



<b>Test samples supplier</b> .....	Same as applicant
<b>Manufacturer</b> .....	Same as applicant

<b>Test method requested</b> .....	See Standard		
<b>Standard</b> .....	<p>USA FCC Part 15.407 (10-1-11 Edition). Unlicensed National Information Infrastructure Devices. General technical requirements.</p> <p>ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices.</p> <p>CANADA RSS-210 Issue 8 (December 2010). Licence-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment. Annex 9.</p> <p>FCC Order, ET Docket No.03-122 (FCC 06-96): Compliance measurement procedures for unlicensed-national information infrastructure devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands incorporating dynamic frequency selection (DFS).</p>		
<b>Test procedure</b> .....	PERF034		
<b>Non-standardized test method</b> .....	N/A		
<b>Used instrumentation</b> .....		<b>Last Cal. date</b>	<b>Cal. due date</b>
	1. Semianechoic Absorber Lined Chamber IR 11. BS	N.A.	N.A.
	2. Control Chamber IR 12.BC	N.A.	N.A.
	6. Double-ridge Guide Horn antenna 1-18 GHz HP 11966E	2011/05	2014/05
	14. EMI Test Receiver R&S ESU40	2012/03	2014/03
	15. Pulse function generator HP8116a	2013/06	2015/06
	16. Vector signal generator Agilent E4438C	2012/11	2014/11
	17. Oscilloscope Tektronix DPO4104B	2013/06	2014/06
	18. Double-ridge Guide Horn antenna 1-18 GHz HP 11966E	2012/04	2015/04

<b>Report template No.</b> .....	FDT08_14
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### **Competences and guarantees**

AT4 wireless, S.A. is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 905266.

AT4 wireless, S.A. is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621A-1.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance programme for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

### **General conditions**

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

### **Uncertainty**

Uncertainty (factor  $k=2$ ) was calculated according to the AT4 wireless internal documents:

PODT000: : Procedimiento para el cálculo de incertidumbres de medida

## Usage of samples

Sample S/01 is composed of the following elements:

<u>Control N°</u>	<u>Description</u>	<u>Model</u>	<u>Serial N°</u>	<u>Date of reception</u>
40079/02	2x2 antenna configuration, solder-down module	7260SDW	TA#: H10137-002 WF MAC: 001500D08635 BD MAC: 001500D08639	05/09/2013

Auxiliary elements used with the sample S/01:

<u>Control N°</u>	<u>Description</u>	<u>Manufacture</u>	<u>Model</u>	<u>Serial N°</u>	<u>Date of reception</u>
40079/04	PC	DELL	Optiplex 960	W724KA01	26/09/2013
40079/05	Mains cord	DELL	---	---	26/09/2013
40079/05	Interface Board PCIe	INTEL	PCB00284	---	26/09/2013
40104B/16	Reference Antenna	SkyCross	WIMAX/WLAN	---	26/09/2013
40104B/17	Reference Antenna	SkyCross	WIMAX/WLAN	---	26/09/2013
40079/11	Interface extender cable	---	---	---	26/09/2013
38067/37	HMC/NGFF Testing board	INTEL	PCB00390	3902412-252	11/01/2013
38067/38	Adapter of the AC/DC Board Testing Board	SINPRO	SPU60-102	07990464 1249	11/01/2013
1302	35mmx35mm	---	---	---	---
4045	Access Point	CISCO	AIR-LAP1262N-A-K9	FTX1550E2C5	---
38067/28	Laptop PC	DELL	Latitude E5420	CTFQQL1	08/01/2013
38067/29	Cable of the AC/DC Adapter	DELL	---	---	08/01/2013
38067/30	AC/DC Adapter	DELL	LA90PM111	---	08/01/2013

- Sample S/01 has undergone following test(s).  
All tests indicated in appendix A.

## Testing period

The performed test started on 2013-10-25 and finished in the same day.

