RADIO TEST REPORT

Test Report No. : 4786001102S-C

Applicant	:	**Canon Inc.**
Type of Equipment	:	**Wireless Module**
Model No.	:	**RF400**
FCC ID	:	**AZD400**
Test regulation	:	**FCC Part 15 Subpart E: 2012 Section 15.407(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 the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.

Date of test : January 23, 2013

Representative test engineer:

Kenichi Adachi
Engineer of WiSE Japan, UL
Verification Service

Approved by :

Toyokazu Imamura
Leader of WiSE Japan, UL
Verification Service

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☒ There is no testing item of "Non-accreditation".

RTL02610

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REVISION HISTORY

Original Test Report No.: 4786001102S-C

Revision	Test report No.	Date	Page revised	Contents
- (Original)	4786001102S-C	March 5, 2013	-	-
1	4786001102S-C	April 2, 2013	1-2, 4-5, 9	P4-5: Change of specification P4,9: Change of test report #
2	4786001102S-C	April 2, 2013	9	highest power and frequency band lowest power and frequency band Power level of the EUT: Output power

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CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	Canon Inc.
Address	:	30-2, Shimomaruko 3-chome, Ohta-ku, Tokyo, 146-8501 Japan
Telephone Number	:	+81-3-5482-8070
Facsimile Number	:	+81-3-3757-8431
Contact Person	:	Yasushi Sasaki

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

2.1 Identification of E.U.T.

Type of Equipment	:	Wireless Module
Model Number	:	RF400
Serial Number	:	Refer to 5.2 in this report.
Rating	:	DC 3.3V
Country of Mass-production	:	China
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Receipt Date of Sample	:	January 22, 2013
Modification of EUT	:	No modification by the test lab.

2.2 Product description

Model: RF400 (referred to as the EUT in this report) is a Wireless Module.

Clock frequency(ies) in the system : 32.768kHz, 38.4MHz

Radio specification:

Equipment type	:	Transceiver	
Frequency of operation *1)	:	2.4GHz:	2412-2462MHz (IEEE 802.11b, 11g, 11n (20HT)) 2422-2452MHz (IEEE 802.11n (40HT))
		W53:	5280-5320MHz (IEEE 802.11a, 11n (20HT)) 5310MHz (IEEE 802.11n (40HT))
		W58:	5745-5805MHz (IEEE 802.11a, 11n (20HT)) 5755-5795MHz (IEEE 802.11n (40HT))
Bandwidth	:	20MHz (IEEE 802.11a/b/g/n), 40MHz (IEEE 802.11n)	
Channel spacing	:	5MHz (2.4GHz), 20MHz (11a, 11n (20HT, 5GHz)), 40MHz (11n (40HT, 5GHz))	
Type of modulation	:	DSSS, OFDM	
Antenna type	:	Monopole type chip antenna	
Antenna connector type	:	None	
Antenna gain with cable loss	:	2.1dBi (2.4GHz), 2.4dBi (5GHz)	
ITU code	:	D1D, G1D	
Operation temperature range	:	-20 to +80 deg.C	

* Refer to the test report 4786001102S-A for FCC 15.247 part, 4786001102S-B-R1 for FCC 15.407 except DFS.

FCC 15.31 (e) / 212
The module is constantly provided the stable voltage from the host device regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC 15.203 / 212
It is impossible for end users to replace the antenna, because it is soldered on the circuit board. Therefore the equipment complies with the requirement of 15.203/212.

SECTION 3: Scope of Report

The EUT has the channels from 5280 to 5320MHz and from 5745 to 5805MHz.
This report only covers DFS requirement subject to 5250-5350MHz band, as specified by the following referenced procedures.

