

4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.247(b)

Peak output power :

For systems using digital modulation in the 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt(30 dBm) and the e.i.r.p. shall not exceed 4Watt(36 dBm), base on the use of antennas with directional gain not exceed 6 dBi If transmitting antennas of directional gain greater than 6dBi are used the peak output power the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Limit	☒ Antenna not exceed 6 dBi : 30dBm ☐ Antenna with DG greater than 6 dBi : [Limit = 30 – (DG – 6)] ☐ Point-to-point operation :
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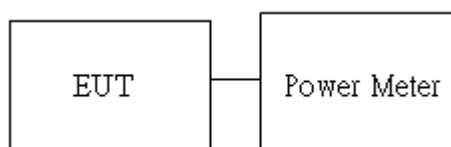
Average output power : For reporting purposes only.

4.3.2 Test Procedure

Test method Refer as ANSI C63.10:2013.

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power. in the test report.

4.3.3 Test Setup



Report No.: TMWK2304001000KR

4.3.4 Test Result

Non-Beamforming

Temperature: 24.8°C

Test date: April 21, 2023

Humidity: 64% RH

Tested by: Marco Chan

Peak Output Power

Test Mode: IEEE 802.11b Mode

802.11b Ch0						
CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	15	19.61	30.00	PASS
6	2437	1	14	18.65	30.00	PASS
11	2462	1	13.5	18.12	30.00	PASS

802.11b Ch1						
CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	13	19.23	30.00	PASS
6	2437	1	13	19.12	30.00	PASS
11	2462	1	13	18.96	30.00	PASS

Test Mode: IEEE 802.11g Mode

802.11g Ch0						
CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	18.5	24.65	30.00	PASS
6	2437	6	21.5	25.51	30.00	PASS
11	2462	6	18	23.98	30.00	PASS

802.11g Ch1						
CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	16.5	25.08	30.00	PASS
6	2437	6	20	25.85	30.00	PASS
11	2462	6	17.5	24.91	30.00	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.

Test Mode: IEEE 802.11n HT20 Mode
802.11n_HT20M_2TX

CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
1	2412	MCS0	17.5	23.88	24.54	27.23	30.00	PASS
6	2437	MCS0	21.5	25.06	25.82	28.47	30.00	PASS
11	2462	MCS0	18.5	23.22	23.89	26.58	30.00	PASS

Test Mode: IEEE 802.11n HT40 Mode
802.11n_HT40M_2TX

CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
3	2422	MCS0	16	20.75	22.09	24.48	30.00	PASS
6	2437	MCS0	19	23.27	24.52	26.95	30.00	PASS
9	2452	MCS0	17.5	21.86	23.25	25.62	30.00	PASS

Test Mode: IEEE 802.11ax HE20 Mode
802.11ax_HE20M_2TX

CH	Freq. (MHz)	Data Rate	RU Config	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
1	2412	MCS0	full	17	23.66	24.22	26.96	30.00	PASS
6	2437	MCS0	full	20.5	24.89	25.68	28.31	30.00	PASS
11	2462	MCS0	full	18	22.41	24.27	26.45	30.00	PASS

Test Mode: IEEE 802.11ax HE40 Mode
802.11ax_HE40M_2TX

CH	Freq. (MHz)	Data Rate	RU Config	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
3	2422	MCS0	full	16	21.06	22.69	24.96	30.00	PASS
6	2437	MCS0	full	18	22.69	24.04	26.43	30.00	PASS
9	2452	MCS0	full	17.5	22.02	23.61	25.90	30.00	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.



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Average Output Power
Test Mode: IEEE 802.11b Mode

802.11b Ch0						
CH	Freq. (MHz)	Data Rate	Power set	Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	15	17.09	30.00	PASS
6	2437	1	14	16.26	30.00	PASS
11	2462	1	13.5	15.55	30.00	PASS

802.11b Ch1						
CH	Freq. (MHz)	Data Rate	Power set	Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	13	16.71	30.00	PASS
6	2437	1	13	16.66	30.00	PASS
11	2462	1	13	16.47	30.00	PASS

Test Mode: IEEE 802.11g Mode

802.11g Ch0						
CH	Freq. (MHz)	Data Rate	Power set	Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	18.5	18.48	30.00	PASS
6	2437	6	21.5	21.20	30.00	PASS
11	2462	6	18	17.86	30.00	PASS

802.11g Ch1						
CH	Freq. (MHz)	Data Rate	Power set	Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	16.5	18.19	30.00	PASS
6	2437	6	20	21.40	30.00	PASS
11	2462	6	17.5	18.92	30.00	PASS

Test Mode: IEEE 802.11n HT20 Mode
802.11n_HT20M_2TX

CH	Freq. (MHz)	Data Rate	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
1	2412	MCS0	17.5	16.02	17.28	19.90	30.00	PASS
6	2437	MCS0	21.5	19.81	21.09	23.70	30.00	PASS
11	2462	MCS0	18.5	16.71	18.12	20.67	30.00	PASS

Test Mode: IEEE 802.11n HT40 Mode
802.11n_HT40M_2TX

CH	Freq. (MHz)	Data Rate	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
3	2422	MCS0	16	13.96	15.43	18.14	30.00	PASS
6	2437	MCS0	19	16.89	18.25	21.00	30.00	PASS
9	2452	MCS0	17.5	15.36	16.82	19.53	30.00	PASS

Test Mode: IEEE 802.11ax HE20 Mode
802.11ax_HE20M_2TX

CH	Freq. (MHz)	Data Rate	RU Config	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
1	2412	MCS0	full	17	15.64	16.95	20.08	30.00	PASS
6	2437	MCS0	full	20.5	18.87	20.31	23.39	30.00	PASS
11	2462	MCS0	full	18	16.25	17.73	20.79	30.00	PASS

Test Mode: IEEE 802.11ax HE40 Mode
802.11ax_HE40M_2TX

CH	Freq. (MHz)	Data Rate	RU Config	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
3	2422	MCS0	full	16	14.17	15.57	18.67	30.00	PASS
6	2437	MCS0	full	18	16.11	17.46	20.58	30.00	PASS
9	2452	MCS0	full	17.5	15.51	16.89	19.99	30.00	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.

Beamforming

Temperature: 23.1~24.8°C

Test date: April 21~May 4, 2023

Humidity: 57~68% RH

Tested by: Marco Chan

Peak Output Power

Test Mode: IEEE 802.11n HT20 Mode

802.11n_HT20M_2TX

CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
1	2412	MCS0	14.5	20.24	21.34	23.84	30.00	PASS
6	2437	MCS0	18	22.01	22.71	25.38	30.00	PASS
11	2462	MCS0	15	19.63	20.78	23.25	30.00	PASS

Test Mode: IEEE 802.11n HT40 Mode

802.11n_HT40M_2TX

CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
3	2422	MCS0	12.5	17.21	18.67	21.01	30.00	PASS
6	2437	MCS0	15.5	19.96	21.35	23.72	30.00	PASS
9	2452	MCS0	14	18.59	19.78	22.24	30.00	PASS

Test Mode: IEEE 802.11ax HE20 Mode

802.11ax_HE20M_2TX

CH	Freq. (MHz)	Data Rate	RU Config	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
1	2412	MCS0	full	14	20.16	21.04	23.63	30.00	PASS
6	2437	MCS0	full	17.5	21.86	22.43	25.16	30.00	PASS
11	2462	MCS0	full	14.5	19.22	20.71	23.04	30.00	PASS

Test Mode: IEEE 802.11ax HE40 Mode

802.11ax_HE40M_2TX

CH	Freq. (MHz)	Data Rate	RU Config	Power set	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
3	2422	MCS0	full	13	17.94	19.37	21.72	30.00	PASS
6	2437	MCS0	full	15	19.55	20.96	23.32	30.00	PASS
9	2452	MCS0	full	14.5	18.99	20.52	22.83	30.00	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.

Average Output Power

Test Mode: IEEE 802.11n HT20 Mode

802.11n_HT20M_2TX								
CH	Freq. (MHz)	Data Rate	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
1	2412	MCS0	14.5	12.94	14.23	16.83	30.00	PASS
6	2437	MCS0	18	16.45	17.79	20.37	30.00	PASS
11	2462	MCS0	15	13.52	14.93	17.48	30.00	PASS

Test Mode: IEEE 802.11n HT40 Mode

802.11n_HT40M_2TX								
CH	Freq. (MHz)	Data Rate	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1			
3	2422	MCS0	12.5	10.84	12.22	14.96	30.00	PASS
6	2437	MCS0	15.5	13.71	15.14	17.86	30.00	PASS
9	2452	MCS0	14	12.23	13.68	16.40	30.00	PASS

Test Mode: IEEE 802.11ax HE20 Mode

802.11ax_HE20M_2TX									
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
1	2412	MCS0	full	14	12.55	13.87	17.00	30.00	PASS
6	2437	MCS0	full	17.5	15.78	17.17	20.27	30.00	PASS
11	2462	MCS0	full	14.5	12.94	14.41	17.48	30.00	PASS

Test Mode: IEEE 802.11ax HE40 Mode

802.11ax_HE40M_2TX									
CH	Freq. (MHz)	Data Rate	RU Config	Power set	Avg. Output Power (dBm)		Max. Avg. Output Power (dBm)	Limit (dBm)	RESULT
					Ch0	Ch1			
3	2422	MCS0	full	13	11.14	12.43	15.57	30.00	PASS
6	2437	MCS0	full	15	13.03	14.35	17.48	30.00	PASS
9	2452	MCS0	full	14.5	12.44	13.86	16.95	30.00	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.

4.4 POWER SPECTRAL DENSITY

4.4.1 Test Limit

According to §15.247(e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

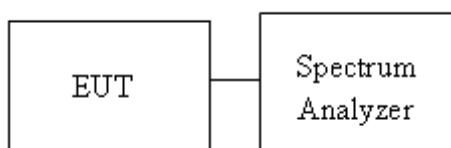
Limit	☒ Antenna not exceed 6 dBi : 8dBm ☐ Antenna with DG greater than 6 dBi : [Limit = 8 – (DG – 6)] ☐ Point-to-point operation :
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4.4.2 Test Procedure

Test method Refer as ANSI C63.10:2013,

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 3kHz, VBW = 10kHz, Span = 1.5 times DTS Bandwidth (6 dB BW), Detector = Peak, Sweep Time = Auto and Trace = Max hold.
4. The path loss and Duty Factor were compensated to the results for each measurement by SA.
5. Mark the maximum level.
6. Measure and record the result of power spectral density. in the test report.

