LSR
a Laird Business
ACCREDITED
TESTING CERT #1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.Laird Technologies, Inc..com

TEST REPORT #: 316393 A
Job #: C-2631

Compliance Testing of:

Cor 5C

Test Date(s):

1/5/17	1/9/17	1/27/17	2/21/17	2/23/17	2/27/17	3/10/17
1/6/17	1/26/17	2/20/17	2/22/17	2/24/17	2/28/17	

Prepared For:

United Technology Electronic Controls, Inc.
Attention: Gregg Householder
3650 W 200 N
Huntington, IN 46750

This Test Report is issued under the Authority of:
Michael Hintzke, EMC Engineer III

Signature: Date: 3/15/17

Test Report Reviewed by:	Project Engineer:
Adam Alger, Quality Systems Engineer	Michael Hintzke, EMC Engineer III
Signature: Date: 3/15/17	Signature: Date: 3/15/17

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EXHIBIT 1 INTRODUCTION

1.1 Scope

References:	FCC Part 15, Subpart C, Section 15.247 RSS GEN issue 4 and RSS 247 issue 1
Title:	FCC: Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Purpose of Test:	To determine FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	FCC KDB 558074 D01 DTS Measurement Guidance v03r04 ANSI C63.10

1.2 Normative References

Publication	Year	Title
FCC CFR Parts 0-15	2017	Code of Federal Regulations – Telecommunications
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
RSS-247 Issue 2	2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
FCC KDB 558074 D01 DTS Measurement Guidance v03r05	2016	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.3 Laird Technologies, Inc. Test Facility

Laird Technologies, Inc. is accredited by A2LA (American Association for Laboratory Accreditation) as conforming to ISO/IEC 17025, 2005 "General Requirements for the Competence of Calibration and Testing Laboratories".

The Laird Technologies, Inc. scope of accreditation includes all test methods listed herein, unless otherwise noted. Accreditation status can be verified at A2LA's web site: www.a2la2.org.

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

ACCREDITED
TESTING CERT # 1255.01

A2LA – American Association for Laboratory Accreditation
Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

FC

Federal Communications Commission (FCC) – USA
Listing of two 3 Meter Semi-Anechoic Chambers based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Industrie Canada Industry Canada
Canada

Industry Canada
On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4
File Number: IC 3088A-2
On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4
File Number: IC 3088A-3

1.4 Location of Testing

All testing was performed at the following location utilizing the facilities listed below, unless otherwise noted.

Laird Technologies, Inc.
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA,

List of Facilities Located at Laird Technologies, Inc.:

Semi-Anechoic Chamber

1.5 Test Equipment Utilized

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated to the requirements of ISO/IEC 17025, and traceable to the SI standard.

EXHIBIT 2 PERFORMANCE ASSESSMENT

2.1 Client Information

Manufacturer Name:	United Technology Electronic Controls, Inc.
Address:	3650 W 200 N
Contact Name:	Gregg Householder
E-mail:	gregg.householder@uthvac.com

2.2 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	Cor 5c
Model Number:	TSTWHA01
Serial Number:	Engineering Sample
FCC ID	2AK6N-TSTWHA01
IC ID	703A-TSTWHA01

A laptop computer running the TI CC3100/CC3200 Radio Tool v1.2.5942.19689 interfaced to a TI CC31XXEMUBOOST Advanced Emulation BoosterPack which was connected to the EUT via UART connection was used to program the EUT. The Continuous Tx Mode option of the test tool was selected for compliance testing. The EUT operates on WLAN channels 1 (2412 MHz) to 11 (2462 MHz).

Throughout all testing the EUT was powered from the following off-the-wall 120 VAC to 24 VAC power supply:

Manufacturer	CUI Inc.
Model Number	48A-24-500
Serial Number	EPA240050-S/T0SZ
Part Number	2AK6N-TSTWHA01
Input	120V 60Hz 18W
Output	24VAC 500mA

2.3 Associated Antenna Description

TAIYO YUDEN chip antenna with +1.9 dBi peak gain.

2.4 EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2412MHz – 2462MHz (WLAN)
RF Power in Watts (Conducted measurement)	
Minimum:	2.4GHz WLAN 802.11 b: 0.020 Watts 802.11 g: 0. 035 Watts 802.11 n (HT20): 0.035 Watts
Maximum:	2.4GHz WLAN 802.11 b: 0.033 Watts 802.11 g: 0.151 Watts 802.11 n (HT20): 0.141 Watts
Conducted (Average) Output Power (dBm)	2.4GHz WLAN 802.11 b: Maximum = 15.2 dBm Minimum = 13.1 dBm 802.11 g: Maximum = 21.8 dBm Minimum = 15.5 dBm 802.11 n (HT20): Maximum = 21.5 dBm Minimum = 15.4 dBm
Field Strength at 3 meters (Maximum)	Not Applicable
99% Bandwidth	2.4GHz WLAN: 802.11 b: 14.4 MHz 802.11 g: 17.6 MHz 802.11 n (HT20): 18.6 MHz
Type of Modulation	OFDM (WLAN), DSSS(WLAN)
DTS Bandwidth (6dB BW)	2.4GHz WLAN: 802.11 b: 9.2 MHz 802.11 g: 16.5 MHz 802.11 n (HT20): 17.7 MHz
Transmitter Spurious (worst case) at 3 meters	52.6 dBµV/m at 4924 MHz
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	Chip
Gain	Peak Gain in 2.4GHz band = +1.9dBi
EUT will be operated under FCC Rule Part(s)	Title 47 part 15.247
EUT will be operated under RSS Rule Part(s)	RSS 247
Modular Filing	☐ Yes ☒ No

2.5 Product Description

The Côr 5 series thermostat is available as a Non-Wi-Fi model (Côr 5) or a Wi-Fi model (Côr 5C). The Côr 5C thermostat model is a Wi-Fi connected device and can be remotely controlled by the free mobile app* (Android or iOS compatible devices).

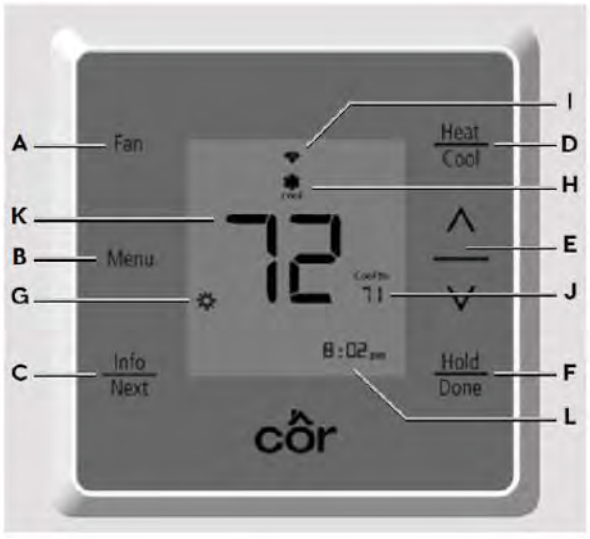
The Côr 5 Series Thermostat has no need for batteries to store user-configured settings in memory. During AC power loss, its internal memory saves settings for an unlimited time, and the clock continues to run for at least 12 hours.

Both thermostat models provide 7-day, 5/2-day and 1-day programmable control. The Côr 5 series models provide temperature control only This Product is a wall-mounted, low-voltage HVAC control which is powered by 24VAC.

The Côr thermostat has programmable configuration capability providing different heating and cooling setpoints associated with time periods which are user selectable as either 2 or 4 periods per day. Programming can be done for 7 days per week (individually), 5/2 days per week (holding week days and weekends separate), or 1 day (every day follows same 2 or 4 period schedule). These thermostats can also be configured as non-programmable thermostats. When operating in non-programmable mode, the Côr Thermostat will maintain temperature control at the fixed temperature set on the display.

The Côr 5 Series Thermostats can be configured for AC or HP, 1 or 2-speed 4 compressor, and for Hybrid Heat installations.

The following figure shows the Côr 5 series thermostat.



A. Fan (On or Auto)
B. View Menu options (Schedule, Alerts, Settings, Wi-Fi®)
C. Info/Next (toggle between various status screens)
D. Change equipment mode (heat, cool, etc.)
E. Manual temperature adjustment or navigate through menu options
F. Hold/Done

ON-SCREEN INDICATORS
G. Weather
H. Active equipment mode
I. Wi-Fi signal strength
J. Temperature set point
K. Indoor temperature
L. Information button scrolls through display options for text box (time, etc.)

EXHIBIT 3 EUT OPERATING CONDITIONS & TEST CONFIGURATIONS

3.1 Climate Test Conditions

Temperature:	70 -71° F
Humidity:	32-42%
Pressure:	728-741mmHg

3.2 Summary of Test Results

FCC/IC Reference	Test Requirements	Compliance
FCC: 15.207 IC: RSS-Gen section 8.8	Conducted AC Line Emissions	Yes
IC: RSS-Gen section 6.6	99% Bandwidth	Yes
FCC:15.247 (a)(2) IC: RSS-247 section 5.2(a)	DTS Bandwidth	Yes
FCC: 15.247(b) (3) FCC 1.1310 IC: RSS-247 section 5.4(4)	Maximum Output Power	Yes
FCC: 15.247(d) IC: RSS-247 section 5.5	RF Conducted Transmitter Spurious Emissions at the Antenna Terminal	Yes
FCC:15.247 (e) IC: RSS 247 5.2 (2)	Power Spectral Density of a Digital Modulation System	Yes
FCC: 15.209 FCC: 15.205 IC: RSS-Gen section 6.13 IC: RSS-Gen section 8.10	Transmitter Radiated Emissions	Yes

3.3 Modifications Incorporated In The EUT For Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 Deviations & Exclusions from Test Specifications

☒ None ☐ Yes (explain below)

EXHIBIT 4 SUMMARY OF CONFORMITY

When tested between 1/5/17 to 3/10/17, it was determined that the EUT, Cor5c, as provided by United Technology Electronic Controls, Inc. was compliant with the requirements of:

FCC Title 47, CFR Part 15.247
Industry Canada RSS-247, Issue 2

Using the methods of ANSI C63.10-2013

Any modifications made to the EUT after the specified test date(s) will invalidate the data herein.

If some emissions measurements are seen to be within the uncertainty value, as listed in Appendix C there is a possibility that this unit may not meet the required limit specification if subsequently tested.

EXHIBIT 5 DUTY CYCLE & Transmission Duration

Manufacturer	United Technology Electronic Controls, Inc.
Date	2/24/17
Operator	Shane Dock
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Sample Calculations	• Transmit Duration = Tx on-time • Duty Cycle = Tx on-time /(Tx on-time + Tx off-time)
Additional Notes	• Continuous transmit modulated used for this test. • 802.11g/n modes exhibit a non-constant duty cycle

5.1 Measurement Procedure

ANSI C63.10-2013 Section 11.6.

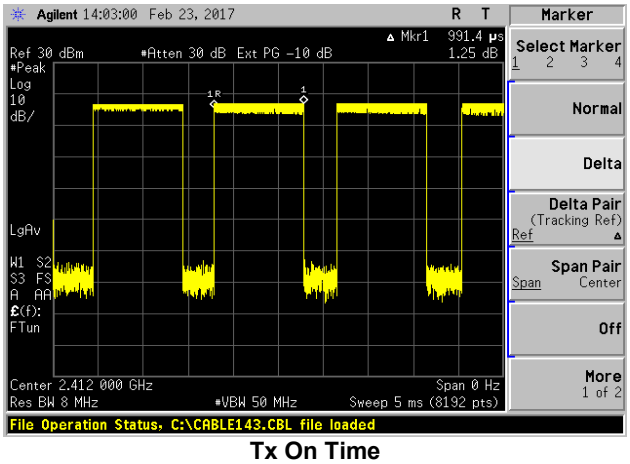
5.2 Test Data

802.11 Mode	Data Rate	T (ms)	1/T (kHz)	Total Time (ms)	x	$10*\log_{10}(1/x)$
b	1	0.991	1.009	1.396	0.71	1.49
	11	0.264	3.788	0.564	0.47	3.29
g	6	0.160	6.250	-	-	-
	54	0.037	27.027	-	-	-
n	MCS0	0.166	6.024	-	-	-
	MCS7	0.052	19.231	-	-	-

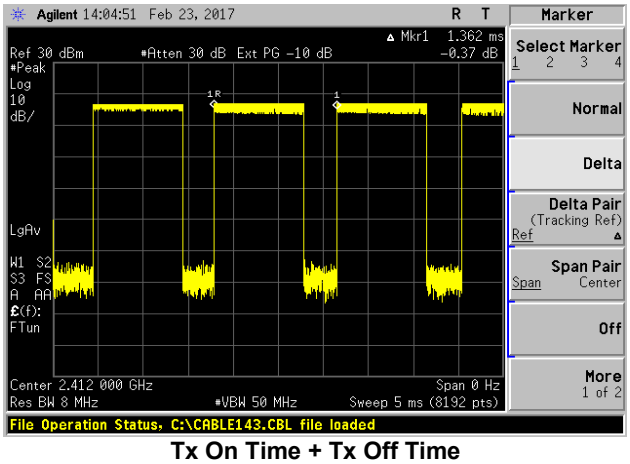
T = transmit on-time

x = duty cycle

1 Mbps

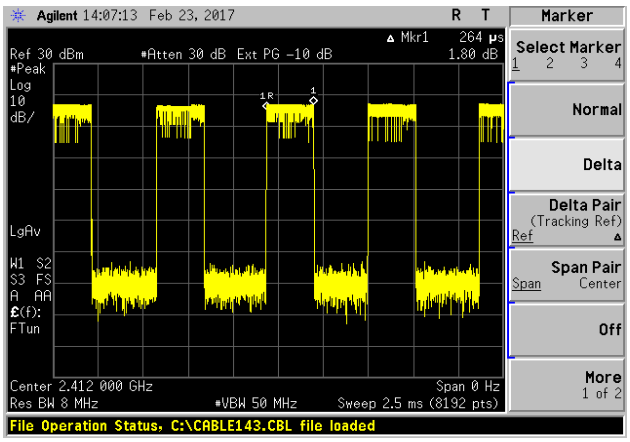


Tx On Time

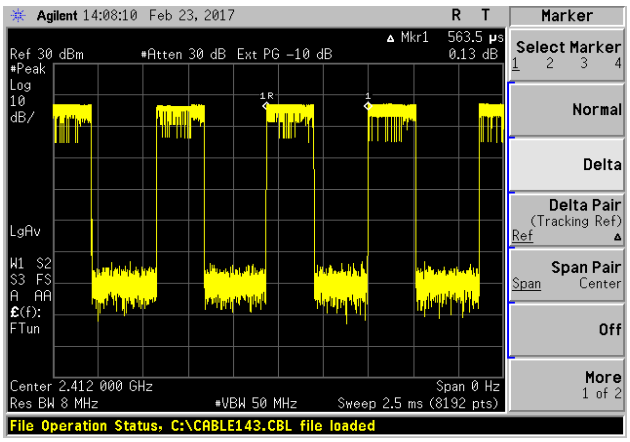


Tx On Time + Tx Off Time

11 Mbps

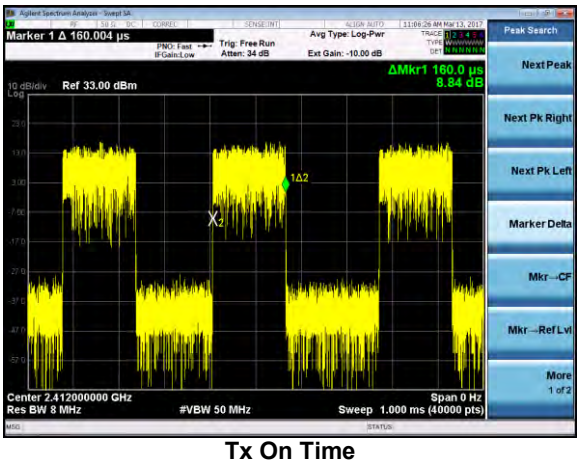


Tx On Time



Tx On Time + Tx Off Time

6 Mbps



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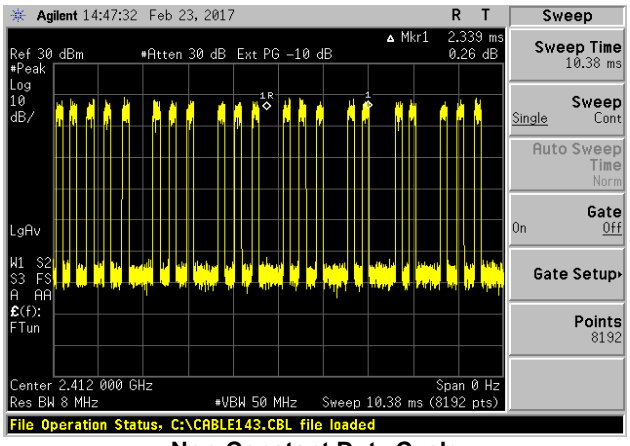
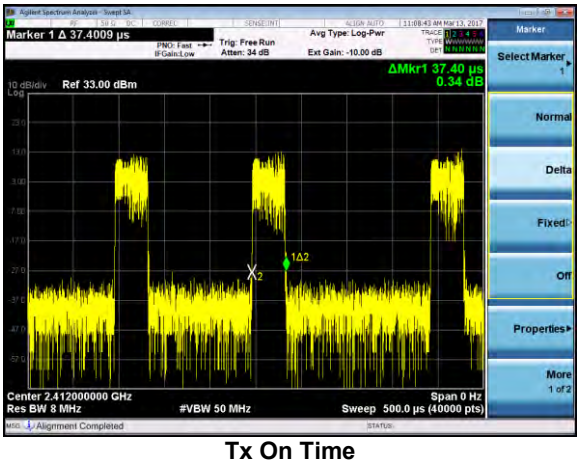


Non-Constant Duty Cycle

54 Mbps



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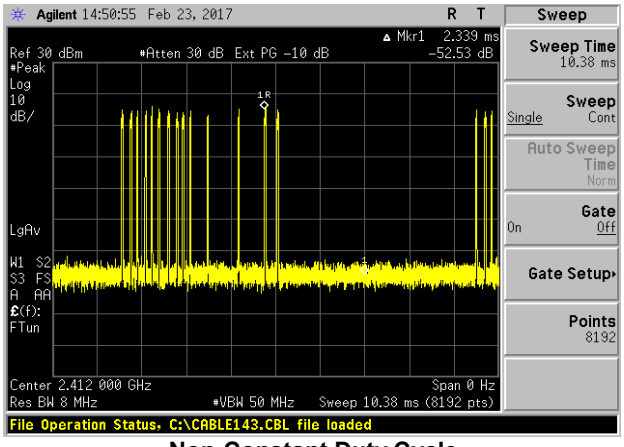
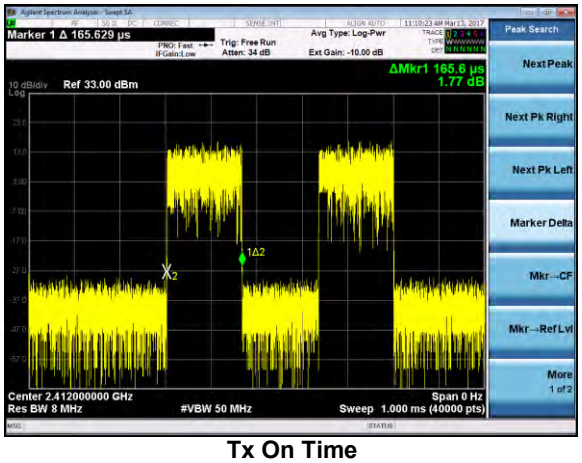


