Test of MSM466 802.11a/b/g/n Wireless Access Point

To: DFS Requirements of FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: HWPD14-U1 Rev A





DFS Testing of MSM466 802.11a/b/g/n Wireless Access Point to To: DFS Requirements of FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: HWPD14-U1 Rev A

This report supersedes NONE

Applicant: Hewlett-Packard 200 Forest Street MR01-2/M18 Marlborough Massachusetts 01752-3085, USA

Product Function: 802.11a/b/g/n Wireless Access Point

Copy No: pdf Issue Date: 23rd March 2011





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### **ACCREDITATION, LISTINGS & RECOGNITION**

### **TESTING ACCREDITATION**

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) <u>www.a2la.org</u> test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <u>http://www.a2la.org/scopepdf/2381-01.pdf</u>



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### RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA\*\* countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	Listing #: 4143A
Japan	VCCI	-	-	No. 2959
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	030159
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

\*\*APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing

Phase II - recognition for both product testing and certification N/A – Not Applicable

\*\*EU MRA - European Union Mutual Recognition Agreement. Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

\*\*NB - Notified Body

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### **PRODUCT CERTIFICATION**

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) <u>www.a2la.org</u> test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <u>http://www.a2la.org/scopepdf/2381-02.pdf</u>



### United States of America – Telecommunication Certification Body

TCB Identifier - US0159

### Industry Canada – Certification Body

CAB Identifier - US0159

### Europe – Notified Body

Notified Body Identifier - 2280

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### **DOCUMENT HISTORY**

Document History							
Revision	Date	Comments					
Draft							
Rev A	23 <sup>rd</sup> March 2011	Initial release.					

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# 1. TEST RESULT CERTIFICATE

Applicant:	Hewlett-Packard	Tested By:	MiCOM Labs, Inc.
	200 Forest Street MR01-2/M18		440 Boulder Court
	Marlborough		Suite 200
	Massachusetts 01752-3085,		Pleasanton
	USA		California, 94566, USA
EUT:	Wireless Access Point	Telephone:	+1 925 462 0304
Model:	MSM466	Fax:	+1 925 462 0306
S/N:	TWOZDLL02H		
Test Date(s):	28th to 31st January 2011	Website:	www.micomlabs.com

### STANDARD(S)

### **TEST RESULTS**

DFS Requirements of FCC 47 CFR Part 15.407 & IC RSS-210

EQUIPMENT COMPLIES

ACCREDITE TESTING CERTIFICATE #2381.01

The MSM466 will not operate in the weather radar band 5600 -5650 MHz.

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

### Notes:

- 1. This document reports conditions under which testing was conducted and the results of testing performed.
- 2. Details of test methods used have been recorded and kept on file by the laboratory.
- 3. Test results apply only to the item(s) tested.

### Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve Quality/Manager MiCOM Labs,

G brdoh Hurst President & CEO MiCOM Labs, Inc.

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## 2. REFERENCES AND MEASUREMENT UNCERTAINTY

### 2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.407	2010	Code of Federal Regulations
(ii)	FCC 06-96	June 2006	Memorandum Opinion and Order
(iii)	Industry Canada RSS-210	Issue 8 December 2010	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands): Category 1 Equipment
(iv)	Industry Canada RSS-Gen	Issue 3 December 2010	General Requirements and Information for the Certification of Radiocommunication Equipment
(v)	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(vi)	CISPR 22/ EN 55022	2008 2006+A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vii)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(viii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(ix)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(x)	A2LA	9 <sup>th</sup> June 2010	Reference to A2LA Accreditation Status – A2LA Advertising Policy
(xi)	FCC Public Notice – DA 02-2138	2002	Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices

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### 2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.



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### 3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details	
Details	Description
Purpose:	Compliance testing of the MSM466 802.11a/b/g/n
	Wireless Access Point to Dynamic Frequency
	Selection (DFS) requirements of FCC Part 15.407 and
	Industry Canada RSS-210 regulations in the frequency
	ranges 5150 to 5350 MHz, and 5470 to 5,725 MHz.
	The EUT will not operate in the weather radar band
	5600 – 5650 MHz.
Applicant:	Hewlett-Packard
	200 Forest Street MR01-2/M18
	Marlborough
	Massachusetts 01752-3085, USA
Manufacturer:	As applicant
Laboratory performing the tests:	MiCOM Labs, Inc.
	440 Boulder Court, Suite 200
	Pleasanton, California 94566 USA
Test report reference number:	HWPD14-U1 Rev A
Date EUT received:	26 <sup>m</sup> January 2011
Standard(s) applied:	FCC 47 CFR Part 15.407 & IC RSS-210
Dates of test (from - to):	26 <sup>™</sup> January 2011 to 31 <sup>st</sup> January 2011
No of Units Tested:	1
Type of Equipment:	802.11a/b/g/n Wireless Access Point
Applicants Trade Name:	Hewlett-Packard
Model(s):	MSM466
HP Software Release	5.5.0.0
Location for use:	Indoor/outdoor
Declared Frequency Range(s):	5,150 to 5,350 MHz
I ype of Modulation:	
	802.118. Legacy +17 0BIII
(Average Power)	802.11 m H - 20 + 19 abm
	$602.1111.11.40 \pm 19 \text{ up}$
Pated Input Voltage and Current:	Legacy 602. I ia, 602. I III II -20, III - $\frac{1}{7}$ 0 Dower Over Ethernet (DOE) 48 V/dc @ 1.25 A
Operating Temperature Range:	Declared range 0 to +40°C
Frequency Stability:	+20 nnm
Fauinment Dimensions:	Δ20 ppm 6 16" Y 5 10" v 1 04"
Weight:	
Primary function of equipment:	Wireless Access Doint for transmitting data and voice

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### 3.2. Scope of Test Program

The scope of the test program was to test the Hewlett Packard MSM466 wireless access point in the frequency range 5,470 to 5,725 MHz as a Master device for compliance against DFS requirements of FCC 47 CFR Part 15.407 and the FCC specification Memorandum Opinion and Order FCC 06-96.

The MSM466 uses the MRLBB-1003 802.11a/b/g/n Radio Module.

