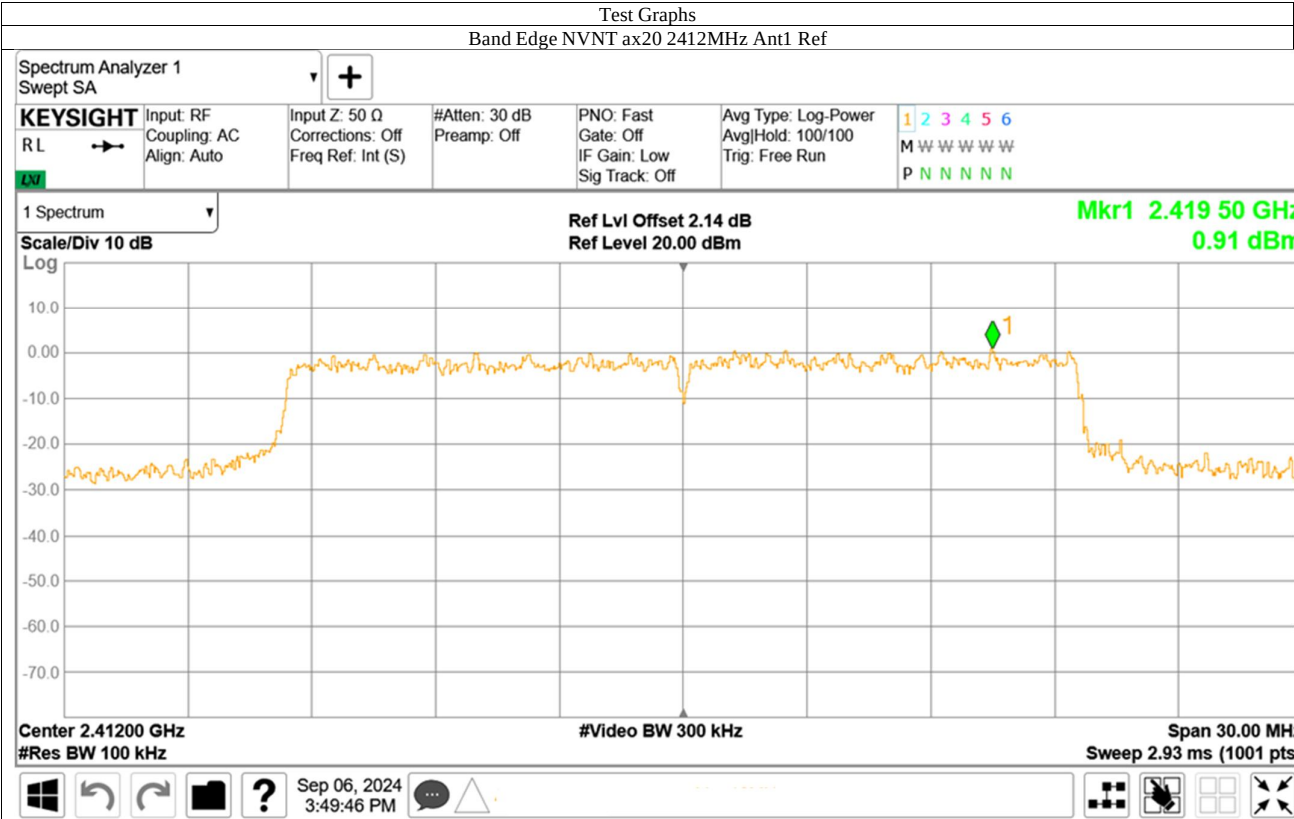


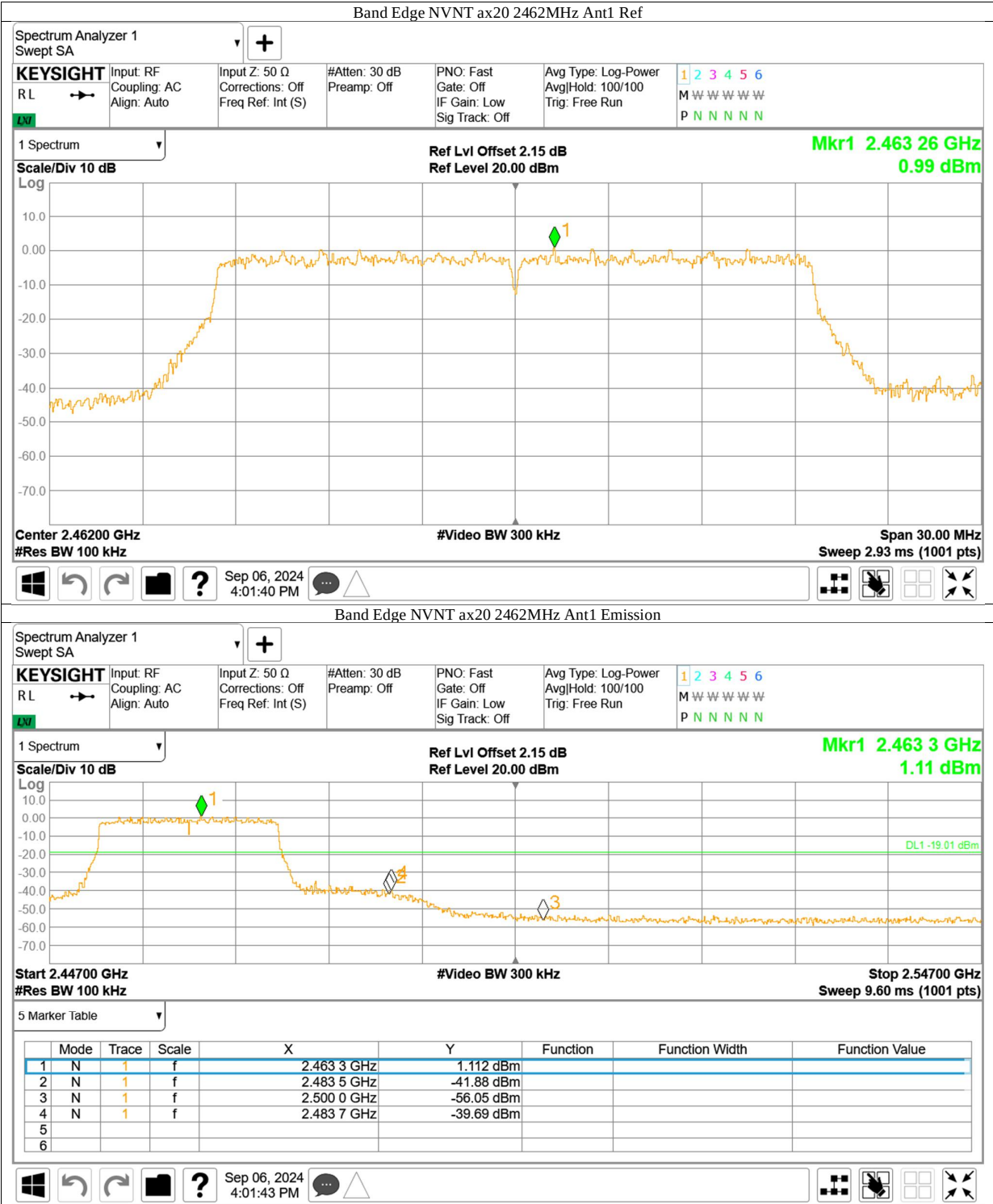


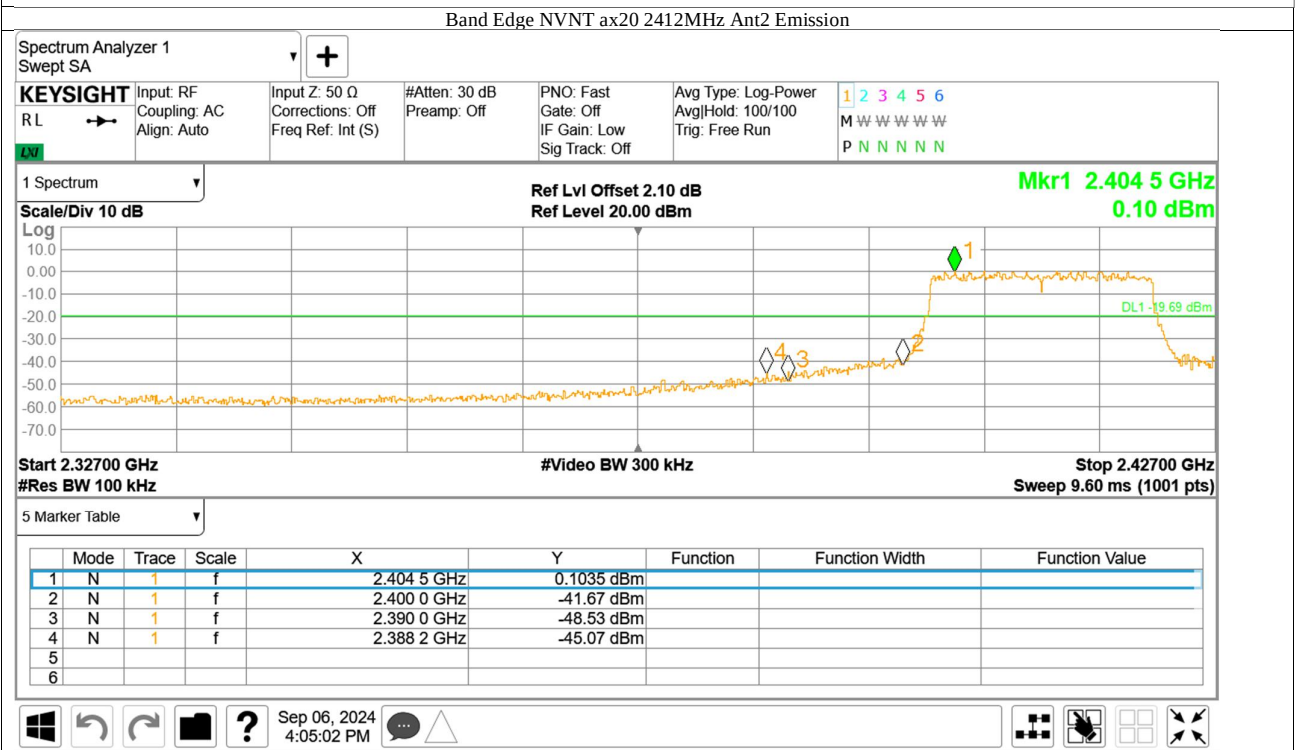
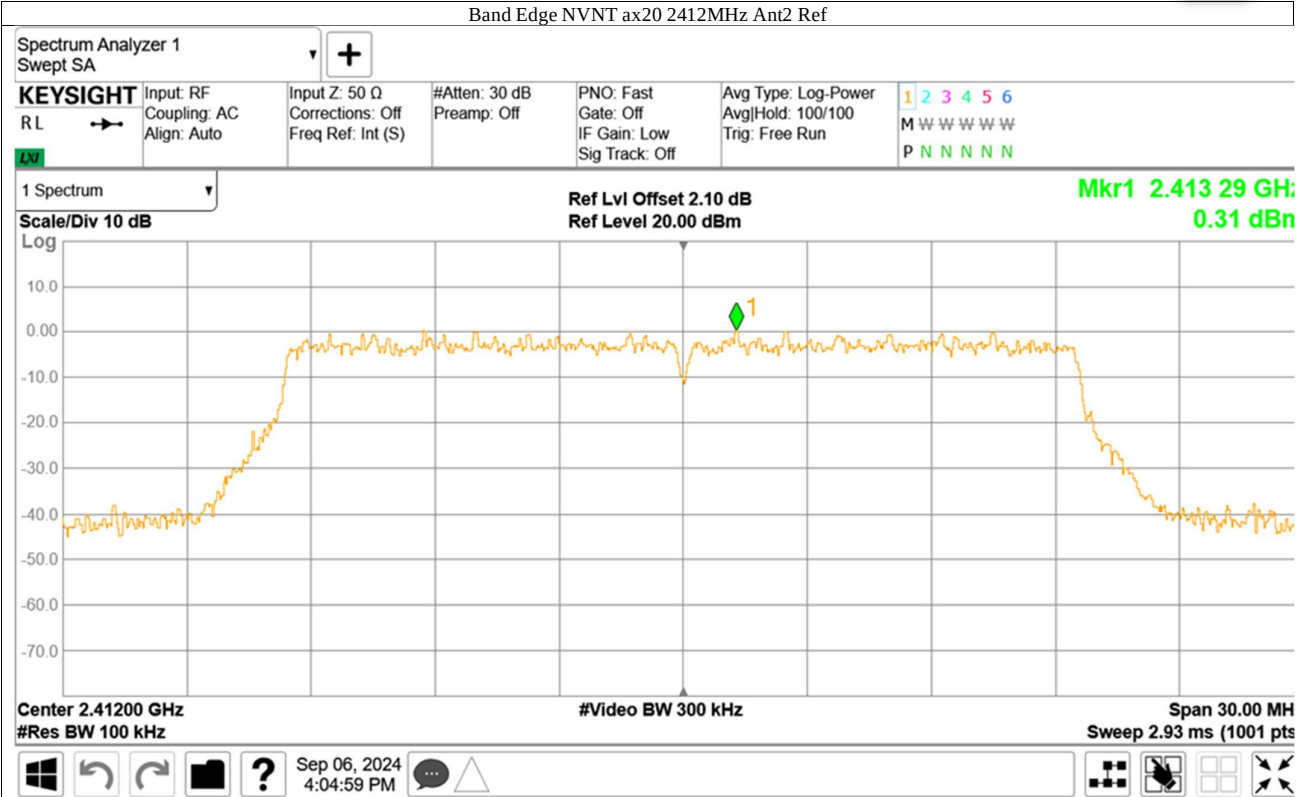


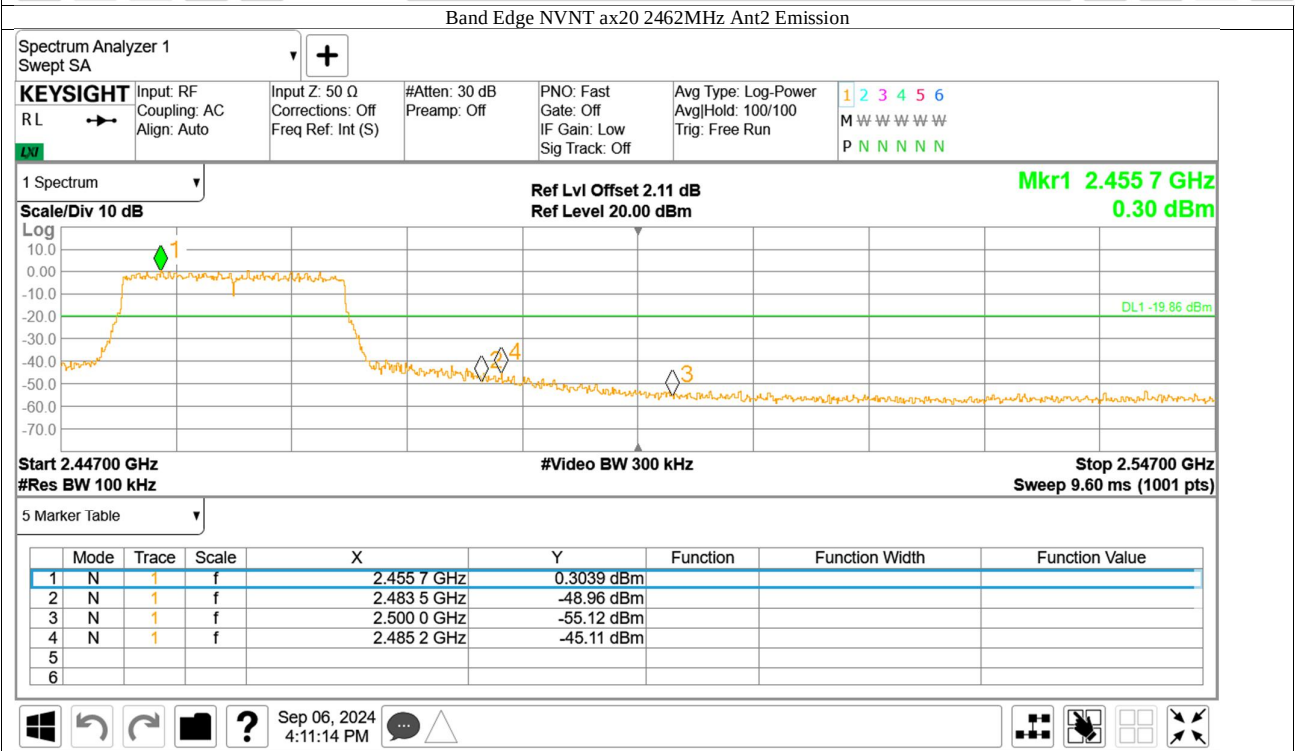
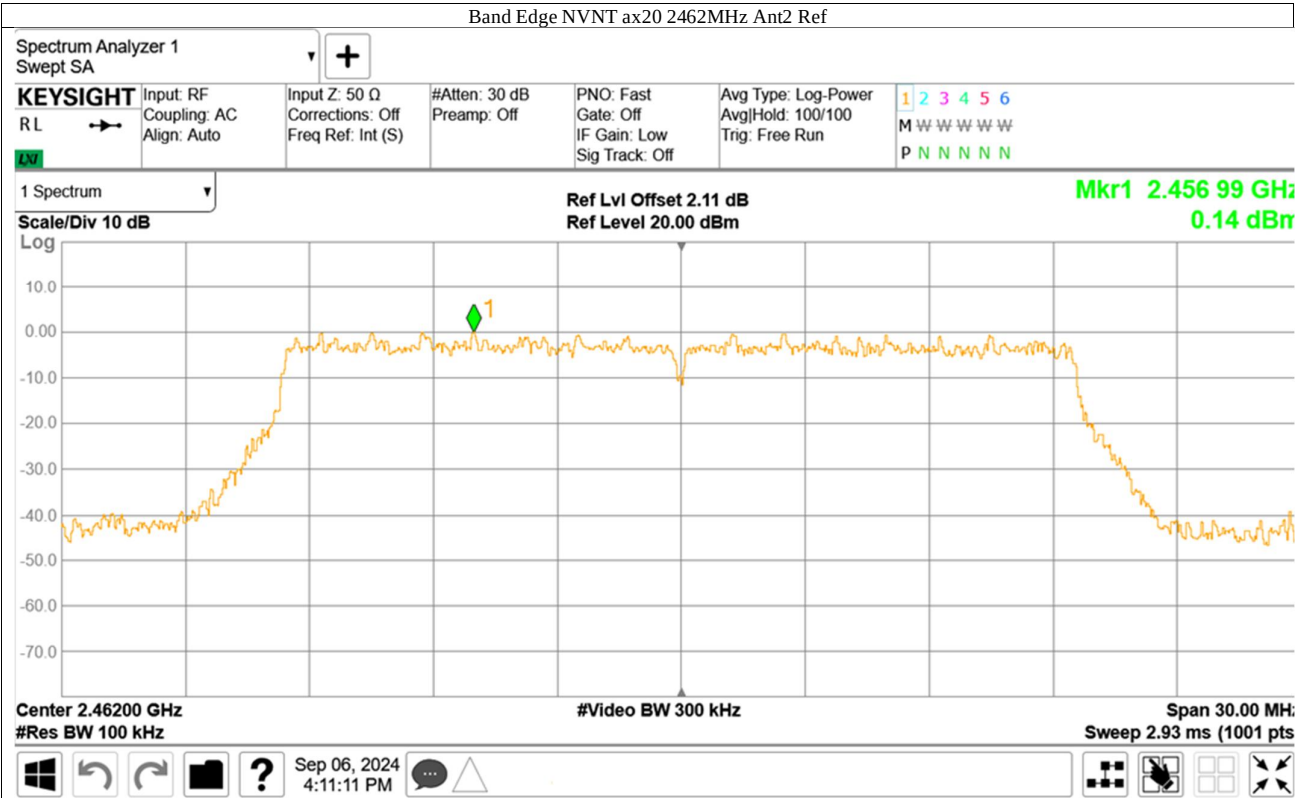


802.11 ax20









10.7 Spurious radiated emissions for transmitter

Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10
 - 1) Procedure for Unwanted Emissions Measurements Below 1000 MHz
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz to 120kHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
 - 2) For Peak unwanted emissions Above 1GHz:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
Procedures for average unwanted emissions measurements above 1GHz
 - a) RBW = 1MHz.
 - b) $VBW \setminus [3 \times RBW]$.
 - c) Detector = RMS (power averaging), if $[span / (\# \text{ of points in sweep})] \setminus RBW / 2$.
Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
 - d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
 - e) Sweep time = auto.
 - f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of $1 / D$, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
 - g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is $[10 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.



2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is $[20 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission (AV) at frequency above 1GHz.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under § 15.247(b)(3) and RSS 247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in § 15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a) and RSS-Gen section 8.9, must also comply with the radiated emission limits specified in § 15.209(a) and RSS-Gen section 8.10.

Frequency MHz	Field Strength $\mu\text{V/m}$	Field Strength $\text{dB}\mu\text{V/m}$	Detector	Measurement distance meters
0.009-0.490	2400/F(kHz)	48.5-13.8	AV	300
0.490-1.705	24000/F(kHz)	33.8-23.0	QP	30
1.705-30	30	29.5	QP	30
30-88	100	40	QP	3
88-216	150	43.5	QP	3
216-960	200	46	QP	3
960-1000	500	54	QP	3
Above 1000	500	54	AV	3
Above 1000	5000	74	PK	3

Note 1: Limit $3\text{m}(\text{dB}\mu\text{V/m}) = \text{Limit } 300\text{m}(\text{dB}\mu\text{V/m}) + 40\text{Log}(300\text{m}/3\text{m})$ (Below 30MHz)

Note 2: Limit $3\text{m}(\text{dB}\mu\text{V/m}) = \text{Limit } 30\text{m}(\text{dB}\mu\text{V/m}) + 40\text{Log}(30\text{m}/3\text{m})$ (Below 30MHz)

Spurious Radiated Emissions for Transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Data of measurement within frequency range 9kHz-30MHz is the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report.

Above 1GHz Transmitting spurious emission test result as below:

ANTI1					
Test mode:2.4G 802.11b 2412MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2389.94	53.50	74.00	20.50	PK	Ver
2389.94	43.80	54.00	10.20	AV	Ver
2398.70	51.76	74.00	22.24	PK	Hor
4797.19	48.46	74.00	25.54	PK	Ver
4823.94	44.80	74.00	29.20	PK	Hor
4824.47	42.84	74.00	31.16	PK	Ver

ANT1					
Test mode:2.4G 802.11b 2437MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
4654.47	49.41	74.00	24.59	PK	Ver
4873.88	43.22	74.00	30.78	PK	Hor
4873.88	43.83	74.00	30.17	PK	Ver

ANT1					
Test mode:2.4G 802.11b 2462MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2483.47	55.94	74.00	18.06	PK	Hor
2483.47	46.20	54.00	7.80	AV	Hor
2483.57	56.95	74.00	17.05	PK	Ver
2483.57	47.00	54.00	7.00	AV	Ver
2493.12	56.28	74.00	17.72	PK	Ver
3052.75	49.63	74.00	24.37	PK	Ver
4923.81	43.96	74.00	30.04	PK	Hor
4925.94	43.36	74.00	30.64	PK	Ver



ANT 2					
Test mode:2.4G_802.11b_2412MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2389.26	51.57	74.00	22.43	PK	Hor
2389.26	49.70	54.00	4.30	AV	Hor
2389.71	47.30	54.00	6.70	AV	Ver
2389.71	55.30	74.00	18.70	PK	Ver
4822.34	42.34	74.00	31.66	PK	Ver
4823.94	42.86	74.00	31.14	PK	Hor

ANT 2					
Test mode:2.4G_802.11b_2437MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
4872.81	41.14	74.00	32.86	PK	Ver
4879.19	42.68	74.00	31.32	PK	Hor

ANT 2					
Test mode:2.4G_802.11b_2462MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2435.06	50.53	74.00	23.47	PK	Hor
2483.50	53.08	74.00	20.92	PK	Ver
2483.50	43.60	54.00	10.40	AV	Ver
4923.81	42.96	74.00	31.04	PK	Hor
4923.81	42.97	74.00	31.03	PK	Ver



ANT 1					
Test mode:2.4G_802.11g_2412MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2387.93	53.05	74.00	20.95	PK	Hor
2389.53	51.42	74.00	22.59	PK	Hor
2389.53	39.90	54.00	14.10	AV	Hor
2389.91	49.24	74.00	24.76	PK	Ver
4823.41	41.13	74.00	32.87	PK	Hor
4827.66	41.65	74.00	32.35	PK	Ver

ANT 1					
Test mode:2.4G_802.11g_2437MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4873.88	41.36	74.00	32.64	PK	Hor
4873.88	41.03	74.00	32.97	PK	Ver

ANT 1					
Test mode:2.4G_802.11g_2462MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.37	63.67	74.00	10.33	PK	Ver
2483.37	49.10	54.00	4.90	AV	Ver
2483.56	56.32	74.00	17.68	PK	Hor
2483.56	45.30	74.00	28.70	PK	Hor
4924.88	41.33	74.00	32.67	PK	Ver
4926.47	41.75	74.00	32.25	PK	Hor



ANT 2					
Test mode:2.4G_802.11g_2412MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2389.01	57.77	74.00	16.23	PK	Hor
2389.01	42.00	54.00	12.00	AV	Hor
2389.11	62.49	74.00	11.51	PK	Ver
2389.11	46.50	54.00	7.50	AV	Ver
4812.81	41.75	74.00	32.25	PK	Hor
4825.53	41.96	74.00	32.04	PK	Ver

ANT 2					
Test mode:2.4G_802.11g_2437MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
4873.34	42.58	74.00	31.42	PK	Ver
4873.88	40.61	74.00	33.39	PK	Hor

ANT 2					
Test mode:2.4G_802.11g_2462MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2483.57	59.87	74.00	14.13	PK	Hor
2483.57	46.40	54.00	7.60	AV	Hor
2484.03	65.42	74.00	8.58	PK	Ver
2484.03	50.50	54.00	3.50	AV	Ver
4924.34	42.56	74.00	31.44	PK	Ver
4929.13	42.22	74.00	31.78	PK	Hor



MIMO					
Test mode:2.4G_802.11n_2412MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2387.64	62.91	74.00	11.09	PK	Ver
2387.64	47.10	54.00	6.90	AV	Ver
2388.45	63.07	74.00	10.93	PK	Hor
2388.45	47.60	54.00	6.40	AV	Hor
4821.81	43.44	74.00	30.56	PK	Ver
4824.47	42.94	74.00	31.06	PK	Hor

MIMO					
Test mode:2.4G_802.11n_2437MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
4872.28	41.67	74.00	32.33	PK	Ver
4876.53	42.32	74.00	31.68	PK	Hor

MIMO					
Test mode:2.4G_802.11n_2462MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2483.66	70.58	74.00	3.42	PK	Hor
2483.66	52.90	54.00	1.10	AV	Hor
2483.82	71.23	74.00	2.77	PK	Ver
2483.82	51.20	54.00	2.80	AV	Ver
4923.81	42.15	74.00	31.85	PK	Ver
4924.34	41.57	74.00	32.43	PK	Hor



MIMO					
Test mode:2.4G_802.11AX_2412MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
1199.75	36.53	74.00	37.47	PK	Ver
2389.98	60.23	74.00	13.77	PK	Ver
2389.98	47.50	54.00	6.50	AV	Ver
4825.00	40.03	74.00	33.97	PK	Ver
2389.94	60.44	74.00	13.56	PK	Hor
2389.94	45.90	54.00	8.10	AV	Hor
4825.00	41.07	74.00	32.93	PK	Hor

MIMO					
Test mode:2.4G_802.11AX_2437MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
4874.41	40.86	74.00	33.14	PK	Ver
4873.88	42.22	74.00	31.78	PK	Hor

MIMO					
Test mode:2.4G_802.11AX_2462MHz					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2483.57	66.62	74.00	7.38	PK	Hor
2483.57	48.4	54.00	5.60	AV	Hor
4924.88	39.98	74.00	34.02	PK	Hor
2483.50	67.32	74.00	6.68	PK	Ver
2483.50	52.80	54.00	1.20	AV	Ver
2484.70	67.95	74.00	6.05	PK	Ver
2483.50	49.70	54.00	4.30	AV	Ver
4923.28	41.24	74.00	32.76	PK	Ver

Remark:

- (1) Emission level= Original Receiver Reading + Correct Factor
- (2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (3) Margin = limit – Corrected Reading

The worst case of Radiated Emission below 1GHz:

30-1000MHz Radiated Emission

EUT Information

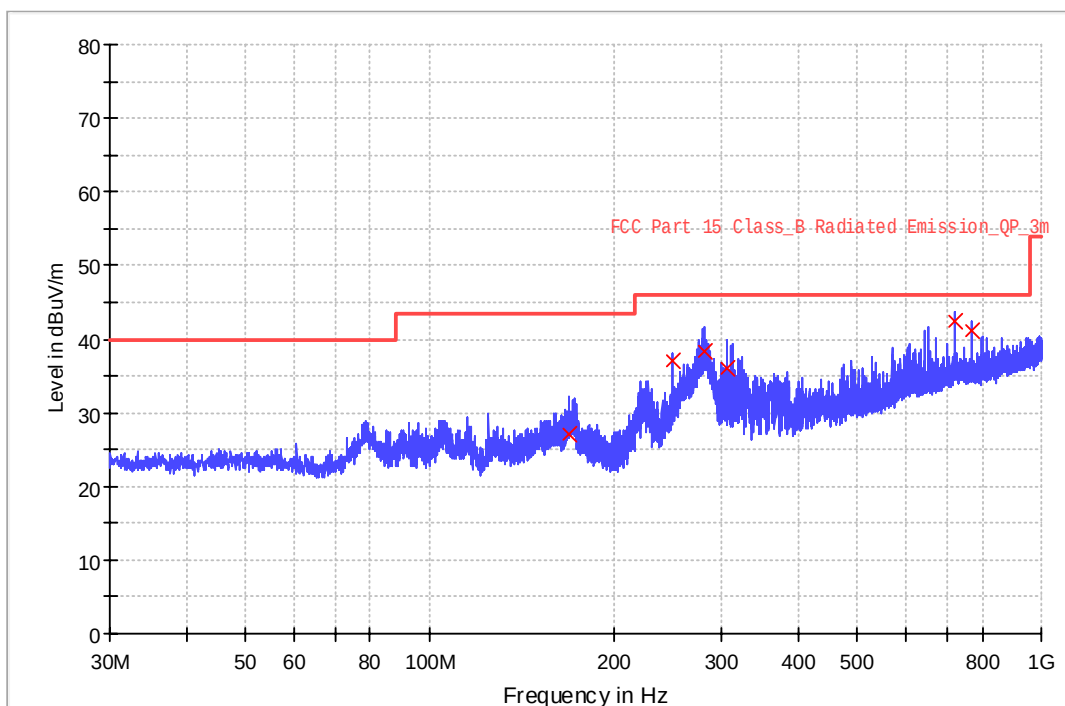
EUT Name: Laser 3D Scanner
Model: FreeScan UE Pro2
Client: Shining 3D Tech Co., Ltd.
Op Cond: TX at 802.11 ax20 MIMO_2412MHz, AC 120V,60Hz.
Operator: Guo Chengjie
Test Spec: FCC part15.209(a)
Sample No: SHA-828049-2

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup: RE_VULB9168
Receiver: [ESR 3]
Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamplifier
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB

RE_VULB9168_pre_Cont_30-1000





Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)
168.600000	27.0	1000.0	120.000	187.0	H	153.0	20.4	16.5
249.960000	37.2	1000.0	120.000	185.0	H	221.0	19.9	8.8
281.680000	38.4	1000.0	120.000	122.0	H	186.0	21.1	7.6
307.280000	36.1	1000.0	120.000	125.0	H	321.0	21.7	9.9
720.000000	42.3	1000.0	120.000	124.0	H	174.0	31.0	3.7
767.960000	41.2	1000.0	120.000	120.0	H	216.0	31.9	4.8

(continuation of the "Limit and Margin" table from column 16 ...)

Frequency (MHz)	Limit - QPK (dBuV/m)	Comment
168.600000	43.5	
249.960000	46.0	
281.680000	46.0	
307.280000	46.0	
720.000000	46.0	
767.960000	46.0	

