TEST REPORT
FROM
RFI GLOBAL SERVICES LTD

Test of: XE500T1C

FCC ID: A3LXE500T1C & A3LXE500T1CN

IC Certification Number: 649E-XE500T1C & 649E-XE500T1CN

To: FCC Part 15.407: 2011, Industry Canada RSS-210 Issue 8 December 2010 & RSS-Gen Issue 3 December 2010

Version 2.0 supersedes all previous versions

Test Report Serial No.:
RFI-RPT-RP89958JD05C V2.0

Version 2.0 supersedes all previous versions

This Test Report Is Issued Under The Authority Of John Newell, Group Quality Manager:	pp
Checked By:	Philip Harrison
Signature:	pp
Date of Issue:	02 October 2012

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1. Customer Information

Company Name:	Samsung Electronics Co., Ltd.
Address:	416, Maetan-3Dong, Yeongtong-Gu, Suwon-City, Gyeonggi-Do, 443-742, Korea

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.407
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2011: Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) - Section 15.407
Specification Reference:	Industry Canada 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
Test Date:	24 September 2012

2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Result
Part 15.407(h)(2)(iii)	RSS-210 A9.3(b)(iii)(iv)	Channel Closing Transmission Time and Channel Move Time	✓
Part 15.407(h)(2)(iv)	RSS-210 A9.3(b)(v)	Non-occupancy Period	✓
Key to Results ✓ = Complied ✗ = Did not comply			

Note(s):

1. The Manufacturer confirms that information regarding the parameters of the radar waveforms is not available to the end user.

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:	Samsung
Model Name or Number:	XE500T1C
Serial Number:	HX2W91SC700031T (*Conducted sample RF port*)
Hardware Version Number:	PV
Software Version Number:	Windows 8
Windows Driver Version:	5.93.97.68
FCC ID:	A3LXE500T1C
FCC ID:	A3LXE500T1CN
Industry Canada Certification Number:	649E-XE500T1C
Industry Canada Certification Number:	649E-XE500T1CN

3.2. Description of EUT

The equipment under test was a Tablet PC with 3G, *Bluetooth* and IEEE 802.11a/b/g/n operating in the 2.4 GHz and 5 GHz bands.

The EUT supports DFS as a Client without Radar Detection.

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:	IEEE 802.11a,b,g,n / Digital Transmission System		
Type of Unit:	Transceiver		
Modulation:	CCK, BPSK, QPSK, 16QAM, 64QAM		
Data rates:	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	
Power Supply Requirement(s):	Nominal	12 VDC via 120 VAC 60 Hz adaptor	
Channel Spacing:	20 MHz		
Transmit / Receive Frequency Range:	5250 MHz to 5350 MHz & 5470 to 5725 MHz		
Transmit / Receive Channels Tested:	**Test**	**Channel ID**	**Channel Frequency (MHz)**
	Channel Move Time	64	5320
	Channel Non-Occupancy	64	5320

Intended antenna for use with the Client device.

Antenna Model:	**Antenna Gain (dBi)**			
	2.4	5.15-5.35	5.47-5.725	5.725-5.850
Pulse Part No. J90-OY5448	3.48	6.20	2.55	2.45

Note: Antenna Impedance is 50 Ohms.

3.5. Support Equipment

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

Description:	DFS Enabled Wireless Access Point
Brand Name:	Cisco
Model Name or Number:	VEN401-AT
Software Version:	1.24.32.42D-DFS
FCC ID:	MXF-AP990624M
Serial Number:	DVT3000539

Description:	Laptop
Brand Name:	Lenovo
Model Name or Number:	G560
Serial Number:	CBL3805393

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating modes, unless otherwise stated:

- Operating on the channel selected by the Master device in UNII Band II.
- The Master device was set with a maximum power level of 20 dBm (100 mW).
- The Master device was set to 802.11a / 54 Mbps.
- The Master device used a channel bandwidth of 20 MHz and defined the channel the EUT (Client) operated at during testing.
- The DFS detection threshold of -63 dBm was used at the Master device antenna port. The Master has a maximum EIRP of 20 dBm with 0 dBi gain.

