9 FCC §15.247(a)(2) and RSS-247 Sec 5.2 – 6 dB Emission Bandwidth and RSS-Gen Sec 6.7 99% OBW

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 a),
The minimum 6 dB bandwidth shall be 500 kHz.

According to RSS-Gen §6.7,

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

9.2 Test Procedure

6 dB Emission Bandwidth

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

(1) Set RBW = 100 kHz. (2) Set the VBW ≥ [3 × 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.

99% Emission Bandwidth

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

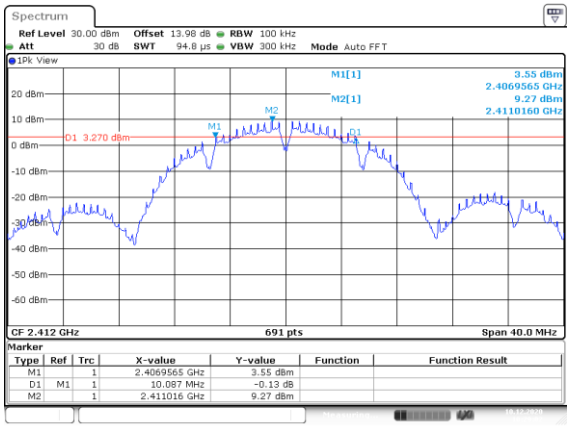
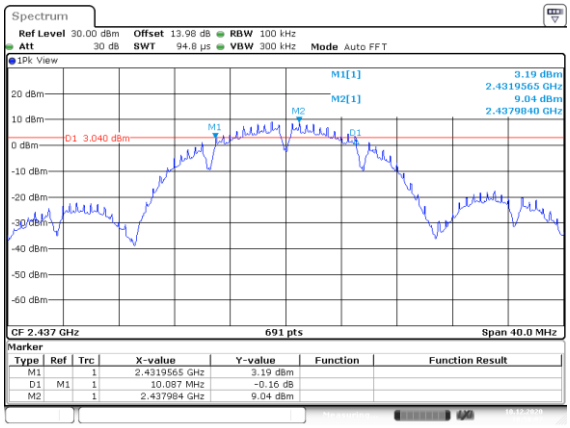
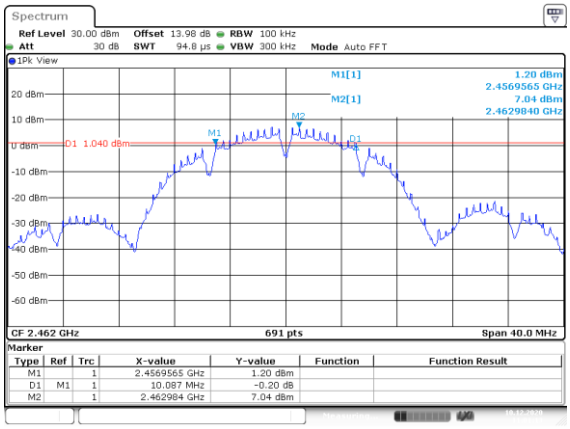
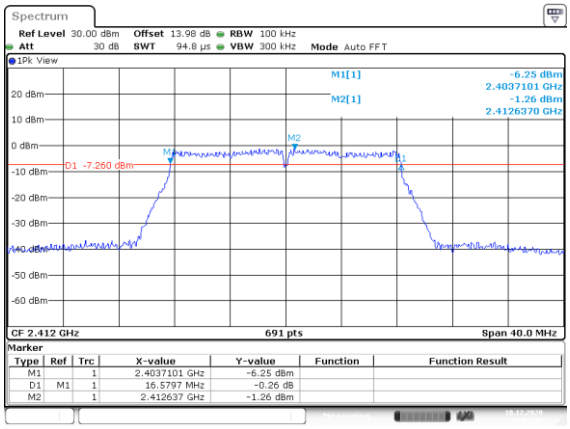
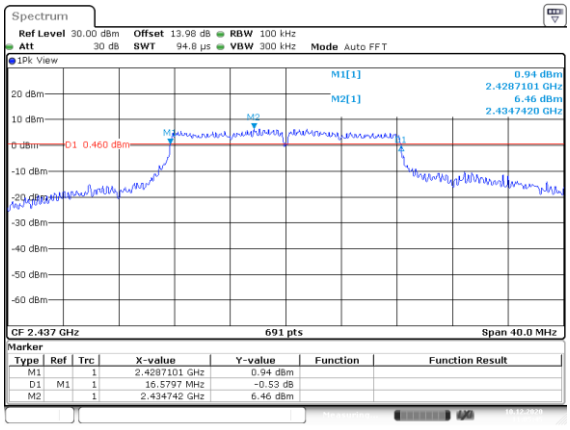
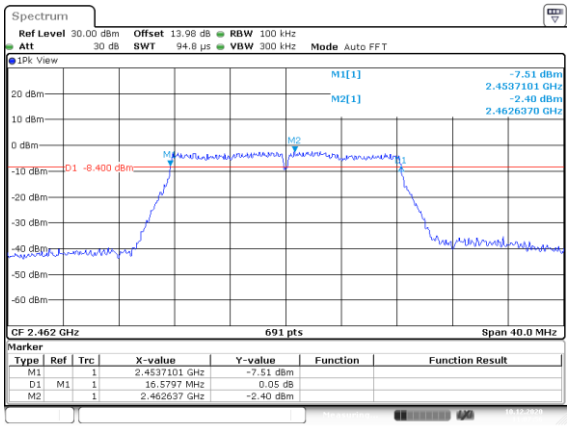
9.3 Test Equipment List and Details

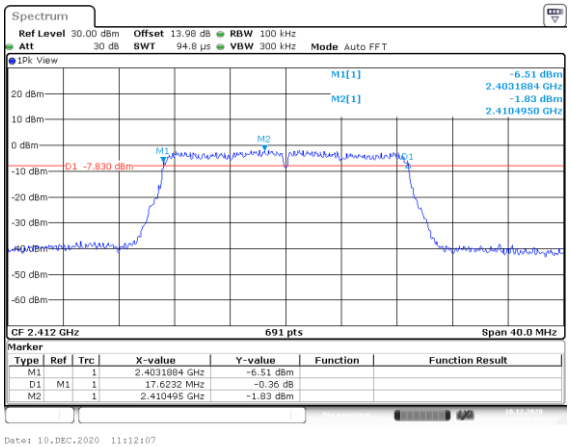
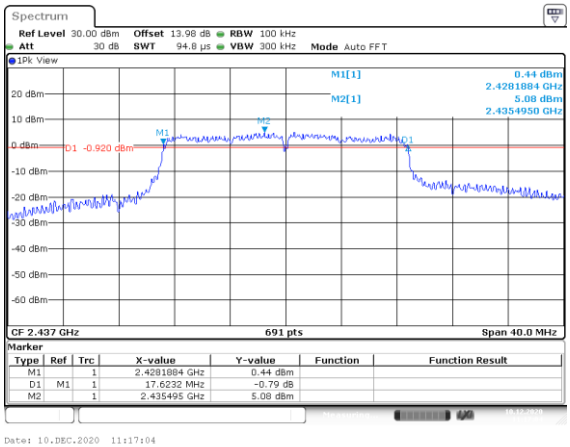
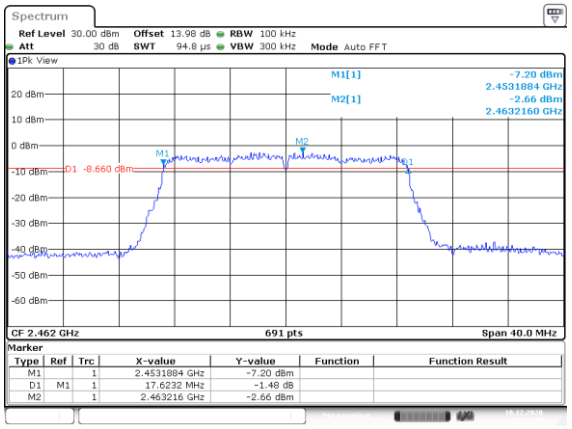
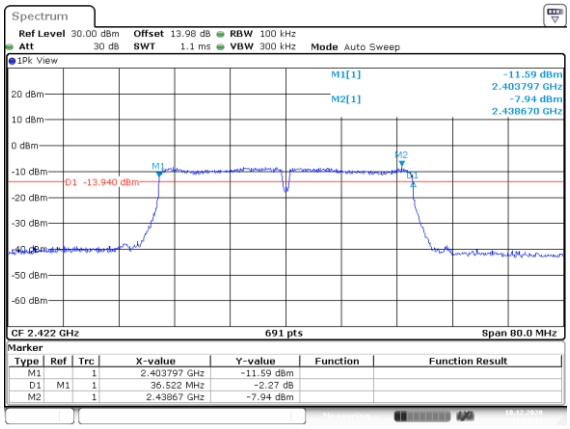
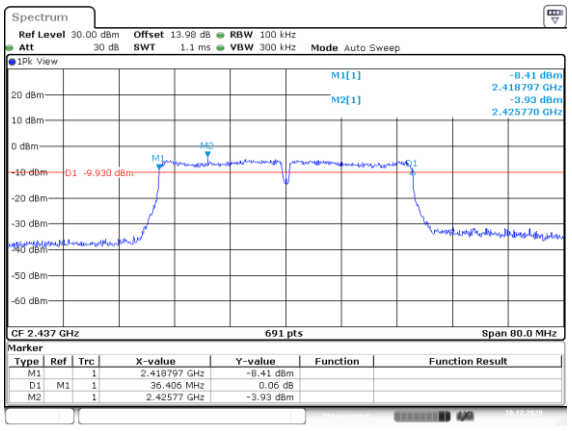
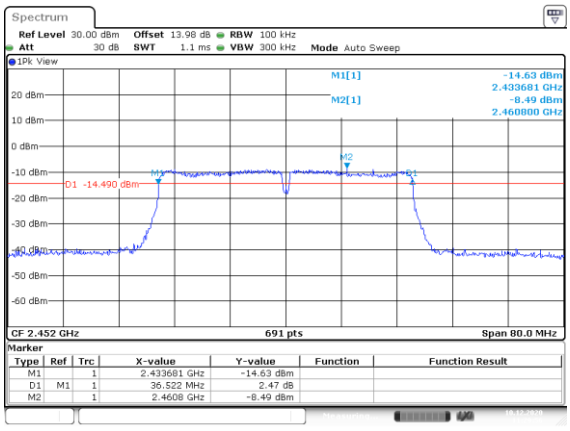
Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Spectrum Analyzer	Rohde & Schwarz	FSU26	100406	2020/03/11	2021/03/10
Cable	MTJ	MT40S	620620-MT40S-100	Each Use	-

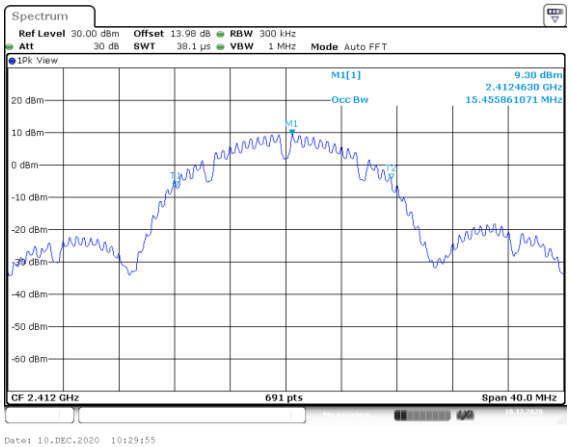
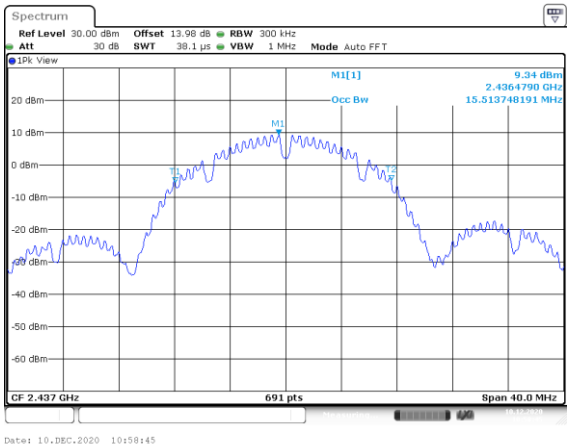
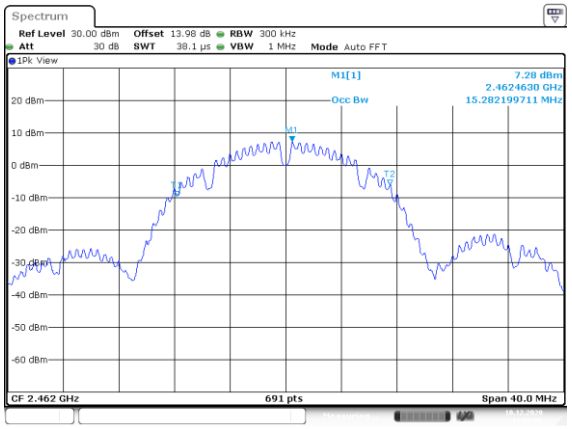
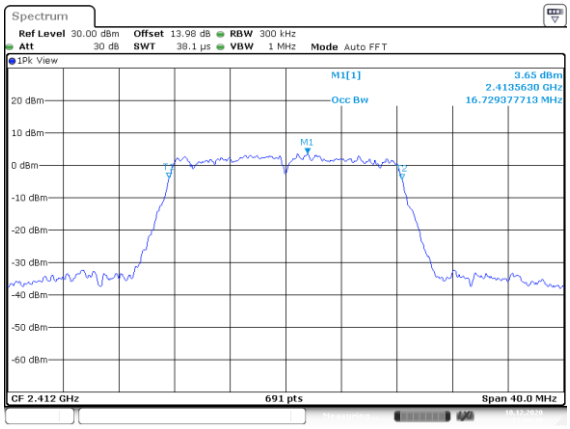
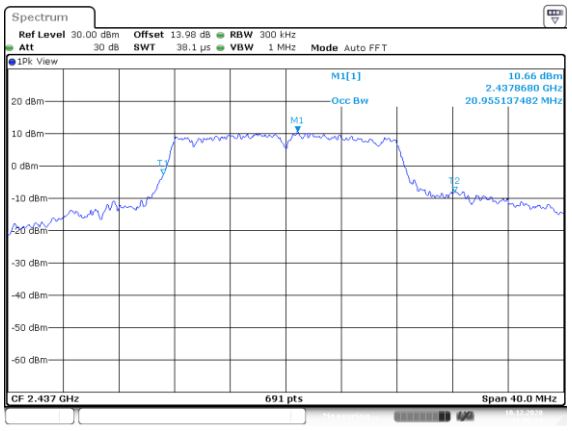
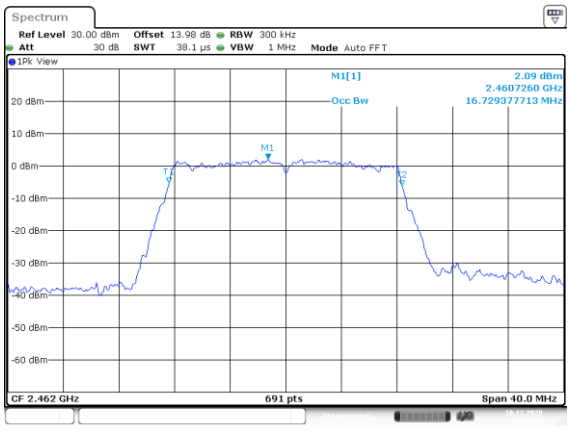
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

