

9 FCC §15.247(a)(2) and RSS-247 Sec 5.2 – 6 dB Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a) (2),

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

According to RSS-247 §5.2

The minimum 6 dB bandwidth shall be 500 kHz.

According to RSS-GEN §6.7

The emission bandwidth (\times dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated \times dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3 \times the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured

9.2 Test Procedure

According to ANSI C63.10-2013, the steps for the first option are as follows:

(1) Set RBW = 100 kHz. (2) Set the VBW \geq [3 \times RBW]. (3) Detector = peak. (4) Trace mode = max hold.

(5) Sweep = auto couple. (6) Allow the trace to stabilize. (7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

9.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	101457	2019/06/24	2020/06/23
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).

9.4 Test Results

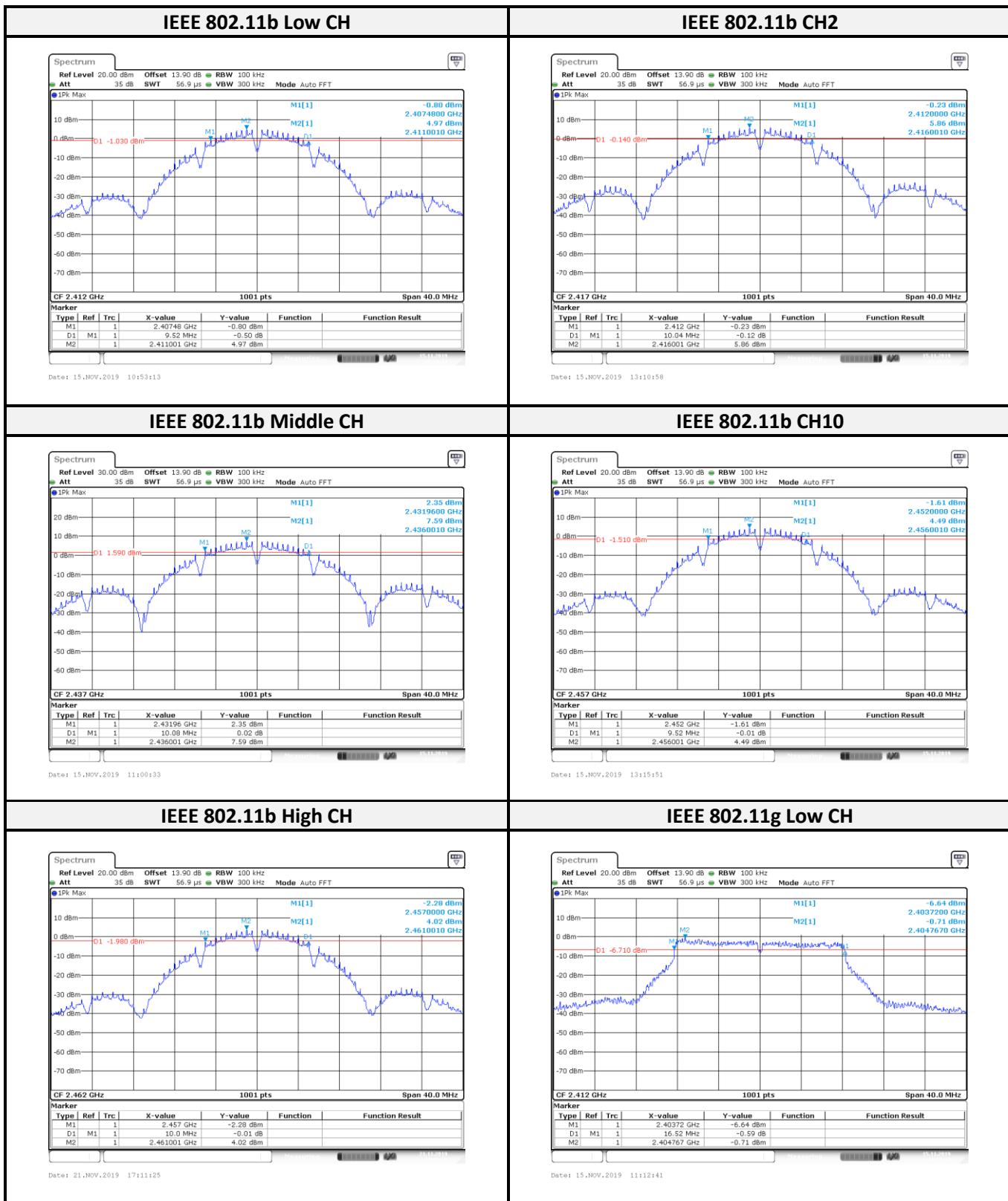
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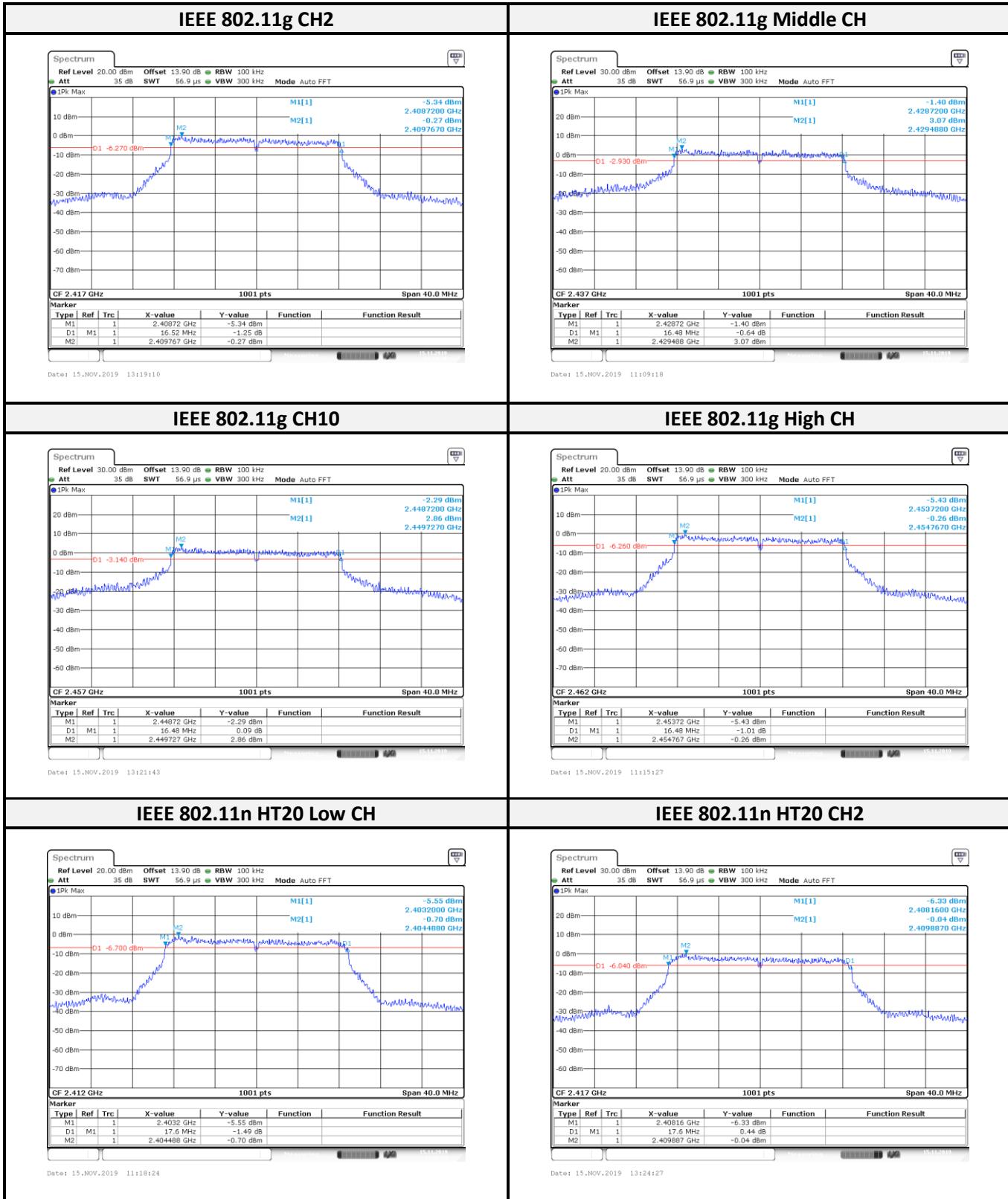
Configuration	Channel	Frequency (MHz)	99% OBW (MHz)	6 dB BW (MHz)	6dB Limit (MHz)	Result
IEEE 802.11b	Low	2412	14.5854	9.52	> 0.5	Compliance
	Ch2	2417	14.9850	10.04	> 0.5	Compliance
	Mid	2437	17.5824	10.08	> 0.5	Compliance
	Ch10	2457	14.6653	9.52	> 0.5	Compliance
	High	2462	14.6653	10.00	> 0.5	Compliance
IEEE 802.11g	Low	2412	16.8631	16.52	> 0.5	Compliance
	Ch2	2417	16.9830	16.52	> 0.5	Compliance
	Mid	2437	23.5365	16.48	> 0.5	Compliance
	Ch10	2457	22.6174	16.48	> 0.5	Compliance
	High	2462	17.0230	16.48	> 0.5	Compliance
IEEE 802.11n HT20	Low	2412	17.7423	17.60	> 0.5	Compliance
	Ch2	2417	17.7822	17.60	> 0.5	Compliance
	Mid	2437	23.9361	17.60	> 0.5	Compliance
	Ch10	2457	23.4965	17.60	> 0.5	Compliance
	High	2462	17.8222	17.60	> 0.5	Compliance
IEEE 802.11n HT40	Low	2422	36.2837	36.40	> 0.5	Compliance
	Mid	2437	36.2837	36.48	> 0.5	Compliance
	High	2452	36.2038	36.40	> 0.5	Compliance