FCC 06-96 Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

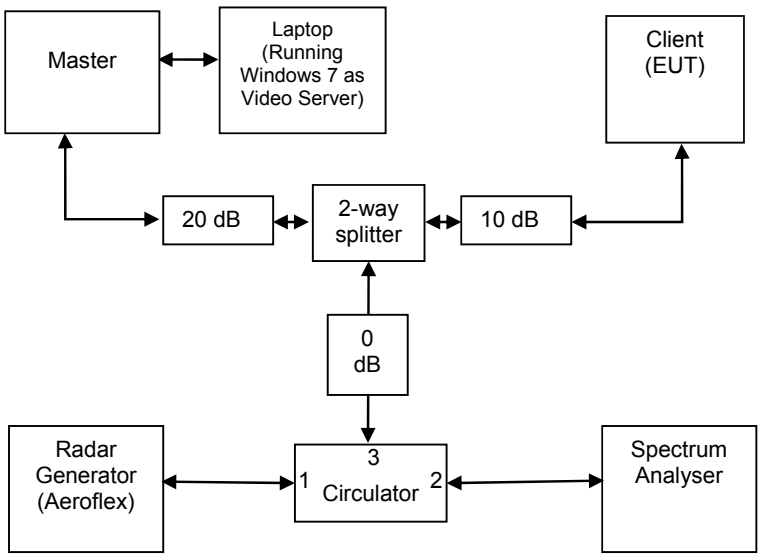
Maximum Transmit Power	**Value (See Notes 1 and 2)**
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

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 a FCC approved Cisco DFS enabled router (FCC ID: MXF-AP990624M) being used as the Master. Due to the full compliance of the Master, radar pulse type 1 was injected to test the Client channel move behaviour.
- All measurements were made using a conducted link. The EUT has one external antenna port, one transmit chain and one receive chain, MIMO is not supported. System losses for the interconnecting hardware were measured and taken into consideration.
- For the required channel loading, the test MPEG video file was downloaded from the website http://ntiacsd.ntia.doc.gov/dfs/. The test file was then streamed in full motion at 30 frames per second from a laptop PC, via the Master device to the Client Device (EUT).
- The Radar test platform used was the Aeroflex DFS Radar 110105 Simulator which has been verified and accepted by Andrew Leimer of the FCC/NTIA on the 23rd of September 2011. Refer to Appendix 2 of this Test Report for the original confirmation email.
- The plots were captured using a Rohde & Schwarz FSU set to the maximum sampling rate of 30001 data points. These were then exported as delimited ASCII files so the data could be analysed in greater detail than available on the analyser screen.
- The Rohde & Schwarz ESU was given a Reference Level offset so that the radar shown on the plot was the level as seen at the input to the DFS master.
- The Channel move time was 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 of which the aggregate time was also recorded.

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 EUT (Client) and then the ancillary equipment (DFS Master device). The step attenuator in the centre can adjust the balance between the transmission network amplitude and the radar amplitude on the analyser. This was set to 0 dB however for this testing.

Description

The Radar signal is set to the stated DFS detection threshold level at the Master.

The attenuators set up the order of magnitude of the signals and also prevent the Master from saturating the front end of the Client, whilst not being so high as to exceed the maximum output of the Radar Generator.

The spectrum analyser was set to the maximum sampling rate possible. After each test the data was then exported in ASCII format so it could be analysed in greater detail.

Setup diagram for test of DFS Client without Radar Detection (continued)

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 + 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.