Non-Constant Duty Cycle

MCS0



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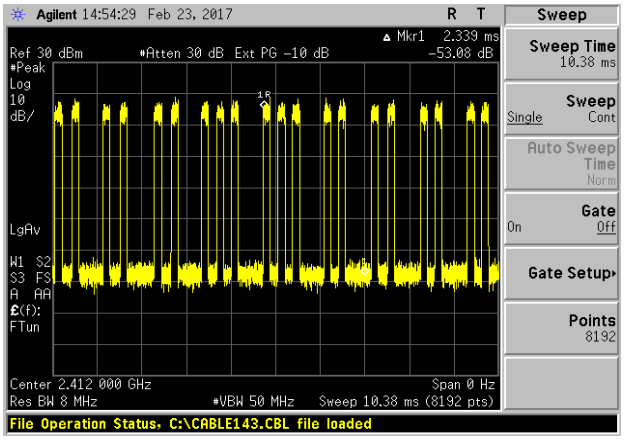
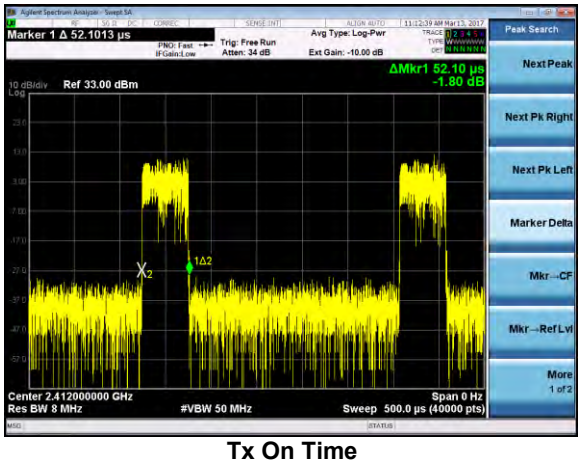
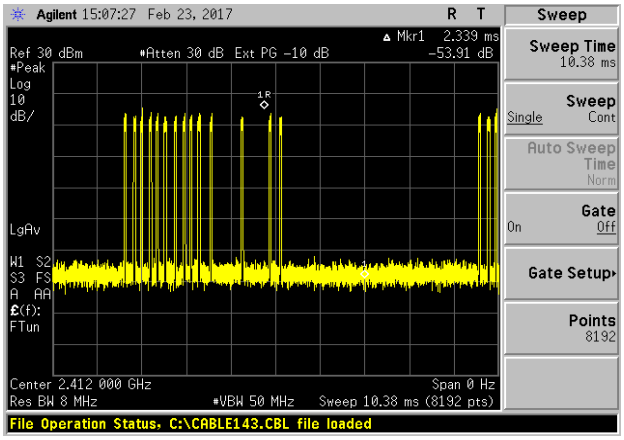


Non-Constant Duty Cycle

MCS7



Tx On Time



Non-Constant Duty Cycle

EXHIBIT 6 OCCUPIED BANDWIDTH

Manufacturer	United Technology Electronic Controls, Inc.
Date	2/24/17
Operator	Shane Dock
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(2) RSS-Gen section 6.6
Additional Notes	• Peak detector used • Continuous transmit modulated used for this test. • Sample Calculation: Margin (dB) = Limit – Measured level

6.1 Measurement Procedure

ANSI C63.10-2013 Section 11.8.2
RSS-Gen Issue 4 section 6.6

6.2 Measurement Limit

The minimum 6 dB bandwidth shall be at least 500 kHz for systems using digital modulation techniques.

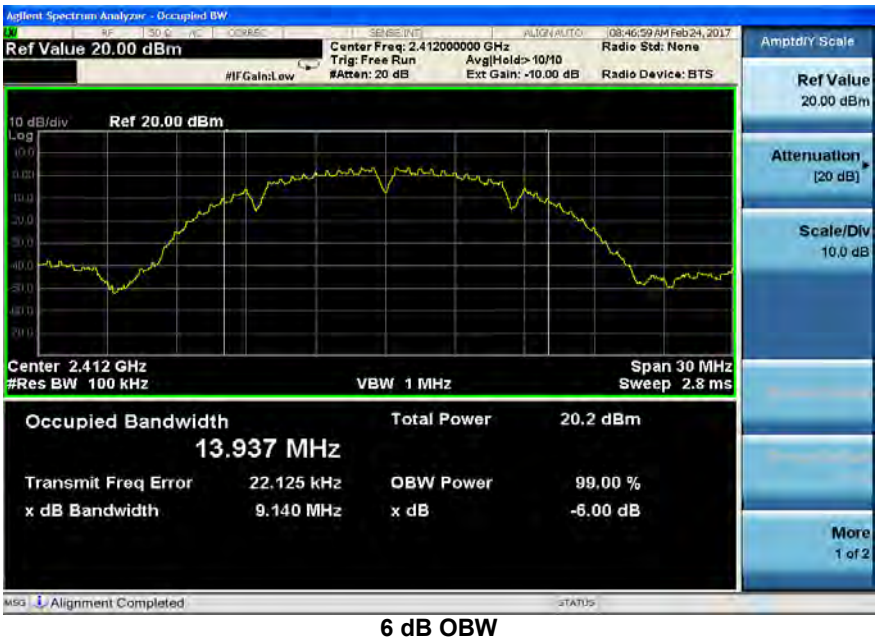
6.3 Test Data

802.11 Standard	Data Rate (MBPS)	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	6dB Bandwidth minimum limit (MHz)
b	1 (DBPSK)	1	9.1	13.9	0.5
		6	9.2	14.0	0.5
		11	9.1	14.0	0.5
b	11 (8QPSK)	1	9.1	14.4	0.5
		6	9.1	14.4	0.5
		11	9.1	14.4	0.5
g	6 (BPSK)	1	15.1	16.7	0.5
		6	15.1	17.6	0.5
		11	15.1	16.8	0.5
g	54 (64QAM)	1	16.5	16.9	0.5
		6	16.5	16.9	0.5
		11	16.5	17.0	0.5
n	MCS0 (BPSK)	1	15.1	17.7	0.5
		6	15.1	18.6	0.5
		11	15.1	17.8	0.5
n	MCS7 (64QAM)	1	17.7	18.1	0.5
		6	17.7	18.1	0.5
		11	17.7	18.1	0.5

