

Qingdao Intelligent&Precise Electronics Co., Ltd

RF TEST REPORT

Report Type:

FCC Part 15.247 & ISED RSS-247 RF report

Model:

ZDRK8812CU

REPORT NUMBER:

210500681SHA-001

ISSUE DATE:

May 11, 2021

DOCUMENT CONTROL NUMBER:

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Factory: Qingdao Intelligent&Precise Electronics Co., Ltd
No.218, Qianwangang Road, Qingdao Economic&Technological
Development Zone, Shandong, China.

FCC ID: 2AJVQ-RK8812CU

IC: 22470-RK8812CU

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

47CFR Part 15 (2019): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-247 Issue 2 (February 2017): Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5 (March 2019) Amendment 1: General Requirements for Compliance of Radio Apparatus

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Revision History

Report No.	Version	Description	Issued Date
210500681SHA-001	Rev. 01	Initial issue of report	May 11, 2021

Measurement result summary

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Maximum conducted output power and e.i.r.p.	15.247(b)(3)	RSS-247 Issue 2 Clause 5.4	Pass
Radiated Emissions in restricted frequency bands	15.247(d), 15.205&15.209	RSS-Gen Issue 5 Clause 8.9&8.10	Pass

Notes: 1: NA =Not Applicable

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Wireless Module
Type/Model:	ZDRK8812CU
Description of EUT:	This product is based on the original FCC ID:2AJVQ-RK8812CU, IC: 22470-RK8812CU. This time client adds another factory's WIFI antenna duplexer. By technical analysis and evaluation, only the worst case of maximum conducted output power and radiated emissions in restricted frequency bands was retested.
Rating:	DC 3.3V
EUT type:	<input checked="" type="checkbox"/> Table top <input type="checkbox"/> Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	April 22, 2021
Date of test:	April 26, 2021~ May 9, 2021

1.2 Technical Specification

Frequency Band:	2400MHz ~ 2483.5MHz
Support Standards:	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n(HT20), IEEE 802.11n(HT40)
Type of Modulation:	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n(HT20): OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n(HT40): OFDM (64-QAM, 16-QAM, QPSK, BPSK)
Operating Frequency:	2412MHz to 2462MHz for IEEE 802.11b/g/n(HT20) 2422MHz to 2452MHz for IEEE 802.11n(HT40)
Channel Number:	11 Channels for 802.11b, 802.11g and 802.11n(HT20) 7 Channels for 802.11n(HT40)
Channel Separation:	5 MHz
Antenna:	PIFA Antenna Antenna 0: 1.06dBi, Antenna 1: 2.72dBi

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1.3 Antenna information

Mode	Tx/Rx Function	Beamforming function	CDD function	Directional gain (dBi)
802.11b	1Tx/1Rx	NO	NO	-
802.11g	1Tx/1Rx	NO	NO	-
802.11n(HT20)	2Tx/2Rx	NO	NO	1.97
802.11n(HT40)	2Tx/2Rx	NO	NO	1.97

Note: For 802.11b and 802.11g mode, it only supports 1TX.
 For 802.11n modes, it can support 2TX, all the two transmit signals are completely uncorrelated with each other, so the directional gain = $10 \log ((10^{G1/10} + 10^{G2/10} + \dots + 10^{Gn/10}) / N_{ANT})$

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1.4 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN1175
	IC Registration Lab CAB identifier.: CN0051
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

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2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2019)
 ANSI C63.10 (2013)
 KDB 662911 D01 (v02r01)
 KDB 558074 (v05r02)
 RSS-247 Issue 2 (February 2017)
 RSS-Gen Issue 5 (March 2019) Amendment 1

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

Software name	Manufacturer	Version	Supplied by
MP Tool	-	-	Client

The lowest, middle and highest channel were tested as representatives.

Frequency Band (MHz)	Mode	Lowest (MHz)	Middle (MHz)	Highest (MHz)
2400-2483.5	802.11b	2412	2437	2462
	802.11g	2412	2437	2462
	802.11n(HT20)	2412	2437	2462
	802.11n(HT40)	2422	2437	2452

Data rate and Power setting:

The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases. After this pre-scan, we choose the following table of the data rata as the worst case.

