

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China

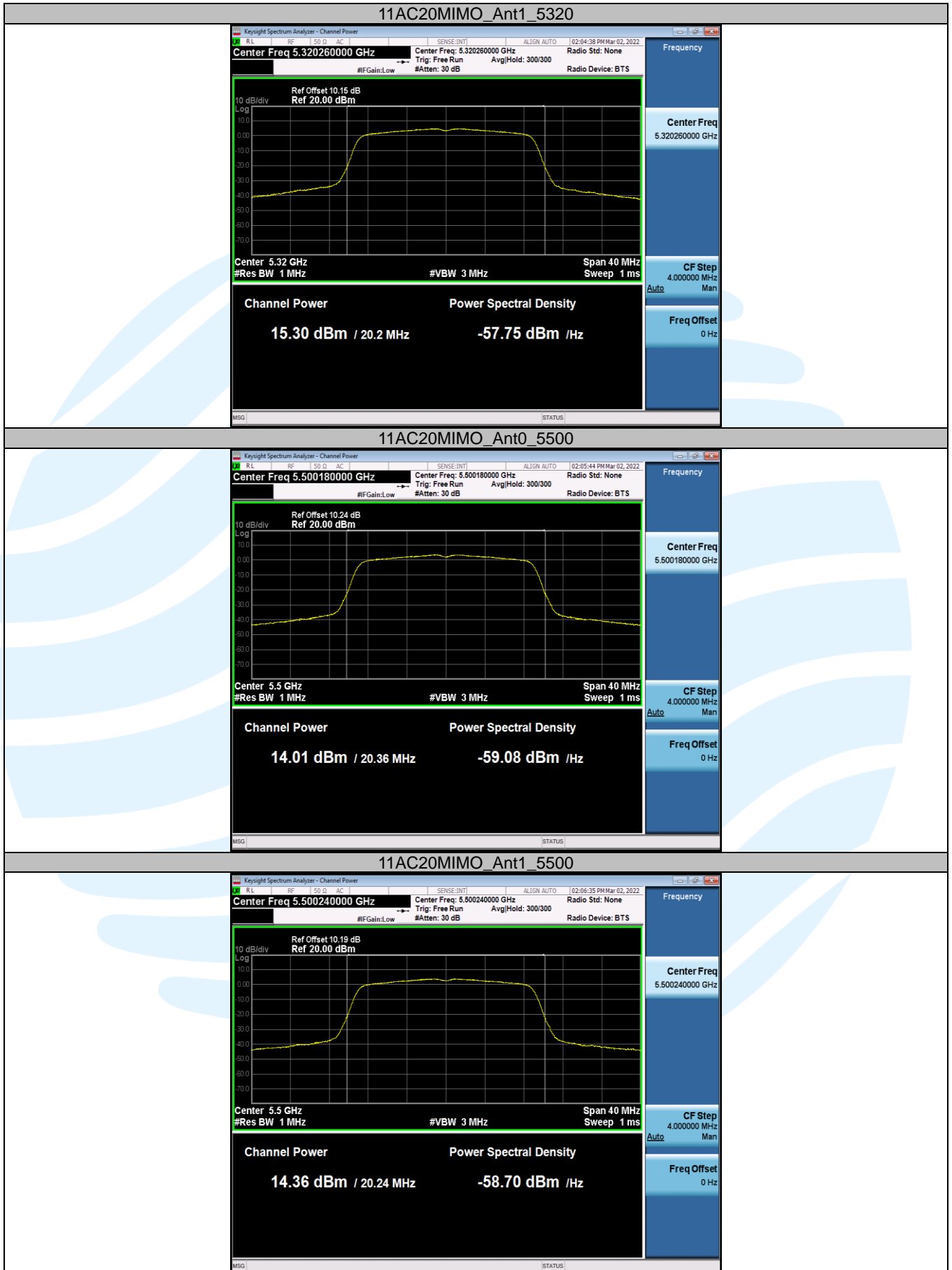
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UTTR-RF-RSS247-V1.1



