



EchoNous, Inc.

Thor Radio Module AC WLAN and Bluetooth and BLE

FCC 15.407:2020

802.11 an, ac Radio

Report # ECHN0015.2 Rev 1



NVLAP LAB CODE: 200630-0
NVLAP LAB CODE: 200629-0

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government. This Report shall not be reproduced, except in full without written approval of the laboratory.

EAR-Controlled Data - This document contains technical data whose export and reexport/retransfer is subject to control by the U.S. Department of Commerce under the Export Administration Act and the Export Administration Regulations. The Department of Commerce's prior written approval may be required for the export or re-export/retransfer of such technical data to any foreign person, foreign entity or foreign organization whether in the United States or abroad.

CERTIFICATE OF TEST

Last Date of Test: February 5, 2020

EchoNous, Inc.

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2019	ANSI C63.10:2013
FCC 15.407:2020	ANSI C63.10:2013, KDB 789033, KDB 905462, KDB 662911

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	Yes	Pass	
6.8	Frequency Stability	Yes	Pass	
12.2	Duty Cycle - Chain 1	Yes	Pass	
12.2	Duty Cycle - Chain 2	Yes	Pass	
12.2	Duty Cycle - 2x2 Chains	Yes	Pass	
12.3.2.4	Maximum Conducted Output Power - Chain 1	Yes	Pass	
12.3.2.4	Maximum Conducted Output Power - Chain 2	Yes	Pass	
12.3.2.4	Maximum Conducted Output Power - 2x2 Chains	Yes	Pass	
12.3.2.4	Equivalent Isotropic Radiated Power (EIRP) - Chain 1	Yes	Pass	
12.3.2.4	Equivalent Isotropic Radiated Power (EIRP) - Chain 2	Yes	Pass	
12.3.2.4	Equivalent Isotropic Radiated Power (EIRP) - 2x2 Chains	Yes	Pass	
12.4.1	Emission Bandwidth - Chain 1	Yes	Pass	
12.4.1	Emission Bandwidth - Chain 2	Yes	Pass	
12.4.1	Emission Bandwidth - 2x2 Chains	Yes	Pass	
12.4.2	Occupied Bandwidth - Chain 1	Yes	Pass	
12.4.2	Occupied Bandwidth - Chain 2	Yes	Pass	
12.4.2	Occupied Bandwidth - 2x2 Chains	Yes	Pass	
12.4.2	Band Edge	Yes	Pass	
12.5	Maximum Power Spectral Density - Chain 1	Yes	Pass	
12.5	Maximum Power Spectral Density - Chain 2	Yes	Pass	
12.5	Maximum Power Spectral Density - 2x2 Chains	Yes	Pass	
12.7, 6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
KDB 789033 -H	Measurement of Emission at Elevation Angle Higher Than 30 Degrees From Horizon	No	N/A	Not required unless the EUT is a Master device used outdoors.

Deviations From Test Standards

None

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

CERTIFICATE OF TEST



Approved By:

Rod Munro, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
01	Removed all screen captures other than for those which contain reportable parameters for the purpose of reducing the file size of the report.	2020-03-12	Various

ACCREDITATIONS AND AUTHORIZATIONS



United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC – Recognized by MIC as a CAB for the acceptance of test data.

SCOPE

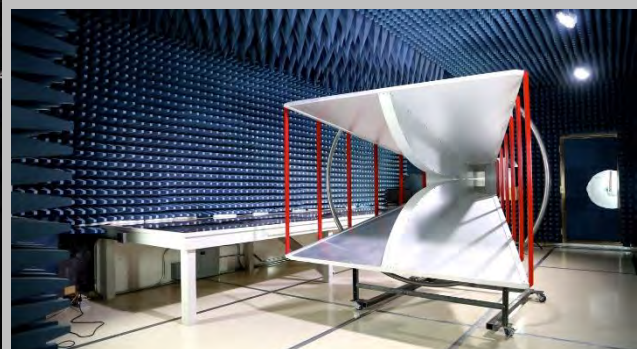
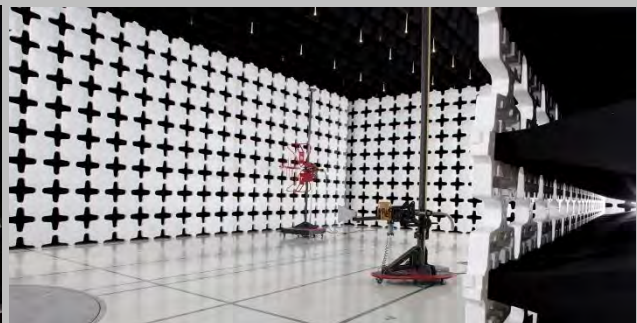
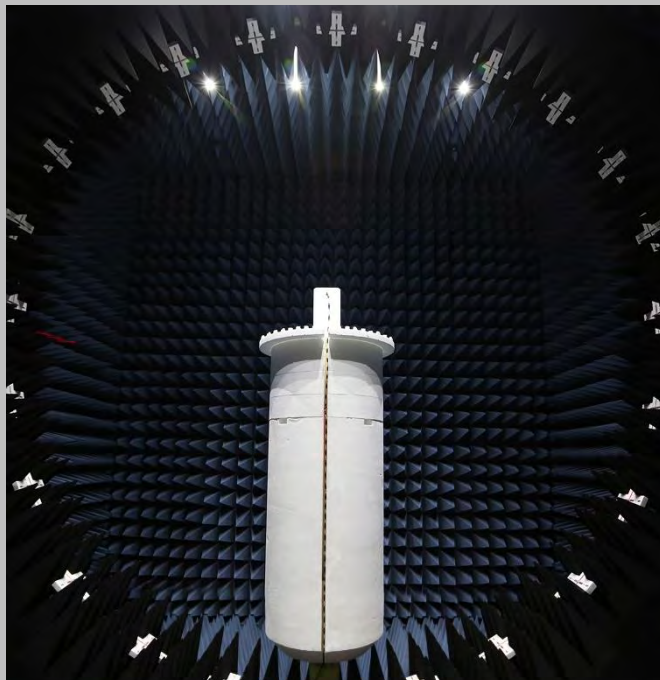
For details on the Scopes of our Accreditations, please visit:

<https://www.nwemc.com/emc-testing-accreditations>

FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157



MEASUREMENT UNCERTAINTY



Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

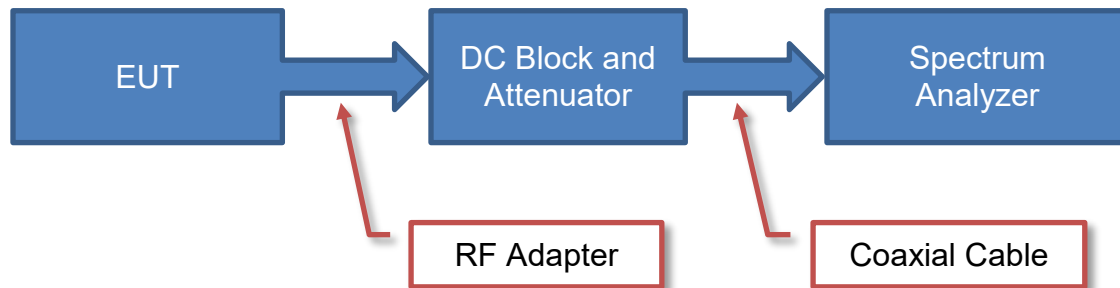
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

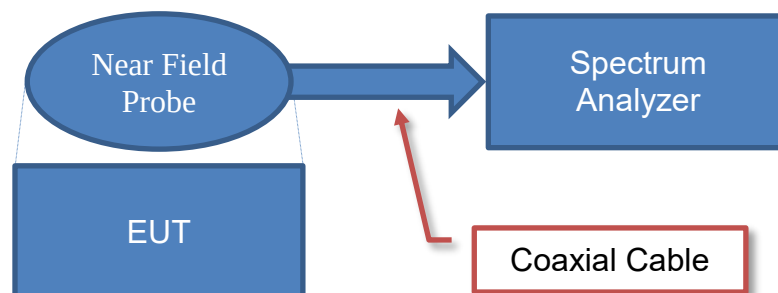
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

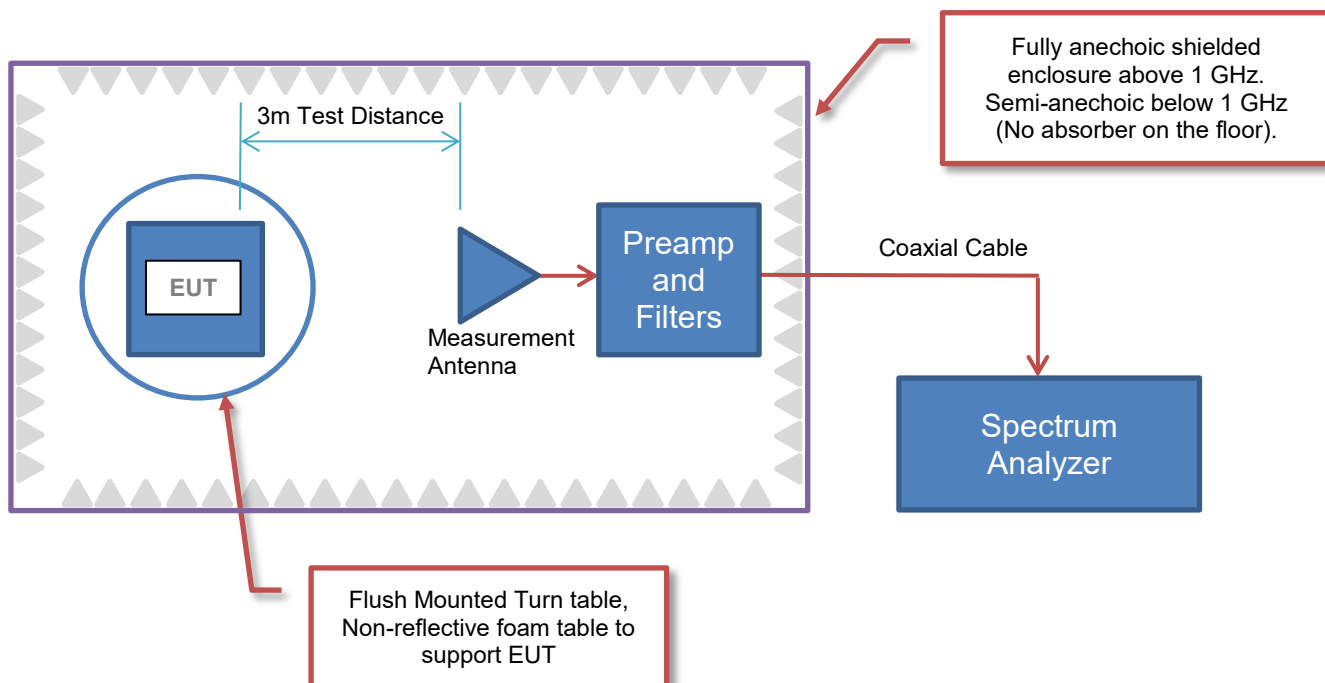
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	EchoNous, Inc.
Address:	8310 154th Ave NE, Bldg. B, Ste. 200
City, State, Zip:	Redmond, WA 98052
Test Requested By:	Sanchit Chirania
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE
First Date of Test:	July 25, 2019
Last Date of Test:	February 5, 2020
Receipt Date of Samples:	July 16, 2019
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Qualcomm Snapdragon 835 WLAN with Bluetooth 5.0 and BLE for QCA6174 based NFA324 Foxconn Module, 2x2 802.11ac with MU-MIMO
Testing Objective:
To demonstrate compliance of the 802.11 radio under FCC 15.407 for operation in the 5.2 GHz, 5.3 GHz, 5.6 GHz and 5.8 GHz band(s).

CONFIGURATIONS



Configuration ECHN0015- 1

Software/Firmware Running during test	
Description	Version
Qualcomm Radio Control Tool	4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	Qualcomm	Thor 1.0	Pre-production #1

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop #1	Lenovo	E590	PF-1KP4WR

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
USB-C Cable	No	1.2m	No	USB-C Connector (Laptop)	USB-C Connector (Thor Radio Module)

Configuration ECHN0015- 4

Software/Firmware Running during test	
Description	Version
Qualcomm Radio Control Tool	4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	EchoNous, Inc.	Thor 1.0	H1UR1944002-03

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop #1	Lenovo	E590	PF-1KP4WR

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
USB-C Cable	No	1.2m	No	USB-C Connector (Laptop)	USB-C Connector (Thor Radio Module)
USB-C Cable	No	2.0m	No	Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	Unterminated

CONFIGURATIONS



Configuration ECHN0015- 5

Software/Firmware Running during test	
Description	Version
Qualcomm Radio Control Tool	4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	EchoNous, Inc.	Thor 1.0	H1UR1944002-04

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop #2	Lenovo	E590	PF-1KP4Z1

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
USB-C Cable	No	1.2m	No	USB-C Connector (Laptop)	USB-C Connector (Thor Radio Module)
USB-C Cable	No	2.0m	No	Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	Unterminated

CONFIGURATIONS



Configuration ECHN0015- 10

Software/Firmware Running during test	
Description	Version
Qualcomm Radio Control Tool	4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	EchoNous, Inc.	Thor 1.0	30

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop #1	Lenovo	E590	PF-1KP4WR
USB-C Hub	Monprice	15249	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
USB-C Cable	No	2.0m	No	Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	Unterminated
USB-C	Yes	0.1m	No	Laptop	USB-C Hub
USB-C	Yes	1.4m	No	AC/DC Adapter	USB-C Hub
USB-C	Yes	2.0m	No	USB-C Hub	Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE

CONFIGURATIONS



Configuration ECHN0015- 12

Software/Firmware Running during test	
Description	Version
Qualcomm Radio Control Tool	4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	Qualcomm	Thor 1.0	Pre-production #1

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop #1	Lenovo	E590	PF-1KP4WR
50 Ohm Terminator	Anne-50+	3 1432	N/A

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
USB-C Cable	No	1.2m	No	USB-C Connector (Laptop)	USB-C Connector (Thor Radio Module)
U.FL Patch Cable	Yes	0.1m	No	50 Ohm Terminator	Antenna Port

Configuration ECHN0015- 13

Software/Firmware Running during test	
Description	Version
Qualcomm Radio Control Tool	4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Thor Radio Module AC WLAN and Bluetooth 5.0 and BLE	Qualcomm	Thor 1.0	HIUR1947005-01

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop #1	Lenovo	E590	PF-1KP4WR

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
USB-C Cable	No	1.2m	No	USB-C Connector (Laptop)	USB-C Connector (Thor Radio Module)

MODIFICATIONS



Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-07-25	Emission Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2019-07-29	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2019-07-30	Band Edge	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2019-07-30	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2019-10-25	Frequency Stability	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2019-12-18	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	2019-12-27	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2020-02-05	Equivalent Isotropic Radiated Power (EIRP)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
9	2020-02-05	Maximum Conducted Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
10	2020-02-05	Maximum Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWER SETTINGS



The EUT was tested using the power settings provided by the manufacturer:

SETTINGS FOR ALL TESTS IN THIS REPORT

Chain	Modulation Types	Channel Bandwidths	Channel	Position	Frequency (MHz)	Power Setting
A	6 Mbps	20	36	Low Channel	5180	14
			40	Mid Channel	5200	14
			48	High Channel	5240	14
A	36 Mbps	20	36	Low Channel	5180	13.5
			40	Mid Channel	5200	13.5
			48	High Channel	5240	13.5
A	54 Mbps	20	36	Low Channel	5180	13
			40	Mid Channel	5200	13
			48	High Channel	5240	13
A	MCS0	20	36	Low Channel	5180	14
			40	Mid Channel	5200	14
			48	High Channel	5240	14
A	MCS7	20	36	Low Channel	5180	14
			40	Mid Channel	5200	14
			48	High Channel	5240	14
A	MCS8 (256-QAM)	20	36	Low Channel	5180	13
			40	Mid Channel	5200	13
			48	High Channel	5240	13
A	MCS0	40	36/40	Low Channel	5190	14
			44/48	High Channel	5230	14
A	MCS7	40	36/40	Low Channel	5190	14
			44/48	High Channel	5230	14
A	MCS9 (256-QAM)	40	36/40	Low Channel	5190	11
			44/48	High Channel	5230	11
A	MCS0	80	36-48	Low Channel	5210	14
A	MCS9 (256-QAM)	80	36-48	Low Channel	5210	11
B	6 Mbps	20	36	Low Channel	5180	14
			40	Mid Channel	5200	14
			48	High Channel	5240	14
B	36 Mbps	20	36	Low Channel	5180	13.5
			40	Mid Channel	5200	13.5
			48	High Channel	5240	13.5
B	54 Mbps	20	36	Low Channel	5180	13
			40	Mid Channel	5200	13
			48	High Channel	5240	13
B	MCS0	20	36	Low Channel	5180	14
			40	Mid Channel	5200	14
			48	High Channel	5240	14
B	MCS7	20	36	Low Channel	5180	14
			40	Mid Channel	5200	14
			48	High Channel	5240	14
B	MCS8 (256-QAM)	20	36	Low Channel	5180	13
			40	Mid Channel	5200	13
			48	High Channel	5240	13
B	MCS0	40	36/40	Low Channel	5190	14
			44/48	High Channel	5230	14
B	MCS7	40	36/40	Low Channel	5190	14
			44/48	High Channel	5230	14
B	MCS9 (256-QAM)	40	36/40	Low Channel	5190	11
			44/48	High Channel	5230	11
B	MCS0	80	36-48	Low Channel	5210	14
B	MCS9 (256-QAM)	80	36-48	Low Channel	5210	11
AB	MCS8	20	36	Low Channel	5180	14
			40	Mid Channel	5200	14
			48	High Channel	5240	14
AB	MCS15	20	36	Low Channel	5180	14

POWER SETTINGS



			40	Mid Channel	5200	14
			48	High Channel	5240	14
AB	MCS8 (256-QAM)	20	36	Low Channel	5180	12
			40	Mid Channel	5200	12
			48	High Channel	5240	12
AB	MCS8	40	36/40	Low Channel	5190	14
			44/48	High Channel	5230	14
AB	MCS15	40	36/40	Low Channel	5190	14
			44/48	High Channel	5230	14
AB	MCS9 (256-QAM)	40	36/40	Low Channel	5190	11
			44/48	High Channel	5230	11
AB	MCS0	80	36-48	Low Channel	5210	14
AB	MCS9 (256-QAM)	80	36-48	Low Channel	5210	11
A	6 Mbps	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
A	36 Mbps	20	52	Low Channel	5260	13.5
			60	Mid Channel	5300	13.5
			64	High Channel	5320	13.5
A	54 Mbps	20	52	Low Channel	5260	13
			60	Mid Channel	5300	13
			64	High Channel	5320	13
A	MCS0	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
A	MCS7	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
A	MCS8 (256-QAM)	20	52	Low Channel	5260	13
			60	Mid Channel	5300	13
			64	High Channel	5320	13
A	MCS0	40	52/56	Low Channel	5270	14
			60/64	High Channel	5310	14
A	MCS7	40	52/56	Low Channel	5270	14
			60/64	High Channel	5310	14
A	MCS9 (256-QAM)	40	52/56	Low Channel	5270	11
			60/64	High Channel	5310	11
A	MCS0	80	52-64	Low Channel	5290	14
A	MCS9 (256-QAM)	80	52-64	Low Channel	5290	11
B	6 Mbps	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
B	36 Mbps	20	52	Low Channel	5260	13.5
			60	Mid Channel	5300	13.5
			64	High Channel	5320	13.5
B	54 Mbps	20	52	Low Channel	5260	13
			60	Mid Channel	5300	13
			64	High Channel	5320	13
B	MCS0	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
B	MCS7	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
B	MCS8 (256-QAM)	20	52	Low Channel	5260	13
			60	Mid Channel	5300	13
			64	High Channel	5320	13
B	MCS0	40	52/56	Low Channel	5270	14
			60/64	High Channel	5310	14
B	MCS7	40	52/56	Low Channel	5270	14
			60/64	High Channel	5310	14
B	MCS9 (256-QAM)	40	52/56	Low Channel	5270	11
			60/64	High Channel	5310	11

POWER SETTINGS



B	MCS0	80	52-64	Low Channel	5290	14
B	MCS9 (256-QAM)	80	52-64	Low Channel	5290	11
AB	MCS8	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
AB	MCS15	20	52	Low Channel	5260	14
			60	Mid Channel	5300	14
			64	High Channel	5320	14
AB	MCS8 (256-QAM)	20	52	Low Channel	5260	12
			60	Mid Channel	5300	12
			64	High Channel	5320	12
AB	MCS8	40	52/56	Low Channel	5270	14
			60/64	High Channel	5310	14
AB	MCS15	40	52/56	Low Channel	5270	14
			60/64	High Channel	5310	14
AB	MCS9 (256-QAM)	40	52/56	Low Channel	5270	11
			60/64	High Channel	5310	11
AB	MCS0	80	52-64	Low Channel	5290	14
AB	MCS9 (256-QAM)	80	52-64	Low Channel	5290	11
A	6 Mbps	20	100	Low Channel	5500	14
			116	Mid Channel	5580	14
			140	High Channel	5700	14
A	36 Mbps	20	100	Low Channel	5500	13.5
			116	Mid Channel	5580	13.5
			140	High Channel	5700	13.5
A	54 Mbps	20	100	Low Channel	5500	13
			116	Mid Channel	5580	13
			140	High Channel	5700	13
A	MCS0	20	100	Low Channel	5500	14
			116	Mid Channel	5580	14
			140	High Channel	5700	14
A	MCS7	20	100	Low Channel	5500	14
			116	Mid Channel	5580	14
			140	High Channel	5700	14
A	MCS8 (256-QAM)	20	100	Low Channel	5500	13
			116	Mid Channel	5580	13
			140	High Channel	5700	13
A	MCS0	40	100/104	Low Channel	5510	14
			116/120	Mid Channel	5590	14
			132/136	High Channel	5670	14
A	MCS7	40	100/104	Low Channel	5510	14
			116/120	Mid Channel	5590	14
			132/136	High Channel	5670	14
A	MCS9 (256-QAM)	40	100/104	Low Channel	5510	11
			116/120	Mid Channel	5590	11
			132/136	High Channel	5670	11
A	MCS0	80	100-112	Low Channel	5530	14
			116-128	High Channel	5610	14
A	MCS9 (256-QAM)	80	100-112	Low Channel	5530	11
			116-128	High Channel	5610	11
B	6 Mbps	20	100	Low Channel	5500	14
			116	Mid Channel	5580	14
			140	High Channel	5700	14
B	36 Mbps	20	100	Low Channel	5500	13.5
			116	Mid Channel	5580	13.5
			140	High Channel	5700	13.5
B	54 Mbps	20	100	Low Channel	5500	13
			116	Mid Channel	5580	13
			140	High Channel	5700	13
B	MCS0	20	100	Low Channel	5500	14
			116	Mid Channel	5580	14
			140	High Channel	5700	14
B	MCS7	20	100	Low Channel	5500	14

POWER SETTINGS



			116	Mid Channel	5580	14
			140	High Channel	5700	14
B	MCS8 (256-QAM)	20	100	Low Channel	5500	13
			116	Mid Channel	5580	13
			140	High Channel	5700	13
			100/104	Low Channel	5510	14
B	MCS0	40	116/120	Mid Channel	5590	14
			132/136	High Channel	5670	14
			100/104	Low Channel	5510	14
B	MCS7	40	116/120	Mid Channel	5590	14
			132/136	High Channel	5670	14
			100/104	Low Channel	5510	11
B	MCS9 (256-QAM)	40	116/120	Mid Channel	5590	11
			132/136	High Channel	5670	11
			100-112	Low Channel	5530	14
B	MCS0	80	116-128	High Channel	5610	14
			100-112	Low Channel	5530	11
B	MCS9 (256-QAM)	80	116-128	High Channel	5610	11
			100	Low Channel	5500	14
AB	MCS8	20	116	Mid Channel	5580	14
			140	High Channel	5700	14
			100	Low Channel	5500	14
AB	MCS15	20	116	Mid Channel	5580	14
			140	High Channel	5700	14
			100	Low Channel	5500	12
AB	MCS8 (256-QAM)	20	116	Mid Channel	5580	12
			140	High Channel	5700	12
			100/104	Low Channel	5510	14
AB	MCS8	40	116/120	Mid Channel	5590	14
			132/136	High Channel	5670	14
			100/104	Low Channel	5510	14
AB	MCS15	40	116/120	Mid Channel	5590	14
			132/136	High Channel	5670	14
			100/104	Low Channel	5510	11
AB	MCS9 (256-QAM)	40	116/120	Mid Channel	5590	11
			132/136	High Channel	5670	11
			100-112	Low Channel	5530	14
AB	MCS0	80	116-128	High Channel	5610	14
			100-112	Low Channel	5530	11
AB	MCS9 (256-QAM)	80	116-128	High Channel	5610	11
			149	Low Channel	5745	14
A	6 Mbps	20	157	Mid Channel	5785	14
			165	High Channel	5825	14
			149	Low Channel	5745	13.5
A	36 Mbps	20	157	Mid Channel	5785	13.5
			165	High Channel	5825	13.5
			149	Low Channel	5745	13
A	54 Mbps	20	157	Mid Channel	5785	13
			165	High Channel	5825	13
			149	Low Channel	5745	14
A	MCS0	20	157	Mid Channel	5785	14
			165	High Channel	5825	14
			149	Low Channel	5745	14
A	MCS7	20	157	Mid Channel	5785	14
			165	High Channel	5825	14
			149	Low Channel	5745	13
A	MCS8 (256-QAM)	20	157	Mid Channel	5785	13
			165	High Channel	5825	13
			149/153	Low Channel	5755	14
A	MCS0	40	157/161	High Channel	5795	14
			149/153	Low Channel	5755	14
A	MCS7	40	157/161	High Channel	5795	14
			149/153	Low Channel	5755	11
A	MCS9 (256-QAM)	40	157/161	High Channel	5795	11
			149/153	Low Channel	5755	11

POWER SETTINGS



A	MCS0	80	149-161	Low Channel	5775	14
A	MCS9 (256-QAM)	80	149-161	Low Channel	5775	11
B	6 Mbps	20	149	Low Channel	5745	14
			157	Mid Channel	5785	14
			165	High Channel	5825	14
B	36 Mbps	20	149	Low Channel	5745	13.5
			157	Mid Channel	5785	13.5
			165	High Channel	5825	13.5
B	54 Mbps	20	149	Low Channel	5745	13
			157	Mid Channel	5785	13
			165	High Channel	5825	13
B	MCS0	20	149	Low Channel	5745	14
			157	Mid Channel	5785	14
			165	High Channel	5825	14
B	MCS7	20	149	Low Channel	5745	14
			157	Mid Channel	5785	14
			165	High Channel	5825	14
B	MCS8 (256-QAM)	20	149	Low Channel	5745	13
			157	Mid Channel	5785	13
			165	High Channel	5825	13
B	MCS0	40	149/153	Low Channel	5755	14
			157/161	High Channel	5795	14
B	MCS7	40	149/153	Low Channel	5755	14
			157/161	High Channel	5795	14
B	MCS9 (256-QAM)	40	149/153	Low Channel	5755	11
			157/161	High Channel	5795	11
B	MCS0	80	149-161	Low Channel	5775	14
B	MCS9 (256-QAM)	80	149-161	Low Channel	5775	11
AB	MCS8	20	149	Low Channel	5745	14
			157	Mid Channel	5785	14
			165	High Channel	5825	14
AB	MCS15	20	149	Low Channel	5745	14
			157	Mid Channel	5785	14
			165	High Channel	5825	14
AB	MCS8 (256-QAM)	20	149	Low Channel	5745	12
			157	Mid Channel	5785	12
			165	High Channel	5825	12
AB	MCS8	40	149/153	Low Channel	5755	14
			157/161	High Channel	5795	14
AB	MCS15	40	149/153	Low Channel	5755	14
			157/161	High Channel	5795	14
AB	MCS9 (256-QAM)	40	149/153	Low Channel	5755	11
			157/161	High Channel	5795	11
AB	MCS0	80	149-161	Low Channel	5775	14
AB	MCS9 (256-QAM)	80	149-161	Low Channel	5775	11

POWERLINE CONDUCTED EMISSIONS



TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Rohde & Schwarz	ESCI	ARH	2019-05-02	2020-05-02
LISN	Solar Electronics	9252-50-R-24-BNC	LIP	2019-08-28	2020-08-28
Cable - Conducted Cable Assembly	Northwest EMC	EVG, HHD, RKT	EVGA	2019-01-07	2020-01-07

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

ECHN0015-10

MODES INVESTIGATED

On, Continuous Tx 6 Mbps Low Ch. 5260 MHz
On, Continuous Tx 6 Mbps Mid Ch. 5580 MHz
On, Continuous Tx 6 Mbps Mid Ch. 5785 MHz

POWERLINE CONDUCTED EMISSIONS



EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order:	ECHN0015
Serial Number:	30	Date:	2019-12-27
Customer:	EchoNous, Inc.	Temperature:	20.3°C
Attendees:	None	Relative Humidity:	36.9%
Customer Project:	None	Bar. Pressure:	1026 mb
Tested By:	Cole Ghizzone	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	ECHN0015-10

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	12	Line:	Neutral	Add. Ext. Attenuation (dB):	0
--------	----	-------	---------	-----------------------------	---

COMMENTS

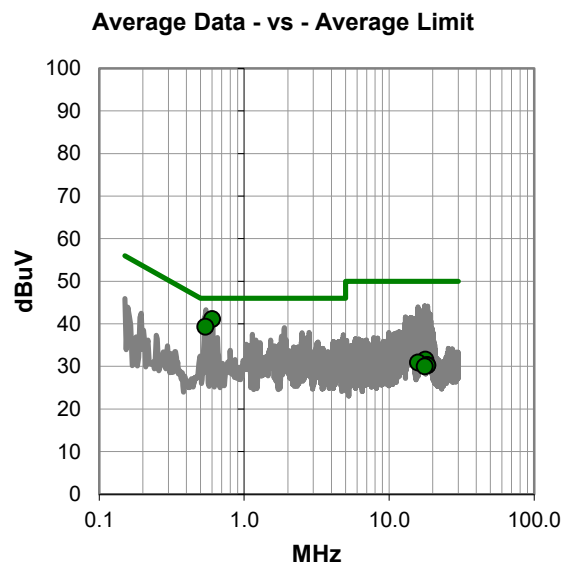
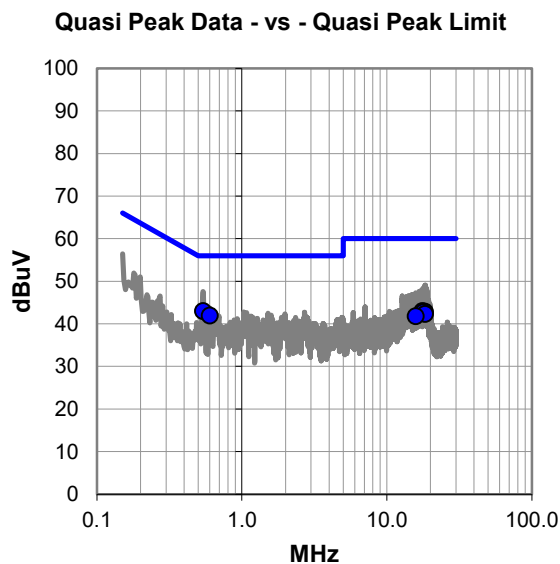
None

EUT OPERATING MODES

On, Continuous Tx 6 Mbps Low Ch. 5260 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.5	23.100	19.9	43.0	56.0	-13.0
0.6	22.000	19.9	41.9	56.0	-14.1
17.6	22.400	20.6	43.0	60.0	-17.0
18.3	22.200	20.6	42.8	60.0	-17.2
17.8	22.100	20.6	42.7	60.0	-17.3
18.4	21.600	20.7	42.3	60.0	-17.7
15.8	21.300	20.5	41.8	60.0	-18.2

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.6	21.200	19.9	41.1	46.0	-4.9
0.5	19.400	19.9	39.3	46.0	-6.7
17.8	11.000	20.6	31.6	50.0	-18.4
15.8	10.400	20.5	30.9	50.0	-19.1
18.3	9.700	20.6	30.3	50.0	-19.7
18.4	9.500	20.7	30.2	50.0	-19.8
17.6	9.400	20.6	30.0	50.0	-20.0

CONCLUSION

Pass



Tested By

POWERLINE CONDUCTED EMISSIONS



EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order:	ECHN0015
Serial Number:	30	Date:	2019-12-27
Customer:	EchoNous, Inc.	Temperature:	20.3°C
Attendees:	None	Relative Humidity:	36.9%
Customer Project:	None	Bar. Pressure:	1026 mb
Tested By:	Cole Ghizzone	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	ECHN0015-10

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	13	Line:	High Line	Add. Ext. Attenuation (dB):	0
--------	----	-------	-----------	-----------------------------	---

COMMENTS

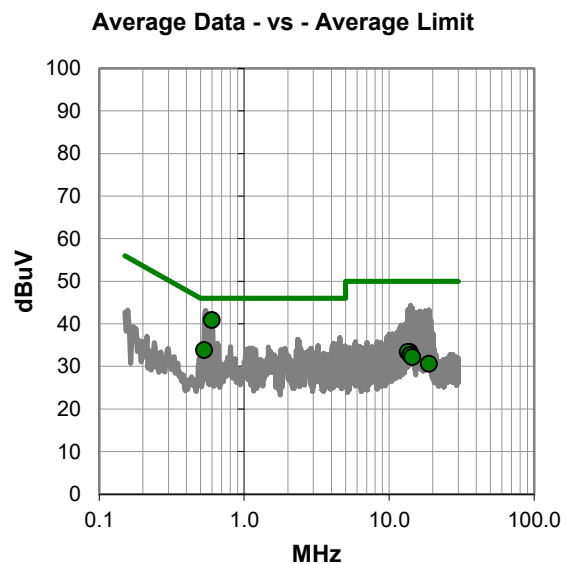
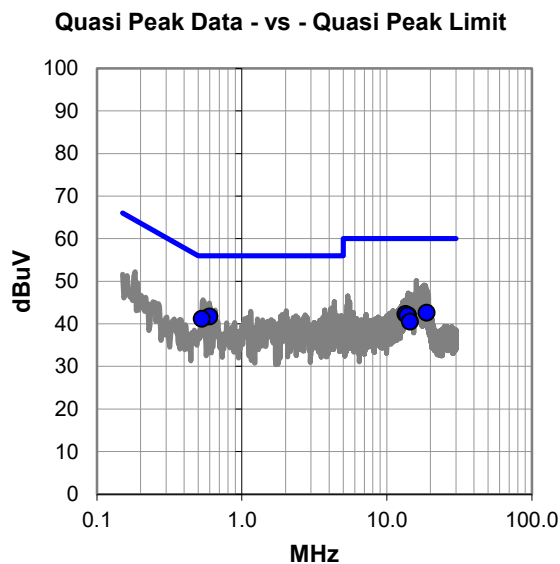
None

EUT OPERATING MODES

On, Continuous Tx 6 Mbps Low Ch. 5260 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.6	21.800	19.9	41.7	56.0	-14.3
0.5	21.300	19.9	41.2	56.0	-14.8
18.8	21.800	20.8	42.6	60.0	-17.4
13.5	21.900	20.4	42.3	60.0	-17.7
14.0	21.600	20.4	42.0	60.0	-18.0
13.9	21.500	20.4	41.9	60.0	-18.1
14.4	20.100	20.4	40.5	60.0	-19.5

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.6	21.000	19.9	40.9	46.0	-5.1
0.5	13.900	19.9	33.8	46.0	-12.2
13.9	13.000	20.4	33.4	50.0	-16.6
13.5	13.000	20.4	33.4	50.0	-16.6
14.0	12.300	20.4	32.7	50.0	-17.3
14.4	11.800	20.4	32.2	50.0	-17.8
18.8	9.800	20.8	30.6	50.0	-19.4

CONCLUSION

Pass



Tested By

POWERLINE CONDUCTED EMISSIONS



EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order:	ECHN0015
Serial Number:	30	Date:	2019-12-27
Customer:	EchoNous, Inc.	Temperature:	20.3°C
Attendees:	None	Relative Humidity:	36.9%
Customer Project:	None	Bar. Pressure:	1026 mb
Tested By:	Cole Ghizzone	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	ECHN0015-10

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	14	Line:	High Line	Add. Ext. Attenuation (dB):	0
--------	----	-------	-----------	-----------------------------	---

COMMENTS

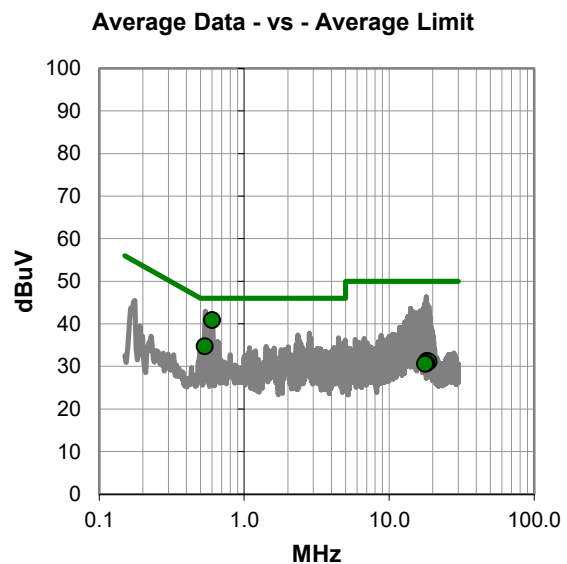
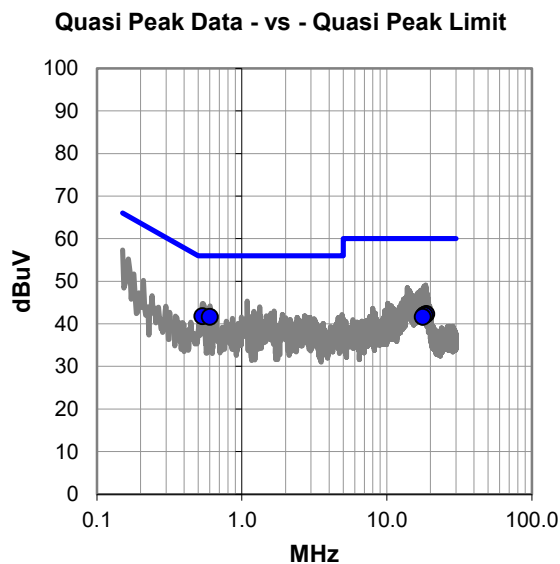
None

EUT OPERATING MODES

On, Continuous Tx 6 Mbps Mid Ch. 5580 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #14

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.5	21.900	19.9	41.8	56.0	-14.2
0.6	21.700	19.9	41.6	56.0	-14.4
18.8	21.500	20.8	42.3	60.0	-17.7
18.1	21.400	20.6	42.0	60.0	-18.0
18.3	21.400	20.6	42.0	60.0	-18.0
17.7	21.000	20.6	41.6	60.0	-18.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.6	21.000	19.9	40.9	46.0	-5.1
0.5	14.800	19.9	34.7	46.0	-11.3
18.3	10.700	20.6	31.3	50.0	-18.7
18.8	10.300	20.8	31.1	50.0	-18.9
18.1	10.100	20.6	30.7	50.0	-19.3
17.7	10.000	20.6	30.6	50.0	-19.4

CONCLUSION

Pass



Tested By

POWERLINE CONDUCTED EMISSIONS



EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order:	ECHN0015
Serial Number:	30	Date:	2019-12-27
Customer:	EchoNous, Inc.	Temperature:	20.3°C
Attendees:	None	Relative Humidity:	36.9%
Customer Project:	None	Bar. Pressure:	1026 mb
Tested By:	Cole Ghizzone	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	ECHN0015-10

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	15	Line:	Neutral	Add. Ext. Attenuation (dB):	0
--------	----	-------	---------	-----------------------------	---

COMMENTS

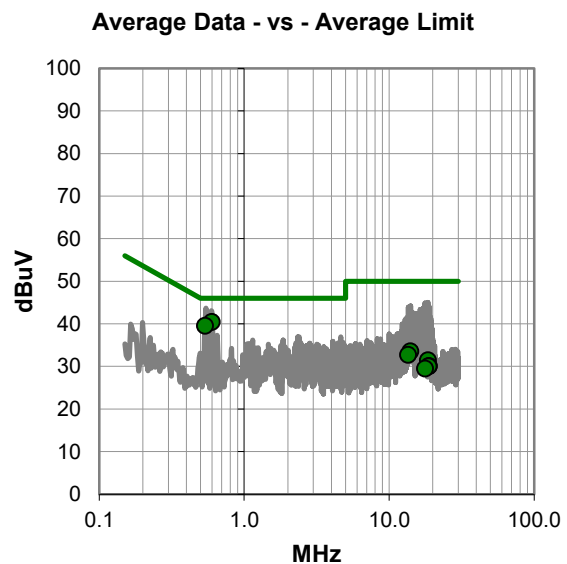
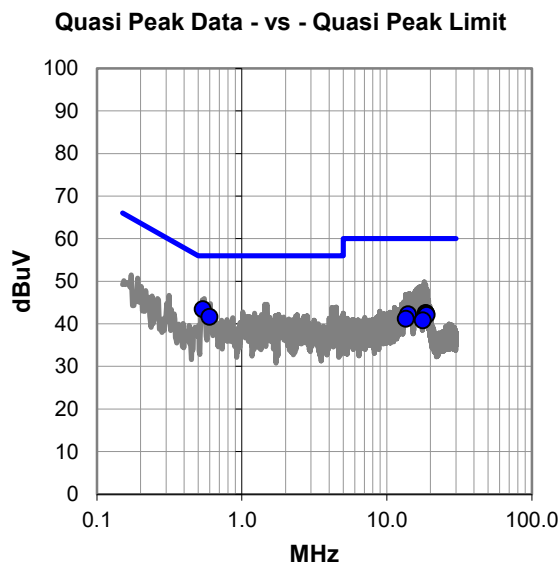
None

EUT OPERATING MODES

On, Continuous Tx 6 Mbps Mid Ch. 5580 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #15

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.5	23.500	19.9	43.4	56.0	-12.6
0.6	21.700	19.9	41.6	56.0	-14.4
18.5	21.700	20.8	42.5	60.0	-17.5
18.8	21.600	20.8	42.4	60.0	-17.6
14.0	21.800	20.4	42.2	60.0	-17.8
18.8	21.300	20.8	42.1	60.0	-17.9
13.6	20.800	20.4	41.2	60.0	-18.8
17.7	20.200	20.6	40.8	60.0	-19.2

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.6	20.500	19.9	40.4	46.0	-5.6
0.5	19.600	19.9	39.5	46.0	-6.5
14.0	13.100	20.4	33.5	50.0	-16.5
13.6	12.300	20.4	32.7	50.0	-17.3
18.5	10.600	20.8	31.4	50.0	-18.6
18.8	9.300	20.8	30.1	50.0	-19.9
18.8	9.200	20.8	30.0	50.0	-20.0
17.7	8.900	20.6	29.5	50.0	-20.5

CONCLUSION

Pass



Tested By

POWERLINE CONDUCTED EMISSIONS



EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order:	ECHN0015
Serial Number:	30	Date:	2019-12-27
Customer:	EchoNous, Inc.	Temperature:	20.3°C
Attendees:	None	Relative Humidity:	36.9%
Customer Project:	None	Bar. Pressure:	1026 mb
Tested By:	Cole Ghizzone	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	ECHN0015-10

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	16	Line:	Neutral	Add. Ext. Attenuation (dB):	0
--------	----	-------	---------	-----------------------------	---

COMMENTS

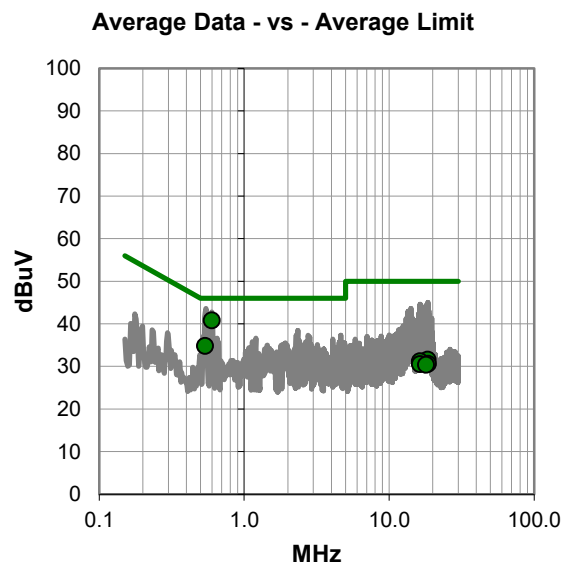
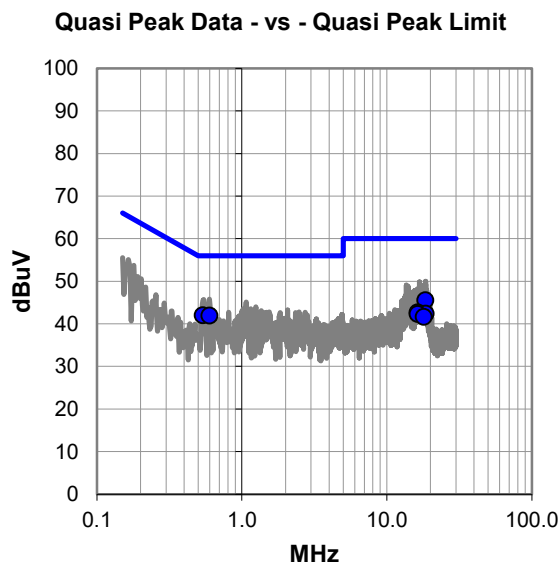
None

EUT OPERATING MODES

On, Continuous Tx 6 Mbps Mid Ch. 5785 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #16

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.5	22.100	19.9	42.0	56.0	-14.0
0.6	22.000	19.9	41.9	56.0	-14.1
18.5	24.700	20.8	45.5	60.0	-14.5
16.3	22.100	20.6	42.7	60.0	-17.3
18.5	21.600	20.8	42.4	60.0	-17.6
16.4	21.700	20.6	42.3	60.0	-17.7
18.0	21.000	20.6	41.6	60.0	-18.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.6	20.900	19.9	40.8	46.0	-5.2
0.5	14.900	19.9	34.8	46.0	-11.2
18.5	10.800	20.8	31.6	50.0	-18.4
16.4	10.600	20.6	31.2	50.0	-18.8
18.5	9.800	20.8	30.6	50.0	-19.4
16.3	9.900	20.6	30.5	50.0	-19.5
18.0	9.800	20.6	30.4	50.0	-19.6

CONCLUSION

Pass



Tested By

POWERLINE CONDUCTED EMISSIONS



EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order:	ECHN0015
Serial Number:	30	Date:	2019-12-27
Customer:	EchoNous, Inc.	Temperature:	20.3°C
Attendees:	None	Relative Humidity:	36.9%
Customer Project:	None	Bar. Pressure:	1026 mb
Tested By:	Cole Ghizzone	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	ECHN0015-10

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	17	Line:	High Line	Add. Ext. Attenuation (dB):	0
--------	----	-------	-----------	-----------------------------	---

COMMENTS

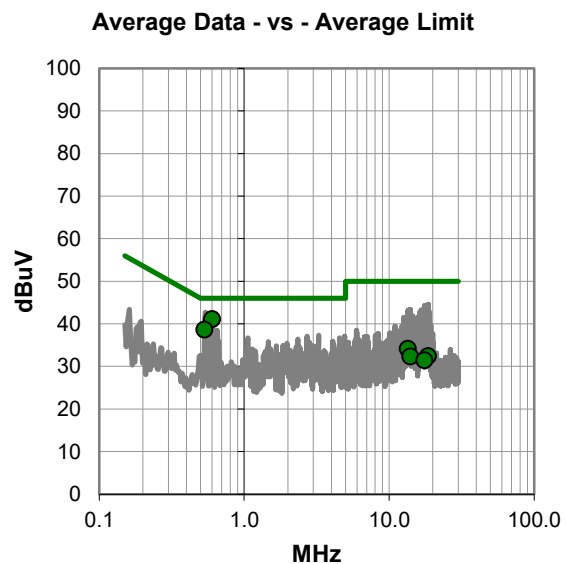
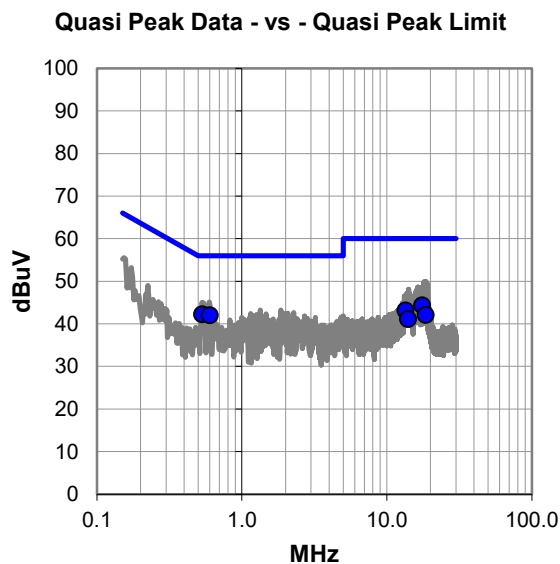
None

EUT OPERATING MODES

On, Continuous Tx 6 Mbps Mid Ch. 5785 MHz

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS

RESULTS - Run #17

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.5	22.300	19.9	42.2	56.0	-13.8
0.6	22.100	19.9	42.0	56.0	-14.0
17.6	23.700	20.6	44.3	60.0	-15.7
13.5	22.700	20.4	43.1	60.0	-16.9
18.6	21.300	20.8	42.1	60.0	-17.9
14.0	20.700	20.4	41.1	60.0	-18.9

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.6	21.200	19.9	41.1	46.0	-4.9
0.5	18.700	19.9	38.6	46.0	-7.4
13.5	13.700	20.4	34.1	50.0	-15.9
18.6	11.600	20.8	32.4	50.0	-17.6
14.0	11.900	20.4	32.3	50.0	-17.7
17.6	10.800	20.6	31.4	50.0	-18.6

CONCLUSION

Pass



Tested By

FREQUENCY STABILITY



XMIT 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Chamber - Temperature/Humidity	Tenney	T6S	TBG	NCR	NCR
Meter - Multimeter	Fluke	111	MMM	28-Feb-19	28-Feb-22
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Thermometer	Omega Engineering, Inc.	HH311	DUH	2-Apr-18	2-Apr-21
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spectrum analyzer is equipped with a precision frequency reference that exceeds the stability requirement of the EUT.

Measurements were made at the edges of the main transmit bands as called out on the data sheets. Testing was done with an absence of modulation in a CW mode of operation.

The primary supply voltage was varied from 85 % to 115% of the nominal voltage Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range (-10 ° to +50° C) and at 10°C intervals.

Where a ppm limit applies: $\text{ppm} = (\text{Measured Frequency} / \text{Measured Nominal Frequency} - 1) * 1,000,000$

Per the requirements of FCC 15.407:

"Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual."

No specific limits are provided in either FCC 15.407, the product specific rule part, or FCC 2.1055, the equipment authorization procedure for testing frequency stability. While there are no limits called out, any results less than 100ppm will still allow the radio to be operating within the band.

