

Appendix A: Test Results of Lora

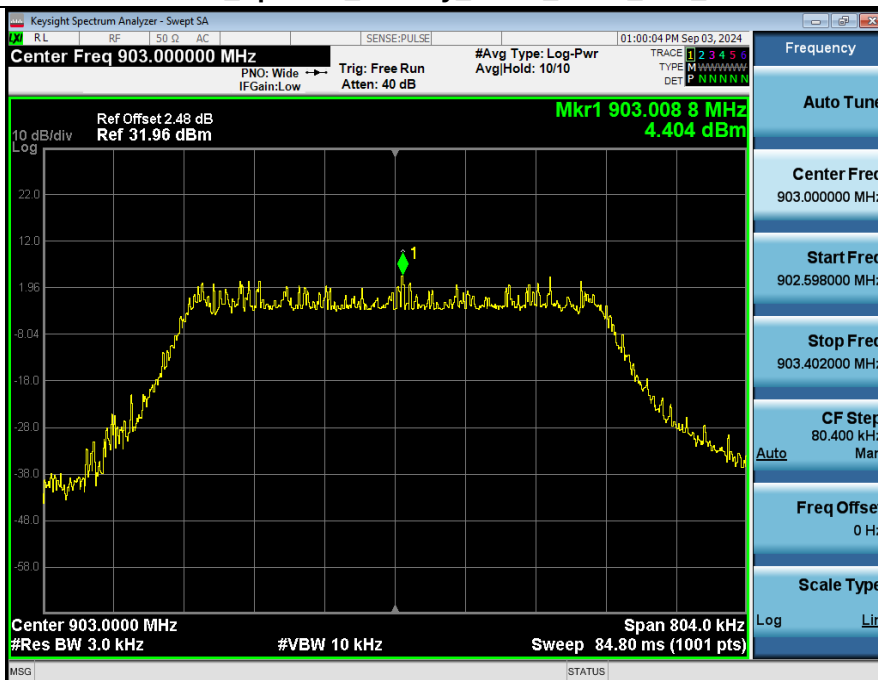
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Appendix A.1: Test Results of Conducted Power Spectral Density

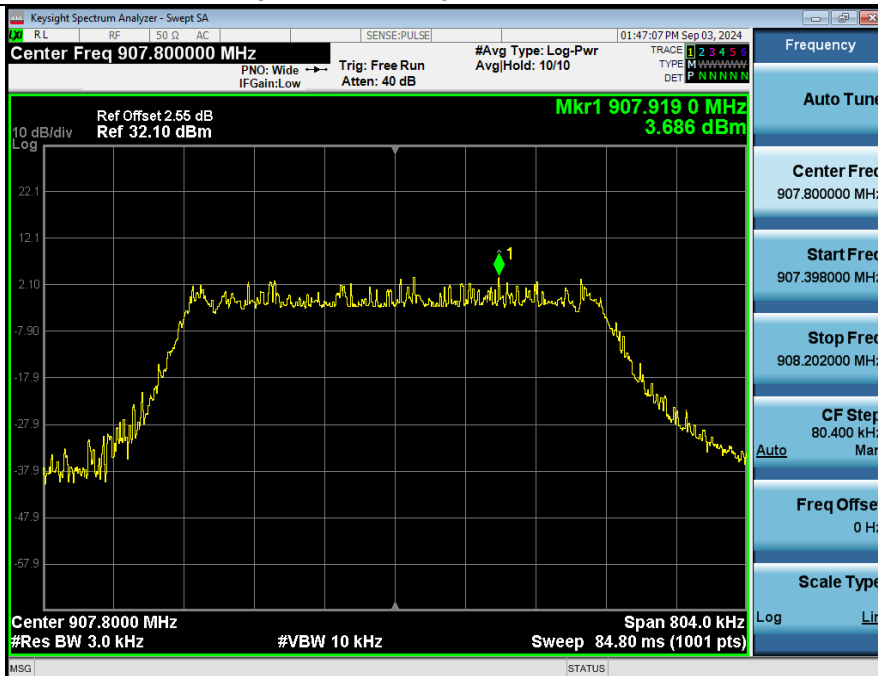
Lora DTS

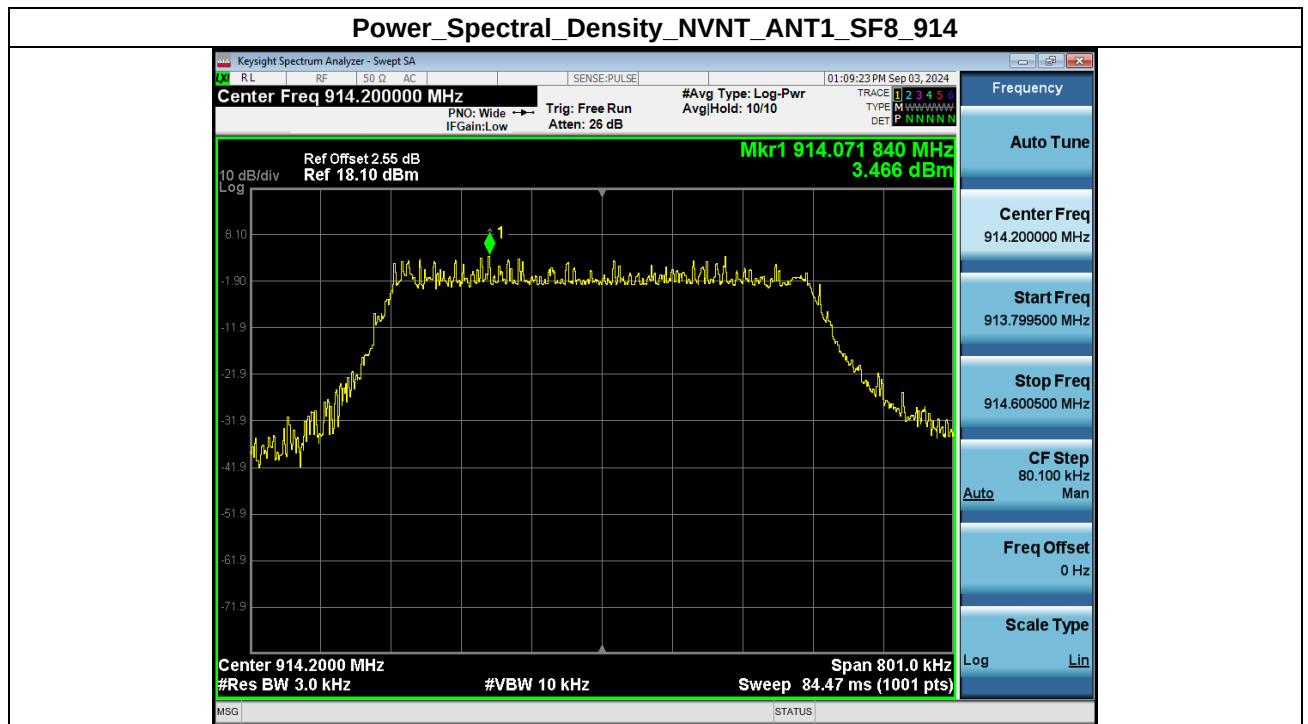
Condition	Antenna	Rate	Frequency (MHz)	Power Spectral Density(dBm)	Limit (dBm/3kHz)	Result
NVNT	ANT1	SF8	903.00	4.40	8	Pass
NVNT	ANT1	SF8	907.80	3.69	8	Pass
NVNT	ANT1	SF8	914.20	3.47	8	Pass

Power Spectral Density_NVNT_ANT1_SF8_903



Power Spectral Density_NVNT_ANT1_SF8_907



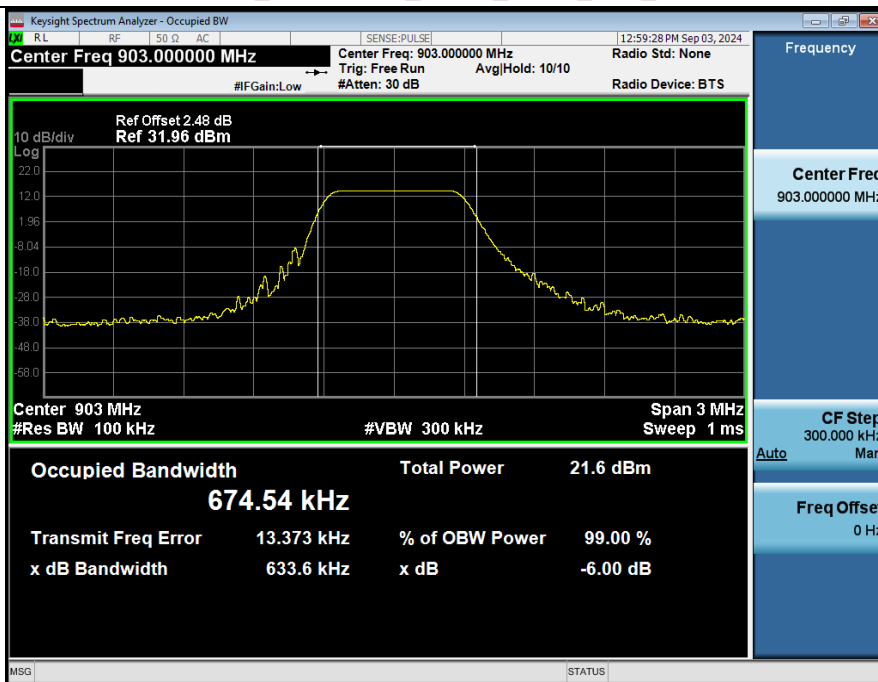


Appendix A.2: Test Results of 6dB Bandwidth

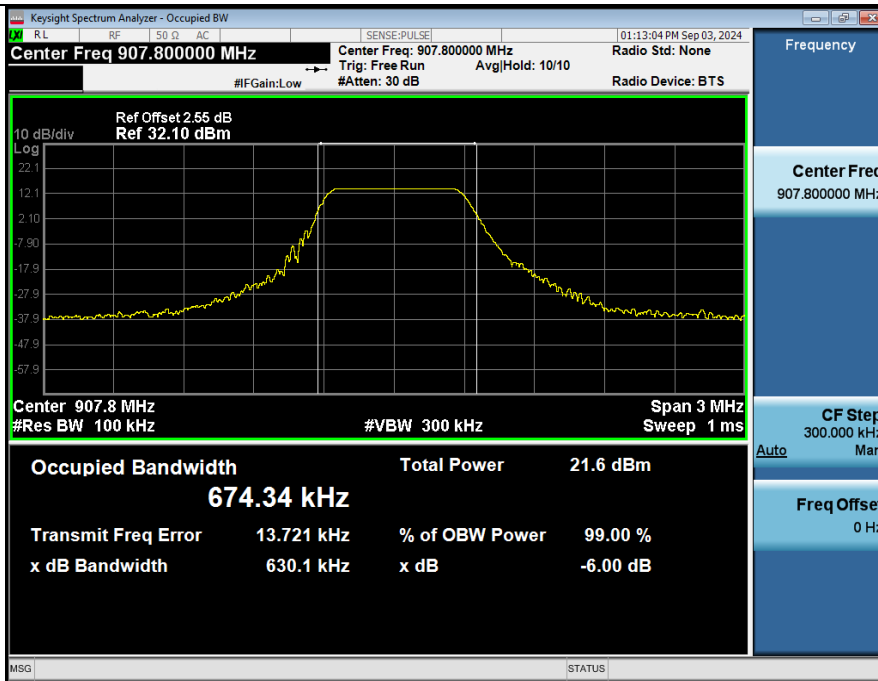
Lora DTS

Condition	Antenna	Rate	Frequency (MHz)	-6dB BW (kHz)	Limit(kHz)	Result
NVNT	ANT1	SF8	903.00	633.61	>500	Pass
NVNT	ANT1	SF8	907.80	630.06	>500	Pass
NVNT	ANT1	SF8	914.20	634.75	>500	Pass

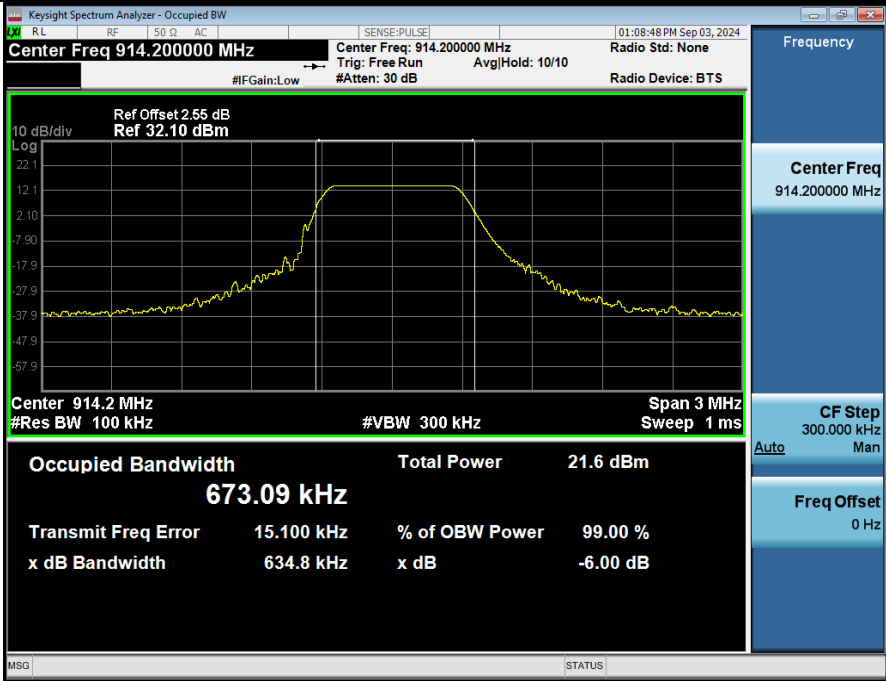
-6dB_Bandwidth_NVNT_ANT1_SF8_903



-6dB_Bandwidth_NVNT_ANT1_SF8_907



-6dB_Bandwidth_NVNT_ANT1_SF8_914

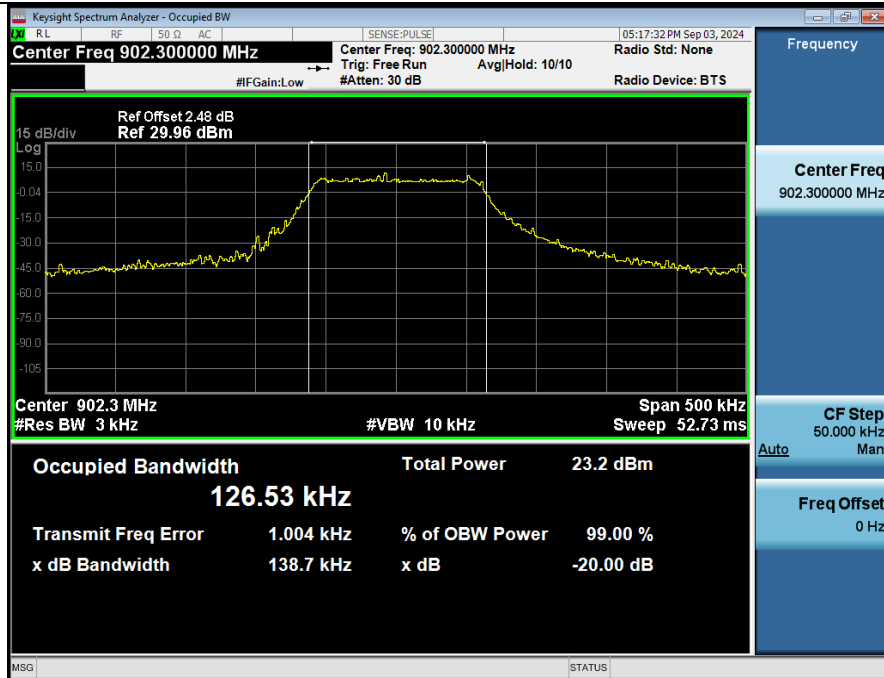


Appendix A.3: Test Results of 20dB Bandwidth

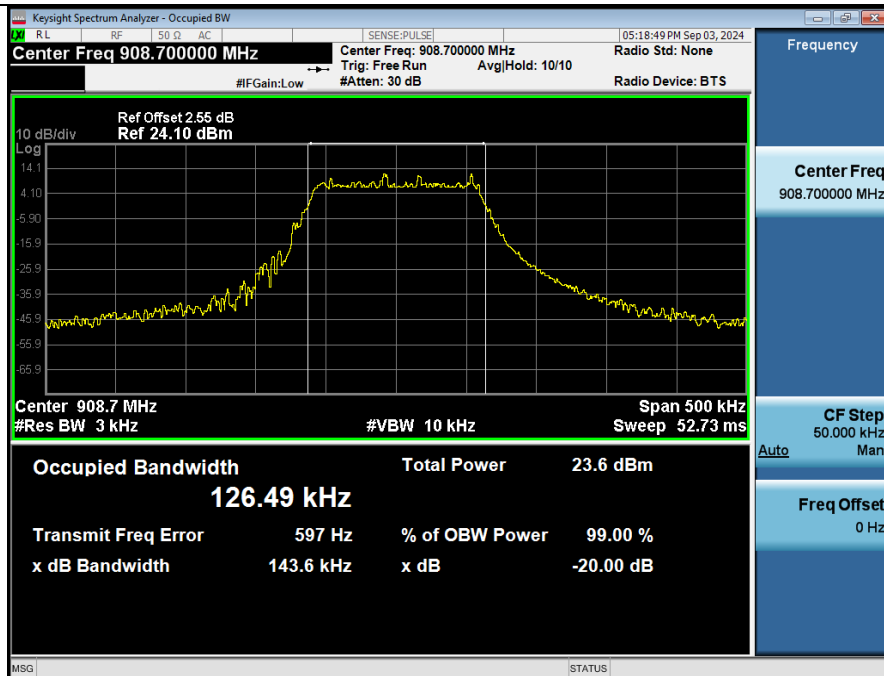
Lora FHSS, Data rate SF7

Condition	Antenna	Modulation	Frequency (MHz)	-20dB BW(MHz)	More than 500k
NVNT	ANT1	Lora SF7	902.30	0.139	No
NVNT	ANT1	Lora SF7	908.70	0.144	No
NVNT	ANT1	Lora SF7	914.90	0.141	No

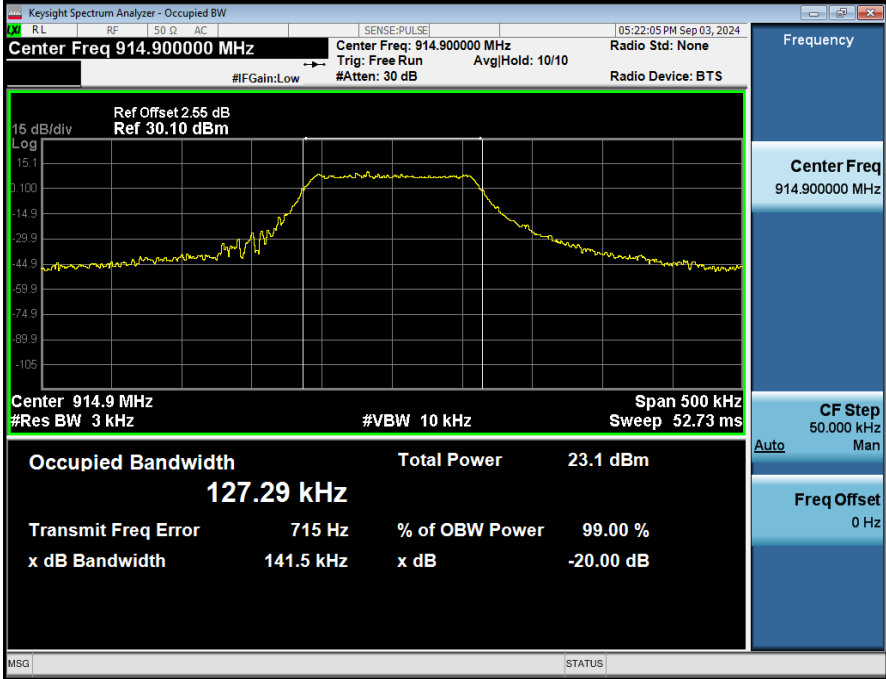
-20dB_Bandwidth_NVNT_ANT1_Lora_SF7_902_30



