

Test Report

FCC ID: 2AKMKMCBL53

Date of issue: Dec. 05, 2016

Sample Description: mCookie Module WIFI

Model(s): MCBL53, MDBL53

Applicant: Microduino Inc.

Address: 2659 Townsgate Rd. #213, Westlake Village, CA 91361,
USA

Date of Test: Dec. 01, 2016 to Dec. 04, 2016

Shenzhen Microtest Co., Ltd.
<http://www.mtitest.com>

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Test Result Certification	
Applicant's name:	Microduino Inc.
Address:	2659 Townsgate Rd. #213, Westlake Village, CA 91361, USA
Manufacture's Name:	Microduino Inc.
Address:	2659 Townsgate Rd. #213, Westlake Village, CA 91361, USA
Product name:	mCookie Module WIFI
Trademark:	mCookie
Model name:	MCBL53, MDBL53
Standards:	FCC Part 15.247
Test Procedure:	ANSI C63.10-2013 558074 D01 DTS Meas Guidance v03r05

This device described above has been tested by Shenzhen Toby Technology Co., Ltd. and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

Tested by:

David Chen

David Chen

Dec. 05, 2016

Reviewed by:

Leon Chen

Leon Chen

Dec. 05, 2016

Approved by:

Ares Liu

Ares Liu

Dec. 05, 2016

Summary of Test Result

Item	FCC Part No.	Description of Test	Result
1	15.203	Antenna requirement	Pass
2	15.207	AC power line conducted emission	Pass
3	15.247(b)(3)	Maximum output power	Pass
4	15.247(a)(2)	6dB emission bandwidth	Pass
5	15.247(e)	Power spectral density (PSD)	Pass
8	15.247(d)	Band edge & conducted spurious emission	Pass
9	15.247(d), 15.205, 15.209	Radiated emission	Pass

1 General description

1.1 Feature of equipment under test (EUT)

Product name:	mCookie Module WIFI
Model name:	MCBL53, MDBL53
Operating frequency range:	2412MHz~2462MHz
WIFI feature:	☒ 802.11b ☒ 802.11g ☒ 802.11n20
Modulation type:	DSSS, OFDM
Power source:	DC 3.3V
Antenna designation:	Chip antenna (Antenna Gain: 2.5dBi)
Remark:	All the models above are identical in interior structure, electrical circuits and components; just model names are different for marking requirement.

1.2 Operation channel list

Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	6	2437MHz	11	2462MHz
2	2417MHz	7	2442MHz	--	--
3	2422MHz	8	2447MHz	--	--
4	2427MHz	9	2452MHz	---	---
5	2432MHz	10	2457MHz	---	---

1.3 Test frequency channel

Channel	802.11b/g/n20
Low	2412MHz
Middle	2437MHz
High	2462MHz

1.4 EUT operation mode

During testing, RF test program provided by the manufacture to control the Tx operation followed the test requirement. The EUT is configured to transmit continuously (duty cycle > 98 %) at the maximum power control level.

1.5 Test conditions

During the measurement the environmental conditions were within the listed ranges:

- Temperature: 20°C~30°C
- Humidity: 30%~70%
- Atmospheric pressure: 98kPa~101kPa

1.6 Testing site

Test Site	Shenzhen Toby Technology Co., Ltd.
Test Site Location	1 A/F., Bldg.6, Yusheng Industrial Zone The National Road No.107 Xixiang Section 467, Shenzhen, Guangdong, China
FCC Registration No.:	811562
CNAS Registration No.:	CNAS L5813

1.7 Ancillary equipment list

Equipment	Model	S/N	Manufacturer	Certificate type
Adapter	T48-12-800D-2	/	CUI INC	FCC VOC
Power Module	/	/	mCookie	FCC VOC

1.8 Measurement uncertainty

Measurement Uncertainty for a Level of Confidence of 95 %, $U=2 \times U_c(y)$

RF frequency	1×10^{-7}
RF power, conducted	± 1 dB
Conducted emission(150kHz~30MHz)	± 2.5 dB
Radiated emission(30MHz~1GHz)	± 4.2 dB
Radiated emission (above 1GHz)	± 4.3 dB
Temperature	± 1 degree
Humidity	± 5 %

2 List of test equipment

For AC power line conducted emission:

Equipment	Manufacturer	Model	Serial No.	Calibration Due
LISN	R&S	ENV216	101313	2016.12.06
LISN	SCHWARZBECK	NNLK 8129	8129245	2016.12.25
Pulse Limiter	SCHWARZBECK	VTSD 9561F	9716	2016.12.25
Test Cable	N/A	N/A	C01	2016.12.06
EMI Test Receiver	R&S	ESCI	101160	2016.12.06

For Radiated emission:

Equipment	Manufacturer	Model	Serial No.	Calibration Due
Log-Bicon Antenna	MESS-ELEKTRO NIK	VULB 9160	3058	2016.12.11
Horn Antenna	Schwarzbeck	BBHA 9120D	631	2016.12.05
Horn Antenna	Schwarzbeck	BBHA 9170	373	2016.12.05
Test Cable	United Microwave	57793	1m	2016.12.05
Test Cable	United Microwave	A30A30-5006	10m	2016.12.05
Microwave Pre_amplifier	Agilent	8449B	3008A01714	2016.12.05
Pre-Amplifier	Anritsu	MH648A	M09961	2016.12.05
EMI Test Receiver	R&S	ESPI-7	101318	2016.12.05
Spectrum analyzer	Agilent	E4470B	MY41441082	2017.06.01

For RF conducted emission:

Equipment	Manufacturer	Model	Serial No.	Calibration Due
Spectrum analyzer	Agilent	E4470B	MY41441082	2017.06.01
Power meter	Anritsu	ML2495A	1005002	2017.09.11
Power Sensor	Anritsu	MA2411B	0917070	2017.09.11

