RADIO TEST REPORT

Test Report No. : 10852538H-B

Applicant	:	**silex technology, Inc.**
Type of Equipment	:	**PCI Express mini card WLAN module**
Model No.	:	**SX-PCEAC**
FCC ID	:	**N6C-PCEAC**
Test regulation	:	**FCC Part 15 Subpart E: 2015 (DFS test only)**
Test Result	:	**Complied**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
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6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)

Date of test: August 25, 2015

Representative test engineer: T. Shimada
Takumi Shimada
Engineer
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Leader
Consumer Technology Division

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REVISION HISTORY

Original Test Report No.: 10852538H-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10852538H-B	September 2, 2015	-	-

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SECTION 1: Customer information

Company Name	:	silex technology, Inc.
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Contact Person	:	Toshiro Kometani

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	PCI Express mini card WLAN module
Model No.	:	SX-PCEAC
Serial No.	:	Refer to Clause 4.2
Rating	:	DC 3.3 V
Receipt Date of Sample	:	June 1, 2015
Country of Mass-production	:	Japan
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: SX-PCEAC (referred to as the EUT in this report) is a PCI Express mini card WLAN module.

General Specification

Clock frequency(ies) in the system	:	40 MHz
Operating Temperature	:	0 deg. C - +60 deg. C

Radio Specification

Radio Type	:	Transceiver
Method of Frequency Generation	:	Synthesizer
Power Supply (inner)	:	DC 1.2 V

Type of radio	IEEE802.11a/n/ac (20 M band)	IEEE802.11n/ac (40 M band)	IEEE802.11ac (80 M band)
Frequency of operation	5180 MHz - 5240 MHz 5260 MHz - 5320 MHz 5500 MHz - 5700 MHz 5745 MHz - 5825 MHz	5190 MHz - 5230 MHz 5270 MHz - 5310 MHz 5510 MHz - 5670 MHz 5755 MHz - 5795 MHz	5210 MHz 5290 MHz 5530 MHz - 5610 MHz 5775 MHz
Type of modulation	11a/n: OFDM (64QAM, 16QAM, QPSK, BPSK) 11ac: OFDM (64QAM, 16QAM, QPSK, BPSK, 256QAM)		
Channel spacing	20 MHz	40 MHz	80 MHz
Antenna type	External Antenna		
Antenna connector type	U.FL Alternative connector		
Antenna Gain	W52: 3.5 dBi W53: 3.7 dBi W56: 3.4 dBi W58: 3.1 dBi		

SECTION 3: Scope of Report

This report only covers DFS requirement, as specified by the following referenced procedures.

SECTION 4: Test specification, procedures & results

4.1 Test Specification

Test Specification	:	FCC Part 15 Subpart E: 2015, final revised on June 12, 2015 and effective July 13, 2015
Test Specification	:	KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02
Title	:	COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350MHz AND 5470-5725MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION
Test Specification	:	KDB905462 D03 Client Without DFS New Rules v01r01
Title	:	U-NII CLIENT DEVICES WITHOUT RADAR DETECTION CAPABILITY

FCC Part 15.31 (e)
This EUT provides stable voltage (DC 1.2 V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement
The EUT has a unique coupling/antenna connector (U.FL Alternative connector). Therefore the equipment complies with the requirement of 15.203/212.

4.2 Procedures and results

Table 1: Applicability of DFS Requirements

Requirement	Operating Mode Client without Radar Detection	Test Procedures & Limits	Deviation	Results
U-NII Detection Bandwidth	Not required	KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02	N/A	N/A
Initial Channel Availability Check Time	Not required	FCC15.407 (h) KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02 RSS-247 6.3	N/A	N/A
Radar Burst at the Beginning of the Channel Availability Check Time	Not required	FCC15.407 (h) KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02 RSS-247 6.3	N/A	N/A
Radar Burst at the End of the Channel Availability Check Time	Not required	FCC15.407 (h) KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02 RSS-247 6.3	N/A	N/A
In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time	Yes	FCC15.407 (h) KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02 RSS-247 6.3	N/A	Complied
In-Service Monitoring for Non-Occupancy period	Yes *	FCC15.407 (h) KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02 RSS-247 6.3	N/A	Complied
Statistical Performance Check	Not required	FCC15.407 (h) KDB905462 D02 UNII DFS Compliance Procedures New Rules v01r02	N/A	N/A
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0422.				