Frequency Band (MHz)	Mode	Worst case data rate
2400-2483.5	802.11b	11Mbps
	802.11g	54Mbps
	802.11n(HT20)	MCS15
	802.11n(HT40)	MCS15

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2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	Laptop computer	DELL 5480	-
2	Mouse	Dell	-

2.5 Test environment condition:

Test items	Temperature	Humidity
Maximum conducted output power and e.i.r.p.	23°C	52% RH
Radiated Emissions in restricted frequency bands	24°C	53% RH

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2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESCS 30	EC 2107	2021-07-14
<input checked="" type="checkbox"/>	A.M.N.	R&S	ESH2-Z5	EC 3119	2021-11-28
<input type="checkbox"/>	A.M.N.	R&S	ENV 216	EC 3393	2021-07-14
<input type="checkbox"/>	A.M.N.	R&S	ENV4200	EC 3558	2021-06-11
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESIB 26	EC 3045	2021-09-16
<input checked="" type="checkbox"/>	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2021-12-10
<input checked="" type="checkbox"/>	Pre-amplifier	R&S	AFS42-00101800-25-S-42	EC5262	2021-06-11
<input type="checkbox"/>	Horn antenna	R&S	HF 906	EC 3049	2021-11-16
<input checked="" type="checkbox"/>	Horn antenna	ETS	3117	EC 4792-1	2022-02-25
<input type="checkbox"/>	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2021-07-09
<input type="checkbox"/>	Horn antenna	ETS	3116C	EC 5954	2022-01-04
<input checked="" type="checkbox"/>	Horn antenna	ETS	3116C	EC 5955	2022-01-04
<input type="checkbox"/>	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2022-03-14
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2022-03-04
<input type="checkbox"/>	Power sensor	Agilent	U2021XA	EC 5338-1	2022-03-04
<input type="checkbox"/>	Vector Signal Generator	Agilent	N5182B	EC 5175	2022-03-04
<input type="checkbox"/>	Universal Radio Communication Tester	R&S	CMW500	EC5944	2021-12-22
<input type="checkbox"/>	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2022-03-04
<input type="checkbox"/>	Mobile Test System	Litepoint	lqxel	EC 5176	2022-01-08
<input type="checkbox"/>	Test Receiver	R&S	ESCI 7	EC 4501	2021-09-16
<input checked="" type="checkbox"/>	Climate chamber	GWS	MT3065	EC 6021	2021-07-04
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030B	EC 6078	2021-06-11
Tet Site					

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Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input type="checkbox"/>	Shielded room	Zhongyu	-	EC 2838	2022-01-13
<input type="checkbox"/>	Shielded room	Zhongyu	-	EC 2839	2022-01-13
<input checked="" type="checkbox"/>	Semi-anechoic chamber	Albatross project	-	EC 3048	2021-07-14
<input type="checkbox"/>	Fully-anechoic chamber	Albatross project	-	EC 3047	2021-07-14
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2022-03-10
<input type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3481	2021-12-22
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 5198	2022-02-27
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3325	2022-04-07
<input type="checkbox"/>	Pressure meter	YM3	Shanghai Mengde	EC 3320	2021-07-14

TEST REPORT**2.7 Measurement uncertainty**

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Measurement uncertainty
Maximum peak output power	$\pm 0.74\text{dB}$
Radiated Emissions in restricted frequency bands below 1GHz	$\pm 4.90\text{dB}$
Radiated Emissions in restricted frequency bands above 1GHz	$\pm 5.02\text{dB}$
Emission outside the frequency band	$\pm 2.89\text{dB}$
Power line conducted emission	$\pm 3.19\text{dB}$

3 Maximum conducted output power and e.i.r.p.

Test result: Pass

3.1 Limit

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 W. (The e.i.r.p. shall not exceed 4 W)

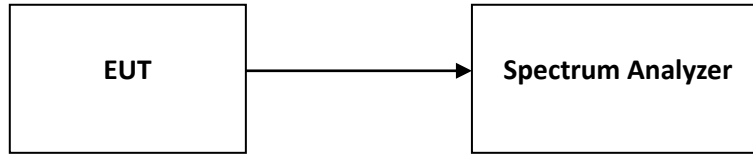
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 30dBm and 30+ (6 –antenna gain-beam forming gain).

