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检测
TESTING
CNAS L2264

RF TEST REPORT

Applicant	Huawei Technologies Co., Ltd.
FCC ID	QISR218H
Product	Mobile WiFi
Model	R218h
Report No.	RHA1705-0045RF04
Issue Date	July 4, 2017

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2016)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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Summary of measurement results

Number	Summary of measurements of results	Clause in FCC rules	Verdict
1	Maximum Average conducted output power	15.247(b)(3)	PASS
2	6 dB bandwidth	15.247(a)(2)	PASS
3	Power spectral density	15.247(e)	PASS
4	Band Edge	15.247(d)	PASS
5	Spurious RF Conducted Emissions	15.247(d)	PASS
6	Radiated Emissions in restricted frequency bands	15.247(d),15.205,15.209	PASS
7	Radiated Emissions	15.247(d),15.205,15.209	PASS
8	Conducted Emissions	15.207	PASS
Date of Testing: May 9, 2017 ~ May 16, 2017 and June 25, 2017 ~ June 30, 2017			

1. Test Laboratory

1.1. Notes of the test report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above. This report must not be used by the client to claim product certification, approval, or endorsement by CNAS or any government agencies.

1.2. Test facility

CNAS (accreditation number: L2264)

TA Technology (Shanghai) Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (recognition number is 428261)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

IC (recognition number is 8510A)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Canada to perform electromagnetic emission measurement.

VCCI (recognition number is C-4595, T-2154, R-4113, G-766)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Japan to perform electromagnetic emission measurement.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.



1.3. Testing Location

Company: TA Technology (Shanghai) Co., Ltd.
Address: No.145, Jintang Rd, Tangzhen Industry Park, Pudong
City: Shanghai
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Website: <http://www.ta-shanghai.com>
E-mail: xukai@ta-shanghai.com

2. General Description of Equipment under Test

Client Information

Applicant	Huawei Technologies Co., Ltd.
Applicant address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.China.
Manufacturer	Huawei Technologies Co., Ltd.
Manufacturer address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.China.

General information

EUT Description	
Model:	R218h
SN:	/
Hardware Version:	CL1E5573CSM16
Software Version:	21.326.06.00.11
Power Supply:	Battery/AC adapter
Antenna Type:	Internal Antenna
Antenna Connector:	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)
Antenna Gain:	Antenna 1: 1.21 dBi Antenna 2: 1.21 dBi
Directional Gain:	1.21 dBi
Test Mode:	802.11b 802.11g, 802.11n(HT20/HT40);
Modulation Type:	802.11b: DSSS; 802.11g/n(HT20/HT40): OFDM
Max. Conducted Power	Wi-Fi 2.4G : 16.04dBm
Operating Frequency Range(s)	802.11b/g/n(HT20): 2412 ~ 2457 MHz 802.11n(HT40): 2422 ~ 2447 MHz
EUT Accessory	
Adapter 1	Manufacturer: Dongguan Phitek Electronic Co., Ltd Model: HW-050100E01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 2	Manufacturer: Huizhou BYD Electronic Co., Ltd Model: HW-050100E01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 3	Manufacturer: Shenzhen Huntkey Electric Co., Ltd. Model: HW-050100E01 Input power: 100-240V AC 50/60Hz 0.2A



	Output power: 5V DC 1A
Adapter 4	Manufacturer: Dongguan Phitek Electronic Co., Ltd Model: HW-050100U01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 5	Manufacturer: Huizhou BYD Electronic Co., Ltd Model: HW-050100U01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 6	Manufacturer: Shenzhen Huntkey Electric Co., Ltd. Model: HW-050100U01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 7	Manufacturer: Dongguan Phitek Electronic Co., Ltd Model: HW-050100B01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 8	Manufacturer: Huizhou BYD Electronic Co., Ltd Model: HW-050100B01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 9	Manufacturer: Shenzhen Huntkey Electric Co., Ltd. Model: HW-050100B01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 10	Manufacturer: Dongguan Phitek Electronic Co., Ltd Model: HW-050100A01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 11	Manufacturer: Huizhou BYD Electronic Co., Ltd Model: HW-050100A01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Adapter 12	Manufacturer: Shenzhen Huntkey Electric Co., Ltd. Model: HW-050100A01 Input power: 100-240V AC 50/60Hz 0.2A Output power: 5V DC 1A
Battery 1	Manufacturer: Sunwoda Electronic Co.,LTD Model: HB434666RBC Power Rating: DC 3.8V, 1500mAh, Li-ion
Battery 2	Manufacturer: SCUD (Fujian) Electronics Co., LTD Model: HB434666RBC Power Rating: DC 3.8V, 1500mAh, Li-ion
USB Extend Cable	100cm Cable, Shielded



Note: The information of the EUT is declared by the manufacturer.
Please refer to the specifications or user manual for details.

3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards

- **FCC CFR47 Part 15C (2016) Radio Frequency Devices**
- **ANSI C63.10 (2013)**
- **KDB 558074 D01 DTS Meas Guidance v04**
- **KDB 662911 D01 Multiple Transmitter Output v02r01**

4. Test Configuration

Test Mode

The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate below means worst-case rate of each test item.

Worst-case data rates are shown as following table.

Band	Data Rate		
	Antenna 1	Antenna 2	MIMO
802.11b	1 Mbps	1 Mbps	/
802.11g	6 Mbps	6 Mbps	/
802.11n HT20	MCS0	MCS0	MCS8
802.11n HT40	MCS0	MCS0	MCS8

The worst case Antenna mode for each of the following tests for Wi-Fi:

Test Cases	Antenna 1	Antenna 2	MIMO
Average Power Output –Conducted	O	O	802.11n HT20 802.11n HT40
6dB Bandwidth	--	O	--
Band Edge	--	O	--
Power Spectral Density	O	O	802.11n HT20 802.11n HT40
Spurious RF Conducted Emissions	O	O	802.11n HT20 802.11n HT40
Radiates Emission in the Restricted Band	--	802.11b 802.11g	802.11n HT20 802.11n HT40
Radiates Emission	--	802.11b 802.11g	802.11n HT20 802.11n HT40
Conducted Emission	--	802.11b 802.11g	802.11n HT20 802.11n HT40
Note: "O": test all bands			

5. Test Case Results

5.1. Average Power Output –Conducted

Ambient condition

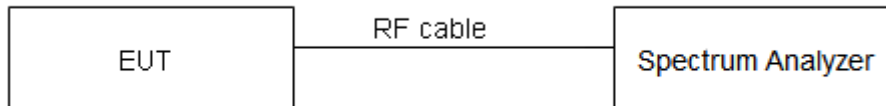
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

During the process of the testing, The EUT was connected to Spectrum Analyzer with a known loss. The EUT is max power transmission with proper modulation. The Average detector is used. We use Maximum Average Conducted Output Power Level Method in KDB 558074 D01/KDB662911 D01 for this test.

The conducted Power is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically.

Test Setup



Limits

Rule Part 15.247 (b) (3) specifies that " For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz: 1 Watt."

Average Output Power	$\leq 1W$ (30dBm)
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.44$ dB.

Test Results

Packet Type	Antenna 1 Power Index			Antenna 2 Power Index		
	CH1	CH6	CH10	CH1	CH6	CH10
802.11b	16	16	16	16	16	16
802.11g	13	13	13	13	13	13
802.11n HT20	12	12	12	12	12	12
Packet Type	CH3	CH5	CH8	CH3	CH5	CH8
802.11n HT40	12	12	12	12	12	12

MIMO Power Index			
Packet Type	CH1	CH6	CH10
802.11n HT20	10	10	10
Packet Type	CH3	CH5	CH8
802.11n HT40	10	10	10

SISO Antenna 1

Network Standards	Carrier frequency (MHz)	Average Output Power (dBm)	Limit (dBm)	Conclusion
802.11b	2412	15.65	30	PASS
	2437	15.71	30	PASS
	2457	15.73	30	PASS
802.11g	2412	12.36	30	PASS
	2437	12.99	30	PASS
	2457	12.98	30	PASS
802.11n HT20	2412	11.51	30	PASS
	2437	12.03	30	PASS
	2457	12.16	30	PASS
802.11n HT40	2422	11.63	30	PASS
	2432	11.83	30	PASS
	2447	11.70	30	PASS

SISO Antenna 2

Network Standards	Carrier frequency (MHz)	Average Output Power (dBm)	Limit (dBm)	Conclusion
802.11b	2412	15.66	30	PASS
	2437	16.04	30	PASS
	2457	15.73	30	PASS
802.11g	2412	11.40	30	PASS
	2437	13.13	30	PASS
	2457	12.29	30	PASS
802.11n HT20	2412	10.51	30	PASS
	2437	12.02	30	PASS
	2457	11.38	30	PASS
802.11n HT40	2422	12.18	30	PASS
	2432	12.07	30	PASS
	2447	12.30	30	PASS

MIMO

Network Standards	Carrier frequency (MHz)	Average Output Power (dBm)			Limit (dBm)	Conclusion
		Ant 1	Ant 2	MIMO		
802.11n HT20	2412	8.51	8.99	11.77	30	PASS
	2437	9.10	10.21	12.70	30	PASS
	2457	9.03	9.85	12.47	30	PASS
802.11n HT40	2422	7.74	8.28	11.03	30	PASS
	2437	7.96	8.51	11.25	30	PASS
	2447	7.76	8.39	11.10	30	PASS

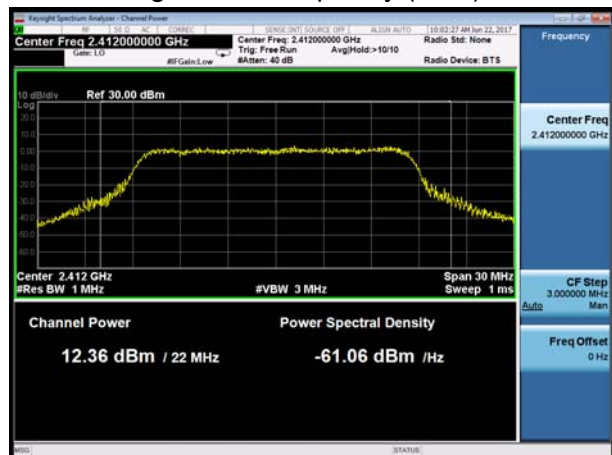


SISO Antenna 1

802.11b, Carrier frequency (MHz): 2412



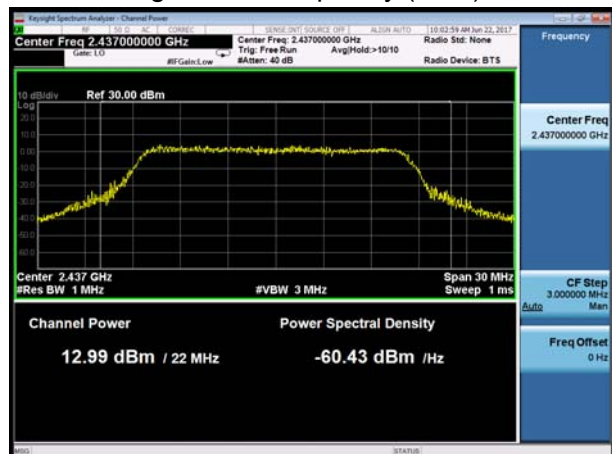
802.11g, Carrier frequency (MHz): 2412



802.11b, Carrier frequency (MHz): 2437



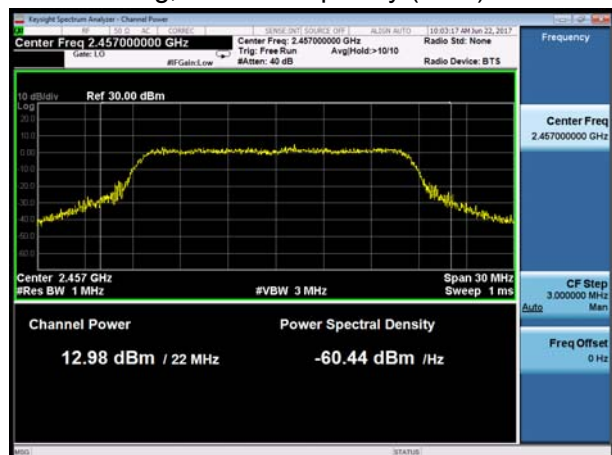
802.11g, Carrier frequency (MHz): 2437



802.11b, Carrier frequency (MHz): 2457



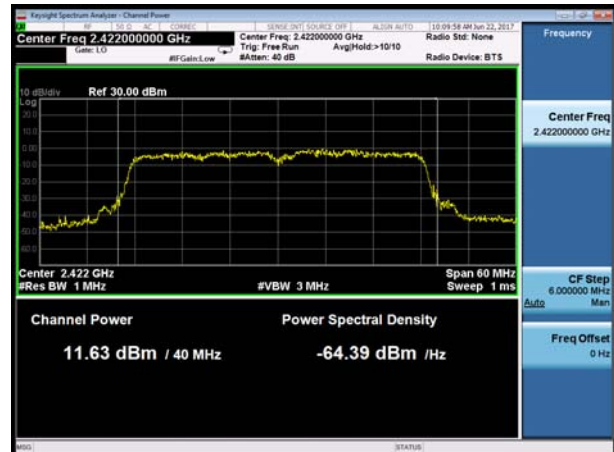
802.11g, Carrier frequency (MHz): 2457



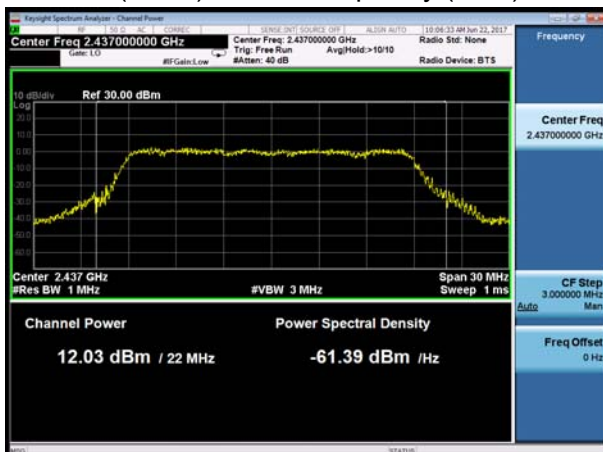
802.11n(HT20), Carrier frequency (MHz): 2412



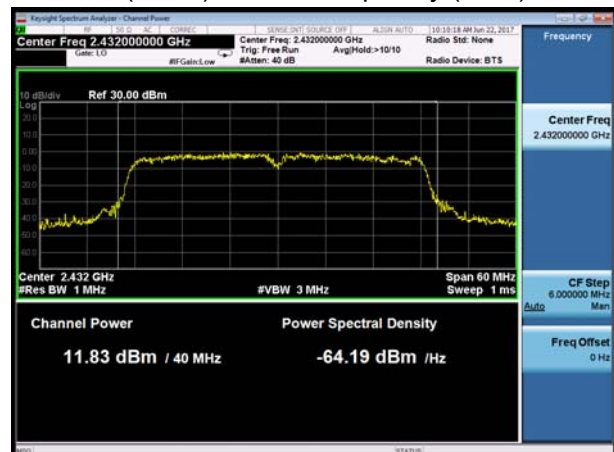
802.11n(HT40), Carrier frequency (MHz): 2422



802.11n(HT20), Carrier frequency (MHz): 2437



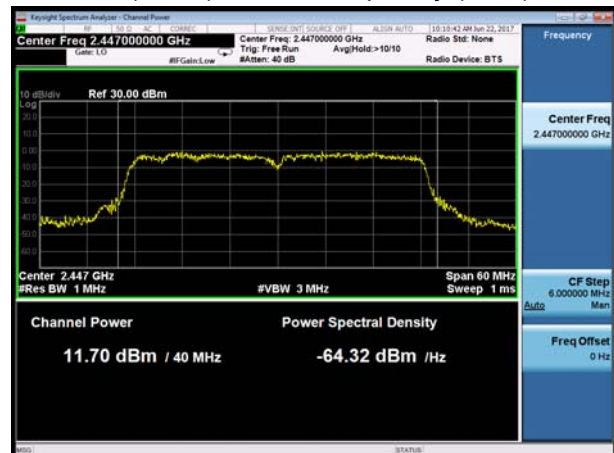
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2457



802.11n(HT40), Carrier frequency (MHz): 2447

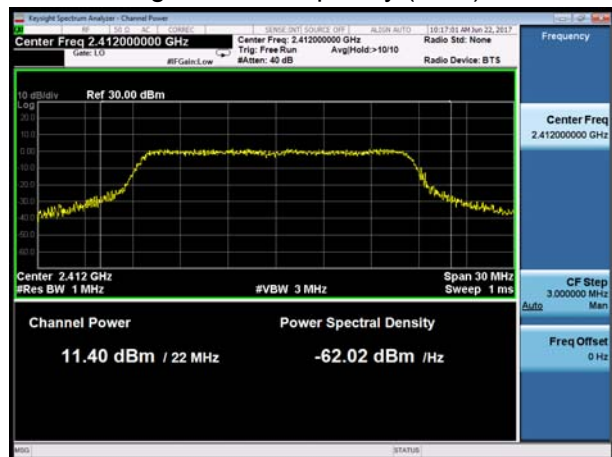


SISO Antenna 2

802.11b, Carrier frequency (MHz): 2412



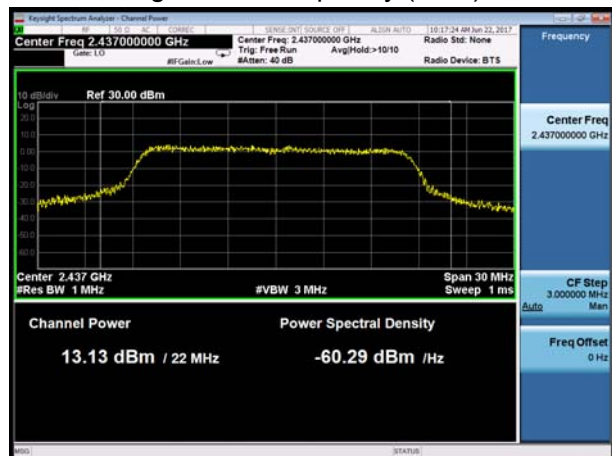
802.11g, Carrier frequency (MHz): 2412



802.11b, Carrier frequency (MHz): 2437



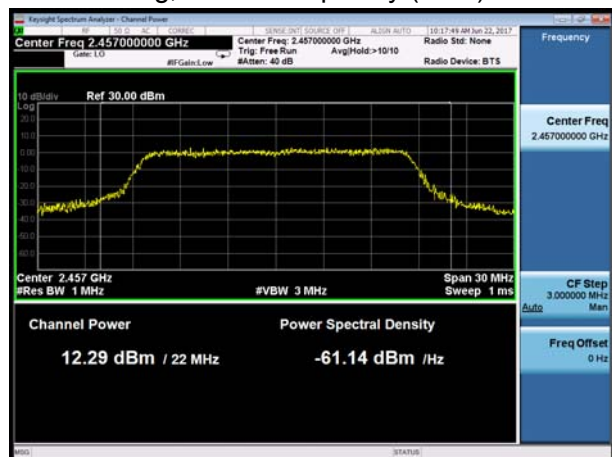
802.11g, Carrier frequency (MHz): 2437



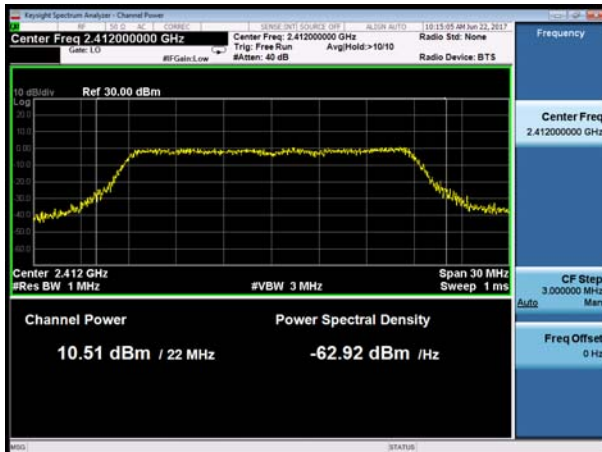
802.11b, Carrier frequency (MHz): 2457



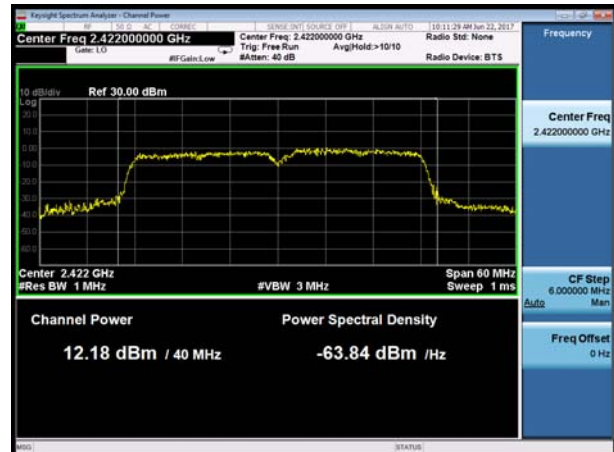
802.11g, Carrier frequency (MHz): 2457



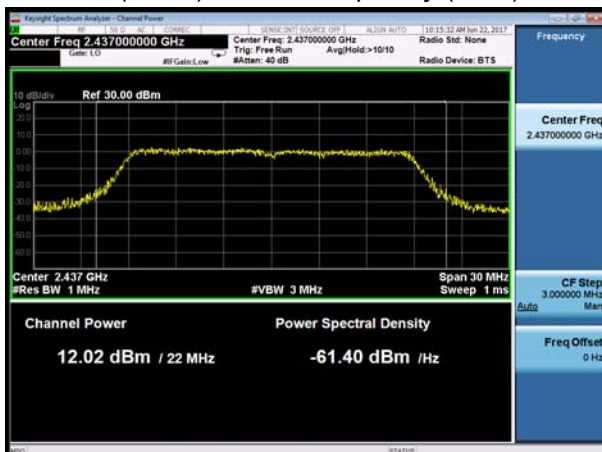
802.11n(HT20), Carrier frequency (MHz): 2412