*Although this test was not required in FCC, KDB 905462 D02, it was performed as additional test.

Table 2 DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value (See Notes 1,2, and 3)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt and power spectral density < 10dBm/MHz	-62 dBm
< 200 milliwatt that do not meet the power spectral density requirement	-64 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. Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

Table 3 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 100% of the U-NII 99% transmission power bandwidth See Note 3
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. **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 a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signal will not count quiet periods in between transmissions. **Note 3:** During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

Table 4 Short Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Traials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup{(1/360)* (19*10^6/PRI $_{usec}$)}	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A			
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 (Rader Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Table 5 Long Pulse Radar Test Waveform

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

Table 6 Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulse per Hop (kHz)	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

4.3 Test Location

UL Japan, Inc. Ise EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	6.2 x 4.7 x 3.0m	4.8 x 4.6m	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

4.4 Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.
Time Measurement uncertainty for this test was: (±) 0.012%

4.5 Test instruments of DFS, Test set up

Refer to APPENDIX.

SECTION 5: Operation of E.U.T. during testing

5.1 Operating Modes

For FCC the EUT operates over the 5260-5320MHz, 5500-5700MHz, 5270-5310MHz, 5510-5670MHz, 5290MHz and 5530-5610MHz ranges.
For IC the EUT operates over the 5260-5320MHz, 5500-5700MHz, 5270-5310MHz, 5510-5670MHz, 5290MHz and 5530-5610MHz ranges, excluding the 5600-5650MHz range.

The highest output power level is 24.47dBm (11n-40 ANT 0+1+2) EIRP in the 5250-5350MHz and 5500 - 5700MHz band.
The highest power spectral density level is 9.23dBm/MHz (11n-20 ANT 0+1+2) in the 5250-5350MHz and 5500 - 5700MHz band.

Power level (EIRP) of the EUT[dBm]

Output Power (Max)		
20Mband	40MHz	80MHz
23.79	24.47	20.53

Power spectral density level (Conducted) of the EUT[dBm/MHz]

Output Power (Max)		
20Mband	40MHz	80MHz
9.23	6.76	1.13

*Refer to 10852538H-A, FCC Part 15E (FCC 15.407) report for other parts than DFS.

WLAN traffic is generated by streaming the MPEG Test file "6 ½ Magic Hours" from the Master to the Client in full motion video mode using the media player with the V2.61 Codec package.

The EUT utilizes the 802.11ac architecture, with a 80MHz channel bandwidth.

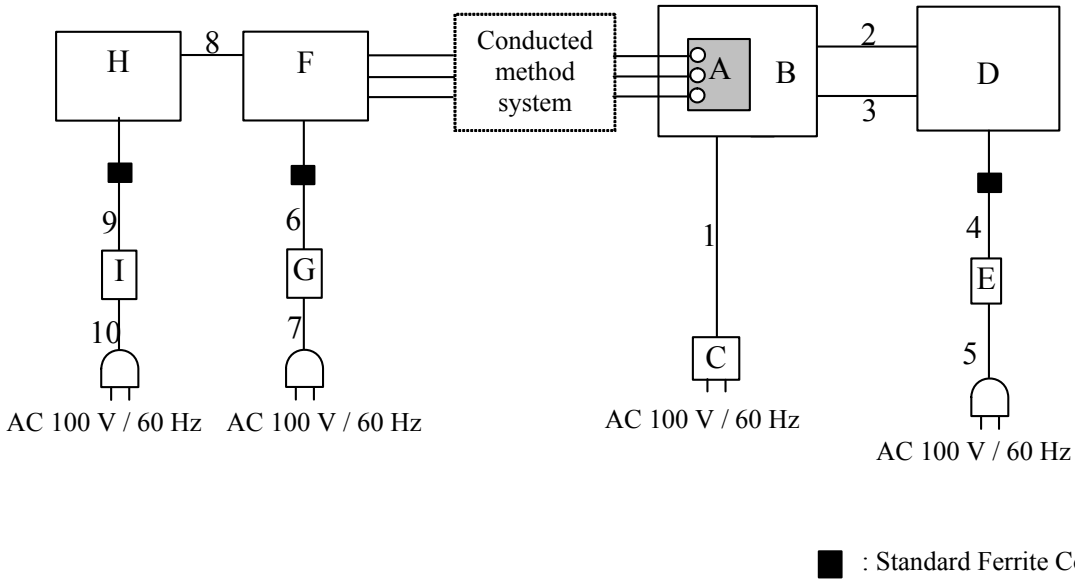
The FCC ID for the Master Device used with EUT for DFS testing is LDK102087.