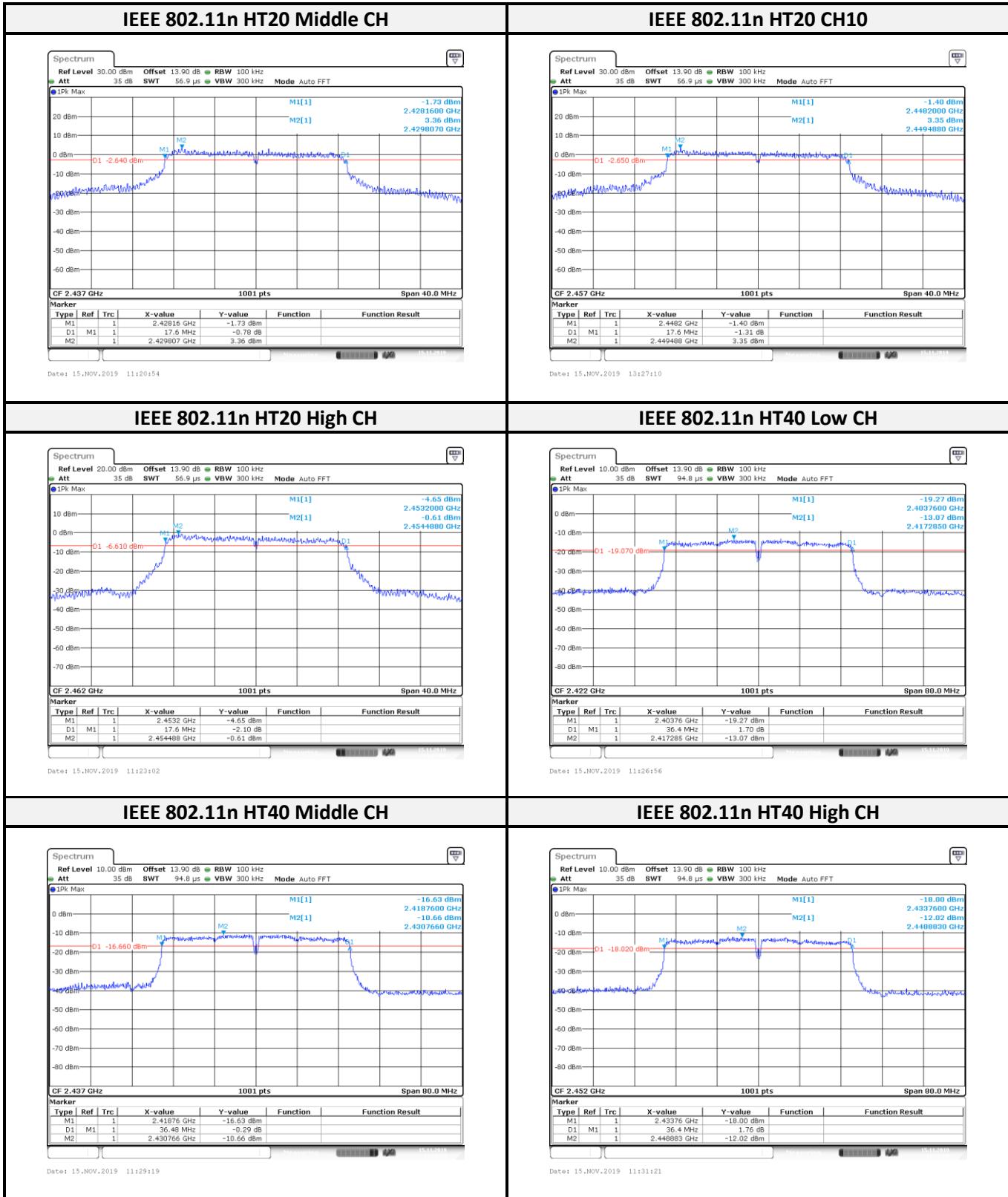
<Chip Antenna 3.3V>

Configuration	Channel	Frequency (MHz)	99% OBW (MHz)	6 dB BW (MHz)	6dB Limit (MHz)	Result
IEEE 802.11b	Low	2412	14.1459	9.04	> 0.5	Compliance
	Mid	2437	13.8661	9.04	> 0.5	Compliance
	High	2462	13.7063	9.04	> 0.5	Compliance
IEEE 802.11g	Low	2412	16.7832	16.56	> 0.5	Compliance
	Mid	2437	16.7433	16.52	> 0.5	Compliance
	High	2462	16.7433	16.60	> 0.5	Compliance
IEEE 802.11n HT20	Low	2412	17.6623	17.64	> 0.5	Compliance
	Mid	2437	17.6224	17.64	> 0.5	Compliance
	High	2462	17.6623	17.64	> 0.5	Compliance
IEEE 802.11n HT40	Low	2422	36.3636	36.56	> 0.5	Compliance
	Mid	2437	36.3636	36.48	> 0.5	Compliance
	High	2452	36.3636	36.56	> 0.5	Compliance

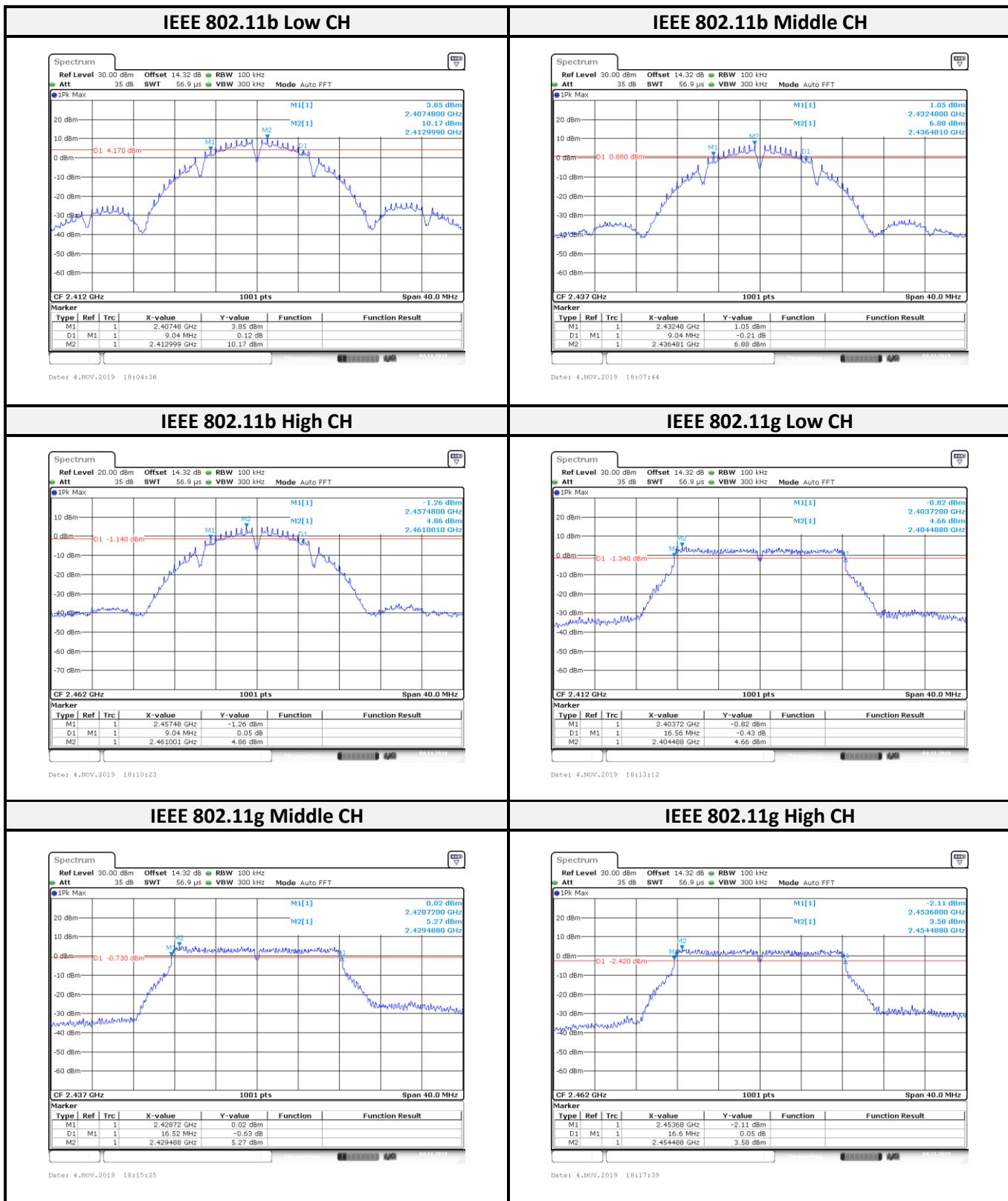
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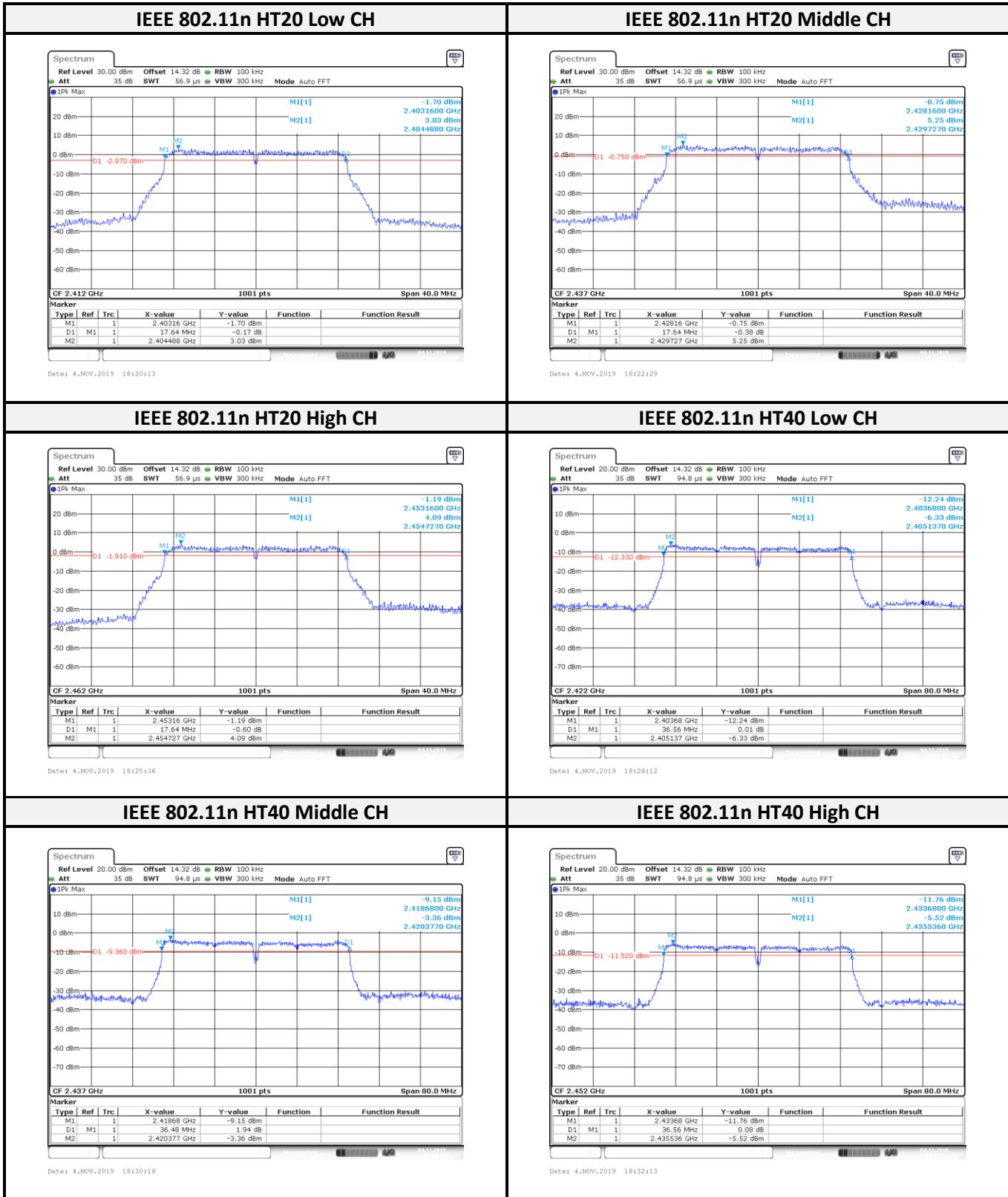