SECTION 4: Test specification, procedures & results

4.1 Test Specification

Test specification:		FCC Part 15 Subpart E: 2012, final revised on December 27, 2012 and effective January 28, 2013
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart E Unlicensed National Information Infrastructure Devices Section 15.407 General technical requirements
Test Specification	:	FCC 06-96 APPENDIX
Title	:	COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION

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	FCC 06-96 Appendix 7.8.1	N/A	N/A
Initial Channel Availability Check Time	Not required	FCC15.407 (h) FCC 06-96 Appendix 7.8.2.1 RSS-210 A9.3	N/A	N/A
Radar Burst at the Beginning of the Channel Availability Check Time	Not required	FCC15.407 (h) FCC 06-96 Appendix 7.8.2.2 RSS-210 A9.3	N/A	N/A
Radar Burst at the End of the Channel Availability Check Time	Not required	FCC15.407 (h) FCC 06-96 Appendix 7.8.2.3 RSS-210 A9.3	N/A	N/A
In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time	Yes	FCC15.407 (h) FCC 06-96 Appendix 7.8.3 RSS-210 A9.3	N/A	Complied
In-Service Monitoring for Non-Occupancy period	Yes *	FCC15.407 (h) FCC 06-96 Appendix 7.8.3 RSS-210 A9.3	N/A	Complied
Statistical Performance Check	Not required	FCC15.407 (h) FCC 06-96 Appendix 7.8.4	N/A	N/A

*Although this test was not required in FCC 06-96, it was performed as additional test.

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

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.	

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 80% of the U-NII 99% transmission 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 Waveform*.

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 1 is used and 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
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 (Rader Types 1-4)				80%	120

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. Shonan EMC Lab.
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Telephone number : +81 463 50 6400
Facsimile number : +81 463 50 6401

No.1/ No.2/ No.3 anechoic chamber has been fully described in a report submitted to FCC office, and accepted on April 17, 2009 (Registration No.: 697847).
IC Registration No. : 2973D-1 (No1 anechoic chamber)
2973D-2 (No2 anechoic chamber)
2973D-3 (No3 anechoic chamber)

Test room	Width x Depth x Height (m)
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65 Maximum measurement distance: 10m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65 Maximum measurement distance: 10m
No.3 Semi-anechoic chamber	12.7 x 7.7 x 5.35 Maximum measurement distance: 5m
No.4 Semi-anechoic chamber	8.1 x 5.1 x 3.55

Test room	Width x Depth x Height (m)
No.1 Shielded room	6.8 x 4.1 x 2.7
No.2 Shielded room	6.8 x 4.1 x 2.7
No.3 Shielded room	6.3 x 4.7 x 2.7
No.4 Shielded room	4.4 x 4.7 x 2.7
No.5 Shielded room	7.8 x 6.4 x 2.7
No.6 Shielded room	7.8 x 6.4 x 2.7

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 set up, Data of DFS test, and Test instruments of DFS

Refer to APPENDIX 1 to 3.

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

5.1 Operating Modes

The EUT, which is a Client Device without Radar detection capability, operates over the 5260-5320MHz.

Operation : Communication mode IEEE 802.11a (OFDM) *2)
Tests Channel : W53 band 60ch 5300MHz
Data Rate : 6Mbps *1)

*1) The DFS tests shall be performed by using a test transmission sequence that shall consist of packet transmissions that together the transmitter minimum activity ratio of maximum duty. Thus , the test was performed with 6Mbps to comply with the conditions.
*2) Transmitting mode is normal operating, and it cannot select operating mode.

[W53 Band]
The highest power level is 14.96dBm EIRP in the 5280-5350MHz band.
The lowest power level is 14.68dBm EIRP in the 5280-5350MHz band.

Power level of the EUT [dBm]

Antenna	Band	Antenna Gain [dBi]	Output Power (Min) [dBm]	Output Power(Max) [dBm]
chip antenna	W53	2.40	12.28	12.56

*1) Refer to 4786001102-B-R1, FCC Part 15E (FCC 15.407) report for other parts than DFS.

The lowest antenna assembly gain of all available antenna assemblies is 2.4dBi (for 5280MHz to 5350MHz).

The EUT uses one transmitter connected to one 50-ohm coaxial antenna ports.

