

## 9 MAXIMUM POWER SPECTRAL DENSITY

### MEASUREMENT

#### 9.1 Test Equipment

The following test equipment was used during the power spectral density measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.09.16	1 Year
2.	Coaxial Cable	WOKEN	SFL402-105F LEX	F02-150819-045	2022.06.06	1 Year
3.	20 dB Attenuator	Mini-Circuits	VAT-20+	001	2021.08.06	1 Year

#### 9.2 Block Diagram of Test Setup

The Same as section 6.2.

#### 9.3 Specification Limits (§15.407(a))

(1) For the band 5.15-5.25 GHz.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

(3) For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

#### 9.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

#### 9.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

(i) Measure the duty cycle,  $x$ , of the transmitter output signal.

(ii) For the 5.15-5.25 GHz, 5.25-5.35 GHz and 5.47-5.725 GHz bands. set  $RBW = 1 \text{ MHz}$ . For the band 5.725-5.85 GHz set  $RBW = 300 \text{ kHz}$ .

(iii) Set  $VBW \geq 3 \times RBW$ .

(iv) Number of points in sweep  $\geq 2 \times \text{span} / RBW$ . (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 = power averaging (rms).

(vii) Allow the sweep to “free run.”

(viii) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over

the on and off periods of the transmitter.

(ix) Use the peak search function on the instrument to find the peak of the spectrum.

(x) As the Method SA-2 was used, add  $10 \log (1/x)$ , where x is the duty cycle, to the peak of the spectrum. The result is the Peak Power Spectral Density.

(xi) For the band 5.725-5.85 GHz, additional add  $10 \log (500 \text{ kHz}/300 \text{ kHz}) = 2.22 \text{ dB}$  to the measured result, whereas RBW is set to 300 kHz (<500 kHz) during measurement.

The test procedure is defined in KDB789033 D02 (the clause II.F Measurement Procedure “ Maximum Power Spectral Density (PSD)” was used).

## 9.6 Test Results

**PASSED.**

All the test results are attached in next pages.

(Test Date: 2022.06.21 Temperature: 23°C Humidity: 51 %)

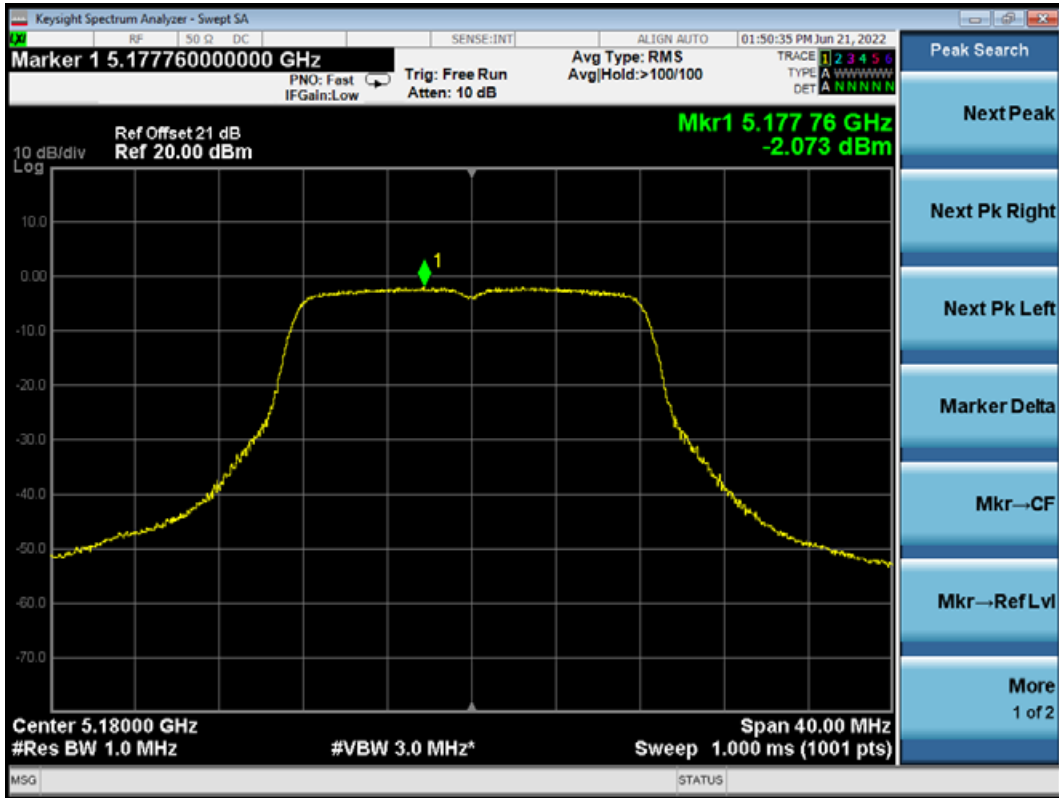
Modulation	Channel	Frequency (MHz)	Average Power Spectral Density (dBm/MHz)	Maximum Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)
802.11a	36	5180	<b>-2.073</b>	<b>-2.073</b>	11
	40	5200	<b>-0.566</b>	<b>-0.566</b>	11
	48	5240	<b>-1.228</b>	<b>-1.228</b>	11
	52	5260	<b>-3.867</b>	<b>-3.867</b>	11
	60	5300	<b>-3.576</b>	<b>-3.576</b>	11
	64	5320	<b>-3.396</b>	<b>-3.396</b>	11
	100	5500	<b>-3.355</b>	<b>-3.355</b>	11
	120	5600	<b>-2.825</b>	<b>-2.825</b>	11
	140	5700	<b>-2.805</b>	<b>-2.805</b>	11

Modulation	Channel	Frequency (MHz)	Average Power Spectral Density (dBm/MHz)	Maximum Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)
802.11n20	36	5180	<b>-2.014</b>	<b>-2.014</b>	11
	40	5200	<b>-0.899</b>	<b>-0.899</b>	11
	48	5240	<b>-1.501</b>	<b>-1.501</b>	11
	52	5260	<b>-4.072</b>	<b>-4.072</b>	11
	60	5300	<b>-3.687</b>	<b>-3.687</b>	11
	64	5320	<b>-3.677</b>	<b>-3.677</b>	11
	100	5500	<b>-3.682</b>	<b>-3.682</b>	11
	120	5600	<b>-3.128</b>	<b>-3.128</b>	11
		140	5700	<b>-3.11</b>	<b>-3.11</b>

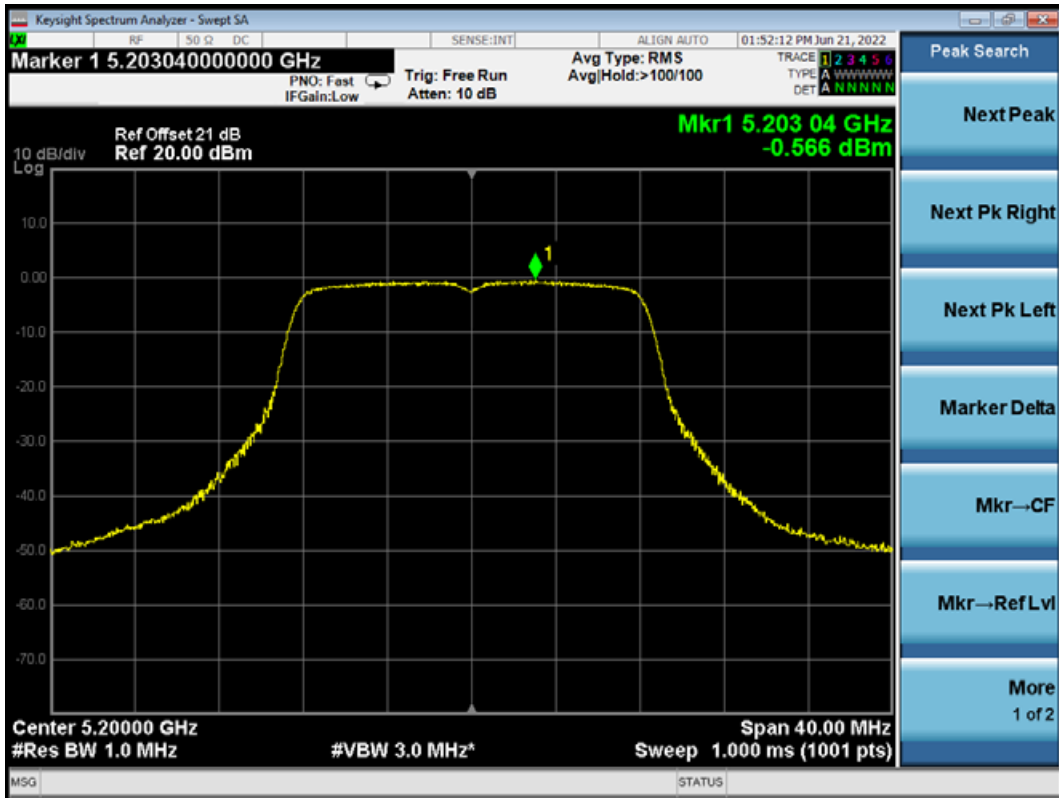
Modulation	Channel	Frequency (MHz)	Average Power Spectral Density (dBm/MHz)	Maximum Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)
802.11n40	38	5190	<b>-3.912</b>	<b>-3.912</b>	11
	46	5230	<b>-4.287</b>	<b>-4.287</b>	11
	54	5270	<b>-5</b>	<b>-5</b>	11
	62	5310	<b>-4.609</b>	<b>-4.609</b>	11
	102	5510	<b>-4.69</b>	<b>-4.69</b>	11
	118	5590	<b>-4.225</b>	<b>-4.225</b>	11
	134	5670	<b>-4.304</b>	<b>-4.304</b>	11

Modulation	Channel	Frequency (MHz)	Average Power Spectral Density (dBm/300kHz)	Maximum Power Spectral Density (dBm/500kHz)	Limit (dBm/500kHz)
802.11a	149	5745	<b>-14.088</b>	<b>-11.868</b>	30
	157	5785	<b>-13.5</b>	<b>-11.28</b>	30
	165	5825	<b>-13.323</b>	<b>-11.103</b>	30
802.11n-HT20	149	5745	<b>-14.154</b>	<b>-11.934</b>	30
	157	5785	<b>-14.467</b>	<b>-12.247</b>	30
	165	5825	<b>-13.632</b>	<b>-11.412</b>	30
802.11n-HT40	151	5755	<b>-9.845</b>	<b>-7.625</b>	30
	159	5795	<b>-9.236</b>	<b>-7.016</b>	30