The rated output power of the Master unit is >200mW(23dBm). Therefore the required interference threshold level is -64 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is -64 + 1 + 0 = -63.0 dBm (threshold level + additional 1dB + antenna gain).

It is impossible for users to change DFS control, because the DFS function is written on the firmware and users cannot access it.

The EUT was set by the software as follows:
Software name & version: LSDK 10.x

5.2 Configuration and peripherals



Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	PCI Express mini card WLAN module	SX-PCEAC	84:25:3F:01:07:8D	silex technology, Inc.	EUT
B	Jig Board	-	-	silex technology, Inc.	-
C	AC Adapter	AG2412-B	-	JENTECTECHNOLOGY CO, LTD.	-
D	Laptop PC	T60	L3-DM302 06/11	Lenovo	-
E	AC Adapter	42T4418	11S42T4418Z1ZF3B 98T9P1	Lenovo	-
F	Wireless LAN access point	AIR-CAP3702E-A-K9	FTX182276QN	CISCO	-
G	AC Adapter	AA25480L	ADL02510GYT	CISCO	-
H	Laptop PC	T60	L3-DM301 06/11	Lenovo	-
I	AC Adapter	92P1160	11S92P1160Z1ZBGH 7B99A8	Lenovo	-

List of cables used

No.	Name	Length (m)	Shield	
			Cable	Connector
1	DC Cable	1.8	Unshielded	Unshielded
2	USB Cable	1.2	Shielded	Shielded
3	LAN Cable	3.0	Unshielded	Unshielded
4	DC Cable	1.8	Unshielded	Unshielded
5	AC Cable	1.0	Unshielded	Unshielded
6	DC Cable	1.9	Unshielded	Unshielded
7	AC Cable	2.0	Unshielded	Unshielded
8	LAN Cable	3.0	Unshielded	Unshielded
9	DC Cable	1.8	Unshielded	Unshielded
10	AC Cable	0.8	Unshielded	Unshielded

5.3 Test and Measurement System

SYSTEM OVERVIEW

The measurement system is based on a conducted test method.

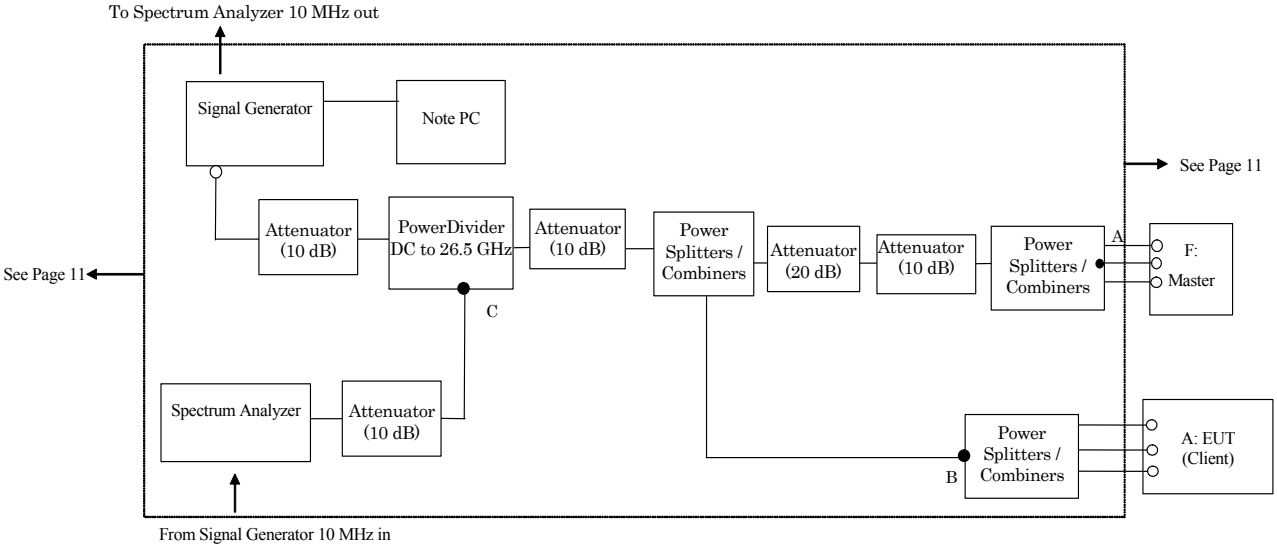
The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution. The short pulse types 2, 3, and 4, the long pulse type 5, and the frequency hopping type 6 parameters are randomized at run-time.