Setup diagram for test of DFS Client without Radar Detection (continued)

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. Channel Closing Transmission Time and Channel Move Time

Test Summary:

Test Engineer:	Philip Harrison	**Test Date:**	24 September 2012
Test Sample Serial No.:	HX2W91SC700031T		

FCC Reference:	Part 15.407(h)(2)(iii)
Industry Canada Reference:	RSS-210 A9.3(b)(iii)(iv)
Test Method Used:	FCC 06-96 Section 7.8.3

Environmental Conditions:

Temperature (°C):	23.4
Relative Humidity (%):	37

Note(s):

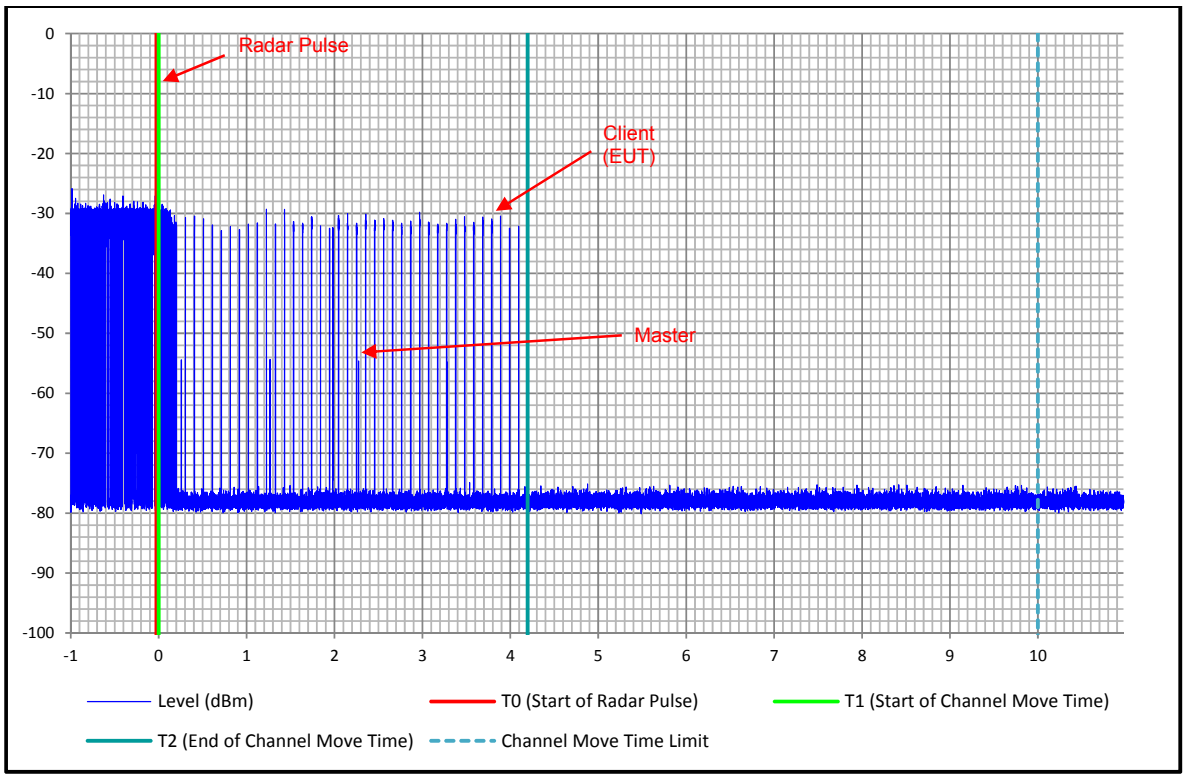
1. The channel move time is the time taken from the end of the radar burst to the ceasing of transmissions of the EUT. The smaller transmissions seen in the first plot that are less than -50 dBm, come from the Master device and not from the Client, these transmissions can be ignored.