4.4.3 Test Setup





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4.4.4 Test Result

Non-Beamforming

Temperature: 24.8°C

Test date: April 21, 2023

Humidity: 64% RH

Tested by: Marco Chan

POWER DENSITY 802.11b					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-3.67	-5.05	-3.67	8.00	PASS
2437	-6.08	-5.65	-5.65	8.00	PASS
2462	-6.69	-5.81	-5.81	8.00	PASS

POWER DENSITY 802.11g					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-6.37	-6.51	-6.37	8.00	PASS
2437	-2.86	-3.64	-2.86	8.00	PASS
2462	-6.73	-5.9	-5.9	8.00	PASS

POWER DENSITY 802.11n HT20					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-9.67	-6.59	-4.85	8.00	PASS
2437	-5.33	-3.63	-1.39	8.00	PASS
2462	-7.21	-6.39	-3.77	8.00	PASS

POWER DENSITY 802.11n HT40					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2422	-12.9	-12.55	-9.71	8.00	PASS
2437	-10.51	-7.07	-5.45	8.00	PASS
2452	-12.24	-8.92	-7.26	8.00	PASS



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POWER DENSITY 802.11ax HE20						
Freq. (MHz)	RU Config	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	full	-9.91	-8.63	-6.21	8.00	PASS
2437	full	-6.3	-5.46	-2.85	8.00	PASS
2462	full	-9.04	-7.58	-5.24	8.00	PASS

POWER DENSITY 802.11ax HE40						
Freq. (MHz)	RU Config	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2422	full	-13.6	-11.84	-9.62	8.00	PASS
2437	full	-12.79	-10.71	-8.62	8.00	PASS
2452	full	-12.69	-11.59	-9.09	8.00	PASS



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Beamforming

Temperature: 23.1~24.8°C

Test date: April 21~May 4, 2023

Humidity: 57~68% RH

Tested by: Marco Chan

POWER DENSITY 802.11n HT20					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-11.81	-9.87	-7.72	8.00	PASS
2437	-8.17	-7.04	-4.56	8.00	PASS
2462	-9.42	-9.03	-6.21	8.00	PASS

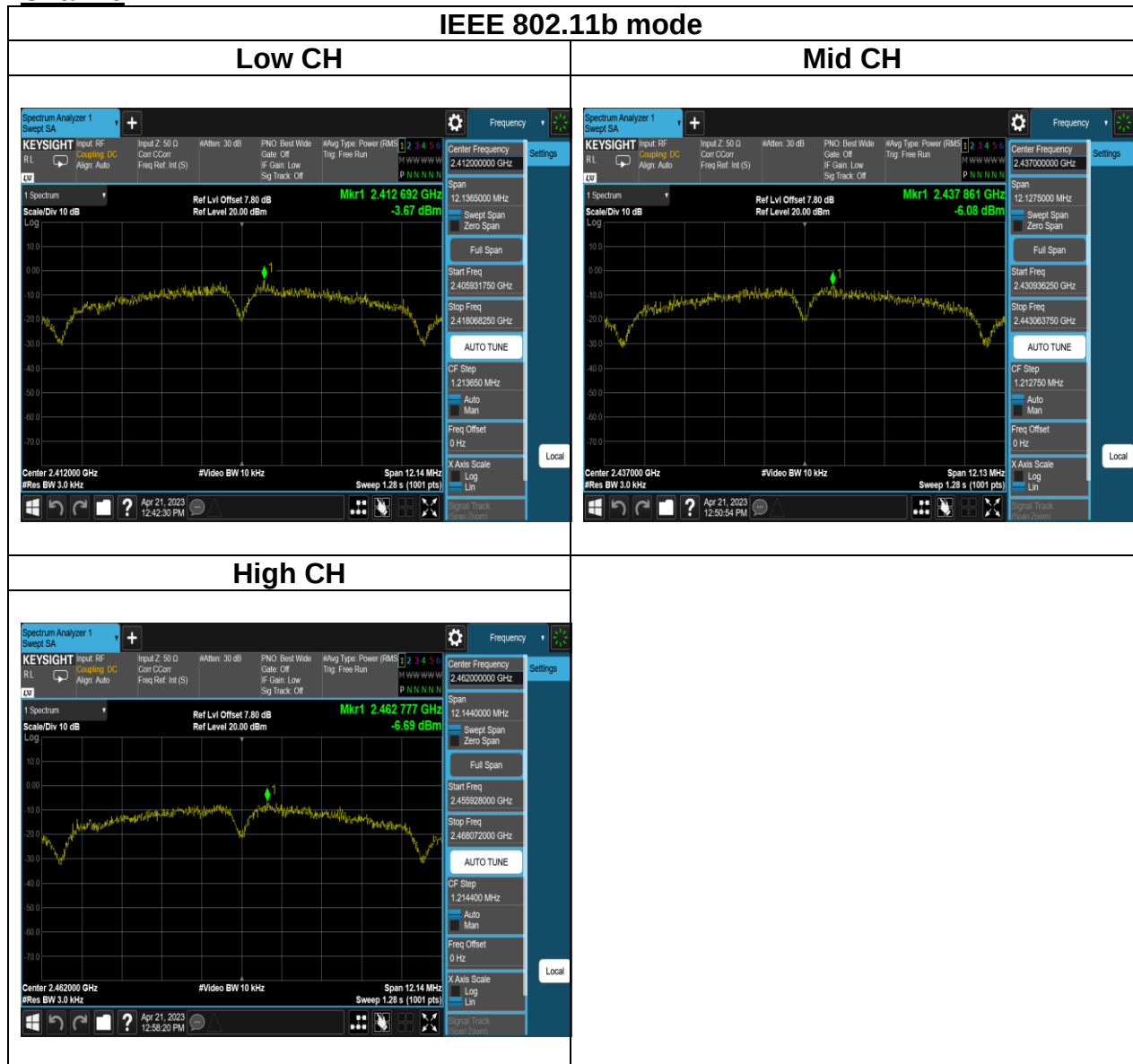
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Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2422	-16.39	-13.73	-11.85	8.00	PASS
2437	-13.53	-11.33	-9.28	8.00	PASS
2452	-12.88	-12.9	-9.88	8.00	PASS

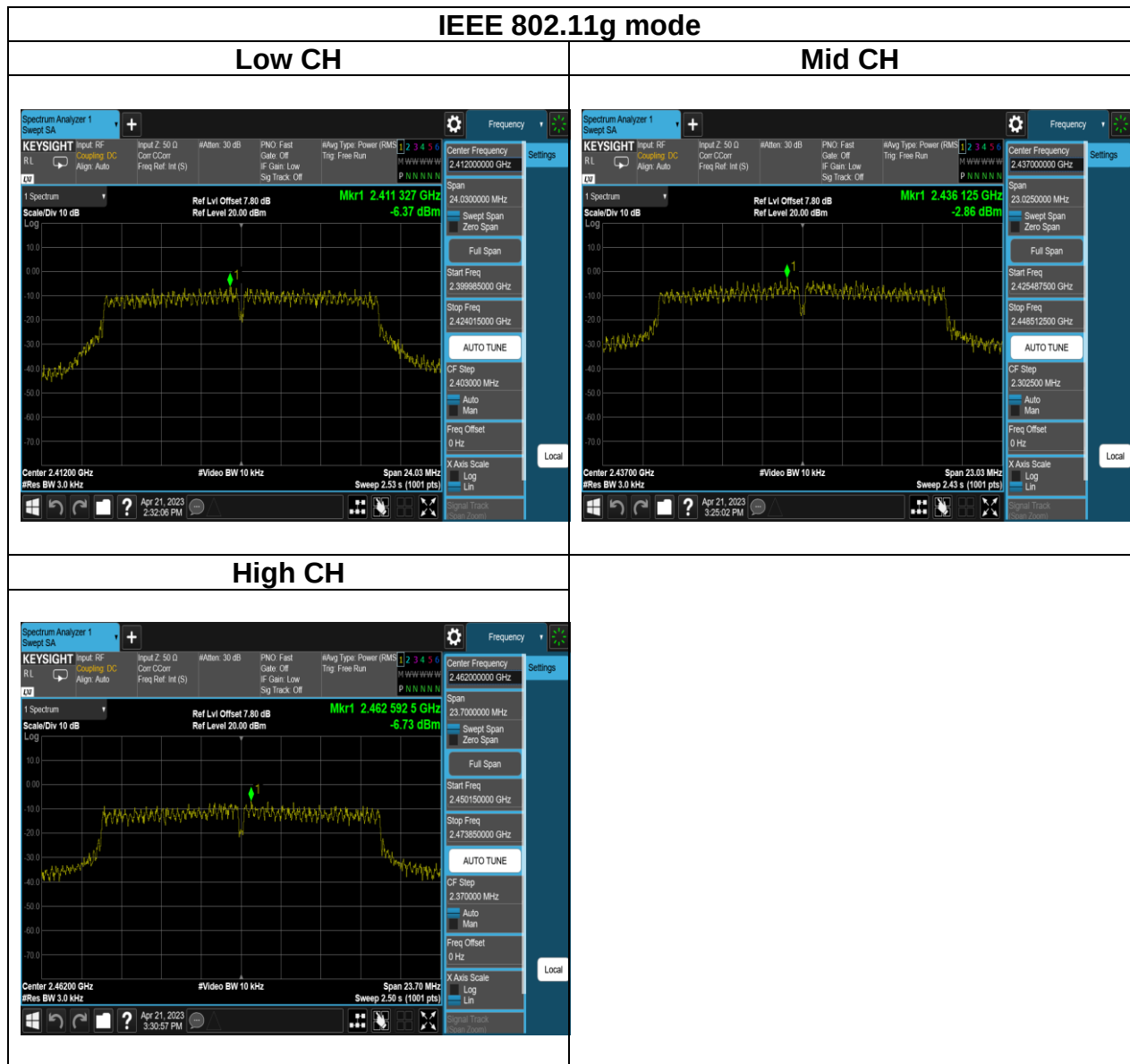
POWER DENSITY 802.11ax HE20						
Freq. (MHz)	RU Config	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	full	-12.9	-10.97	-8.82	8.00	PASS
2437	full	-8.83	-7.68	-5.21	8.00	PASS
2462	full	-12.35	-11.65	-8.98	8.00	PASS