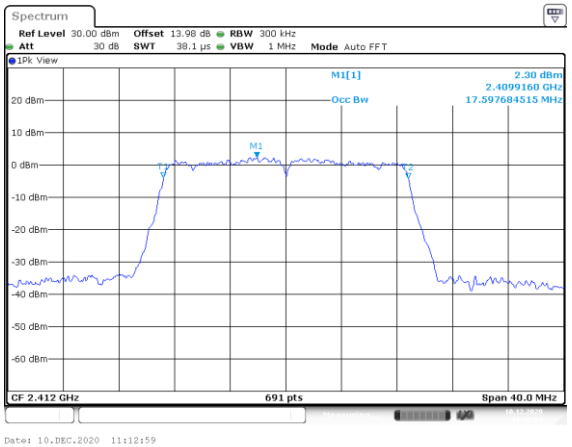
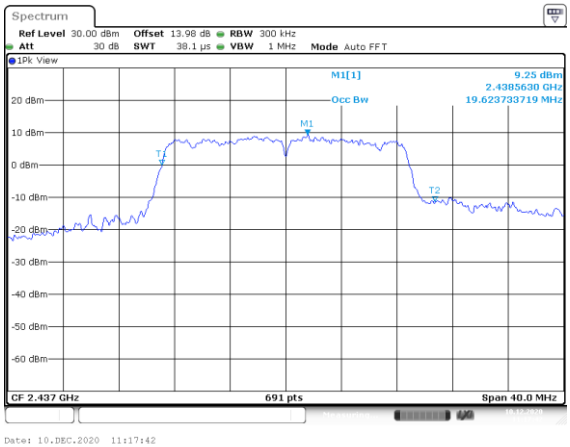
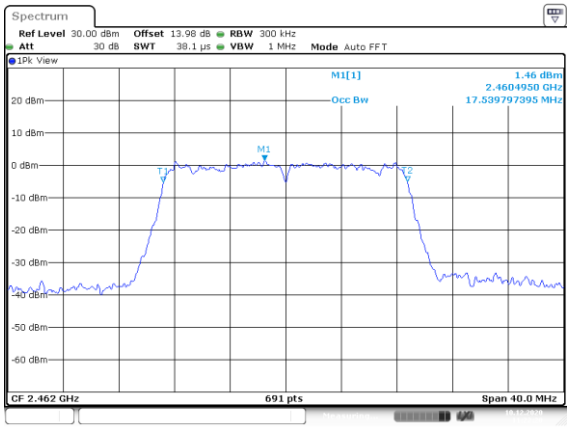
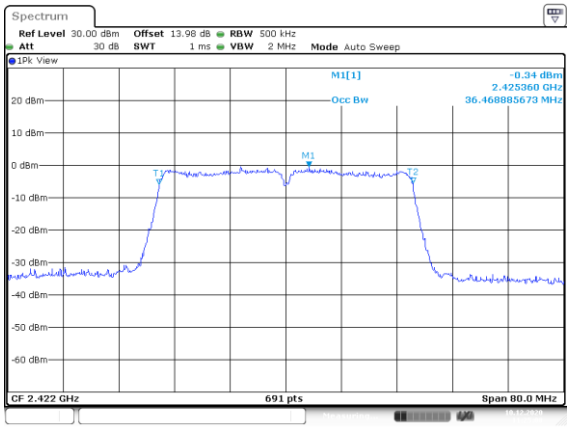
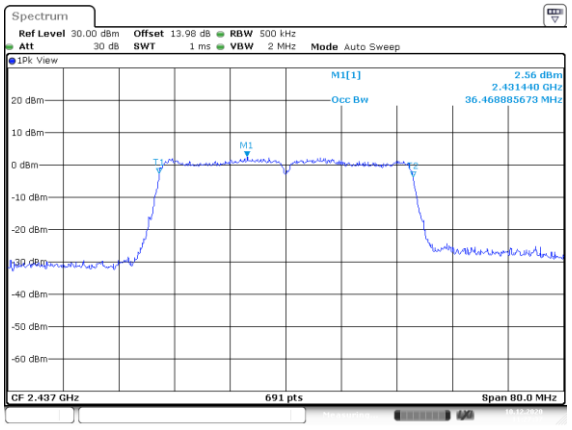
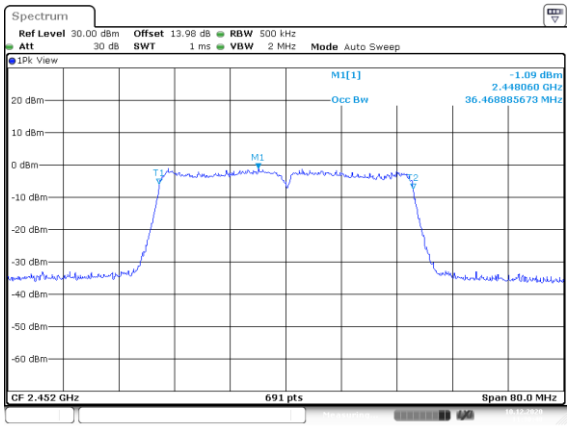
9.4 Test Results

Configuration	Channel	Frequency (MHz)	99% OBW (MHz)	6 dB BW (MHz)	6dB Limit (MHz)	Result
IEEE 802.11b	Low	2412	15.46	10.09	> 0.5	Compliance
	Middle	2437	15.51	10.09	> 0.5	Compliance
	High	2462	15.28	10.09	> 0.5	Compliance
IEEE 802.11g	Low	2412	16.73	16.58	> 0.5	Compliance
	Middle	2437	20.96	16.58	> 0.5	Compliance
	High	2462	16.73	16.58	> 0.5	Compliance
IEEE 802.11n HT20	Low	2412	17.60	17.62	> 0.5	Compliance
	Middle	2437	19.62	17.62	> 0.5	Compliance
	High	2462	17.54	17.62	> 0.5	Compliance
IEEE 802.11n HT40	Low	2422	36.47	36.52	> 0.5	Compliance
	Middle	2437	36.47	36.41	> 0.5	Compliance
	High	2452	36.47	36.52	> 0.5	Compliance

IEEE 802.11b 6 dB BW Low CH	IEEE 802.11b 6 dB BW Middle CH
	
IEEE 802.11b 6 dB BW High CH	**IEEE 802.11g 6 dB BW Low CH**
	
IEEE 802.11g 6 dB BW Middle CH	**IEEE 802.11g 6 dB BW High CH**
	

IEEE 802.11n HT20 6 dB BW Low CH	IEEE 802.11n HT20 6 dB BW Middle CH
	
IEEE 802.11n HT20 6 dB BW High CH	**IEEE 802.11n HT40 6 dB BW Low CH**
	
IEEE 802.11n HT40 6 dB BW Middle CH	**IEEE 802.11n HT40 6 dB BW High CH**
	

IEEE 802.11b 99% OBW Low CH	IEEE 802.11b 99% OBW Middle CH
	
IEEE 802.11b 99% OBW High CH	**IEEE 802.11g 99% OBW Low CH**
	
IEEE 802.11g 99% OBW Middle CH	**IEEE 802.11g 99% OBW High CH**
	

IEEE 802.11n HT20 99% OBW Low CH	IEEE 802.11n HT20 99% OBW Middle CH
	
IEEE 802.11n HT20 99% OBW High CH	**IEEE 802.11n HT40 99% OBW Low CH**
	
IEEE 802.11n HT40 99% OBW Middle CH	**IEEE 802.11n HT40 99% OBW High CH**
	

10 FCC §15.247(b)(3) and RSS-247 §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	MY52500008	2020/01/06	2021/01/05
Cable	MTJ	MT40S	620620-MT40S-100	Each Use	-

***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

<Chip Antenna (FR05-S1-N-0-102) with 1.8V_{dc}>

Mode	CH	Freq. (MHz)	Peak Output Power		Ant Gain (dBi)	EIRP Peak Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	15.94	0.0393	1.70	15.79	0.0379	30	36
	Middle	2437	16.59	0.0456	1.70	19.10	0.0813	30	36
	High	2462	14.57	0.0286	1.70	14.57	0.0286	30	36
IEEE 802.11g	Low	2412	14.09	0.0256	1.70	14.16	0.0261	30	36
	Middle	2437	17.40	0.0550	1.70	18.84	0.0766	30	36
	High	2462	12.87	0.0194	1.70	13.04	0.0201	30	36
IEEE 802.11n HT20	Low	2412	12.46	0.0176	1.70	11.71	0.0148	30	36
	Middle	2437	17.14	0.0518	1.70	15.57	0.0361	30	36
	High	2462	11.34	0.0136	1.70	11.92	0.0156	30	36
IEEE 802.11n HT40	Low	2422	10.01	0.0100	1.70	15.79	0.0379	30	36
	Middle	2437	13.87	0.0244	1.70	19.10	0.0813	30	36
	High	2452	10.22	0.0105	1.70	14.57	0.0286	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm

Mode	CH	Freq. (MHz)	Average Output Power		Ant Gain (dBi)	EIRP Average Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	14.24	0.0265	1.70	15.94	0.0393	30	36
	Middle	2437	15.23	0.0333	1.70	16.93	0.0493	30	36
	High	2462	12.94	0.0197	1.70	14.64	0.0291	30	36
IEEE 802.11g	Low	2412	9.27	0.0085	1.70	10.97	0.0125	30	36
	Middle	2437	15.20	0.0331	1.70	16.9	0.0490	30	36
	High	2462	8.13	0.0065	1.70	9.83	0.0096	30	36
IEEE 802.11n HT20	Low	2412	7.25	0.0053	1.70	8.95	0.0079	30	36
	Middle	2437	14.46	0.0279	1.70	16.16	0.0413	30	36
	High	2462	6.28	0.0042	1.70	7.98	0.0063	30	36
IEEE 802.11n HT40	Low	2422	4.43	0.0028	1.70	6.13	0.0041	30	36
	Middle	2437	8.88	0.0077	1.70	10.58	0.0114	30	36
	High	2452	4.75	0.0030	1.70	6.45	0.0044	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm; Note2: Duty Cycle is 100% and Duty Factor is 0 dB.

<Chip Antenna (FR05-S1-N-0-102) with 3.3V_{dc}>

Mode	CH	Freq. (MHz)	Peak Output Power		Ant Gain (dBi)	EIRP Peak Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	19.41	0.0873	1.70	21.11	0.1291	30	36
	Middle	2437	19.70	0.0933	1.70	21.40	0.1380	30	36
	High	2462	17.65	0.0582	1.70	19.35	0.0861	30	36
IEEE 802.11g	Low	2412	16.96	0.0497	1.70	18.66	0.0735	30	36
	Middle	2437	22.35	0.1718	1.70	24.05	0.2541	30	36
	High	2462	16.82	0.0481	1.70	18.52	0.0711	30	36
IEEE 802.11n HT20	Low	2412	16.28	0.0425	1.70	17.98	0.0628	30	36
	Middle	2437	22.00	0.1585	1.70	23.70	0.2344	30	36
	High	2462	17.08	0.0511	1.70	18.78	0.0755	30	36
IEEE 802.11n HT40	Low	2422	12.56	0.0180	1.70	14.26	0.0267	30	36
	Middle	2437	17.49	0.0561	1.70	19.19	0.0830	30	36
	High	2452	14.91	0.0310	1.70	16.61	0.0458	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm

Mode	CH	Freq. (MHz)	Average Output Power		Ant Gain (dBi)	EIRP Average Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	17.49	0.0561	1.70	19.19	0.0830	30	36
	Middle	2437	17.75	0.0596	1.70	19.45	0.0881	30	36
	High	2462	15.68	0.0370	1.70	17.38	0.0547	30	36
IEEE 802.11g	Low	2412	10.96	0.0125	1.70	12.66	0.0185	30	36
	Middle	2437	18.60	0.0724	1.70	20.30	0.1072	30	36
	High	2462	10.94	0.0124	1.70	12.64	0.0184	30	36
IEEE 802.11n HT20	Low	2412	10.11	0.0103	1.70	11.81	0.0152	30	36
	Middle	2437	17.73	0.0593	1.70	19.43	0.0877	30	36
	High	2462	10.98	0.0125	1.70	12.68	0.0185	30	36
IEEE 802.11n HT40	Low	2422	6.27	0.0042	1.70	7.97	0.0063	30	36
	Middle	2437	11.23	0.0133	1.70	12.93	0.0196	30	36
	High	2452	8.44	0.0070	1.70	10.14	0.0103	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm; Note2: Duty Cycle is 100% and Duty Factor is 0 dB.

