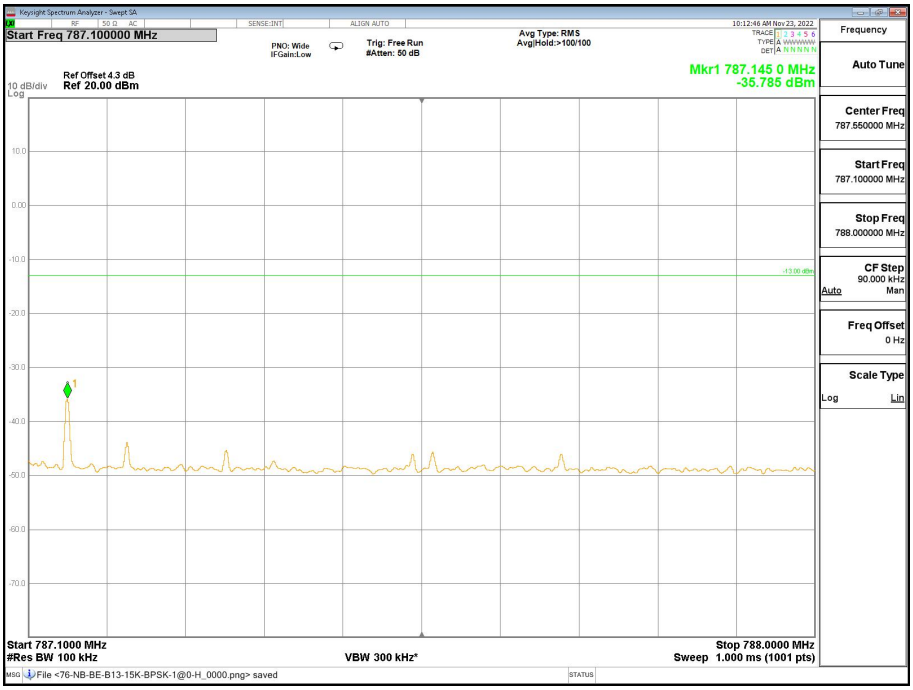
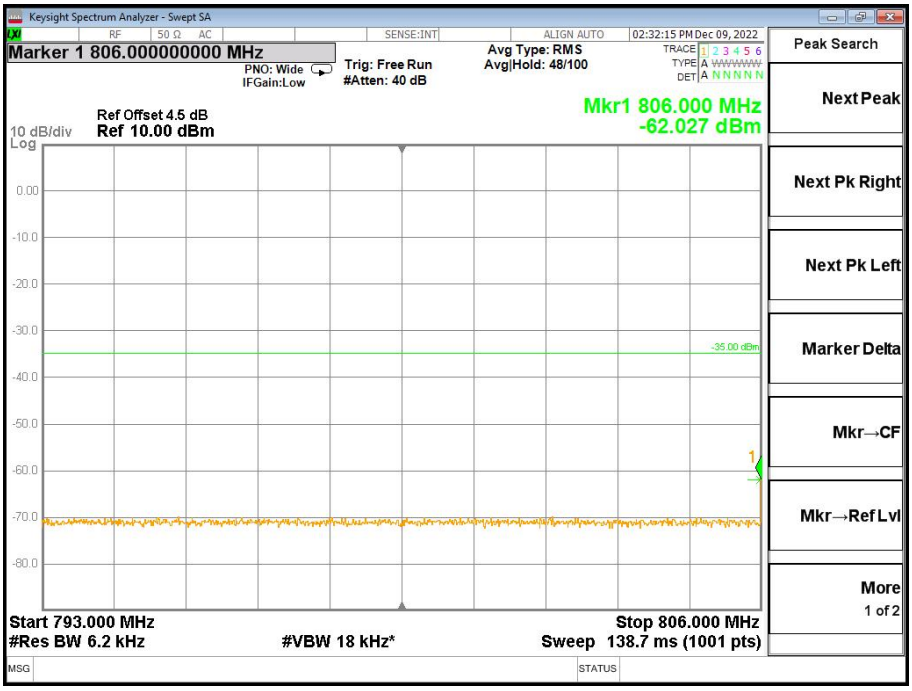
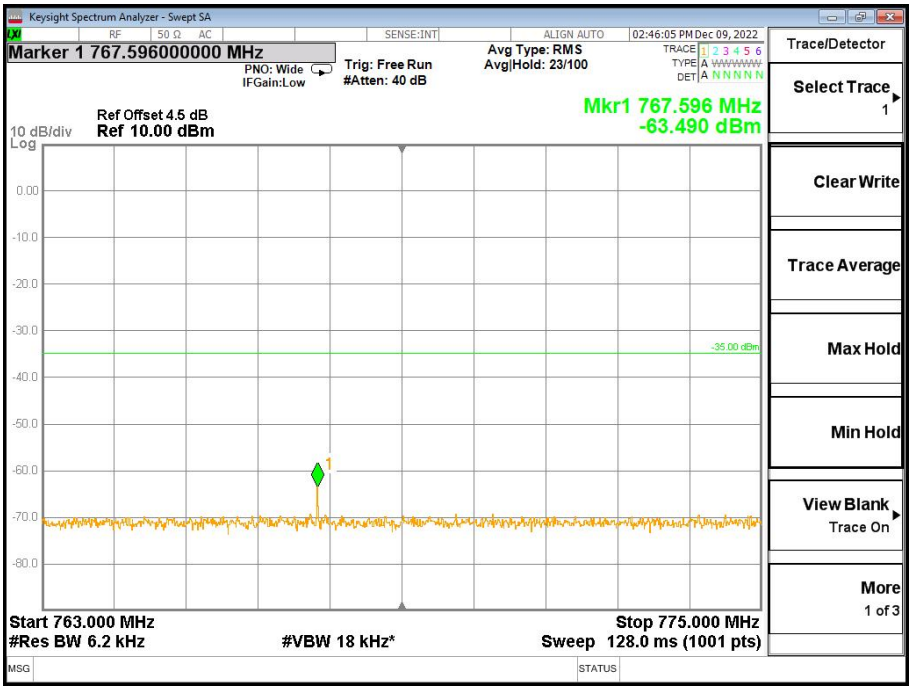
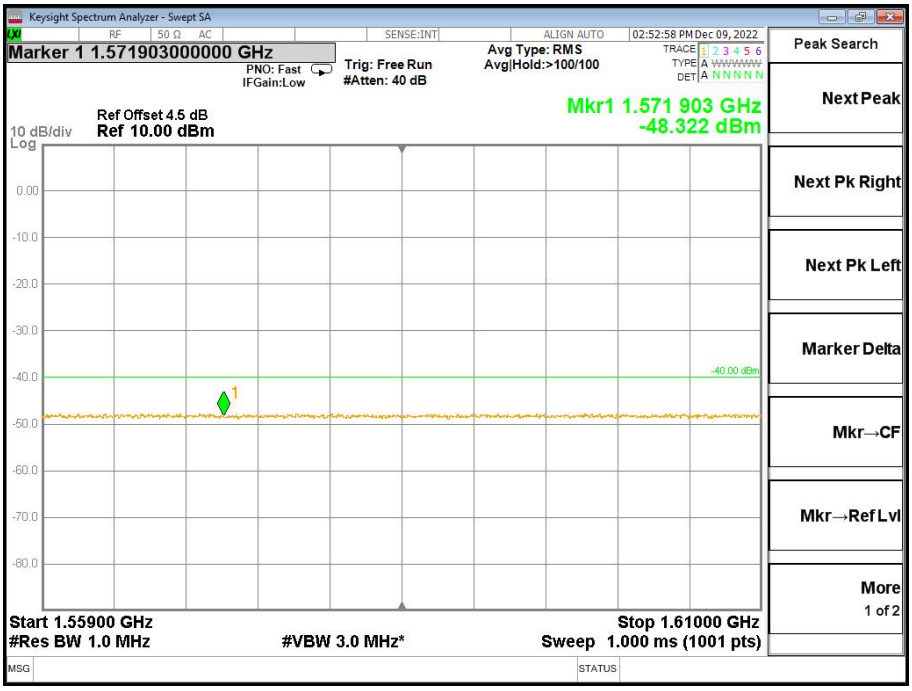

Start Freq 787.100000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 50 dB
Avg Type: RMS
Avg|Hold:>100/100
Mkr1 787.145 0 MHz
-35.785 dBm
Ref Offset 4.3 dB
10 dB/div
Log
Ref 20.00 dBm
Frequency
Auto Tune
Center Freq
787.550000 MHz
Start Freq
787.100000 MHz
Stop Freq
788.000000 MHz
CF Step
90.000 kHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
Start 787.1000 MHz
#Res BW 100 kHz
VBW 300 kHz*
Stop 788.0000 MHz
Sweep 1.000 ms (1001 pts)
File <76-NB-BE-B13-15K-BPSK-1@0-H_0000.png> saved

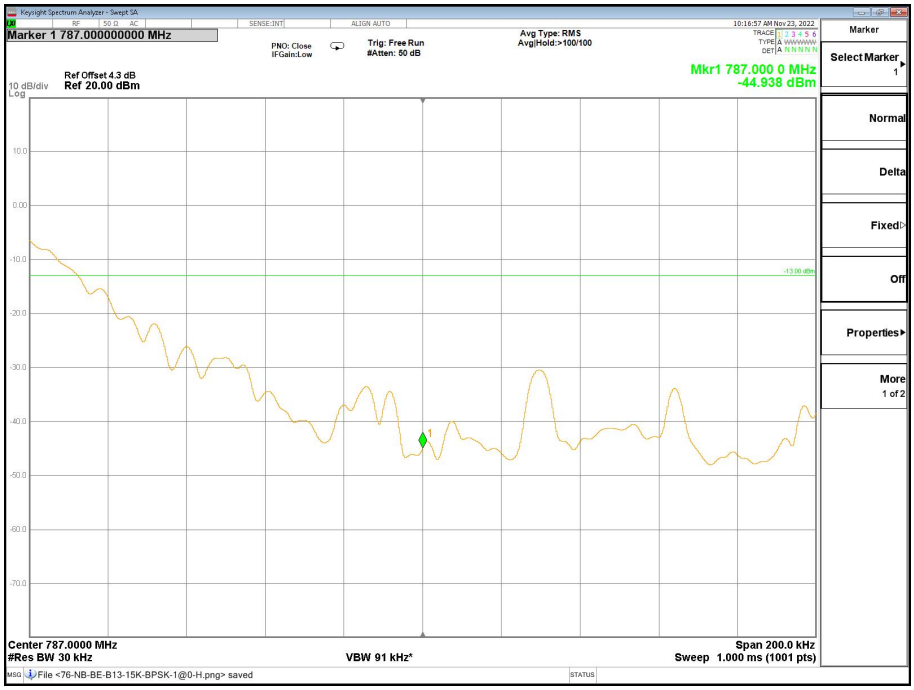

Keysight Spectrum Analyzer - Swept SA
Marker 1 806.000000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold: 48/100
02:32:15 PM Dec 09, 2022
Mkr1 806.000 MHz
-62.027 dBm
Ref Offset 4.5 dB
10 dB/div
Log
Ref 10.00 dBm
-35.00 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
Start 793.000 MHz
#Res BW 6.2 kHz
#VBW 18 kHz*
Stop 806.000 MHz
Sweep 138.7 ms (1001 pts)