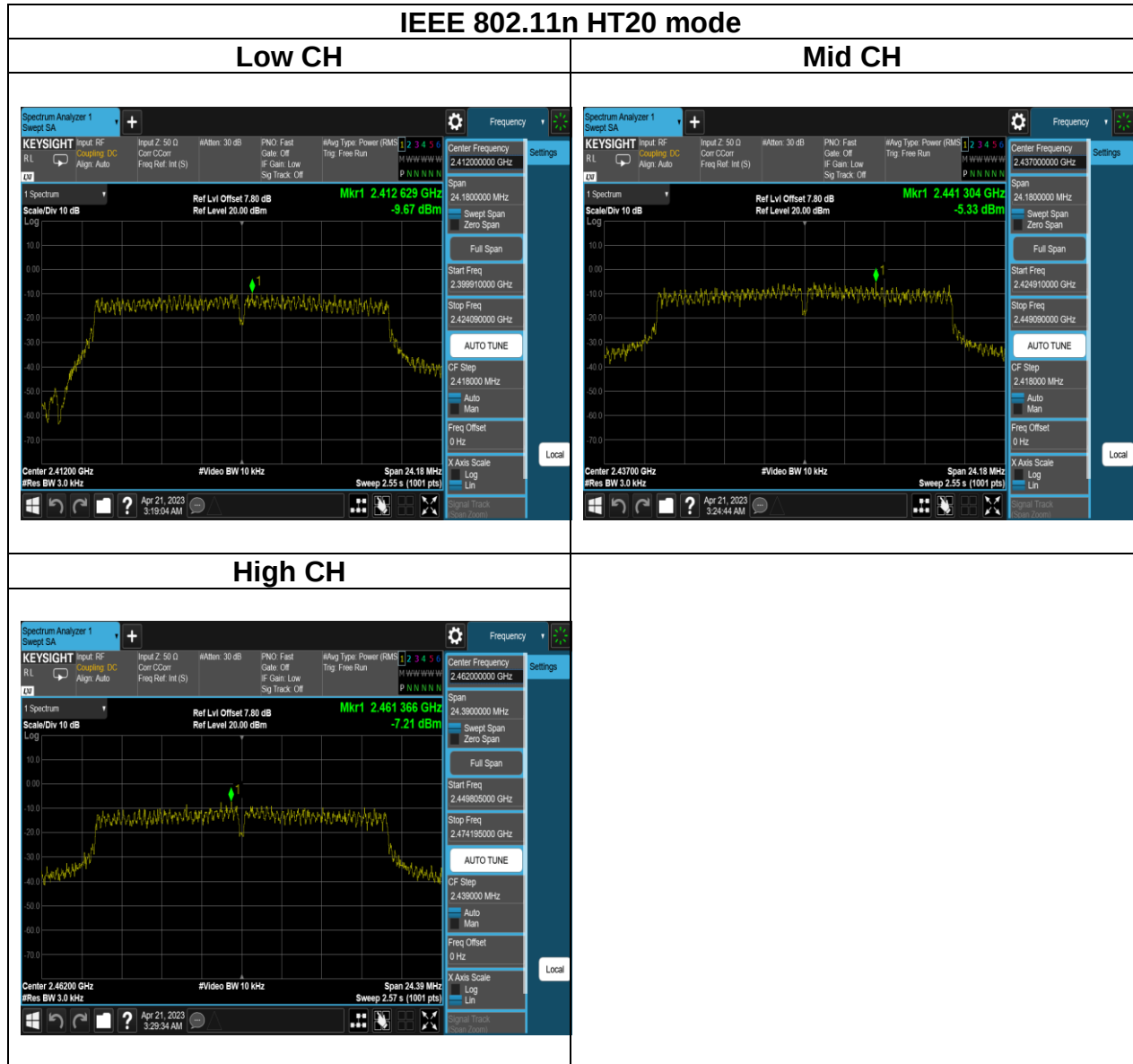
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Freq. (MHz)	RU Config	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2422	full	-16.71	-14.23	-12.29	8.00	PASS
2437	full	-14.75	-13.15	-10.87	8.00	PASS
2452	full	-15.03	-13.79	-11.36	8.00	PASS