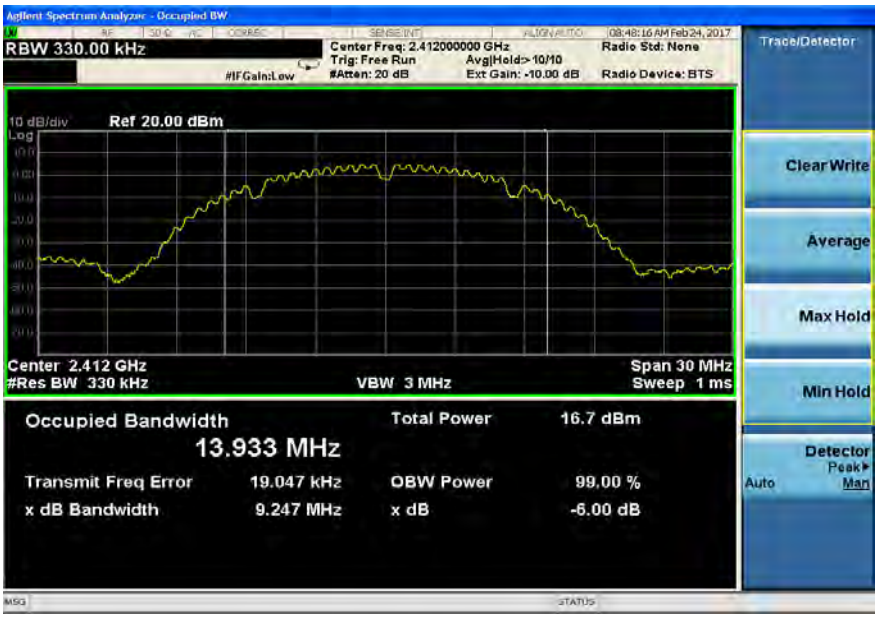
6.4 Screen Captures

802.11b – 1 Mbps

Low Channel



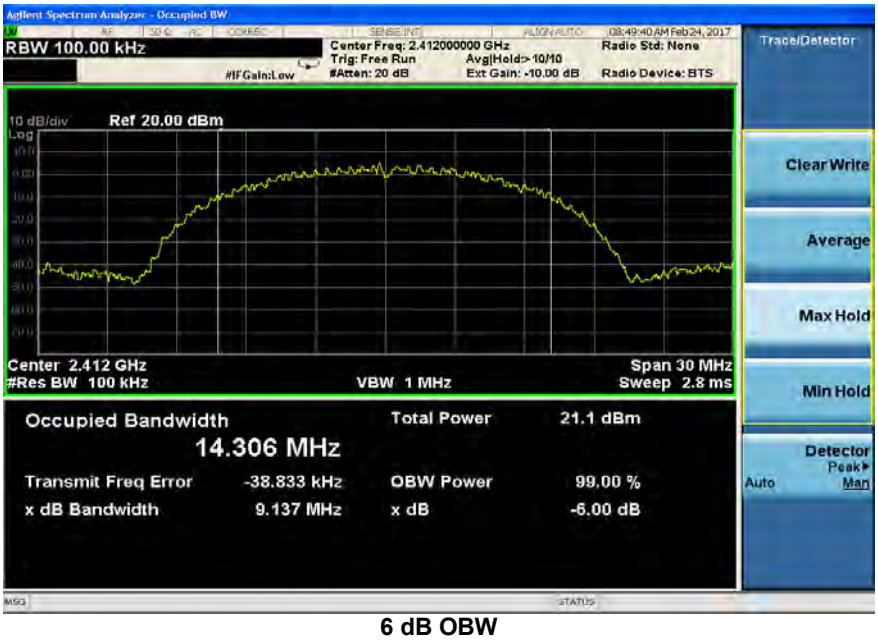
6 dB OBW



99 % OBW

802.11b – 11 Mbps

Low Channel



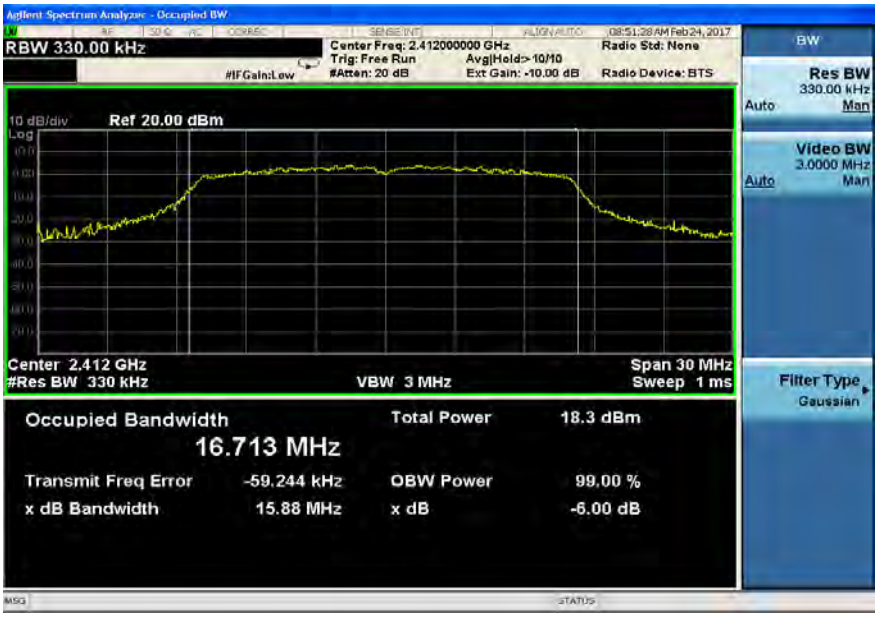
6 dB OBW

99 % OBW

802.11g – 6 Mbps

Low Channel

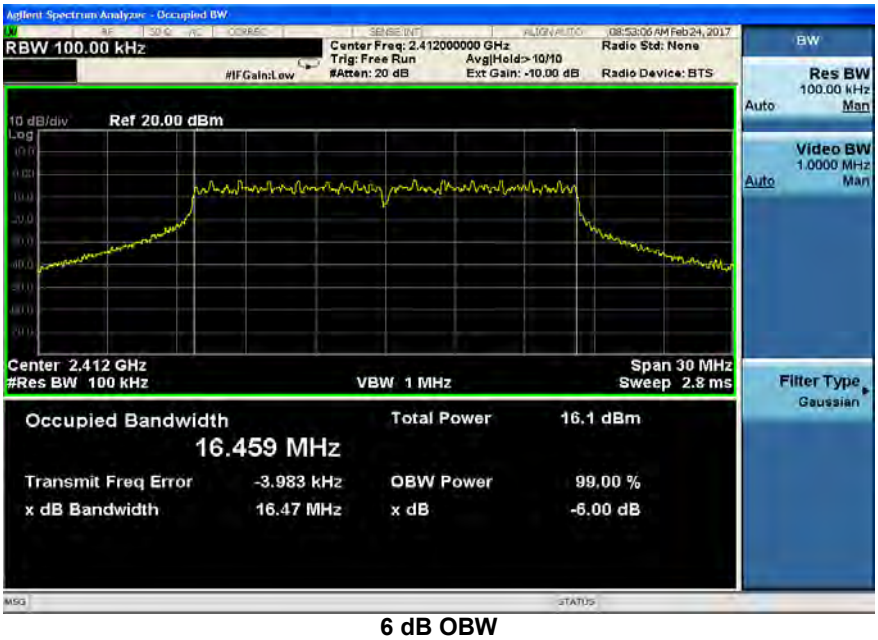
6 dB OBW



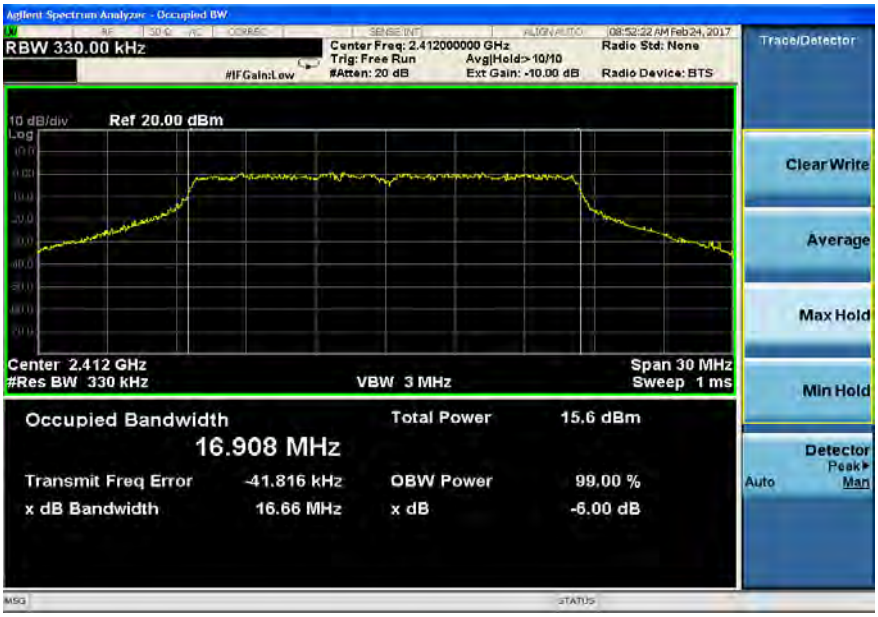
99 % OBW

802.11g – 54 Mbps

Low Channel



6 dB OBW

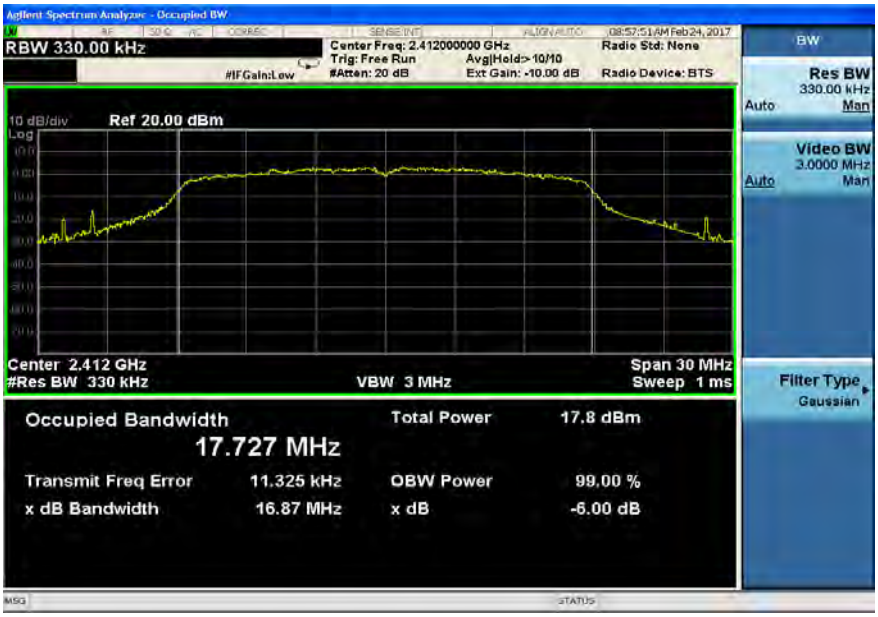


99 % OBW

802.11n – MCS0

Low Channel

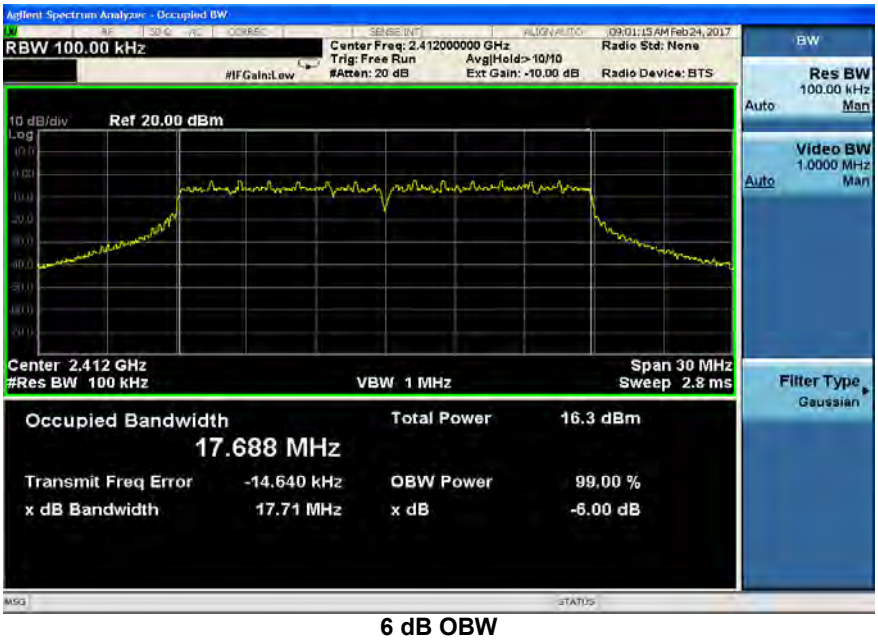
6 dB OBW



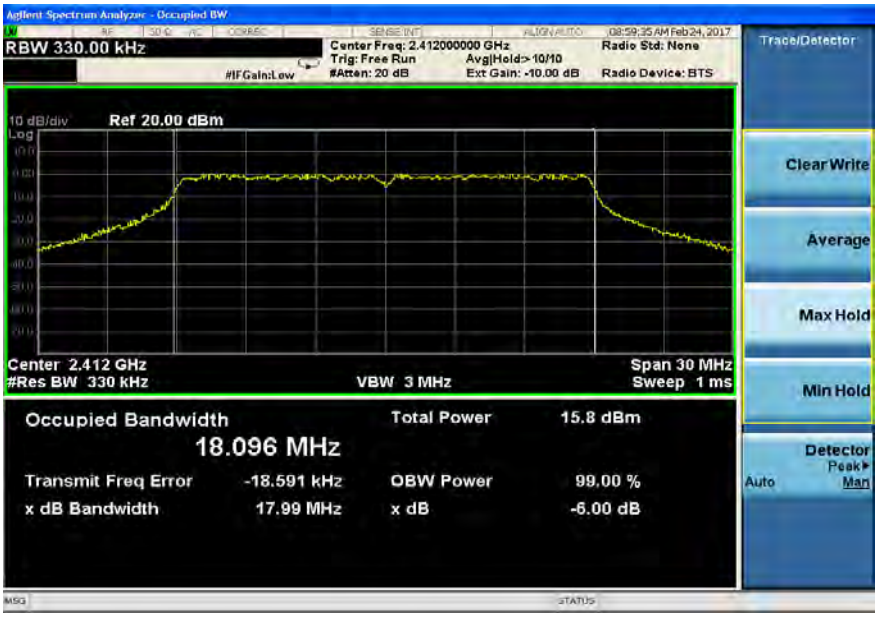
99 % OBW

802.11n – MCS7

Low Channel



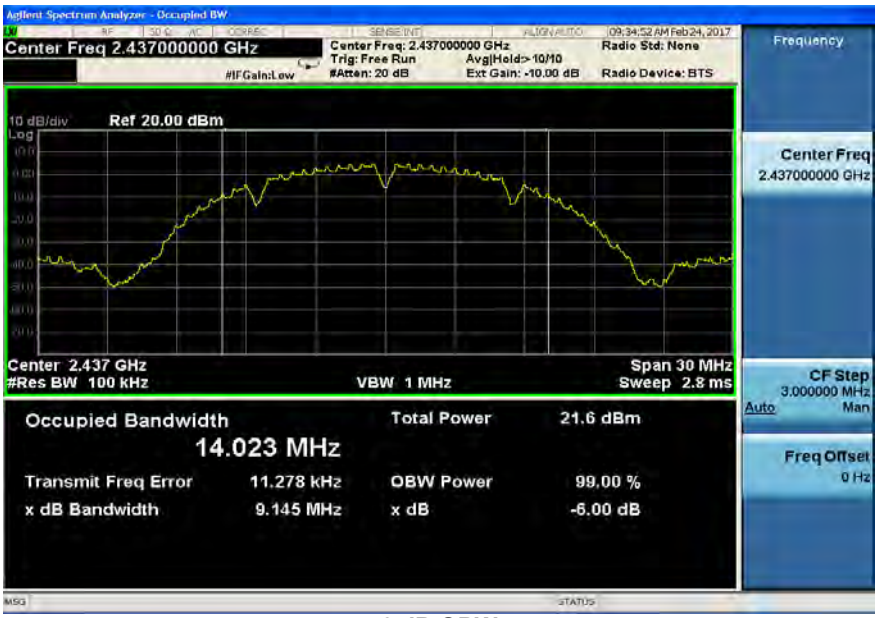
6 dB OBW



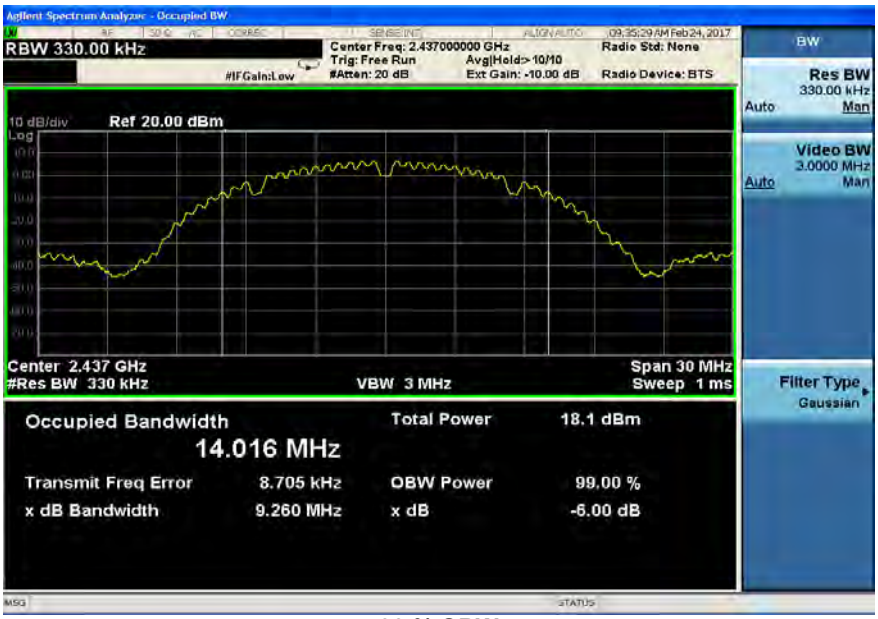
99 % OBW

802.11b – 1 Mbps

Middle Channel



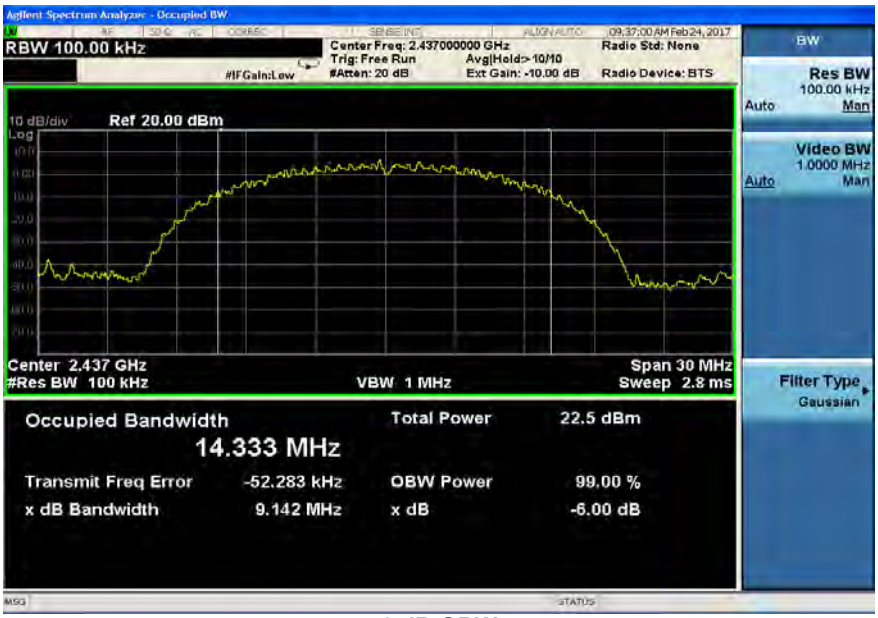
6 dB OBW



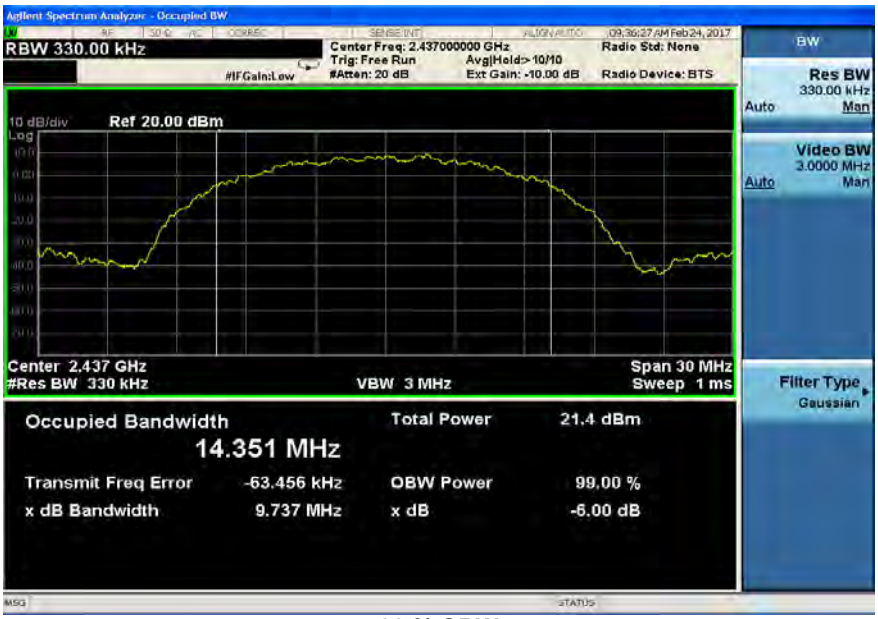
99 % OBW

802.11b – 11 Mbps

Middle Channel



6 dB OBW



99 % OBW

802.11g – 6 Mbps

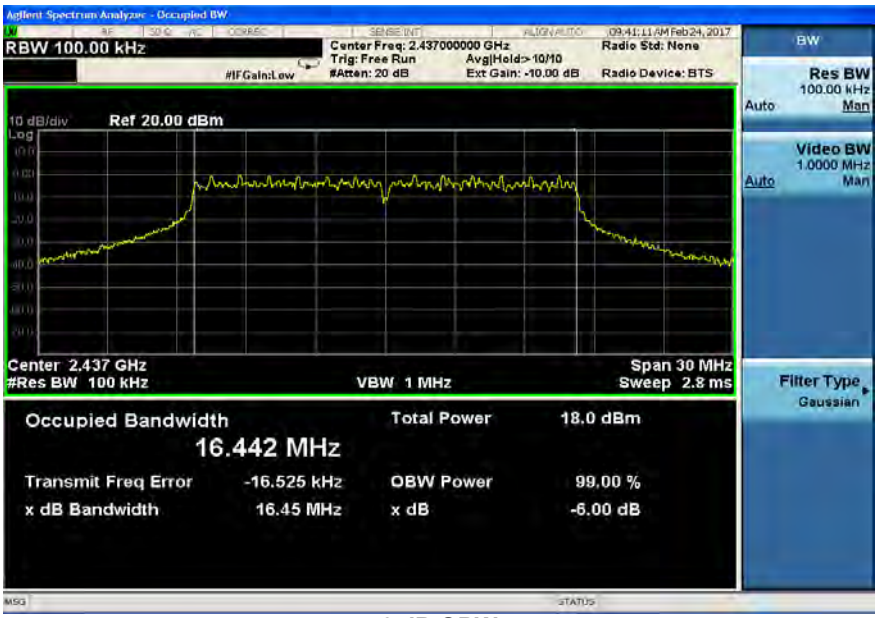
Middle Channel

6 dB OBW

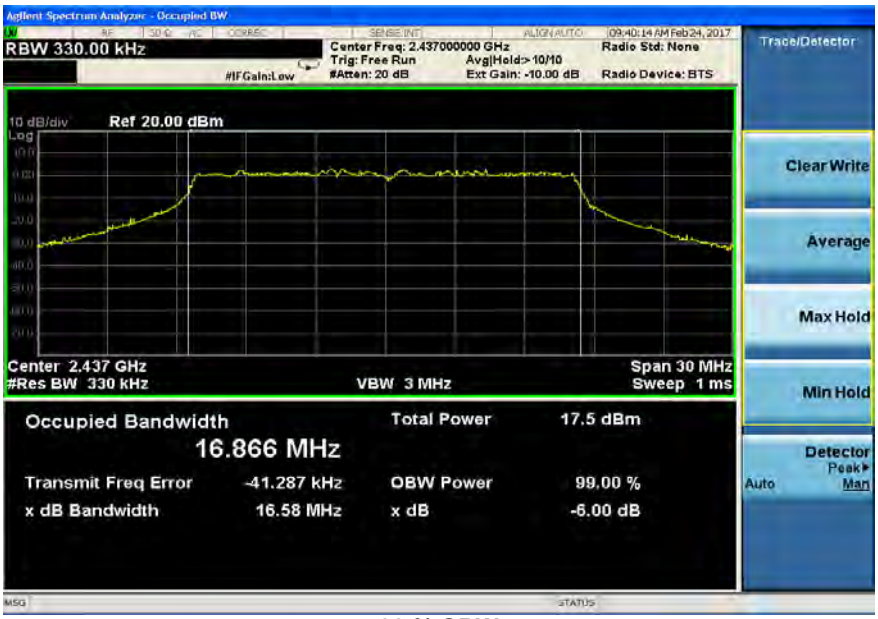
99 % OBW

802.11g – 54 Mbps

Middle Channel



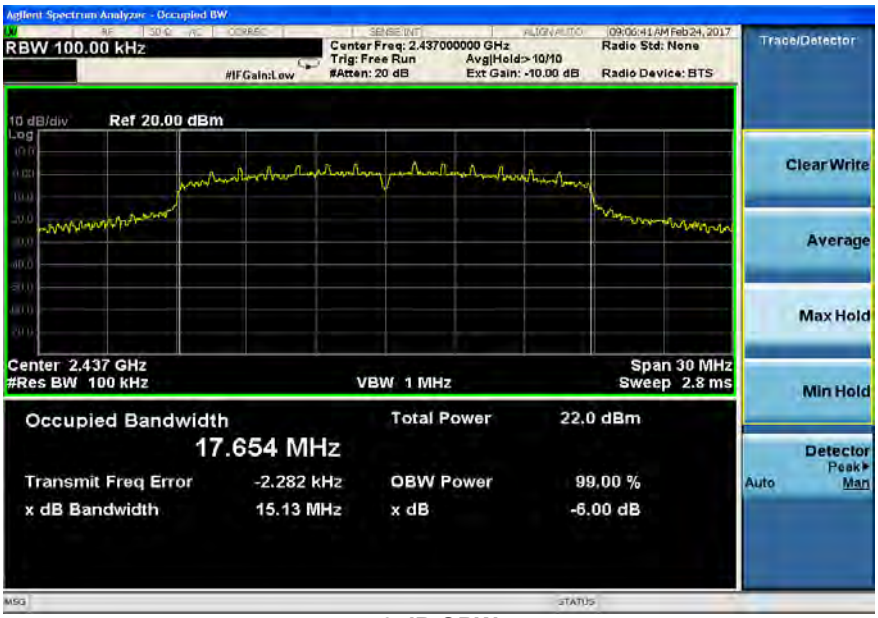
6 dB OBW



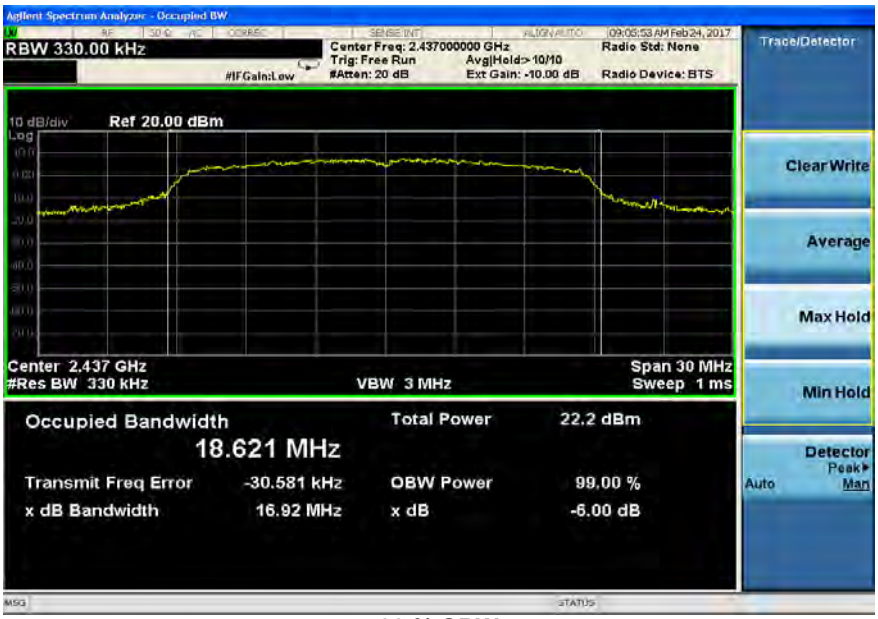
99 % OBW

802.11n – MCS0

Middle Channel



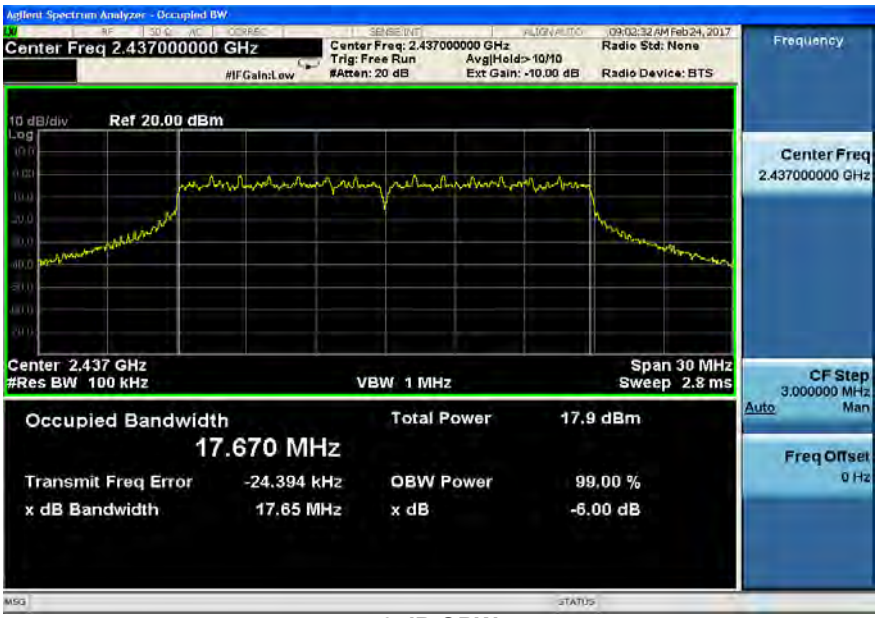
6 dB OBW



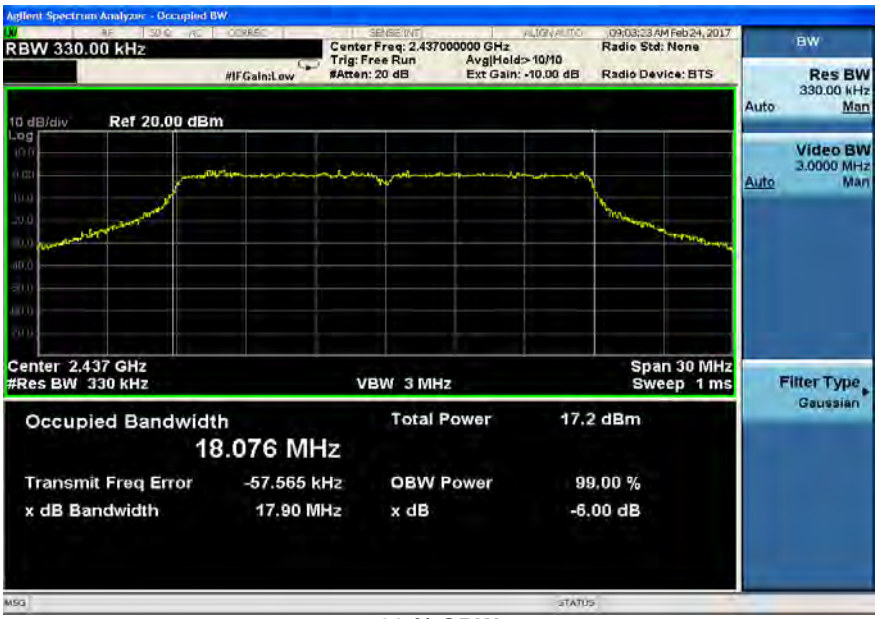
99 % OBW

802.11n – MCS7

Middle Channel



6 dB OBW

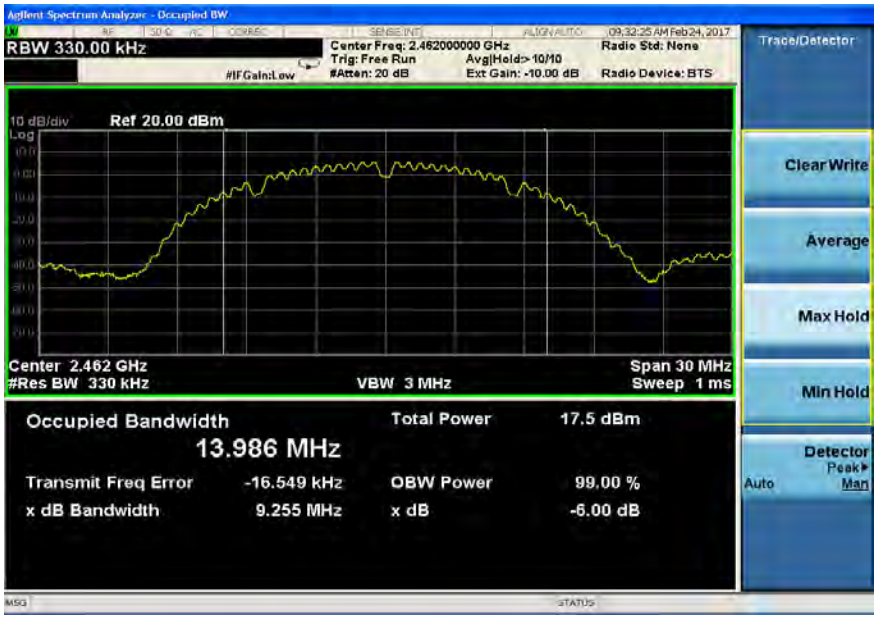


99 % OBW

802.11b – 1 Mbps

High Channel

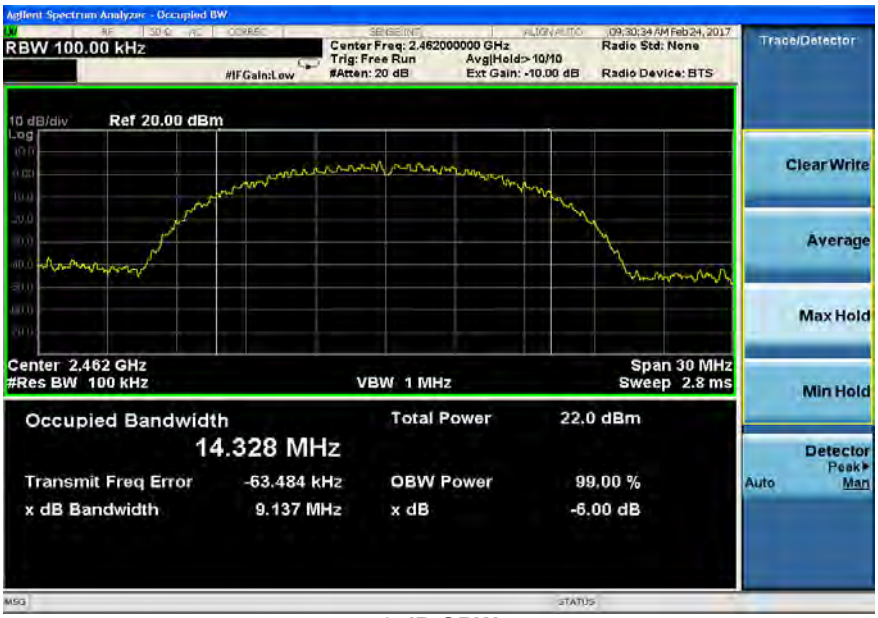