The UUT was tested both in 11a mode at 5500 MHz and HT-40 mode at 5510 MHz from the operating channels of the UUT within the 5,470 – 5,725 MHz band for DFS testing per the requirements of FCC specification "Memorandum Opinion and Order FCC 06-96", Section 7.8 "DFS Conformance Test Procedures".

U-NII devices operating in the 5,250 - 5,350 MHz and 5,470 - 5,725 MHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

The Hewlett Packard MSM466 product operates as a Master device with full radar detection and Dynamic Frequency Selection (DFS) capability.

The Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm.

The EUT will not operate in the weather radar band 5600 - 5650 MHz.

The MSM466 802.11a/b/g/n Wireless Access Point can be set up to operate in the following configurations;-

3x3:3 (3 transmit antennas, 3 receive antennas, using 3 spatial streams).

2x3:2 (2 transmit antennas, 3 receive antennas, using only 2 spatial streams)

DFS testing was performed with the radio card operating in the 3X3:3 configuration.

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### 3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Type (EUT/ Support) Equipment Description (Including Brand Name)		Model No.	Serial No.
EUT	802.11 a/b/g/n Wireless Access Point	HP	MSM466	TWOZDLL02H
Support	Laptop PC – HP EliteBook	HP	8440P	CND01925IO
Support	Laptop PC – HP EliteBook	HP	8440P	CND01923JR
Support	Mini card to express card adapter	WNC	48DNXR07	N/A
Support	Wireless AP Client device	HP	MRLBB-1003	N/A
Support	HP ProCurve Switch	HP	J9298A	CN019JD0D9

### 3.4. Antenna Details

No antennas were tested as part of this program.



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### 3.5. Cabling and I/O Ports

Number and type of I/O ports on supporting MSM466 wireless access point.

- 1. DATA; 1 X RJ-45 , 10/100/1000 BASE-T Ethernet with POE.
- 2. Console; 1 X RJ-45 , 10/100/1000 BASE-T Ethernet.

### 3.6. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

### 3.7. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

### 3.8. Subcontracted Testing or Third Party Data

The following subcontracted testing was required in order to complete the test program:

1. NONE



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### 4. TEST SUMMARY

### **List of Measurements**

### **Dynamic Frequency Selection (DFS)**

The following table represents the list of measurements required under the FCC CFR47 Part 15.407(h)(2) and FCC Memorandum Opinion and Order FCC 06-96 (Compliance Measurement procedures for Unlicensed National Information Infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection).

Section	Test Items	Description	Condition	Result	Test Report Section
7.8.1	Detection Bandwidth	UNII Detection Bandwidth	Conducted	Complies	5.2.1
7.8.2.1	Performance Requirements	Initial Channel Availability Check Time	Conducted	Complies	5.2.2
7.8.2.2	Check	Radar Burst at the Beginning of the Channel Availability Check Time	Conducted	Complies	5.2.3
7.8.2.3		Radar Burst at the End of the Channel Availability Check Time	Conducted	Complies	5.2.4
7.8.3	In-Service Monitoring	In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non- Occupancy Period	Conducted	Complies	5.2.5
7.8.4	Radar Detection	Statistical Performance Check	Conducted	Complies	5.2.6

### **Tests performed on Master Device**

*Note 1:* Test results reported in this document relate only to the items tested. **Note 2:** The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria.



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### 5. Dynamic Frequency Selection (DFS)

### 5.1. Test Procedure and Setup

FCC, Part 15 Subpart C §15.407(h) FCC 06-96 Memorandum Opinion and Order Industry Canada RSS-210 A9.3

### 5.1.1. Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value
	(see note)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a	a 0 dBi receive antenna

### 5.1.2. 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 99% 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 transmission.
- 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 *Channel* changes (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 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.



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### 5.1.3. 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.

### Short Pulse Radar Test Waveforms

Radar	Pulse Width	PRI	Number	Minimum	Minimum
Туре	(µsec)	(µsec)	of	Percentage of	Trials
-			Pulses	Successful	
				Detection	
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%					

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.

### Long Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Number of Pulses per <i>Burst</i>	Number of <i>Bursts</i>	Minimum Percentage of Successful Detection	Minimum 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 test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.



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Each waveform is defined as follows:

- 1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
- 2) There are a total of 8 to 20 *Bursts* in the 12 second period, with the number of *Bursts* being randomly chosen. This number is *Burst Count*.
- Each *Burst* consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each *Burst* within the 12 second sequence may have a different number of pulses.
- 4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a *Burst* will have the same pulse width. Pulses in different *Bursts* may have different pulse widths.
- 5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a *Burst* will have the same chirp width. Pulses in different *Bursts* may have different chirp widths. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
- 6) If more than one pulse is present in a *Burst*, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a *Burst*, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
- 7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to *Burst\_Count*. Each interval is of length (12,000,000 / *Burst\_Count*) microseconds. Each interval contains one *Burst*. The start time for the *Burst*, relative to the beginning of the interval, is between 1 and [(12,000,000 / *Burst\_Count*) (Total *Burst* Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each *Burst* is chosen randomly.



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### A representative example of a Long Pulse radar test waveform:

- 1) The total test signal length is 12 seconds.
- 2) 8 Bursts are randomly generated for the Burst\_Count.
- 3) Burst 1 has 2 randomly generated pulses.
- 4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
- 5) The PRI is randomly selected to be at 1213 microseconds.
- 6) Bursts 2 through 8 are generated using steps 3 5.
- 7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 3,000,000 microsecond range).

### Graphical representation of the Long Pulse radar Test Waveform.



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### 5.1.4. Frequency Hopping Radar Test Waveform

		F	requency	/ Hopping I	Radar Test W	aveform	
Radar	Pulse	PRI	Pulses	Hopping	Hopping	Minimum	Minimum
Туре	Width	(µsec)	per	Rate	Sequence	Percentage of	Trials
-	(µsec)		Нор	(kHz)	Length	Successful	
					(msec)	Detection	
6	1	333	9	.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:

### 5.1.5. Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3 MHz.

The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -61dBm (Ref Section 5.1). The 30dB amplifier gain was entered as an amplitude offset on the spectrum analyzer.