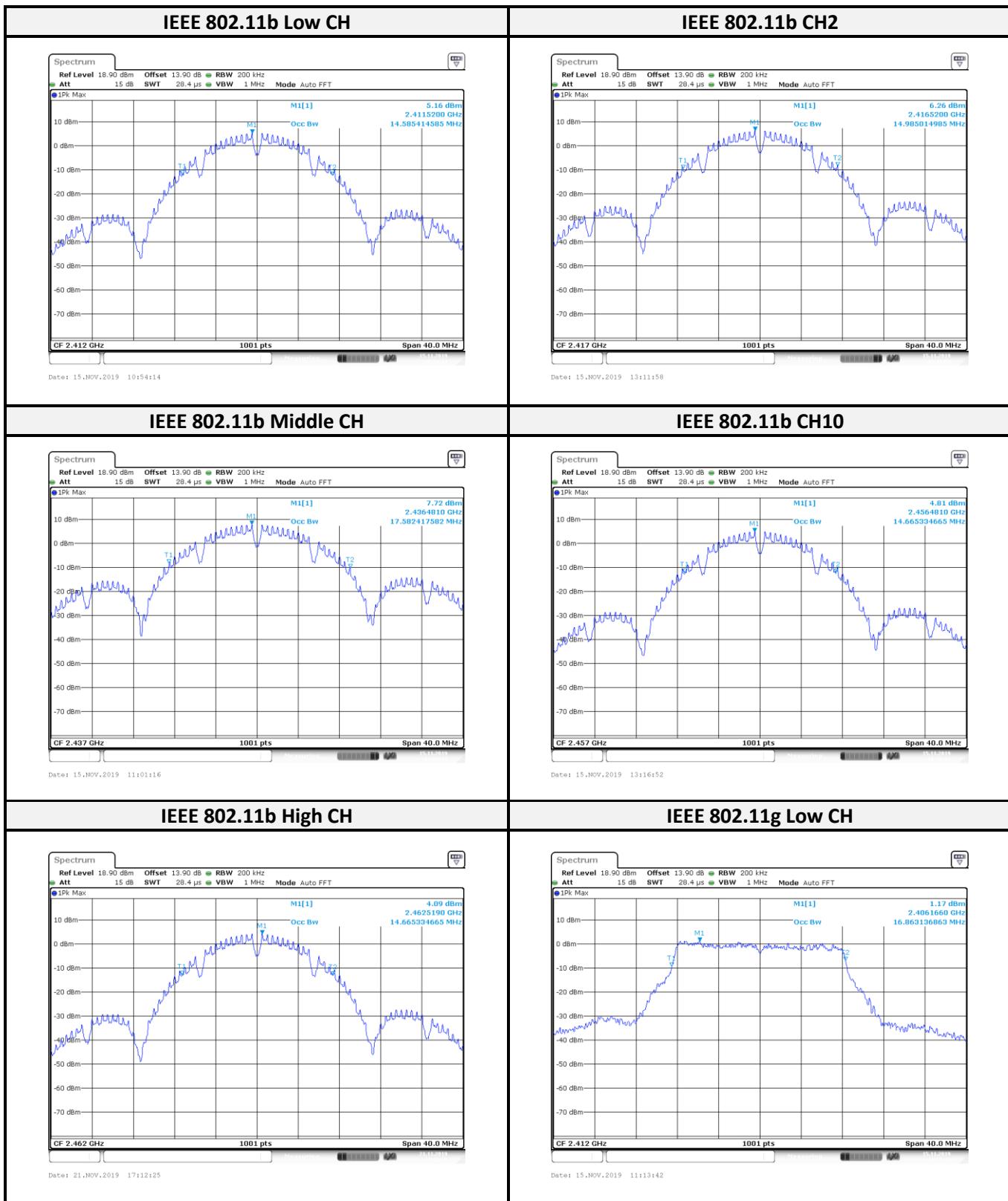


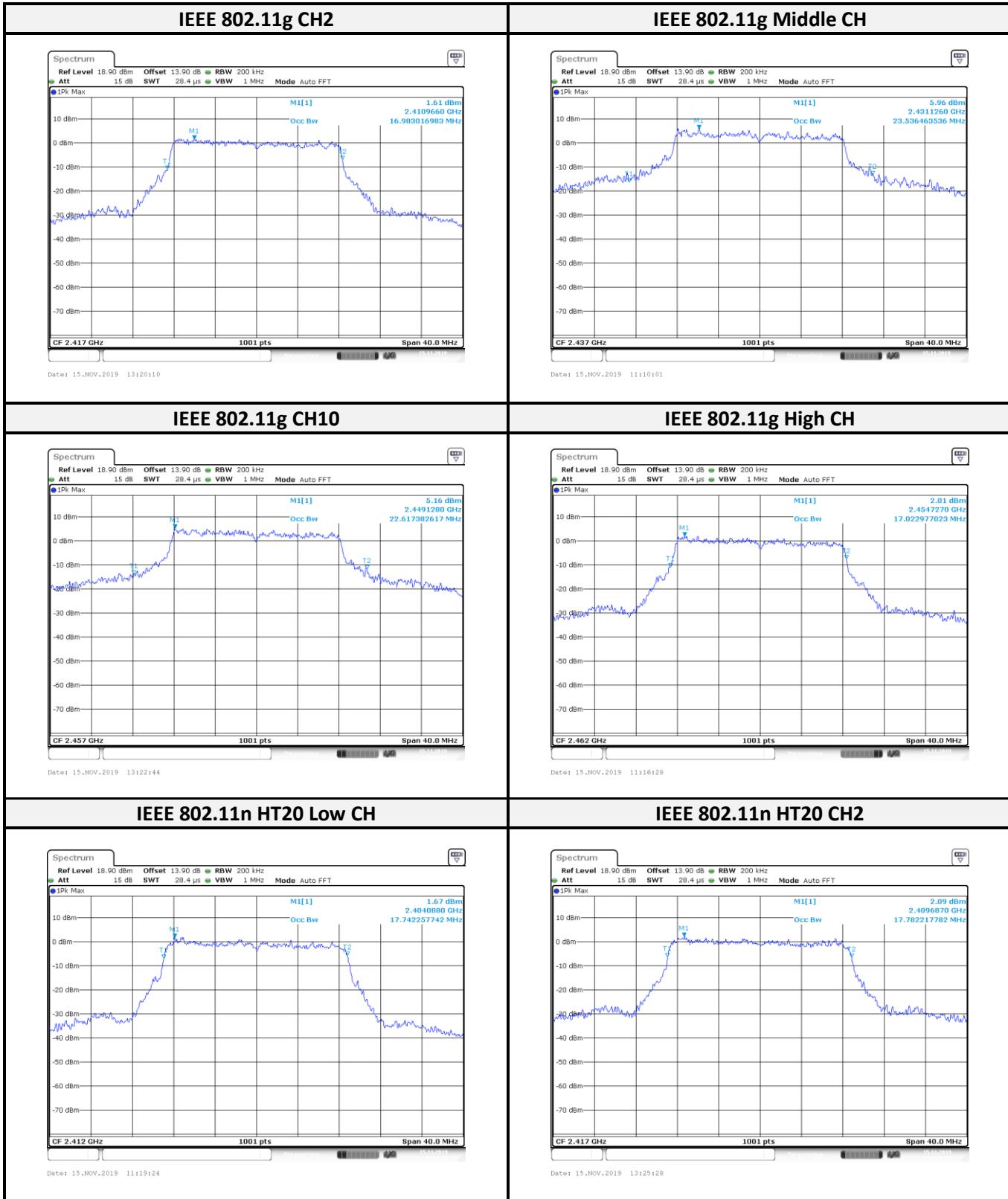
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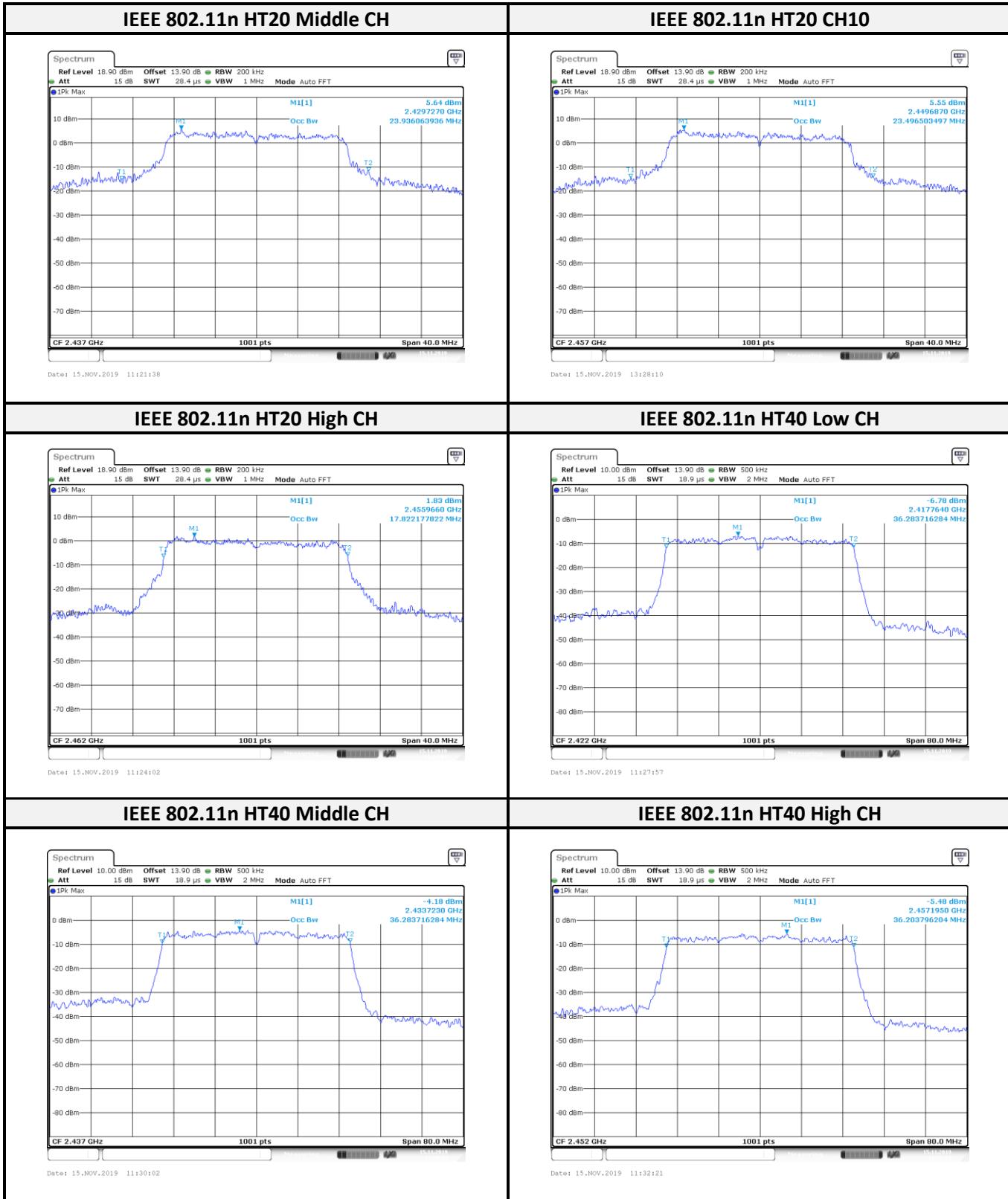