< Dipole Antenna (GW.34.5153) with 1.8V_{dc}>

Mode	CH	Freq. (MHz)	Peak Output Power		Ant Gain (dBi)	EIRP Peak Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	16.27	0.0424	5.89	22.16	0.1644	30	36
	Middle	2437	16.43	0.0440	5.89	22.32	0.1706	30	36
	High	2462	14.54	0.0284	5.89	20.43	0.1104	30	36
IEEE 802.11g	Low	2412	15.36	0.0344	5.89	21.25	0.1334	30	36
	Middle	2437	17.24	0.0530	5.89	23.13	0.2056	30	36
	High	2462	13.20	0.0209	5.89	19.09	0.0811	30	36
IEEE 802.11n HT20	Low	2412	14.57	0.0286	5.89	20.46	0.1112	30	36
	Middle	2437	17.31	0.0538	5.89	23.20	0.2089	30	36
	High	2462	13.25	0.0211	5.89	19.14	0.0820	30	36
IEEE 802.11n HT40	Low	2422	11.20	0.0132	5.89	17.09	0.0512	30	36
	Middle	2437	13.91	0.0246	5.89	19.80	0.0955	30	36
	High	2452	10.59	0.0115	5.89	16.48	0.0445	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm

Mode	CH	Freq. (MHz)	Average Output Power		Ant Gain (dBi)	EIRP Average Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	14.70	0.0295	5.89	20.59	0.1146	30	36
	Middle	2437	15.10	0.0324	5.89	20.99	0.1256	30	36
	High	2462	12.88	0.0194	5.89	18.77	0.0753	30	36
IEEE 802.11g	Low	2412	10.50	0.0112	5.89	16.39	0.0436	30	36
	Middle	2437	15.01	0.0317	5.89	20.90	0.1230	30	36
	High	2462	8.16	0.0065	5.89	14.05	0.0254	30	36
IEEE 802.11n HT20	Low	2412	9.45	0.0088	5.89	15.34	0.0342	30	36
	Middle	2437	15.04	0.0319	5.89	20.93	0.1239	30	36
	High	2462	8.15	0.0065	5.89	14.04	0.0254	30	36
IEEE 802.11n HT40	Low	2422	5.33	0.0034	5.89	11.22	0.0132	30	36
	Middle	2437	8.72	0.0074	5.89	14.61	0.0289	30	36
	High	2452	4.73	0.0030	5.89	10.62	0.0115	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm; Note2: Duty Cycle is 100% and Duty Factor is 0 dB.

< Dipole Antenna (GW.34.5153) with 3.3V_{dc}>

Mode	CH	Freq. (MHz)	Peak Output Power		Ant Gain (dBi)	EIRP Peak Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	19.75	0.0944	5.89	25.64	0.3664	30	36
	Middle	2437	19.51	0.0893	5.89	25.40	0.3467	30	36
	High	2462	17.65	0.0582	5.89	23.54	0.2259	30	36
IEEE 802.11g	Low	2412	17.60	0.0575	5.89	23.49	0.2234	30	36
	Middle	2437	22.22	0.1667	5.89	28.11	0.6471	30	36
	High	2462	16.65	0.0462	5.89	22.54	0.1795	30	36
IEEE 802.11n HT20	Low	2412	17.12	0.0515	5.89	23.01	0.2000	30	36
	Middle	2437	21.91	0.1552	5.89	27.80	0.6026	30	36
	High	2462	16.05	0.0403	5.89	21.94	0.1563	30	36
IEEE 802.11n HT40	Low	2422	14.20	0.0263	5.89	20.09	0.1021	30	36
	Middle	2437	17.22	0.0527	5.89	23.11	0.2046	30	36
	High	2452	13.89	0.0245	5.89	19.78	0.0951	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm

Mode	CH	Freq. (MHz)	Average Output Power		Ant Gain (dBi)	EIRP Average Output Power		Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)		(dBm)	(W)		
IEEE 802.11b	Low	2412	17.84	0.0608	5.89	23.73	0.2360	30	36
	Middle	2437	17.60	0.0575	5.89	23.49	0.2234	30	36
	High	2462	15.64	0.0366	5.89	21.53	0.1422	30	36
IEEE 802.11g	Low	2412	11.76	0.0150	5.89	17.65	0.0582	30	36
	Middle	2437	18.51	0.0710	5.89	24.40	0.2754	30	36
	High	2462	10.75	0.0119	5.89	16.64	0.0461	30	36
IEEE 802.11n HT20	Low	2412	10.97	0.0125	5.89	16.86	0.0485	30	36
	Middle	2437	17.47	0.0558	5.89	23.36	0.2168	30	36
	High	2462	9.86	0.0097	5.89	15.75	0.0376	30	36
IEEE 802.11n HT40	Low	2422	7.89	0.0062	5.89	13.78	0.0239	30	36
	Middle	2437	10.87	0.0122	5.89	16.76	0.0474	30	36
	High	2452	7.31	0.0054	5.89	13.20	0.0209	30	36

Note1: Conducted Power Limit: 1W = 30 dBm, 4W = 36 dBm; Note2: Duty Cycle is 100% and Duty Factor is 0 dB.

11 FCC §15.247(d) and RSS-247 §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

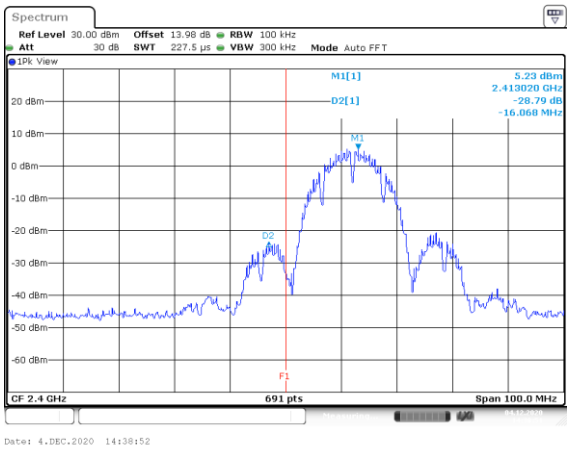
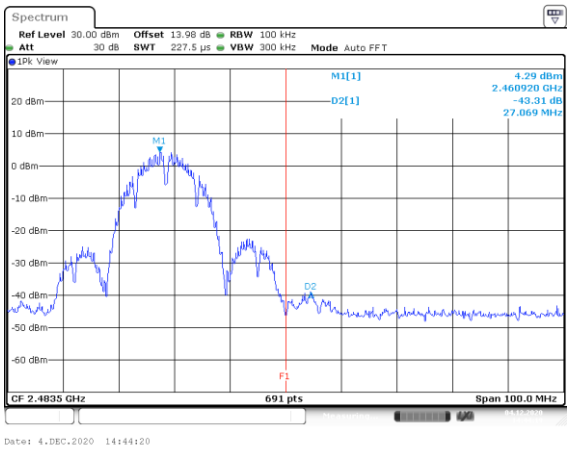
Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Spectrum Analyzer	Rohde & Schwarz	FSU26	100406	2020/03/11	2021/03/10
Cable	MTJ	MT40S	620620-MT40S-100	Each Use	-

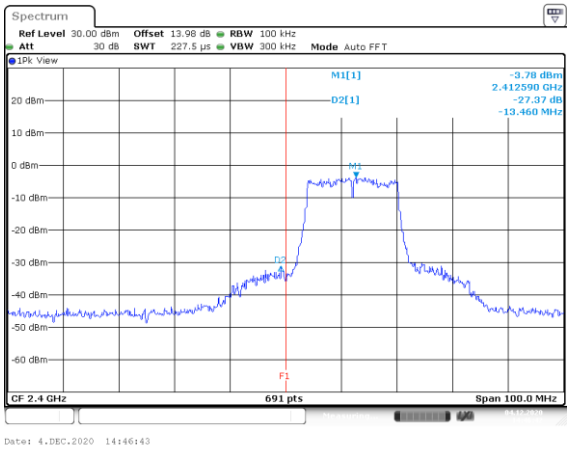
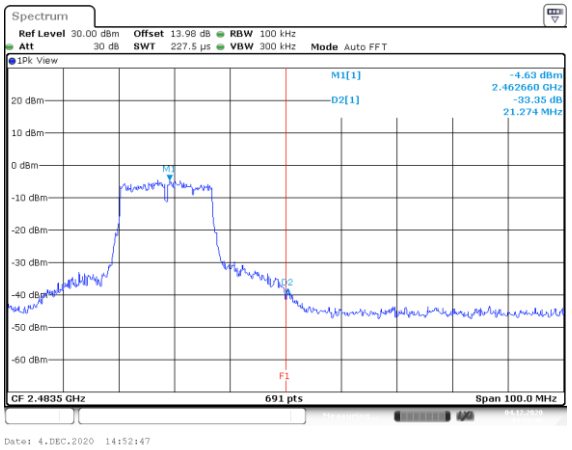
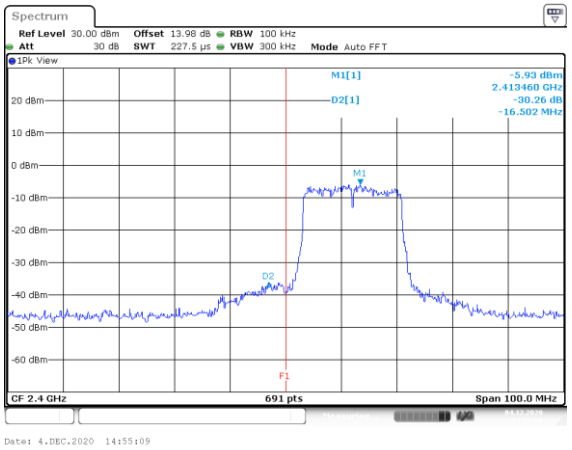
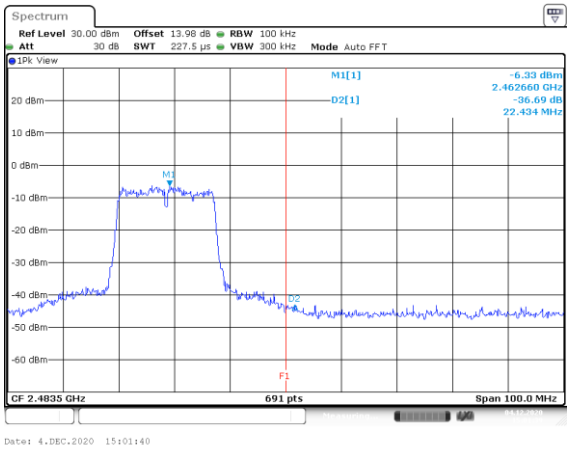
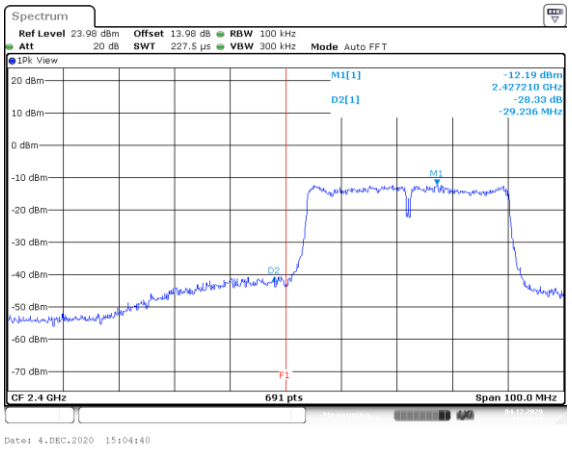
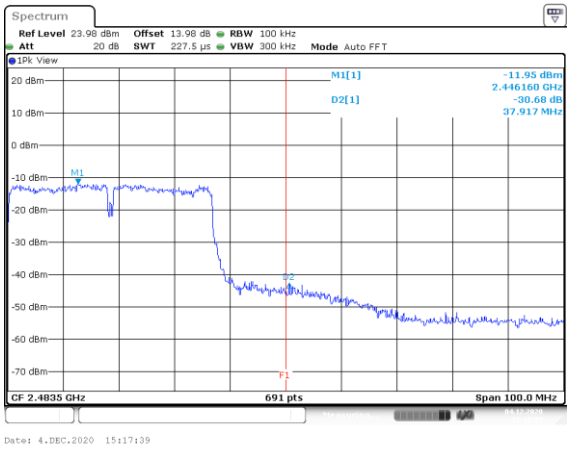
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

11.4 Test Results

<Chip Antenna (FR05-S1-N-0-102) with 1.8V_{dc}>

Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
IEEE 802.11b	Low	2412	28.79	≥ 20	Compliance
	High	2462	43.31	≥ 20	Compliance
BLE-2M IEEE 802.11g	Low	2412	27.37	≥ 20	Compliance
	High	2462	33.35	≥ 20	Compliance
IEEE 802.11n HT20	Low	2412	30.26	≥ 20	Compliance
	High	2462	36.69	≥ 20	Compliance
IEEE 802.11n HT40	Low	2422	28.33	≥ 20	Compliance
	High	2452	30.68	≥ 20	Compliance