6 dB OBW



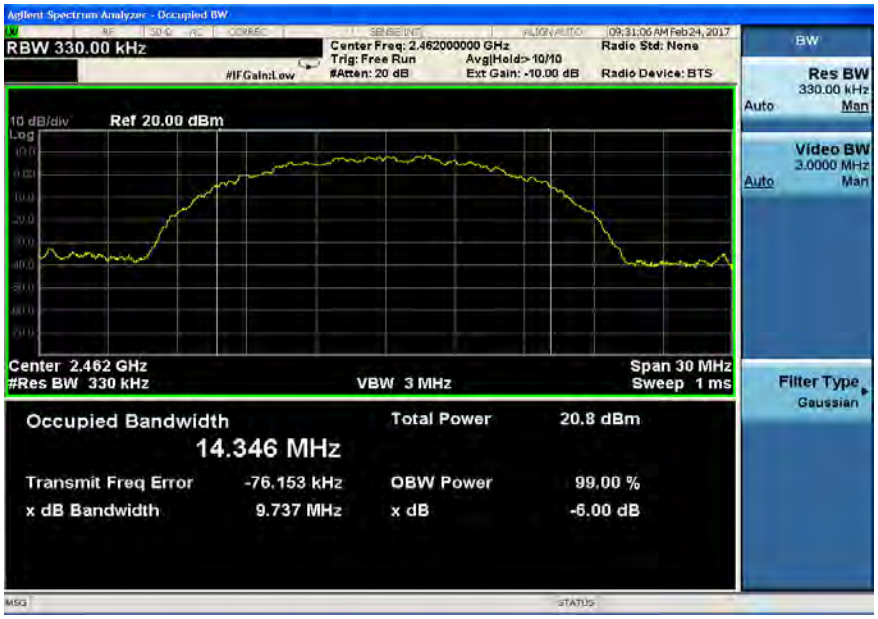
99 % OBW

802.11b – 11 Mbps

High Channel



6 dB OBW

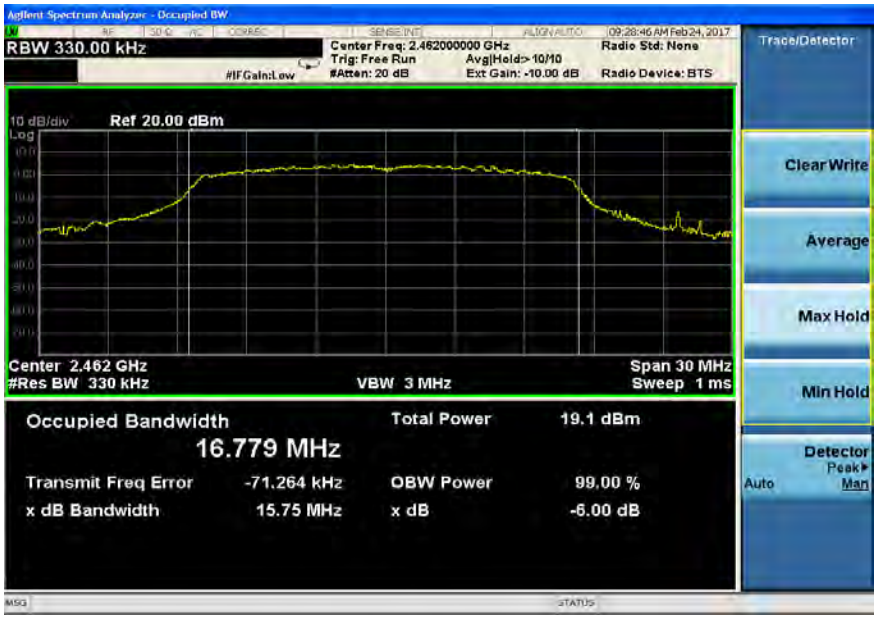


99 % OBW

802.11g – 6 Mbps

High Channel

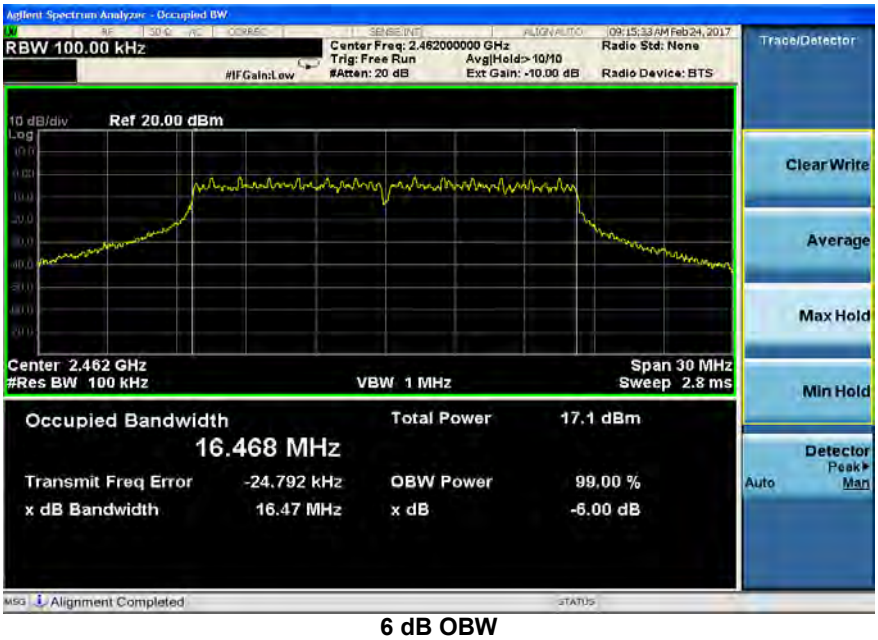
6 dB OBW



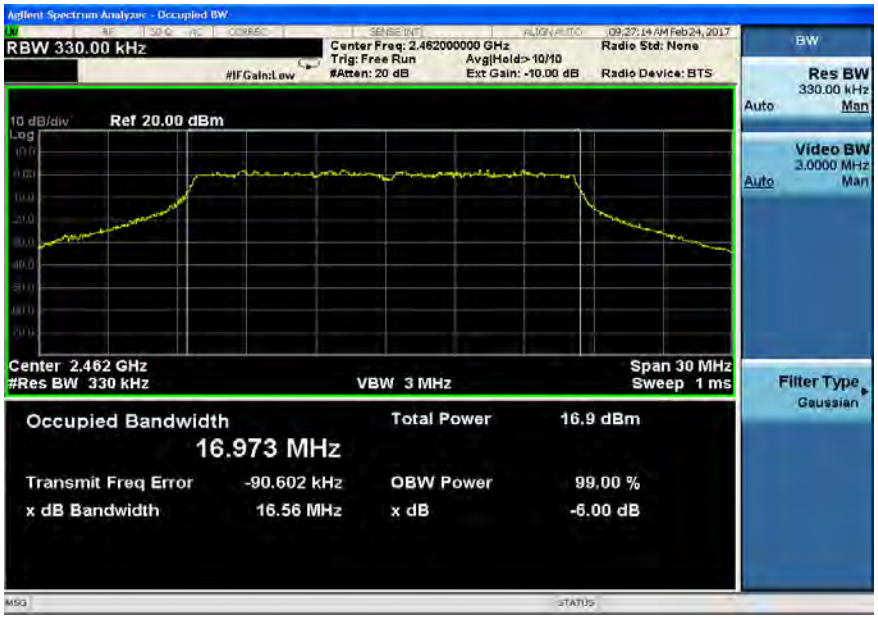
99 % OBW

802.11g – 54 Mbps

High Channel



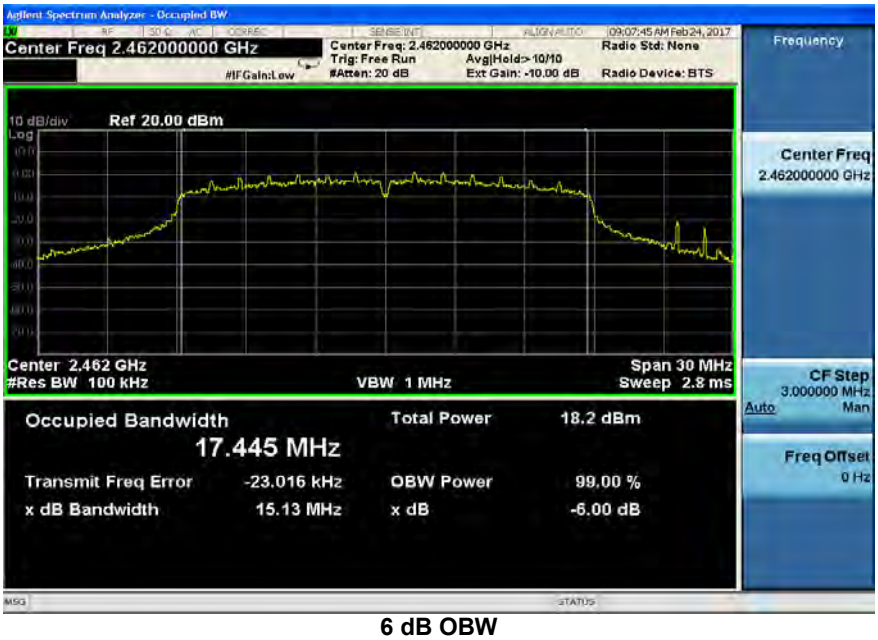
6 dB OBW



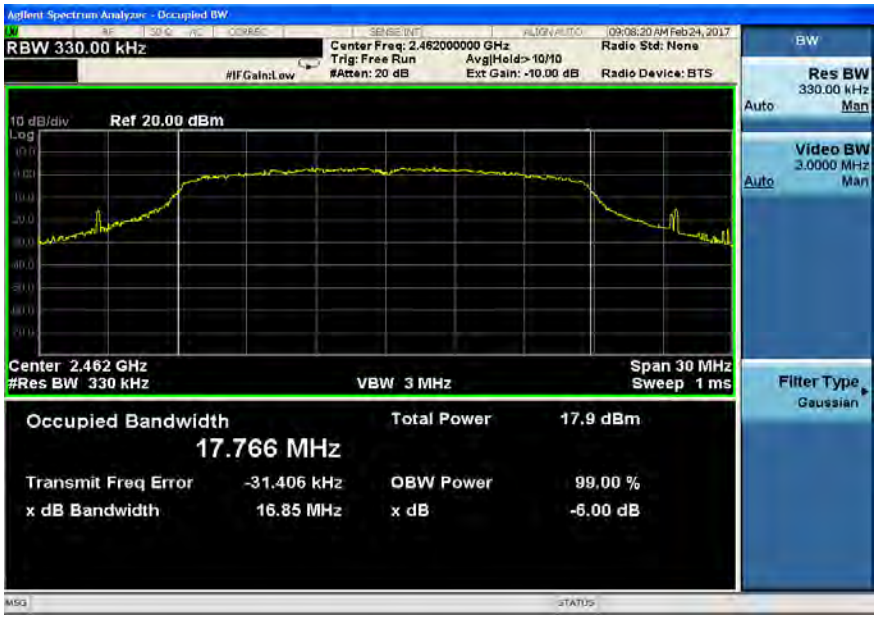
99 % OBW

802.11n – MCS0

High Channel



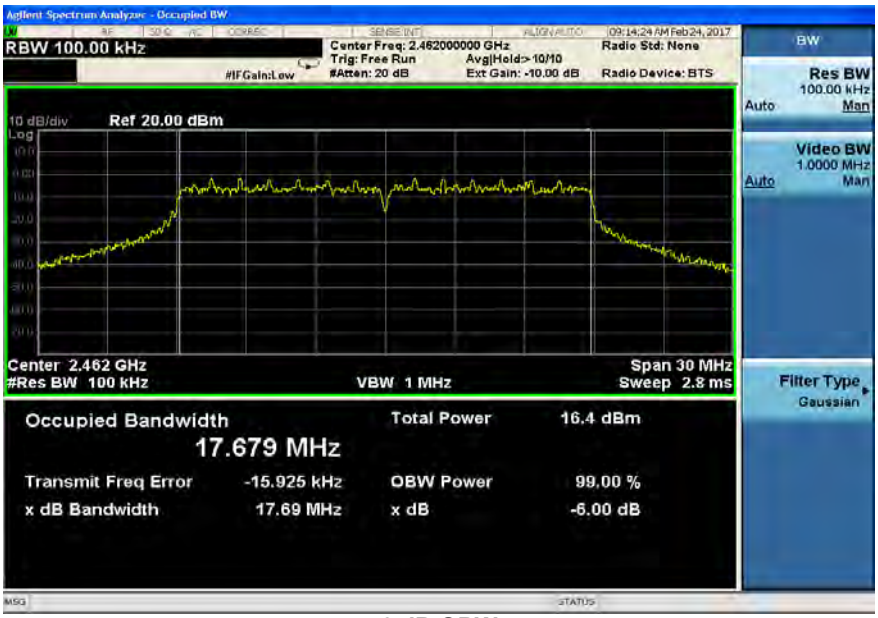
6 dB OBW



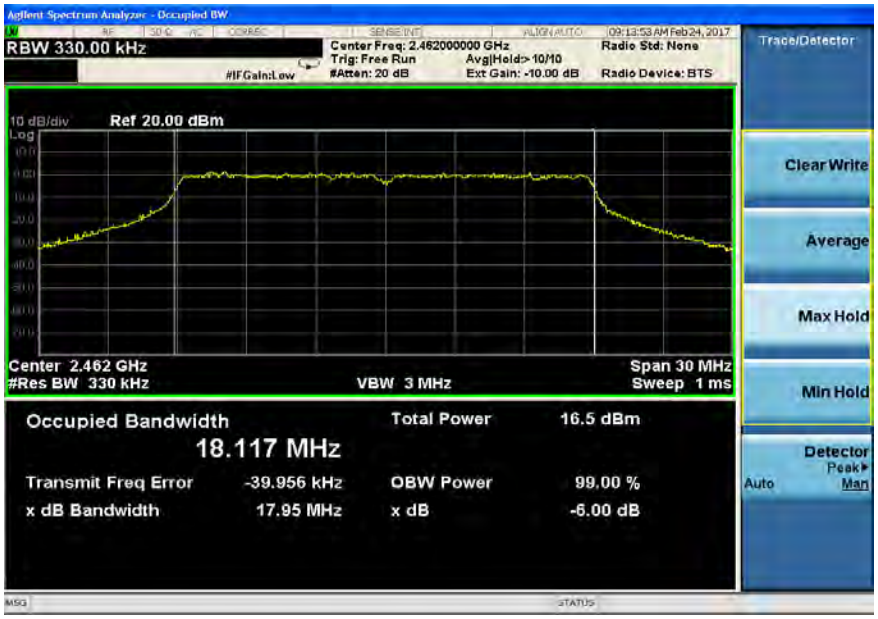
99 % OBW

802.11n – MCS7

High Channel



6 dB OBW



99 % OBW

EXHIBIT 7 MAXIMUM CONDUCTED (AVERAGE) OUTPUT POWER

Manufacturer	United Technology Electronic Controls, Inc.
Date	2/23/17
Test Engineer	Shane Dock
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (b) RSS-247 section 5.4
Sample Calculations	• Duty cycle correction = 10 log(1/D) where D is the duty cycle • Maximum conducted (average) output power = average power + duty cycle correction • Power margin = Power limit – Maximum conducted (average) output power
Additional Notes	• RMS detector used • Continuous transmit modulated used for this test. • 802.11b modes utilized method AVGSA-2 • 802.11g/n modes utilized method AVGSA-3

7.1 Measurement Procedure

ANSI C63.10-2013 Section 11.9.2.2.4 & 11.9.2.2.6

7.2 Limit

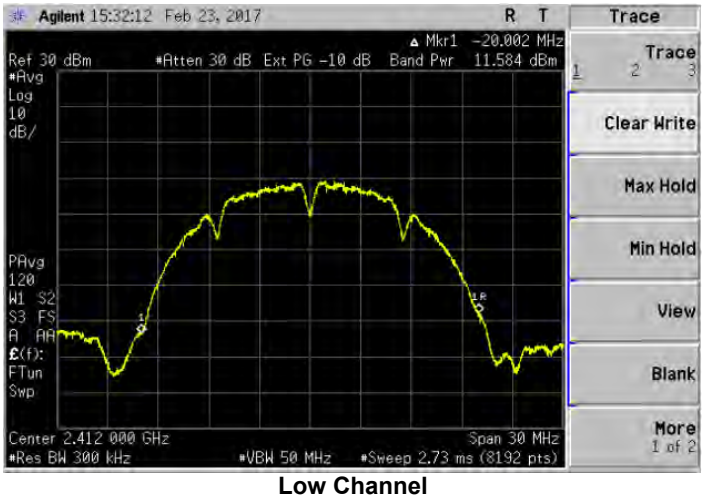
The maximum peak conducted output power for systems using digital modulation shall not exceed 1 Watt (30 dBm).