The tests have been performed at AT4 wireless.

## Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 23.3 °C Max. = 24.2°C
Relative humidity	Min. =44 % Max. = 46 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω

In the semianechoic chamber (21 meters x 11 meters x 8 meters), the following limits were not exceeded during the test.

Temperature	Min. = 19.3 °C Max. = 19.7°C
Relative humidity	Min. =49 % Max. = 55 %
Air pressure	Min. = 1017mbar Max. = 1019mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

## Summary

Considering the results of the performed test according to standard USA FCC Parts 15.407 / RSS-210, the item under test is **IN COMPLIANCE** with the requested specifications specified in the standard.

NOTE: The results presented in this Test Report apply only to the particular item under test established in page 1 of this document, as presented for test on the date(s) shown in section, "USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS".

## Remarks and comments

1: The EUT is a client device without radar detection.

**Testing verdicts**

Not applicable..... : NA  
 Pass..... : P  
 Fail..... : F  
 Not measured..... : NM

DFS Requirements Prior to Use of a Channel	VERDICT			
	NA	P	F	NM
<i>Non-Occupancy Period</i>	P			
<i>DFS Detection Threshold</i>	NA			
<i>Channel Availability Check Time</i>	NA			
<i>Uniform Spreading</i>	NA			
<i>U-NII Detection Bandwidth</i>	NA			

DFS requirements during normal operation	VERDICT			
	NA	P	F	NM
<i>DFS Detection Threshold</i>	NA			
<i>Channel Closing Transmission Time</i>	P			
<i>Channel Move Time</i>	P			
<i>U-NII Detection Bandwidth</i>	NA			

**APPENDIX A: Test results for Dynamic  
Frequency Selection (DFS). FCC 15.407 (h)(2) /  
RSS-210 A9.3.”**



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## TEST CONDITIONS

Power supply (V):

$$V_{\text{nominal}} = 3.3 \text{ Vdc}$$

Type of power supply = DC voltage from HMC/NGFC test board.

Type of antenna = External attachable PIFA antenna.

Declared Gain for antenna:

5250 – 5350MHz – 3.73dBi

5470 – 5725MHz – 4.77dBi

The test set-up was made in accordance to the general provisions of Compliance measurement procedures for unlicensed-national information infrastructure devices operating in the 5.25-5.35GHz and 5.47-5.725GHz Bands incorporating Dynamic Frequency Selection (FCC Order, ET Docket No.03-122 (FCC 06-96).

For radio testing purposes the EUT card was installed in a test fixture. The test fixture is connected to a laptop computer and dc power supplied. During the test a streaming video file (MPEG) is sent from the master device (connected to a server via an Ethernet interface) to the laptop computer.

The PC was using the Intel test SW: 16.1.5.

The manufacturer declared values for the EUT operational characteristics that affect DFS are as follows:

- Client Device with no DFS (no In Service Monitoring, no Ad-Hoc mode).
- Maximum declared antenna gain (dBi) for 5.25-5.35 GHz is 3.73 dBi & 5.47-5.725 GHz is 4.77 dBi.

### DFS Measurement instrumentation

A Pulse function generator HP8116A and an Agilent E4438C Vector signal generator are used as the radar-generating source. The waveform of pulses and burst configuration are programmed using the Pulse function generator and the Vector signal generator is used for up-converting the signal to the 5 GHz band.

The output of the Vector signal generator is connected to a calibrated horn antenna.

Channel monitoring is implemented by using a spectrum analyzer and digital storage oscilloscope. The analyzer is configured in a zero-span mode, center frequency set to the radar waveform's frequency or the center frequency of the EUT's operating channel.

The IF output of the spectrum analyzer is connected to one input of the oscilloscope. The output of the Pulse function generator is used to send the modulating signal. This output is also connected to a second input on the oscilloscope and the oscilloscope display both the RF channel traffic and the radar pulses on its display.