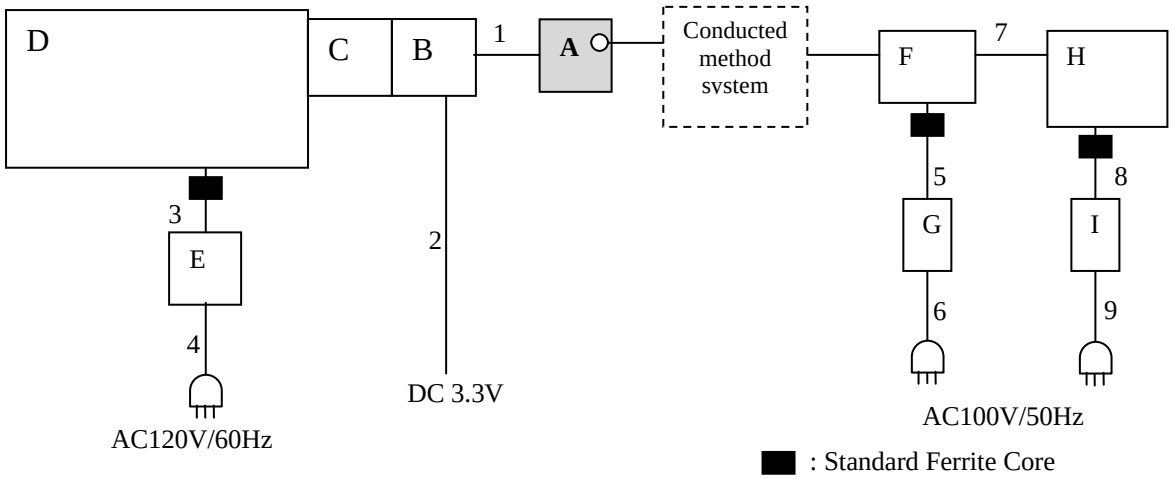
WLAN traffic is generated by streaming the MPEG Test file “6 ½ Magic Hours” from the Master to the Client in full motion video mode using the media player with the V2.61 Codec package.

The EUT utilizes the 802.11a and 802.11n architecture, with a nominal channel bandwidth.

The FCC ID for the Master Device used with EUT for DFS testing is LDK102073.

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 + 3.5 = -59.5 dBm (threshold level + additional 1dB + antenna gain).

5.2 Configuration and peripherals



Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless Module	RF400	11	Canon	EUT
B	SDIO EV Board	-	-	-	-
C	SDIO adapter	SK-1520	SK018C159	MAEVELL	-
D	Notebook Computer	CF-F9LWFJDS	1AKSA26004	Panasonic	-
E	AC Adaptor	CF-AA6502A	6502AM110X00440D	Panasonic	-
F	Wireless LAN access point (Master Device)	AIR-AP1262N-A-K9	FTX1619E5EZ	Cisco Systems	FCC ID: LDK102073
G	AC Adapter	EADP-18MB	DAB1528MANP	Cisco Systems	-
H	Notebook Computer	DELL Vostro V1510	29090510205	Dell	-
I	AC Adapter	LA65NS1-00	71615-93B-385D	Dell	-

List of cables used

No.	Cable Name	Length (m)	Shield	
			Cable	Connector
1	FPC	0.1	Unshielded	Unshielded
2	DC	0.5	Unshielded	Unshielded
3	Panasonic PC DC Power	1.2	Unshielded	Unshielded
4	Panasonic PC AC Power	0.8	Unshielded	Unshielded
5	Access Point DC Power	1.8	Unshielded	Unshielded
6	Access Point AC Power	2.0	Unshielded	Unshielded
7	LAN	3.0	Unshielded	Unshielded
8	DELL PC DC Power	1.8	Unshielded	Unshielded
9	DELL PC AC Power	0.7	Unshielded	Unshielded

5.3 Test and Measurement System

SYSTEM OVERVIEW

The measurement system is based on a conducted test method.