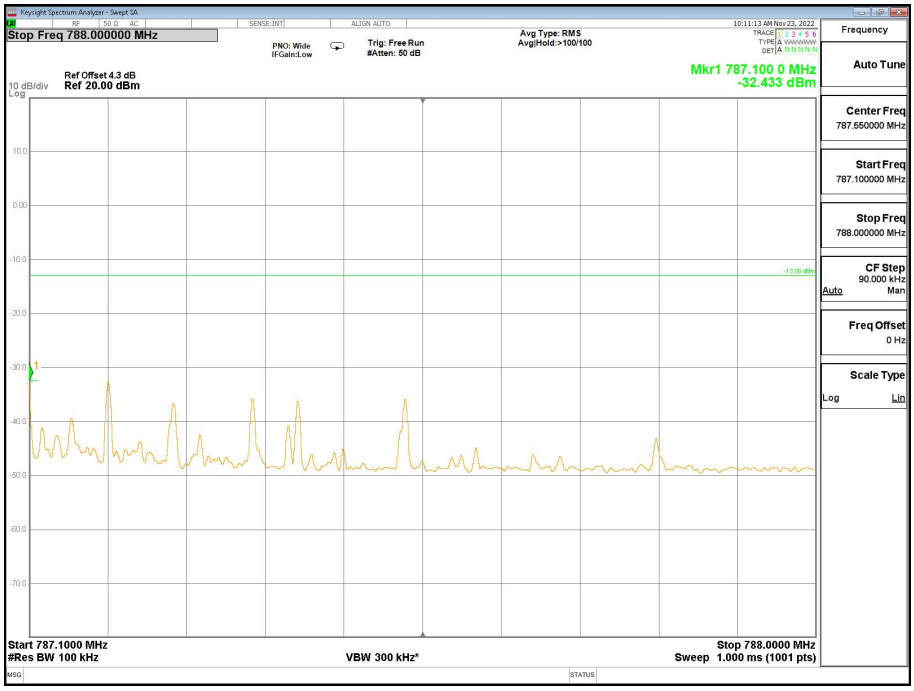


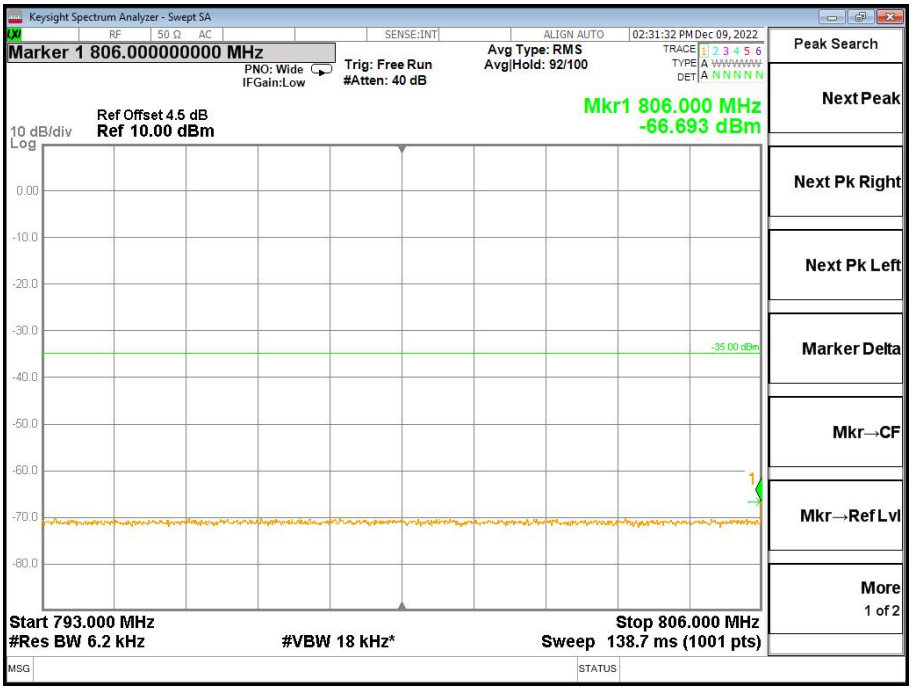


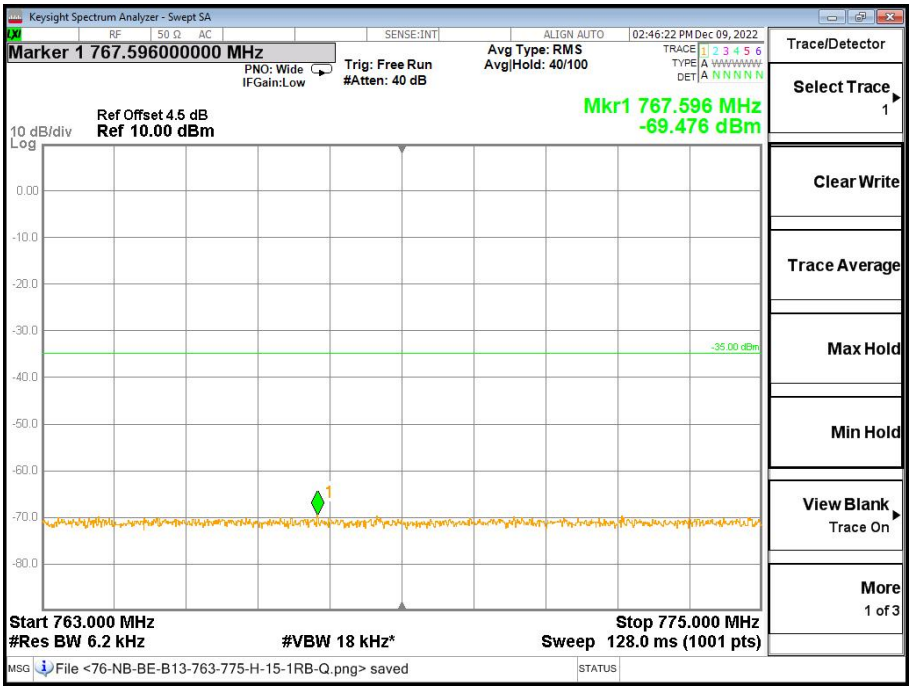
For the 1559-1610MHz test band，the worst case: -48.322dBm+Antenna Gain(4dBi)=-44.322dBm

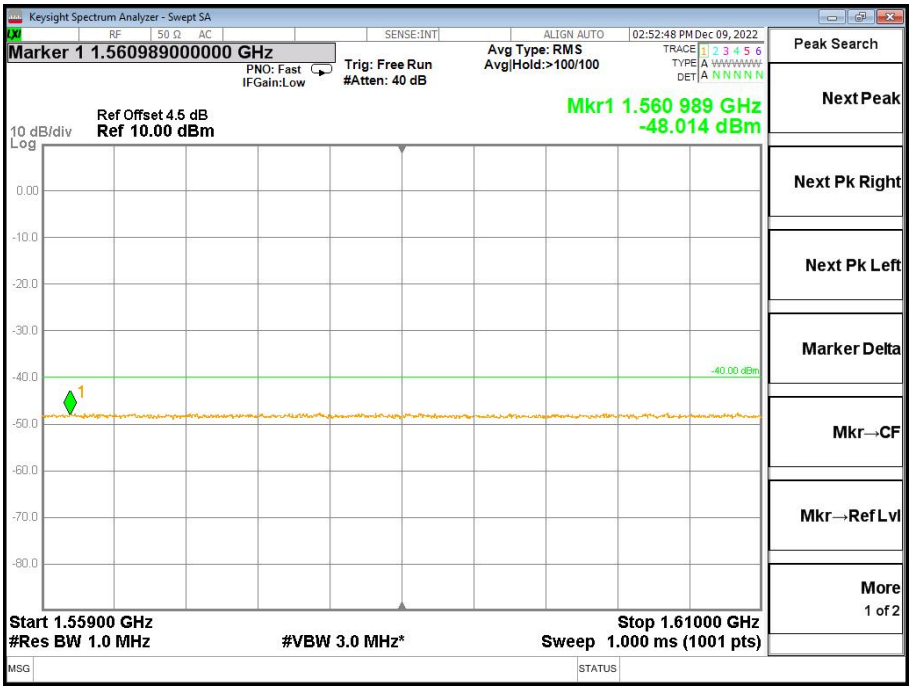
High Channel, Subcarrier (15kHz), QPSK, 1@11


Marker 1 787.000000000 MHz
PNO: Close
IFGain:Low
Trig: Free Run
#Atten: 50 dB
Avg Type: RMS
Avg|Hold:>100/100
Mkr1 787.000 0 MHz
-44.938 dBm
Ref Offset 4.3 dB
10 dB/div
Ref 20.00 dBm
Log
Center 787.0000 MHz
#Res BW 30 kHz
VBW 91 kHz*
Span 200.0 kHz
Sweep 1.000 ms (1001 pts)
File <76-NB-BE-B13-15K-BPSK-1@0-H.png> saved
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2


Stop Freq 788.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 50 dB
Avg Type: RMS
Avg|Hold:>100/100
Mkr1 787.100 0 MHz
-32.433 dBm
Ref Offset 4.3 dB
10 dB/div
Ref 20.00 dBm
Log
Start 787.1000 MHz
#Res BW 100 kHz
VBW 300 kHz*
Stop 788.0000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
787.550000 MHz
Start Freq
787.100000 MHz
Stop Freq
788.000000 MHz
CF Step
90.000 kHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

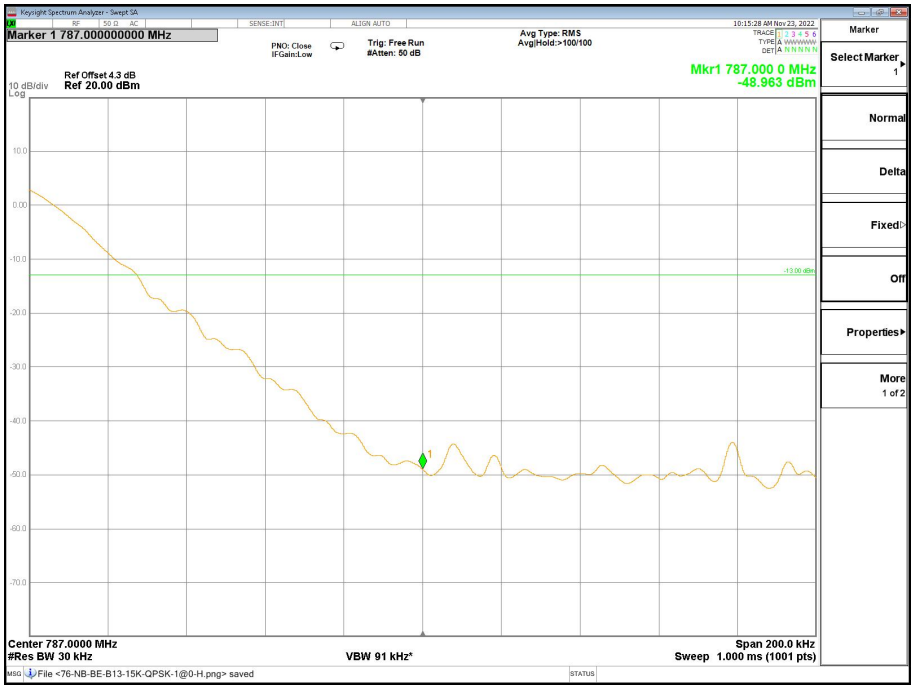

Keysight Spectrum Analyzer - Swept SA
Marker 1 806.000000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold: 92/100
02:31:32 PM Dec 09, 2022
Mkr1 806.000 MHz
-66.693 dBm
Ref Offset 4.5 dB
10 dB/div
Ref 10.00 dBm
Log
-35.00 dBm
Start 793.000 MHz
#Res BW 6.2 kHz
#VBW 18 kHz*
Stop 806.000 MHz
Sweep 138.7 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

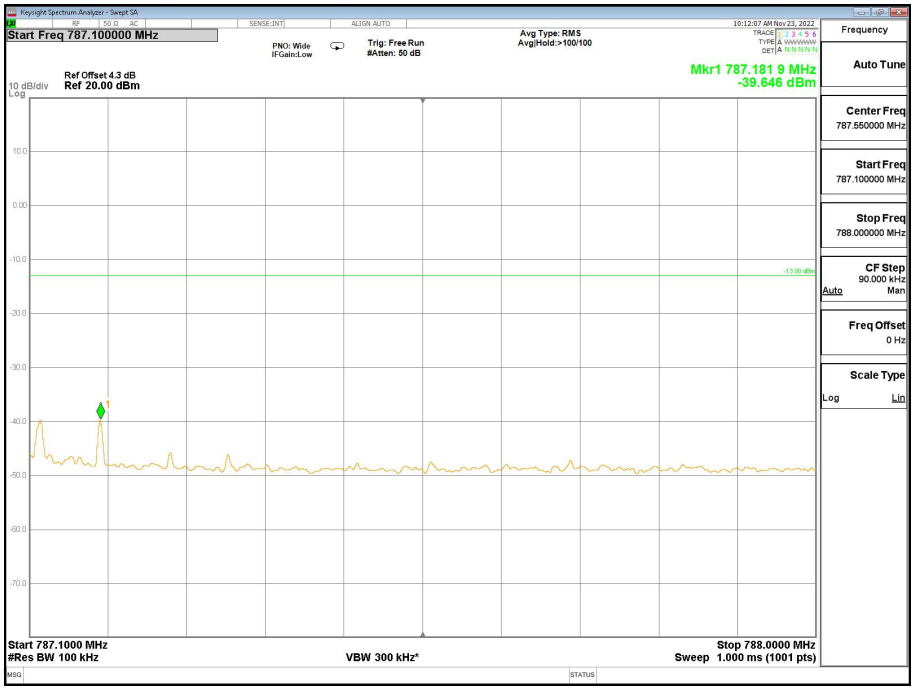

Keysight Spectrum Analyzer - Swept SA
Marker 1 767.596000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold: 40/100
02:46:22 PM Dec 09, 2022
Mkr1 767.596 MHz
-69.476 dBm
Ref Offset 4.5 dB
10 dB/div
Ref 10.00 dBm
Log
-35.00 dBm
Start 763.000 MHz
#Res BW 6.2 kHz
#VBW 18 kHz*
Stop 775.000 MHz
Sweep 128.0 ms (1001 pts)
File <76-NB-BE-B13-763-775-H-15-1RB-Q.png> saved
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More
1 of 3

