



TEST REPORT

Reference No..... : WTN22F11236598W002
FCC ID : 2A9TP-ZIGBEE
Applicant..... : CES2020 LLC
Address..... : 150 Bishop Landing, Irvine, CA 92620,USA
Manufacturer : The same as above
Address..... : The same as above
Product Name..... : Zigbee gateway
Model No..... : Zigbee
Test specification..... : FCC CFR47 Part 15 Subpart C (Section 15.247):2020
Date of Receipt sample : 2022-11-25
Date of Test : 2022-12-05
Date of Issue..... : 2023-02-13
Test Report Form No. : WEW-15247A-01A
Test Result..... Pass

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of approver.

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1 Revision History

Test Report No.	Date of Issue	Description	Status
WTN22F11236598W002	2023-02-13	Original	Valid

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3 General Information

3.1 General Description of E.U.T

Product Name : Zigbee gateway

Model No. : Zigbee

Model Description : ---

Rated Voltage..... : DC 5V, 0.1A

Battery Capacity : ---

Power Adapter : ---

3.2 Technical Characteristics of EUT

Support Standards : 802.11b, 802.11g, 802.11n

Frequency Range : 2412-2462MHz for 802.11b/g/n(HT20)
2422-2452MHz for 802.11n(HT40)

RF Output Power : 18.41dBm (Conducted)

Modulation : 802.11b: DSSS(DBPSK/DQPSK/CCK)
802.11g/n: OFDM (BPSK/QPSK/16QAM/64QAM)

Data Rate : 1-11Mbps, 6-54Mbps, up to 300Mbps

Quantity of Channels : 11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)

Channel Separation..... : 5MHz

Type of Antenna : PCB Printed Antenna

Antenna Gain : 2.5dBi

3.3 Standards Applicable for Testing

The tests were performed according to following standards:

FCC Rules Part 15.247	Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
558074 D01 15.247 Meas Guidance v05r02	Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, And Hybrid System Devices Operating Under Section 15.247 Of The FCC Rules
662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices



3.4 Test Facility

The test facility has a test site registered with the following organizations:

- **ISED – Registration No.: 21895**

Waltek Testing Group (Foshan) Co., Ltd. has been registered and fully described in a report filed with the Innovation, Science and Economic Development Canada (ISED). The acceptance letter from the ISED is maintained in our files. Registration ISED number: 21895, March 12, 2019

- **FCC – Registration No.: 820106**

Waltek Testing Group (Foshan) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 820106, August 16, 2018

- **FCC – Designation No.: CN5034**

Waltek Testing Group (Foshan) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation No. CN5034.

- **NVLAP – Lab Code: 600191-0**

Waltek Testing Group (Foshan) Co., Ltd. EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 600191-0.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

3.5 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test items: ---

Lab information: ---

3.6 Abnormalities from Standard Conditions

None.



4 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List

Test Mode	Description	Remark
TM1	802.11b	Low:2412MHz, Middle:2437MHz, High:2462MHz
TM2	802.11g	Low:2412MHz, Middle:2437MHz, High:2462MHz
TM3	802.11n (HT20)	Low:2412MHz, Middle:2437MHz, High:2462MHz
TM4	802.11n (HT40)	Low:2422MHz, Middle:2437MHz, High:2452MHz

Test Conditions

Temperature:	22~25°C
Relative Humidity:	50~55%
Atmospheric pressure:	101.8kPa



5 Equipment Used during Test

5.1 Equipment List

☐ Conducted Emissions 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal Date	Cal Due Date
1.	EMI Test Receiver	R&S	ESR3	102423	2022-01-06	2023-01-05
2.	LISN	R&S	ENV216	101343	2022-01-06	2023-01-05
3.	Cable	HUBER+SUHNER	CBL2-NN-6M	223NN624	2022-01-06	2023-01-05
4.	Switch	CD	RSU-A4 18G	RSUA4008	2022-01-06	2023-01-05
☐ Conducted Emissions 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal Date	Cal Due Date
1.	EMI Test Receiver	R&S	ESCI	101178	2022-01-06	2023-01-05
2.	LISN	R&S	ENV216	101215	2022-01-06	2023-01-05
3.	Cable	HUBER+SUHNER	CBL2-NN-6M	6102701	2022-01-06	2023-01-05
4.	Switch	ESE	RSU/M2	---	2022-01-07	2023-01-06
☐ Conducted Emissions 3#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal Date	Cal Due Date
1.	EMI Test Receiver	R&S	ESR3	102842	2022-01-06	2023-01-05
2.	LISN	R&S	ENV216	101542	2022-01-06	2023-01-05
3.	Cable	YIHENG	LMR195UF-NMNM-2.5	---	2022-01-07	2023-01-06
4.	Manual RF Switch	YIHENG	SW-2	RSU0402	2022-01-07	2023-01-06
☒ Radiation Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	3m Semi-anechoic Chamber	CHANGCHUANG	9m×6m×6m	-	2021-01-11	2024-01-10
2.	EMI Test Receiver	RS	ESR7	101566	2022-01-07	2023-01-06
3.	EMC Analyzer	Agilent	N9020A	MY48011796	2022-05-16	2023-05-17
4.	Active Loop Antenna	SCHWARZBECK	FMZB1519B	00004	2022-01-10	2023-01-09
5.	Trilog Broadband Antenna	SCHWARZBECK	VULB 9162	9162-117	2022-01-09	2023-01-08
6.	Coaxial Cable (below 1GHz)	H+S	CBL3-NN-12+3 m	214NN320	2022-01-07	2023-01-06
7.	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	01561	2022-01-09	2023-01-08
8.	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	01119	2022-01-09	2023-01-08
9.	Coaxial Cable (above 1GHz)	Times-Microwave	CBL5-NN	-	2022-01-06	2023-01-05
10.	Amplifier	Lunar E M	LNA1G18-40	20160501002	2022-01-06	2023-01-05



☒ RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	Spectrum Analyzer	Agilent	N9020A	MY48011796	2022-05-16	2023-05-17
2.	Analog Signal Generator	Agilent	N5181A	MY48180720	2022-01-06	2023-01-05
3.	RF Control Unit	CHANGCHUANG	JS0806-2	-	2022-01-06	2023-01-05

☐: Not Used

☒: Used

5.2 Test Software

Description	Manufacturer	Model	Version
EMI Test Software (Conducted Emission 1#)	FARATRONIC	EZ-EMC	EMEC-3A1
EMI Test Software (Conducted Emission 2#)	FARATRONIC	EZ-EMC	CON-03A1
EMI Test Software (Conducted Emission 3#)	FARATRONIC	EZ-EMC	COM 3A1.1
EMI Test Software (Radiated Emission)	FARATRONIC	EZ-EMC	RA-03A1-1
RF Conducted Test Software	TONSCEND	JS1120-2	V2.6

5.3 Special Accessories and Auxiliary Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.
1.	/	/	/	/

5.4 Measurement Uncertainty

Parameter	Uncertainty
RF Output Power	±2.2dB
Occupied Bandwidth	±1.5%
Conducted Emission	±2.6dB
Transmitter Spurious Emission	±3.8dB (for 25MHz-1GHz)
	±5.0dB (for 1GHz-18GHz)



6 Summary of Test Result

Test Items	FCC Rules	Result
Antenna Requirement	§15.203; §15.247(b)(4)(i)	Compliant
Restricted Band of Operation	§15.205	Compliant
Conducted Emissions	§15.207(a)	N/A
Radiated Spurious Emissions	§15.209(a)	Compliant
Power Spectral Density	§15.247(e)	Compliant
DTS Bandwidth	§ 15.247(a)(2)	Compliant
RF Output Power	§15.247(b)(3)	Compliant
Band edge (Out of Band Emissions)	§15.247(d)	Compliant

Remark:

Pass Test item meets the requirement

Fail Test item does not meet the requirement

N/A Test case does not apply to the test object

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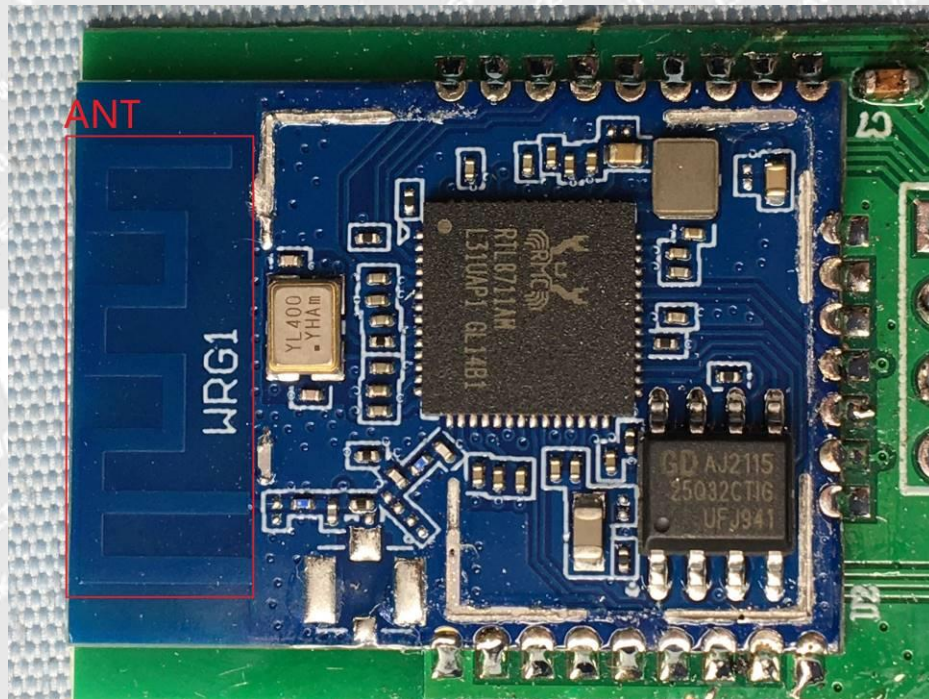
6.1 Antenna Requirement

6.1.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

6.1.2 Evaluation Information

The EUT has an PCB Printed Antenna, the gain is 2.5dBi, fulfil the requirement of this section.





6.2 Radiated Spurious Emissions

6.2.1 Standard Applicable

According to §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).

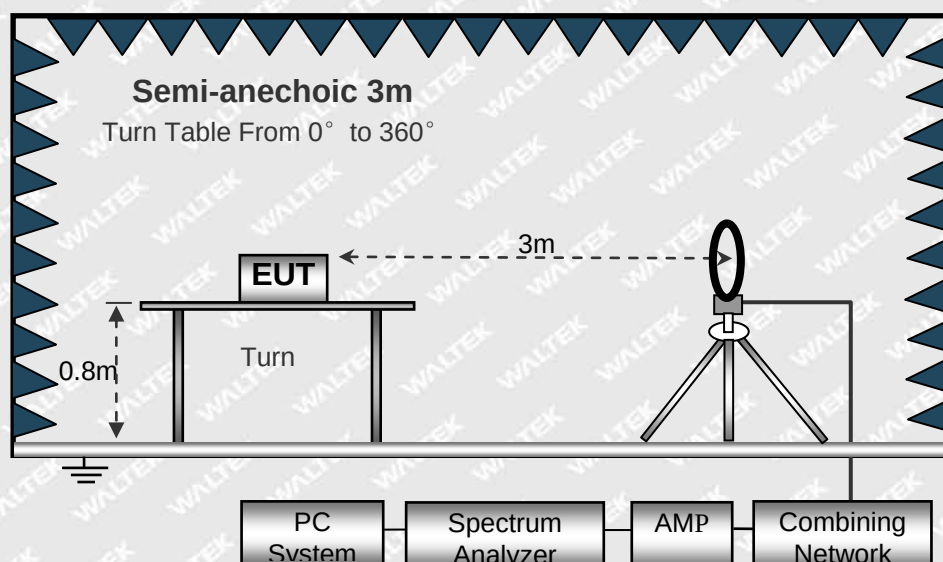
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

6.2.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

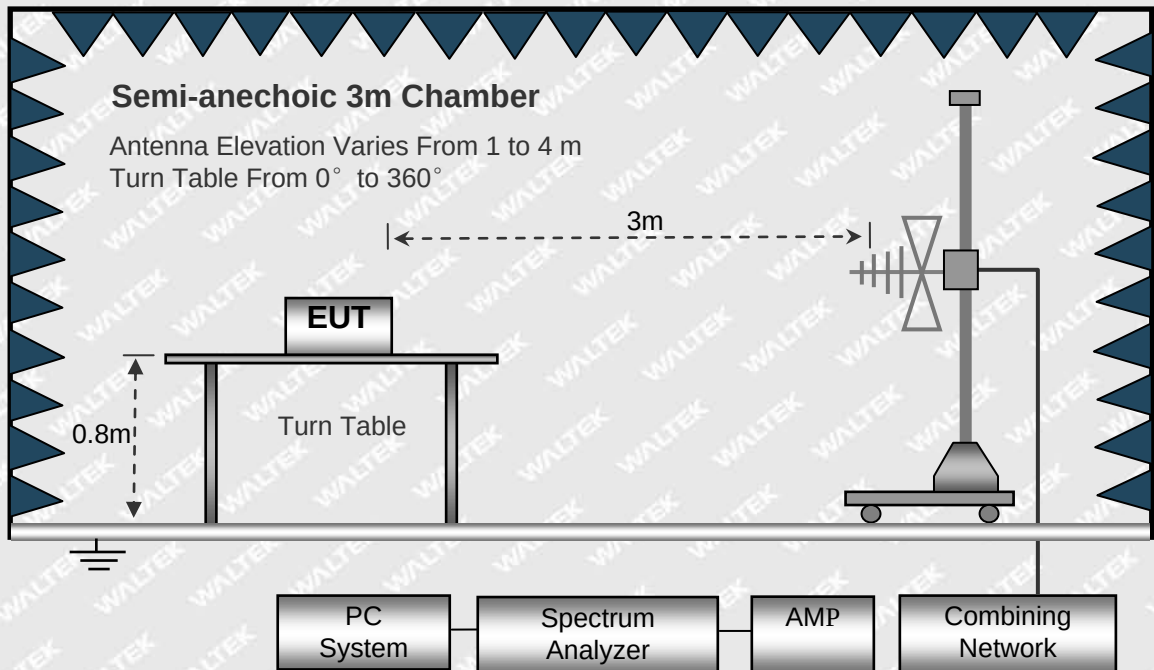
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.

