TEST REPORT
FROM
RFI GLOBAL SERVICES LTD

Partial Test of: OWL253 (DFS Client without Radar Detection)

To: FCC Part 15.407: 2010 Subpart E, RSS-210 Issue 8 December 2010

Test Report Serial No:
RFI-RPT-RP78718JD33B V2.0

Version 2.0 Supersedes All Previous Versions

This Test Report Is Issued Under The Authority Of Chris Guy, Head of Global Approvals:	
Checked By:	Nigel Davison
Signature:	pp
Date of Issue:	18 November 2011

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1. Customer Information

Company Name:	connectBlue AB
Address:	Norra Vallgatan 64 3V Malmo Sweden SE-211 22

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.407
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2010: Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) - Section 15.407
Specification Reference:	RSS-210 Issue 8 December 2010
Specification Title:	Low-power Licence-exempt Radio communication Devices (All Frequency Bands): Category I Equipment.
Site Registration:	FCC: 209735; Industry Canada: 3245B-2
Location of Testing:	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.
Test Dates:	01 June 2011

2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Result
15.407(h)	RSS 210 A9.3	Dynamic Frequency Selection – DFS Client without Radar Detection (Channel move time, closing time and non-occupancy period.)	

Key to Results

 = Complied  = Did not comply

2.3. Methods and Procedures

Reference:	FCC 06-96
Title:	Compliance measurement procedures for Unlicensed-National-Information Infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection.

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	connectBlue AB
Model Name or Number:	OWL253
Serial Number:	0283-01-000003
Hardware Version Number:	cB-0941-02
Software Version Number:	2.10.0
FCC ID:	PVH0941
IC Certification Number:	5325A-0941

3.2. Description of EUT

The equipment under test was a IEEE802.11a/b/g/n Client without Radar Detection WLAN module supporting an external antenna port.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	Unlicensed National Information Infrastructure Devices (U-NII)/License-exempt local area network (LE-LAN)	
Type of Unit:	Transceiver	
Data Rate:	802.11a: 6,9,12,18,24,36,48,54 Mbps 802.11n: 6.5,13,19.5,26,39,52,58.5,65 Mbps	
Maximum Conducted Output Power (dBm):	11.6	
Maximum Radiated EIRP (dBm):	14.6	
Antenna Gain:	3dBi	
Channel Spacing:	20 MHz	
Modulation:	OFDM (BPSK / QPSK / 16QAM / 64QAM)	
Power Supply Requirement(s):	Nominal	3.3V min, 5.0 V nom, 5.5V max
System Architecture:	IP Based	
Transmit & Receive Frequency Range:	5150 to 5725MHz	
Transmit Channel Tested Band 1:	**Channel Frequency (MHz)**	
	5280	
Transmit Channel Tested Band 2:	**Channel Frequency (MHz)**	
	5660	

Intended antennas for use with the Client device.

Antenna Model:	Min Antenna Gain:	Max Antenna Gain:
Fractus FR05-S1-NO-1-004	+3dBi	+3dBi
ProAnt Inside-EPA-WLAN	+3dBi	+3dBi
ProAnt Inside-WLAN	+3dBi	+3dBi
Proant Ex-IT WLAN	+3dBi	+3dBi

Note: Antenna Impedances is 50Ohms.

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop
Brand Name:	Acer Aspire 1
Model Name or Number:	ZG8
Serial Number:	LUS750B02191210D892500

Description:	Cisco Aironet IOS Access Point
Brand Name:	Cisco
Model Name or Number:	AIR-AP1252AG-A-K9
Serial Number:	FTX143490WE