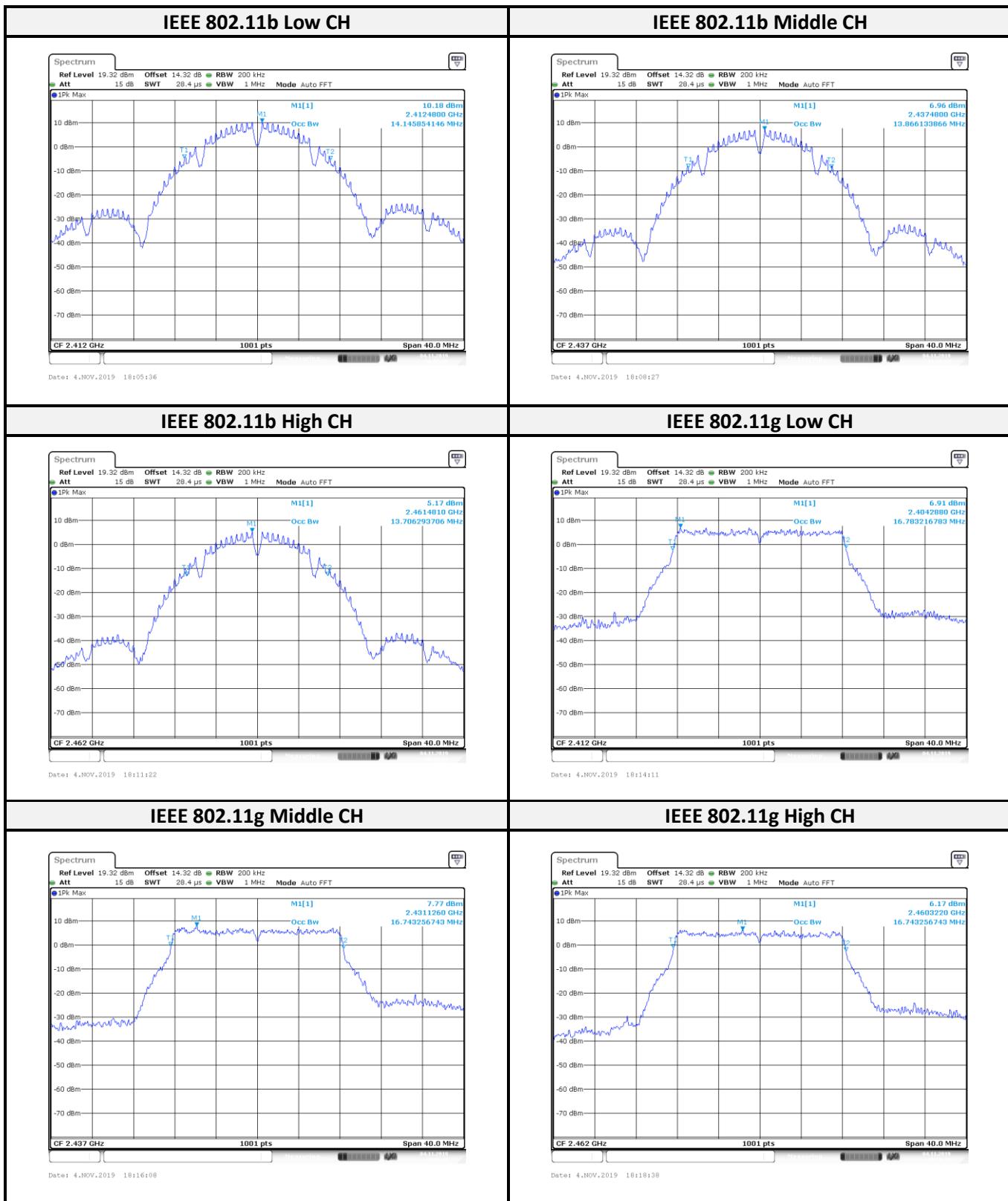
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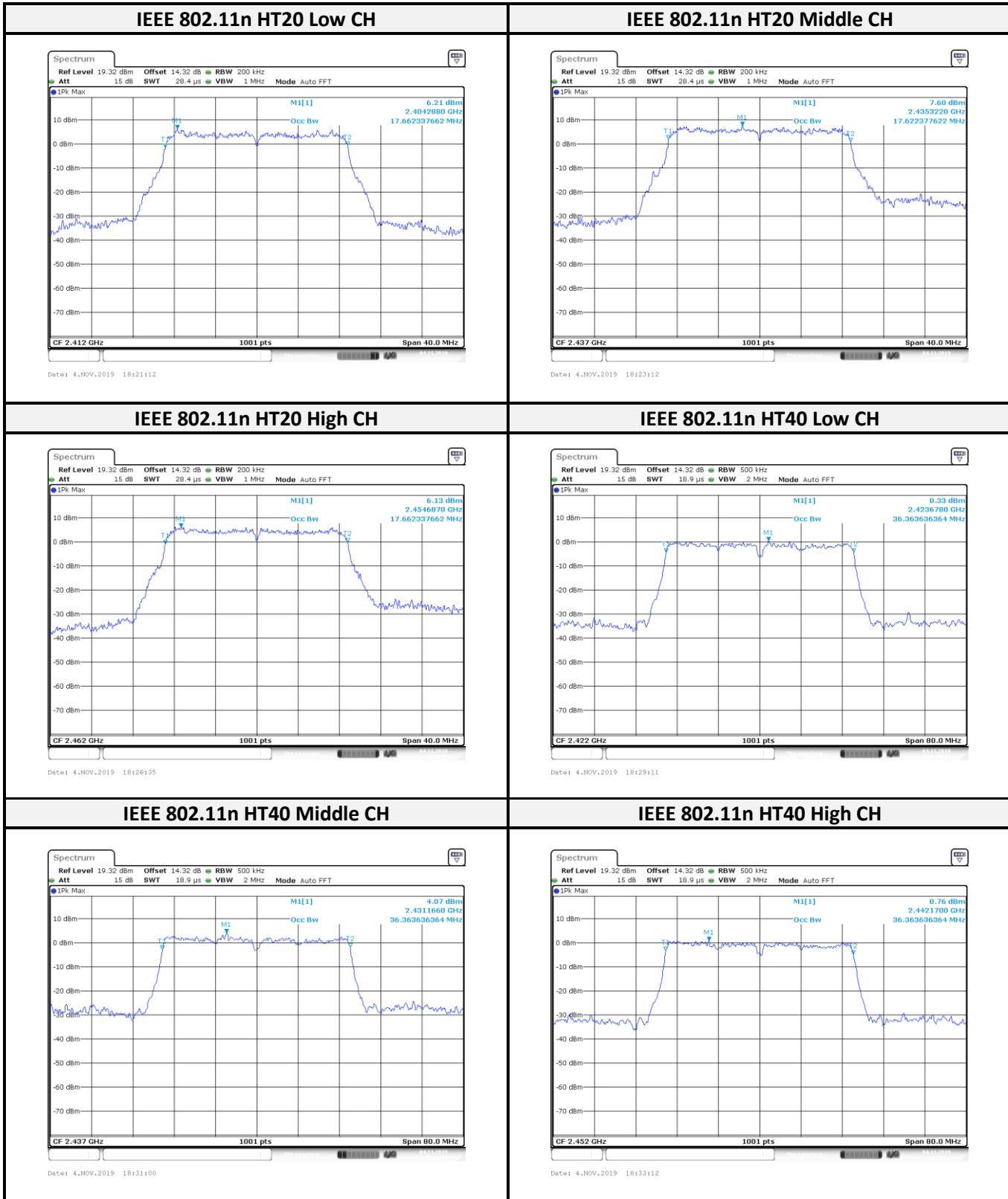






<Chip Antenna 3.3V, 99% OBW>





10 FCC §15.247(b) (3) and RSS-247 Sec 5.4(d) – Maximum Output Power

10.1 Applicable Standard

According to FCC §15.247(b) (3),

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to RSS-247 §5.4(d).

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

10.2 Test Procedure

(1) Place the EUT on a bench and set it in transmitting mode.

(2) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment. (3). Add a correction factor to the display.