Note: the calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

3 Test Result

3.1 Conducted emission

3.1.1 Limit

Frequency (MHz)	Limit	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

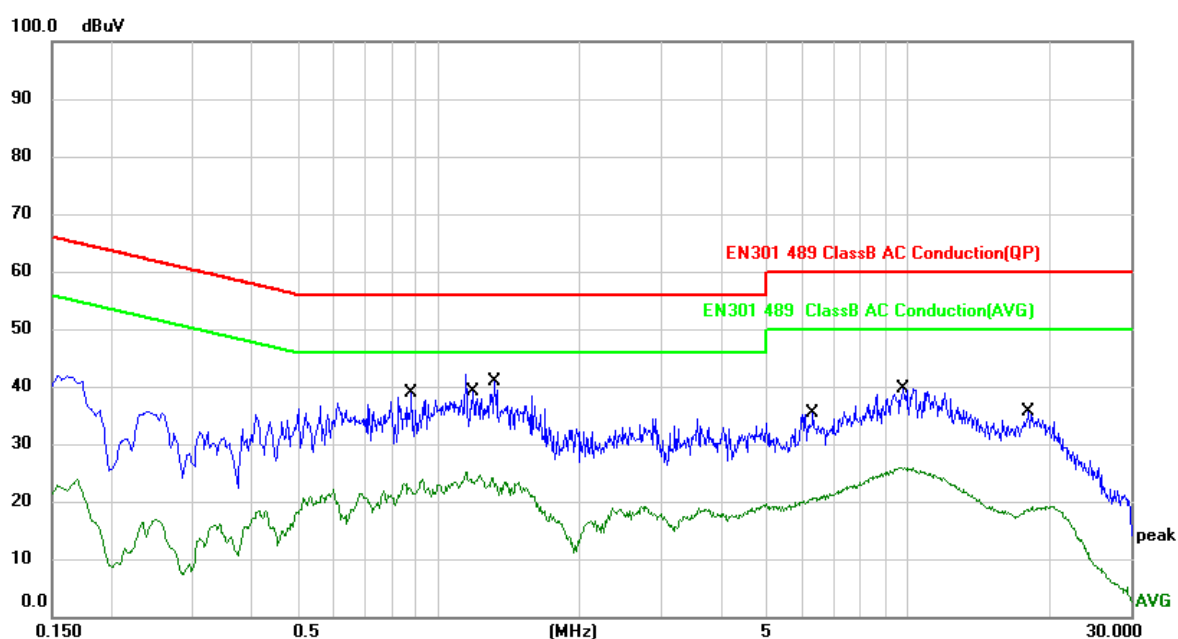
Note: Decreases with the logarithm of the frequency from 0.15MHz to 0.5MHz.

3.1.2 Test method

1. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/50uH of coupling impedance for the measuring instrument.
2. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
3. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
4. LISN is at least 80 cm from nearest part of EUT chassis.
5. The resolution bandwidth of EMI test receiver is set at 9 kHz.

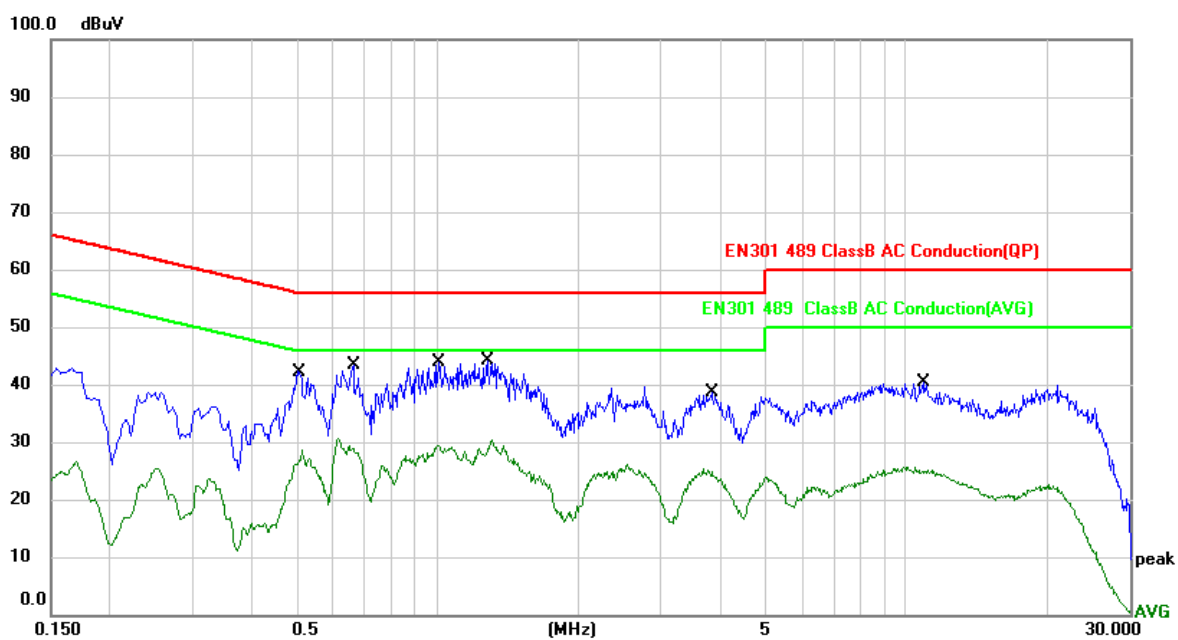
3.1.3 Test Result

Temperature:	25°C	Relative	53%
Pressure:	101kPa	Polarization:	L
Test voltage:	AC 120V/60Hz	Test mode:	Transmitting



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.8734	30.68	-0.04	30.64	56.00	-25.36	QP	
2		0.8734	22.25	-0.04	22.21	46.00	-23.79	AVG	
3		1.1824	31.79	-0.04	31.75	56.00	-24.25	QP	
4	*	1.1824	23.70	-0.04	23.66	46.00	-22.34	AVG	
5		1.3204	32.44	-0.04	32.40	56.00	-23.60	QP	
6		1.3204	23.29	-0.04	23.25	46.00	-22.75	AVG	
7		6.2839	25.79	-0.05	25.74	60.00	-34.26	QP	
8		6.2839	19.84	-0.05	19.79	50.00	-30.21	AVG	
9		9.8660	30.80	-0.09	30.71	60.00	-29.29	QP	
10		9.8660	25.12	-0.09	25.03	50.00	-24.97	AVG	
11		18.1198	25.60	-0.23	25.37	60.00	-34.63	QP	
12		18.1198	17.86	-0.23	17.63	50.00	-32.37	AVG	

Temperature:	25°C	Relative	53%
Pressure:	101kPa	Polarization:	N
Test voltage:	AC 120V/60Hz	Test mode:	Transmitting



