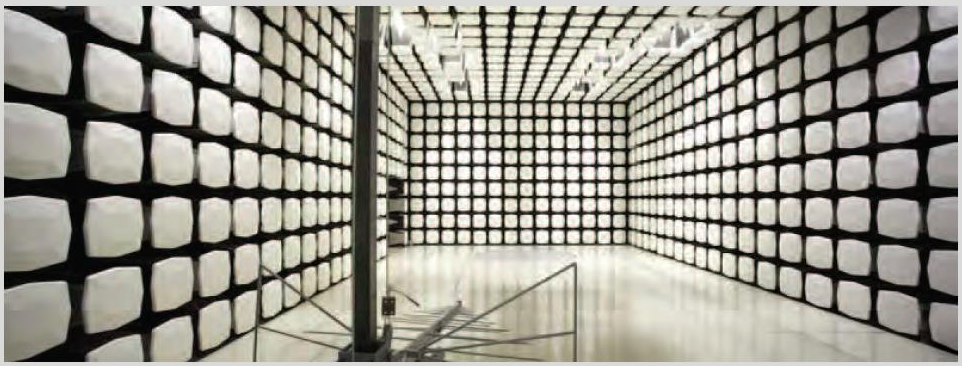
EchoNous, Inc.

Thor Radio Module AC WLAN and Bluetooth and BLE

FCC 15.407:2019

802.11an, ac, 2x2 MIMO Radio

Report # ECHN0015.3



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

CERTIFICATE OF TEST

Last Date of Test: December 20, 2019
EchoNous, Inc.
EUT: Thor Radio Module AC WLAN and Bluetooth and BLE

Radio Equipment Testing

Standards

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

Results

Method Clause	Test Description	Applied	Results	Comments
KDB 905462 -7.5	DFS Testing - Test Signal Level	No	N/A	Not required if EUT does not support DFS Bands or device is a "Client" without radar detection.
KDB 905462 -7.7	DFS Testing - Channel Loading/Channel Utilization	Yes	Pass	
KDB 905462 -7.8.1	DFS Testing - Detection Bandwidth	No	N/A	Not required if EUT does not support DFS Bands or device is a "Client" without radar detection.
KDB 905462 -7.8.2	DFS Testing - Channel Availability Check	No	N/A	Not required if EUT does not support DFS Bands or device is a "Client" without radar detection.
KDB 905462 -7.8.3	DFS Testing - Move Time	Yes	Pass	
KDB 905462 -7.8.3	DFS Testing - Closing Time	Yes	Pass	
KDB 905462 -7.8.3	DFS Testing - Non Occupancy Period	Yes	Pass	
KDB 905462 -7.8.4	DFS Testing - Statistical Performance	No	N/A	Not required if EUT does not support DFS Bands or device is a "Client" without radar detection.

Deviations From Test Standards

None

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
00	None		

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

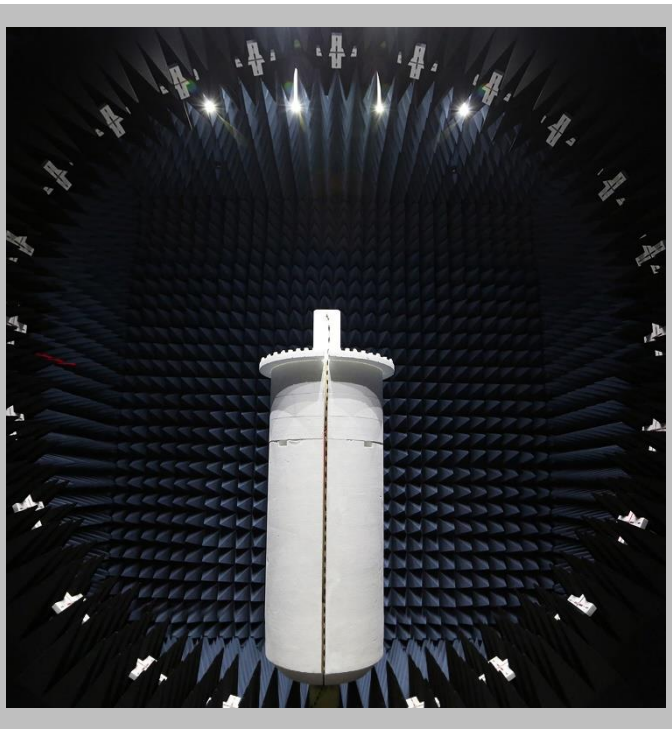
MIC – Recognized by MIC as a CAB for the acceptance of test data.

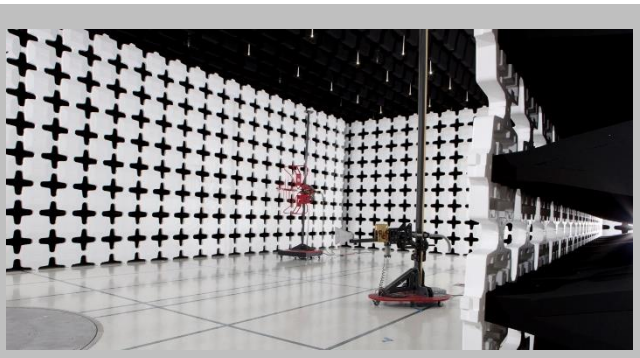
SCOPE

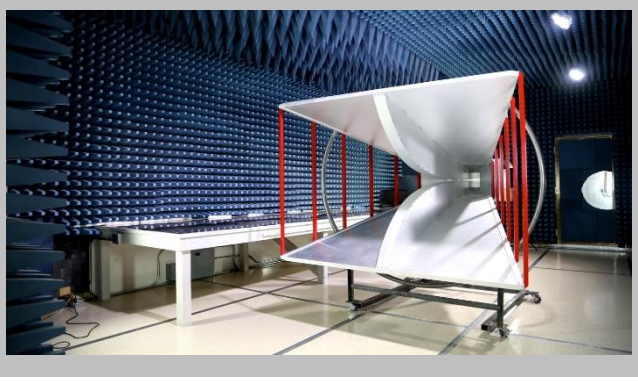
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th 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

element
TMU.2015.07.10

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.

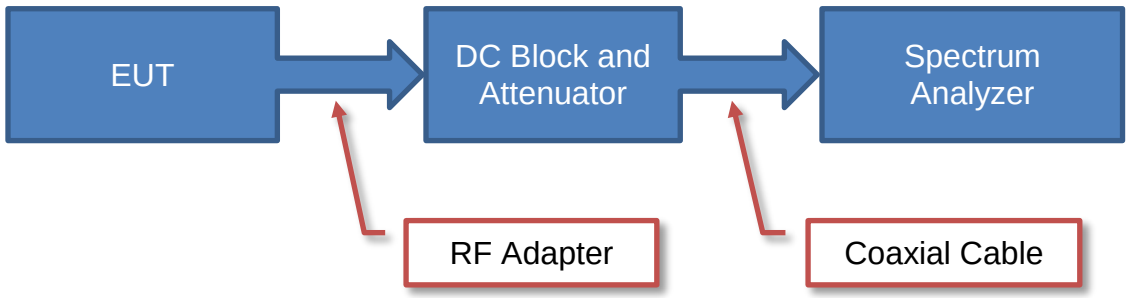
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable 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.