The signal monitoring equipment consists of a spectrum analyzer with the capacity to display 8001 bins on the horizontal axis. A time-domain resolution of 2 msec/bin is achievable with a 16 second sweep time, meeting the 10 seconds short pulse reporting criteria. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection. A time-domain resolution of 3 msec/bin is achievable with a 24 second sweep time, meeting the 22 second long pulse reporting criteria and allowing a minimum of 10 seconds after the end of the long pulse waveform.

FREQUENCY HOPPING RADAR WAVEFORM GENERATING SUBSYSTEM

The first 100 frequencies are selected out of the hopping sequence of the randomized 475 hop frequencies.
Only a *Burst* that has the frequency falling within the receiver bandwidth of the tested U-NII device is selected among those frequencies. (Frequency-domain simulation). The radar waveform generated at the start time of the selected *Burst* (Time-domain simulation) is download to the Signal Generator.
If all of the randomly selected 100 frequencies do not fall within the receiver bandwidth of the U-NII device, the radar waveform is not used for the test.

CONDUCTED METHODS SYSTEM BLOCK DIAGRM



MEASUREMENT SYSTEM FREQUENCY REFERENCE

Lock the signal generator and the spectrum analyzer to the same reference sources as follows: Connect the 10MHz OUT on the signal generator to the 10MHz IN on the spectrum analyzer and set the spectrum analyzer 10MHz In to On.

SYSTEM CALIBRATION

Step 1: Set the system as shown in Figure 3 of KDB905462 D02 7.2.2.

Step 2: Adjust each attenuator to fulfill the following three conditions:
- WLAN can be communicated, and
- Rader detection threshold level is bigger than Client Device traffic level on the spectrum analyzer, and
- Master Device traffic level is not displayed on the spectrum analyzer.

Step 3: Terminate 50 ohm at B and C points, and connect the spectrum analyzer to the point A. (See the figure on page 13)
At the point A, adjust the signal generator and spectrum analyzer to the center frequency of the channel to be measured.
Download the applicable radar waveforms to the signal generator. Select the radar waveform, trigger a burst manually and measure the amplitude on the spectrum analyzer. Readjust the amplitude of the signal generator as required so that the peak level of the waveform is at a displayed level equal to the required or desired interference detection threshold.
Separate signal generator amplitude settings are determined as required for each radar type.