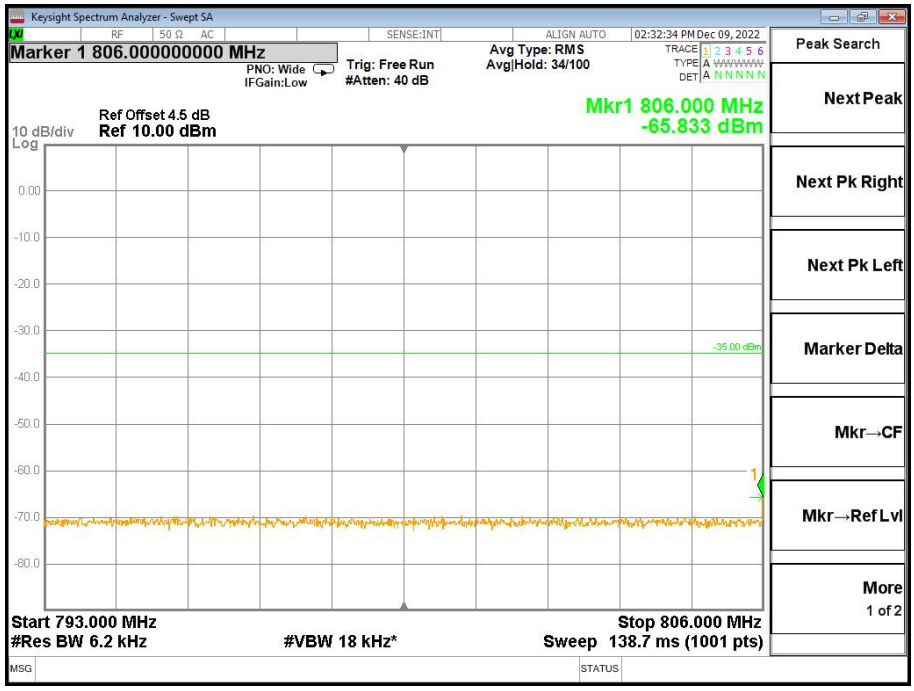


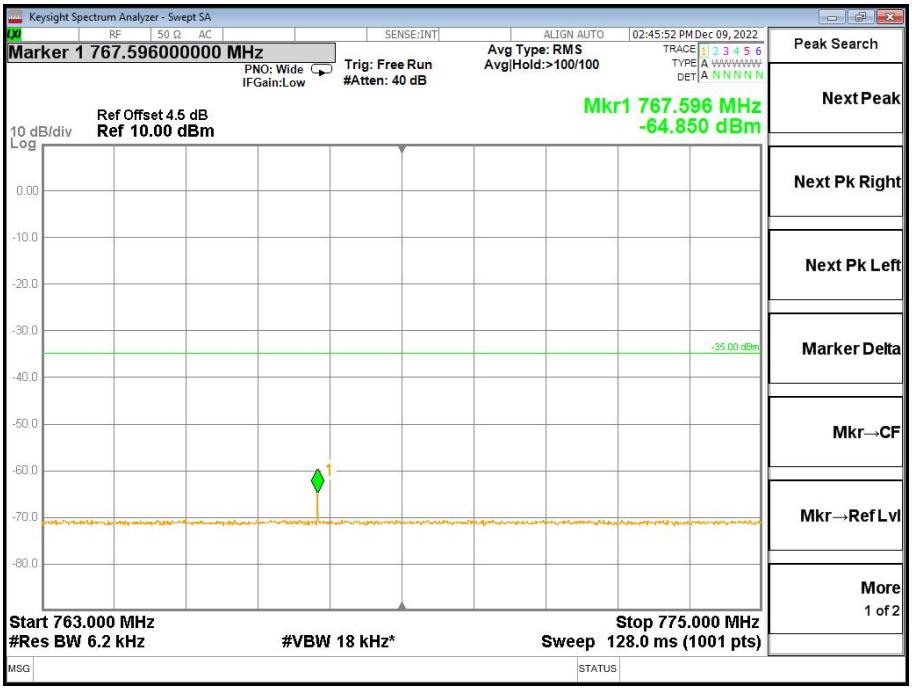
For the 1559-1610MHz test band，the worst case: -48.014dBm+Antenna Gain(4dBi)=-44.014dBm

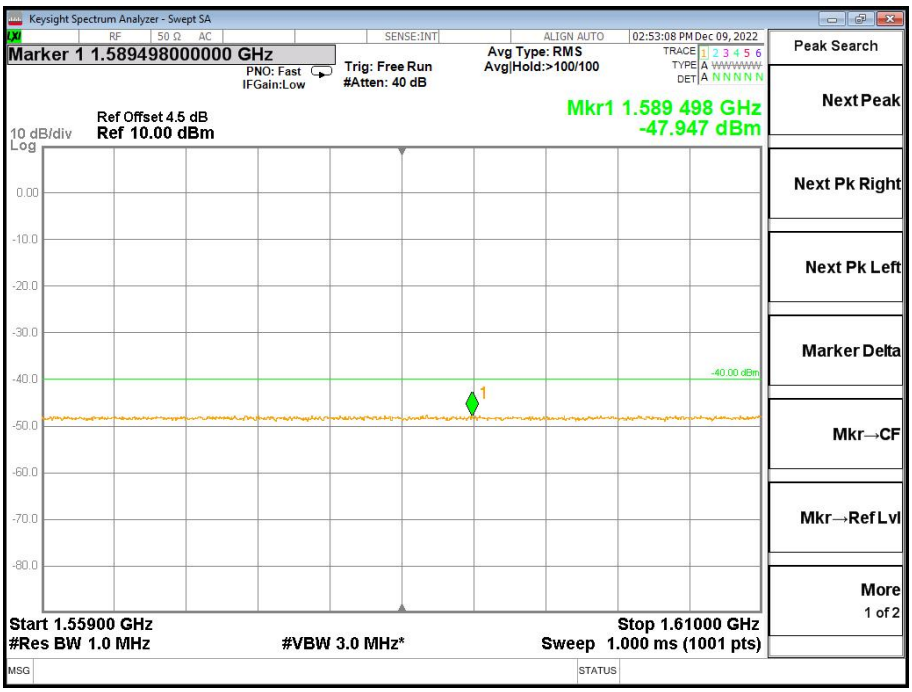
High Channel, Subcarrier (15kHz), QPSK, 12@0




Start Freq 787.100000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 50 dB
Avg Type: RMS
Avg|Hold:>100/100
Mkr1 787.181 9 MHz
-39.646 dBm
Ref Offset 4.3 dB
10 dB/div
Log
Ref 20.00 dBm
Frequency
Auto Tune
Center Freq
787.550000 MHz
Start Freq
787.100000 MHz
Stop Freq
788.000000 MHz
CF Step
90.000 kHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
Start 787.1000 MHz
#Res BW 100 kHz
VBW 300 kHz*
Stop 788.0000 MHz
Sweep 1.000 ms (1001 pts)


Keysight Spectrum Analyzer - Swept SA
Marker 1 806.000000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold: 34/100
02:32:34 PM Dec 09, 2022
Mkr1 806.000 MHz
-65.833 dBm
Ref Offset 4.5 dB
10 dB/div
Log
Ref 10.00 dBm
-35.00 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
Start 793.000 MHz
#Res BW 6.2 kHz
#VBW 18 kHz*
Stop 806.000 MHz
Sweep 138.7 ms (1001 pts)

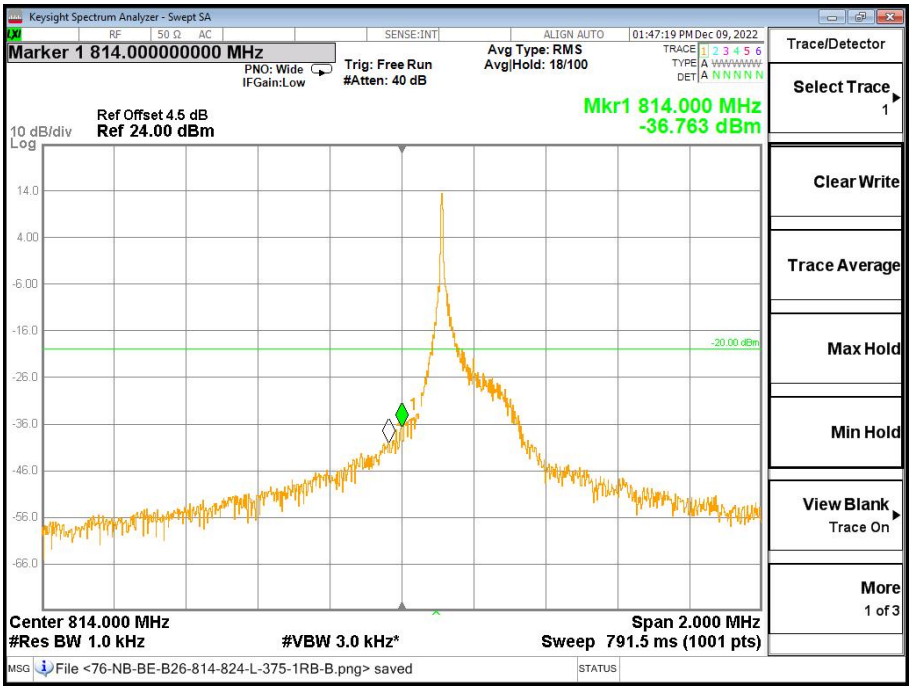




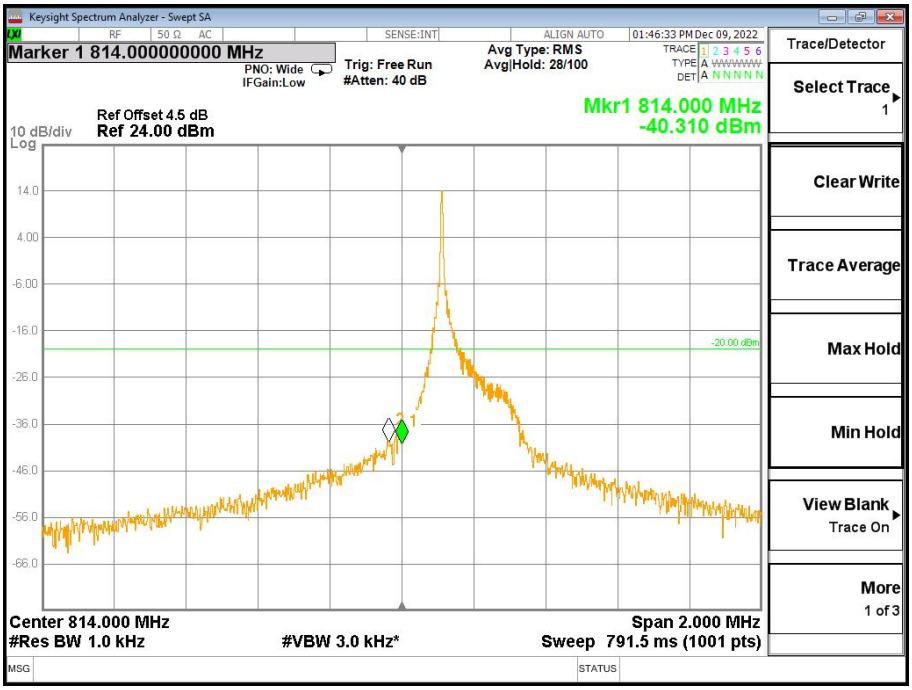
For the 1559-1610MHz test band，the worst case: -47.947dBm+Antenna Gain(4dBi)=-43.947dBm