The test setup for emission measurement below 30MHz.

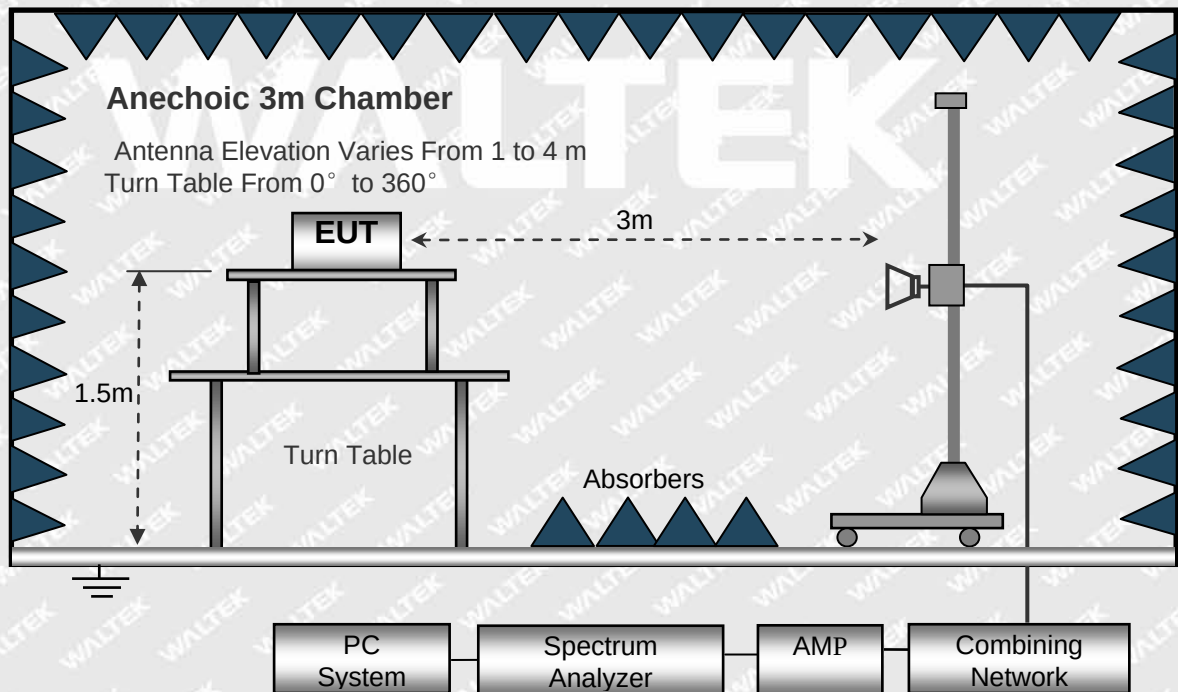




The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.





6.2.3 Spectrum Analyzer Setup

9KHz-30MHz

RBW=10kHz

VBW=30kHz

Sweep time=Auto

Trace=Max hold

Detector function=peak

30MHz-1GHz

RBW=120kHz

VBW=300kHz

Sweep time=Auto

Trace=Max hold

Detector function=peak, QP

Above 1GHz

RBW=1MHz

VBW=3MHz(Peak), 10MHz(AV)

Sweep time=Auto

Trace=Max hold

Detector function=peak, AV

6.2.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Corr. Factor}$$

$$\text{Corr. Factor} = \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$



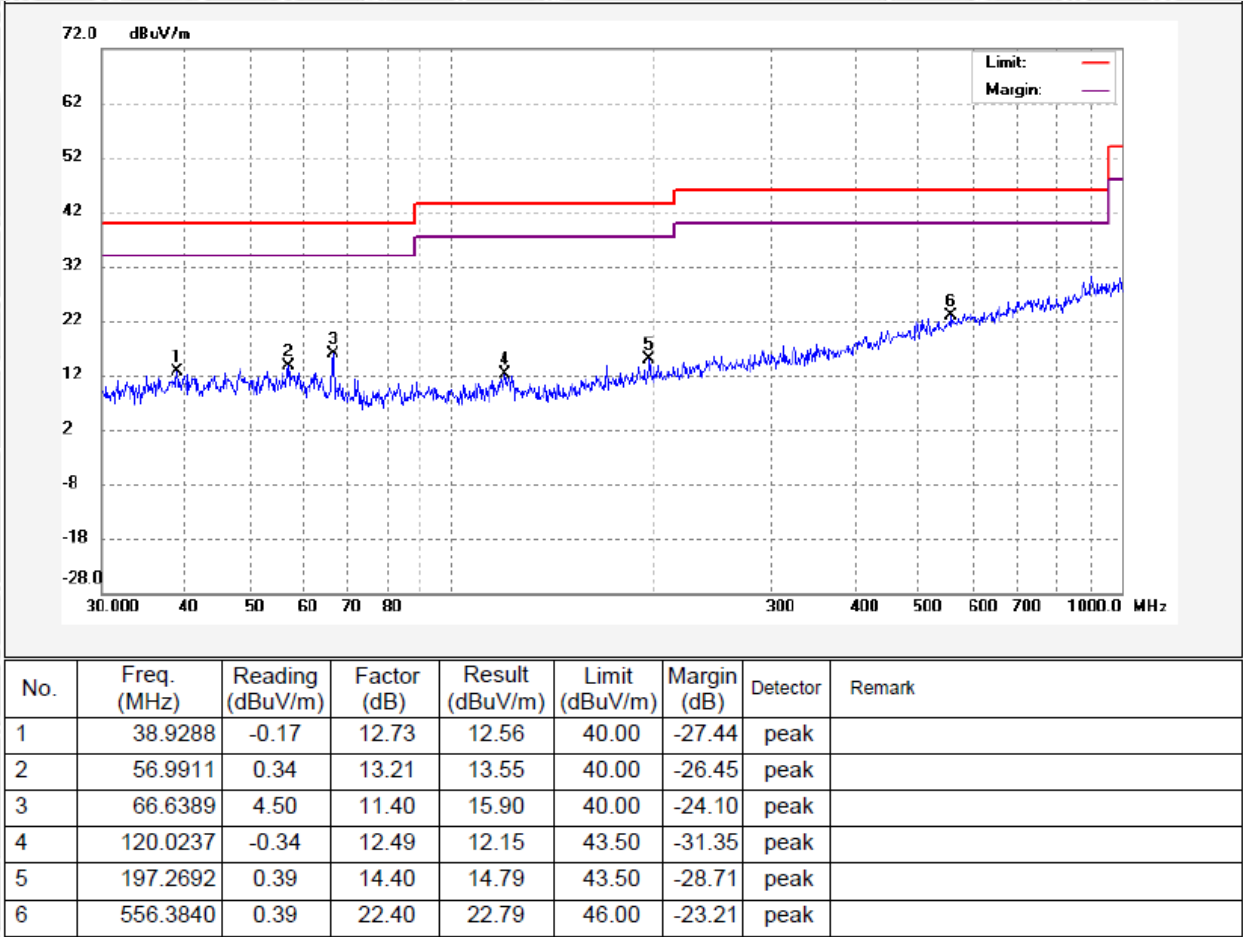
6.2.5 Test Results

Note: All test modes (different data rate and different modulation) are performed, but only the worst case is recorded in this report.

Test Frequency: Below 1GHz

Test Mode: 802.11b (worst case)

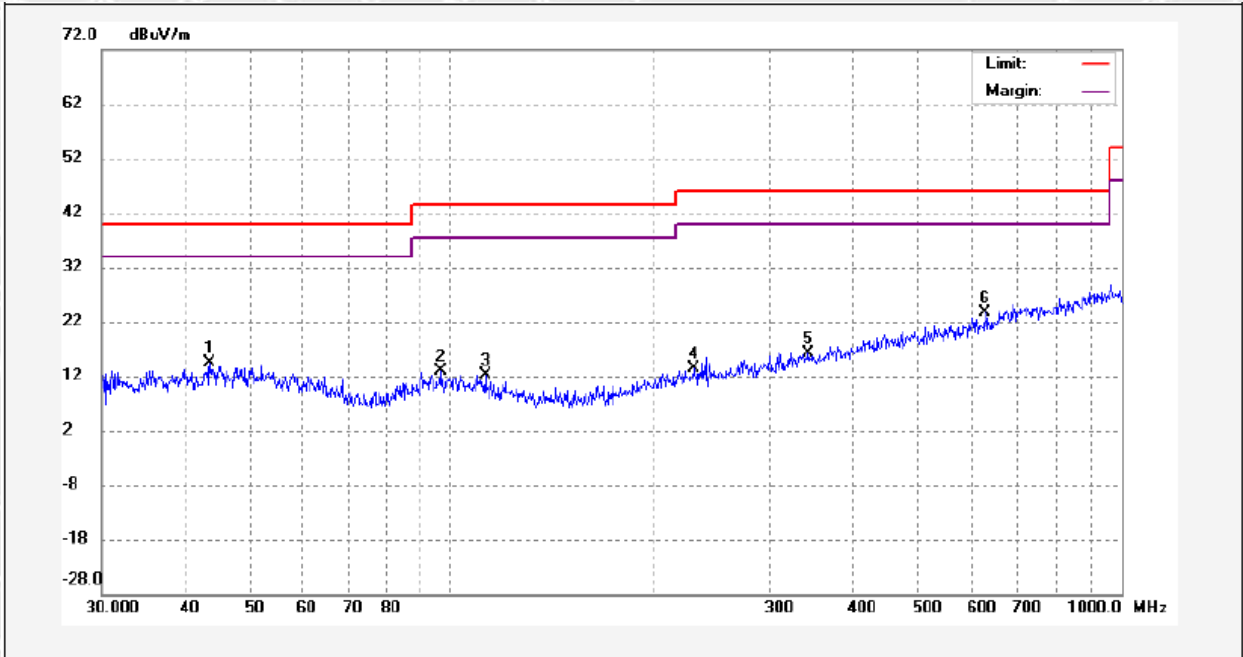
Test Channel Low Channel Polarization Vertical





Test Channel Low Channel

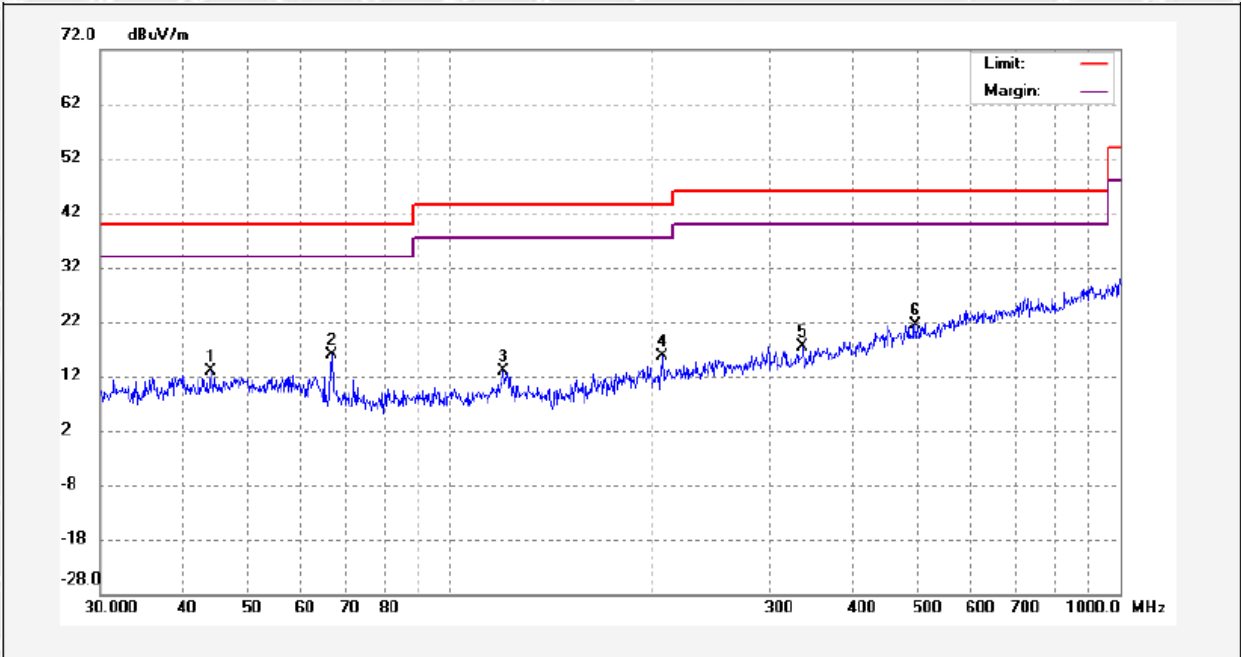
Polarization Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	43.5208	-0.95	15.37	14.42	40.00	-25.58	peak	
2	96.2672	-0.66	13.48	12.82	43.50	-30.68	peak	
3	112.4060	-1.04	13.06	12.02	43.50	-31.48	peak	
4	229.6149	-0.34	13.83	13.49	46.00	-32.51	peak	
5	341.7389	-1.40	17.48	16.08	46.00	-29.92	peak	
6	625.2970	1.47	22.04	23.51	46.00	-22.49	peak	