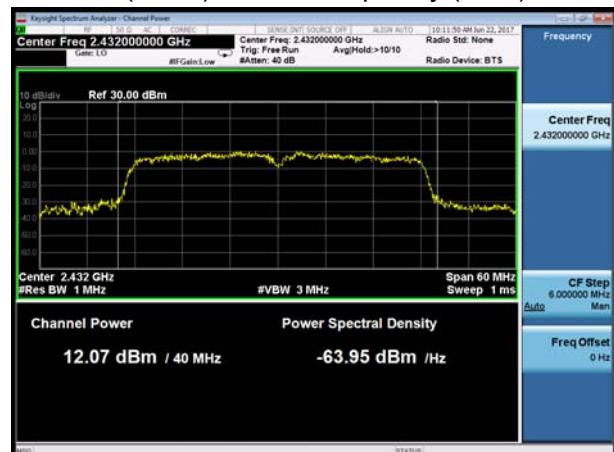
802.11n(HT40), Carrier frequency (MHz): 2422



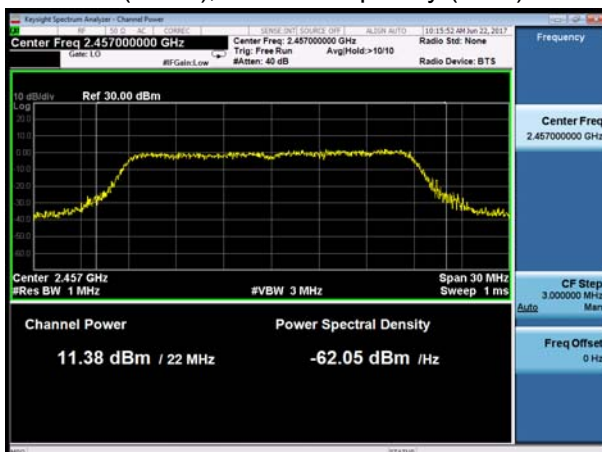
802.11n(HT20), Carrier frequency (MHz): 2437



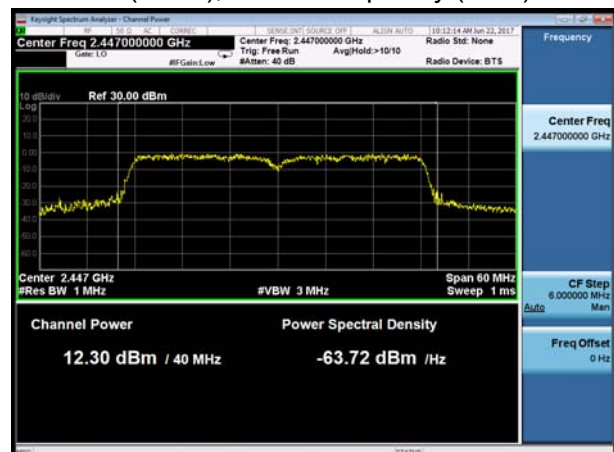
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2457



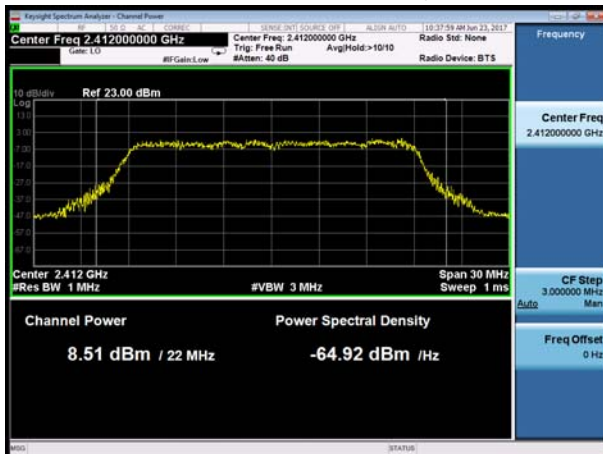
802.11n(HT40), Carrier frequency (MHz): 2447



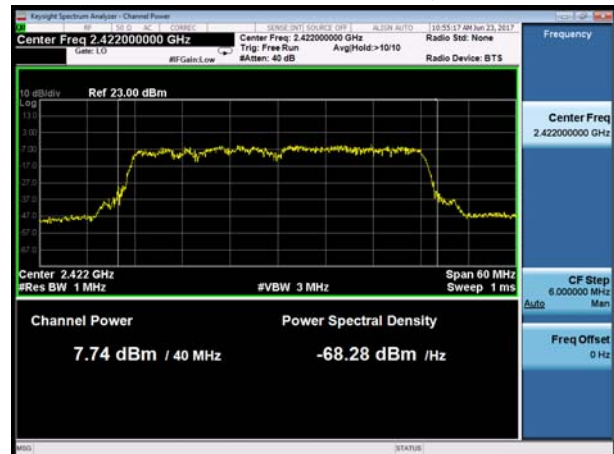


MIMO Antenna 1

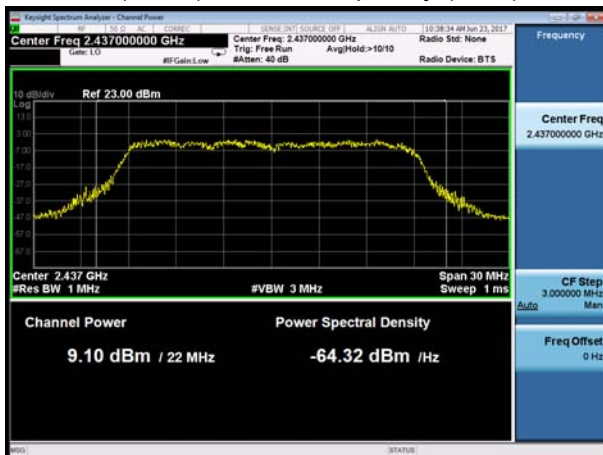
802.11n(HT20), Carrier frequency (MHz): 2412



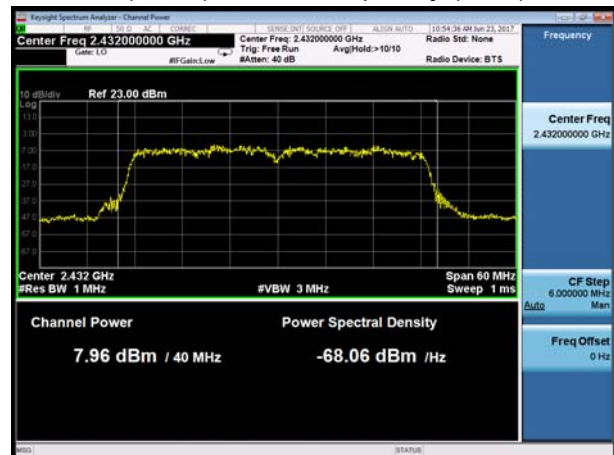
802.11n(HT40), Carrier frequency (MHz): 2422



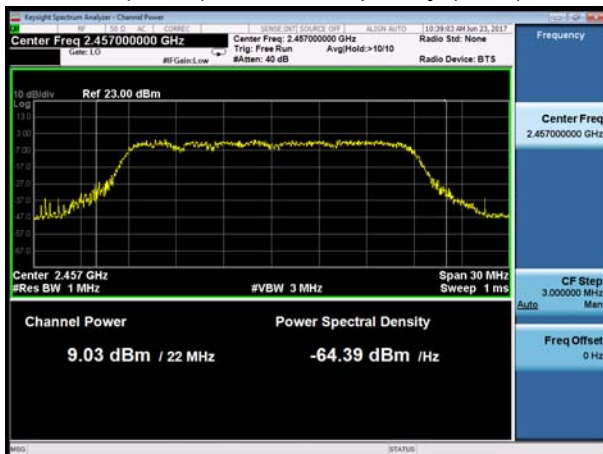
802.11n(HT20), Carrier frequency (MHz): 2437



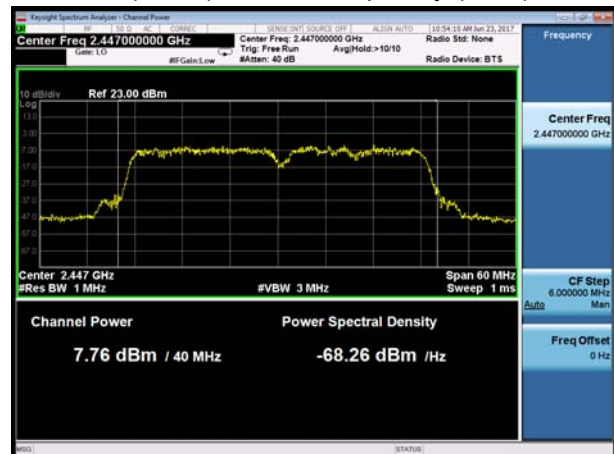
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2457



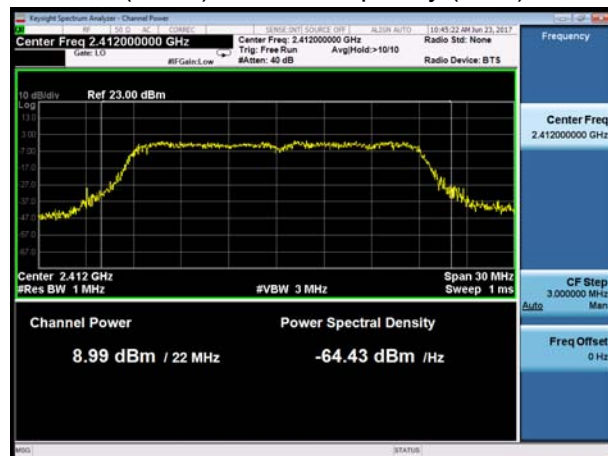
802.11n(HT40), Carrier frequency (MHz): 2447



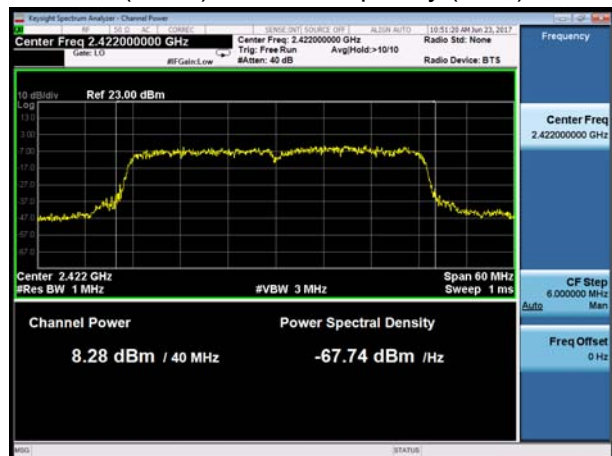


MIMO Antenna 2

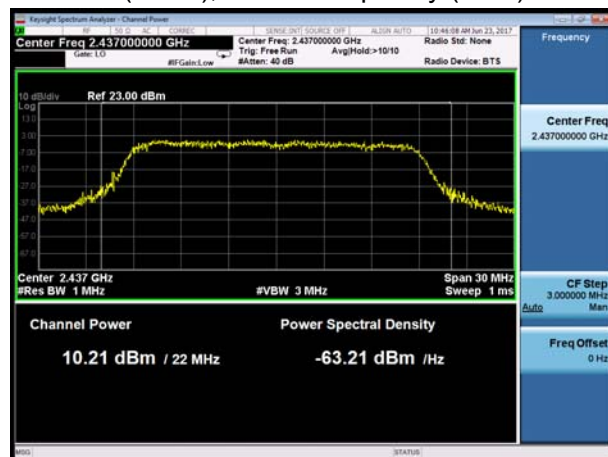
802.11n(HT20), Carrier frequency (MHz): 2412



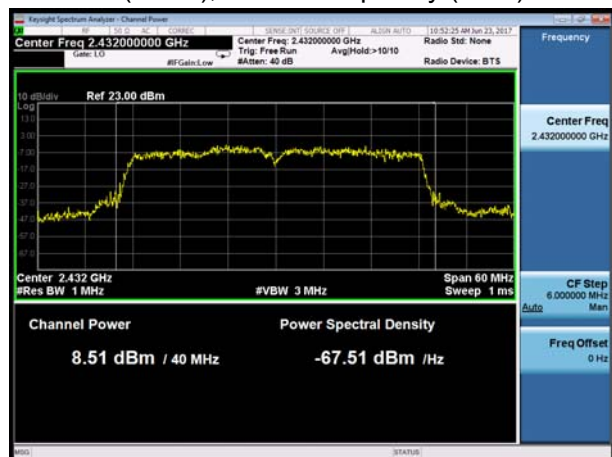
802.11n(HT40), Carrier frequency (MHz): 2422



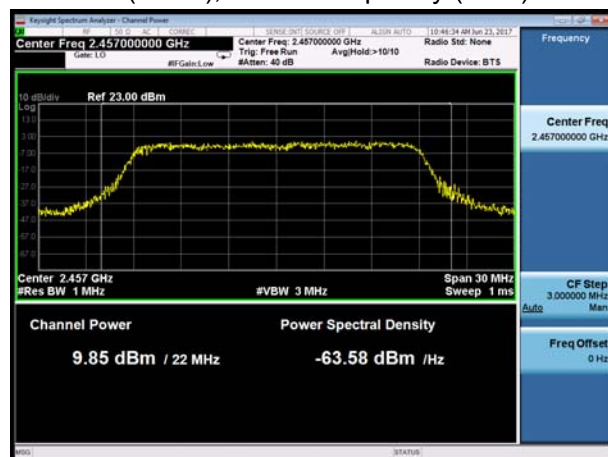
802.11n(HT20), Carrier frequency (MHz): 2437



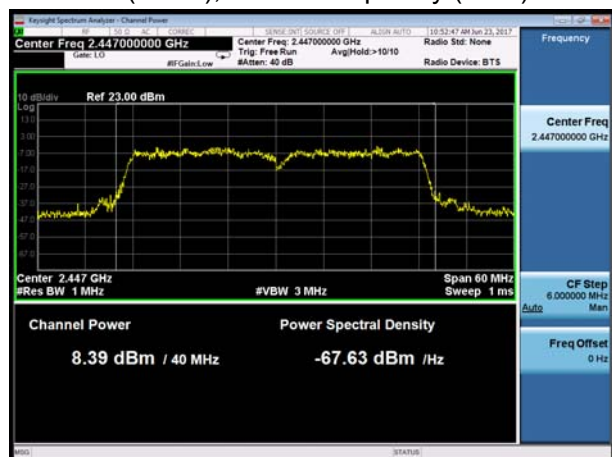
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2457



802.11n(HT40), Carrier frequency (MHz): 2447



5.2. 6dB Bandwidth

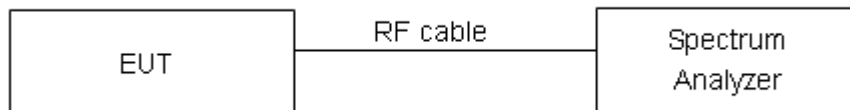
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 100 kHz; VBW is set to 300 kHz on spectrum analyzer.

Test Setup



Limits

Rule Part 15.247 (a) (2) specifies that “Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.”

minimum 6 dB bandwidth	≥ 500 kHz
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936$ Hz.

Test Results:
SISO Antenna 2

Network Standards	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11b	2412	15.186	9.590	500	PASS
	2437	15.211	9.586	500	PASS
	2457	15.022	9.579	500	PASS
802.11g	2412	16.459	16.340	500	PASS
	2437	16.467	16.350	500	PASS
	2457	16.440	16.350	500	PASS
802.11n HT20	2412	17.698	16.950	500	PASS
	2437	17.697	17.330	500	PASS
	2457	17.670	17.320	500	PASS
802.11n HT40	2422	35.852	35.320	500	PASS
	2432	35.944	35.170	500	PASS
	2447	36.102	36.320	500	PASS

MIMO

Network Standards	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11n HT20	2412	17.656	16.970	500	PASS
	2437	17.649	17.610	500	PASS
	2457	17.635	17.580	500	PASS
802.11n HT40	2422	35.889	35.190	500	PASS
	2432	35.972	35.200	500	PASS
	2447	36.083	36.080	500	PASS



SISO Antenna 2

802.11b, Carrier frequency (MHz): 2412



802.11g, Carrier frequency (MHz): 2412



802.11b, Carrier frequency (MHz): 2437



802.11g, Carrier frequency (MHz): 2437



802.11b, Carrier frequency (MHz): 2457



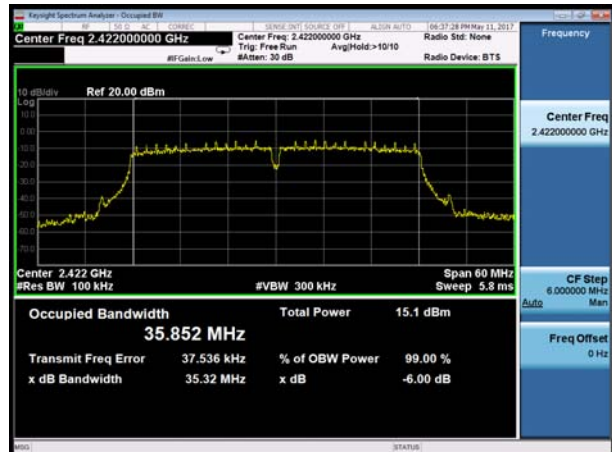
802.11g, Carrier frequency (MHz): 2457



802.11n(HT20), Carrier frequency (MHz): 2412



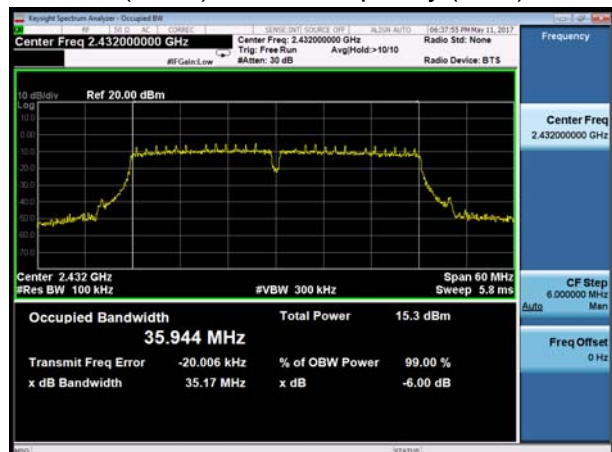
802.11n(HT40), Carrier frequency (MHz): 2422



802.11n(HT20), Carrier frequency (MHz): 2437



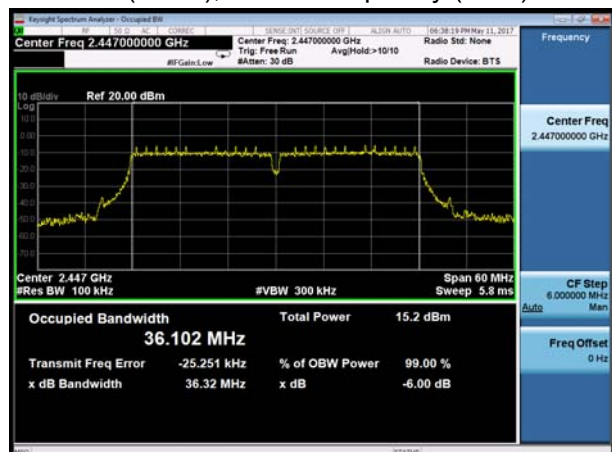
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2457



802.11n(HT40), Carrier frequency (MHz): 2447



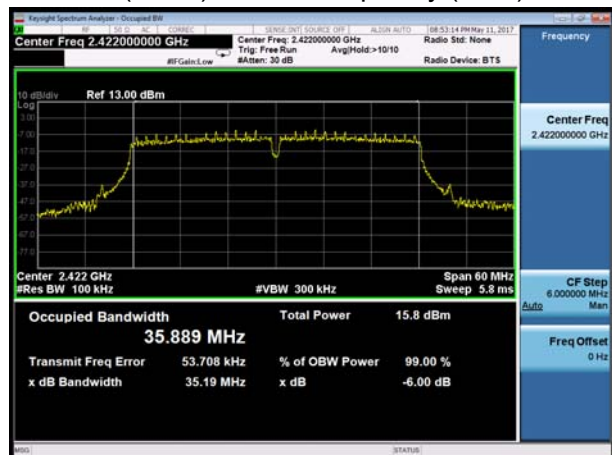


MIMO

802.11n(HT20), Carrier frequency (MHz): 2412



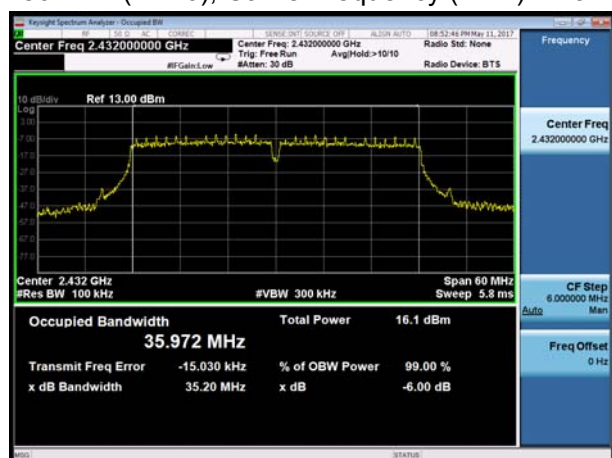
802.11n(HT40), Carrier frequency (MHz): 2422



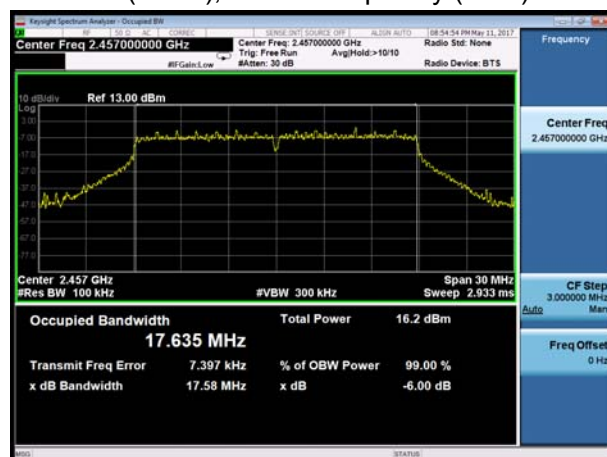
802.11n(HT20), Carrier frequency (MHz): 2437



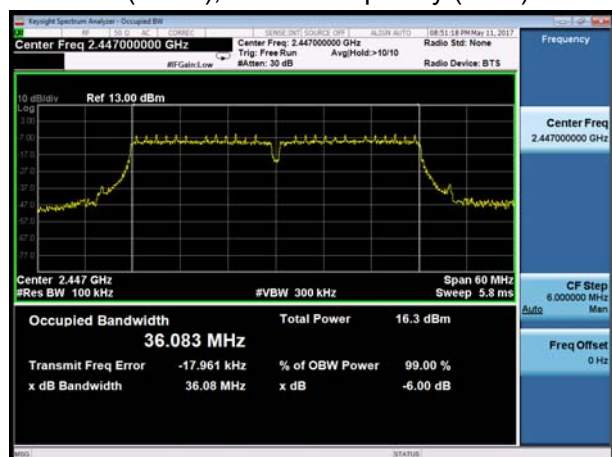
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2457



802.11n(HT40), Carrier frequency (MHz): 2447



5.3. Band Edge

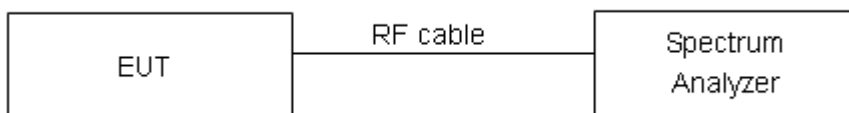
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

Rule Part 15.247(d) specifies that “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.”

