



RF TEST REPORT

Applicant Espressif Systems (Shanghai) Co.,Ltd.

FCC ID 2AC7Z-ESP868504

Product Wi-Fi & Bluetooth Internet of Things
 Module

Brand ESPRESSIF

Model ESP8685-WROOM-04

Report No. R2105A0444-R1V2

Issue Date August 22, 2022

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2021)**. 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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TABLE OF CONTENT

1. Test Laboratory	5
1.1. Notes of the test report	5
1.2. Test facility	5
1.3. Testing Location	5
2. General Description of Equipment under Test	6
2.1. Applicant and Manufacturer Information	6
2.2. General information	6
3. Applied Standards	7
4. Test Configuration	8
5. Test Case Results	9
5.1. Maximum output power	9
5.2. 99% Bandwidth and 6dB Bandwidth	12
5.3. Band Edge	24
5.4. Power Spectral Density	33
5.5. Spurious RF Conducted Emissions	41
5.6. Unwanted Emission	53
5.7. Conducted Emission	117
6. Main Test Instruments	122
ANNEX A: The EUT Appearance	123
ANNEX B: Test Setup Photos	124



Version	Revision description	Issue Date
Rev.0	Initial issue of report.	August 6, 2022
Rev.1	Update FCC ID.	August 12, 2022
Rev.2	Update description.	August 22, 2022
Note: This revised report (Report No. R2105A0444-R1V2) supersedes and replaces the previously issued report (Report No. R2105A0444-R1V1). Please discard or destroy the previously issued report and dispose of it accordingly.		

Summary of measurement results

Number	Test Case	Clause in FCC rules	Verdict
1	Maximum 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	Unwanted Emissions	15.247(d),15.205,15.209	PASS
7	Conducted Emissions	15.207	PASS
Date of Testing: May 25, 2021 ~ November 30, 2021, July 11, 2022 ~ July 19, 2022 and July 27, 2022 Date of Sample Received: May 25, 2021			
Note: All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

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.

1.2. Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

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

A2LA (Certificate Number: 3857.01)

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

1.3. Testing Location

Company: TA Technology (Shanghai) Co., Ltd.
Address: Building 3, No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China
City: Shanghai
Post code: 201201
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Fax: +86-021-50791141/2/3-8000
Website: <http://www.ta-shanghai.com>
E-mail: xukai@ta-shanghai.com

2. General Description of Equipment under Test

2.1. Applicant and Manufacturer Information

Applicant	Espressif Systems (Shanghai) Co.,Ltd.
Applicant address	Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China
Manufacturer	Espressif Systems (Shanghai) Co.,Ltd.
Manufacturer address	Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

2.2. General information

EUT Description	
Model	ESP8685-WROOM-04
Lab internal SN	R2105A0444/S01
Hardware Version	V1.2
Software Version	V1.1.3.0
Power Supply	External power supply
Antenna Type	PCB Antenna
Antenna Connector	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)
Antenna Gain	3.26dBi
additional beamforming gain	NA
Operating Frequency Range(s)	802.11b/g/n(HT20): 2412 ~ 2462 MHz 802.11n(HT40): 2422 ~ 2452 MHz Bluetooth LE V5.0: 2402 ~2480 MHz
Modulation Type	802.11b: DSSS 802.11g/n(HT20/HT40): OFDM Bluetooth LE: GFSK
Max. Conducted Power	Wi-Fi 2.4G: 18.73dBm Bluetooth LE: 19.42dBm
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.	



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 (2021) Radio Frequency Devices

ANSI C63.10-2013

Reference standard:

KDB 558074 D01 15.247 Meas Guidance v05r02

4. Test Configuration

Test Mode

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 lie-down position (X axis) and the loop antenna is vertical, the others are vertical and horizontal. 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.

Test Mode	Data Rate
Bluetooth(Low Energy)	1Mbps, 2Mbps
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

5. Test Case Results

5.1. Maximum output power

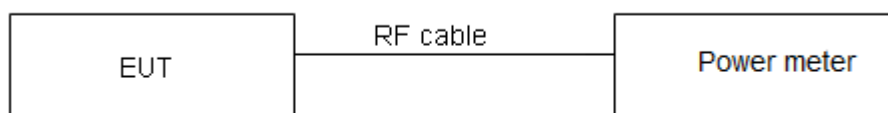
Ambient condition

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 Power meter with a known loss. The EUT is max power transmission with proper modulation.

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

WIFI 2.4G

Power Index					
Channel	802.11b	802.11g	802.11n HT20	Channel	802.11n HT40
CH1	0	12	12	CH3	16
CH2	/	0	0	CH4	8
CH6	0	0	0	CH5	4
CH8	/	0	0	CH6	0
CH9	/	4	0	CH7	12
CH10	/	8	8	CH8	16
CH11	0	20	20	CH9	20

Bluetooth LE

Power Index			
Channel	CH0	CH19	CH39
Bluetooth (Low Energy) (1M)	15	15	15
Bluetooth (Low Energy) (2M)	15	15	15

Test Mode	T _{on} (ms)	T _(on+off) (ms)	Duty cycle	Duty cycle correction Factor(dB)
802.11b	1.00	1.00	1.00	0.00
802.11g	1.00	1.00	1.00	0.00
802.11n HT20	1.00	1.00	1.00	0.00
802.11n HT40	1.00	1.00	1.00	0.00
Bluetooth LE (1M)	2.10	2.50	0.84	0.76
Bluetooth LE (2M)	1.06	1.87	0.57	2.47

Note: when Duty cycle ≥ 0.98 , Duty cycle correction Factor not required.

Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11b	2412/CH1	18.73	18.73	30	PASS
	2437/CH6	18.54	18.54	30	PASS
	2462/CH11	18.68	18.68	30	PASS
802.11g	2412/CH1	14.95	14.95	30	PASS
	2417/CH2	17.69	17.69	30	PASS
	2437/CH6	18.14	18.14	30	PASS
	2447/CH8	18.38	18.38	30	PASS
	2452/CH9	17.17	17.17	30	PASS
	2457/CH10	16.31	16.31	30	PASS
	2462/CH11	13.06	13.06	30	PASS
802.11n HT20	2412/CH1	13.57	13.57	30	PASS
	2417/CH2	16.92	16.92	30	PASS
	2437/CH6	17.34	17.34	30	PASS
	2447/CH8	17.32	17.32	30	PASS
	2452/CH9	17.00	17.00	30	PASS
	2457/CH10	15.50	15.50	30	PASS
	2462/CH11	12.16	12.16	30	PASS
802.11n HT40	2422/CH3	12.63	12.63	30	PASS
	2427/CH4	14.74	14.74	30	PASS
	2432/CH5	16.18	16.18	30	PASS
	2437/CH6	16.85	16.85	30	PASS
	2442/CH7	14.10	14.10	30	PASS
	2447/CH8	12.95	12.95	30	PASS
	2452/CH9	11.69	11.69	30	PASS
Bluetooth (Low Energy) (1M)	2402/CH0	18.53	19.29	30	PASS
	2440/CH19	18.33	19.09	30	PASS
	2480/CH39	18.36	19.12	30	PASS
Bluetooth (Low Energy) (2M)	2402/CH0	16.75	19.22	30	PASS
	2440/CH19	16.95	19.42	30	PASS
	2480/CH39	16.87	19.34	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

5.2. 99% Bandwidth and 6dB Bandwidth

Ambient condition

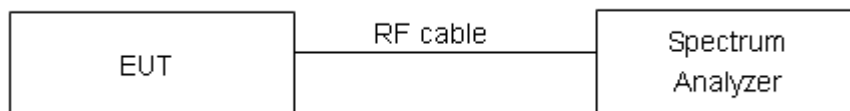
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

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.
Detector=Peak, Trace mode=max hold.

The EUT was connected to the spectrum analyzer through a known loss cable. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value.

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

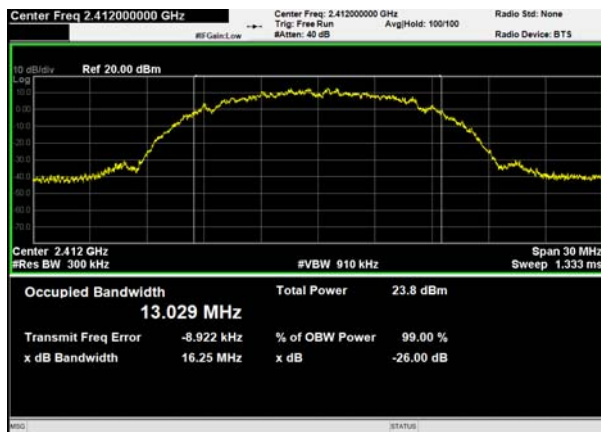
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936$ Hz.

Test Results:

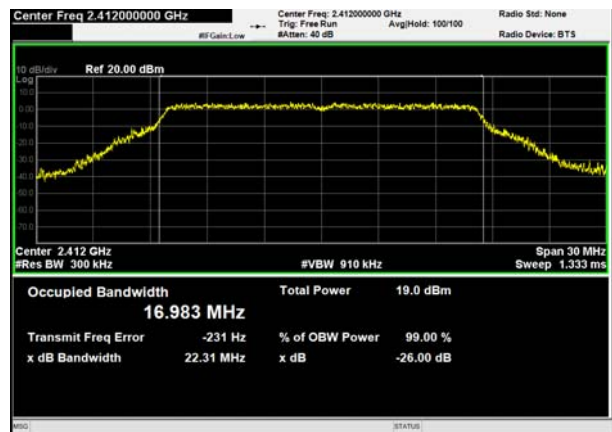
Test Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11b	2412/CH1	13.029	9.540	500	PASS
	2437/CH6	13.013	9.519	500	PASS
	2462/CH11	13.078	8.317	500	PASS
802.11g	2412/CH1	16.983	16.340	500	PASS
	2417/CH2	17.109	16.360	500	PASS
	2437/CH6	17.121	16.320	500	PASS
	2447/CH8	17.052	16.540	500	PASS
	2452/CH9	17.085	16.370	500	PASS
	2457/CH10	17.049	16.369	500	PASS
	2462/CH11	17.039	16.360	500	PASS
802.11n HT20	2412/CH1	18.154	17.569	500	PASS
	2417/CH2	18.163	17.591	500	PASS
	2437/CH6	18.193	17.603	500	PASS
	2447/CH8	18.140	17.668	500	PASS
	2452/CH9	18.056	17.609	500	PASS
	2457/CH10	18.143	17.619	500	PASS
	2462/CH11	18.140	17.560	500	PASS
802.11n HT40	2422/CH3	35.460	33.100	500	PASS
	2427/CH4	35.408	34.010	500	PASS
	2432/CH5	35.417	33.820	500	PASS
	2437/CH6	35.408	34.410	500	PASS
	2442/CH7	35.381	34.990	500	PASS
	2447/CH8	35.385	33.380	500	PASS
	2452/CH9	35.415	32.790	500	PASS
Bluetooth (Low Energy) (1M)	2402/CH0	1.034	0.630	500	PASS
	2440/CH19	1.035	0.644	500	PASS
	2480/CH39	1.026	0.624	500	PASS
Bluetooth (Low Energy) (2M)	2402/CH0	2.048	1.086	500	PASS
	2440/CH19	2.040	1.067	500	PASS
	2480/CH39	2.045	1.132	500	PASS