FREQUENCY STABILITY



TstTx 2019.08.30.0 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: HIUR1947005-01		Date: 25-Oct-19	
Customer: EchoNous, Inc.		Temperature: 22.3 °C	
Attendees: None		Humidity: 47.7% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brian Fahey	Power: 3.7 VDC	Job Site: NC04	
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Per the client, the DC operating voltage is 2.8 - 4.2 VDC.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	13	Signature 	
		Measured Value (MHz)	Assigned Value (MHz)
		Error (ppm)	Limit (ppm)
			Results
5150 MHz - 5250 MHz - Low Channel, 5180 MHz			
	Voltage: 115% = 4.2 VDC	5180.062663	5180
	Voltage: 100% = 3.7 VDC	5180.062813	5180
	Voltage: 85% = 3.145 VDC	5180.063616	5180
	Temperature: +50°	5180.057955	5180
	Temperature: +40°	5180.055769	5180
	Temperature: +30°	5180.061562	5180
	Temperature: +20°	5180.074637	5180
	Temperature: +10°	5180.089569	5180
	Temperature: 0°	5180.104044	5180
	Temperature: -10°	5180.113841	5180
5250 MHz - 5350 MHz - High Channel, 5320 MHz			
	Voltage: 115% = 4.2 VDC	5320.064284	5320
	Voltage: 100% = 3.7 VDC	5320.064701	5320
	Voltage: 85% = 3.145 VDC	5320.065087	5320
	Temperature: +50°	5320.06017	5320
	Temperature: +40°	5320.057229	5320
	Temperature: +30°	5320.06375	5320
	Temperature: +20°	5320.076229	5320
	Temperature: +10°	5320.092669	5320
	Temperature: 0°	5320.10674	5320
	Temperature: -10°	5320.117091	5320
5470 MHz - 5725 MHz - Low Channel, 5500 MHz			
	Voltage: 115% = 4.2 VDC	5500.066884	5500
	Voltage: 100% = 3.7 VDC	5500.066985	5500
	Voltage: 85% = 3.145 VDC	5500.066884	5500
	Temperature: +50°	5500.062178	5500
	Temperature: +40°	5500.059391	5500
	Temperature: +30°	5500.066001	5500
	Temperature: +20°	5500.078065	5500
	Temperature: +10°	5500.095612	5500
	Temperature: 0°	5500.110362	5500
	Temperature: -10°	5500.121049	5500
5470 MHz - 5725 MHz - High Channel, 5700 MHz			
	Voltage: 115% = 4.2 VDC	5700.070622	5700
	Voltage: 100% = 3.7 VDC	5700.069716	5700
	Voltage: 85% = 3.145 VDC	5700.070467	5700
	Temperature: +50°	5700.064283	5700
	Temperature: +40°	5700.061676	5700
	Temperature: +30°	5700.068732	5700
	Temperature: +20°	5700.079674	5700
	Temperature: +10°	5700.099672	5700
	Temperature: 0°	5700.113291	5700
	Temperature: -10°	5700.125636	5700
5725 MHz - 5850 MHz - High Channel, 5825 MHz			
	Voltage: 115% = 4.2 VDC	5825.070138	5825
	Voltage: 100% = 3.7 VDC	5825.070662	5825
	Voltage: 85% = 3.145 VDC	5825.071224	5825
	Temperature: +50°	5825.064228	5825
	Temperature: +40°	5825.062814	5825
	Temperature: +30°	5825.06842	5825
	Temperature: +20°	5825.084597	5825
	Temperature: +10°	5825.099366	5825
	Temperature: 0°	5825.117006	5825
	Temperature: -10°	5825.127205	5825

DUTY CYCLE - MIMO 5.2 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	D150A-1-0720-200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

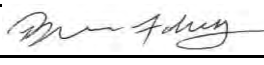
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - MIMO 5.2 GHz BAND



EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015				
Serial Number: Pre-production #1				Date: 29-Jul-19				
Customer: EchoNous, Inc.				Temperature: 22.8 °C				
Attendees: None				Humidity: 48.9% RH				
Project: None				Barometric Pres.: 1020 mbar				
Tested by: Brian Fahey and Jeff Alcock				Power: 3.7 VDC		Job Site: NC0A		
TEST SPECIFICATIONS				Test Method				
FCC 15.407:2019				ANSI C63.10:2013				
COMMENTS								
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB.								
DEVIATIONS FROM TEST STANDARD								
None								
Configuration #	12	Signature						
			Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A (N/A)	Results
2x2 Chain_1								
20 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36 - 5180 MHz								
802.11(n) MCS8			967.684 us	1.055 ms	1	91.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			139.2 us	228.1 us	1	61	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.2 us	211 us	1	58.4	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 40 - 5200 MHz								
802.11(n) MCS8			967.1 us	1.064 ms	1	90.9	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.2 us	227.1 us	1	61.3	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.1 us	211 us	1	58.3	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 48 - 5240 MHz								
802.11(n) MCS8			967.1 us	1.066 ms	1	90.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139 us	230 us	1	60.4	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.2 us	222 us	1	55.5	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
40 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36/40 - 5190 MHz								
802.11(n) MCS8			487.203 us	575 us	1	84.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			90.693 us	178.856 us	1	50.7	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			79.037 us	175.1 us	1	45.1	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 44/48 - 5230 MHz								
802.11(n) MCS8			487.303 us	585.106 us	1	83.3	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			91.547 us	178.544 us	1	51.3	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			78.907 us	166.092 us	1	47.5	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
80 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36-48 - 5210 MHz								
802.11(n) MCS9 (256-QAM)			250.837 us	339 us	1	74	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS0			59.359 us	146 us	1	40.7	N/A	N/A
802.11(n) MCS0			N/A	N/A	5	N/A	N/A	N/A
2x2 Chain_2								
20 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36 - 5180 MHz								
802.11(n) MCS8			967.7 us	1.059 ms	1	91.4	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.422 us	227 us	1	61.4	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.1 us	212 us	1	58.1	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 40 - 5200 MHz								
802.11(n) MCS8			967.64 us	1.064 ms	1	90.9	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			139.4 us	227.1 us	1	61.4	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.3 us	211.1 us	1	58.4	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 48 - 5240 MHz								
802.11(n) MCS8			967.44 us	1.055 ms	1	91.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			139.422 us	237.1 us	1	58.8	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.3 us	211 us	1	58.4	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
40 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36/40 - 5190 MHz								
802.11(n) MCS8			486.991 us	576 us	1	84.5	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			90.947 us	186.1 us	1	48.9	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			80.024 us	165.956 us	1	48.2	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 44/48 - 5230 MHz								
802.11(n) MCS8			487.235 us	578.366 us	1	84.2	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A

80 MHz	802.11(n) MCS15	90.655 us	182.611 us	1	49.6	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	79.257 us	167.122 us	1	47.4	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	5150 - 5250 MHz Band						
	Low Channel, Ch 36-48 - 5210 MHz						
	802.11(n) MCS9 (256-QAM)	251.203 us	338.056 us	1	74.3	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	59.24 us	147.823 us	1	40.1	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE - MIMO 5.3 GHZ BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - MIMO 5.3 GHz BAND



TM19 2018.09.13 XMI 2019.06.11

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015				
Serial Number: Pre-production #1				Date: 29-Jul-19				
Customer: EchoNus, Inc.				Temperature: 22.8 °C				
Attendees: None				Humidity: 48.8% RH				
Project: None				Barometric Pres.: 1020 mbar				
Tested by: Brian Fahey and Jeff Alcock				Job Site: NC0A				
Power: 3.7 VDC								
TEST SPECIFICATIONS				Test Method				
FCC 15.407:2019				ANSI C63.10:2013				
COMMENTS								
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB.								
DEVIATIONS FROM TEST STANDARD								
None								
Configuration #	12	Signature  						
			Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A (N/A)	Results
2x2 Chain_1								
20 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52 - 5260 MHz								
802.11(n) MCS8			967.2 us	1.067 ms	1	90.6	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.2 us	229 us	1	60.8	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.2 us	214 us	1	57.6	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 60 - 5300 MHz								
802.11(n) MCS8			967.766 us	1.067 ms	1	90.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			138.7 us	227.1 us	1	61.1	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.1 us	213 us	1	57.8	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 64 - 5320 MHz								
802.11(n) MCS8			966.856 us	1.057 ms	1	91.5	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.1 us	227.1 us	1	61.3	N/A	N/A
802.11(n) MCS15			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.2 us	213.1 us	1	57.8	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
40 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52/56 - 5270 MHz								
802.11(n) MCS8			486.753 us	577.305 us	1	84.3	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			90.952 us	189.259 us	1	48.1	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			78.837 us	165.634 us	1	47.6	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 60/64 - 5310 MHz								
802.11(n) MCS8			487.059 us	574.1 us	1	84.8	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			90.731 us	179.061 us	1	50.7	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			78.993 us	166 us	1	47.6	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
80 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52-64 - 5290 MHz								
802.11(n) MCS9 (256-QAM)			251.22 us	339.099 us	1	74.1	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS0			59.631 us	147.05 us	1	40.6	N/A	N/A
802.11(n) MCS0			N/A	N/A	5	N/A	N/A	N/A
2x2 Chain_2								
20 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52 - 5260 MHz								
802.11(n) MCS8			967.64 us	1.056 ms	1	91.6	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			139.3 us	226.9 us	1	61.4	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.3 us	214 us	1	57.6	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 60 - 5300 MHz								
802.11(n) MCS8			967.4 us	1.067 ms	1	90.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.4 us	226.9 us	1	61.4	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.4 us	211 us	1	58.5	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 64 - 5320 MHz								
802.11(n) MCS8			967.64 us	1.065 ms	1	90.8	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.1 us	226.9 us	1	61.3	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.1 us	220 us	1	56	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
40 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52/56 - 5270 MHz								
802.11(n) MCS8			487.015 us	574.916 us	1	84.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			91.069 us	178.978 us	1	50.9	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			79.047 us	167.788 us	1	47.1	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 60/64 - 5310 MHz								
802.11(n) MCS8			487.169 us	585.093 us	1	83.3	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A

	802.11(n) MCS15	91.257 us	182.878 us	1	49.9	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	79.313 us	167.178 us	1	47.4	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
80 MHz							
	5250 - 5350 MHz Band						
	Low Channel, Ch 52-64 - 5290 MHz						
	802.11(n) MCS9 (256-QAM)	251.557 us	348.322 us	1	72.2	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS0	59.503 us	150.055 us	1	39.7	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE - MIMO 5.6 GHZ BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - MIMO 5.6 GHz BAND



TMTX 2018.09.13 XMM 2019.06.11

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 29-Jul-19
Customer: EchoNous, Inc.	Temperature: 22.7 °C
Attendees: None	Humidity: 48.5% RH
Project: None	Barometric Pres.: 1020 mbar
Tested by: Brian Fahey and Jeff Alcock	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2019	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	12	Signature	<i>Brian Fahey</i> <i>Jeff Alcock</i>
-----------------	----	-----------	---------------------------------------

		Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A (N/A)	Results
2x2 Chain_1							
20 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100 - 5500 MHz							
	802.11(n) MCS8	967.003 us	1.065 ms	1	90.8	N/A	N/A
	802.11(n) MCS8	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS15	139 us	230 us	1	60.4	N/A	N/A
	802.11(n) MCS15	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	123 us	211.9 us	1	58	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 116 - 5580 MHz							
	802.11(n) MCS8	967.147 us	1.058 ms	1	91.4	N/A	N/A
	802.11(n) MCS8	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS15	139.122 us	227 us	1	61.3	N/A	N/A
	802.11(n) MCS15	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	123.119 us	212 us	1	58.1	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 140 - 5700 MHz							
	802.11(n) MCS8	967.282 us	1.058 ms	1	91.5	N/A	N/A
	802.11(n) MCS8	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS15	139.2 us	237.1 us	1	58.7	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	123.3 us	211 us	1	58.4	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
40 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100/104 - 5510 MHz							
	802.11(n) MCS8	487.425 us	584.983 us	1	83.3	N/A	N/A
	802.11(n) MCS8	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS15	90.47 us	178 us	1	50.8	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	79.453 us	166.267 us	1	47.8	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 116/120 - 5590 MHz							
	802.11(n) MCS8	487.159 us	578.956 us	1	84.1	N/A	N/A
	802.11(n) MCS8	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS15	91.813 us	178.122 us	1	51.5	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	78.937 us	165.634 us	1	47.7	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 132/136 - 5670 MHz							
	802.11(n) MCS8	487.426 us	585.106 us	1	83.3	N/A	N/A
	802.11(n) MCS8	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS15	91.508 us	179.227 us	1	51.1	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	79.569 us	166.488 us	1	47.8	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
80 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100-112 - 5530 MHz							
	802.11(n) MCS9 (256-QAM)	250.693 us	338.9 us	1	74	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	58.725 us	146.544 us	1	40.1	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 116-128 - 5610 MHz							
	802.11(n) MCS9 (256-QAM)	251.159 us	339.04 us	1	74.1	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	59.203 us	145.723 us	1	40.6	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A

2x2 Chain_2							
20 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100 - 5500 MHz							
	802.11(n) MCS8	967.392 us	1.057 ms	1	91.5	N/A	N/A
	802.11(n) MCS8	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS15	139.3 us	231 us	1	60.3	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	123.2 us	211.1 us	1	58.4	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 116 - 5580 MHz							
	802.11(n) MCS8	967.4 us	1.066 ms	1	90.7	N/A	N/A
	802.11(n) MCS8	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS15	139.4 us	227 us	1	61.4	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	123.3 us	221 us	1	55.8	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 140 - 5700 MHz							
	802.11(n) MCS8	966.9 us	1.064 ms	1	90.9	N/A	N/A
	802.11(n) MCS8	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS15	139.3 us	227.1 us	1	61.3	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	123.3 us	211 us	1	58.4	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A

40 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100/104 - 5510 MHz							
802.11(n) MCS8	487.113 us	585 us	1	83.3	N/A	N/A	
802.11(n) MCS8	N/A	N/A	5	N/A	N/A	N/A	
802.11(n) MCS15	91.618 us	182.193 us	1	50.3	N/A	N/A	
802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A	
802.11(n) MCS9 (256-QAM)	79.103 us	167.066 us	1	47.3	N/A	N/A	
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A	
Mid Channel, Ch 116/120 - 5590 MHz							
802.11(n) MCS8	487.625 us	575.246 us	1	84.8	N/A	N/A	
802.11(n) MCS8	N/A	N/A	5	N/A	N/A	N/A	
802.11(n) MCS15	91.358 us	183.778 us	1	49.7	N/A	N/A	
802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A	
802.11(n) MCS9 (256-QAM)	78.837 us	166.99 us	1	47.2	N/A	N/A	
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A	
High Channel, Ch 132/136 - 5670 MHz							
802.11(n) MCS8	487.558 us	576.2 us	1	84.6	N/A	N/A	
802.11(n) MCS8	N/A	N/A	6	N/A	N/A	N/A	
802.11(n) MCS15	91.037 us	179.972 us	1	50.6	N/A	N/A	
802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A	
802.11(n) MCS9 (256-QAM)	79.03 us	168.215 us	1	47	N/A	N/A	
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A	
80 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100-112 - 5530 MHz							
802.11(n) MCS9 (256-QAM)	251.297 us	338.954 us	1	74.1	N/A	N/A	
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A	
802.11(n) MCS0	59.647 us	146 us	1	40.9	N/A	N/A	
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A	
High Channel, Ch 116-128 - 5610 MHz							
802.11(n) MCS9 (256-QAM)	251.059 us	338.122 us	1	74.3	N/A	N/A	
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A	
802.11(n) MCS0	58.737 us	147.006 us	1	40	N/A	N/A	
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A	

DUTY CYCLE - MIMO 5.8 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - MIMO 5.8 GHz BAND



EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015				
Serial Number: Pre-production #1				Date: 29-Jul-19				
Customer: EchoNous, Inc.				Temperature: 22.7 °C				
Attendees: None				Humidity: 48.9% RH				
Project: None				Barometric Pres.: 1020 mbar				
Tested by: Brian Fahey and Jeff Alcock				Job Site: NC0A				
Power: 3.7 VDC								
TEST SPECIFICATIONS				Test Method				
FCC 15.407:2019				ANSI C63.10:2013				
COMMENTS								
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.								
DEVIATIONS FROM TEST STANDARD								
None								
Configuration #	12	Signature  						
			Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
2x2 Chain_1								
20 MHz								
5725 - 5785 MHz Band								
Low Channel, Ch 149 - 5745 MHz								
802.11(n) MCS8			967.4 us	1.057 ms	1	91.5	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			138.8 us	226.9 us	1	61.2	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.2 us	211.1 us	1	58.4	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 157 - 5785 MHz								
802.11(n) MCS8			967.879 us	1.067 ms	1	90.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.2 us	227.1 us	1	61.3	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.1 us	211 us	1	58.3	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 165 - 5825 MHz								
802.11(n) MCS8			967.4 us	1.056 ms	1	91.6	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			139.2 us	226.1 us	1	61.6	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.2 us	214.9 us	1	57.3	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
40 MHz								
5725 - 5785 MHz Band								
Low Channel, Ch 149/153 - 5755 MHz								
802.11(n) MCS8			486.893 us	585 us	1	83.2	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			91.059 us	178.244 us	1	51.1	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			79.043 us	165.657 us	1	47.7	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 157/161 - 5795 MHz								
802.11(n) MCS8			486.775 us	576.349 us	1	84.5	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			91.303 us	180.063 us	1	50.7	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			79.69 us	167.533 us	1	47.6	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
80 MHz								
5725 - 5785 MHz Band								
Low Channel, Ch 149-161 - 5775 MHz								
802.11(n) MCS9 (256-QAM)			251.103 us	339.024 us	1	74.1	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS0			59.037 us	148.022 us	1	39.9	N/A	N/A
802.11(n) MCS0			N/A	N/A	5	N/A	N/A	N/A
2x2 Chain_2								
20 MHz								
5725 - 5785 MHz Band								
Low Channel, Ch 149 - 5745 MHz								
802.11(n) MCS8			966.6 us	1.066 ms	1	90.7	N/A	N/A
802.11(n) MCS8			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS15			139.1 us	228 us	1	61	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.4 us	211 us	1	58.5	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 157 - 5785 MHz								
802.11(n) MCS8			967.4 us	1.057 ms	1	91.5	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.2 us	229.1 us	1	60.8	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.022 us	210.9 us	1	58.3	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 165 - 5825 MHz								
802.11(n) MCS8			967.2 us	1.056 ms	1	91.6	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			139.3 us	229 us	1	60.8	N/A	N/A
802.11(n) MCS15			N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)			123.2 us	212.9 us	1	57.9	N/A	N/A
802.11(n) MCS8 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
40 MHz								
5725 - 5785 MHz Band								
Low Channel, Ch 149/153 - 5755 MHz								
802.11(n) MCS8			487.413 us	590.099 us	1	82.6	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS15			90.994 us	177.807 us	1	51.2	N/A	N/A
802.11(n) MCS15			N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)			79.558 us	174.978 us	1	45.5	N/A	N/A
802.11(n) MCS9 (256-QAM)			N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 157/161 - 5795 MHz								
802.11(n) MCS8			487.181 us	576.229 us	1	84.5	N/A	N/A
802.11(n) MCS8			N/A	N/A	5	N/A	N/A	N/A

80 MHz	802.11(n) MCS15	91.281 us	182.168 us	1	50.1	N/A	N/A
	802.11(n) MCS15	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	79.259 us	167.09 us	1	47.4	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	5725 - 5785 MHz Band						
	Low Channel, Ch 149-161 - 5775 MHz						
	802.11(n) MCS9 (256-QAM)	251.535 us	339.044 us	1	74.2	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	58.199 us	146.139 us	1	39.8	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE - SISO 5.2 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - SISO 5.2 GHz BAND



TM19 2018.09.13 XMI 2019.06.11

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 30-Jul-19
Customer: EchoNus, Inc.	Temperature: 22.2 °C
Attendees: None	Humidity: 48.6% RH
Project: None	Barometric Pres.: 1020 mbar
Tested by: Brian Fahey and Jeff Alcock	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2019	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	1	Signature		
-----------------	---	-----------	---	--

Chain_1	Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A (N/A)	Results
20 MHz						
5150 - 5250 MHz Band						
Low Channel, Ch 36 - 5180 MHz						
802.11(a) 6 Mbps	2.026 ms	2.127 ms	1	95.3	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 36 Mbps	355.2 us	444.1 us	1	80	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 54 Mbps	243.2 us	342.1 us	1	71.1	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS0	1.899 ms	1.991 ms	1	95.4	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS7	227.2 us	316.1 us	1	71.9	N/A	N/A
802.11(n) MCS7	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	195.466 us	285 us	1	68.6	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	6	N/A	N/A	N/A
Mid Channel, Ch 40 - 5200 MHz						
802.11(a) 6 Mbps	2.027 ms	2.127 ms	1	95.3	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 36 Mbps	355.3 us	453.1 us	1	78.4	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 54 Mbps	243.2 us	333.1 us	1	73	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS0	1.899 ms	1.999 ms	1	95	N/A	N/A
802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS7	227.1 us	322.1 us	1	70.5	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	194.8 us	289 us	1	67.4	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	6	N/A	N/A	N/A
High Channel, Ch 48 - 5240 MHz						
802.11(a) 6 Mbps	2.025 ms	2.126 ms	1	95.2	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 36 Mbps	355.2 us	443.1 us	1	80.2	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 54 Mbps	243.2 us	331.1 us	1	73.5	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS0	1.899 ms	1.996 ms	1	95.2	N/A	N/A
802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS7	227.1 us	315.1 us	1	72.1	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	195.1 us	286.1 us	1	68.2	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
40 MHz						
5150 - 5250 MHz Band						
Low Channel, Ch 36/40 - 5190 MHz						
802.11(n) MCS0	928.3 us	1.034 ms	1	89.8	N/A	N/A
802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS7	123.8 us	219 us	1	56.5	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)	106.57 us	195 us	1	54.7	N/A	N/A
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 44/48 - 5230 MHz						
802.11(n) MCS0	928.1 us	1.04 ms	1	89.2	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS7	123.1 us	220.3 us	1	55.9	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)	106.959 us	193.512 us	1	55.3	N/A	N/A
802.11(n) MCS9 (256-QAM)	N/A	N/A	6	N/A	N/A	N/A
80 MHz						
5150 - 5250 MHz Band						
Low Channel, Ch 36-48 - 5210 MHz						
802.11(n) MCS0	448.3 us	540.4 us	1	83	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)	70.238 us	159.712 us	1	44	N/A	N/A
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A

Chain_2						
20 MHz						
5150 - 5250 MHz Band						
Low Channel, Ch 36 - 5180 MHz						
802.11(a) 6 Mbps	2.027 ms	2.126 ms	1	95.4	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 36 Mbps	355.3 us	443.1 us	1	80.2	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 54 Mbps	243 us	334 us	1	72.8	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS0	1.899 ms	1.998 ms	1	95.1	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS7	227.4 us	314.2 us	1	72.4	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	195.71 us	285 us	1	68.7	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	6	N/A	N/A	N/A
Mid Channel, Ch 40 - 5200 MHz						
802.11(a) 6 Mbps	2.027 ms	2.129 ms	1	95.2	N/A	N/A

	802.11(a) 6 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 36 Mbps	355.1 us	448 us	1	79.3	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.4 us	335.1 us	1	72.6	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	1.899 ms	1.992 ms	1	95.3	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.4 us	314 us	1	72.4	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.5 us	287.1 us	1	68.1	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	High Channel, Ch 48 - 5240 MHz						
	802.11(a) 6 Mbps	2.028 ms	2.127 ms	1	95.3	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 36 Mbps	355.1 us	444 us	1	80	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 54 Mbps	242.9 us	331.1 us	1	73.4	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	1.899 ms	1.992 ms	1	95.4	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.5 us	315.1 us	1	72.2	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.2 us	285 us	1	68.5	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
40 MHz							
	5150 - 5250 MHz Band						
	Low Channel, Ch 36/40 - 5190 MHz						
	802.11(n) MCS0	928.4 us	1.025 ms	1	90.5	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7	124 us	218 us	1	56.9	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	107.369 us	195 us	1	55.1	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	High Channel, Ch 44/48 - 5230 MHz						
	802.11(n) MCS0	928.1 us	1.026 ms	1	90.5	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7	124.3 us	223.1 us	1	55.7	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	107.359 us	194.978 us	1	55.1	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
80 MHz							
	5150 - 5250 MHz Band						
	Low Channel, Ch 36-48 - 5210 MHz						
	802.11(n) MCS0	448.1 us	544.1 us	1	82.4	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	70.252 us	157.756 us	1	44.5	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE - SISO 5.3 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - SISO 5.3 GHz BAND



TM19 2018.09.13 XMI 2019.06.11

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 30-Jul-19
Customer: EchoNus, Inc.	Temperature: 22.2 °C
Attendees: None	Humidity: 49.9% RH
Project: None	Barometric Pres.: 1020 mbar
Tested by: Brian Fahey and Jeff Alcock	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2019	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcock</i>
-----------------	---	---

Chain_1	Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A (N/A)	Results
20 MHz						
5250 - 5350 MHz Band						
Low Channel, Ch 52 - 5260 MHz						
802.11(a) 6 Mbps	2.027 ms	2.126 ms	1	95.3	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 36 Mbps	355 us	443.1 us	1	80.1	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 54 Mbps	242.9 us	331 us	1	73.4	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS0	1.899 ms	1.997 ms	1	95.1	N/A	N/A
802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS7	227.1 us	316.1 us	1	71.8	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	195.81 us	286 us	1	68.5	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 60 - 5300 MHz						
802.11(a) 6 Mbps	2.027 ms	2.125 ms	1	95.4	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 36 Mbps	355 us	443 us	1	80.1	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 54 Mbps	243.2 us	332 us	1	73.3	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS0	1.898 ms	1.993 ms	1	95.2	N/A	N/A
802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
802.11(n) MCS7	227.2 us	324.9 us	1	69.9	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	195.3 us	292.1 us	1	66.9	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 64 - 5320 MHz						
802.11(a) 6 Mbps	2.027 ms	2.129 ms	1	95.2	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 36 Mbps	355.1 us	443.2 us	1	80.1	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 54 Mbps	243.1 us	332 us	1	73.2	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS0	1.899 ms	1.991 ms	1	95.4	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS7	227.2 us	316 us	1	71.9	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	195.3 us	285.1 us	1	68.5	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
40 MHz						
5250 - 5350 MHz Band						
Low Channel, Ch 52/56 - 5270 MHz						
802.11(n) MCS0	928.4 us	1.019 ms	1	91.1	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS7	124 us	224 us	1	55.4	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)	107.447 us	196.122 us	1	54.8	N/A	N/A
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 60/64 - 5310 MHz						
802.11(n) MCS0	928.1 us	1.025 ms	1	90.5	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS7	124.3 us	218 us	1	57	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)	107.281 us	195.877 us	1	54.8	N/A	N/A
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
80 MHz						
5250 - 5350 MHz Band						
Low Channel, Ch 52-64 - 5290 MHz						
802.11(n) MCS0	453 us	543 us	1	83.4	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS9 (256-QAM)	70.636 us	166.755 us	1	42.4	N/A	N/A
802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A

Chain_2						
20 MHz						
5250 - 5350 MHz Band						
Low Channel, Ch 52 - 5260 MHz						
802.11(a) 6 Mbps	2.027 ms	2.126 ms	1	95.3	N/A	N/A
802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
802.11(a) 36 Mbps	355.2 us	442 us	1	80.4	N/A	N/A
802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(a) 54 Mbps	243.2 us	335 us	1	72.6	N/A	N/A
802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS0	1.899 ms	1.992 ms	1	95.3	N/A	N/A
802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS7	227.4 us	315.2 us	1	72.1	N/A	N/A
802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
802.11(n) MCS8 (256-QAM)	195.2 us	285.9 us	1	68.3	N/A	N/A
802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 60 - 5300 MHz						
802.11(a) 6 Mbps	2.026 ms	2.127 ms	1	95.2	N/A	N/A

	802.11(a) 6 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 36 Mbps	355.2 us	444 us	1	80	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.2 us	336.1 us	1	72.4	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS0	1.899 ms	1.992 ms	1	95.3	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7	227.2 us	314.9 us	1	72.1	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.1 us	289.9 us	1	67.3	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 64 - 5320 MHz							
	802.11(a) 6 Mbps	2.027 ms	2.129 ms	1	95.2	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 36 Mbps	355.4 us	453.1 us	1	78.4	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.2 us	333 us	1	73	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	1.899 ms	2.001 ms	1	94.9	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.2 us	316 us	1	71.9	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.5 us	292.2 us	1	66.9	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
40 MHz							
5250 - 5350 MHz Band							
Low Channel, Ch 52/56 - 5270 MHz							
	802.11(n) MCS0	933 us	1.031 ms	1	90.5	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7	124.3 us	219 us	1	56.8	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	107.424 us	194 us	1	55.4	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 60/64 - 5310 MHz							
	802.11(n) MCS0	928.4 us	1.032 ms	1	90	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	124.1 us	218 us	1	56.9	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	106.937 us	195.856 us	1	54.6	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
80 MHz							
5250 - 5350 MHz Band							
Low Channel, Ch 52-64 - 5290 MHz							
	802.11(n) MCS0	448.4 us	549.2 us	1	81.6	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	70.77 us	160.1 us	1	44.2	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE - SISO 5.6 GHz BAND



XMit 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

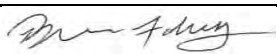
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - SISO 5.6 GHz BAND



EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015				
Serial Number: Pre-production #1				Date: 30-Jul-19				
Customer: EchoNus, Inc.				Temperature: 22.2 °C				
Attendees: None				Humidity: 48.7% RH				
Project: None				Barometric Pres.: 1021 mbar				
Tested by: Brian Fahey and Jeff Alcock			Power: 3.7 VDC		Job Site: NC0A			
TEST SPECIFICATIONS			Test Method					
FCC 15.407:2019			ANSI C63.10:2013					
COMMENTS								
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.								
DEVIATIONS FROM TEST STANDARD								
None								
Configuration #	1	Signature  						
			Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A (N/A)	Results
Chain_1								
20 MHz								
5470 - 5725 MHz Band								
Low Channel, Ch 100 - 5500 MHz								
	802.11(a) 6 Mbps		2.026 ms	2.134 ms	1	94.9	N/A	N/A
	802.11(a) 6 Mbps		N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 36 Mbps		355.1 us	443 us	1	80.2	N/A	N/A
	802.11(a) 36 Mbps		N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps		243.2 us	343.1 us	1	70.9	N/A	N/A
	802.11(a) 54 Mbps		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0		1.899 ms	1.992 ms	1	95.4	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7		227 us	314.9 us	1	72.1	N/A	N/A
	802.11(n) MCS7		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)		195.422 us	285.1 us	1	68.5	N/A	N/A
	802.11(n) MCS8 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 116 - 5580 MHz								
	802.11(a) 6 Mbps		2.026 ms	2.127 ms	1	95.2	N/A	N/A
	802.11(a) 6 Mbps		N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 36 Mbps		355.1 us	442 us	1	80.3	N/A	N/A
	802.11(a) 36 Mbps		N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps		243.1 us	331.9 us	1	73.2	N/A	N/A
	802.11(a) 54 Mbps		N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS0		1.899 ms	1.997 ms	1	95.1	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7		227.1 us	315.9 us	1	71.9	N/A	N/A
	802.11(n) MCS7		N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)		195.022 us	285 us	1	68.4	N/A	N/A
	802.11(n) MCS8 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 140 - 5700 MHz								
	802.11(a) 6 Mbps		2.027 ms	2.127 ms	1	95.3	N/A	N/A
	802.11(a) 6 Mbps		N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 36 Mbps		355.1 us	453 us	1	78.4	N/A	N/A
	802.11(a) 36 Mbps		N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 54 Mbps		243.2 us	331.1 us	1	73.5	N/A	N/A
	802.11(a) 54 Mbps		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0		1.897 ms	2.006 ms	1	94.6	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7		227.2 us	315.1 us	1	72.1	N/A	N/A
	802.11(n) MCS7		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)		195.2 us	284.1 us	1	68.7	N/A	N/A
	802.11(n) MCS8 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
40 MHz								
5470 - 5725 MHz Band								
Low Channel, Ch 100/104 - 5510 MHz								
	802.11(n) MCS0		928.3 us	1.028 ms	1	90.3	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7		124.1 us	222.1 us	1	55.9	N/A	N/A
	802.11(n) MCS7		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)		107.369 us	197.1 us	1	54.5	N/A	N/A
	802.11(n) MCS9 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
Mid Channel, Ch 116/120 - 5590 MHz								
	802.11(n) MCS0		928.1 us	1.034 ms	1	89.7	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7		123.8 us	219 us	1	56.5	N/A	N/A
	802.11(n) MCS7		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)		107.159 us	193.978 us	1	55.2	N/A	N/A
	802.11(n) MCS9 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 132/136 - 5670 MHz								
	802.11(n) MCS0		933 us	1.03 ms	1	90.6	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7		123.9 us	220 us	1	56.3	N/A	N/A
	802.11(n) MCS7		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)		107.003 us	195.878 us	1	54.6	N/A	N/A
	802.11(n) MCS9 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
80 MHz								
5470 - 5725 MHz Band								
Low Channel, Ch 100-112 - 5530 MHz								
	802.11(n) MCS0		447.8 us	544 us	1	82.3	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)		70.726 us	160.466 us	1	44.1	N/A	N/A
	802.11(n) MCS9 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 116-128 - 5610 MHz								
	802.11(n) MCS0		448.6 us	543.2 us	1	82.6	N/A	N/A
	802.11(n) MCS0		N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)		70.643 us	158.01 us	1	44.7	N/A	N/A
	802.11(n) MCS9 (256-QAM)		N/A	N/A	5	N/A	N/A	N/A
Chain_2								
20 MHz								
5470 - 5725 MHz Band								
Low Channel, Ch 100 - 5500 MHz								
	802.11(a) 6 Mbps		2.027 ms	2.131 ms	1	95.1	N/A	N/A
	802.11(a) 6 Mbps		N/A	N/A	6	N/A	N/A	N/A

55/181

DUTY CYCLE - SISO 5.8 GHz BAND



XMR 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

DUTY CYCLE - SISO 5.8 GHz BAND



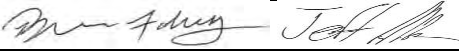
TM19 2018.09.13 XMI 2019.06.11

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 30-Jul-19
Customer: EchoNus, Inc.	Temperature: 22.3 °C
Attendees: None	Humidity: 48.7% RH
Project: None	Barometric Pres.: 1021 mbar
Tested by: Brian Fahey and Jeff Alcock	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2019	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	1	Signature 
-----------------	---	--

Chain_1		Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
20 MHz	5725 - 5785 MHz Band						
	Low Channel, Ch 149 - 5745 MHz						
	802.11(a) 6 Mbps	2.026 ms	2.129 ms	1	95.2	N/A	N/A
	802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 36 Mbps	355.2 us	444.2 us	1	80	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.3 us	332.1 us	1	73.3	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	1.900 ms	1.998 ms	1	95.1	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.2 us	317.1 us	1	71.6	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.1 us	283.1 us	1	68.9	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	6	N/A	N/A	N/A
	Mid Channel, Ch 157 - 5785 MHz						
	802.11(a) 6 Mbps	2.026 ms	2.125 ms	1	95.4	N/A	N/A
	802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 36 Mbps	355.1 us	443 us	1	80.2	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.1 us	342 us	1	71.1	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	1.898 ms	1.998 ms	1	95	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.2 us	320 us	1	71	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.2 us	283.1 us	1	69	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	High Channel, Ch 165 - 5825 MHz						
	802.11(a) 6 Mbps	2.028 ms	2.124 ms	1	95.4	N/A	N/A
	802.11(a) 6 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 36 Mbps	354.9 us	445 us	1	79.8	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.1 us	340 us	1	71.5	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS0	1.899 ms	1.996 ms	1	95.1	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.1 us	317.1 us	1	71.6	N/A	N/A
	802.11(n) MCS7	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	194.9 us	283 us	1	68.9	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
40 MHz	5725 - 5785 MHz Band						
	Low Channel, Ch 149/153 - 5755 MHz						
	802.11(n) MCS0	934.156 us	1.026 ms	1	91.1	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7	130.648 us	218.856 us	1	59.7	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	106.793 us	194.612 us	1	54.9	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
	High Channel, Ch 157/161 - 5795 MHz						
	802.11(n) MCS0	934.144 us	1.037 ms	1	90.1	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7	131.059 us	219.366 us	1	59.7	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	107.835 us	195 us	1	55.3	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
80 MHz	5725 - 5785 MHz Band						
	Low Channel, Ch 149-161 - 5775 MHz						
	802.11(n) MCS0	454.382 us	542.345 us	1	83.8	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	71.403 us	167.956 us	1	42.5	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A

Chain_2	20 MHz	5725 - 5785 MHz Band					
		Low Channel, Ch 149 - 5745 MHz					
		802.11(a) 6 Mbps	2.027 ms	2.128 ms	1	95.3	N/A
		802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A
		802.11(a) 36 Mbps	355.1 us	443 us	1	80.2	N/A
		802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A
		802.11(a) 54 Mbps	243.3 us	340 us	1	71.6	N/A
		802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A
		802.11(n) MCS0	1.899 ms	1.998 ms	1	95.1	N/A
		802.11(n) MCS0	N/A	N/A	5	N/A	N/A
		802.11(n) MCS7	227.3 us	315 us	1	72.2	N/A
		802.11(n) MCS7	N/A	N/A	6	N/A	N/A
		802.11(n) MCS8 (256-QAM)	195.5 us	283.1 us	1	69.1	N/A
		802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A
		Mid Channel, Ch 157 - 5785 MHz					
		802.11(a) 6 Mbps	2.028 ms	2.125 ms	1	95.4	N/A

	802.11(a) 6 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 36 Mbps	355 us	444 us	1	80	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.2 us	331.9 us	1	73.3	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	1.899 ms	1.995 ms	1	95.2	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.5 us	315.2 us	1	72.2	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.3 us	283 us	1	69	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 165 - 5825 MHz							
	802.11(a) 6 Mbps	2.027 ms	2.127 ms	1	95.3	N/A	N/A
	802.11(a) 6 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 36 Mbps	355.3 us	443 us	1	80.2	N/A	N/A
	802.11(a) 36 Mbps	N/A	N/A	6	N/A	N/A	N/A
	802.11(a) 54 Mbps	243.3 us	330.9 us	1	73.5	N/A	N/A
	802.11(a) 54 Mbps	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS0	1.899 ms	1.993 ms	1	95.3	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	227.2 us	326.1 us	1	69.7	N/A	N/A
	802.11(n) MCS7	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS8 (256-QAM)	195.5 us	283.1 us	1	69.1	N/A	N/A
	802.11(n) MCS8 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
40 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149/153 - 5755 MHz							
	802.11(n) MCS0	934.5 us	1.027 ms	1	91	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS7	130.792 us	218.878 us	1	59.8	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	107.791 us	194.834 us	1	55.3	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
High Channel, Ch 157/161 - 5795 MHz							
	802.11(n) MCS0	934.672 us	1.037 ms	1	90.1	N/A	N/A
	802.11(n) MCS0	N/A	N/A	6	N/A	N/A	N/A
	802.11(n) MCS7	130.67 us	220 us	1	59.4	N/A	N/A
	802.11(n) MCS7	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	107.791 us	195 us	1	55.3	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A
80 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149-161 - 5775 MHz							
	802.11(n) MCS0	454.065 us	554.81 us	1	81.8	N/A	N/A
	802.11(n) MCS0	N/A	N/A	5	N/A	N/A	N/A
	802.11(n) MCS9 (256-QAM)	70.993 us	159 us	1	44.6	N/A	N/A
	802.11(n) MCS9 (256-QAM)	N/A	N/A	5	N/A	N/A	N/A

MAXIMUM CONDUCTED OUTPUT POWER - MIMO

5.2 GHz BAND



XMM 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

- RMS Detector
- Trace average 100 traces in power averaging mode.
- Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015				
Serial Number: Pre-production #1				Date: 5-Feb-20				
Customer: EchoNous, Inc.				Temperature: 21.6 °C				
Attendees: None				Humidity: 43.4% RH				
Project: None				Barometric Pres.: 1019 mbar				
Tested by: Brian Fahey and Jeff Alcoke		Power: 3.7 VDC		Job Site: NC0A				
TEST SPECIFICATIONS				Test Method				
FCC 15.407:2020				ANSI C63.10:2013				
COMMENTS								
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 SectionE, 1), the sum of both individual port measurements were compared to the limit as shown in the power summing table. The port not being measured is terminated with a 50ohm terminator.								
DEVIATIONS FROM TEST STANDARD								
None								
Configuration #	12	Signature						
			Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
2x2 Chain_1								
20 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36 - 5180 MHz								
802.11(n) MCS8			12.587	1.7	14.3	24	Pass	
802.11(n) MCS15			13.12	2.1	15.2	24	Pass	
802.11(n) MCS8 (256-QAM)			11.084	2.4	13.4	24	Pass	
Mid Channel, Ch 40 - 5200 MHz								
802.11(n) MCS8			12.585	1.6	14.2	24	Pass	
802.11(n) MCS15			13.066	2.1	15.2	24	Pass	
802.11(n) MCS8 (256-QAM)			11.053	2.3	13.4	24	Pass	
High Channel, Ch 48 - 5240 MHz								
802.11(n) MCS8			12.67	1.7	14.4	24	Pass	
802.11(n) MCS15			13.225	2.1	15.3	24	Pass	
802.11(n) MCS8 (256-QAM)			11.001	2.3	13.3	24	Pass	
40 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36/40 - 5190 MHz								
802.11(n) MCS8			11.866	2.4	14.3	24	Pass	
802.11(n) MCS15			12.377	2.9	15.3	24	Pass	
802.11(n) MCS9 (256-QAM)			9.055	3.6	12.6	24	Pass	
High Channel, Ch 44/48 - 5230 MHz								
802.11(n) MCS8			12.006	2.6	14.6	24	Pass	
802.11(n) MCS15			12.556	2.9	15.4	24	Pass	
802.11(n) MCS9 (256-QAM)			9.04	3.3	12.3	24	Pass	
80 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36-48 - 5210 MHz								
802.11(n) MCS0			14.493	0.9	15.3	24	Pass	
802.11(n) MCS9 (256-QAM)			8.466	3.9	12.3	24	Pass	
2x2 Chain_2								
20 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36 - 5180 MHz								
802.11(n) MCS8			13.005	1.6	14.6	24	Pass	
802.11(n) MCS15			13.307	2.1	15.4	24	Pass	
802.11(n) MCS8 (256-QAM)			11.436	2.3	13.7	24	Pass	
Mid Channel, Ch 40 - 5200 MHz								
802.11(n) MCS8			13.164	1.7	14.8	24	Pass	
802.11(n) MCS15			13.49	2.1	15.6	24	Pass	
802.11(n) MCS8 (256-QAM)			11.475	2.5	14	24	Pass	
High Channel, Ch 48 - 5240 MHz								
802.11(n) MCS8			13.001	1.6	14.6	24	Pass	
802.11(n) MCS15			13.538	2.1	15.7	24	Pass	
802.11(n) MCS8 (256-QAM)			11.395	2.3	13.7	24	Pass	
40 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36/40 - 5190 MHz								
802.11(n) MCS8			12.479	2.7	15.1	24	Pass	
802.11(n) MCS15			12.853	2.9	15.8	24	Pass	
802.11(n) MCS9 (256-QAM)			9.133	3.2	12.3	24	Pass	
High Channel, Ch 44/48 - 5230 MHz								
802.11(n) MCS8			12.479	2.4	14.9	24	Pass	
802.11(n) MCS15			12.913	2.9	15.8	24	Pass	
802.11(n) MCS9 (256-QAM)			9.148	3.2	12.4	24	Pass	
80 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36-48 - 5210 MHz								
802.11(n) MCS0			14.851	0.8	15.6	24	Pass	
802.11(n) MCS9 (256-QAM)			8.309	3.9	12.2	24	Pass	
2x2 MIMO, Power Summing Table								
20 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36 - 5180 MHz								
802.11(n) MCS8			26.9	28.8	55.8	17.5	24	Pass
802.11(n) MCS15			33.1	34.7	67.8	18.3	24	Pass
802.11(n) MCS8 (256-QAM)			21.9	23.4	45.3	16.6	24	Pass
Mid Channel, Ch 40 - 5200 MHz								
802.11(n) MCS8			26.3	30.2	56.5	17.5	24	Pass
802.11(n) MCS15			33.1	36.3	69.4	18.4	24	Pass
802.11(n) MCS8 (256-QAM)			21.9	25.1	47.0	16.7	24	Pass
High Channel, Ch 48 - 5240 MHz								
802.11(n) MCS8			27.5	28.8	56.4	17.5	24	Pass
802.11(n) MCS15			33.9	37.2	71.0	18.5	24	Pass
802.11(n) MCS8 (256-QAM)			21.4	23.4	44.8	16.5	24	Pass
40 MHz								
5150 - 5250 MHz Band								
Low Channel, Ch 36/40 - 5190 MHz								
802.11(n) MCS8			26.9	32.4	59.3	17.7	24	Pass
802.11(n) MCS15			33.9	38.0	71.9	18.6	24	Pass
802.11(n) MCS9 (256-QAM)			18.2	17.0	35.2	15.5	24	Pass
High Channel, Ch 44/48 - 5230 MHz								
802.11(n) MCS8			28.8	30.9	59.7	17.8	24	Pass

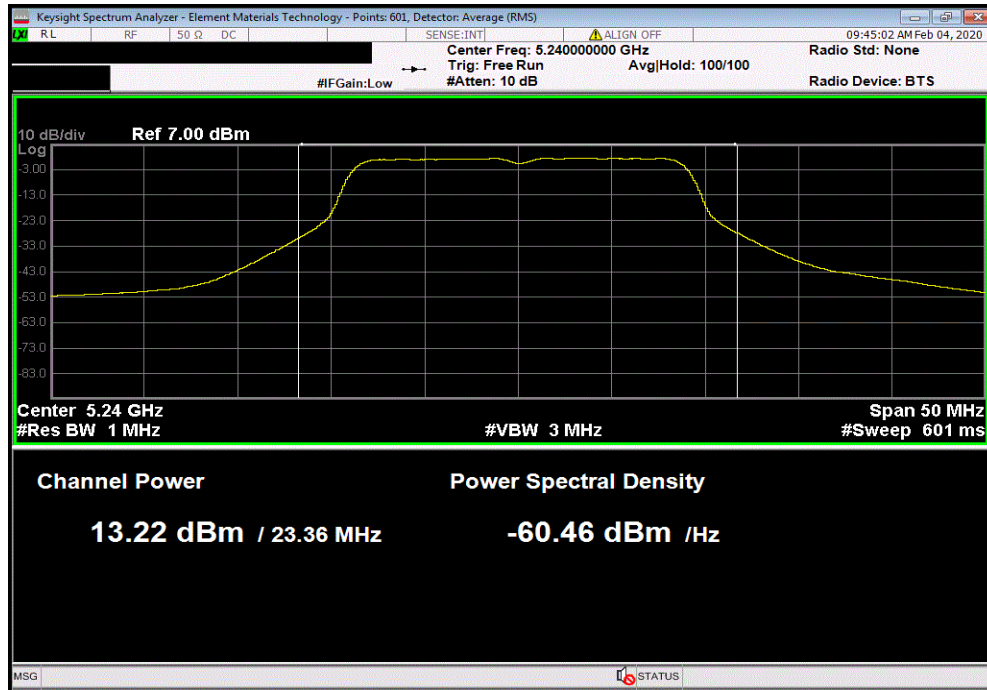
80 MHz	5150 - 5250 MHz Band	802.11(n) MCS15	34.7	38.0	72.7	18.6	24	Pass
		802.11(n) MCS9 (256-QAM)	17.0	17.4	34.4	15.4	24	Pass
		Low Channel, Ch 36-48 - 5210 MHz						
		802.11(n) MCS0	33.9	36.3	70.2	18.5	24	Pass
		802.11(n) MCS9 (256-QAM)	17.0	16.6	33.6	15.3	24	Pass

MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.2 GHz BAND

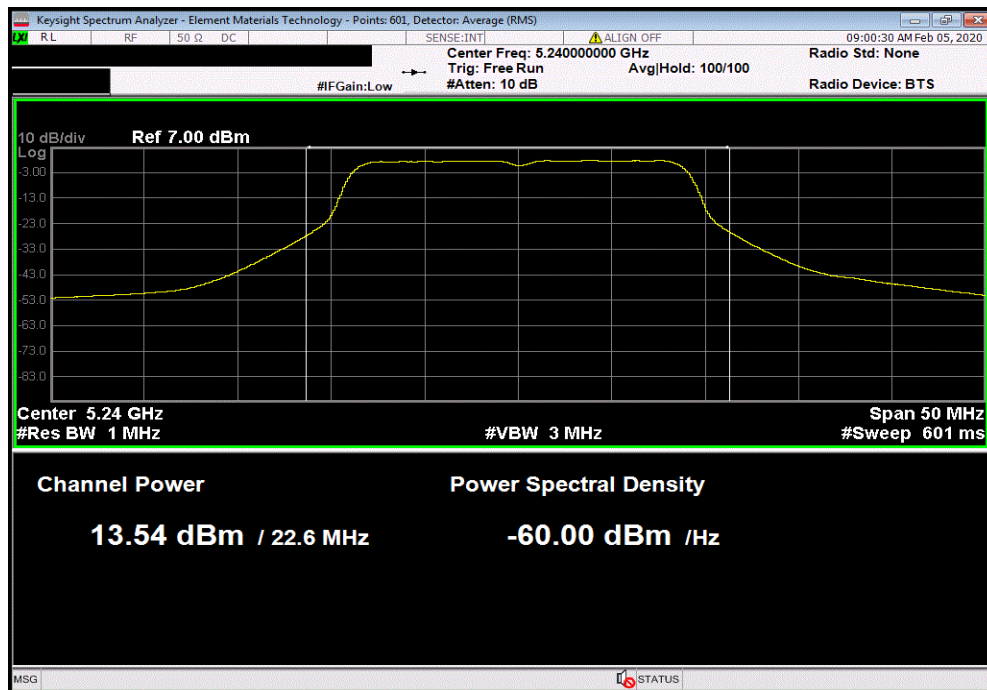


TbTx 2019.08.30.0 XMt 2019.09.05

2x2 Chain_1, 20 MHz, 5150 - 5250 MHz Band, High Channel, Ch 48 - 5240 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.225	2.1	15.3	24	Pass	



2x2 Chain_2, 20 MHz, 5150 - 5250 MHz Band, High Channel, Ch 48 - 5240 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.538	2.1	15.7	24	Pass	

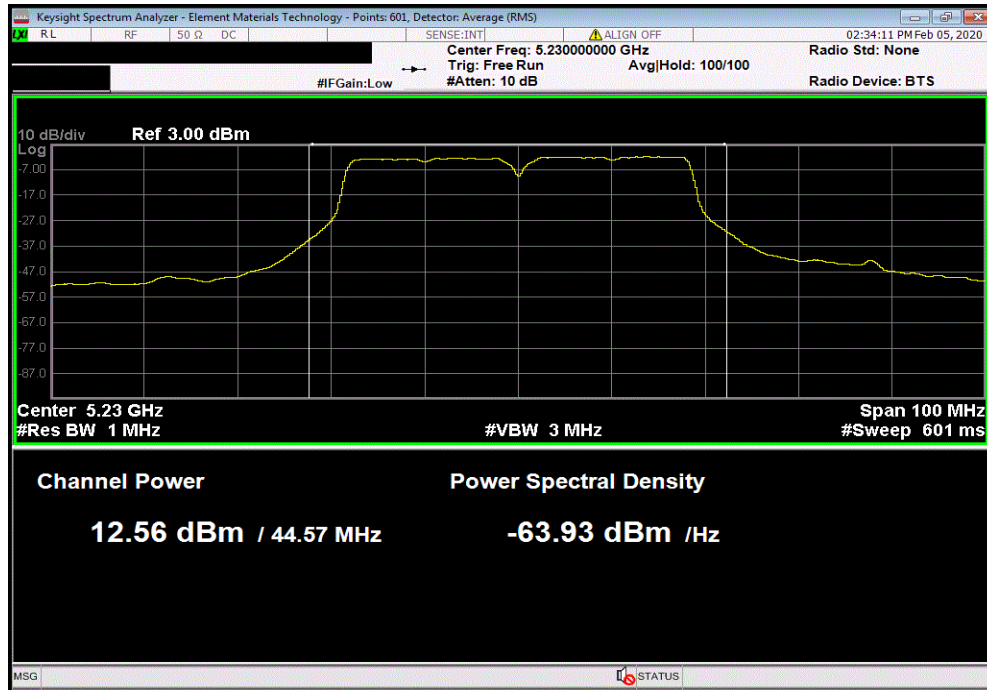


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.2 GHz BAND

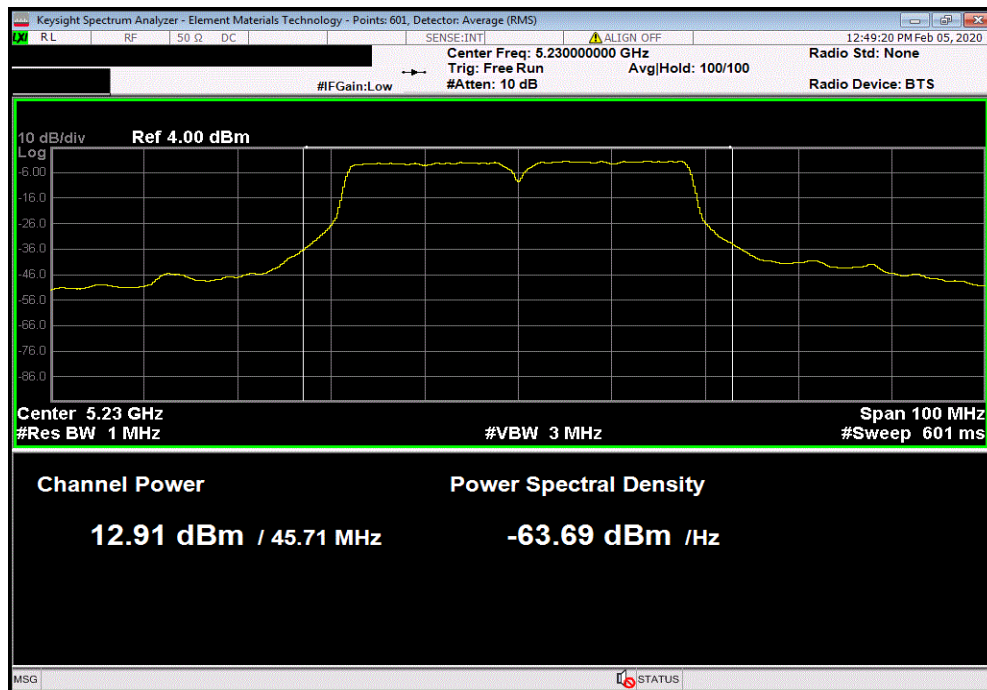


TbTtx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 40 MHz, 5150 - 5250 MHz Band, High Channel, Ch 44/48 - 5230 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	12.556	2.9	15.4	24	Pass	



2x2 Chain_2, 40 MHz, 5150 - 5250 MHz Band, High Channel, Ch 44/48 - 5230 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	12.913	2.9	15.8	24	Pass	

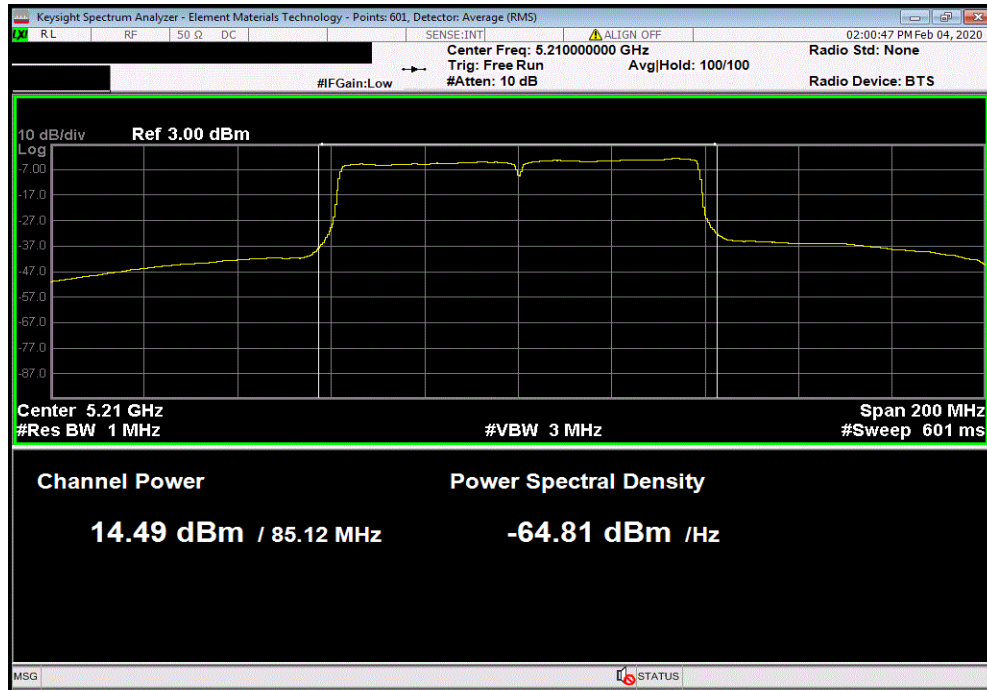


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.2 GHz BAND

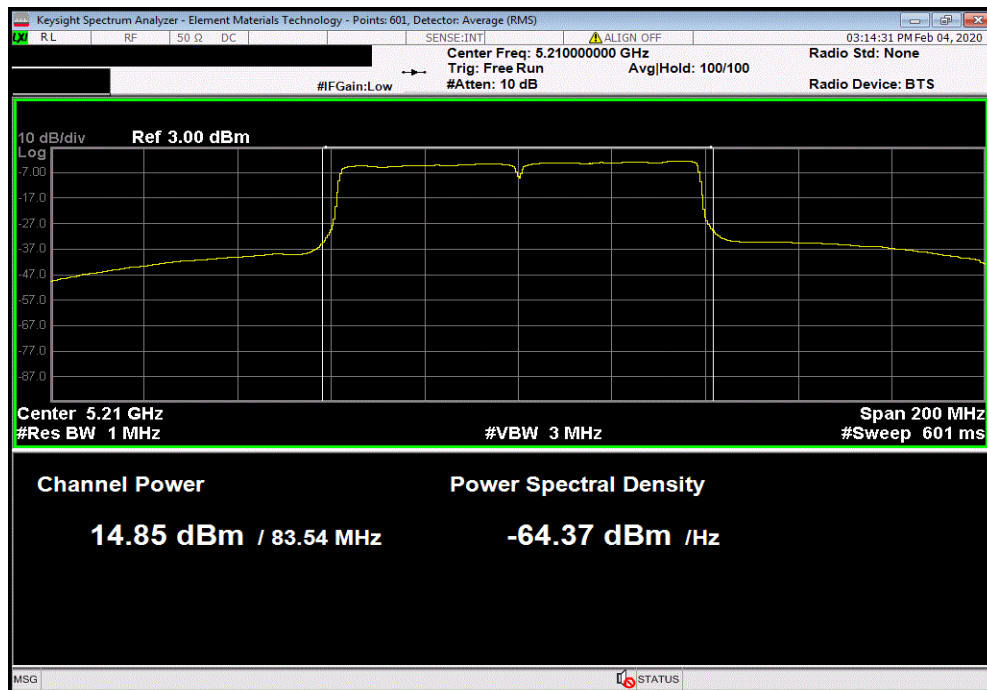


TbTx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 80 MHz, 5150 - 5250 MHz Band, Low Channel, Ch 36-48 - 5210 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.493	0.9	15.3	24	Pass	



2x2 Chain_2, 80 MHz, 5150 - 5250 MHz Band, Low Channel, Ch 36-48 - 5210 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.851	0.8	15.6	24	Pass	



MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.3 GHz BAND



XMM 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

66/181

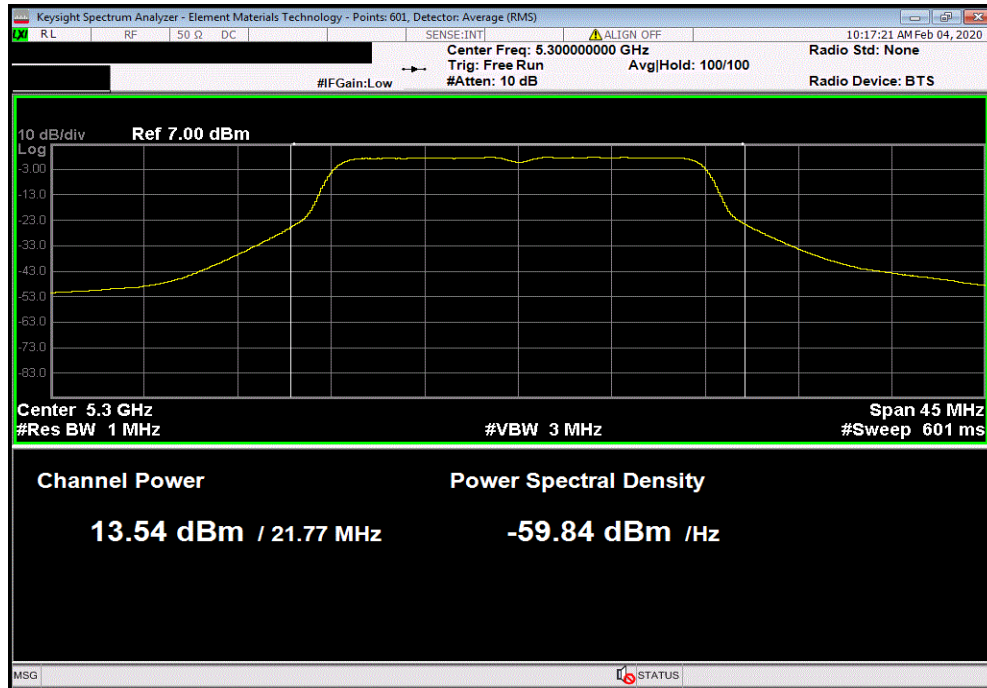
80 MHz	802.11(n) MCS15	38.0	40.7	78.8	19.0	24	Pass
	802.11(n) MCS9 (256-QAM)	19.5	20.9	40.4	16.1	24	Pass
	5250 - 5350 MHz Band						
	Low Channel, Ch 52-64 - 5290 MHz						
	802.11(n) MCS0	36.1	38.0	74.1	18.7	24	Pass
	802.11(n) MCS9 (256-QAM)	19.1	20.0	39.0	15.9	24	Pass

MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.3 GHz BAND

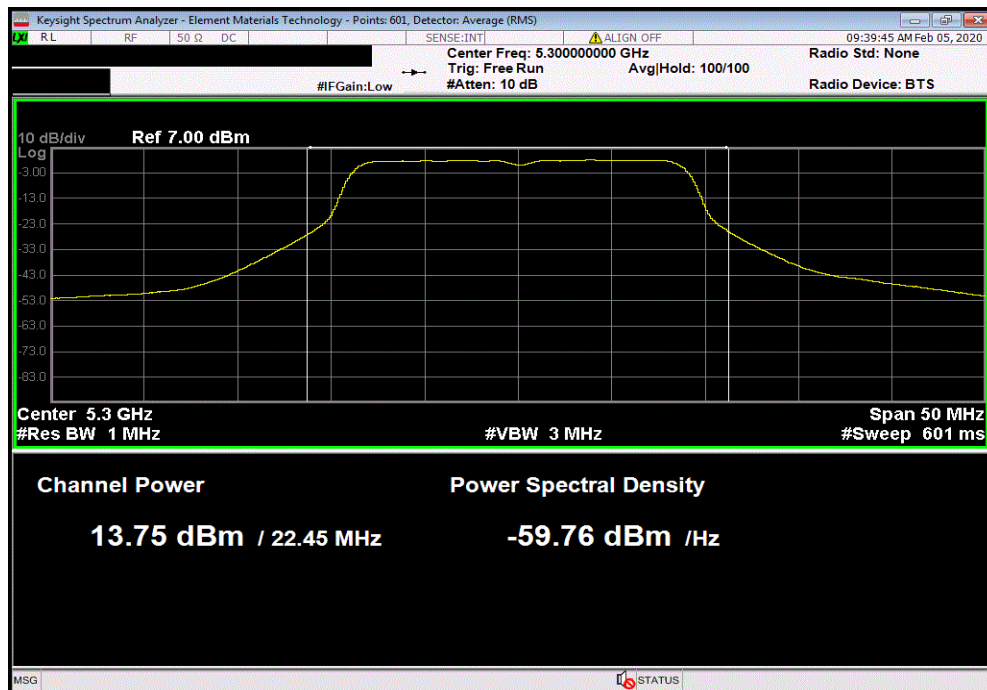


TbTx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 20 MHz, 5250 - 5350 MHz Band, Mid Channel, Ch 60 - 5300 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.54	2.1	15.7	24	Pass	



2x2 Chain_2, 20 MHz, 5250 - 5350 MHz Band, Mid Channel, Ch 60 - 5300 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.753	2.1	15.9	24	Pass	

