FCC & IC TEST REPORT for DTS Device (2.4G Band)

No. 150601698SHA-001

Applicant	:	Zhone Technologies, Inc. 7195 Oakport St. Oakland, California, USA 94621
Manufacturer	:	TDG Technology Co., Ltd. No.1 Yatai Road, Jiaxing City, Zhejiang Province, P.R.C.
Product Name	:	Optical Network Terminal (ONT)
Type/Model	:	WAW-F-021WRP-A-G-E, ZNID-GPON-2815P-WAC, WAW-F-021WRP-D-G-E, ZNID-GPON-2815P-WDC, WAW-F-021WP-A-G-E, ZNID-GPON-2814P-WAC, WAW-F-021WP-D-G-E, ZNID-GPON-2814P-WDC, WAW-F-021WP-A-E-E, ZNID-GE-2814P-WAC, WAW-F-021WP-D-E-E, ZNID-GE-2814P-WDC,
TEST RESULT	**:**	**PASS**

SUMMARY

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

47CFR Part 15 (2014): Radio Frequency Devices

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

RSS-Gen (Issue 4, November 2014): General Requirements for Compliance of Radio Apparatus

RSS-247 (Issue 1, 2015): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Date of issue: Aug 21, 2015

Prepared by: Reviewed by:

Wakeyou Wang (*Project Engineer*) Daniel Zhao (*Reviewer*)

Description of Test Facility

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Content

1 GENERAL INFORMATION

1.1 Description of Client

Applicant : Zhone Technologies, Inc.

7195 Oakport St. Oakland, California, USA 94621

Name of contact : Doron Paz

Tel : +1 510 777-7143

Fax : /

Email : dpaz@ zhone.com

Manufacturer : TDG Technology Co., Ltd.

No.1 Yatai Road, Jiaxing City, Zhejiang Province, P.R.C.

1.2 Identification of the EUT

Product Name : Optical Network Terminal (ONT)

Type/model : WAW-F-021WRP-A-G-E, ZNID-GPON-2815P-WAC, WAW-F-021WRP-D-G-E, ZNID-GPON-2815P-WDC, WAW-F-021WP-A-G-E, ZNID-GPON-2814P-WAC, WAW-F-021WP-D-G-E, ZNID-GPON-2814P-WDC, WAW-F-021WP-A-E-E, ZNID-GE-2814P-WAC, WAW-F-021WP-D-E-E, ZNID-GE-2814P-WDC,

Description of EUT : EUT has serial models with three kinds of input power: for Adaptor (HKA08054015-6A); POE (S24G0Z-480A050-04) and AC input. They are electrically identical except for different power supply or with/without RFV. We test ZNIDGE-2814P-WAC, ZNID-GE-2814P-WDC, ZNID-GPON-2815P-WAC and ZNID-GPON-2815P-WDC as typical modes and list the worst data.

WAW-F-021WRP-A-G-E	ZNID-GPON-2815P-WAC	1 POTS + 2 GE LAN with PoE + dual-mode Wi-Fi + RFV, AC
WAW-F-021WRP-D-G-E	ZNID-GPON-2815P-WDC	1 POTS + 2 GE LAN with PoE + dual-mode Wi-Fi + RFV, DC
WAW-F-021WP-A-G-E	ZNID-GPON-2814P-WAC	1 POTS + 2 GE LAN with PoE + dual-mode Wi-Fi, AC
WAW-F-021WP-D-G-E	ZNID-GPON-2814P-WDC	1 POTS + 2 GE LAN with PoE + dual-mode Wi-Fi, DC
WAW-F-021WP-A-E-E	ZNID-GE-2814P-WAC	1 POTS + 2 GE LAN with PoE + dual-mode Wi-Fi, AC
WAW-F-021WP-D-E-E	ZNID-GE-2814P-WDC	1 POTS + 2 GE LAN with PoE + dual-mode Wi-Fi, DC

FCC ID : PJZ281XP

1.3 Technical Specification

Operation Frequency Band	:	2400 – 2483.5 MHz
Type of Modulation	:	DBPSK, DQPSK, CCK, BPSK QPSK, 16-QAM, 64-QAM
EUT Modes of Modulation	:	802.11b/g/n20/n40
Channel Number	:	11 channels for 2412~2462MHz 7 channels for 2422~2452MHz for 11n HT40;
Antenna	:	4.0dBi max., un-detachable
Rating		36-56VDC , 1.0A Max for Adaptor; 36-56VDC , 1.0A Max for POE 100~240VAC 50/60Hz
Category of EUT	:	Class B
EUT type	:	☒ Table top ☐ Floor standing
Sample received date	:	July 3, 2015
Sample Identification No	:	/
Date of test	:	July 3, 2015 ~ Aug 13, 2015

MIMO Function Description:

Modulation	Transmission / Idle		Beam forming	Beam forming gain
	Port 0	Port 1		
802.11b	Transmission	NO	NO	0 dBi
802.11g	Transmission	NO	NO	0 dBi
802.11 n20	Transmission	Transmission	NO	0 dBi
802.11 n40	Transmission	Transmission	NO	0 dBi

Note: the graphs showed in the report under 802.11 n20 & 802.11 n40 is the first one for port 0 while second one for port 1.

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2014)
RSS-Gen (Issue 4, November 2014)
RSS-247 (Issue 1, 2015)
ANSI C63.10 (2013)
KDB 558074 (V03R03)

2.2 Mode of operation during the test

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

2.3 Test software list

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

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	PC	HP ProBook 6450b	/
2	POE Adapter	Xingjin S24G0Z-480A050-04	Non-Shielded, 1.8m
3	Adapter	Huntkey HKA08054015-6A	Non-Shielded, 1.8m

2.5 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2014-10-21	2015-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2014-10-20	2015-10-19
Test Receiver	ESCI 7	R&S	EC4501	2014-12-25	2015-12-24
Semi-anechoic chamber	-	Albatross project	EC 3048	2015-5-11	2016-5-10
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2015-1-8	2016-1-7
High Pass Filter	WHKX 2.8/18G-12SS	Wainwright	EC4297-2	2015-1-8	2016-1-7
High Pass Filter	WHKX 7.0/1.8G-8SS	Wainwright	EC4297-3	2015-1-8	2016-1-7
Band Reject Filter	WRCGV 2400/2483-2390/2493-35/10SS	Wainwright	EC4297-4	2015-1-8	2016-1-7
RF cable	SUCOFLEX 104	HUBER+SUHNER	/	2015-2-13	2016-2-12
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2015-4-27	2016-4-26
Horn antenna	HF 906	R&S	EC 3049	2015-4-27	2016-4-26
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2015-4-20	2016-4-19
Spectrum analyzer	E7402A	Agilent	EC2254	2014-08-16	2015-08-15

2.6 Test Summary

This report applies to tested sample only. The test results have been compared directly with the limits, and the measurement uncertainty is recorded. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Minimum 6dB Bandwidth & Occupied bandwidth	15.247(a)(2)	RSS-247 Issue 1 Annex 5.2	Pass
Maximum peak output power	15.247(b)	RSS-247 Issue 1 Annex 5.4	Pass
Power spectrum density	15.247(e)	RSS-247 Issue 1 Annex 5.2	Pass
Radiated emission	15.205 & 15.209	RSS-Gen Issue 4 Clause 8.10	Pass
Emission outside the frequency band	15.247(d)	RSS-247 Issue 1 Annex 5.4	Pass
Power line conducted emission	15.207	RSS-Gen Issue 4 Clause 8.8	Pass
99% Bandwidth	/	RSS-Gen Issue 4 Clause 6.6	Tested

Notes: 1: NA =Not Applicable

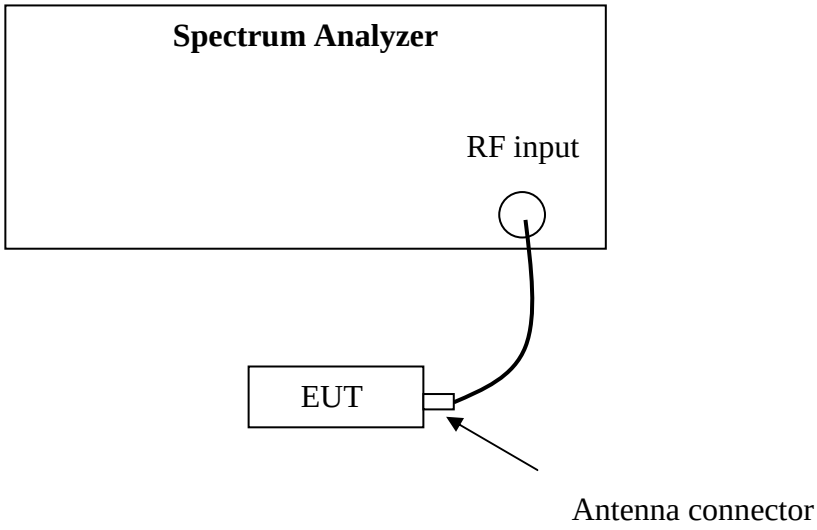
3 Minimum 6dB Bandwidth

Test result: Pass

3.1 Limit

For systems using digital modulation techniques that may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands, the minimum 6 dB bandwidth shall be at least 500 kHz.

3.2 Test Configuration



3.3 Test Procedure and test setup

The minimum 6dB bandwidth per FCC §15.247(a)(2) is measured using the Spectrum Analyzer according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance v03r03” for compliance to FCC 47CFR 15.247 requirements(clause 8.2).

3.4 Test Protocol

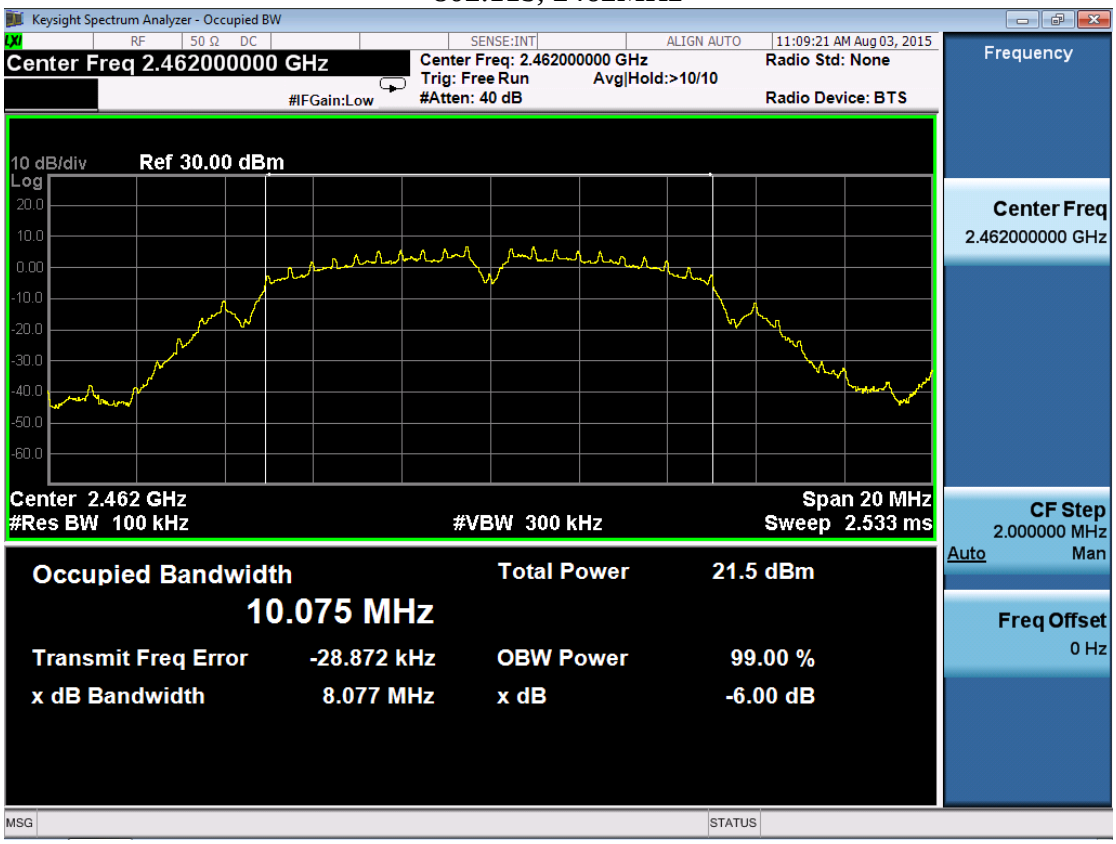
Temperature: 25 °C
Relative Humidity: 55 %

Modulation	Frequency (MHz)	Minimum 6dB Bandwidth(MHz)		Limits (MHz)
		Port 0	Port 1	
802.11b	2412	8.07	/	> 0.5
	2437	8.08	/	> 0.5
	2462	8.08	/	> 0.5
802.11g	2412	15.10	/	> 0.5
	2437	15.11	/	> 0.5
	2462	15.11	/	> 0.5
802.11n20	2412	15.11	17.13	> 0.5
	2437	15.11	16.07	> 0.5
	2462	15.11	15.91	> 0.5
802.11n40	2422	36.32	36.32	> 0.5
	2437	36.33	36.34	> 0.5
	2452	35.75	36.33	> 0.5