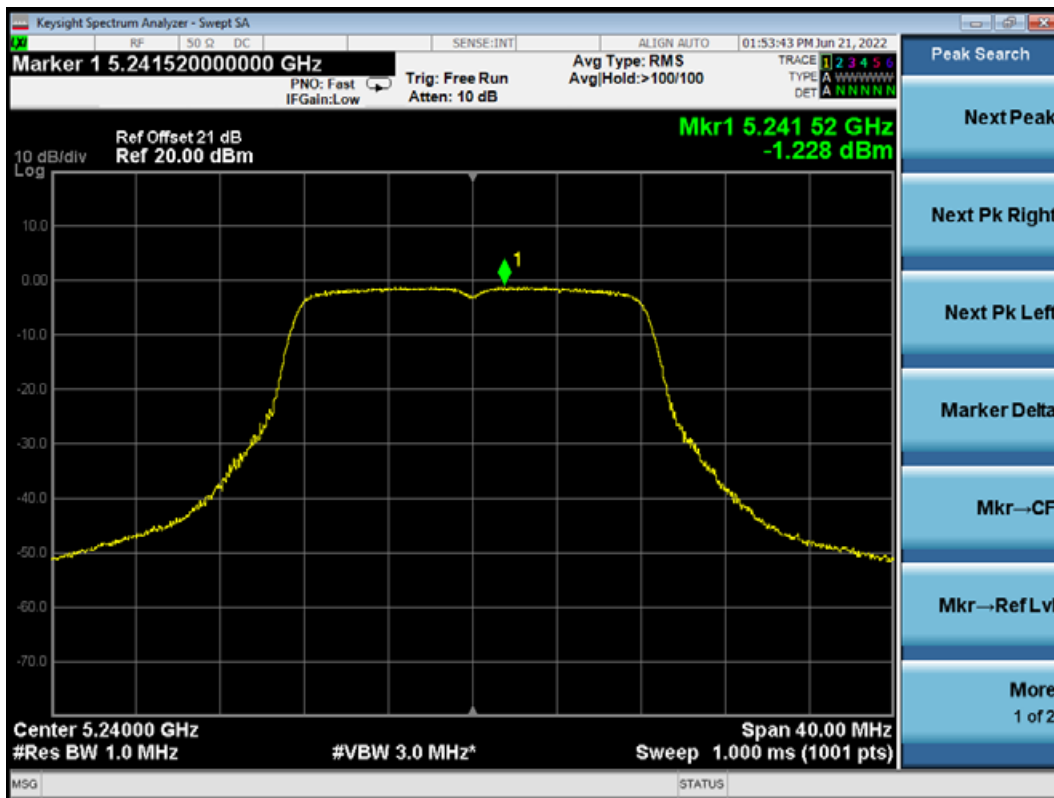
### 802.11a CH5180MHz



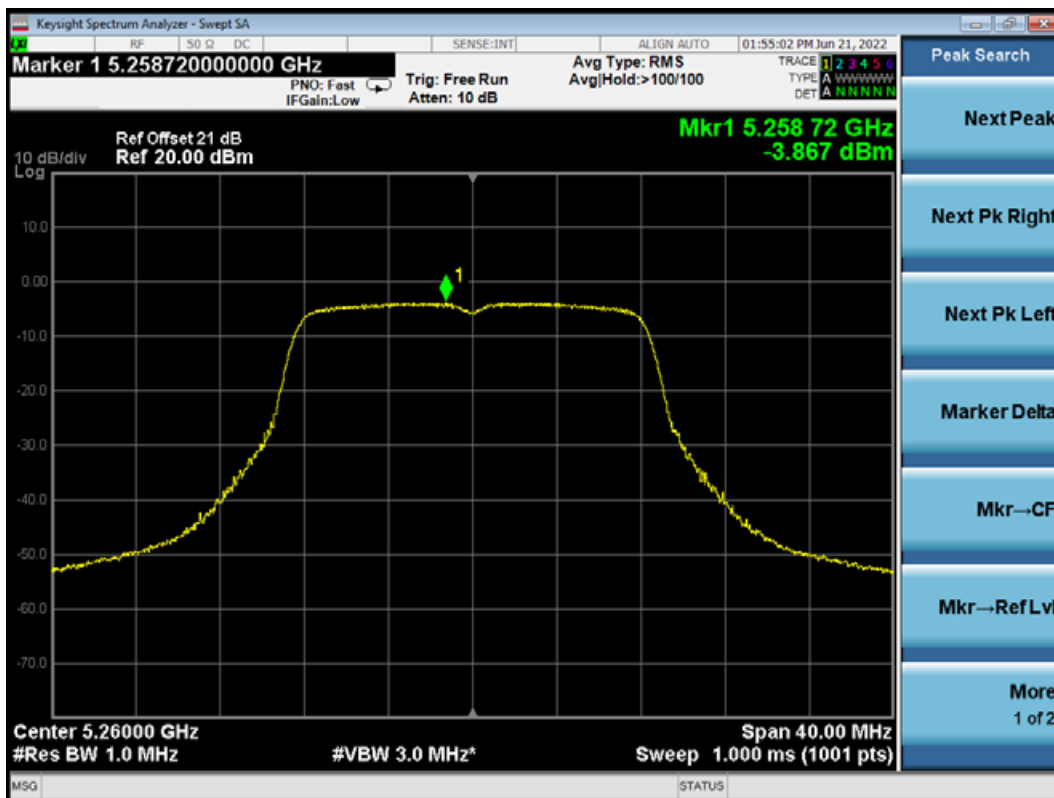
### 802.11a CH5200MHz



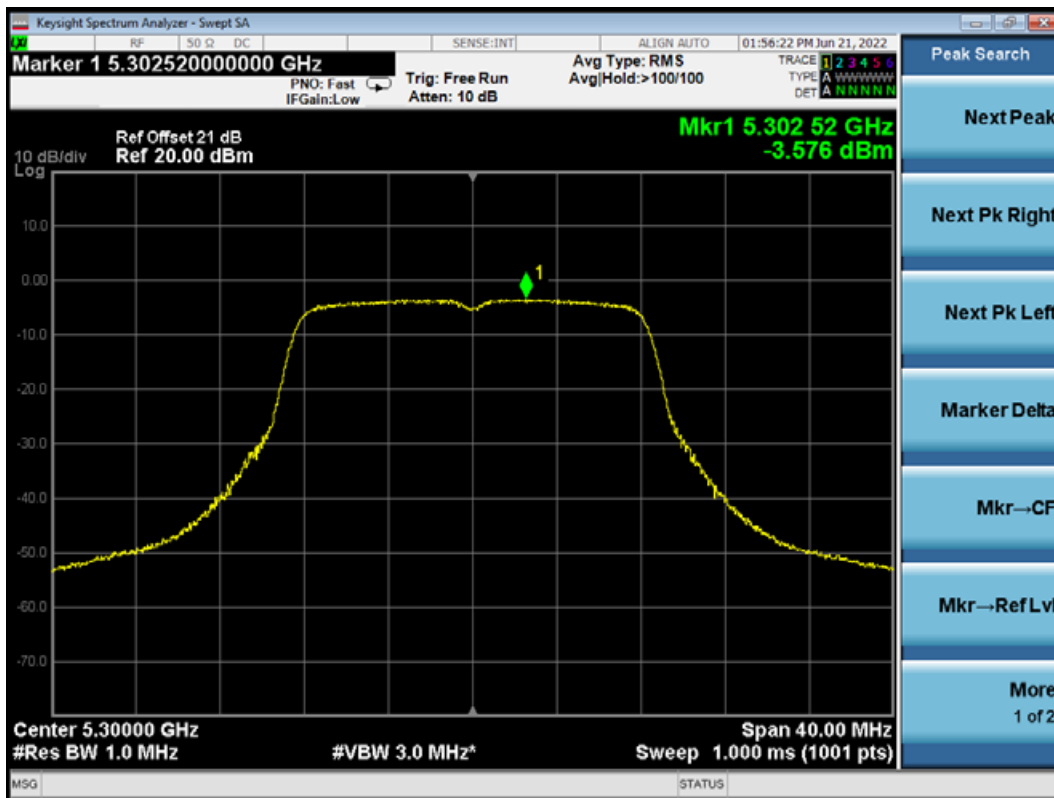
### 802.11a CH5240MHz



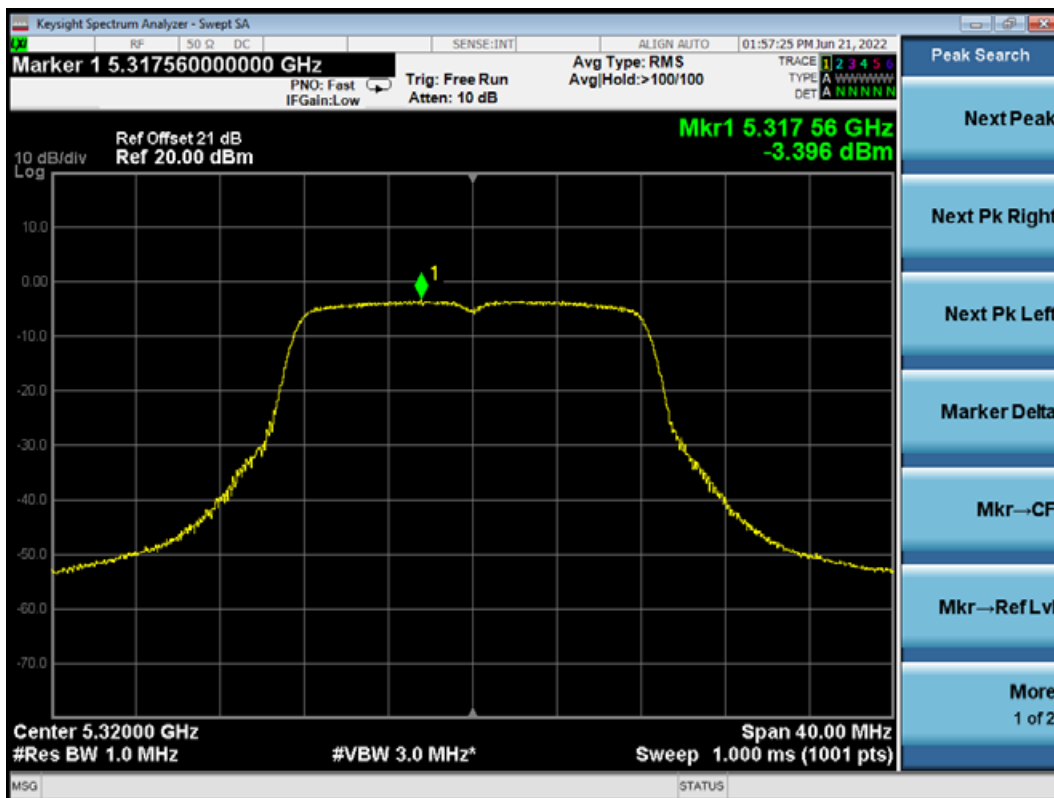
### 802.11a CH5260MHz



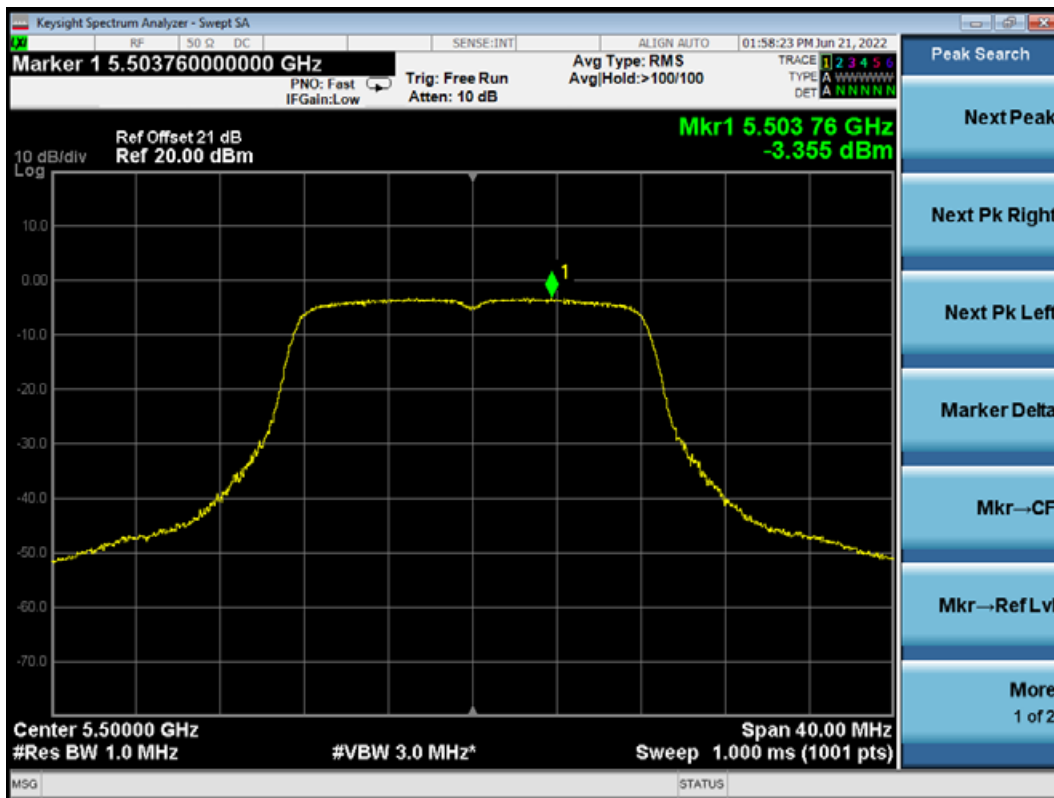
### 802.11a CH5300MHz



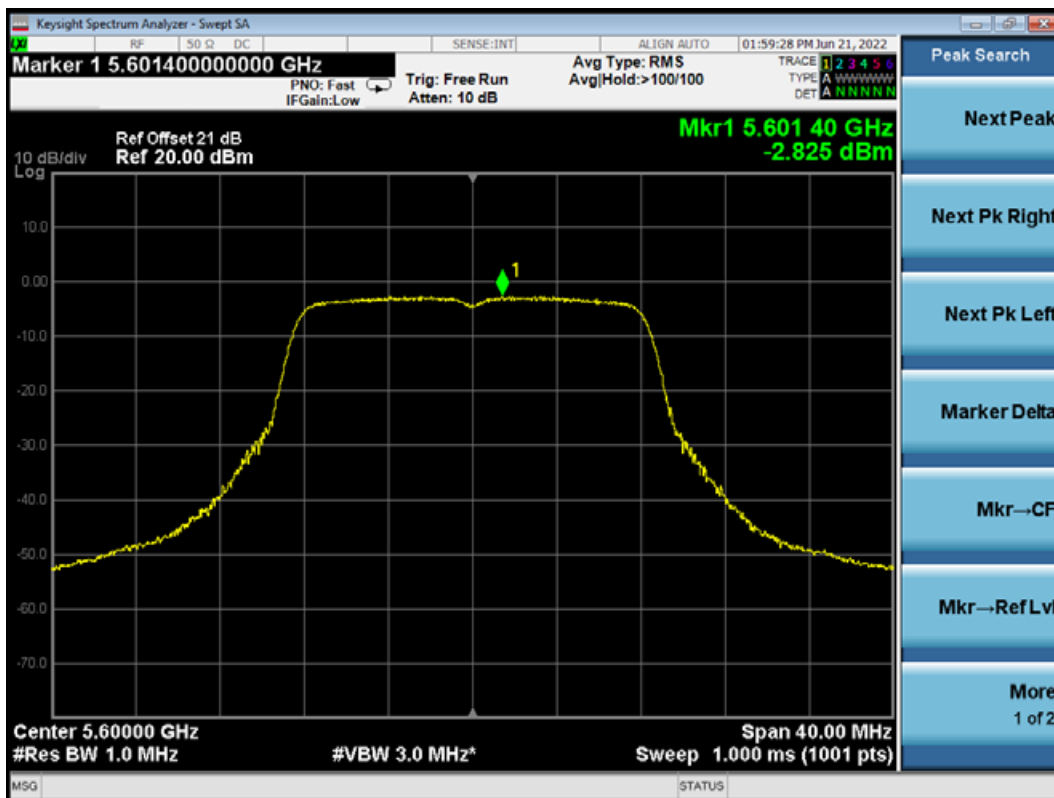
### 802.11a CH5320MHz



### 802.11a CH5500MHz

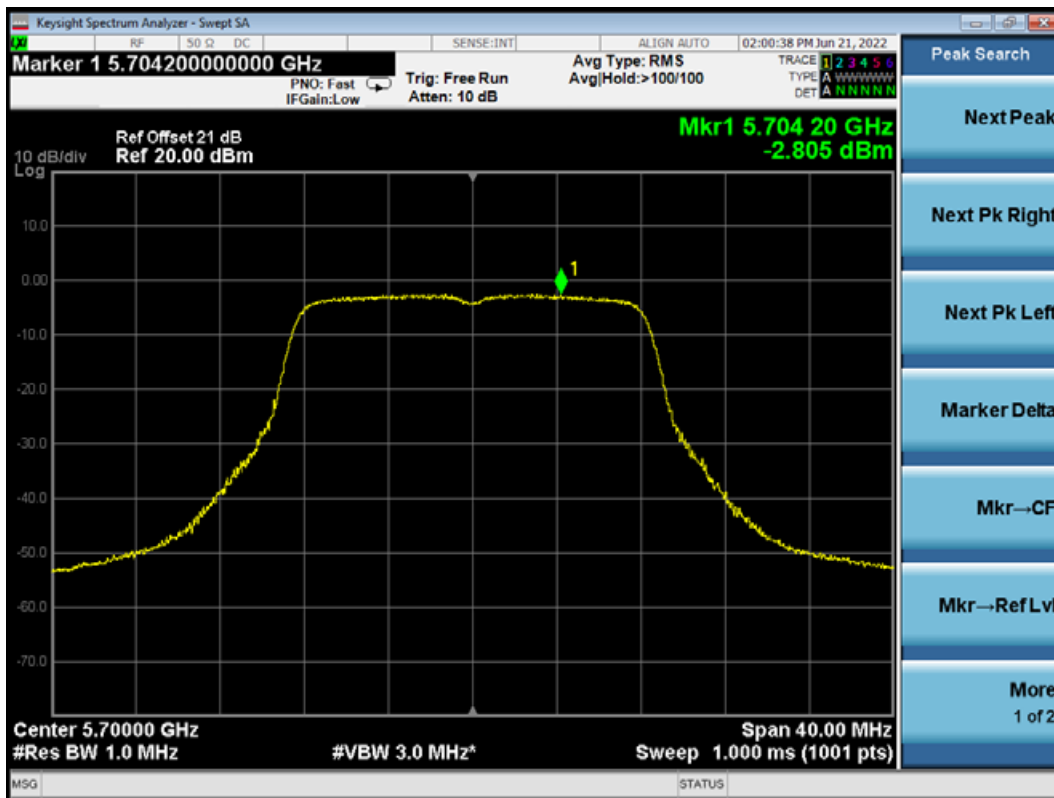


### 802.11a CH5600MHz

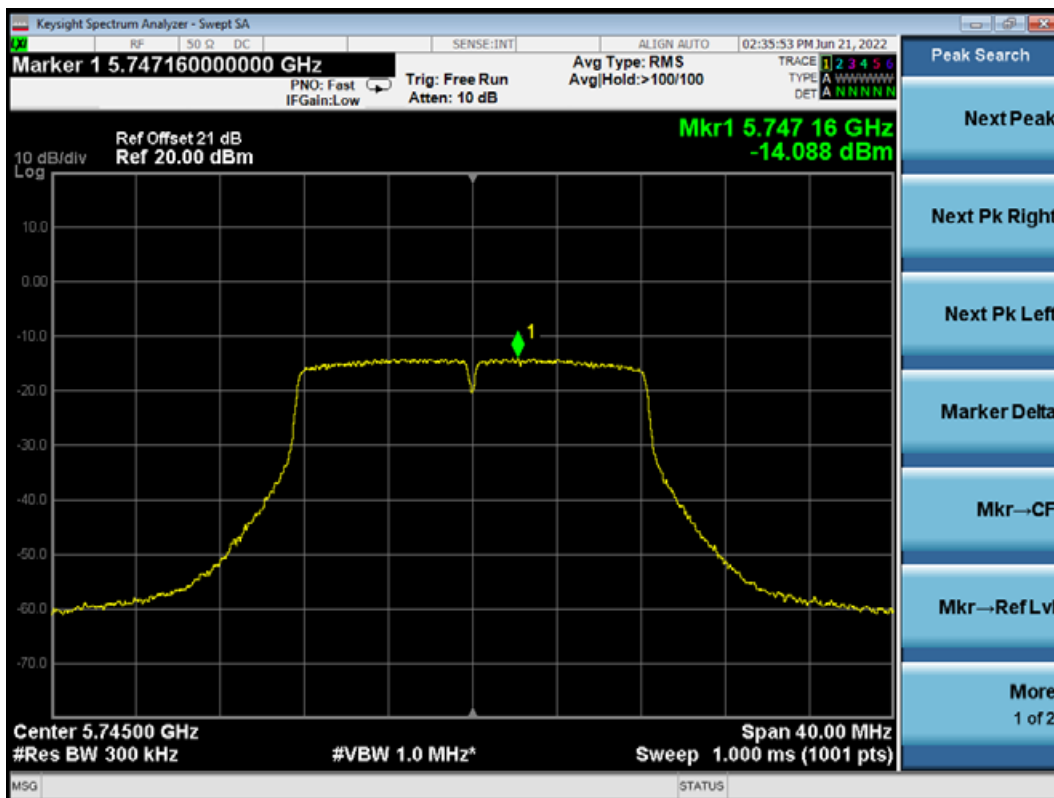




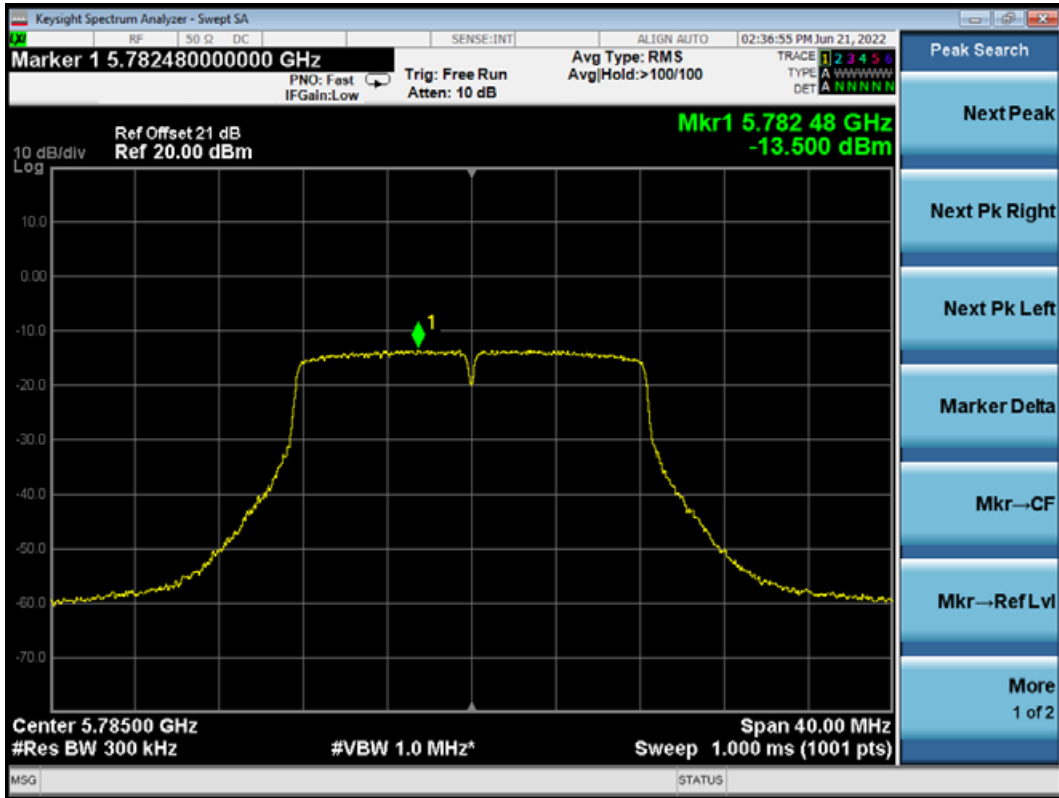
### 802.11a CH5700MHz



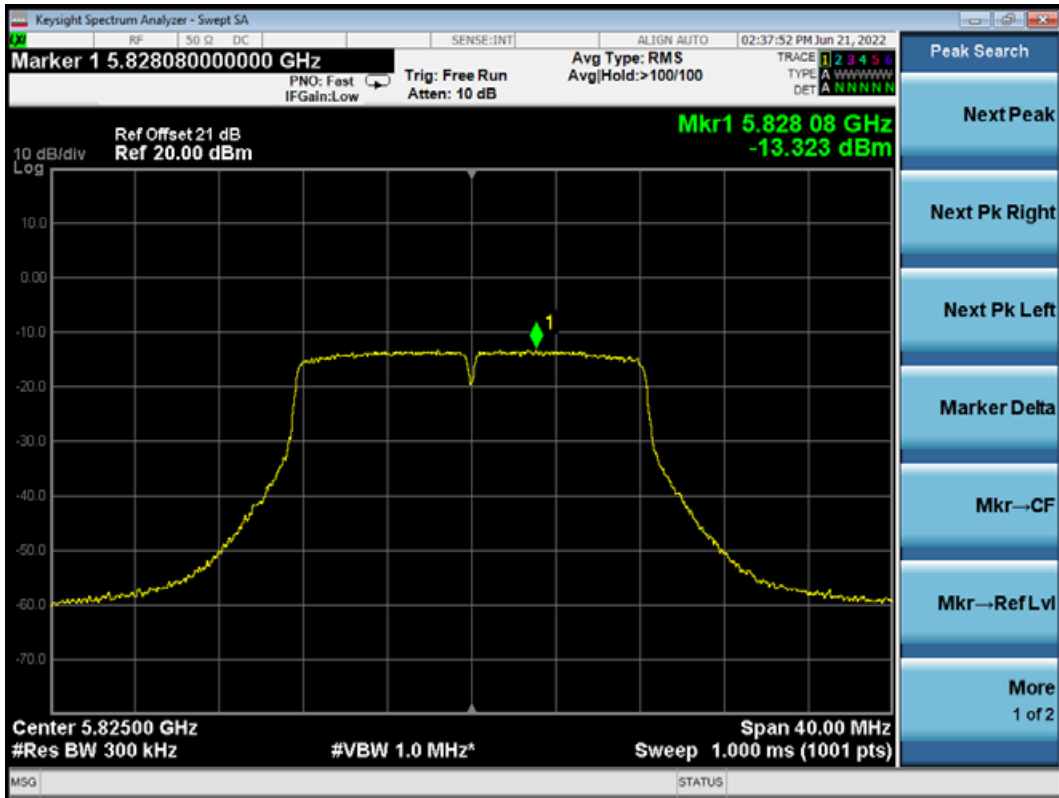
### 802.11a CH5745MHz



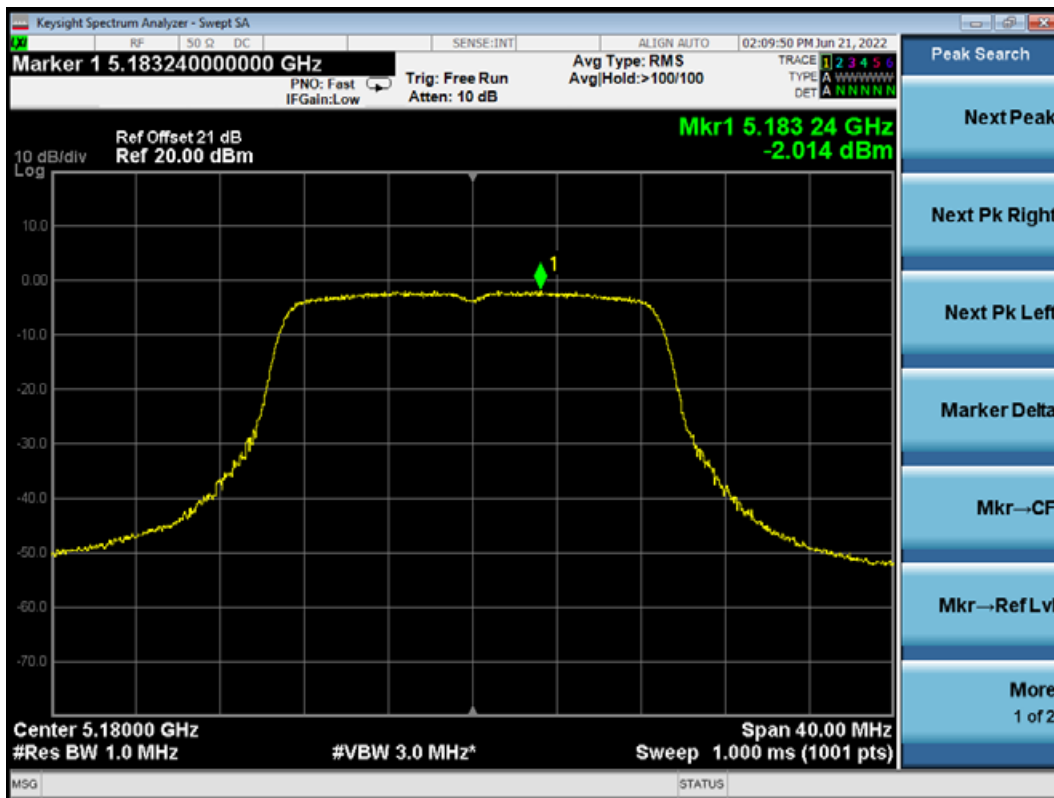
### 802.11a CH5785MHz



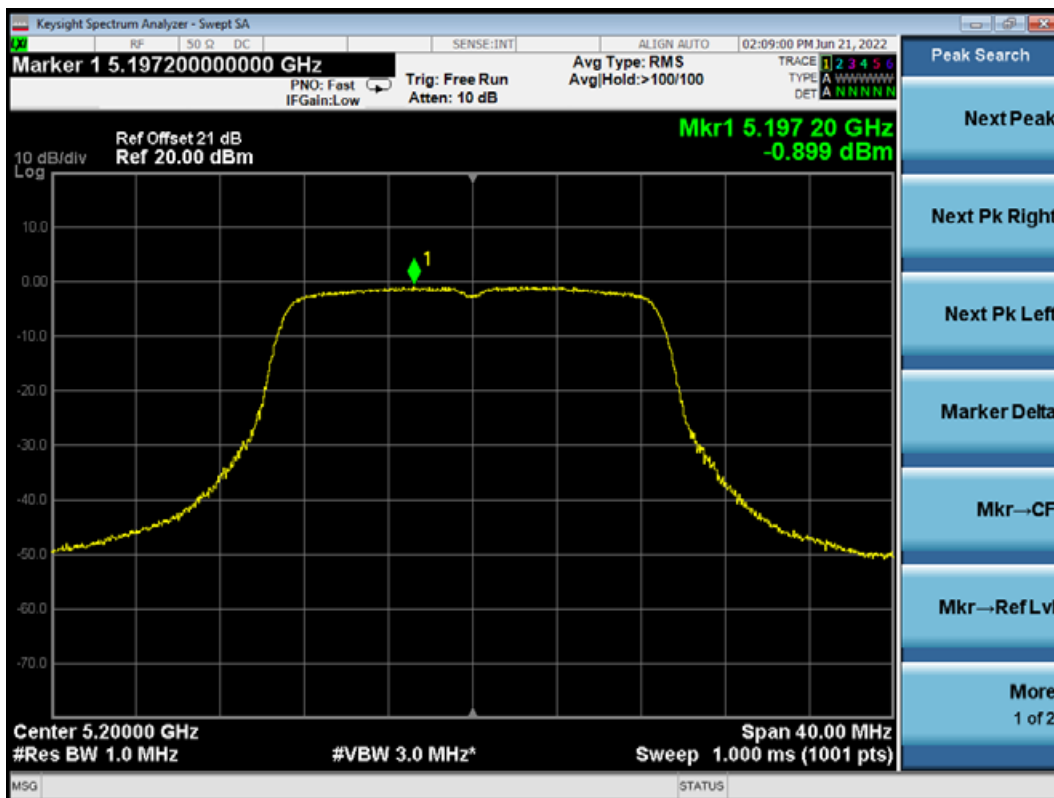
### 802.11a CH5825MHz



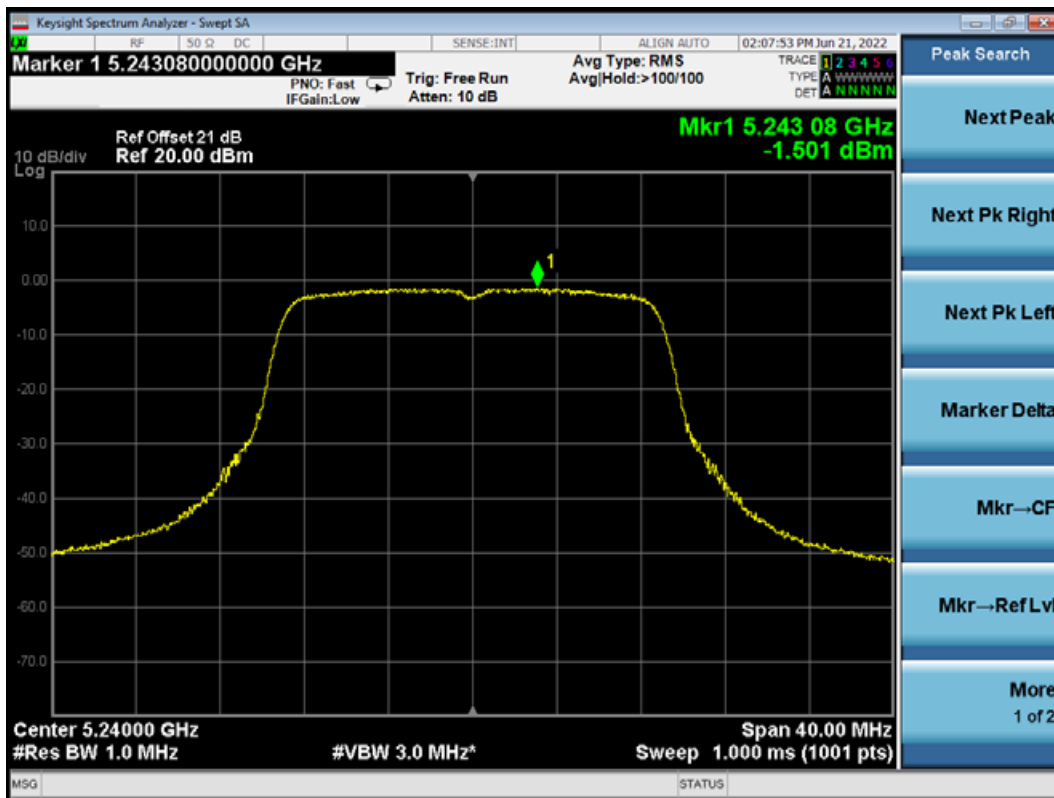
### 801.11n20 CH5180MHz



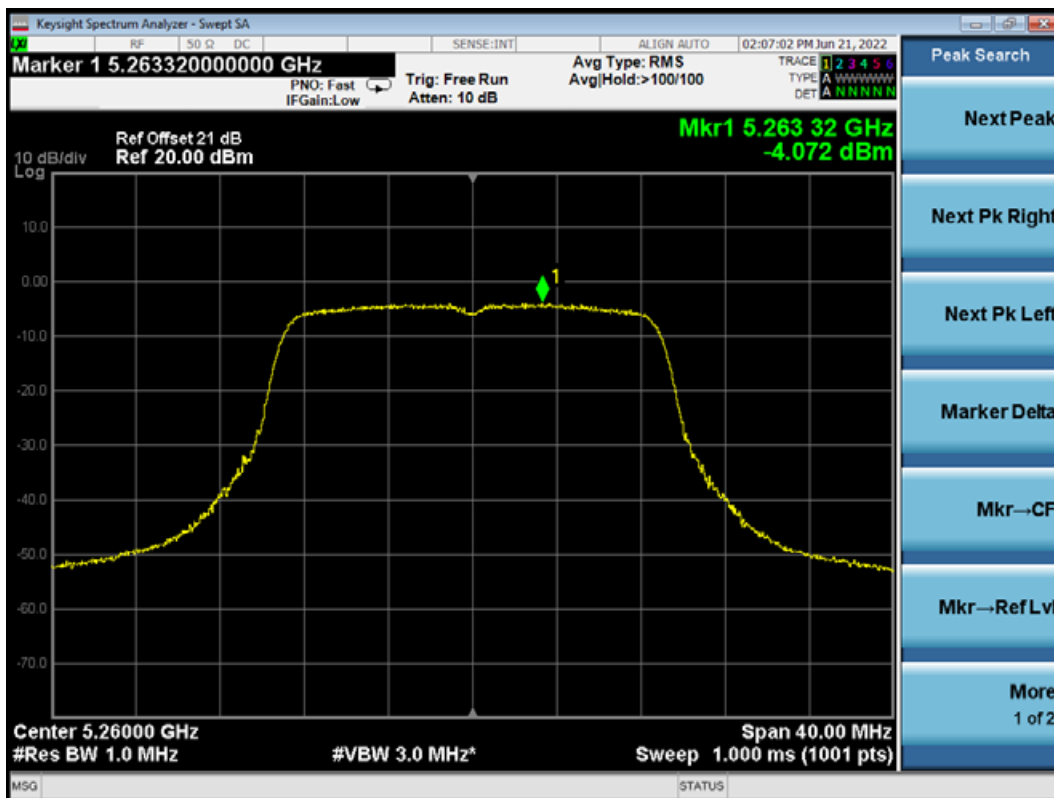
### 801.11n20 CH5200MHz



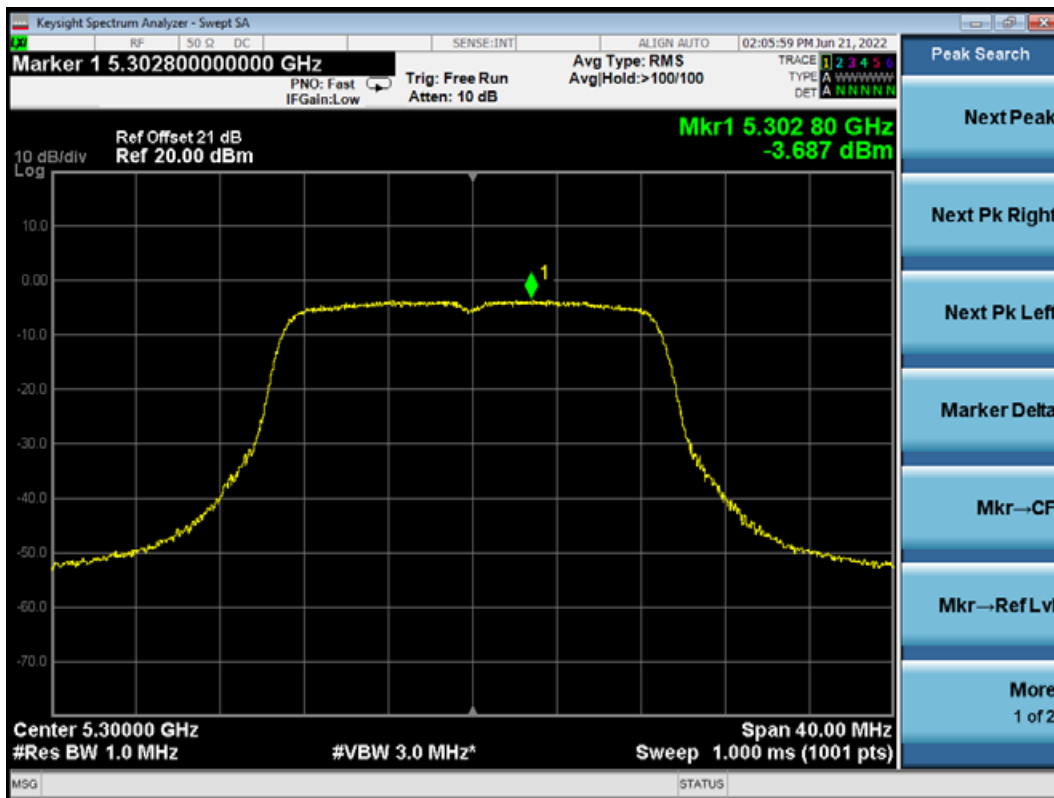
### 801.11n20 CH5240MHz



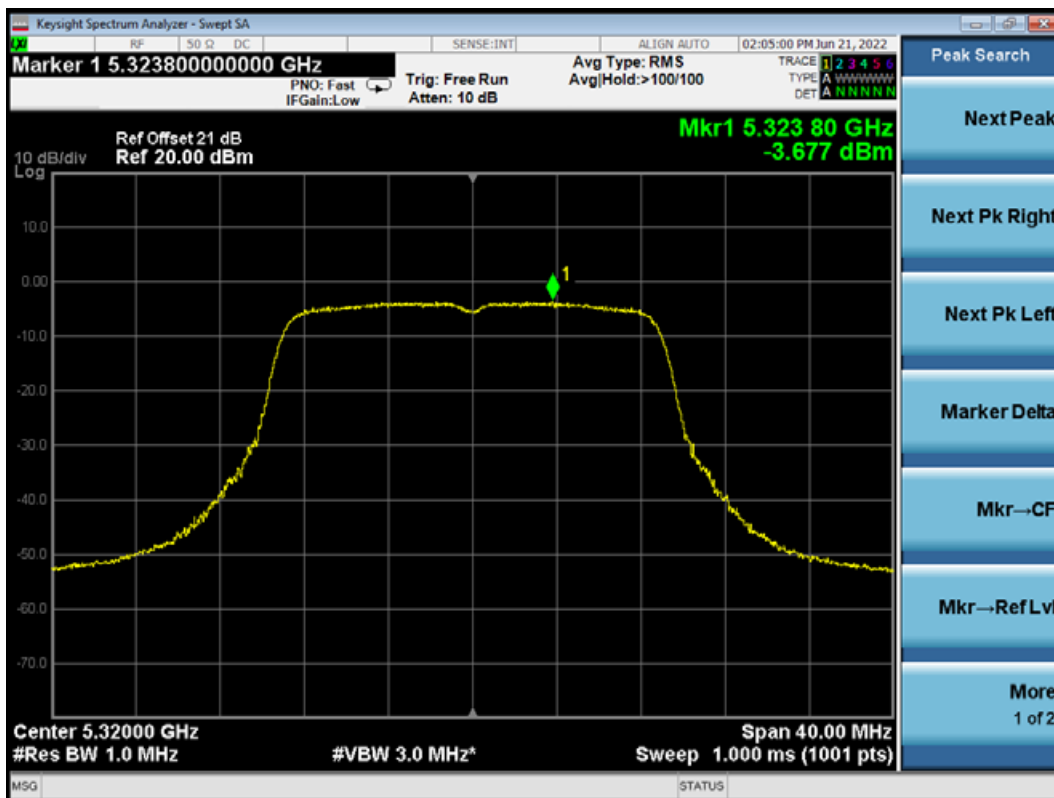
### 801.11n20 CH5260MHz



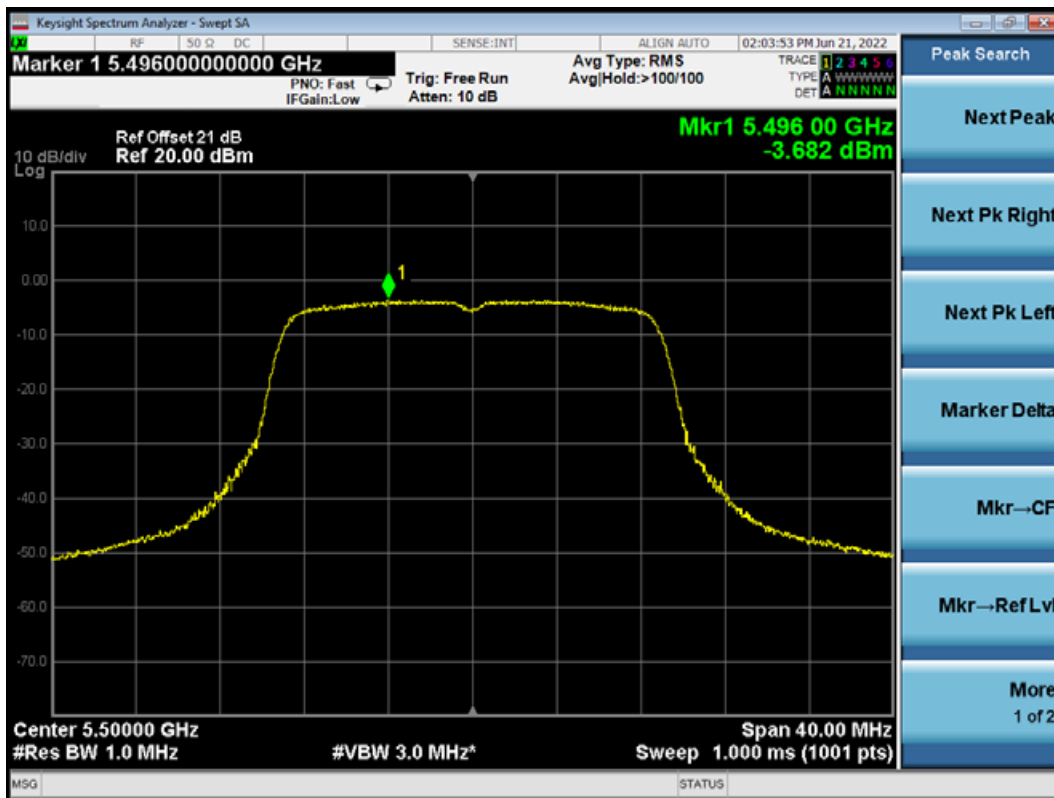
### 801.11n20 CH5300MHz



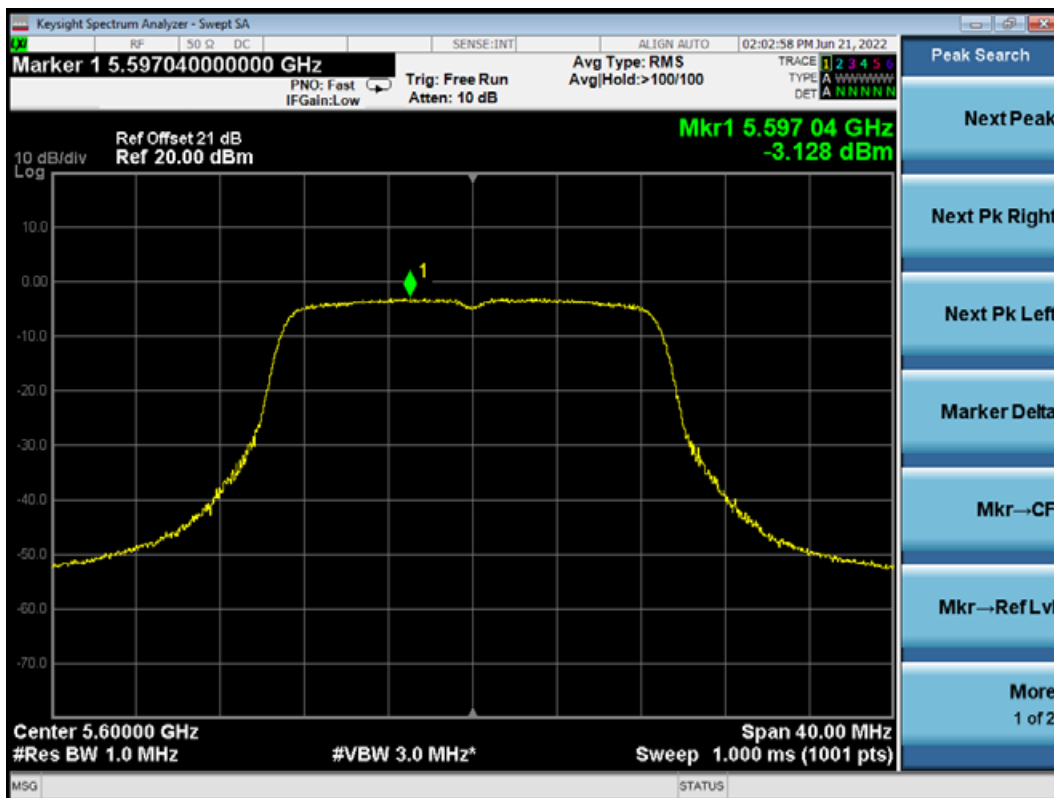
### 801.11n20 CH5320MHz



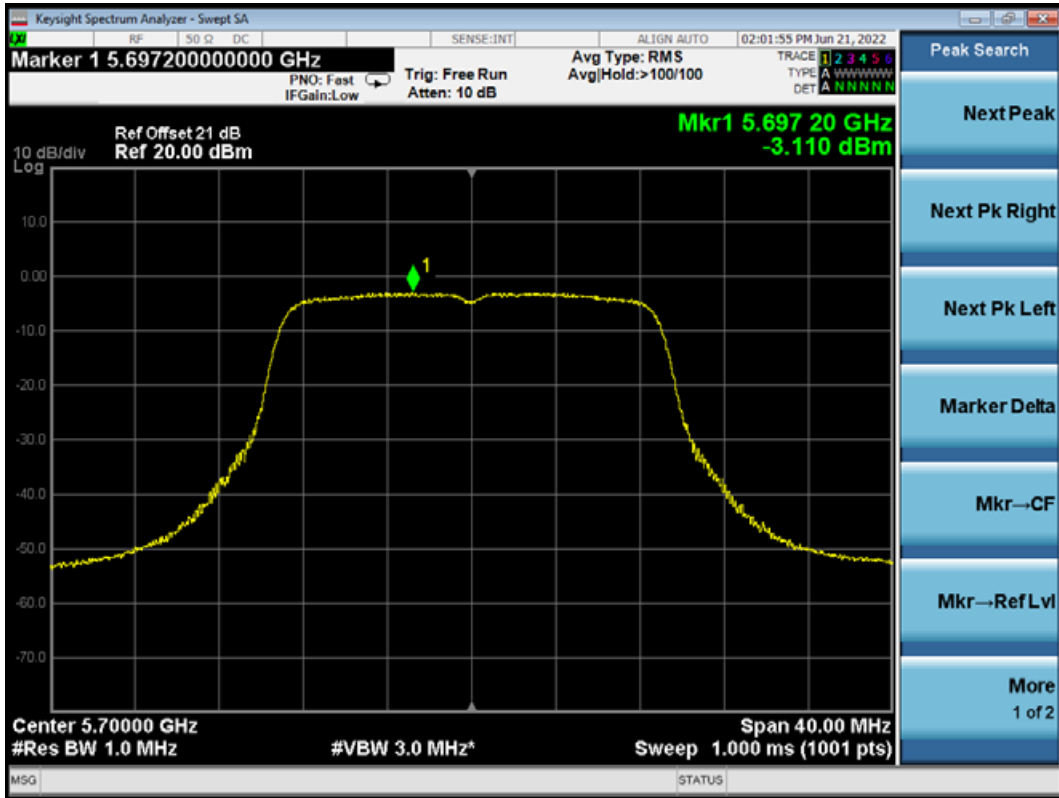
### 801.11n20 CH5500MHz



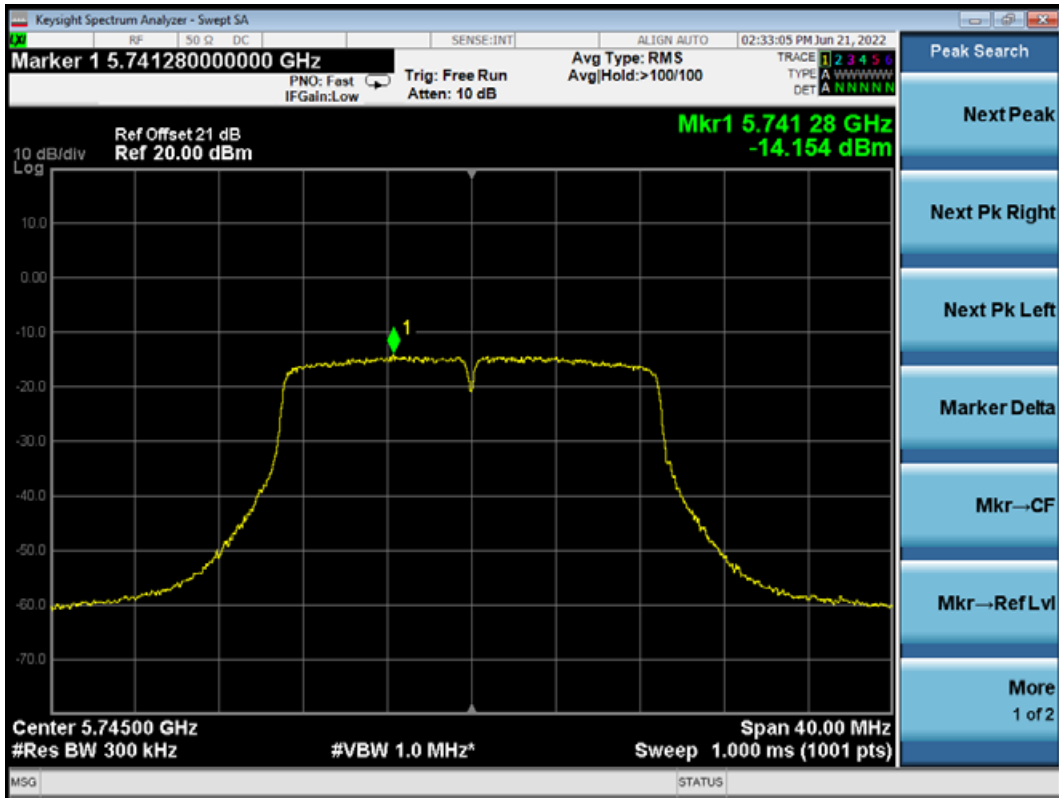