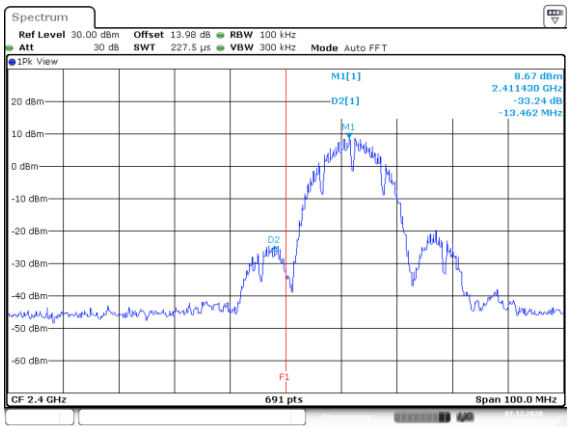
IEEE 802.11b Low CH	IEEE 802.11b High CH
	

IEEE 802.11g Low CH	IEEE 802.11g High CH
	
IEEE 802.11n HT20 Low CH	**IEEE 802.11n HT20 High CH**
	
IEEE 802.11n HT20 Low CH	**IEEE 802.11n HT20 High CH**
	

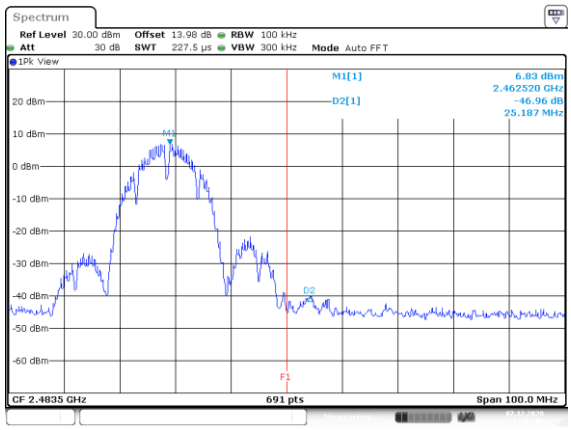
<Chip Antenna (FR05-S1-N-0-102) with 3.3V_{dc}>

Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
IEEE 802.11b	Low	2412	33.24	≥ 20	Compliance
	High	2462	46.96	≥ 20	Compliance
BLE-2M IEEE 802.11g	Low	2412	36.09	≥ 20	Compliance
	High	2462	39.95	≥ 20	Compliance
IEEE 802.11n HT20	Low	2412	35.20	≥ 20	Compliance
	High	2462	38.15	≥ 20	Compliance
IEEE 802.11n HT40	Low	2422	31.45	≥ 20	Compliance
	High	2452	31.88	≥ 20	Compliance

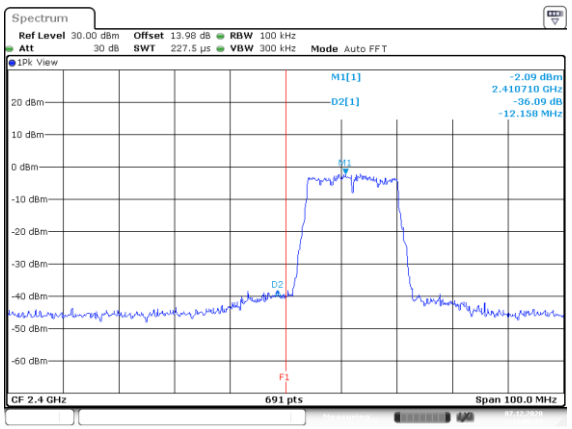
IEEE 802.11b Low CH



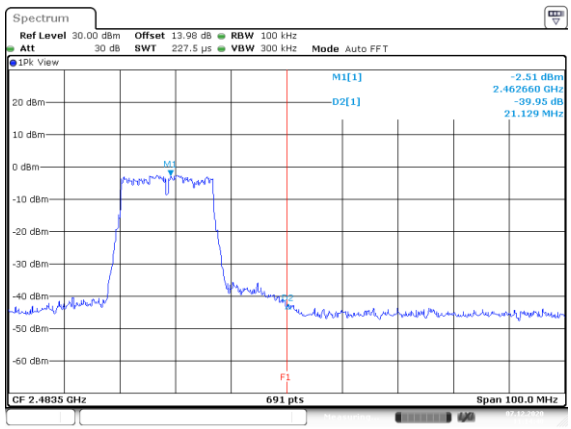
IEEE 802.11b High CH

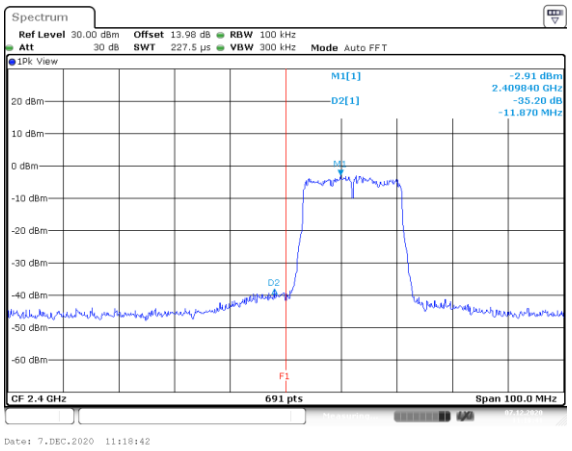
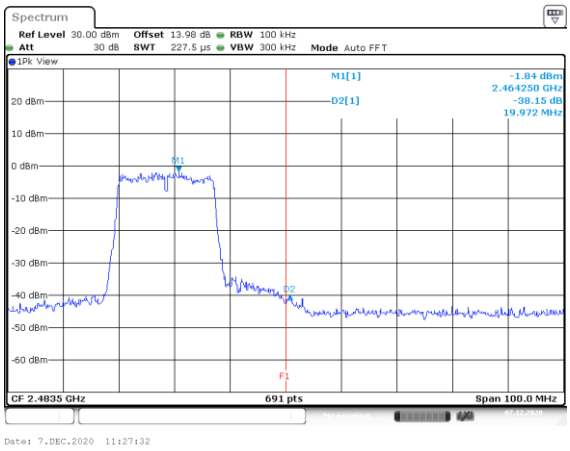
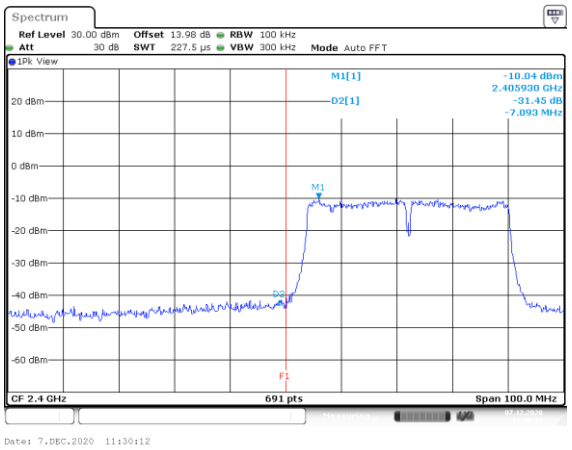
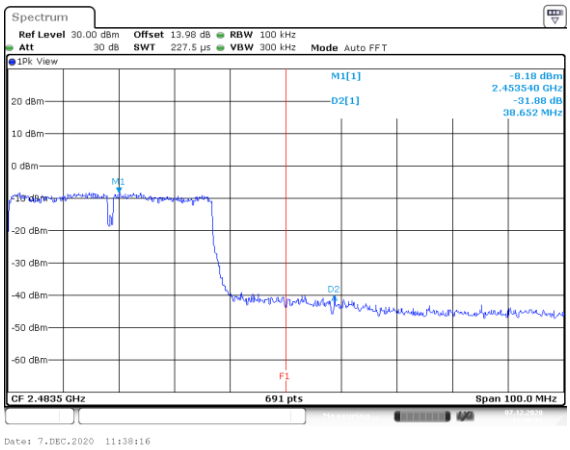


IEEE 802.11g Low CH



IEEE 802.11g High CH

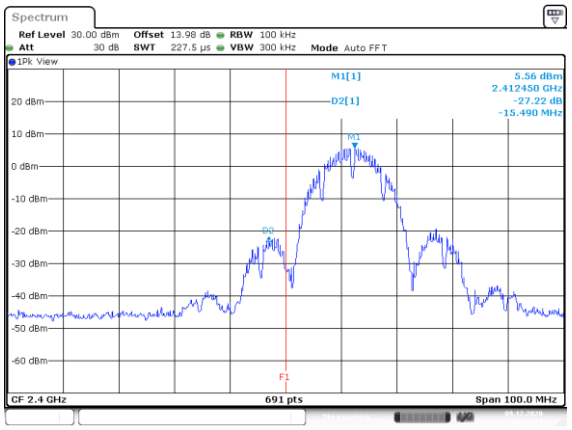


IEEE 802.11n HT20 Low CH	IEEE 802.11n HT20 High CH
	
IEEE 802.11n HT40 Low CH	**IEEE 802.11n HT40 High CH**
	

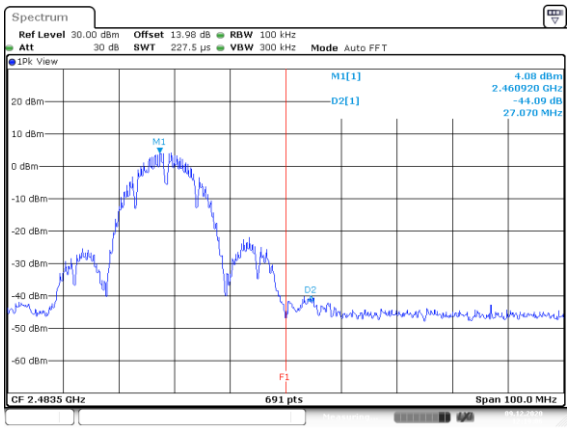
< Dipole Antenna (GW.34.5153) with 1.8V_{dc}>

Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
IEEE 802.11b	Low	2412	27.22	≥ 20	Compliance
	High	2462	44.09	≥ 20	Compliance
BLE-2M IEEE 802.11g	Low	2412	27.71	≥ 20	Compliance
	High	2462	34.26	≥ 20	Compliance
IEEE 802.11n HT20	Low	2412	28.00	≥ 20	Compliance
	High	2462	31.86	≥ 20	Compliance
IEEE 802.11n HT40	Low	2422	25.97	≥ 20	Compliance
	High	2452	32.40	≥ 20	Compliance

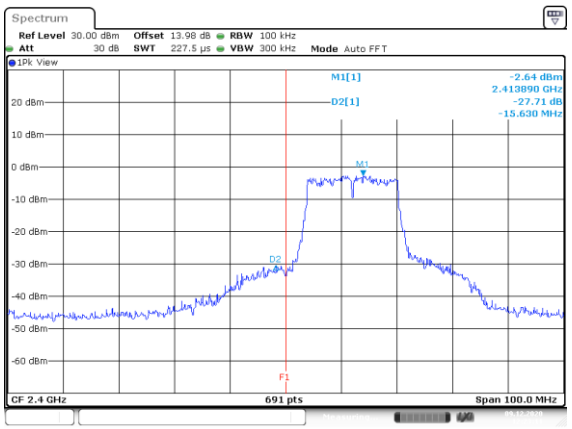
IEEE 802.11b Low CH



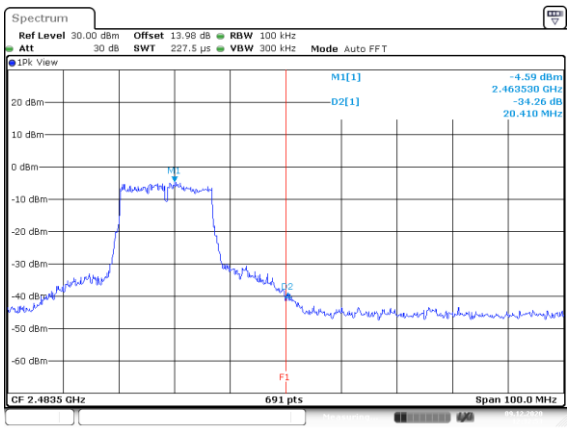
IEEE 802.11b High CH

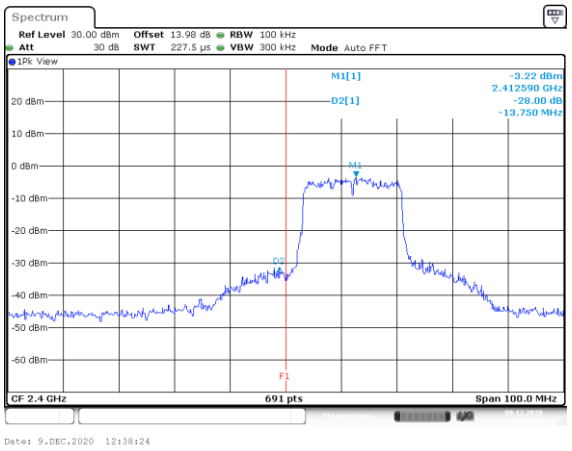
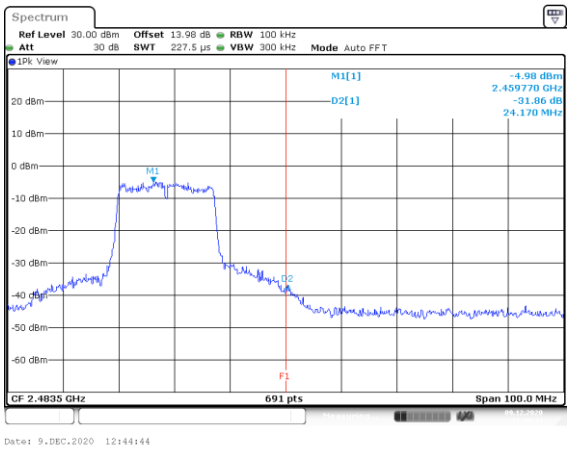
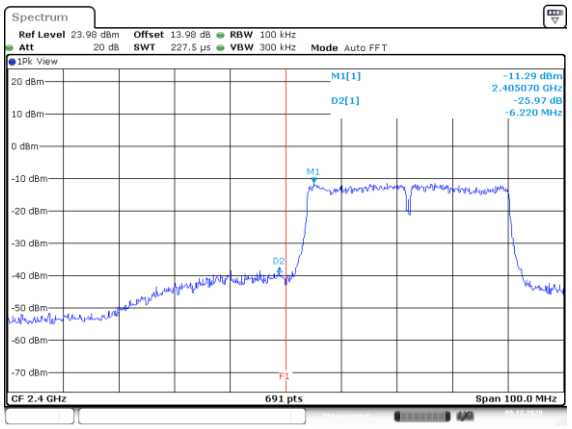
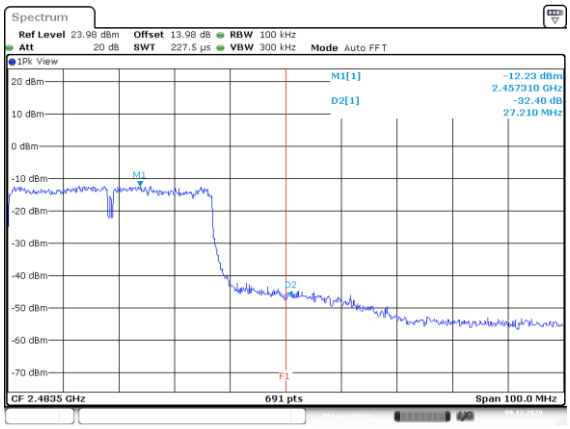