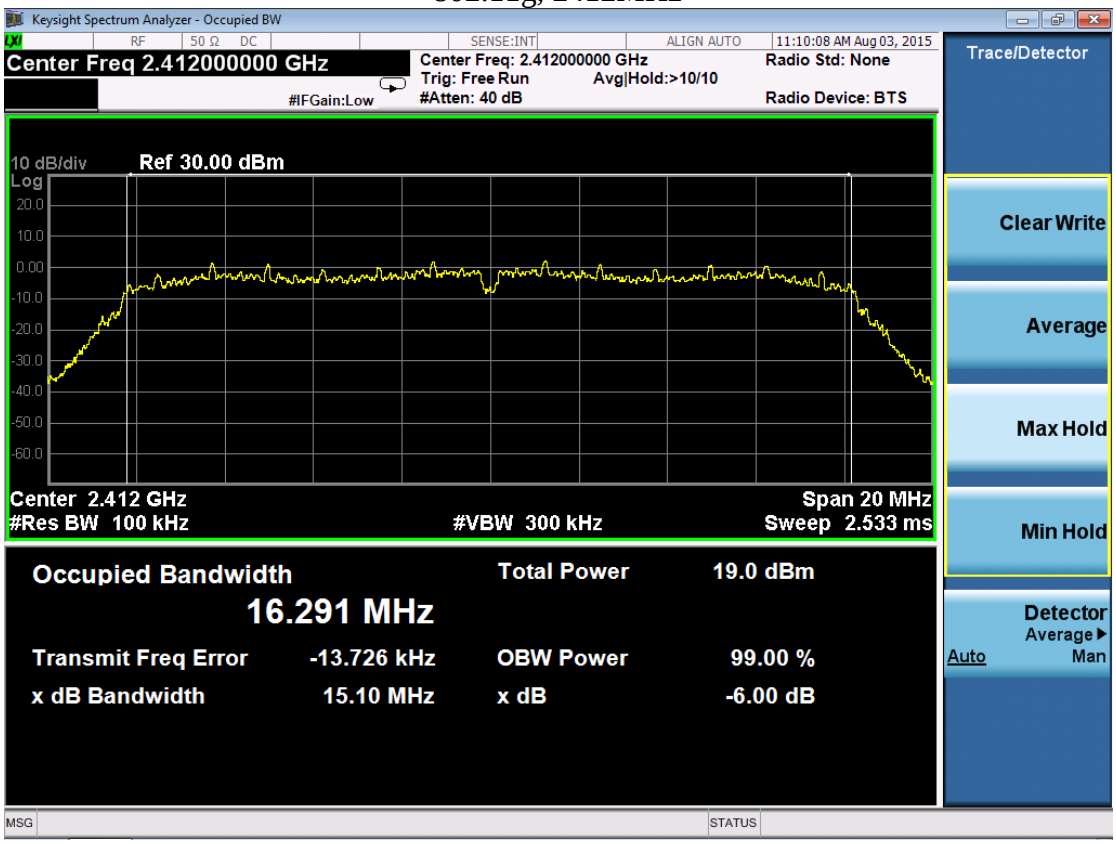
802.11b, 2412MHz

802.11b, 2437MHz

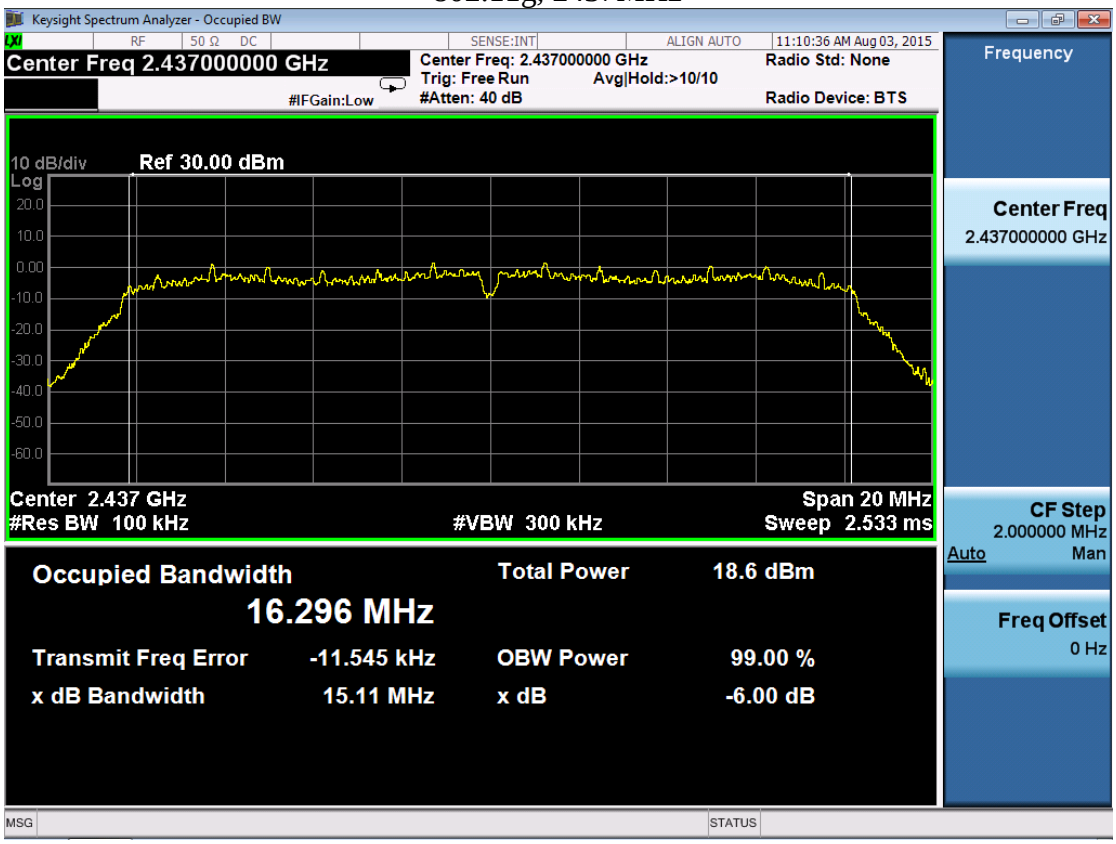
802.11b, 2462MHz



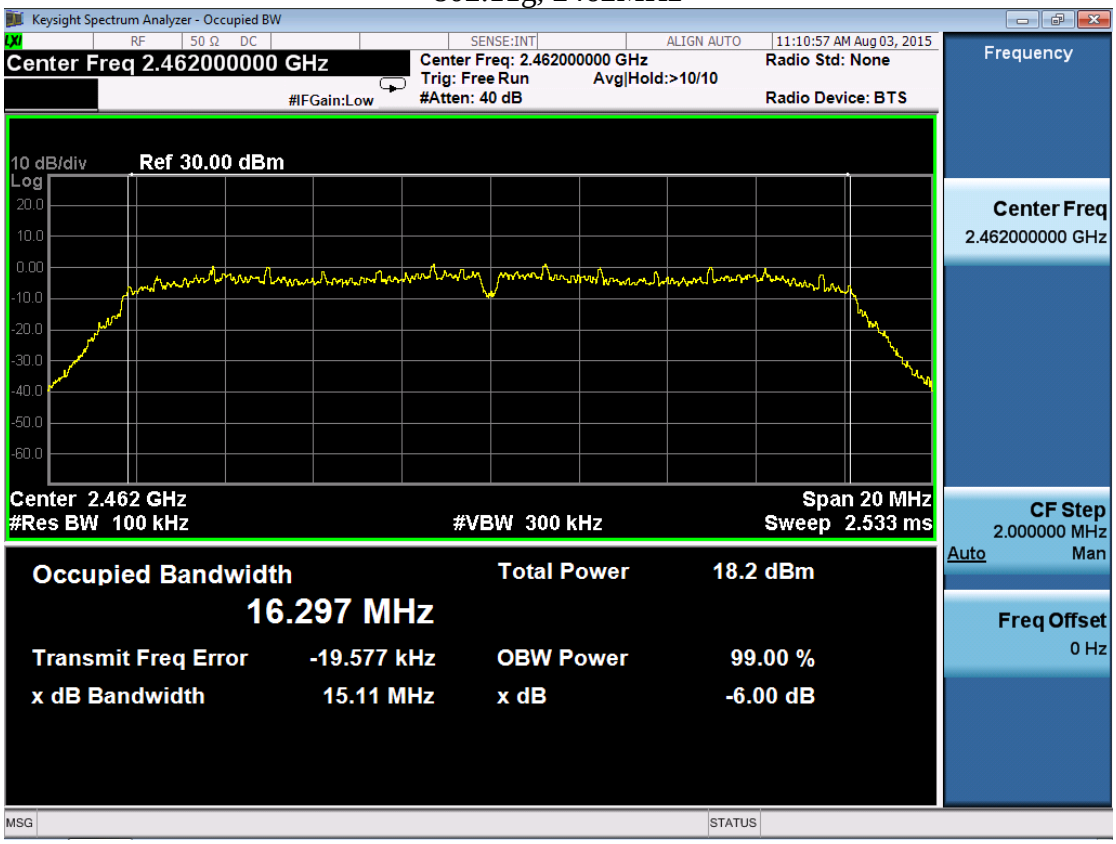
802.11g, 2412MHz



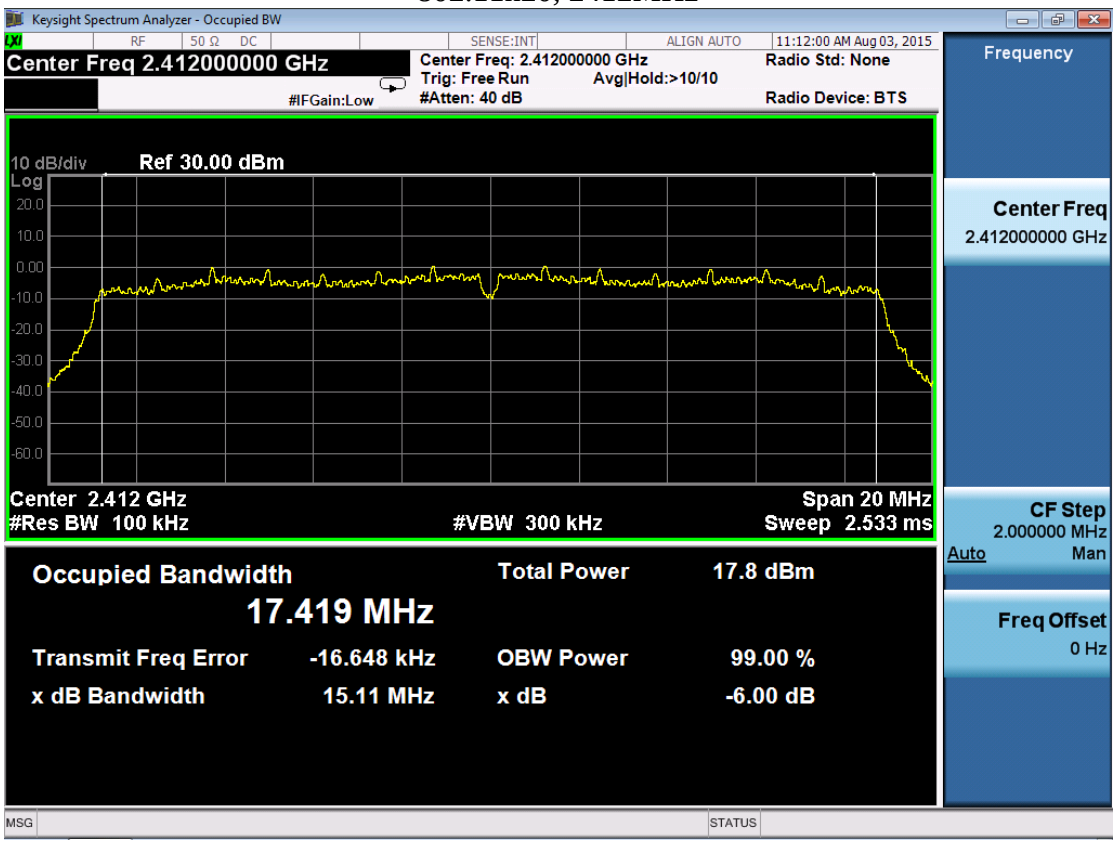
802.11g, 2437MHz

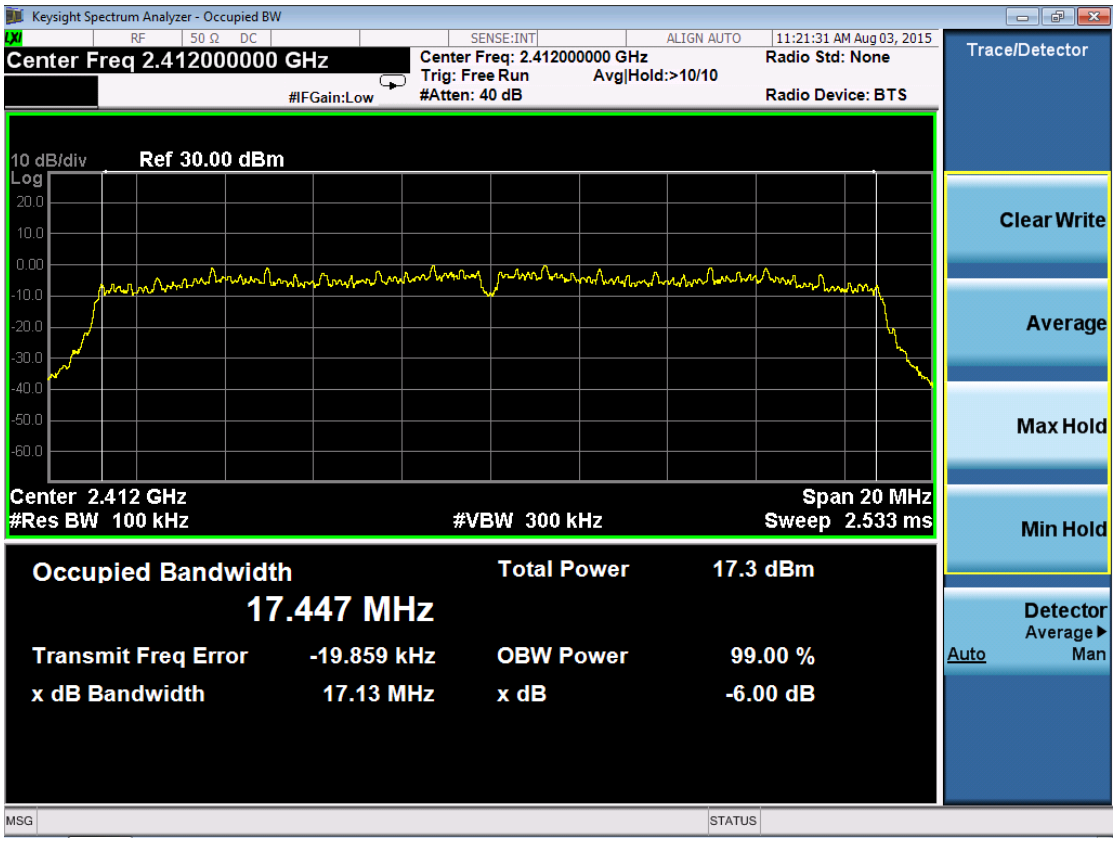


802.11g, 2462MHz

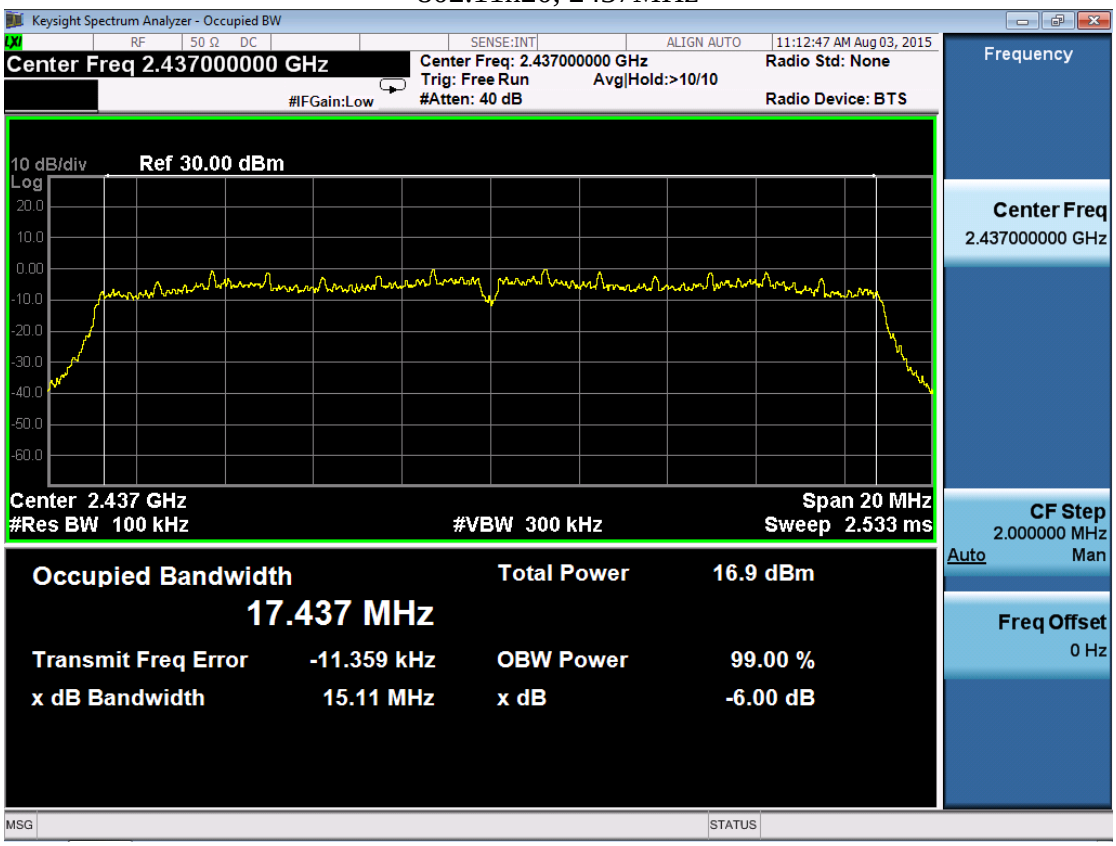


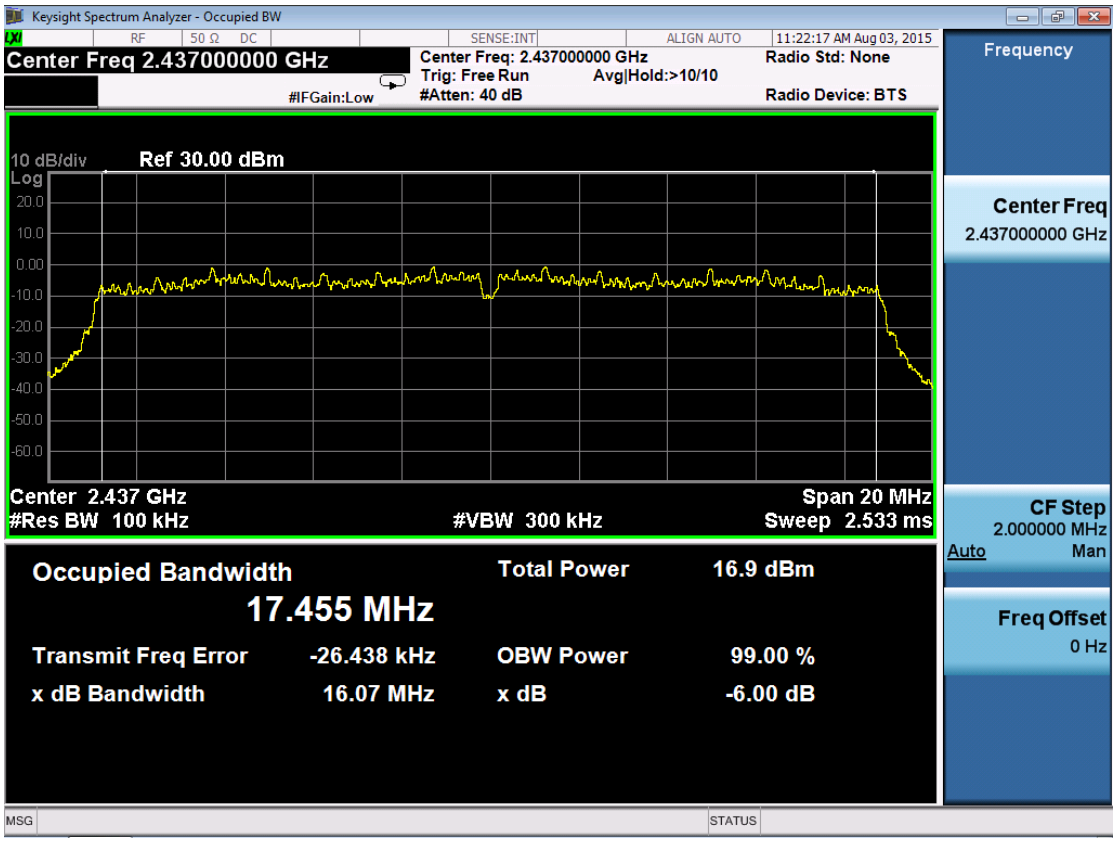
802.11n20, 2412MHz



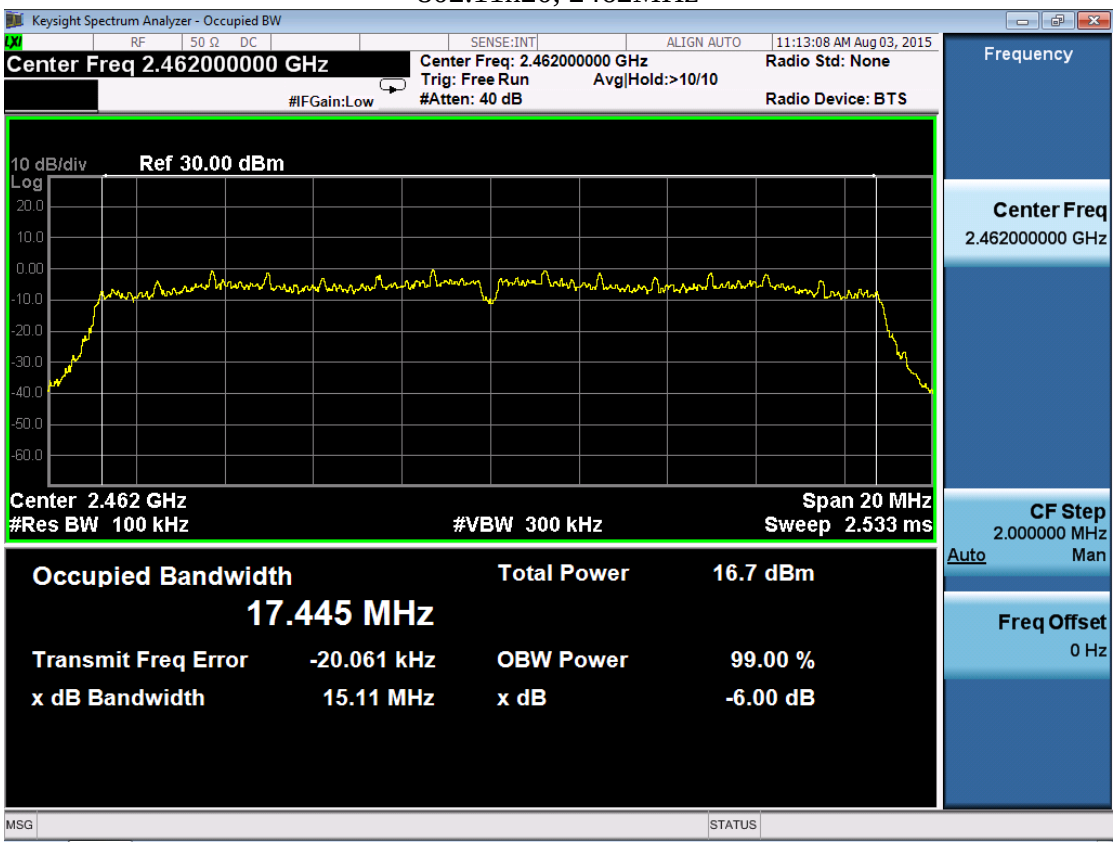


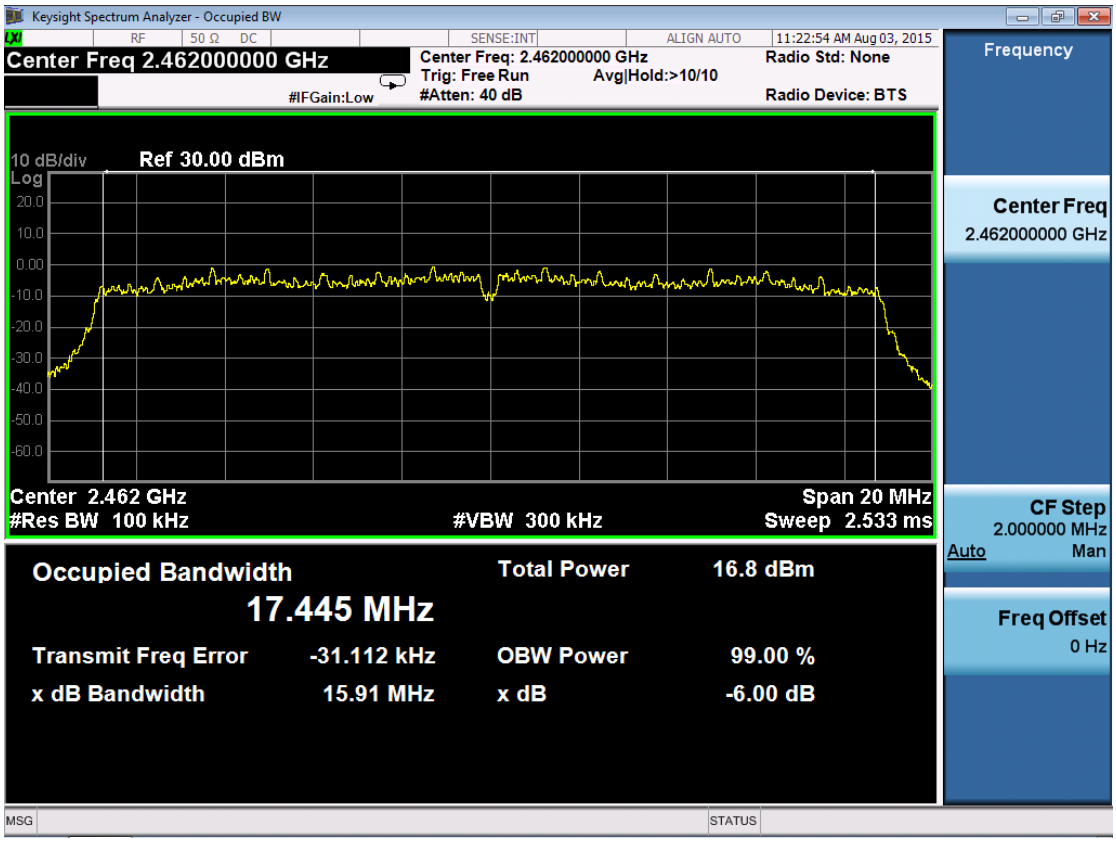
802.11n20, 2437MHz



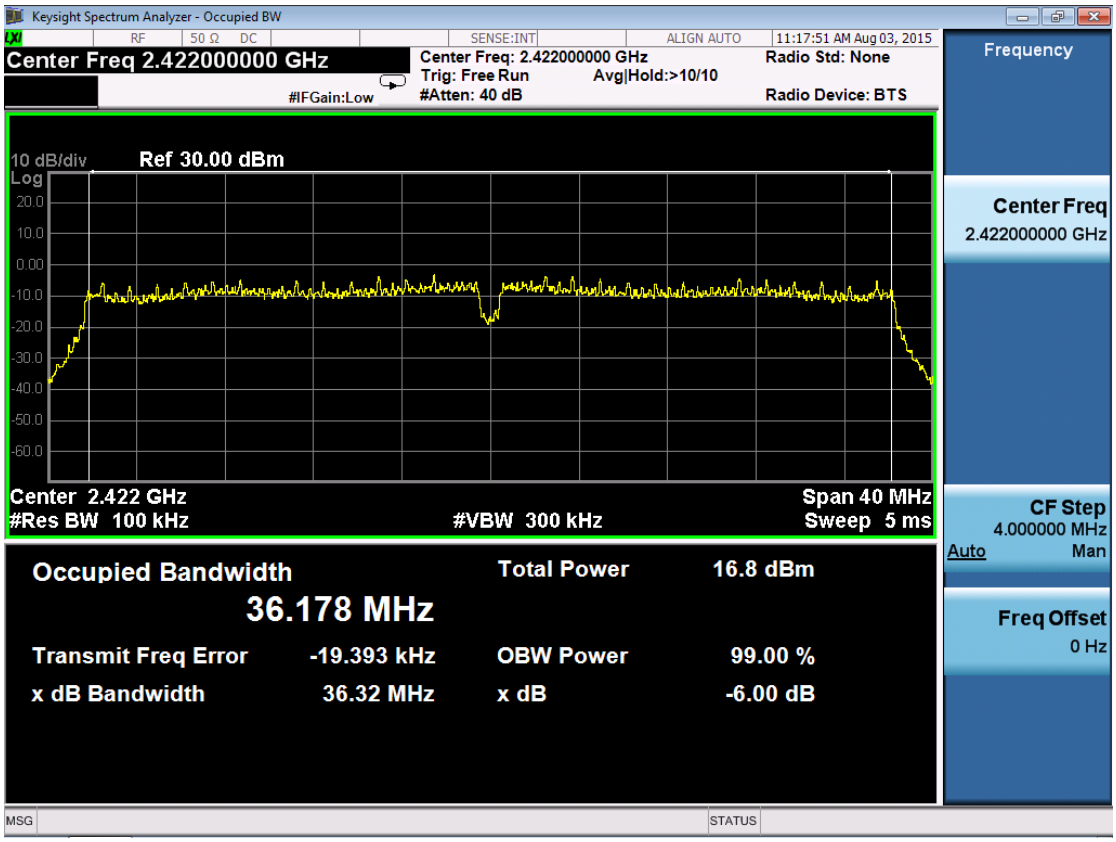


802.11n20, 2462MHz

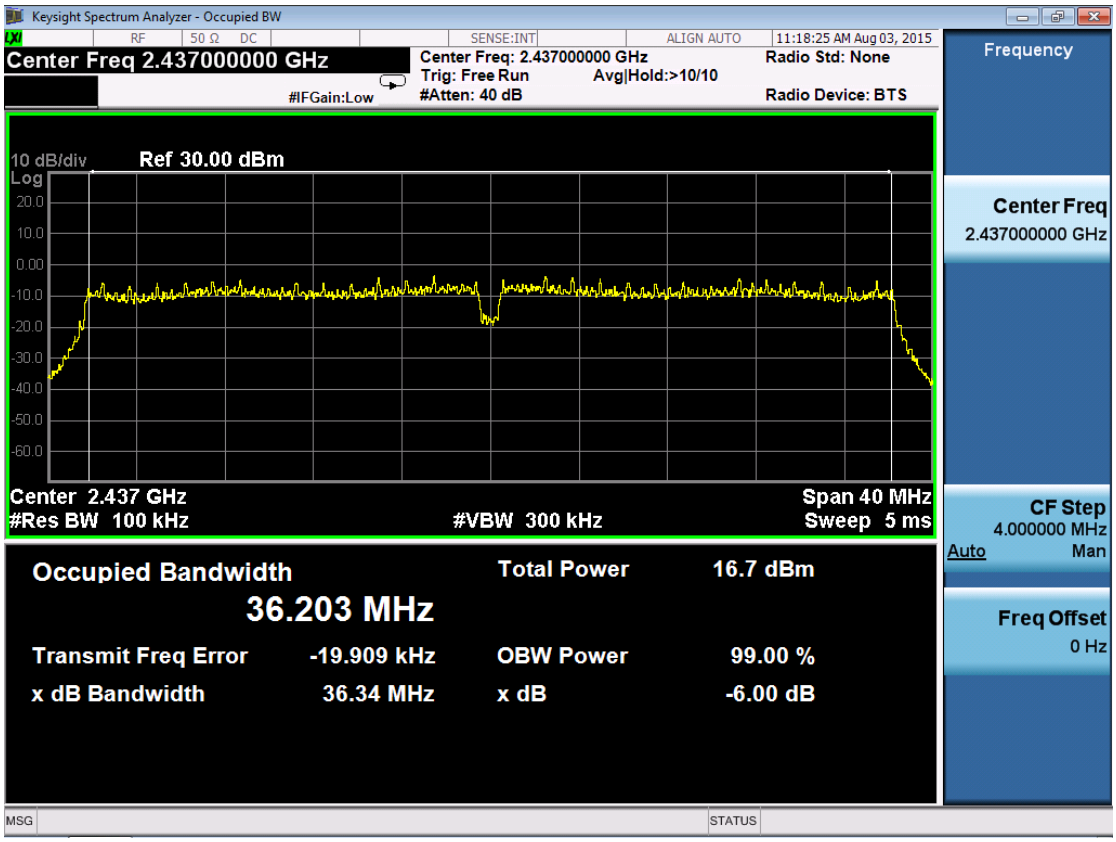




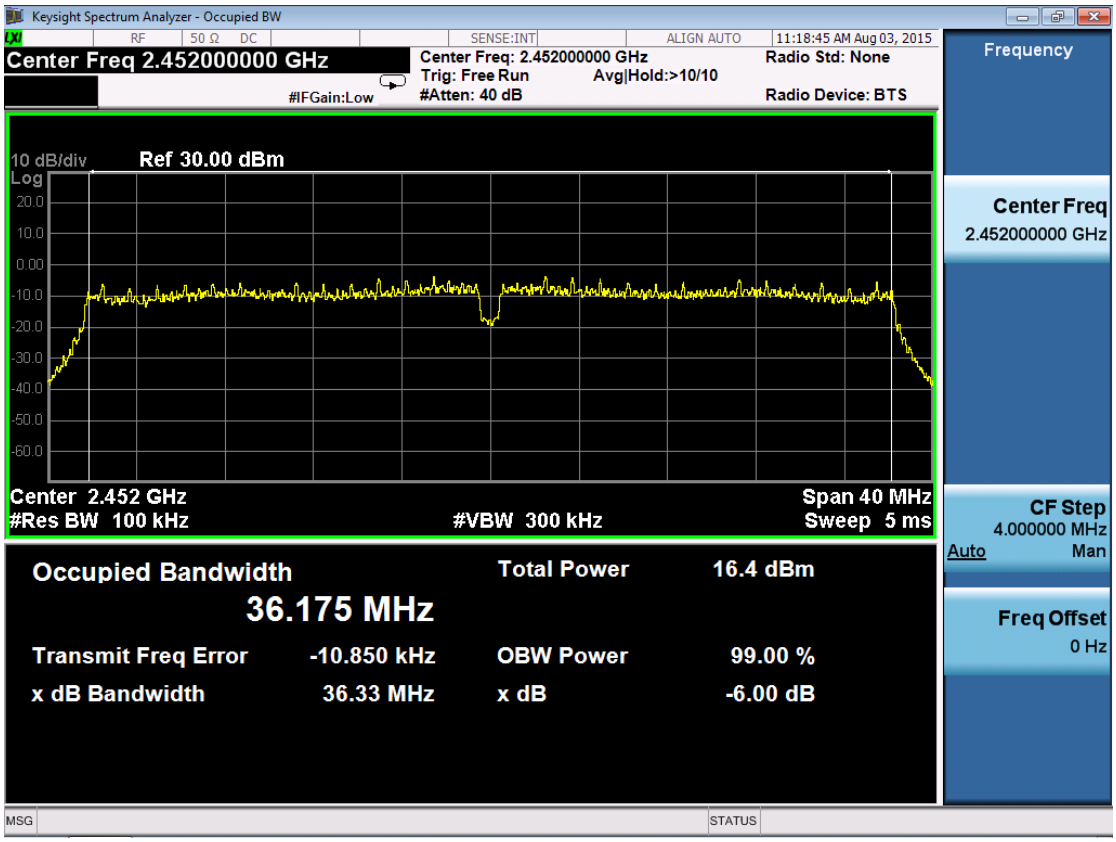
802.11n40, 2422MHz



802.11n40, 2437MHz



802.11n40, 2452MHz



4 Maximum Conducted Output power

Test result: Pass

4.1 Test limit

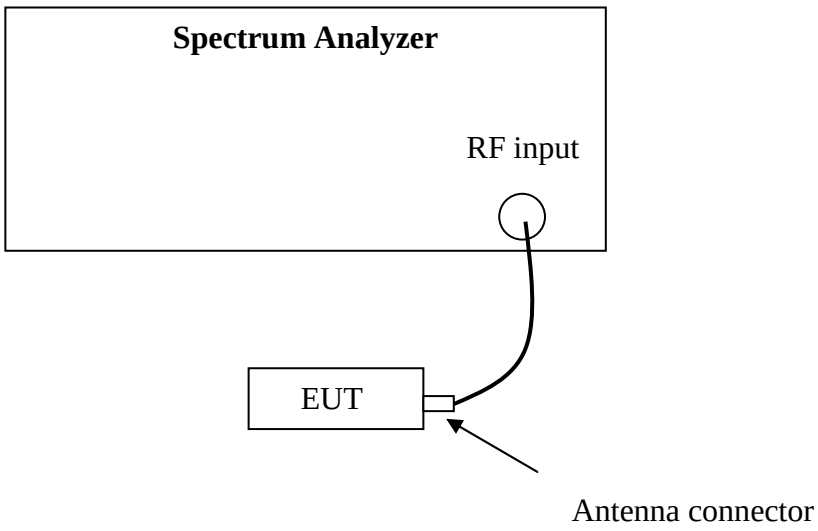
☐ For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

☐ For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

☒ For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

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

4.2 Test Configuration



4.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r03" for compliance to FCC 47CFR 15.247 requirements (clause 9.2.2.4).

a) Measure the duty cycle, x, of the transmitter output signal as described in 6.0.

b) Set span to at least 1.5 times the OBW.

c) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.

d) Set VBW ≥ 3 x RBW.

e) Number of points in sweep ≥ 2 span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)

f) Sweep time = auto.

g) Detector = RMS (*i.e.*, power averaging), if available. Otherwise, use sample detector mode.

h) Do not use sweep triggering. Allow the sweep to "free run".

i) Trace average at least 100 traces in power averaging (*i.e.*, RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.

j) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

k) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle is 25 %.

4.4 Test protocol

Temperature: 25 °C
Relative Humidity: 55 %

Test Mode	Frequency (MHz)	Reading (dBm)		Duty cycle factor (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
		Port 0	Port 1				
802.11b	2412	15.66	/	0	15.66	30.00	14.34
	2437	15.01	/	0	15.01	30.00	14.99
	2462	14.67	/	0	14.67	30.00	15.33
802.11g	2412	12.65	/	0.58	13.23	30.00	16.77
	2437	12.31	/	0.58	12.89	30.00	17.11
	2462	11.98	/	0.58	12.56	30.00	17.44
802.11n20	2412	10.65	11.07	0.61	14.49	30.00	15.51
	2437	10.15	10.82	0.61	14.12	30.00	15.88
	2462	10.01	10.52	0.61	13.89	30.00	16.11
802.11n40	2422	9.18	9.98	1.07	13.68	30.00	16.32
	2437	8.96	9.81	1.07	13.49	30.00	16.51
	2452	8.76	9.72	1.07	13.35	30.00	16.65

Note:

Reading port x (mW) = 10 ^ (reading port x (dBm)/10+ duty cycle factor (dB)/10);
x = 0, 1.
Total Power (mW) = reading port 0 (mW)+reading port 1 (mW)
Total power (dBm) = 10 * log (Total power(mW))

5 Power spectrum density

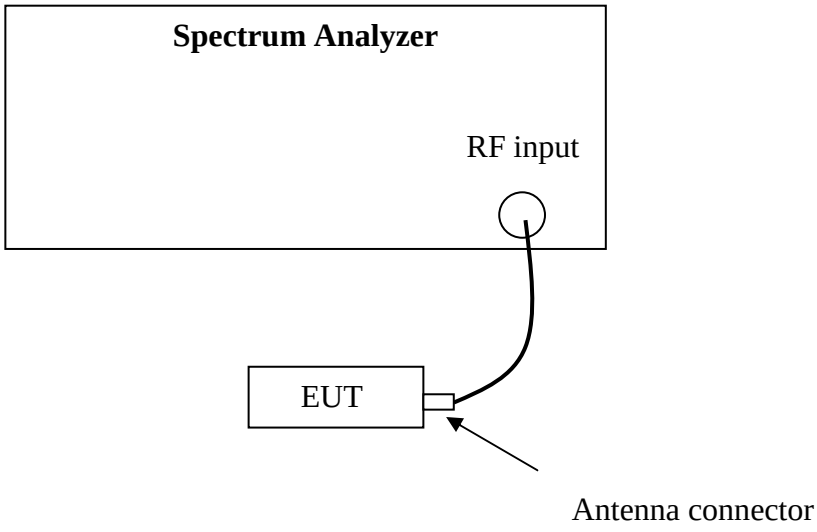
Test result: Pass

5.1 Test limit

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

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 8dBm/MHz and 8+ (6 –antenna gain-beam forming gain).

5.2 Test Configuration



5.3 Test procedure and test setup

The power output per FCC §15.247(e) was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r03" (clause 10.5) for compliance to FCC 47CFR 15.247 requirements.