### 801.11n20 CH5600MHz



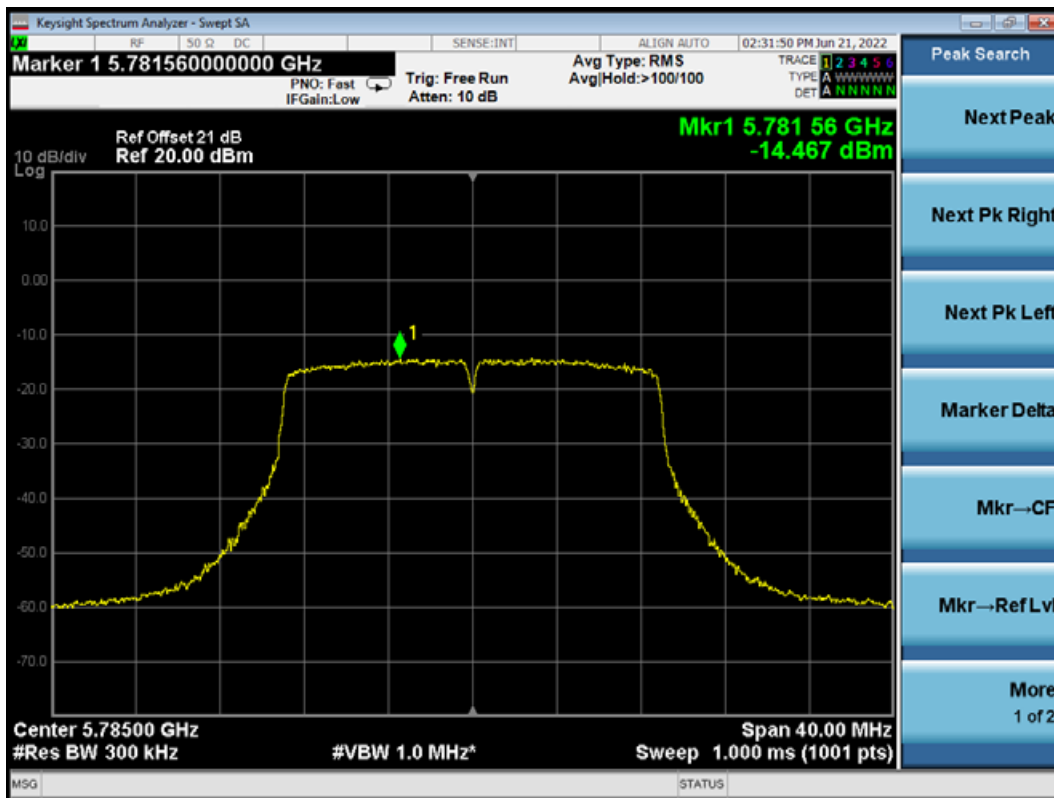
### 801.11n20 CH5700MHz



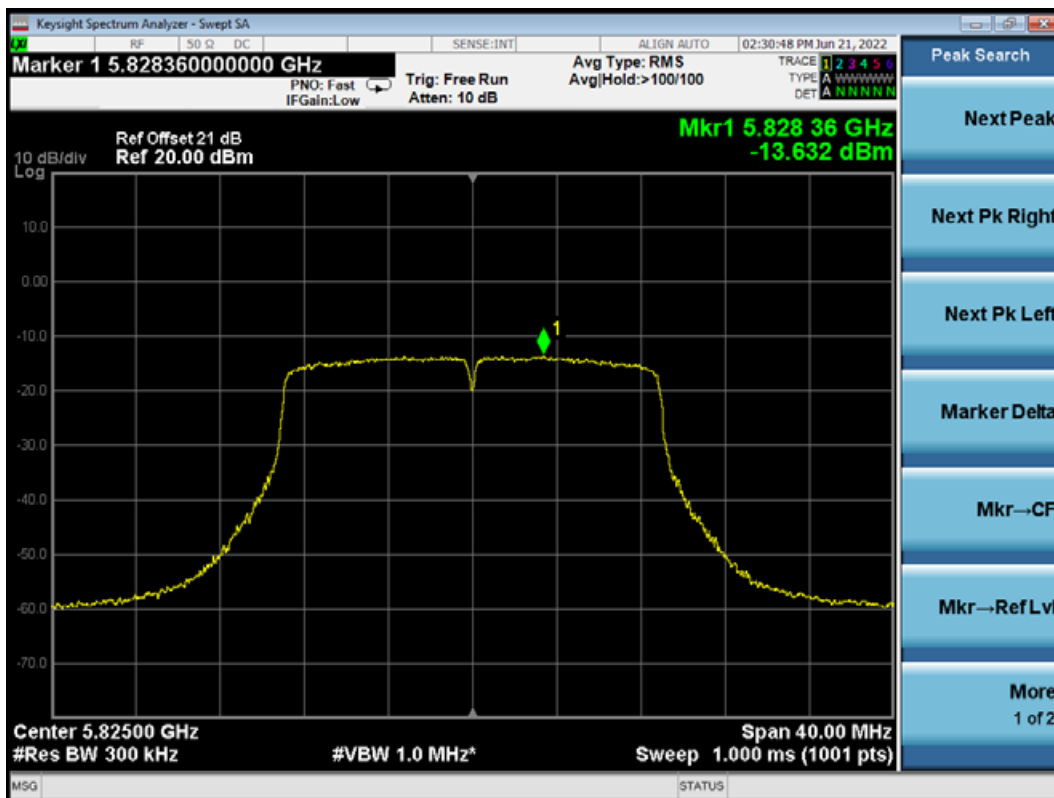
### 801.11n20 CH5745MHz



### 801.11n20 CH5785MHz

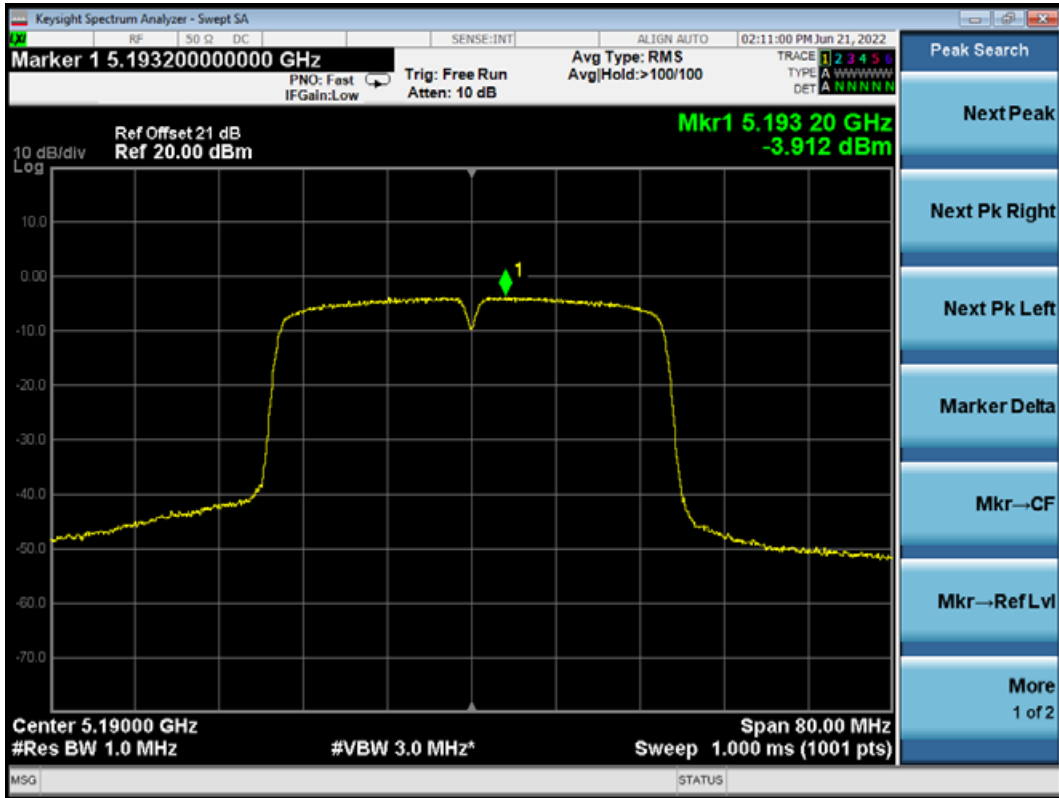


### 801.11n20 CH5825MHz

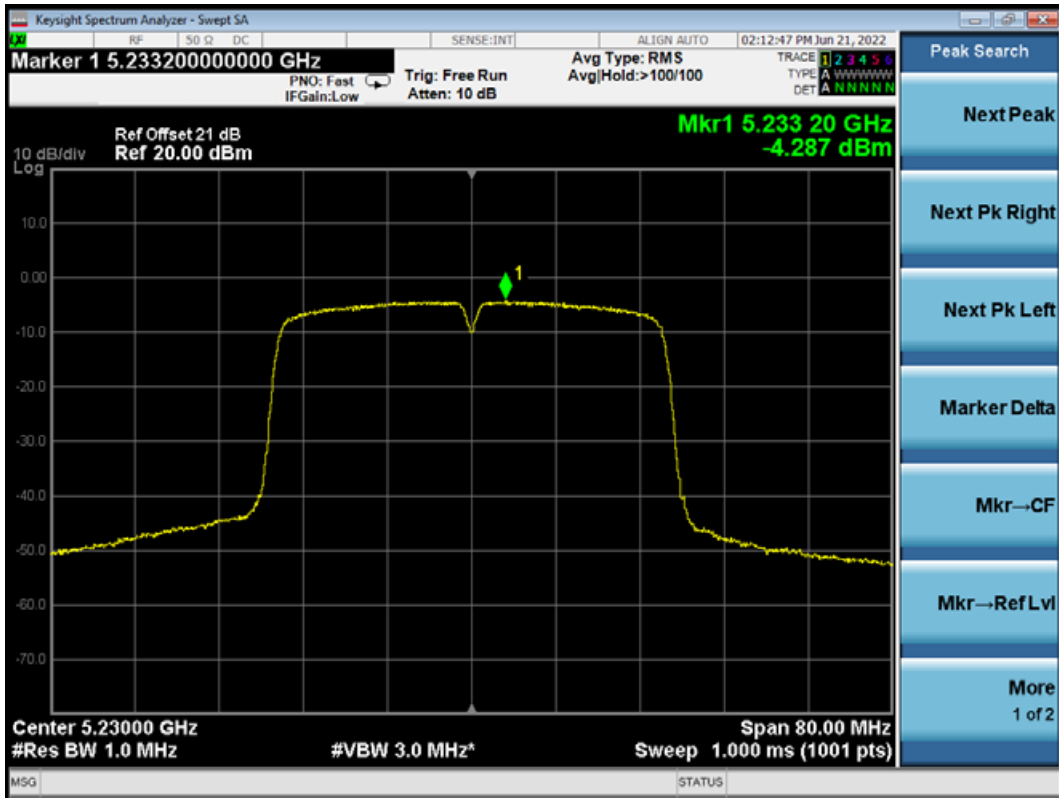




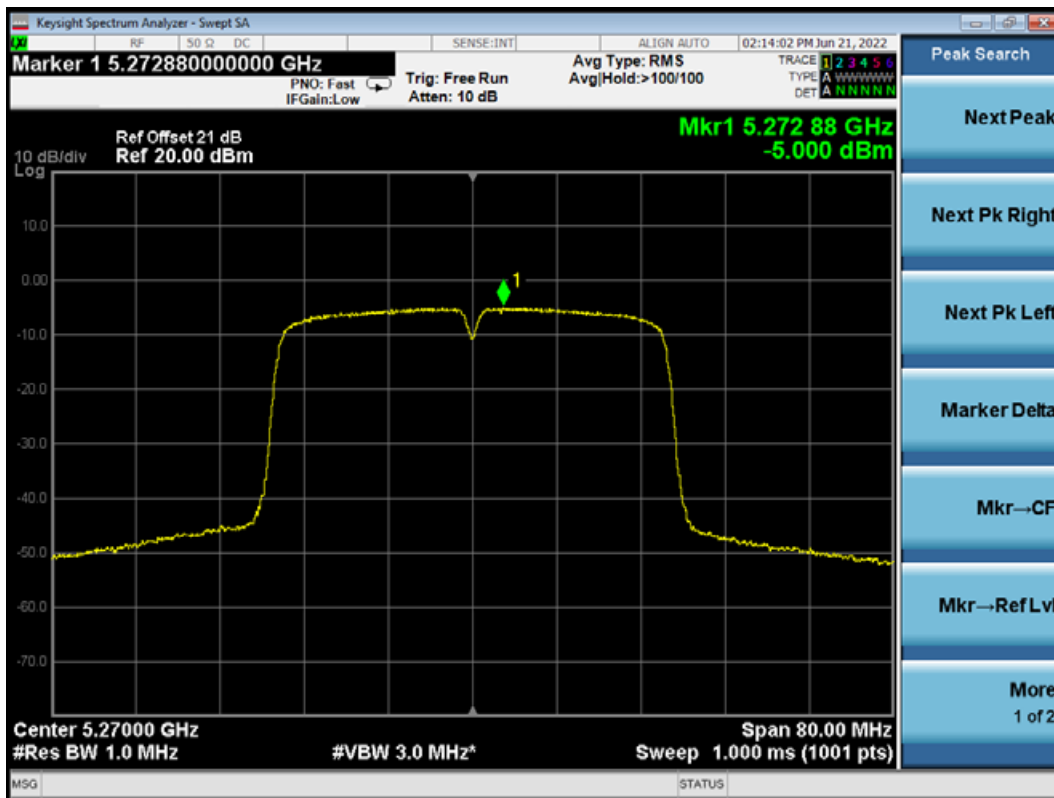
### 801.11n40 CH5190MHz



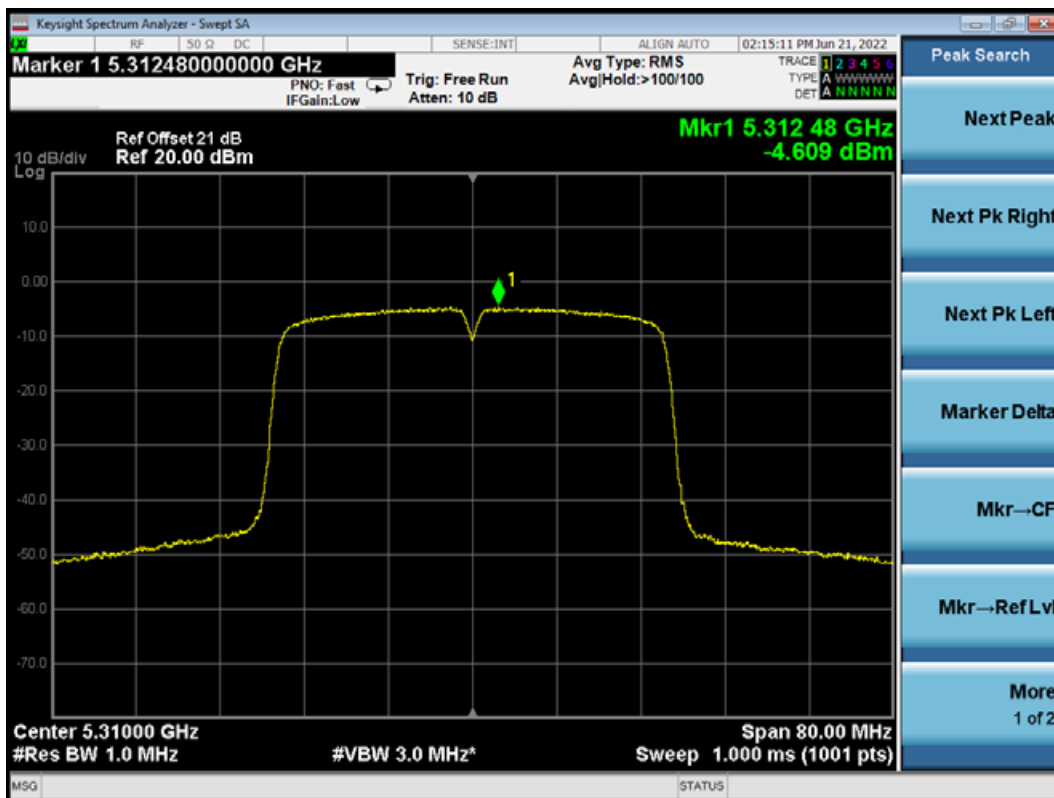
### 801.11n40 CH5230MHz



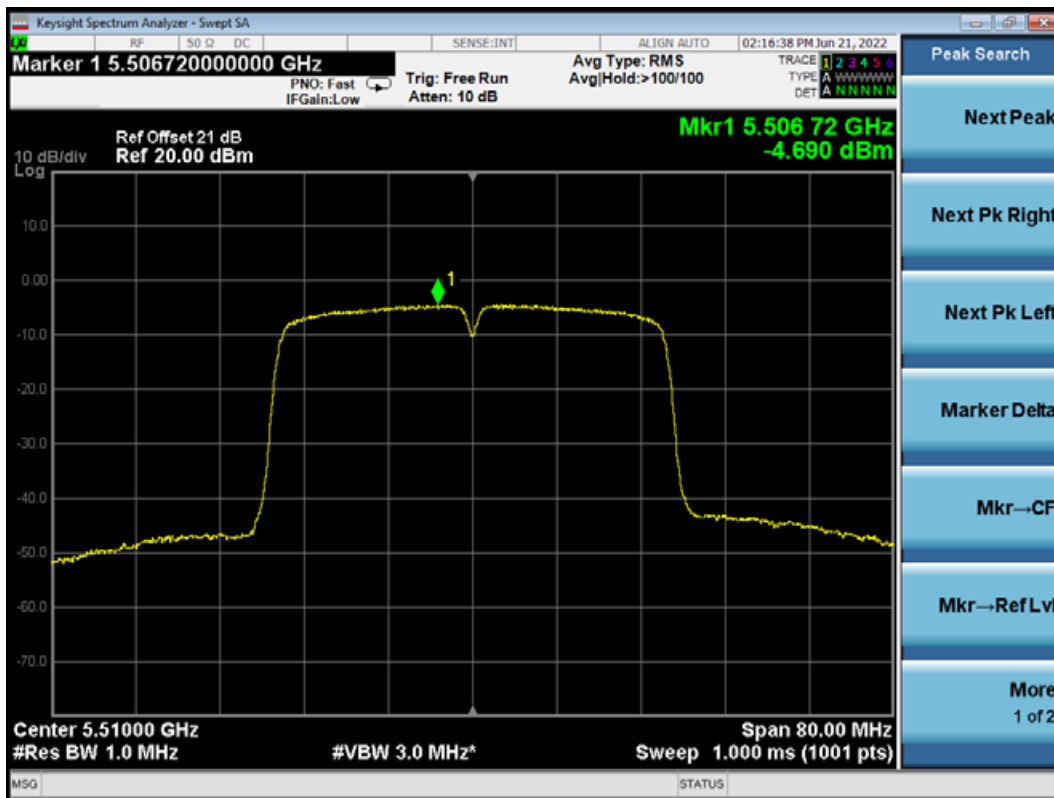
### 801.11n40 CH5270MHz



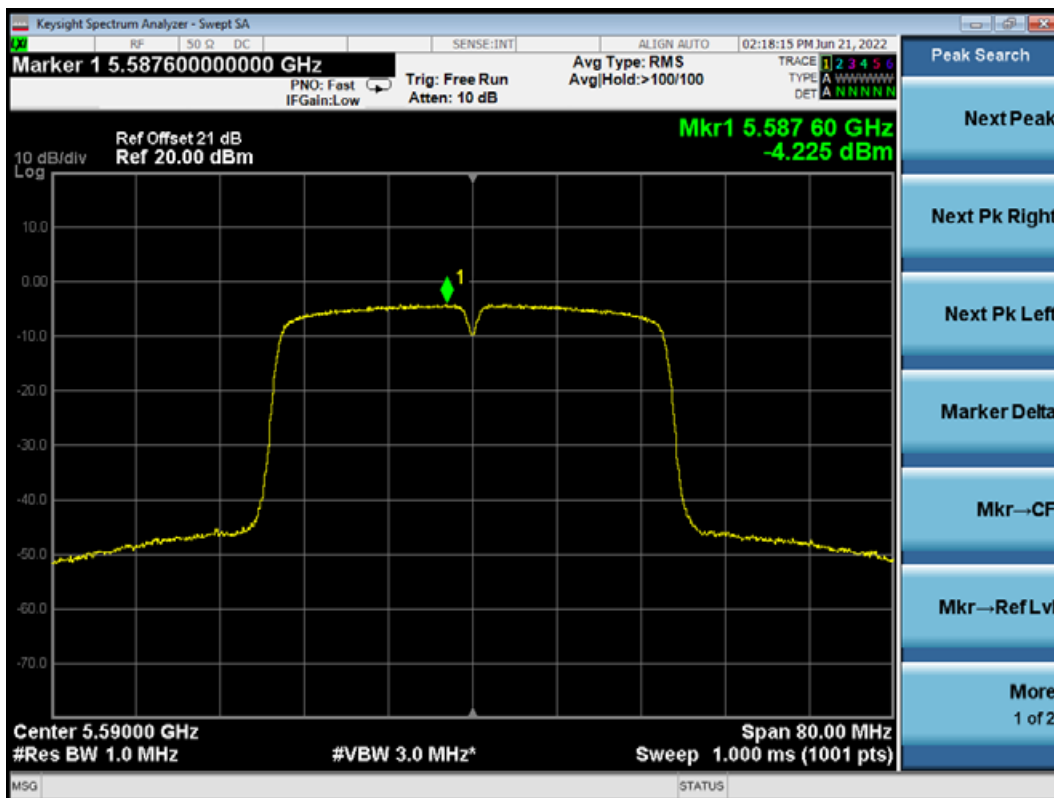
### 801.11n40 CH5310MHz



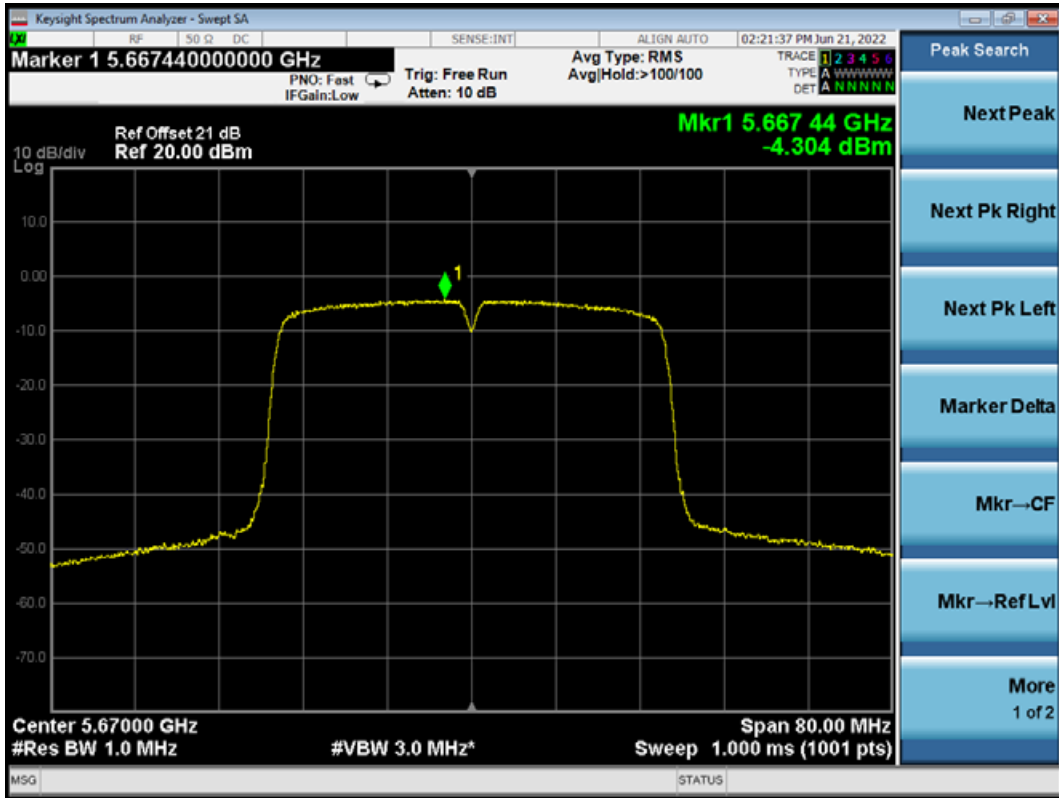
### 801.11n40 CH5510MHz



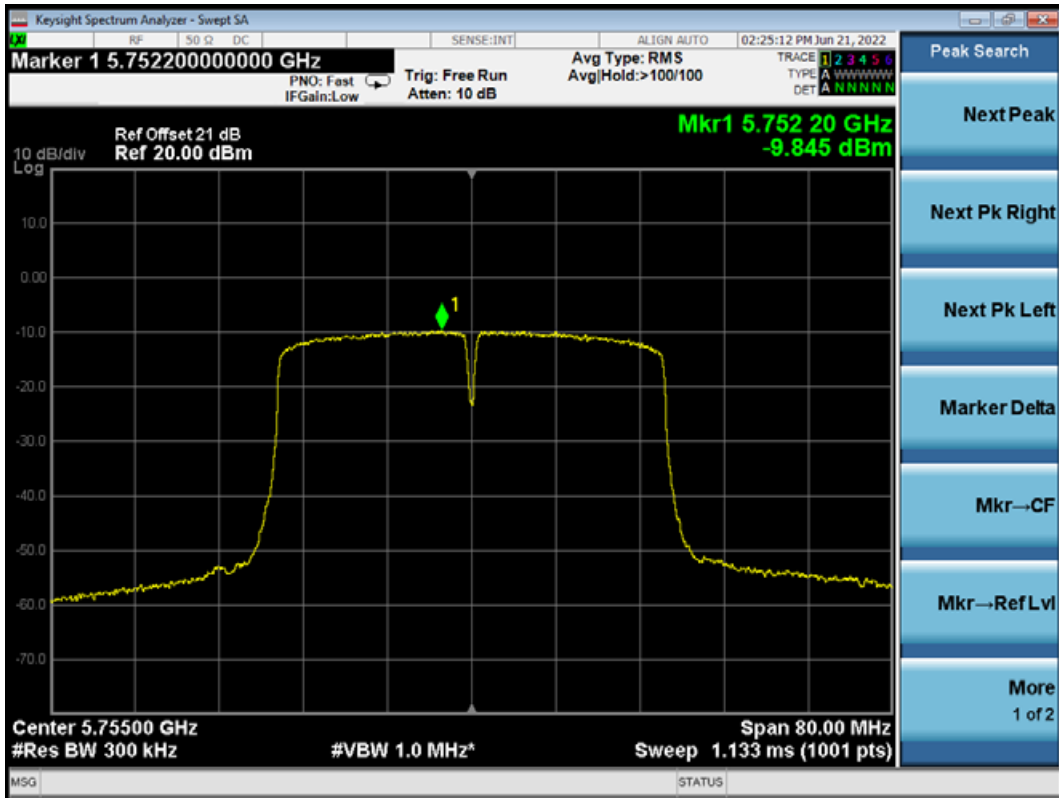
### 801.11n40 CH5590MHz



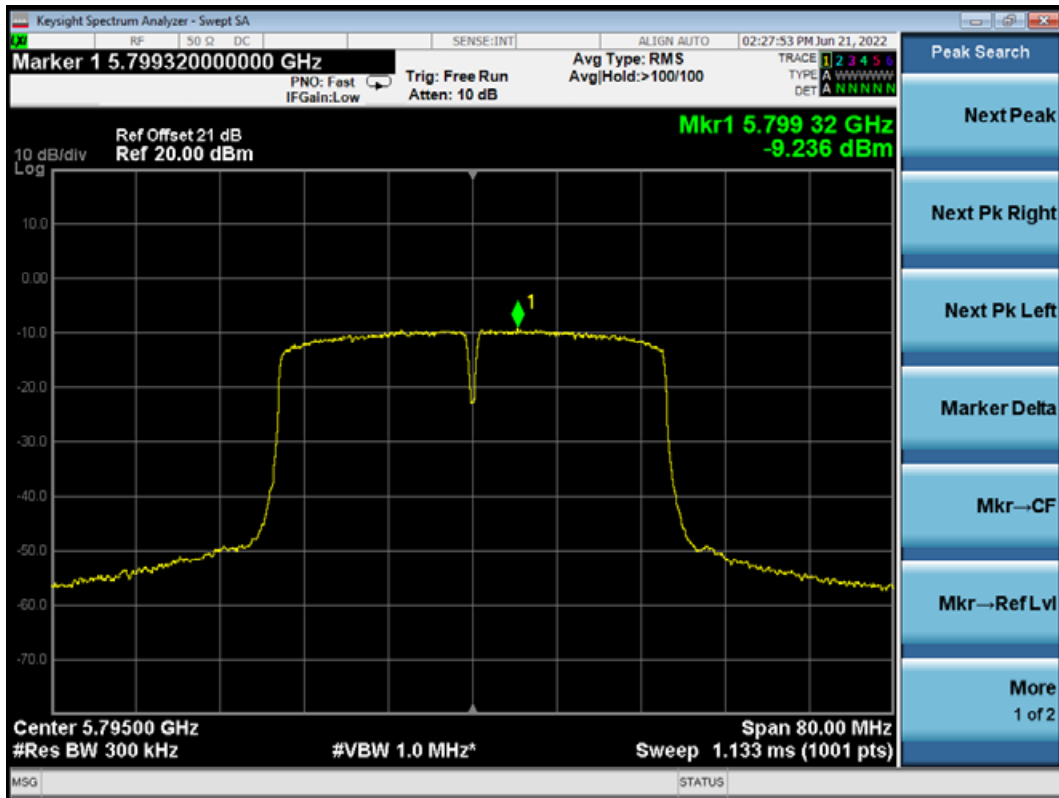
### 801.11n40 CH5670MHz



### 801.11n40 CH5755MHz



### 801.11n40 CH5795MHz



## 10 FREQUENCY STABILITY MEASUREMENT

### 10.1 Test Equipment

The following test equipment was used during the power spectral density measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
4.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.09.16	1 Year
5.	Coaxial Cable	WOKEN	SFL402-105F LEX	F02-150819- 045	2022.06.06	1 Year
6.	20 dB Attenuator	Mini-Circuits	VAT-20+	001	2021.08.06	1 Year

### 10.2 Block Diagram of Test Setup

The Same as section 6.2.

### 10.3 Specification Limits (§15.407(g))

Manufacturers 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 or  $\pm 20$ ppm.