**99%bandwidth**

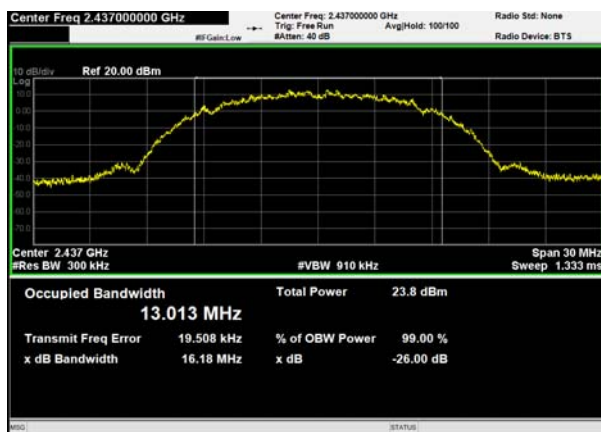
802.11b, Carrier frequency (MHz): 2412



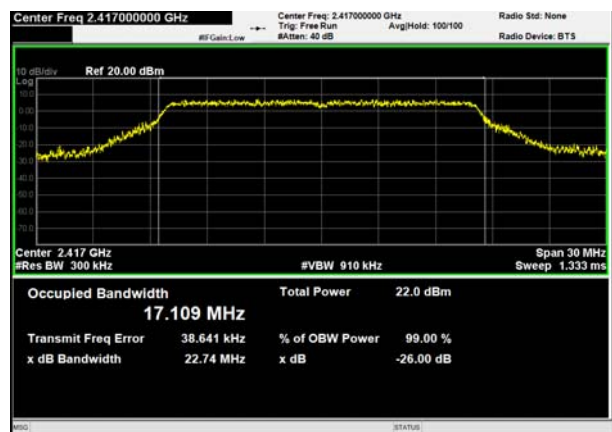
802.11g, Carrier frequency (MHz): 2412



802.11b, Carrier frequency (MHz): 2437



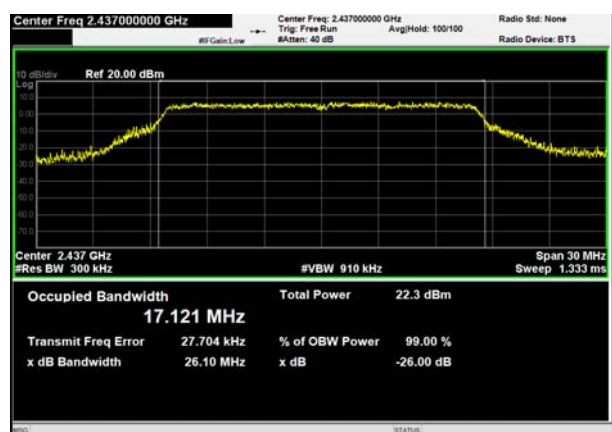
802.11g, Carrier frequency (MHz): 2417



802.11b, Carrier frequency (MHz): 2462

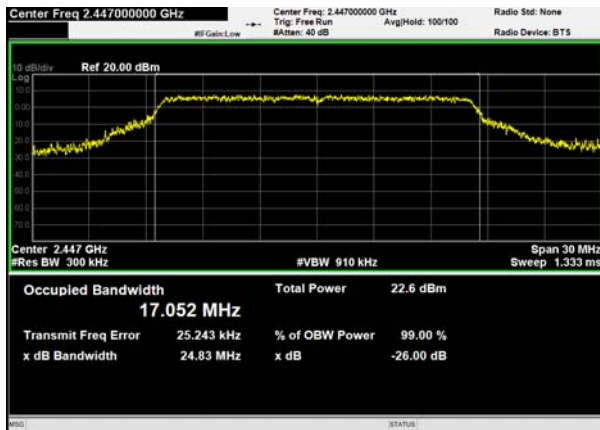


802.11g, Carrier frequency (MHz): 2437

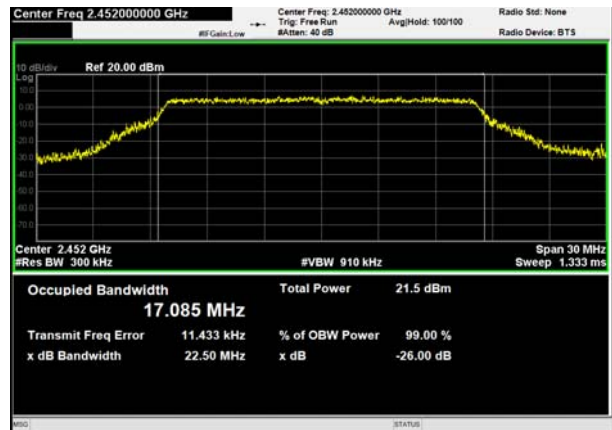




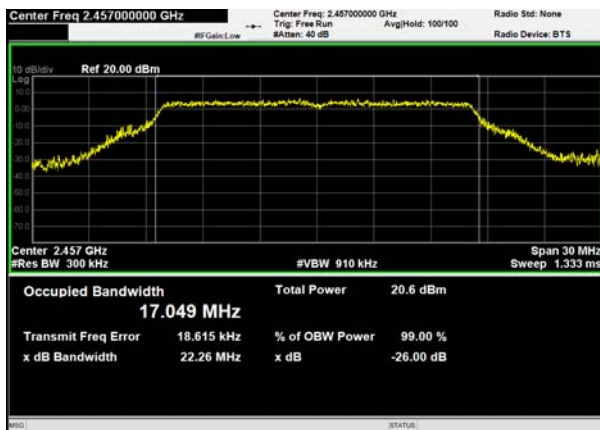
802.11g, Carrier frequency (MHz): 2447



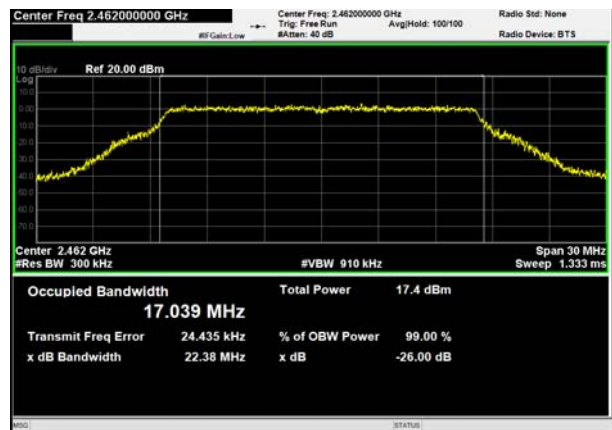
802.11g, Carrier frequency (MHz): 2452



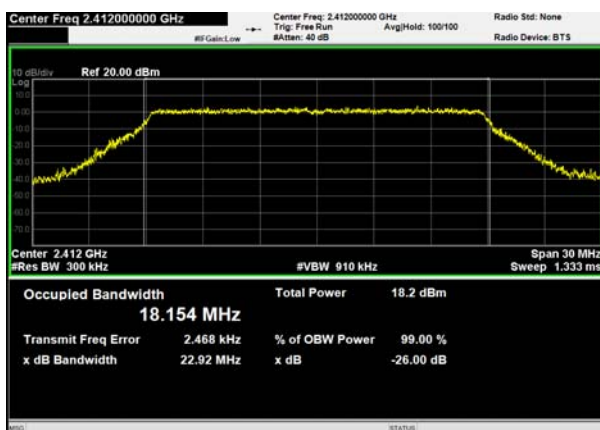
802.11g, Carrier frequency (MHz): 2457



802.11g, Carrier frequency (MHz): 2462



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

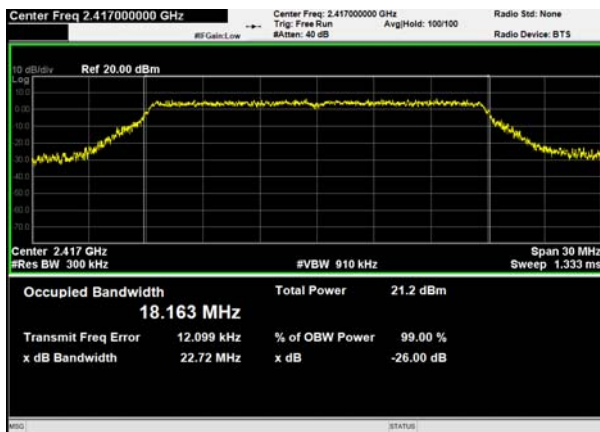


802.11n(HT40), Carrier frequency (MHz): 2422

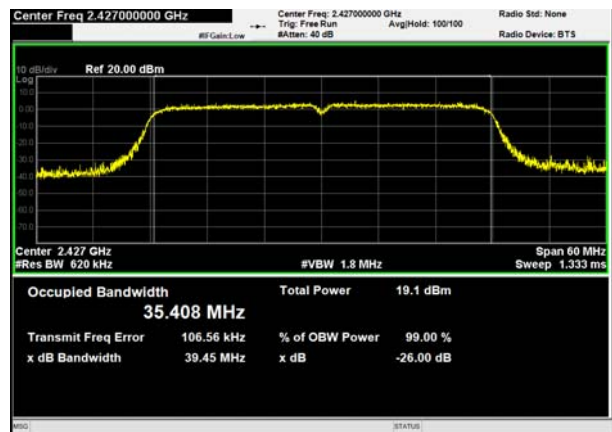




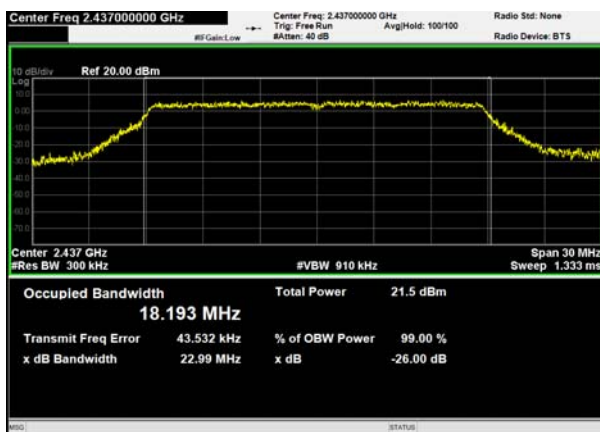
802.11n(HT20), Carrier frequency (MHz): 2417



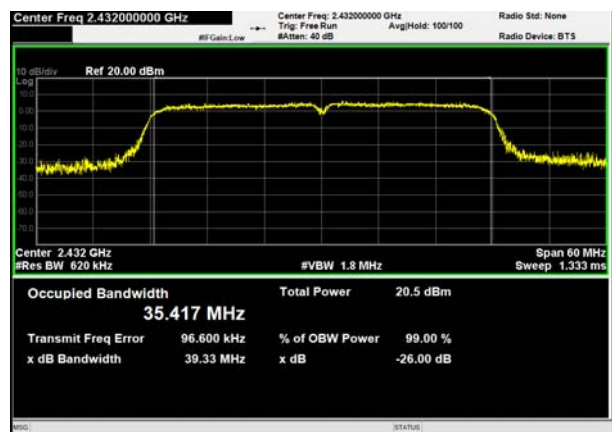
802.11n(HT40), Carrier frequency (MHz): 2427



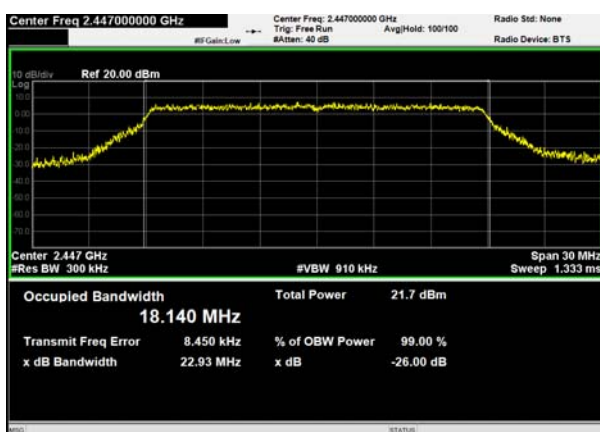
802.11n(HT20), Carrier frequency (MHz): 2437



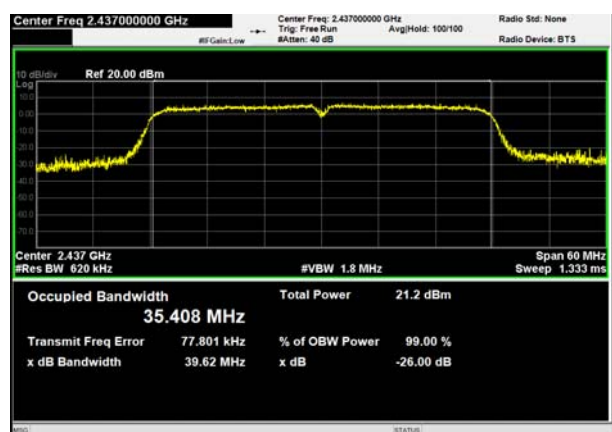
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2447

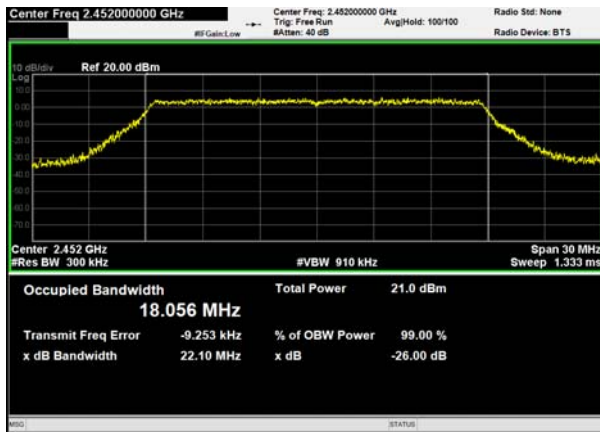


802.11n(HT40), Carrier frequency (MHz): 2437

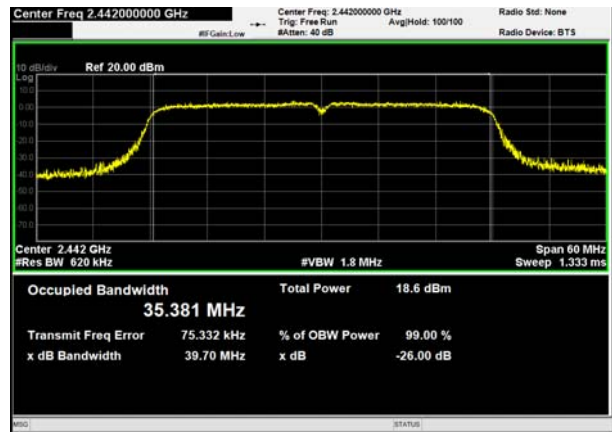




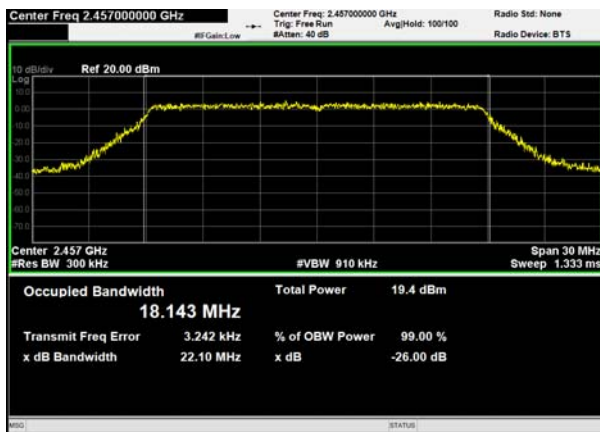
802.11n(HT20), Carrier frequency (MHz): 2452



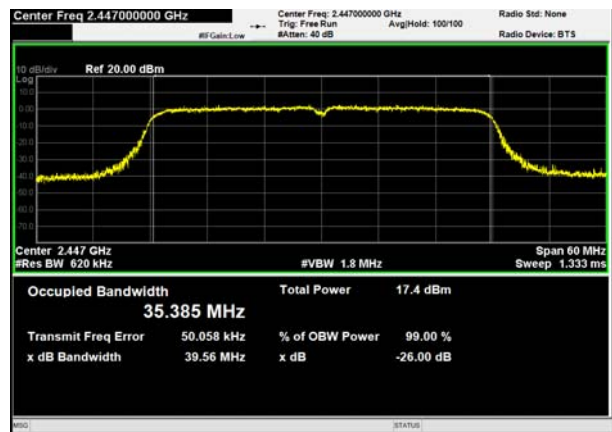
802.11n(HT40), Carrier frequency (MHz): 2442



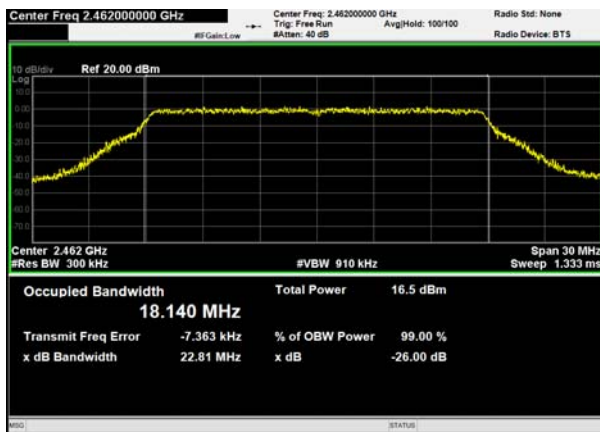
802.11n(HT20), Carrier frequency (MHz): 2457



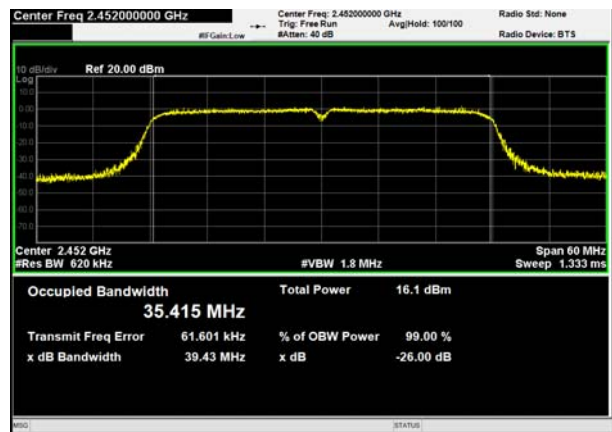
802.11n(HT40), Carrier frequency (MHz): 2447

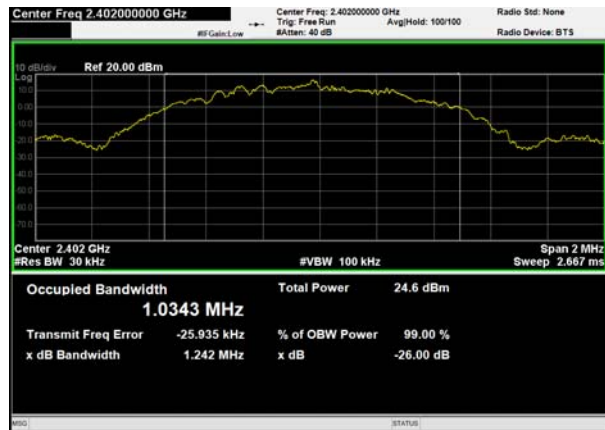
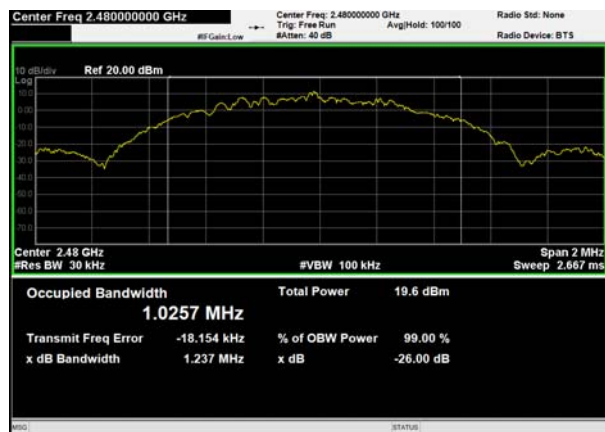
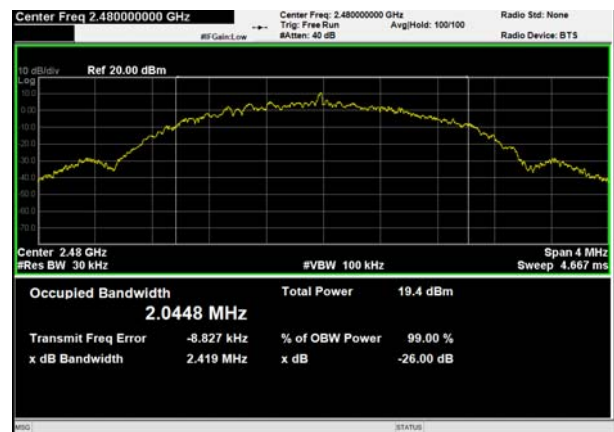