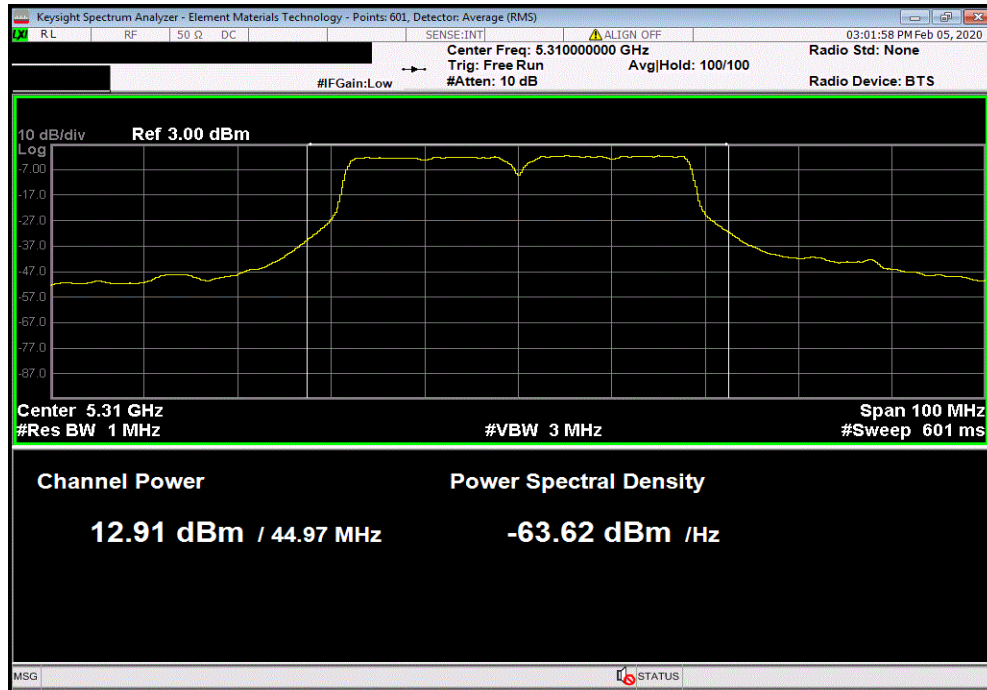


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.3 GHz BAND

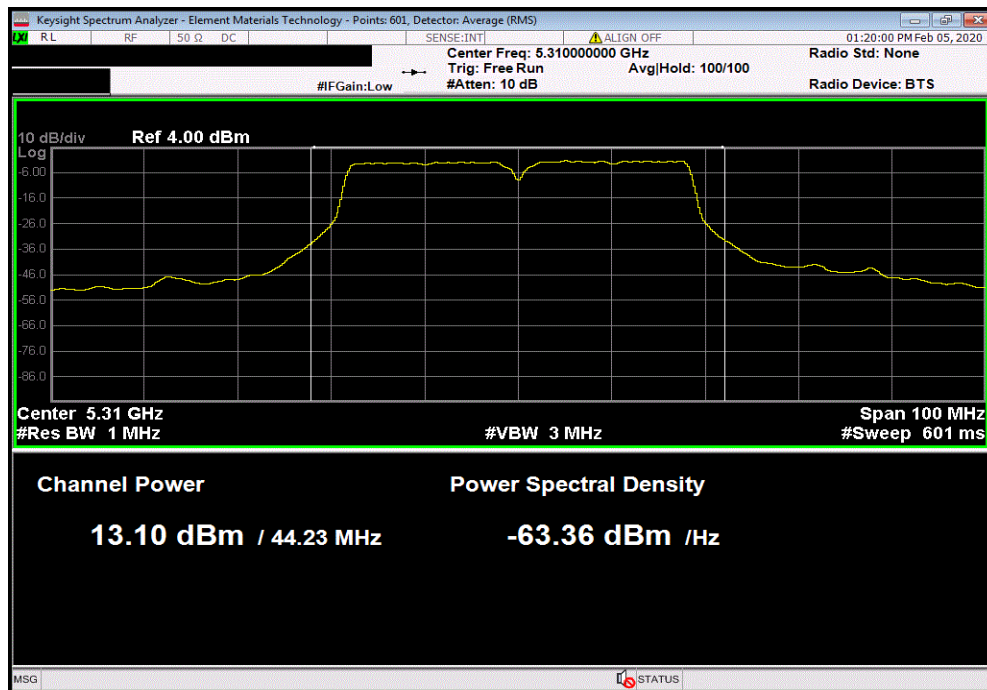


TbTtx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 40 MHz, 5250 - 5350 MHz Band, High Channel, Ch 60/64 - 5310 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	12.913	2.9	15.8	24	Pass	



2x2 Chain_2, 40 MHz, 5250 - 5350 MHz Band, High Channel, Ch 60/64 - 5310 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.097	3	16.1	24	Pass	

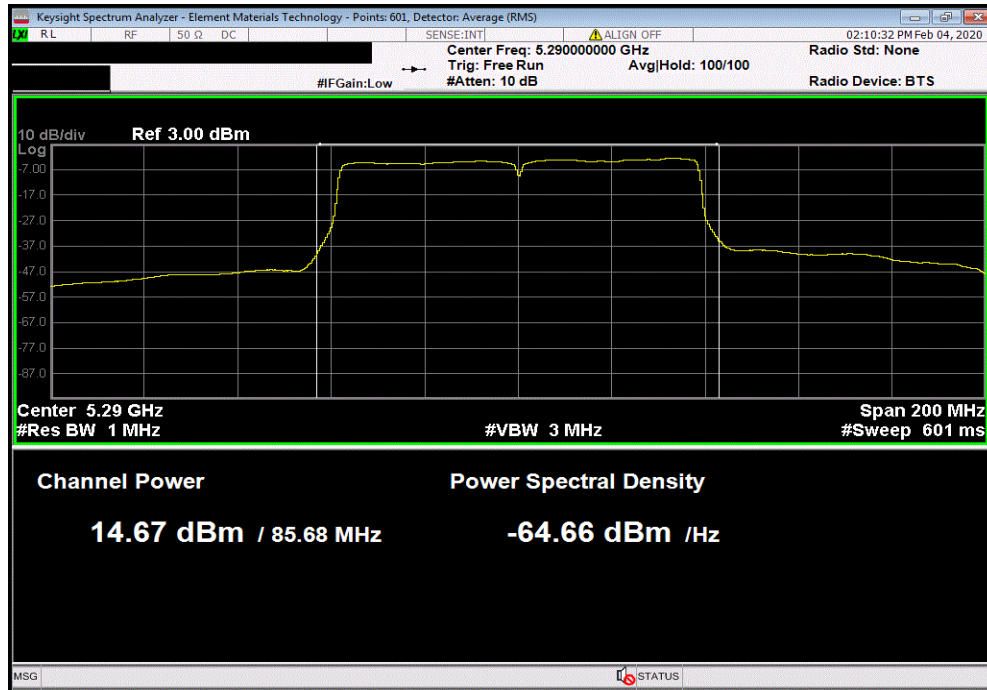


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.3 GHz BAND

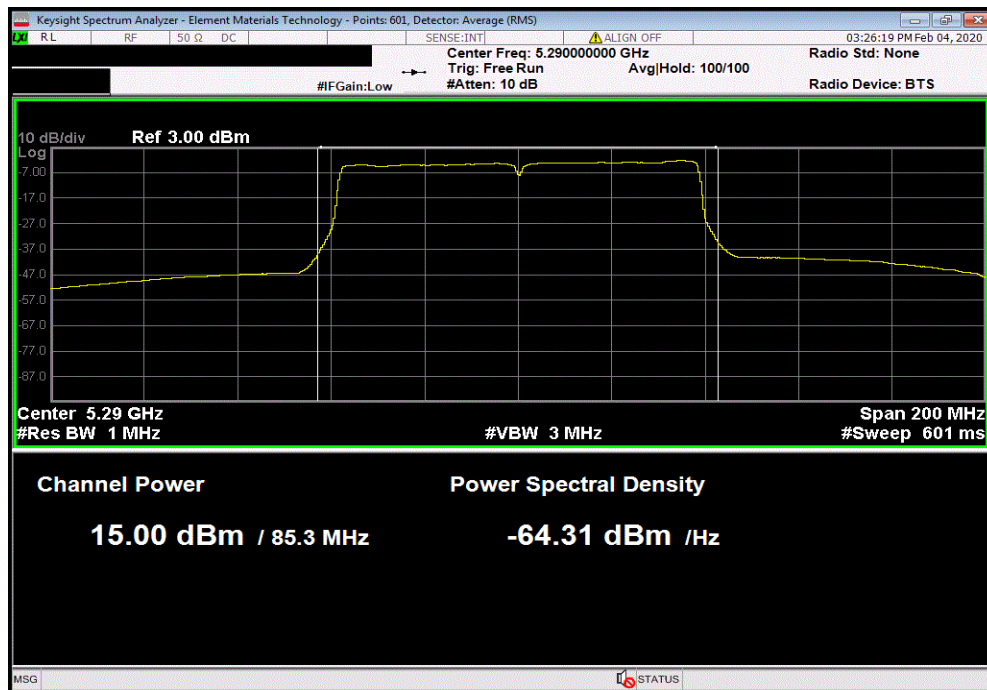


TbTtx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 80 MHz, 5250 - 5350 MHz Band, Low Channel, Ch 52-64 - 5290 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.673	0.9	15.573	24	Pass	



2x2 Chain_2, 80 MHz, 5250 - 5350 MHz Band, Low Channel, Ch 52-64 - 5290 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	15.001	0.8	15.8	24	Pass	



MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.6 GHz BAND



XMR 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

TbtTx 2019.08.30.0 XMit 2019.09.05

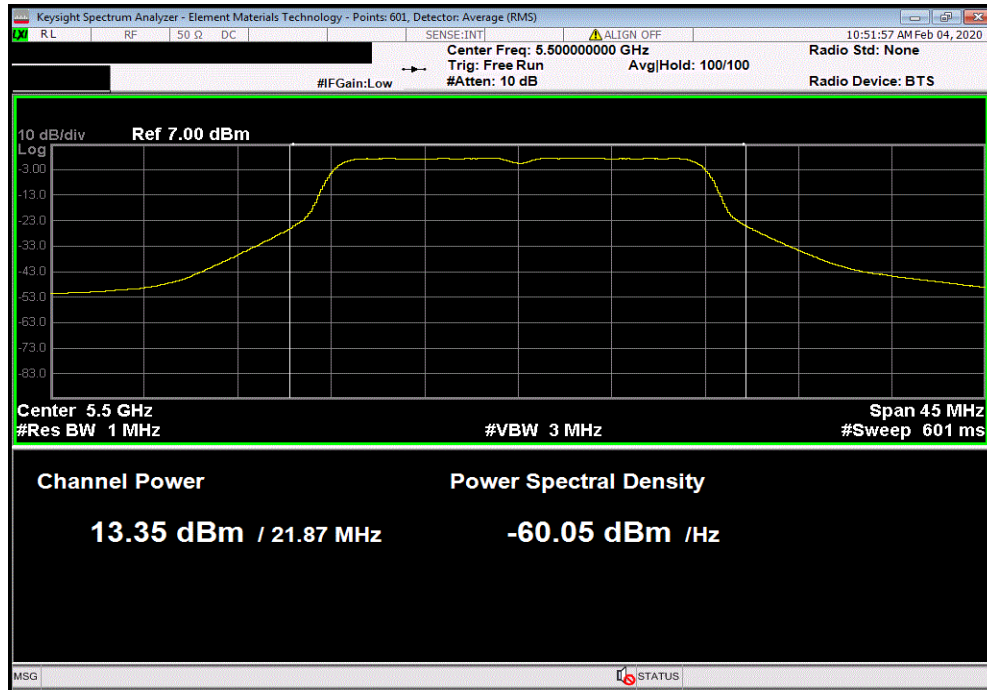
40 MHz	5470 - 5725 MHz Band	802.11(n) MCS15	31.6	33.9	65.5	18.2	24	Pass
		802.11(n) MCS8 (256-QAM)	21.4	20.9	42.3	16.3	24	Pass
		High Channel, Ch 140 - 5700 MHz						
		802.11(n) MCS8	25.1	25.7	50.8	17.1	24	Pass
		802.11(n) MCS15	32.4	33.9	66.2	18.2	24	Pass
		802.11(n) MCS8 (256-QAM)	20.9	21.4	42.3	16.3	24	Pass
		Low Channel, Ch 100/104 - 5510 MHz						
		802.11(n) MCS8	29.5	30.9	60.4	17.8	24	Pass
		802.11(n) MCS15	38.0	39.8	77.8	18.9	24	Pass
		802.11(n) MCS9 (256-QAM)	19.1	20.4	39.5	16.0	24	Pass
		Mid Channel, Ch 116/120 - 5590 MHz						
		802.11(n) MCS8	26.3	29.5	55.8	17.5	24	Pass
		802.11(n) MCS15	33.1	36.3	69.4	18.4	24	Pass
		802.11(n) MCS9 (256-QAM)	16.6	16.6	33.2	15.2	24	Pass
		High Channel, Ch 132/136 - 5670 MHz						
		802.11(n) MCS8	26.9	28.2	55.1	17.4	24	Pass
		802.11(n) MCS15	33.1	35.5	68.6	18.4	24	Pass
		802.11(n) MCS9 (256-QAM)	16.6	18.2	34.8	15.4	24	Pass
80 MHz	5470 - 5725 MHz Band	Low Channel, Ch 100-112 - 5530 MHz						
		802.11(n) MCS0	35.5	36.3	71.8	18.6	24	Pass
		802.11(n) MCS9 (256-QAM)	18.2	19.5	37.7	15.8	24	Pass
		High Channel, Ch 116-128 - 5610 MHz						
		802.11(n) MCS0	31.6	31.3	62.9	18.0	24	Pass
		802.11(n) MCS9 (256-QAM)	15.8	16.6	32.4	15.1	24	Pass

MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.6 GHz BAND

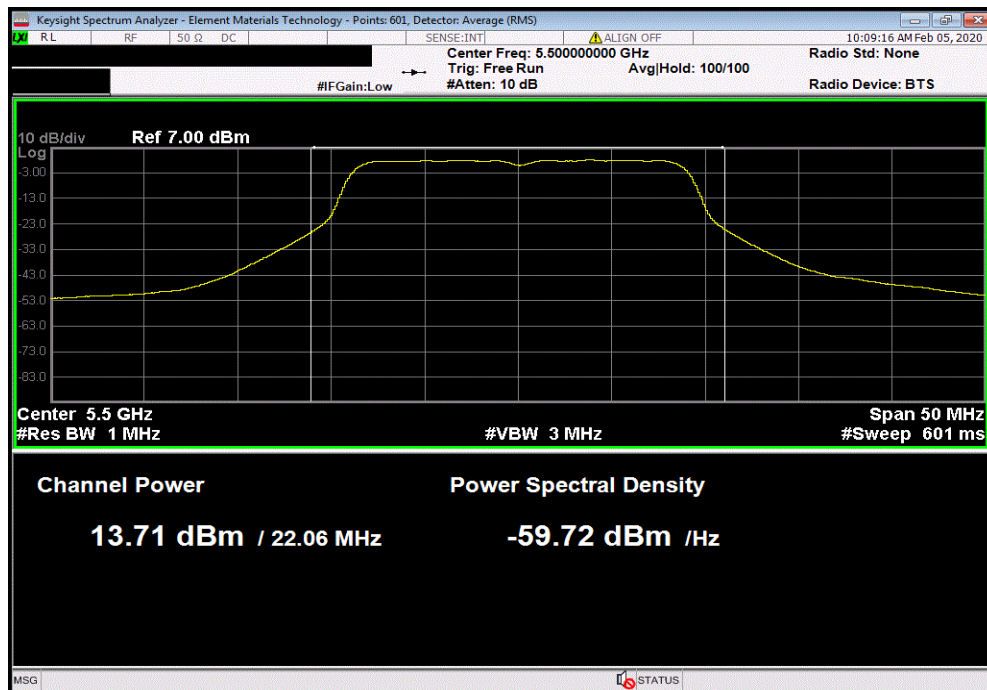


TbTtX 2019.08.30.0 XMt 2019.09.05

2x2 Chain_1, 20 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100 - 5500 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.352	2.1	15.4	24	Pass	



2x2 Chain_2, 20 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100 - 5500 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.713	2.1	15.9	24	Pass	

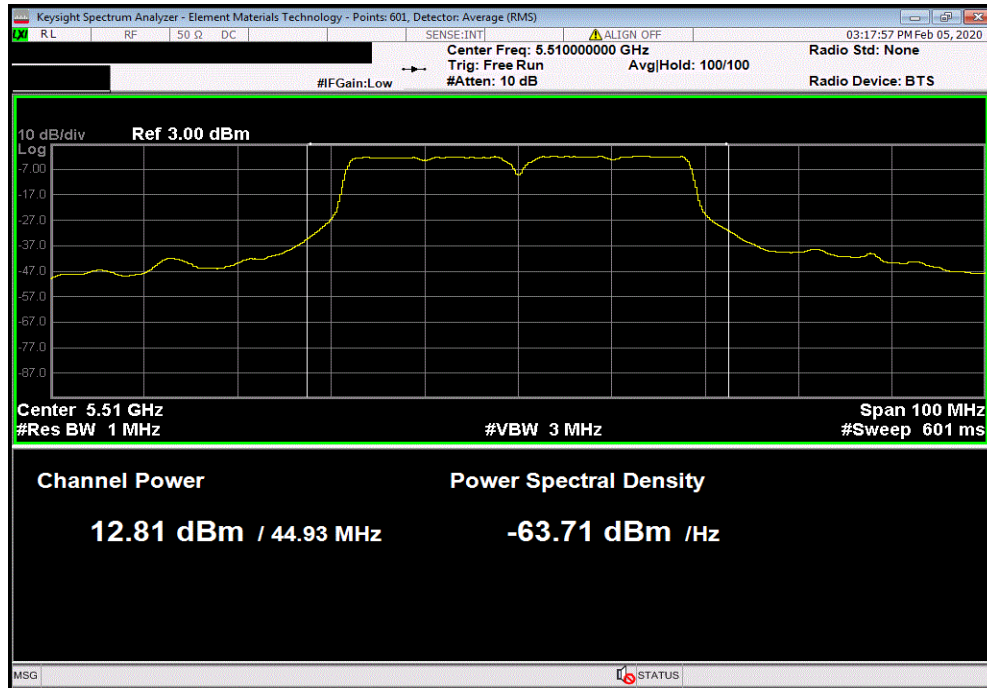


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.6 GHz BAND

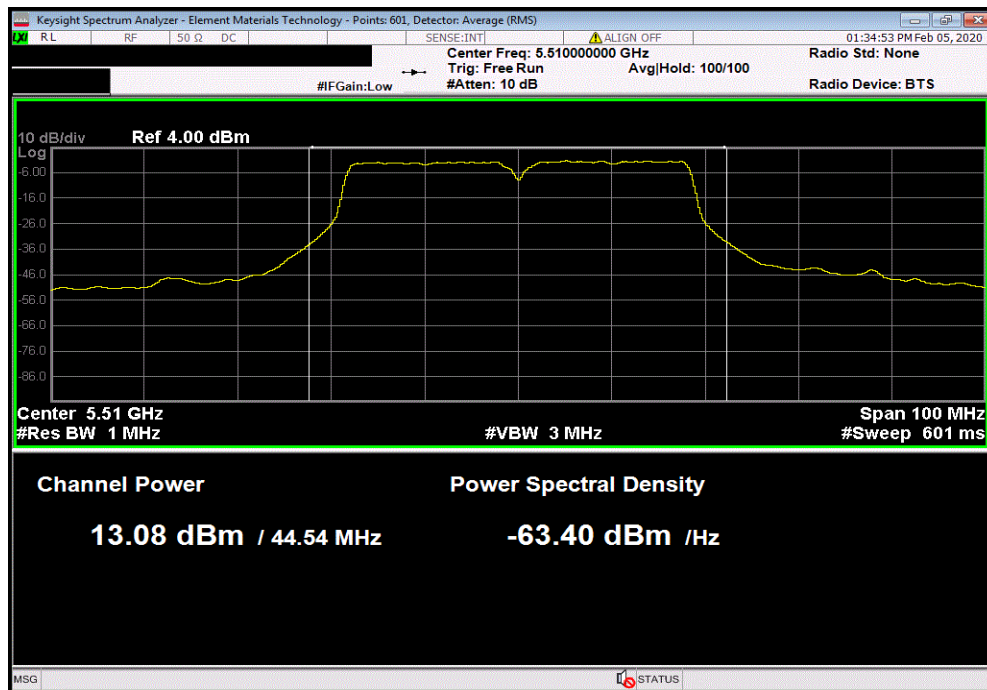


TbTtx 2019.08.30.0 XMt 2019.09.05

2x2 Chain_1, 40 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100/104 - 5510 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	12.812	2.9	15.8	24	Pass	



2x2 Chain_2, 40 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100/104 - 5510 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.084	2.9	16	24	Pass	

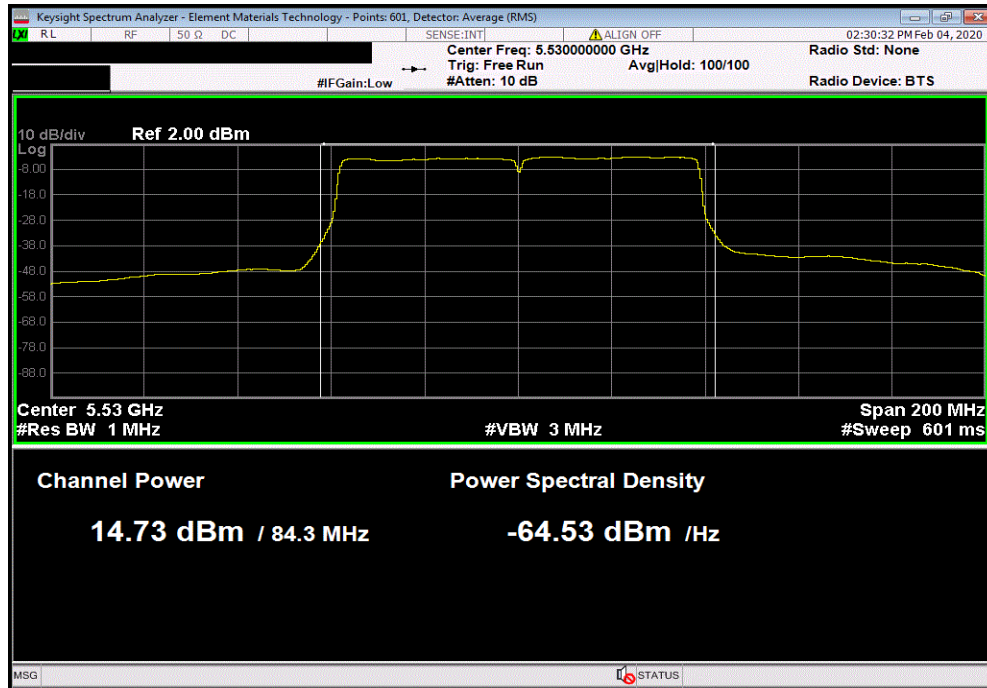


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.6 GHz BAND

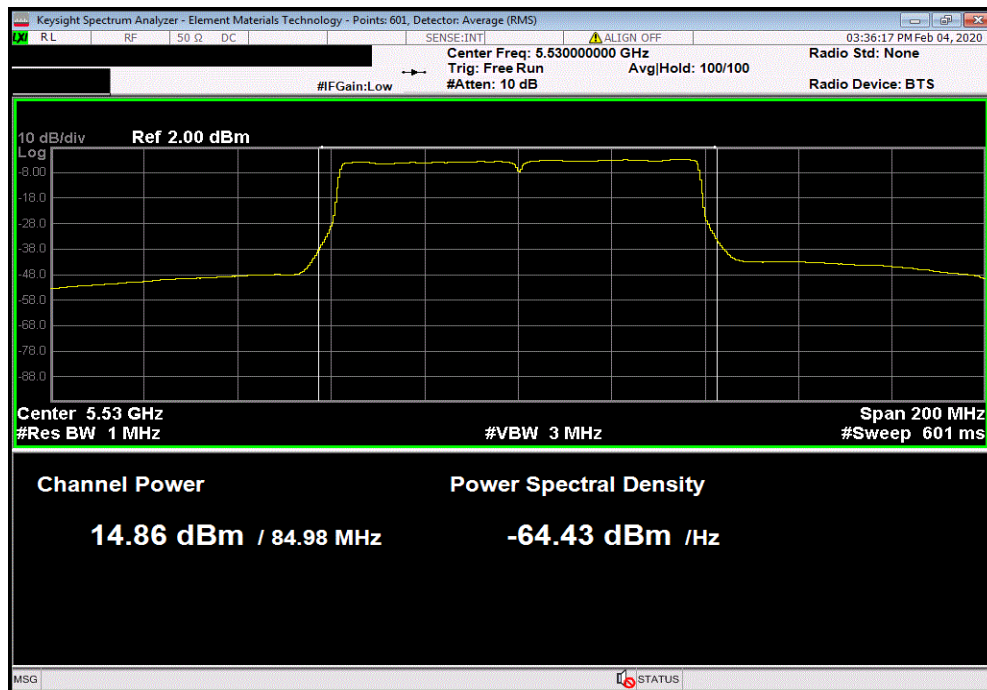


TbTx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 80 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100-112 - 5530 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.73	0.8	15.5	24	Pass	



2x2 Chain_2, 80 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100-112 - 5530 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.862	0.8	15.6	24	Pass	



MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.8GHz BAND



XMR 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.8GHz BAND



THTx 2019.08.30.0 XMM 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015
Serial Number: Pre-production #1		Date: 5-Feb-20
Customer: EchoNous, Inc.		Temperature: 22.4 °C
Attendees: None		Humidity: 39.5% RH
Project: None		Barometric Pres.: 1020 mbar
Tested by: Brian Fahey and Jeff Alcock		Job Site: NC0A
Power: 3.7 VDC		
TEST SPECIFICATIONS		Test Method
FCC 15.407:2020		ANSI C63.10:2013
COMMENTS		
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 SectionE), 1), the sum of both individual port measurements were compared to the limit as shown in the power summing table. The port not being measured is terminated with a 50ohm terminator.		
DEVIATIONS FROM TEST STANDARD		
None		
Configuration #	12	Signature  
		Avg Cond Pwr (dBm) Duty Cycle Factor (dB) Out Pwr (dBm) Limit (dBm) Result

2x2 Chain_1						
20 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149 - 5745 MHz						
802.11(n) MCS8			12.825	1.6	14.4	30 Pass
802.11(n) MCS15			13.253	2.1	15.4	30 Pass
802.11(n) MCS8 (256-QAM)			11.171	2.5	13.7	30 Pass
Mid Channel, Ch 157 - 5785 MHz						
802.11(n) MCS8			12.774	1.6	14.4	30 Pass
802.11(n) MCS15			13.28	2.2	15.4	30 Pass
802.11(n) MCS8 (256-QAM)			11.297	2.5	13.8	30 Pass
High Channel, Ch 165 - 5825 MHz						
802.11(n) MCS8			12.903	1.6	14.5	30 Pass
802.11(n) MCS15			13.368	2.1	15.5	30 Pass
802.11(n) MCS8 (256-QAM)			11.451	2.4	13.8	30 Pass
40 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149/153 - 5755 MHz						
802.11(n) MCS8			11.864	2.4	14.3	30 Pass
802.11(n) MCS15			12.439	3.1	15.6	30 Pass
802.11(n) MCS9 (256-QAM)			9.314	3.2	12.5	30 Pass
High Channel, Ch 157/161 - 5795 MHz						
802.11(n) MCS8			11.942	2.4	14.4	30 Pass
802.11(n) MCS15			12.532	2.9	15.4	30 Pass
802.11(n) MCS9 (256-QAM)			9.372	3.3	12.7	30 Pass
80 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149-161 - 5775 MHz						
802.11(n) MCS0			14.446	0.8	15.2	30 Pass
802.11(n) MCS9 (256-QAM)			8.685	3.9	12.5	30 Pass

2x2 Chain_2						
20 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149 - 5745 MHz						
802.11(n) MCS8			13.187	1.6	14.8	30 Pass
802.11(n) MCS15			13.658	2.2	15.8	30 Pass
802.11(n) MCS8 (256-QAM)			11.492	2.3	13.8	30 Pass
Mid Channel, Ch 157 - 5785 MHz						
802.11(n) MCS8			13.197	1.6	14.8	30 Pass
802.11(n) MCS15			13.662	2.2	15.8	30 Pass
802.11(n) MCS8 (256-QAM)			11.644	2.3	14	30 Pass
High Channel, Ch 165 - 5825 MHz						
802.11(n) MCS8			13.544	1.6	15.1	30 Pass
802.11(n) MCS15			14.015	2.2	16.2	30 Pass
802.11(n) MCS8 (256-QAM)			12.078	2.5	14.6	30 Pass
40 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149/153 - 5755 MHz						
802.11(n) MCS8			12.567	2.7	15.2	30 Pass
802.11(n) MCS15			13.004	2.9	15.9	30 Pass
802.11(n) MCS9 (256-QAM)			10.027	3.2	13.2	30 Pass
High Channel, Ch 157/161 - 5795 MHz						
802.11(n) MCS8			12.605	2.4	15.1	30 Pass
802.11(n) MCS15			13.03	3.1	16.1	30 Pass
802.11(n) MCS9 (256-QAM)			9.948	3.2	13.1	30 Pass
80 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149-161 - 5775 MHz						
802.11(n) MCS0			14.804	0.8	15.6	30 Pass
802.11(n) MCS9 (256-QAM)			9.08	3.9	12.9	30 Pass

2x2 MIMO, Power Summing Table						
20 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149 - 5745 MHz						
802.11(n) MCS8			Chain_1 Value (mW)	Chain_2 Value (mW)	Summed Value (mW)	Summed Value (dBm) Limit (dBm) Results
802.11(n) MCS15			27.5	30.2	57.7	17.6 30 Pass
802.11(n) MCS8 (256-QAM)			34.7	38.0	72.7	18.6 30 Pass
802.11(n) MCS8 (256-QAM)			23.4	24.0	47.4	16.8 30 Pass
Mid Channel, Ch 157 - 5785 MHz						
802.11(n) MCS8			27.5	30.2	57.7	17.6 30 Pass
802.11(n) MCS15			34.7	38.0	72.7	18.6 30 Pass
802.11(n) MCS8 (256-QAM)			24.0	25.1	49.1	16.9 30 Pass
High Channel, Ch 165 - 5825 MHz						
802.11(n) MCS8			28.2	32.4	60.5	17.8 30 Pass
802.11(n) MCS15			35.5	41.7	77.2	18.9 30 Pass
802.11(n) MCS8 (256-QAM)			24.0	28.8	52.8	17.2 30 Pass
40 MHz						
5725 - 5785 MHz Band						
Low Channel, Ch 149/153 - 5755 MHz						
802.11(n) MCS8			26.9	33.1	60.0	17.8 30 Pass
802.11(n) MCS15			36.3	38.9	75.2	18.8 30 Pass
802.11(n) MCS9 (256-QAM)			17.8	20.9	38.7	15.9 30 Pass
High Channel, Ch 157/161 - 5795 MHz						
802.11(n) MCS8			27.5	32.4	59.9	17.8 30 Pass

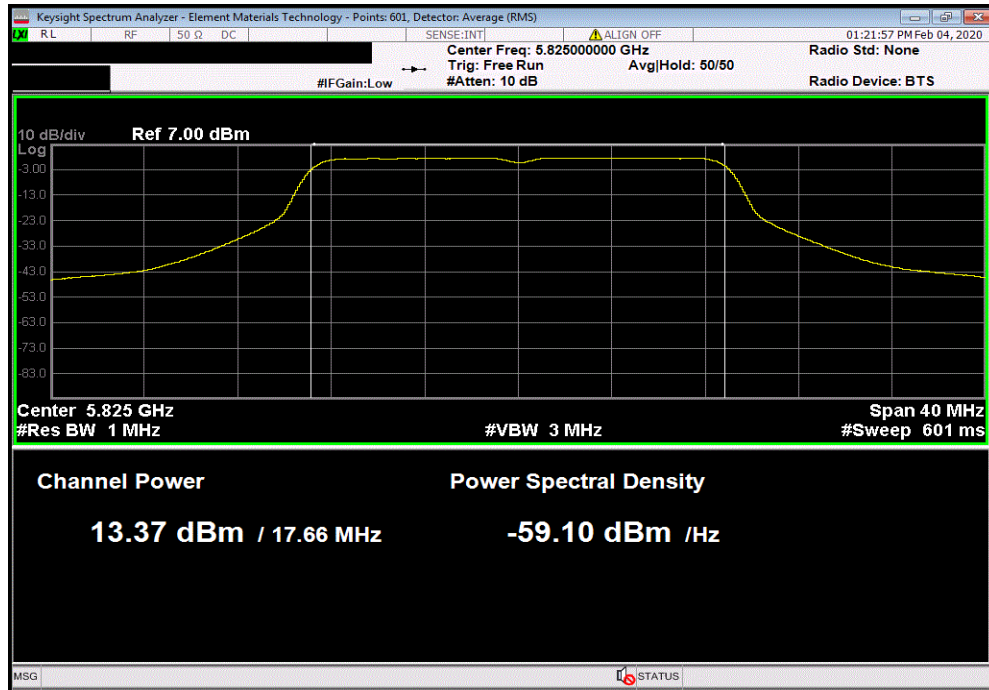
80 MHz	5725 - 5785 MHz Band	Low Channel, Ch 149-161 - 5775 MHz	802.11(n) MCS15	34.7	40.7	75.4	18.8	30	Pass
			802.11(n) MCS9 (256-QAM)	18.6	20.4	39.0	15.9	30	Pass
			802.11(n) MCS0	33.1	36.3	69.4	18.4	30	Pass
			802.11(n) MCS9 (256-QAM)	17.8	19.5	37.3	15.7	30	Pass

MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.8GHz BAND

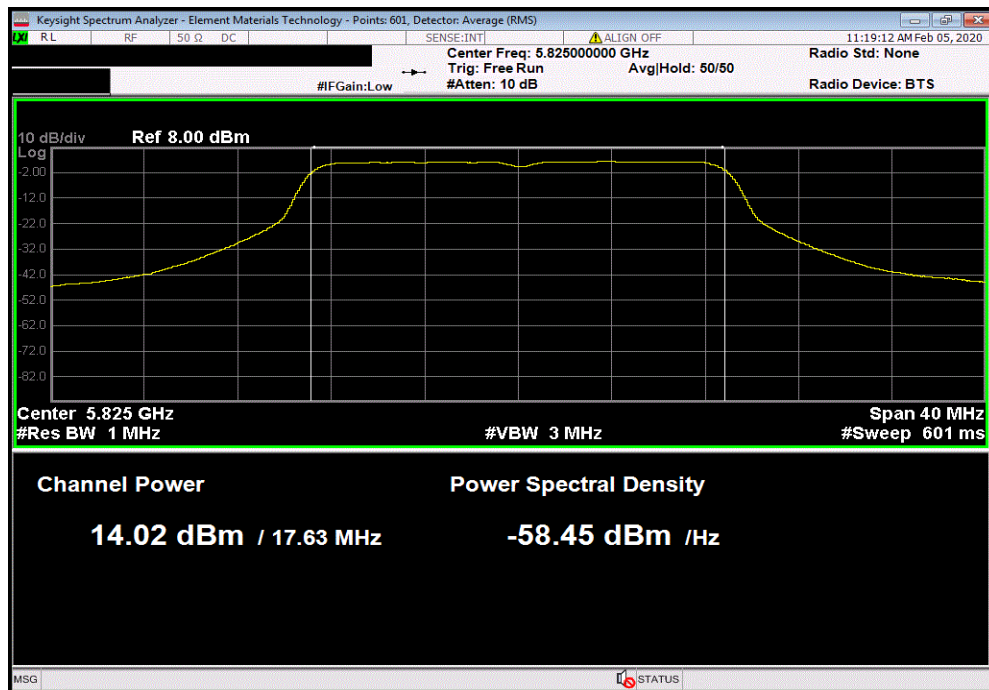


TbTx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 20 MHz, 5725 - 5785 MHz Band, High Channel, Ch 165 - 5825 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.368	2.1	15.5	30	Pass	



2x2 Chain_2, 20 MHz, 5725 - 5785 MHz Band, High Channel, Ch 165 - 5825 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.015	2.2	16.2	30	Pass	

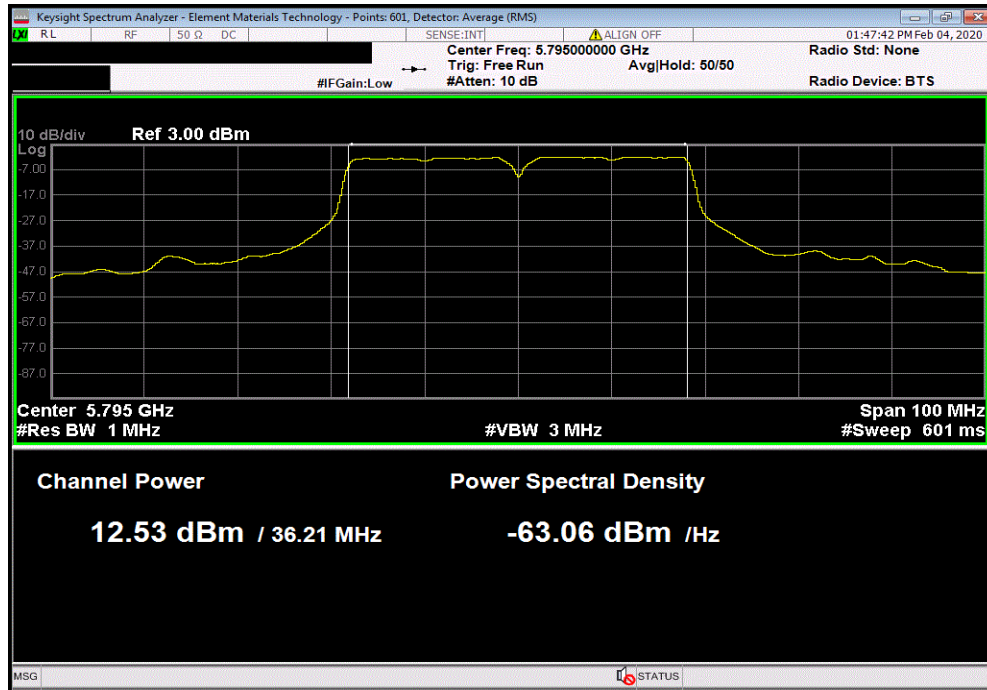


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.8GHz BAND

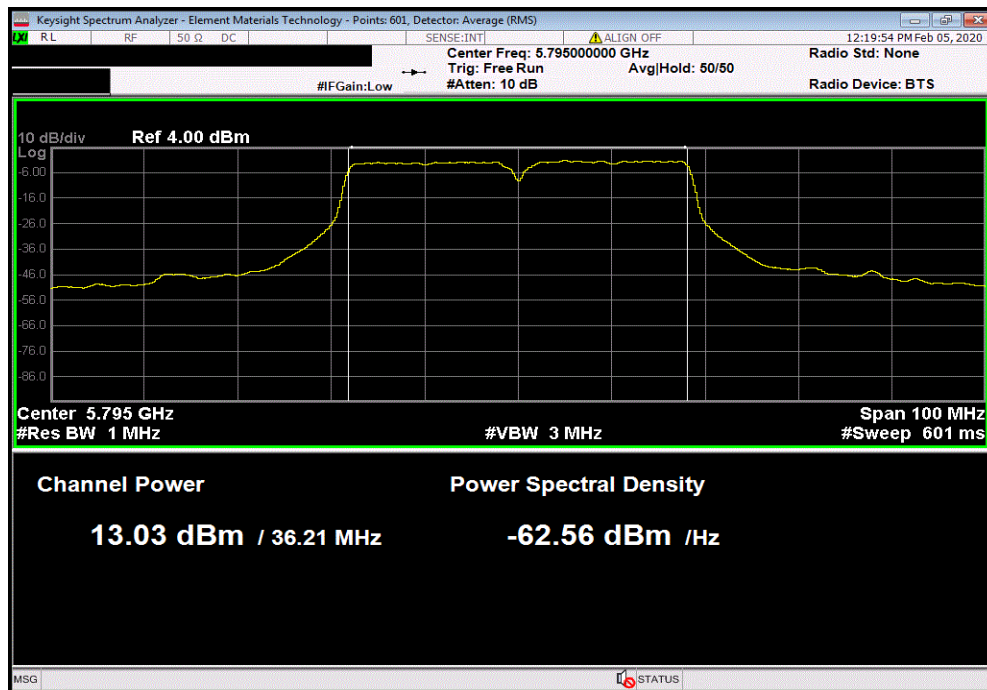


TbTtx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 40 MHz, 5725 - 5785 MHz Band, High Channel, Ch 157/161 - 5795 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	12.532	2.9	15.4	30	Pass	



2x2 Chain_2, 40 MHz, 5725 - 5785 MHz Band, High Channel, Ch 157/161 - 5795 MHz, 802.11(n) MCS15						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	13.03	3.1	16.1	30	Pass	

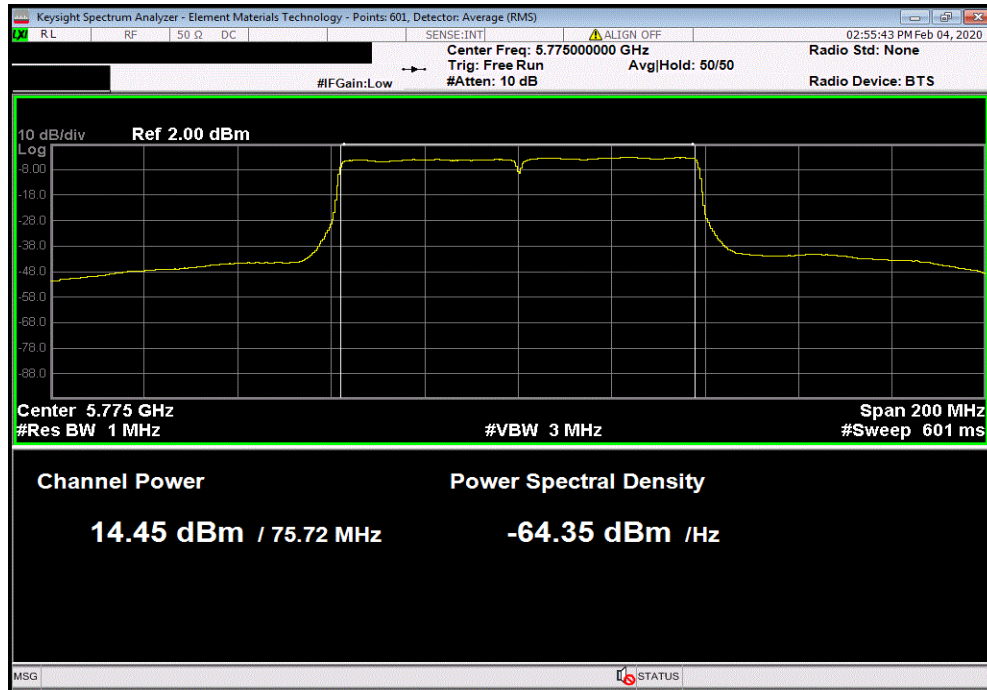


MAXIMUM CONDUCTED OUTPUT POWER - MIMO 5.8GHz BAND

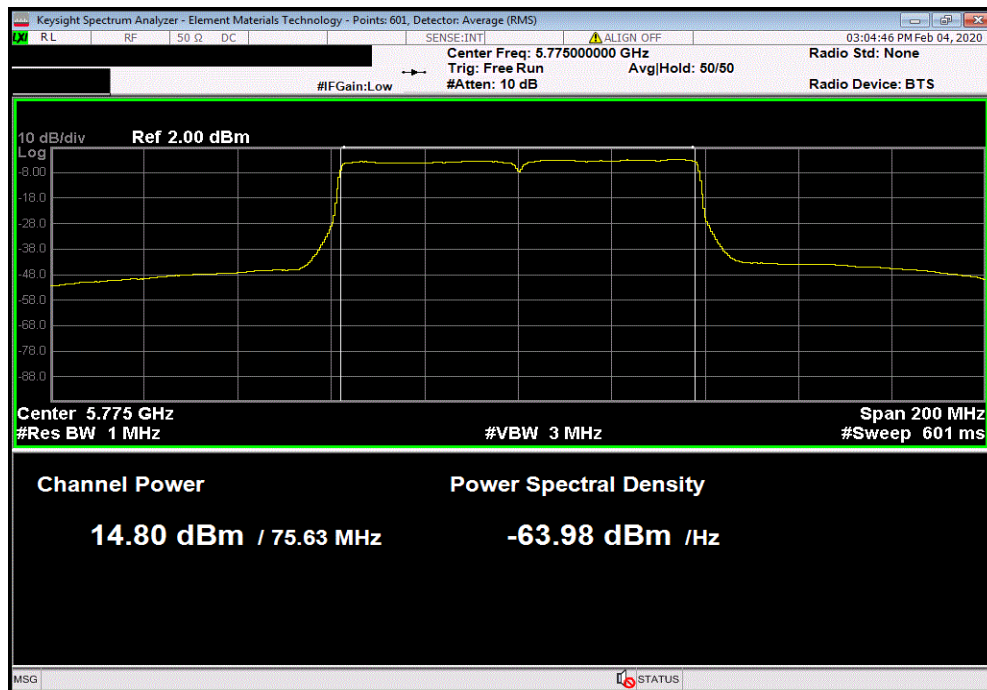


TbTx 2019.08.30.0 XMI 2019.09.05

2x2 Chain_1, 80 MHz, 5725 - 5785 MHz Band, Low Channel, Ch 149-161 - 5775 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.446	0.8	15.2	30	Pass	



2x2 Chain_2, 80 MHz, 5725 - 5785 MHz Band, Low Channel, Ch 149-161 - 5775 MHz, 802.11(n) MCS0						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result	
	14.804	0.8	15.6	30	Pass	



MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.2 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.2 GHz BAND



TMTx 2018.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNus, Inc.		Temperature: 22 °C	
Attendees: None		Humidity: 28% RH	
Project: None		Barometric Pres.: 1023 mbar	
Tested by: Brian Fahey & Jeff Alcoke		Job Site: NC0A	
Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcoke</i>	
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)
		Out Pwr (dBm)	Limit (dBm)
			Result

Chain_1			
20 MHz	5150 - 5250 MHz Band		
	Low Channel, Ch 36 - 5180 MHz		
	802.11(a) 6 Mbps	14.664	0.2
	802.11(a) 36 Mbps	13.375	1
	802.11(a) 54 Mbps	12.517	1.3
	802.11(n) MCS0	14.665	0.2
	802.11(n) MCS7	13.466	1.5
	802.11(n) MCS8 (256-QAM)	12.279	1.6
	Mid Channel, Ch 40 - 5200 MHz		
	802.11(a) 6 Mbps	14.671	0.2
	802.11(a) 36 Mbps	13.392	1.1
	802.11(a) 54 Mbps	12.511	1.4
	802.11(n) MCS0	14.633	0.2
	802.11(n) MCS7	13.422	1.5
	802.11(n) MCS8 (256-QAM)	12.432	1.7
	High Channel, Ch 48 - 5240 MHz		
	802.11(a) 6 Mbps	14.636	0.2
	802.11(a) 36 Mbps	13.311	0.9
	802.11(a) 54 Mbps	13.831	1
	802.11(n) MCS0	14.62	0.2
	802.11(n) MCS7	13.436	1.5
	802.11(n) MCS8 (256-QAM)	12.244	1.8
40 MHz	5150 - 5250 MHz Band		
	Low Channel, Ch 36/40 - 5190 MHz		
	802.11(n) MCS0	14.404	0.4
	802.11(n) MCS7	12.615	2.5
	802.11(n) MCS9 (256-QAM)	9.174	2.6
	High Channel, Ch 44/48 - 5230 MHz		
	802.11(n) MCS0	14.449	0.5
	802.11(n) MCS7	12.426	2.5
	802.11(n) MCS9 (256-QAM)	9.096	2.6
80 MHz	5150 - 5250 MHz Band		
	Low Channel, Ch 36-48 - 5210 MHz		
	802.11(n) MCS0	13.997	0.8
	802.11(n) MCS9 (256-QAM)	8.081	3.6
Chain_2			
20 MHz	5150 - 5250 MHz Band		
	Low Channel, Ch 36 - 5180 MHz		
	802.11(a) 6 Mbps	15.068	0.2
	802.11(a) 36 Mbps	13.882	1
	802.11(a) 54 Mbps	13.013	1.3
	802.11(n) MCS0	15.092	0.2
	802.11(n) MCS7	13.73	1.4
	802.11(n) MCS8 (256-QAM)	12.74	1.6
	Mid Channel, Ch 40 - 5200 MHz		
	802.11(a) 6 Mbps	15.016	0.2
	802.11(a) 36 Mbps	13.647	1
	802.11(a) 54 Mbps	12.987	1.4
	802.11(n) MCS0	15.023	0.2
	802.11(n) MCS7	13.692	1.4
	802.11(n) MCS8 (256-QAM)	12.704	1.7
	High Channel, Ch 48 - 5240 MHz		
	802.11(a) 6 Mbps	15.027	0.2
	802.11(a) 36 Mbps	13.726	1
	802.11(a) 54 Mbps	12.813	1.4
	802.11(n) MCS0	15.052	0.2
	802.11(n) MCS7	13.738	1.4
	802.11(n) MCS8 (256-QAM)	12.536	1.6
40 MHz	5150 - 5250 MHz Band		
	Low Channel, Ch 36/40 - 5190 MHz		
	802.11(n) MCS0	14.823	0.4
	802.11(n) MCS7	12.915	2.4
	802.11(n) MCS9 (256-QAM)	9.161	2.6
	High Channel, Ch 44/48 - 5230 MHz		
	802.11(n) MCS0	14.81	0.4
	802.11(n) MCS7	12.935	2.5
	802.11(n) MCS9 (256-QAM)	9.117	2.6
80 MHz	5150 - 5250 MHz Band		
	Low Channel, Ch 36-48 - 5210 MHz		
	802.11(n) MCS0	14.406	0.8
	802.11(n) MCS9 (256-QAM)	8.282	3.5

MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.3 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.3 GHz BAND



TMTx 2018.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNus, Inc.		Temperature: 22 °C	
Attendees: None		Humidity: 28.1% RH	
Project: None		Barometric Pres.: 1023 mbar	
Tested by: Brian Fahey & Jeff Alcoke		Job Site: NC0A	
Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcoke</i>	
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)
		Out Pwr (dBm)	Limit (dBm)
			Result

Chain_1			
20 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52 - 5260 MHz		
	802.11(a) 6 Mbps	14.635	0.2
	802.11(a) 36 Mbps	13.341	1
	802.11(a) 54 Mbps	12.521	1.3
	802.11(n) MCS0	14.664	0.2
	802.11(n) MCS7	13.449	1.4
	802.11(n) MCS8 (256-QAM)	12.238	1.6
	Mid Channel, Ch 60 - 5300 MHz		
	802.11(a) 6 Mbps	14.792	0.2
	802.11(a) 36 Mbps	13.44	1
	802.11(a) 54 Mbps	12.686	1.3
	802.11(n) MCS0	14.764	0.2
	802.11(n) MCS7	13.56	1.6
	802.11(n) MCS8 (256-QAM)	12.449	1.7
	High Channel, Ch 64 - 5320 MHz		
	802.11(a) 6 Mbps	15.034	0.2
	802.11(a) 36 Mbps	13.929	1
	802.11(a) 54 Mbps	12.95	1.4
	802.11(n) MCS0	15.021	0.2
	802.11(n) MCS7	13.876	1.5
	802.11(n) MCS8 (256-QAM)	12.713	1.6
40 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52/56 - 5270 MHz		
	802.11(n) MCS0	14.338	0.4
	802.11(n) MCS7	12.547	2.6
	802.11(n) MCS9 (256-QAM)	9.297	2.6
	High Channel, Ch 60/64 - 5310 MHz		
	802.11(n) MCS0	14.542	0.4
	802.11(n) MCS7	12.61	2.4
	802.11(n) MCS9 (256-QAM)	9.757	2.6
80 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52-64 - 5290 MHz		
	802.11(n) MCS0	14.127	0.8
	802.11(n) MCS9 (256-QAM)	8.717	3.7
Chain_2			
20 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52 - 5260 MHz		
	802.11(a) 6 Mbps	14.938	0.2
	802.11(a) 36 Mbps	13.585	0.9
	802.11(a) 54 Mbps	12.666	1.3
	802.11(n) MCS0	14.823	0.2
	802.11(n) MCS7	13.581	1.4
	802.11(n) MCS8 (256-QAM)	12.379	1.6
	Mid Channel, Ch 60 - 5300 MHz		
	802.11(a) 6 Mbps	15.119	0.2
	802.11(a) 36 Mbps	13.859	1
	802.11(a) 54 Mbps	12.988	1.4
	802.11(n) MCS0	15.138	0.2
	802.11(n) MCS7	13.8	1.4
	802.11(n) MCS8 (256-QAM)	12.689	1.7
	High Channel, Ch 64 - 5320 MHz		
	802.11(a) 6 Mbps	15.101	0.2
	802.11(a) 36 Mbps	14.048	1
	802.11(a) 54 Mbps	13.039	1.3
	802.11(n) MCS0	15.115	0.2
	802.11(n) MCS7	13.849	1.4
	802.11(n) MCS8 (256-QAM)	12.794	1.7
40 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52/56 - 5270 MHz		
	802.11(n) MCS0	14.793	0.4
	802.11(n) MCS7	12.864	2.5
	802.11(n) MCS9 (256-QAM)	9.681	2.6
	High Channel, Ch 60/64 - 5310 MHz		
	802.11(n) MCS0	14.914	0.5
	802.11(n) MCS7	13.054	2.4
	802.11(n) MCS9 (256-QAM)	9.928	2.6
80 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52-64 - 5290 MHz		
	802.11(n) MCS0	14.403	0.9
	802.11(n) MCS9 (256-QAM)	8.867	3.5

MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.6 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power, the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \text{LOG}(1/D)$ where D is the duty cycle.

MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.6 GHz BAND



TMTx 2018.09.13 XMM 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNous, Inc.		Temperature: 25.7 °C	
Attendees: None		Humidity: 22.9% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brian Fahey & Jeff Alcoke		Job Site: NC0A	
Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcoke</i>	
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)
		Out Pwr (dBm)	Limit (dBm)
			Result

Chain_1			
20 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100 - 5500 MHz			
802.11(a) 6 Mbps	15.11	0.2	15.3
802.11(a) 36 Mbps	13.942	1	14.9
802.11(a) 54 Mbps	13.077	1.4	14.4
802.11(n) MCS0	15.074	0.2	15.3
802.11(n) MCS7	13.939	1.4	15.4
802.11(n) MCS8 (256-QAM)	12.765	1.6	14.4
Mid Channel, Ch 116 - 5580 MHz			
802.11(a) 6 Mbps	14.498	0.2	14.7
802.11(a) 36 Mbps	13.365	1	14.3
802.11(a) 54 Mbps	12.509	1.5	14
802.11(n) MCS0	14.472	0.2	14.7
802.11(n) MCS7	13.411	1.4	14.8
802.11(n) MCS8 (256-QAM)	12.154	1.7	13.8
High Channel, Ch 140 - 5700 MHz			
802.11(a) 6 Mbps	15.092	0.2	15.3
802.11(a) 36 Mbps	13.844	0.9	14.8
802.11(a) 54 Mbps	13.045	1.4	14.5
802.11(n) MCS0	15.169	0.2	15.4
802.11(n) MCS7	13.921	1.4	15.3
802.11(n) MCS8 (256-QAM)	12.734	1.6	14.3
40 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100/104 - 5510 MHz			
802.11(n) MCS0	14.674	0.4	15.1
802.11(n) MCS7	12.917	2.5	15.4
802.11(n) MCS9 (256-QAM)	9.791	2.6	12.4
Mid Channel, Ch 116/120 - 5590 MHz			
802.11(n) MCS0	14.06	0.5	14.5
802.11(n) MCS7	12.288	2.5	14.8
802.11(n) MCS9 (256-QAM)	8.748	2.6	11.3
High Channel, Ch 132/136 - 5670 MHz			
802.11(n) MCS0	14.515	0.4	14.9
802.11(n) MCS7	12.685	2.5	15.2
802.11(n) MCS9 (256-QAM)	9.47	2.6	12.1
80 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100-112 - 5530 MHz			
802.11(n) MCS0	14.224	0.8	15.1
802.11(n) MCS9 (256-QAM)	8.686	3.6	12.2
High Channel, Ch 116-128 - 5610 MHz			
802.11(n) MCS0	13.976	0.8	14.8
802.11(n) MCS9 (256-QAM)	8.206	3.5	11.7
Chain_2			
20 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100 - 5500 MHz			
802.11(a) 6 Mbps	15.224	0.2	15.4
802.11(a) 36 Mbps	14.012	1.1	15.1
802.11(a) 54 Mbps	13.061	1.3	14.4
802.11(n) MCS0	15.198	0.2	15.4
802.11(n) MCS7	13.962	1.4	15.4
802.11(n) MCS8 (256-QAM)	12.793	1.6	14.4
Mid Channel, Ch 116 - 5580 MHz			
802.11(a) 6 Mbps	14.609	0.2	14.8
802.11(a) 36 Mbps	13.502	0.9	14.4
802.11(a) 54 Mbps	12.672	1.3	14
802.11(n) MCS0	14.702	0.2	14.9
802.11(n) MCS7	13.524	1.4	15
802.11(n) MCS8 (256-QAM)	12.38	1.6	14
High Channel, Ch 140 - 5700 MHz			
802.11(a) 6 Mbps	15.106	0.2	15.3
802.11(a) 36 Mbps	13.836	1	14.8
802.11(a) 54 Mbps	13.036	1.3	14.4
802.11(n) MCS0	15.169	0.2	15.4
802.11(n) MCS7	13.942	1.5	15.5
802.11(n) MCS8 (256-QAM)	12.76	1.6	14.4
40 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100/104 - 5510 MHz			
802.11(n) MCS0	14.92	0.4	15.4
802.11(n) MCS7	13.1	2.7	15.8
802.11(n) MCS9 (256-QAM)	9.901	2.6	12.5
Mid Channel, Ch 116/120 - 5590 MHz			
802.11(n) MCS0	14.433	0.4	14.8
802.11(n) MCS7	12.621	2.5	15.1
802.11(n) MCS9 (256-QAM)	8.886	2.6	11.5
High Channel, Ch 132/136 - 5670 MHz			
802.11(n) MCS0	14.658	0.4	15.1
802.11(n) MCS7	12.811	2.5	15.3

80 MHz	802.11(n) MCS9 (256-QAM)	9.572	2.6	12.2	24	Pass
	5470 - 5725 MHz Band					
	Low Channel, Ch 100-112 - 5530 MHz					
	802.11(n) MCS0	14.407	0.9	15.3	24	Pass
	802.11(n) MCS9 (256-QAM)	8.903	3.5	12.4	24	Pass
	High Channel, Ch 116-128 - 5610 MHz					
	802.11(n) MCS0	13.843	0.9	14.8	24	Pass
	802.11(n) MCS9 (256-QAM)	8.311	3.4	11.8	24	Pass

MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.8 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor).