IEEE 802.11g Low CH



IEEE 802.11g High CH

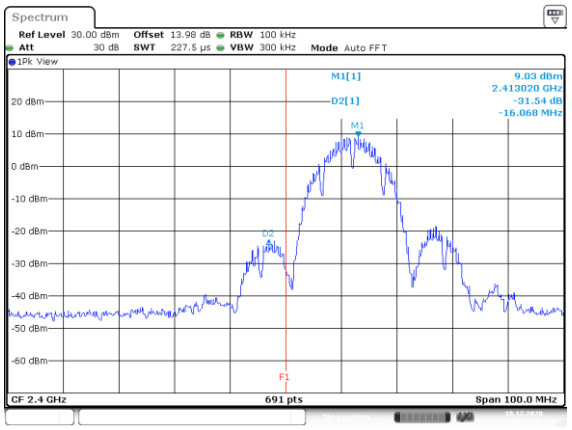


IEEE 802.11n HT20 Low CH	IEEE 802.11n HT20 High CH
	
IEEE 802.11n HT40 Low CH	**IEEE 802.11n HT40 High CH**
	

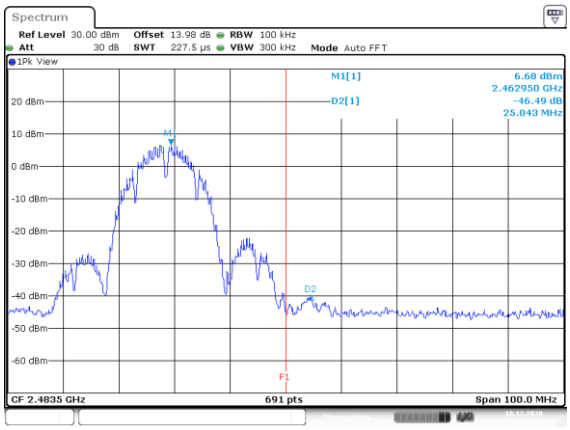
< Dipole Antenna (GW.34.5153) with 3.3V_{dc}>

Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
IEEE 802.11b	Low	2412	31.54	≥ 20	Compliance
	High	2462	46.49	≥ 20	Compliance
BLE-2M IEEE 802.11g	Low	2412	35.90	≥ 20	Compliance
	High	2462	38.00	≥ 20	Compliance
IEEE 802.11n HT20	Low	2412	36.82	≥ 20	Compliance
	High	2462	39.35	≥ 20	Compliance
IEEE 802.11n HT40	Low	2422	30.00	≥ 20	Compliance
	High	2452	32.67	≥ 20	Compliance

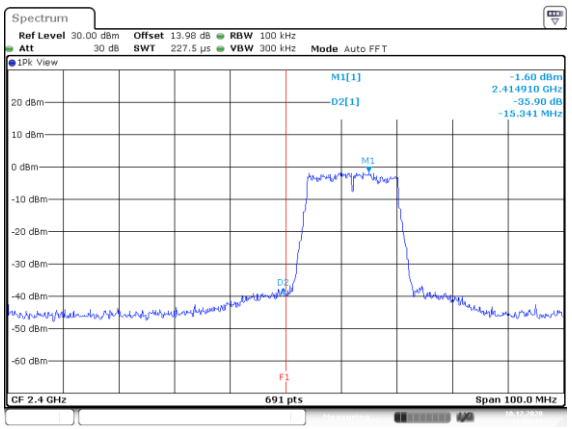
IEEE 802.11b Low CH



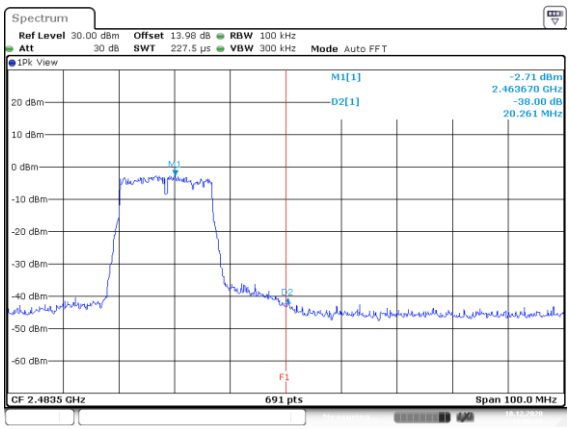
IEEE 802.11b High CH

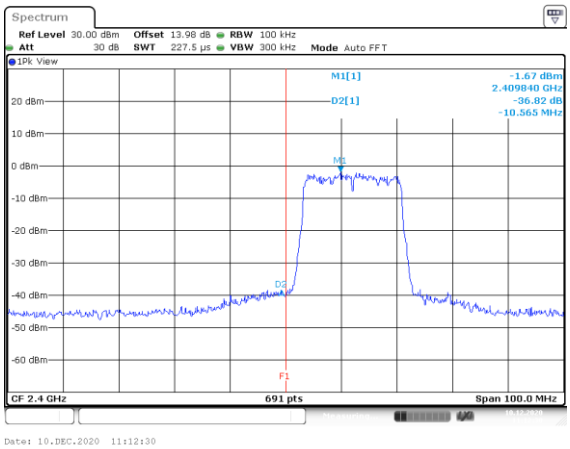
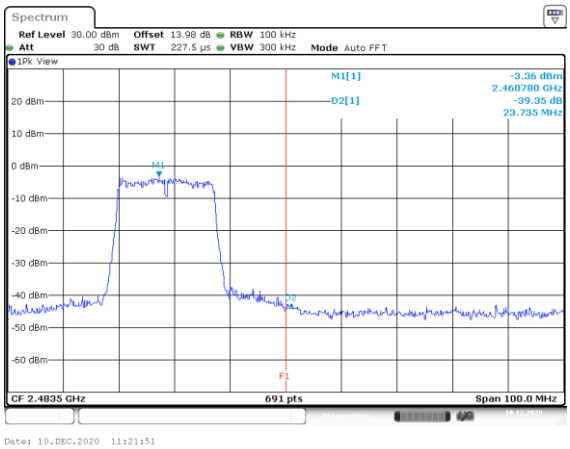
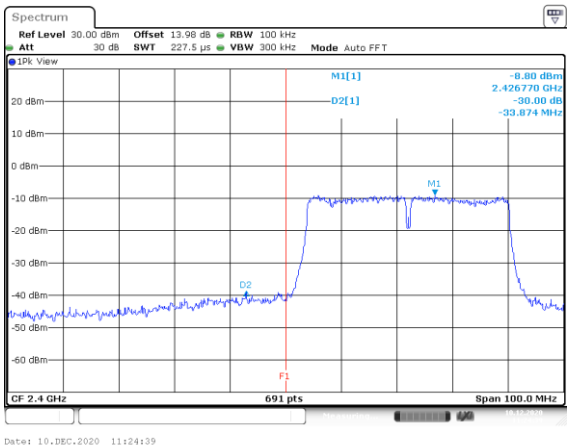
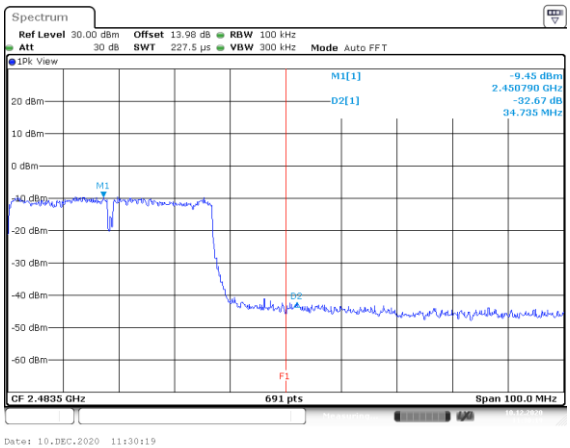


IEEE 802.11g Low CH



IEEE 802.11g High CH



IEEE 802.11n HT20 Low CH	IEEE 802.11n HT20 High CH
	
IEEE 802.11n HT40 Low CH	**IEEE 802.11n HT40 High CH**
	

12 FCC §15.247(e) and RSS-247 §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 kHz ≤ RBW ≤ 100 kHz.

(4) Set the VBW ≥ [3 × 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

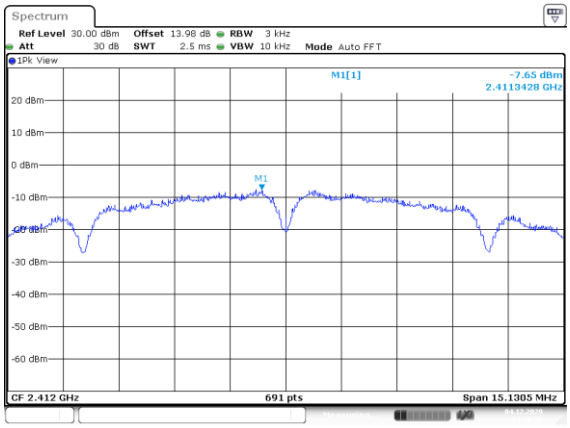
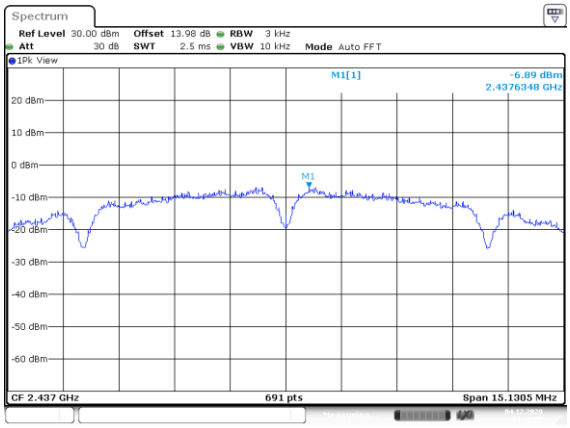
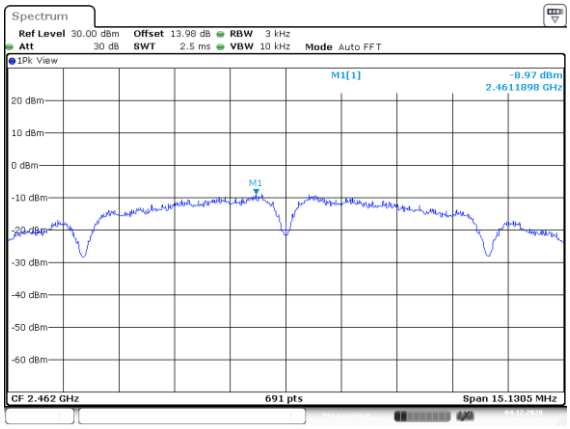
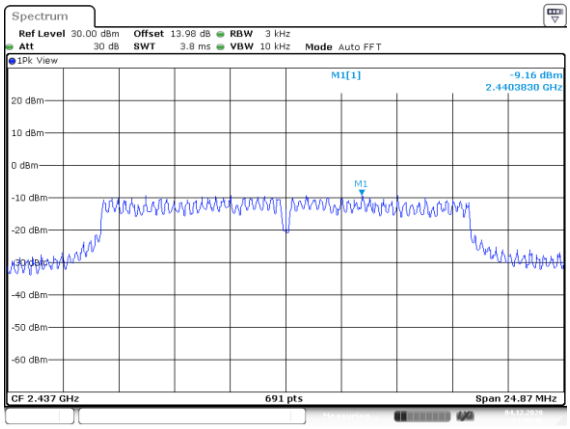
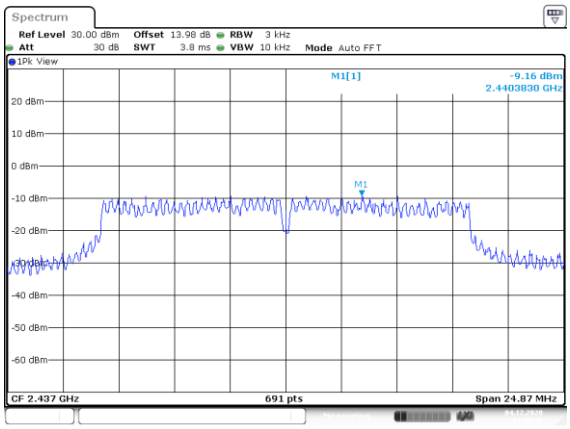
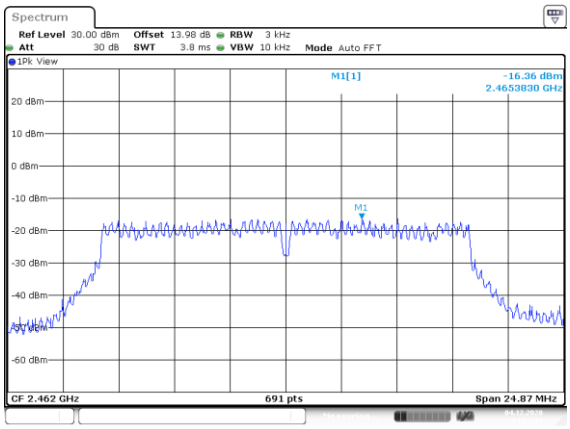
Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Spectrum Analyzer	Rohde & Schwarz	FSU26	100406	2020/03/11	2021/03/10
Cable	MTJ	MT40S	620620-MT40S-100	Each Use	-