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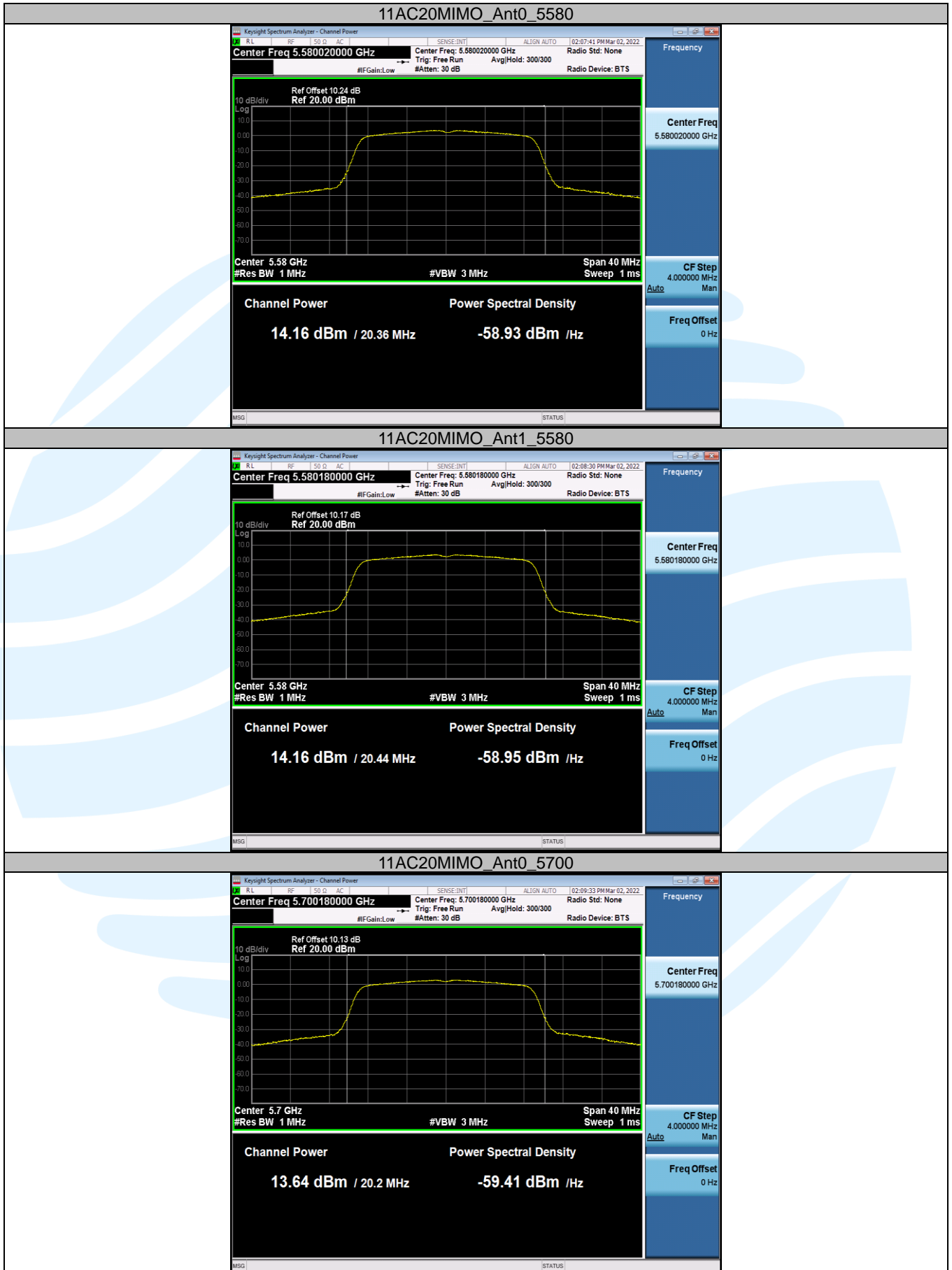
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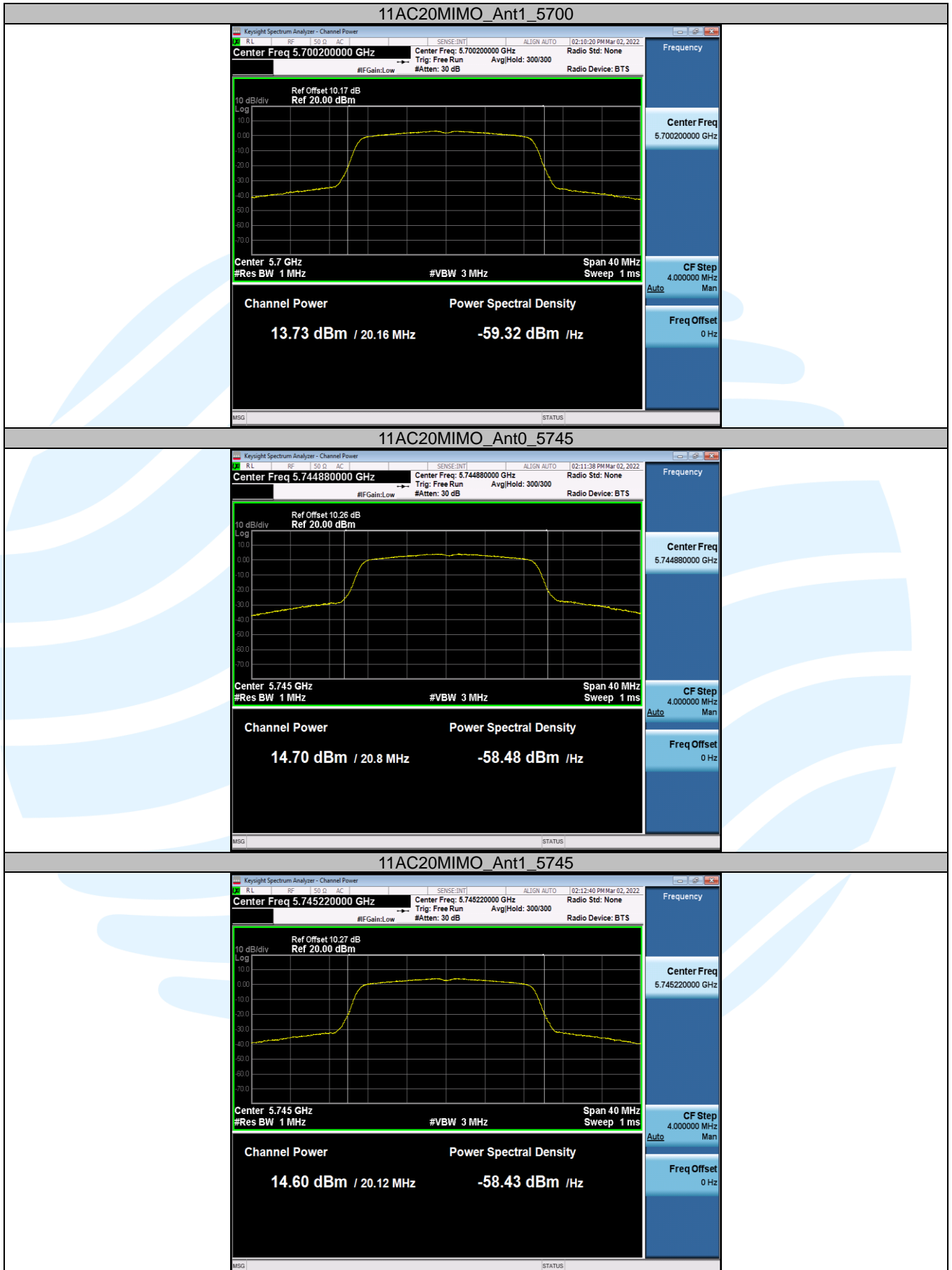
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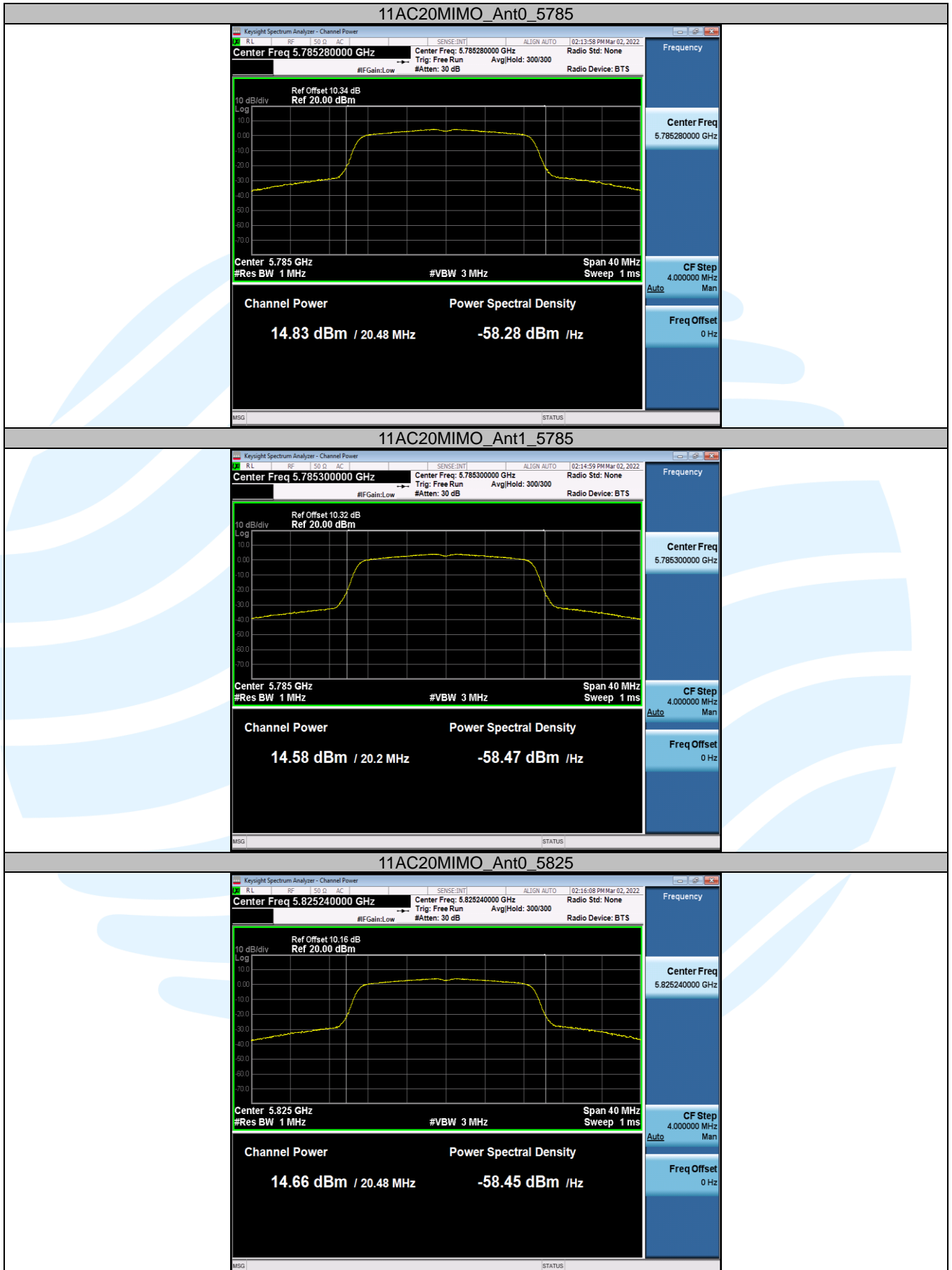