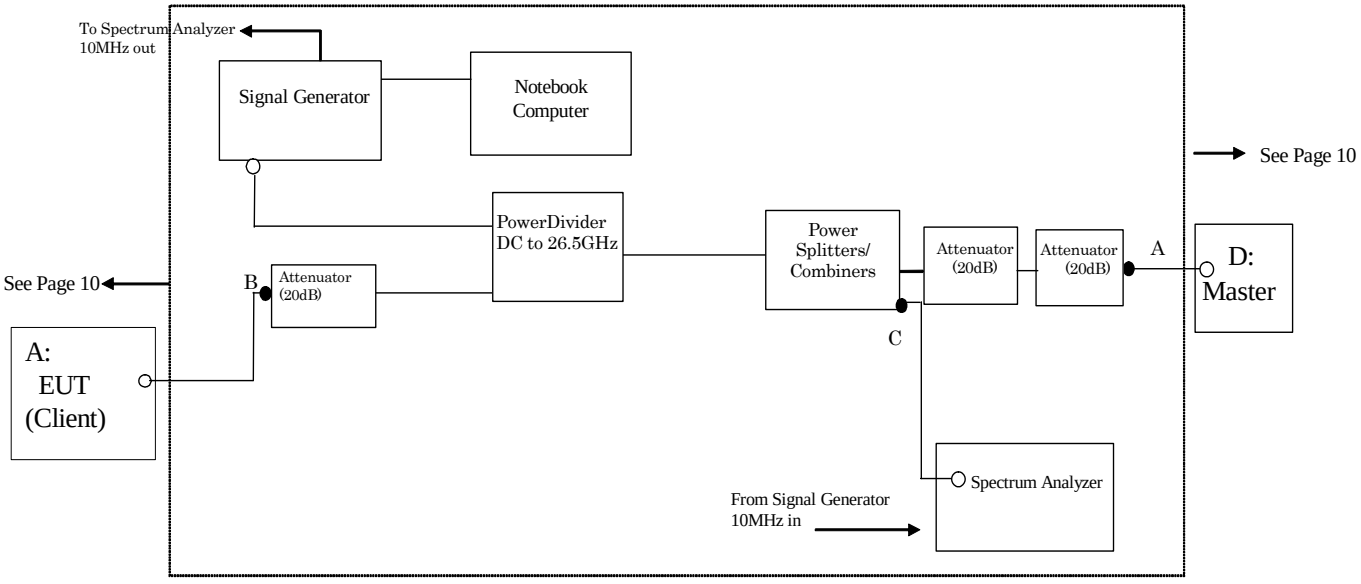
The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution. The short pulse types 2, 3, and 4, the long pulse type 5, and the frequency hopping type 6 parameters are randomized at run-time.

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 FCC 06-96 7.2.1.

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 11) 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.

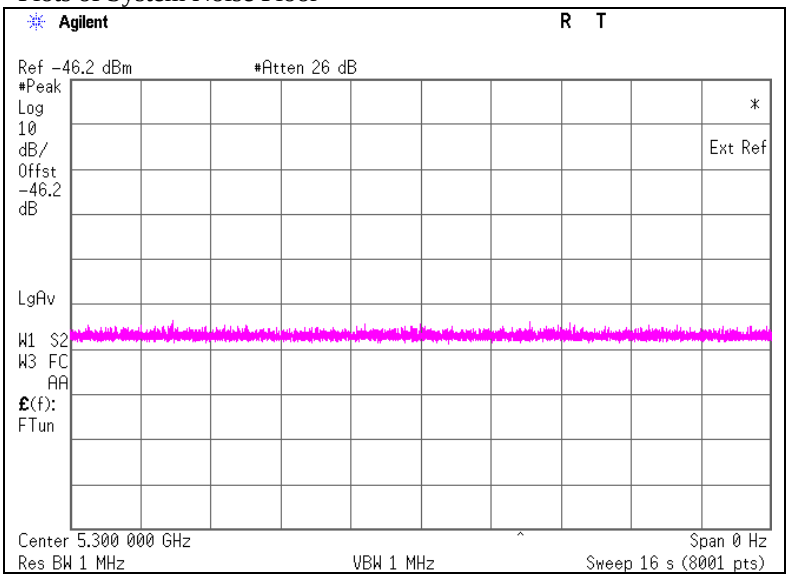
Step 4: Without changing any of the instrument settings, restore the system setting to Step 2 and adjust the Reference Level Offset of the spectrum analyzer to the level at Step 3.