10.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
USB Wideband Power Sensor	Agilent	U2021XA	MY54250014	2018/11/22	2019/11/21
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).

10.4 Test Results

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Configuration	Channel	Frequency (MHz)	Maximum Peak Output Power (dBm)	Maximum Peak Output Power (W)	Limit (dBm)	Result
IEEE 802.11b	Low	2412	17.42	0.0552	30 dBm	Compliance
	Ch2	2417	18.01	0.0632	30 dBm	Compliance
	Mid	2437	18.39	0.0690	30 dBm	Compliance
	Ch10	2457	17.17	0.0521	30 dBm	Compliance
	High	2462	16.94	0.0494	30 dBm	Compliance
IEEE 802.11g	Low	2412	17.21	0.0526	30 dBm	Compliance
	Ch2	2417	18.62	0.0728	30 dBm	Compliance
	Mid	2437	18.44	0.0698	30 dBm	Compliance
	Ch10	2457	18.68	0.0738	30 dBm	Compliance
	High	2462	17.42	0.0552	30 dBm	Compliance
IEEE 802.11n HT20	Low	2412	17.23	0.0528	30 dBm	Compliance
	Ch2	2417	18.57	0.0719	30 dBm	Compliance
	Mid	2437	18.45	0.0700	30 dBm	Compliance
	Ch10	2457	18.64	0.0731	30 dBm	Compliance
	High	2462	17.36	0.0545	30 dBm	Compliance
IEEE 802.11n HT40	Low	2422	11.15	0.0130	30 dBm	Compliance
	Mid	2437	13.75	0.0237	30 dBm	Compliance
	High	2452	14.87	0.0307	30 dBm	Compliance

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Configuration	Channel	Frequency (MHz)	Average Output Power (dBm)	Average Output Power (W)	Limit (dBm)	Result
IEEE 802.11b	Low	2412	15.56	0.0360	30 dBm	Compliance
	Ch2	2417	16.34	0.0431	30 dBm	Compliance
	Mid	2437	16.87	0.0486	30 dBm	Compliance
	Ch10	2457	15.33	0.0341	30 dBm	Compliance
	High	2462	15.18	0.0330	30 dBm	Compliance
IEEE 802.11g	Low	2412	13.34	0.0216	30 dBm	Compliance
	Ch2	2417	14.41	0.0276	30 dBm	Compliance
	Mid	2437	15.57	0.0361	30 dBm	Compliance
	Ch10	2457	15.49	0.0354	30 dBm	Compliance
	High	2462	13.79	0.0239	30 dBm	Compliance
IEEE 802.11n HT20	Low	2412	13.44	0.0221	30 dBm	Compliance
	Ch2	2417	14.39	0.0275	30 dBm	Compliance
	Mid	2437	15.57	0.0361	30 dBm	Compliance
	Ch10	2457	15.49	0.0354	30 dBm	Compliance
	High	2462	13.80	0.0240	30 dBm	Compliance
IEEE 802.11n HT40	Low	2422	5.18	0.0033	30 dBm	Compliance
	Mid	2437	6.47	0.0044	30 dBm	Compliance
	High	2452	9.05	0.0080	30 dBm	Compliance

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Configuration	Channel	Frequency (MHz)	Maximum Peak Output Power (dBm)	Maximum Peak Output Power (W)	Limit (dBm)	Result
IEEE 802.11b	Low	2412	20.26	0.1062	30 dBm	Compliance
	Mid	2437	17.17	0.0521	30 dBm	Compliance
	High	2462	15.33	0.0341	30 dBm	Compliance
IEEE 802.11g	Low	2412	21.23	0.1327	30 dBm	Compliance
	Mid	2437	21.75	0.1496	30 dBm	Compliance
	High	2462	20.75	0.1189	30 dBm	Compliance
IEEE 802.11n HT20	Low	2412	20.25	0.1059	30 dBm	Compliance
	Mid	2437	21.75	0.1496	30 dBm	Compliance
	High	2462	20.58	0.1143	30 dBm	Compliance
IEEE 802.11n HT40	Low	2422	15.72	0.0373	30 dBm	Compliance
	Mid	2437	18.57	0.0719	30 dBm	Compliance
	High	2452	16.56	0.0453	30 dBm	Compliance

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Configuration	Channel	Frequency (MHz)	Average Output Power (dBm)	Average Output Power (W)	Limit (dBm)	Result
IEEE 802.11b	Low	2412	18.04	0.0637	30 dBm	Compliance
	Mid	2437	14.83	0.0304	30 dBm	Compliance
	High	2462	12.95	0.0197	30 dBm	Compliance
IEEE 802.11g	Low	2412	17.22	0.0527	30 dBm	Compliance
	Mid	2437	17.92	0.0619	30 dBm	Compliance
	High	2462	16.77	0.0475	30 dBm	Compliance
IEEE 802.11n HT20	Low	2412	16.24	0.0421	30 dBm	Compliance
	Mid	2437	17.89	0.0615	30 dBm	Compliance
	High	2462	16.61	0.0458	30 dBm	Compliance
IEEE 802.11n HT40	Low	2422	10.01	0.0100	30 dBm	Compliance
	Mid	2437	12.84	0.0192	30 dBm	Compliance
	High	2452	10.76	0.0119	30 dBm	Compliance

11 FCC §15.247(d) and RSS-247 Sec 5.5 – 100 kHz Bandwidth of Frequency Band Edge

11.1 Applicable Standard

According to FCC §15.247(d),

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions 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) (see §15.205(c)).

According to RSS-247 §5.5. In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

11.2 Test Procedure

- (1) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- (2) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- (3) Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- (4) Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.

11.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	101457	2019/06/24	2020/06/23
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).

11.4 Test Results

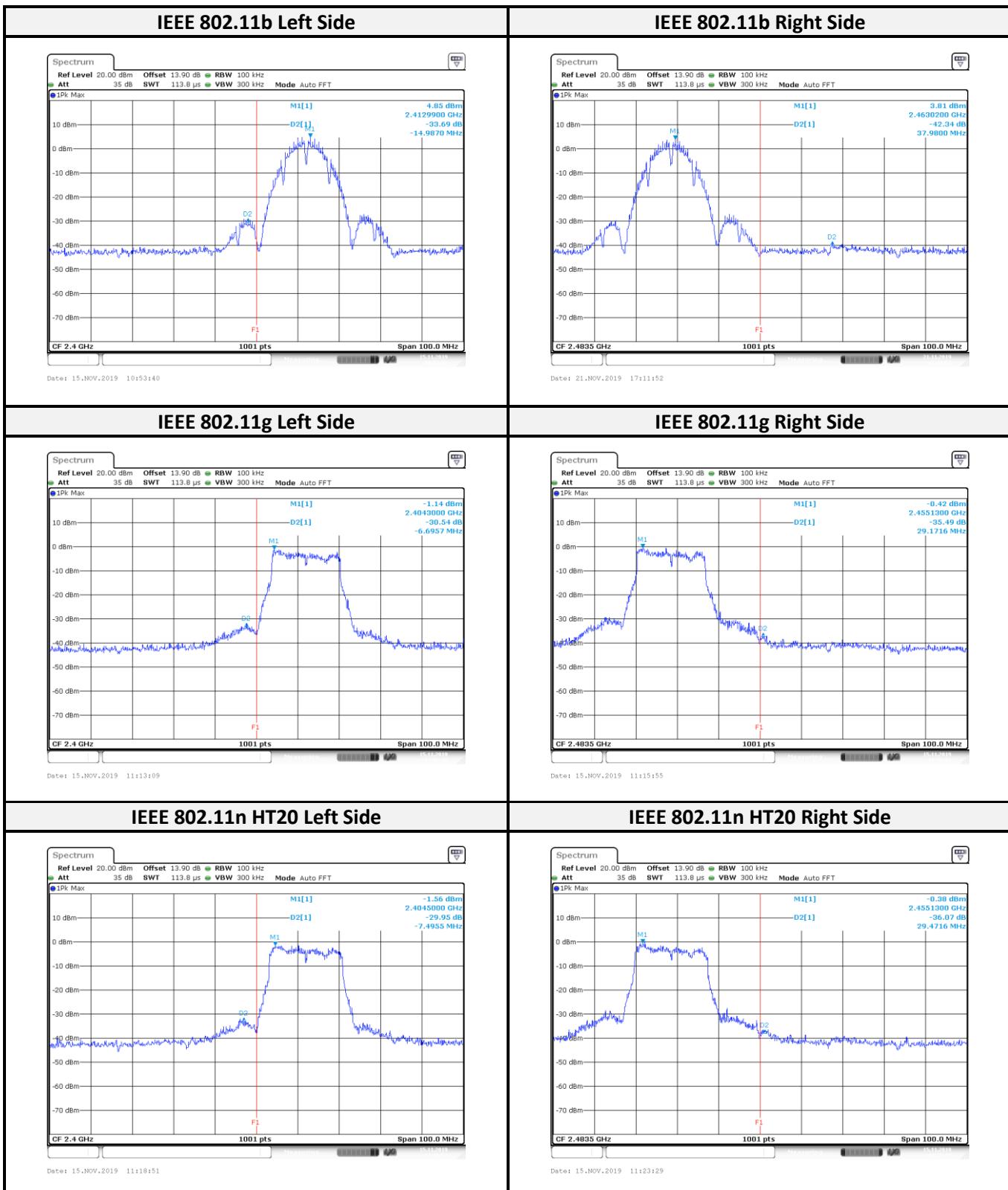
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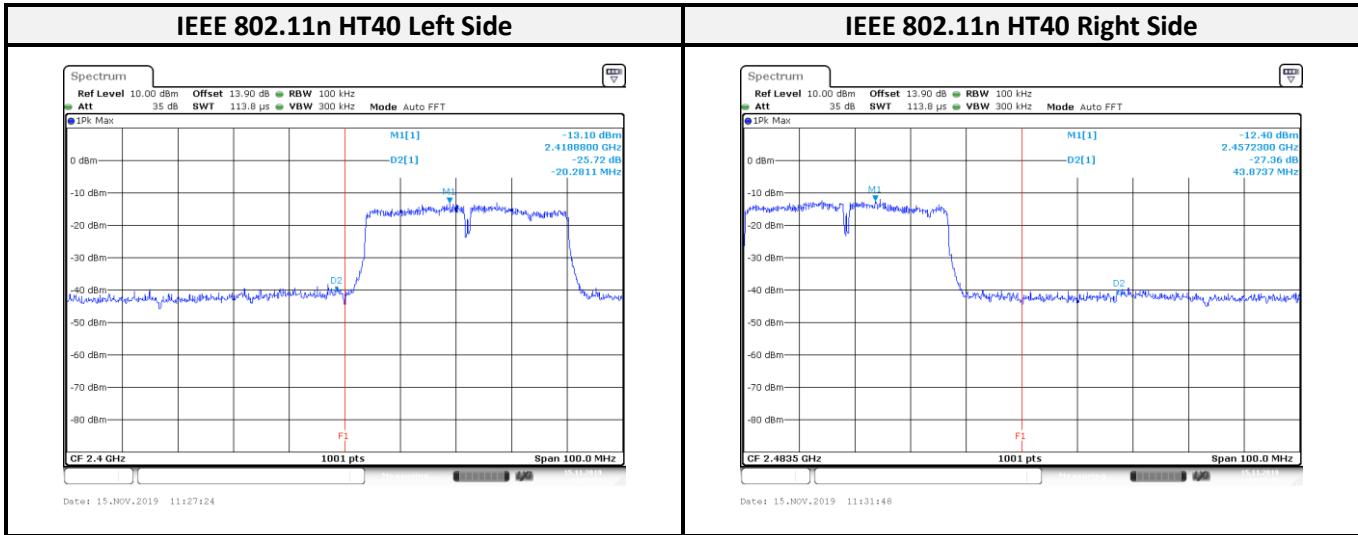
Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
IEEE 802.11b	Low	2412	33.69	≥ 20	Compliance
	High	2462	42.34	≥ 20	Compliance
IEEE 802.11g	Low	2412	30.54	≥ 20	Compliance
	High	2462	35.49	≥ 20	Compliance
IEEE 802.11n HT20	Low	2412	29.95	≥ 20	Compliance
	High	2462	36.07	≥ 20	Compliance
IEEE 802.11n HT40	Low	2422	25.72	≥ 20	Compliance
	High	2452	27.36	≥ 20	Compliance