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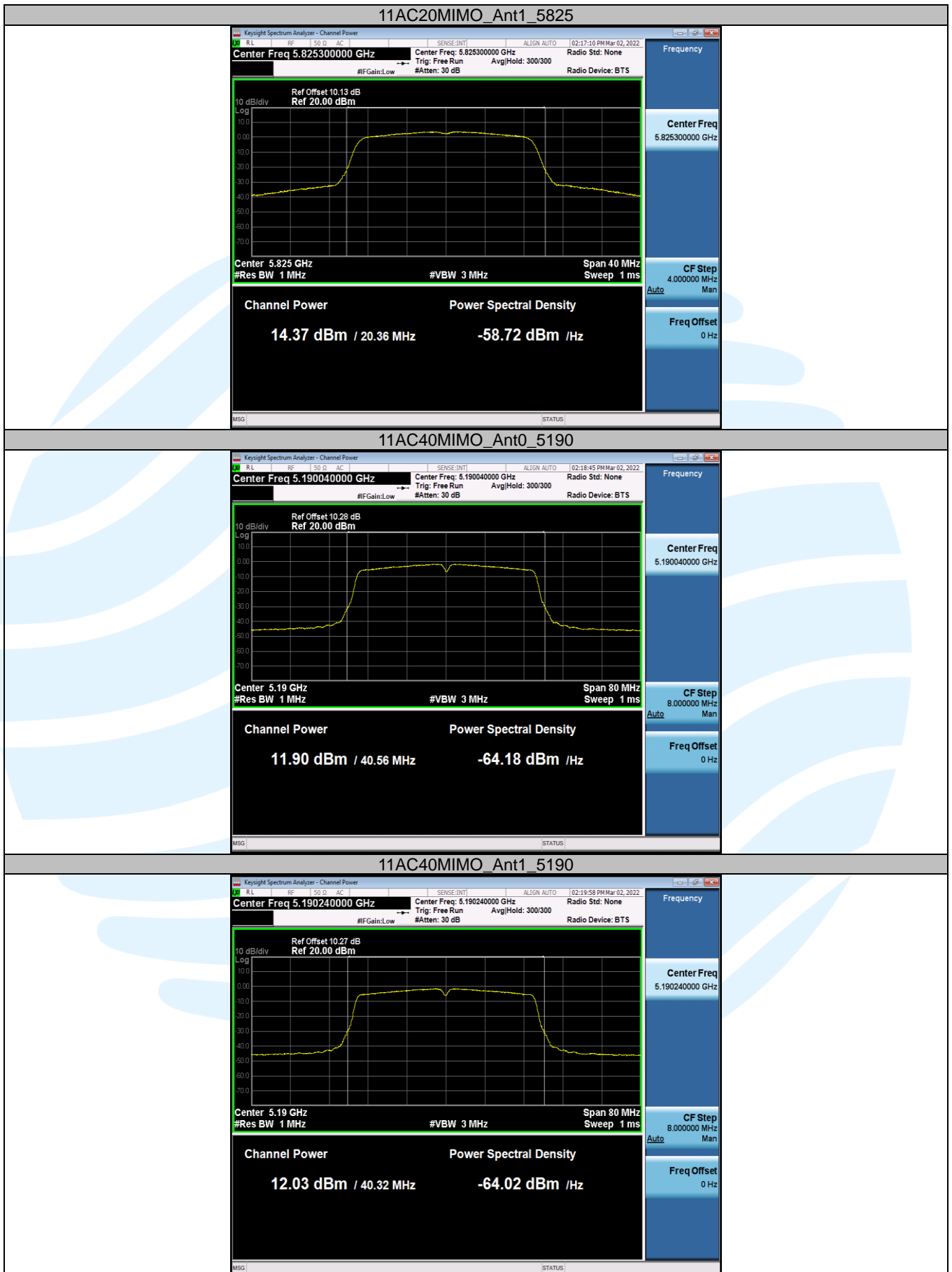
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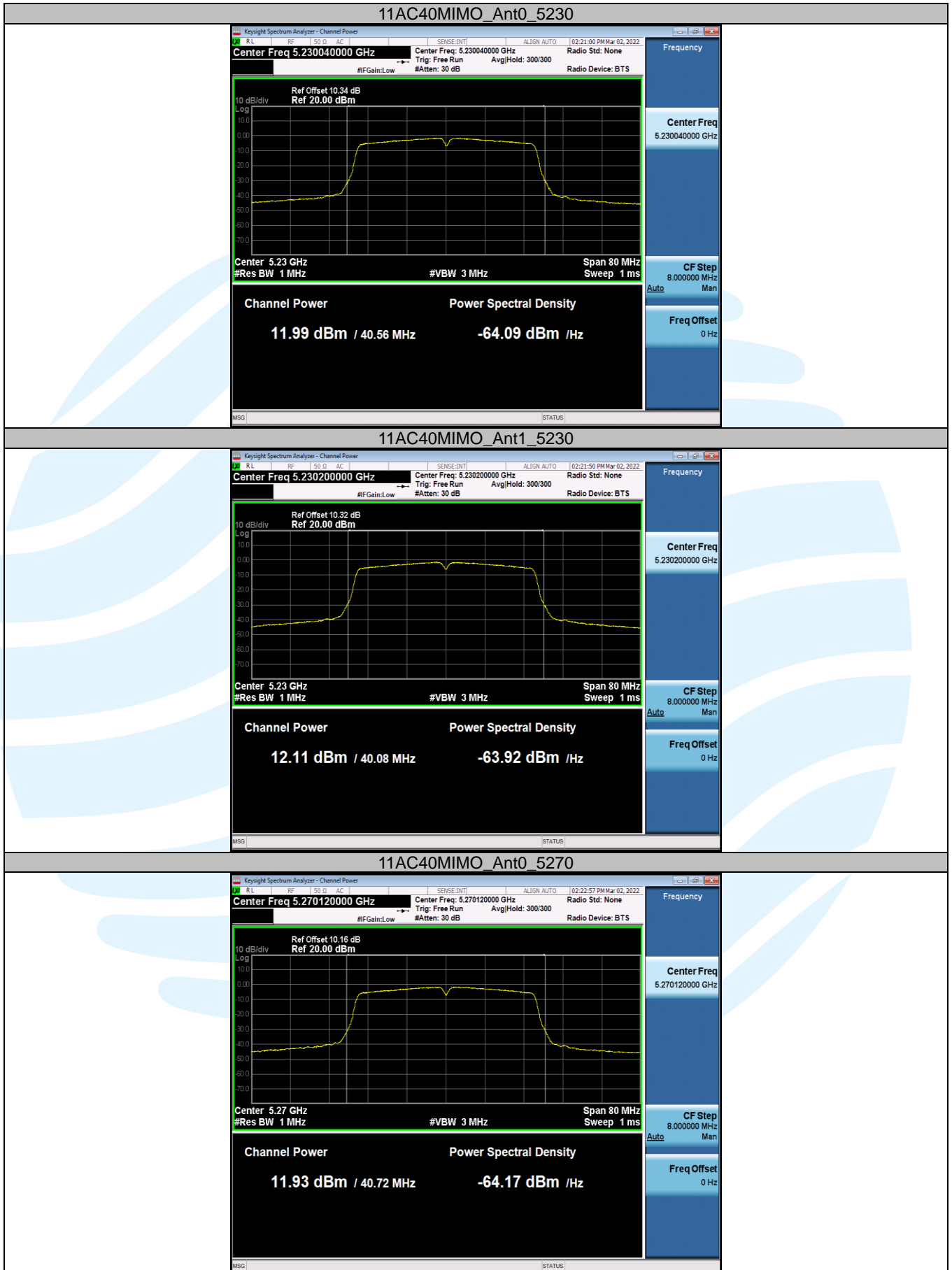
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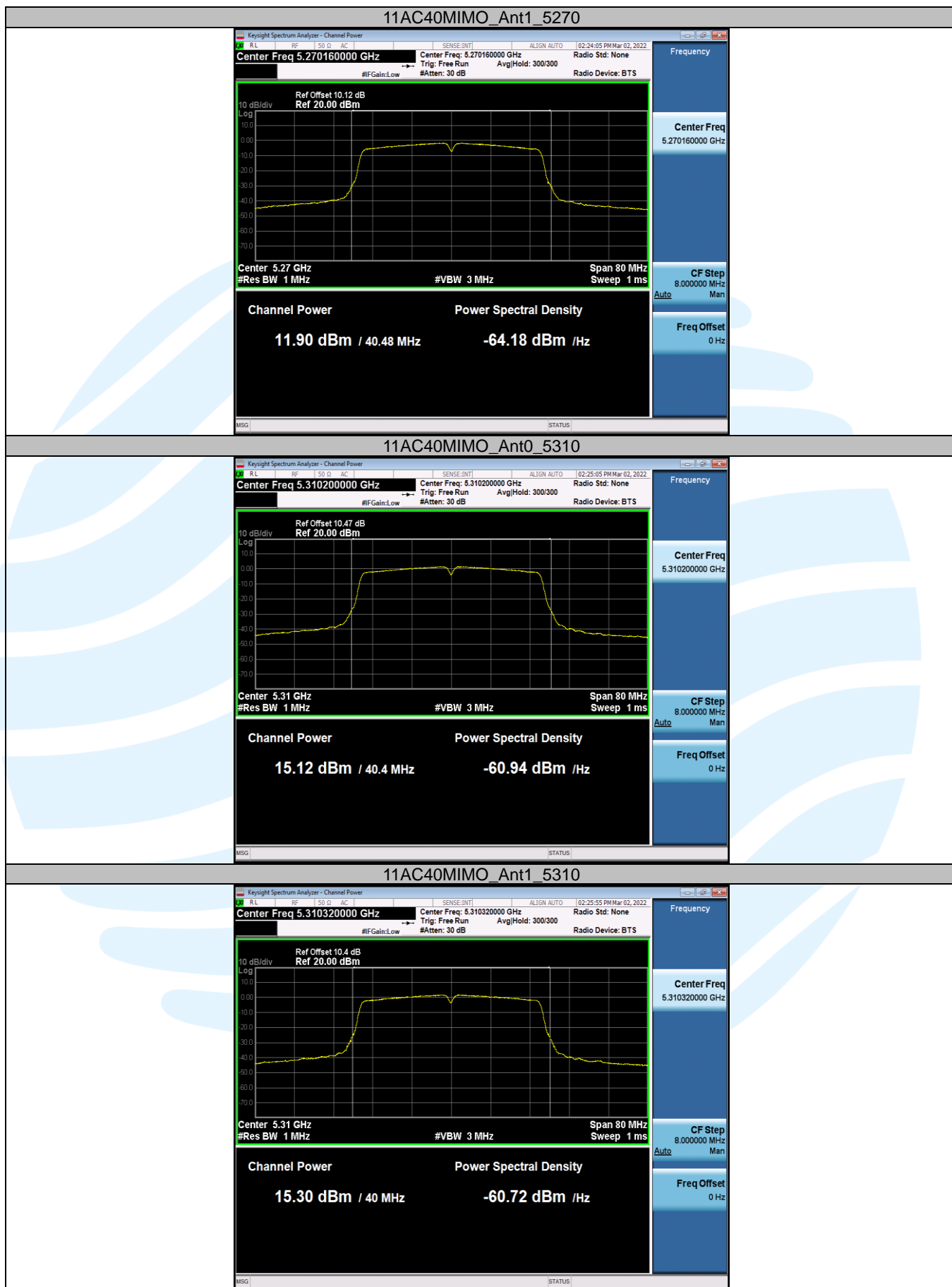
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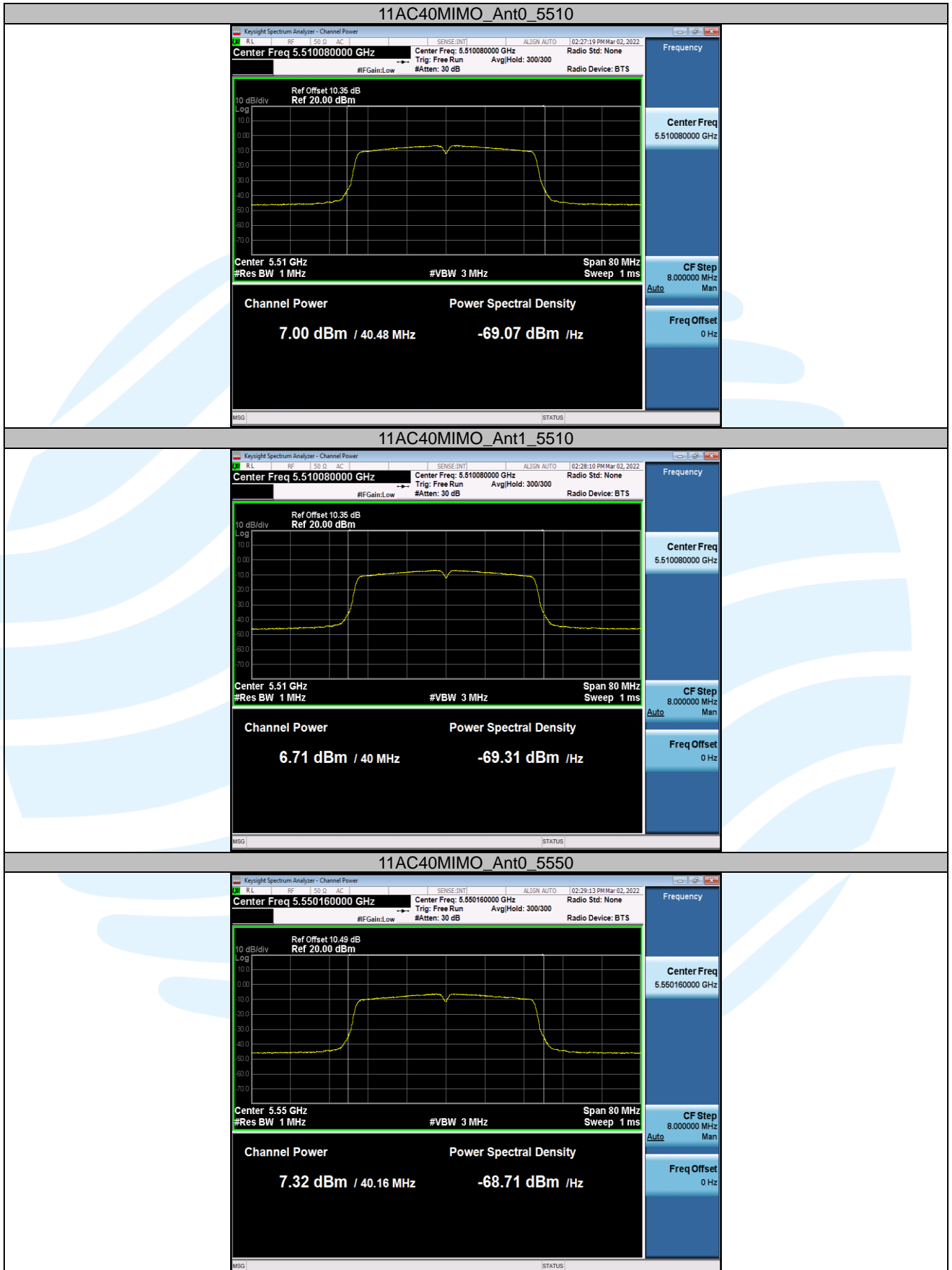