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

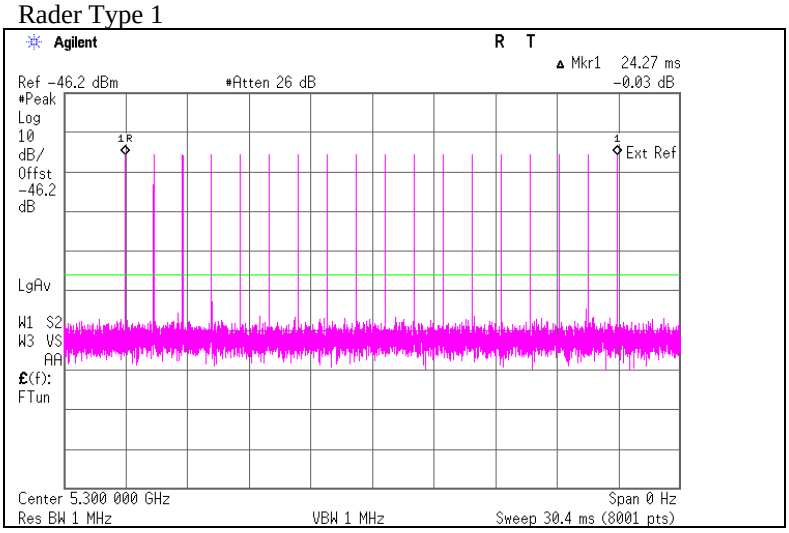
Plots of System Noise Floor



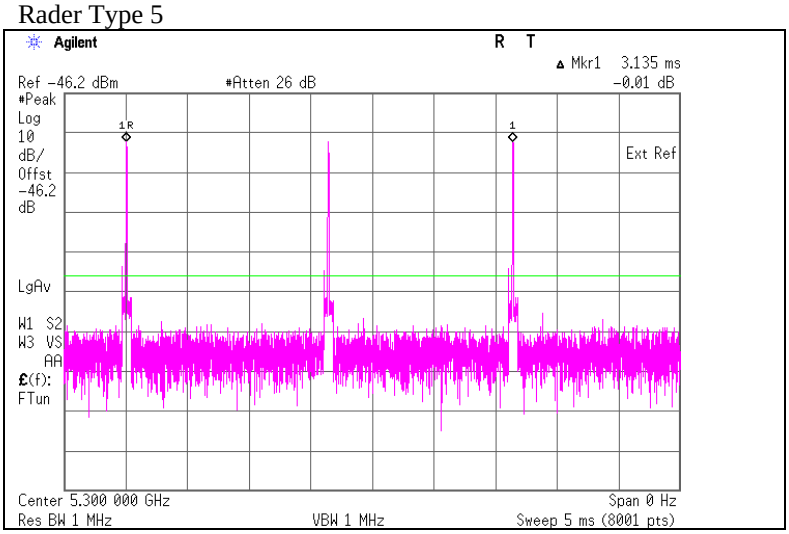
It was confirmed that the EUT did not transmit before having received appropriate control signals from a Master Device.

Plots of Radar Waveforms

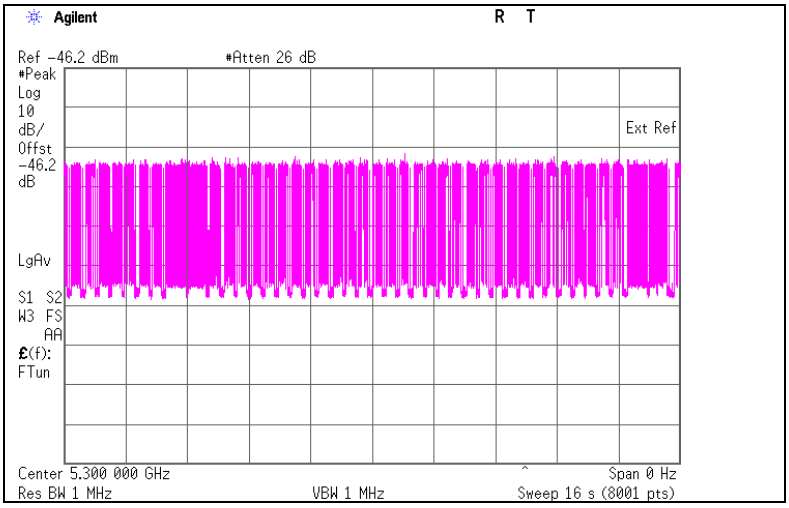
Rader Type 1



Rader Type 5



Plots of WLAN Traffic



SECTION 6: In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time

6.1 Operating environment

Test place : No.1 Measurement room
Temperature : 23 deg.C
Humidity : 45 %RH

6.2 Test Procedure

Transfer files from the Master Device to the Client Device on the tested channel during the entire period of the test. The Radar Waveform generator sends a Burst of pulses for one of the Short Pulse Radar Types 1-4 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.