The master and slave (EUT) devices are placed inside an anechoic chamber. The simulated radar waveform is transmitted using a directional calibrated horn antenna toward the unit performing the radar detection (master).

The radar signal level at the master device is verified by measuring the continuous signal level from the Vector signal generator using a reference measuring antenna placed at the master's location and connected to a spectrum analyzer. The signal level is calculated from the measured level at the reference antenna and taking into account the cable loss and reference antenna gain.

$$\text{Applied level (dBm)} = M \text{ (dBm)} - G_{\text{ref}} \text{ (dBi)} + L \text{ (dB)}$$

Where:

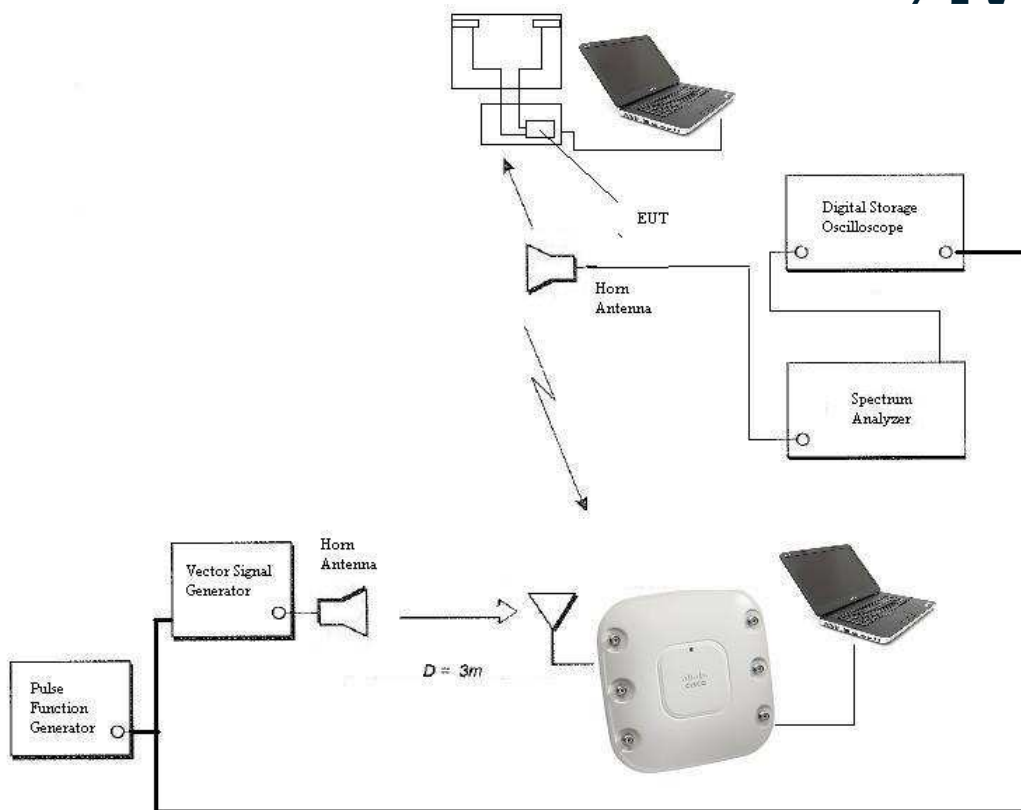
M (dBm): Measured level in the spectrum analyzer

G<sub>ref</sub> (dBi): Reference antenna gain

L (dB): Loss of connecting cable between antenna and spectrum analyzer.

The antenna connected to the channel monitoring system is positioned to allow both master and slave (EUT) transmissions to be observed, with the level of the EUT's transmissions between at least 10 dB higher than those from the master device.

The setup is shown in the next figure.



### **DFS Channel Closing Transmission Time and Channel Move Time measurement method**

These times are measured by applying a burst of radar signal and observing the transmissions in the operating channel. The time between the end of the applied radar burst and the end of transmissions on the channel is the Channel Move Time.