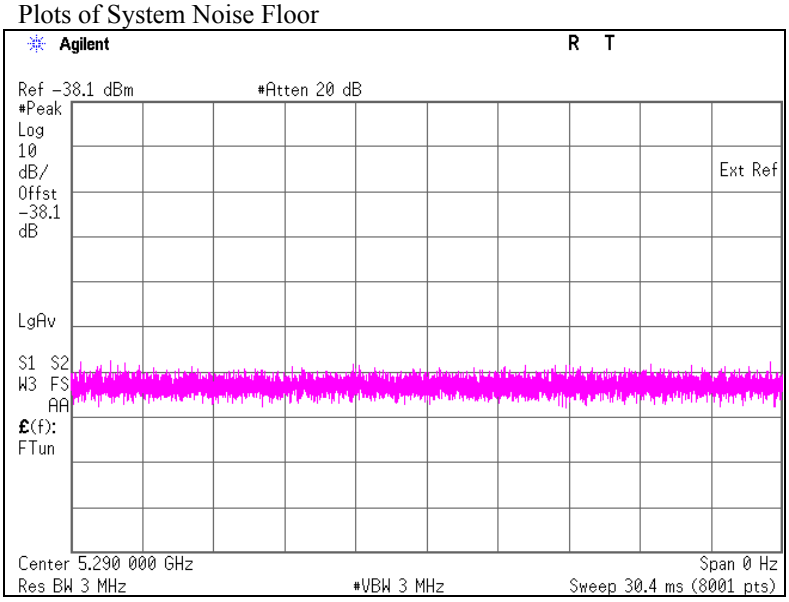
Step 4: Without changing any of the instrument settings, restore the system setting to Step 2 and adjust the Reference Level Offset of the spectrum analyzer to the level at Step 3.

By taking the above steps 1 to 4, the spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device.

See Clause 5.4 for Plots of Noise, Rader Waveforms, and WLAN signals.

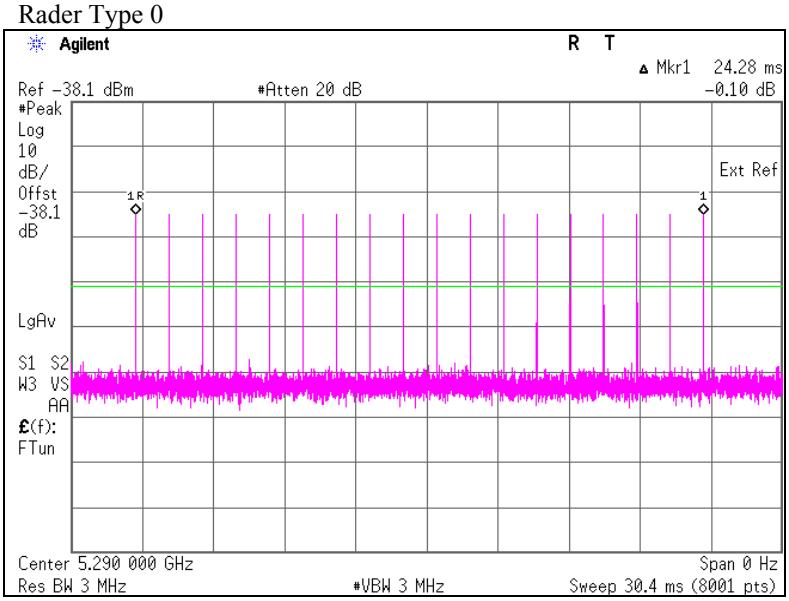
5.4 Plots of Noise, Rader Waveforms, and WLAN signals