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.5101	36.76	-0.03	36.73	56.00	-19.27	QP	
2		0.5101	27.41	-0.03	27.38	46.00	-18.62	AVG	
3		0.6554	36.17	-0.03	36.14	56.00	-19.86	QP	
4		0.6554	28.47	-0.03	28.44	46.00	-17.56	AVG	
5		1.0034	35.77	-0.04	35.73	56.00	-20.27	QP	
6	*	1.0034	29.18	-0.04	29.14	46.00	-16.86	AVG	
7		1.2585	35.99	-0.04	35.95	56.00	-20.05	QP	
8		1.2585	27.62	-0.04	27.58	46.00	-18.42	AVG	
9		3.8151	32.44	-0.05	32.39	56.00	-23.61	QP	
10		3.8151	24.52	-0.05	24.47	46.00	-21.53	AVG	
11		10.8701	32.58	-0.10	32.48	60.00	-27.52	QP	
12		10.8701	24.22	-0.10	24.12	50.00	-25.88	AVG	

3.2 Antenna requirement

3.2.1 Requirement defined in FCC 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

3.2.2 EUT antenna description

The WIFI antenna of EUT is an permanently attached Chip antenna, the maximum gain of the antenna is 2.5dBi. So the antenna meets the requirement of this part.

3.3 Maximum output power

3.3.1 Limits

Conducted output power limit is 1W (30dBm).

3.3.2 Test Method

The maximum conducted output power may be measured using a broadband RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

3.3.3 Test Result

Frequency (MHz)	Maximum peak output power (dBm)	Limit (dBm)
802.11b		
2412	15.23	30
2437	14.76	30
2462	14.35	30
802.11g		
2412	16.87	30
2437	15.96	30
2462	15.31	30
802.11n20		
2412	13.36	30
2437	13.93	30
2462	13.61	30

3.4 6dB emission bandwidth

3.4.1 Limits

The minimum 6 dB bandwidth shall be at least 500 kHz.

3.4.2 Test method

Use the following spectrum analyzer settings:

RBW = 100kHz

VBW $\geq$ 3RBW

Detector = peak

Trace mode = max hold

Sweep time = 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.

3.4.3 Test result

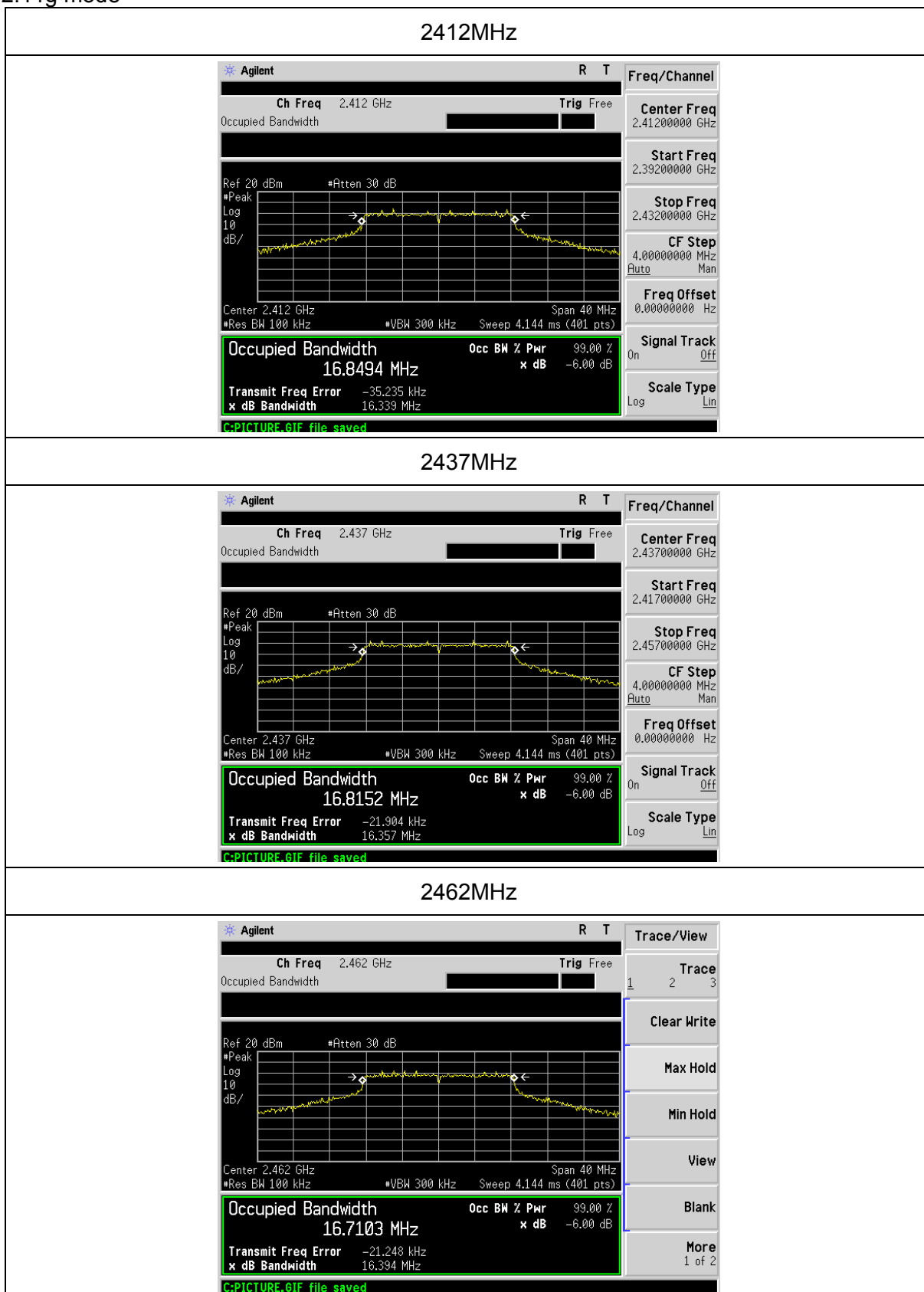
Frequency (MHz)	6dB emission bandwidth (MHz)	Limit
802.11b		
2412	9.09	500kHz
2437	8.214	
2462	9.123	
802.11g		
2412	16.339	500kHz
2437	16.357	
2462	16.394	
802.11n20		
2412	17.531	500kHz
2437	17.314	
2462	17.582	