**Conducted Calibration Setup** 

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### 5.1.6. Test Set Up:

### Block Diagram(s) of Test Setup

Setup for Conducted Measurements where the EUT is the Master with injection of Radar Test Waveforms at the Master.



### **Support Equipment Configuration**



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The EUT is a Master Device with radar detection.

### Applicability of DFS Requirements Prior to Use of a Channel (Ref Table 1 of FCC 06-96)

Requirement	C	Operational M	lode
	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

### Applicability of DFS requirements during normal operation (Ref Table 2 of FCC 06-96)

Requirement		Operational Mo	ode
	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

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For the frequency band 5,470 - 5,725 MHz, the Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm. The EUT was tested in 11a and HT-40 modes.

Declared minimum antenna gain 0 dBi. ;

Radar receive signal level = -62 dBm + minimum antenna gain + 1 dB

= -62 + 0 + 1

Radar receive signal level = -61 dBm

### Measurement Results - Dynamic Frequency Selection (DFS)

Ambient conditions. Temperature: 17 to 23 °C Relative humidity: 31 to 57% Press

Pressure: 999 to 1012 mbar

Radio parameters. Test methodology: Conducted Device Type: Master Transmit Power: Maximum

### **Operational Details - Dynamic Frequency Selection (DFS)**

Operational Modes: 802.11a & 802.11n HT40

Data Rates: 6mpbs 802.11a / 0 MCS 802.11n

\*Note\* No video pixilation was observed during the video stream at these rates. Video frames per second were noted to be at 30fps.

### Video Streaming Method - Dynamic Frequency Selection (DFS)

The requisite MPEG video file ("TestFile.mpg" available on the NTIA website at the following link http://ntiacsd.ntia.doc.gov/dfs/) is used during this video stream.

A video stream was established on the master laptop using the VideoLan player with the destination being the client laptop. The video profile chosen for the video stream is "MPEG-2 + MPGA (TS)". On the client laptop the VideoLan player was setup to receive an incoming video stream from the master device.



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### 5.2. Dynamic Frequency Selection (DFS) Test Results

### 5.2.1. UNII Detection Bandwidth:

All UNII channels for this device have identical channel bandwidths and DFS testing was completed on channel 5,500 MHz (802.11a) and 5510MHz (HT40).

The generating equipment is configured as shown in the Conducted Test Setup above. A single Burst of the short pulse radar Type 1 through 6 was produced at 5500 MHz (802.11a) and 5510 MHz (802.11n HT40) at a level of -61 dBm (Ref Section 5.1.6). The EUT is set up as a standalone device (no associated Client and no traffic).

A single radar Burst is generated for a minimum of 10 trials, and the response of the EUT is noted. The EUT must detect the Radar Waveform 90% or more of the time.

The radar frequency is increased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The highest frequency at which detection is greater than or equal to 90% is denoted as  $F_{\rm H}$ .

The radar frequency is decreased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The lowest frequency at which detection is greater than or equal to 90% is denoted as  $F_L$ .

The U-NII Detection Bandwidth is calculated as follows: U-NII Detection Bandwidth =  $F_H - F_L$ 

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power Table of results are continued on the next page.

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EUT Frequency	y= 5	550	<b>M</b> 0	Hz	802	.11;	a (C	)ete	ctio	on =	, No Detection = 0)
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
-20											%
-19											%
-18											%
-17											%
-16											%
-15											%
-14											%
-13											%
-12											%
-11	0	0									<90%
-10											100%
-9										0	90%
-8											100%
-7											100%
-6											100%
-5											100%
-4								0			90%
-3											100%
-2											100%
-1											100%
Fo				$\checkmark$					$\checkmark$		100%
+1											100%
+2					0						90%
+3											100%
+4											100%
+5											100%
+6											100%
+7											100%
+8											100%
+9											100%
+10											100%
+11	0					0					<90%
+12											%
+13											%
+14											%
+15											%
+16											%
+17	1				1						%
Detection Bandwidth = $F_{H}$	-F∟	= 5	590	-55	10 =	= 20	M	Ηz			
EUT 99% Bandwidth = 17	. <u>13</u>	4 M	Hz	(ref	. ba	ndv	vidtl	n ch	<u>an</u> r	nel 5	500 MHz)
17.134 MHz *80% = 13.7	07N	/Hz									
E an a a de fue avec a avec atava t								-1 - 4	1 !	!-	000/

For each frequency step the minimum percentage detection is 90%



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EUT Frequency=	551	0 M	Hz	802	2.11	n H	T40	) (D	ete	ctior	$n = \sqrt{1}$ , No Detection = 0)
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
-21	0	0									<90%
-20		$\checkmark$						$\checkmark$			100%
-19		$\checkmark$						$\checkmark$			100%
-18		$\checkmark$						$\checkmark$			100%
-17											100%
-16											100%
-15											100%
-14											100%
-13											100%
-12											100%
-11											100%
-10											100%
-9											100%
-8											100%
-7											100%
-6											100%
-5											100%
-4											100%
-3											100%
-2											100%
-1											100%
F <sub>0</sub>		$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	100%

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EUT Frequency=	551	0 M	Hz	802	2.11	n H	T40	) (D	ete	ctior	$n = \sqrt{1}$ , No Detection = 0)
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
F <sub>o</sub>				$\checkmark$		$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	100%
+1											100%
+2											100%
+3				$\checkmark$			$\checkmark$	$\checkmark$	$\checkmark$		100%
+4				$\checkmark$			$\checkmark$	$\checkmark$	$\checkmark$		100%
+5				$\checkmark$			$\checkmark$	$\checkmark$	$\checkmark$		100%
+6							$\checkmark$	$\checkmark$			100%
+7											100%
+8				$\checkmark$					$\checkmark$		100%
+9				$\checkmark$					$\checkmark$		100%
+10				$\checkmark$					$\checkmark$		100%
+11			$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			$\checkmark$		100%
+12				$\checkmark$					$\checkmark$		100%
+13			$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			$\checkmark$		100%
+14				$\checkmark$					$\checkmark$		100%
+15			$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			$\checkmark$		100%
+16							$\checkmark$	$\checkmark$			100%
+17			$\checkmark$		100%						
+18											100%
+19				$\checkmark$					$\checkmark$		100%
+20											100%
+21	0	0									<90%
Detection Bandwidth = F <sub>H</sub>	-FL	= 5	590	-55	30 =	= 40	) Mł	Ηz			
EUT 99% Bandwidth = 36	6.47	2 M	Hz	(ref	. ba	ndv	vidt	h ch	nanr	nel 5	510 MHz)
36.472 MHz *80% = 29.1	77	MH:	Z								

For each frequency step the minimum percentage detection is 90%

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### 5.2.2. Initial Channel Availability Check Time

This test verifies that the EUT does not emit pulse, control, or data signals on the test Channel until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test Channel. This test does not use any Radar Waveforms.