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM CONDUCTED OUTPUT POWER - SISO 5.8 GHz BAND



TMTx 2018.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNus, Inc.		Temperature: 25 °C	
Attendees: None		Humidity: 23.6% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brian Fahey & Jeff Alcoke		Job Site: NC0A	
Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcoke</i>	
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)
		Out Pwr (dBm)	Limit (dBm)
			Result

Chain_1			
20 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149 - 5745 MHz		
	802.11(a) 6 Mbps	15.018	0.2
	802.11(a) 36 Mbps	13.791	1
	802.11(a) 54 Mbps	13.067	1.3
	802.11(n) MCS0	15.066	0.2
	802.11(n) MCS7	13.903	1.5
	802.11(n) MCS8 (256-QAM)	12.838	1.6
	Mid Channel, Ch 157 - 5785 MHz		
	802.11(a) 6 Mbps	15.359	0.2
	802.11(a) 36 Mbps	14.107	1
	802.11(a) 54 Mbps	13.349	1.5
	802.11(n) MCS0	15.371	0.2
	802.11(n) MCS7	14.251	1.5
	802.11(n) MCS8 (256-QAM)	13.107	1.6
	High Channel, Ch 165 - 5825 MHz		
	802.11(a) 6 Mbps	15.249	0.2
	802.11(a) 36 Mbps	14.157	1
	802.11(a) 54 Mbps	13.189	1.5
	802.11(n) MCS0	15.232	0.2
	802.11(n) MCS7	14.103	1.5
	802.11(n) MCS8 (256-QAM)	12.919	1.6
40 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149/153 - 5755 MHz		
	802.11(n) MCS0	14.944	0.4
	802.11(n) MCS7	13.265	2.2
	802.11(n) MCS9 (256-QAM)	10.101	2.6
	High Channel, Ch 157/161 - 5795 MHz		
	802.11(n) MCS0	15.118	0.5
	802.11(n) MCS7	13.416	2.2
	802.11(n) MCS9 (256-QAM)	10.289	2.6
80 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149-161 - 5775 MHz		
	802.11(n) MCS0	14.73	0.8
	802.11(n) MCS9 (256-QAM)	9.092	3.7
Chain_2			
20 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149 - 5745 MHz		
	802.11(a) 6 Mbps	15.415	0.2
	802.11(a) 36 Mbps	14.322	1
	802.11(a) 54 Mbps	13.541	1.5
	802.11(n) MCS0	15.428	0.2
	802.11(n) MCS7	14.273	1.4
	802.11(n) MCS8 (256-QAM)	13.292	1.4
	Mid Channel, Ch 157 - 5785 MHz		
	802.11(a) 6 Mbps	15.792	0.2
	802.11(a) 36 Mbps	14.683	1
	802.11(a) 54 Mbps	13.902	1.3
	802.11(n) MCS0	15.815	0.2
	802.11(n) MCS7	14.625	1.4
	802.11(n) MCS8 (256-QAM)	13.615	1.6
	High Channel, Ch 165 - 5825 MHz		
	802.11(a) 6 Mbps	16.042	0.2
	802.11(a) 36 Mbps	14.856	1
	802.11(a) 54 Mbps	14.004	1.3
	802.11(n) MCS0	16.065	0.2
	802.11(n) MCS7	14.945	1.6
	802.11(n) MCS8 (256-QAM)	13.729	1.6
40 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149/153 - 5755 MHz		
	802.11(n) MCS0	15.384	0.4
	802.11(n) MCS7	13.553	2.2
	802.11(n) MCS9 (256-QAM)	10.509	2.6
	High Channel, Ch 157/161 - 5795 MHz		
	802.11(n) MCS0	15.581	0.5
	802.11(n) MCS7	13.74	2.3
	802.11(n) MCS9 (256-QAM)	10.685	2.6
80 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149-161 - 5775 MHz		
	802.11(n) MCS0	15.143	0.9
	802.11(n) MCS9 (256-QAM)	9.739	3.5

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO 5.2 GHz BAND



XMR 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

- RMS Detector
- Trace average 100 traces in power averaging mode.
- Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO 5.2 GHz BAND



THTx 2019.08.30.0 XMt 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 5-Feb-20
Customer: EchoNous, Inc.	Temperature: 21.8 °C
Attendees: None	Humidity: 42.8% RH
Project: None	Barometric Pres.: 1019 mbar
Tested by: Brian Fahey and Jeff Alcock	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2020	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 SectionE), 1), the sum of both individual port measurements were compared to the limit as shown in the power summing table. The port not being measured is terminated with a 50ohm terminator.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	12	Signature	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
-----------------	----	-----------	--------------------	------------------------	---------------	--------------------	------------	------------------	--------

2x2 Chain_1	20 MHz	5150 - 5250 MHz Band	Low Channel, Ch 36 - 5180 MHz	802.11(n) MCS8	12.587	1.7	14.3	-0.95	13.4	30	Pass
				802.11(n) MCS15	13.12	2.1	15.2	-0.95	14.3	30	Pass
				802.11(n) MCS8 (256-QAM)	11.084	2.4	13.4	-0.95	12.5	30	Pass
			Mid Channel, Ch 40 - 5200 MHz	802.11(n) MCS8	12.585	1.6	14.2	-0.95	13.2	30	Pass
				802.11(n) MCS15	13.066	2.1	15.2	-0.95	14.2	30	Pass
				802.11(n) MCS8 (256-QAM)	11.053	2.3	13.4	-0.95	12.4	30	Pass
			High Channel, Ch 48 - 5240 MHz	802.11(n) MCS8	12.67	1.7	14.4	-0.95	13.5	30	Pass
				802.11(n) MCS15	13.225	2.1	15.3	-0.95	14.4	30	Pass
				802.11(n) MCS8 (256-QAM)	11.001	2.3	13.3	-0.95	12.4	30	Pass
	40 MHz	5150 - 5250 MHz Band	Low Channel, Ch 36/40 - 5190 MHz	802.11(n) MCS8	11.866	2.4	14.3	-0.95	13.4	30	Pass
				802.11(n) MCS15	12.377	2.9	15.3	-0.95	14.3	30	Pass
				802.11(n) MCS9 (256-QAM)	9.055	3.6	12.6	-0.95	11.7	30	Pass
			High Channel, Ch 44/48 - 5230 MHz	802.11(n) MCS8	12.006	2.6	14.6	-0.95	13.7	30	Pass
				802.11(n) MCS15	12.556	2.9	15.4	-0.95	14.5	30	Pass
				802.11(n) MCS9 (256-QAM)	9.04	3.3	12.3	-0.95	11.4	30	Pass
	80 MHz	5150 - 5250 MHz Band	Low Channel, Ch 36-48 - 5210 MHz	802.11(n) MCS0	14.493	0.9	15.3	-0.95	14.4	30	Pass
				802.11(n) MCS9 (256-QAM)	8.466	3.9	12.3	-0.95	11.4	30	Pass

2x2 Chain_2	20 MHz	5150 - 5250 MHz Band	Low Channel, Ch 36 - 5180 MHz	802.11(n) MCS8	13.005	1.6	14.6	1.92	16.5	30	Pass
				802.11(n) MCS15	13.307	2.1	15.4	1.92	17.3	30	Pass
				802.11(n) MCS8 (256-QAM)	11.436	2.3	13.7	1.92	15.7	30	Pass
			Mid Channel, Ch 40 - 5200 MHz	802.11(n) MCS8	13.164	1.7	14.8	1.92	16.7	30	Pass
				802.11(n) MCS15	13.49	2.1	15.6	1.92	17.5	30	Pass
				802.11(n) MCS8 (256-QAM)	11.475	2.5	14	1.92	15.9	30	Pass
			High Channel, Ch 48 - 5240 MHz	802.11(n) MCS8	13.001	1.6	14.6	1.92	16.5	30	Pass
				802.11(n) MCS15	13.538	2.1	15.7	1.92	17.6	30	Pass
				802.11(n) MCS8 (256-QAM)	11.395	2.3	13.7	1.92	15.7	30	Pass
	40 MHz	5150 - 5250 MHz Band	Low Channel, Ch 36/40 - 5190 MHz	802.11(n) MCS8	12.479	2.7	15.1	1.92	17.1	30	Pass
				802.11(n) MCS15	12.853	2.9	15.8	1.92	17.7	30	Pass
				802.11(n) MCS9 (256-QAM)	9.133	3.2	12.3	1.92	14.2	30	Pass
			High Channel, Ch 44/48 - 5230 MHz	802.11(n) MCS8	12.479	2.4	14.9	1.92	16.8	30	Pass
				802.11(n) MCS15	12.913	2.9	15.8	1.92	17.7	30	Pass
				802.11(n) MCS9 (256-QAM)	9.148	3.2	12.4	1.92	14.3	30	Pass
	80 MHz	5150 - 5250 MHz Band	Low Channel, Ch 36-48 - 5210 MHz	802.11(n) MCS0	14.851	0.8	15.6	1.92	17.5	30	Pass
				802.11(n) MCS9 (256-QAM)	8.309	3.9	12.2	1.92	14.1	30	Pass

2x2 MIMO, Power Summing Table									
20 MHz									
5150 - 5250 MHz Band									
Low Channel, Ch 36 - 5180 MHz				Chain_1 Value (mW)	Chain_2 Value (mW)	Summed Value (mW)	Summed Value (dBm)	Limit (dBm)	Results
802.11(n) MCS8				21.9	44.7	66.5	18.2	30	Pass
802.11(n) MCS15				26.9	53.7	80.6	19.1	30	Pass
802.11(n) MCS8 (256-QAM)				17.8	37.2	54.9	17.4	30	Pass
Mid Channel, Ch 40 - 5200 MHz									
802.11(n) MCS8				20.9	46.8	67.7	18.3	30	Pass
802.11(n) MCS15				26.3	56.2	82.5	19.2	30	Pass
802.11(n) MCS8 (256-QAM)				17.4	38.9	56.3	17.5	30	Pass
High Channel, Ch 48 - 5240 MHz									
802.11(n) MCS8				22.4	44.7	67.1	18.3	30	Pass
802.11(n) MCS15				27.5	57.5	85.1	19.3	30	Pass
802.11(n) MCS8 (256-QAM)				17.4	37.2	54.5	17.4	30	Pass
40 MHz									
5150 - 5250 MHz Band									
Low Channel, Ch 36/40 - 5190 MHz									
802.11(n) MCS8				21.9	51.3	73.2	18.6	30	Pass
802.11(n) MCS15				26.9	58.9	85.8	19.3	30	Pass
802.11(n) MCS9 (256-QAM)				14.8	26.3	41.1	16.1	30	Pass
High Channel, Ch 44/48 - 5230 MHz									
802.11(n) MCS8				23.4	47.9	71.3	18.5	30	Pass

80 MHz	5150 - 5250 MHz Band	802.11(n) MCS15	28.2	58.9	87.1	19.4	30	Pass
		802.11(n) MCS9 (256-QAM)	13.8	26.9	40.7	16.1	30	Pass
		Low Channel, Ch 36-48 - 5210 MHz						
		802.11(n) MCS0	27.5	56.2	83.8	19.2	30	Pass
		802.11(n) MCS9 (256-QAM)	13.8	25.7	39.5	16.0	30	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO 5.3GHz BAND



XMM 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO

5.3GHz BAND



TH17x 2019.08.30.0 XM19 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 5-Feb-20
Customer: EchoNous, Inc.	Temperature: 21.7 °C
Attende: None	Humidity: 43.2% RH
Project: None	Barometric Pres.: 1019 mbar
Tested by: Brian Fahey and Jeff Alcock	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2020	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 SectionE), 1), the sum of both individual port measurements were compared to the limit as shown in the power summing table. The port not being measured is terminated with a 50ohm terminator.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	12	Signature	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
-----------------	----	-----------	--------------------	------------------------	---------------	--------------------	------------	------------------	--------

2x2 Chain_1	20 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52 - 5260 MHz	802.11(n) MCS8	12.577	1.6	14.2	-0.95	13.3	30	Pass
				802.11(n) MCS15	13.264	2.1	15.4	-0.95	14.4	30	Pass
				802.11(n) MCS8 (256-QAM)	11.251	2.3	13.6	-0.95	12.6	30	Pass
			Mid Channel, Ch 60 - 5300 MHz	802.11(n) MCS8	12.815	1.6	14.4	-0.95	13.5	30	Pass
				802.11(n) MCS15	13.54	2.1	15.7	-0.95	14.7	30	Pass
				802.11(n) MCS8 (256-QAM)	11.28	2.3	13.6	-0.95	12.6	30	Pass
			High Channel, Ch 64 - 5320 MHz	802.11(n) MCS8	13.184	1.6	14.8	-0.95	13.8	30	Pass
				802.11(n) MCS15	13.466	2.1	15.6	-0.95	14.6	30	Pass
				802.11(n) MCS8 (256-QAM)	11.662	2.3	14	-0.95	13	30	Pass
	40 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52/56 - 5270 MHz	802.11(n) MCS8	12.015	2.4	14.4	-0.95	13.5	30	Pass
				802.11(n) MCS15	12.581	2.9	15.5	-0.95	14.5	30	Pass
				802.11(n) MCS9 (256-QAM)	9.398	3.2	12.6	-0.95	11.7	30	Pass
			High Channel, Ch 60/64 - 5310 MHz	802.11(n) MCS8	12.281	2.4	14.7	-0.95	13.7	30	Pass
				802.11(n) MCS15	12.913	2.9	15.8	-0.95	14.9	30	Pass
				802.11(n) MCS9 (256-QAM)	9.738	3.2	12.9	-0.95	11.9	30	Pass
	80 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52-64 - 5290 MHz	802.11(n) MCS0	14.673	0.9	15.6	-0.95	14.6	30	Pass
				802.11(n) MCS9 (256-QAM)	8.828	3.9	12.8	-0.95	11.8	30	Pass

2x2 Chain_2	20 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52 - 5260 MHz	802.11(n) MCS8	13.032	1.6	14.6	1.92	16.5	30	Pass
				802.11(n) MCS15	13.637	2.1	15.7	1.92	17.6	30	Pass
				802.11(n) MCS8 (256-QAM)	11.492	2.3	13.8	1.92	15.8	30	Pass
			Mid Channel, Ch 60 - 5300 MHz	802.11(n) MCS8	13.242	1.6	14.8	1.92	16.8	30	Pass
				802.11(n) MCS15	13.753	2.1	15.9	1.92	17.8	30	Pass
				802.11(n) MCS8 (256-QAM)	11.646	2.4	14	1.92	15.9	30	Pass
			High Channel, Ch 64 - 5320 MHz	802.11(n) MCS8	13.302	1.6	14.9	1.92	16.8	30	Pass
				802.11(n) MCS15	13.742	2.2	15.9	1.92	17.8	30	Pass
				802.11(n) MCS8 (256-QAM)	11.743	2.3	14.1	1.92	16	30	Pass
	40 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52/56 - 5270 MHz	802.11(n) MCS8	12.504	2.4	14.9	1.92	16.9	30	Pass
				802.11(n) MCS15	13.034	2.9	15.9	1.92	17.8	30	Pass
				802.11(n) MCS9 (256-QAM)	9.871	3.6	13.4	1.92	15.3	30	Pass
			High Channel, Ch 60/64 - 5310 MHz	802.11(n) MCS8	12.517	2.4	15	1.92	16.9	30	Pass
				802.11(n) MCS15	13.097	3	16.1	1.92	18	30	Pass
				802.11(n) MCS9 (256-QAM)	10.053	3.2	13.2	1.92	15.2	30	Pass
	80 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52-64 - 5290 MHz	802.11(n) MCS0	15.001	0.8	15.8	1.92	17.7	30	Pass
				802.11(n) MCS9 (256-QAM)	9.135	3.9	13	1.92	14.9	30	Pass

2x2 MIMO, Power Summing Table									
20 MHz									
5250 - 5350 MHz Band									
Low Channel, Ch 52 - 5260 MHz				Chain_1 Value (mW)	Chain_2 Value (mW)	Summed Value (mW)	Summed Value (dBm)	Limit (dBm)	Results
802.11(n) MCS8				21.4	44.7	66.0	18.2	30	Pass
802.11(n) MCS15				27.5	57.5	85.1	19.3	30	Pass
802.11(n) MCS8 (256-QAM)				18.2	38.0	56.2	17.5	30	Pass
Mid Channel, Ch 60 - 5300 MHz									
802.11(n) MCS8				22.4	47.9	70.3	18.5	30	Pass
802.11(n) MCS15				29.5	60.3	89.8	19.5	30	Pass
802.11(n) MCS8 (256-QAM)				18.2	38.9	57.1	17.6	30	Pass
High Channel, Ch 64 - 5320 MHz									
802.11(n) MCS8				24.0	47.9	71.9	18.6	30	Pass
802.11(n) MCS15				28.8	60.3	89.1	19.5	30	Pass
802.11(n) MCS8 (256-QAM)				20.0	39.8	59.8	17.8	30	Pass
40 MHz									
5250 - 5350 MHz Band									
Low Channel, Ch 52/56 - 5270 MHz									
802.11(n) MCS8				22.4	49.0	71.4	18.5	30	Pass
802.11(n) MCS15				28.2	60.3	88.4	19.5	30	Pass
802.11(n) MCS9 (256-QAM)				14.8	33.9	48.7	16.9	30	Pass
High Channel, Ch 60/64 - 5310 MHz									
802.11(n) MCS8				23.4	49.0	72.4	18.6	30	Pass

80 MHz	5250 - 5350 MHz Band	802.11(n) MCS15	30.9	63.1	94.0	19.7	30	Pass
		802.11(n) MCS9 (256-QAM)	15.5	33.1	48.6	16.9	30	Pass
		Low Channel, Ch 52-64 - 5290 MHz						
		802.11(n) MCS0	29.0	58.9	87.9	19.4	30	Pass
		802.11(n) MCS9 (256-QAM)	15.1	30.9	46.0	16.6	30	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO 5.6 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

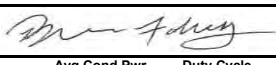
-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO 5.6 GHz BAND



Thx 2019.08.30.0 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE						Work Order: ECHN0015			
Serial Number: Pre-production #1						Date: 5-Feb-20			
Customer: EchoNous, Inc.						Temperature: 22.6 °C			
Attendees: None						Humidity: 39.9% RH			
Project: None						Barometric Pres.: 1020 mbar			
Tested by: Brian Fahey and Jeff Alcock						Job Site: NC0A			
Power: 3.7 VDC									
TEST SPECIFICATIONS						Test Method			
FCC 15.407:2020						ANSI C63.10:2013			
COMMENTS									
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 SectionE), 1), the sum of both individual port measurements were compared to the limit as shown in the power summing table. The port not being measured is terminated with a 50ohm terminator.									
DEVIATIONS FROM TEST STANDARD									
None									
Configuration #	12	Signature 							
			Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
2x2 Chain_1									
20 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100 - 5500 MHz									
802.11(n) MCS8			13.038	1.8	14.8	-0.95	13.8	30	Pass
802.11(n) MCS15			13.352	2.1	15.4	-0.95	14.5	30	Pass
802.11(n) MCS8 (256-QAM)			11.394	2.3	13.7	-0.95	12.8	30	Pass
Mid Channel, Ch 116 - 5580 MHz									
802.11(n) MCS8			12.576	1.8	14.4	-0.95	13.4	30	Pass
802.11(n) MCS15			12.946	2.1	15	-0.95	14.1	30	Pass
802.11(n) MCS8 (256-QAM)			10.989	2.3	13.3	-0.95	12.3	30	Pass
High Channel, Ch 140 - 5700 MHz									
802.11(n) MCS8			12.388	1.6	14	-0.95	13	30	Pass
802.11(n) MCS15			12.943	2.1	15.1	-0.95	14.1	30	Pass
802.11(n) MCS8 (256-QAM)			10.854	2.3	13.2	-0.95	12.2	30	Pass
40 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100/104 - 5510 MHz									
802.11(n) MCS8			12.308	2.4	14.7	-0.95	13.8	30	Pass
802.11(n) MCS15			12.812	2.9	15.8	-0.95	14.8	30	Pass
802.11(n) MCS9 (256-QAM)			9.653	3.2	12.8	-0.95	11.9	30	Pass
Mid Channel, Ch 116/120 - 5590 MHz									
802.11(n) MCS8			11.787	2.4	14.2	-0.95	13.2	30	Pass
802.11(n) MCS15			12.322	2.9	15.2	-0.95	14.3	30	Pass
802.11(n) MCS9 (256-QAM)			8.993	3.2	12.2	-0.95	11.2	30	Pass
High Channel, Ch 132/136 - 5670 MHz									
802.11(n) MCS8			11.861	2.4	14.3	-0.95	13.3	30	Pass
802.11(n) MCS15			12.279	2.9	15.2	-0.95	14.2	30	Pass
802.11(n) MCS9 (256-QAM)			9.069	3.2	12.2	-0.95	11.3	30	Pass
80 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100-112 - 5530 MHz									
802.11(n) MCS0			14.73	0.8	15.5	-0.95	14.5	30	Pass
802.11(n) MCS9 (256-QAM)			8.74	3.9	12.6	-0.95	11.7	30	Pass
High Channel, Ch 116-128 - 5610 MHz									
802.11(n) MCS0			14.184	0.8	15	-0.95	14	30	Pass
802.11(n) MCS9 (256-QAM)			8.109	3.9	12	-0.95	11	30	Pass
2x2 Chain_2									
20 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100 - 5500 MHz									
802.11(n) MCS8			13.212	1.8	15	1.92	16.9	30	Pass
802.11(n) MCS15			13.713	2.1	15.9	1.92	17.8	30	Pass
802.11(n) MCS8 (256-QAM)			11.634	2.3	14	1.92	15.9	30	Pass
Mid Channel, Ch 116 - 5580 MHz									
802.11(n) MCS8			12.716	1.8	14.5	1.92	16.4	30	Pass
802.11(n) MCS15			13.223	2.1	15.3	1.92	17.2	30	Pass
802.11(n) MCS8 (256-QAM)			10.936	2.3	13.2	1.92	15.2	30	Pass
High Channel, Ch 140 - 5700 MHz									
802.11(n) MCS8			12.55	1.6	14.1	1.92	16	30	Pass
802.11(n) MCS15			13.16	2.2	15.3	1.92	17.2	30	Pass
802.11(n) MCS8 (256-QAM)			10.968	2.3	13.3	1.92	15.2	30	Pass
40 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100/104 - 5510 MHz									
802.11(n) MCS8			12.456	2.4	14.9	1.92	16.8	30	Pass
802.11(n) MCS15			13.084	2.9	16	1.92	17.9	30	Pass
802.11(n) MCS9 (256-QAM)			9.928	3.2	13.1	1.92	15.1	30	Pass
Mid Channel, Ch 116/120 - 5590 MHz									
802.11(n) MCS8			12.179	2.5	14.7	1.92	16.6	30	Pass
802.11(n) MCS15			12.651	3	15.6	1.92	17.6	30	Pass
802.11(n) MCS9 (256-QAM)			8.968	3.2	12.2	1.92	14.1	30	Pass
High Channel, Ch 132/136 - 5670 MHz									
802.11(n) MCS8			12.027	2.4	14.5	1.92	16.4	30	Pass
802.11(n) MCS15			12.571	2.9	15.5	1.92	17.4	30	Pass
802.11(n) MCS9 (256-QAM)			9.362	3.3	12.6	1.92	14.6	30	Pass
80 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100-112 - 5530 MHz									
802.11(n) MCS0			14.862	0.8	15.6	1.92	17.5	30	Pass
802.11(n) MCS9 (256-QAM)			9.035	3.9	12.9	1.92	14.8	30	Pass
High Channel, Ch 116-128 - 5610 MHz									
802.11(n) MCS0			14.149	0.8	14.9	1.92	16.9	30	Pass
802.11(n) MCS9 (256-QAM)			8.268	4	12.2	1.92	14.2	30	Pass
2x2 MIMO, Power Summing Table									
20 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100 - 5500 MHz									
				Chain_1 Value (mW)	Chain_2 Value (mW)	Summed Value (mW)	Summed Value (dBm)	Limit (dBm)	Results
802.11(n) MCS8				24.0	49.0	73.0	18.6	30	Pass
802.11(n) MCS15				28.2	60.3	88.4	19.5	30	Pass
802.11(n) MCS8 (256-QAM)				19.1	38.9	58.0	17.6	30	Pass
Mid Channel, Ch 116 - 5580 MHz									
802.11(n) MCS8				21.9	43.7	65.5	18.2	30	Pass

	802.11(n) MCS15	25.7	52.5	78.2	18.9	30	Pass
	802.11(n) MCS8 (256-QAM)	17.0	33.1	50.1	17.0	30	Pass
	High Channel, Ch 140 - 5700 MHz						
	802.11(n) MCS8	20.0	39.8	59.8	17.8	30	Pass
	802.11(n) MCS15	25.7	52.5	78.2	18.9	30	Pass
	802.11(n) MCS8 (256-QAM)	16.6	33.1	49.7	17.0	30	Pass
40 MHz	5470 - 5725 MHz Band						
	Low Channel, Ch 100/104 - 5510 MHz						
	802.11(n) MCS8	24.0	47.9	71.9	18.6	30	Pass
	802.11(n) MCS15	30.2	61.7	91.9	19.6	30	Pass
	802.11(n) MCS9 (256-QAM)	15.5	32.4	47.8	16.8	30	Pass
	Mid Channel, Ch 116/120 - 5590 MHz						
	802.11(n) MCS8	20.9	45.7	66.6	18.2	30	Pass
	802.11(n) MCS15	26.9	57.5	84.5	19.3	30	Pass
	802.11(n) MCS9 (256-QAM)	13.2	25.7	38.9	15.9	30	Pass
	High Channel, Ch 132/136 - 5670 MHz						
	802.11(n) MCS8	21.4	43.7	65.0	18.1	30	Pass
	802.11(n) MCS15	26.3	55.0	81.3	19.1	30	Pass
	802.11(n) MCS9 (256-QAM)	13.5	28.8	42.3	16.3	30	Pass
80 MHz	5470 - 5725 MHz Band						
	Low Channel, Ch 100-112 - 5530 MHz						
	802.11(n) MCS0	28.2	56.2	84.4	19.3	30	Pass
	802.11(n) MCS9 (256-QAM)	14.8	30.2	45.0	16.5	30	Pass
	High Channel, Ch 116-128 - 5610 MHz						
	802.11(n) MCS0	25.1	48.6	73.7	18.7	30	Pass
	802.11(n) MCS9 (256-QAM)	12.6	26.3	38.9	15.9	30	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO 5.8 GHz BAND



XMM 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - MIMO 5.8 GHz BAND



THTx 2019.08.30.0 XMM 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 5-Feb-20
Customer: EchoNous, Inc.	Temperature: 22.4 °C
Attende: None	Humidity: 40.4% RH
Project: None	Barometric Pres.: 1020 mbar
Tested by: Brian Fahey and Jeff Alcock	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2020	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 SectionE), 1), the sum of both individual port measurements were compared to the limit as shown in the power summing table. The port not being measured is terminated with a 50ohm terminator.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	12	Signature	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
-----------------	----	-----------	--------------------	------------------------	---------------	--------------------	------------	------------------	--------

2x2 Chain_1	20 MHz	5725 - 5785 MHz Band	Low Channel, Ch 149 - 5745 MHz	802.11(n) MCS8	12.825	1.6	14.4	-0.95	13.5	36	Pass
				802.11(n) MCS15	13.253	2.1	15.4	-0.95	14.4	36	Pass
				802.11(n) MCS8 (256-QAM)	11.171	2.5	13.7	-0.95	12.7	36	Pass
			Mid Channel, Ch 157 - 5785 MHz	802.11(n) MCS8	12.774	1.6	14.4	-0.95	13.4	36	Pass
				802.11(n) MCS15	13.28	2.2	15.4	-0.95	14.5	36	Pass
				802.11(n) MCS8 (256-QAM)	11.297	2.5	13.8	-0.95	12.9	36	Pass
			High Channel, Ch 165 - 5825 MHz	802.11(n) MCS8	12.903	1.6	14.5	-0.95	13.6	36	Pass
				802.11(n) MCS15	13.368	2.1	15.5	-0.95	14.5	36	Pass
				802.11(n) MCS8 (256-QAM)	11.451	2.4	13.8	-0.95	12.9	36	Pass
	40 MHz	5725 - 5785 MHz Band	Low Channel, Ch 149/153 - 5755 MHz	802.11(n) MCS8	11.864	2.4	14.3	-0.95	13.3	36	Pass
				802.11(n) MCS15	12.439	3.1	15.6	-0.95	14.6	36	Pass
				802.11(n) MCS9 (256-QAM)	9.314	3.2	12.5	-0.95	11.5	36	Pass
			High Channel, Ch 157/161 - 5795 MHz	802.11(n) MCS8	11.942	2.4	14.4	-0.95	13.4	36	Pass
				802.11(n) MCS15	12.532	2.9	15.4	-0.95	14.4	36	Pass
				802.11(n) MCS9 (256-QAM)	9.372	3.3	12.7	-0.95	11.7	36	Pass
	80 MHz	5725 - 5785 MHz Band	Low Channel, Ch 149-161 - 5775 MHz	802.11(n) MCS0	14.446	0.8	15.2	-0.95	14.2	36	Pass
				802.11(n) MCS9 (256-QAM)	8.685	3.9	12.5	-0.95	11.6	36	Pass

2x2 Chain_2	20 MHz	5725 - 5785 MHz Band	Low Channel, Ch 149 - 5745 MHz	802.11(n) MCS8	13.187	1.6	14.8	1.92	16.7	36	Pass
				802.11(n) MCS15	13.658	2.2	15.8	1.92	17.7	36	Pass
				802.11(n) MCS8 (256-QAM)	11.492	2.3	13.8	1.92	15.7	36	Pass
			Mid Channel, Ch 157 - 5785 MHz	802.11(n) MCS8	13.197	1.6	14.8	1.92	16.7	36	Pass
				802.11(n) MCS15	13.662	2.2	15.8	1.92	17.7	36	Pass
				802.11(n) MCS8 (256-QAM)	11.644	2.3	14	1.92	15.9	36	Pass
			High Channel, Ch 165 - 5825 MHz	802.11(n) MCS8	13.544	1.6	15.1	1.92	17.1	36	Pass
				802.11(n) MCS15	14.015	2.2	16.2	1.92	18.1	36	Pass
				802.11(n) MCS8 (256-QAM)	12.078	2.5	14.6	1.92	16.5	36	Pass
	40 MHz	5725 - 5785 MHz Band	Low Channel, Ch 149/153 - 5755 MHz	802.11(n) MCS8	12.567	2.7	15.2	1.92	17.2	36	Pass
				802.11(n) MCS15	13.004	2.9	15.9	1.92	17.8	36	Pass
				802.11(n) MCS9 (256-QAM)	10.027	3.2	13.2	1.92	15.2	36	Pass
			High Channel, Ch 157/161 - 5795 MHz	802.11(n) MCS8	12.605	2.4	15.1	1.92	17	36	Pass
				802.11(n) MCS15	13.03	3.1	16.1	1.92	18.1	36	Pass
				802.11(n) MCS9 (256-QAM)	9.948	3.2	13.1	1.92	15	36	Pass
	80 MHz	5725 - 5785 MHz Band	Low Channel, Ch 149-161 - 5775 MHz	802.11(n) MCS0	14.804	0.8	15.6	1.92	17.5	36	Pass
				802.11(n) MCS9 (256-QAM)	9.08	3.9	12.9	1.92	14.9	36	Pass

Power Summing Table	20 MHz	5725 - 5785 MHz Band	Chain_1 Value (mW)	Chain_2 Value (mW)	Summed Value (mW)	Summed Value (dBm)	Limit (dBm)	Results
		Low Channel, Ch 149 - 5745 MHz	22.4	46.8	69.2	18.4	36	Pass
		802.11(n) MCS8	27.5	58.9	86.4	19.4	36	Pass
		802.11(n) MCS15	18.6	37.2	55.8	17.5	36	Pass
		802.11(n) MCS8 (256-QAM)	21.9	46.8	68.7	18.4	36	Pass
		Mid Channel, Ch 157 - 5785 MHz	28.2	58.9	87.1	19.4	36	Pass
		802.11(n) MCS8	19.5	38.9	58.4	17.7	36	Pass
		802.11(n) MCS15	22.9	51.3	74.2	18.7	36	Pass
		802.11(n) MCS8 (256-QAM)	28.2	64.6	92.7	19.7	36	Pass
		High Channel, Ch 165 - 5825 MHz	19.5	44.7	64.2	18.1	36	Pass
		802.11(n) MCS8	21.4	52.5	73.9	18.7	36	Pass
		Low Channel, Ch 149/153 - 5755 MHz	28.8	60.3	89.1	19.5	36	Pass
		802.11(n) MCS8	14.1	33.1	47.2	16.7	36	Pass
		802.11(n) MCS15						
		802.11(n) MCS9 (256-QAM)						
		High Channel, Ch 157/161 - 5795 MHz	21.9	50.1	72.0	18.6	36	Pass
		802.11(n) MCS8						

	802.11(n) MCS15	27.5	64.6	92.1	19.6	36	Pass
	802.11(n) MCS9 (256-QAM)	14.8	31.6	46.4	16.7	36	Pass
80 MHz	5725 - 5785 MHz Band						
	Low Channel, Ch 149-161 - 5775 MHz						
	802.11(n) MCS0	26.3	56.2	82.5	19.2	36	Pass
	802.11(n) MCS9 (256-QAM)	14.5	30.9	45.4	16.6	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.2 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

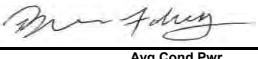
-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.2 GHz BAND



TMTX 2018.09.13 XMM 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNus, Inc.		Temperature: 22 °C	
Attendees: None		Humidity: 27.8% RH	
Project: None		Barometric Pres.: 1023 mbar	
Tested by: Brian Fahey & Jeff Alcoke		Power: 3.7 VDC	
Job Site: NC0A			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature  	
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)
		Out Pwr (dBm)	Antenna Gain (dBi)
		EIRP (dBm)	EIRP Limit (dBm)
			Result

Chain_1			
20 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36 - 5180 MHz			
802.11(a) 6 Mbps	14.664	0.2	14.9
802.11(a) 36 Mbps	13.375	1	14.3
802.11(a) 54 Mbps	12.517	1.3	13.9
802.11(n) MCS0	14.665	0.2	14.9
802.11(n) MCS7	13.466	1.5	14.9
802.11(n) MCS8 (256-QAM)	12.279	1.6	13.9
Mid Channel, Ch 40 - 5200 MHz			
802.11(a) 6 Mbps	14.671	0.2	14.9
802.11(a) 36 Mbps	13.392	1.1	14.4
802.11(a) 54 Mbps	12.511	1.4	13.9
802.11(n) MCS0	14.633	0.2	14.9
802.11(n) MCS7	13.422	1.5	14.9
802.11(n) MCS8 (256-QAM)	12.432	1.7	14.1
High Channel, Ch 48 - 5240 MHz			
802.11(a) 6 Mbps	14.636	0.2	14.8
802.11(a) 36 Mbps	13.311	0.9	14.3
802.11(a) 54 Mbps	13.831	1	14.8
802.11(n) MCS0	14.62	0.2	14.8
802.11(n) MCS7	13.436	1.5	14.9
802.11(n) MCS8 (256-QAM)	12.244	1.8	14
40 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36/40 - 5190 MHz			
802.11(n) MCS0	14.404	0.4	14.8
802.11(n) MCS7	12.615	2.5	15.1
802.11(n) MCS9 (256-QAM)	9.174	2.6	11.8
High Channel, Ch 44/48 - 5230 MHz			
802.11(n) MCS0	14.449	0.5	14.9
802.11(n) MCS7	12.426	2.5	15
802.11(n) MCS9 (256-QAM)	9.096	2.6	11.7
80 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36-48 - 5210 MHz			
802.11(n) MCS0	13.997	0.8	14.8
802.11(n) MCS9 (256-QAM)	8.081	3.6	11.6
Chain_2			
20 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36 - 5180 MHz			
802.11(a) 6 Mbps	15.068	0.2	15.3
802.11(a) 36 Mbps	13.882	1	14.8
802.11(a) 54 Mbps	13.013	1.3	14.3
802.11(n) MCS0	15.092	0.2	15.3
802.11(n) MCS7	13.73	1.4	15.1
802.11(n) MCS8 (256-QAM)	12.74	1.6	14.3
Mid Channel, Ch 40 - 5200 MHz			
802.11(a) 6 Mbps	15.016	0.2	15.2
802.11(a) 36 Mbps	13.847	1	14.9
802.11(a) 54 Mbps	12.987	1.4	14.4
802.11(n) MCS0	15.023	0.2	15.2
802.11(n) MCS7	13.692	1.4	15.1
802.11(n) MCS8 (256-QAM)	12.704	1.7	14.4
High Channel, Ch 48 - 5240 MHz			
802.11(a) 6 Mbps	15.027	0.2	15.2
802.11(a) 36 Mbps	13.726	1	14.7
802.11(a) 54 Mbps	12.813	1.4	14.3
802.11(n) MCS0	15.052	0.2	15.3
802.11(n) MCS7	13.738	1.4	15.1
802.11(n) MCS8 (256-QAM)	12.536	1.6	14.2
40 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36/40 - 5190 MHz			
802.11(n) MCS0	14.823	0.4	15.3
802.11(n) MCS7	12.915	2.4	15.4
802.11(n) MCS9 (256-QAM)	9.161	2.6	11.7
High Channel, Ch 44/48 - 5230 MHz			
802.11(n) MCS0	14.81	0.4	15.2
802.11(n) MCS7	12.935	2.5	15.5
802.11(n) MCS9 (256-QAM)	9.117	2.6	11.7
80 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36-48 - 5210 MHz			
802.11(n) MCS0	14.406	0.8	15.2
802.11(n) MCS9 (256-QAM)	8.282	3.5	11.8

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.3 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.3 GHz BAND



TMTX 2018.09.13 XMM 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 26-Dec-19
Customer: EchoNus, Inc.	Temperature: 21.9 °C
Attendees: None	Humidity: 28% RH
Project: None	Barometric Pres.: 1022 mbar
Tested by: Brian Fahey & Jeff Alcoke	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2019	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23 dB.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	1	Signature	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
-----------------	---	-----------	--------------------	------------------------	---------------	--------------------	------------	------------------	--------

Chain_1	20 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52 - 5260 MHz	802.11(a) 6 Mbps	14.635	0.2	14.8	-0.95	13.9	30	Pass
				802.11(a) 36 Mbps	13.341	1	14.4	-0.95	13.4	30	Pass
				802.11(a) 54 Mbps	12.521	1.3	13.9	-0.95	12.9	30	Pass
				802.11(n) MCS0	14.664	0.2	14.9	-0.95	13.9	30	Pass
				802.11(n) MCS7	13.449	1.4	14.9	-0.95	13.9	30	Pass
				802.11(n) MCS8 (256-QAM)	12.238	1.6	13.8	-0.95	12.9	30	Pass
			Mid Channel, Ch 60 - 5300 MHz	802.11(a) 6 Mbps	14.792	0.2	15	-0.95	14	30	Pass
				802.11(a) 36 Mbps	13.44	1	14.4	-0.95	13.5	30	Pass
				802.11(a) 54 Mbps	12.686	1.3	14	-0.95	13.1	30	Pass
				802.11(n) MCS0	14.764	0.2	15	-0.95	14	30	Pass
				802.11(n) MCS7	13.56	1.6	15.1	-0.95	14.2	30	Pass
				802.11(n) MCS8 (256-QAM)	12.449	1.7	14.2	-0.95	13.2	30	Pass
			High Channel, Ch 64 - 5320 MHz	802.11(a) 6 Mbps	15.034	0.2	15.2	-0.95	14.3	30	Pass
				802.11(a) 36 Mbps	13.929	1	14.9	-0.95	13.9	30	Pass
				802.11(a) 54 Mbps	12.95	1.4	14.4	-0.95	13.4	30	Pass
				802.11(n) MCS0	15.021	0.2	15.2	-0.95	14.3	30	Pass
				802.11(n) MCS7	13.876	1.5	15.4	-0.95	14.5	30	Pass
				802.11(n) MCS8 (256-QAM)	12.713	1.6	14.3	-0.95	13.4	30	Pass
	40 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52/56 - 5270 MHz	802.11(n) MCS0	14.338	0.4	14.7	-0.95	13.8	30	Pass
				802.11(n) MCS7	12.547	2.6	15.1	-0.95	14.2	30	Pass
				802.11(n) MCS9 (256-QAM)	9.297	2.6	11.9	-0.95	11	30	Pass
			High Channel, Ch 60/64 - 5310 MHz	802.11(n) MCS0	14.542	0.4	15	-0.95	14	30	Pass
				802.11(n) MCS7	12.61	2.4	15.1	-0.95	14.1	30	Pass
				802.11(n) MCS9 (256-QAM)	9.757	2.6	12.4	-0.95	11.4	30	Pass
	80 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52-64 - 5290 MHz	802.11(n) MCS0	14.127	0.8	14.9	-0.95	14	30	Pass
				802.11(n) MCS9 (256-QAM)	8.717	3.7	12.4	-0.95	11.5	30	Pass
Chain_2	20 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52 - 5260 MHz	802.11(a) 6 Mbps	14.938	0.2	15.1	1.92	17.1	30	Pass
				802.11(a) 36 Mbps	13.585	0.9	14.5	1.92	16.5	30	Pass
				802.11(a) 54 Mbps	12.666	1.3	14	1.92	15.9	30	Pass
				802.11(n) MCS0	14.823	0.2	15	1.92	16.9	30	Pass
				802.11(n) MCS7	13.581	1.4	15	1.92	16.9	30	Pass
				802.11(n) MCS8 (256-QAM)	12.379	1.6	14	1.92	15.9	30	Pass
			Mid Channel, Ch 60 - 5300 MHz	802.11(a) 6 Mbps	15.119	0.2	15.3	1.92	17.3	30	Pass
				802.11(a) 36 Mbps	13.859	1	14.8	1.92	16.7	30	Pass
				802.11(a) 54 Mbps	12.988	1.4	14.4	1.92	16.3	30	Pass
				802.11(n) MCS0	15.138	0.2	15.3	1.92	17.3	30	Pass
				802.11(n) MCS7	13.8	1.4	15.2	1.92	17.1	30	Pass
				802.11(n) MCS8 (256-QAM)	12.689	1.7	14.4	1.92	16.3	30	Pass
			High Channel, Ch 64 - 5320 MHz	802.11(a) 6 Mbps	15.101	0.2	15.3	1.92	17.2	30	Pass
				802.11(a) 36 Mbps	14.048	1	15	1.92	16.9	30	Pass
				802.11(a) 54 Mbps	13.039	1.3	14.4	1.92	16.3	30	Pass
				802.11(n) MCS0	15.115	0.2	15.3	1.92	17.2	30	Pass
				802.11(n) MCS7	13.849	1.4	15.3	1.92	17.2	30	Pass
				802.11(n) MCS8 (256-QAM)	12.794	1.7	14.5	1.92	16.4	30	Pass
	40 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52/56 - 5270 MHz	802.11(n) MCS0	14.793	0.4	15.2	1.92	17.1	30	Pass
				802.11(n) MCS7	12.864	2.5	15.3	1.92	17.2	30	Pass
				802.11(n) MCS9 (256-QAM)	9.681	2.6	12.2	1.92	14.2	30	Pass
			High Channel, Ch 60/64 - 5310 MHz	802.11(n) MCS0	14.914	0.5	15.4	1.92	17.3	30	Pass
				802.11(n) MCS7	13.054	2.4	15.5	1.92	17.4	30	Pass
				802.11(n) MCS9 (256-QAM)	9.928	2.6	12.6	1.92	14.5	30	Pass
	80 MHz	5250 - 5350 MHz Band	Low Channel, Ch 52-64 - 5290 MHz	802.11(n) MCS0	14.403	0.9	15.3	1.92	17.2	30	Pass
				802.11(n) MCS9 (256-QAM)	8.867	3.5	12.4	1.92	14.3	30	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.6 GHz BAND



X3Mit 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.6 GHz BAND



TMTx 2018.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015					
Serial Number: Pre-production #1				Date: 23-Dec-19					
Customer: EchoNus, Inc.				Temperature: 22.1 °C					
Attendees: None				Humidity: 37.5% RH					
Project: None				Barometric Pres.: 1018 mbar					
Tested by: Brian Fahey & Jeff Alcoke				Job Site: NC0A					
Power: 3.7 VDC									
TEST SPECIFICATIONS				Test Method					
FCC 15.407:2019				ANSI C63.10:2013					
COMMENTS									
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.									
DEVIATIONS FROM TEST STANDARD									
None									
Configuration #	1	Signature  							
			Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
Chain_1									
20 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100 - 5500 MHz									
		802.11(a) 6 Mbps	15.11	0.2	15.3	-0.95	14.4	30	Pass
		802.11(a) 36 Mbps	13.942	1	14.9	-0.95	13.9	30	Pass
		802.11(a) 54 Mbps	13.077	1.4	14.4	-0.95	13.5	30	Pass
		802.11(n) MCS0	15.074	0.2	15.3	-0.95	14.3	30	Pass
		802.11(n) MCS7	13.939	1.4	15.4	-0.95	14.4	30	Pass
		802.11(n) MCS8 (256-QAM)	12.765	1.6	14.4	-0.95	13.4	30	Pass
Mid Channel, Ch 116 - 5580 MHz									
		802.11(a) 6 Mbps	14.498	0.2	14.7	-0.95	13.8	30	Pass
		802.11(a) 36 Mbps	13.365	1	14.3	-0.95	13.4	30	Pass
		802.11(a) 54 Mbps	12.509	1.5	14	-0.95	13	30	Pass
		802.11(n) MCS0	14.472	0.2	14.7	-0.95	13.7	30	Pass
		802.11(n) MCS7	13.411	1.4	14.8	-0.95	13.9	30	Pass
		802.11(n) MCS8 (256-QAM)	12.154	1.7	13.8	-0.95	12.9	30	Pass
High Channel, Ch 140 - 5700 MHz									
		802.11(a) 6 Mbps	15.092	0.2	15.3	-0.95	14.3	30	Pass
		802.11(a) 36 Mbps	13.844	0.9	14.8	-0.95	13.8	30	Pass
		802.11(a) 54 Mbps	13.045	1.4	14.5	-0.95	13.5	30	Pass
		802.11(n) MCS0	15.169	0.2	15.4	-0.95	14.4	30	Pass
		802.11(n) MCS7	13.921	1.4	15.3	-0.95	14.4	30	Pass
		802.11(n) MCS8 (256-QAM)	12.734	1.6	14.3	-0.95	13.4	30	Pass
40 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100/104 - 5510 MHz									
		802.11(n) MCS0	14.674	0.4	15.1	-0.95	14.2	30	Pass
		802.11(n) MCS7	12.917	2.5	15.4	-0.95	14.5	30	Pass
		802.11(n) MCS9 (256-QAM)	9.791	2.6	12.4	-0.95	11.5	30	Pass
Mid Channel, Ch 116/120 - 5590 MHz									
		802.11(n) MCS0	14.06	0.5	14.5	-0.95	13.6	30	Pass
		802.11(n) MCS7	12.288	2.5	14.8	-0.95	13.8	30	Pass
		802.11(n) MCS9 (256-QAM)	8.748	2.6	11.3	-0.95	10.4	30	Pass
High Channel, Ch 132/136 - 5670 MHz									
		802.11(n) MCS0	14.515	0.4	14.9	-0.95	14.0	30	Pass
		802.11(n) MCS7	12.685	2.5	15.2	-0.95	14.2	30	Pass
		802.11(n) MCS9 (256-QAM)	9.47	2.6	12.1	-0.95	11.1	30	Pass
80 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100-112 - 5530 MHz									
		802.11(n) MCS0	14.224	0.8	15.1	-0.95	14.1	30	Pass
		802.11(n) MCS9 (256-QAM)	8.686	3.6	12.2	-0.95	11.3	30	Pass
High Channel, Ch 116-128 - 5610 MHz									
		802.11(n) MCS0	13.976	0.8	14.8	-0.95	13.9	30	Pass
		802.11(n) MCS9 (256-QAM)	8.206	3.5	11.7	-0.95	10.8	30	Pass
Chain_2									
20 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100 - 5500 MHz									
		802.11(a) 6 Mbps	15.224	0.2	15.4	1.92	17.4	30	Pass
		802.11(a) 36 Mbps	14.012	1.1	15.1	1.92	17	30	Pass
		802.11(a) 54 Mbps	13.061	1.3	14.4	1.92	16.3	30	Pass
		802.11(n) MCS0	15.198	0.2	15.4	1.92	17.3	30	Pass
		802.11(n) MCS7	13.962	1.4	15.4	1.92	17.3	30	Pass
		802.11(n) MCS8 (256-QAM)	12.793	1.6	14.4	1.92	16.3	30	Pass
Mid Channel, Ch 116 - 5580 MHz									
		802.11(a) 6 Mbps	14.609	0.2	14.8	1.92	16.7	30	Pass
		802.11(a) 36 Mbps	13.502	0.9	14.4	1.92	16.4	30	Pass
		802.11(a) 54 Mbps	12.672	1.3	14	1.92	15.9	30	Pass
		802.11(n) MCS0	14.702	0.2	14.9	1.92	16.8	30	Pass
		802.11(n) MCS7	13.524	1.4	15	1.92	16.9	30	Pass
		802.11(n) MCS8 (256-QAM)	12.38	1.6	14	1.92	15.9	30	Pass
High Channel, Ch 140 - 5700 MHz									
		802.11(a) 6 Mbps	15.106	0.2	15.3	1.92	17.2	30	Pass
		802.11(a) 36 Mbps	13.836	1	14.8	1.92	16.7	30	Pass
		802.11(a) 54 Mbps	13.036	1.3	14.4	1.92	16.3	30	Pass
		802.11(n) MCS0	15.169	0.2	15.4	1.92	17.3	30	Pass
		802.11(n) MCS7	13.942	1.5	15.5	1.92	17.4	30	Pass
		802.11(n) MCS8 (256-QAM)	12.76	1.6	14.4	1.92	16.3	30	Pass
40 MHz									
5470 - 5725 MHz Band									
Low Channel, Ch 100/104 - 5510 MHz									
		802.11(n) MCS0	14.92	0.4	15.4	1.92	17.3	30	Pass
		802.11(n) MCS7	13.1	2.7	15.8	1.92	17.7	30	Pass
		802.11(n) MCS9 (256-QAM)	9.901	2.6	12.5	1.92	14.4	30	Pass
Mid Channel, Ch 116/120 - 5590 MHz									
		802.11(n) MCS0	14.433	0.4	14.8	1.92	16.8	30	Pass
		802.11(n) MCS7	12.621	2.5	15.1	1.92	17	30	Pass
		802.11(n) MCS9 (256-QAM)	8.886	2.6	11.5	1.92	13.4	30	Pass
High Channel, Ch 132/136 - 5670 MHz									
		802.11(n) MCS0	14.658	0.4	15.1	1.92	17	30	Pass
		802.11(n) MCS7	12.811	2.5	15.3	1.92	17.2	30	Pass

80 MHz	802.11(n) MCS9 (256-QAM)	9.572	2.6	12.2	1.92	14.1	30	Pass
5470 - 5725 MHz Band								
Low Channel, Ch 100-112 - 5530 MHz								
	802.11(n) MCS0	14.407	0.9	15.3	1.92	17.2	30	Pass
	802.11(n) MCS9 (256-QAM)	8.903	3.5	12.4	1.92	14.3	30	Pass
High Channel, Ch 116-128 - 5610 MHz								
	802.11(n) MCS0	13.843	0.9	14.8	1.92	16.7	30	Pass
	802.11(n) MCS9 (256-QAM)	8.311	3.4	11.8	1.92	13.7	30	Pass

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.8 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum transmit power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The maximum conducted output power was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor). The antenna gain of the EUT was then added to the conducted output power to derive the EIRP values.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-RMS Detector

-Trace average 100 traces in power averaging mode.

-Power was integrated across "B", by using the channel power function of the analyzer.

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) - SISO 5.8 GHz BAND



TMTX 2018.09.13 XM1 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE	Work Order: ECHN0015
Serial Number: Pre-production #1	Date: 23-Dec-19
Customer: EchoNus, Inc.	Temperature: 22.2 °C
Attendees: None	Humidity: 37.1% RH
Project: None	Barometric Pres.: 1018 mbar
Tested by: Brian Fahey & Jeff Alcoke	Power: 3.7 VDC
	Job Site: NC0A

TEST SPECIFICATIONS	Test Method
FCC 15.407:2019	ANSI C63.10:2013

COMMENTS
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.

DEVIATIONS FROM TEST STANDARD
None

Configuration #	1	Signature							
-----------------	---	-----------	--	--	--	--	--	--	--

Chain_1			Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
20 MHz	5725 - 5785 MHz Band								
	Low Channel, Ch 149 - 5745 MHz								
	802.11(a) 6 Mbps		15.018	0.2	15.2	-0.95	14.3	36	Pass
	802.11(a) 36 Mbps		13.791	1	14.8	-0.95	13.8	36	Pass
	802.11(a) 54 Mbps		13.067	1.3	14.4	-0.95	13.5	36	Pass
	802.11(n) MCS0		15.066	0.2	15.3	-0.95	14.3	36	Pass
	802.11(n) MCS7		13.903	1.5	15.4	-0.95	14.4	36	Pass
	802.11(n) MCS8 (256-QAM)		12.838	1.6	14.5	-0.95	13.5	36	Pass
	Mid Channel, Ch 157 - 5785 MHz								
	802.11(a) 6 Mbps		15.359	0.2	15.6	-0.95	14.6	36	Pass
	802.11(a) 36 Mbps		14.107	1	15.1	-0.95	14.1	36	Pass
	802.11(a) 54 Mbps		13.349	1.5	14.8	-0.95	13.9	36	Pass
	802.11(n) MCS0		15.371	0.2	15.6	-0.95	14.6	36	Pass
	802.11(n) MCS7		14.251	1.5	15.7	-0.95	14.8	36	Pass
	802.11(n) MCS8 (256-QAM)		13.107	1.6	14.7	-0.95	13.8	36	Pass
	High Channel, Ch 165 - 5825 MHz								
	802.11(a) 6 Mbps		15.249	0.2	15.5	-0.95	14.5	36	Pass
	802.11(a) 36 Mbps		14.157	1	15.1	-0.95	14.2	36	Pass
	802.11(a) 54 Mbps		13.189	1.5	14.6	-0.95	13.7	36	Pass
	802.11(n) MCS0		15.232	0.2	15.5	-0.95	14.5	36	Pass
	802.11(n) MCS7		14.103	1.5	15.6	-0.95	14.6	36	Pass
	802.11(n) MCS8 (256-QAM)		12.919	1.6	14.5	-0.95	13.6	36	Pass
40 MHz	5725 - 5785 MHz Band								
	Low Channel, Ch 149/153 - 5755 MHz								
	802.11(n) MCS0		14.944	0.4	15.3	-0.95	14.4	36	Pass
	802.11(n) MCS7		13.265	2.2	15.5	-0.95	14.6	36	Pass
	802.11(n) MCS9 (256-QAM)		10.101	2.6	12.7	-0.95	11.8	36	Pass
	High Channel, Ch 157/161 - 5795 MHz								
	802.11(n) MCS0		15.118	0.5	15.6	-0.95	14.6	36	Pass
	802.11(n) MCS7		13.416	2.2	15.7	-0.95	14.7	36	Pass
	802.11(n) MCS9 (256-QAM)		10.289	2.6	12.9	-0.95	11.9	36	Pass
80 MHz	5725 - 5785 MHz Band								
	Low Channel, Ch 149-161 - 5775 MHz								
	802.11(n) MCS0		14.73	0.8	15.5	-0.95	14.5	36	Pass
	802.11(n) MCS9 (256-QAM)		9.092	3.7	12.8	-0.95	11.9	36	Pass
Chain_2	20 MHz	5725 - 5785 MHz Band							
	Low Channel, Ch 149 - 5745 MHz								
	802.11(a) 6 Mbps		15.415	0.2	15.6	1.92	17.5	36	Pass
	802.11(a) 36 Mbps		14.322	1	15.3	1.92	17.2	36	Pass
	802.11(a) 54 Mbps		13.541	1.5	15	1.92	16.9	36	Pass
	802.11(n) MCS0		15.428	0.2	15.6	1.92	17.6	36	Pass
	802.11(n) MCS7		14.273	1.4	15.7	1.92	17.6	36	Pass
	802.11(n) MCS8 (256-QAM)		13.292	1.4	14.7	1.92	16.6	36	Pass
	Mid Channel, Ch 157 - 5785 MHz								
	802.11(a) 6 Mbps		15.792	0.2	16	1.92	17.9	36	Pass
	802.11(a) 36 Mbps		14.683	1	15.7	1.92	17.6	36	Pass
	802.11(a) 54 Mbps		13.902	1.3	15.3	1.92	17.2	36	Pass
	802.11(n) MCS0		15.815	0.2	16	1.92	17.9	36	Pass
	802.11(n) MCS7		14.625	1.4	16	1.92	18	36	Pass
	802.11(n) MCS8 (256-QAM)		13.615	1.6	15.2	1.92	17.1	36	Pass
	High Channel, Ch 165 - 5825 MHz								
	802.11(a) 6 Mbps		16.042	0.2	16.3	1.92	18.2	36	Pass
	802.11(a) 36 Mbps		14.856	1	15.8	1.92	17.7	36	Pass
	802.11(a) 54 Mbps		14.004	1.3	15.3	1.92	17.3	36	Pass
	802.11(n) MCS0		16.065	0.2	16.3	1.92	18.2	36	Pass
	802.11(n) MCS7		14.945	1.6	16.5	1.92	18.4	36	Pass
	802.11(n) MCS8 (256-QAM)		13.729	1.6	15.3	1.92	17.3	36	Pass
40 MHz	5725 - 5785 MHz Band								
	Low Channel, Ch 149/153 - 5755 MHz								
	802.11(n) MCS0		15.384	0.4	15.8	1.92	17.7	36	Pass
	802.11(n) MCS7		13.553	2.2	15.8	1.92	17.7	36	Pass
	802.11(n) MCS9 (256-QAM)		10.509	2.6	13.1	1.92	15	36	Pass
	High Channel, Ch 157/161 - 5795 MHz								
	802.11(n) MCS0		15.581	0.5	16	1.92	18	36	Pass
	802.11(n) MCS7		13.74	2.3	16	1.92	17.9	36	Pass
	802.11(n) MCS9 (256-QAM)		10.685	2.6	13.3	1.92	15.2	36	Pass
80 MHz	5725 - 5785 MHz Band								
	Low Channel, Ch 149-161 - 5775 MHz								
	802.11(n) MCS0		15.143	0.9	16	1.92	17.9	36	Pass
	802.11(n) MCS9 (256-QAM)		9.739	3.5	13.2	1.92	15.2	36	Pass

EMISSION BANDWIDTH - MIMO 5.2 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = Approx. 1% of the emission bandwidth (B).

-VBW = > RBW

-Detector = Peak

-

-Trace mode = max hold

The spectrum analyzer occupied bandwidth measurement function was then used to measure 26 dB emission bandwidth.