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

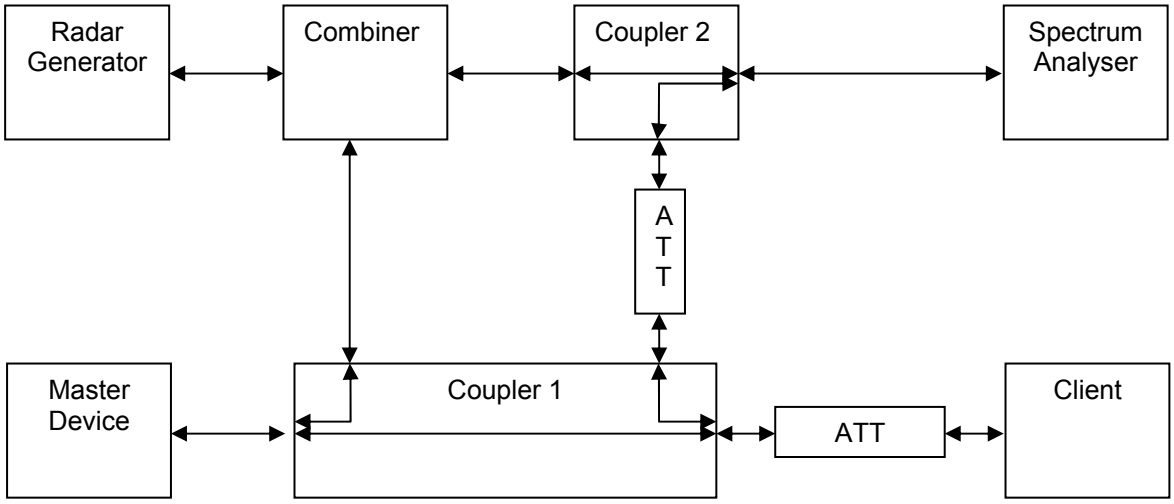
- Continuously transmitting at maximum power
- 802.11n – 12 Mbps

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- The EUT is a DFS Client without Radar Detection capability. It was tested in combination with Cisco DFS enabled master FCC ID LDK102062.
- The Radar test platform used was the RFI Global alternate platform verified and accepted by Robert sole of the FCC/NTIA on the 4th Sept 2008. See original confirmation email in Appendix 2.
- The client was associated the master. The NTIA recommended movie file was streamed the master to client.
- The Channel move time was the time taken as the time taken from the end of the radar waveform to the time the client ceased transmission. Any additional pulses were taken as control signals the aggregate time of which was also recorded.
- All measurements were made at the DUT 50 Ohm antenna port. System losses for the interconnecting hardware were measured and taken into consideration.

Setup diagram for test of DFS Client without Radar Detection.



Rationale

The setup shown above ensures the waveforms indicated on the spectrum analyser are in order of magnitude. The Radar signal is most predominant followed by the Client and then the Master device.

Description

The Radar signal is set to the stated DFS detection threshold level. The signal is injected into the master via the combiner and coupler 1. The coupled port ensure the radar is isolated from the client.

The Radar signal is also directed through coupler 2 into the spectrum analyser where it can be observed.

Coupler 1 through port allows the Master and Client to associate with each other. The Attenuator into the client is aimed at preventing the master from saturating the front end of the client.

The Client signal passes to the Master but also is coupled via coupler 1 to coupler 2 and into the spectrum analyser. Coupler 2 prevents the Radar from entering the Client whilst allowing both Radar and Client device traces to be observed on the spectrum analyser.

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

Applicability of DFS requirements during normal operation

Requirement	Operational Mode		
	Master	Client (without DFS)	Client (with DFS)
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes

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 0 dBi receive antenna Note 2: Throughout these test procedures an additional 1dB 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	30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds
Channel Closing Transmission Time	200 milliseconds + approx. 60 milliseconds over remaining 10 second period

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. 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 approximately 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (Microseconds)	PRI (Microseconds)	Pulses	Minimum Percentage of Successful Detection	Minimum 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	

Long Pulse Radar Test Signal

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

Frequency Hopping Radar Test Signal

Radar Waveform	Pulse Width (µsec)	PRI (µsec)	Burst Length (ms)	Pulses per Hop	Hopping Rate (kHz)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	300	9	.333	70%	30

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6; Measurement Uncertainty* for details.

5.2. Test Results

5.2.1.Dynamic Frequency Selection (DFS)

Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period

Test Summary:

Test Engineer:	Nigel Davison	**Test Date:**	01 June 2011
Test Sample Serial No:	ID 0283-01-000003		

FCC/IC Part:	15.407(h) and RSS 210 A9.3
Test Method Used:	FCC 06-96

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	26

Note: TPC is not required for devices with an EIRP of less than 27dBm.

The EUT is an IP based DFS Client without Radar Detection capability. Only channel move and closing times are required in accordance with FCC 06-96. FCC KDB 848637also makes reference to the non-occupancy period and as such the non-occupancy period was also recorded.

The EUT was associated with a master device. A random radar signal was injected into the master, the radar being randomly chosen from radars 1 through 4.

The client RF output was monitored over the measurement period required and the time periods of the transmissions were recorded.

The antennas to be used for the device are listed at the beginning of this report. The antenna gains are 3dBi however, the measurement was performed conduced. Because the test was performed conducted no antenna gain was incorporated into the detection threshold so its level was set to the default -62dBm as per FCC 06-96 section 7.5 and section 8.1 (5).