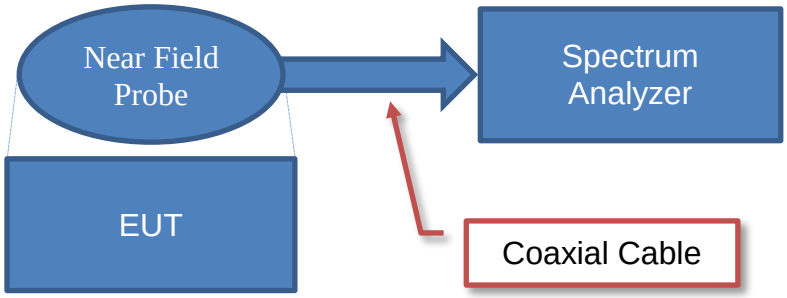
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field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

Test Setup Block Diagrams

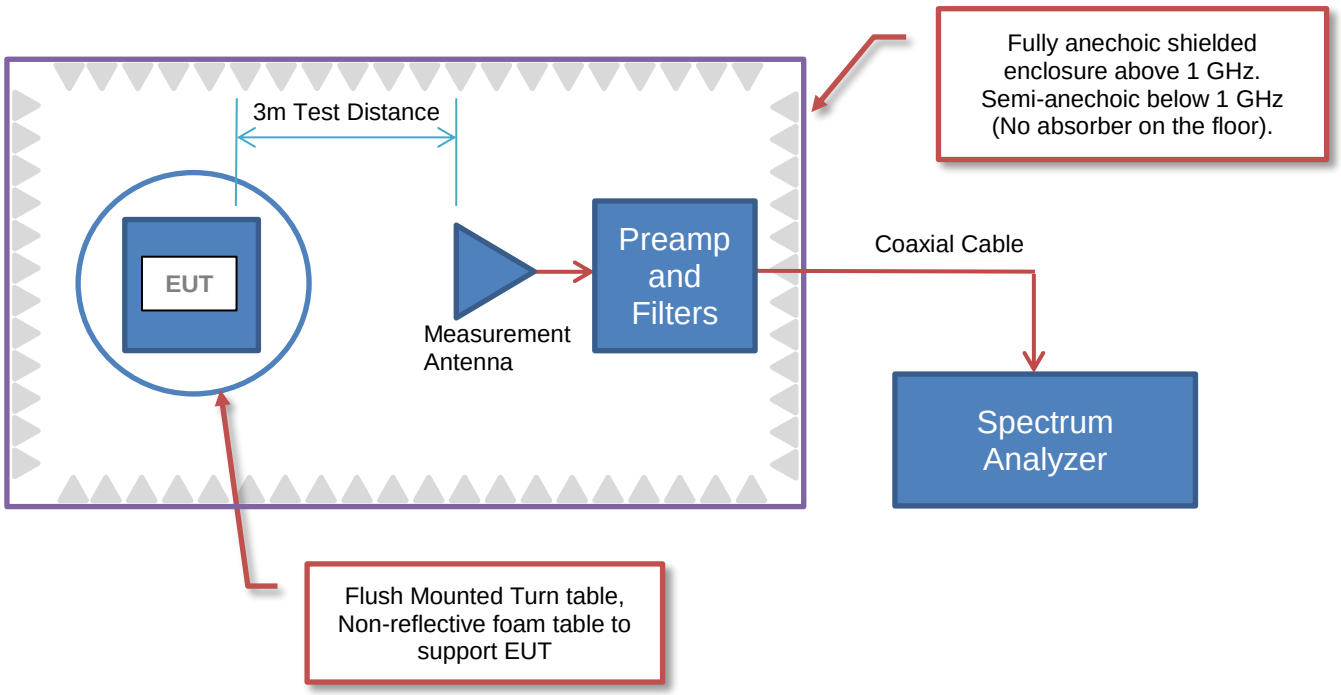
Antenna Port Conducted Measurements



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:	December 20, 2019
Last Date of Test:	December 20, 2019
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- 9

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 Sample #2

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AC/DC Adapter	GlobTek Inc.	GTM96605-GEN2-A1-T3	TR9CZ3000USBCR6G3272

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Power Cable	No	2.4m	No	AC Mains	AC/DC Adapter
DC Power Cable	No	1.4m	No	DC Power	USB-C Connector

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-12-20	DFS Testing - Channel Loading/Channel Utilization	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	2019-12-20	DFS Testing - Move Time	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	2019-12-20	DFS Testing - Closing Time	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	2019-12-20	DFS Testing - Non Occupancy Period	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed

DFS TESTING - CHANNEL LOADING/CHANNEL UTILIZATION

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
Access Point	Cisco	AIR-SAP2602E-A-K9	TIY	NCR	NCR
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	12-Feb-19	12-Feb-20
Attenuator	Fairview Microwave	SA26B-10	TWH	28-Mar-19	28-Mar-20
Attenuator	S.M. Electronics	SA26B-10	AWR	31-Jul-19	31-Jul-20
Attenuator	Fairview Microwave	SA26B-10	TWG	28-Mar-19	28-Mar-20
Attenuator	Pasternack	PE7005-20	AUN	23-Jul-19	23-Jul-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Block - DC	Fairview Microwave	SD3379	AMW	28-Mar-19	28-Mar-20
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAJ	NCR	NCR
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAI	NCR	NCR
Attenuator	Aeroflex/Weinschel	3053	RKF	NCR	NCR
Attenuator	Aeroflex/Weinschel	3053	RKG	NCR	NCR
Attenuator	Weinschel Corp	3330A-6	AUF	4-Nov-19	4-Nov-20
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The master and client were connected using the conducted method described in the FCC KDB procedure via a series of splitters and attenuators which allows the communication traffic to be greater than 17%.

DFS TESTING - CHANNEL LOADING/CHANNEL UTILIZATION

XMit 2019.09.05

EUT:	Thor Radio Module AC WLAN and Bluetooth and BLE			**Work Order:**	ECHN0015
Serial Number:	Pre-Production Sample 2			**Date:**	20-Dec-19
Customer:	EchoNous, Inc.			**Temperature:**	21.8 °C
Attendees:	None			**Humidity:**	46.4% RH
Project:	None			**Barometric Pres.:**	1013 mbar
Tested by:	Brandon Hobbs	**Power:**	5.0 VDC via 110VAC/60Hz	**Job Site:**	EV06

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

COMMENTS

Reference the DFS client conducted setup in the DFS UNII KDB 905462 section 7.2.2 for the configuration of attenuators, couplers and splitters used while under test.

