DFS Test Report

Report No.: RE160104C01-2

Model Name: Type1GC

Received Date: Jan. 04, 2016

Test Date: Mar. 18 ~ Mar. 21, 2016

Issued Date: Mar. 23, 2016

Applicant: Murata Manufacturing Co., Ltd.

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location: No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)

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Release Control Record

Issue No.	Description	Date Issued
RE160104C01-2	Original release.	Mar. 23, 2016

1   Certificate of Conformity

Product:	Communication Module
Brand:	MURATA
Model Name:	Type1GC
Sample Status:	Engineering sample
Applicant:	MURATA Manufacturing Co., Ltd.
Test Date:	Mar. 18 ~ Mar. 21, 2016
Standards:	EN 301 893 V1.8.1 (2015-03)
Test Item:	Dynamic Frequency Selection (Clause 4.7)

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** _____ Mar. 23, 2016 _____

Ivy Lin / Specialist

Approved by : _____ , **Date:** _____ Mar. 23, 2016 _____

Ken Liu / Senior Manager

2 Dynamic Frequency Selection

The manufacturer shall state whether the UUT is capable of operating as a Master and/or a Slave. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See below table for the applicability of DFS requirements for each of the operational modes.

Applicability of DFS requirements

Requirement	Operational Mode		
	Master	Slave (without radar detection)	Slave (with radar detection)
Channel Availability Check	✓	Not required	✓ (see note 2)
Off-Channel CAC (see note 1)	✓	Not required	✓ (see note 2)
In-Service Monitoring	✓	Not required	✓
Channel Shutdown	✓	✓	✓
Non-Occupancy Period	✓	Not required	✓
Uniform Spreading	✓	Not required	Not required

NOTE 1: Where implemented by the manufacturer.
NOTE 2: A slave with radar detection is not required to perform a CAC or Off-Channel CAC at initial use of the channel but only after the slave has detected a radar signal on the Operating Channel by In-Service Monitoring.

The radar detection requirements specified in EN 301 893 clauses 4.7.2.1 to 4.7.2.3 assume that the centre frequencies of the radar signals fall within the central 80 % of the Occupied Channel Bandwidth of the RLAN channel.

3   Test Limits and Radar Signal Parameters

DFS requirement values

Parameter	Value
Channel Availability Check Time	60 s (see note 1)
Minimum Off-Channel CAC Time	6 minutes (see note 2)
Maximum Off-Channel CAC Time	4 hours (see note 2)
Channel Move Time	10 s
Channel Closing Transmission Time	1 s
Non-Occupancy Period	30 minutes
NOTE 1: For channels whose nominal bandwidth falls completely or partly within the band 5 600 MHz to 5 650 MHz, the Channel Availability Check Time shall be 10 minutes.	
NOTE 2: For channels whose nominal bandwidth falls completely or partly within the band 5 600 MHz to 5 650 MHz, the Maximum Off-Channel CAC Time shall be within the range 1 to 24 hours.	

Interference threshold values

| EIRP Spectral Density dBm/MHz	Value (see notes 1 and 2)
10	-62 dBm
NOTE 1: This is the level at the input of the receiver of a RLAN device with a maximum EIRP density of 10 dBm/MHz and assuming a 0 dBi receive antenna. For devices employing different EIRP spectral density and/or a different receive antenna gain G (dBi) the DFS threshold level at the receiver input follows the following relationship: DFS Detection Threshold (dBm) = -62 + 10 - EIRP Spectral Density (dBm/MHz) + G (dBi), however the DFS threshold level shall not be lower than -64 dBm assuming a 0 dBi receive antenna gain.	
NOTE 2: Slave devices with a maximum EIRP of less than 23 dBm do not have to implement radar detection.	