For this test the Radar DFS Detection Threshold was set to -62dBm + 1dB as per FCC 06-96 section 7.8.3.

The recommended FCC MPEG file was streamed from the master to the client for the duration of the test.

The channel move time is the time taken from the end of the radar burst to the ceasing of transmissions from the EUT. M1 denotes the end of the radar burst in the plots below and D1 denoted the period of transmission after the radar has been injected. The smaller transmission seen in the plot that are less than -50dBm are 6 x 3.48mS (20.88mS Total) beacons from the master device and not from the client under test, as such these can be ignored.

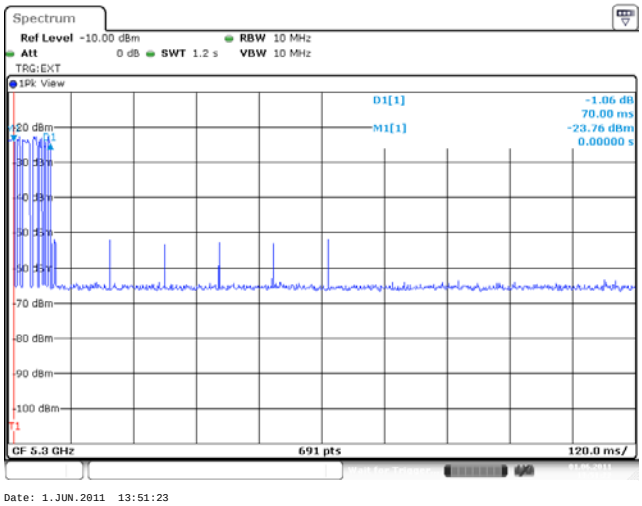
The client transmitted a single 223.19uS packet after the shutdown period.

Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (continued).

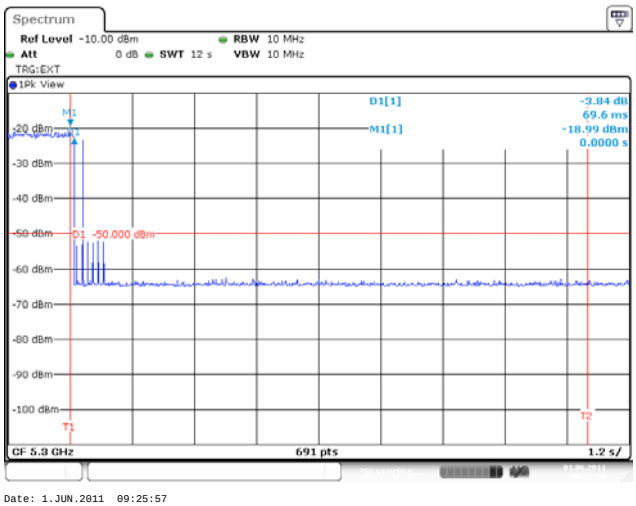
Band 2: 5250 – 5350MHz.

Radar #	Channel Frequency (MHz)	Channel Move Time (ms)	Total Aggregate Time (ms)	Limit (ms)	Margin (ms)	Status
3	5300	70	-	200	130.0	Complied
3	5300	-	0.223	60	59.777	Complied

Channel move time and closing time close up.

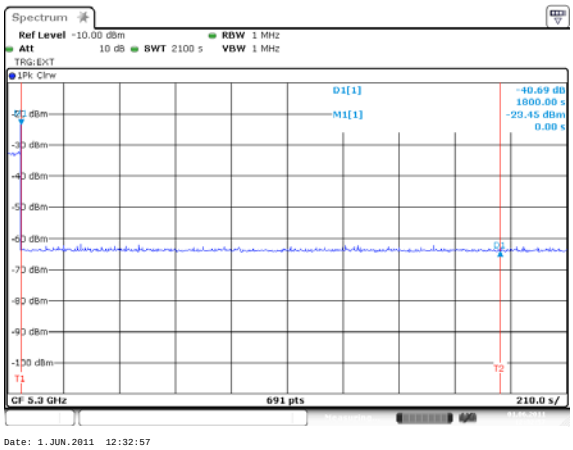


Channel move time and closing time overall.



Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (continued).