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

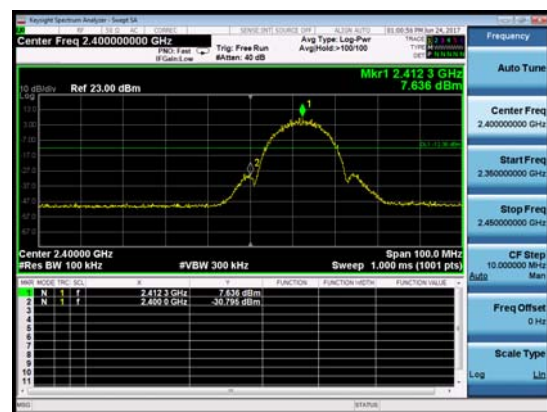
Frequency	Uncertainty
2GHz-3GHz	1.407 dB



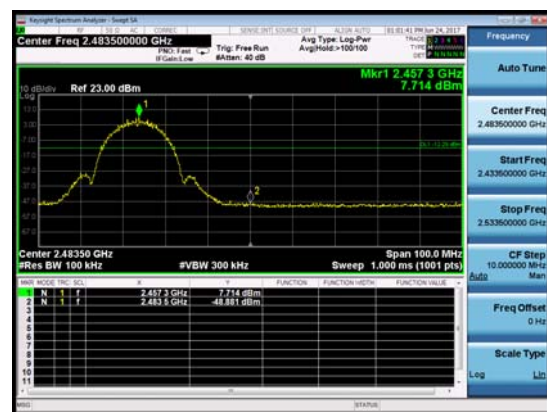
Test Results:

SISO Antenna 2

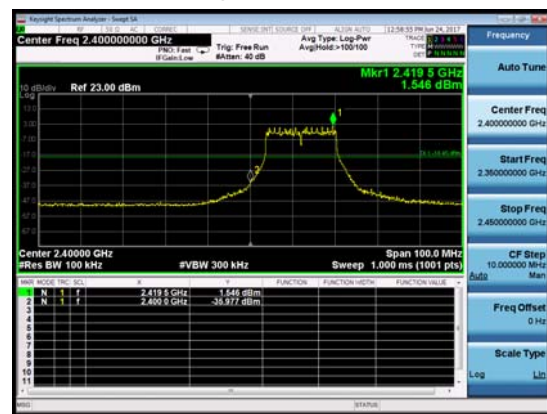
802.11b, Channel No.: 1



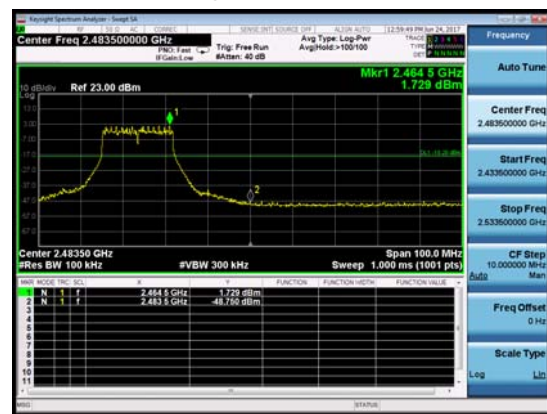
802.11b, Channel No.: 10



802.11g, Channel No.: 1



802.11g, Channel No.: 10



802.11n(HT20), Channel No.: 1



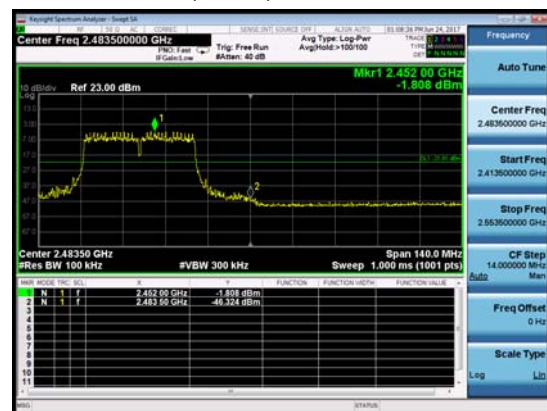
802.11n(HT20), Channel No.: 10



802.11n(HT40), Channel No.: 3



802.11n(HT40), Channel No.: 8



5.4. Power Spectral Density

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

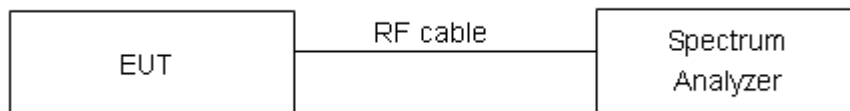
The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable.

RBW is set to 3 kHz and VBW is set to 10 kHz for Wi-Fi 2.4G on spectrum analyzer.

Set the span to 1.5 times the DTS channel bandwidth. Sweep time = auto couple. Trace mode = max hold. The Average power spectral density is recorded.

The conducted Power is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically.

Test setup



Limits

Rule Part 15.247(e) specifies that” 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. ”

Limits	≤ 8 dBm / 3kHz
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.75\text{dB}$.

Test Results:
SISO Antenna 1

Network Standards	Channel Number	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	1	-16.342	8	PASS
	6	-16.175	8	PASS
	10	-16.008	8	PASS
802.11g	1	-22.393	8	PASS
	6	-20.987	8	PASS
	10	-21.575	8	PASS
802.11n HT20	1	-22.336	8	PASS
	6	-22.601	8	PASS
	10	-22.248	8	PASS
802.11n HT40	3	-25.977	8	PASS
	5	-25.633	8	PASS
	8	-25.958	8	PASS

SISO Antenna 2

Network Standards	Channel Number	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	1	-16.493	8	PASS
	6	-16.089	8	PASS
	10	-15.611	8	PASS
802.11g	1	-23.412	8	PASS
	6	-20.878	8	PASS
	10	-22.279	8	PASS
802.11n HT20	1	-23.421	8	PASS
	6	-22.673	8	PASS
	10	-22.264	8	PASS
802.11n HT40	3	-25.047	8	PASS
	5	-24.864	8	PASS
	8	-24.844	8	PASS

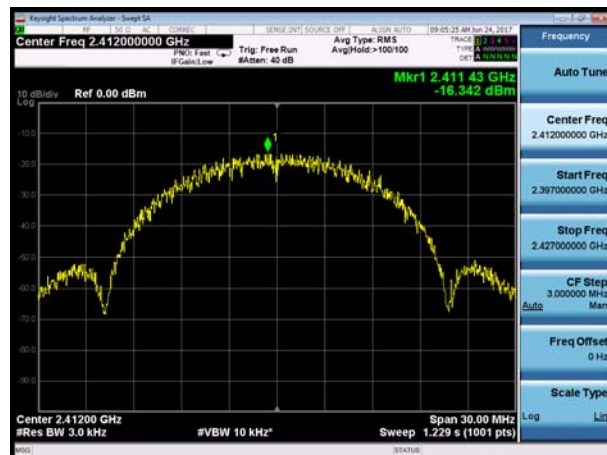
MIMO

Network Standards	Channel Number	Power Spectral Density (dBm / 3kHz)			Limit (dBm / 3kHz)	Conclusion
		Ant 1	Ant 2	MIMO		
802.11n HT20	1	-22.681	-22.807	-19.733	8	PASS
	6	-21.839	-21.428	-18.618	8	PASS
	10	-21.900	-21.92	-18.900	8	PASS
802.11n HT40	3	-26.119	-24.27	-22.087	8	PASS
	5	-26.058	-23.442	-21.546	8	PASS
	8	-26.698	-25.24	-22.898	8	PASS