Parameters of the reference DFS test signal

Pulse width W [µs]	Pulse repetition frequency PRF [pps]	Pulses per burst [PPB]
1	700	18

Parameters of radar test signals

Radar Test Signal # (see notes 1 to 3)	Pulse width W [µs]		Pulse Repetition Frequency (pps)		Number of different PRFs	Pulses per Burst for each PRF(PPB) (see notes 5)
	Min	Max	Min	Max		
1	0.5	5	200	1000	1	10 (see note 6)
2	0.5	15	200	1600	1	15 (see note 6)
3	0.5	15	2300	4000	1	25
4	20	30	2000	4000	1	20
5	0.5	2	300	400	2/3	10 (see note 6)
6	0.5	2	400	1200	2/3	15 (see note 6)

NOTE 1: Radar test signals 1 to 4 are constant PRF based signals. See figure D.1. These radar test signals are intended to simulate also radars using a packet based Staggered PRF. See figure D.2.

NOTE 2: Radar test signal 4 is a modulated radar test signal. The modulation to be used is a chirp modulation with a ±2,5 MHz frequency deviation which is described below.
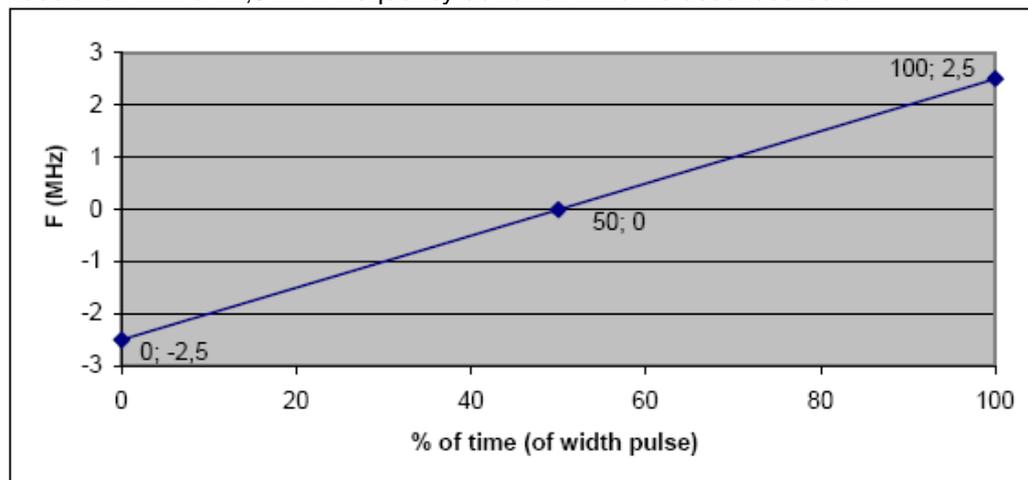
NOTE 3: Radar test signals 5 and 6 are single pulse based Staggered PRF radar test signals using 2 or 3 different PRF values. For radar test signal 5, the difference between the PRF values chosen shall be between 20 pps and 50 pps. For radar test signal 6, the difference between the PRF values chosen shall be between 80 pps and 400 pps. See figure D.3

NOTE 4: Apart for the Off-Channel CAC testing, the radar test signals above shall only contain a single burst of pulses. See figures D.1, D.3 and D.4. For the Off-Channel CAC testing, repetitive bursts shall be used for the total duration of the test. See figures D.2 and D.5. See also clause 4.7.2.2. , 5.3.8.2.1.3.1 and 5.3.8.2.1.3.2.

NOTE 5: The total number of pulses in a burst is equal to the number of pulses for a single PRF multiplied by the number of different PRFs used.

NOTE 6: For the CAC and Off-Channel CAC requirements, the minimum number of pulses (for each PRF) for any of the radar test signals to be detected in the band 5 600 MHz to 5 650 MHz shall be 18.

Detection probability

Parameter	Detection Probability (Pd)	
	Channels whose nominal bandwidth falls partly or completely within the 5600 MHz to 5650 MHz band	**Other channels**
CAC, Off-Channel CAC	99,99 %	60 %
In-Service Monitoring	60 %	60 %
NOTE: Pd gives the probability of detection per simulated radar burst and represents a minimum level of detection performance under defined conditions. Therefore Pd does not represent the overall detection probability for any particular radar under real life conditions.		