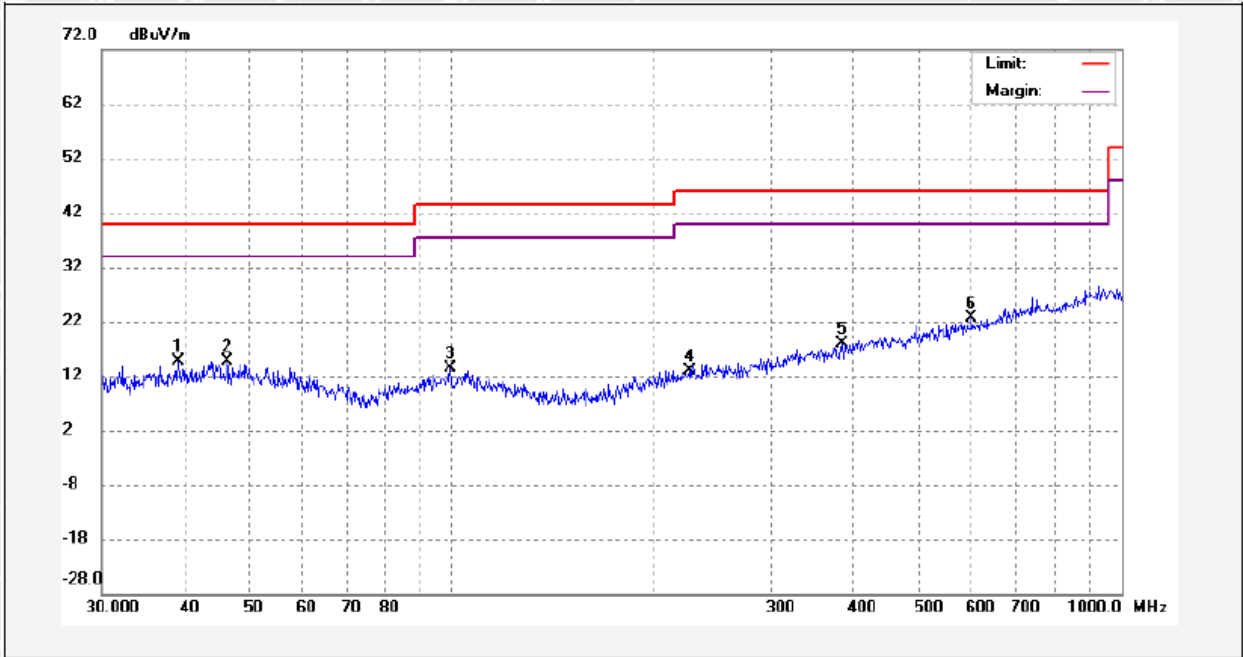
Test Channel Middle Channel Polarization Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	43.8887	-0.51	13.43	12.92	40.00	-27.08	peak	
2	66.6156	4.56	11.41	15.97	40.00	-24.03	peak	
3	120.0237	0.42	12.49	12.91	43.50	-30.59	peak	
4	207.5587	1.16	14.35	15.51	43.50	-27.99	peak	
5	336.1530	0.64	16.81	17.45	46.00	-28.55	peak	
6	494.5450	0.16	21.21	21.37	46.00	-24.63	peak	



Test Channel Middle Channel Polarization Horizontal

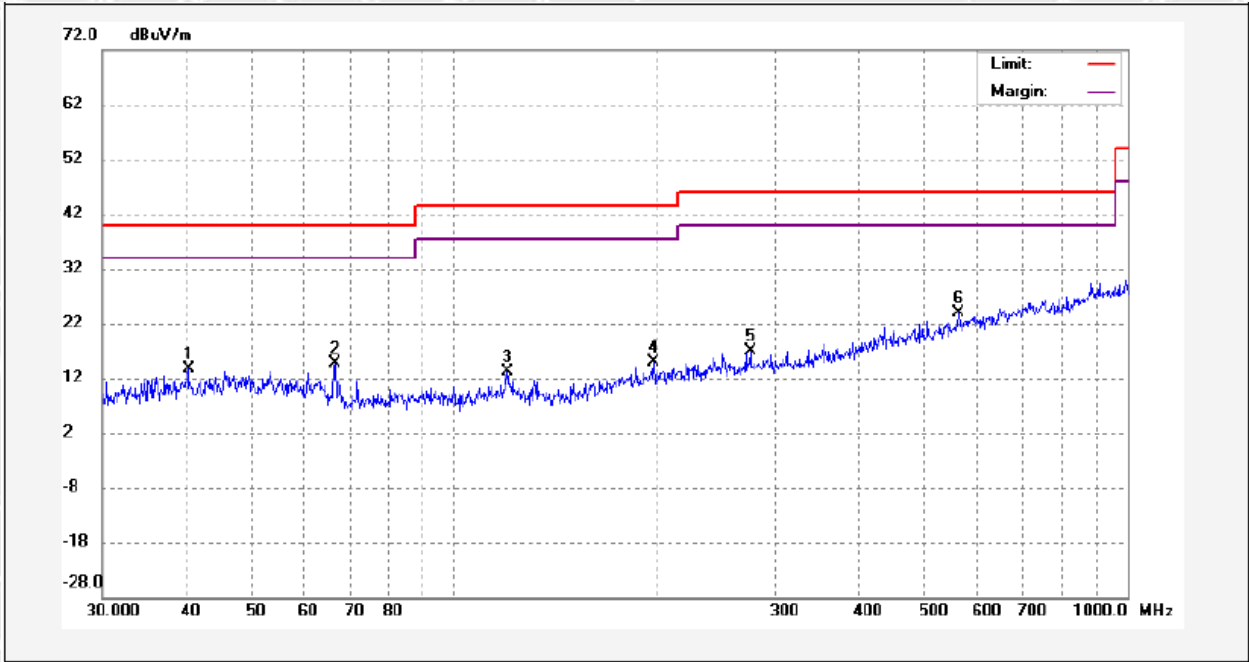


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	39.0792	-0.01	14.62	14.61	40.00	-25.39	peak	
2	46.3239	-0.86	15.42	14.56	40.00	-25.44	peak	
3	99.5630	-0.34	13.84	13.50	43.50	-30.00	peak	
4	226.1785	-0.77	13.69	12.92	46.00	-33.08	peak	
5	382.9904	-0.16	17.95	17.79	46.00	-28.21	peak	
6	597.2233	0.91	21.84	22.75	46.00	-23.25	peak	



Test Channel High Channel

Polarization Vertical

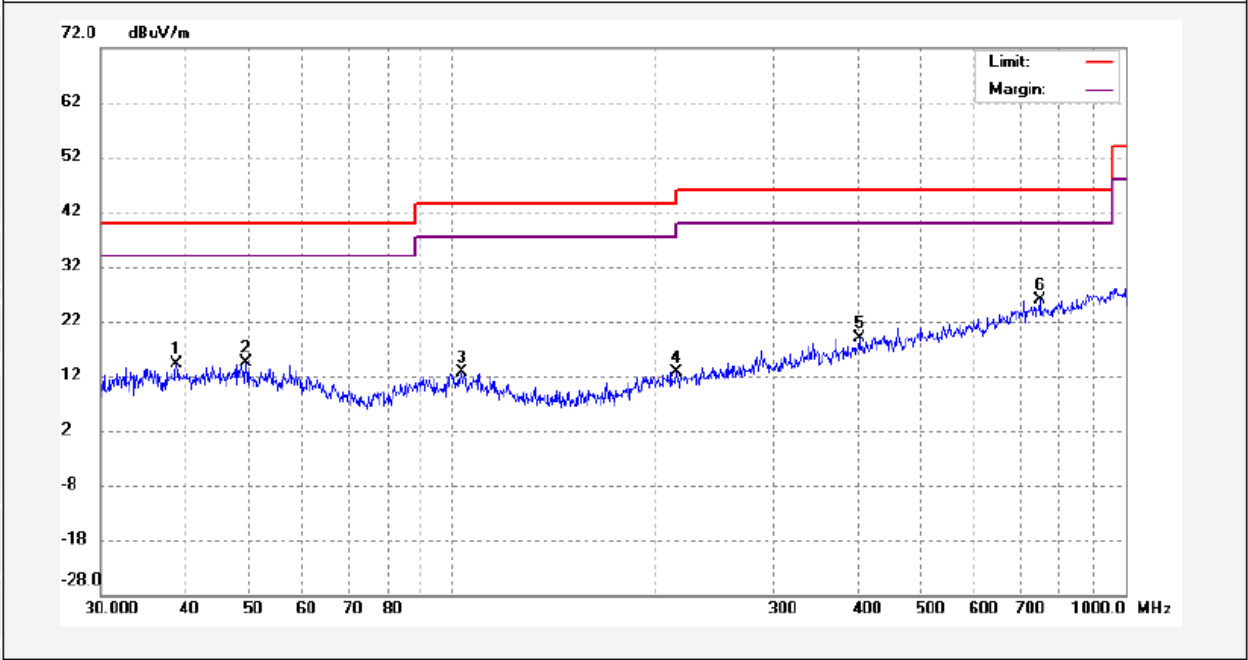


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	40.3322	0.75	12.96	13.71	40.00	-26.29	peak	
2	66.5455	3.29	11.42	14.71	40.00	-25.29	peak	
3	120.0237	0.69	12.49	13.18	43.50	-30.32	peak	
4	198.3095	0.35	14.41	14.76	43.50	-28.74	peak	
5	275.9300	0.86	16.00	16.86	46.00	-29.14	peak	
6	561.0860	1.38	22.51	23.89	46.00	-22.11	peak	



Test Channel High Channel

Polarization Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	38.8877	-0.53	14.57	14.04	40.00	-25.96	peak	
2	49.4285	-0.78	15.05	14.27	40.00	-25.73	peak	
3	103.2971	-1.48	14.10	12.62	43.50	-30.88	peak	
4	215.5700	-0.78	13.31	12.53	43.50	-30.97	peak	
5	402.5436	0.34	18.51	18.85	46.00	-27.15	peak	
6	747.2204	1.15	24.74	25.89	46.00	-20.11	peak	

**Test Frequency: Above 1GHz****Test Mode: 802.11b (worst case)**

Frequency (MHz)	Receiver Reading (dBμV/m)	Detector (PK/QP/AVG)	Turn table Angle (°)	RX Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247	
				Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
802.11b_Low Channel									
6228.75	42.41	Peak	222	1.1	H	-0.45	41.96	74	-32.04
6228.75	31.84	AVG	127	1.4	H	-0.45	31.39	54	-22.61
11187.25	40.08	Peak	107	1.1	H	10.41	50.49	74	-23.51
11187.25	30.36	AVG	244	1	H	10.41	40.77	54	-13.23
5711.75	43.53	Peak	230	2	V	-1.46	42.07	74	-31.93
5711.75	33.95	AVG	290	1.4	V	-1.46	32.49	54	-21.51
11034.50	39.21	Peak	206	1.7	V	9.62	48.83	74	-25.17
11034.50	29.69	AVG	121	1.7	V	9.62	39.31	54	-14.69
802.11b_Middle Channel									
5288.75	42.2	Peak	153	1.2	H	-2.62	39.58	74	-34.42
5288.75	32.23	AVG	307	1.5	H	-2.62	29.61	54	-24.39
10517.50	41.36	Peak	178	1.3	H	8.70	50.06	74	-23.94
10517.50	31.51	AVG	150	1.6	H	8.70	40.21	54	-13.79
4771.75	44.94	Peak	281	1.5	V	-3.57	41.37	74	-32.63
4771.75	36.43	AVG	296	2	V	-3.57	32.86	54	-21.14
10799.50	41.52	Peak	309	1.1	V	9.01	50.53	74	-23.47
10799.50	31.16	AVG	177	1	V	9.01	40.17	54	-13.83
802.11b_High Channel									
4113.75	40.69	Peak	312	1.9	H	-5.45	35.24	74	-38.76
4113.75	31.76	AVG	134	1.6	H	-5.45	26.31	54	-27.69
11187.25	39.71	Peak	126	1	H	10.41	50.12	74	-23.88
11187.25	31.05	AVG	178	1.1	H	10.41	41.46	54	-12.54
5453.25	42.2	Peak	170	2	V	-2.14	40.06	74	-33.94
5453.25	32.48	AVG	119	1.4	V	-2.14	30.34	54	-23.66
10517.50	41.29	Peak	219	1.1	V	8.19	49.48	74	-24.52
10517.50	32.11	AVG	158	1.5	V	8.19	40.30	54	-13.70

Note: Testing is carried out with frequency range 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.