7.3 Test Data

802.11 Standard	Data Rate (MBPS)	Channel	Conducted (average) Output Power (dBm)	Duty Cycle Correction (dB)	Maximum Conducted (average) Output Power (dBm)	Power Limit (dBm)	Power margin (dB)
b	1 (DBPSK)	1	11.6	1.49	13.1	30.0	16.4
		6	13.1	1.49	14.6	30.0	15.9
		11	13.0	1.49	14.5	30.0	17.0
b	11 (8QPSK)	1	10.6	3.29	13.9	30.0	19.4
		6	11.9	3.29	15.2	30.0	18.1
		11	11.4	3.29	14.7	30.0	18.6
g	6 (BPSK)	1	17.8	-	17.8	30.0	12.2
		6	21.8	-	21.8	30.0	8.2
		11	17.6	-	17.6	30.0	12.4
g	54 (64QAM)	1	15.5	-	15.5	30.0	14.5
		6	18.1	-	18.1	30.0	11.9
		11	15.7	-	15.7	30.0	14.3
n	MCS0 (BPSK)	1	17.4	-	17.4	30.0	12.6
		6	21.5	-	21.5	30.0	8.5
		11	17.3	-	17.3	30.0	12.7
n	MCS7 (64QAM)	1	15.4	-	15.4	30.0	14.6
		6	16.7	-	16.7	30.0	13.3
		11	15.5	-	15.5	30.0	14.5

7.4 Screen Captures

802.11b – 1 Mbps

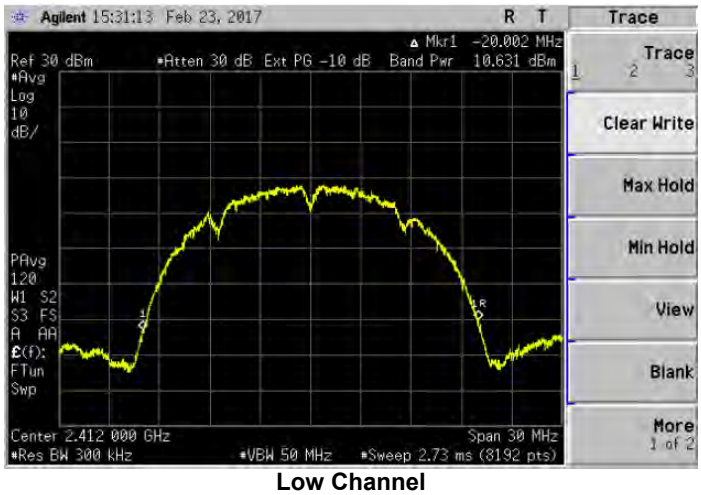


Low Channel

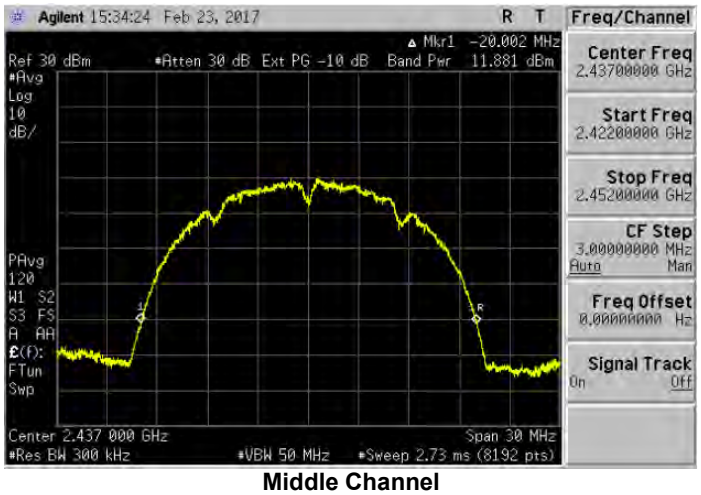
Middle Channel

High Channel

802.11b – 11 Mbps



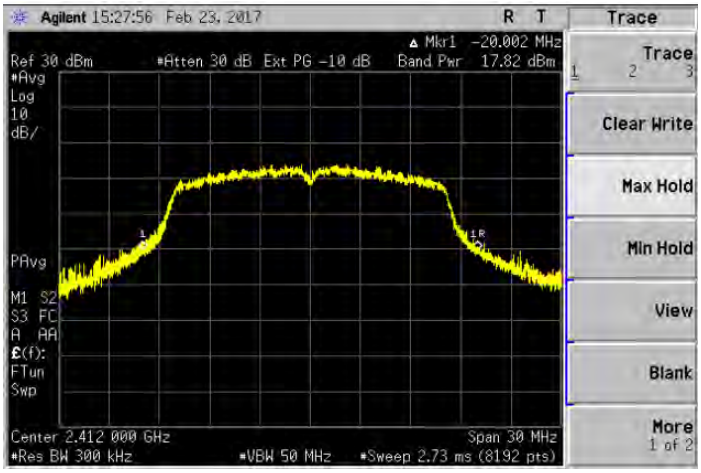
Low Channel



Middle Channel

High Channel

802.11g – 6 Mbps

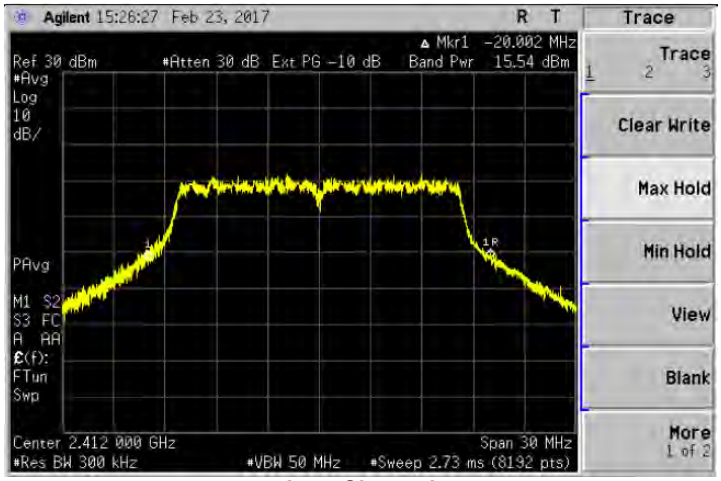


Low Channel

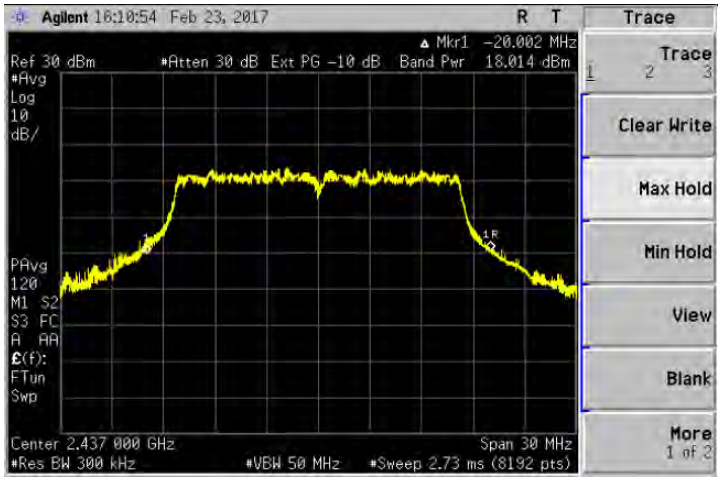
Middle Channel

High Channel

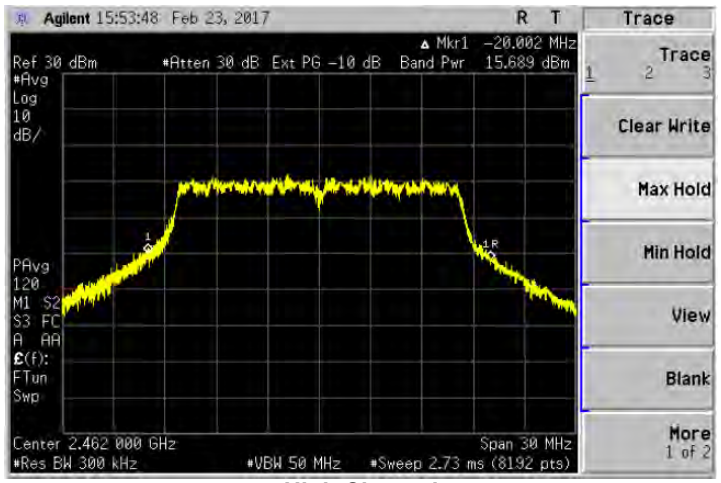
802.11g – 54 Mbps



Low Channel

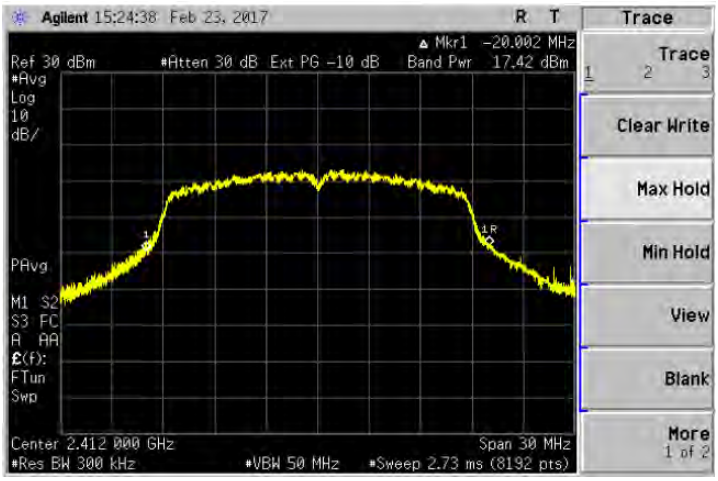


Middle Channel

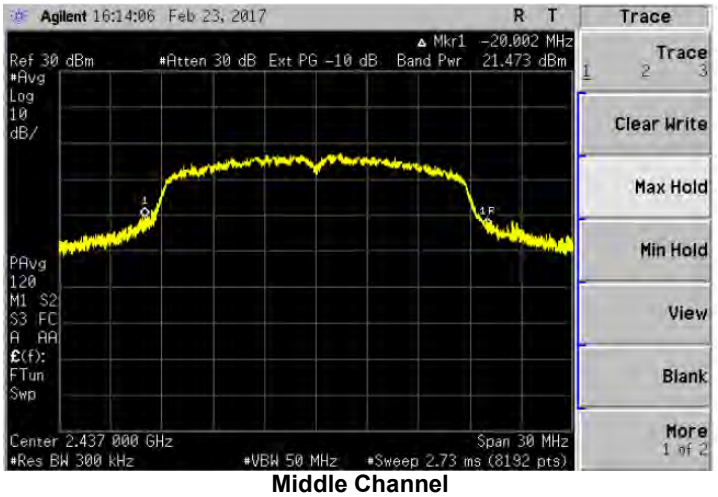


High Channel

802.11n – MCS0



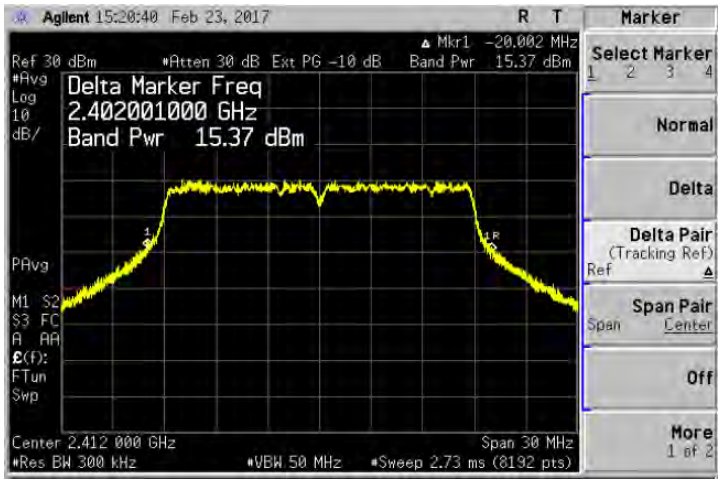
Low Channel



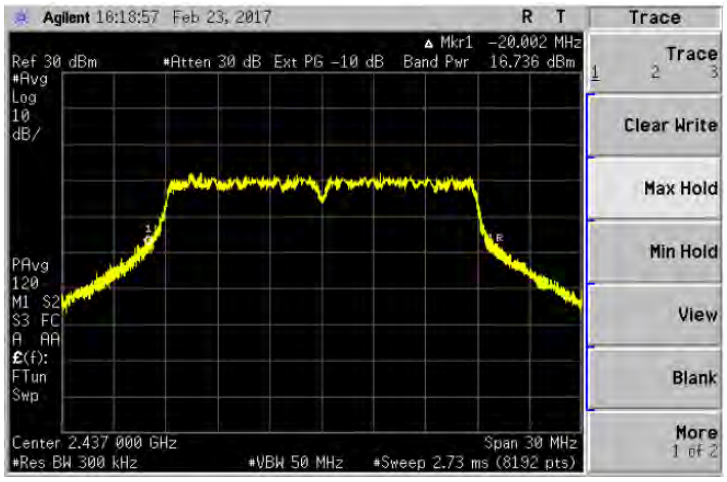
Middle Channel

High Channel

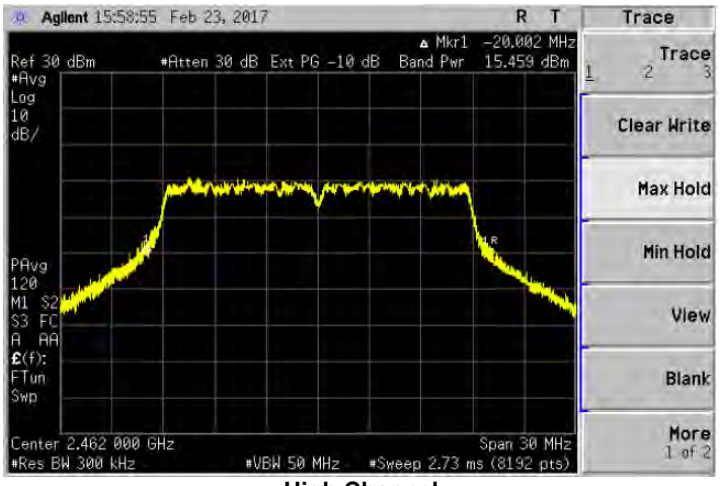
802.11n – MCS7



Low Channel



Middle Channel



High Channel

EXHIBIT 8 POWER SPECTRAL DENSITY

Manufacturer	United Technologies Electrical Controls, Inc.
Date	2/24/17
Operator	Shane Dock
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (e) RSS-247 section 5.2 (b)
Sample Calculations	• Corrected PSD = Peak PSD + Duty Cycle Correction • PSD Margin = PSD Limit – Corrected PSD
Additional Notes	• RMS detector used • Continuous transmit modulated used for this test. • Sample Calculation: Margin (dB) = Limit – Measured level • 802.11b mode utilized method AVGPSD-2 • 802.11g/n modes utilized method AVGPSD-3

8.1 Measurement Procedure

ANSI C63.10-2013 Section 11.10.5 and Section 11.10.7

8.2 Limit

For digitally modulated systems, the conducted power spectral density shall not be greater than 8 dBm in any 3-kHz band.

8.3 Test Data

802.11 Standard	Data Rate (MBPS)	Channel	Duty Cycle Correction (dB)	Peak PSD in 100kHz Minimum BW (dBm)	Corrected PSD (dBm)	PSD in 3kHz limit(dBm)	PSD margin (dBm)
b	1 (DBPSK)	1	1.49	-5.5	-4.0	8.0	13.5
		6	1.49	-3.8	-2.3	8.0	11.8
		11	1.49	-3.8	-2.3	8.0	11.8
b	11 (8QPSK)	1	3.29	-7.2	-3.9	8.0	15.2
		6	3.29	-5.7	-2.4	8.0	13.7
		11	3.29	-6.3	-3.0	8.0	14.3
g	6 (BPSK)	1	-	0.8	0.8	8.0	7.2
		6	-	4.6	4.6	8.0	3.4
		11	-	0.6	0.6	8.0	7.4
g	54 (64QAM)	1	-	-2.2	-2.2	8.0	10.2
		6	-	0.1	0.1	8.0	7.9
		11	-	-2.4	-2.4	8.0	10.4
n	MCS0 (BPSK)	1	-	0.3	0.3	8.0	7.7
		6	-	3.5	3.5	8.0	4.5
		11	-	0.3	0.3	8.0	7.7
n	MCS7 (64QAM)	1	-	-3.3	-3.3	8.0	11.3
		6	-	-2.4	-2.4	8.0	10.4
		11	-	-3.7	-3.7	8.0	11.7