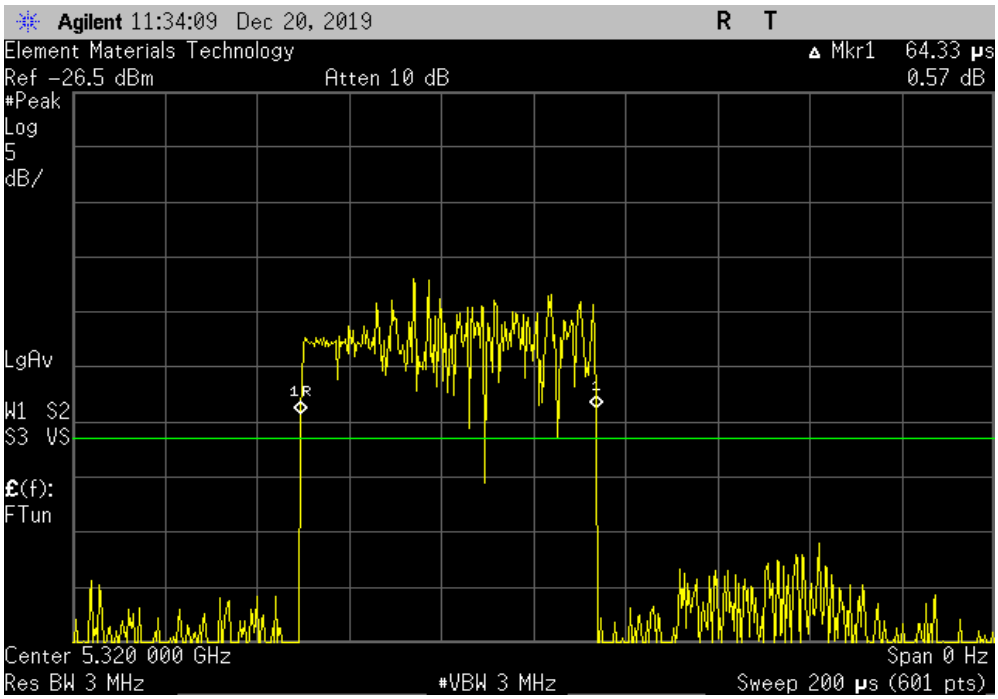
DEVIATIONS FROM TEST STANDARD

None

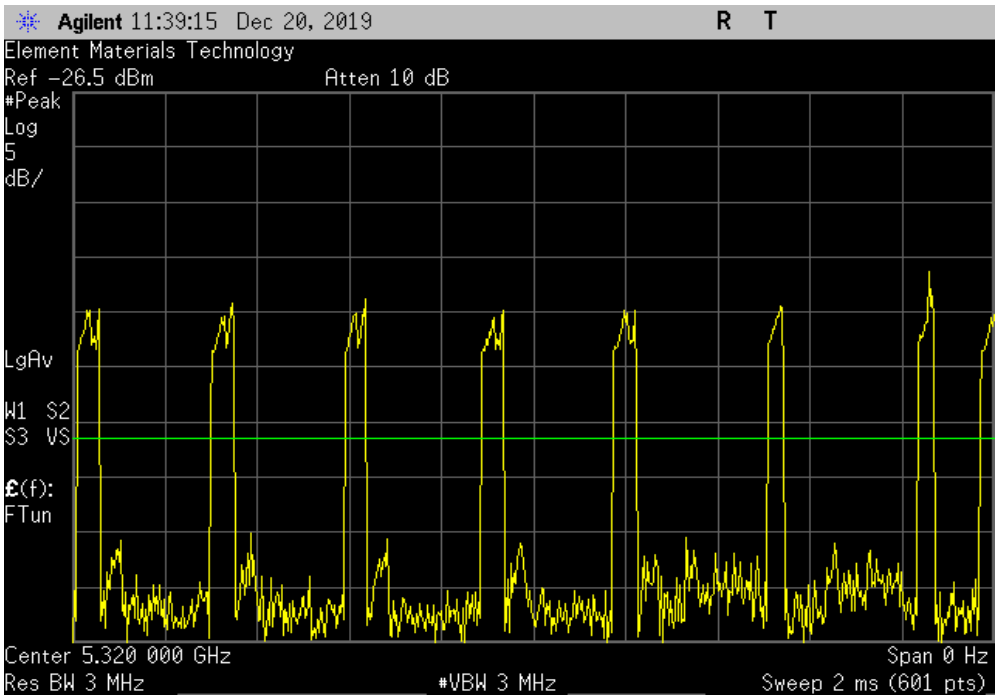
Configuration #	9	Signature

	Pulse On Time (µsec)	Value	Limit	Result
CH. 64, 5320 MHz				
Pulse On Time	64.33	N/A	N/A	N/A
2mS	64.33	>17%	≥17%	Pass
10mS	64.33	>17%	≥17%	Pass
25mS	64.33	>17%	≥17%	Pass
100mS	64.33	>17%	≥17%	Pass
10Sec	64.33	>17%	≥17%	Pass

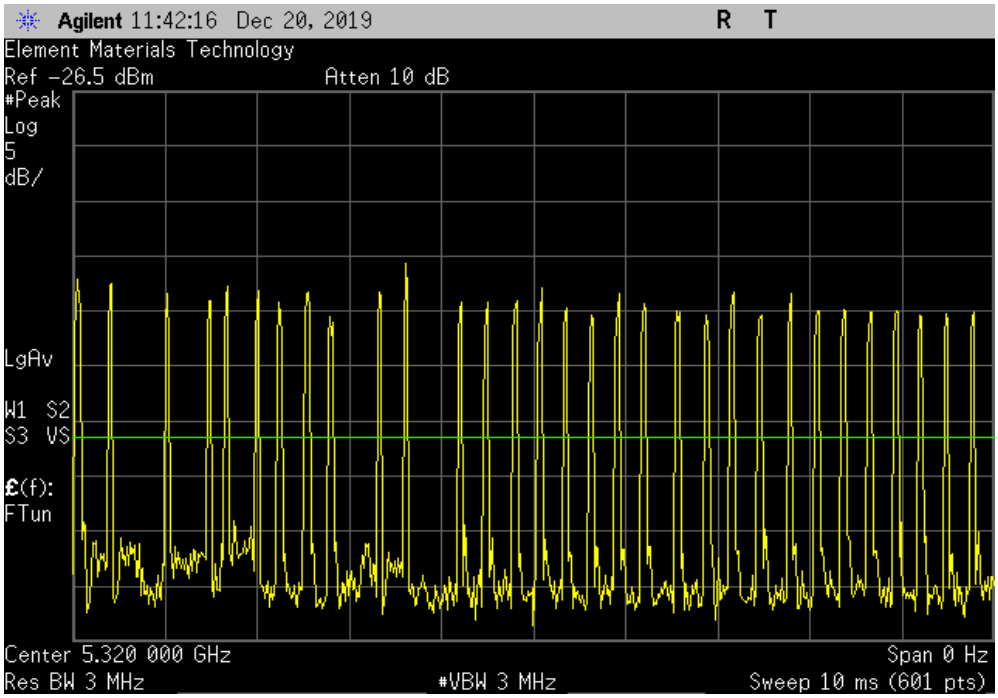
CH. 64, 5320 MHz, Pulse On Time						
			Pulse On Time (µsec)	Value	Limit	Result
			64.33	N/A	N/A	N/A