There is no required limit to be met in the rule part for this test. The purpose of the test is to both report the results as required and to utilize the emission bandwidth for setting the channel power integration bandwidth during conducted output power testing.

EMISSION BANDWIDTH - MIMO 5.2 GHz BAND



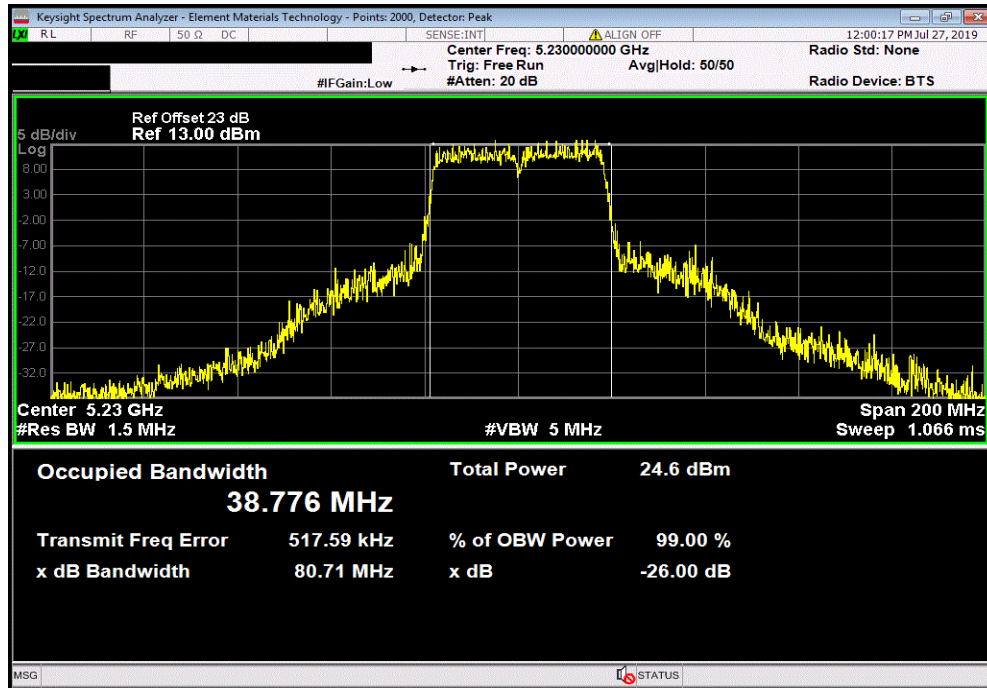
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015			
Serial Number: Pre-production #1		Date: 29-Jul-19			
Customer: EchoNous, Inc.		Temperature: 22.4 °C			
Attendees: None		Humidity: 45.8% RH			
Project: None		Barometric Pres.: 1020 mbar			
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC			
Job Site: NC0A					
TEST SPECIFICATIONS		Test Method			
FCC 15.407:2019		ANSI C63.10:2013			
COMMENTS					
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dBm.					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	12	Signature  			
		99% (MHz)	26 dB (MHz)	Limit	Result
2x2 Chain_1					
20 MHz					
5150 - 5250 MHz Band					
Low Channel, Ch 36 - 5180 MHz					
802.11(n) MCS8		18.157 MHz	24.214 MHz	N/A	N/A
802.11(n) MCS15		18.007 MHz	22.817 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.83 MHz	21.278 MHz	N/A	N/A
Mid Channel, Ch 40 - 5200 MHz					
802.11(n) MCS8		18.28 MHz	25.127 MHz	N/A	N/A
802.11(n) MCS15		17.98 MHz	22.569 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		18.024 MHz	21.999 MHz	N/A	N/A
High Channel, Ch 48 - 5240 MHz					
802.11(n) MCS8		18.267 MHz	24.874 MHz	N/A	N/A
802.11(n) MCS15		18.003 MHz	22.88 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.945 MHz	22.037 MHz	N/A	N/A
40 MHz					
5150 - 5250 MHz Band					
Low Channel, Ch 36/40 - 5190 MHz					
802.11(n) MCS8		36.991 MHz	60.892 MHz	N/A	N/A
802.11(n) MCS15		36.906 MHz	59.355 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		36.801 MHz	45.955 MHz	N/A	N/A
High Channel, Ch 44/48 - 5230 MHz					
802.11(n) MCS8		38.776 MHz	80.714 MHz	N/A	N/A
802.11(n) MCS15		36.898 MHz	59.708 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		36.811 MHz	44.789 MHz	N/A	N/A
80 MHz					
5150 - 5250 MHz Band					
Low Channel, Ch 36-48 - 5210 MHz					
802.11(n) MCS9 (256-QAM)		76.545 MHz	137.401 MHz	N/A	N/A
802.11(n) MCS0		76.719 MHz	90.795 MHz	N/A	N/A
2x2 Chain_2					
20 MHz					
5150 - 5250 MHz Band					
Low Channel, Ch 36 - 5180 MHz					
802.11(n) MCS8		18.363 MHz	25.814 MHz	N/A	N/A
802.11(n) MCS15		18.217 MHz	25.038 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.893 MHz	21.922 MHz	N/A	N/A
Mid Channel, Ch 40 - 5200 MHz					
802.11(n) MCS8		18.332 MHz	26.841 MHz	N/A	N/A
802.11(n) MCS15		18.151 MHz	23.353 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		18.334 MHz	27.977 MHz	N/A	N/A
High Channel, Ch 48 - 5240 MHz					
802.11(n) MCS8		18.68 MHz	35.54 MHz	N/A	N/A
802.11(n) MCS15		17.996 MHz	22.799 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.927 MHz	21.854 MHz	N/A	N/A
40 MHz					
5150 - 5250 MHz Band					
Low Channel, Ch 36/40 - 5190 MHz					
802.11(n) MCS8		38.479 MHz	73.787 MHz	N/A	N/A
802.11(n) MCS15		37.185 MHz	66.893 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		36.802 MHz	45.29 MHz	N/A	N/A
High Channel, Ch 44/48 - 5230 MHz					
802.11(n) MCS8		36.799 MHz	42.679 MHz	N/A	N/A
802.11(n) MCS15		38.326 MHz	76.241 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		36.874 MHz	42.242 MHz	N/A	N/A
80 MHz					
5150 - 5250 MHz Band					
Low Channel, Ch 36-48 - 5210 MHz					
802.11(n) MCS9 (256-QAM)		79.709 MHz	182.786 MHz	N/A	N/A
802.11(n) MCS0		76.314 MHz	85.928 MHz	N/A	N/A

EMISSION BANDWIDTH - MIMO 5.2 GHz BAND

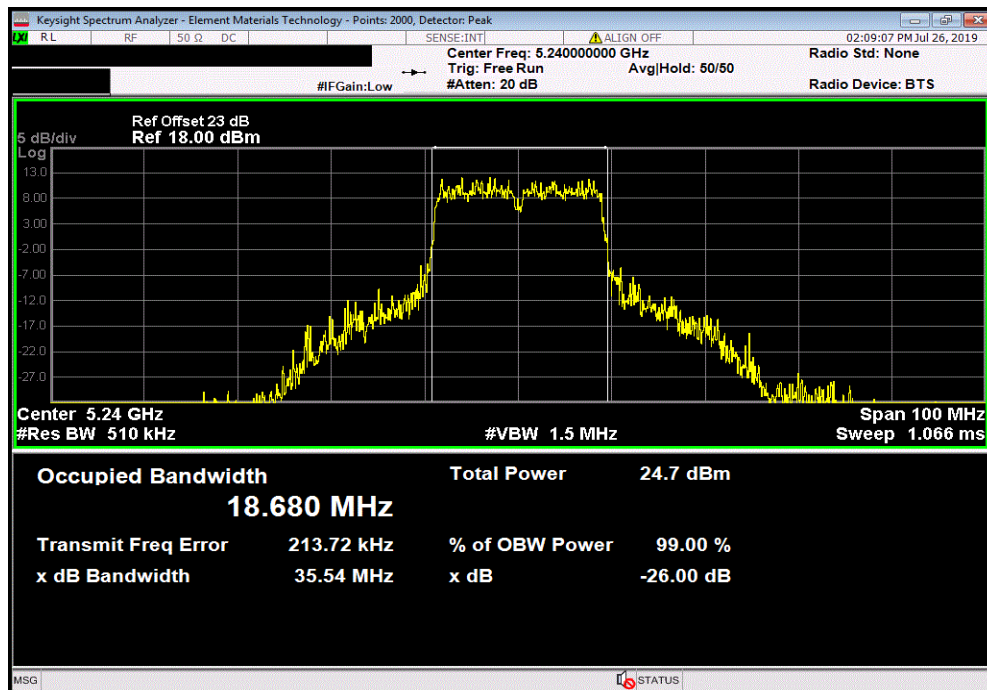


TMTx 2018.09.13 XMI 2019.06.11

2x2 Chain_1, 40 MHz, 5150 - 5250 MHz Band, High Channel, Ch 44/48 - 5230 MHz, 802.11(n) MCS8						
	0.99 (MHz)	26 dB (MHz)	Limit	Result		
	38.776 MHz	80.714 MHz	N/A	N/A		



2x2 Chain_2, 20 MHz, 5150 - 5250 MHz Band, High Channel, Ch 48 - 5240 MHz, 802.11(n) MCS8						
	0.99 (MHz)	26 dB (MHz)	Limit	Result		
	18.68 MHz	35.54 MHz	N/A	N/A		

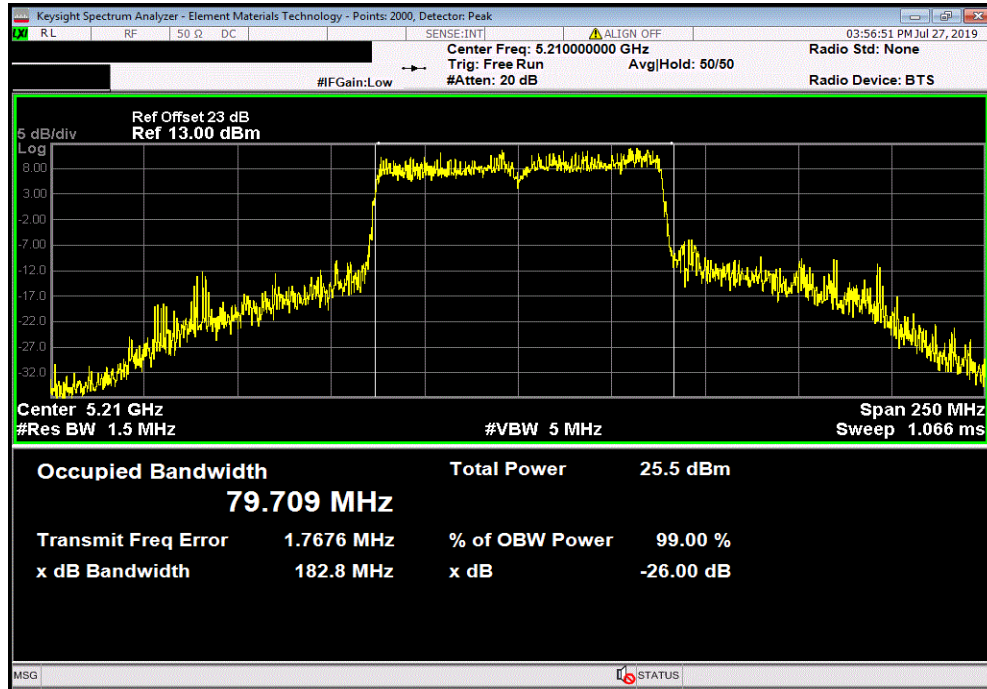


EMISSION BANDWIDTH - MIMO 5.2 GHz BAND



TMTx 2018.09.13 XMI 2019.06.11

2x2 Chain_2, 80 MHz, 5150 - 5250 MHz Band, Low Channel, Ch 36-48 - 5210 MHz, 802.11(n) MCS9 (256-QAM)					
0.99 (MHz)		26 dB (MHz)		Limit	Result
79.709 MHz		182.786 MHz		N/A	N/A



EMISSION BANDWIDTH - MIMO 5.3 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = Approx. 1% of the emission bandwidth (B).

-VBW = > RBW

-Detector = Peak

-

-Trace mode = max hold

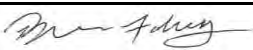
The spectrum analyzer occupied bandwidth measurement function was then used to measure 26 dB emission bandwidth.

There is no required limit to be met in the rule part for this test. The purpose of the test is to both report the results as required and to utilize the emission bandwidth for setting the channel power integration bandwidth during conducted output power testing.

EMISSION BANDWIDTH - MIMO 5.3 GHz BAND



TMTx 2018.09.13 XMt 2019.06.11

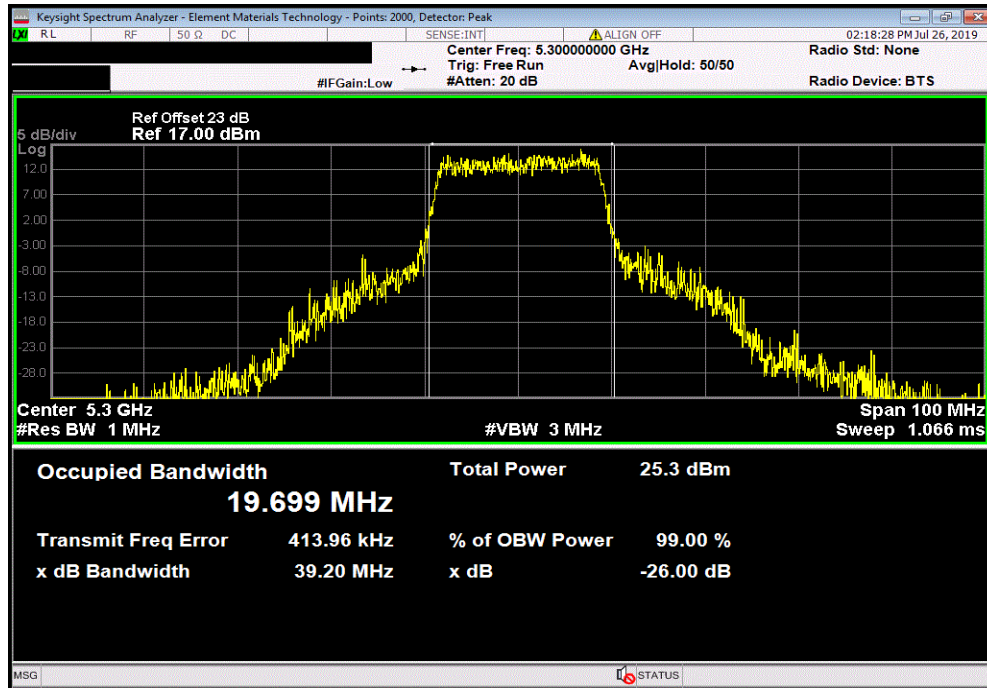
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015			
Serial Number: Pre-production #1		Date: 29-Jul-19			
Customer: EchoNous, Inc.		Temperature: 22 °C			
Attendees: None		Humidity: 53.6% RH			
Project: None		Barometric Pres.: 1020 mbar			
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method			
FCC 15.407:2019		ANSI C63.10:2013			
COMMENTS					
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB.					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	12	Signature  			
		99% (MHz)	26 dB (MHz)	Limit	Result
2x2 Chain_1					
20 MHz					
5250 - 5350 MHz Band					
Low Channel, Ch 52 - 5260 MHz					
802.11(n) MCS8		18.574 MHz	38.133 MHz	N/A	N/A
802.11(n) MCS15		18.003 MHz	23.107 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.895 MHz	22.423 MHz	N/A	N/A
Mid Channel, Ch 60 - 5300 MHz					
802.11(n) MCS8		18.098 MHz	23.368 MHz	N/A	N/A
802.11(n) MCS15		17.975 MHz	22.733 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		18.21 MHz	25.681 MHz	N/A	N/A
High Channel, Ch 64 - 5320 MHz					
802.11(n) MCS8		18.186 MHz	29 MHz	N/A	N/A
802.11(n) MCS15		18.037 MHz	22.393 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.96 MHz	22.006 MHz	N/A	N/A
40 MHz					
5250 - 5350 MHz Band					
Low Channel, Ch 52/56 - 5270 MHz					
802.11(n) MCS8		37.611 MHz	60.871 MHz	N/A	N/A
802.11(n) MCS15		38.188 MHz	76.145 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		36.897 MHz	45.604 MHz	N/A	N/A
High Channel, Ch 60/64 - 5310 MHz					
802.11(n) MCS8		37.004 MHz	61.582 MHz	N/A	N/A
802.11(n) MCS15		37.874 MHz	69.781 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		36.859 MHz	45.485 MHz	N/A	N/A
80 MHz					
5250 - 5350 MHz Band					
Low Channel, Ch 52-64 - 5290 MHz					
802.11(n) MCS9 (256-QAM)		76.574 MHz	131.215 MHz	N/A	N/A
802.11(n) MCS0		76.88 MHz	103.685 MHz	N/A	N/A
2x2 Chain_2					
20 MHz					
5250 - 5350 MHz Band					
Low Channel, Ch 52 - 5260 MHz					
802.11(n) MCS8		18.446 MHz	31.382 MHz	N/A	N/A
802.11(n) MCS15		17.974 MHz	22.097 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		18.297 MHz	28.881 MHz	N/A	N/A
Mid Channel, Ch 60 - 5300 MHz					
802.11(n) MCS8		19.699 MHz	39.203 MHz	N/A	N/A
802.11(n) MCS15		18.059 MHz	25.591 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.965 MHz	23.641 MHz	N/A	N/A
High Channel, Ch 64 - 5320 MHz					
802.11(n) MCS8		18.48 MHz	29.092 MHz	N/A	N/A
802.11(n) MCS15		18.869 MHz	35.401 MHz	N/A	N/A
802.11(n) MCS8 (256-QAM)		17.912 MHz	22.224 MHz	N/A	N/A
40 MHz					
5250 - 5350 MHz Band					
Low Channel, Ch 52/56 - 5270 MHz					
802.11(n) MCS8		37.21 MHz	69.475 MHz	N/A	N/A
802.11(n) MCS15		37.222 MHz	53.862 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		36.779 MHz	44.857 MHz	N/A	N/A
High Channel, Ch 60/64 - 5310 MHz					
802.11(n) MCS8		38.686 MHz	80.971 MHz	N/A	N/A
802.11(n) MCS15		37.113 MHz	75.288 MHz	N/A	N/A
802.11(n) MCS9 (256-QAM)		37.075 MHz	63.284 MHz	N/A	N/A
80 MHz					
5250 - 5350 MHz Band					
Low Channel, Ch 52-64 - 5290 MHz					
802.11(n) MCS9 (256-QAM)		76.694 MHz	143.171 MHz	N/A	N/A
802.11(n) MCS0		76.492 MHz	86.491 MHz	N/A	N/A

EMISSION BANDWIDTH - MIMO 5.3 GHz BAND

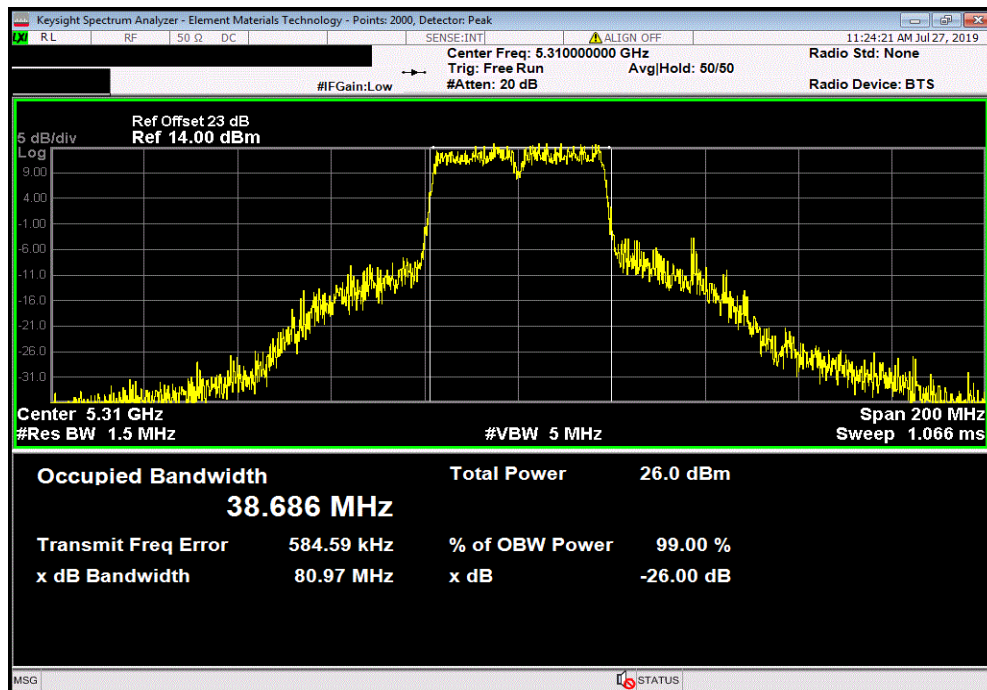


TMTx 2018.09.13 XMt 2019.06.11

2x2 Chain_2, 20 MHz, 5250 - 5350 MHz Band, Mid Channel, Ch 60 - 5300 MHz, 802.11(n) MCS8						
	0.99 (MHz)	26 dB (MHz)	Limit	Result		
	19.699 MHz	39.203 MHz	N/A	N/A		



2x2 Chain_2, 40 MHz, 5250 - 5350 MHz Band, High Channel, Ch 60/64 - 5310 MHz, 802.11(n) MCS8						
	0.99 (MHz)	26 dB (MHz)	Limit	Result		
	38.686 MHz	80.971 MHz	N/A	N/A		

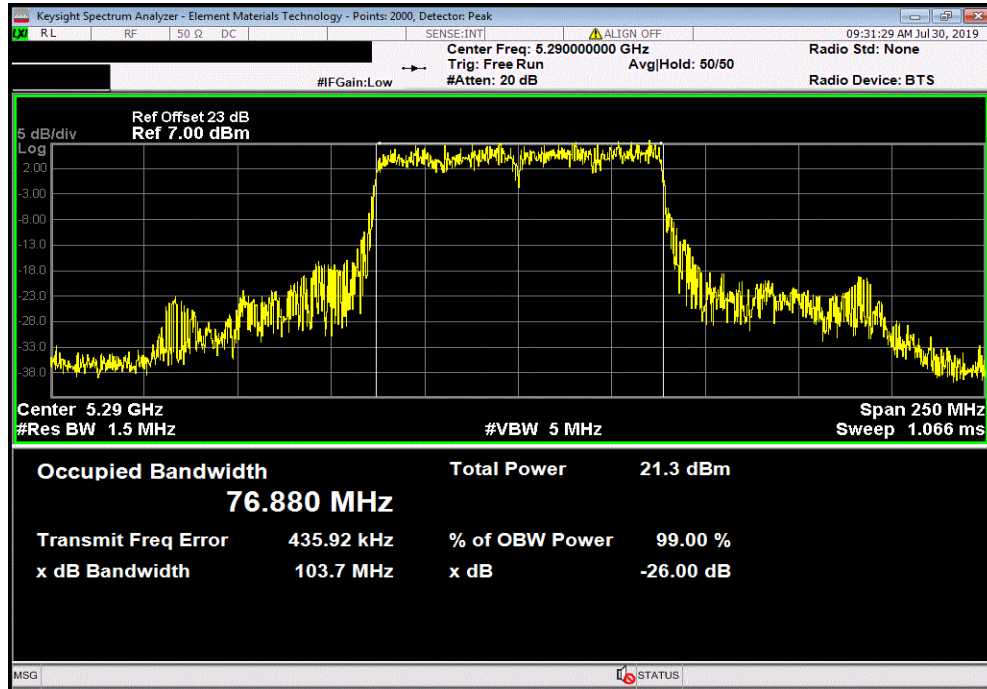


EMISSION BANDWIDTH - MIMO 5.3 GHz BAND



TMTx 2018.09.13 XMI 2019.06.11

2x2 Chain_1, 80 MHz, 5250 - 5350 MHz Band, Low Channel, Ch 52-64 - 5290 MHz, 802.11(n) MCS0						
0.99 (MHz)		26 dB (MHz)		Limit	Result	
76.88 MHz		103.685 MHz		N/A	N/A	



EMISSION BANDWIDTH - MIMO 5.6GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = Approx. 1% of the emission bandwidth (B).

-VBW = > RBW

-Detector = Peak

-

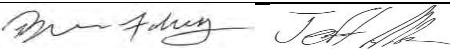
-Trace mode = max hold

The spectrum analyzer occupied bandwidth measurement function was then used to measure 26 dB emission bandwidth.

There is no required limit to be met in the rule part for this test. The purpose of the test is to both report the results as required and to utilize the emission bandwidth for setting the channel power integration bandwidth during conducted output power testing.

EMISSION BANDWIDTH - MIMO 5.6GHz BAND



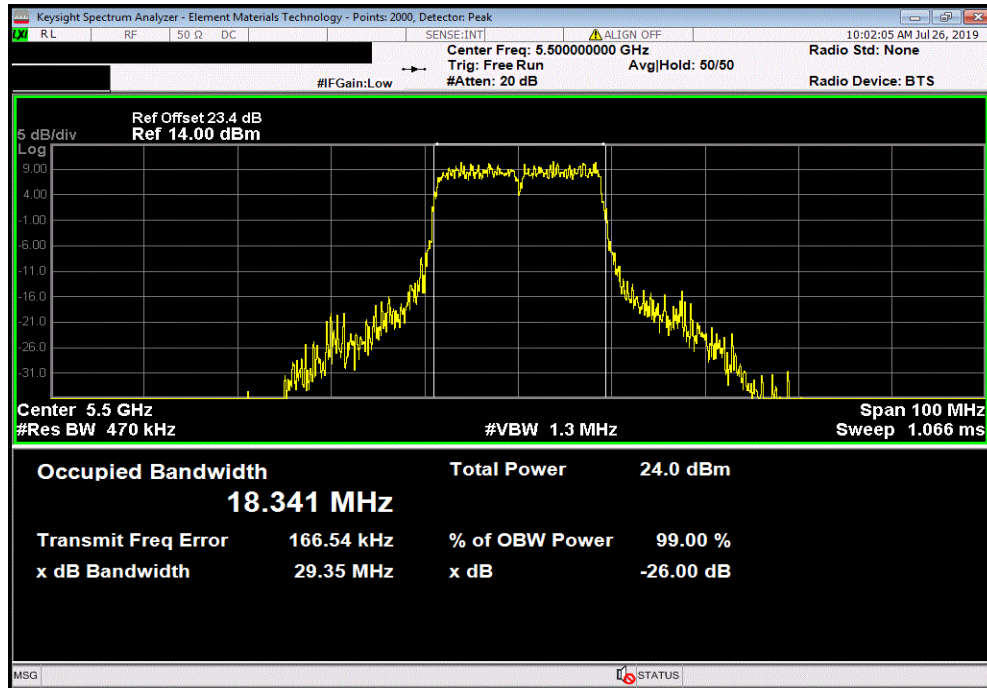
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 29-Jul-19	
Customer: EchoNus, Inc.		Temperature: 22 °C	
Attendees: None		Humidity: 55.3% RH	
Project: None		Barometric Pres.: 1020 mbar	
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC	
Job Site: NC0A			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	12	Signature 	
		99% (MHz)	26 dB (MHz) Limit Result
2x2 Chain_1			
20 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100 - 5500 MHz			
802.11(n) MCS8		18.341 MHz	29.352 MHz N/A N/A
802.11(n) MCS15		17.967 MHz	23.82 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.921 MHz	22.064 MHz N/A N/A
Mid Channel, Ch 116 - 5580 MHz			
802.11(n) MCS8		18.2 MHz	23.677 MHz N/A N/A
802.11(n) MCS15		18.022 MHz	23.204 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.934 MHz	21.03 MHz N/A N/A
High Channel, Ch 140 - 5700 MHz			
802.11(n) MCS8		18.07 MHz	23.559 MHz N/A N/A
802.11(n) MCS15		17.898 MHz	22.221 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.885 MHz	22.378 MHz N/A N/A
40 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100/104 - 5510 MHz			
802.11(n) MCS8		38.075 MHz	72.308 MHz N/A N/A
802.11(n) MCS15		36.948 MHz	59.998 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.84 MHz	45.918 MHz N/A N/A
Mid Channel, Ch 116/120 - 5590 MHz			
802.11(n) MCS8		36.873 MHz	58.682 MHz N/A N/A
802.11(n) MCS15		37.298 MHz	72.936 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.817 MHz	45.728 MHz N/A N/A
High Channel, Ch 132/136 - 5670 MHz			
802.11(n) MCS8		36.926 MHz	62.933 MHz N/A N/A
802.11(n) MCS15		37.02 MHz	45.435 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.794 MHz	45.1 MHz N/A N/A
80 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100-112 - 5530 MHz			
802.11(n) MCS9 (256-QAM)		76.701 MHz	143.392 MHz N/A N/A
802.11(n) MCS0		76.602 MHz	92.194 MHz N/A N/A
High Channel, Ch 116-128 - 5610 MHz			
802.11(n) MCS9 (256-QAM)		76.488 MHz	94.278 MHz N/A N/A
802.11(n) MCS0		76.549 MHz	93.057 MHz N/A N/A
2x2 Chain_2			
20 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100 - 5500 MHz			
802.11(n) MCS8		18.217 MHz	30.381 MHz N/A N/A
802.11(n) MCS15		17.939 MHz	23.587 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		18.001 MHz	22.309 MHz N/A N/A
Mid Channel, Ch 116 - 5580 MHz			
802.11(n) MCS8		18.21 MHz	26.943 MHz N/A N/A
802.11(n) MCS15		17.906 MHz	25.229 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.901 MHz	22.233 MHz N/A N/A
High Channel, Ch 140 - 5700 MHz			
802.11(n) MCS8		18.248 MHz	30.309 MHz N/A N/A
802.11(n) MCS15		18.045 MHz	22.482 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.934 MHz	21.792 MHz N/A N/A
40 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100/104 - 5510 MHz			
802.11(n) MCS8		39.157 MHz	80.39 MHz N/A N/A
802.11(n) MCS15		37.184 MHz	75.593 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.906 MHz	44.895 MHz N/A N/A
Mid Channel, Ch 116/120 - 5590 MHz			
802.11(n) MCS8		37.044 MHz	69.493 MHz N/A N/A
802.11(n) MCS15		36.912 MHz	69.55 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.793 MHz	44.567 MHz N/A N/A
High Channel, Ch 132/136 - 5670 MHz			
802.11(n) MCS8		37.887 MHz	73.72 MHz N/A N/A
802.11(n) MCS15		37.613 MHz	70.992 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.99 MHz	46.048 MHz N/A N/A
80 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100-112 - 5530 MHz			
802.11(n) MCS9 (256-QAM)		76.97 MHz	180.804 MHz N/A N/A
802.11(n) MCS0		76.36 MHz	88.309 MHz N/A N/A
High Channel, Ch 116-128 - 5610 MHz			
802.11(n) MCS9 (256-QAM)		77.248 MHz	182.503 MHz N/A N/A
802.11(n) MCS0		76.513 MHz	87.096 MHz N/A N/A

EMISSION BANDWIDTH - MIMO 5.6GHz BAND

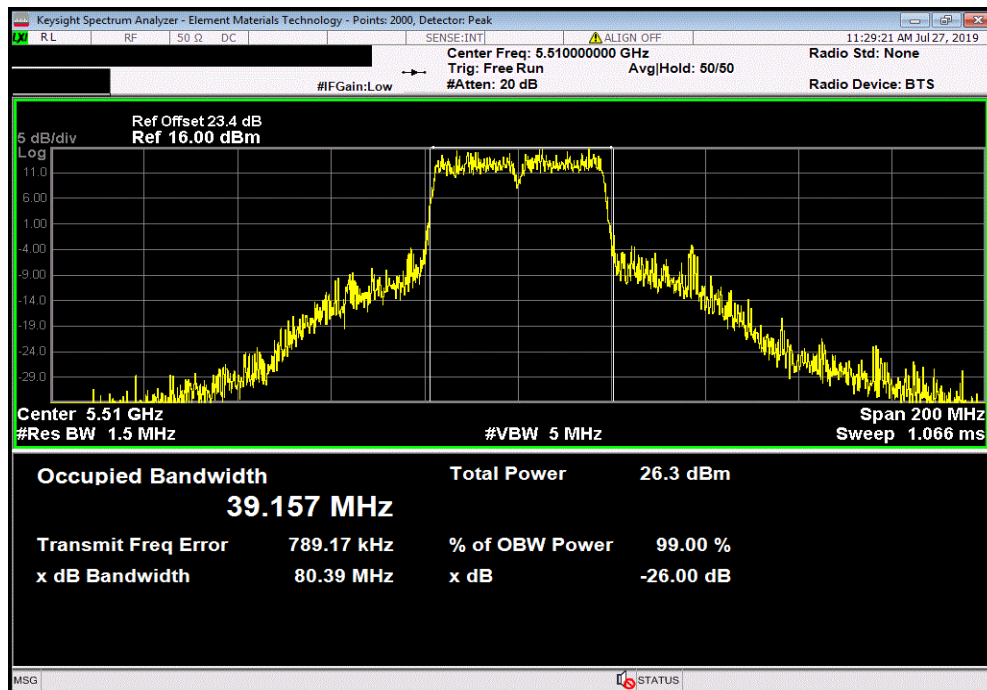


TMTx 2018.09.13 XMI 2019.06.11

2x2 Chain_1, 20 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100 - 5500 MHz, 802.11(n) MCS8						
	0.99 (MHz)	26 dB (MHz)	Limit	Result		
	18.341 MHz	29.352 MHz	N/A	N/A		



2x2 Chain_2, 40 MHz, 5470 - 5725 MHz Band, Low Channel, Ch 100/104 - 5510 MHz, 802.11(n) MCS8						
	0.99 (MHz)	26 dB (MHz)	Limit	Result		
	39.157 MHz	80.39 MHz	N/A	N/A		

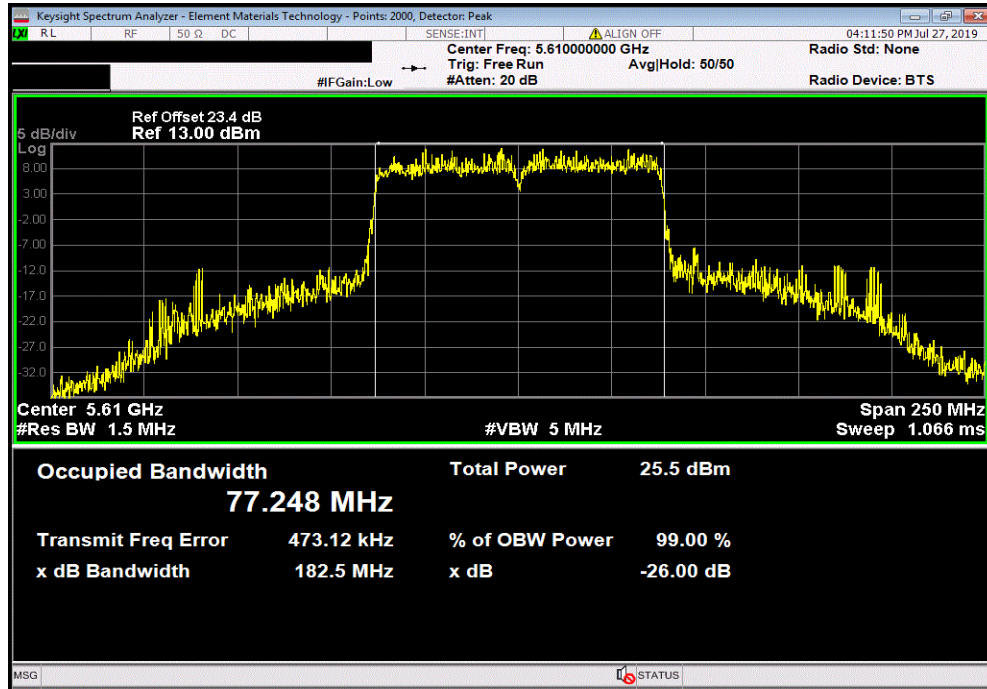


EMISSION BANDWIDTH - MIMO 5.6GHz BAND



TMTx 2018.09.13 XMt 2019.06.11

2x2 Chain_2, 80 MHz, 5470 - 5725 MHz Band, High Channel, Ch 116-128 - 5610 MHz, 802.11(n) MCS9 (256-QAM)					
0.99 (MHz)		26 dB (MHz)		Limit	Result
77.248 MHz		182.503 MHz		N/A	N/A



EMISSION BANDWIDTH - SISO 5.2 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = Approx. 1% of the emission bandwidth (B).

-VBW = > RBW

-Detector = Peak

-

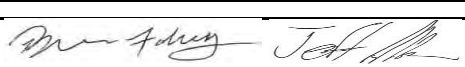
-Trace mode = max hold

The spectrum analyzer occupied bandwidth measurement function was then used to measure 26 dB emission bandwidth.

There is no required limit to be met in the rule part for this test. The purpose of the test is to both report the results as required and to utilize the emission bandwidth for setting the channel power integration bandwidth during conducted output power testing.

EMISSION BANDWIDTH - SISO 5.2 GHz BAND



EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 25-Jul-19	
Customer: EchoNous, Inc.		Temperature: 22.7 °C	
Attendees: None		Humidity: 45.3% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC	
Job Site: NC0A			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		99% (MHz)	26 dB (MHz) Limit Result
Chain_1			
20 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36 - 5180 MHz			
802.11(a) 6 Mbps		16.963 MHz	22.15 MHz N/A N/A
802.11(a) 36 Mbps		16.75 MHz	21.265 MHz N/A N/A
802.11(a) 54 Mbps		16.766 MHz	22.092 MHz N/A N/A
802.11(n) MCS0		18.363 MHz	26.352 MHz N/A N/A
802.11(n) MCS7		17.92 MHz	22.744 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.957 MHz	22.138 MHz N/A N/A
Mid Channel, Ch 40 - 5200 MHz			
802.11(a) 6 Mbps		16.953 MHz	22.628 MHz N/A N/A
802.11(a) 36 Mbps		16.863 MHz	21.763 MHz N/A N/A
802.11(a) 54 Mbps		16.8 MHz	21.704 MHz N/A N/A
802.11(n) MCS0		18.112 MHz	22.825 MHz N/A N/A
802.11(n) MCS7		18.039 MHz	22.518 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.908 MHz	22.235 MHz N/A N/A
High Channel, Ch 48 - 5240 MHz			
802.11(a) 6 Mbps		16.941 MHz	23.373 MHz N/A N/A
802.11(a) 36 Mbps		16.807 MHz	21.502 MHz N/A N/A
802.11(a) 54 Mbps		16.872 MHz	22.516 MHz N/A N/A
802.11(n) MCS0		18.058 MHz	23.27 MHz N/A N/A
802.11(n) MCS7		17.999 MHz	23.02 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.943 MHz	22.354 MHz N/A N/A
40 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36/40 - 5190 MHz			
802.11(n) MCS0		36.85 MHz	43.183 MHz N/A N/A
802.11(n) MCS7		36.819 MHz	45.215 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.786 MHz	44.993 MHz N/A N/A
High Channel, Ch 44/48 - 5230 MHz			
802.11(n) MCS0		37.062 MHz	45.709 MHz N/A N/A
802.11(n) MCS7		36.876 MHz	46.129 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.757 MHz	44.839 MHz N/A N/A
80 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36-48 - 5210 MHz			
802.11(n) MCS0		76.249 MHz	86.33 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		76.784 MHz	117.838 MHz N/A N/A
Chain_2			
20 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36 - 5180 MHz			
802.11(a) 6 Mbps		17.2 MHz	25.48 MHz N/A N/A
802.11(a) 36 Mbps		16.849 MHz	21.655 MHz N/A N/A
802.11(a) 54 Mbps		16.761 MHz	22.16 MHz N/A N/A
802.11(n) MCS0		18.464 MHz	27.66 MHz N/A N/A
802.11(n) MCS7		18.033 MHz	25.237 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.95 MHz	22.797 MHz N/A N/A
Mid Channel, Ch 40 - 5200 MHz			
802.11(a) 6 Mbps		17.063 MHz	24.195 MHz N/A N/A
802.11(a) 36 Mbps		16.937 MHz	23.297 MHz N/A N/A
802.11(a) 54 Mbps		16.926 MHz	21.403 MHz N/A N/A
802.11(n) MCS0		18.365 MHz	31.096 MHz N/A N/A
802.11(n) MCS7		17.999 MHz	24.188 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.884 MHz	21.838 MHz N/A N/A
High Channel, Ch 48 - 5240 MHz			
802.11(a) 6 Mbps		17.272 MHz	24.898 MHz N/A N/A
802.11(a) 36 Mbps		16.783 MHz	22.157 MHz N/A N/A
802.11(a) 54 Mbps		16.868 MHz	22.011 MHz N/A N/A
802.11(n) MCS0		18.47 MHz	25.292 MHz N/A N/A
802.11(n) MCS7		18.003 MHz	25.8 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.877 MHz	22.038 MHz N/A N/A
40 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36/40 - 5190 MHz			
802.11(n) MCS0		36.996 MHz	63.511 MHz N/A N/A
802.11(n) MCS7		36.987 MHz	56.615 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.854 MHz	46.108 MHz N/A N/A
High Channel, Ch 44/48 - 5230 MHz			
802.11(n) MCS0		36.98 MHz	64.365 MHz N/A N/A
802.11(n) MCS7		37.025 MHz	56.115 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.802 MHz	45.97 MHz N/A N/A
80 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36-48 - 5210 MHz			
802.11(n) MCS0		76.591 MHz	109.576 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		76.826 MHz	111.684 MHz N/A N/A

EMISSION BANDWIDTH - SISO 5.3 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = Approx. 1% of the emission bandwidth (B).

-VBW = > RBW

-Detector = Peak

-

-Trace mode = max hold

The spectrum analyzer occupied bandwidth measurement function was then used to measure 26 dB emission bandwidth.

There is no required limit to be met in the rule part for this test. The purpose of the test is to both report the results as required and to utilize the emission bandwidth for setting the channel power integration bandwidth during conducted output power testing.

EMISSION BANDWIDTH - SISO 5.3 GHz BAND



TM19 2018.09.13 XMI 2019.06.11

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015			
Serial Number: Pre-production #1				Date: 25-Jul-19			
Customer: EchoNus, Inc.				Temperature: 22.7 °C			
Attendees: None				Humidity: 45.1% RH			
Project: None				Barometric Pres.: 1024 mbar			
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC		Job Site: NC0A			
TEST SPECIFICATIONS				Test Method			
FCC 15.407:2019				ANSI C63.10:2013			
COMMENTS							
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB.							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #		1		Signature  			
				99% (MHz)		26 dB (MHz)	
				Limit		Result	

Chain_1			
20 MHz			
5250 - 5350 MHz Band			
Low Channel, Ch 52 - 5260 MHz			
802.11(a) 6 Mbps	17.001 MHz	23.199 MHz	N/A N/A
802.11(a) 36 Mbps	16.853 MHz	21.606 MHz	N/A N/A
802.11(a) 54 Mbps	16.839 MHz	21.224 MHz	N/A N/A
802.11(n) MCS0	18.096 MHz	24.626 MHz	N/A N/A
802.11(n) MCS7	17.942 MHz	21.572 MHz	N/A N/A
802.11(n) MCS8 (256-QAM)	17.922 MHz	21.559 MHz	N/A N/A
Mid Channel, Ch 60 - 5300 MHz			
802.11(a) 6 Mbps	17.024 MHz	21.997 MHz	N/A N/A
802.11(a) 36 Mbps	16.837 MHz	21.9 MHz	N/A N/A
802.11(a) 54 Mbps	16.755 MHz	21.499 MHz	N/A N/A
802.11(n) MCS0	18.205 MHz	22.561 MHz	N/A N/A
802.11(n) MCS7	17.93 MHz	21.782 MHz	N/A N/A
802.11(n) MCS8 (256-QAM)	17.943 MHz	22.052 MHz	N/A N/A
High Channel, Ch 64 - 5320 MHz			
802.11(a) 6 Mbps	16.934 MHz	22.167 MHz	N/A N/A
802.11(a) 36 Mbps	16.779 MHz	21.642 MHz	N/A N/A
802.11(a) 54 Mbps	16.812 MHz	21.544 MHz	N/A N/A
802.11(n) MCS0	18.157 MHz	23.57 MHz	N/A N/A
802.11(n) MCS7	17.937 MHz	22.747 MHz	N/A N/A
802.11(n) MCS8 (256-QAM)	17.98 MHz	22.843 MHz	N/A N/A
40 MHz			
5250 - 5350 MHz Band			
Low Channel, Ch 52/56 - 5270 MHz			
802.11(n) MCS0	36.823 MHz	46.777 MHz	N/A N/A
802.11(n) MCS7	36.778 MHz	45.964 MHz	N/A N/A
802.11(n) MCS9 (256-QAM)	36.767 MHz	45.049 MHz	N/A N/A
High Channel, Ch 60/64 - 5310 MHz			
802.11(n) MCS0	36.918 MHz	47.621 MHz	N/A N/A
802.11(n) MCS7	36.855 MHz	45.561 MHz	N/A N/A
802.11(n) MCS9 (256-QAM)	36.708 MHz	45.341 MHz	N/A N/A
80 MHz			
5250 - 5350 MHz Band			
Low Channel, Ch 52-64 - 5290 MHz			
802.11(n) MCS0	76.155 MHz	89.625 MHz	N/A N/A
802.11(n) MCS9 (256-QAM)	76.638 MHz	107.478 MHz	N/A N/A
Chain_2			
20 MHz			
5250 - 5350 MHz Band			
Low Channel, Ch 52 - 5260 MHz			
802.11(a) 6 Mbps	16.979 MHz	25.605 MHz	N/A N/A
802.11(a) 36 Mbps	16.888 MHz	21.523 MHz	N/A N/A
802.11(a) 54 Mbps	16.798 MHz	21.655 MHz	N/A N/A
802.11(n) MCS0	18.454 MHz	29.427 MHz	N/A N/A
802.11(n) MCS7	17.953 MHz	22.175 MHz	N/A N/A
802.11(n) MCS8 (256-QAM)	17.914 MHz	22.57 MHz	N/A N/A
Mid Channel, Ch 60 - 5300 MHz			
802.11(a) 6 Mbps	17.032 MHz	29.023 MHz	N/A N/A
802.11(a) 36 Mbps	16.763 MHz	21.427 MHz	N/A N/A
802.11(a) 54 Mbps	16.942 MHz	22.278 MHz	N/A N/A
802.11(n) MCS0	18.206 MHz	26.837 MHz	N/A N/A
802.11(n) MCS7	17.996 MHz	24.151 MHz	N/A N/A
802.11(n) MCS8 (256-QAM)	18.106 MHz	23.259 MHz	N/A N/A
High Channel, Ch 64 - 5320 MHz			
802.11(a) 6 Mbps	17.132 MHz	23.07 MHz	N/A N/A
802.11(a) 36 Mbps	16.802 MHz	21.228 MHz	N/A N/A
802.11(a) 54 Mbps	16.777 MHz	21.836 MHz	N/A N/A
802.11(n) MCS0	18.269 MHz	24.522 MHz	N/A N/A
802.11(n) MCS7	18.024 MHz	24.133 MHz	N/A N/A
802.11(n) MCS8 (256-QAM)	17.956 MHz	22.61 MHz	N/A N/A
40 MHz			
5250 - 5350 MHz Band			
Low Channel, Ch 52/56 - 5270 MHz			
802.11(n) MCS0	36.998 MHz	63.337 MHz	N/A N/A
802.11(n) MCS7	36.861 MHz	57.111 MHz	N/A N/A
802.11(n) MCS9 (256-QAM)	36.797 MHz	45.575 MHz	N/A N/A
High Channel, Ch 60/64 - 5310 MHz			
802.11(n) MCS0	37.096 MHz	56.239 MHz	N/A N/A
802.11(n) MCS7	37.081 MHz	55.905 MHz	N/A N/A
802.11(n) MCS9 (256-QAM)	36.625 MHz	44.476 MHz	N/A N/A
80 MHz			
5250 - 5350 MHz Band			
Low Channel, Ch 52-64 - 5290 MHz			
802.11(n) MCS0	76.422 MHz	121.909 MHz	N/A N/A
802.11(n) MCS9 (256-QAM)	76.714 MHz	110.606 MHz	N/A N/A

EMISSION BANDWIDTH - SISO 5.6 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = Approx. 1% of the emission bandwidth (B).

-VBW = > RBW

-Detector = Peak

-

-Trace mode = max hold

The spectrum analyzer occupied bandwidth measurement function was then used to measure 26 dB emission bandwidth.

There is no required limit to be met in the rule part for this test. The purpose of the test is to both report the results as required and to utilize the emission bandwidth for setting the channel power integration bandwidth during conducted output power testing.

EMISSION BANDWIDTH - SISO 5.6 GHz BAND



TMTx 2018.09.13 XMI 2019.06.11

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 25-Jul-19	
Customer: EchoNous, Inc.		Temperature: 22.8 °C	
Attendees: None		Humidity: 44.2% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC	
Job Site: NC0A			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature  	
		99% (MHz)	26 dB (MHz) Limit Result
Chain_1			
20 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100 - 5500 MHz			
802.11(a) 6 Mbps		16.886 MHz	22.842 MHz N/A N/A
802.11(a) 36 Mbps		16.828 MHz	21.542 MHz N/A N/A
802.11(a) 54 Mbps		16.854 MHz	21.698 MHz N/A N/A
802.11(n) MCS0		18.174 MHz	23.387 MHz N/A N/A
802.11(n) MCS7		17.932 MHz	22.877 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		18.006 MHz	22.708 MHz N/A N/A
Mid Channel, Ch 116 - 5580 MHz			
802.11(a) 6 Mbps		16.917 MHz	22.406 MHz N/A N/A
802.11(a) 36 Mbps		16.862 MHz	21.383 MHz N/A N/A
802.11(a) 54 Mbps		16.793 MHz	21.933 MHz N/A N/A
802.11(n) MCS0		18.049 MHz	23.204 MHz N/A N/A
802.11(n) MCS7		17.896 MHz	22.889 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.946 MHz	22.647 MHz N/A N/A
High Channel, Ch 140 - 5700 MHz			
802.11(a) 6 Mbps		16.903 MHz	24.385 MHz N/A N/A
802.11(a) 36 Mbps		16.85 MHz	21.714 MHz N/A N/A
802.11(a) 54 Mbps		16.823 MHz	22.024 MHz N/A N/A
802.11(n) MCS0		18.204 MHz	22.94 MHz N/A N/A
802.11(n) MCS7		17.945 MHz	22.082 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.912 MHz	22.45 MHz N/A N/A
40 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100/104 - 5510 MHz			
802.11(n) MCS0		36.819 MHz	48.704 MHz N/A N/A
802.11(n) MCS7		36.814 MHz	45.165 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.703 MHz	44.487 MHz N/A N/A
Mid Channel, Ch 116/120 - 5590 MHz			
802.11(n) MCS0		36.799 MHz	42.447 MHz N/A N/A
802.11(n) MCS7		36.79 MHz	45.474 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.673 MHz	45.196 MHz N/A N/A
High Channel, Ch 132/136 - 5670 MHz			
802.11(n) MCS0		36.778 MHz	42.917 MHz N/A N/A
802.11(n) MCS7		36.948 MHz	45.625 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.745 MHz	44.982 MHz N/A N/A
80 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100-112 - 5530 MHz			
802.11(n) MCS0		76.214 MHz	88.305 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		76.744 MHz	90.726 MHz N/A N/A
High Channel, Ch 116-128 - 5610 MHz			
802.11(n) MCS0		76.246 MHz	87.158 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		76.645 MHz	91.223 MHz N/A N/A
Chain_2			
20 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100 - 5500 MHz			
802.11(a) 6 Mbps		17.089 MHz	24.997 MHz N/A N/A
802.11(a) 36 Mbps		16.772 MHz	21.832 MHz N/A N/A
802.11(a) 54 Mbps		16.785 MHz	22.326 MHz N/A N/A
802.11(n) MCS0		18.175 MHz	24.285 MHz N/A N/A
802.11(n) MCS7		18.052 MHz	21.722 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.997 MHz	21.267 MHz N/A N/A
Mid Channel, Ch 116 - 5580 MHz			
802.11(a) 6 Mbps		16.916 MHz	23.762 MHz N/A N/A
802.11(a) 36 Mbps		16.831 MHz	22.14 MHz N/A N/A
802.11(a) 54 Mbps		16.793 MHz	21.747 MHz N/A N/A
802.11(n) MCS0		18.315 MHz	24.351 MHz N/A N/A
802.11(n) MCS7		18.02 MHz	22.386 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.947 MHz	21.439 MHz N/A N/A
High Channel, Ch 140 - 5700 MHz			
802.11(a) 6 Mbps		16.993 MHz	23.8 MHz N/A N/A
802.11(a) 36 Mbps		16.829 MHz	21.12 MHz N/A N/A
802.11(a) 54 Mbps		16.807 MHz	21.578 MHz N/A N/A
802.11(n) MCS0		18.209 MHz	22.964 MHz N/A N/A
802.11(n) MCS7		18.036 MHz	22.457 MHz N/A N/A
802.11(n) MCS8 (256-QAM)		17.794 MHz	22.313 MHz N/A N/A
40 MHz			
5470 - 5725 MHz Band			
Low Channel, Ch 100/104 - 5510 MHz			
802.11(n) MCS0		37.087 MHz	51.275 MHz N/A N/A
802.11(n) MCS7		36.928 MHz	56.16 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.754 MHz	45.236 MHz N/A N/A
Mid Channel, Ch 116/120 - 5590 MHz			
802.11(n) MCS0		36.84 MHz	61.367 MHz N/A N/A
802.11(n) MCS7		36.783 MHz	45.842 MHz N/A N/A
802.11(n) MCS9 (256-QAM)		36.814 MHz	45.796 MHz N/A N/A
High Channel, Ch 132/136 - 5670 MHz			
802.11(n) MCS0		36.905 MHz	48.017 MHz N/A N/A
802.11(n) MCS7		36.885 MHz	46.208 MHz N/A N/A

80 MHz	802.11(n) MCS9 (256-QAM)	36.757 MHz	44.378 MHz	N/A	N/A
	5470 - 5725 MHz Band				
	Low Channel, Ch 100-112 - 5530 MHz				
	802.11(n) MCS0	76.334 MHz	91.097 MHz	N/A	N/A
	802.11(n) MCS9 (256-QAM)	76.315 MHz	88.849 MHz	N/A	N/A
	High Channel, Ch 116-128 - 5610 MHz				
	802.11(n) MCS0	76.304 MHz	95.901 MHz	N/A	N/A
	802.11(n) MCS9 (256-QAM)	76.752 MHz	86.835 MHz	N/A	N/A

OCCUPIED BANDWIDTH - MIMO 5.8GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = 100 kHz

-VBW = $\geq 3 \times$ RBW

-Detector = Peak

-Trace mode = max hold

The spectrum analyzer occupied bandwidth measurement function was then used to measure the 6 dB emission bandwidth.