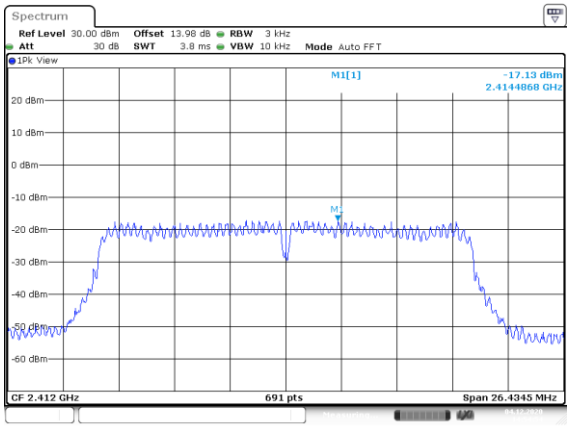
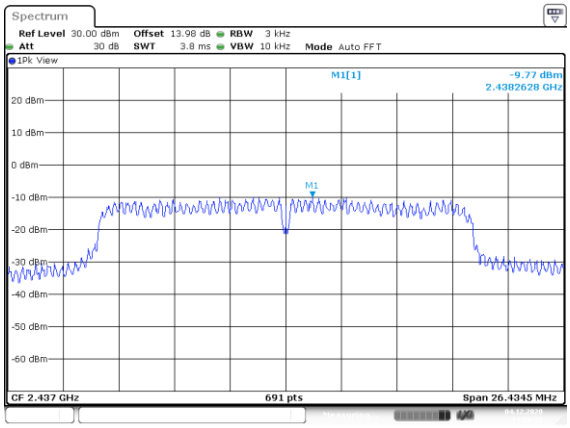
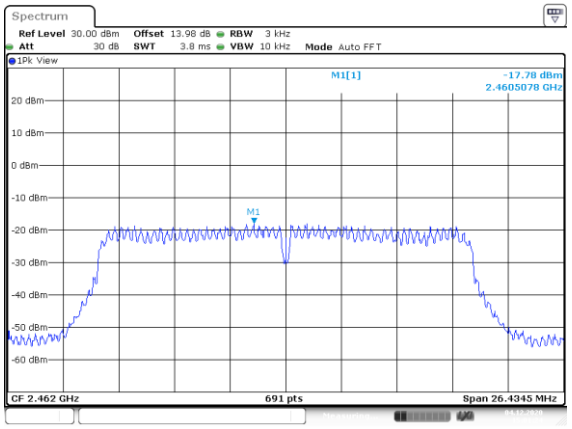
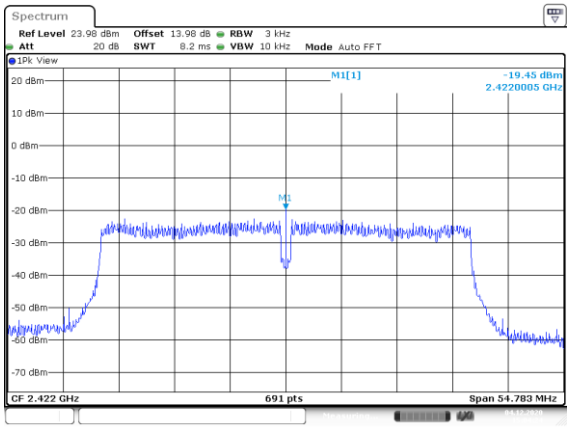
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

12.4 Test Results

<Chip Antenna (FR05-S1-N-0-102) with 1.8V_{dc}>

Configuration	Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
IEEE 802.11b	Low	2412	-7.65	8	Compliance
	Middle	2437	-6.89	8	Compliance
	High	2462	-8.97	8	Compliance
IEEE 802.11g	Low	2412	-15.02	8	Compliance
	Middle	2437	-9.16	8	Compliance
	High	2462	-16.36	8	Compliance
IEEE 802.11n HT20	Low	2412	-17.13	8	Compliance
	Middle	2437	-9.77	8	Compliance
	High	2462	-17.78	8	Compliance
IEEE 802.11n HT40	Low	2422	-19.45	8	Compliance
	Middle	2437	-15.91	8	Compliance
	High	2452	-20.43	8	Compliance

IEEE 802.11b Low CH	IEEE 802.11b Middle CH
	
IEEE 802.11b High CH	**IEEE 802.11g Low CH**
	
IEEE 802.11g Middle CH	**IEEE 802.11g High CH**
	

IEEE 802.11n HT20 Low CH	IEEE 802.11n HT20 Middle CH
	
IEEE 802.11n HT20 High CH	**IEEE 802.11n HT40 Low CH**
	
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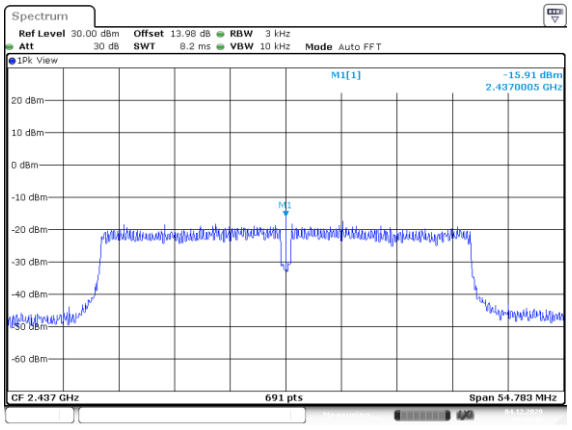
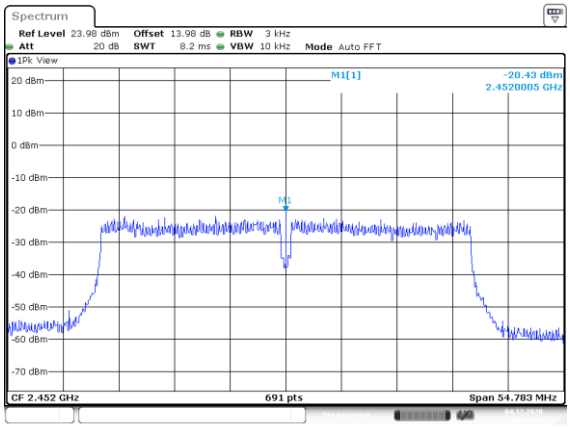
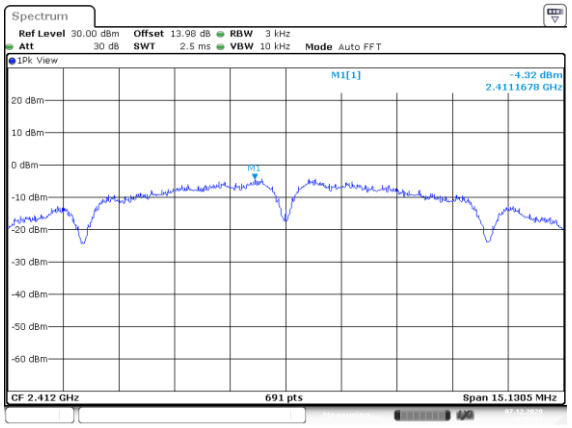
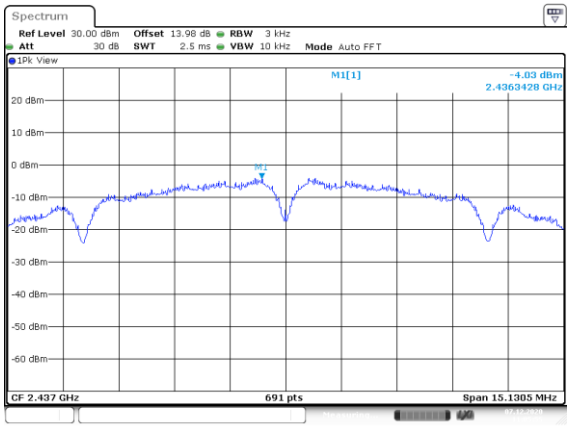
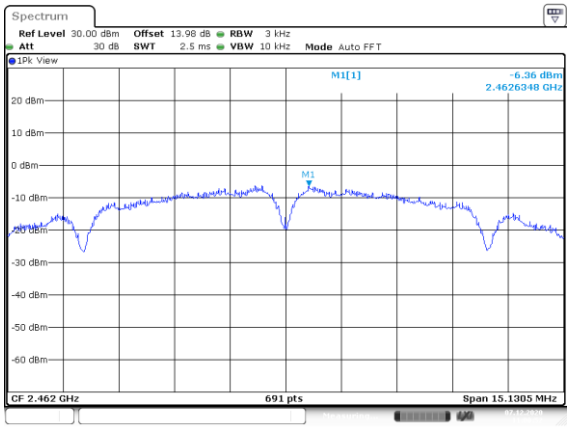
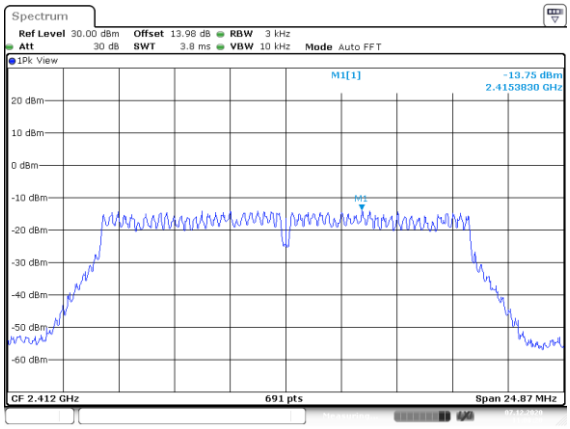
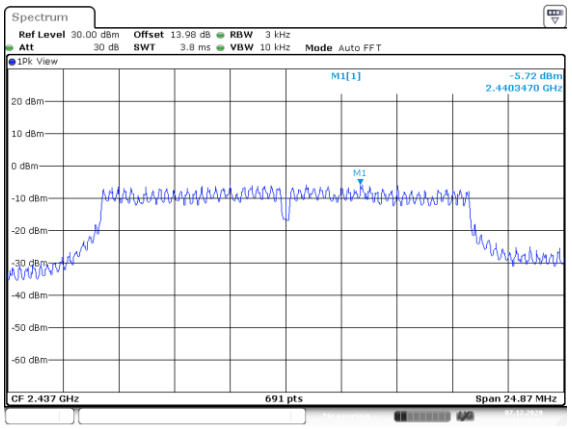
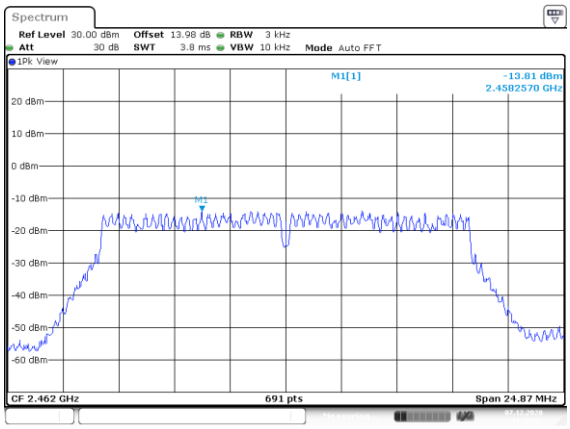
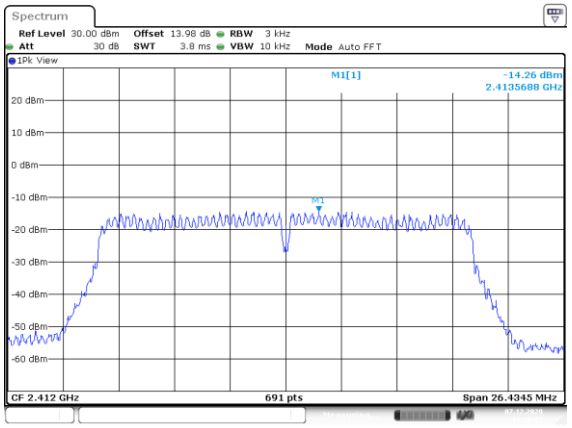
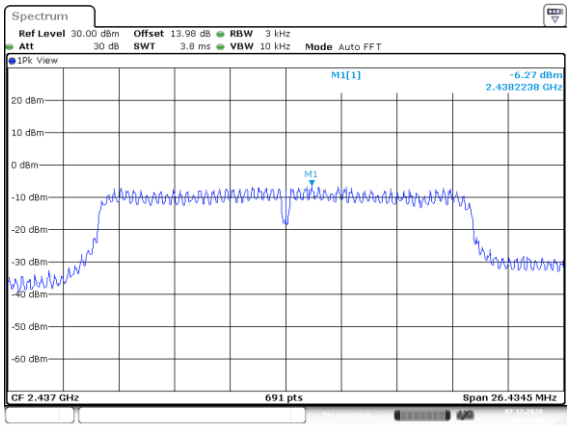
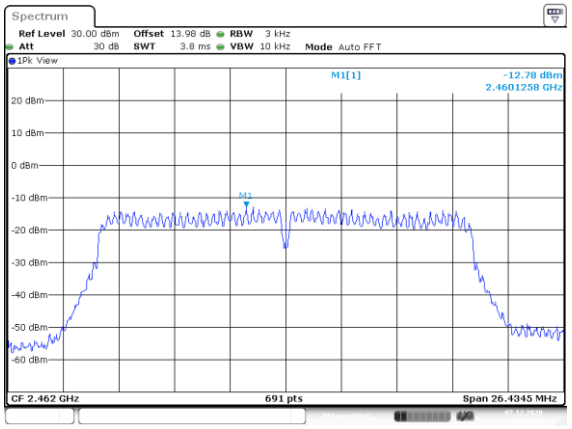
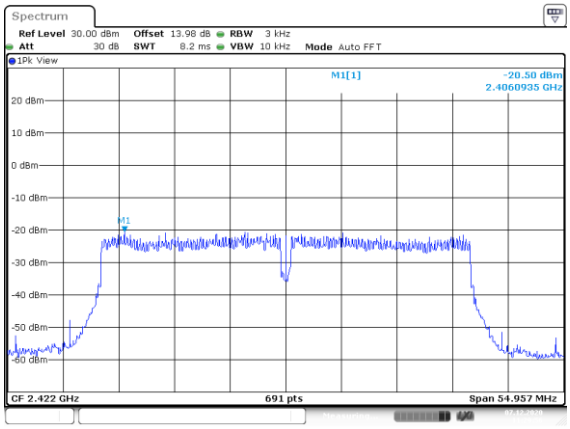
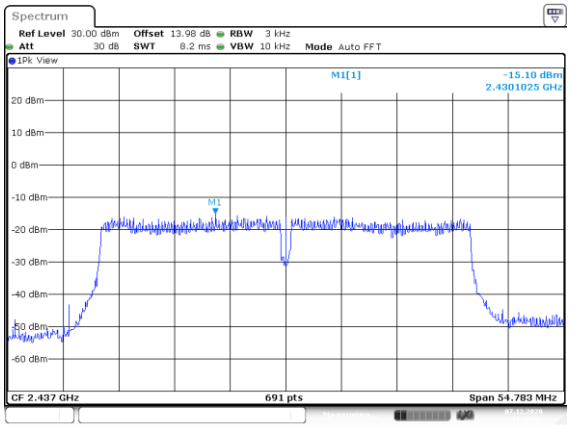
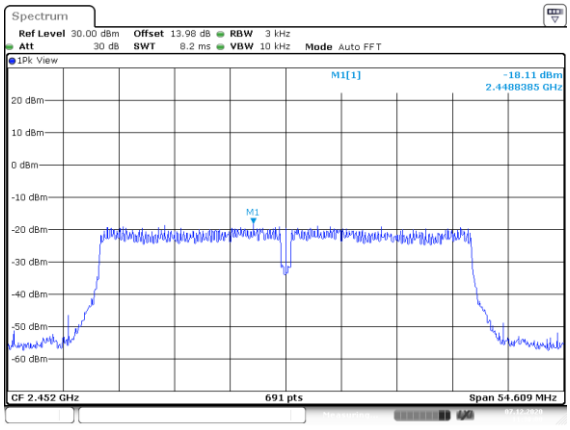
	