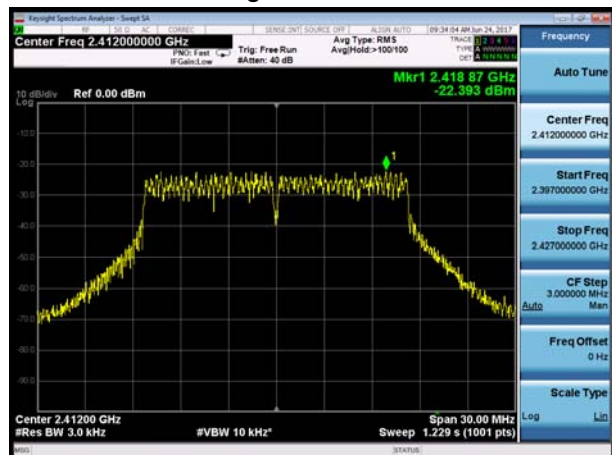


SISO Antenna 1

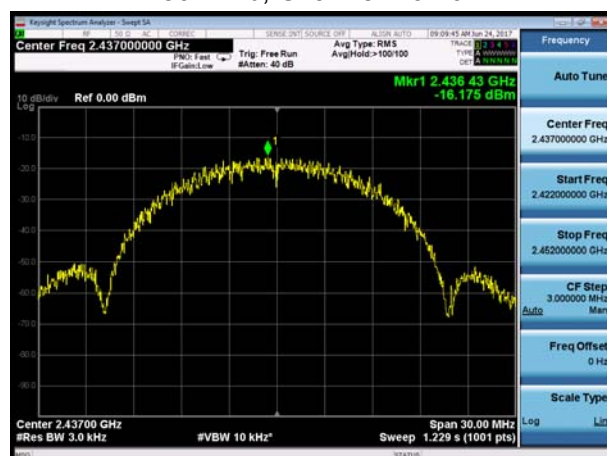
802.11b, Channel No.: 1



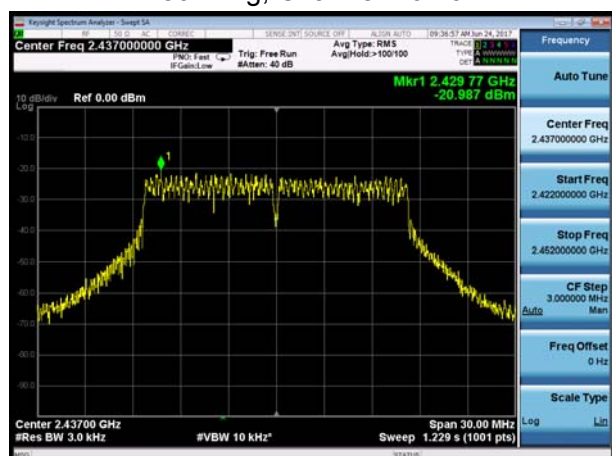
802.11g, Channel No.: 1



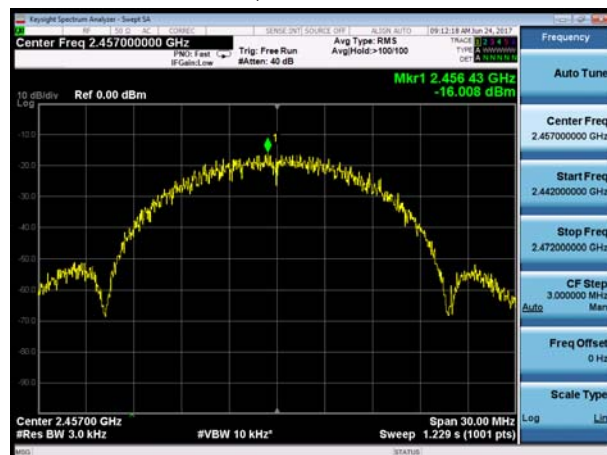
802.11b, Channel No.: 6



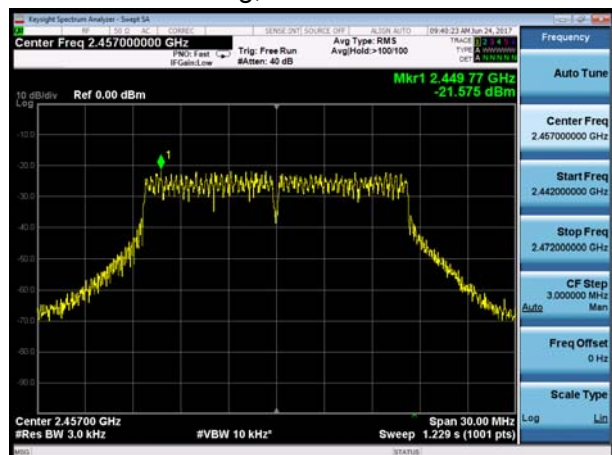
802.11g, Channel No.: 6



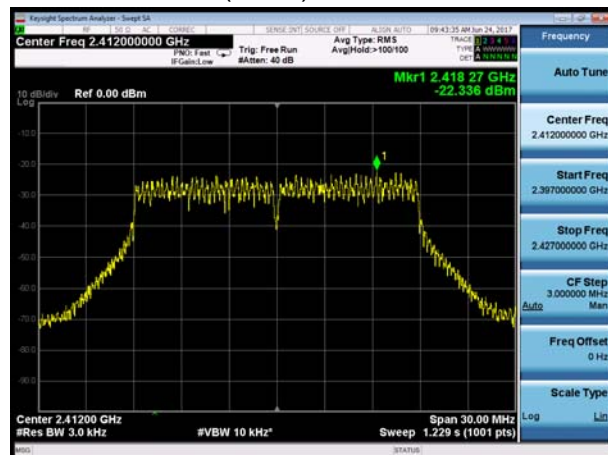
802.11b, Channel No.: 10



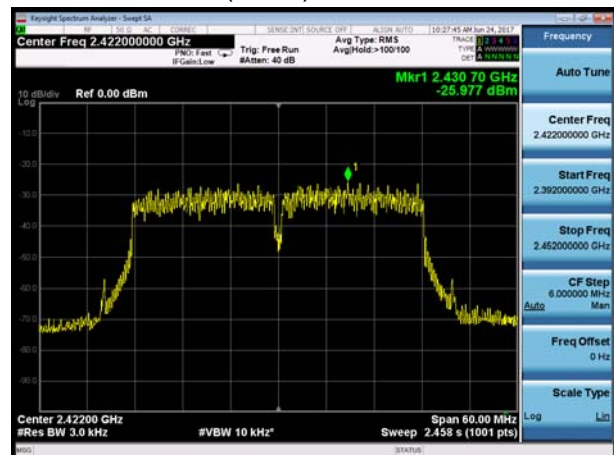
802.11g, Channel No.: 10



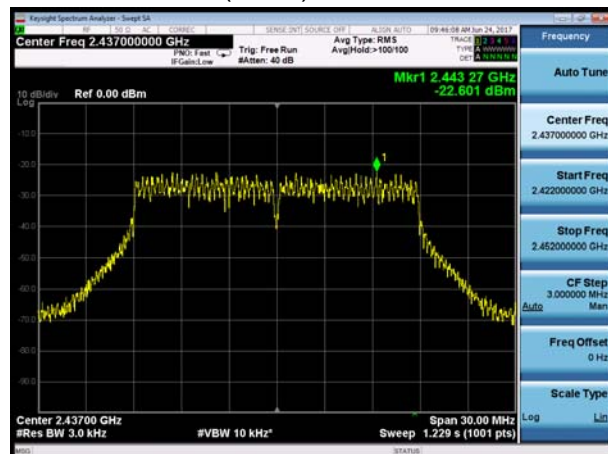
802.11n(HT20), Channel No. 1



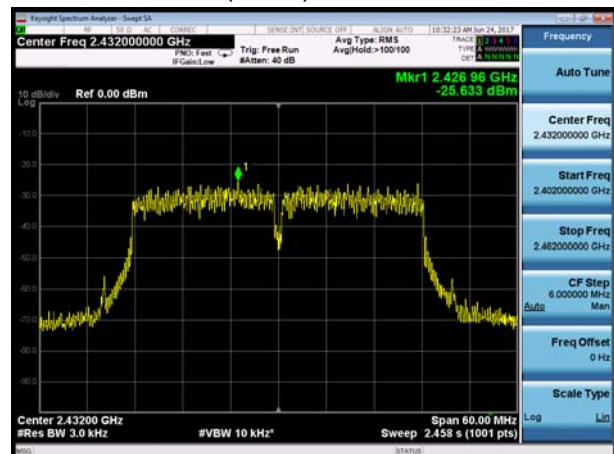
802.11n(HT40), Channel No. 3



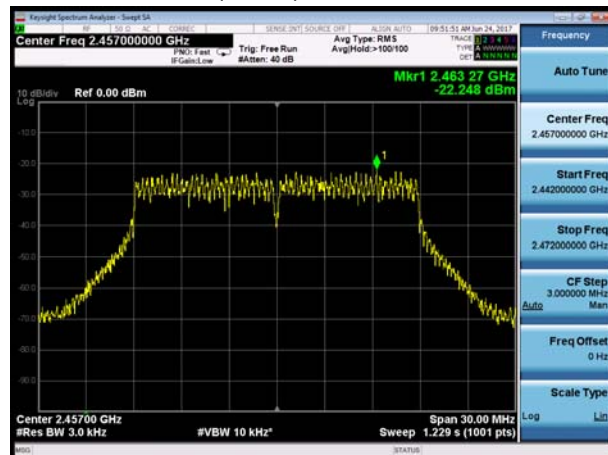
802.11n(HT20), Channel No. 6



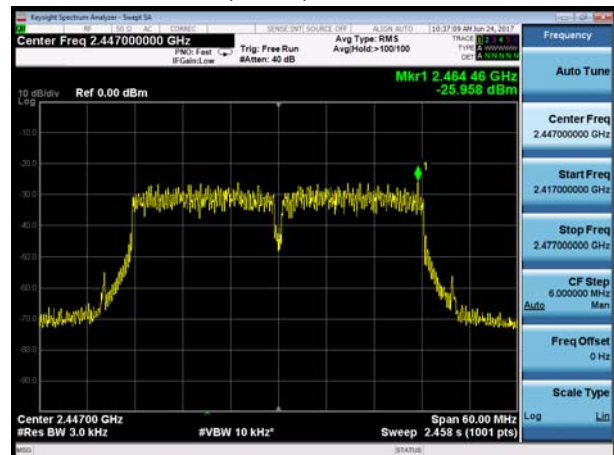
802.11n(HT40), Channel No. 5



802.11n(HT20), Channel No. 10



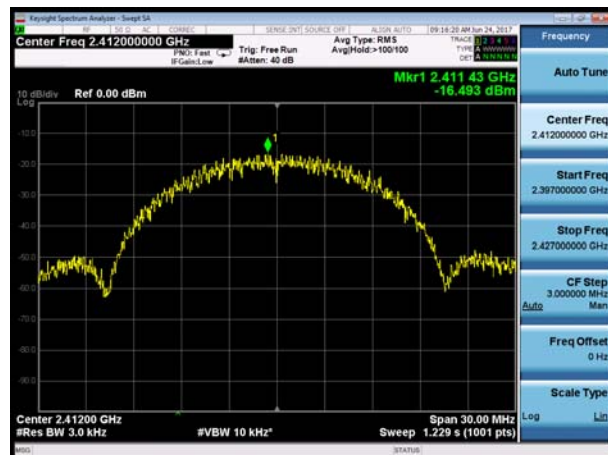
802.11n(HT40), Channel No. 8



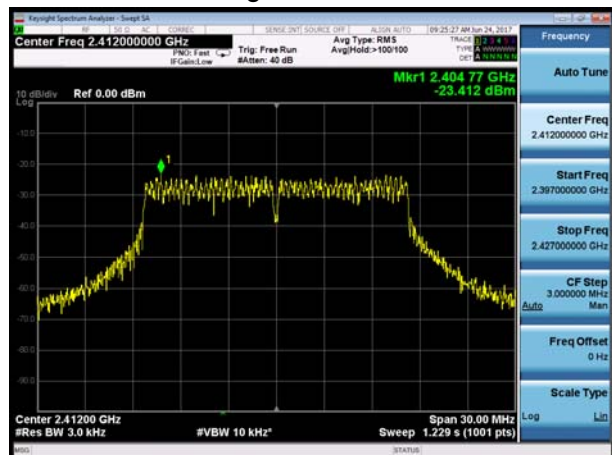


SISO Antenna 2

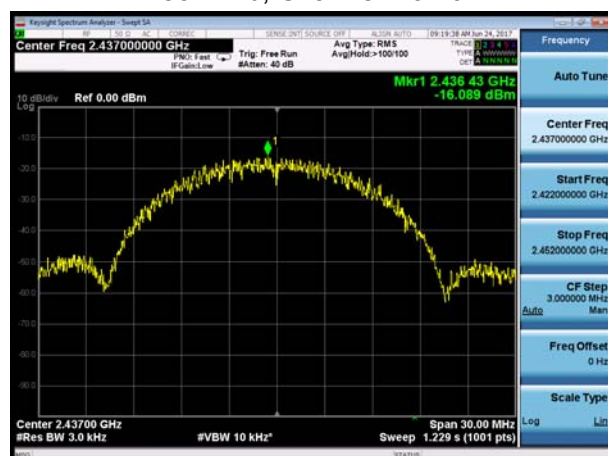
802.11b, Channel No.: 1



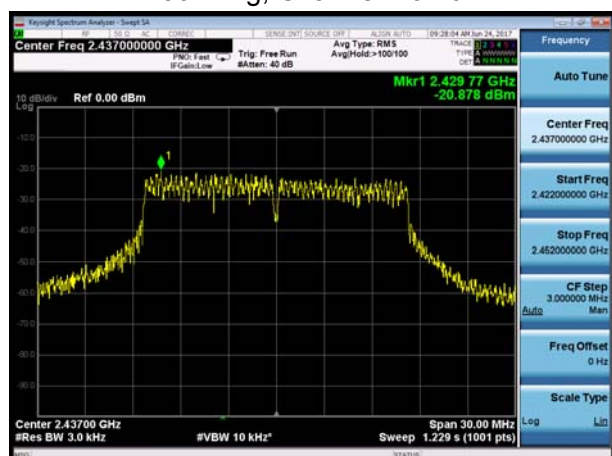
802.11g, Channel No.: 1



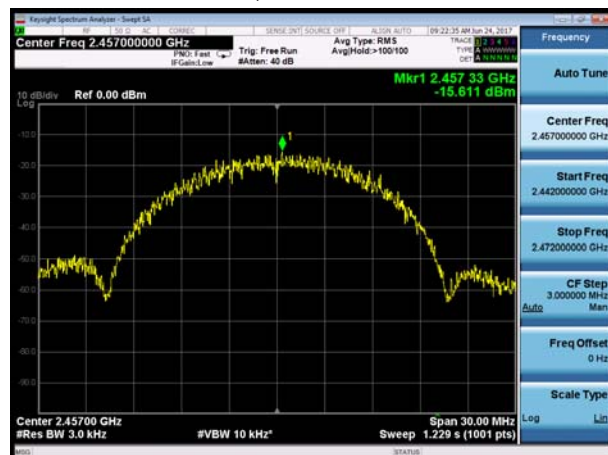
802.11b, Channel No.: 6



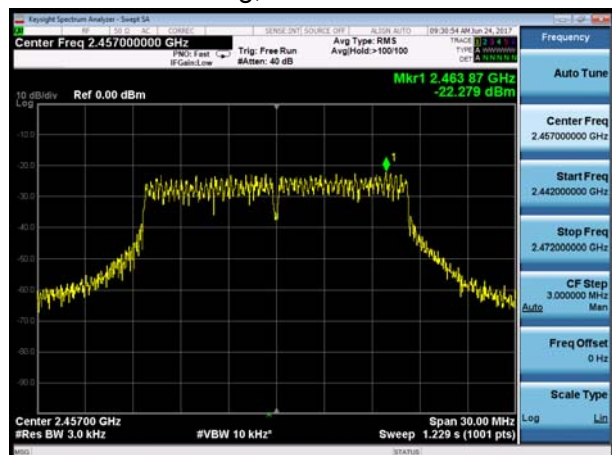
802.11g, Channel No.: 6



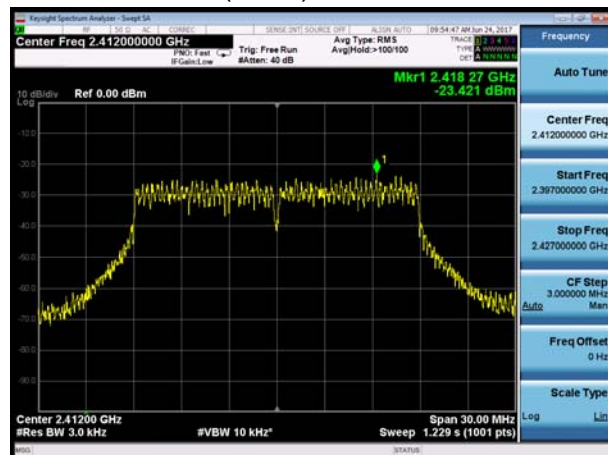
802.11b, Channel No.: 10



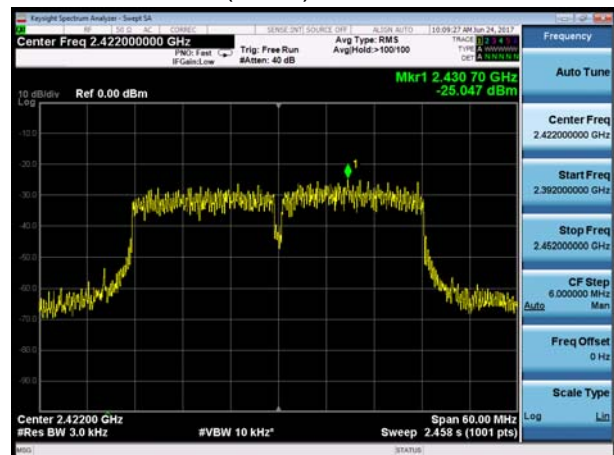
802.11g, Channel No.: 10



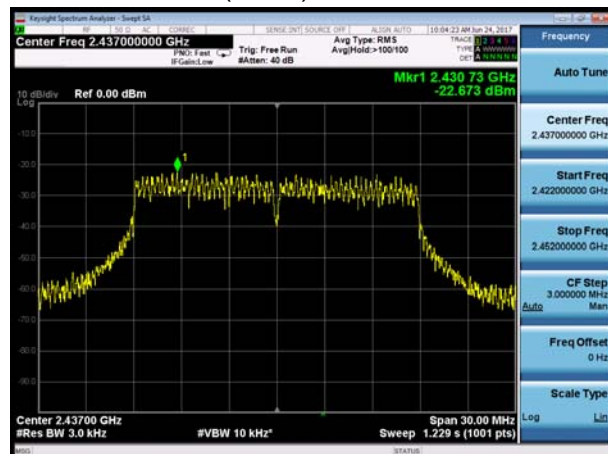
802.11n(HT20), Channel No. 1



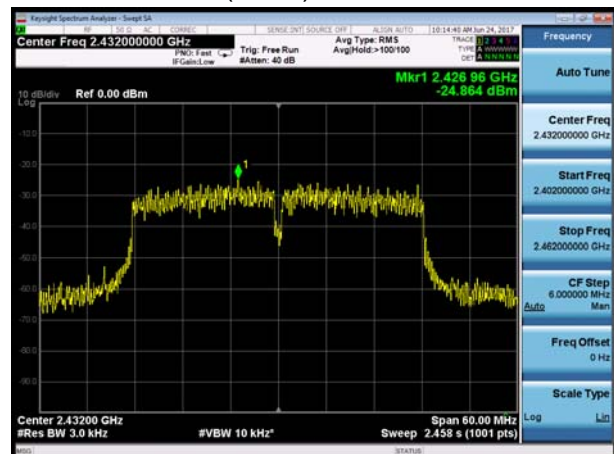
802.11n(HT40), Channel No. 3



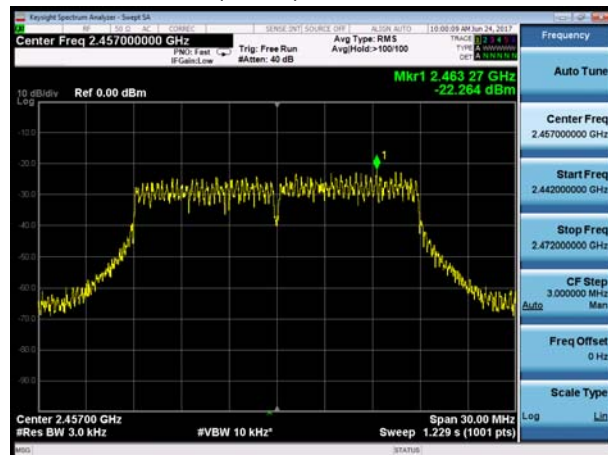
802.11n(HT20), Channel No. 6



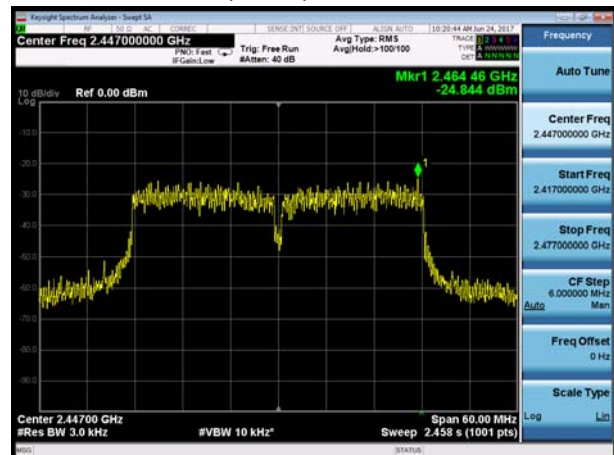
802.11n(HT40), Channel No. 5



802.11n(HT20), Channel No. 10



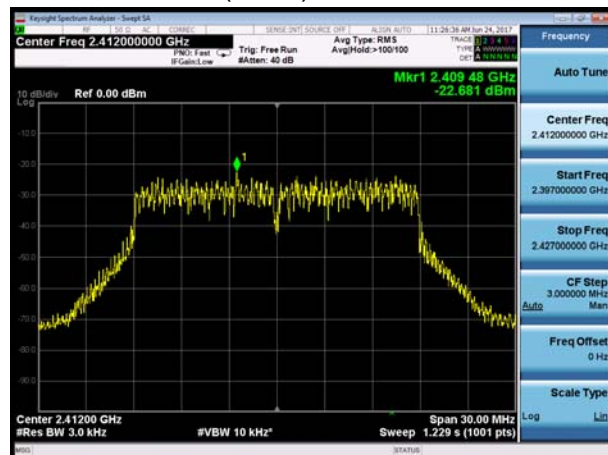
802.11n(HT40), Channel No. 8



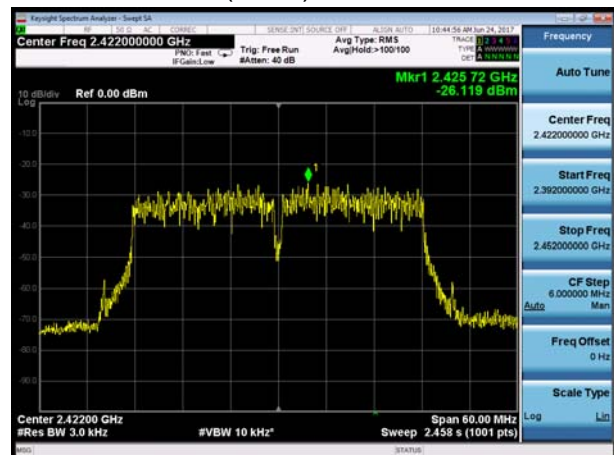


MIMO Antenna 1

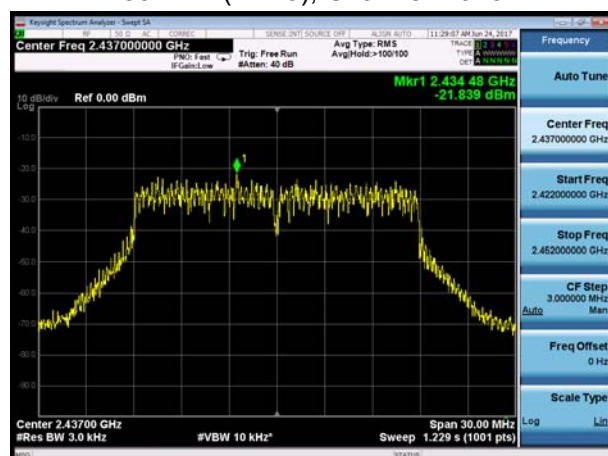
802.11n(HT20), Channel No. 1



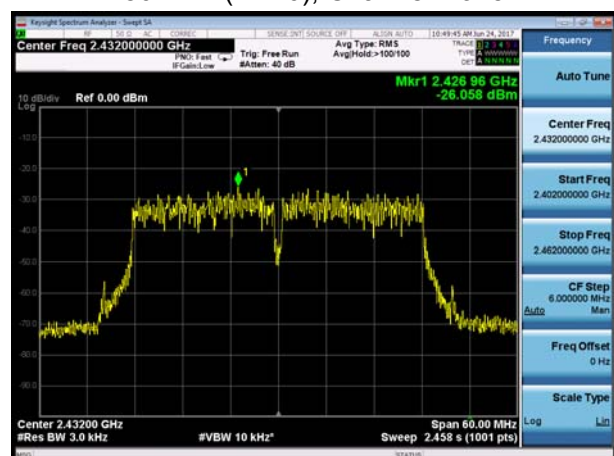
802.11n(HT40), Channel No. 3



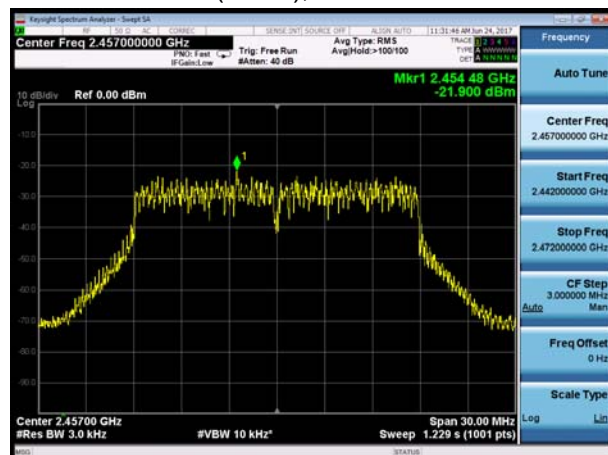
802.11n(HT20), Channel No. 6



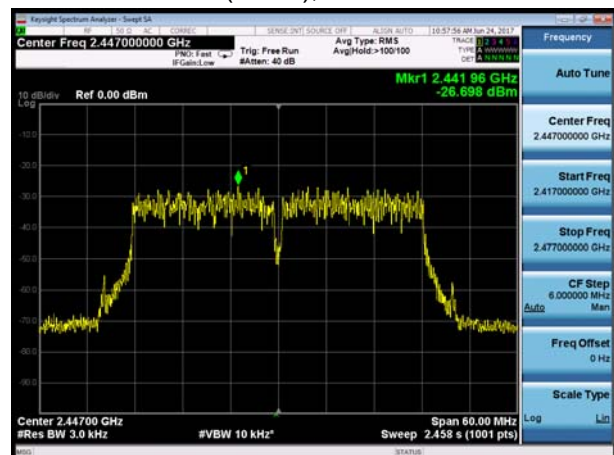
802.11n(HT40), Channel No. 5



802.11n(HT20), Channel No. 10



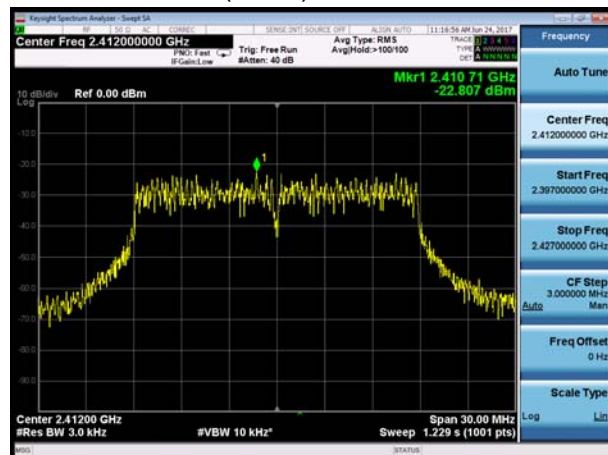
802.11n(HT40), Channel No. 8



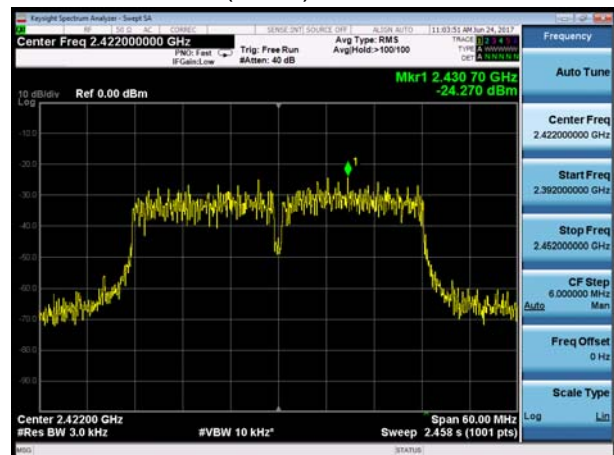


MIMO Antenna 2

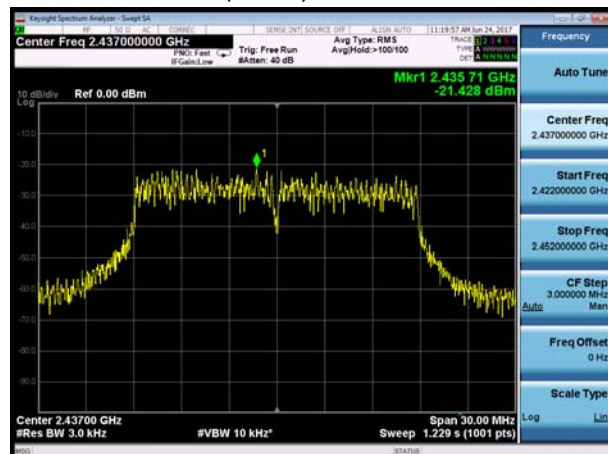
802.11n(HT20), Channel No. 1



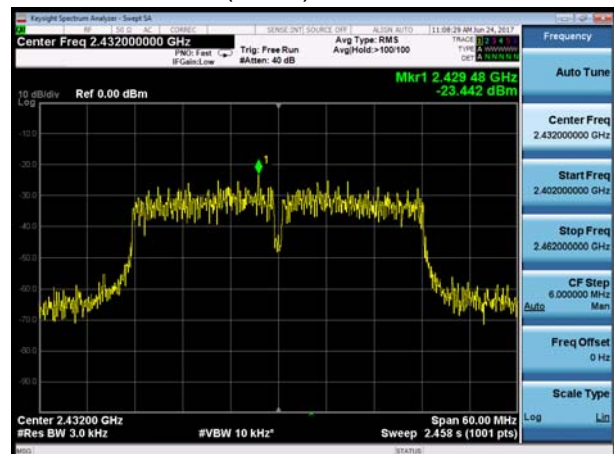
802.11n(HT40), Channel No. 3



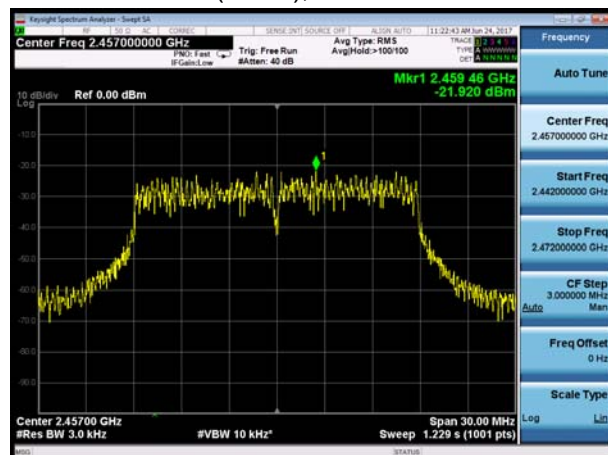
802.11n(HT20), Channel No. 6



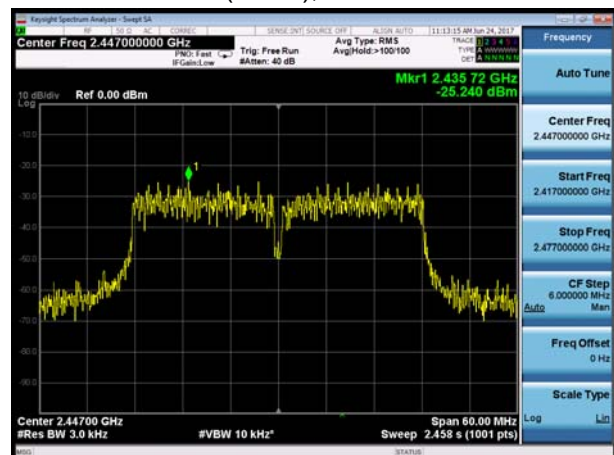
802.11n(HT40), Channel No. 5



802.11n(HT20), Channel No. 10



802.11n(HT40), Channel No. 8



5.5. Spurious RF Conducted Emissions

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer with a known loss. The spectrum analyzer scans from 30MHz to the 10th harmonic of the carrier. The peak detector is used. RBW and VBW are set to 100 kHz, Sweep is set to ATUO.