802.11n(HT20), Carrier frequency (MHz): 2462



802.11n(HT40), Carrier frequency (MHz): 2452

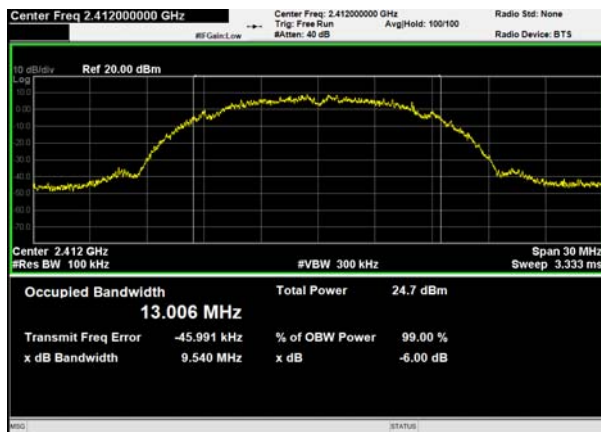


Bluetooth LE (1M) Carrier frequency (MHz):
2402Bluetooth LE (2M) Carrier frequency (MHz):
2402Bluetooth LE (1M) Carrier frequency (MHz):
2440Bluetooth LE (2M) Carrier frequency (MHz):
2440Bluetooth LE (1M) Carrier frequency (MHz):
2480Bluetooth LE (2M) Carrier frequency (MHz):
2480

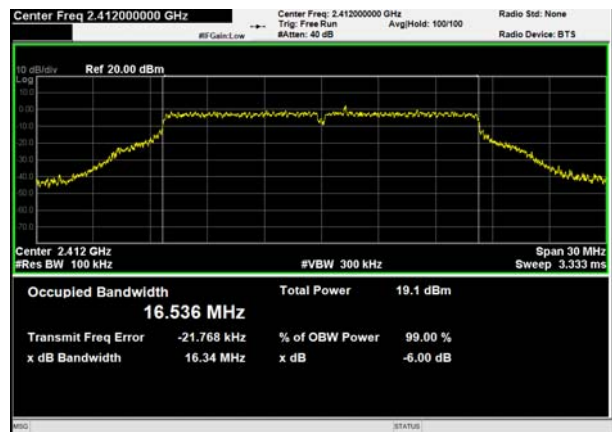


6 dB bandwidth

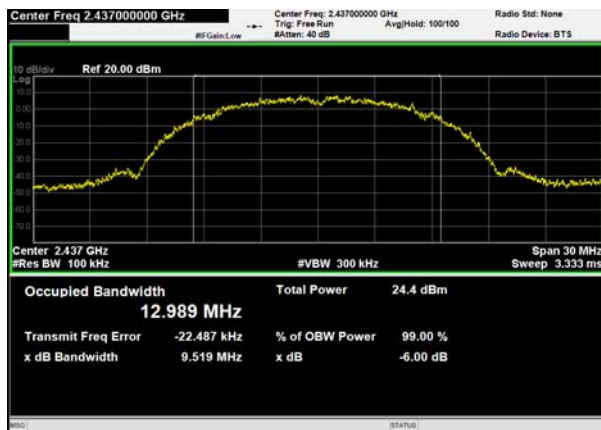
802.11b, Carrier frequency (MHz): 2412



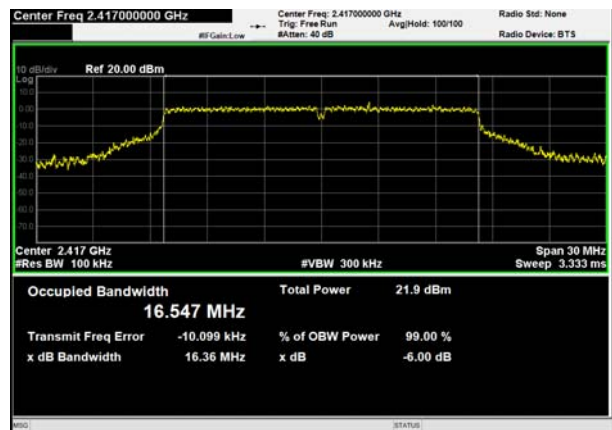
802.11g, Carrier frequency (MHz): 2412



802.11b, Carrier frequency (MHz): 2437



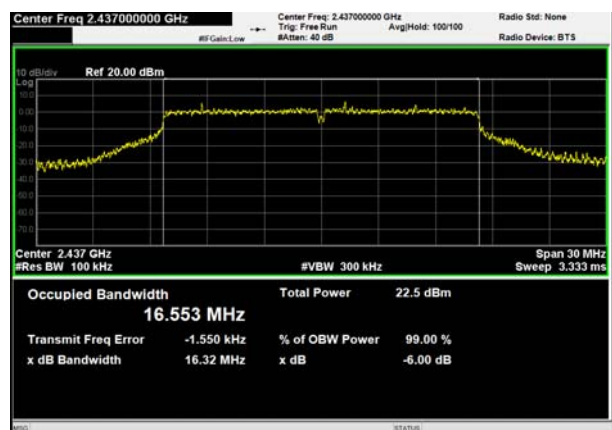
802.11g, Carrier frequency (MHz): 2437



802.11b, Carrier frequency (MHz): 2462

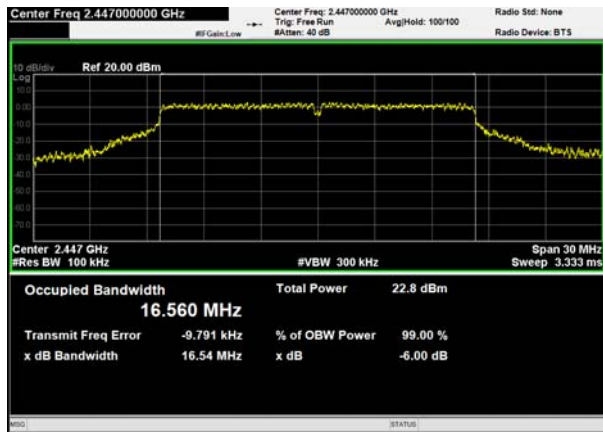


802.11g, Carrier frequency (MHz): 2437

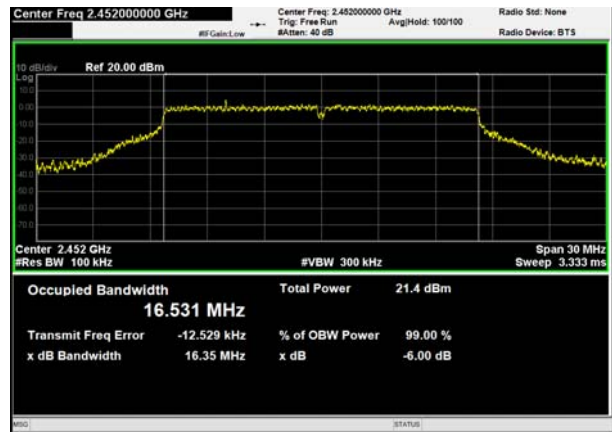




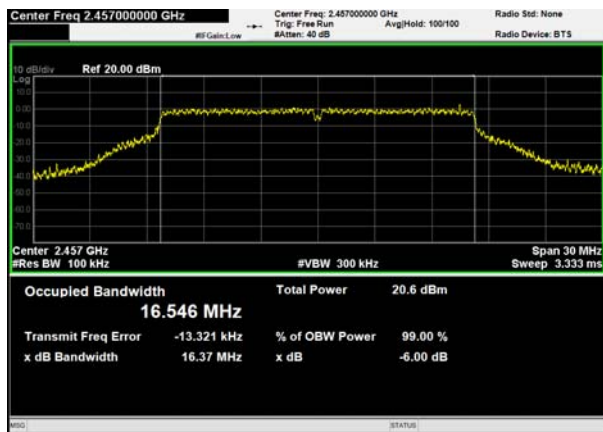
802.11g, Carrier frequency (MHz): 2447



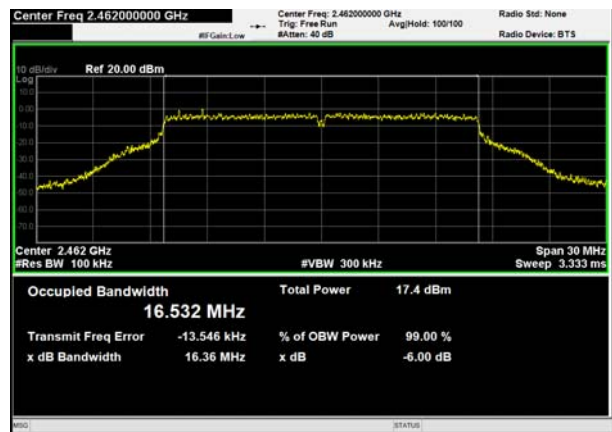
802.11g, Carrier frequency (MHz): 2452



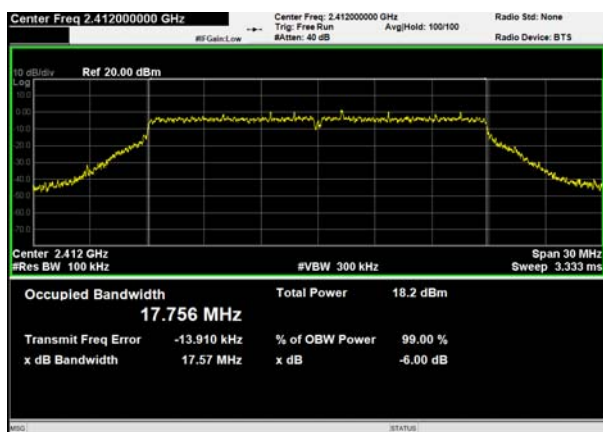
802.11g, Carrier frequency (MHz): 2457



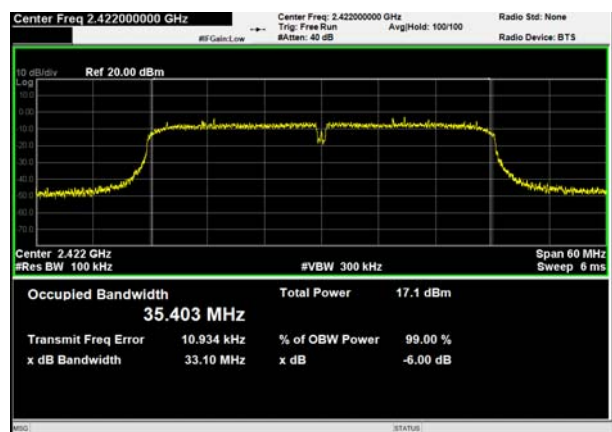
802.11g, Carrier frequency (MHz): 2462



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

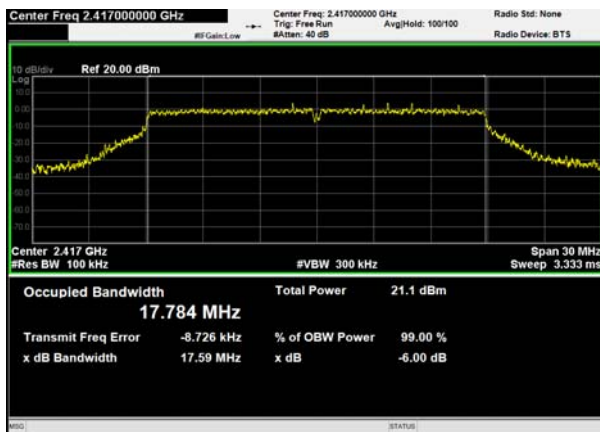


802.11n(HT40), Carrier frequency (MHz): 2422

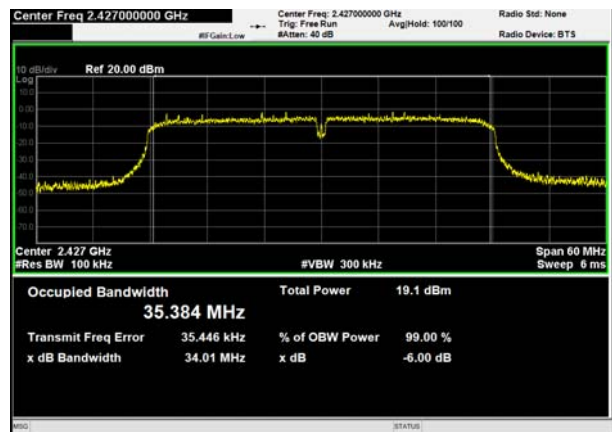




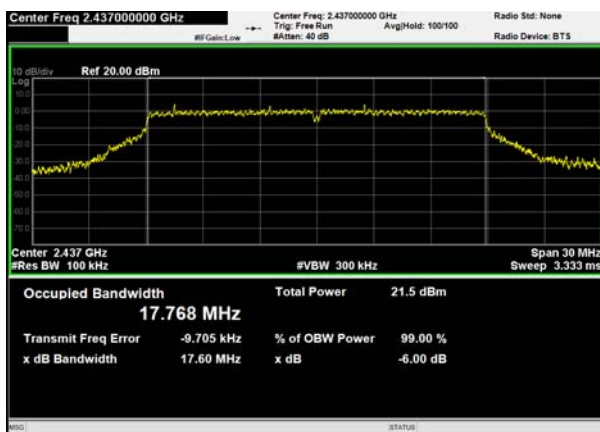
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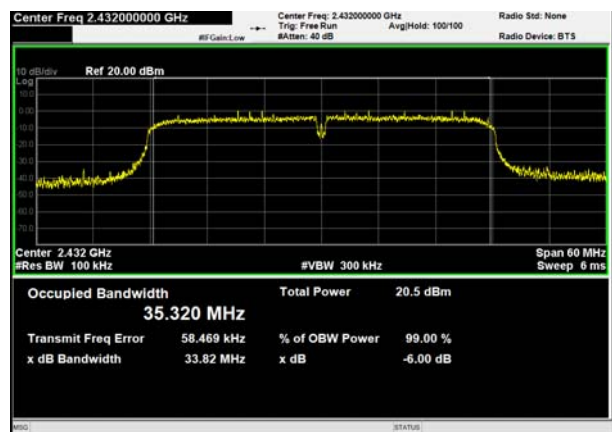
802.11n(HT40), Carrier frequency (MHz): 2427