Test plots as below:

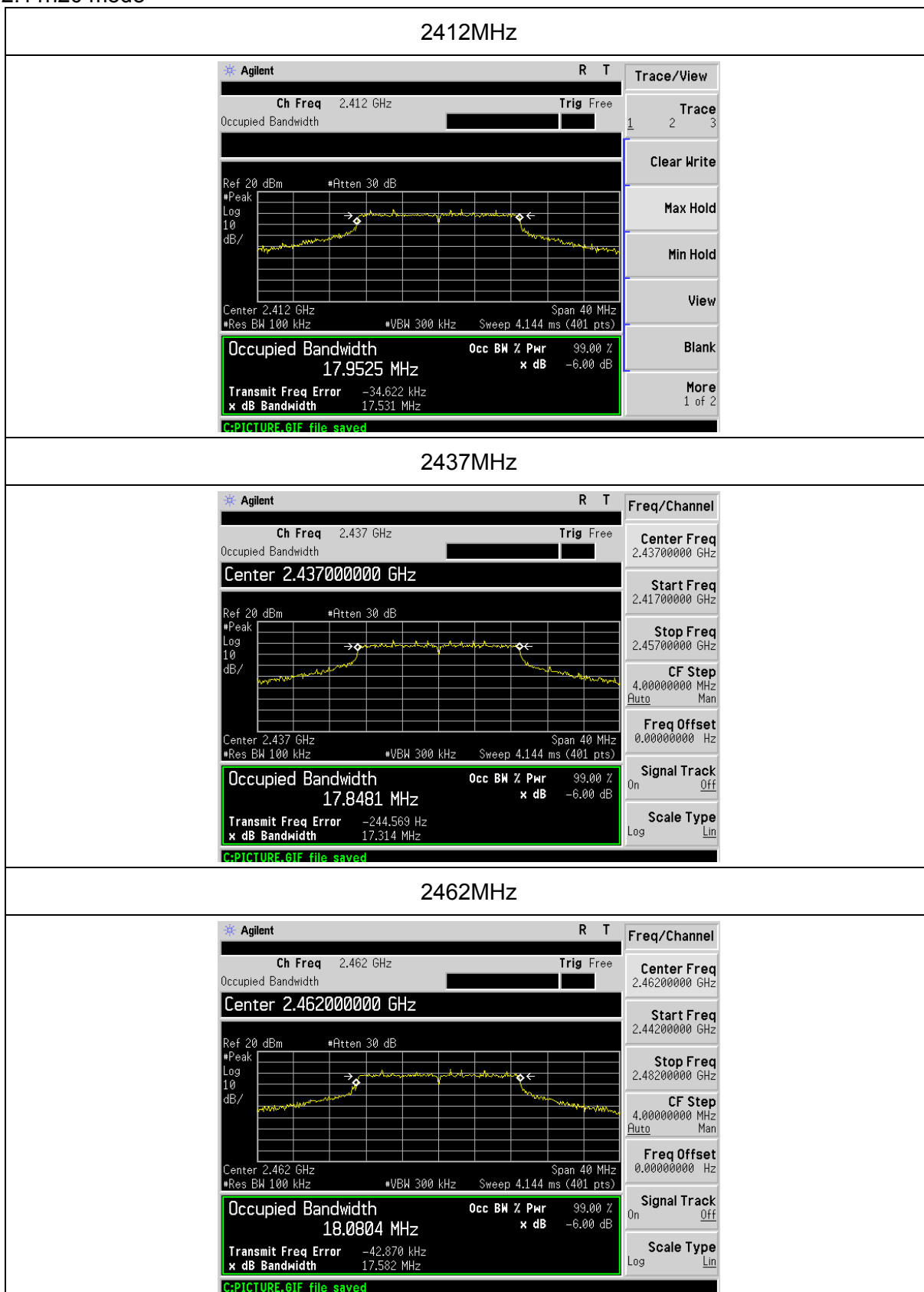
802.11b mode



802.11g mode



802.11n20 mode



3.5 Power spectral density

3.5.1 Limits

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

3.5.2 Test method

Span = 1.5 times DTS bandwidth (6dB emission bandwidth, see section 4.4)