This procedure is applicable when the EUT cannot be configured to transmit continuously (*i.e.*, duty cycle < 98%), and when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level, and when the transmission duty cycle is constant (*i.e.*, duty cycle variations are less than ± 2 percent):

a) Measure the duty cycle (x) of the transmitter output signal as described in 6.0.
b) Set instrument center frequency to DTS channel center frequency.
c) Set span to at least 1.5 times the OBW.
d) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz..
e) Set VBW ≥3 x RBW.
f) Detector = power averaging (RMS) or sample detector (when RMS not available).
g) Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
h) Sweep time = auto couple.
i) Do not use sweep triggering. Allow sweep to "free run".
j) Employ trace averaging (RMS) mode over a minimum of 100 traces.
k) Use the peak marker function to determine the maximum amplitude level.
l) Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time.
m) If resultant value exceeds the limit, then reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

5.4 Test Protocol

Temperature: 25 °C
Relative Humidity: 55 %

Test Mode	Frequency (MHz)	Reading (dBm/3kHz)		Duty cycle factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
		Port 0	Port 1				
802.11b	2412	-18.75	/	0	-18.75	8.00	26.75
	2437	-18.43	/	0	-18.43	8.00	26.43
	2462	-19.31	/	0	-19.31	8.00	27.31
802.11g	2412	-22.82	/	0.58	-22.24	8.00	30.24
	2437	-23.55	/	0.58	-22.97	8.00	30.97
	2462	-22.86	/	0.58	-22.28	8.00	30.28
802.11n20	2412	-24.25	-24.48	0.61	-20.74	8.00	28.74
	2437	-25.36	-24.17	0.61	-21.10	8.00	29.10
	2462	-24.31	-24.58	0.61	-20.82	8.00	28.82
802.11n40	2422	-24.02	-24.21	1.07	-20.03	8.00	28.03
	2437	-24.09	-23.86	1.07	-19.89	8.00	27.89
	2452	-24.06	-24.27	1.07	-20.08	8.00	28.08

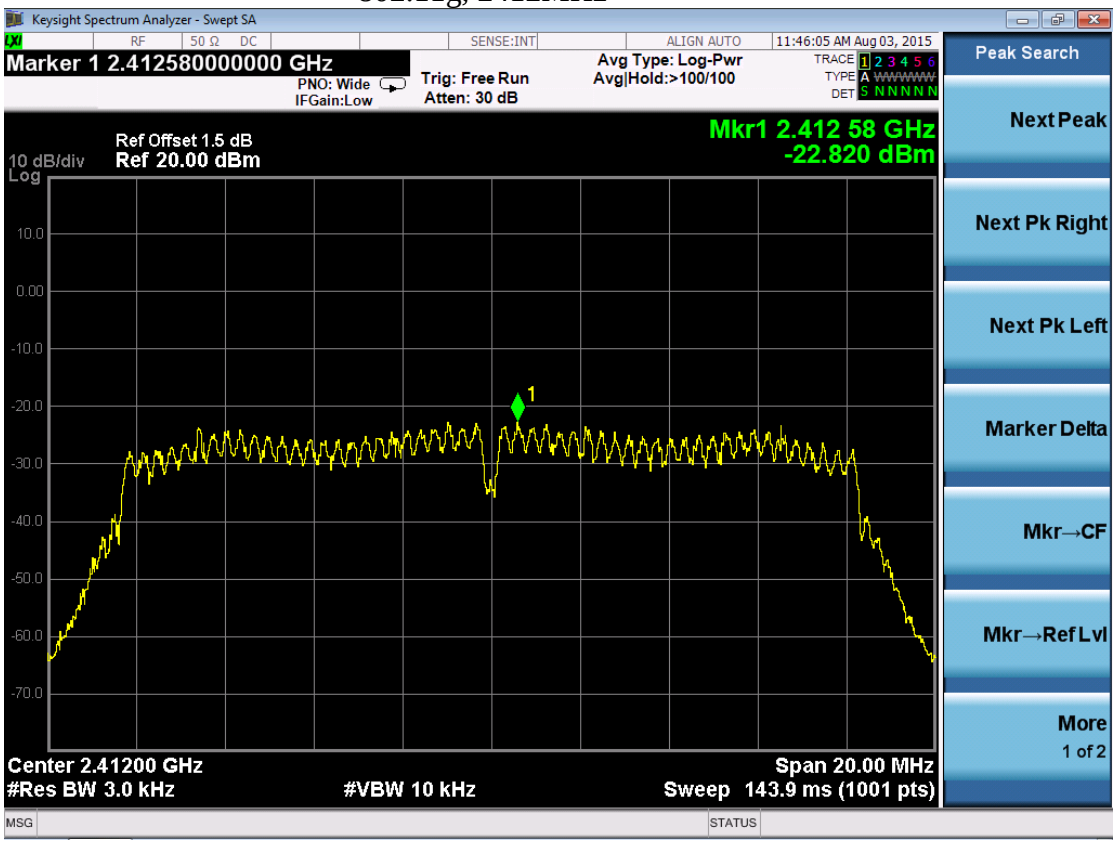
Note 1:
PSD port x (mW) = 10 ^ (PSD port x (dBm)/10+ duty cycle factor (dB)/10);
x = 0, 1.
Total PSD (mW) = PSD port 0 (mW) + PSD port 1 (mW)
Total PSD (dBm) = 10 * log (Total PSD (mW))