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.

### **DFS Channel Non Occupancy Period measurement method**

The channel is monitored for 30 minutes to check that there are no transmissions on the channel over the required non-occupancy period. This is achieved by allowing the analyzer to perform a sweep over a 30 minutes period to capture any transmissions on the channel after the detection of the radar waveform.

**Section 15.407 Subclause (h) (2). RSS-210 A.9.3. Channel Closing Time, Channel Move Time and Non-occupancy period measurement**

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 + 1dB is generated on the Operating Channel of the U-NII device.

Operating Frequency: 5.70 GHz. Channel 140 BW=20MHz.

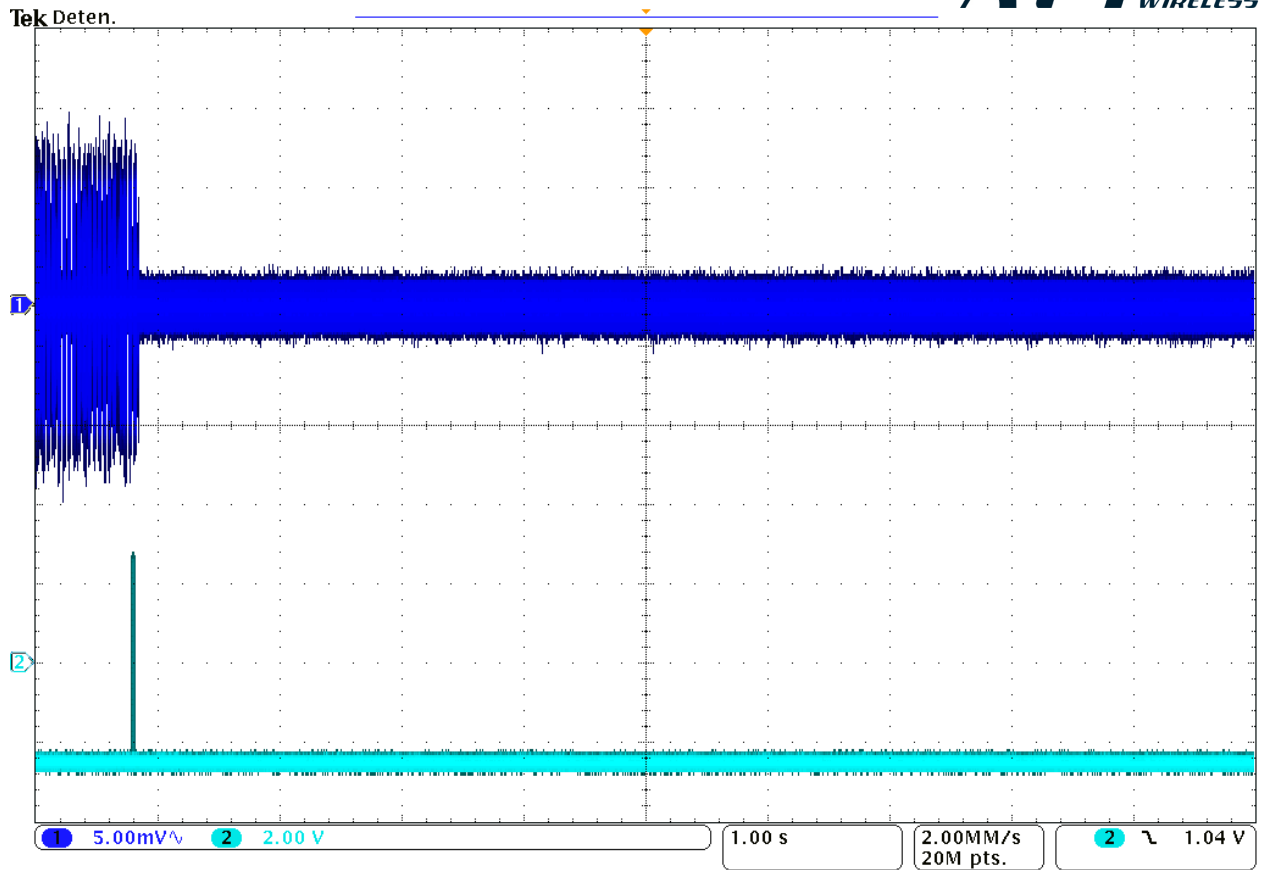
Radar type: Radar type 1

Table 1 FCC Short Pulse Radar Test Waveforms					
Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses / burst	Minimum Detection Percentage	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

RESULTS: (See next plots)

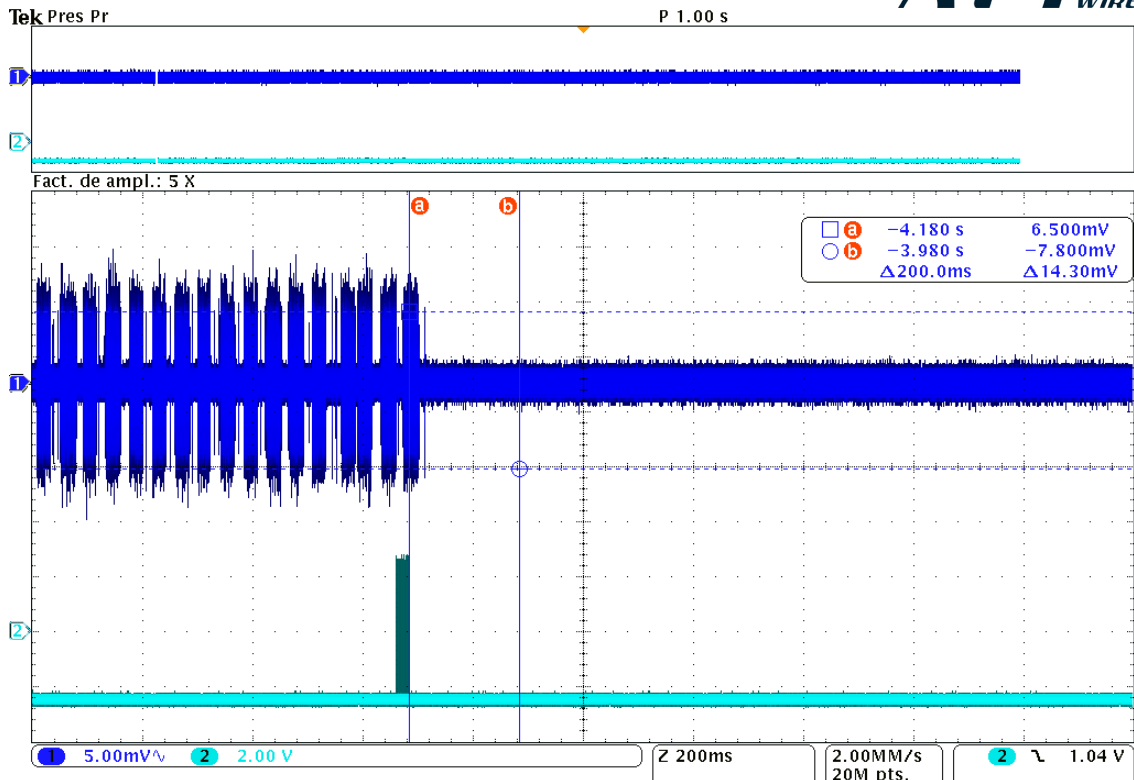
FCC part 15.407 (h)(2) Tests Result Summary					
Description	Radar Type	Radar Frequency (MHz)	Measured Value	Requirement	Result
Channel Closing transmission time	1	5700	11.6 ms	200 ms + an aggregate of 60 ms.	PASS
Channel move time	1	5700	26.3 ms	10 seconds	PASS
Non-occupancy period	1	5700	0	>30 minutes	PASS