### 10.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

### 10.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

- (i) Set RBW = 100 kHz
- (ii) Set VBW = 300 kHz.
- (iii) Detector = Positive Peak.
- (iv) Trace = Max Hold.
- (v) Use the peak search function of the spectrum analyzer to mark the max peak value.
- (vi) Use the Display line function to display the level of -10dBc of peak level.
- (vii) Marker and record the frequency of the lower and higher -10dBc level, as  $F_l$  and  $F_h$ .
- (viii) Calculate the  $f_c = (f_l + f_h) / 2$ . The frequency error is  $(f_c - f) / f \times 10^6$  ppm and must less than  $\pm 20$ ppm.
- (ix) All condition of normal operation as specified in the user's manual should be considered.

## 10.6 Test Results

**PASSED.**

All the test results are attached in next pages.

(Test Date: 2022.06.21 Temperature: 23°C Humidity: 51 %)

Test Voltage (V)	Temperature (°C)	Channel	Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
DC 3.3V	25	36	5180	5179.975	<b>-4.8</b>	±20
		40	5200	5199.975	<b>-4.8</b>	±20
		44	5220	5219.975	<b>-4.8</b>	±20
		48	5240	5239.975	<b>-4.8</b>	±20
		52	5260	5259.975	<b>-4.8</b>	±20
		56	5280	5279.975	<b>-4.7</b>	±20
		60	5300	5299.975	<b>-4.7</b>	±20
		64	5320	5319.975	<b>-4.7</b>	±20