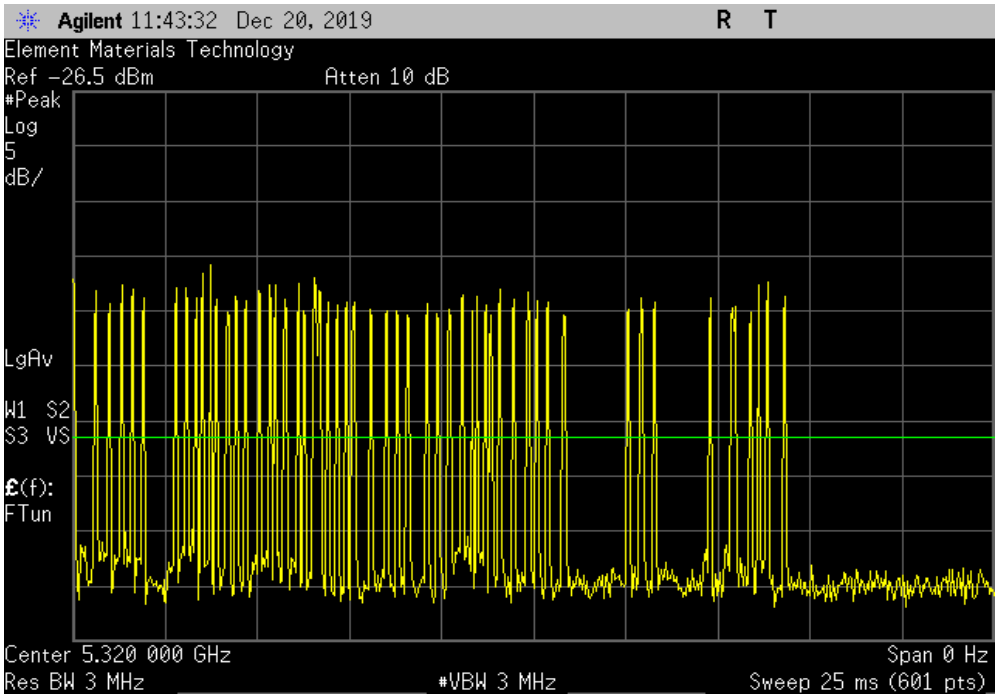
CH. 64, 5320 MHz, 2mS						
			Pulse On Time (µsec)	Value	Limit	Result
			64.33	>17%	≥17%	Pass



CH. 64, 5320 MHz, 10mS						
			Pulse On Time (µsec)	Value	Limit	Result
			64.33	>17%	≥17%	Pass



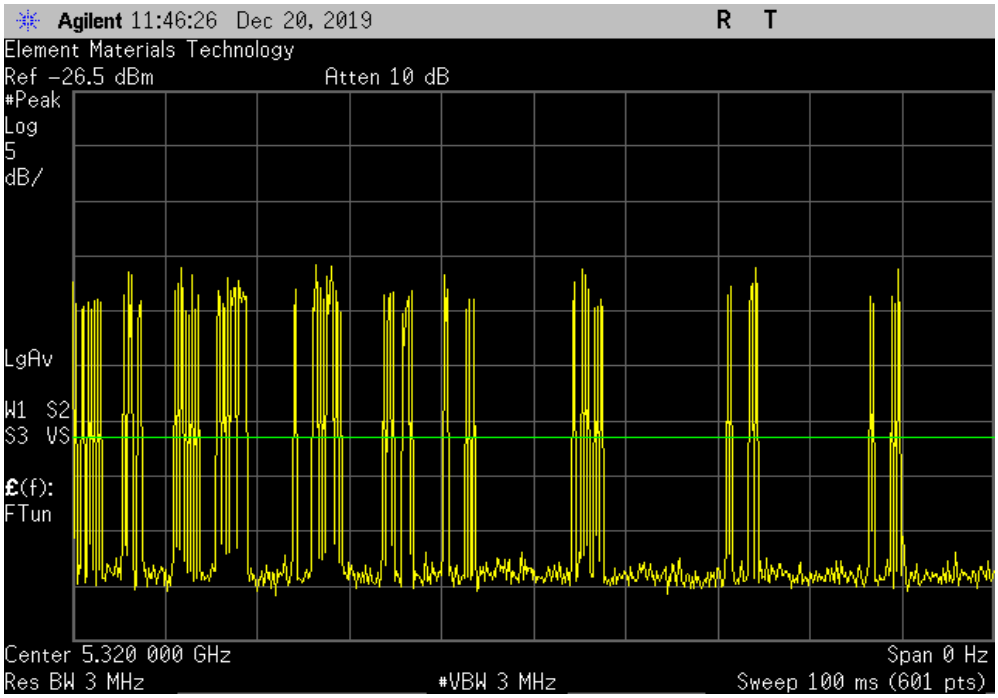
CH. 64, 5320 MHz, 25mS						
			Pulse On Time (µsec)	Value	Limit	Result
			64.33	>17%	≥17%	Pass



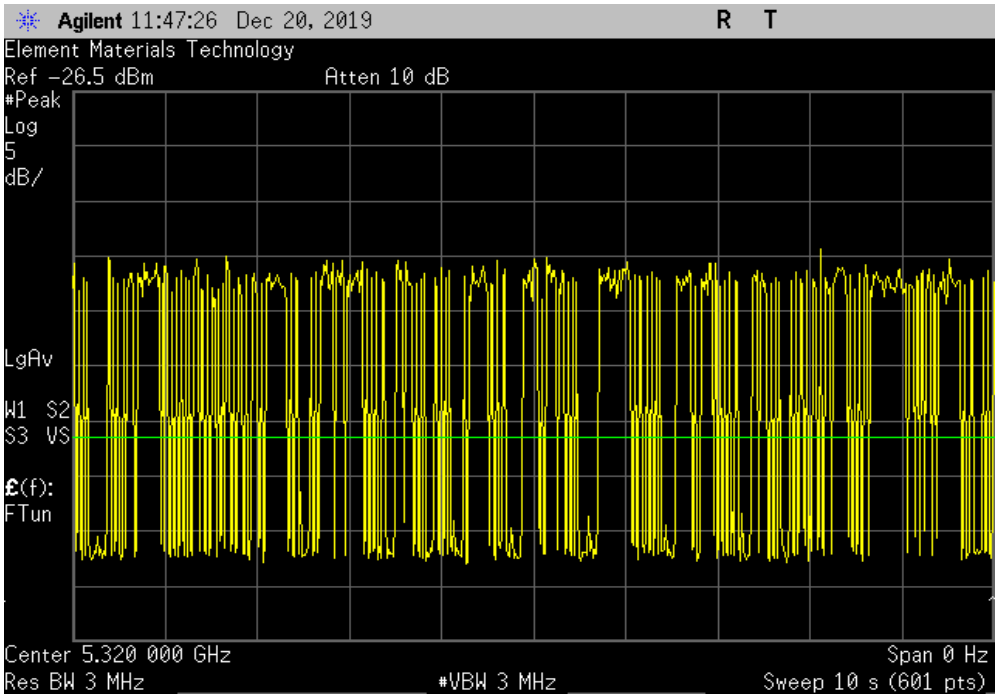
DFS TESTING - CHANNEL LOADING/CHANNEL UTILIZATION

XMit 2019.09.05

CH. 64, 5320 MHz, 100mS						
			Pulse On Time (µsec)	Value	Limit	Result
			64.33	>17%	≥17%	Pass



CH. 64, 5320 MHz, 10Sec						
			Pulse On Time (µsec)	Value	Limit	Result
			64.33	>17%	≥17%	Pass