4   EUT Information

4.1   EUT Information

Operating Frequency Bands and Mode of EUT

Operational Mode	Operating Frequency Range	
	5250~5350MHz	**5470~5725MHz**
Slave without radar detection and ad hoc function	✓	✓

EUT Software and Firmware Version

No.	Product	Model No.	Software/Firmware Version
1	Communication Module	Type1GC	communication F/W 7.15.168.50

Description of Available Antennas to the EUT

Ant. No.	Type	Operation Frequency Range	Gain(dBi)
1	Monopole pattern	5250-5350 MHz	2.5
1	Monopole pattern	5470-5725 MHz	2.5

4.2   Test Instruments

Description & Manufacture	Model No.	Brand	Calibrated Date	Calibratd Until
R&S Spectrum analyzer	ESR	R&S	2016/02/02	2017/02/01
Signal generator	8645A	Agilent	2015/08/05	2016/08/04

4.3   Description of Support Units

Support Unit information.

No.	Product	Model No.	Spec.
1	WIRELESS AC MODULE	WMC-AC01	5G Ant gain : 3.82 dB

NOTE1: This device was functioned as a ☒Master ☐Slave device during the DFS test.
NOTE2: The WLAN module (model no.: WMC-AC01) is collocated in Wireless AP (Model: DIR-868L).

Software/Firmware information.

No.	Product	Model No.	Software/Firmware Version
1	WIRELESS AC MODULE	WMC-AC01	1.0.0 Mon 04 Feb 2013 (version 6.30.163.13.r373323 WLTEST)

NOTE: The WLAN module (model no.: WMC-AC01) is collocated in Wireless AP (Model: DIR-868L).

5   Test Procedure

The measured channel is 5300MHz and 5500MHz in 20MHz Bandwidth, 5310MHz and 5510MHz in 40MHz Bandwidth. The radar signal was the same as transmitted channels, and injected into the antenna of AP (master), measured the channel shutdown. The slave transmitted the test data to master. The transmitted duty cycle is 30.456%.
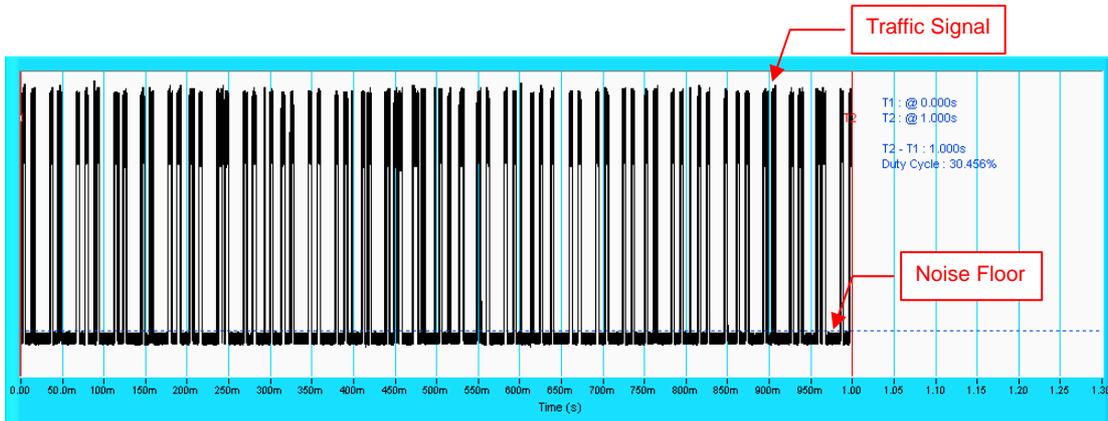
NOTE: T1 denotes the start of duty cycle period is 0th second. T2 denotes the end of duty cycle period is 1th second. T2 – T1= 1 seconds. Duty Cycle = 30.456%

Note: Traffic signals transmit from master to slave.

5.1   Deviation From Test Standard

No deviation.

