

NORTHWEST EMC

Digi International Inc.

Sigma Pumps Gen IV 802.11abgn Module
802.11an

FCC 15.407:2016 DFS Compliance

Report # DGII0152.5



NVLAP Lab Code: 200881-0

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government of the United States of America. This Report may only be duplicated in its entirety

CERTIFICATE OF TEST



Last Date of Test: January 12, 2016
Digi International Inc.
Model: Sigma Pumps Gen IV 802.11abgn Module

Radio Equipment Testing

Standards

Specification	Method
FCC 15.407:2016	KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02

Results

Method Clause	Test Description	Applied	Results	Comments
KDB 905462 -7.7	Channel Loading/Channel Utilization	Yes	Pass	
KDB 905462 -7.8.1	Detection Bandwidth	No	N/A	Not required if device is a "Client".
KDB 905462 -7.8.2	Channel Availability Check	No	N/A	Not required if device is a "Client".
KDB 905462 -7.8.3	Move Time	Yes	Pass	
KDB 905462 -7.8.3	Closing Time	Yes	Pass	
KDB 905462 -7.8.3	Non Occupancy Period	Yes	Pass	
KDB 905462 -7.8.4	Statistical Performance	No	N/A	Not required if device is a "Client".

Deviations From Test Standards

None

Approved By:

Jeremiah Darden, 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.

REVISION HISTORY

Revision Number		Description	Date	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 Northwest EMC to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

IC - Recognized by Industry Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with IC.

European Union

European Commission – Validated by the European Commission as a Conformity Assessment Body (CAB) under the EMC directive and as a Notified Body under the R&TTE Directive.

Australia/New Zealand

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

Korea

MSIP / 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

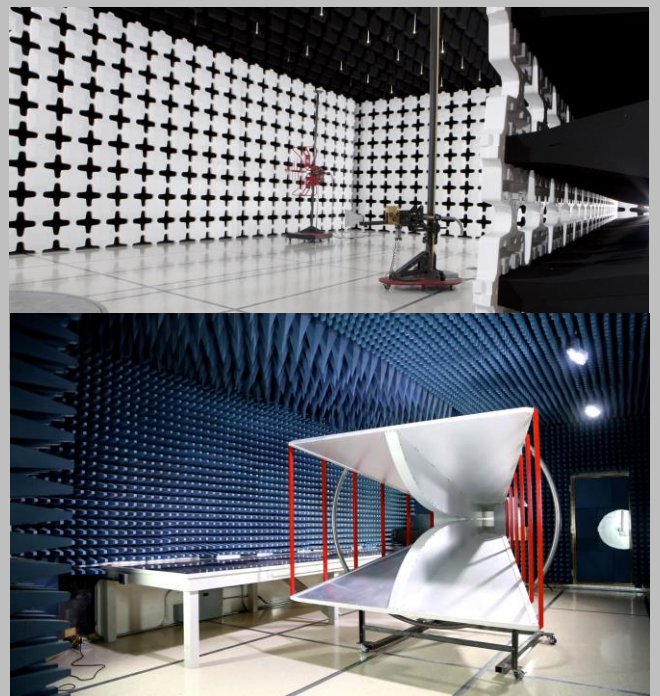
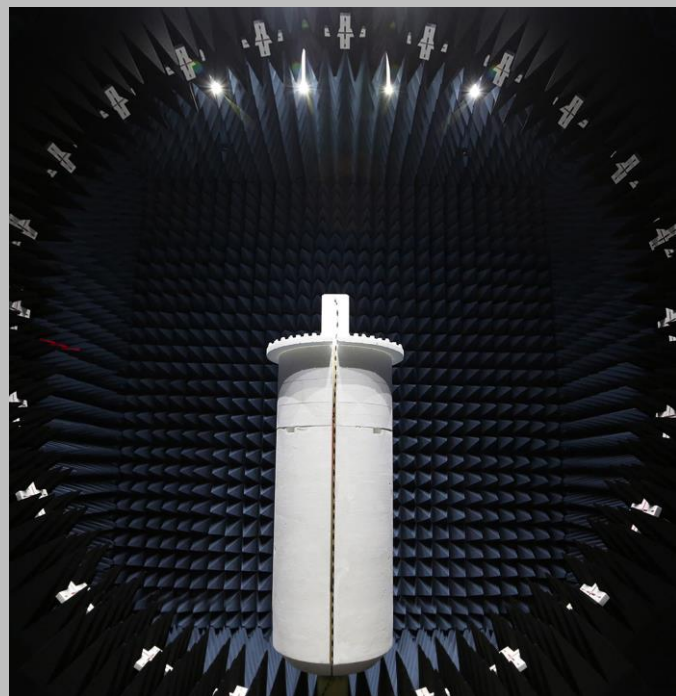
For details on the Scopes of our Accreditations, please visit:

<http://www.nwemc.com/accreditations/>
<http://gsi.nist.gov/global/docs/cabs/designations.html>

FACILITIES



California Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-08, MN10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	New York Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Oregon Labs EV01-12 22975 NW Evergreen Pkwy 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: 200761-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Industry Canada					
2834B-1, 2834B-3	2834E-1	N/A	2834D-1, 2834D-2	2834G-1	2834F-1
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Digi International Inc.
Address:	11001 Bren Road E.
City, State, Zip:	Minnetonka, MN 55343
Test Requested By:	Slava Gekht
Model:	Sigma Pumps Gen IV 802.11abgn Module
First Date of Test:	January 11, 2016
Last Date of Test:	January 12, 2016
Receipt Date of Samples:	November 19, 2015
Equipment Design Stage:	Production
Equipment Condition:	No Damage

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
802.11abgn SISO radio with 1 stream and 2 antennas – one primary and the other one secondary.
Hardware, Firmware, and OS Versions:
Hardware Version: 50001857-01 RevXX OS Version: Net-OS 7.6
The operating frequency band(s) of the equipment.
5150 – 5250 MHz, 5250 - 5350 MHz (DFS Band), 5500 - 5700 MHz (DFS Band), 5740-5825 MHz
The operating modes (Master and/or Client) of the U-NII device.
Client device with no ad-hoc capability, with both 802.11a and 802.11n (20/40MHz)
For Client devices, indicate whether or not it has DFS capabilities and indicate the FCC (and IC) identifier for the Master U-NII Device that is used with it for DFS testing.
The EUT is client only DFS device with no radar protection. The master device used for testing is a CISCO Aironet IOS Access Point (AIR-AP1252AG-A-K9) with FCC IDs LDK102061 and LDK102062.
List the highest and the lowest possible power level (equivalent isotropic radiated power (EIRP) of the equipment.
18 dBm conducted.
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. Transferred NTIA MPEG video file using a data rate 6 Mbps from the Master to the Client device using an IP based system
Transmit Power Control description.
This device does not exceed 18dBm EIRP, so no transmit power control is implemented
For Client devices, indicate whether or not it has DFS Radar detection capabilities.
The client device does not have radar detection or ad-hoc capability.