8.4 Screen Captures

802.11b – 1 Mbps

Low Channel

Middle Channel

High Channel

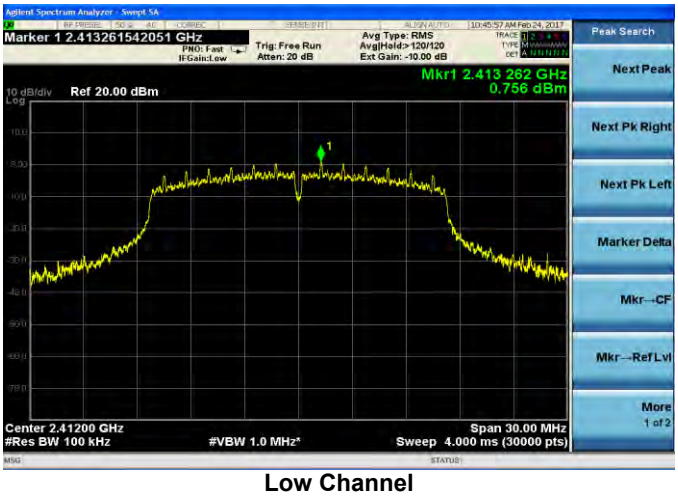
802.11b – 11 Mbps

Low Channel

Middle Channel

High Channel

802.11g – 6 Mbps

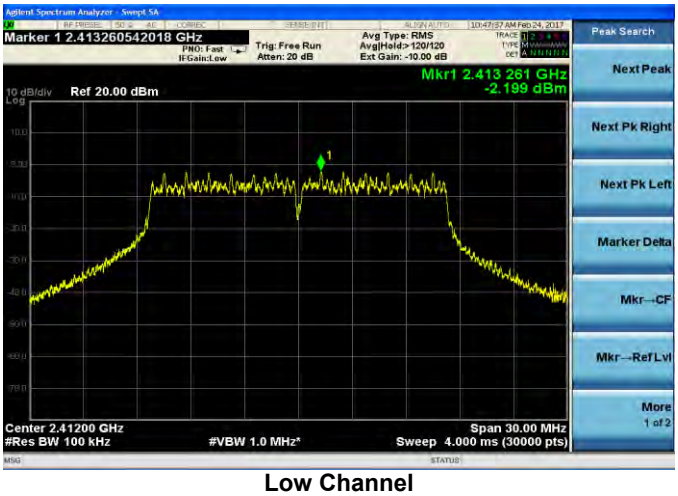


Low Channel

Middle Channel

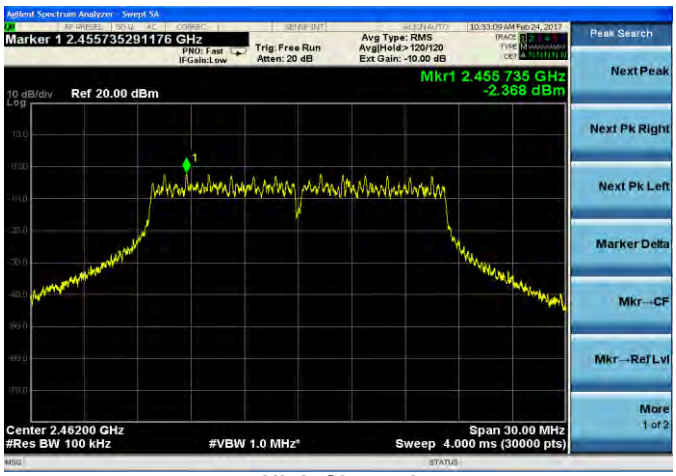
High Channel

802.11g – 54 Mbps



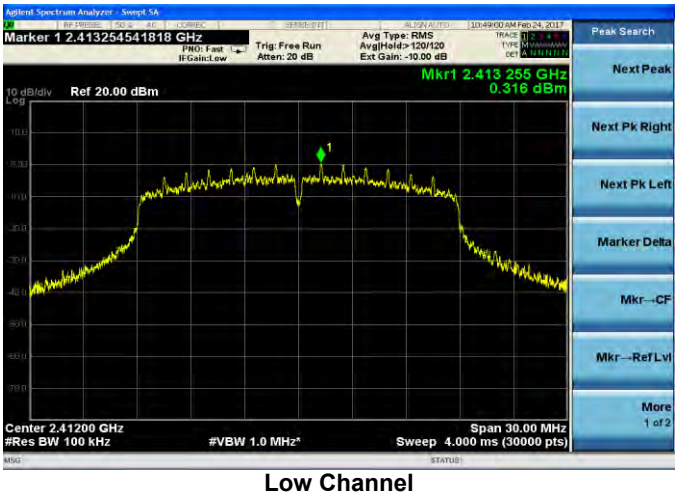
Low Channel

Middle Channel

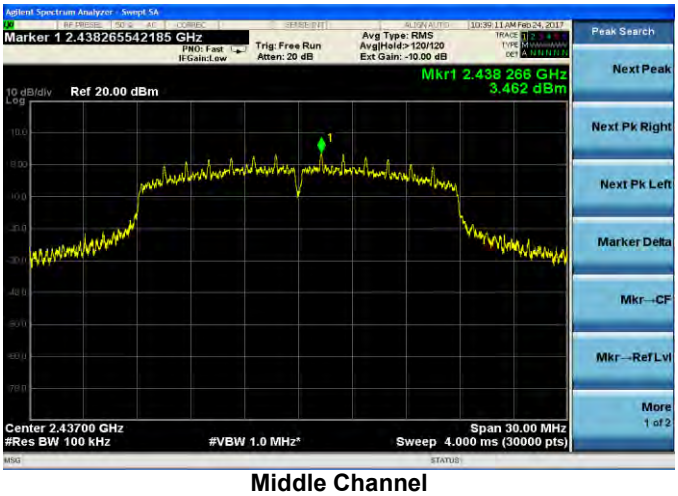


High Channel

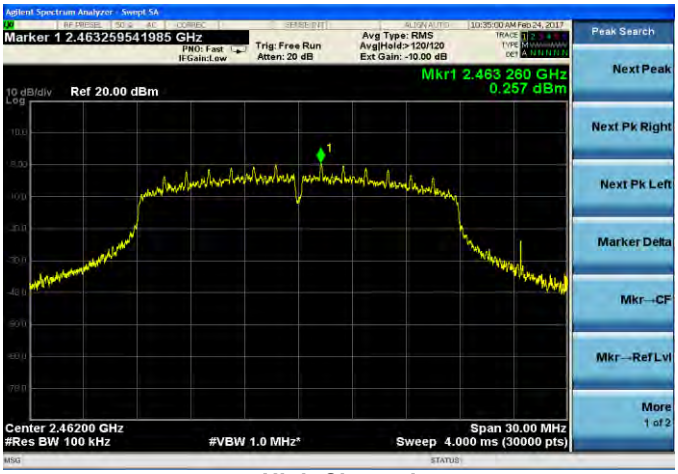
802.11n – MCS0



Low Channel

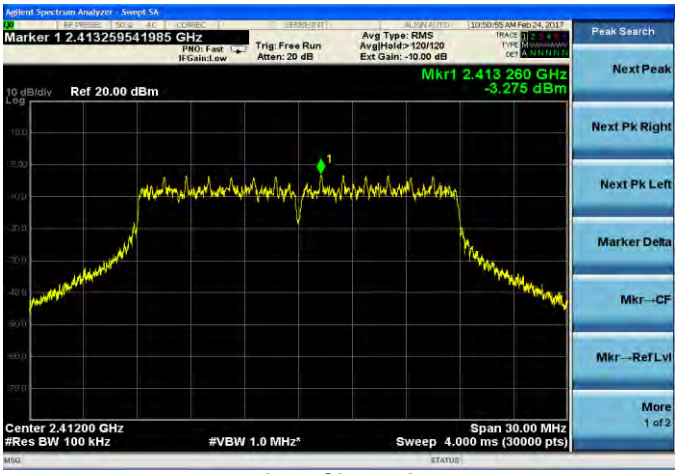


Middle Channel

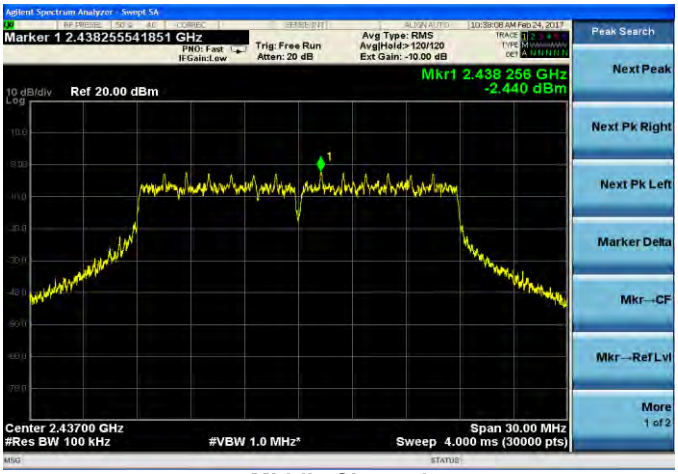


High Channel

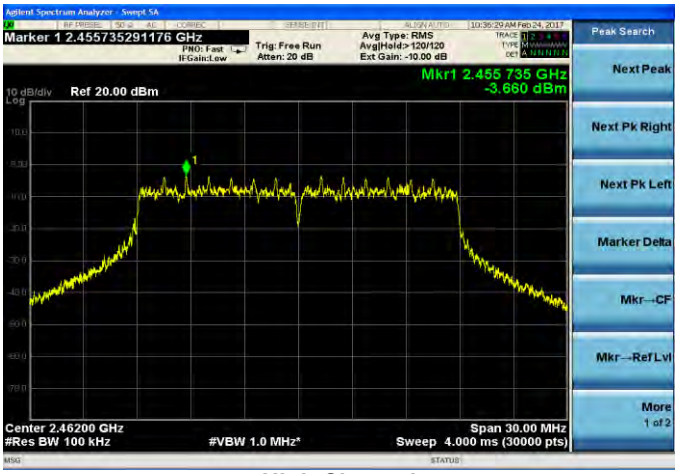
802.11n – MCS7



Low Channel



Middle Channel



High Channel

EXHIBIT 9 FREQUENCY STABILITY

Manufacturer	United Technology Electronic Controls, Inc.
Date	2/27/17
Operator	Mike Hintzke
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 2.1055 (d) RSS-Gen section 6.11
Example Calculations	• Frequency Deviation = Nominal Channel Frequency – Measured Channel Frequency • PPM Deviation = Frequency Deviation / 1000000
Additional Notes	• Peak detector used • Continuous transmit un-modulated used for this test.

9.1 Measurement Procedure

ANSI C63.10-2013 Section 6.8.2

9.2 Test Data

Frequency Stability f = 2412 MHz				
Supply Voltage (VAC)	Frequency (Hz)	Deviation		
		Hz	%	ppm
20.4	2412296359	296359	0.012	0.296
24	2412297551	297551	0.012	0.298
27.6	2412298923	298923	0.012	0.299

Frequency Stability f = 2437 MHz				
Supply Voltage (VAC)	Frequency (Hz)	Deviation		
		Hz	%	ppm
20.4	2437294857	294857	0.012	0.295
24	2437296507	296507	0.012	0.297
27.6	2437295163	295163	0.012	0.295

Frequency Stability f = 2462 MHz				
Supply Voltage (VAC)	Frequency (Hz)	Deviation		
		Hz	%	ppm
20.4	2462297539	297539	0.012	0.298
24	2462293149	293149	0.012	0.293
27.6	2462294743	294743	0.012	0.295

EXHIBIT 10 BAND EDGE MEASUREMENTS

Manufacturer	United Technology Electronic Controls, Inc.	
Date	2/20/17, 2/27/17, 3/10/17	
Operator	Michael Hintzke	
Temp. / R.H.	20 - 25º C / 30-60% R.H.	
Rule Part	FCC 15.247 (d) / RSS-247 section 5.5 FCC 15.209 (a) / RSS-Gen section 8.9 FCC 15.205 (a) / RSS-Gen section 8.10	
Measurement Detectors	Conducted: RBW = 100 kHz VBW = ≥ 300 kHz	Radiated: RBW = 1 MHz VBW = ≥ 3 MHz
Description of Radiated Measurements	1. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed. The data is gathered and reported as the corrected values. 2. The EUT is placed on a 150 cm non-conductive pedestal centered on a turn-table in the test location with the antenna 3 meters from the EUT. 3. Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.	
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)	
Additional Notes:	ANSI C63.10: 2013 section 4.1.4.2.3 f) used for radiated average measurements	

10.1 Methods of Measurement

ANSI C63.10-2013 Sections 6,3, 6.6 and 6.10

10.2 Limit(s)

Conducted Measurement:

The spurious emissions produced by the intentional radiator shall be at least 30 dB below that in the 100-kHz bandwidth that contains the highest level of the desired power.

Radiated Measurement:

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)	Detector Type
Above 960	500	54.0	Average (>1 GHz)
Above 960	-	74.0	Peak (>1 GHz)

10.3 Test Data

10.3.1 Bandedges in 100 kHz Bandwidth

802.11b – 1 Mbps

Lower Bandedge

Upper Bandedge

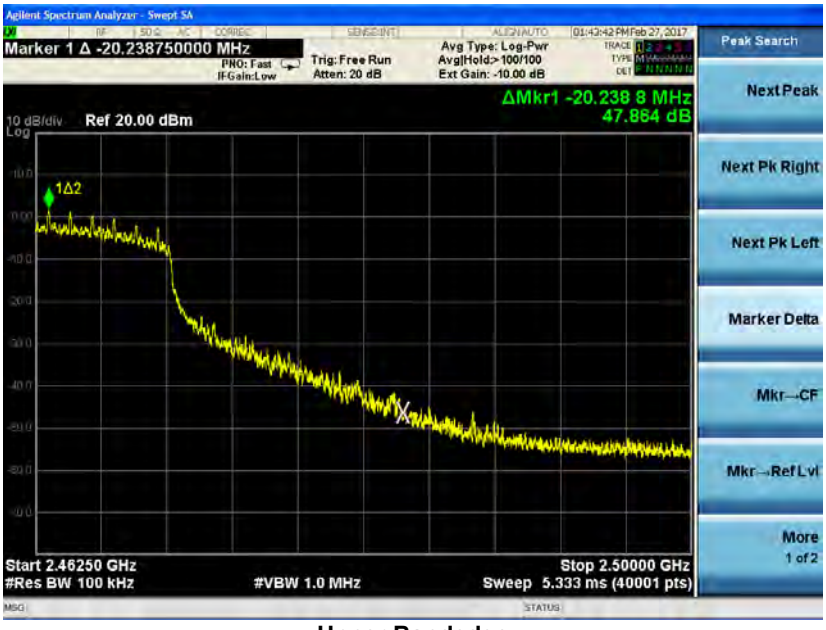
802.11b – 11 Mbps

Lower Bandedge

Upper Bandedge

802.11g – 6 Mbps

Lower Bandedge



Upper Bandedge

802.11g – 54 Mbps

Lower Bandedge

Upper Bandedge

802.11n – MCS0

Lower Bandedge

Upper Bandedge

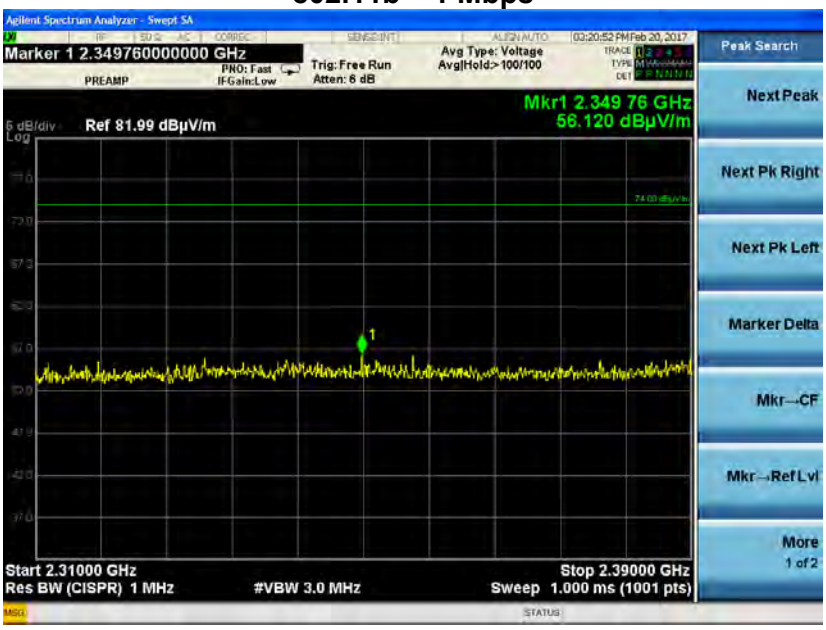
802.11n – MCS7

Lower Bandedge

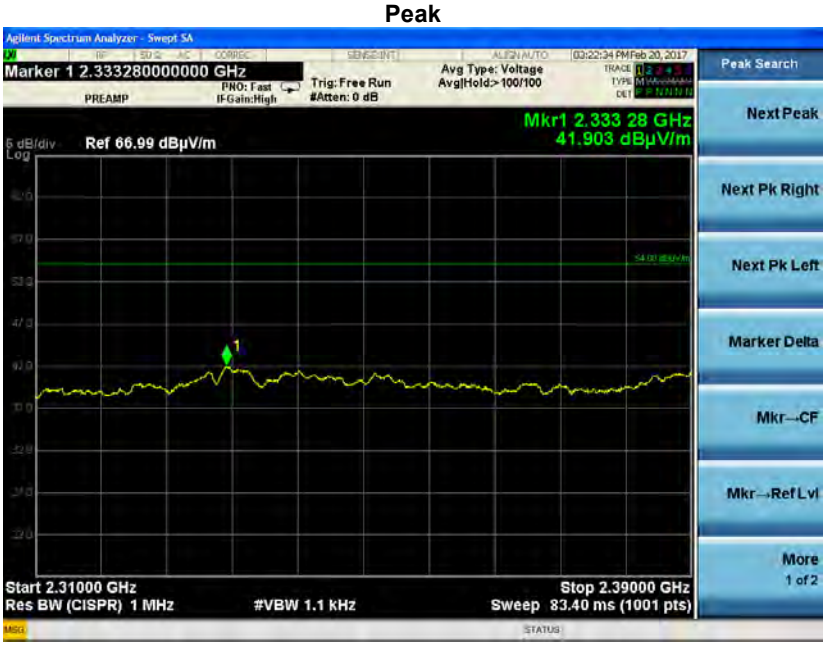
Upper Bandedge

10.3.2 Radiated Bandedges in the 2310 MHz – 2390 MHz Restricted Band

802.11b – 1 Mbps



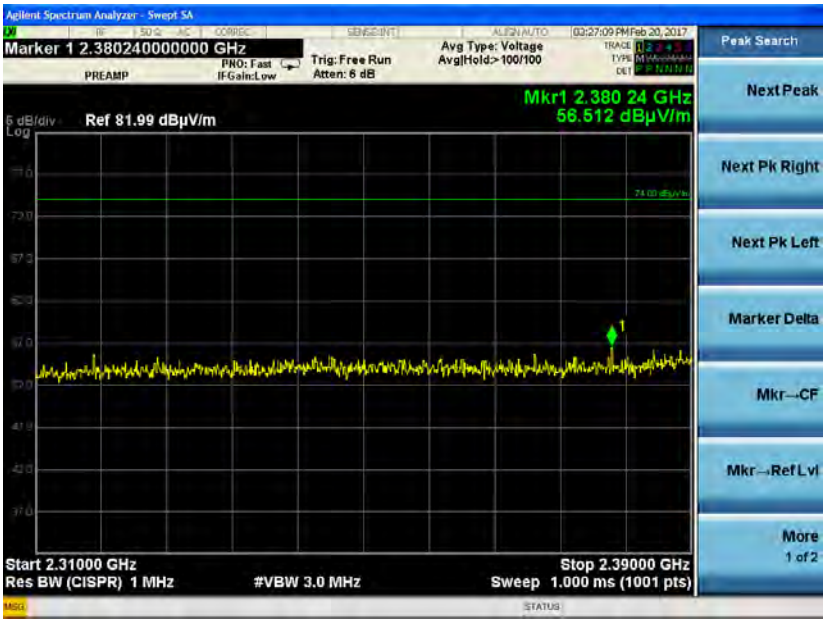
Peak



Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2349.7	56.1	74.0	17.9	2333.3	41.9	54.0	12.1

802.11b – 11 Mbps



Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2380.2	56.5	74.0	17.5	2388.6	43.3	54.0	10.7

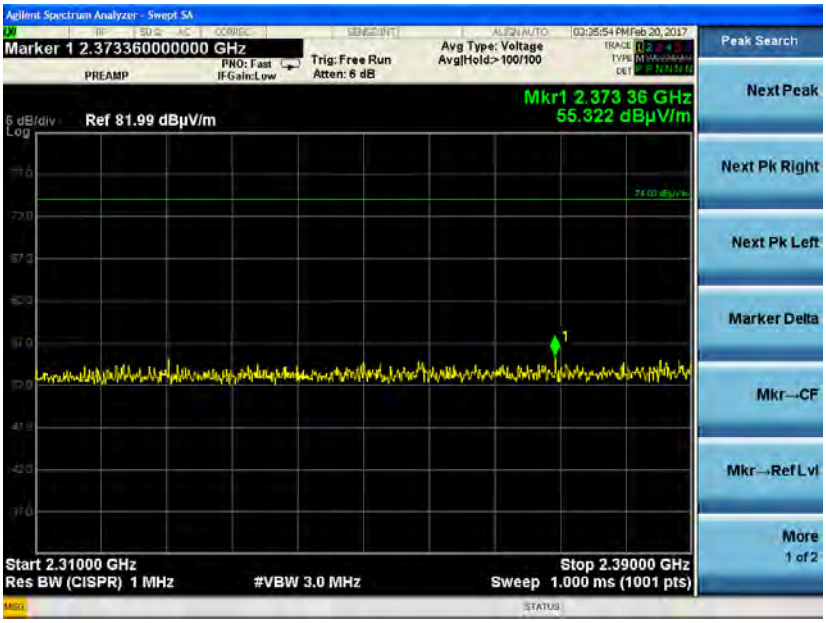
802.11g – 6 Mbps

Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2389.8	61.9	74.0	12.1	2389.6	48.0	54.0	6.0