OCCUPIED BANDWIDTH - MIMO 5.8GHz BAND



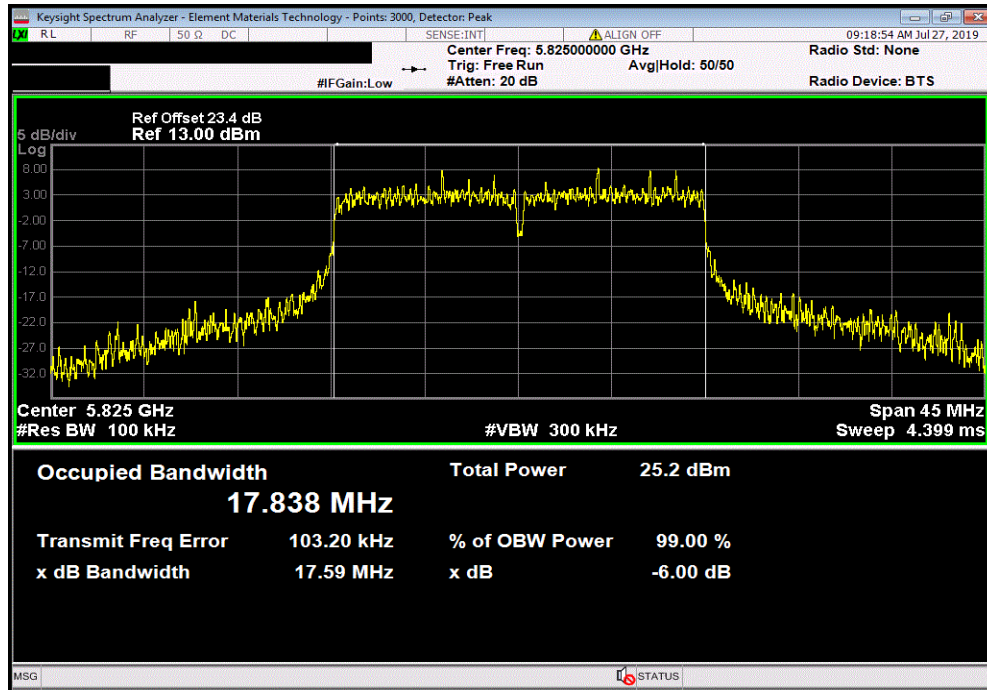
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015			
Serial Number: Pre-production #1		Date: 29-Jul-19			
Customer: EchoNous, Inc.		Temperature: 22.2 °C			
Attendees: None		Humidity: 51.8% RH			
Project: None		Barometric Pres.: 1020 mbar			
Tested by: Brian Fahey and Jeff Alcock		Job Site: NC0A			
Power: 3.7 VDC					
TEST SPECIFICATIONS		Test Method			
FCC 15.407:2019		ANSI C63.10:2013			
COMMENTS					
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	12	Signature  			
		99% (MHz)	6 dB (MHz)	6 dB Limit (>)	Result
2x2 Chain_1					
20 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149 - 5745 MHz					
802.11(n) MCS8		17.68 MHz	17.604 MHz	500 kHz	Pass
802.11(n) MCS15		17.663 MHz	17.635 MHz	500 kHz	Pass
802.11(n) MCS8 (256-QAM)		17.644 MHz	17.594 MHz	500 kHz	Pass
Mid Channel, Ch 157 - 5785 MHz					
802.11(n) MCS8		17.679 MHz	17.618 MHz	500 kHz	Pass
802.11(n) MCS15		17.673 MHz	17.683 MHz	500 kHz	Pass
802.11(n) MCS8 (256-QAM)		17.671 MHz	17.644 MHz	500 kHz	Pass
High Channel, Ch 165 - 5825 MHz					
802.11(n) MCS8		17.68 MHz	17.611 MHz	500 kHz	Pass
802.11(n) MCS15		17.661 MHz	17.67 MHz	500 kHz	Pass
802.11(n) MCS8 (256-QAM)		17.607 MHz	17.614 MHz	500 kHz	Pass
40 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149/153 - 5755 MHz					
802.11(n) MCS8		36.247 MHz	36.348 MHz	500 kHz	Pass
802.11(n) MCS15		36.206 MHz	36.388 MHz	500 kHz	Pass
802.11(n) MCS9 (256-QAM)		36.208 MHz	36.351 MHz	500 kHz	Pass
High Channel, Ch 157/161 - 5795 MHz					
802.11(n) MCS8		36.222 MHz	36.308 MHz	500 kHz	Pass
802.11(n) MCS15		36.217 MHz	36.389 MHz	500 kHz	Pass
802.11(n) MCS9 (256-QAM)		36.177 MHz	36.339 MHz	500 kHz	Pass
80 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149-161 - 5775 MHz					
802.11(n) MCS9 (256-QAM)		75.653 MHz	75.56 MHz	500 kHz	Pass
802.11(n) MCS0		75.674 MHz	75.717 MHz	500 kHz	Pass
2x2 Chain_2					
20 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149 - 5745 MHz					
802.11(n) MCS8		17.741 MHz	17.615 MHz	500 kHz	Pass
802.11(n) MCS15		17.699 MHz	17.601 MHz	500 kHz	Pass
802.11(n) MCS8 (256-QAM)		17.66 MHz	17.688 MHz	500 kHz	Pass
Mid Channel, Ch 157 - 5785 MHz					
802.11(n) MCS8		17.736 MHz	17.203 MHz	500 kHz	Pass
802.11(n) MCS15		17.655 MHz	17.568 MHz	500 kHz	Pass
802.11(n) MCS8 (256-QAM)		17.627 MHz	17.573 MHz	500 kHz	Pass
High Channel, Ch 165 - 5825 MHz					
802.11(n) MCS8		17.838 MHz	17.595 MHz	500 kHz	Pass
802.11(n) MCS15		17.675 MHz	17.676 MHz	500 kHz	Pass
802.11(n) MCS8 (256-QAM)		17.662 MHz	17.67 MHz	500 kHz	Pass
40 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149/153 - 5755 MHz					
802.11(n) MCS8		36.336 MHz	36.358 MHz	500 kHz	Pass
802.11(n) MCS15		36.303 MHz	36.363 MHz	500 kHz	Pass
802.11(n) MCS9 (256-QAM)		36.137 MHz	36.056 MHz	500 kHz	Pass
High Channel, Ch 157/161 - 5795 MHz					
802.11(n) MCS8		36.356 MHz	36.368 MHz	500 kHz	Pass
802.11(n) MCS15		36.295 MHz	36.371 MHz	500 kHz	Pass
802.11(n) MCS9 (256-QAM)		36.224 MHz	36.437 MHz	500 kHz	Pass
80 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149-161 - 5775 MHz					
802.11(n) MCS9 (256-QAM)		75.811 MHz	75.984 MHz	500 kHz	Pass
802.11(n) MCS0		75.594 MHz	76.031 MHz	500 kHz	Pass

OCCUPIED BANDWIDTH - MIMO 5.8GHz BAND

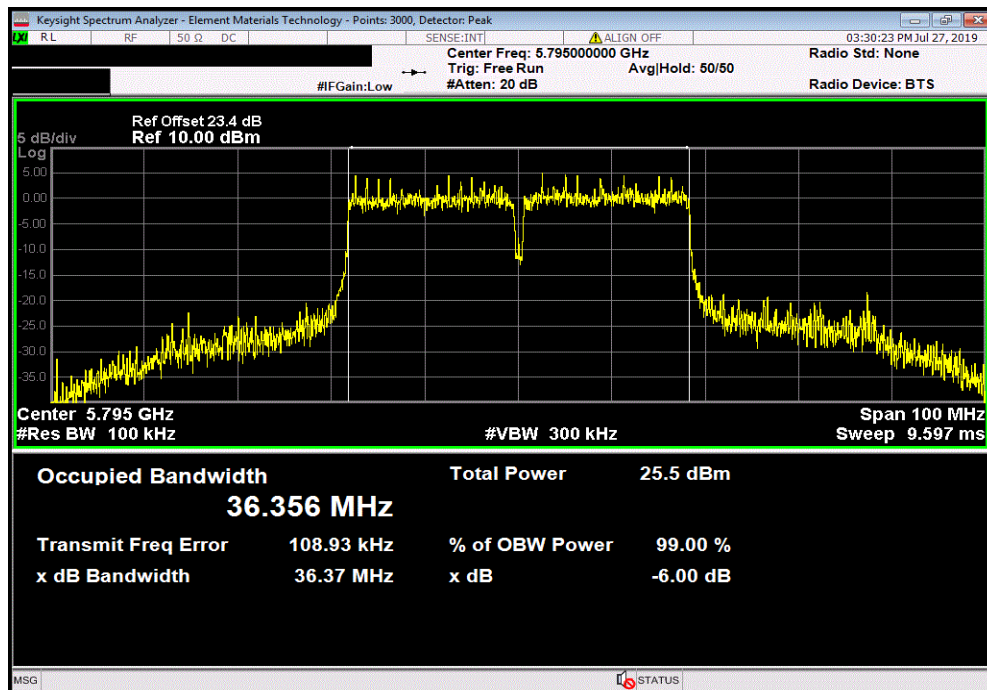


TMTx 2018.09.13 XMt 2019.06.11

2x2 Chain_2, 20 MHz, 5725 - 5785 MHz Band, High Channel, Ch 165 - 5825 MHz, 802.11(n) MCS8						
	0.99 (MHz)	6 dB (MHz)	6 dB Limit (>)	Result		
	17.838 MHz	17.595 MHz	500 kHz	Pass		



2x2 Chain_2, 40 MHz, 5725 - 5785 MHz Band, High Channel, Ch 157/161 - 5795 MHz, 802.11(n) MCS8						
	0.99 (MHz)	6 dB (MHz)	6 dB Limit (>)	Result		
	36.356 MHz	36.368 MHz	500 kHz	Pass		



OCCUPIED BANDWIDTH - SISO 5.8 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequencies and data rates listed in the datasheet were measured in each band utilized by the radio. The transmit power was set to its default maximum.

Per ANSI C63.10, the spectrum analyzer settings were as follows:

-RBW = 100 kHz

-VBW = $\geq 3 \times$ RBW

-Detector = Peak

-Trace mode = max hold

The spectrum analyzer occupied bandwidth measurement function was then used to measure the 6 dB emission bandwidth.

OCCUPIED BANDWIDTH - SISO 5.8 GHz BAND



TM19 2018.09.13 XMI 2019.06.11

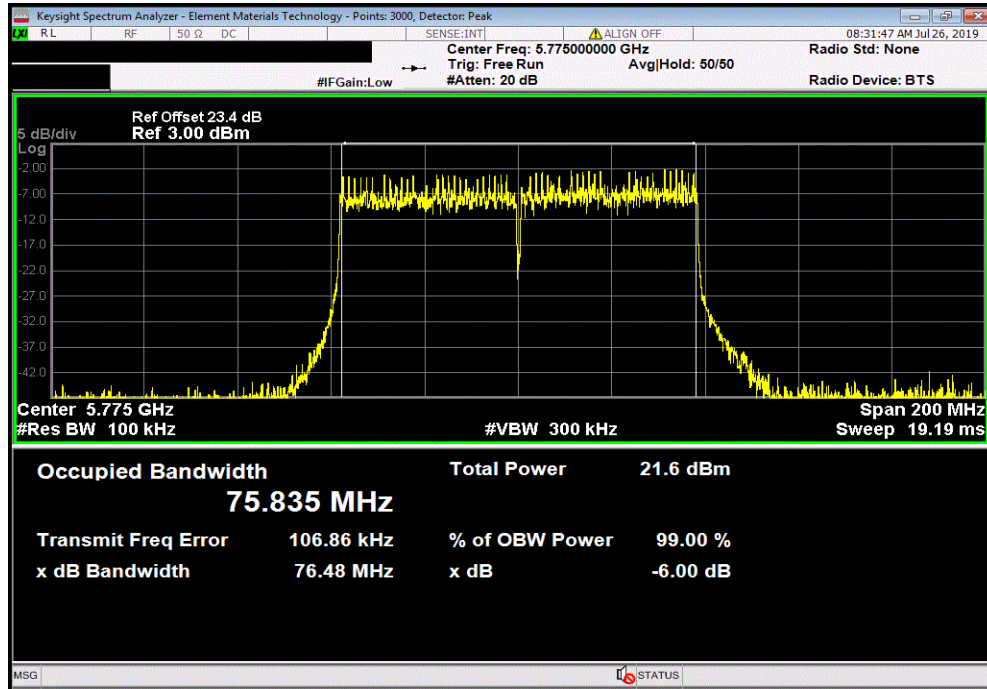
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015			
Serial Number: Pre-production #1		Date: 25-Jul-19			
Customer: EchoNous, Inc.		Temperature: 22.6 °C			
Attendees: None		Humidity: 44.6% RH			
Project: None		Barometric Pres.: 1024 mbar			
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC			
Job Site: NC0A					
TEST SPECIFICATIONS		Test Method			
FCC 15.407:2019		ANSI C63.10:2013			
COMMENTS					
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	1	Signature  			
		99% (MHz)	6 dB (MHz)	6 dB Limit (>)	Result
Chain_1					
20 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149 - 5745 MHz					
802.11(a) 6 Mbps					
802.11(a) 36 Mbps					
802.11(a) 54 Mbps					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS8 (256-QAM)					
Mid Channel, Ch 157 - 5785 MHz					
802.11(a) 6 Mbps					
802.11(a) 36 Mbps					
802.11(a) 54 Mbps					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS8 (256-QAM)					
High Channel, Ch 165 - 5825 MHz					
802.11(a) 6 Mbps					
802.11(a) 36 Mbps					
802.11(a) 54 Mbps					
802.11(n) MCS0					
802.11(n) MCS7					
40 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149/153 - 5755 MHz					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS9 (256-QAM)					
High Channel, Ch 157/161 - 5795 MHz					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS9 (256-QAM)					
80 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149-161 - 5775 MHz					
802.11(n) MCS0					
802.11(n) MCS9 (256-QAM)					
Chain_2					
20 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149 - 5745 MHz					
802.11(a) 6 Mbps					
802.11(a) 36 Mbps					
802.11(a) 54 Mbps					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS8 (256-QAM)					
Mid Channel, Ch 157 - 5785 MHz					
802.11(a) 6 Mbps					
802.11(a) 36 Mbps					
802.11(a) 54 Mbps					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS8 (256-QAM)					
High Channel, Ch 165 - 5825 MHz					
802.11(a) 6 Mbps					
802.11(a) 36 Mbps					
802.11(a) 54 Mbps					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS8 (256-QAM)					
40 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149/153 - 5755 MHz					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS9 (256-QAM)					
High Channel, Ch 157/161 - 5795 MHz					
802.11(n) MCS0					
802.11(n) MCS7					
802.11(n) MCS9 (256-QAM)					
80 MHz					
5725 - 5785 MHz Band					
Low Channel, Ch 149-161 - 5775 MHz					
802.11(n) MCS0					
802.11(n) MCS9 (256-QAM)					

OCCUPIED BANDWIDTH - SISO 5.8 GHz BAND



TMTx 2018.09.13 XMI 2019.06.11

Chain_1, 80 MHz, 5725 - 5785 MHz Band, Low Channel, Ch 149-161 - 5775 MHz, 802.11(n) MCS9 (256-QAM)						
	0.99 (MHz)	6 dB (MHz)	6 dB Limit (>)	Result		
	75.835 MHz	76.48 MHz	500 kHz	Pass		



BAND EDGE - MIMO 5.2 & 5.8 GHz BAND



XMM 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The 99% emission bandwidth of the carrier was measured to ensure that no part of the emission of the carrier operating in a non-DFS band was operating in a band where DFS testing is required. This test is done with the U-NII-1 band (5.2 GHz band) to ensure no portion of the carrier is contained within the U-NII-2A band and with the U-NII-3 band (5.8 GHz band) to ensure no portion of the carrier is contained in the U-NII-2C band.

The transmit frequencies and data rates listed in the datasheet were measured.

The transmit power was set to its default maximum.

BAND EDGE - MIMO 5.2 & 5.8 GHz BAND



EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015
Serial Number: Pre-production #1		Date: 30-Jul-19
Customer: EchoNous, Inc.		Temperature: 22.1 °C
Attendees: None		Humidity: 48.5% RH
Project: None		Barometric Pres.: 1020 mbar
Tested by: Brian Fahey and Jeff Alcock		Job Site: NC0A
Power: 3.7 VDC		
TEST SPECIFICATIONS		Test Method
FCC 15.407:2019		ANSI C63.10:2013
COMMENTS		
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB (5.2 GHz) & 23.4 dB (5.8 GHz).		
DEVIATIONS FROM TEST STANDARD		
None		
Configuration #	12	Signature <i>Brian Fahey</i> <i>Jeff Alcock</i>
		OBW Within Band Band Edge (MHz) Result
2x2 Chain_1		
20 MHz		
5150 - 5250 MHz Band		
High Channel, Ch 48 - 5240 MHz		
802.11(n) MCS8		
		Yes 5250 Pass
802.11(n) MCS15		
		Yes 5250 Pass
802.11(n) MCS8 (256-QAM)		
		Yes 5250 Pass
5725 - 5785 MHz Band		
Low Channel, Ch 149 - 5745 MHz		
802.11(n) MCS8		
		Yes 5725 Pass
802.11(n) MCS15		
		Yes 5725 Pass
802.11(n) MCS8 (256-QAM)		
		Yes 5725 Pass
40 MHz		
5150 - 5250 MHz Band		
High Channel, Ch 44/48 - 5230 MHz		
802.11(n) MCS8		
		Yes 5250 Pass
802.11(n) MCS15		
		Yes 5250 Pass
802.11(n) MCS9 (256-QAM)		
		Yes 5250 Pass
5725 - 5785 MHz Band		
Low Channel, Ch 149/153 - 5755 MHz		
802.11(n) MCS8		
		Yes 5725 Pass
802.11(n) MCS15		
		Yes 5725 Pass
802.11(n) MCS9 (256-QAM)		
		Yes 5725 Pass
80 MHz		
5150 - 5250 MHz Band		
Low Channel, Ch 36-48 - 5210 MHz		
802.11(n) MCS9 (256-QAM)		
		Yes 5150 Pass
802.11(n) MCS0		
		Yes 5150 Pass
5725 - 5785 MHz Band		
Low Channel, Ch 149-161 - 5775 MHz		
802.11(n) MCS9 (256-QAM)		
		Yes 5725 Pass
802.11(n) MCS0		
		Yes 5725 Pass
2x2 Chain_2		
20 MHz		
5150 - 5250 MHz Band		
High Channel, Ch 48 - 5240 MHz		
802.11(n) MCS8		
		Yes 5250 Pass
802.11(n) MCS15		
		Yes 5250 Pass
802.11(n) MCS8 (256-QAM)		
		Yes 5250 Pass
5725 - 5785 MHz Band		
Low Channel, Ch 149 - 5745 MHz		
802.11(n) MCS8		
		Yes 5725 Pass
802.11(n) MCS15		
		Yes 5725 Pass
802.11(n) MCS8 (256-QAM)		
		Yes 5725 Pass
40 MHz		
5150 - 5250 MHz Band		
High Channel, Ch 44/48 - 5230 MHz		
802.11(n) MCS8		
		Yes 5250 Pass
802.11(n) MCS15		
		Yes 5250 Pass
802.11(n) MCS9 (256-QAM)		
		Yes 5250 Pass
5725 - 5785 MHz Band		
Low Channel, Ch 149/153 - 5755 MHz		
802.11(n) MCS8		
		Yes 5725 Pass
802.11(n) MCS15		
		Yes 5725 Pass
802.11(n) MCS9 (256-QAM)		
		Yes 5725 Pass
80 MHz		
5150 - 5250 MHz Band		
Low Channel, Ch 36-48 - 5210 MHz		
802.11(n) MCS9 (256-QAM)		
		Yes 5150 Pass
802.11(n) MCS0		
		Yes 5150 Pass
5725 - 5785 MHz Band		
Low Channel, Ch 149-161 - 5775 MHz		
802.11(n) MCS9 (256-QAM)		
		Yes 5725 Pass
802.11(n) MCS0		
		Yes 5725 Pass

BAND EDGE - SISO 5.2 & 5.8 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20

TEST DESCRIPTION

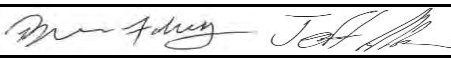
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The 99% emission bandwidth of the carrier was measured to ensure that no part of the emission of the carrier operating in a non-DFS band was operating in a band where DFS testing is required. This test is done with the U-NII-1 band (5.2 GHz band) to ensure no portion of the carrier is contained within the U-NII-2A band and with the U-NII-3 band (5.8 GHz band) to ensure no portion of the carrier is contained in the U-NII-2C band.

The transmit frequencies and data rates listed in the datasheet were measured.

The transmit power was set to its default maximum.

BAND EDGE - SISO 5.2 & 5.8 GHz BAND



EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015					
Serial Number: Pre-production #1		Date: 29-Jul-19					
Customer: EchoNous, Inc.		Temperature: 22.8 °C					
Attendees: None		Humidity: 46.3% RH					
Project: None		Barometric Pres.: 1019 mbar					
Tested by: Brian Fahey and Jeff Alcock		Job Site: NC0A					
Power: 3.7 VDC							
TEST SPECIFICATIONS		Test Method					
FCC 15.407:2019		ANSI C63.10:2013					
COMMENTS							
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.0 dB (5.2 GHz) & 23.4 dB (5.8 GHz).							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #	1	Signature 					
		OBW Within Band	Band Edge (MHz)	Result			
Chain_1							
20 MHz							
5150 - 5250 MHz Band							
High Channel, Ch 48 - 5240 MHz							
802.11(a) 6 Mbps					Yes	5250	Pass
802.11(a) 36 Mbps					Yes	5250	Pass
802.11(a) 54 Mbps					Yes	5250	Pass
802.11(n) MCS0					Yes	5250	Pass
802.11(n) MCS7					Yes	5250	Pass
802.11(n) MCS8 (256-QAM)					Yes	5250	Pass
5725 - 5785 MHz Band							
Low Channel, Ch 149 - 5745 MHz							
802.11(a) 6 Mbps					Yes	5725	Pass
802.11(a) 36 Mbps					Yes	5725	Pass
802.11(a) 54 Mbps					Yes	5725	Pass
802.11(n) MCS0					Yes	5725	Pass
802.11(n) MCS7					Yes	5725	Pass
802.11(n) MCS8 (256-QAM)					Yes	5725	Pass
40 MHz							
5150 - 5250 MHz Band							
High Channel, Ch 44/48 - 5230 MHz							
802.11(n) MCS0					Yes	5250	Pass
802.11(n) MCS7					Yes	5250	Pass
802.11(n) MCS9 (256-QAM)					Yes	5250	Pass
5725 - 5785 MHz Band							
Low Channel, Ch 149/153 - 5755 MHz							
802.11(n) MCS0					Yes	5725	Pass
802.11(n) MCS7					Yes	5725	Pass
802.11(n) MCS9 (256-QAM)					Yes	5725	Pass
80 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36-48 - 5210 MHz							
802.11(n) MCS0					Yes	5150	Pass
802.11(n) MCS9 (256-QAM)					Yes	5150	Pass
5725 - 5785 MHz Band							
Low Channel, Ch 149-161 - 5775 MHz							
802.11(n) MCS0					Yes	5725	Pass
802.11(n) MCS9 (256-QAM)					Yes	5725	Pass
Chain_2							
20 MHz							
5150 - 5250 MHz Band							
High Channel, Ch 48 - 5240 MHz							
802.11(a) 6 Mbps					Yes	5250	Pass
802.11(a) 36 Mbps					Yes	5250	Pass
802.11(a) 54 Mbps					Yes	5250	Pass
802.11(n) MCS0					Yes	5250	Pass
802.11(n) MCS7					Yes	5250	Pass
802.11(n) MCS8 (256-QAM)					Yes	5250	Pass
5725 - 5785 MHz Band							
Low Channel, Ch 149 - 5745 MHz							
802.11(a) 6 Mbps					Yes	5725	Pass
802.11(a) 36 Mbps					Yes	5725	Pass
802.11(a) 54 Mbps					Yes	5725	Pass
802.11(n) MCS0					Yes	5725	Pass
802.11(n) MCS7					Yes	5725	Pass
802.11(n) MCS8 (256-QAM)					Yes	5725	Pass
40 MHz							
5150 - 5250 MHz Band							
High Channel, Ch 44/48 - 5230 MHz							
802.11(n) MCS0					Yes	5250	Pass
802.11(n) MCS7					Yes	5250	Pass
802.11(n) MCS9 (256-QAM)					Yes	5250	Pass
5725 - 5785 MHz Band							
Low Channel, Ch 149/153 - 5755 MHz							
802.11(n) MCS0					Yes	5725	Pass
802.11(n) MCS7					Yes	5725	Pass
802.11(n) MCS9 (256-QAM)					Yes	5725	Pass
80 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36-48 - 5210 MHz							
802.11(n) MCS0					Yes	5150	Pass
802.11(n) MCS9 (256-QAM)					Yes	5150	Pass
5725 - 5785 MHz Band							
Low Channel, Ch 149-161 - 5775 MHz							
802.11(n) MCS0					Yes	5725	Pass
802.11(n) MCS9 (256-QAM)					Yes	5725	Pass

MAXIMUM POWER SPECTRAL DENSITY - MIMO

5.2 GHz BAND



XMM 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 1 MHz

-RMS Detector

-Trace average 100 traces in power averaging mode

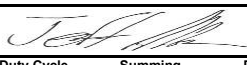
The peak power spectral density (PPSD) was determined to be the highest level found across the emission in any 1 MHz band after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - MIMO 5.2 GHz BAND



THMx 2019.08.30.0 XM0 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015					
Serial Number: Pre-production #1				Date: 5-Feb-20					
Customer: EchoNous, Inc.				Temperature: 22.7 °C					
Attendees: None				Humidity: 40.6% RH					
Project: None				Barometric Pres.: 1020 mbar					
Tested by: Brian Fahey and Jeff Alcock				Power: 3.7 VDC		Job Site: NC0A			
TEST SPECIFICATIONS				Test Method					
FCC 15.407:2020				ANSI C63.10:2013					
COMMENTS									
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 Section E), 2), c), the summed PSD value is calculated by adding the value of 10*LOG(number of antennas) dB or 3.0 dB to each of the single port measurements in MIMO mode. The port not being measured is terminated with a 50ohm terminator.									
DEVIATIONS FROM TEST STANDARD									
None									
Configuration #		12		Signature  					
				Power (dBm/Ref BW)	Duty Cycle Factor (dB)	Summing Factor (dB)	Density (dBm/Ref BW)	Limit ≤ (dBm/Ref BW)	Results

2x2 Chain_1							
20 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36 - 5180 MHz							
802.11(n) MCS8		0.824	1.7	3	5.5	11	Pass
802.11(n) MCS15		1.212	2.1	3	6.3	11	Pass
802.11(n) MCS8 (256-QAM)		-0.761	2.4	3	4.6	11	Pass
Mid Channel, Ch 40 - 5200 MHz							
802.11(n) MCS8		0.812	1.6	3	5.4	11	Pass
802.11(n) MCS15		1.183	2.1	3	6.3	11	Pass
802.11(n) MCS8 (256-QAM)		-0.638	2.3	3	4.7	11	Pass
High Channel, Ch 48 - 5240 MHz							
802.11(n) MCS8		0.905	1.7	3	5.6	11	Pass
802.11(n) MCS15		1.54	2.1	3	6.6	11	Pass
802.11(n) MCS8 (256-QAM)		-0.654	2.3	3	4.6	11	Pass
40 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36/40 - 5190 MHz							
802.11(n) MCS8		-2.659	2.4	3	2.7	11	Pass
802.11(n) MCS15		-2.272	2.9	3	3.6	11	Pass
802.11(n) MCS9 (256-QAM)		-5.422	3.6	3	1.2	11	Pass
High Channel, Ch 44/48 - 5230 MHz							
802.11(n) MCS8		-2.452	2.6	3	3.1	11	Pass
802.11(n) MCS15		-2.036	2.9	3	3.9	11	Pass
802.11(n) MCS9 (256-QAM)		-5.411	3.3	3	0.9	11	Pass
80 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36-48 - 5210 MHz							
802.11(n) MCS0		-2.678	0.9	3	1.2	11	Pass
802.11(n) MCS9 (256-QAM)		-8.046	3.9	3	-1.1	11	Pass
2x2 Chain_2							
20 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36 - 5180 MHz							
802.11(n) MCS8		1.203	1.6	3	5.8	11	Pass
802.11(n) MCS15		1.752	2.1	3	6.9	11	Pass
802.11(n) MCS8 (256-QAM)		-0.293	2.3	3	5.0	11	Pass
Mid Channel, Ch 40 - 5200 MHz							
802.11(n) MCS8		1.325	1.7	3	6.0	11	Pass
802.11(n) MCS15		1.888	2.1	3	7.0	11	Pass
802.11(n) MCS8 (256-QAM)		-0.22	2.5	3	5.3	11	Pass
High Channel, Ch 48 - 5240 MHz							
802.11(n) MCS8		1.239	1.6	3	5.8	11	Pass
802.11(n) MCS15		1.946	2.1	3	7.0	11	Pass
802.11(n) MCS8 (256-QAM)		-0.261	2.3	3	5.0	11	Pass
40 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36/40 - 5190 MHz							
802.11(n) MCS8		-2.166	2.7	3	3.5	11	Pass
802.11(n) MCS15		-1.688	2.9	3	4.2	11	Pass
802.11(n) MCS9 (256-QAM)		-5.316	3.2	3	0.9	11	Pass
High Channel, Ch 44/48 - 5230 MHz							
802.11(n) MCS8		-2.131	2.4	3	3.3	11	Pass
802.11(n) MCS15		-1.574	2.9	3	4.3	11	Pass
802.11(n) MCS9 (256-QAM)		-5.295	3.2	3	0.9	11	Pass
80 MHz							
5150 - 5250 MHz Band							
Low Channel, Ch 36-48 - 5210 MHz							
802.11(n) MCS0		-2.331	0.8	3	1.5	11	Pass
802.11(n) MCS9 (256-QAM)		-8.091	3.9	3	-1.2	11	Pass

MAXIMUM POWER SPECTRAL DENSITY - MIMO

5.3 GHz BAND



XMM 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 1 MHz

-RMS Detector

-Trace average 100 traces in power averaging mode

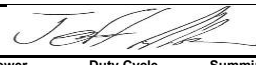
The peak power spectral density (PPSD) was determined to be the highest level found across the emission in any 1 MHz band after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - MIMO 5.3 GHz BAND



TH1x 2019.08.30.0 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015				
Serial Number: Pre-production #1				Date: 5-Feb-20				
Customer: EchoNous, Inc.				Temperature: 22.4 °C				
Attendees: None				Humidity: 41.2% RH				
Project: None				Barometric Pres.: 1020 mbar				
Tested by: Brian Fahey and Jeff Alcock				Power: 3.7 VDC		Job Site: NC0A		
TEST SPECIFICATIONS				Test Method				
FCC 15.407:2020				ANSI C63.10:2013				
COMMENTS								
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 Section E), 2), c), the summed PSD value is calculated by adding the value of 10*LOG(number of antennas) dB or 3.0 dB to each of the single port measurements in MIMO mode. The port not being measured is terminated with a 50ohm terminator.								
DEVIATIONS FROM TEST STANDARD								
None								
Configuration #	12	Signature  						
			Power (dBm/Ref BW)	Duty Cycle Factor (dB)	Summing Factor (dB)	Density (dBm/Ref BW)	Limit ≤ (dBm/Ref BW)	Results
2x2 Chain_1								
20 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52 - 5260 MHz								
802.11(n) MCS8			1.018	1.6	3	5.6	11	Pass
802.11(n) MCS15			1.534	2.1	3	6.6	11	Pass
802.11(n) MCS8 (256-QAM)			-0.463	2.3	3	4.8	11	Pass
Mid Channel, Ch 60 - 5300 MHz								
802.11(n) MCS8			1.237	1.6	3	5.8	11	Pass
802.11(n) MCS15			1.784	2.1	3	6.9	11	Pass
802.11(n) MCS8 (256-QAM)			-0.442	2.3	3	4.9	11	Pass
High Channel, Ch 64 - 5320 MHz								
802.11(n) MCS8			1.559	1.6	3	6.2	11	Pass
802.11(n) MCS15			1.691	2.1	3	6.8	11	Pass
802.11(n) MCS8 (256-QAM)			-0.015	2.3	3	5.3	11	Pass
40 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52/56 - 5270 MHz								
802.11(n) MCS8			-2.582	2.4	3	2.8	11	Pass
802.11(n) MCS15			-2.105	2.9	3	3.8	11	Pass
802.11(n) MCS9 (256-QAM)			-5.1	3.2	3	1.1	11	Pass
High Channel, Ch 60/64 - 5310 MHz								
802.11(n) MCS8			-2.416	2.4	3	3.0	11	Pass
802.11(n) MCS15			-1.751	2.9	3	4.1	11	Pass
802.11(n) MCS9 (256-QAM)			-4.849	3.2	3	1.4	11	Pass
80 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52-64 - 5290 MHz								
802.11(n) MCS0			-2.477	0.8	3	1.3	11	Pass
802.11(n) MCS9 (256-QAM)			-8.022	3.9	3	-1.1	11	Pass
2x2 Chain_2								
20 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52 - 5260 MHz								
802.11(n) MCS8			1.307	1.6	3	5.9	11	Pass
802.11(n) MCS15			2.054	2.1	3	7.2	11	Pass
802.11(n) MCS8 (256-QAM)			-0.187	2.3	3	5.1	11	Pass
Mid Channel, Ch 60 - 5300 MHz								
802.11(n) MCS8			1.478	1.6	3	6.1	11	Pass
802.11(n) MCS15			2.12	2.1	3	7.2	11	Pass
802.11(n) MCS8 (256-QAM)			-0.029	2.4	3	5.4	11	Pass
High Channel, Ch 64 - 5320 MHz								
802.11(n) MCS8			1.427	1.6	3	6.0	11	Pass
802.11(n) MCS15			2.183	2.2	3	7.4	11	Pass
802.11(n) MCS8 (256-QAM)			0.039	2.3	3	5.3	11	Pass
40 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52/56 - 5270 MHz								
802.11(n) MCS8			-2.189	2.4	3	3.2	11	Pass
802.11(n) MCS15			-1.477	2.9	3	4.4	11	Pass
802.11(n) MCS9 (256-QAM)			-4.337	3.6	3	2.3	11	Pass
High Channel, Ch 60/64 - 5310 MHz								
802.11(n) MCS8			-1.993	2.4	3	3.4	11	Pass
802.11(n) MCS15			-1.429	3	3	4.6	11	Pass
802.11(n) MCS9 (256-QAM)			-4.342	3.2	3	1.9	11	Pass
80 MHz								
5250 - 5350 MHz Band								
Low Channel, Ch 52-64 - 5290 MHz								
802.11(n) MCS0			-2.247	0.8	3	1.6	11	Pass
802.11(n) MCS9 (256-QAM)			-7.567	3.9	3	-0.7	11	Pass

MAXIMUM POWER SPECTRAL DENSITY - MIMO

5.6 GHz BAND



XMM 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 1 MHz

-RMS Detector

-Trace average 100 traces in power averaging mode

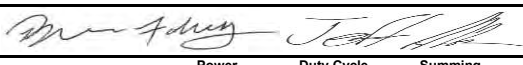
The peak power spectral density (PPSD) was determined to be the highest level found across the emission in any 1 MHz band after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - MIMO 5.6 GHz BAND



THx 2019.08.30.0 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE			Work Order: ECHN0015				
Serial Number: Pre-production #1			Date: 5-Feb-20				
Customer: EchoNous, Inc.			Temperature: 22.5 °C				
Attendees: None			Humidity: 40.7% RH				
Project: None			Barometric Pres.: 1020 mbar				
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC	Job Site: NC0A				
TEST SPECIFICATIONS			Test Method				
FCC 15.407:2020			ANSI C63.10:2013				
COMMENTS							
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 Section E), 2), c), the summed PSD value is calculated by adding the value of 10*LOG(number of antennas) dB or 3.0 dB to each of the single port measurements in MIMO mode. The port not being measured is terminated with a 50ohm terminator.							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #	12	Signature 					
		Power (dBm/Ref BW)	Duty Cycle Factor (dB)	Summing Factor (dB)	Density (dBm/Ref BW)	Limit ≤ (dBm/Ref BW)	Results

2x2 Chain_1							
20 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100 - 5500 MHz							
802.11(n) MCS8		1.389	1.8	3	6.2	11	Pass
802.11(n) MCS15		1.591	2.1	3	6.7	11	Pass
802.11(n) MCS8 (256-QAM)		-0.232	2.3	3	5.1	11	Pass
Mid Channel, Ch 116 - 5580 MHz							
802.11(n) MCS8		0.91	1.8	3	5.7	11	Pass
802.11(n) MCS15		1.231	2.1	3	6.3	11	Pass
802.11(n) MCS8 (256-QAM)		-0.745	2.3	3	4.6	11	Pass
High Channel, Ch 140 - 5700 MHz							
802.11(n) MCS8		0.744	1.6	3	5.3	11	Pass
802.11(n) MCS15		1.15	2.1	3	6.3	11	Pass
802.11(n) MCS8 (256-QAM)		-0.819	2.3	3	4.5	11	Pass
40 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100/104 - 5510 MHz							
802.11(n) MCS8		-2.275	2.4	3	3.1	11	Pass
802.11(n) MCS15		-1.916	2.9	3	4.0	11	Pass
802.11(n) MCS9 (256-QAM)		-4.987	3.2	3	1.2	11	Pass
Mid Channel, Ch 116/120 - 5590 MHz							
802.11(n) MCS8		-2.917	2.4	3	2.5	11	Pass
802.11(n) MCS15		-2.41	2.9	3	3.5	11	Pass
802.11(n) MCS9 (256-QAM)		-5.688	3.2	3	0.5	11	Pass
High Channel, Ch 132/136 - 5670 MHz							
802.11(n) MCS8		-2.613	2.4	3	2.8	11	Pass
802.11(n) MCS15		-2.293	2.9	3	3.6	11	Pass
802.11(n) MCS9 (256-QAM)		-5.499	3.2	3	0.7	11	Pass
80 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100-112 - 5530 MHz							
802.11(n) MCS0		-3.097	0.8	3	0.7	11	Pass
802.11(n) MCS9 (256-QAM)		-8.449	3.9	3	-1.5	11	Pass
High Channel, Ch 116-128 - 5610 MHz							
802.11(n) MCS0		-3.53	0.8	3	0.3	11	Pass
802.11(n) MCS9 (256-QAM)		-9.274	3.9	3	-2.4	11	Pass
2x2 Chain_2							
20 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100 - 5500 MHz							
802.11(n) MCS8		1.362	1.8	3	6.2	11	Pass
802.11(n) MCS15		2.073	2.1	3	7.2	11	Pass
802.11(n) MCS8 (256-QAM)		-0.01	2.3	3	5.3	11	Pass
Mid Channel, Ch 116 - 5580 MHz							
802.11(n) MCS8		0.913	1.8	3	5.7	11	Pass
802.11(n) MCS15		1.566	2.1	3	6.7	11	Pass
802.11(n) MCS8 (256-QAM)		-0.638	2.3	3	4.7	11	Pass
High Channel, Ch 140 - 5700 MHz							
802.11(n) MCS8		0.801	1.6	3	5.4	11	Pass
802.11(n) MCS15		1.395	2.2	3	6.6	11	Pass
802.11(n) MCS8 (256-QAM)		-0.864	2.3	3	4.4	11	Pass
40 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100/104 - 5510 MHz							
802.11(n) MCS8		-2.156	2.4	3	3.2	11	Pass
802.11(n) MCS15		-1.491	2.9	3	4.4	11	Pass
802.11(n) MCS9 (256-QAM)		-4.555	3.2	3	1.6	11	Pass
Mid Channel, Ch 116/120 - 5590 MHz							
802.11(n) MCS8		-2.534	2.5	3	3.0	11	Pass
802.11(n) MCS15		-1.615	3	3	4.4	11	Pass
802.11(n) MCS9 (256-QAM)		-5.373	3.2	3	0.8	11	Pass
High Channel, Ch 132/136 - 5670 MHz							
802.11(n) MCS8		-2.512	2.4	3	2.9	11	Pass
802.11(n) MCS15		-1.851	2.9	3	4.0	11	Pass
802.11(n) MCS9 (256-QAM)		-5.147	3.3	3	1.2	11	Pass
80 MHz							
5470 - 5725 MHz Band							
Low Channel, Ch 100-112 - 5530 MHz							
802.11(n) MCS0		-2.69	0.8	3	1.1	11	Pass
802.11(n) MCS9 (256-QAM)		-7.748	3.9	3	-0.8	11	Pass
High Channel, Ch 116-128 - 5610 MHz							
802.11(n) MCS0		-3.394	0.8	3	0.4	11	Pass
802.11(n) MCS9 (256-QAM)		-8.868	4	3	-1.9	11	Pass

MAXIMUM POWER SPECTRAL DENSITY - MIMO

5.8 GHz BAND



XMM 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	17-Jan-20	17-Jan-21
Block - DC	Fairview Microwave	SD3379	AMU	20-Jan-20	20-Jan-21
Attenuator	Fairview Microwave	SA4014-20	TKV	17-Jan-20	17-Jan-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	5-May-19	5-May-20
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 510 kHz

-RMS Detector

-Trace average 100 traces in power averaging mode

The peak power spectral density (PPSD) was determined to be the highest level found across the emission in any 1 MHz band after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - MIMO 5.8 GHz BAND



THTx 2019.08.30.0 XMM 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE			Work Order: ECHN0015				
Serial Number: Pre-production #1			Date: 5-Feb-20				
Customer: EchoNous, Inc.			Temperature: 22.5 °C				
Attendees: None			Humidity: 40.8% RH				
Project: None			Barometric Pres.: 1019 mbar				
Tested by: Brian Fahey and Jeff Alcock		Power: 3.7 VDC	Job Site: NC0A				
TEST SPECIFICATIONS			Test Method				
FCC 15.407:2020			ANSI C63.10:2013				
COMMENTS							
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 24 dB. Per FCC KDB 662911 Section E), 2), c), the summed PSD value is calculated by adding the value of 10*LOG(number of antennas) dB or 3.0 dB to each of the single port measurements in MIMO mode. The port not being measured is terminated with a 50ohm terminator.							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #	12	Signature  					
		Power (dBm/Ref BW)	Duty Cycle Factor (dB)	Summing Factor (dB)	Density (dBm/Ref BW)	Limit ≤ (dBm/Ref BW)	Results

2x2 Chain_1							
20 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149 - 5745 MHz							
802.11(n) MCS8		-1.359	1.6	3	3.2	30	Pass
802.11(n) MCS15		-0.956	2.1	3	4.1	30	Pass
802.11(n) MCS8 (256-QAM)		-2.923	2.5	3	2.6	30	Pass
Mid Channel, Ch 157 - 5785 MHz							
802.11(n) MCS8		-1.362	1.6	3	3.2	30	Pass
802.11(n) MCS15		-0.874	2.2	3	4.3	30	Pass
802.11(n) MCS8 (256-QAM)		-2.75	2.5	3	2.8	30	Pass
High Channel, Ch 165 - 5825 MHz							
802.11(n) MCS8		-1.333	1.6	3	3.3	30	Pass
802.11(n) MCS15		-0.767	2.1	3	4.3	30	Pass
802.11(n) MCS8 (256-QAM)		-2.654	2.4	3	2.7	30	Pass
40 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149/153 - 5755 MHz							
802.11(n) MCS8		-5.164	2.4	3	0.2	30	Pass
802.11(n) MCS15		-4.515	3.1	3	1.6	30	Pass
802.11(n) MCS9 (256-QAM)		-7.394	3.2	3	-1.2	30	Pass
High Channel, Ch 157/161 - 5795 MHz							
802.11(n) MCS8		-4.979	2.4	3	0.4	30	Pass
802.11(n) MCS15		-4.3	2.9	3	1.6	30	Pass
802.11(n) MCS9 (256-QAM)		-7.245	3.3	3	-0.9	30	Pass
80 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149-161 - 5775 MHz							
802.11(n) MCS0		-5.949	0.8	3	-2.1	30	Pass
802.11(n) MCS9 (256-QAM)		-10.38	3.9	3	-3.5	30	Pass
2x2 Chain_2							
20 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149 - 5745 MHz							
802.11(n) MCS8		-1.206	1.6	3	3.4	30	Pass
802.11(n) MCS15		-0.424	2.2	3	4.8	30	Pass
802.11(n) MCS8 (256-QAM)		-2.527	2.3	3	2.8	30	Pass
Mid Channel, Ch 157 - 5785 MHz							
802.11(n) MCS8		-0.949	1.6	3	3.7	30	Pass
802.11(n) MCS15		-0.231	2.2	3	5.0	30	Pass
802.11(n) MCS8 (256-QAM)		-2.322	2.3	3	3.0	30	Pass
High Channel, Ch 165 - 5825 MHz							
802.11(n) MCS8		-0.614	1.6	3	4.0	30	Pass
802.11(n) MCS15		0.257	2.2	3	5.5	30	Pass
802.11(n) MCS8 (256-QAM)		-1.94	2.5	3	3.6	30	Pass
40 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149/153 - 5755 MHz							
802.11(n) MCS8		-4.365	2.7	3	1.3	30	Pass
802.11(n) MCS15		-3.514	2.9	3	2.4	30	Pass
802.11(n) MCS9 (256-QAM)		-6.487	3.2	3	-0.3	30	Pass
High Channel, Ch 157/161 - 5795 MHz							
802.11(n) MCS8		-4.127	2.4	3	1.3	30	Pass
802.11(n) MCS15		-3.493	3.1	3	2.6	30	Pass
802.11(n) MCS9 (256-QAM)		-6.556	3.2	3	-0.4	30	Pass
80 MHz							
5725 - 5785 MHz Band							
Low Channel, Ch 149-161 - 5775 MHz							
802.11(n) MCS0		-5.673	0.8	3	-1.9	30	Pass
802.11(n) MCS9 (256-QAM)		-9.574	3.9	3	-2.7	30	Pass

MAXIMUM POWER SPECTRAL DENSITY - SISO

5.2 GHz BAND



XMII 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 1 MHz

-RMS Detector

-Trace average 100 traces in power averaging mode

The peak power spectral density (PPSD) was determined to be the highest level found across the emission in any 1 MHz band after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - SISO 5.2 GHz BAND



TMTX 2019.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNus, Inc.		Temperature: 21.9 °C	
Attendees: None		Humidity: 28.4% RH	
Project: None		Barometric Pres.: 1022 mbar	
Tested by: Brian Fahey and Jeff Alcock		Job Site: NC0A	
Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcock</i>	
		Power (dBm/Ref BW)	Duty Cycle Factor (dB)
		Density (dBm/Ref BW)	Limit ≤ (dBm/Ref BW)
			Results

Chain_1			
20 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36 - 5180 MHz			
802.11(a) 6 Mbps	2.983	0.2	3.2
802.11(a) 36 Mbps	1.722	1	2.7
802.11(a) 54 Mbps	0.881	1.3	2.2
802.11(n) MCS0	2.701	0.2	2.9
802.11(n) MCS7	1.584	1.5	3
802.11(n) MCS8 (256-QAM)	0.398	1.6	2
Mid Channel, Ch 40 - 5200 MHz			
802.11(a) 6 Mbps	2.97	0.2	3.2
802.11(a) 36 Mbps	1.742	1.1	2.8
802.11(a) 54 Mbps	0.853	1.4	2.2
802.11(n) MCS0	2.661	0.2	2.9
802.11(n) MCS7	1.572	1.5	3.1
802.11(n) MCS8 (256-QAM)	0.561	1.7	2.3
High Channel, Ch 48 - 5240 MHz			
802.11(a) 6 Mbps	2.927	0.2	3.1
802.11(a) 36 Mbps	1.651	0.9	2.6
802.11(a) 54 Mbps	2.172	1	3.1
802.11(n) MCS0	2.619	0.2	2.8
802.11(n) MCS7	1.566	1.5	3
802.11(n) MCS8 (256-QAM)	0.307	1.8	2.1
40 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36/40 - 5190 MHz			
802.11(n) MCS0	-0.167	0.4	0.3
802.11(n) MCS7	-1.99	2.5	0.5
802.11(n) MCS9 (256-QAM)	-5.415	2.6	-2.8
High Channel, Ch 44/48 - 5230 MHz			
802.11(n) MCS0	-0.256	0.5	0.2
802.11(n) MCS7	-2.26	2.5	0.3
802.11(n) MCS9 (256-QAM)	-5.566	2.6	-3
80 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36-48 - 5210 MHz			
802.11(n) MCS0	-3.155	0.8	-2.3
802.11(n) MCS9 (256-QAM)	-8.743	3.6	-5.2
Chain_2			
20 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36 - 5180 MHz			
802.11(a) 6 Mbps	3.371	0.2	3.6
802.11(a) 36 Mbps	2.215	1	3.2
802.11(a) 54 Mbps	1.34	1.3	2.7
802.11(n) MCS0	3.111	0.2	3.3
802.11(n) MCS7	1.823	1.4	3.2
802.11(n) MCS8 (256-QAM)	0.853	1.6	2.4
Mid Channel, Ch 40 - 5200 MHz			
802.11(a) 6 Mbps	3.307	0.2	3.5
802.11(a) 36 Mbps	2.154	1	3.2
802.11(a) 54 Mbps	1.298	1.4	2.7
802.11(n) MCS0	3.031	0.2	3.2
802.11(n) MCS7	1.78	1.4	3.2
802.11(n) MCS8 (256-QAM)	0.801	1.7	2.5
High Channel, Ch 48 - 5240 MHz			
802.11(a) 6 Mbps	3.31	0.2	3.5
802.11(a) 36 Mbps	1.995	1	2.9
802.11(a) 54 Mbps	1.147	1.4	2.6
802.11(n) MCS0	3.012	0.2	3.2
802.11(n) MCS7	1.798	1.4	3.2
802.11(n) MCS8 (256-QAM)	0.611	1.6	2.2
40 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36/40 - 5190 MHz			
802.11(n) MCS0	0.118	0.4	0.6
802.11(n) MCS7	-1.727	2.4	0.7
802.11(n) MCS9 (256-QAM)	-5.452	2.6	-2.9
High Channel, Ch 44/48 - 5230 MHz			
802.11(n) MCS0	0.052	0.4	0.5
802.11(n) MCS7	-1.808	2.5	0.7
802.11(n) MCS9 (256-QAM)	-5.55	2.6	-3
80 MHz			
5150 - 5250 MHz Band			
Low Channel, Ch 36-48 - 5210 MHz			
802.11(n) MCS0	-2.84	0.8	-2
802.11(n) MCS9 (256-QAM)	-8.729	3.5	-5.2

MAXIMUM POWER SPECTRAL DENSITY - SISO

5.3 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 1 MHz

-RMS Detector

-Trace average 100 traces in power averaging mode

The peak power spectral density (PPSD) was determined to be the highest level found across the emission in any 1 MHz band after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - SISO 5.3 GHz BAND



TMTX 2018.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNus, Inc.		Temperature: 22 °C	
Attendees: None		Humidity: 28% RH	
Project: None		Barometric Pres.: 1023 mbar	
Tested by: Brian Fahey & Jeff Alcoke		Job Site: NC0A	
Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcoke</i>	
		Power (dBm/Ref BW)	Duty Cycle Factor (dB)
		Density (dBm/Ref BW)	Limit ≤ (dBm/Ref BW)
			Results

Chain_1			
20 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52 - 5260 MHz		
	802.11(a) 6 Mbps	3.018	0.2
	802.11(a) 36 Mbps	1.696	1
	802.11(a) 54 Mbps	0.859	1.3
	802.11(n) MCS0	2.73	0.2
	802.11(n) MCS7	1.582	1.4
	802.11(n) MCS8 (256-QAM)	0.371	1.6
	Mid Channel, Ch 60 - 5300 MHz		
	802.11(a) 6 Mbps	3.092	0.2
	802.11(a) 36 Mbps	1.713	1
	802.11(a) 54 Mbps	1.031	1.3
	802.11(n) MCS0	2.778	0.2
	802.11(n) MCS7	1.62	1.6
	802.11(n) MCS8 (256-QAM)	0.531	1.7
	High Channel, Ch 64 - 5320 MHz		
	802.11(a) 6 Mbps	3.295	0.2
	802.11(a) 36 Mbps	2.179	1
	802.11(a) 54 Mbps	1.257	1.4
	802.11(n) MCS0	2.984	0.2
	802.11(n) MCS7	1.929	1.5
	802.11(n) MCS8 (256-QAM)	0.808	1.6
40 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52/56 - 5270 MHz		
	802.11(n) MCS0	-0.253	0.4
	802.11(n) MCS7	-2.095	2.6
	802.11(n) MCS9 (256-QAM)	-5.31	2.6
	High Channel, Ch 60/64 - 5310 MHz		
	802.11(n) MCS0	-0.203	0.4
	802.11(n) MCS7	-2.183	2.4
	802.11(n) MCS9 (256-QAM)	-4.99	2.6
80 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52-64 - 5290 MHz		
	802.11(n) MCS0	-3.256	0.8
	802.11(n) MCS9 (256-QAM)	-8.338	3.7
Chain_2			
20 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52 - 5260 MHz		
	802.11(a) 6 Mbps	3.275	0.2
	802.11(a) 36 Mbps	1.972	0.9
	802.11(a) 54 Mbps	1.01	1.3
	802.11(n) MCS0	2.869	0.2
	802.11(n) MCS7	1.72	1.4
	802.11(n) MCS8 (256-QAM)	0.508	1.6
	Mid Channel, Ch 60 - 5300 MHz		
	802.11(a) 6 Mbps	3.427	0.2
	802.11(a) 36 Mbps	2.163	1
	802.11(a) 54 Mbps	1.298	1.4
	802.11(n) MCS0	3.151	0.2
	802.11(n) MCS7	1.882	1.4
	802.11(n) MCS8 (256-QAM)	0.787	1.7
	High Channel, Ch 64 - 5320 MHz		
	802.11(a) 6 Mbps	3.349	0.2
	802.11(a) 36 Mbps	2.295	1
	802.11(a) 54 Mbps	1.32	1.3
	802.11(n) MCS0	3.105	0.2
	802.11(n) MCS7	1.872	1.4
	802.11(n) MCS8 (256-QAM)	0.862	1.7
40 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52/56 - 5270 MHz		
	802.11(n) MCS0	0.123	0.4
	802.11(n) MCS7	-1.758	2.5
	802.11(n) MCS9 (256-QAM)	-4.939	2.6
	High Channel, Ch 60/64 - 5310 MHz		
	802.11(n) MCS0	0.077	0.5
	802.11(n) MCS7	-1.75	2.4
	802.11(n) MCS9 (256-QAM)	-4.811	2.6
80 MHz	5250 - 5350 MHz Band		
	Low Channel, Ch 52-64 - 5290 MHz		
	802.11(n) MCS0	-2.993	0.9
	802.11(n) MCS9 (256-QAM)	-8.238	3.5

MAXIMUM POWER SPECTRAL DENSITY - SISO

5.6 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 1 MHz

-RMS Detector

-Trace average 100 traces in power averaging mode

The peak power spectral density (PPSD) was determined to be the highest level found across the emission in any 1 MHz band after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - SISO 5.6 GHz BAND



TMTX 2018.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Work Order: ECHN0015		
Serial Number: Pre-production #1				Date: 26-Dec-19		
Customer: EchoNus, Inc.				Temperature: 25.6 °C		
Attendees: None				Humidity: 23.1% RH		
Project: None				Barometric Pres.: 1024 mbar		
Tested by: Brian Fahey & Jeff Alcoke			Power: 3.7 VDC		Job Site: NC0A	
TEST SPECIFICATIONS				Test Method		
FCC 15.407:2019				ANSI C63.10:2013		
COMMENTS						
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.						
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #1Signature  						
		Power (dBm/Ref BW)		Duty Cycle Factor (dB)		Results
Chain_1		Density (dBm/Ref BW)		Limit ≤ (dBm/Ref BW)		
20 MHz						
5470 - 5725 MHz Band						
Low Channel, Ch 100 - 5500 MHz						
802.11(a) 6 Mbps		3.439		0.2		Pass
802.11(a) 36 Mbps		2.264		1		Pass
802.11(a) 54 Mbps		1.423		1.4		Pass
802.11(n) MCS0		3.107		0.2		Pass
802.11(n) MCS7		2.046		1.4		Pass
802.11(n) MCS8 (256-QAM)		0.968		1.6		Pass
Mid Channel, Ch 116 - 5580 MHz						
802.11(a) 6 Mbps		2.75		0.2		Pass
802.11(a) 36 Mbps		1.603		1		Pass
802.11(a) 54 Mbps		0.783		1.5		Pass
802.11(n) MCS0		2.437		0.2		Pass
802.11(n) MCS7		1.466		1.4		Pass
802.11(n) MCS8 (256-QAM)		0.194		1.7		Pass
High Channel, Ch 140 - 5700 MHz						
802.11(a) 6 Mbps		3.331		0.2		Pass
802.11(a) 36 Mbps		2.134		0.9		Pass
802.11(a) 54 Mbps		1.345		1.4		Pass
802.11(n) MCS0		3.166		0.2		Pass
802.11(n) MCS7		1.979		1.4		Pass
802.11(n) MCS8 (256-QAM)		0.807		1.6		Pass
40 MHz						
5470 - 5725 MHz Band						
Low Channel, Ch 100/104 - 5510 MHz						
802.11(n) MCS0		-0.152		0.4		Pass
802.11(n) MCS7		-2		2.5		Pass
802.11(n) MCS9 (256-QAM)		-5.075		2.6		Pass
Mid Channel, Ch 116/120 - 5590 MHz						
802.11(n) MCS0		-0.62		0.5		Pass
802.11(n) MCS7		-2.457		2.5		Pass
802.11(n) MCS9 (256-QAM)		-5.995		2.6		Pass
High Channel, Ch 132/136 - 5670 MHz						
802.11(n) MCS0		-0.27		0.4		Pass
802.11(n) MCS7		-2.051		2.5		Pass
802.11(n) MCS9 (256-QAM)		-5.242		2.6		Pass
80 MHz						
5470 - 5725 MHz Band						
Low Channel, Ch 100-112 - 5530 MHz						
802.11(n) MCS0		-3.472		0.8		Pass
802.11(n) MCS9 (256-QAM)		-8.725		3.6		Pass
High Channel, Ch 116-128 - 5610 MHz						
802.11(n) MCS0		-3.776		0.8		Pass
802.11(n) MCS9 (256-QAM)		-9.241		3.5		Pass
Chain_2						
20 MHz						
5470 - 5725 MHz Band						
Low Channel, Ch 100 - 5500 MHz						
802.11(a) 6 Mbps		3.512		0.2		Pass
802.11(a) 36 Mbps		2.318		1.1		Pass
802.11(a) 54 Mbps		1.468		1.3		Pass
802.11(n) MCS0		3.206		0.2		Pass
802.11(n) MCS7		2.09		1.4		Pass
802.11(n) MCS8 (256-QAM)		0.948		1.6		Pass
Mid Channel, Ch 116 - 5580 MHz						
802.11(a) 6 Mbps		2.86		0.2		Pass
802.11(a) 36 Mbps		1.739		0.9		Pass
802.11(a) 54 Mbps		0.947		1.3		Pass
802.11(n) MCS0		2.642		0.2		Pass
802.11(n) MCS7		1.557		1.4		Pass
802.11(n) MCS8 (256-QAM)		0.453		1.6		Pass
High Channel, Ch 140 - 5700 MHz						
802.11(a) 6 Mbps		3.372		0.2		Pass
802.11(a) 36 Mbps		2.15		1		Pass
802.11(a) 54 Mbps		1.346		1.3		Pass
802.11(n) MCS0		3.17		0.2		Pass
802.11(n) MCS7		2.002		1.5		Pass
802.11(n) MCS8 (256-QAM)		0.83		1.6		Pass
40 MHz						
5470 - 5725 MHz Band						
Low Channel, Ch 100/104 - 5510 MHz						
802.11(n) MCS0		0.081		0.4		Pass
802.11(n) MCS7		-1.762		2.7		Pass
802.11(n) MCS9 (256-QAM)		-4.898		2.6		Pass
Mid Channel, Ch 116/120 - 5590 MHz						
802.11(n) MCS0		-0.18		0.4		Pass
802.11(n) MCS7		-1.991		2.5		Pass
802.11(n) MCS9 (256-QAM)		-5.741		2.6		Pass
High Channel, Ch 132/136 - 5670 MHz						
802.11(n) MCS0		0.002		0.4		Pass
802.11(n) MCS7		-1.849		2.5		Pass

80 MHz	802.11(n) MCS9 (256-QAM)	-5.081	2.6	-2.5	11	Pass
	5470 - 5725 MHz Band					
	Low Channel, Ch 100-112 - 5530 MHz					
	802.11(n) MCS0	-3.041	0.9	-2.1	11	Pass
	802.11(n) MCS9 (256-QAM)	-8.25	3.5	-4.8	11	Pass
	High Channel, Ch 116-128 - 5610 MHz					
	802.11(n) MCS0	-3.616	0.9	-2.7	11	Pass
	802.11(n) MCS9 (256-QAM)	-8.837	3.4	-5.4	11	Pass

MAXIMUM POWER SPECTRAL DENSITY - SISO

5.8 GHz BAND



XMIT 2019.06.11

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	25-Apr-18	25-Apr-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-19	29-Mar-20
Attenuator	Fairview Microwave	SA4014-20	TKV	18-Jan-19	18-Jan-20
Block - DC	Fairview Microwave	SD3379	AMU	18-Jan-19	18-Jan-20
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-19	28-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. The radio was operated in the modes as shown in the following data sheets.

Prior to measuring maximum power spectral density, the emission bandwidth (B) was measured. The method of measuring the emission bandwidth and the associated data are found elsewhere in this test report

The maximum power spectral density was measured using ANSI C63.10, Method SA-2 (RMS detection and trace averaging across the on and off times of the EUT transmission and use of a duty cycle correction factor), consistent with the method used for maximum conducted output power.

The spectrum analyzer settings were set per the guidance as well as the following specifics:

-Resolution Bandwidth of 510 kHz

-RMS Detector

-Trace average 100 traces in power averaging mode

The peak power spectral density (PPSD) was determined to be the highest level found across the emission in the reference bandwidth after 100 sweeps of power averaging (not video averaging).