-20dB Bandwidth NVNT ANT1 Lora SF7 908 70



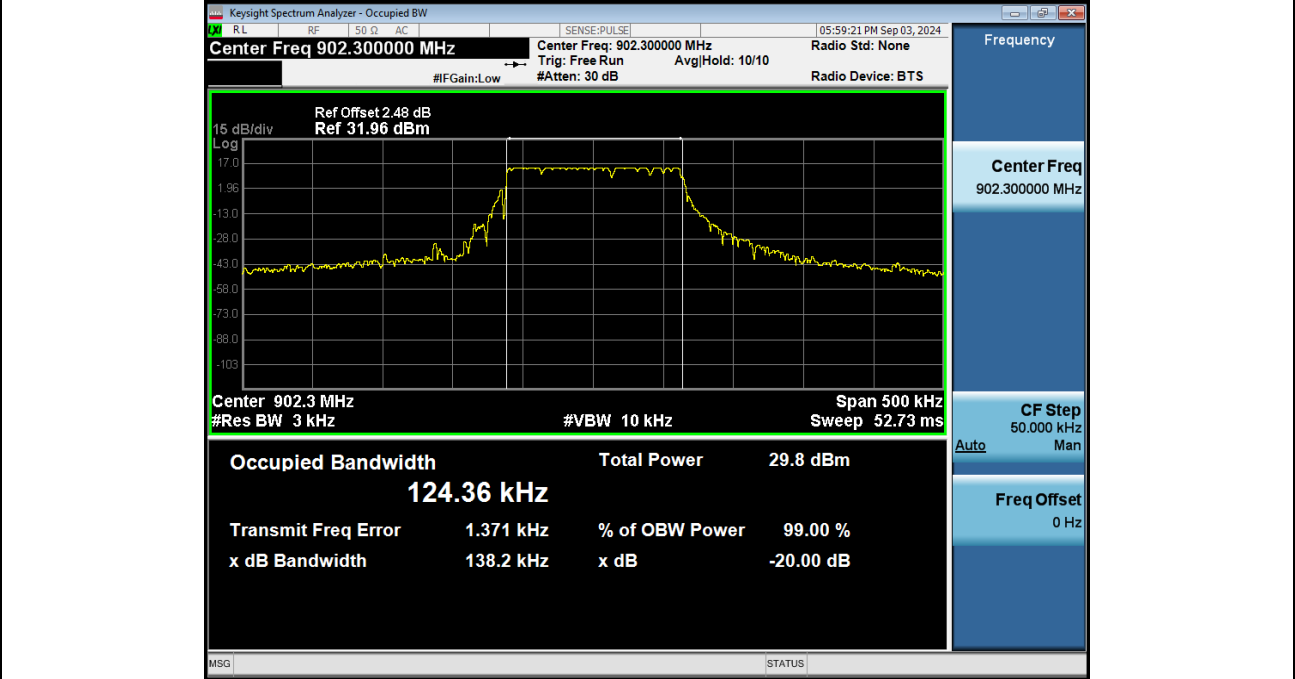
-20dB_Bandwidth_NVNT_ANT1_Lora SF7_914_90



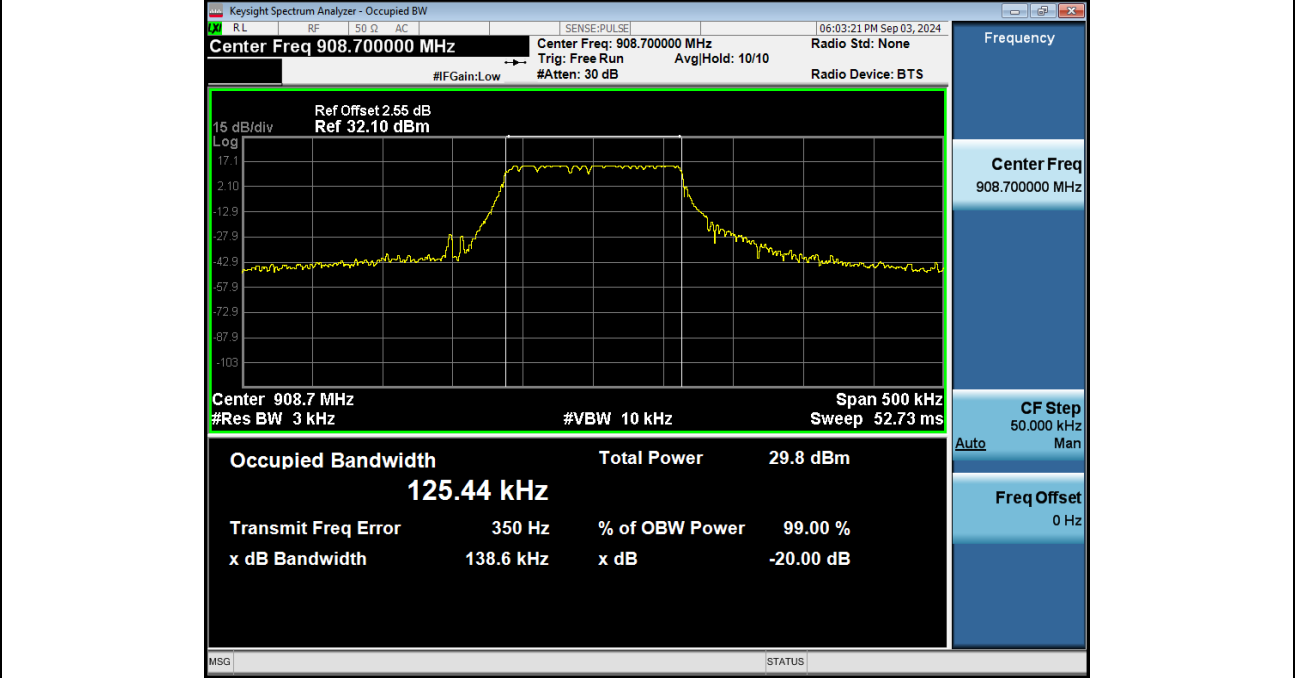
Lora FHSS, Data rate SF10

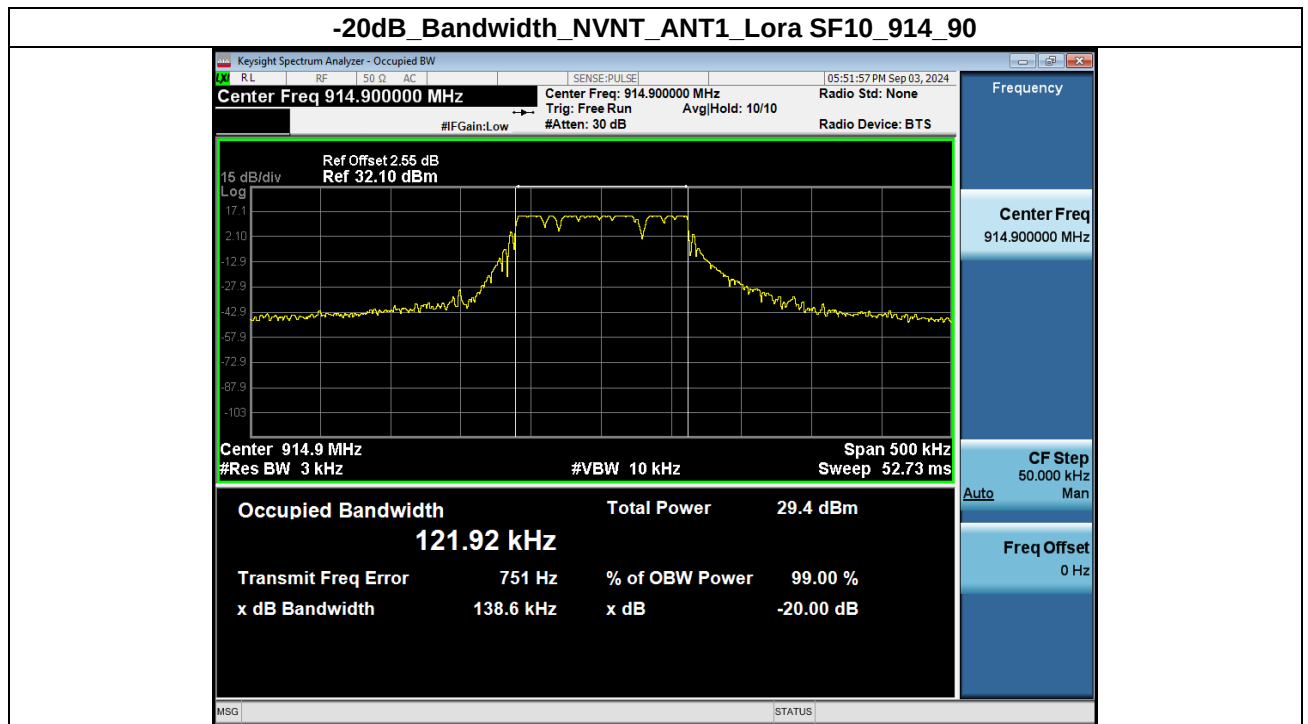
Condition	Antenna	Modulation	Frequency (MHz)	-20dB BW(MHz)	More than 500k
NVNT	ANT1	Lora SF10	902.30	0.138	No
NVNT	ANT1	Lora SF10	908.70	0.139	No
NVNT	ANT1	Lora SF10	914.90	0.139	No

-20dB_Bandwidth_NVNT_ANT1_Lora SF10_902_30



-20dB_Bandwidth_NVNT_ANT1_Lora SF10_908_70



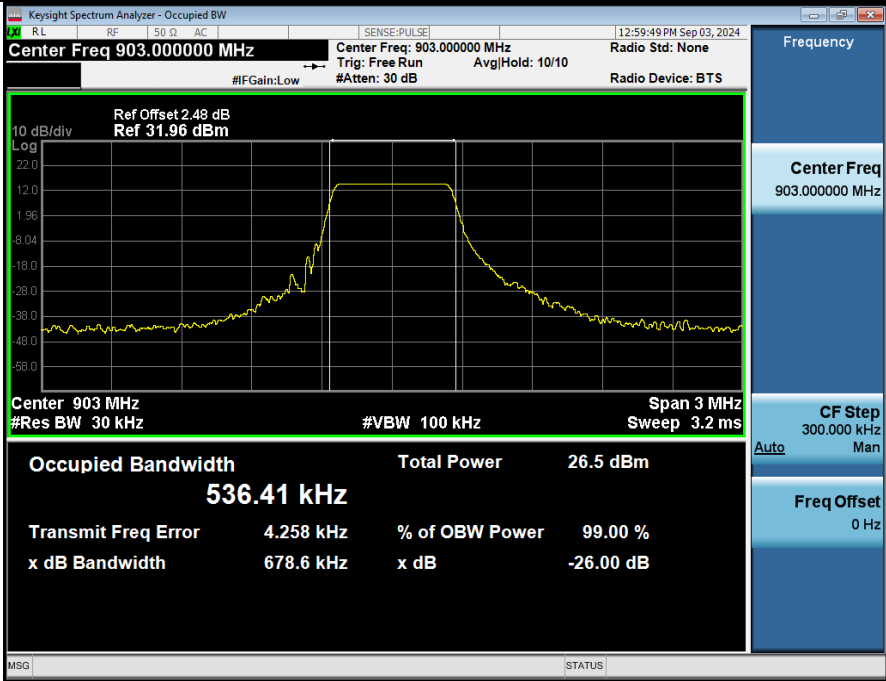


Appendix A.4: Test Results of 99% Bandwidth

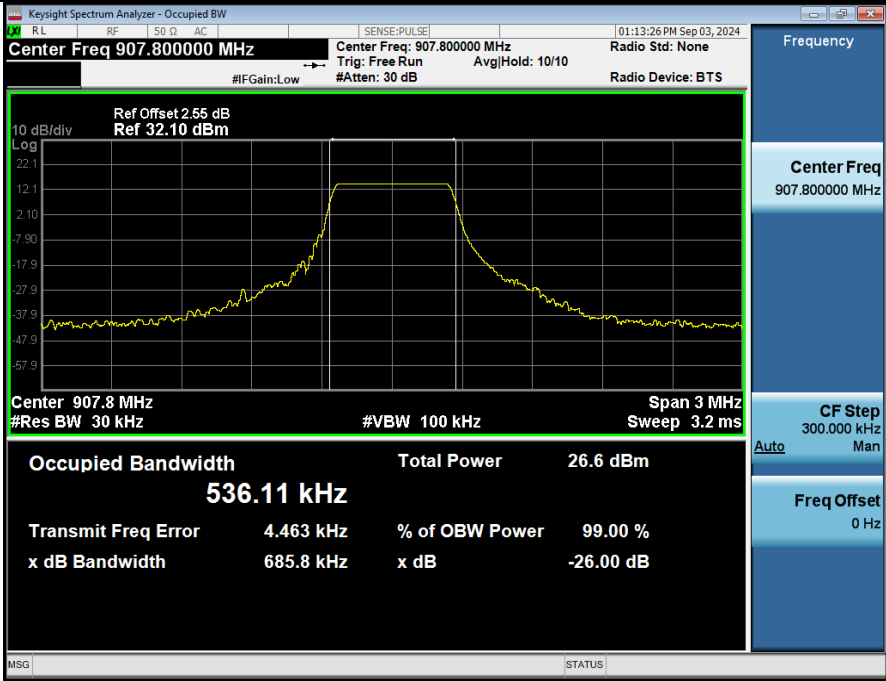
Lora DTS

Condition	Antenna	Rate	Frequency (MHz)	99%%BW(MHz)
NVNT	ANT1	SF8	903.00	0.536
NVNT	ANT1	SF8	907.80	0.536
NVNT	ANT1	SF8	914.20	0.534

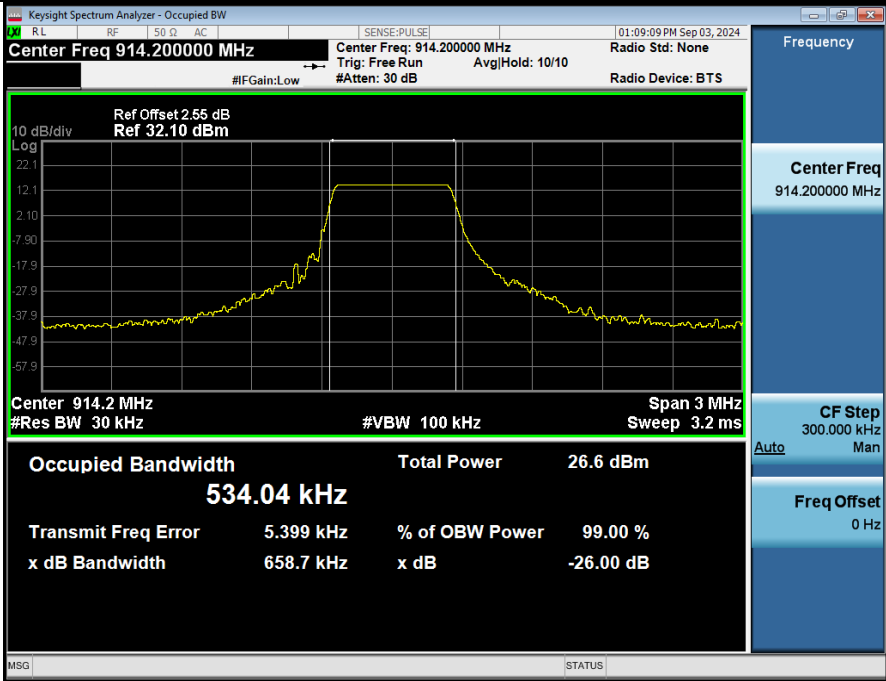
99%_Occupied_Bandwidth_NVNT_ANT1_SF8_903



99%_Occupied_Bandwidth_NVNT_ANT1_SF8_907



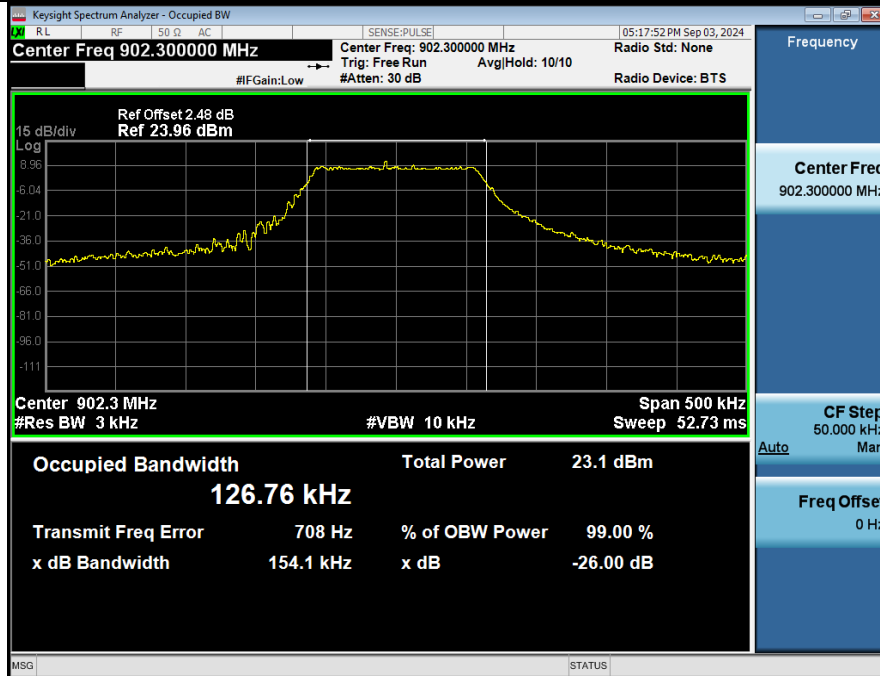
99%_Occupied_Bandwidth_NVNT_ANT1_SF8_914