PRODUCT DESCRIPTION

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.*

The client device (EUT) employs IP based system architecture.

The time required for the Master Device and/or Client Device to complete its power-on cycle.

The time it takes for the Client Device to complete its power –on cycle is 60-120 sec.

Manufacturer statement confirming that information regarding the parameters of the detected Radar Waveforms is not available to the end user.

Digi International Inc. confirms that information regarding the parameters of the detected Radar Waveforms is not available to the end user.

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.

This is a client device

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.

The client device (EUT) has two 50 ohm antenna ports (one primary and one for diversity). The antennas were designed by Digi and are part of the PCB of the board. The antenna gains of the client device were measured by the antenna manufacturer (Digi International Inc.). The maximum gain in the 5 GHz bands is 3.5 dBi.

CONFIGURATIONS

Configuration DGII0152- 3

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Sigma Pumps Gen IV Radio Module	Digi International Inc.	50001857-1	UUT #7 (55001769-1 rev. 1P)
Development Board	Digi International Inc.	55001610-2 rev. 01	None

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
DC Power Supply	Agilent	U8002A	TPZ

Remote Equipment Outside of Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop	Hewlett-Packard	Compaq nc6320	CNU7D62VS5
AC Adapter (Laptop)	Hewlett-Packard	PPP014L-S	W97950EBMVYB2Z
Wireless Router	Cisco	Linksys	Linksys 2
AC/DC Adapter	Cisco	None	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
Serial Cable	Yes	>3m	Yes	Development Board	Laptop
DC Cable (Laptop)	No	1.8m	No	Laptop	AC Adapter (Laptop)
AC Cable (Laptop)	No	1.8m	No	AC Adapter (Laptop)	AC Mains
DC Cable (DC Power Supply)	No	1.0m	No	DC Power Supply	Development Board
DC Cable (Linksys PS)	No	1.5m	No	AC/DC Adapter	Wireless Router
Ethernet Cable	No	1.5m	No	Wireless Router	Cisco AP

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	1/11/2016	Move Time	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
2	1/11/2016	Closing Time	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
3	1/11/2016	Channel Loading/Channel Utilization	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
4	1/12/2016	Non Occupancy Period	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

INTRODUCTION & CLIENT DEVICE DFS CONFORMANCE

Overview

For a Client Device without DFS, the Channel Move Time and Channel Closing Transmission Time requirements are verified with one Short Pulse Radar and one Long Pulse Radar. Non-occupancy period can be confirmed with either short or long pulses.

Channel Closing Transmission Time: The total duration of transmissions, consisting of data signals and the aggregate of control signals, by a U-NII device during the Channel Move Time.

Channel Move Time: The time to cease all transmissions on the current Channel upon detection of a Radar Waveform above the DFS Detection Threshold. A Client Device will not transmit before having received appropriate control signals from a Master Device. A Client Device will stop all its transmissions whenever instructed by a Master Device to which it is associated and will meet the Channel Move Time and Channel Closing Transmission Time requirements. The Client Device will not resume any transmissions until it has again received control signals from a Master Device.

Non-Occupancy Period: Time during which both the client and master device shall not make any transmissions on a channel after a radar signal was detected on that channel. It should at least the minimum requirements but it can be more.

Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	Master	Client (without DFS)	Client (with DFS)
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirement for devices with multiple bandwidth modes	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

DFS Detection Thresholds for Master or Client Devices Incorporating DFS

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP $\geq$ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

DFS Response Requirement Values

Parameter	Value
Non-occupancy	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds (See Note 1)
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. (See Notes 1 and 2).
U-NII Detection Bandwidth	Minimum 100% of the UNII 99% transmission power bandwidth. (See Note 3).
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

INTRODUCTION & CLIENT DEVICE DFS CONFORMANCE

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A	(See KDB section 6.1)	60%	30
2	1 - 5	150 - 230	23 - 29	60%	30
3	6 - 10	200 - 500	16 - 18	60%	30
4	11 - 20	200 - 500	12 - 16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Long Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50 - 100	5 - 20	1000 - 2000	1 - 3	8 - 20	80%	30

Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

Setting the Test Signal Level

The radar test signal level is set at the Master Device, or the Client Device with In-Service Monitoring, as appropriate for the particular test. This device is known as the Radar Detection Device (RDD). The RDD consists of the applicable device and the device antenna assembly that has the lowest antenna assembly gain of all available antenna assemblies. Depending on the UUT, the following configurations exist:

- When the Master Device is the UUT, the Master Device is the RDD.
- When a Client Device without Radar Detection is the UUT, the Master Device is the RDD.
- When a Client Device with Radar Detection is the UUT, and is tested for response to the Master Device detections, the Master Device is the RDD.
- When a Client Device with Radar Detection is the UUT, and is tested for independent response to detections by the Client Device, the Client Device is the RDD.

A spectrum analyzer is used to establish the test signal level for each radar type. During this process, there are no transmissions by either the Master Device or Client Device. The spectrum analyzer is switched to the zero span (time domain) mode at the frequency of the Radar Waveform generator. The peak detector function of the spectrum analyzer is utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) are set to at least 3 MHz.

The signal generator amplitude and/or step attenuators are set so that the power level measured at the spectrum analyzer is equal to the DFS Detection Threshold that is required for the tests. The signal generator and attenuator settings are recorded for use during the test.

Data demonstrating that the test signal level is correctly set for each radar type (0-6) will be recorded and reported.