High Channel, Subcarrier (15kHz), BPSK, 1@11

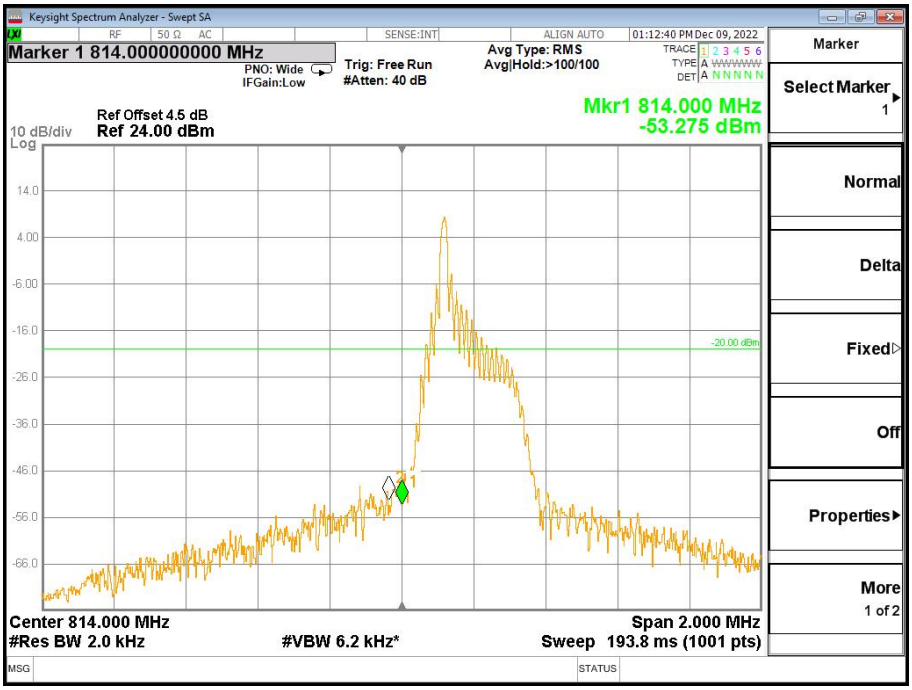
6.7.5 NB-IoT Band 26 Edge Results



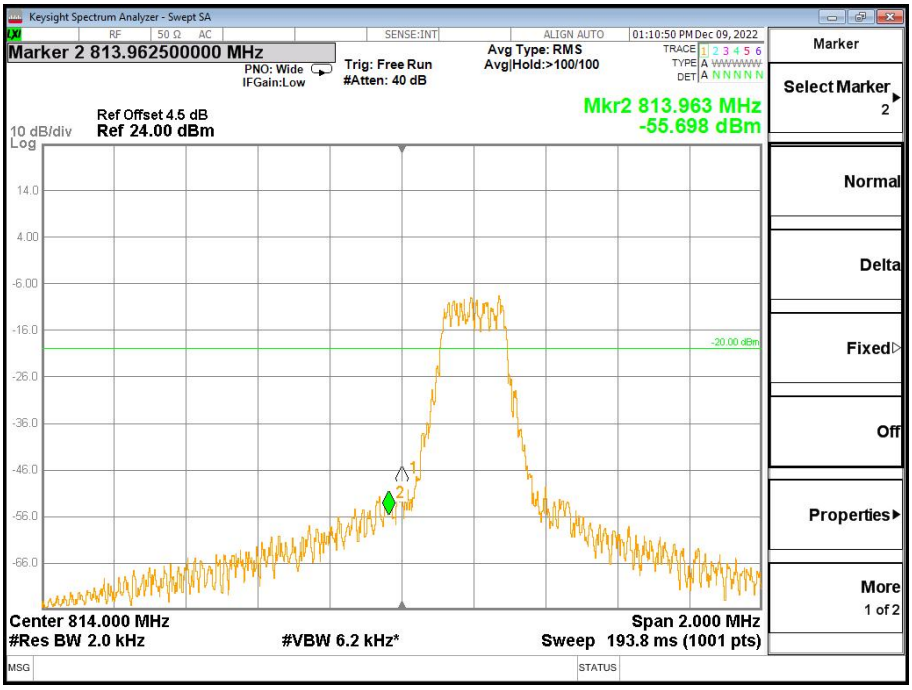
Low Channel, Subcarrier (3.75kHz), QPSK, 1@0



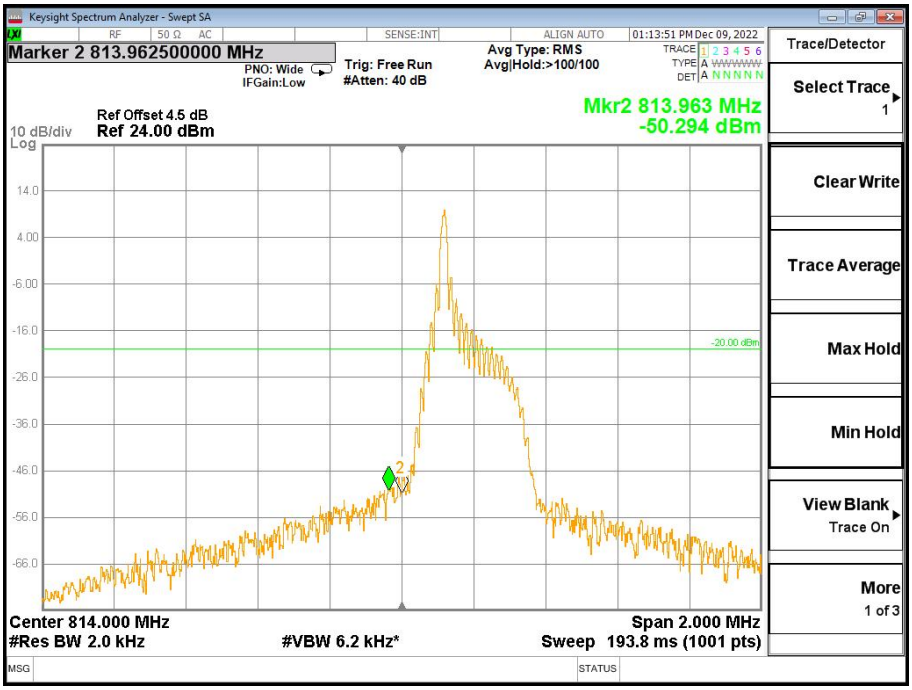
Low Channel, Subcarrier (3.75kHz), BPSK, 1@0



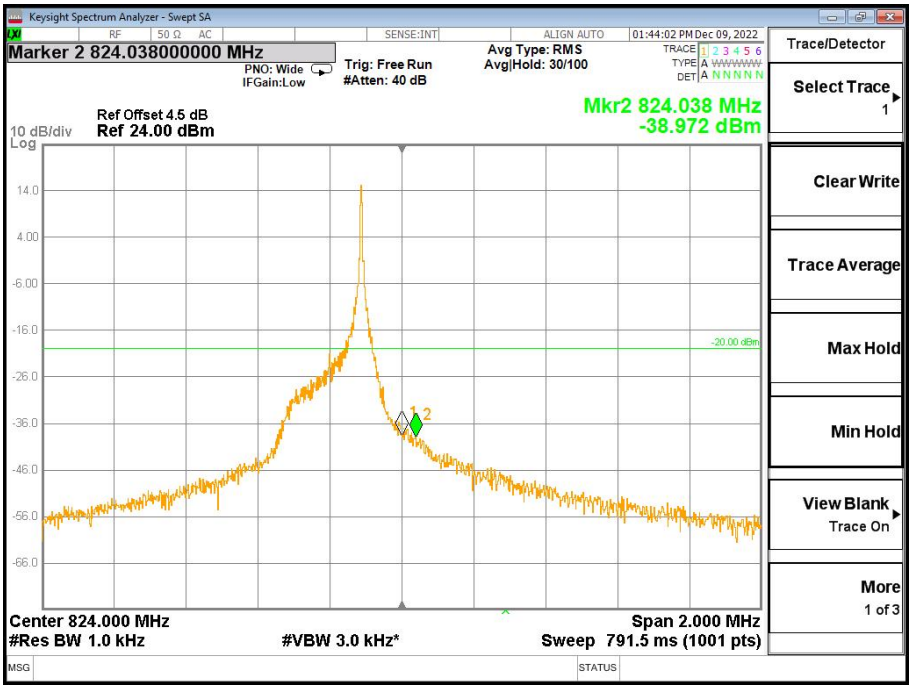
Low Channel, Subcarrier (15kHz), QPSK, 1@0



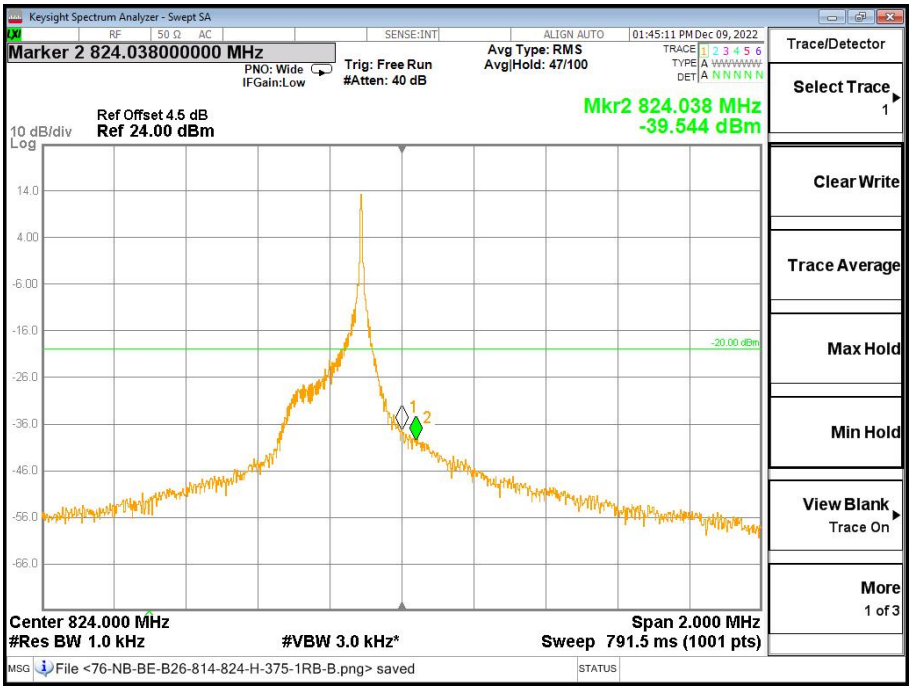
Low Channel, Subcarrier (15kHz), QPSK, 12@0



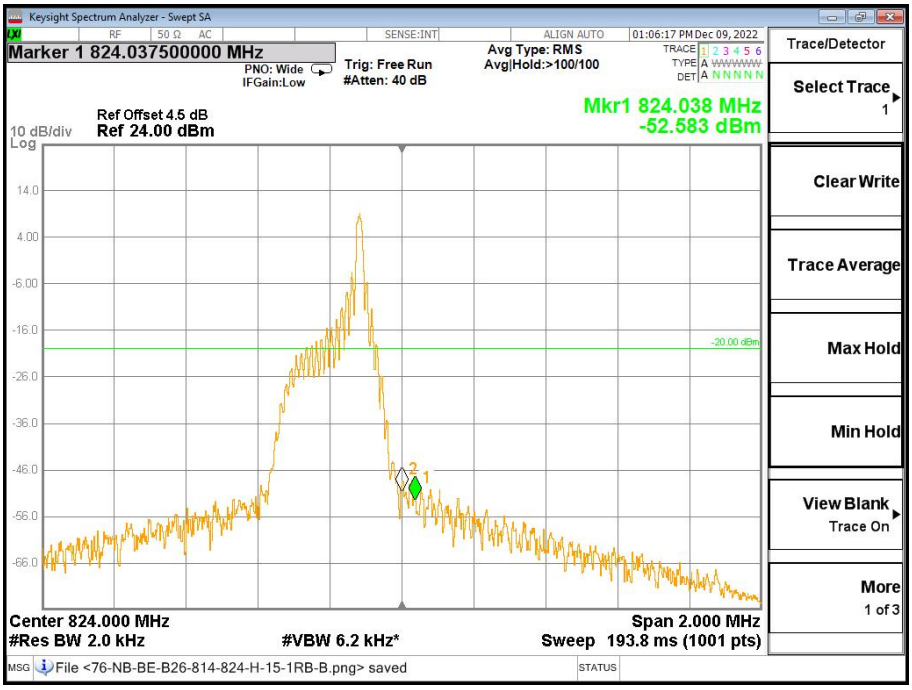
Low Channel, Subcarrier (15kHz), BPSK, 1@0



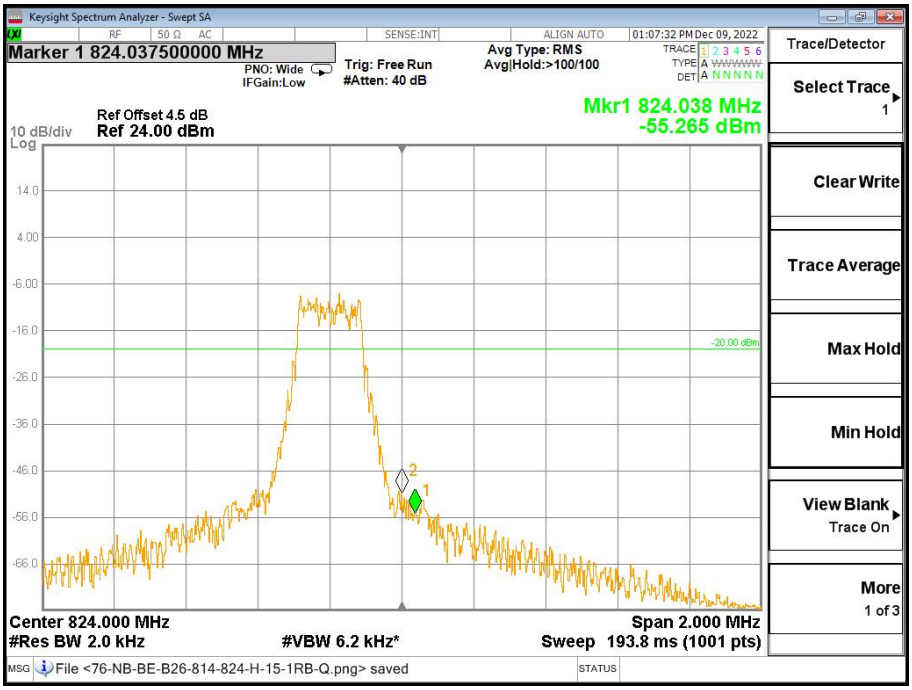
High Channel, Subcarrier (3.75kHz), QPSK, 1@47