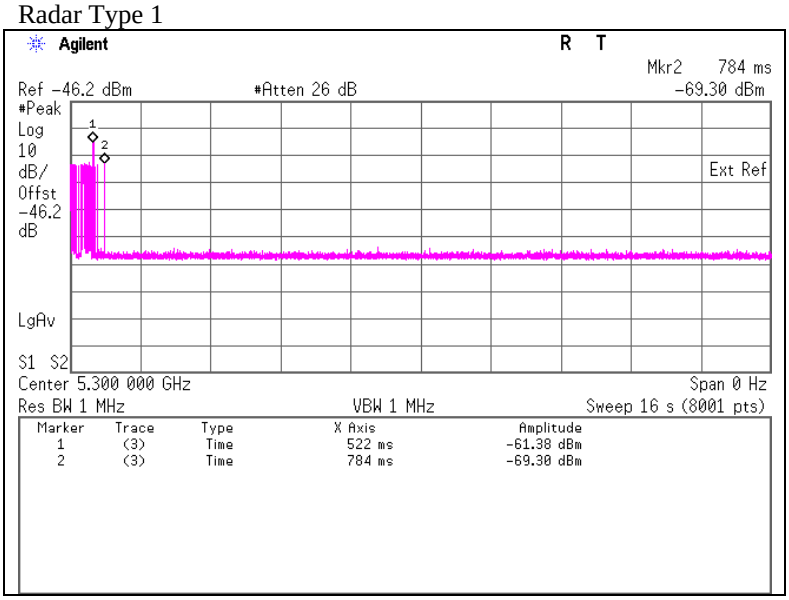
6.3 Test data

Test Item	Unit	Measurement Time	Limit	Results
Channel Move Time *1)	[sec]	0.262	10.000	Pass
Channel Closing Transmission Time *2)	[msec]	24	60	Pass

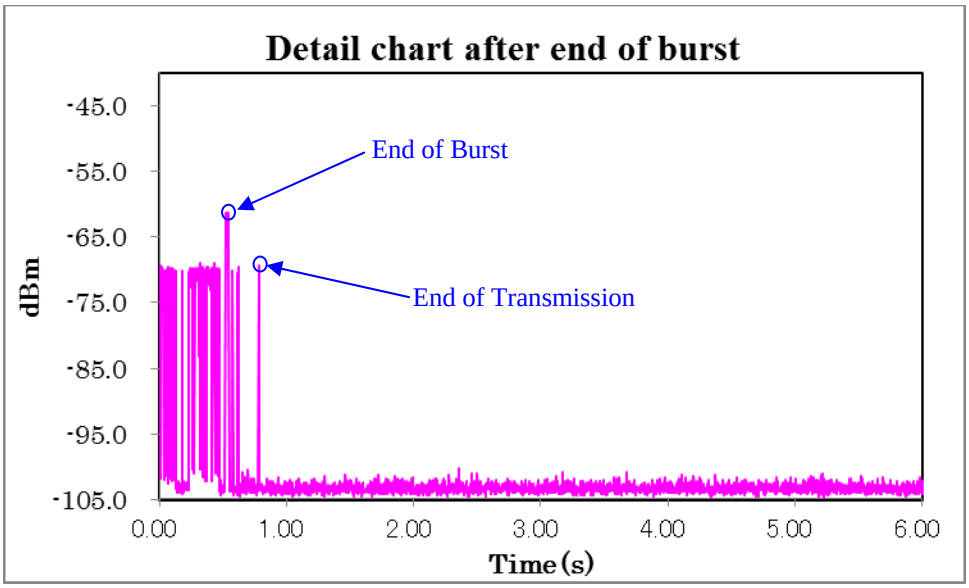
*1) Channel Move Time is calculated as follows:
(Channel Move Time) = (End of Transmission) - (End of Burst) = 784 [ms]– 522 [ms]

*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)
= 12＊2(msec)