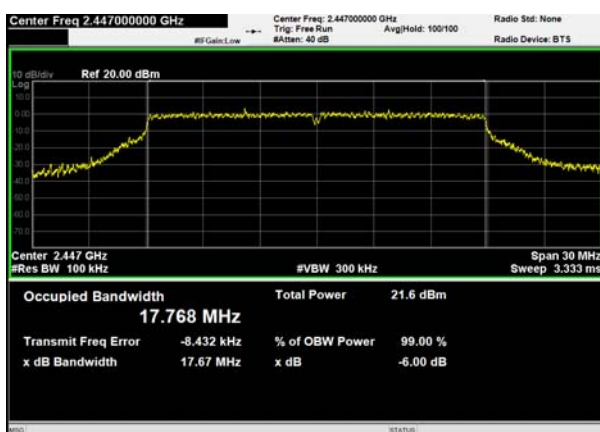
802.11n(HT20), Carrier frequency (MHz): 2437



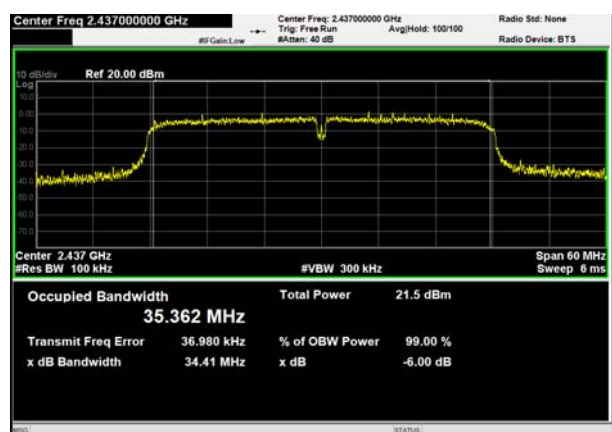
802.11n(HT40), Carrier frequency (MHz): 2432



802.11n(HT20), Carrier frequency (MHz): 2447

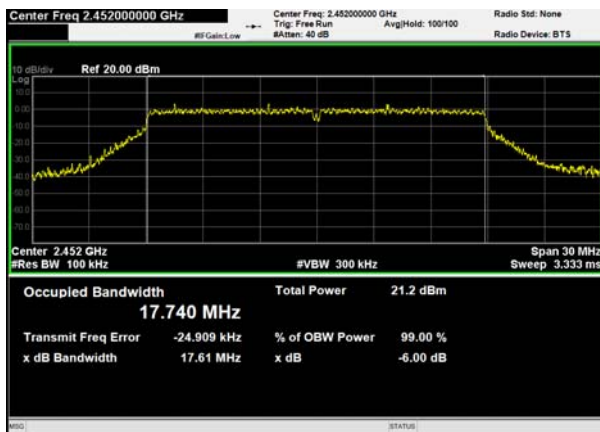


802.11n(HT40), Carrier frequency (MHz): 2437

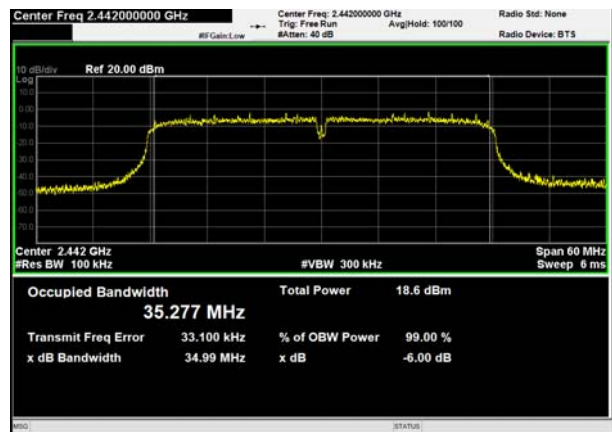




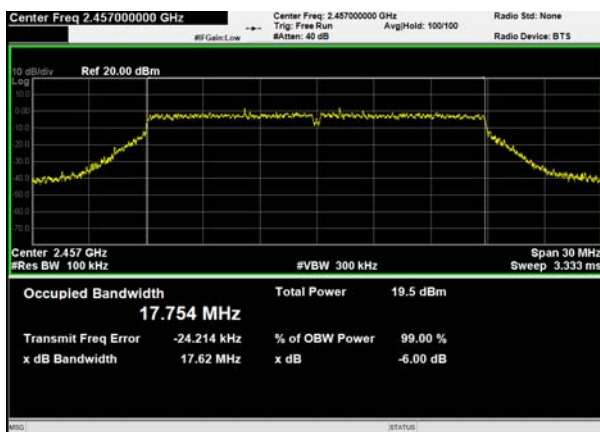
802.11n(HT20), Carrier frequency (MHz): 2452



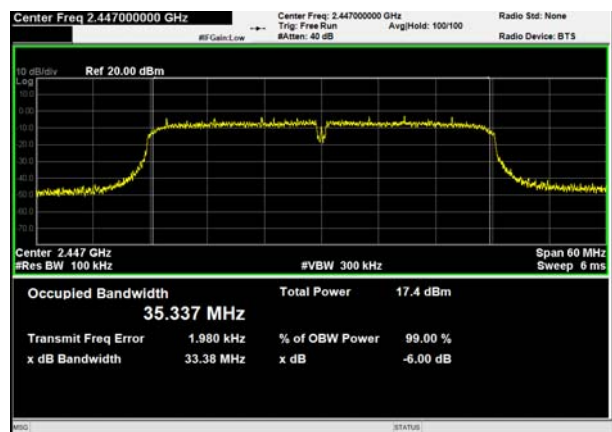
802.11n(HT40), Carrier frequency (MHz): 2442



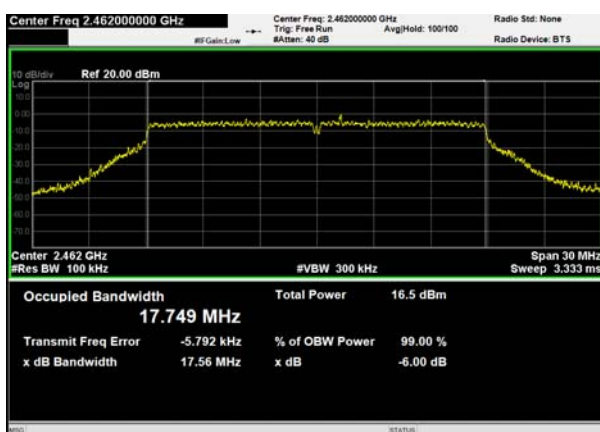
802.11n(HT20), Carrier frequency (MHz): 2457



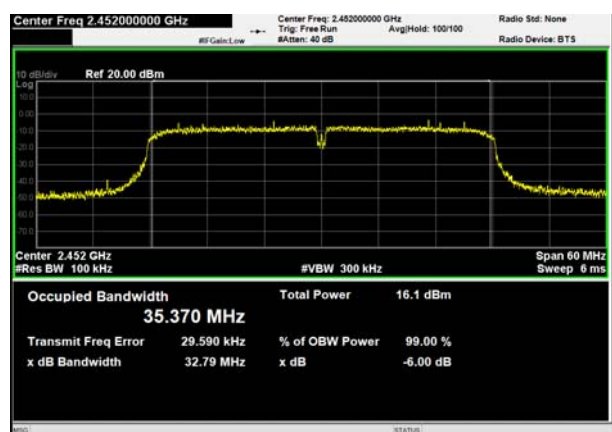
802.11n(HT40), Carrier frequency (MHz): 2447

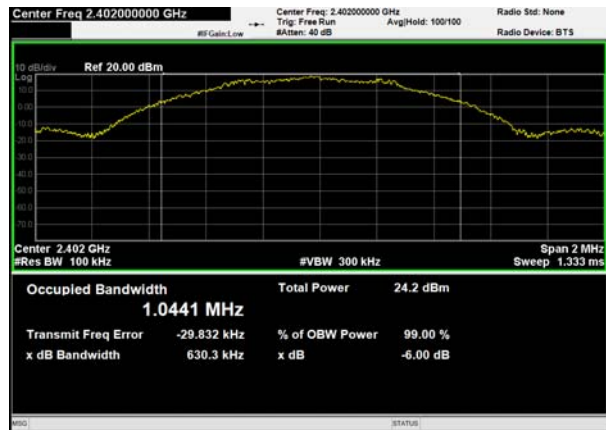
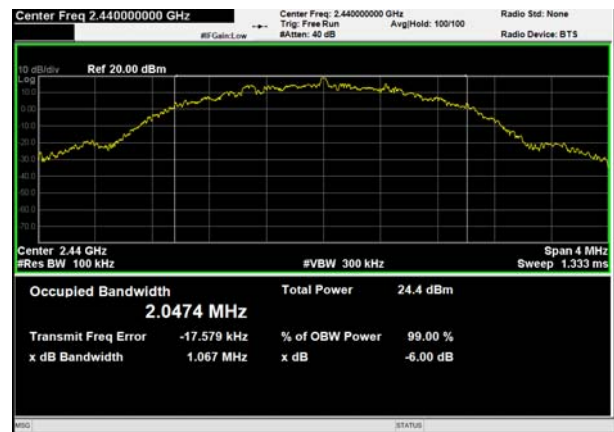
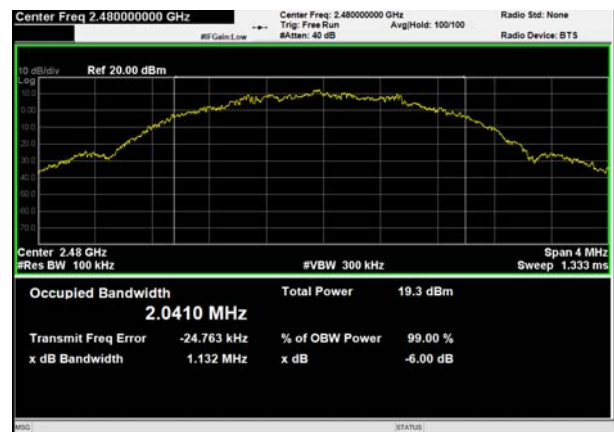


802.11n(HT20), Carrier frequency (MHz): 2462



802.11n(HT40), Carrier frequency (MHz): 2452



Bluetooth LE (1M) Carrier frequency (MHz):
2402Bluetooth LE (2M) Carrier frequency (MHz):
2402Bluetooth LE (1M) Carrier frequency (MHz):
2440Bluetooth LE (2M) Carrier frequency (MHz):
2440Bluetooth LE (1M) Carrier frequency (MHz):
2480Bluetooth LE (2M) Carrier frequency (MHz):
2480

5.3. Band Edge

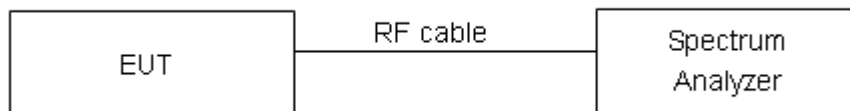
Ambient condition

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.” If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.”

Measurement Uncertainty

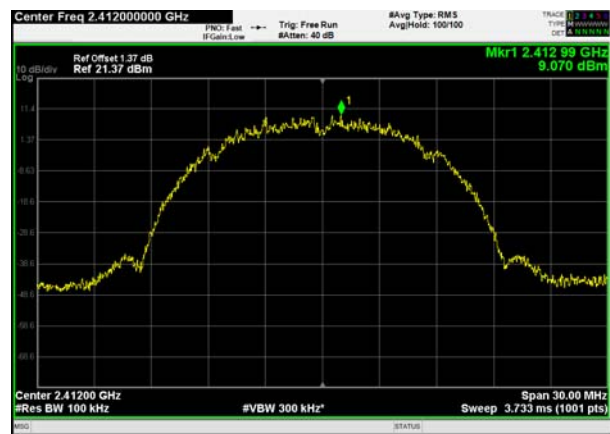
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
2GHz-3GHz	1.407 dB

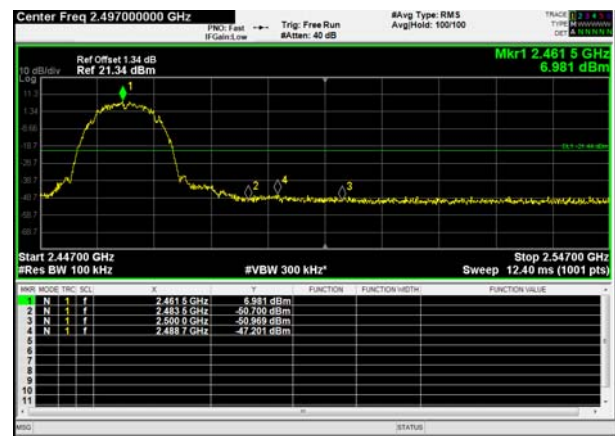
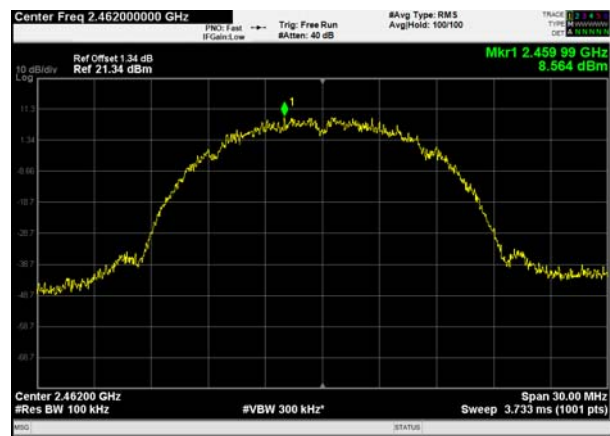


Test Results: PASS

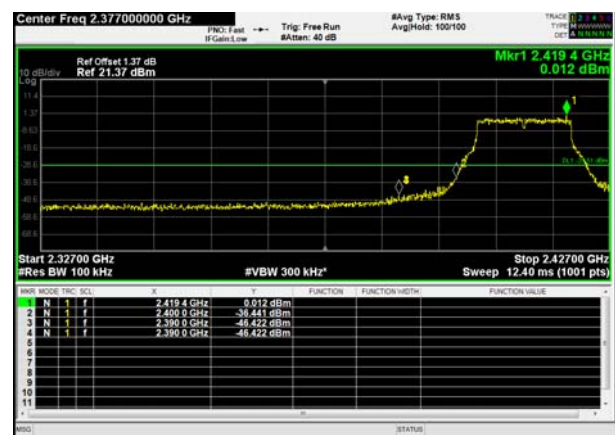
802.11b, Channel No.: 1



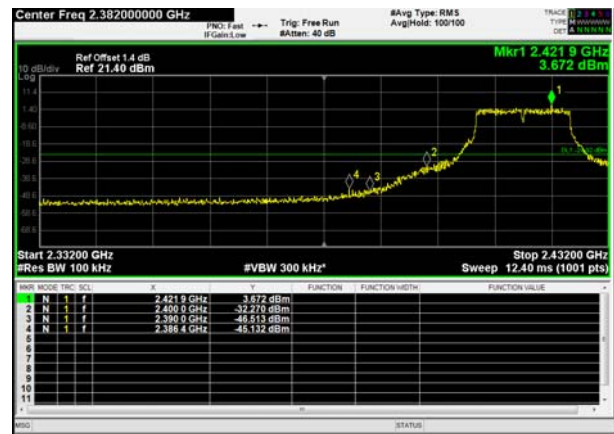
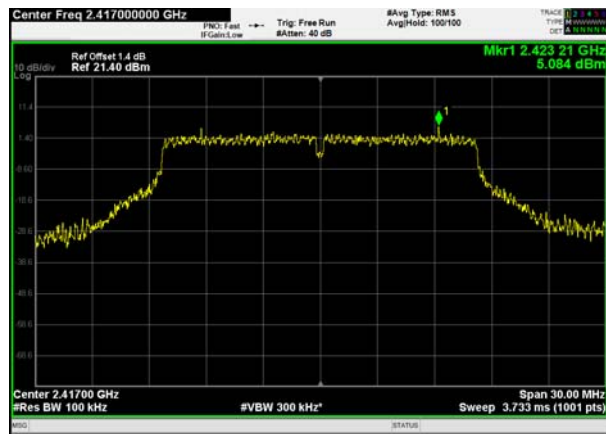
802.11b, Channel No.: 11