Results: 20 MHz / 5250 – 5350 MHz band

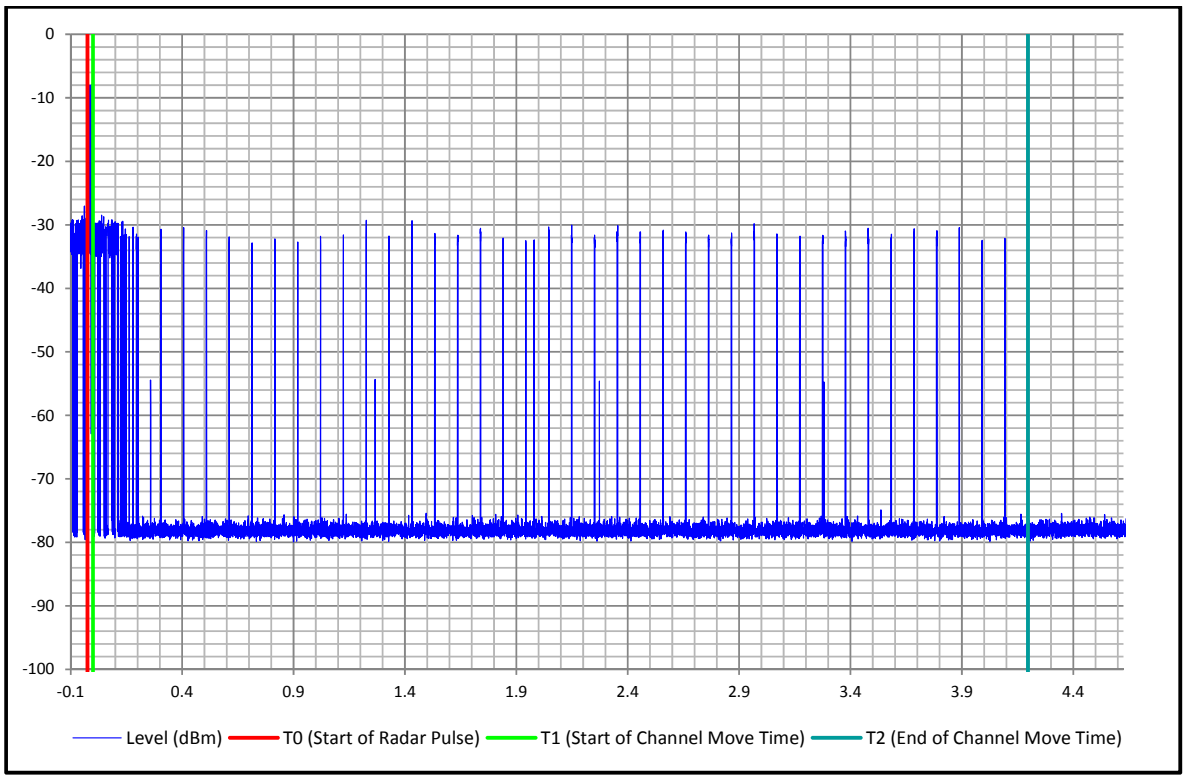
Radar #	Channel Frequency (MHz)	Channel Move Time (ms)	Total Transmission Aggregate Time after the first 200 ms of the radar end (ms)	Limit (ms)	Margin (ms)	Status
1	5320	4196	-	10000	5804	Complied
1	5320	-	35	60	25	Complied

Radar burst type 1 was detected and channel move occurred.

Channel Closing Transmission Time and Channel Move Time (continued)