CHANNEL LOADING / CHANNEL UTILIZATION

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.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	4/20/2015	12
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAE	NCR	0
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAF	NCR	0
Generator - Signal	Benchforge Manufacturing	Colt	TIP	NCR	0
Attenuator	Aeroflex/Weinschel	3053	RKM	NCR	0
Attenuator	Aeroflex/Weinschel	3053	RKN	NCR	0
Access Point	Cisco	AIR-AP1252AG-A-K9	TIV	NCR	0
Power Supply	Cisco	AIR-PWR-SPLY1	TIVA	NCR	0

TEST DESCRIPTION

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. 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 verified. Configuration and status of the master and client devices were then monitored using the spectrum analyzer.

CHANNEL LOADING / CHANNEL UTILIZATION

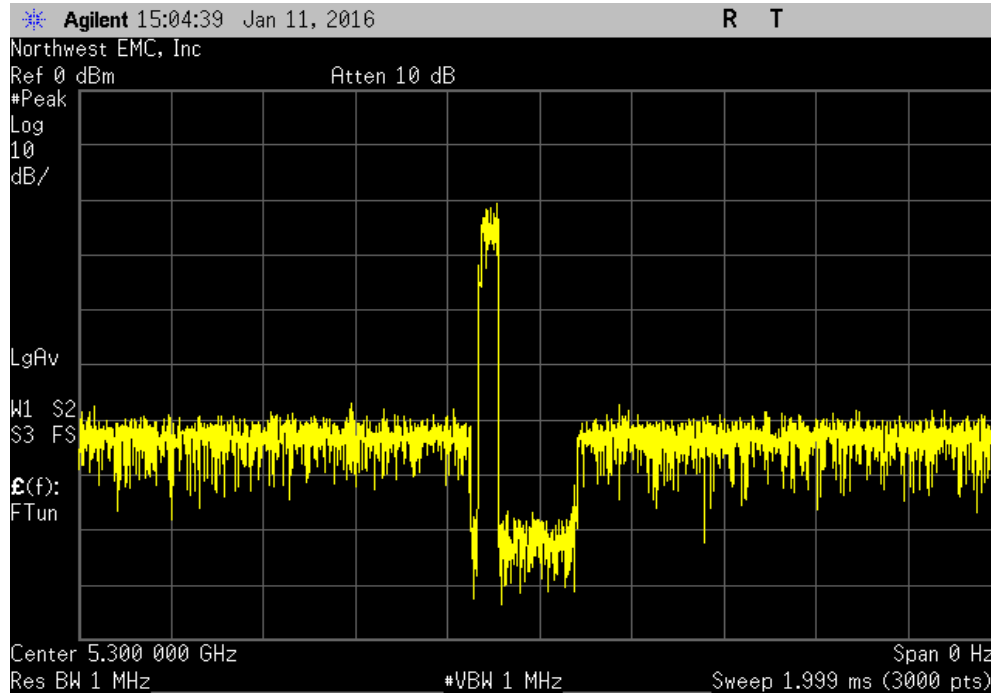


XMR 2015.01.14

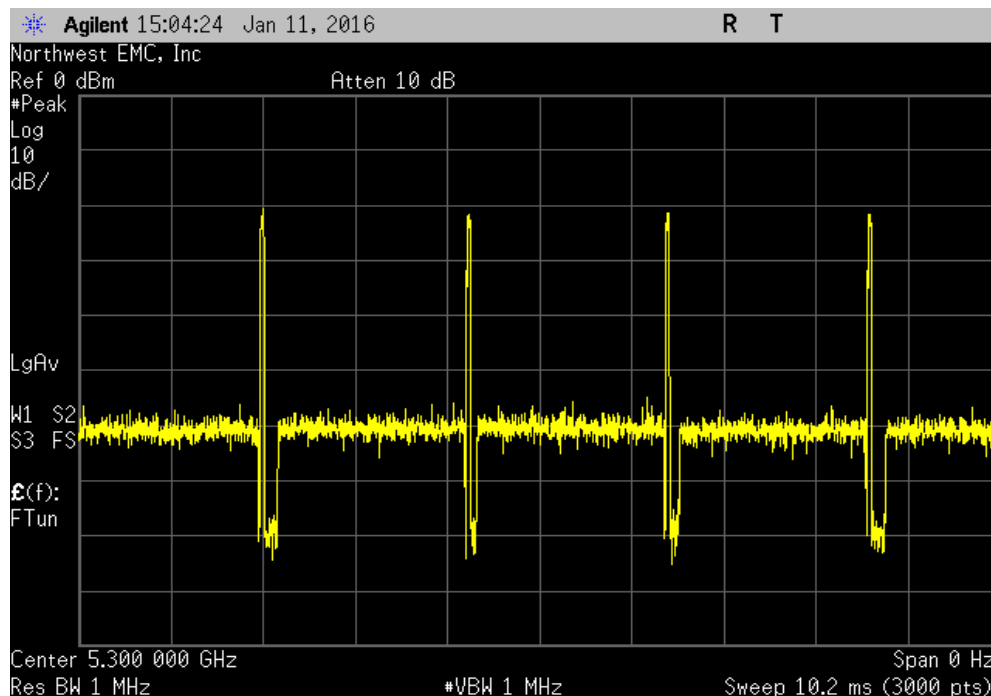
EUT: Sigma Pumps Gen IV 802.11abgn Module		Work Order: DGII0152				
Serial Number: UUT #7 (55001769-1 rev. 1P)		Date: 01/11/16				
Customer: Digi International Inc.		Temperature: 21.1°C				
Attendees: Slava Gehkt		Humidity: 16%				
Project: None		Barometric Pres.: 984				
Tested by: Jared Ison	Power: 110VAC/60Hz	Job Site: MN08				
TEST SPECIFICATIONS						
FCC 15.407:2016		Test Method				
		KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02				
COMMENTS						
EUT transferring NTIA MPEG video file using a data rate 6 Mbps. Pulse width measurement of 0.1367 ms was captured in previous testing. EUT is the client device in this setup. Loading is based on the data from the Master device.						
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #	3	Signature 				
		Pulse Width (ms)	Ch. Loading (%)	Avg Loading (%)	Limit (%)	Result
Ch. 60: 5300 MHz						
	2 ms sweep	0.1367	60.00	68.00	> 17	Pass
	10 ms sweep	0.1367	60.00	68.00	> 17	Pass
	25 ms sweep	0.1367	40.00	61.33	> 17	Pass
	100 ms sweep	0.1367	38.00	60.67	> 17	Pass
	10 s sweep	N/A	N/A	50	> 17	Pass