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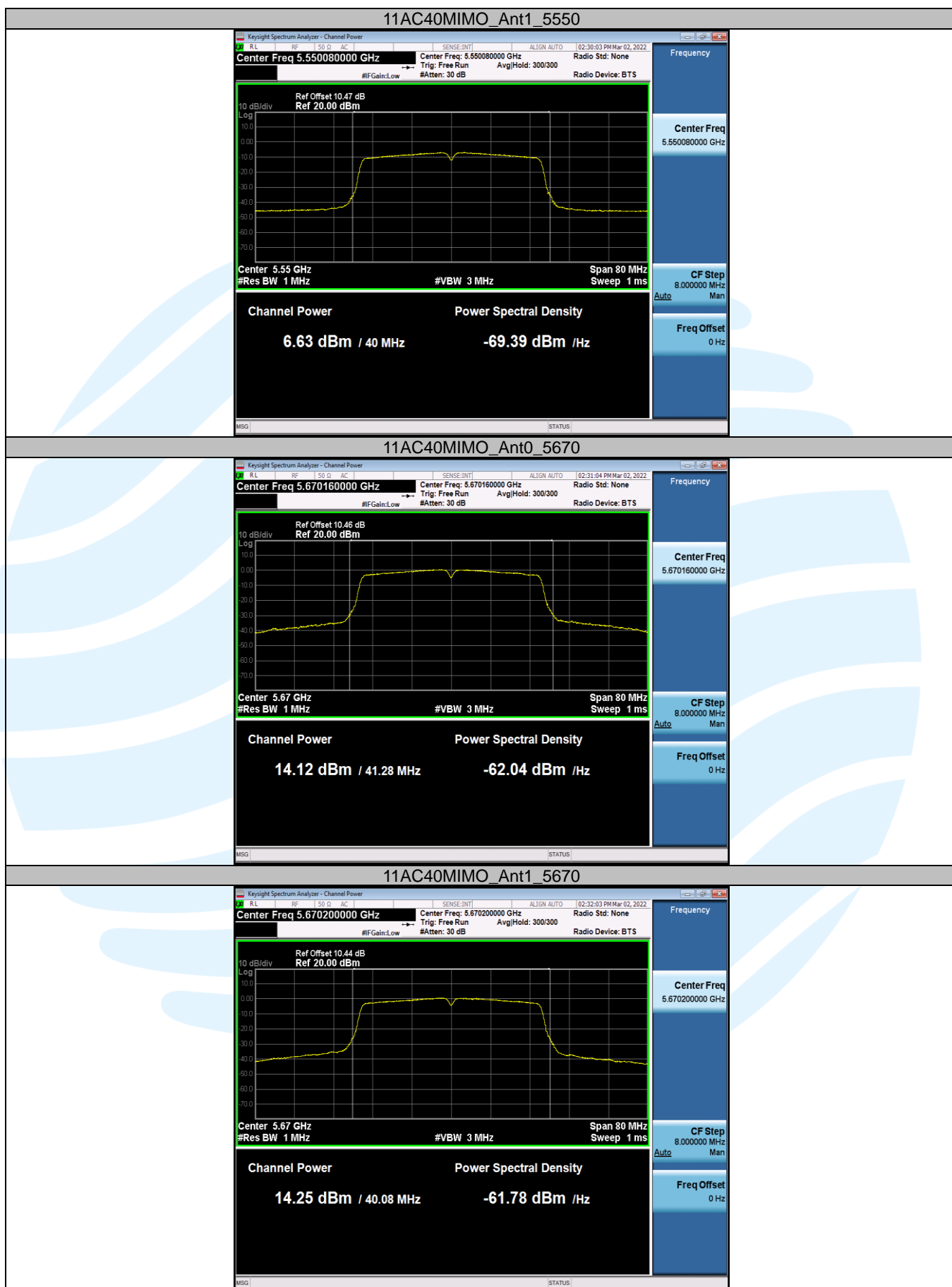
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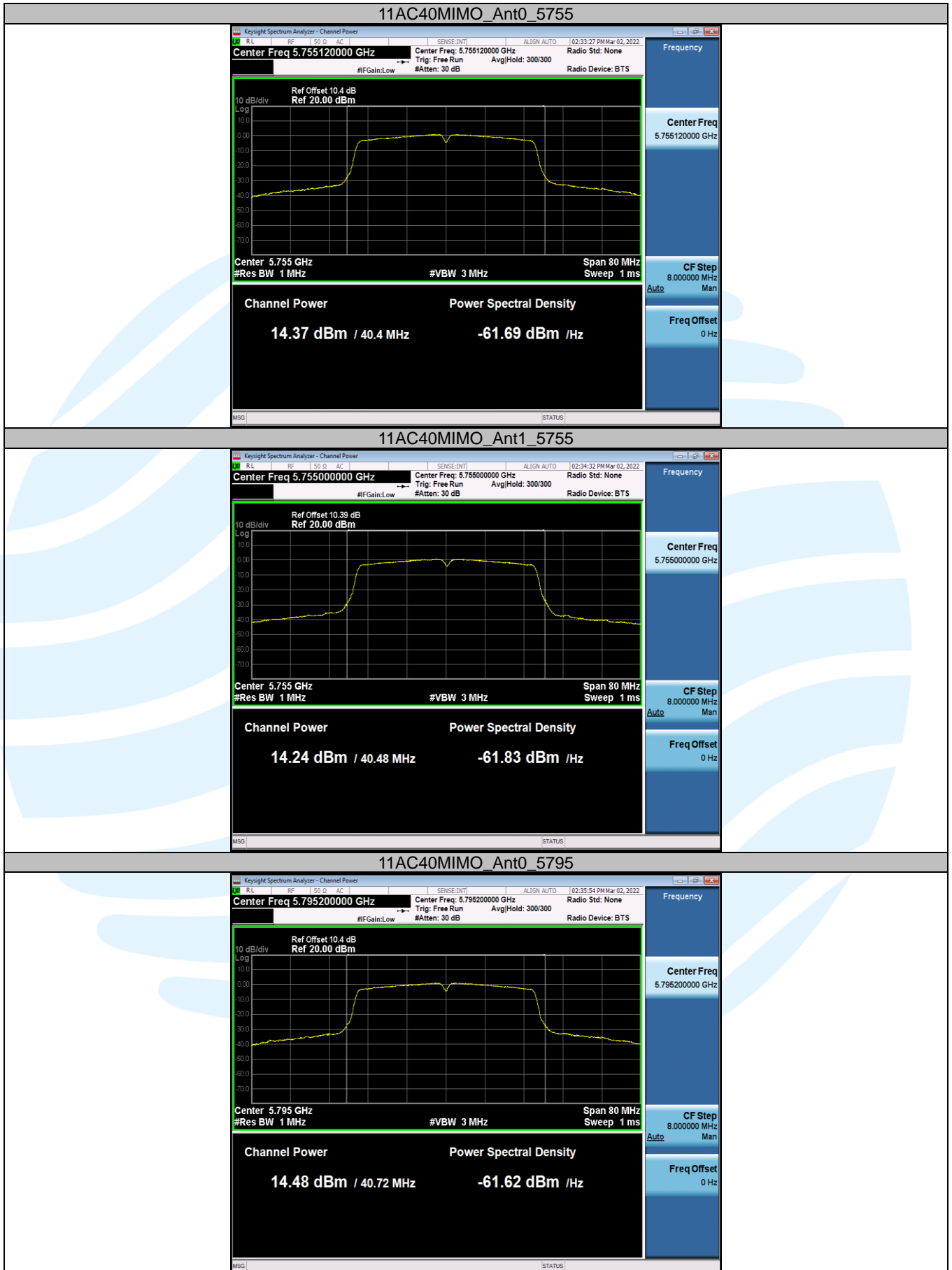
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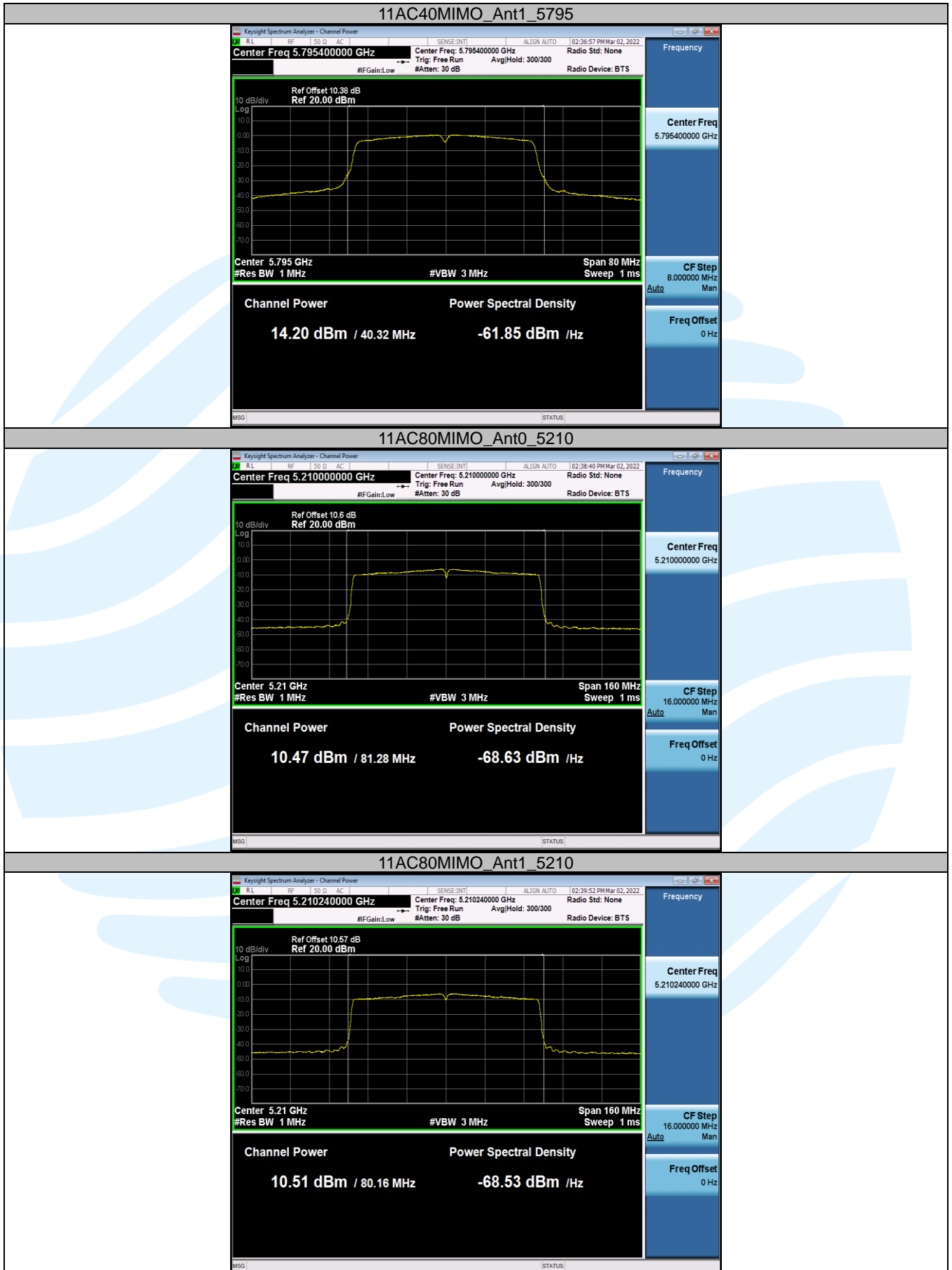