A duty cycle correction factor was added to the measurement using the results of the formula of $10 \cdot \log(1/D)$ where D is the duty cycle.

MAXIMUM POWER SPECTRAL DENSITY - SISO 5.8 GHz BAND



TMTX 2018.09.13 XMI 2019.09.05

EUT: Thor Radio Module AC WLAN and Bluetooth and BLE		Work Order: ECHN0015	
Serial Number: Pre-production #1		Date: 26-Dec-19	
Customer: EchoNus, Inc.		Temperature: 23.9 °C	
Attendees: None		Humidity: 24.9% RH	
Project: None		Barometric Pres.: 1024 mbar	
Tested by: Brian Fahey & Jeff Alcoke		Job Site: NC0A	
Power: 3.7 VDC			
TEST SPECIFICATIONS		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
COMMENTS			
Reference level offset: RF measurement cable, 20 dB attenuator, and DC Block = 23.4 dB.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature <i>Brian Fahey</i> <i>Jeff Alcoke</i>	
		Power (dBm/Ref BW)	Duty Cycle Factor (dB)
		Density (dBm/Ref BW)	Limit ≤ (dBm/Ref BW)
			Results

Chain_1			
20 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149 - 5745 MHz		
	802.11(a) 6 Mbps	0.563	0.2
	802.11(a) 36 Mbps	-0.575	1
	802.11(a) 54 Mbps	-1.252	1.3
	802.11(n) MCS0	0.311	0.2
	802.11(n) MCS7	-0.593	1.5
	802.11(n) MCS8 (256-QAM)	-1.595	1.6
	Mid Channel, Ch 157 - 5785 MHz		
	802.11(a) 6 Mbps	1	0.2
	802.11(a) 36 Mbps	-0.233	1
	802.11(a) 54 Mbps	-0.932	1.5
	802.11(n) MCS0	0.656	0.2
	802.11(n) MCS7	-0.159	1.5
	802.11(n) MCS8 (256-QAM)	-1.271	1.6
	High Channel, Ch 165 - 5825 MHz		
	802.11(a) 6 Mbps	0.795	0.2
	802.11(a) 36 Mbps	-0.194	1
	802.11(a) 54 Mbps	-1.098	1.5
	802.11(n) MCS0	0.532	0.2
	802.11(n) MCS7	-0.316	1.5
	802.11(n) MCS8 (256-QAM)	-1.481	1.6
40 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149/153 - 5755 MHz		
	802.11(n) MCS0	-2.561	0.4
	802.11(n) MCS7	-3.861	2.2
	802.11(n) MCS9 (256-QAM)	-6.926	2.6
	High Channel, Ch 157/161 - 5795 MHz		
	802.11(n) MCS0	-2.481	0.5
	802.11(n) MCS7	-3.671	2.2
	802.11(n) MCS9 (256-QAM)	-6.792	2.6
80 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149-161 - 5775 MHz		
	802.11(n) MCS0	-5.599	0.8
	802.11(n) MCS9 (256-QAM)	-10.358	3.7
Chain_2			
20 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149 - 5745 MHz		
	802.11(a) 6 Mbps	0.914	0.2
	802.11(a) 36 Mbps	-0.023	1
	802.11(a) 54 Mbps	-0.754	1.5
	802.11(n) MCS0	0.683	0.2
	802.11(n) MCS7	-0.199	1.4
	802.11(n) MCS8 (256-QAM)	-1.121	1.4
	Mid Channel, Ch 157 - 5785 MHz		
	802.11(a) 6 Mbps	1.275	0.2
	802.11(a) 36 Mbps	0.356	1
	802.11(a) 54 Mbps	-0.394	1.3
	802.11(n) MCS0	1.06	0.2
	802.11(n) MCS7	0.149	1.4
	802.11(n) MCS8 (256-QAM)	-0.768	1.6
	High Channel, Ch 165 - 5825 MHz		
	802.11(a) 6 Mbps	1.549	0.2
	802.11(a) 36 Mbps	0.501	1
	802.11(a) 54 Mbps	-0.317	1.3
	802.11(n) MCS0	1.274	0.2
	802.11(n) MCS7	0.503	1.6
	802.11(n) MCS8 (256-QAM)	-0.648	1.6
40 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149/153 - 5755 MHz		
	802.11(n) MCS0	-2.092	0.4
	802.11(n) MCS7	-3.556	2.2
	802.11(n) MCS9 (256-QAM)	-6.511	2.6
	High Channel, Ch 157/161 - 5795 MHz		
	802.11(n) MCS0	-1.991	0.5
	802.11(n) MCS7	-3.357	2.3
	802.11(n) MCS9 (256-QAM)	-6.327	2.6
80 MHz	5725 - 5785 MHz Band		
	Low Channel, Ch 149-161 - 5775 MHz		
	802.11(n) MCS0	-5.076	0.9
	802.11(n) MCS9 (256-QAM)	-9.664	3.5

SPURIOUS RADIATED EMISSIONS



PSA-ESCI 2019.05.10

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

802.11ac; 20 MHz Bandwidth: Ch. 36, Ch. 48, Ch. 52, Ch. 64, Ch. 100, Ch. 116, Ch. 140, Ch. 149, Ch. 157, Ch. 165;
40 MHz Bandwidth: Ch. 38, Ch. 46, Ch. 54, Ch. 62, Ch. 102, Ch. 118, Ch. 134, Ch. 151, Ch. 159;
80 MHz Bandwidth: Ch. 42, Ch. 58, Ch. 106, Ch. 122, Ch. 155.

POWER SETTINGS INVESTIGATED

3.7 VDC

CONFIGURATIONS INVESTIGATED

ECHN0015 - 4

ECHN0015 - 5

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	40 GHz
-----------------	--------	----------------	--------

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	28-May-2019	12 mo
Filter - Band Pass/Notch	Micro-Tronics	BRC50705	HGJ	8-Nov-2019	12 mo
Filter - Band Pass/Notch	Micro-Tronics	BRC50704	HGI	8-Nov-2019	12 mo
Filter - Band Pass/Notch	Micro-Tronics	BRC50703	HHJ	8-Nov-2019	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AJM	23-May-2018	24 mo
Filter - Low Pass	Micro-Tronics	LPM50004	LFD	15-Feb-2019	12 mo
Antenna - Double Ridge	EMCO	3115	AHC	2-Jul-2018	24 mo
Cable	Micro-Coax	UFD150A-1-0720-200200	EVK	29-Mar-2019	12 mo
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-2019	12 mo
Cable	Northwest EMC	N/A	NC8	18-Jan-2019	12 mo
Cable	ESM Cable Corp.	TTBJ141-KMKM-72	NCV	18-Jan-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	JSW45-26004000-40-5P	TTV	18-Jan-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-18002650-25-10P	AOD	18-Jan-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-10	AJE	NCR	0 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AIY	NCR	0 mo
Cable	None	Standard Gain Horns Cable	EVF	19-Nov-2019	12 mo
Cable	N/A	Double Ridge Horn Cables	EVB	18-Nov-2019	12 mo
Cable	N/A	Bilog Cables	EVA	18-Nov-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVD	19-Nov-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	18-Nov-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AOL	18-Nov-2019	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AHV	NCR	0 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AHU	NCR	0 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIZ	7-Feb-2018	24 mo
Antenna - Biconilog	Teseq	CBL 6141B	AXR	2-Oct-2018	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-2019	12 mo

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies in each operational band and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector
PK = Peak Detector
AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Measurements at the edges of the allowable band may be presented in an alternative method as provided for in the ANSI C63.10 Marker-Delta method. This method involves performing an in-band fundamental measurement followed by a screen capture of the fundamental and out-of-band emission using reduced measurement instrumentation bandwidths. The amplitude delta measured on this screen capture is applied to the fundamental emission value to show the out-of-band emission level as applied to the limit.

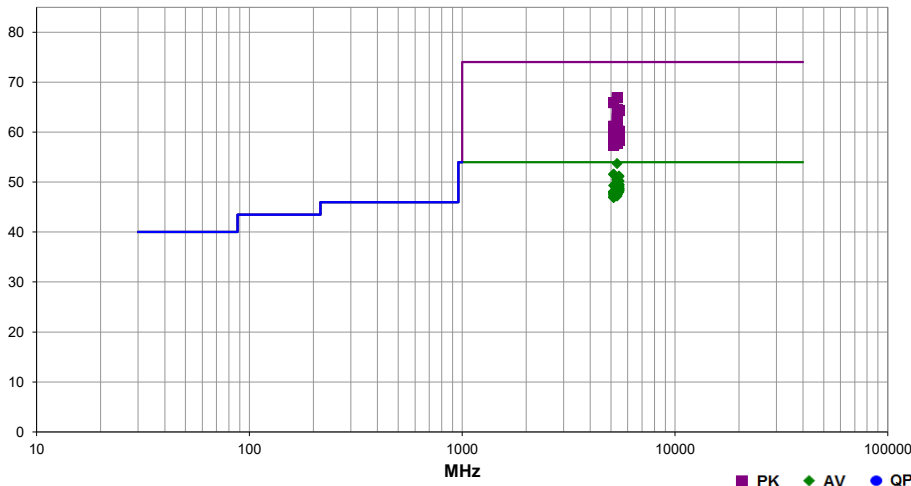
SPURIOUS RADIATED EMISSIONS



Work Order:	ECHN0015	Date:	16-Dec-2019	
Project:	None	Temperature:	25.1 °C	
Job Site:	NC01	Humidity:	29.1% RH	
Serial Number:	H1UR1944002-04	Barometric Pres.:	1029 mbar	
Tested by: Brian Fahey and Jeff Alcock				
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	5			
Customer:	EchoNus, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11ac; 20 MHz Bandwidth: Ch. 36, Ch. 64, Ch. 100; 40 MHz Bandwidth: Ch. 38, Ch. 62, Ch. 102; 80 MHz Bandwidth: Ch. 42, Ch. 58, Ch. 106.			
Deviations:	None			
Comments:	See comments for channel, chain, bandwidth, data rate, EUT orientation, and power setting.			

Test Specifications	Test Method
FCC 15.407:2019	ANSI C63.10:2013

Run #	110	Test Distance (m)	1	Antenna Height(s)	1 to 4(m)	Results	Pass
-------	-----	-------------------	---	-------------------	-----------	---------	------



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
5350.050	24.4	34.8	1.6	248.0	4.0	0.0	Vert	AV	-9.5	53.7	54.0	-0.3	High Ch. 58, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5148.447	22.8	34.3	1.6	248.0	4.0	0.0	Vert	AV	-9.5	51.6	54.0	-2.4	Low Ch. 42, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5149.587	26.0	34.3	1.6	248.0	0.7	0.0	Vert	AV	-9.5	51.5	54.0	-2.5	Low Ch. 38, Chain_12, 40MHz, MCS8, EUT Vert, Power=14dBm
5458.113	21.8	35.6	1.6	248.0	3.3	0.0	Vert	AV	-9.5	51.2	54.0	-2.8	Low Ch. 102, Chain_12, 40MHz, MCS9(256-QAM), EUT Vert, Power=11dBm
5459.700	22.3	35.6	1.6	248.0	2.7	0.0	Vert	AV	-9.5	51.1	54.0	-2.9	Low Ch. 102, Chain_12, 40MHz, MCS7, EUT Vert, Power=14dBm
5350.010	24.7	34.8	1.6	248.0	0.9	0.0	Vert	AV	-9.5	50.9	54.0	-3.1	High Ch. 58, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5351.193	22.0	34.8	1.6	248.0	3.2	0.0	Vert	AV	-9.5	50.5	54.0	-3.5	High Ch. 58, Chain_12, 80MHz, MCS9(256-QAM), EUT Vert, Power=11dBm
5350.560	22.3	34.8	1.6	248.0	2.9	0.0	Vert	AV	-9.5	50.5	54.0	-3.5	High Ch. 62, Chain_12, 40MHz, MCS15, EUT Vert, Power=14dBm
5350.060	21.9	34.8	1.6	248.0	3.3	0.0	Vert	AV	-9.5	50.5	54.0	-3.5	High Ch. 62, Chain_12, 40MHz, MCS9(256-QAM), EUT Vert, Power=11dBm
5350.217	22.6	34.8	1.6	248.0	2.4	0.0	Vert	AV	-9.5	50.3	54.0	-3.7	High Ch. 62, Chain_12, 40MHz, MCS7, EUT Vert, Power=14dBm
5459.047	21.9	35.6	1.6	248.0	2.2	0.0	Vert	AV	-9.5	50.2	54.0	-3.8	Low Ch. 100, Chain_12, 20MHz, MCS15, EUT Vert, Power=14dBm
5458.580	21.8	35.6	1.6	248.0	2.3	0.0	Vert	AV	-9.5	50.2	54.0	-3.8	Low Ch. 100, Chain_12, 20MHz, MCS9(256-QAM), EUT Vert, Power=12dBm
5350.087	22.1	34.8	1.6	248.0	2.5	0.0	Vert	AV	-9.5	49.9	54.0	-4.1	High Ch. 64, Chain_12, 20MHz, MCS8(256-QAM), EUT Vert, Power=12dBm
5459.830	22.5	35.6	1.6	248.0	0.9	0.0	Vert	AV	-9.5	49.5	54.0	-4.5	Low Ch. 106, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5459.770	22.0	35.6	1.6	248.0	1.4	0.0	Vert	AV	-9.5	49.5	54.0	-4.5	Low Ch. 100, Chain_12, 20MHz, MCS7, EUT Vert, Power=14dBm
5459.050	22.0	35.6	1.6	248.0	1.3	0.0	Vert	AV	-9.5	49.4	54.0	-4.6	Low Ch. 100, Chain_12, 20MHz, 54Mbps, EUT Vert, Power=13dBm
5149.093	22.1	34.3	1.6	248.0	2.4	0.0	Vert	AV	-9.5	49.3	54.0	-4.7	Low Ch. 38, Chain_12, 40MHz, MCS7, EUT Vert, Power=14dBm
5459.497	22.0	35.6	1.6	248.0	1.1	0.0	Vert	AV	-9.5	49.2	54.0	-4.8	Low Ch. 100, Chain_12, 20MHz, 36Mbps, EUT Vert, Power=13.5dBm
5350.277	23.3	34.8	1.6	248.0	0.5	0.0	Vert	AV	-9.5	49.1	54.0	-4.9	High Ch. 62, Chain_12, 40MHz, MCS0, EUT Vert, Power=14dBm
5459.283	22.5	35.6	1.6	248.0	0.4	0.0	Vert	AV	-9.5	49.0	54.0	-5.0	Low Ch. 102, Chain_12, 40MHz, MCS0, EUT Vert, Power=14dBm
5459.833	21.8	35.6	1.6	248.0	0.9	0.0	Vert	AV	-9.5	48.8	54.0	-5.2	Low Ch. 106, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5458.293	21.8	35.6	1.6	248.0	0.8	0.0	Vert	AV	-9.5	48.7	54.0	-5.3	Low Ch. 106, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5459.983	21.8	35.6	1.6	248.0	0.8	0.0	Vert	AV	-9.5	48.7	54.0	-5.3	Low Ch. 102, Chain_12, 40MHz, MCS8, EUT Vert, Power=14dBm
5350.433	22.0	34.8	1.6	248.0	1.4	0.0	Vert	AV	-9.5	48.7	54.0	-5.3	High Ch. 64, Chain_12, 20MHz, MCS7, EUT Vert, Power=14dBm
5459.907	22.0	35.6	1.6	248.0	0.4	0.0	Vert	AV	-9.5	48.5	54.0	-5.5	Low Ch. 100, Chain_12, 20MHz, MCS8, EUT Vert, Power=14dBm
5351.527	21.9	34.8	1.6	248.0	1.3	0.0	Vert	AV	-9.5	48.5	54.0	-5.5	High Ch. 64, Chain_12, 20MHz, 54Mbps, EUT Vert, Power=13dBm
5459.527	22.1	35.6	1.6	248.0	0.2	0.0	Vert	AV	-9.5	48.4	54.0	-5.6	Low Ch. 100, Chain_12, 20MHz, MCS0, EUT Vert, Power=14dBm
5350.047	22.4	34.8	1.6	248.0	0.7	0.0	Vert	AV	-9.5	48.4	54.0	-5.6	High Ch. 62, Chain_12, 40MHz, MCS8, EUT Vert, Power=14dBm
5458.443	22.0	35.6	1.6	248.0	0.2	0.0	Vert	AV	-9.5	48.3	54.0	-5.7	Low Ch. 100, Chain_12, 20MHz, 6Mbps, EUT Vert, Power=14dBm
5458.083	21.8	35.6	1.6	248.0	0.4	0.0	Vert	AV	-9.5	48.3	54.0	-5.7	Low Ch. 102, Chain_12, 40MHz, MCS0, EUT Vert, Power=14dBm
5350.327	22.0	34.8	1.6	248.0	0.9	0.0	Vert	AV	-9.5	48.2	54.0	-5.8	High Ch. 64, Chain_12, 20MHz, 36Mbps, EUT Vert, Power=13.5dBm
5149.743	21.9	34.3	1.6	248.0	1.4	0.0	Vert	AV	-9.5	48.1	54.0	-5.9	Low Ch. 36, Chain_12, 20MHz, MCS7, EUT Vert, Power=14dBm
5458.220	21.7	35.6	1.6	248.0	0.2	0.0	Vert	AV	-9.5	48.0	54.0	-6.0	Low Ch. 100, Chain_12, 20MHz, MCS0, EUT Vert, Power=14dBm
5149.417	22.4	34.3	1.6	248.0	0.8	0.0	Vert	AV	-9.5	48.0	54.0	-6.0	Low Ch. 42, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5351.657	21.9	34.8	1.6	248.0	0.8	0.0	Vert	AV	-9.5	48.0	54.0	-6.0	High Ch. 58, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5149.407	21.9	34.3	1.6	248.0	1.3	0.0	Vert	AV	-9.5	48.0	54.0	-6.0	Low Ch. 36, Chain_12, 20MHz, 54Mbps, EUT Vert, Power=13dBm
5149.017	21.9	34.3	1.6	248.0	1.3	0.0	Vert	AV	-9.5	48.0	54.0	-6.0	Low Ch. 36, Chain_12, 20MHz, 54Mbps, EUT Vert, Power=13dBm
5149.387	22.3	34.3	1.6	248.0	0.8	0.0	Vert	AV	-9.5	47.9	54.0	-6.1	Low Ch. 42, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5149.663	21.9	34.3	1.6	248.0	1.0	0.0	Vert	AV	-9.5	47.7	54.0	-6.3	Low Ch. 36, Chain_12, 20MHz, 36Mbps, EUT Vert, Power=13.5dBm
5350.000	22.1	34.8	1.6	248.0	0.2	0.0	Vert	AV	-9.5	47.6	54.0	-6.4	High Ch. 64, Chain_12, 20MHz, MCS0, EUT Vert, Power=14dBm
5350.400	22.1	34.8	1.6	248.0	0.2	0.0	Vert	AV	-9.5	47.6	54.0	-6.4	High Ch. 64, Chain_12, 20MHz, 6Mbps, EUT Vert, Power=14dBm
5350.200	21.9	34.8	1.6	248.0	0.4	0.0	Vert	AV	-9.5	47.6	54.0	-6.4	High Ch. 64, Chain_12, 20MHz, MCS8, EUT Vert, Power=14dBm
5149.543	22.3	34.3	1.6	248.0	0.4	0.0	Vert	AV	-9.5	47.5	54.0	-6.5	Low Ch. 38, Chain_12, 40MHz, MCS0, EUT Vert, Power=14dBm
5351.757	21.8	34.8	1.6	248.0	0.4	0.0	Vert	AV	-9.5	47.5	54.0	-6.5	High Ch. 62, Chain_12, 40MHz, MCS0, EUT Vert, Power=14dBm

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
5149.553	22.2	34.3	1.6	248.0	0.4	0.0	Vert	AV	-9.5	47.4	54.0	-6.6	Low Ch. 38, Chain_2, 40MHz, MCS0, EUT Vert, Power=14dBm
5350.703	21.7	34.8	1.6	248.0	0.2	0.0	Vert	AV	-9.5	47.2	54.0	-6.8	Low Ch. 64, Chain_1, 20MHz, MCS0, EUT Vert, Power=14dBm
5149.427	21.9	34.3	1.6	248.0	0.4	0.0	Vert	AV	-9.5	47.1	54.0	-6.9	Low Ch. 36, Chain_12, 20MHz, MCS8, EUT Vert, Power=14dBm
5350.223	41.6	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	66.9	74.0	-7.1	High Ch. 58, Chain_2, 80MHz, MCS0, EUT Vert, Power=14dBm
5149.343	21.9	34.3	1.6	248.0	0.2	0.0	Vert	AV	-9.5	46.9	54.0	-7.1	Low Ch. 36, Chain_2, 20MHz, MCS0, EUT Vert, Power=14dBm
5148.973	21.9	34.3	1.6	248.0	0.2	0.0	Vert	AV	-9.5	46.9	54.0	-7.1	Low Ch. 36, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
5148.300	41.1	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	65.9	74.0	-8.1	Low Ch. 38, Chain_12, 40MHz, MCS8, EUT Vert, Power=14dBm
5351.940	39.2	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	64.5	74.0	-9.5	High Ch. 58, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5459.123	38.2	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	64.3	74.0	-9.7	Low Ch. 106, Chain_2, 80MHz, MCS0, EUT Vert, Power=14dBm
5350.507	37.5	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	62.8	74.0	-11.2	High Ch. 62, Chain_12, 40MHz, MCS8, EUT Vert, Power=14dBm
5351.153	37.0	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	62.3	74.0	-11.7	High Ch. 62, Chain_2, 40MHz, MCS0, EUT Vert, Power=14dBm
5149.027	36.4	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	61.2	74.0	-12.8	Low Ch. 42, Chain_2, 80MHz, MCS0, EUT Vert, Power=14dBm
5149.647	36.3	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	61.1	74.0	-12.9	Low Ch. 42, Chain_1, 80MHz, MCS0, EUT Vert, Power=14dBm
5148.150	35.8	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	60.6	74.0	-13.4	Low Ch. 42, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5351.120	35.2	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	60.5	74.0	-13.5	High Ch. 62, Chain_2, 40MHz, MCS7, EUT Vert, Power=14dBm
5458.287	34.1	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	60.2	74.0	-13.8	Low Ch. 102, Chain_2, 40MHz, MCS0, EUT Vert, Power=14dBm
5459.983	34.0	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	60.1	74.0	-13.9	Low Ch. 102, Chain_2, 40MHz, MCS7, EUT Vert, Power=14dBm
5351.820	34.7	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	60.0	74.0	-14.0	High Ch. 62, Chain_12, 40MHz, MCS15, EUT Vert, Power=14dBm
5458.213	33.8	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.9	74.0	-14.1	Low Ch. 100, Chain_2, 20MHz, 54Mbps, EUT Vert, Power=13dBm
5458.883	33.6	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.7	74.0	-14.3	Low Ch. 100, Chain_2, 20MHz, 36Mbps, EUT Vert, Power=13.5dBm
5149.793	34.9	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.7	74.0	-14.3	Low Ch. 38, Chain_1, 40MHz, MCS0, EUT Vert, Power=14dBm
5459.793	33.5	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.6	74.0	-14.4	Low Ch. 106, Chain_1, 80MHz, MCS0, EUT Vert, Power=14dBm
5458.597	33.3	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.4	74.0	-14.6	Low Ch. 102, Chain_12, 40MHz, MCS8, EUT Vert, Power=14dBm
5350.177	34.1	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.4	74.0	-14.6	High Ch. 64, Chain_2, 20MHz, 54Mbps, EUT Vert, Power=14dBm
5351.707	34.0	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.3	74.0	-14.7	High Ch. 64, Chain_2, 20MHz, MCS7, EUT Vert, Power=14dBm
5458.573	33.1	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.2	74.0	-14.8	Low Ch. 100, Chain_12, 20MHz, MCS8(256-QAM), EUT Vert, Power=12dBm
5148.070	34.3	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.1	74.0	-14.9	Low Ch. 38, Chain_2, 40MHz, MCS7, EUT Vert, Power=14dBm
5458.783	33.0	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.1	74.0	-14.9	Low Ch. 100, Chain_2, 20MHz, MCS0, EUT Vert, Power=14dBm
5459.883	33.0	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.1	74.0	-14.9	Low Ch. 100, Chain_1, 20MHz, MCS0, EUT Vert, Power=14dBm
5458.830	32.9	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.0	74.0	-15.0	Low Ch. 100, Chain_2, 20MHz, MCS7, EUT Vert, Power=14dBm
5458.677	32.9	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.0	74.0	-15.0	Low Ch. 100, Chain_12, 20MHz, MCS15, EUT Vert, Power=14dBm
5351.990	33.7	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	59.0	74.0	-15.0	High Ch. 64, Chain_2, 20MHz, 36Mbps, EUT Vert, Power=13.5dBm
5458.533	32.8	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.9	74.0	-15.1	Low Ch. 106, Chain_12, 80MHz, MCS0, EUT Vert, Power=14dBm
5350.387	33.6	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.9	74.0	-15.1	High Ch. 64, Chain_12, 20MHz, MCS8, EUT Vert, Power=14dBm
5458.837	32.7	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.8	74.0	-15.2	Low Ch. 102, Chain_1, 40MHz, MCS0, EUT Vert, Power=14dBm
5458.743	32.7	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.8	74.0	-15.2	Low Ch. 100, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
5148.913	34.0	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.8	74.0	-15.2	Low Ch. 38, Chain_2, 40MHz, MCS0, EUT Vert, Power=14dBm
5459.840	32.6	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.7	74.0	-15.3	Low Ch. 102, Chain_12, 40MHz, MCS9(256-QAM), EUT Vert, Power=11dBm
5351.723	33.4	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.7	74.0	-15.3	High Ch. 64, Chain_12, 20MHz, MCS8(256-QAM), EUT Vert, Power=12dBm
5350.707	33.1	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.4	74.0	-15.6	Low Ch. 64, Chain_1, 20MHz, MCS0, EUT Vert, Power=14dBm
5149.093	33.6	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.4	74.0	-15.6	Low Ch. 36, Chain_2, 20MHz, 54Mbps, EUT Vert, Power=13dBm
5459.040	32.3	35.6	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.4	74.0	-15.6	Low Ch. 100, Chain_12, 20MHz, MCS8, EUT Vert, Power=14dBm
5350.277	33.1	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.4	74.0	-15.6	High Ch. 58, Chain_12, 80MHz, MCS9(256-QAM), EUT Vert, Power=11dBm
5350.383	32.9	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.2	74.0	-15.8	High Ch. 64, Chain_2, 20MHz, MCS0, EUT Vert, Power=14dBm
5351.653	32.9	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.2	74.0	-15.8	High Ch. 62, Chain_12, 40MHz, MCS9(256-QAM), EUT Vert, Power=11dBm
5148.507	33.3	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.1	74.0	-15.9	Low Ch. 36, Chain_2, 20MHz, 36Mbps, EUT Vert, Power=13.5dBm
5148.457	33.2	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.0	74.0	-16.0	Low Ch. 36, Chain_12, 20MHz, MCS8, EUT Vert, Power=14dBm
5350.507	32.7	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	58.0	74.0	-16.0	High Ch. 62, Chain_1, 40MHz, MCS0, EUT Vert, Power=14dBm
5350.103	32.6	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	57.9	74.0	-16.1	High Ch. 64, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
5350.303	32.5	34.8	1.6	248.0	0.0	0.0	Vert	PK	-9.5	57.8	74.0	-16.2	High Ch. 58, Chain_1, 80MHz, MCS0, EUT Vert, Power=14dBm
5149.240	32.9	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	57.7	74.0	-16.3	Low Ch. 36, Chain_2, 20MHz, MCS7, EUT Vert, Power=14dBm
5148.823	32.9	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	57.7	74.0	-16.3	Low Ch. 36, Chain_1, 20MHz, 54Mbps, EUT Vert, Power=13dBm
5149.260	32.7	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	57.5	74.0	-16.5	Low Ch. 36, Chain_2, 20MHz, MCS0, EUT Vert, Power=14dBm
5149.570	32.6	34.3	1.6	248.0	0.0	0.0	Vert	PK	-9.5	57.4	74.0	-16.6	Low Ch. 36, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm

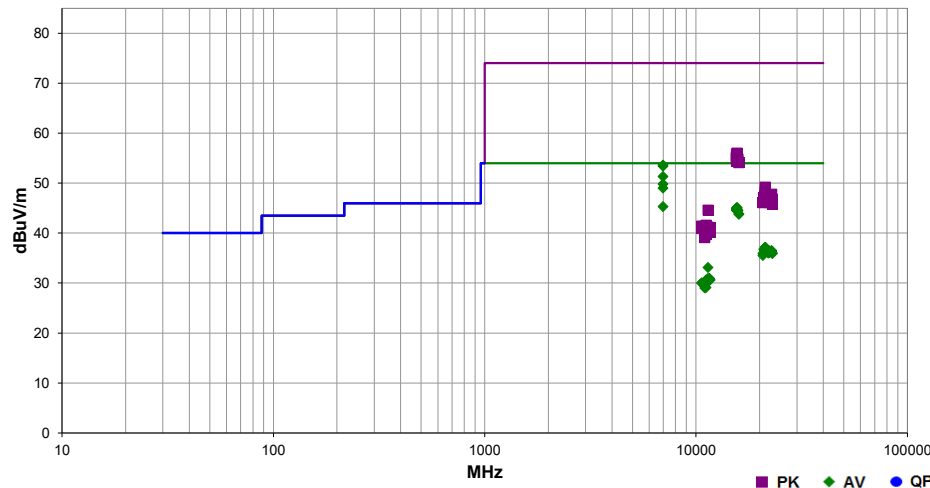
SPURIOUS RADIATED EMISSIONS



Work Order:	ECHN0015	Date:	18-Dec-2019	<i>Brian Fahey</i> <i>Jeff Alcoke</i>
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	32.8% RH	
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	5			
Customer:	EchoNus, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11ac; 20 MHz Bandwidth: Ch. 36, Ch. 48, Ch. 52, Ch. 64, Ch. 100, Ch. 116, Ch. 140, Ch. 149, Ch. 157, Ch. 165; 40 MHz Bandwidth: Ch. 38, Ch. 62; 80 MHz Bandwidth: Ch. 42, Ch. 58.			
Deviations:	None			
Comments:	See comments for channel, chain, bandwidth, data rate, EUT orientation, and power setting.			

Test Specifications	Test Method
FCC 15.407:2019	ANSI C63.10:2013

Run #	142	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
-------	-----	-------------------	---	-------------------	-----------	---------	------



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
6986.738	42.7	10.9	1.15	105.0	3.0	0.0	Vert	AV	0.0	53.6	54.0	-0.4	High Ch. 48, Chain_2, 6Mbps, EUT Vert
6986.713	42.5	10.9	2.78	257.0	3.0	0.0	Horz	AV	0.0	53.4	54.0	-0.6	High Ch. 48, Chain_2, 6Mbps, EUT Horz
6986.763	40.4	10.9	3.85	187.0	3.0	0.0	Horz	AV	0.0	51.3	54.0	-2.7	High Ch. 48, Chain_2, 6Mbps, EUT on Side
6986.730	38.9	10.9	1.5	255.0	3.0	0.0	Horz	AV	0.0	49.8	54.0	-4.2	High Ch. 48, Chain_2, 6Mbps, EUT Vert
6986.763	38.1	10.9	1.5	238.0	3.0	0.0	Vert	AV	0.0	49.0	54.0	-5.0	High Ch. 48, Chain_2, 6Mbps, EUT Horz
6986.713	34.4	10.9	3.22	34.0	3.0	0.0	Vert	AV	0.0	45.3	54.0	-8.7	High Ch. 48, Chain_2, 6Mbps, EUT on Side
15632.280	28.0	17.1	1.5	83.0	3.0	0.0	Horz	AV	0.0	45.1	54.0	-8.9	Low Ch. 42, Chain_1, 80MHz, MCS0, EUT Horz
15627.800	27.9	17.1	1.5	0.0	3.0	0.0	Horz	AV	0.0	45.0	54.0	-9.0	Low Ch. 42, Chain_2, 80MHz, MCS0, EUT Horz
15628.170	27.9	17.1	2.36	163.0	3.0	0.0	Horz	AV	0.0	45.0	54.0	-9.0	Low Ch. 42, Chain_12, 80MHz, MCS9(256-QAM), EUT Horz
15568.260	28.1	16.8	1.5	0.0	3.0	0.0	Horz	AV	0.0	44.9	54.0	-9.1	Low Ch. 38, Chain_2, 40MHz, MCS7, EUT Horz
15569.340	28.1	16.8	1.5	215.0	3.0	0.0	Horz	AV	0.0	44.9	54.0	-9.1	Low Ch. 38, Chain_12, 40MHz, MCS9(256-QAM), EUT Horz
15570.450	28.1	16.8	1.5	360.0	3.0	0.0	Horz	AV	0.0	44.9	54.0	-9.1	Low Ch. 38, Chain_2, 40MHz, MCS0, EUT Horz
15570.700	28.1	16.8	1.5	216.0	3.0	0.0	Horz	AV	0.0	44.9	54.0	-9.1	Low Ch. 38, Chain_12, 40MHz, MCS8(256-QAM), EUT Horz
15571.080	28.1	16.8	1.5	5.0	3.0	0.0	Horz	AV	0.0	44.9	54.0	-9.1	Low Ch. 38, Chain_12, 40MHz, MCS8, EUT Horz
15572.380	28.1	16.8	1.5	269.0	3.0	0.0	Horz	AV	0.0	44.9	54.0	-9.1	Low Ch. 38, Chain_12, 40MHz, MCS15, EUT Horz
15571.250	28.0	16.8	2.14	18.0	3.0	0.0	Horz	AV	0.0	44.8	54.0	-9.2	Low Ch. 38, Chain_1, 40MHz, MCS7, EUT Horz
15537.610	28.1	16.6	1.5	0.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	Low Ch. 36, Chain_2, 6Mbps, EUT Horz
15538.190	28.1	16.6	1.47	26.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	Low Ch. 36, Chain_12, 20MHz, MCS8, EUT Horz
15538.320	28.1	16.6	1.81	96.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	Low Ch. 36, Chain_12, 20MHz, MCS15, EUT Horz
15538.380	28.1	16.6	1.5	319.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	Low Ch. 36, Chain_12, 20MHz, MCS9(256-QAM), EUT Horz
15538.850	28.1	16.6	1.5	77.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	Low Ch. 36, Chain_12, 20MHz, MCS8(256-QAM), EUT Horz
15539.550	28.1	16.6	1.5	360.0	3.0	0.0	Vert	AV	0.0	44.7	54.0	-9.3	Low Ch. 36, Chain_2, 6Mbps, EUT Vert
15540.920	28.1	16.6	1.5	360.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	Low Ch. 36, Chain_2, 20MHz, MCS7, EUT Horz
15542.150	28.0	16.7	1.5	280.0	3.0	0.0	Horz	AV	0.0	44.7	54.0	-9.3	Low Ch. 38, Chain_1, 40MHz, MCS7, EUT Horz
15537.680	28.0	16.6	1.5	0.0	3.0	0.0	Horz	AV	0.0	44.6	54.0	-9.4	Low Ch. 36, Chain_2, 20MHz, 36Mbps, EUT Horz
15537.880	28.0	16.6	1.5	360.0	3.0	0.0	Horz	AV	0.0	44.6	54.0	-9.4	Low Ch. 36, Chain_2, 20MHz, 54Mbps, EUT Horz
15539.610	28.0	16.6	1.5	0.0	3.0	0.0	Horz	AV	0.0	44.6	54.0	-9.4	Low Ch. 36, Chain_2, 20MHz, MCS0, EUT Horz
15717.520	27.6	16.9	1.5	0.0	3.0	0.0	Vert	AV	0.0	44.5	54.0	-9.5	High Ch. 48, Chain_2, 6Mbps, EUT Vert
15720.990	27.6	16.9	1.5	360.0	3.0	0.0	Horz	AV	0.0	44.5	54.0	-9.5	High Ch. 48, Chain_2, 6Mbps, EUT Horz
15779.330	27.5	17.0	1.5	0.0	3.0	0.0	Horz	AV	0.0	44.5	54.0	-9.5	Low Ch. 52, Chain_2, 6Mbps, EUT Horz
15781.170	27.5	17.0	1.5	360.0	3.0	0.0	Vert	AV	0.0	44.5	54.0	-9.5	Low Ch. 52, Chain_2, 6Mbps, EUT Vert
15988.450	26.8	17.0	1.5	360.0	3.0	0.0	Horz	AV	0.0	43.8	54.0	-10.2	High Ch. 64, Chain_2, 6Mbps, EUT Horz
15960.200	26.8	17.0	1.5	0.0	3.0	0.0	Vert	AV	0.0	43.8	54.0	-10.2	High Ch. 64, Chain_2, 6Mbps, EUT Vert
21278.660	37.0	0.1	1.6	0.0	3.0	0.0	Horz	AV	0.0	37.1	54.0	-16.9	High Ch. 64, Chain_1, 20MHz, MCS7, EUT Horz, Power=14dBm
21279.600	37.0	0.1	1.6	360.0	3.0	0.0	Horz	AV	0.0	37.1	54.0	-16.9	High Ch. 64, Chain_2, 20MHz, MCS7, EUT Horz, Power=14dBm
21279.880	37.0	0.1	1.6	360.0	3.0	0.0	Horz	AV	0.0	37.1	54.0	-16.9	High Ch. 62, Chain_12, 40MHz, MCS9(256-QAM), EUT Horz, Power=11dBm
21280.120	37.0	0.1	1.6	0.0	3.0	0.0	Horz	AV	0.0	37.1	54.0	-16.9	High Ch. 64, Chain_12, 20MHz, MCS8(256-QAM), EUT Horz, Power=12dBm
21280.250	36.9	0.1	1.6	0.0	3.0	0.0	Horz	AV	0.0	37.0	54.0	-17.0	High Ch. 64, Chain_12, 20MHz, MCS8, EUT Horz, Power=14dBm
21282.450	36.9	0.1	1.6	360.0	3.0	0.0	Horz	AV	0.0	37.0	54.0	-17.0	High Ch. 64, Chain_12, 20MHz, MCS15, EUT Horz, Power=14dBm
21237.620	36.9	0.0	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 64, Chain_12, 20MHz, MCS8(256-QAM), EUT Horz, Power=12dBm
21238.070	36.9	0.0	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 62, Chain_1, 40MHz, MCS7, EUT Horz, Power=14dBm
21240.080	36.9	0.0	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 62, Chain_2, 40MHz, MCS0, EUT Horz, Power=14dBm
21240.320	36.9	0.0	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 62, Chain_12, 40MHz, MCS9(256-QAM), EUT Horz, Power=11dBm
21241.020	36.9	0.0	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 62, Chain_12, 40MHz, MCS15, EUT Horz, Power=14dBm

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
21241.420	36.9	0.0	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 62, Chain_12, 40MHz, MCS8, EUT Horz, Power=14dBm
21242.170	36.9	0.0	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 62, Chain_2, 40MHz, MCS7, EUT Horz, Power=14dBm
21278.240	36.8	0.1	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 64, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
21280.710	36.8	0.1	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 64, Chain_2, 20MHz, MCS0, EUT Horz, Power=14dBm
21281.320	36.8	0.1	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	High Ch. 64, Chain_2, 20MHz, 54Mbps, EUT Horz, Power=13dBm
20961.810	36.1	0.7	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.8	54.0	-17.2	High Ch. 48, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
21280.610	36.7	0.1	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.8	54.0	-17.2	High Ch. 64, Chain_2, 20MHz, 36Mbps, EUT Horz, Power=13.5dBm
20960.610	36.0	0.7	1.6	0.0	3.0	0.0	Vert	AV	0.0	36.7	54.0	-17.3	High Ch. 48, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
21278.640	36.6	0.1	1.6	0.0	3.0	0.0	Vert	AV	0.0	36.7	54.0	-17.3	High Ch. 64, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
21040.960	36.0	0.5	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.5	54.0	-17.5	High Ch. 52, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
22000.320	37.1	-0.6	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.5	54.0	-17.5	High Ch. 100, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
22800.390	37.7	-1.2	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.5	54.0	-17.5	High Ch. 140, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
22320.040	37.0	-0.6	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.4	54.0	-17.6	High Ch. 116, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
22800.880	37.5	-1.2	1.6	360.0	3.0	0.0	Vert	AV	0.0	36.3	54.0	-17.7	High Ch. 140, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
21038.090	35.7	0.5	1.6	360.0	3.0	0.0	Vert	AV	0.0	36.2	54.0	-17.8	High Ch. 52, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
2161.040	36.1	0.1	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.2	54.0	-17.8	High Ch. 58, Chain_12, 80MHz, MCS9(256-QAM), EUT Horz, Power=11dBm
2162.210	36.1	0.1	1.6	0.0	3.0	0.0	Horz	AV	0.0	36.2	54.0	-17.8	High Ch. 58, Chain_2, 80MHz, MCS0, EUT Horz, Power=14dBm
2162.330	36.1	0.1	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.2	54.0	-17.8	High Ch. 58, Chain_1, 80MHz, MCS0, EUT Horz, Power=14dBm
22319.490	36.7	-0.6	1.6	0.0	3.0	0.0	Vert	AV	0.0	36.1	54.0	-17.9	High Ch. 116, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
15631.850	38.9	17.1	1.5	0.0	3.0	0.0	Horz	PK	0.0	56.0	74.0	-18.0	Low Ch. 42, Chain_2, 80MHz, MCS0, EUT Horz
21999.530	36.6	-0.6	1.6	360.0	3.0	0.0	Vert	AV	0.0	36.0	54.0	-18.0	High Ch. 100, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
22977.710	37.2	-1.2	1.6	360.0	3.0	0.0	Horz	AV	0.0	36.0	54.0	-18.0	High Ch. 149, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
20717.570	35.4	0.5	1.6	0.0	3.0	0.0	Horz	AV	0.0	35.9	54.0	-18.1	High Ch. 36, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
22979.390	37.1	-1.2	1.6	0.0	3.0	0.0	Vert	AV	0.0	35.9	54.0	-18.1	High Ch. 149, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
15537.660	39.2	16.6	1.5	360.0	3.0	0.0	Horz	PK	0.0	55.8	74.0	-18.2	Low Ch. 36, Chain_2, 20MHz, 54Mbps, EUT Horz
15569.720	39.0	16.8	1.5	216.0	3.0	0.0	Horz	PK	0.0	55.8	74.0	-18.2	Low Ch. 38, Chain_12, 40MHz, MCS8(256-QAM), EUT Horz
15570.930	39.0	16.8	1.5	0.0	3.0	0.0	Horz	PK	0.0	55.8	74.0	-18.2	Low Ch. 38, Chain_2, 40MHz, MCS7, EUT Horz
15569.410	38.7	16.8	1.5	269.0	3.0	0.0	Horz	PK	0.0	55.5	74.0	-18.5	Low Ch. 38, Chain_12, 40MHz, MCS15, EUT Horz
20717.540	35.0	0.5	1.6	360.0	3.0	0.0	Vert	AV	0.0	35.5	54.0	-18.5	High Ch. 36, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
15542.350	38.7	16.7	1.5	319.0	3.0	0.0	Horz	PK	0.0	55.4	74.0	-18.6	Low Ch. 36, Chain_12, 20MHz, MCS9(256-QAM), EUT Horz
15627.740	38.3	17.1	2.36	163.0	3.0	0.0	Horz	PK	0.0	55.4	74.0	-18.6	Low Ch. 42, Chain_12, 80MHz, MCS9(256-QAM), EUT Horz
15571.240	38.5	16.8	2.14	18.0	3.0	0.0	Horz	PK	0.0	55.3	74.0	-18.7	Low Ch. 38, Chain_1, 40MHz, MCS7, EUT Horz
15539.580	38.6	16.6	1.5	360.0	3.0	0.0	Horz	PK	0.0	55.2	74.0	-18.8	Low Ch. 36, Chain_2, 20MHz, MCS7, EUT Horz
15631.980	38.1	17.1	1.5	83.0	3.0	0.0	Horz	PK	0.0	55.2	74.0	-18.8	Low Ch. 42, Chain_1, 80MHz, MCS0, EUT Horz
15537.610	38.5	16.6	1.81	96.0	3.0	0.0	Horz	PK	0.0	55.1	74.0	-18.9	Low Ch. 36, Chain_12, 20MHz, MCS15, EUT Horz
15538.730	38.5	16.6	1.47	26.0	3.0	0.0	Horz	PK	0.0	55.1	74.0	-18.9	Low Ch. 36, Chain_12, 20MHz, MCS8, EUT Horz
15539.150	38.5	16.6	1.5	360.0	3.0	0.0	Vert	PK	0.0	55.1	74.0	-18.9	Low Ch. 36, Chain_2, 6Mbps, EUT Vert
15539.740	38.5	16.6	1.5	280.0	3.0	0.0	Horz	PK	0.0	55.1	74.0	-18.9	Low Ch. 38, Chain_1, 40MHz, MCS7, EUT Horz
15570.000	38.3	16.8	1.5	5.0	3.0	0.0	Horz	PK	0.0	55.1	74.0	-18.9	Low Ch. 38, Chain_12, 40MHz, MCS8, EUT Horz
15539.190	38.4	16.6	1.5	77.0	3.0	0.0	Horz	PK	0.0	55.0	74.0	-19.0	Low Ch. 36, Chain_12, 20MHz, MCS8(256-QAM), EUT Horz
15540.680	38.4	16.6	1.5	0.0	3.0	0.0	Horz	PK	0.0	55.0	74.0	-19.0	Low Ch. 36, Chain_2, 20MHz, MCS0, EUT Horz
15720.040	38.0	16.9	1.5	0.0	3.0	0.0	Vert	PK	0.0	54.9	74.0	-19.1	High Ch. 48, Chain_2, 6Mbps, EUT Vert
15539.430	38.2	16.6	1.5	0.0	3.0	0.0	Horz	PK	0.0	54.8	74.0	-19.2	Low Ch. 36, Chain_2, 20MHz, 36Mbps, EUT Horz
15569.190	38.0	16.8	1.5	215.0	3.0	0.0	Horz	PK	0.0	54.8	74.0	-19.2	Low Ch. 38, Chain_12, 40MHz, MCS9(256-QAM), EUT Horz
15781.010	37.8	17.0	1.5	0.0	3.0	0.0	Horz	PK	0.0	54.8	74.0	-19.2	Low Ch. 52, Chain_2, 6Mbps, EUT Horz
15722.030	37.8	16.9	1.5	360.0	3.0	0.0	Horz	PK	0.0	54.7	74.0	-19.3	High Ch. 48, Chain_2, 6Mbps, EUT Horz
15570.860	37.8	16.8	1.5	360.0	3.0	0.0	Horz	PK	0.0	54.6	74.0	-19.4	Low Ch. 38, Chain_2, 40MHz, MCS0, EUT Horz
15541.500	37.8	16.6	1.5	0.0	3.0	0.0	Horz	PK	0.0	54.4	74.0	-19.6	Low Ch. 36, Chain_2, 6Mbps, EUT Horz
15780.900	37.3	17.0	1.5	360.0	3.0	0.0	Vert	PK	0.0	54.3	74.0	-19.7	Low Ch. 52, Chain_2, 6Mbps, EUT Vert
15960.870	37.1	17.0	1.5	0.0	3.0	0.0	Vert	PK	0.0	54.1	74.0	-19.9	High Ch. 64, Chain_2, 6Mbps, EUT Vert
15961.810	37.1	17.0	1.5	360.0	3.0	0.0	Horz	PK	0.0	54.1	74.0	-19.9	High Ch. 64, Chain_2, 6Mbps, EUT Horz
11400.480	33.3	-0.2	1.5	203.0	3.0	0.0	Horz	AV	0.0	33.1	54.0	-20.9	High Ch. 140, Chain_2, 6Mbps, EUT Horz
11400.140	31.1	-0.2	1.5	360.0	3.0	0.0	Vert	AV	0.0	30.9	54.0	-23.1	High Ch. 140, Chain_2, 6Mbps, EUT Vert
11569.040	30.4	0.5	1.5	360.0	3.0	0.0	Horz	AV	0.0	30.9	54.0	-23.1	Mid Ch. 157, Chain_2, 6Mbps, EUT Horz
11571.840	30.4	0.5	1.5	360.0	3.0	0.0	Vert	AV	0.0	30.9	54.0	-23.1	Mid Ch. 157, Chain_2, 6Mbps, EUT Vert
11491.910	30.7	0.0	1.5	0.0	3.0	0.0	Horz	AV	0.0	30.7	54.0	-23.3	Low Ch. 149, Chain_2, 6Mbps, EUT Horz
11648.540	30.1	0.6	1.5	0.0	3.0	0.0	Horz	AV	0.0	30.7	54.0	-23.3	High Ch. 165, Chain_2, 6Mbps, EUT Horz
11159.650	32.3	-1.7	1.5	91.0	3.0	0.0	Horz	AV	0.0	30.6	54.0	-23.4	Mid Ch. 116, Chain_2, 6Mbps, EUT Horz
11651.380	30.0	0.6	1.5	0.0	3.0	0.0	Vert	AV	0.0	30.6	54.0	-23.4	High Ch. 165, Chain_2, 6Mbps, EUT Vert
11488.800	30.6	-0.1	1.5	0.0	3.0	0.0	Vert	AV	0.0	30.5	54.0	-23.5	Low Ch. 149, Chain_2, 6Mbps, EUT Vert
10641.580	30.6	-0.6	1.5	0.0	3.0	0.0	Vert	AV	0.0	30.0	54.0	-24.0	High Ch. 64, Chain_2, 6Mbps, EUT Vert
10641.770	30.6	-0.6	1.5	0.0	3.0	0.0	Horz	AV	0.0	30.0	54.0	-24.0	High Ch. 64, Chain_2, 6Mbps, EUT Horz
11001.230	30.8	-1.4	1.5	360.0	3.0	0.0	Horz	AV	0.0	29.4	54.0	-24.6	Low Ch. 100, Chain_2, 6Mbps, EUT Horz
21241.910	49.2	0.0	1.6	360.0	3.0	0.0	Horz	PK	0.0	49.2	74.0	-24.8	High Ch. 62, Chain_2, 40MHz, MCS0, EUT Horz, Power=14dBm
11158.340	30.8	-1.7	1.5	0.0	3.0	0.0	Vert	AV	0.0	29.1	54.0	-24.9	Mid Ch. 116, Chain_2, 6Mbps, EUT Vert
11002.310	30.4	-1.4	1.5	360.0	3.0	0.0	Vert	AV	0.0	29.0	54.0	-25.0	Low Ch. 100, Chain_2, 6Mbps, EUT Vert
21277.700	48.4	0.1	1.6	360.0	3.0	0.0	Horz	PK	0.0	48.5	74.0	-25.5	High Ch. 64, Chain_2, 20MHz, MCS7, EUT Horz, Power=14dBm
21241.180	48.2	0.0	1.6	360.0	3.0	0.0	Horz	PK	0.0	48.2	74.0	-25.8	High Ch. 62, Chain_1, 40MHz, MCS7, EUT Horz, Power=14dBm
21278.900	48.1	0.1	1.6	360.0	3.0	0.0	Horz	PK	0.0	48.2	74.0	-25.8	High Ch. 64, Chain_12, 20MHz, MCS9(256-QAM), EUT Horz, Power=11dBm
21240.610	47.8	0.0	1.6	360.0	3.0	0.0	Horz	PK	0.0	47.8	74.0	-26.2	High Ch. 62, Chain_12, 40MHz, MCS8, EUT Horz, Power=14dBm
22800.630	49.0	-1.2	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.8	74.0	-26.2	High Ch. 140, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
21281.150	47.5	0.1	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.6	74.0	-26.4	High Ch. 64, Chain_12, 20MHz, MCS8(256-QAM), EUT Horz, Power=12dBm
22001.280	48.2	-0.6	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.6	74.0	-26.4	High Ch. 100, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
21282.350	47.4	0.1	1.6	360.0	3.0	0.0	Horz	PK	0.0	47.5	74.0	-26.5	High Ch. 64, Chain_2, 20MHz, 54Mbps, EUT Horz, Power=13dBm
21237.980	47.4	0.0	1.6	360.0	3.0	0.0	Horz	PK	0.0	47.4	74.0	-26.6	High Ch. 62, Chain_12, 40MHz, MCS9(256-QAM), EUT Horz, Power=14dBm
21238.310	47.4	0.0	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.4	74.0	-26.6	High Ch. 62, Chain_12, 40MHz, MCS15, EUT Horz, Power=14dBm
21277.870	47.3	0.1	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.4	74.0	-26.6	High Ch. 64, Chain_1, 20MHz, MCS7, EUT Horz, Power=14dBm
21239.580	47.3	0.0	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.3	74.0	-26.7	High Ch. 62, Chain_2, 40MHz, MCS7, EUT Horz, Power=14dBm
21278.110	47.2	0.1	1.6	0.0	3.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	High Ch. 64, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
21279.150	47.2	0.1	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.3	74.0	-26.7	High Ch. 64, Chain_2, 20MHz, 36Mbps, EUT Horz, Power=13.5dBm
21281.630	47.2	0.1	1.6	0.0	3.0	0.0	Horz	PK	0.0	47.3	74.0	-26.7	High Ch. 64, Chain_2, 20MHz, MCS0, EUT Horz, Power=14dBm
20959.090	46.5	0.7	1.6	360.0	3.0	0.0	Horz	PK	0.0	47.2	74.0	-26.8	High Ch. 48, Chain_2

SPURIOUS RADIATED EMISSIONS



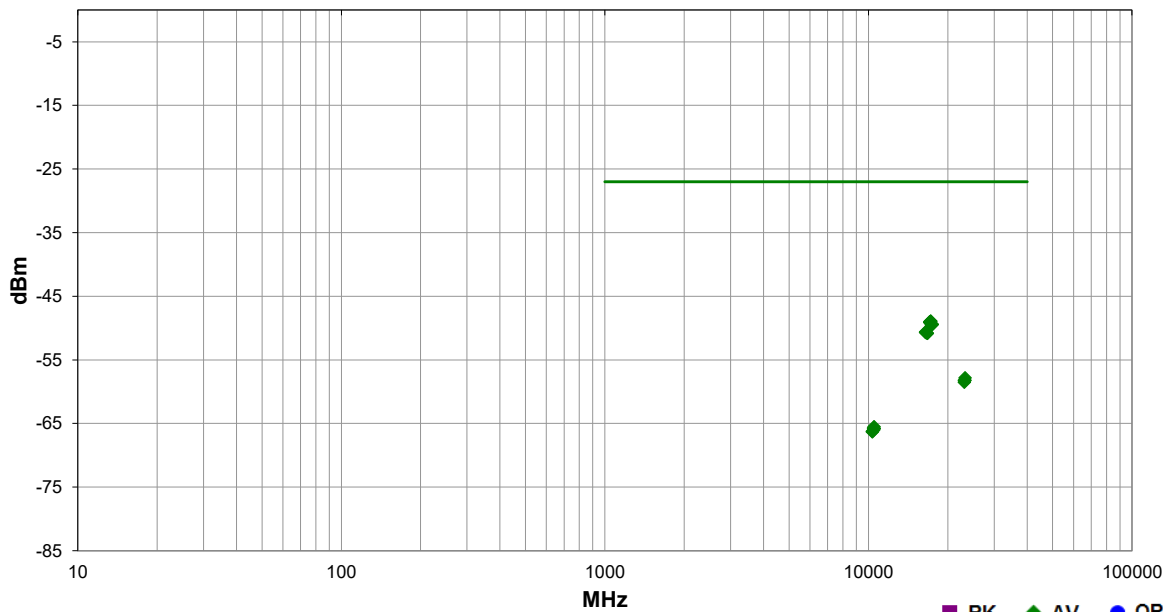
EmiRS 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019	<i>Brian Fahey</i> <i>Jeff Alcoke</i>
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	32.8% RH	
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	Tested by: Brian Fahey and Jeff Alcoke
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	5			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11ac; 20 MHz Bandwidth: Ch. 36, Ch. 48, Ch. 52, Ch. 100, Ch. 116, Ch. 140, Ch. 149, Ch. 157, Ch. 165;			
Deviations:	None			
Comments:	See comments for channel, chain, bandwidth, data rate, EUT orientation, and power setting.			