The test is in transmitting mode.

Test setup



Limits

Rule Part 15.247(d) pacifies that “In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.”

Antenna 1

Network Standards	Carrier frequency (MHz)	Reference value (dBm)	Limit
802.11b	2412	1.21	-18.79
	2437	0.50	-19.50
	2457	0.35	-19.65
802.11g	2412	-2.47	-22.47
	2437	-2.72	-22.72
	2457	-2.51	-22.51
802.11n HT20	2412	-4.91	-24.91
	2437	-4.99	-24.99
	2457	-4.30	-24.30
802.11n HT40	2422	-7.55	-27.55
	2432	-7.67	-27.67
	2447	-7.91	-27.91

Antenna 2

Network Standards	Carrier frequency (MHz)	Reference value (dBm)	Limit
802.11b	2412	1.22	-18.78
	2437	3.39	-16.61
	2457	0.73	-19.27
802.11g	2412	-2.77	-22.77
	2437	-1.85	-21.85
	2457	-2.36	-22.36
802.11n HT20	2412	-5.26	-25.26
	2437	-5.20	-25.20
	2457	-5.79	-25.79
802.11n HT40	2422	-6.60	-26.60
	2432	-7.01	-27.01
	2447	-7.24	-27.24

MIMO

Network Standards	Carrier frequency (MHz)	Reference value (dBm)	Limit
802.11n HT20	2412	-8.42	-28.42
	2437	-6.03	-26.03
	2457	-5.76	-25.76
802.11n HT40	2422	-8.52	-28.52
	2432	-9.04	-29.04
	2447	-9.69	-29.69

Measurement Uncertainty

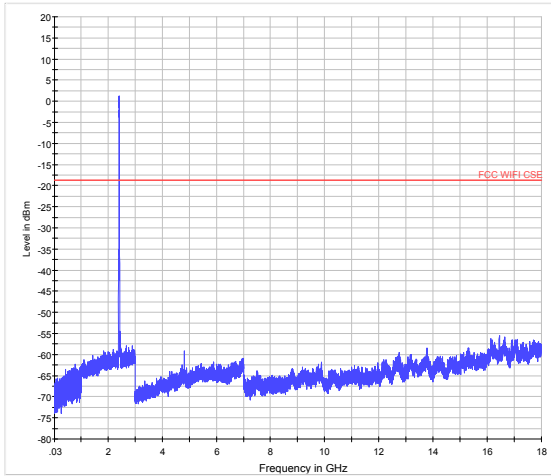
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-26GHz	1.407 dB

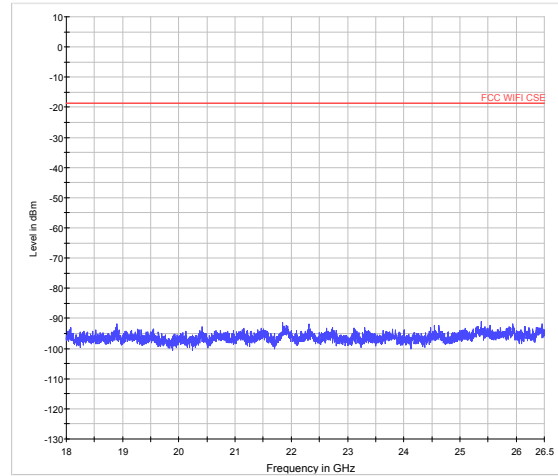
Test Results:

If disturbances were found more than 20dB below limit line, the mark is not required for the EUT.
The signal beyond the limit is carrier.