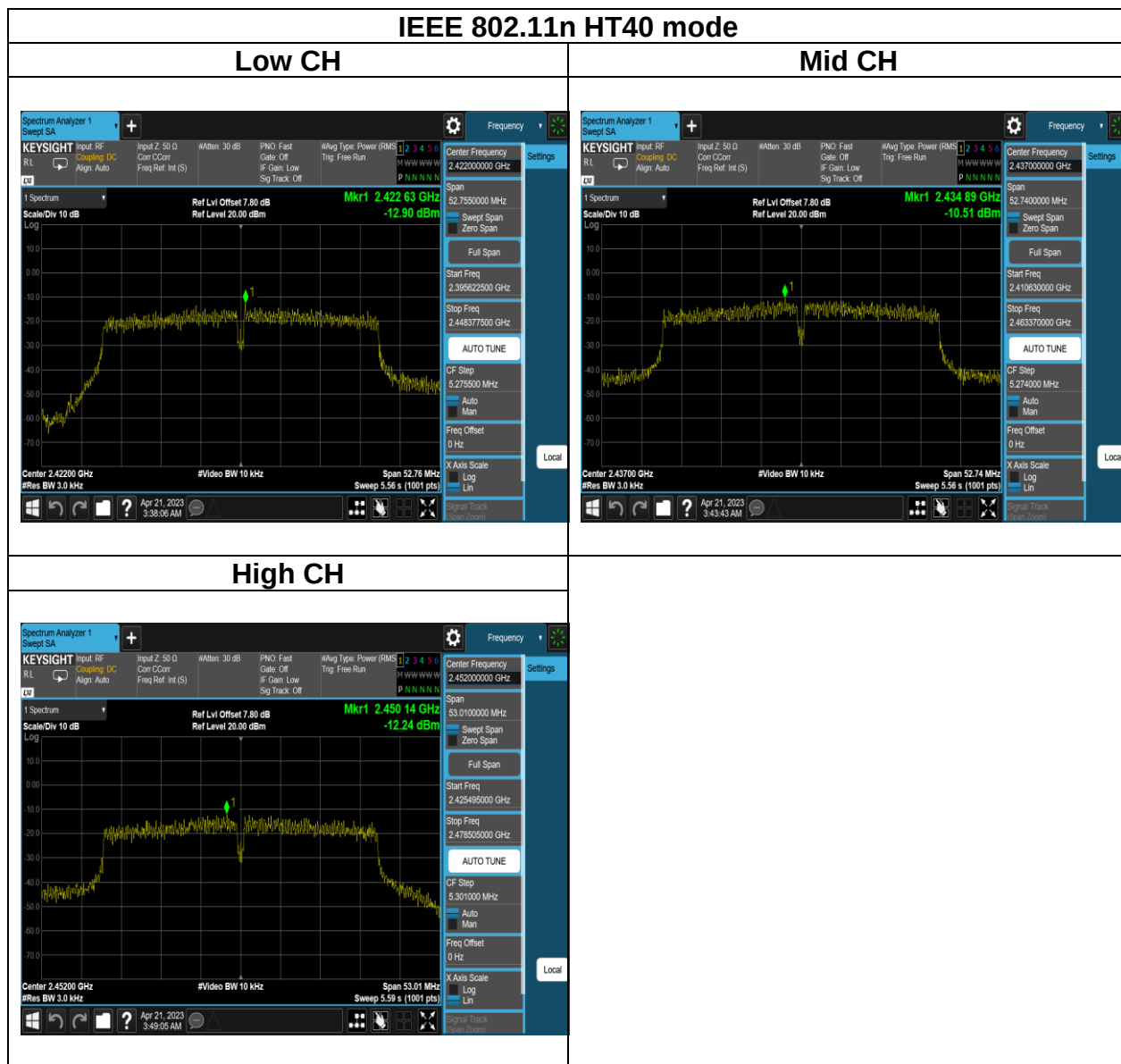
Test Data: Non-Beamforming

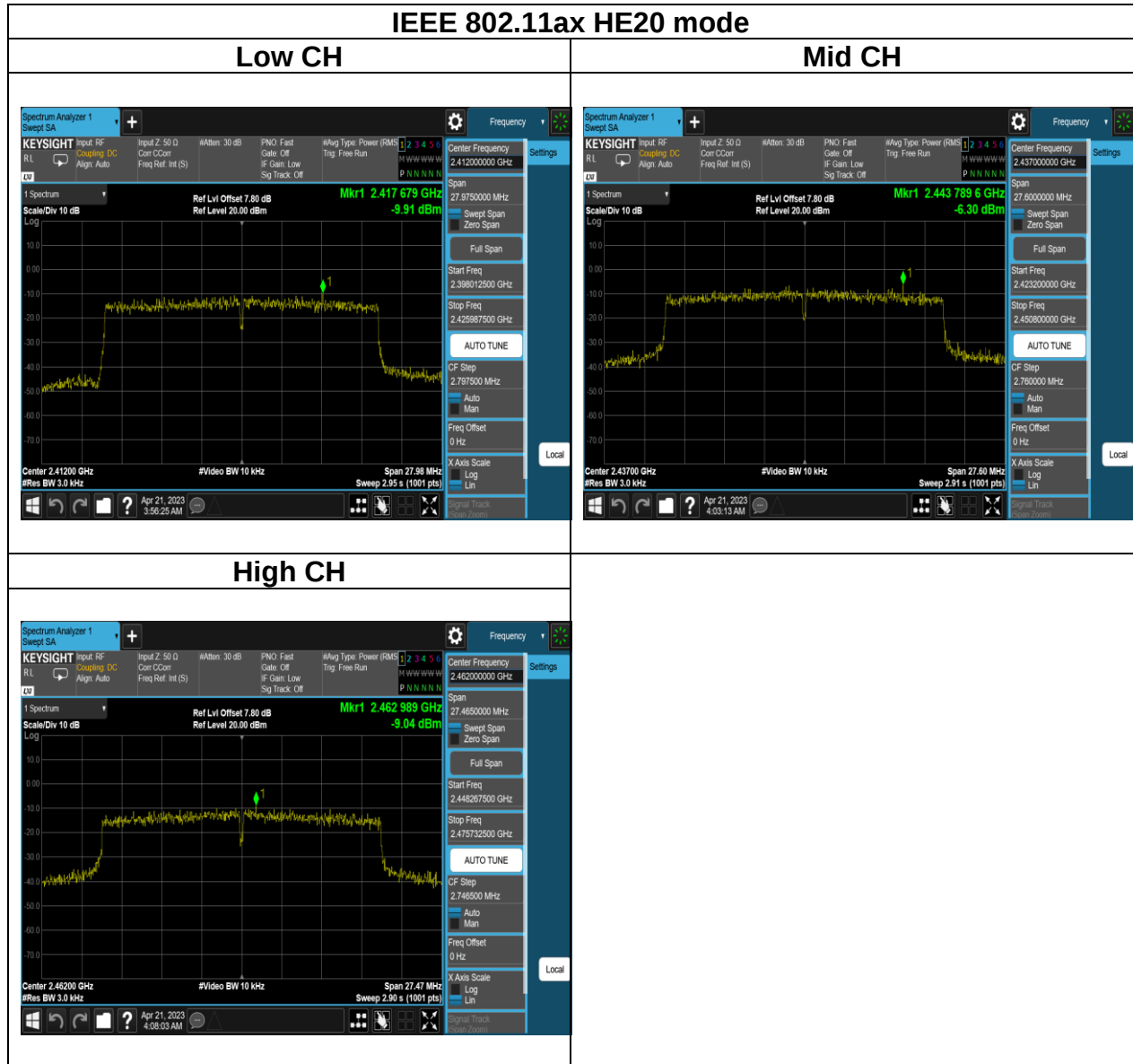
Chain 0

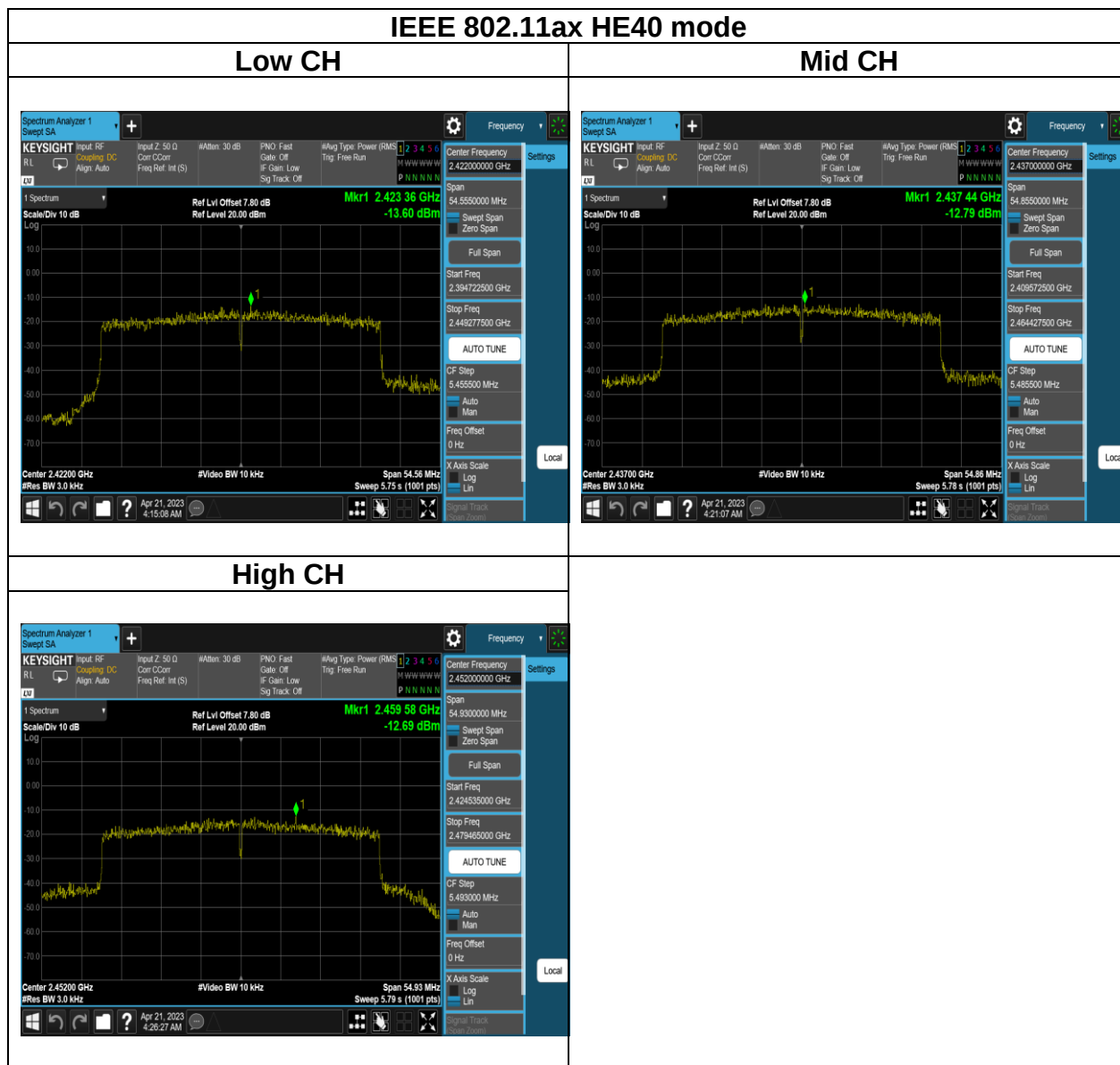