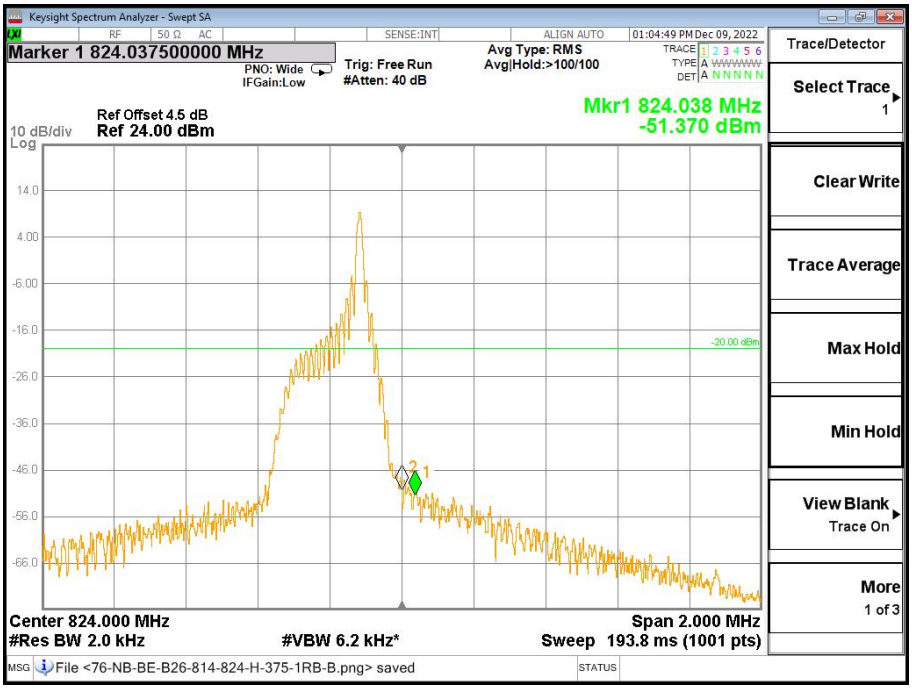
High Channel, Subcarrier (3.75kHz), BPSK, 1@47



High Channel, Subcarrier (15kHz), QPSK, 1@11

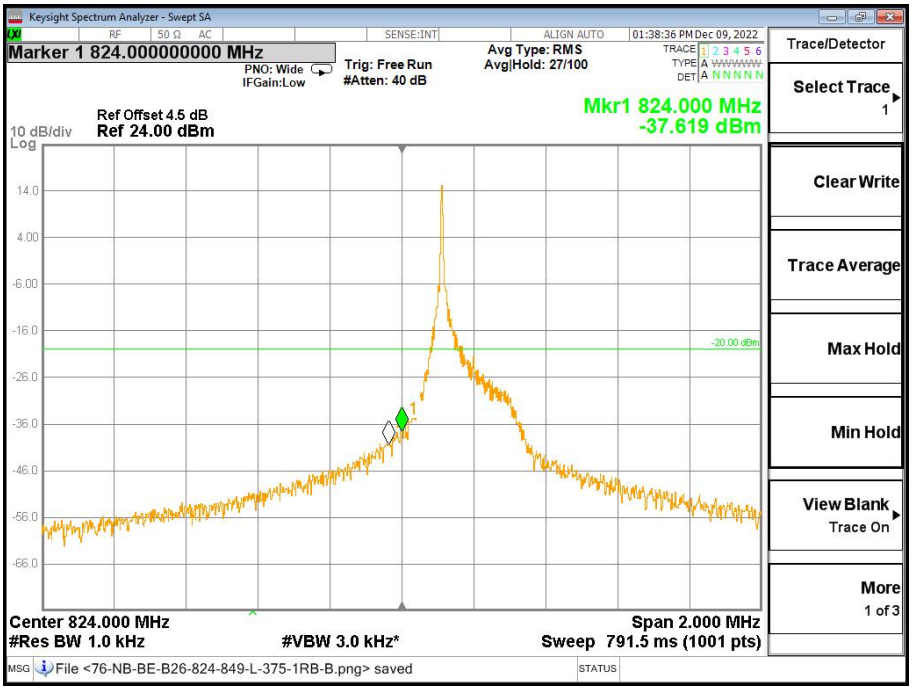


High Channel, Subcarrier (15kHz), QPSK, 12@0

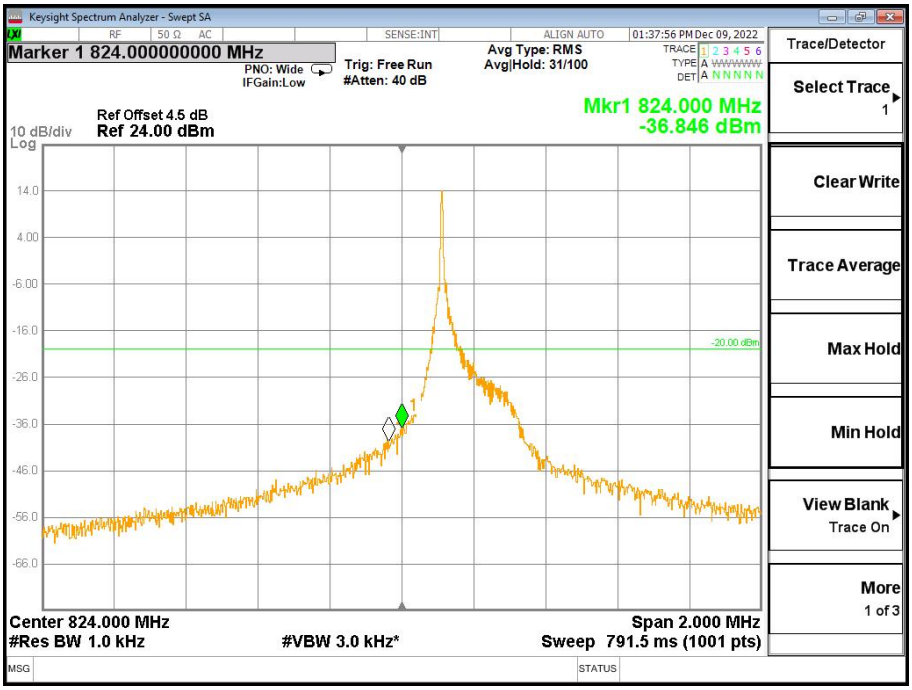


High Channel, Subcarrier (15kHz), BPSK, 1@11

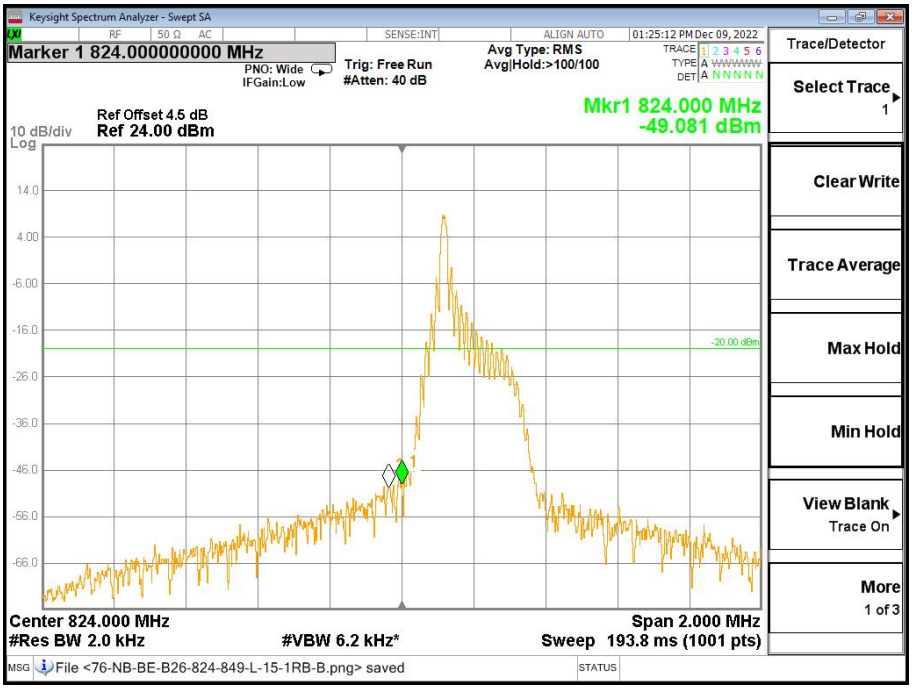
(824MHz-849MHz)



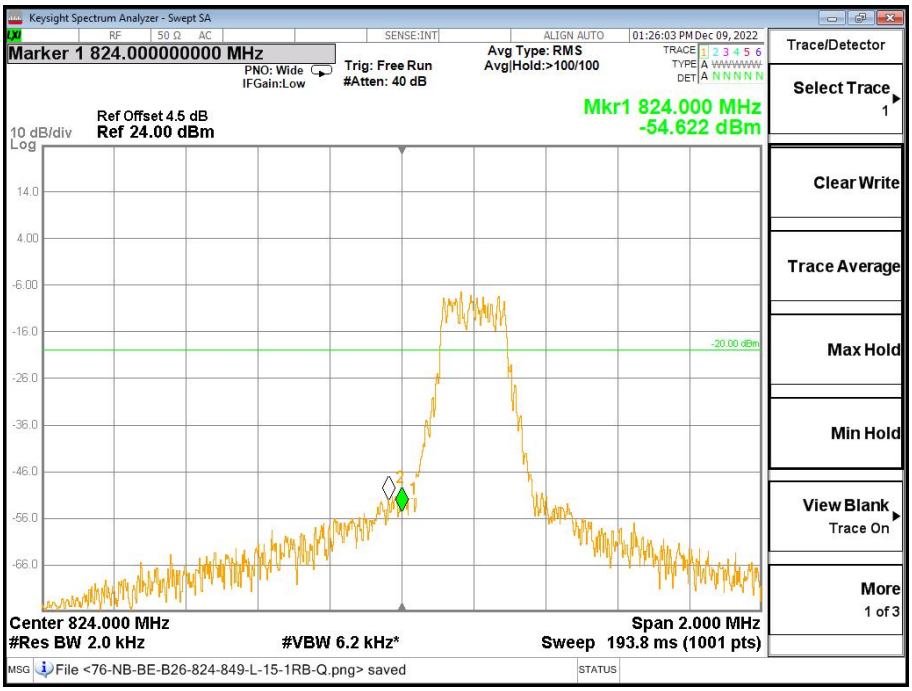
Low Channel, Subcarrier (3.75kHz), QPSK, 1@0



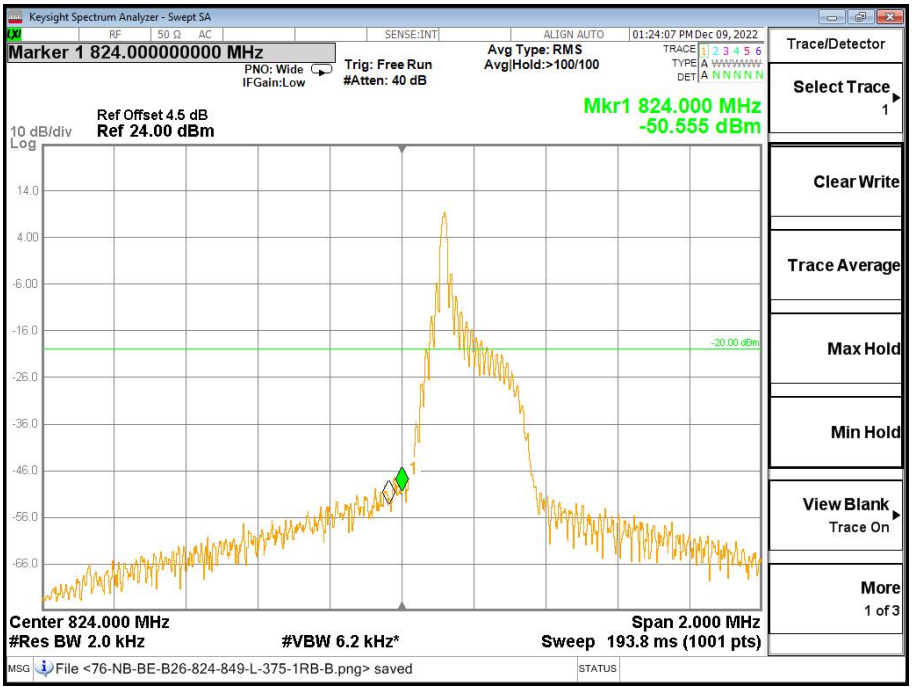
Low Channel, Subcarrier (3.75kHz), BPSK, 1@0