CHANNEL LOADING / CHANNEL UTILIZATION

Ch. 60: 5300 MHz, 2 ms sweep						
	Pulse Width (ms)	Ch. Loading (%)	Avg Loading (%)	Limit (%)	Result	
	0.1367	60.00	68.00	> 17	Pass	

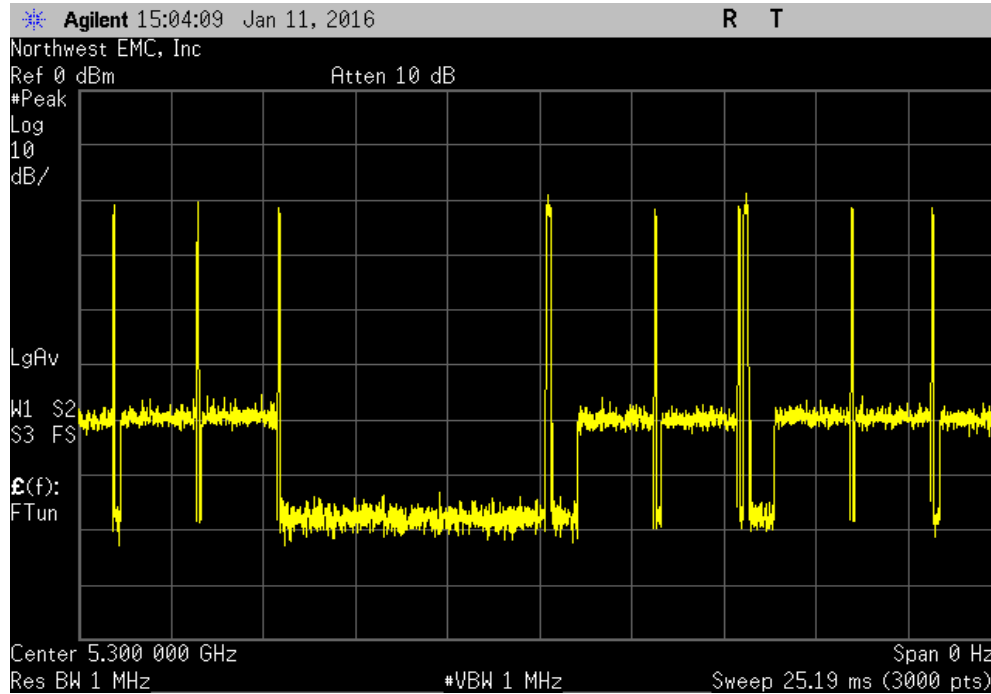


Ch. 60: 5300 MHz, 10 ms sweep						
	Pulse Width (ms)	Ch. Loading (%)	Avg Loading (%)	Limit (%)	Result	
	0.1367	60.00	68.00	> 17	Pass	

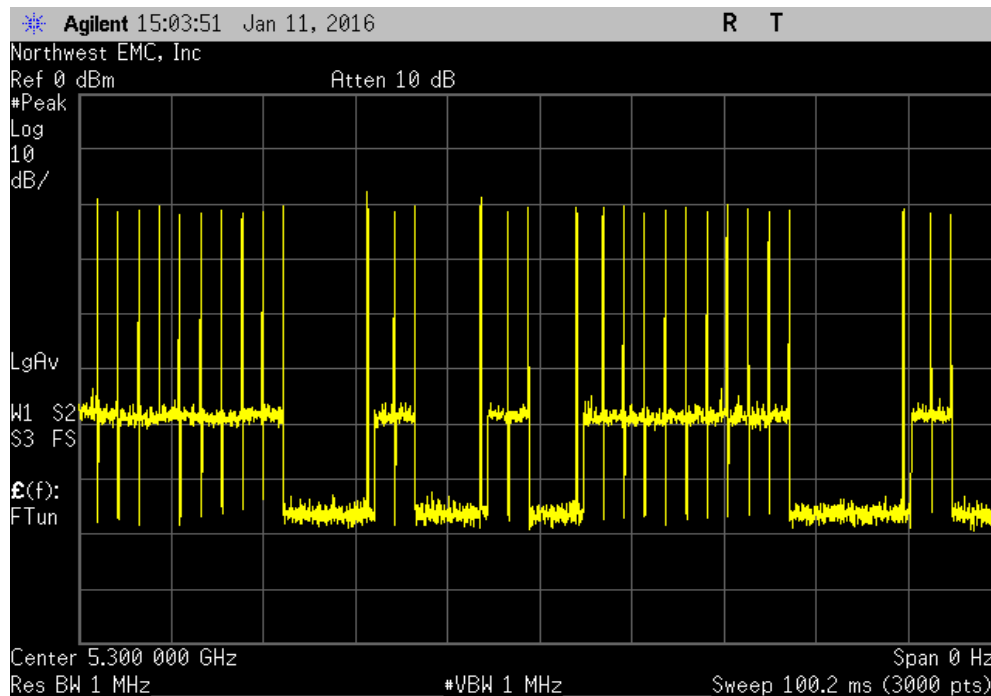


CHANNEL LOADING / CHANNEL UTILIZATION

Ch. 60: 5300 MHz, 25 ms sweep						
	Pulse Width (ms)	Ch. Loading (%)	Avg Loading (%)	Limit (%)	Result	
	0.1367	40.00	61.33	> 17	Pass	