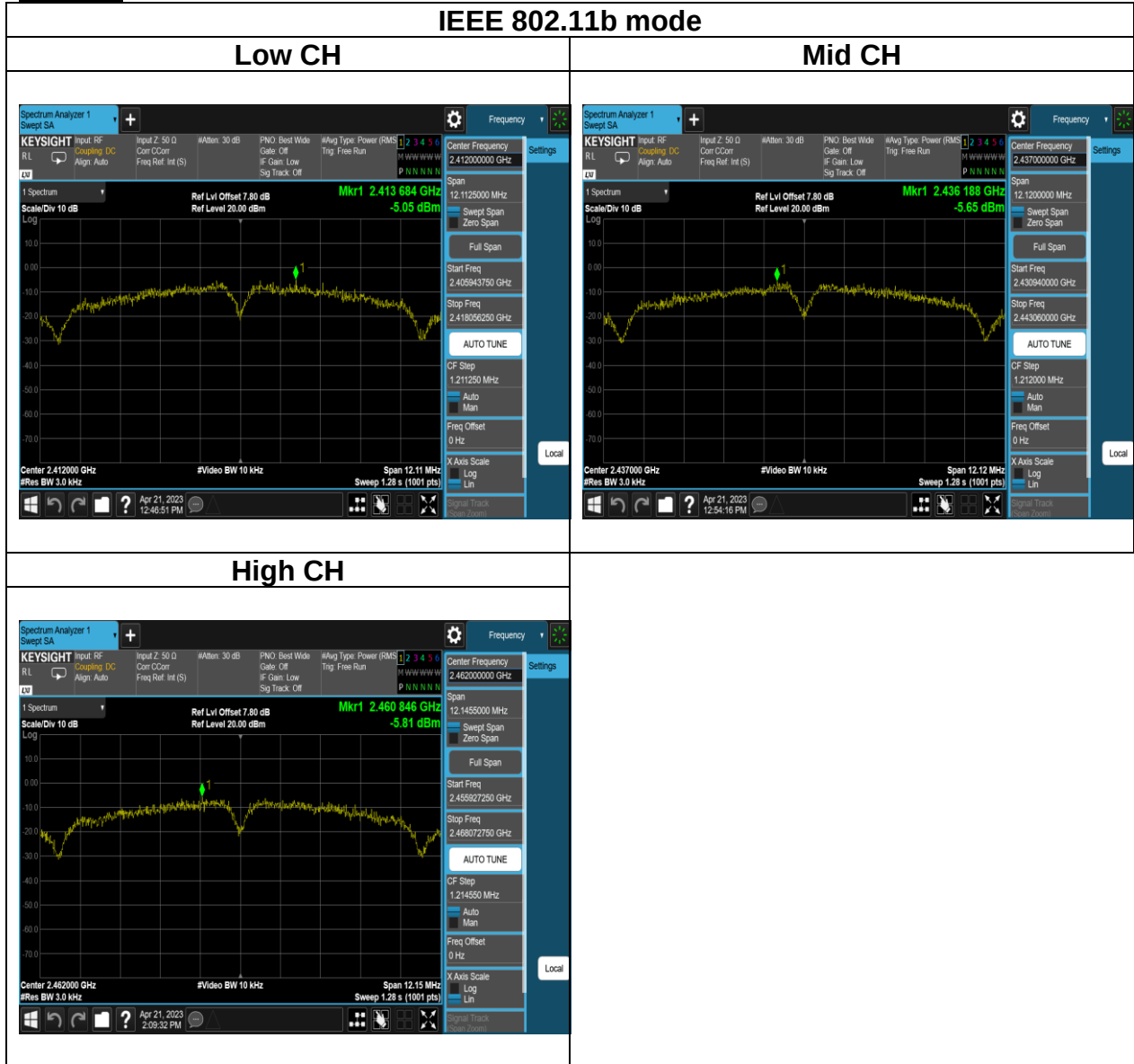


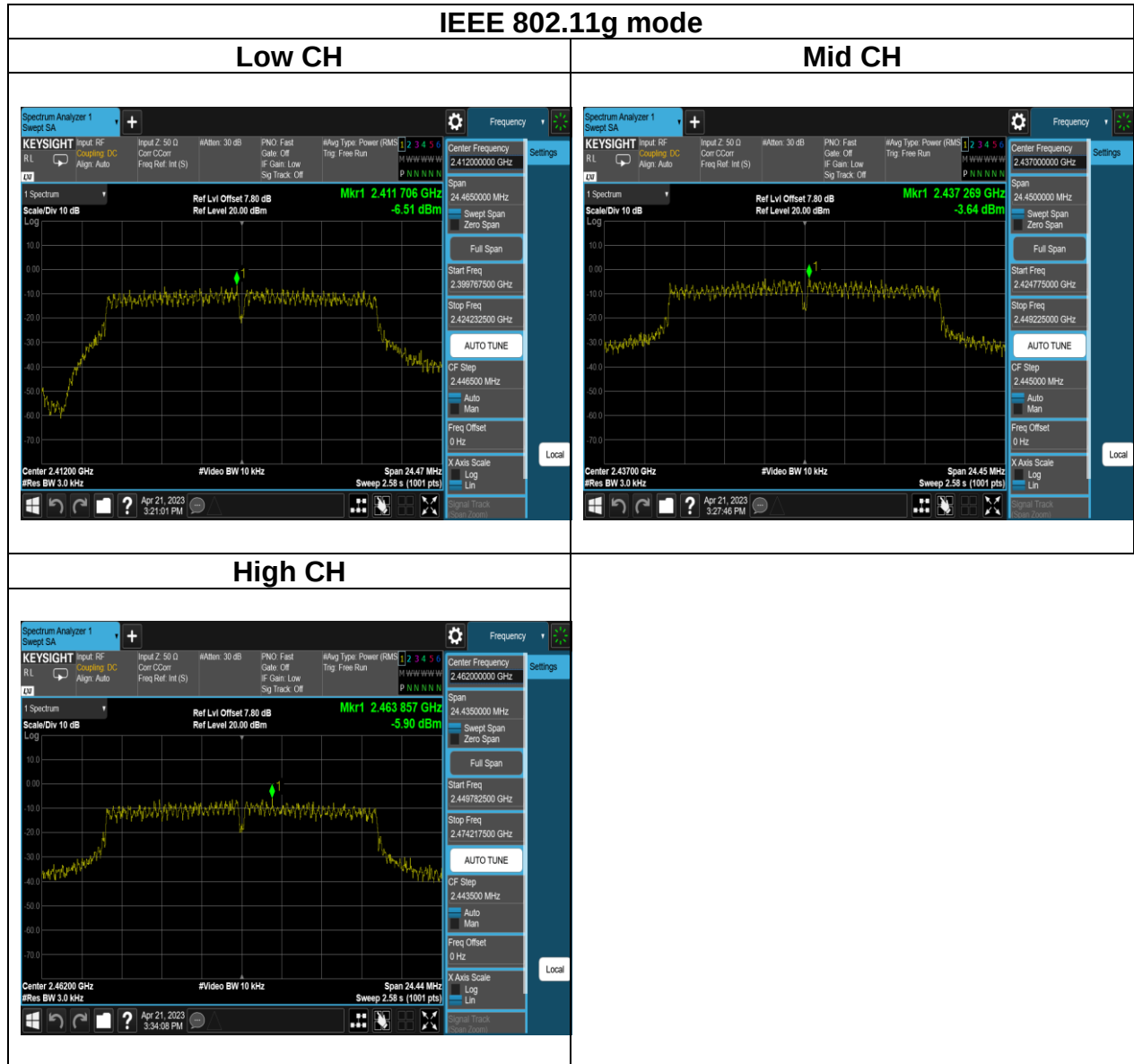


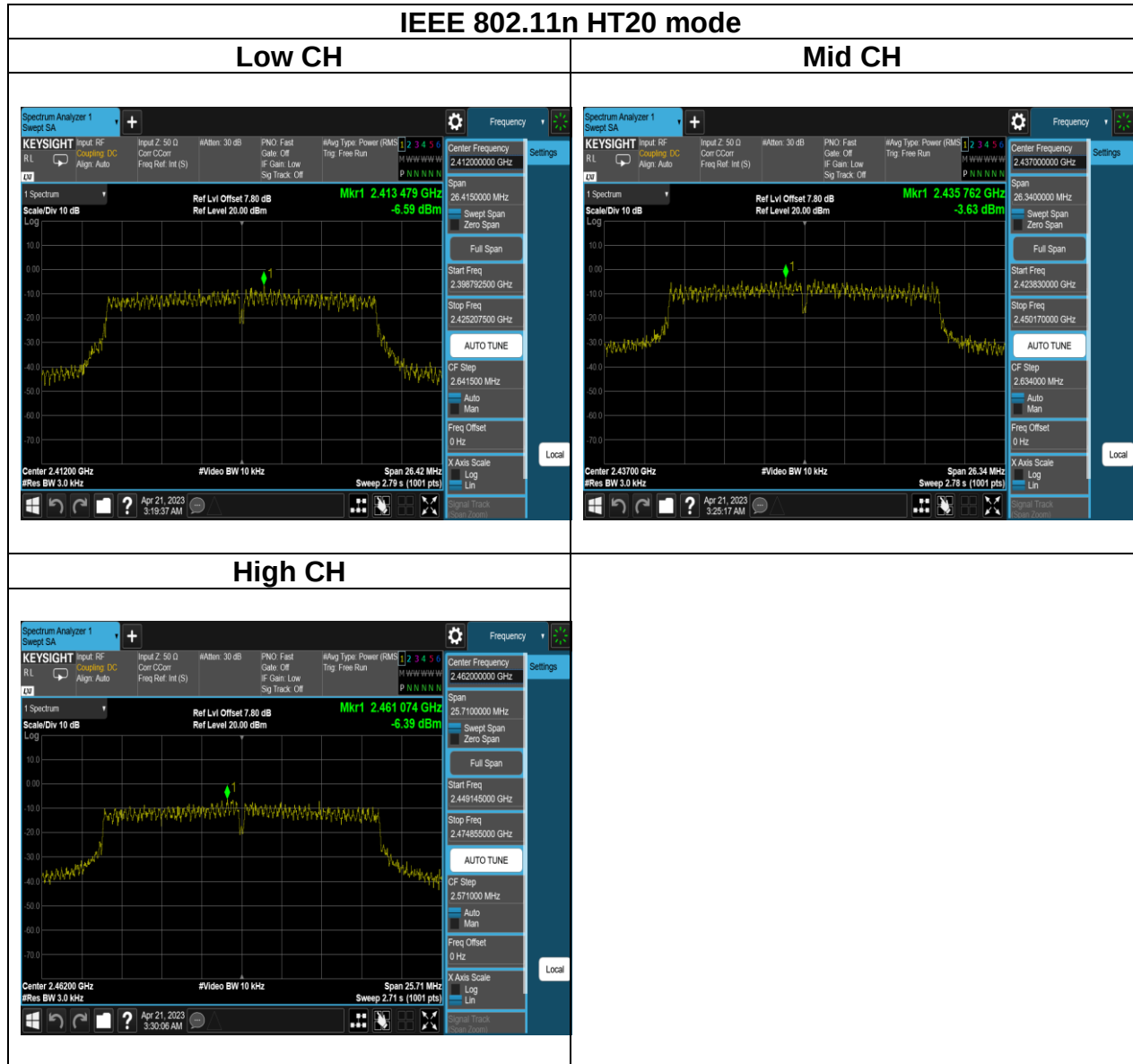




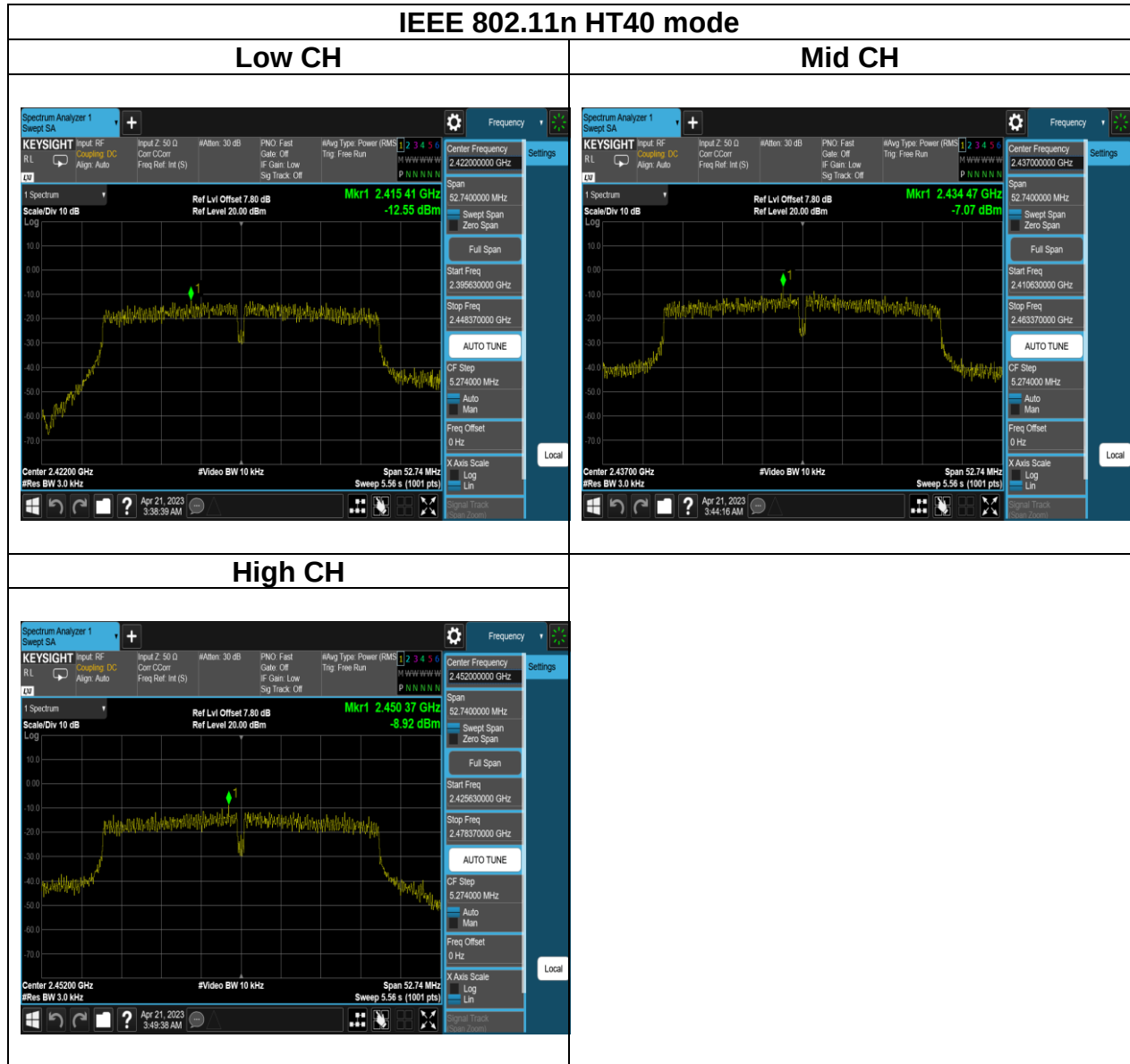
Chain 1