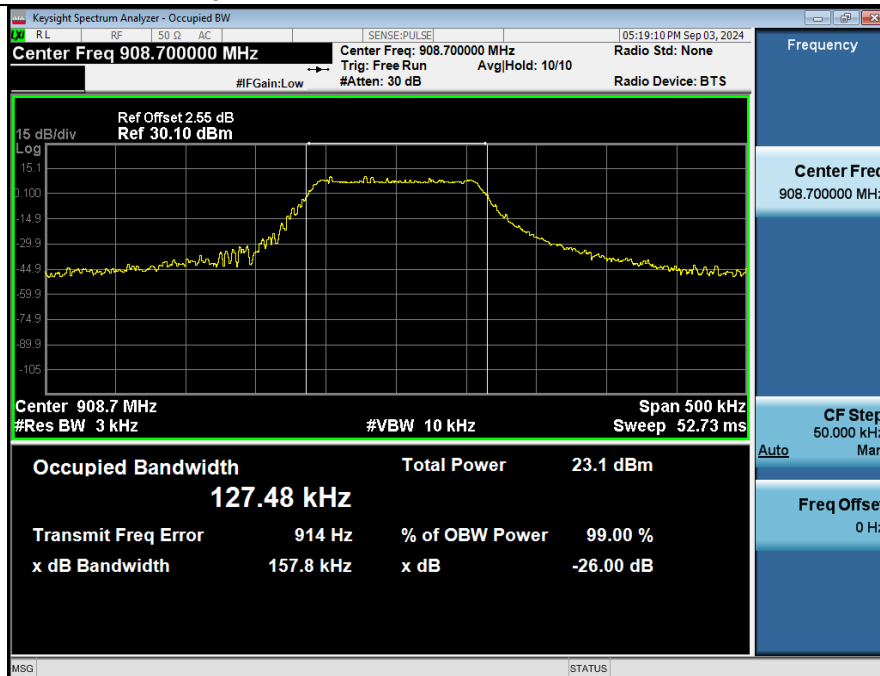
Lora FHSS, Data rate SF7

Condition	Antenna	Modulation	Frequency (MHz)	99%%BW(MHz)
NVNT	ANT1	Lora SF7	902.30	0.127
NVNT	ANT1	Lora SF7	908.70	0.127
NVNT	ANT1	Lora SF7	914.90	0.126

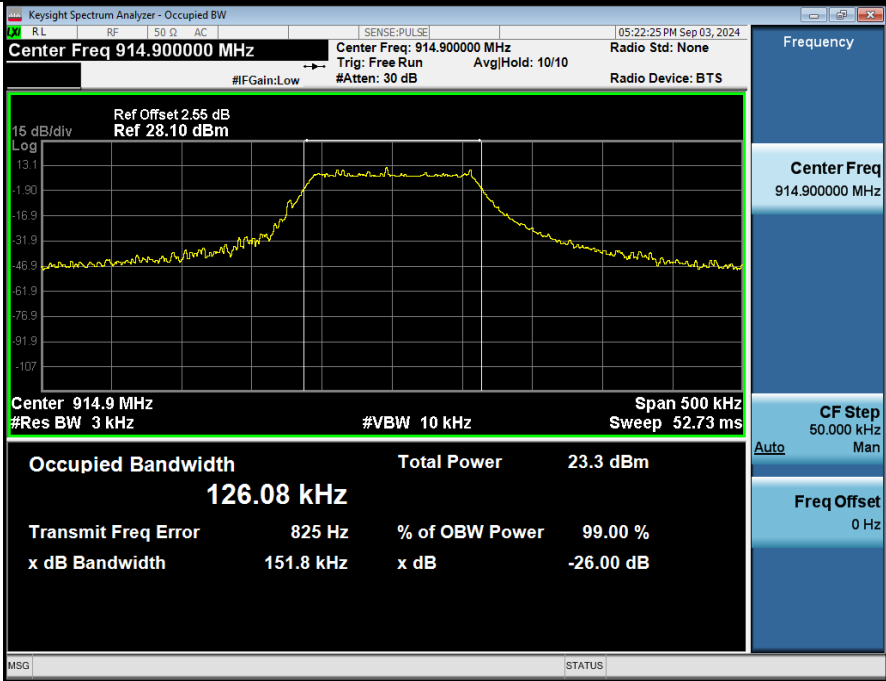
99%_Occupied_Bandwidth_NVNT_ANT1_Lora SF7_902_30



99%_Occupied_Bandwidth_NVNT_ANT1_Lora SF7_908_70



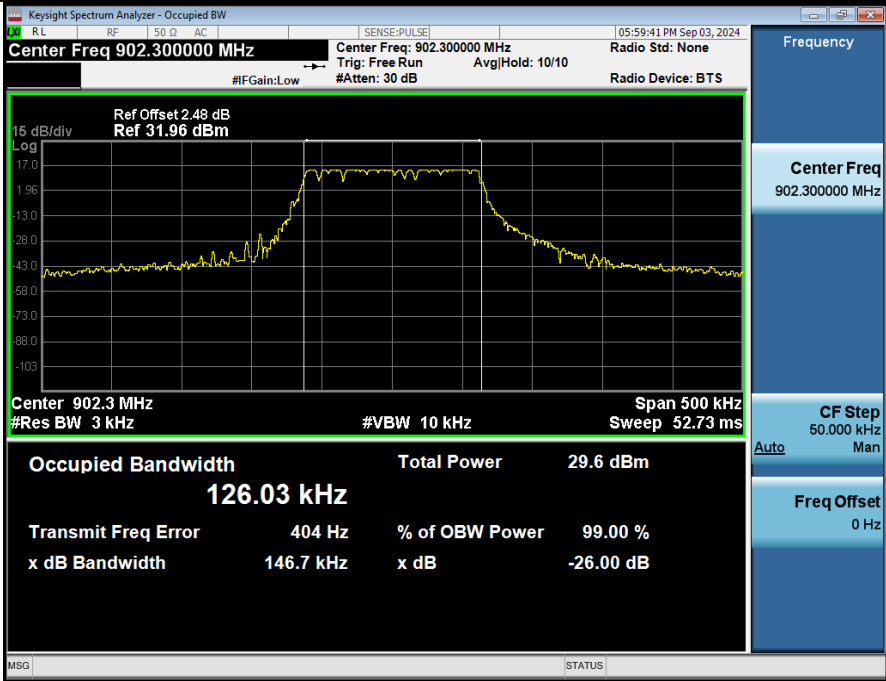
99%_Occupied_Bandwidth_NVNT_ANT1_Lora SF7_914_90



Lora FHSS, Data rate SF10

Condition	Antenna	Modulation	Frequency (MHz)	99%%BW(MHz)
NVNT	ANT1	Lora SF10	902.30	0.126
NVNT	ANT1	Lora SF10	908.70	0.126
NVNT	ANT1	Lora SF10	914.90	0.126

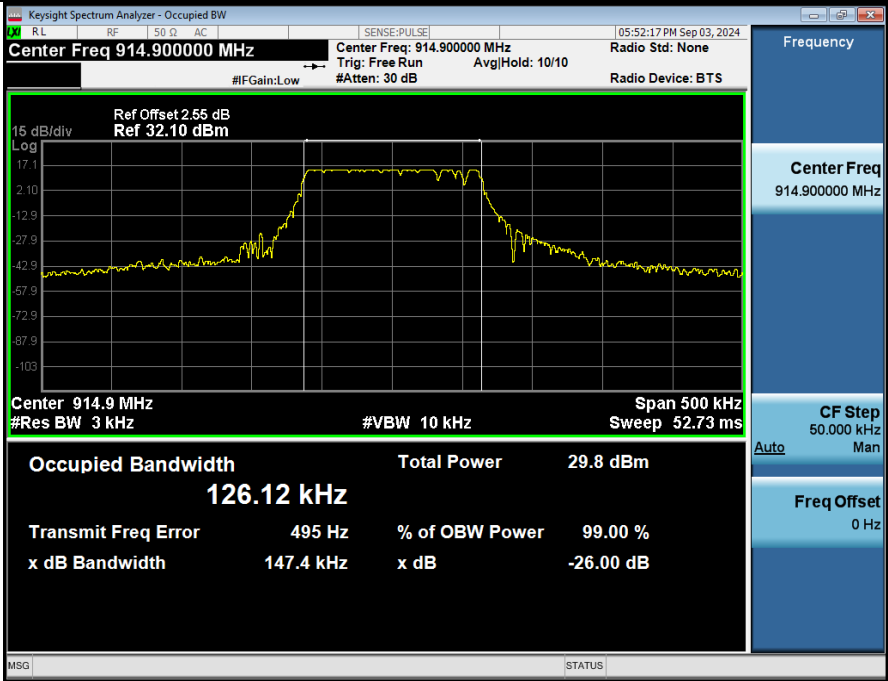
99%_Occupied_Bandwidth_NVNT_ANT1_Lora SF10_902_30



99%_Occupied_Bandwidth_NVNT_ANT1_Lora SF10_908_70



99%_Occupied_Bandwidth_NVNT_ANT1_Lora SF10_914_90



Appendix A.5: Test Results of Carrier Frequency Separation

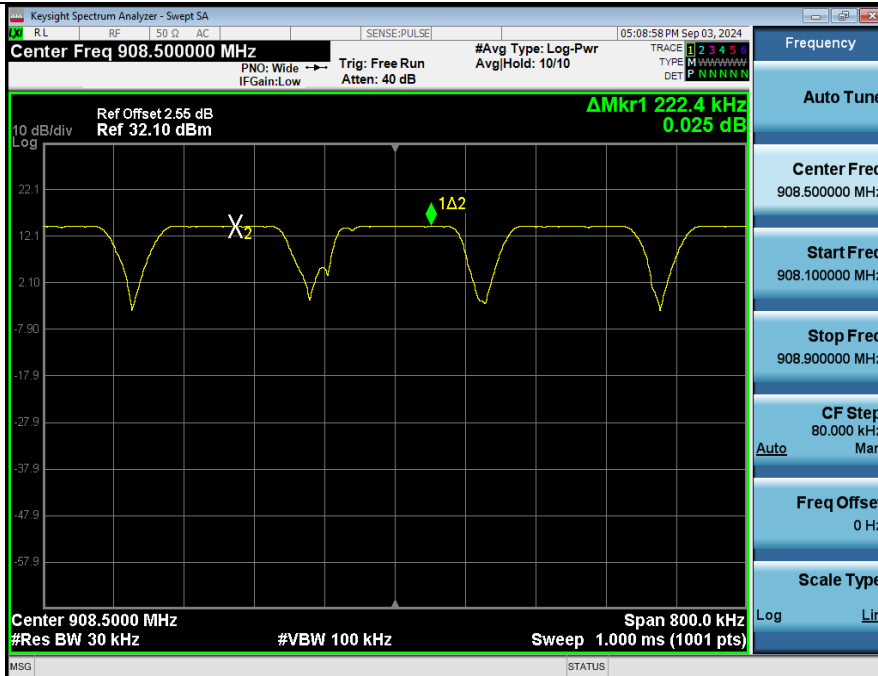
Lora FHSS, Data rate SF7

Condition	Antenna	Modulation	Frequency (MHz)	Hopping NO.0 (MHz)	Hopping NO.1 (MHz)	Carrier Frequencies Separation (MHz)	Limit (MHz)	Result
NVNT	ANT1	Lora SF7	902.30	902.299	902.518	0.22	0.14	Pass
NVNT	ANT1	Lora SF7	908.70	908.318	908.541	0.22	0.14	Pass
NVNT	ANT1	Lora SF7	914.90	914.706	914.907	0.20	0.14	Pass

Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_Lora SF7_Hopping



Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_Lora SF7_Hopping



Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_Lora SF7_Hopping



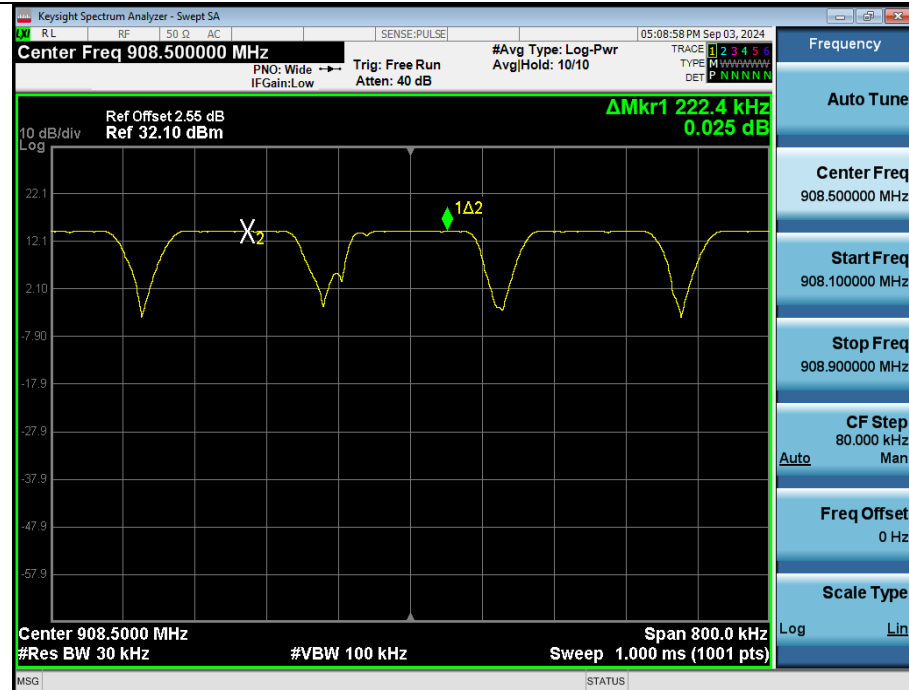
Lora FHSS, Data rate SF10

Condition	Antenna	Modulation	Frequency (MHz)	Hopping NO.0 (MHz)	Hopping NO.1 (MHz)	Carrier Frequencies Separation (MHz)	Limit (MHz)	Result
NVNT	ANT1	Lora SF10	902.30	902.311	902.500	0.19	0.14	Pass
NVNT	ANT1	Lora SF10	908.70	908.318	908.541	0.22	0.14	Pass
NVNT	ANT1	Lora SF10	914.90	914.707	914.900	0.19	0.14	Pass

Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_Lora_SF10_Hopping



Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_Lora_SF10_Hopping



Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_Lora_SF10_Hopping

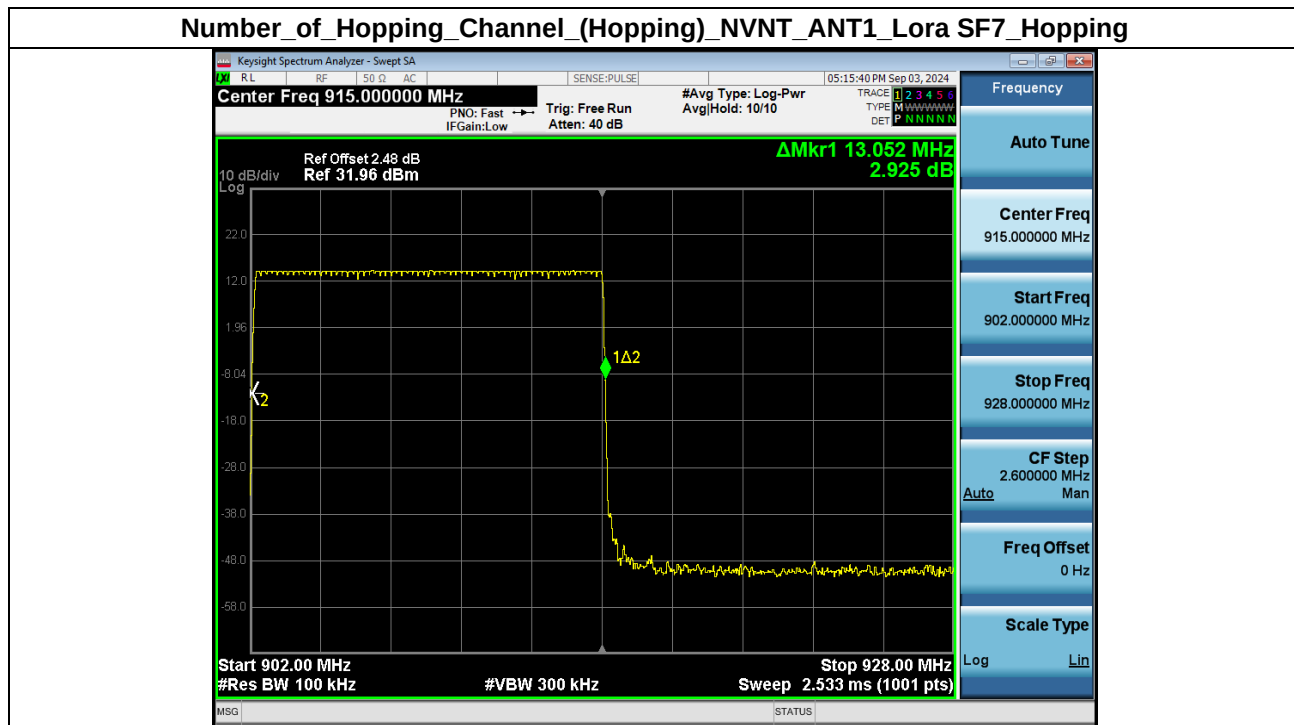


Appendix A.6: Test Results of Number of Hopping Frequency

Lora FHSS, Data rate SF7

Condition	Antenna	Modulation	Hopping Num	Limit	Result
NVNT	ANT1	Lora SF7	64	≥50	Pass

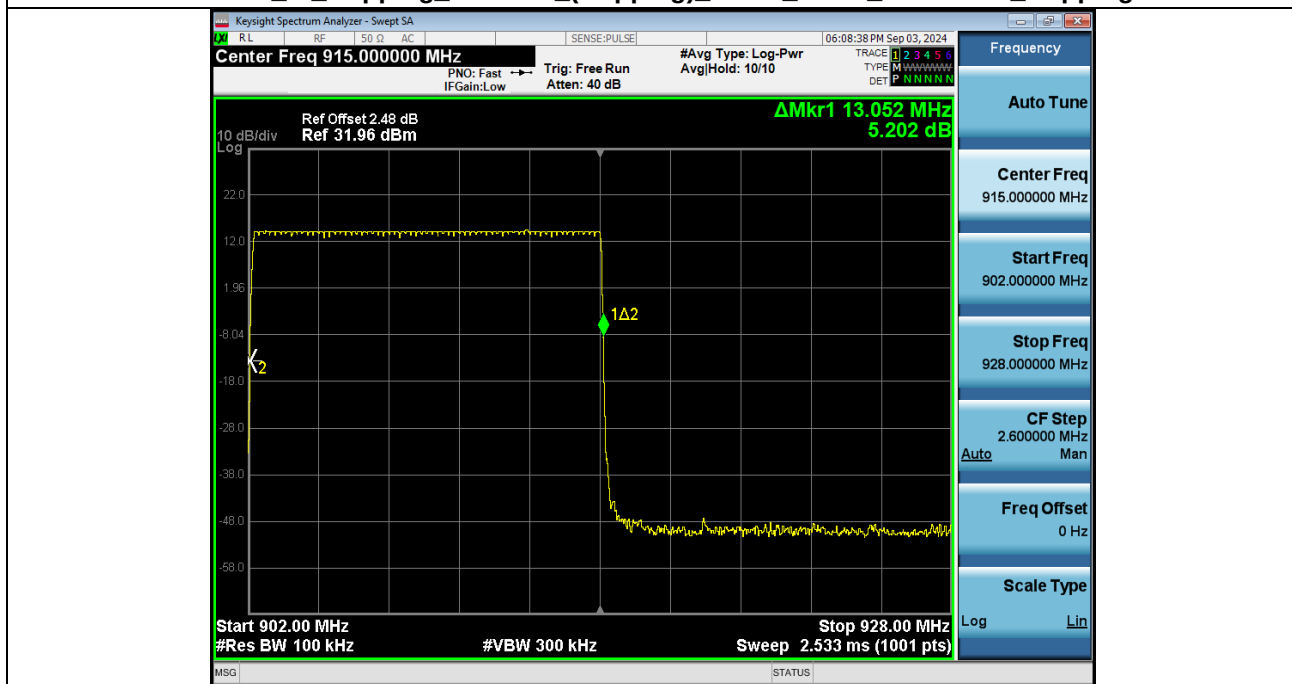
Number_of_Hopping_Channel_(Hopping)_NVNT_ANT1_Lora_SF7_Hopping