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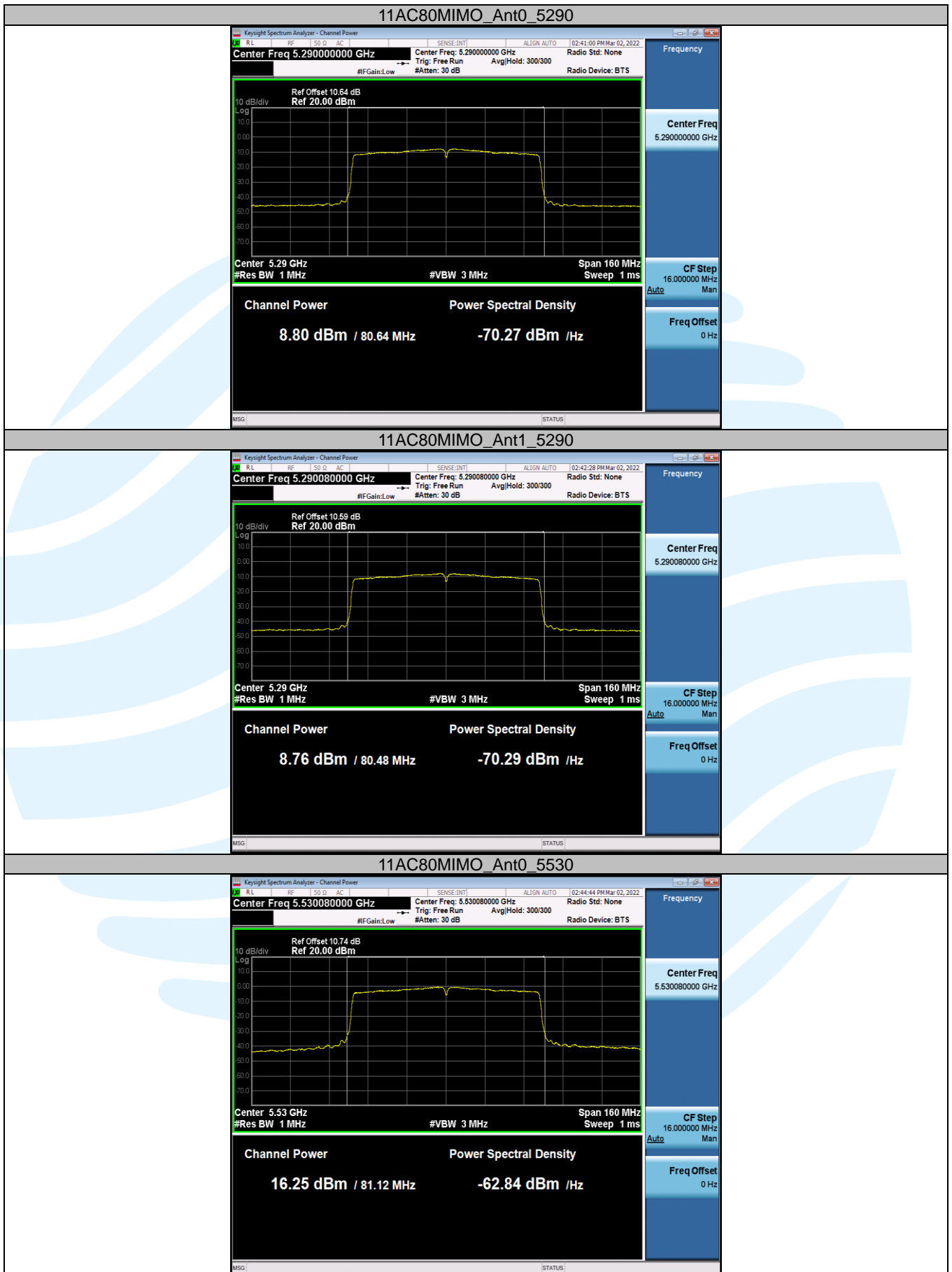
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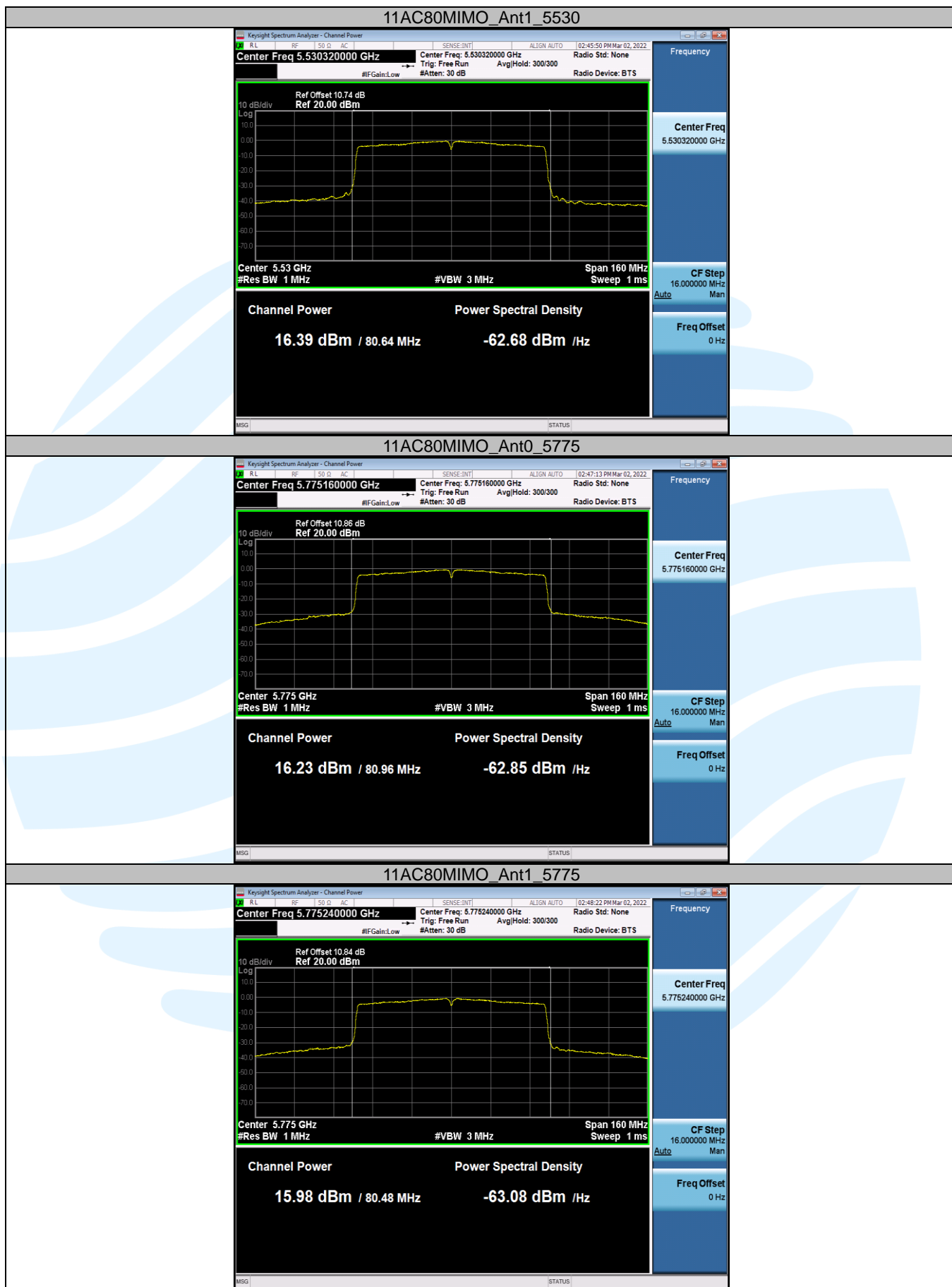
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5.6 POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section F