DFS TESTING - MOVE TIME

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
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Attenuator	Weinschel Corp	3330A-6	AUF	4-Nov-19	4-Nov-20
Attenuator	Aeroflex/Weinschel	3053	RKG	NCR	NCR
Attenuator	Aeroflex/Weinschel	3053	RKF	NCR	NCR
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAI	NCR	NCR
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAJ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMW	28-Mar-19	28-Mar-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Pasternack	PE7005-20	AUN	23-Jul-19	23-Jul-20
Attenuator	Fairview Microwave	SA26B-10	TWG	28-Mar-19	28-Mar-20
Attenuator	S.M. Electronics	SA26B-10	AWR	31-Jul-19	31-Jul-20
Attenuator	Fairview Microwave	SA26B-10	TWH	28-Mar-19	28-Mar-20
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	12-Feb-19	12-Feb-20
Access Point	Cisco	AIR-SAP2602E-A-K9	TIY	NCR	NCR

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The master and client were connected using the conducted method described in the FCC KDB procedure via a series of splitters and attenuators which allows the radar signals to be injected and monitored. For master devices, the detection level was set prior to testing by temporarily replacing the master device with the analyzer and setting the power level according to Table 3 and Section 7.5. Where required, an approved Media file was streamed between the master and client or an alternative method to load the channel may be used instead. Channel loading requirements were also verified prior to testing. Configuration and status of the master and client devices were then monitored using the spectrum analyzer. The Move Time test was performed by starting a transmission between the master and client device, and then injecting the appropriate radar signals and making sure both the master and client device vacate the DFS channel within the time specified by the standard.

DFS TESTING - MOVE TIME

XMit 2019.09.05

EUT:	**Thor Radio Module AC WLAN and Bluetooth and BLE**			**Work Order:**	**ECHN0015**
Serial Number:	**Pre-Production Sample 2**			**Date:**	**20-Dec-19**
Customer:	**EchoNous, Inc.**			**Temperature:**	**21.5 °C**
Attendees:	**None**			**Humidity:**	**48% RH**
Project:	**None**			**Barometric Pres.:**	**1012 mbar**
Tested by:	**Brandon Hobbs**	**Power:**	**5.0 VDC via 110VAC/60Hz**	**Job Site:**	**EV06**

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

COMMENTS

Reference the DFS client conducted setup in the DFS UNII KDB 905462 section 7.2.2 for the configuration of attenuators, couplers and splitters used while under test.

DEVIATIONS FROM TEST STANDARD

None

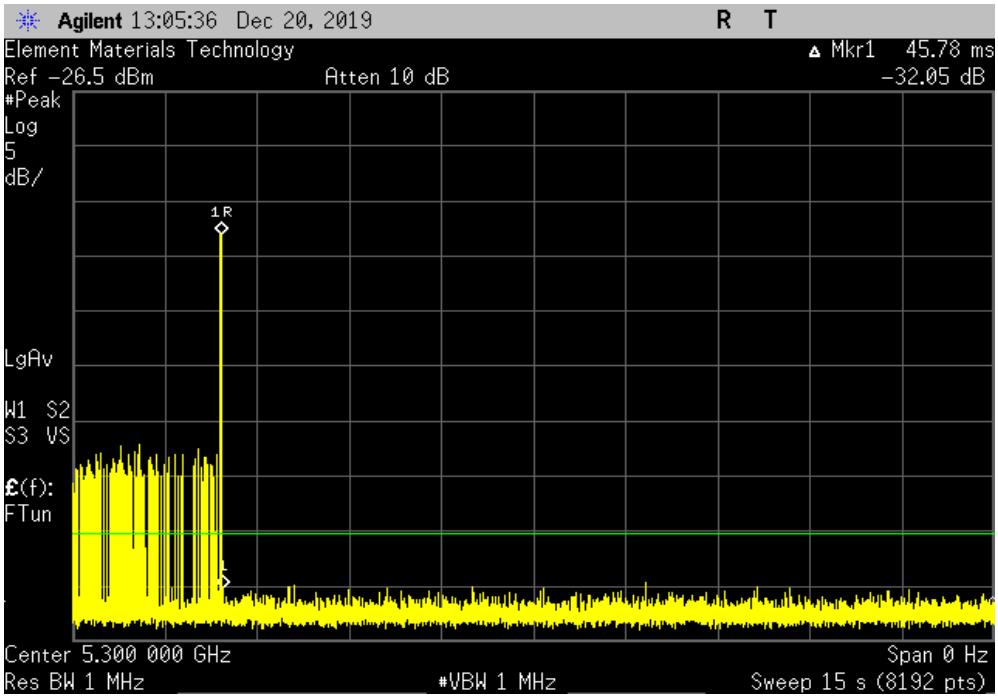
Configuration #	**9**	*Signature*

		Value	**Limit**	**Result**
CH. 60, 5300 MHz				
	Short Pulse Radar Type 0	.046 Sec	≤ 10 Sec	Pass
CH. 112, 5560 MHz				
	Short Pulse Radar Type 0	.033 Sec	≤ 10 Sec	Pass

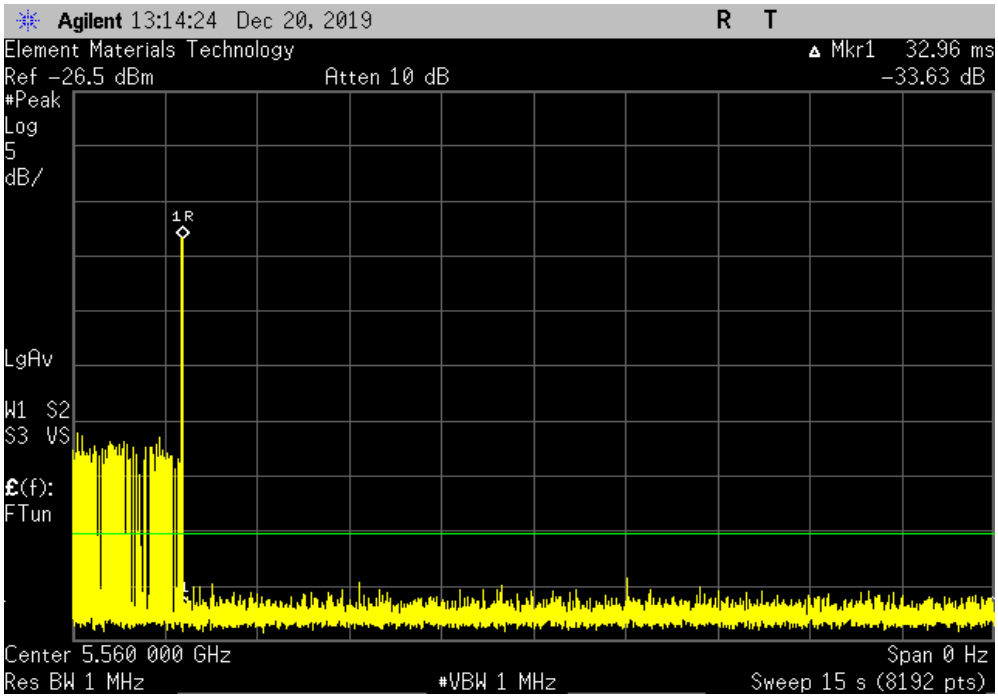
DFS TESTING - MOVE TIME

XMit 2019.09.05

CH. 60, 5300 MHz, Short Pulse Radar Type 0						
				Value	Limit	Result
				.046 Sec	≤ 10 Sec	Pass