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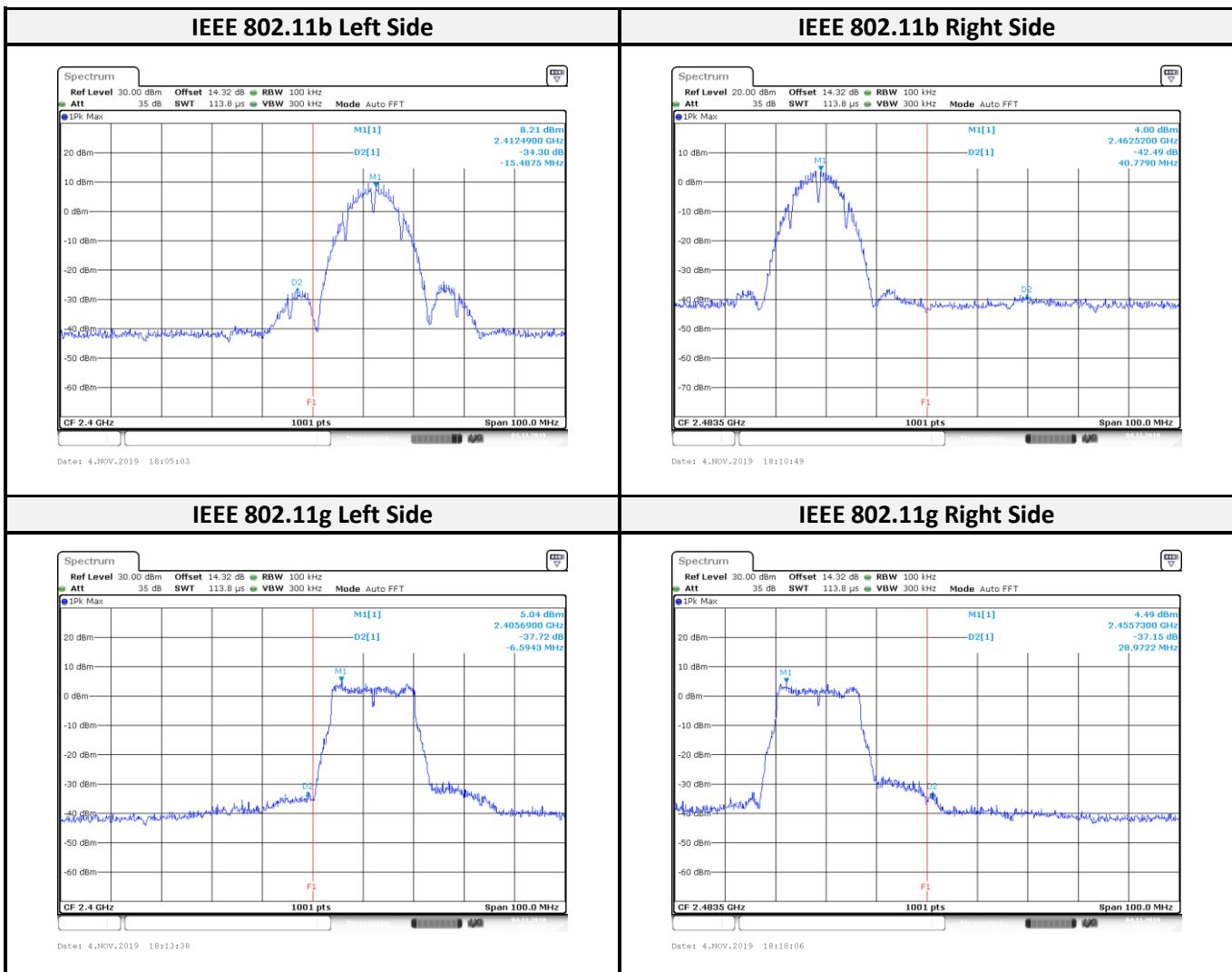
Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
IEEE 802.11b	Low	2412	34.30	≥ 20	Compliance
	High	2462	42.49	≥ 20	Compliance
IEEE 802.11g	Low	2412	37.72	≥ 20	Compliance
	High	2462	37.15	≥ 20	Compliance
IEEE 802.11n HT20	Low	2412	36.51	≥ 20	Compliance
	High	2462	35.12	≥ 20	Compliance
IEEE 802.11n HT40	Low	2422	29.98	≥ 20	Compliance
	High	2452	29.22	≥ 20	Compliance

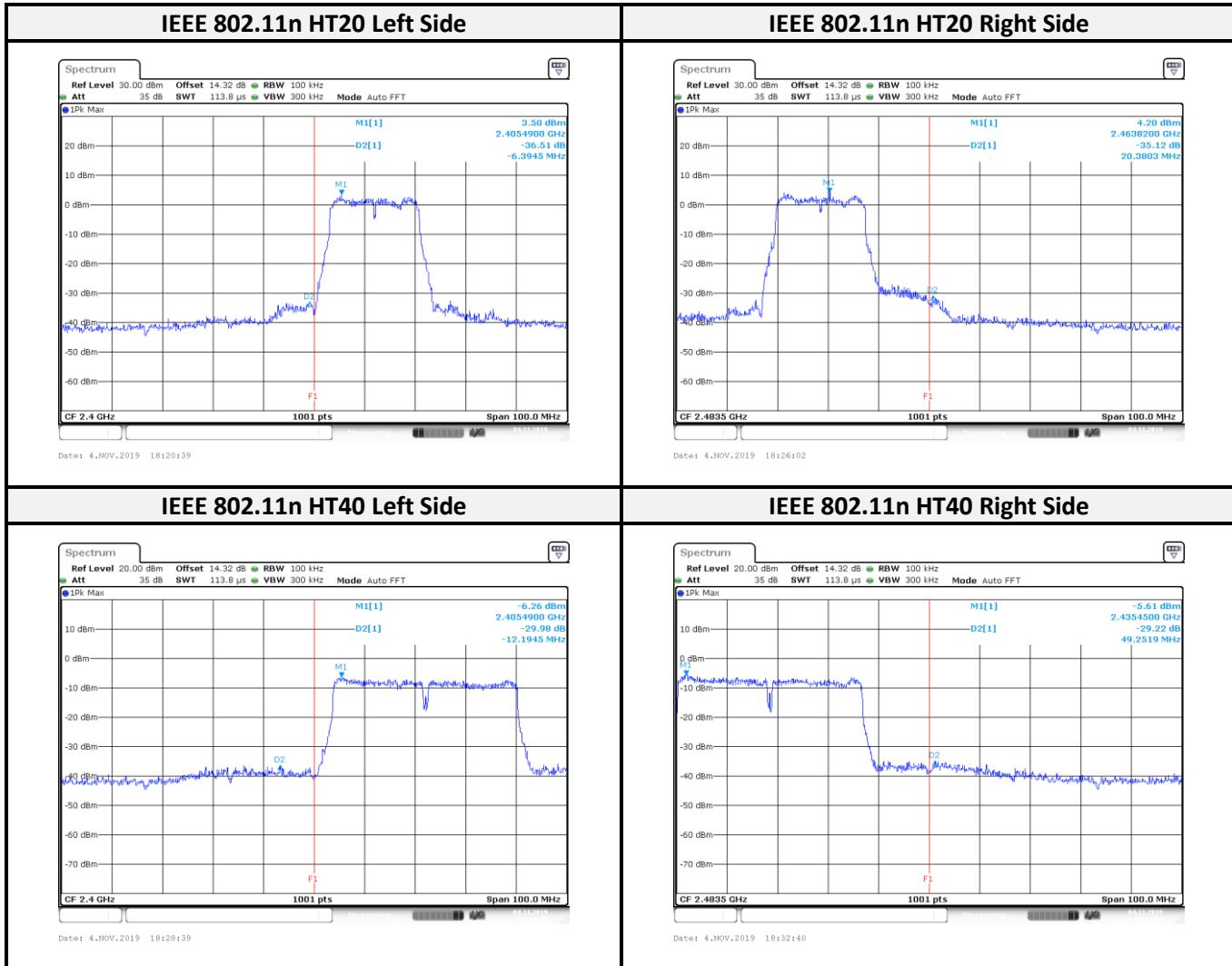
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12 FCC §15.247(e) and RSS-247 Sec 5.2(b)– Power Spectral Density

12.1 Applicable Standard

According to FCC §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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

According to RSS-247 §5.2(b).

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

12.2 Test Procedure

According to ANSI C63.10-2013,

- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth. (3) Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- (4) Set the VBW $\geq [3 \times \text{RBW}]$. (5) Detector = peak. (6) Sweep time = auto couple.
- (7) Trace mode = max hold. (8) Allow trace to fully stabilize.
- (9) Use the peak marker function to determine the maximum amplitude level within the RBW.
- (10) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

12.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	101457	2019/06/24	2020/06/23
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).