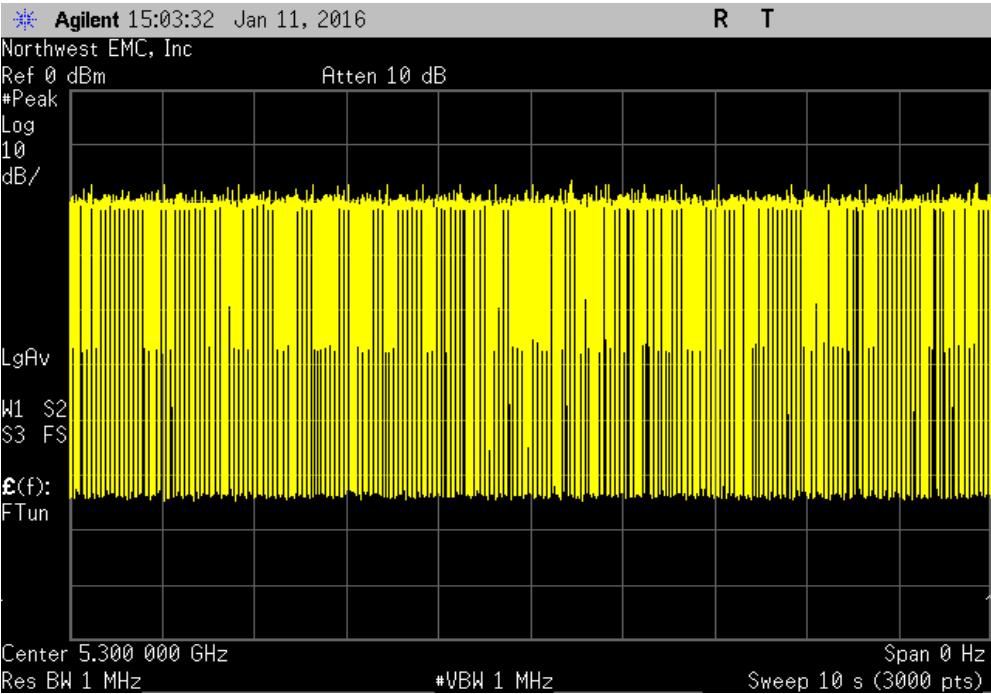


Ch. 60: 5300 MHz, 100 ms sweep						
	Pulse Width (ms)	Ch. Loading (%)	Avg Loading (%)	Limit (%)	Result	
	0.1367	38.00	60.67	> 17	Pass	



CHANNEL LOADING / CHANNEL UTILIZATION

Ch. 60: 5300 MHz, 10 s sweep						
	Pulse Width	Ch. Loading	Avg Loading	Limit	Result	
	(ms)	(%)	(%)	(%)		
	N/A	N/A	50	> 17	Pass	



MOVE TIME

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.	Interval (mo)
Generator - Signal	Agilent	N5183A	TIK	10/17/2014	36
Generator - Signal	Benchforge Manufacturing	Colt	TIP	NCR	0
Power Supply	Cisco	AIR-PWR-SPLY1	TIVA	NCR	0
Access Point	Cisco	AIR-AP1252AG-A-K9	TIV	NCR	0
Attenuator	Aeroflex/Weinschel	3053	RKM	NCR	0
Attenuator	Aeroflex/Weinschel	3053	RKN	NCR	0
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAE	NCR	0
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAF	NCR	0
Block - DC	Fairview Microwave	SD3379	AMI	9/18/2015	12
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/18/2015	12
Attenuator	S.M. Electronics	SA26B-20	RFW	3/10/2015	12
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	4/20/2015	12

TEST DESCRIPTION

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.