RBW = 3kHz to 100kHz

VBW $\geq$ 3RBW

Detector = Peak

Sweep time = auto

Trace mode = max hold

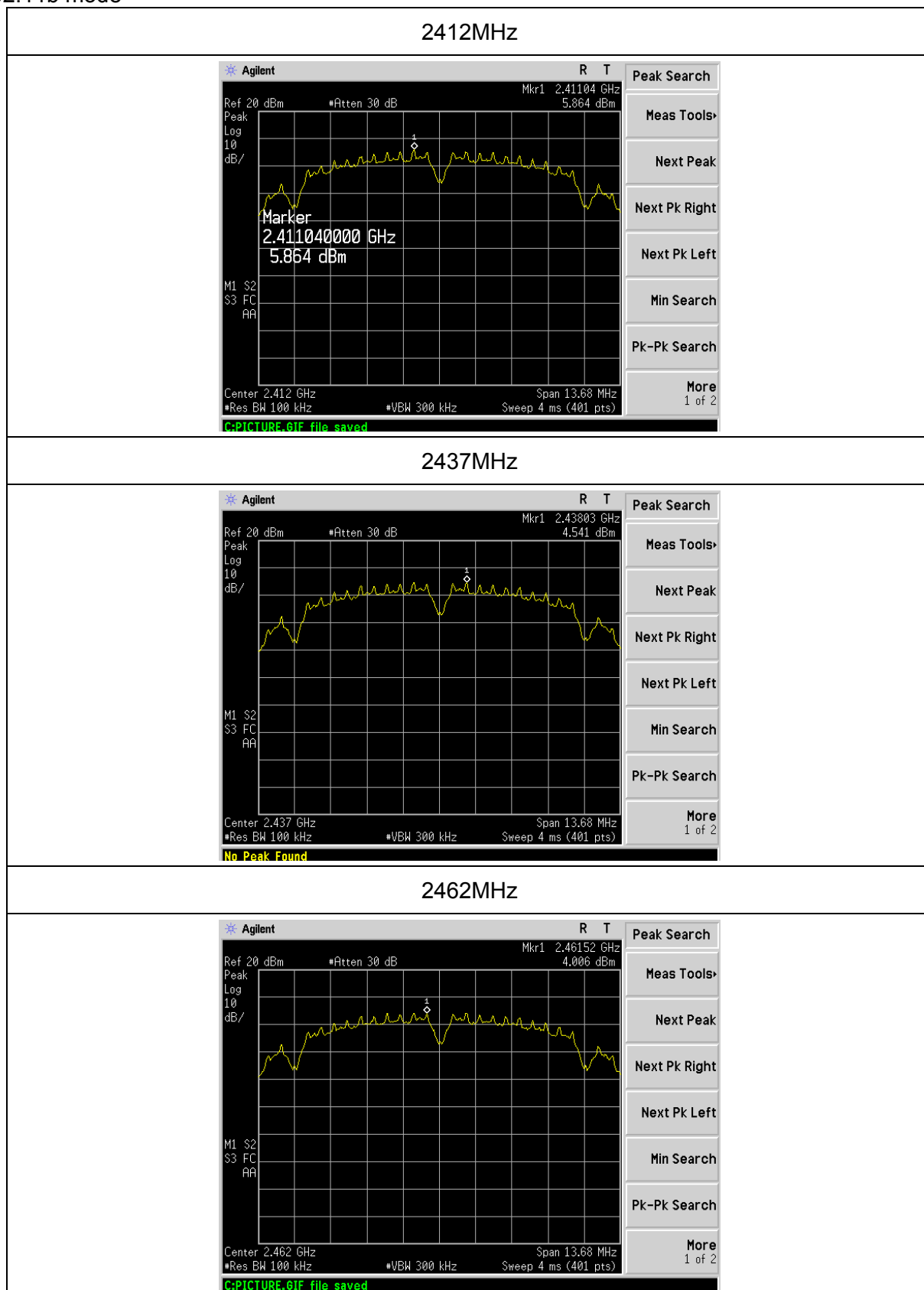
Allow the trace to stabilize. Use the peak marker function to determine the maximum amplitude level within the RBW.

3.5.3 Test result

Frequency (MHz)	PSD (dBm/100kHz)	Limit (dBm/3kHz)
802.11b		
2412	5.864	8
2437	4.541	
2462	4.006	
802.11g		
2412	3.498	8
2437	2.6	
2462	3.052	
802.11n20		
2412	3.427	8
2437	2.684	
2462	3.248	

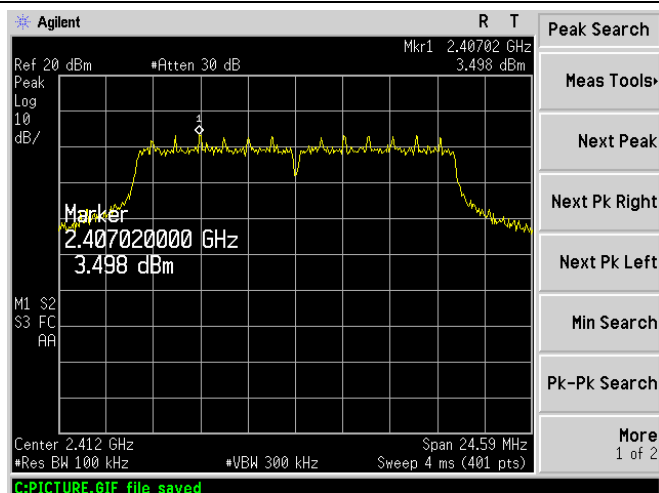
Test plots as below:

802.11b mode

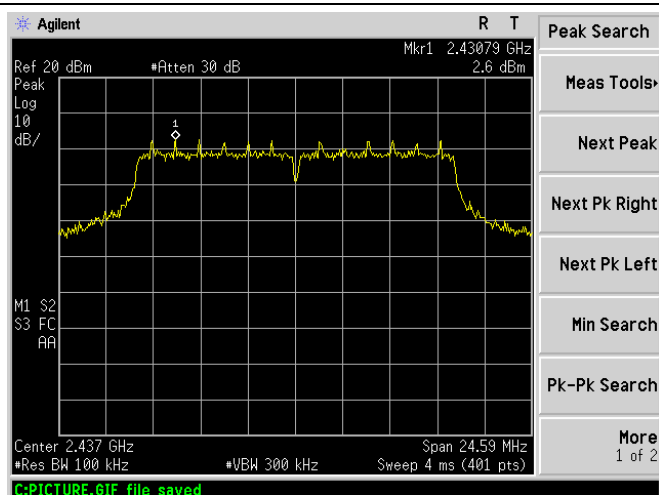


802.11g mode

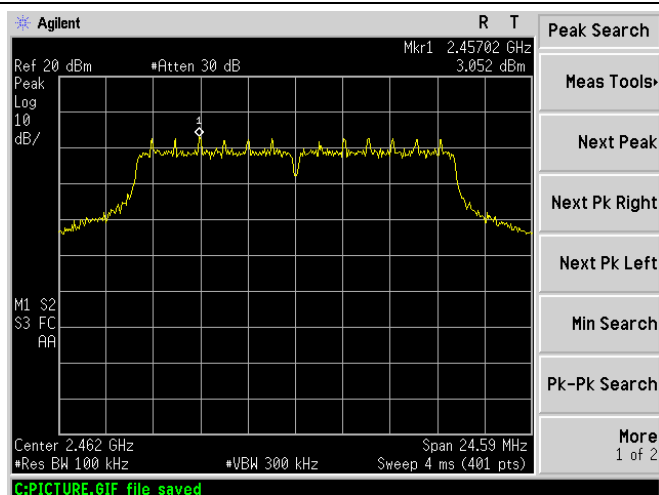
2412MHz



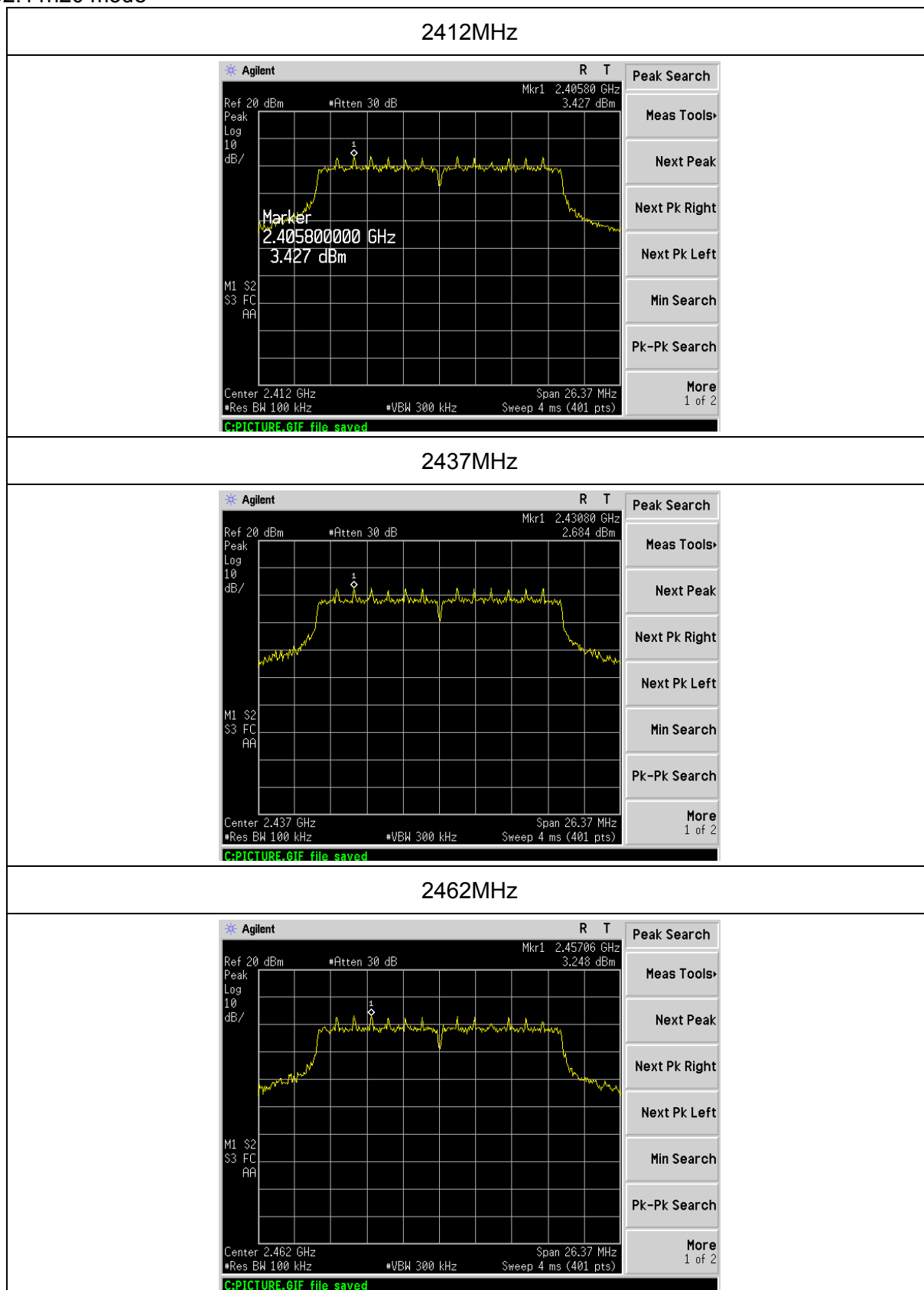
2437MHz



2462MHz



802.11n20 mode



3.6 Band edge

3.6.1 Limit

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, the attenuation required under this paragraph shall be 30dB instead of 20dB.

3.6.2 Test method

Use the following spectrum analyzer settings:

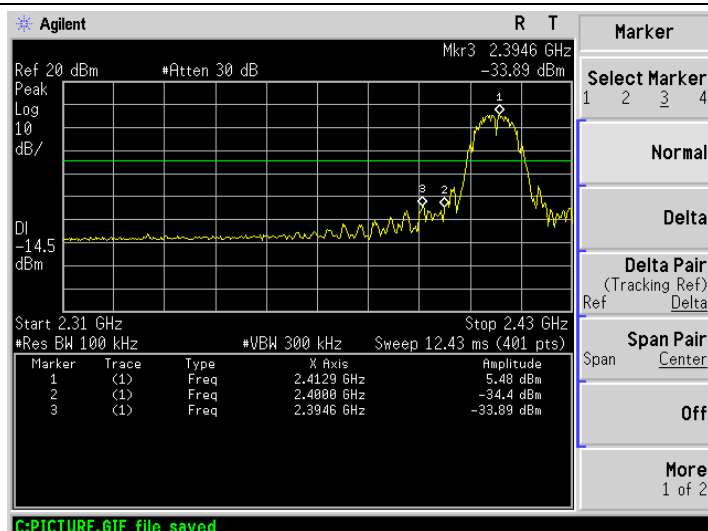
Set RBW = 100 kHz. VBW $\geq$ 3RBW. Detector = peak, Sweep time = auto couple, Trace mode = max hold.

3.6.3 Test Result

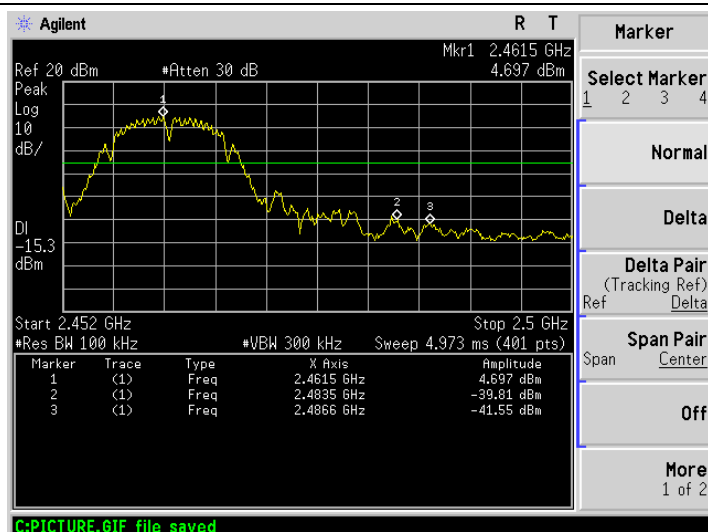
Test plots as below:

802.11b mode, Band edge

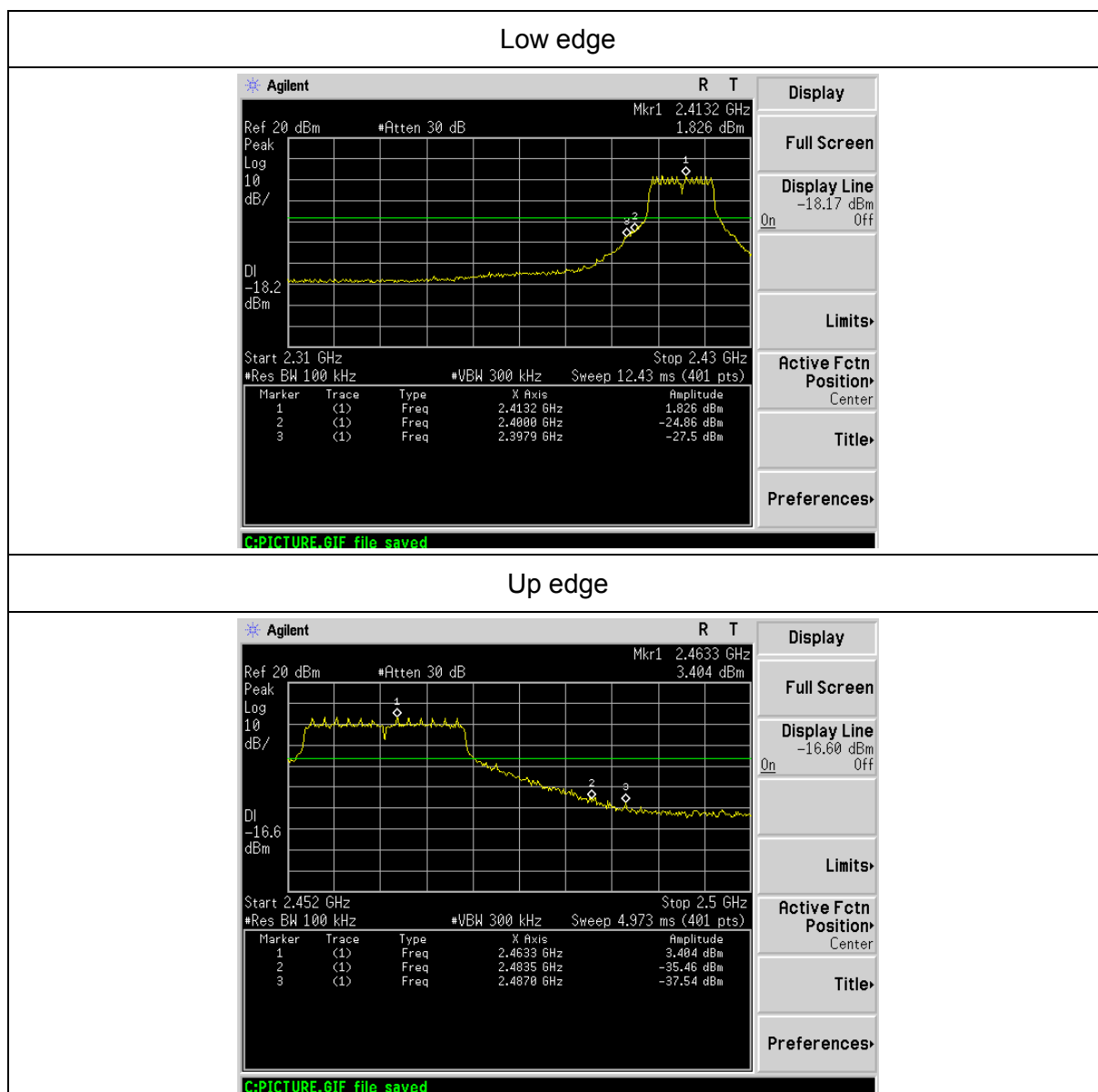
Low edge



Up edge

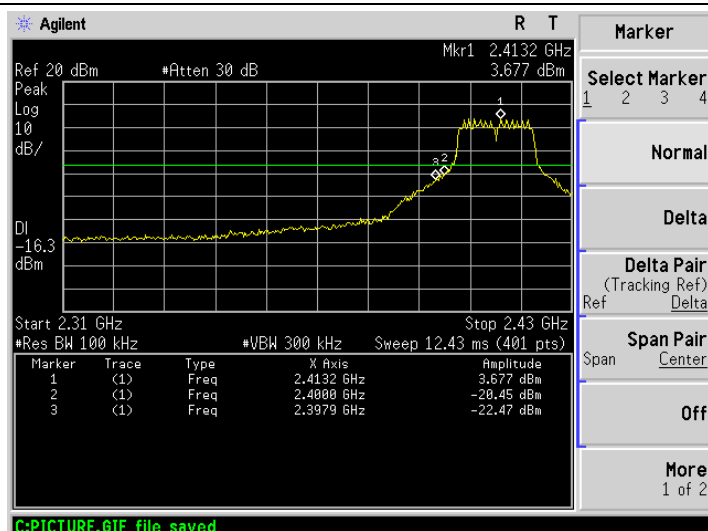


802.11g mode, Band edge

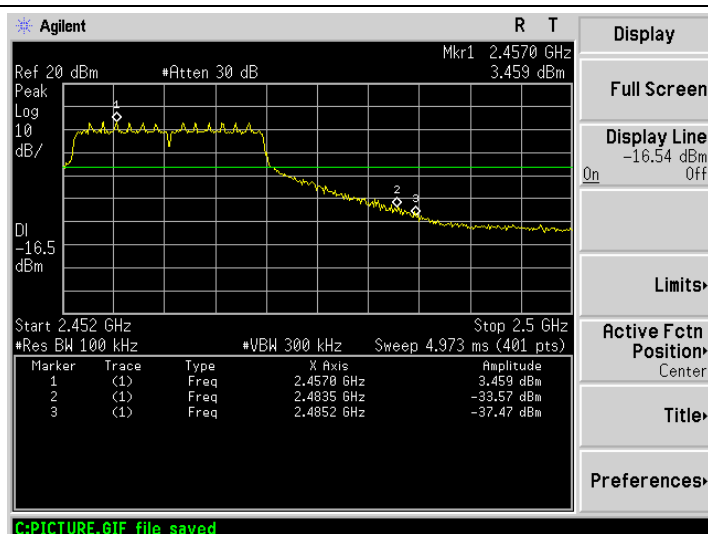


802.11n20 mode, Band edge

Low edge



Up edge



3.7 Radiated emission

3.7.1 Limit

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, the attenuation required under this paragraph shall be 30 dB instead of 20dB. Attenuation below the general limits defined 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 defined in §15.209(a).