		100	5500	5499.976	<b>-4.4</b>	±20
		104	5520	5519.976	<b>-4.3</b>	±20
		108	5540	5539.976	<b>-4.3</b>	±20
		112	5560	5559.976	<b>-4.3</b>	±20
		116	5580	5579.976	<b>-4.3</b>	±20
		120	5600	5599.976	<b>-4.3</b>	±20
		124	5620	5619.976	<b>-4.3</b>	±20
		128	5640	5639.976	<b>-4.3</b>	±20
		132	5660	5659.976	<b>-4.2</b>	±20
		136	5680	5679.976	<b>-4.2</b>	±20
		140	5700	5699.976	<b>-4.2</b>	±20
		149	5745	5744.976	<b>-4.2</b>	±20
153	5765	5764.976	<b>-4.2</b>	±20		
157	5785	5784.976	<b>-4.1</b>	±20		
161	5805	5804.976	<b>-4.1</b>	±20		
165	5825	5824.976	<b>-4.1</b>	±20		

Test Voltage (V)	Temperature (°C)	Channel	Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
DC 2.97V	25	36	5180	5179.971	<b>-5.6</b>	±20
		40	5200	5199.971	<b>-5.6</b>	±20
		44	5220	5219.971	<b>-5.6</b>	±20
		48	5240	5239.971	<b>-5.5</b>	±20
		52	5260	5259.971	<b>-5.5</b>	±20
		56	5280	5279.972	<b>-5.3</b>	±20
		60	5300	5299.972	<b>-5.3</b>	±20
		64	5320	5319.972	<b>-5.3</b>	±20
		100	5500	5499.972	<b>-5.1</b>	±20
		104	5520	5519.972	<b>-5.1</b>	±20
		108	5540	5539.972	<b>-5.1</b>	±20
		112	5560	5559.973	<b>-4.9</b>	±20
		116	5580	5579.973	<b>-4.8</b>	±20
		120	5600	5599.973	<b>-4.8</b>	±20
		124	5620	5619.973	<b>-4.8</b>	±20
		128	5640	5639.973	<b>-4.8</b>	±20
		132	5660	5659.973	<b>-4.8</b>	±20
		136	5680	5679.973	<b>-4.8</b>	±20
		140	5700	5699.973	<b>-4.7</b>	±20
