



RADIO TEST REPORT

Test Report No. : 32DE0235-HO-D

Applicant : SAMSUNG ELECTRONICS CO., LTD.
Type of Equipment : GSM/GPRS 1900 Phone with 802.11abgn, BT3.0 (EDR)
Model No. : SHW-M410K
FCC ID : A3LSHWM410K
Test regulation : FCC Part 15 Subpart E: 2011 (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.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Date of test: November 28, 2011

Representative test engineer:

Takayuki Shimada
Engineer of WiSE Japan,
UL Verification Service

Approved by:

Takahiro Hatakeda
Leader of WiSE Japan,
UL Verification Service



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SECTION 1: Customer information

Company Name : SAMSUNG ELECTRONICS CO., LTD.
 Address : 416, MAETAN 3-DONG, YEONGTONG-GU SUWON-CITY,
 GYEONGGI-DO 443-742, SOUTH KOREA

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

2.1 Identification of E.U.T.

Type of Equipment : GSM/GPRS 1900 Phone with 802.11abgn, BT3.0 (EDR)
 Model No. : SHW-M410K
 Serial No. : Refer to Section 5, Clause 5.2
 Rating : DC3.7V
 Receipt Date of Sample : November 21, 2011
 Modification of EUT : No Modification by the test lab

2.2 Product Description

Radio Specification

Bluetooth

Equipment Type	Transceiver
Frequency of Operation	2402-2480MHz
Type of Modulation	FHSS
Bandwidth & Channel spacing	1MHz & 1MHz
Antenna Gain	-11.5dBi

WLAN (IEEE802.11a/b/g/n-20)

Equipment Type	Transceiver	
Frequency of Operation	2412-2462MHz	5180-5240MHz 5260-5320MHz 5500-5640MHz 5745-5825MHz
Type of Modulation	DSSS, OFDM	OFDM
Bandwidth & Channel spacing	20MHz & 5MHz	20MHz & 20MHz
Antenna Gain	2.4G: -11.5dBi	5G: -11.5dBi

*EUT cannot operate in the frequency range from 5660 to 5700MHz

GSM

Equipment Type	Transceiver
Frequency of Operation	[Up Link] PCS: 1850 – 1910MHz [Down Link] PCS: 1930 – 1990MHz
Type of Modulation	GMSK
Antenna Gain	-3.93dBi

[Additional model]

EUT (SHW-M410K) has a variant model: SHW-M410S.

Difference between two models is only software version name to identify each model.

Basic		Additional	
Model	SHW-M410K	Model	SHW-M410S
HW version	REV 0.7	HW version	REV 0.7
SW version	M410K.002	SW version	M410S.000

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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: 2011, final revised on July 8, 2011 and effective August 8, 2011

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	Test Procedures & Limits	Deviation	Results
	Client without Radar Detection			
U-NII Detection Bandwidth	Not required	FCC 06-96 Appendix 7.8.1	N/A	N/A
Channel Availability Check Time	Not required	FCC15.407 (h)	N/A	N/A
		FCC 06-96 Appendix 7.8.2.1		
		Appendix 7.8.2.2		
		Appendix 7.8.2.3		
Channel Move Time, Channel Closing Transmission Time	Yes	RSS-210 A9.3	N/A	Complied
		FCC15.407 (h)		
		FCC 06-96 Appendix 7.8.3		
		RSS-210 A9.3		
Non-Occupancy period	Yes	FCC15.407 (h)	N/A	Complied
		FCC 06-96 Appendix 7.8.3		
		RSS-210 A9.3		
In-Service Monitoring	Not required	FCC15.407 (h)	N/A	N/A
		FCC 06-96 Appendix 7.8.4		
Overlapping Channel Tests	Not required	FCC15.407 (h)	N/A	N/A

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 <i>Burst</i>. • For the Frequency Hopping radar Test Signal, this instant is the end of the last radar <i>Burst</i> generated • For the Long Pulse Radar Test Signal this instant is the end of the 12 second period defining the <i>Radar Waveform</i>. 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 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 (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

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	FCC Registration Number	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	313583	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	655103	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	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	134570	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	4.75 x 5.4 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 4.5 x 2.8m	2.0 x 2.0m	-
No.10 measurement room	-	-	2.6 x 2.8 x 2.5m	2.4 x 2.4m	-
No.11 measurement room	-	-	3.1 x 3.4 x 3.0m	2.4 x 3.4m	-

* 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 Test instruments of DFS and Test set up

Refer to APPENDIX.

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 5250–5350 MHz and 5470–5650 MHz bands.

Power level (EIRP) of the EUT[dBm]

5250-5350MHz Band*		5470-5725MHz Band*	
Output Power (Min)	Output Power(Max)	Output Power (Min)	Output Power(Max)
0.21	1.39	-0.01	1.36

*Refer to 32DE0235-HO-C, FCC Part 15E (FCC 15.407) report for other parts than DFS.

WLAN traffic is generated by performing a HTTP file transfer. The file transfer from the master device to the client device consist of a 4.1Gbyte compressed data folder containing multiple copies of a 418 Mbyte file.

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 LDK102056.

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).

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: HW: Rev. 0.7, SW: M410K.002

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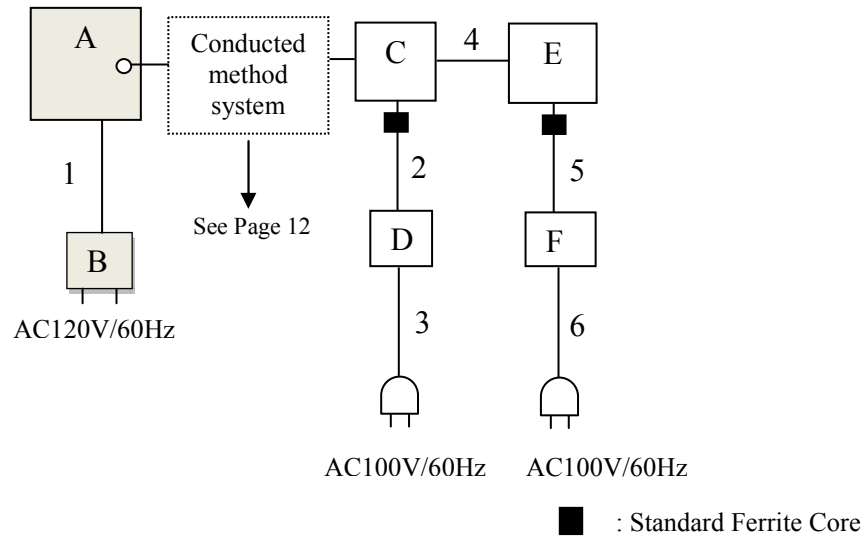
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5.2 Configuration and peripherals



Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	GSM/GPRS 1900 Phone with 802.11abgn, BT3.0 (EDR)	SHW-M410K	F1-294-E	SAMSUNG	EUT
B	AC Adapter	ETA0U10KKBK	RT2B728MS/7-E	SAMSUNG	EUT
C	Wireless LAN access point	AIR-AP1242AG-A-K9	FTX1045B9L0	Cisco Systems	-
D	AC Adapter	ADP-18PB	PZT0639562214	DELTA ELECTRONICS, INC.,	-
E	Laptop PC	7661CB9	L3-Y3936	lenovo	-
F	AC adapter	92P1156	11S92P1156Z1ZD XN85M5PY	lenovo	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.5	Unshielded	Unshielded	-
2	DC Cable	1.8	Unshielded	Unshielded	-
3	AC Cable	2.0	Unshielded	Unshielded	-
4	LAN Cable	3.0	Unshielded	Unshielded	-
5	DC Cable	1.8	Unshielded	Unshielded	-
6	AC Cable	0.9	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.

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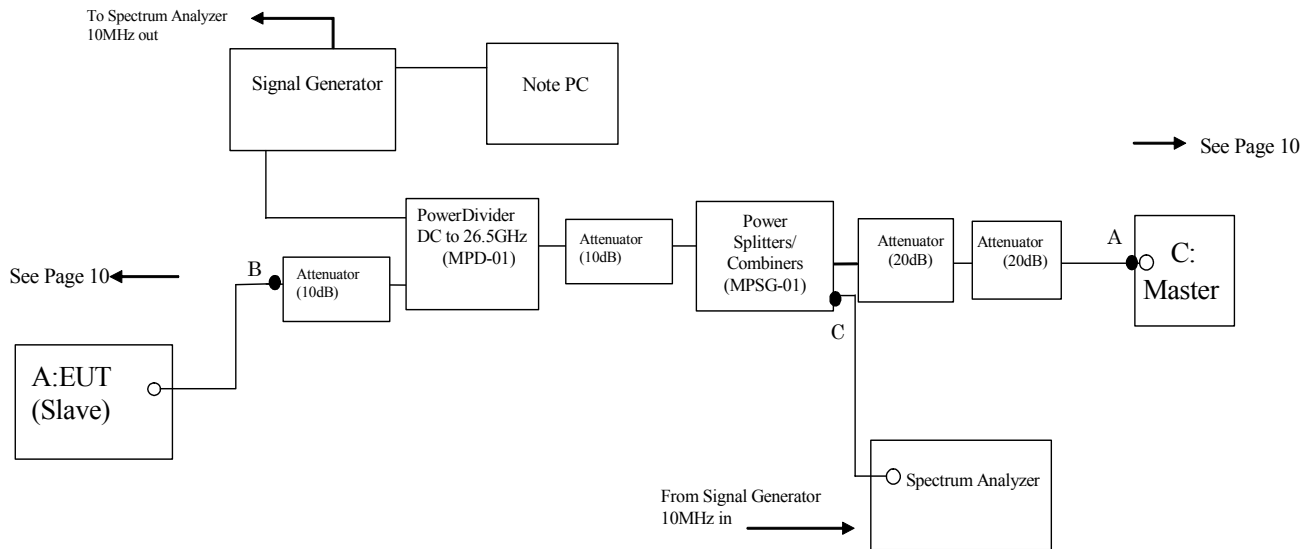
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CONDUCTED METHODS SYSTEM BLOCK DIAGRAM



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 higher 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.

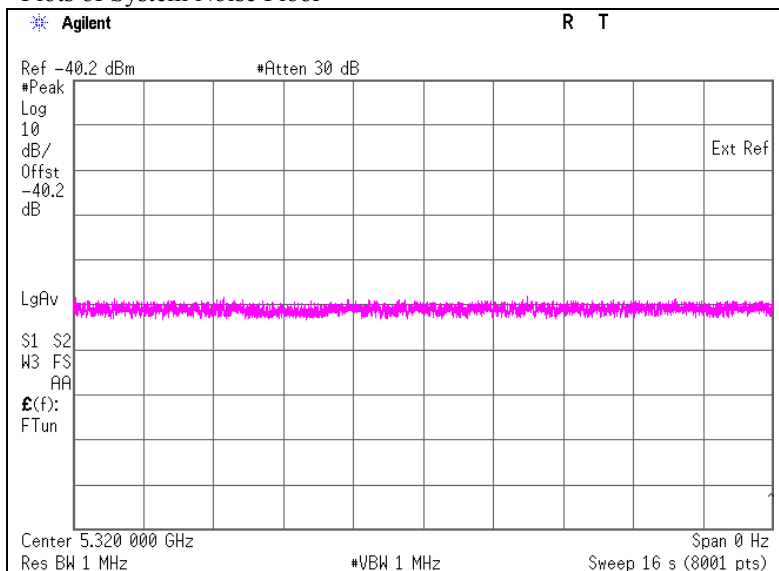
Step 4: Without changing any of the instrument settings, restore the system setting to Step 2 and adjust the Reference Level Offset of the spectrum analyzer to the level at Step 3.

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



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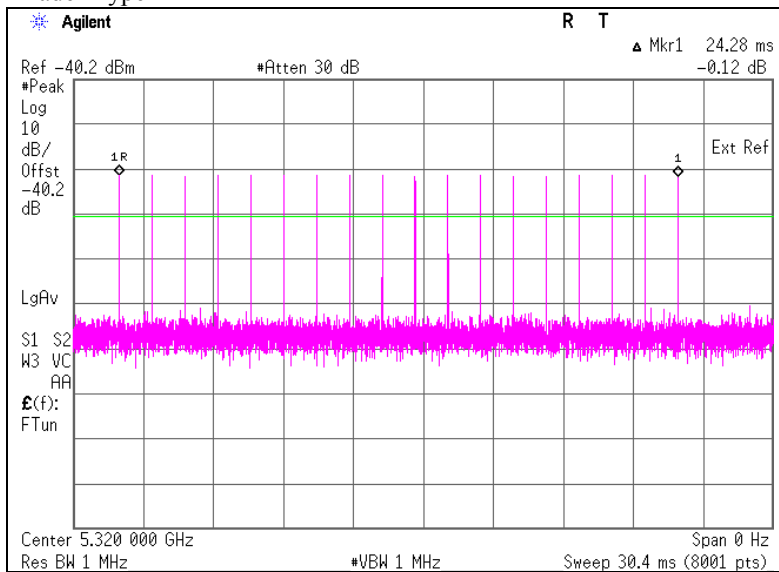
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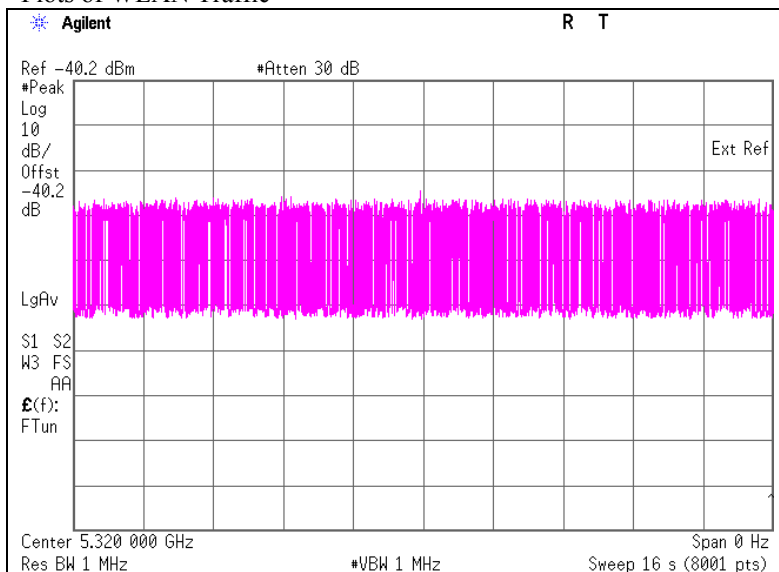
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Plots of Radar Waveforms

Rader Type 1



Plots of WLAN Traffic



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SECTION 6: Channel Move Time, Channel Closing Transmission Time

6.1 Operating environment

Test place : No.11 measurement room
Temperature : 24 deg. C
Humidity : 42 % 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]	0.076	10.000	Pass
Channel Closing Transmission Time *2)	[msec]	0	60	Pass

*1) Channel Move Time is calculated as follows:

$$(\text{Channel Move Time}) = (\text{End of Transmission}) - (\text{End of Burst}) = 1.132 - 1.056$$

*2) Channel Closing Transmission Time is calculated from (End of Burst + 200msec) to (End of Burst + 10sec)

$$\begin{aligned} (\text{Channel Closing Transmission Time}) &= (\text{Number of analyzer bins showing transmission}) * (\text{dwell time per bin}) \\ &= 0 * 2(\text{msec}) \end{aligned}$$

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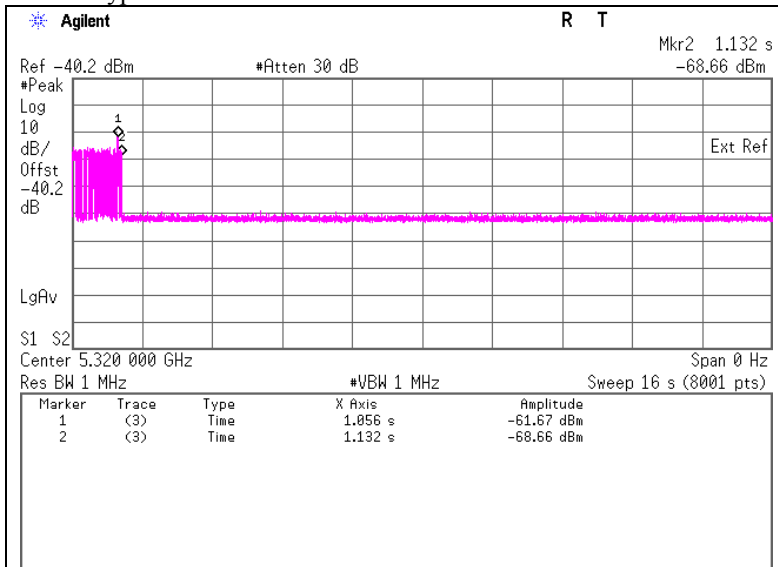
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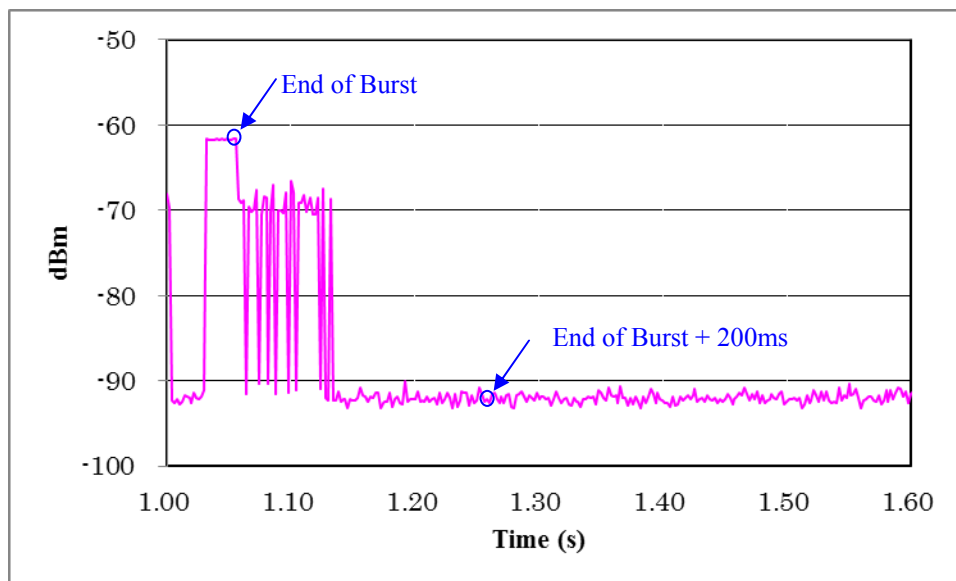
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Radar Type 1



Marker 1 : End of Burst : 1056ms
Marker 2 : End of Transmission : 1132 ms



6.4 Test result

Test result: Pass

Date: November 28, 2011

Test engineer: Takayuki Shimada

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SECTION 7: Non-Occupancy Period

7.1 Operating environment

Test place : No.11 measurement room
 Temperature : 24 deg. C
 Humidity : 42 % RH

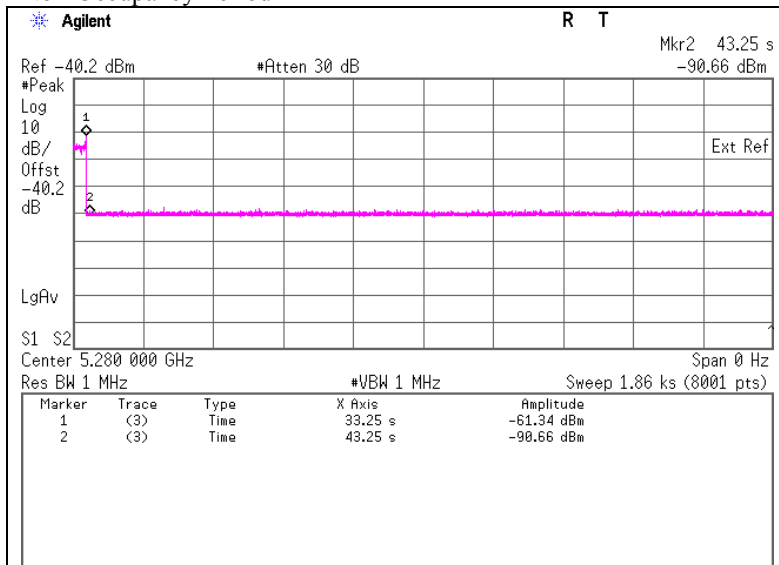
7.2 Test Procedure

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

Non-Occupancy Period



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

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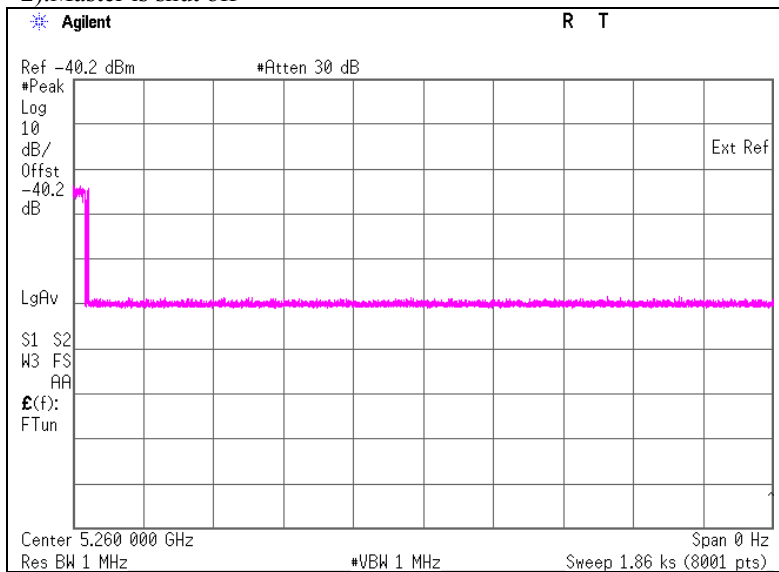
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2).Master is shut off



7.4 Test result

Test result: Pass

Date: November 28, 2011

Test engineer: Takayuki Shimada

APPENDIX 1: Test instruments

EMI Test Equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MOS-19	Thermo-Hygrometer	Custom	CTH-201	0001	DFS	2010/12/13 * 12
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	DFS	2011/11/23 * 12
EST-47	Signal Generator	Agilent	E4438C	MY45090353	DFS	2011/11/09 * 12
MCC-66	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	DFS	2011/04/22 * 12
MCC-67	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28635/2	DFS	2011/04/22 * 12
MCC-91	Microwave Cable 1G-40GHz	Schner	SUCOFLEX102	30812/2	DFS	2011/05/27 * 12
MCC-93	Microwave Cable 1G-40GHz	Schner	SUCOFLEX102	30814/2	DFS	2011/05/27 * 12
MPD-01	PowerDivider DC to 26.5GHz	Agilent	11636B	52258	DFS	2011/03/17 * 12
MPSC-01	Power splitters/Combiners	Mini-Circuit	ZFSC-2-2500	0124	DFS	2011/09/27 * 12
MAT-56	Attenuator(10dB)	Suhner	6810.19.A	-	DFS	Pre Check
MAT-58	Attenuator(10dB)	Suhner	6810.19.A	-	DFS	Pre Check
MAT-59	Attenuator(20dB)	Suhner	6820.19.A	-	DFS	Pre Check
MAT-60	Attenuator(20dB)	Suhner	6820.19.A	-	DFS	Pre Check
MTA-09	Terminator	HP	HP 909D	03745	DFS	2011/02/01 * 12
MTA-36	Terminator	-	50ΩSMA	-	DFS	Pre Check
COTS-MDFS-01	Signal Studio Software for DFS	Agilent	N7620A-101	5010-7739	DFS	-
COTS-MDFS-02	Radar Generating Software for DFS	Agilent	-	-	DFS	-

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