5.2   Test Setup Configuration
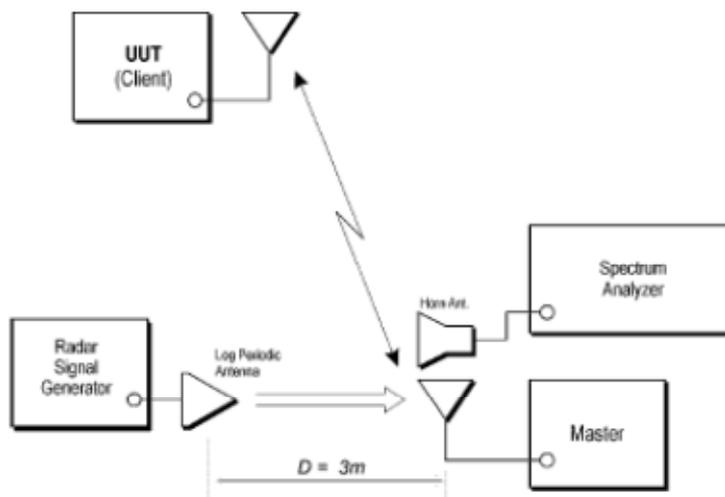
The UUT is a RLAN device operating in slave mode, without Radar Interference Detection function. The radar test signals are injected into the master device.

6   List of Measurements

The UUT is capable of operating as a slave (without radar detection).

Clause	Test Parameter	Remarks	Pass/Fail
4.7.2.1	Channel Availability Check Time	Not Applicable	NA
4.7.2.2	Off-Channel CAC	Not implemented	NA
4.7.2.3	In-Service Monitoring	Not Applicable	NA
4.7.2.4	Channel Shutdown	Applicable	Pass
4.7.2.5	Non-Occupancy Period	Not Applicable	NA
4.7.2.6	Uniform Spreading	Not Applicable	NA

7　Test Result

7.1　Interference Threshold Values

The AP Maximum EIRP Spectral Density is 16.9dBm/MHz and antenna gain is 3.82dBi.
DFS Detection Threshold = -62 + 10 - EIRP Spectral Density (16.9dBm/MHz) = -68.9dBm.
The radar Burst signal level to the AP is -64dBm.
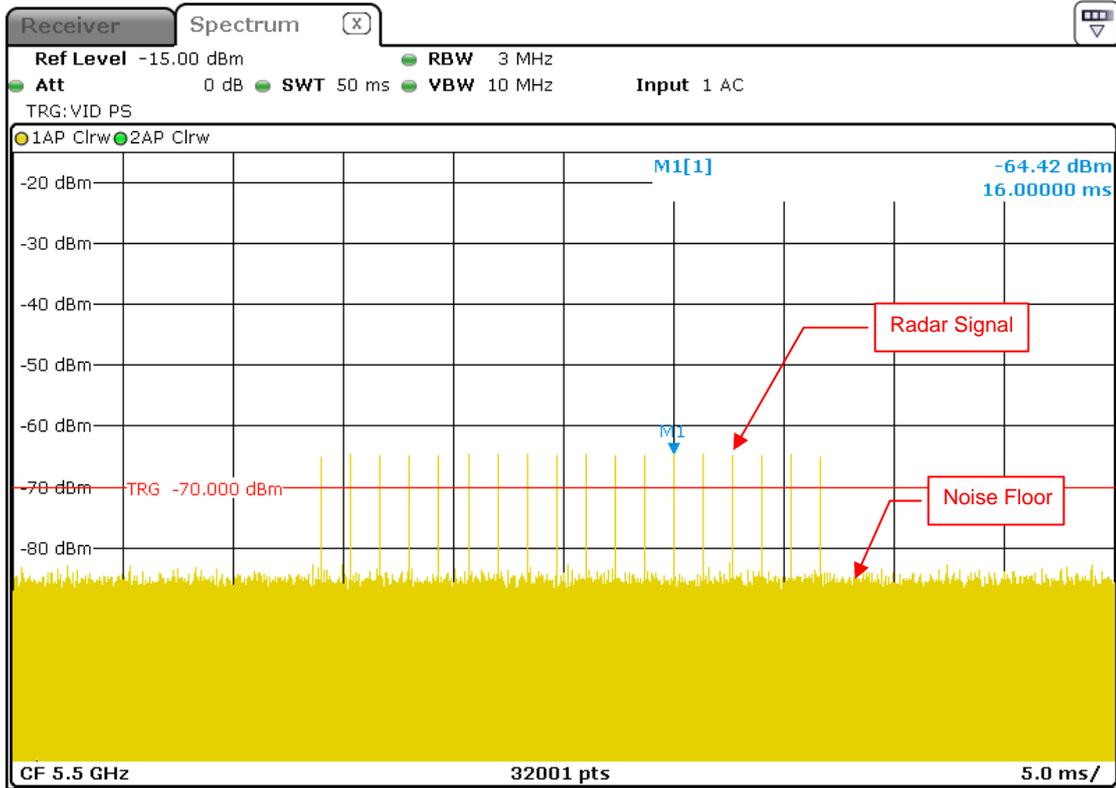
Reference DFS test signal