<Chip Antenna (FR05-S1-N-0-102) with 3.3V_{dc}>

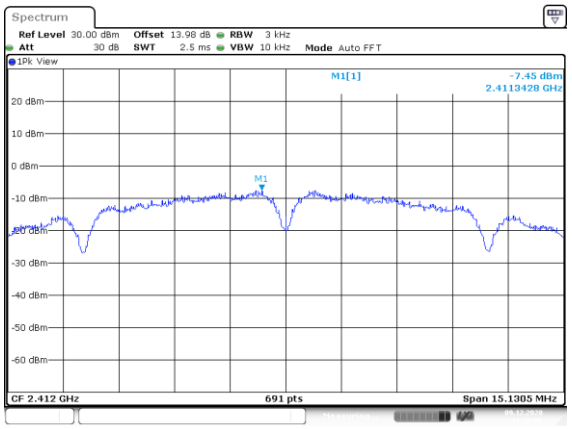
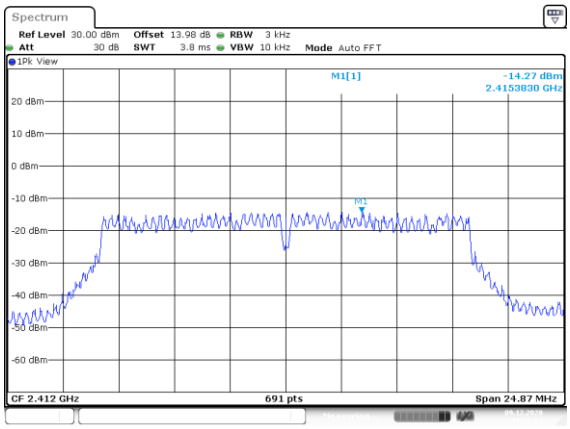
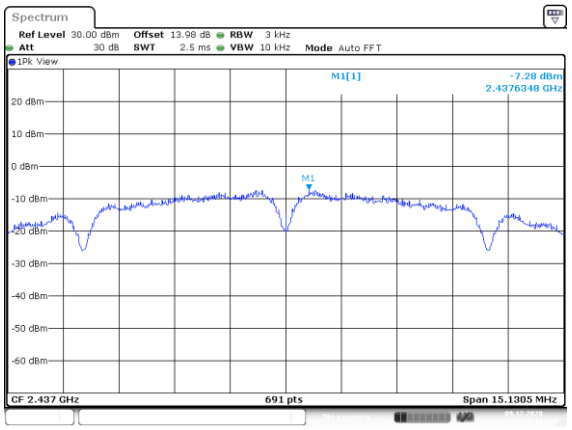
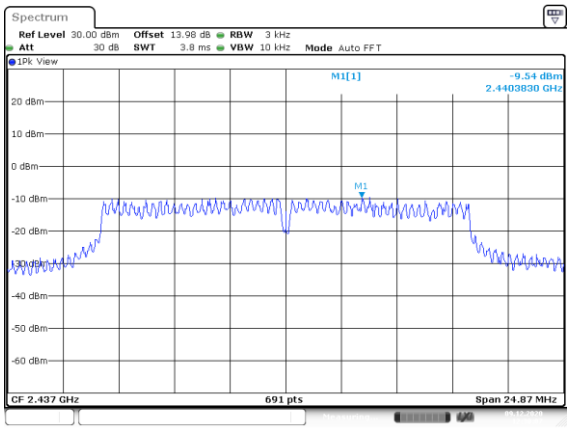
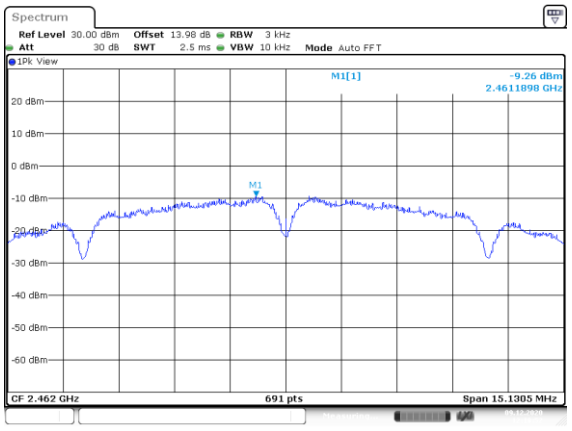
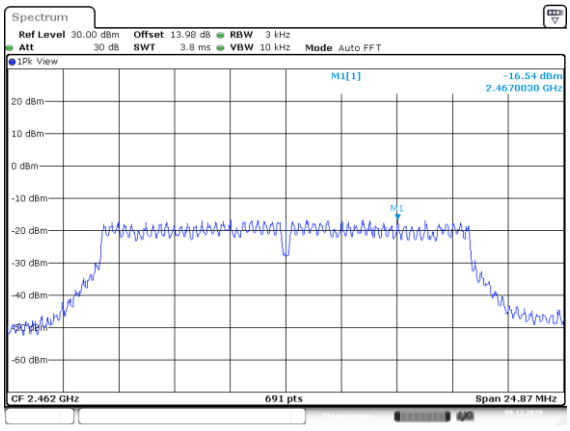
Configuration	Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
IEEE 802.11b	Low	2412	-4.32	8	Compliance
	Middle	2437	-4.03	8	Compliance
	High	2462	-6.36	8	Compliance
IEEE 802.11g	Low	2412	-13.75	8	Compliance
	Middle	2437	-5.72	8	Compliance
	High	2462	-13.81	8	Compliance
IEEE 802.11n HT20	Low	2412	-14.26	8	Compliance
	Middle	2437	-6.27	8	Compliance
	High	2462	-12.78	8	Compliance
IEEE 802.11n HT40	Low	2422	-20.50	8	Compliance
	Middle	2437	-15.10	8	Compliance
	High	2452	-18.11	8	Compliance

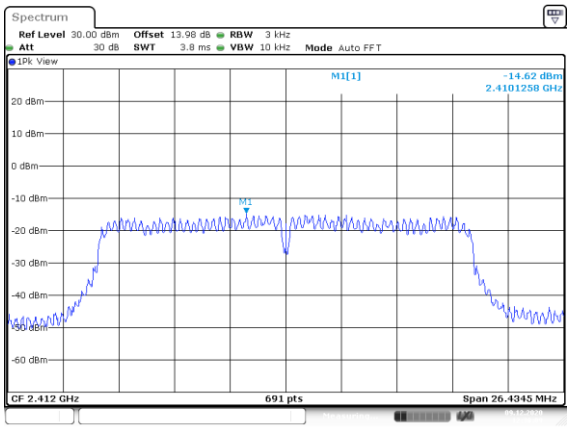
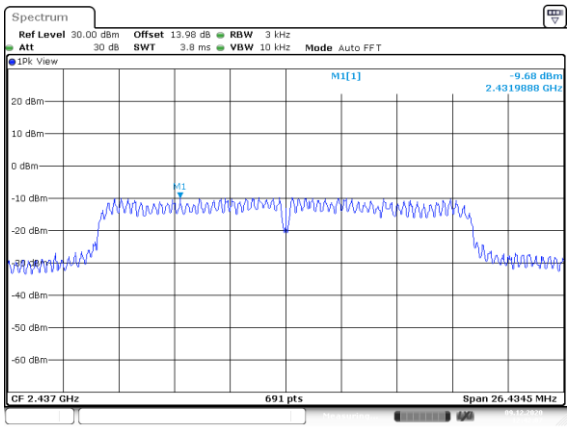
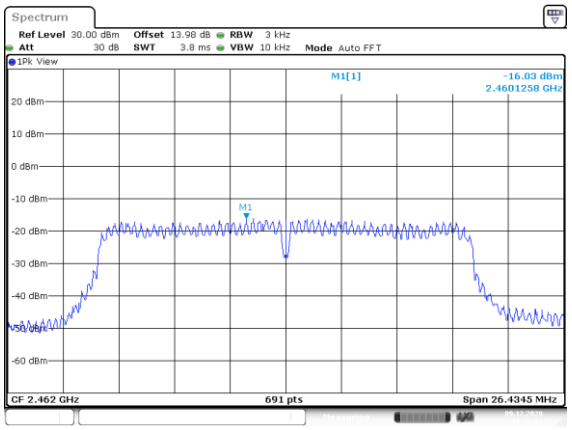
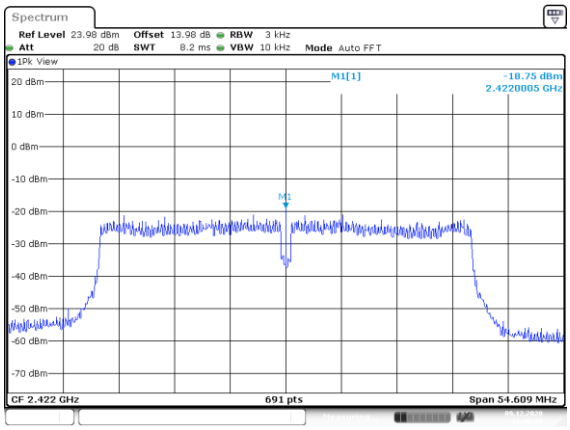
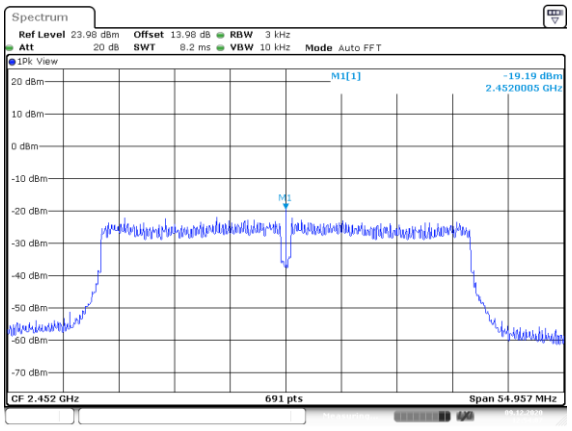
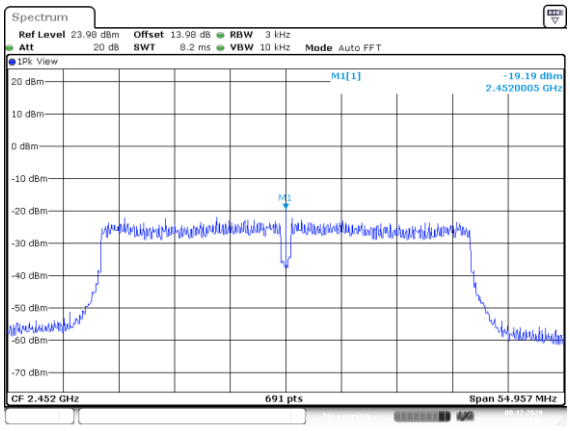
IEEE 802.11b Low CH	IEEE 802.11b Middle CH
	