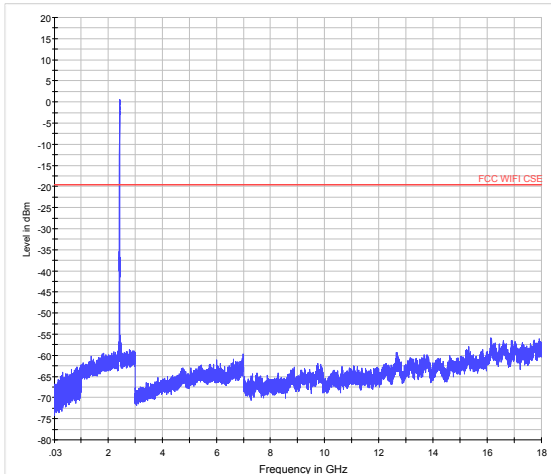
Antenna 1



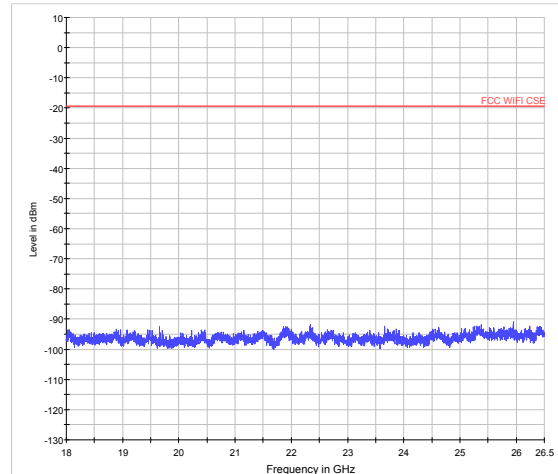
802.11b CH1 30MHz to 18GHz



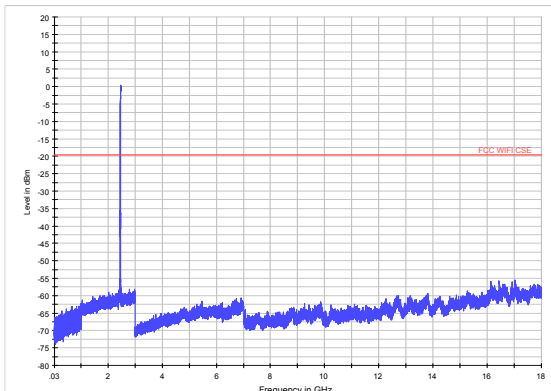
802.11b CH1 18GHz to 26.5GHz



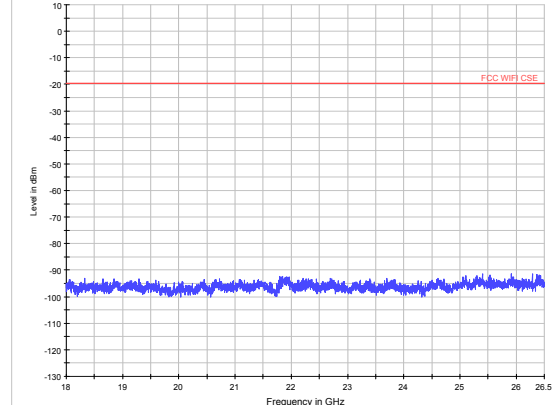
802.11b CH6 30MHz to 18GHz



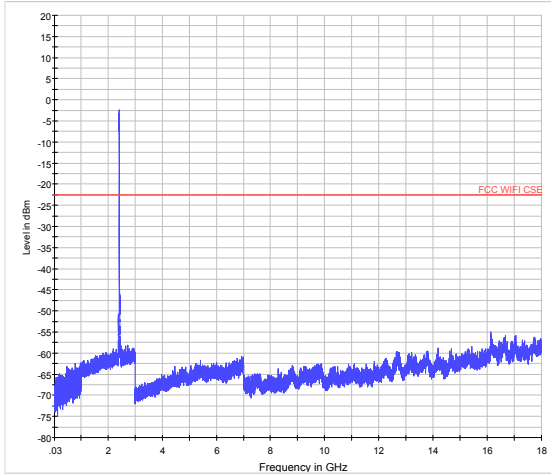
802.11b CH6 18GHz to 26.5GHz



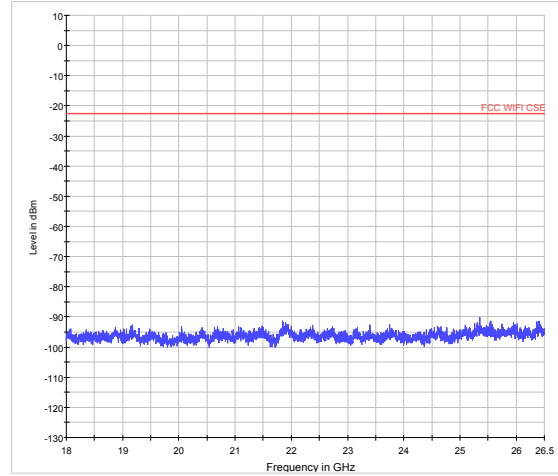
802.11b CH10 30MHz to 18GHz



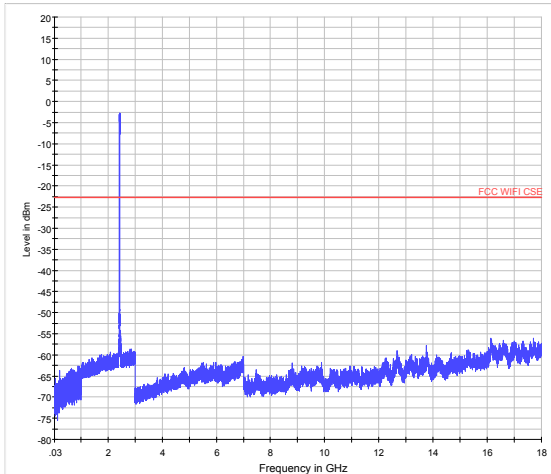
802.11b CH10 18GHz to 26.5GHz



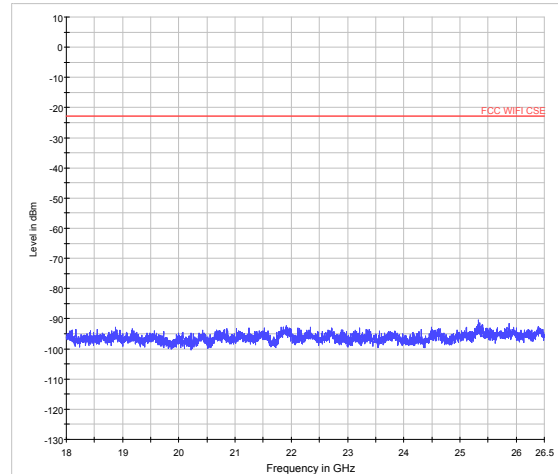
802.11g CH1 30MHz to 18GHz



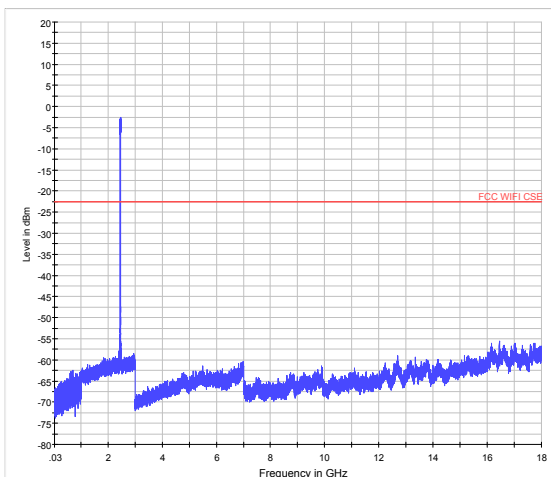
802.11g CH1 18GHz to 26.5GHz



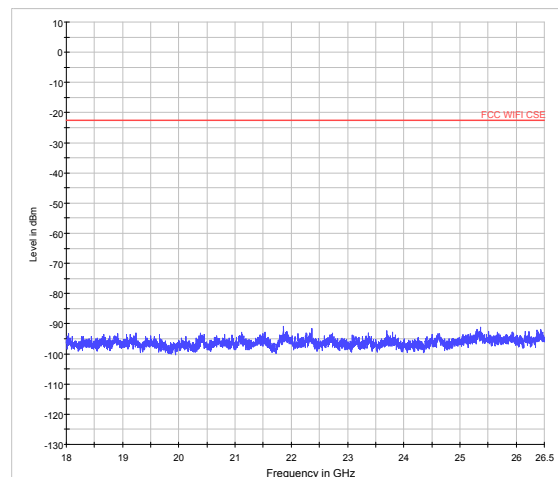
802.11g CH6 30MHz to 18GHz



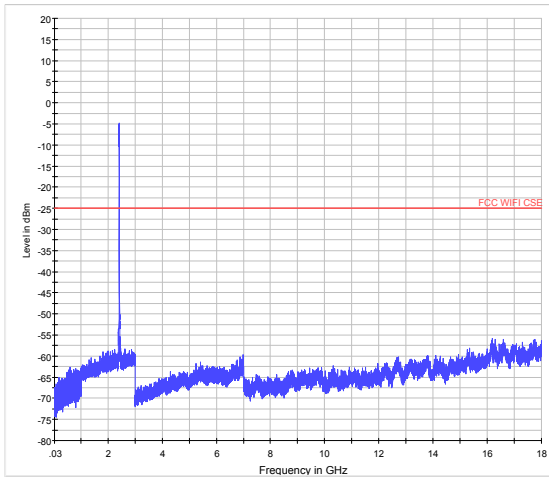
802.11g CH6 18GHz to 26.5GHz



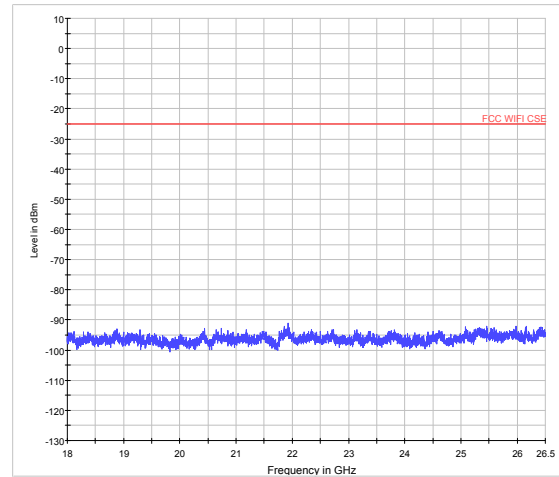
802.11g CH10 30MHz to 18GHz



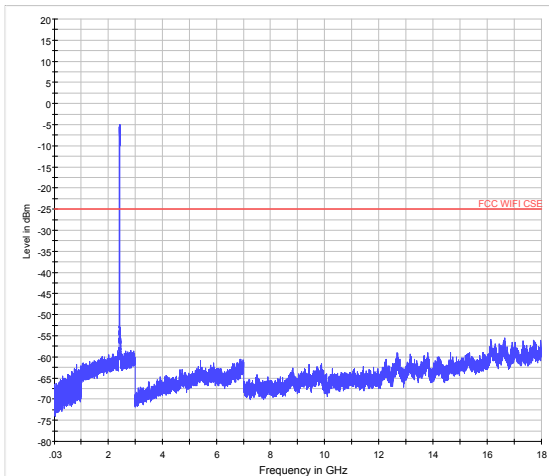
802.11g CH10 18GHz to 26.5GHz



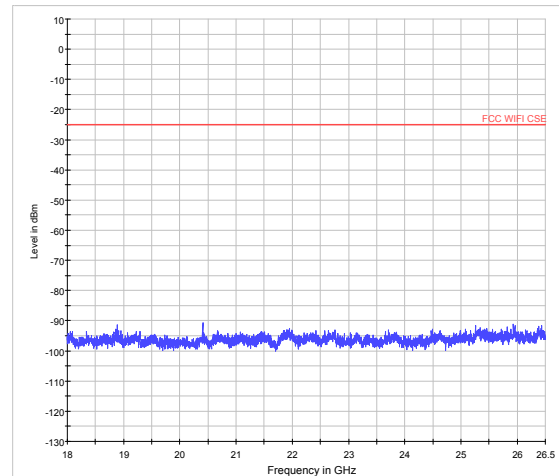
802.11n (HT20) CH1 30MHz to 18GHz



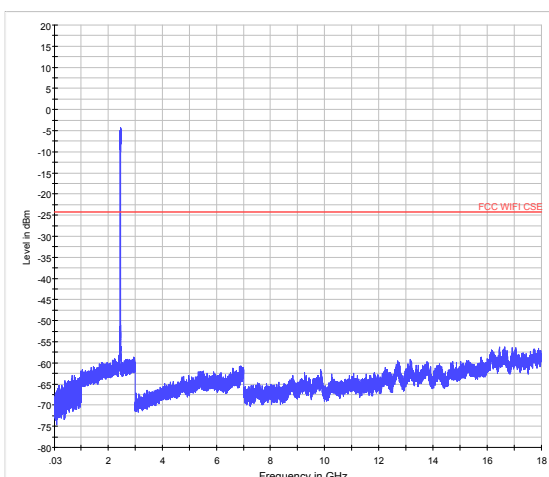
802.11n (HT20) CH1 18GHz to 26.5GHz



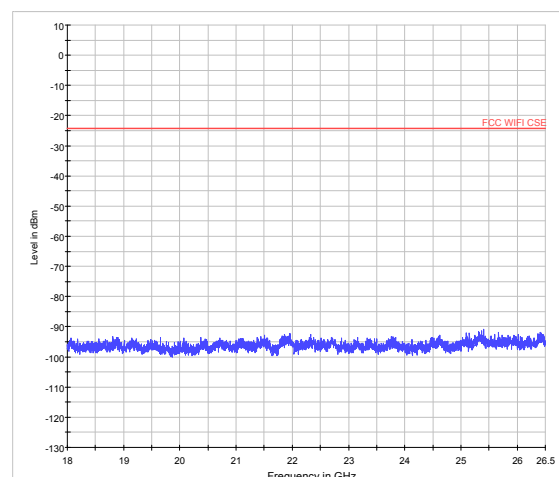
802.11n (HT20) CH6 30MHz to 18GHz



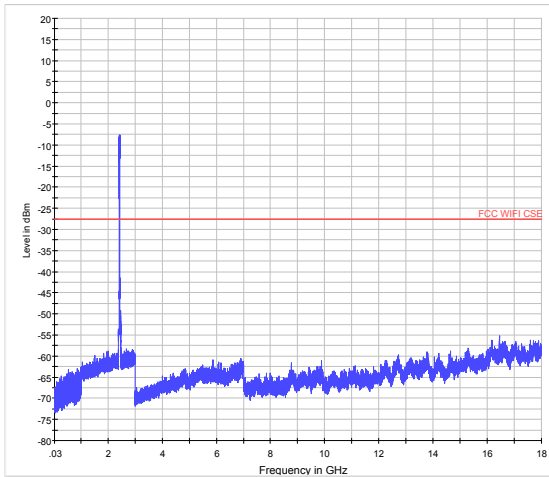
802.11n (HT20) CH6 18GHz to 26.5GHz



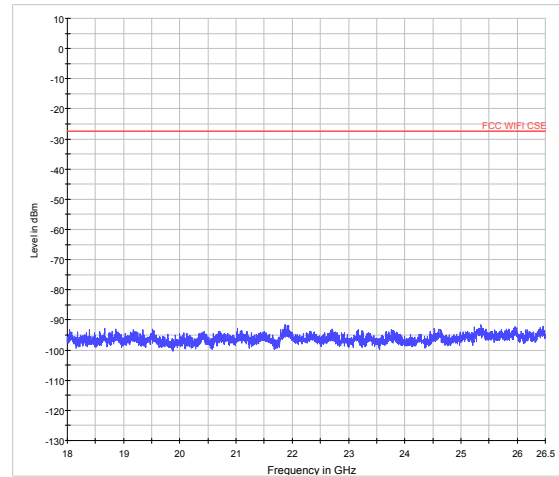
802.11n (HT20) CH10 30MHz to 18GHz



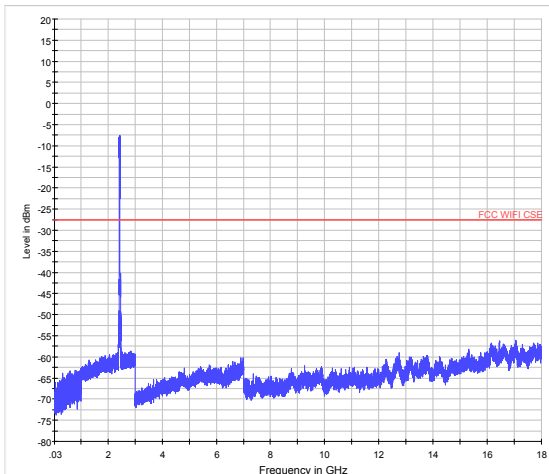
802.11n (HT20) CH10 18GHz to 26.5GHz



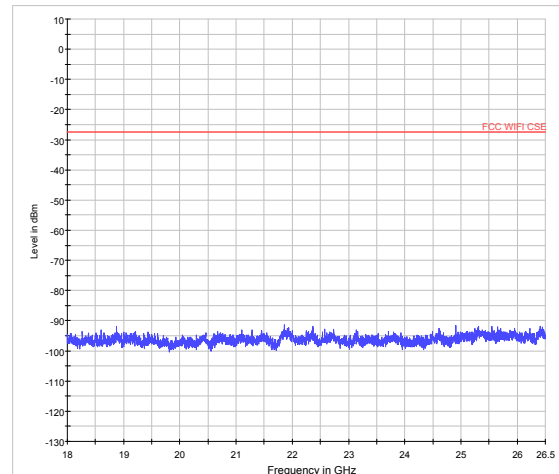
802.11n (HT40) CH3 30MHz to 18GHz



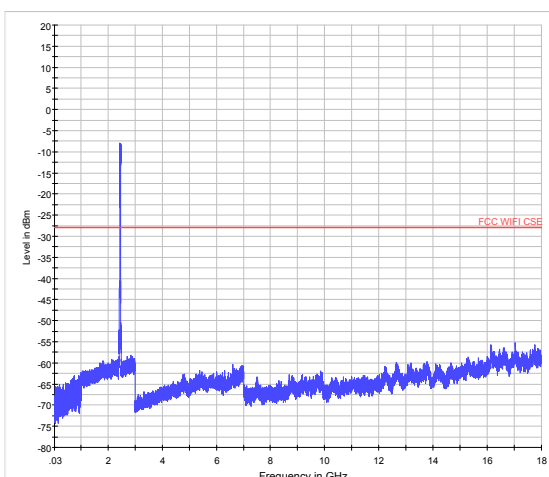
802.11n (HT40) CH3 18GHz to 26.5GHz



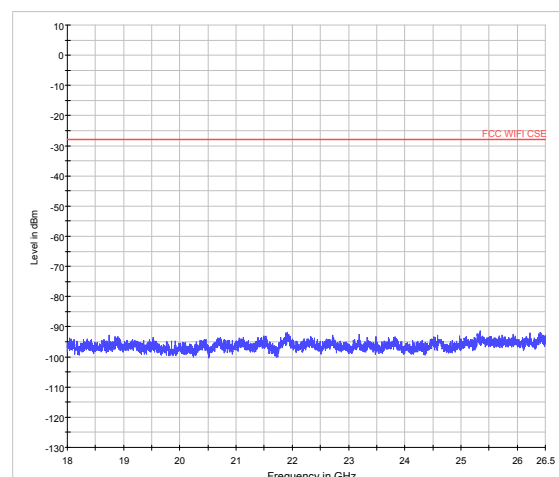
802.11n (HT40) CH5 30MHz to 18GHz



802.11n (HT40) CH5 18GHz to 26.5GHz



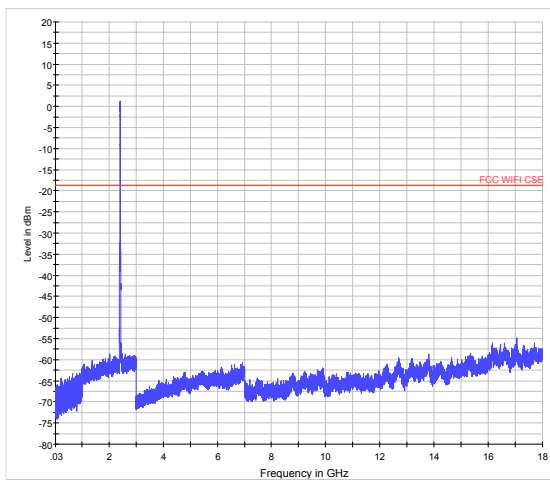
802.11n (HT40) CH8 30MHz to 18GHz



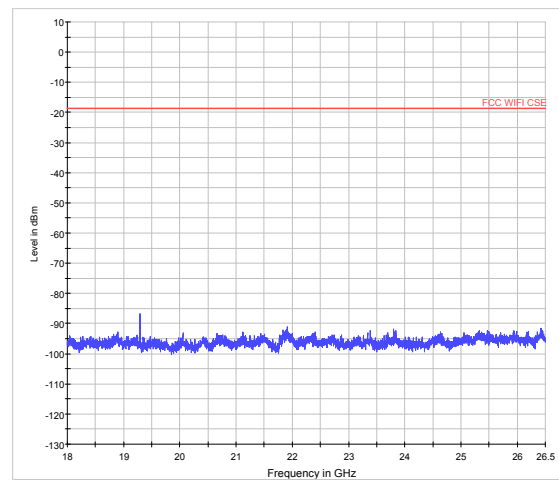
802.11n (HT40) CH8 18GHz to 26.5GHz



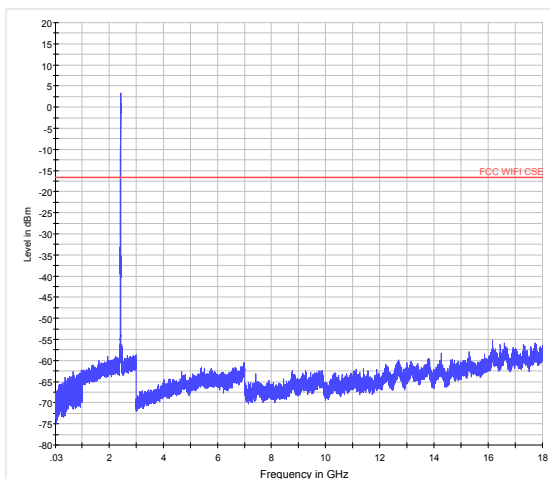
Antenna 2



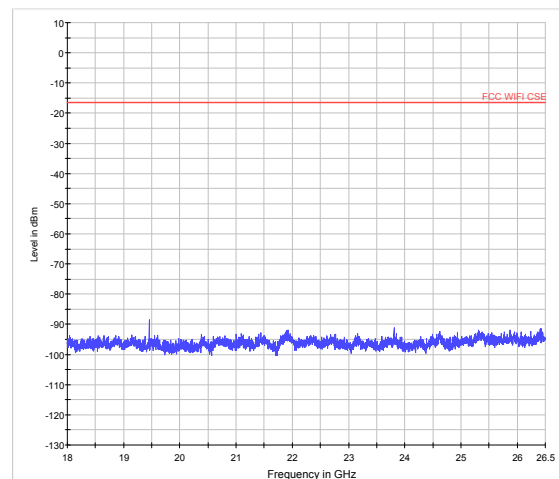
802.11b CH1 30MHz to 18GHz



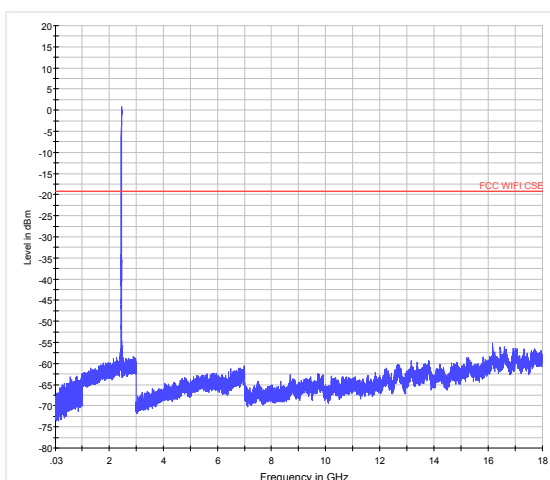
802.11b CH1 18GHz to 26.5GHz



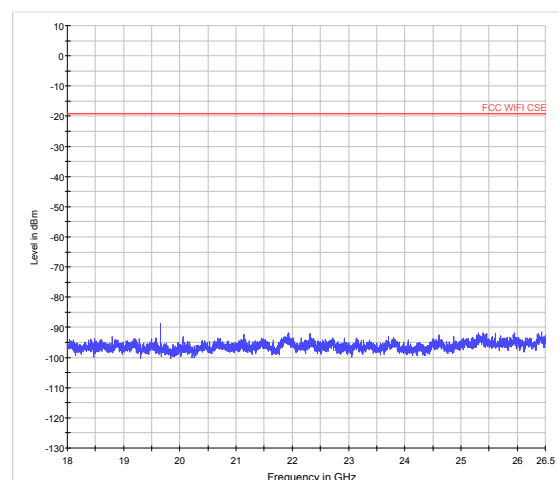
802.11b CH6 30MHz to 18GHz



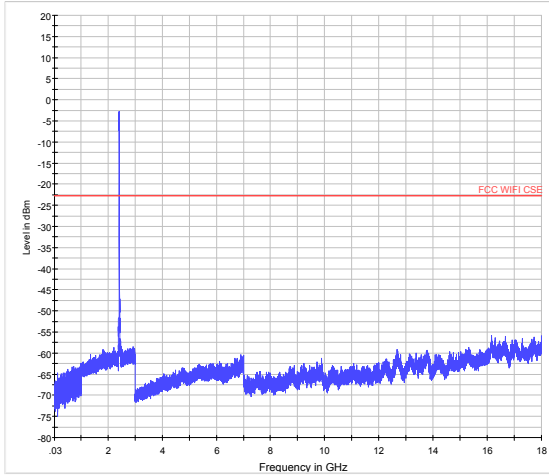
802.11b CH6 18GHz to 26.5GHz



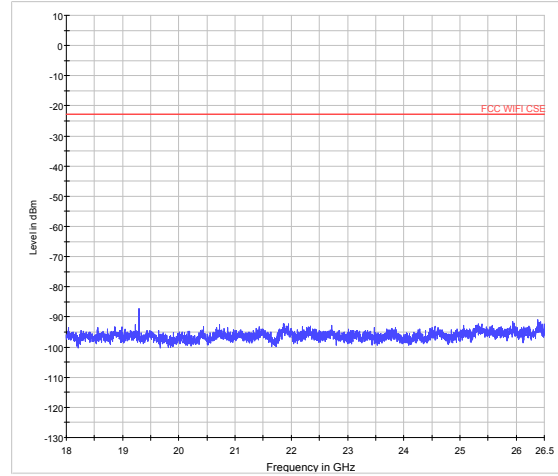
802.11b CH10 30MHz to 18GHz



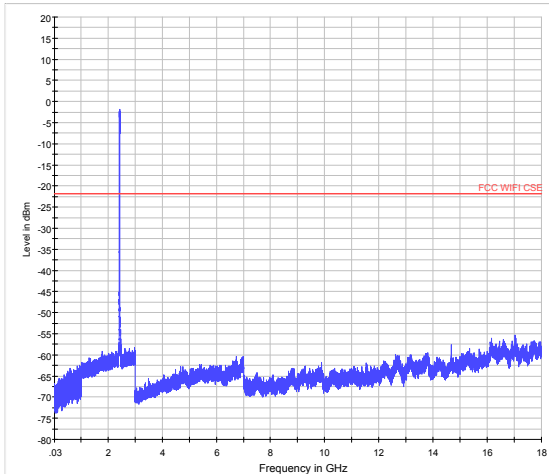
802.11b CH10 18GHz to 26.5GHz



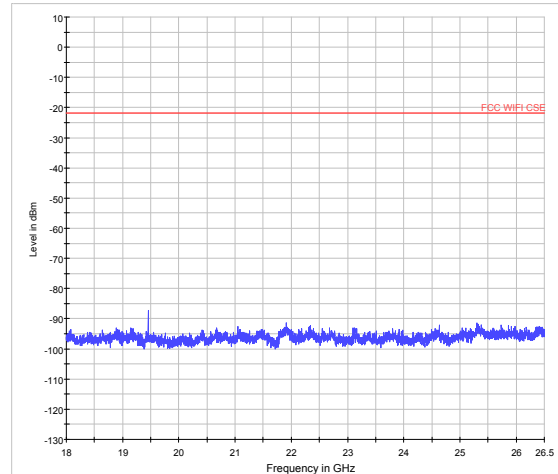
802.11g CH1 30MHz to 18GHz



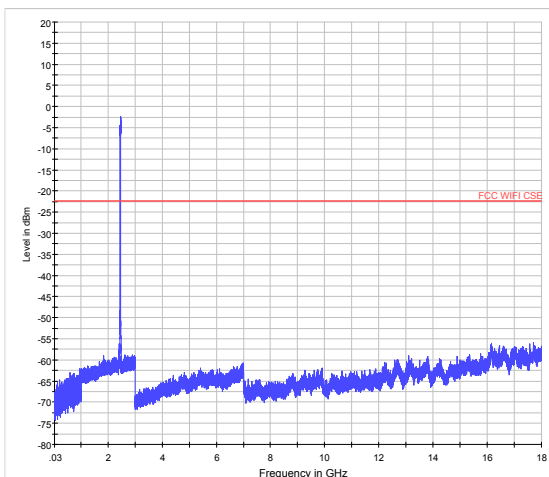
802.11g CH1 18GHz to 26.5GHz



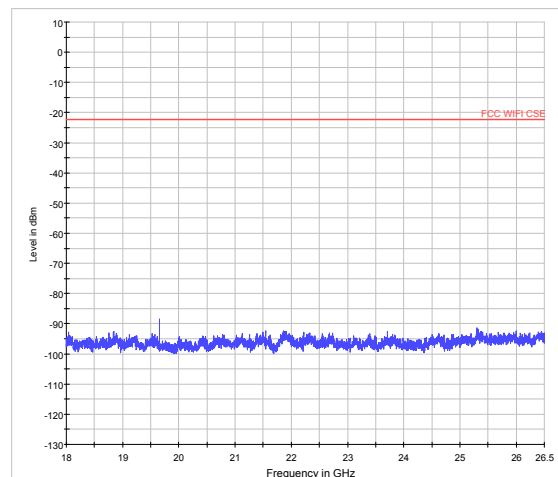
802.11g CH6 30MHz to 18GHz



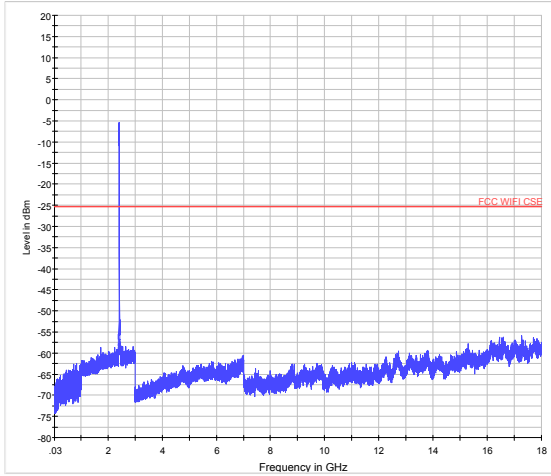
802.11g CH6 18GHz to 26.5GHz



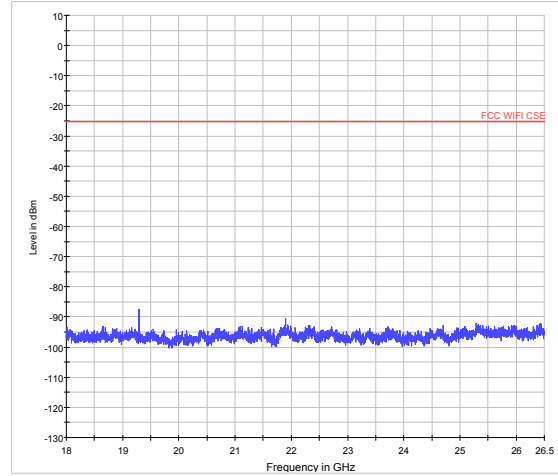
802.11g CH10 30MHz to 18GHz



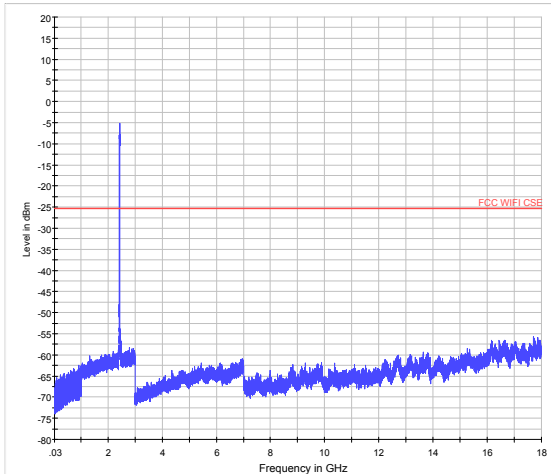
802.11g CH10 18GHz to 26.5GHz



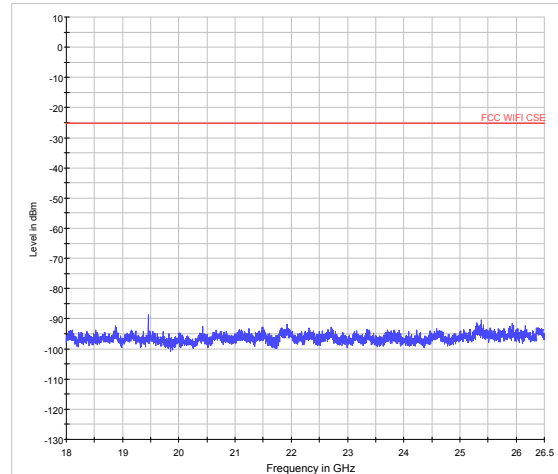
802.11n (HT20) CH1 30MHz to 18GHz



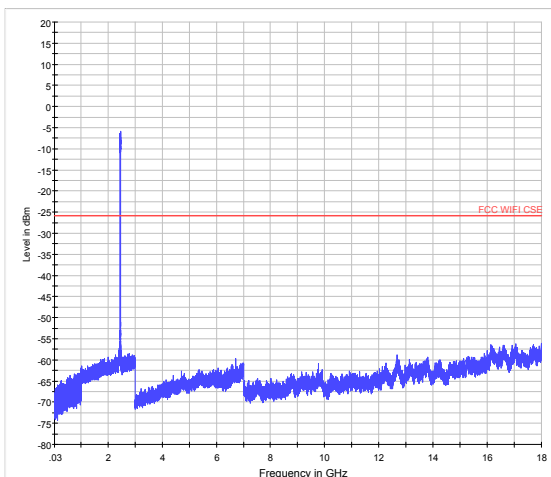
802.11n (HT20) CH1 18GHz to 26.5GHz



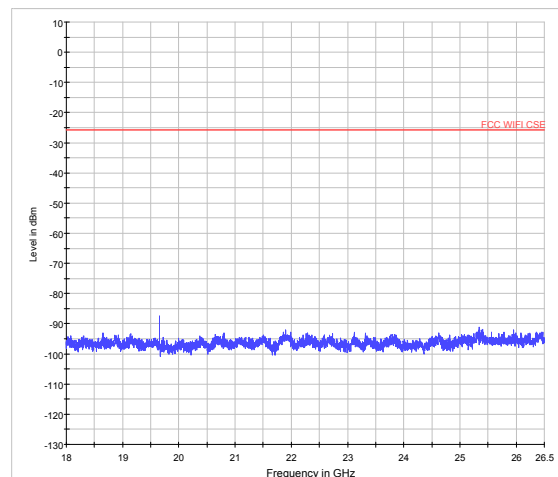
802.11n (HT20) CH6 30MHz to 18GHz