30-1000MHz Radiated Emission

EUT Information

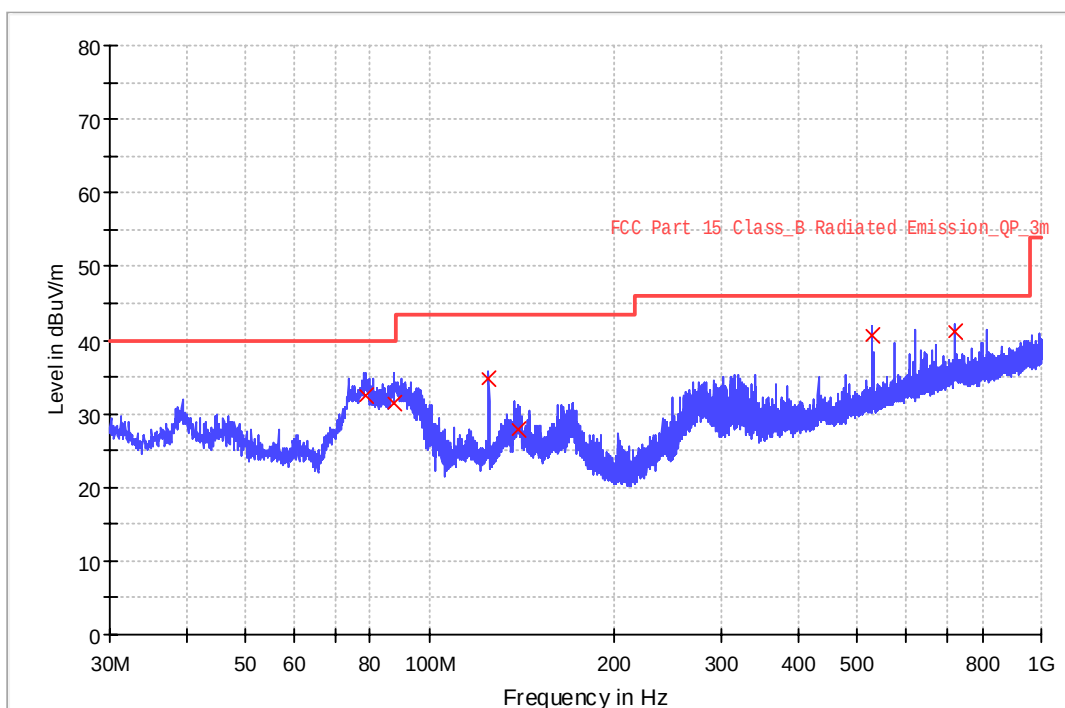
EUT Name: Laser 3D Scanner
Model: FreeScan UE Pro2
Client: Shining 3D Tech Co., Ltd.
Op Cond: TX at 802.11 ax20 MIMO_2412MHz, AC 120V,60Hz.
Operator: Guo Chengjie
Test Spec: FCC part15.209(a)
Sample No: SHA-828049-2

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup: RE_VULB9168
Receiver: [ESR 3]
Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB

RE_VULB9168_pre_Cont_30-1000





Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)
78.840000	32.6	1000.0	120.000	175.0	V	211.0	16.4	7.4
87.560000	31.5	1000.0	120.000	197.0	V	127.0	14.7	8.5
125.000000	34.8	1000.0	120.000	124.0	V	237.0	18.5	8.7
139.480000	28.0	1000.0	120.000	175.0	V	327.0	20.2	15.6
528.000000	40.5	1000.0	120.000	126.0	V	99.0	27.0	5.5
719.960000	41.1	1000.0	120.000	175.0	V	176.0	31.0	4.9

(continuation of the "Limit and Margin" table from column 16 ...)

Frequency (MHz)	Limit - QPK (dBuV/m)	Comment
78.840000	40.0	
87.560000	40.0	
125.000000	43.5	
139.480000	43.5	
528.000000	46.0	
719.960000	46.0	

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report

11 Test Equipment List

List of Test Instruments
Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
C	Signal spectrum analyzer	Agilent	N9020B	MY59050168	2024-2-19	2025-2-18
	Wideband power sensor	Rohde & Schwarz	NRP-Z81	105903	2024-2-19	2025-2-18
	10dB Attenuator	Aeroflex Weinschel	CG-4689	93459	2024-2-19	2025-2-18
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2023-8-1	2024-7-31
	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2024-8-1	2025-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2023-8-1	2024-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2024-8-1	2025-7-31
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2021-9-23	2024-9-22
	Double-ridged waveguide horn antenna	Rohde & Schwarz	HF907	102868	2024-4-14	2027-4-13
	Pre-amplifier	Shenzhen HzEMC	HPA-081843	HYP A23026	2024-4-16	2025-4-15
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2024-6-26	2025-6-25
	Double Ridged Horn Antenna	ETS-Lindgren	3116C	00246076	2023-7-7	2026-7-6
	3m Semi-anechoic chamber	TDK	9X6X6	----	2024-5-8	2027-5-7
	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2023-8-1	2024-7-31
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2024-8-1	2025-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2023-8-1	2024-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2024-8-1	2025-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2024-8-1	2025-7-31

Measurement Software Information			
Test Item	Software	Manufacturer	Version
C	MTS 8310	MWRFTest	3.0.0.0
	Power Viewer	Rohde & Schwarz	V 11.0
RE	EMC 32	Rohde & Schwarz	V10.50.40
CE	EMC 32	Rohde & Schwarz	V9.15.03

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Band edge

12 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, 3.16dB
Radiated Disturbance	9kHz to 30MHz, 3.52dB 30MHz to 1GHz, 5.03dB (Horizontal) 5.12dB (Vertical) 1GHz to 18GHz, 5.49dB 18GHz to 40GHz, 5.63dB
RF Conducted Measurement	Power related: 1.16dB Frequency related: 6.00×10^{-8}

Measurement Uncertainty Decision Rule:

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2023, clause 4.3.3.



13 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



14 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

-----End of Test Report-----