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Limits: RSS-247 Issue 2

1. Frequency band 5150-5250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

2. Frequency band 5250-5350 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10 \log_{10} B$, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

- a) The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;
- b) The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Additional requirements

In addition to the above requirements, devices shall comply with the following, where applicable:

- a) Outdoor fixed devices with a maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. at different elevations, where θ is the angle above the local horizontal plane (of the Earth) as shown below:
 - i. -13 dBW/MHz for $0^\circ \leq \theta < 8^\circ$
 - ii. $-13 - 0.716 (\theta - 8)$ dBW/MHz for $8^\circ \leq \theta < 40^\circ$
 - iii. $-35.9 - 1.22 (\theta - 40)$ dBW/MHz for $40^\circ \leq \theta \leq 45^\circ$
 - iv. -42 dBW/MHz for $\theta > 45^\circ$

The measurement procedure defined in Annex A of this document shall be used to verify the compliance to the e.i.r.p. at different elevations.

- b) Devices, other than outdoor fixed devices, having an e.i.r.p. greater than 200 mW shall comply with either i. or ii. below:
 - iii. devices shall comply with the e.i.r.p. elevation mask in 6.2.2.3(a); or
 - iv. devices shall implement a method to permanently reduce their e.i.r.p. via a firmware feature in the event that the Department requires it. The test report must demonstrate how the device's power table can be updated to meet this firmware requirement. The manufacturer shall provide this firmware to update all systems automatically in compliance with the directions received from the Department.

3. Frequency bands 5470-5600 MHz and 5650-5725 MHz

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

4. Frequency band 5725-5850 MHz

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of

point-to-multipoint³ systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

1. For U-NII-1, U-NII-2A, U-NII-2C band:

Using method SA-2

- a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
- b) Set RBW = 1 MHz, Set VBW \geq 3 RBW, Detector = RMS
- c) Sweep time = auto, trigger set to "free run".
- d) Trace average at least 100 traces in power averaging mode.
- e) Record the max value and add 10 log (1/duty cycle)

2. For U-NII-3 band:

- a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
- b) Set RBW = 500 kHz, Set VBW \geq 3 RBW, Detector = RMS
- c) Use the peak marker function to determine the maximum power level in any 500 kHz band segment within the fundamental EBW.
- d) Sweep time = auto, trigger set to "free run".
- e) Trace average at least 100 traces in power averaging mode.
- f) Record the max value and add 10 log (1/duty cycle)

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

For U-NII-1, U-NII-2A, U-NII-2C band

Test Mode	Antenna	Channel	Result	FCC Part 15E	RSS-247			Verdict
				Limit	Limit	EIRP	EIRP Limit	
			[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	
IEEE 802.11a	Ant0	5180	5.56	11	---	6.06	10	PASS
	Ant1	5180	5.57	11	---	6.02	10	PASS
	Ant0	5220	5.46	11	---	5.96	10	PASS
	Ant1	5220	5.15	11	---	5.60	10	PASS
	Ant0	5240	5.77	11	---	6.27	10	PASS
	Ant1	5240	5.37	11	---	5.82	10	PASS
	Ant0	5260	6.29	11	11	---	---	PASS
	Ant1	5260	5.42	11	11	---	---	PASS
	Ant0	5300	5.36	11	11	---	---	PASS
	Ant1	5300	5.42	11	11	---	---	PASS
	Ant0	5320	5.37	11	11	---	---	PASS
	Ant1	5320	5.26	11	11	---	---	PASS
	Ant0	5500	5.68	11	11	---	---	PASS
	Ant1	5500	5.65	11	11	---	---	PASS
	Ant0	5580	5.58	11	11	---	---	PASS
	Ant1	5580	5.39	11	11	---	---	PASS
	Ant0	5700	5.22	11	11	---	---	PASS
	Ant1	5700	4.98	11	11	---	---	PASS

Note : 1. The Duty Cycle Factor and RBW Factor is compensated in the graph.

2. The maximum ERP/EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

Test Mode	Antenna	Channel	Result	FCC Part 15E	RSS-247			Verdict
				Limit	Limit	EIRP	EIRP Limit	
			[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	
IEEE 802.11n20 MIMO	Ant0	5180	4.61	11	---	5.11	10	PASS
	Ant1	5180	4.97	11	---	5.42	10	PASS
	total	5180	7.80	11	---	8.30	10	PASS
	Ant0	5220	4.39	11	---	4.89	10	PASS
	Ant1	5220	4.71	11	---	5.16	10	PASS
	total	5220	7.56	11	---	8.06	10	PASS
	Ant0	5240	4.99	11	---	5.49	10	PASS
	Ant1	5240	4.85	11	---	5.30	10	PASS
	total	5240	7.93	11	---	8.43	10	PASS
	Ant0	5260	4.66	11	11	---	---	PASS
	Ant1	5260	4.95	11	11	---	---	PASS
	total	5260	7.82	11	11	---	---	PASS
	Ant0	5300	4.92	11	11	---	---	PASS
	Ant1	5300	4.76	11	11	---	---	PASS
	total	5300	7.85	11	11	---	---	PASS
	Ant0	5320	4.78	11	11	---	---	PASS
	Ant1	5320	4.91	11	11	---	---	PASS
	total	5320	7.86	11	11	---	---	PASS
	Ant0	5500	4.02	11	11	---	---	PASS
	Ant1	5500	4.04	11	11	---	---	PASS
	total	5500	7.04	11	11	---	---	PASS
	Ant0	5580	3.87	11	11	---	---	PASS
	Ant1	5580	3.95	11	11	---	---	PASS
	total	5580	6.92	11	11	---	---	PASS
	Ant0	5700	3.30	11	11	---	---	PASS
	Ant1	5700	3.68	11	11	---	---	PASS
	total	5700	6.50	11	11	---	---	PASS

Note : 1. The Duty Cycle Factor and RBW Factor is compensated in the graph.

2. The maximum ERP/EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

Test Mode	Antenna	Channel	Result	FCC Part 15E	RSS-247			Verdict
				Limit	Limit	EIRP	EIRP Limit	
			[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	
IEEE 802.11n40 MIMO	Ant0	5190	-1.43	11	---	-0.93	10	PASS
	Ant1	5190	-1.16	11	---	-0.71	10	PASS
	total	5190	1.72	11	---	2.22	10	PASS
	Ant0	5230	-1.43	11	---	-0.93	10	PASS
	Ant1	5230	-1.27	11	---	-0.82	10	PASS
	total	5230	1.66	11	---	2.16	10	PASS
	Ant0	5270	-1.35	11	11	---	---	PASS
	Ant1	5270	-1.2	11	11	---	---	PASS
	total	5270	1.74	11	11	---	---	PASS
	Ant0	5310	1.91	11	11	---	---	PASS
	Ant1	5310	1.83	11	11	---	---	PASS
	total	5310	4.88	11	11	---	---	PASS
	Ant0	5510	-6.35	11	11	---	---	PASS
	Ant1	5510	-6.70	11	11	---	---	PASS
	total	5510	-3.51	11	11	---	---	PASS
	Ant0	5550	-6.01	11	11	---	---	PASS
	Ant1	5550	-6.77	11	11	---	---	PASS
	total	5550	-3.36	11	11	---	---	PASS
	Ant0	5670	0.94	11	11	---	---	PASS
	Ant1	5670	0.76	11	11	---	---	PASS
	total	5670	3.86	11	11	---	---	PASS

Note : 1. The Duty Cycle Factor and RBW Factor is compensated in the graph.