12.4 Test Results

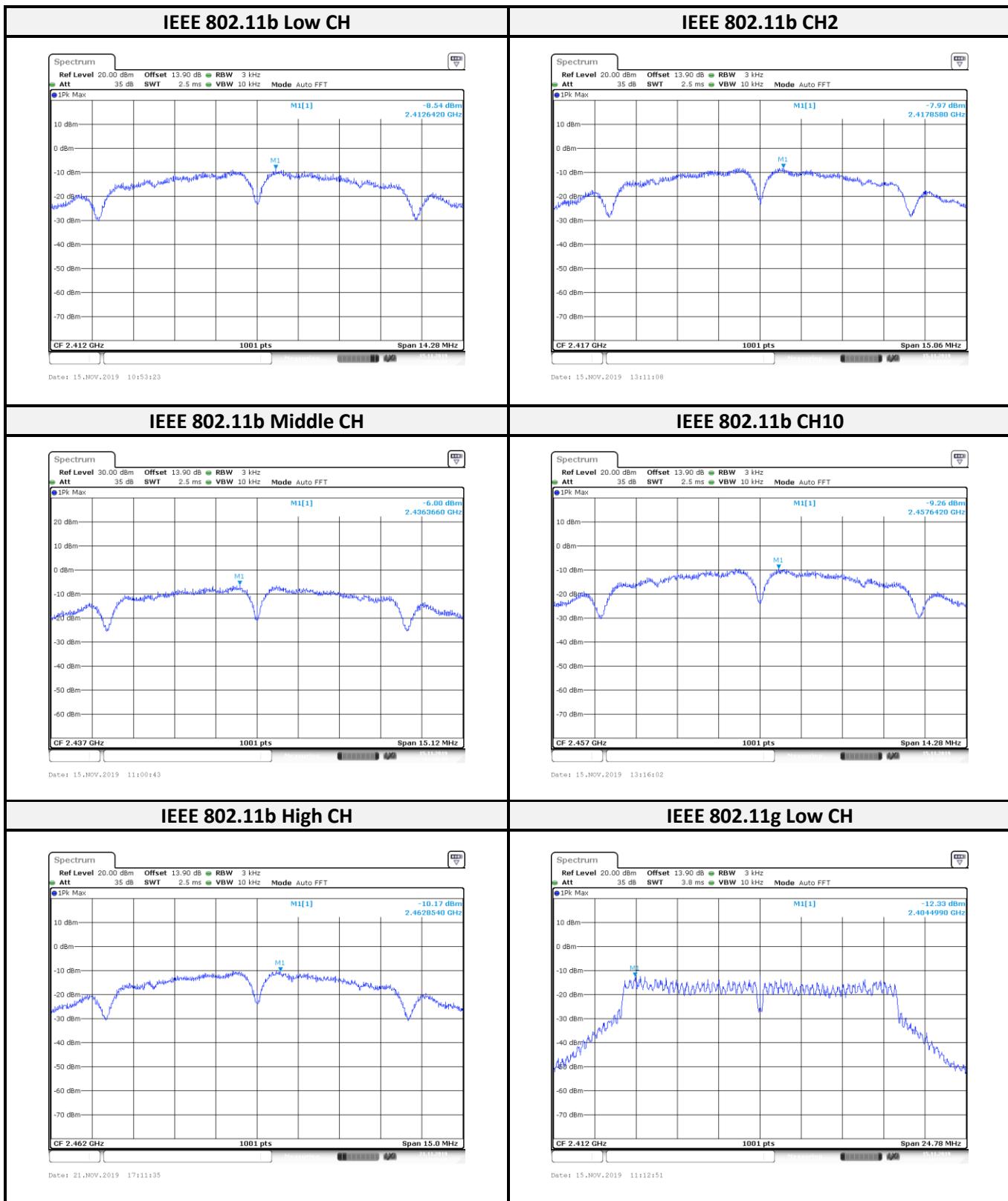
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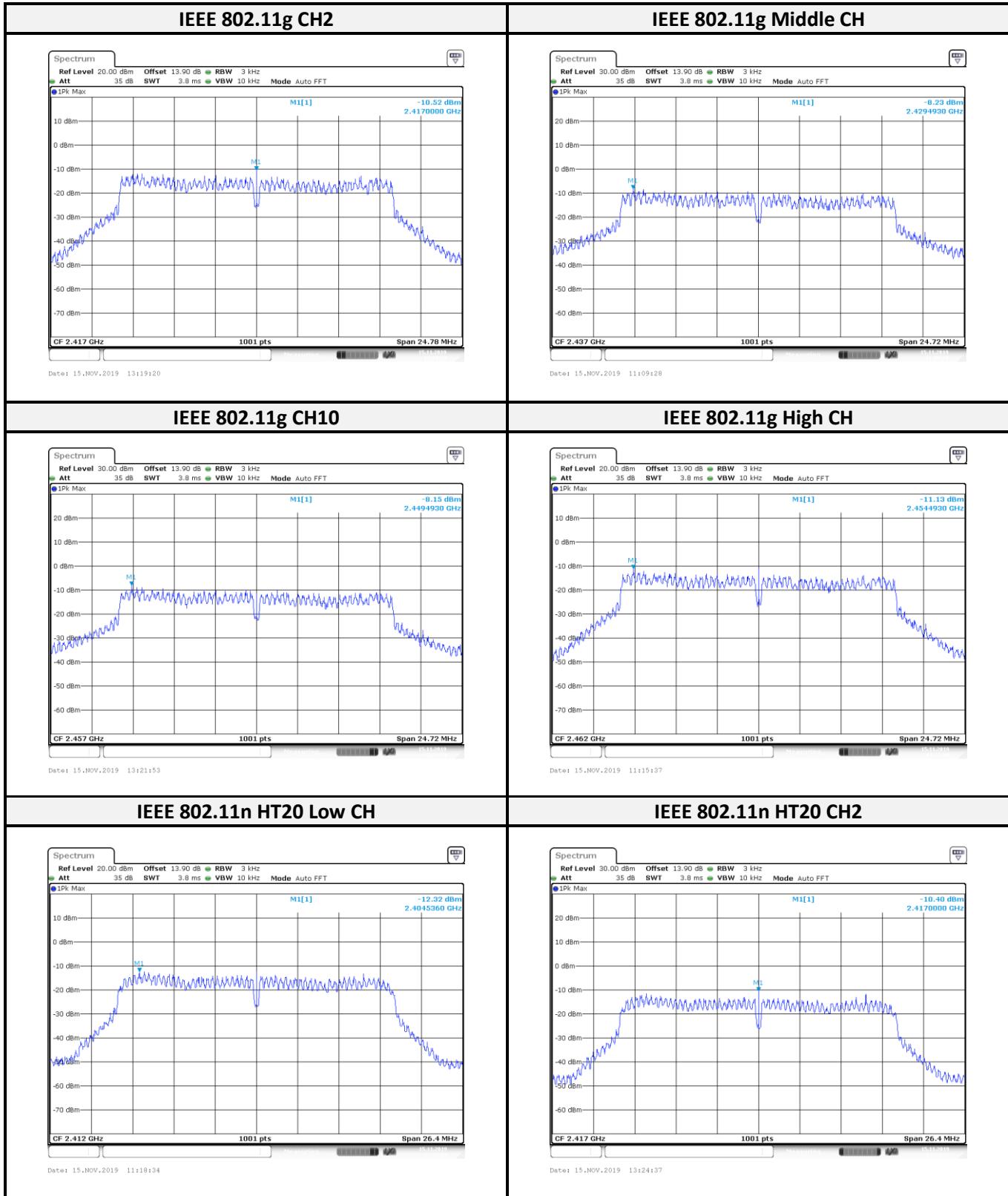
Configuration	Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
IEEE 802.11b	Low	2412	-8.54	8	Compliance
	Ch2	2417	-7.97	8	Compliance
	Mid	2437	-6.00	8	Compliance
	Ch10	2457	-9.26	8	Compliance
	High	2462	-10.17	8	Compliance
IEEE 802.11g	Low	2412	-12.33	8	Compliance
	Ch2	2417	-10.52	8	Compliance
	Mid	2437	-8.23	8	Compliance
	Ch10	2457	-8.15	8	Compliance
	High	2462	-11.13	8	Compliance
IEEE 802.11n HT20	Low	2412	-12.32	8	Compliance
	Ch2	2417	-10.40	8	Compliance
	Mid	2437	-8.66	8	Compliance
	Ch10	2457	-8.56	8	Compliance
	High	2462	-10.11	8	Compliance
IEEE 802.11n HT40	Low	2422	-21.56	8	Compliance
	Mid	2437	-17.98	8	Compliance
	High	2452	-19.95	8	Compliance