CH. 112, 5560 MHz, Short Pulse Radar Type 0						
				Value	Limit	Result
				.033 Sec	≤ 10 Sec	Pass



DFS TESTING - CLOSING TIME

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
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Attenuator	Weinschel Corp	3330A-6	AUF	4-Nov-19	4-Nov-20
Attenuator	Aeroflex/Weinschel	3053	RKG	NCR	NCR
Attenuator	Aeroflex/Weinschel	3053	RKF	NCR	NCR
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAI	NCR	NCR
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAJ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMW	28-Mar-19	28-Mar-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Pasternack	PE7005-20	AUN	23-Jul-19	23-Jul-20
Attenuator	Fairview Microwave	SA26B-10	TWG	28-Mar-19	28-Mar-20
Attenuator	S.M. Electronics	SA26B-10	AWR	31-Jul-19	31-Jul-20
Attenuator	Fairview Microwave	SA26B-10	TWH	28-Mar-19	28-Mar-20
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	12-Feb-19	12-Feb-20
Access Point	Cisco	AIR-SAP2602E-A-K9	TIY	NCR	NCR
Generator - Signal	Benchforge Manufacturing	Colt	TIN	NCR	NCR

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The master and client were connected using the conducted method described in the FCC KDB procedure via a series of splitters and attenuators which allows the radar signals to be injected and monitored. For master devices, the detection level was set prior to testing by temporarily replacing the master device with the analyzer and setting the power level according to Table 3 and Section 7.5. Where required, an approved Media file was streamed through the master and client or an alternative method to load the channel may be used instead. Channel loading requirements were also verified prior to testing. Configuration and status of the master and client devices were then monitored using the spectrum analyzer. The Closing Time test was performed by starting a transmission between the master and client device, and then injecting the appropriate radar signals. All transmission signals between the master and client in the first 200mS are allowed. After this time period, the number of transmissions signals are counted and multiplied by the pulse width value(s). This aggregate is then added to the 200mS allowance for the final value and compared to the specified limit.

DFS TESTING - CLOSING TIME

XMit 2019.09.05

EUT:	**Thor Radio Module AC WLAN and Bluetooth and BLE**			**Work Order:**	**ECHN0015**
Serial Number:	**Pre-Production Sample 2**			**Date:**	**20-Dec-19**
Customer:	**EchoNous, Inc.**			**Temperature:**	**21.6 °C**
Attendees:	**None**			**Humidity:**	**47.9% RH**
Project:	**None**			**Barometric Pres.:**	**1012 mbar**
Tested by:	**Brandon Hobbs**	**Power:**	**5.0 VDC via 110VAC/60Hz**	**Job Site:**	**EV06**

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

COMMENTS

Reference the DFS client conducted setup in the DFS UNII KDB 905462 section 7.2.2 for the configuration of attenuators, couplers and splitters used while under test.

DEVIATIONS FROM TEST STANDARD

None

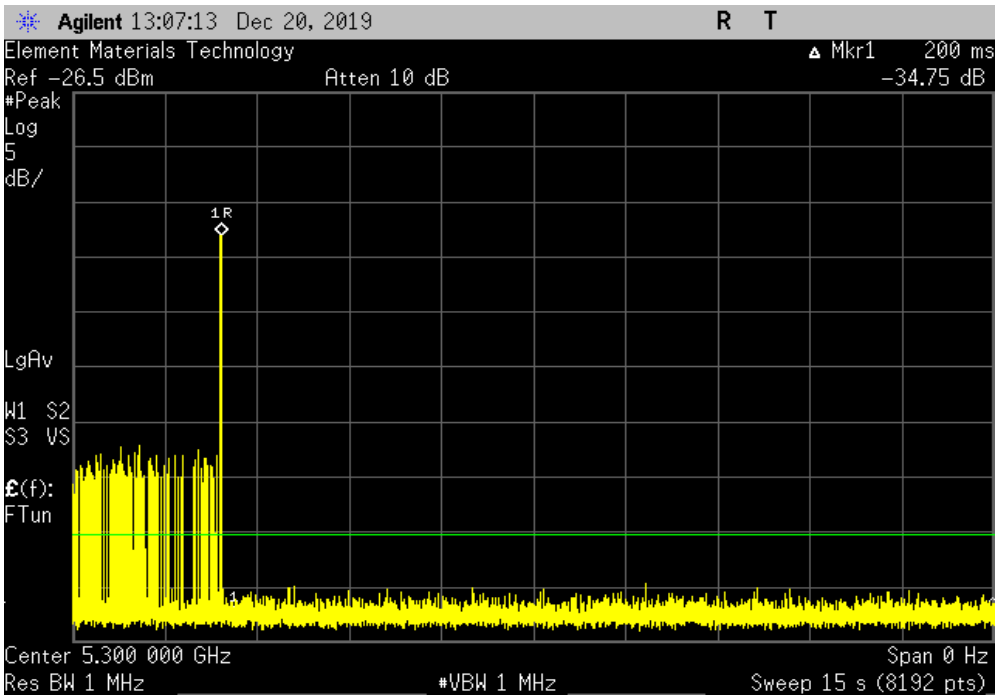
Configuration #	**9**	*Signature*

	# of Signals	Pulse Width	Value	Limit	Result
CH. 60, 5300 MHz					
Radar Type 0 200 mS	N/A	N/A	200mS	200mS	N/A
Radar Type 0 Aggregate	0	N/A	200mS	260mS	Pass
CH. 112, 5560 MHz					
Radar Type 0 200 mS	N/A	N/A	200mS	200mS	N/A
Radar Type 0 Aggregate	0	N/A	200mS	260mS	Pass

DFS TESTING - CLOSING TIME

XMit 2019.09.05

CH. 60, 5300 MHz, Radar Type 0 200 mS						
# of Signals		**Pulse Width**		**Value**	**Limit**	**Result**
N/A		N/A		200mS	200mS	N/A

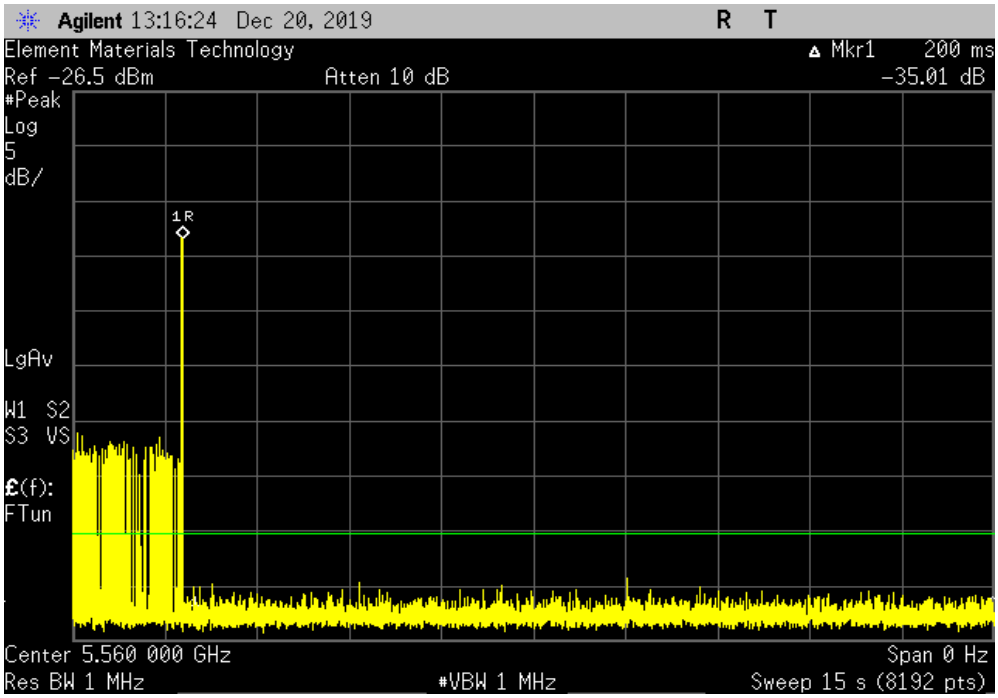


CH. 60, 5300 MHz, Radar Type 0 Aggregate						
# of Signals		**Pulse Width**		**Value**	**Limit**	**Result**
0		N/A		200mS	260mS	Pass