Lora FHSS, Data rate SF10

Condition	Antenna	Modulation	Hopping Num	Limit	Result
NVNT	ANT1	Lora SF10	64	≥50	Pass

Number_of_Hopping_Channel_(Hopping)_NVNT_ANT1_Lora_SF10_Hopping

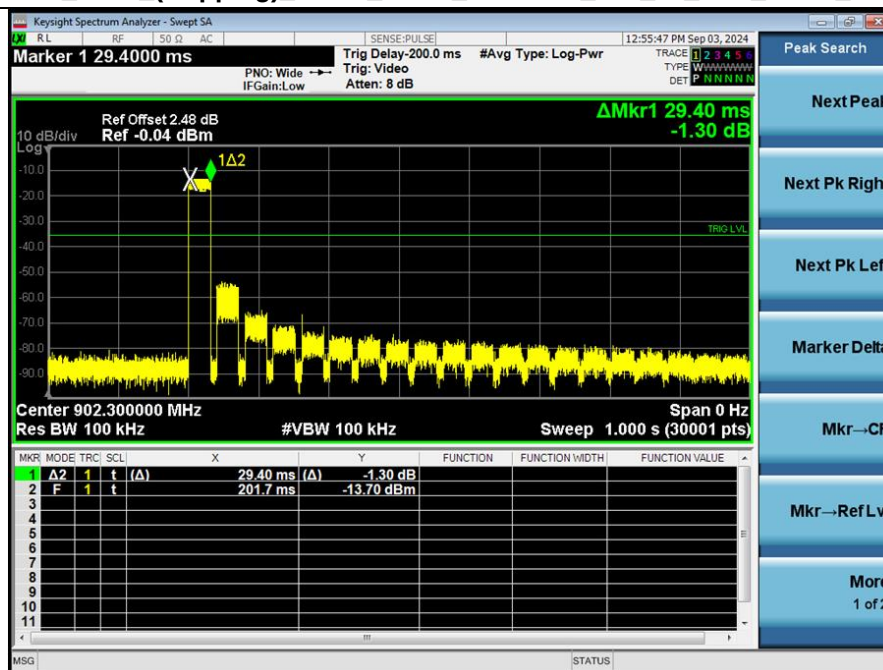


Appendix A.7: Test Results of Time of Occupancy

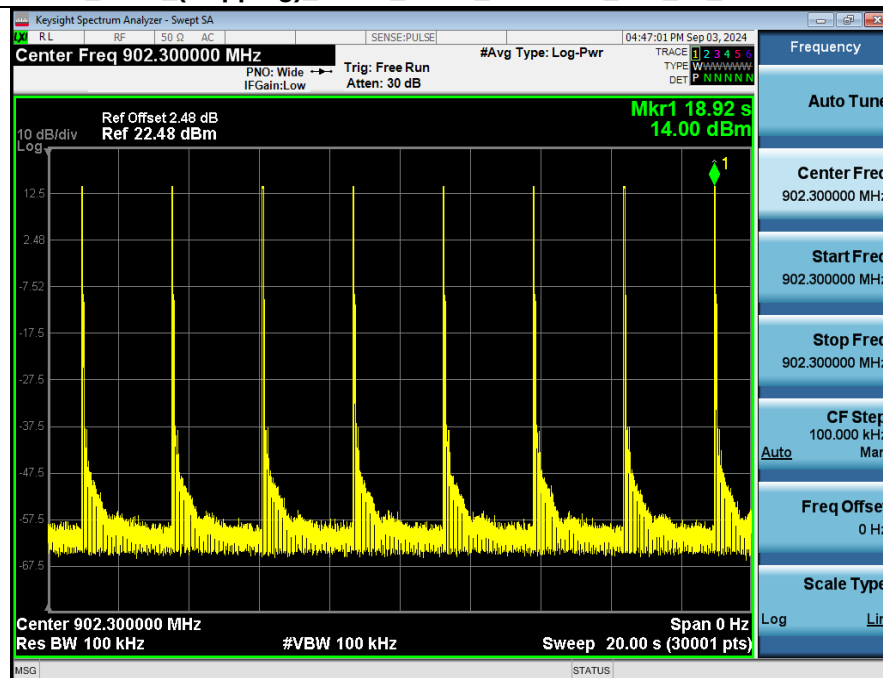
Lora FHSS, Data rate SF7

Condition	Antenna	Packet Type	Pulse Time(ms)	Hops	Dwell Time(ms)	Limit(s)	Result
NVNT	ANT1	Lora SF7	29.40	8.00	235.2	0.40	Pass

Dwell_Time_(Hopping)_NVNT_ANT1_Lora SF7_902_30_One_Burst_Time



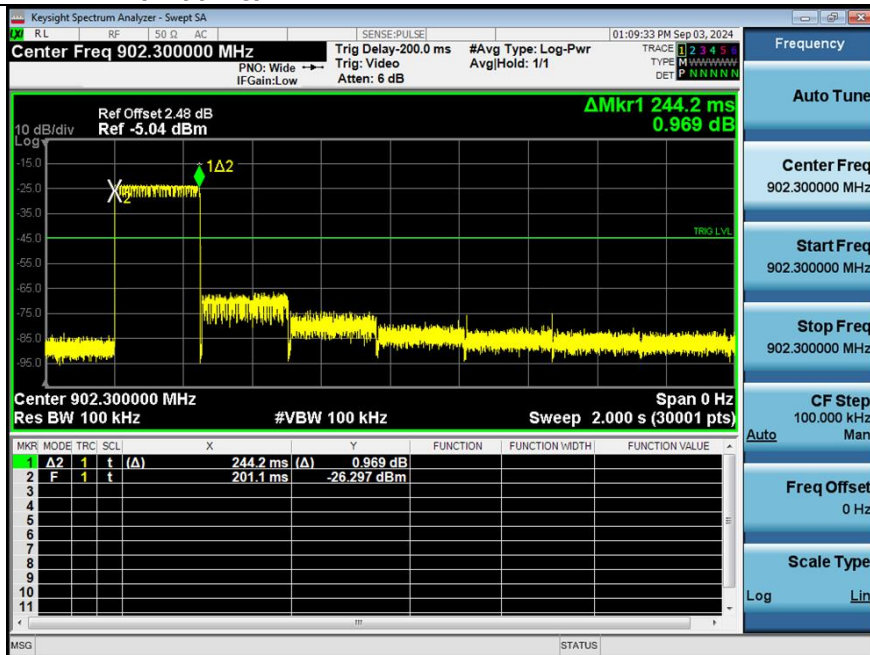
Dwell_Time_(Hopping)_NVNT_ANT1_Lora SF7_902_30_Accumulated



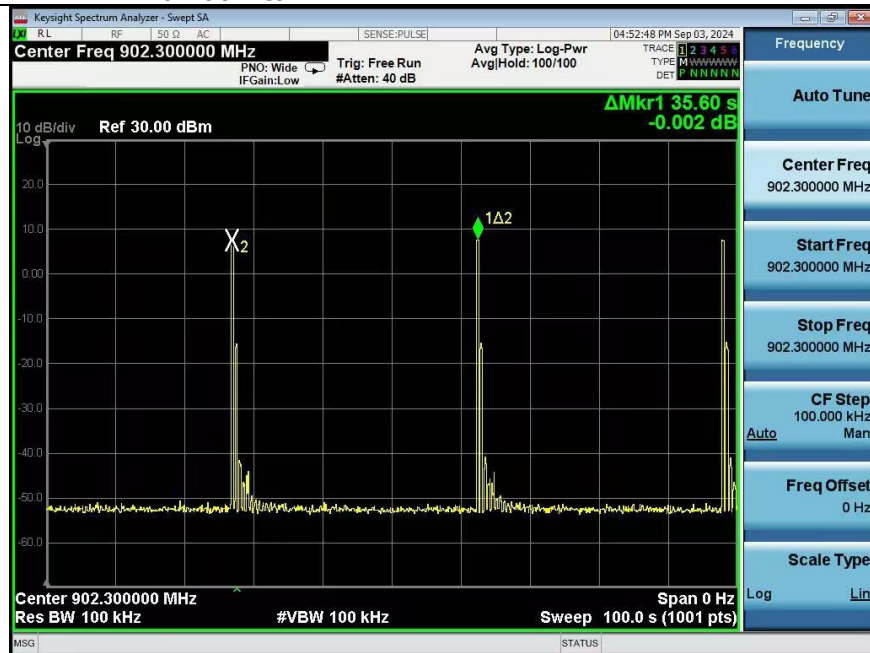
Lora FHSS, Data rate SF10

Condition	Antenna	Packet Type	Pulse Time(ms)	Hops (In 20s)	Dwell Time(ms)	Limit(s)	Result
NVNT	ANT1	Lora SF10	244.2	1.00	244.2	0.40	Pass

Dwell_Time_(Hopping)_NVNT_ANT1_Lora SF10_902_30_One_Burst_Time



Dwell_Time_(Hopping)_NVNT_ANT1_Lora SF10_902_30_Accumulated

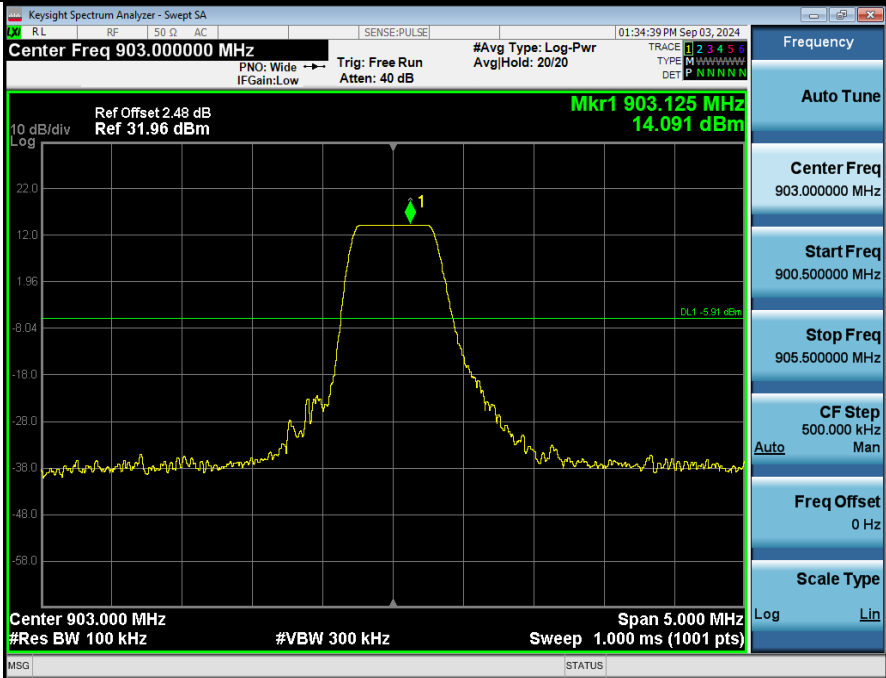


Appendix A.8: Test Results of Conducted Spurious Emissions Measured in 100 kHz Bandwidth

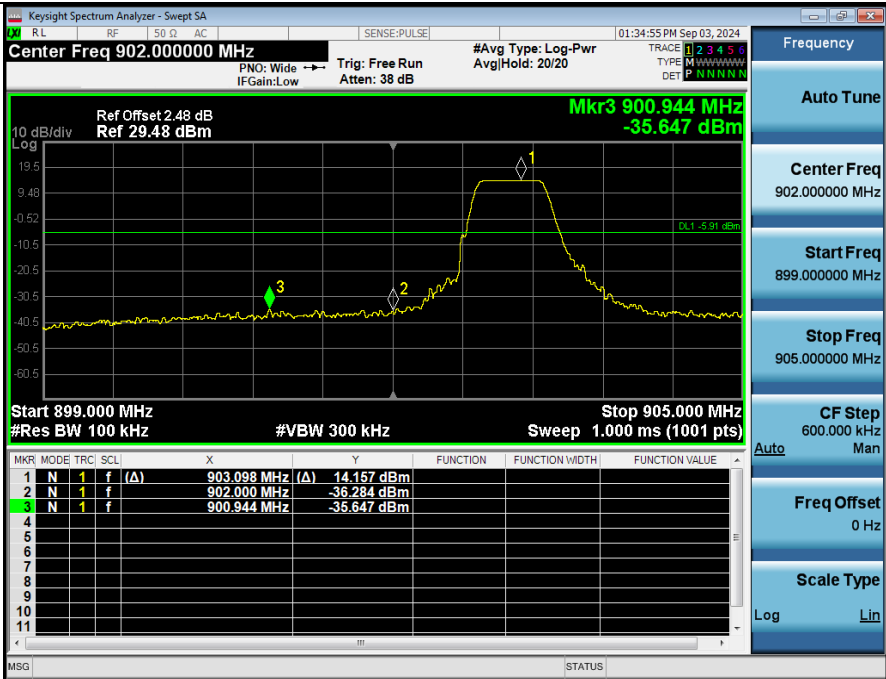
Lora DTS, Band Edge

Condition	Antenna	Rate	TX_Frequency (MHz)	Max. Mark Frequency (MHz)	Spurious level(dBm)	Limit(dBm)	Result
NVNT	ANT1	SF8	903.00	900.944	-35.647	-5.909	Pass
NVNT	ANT1	SF8	914.20	930.340	-49.998	-5.860	Pass