The U-NII device is powered on and be instructed to operate at 5,500 MHz 802.11a and 5510 802.11n HT40. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 1 MHz resolution bandwidth at 5,500 & 5510 MHz with a 260 second sweep time. The analyzer's sweep will be started the same time power is applied to the U-NII device.

The EUT should not transmit any pulse or data transmissions until at least 1 minute after the completion of the power-on cycle.

The first red marker line shown on the following plot denotes the instant when the EUT starts its power-up sequence i.e.  $T_0$  (as defined within the FCC's MO&O 06-96 Normative Reference 2). The power-up reference  $T_0$  is determined by the time it takes for the EUT to start "beaconing" i.e. initial beacon – 60 secs = end of power-up.

The Channel Availability Check Time commences at instant  $T_0$  and will end no sooner than  $T_0$  + 60 seconds.



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### EUT power up and Initial Channel Availability Check Time = 87.014 Seconds Ch 5,500 MHz 802.11a



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### EUT power up and Initial Channel Availability Check Time = 87.535 Seconds Ch 5,510 MHz 802.11n HT40



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### 5.2.3. Radar Burst at the Beginning of the Channel Availability Check Time:

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold +1 dB (-61 dBm Ref Section 5.1.6) occurs at the beginning of the Channel Availability Check Time.

A single Burst of short pulse of radar Type 1 will commence within a 6 second window starting at  $T_0$  (first red marker line on the following plot).

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5,500 MHz 802.11a & 5510 MHz 802.11n HT40 will continue for 2.5 minutes after the radar burst has been generated.



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### Channel Availability Check Time at the start T<sub>0</sub> + 6 seconds Check Time Ch 5,500 MHz 802.11a



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### Channel Availability Check Time at the start T<sub>0</sub> + 6 seconds Check Time Ch 5,510 MHz 802.11n HT40



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### 5.2.4. Radar Burst at the End of the Channel Availability Check Time:

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel Availability Check Time.

A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at  $T_0$ + 54 seconds. The window will commence at marker 3 and end at the red line  $T_2$ .

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5,500MHz 802.11a & 5510 MHz 802.11n HT40 will continue for 2.5 minutes after the radar burst has been generated.



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### Channel Availability Check Time at T<sub>0</sub> + 54 seconds Check Time Ch 5,500 MHz 802.11a



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### Channel Availability Check Time at T<sub>0</sub> + 54 seconds Check Time Ch 5,510 MHz 802.11n HT40



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#### 5.2.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period FCC §15.407(h)(2)(iii)

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the EUT (Master). The requisite MPEG video file ("TestFile.mpg" available on the NTIA website at the following link http://ntiacsd.ntia.doc.gov/dfs/) is streamed from the master device (AP) to the client.

### **Channel Closing Transmission Time - Measurement**

A Type 1 waveform was introduced to the EUT, from which a 12 second transmission record was digitally captured, collecting nearly 250M samples of data, which included in excess of 600 ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the radar waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The test system was set-up to capture all transmission data for access point events above a threshold level of -50 dBm. The test equipment time stamps all captured events with respect to  $T_0$  (zero time indicating the start of the measurements sequence) starting the 612.1 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period 612.1 ms

Type 1 burst period 25.704 ms

(The period of the 18 pulse burst includes [18 pulses \*1.428mS PRI] = 25.704 ms. Then add 1 µs pulse width for the final pulse.)

Channel Closing Transmission Time starts immediately after the last radar pulse is transmitted i.e. 637.8 ms after the start of the trace capture period.



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Therefore, pulses seen after this 637.8 ms boundary are identified and totaled to provide an aggregate total of transmissions in order to determine whether the EUT is compliant with the Channel Closing Transmission Time requirements as described in MO&O FCC 06-96. In this case, it was found that an aggregate total of <u>1.756 ms</u> of transmission time accrued. This value is found at the right hand side at the foot of the following plot (10s Total).

### Channel Closing Transmission Time (802.11a) = <u>1.756 mSecs (limit 260 mSecs)</u>

### Channel Move Time (802.11a)

= 0.5222 Secs (limit 10 Secs)

Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 0 to 2 seconds (5500 MHz 11a mode)



From the plot above it can be seen that the transmission activity within the 200 mS window is 0.592 mS (see 200 mS Total). From the following plots which shows all additional activity within the remained of the 10 sec measurement window it can be determined that the aggregate transmission is 1.164 mS. This is less than the 60 mS limit.



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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 2 to 4 seconds(5500 MHz 11a mode)

