



International Certification Corp.

No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.

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FCC DFS Test Report

FCC ID : SQG-WB45NBT
Equipment : 45 Series WB module with Bluetooth
Model No. : WB45NBT
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 03, 2013
Tested Date : May 22 ~ May 28, 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





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Release Record

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FZ350301	Rev. 01	Initial issue	Aug. 20, 2013



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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
Wireless Function	11a / HT20
Operating Mode at DFS Band	Client without ad hoc and radar detection function
Firmware / Software Version	AT91Bootstrap 3.4.4(Tue May 7 13:55:08 EDT 2013) U-Boot 2013.01-rc2(May 07 2013-13:58:12) Linux-3.8.0-Laird1

Note : IEEE 11ac standard is still Draft version

1.1.2 Antenna Details

Ant. No.	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	Laird NanoBlade-IP04	PCB Dipole	UFL	2	3.9	3.9	4	4
4	Laird 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
3	Notebook	DELL	LATITUDE-E6430	9ZFB4X1



1.3 Information of Certified Master

FCC ID	Software / Firmware Version	Max Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
KA2IR826LMO1	1.00	23.8	0	23.8

1.4 The Equipment List

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Until	Remark
Spectrum Analyzer	R&S	FSV-7	101607	9kHz ~ 7GHz	2012/12/19	2013/12/18	DF01-WS
RF Cable-01	Huber&Suhner	SUCOFLEX 104	296081/4	0.5m	2012/12/24	2013/12/23	DF01-WS
RF Cable-02	Huber&Suhner	SUCOFLEX 104	329023/4	0.2m	2012/12/24	2013/12/23	DF01-WS
RF Cable-03	Huber&Suhner	SUCOFLEX 104	329021/4	0.2m	2012/12/24	2013/12/23	DF01-WS
RF Cable-04	Huber&Suhner	SUCOFLEX 104	MY15686/4	4m	2012/12/24	2013/12/23	DF01-WS
RF Cable-05	Huber&Suhner	SUCOFLEX 104	500199/4	0.5m	2012/12/24	2013/12/23	DF01-WS
Vector Signal Generator	R&S	SMJ100A	100498	100kHz ~ 6GHz	2012/12/13	2013/12/12	DF01-WS
Combiner(1x2)	WOKEN	2WAYDIV	12101200003	--	2012/12/24	2013/12/23	DF01-WS
Combiner(1x3)	MCLI	PS3-7	24940	--	2012/12/24	2013/12/23	DF01-WS
Combiner(1x4)	MCLI	PS4-14	24939		2012/12/24	2013/12/23	DF01-WS

1.5 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
DFS	DF01-WS	26°C / 65%	Alex Huang