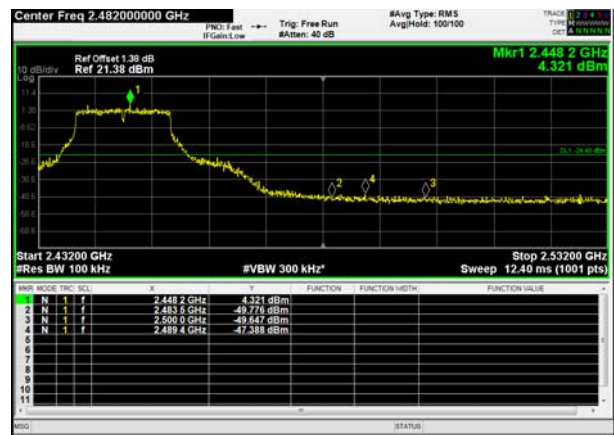
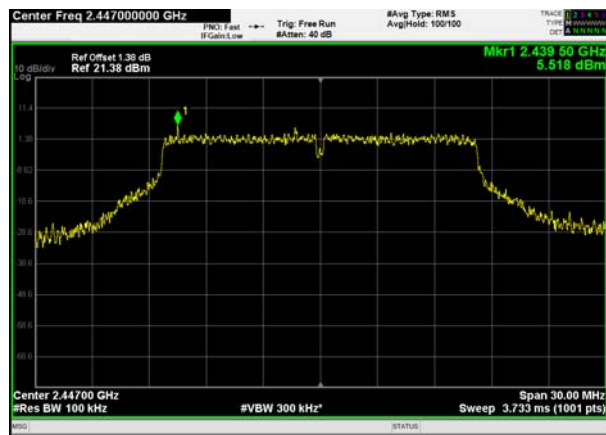
802.11g, Channel No.: 1



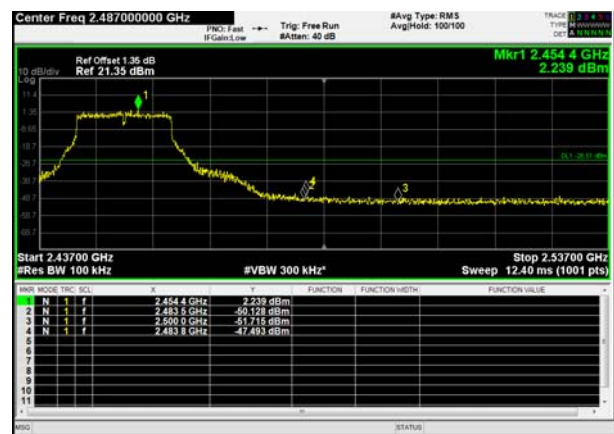
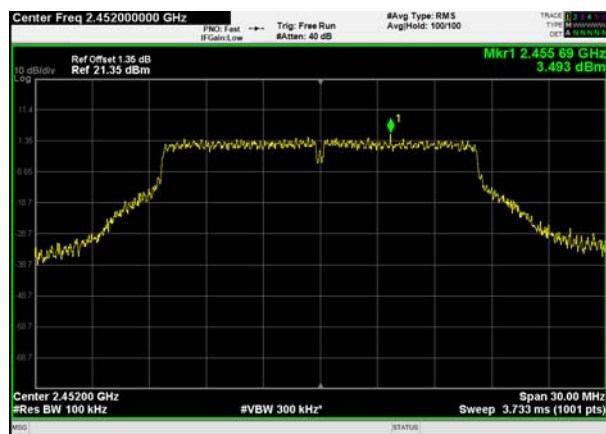
802.11g, Channel No.: 2



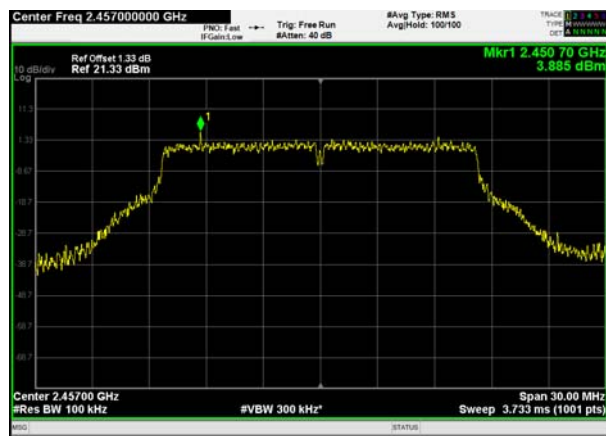
802.11g, Channel No.: 8



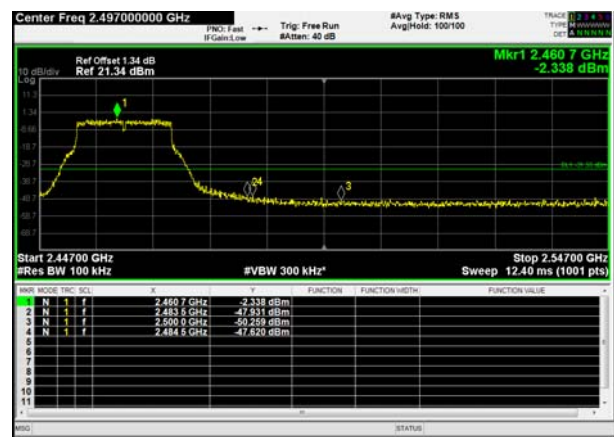
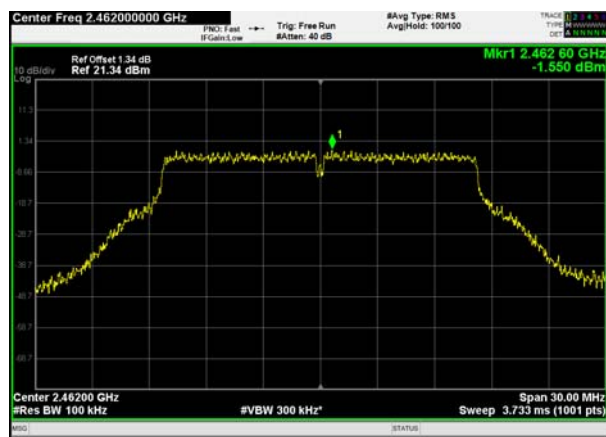
802.11g, Channel No.: 9



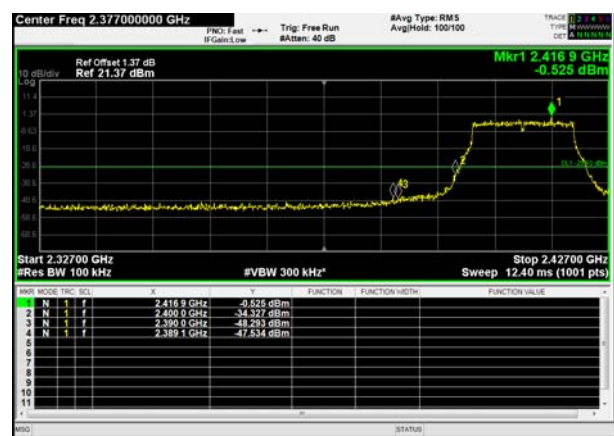
802.11g, Channel No.: 10



802.11g, Channel No.: 11

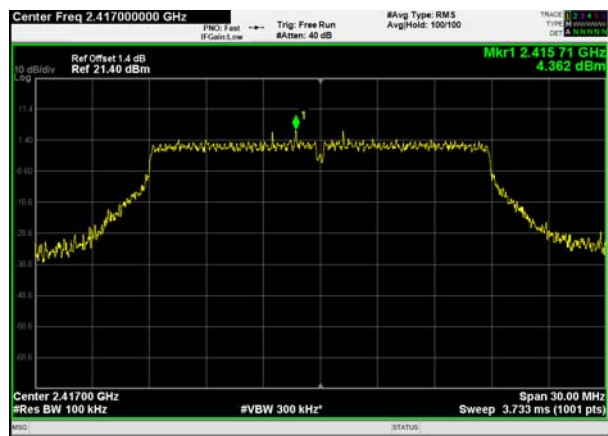


802.11n(HT20), Channel No. 1

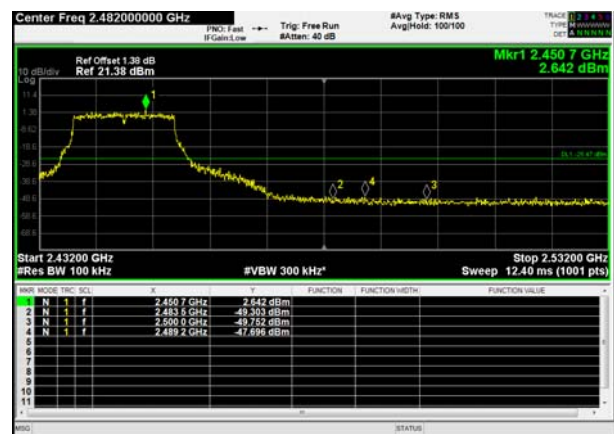




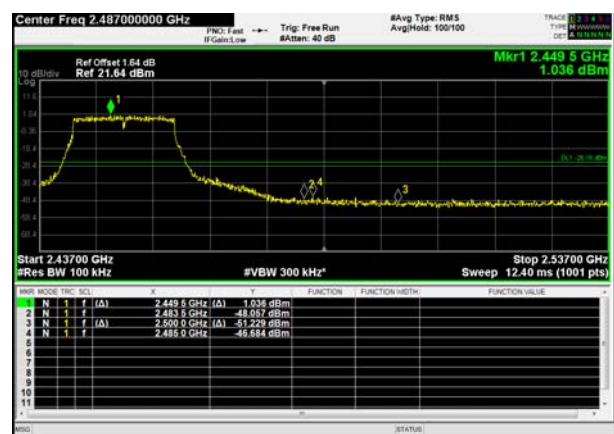
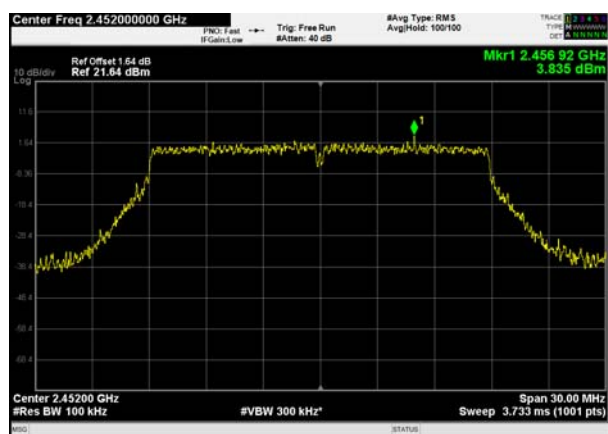
802.11n(HT20), Channel No. 2



802.11n(HT20), Channel No. 8

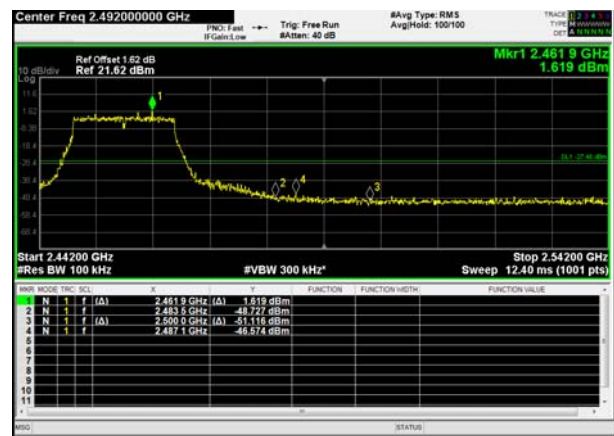
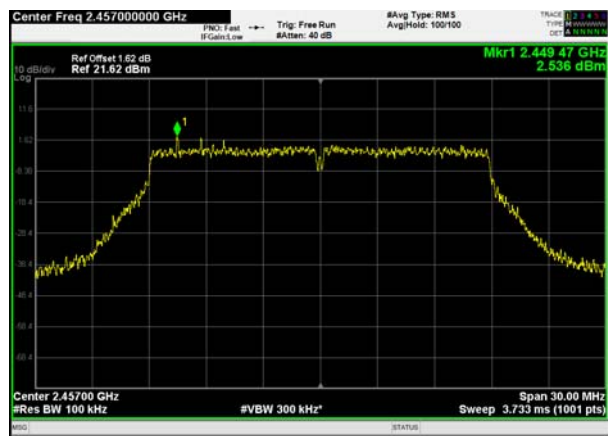


802.11n(HT20), Channel No. 9

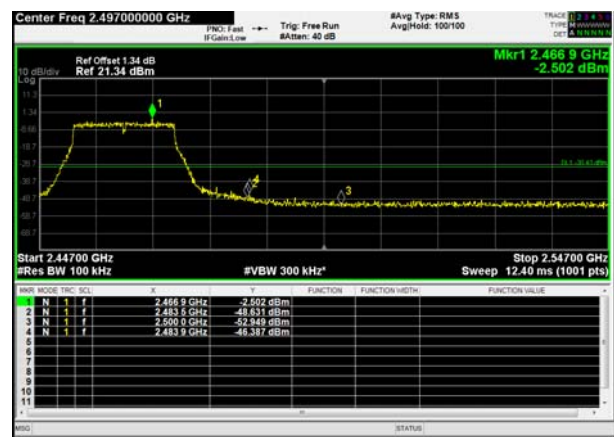
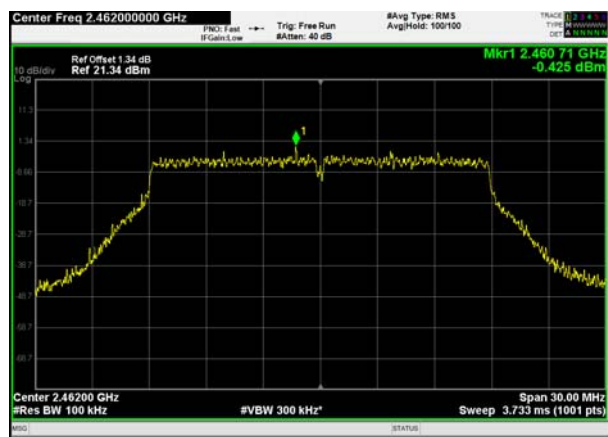