Configure Help										
lutput Frequency:	i495 MH:	:	RF On	Stim	iulus Output Path Li	oss: 0.0 dB	Bm M	kr 2 Route SMB Of	f	Snap Sho
Output Level:	6 dBm	Conti	nuous Wave	D	igitizer Input Path L	oss: 0.0 dB	3m			
reate New Wavefo	rm Capture Wave	form Measuremen	t / Analysis 🛛							
Top Of Screen:	0 dBm	Sample Rate:	5.0 MHz	Input l	.evel: 0 dBm	ARB	Single Shot	Sele	ct ARB File	Next Page >
dB Per Division:	10	Capture Duration:	12.0 ÷ Secon	ıd(s)		Play Mode	C No Of Repeats	Ch	annel List	< Previous Page
1										Marker Info.
0.00										Start Waveform
40.00										0.61210 sec
-10.00										0.63780 sec
-20.00										200ms Boundary
-20.00										0.83780 sec
-30.00										10s Boundary
										10.63780 sec
E40.00										Aggregates
7										Burst Cnt: 543
-50.00									_	200ms Total:
										0.000552 \$86
-60.00									_	Burst Cnt: 86188
	and hard alter to see	the second state of the second	(la astronica da la da mala da	here a Harrish and the state	and a surface of the state of the state of the surface of the surf	and all and all and the		Receivedencepte	and a second	9.8s Total: 0.001164 sec
-70.00										Tabel Cab 00701
										10s Total:
-80.00 2.00000	2.20000	2.40000 2.6	60000 2.800	000 3.000 Seco	000 3.20000 inds	3.4000	0 3.60000	3.80000	4.00000	0.001756 sec
ARB File:		DfsType1Pw1P	i1428Nop18NoChi	rp60Msps.aiq		Trigg	ger Threshold: -50	dBm 30 Min De	elay Arm 3	0 Min End CAC 🔽
		The Plotting Funct	ion Completed Suc	cessfully.			Play Capture Auto	Play Capture	Manual	Play
	2-12-INSTR	10·F	VI2-15-INSTR							

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 4 to 6 seconds(5500 MHz 11a mode)

Itou	t Frequency: 5	495	MH <sub>2</sub>		BE	Ωn	s	timulus Outi	put Path Loss	: 0.0 de	3m	Mkra	2 Route Sh	AB Off		Snap Sh
0	lutput Level:	dBm		Cor	itinuous W	ave		Digitizer In	put Path Loss	0.0 dE	3m					
		- Capture	a Waveform													
sate	INEW WAVEIU	m captar	5 W 4 V 6 I O I III	Measurem	nt 7 Analys	as										
Т	op Of Screen:	0 dB	m	Sample Rat	e: 5.0	MHz	Inp	ut Level: 0	dBm	ARB	Single S	hot		Select ARB	File	Next Page >
d	B Per Division:	10	Ca	apture Duratio	n: 12.0	Second	(s)			Mode	C Continu	ous		Channel Li	st	< Previous Page
r.																Marker Info.
	0.00															Start Waveform
	10.00															U.61210 sec
	10.00															0.63780 sec
-3	20.00															200ms Boundary
Ľ																0.83780 sec
-3	30.00															10s Boundary
																10.63780 sec
шġ	40.00															Aggregates
0																Burst Cnt: 543
-4	50.00													_		200ms Total:
																0.000002.000
-6	60.00															9 8s Total
	and hards	bahasi badine	- Intersteeling	politic with plant	and only pro-	soluble des	hales provide had	in the labor	disconducible	dinter to and a	an an tao shi	learn at the same	dependent das	a the start she had		0.001164 sec
-	70.00															Total Cnt: 86731
	20.00															10s Total:
-(	4.00000	4.20000	4.4	0000 4	.60000	4.8000	10 5.1 Se	00000 conds	5.20000	5.4000	0 5.6	50000	5.80000	6.0000	00	0.001756 sec
AF	D Eiler			V T 15 1		1011 011		oondo			Theory 1	+ 50	201	fin Dielen A		the Fund Care I
AF	ib rile:		l	prstype1Pw1	Pri 1428Noj	o i 8NoChirp	buMsps.aiq			Ingg	ger i nreshol	a:  -50   dB	im _301	vin Delay Arm	301	
			Th	e Plotting Fun	ction Comp	leted Succe	essfully.				Play Capt	ure Auto	Play Ca	pture Manual		Play
_																

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 6 to 8 seconds(5500 MHz 11a mode)

Configure Help									
utput Frequency:	i495 MHz		RF On	Stimulus Out	put Path Loss: 0	.0 dBm	Mkr 2 Rou	te SMB Off	Snap Sho
Output Level:	6 dBm	Contin	uous Wave	Digitizer In	put Path Loss: 0	.0 dBm			
ireate New Wavefo	rm Capture Wavef	orm Measurement	/ Analysis						
Top Of Screen:	0 dBm	Sample Rate:	5.0 MHz	Input Level: 0	dBm	ARB 🔍 Singl	e Shot	Select ARB File	Next Page >
dB Per Division:	10	Capture Duration:	12.0 🕂 Second(s	)		Play O No U Mode O Conti	f Repeats   nuous	Channel List	< Previous Page
0.00									Marker Info.
0.00									Start Waveform 0.61210 sec
-10.00									End Waveform
									0.63780 sec
-20.00									200ms Boundary
20.00									10s Boundary
-30.00									10.63780 sec
E40.00									Aggregates
0									Burst Cnt: 543
-50.00									200ms Total: 0.000592 sec
60.00									Burst Cnt: 86188
-60.00	her contractions of	na altra como o no	uli un lun	na na dhalan a	1.1			k the base of the	9.8s Total:
-70.00	a ann a bhliathr an Ardan an Ann	a na alfana an	n an ann ann an Ann ann an	and the factor of the state of the second	ana an	ales esti finaliste e states	بالمرابعية والشمية والمربية والمرابية	a addition of the second	0.001164 sec
									Total Cnt: 86731
-80.00 6.00000	6.20000	6.40000 6.60	0000 6.80000	7.00000 Seconds	7.20000	7.40000	7.60000 7.80	000 8.00000	0.001756 sec
ARB File:		DfsType1Pw1Pri1	428Nop18NoChirp6	OMsps.aiq		Trigger Thres	hold: -50 dBm	30 Min Delay Arm	30 Min End CAC 🔽
		The Plotting Functio	n Completed Succes	:sfullv.		Play Ca	apture Auto Pla	y Capture Manual	Play
							······		
		10.0	12-1E-INCTD						

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 8 to 10 seconds(5500 MHz 11a mode)