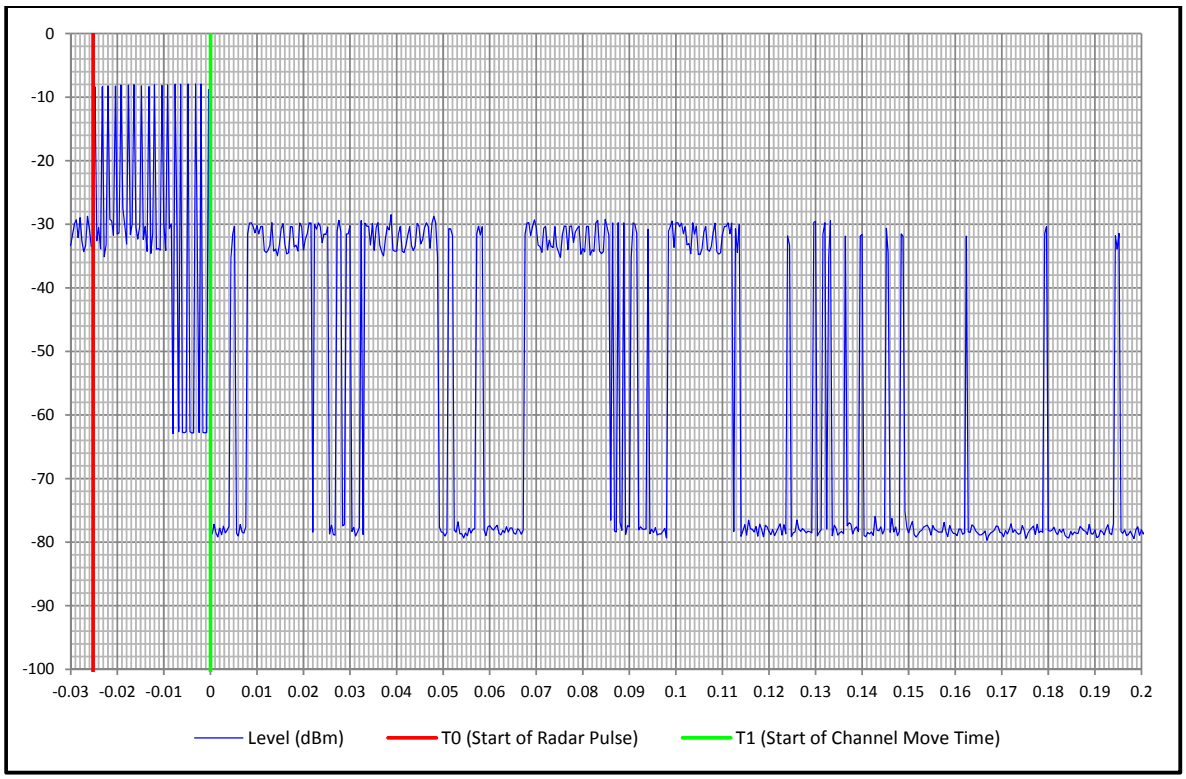


Channel Move Time



Zoomed Plot of Channel Move Time

Channel Closing Transmission Time and Channel Move Time (continued)



Plot Showing Radar Pulse Relative to Time Scale (0=T1) and first 200 ms of Channel Shutdown

5.2.1.1. Non-occupancy Period

Test Summary:

Test Engineer:	Philip Harrison	**Test Date:**	24 September 2012
Test Sample Serial No.:	HX2W91SC700031T		