7.2   Channel Shutdown

802.11n HT20 5300MHz

Channel Closing Transmission Time & Channel Move Time
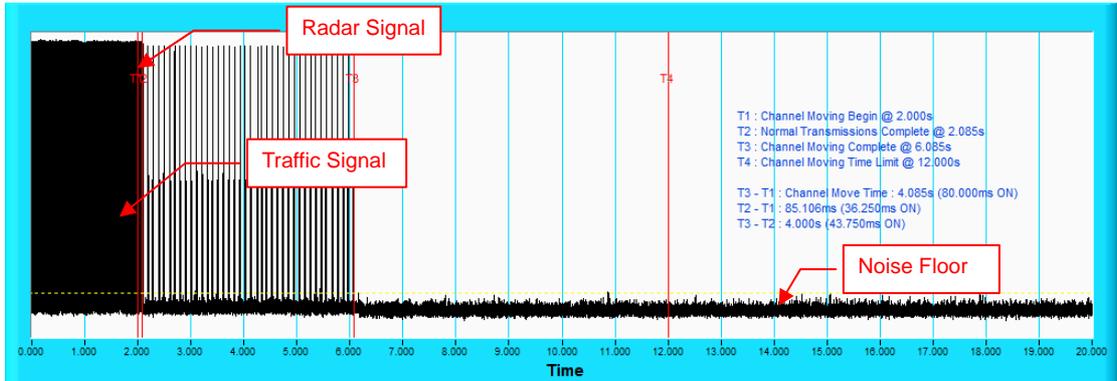
T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.085s
T3 : Channel Moving Complete @ 6.085s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 4.085s (80.000ms ON)
T2 - T1 : 85.106ms (36.250ms ON)
T3 - T2 : 4.000s (43.750ms ON)

NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst.
T2 denotes the data transmissions complete time. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

802.11n HT20 5500MHz

Channel Closing Transmission Time & Channel Move Time
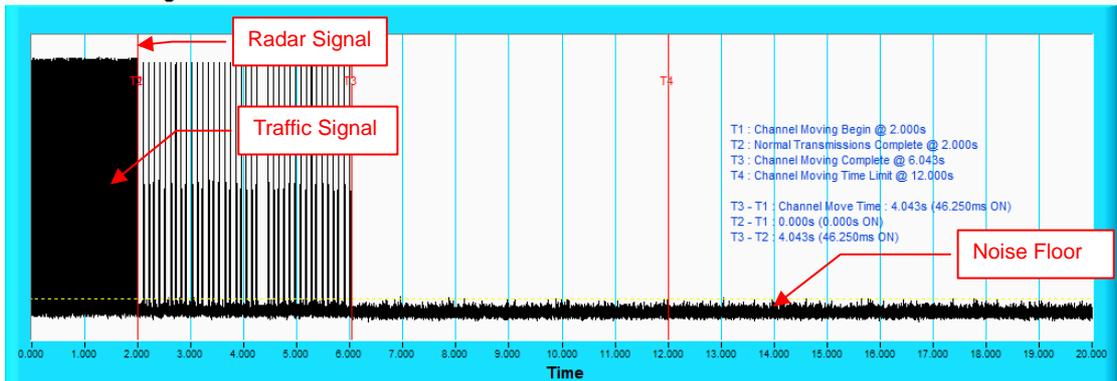
T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.000s
T3 : Channel Moving Complete @ 6.043s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 4.043s (46.250ms ON)
T2 - T1 : 0.000s (0.000s ON)
T3 - T2 : 4.043s (46.250ms ON)

NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst.
T2 denotes the data transmissions complete time. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

802.11n HT40 5310MHz

Channel Closing Transmission Time & Channel Move Time
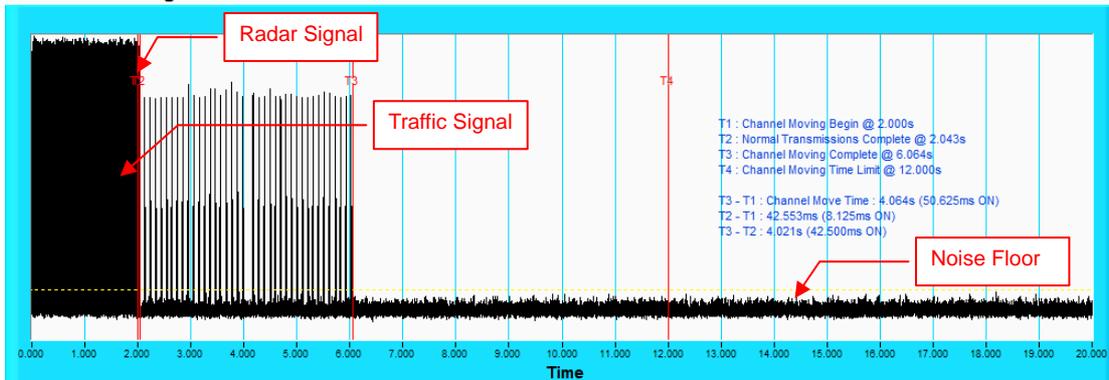
T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.043s
T3 : Channel Moving Complete @ 6.064s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 4.064s (50.625ms ON)
T2 - T1 : 42.553ms (8.125ms ON)
T3 - T2 : 4.021s (42.500ms ON)

NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst.
T2 denotes the data transmissions complete time. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

802.11n HT40 5510MHz

Channel Closing Transmission Time & Channel Move Time
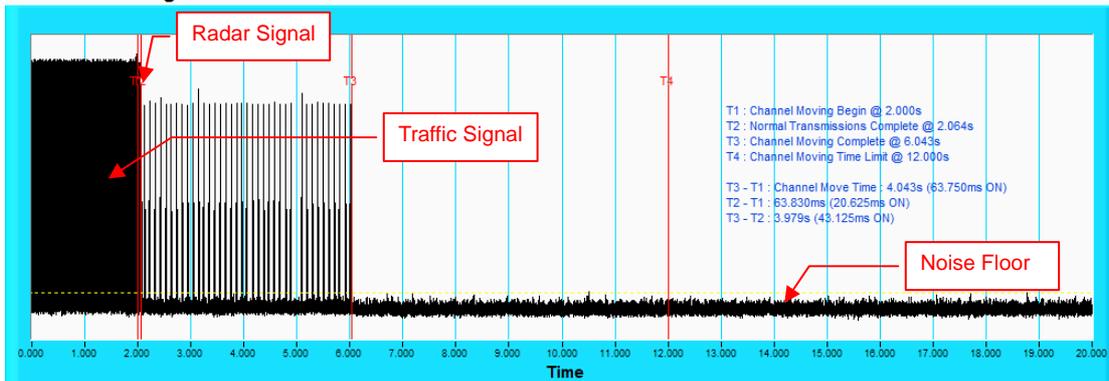
T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.064s
T3 : Channel Moving Complete @ 6.043s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 4.043s (63.750ms ON)
T2 - T1 : 63.830ms (20.625ms ON)
T3 - T2 : 3.979s (43.125ms ON)

NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst.
T2 denotes the data transmissions complete time. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

8   Photographs of the Test Configuration

Set UUT as Client without radar detection mode (Radar injected into Master)

Receiver Antenna to S.A.