802.11n(HT20), Channel No. 10



802.11n(HT20), Channel No. 11

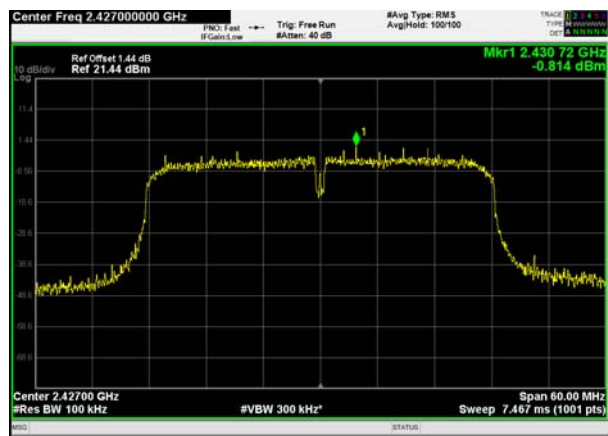


802.11n(HT40), Channel No. 3

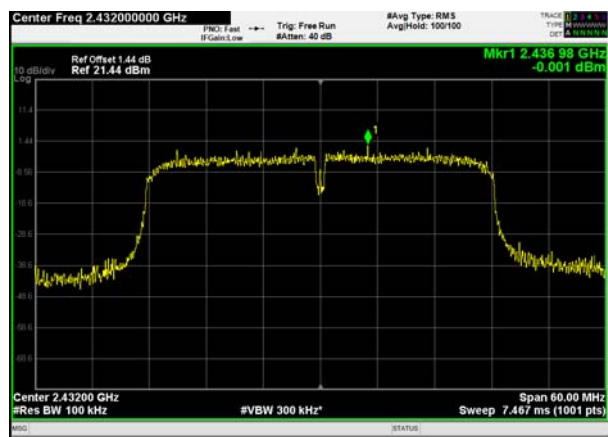




802.11n(HT40), Channel No. 4



802.11n(HT40), Channel No. 5



802.11n(HT40), Channel No. 7





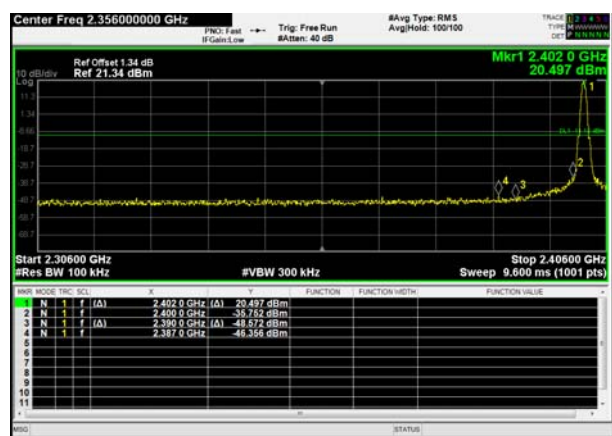
802.11n(HT40), Channel No. 8



802.11n(HT40), Channel No. 9

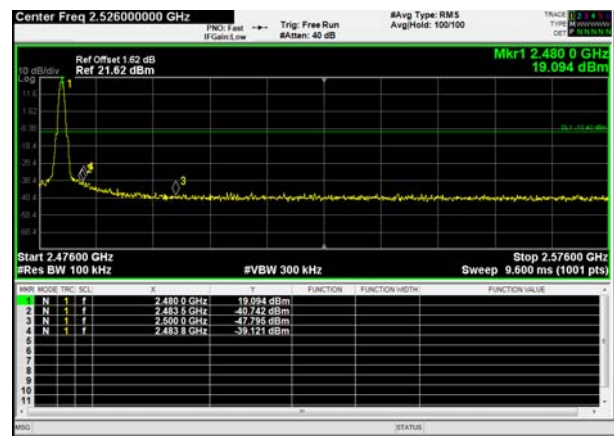


Bluetooth LE (1M), Channel No.: 0

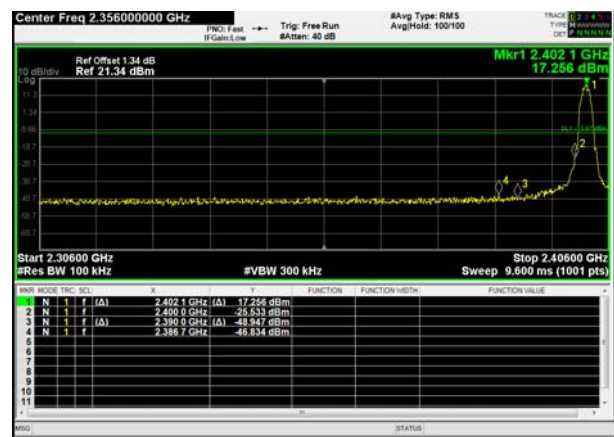




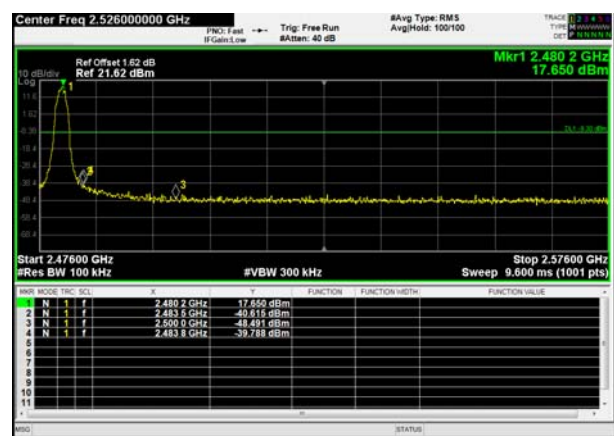
Bluetooth LE (1M), Channel No.: 39



Bluetooth LE (2M), Channel No.: 0



Bluetooth LE (2M), Channel No.: 39



5.4. Power Spectral Density

Ambient condition

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

Method 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.

Method AVGPS-1 was used for this test.

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

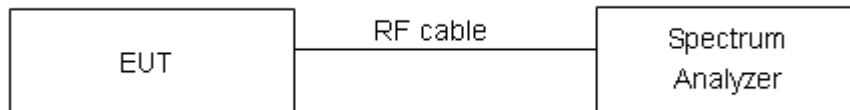
Method AVGPS-2 was used for this test.

- Measure the duty cycle (D) of the transmitter output signal as described in 11.6
- Set instrument center frequency to DTS channel center frequency
- Set span to at least 1.5 times the OBW
- Set RBW to: $3\text{kHz} \leq \text{RBW} \leq 100\text{Kh}$
- Set VBW $\geq [3 \times \text{RBW}]$
- Detector= power averaging (rms) or sample detector (when rms not available)
- Ensure that the number of measurement points in the sweep $2[2 \times \text{span}/\text{RBW}]$
- Sweep time =auto couple
- Do not use sweep triggering; allow sweep to "free run"
- Employ trace averaging (rms) mode over a minimum of 100 traces
- Use the peak marker function to determine the maximum amplitude level

l) Add $[10 \log(1/D)]$, where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time

m) If measured value exceeds requirement specified by regulatory agency then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced)

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	$\leq 8 \text{ dBm} / 3\text{kHz}$
--------	------------------------------------

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:**

Test Mode	Channel Number	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	2412/CH1	-3.42	-13.42	8	PASS
	2437/CH6	-3.25	-13.25	8	PASS
	2462/CH11	-3.76	-13.76	8	PASS
802.11g	2412/CH1	-9.59	-19.59	8	PASS
	2417/CH2	-6.81	-16.81	8	PASS
	2437/CH6	-6.15	-16.15	8	PASS
	2447/CH8	-5.72	-15.72	8	PASS
	2452/CH9	-7.00	-17.00	8	PASS
	2457/CH10	-8.20	-18.20	8	PASS
	2462/CH11	-10.91	-20.91	8	PASS
802.11n HT20	2412/CH1	-10.54	-20.54	8	PASS
	2417/CH2	-7.48	-17.48	8	PASS
	2437/CH6	-7.05	-17.05	8	PASS
	2447/CH8	-6.98	-16.98	8	PASS
	2452/CH9	-7.64	-17.64	8	PASS
	2457/CH10	-9.23	-19.23	8	PASS
	2462/CH11	-12.44	-22.44	8	PASS
802.11n HT40	2422/CH3	-12.75	-22.75	8	PASS
	2427/CH4	-11.31	-21.31	8	PASS
	2432/CH5	-9.91	-19.91	8	PASS
	2437/CH6	-8.86	-18.86	8	PASS
	2442/CH7	-12.35	-22.35	8	PASS
	2447/CH8	-12.12	-22.12	8	PASS
	2452/CH9	-14.04	-24.04	8	PASS
Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*LOG10(3 / 30)					

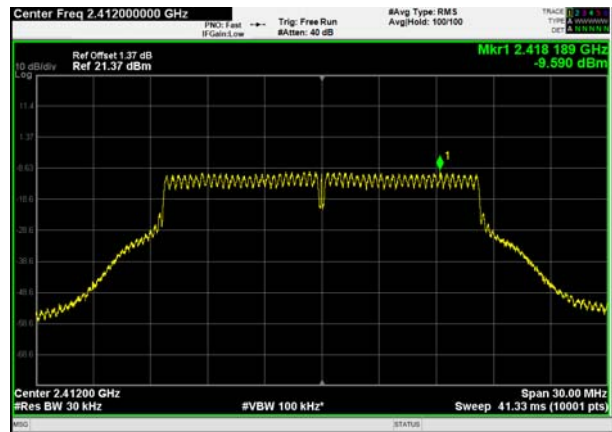
Test Mode	Channel Number	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
Bluetooth (Low Energy) (1M)	2402/CH0	-1.34	-0.58	8.00	PASS
	2440/CH19	-1.67	-0.91	8.00	PASS
	2480/CH39	-1.89	-1.13	8.00	PASS
Bluetooth (Low Energy) (2M)	2402/CH0	-4.63	-2.16	8.00	PASS
	2440/CH19	-3.81	-1.34	8.00	PASS
	2480/CH39	-4.46	-1.99	8.00	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					



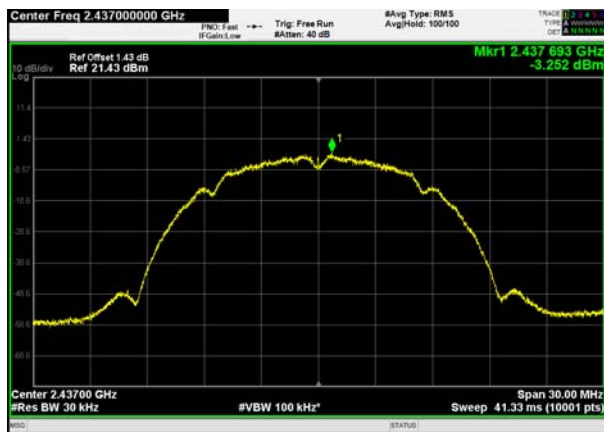
802.11b, Channel No.: 1



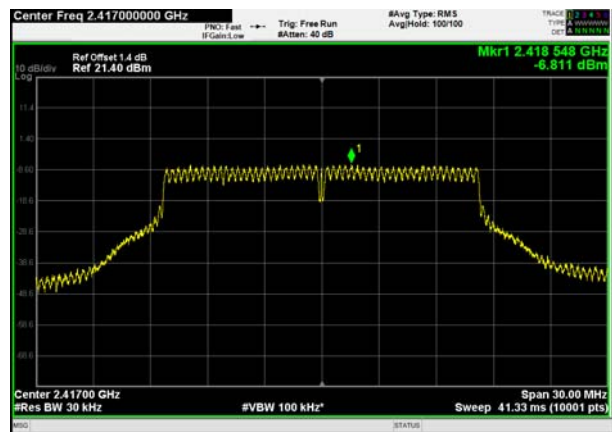
802.11g, Channel No.: 1



802.11b, Channel No.: 6



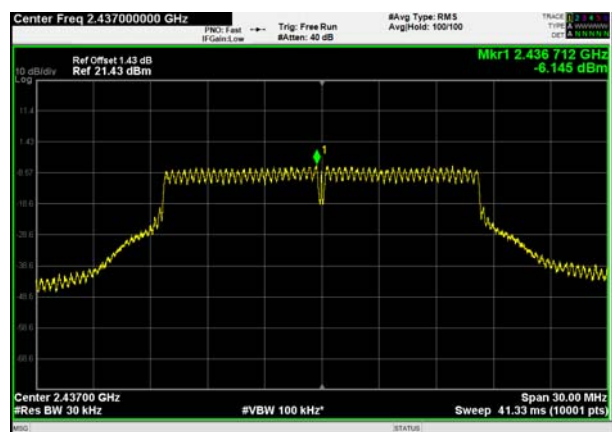
802.11g, Channel No.: 2



802.11b, Channel No.: 11

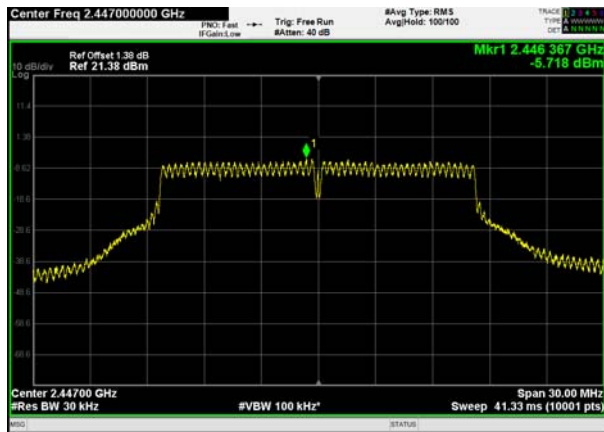


802.11g, Channel No.: 6

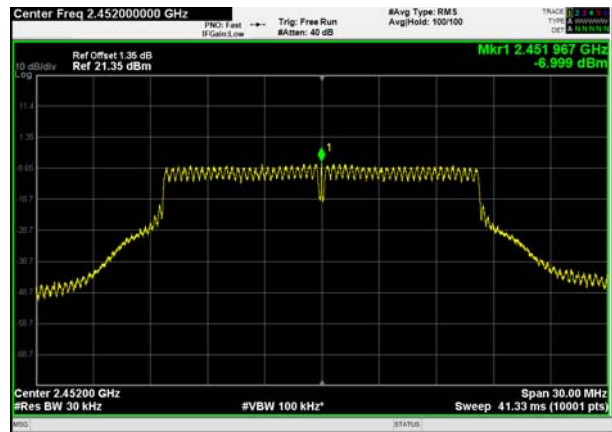




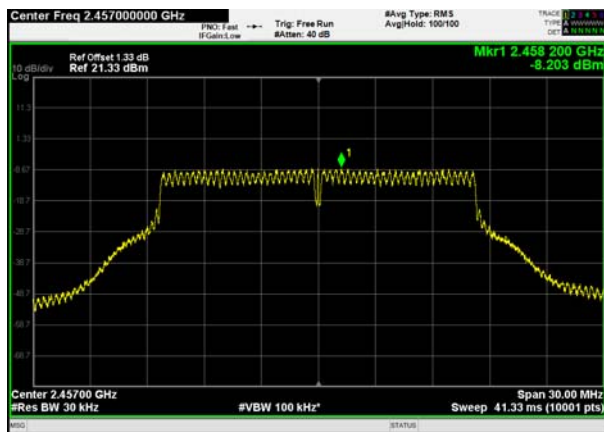
802.11g, Channel No.: 8



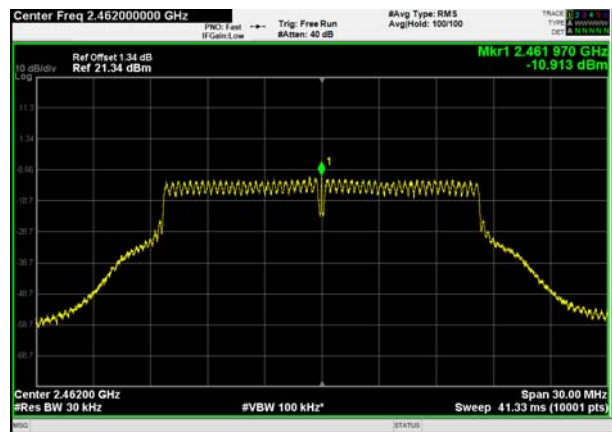
802.11g, Channel No.: 9



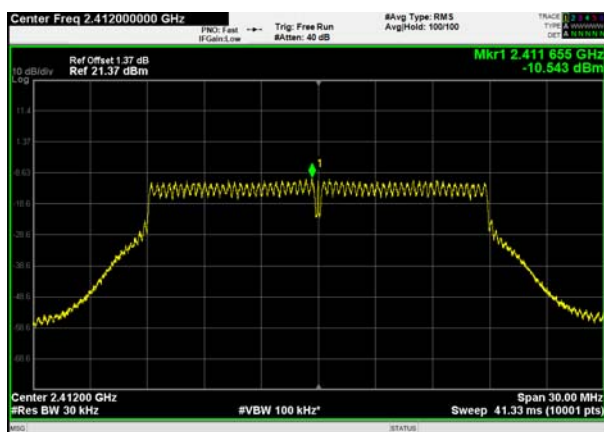
802.11g, Channel No.: 10



802.11g, Channel No.: 11



802.11n(HT20), Channel No. 1

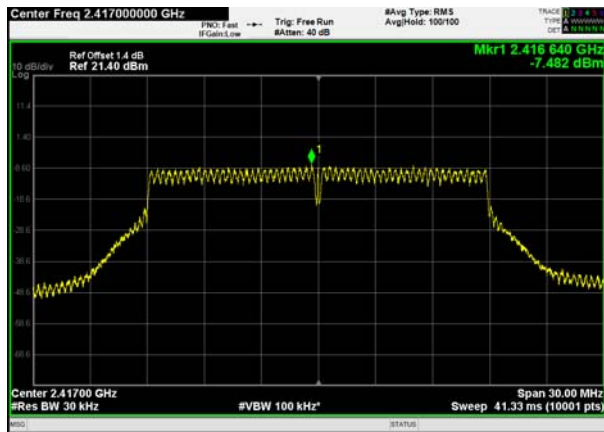


802.11n(HT40), Channel No. 3





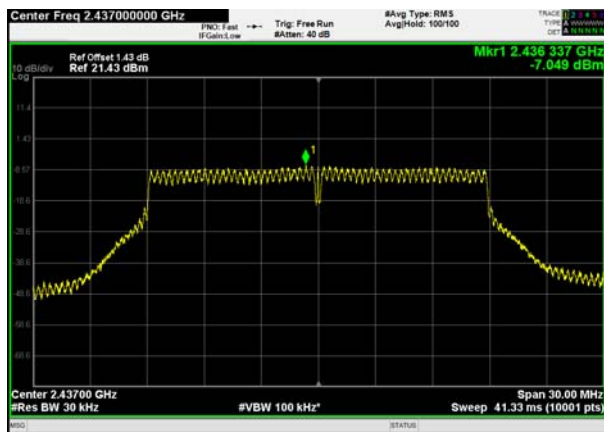
802.11n(HT20), Channel No. 2



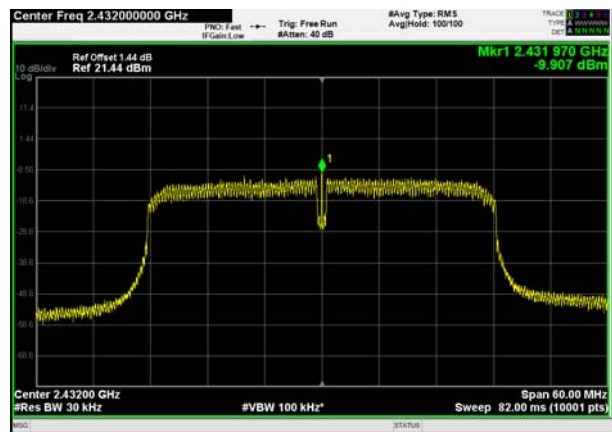
802.11n(HT40), Channel No. 4



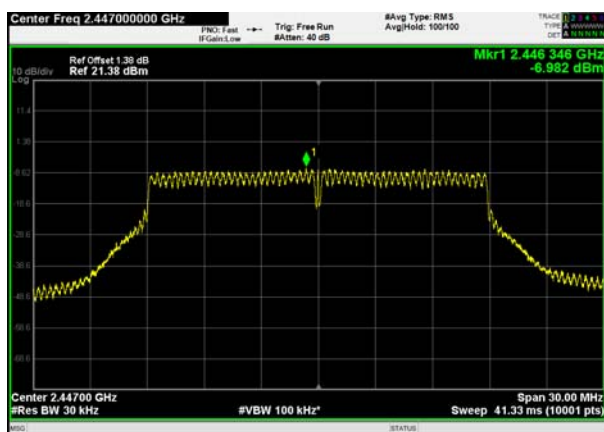
802.11n(HT20), Channel No. 6



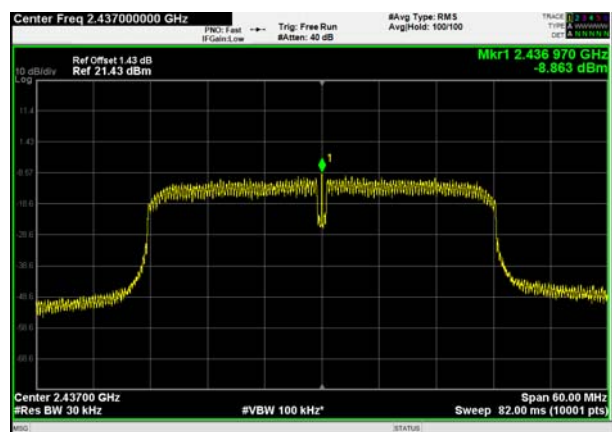
802.11n(HT40), Channel No. 5



802.11n(HT20), Channel No. 8

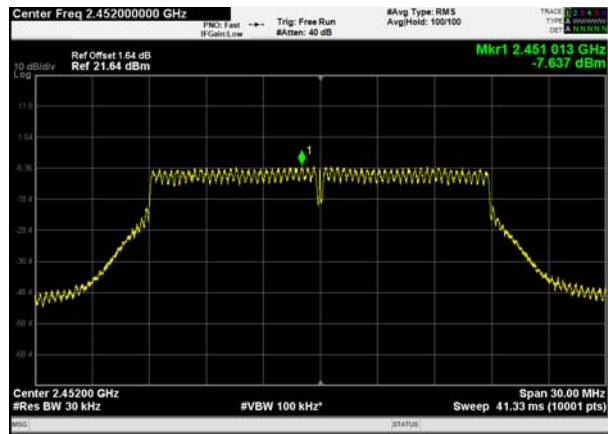


802.11n(HT40), Channel No. 6

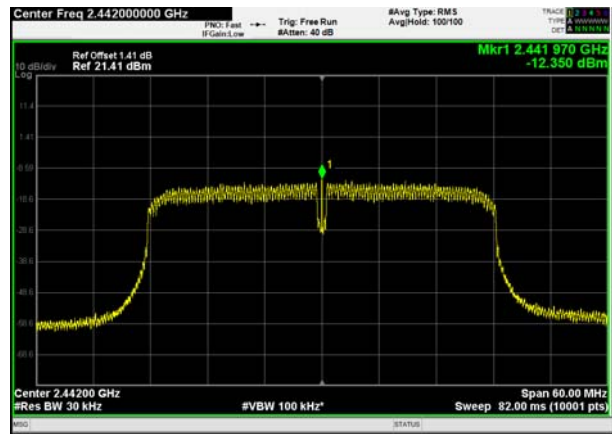




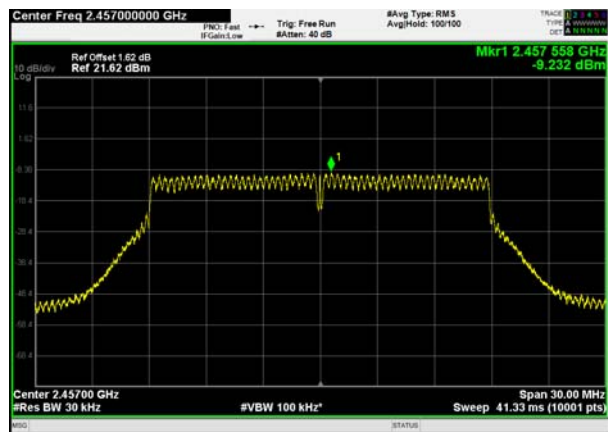
802.11n(HT20), Channel No. 9



802.11n(HT40), Channel No. 7



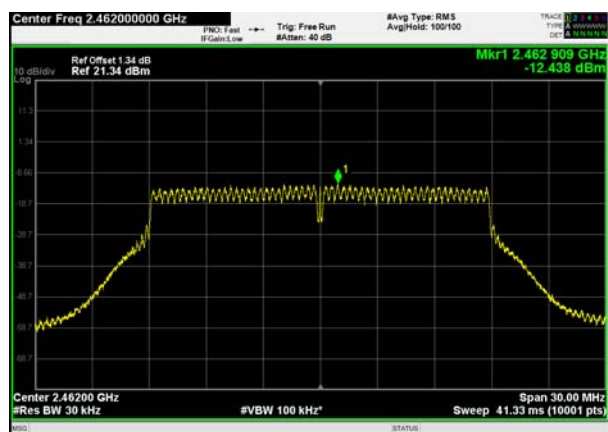
802.11n(HT20), Channel No. 10



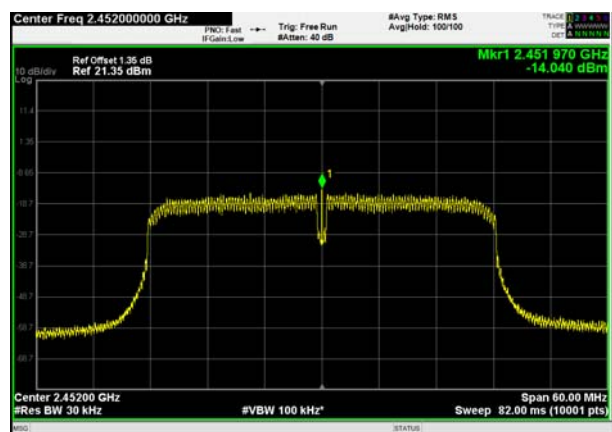
802.11n(HT40), Channel No. 8



802.11n(HT20), Channel No. 11

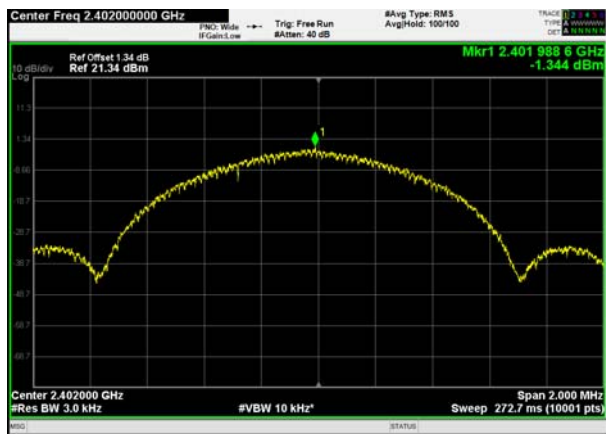


802.11n(HT40), Channel No. 9

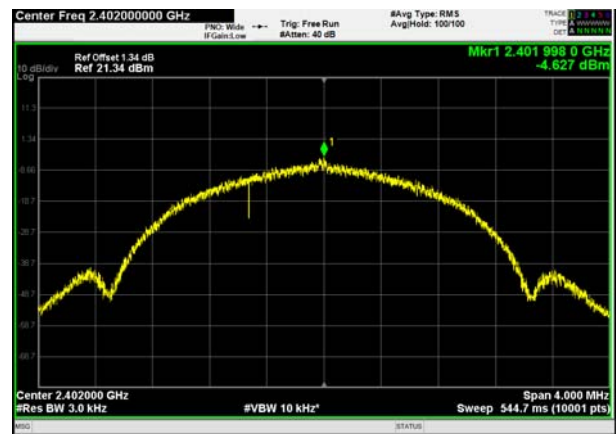




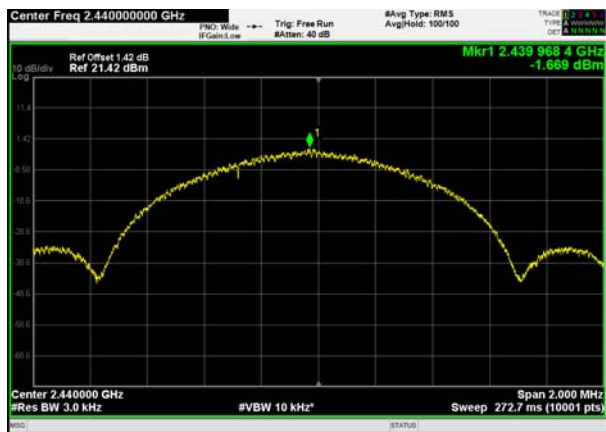
Bluetooth LE (1M), Channel No.: 0



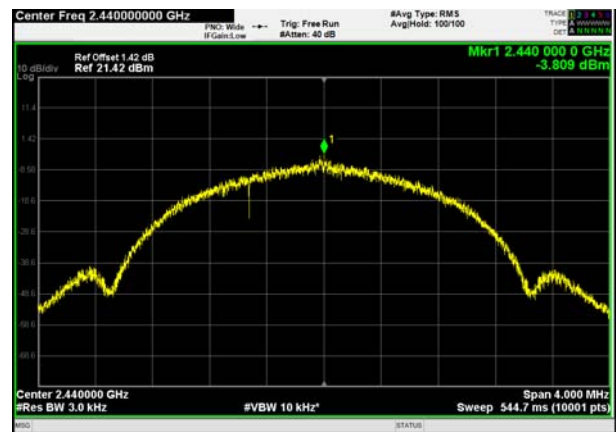
Bluetooth LE (2M), Channel No.: 0



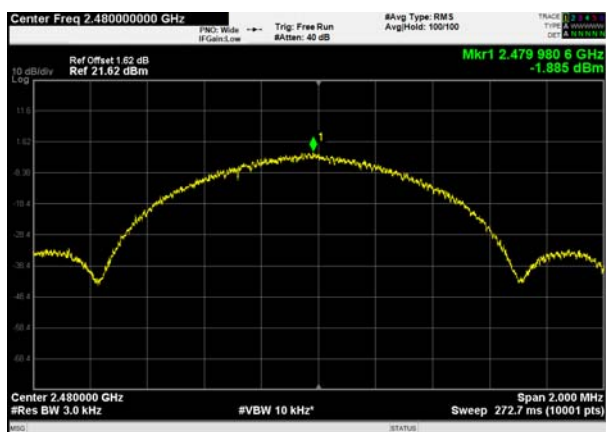
Bluetooth LE (1M), Channel No.: 19



Bluetooth LE (2M), Channel No.: 19



Bluetooth LE (1M), Channel No.: 39



Bluetooth LE (2M), Channel No.: 39



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. Set RBW to 100 kHz and VBW to 300 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 or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. "

Test Mode	Carrier frequency (MHz)	Reference value (dBm)	Limit
802.11b	2412/CH1	9.93	-20.07
	2437/CH6	9.08	-20.92
	2462/CH11	8.55	-21.45
802.11g	2412/CH1	1.29	-28.71
	2417/CH2	6.17	-23.83
	2437/CH6	5.41	-24.59
	2447/CH8	5.77	-24.23
	2452/CH9	3.58	-26.42
	2457/CH10	3.69	-26.31
	2462/CH11	-0.90	-30.90
802.11n HT20	2412/CH1	-0.72	-30.72
	2417/CH2	4.25	-25.75



	2437/CH6	4.88	-25.12
	2447/CH8	5.01	-24.99
	2452/CH9	4.98	-25.02
	2457/CH10	2.55	-27.45
	2462/CH11	-0.57	-30.57
802.11n HT40	2422/CH3	-4.68	-34.68
	2427/CH4	-1.60	-31.60
	2432/CH5	-0.30	-30.30
	2437/CH6	1.41	-28.59
	2442/CH7	-1.19	-31.19
	2447/CH8	-3.43	-33.43
	2452/CH9	-4.05	-34.05
Bluetooth (Low Energy) (1M)	2402/CH0	18.93	-11.07
	2440/CH19	19.99	-10.01
	2480/CH39	20.44	-9.56
Bluetooth (Low Energy) (2M)	2402/CH0	19.43	-10.57
	2440/CH19	20.61	-9.39
	2480/CH39	20.69	-9.31

Measurement Uncertainty

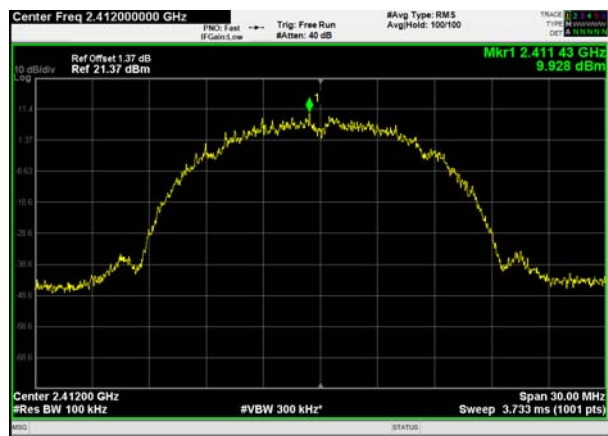
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

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

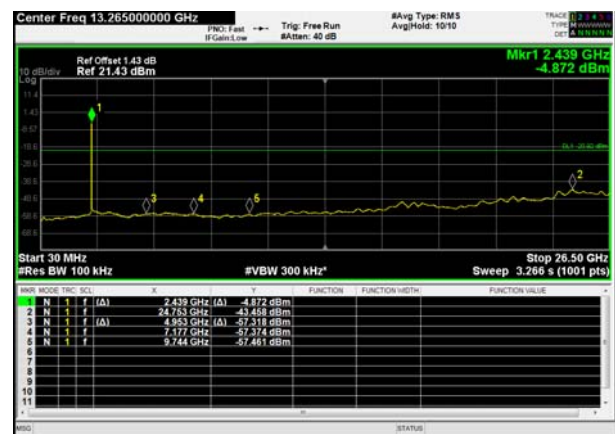
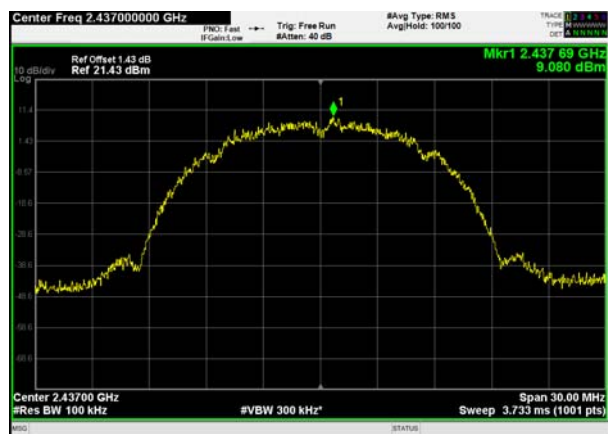


Test Results:

802.11b, Channel No.: 1



802.11b, Channel No.: 6

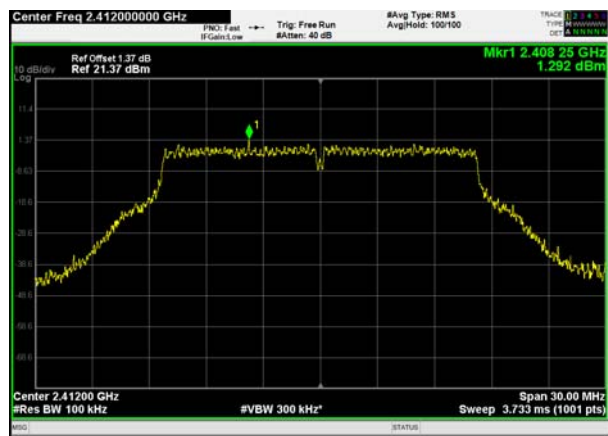


802.11b, Channel No.: 11





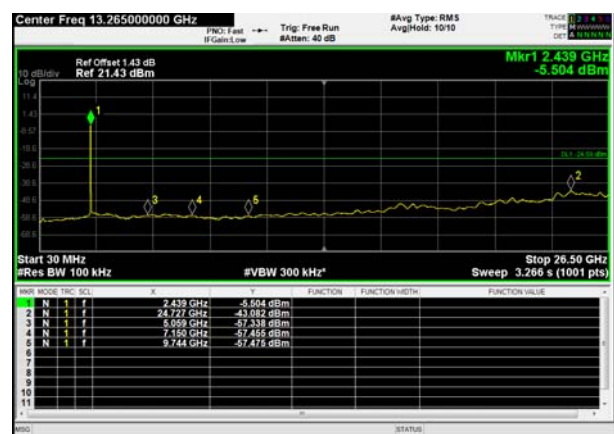
802.11g, Channel No.: 1



802.11g, Channel No.: 2

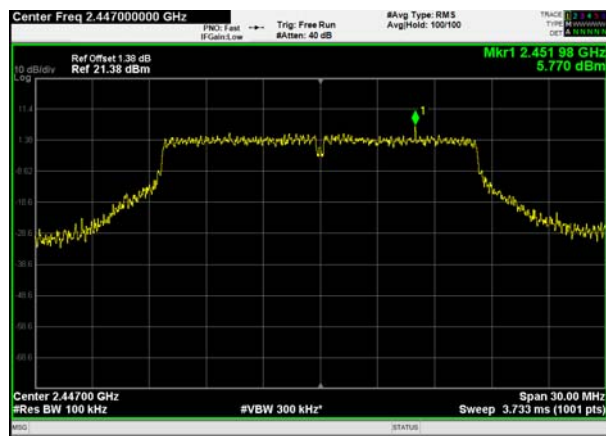


802.11g, Channel No.: 6





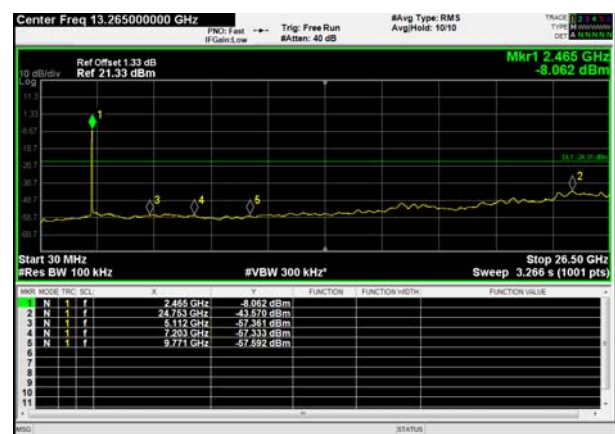
802.11g, Channel No.: 8



802.11g, Channel No.: 9

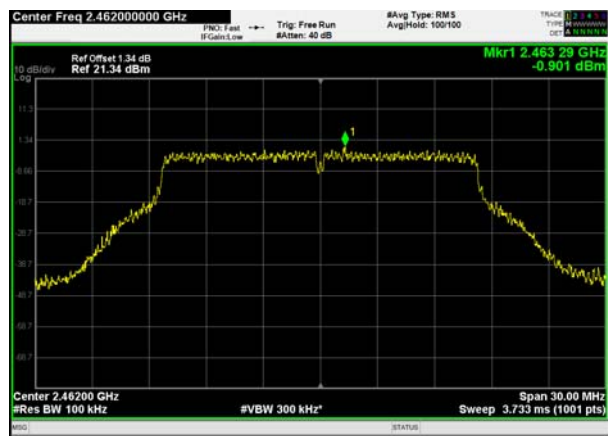


802.11g, Channel No.: 10

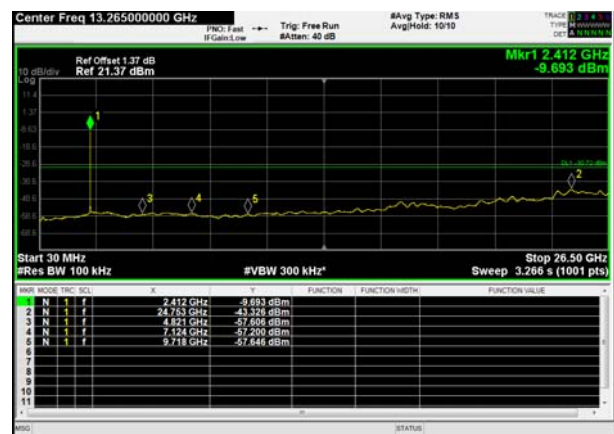




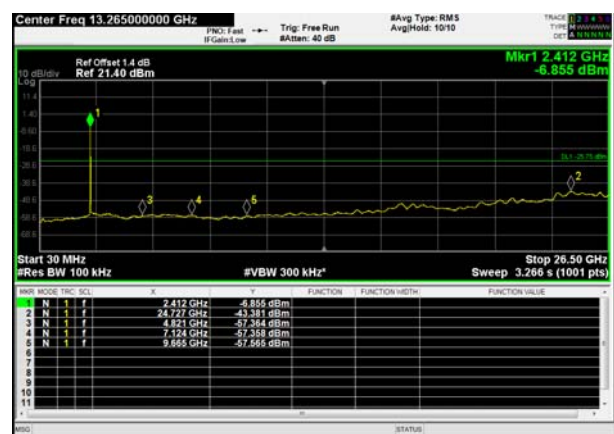
802.11g, Channel No.: 11



802.11n(HT20), Channel No. 1

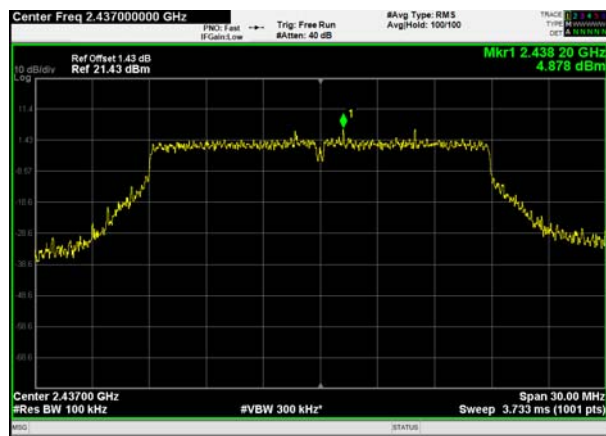


802.11n(HT20), Channel No. 2

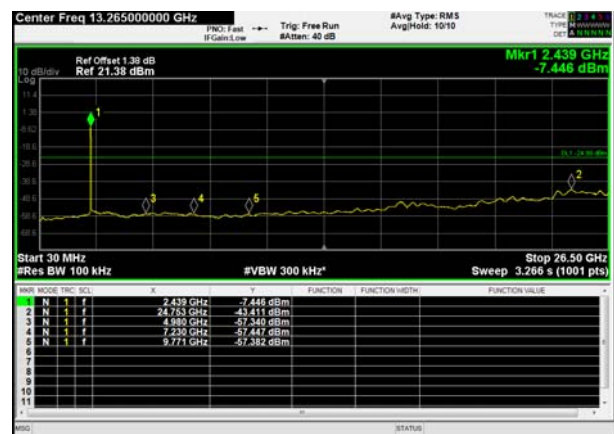




802.11n(HT20), Channel No. 6



802.11n(HT20), Channel No. 8

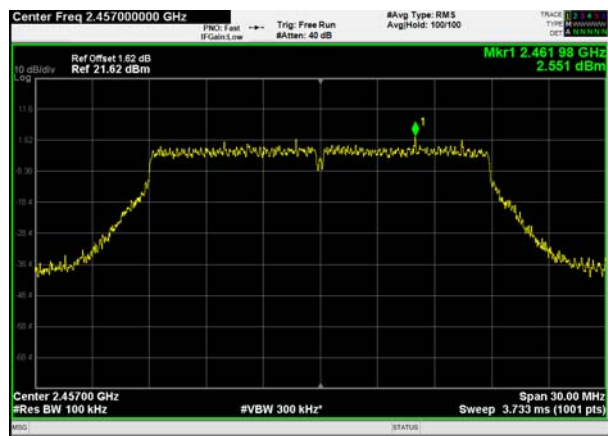


802.11n(HT20), Channel No. 9





802.11n(HT20), Channel No. 10



802.11n(HT20), Channel No. 11



802.11n(HT40), Channel No. 3

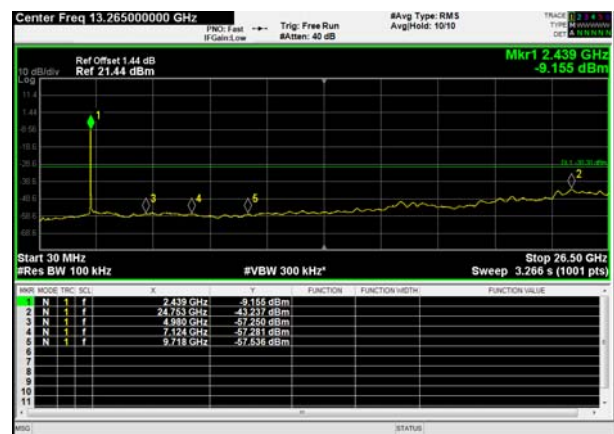




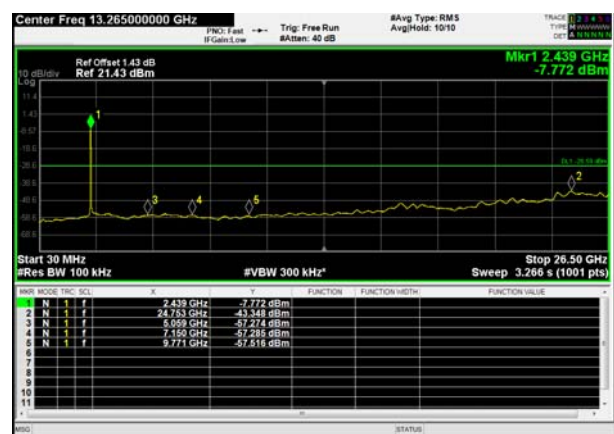
802.11n(HT40), Channel No. 4



802.11n(HT40), Channel No. 5

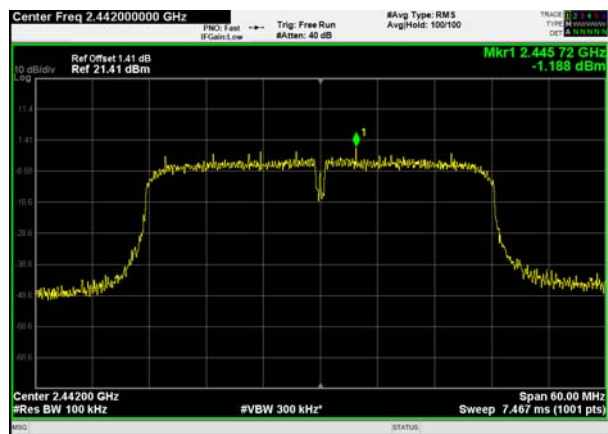


802.11n(HT40), Channel No. 6





802.11n(HT40), Channel No. 7



802.11n(HT40), Channel No. 8



802.11n(HT40), Channel No. 9