DFS TESTING - CLOSING TIME

XMit 2019.09.05

CH. 112, 5560 MHz, Radar Type 0 200 mS						
# of Signals		**Pulse Width**		**Value**	**Limit**	**Result**
N/A		N/A		200mS	200mS	N/A



CH. 112, 5560 MHz, Radar Type 0 Aggregate						
# of Signals		**Pulse Width**		**Value**	**Limit**	**Result**
0		N/A		200mS	260mS	Pass

DFS TESTING - NON OCCUPANCY PERIOD

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
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Attenuator	Weinschel Corp	3330A-6	AUF	4-Nov-19	4-Nov-20
Attenuator	Aeroflex/Weinschel	3053	RKG	NCR	NCR
Attenuator	Aeroflex/Weinschel	3053	RKJ	NCR	NCR
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAI	NCR	NCR
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAJ	NCR	NCR
Block - DC	Fairview Microwave	SD3379	AMW	28-Mar-19	28-Mar-20
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Pasternack	PE7005-20	AUN	23-Jul-19	23-Jul-20
Attenuator	Fairview Microwave	SA26B-10	TWG	28-Mar-19	28-Mar-20
Attenuator	S.M. Electronics	SA26B-10	AWR	31-Jul-19	31-Jul-20
Attenuator	Fairview Microwave	SA26B-10	TWH	28-Mar-19	28-Mar-20
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFA	12-Feb-19	12-Feb-20
Access Point	Cisco	AIR-SAP2602E-A-K9	TIY	NCR	NCR

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The master and client were connected using the conducted method described in the FCC KDB procedure via a series of splitters and attenuators which allows the communication and injected radar signals to be monitored simultaneously. The spectrum analyzer was configured to sweep the frequency for at least 30 minutes. The appropriate radar signal was injected and the channel was monitored to make sure the master and client devices vacated the channel and did not use it again for a period of time equal to or greater than 30 minutes.

DFS TESTING - NON OCCUPANCY PERIOD

XMit 2019.09.05

EUT:	**Thor Radio Module AC WLAN and Bluetooth and BLE**			**Work Order:**	**ECHN0015**
Serial Number:	**Pre-Preduction Sample 2**			**Date:**	**20-Dec-19**
Customer:	**EchoNous, Inc.**			**Temperature:**	**21.5 °C**
Attendees:	**None**			**Humidity:**	**48% RH**
Project:	**None**			**Barometric Pres.:**	**1012 mbar**
Tested by:	**Brandon Hobbs**	**Power:**	**5.0 VDC via 110VAC/60Hz**	**Job Site:**	**EV06**

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

COMMENTS

Reference the DFS client conducted setup in the DFS UNII KDB 905462 section 7.2.2 for the configuration of attenuators, couplers and splitters used while under test.

DEVIATIONS FROM TEST STANDARD

None

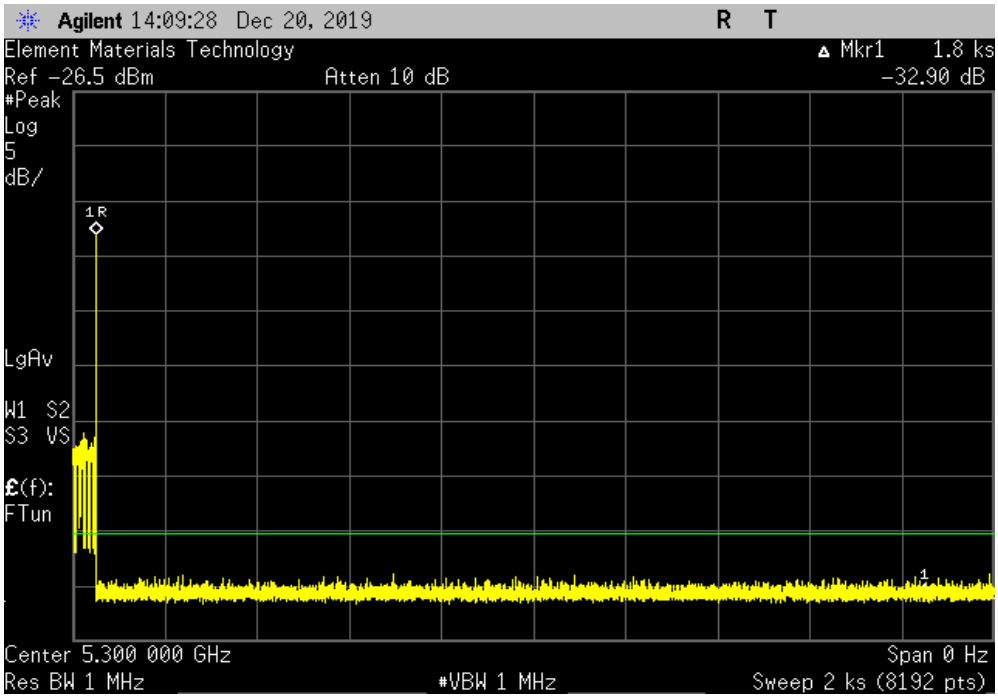
Configuration #	**9**	*Signature*

		Value	**Limit**	**Result**
CH. 60, 5300 MHz				
	30min Non Occupancy Period	> 30 min	≥ 30 min	Pass
CH. 112, 5560 MHz				
	30min Non Occupancy Period	> 30 min	≥ 30 min	Pass