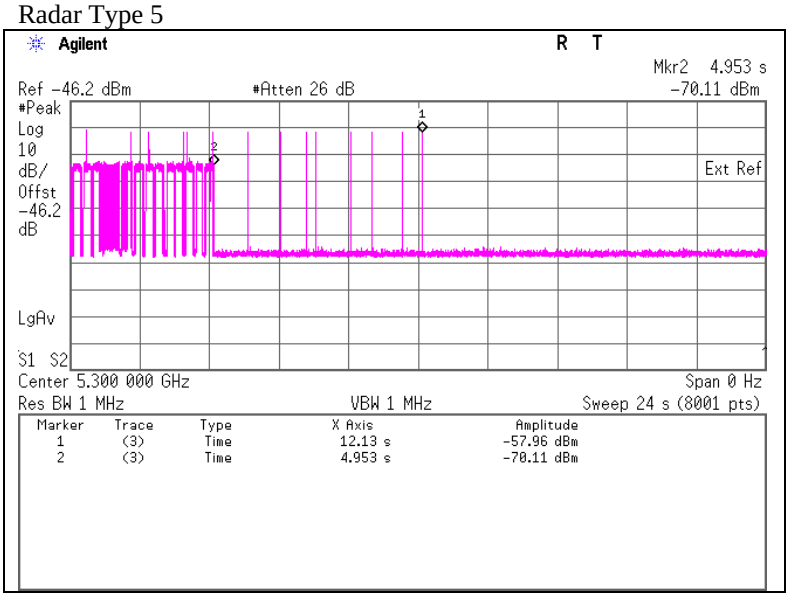
Radar Type 1



Marker 1: - End of Burst : 522ms
Marker 2: - End of Transmission : 784ms



Radar Type 5



Marker 1 : End of Burst : 12130ms
Marker 2 : End of Transmission : 4953ms

6.4 Test result

Test result: Pass

Date : January 23, 2013 Test engineer : Kenichi Adachi

SECTION 7: In-Service Monitoring for Non-Occupancy Period

7.1 Operating environment

Test place : No.1 Measurement room
Temperature : 24 deg.C
Humidity : 56 %RH

7.2 Test Procedure

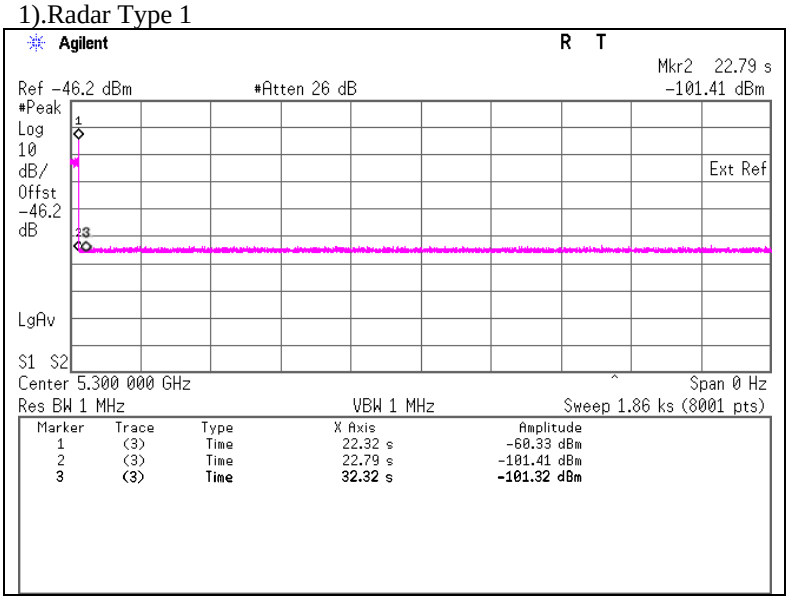
The following two tests are performed:

1). Transfer files from the Master Device to the Client Device on the tested channel during the entire period of the test. The Radar Waveform generator sends a Burst of pulses for one of the Radar Types 1-6 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). Transfer files from the Master Device to the Client Device on the tested channel during 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