1.6 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

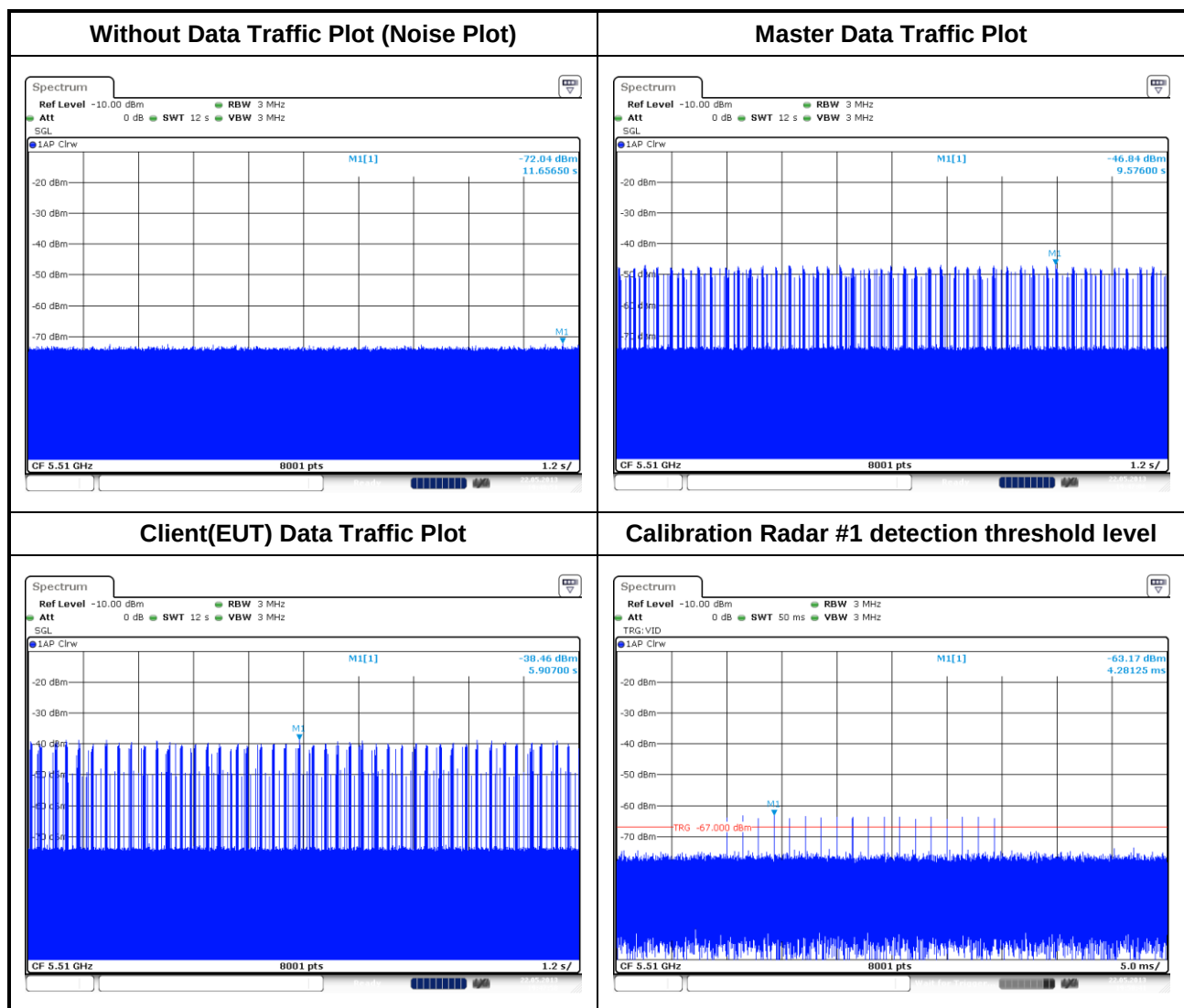
2.3.4 Radar waveform generation

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 $(-64\text{dBm}) + (0\text{ [dBi]}) + \{1\text{ dB}\} = -63\text{ dBm}$. That had been taken into account the master output power range and antenna gain.	





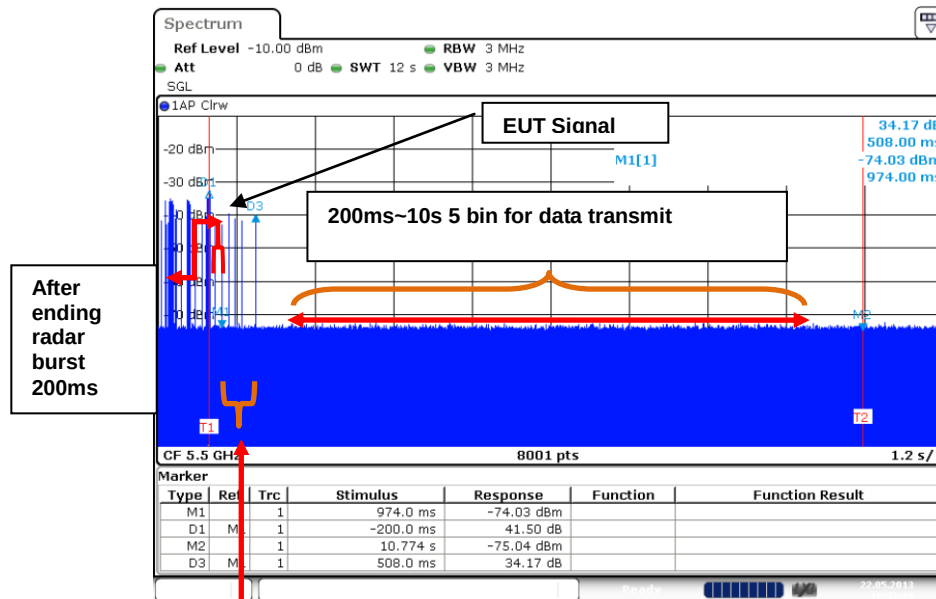
3 Test Result

3.1 Channel Closing Transmission and Channel Move Time

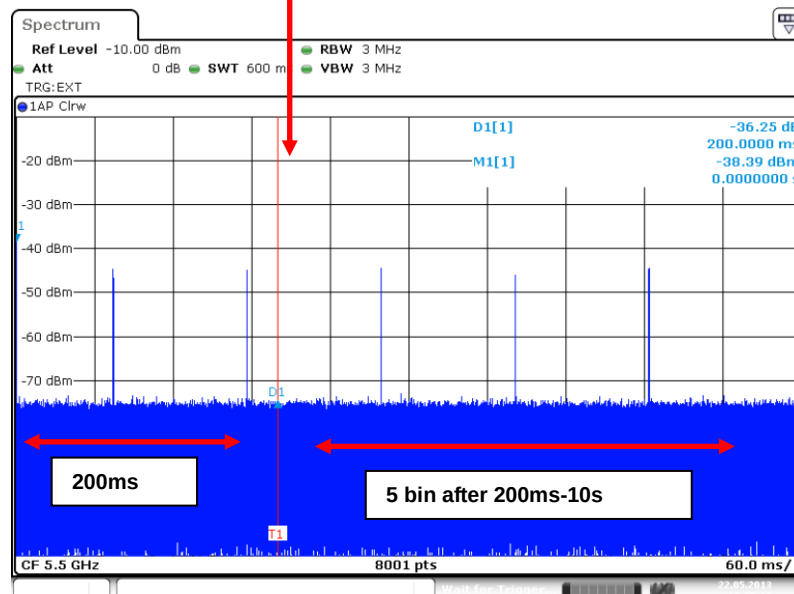
Channel Closing Transmission Timeand Channel Move Time Result								
Modulation Mode	Freq. (MHz)	Radar Type	Channel Closing Transmission Time				Channel Move Time	
			Test (0-200ms)	Limit (0-200ms)	Test (200ms-10s)	Limit (200ms-10s)	Test	Limit
HT20	5500	1	< 200ms	200ms	7.5ms	60ms	708ms	10 s
8001 sample bin for measurement			5 bin [200ms~10s]					



12 sec Timing Plot



Zoom-in 600 ms Timing Plot





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3.2 Non-Occupancy