Plots of System Noise Floor

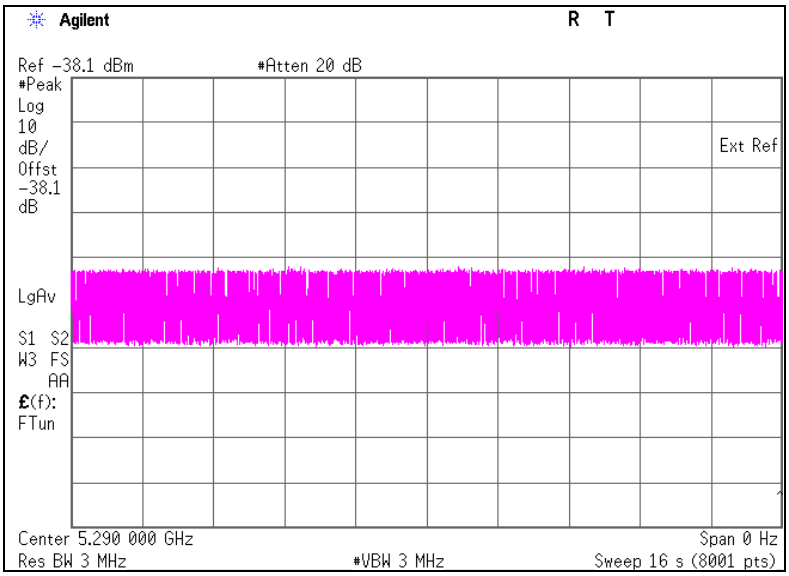


Plots of Radar Waveforms

Rader Type 0



Plots of WLAN Traffic



SECTION 6: Channel Move Time, Channel Closing Transmission Time

6.1 Operating environment

Test place : No.11 measurement room
Temperature : 24 deg. C
Humidity : 57 % RH

6.2 Test Procedure

Stream the MPEG test file from the Master Device to the Client Device on the test Channel for the entire period of the test.
The Radar Waveform generator sends a Burst of pulses for one of the Short Pulse Radar Types 0 at levels defined , on the Operating Channel. An additional 1 dB is added to the radar test signal to ensure it is at or above the DFS Detection Threshold, accounting for equipment variations/errors.
Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds.

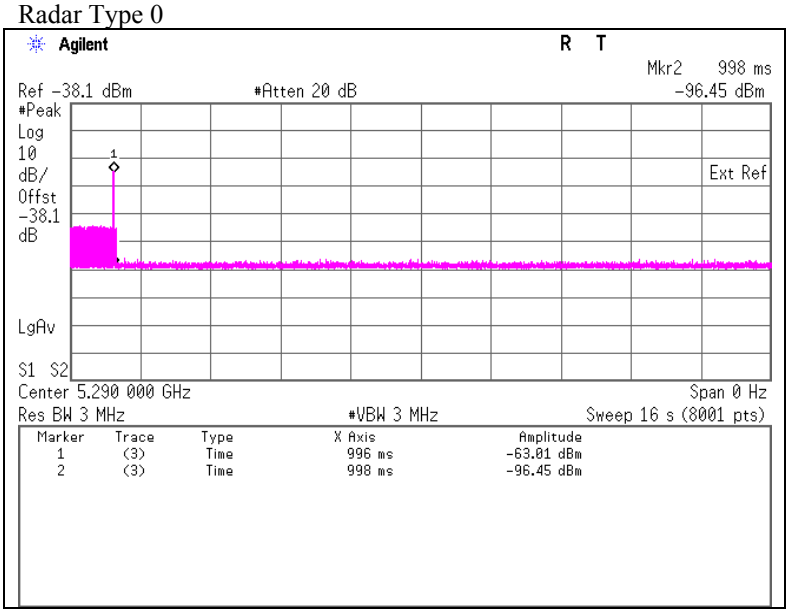
6.3 Test data

Test Item	Unit	Measurement Time	Limit	Results
Channel Move Time *1)	[sec]	0.002	10.000	Pass
Channel Closing Transmission Time *2)	[msec]	0	60	Pass

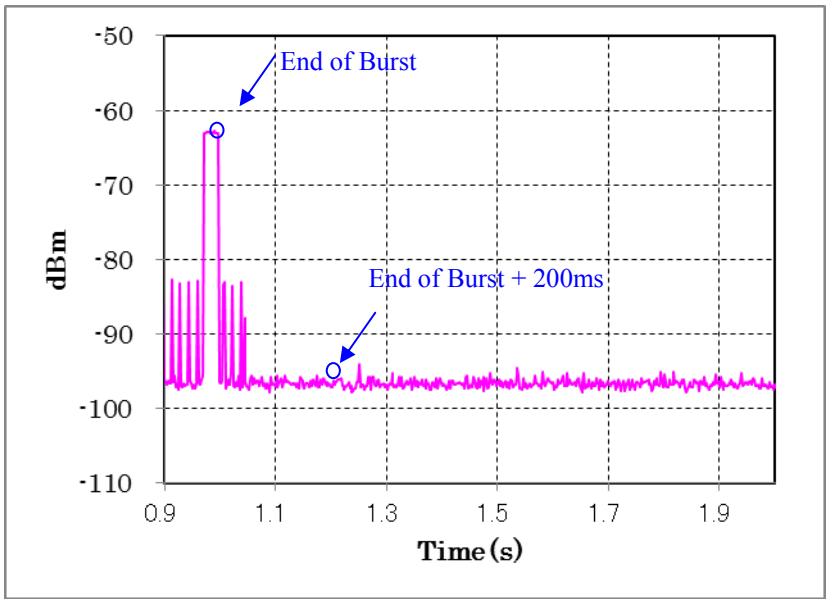
*1) Channel Move Time is calculated as follows:
(Channel Move Time) = (End of Transmission) - (End of Burst) = 0.998-0.996