Radar (Radiated)

Master

UUT
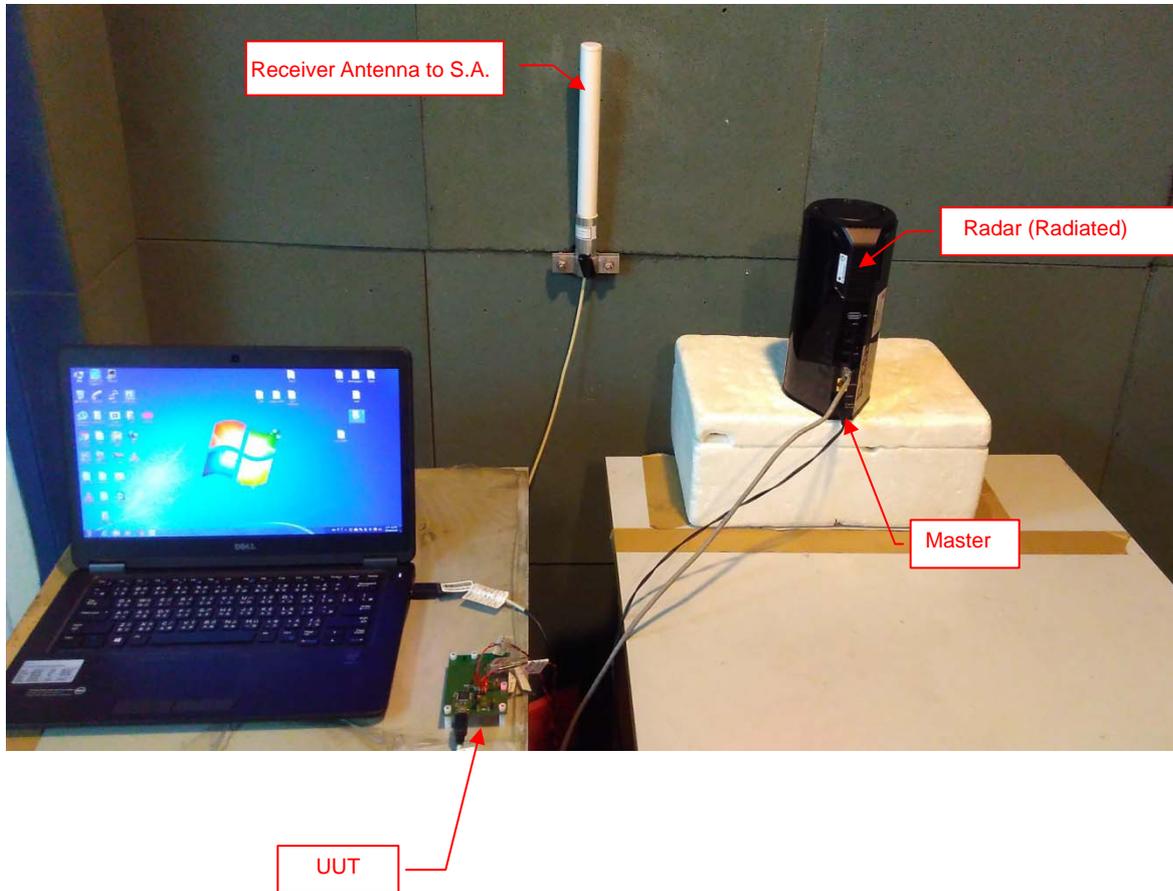
Appendix - Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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