Aeroflex DFS Radar Simulator and Analyzer e Configure Help	
Output Frequency:     5495     MHz     BF On     Stimulus Output Path Loss:     0.0     dBm     Mkr 2 Route SMB Off       Output Level:     -6     dBm     Continuous Wave     Digitizer Input Path Loss:     0.0     dBm       Create New Waveform     Capture Waveform     Measurement / Analysis	Snap Shot
Top Of Screen:     0     dBm     Sample Rate:     5.0     MHz     Input Level:     0     dBm     ARB     Single Shot     Select ARB File       dB Per Division:     10     Capture Duration:     12.0     Second(s)     Mode C Continuous     Channel List	Next Page > < Previous Page Marker Info.
-10.00	Start Waveform 0.61210 sec End Waveform 0.63780 sec 200ms Raundan
-20.00	0.83780 sec 0.83780 sec 10s Boundary 10.63780 sec
-50.00	Agglegates Burst Cnt: 543 200ms Total: 0.000592 sec Burst Cnt: 86188
	9.8s Total: 0.0011164 sec Total Cnt: <mark>86731</mark> 10s Total:
-80.00         8.20000         8.20000         8.40000         8.60000         9.20000         9.40000         9.60000         9.80000         10.00000           ARB File:         DfsType1Pw1Pri1428Nop18NoChirp60Msps.aiq         Trigger Threshold:         50         dBm         30 Min Delay Arm         30	0.001756 sec
The Plotting Function Completed Successfully.     Play Capture Auto     Play Capture Manual	Play
SigGen: LU: PAI2:112:INSTH Digitizer: LD: PAI2:15:INSTR Quick Boot Booted	Exit Application

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 10 to 12 seconds(5500 MHz 11a mode)

							or 1 0		0.0	_			
Output Lev	et -6	dBm		Continuous	Wave		Digitizer Ir	iput Path Loss: iput Path Loss:			VIKI 2 HOULE	SMD UII	shap sho
Output Eev	or lo	ubili		Continuous	wave		Digitizer fi	iputir dur Eoss.	Joro apur				
eate New Wa	veform Ca	apture Wavef	orm Measu	ement / An	alysis								
Top Of Scr	een: ()	dBm	Sample	Rate: 5.0	MHz	In	out Level: 🛛	dBm	ARB •	Single Shot		Select ARB Fi	le Next Page >
dB Per Divi	sion: 10	-	Capture Du	ation: 12.0	÷ Secon	d(s)			Play O Mode O	No Of Repeats Continuous		Channel List	< Previous Page
					_								Marker Info.
0.00													Start Waveform
													0.61210 sec
-10.00													0.63780 sec
-20.00													200ms Boundary
20.00													0.83780 sec
-30.00													10s Boundary
00.00													10.63780 sec
E40.00													Aggregates
9													Burst Cnt: 543
-50.00												_	200ms Total:
													0.000592 sec
-60.00													Burst Cnt: 86188
	pendentana b	- differentede	an an an Anna an Anna Anna Anna Anna An	and strange	a an an tha that a star	dela dela solo	a south of the	he well a strategy	analasi biri.		alles to a stability	uullii liin ayyaa	9.8s Total: 0.001164 sec
-70.00													Table to De 701
													10s Total:
-80.00	0 10.:	20000	0.40000	10.60000	10.80	000 11 St	00000 econds	11.20000	11.40000	11.60000	11.8000	0 12.00000	0.001756 sec
ARB File:			DfsType1F	Pw1Pri1428	Nop18NoChi	p60Msps.ai	a		Trigger	Threshold: -50	dBm 3	) Min Delay Arm	30 Min End CAC
										Dieu Caebus A. J.			
			he Auto Tesl	Function C	ompleted Su	ccessfully.				may capture Auto	Play (	sapture Manual	Play

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Channel Closing Transmission Time (802.11n HT40) = 1.718 mSecs (limit 260 mSecs)

Channel Move Time 5510 MHz (802.11n HT40)

=<u>0.5122 Secs (limit 10 Secs)</u>

Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 0 to 2 seconds (5510 MHz HT-40 mode)



From the plot above it can be seen that the transmission activity within the 200 mS window is 0.569 mS (see 200 mS Total). From the following plots which shows all additional activity within the remained of the 10 sec measurement window it can be determined that the aggregate transmission is 1.149 mS. This is less than the 60 mS limit.



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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 2 to 4 seconds (5510 MHz HT-40 mode)

	505 MH-		PE On	Stimulue Ou	utput Path Loss:	III dBm	Mkr 2 Bo	te SMB Off	Snap Sh
Output Level:	6 dBm	Contin	uous Wave	Digitizer I	nput Path Loss: 0	LO dBm	Pild E Hos		Childpoin
o albai co i on j	dom			- Ignizer I	internet and a second a	dom			
eate New Wavefo	rm Capture Wave	orm Measurement	/ Analysis						
Top Of Screen:	0 dBm	Sample Bater	50 MHz	Input Level:	0 dRm	ARR 🖲 Singl	e Shot	Select ABB File	Next Page >
dP. Por Division:	10	Conture Duration:	120 10 11		o dom	Play C No O	f Repeats	Channel List	
ub rei Division.	110	capture Duration.	12.0 T Second(s			Mode () Conti	nuous	Undrindi List	
0.00									Start Waveform
									0.61210 sec
-10.00									End Waveform
									0.63780 sec
-20.00									200ms Boundary
									0.83780 sec
-30.00									10s Boundary
-									10.63700 Sec
튭40.00 -									Aggregates
									Burst Cnt: 518
-50.00									200ms 1 otal: 0.000569 sec
									Durat Cata DODE
-60.00									9.8s Total:
<mark>- al-da</mark>	and a state of the second s		And evel alternative departure		ontel a contrata da se de la	al of the state of	and the state of the second	a di kayang di Katang katang sa katang s	0.001149 sec
-70.00									Total Cott 89375
									10s Total:
2.00000	2.20000	2.40000 2.6	0000 2.80000	3.00000 Seconds	3.20000	3.40000	3.60000 3.8	0000 4.00000	0.001718 sec
ARB File:		DfsTupe1Pw1Pri	1428Nop18NoChirpE	Mene ain		Trigger Three	hold: 50 dBm	30 Min Delay Arm	30 Min End CAC
		enerypen with		an apacaid		riggor rinos			
		The Plotting Function	on Completed Succes	sfully.		Play Ca	apture Auto Pla	ay Capture Manual	Play