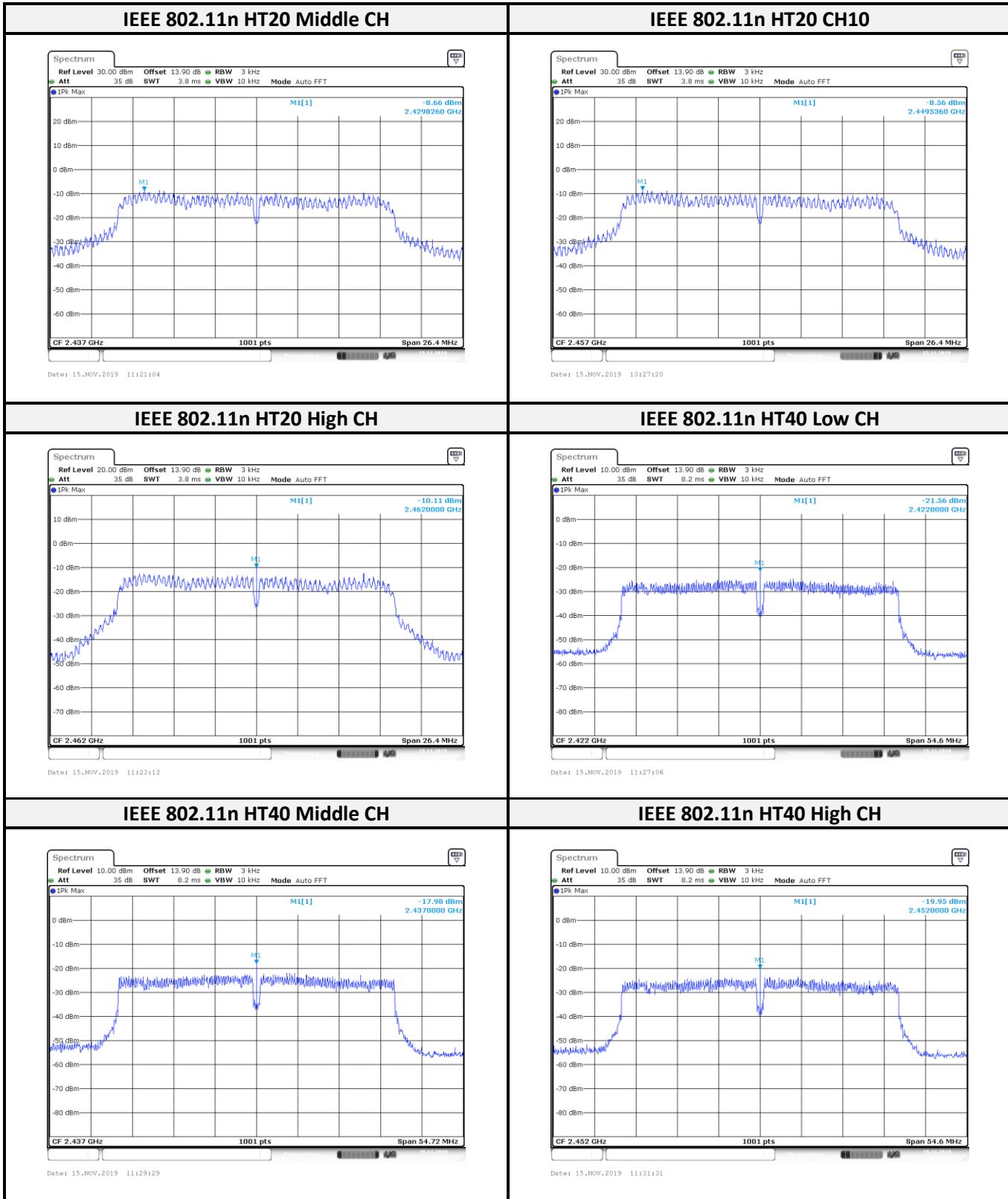
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Configuration	Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
IEEE 802.11b	Low	2412	-3.39	8	Compliance
	Mid	2437	-7.04	8	Compliance
	High	2462	-8.48	8	Compliance
IEEE 802.11g	Low	2412	-6.66	8	Compliance
	Mid	2437	-5.28	8	Compliance
	High	2462	-6.85	8	Compliance
IEEE 802.11n HT20	Low	2412	-6.79	8	Compliance
	Mid	2437	-5.45	8	Compliance
	High	2462	-6.79	8	Compliance
IEEE 802.11n HT40	Low	2422	-16.17	8	Compliance
	Mid	2437	-13.14	8	Compliance
	High	2452	-15.84	8	Compliance

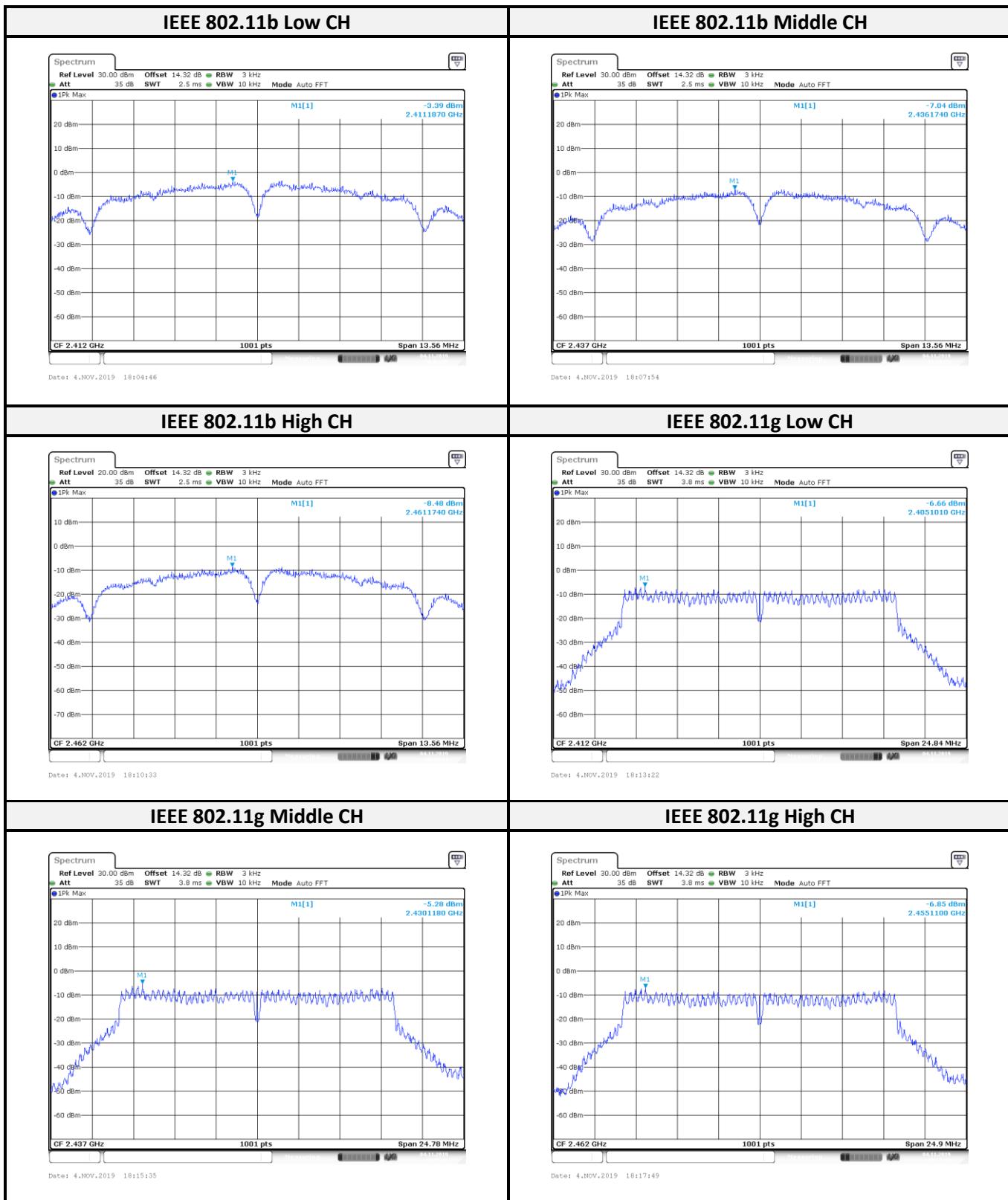
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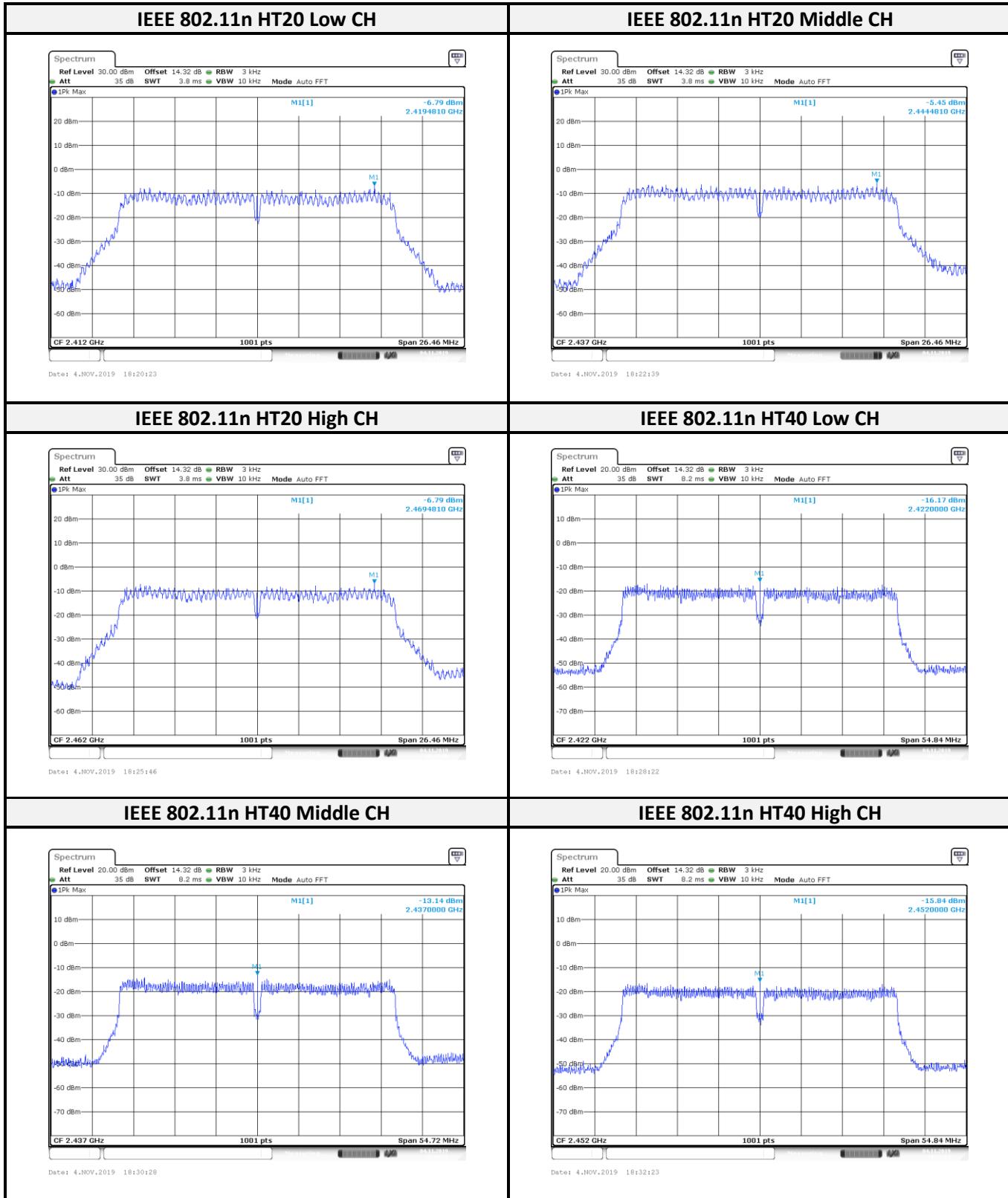






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