*2) Channel Closing Transmission Time is calculated from (End of Burst + 200msec) to (End of Burst + 10sec)
(Channel Closing Transmission Time) = (Number of analyzer bins showing transmission)＊(dwell time per bin)
= 0＊2(msec)

Radar Type 0



Marker 1 : End of Burst
Marker 2 : End of Transmission



6.4 Test result

Test result: Pass

Date : August 25, 2015 Test engineer : Takumi Shimada

SECTION 7: Non-Occupancy Period

7.1 Operating environment

Test place : No.11 measurement room
Temperature : 24 deg. C
Humidity : 57 % RH

7.2 Test Procedure

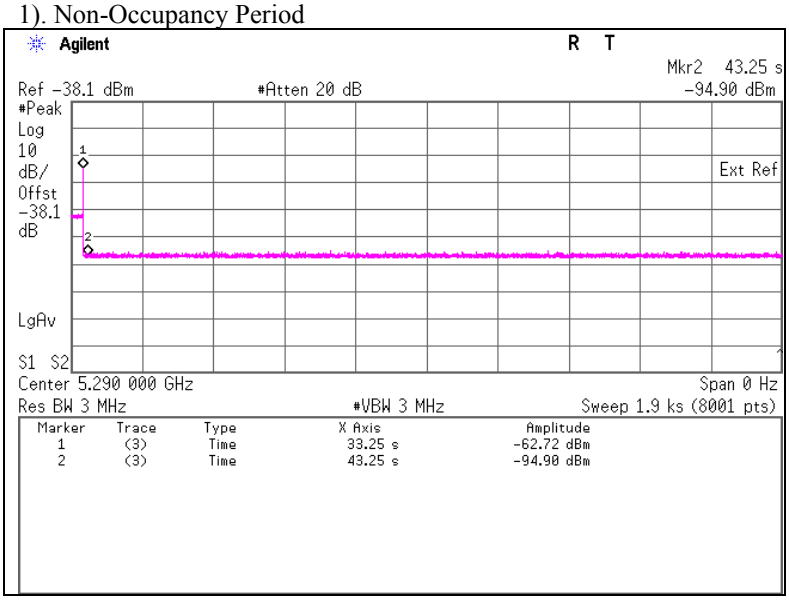
The following two tests are performed:

1).Stream the MPEG test file from the Master Device to the Client Device on the test Channel for the entire period of the test.
The Radar Waveform generator sends a Burst of pulses for one of the Radar Types 0 at levels defined on the Operating Channel. An additional 1 dB is added to the radar test signal to ensure it is at or above the DFS Detection Threshold, accounting for equipment variations/errors.
Observe the transmissions of the EUT after the Channel Move Time on the Operating Channel for duration greater than
30 minutes.

2). Stream the MPEG test file from the Master Device to the Client Device on the test Channel for the entire period of the test.
Observe the transmissions of the EUT on the Operating Channel for duration greater than 30 minutes after the Master Device is shut off.