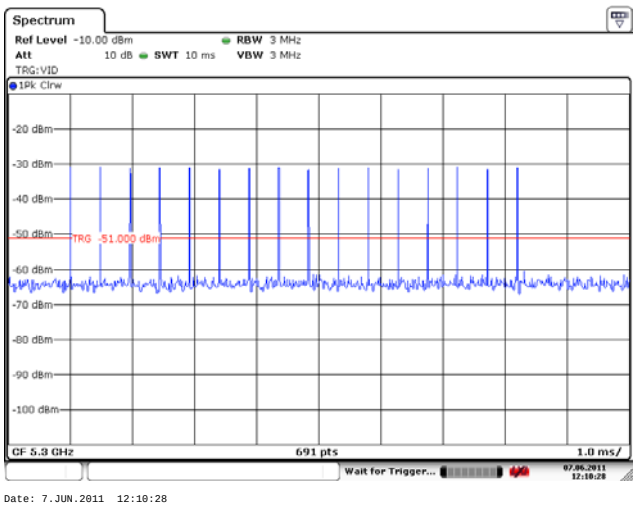
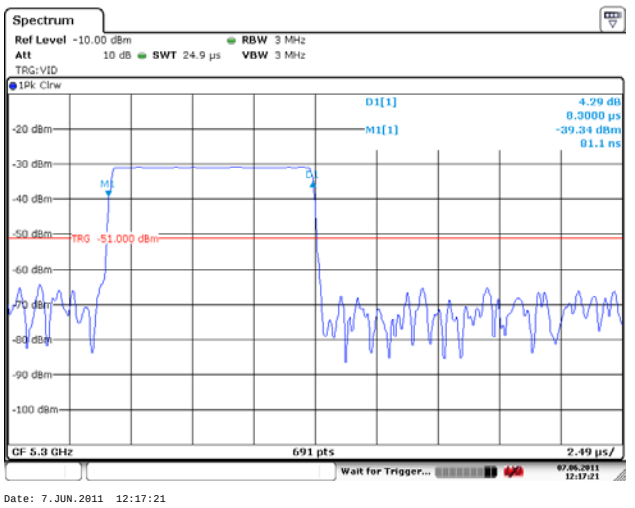
Non-Occupancy Period.



There were no transmissions during the non-occupancy period.

Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (continued).

Radar #3 Details.

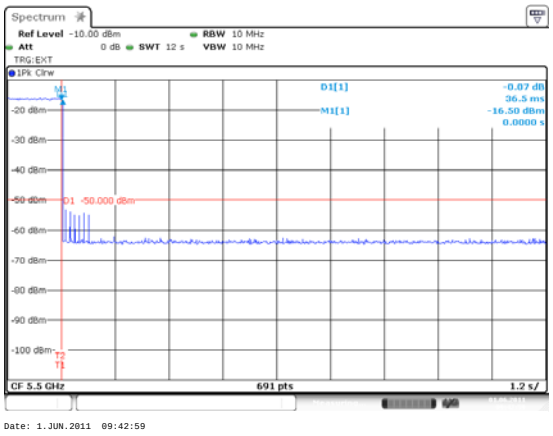
	
Number of Pulses:16	Pulse Width: 8.3uS

Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (continued).

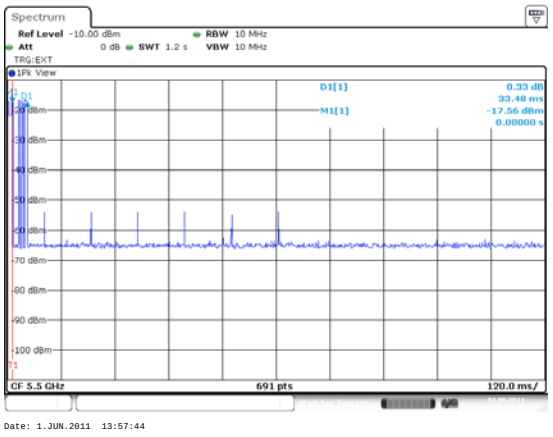
Band 3: 5470 – 5725MHz.

Radar #	Frequency (MHz)	Channel Move Time (ms)	Total Aggregate Time (ms)	Limit (ms)	Margin(ms)	Status
4	5500	33.5	-	200	166.5	Complied
4	5500	-	0.223	60	59.777	Complied

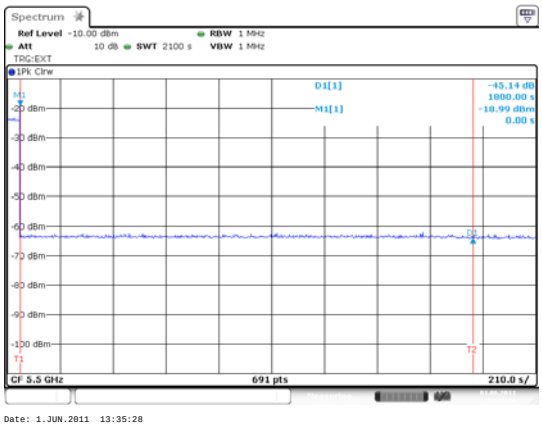
Channel move time and closing time close up.