	Measurement uncertainty
Timing	± 0.057 ms
DFS Detection Threshold Level	± 4.09 dB



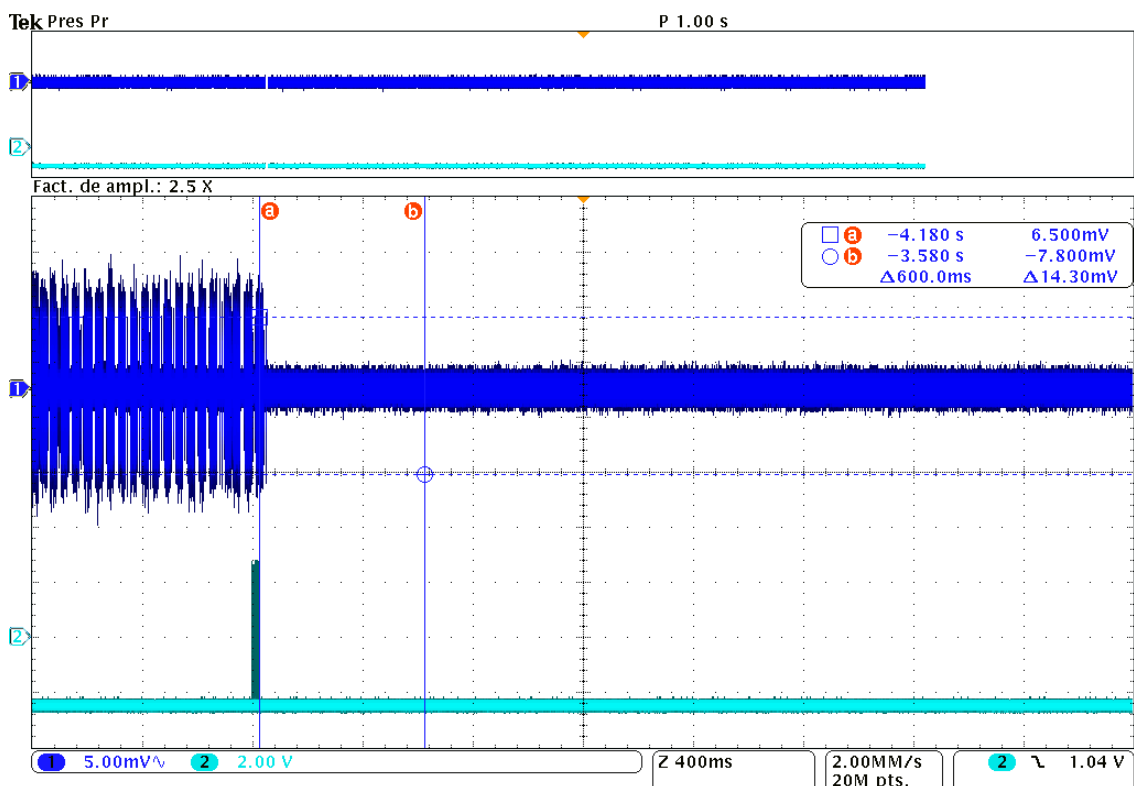
25 Oct 2013  
09:41:14

The upper trace in the above plot has 10 seconds of EUT final transmission data and the lower trace shows the simulated radar signal.



25 Oct 2013  
09:45:45

This plot provides a zoom-in to show the 200 ms time interval after the radar burst.



25 Oct 2013  
09:55:28

This plot provides a zoom-in to show the 600 ms time interval after the radar burst. This shows that there were not any transmissions after 200 ms following the radar burst.

The non-occupancy period plot was made over a 2000-seconds (33.3 minutes) time period that included the channel move period plus a minimum of 30 minutes thereafter. No transmissions were observed in the 30 minutes following the channel move time.