2. The maximum ERP/EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

Test Mode	Antenna	Channel	Result	FCC Part 15E	RSS-247			Verdict
				Limit	Limit	EIRP	EIRP Limit	
			[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	
IEEE 802.11ac20 MIMO	Ant0	5180	4.48	11	---	4.98	10	PASS
	Ant1	5180	4.99	11	---	5.44	10	PASS
	total	5180	7.75	11	---	8.25	10	PASS
	Ant0	5220	4.56	11	---	5.06	10	PASS
	Ant1	5220	5.10	11	---	5.55	10	PASS
	total	5220	7.85	11	---	8.35	10	PASS
	Ant0	5240	4.86	11	---	5.36	10	PASS
	Ant1	5240	4.83	11	---	5.28	10	PASS
	total	5240	7.86	11	---	8.36	10	PASS
	Ant0	5260	4.72	11	11	---	---	PASS
	Ant1	5260	4.79	11	11	---	---	PASS
	total	5260	7.77	11	11	---	---	PASS
	Ant0	5300	4.82	11	11	---	---	PASS
	Ant1	5300	4.91	11	11	---	---	PASS
	total	5300	7.88	11	11	---	---	PASS
	Ant0	5320	4.69	11	11	---	---	PASS
	Ant1	5320	5.01	11	11	---	---	PASS
	total	5320	7.86	11	11	---	---	PASS
	Ant0	5500	3.63	11	11	---	---	PASS
	Ant1	5500	4.02	11	11	---	---	PASS
	total	5500	6.84	11	11	---	---	PASS
	Ant0	5580	3.74	11	11	---	---	PASS
	Ant1	5580	4.02	11	11	---	---	PASS
	total	5580	6.89	11	11	---	---	PASS
	Ant0	5700	3.36	11	11	---	---	PASS
	Ant1	5700	3.43	11	11	---	---	PASS
	total	5700	6.41	11	11	---	---	PASS

Note : 1. The Duty Cycle Factor and RBW Factor is compensated in the graph.

2. The maximum ERP/EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

Test Mode	Antenna	Channel	Result	FCC Part 15E	RSS-247			Verdict
				Limit	Limit	EIRP	EIRP Limit	
			[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	[dBm/MHz]	
IEEE 802.11ac40 MIMO	Ant0	5190	-1.56	11	---	-1.06	10	PASS
	Ant1	5190	-1.15	11	---	-0.70	10	PASS
	total	5190	1.66	11	---	2.16	10	PASS
	Ant0	5230	-0.92	11	---	-0.42	10	PASS
	Ant1	5230	-1.15	11	---	-0.70	10	PASS
	total	5230	1.98	11	---	2.48	10	PASS
	Ant0	5270	-1.26	11	11	---	---	PASS
	Ant1	5270	-1.09	11	11	---	---	PASS
	total	5270	1.84	11	11	---	---	PASS
	Ant0	5310	1.84	11	11	---	---	PASS
	Ant1	5310	1.93	11	11	---	---	PASS
	total	5310	4.90	11	11	---	---	PASS
	Ant0	5510	-6.45	11	11	---	---	PASS
	Ant1	5510	-6.60	11	11	---	---	PASS
	total	5510	-3.51	11	11	---	---	PASS
	Ant0	5550	-6.00	11	11	---	---	PASS
	Ant1	5550	-6.79	11	11	---	---	PASS
	total	5550	-3.37	11	11	---	---	PASS
	Ant0	5670	0.91	11	11	---	---	PASS
	Ant1	5670	0.87	11	11	---	---	PASS
	total	5670	3.90	11	11	---	---	PASS
IEEE 802.11ac80 MIMO	Ant0	5210	-5.8	11	---	-5.30	10	PASS
	Ant1	5210	-5.7	11	---	-5.25	10	PASS
	total	5210	-2.74	11	---	-2.24	10	PASS
	Ant0	5290	-7.66	11	11	---	---	PASS
	Ant1	5290	-7.35	11	11	---	---	PASS
	total	5290	-4.49	11	11	---	---	PASS
	Ant0	5530	0.02	11	11	---	---	PASS
	Ant1	5530	0.28	11	11	---	---	PASS
	total	5530	3.16	11	11	---	---	PASS

Note : 1. The Duty Cycle Factor and RBW Factor is compensated in the graph.

2. The maximum ERP/EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

For U-NII-3 band

Test Mode	Antenna	Channel	Result	Result	Limit	Verdict
			[dBm/470kHz]	[dBm/500kHz]	[dBm/500kHz]	
1 IEEE 802.11a	Ant0	5745	1.90	2.17	30	PASS
	Ant1	5745	1.99	2.26	30	PASS
	Ant0	5785	2.51	2.78	30	PASS
	Ant1	5785	1.78	2.05	30	PASS
	Ant0	5825	1.78	2.05	30	PASS
	Ant1	5825	1.89	2.16	30	PASS
IEEE 802.11n20 MIMO	Ant0	5745	1.33	1.60	30	PASS
	Ant1	5745	1.16	1.43	30	PASS
	total	5745	---	4.52	30	PASS
	Ant0	5785	1.5	1.77	30	PASS
	Ant1	5785	1.32	1.59	30	PASS
	total	5785	---	4.69	30	PASS
	Ant0	5825	1.23	1.50	30	PASS
	Ant1	5825	1.10	1.37	30	PASS
	total	5825	---	4.44	30	PASS
1 IEEE 802.11n40 MIMO	Ant0	5755	-2.14	-1.87	30	PASS
	Ant1	5755	-2.24	-1.97	30	PASS
	total	5755	---	1.09	30	PASS
	Ant0	5795	-1.85	-1.58	30	PASS
	Ant1	5795	-2.27	-2.00	30	PASS
	total	5795	---	1.22	30	PASS
IEEE 802.11ac20 MIMO	Ant0	5745	1.13	1.40	30	PASS
	Ant1	5745	1.22	1.49	30	PASS
	total	5745	---	4.45	30	PASS
	Ant0	5785	1.32	1.59	30	PASS
	Ant1	5785	0.99	1.26	30	PASS
	total	5785	---	4.44	30	PASS
	Ant0	5825	1.34	1.61	30	PASS
	Ant1	5825	1.06	1.33	30	PASS
	total	5825	---	4.48	30	PASS
IEEE 802.11ac40 MIMO	Ant0	5755	-2.13	-1.86	30	PASS
	Ant1	5755	-2.29	-2.02	30	PASS
	total	5755	---	1.07	30	PASS
	Ant0	5795	-2.07	-1.80	30	PASS
	Ant1	5795	-2.30	-2.03	30	PASS
	total	5795	---	1.10	30	PASS
IEEE 802.11ac80 MIMO	Ant0	5775	-3.35	-3.08	30	PASS
	Ant1	5775	-3.49	-3.22	30	PASS
	total	5775	---	-0.14	30	PASS

Note : 1.The Result and Limit Unit is dBm/500 kHz in the band 5.725–5.85 GHz.

2.The Duty Cycle Factor and RBW Factor is compensated in the graph.

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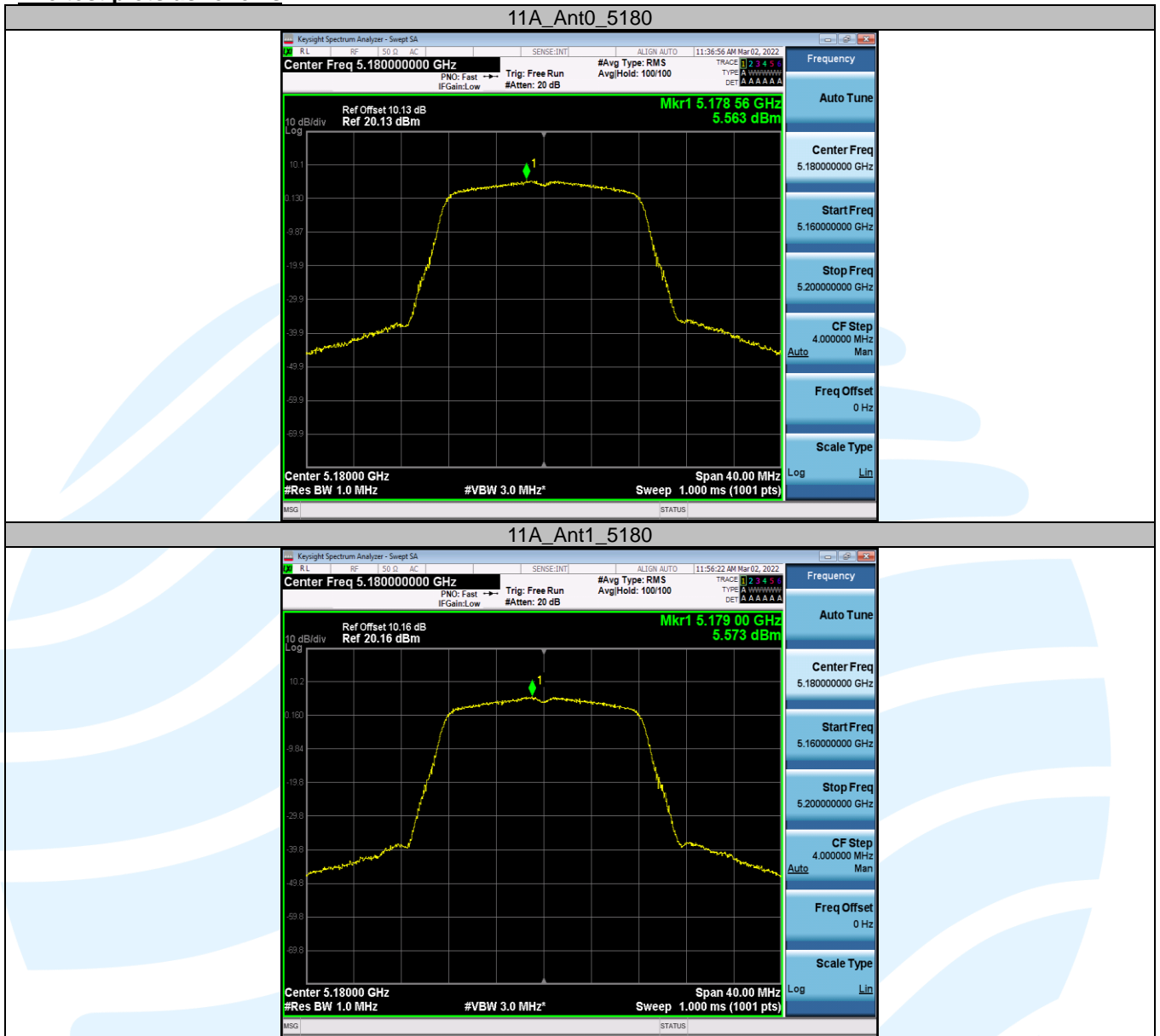
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The test plots as follows