MOVE TIME

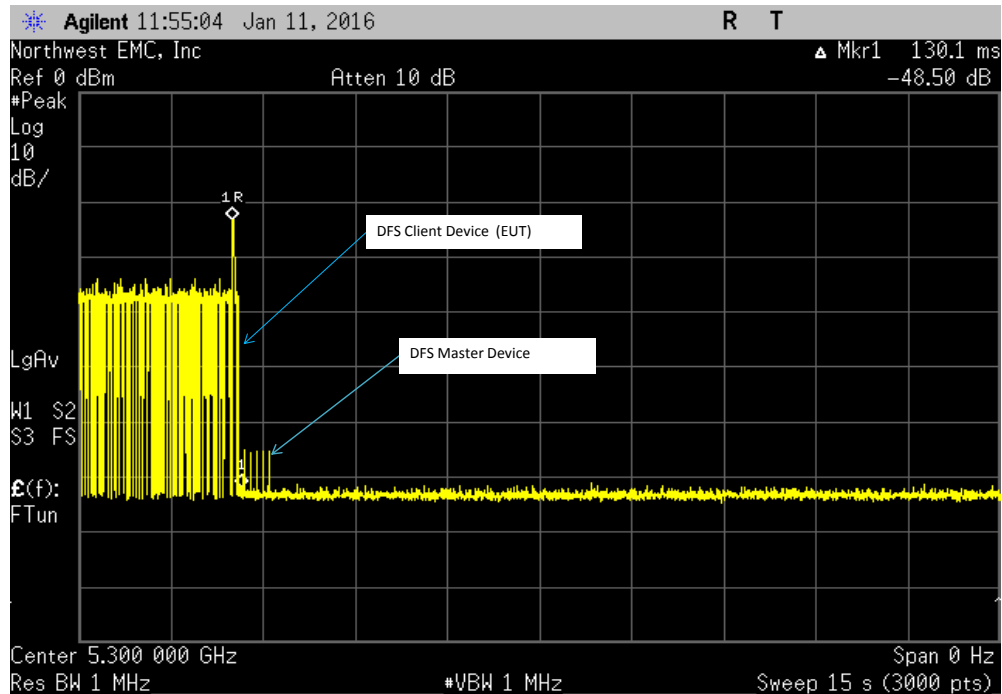


XMR 2015.01.14

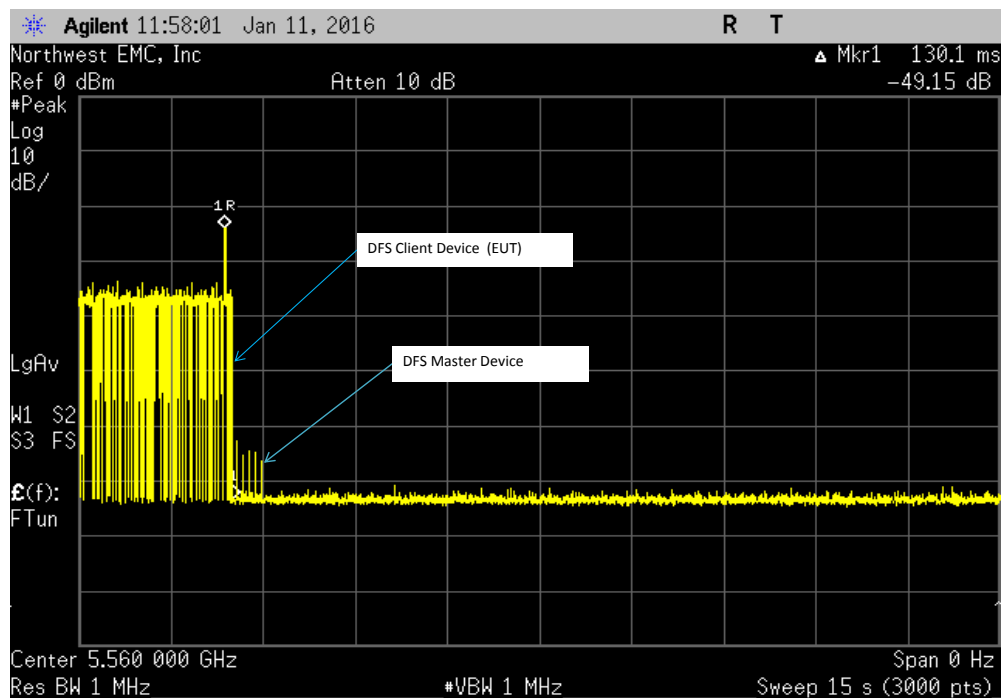
EUT: Sigma Pumps Gen IV 802.11abgn Module		Work Order: DGII0152	
Serial Number: UUT #7 (55001769-1 rev. 1P)		Date: 01/11/16	
Customer: Digi International Inc.		Temperature: 21.1°C	
Attendees: Slava Gehkt		Humidity: 16%	
Project: None		Barometric Pres.: 984	
Tested by: Jared Ison	Power: 110VAC/60Hz	Job Site: MN08	
TEST SPECIFICATIONS			
FCC 15.407:2016		Test Method	
		KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02	
COMMENTS			
EUT transferring NTIA MPEG video file using a data rate of 6 Mbps.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value	Limit
20 MHz			
Ch. 60: 5300 MHz			
Radar 1		700ms	< 10 s
Ch. 112: 5560 MHz			
Radar 1		700 ms	< 10 s
			Pass

MOVE TIME

20 MHz, Ch. 60: 5300 MHz, Radar 1						
				Value	Limit	Result
				700ms	< 10 s	Pass



20 MHz, Ch. 112: 5560 MHz, Radar 1						
				Value	Limit	Result
				700 ms	< 10 s	Pass



CLOSING TIME

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.	Interval (mo)
Power Supply	Cisco	AIR-PWR-SPLY1	TIVA	NCR	0
Access Point	Cisco	AIR-AP1252AG-A-K9	TIV	NCR	0
Attenuator	Aeroflex/Weinschel	3053	RKN	NCR	0
Attenuator	Aeroflex/Weinschel	3053	RKM	NCR	0
Generator - Signal	Benchforge Manufacturing	Colt	TIP	NCR	0
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAF	NCR	0
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAE	NCR	0
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	4/20/2015	12

TEST DESCRIPTION

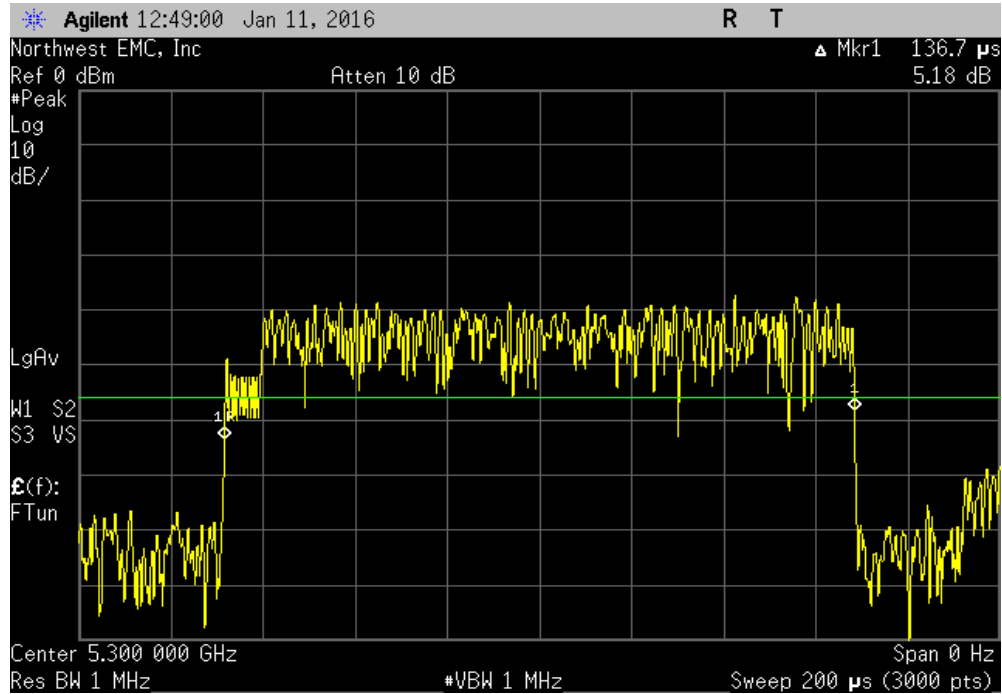
The master and client were connected using the conducted method described in the FCC KDB procedure via a series of splitters and attenuators which allows the radar signals to be injected and monitored. For master devices, the detection level was set prior to testing by temporarily replacing the master 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.

CLOSING TIME

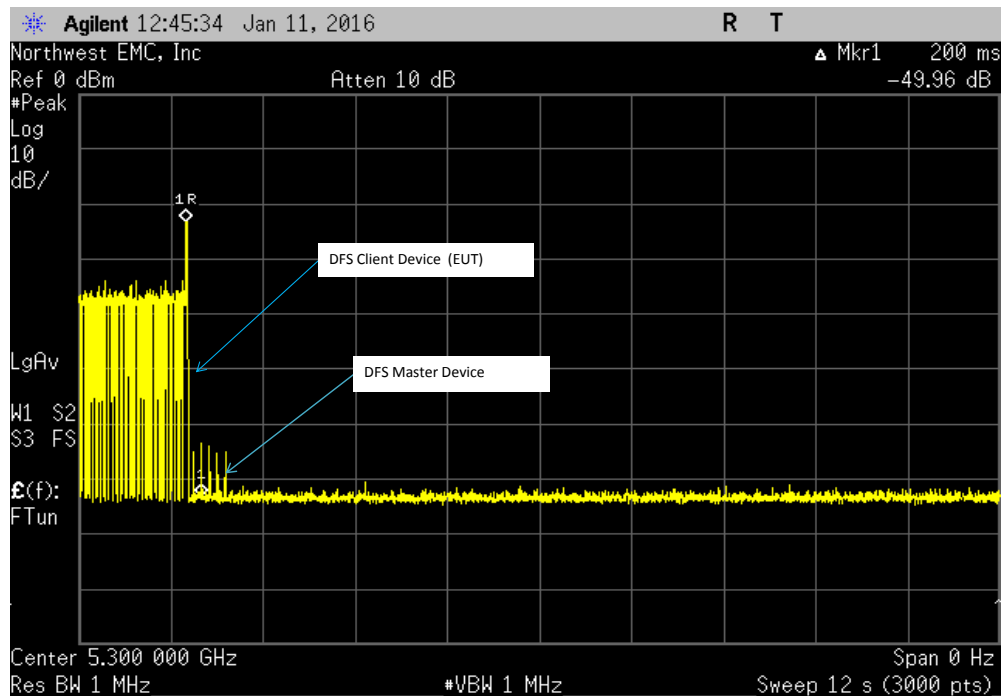
EUT: Sigma Pumps Gen IV 802.11abgn Module		Work Order: DGII0152	
Serial Number: UUT #7 (55001769-1 rev. 1P)		Date: 01/11/16	
Customer: Digi International Inc.		Temperature: 21.1°C	
Attendees: Slava Gehkt		Humidity: 16%	
Project: None		Barometric Pres.: 984	
Tested by: Jared Ison		Power: 110VAC/60Hz	
		Job Site: MN08	
TEST SPECIFICATIONS			
FCC 15.407:2016		Test Method	
		KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02	
COMMENTS			
EUT transferring NTIA MPEG video file using a data rate 6 Mbps.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		# of Pulses	Pulse Width (mS)
			Value
			Limit (mS)
			Result
20 MHz			
Radar 1			
Control Signal Pulse Width			
		N/A	0.1367
		0	N/A
			200
			260
			N/A
			Pass
200 ms + Aggregate			
		N/A	0.1367
		0	N/A
			200
			260
			N/A
			Pass

CLOSING TIME

20 MHz, Radar 1, Control Signal Pulse Width, Ch. 60: 5300 MHz						
# of Pulses	Pulse Width (mS)	Value	Limit (mS)	Result		
N/A	0.1367	N/A	N/A	N/A		

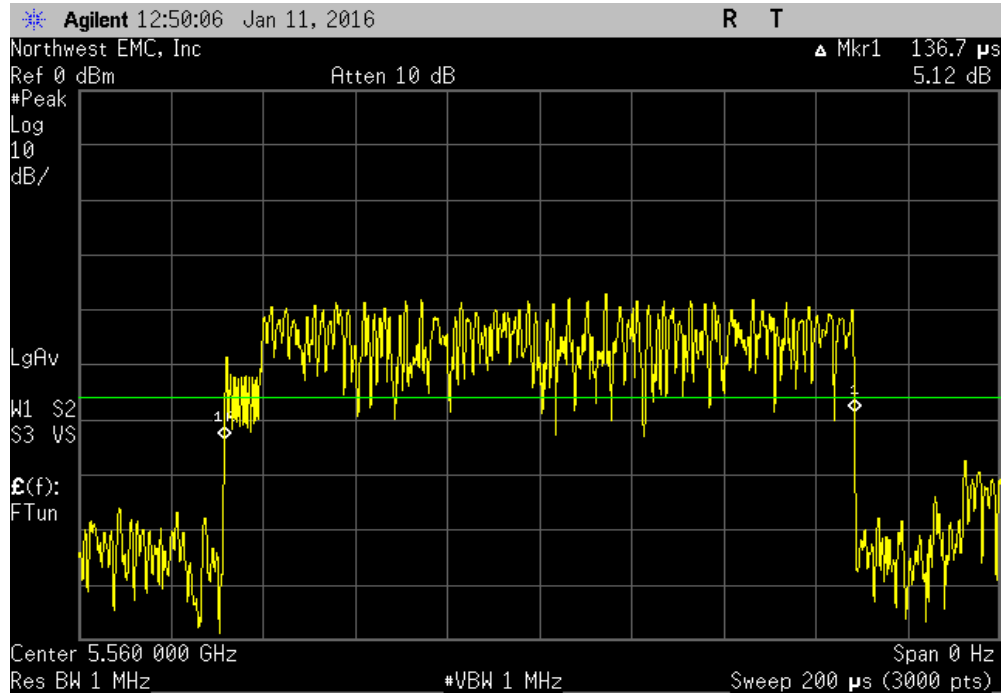


20 MHz, Radar 1, Control Signal Pulse Width, Ch. 112: 5560 MHz						
# of Pulses	Pulse Width (mS)	Value	Limit (mS)	Result		
0	N/A	200	260	Pass		

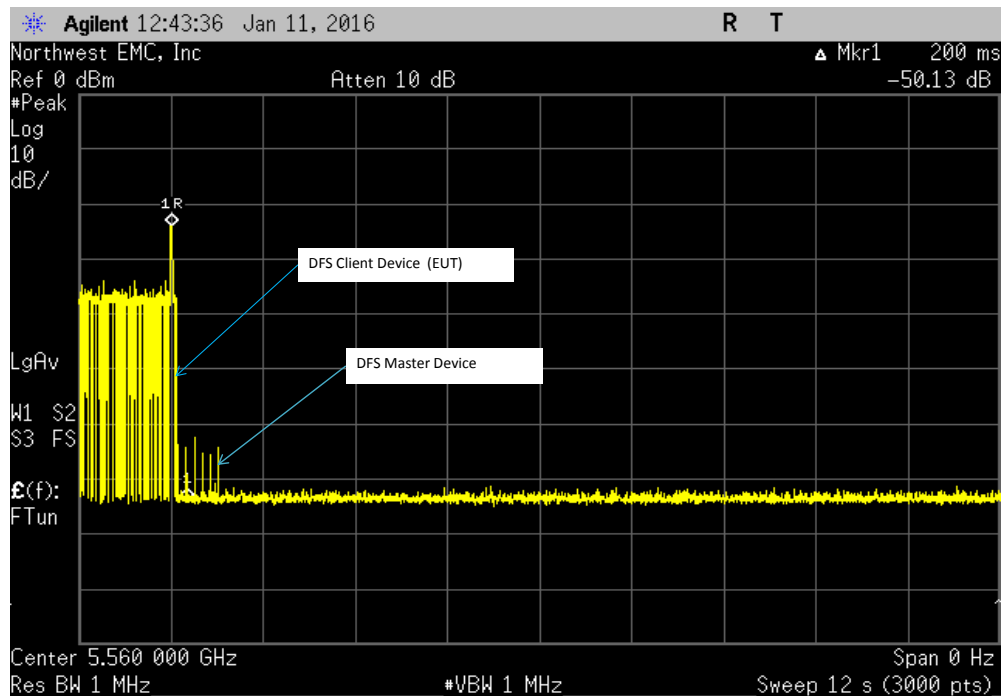


CLOSING TIME

20 MHz, Radar 1, 200 ms + Aggregate, Ch. 60: 5300 MHz						
# of Pulses	Pulse Width (mS)	Value	Limit (mS)	Result		
N/A	0.1367	N/A	N/A	N/A		



20 MHz, Radar 1, 200 ms + Aggregate, Ch. 112: 5560 MHz						
# of Pulses	Pulse Width (mS)	Value	Limit (mS)	Result		
0	N/A	200	260	Pass		



NON OCCUPANCY PERIOD

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.	Interval (mo)
Block - DC	Fairview Microwave	SD3379	AMI	9/18/2015	12
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/18/2015	12
Attenuator	Aeroflex/Weinschel	3053	RKM	NCR	0
Attenuator	Aeroflex/Weinschel	3053	RKN	NCR	0
Generator - Signal	Benchforge Manufacturing	Colt	TIP	NCR	0
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAF	NCR	0
Power Divider/Combiner	Fairview Microwave	MP0208-2	IAE	NCR	0
Attenuator	S.M. Electronics	SA26B-20	RFW	3/10/2015	12
Generator - Signal	Agilent	N5183A	TIK	10/17/2014	36
Analyzer - Spectrum Analyzer	Agilent	E4440A	AAX	4/20/2015	12
Power Supply	Cisco	AIR-PWR-SPLY1	TIVA	NCR	0
Access Point	Cisco	AIR-AP1252AG-A-K9	TIV	NCR	0

TEST DESCRIPTION

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.

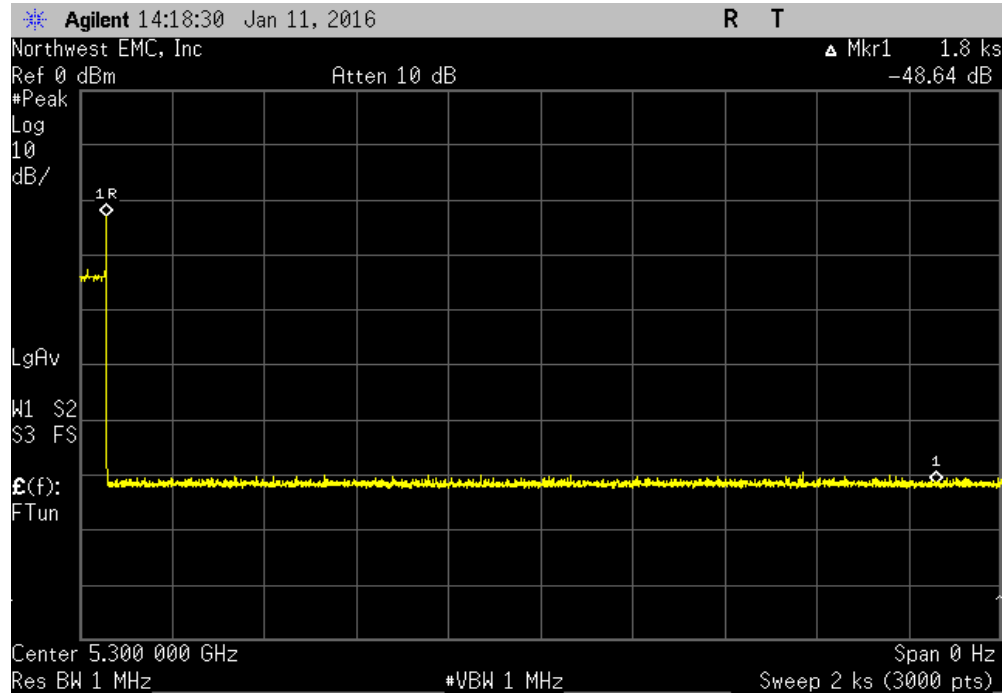
NON OCCUPANCY PERIOD

EUT: Sigma Pumps Gen IV 802.11abgn Module		Work Order: DGII0152	
Serial Number: UUT #7 (55001769-1 rev. 1P)		Date: 01/12/16	
Customer: Digi International Inc.		Temperature: 21.1°C	
Attendees: Slava Gehkt		Humidity: 16%	
Project: None		Barometric Pres.: 984	
Tested by: Jared Ison		Power: 110VAC/60Hz	Job Site: MN08
TEST SPECIFICATIONS			
FCC 15.407:2016		Test Method	
		KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02	
COMMENTS			
EUT transferring NTIA MPEG video file using a data rate 6 Mbps.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	

20 MHz	Ch. 60: 5300 MHz
	30 Minute Non Occupancy Period
	Ch. 112: 5560 MHz
	30 Minute Non Occupancy Period

NON OCCUPANCY PERIOD

20 MHz, Ch. 60: 5300 MHz, 30 Minute Non Occupancy Period



20 MHz, Ch. 112: 5560 MHz, 30 Minute Non Occupancy Period