Channel move time and closing time overall.

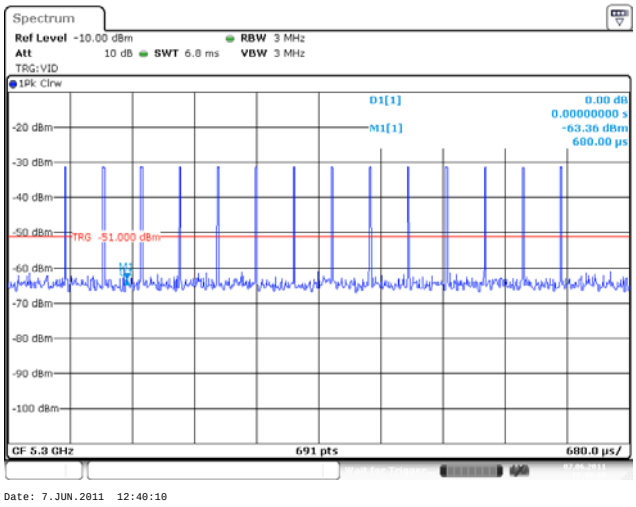
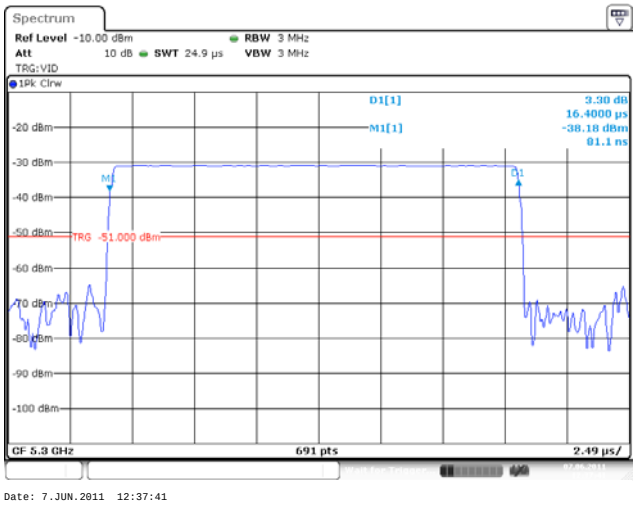


Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (continued).

Non-Occupancy Period.


There were no transmissions during the non-occupancy period.

Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (continued).

	
Number of Pulses:14	Pulse Width: 16.4uS

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Channel Move Time	5.15 GHz to 5.825 GHz	95%	0.32%
Channel Close Time	5.15 GHz to 5.825 GHz	95%	0.32%
Non-Occupancy Period	5.15 GHz to 5.825 GHz	95%	0.32%
DFS Threshold (Conducted)	5.15 GHz to 5.825 GHz	95%	0.27dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A1368	Directional Coupler	Pasternack	PE2214-10	None	Calibrated before use	-
L1028	Spectrum Analyser	Rohde and Schwarz	FSV-30	100854	6 Aug 2011	12
M1435	Power Meter	Hewlett Packard	437B	3125U14631	12 July 2011	12
M283	Power Head	Hewlett Packard	8487A	3318A03241	16 May 2012	12
G0547	Arbitrary Waveform Generator	Agilent	33220A	MY44003336	Calibrated before use	-
M122	Digital Volt Meter	Fluke	77 Series II	64910017	14 Jul 2011	12
M1368	Oscilloscope	Tektronix	TDS 3054B	B040695	9 Jul 2011	12

Appendix 2. FCC Verification email of DFS platform suitability.

From: Robert Sole [mailto:rsole@ntia.doc.gov]
Sent: 04 September 2008 13:57
To: Nigel Davison
Cc: Andrew.Leimer@fcc.gov; Joe.Dichoso@fcc.gov; Edward Drocella; Brian Watson; Steve Flooks; Steven Wong

Subject: RE: FW: RFI DFS Verification Application Request For Info.

Hi Nigel,

I have read your paper and I agree that your system is now properly producing the Long Pulse waveform. So your system is now compliant and can be used for 5 GHz DFS U-NII device testing.

Robert Sole
Spectrum Engineering Branch Chief
Office of Spectrum Management
NTIA/USDOC, Washington DC
Phone 202 482-1245
Fax 202 482-4595

Rsole@ntia.doc.gov

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