6.3 Power Spectral Density

6.3.1 Standard Applicable

According to 15.247(a)(1)(iii), 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.

6.3.2 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.3, such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. The test method of power spectral density as below:

- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 times the OBW.
- Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set VBW $\geq 3 \times \text{RBW}$.
- Detector = power averaging (RMS) or sample detector (when RMS not available).
- Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$.
- Sweep time = auto couple.
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

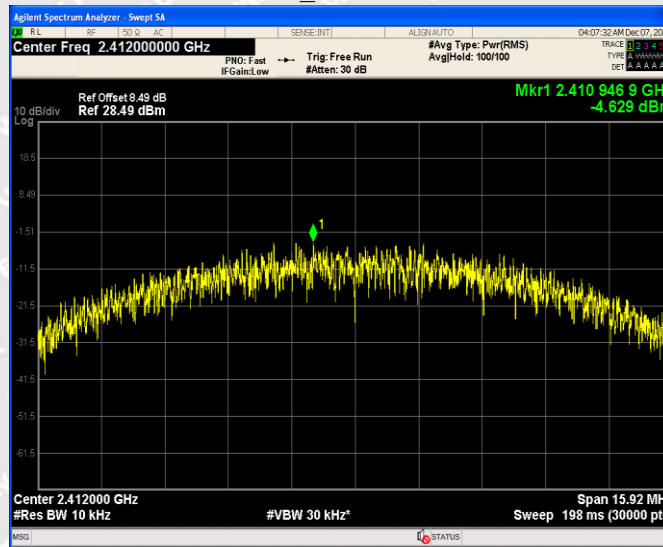
6.3.3 Test Result

Test Mode	Test Channel	Test Result (dBm/10kHz)	Limit (dBm/3kHz)
802.11b	Low	-4.63	8
	Middle	-3.7	8
	High	-4.06	8
802.11g	Low	-13.93	8
	Middle	-14.11	8
	High	-13.89	8
802.11n (HT20)	Low	-14.03	8
	Middle	-14.31	8
	High	-14.15	8
802.11n (HT40)	Low	-15.93	8
	Middle	-16	8
	High	-16.19	8

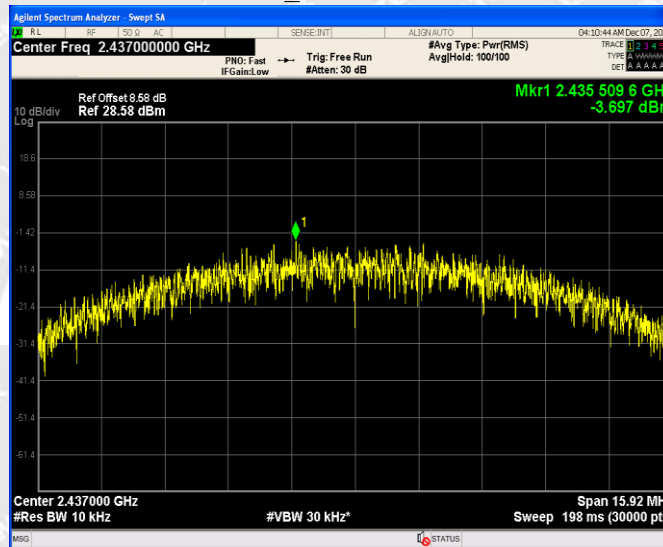


Test plots:

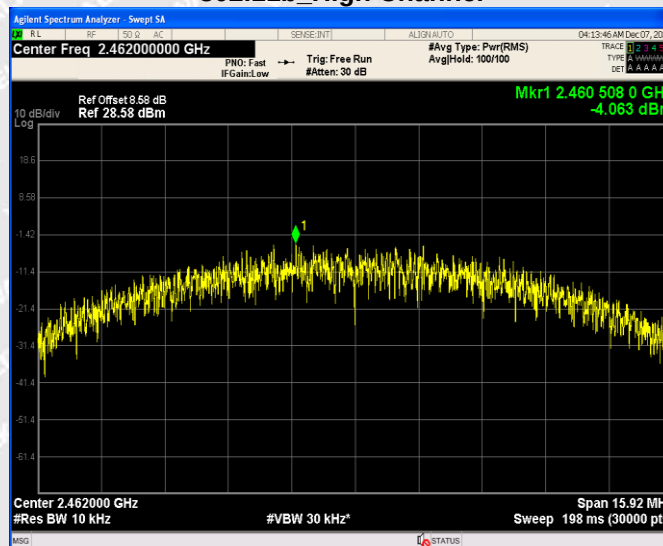
802.11b_Low Channel



802.11b_Middle Channel

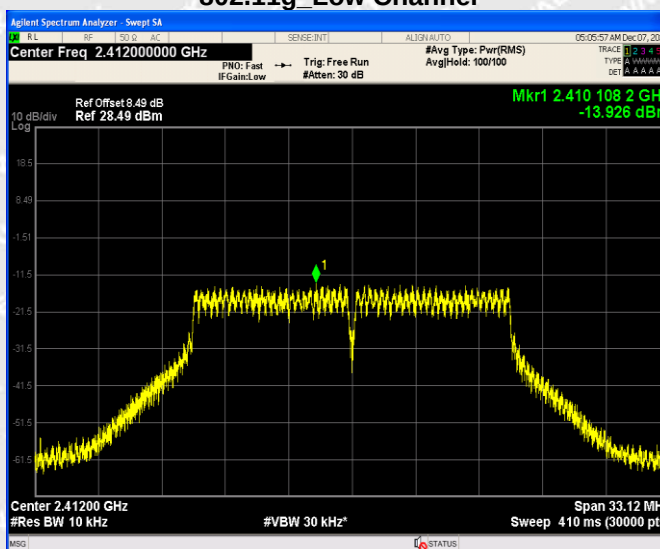


802.11b_High Channel

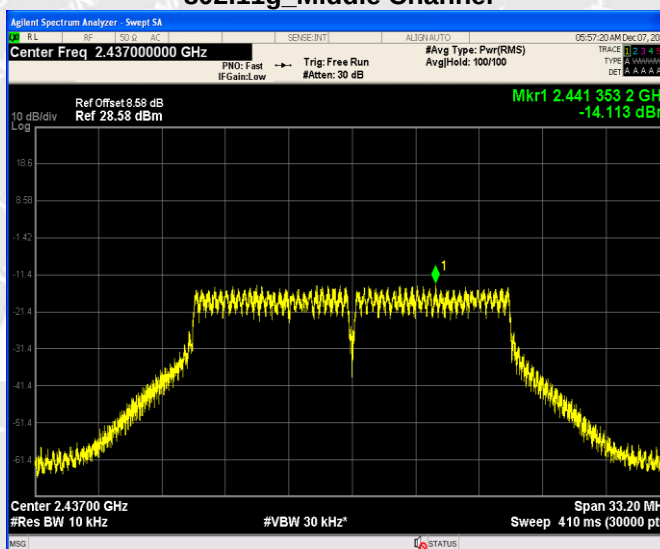




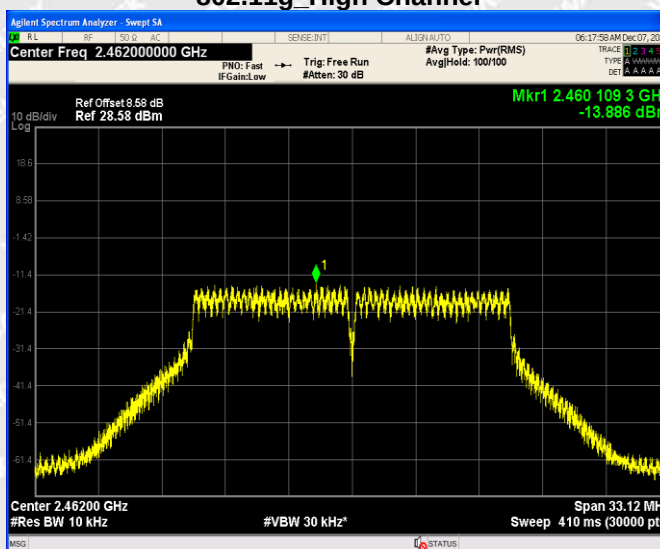
802.11g_Low Channel



802.11g_Middle Channel

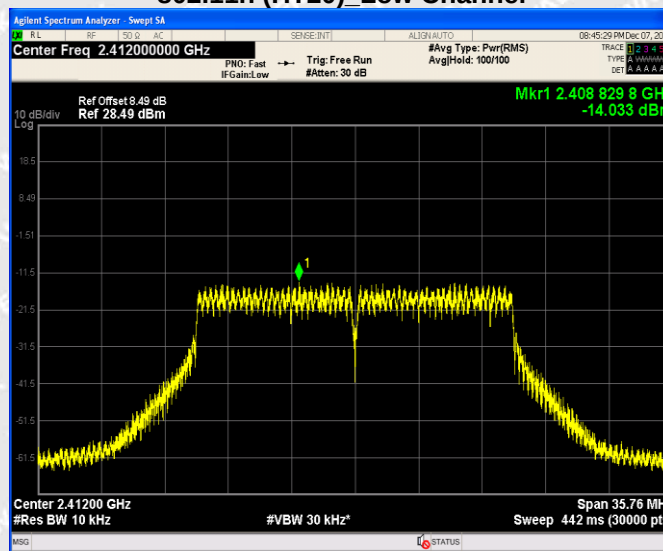


802.11g_High Channel

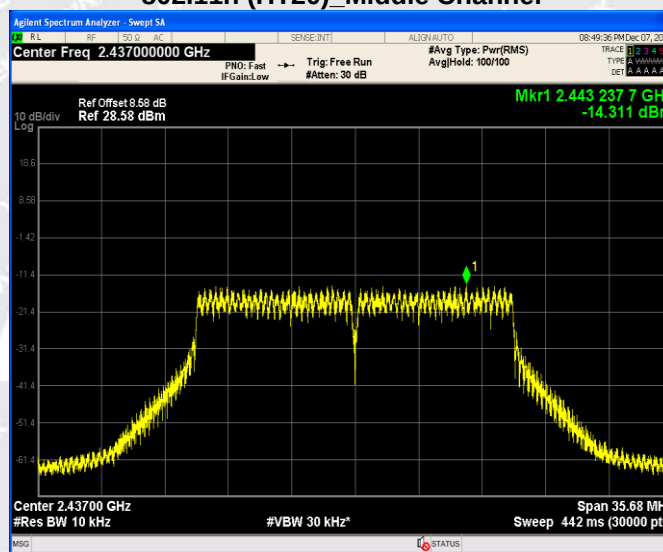




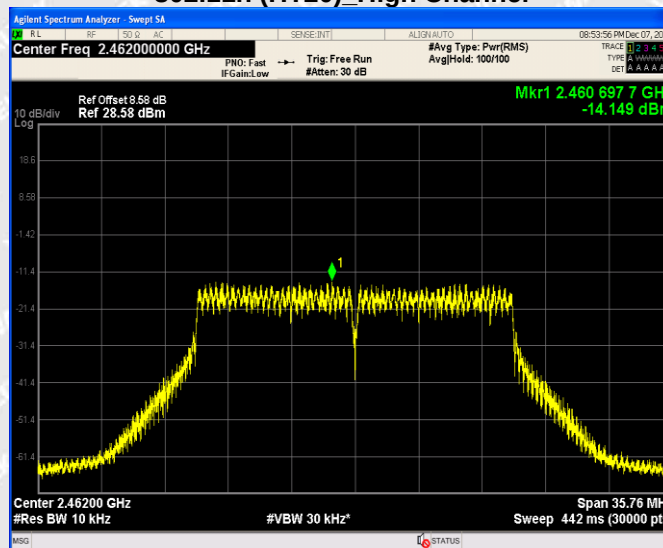
802.11n (HT20)_Low Channel



802.11n (HT20)_Middle Channel

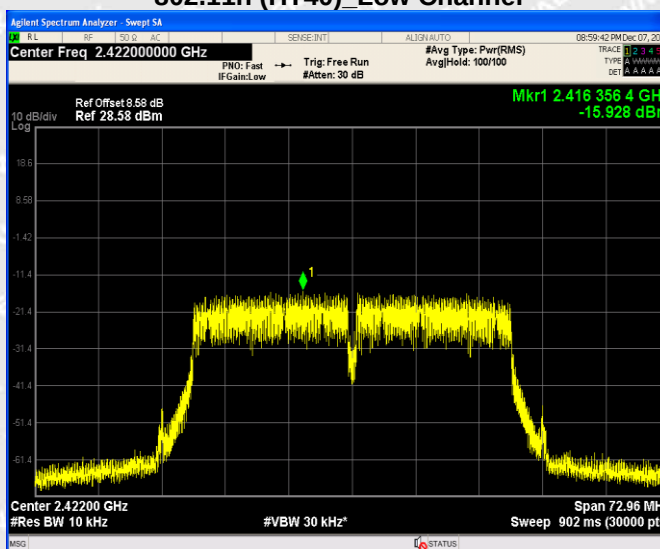


802.11n (HT20)_High Channel

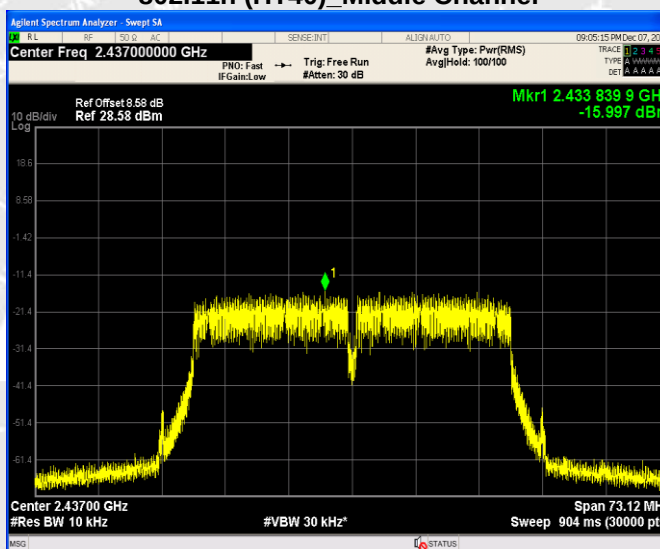




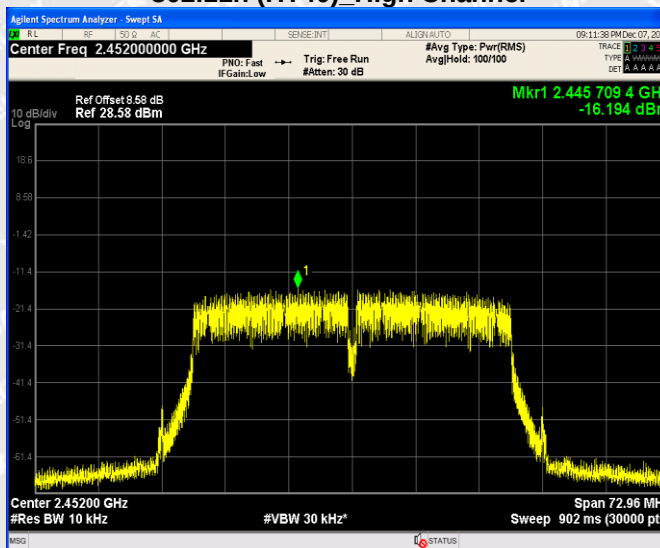
802.11n (HT40)_Low Channel



802.11n (HT40)_Middle Channel



802.11n (HT40)_High Channel





6.4 DTS Bandwidth

6.4.1 Standard Applicable

According to 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.

6.4.2 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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.

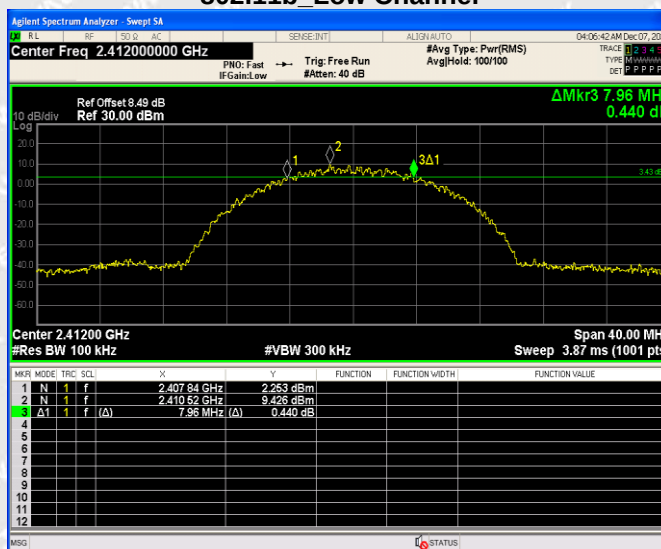
6.4.3 Test Result

Test Mode	Test Channel	Test Result (MHz)	Limit kHz
802.11b	Low	7.960	≥ 500
	Middle	7.960	≥ 500
	High	7.960	≥ 500
802.11g	Low	16.560	≥ 500
	Middle	16.600	≥ 500
	High	16.560	≥ 500
802.11n (HT20)	Low	17.880	≥ 500
	Middle	17.840	≥ 500
	High	17.880	≥ 500
802.11n (HT40)	Low	36.480	≥ 500
	Middle	36.560	≥ 500
	High	36.480	≥ 500

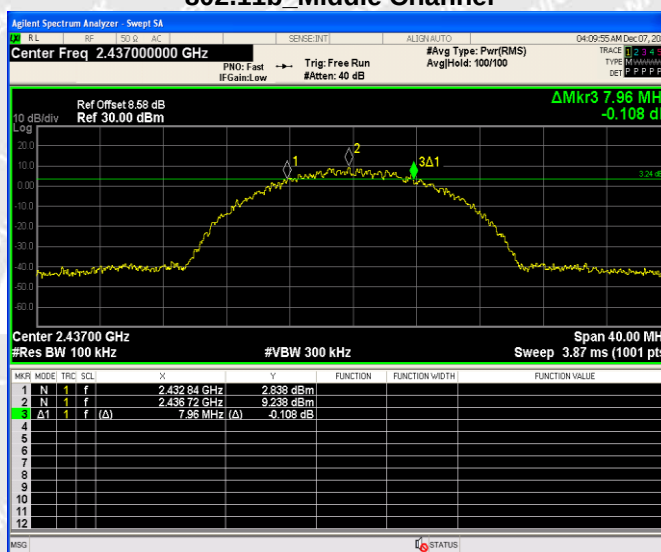


Test plots:

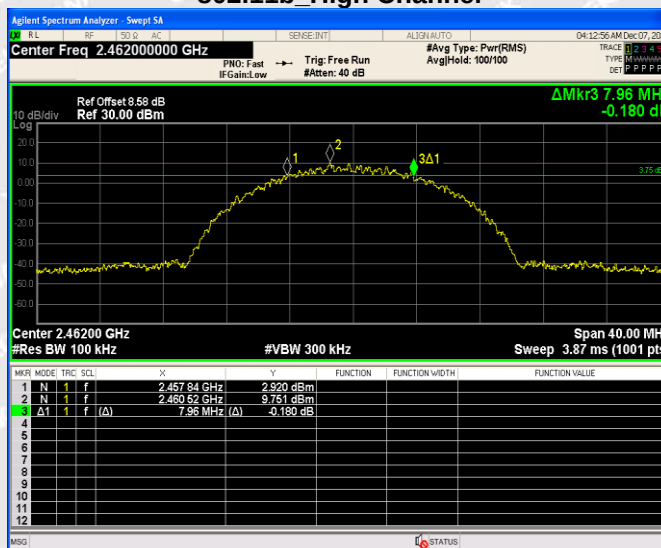
802.11b_Low Channel



802.11b_Middle Channel

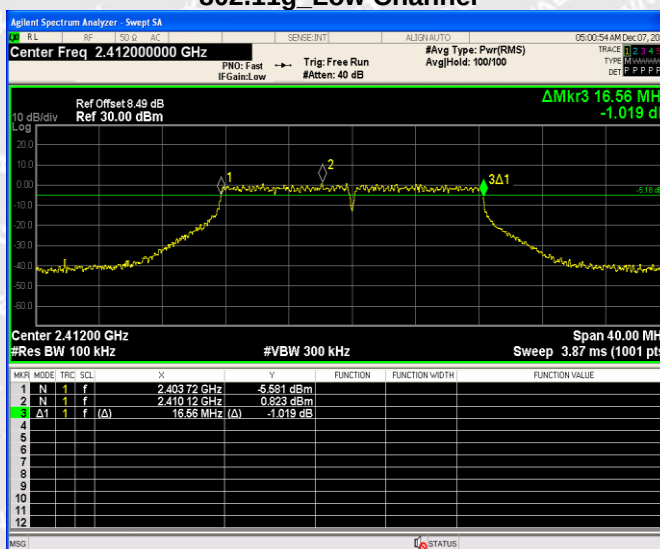


802.11b_High Channel

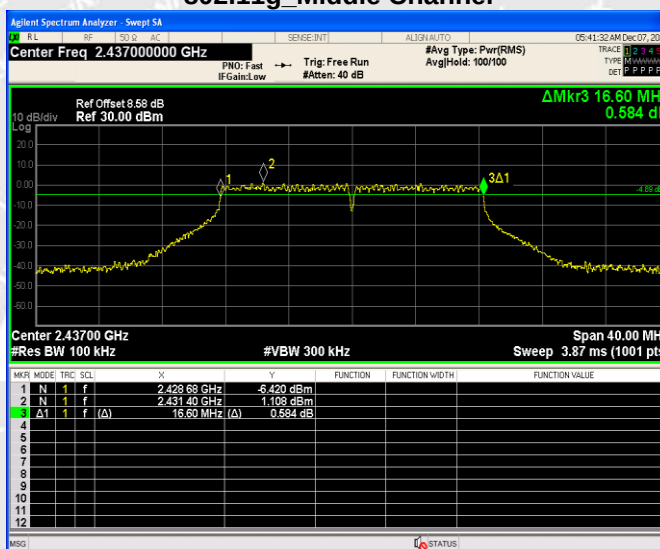




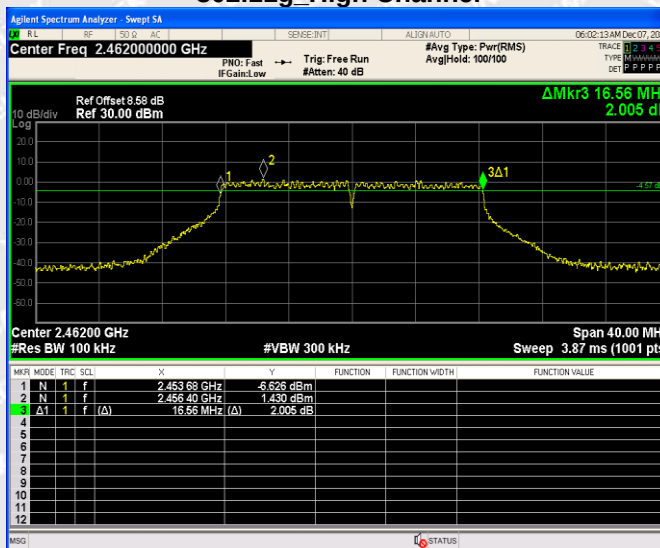
802.11g_Low Channel



802.11g_Middle Channel

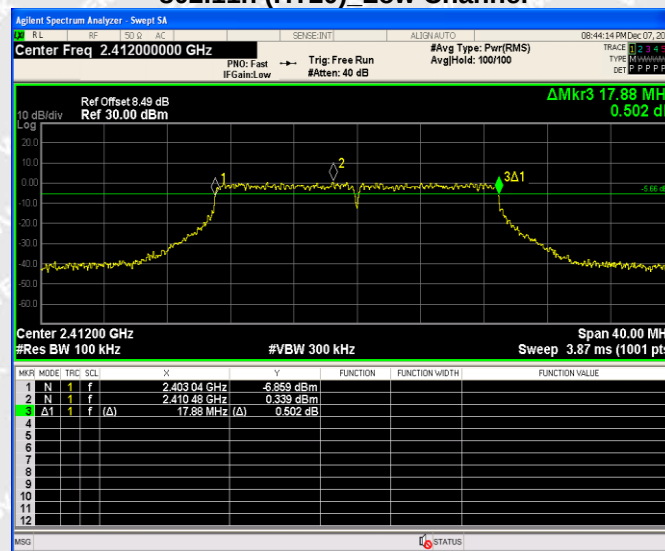


802.11g_High Channel

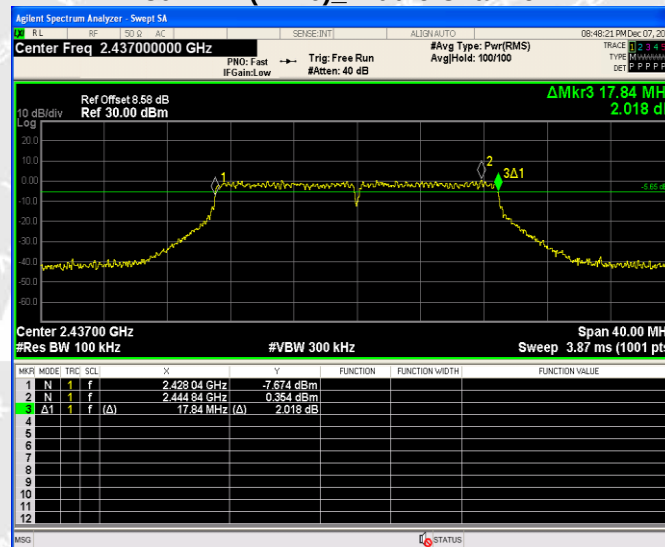




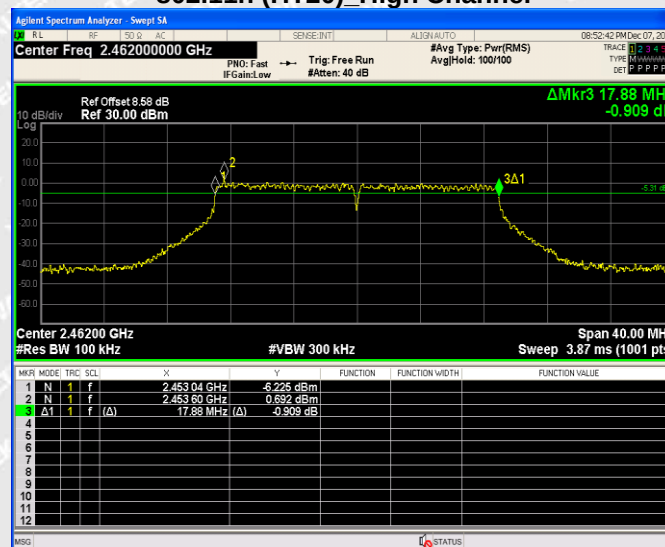
802.11n (HT20)_Low Channel



802.11n (HT20)_Middle Channel

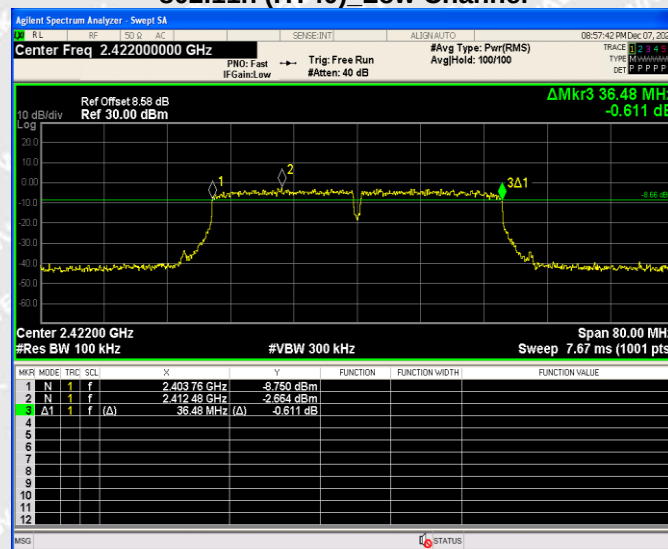


802.11n (HT20)_High Channel

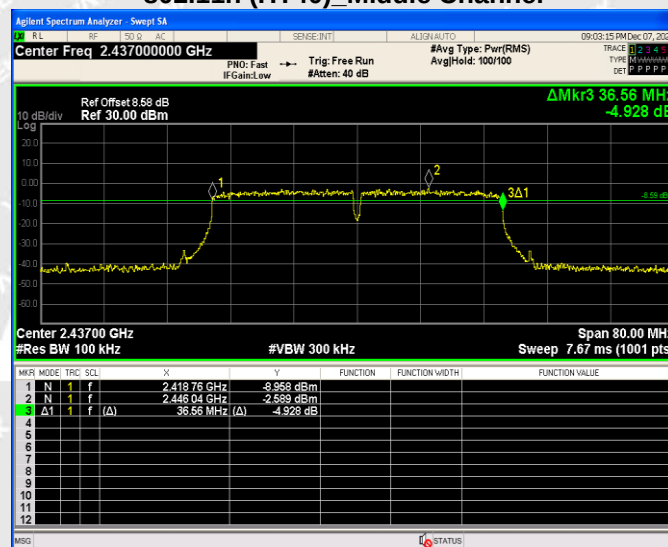




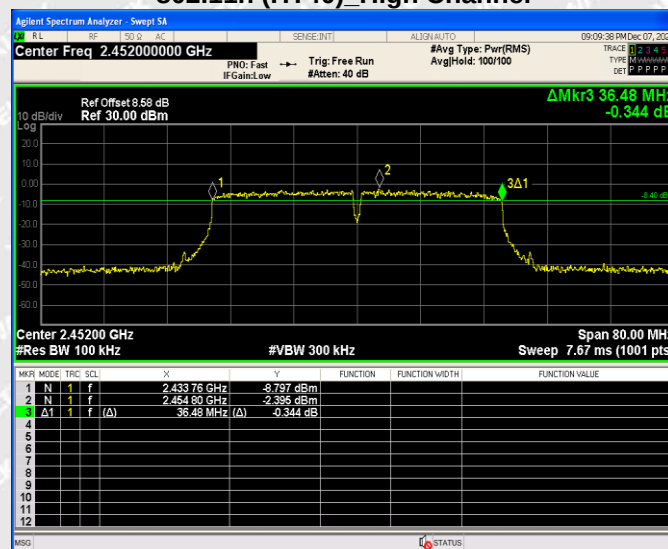
802.11n (HT40) Low Channel



802.11n (HT40) Middle Channel



802.11n (HT40) High Channel





6.5 RF Output Power

6.5.1 Standard Applicable

According to 15.247(b)(3). For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

6.5.2 Test Procedure

According to the KDB-558074 D01 v05r02 Subclause 8.3.2.2 and ANSI C63.10-2013 Subclause 11.9.2.2, when this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth

- a) Set span to at least 1.5 times the OBW.
- b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Number of points in sweep $\geq 2 \times$ span / RBW. (This gives bin-to-bin spacing $\geq$ RBW/2, so that narrowband signals are not lost between frequency bins.)
- e) Sweep time = auto.
- f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- g) If transmit duty cycle < 98 %, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
- h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
- i) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.



6.5.3 Test Result

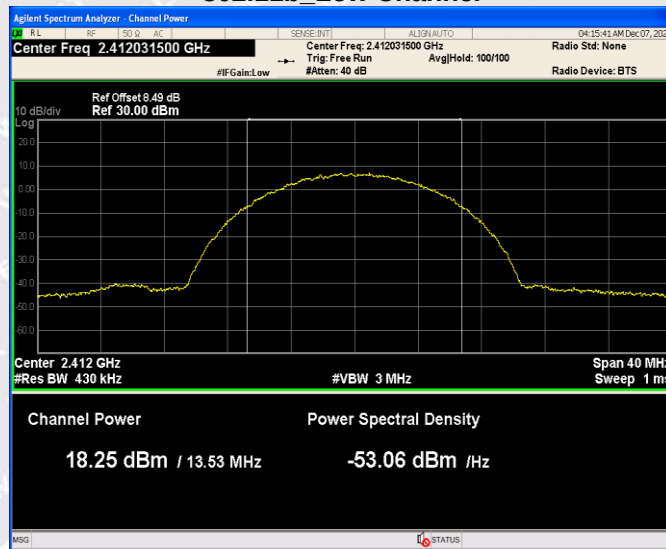
Modulation	Test Channel	Reading (dBm)	Output Power (mW)	Limit (mW)
802.11b	Low	18.25	66.83	1000
	Middle	18.30	67.61	1000
	High	18.41	69.34	1000
802.11g	Low	13.68	23.33	1000
	Middle	13.72	23.55	1000
	High	13.56	22.70	1000
802.11n (HT20)	Low	13.68	23.33	1000
	Middle	13.65	23.17	1000
	High	13.58	22.80	1000
802.11n (HT40)	Low	13.32	21.48	1000
	Middle	13.45	22.13	1000
	High	13.44	22.08	1000

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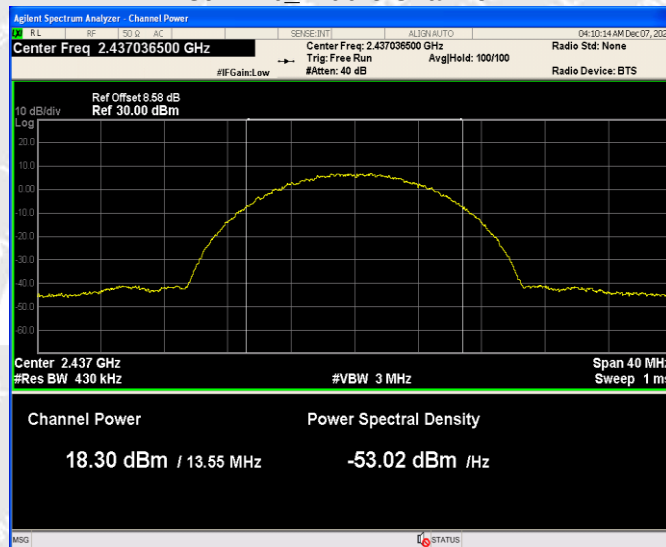


Test plots:

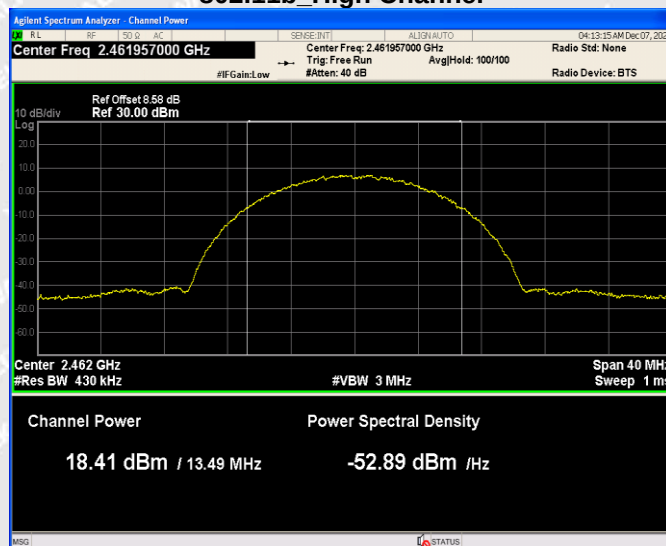
802.11b Low Channel

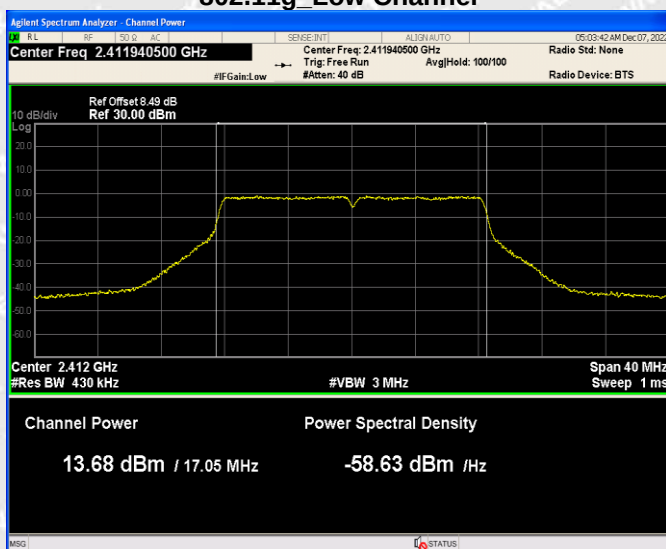
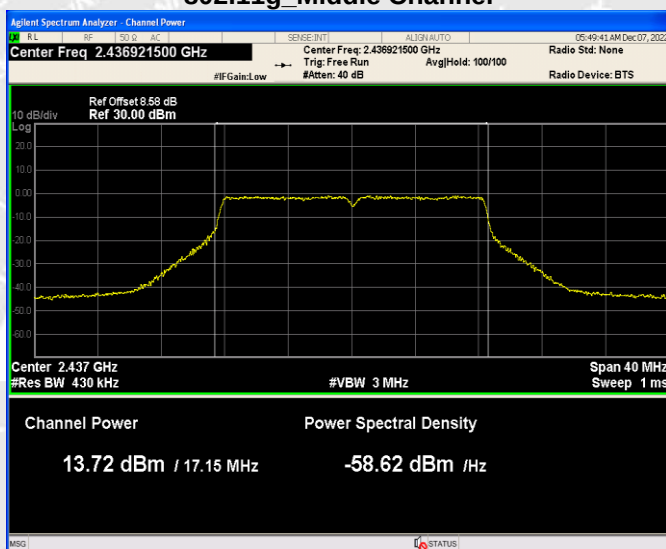
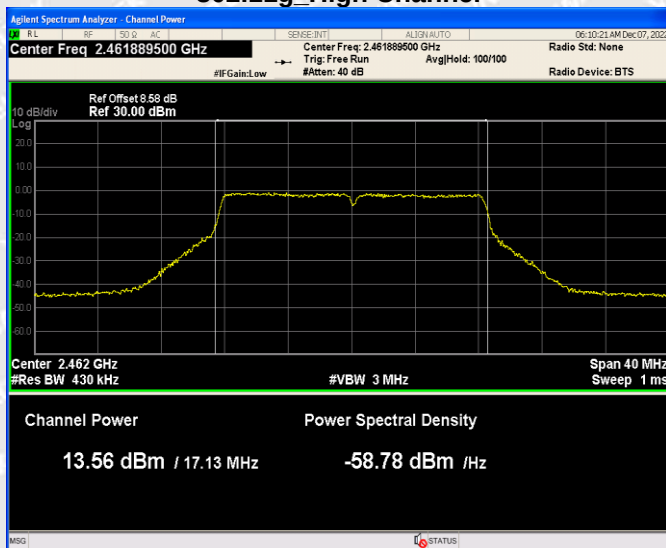


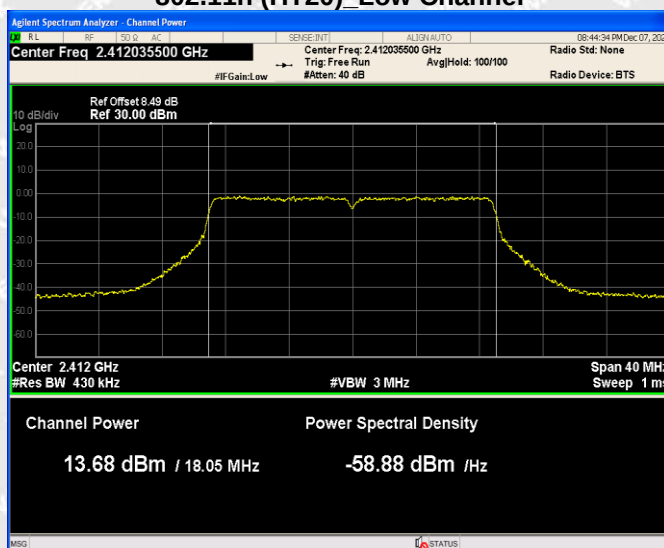
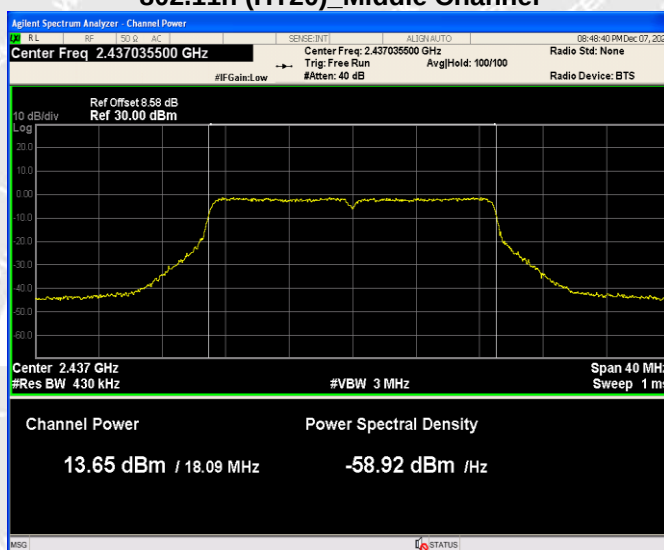
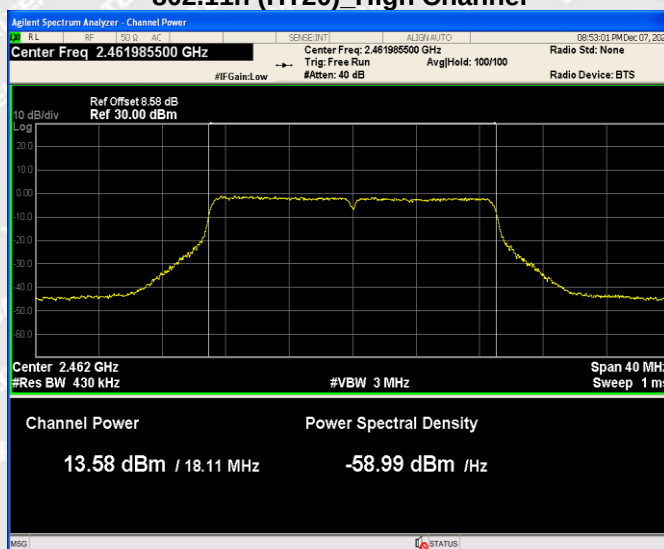
802.11b Middle Channel

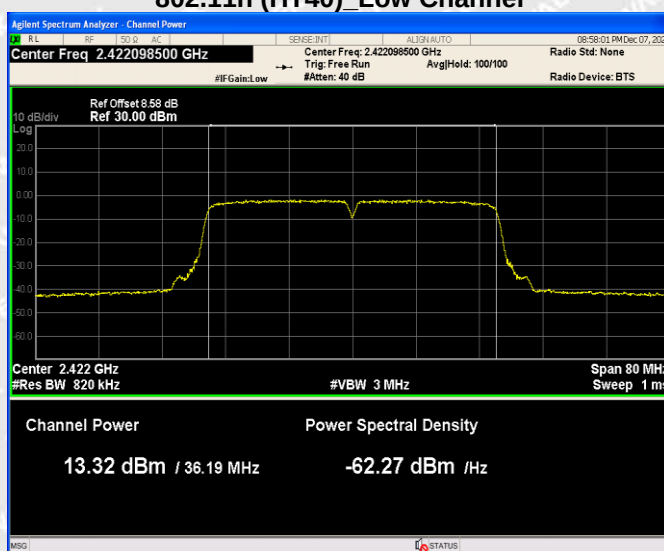
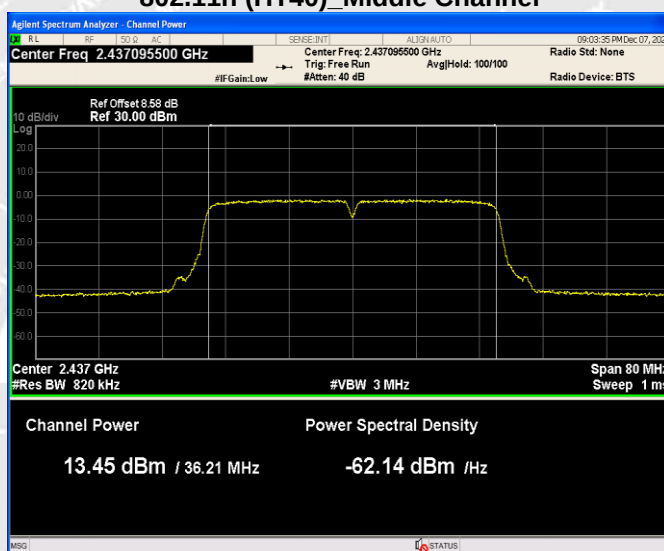
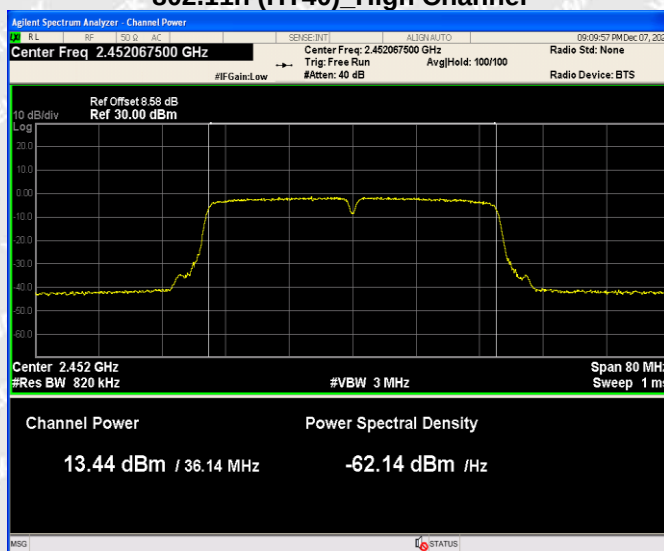


802.11b High Channel



**802.11g_Low Channel****802.11g_Middle Channel****802.11g_High Channel**

**802.11n (HT20)_Low Channel****802.11n (HT20)_Middle Channel****802.11n (HT20)_High Channel**

**802.11n (HT40)_Low Channel****802.11n (HT40)_Middle Channel****802.11n (HT40)_High Channel**



6.6 Out of Band Emissions

6.6.1 Standard Applicable

According to §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).

6.6.2 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW $\geq [3 \times \text{RBW}]$.
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05r02 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

A. Radiated emission measurements:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge,

as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz

for low bandedge, 2460MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

Sweep = auto; Detector function = peak/average; Trace = max hold

All the trace to stabilize, set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emissions must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205.



Note that the method of measurement KDB publication number: 913591 may be used for the radiated band edge measurements.

B. Antenna-port conducted measurements

Peak emission levels are measured by setting the instrument as follows:

- a) RBW = as specified in Table 9/
- b) VBW $\geq [3 \times \text{RBW}]$.
- c) Detector = peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

Table 9—RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1000 MHz	100 kHz to 120 kHz
>1000 MHz	1 MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1.

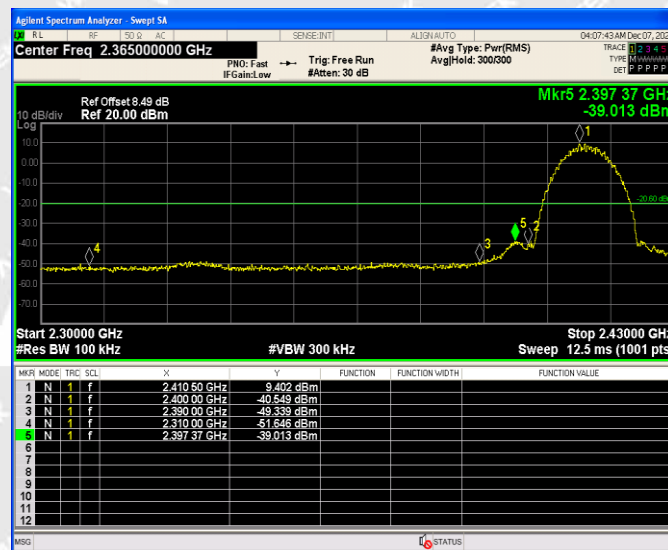


6.6.3 Test Result Conducted Test

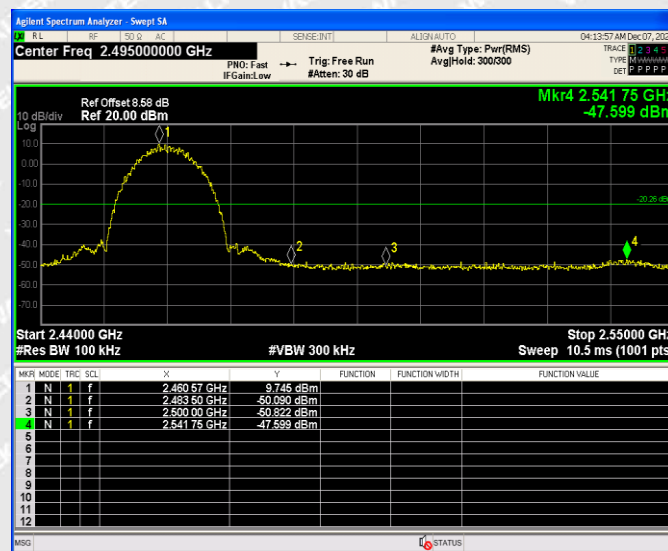
Test Mode	Test Channel	Ref Level (dBm)	Result (dBm)	Limit (dBm)	Verdict
802.11b	Low	9.40	-39.01	≤ -20.6	Pass
	High	9.74	-47.6	≤ -20.26	Pass
802.11g	Low	1.13	-31.67	≤ -28.87	Pass
	High	1.54	-46.04	≤ -28.46	Pass
802.11n (HT20)	Low	0.36	-32.44	≤ -29.64	Pass
	High	0.61	-46.23	≤ -29.39	Pass
802.11n (HT40)	Low	-2.68	-36.24	≤ -32.67	Pass
	High	-1.93	-45.3	≤ -31.93	Pass

Test Plots:

802.11b_Low Channel

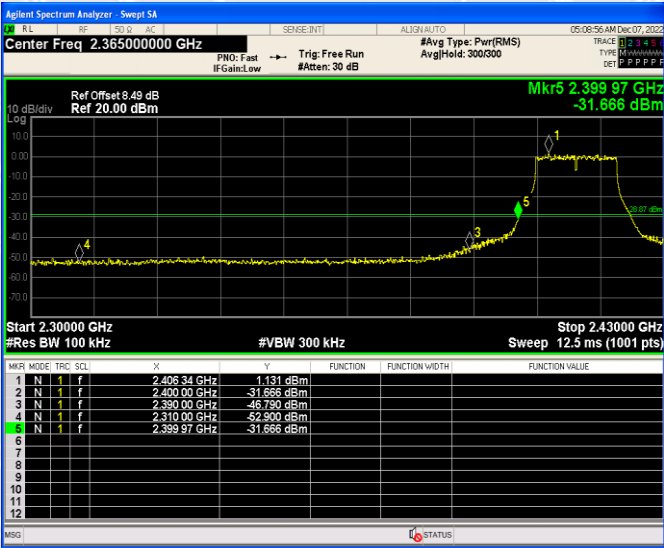


802.11b_High Channel

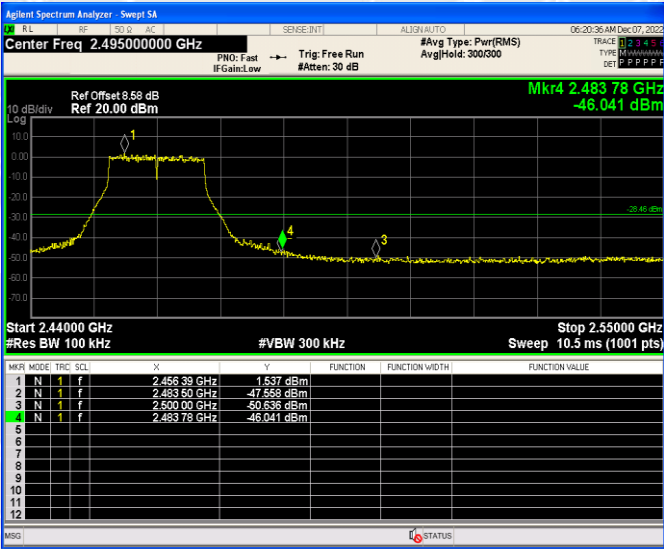




802.11g_Low Channel

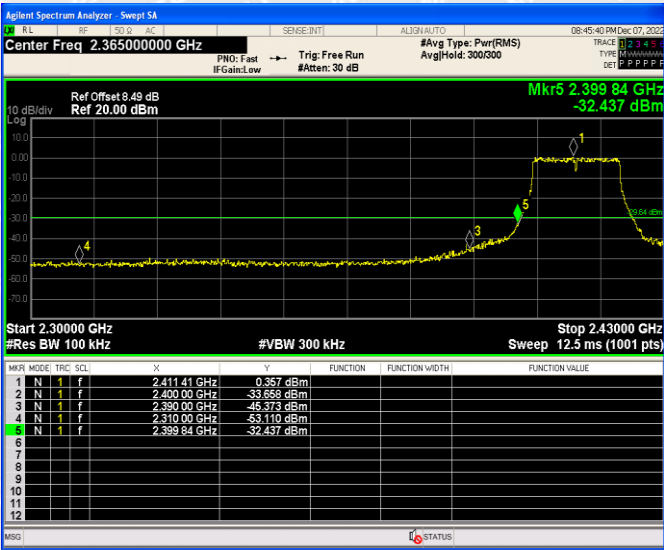


802.11g_High Channel

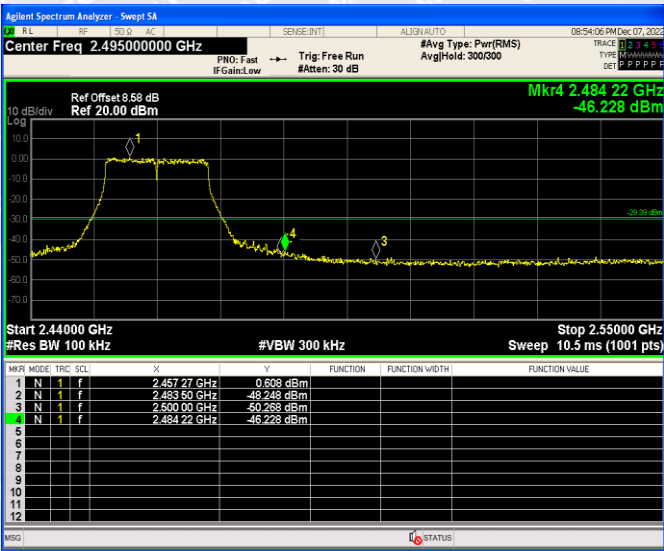




802.11n (HT20)_Low Channel

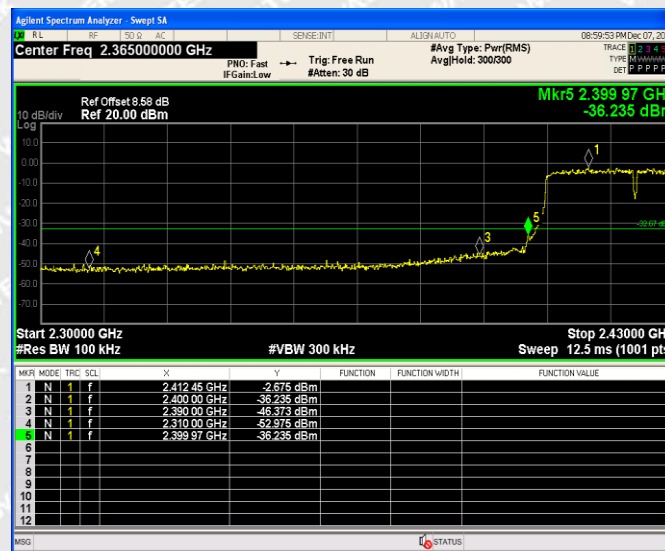


802.11n (HT20)_High Channel

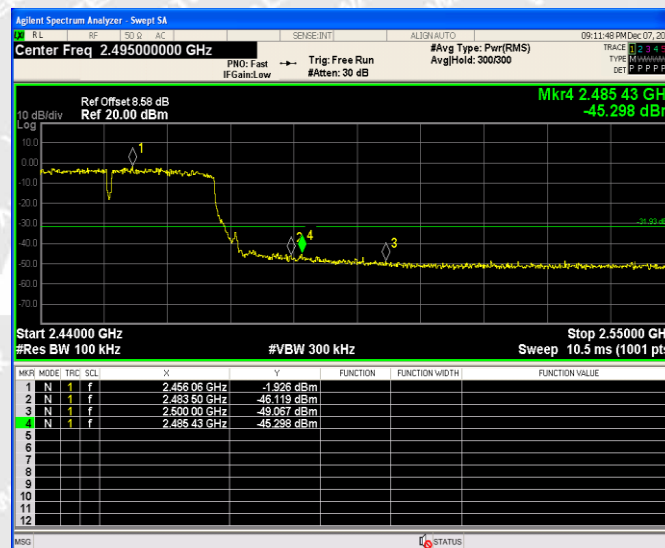




802.11n (HT40) Low Channel



802.11n (HT40) High Channel





7 Photographs Test Setup

7.1 Photographs - Radiated Emission Test Setup

30MHz-1GHz



Above 1GHz





8 Photographs - Constructional Details

8.1 EUT - External Photos

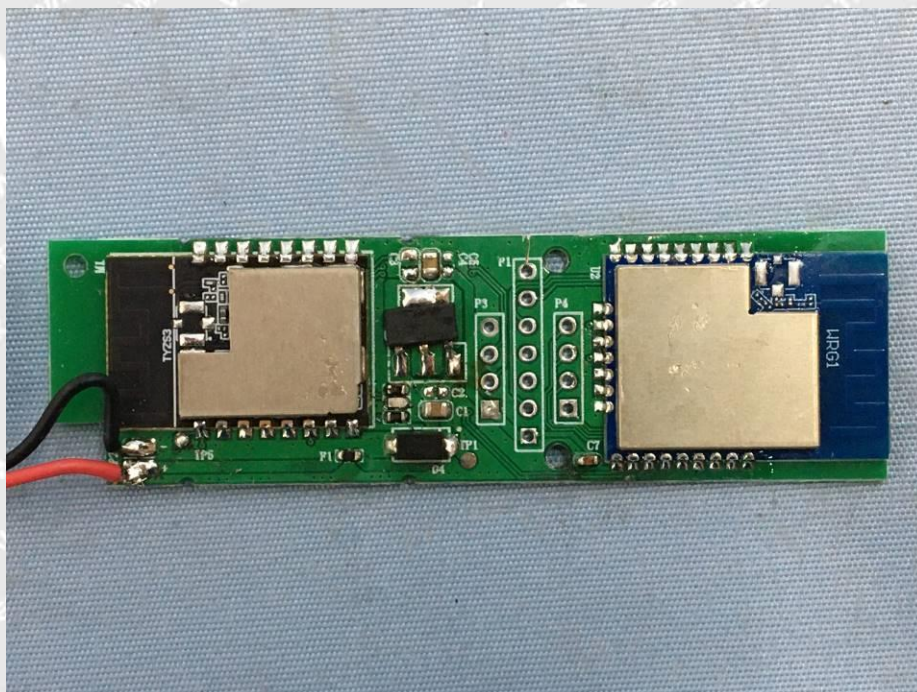
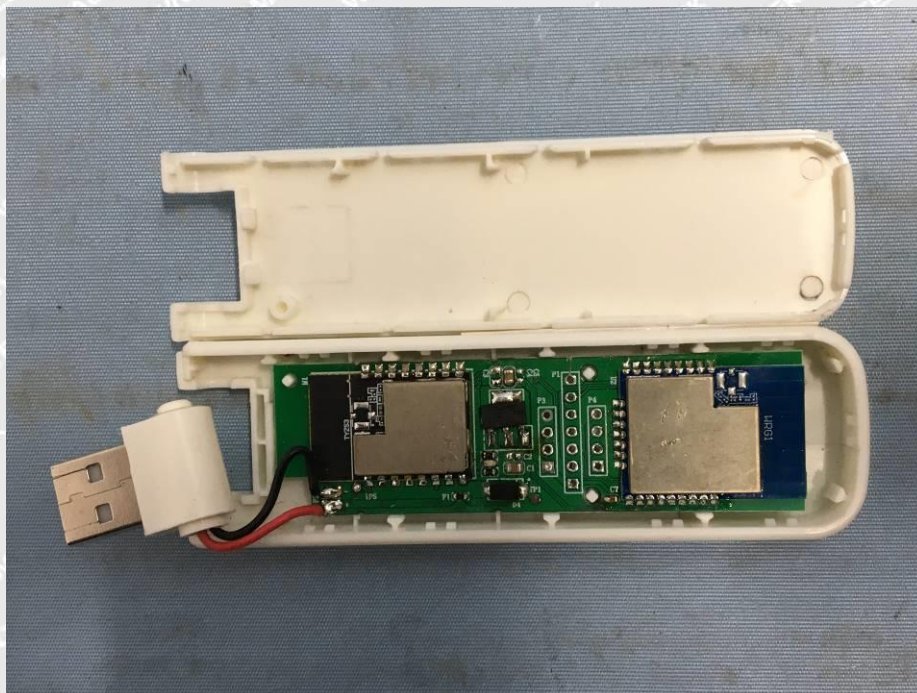


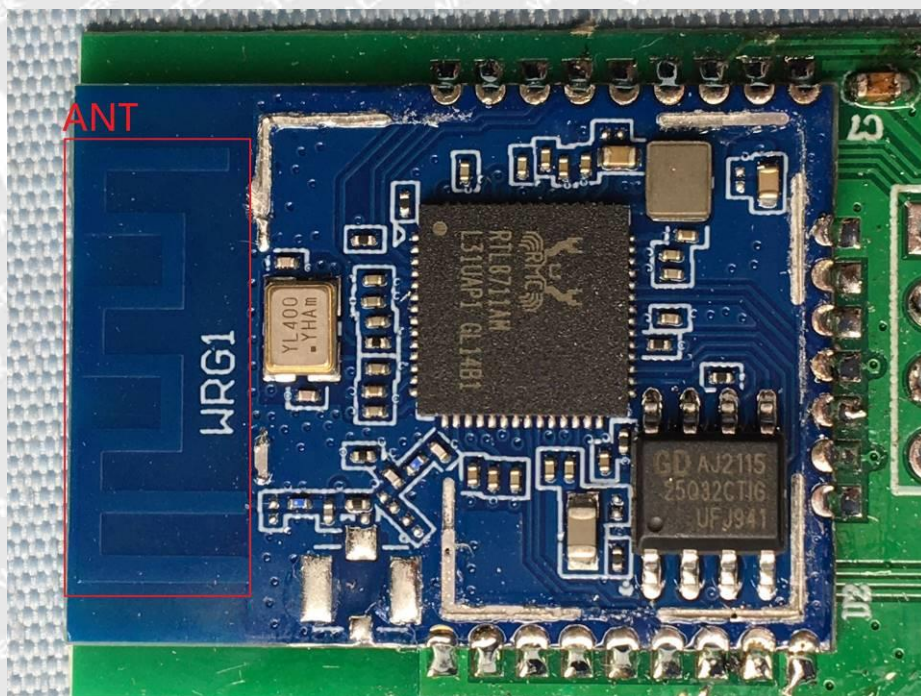
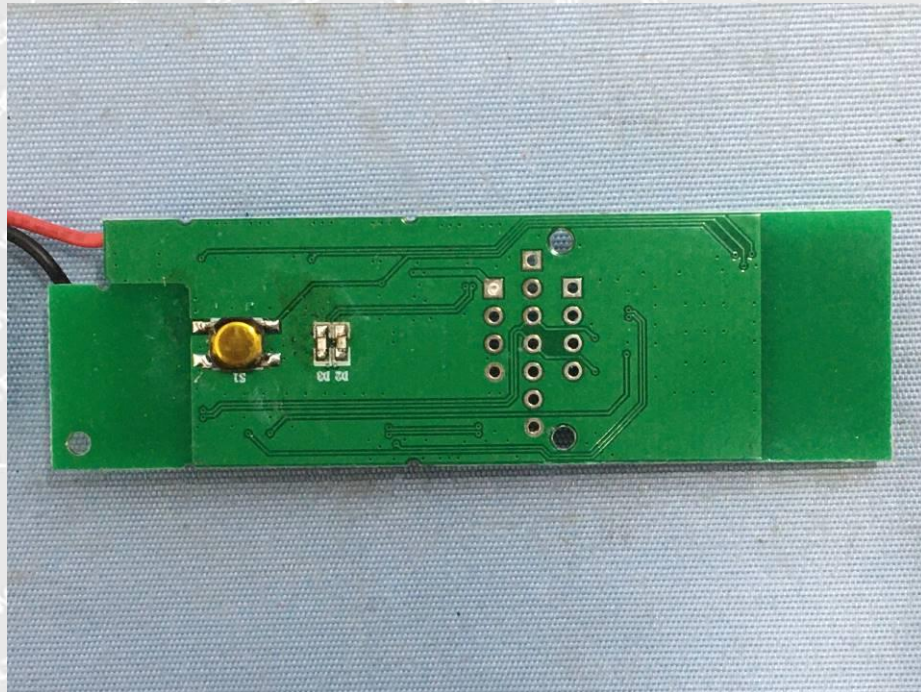






8.2 EUT - Internal Photos





=====End of Report=====