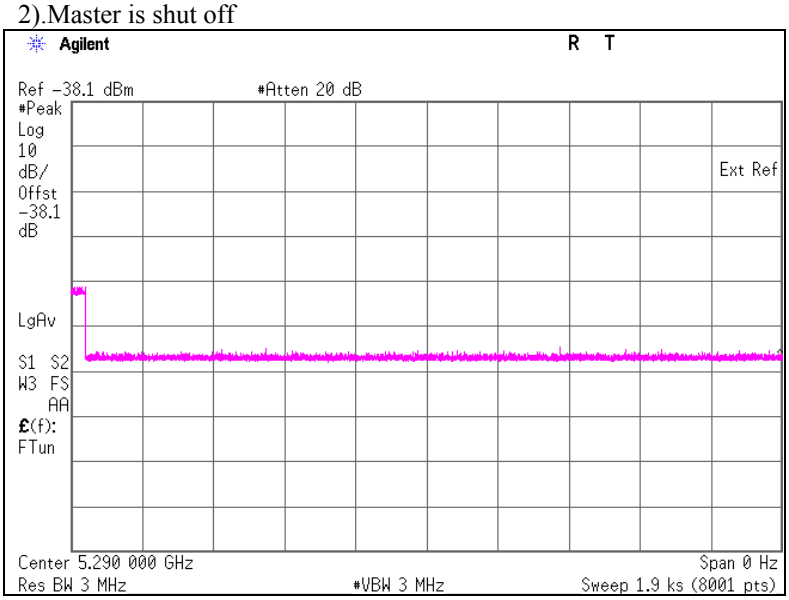
7.3 Test data

1). Non-Occupancy Period



Marker 1 : End of Burst : 33.25 sec
Marker 2 : End of Burst +10sec : 43.25 sec

2).Master is shut off



7.4 Test result

Test result: Pass

Date : August 25, 2015 Test engineer : Takumi Shimada

APPENDIX 1: Test instruments

EMI Test Equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MSA-16	Spectrum Analyzer	Agilent	E4440A	MY46186390	DFS	2015/02/16 * 12
EST-48 *1)	Signal Generator	Agilent	E4438C	MY45090353	DFS	2014/12/19 * 12
MAT-56	Attenuator(10dB)	Suhner	6810.19.A	-	DFS	2015/01/08 * 12
MAT-57	Attenuator(10dB)	Suhner	6810.19.A	-	DFS	2015/01/08 * 12
MAT-58	Attenuator(10dB)	Suhner	6810.19.A	-	DFS	2015/01/09 * 12
MAT-59	Attenuator(20dB)	Suhner	6820.19.A	-	DFS	Pre Check
MAT-22	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	DFS	2015/03/18 * 12
MCC-67	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28635/2	DFS	2015/04/09 * 12
MCC-172	Microwave Cable	Junkosha	MWX221	1409S495	DFS	2015/03/04 * 12
MPS-02	Power Splitter	Mini-Circuits	ZN4PD1-63-S+	001	DFS	2015/06/02 * 12
MPS-03	Power Splitter	Mini-Circuits	ZN4PD1-63-S+	002	DFS	2015/06/02 * 12
MPSC-04	Power Splitters/Combiners	Mini-Circuit	ZFSC-2-10G	0326	DFS	2014/09/26 * 12
MPSC-06	Power Splitters/Combiners	Pasternack Enterprises	ZFRSC-123-S+	ZFRSC-123-00231	DFS	Pre Check
MCC-181	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S308	DFS	Pre Check
MCC-182	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S309	DFS	Pre Check
MCC-183	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S310	DFS	Pre Check
MCC-184	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S311	DFS	Pre Check
MCC-185	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S312	DFS	Pre Check
MCC-35	Microwave Cable	Hirose Electric	U.FL-2LP-066-A-(200)	-	DFS	2014/09/12 * 12
MCC-36	Microwave Cable	Hirose Electric	U.FL-2LP-066-A-(200)	-	DFS	2014/09/12 * 12
MCC-37	Microwave Cable	Hirose Electric	U.FL-2LP-066-A-(200)	-	DFS	2014/09/25 * 12
COTS-MDFS-01	Signal Studio Software for DFS	Agilent	N7620A-101	5010-7739	DFS	-
COTS-MDFS-02	Radar Generating Software for DFS	Agilent	-	-	DFS	-
MOS-19	Thermo-Hygrometer	Custom	CTH-201	0001	DFS	2014/12/22 * 12

***1) Signal generator is only used to generate radar test signal, and the wave form is confirmed with spectrum analyzer every time before the test.**

The expiration date of the calibration is the end of the expired month.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

DFS: Dynamic Frequency Selection