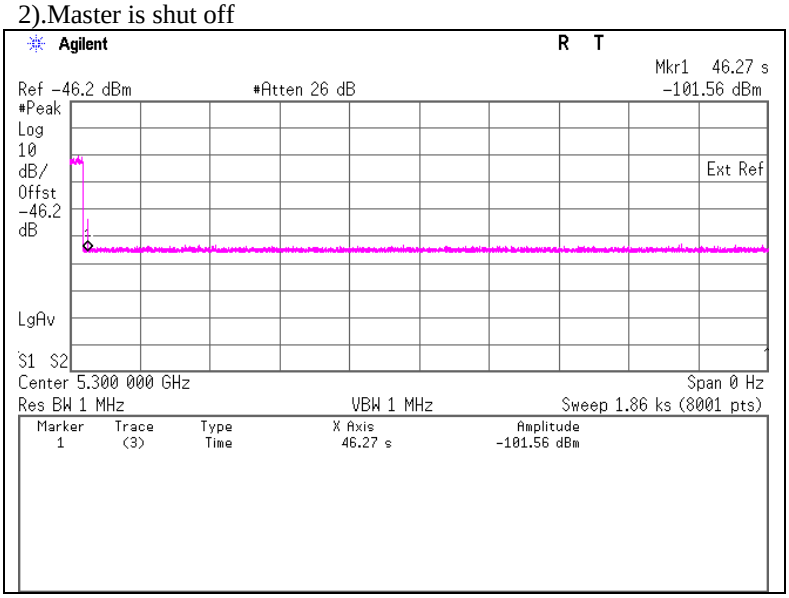
1).Radar Type 1



Marker 1 : End of Burst : 22.32sec
Marker 3 : End of Burst +10sec : 32.32sec

* Measurement non-occupancy period: 30.46 minutes or more (1860 [sec.]– 32.32 [sec.] = 1827.68[sec.] = 30.46 [min.])

2).Master is shut off



* Measurement non-occupancy period: 30.23 minutes or more (1860 [sec.]– 46.27 [sec.] = 1813.73[sec.] = 30.23 [min.])

7.4 Test result

Test result: Pass

Date : January 23, 2013 Test engineer : Kenichi Adachi

APPENDIX 1: Data of DFS test

Parameter Data for Radar Type 5

Trial Number	Burst	Number of Pulses	Pulse Width (usec)	Chirp Width (MHz)	Pulse 1-to-2 Spacing (usec)	Pulse 2-to-3 Spacing (usec)	Starting Location Within Interval (usec)
1	1	1	52	8			64
1	2	2	94	7	1535		680793
1	3	3	67	8	1851	1146	452538
1	4	1	50	18			791967
1	5	3	82	14	1511	1064	61930
1	6	2	98	12	1125		95345
1	7	1	76	6			434356
1	8	1	64	16			720311
1	9	1	79	13			728383
1	10	1	61	15			194181
1	11	3	73	16	1638	1497	569650
1	12	2	95	11	1811		434312
1	13	2	50	19	1491		613325
1	14	3	58	13	1254	1098	431579

APPENDIX 2: Test instruments

EMI Test Equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	DFS	2012/02/16 * 12
SSG-01	Signal Generator	Agilent	E4438C	MY47271584	DFS	2012/02/15 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	DFS	2012/03/12 * 12
SPSC-03	Power Splitters/Combiners	Mini-Circuit	ZFSC-2-10G	-	DFS	2012/04/19 * 12
SPD-01	Power Divider	Agilent	11636B	56998	DFS	2012/04/19 * 12
SAT20-05	Attenuator	Weinschel Corp.	54A-20	Y5649	DFS	2012/11/15 * 12
SCC-G11	Coaxial Cable	Suhner	SUCOFLEX 102	31595/2	DFS	2012/03/12 * 12
SAT20-02	Attenuator	Agilent	8493C-020	74890	DFS	2012/03/12 * 12
SAT20-03	Attenuator	Agilent	8493C-020	74891	DFS	2012/03/12 * 12
SCC-G12	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	DFS	2012/03/12 * 12
SPSC-04	Power Splitters/Combiners	Mini-Circuit	ZN4PD1-63-S+	-	DFS	2012/07/18 * 12
SCC-G24	Coaxial Cable	Suhner	141PE	-	DFS	2012/07/02 * 12
SCC-G25	Coaxial Cable	Suhner	141PE	-	DFS	2012/07/02 * 12
SCC-G26	Coaxial Cable	Suhner	141PE	-	DFS	2012/07/02 * 12
STM-G3	Terminator	Weinschel	M1459A	U6569	DFS	2012/07/18 * 12
SRE-104	Wireless LAN access point	Cisco Systems	AIR-AP1262N-A-K9	FTX1619E5EZ	DFS	
COTS-SDFS-01	Signal Studio Software for DFS	Agilent	N7620A-101	5010-7739	DFS	-

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test Item:

DFS: Dynamic Frequency Selection