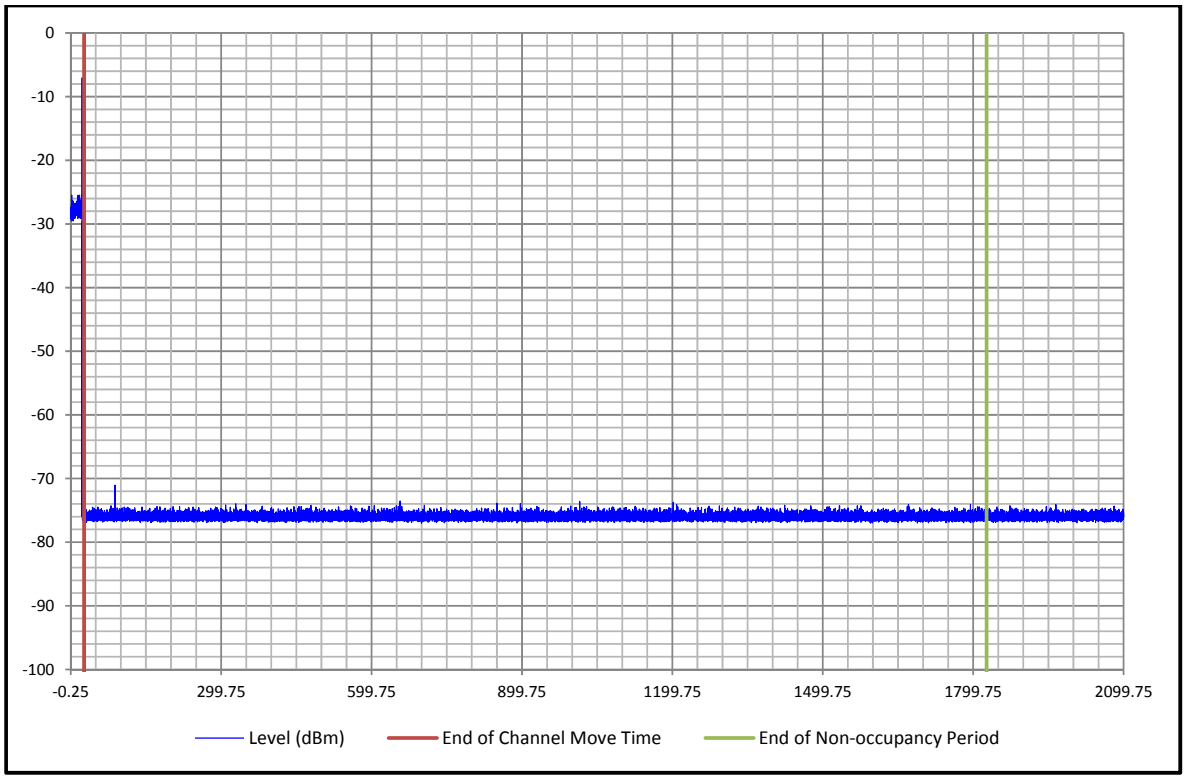
FCC Reference:	Part 15.407(h)(iv)
Industry Canada Reference:	RSS-210 A9.3(b)(v)
Test Method Used:	FCC 06-96 Section 7.8.3

Environmental Conditions:

Temperature (°C):	26.7
Relative Humidity (%):	33

Results: 20 MHz

Radar burst type 1 detected and channel was vacated for >30 minutes.



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)
A248	Variable Attenuator	Narda	743-60	01411	Calibrated Before Use	-
A030	Step Attenuator	Narda	745-69	01544	Calibrated Before Use	-
A163	Step Attenuator	Narda	743-80	01344	Calibrated Before Use	-
A2182	RF Circulator	AtlanTec RF	ACC-20130 SF-SF-SF	120409231	Calibrated Before Use	-
L1056	Power splitter	Mini-Circuits	ZN4PD1-63-S+	F310200814	Calibrated Before Use	-
L1076	Spectrum Analyser	Rohde & Schwarz	FSU8	101349	29 Sep 2012	12
M1361	DFS Radar Simulator and Analyser	Aeroflex	110105	300110/291	11 Feb 2013	12

Appendix 2. Aeroflex Test Platform Approval email

From: Andrew Leimer [mailto:Andrew.Leimer@fcc.gov]
Sent: Friday, September 23, 2011 4:24 PM
To: Chisham, Steve
Cc: Carey, Tim; Hack, Barry; Rashmi Doshi; Joe Dichoso
Subject: RE: Certification for Aeroflex DFS solution

Hello Steve,

The Aeroflex "DXI based DFS test solution" system used for DFS alternative radar signal generation has been approved by the FCC and NTIA.

This approval permits the system to be used by labs in the testing of DFS devices for equipment authorization Certification. It is recommended that applicants that use your system for testing include a statement in the Test Report or a Letter Exhibit stating that the system has FCC and NTIA approval. This E-mail is your record of this approval.
Note that the appropriate term for your system is Approved as the term Certification is reserved for devices gaining equipment authorization through the FCC or a TCB.

Regards,

Andy Leimer

FCC/OET/EACB