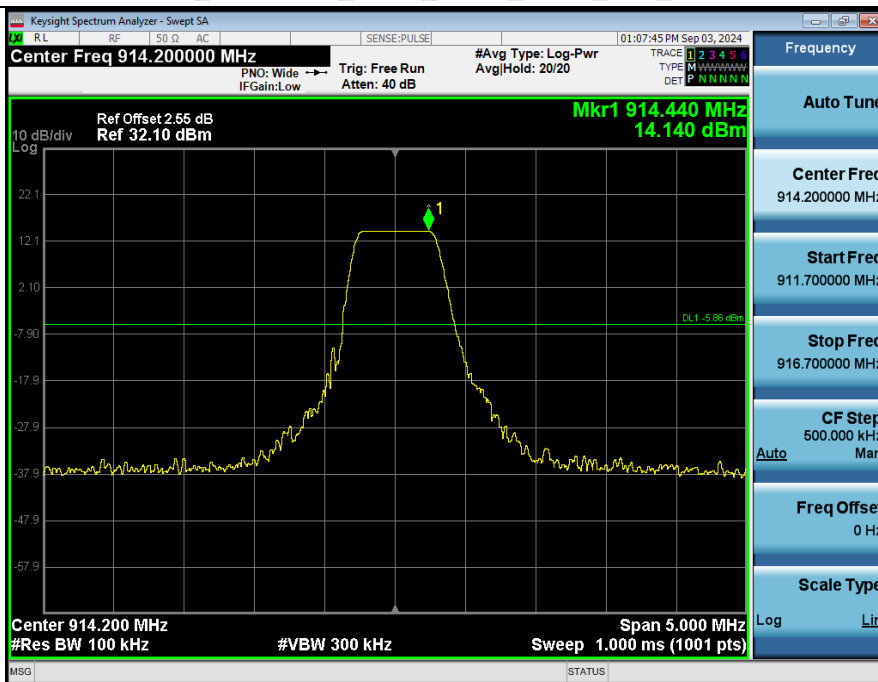
1 Reference_Level_NVNT_ANT1_SF8_903



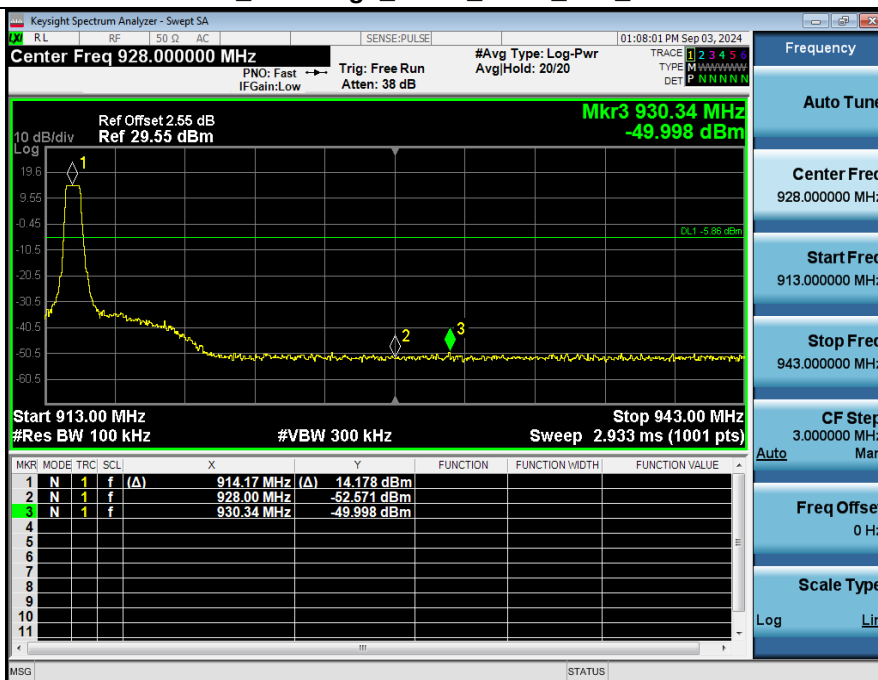
2 Bandedge_NVNT_ANT1_SF8_903



1_Reference_Level_NVNT_ANT1_SF8_914



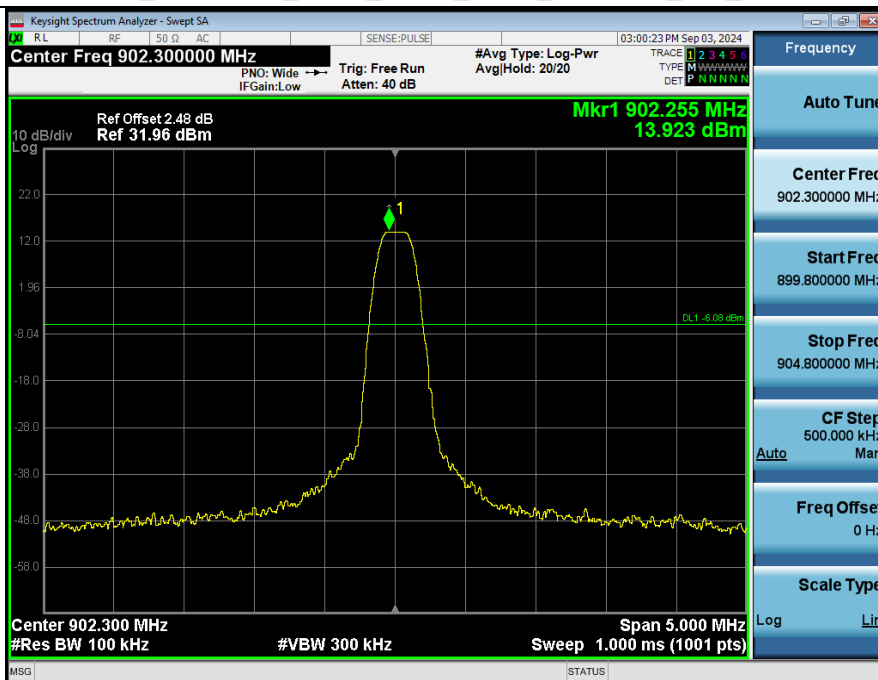
2_Bandedge_NVNT_ANT1_SF8_914



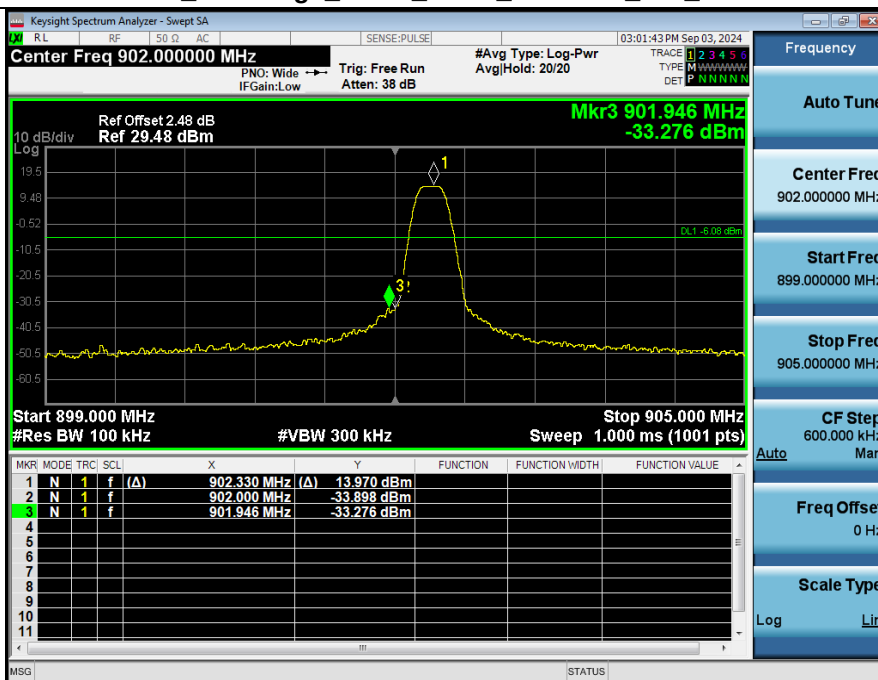
Lora FHSS, Data rate SF7, Band Edge

Condition	Antenna	Modulation	TX Mode	Bandedge MAX.Value	Limit	Result
NVNT	ANT1	Lora SF7	902.30	-33.276	-6.077	Pass
NVNT	ANT1	Lora SF7	Hopping_LCH	-35.888	-5.708	Pass
NVNT	ANT1	Lora SF7	914.90	-50.428	-5.821	Pass
NVNT	ANT1	Lora SF7	Hopping_HCH	-50.718	-5.561	Pass

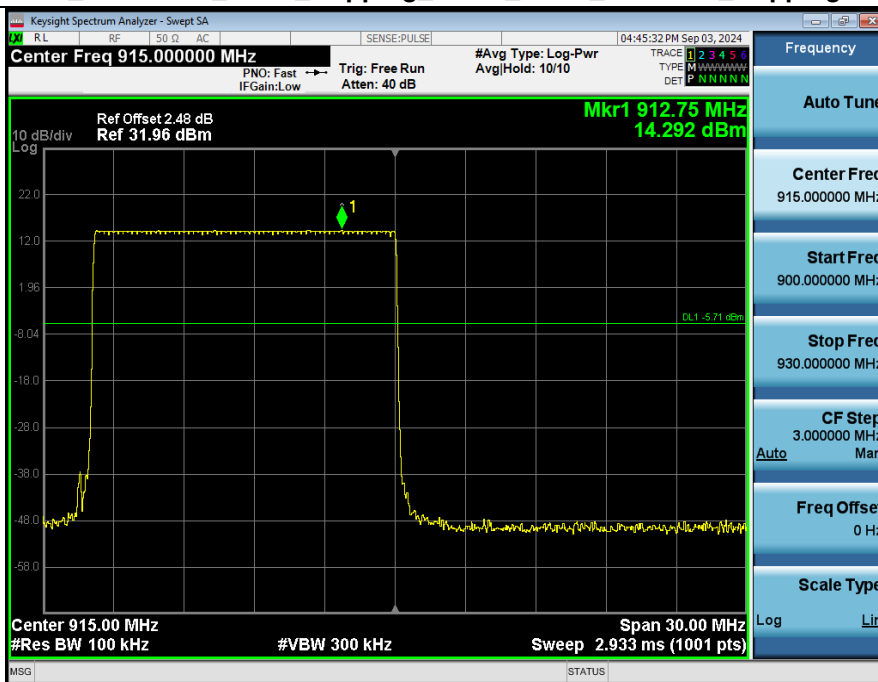
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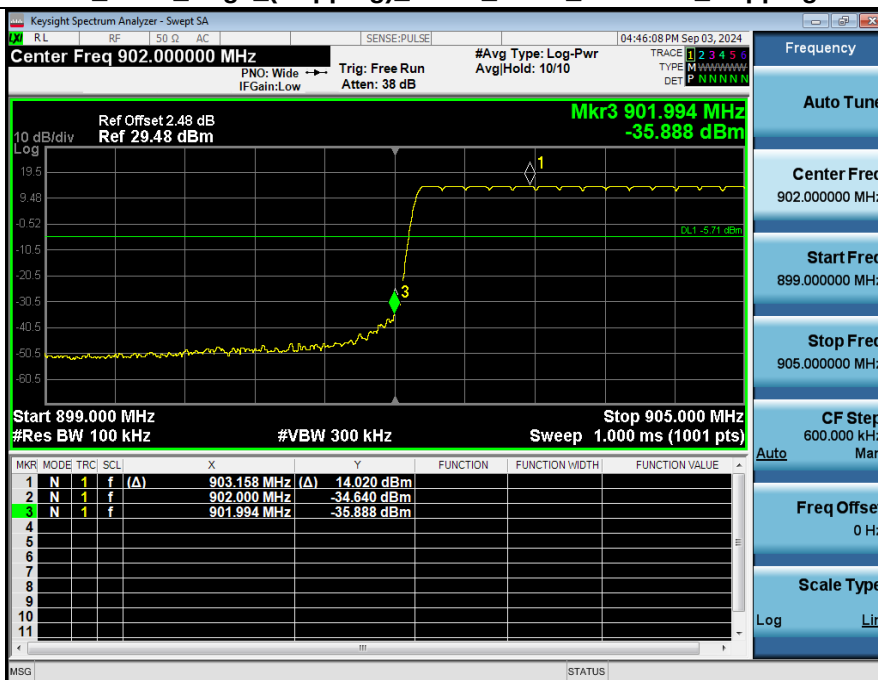
2_Bandedge_NVNT_ANT1_Lora SF7_902_30

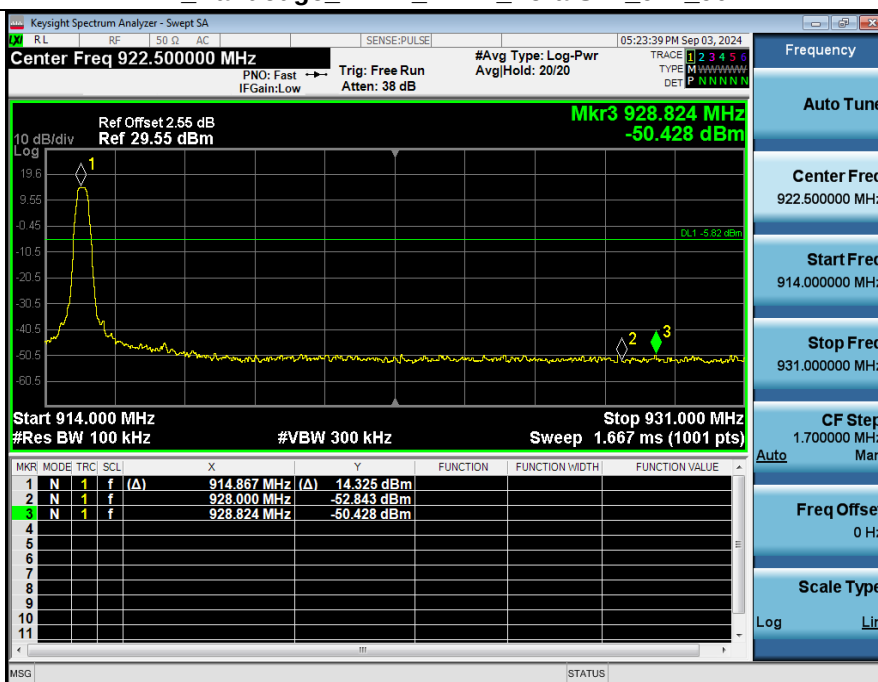


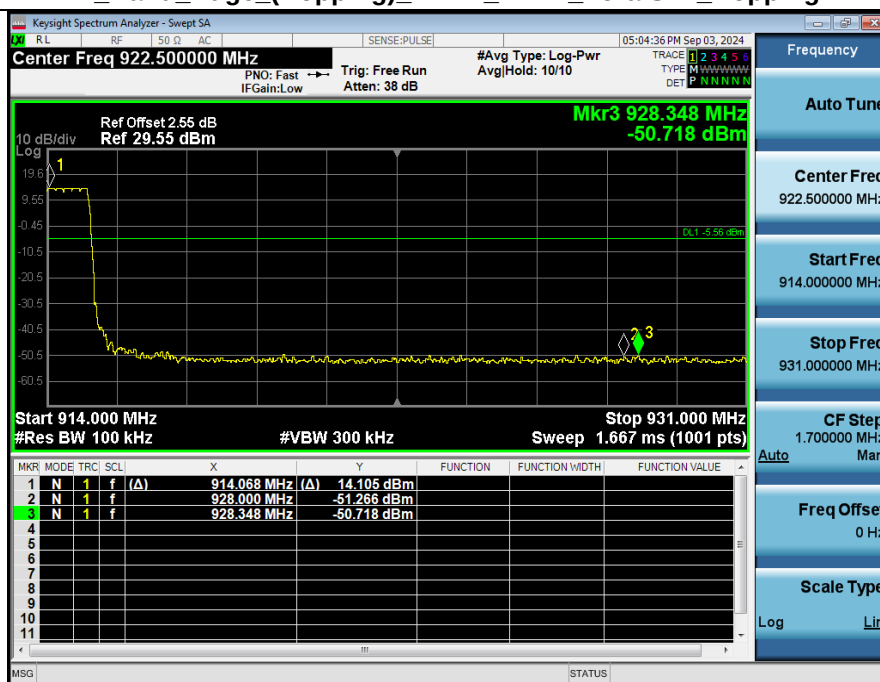
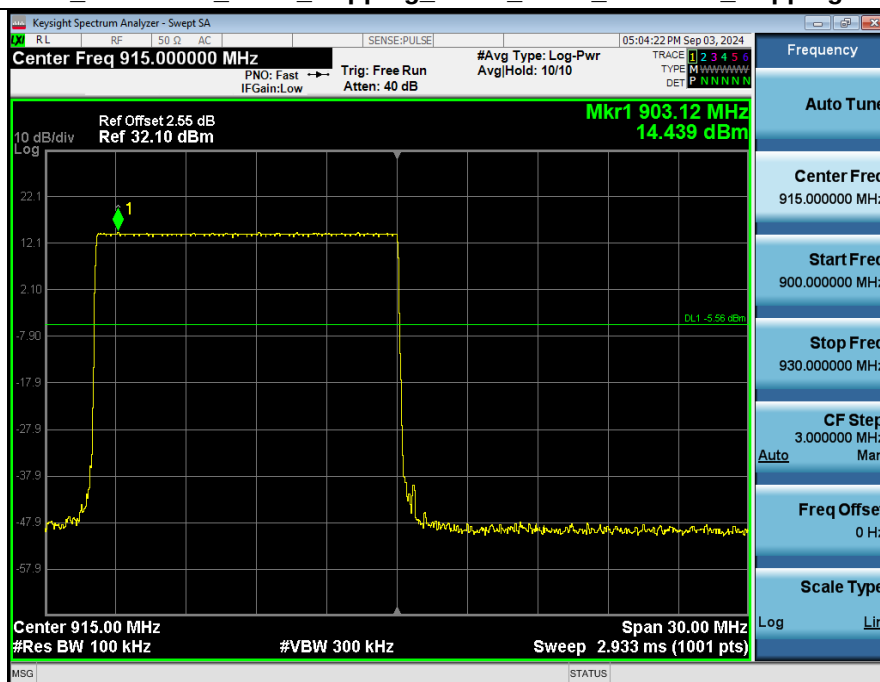
1 Reference_Level_Hopping_NVNT_ANT1_Lora_SF7_Hopping



2 Band_Edge_(Hopping)_NVNT_ANT1_Lora_SF7_Hopping



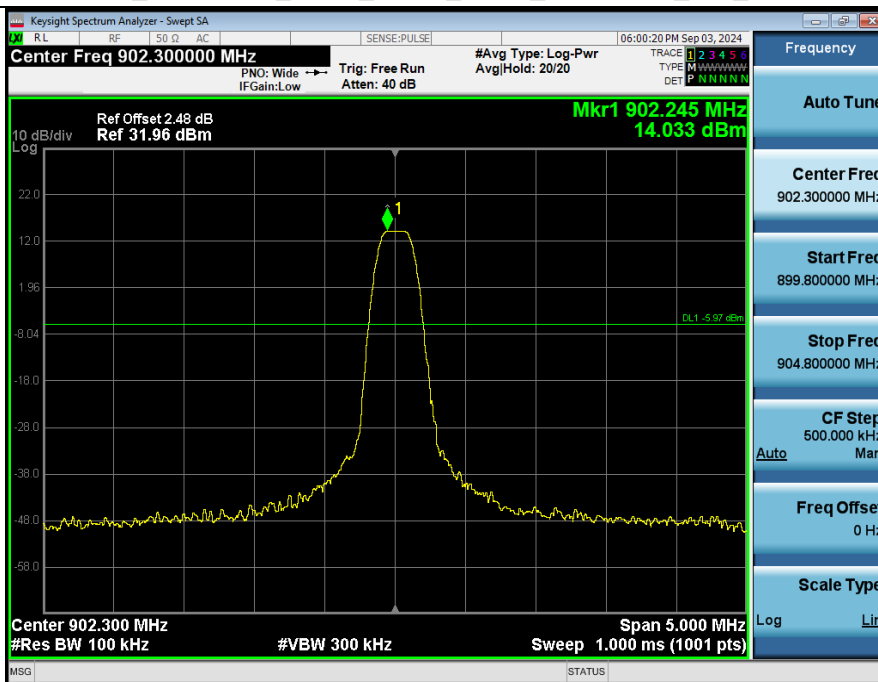




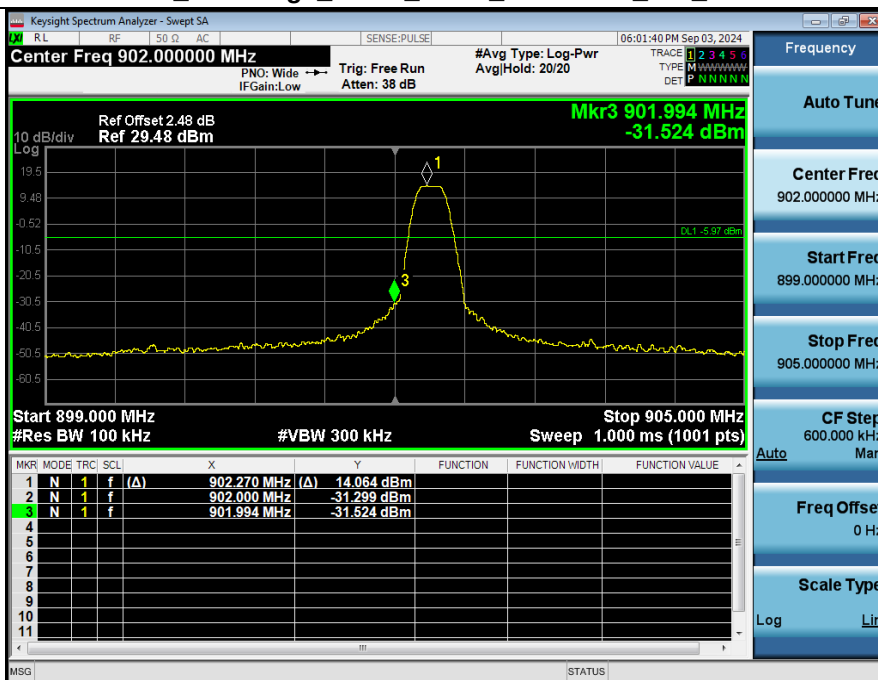
Lora FHSS, Data rate SF10, Band Edge

Condition	Antenna	Modulation	TX Mode	Bandedge MAX.Value	Limit	Result
NVNT	ANT1	Lora SF10	902.30	-31.524	-5.967	Pass
NVNT	ANT1	Lora SF10	Hopping_LCH	-38.262	-5.812	Pass
NVNT	ANT1	Lora SF10	914.90	-50.386	-5.879	Pass
NVNT	ANT1	Lora SF10	Hopping_HCH	-50.253	-5.779	Pass

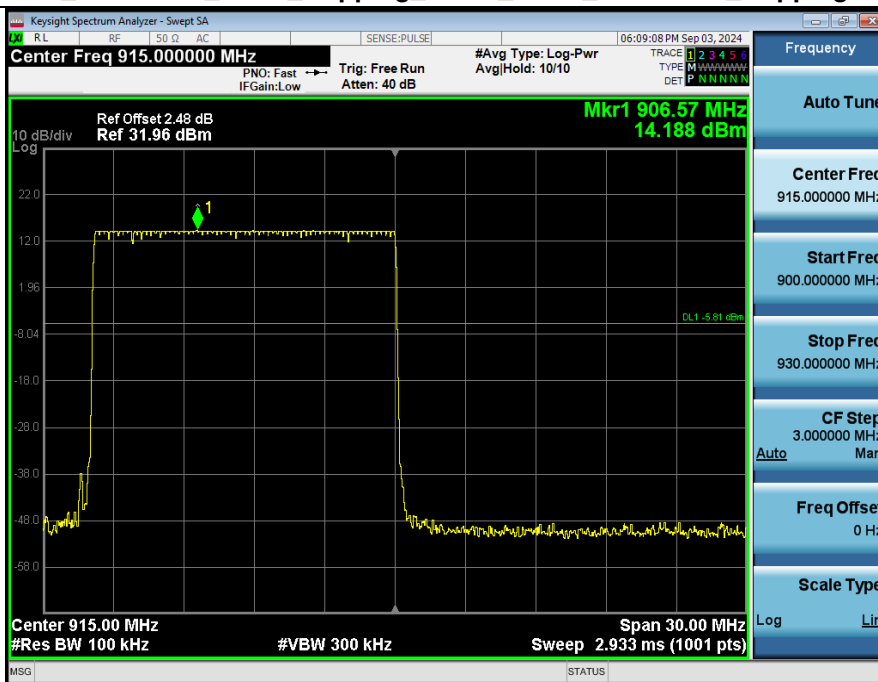
1_Reference_Level_NVNT_ANT1_Lora SF10_902_30