		149	5745	5744.973	<b>-4.7</b>	±20
153	5765	5764.973	<b>-4.7</b>	±20		
157	5785	5784.973	<b>-4.7</b>	±20		
161	5805	5804.973	<b>-4.7</b>	±20		
165	5825	5824.973	<b>-4.6</b>	±20		



Test Voltage (V)	Temperature (°C)	Channel	Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
DC 3.63V	25	36	5180	5179.973	<b>-5.2</b>	±20
		40	5200	5199.973	<b>-5.2</b>	±20
		44	5220	5219.973	<b>-5.2</b>	±20
		48	5240	5239.973	<b>-5.2</b>	±20
		52	5260	5259.973	<b>-5.1</b>	±20
		56	5280	5279.973	<b>-5.1</b>	±20
		60	5300	5299.973	<b>-5.1</b>	±20
		64	5320	5319.973	<b>-5.1</b>	±20
		100	5500	5499.973	<b>-4.9</b>	±20
		104	5520	5519.973	<b>-4.9</b>	±20
		108	5540	5539.973	<b>-4.9</b>	±20
		112	5560	5559.974	<b>-4.7</b>	±20
		116	5580	5579.974	<b>-4.7</b>	±20
		120	5600	5599.974	<b>-4.6</b>	±20
		124	5620	5619.974	<b>-4.6</b>	±20
		128	5640	5639.974	<b>-4.6</b>	±20
		132	5660	5659.974	<b>-4.6</b>	±20
		136	5680	5679.974	<b>-4.6</b>	±20
		140	5700	5699.974	<b>-4.6</b>	±20
		149	5745	5744.974	<b>-4.5</b>	±20
153	5765	5764.974	<b>-4.5</b>	±20		
157	5785	5784.974	<b>-4.5</b>	±20		
161	5805	5804.974	<b>-4.5</b>	±20		
165	5825	5824.974	<b>-4.5</b>	±20		

Test Voltage (V)	Temperature (°C)	Channel	Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
DC 3.3V	0	36	5180	5179.977	<b>-4.4</b>	±20
		40	5200	5199.977	<b>-4.4</b>	±20