802.11g – 54 Mbps

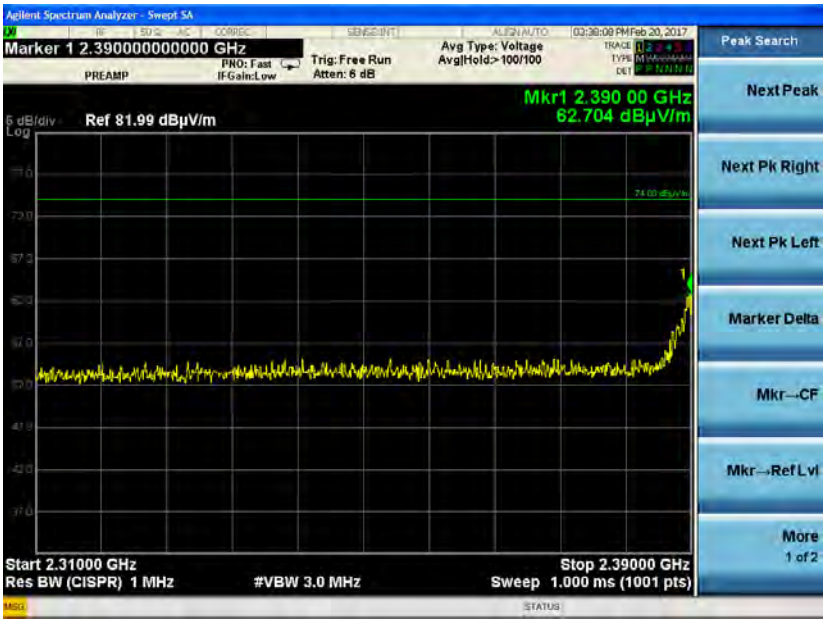


Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2373.4	55.3	74.0	18.7	2373.4	42.6	54.0	11.4

802.11n – MCS0

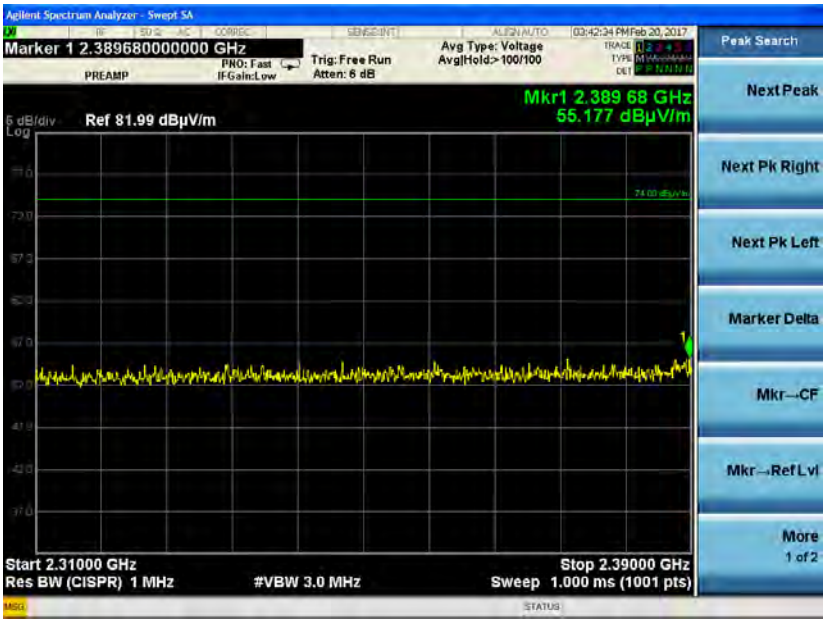


Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2390.0	62.7	74.0	11.3	2389.7	47.5	54.0	6.5

802.11n – MCS7



Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2389.7	55.2	74.0	18.8	2389.8	45.3	54.0	8.7

10.3.3 Radiated Bandedges in the 2483.5 MHz – 2500 MHz Restricted Band

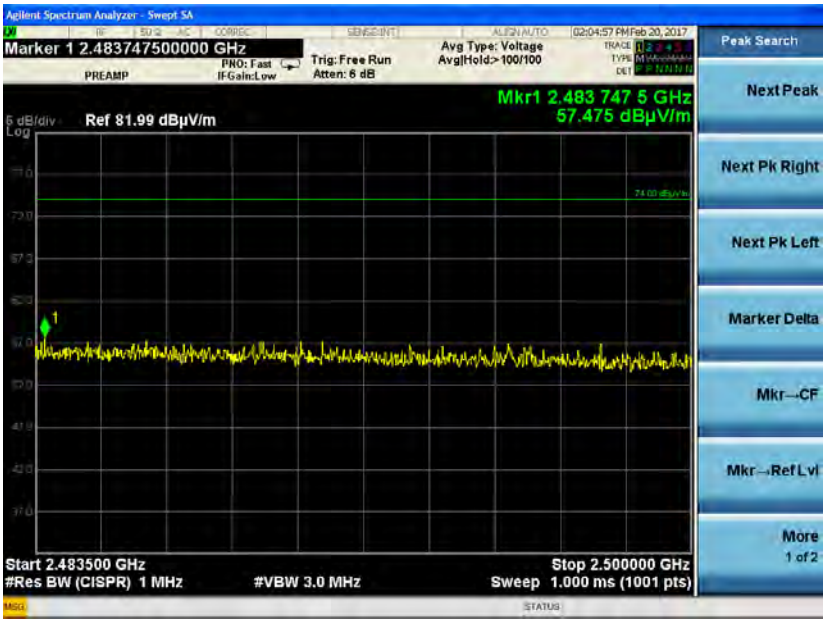
802.11b – 1 Mbps

Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2485.6	58.8	74.0	15.2	2493.7	44.2	54.0	9.8

802.11b – 11 Mbps

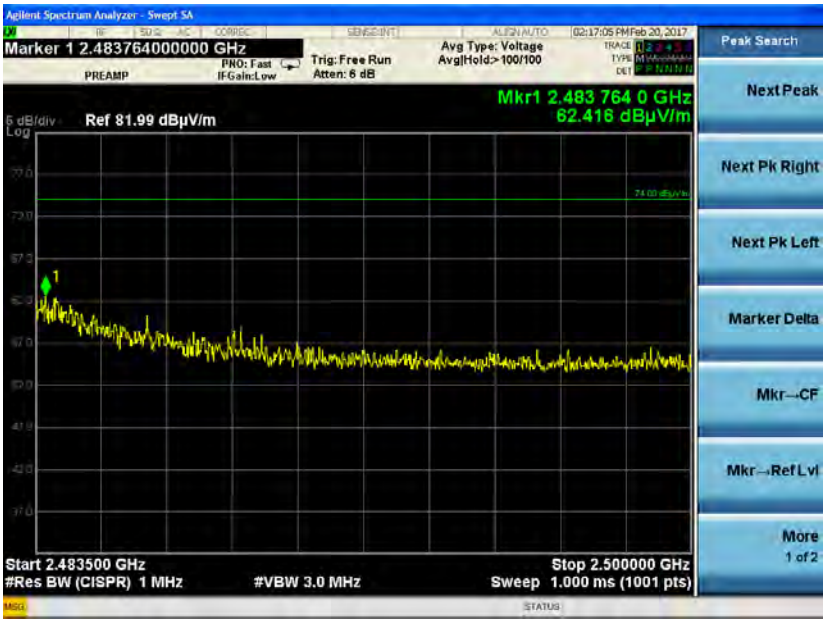


Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2483.7	57.5	74.0	16.5	2486.4	45.3	54.0	8.7

802.11g – 6 Mbps

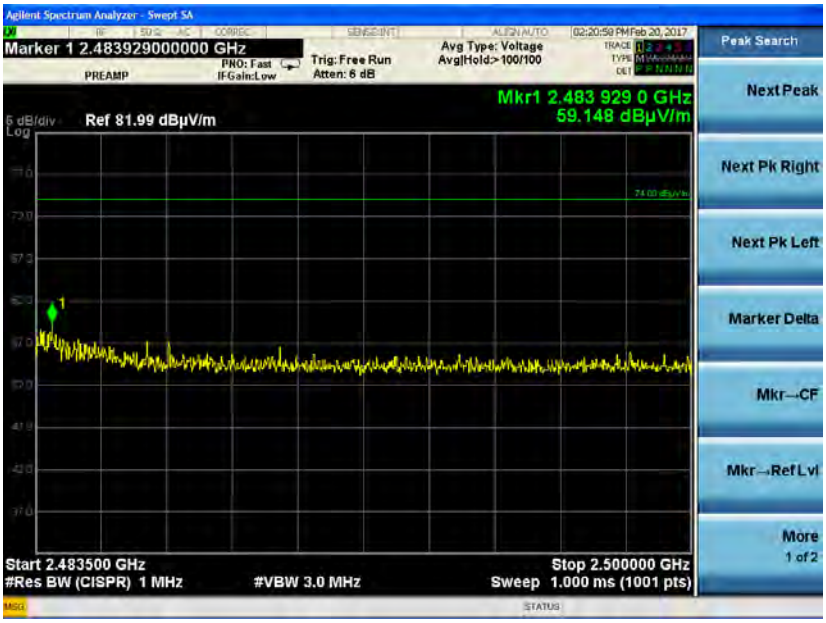


Peak

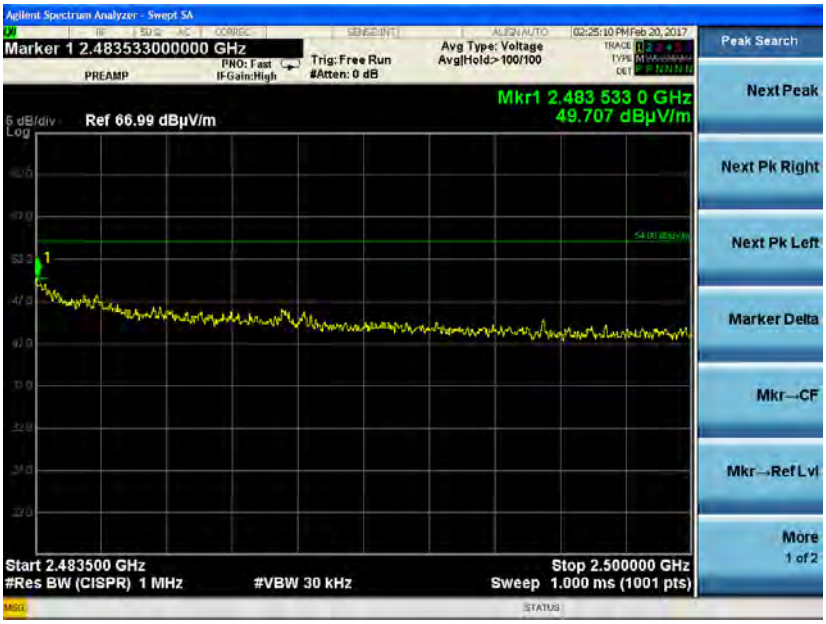
Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2483.8	62.4	74.0	11.6	2483.7	50.1	54.0	4.0

802.11g – 54 Mbps



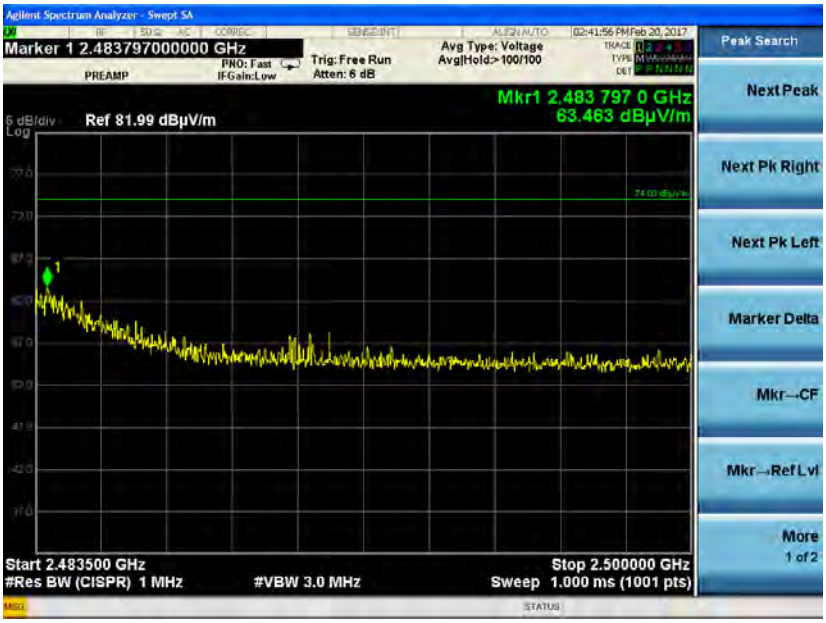
Peak



Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2483.9	59.1	74.0	14.9	2483.5	49.7	54.0	4.3

802.11n – MCS0

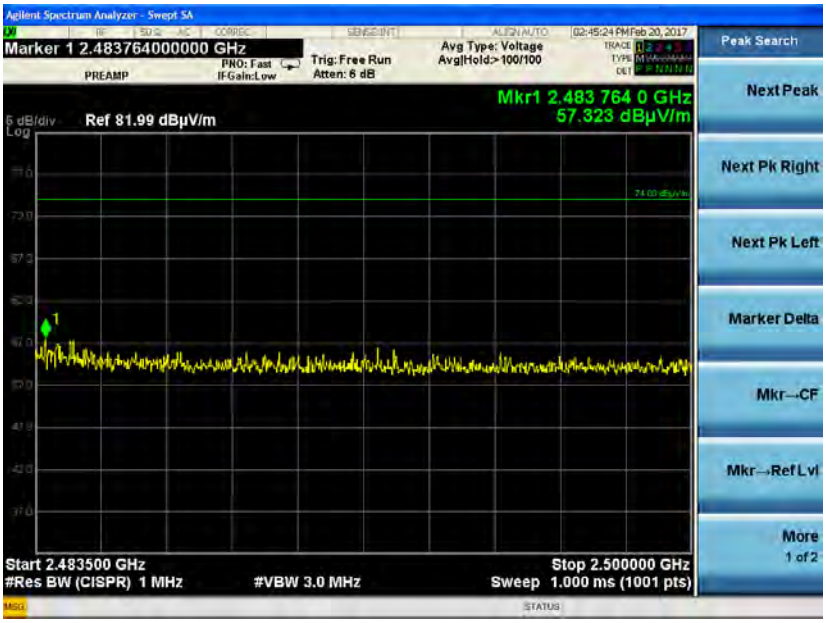


Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2483.8	63.5	74.0	10.5	2483.5	49.6	54.0	4.4

802.11n – MCS7



Peak

Average

Peak Frequency (MHz)	Peak (dBuV/m)	Peak limit (dBuV/m)	Peak Margin (B)	Average Frequency (MHz)	Average (dBuV/m)	Average limit (dBuV/m)	Average Margin (B)
2483.8	57.3	74.0	16.7	2483.6	47.1	54.0	6.9

EXHIBIT 11 Transmitter Spurious Emissions

<table>
<tr><td>Manufacturer</td><td colspan="4">United Technology Electronic Controls, Inc.</td></tr>
<tr><td>Date(s)</td><td colspan="4">2/20/17, 2/22/17, 2/24/17</td></tr>
<tr><td>Test Engineer(s)</td><td colspan="4">Michael Hintzke, Shane Dock</td></tr>
<tr><td>Temp. / R.H.</td><td colspan="4">20 - 25º C / 30-60% R.H.</td></tr>
<tr><td>Rule Part</td><td colspan="4">FCC 15.247 (d) / RSS 247 section 5.5
FCC 15.209 / RSS Gen section 8.9</td></tr>
<tr><td>Measurement Detectors</td><td>Conducted:
RBW = 100 kHz
VBW = ≥ 300 kHz</td><td colspan="2">Radiated:
30 MHz -1000 MHz
RBW = 120 kHz
VBW = ≥ 300 kHz</td><td>Radiated:
1 GHz -40 GHz
RBW = 1 MHz
VBW = ≥ 3 MHz</td></tr>
<tr><td rowspan="3">Description of Radiated Measurements</td><td colspan="2"><u>EUT Placement > 1 GHz</u>
150 cm height non-conductive table above reference ground plane covered with absorbers</td><td colspan="2"><u>EUT Placement < 1 GHz</u>
80 cm height non-conductive table above reference ground plane</td></tr>
<tr><td colspan="4">1. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed. The data is gathered and reported as the corrected values.
2. The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna 3 meters from the EUT.
3. Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.</td></tr>
<tr><td>Biconical
30 MHz- 300 MHz</td><td>Log Periodic Dipole Array:
300 MHz -1000 MHz</td><td>Double-Ridged Waveguide Horn:
1 GHz -18 GHz</td><td>Standard Gain Horn:
18 GHz – 25 GHz</td></tr>
<tr><td>Example Calculations</td><td colspan="4">Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)</td></tr>
<tr><td>Additional Notes:</td><td colspan="4">• Continuous transmit, modulated EUT operation.
• The data rate that yielded the greatest PSD for each 802.11 mode was used to determine the reference levels for emissions within 100 kHz bandwidth, respectively.
• The data rate of 1 Mbps was utilized for radiated measurements in the following frequency ranges:
  • 30 MHz – 2310 MHz
  • 2500 MHz – 25 GHz
• ANSI C63.10: 2013 section 4.1.4.2.3 f) used for radiated average measurements</td></tr>
</table>

11.1 Method of Measurements

ANSI C63.10-2013 Sections 6.5 and 6.6

11.2 Limit

Conducted Measurement:

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth that contains the highest level of the desired power.

Radiated Measurement:

The emissions from an intentional radiator shall not exceed the field strength levels of FCC 15.209.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)	Detector Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

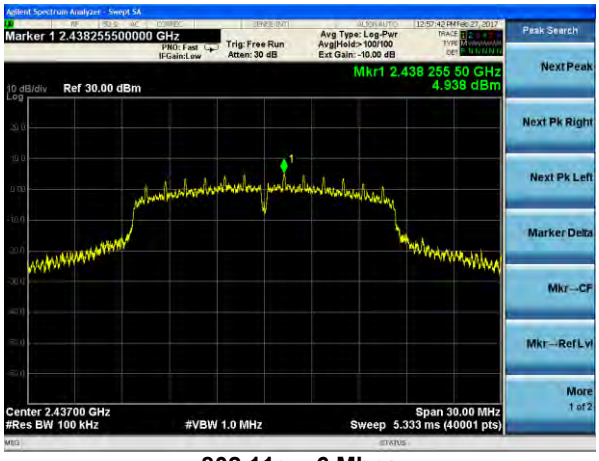
11.3 Test Data

802.11 Standard	Data Rate (MBPS)	Frequency (GHz)	Amplitude (dBm)	Reference Level (dBm)	Required Attenuation (dB)	Limit (dB)	Margin (dB)
b	1 (DBPSK)	3.283	-52.9	4.4	-30	-34.4	18.4
g	54 (64QAM)	2.585	-51.2	4.9	-30	-34.9	16.3
n	MCS0 (BPSK)	2.585	-53.1	3.7	-30	-33.7	19.4

11.3.1 Reference Levels for 100 kHz

The data rate that yielded the greatest PSD for each 802.11 mode was used to determine the reference levels for emissions within 100 kHz bandwidth, respectively.