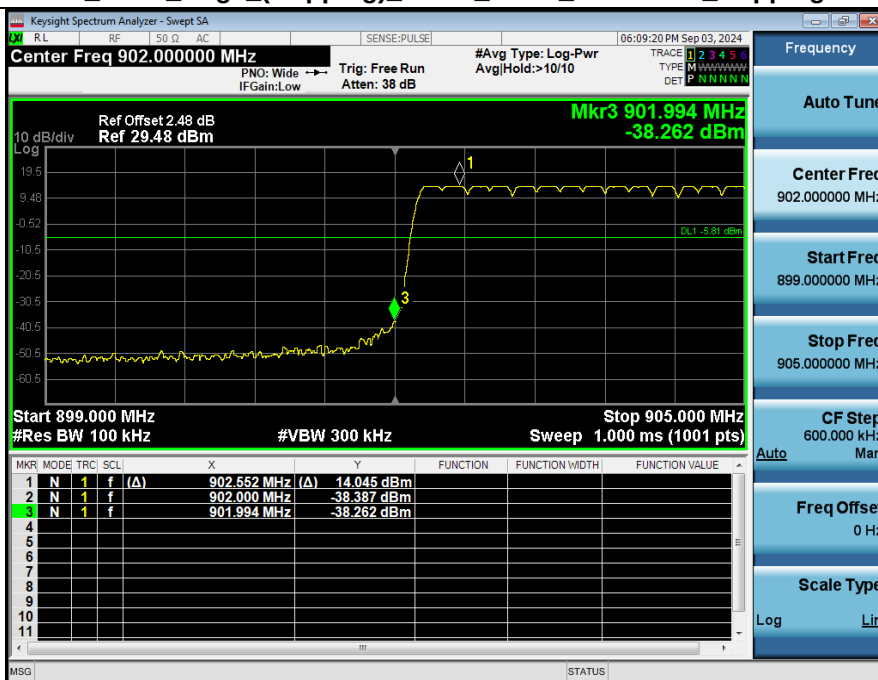
2_Bandedge_NVNT_ANT1_Lora SF10_902_30



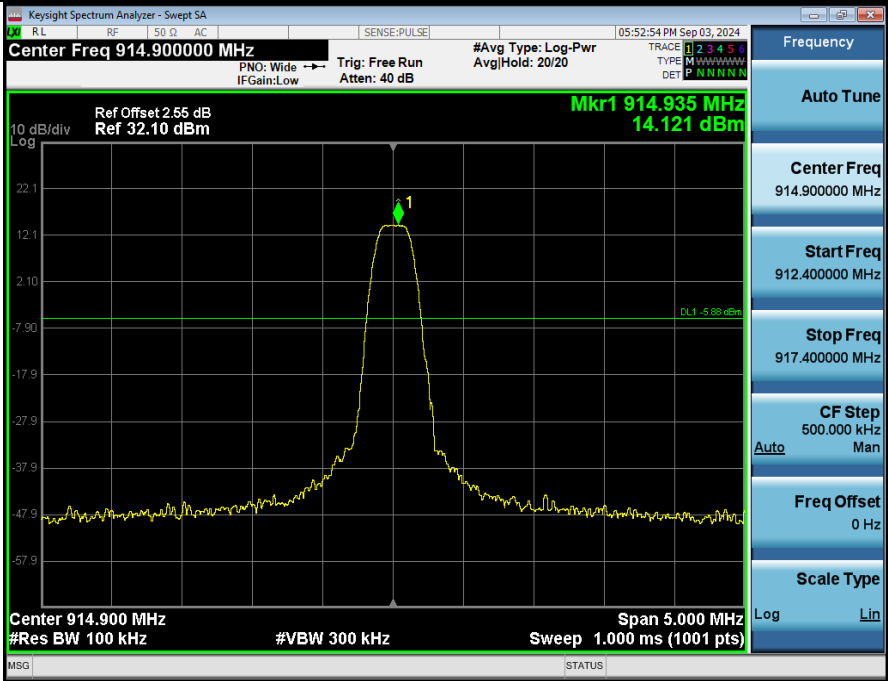
1 Reference_Level_Hopping_NVNT_ANT1_Lora_SF10_Hopping



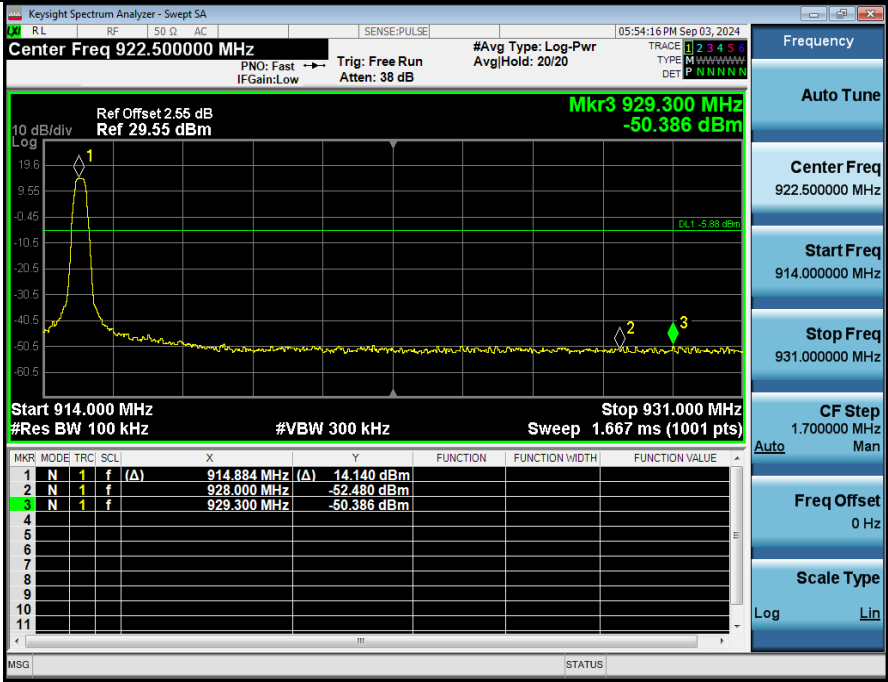
2 Band_Edge_(Hopping)_NVNT_ANT1_Lora_SF10_Hopping



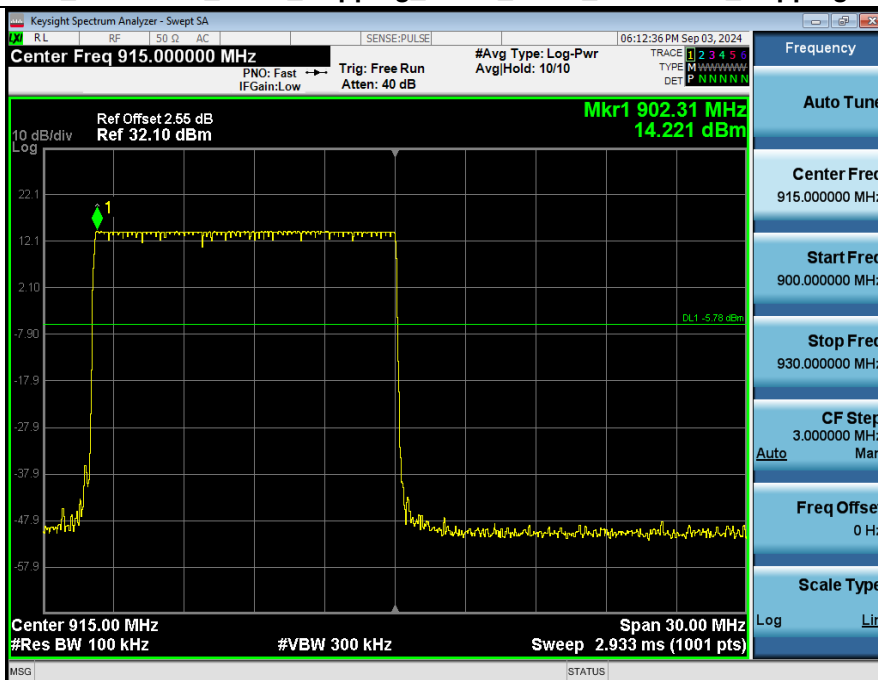
1 Reference_Level_NVNT_ANT1_Lora SF10_914_90



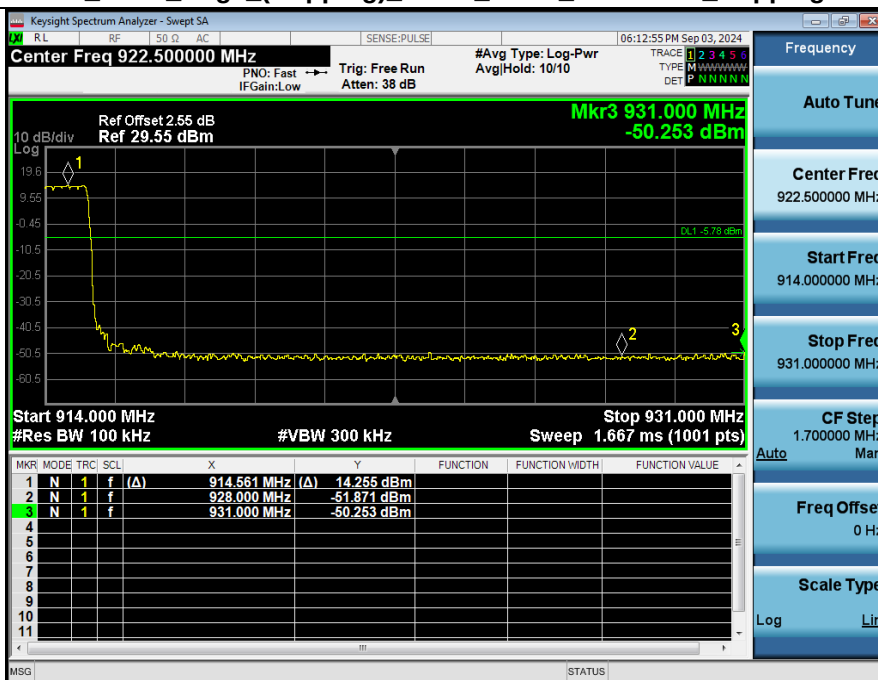
2 Bandedge_NVNT_ANT1_Lora SF10_914_90



1 Reference_Level_Hopping_NVNT_ANT1_Lora_SF10_Hopping



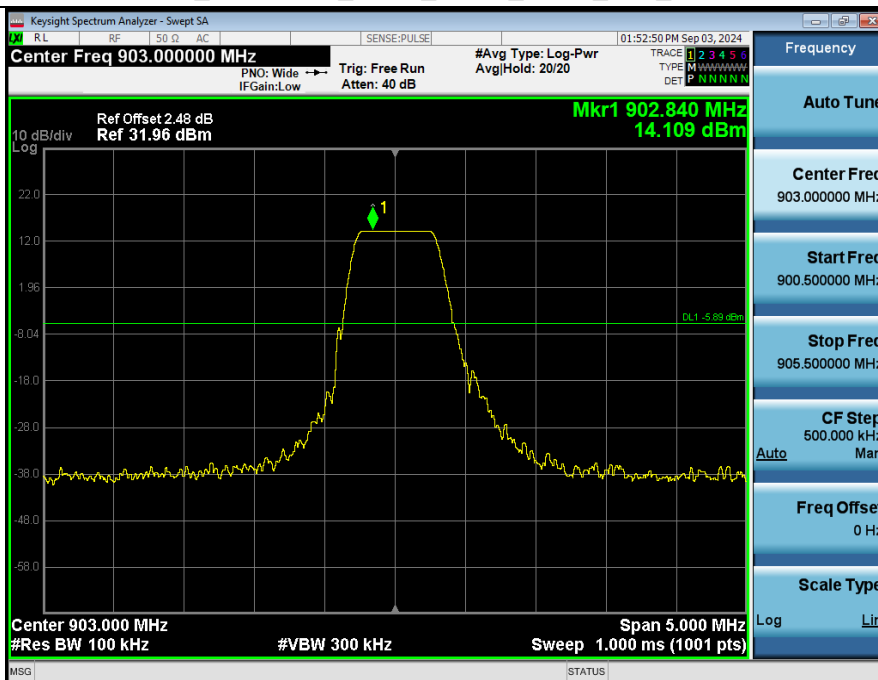
2 Band_Edge_(Hopping)_NVNT_ANT1_Lora_SF10_Hopping



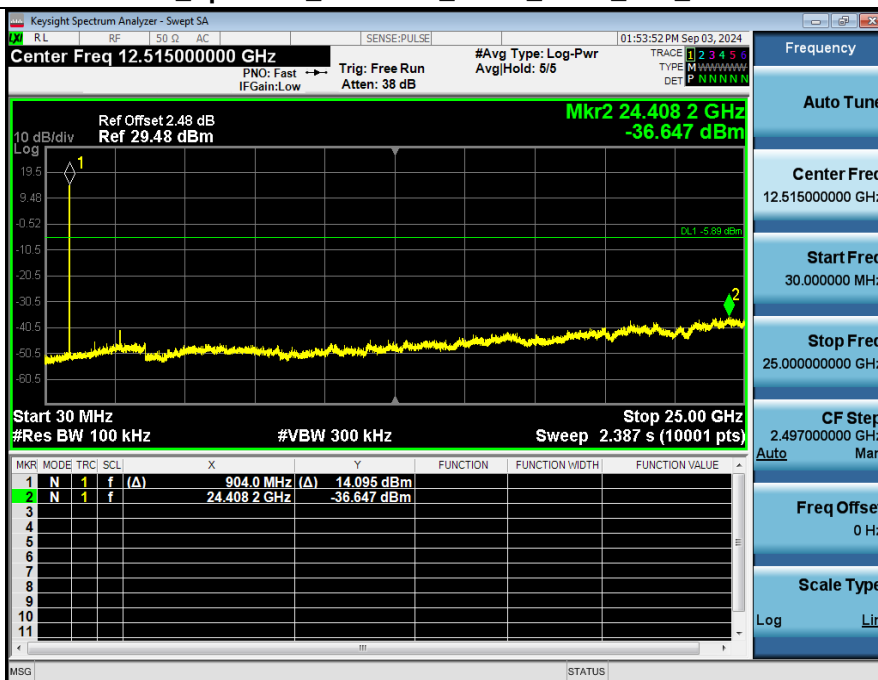
Lora DTS, Conducted Spurious Emission

Condition	Antenna	Rate	TX_Frequency (MHz)	Spurious MAX.Value(dBm)	Limit	Result
NVNT	ANT1	SF8	903.00	-36.647	-5.891	Pass
NVNT	ANT1	SF8	907.80	-35.982	-5.851	Pass
NVNT	ANT1	SF8	914.20	-36.586	-5.850	Pass