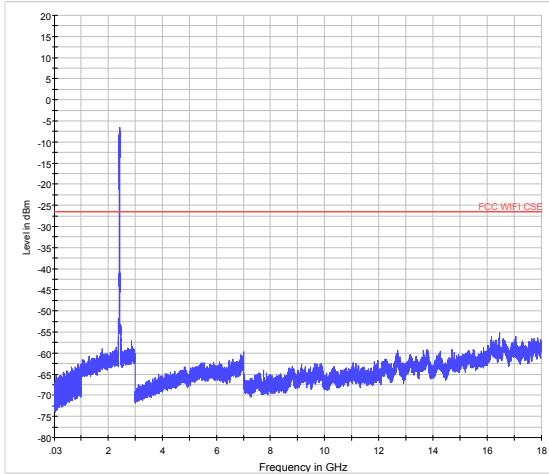
802.11n (HT20) CH6 18GHz to 26.5GHz



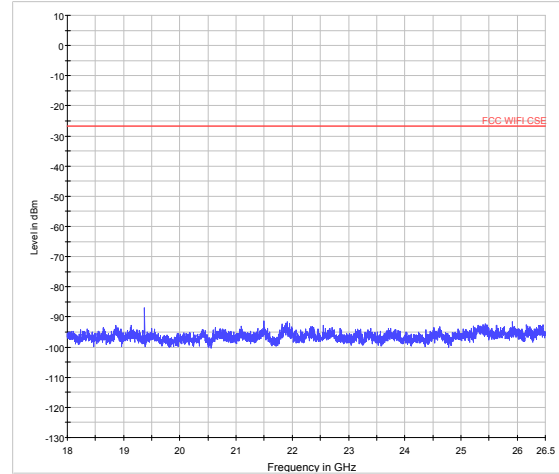
802.11n (HT20) CH10 30MHz to 18GHz



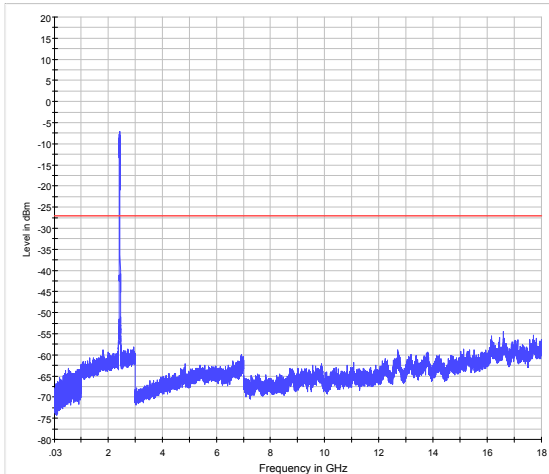
802.11n (HT20) CH10 18GHz to 26.5GHz



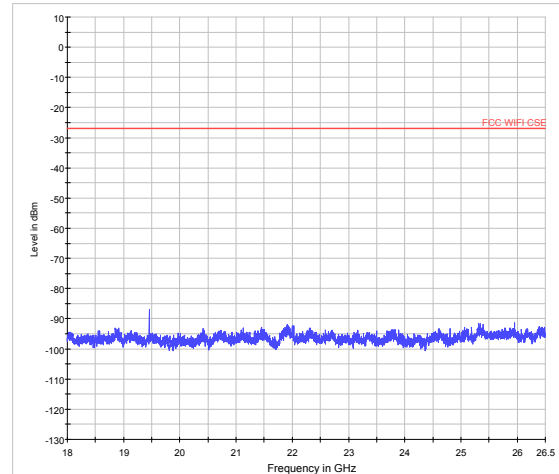
802.11n (HT40) CH3 30MHz to 18GHz



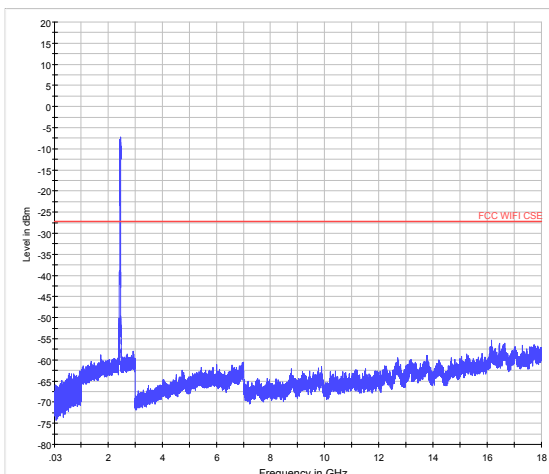
802.11n (HT40) CH3 18GHz to 26.5GHz



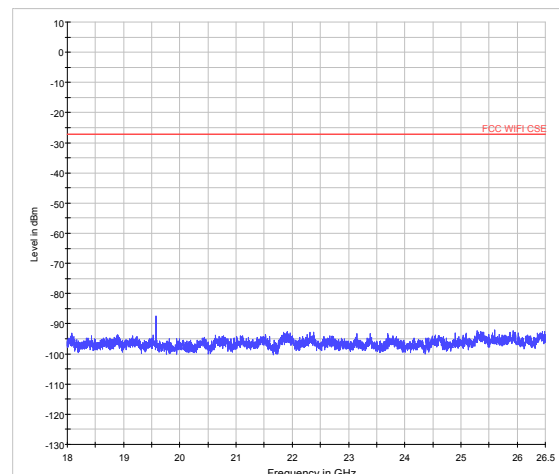
802.11n (HT40) CH5 30MHz to 18GHz



802.11n (HT40) CH5 18GHz to 26.5GHz



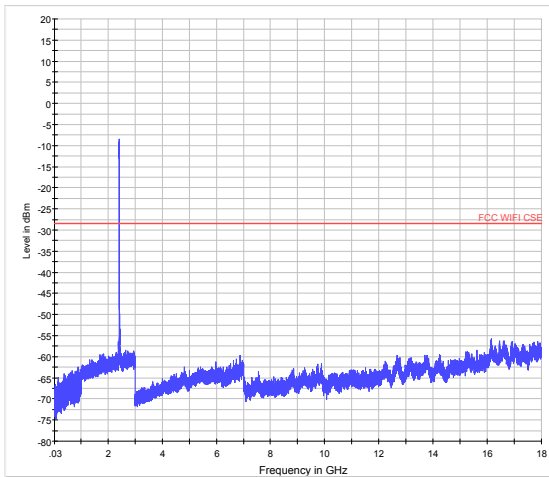
802.11n (HT40) CH8 30MHz to 18GHz



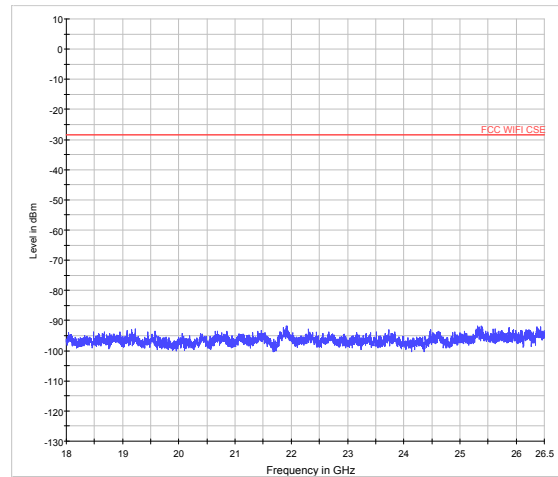
802.11n (HT40) CH8 18GHz to 26.5GHz



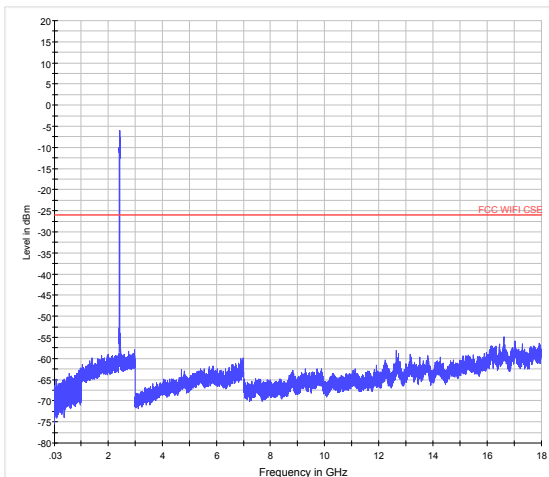
MIMO



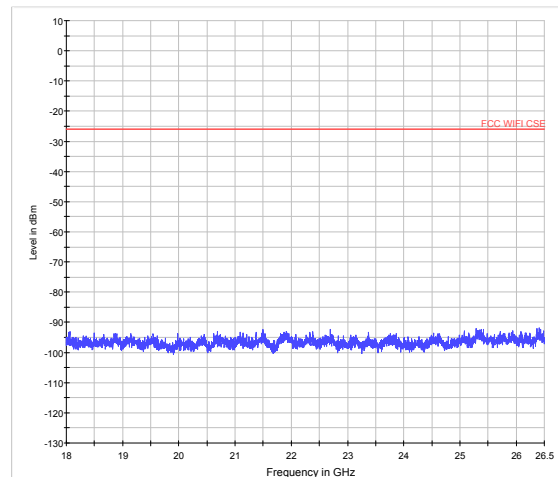
802.11n (HT20) CH1 30MHz to 18GHz



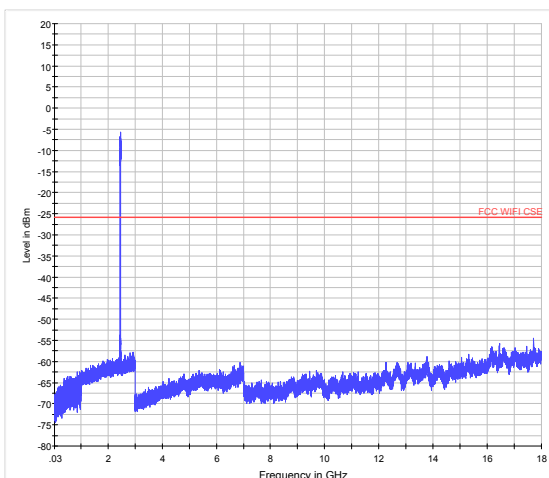
802.11n (HT20) CH1 18GHz to 26.5GHz



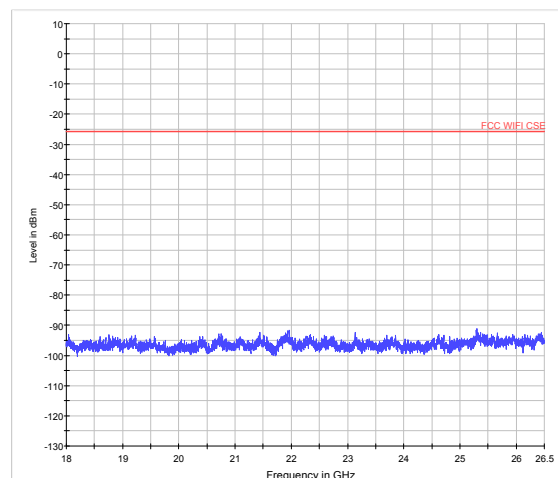
802.11n (HT20) CH6 30MHz to 18GHz



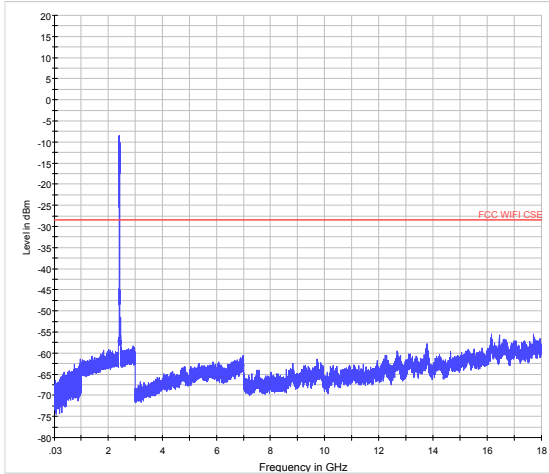
802.11n (HT20) CH6 18GHz to 26.5GHz



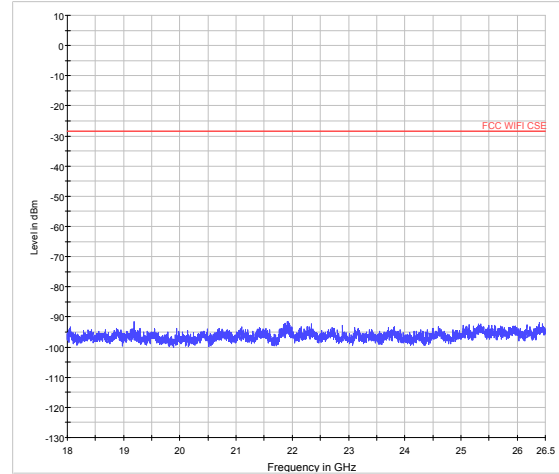
802.11n (HT20) CH10 30MHz to 18GHz



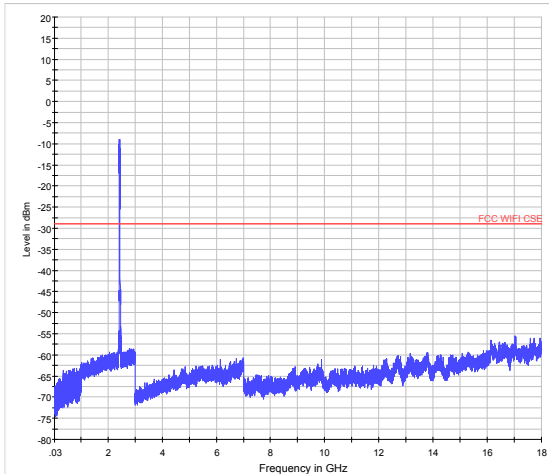
802.11n (HT20) CH10 18GHz to 26.5GHz



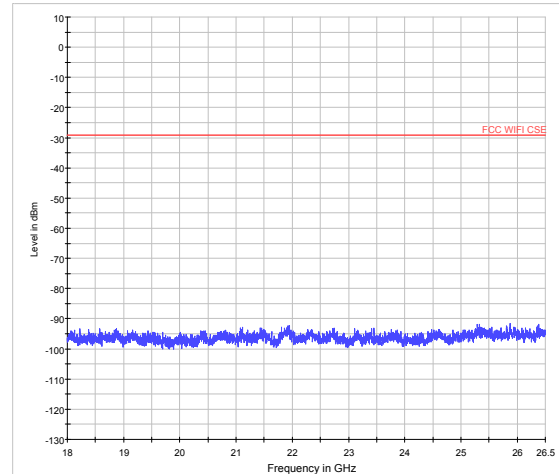
802.11n (HT40) CH3 30MHz to 18GHz



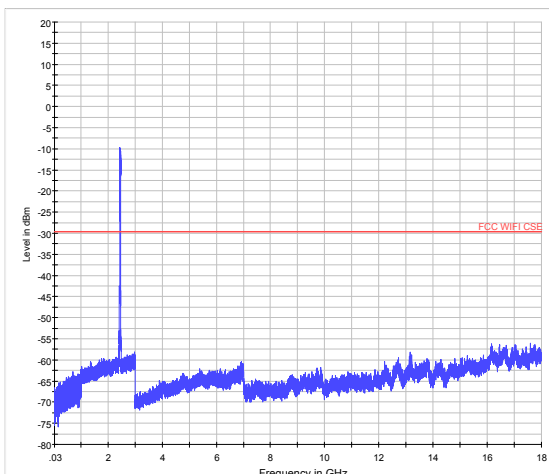
802.11n (HT40) CH3 18GHz to 26.5GHz



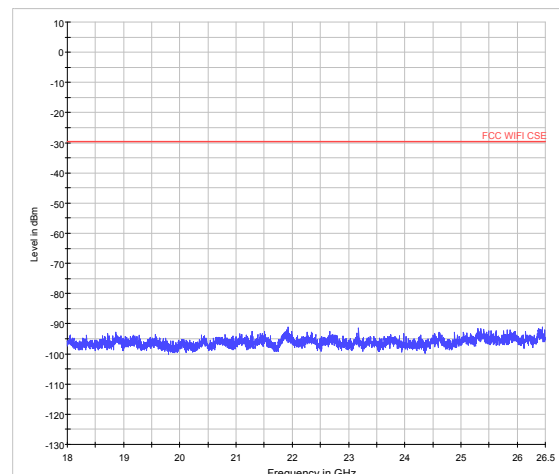
802.11n (HT40) CH5 30MHz to 18GHz



802.11n (HT40) CH5 18GHz to 26.5GHz



802.11n (HT40) CH8 30MHz to 18GHz



802.11n (HT40) CH8 18GHz to 26.5GHz

5.6. Radiated Emissions in the Restricted Band

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna. The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna. RBW is set to 100kHz. The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing. Sweep the whole frequency band through the range from 9kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

Set the spectrum analyzer in the following:

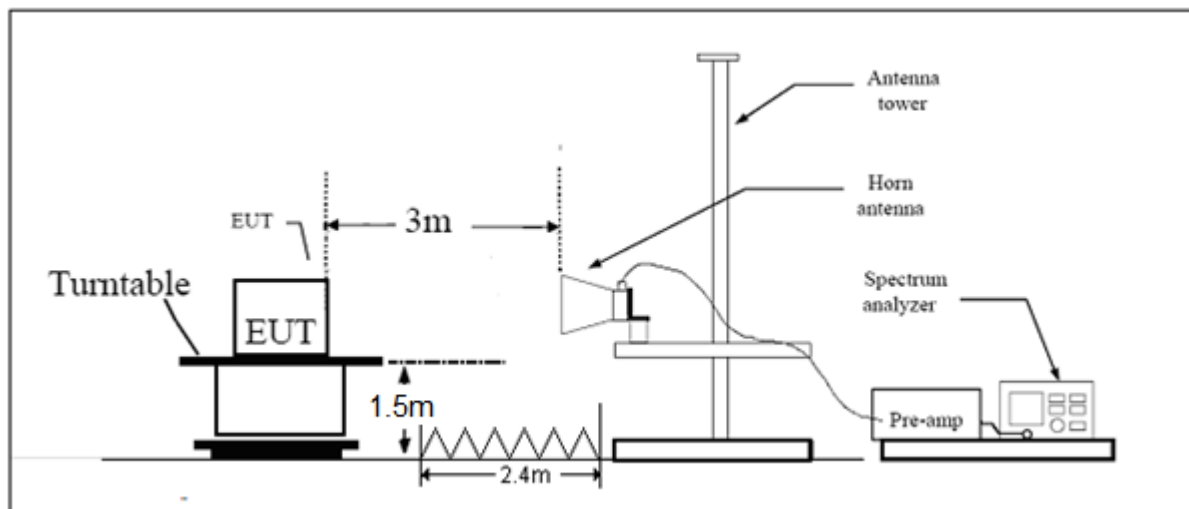
- (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
- (b) AVERAGE: RBW=1MHz / VBW=1MHz / Sweep=AUTO

This setting method can refer to **KDB 558074**.

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Y axis) and the antenna is vertical.

The test is in transmitting mode.

Test setup



Note: Area side: 2.4mX3.6m

Limits

Spurious Radiated Emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 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	(²)
13.36 - 13.41			

Limit in restricted band

Frequency of emission (MHz)	Field strength(uV/m)	Field strength(dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above960	500	54

§15.35(b)

There is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

Peak Limit=74 dBuV/m

Average Limit=54 dBuV/m

Measurement Uncertainty

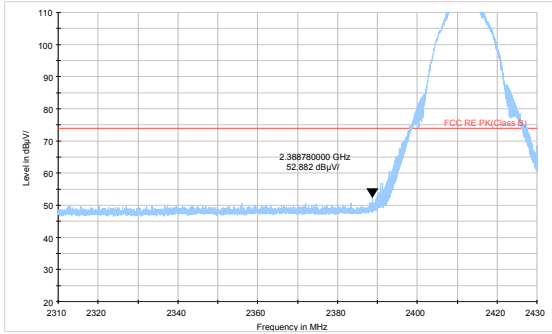
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U = 3.55$ dB.

Test Results:

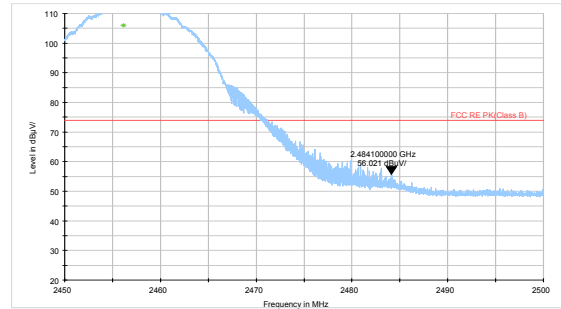
SISO Antenna 2

The signal beyond the limit is carrier.