802.11b, 2412MHz

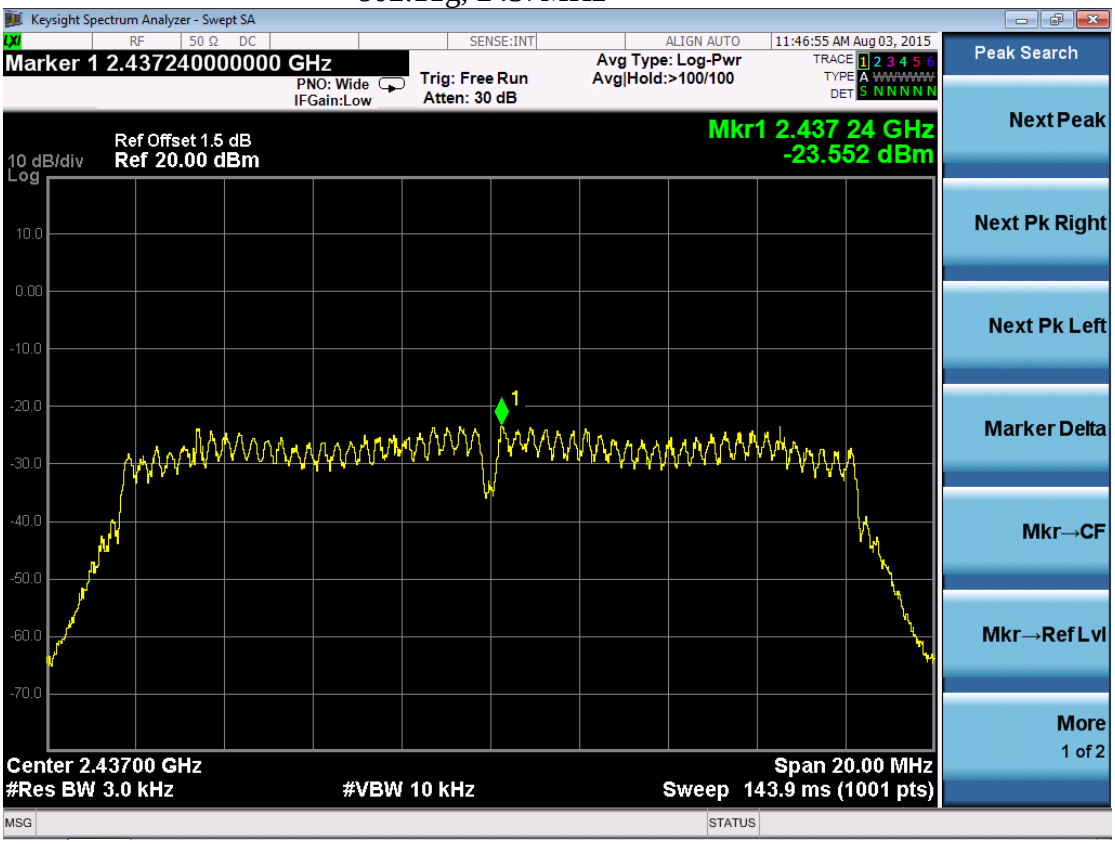
802.11b, 2437MHz

802.11b, 2462MHz

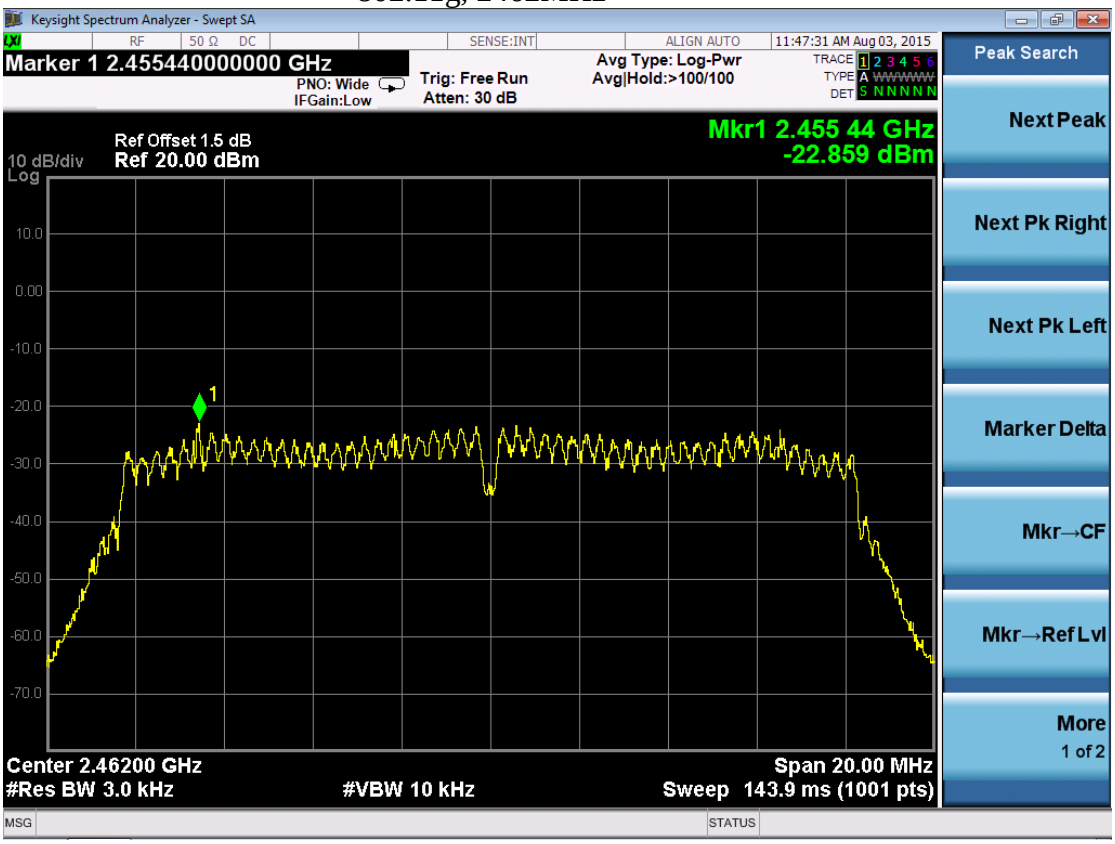
802.11g, 2412MHz



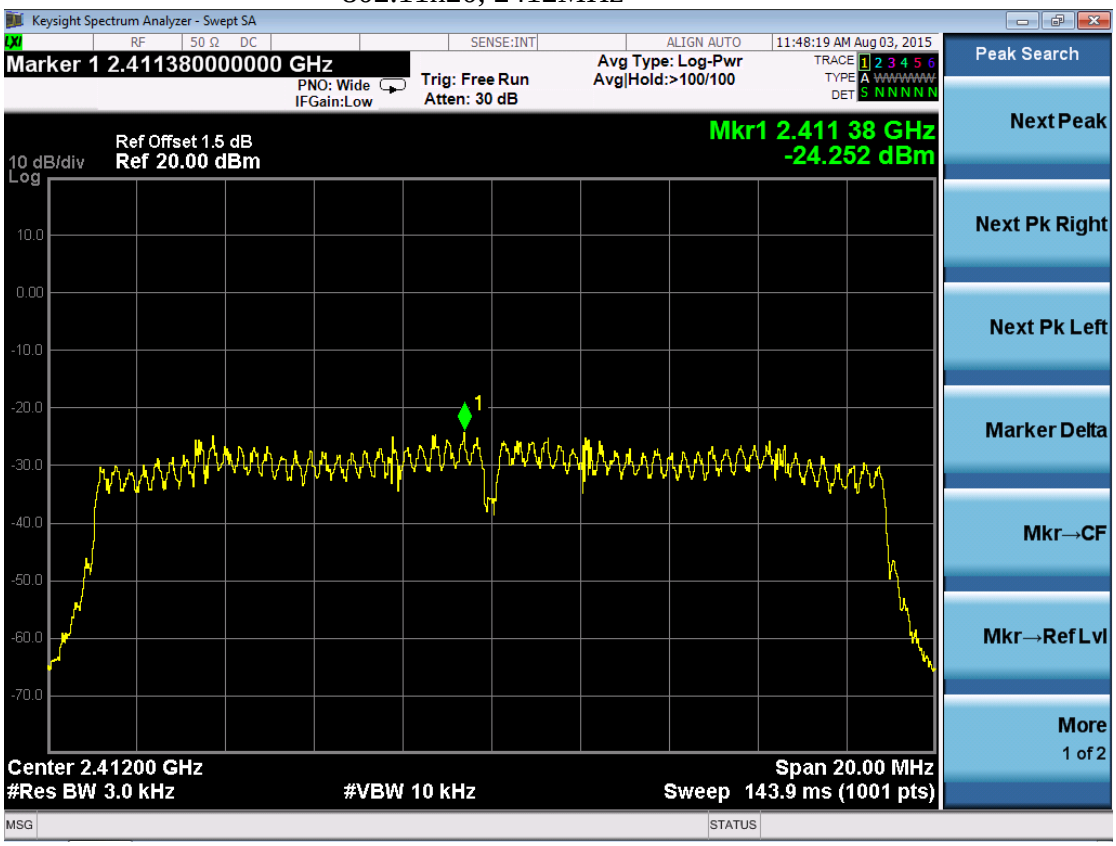
802.11g, 2437MHz

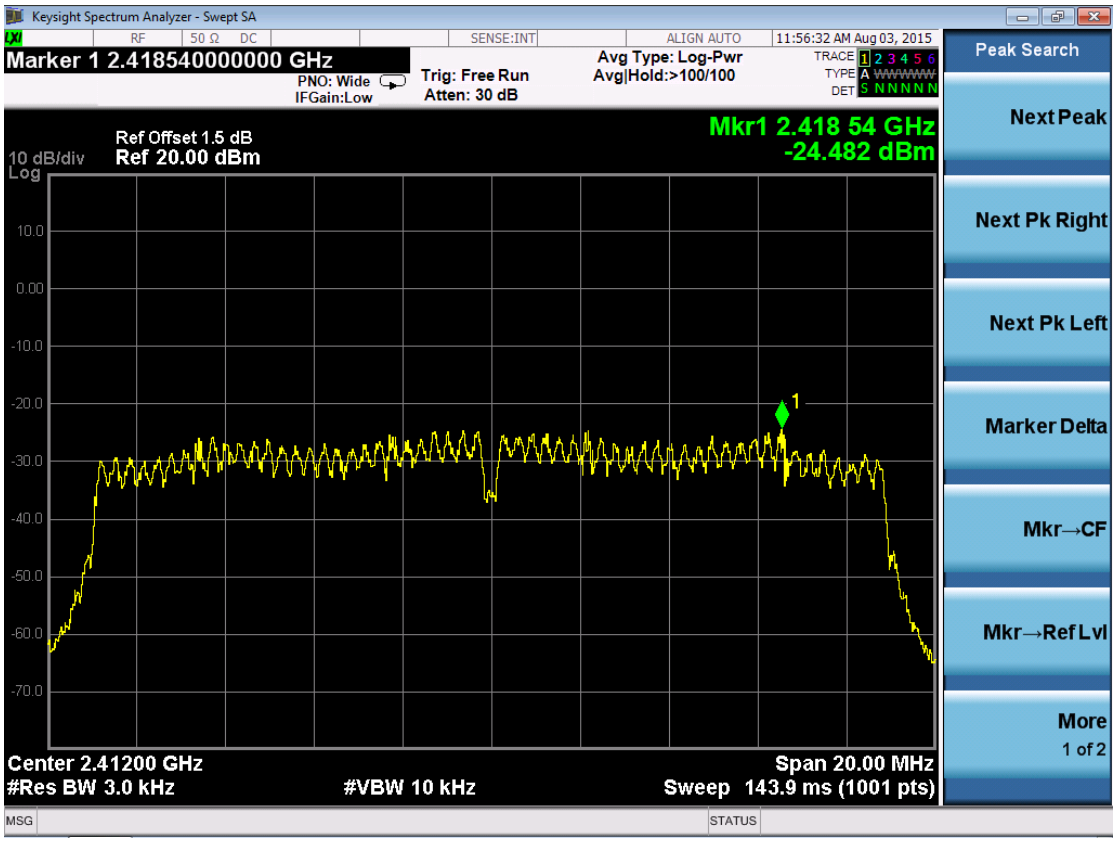


802.11g, 2462MHz

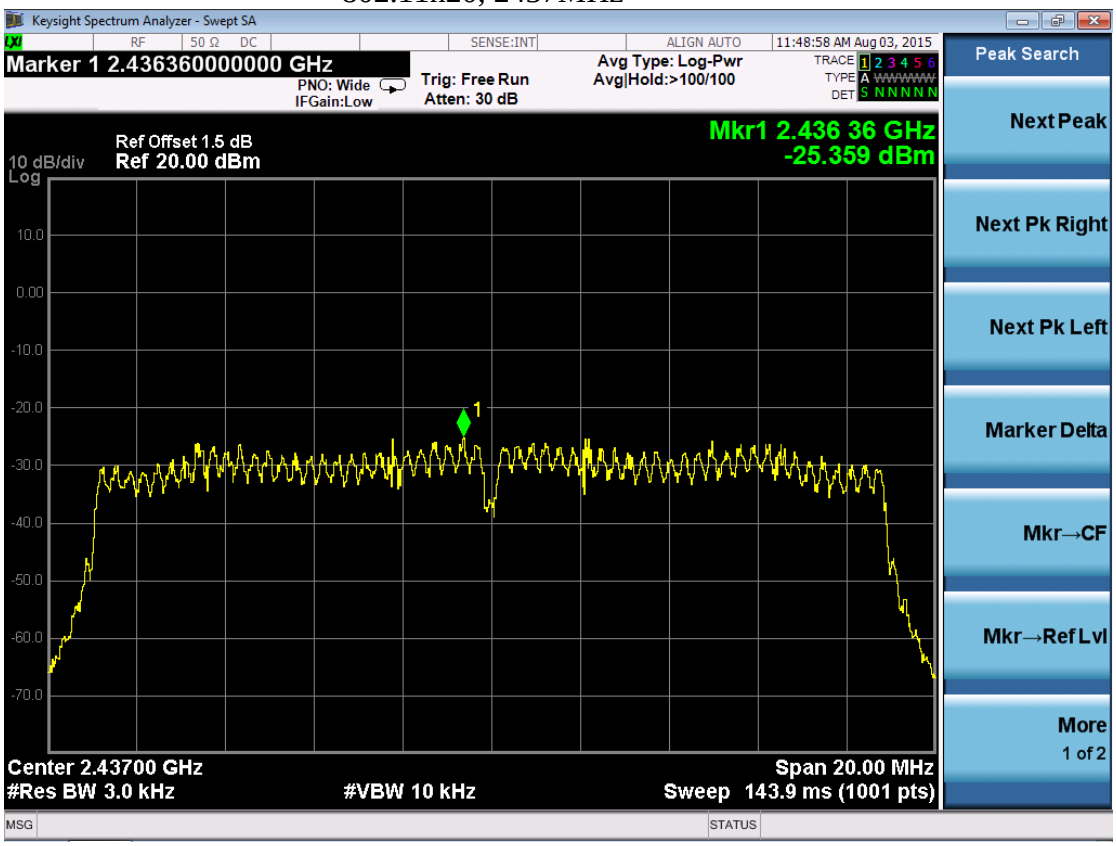


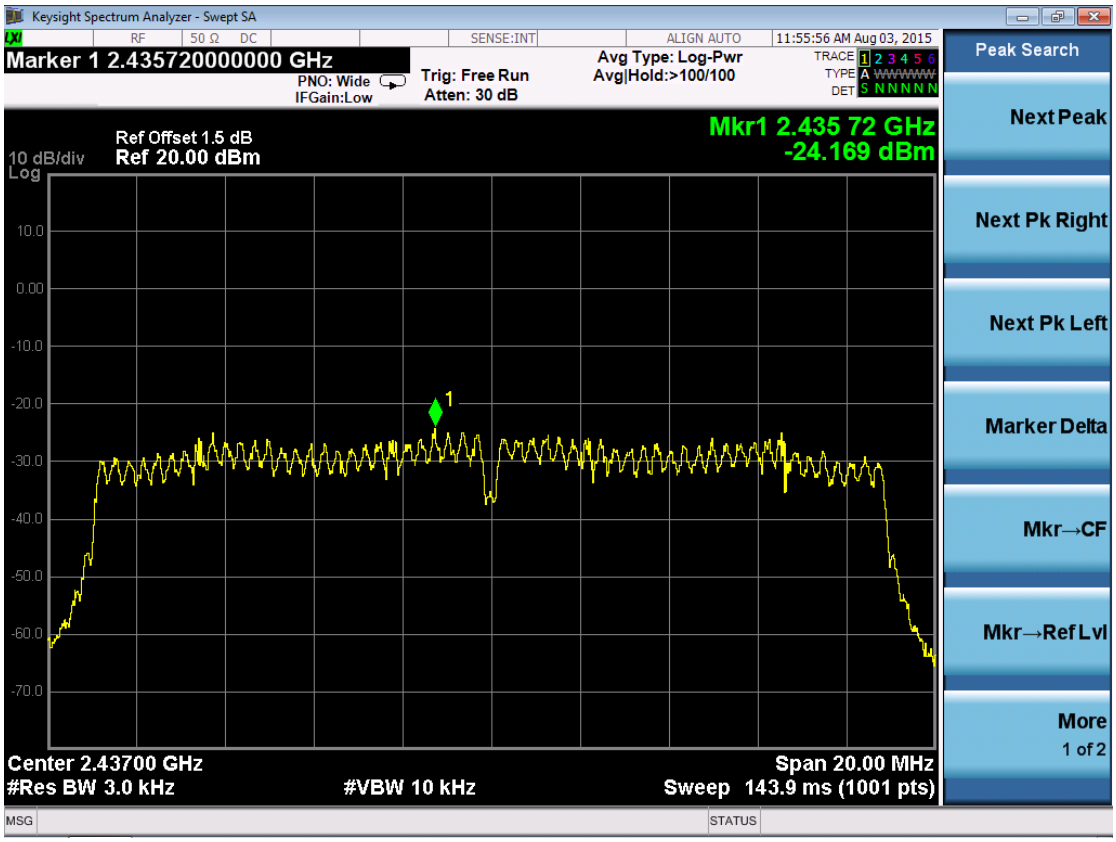
802.11n20, 2412MHz



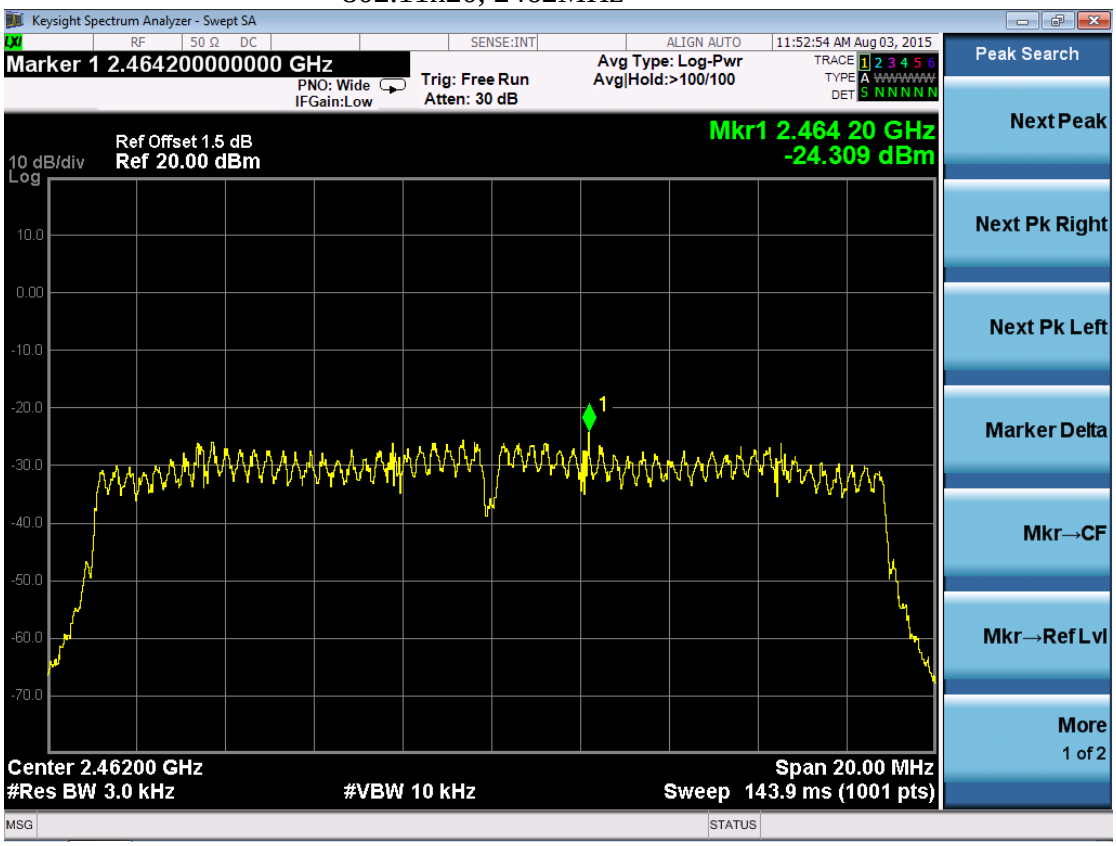


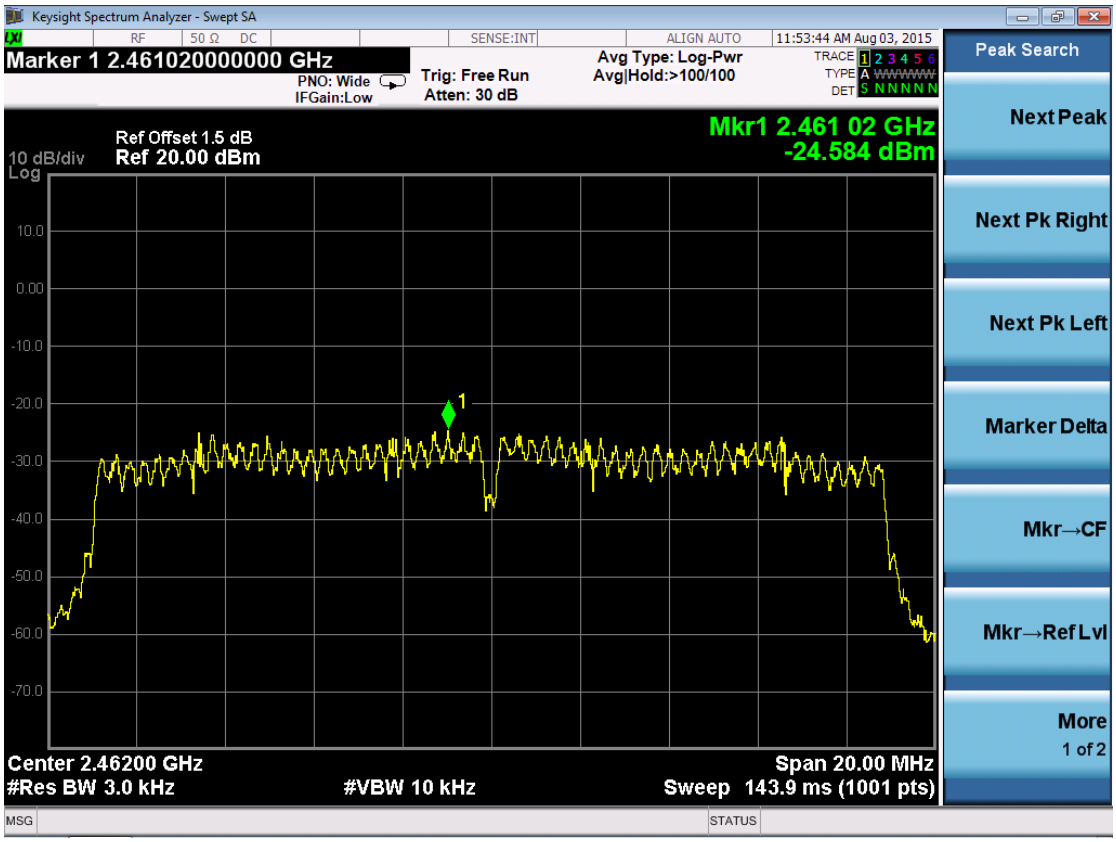
802.11n20, 2437MHz



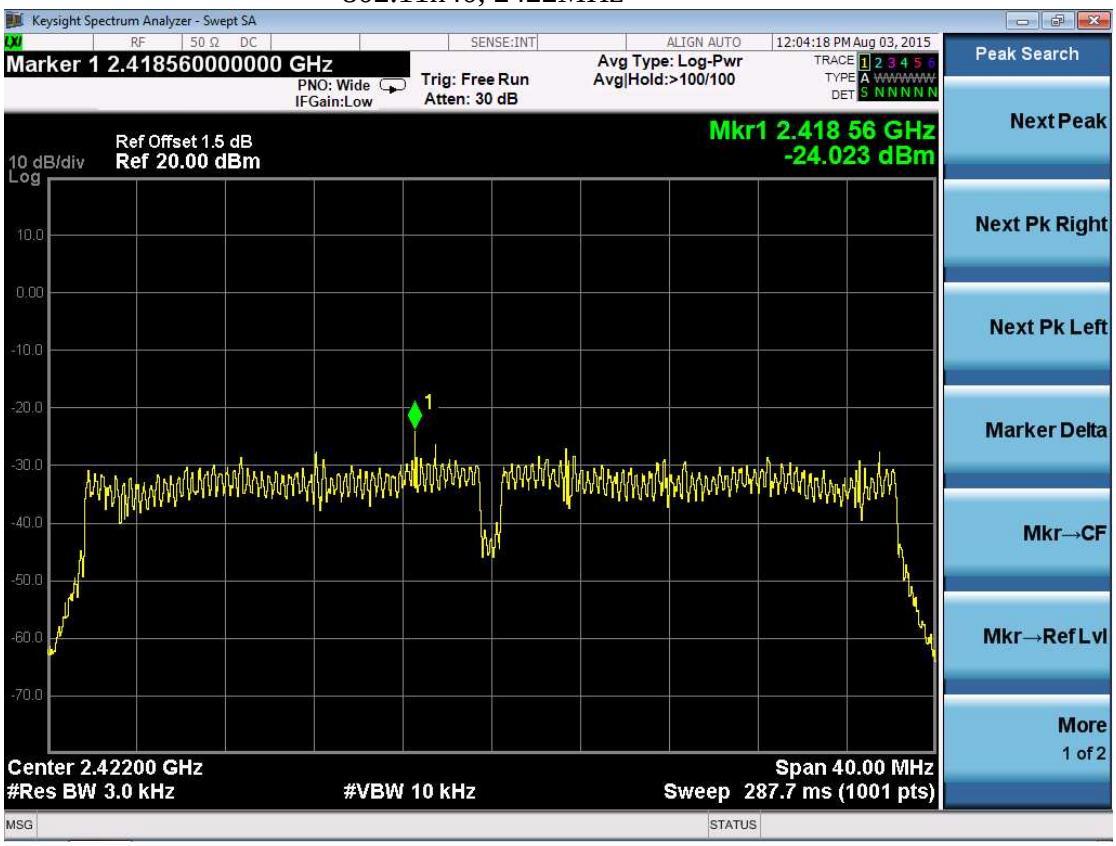


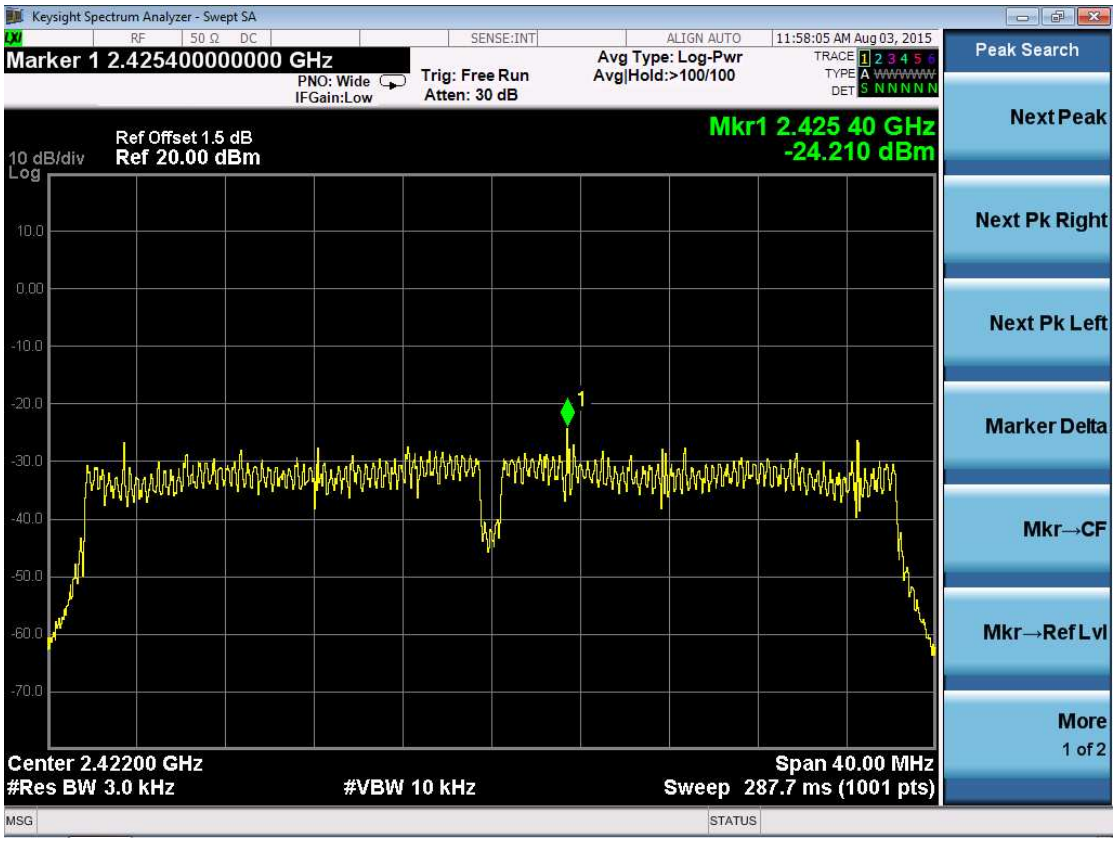
802.11n20, 2462MHz



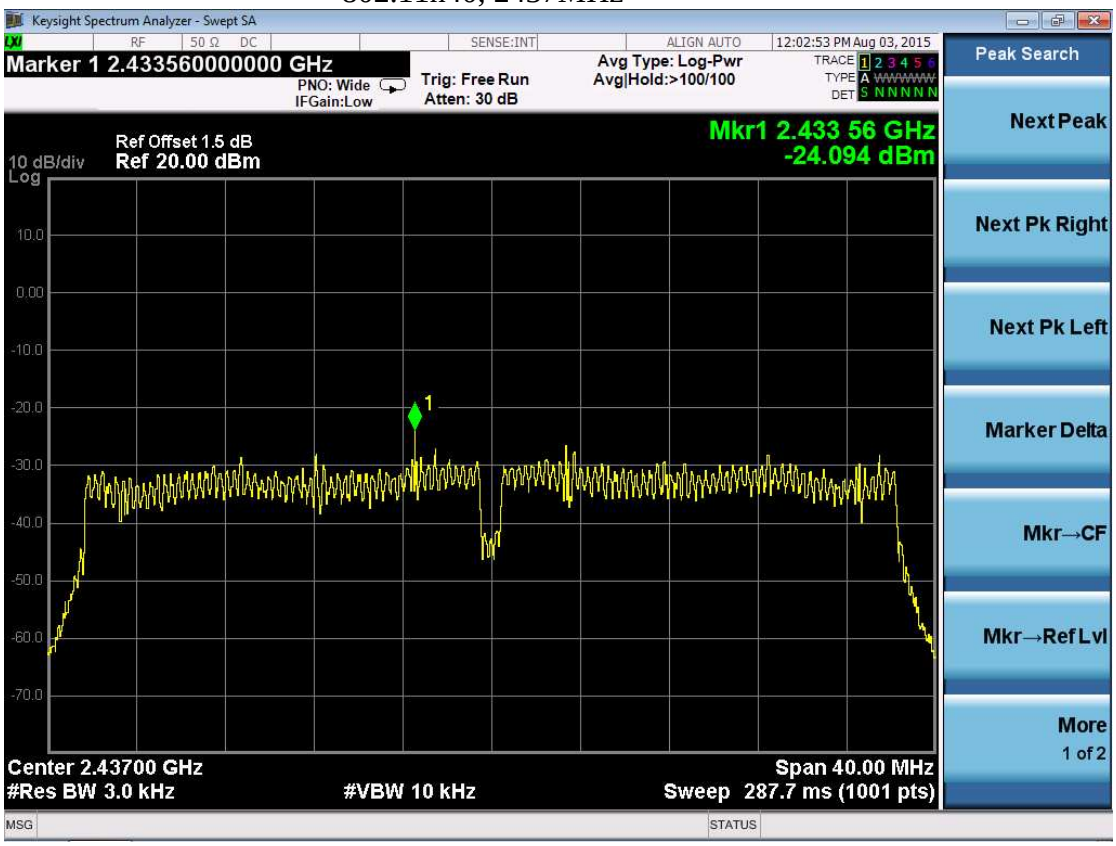


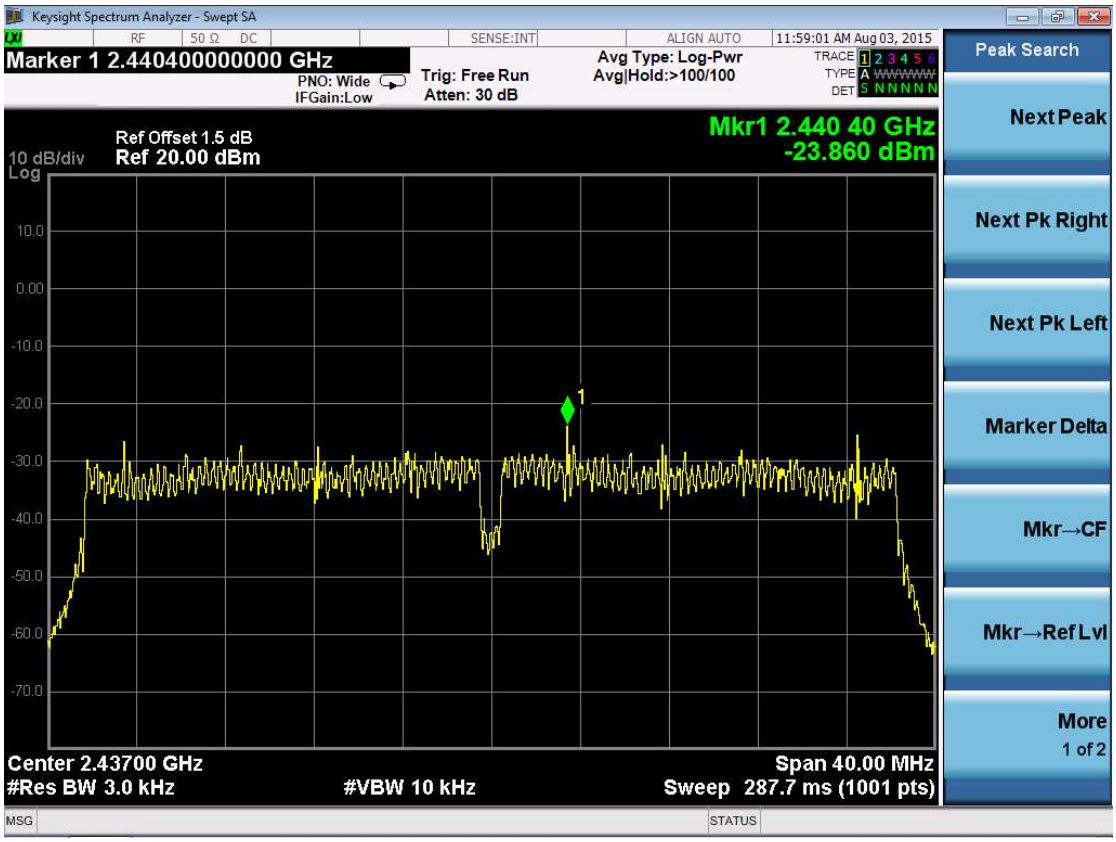
802.11n40, 2422MHz



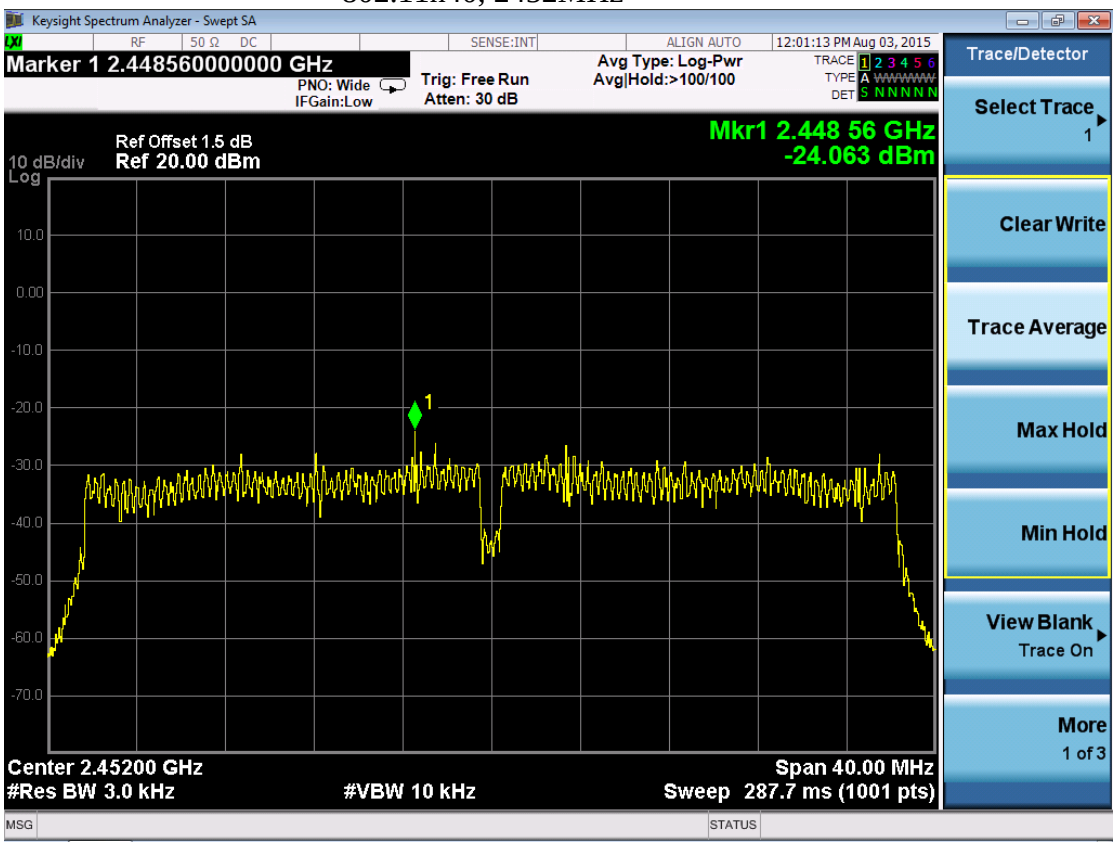


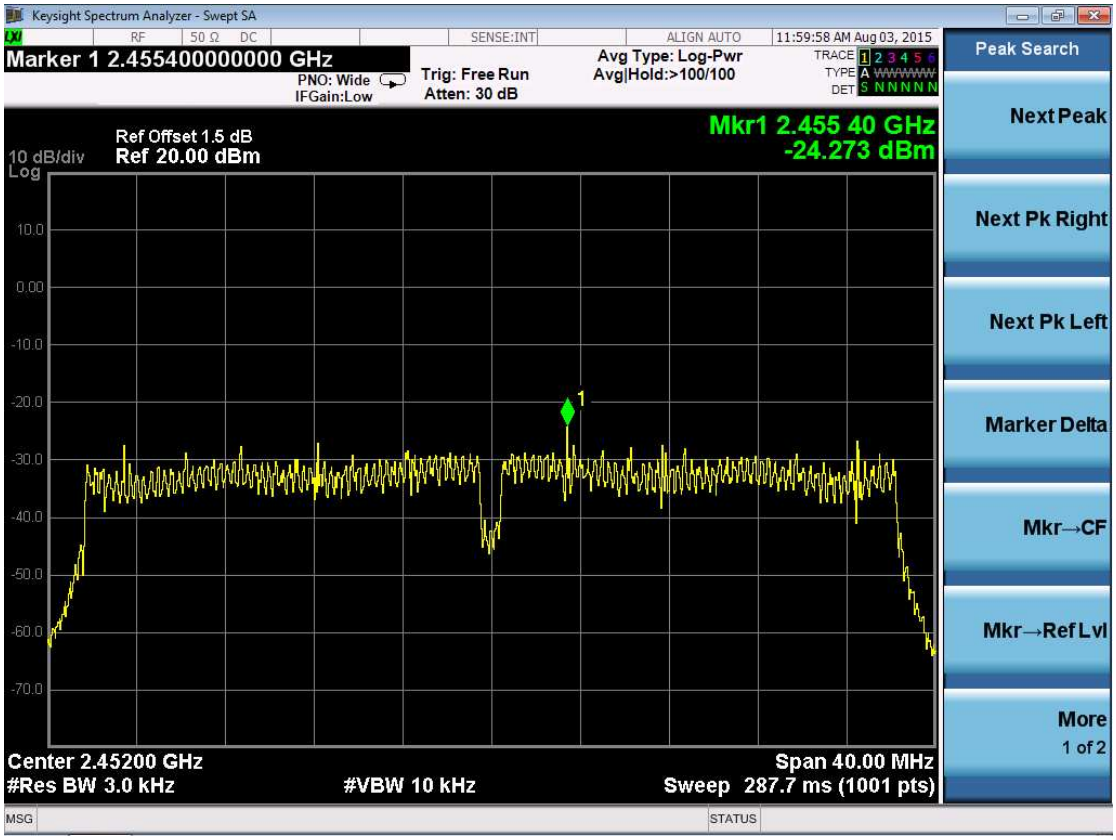
802.11n40, 2437MHz





802.11n40, 2452MHz





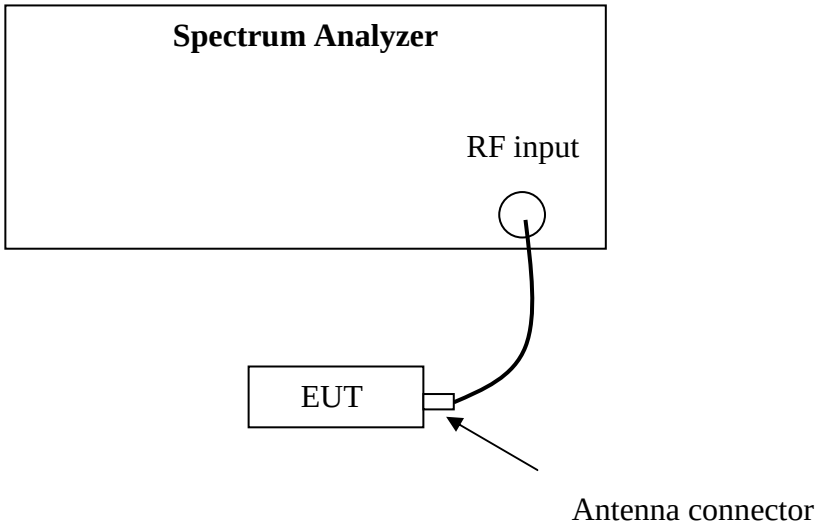
6 Emission outside the frequency band

Test result: Pass

6.1 Test limit

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 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

6.2 Test Configuration



6.3 Test procedure and test setup

The Emission outside the frequency Band per FCC § 15.247(d) is measured using the Spectrum Analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN>>RBW.
The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r03" (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (*i.e.*, 30 dBc).

Reference level measurement

Establish a reference level by using the following procedure:

a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 times the *DTS bandwidth*.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100 kHz.
c) Set the VBW ≥ 3 x RBW.
d) Detector = peak.
e) Ensure that the number of measurement points ≥ span/RBW
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level.

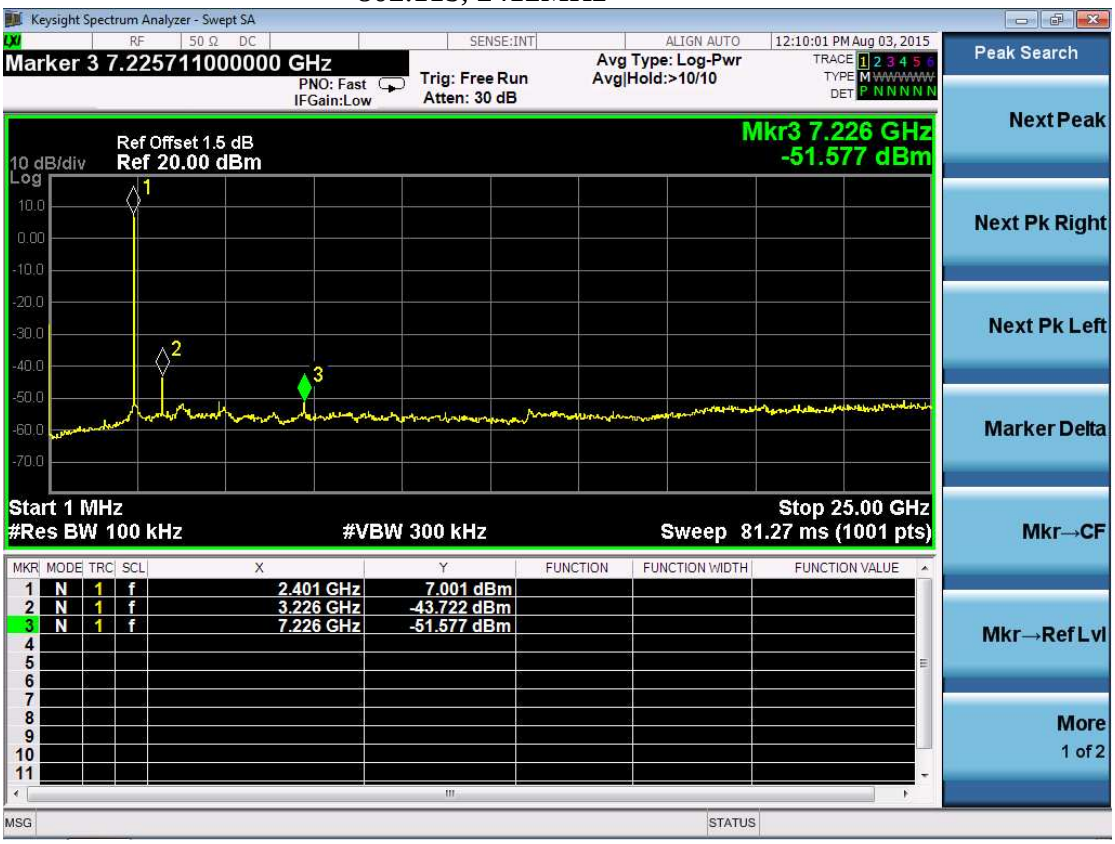
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

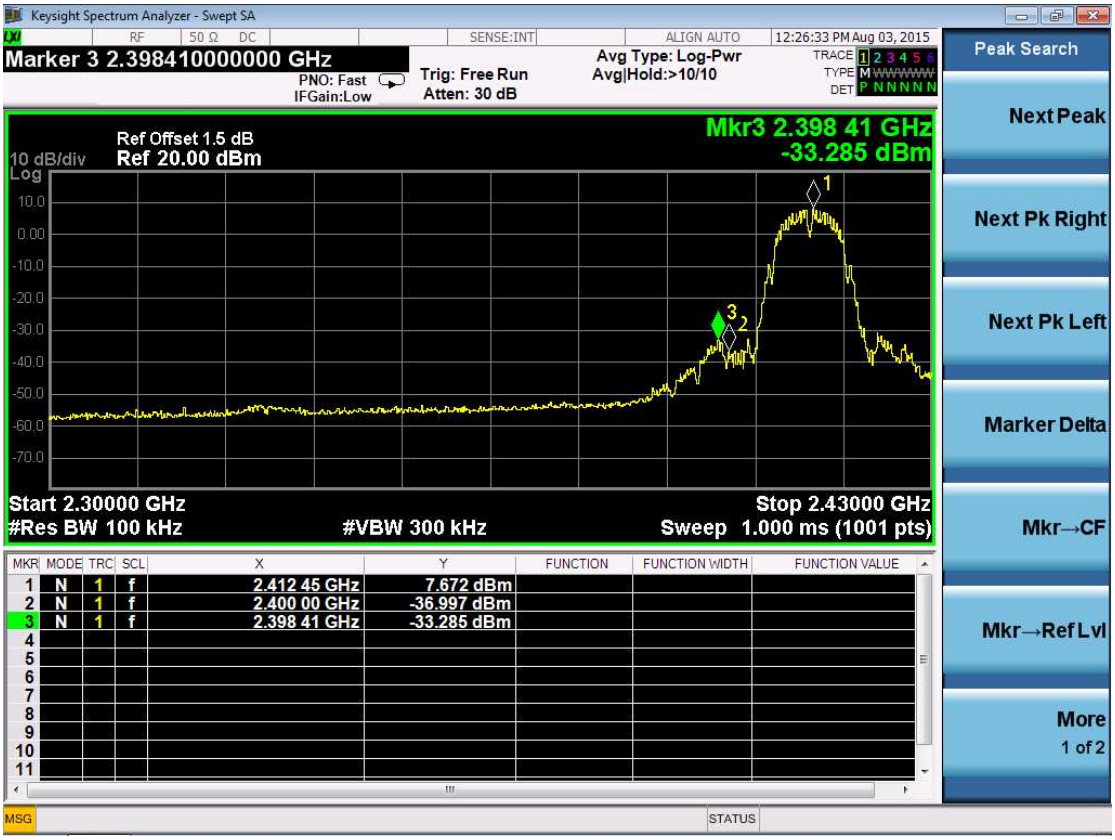
6.4 Test Protocol

Temperature: 25 °C
Relative Humidity: 55 %

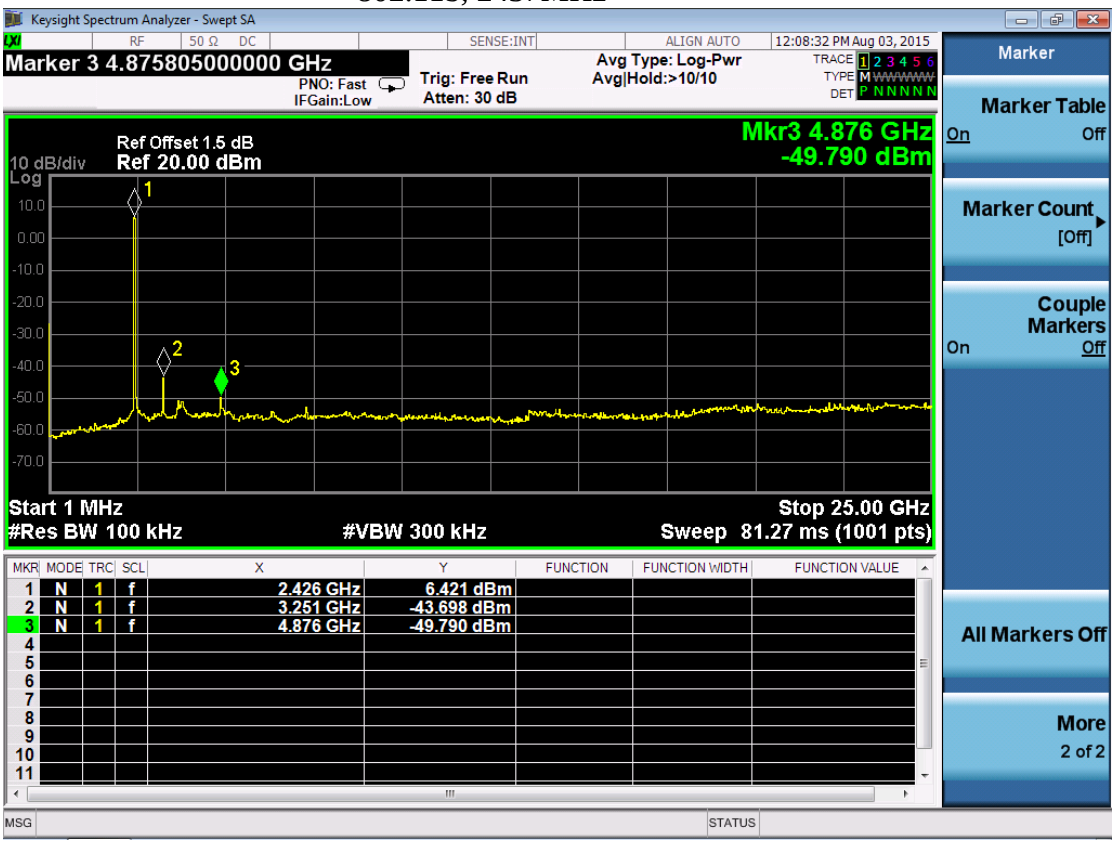
Test Mode	Frequency (MHz)	Results	
		Port 0	Port 1
802.11b	2412	>30dBc	/
	2437	>30dBc	/
	2462	>30dBc	/
802.11g	2412	>30dBc	/
	2437	>30dBc	/
	2462	>30dBc	/
802.11n20	2412	>30dBc	>30dBc
	2437	>30dBc	>30dBc
	2462	>30dBc	>30dBc
802.11n40	2422	>30dBc	>30dBc
	2437	>30dBc	>30dBc
	2452	>30dBc	>30dBc