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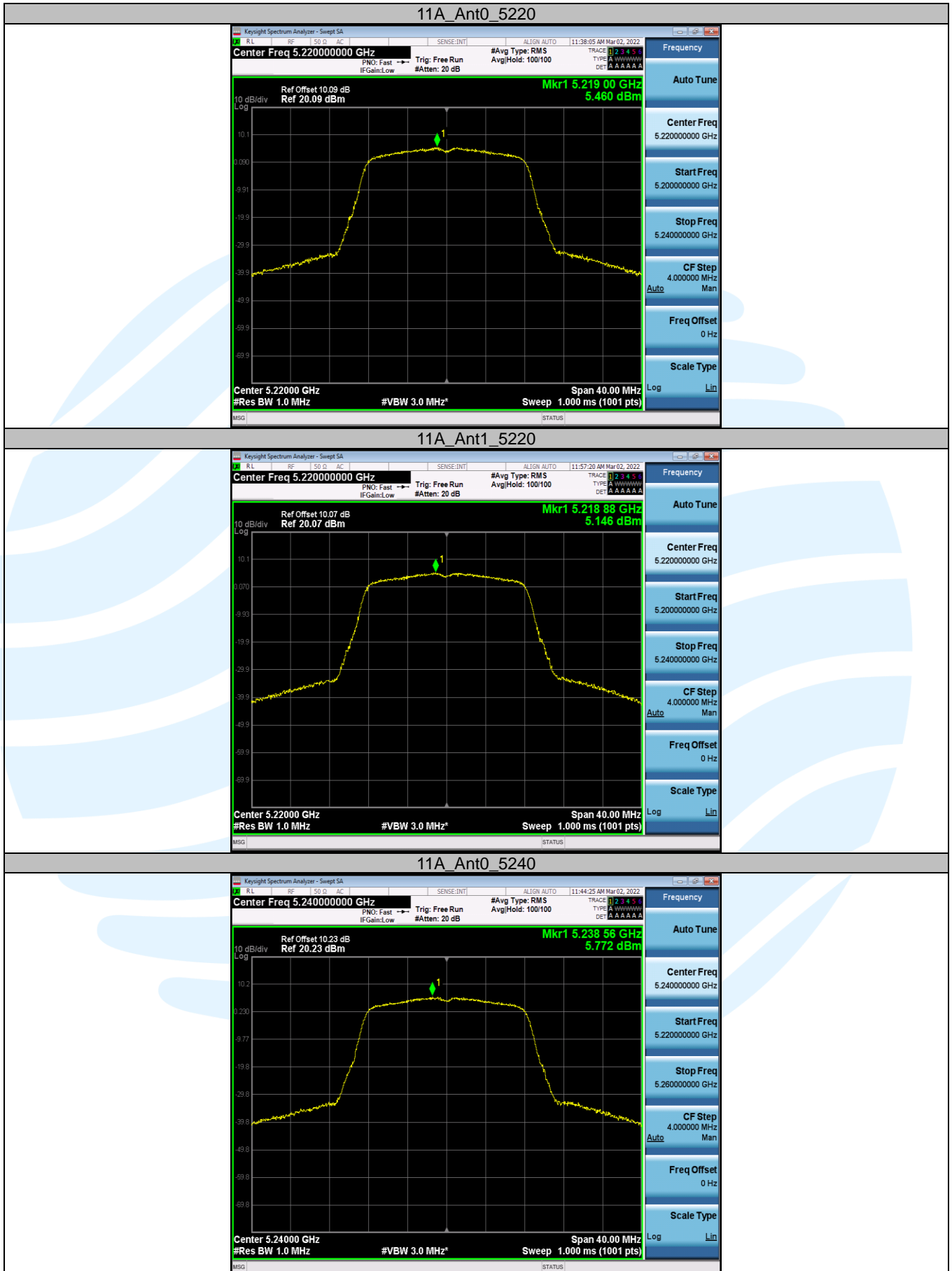
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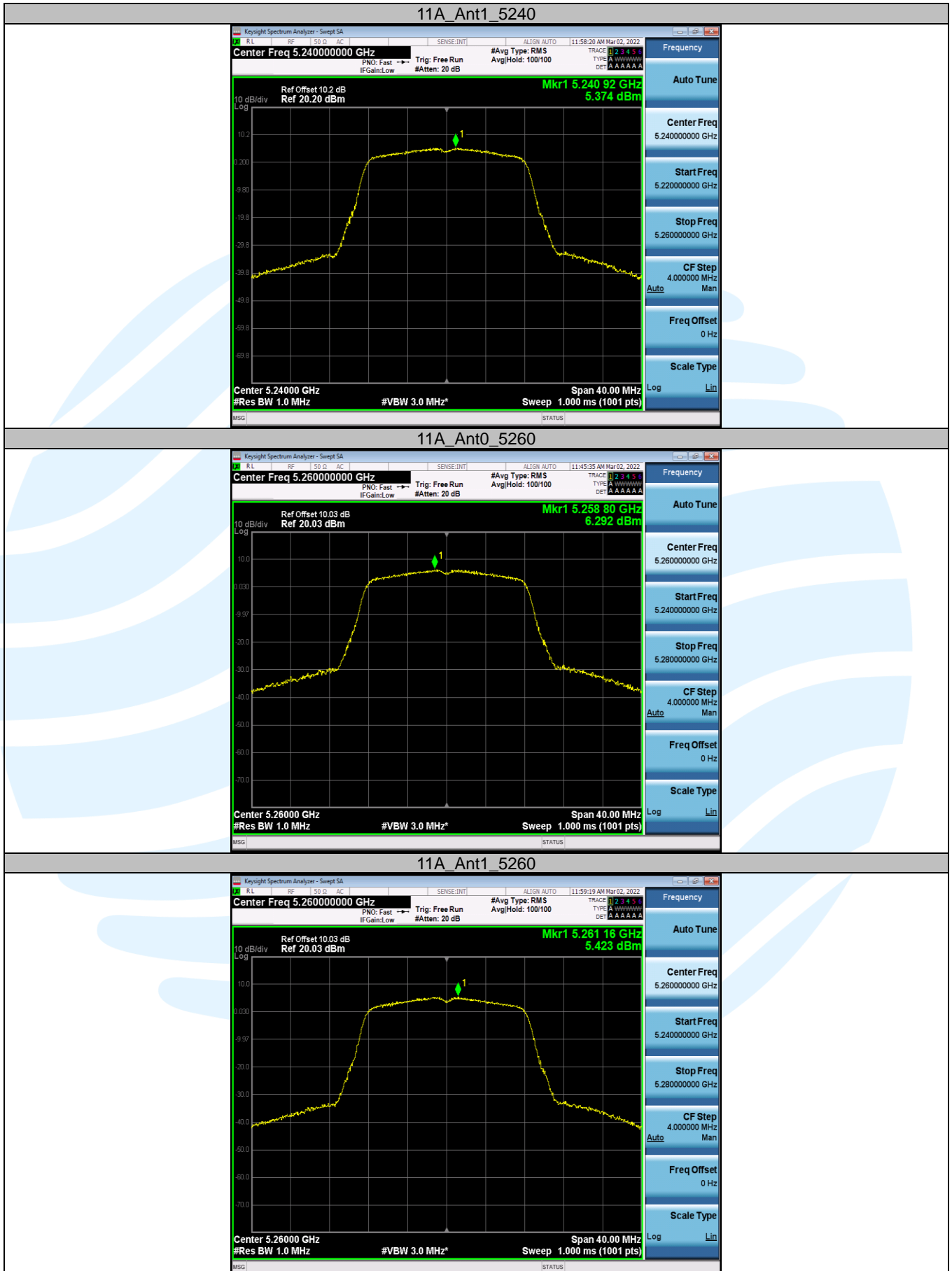
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