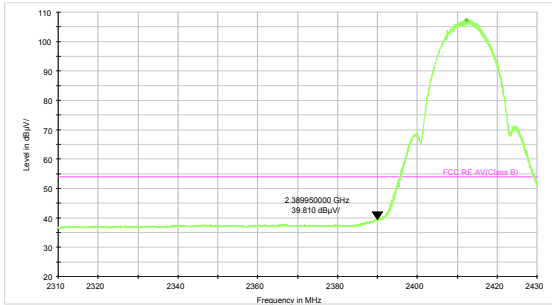
802.11b-Channel 1: Peak



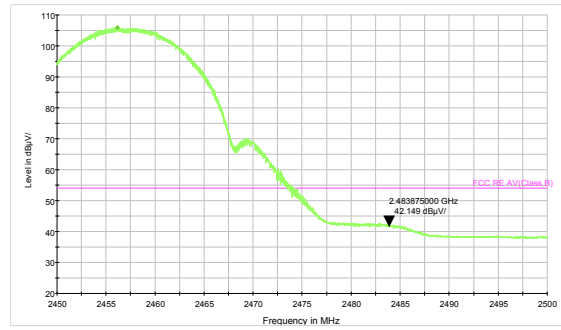
802.11b-Channel 10: Peak



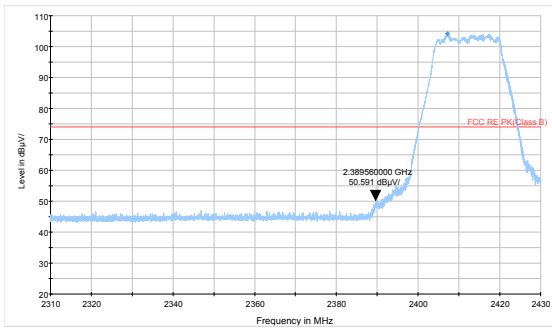
802.11b-Channel 1: Average



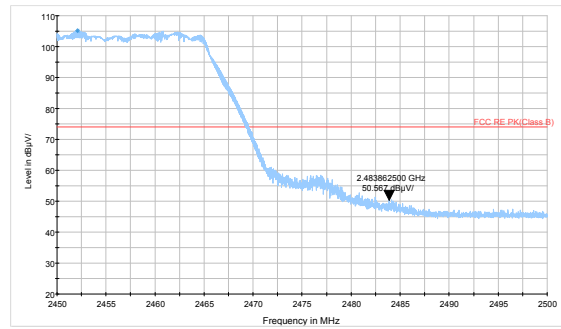
802.11b-Channel 10: Average



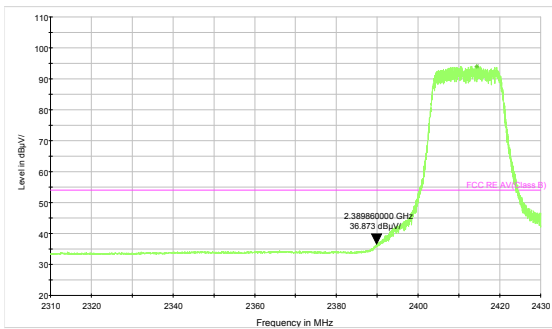
802.11g-Channel 1: Peak



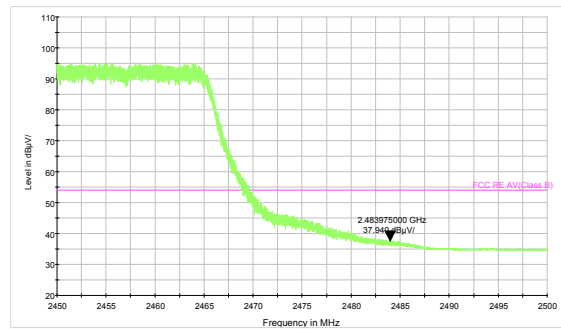
802.11g-Channel 10: Peak



802.11g-Channel 1: Average

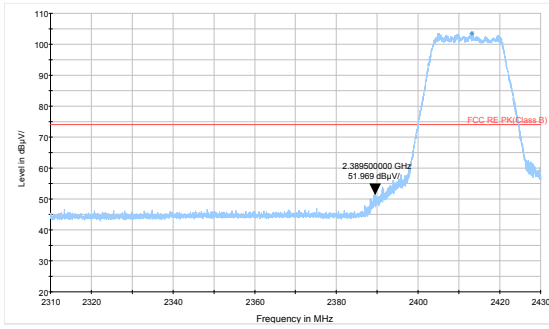


802.11g-Channel 10: Average

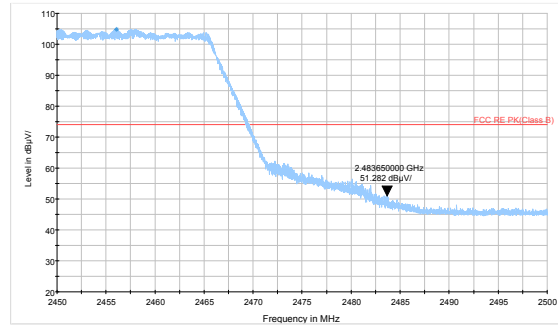


MIMO

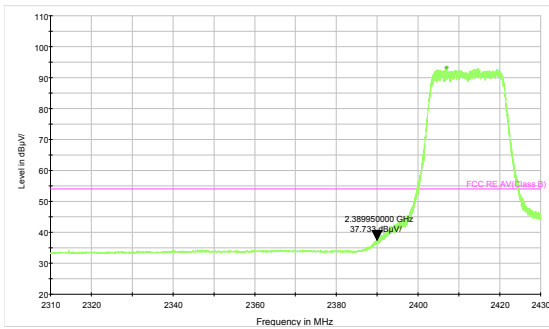
802.11n HT20 -Channel 1: Peak



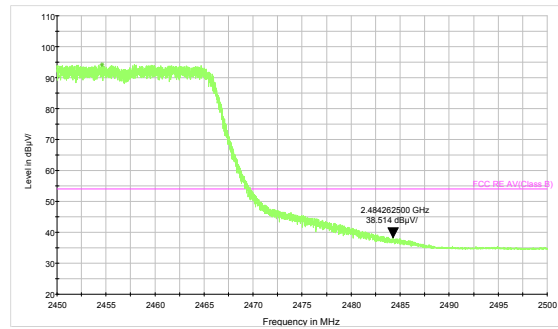
802.11n HT20-Channel 10: Peak



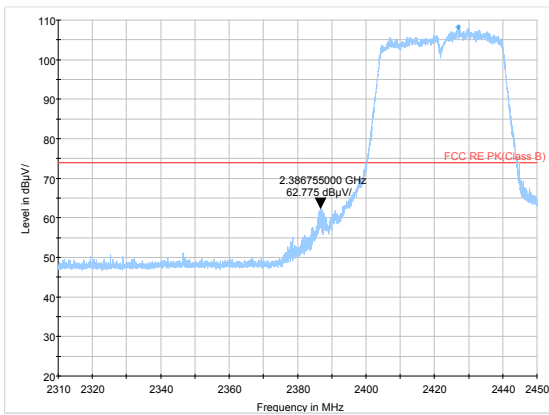
802.11n HT20-Channel 1: Average



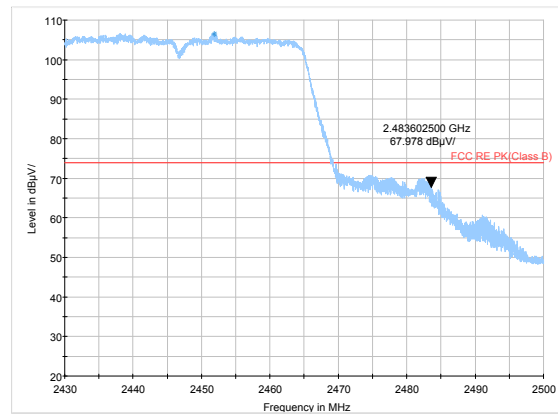
802.11n HT20-Channel 10: Average



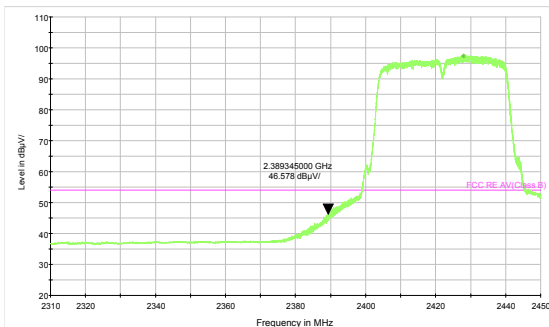
802.11n HT40 -Channel 3: Peak



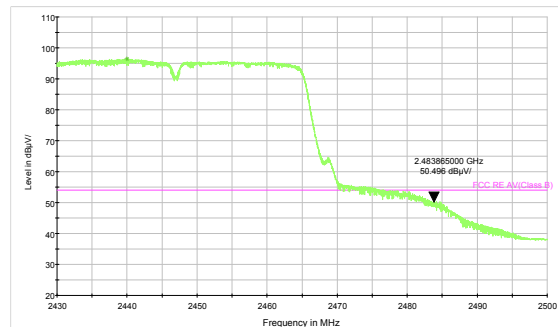
802.11n HT40-Channel 8: Peak



802.11n HT40-Channel 3: Average



802.11n HT40-Channel 8: Average



5.7. Radiates Emission

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	102.5kPa

Method of Measurement

The test set-up was made in accordance to the general provisions of ANSI C63.10-2013. The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna. The radiated emissions measurements were made in a typical installation configuration. Sweep the whole frequency band through the range from 9 kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

During the test, below 30MHz, the center of the loop shall be 1 meters; above 30MHz, the height of receive antenna shall be moved from 1 to 4 meters, and the antenna shall be performed under horizontal and vertical polarization. The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna. The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing.

Set the spectrum analyzer in the following:

Below 1GHz (detector: Peak and Quasi-Peak)

RBW=100 kHz / VBW=300 kHz / Sweep=AUTO

Above 1GHz (detector: Peak):

(a) PEAK: RBW=1MHz VBW=3MHz/ Sweep=AUTO

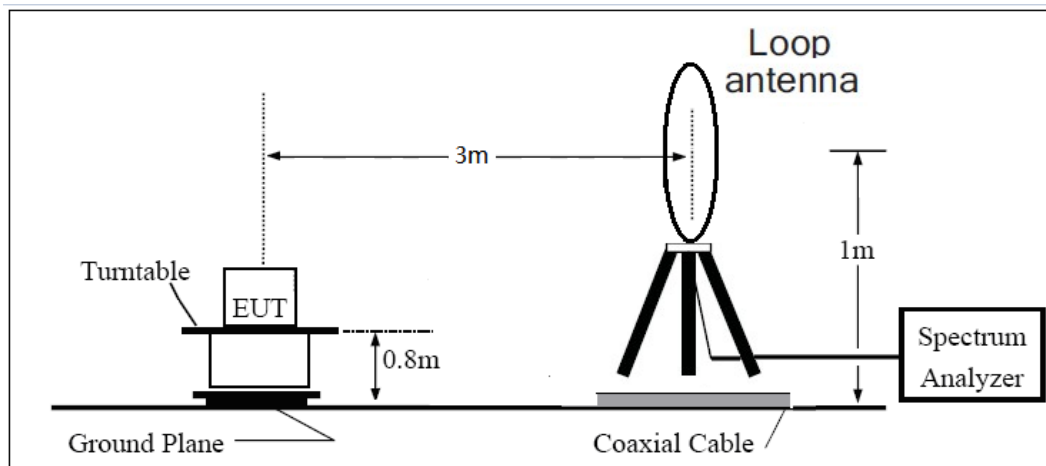
(b) AVERAGE: RBW=1MHz / VBW=3MHz / Sweep=AUTO

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the worst case was recorded.

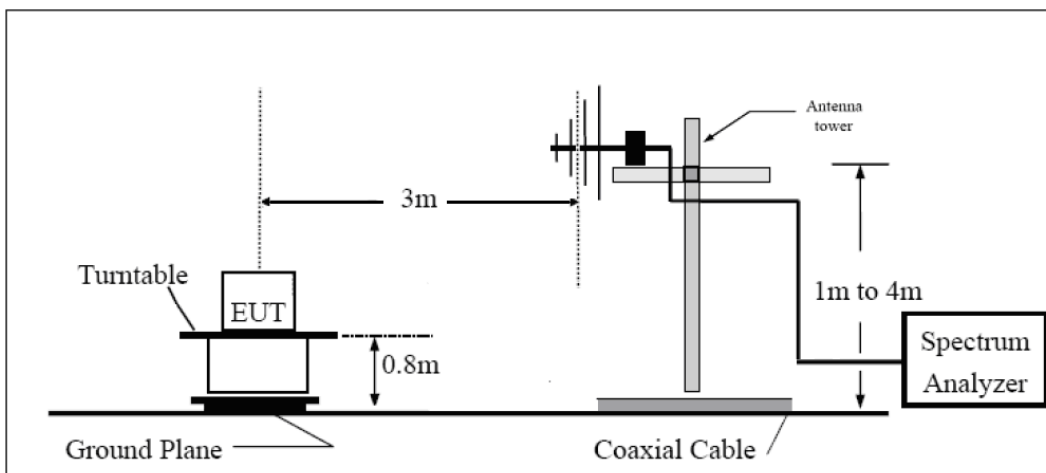
The test is in transmitting mode.

Test setup

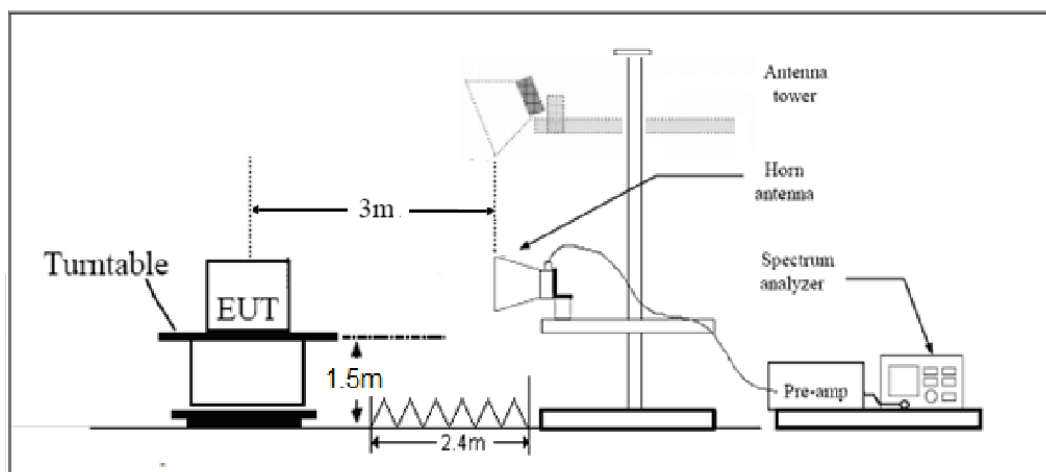
9KHz ~ 30MHz



30MHz ~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

Limits

Rule Part 15.247(d) specifies that “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)).”

Limit in restricted band

Frequency of emission (MHz)	Field strength(uV/m)	Field strength(dBuV/m)
0.009–0.490	2400/F(kHz)	/
0.490–1.705	24000/F(kHz)	/
1.705–30.0	30	/
30-88	100	40
88-216	150	43.5
216-960	200	46
Above960	500	54

§15.35(b)

There is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.19 dB
200MHz-1GHz	3.63 dB
Above 1GHz	3.68 dB

Test result

Sweep from 9 kHz to 30MHz, and the emissions more than 20 dB below the permissible value are not reported.

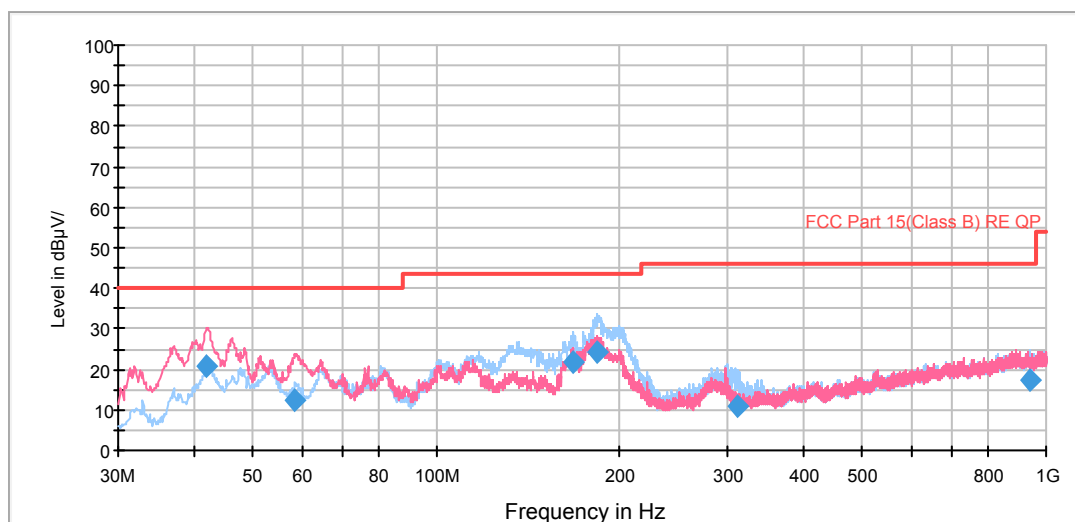
The following graphs display the maximum values of horizontal and vertical by software.

For above 1GHz, Blue trace uses the peak detection, Green trace uses the average detection.

SISO Antenna 2

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RE 30M-1GHz QP



Radiates Emission from 30MHz to 1GHz

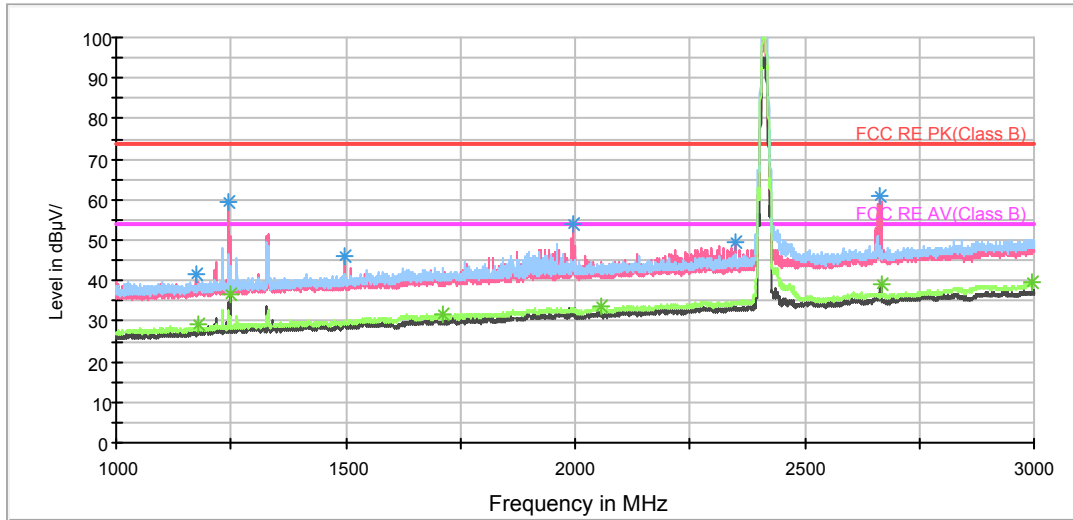
Frequency (MHz)	Quasi-Peak (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
42.019688	20.9	103.0	V	10.0	41.2	-20.3	19.1	40.0
58.627516	12.4	127.0	V	282.0	35.2	-22.8	27.6	40.0
167.036862	21.7	201.0	H	289.0	50.0	-28.3	21.8	43.5
183.560903	24.0	175.0	H	126.0	51.7	-27.7	19.5	43.5
311.442000	10.9	101.0	H	84.0	34.0	-23.1	35.1	46.0
938.189250	17.6	225.0	H	0.0	30.7	-13.1	28.4	46.0

Remark: 1. Quasi-Peak = Reading value + Correction factor

2. Correction Factor = Antenna factor+ Insertion loss (cable loss+amplifier gain)

3. Margin = Limit – Quasi-Peak

RE 1G-3GHz PK+AV



Note: The signal beyond the limit is carrier.

Radiates Emission from 1GHz to 3GHz

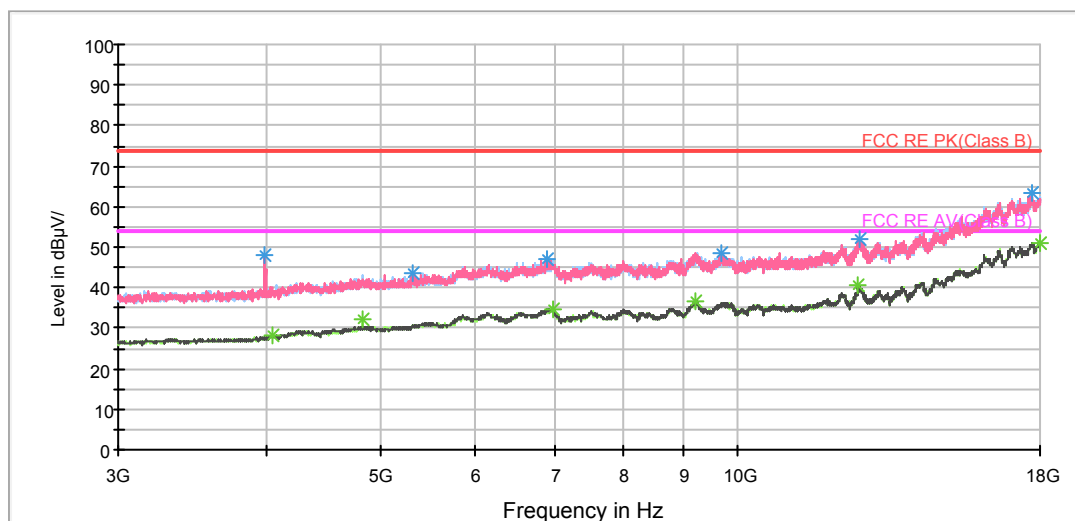
Frequency (MHz)	Peak (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
1172.500000	41.5	100.0	V	182.0	49.6	-8.1	32.5	74
1244.250000	59.3	100.0	V	219.0	67.3	-8.0	14.7	74
1497.750000	46.3	200.0	V	172.0	53.0	-6.7	27.7	74
1996.750000	53.8	100.0	V	182.0	57.1	-3.3	20.2	74
2349.250000	49.6	100.0	V	173.0	50.9	-1.3	24.4	74
2665.750000	61.1	200.0	V	190.0	60.8	0.3	12.9	74

Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)

Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
1178.500000	29.2	100.0	V	200.0	37.2	-8.0	24.8	54
1247.500000	36.5	200.0	V	210.0	44.5	-8.0	17.5	54
1711.250000	31.7	200.0	H	0.0	36.5	-4.8	22.3	54
2055.000000	33.4	200.0	H	288.0	36.6	-3.2	20.6	54
2666.250000	38.9	100.0	V	182.0	38.6	0.3	15.1	54
2997.250000	39.5	100.0	H	26.0	37.2	2.3	14.5	54

Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)

RE 3-18GHz PK+AV



Radiates Emission from 3GHz to 18GHz

Frequency (MHz)	Peak (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
3982.500000	48.0	150.0	V	173.0	49.0	-1.0	26.0	74
5326.875000	43.7	150.0	V	0.0	41.4	2.3	30.3	74
6894.375000	46.9	150.0	V	0.0	40.7	6.2	27.1	74
9686.250000	48.7	150.0	V	63.0	39.2	9.5	25.3	74
12667.500000	51.9	150.0	H	262.0	37.9	14.0	22.1	74
17703.750000	63.3	150.0	H	0.0	38.6	24.7	10.7	74

Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)

Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
4042.500000	28.1	150.0	H	0.0	29.1	-1.0	25.9	54
4822.500000	32.2	150.0	H	150.0	30.9	1.3	21.8	54
6995.625000	34.7	150.0	V	44.0	28.2	6.5	19.3	54
9225.000000	36.5	150.0	V	44.0	26.6	9.9	17.5	54
12639.375000	40.7	150.0	H	299.0	26.2	14.5	13.3	54
17998.125000	51.2	150.0	V	81.0	25.8	25.4	2.8	54

Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)