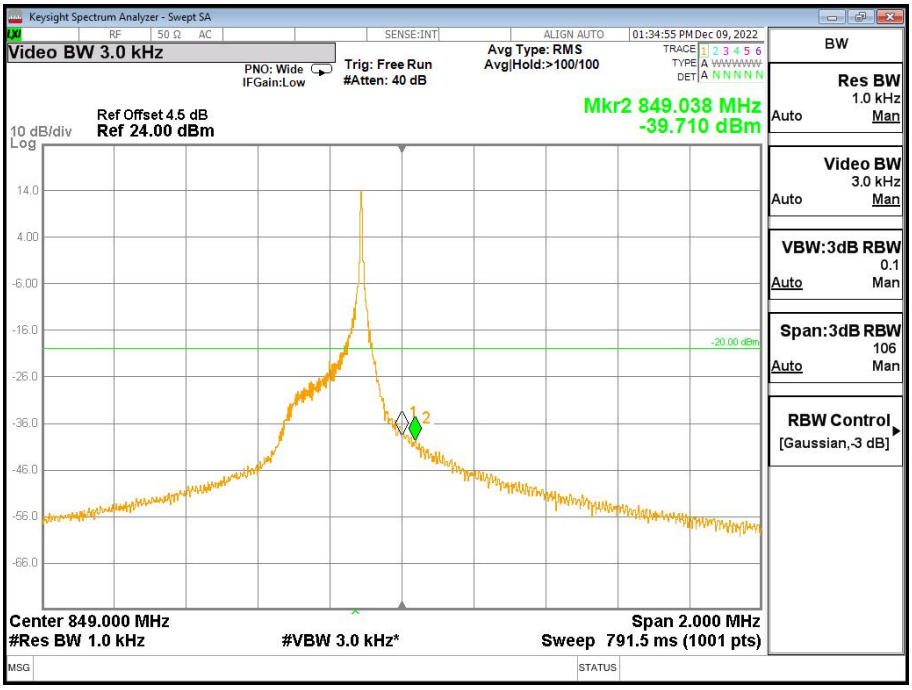
Low Channel, Subcarrier (15kHz), QPSK, 1@0



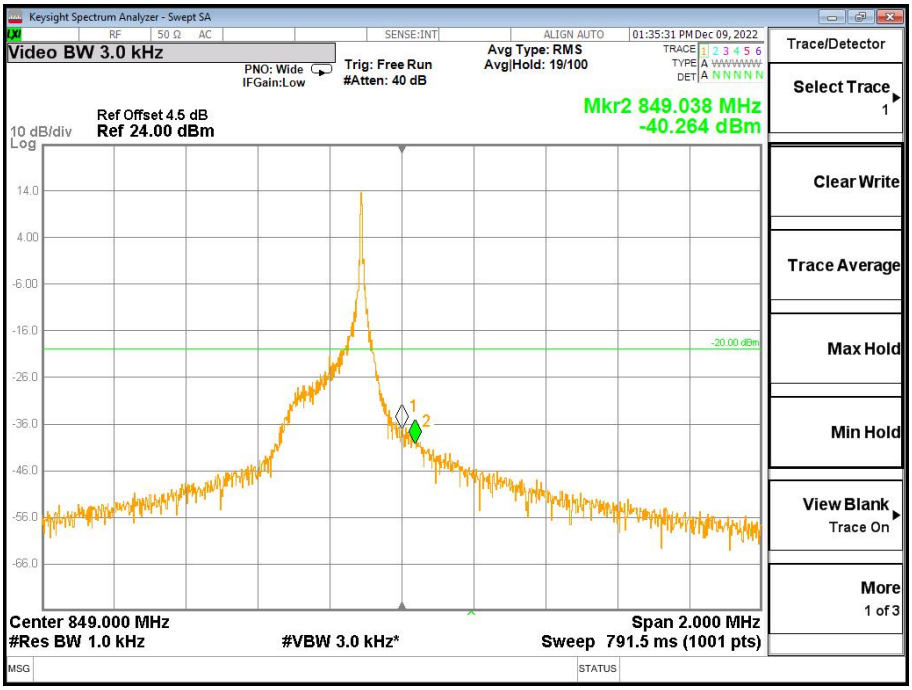
Low Channel, Subcarrier (15kHz), QPSK, 12@0



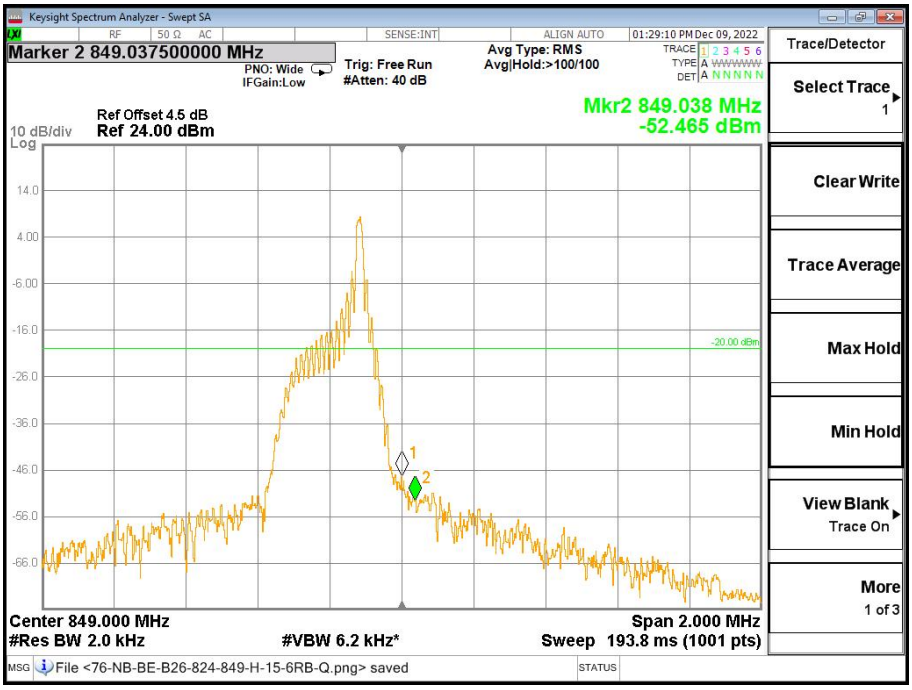
Low Channel, Subcarrier (15kHz), BPSK, 1@0



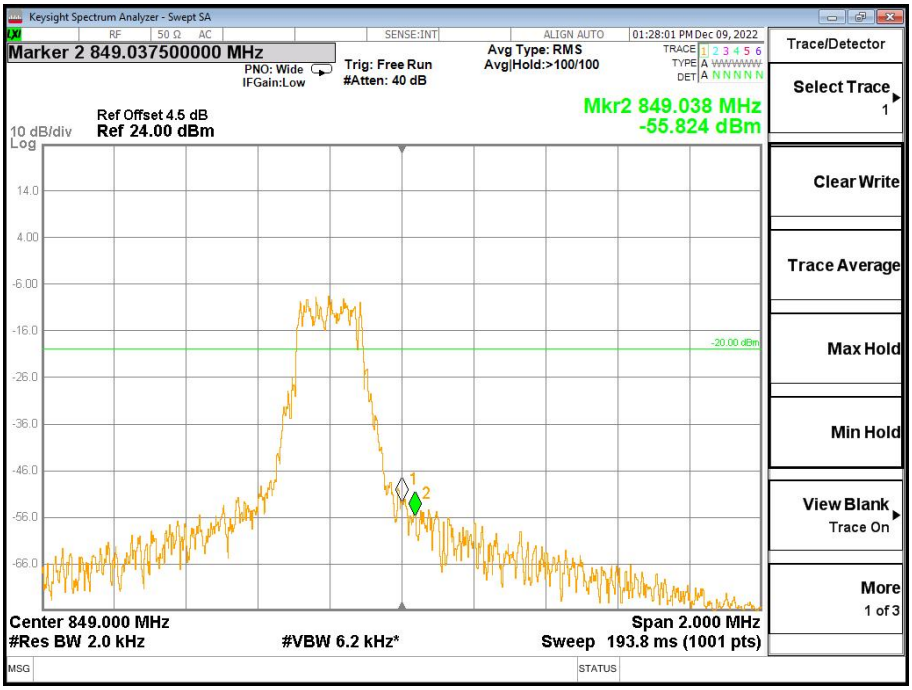
High Channel, Subcarrier (3.75kHz), QPSK, 1@47



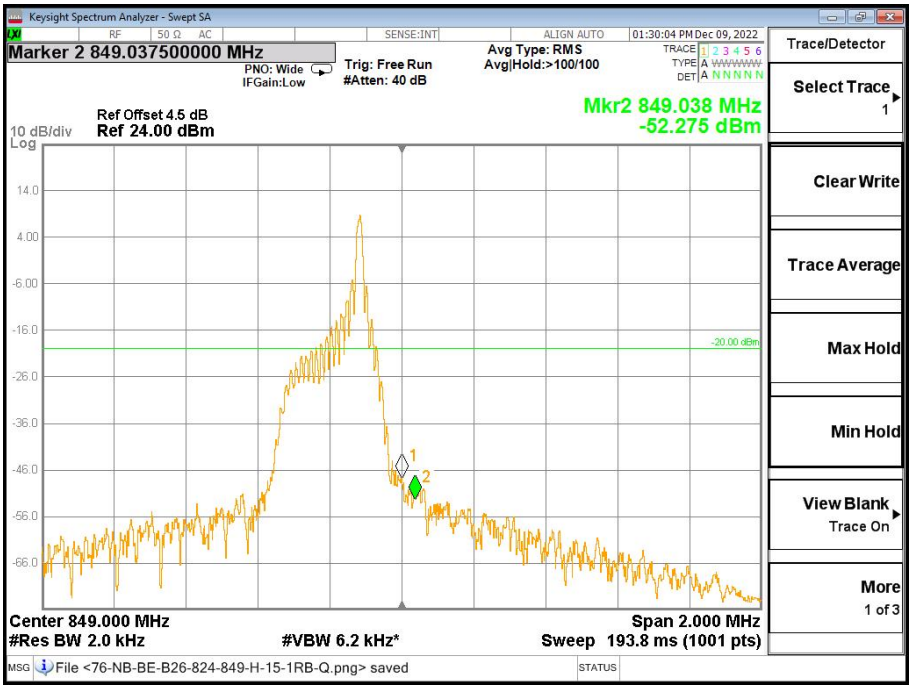
High Channel, Subcarrier (3.75kHz), BPSK, 1@47



High Channel, Subcarrier (15kHz), QPSK, 1@11



High Channel, Subcarrier (15kHz), QPSK, 12@0



High Channel, Subcarrier (15kHz), BPSK, 1@11

6.7. Frequency Stability

Specifications:	FCC Part 2.1055, 22.355,24.235, 27.54,90.213
DUT Serial Number:	866884049909625
Test conditions:	Ambient Temperature:15℃-35℃ Relative Humidity:30%-60% Air pressure: 86-106kPa
Test Results:	Pass

Limit	
Frequency deviation [ppm]	±2.5

Measurement Uncertainty:

Item	Uncertainty
Expanded Uncertainty	1.54 Hz (k=2)

Test Method

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage. Two reference points are established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation shall be identified as FL and FH respectively.

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of CMW500.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30℃.
3. With the EUT, powered via nominal voltage, connected to the CMW500, and in a simulated call on middle channel for each LTE band, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10℃ increments from -30℃ to +50℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Re-measure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments re-measuring carrier frequency at each voltage. Pause at nominal voltage for 1.5 hours unpowered, to allow any self-heating to stabilize, before continuing.

6. Subject the EUT to overnight soak at +50℃.
7. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on the center channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10 ℃increments from +50℃ to -30℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

6.8.1 Frequency Stability over Temperature Variation Results

6.8.1.1 NB-IoT Band Frequency Stability over Temperature Variation Results

Band	Reference channel frequency (MHz)	Offset	Temperature[℃]								
			-30	-20	-10	0	10	20	30	40	50
2	1880	Hz	-9.88	7.11	16.09	18.74	13.69	8.74	9.21	-10.18	-16.48
		ppm	-0.005	0.004	0.009	0.010	0.007	0.005	0.005	-0.005	-0.009
4	1732.5	Hz	-9.63	4.86	9.46	9.48	6.64	5.25	6.79	-8.24	-17.01
		ppm	-0.006	0.003	0.005	0.005	0.004	0.003	0.004	-0.005	-0.010
12	707.5	Hz	-1.63	8.14	8.85	11.43	10.54	6.62	3.42	-1.36	-2.70
		ppm	-0.002	0.012	0.013	0.016	0.015	0.009	0.005	-0.002	-0.004
13	782	Hz	-3.08	4.36	8.25	8.71	8.82	3.88	8.47	-7.16	-8.15
		ppm	-0.004	0.006	0.011	0.011	0.011	0.005	0.011	-0.009	-0.010
26	819	Hz	-5.36	0.80	2.33	3.82	5.43	-2.75	-6.47	-6.24	-13.30
		ppm	-0.006	0.001	0.003	0.005	0.007	-0.003	-0.008	-0.008	-0.016
	836.5	Hz	-3.10	4.68	5.38	5.94	3.22	1.63	4.15	-5.81	-8.71
		ppm	-0.003	0.006	0.006	0.007	0.004	0.002	0.005	-0.007	-0.010

6.8.2 Frequency Stability over Voltage Variation

6.8.2.1 NB-IoT Band Frequency Stability over Voltage Variation Results

Test data:

Band	Reference channel frequency (MHz)	Offset	Voltage (V)		
			3.4	3.8	4.2
2	1880	Hz	9.30	8.74	6.94
		ppm	0.005	0.005	0.004
4	1732.5	Hz	3.58	5.25	4.84
		ppm	0.002	0.003	0.003
12	707.5	Hz	6.75	6.62	6.55
		ppm	0.010	0.009	0.009
13	782	Hz	3.09	3.88	3.81
		ppm	0.004	0.005	0.005
26	819	Hz	-1.39	-2.75	-0.20
		ppm	-0.002	-0.003	-0.0002
	836.5	Hz	5.55	1.63	3.05
		ppm	0.007	0.002	0.004

6.8. Peak to Average Ratio

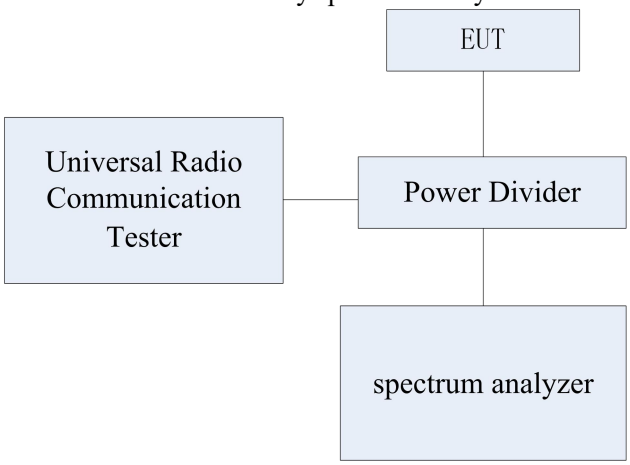
Specifications:	FCC Part 24.232, 27.50
DUT Serial Number:	866884049909625
Test conditions:	Ambient Temperature:15℃-35℃ Relative Humidity:30%-60% Air pressure: 86-106kPa
Test Results:	Pass

Limit

The EUT meets the requirement of having a peak to average ratio of less than 13dB.