802.11b, 2412MHz

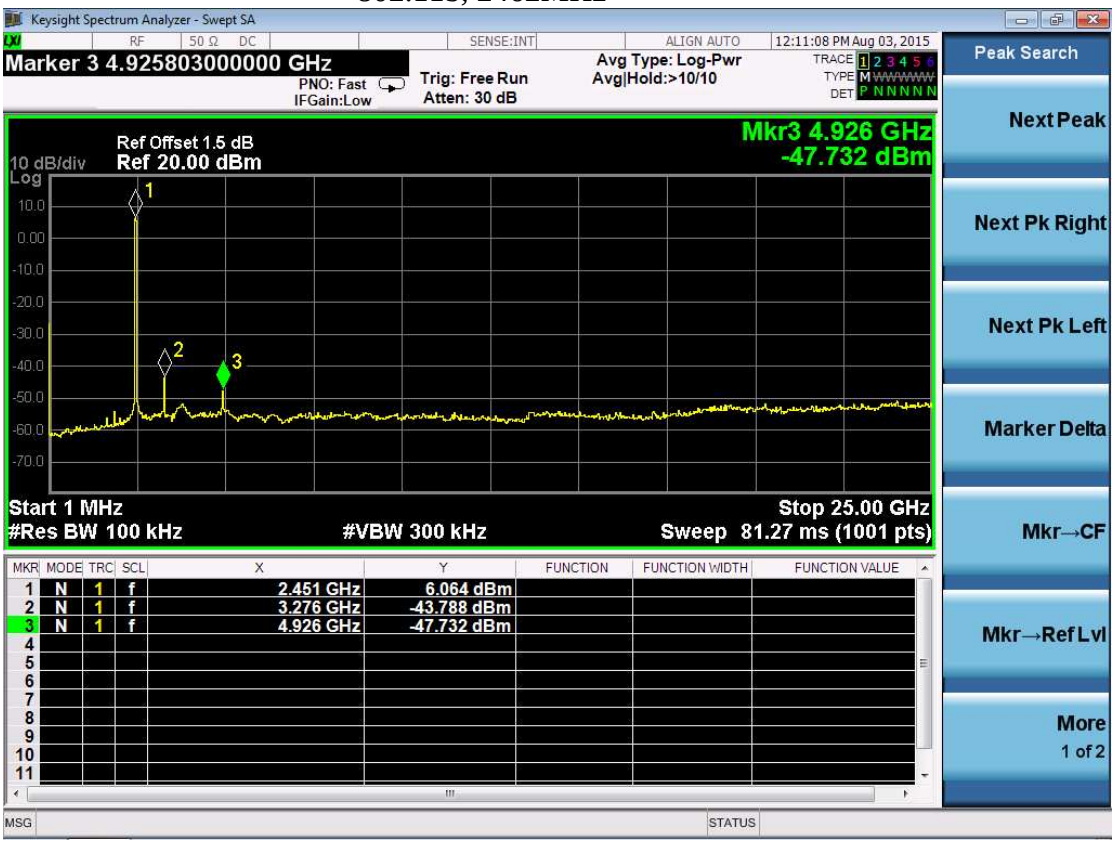




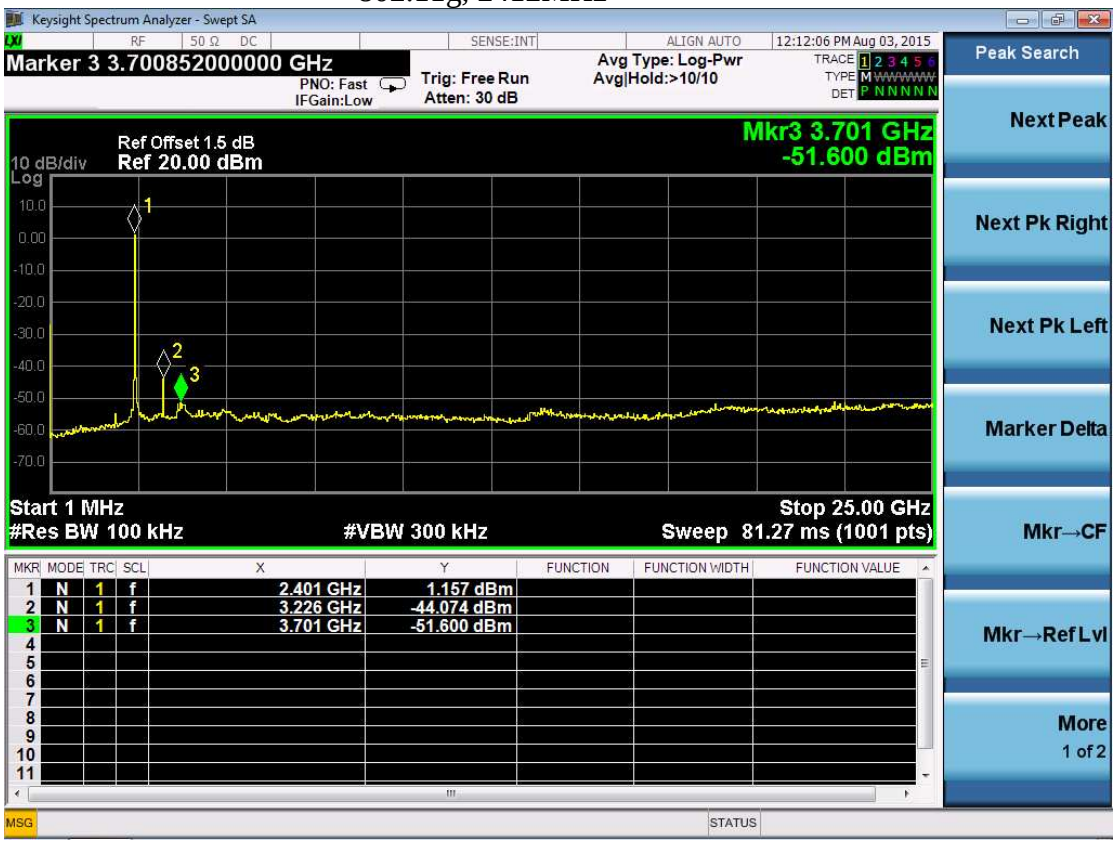
802.11b, 2437MHz



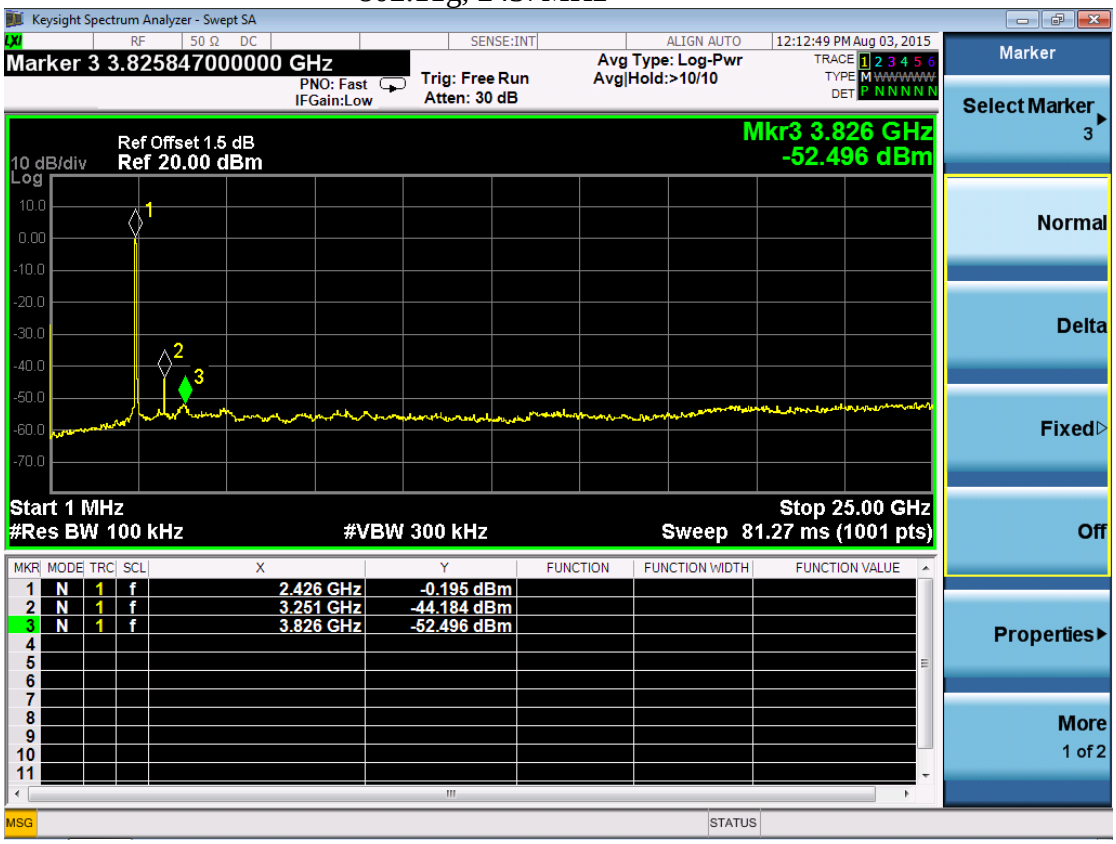
802.11b, 2462MHz



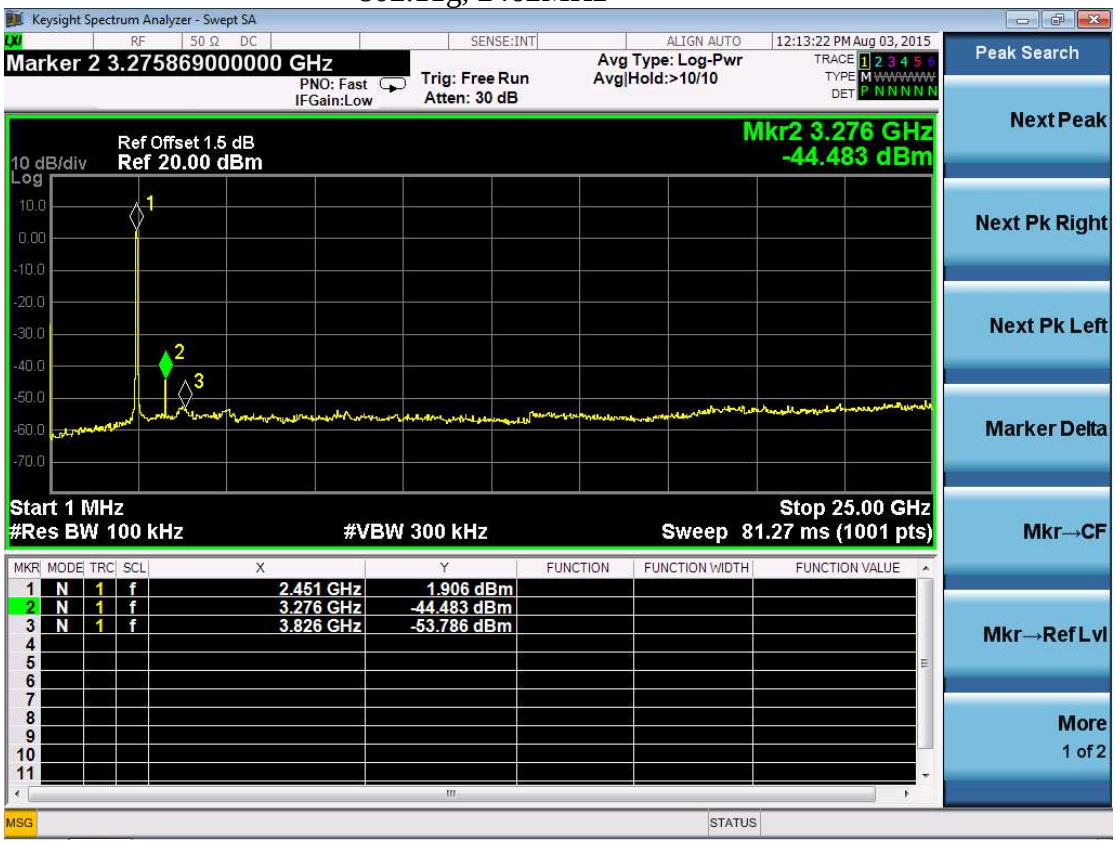
802.11g, 2412MHz



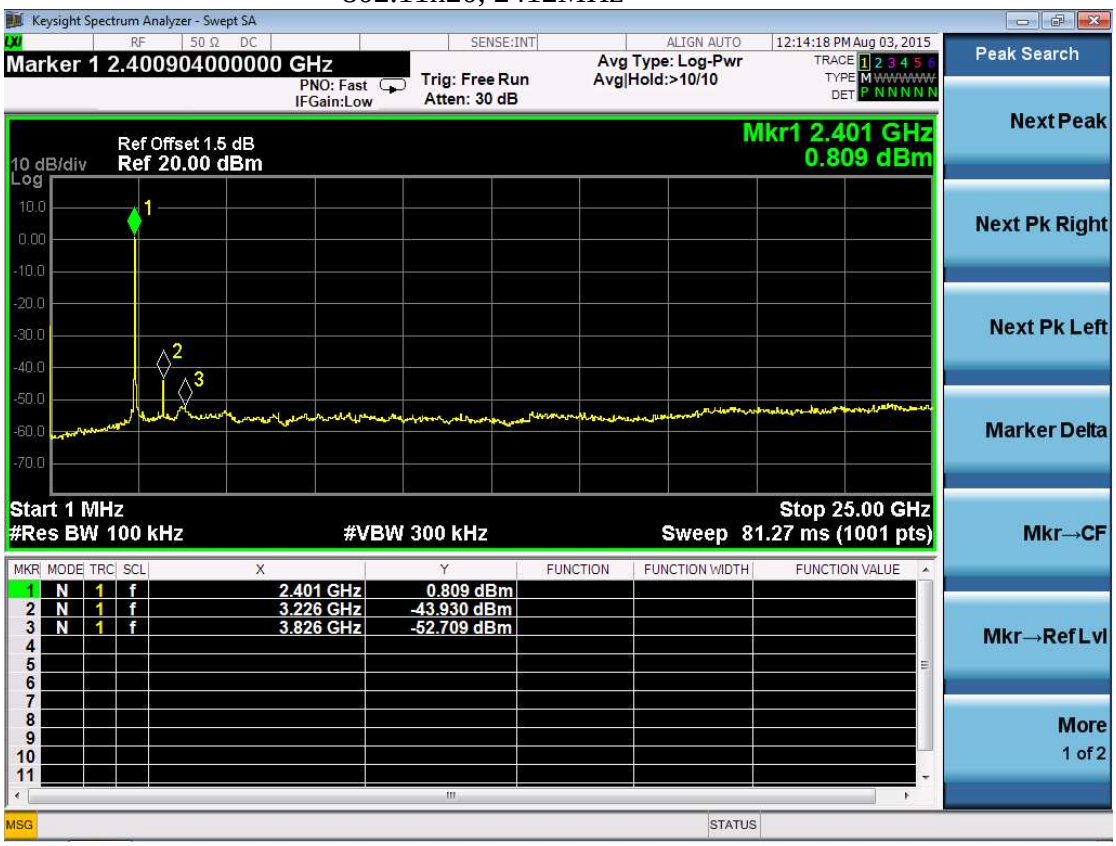
802.11g, 2437MHz

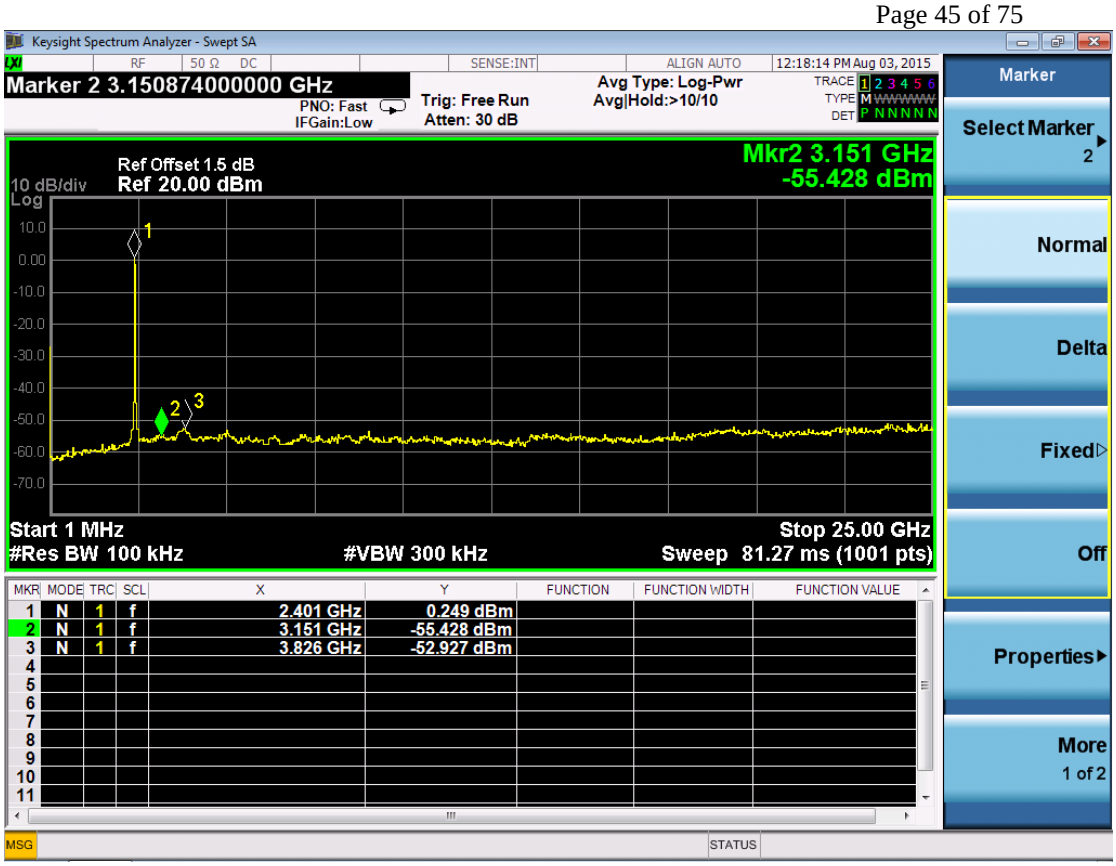


802.11g, 2462MHz



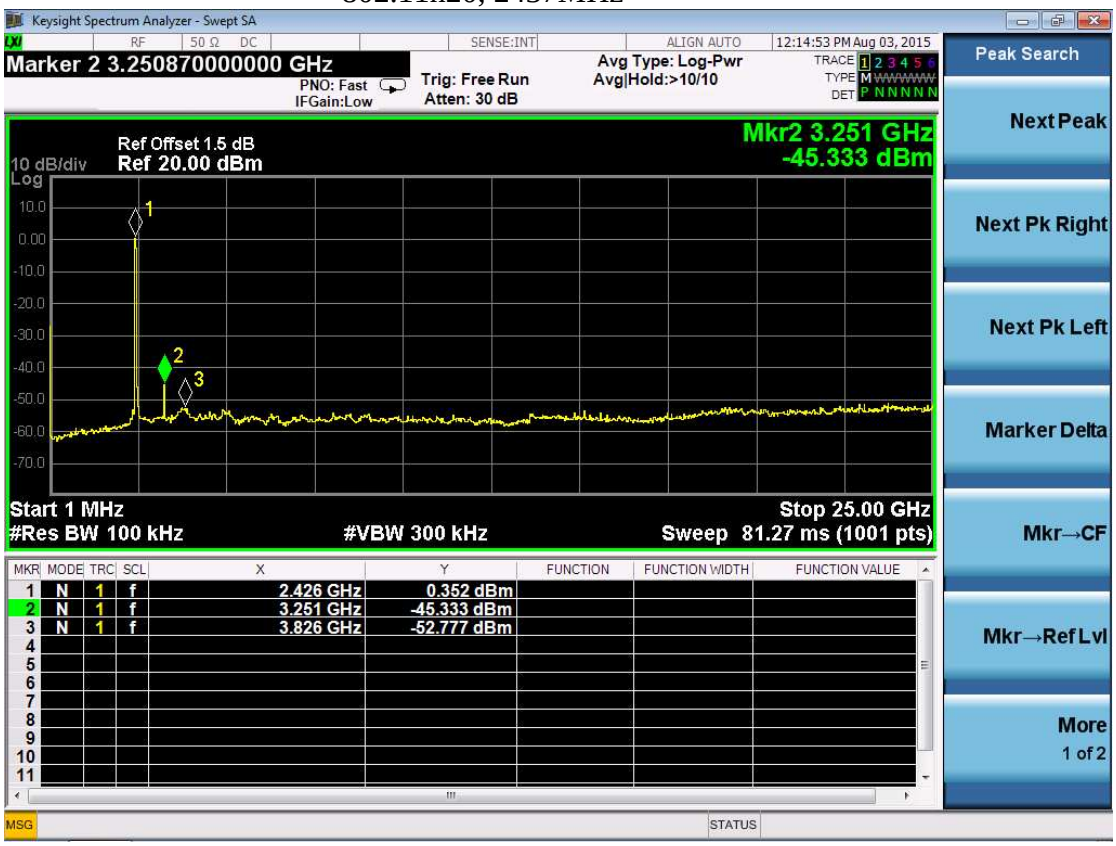
802.11n20, 2412MHz

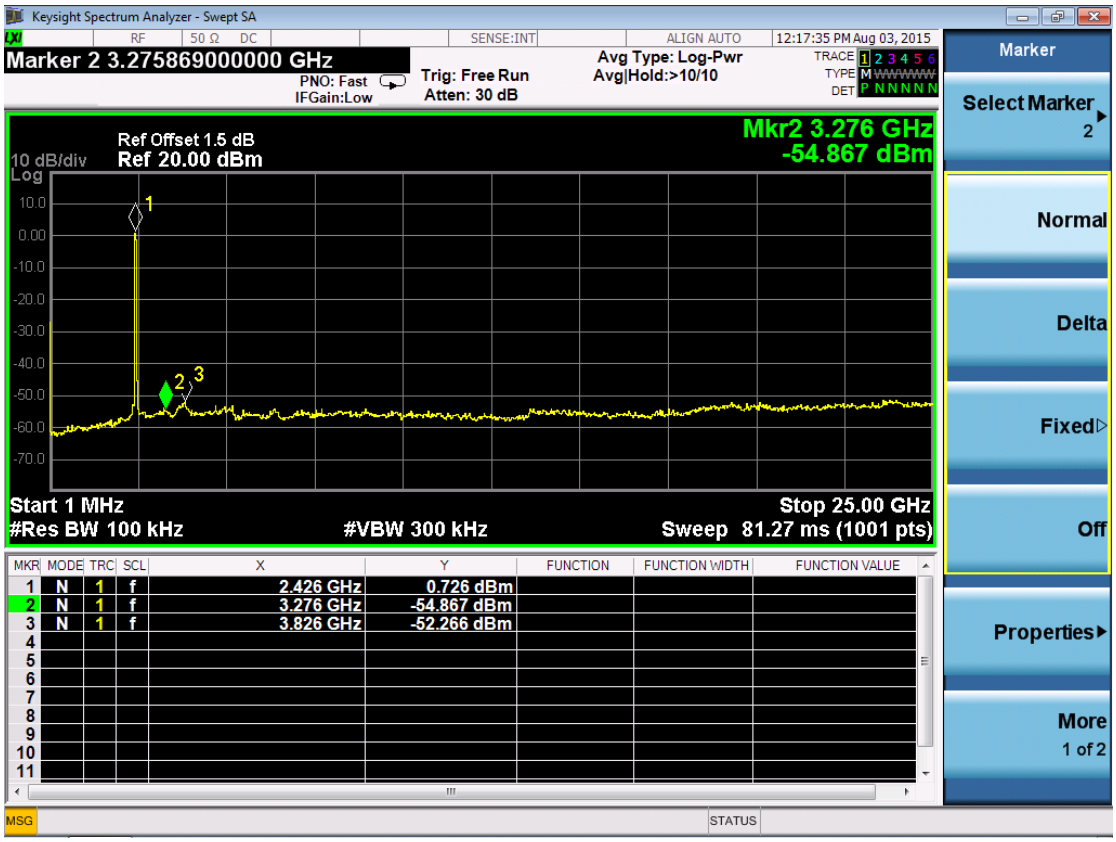



Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
12:18:14 PM Aug 03, 2015
Marker 2 3.150874000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 1.5 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr2 3.151 GHz
-55.428 dBm
Start 1 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 81.27 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.401 GHz 0.249 dBm
2 N 1 f 3.151 GHz -55.428 dBm
3 N 1 f 3.826 GHz -52.927 dBm
MSG
STATUS
Marker
Select Marker 2
Normal
Delta
Fixed
Off
Properties
More 1 of 2

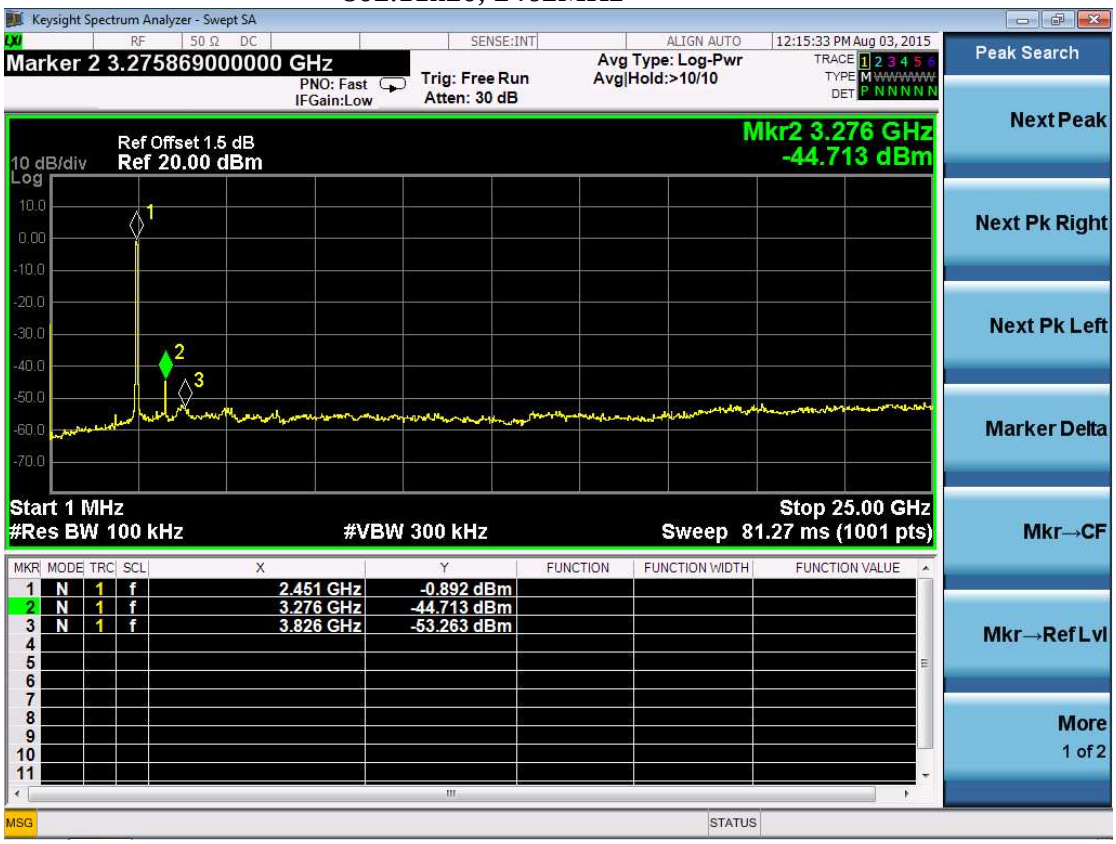

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
05:59:31 PM Aug 03, 2015
Marker 1 2.410890000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 1.5 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.410 89 GHz
1.114 dBm
Start 2.30000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.43000 GHz
Sweep 1.000 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.410 89 GHz 1.114 dBm
2 N 1 f 2.400 00 GHz -36.943 dBm
3 N 1 f 2.389 70 GHz -41.612 dBm
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More 1 of 2