3.2 Measurement Procedure

The EUT was tested according to Subclause 11.9.2.2 of ANSI C63.10.

- a) Measure the duty cycle, x , of the transmitter output signal as described in Section 6.0.
- b) Set span to at least $1.5 \times \text{OBW}$.
- c) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz.
- d) Set VBW $\geq 3 \times \text{RBW}$.
- e) Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$. (This gives bin-to-bin spacing $\leq \text{RBW}/2$, so that narrowband signals are not lost between frequency bins.)
- f) Sweep time = auto.
- g) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- h) Do not use sweep triggering. Allow the sweep to “free run”.
- i) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.
- j) 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.
- k) Add $10 \log (1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on- and off-times of the transmission). For example, add $10 \log (1/0.25) = 6 \text{ dB}$ if the duty cycle is 25 %.

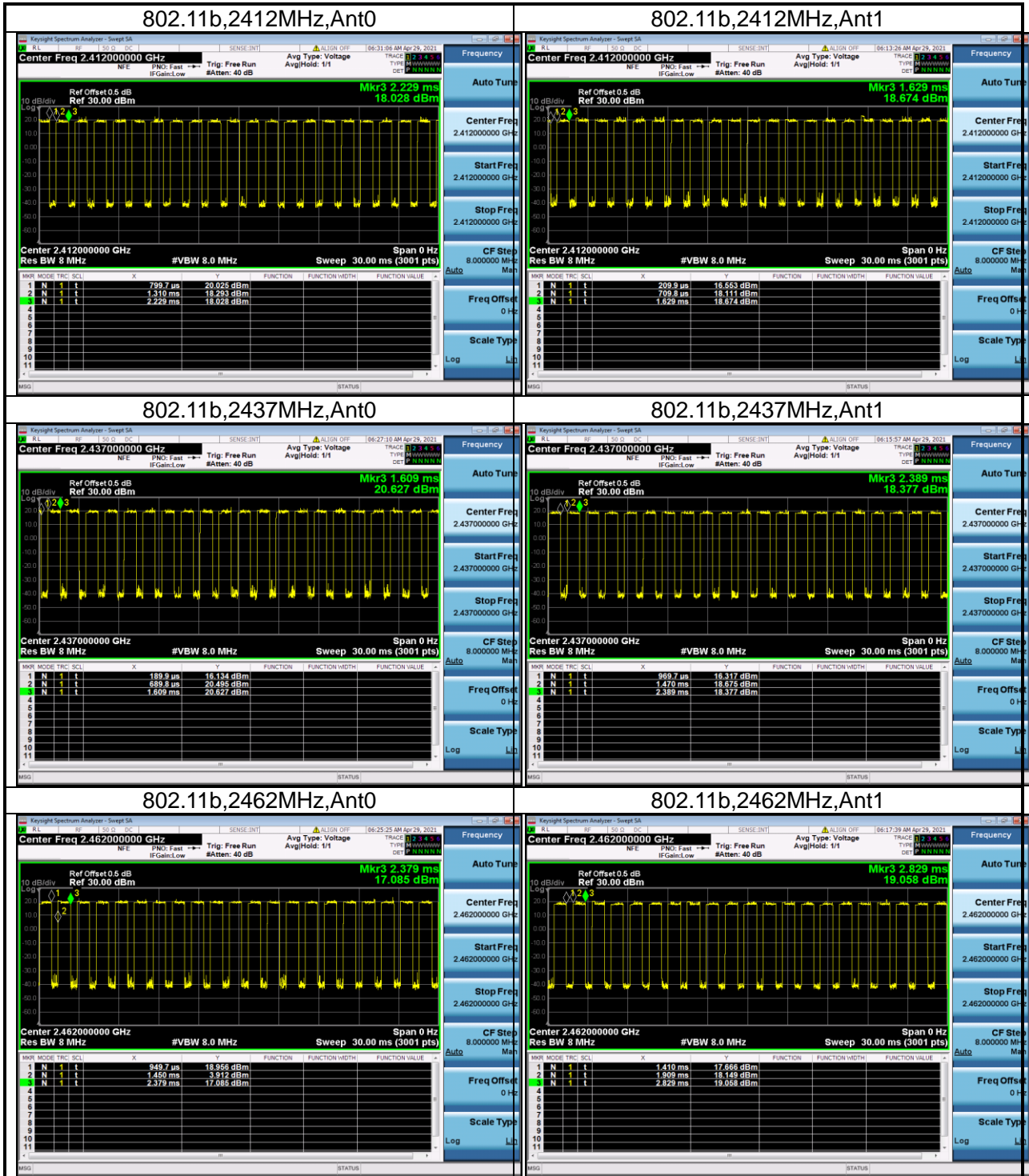
3.3 Test Configuration



3.4 Test Results of Maximum conducted output power

Duty Cycle

WLAN Duty Cycle				
Mode	Test Frequency (MHz)	Ant	Duty Cycle (%)	Duty Cycle Factor (dB)
802.11b	2412	Ant0	64.34	1.92
802.11b	2412	Ant1	64.79	1.88
802.11b	2437	Ant0	64.79	1.88
802.11b	2437	Ant1	64.79	1.88
802.11b	2462	Ant0	65.03	1.87
802.11b	2462	Ant1	64.79	1.88