IEEE 802.11b High CH	**IEEE 802.11g Low CH**
	
IEEE 802.11g Middle CH	**IEEE 802.11g High CH**
	

IEEE 802.11n HT20 Low CH	IEEE 802.11n HT20 Middle CH
	
IEEE 802.11n HT20 High CH	**IEEE 802.11n HT40 Low CH**
	
IEEE 802.11n HT40 Middle CH	**IEEE 802.11n HT40 High CH**
	

< Dipole Antenna (GW.34.5153) with 1.8V_{dc}>

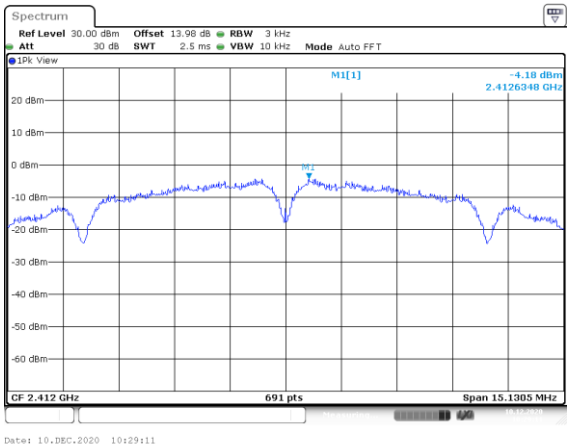
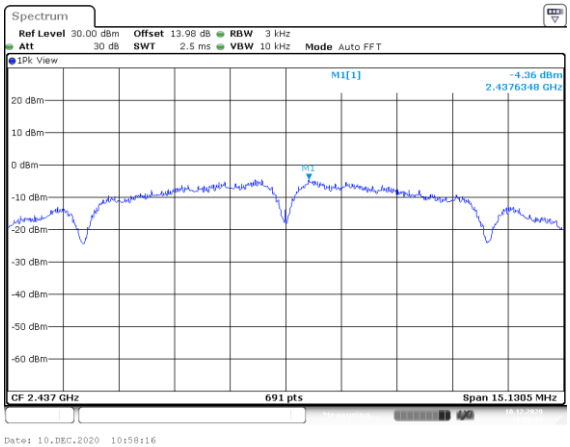
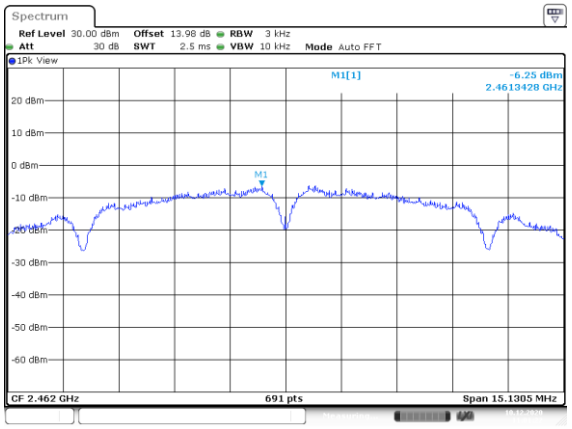
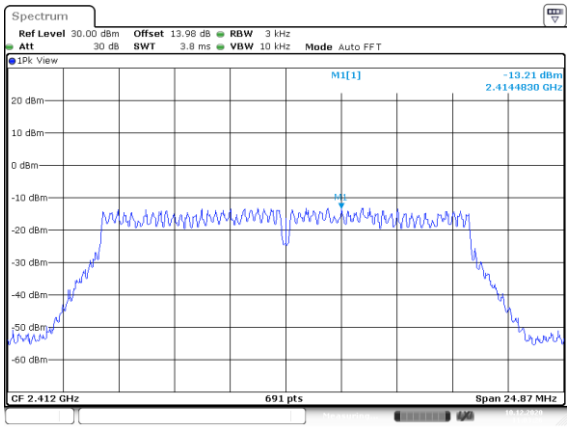
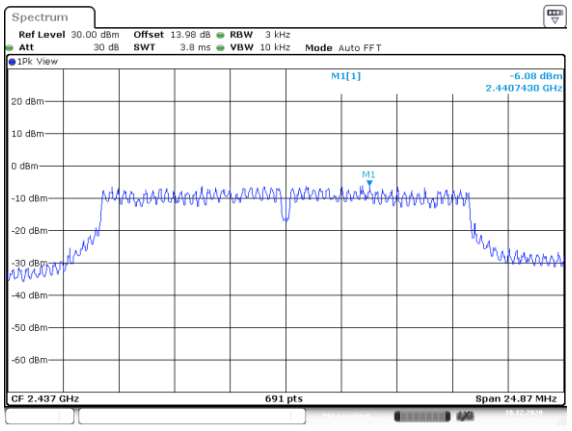
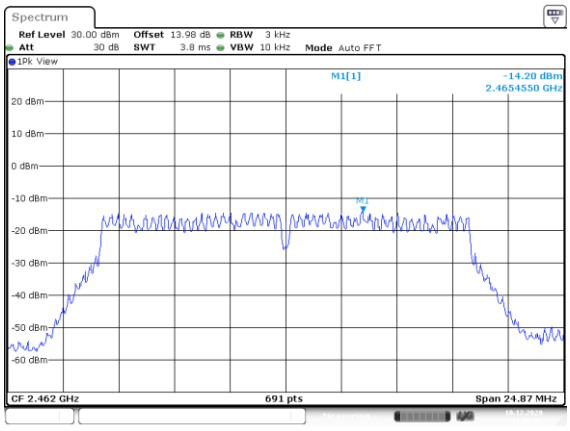
Configuration	Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
IEEE 802.11b	Low	2412	-7.45	8	Compliance
	Middle	2437	-7.28	8	Compliance
	High	2462	-9.26	8	Compliance
IEEE 802.11g	Low	2412	-14.27	8	Compliance
	Middle	2437	-9.54	8	Compliance
	High	2462	-16.54	8	Compliance
IEEE 802.11n HT20	Low	2412	-14.62	8	Compliance
	Middle	2437	-9.68	8	Compliance
	High	2462	-16.03	8	Compliance
IEEE 802.11n HT40	Low	2422	-18.75	8	Compliance
	Middle	2437	-15.99	8	Compliance
	High	2452	-19.19	8	Compliance

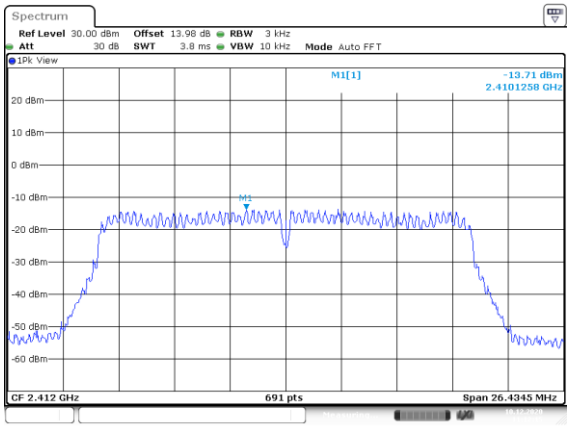
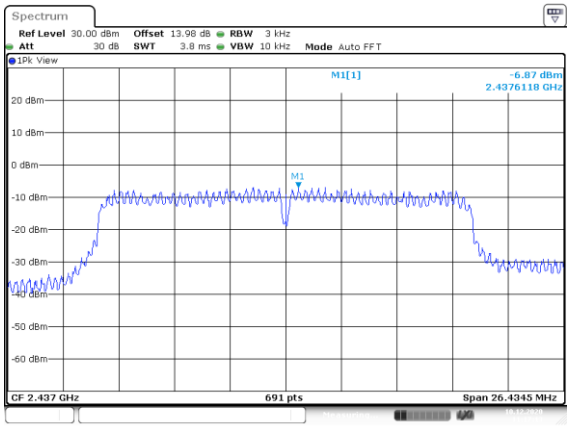
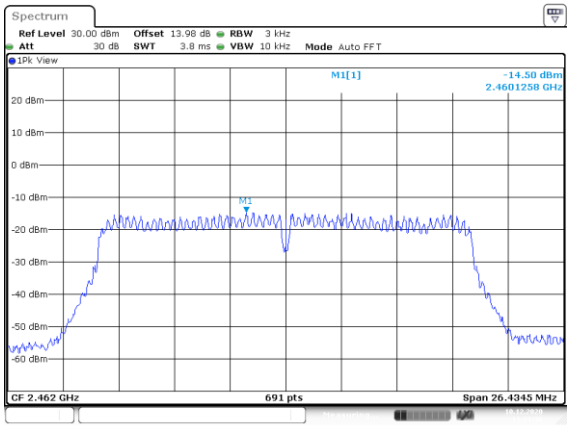
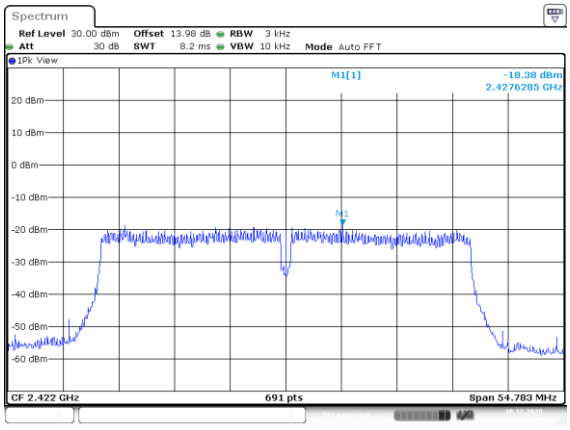
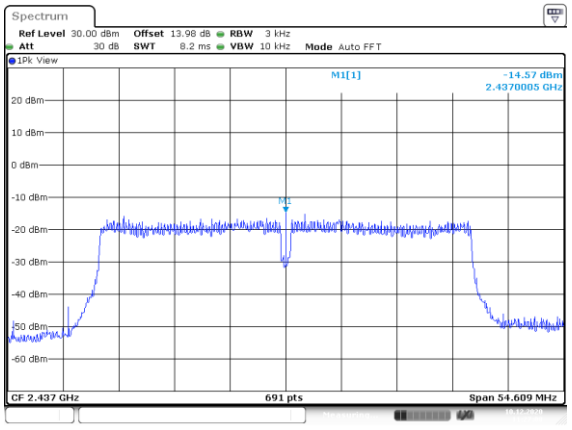
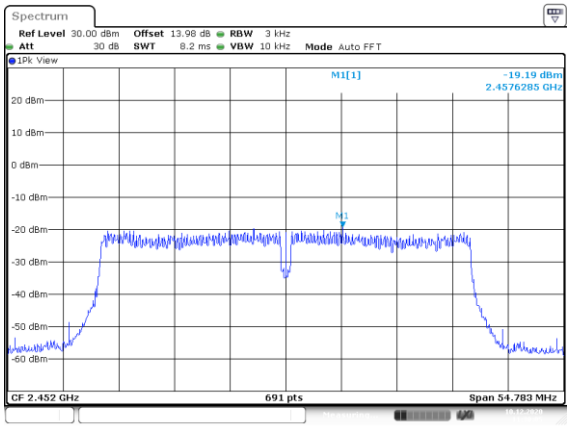
IEEE 802.11b Low CH	IEEE 802.11b Middle CH
	
IEEE 802.11b High CH	**IEEE 802.11g Low CH**
	
IEEE 802.11g Middle CH	**IEEE 802.11g High CH**
	

IEEE 802.11n HT20 Low CH	IEEE 802.11n HT20 Middle CH
	
IEEE 802.11n HT20 High CH	**IEEE 802.11n HT40 Low CH**
	
IEEE 802.11n HT40 Middle CH	**IEEE 802.11n HT40 High CH**
	

< Dipole Antenna (GW.34.5153) with 3.3V_{dc}>

Configuration	Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
IEEE 802.11b	Low	2412	-4.18	8	Compliance
	Middle	2437	-4.36	8	Compliance
	High	2462	-6.25	8	Compliance
IEEE 802.11g	Low	2412	-13.21	8	Compliance
	Middle	2437	-6.08	8	Compliance
	High	2462	-14.20	8	Compliance
IEEE 802.11n HT20	Low	2412	-13.71	8	Compliance
	Middle	2437	-6.87	8	Compliance
	High	2462	-14.50	8	Compliance
IEEE 802.11n HT40	Low	2422	-18.38	8	Compliance
	Middle	2437	-14.57	8	Compliance
	High	2452	-19.19	8	Compliance

IEEE 802.11b Low CH	IEEE 802.11b Middle CH
	
IEEE 802.11b High CH	**IEEE 802.11g Low CH**
	
IEEE 802.11g Middle CH	**IEEE 802.11g High CH**
	

IEEE 802.11n HT20 Low CH	IEEE 802.11n HT20 Middle CH
	
IEEE 802.11n HT20 High CH	**IEEE 802.11n HT40 Low CH**
	
IEEE 802.11n HT40 Middle CH	**IEEE 802.11n HT40 High CH**
	

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