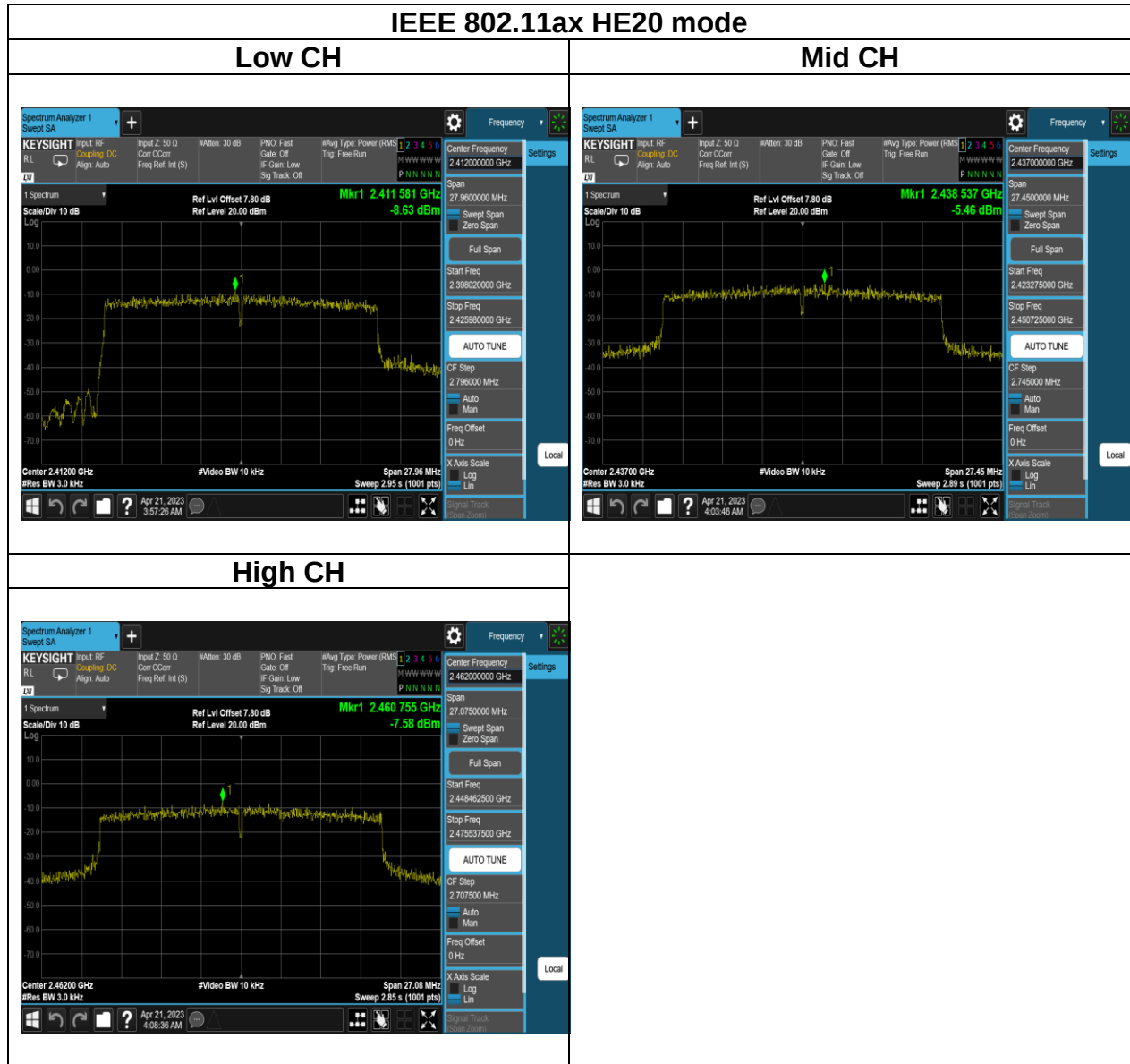


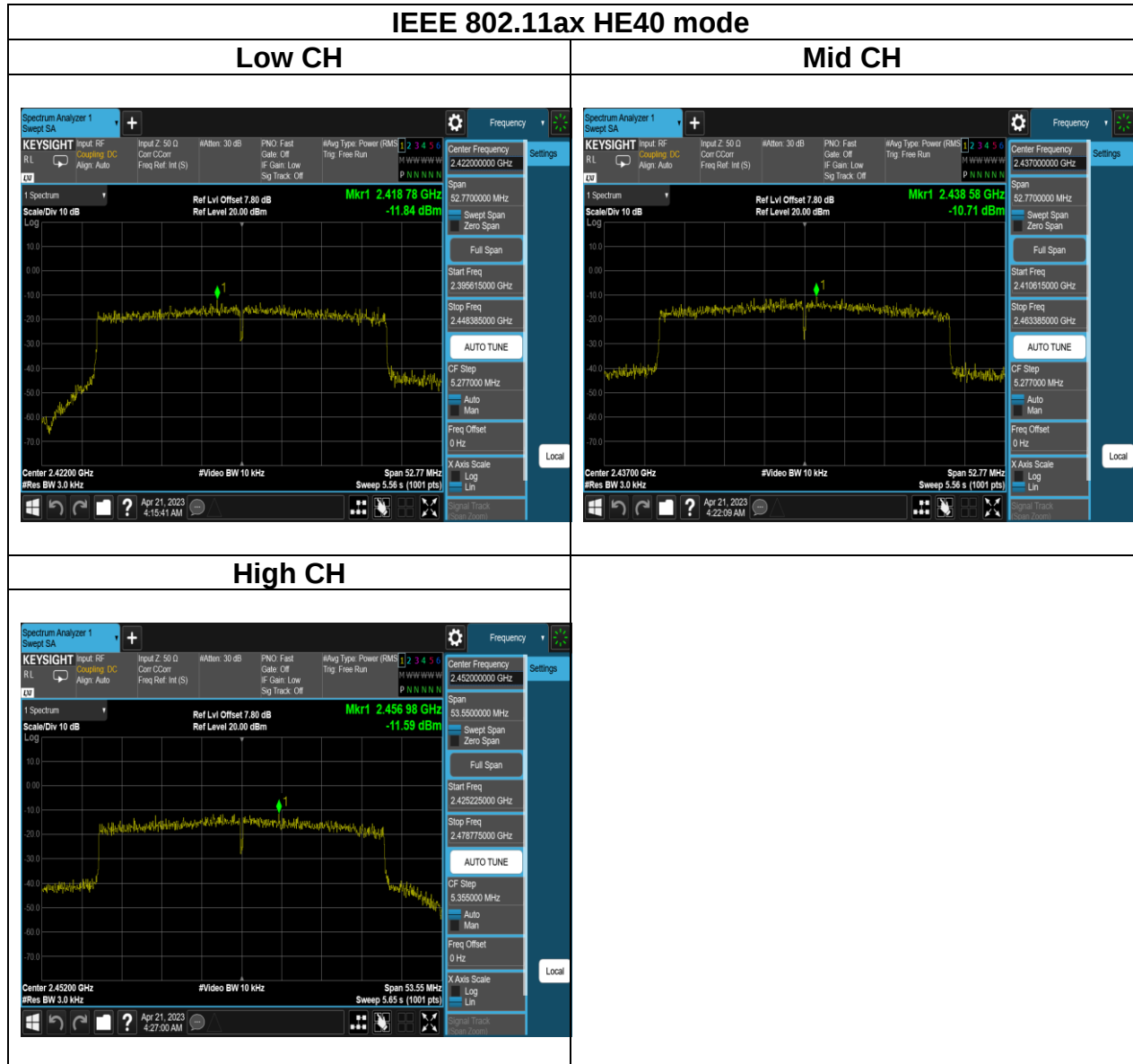




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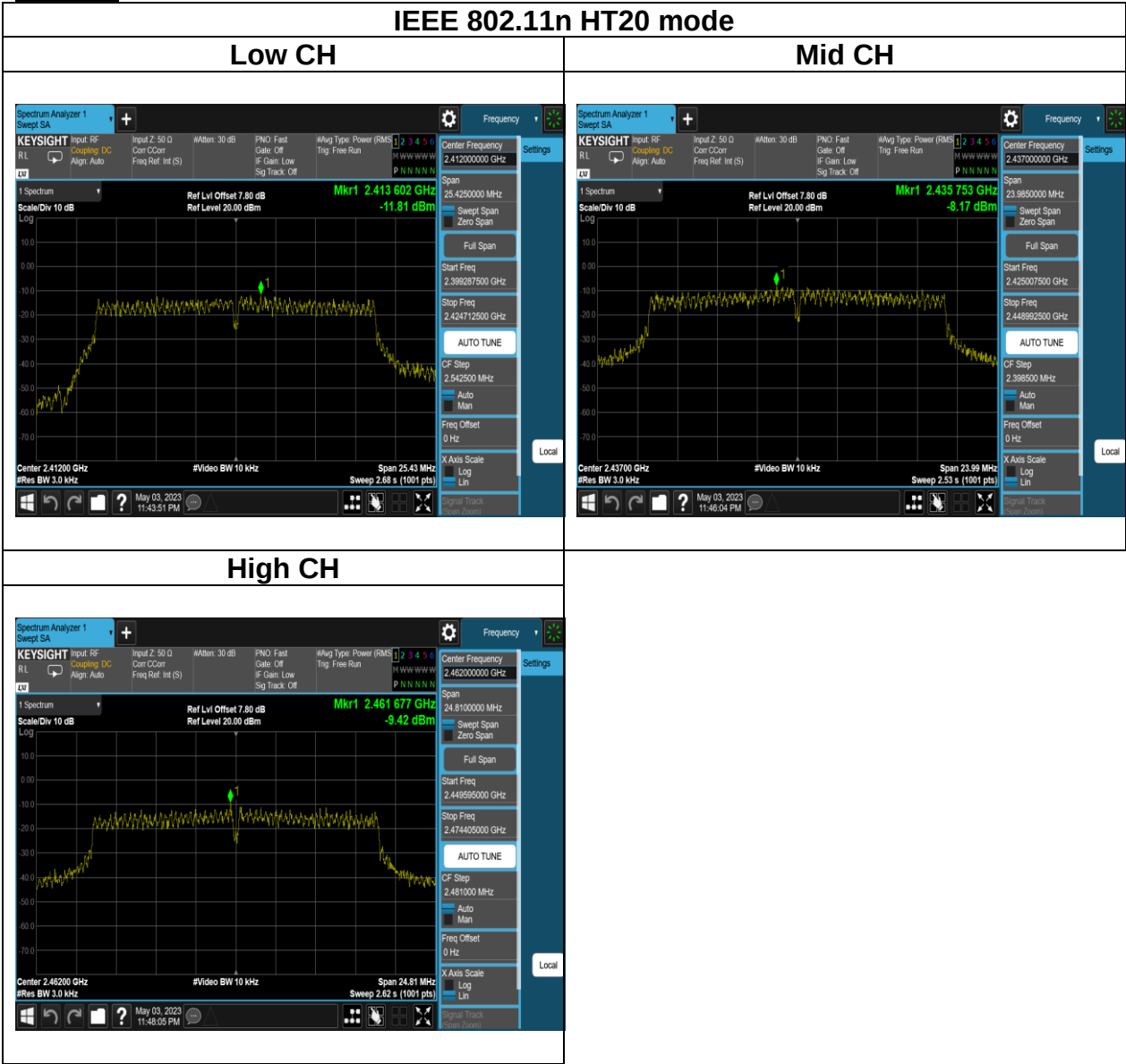