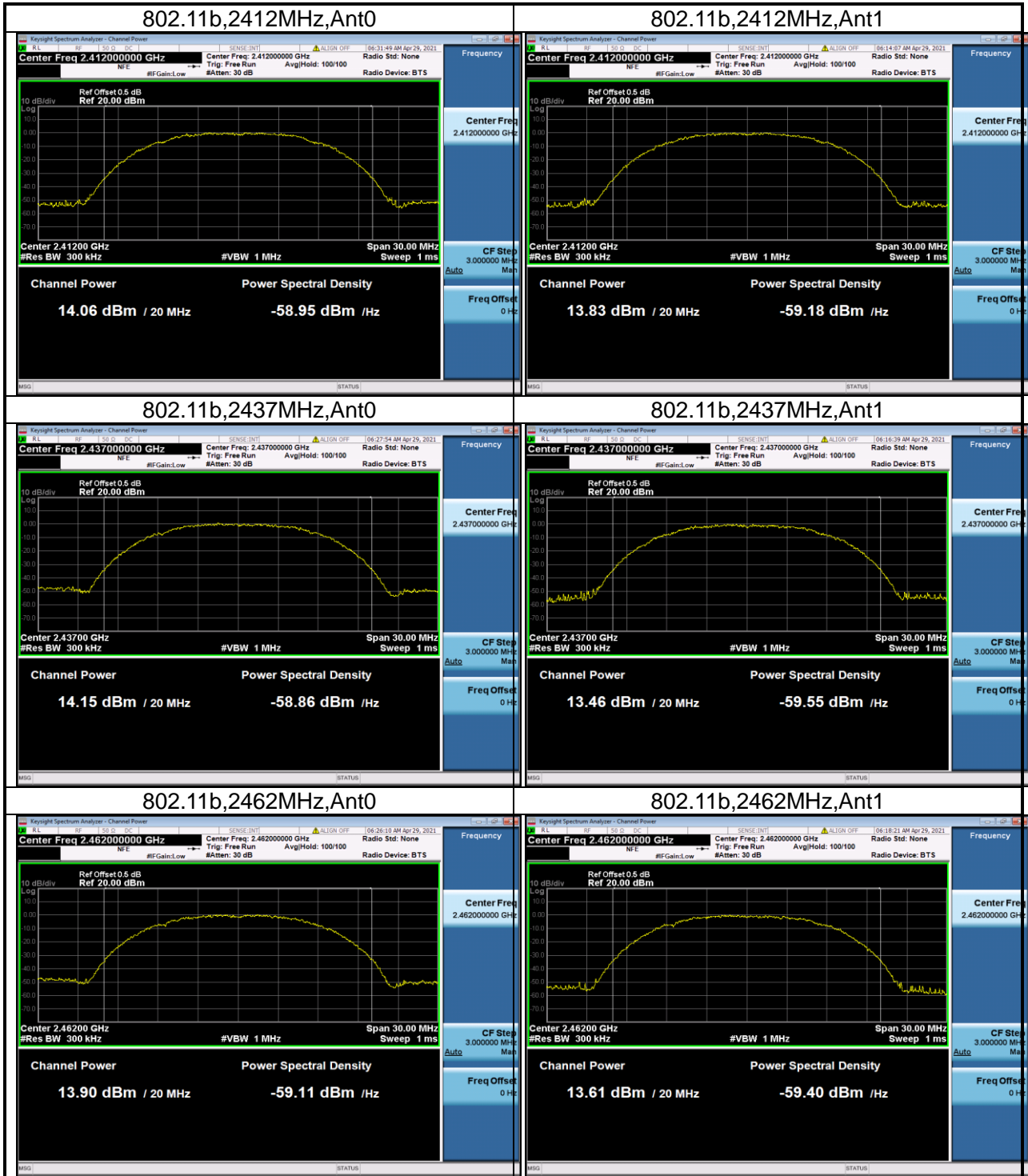


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Maximum conducted output power and e.i.r.p

Test Data

WLAN AVGSA Output Power							
Mode	Test Frequency (MHz)	Ant	Duty Cycle Factor (dB)	Max Power (dBm)	Limit (dBm)	EIRP (dBm)	Result
802.11b	2412	Ant0	1.92	15.98	30	17.04	Pass
802.11b	2412	Ant1	1.88	15.71	30	18.43	Pass
802.11b	2437	Ant0	1.88	16.03	30	17.09	Pass
802.11b	2437	Ant1	1.88	15.34	30	18.06	Pass
802.11b	2462	Ant0	1.87	15.77	30	16.83	Pass
802.11b	2462	Ant1	1.88	15.49	30	18.21	Pass



4 Radiated Emissions in restricted frequency bands

Test result: Pass

4.1 Limit