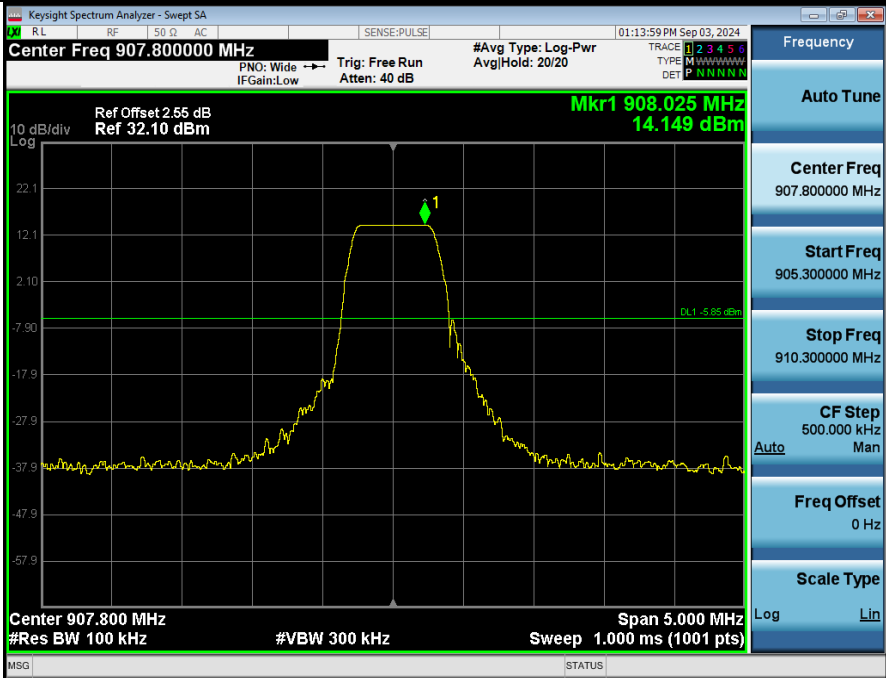
1_Reference_Level_NVNT_ANT1_SF8_903



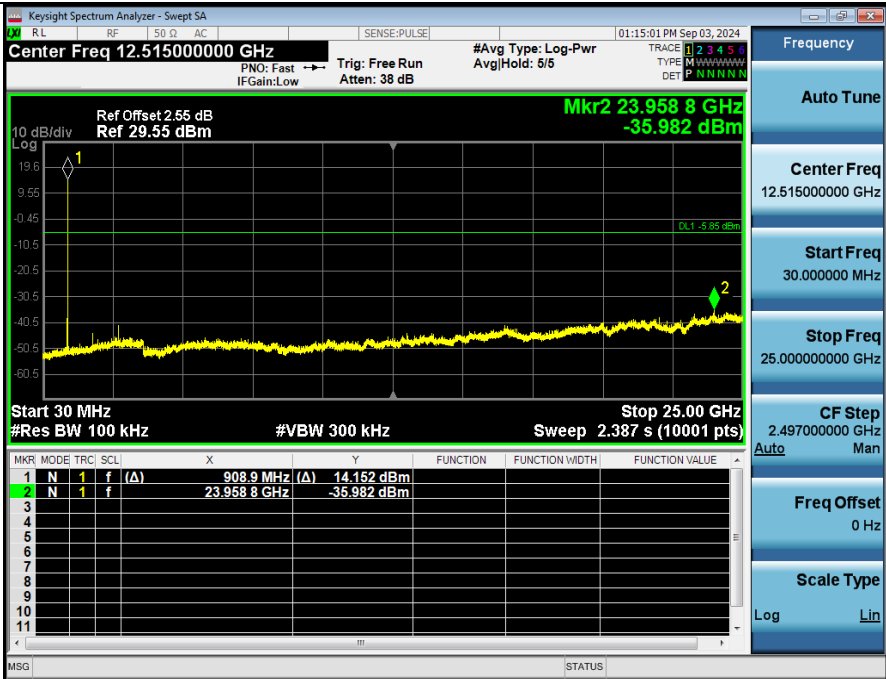
2_Spurious_Emission_NVNT_ANT1_SF8_903



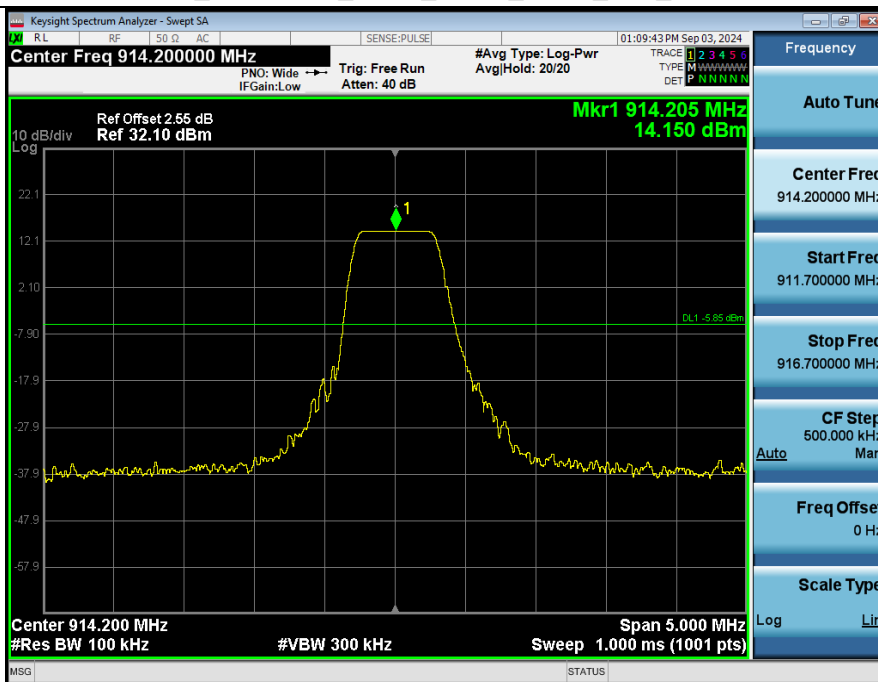
1 Reference_Level_NVNT_ANT1_SF8_907



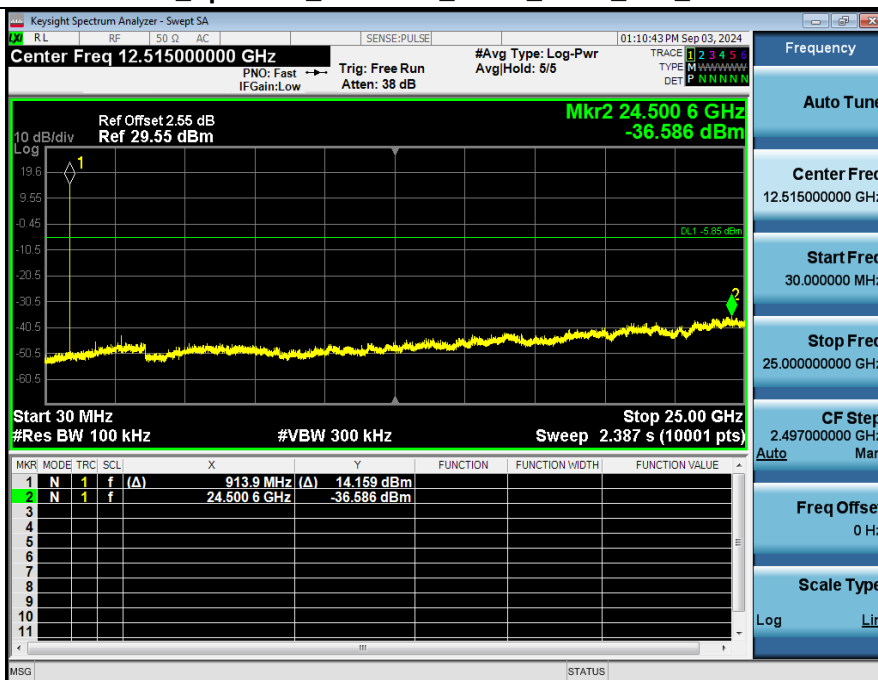
2 Spurious_Emission_NVNT_ANT1_SF8_907



1_Reference_Level_NVNT_ANT1_SF8_914



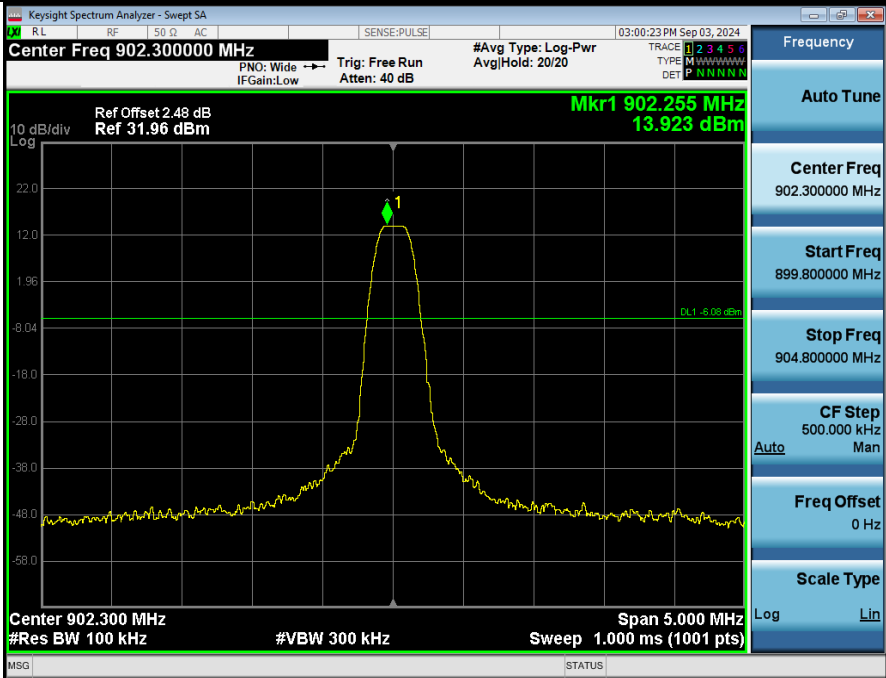
2_Spurious_Emission_NVNT_ANT1_SF8_914



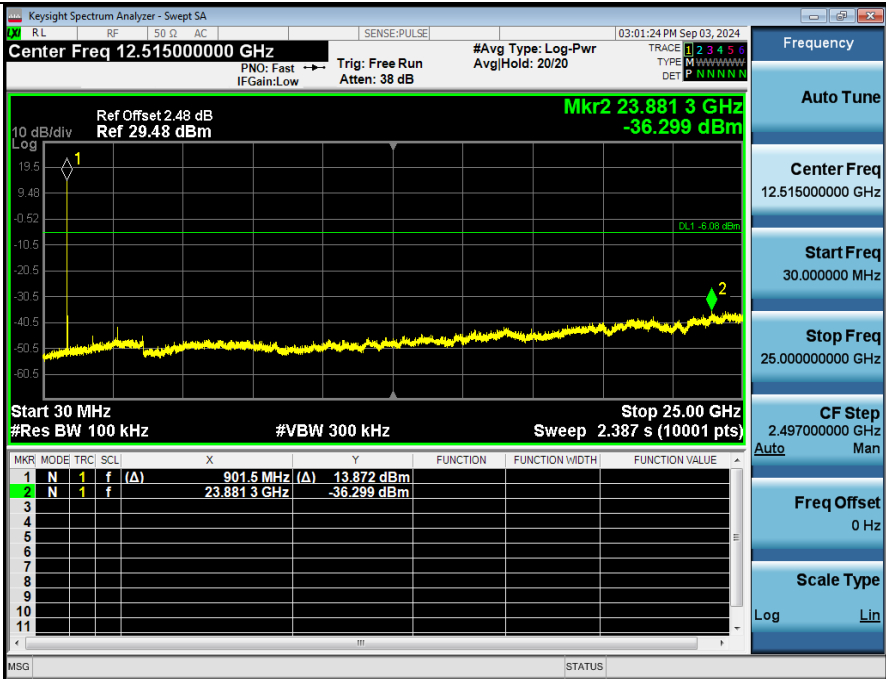
Lora FHSS, Data rate SF7, Conducted Spurious Emission

Condition	Antenna	Modulation	TX Mode	Spurious MAX.Value(dBm)	Limit	Result
NVNT	ANT1	Lora SF7	902.30	-36.299	-6.077	Pass
NVNT	ANT1	Lora SF7	908.70	-36.196	-6.026	Pass
NVNT	ANT1	Lora SF7	914.90	-36.318	-6.076	Pass

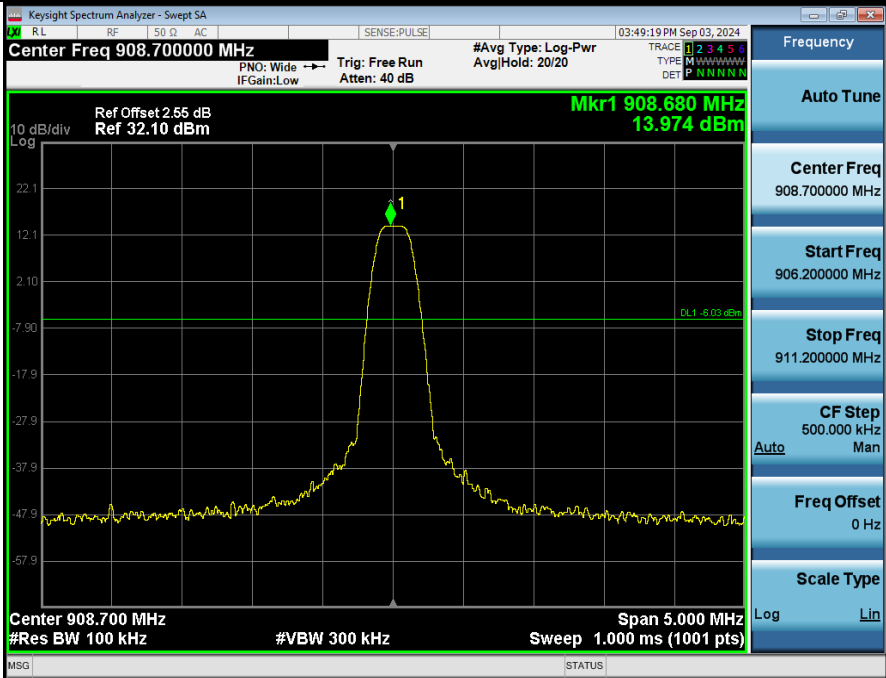
1 Reference Level NVNT_ANT1_Lora SF7_902_30



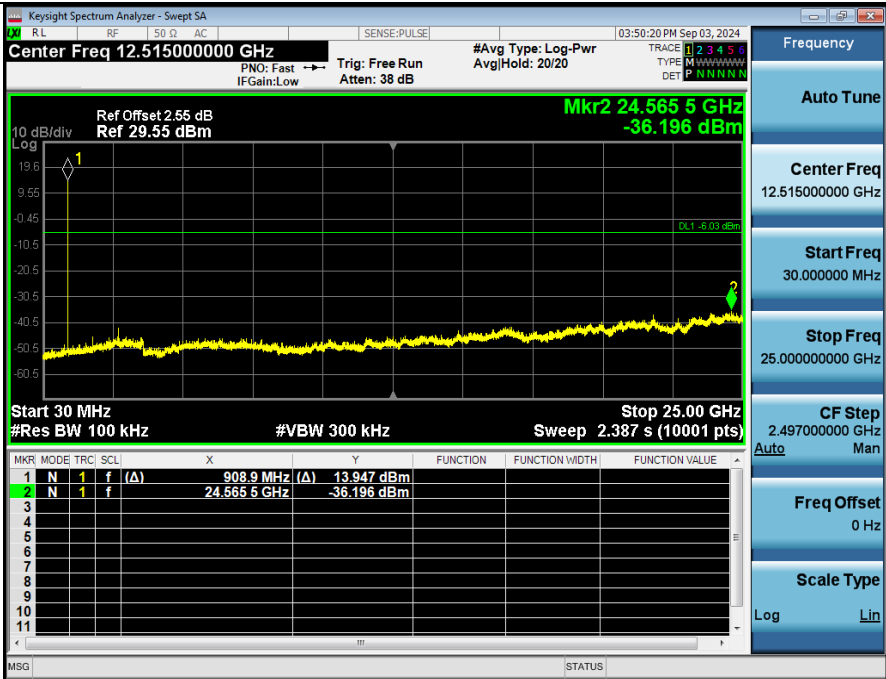
2 Spurious Emissions NVNT_ANT1_Lora SF7_902_30



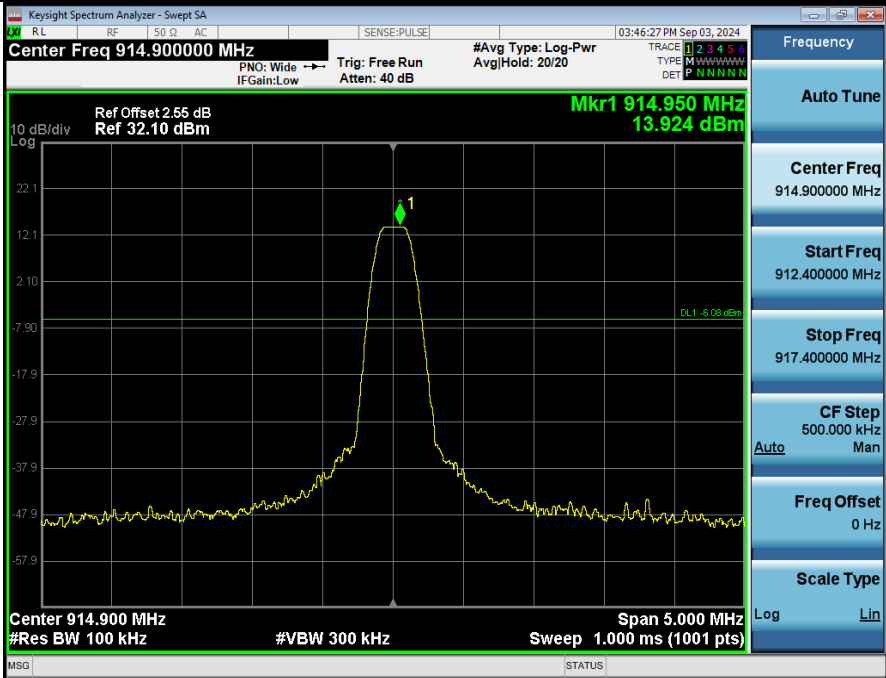
1 Reference_Level_NVNT_ANT1_Lora SF7_908_70



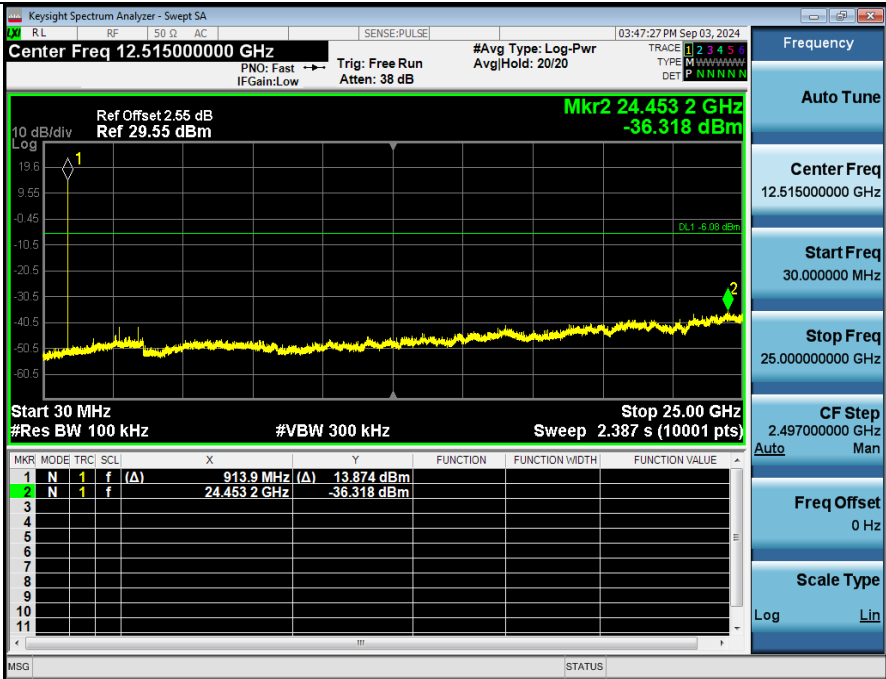
2 Spurious_Emissions_NVNT_ANT1_Lora SF7_908_70



1 Reference Level NVNT_ANT1_Lora SF7_914_90



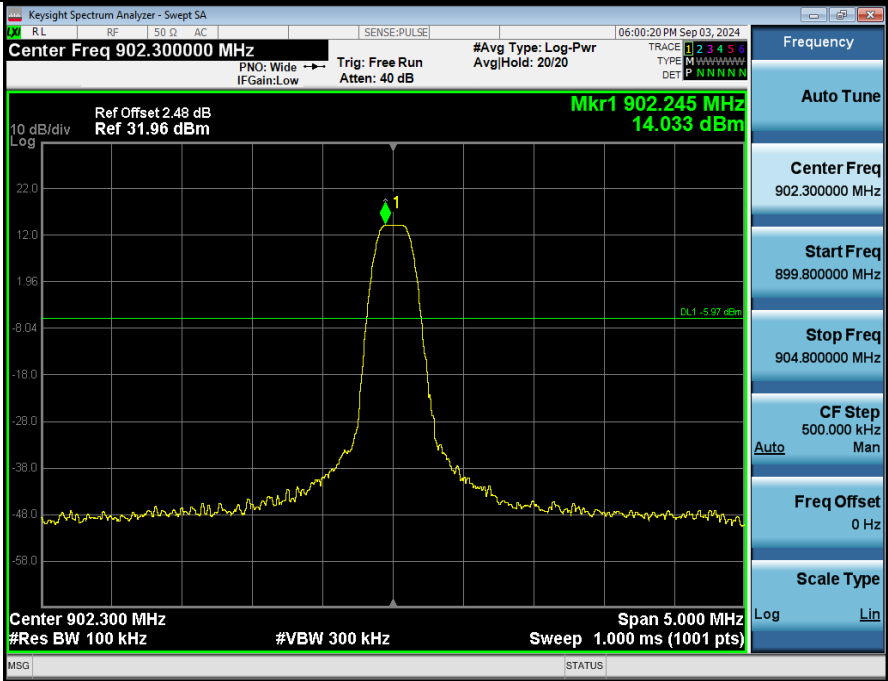
2 Spurious Emissions NVNT_ANT1_Lora SF7_914_90