Radiated emission limits defined in FCC 15.209:

Frequency (MHz)	Field strength $\mu\text{V/m}$	Field strength $\text{dB}\mu\text{V/m}$	Detector	Measurement distance
30-88	100	40	QP	3m
88-216	150	43.5	QP	
216-960	200	46	QP	
960-1000	500	46	QP	
Above 1000	500	54	AV	
Above 1000	5000	74	PK	

Restricted bands defined in FCC 15.205:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

3.7.2 Test method

1. The EUT is placed on a turntable, which is 0.8m above ground plane for test frequency range below 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.
2. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
3. Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured, RBW = 1 MHz for $f \geq 1\text{GHz}$, 100 kHz for $f < 1\text{GHz}$, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 3MHz, Detector = RMS for AV value, while maintaining all of the other instrument settings.
6. The three orthogonal axis (x, y, z) are pre-tested, only the worst emission were reported

3.7.3 Test Result

Remark:

If the PK measured values lower than average mode limit, the EUT shall be deemed to meet average limits and then no additional average mode measurement performed.

802.11b: 2412MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Result	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	25.4	43.5	QP	Pass	Spurious emission
145.35	H	31.5	43.5	QP		Spurious emission
2390	V	50.13	74	PK		Restricted bands
2390	H	52.86	74	PK		Restricted bands
4824	V	53.46	74	PK		Restricted bands
4824	H	56.83	74	PK		Restricted bands
4824	H	51.29	54	AVG		Restricted bands
7236	V	52.59	74	PK		Spurious emission
7236	H	53.17	74	PK		Spurious emission
802.11b: 2437MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Result	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	24.1	43.5	QP	Pass	Spurious emission
145.35	H	30.4	43.5	QP		Spurious emission
4874	V	53.18	74	PK		Restricted bands
4874	H	55.94	74	PK		Restricted bands
4874	H	50.13	54	AVG		Restricted bands
7311	V	50.34	74	PK		Restricted bands
7311	H	51.42	74	PK		Restricted bands
802.11b: 2462MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Pass	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	23.8	43.5	QP		Spurious emission
145.35	H	29.8	43.5	QP		Spurious emission
2483.5	V	45.39	74	PK		Restricted bands
2483.5	H	46.87	74	PK		Restricted bands
4924	V	52.83	74	PK		Restricted bands
4924	H	56.13	74	PK		Restricted bands
4924	H	50.68	54	AVG		Restricted bands
7386	V	50.18	74	PK		Restricted bands
7386	H	50.93	74	PK		Restricted bands

802.11g: 2412MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Result	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	26.7	43.5	QP	Pass	Spurious emission
145.35	H	32.4	43.5	QP		Spurious emission
2390	V	51.28	74	PK		Restricted bands
2390	H	53.52	74	PK		Restricted bands
4824	V	55.62	74	PK		Restricted bands
4824	V	50.34	54	AVG		Restricted bands
4824	H	56.26	74	PK		Restricted bands
4824	H	51.39	54	AVG		Restricted bands
7236	V	51.64	74	PK		Spurious emission
7236	H	52.83	74	PK		Spurious emission
802.11g: 2437MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Result	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	25.8	43.5	QP	Pass	Spurious emission
145.35	H	30.9	43.5	QP		Spurious emission
4874	V	55.37	74	PK		Restricted bands
4874	V	51.24	54	AVG		Restricted bands
4874	H	56.49	74	PK		Restricted bands
4874	H	51.67	54	AVG		Restricted bands
7311	V	51.34	74	PK		Restricted bands
7311	H	52.12	74	PK		Restricted bands
802.11g: 2462MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Pass	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	25.4	43.5	QP		Spurious emission
145.35	H	32.5	43.5	QP		Spurious emission
2483.5	V	46.13	74	PK		Restricted bands
2483.5	H	46.96	74	PK		Restricted bands
4924	V	56.27	74	PK		Restricted bands
4924	V	50.68	54	AVG		Restricted bands
4924	H	56.89	74	PK		Restricted bands
4924	H	51.29	54	AVG		Restricted bands
7386	V	50.69	74	PK		Restricted bands
7386	H	51.83	74	PK		Restricted bands

802.11n20: 2412MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Result	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	24.6	43.5	QP	Pass	Spurious emission
145.35	H	30.2	43.5	QP		Spurious emission
2390	V	48.61	74	PK		Restricted bands
2390	H	49.37	74	PK		Restricted bands
4824	V	52.41	74	PK		Restricted bands
4824	H	53.42	74	PK		Restricted bands
7236	V	49.63	74	PK		Spurious emission
7236	H	50.37	74	PK		Spurious emission
802.11n20: 2437MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Result	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	23.5	43.5	QP	Pass	Spurious emission
145.35	H	29.4	43.5	QP		Spurious emission
4874	V	51.86	74	PK		Restricted bands
4874	H	52.58	74	PK		Restricted bands
7311	V	48.63	74	PK		Restricted bands
7311	H	49.57	74	PK		Restricted bands
802.11n20: 2462MHz						
Frequency	Ant. Polarization	Emission level	Limits	Detector	Result	Comment
(MHz)	H / V	dBμV/m	dBμV/m			
145.35	V	23.7	43.5	QP	Pass	Spurious emission
145.35	H	29.8	43.5	QP		Spurious emission
2483.5	V	44.67	74	PK		Restricted bands
2483.5	H	45.82	74	PK		Restricted bands
4924	V	51.6	74	PK		Restricted bands
4924	H	52.74	74	PK		Restricted bands
7386	V	48.67	74	PK		Restricted bands
7386	H	49.81	74	PK		Restricted bands

----END OF REPORT----