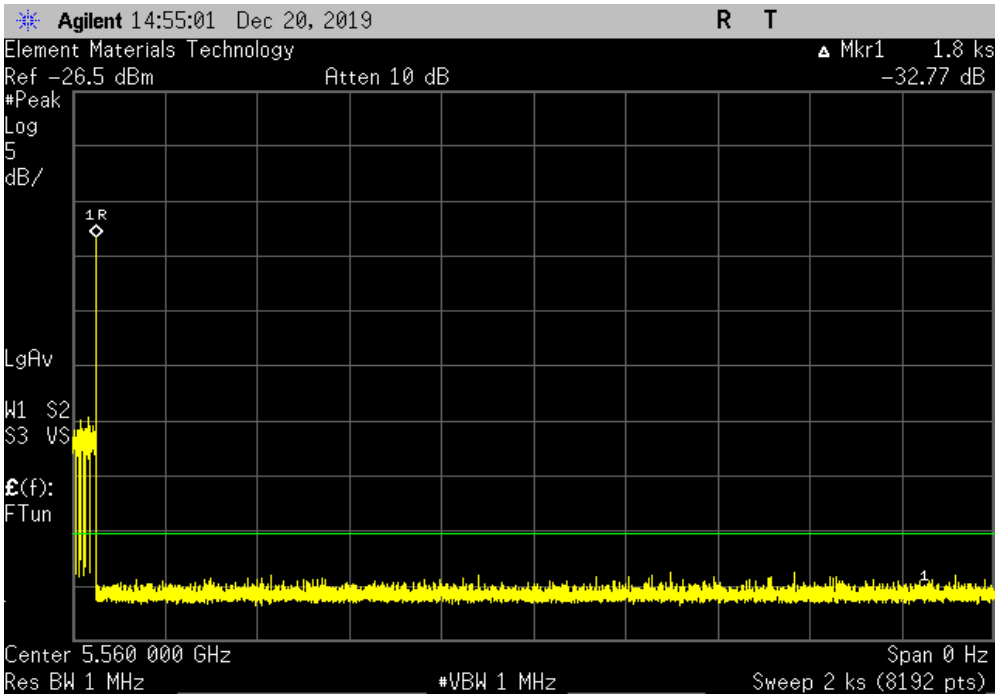
DFS TESTING - NON OCCUPANCY PERIOD

XMit 2019.09.05

CH. 60, 5300 MHz, 30min Non Occupancy Period						
				Value	Limit	Result
				> 30 min	≥ 30 min	Pass



CH. 112, 5560 MHz, 30min Non Occupancy Period						
				Value	Limit	Result
				> 30 min	≥ 30 min	Pass



APPENDIX

Rev 1-31-2017

DFS PRODUCT INFORMATION

Information Provided by the Party Requesting the Test

Example answers have been given (italicized) to help you understand what information is required. Please replace "Your answer here" with information specific to your product.

Section 1

The following information must be provided prior to the start of testing:

List all antenna assemblies and their corresponding gains.

1. If radiated tests are to be performed, the U-NII Device should be tested with the lowest gain antenna assembly (regardless of antenna type). The report should indicate which antenna assembly was used for the tests. For devices with adjustable output power, list the output power range and the maximum EIRP for each antenna assembly.
2. If conducted tests are to be performed, indicate which antenna port/connection was used for the tests and the antenna assembly gain that was used to set the DFS Detection Threshold level during calibration of the test setup.
    a. Indicate the calibrated conducted DFS Detection Threshold level.
    b. For devices with adjustable output power, list the output power range and the maximum EIRP for each antenna assembly.
    c. Indicate the antenna connector impedance. Ensure that the measurement instruments match (usually 50 Ohms) or use a minimum loss pad and take into account the conversion loss.
3. Antenna gain measurement verification for tested antenna.
    a. Describe procedure
    b. Describe the antenna configuration and how it is mounted
    c. If an antenna cable is supplied with the device, cable loss needs to be taken into account. Indicate the maximum cable length and either measure the gain with this cable or adjust the measured gain accordingly. State the cable loss.

Example: *The client device (EUT) has one 50 ohm antenna port. The antenna assembly gain of the client device was measured by the antenna manufacturer. The maximum gain in the 5 GHz bands is 4.2 dBi.*

The client device (EUT) has two 50 ohm U.FL antenna ports (CH0 and CH1).

Functional Description of the EUT (Equipment Under Test):

Example: 802.11abgn SISO radio with 1 stream and 1 antenna.

2.4GHz and 5GHz (2x2) MIMO 802.11ac two antennas ports (CH0 and CH1). WLAN on both ports but BT on Ant CH0 port Only.

The operating modes (Master and/or Client) of the U-NII device.

Example*: Client device with no ad-hoc capability, with both 802.11a and 802.11n (20/40MHz)*

For DFS device can operate in DFS Client (Slave) mode only and no ad-hoc capability.

For Client devices, indicate whether or not it has DFS Radar detection capabilities.

Example: *The client device has no radar detection and no ad-hoc capability.*

The client device has no radar detection and no ad-hoc capability.

System architectures, data rates, U-NII Channel bandwidths. 1. Indicate the type(s) of system architecture (e.g. IP based or Frame based) that the U-NII device employs. Each type of unique architecture must be tested. ***Example:*** *The client device (EUT) employs IP based system architecture.*
Client device is Load based.

Applicable only to devices with Radar detection capabilities: The time required for the Master Device or Client Device (with radar detection) to complete its power-on cycle.
Not Applicable – Client Device with no Radar Detection Capabilities.

Section 2

The following information must be provided prior to the completion of a test report:

Hardware, Firmware, and OS Versions: ***Example:*** *Hardware version: 0.1.5.6* *Firmware version: 12.6.8* *OS versions: CPM 7.8.2.1*
Hardware version: 0200 Firmware version: OS version:

The operating frequency band(s) of the equipment. ***Example:*** *5150 – 5250 MHz, 5250 - 5350 MHz (DFS Band),etc*
2412 – 2462 MHz 5150 – 5250 MHz, 5250-5350 MHz, 5470-5725 MHz, 5725-5850 MHz DFS Frequencies: 5250 - 5350MHz, 5470 - 5725MHz

List the highest and the lowest possible power level (equivalent isotropic radiated power (EIRP) of the equipment. ***Example:*** *The maximum EIRP of the 5 GHz equipment is 24.4 dBm conducted.*
The maximum EIRP of the 5 GHz equipment is 16.5 dBm conducted. (SISO 5.825 GHz, 20MHz BW, MCS7 Chain-2)
The maximum EIRP of the 5 GHz equipment is 16.2 dBm conducted. (MIMO 5.825 GHz, 20MHz BW, MCS15 Chain-2)

Test sequences or messages that should be used for communication between Master and Client Devices, which are used for loading the Channel. 1. Stream the test file from the Master Device to the Client Device for IP based systems or frame based systems which dynamically allocate the talk/listen ratio. 2. For frame based systems with fixed talk/listen ratio, set the ratio to 45%/55% and stream the test file from the Master to the Client. 3. For other system architectures, supply appropriate Channel loading methodology. ***Example:*** *Testing was performed with an audio file streamed from the Master Device to the Client Device. Channel loading was greater than 64%.*
Testing was performed with the communications traffic loading greater than 30%.

Transmit Power Control description. ***Example:*** *This device does not exceed 27dBm EIRP, so no transmit power control is implemented.*
This device supports TPC.

Applicable only to devices with Radar detection capabilities: Manufacturer statement confirming that

information regarding the parameters of the detected Radar Waveforms is not available to the end user.
Not Applicable

Applicable only to Master devices: Uniform Channel Spreading requirement for Master Devices. For Master Devices, indicate how the master provides, on aggregate, uniform Channel loading of the spectrum across all Channels.
Not Applicable

For Client devices, indicate the FCC (and IC) identifier for the Master U-NII Device that is used with it for DFS testing. ***Example:*** *A DFS-compliant Master device was used for testing. It's the CISCO Model AIR-AP1252AG-A-K9, FCC ID: LDK102061, IC: 2461B-102061*
A DFS-compliant Master device was used for testing. It was a CISCO Model AIR-SAP2602E-A-K9, FCC ID: LDK102080, IC: 2461B-102080.