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified showed as below:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

4.2 Measurement Procedure

The EUT was tested according to Subclause 11.12 of ANSI C63.10.

For Radiated emission below 30MHz:

- a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) Both X and Y axes of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

TEST REPORT**For Radiated emission above 30MHz:**

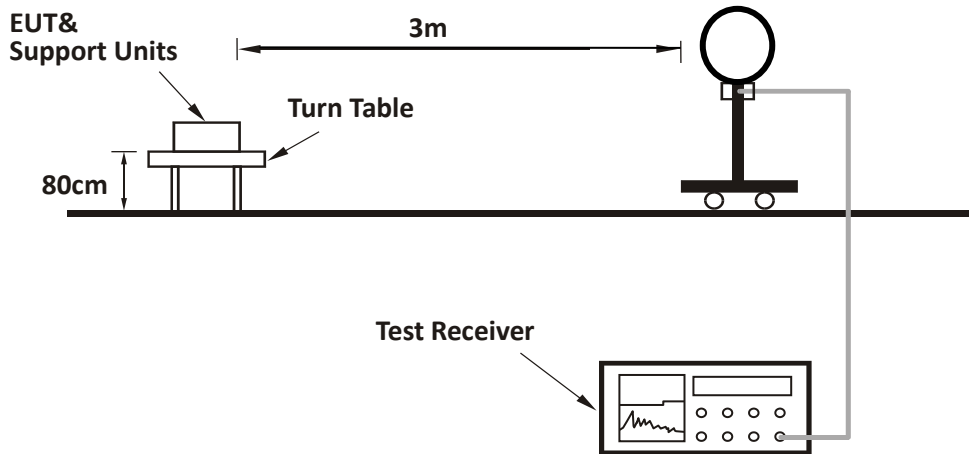
- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f) The test-receiver system was set to peak and average detector function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