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 4 to 6 seconds (5510 MHz HT-40 mode)

tput Frequency: 5	505 MHz		RF On		Stimulus Out	out Path Loss:	0.0 dBm	Mkr 2 Re	oute SMB Off	Snap SI
Output Level: 🕞	6 dBm	Cor	tinuous Wave		Digitizer Inj	out Path Loss:	0.0 dBm			
ate New Wavefor	m Capture Wave	orm Measureme	nt / Analysis							
Top Of Screen:	0 dBm	Sample Rate	: 5.0 MHz		Input Level: 0	dBm	ARB C Sing	le Shot	Select ARB File	Next Page >
dB Per Division:	10	Capture Duration	n: 12.0 📑 Se	econd(s)			Mode C Con	tinuous	Channel List	< Previous Page
0.00										Marker Info.
0.00										Start Waveform  0.61210 sec
-10.00				_						End Waveform
										0.63780 sec
-20.00										200ms Boundary
										10s Boundary
-30.00										10.63780 sec
E40.00										- Aggregates
8.000										Burst Cnt: 518
-50.00				_						200ms Total:
										0.0000003 Sec
-60.00										9.8s Total
70.00	Administration of the second	dialog billia konstanti da		della strategica	and and all opticity of		to an a state of the state of the		ter here the standard states	0.001149 sec
-70.00										Total Cnt: 89375
-80.00										10s Total:
4.00000	4.20000	4.40000 4	.60000 4	1.80000	5.00000 Seconds	5.20000	5.40000	5.60000 5.	6.0000	0.001718 Sec
ARB File:		DfsType1Pw1	Pri1428Nop18N	oChirp60Msp	s.aiq		Trigger Thre	shold: -50 dBm	30 Min Delay Arm	30 Min End CAC 두
		The Plotting Fund	tion Completed	Successfullu			Play 0	apture Auto F	lav Capture Manual	Play
		and houng fund	Alon reompicted	ouccostuly						

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 6 to 8 seconds (5510 MHz HT-40 mode)

put Frequency:	5505 MI	Hz	RF Or		Stimulus Out	out Path Loss:	0.0 dBm	Mkr 2 Ro	ute SMB Off	Snap S
Output Level:	-6 dBm	C	ontinuous Wave		Digitizer In	out Path Loss:	0.0 dBm			
ate New Wavefo	orm Capture Way	veform Measure	nent / Analysis							
Top Of Screen	: 0 dBm	Sample R	ate: 5.0 MH	łz	Input Level: 0	dBm	ARB 🖲 Single	e Shot	Select ARB File	Next Page >
dB Per Division	x 10	Capture Dural	ion: 12.0 📫	Second(s)			Play C No O Mode C Conti	f Repeats	Channel List	A Previous Page     A
										Marker Info. —
0.00										Start Waveform
-10.00										End Waveform
										0.63780 sec
-20.00										200ms Boundary
										0.83780 sec
-30.00										10s Boundary
e l										10.00100.00
·										Aggregates
50.00										200ms Total:
-30.00										0.000569 sec
-60.00										Burst Cnt: 8885
	والمتعارية والمراطق والمحاول	ين والدور الدارياني	and a second state of a second	والمحاودة لدلاله أوريعه	فقر فمقان وعالمه والمغار الرواقل		والارتمان المحافظ والمحالية والمحالية	بعاليه باريه ويستعلمون المع	() filles to this stress here	9.8s Total:
-70.00										0.001143 Sec
										Total Cnt: <mark>8937t</mark> 10s Total:
-80.00 6.00000	6.20000	6.40000	6.60000	6.80000	7.00000 Seconds	7.20000	7.40000	7.60000 7.8	0000 8.00000	0.001718 sec
ARB File:		DfsType1Pv	1Pri1428Nop18	NoChirp60Ms	os.aiq		Trigger Thresh	nold: -50 dBm	30 Min Delay Arm	30 Min End CAC
		The Plotting Fu	nction Complete	ed Successfull	A.		Play Ca	pture Auto P	ay Capture Manual	Play

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 8 to 10 seconds (5510 MHz HT-40 mode)

put Frequency:	5505 M	IHz	RF C	In	Stimulus (	)utput Path Loss	s: 0.0 dBr	n 💻	Mkr 2 Route	e SMB Off	Snap S
Output Level:	-6 dBm		ontinuous Wa	ve	Digitizer	Input Path Loss	s: 0.0 dBr	n			
ate New Wavef	orm Capture Wa	veform Measure	ment / Analysis								
Top Of Screen	: 0 dBm	Sample F	ate: 5.0 M	1Hz	Input Level:	0 dBm	ARB	Single Shot		Select ARB File	Next Page >
dB Per Division	10	Capture Dura	ion: 12.0 🛨	Second(s)			Play ( Mode (	No Of Repe Continuous	ats	Channel List	< Previous Pag
0.00											Marker Info.
0.00											Start Waveform
-10.00											End Waveform
											0.63780 se
-20.00											200ms Boundar
											0.83780 sec
-30.00											10.63780 se
E40.00											
540.00											Burst Cnt: 518
-50.00											200ms Total:
											U.UUU569 sec
-60.00											Burst Cnt: 8885
Uto Inc	and the later of the second second		and and the bush	destanades.	Bit test de la glacil.	an de la companya de	ala da kata kata	o and ellisted in the	and a second	ter og en ser	0.001149 sec
-70.00											Total Cnt: 8937
-80.00											10s Total:
8.00000	8.20000	8.40000	8.60000	8.80000	9.00000 Seconds	9.20000	9.40000	9.6000	9.800	00 10.00000	0.001718 sec
ARB File:		DfsType1Pv	/1Pri1428Nop1	8NoChirp60N	1sps.aiq		Trigge	er Threshold: 🗔	50 dBm 3	30 Min Delay Arm	30 Min End CAC
		The Plotting Fr	Inction Comple	ted Successf	ullu		_	Play Capture A	uto Plav	Capture Manual	Play
		rhorhowngrh	anodor compic	00-040000331	and the second se						r iog