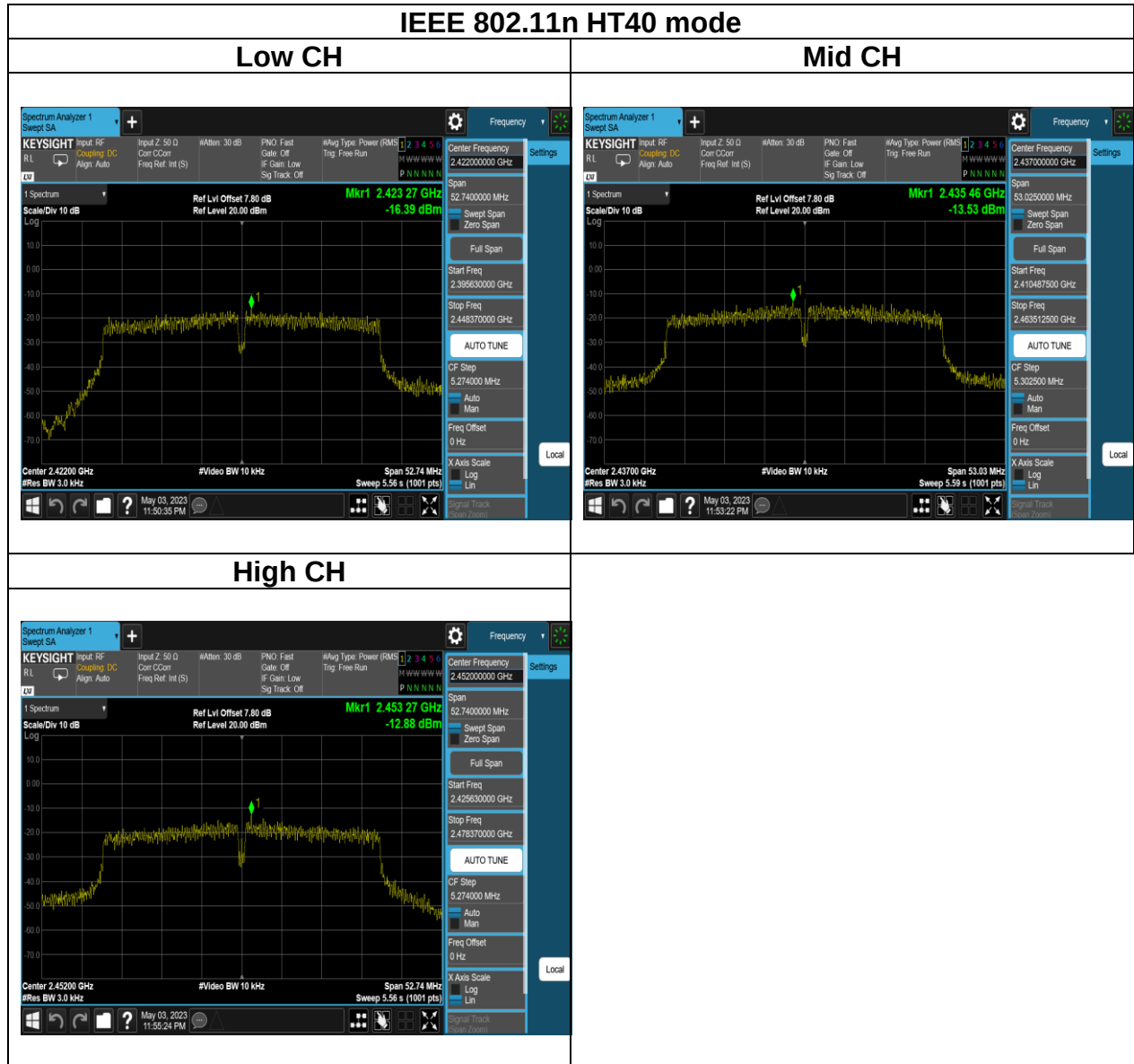


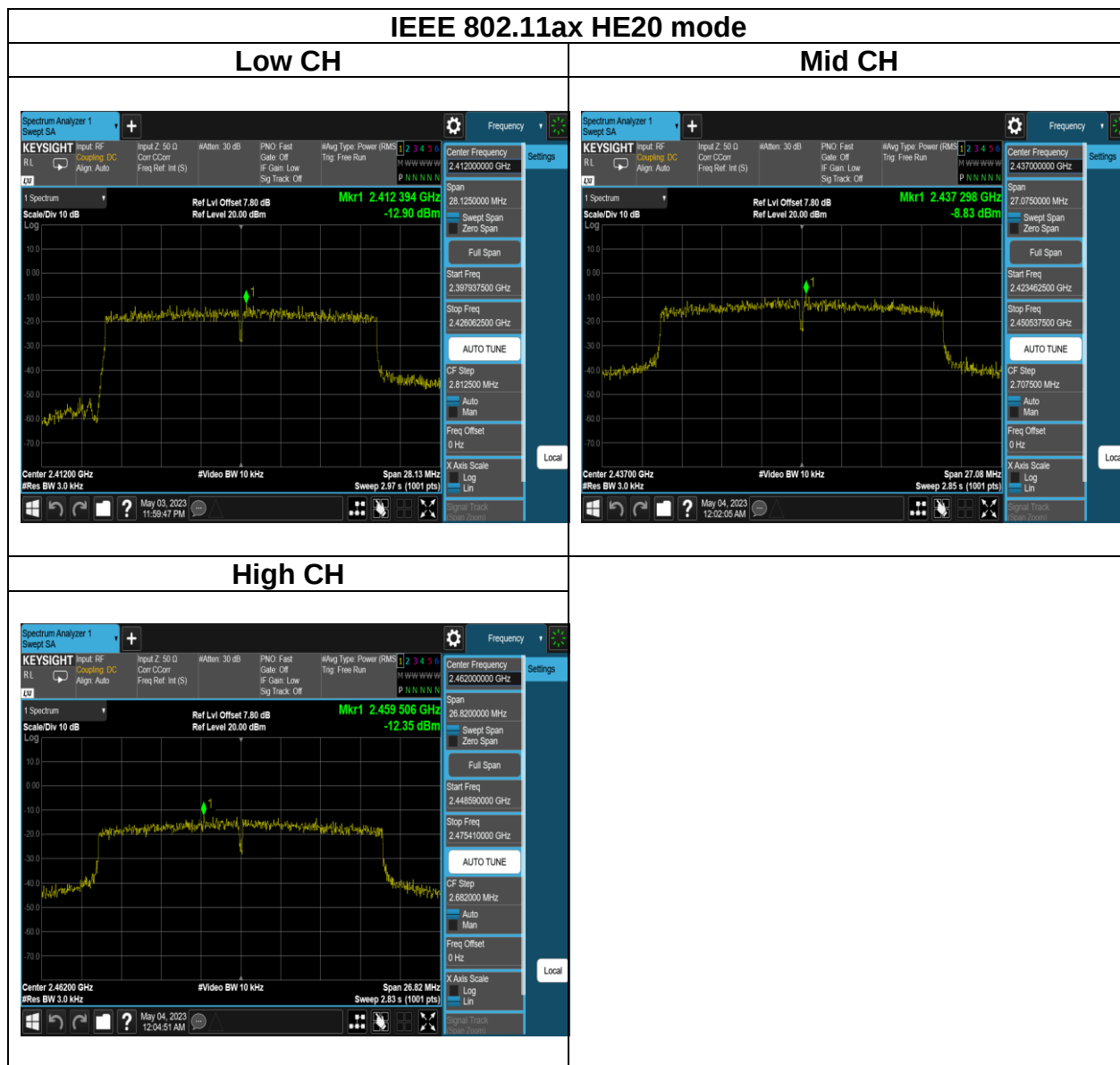


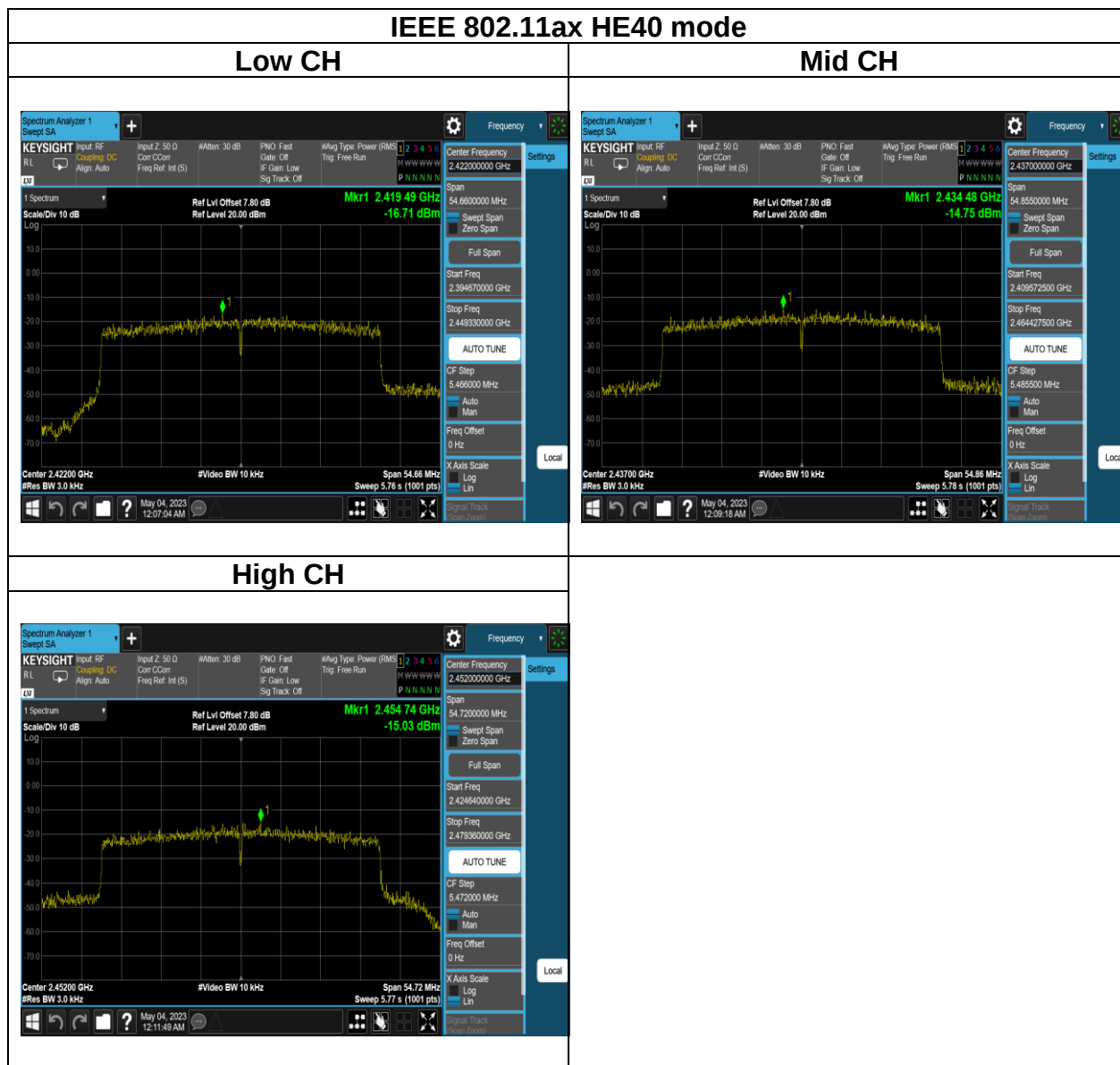
Test Data: Beamforming

Chain 0

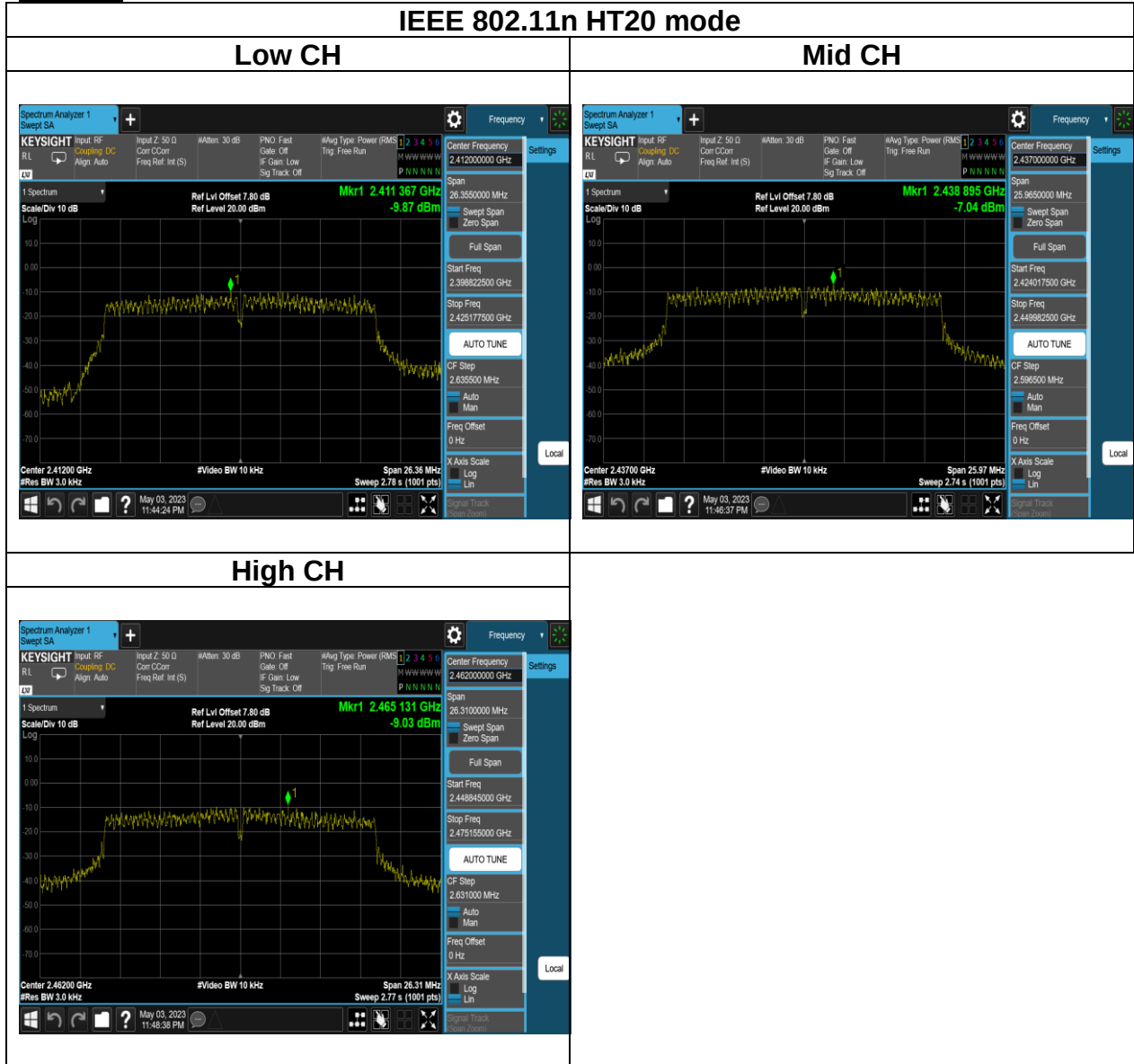


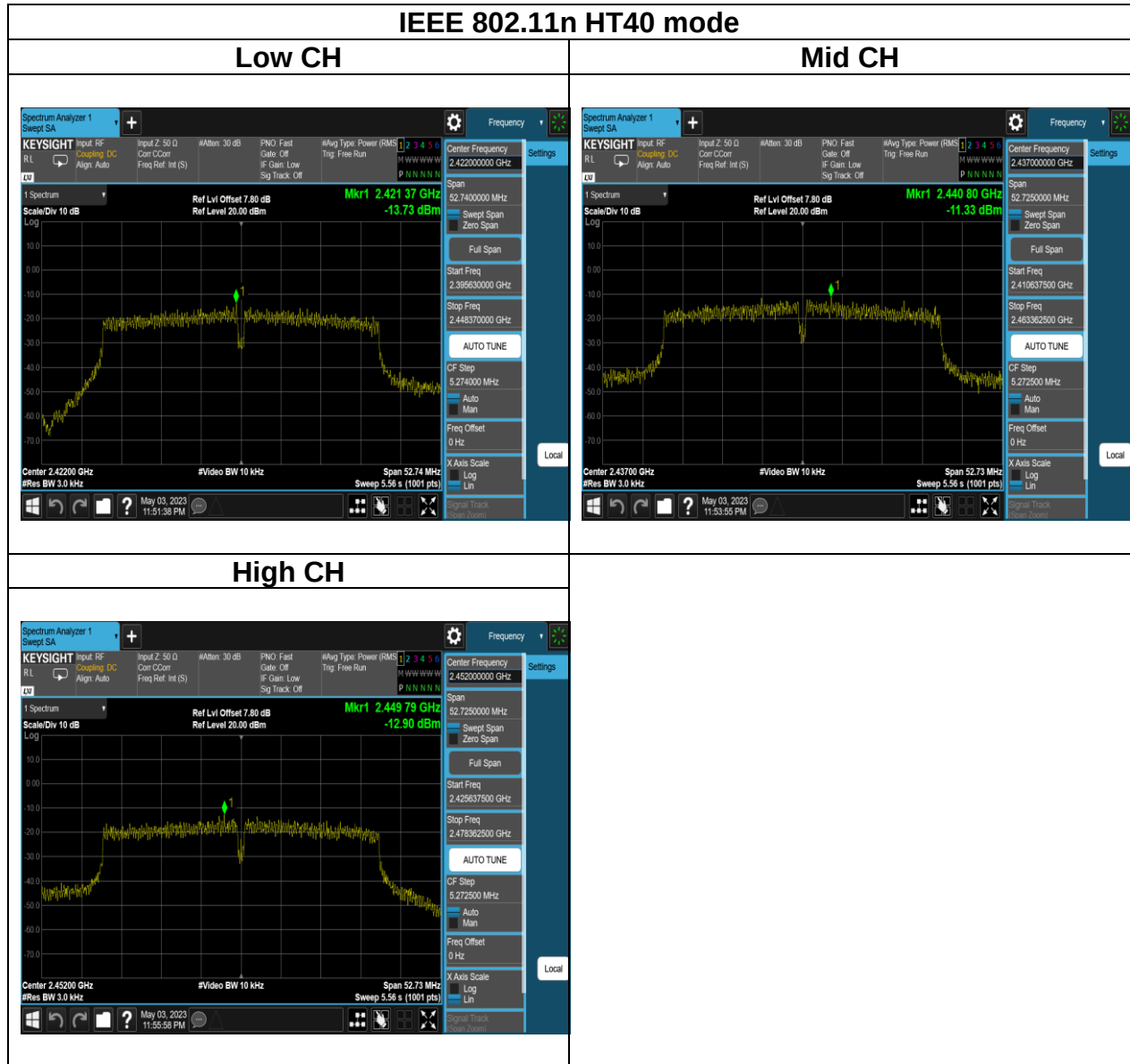




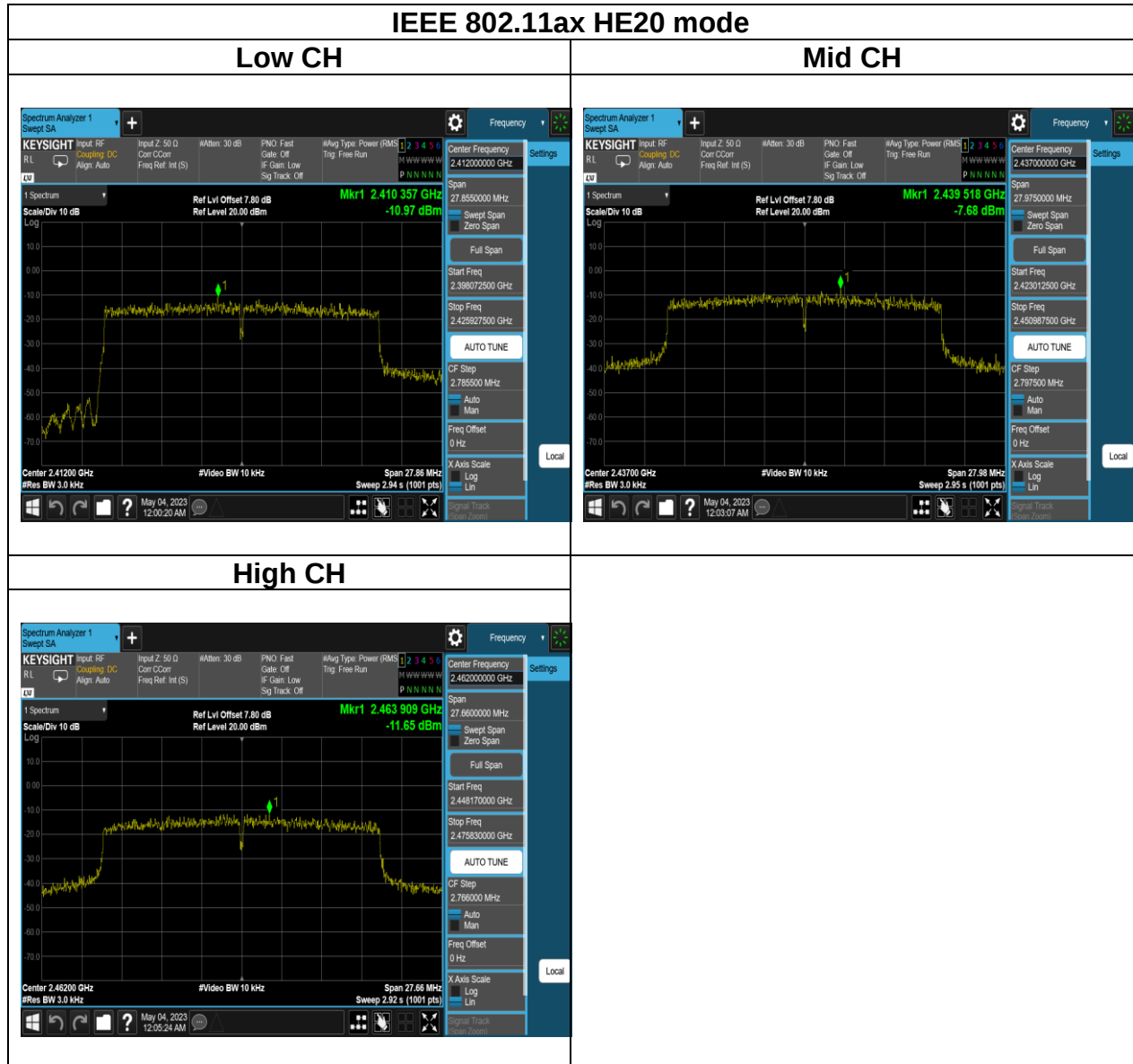


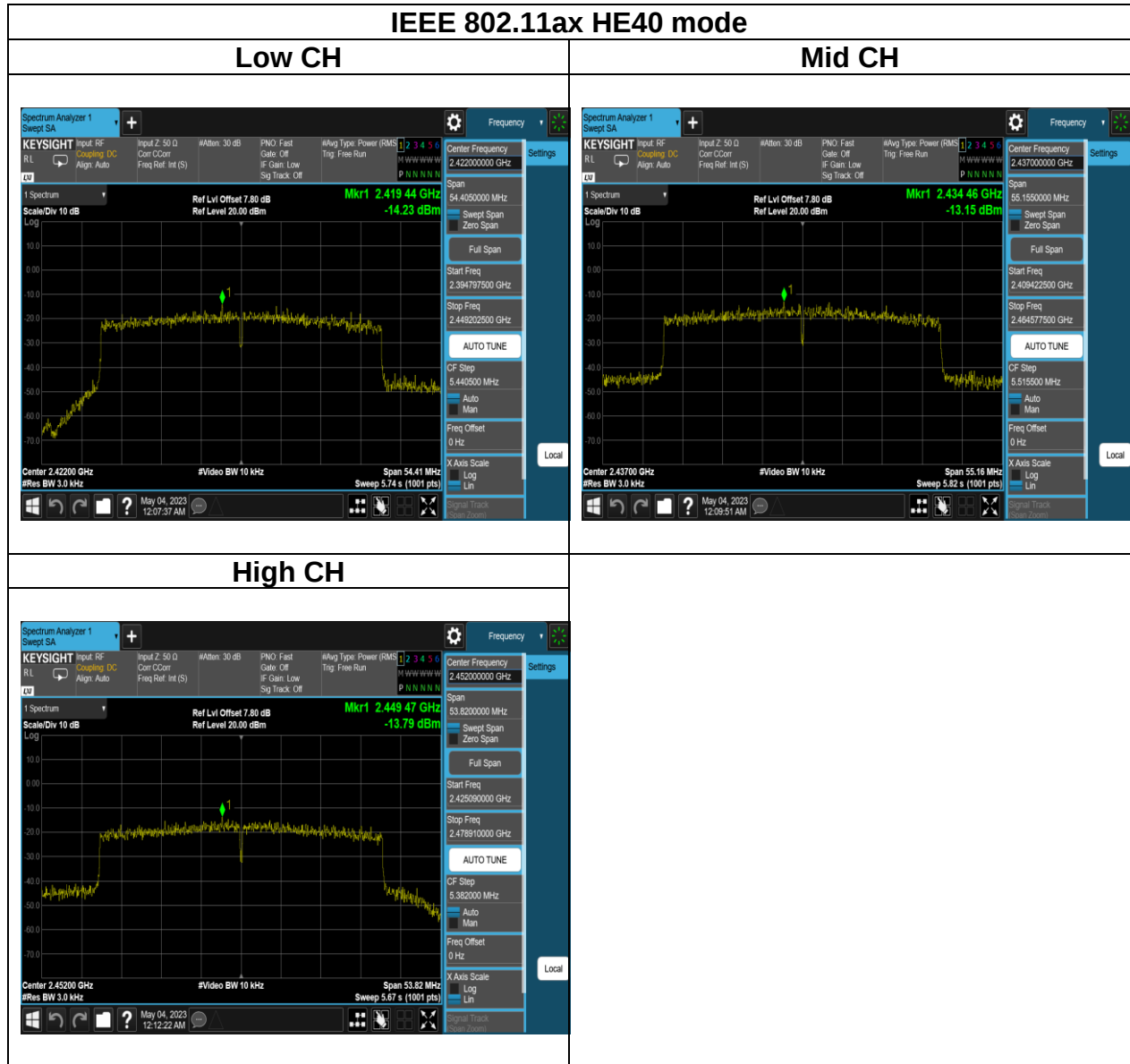
Chain 1





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4.5 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

4.5.1 Test Limit

According to §15.247(d),

In any 100 kHz bandwidth outside the authorized frequency band,

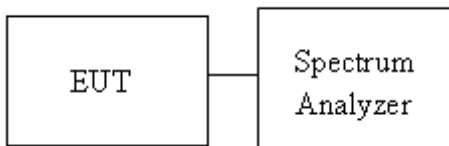
Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

4.5.2 Test Procedure

Test method Refer as ANSI C63.10:2013.

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.
2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.
3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

4.5.3 Test Setup



4.5.4 Test Result

Non-Beamforming

Temperature: 24.8°C

Test date: April 21, 2023

Humidity: 64% RH

Tested by: Marco Chan

Test Data

Chain 0