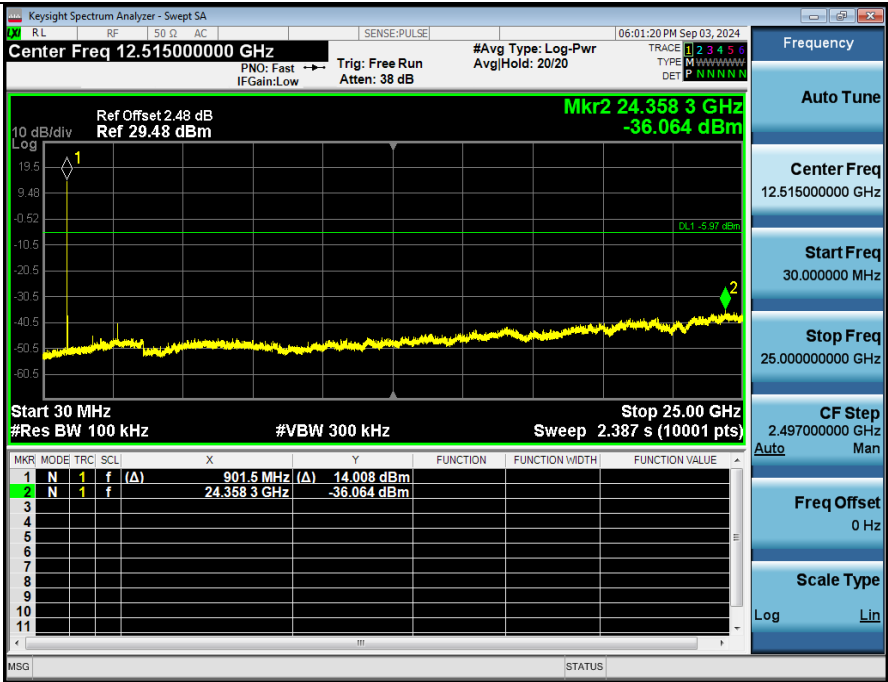
Lora FHSS, Data rate SF10, Conducted Spurious Emission

Condition	Antenna	Modulation	TX Mode	Spurious MAX.Value(dBm)	Limit	Result
NVNT	ANT1	Lora SF10	902.30	-36.064	-5.967	Pass
NVNT	ANT1	Lora SF10	908.70	-35.950	-5.784	Pass
NVNT	ANT1	Lora SF10	914.90	-36.382	-5.879	Pass

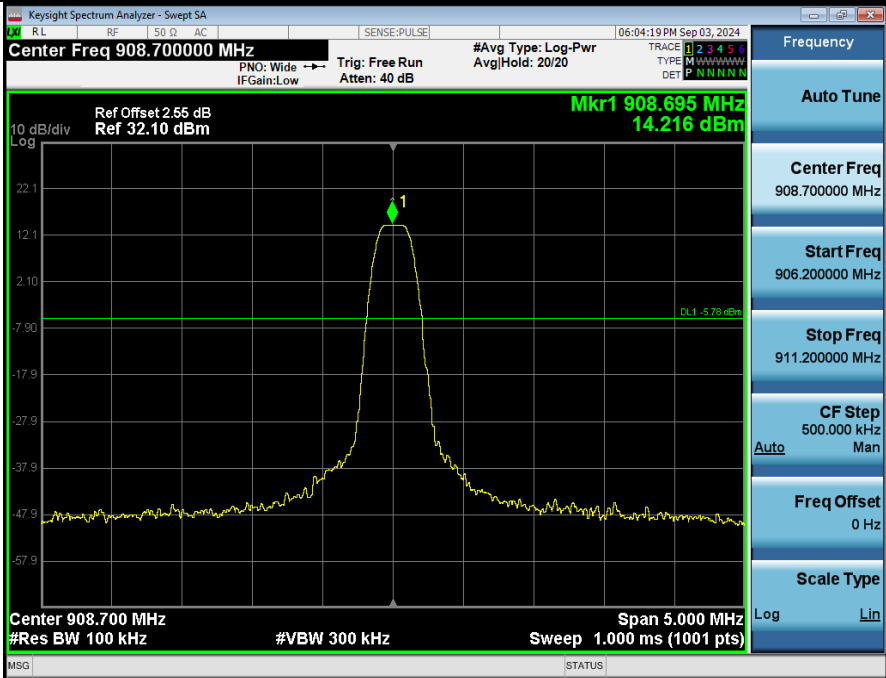
1 Reference_Level_NVNT_ANT1_Lora SF10_902_30



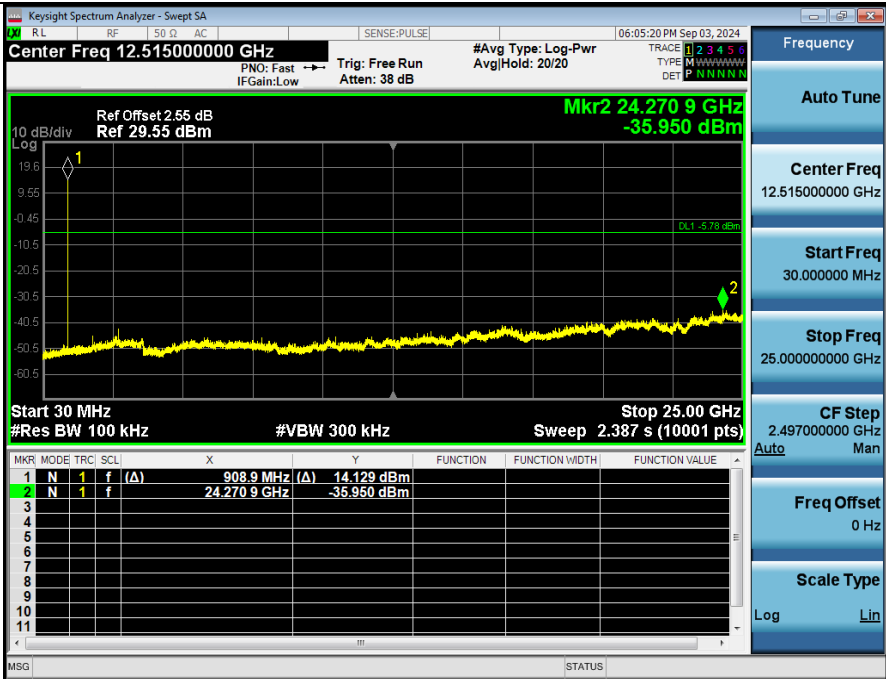
2 Spurious_Emissions_NVNT_ANT1_Lora SF10_902_30



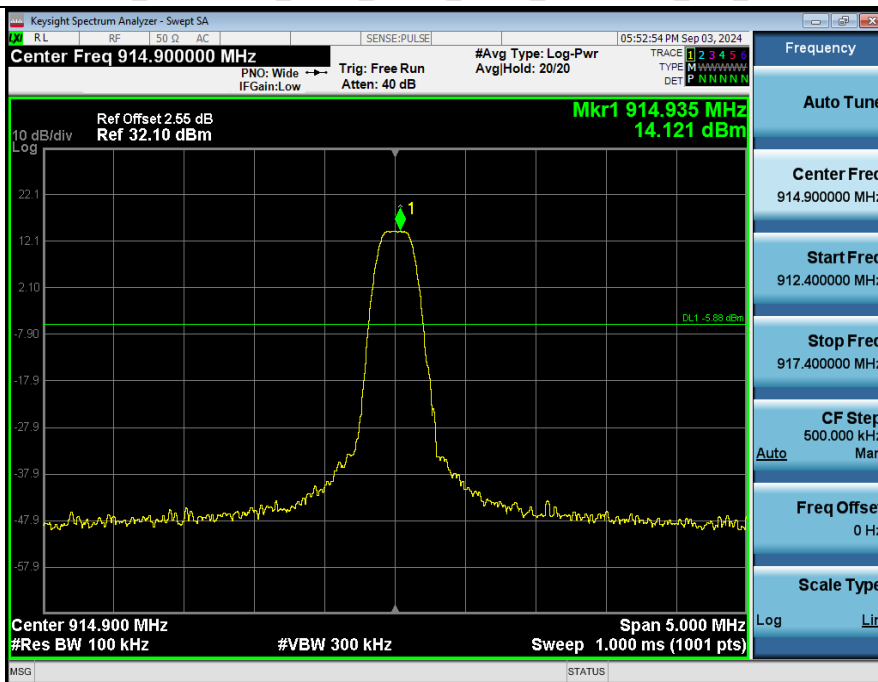
1 Reference_Level_NVNT_ANT1_Lora SF10_908_70



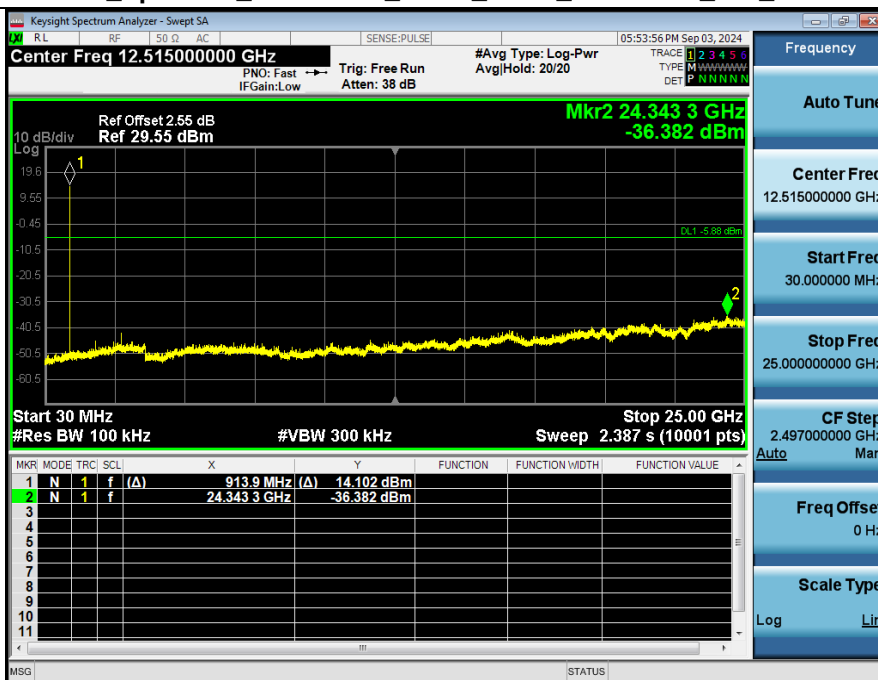
2 Spurious_Emissions_NVNT_ANT1_Lora SF10_908_70



1 Reference_Level_NVNT_ANT1_Lora SF10_914_90



2 Spurious_Emissions_NVNT_ANT1_Lora SF10_914_90



Appendix A.9: Test Results of Radiated Spurious Emissions

Note:

- 1) This testing was carried out on different modulations, but only the worst case was presented in this report.
- 2) Testing was carried out within frequency range 9kHz to the tenth harmonics. The measurement results below 30MHz and 18GHz - 26.5GHz were greater than 20dB below the Limit, so only the radiated spurious emissions from 30MHz to 18GHz were reported.
- 3) The highest emission is the fundamental waves.

30 MHz - 1GHz



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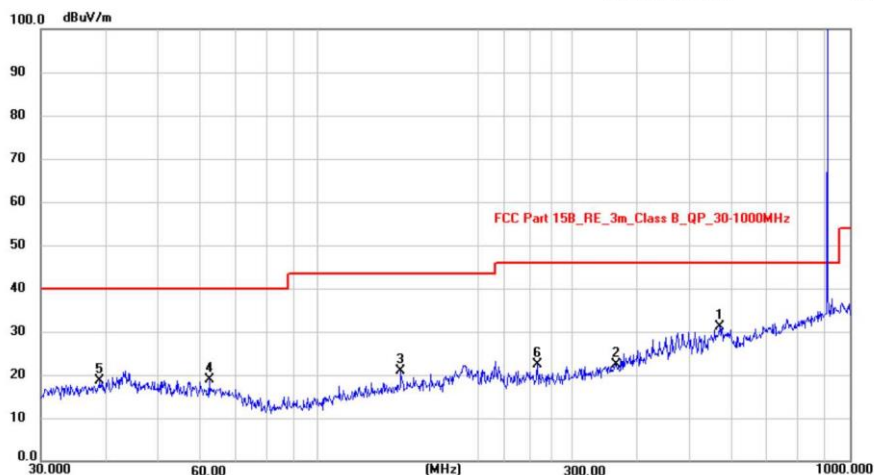
Test Site: PSI EMC Lab-3m Chamber Polarization: **Vertical** Temperature: 26 °C
EUT: WIRELESS BLE/LORA TEMPERATURE Distance: 3m Humidity: 54 %RH
M/N: 7911N-EX-A-A0 Test Engineer: Felix Pang
Test Mode: FSK 125K_SF7_908.5MHz
Test Voltage: DC 3.6V

Note:

Radiated Emission Measurement

Test Date: 2024/9/2

13:17:03



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1 *	569.6104	9.04	22.06	31.10	46.00	-14.90	peak			P	
2	364.1000	5.69	16.71	22.40	46.00	-23.60	peak			P	
3	143.0750	6.82	13.97	20.79	43.50	-22.71	peak			P	
4	62.3220	6.11	12.87	18.98	40.00	-21.02	peak			P	
5	38.8367	4.12	14.40	18.52	40.00	-21.48	peak			P	
6	258.4396	8.91	13.57	22.48	46.00	-23.52	peak			P	

Note: *:Maximum data x:Over limit !:over margin Level = Reading + Factor Margin = Level - Limit



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Test Site: PSI EMC Lab-3m Chamber
EUT: WIRELESS BLE/LORA TEMPERATURE
M/N: 7911N-EX-A-A0
Test Mode: FSK 125K_SF7_908.5MHz
Test Voltage: DC 3.6V

Polarization: **Horizontal**

Distance: 3m

Temperature: 26 °C

Humidity: 54 %RH

Test Engineer: Felix Pang

Note:

Radiated Emission Measurement

Test Date: 2024/9/2

13:24:39



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1 *	30.7182	20.71	13.12	33.83	40.00	-6.17	peak			P	
2	58.5354	7.42	13.26	20.68	40.00	-19.32	peak			P	
3	109.6036	6.16	11.53	17.69	43.50	-25.81	peak			P	
4	223.3411	10.90	12.11	23.01	46.00	-22.99	peak			P	
5	520.8881	9.11	20.73	29.84	46.00	-16.16	peak			P	
6	544.7047	10.16	21.38	31.54	46.00	-14.46	peak			P	

Note: *:Maximum data x:Over limit !:over margin Level = Reading + Factor Margin = Level - Limit



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Test Site: PSI EMC Lab-3m Chamber
EUT: WIRELESS BLE/LORA TEMPERATURE
M/N: 7911N-EX-A-A0
Test Mode: FSK 125K_SF7_902.3MHz
Test Voltage: DC 3.6V

Polarization: **Horizontal**

Distance: 3m

Temperature: 26 °C

Humidity: 54 %RH

Test Engineer: Felix Pang

Note:

Radiated Emission Measurement

Test Date: 2024/9/2

13:30:50



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1 *	30.9000	17.85	13.15	31.00	40.00	-9.00	peak			P	
2	40.4400	5.10	14.55	19.65	40.00	-20.35	peak			P	
3	150.2400	6.98	14.13	21.11	43.50	-22.39	peak			P	
4	262.3200	6.59	13.71	20.30	46.00	-25.70	peak			P	
5	470.5200	8.76	19.44	28.20	46.00	-17.80	peak			P	
6	597.9600	10.30	22.83	33.13	46.00	-12.87	peak			P	

Note: *:Maximum data x:Over limit !:over margin Level = Reading + Factor Margin = Level - Limit



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Test Site: PSI EMC Lab-3m Chamber
EUT: WIRELESS BLE/LORA TEMPERATURE
M/N: 7911N-EX-A-A0
Test Mode: FSK 125K_SF7_902.3MHz
Test Voltage: DC 3.6V

Polarization: **Vertical**
Distance: 3m
Test Engineer: Felix Pang

Temperature: 26 °C
Humidity: 54 %RH

Note:

Radiated Emission Measurement

Test Date: 2024/9/2

13:34:42



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	40.2599	4.77	14.56	19.33	40.00	-20.67	peak			P	
2	55.6200	6.12	13.56	19.68	40.00	-20.32	peak			P	
3	134.4600	5.99	13.53	19.52	43.50	-23.98	peak			P	
4	154.1400	6.83	14.22	21.05	43.50	-22.45	peak			P	
5	315.6600	8.00	15.35	23.35	46.00	-22.65	peak			P	
6 *	593.4600	10.76	22.71	33.47	46.00	-12.53	peak			P	

Note: *:Maximum data x:Over limit !:over margin Level = Reading + Factor Margin = Level - Limit



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Test Site: PSI EMC Lab-3m Chamber
EUT: WIRELESS BLE/LORA TEMPERATURE
M/N: 7911N-EX-A-A0
Test Mode: FSK 125K_SF7_914.9MHz
Test Voltage: DC 3.6V

Polarization: **Vertical**
Distance: 3m
Test Engineer: Felix Pang

Temperature: 26 °C
Humidity: 54 %RH

Note:

Radiated Emission Measurement

Test Date: 2024/9/2

13:40:46



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	32.0400	3.78	13.34	17.12	40.00	-22.88	peak			P	
2	50.4600	4.07	14.10	18.17	40.00	-21.83	peak			P	
3	112.9200	5.16	11.86	17.02	43.50	-26.48	peak			P	
4	157.2600	6.49	14.28	20.77	43.50	-22.73	peak			P	
5	380.5200	9.20	17.18	26.38	46.00	-19.62	peak			P	
6 *	695.7000	8.58	24.45	33.03	46.00	-12.97	peak			P	

Note: *:Maximum data x:Over limit !:over margin Level = Reading + Factor Margin = Level - Limit



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Test Site: PSI EMC Lab-3m Chamber
EUT: WIRELESS BLE/LORA TEMPERATURE
M/N: 7911N-EX-A-A0
Test Mode: FSK 125K_SF7_914.9MHz
Test Voltage: DC 3.6V

Polarization: **Horizontal**

Distance: 3m

Temperature: 26 °C

Humidity: 54 %RH

Test Engineer: Felix Pang

Note:

Radiated Emission Measurement

Test Date: 2024/9/2

13:45:39



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1 *	30.0000	20.94	13.00	33.94	40.00	-6.06	peak			P	
2	39.8400	7.72	14.55	22.27	40.00	-17.73	peak			P	
3	66.3600	6.11	12.46	18.57	40.00	-21.43	peak			P	
4	172.2600	7.50	13.15	20.65	43.50	-22.85	peak			P	
5	360.6600	9.04	16.62	25.66	46.00	-20.34	peak			P	
6	485.1000	9.65	19.79	29.44	46.00	-16.56	peak			P	

Note: *:Maximum data x:Over limit !:over margin Level = Reading + Factor Margin = Level - Limit



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Test Site: PSI EMC Lab-3m Chamber
EUT: WIRELESS BLE/LORA TEMPERATURE
M/N: 7911N-EX-A-A0
Test Mode: Lora DTS 500K_SF8_903MHz
Test Voltage: DC 3.6V

Polarization: **Horizontal**
Distance: 3m
Test Engineer: Felix Pang

Temperature: 26 °C
Humidity: 54 %RH

Note:

Radiated Emission Measurement

Test Date: 2024/9/2

13:51:29



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1 *	30.4800	16.84	13.08	29.92	40.00	-10.08	peak			P	
2	39.7800	7.96	14.54	22.50	40.00	-17.50	peak			P	
3	59.7000	5.61	13.14	18.75	40.00	-21.25	peak			P	
4	132.3600	5.68	13.38	19.06	43.50	-24.44	peak			P	
5	211.9200	6.33	11.60	17.93	43.50	-25.57	peak			P	
6	597.1200	9.74	22.80	32.54	46.00	-13.46	peak			P	

Note: *:Maximum data x:Over limit !:over margin Level = Reading + Factor Margin = Level - Limit