802.11b – 1 Mbps

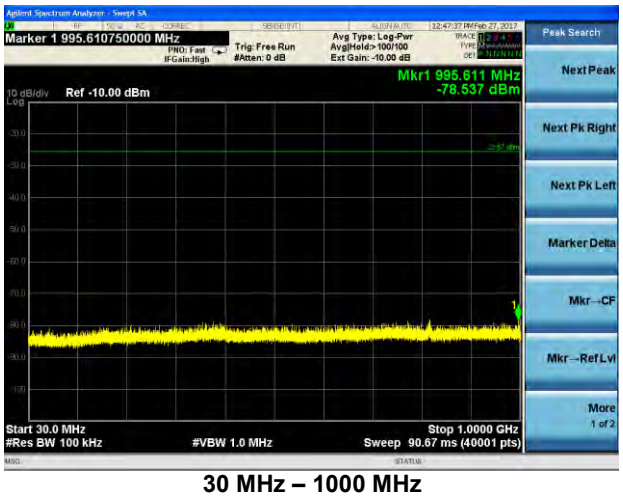


802.11g – 6 Mbps

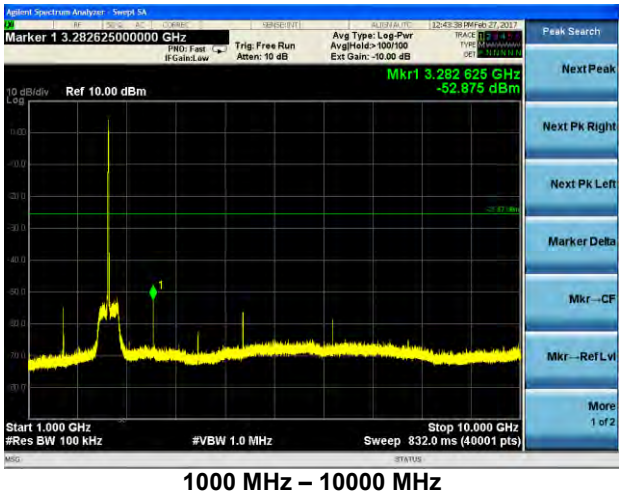
802.11n – MC0

11.3.2 Conducted Spurious Emissions in 100 kHz Bandwidth

801.11b – 1 Mbps



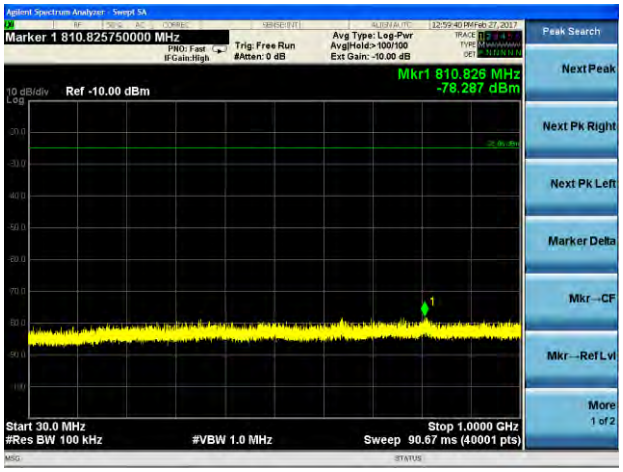
30 MHz – 1000 MHz



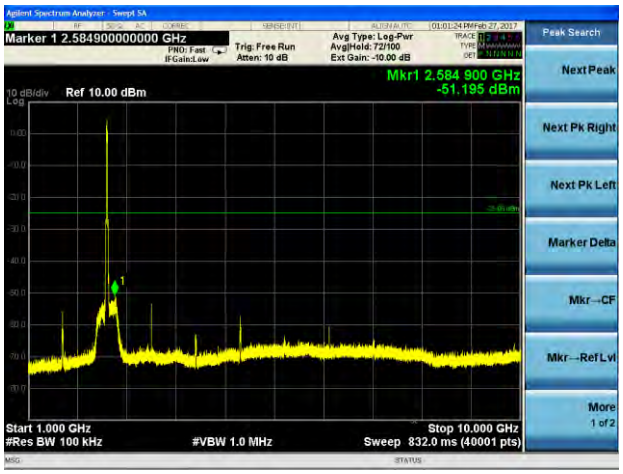
1000 MHz – 10000 MHz

10000 MHz – 250000 MHz

801.11g – 6 Mbps



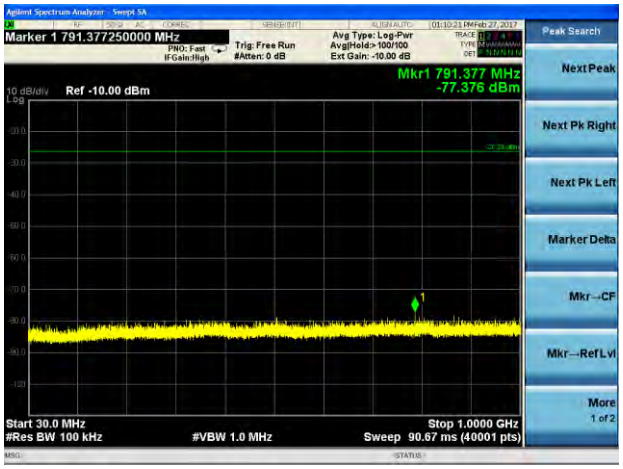
30 MHz – 1000 MHz



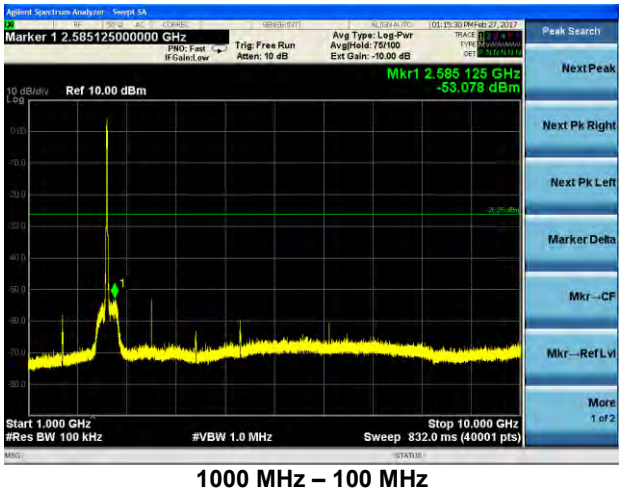
1000 MHz - 10000 MHz

10000 MHz – 25000 MHz

801.11n – MCS0



30 MHz – 1000 MHz



1000 MHz – 100 MHz

10000 MHz – 25000 MHz

11.3.3 Radiated Spurious Emissions

Radiated Emissions below 1GHz

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation	Notes
54.9	1.00	155	34.37	40.0	5.6	V	V	-
60.0	1.00	246	33.78	40.0	6.2	V	V	-
198.3	1.00	0	24.60	43.5	18.9	H	V	1
960.0	1.00	118	37.54	46.0	8.5	V	V	-
960.0	1.09	335	38.00	46.0	8.0	H	V	-

Radiated Emissions above 1GHz

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation	Notes
4824	1.00	233	49.2	46.5	54	7.5	Vertical	Vertical	-
4874	1.06	231	52.0	50.0	54	4.0	Vertical	Vertical	-
4924	1.05	229	52.6	50.7	54	3.3	Vertical	Vertical	-
18294	1.00	0	42.2	-	54	11.8	Vertical	Vertical	2,3
18252	1.00	0	42.1	-	54	11.9	Vertical	Vertical	2,3
21192	1.00	0	41.6	-	54	12.4	Vertical	Vertical	2,3

Note 1 & 2: system noisefloor measurements
Note 3: Peak emission compared to average limit

Screen Captures

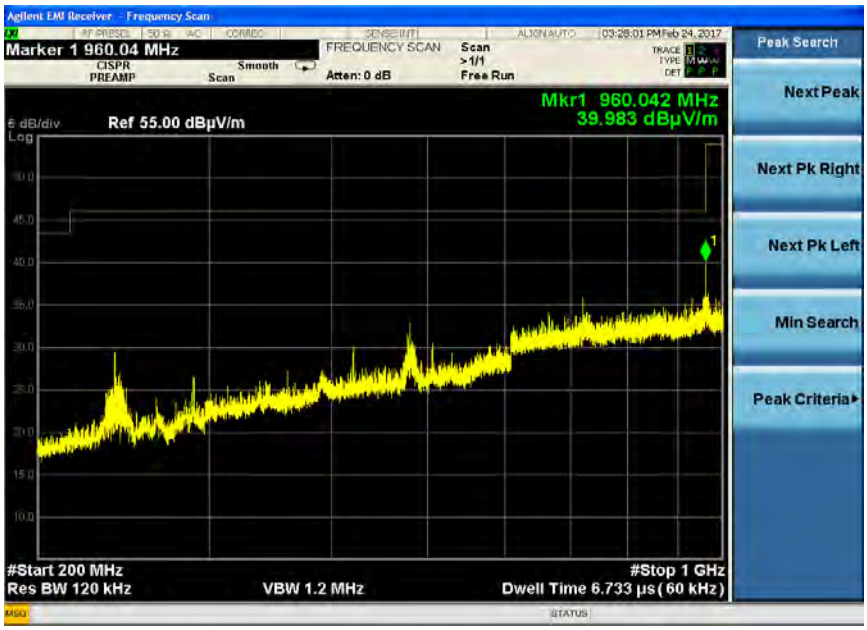
30 MHz - 200 MHz

Horizontal Polarity

Vertical Polarity

Note: The screen captures above utilize the peak detector of the analyzer and were determined to be an appropriate representation of the spectrum scan. Emissions did not change based upon transmit frequency.

200 MHz - 1000 MHz

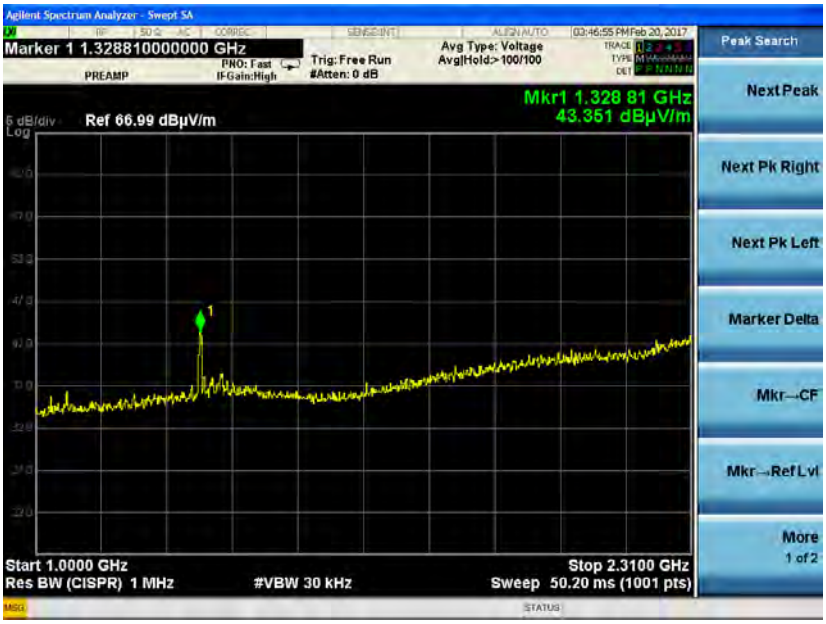


Horizontal Polarity

Vertical Polarity

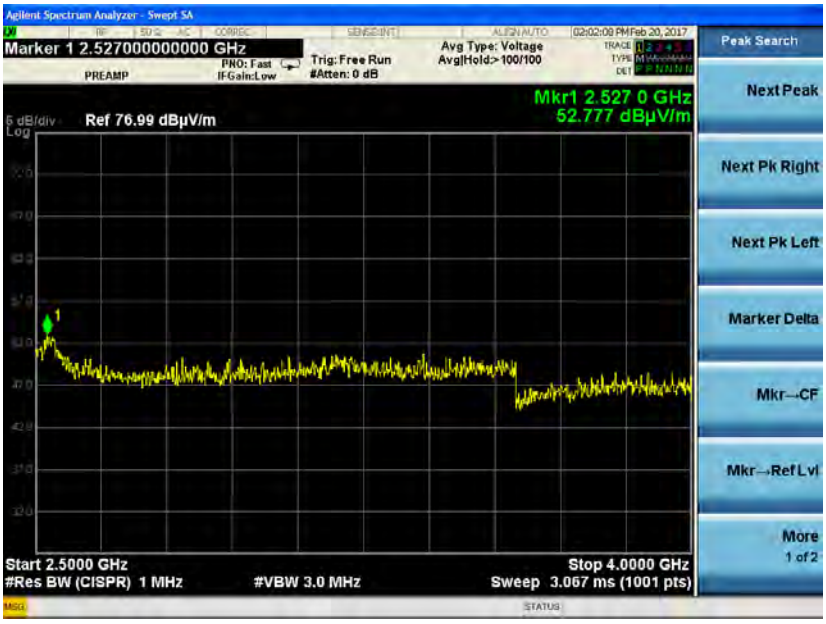
1000 MHz – 2310 MHz

Peak



Average

2500 MHz – 4000 MHz



Peak

Average

4000 MHz - 18000 MHz

Low Channel

Mid Channel

High Channel

18000 MHz - 25000 MHz

Low Channel

Mid Channel

High Channel

EXHIBIT 12 CONDUCTED AC LINE EMISSIONS

Manufacturer	United Technology Electronic Controls, Inc.
Date	2/28/17
Test Engineer	Michael Hintzke
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.207 RSS Gen Section 8.8
Measurement Procedure	ANSI C63.10 - 2013 Section 6.2
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table, 40 cm from vertical ground plane
Detectors	Peak, Quasi-Peak, Average RBW = 9 kHz; VBW ≥ 27 kHz
Description of Measurement	• The LISN, cable, limiter, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed. The data is gathered and reported as the corrected values. • The EUT is placed on a non-conductive pedestal at appropriate distance from ground planes and plugged into LISN. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral). • Maximum emissions are determined with peak detector and measurements at select points are made with quasi-peak and average detectors. Results are recorded and compared to limit.
Example Calculations	Reported Measurement data = Raw receiver measurement + LISN Factor + Cable factor (dB) + Additional factor (when applicable)
Additional Notes	• Continuous transmit modulated EUT operation • There was no significant difference between transmit channels • An off-the-shelf 120 VAC to 24 VAC transformer was used for testing.

12.1 Method of Measurements

ANSI C63.4 - 2014
ANSI C63.10 - 2013 Section 6.2

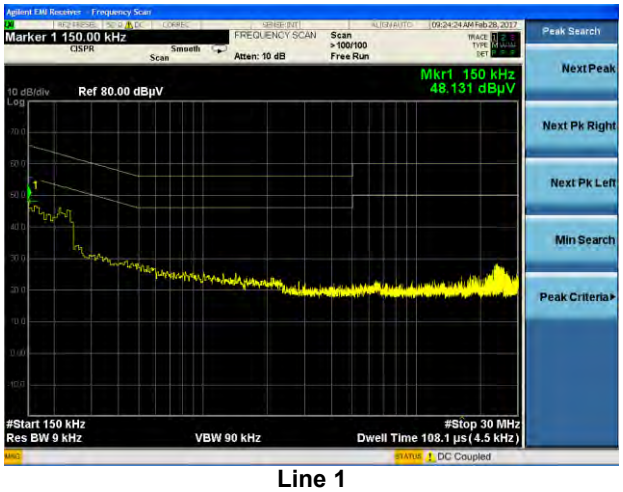
12.2 Limits

Frequency Range (MHz)	Class B Limits (dBµV)	
	Quasi-Peak	Average
0.150 -0.50 *	66-56	56-46
0.5 – 5.0	56	46
5.0 – 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

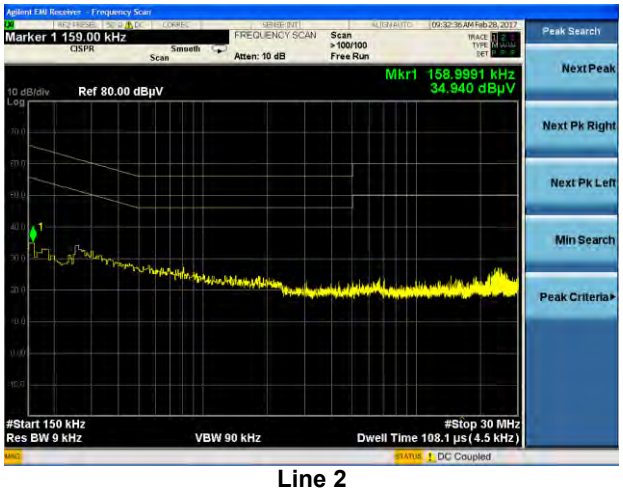
12.3 Test Data

Line	Frequency (MHz)	Quasi-Peak Reading (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
1	0.150	43.1	66.0	22.9	32.8	56.0	23.2
1	0.218	40.2	62.9	22.7	30.0	52.9	22.9
1	24.608	24.2	60.0	35.8	12.7	50.0	37.3
2	0.155	29.6	65.7	36.2	21.5	55.7	34.3
2	0.227	26.7	62.6	35.8	19.3	52.6	33.3
2	23.860	23.6	60.0	36.4	12.6	50.0	37.4

Note: The emissions listed are characteristic of the EUT power supply used and not that of the transmitter. Changing transmit channels did not change the emissions.



Line 1



Line 2

APPENDIX A Test Equipment List

LSR
a Laird Business

Date: 9-Jan-2017 Test: Conducted Measurements Job #: C-2631

PE: Mike Hintzke Customer: UTC Quote #: 316393

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	AA 960173	Cable - low loss 1m	A.H. Systems, Inc.	SAC-26G-1	388	5/16/2016	5/16/2017	Active Calibration

Tested By: Quality Assurance:

LSR
a Laird Business

Date: 24-Feb-2017 Test: Radiated Tx Spurious Emissions Job #: C-2631

PE: Mike Hintzke Customer: Carrier Quote #:

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	2/4/2016	2/4/2017	Active Calibration
3	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	40201429	2/4/2016	2/4/2017	Active Calibration
4	AA 960153	2.4GHz High Pass Filter	KWM	HPF-L-14186	7272-04	4/29/2016	4/29/2017	Active Calibration
5	AA 960174	Small Horn Antenna 18-40 GHz	ETS-Lindgren	3116C-PA	00206880	4/29/2016	4/29/2017	Active Calibration
6	AA 960171	Cable - low loss 1m	A.H. Systems, Inc.	SAC-26G-6	386	3/31/2016	3/31/2017	Active Calibration
7	EE 960088	8GHz MXE Spectrum Analyzer	Agilent	N9038A	MY51210138	2/24/2016	2/24/2017	Active Calibration
8	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	1/14/2016	1/14/2017	Active Calibration
9	AA 960163	Log Periodic Antenna	A.H. Systems, Inc.	SAS-512-2	500	3/18/2016	3/18/2017	Active Calibration

Tested By: Quality Assurance

LSR
a Laird Business

Date: 27-Jan-2017 Test: Conducted AC Emissions - Tx Job #: C-2631

PE: Mike Customer: Carrier Quote #:

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	AA 960162	EM Series Cable	MegaPhase	EM26-S1S1-120	12024301 001	6/29/2016	6/29/2017	Active Verification
3	EE 960110	Milliohm Meter	Extech Instrument	380560	H.292953	12/14/2015	12/14/2016	Active Calibration
4	EE 960054	Multimeter	HP	971A	JP40011152	4/13/2016	4/13/2017	Active Calibration

Tested By: Quality Assurance: Cory Hammerer

APPENDIX B Current Standard Publication Dates

Standard	Edition	Date	AMD 1	AMD 2
CFR 47 Part 15.247	-	2017	-	-
CFR 47 Part 15.207	-	2017	-	-
CFR 47 Part 15.209	-	2017	-	-
ANSI C63.10	-	2013	-	-
RSS-247	2	2017	-	-
RSS-Gen	4	2014	-	-

APPENDIX C Uncertainty Statement

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Configuration	Uncertainty Values
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	AMN	3.4 dB
Telecom Conducted Emissions	AAN	4.9 dB
Disturbance Power (Emissions)	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/Meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst / Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

Parameter	ETSI U.C.+/-	U.C.+/-
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (PM)	1.5 dB	1.2 dB
RF conducted emissions (SA)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %