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FCC DFS Test Report

FCC ID	:	**SQG-MSD45N**
Equipment	:	**45 Series Pluggable module**
Model No.	:	**MSD45N**
Brand Name	:	**Laird Technologies**
Applicant	:	**Laird Technologies**
Address	:	**11160 Thompson Ave. / Lenexa, Kansas / 66219 / USA**
Standard	:	**47 CFR FCC Part 15.407**
Received Date	:	**May 08, 2013**
Tested Date	:	**Jul. 04 ~ Jul. 05, 2013**
Operating Mode	:	**Client without ad hoc and radar detection**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Approved & Reviewed by:

Gary Chang / Manager

Testing Laboratory
2732

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Release Record

Report No.	Version	Description	Issued Date
FZ371704	Rev. 01	Initial issue	Aug. 19, 2013

Summary of Test Results

FCC Rules	Description of Test	Result
15.407	Channel Closing Transmission Time	Pass
15.407	Channel Move Time	Pass
15.407	Non-occupancy	Pass

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

Frequency Range (GHz)	5.15~5.25, 5.25~5.35, 5.47~5.725,5.725~5.85
Wireless Function	11a / n HT20
Operating Mode at DFS Band	Client without radar detection and ad hoc function
Firmware / Software Version	3.4.0

1.1.2 Antenna Details

Ant. No.	Brand / Model	Type	Connector	Operating Frequencies (MHz) / Antenna Gain (dBi)				
				2400~2483.5	5150~5250	5250~5350	5470~5725	5725~5850
1	MAG.LAYERS EDA-1513-25GR 2-B2-CY	Dipole	SMA Jack Reverse	2	2	2	2	2
2	MAG.LAYERS PCA-4606-2G4C 1-A13-CY	PCB Dipole	UFL	2.21	2.21	2.21	2.21	2.21
3	Larid NanoBlade-IP04	PCB Dipole	UFL	2	3.9	3.9	4	4
4	Larid MAF95310 Mini NanoBlade Flex	PCB Dipole	UFL	2.79	3.38	3.38	3.38	3.38
5	Laird NanoBlue-IP04	PCB Dipole	UFL	2	---	---	---	-
6	Ethertronics WLAN_1000146	PIFA	UFL	2.5	3.5	3.5	3.5	3.5

1.2 Support Equipment List

Support Equipment List				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	AP (Master)	D-Link	DIR-826L	KA2IR826LMO1
2	Notebook	DELL	LATITUDE-E5420	B6FV9T1

1.3 The Equipment List

Test Site	DF01-WS				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV 7	101607	Dec. 19, 2012	Dec. 18, 2013
Horn Antenna 1G-18G	ETS-LINDGREN	3115	00149268	Oct. 05, 2012	Oct. 04, 2013
RF Cable	HUBER+SUHNER	SUCOFLEX_104	MY15686/4	Dec. 24, 2012	Dec. 23, 2013
RF Cable	HUBER+SUHNER	SUCOFLEX_104	296081/4	Dec. 24, 2012	Dec. 23, 2013
RF Cable	HUBER+SUHNER	SUCOFLEX_104	329023/4	Dec. 24, 2012	Dec. 23, 2013
RF Cable	HUBER+SUHNER	SUCOFLEX_104	329021/4	Dec. 24, 2012	Dec. 23, 2013
Vector signal generator	R&S	SMJ100A	100498	Dec. 13, 2012	Dec. 12, 2013
Note: Calibration Interval of instruments listed above is one year.					

1.4 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
DFS	DF01-WS	26°C / 66%	Alex Huang

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.407
FCC 06-96 A1

2 Technical Requirements for DFS

2.1 Applicability of DFS Requirements

2.1.1 Applicability of DFS Requirements Prior to use of a Channel

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
Uniform Spreading	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

2.1.2 Applicability of DFS Requirements during Normal Operation

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

2.2 DFS Detection Thresholds and Response Requirement

Below table provides the DFS Detection Thresholds for Master Devices as well as Client Devices incorporating In-Service Monitoring.

DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection.

Maximum Transmit Power	Value (See Notes 1 and 2)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm

Note:
1) This is the level at the input of the receiver assuming a 0 dBi receive antenna.
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.

DFS Response Requirement Values

Parameter	Value
Non-occupancy period	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 80% of the U- NII 99% transmission power bandwidth. (See Note 3.)

Note:
1) The instant that the Channel Move Time and the Channel Closing Transmission Time begins is as follows:
   - For the Short Pulse Radar Test Signals this instant is the end of the Burst.
   - For the Frequency Hopping radar Test Signal, this instant is the end of the last radar Burst generated.
   - For the Long Pulse Radar Test Signal this instant is the end of the 12 second period defining the Radar Waveform.
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.
3) During the U-NII Detection Bandwidth detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

2.3 Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

2.3.1 Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
1	1	1428	18	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

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. For Short Pulse Radar Type 1, the same waveform is used a minimum of 30 times. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of Short Pulse Radar Types 1-4.

2.3.2 Long Pulse Radar Test Waveform

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

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse Radar Type waveforms. If more than 30 waveforms are used for the Long Pulse Radar Type waveforms, then each additional waveform must also be unique and not repeated from the previous waveforms.

2.3.3 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

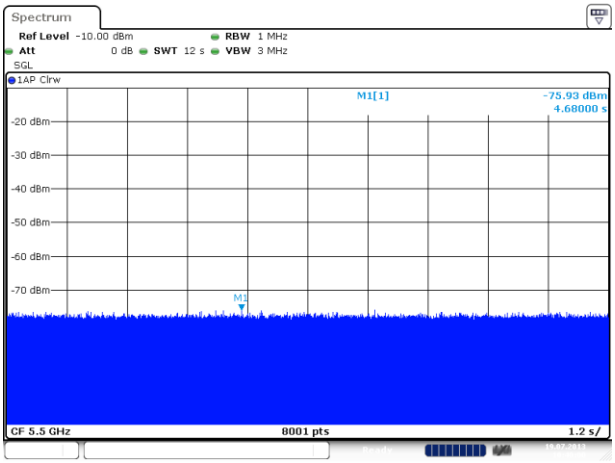
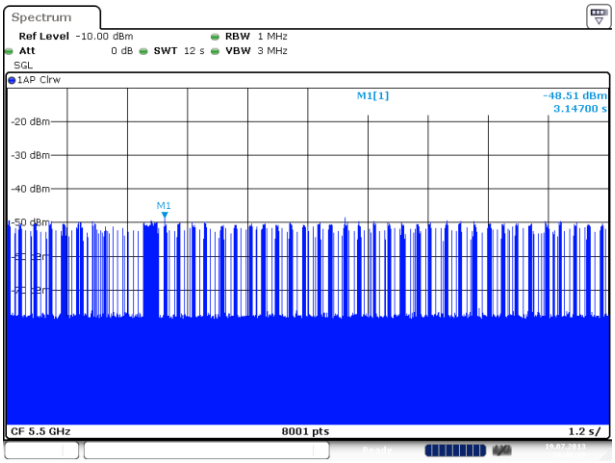
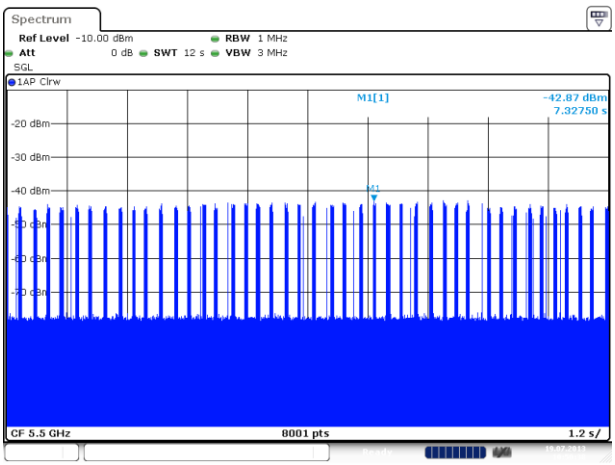
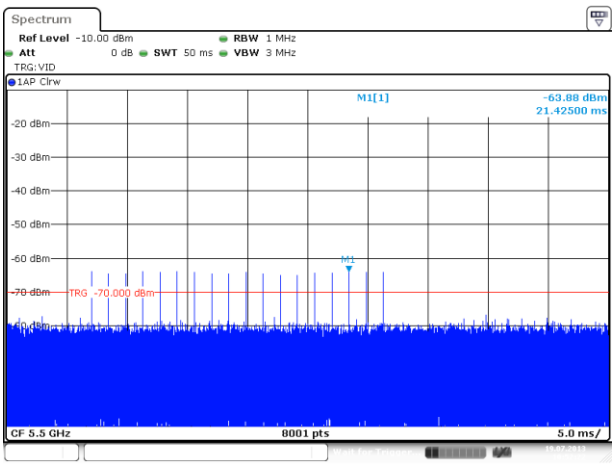
For the Frequency Hopping Radar Type, the same Burst parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined by the following algorithm

2.3.4 Radar waveform generation

A single R&S SMJ100A Vector Signal Generator is used for the DFS signal generation. This instrument is capable of generating all the above waveforms with Pulse Sequencer Software. The R&S Pulse Sequencer Software comes as a stand-alone PC based software with preconfigured project files for DFS. It simplifies the generation of all required waveforms and offers a one box solution

2.3.5 Verify DFS Detection Threshold levels

Master DFS Threshold Level		
DFS Threshold level: -63 dBm	☒	at the antenna connector(-63 dBm conducted)
	☐	in front of the antenna(-63 dBm e.i.r.p.)
The Interference **Radar Detection Threshold Level** is (-64dBm) + (0 [dBi]) + {1 dB}= -63 dBm. That had been taken into account the master output power range and antenna gain.		

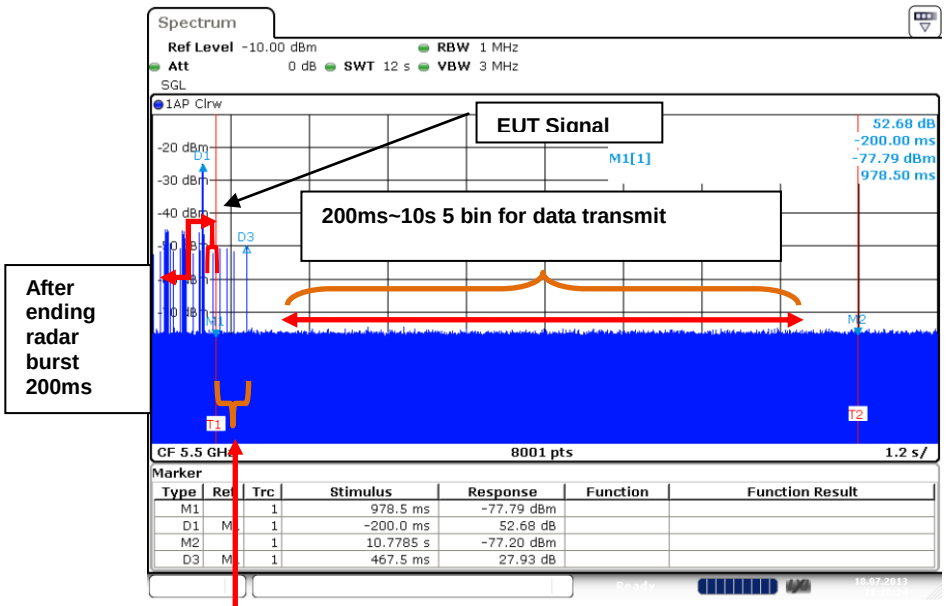
Without Data Traffic Plot (Noise Plot)	Master Data Traffic Plot
	
Client(EUT) Data Traffic Plot	**Calibration Radar #1 detection threshold level**
	

3 Test Result

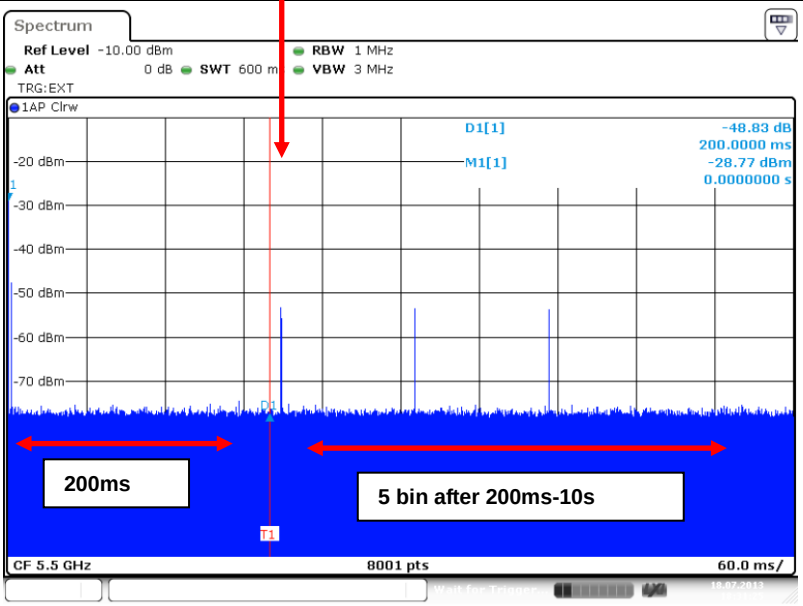
3.1 Channel Closing Transmission and Channel Move Time

Modulation Mode	Freq. (MHz)	Radar Type	Channel Closing Transmission Time				Channel Move Time	
			Test (0-200ms)	Limit (0-200ms)	Test (200ms-10s)	Limit (200ms-10s)	Test	Limit
HT20	5500	1	< 200ms	200ms	7.5ms	60ms	0.467s	10 s
8001 sample bin for measurement			5 bin [200ms~10s]					

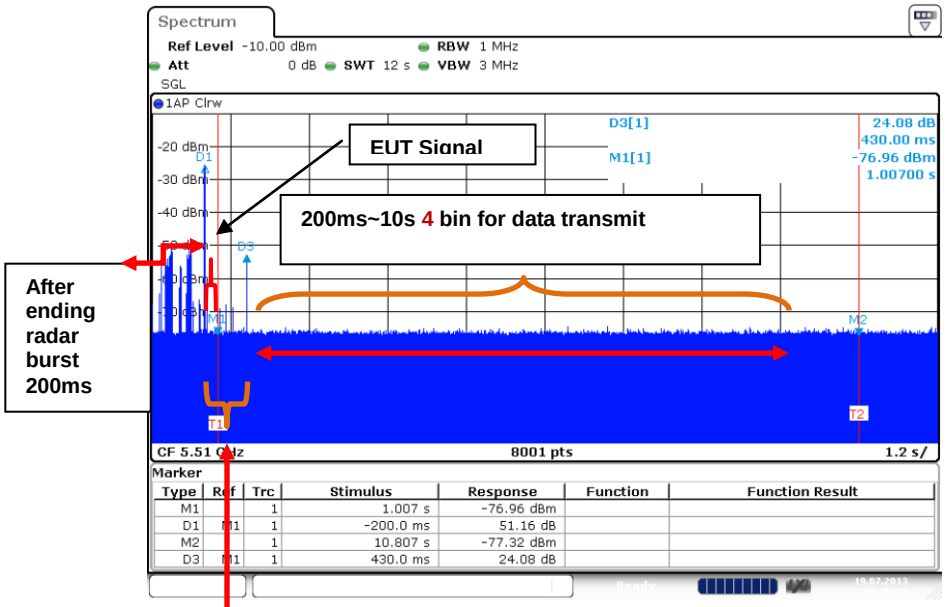
12 sec Timing Plot



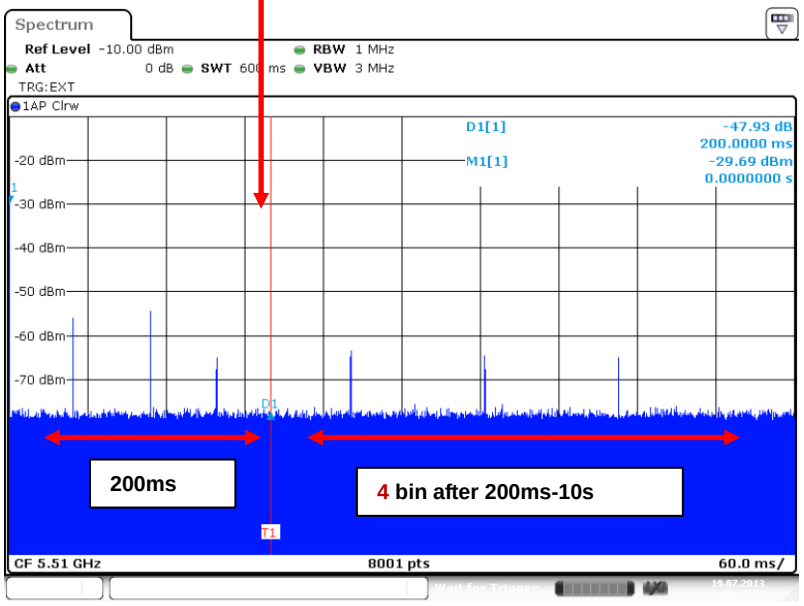
Zoom-in 600 ms Timing Plot



Modulation Mode	Freq. (MHz)	Radar Type	Channel Closing Transmission Time				Channel Move Time	
			Test (0-200ms)	Limit (0-200ms)	Test (200ms-10s)	Limit (200ms-10s)	Test	Limit
HT40	5510	1	< 200ms	200ms	6ms	60ms	0.43s	10s
8001 sample bin for measurement			4 bin [200ms~10s]					
12 sec Timing Plot								

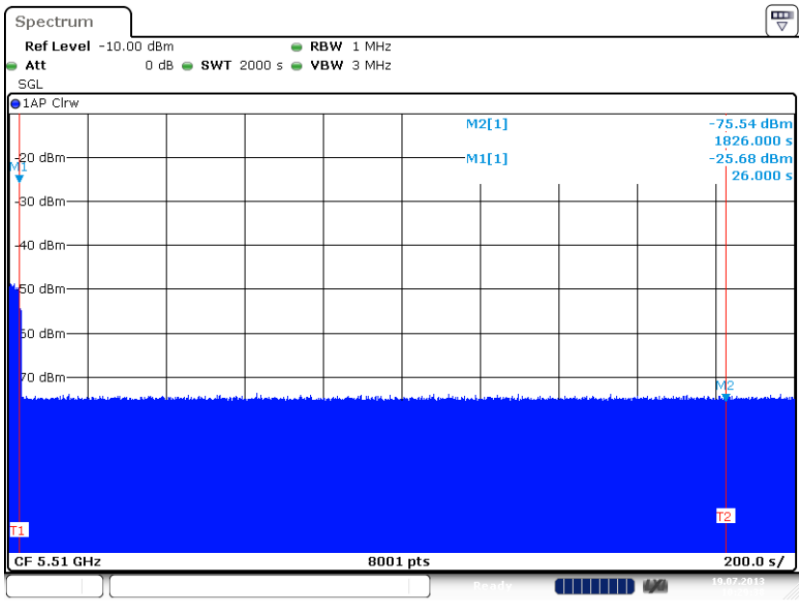


Zoom-in 600 msTiming Plot



3.2 Non-Occupancy

Non-Occupancy Period Result				
Modulation Mode	Freq. (MHz)	Non-Occupancy Period		
		Measured	Limit	Result
HT20	5500	>30min	30min	Complied
2000 sec Timing Plot				



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