		44	5220	5219.978	<b>-4.2</b>	±20
		48	5240	5239.978	<b>-4.2</b>	±20
		52	5260	5259.978	<b>-4.2</b>	±20
		56	5280	5279.978	<b>-4.2</b>	±20
		60	5300	5299.978	<b>-4.2</b>	±20
		64	5320	5319.978	<b>-4.1</b>	±20
		100	5500	5499.978	<b>-4</b>	±20
		104	5520	5519.978	<b>-4</b>	±20
		108	5540	5539.978	<b>-4</b>	±20
		112	5560	5559.978	<b>-4</b>	±20
		116	5580	5579.979	<b>-3.8</b>	±20
		120	5600	5599.979	<b>-3.7</b>	±20
		124	5620	5619.979	<b>-3.7</b>	±20
		128	5640	5639.979	<b>-3.7</b>	±20
		132	5660	5659.979	<b>-3.7</b>	±20
		136	5680	5679.979	<b>-3.7</b>	±20
		140	5700	5699.979	<b>-3.7</b>	±20
		149	5745	5744.979	<b>-3.7</b>	±20
153	5765	5764.979	<b>-3.6</b>	±20		
157	5785	5784.980	<b>-3.5</b>	±20		
161	5805	5804.980	<b>-3.4</b>	±20		
165	5825	5824.980	<b>-3.4</b>	±20		

Test Voltage (V)	Temperature (°C)	Channel	Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
DC 3.3V	50	36	5180	5179.972	-5.4	±20
		40	5200	5199.972	-5.4	±20
		44	5220	5219.972	-5.4	±20
		48	5240	5239.972	-5.3	±20
		52	5260	5259.972	-5.3	±20
		56	5280	5279.972	-5.3	±20
		60	5300	5299.973	-5.1	±20
		64	5320	5319.973	-5.1	±20
		100	5500	5499.973	-4.9	±20
		104	5520	5519.973	-4.9	±20
		108	5540	5539.973	-4.9	±20
		112	5560	5559.973	-4.9	±20
		116	5580	5579.973	-4.8	±20
		120	5600	5599.973	-4.8	±20
		124	5620	5619.973	-4.8	±20
		128	5640	5639.973	-4.8	±20