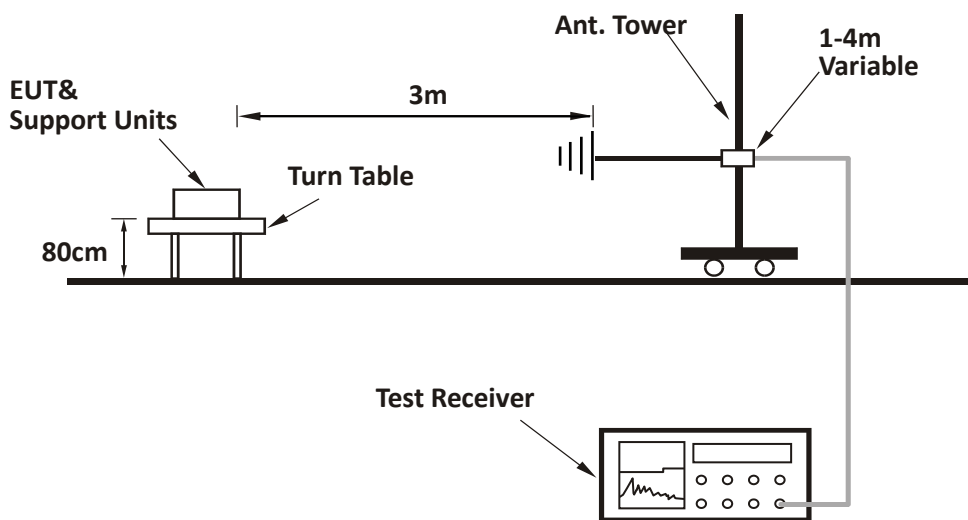
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or $3 \times \text{RBW}$ (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions were reported.

4.3 Test Configuration

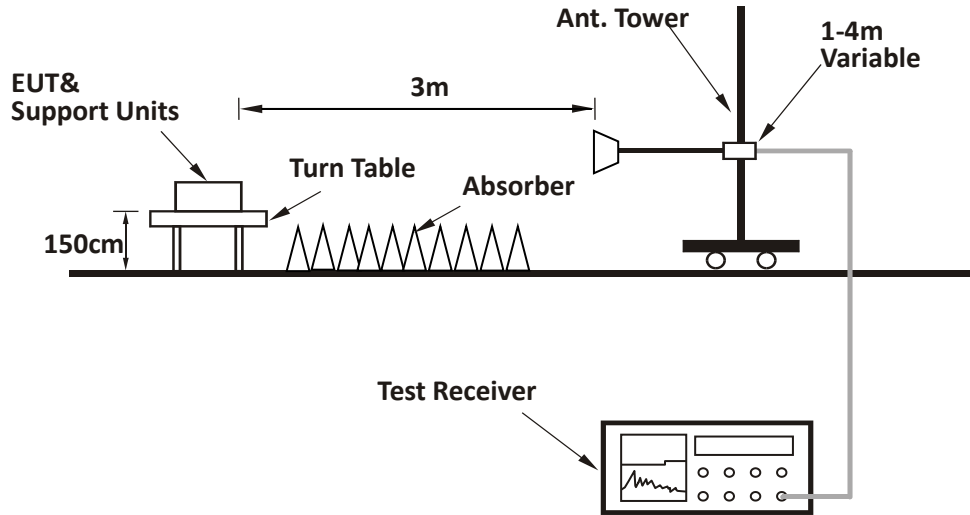
For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



For Radiated emission above 1GHz:



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4.4 Test Results of Radiated Emissions

The emission was conducted from 1GHz to 25GHz

802.11n(HT40)

CH	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2422	101.40	Fundamental	/	PK
	H	2390	61.10	74.00	12.90	PK
	H	2390	46.30	54.00	7.70	AV
M	H	2437	101.20	Fundamental	/	PK
H	H	2452	101.50	Fundamental	/	PK
	H	2483.5	62.60	74.00	11.40	PK
	H	2483.5	46.80	54.00	7.20	AV

- Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
 2. Corrected Reading = Original Receiver Reading + Correct Factor
 3. Margin = Limit - Corrected Reading
 4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
 Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
 Limit = 40.00dBuV/m.
 Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
 Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
 Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

***** END *****