Test Specifications		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	

Run #	142	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
--------------	-----	--------------------------	---	--------------------------	-----------	----------------	------



Freq (MHz)	Antenna Height (meters)	Azimuth (degrees)	Polarity/ Transducer Type	Detector	EIRP (Watts)	EIRP (dBm)	Spec. Limit (dBm)	Compared to Spec. (dB)	Comments
17232.570	1.5	360.0	Horz	AV	12.8E-9	-48.9	-27.0	-21.9	Low Ch. 149, Chain_2, 6Mbps, EUT Horz
17235.950	1.5	0.0	Vert	AV	12.8E-9	-48.9	-27.0	-21.9	Low Ch. 149, Chain_2, 6Mbps, EUT Vert
17101.040	1.5	0.0	Horz	AV	12.5E-9	-49.0	-27.0	-22.0	High Ch. 140, Chain_2, 6Mbps, EUT Horz
17100.840	1.5	360.0	Vert	AV	12.2E-9	-49.1	-27.0	-22.1	High Ch. 140, Chain_2, 6Mbps, EUT Vert
17354.250	1.5	0.0	Horz	AV	11.4E-9	-49.4	-27.0	-22.4	Mid Ch. 157, Chain_2, 6Mbps, EUT Horz
17473.690	1.5	360.0	Horz	AV	11.4E-9	-49.4	-27.0	-22.4	High Ch. 165, Chain_2, 6Mbps, EUT Horz
17474.090	1.5	0.0	Vert	AV	11.4E-9	-49.4	-27.0	-22.4	High Ch. 165, Chain_2, 6Mbps, EUT Vert
17354.030	1.5	360.0	Vert	AV	11.1E-9	-49.5	-27.0	-22.5	Mid Ch. 157, Chain_2, 6Mbps, EUT Vert
16499.240	1.5	0.0	Horz	AV	8.7E-9	-50.6	-27.0	-23.6	Low Ch. 100, Chain_2, 6Mbps, EUT Horz
16500.430	1.5	360.0	Vert	AV	8.5E-9	-50.7	-27.0	-23.7	Low Ch. 100, Chain_2, 6Mbps, EUT Vert
16739.450	1.5	0.0	Vert	AV	8.3E-9	-50.8	-27.0	-23.8	Mid Ch. 116, Chain_2, 6Mbps, EUT Vert
16740.610	1.5	0.0	Horz	AV	8.3E-9	-50.8	-27.0	-23.8	Mid Ch. 116, Chain_2, 6Mbps, EUT Horz
23297.710	1.6	360.0	Horz	AV	1.6E-9	-57.8	-27.0	-30.8	High Ch. 165, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
23139.990	1.6	0.0	Horz	AV	1.5E-9	-58.2	-27.0	-31.2	High Ch. 157, Chain_2, 20MHz, 6Mbps, EUT Horz, Power=14dBm
23297.880	1.6	0.0	Vert	AV	1.5E-9	-58.2	-27.0	-31.2	High Ch. 165, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
23137.880	1.6	360.0	Vert	AV	1.4E-9	-58.5	-27.0	-31.5	High Ch. 157, Chain_2, 20MHz, 6Mbps, EUT Vert, Power=14dBm
10518.010	1.5	0.0	Horz	AV	280.0E-12	-65.5	-27.0	-38.5	Low Ch. 52, Chain_2, 6Mbps, EUT Horz
10468.710	1.15	152.0	Vert	AV	267.4E-12	-65.7	-27.0	-38.7	High Ch. 48, Chain_2, 6Mbps, EUT Vert
10522.400	1.5	360.0	Vert	AV	261.3E-12	-65.8	-27.0	-38.8	Low Ch. 52, Chain_2, 6Mbps, EUT Vert

	Freq (MHz)	Antenna Height (meters)	Azimuth (degrees)	Polarity/ Transducer Type	Detector	EIRP (Watts)	EIRP (dBm)	Spec. Limit (dBm)	Compared to Spec. (dB)	Comments	
	10480.880	1.01	244.0	Horz	AV	249.5E-12	-66.0	-27.0	-39.0	High Ch. 48, Chain_2, 6Mbps, EUT Horz	
	10360.810	1.5	360.0	Horz	AV	238.3E-12	-66.2	-27.0	-39.2	Low Ch. 36, Chain_2, 6Mbps, EUT Horz	
	10362.210	1.5	0.0	Vert	AV	232.9E-12	-66.3	-27.0	-39.3	Low Ch. 36, Chain_2, 6Mbps, EUT Vert	

SPURIOUS RADIATED EMISSIONS

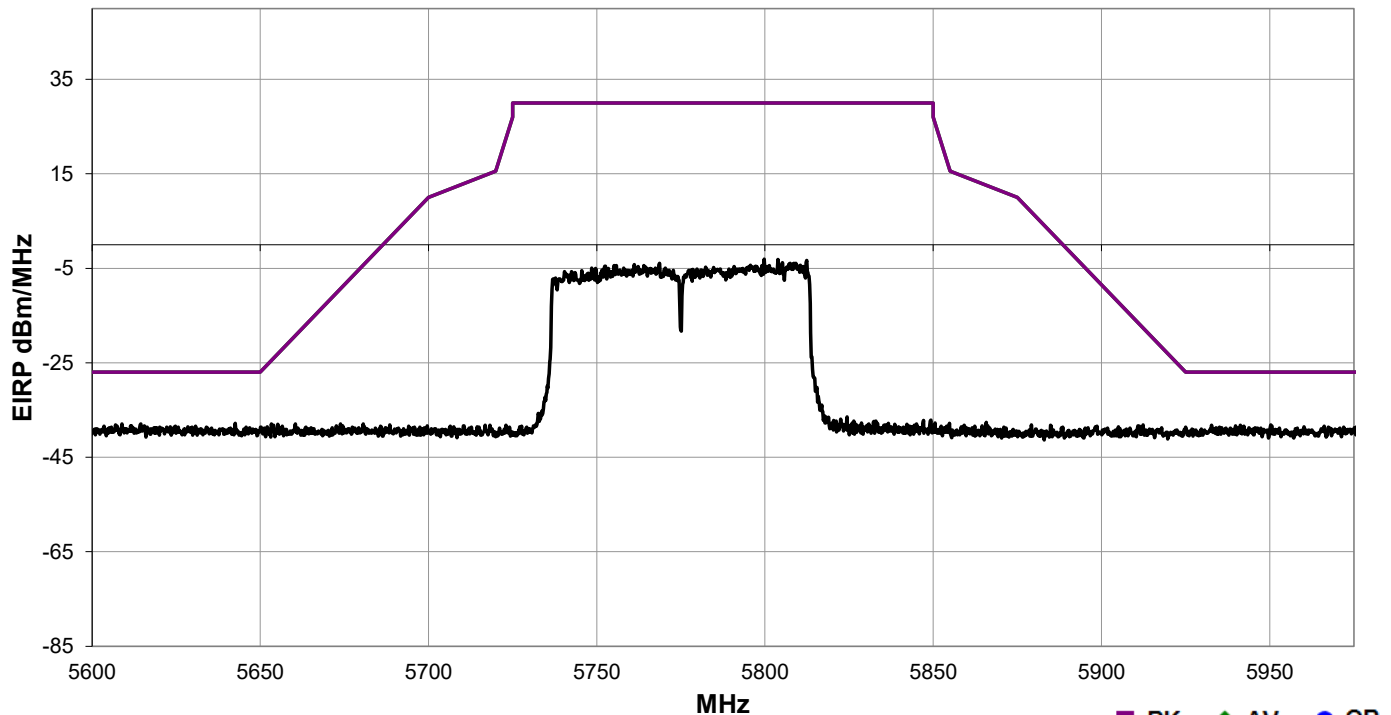


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	6-Dec-2019	
Project:	None	Temperature:	20.9 °C	
Job Site:	EV01	Humidity:	36.8% RH	
Serial Number:	H1UR1944002-03	Barometric Pres.:	1016 mbar	Tested by: Cole Ghizzone
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	4			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11 ac, Chain_2, 80 MHz, MCS0, Low Ch. 149 = 5775 MHz, see power table for Software power setting.			
Deviations:	None			
Comments:	EUT Vertical			

Test Specifications		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	
Run #	104	Test Distance (m)	1
Antenna Height(s)	1.25 (m)	Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

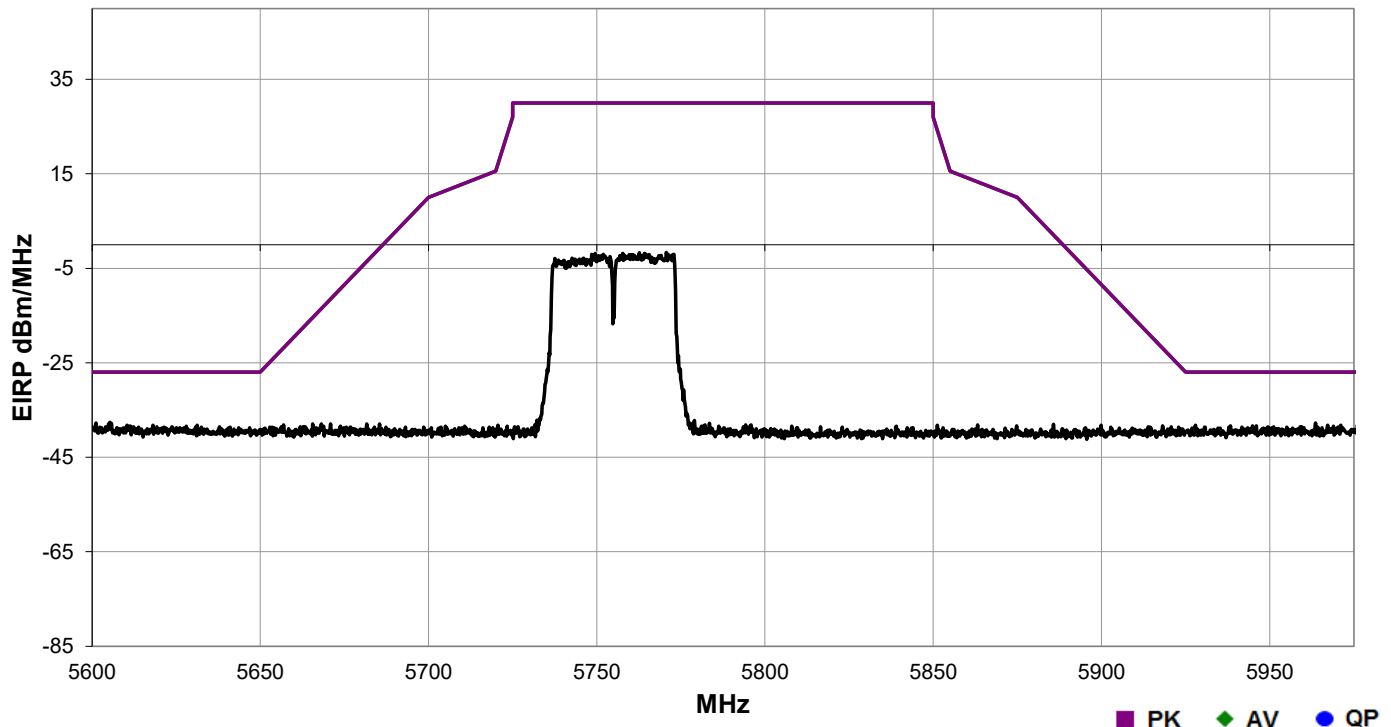


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	6-Dec-2019	
Project:	None	Temperature:	20.9 °C	
Job Site:	EV01	Humidity:	36.8% RH	
Serial Number:	H1UR1944002-03	Barometric Pres.:	1016 mbar	
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Tested by: Cole Ghizzone
Configuration:	4			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11 ac, Chain_2, 40 MHz, MCS0, Low Ch. 149 = 5755 MHz, see power table for Software power setting.			
Deviations:	None			
Comments:	EUT Vertical			

Test Specifications					Test Method		
FCC 15.407:2019					ANSI C63.10:2013		
Run #	105	Test Distance (m)	1	Antenna Height(s)	1.25 (m)	Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

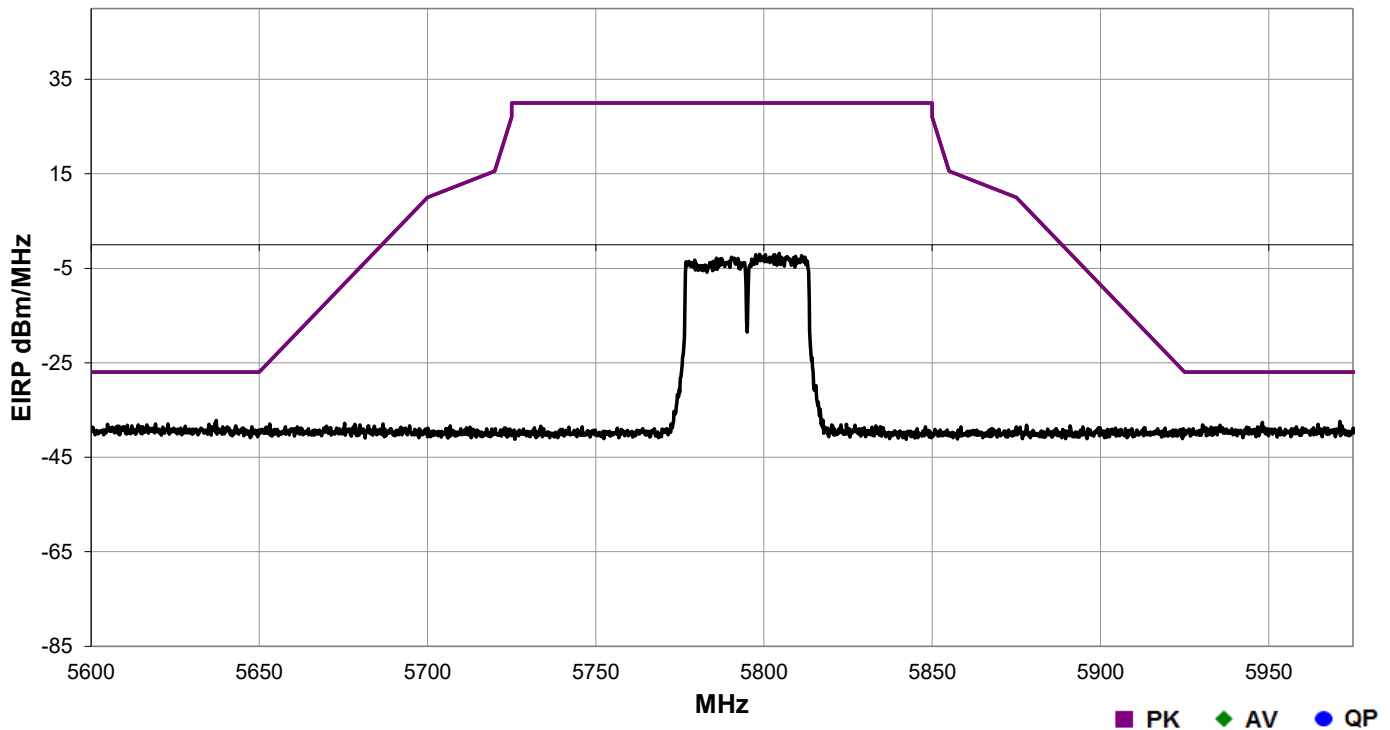


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	6-Dec-2019	
Project:	None	Temperature:	20.9 °C	
Job Site:	EV01	Humidity:	36.8% RH	
Serial Number:	H1UR1944002-03	Barometric Pres.:	1016 mbar	Tested by: Cole Ghizzone
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	4			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11 ac, Chain_2, 40 MHz, MCS0, High Ch. 165 = 5795 MHz, see power table for Software power setting.			
Deviations:	None			
Comments:	EUT Vertical			

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	106	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

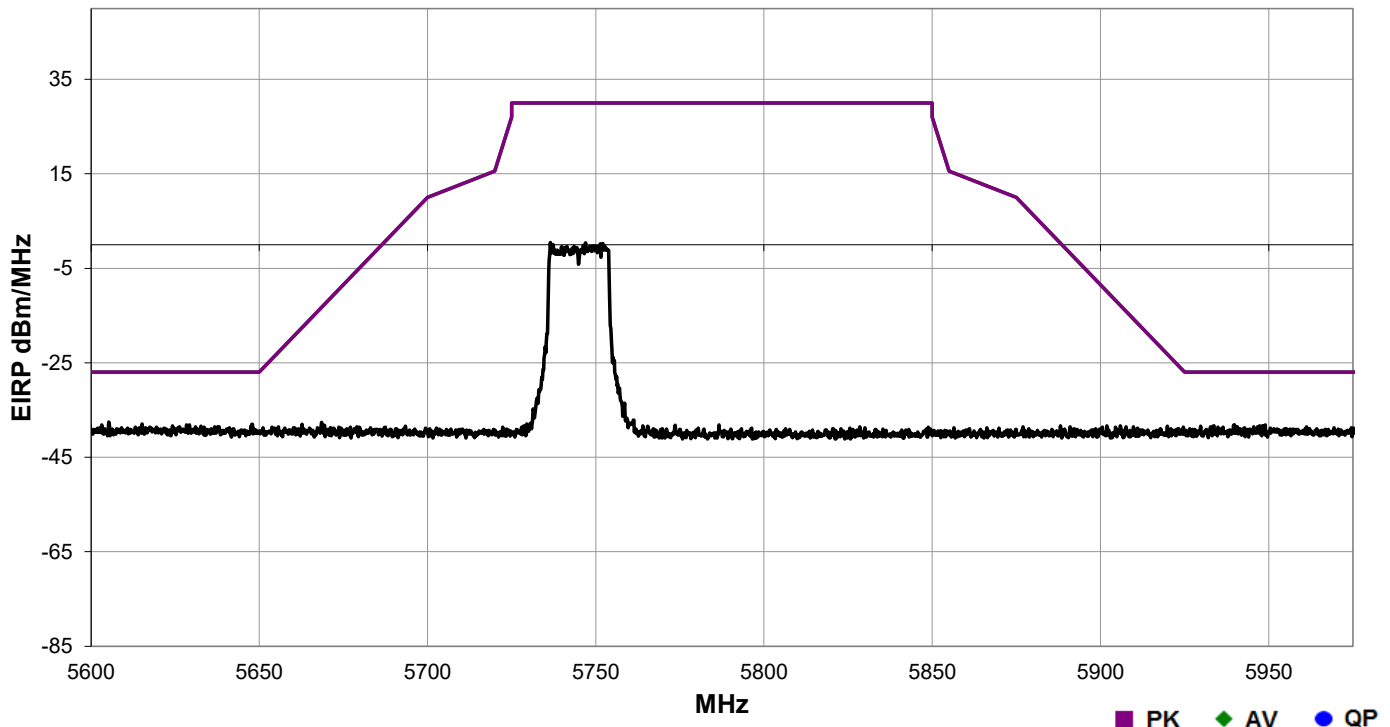


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	6-Dec-2019	
Project:	None	Temperature:	20.9 °C	
Job Site:	EV01	Humidity:	36.8% RH	
Serial Number:	H1UR1944002-03	Barometric Pres.:	1016 mbar	
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE				Tested by: Cole Ghizzone
Configuration:	4			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11 ac, Chain_2, 20 MHz, MCS0, Low Ch. 149 = 5745 MHz, see power table for Software power setting.			
Deviations:	None			
Comments:	EUT Vertical			

Test Specifications					Test Method		
FCC 15.407:2019					ANSI C63.10:2013		
Run #	107	Test Distance (m)	1	Antenna Height(s)	1.25 (m)	Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

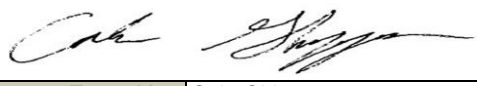
All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS



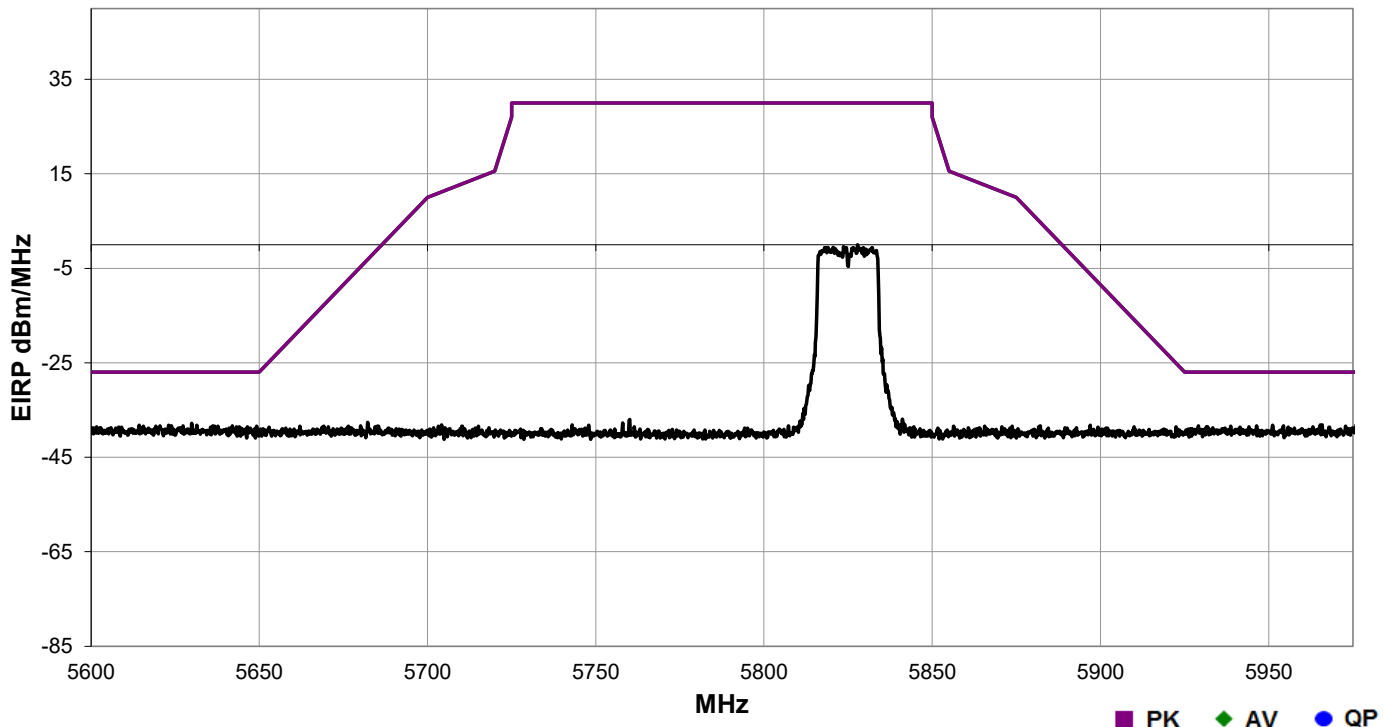
EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	6-Dec-2019	
Project:	None	Temperature:	20.9 °C	
Job Site:	EV01	Humidity:	36.8% RH	
Serial Number:	H1UR1944002-03	Barometric Pres.:	1016 mbar	Tested by: Cole Ghizzone
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	4			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11 ac, Chain_2, 20 MHz, MCS0, High Ch. 165 = 5825 MHz, see power table for Software power setting.			
Deviations:	None			
Comments:	EUT Vertical			

Test Specifications		Test Method	
FCC 15.407:2019		ANSI C63.10:2013	

Run #	108	Test Distance (m)	1	Antenna Height(s)	1.25 (m)	Results	Pass
--------------	-----	--------------------------	---	--------------------------	----------	----------------	------



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

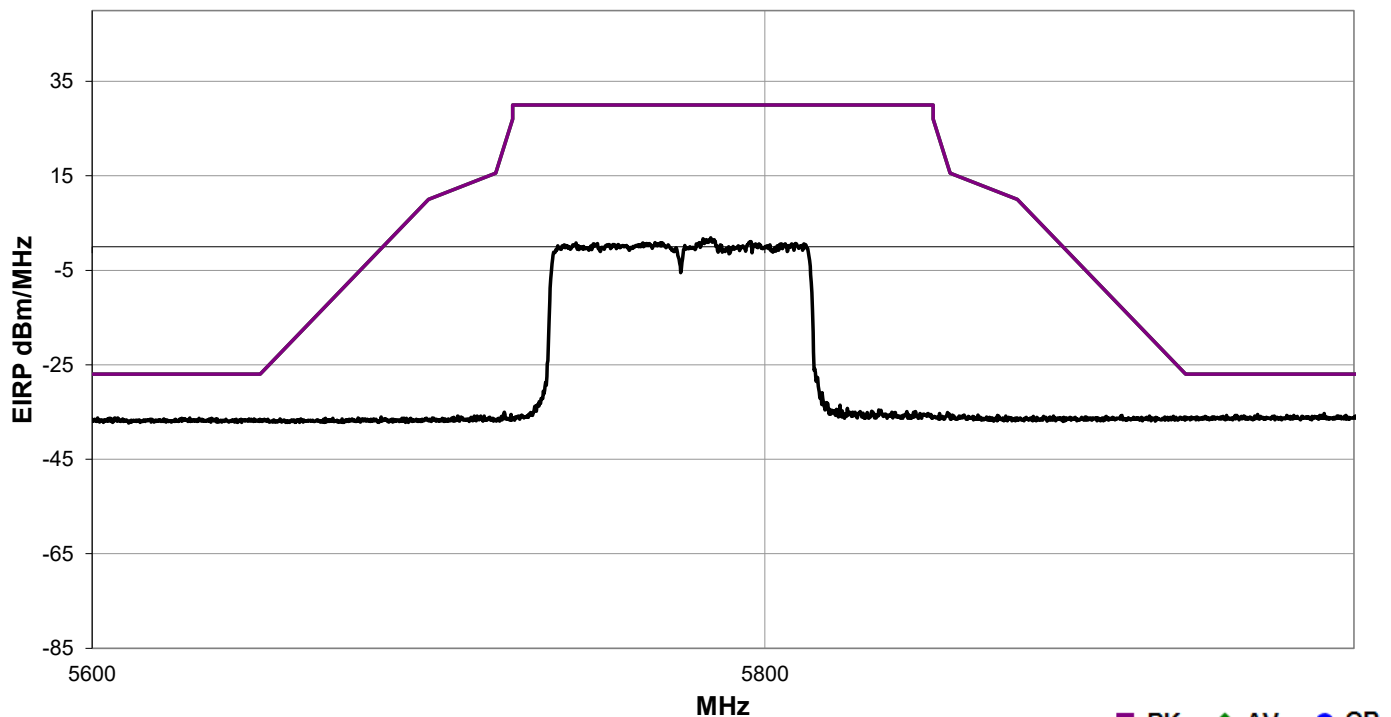


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019	
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	32.8% RH	
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	5			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11ac; 20 MHz: 80 MHz: Mid Ch. 155 = 5775 MHz.			
Deviations:	None			
Comments:	EUT Vert. Chain_1, MCS0, Software Power Setting = 14 dBm.			

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	111	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

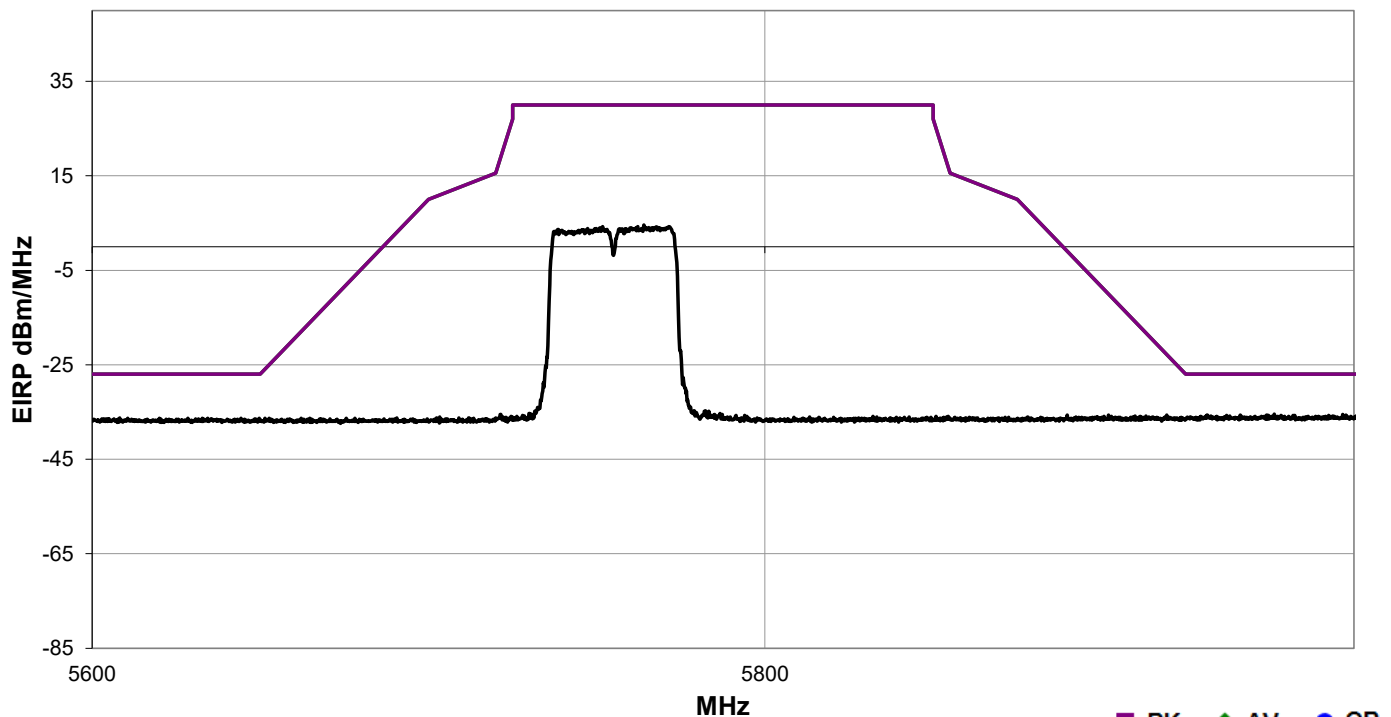


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019	
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	32.8% RH	
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	5			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11ac; 40 MHz; Low Ch. 151 = 5755 MHz			
Deviations:	None			
Comments:	EUT Vert. Chain_1, MCS0, Software Power Setting = 14 dBm.			

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	112	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

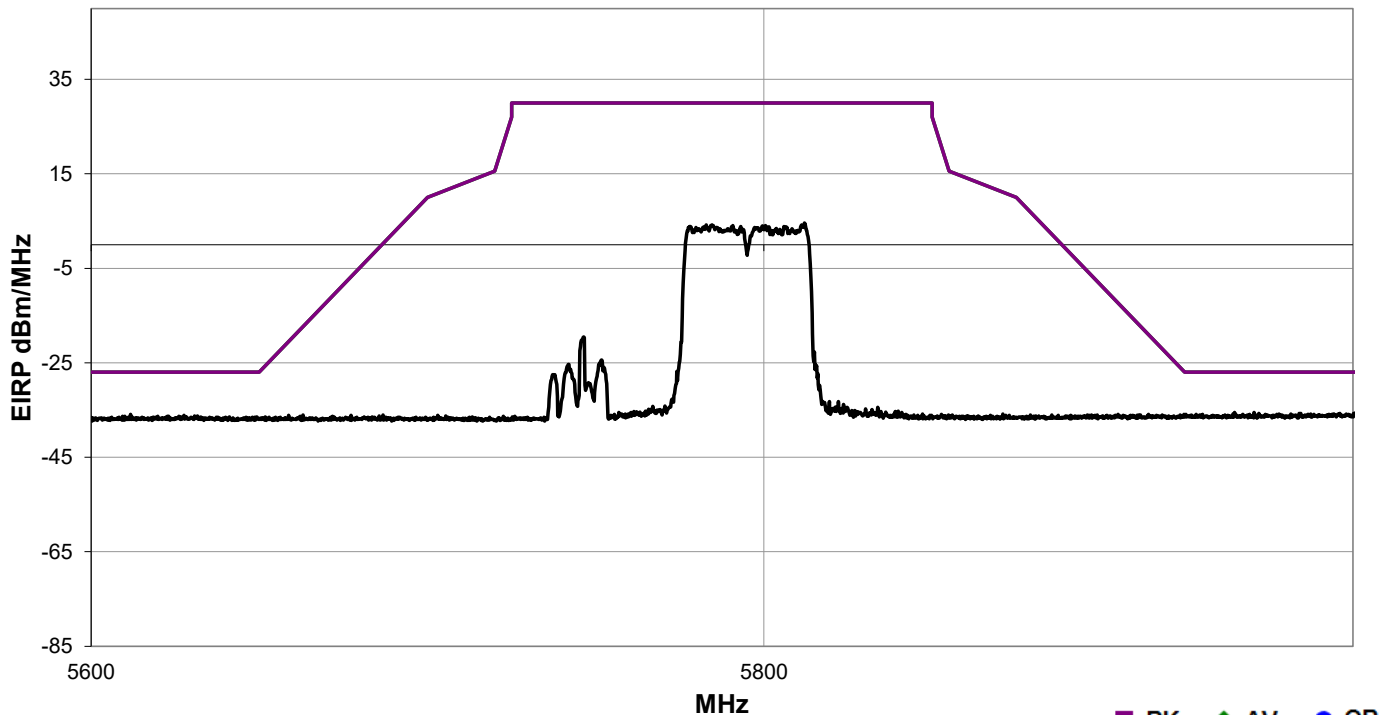


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019		
Project:	None	Temperature:	22.2 °C		
Job Site:	NC01	Humidity:	32.8% RH		
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	Tested by:	Brian Fahey and Jeff Alcock
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE				
Configuration:	5				
Customer:	EchoNous, Inc.				
Attendees:	None				
EUT Power:	3.7 VDC				
Operating Mode:	802.11ac; 20 MHz: 40 MHz: High Ch. 159 = 5795 MHz				
Deviations:	None				
Comments:	EUT Vert. Chain_1, MCS0, Software Power Setting = 14 dBm.				

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	113	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

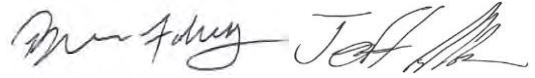
All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

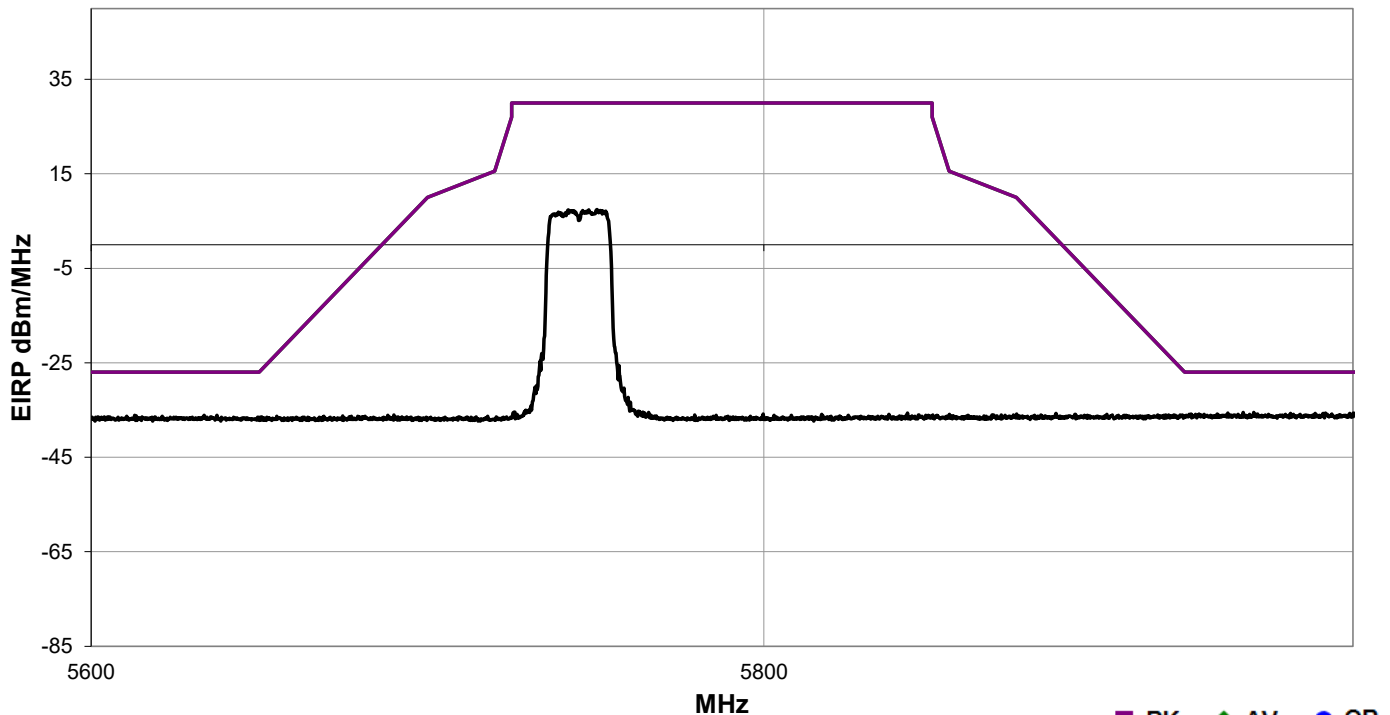


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019	
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	32.8% RH	
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	5			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11ac; 20 MHz: Low Ch. 149 = 5745 MHz			
Deviations:	None			
Comments:	EUT Vert. Chain_1, MCS0, Software Power Setting = 14 dBm.			

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	114	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



PK AV QP

Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

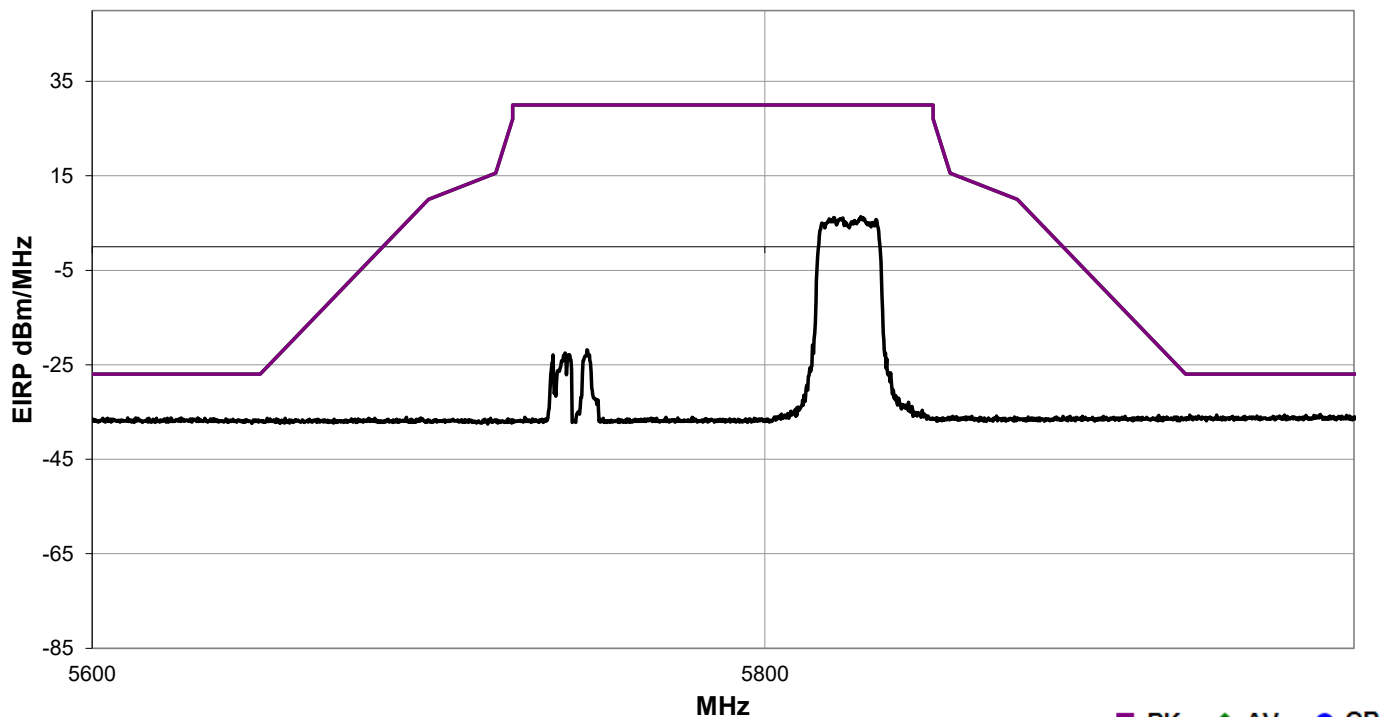


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019	
Project:	None	Temperature:	22.2 °C	
Job Site:	NC01	Humidity:	32.8% RH	
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	
		Tested by: Brian Fahey and Jeff Alcock		
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			
Configuration:	5			
Customer:	EchoNous, Inc.			
Attendees:	None			
EUT Power:	3.7 VDC			
Operating Mode:	802.11ac; 20 MHz: High Ch. 165 = 5825 MHz			
Deviations:	None			
Comments:	EUT Vert. Chain_1, MCS0, Software Power Setting = 14 dBm.			

Test Specifications					Test Method		
FCC 15.407:2019					ANSI C63.10:2013		
Run #	115	Test Distance (m)	1	Antenna Height(s)	1.25 (m)	Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

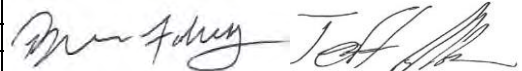
All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

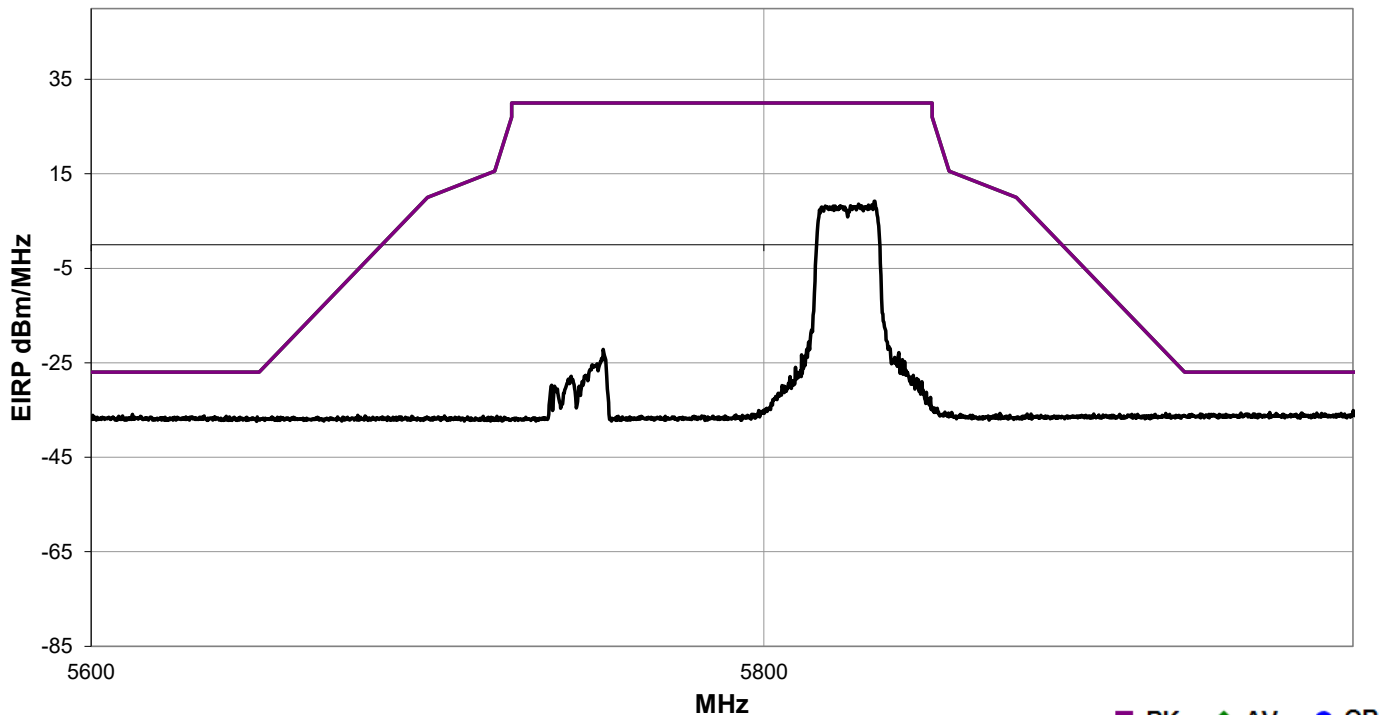


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019		
Project:	None	Temperature:	22.2 °C		
Job Site:	NC01	Humidity:	32.8% RH		
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	Tested by:	Brian Fahey and Jeff Alcock
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE				
Configuration:	5				
Customer:	EchoNous, Inc.				
Attendees:	None				
EUT Power:	3.7 VDC				
Operating Mode:	802.11ac; 20 MHz: High Ch. 165 = 5825 MHz				
Deviations:	None				
Comments:	EUT Vert. Chain_12, MCS8, Software Power Setting = 14 dBm.				

Test Specifications					Test Method		
FCC 15.407:2019					ANSI C63.10:2013		
Run #	116	Test Distance (m)	1	Antenna Height(s)	1.25 (m)	Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

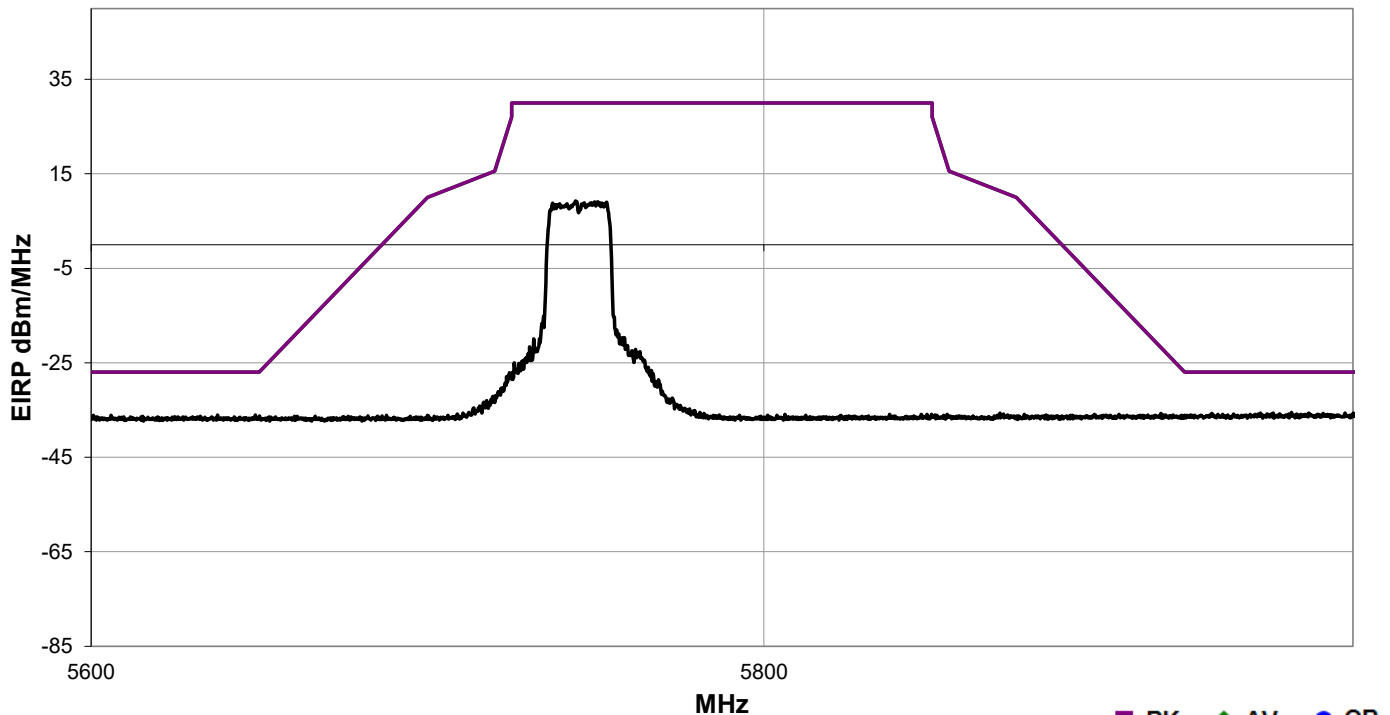


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019		
Project:	None	Temperature:	22.2 °C		
Job Site:	NC01	Humidity:	32.8% RH		
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	Tested by:	Brian Fahey and Jeff Alcock
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE				
Configuration:	5				
Customer:	EchoNous, Inc.				
Attendees:	None				
EUT Power:	3.7 VDC				
Operating Mode:	802.11ac; 20 MHz: Low Ch. 149 = 5745 MHz				
Deviations:	None				
Comments:	EUT Vert. Chain_12, MCS8, Software Power Setting = 14 dBm.				

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	117	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

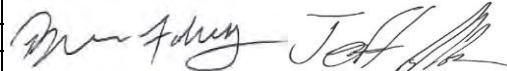
All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

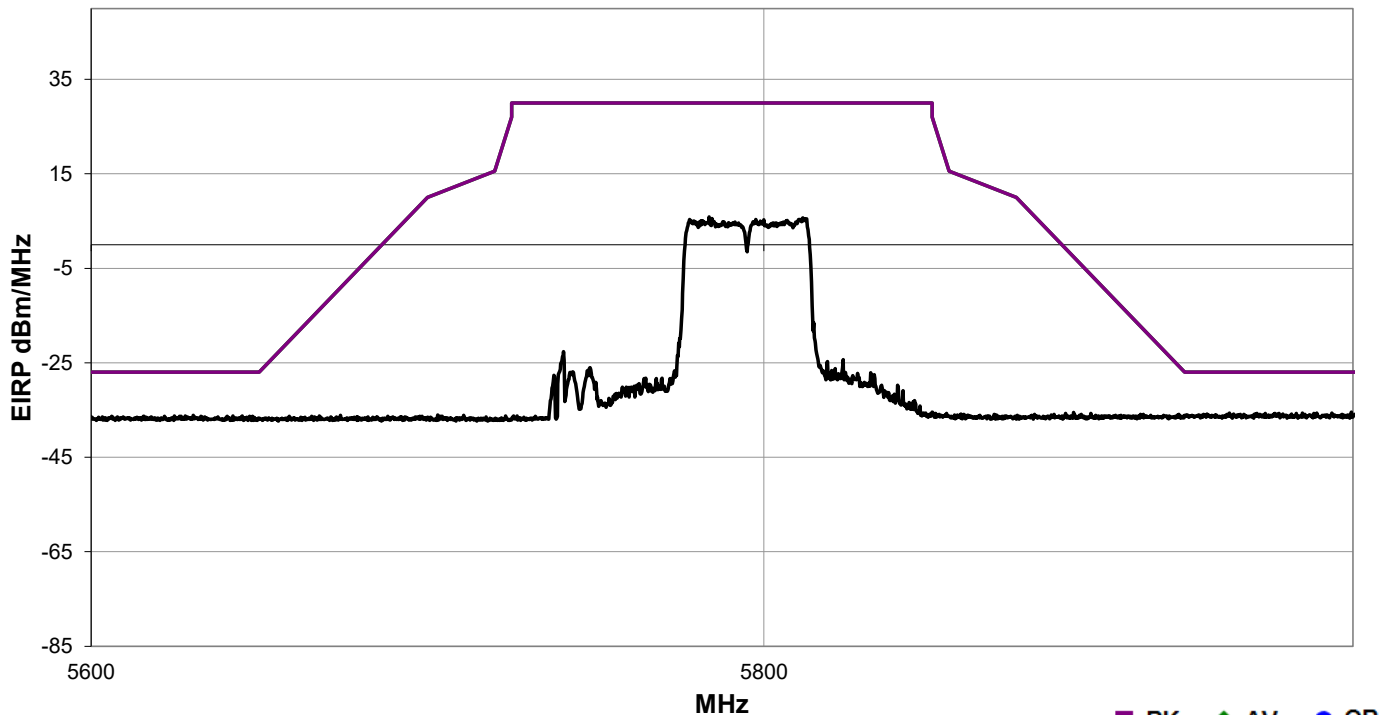


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019		
Project:	None	Temperature:	22.2 °C		
Job Site:	NC01	Humidity:	32.8% RH		
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	Tested by:	Brian Fahey and Jeff Alcock
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE				
Configuration:	5				
Customer:	EchoNous, Inc.				
Attendees:	None				
EUT Power:	3.7 VDC				
Operating Mode:	802.11ac; 40 MHz: High Ch. 159 = 5795 MHz				
Deviations:	None				
Comments:	EUT Vert. Chain_12, MCS8, Software Power Setting = 14 dBm.				

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	118	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

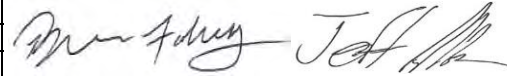
All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

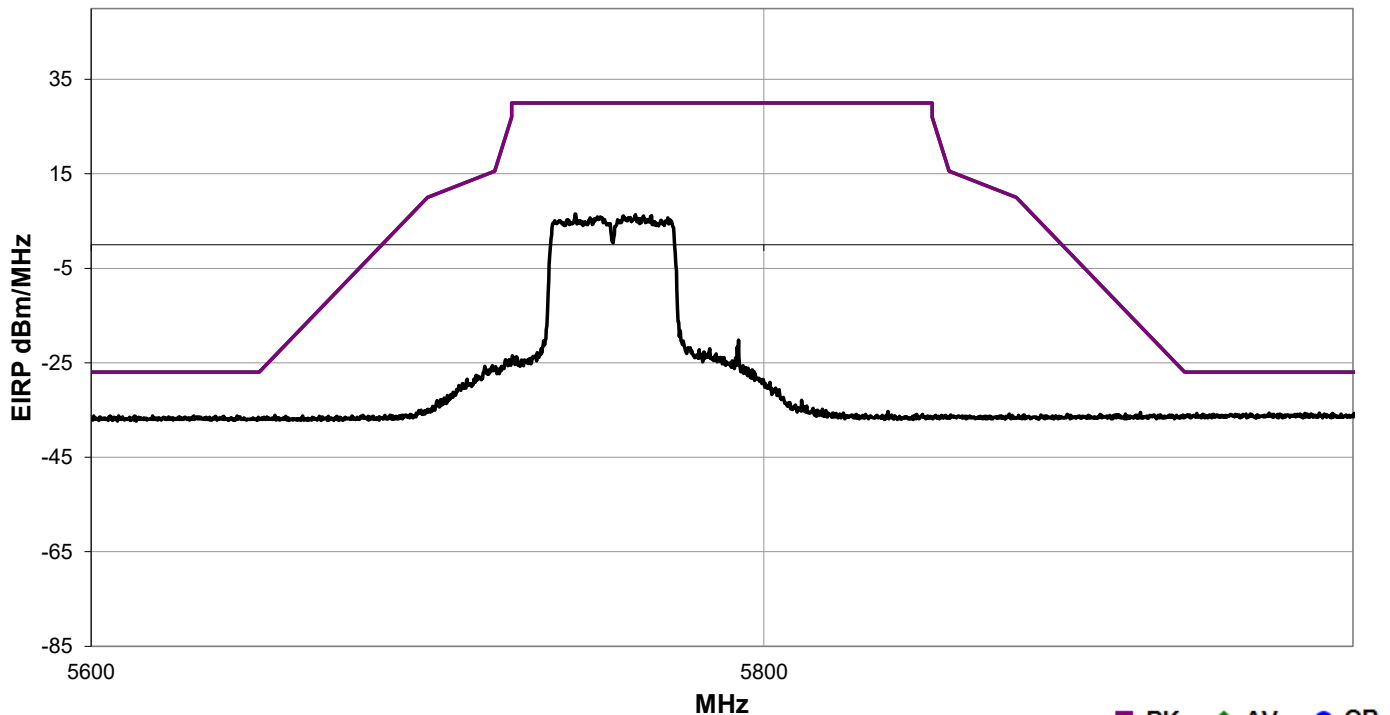


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019		
Project:	None	Temperature:	22.2 °C		
Job Site:	NC01	Humidity:	32.8% RH		
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	Tested by:	Brian Fahey and Jeff Alcock
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE				
Configuration:	5				
Customer:	EchoNous, Inc.				
Attendees:	None				
EUT Power:	3.7 VDC				
Operating Mode:	802.11ac; 40 MHz: Low Ch. 151 = 5755 MHz.				
Deviations:	None				
Comments:	EUT Vert. Chain_12, MCS8, Software Power Setting = 14 dBm.				

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	119	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).

SPURIOUS RADIATED EMISSIONS

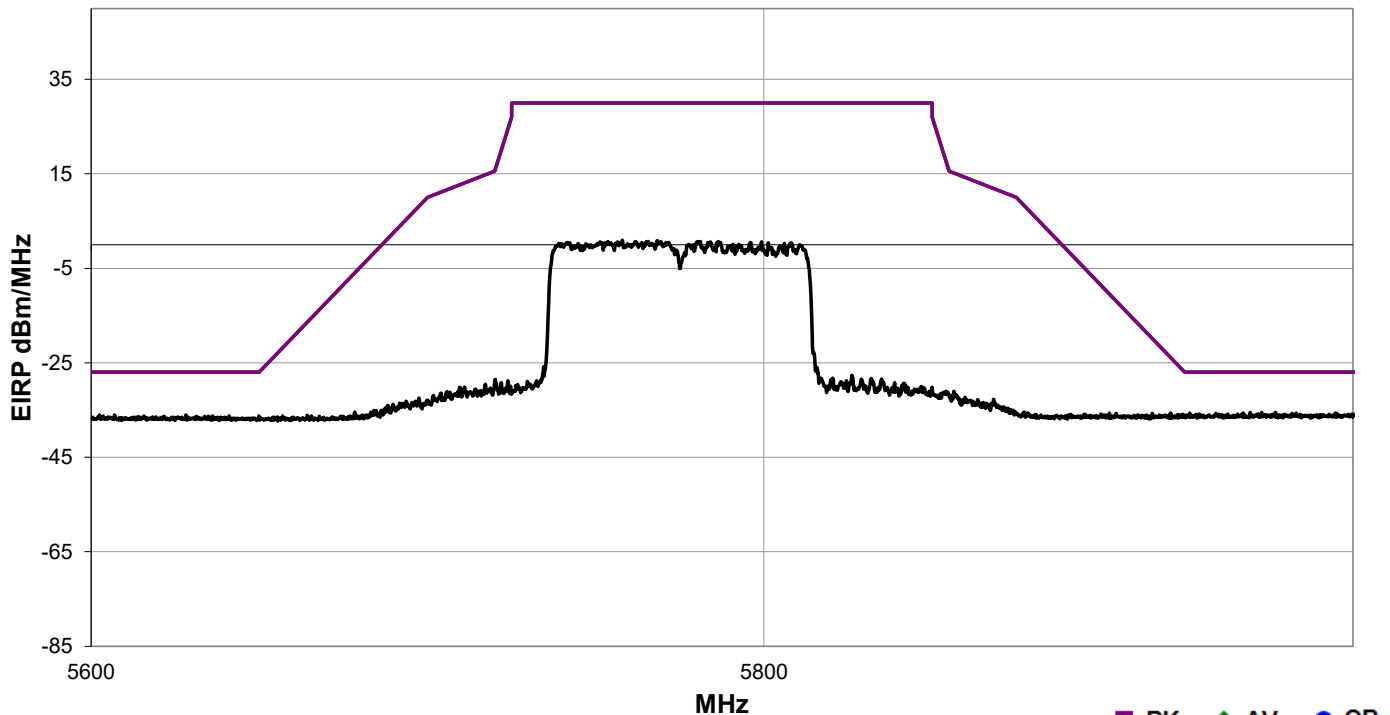


EmiR5 2019.08.15.1

PSA-ESCI 2019.05.10

Work Order:	ECHN0015	Date:	18-Dec-2019		
Project:	None	Temperature:	22.2 °C		
Job Site:	NC01	Humidity:	32.8% RH		
Serial Number:	H1UR1944002-04	Barometric Pres.:	1013 mbar	Tested by:	Brian Fahey and Jeff Alcock
EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE				
Configuration:	5				
Customer:	EchoNous, Inc.				
Attendees:	None				
EUT Power:	3.7 VDC				
Operating Mode:	802.11ac; 80 MHz: Mid Ch. 155 = 5775 MHz.				
Deviations:	None				
Comments:	EUT Vert. Chain_12, MCS0, Software Power Setting = 14 dBm.				

Test Specifications				Test Method	
FCC 15.407:2019				ANSI C63.10:2013	
Run #	120	Test Distance (m)	1	Antenna Height(s)	1.25 (m)
				Results	Pass



Freq (MHz)	Antenna Height (meters)	Transducer (dB)	Polarity/Transducer Type	Detector	EIRP (Watts/MHz)	EIRP (dBm/MHz)	Spec. Limit (dBm/MHz)	Compared to Spec. (dB)	Comments
------------	-------------------------	-----------------	--------------------------	----------	------------------	----------------	-----------------------	------------------------	----------

All emissions were below the limit (see graph above).