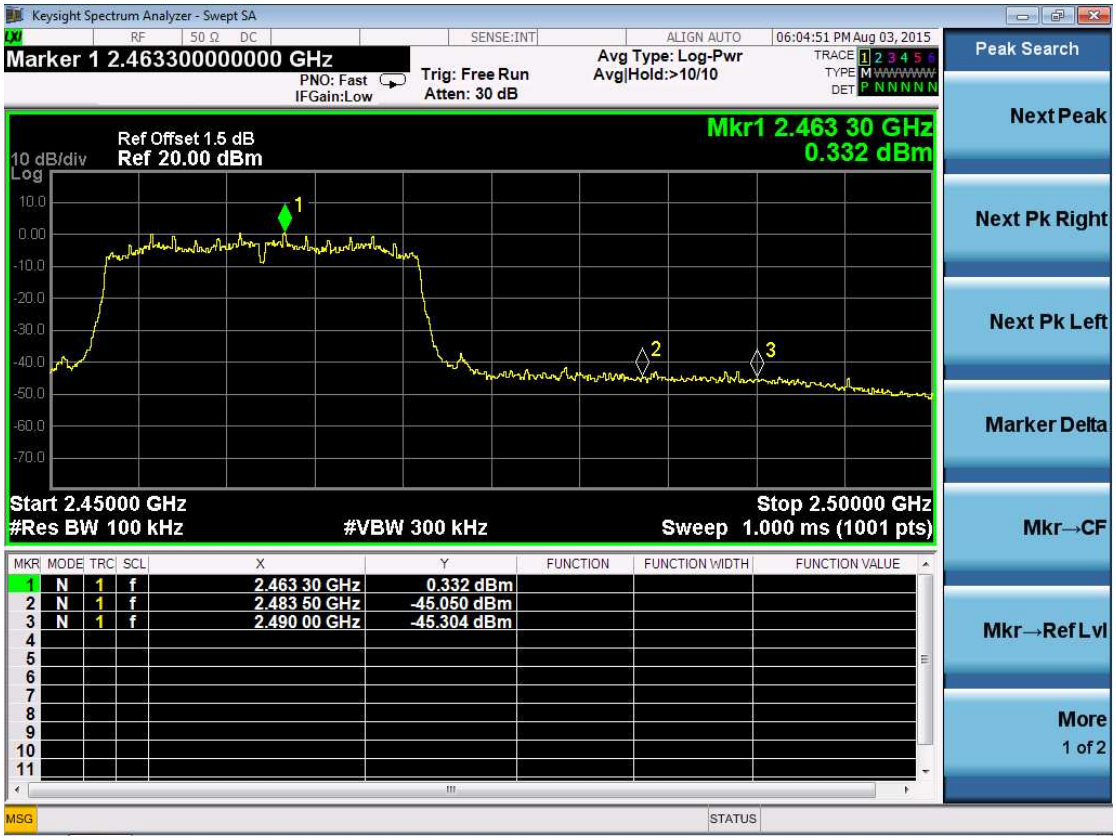
802.11n20, 2437MHz

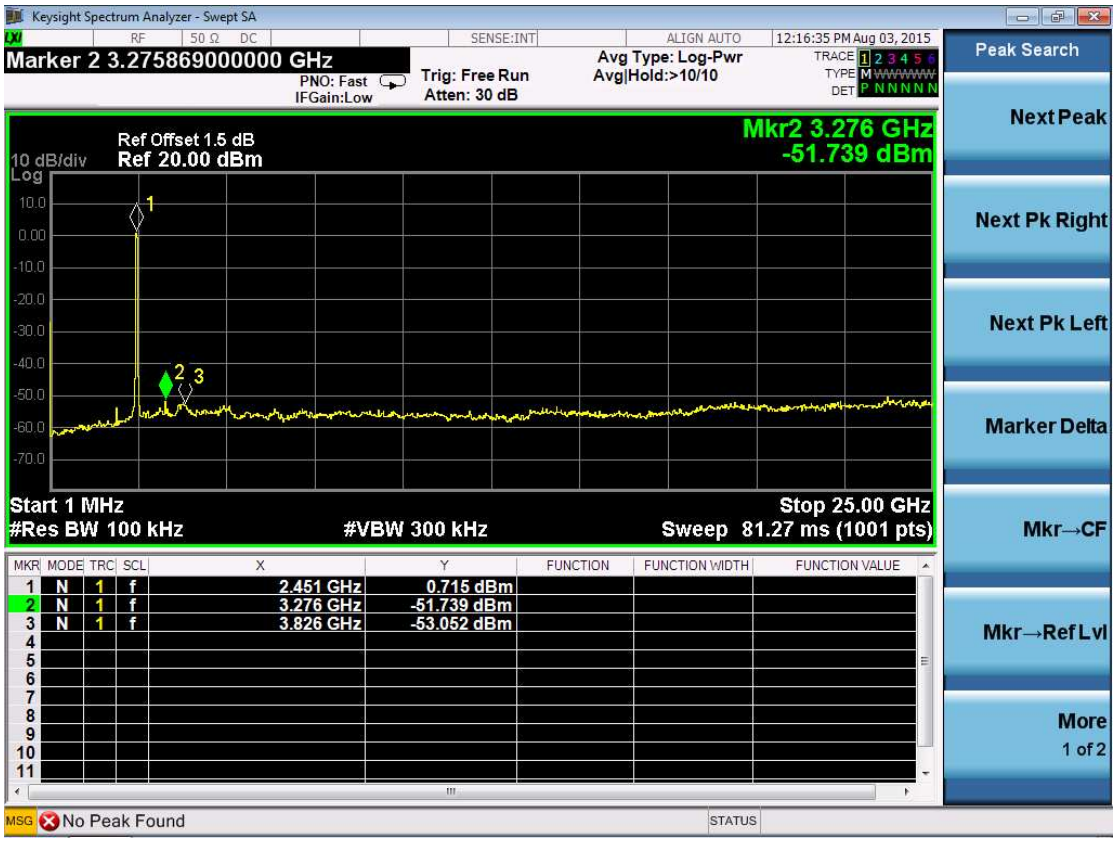




802.11n20, 2462MHz

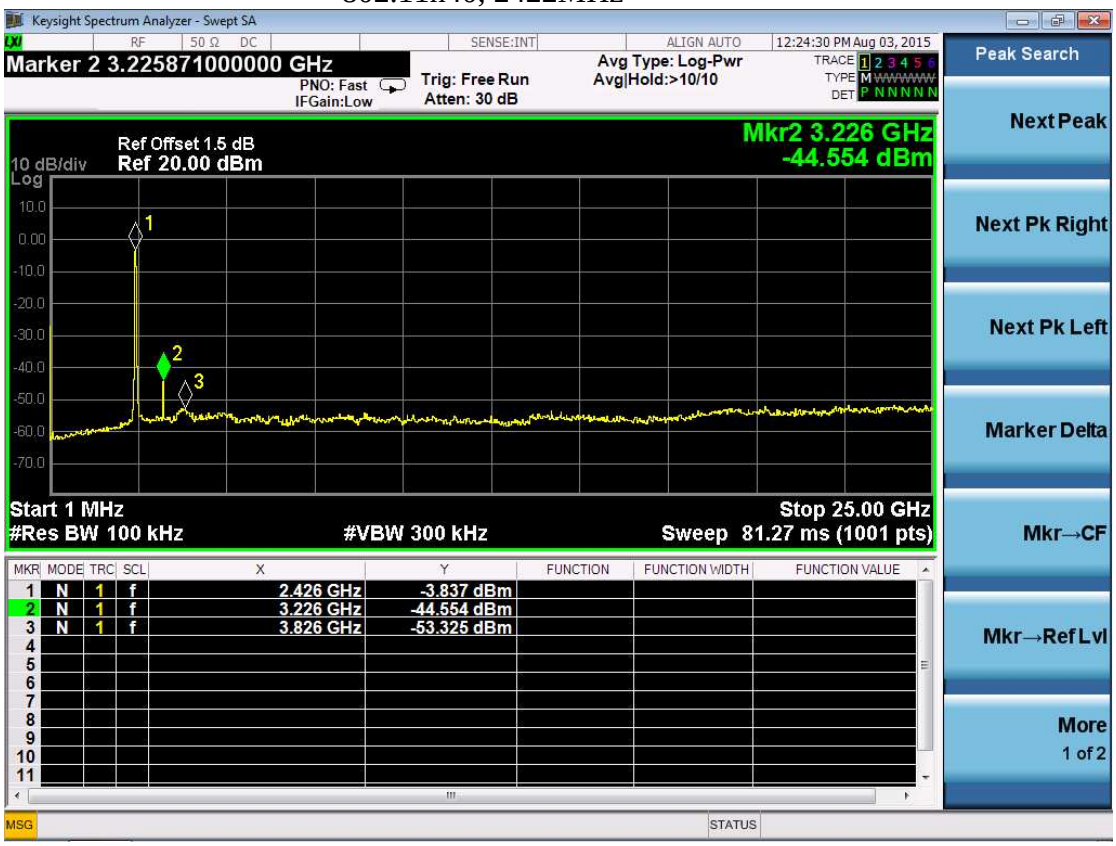


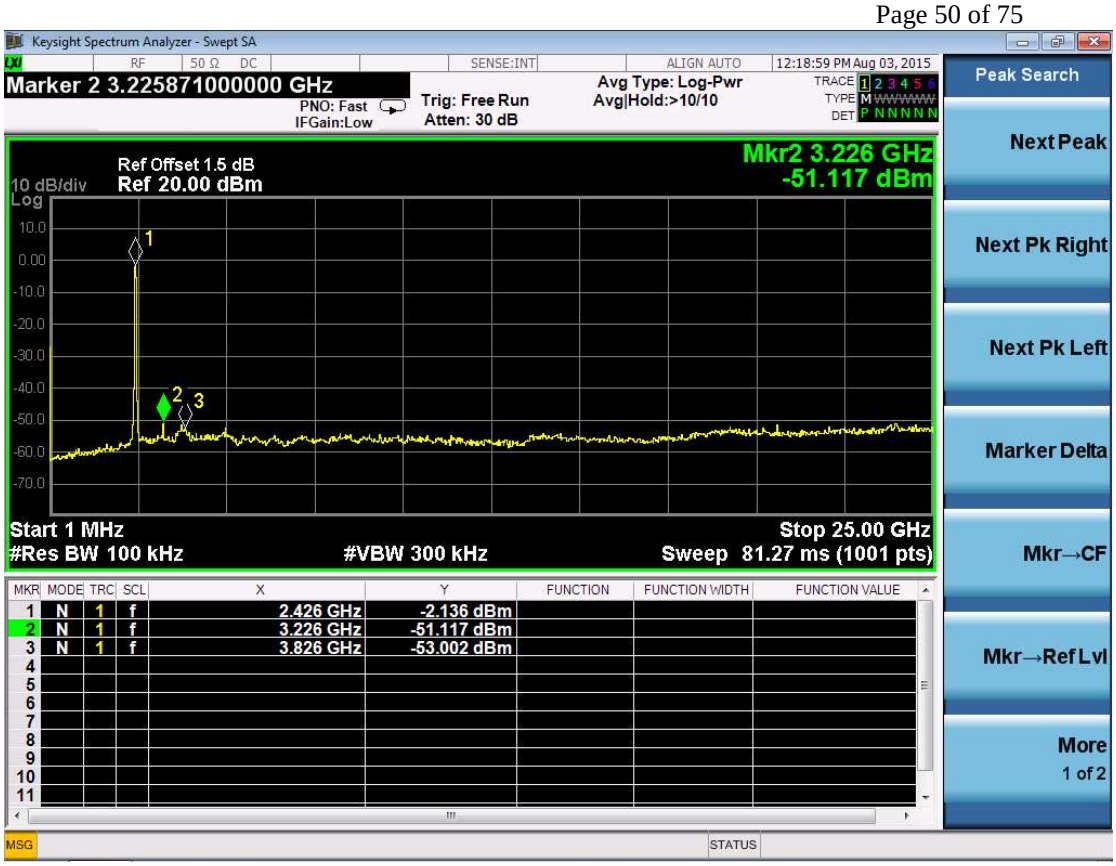



Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
12:16:35 PM Aug 03, 2015
Marker 2 3.275869000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
Ref Offset 1.5 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr2 3.276 GHz
-51.739 dBm
Start 1 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 81.27 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.451 GHz 0.715 dBm
2 N 1 f 3.276 GHz -51.739 dBm
3 N 1 f 3.826 GHz -53.052 dBm
No Peak Found
STATUS


Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
06:05:22 PM Aug 03, 2015
Marker 1 2.460800000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
Ref Offset 1.5 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.460 80 GHz
0.790 dBm
Start 2.45000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 1.000 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.460 80 GHz 0.790 dBm
2 N 1 f 2.483 50 GHz -44.630 dBm
3 N 1 f 2.490 00 GHz -47.002 dBm
STATUS

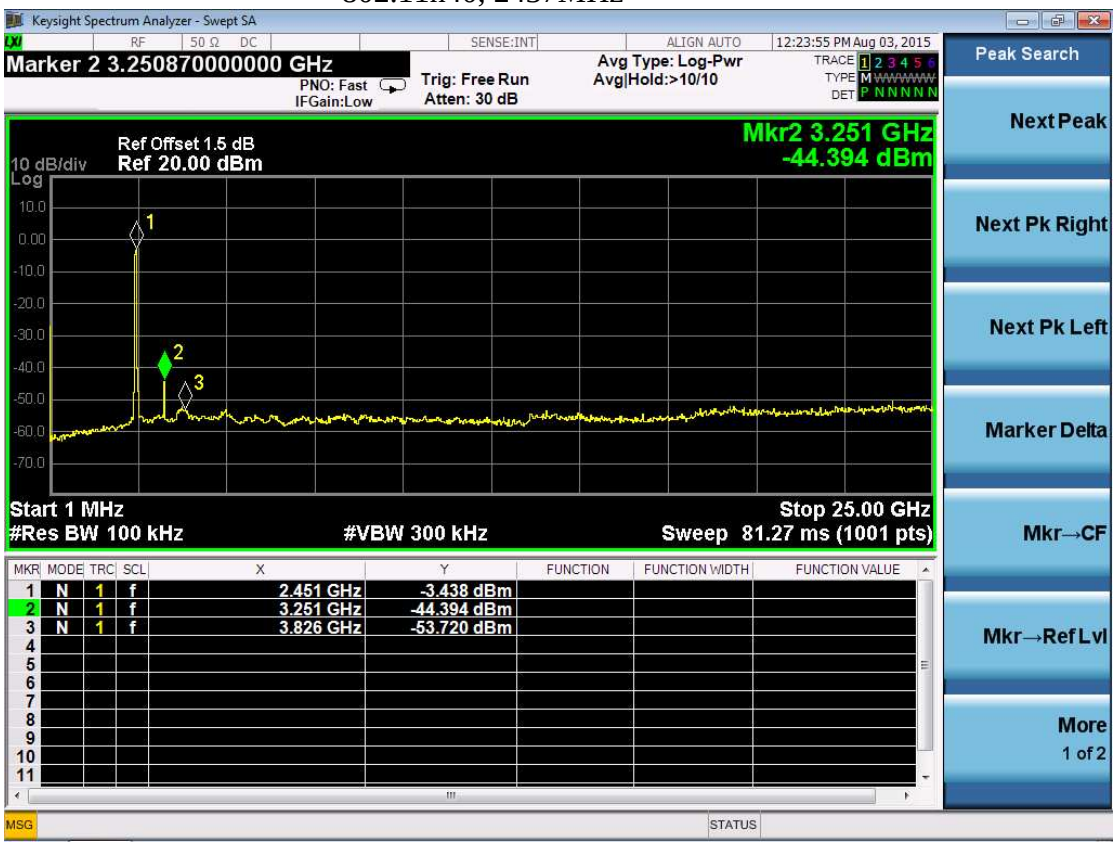
802.11n40, 2422MHz

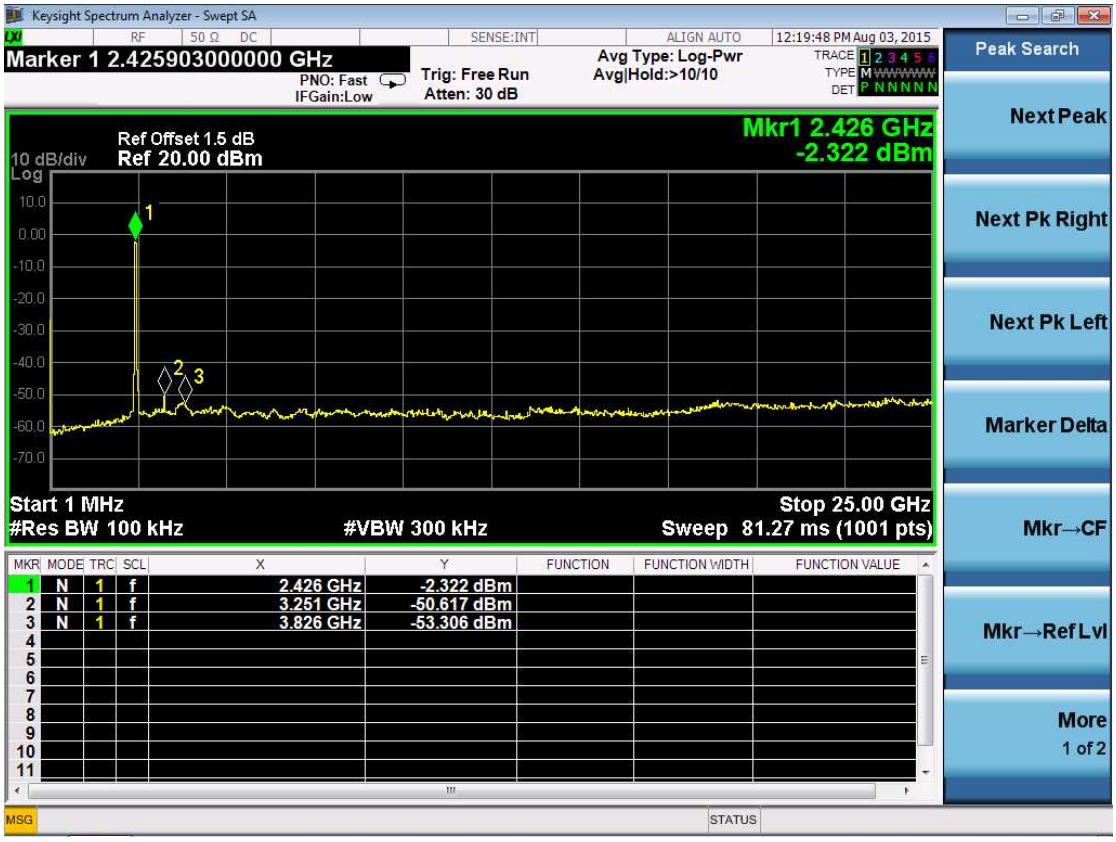



Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
12:18:59 PM Aug 03, 2015
Marker 2 3.225871000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 1.5 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr2 3.226 GHz
-51.117 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Start 1 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 81.27 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.426 GHz -2.136 dBm
2 N 1 f 3.226 GHz -51.117 dBm
3 N 1 f 3.826 GHz -53.002 dBm
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

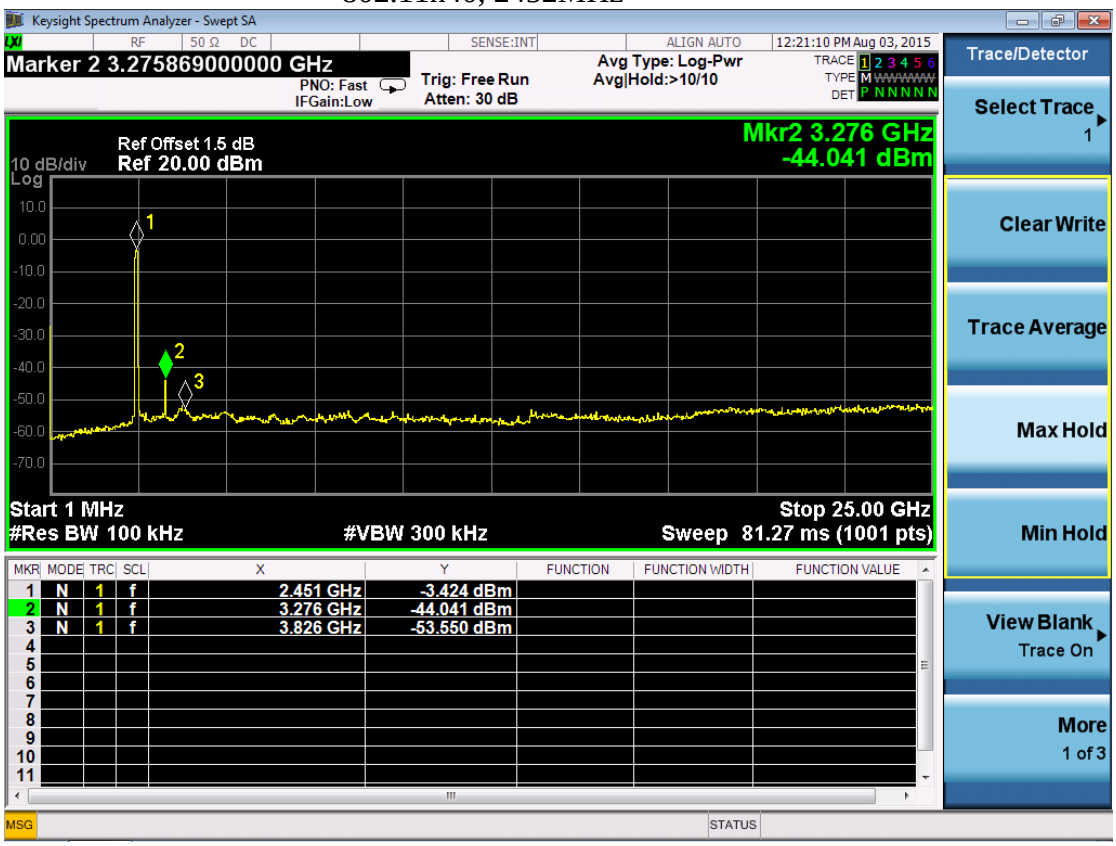

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
05:58:15 PM Aug 03, 2015
Marker 1 2.419600000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 1.5 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.419 60 GHz
-1.920 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Start 2.30000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.43000 GHz
Sweep 1.000 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.419 60 GHz -1.920 dBm
2 N 1 f 2.400 00 GHz -31.935 dBm
3 N 1 f 2.389 70 GHz -33.727 dBm
MSG
STATUS
Trace/Detector
Select Trace
1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
Trace On
More
1 of 3

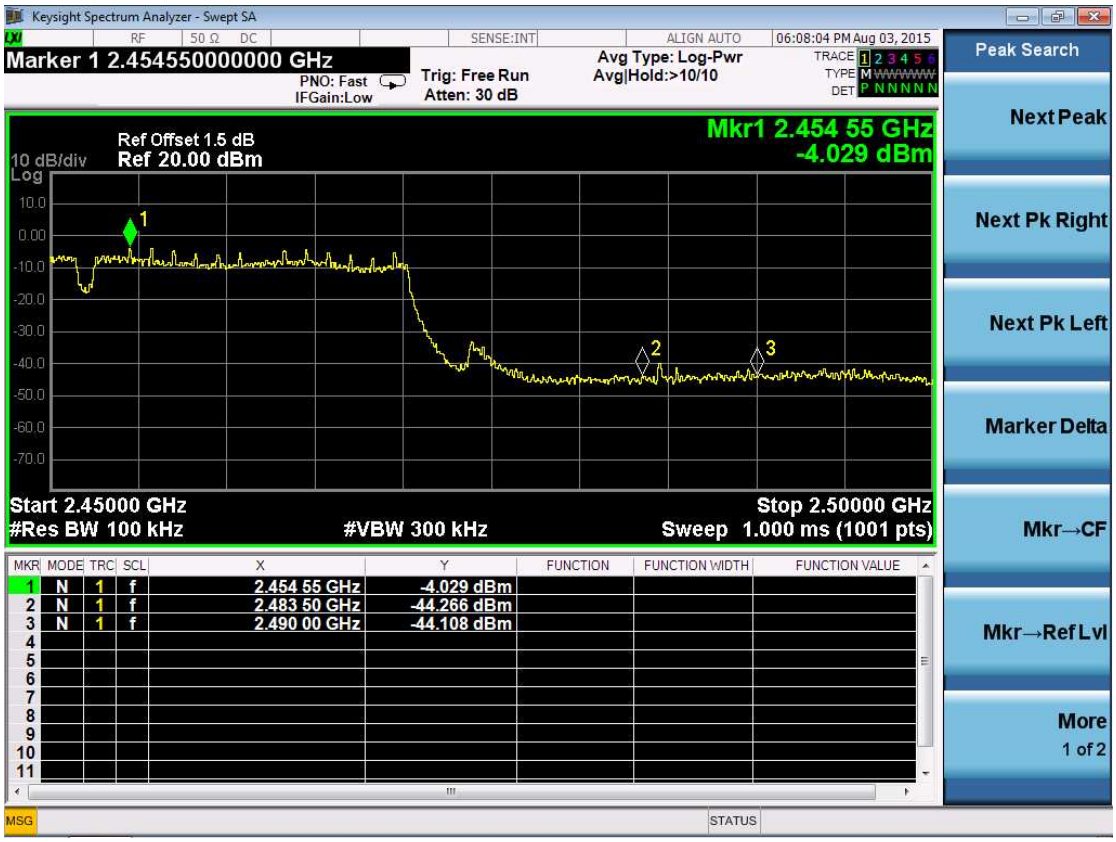
802.11n40, 2437MHz

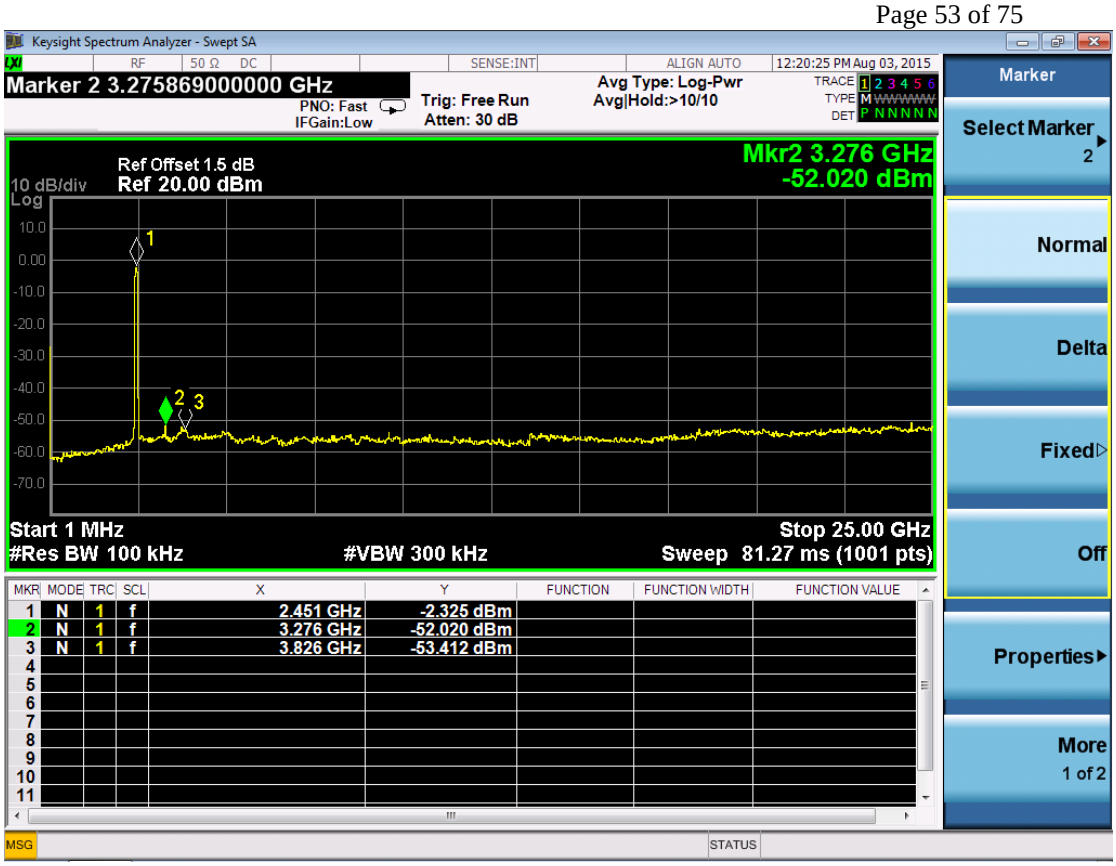


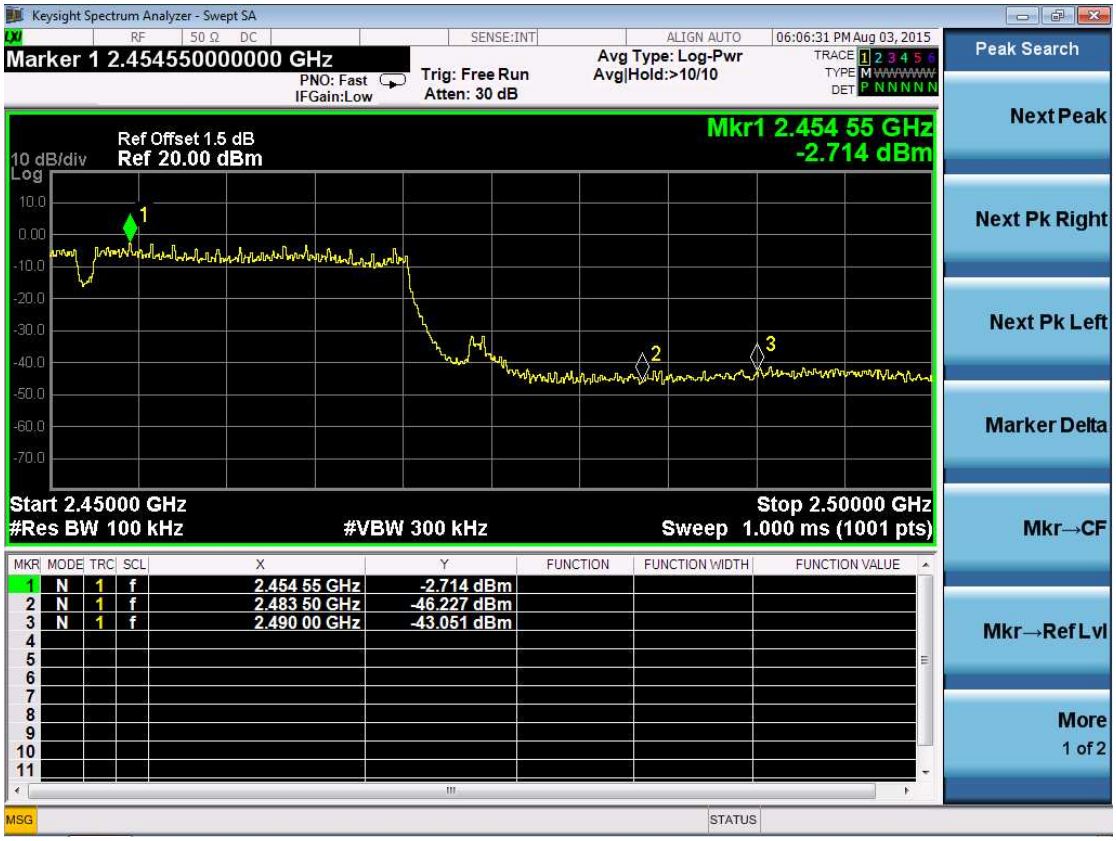


802.11n40, 2452MHz






Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
12:20:25 PM Aug 03, 2015
Marker 2 3.275869000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 1.5 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr2 3.276 GHz
-52.020 dBm
Start 1 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 81.27 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.451 GHz -2.325 dBm
2 N 1 f 3.276 GHz -52.020 dBm
3 N 1 f 3.826 GHz -53.412 dBm
MSG
STATUS
Marker
Select Marker 2
Normal
Delta
Fixed
Off
Properties
More 1 of 2


Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
06:06:31 PM Aug 03, 2015
Marker 1 2.454550000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 1.5 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.454 55 GHz
-2.714 dBm
Start 2.45000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 1.000 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.454 55 GHz -2.714 dBm
2 N 1 f 2.483 50 GHz -46.227 dBm
3 N 1 f 2.490 00 GHz -43.051 dBm
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More 1 of 2

7 Radiated Emissions in restricted frequency bands

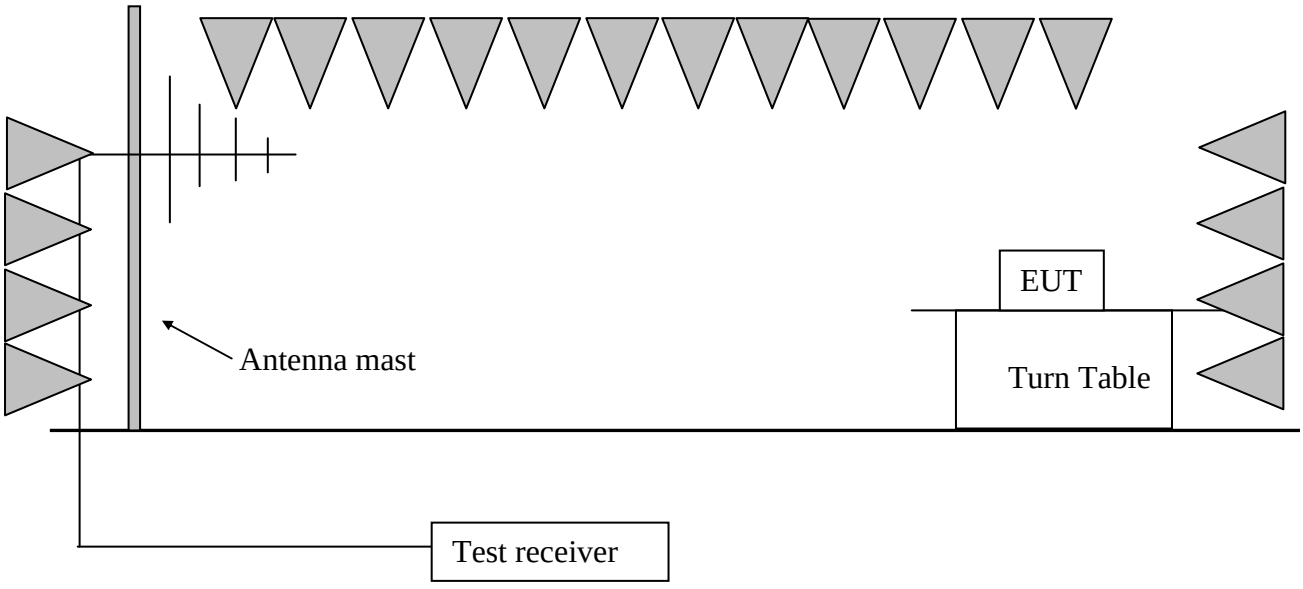
Test result: Pass

7.1 Test limit

The 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) showed as below:

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

7.2 Test Configuration



7.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

Tabletop devices shall be placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The EUT was tested according to DTS test procedure of KDB558074 D01 DTS "Meas Guidance v03r03" for compliance to FCC 47CFR 15.247 requirements.

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 300 Hz, VBW = 1 kHz (9 kHz~150 kHz);
RBW = 10 kHz, VBW = 30 kHz (150 kHz~30MHz);
RBW = 100 kHz, VBW = 300 kHz (30MHz~1GHz for PK)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);
RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

Remark:
1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. If the PK measured level is lower than AV limit, the AV test can be elided.

Example:

Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Measured level = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m,
Measured level = 10.20dBuV/m, then Margin = 54 - 10.20 = 43.80dBuV/m.

7.4 Test Protocol

Temperature: 25 °C
Relative Humidity: 55 %

Mode 802.11b

Freq (MHz)	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
2412	V	2411.81	37.80	109.40	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2390.00	37.69	62.60	74.00	11.40	PK
	V	2390.00	37.69	52.80	54.00	1.20	AV
	V	3364.72	-7.50	48.00	54.00	6.00	PK
	V	4823.64	-3.50	53.10	54.00	0.90	PK
2437	V	2439.02	37.89	109.70	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	H	3182.36	-8.30	43.60	54.00	10.40	PK
	V	3729.45	-6.30	40.70	54.00	13.30	PK
	V	4865.73	-3.40	52.00	54.00	2.00	PK
2462	V	2461.98	38.05	109.60	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2483.50	38.15	62.40	74.00	11.60	PK
	V	2483.50	38.15	53.20	54.00	0.80	AV
	H	3182.36	-8.30	44.70	54.00	9.30	PK
	V	4921.84	-3.30	51.70	54.00	2.30	PK

Mode 802.11g

Freq (MHz)	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
2412	V	2413.26	37.71	108.90	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2390.00	37.69	69.80	74.00	4.20	PK
	V	2390.00	37.69	52.30	54.00	1.70	AV
	V	3210.42	-8.20	47.40	54.00	6.60	PK
	H	4823.64	-3.50	46.70	54.00	7.30	PK
2437	V	2440.29	37.89	108.70	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	H	3182.36	-8.30	43.30	54.00	10.70	PK
	V	3729.45	-6.30	41.60	54.00	12.40	PK
	V	4865.73	-3.40	46.60	54.00	7.40	PK
2462	V	2463.23	38.05	108.40	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2483.50	38.15	70.20	74.00	3.80	PK
	V	2483.50	38.15	52.50	54.00	1.50	AV
	H	3182.36	-8.30	45.10	54.00	8.90	PK
	V	4921.84	-3.30	44.50	54.00	9.50	PK

Mode 802.11n20

Freq (MHz)	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
2412	V	2412.98	37.81	107.10	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2390.00	37.69	69.60	74.00	4.40	PK
	V	2390.00	37.69	53.30	54.00	0.70	AV
	V	3210.42	-8.20	47.40	54.00	6.60	PK
	V	4823.64	-3.50	46.70	54.00	7.30	PK
2437	H	2440.29	37.89	107.00	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	H	3182.36	-8.30	42.80	54.00	11.20	PK
	V	3729.45	-6.30	40.50	54.00	13.50	PK
	V	4865.73	-3.40	46.00	54.00	8.00	PK
2462	V	2462.94	38.05	106.80	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2483.50	38.15	69.40	74.00	4.60	PK
	V	2483.50	38.15	53.20	54.00	0.80	AV
	V	3182.36	-8.30	46.10	54.00	7.90	PK
	V	4921.84	-3.30	45.30	54.00	8.70	PK

Mode 802.11n40

Freq (MHz)	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
2422	V	2427.48	37.88	103.90	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2390.00	37.69	68.60	74.00	5.40	PK
	V	2390.00	37.69	53.60	54.00	0.40	AV
	H	3224.45	-8.10	48.40	54.00	5.60	PK
	V	4851.34	-3.40	40.20	54.00	13.80	PK
2437	V	2440.29	37.89	103.70	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	H	3182.36	-8.30	44.10	54.00	9.90	PK
	V	3729.45	-6.30	41.10	54.00	12.90	PK
	V	4865.73	-3.40	39.80	54.00	14.20	PK
2452	V	2457.57	38.03	103.60	/	/	PK
	V	30.00	22.30	38.90	40.00	1.10	PK
	V	179.67	12.40	42.20	43.50	1.30	PK
	H	249.65	13.20	45.00	46.00	1.00	PK
	V	2495.99	38.15	71.10	74.00	2.90	PK
	V	2495.99	38.15	52.80	54.00	1.20	AV
	H	3182.36	-8.30	45.90	54.00	8.10	PK
	V	4921.84	-3.30	42.50	54.00	11.50	PK

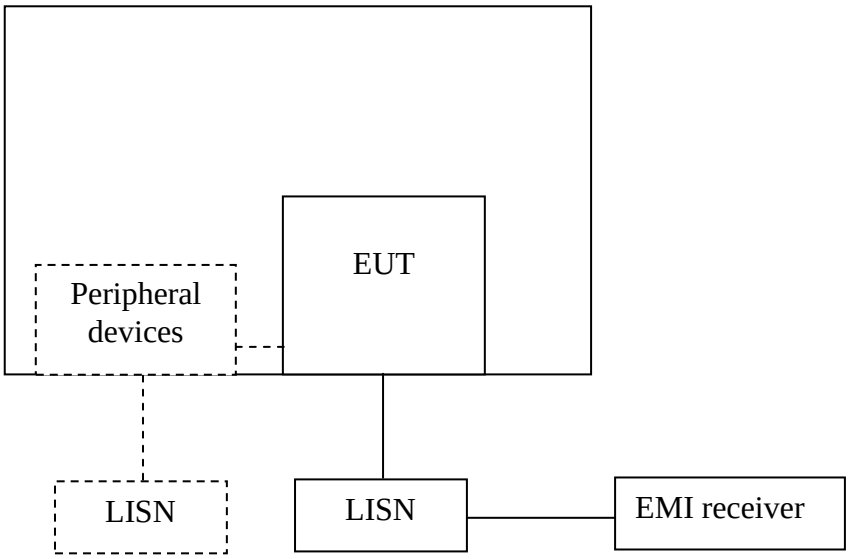
8 Power line conducted emission

Test result: **Pass**

8.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

8.2 Test configuration



☒ For table top equipment, wooden support is 0.8m height table

☐ For floor standing equipment, wooden support is 0.1m height rack.

8.3 Test procedure and test set up

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

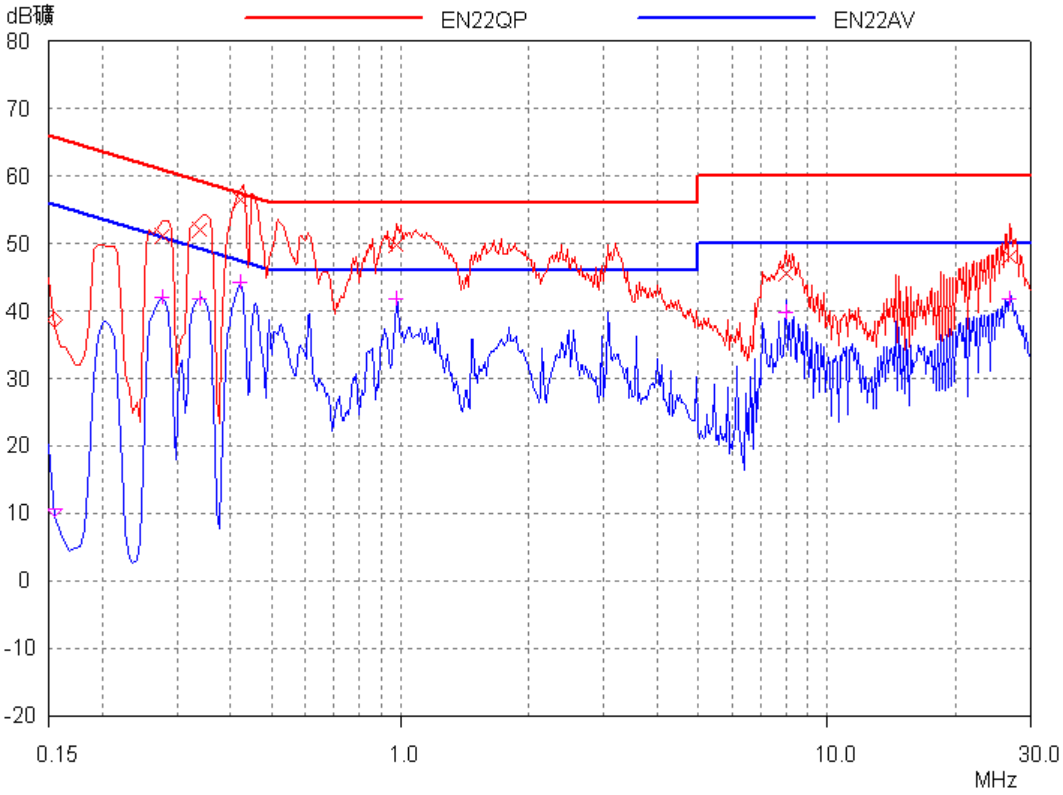
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

8.4 Test protocol

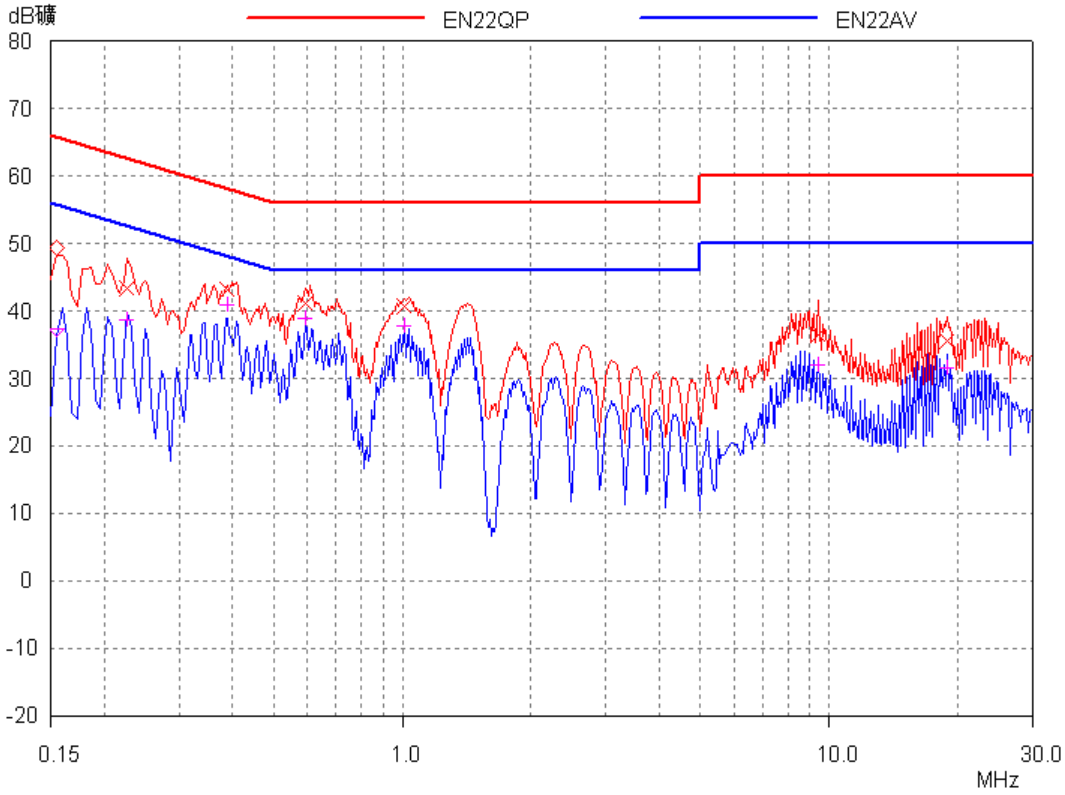
Temperature: 25 °C
Relative Humidity: 55 %

AC powered



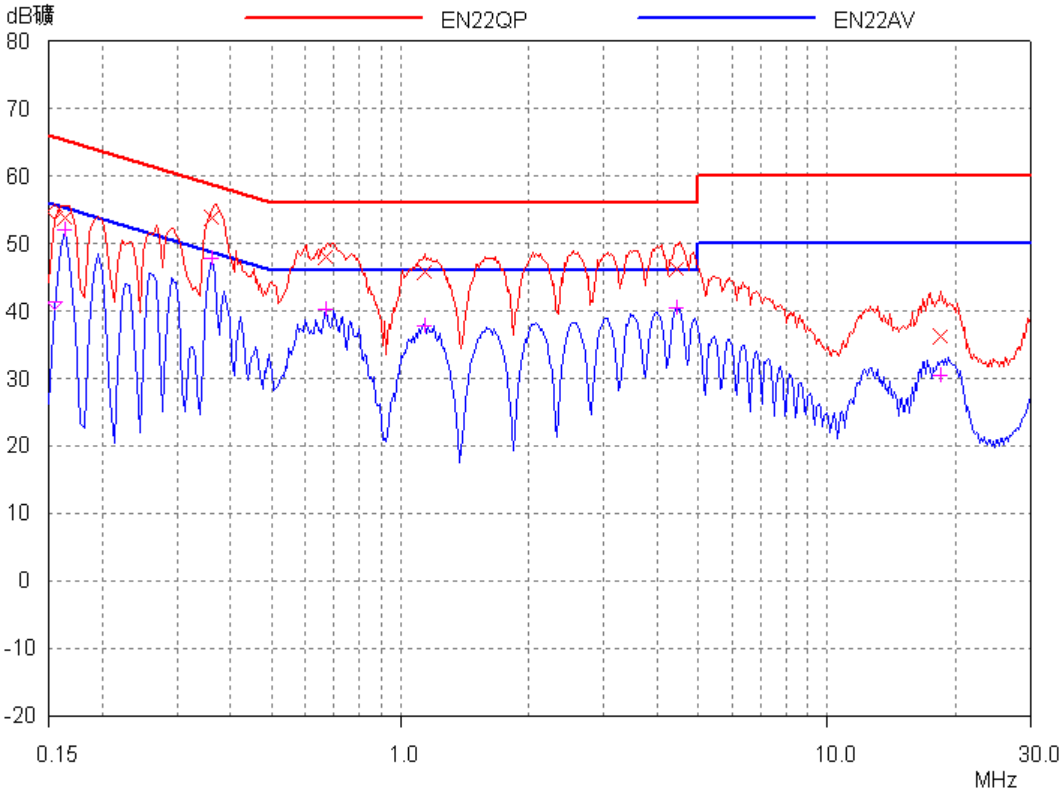
Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.28 (L)	3.00	51.11	41.97	60.94	50.94	9.83	8.97
0.34 (L)	3.00	52.08	41.76	59.23	49.23	7.15	7.47
0.42 (N)	3.00	56.44	44.25	57.45	47.45	1.01	3.20
0.98 (L)	3.00	49.86	41.87	56.00	46.00	6.14	4.13
7.95 (N)	3.00	45.55	39.73	60.00	50.00	14.45	10.27
26.61 (L)	3.00	47.96	41.78	60.00	50.00	12.04	8.22
Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB). 2. Margin (dB) = Limit - Corrected Reading.							

Adaptor powered



Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.23 (N)	3.00	43.31	38.67	62.58	52.58	19.27	13.91
0.39 (L)	3.00	43.13	40.86	58.10	48.10	14.97	7.24
0.59 (L)	3.00	41.14	38.99	56.00	46.00	14.86	7.01
1.01 (L)	3.00	40.59	37.86	56.00	46.00	15.41	8.14
9.38 (N)	3.00	36.42	31.90	60.00	50.00	23.58	18.10
18.76 (L)	3.00	35.50	31.59	60.00	50.00	24.50	18.41
Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB). 2. Margin (dB) = Limit - Corrected Reading.							

POE Adaptor powered



Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.16 (N)	3.00	53.92	51.95	65.28	55.28	11.36	3.33
0.36 (L)	3.00	53.75	47.79	58.69	48.69	4.94	0.90
0.67 (L)	3.00	48.03	40.25	56.00	46.00	7.97	5.75
1.14 (N)	3.00	45.77	37.70	56.00	46.00	10.23	8.30
4.43 (N)	3.00	46.17	40.53	56.00	46.00	9.83	5.47
18.33 (L)	3.00	36.23	30.54	60.00	50.00	23.77	19.46
Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB). 2. Margin (dB) = Limit - Corrected Reading.							

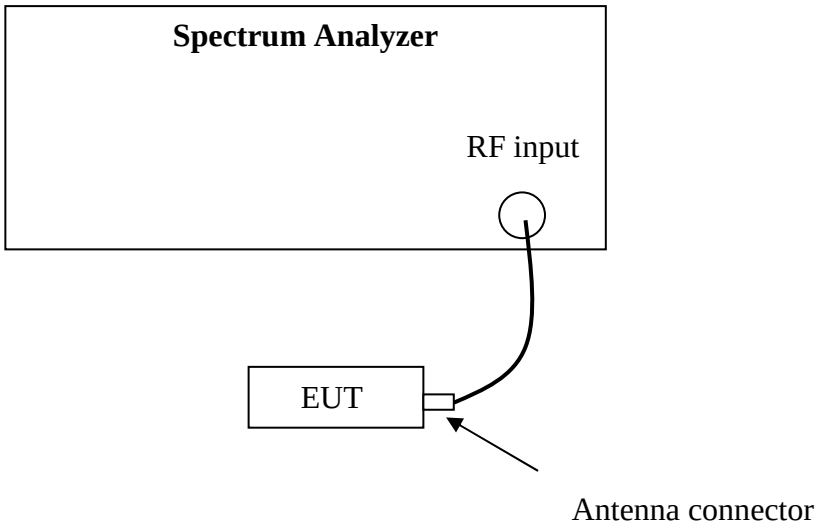
9 Occupied Bandwidth

Test Status: Tested

9.1 Test limit

None

9.2 Test Configuration



9.3 Test procedure and test setup

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

9.4 Test protocol

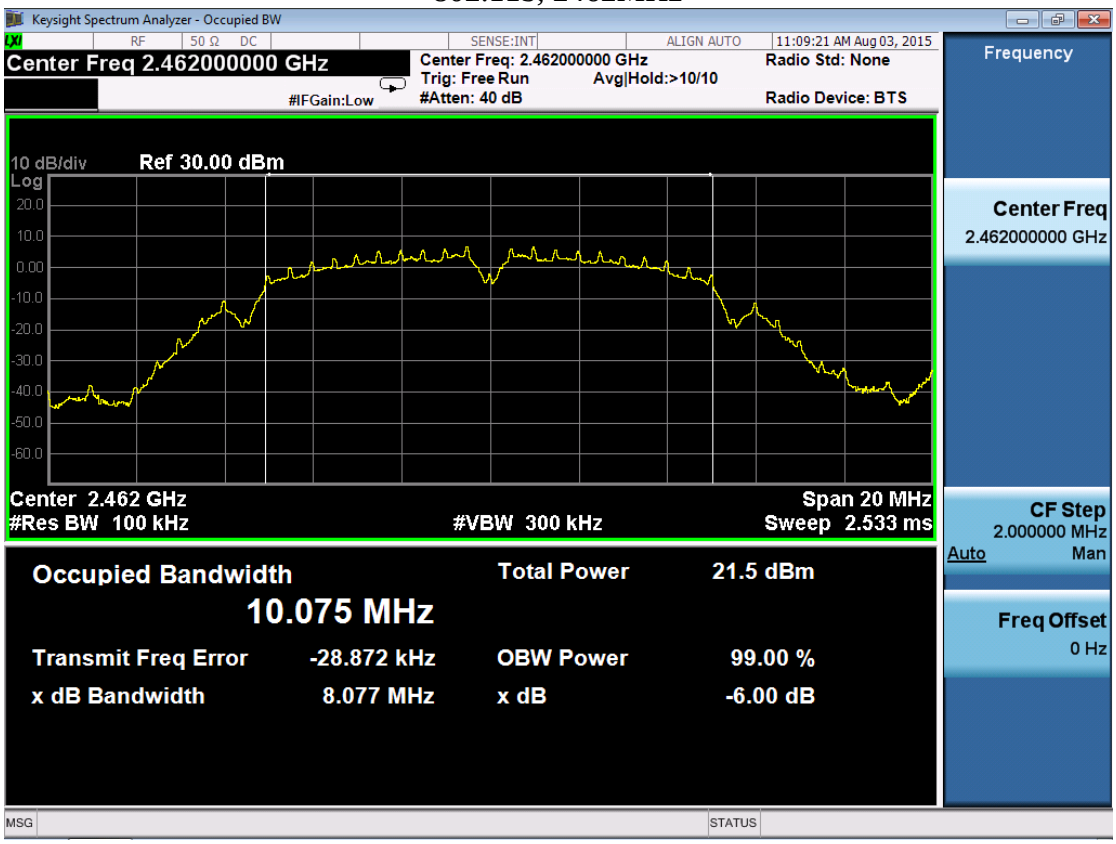
Temperature : 25 °C
Relative Humidity : 55 %

Modulation	Frequency (MHz)	99% Bandwidth(MHz)	
		Port 0	Port 1
802.11b	2412	10.05	/
	2437	10.07	/
	2462	10.08	/
802.11g	2412	16.29	/
	2437	16.30	/
	2462	16.30	/
802.11n20	2412	17.42	17.45
	2437	17.44	17.46
	2462	17.45	17.45
802.11n40	2422	36.20	36.18
	2437	36.20	36.20
	2452	36.17	36.18

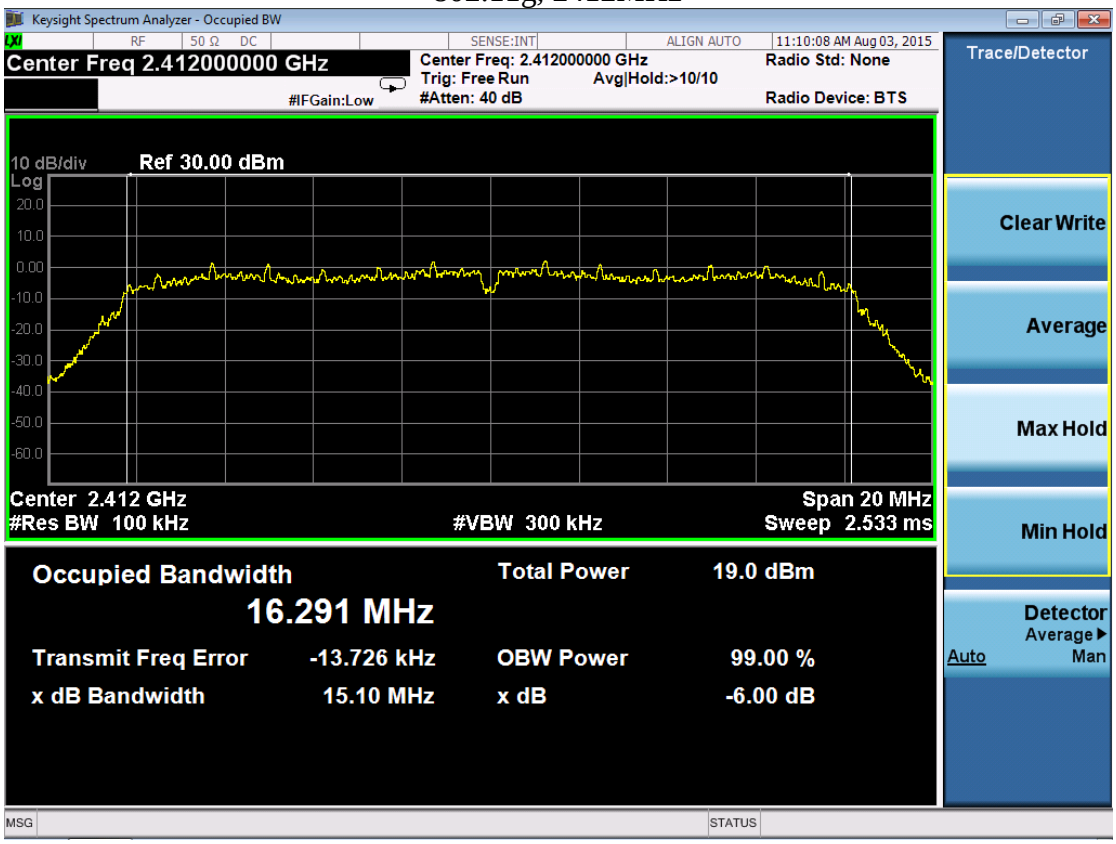
802.11b, 2412MHz

802.11b, 2437MHz

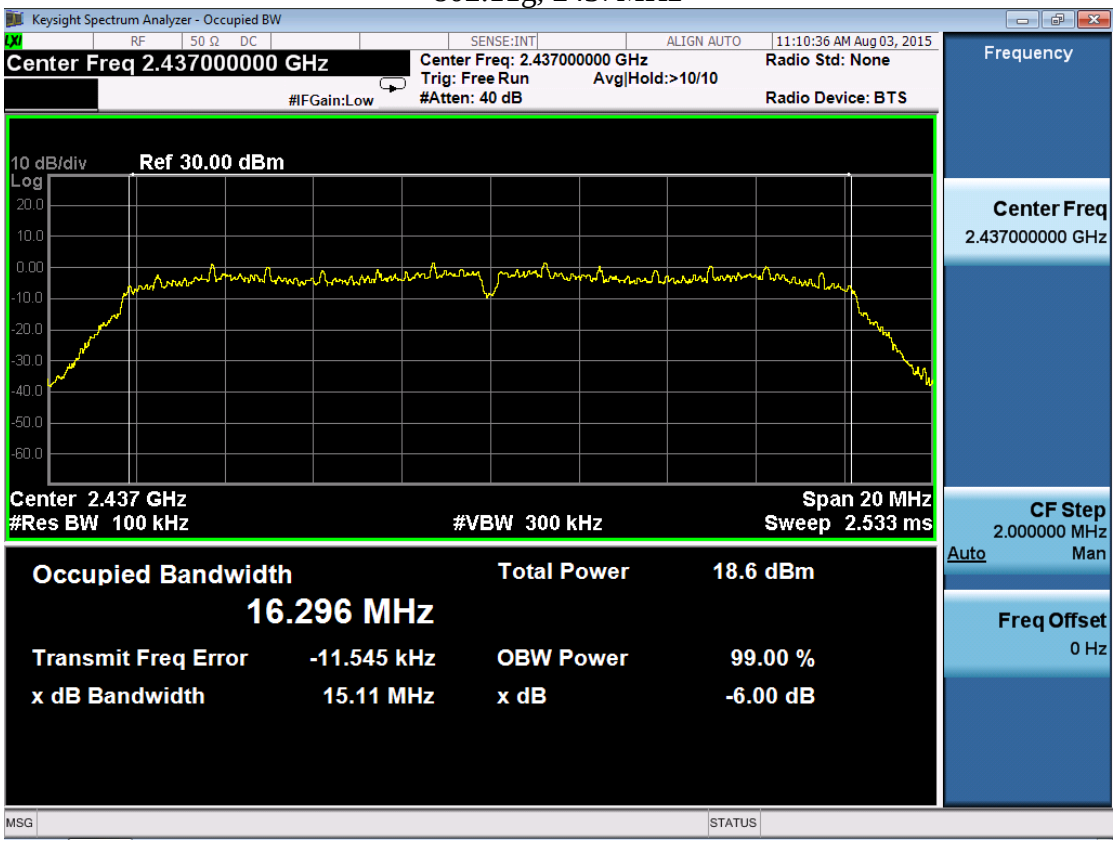
802.11b, 2462MHz



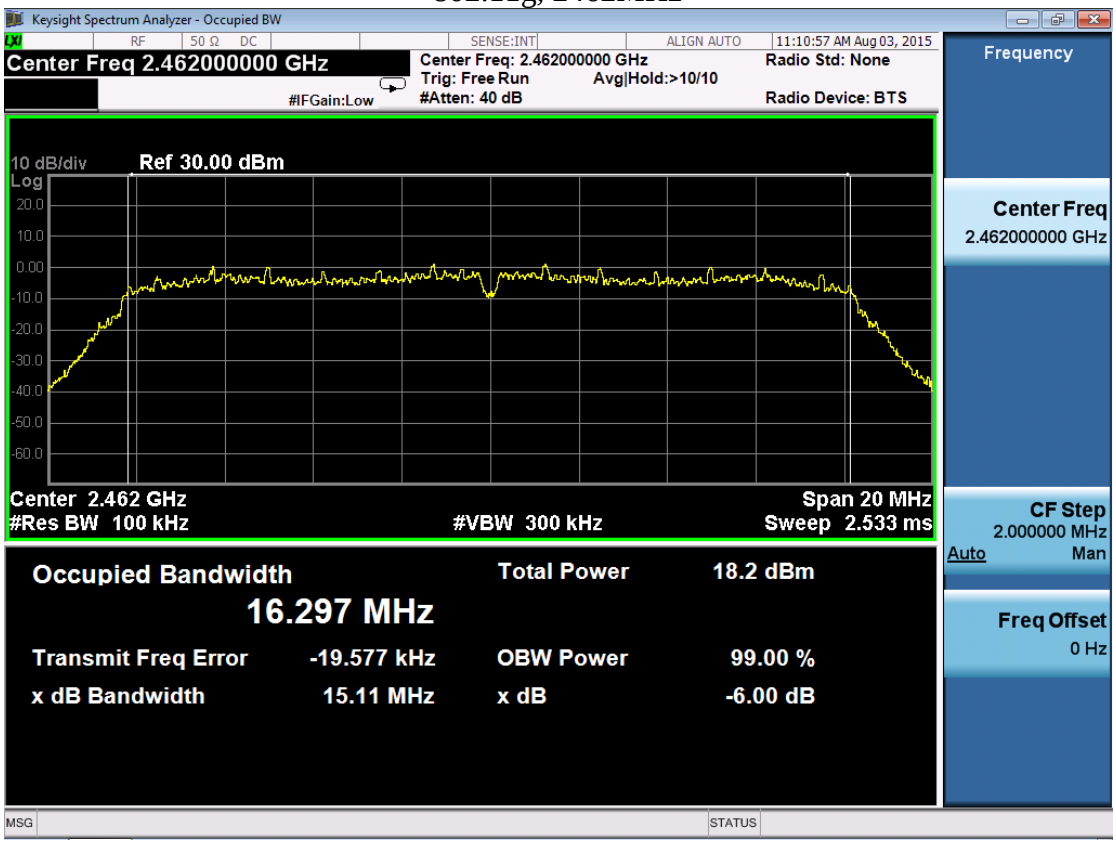
802.11g, 2412MHz



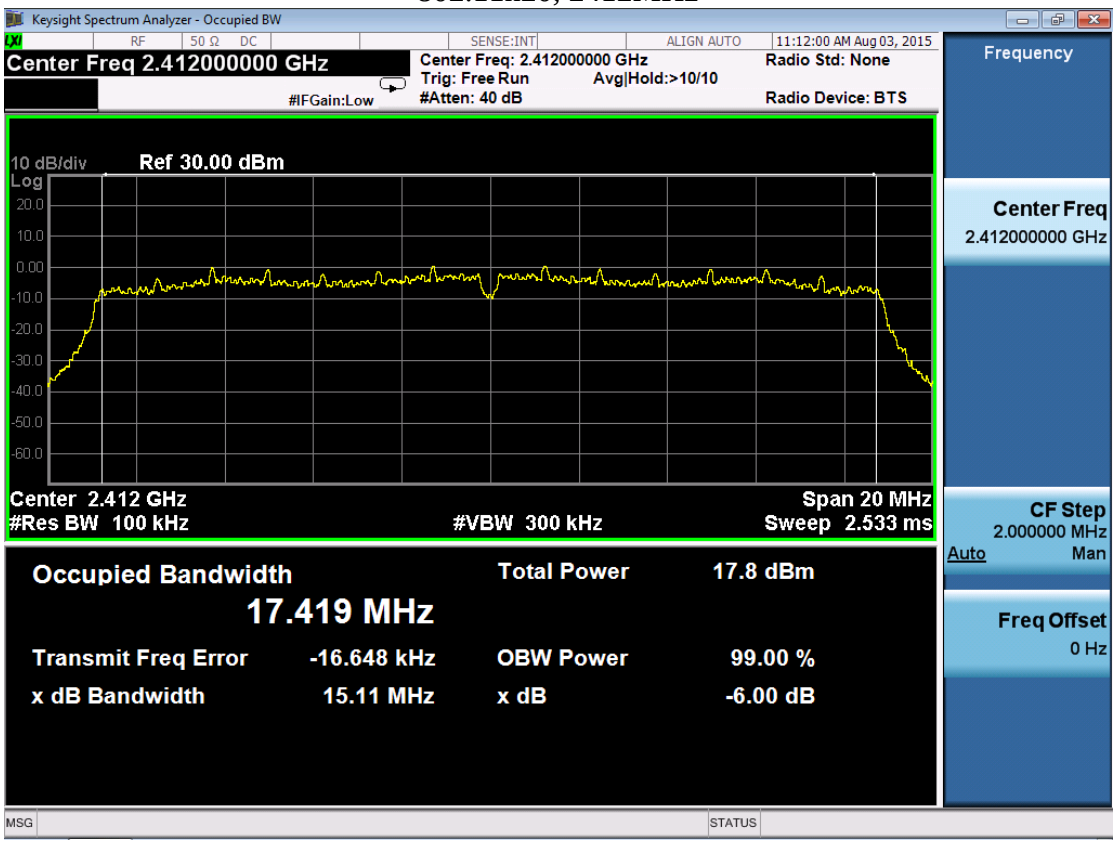
802.11g, 2437MHz

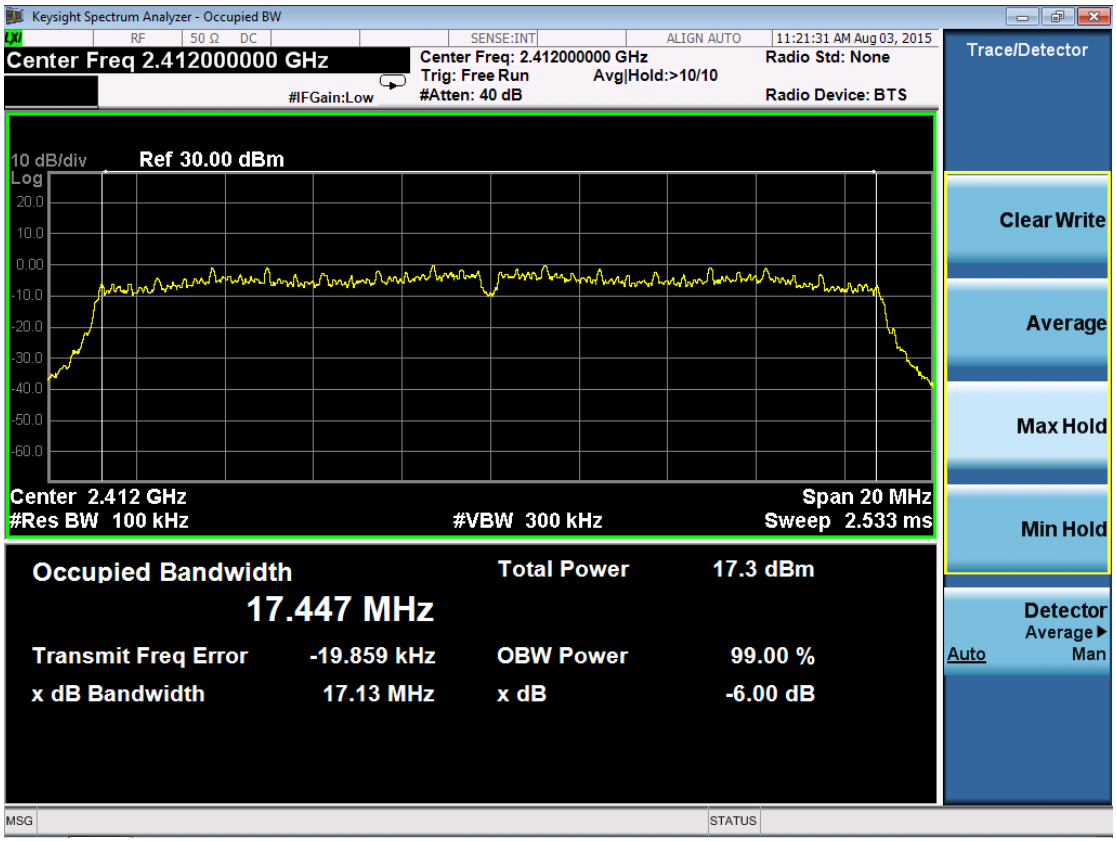


802.11g, 2462MHz

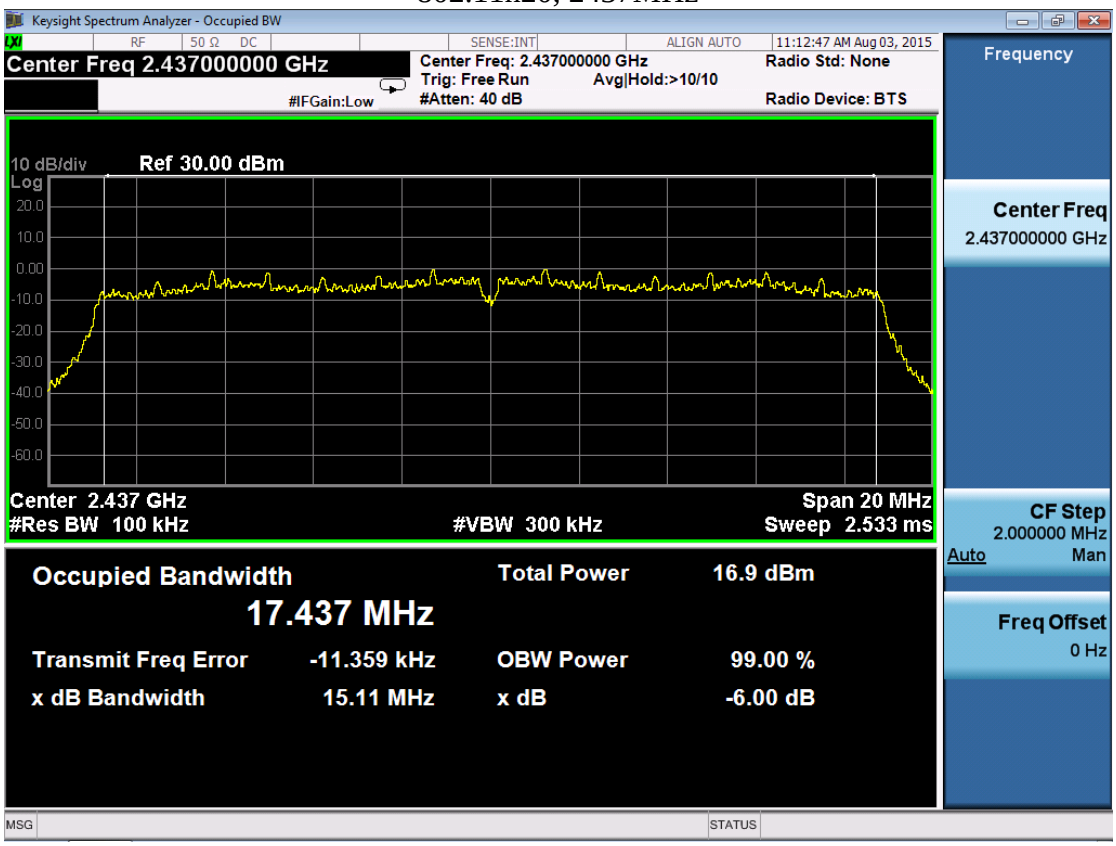


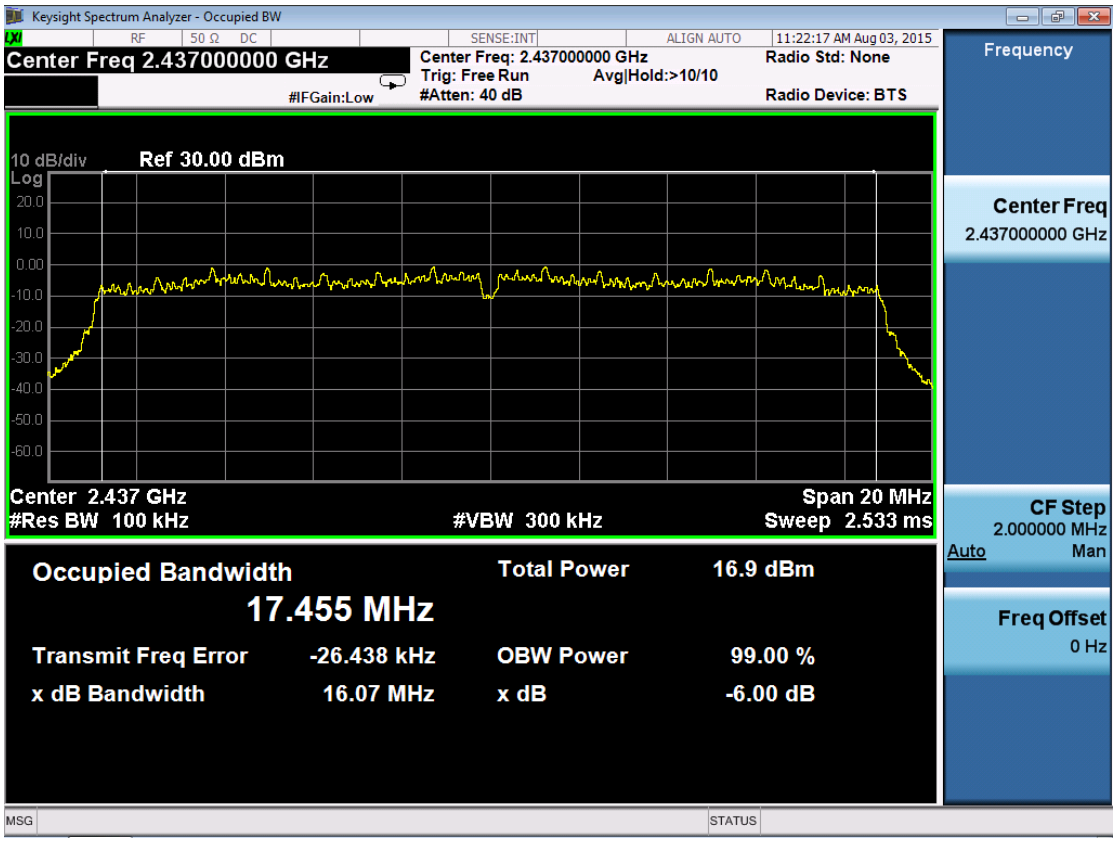
802.11n20, 2412MHz



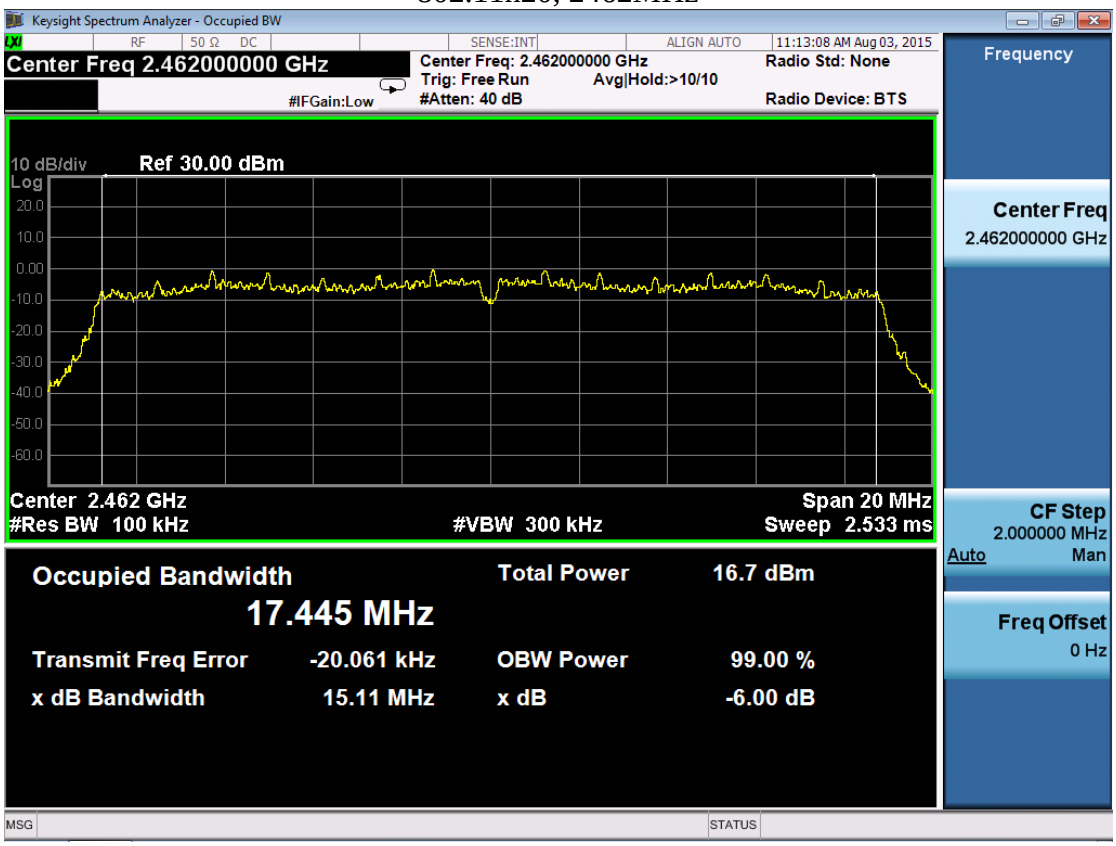


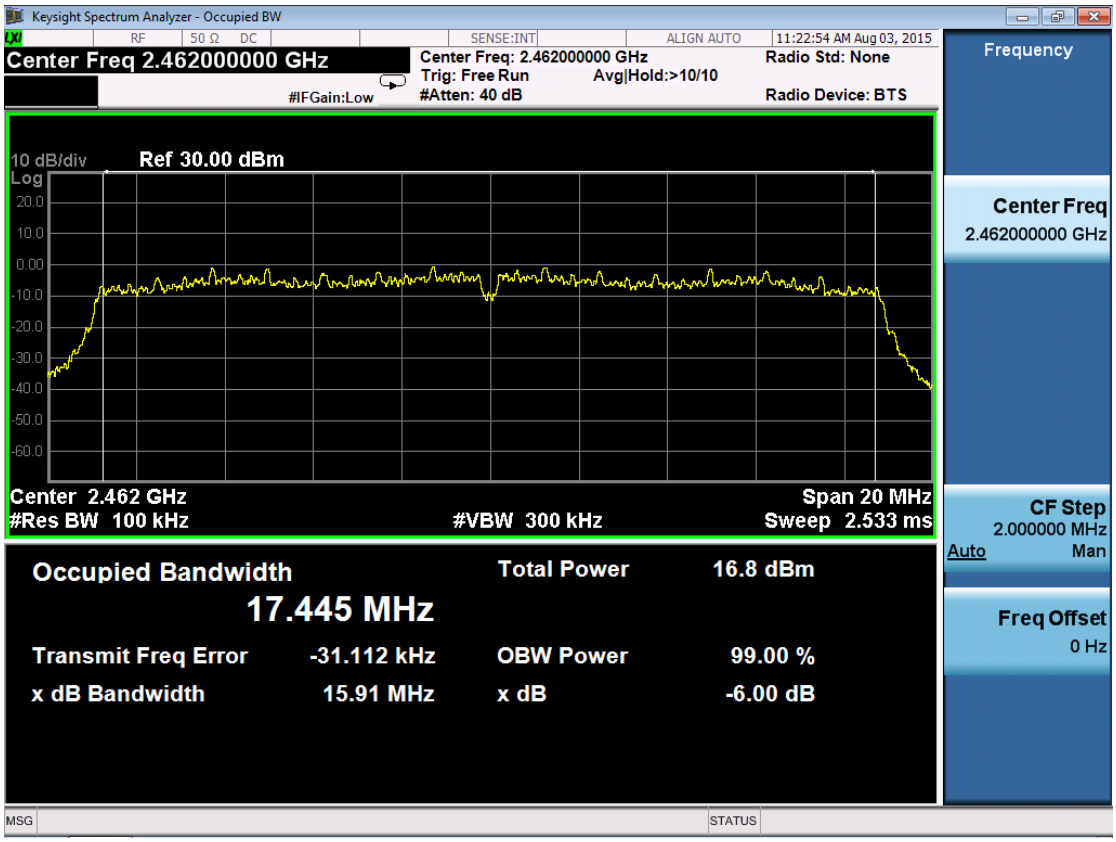
802.11n20, 2437MHz



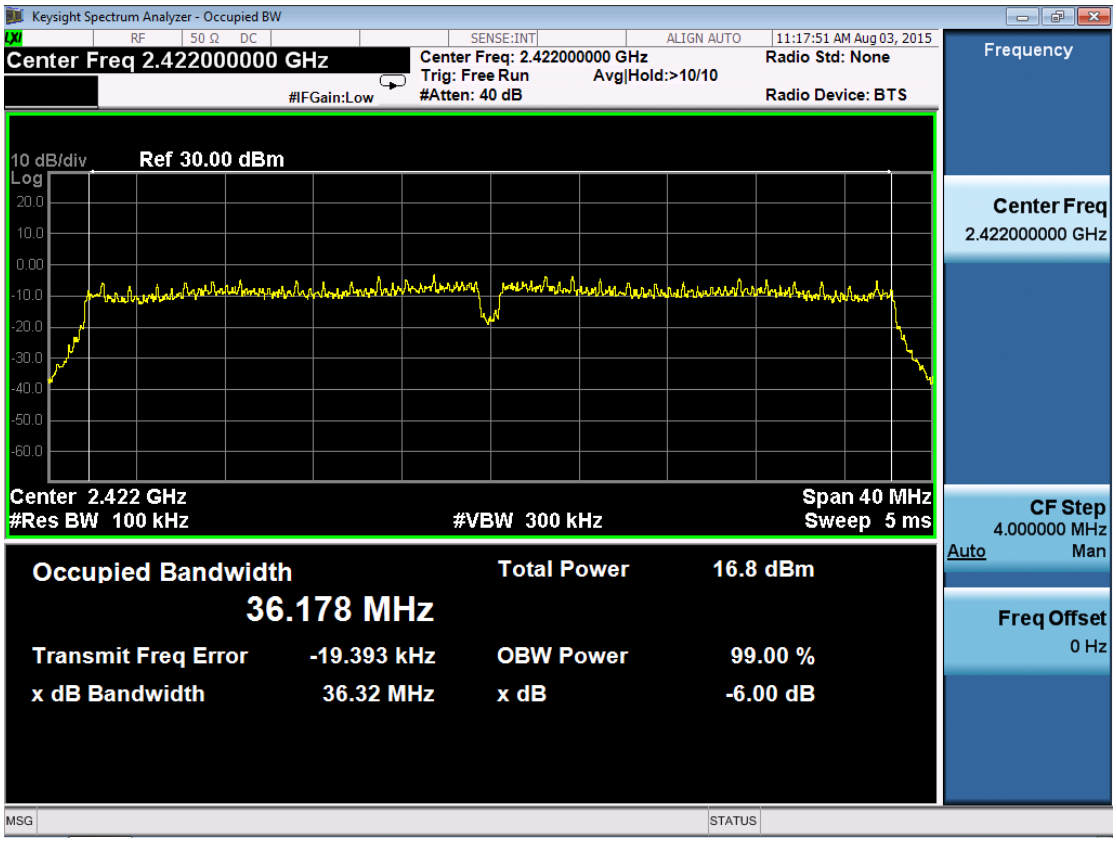


802.11n20, 2462MHz

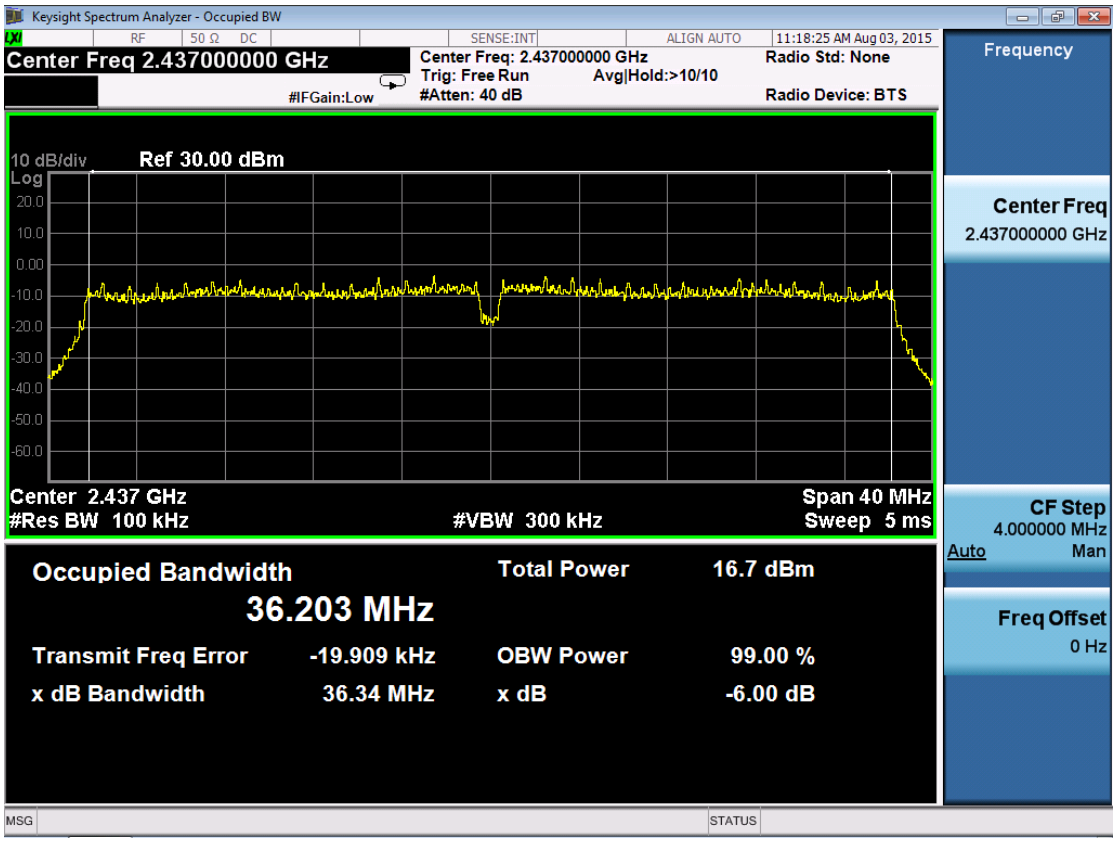




802.11n40, 2422MHz



802.11n40, 2437MHz



802.11n40, 2452MHz