Test Setup

During the test, the EUT was controlled via the Wireless Communications Test Set to ensure max power transmission and proper modulation and measured by spectrum analyzer.



Measurement Uncertainty:

Item	Uncertainty
Expanded Uncertainty	0.62 dB (k=2)

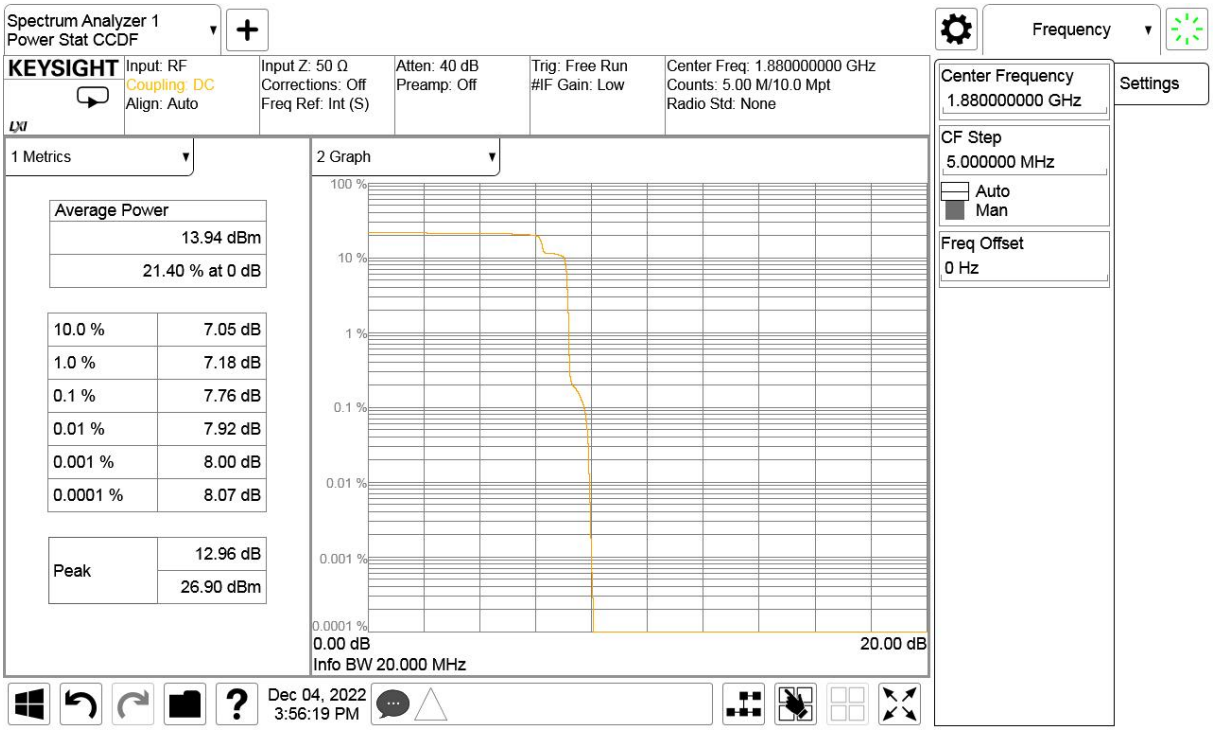
Test Method

The transmitter output was connected to a CMW500 through a coaxial RF cable and directional coupler, and configured to operate at maximum power. The peak to average ratio was measured at the required operating frequencies in each Band on the Spectrum Analyzer.

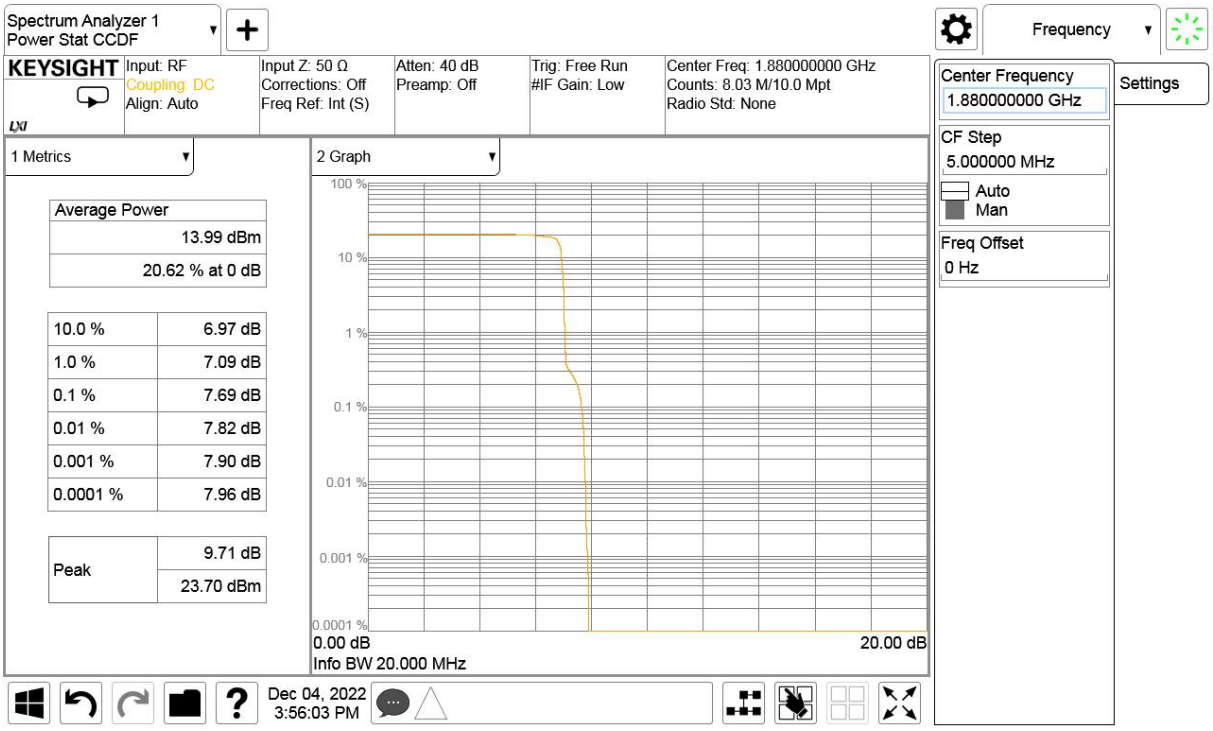
6.9.1 NB-IoT Peak to Average Ratio Results

Mode	Channel	Frequency (MHz)	PAPR(dB) QPSK	PAPR(dB) BPSK
Band2	18900	1880	7.76	7.69
Band4	20175	1732.5	7.74	8.12
Band12	23095	707.5	8.14	8.87
Band13	23230	782.0	8.95	8.20
Band26 （814MH-824MHz）	26740	819	8.45	9.46
Band26 （824MH-849MHz）	26915	836.5	8.20	8.33

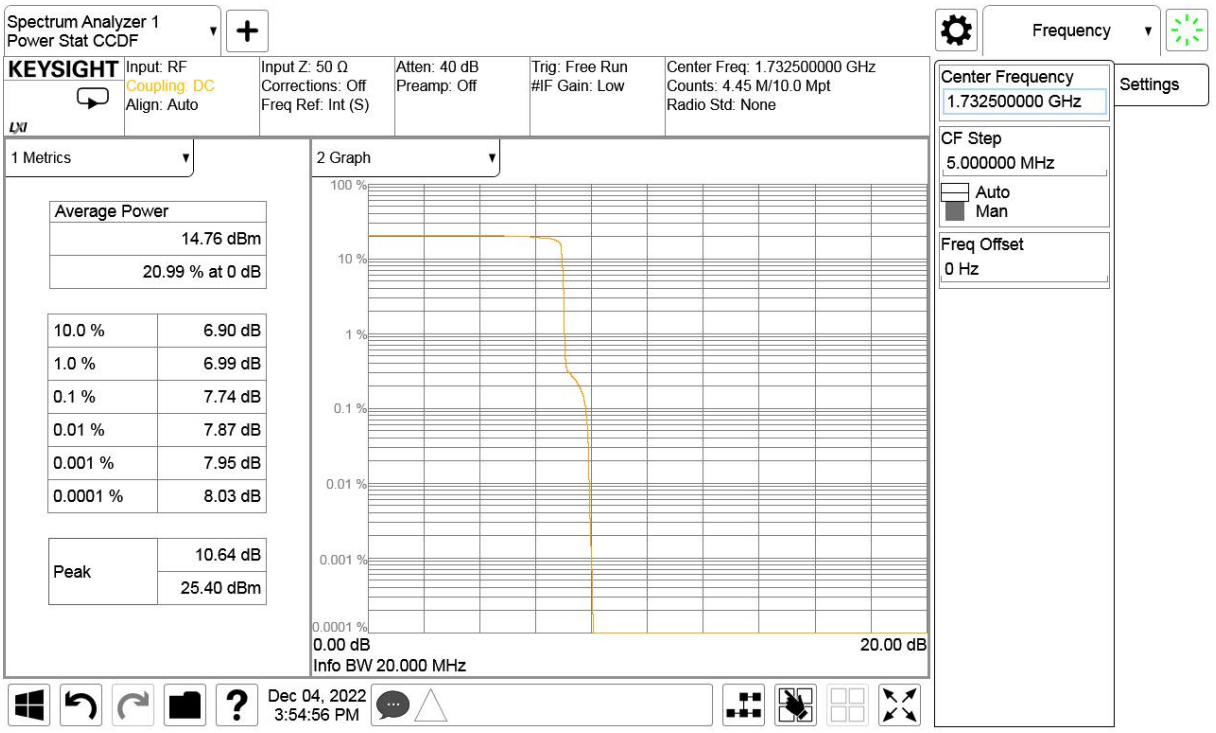
Graphical for Peak to Average Ratio Results for NB-IoT:



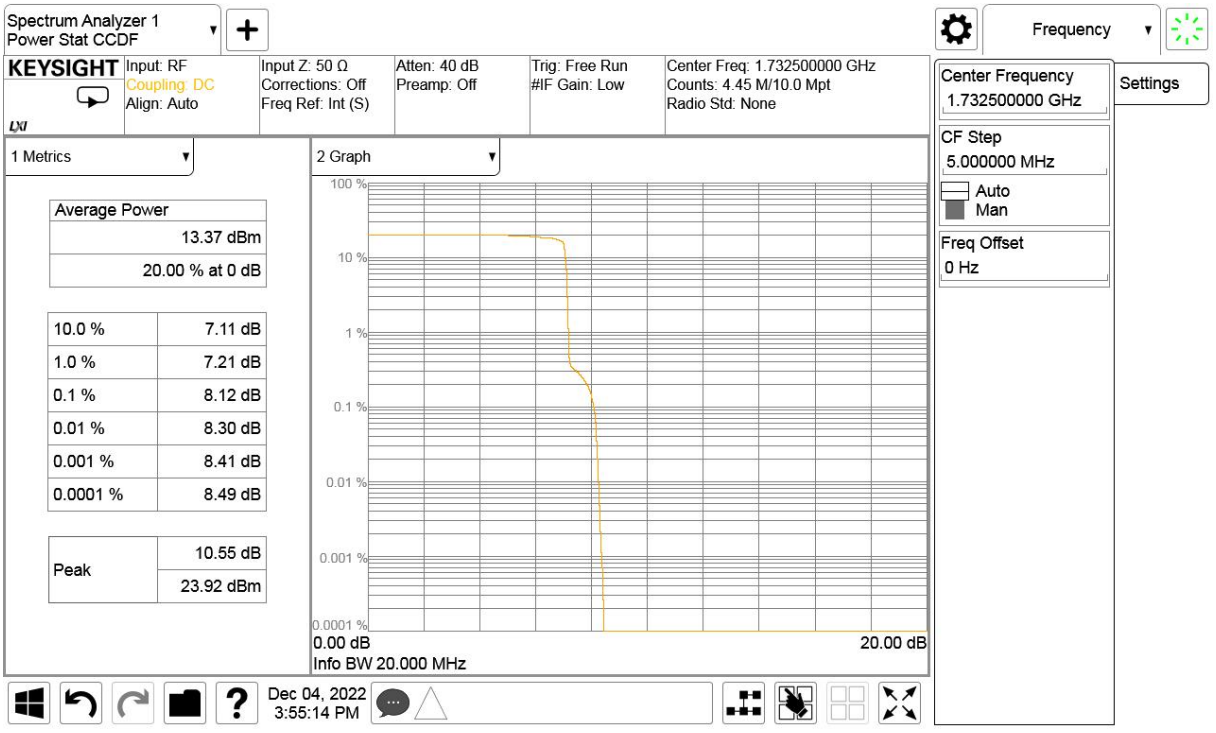
Band2-CH18900-1880MHz-QPSK



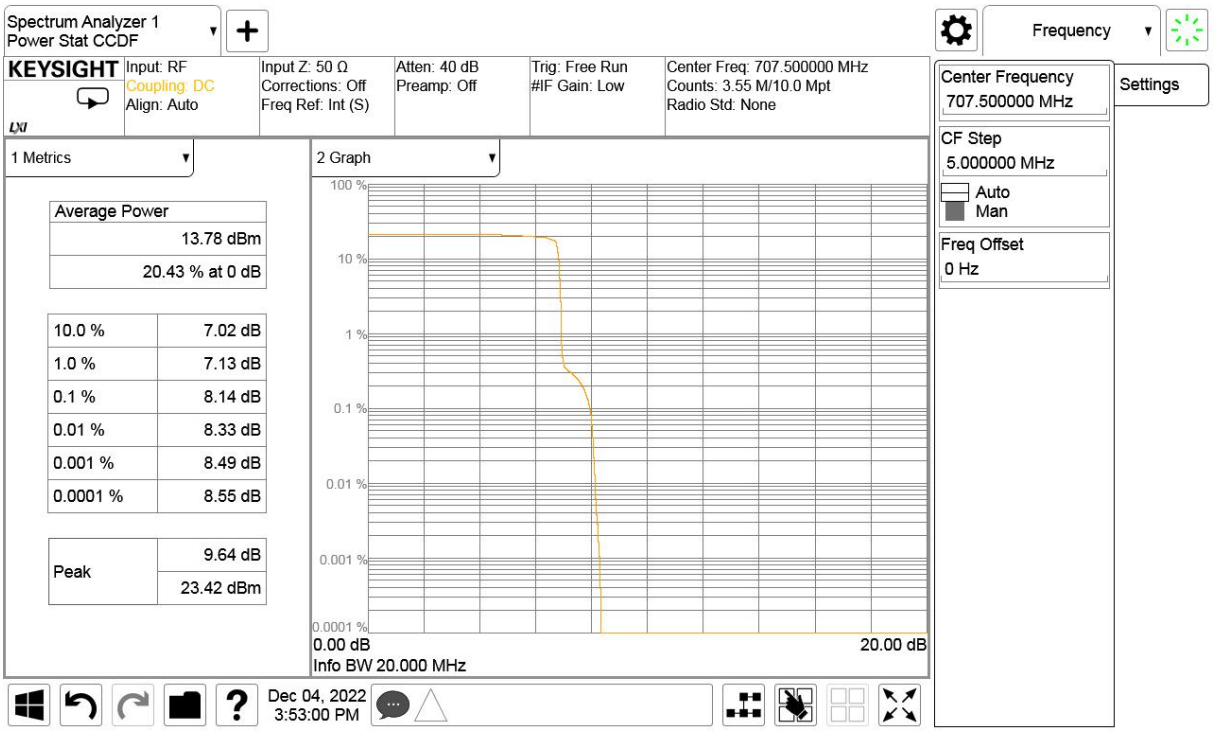
Band2-CH18900-1880MHz-BPSK



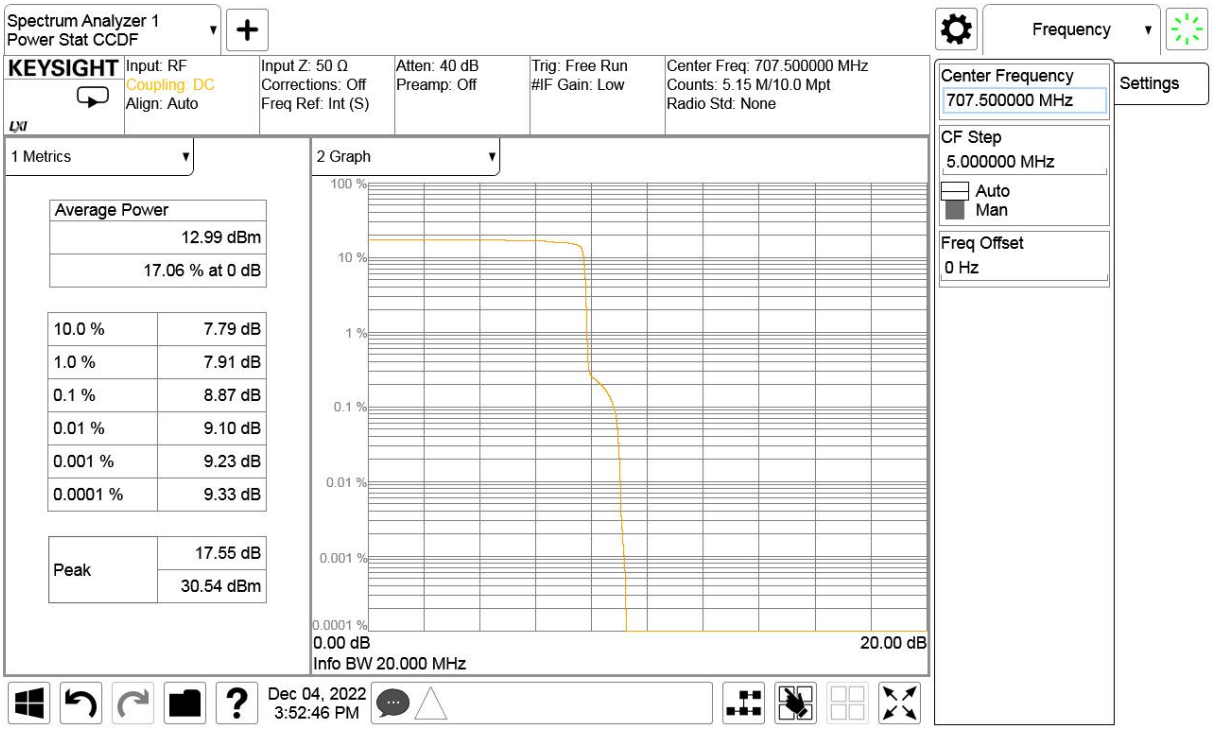
Band4-CH20175-1732.5MHz-QPSK



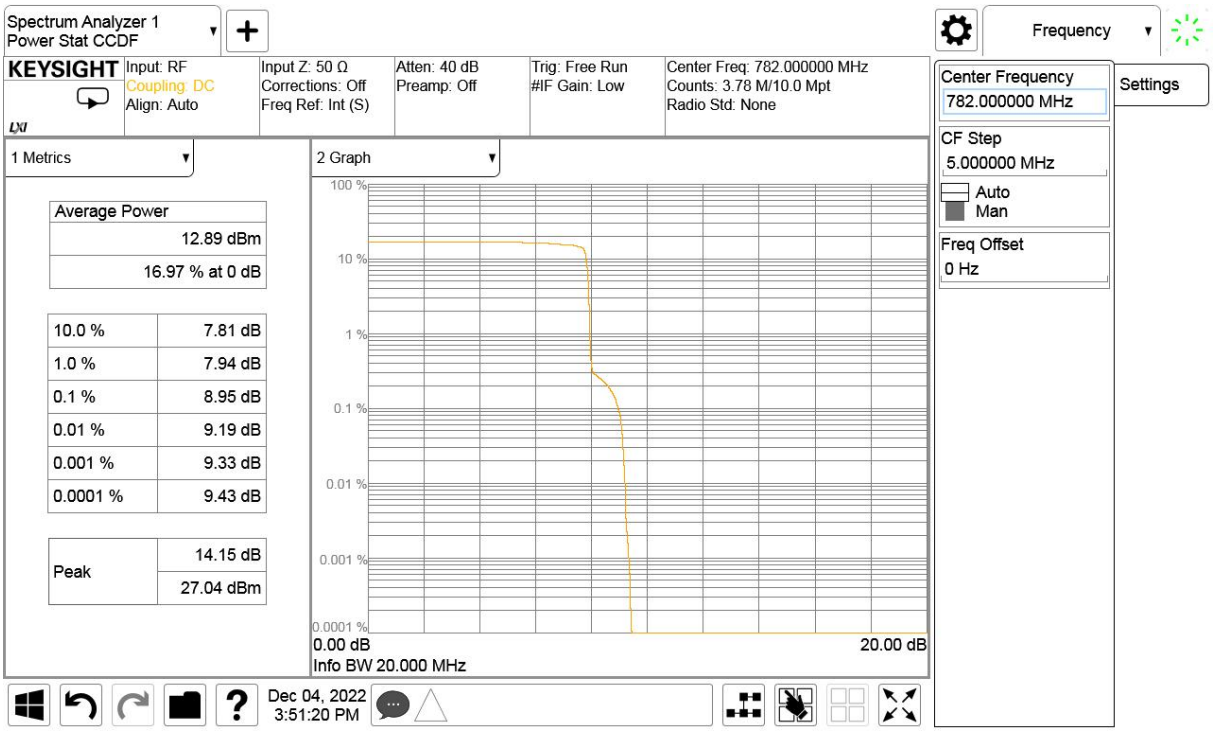
Band4- CH20175-1732.5MHz -BPSK



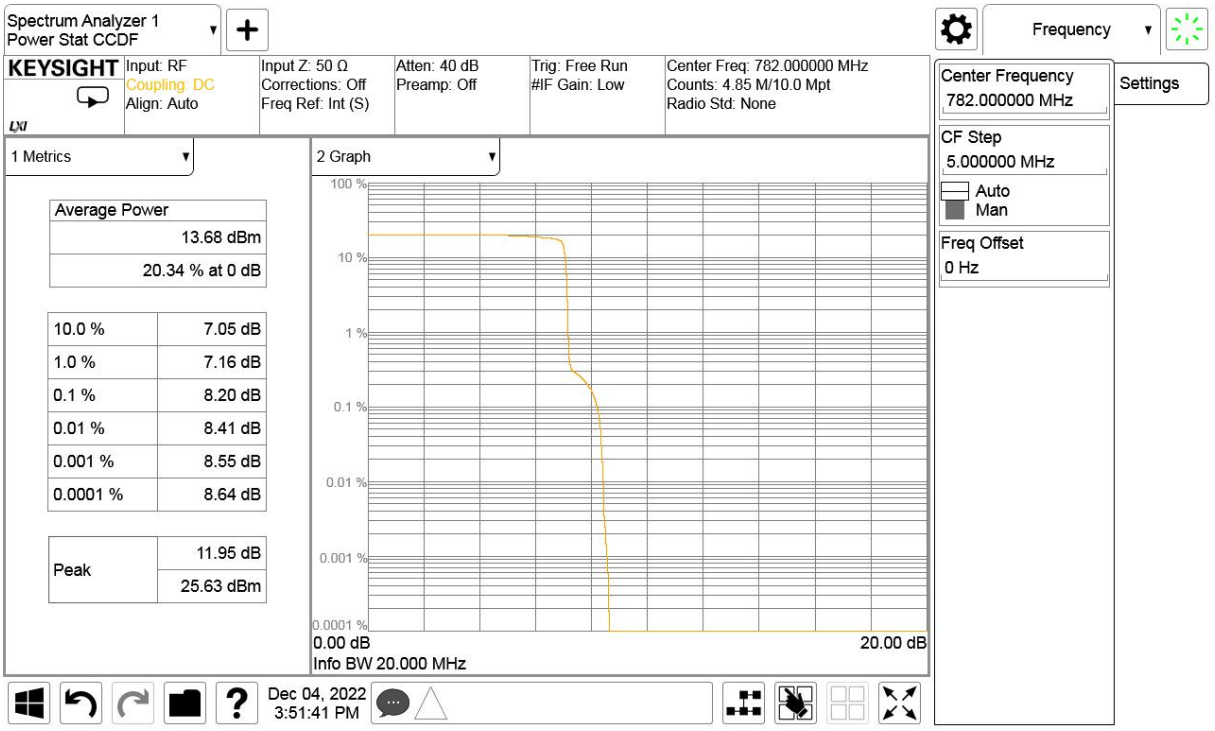
Band12-CH23095-707.5MHz-QPSK



Band12- CH23095-707.5MHz -BPSK



Band13-CH23230-782MHz-QPSK



Band13- CH23230-782MHz -BPSK