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### Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 10 to 12 seconds (5510 MHz HT-40 mode)

tput Frequency: 550	05 MHz		RF On	Stimulus	Output Path Loss	: 0.0 dBm	Mkr 2 Rou	te SMB Off	Snap Sl
Output Level: -6	dBm	Contin	uous Wave	Digitiz	er Input Path Loss	0.0 dBm			
ate New Waveform	Capture Wavefo	m   Measurement	/ Analysis						
Top Of Screen: 0	dBm	Sample Rate:	5.0 MHz	Input Leve	l: 0 dBm	ARB 🖲 Singl	le Shot	Select ARB File	Next Page >
dB Per Division: 1	0	Capture Duration:	12.0 📫 Second(	s)		Play C No C Mode C Cont	If Repeats	Channel List	< Previous Page
0.00								_	Marker Info.
0.00									Start Waveform
-10.00									End Waveform
									0.63780 sec
-20.00									200ms Boundary
									10s Boundaru
-30.00									10.63780 sec
E40.00									Aggregates
8									Burst Cnt: 518
-50.00								_	200ms Total:
									0.000563 sec
-60.00									9.8s Total:
70.00	en general de sellen ter fon	and a supplication of the	tes familian and so	and the strength of the second se	looratel constants	ana ang Kasarang Palasang Pang Pang Pang Pang Pang Pang Pang P	land belige contribution to be	la despirate proven	0.001149 sec
-70.00									Total Cnt: 89375
-80.00									10s Total:
10.00000	10.20000 10	1.40000 10.6	10.8000	0 11.00000 Seconds	11.20000	11.40000 *	11.60000 11.80	12.00000	0.001710 SEC
ARB File:		DfsType1Pw1Pri	1428Nop18NoChirp®	60Msps.aiq		Trigger Thres	hold: -50 dBm	30 Min Delay Arm 3	30 Min End CAC 두
	Tł	e Auto Test Funct	ion Completed Succ	essfully.		Play C	apture Auto Pla	y Capture Manual	Play

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### 30 Minute Non-Occupancy Period

The EUT is monitored for more than 30 minutes following the channel close/move time to verify no transmissions resume on this Channel.



30 Minute Non-Occupancy Period Type 1 Radar Ch 5,500 MHz 802.11a

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### 30 Minute Non-Occupancy Period Type 1 Radar Ch 5,510 MHz 802.11n HT40



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### 5.2.6. Statistical Performance Check

The steps below define the procedure to determine the minimum percentage of detection when a radar burst with a level equal to the DFS Detection Threshold is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5,500 MHz 802.11a and 802.11n HT40.

The Radar Waveform generator sends the individual waveform for each of the radar types 1-6. Statistical data will be gathered to determine the ability of the device to detect the radar test waveforms. The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs. The percentage of successful detection is calculated by:

Total # of detections ÷ Total # of Trials × 100 = Probability of Detection

The Minimum number of trails, minimum percentage of successful detection and the average minimum percentage of successful detection are found in the Radar Test Waveforms section.



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#### Verification of Detection - 5500 MHz 802.11a Mode

Trial #		Det	tection = √, N	lo Detection	= 0	
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1	$\checkmark$	$\checkmark$	$\checkmark$	0	$\checkmark$	0
2	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
3	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$
4	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$
5	$\checkmark$	$\checkmark$	$\checkmark$			$\checkmark$
6	$\checkmark$	$\checkmark$	$\checkmark$	$\overline{\mathbf{v}}$		
7	$\checkmark$	$\checkmark$	$\checkmark$	$\overline{\mathbf{v}}$		
8	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		
9	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		
10	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		
11	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		
12	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		0
13	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		
14	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	0
15	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
16	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
17	$\checkmark$	0	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
18	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$
19	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$
20	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$
21	$\checkmark$	0	$\checkmark$		$\checkmark$	$\checkmark$
22	0	0	$\checkmark$		0	$\checkmark$
23	$\checkmark$	$\checkmark$	$\checkmark$		$\checkmark$	0
24	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
25	$\checkmark$	$\checkmark$	0	$\checkmark$	$\checkmark$	$\checkmark$
26	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	0	0
27	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
28		0				0
29						
30					0	
Detection Percentage	96.6% (>60%)	86.6% (>60%)	96.6% (>60%)	100% (>60%)	90% (>80%)	83.3% (>70%)

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

 $(\underline{P_d1 + \underline{P_d2 + \underline{P_d3 + \underline{P_d4}}}) / 4 = (\underline{96.6\% + 86.6\% + 96.6\% + 100\%}) / 4 = 94.95\% (>80\%)$ 

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#### Verification of Detection - 5510 MHz 802.11n HT40 Mode

Trial #	Detection = $$ , No Detection = 0								
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6			
1	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$	0			
2	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$	$\checkmark$			
3	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$	$\checkmark$			
4		$\checkmark$			$\checkmark$	$\checkmark$			
5	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
6	$\checkmark$	$\checkmark$		$\checkmark$	$\checkmark$	$\checkmark$			
7	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
8	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
9	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
10	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
11	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
12	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
13	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	0			
14	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
15	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
16	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
17	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$			
18	$\checkmark$	$\checkmark$		$\checkmark$					
19	$\checkmark$	$\checkmark$		$\checkmark$		$\checkmark$			
20	$\checkmark$	$\checkmark$		$\checkmark$		0			
21	$\checkmark$	$\checkmark$		$\checkmark$					
22					$\checkmark$				
23				$\checkmark$	0				
24				$\checkmark$					
25				$\checkmark$		$\checkmark$			
26				$\checkmark$		0			
27			0		√	0			
28	$\checkmark$								
29			0						
30	$\checkmark$	0			$\checkmark$				
Detection Percentage	100% (>60%)	96.6% (>60%)	93.3% (>60%)	100% (>60%)	96.6% (>80%)	83.3% (>70%)			

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

 $\frac{(P_d 1 + P_d 2 + P_d 3 + P_d 4)}{4} / 4 = \frac{(100\% + 96.6\% + 93.3\% + 100\%) / 4}{4} = 97.475\% (>80\%)$ 



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Measurement Uncertainty Time/Power							
Measurement uncertainty							
	- Time	4%					
	- Power	1.33dB					

### Traceability

Test Equipment Used

0116, 0158, 0310, 0312, 0314, 0252, 0256, 0293.

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### 6. PHOTOGRAPHS

### 6.1. Dynamic Frequency Selection Test Set-Up



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# 7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787- 3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181- 3G0300	209092-001
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002

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