		132	5660	5659.973	-4.8	±20
		136	5680	5679.973	-4.8	±20
		140	5700	5699.974	-4.6	±20
		149	5745	5744.974	-4.5	±20
153	5765	5764.974	-4.5	±20		
157	5785	5784.974	-4.5	±20		
161	5805	5804.974	-4.5	±20		
165	5825	5824.974	-4.5	±20		

## **11 DEVIATION TO TEST SPECIFICATIONS**

None.

## 12 MEASUREMENT UNCERTAINTY LIST

The measurement uncertainty was estimated for test on the EUT according to CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage of K=2.

The uncertainties value is not used in determining the PASS/FAIL results.

Test Items/Facilities	Frequency/Equipment/Unit	Uncertainty
Conducted Emission No.1 Shielded Room	9kHz~150kHz	±3.1 dB
	150kHz~30MHz	±2.6 dB
Conducted Emission No.3 Shielded Room	9kHz~150kHz	±3.1 dB
	150kHz~30MHz	±2.6 dB
Radiated Emission	30MHz~200MHz, Horizontal	±3.8 dB
	30MHz~200MHz, Vertical	±4.1 dB
	200MHz~1000MHz, Horizontal	±3.6 dB
	200MHz~1000MHz, Vertical	±5.1 dB
	1GHz~6GHz	±5.3 dB
	6GHz~18GHz	±5.3 dB
	18GHz~40GHz	±3.5 dB
Output Power Test	50MHz~18GHz	0.77 dB
Power Density Test	9kHz~6GHz	1.08 dB
RF Frequency Test	9kHz~40GHz	$6 \times 10^{-4}$
Bandwidth Test	9kHz~6GHz	$1.5 \times 10^{-3}$
RF Radiated Power Test	30MHz~1000MHz	3.06 dB
Conducted Output Power Test	50MHz~18GHz	0.83 dB
AC Voltage(<10kHz) Test	120V~230V	0.04 %
DC Power Test	0V~30V	0.4 %
Temperature	-40°C~+100°C	0.52 °C
Humidity	30%~95%	2.6 %