# DFS Test Report

| | |
|---|---|
| **Report No.:** | RE150107E07G-4 |
| **Test Model:** | WLT674 |
| **Received Date:** | Feb. 10 ,2015 |
| **Test Date:** | Feb. 10 ,2015 |
| **Issued Date:** | Oct. 04, 2018 |
| | |
| **Applicant:** | Compex Systems Pte. Ltd. |
| **Address:** | No. 9 Harrison Road, #05-01 Singapore 369651 |
| | |
| **Issued By:** | Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory |
| **Lab Address:** | E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C. |
| **Test Location:** | E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C. |

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## Release Control Record

| Issue No. | Description | Date Issued |
|---|---|---|
| RE150107E07G-4 | Original release. | Oct. 04, 2018 |

# 1    Certificate of Conformity

|              |                                       |
|--------------|---------------------------------------|
| **Product:** | Wireless M.2 Type A/E with BLE Module |
| **Brand:** | Compex |
| **Test Model:** | WLT674 |
| **Sample Status:** | ENGINEERING SAMPLE |
| **Applicant:** | Compex Systems Pte. Ltd. |
| **Test Date:** | Feb. 10 ,2015 |
| **Standards:** | EN 301 893 V2.1.1 (2017-05) |
| **Test Item:** | Dynamic Frequency Selection (Clause 4.2.6) |

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:** _____Oct. 04, 2018_____

Claire Kuan / Specialist
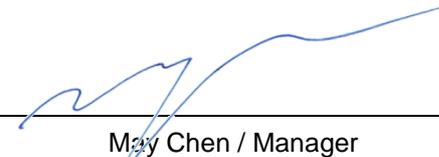
**Approved by :** _____ , **Date:** _____Oct. 04, 2018_____

May Chen / 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 and the Non-Occupancy Period resulting from this detection has elapsed. | | | |

The radar detection requirements specified in EN 301 893 clauses 4.2.6.2.2 to 4.2.6.2.4 assume that the centre frequencies of the radar signals fall within the central 80 % of the Occupied Channel Bandwidth of the RLAN channel.

### 2.1 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<br>dBm/MHz | Value<br>(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:<br>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 e.i.r.p. of less than 23 dBm do not have to implement radar detection unless these devices are used in fixed outdoor point to point or fixed outdoor point to multipoint applications. | |

**Parameters of the reference DFS test signal**

| Pulse width<br>W [µs] | Pulse repetition<br>frequency PRF [pps] | Pulses per burst<br>[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.
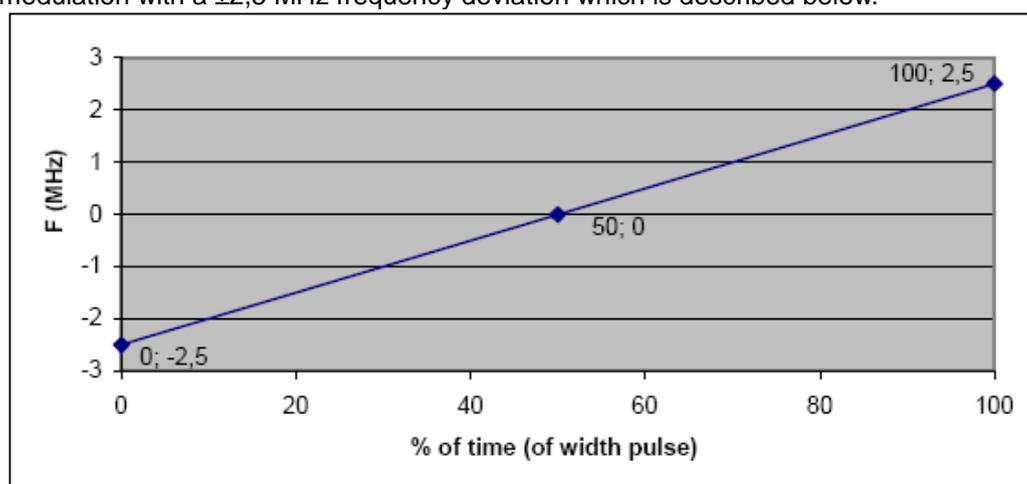


NOTE 3: Radar test signals 5 and 6 are single pulse based Staggered PRF radar test signals using 2 or 3 different PRF values. For radar test signal 5, the difference between the PRF values chosen shall be between 20 pps and 50 pps. For radar test signal 6, the difference between the PRF values chosen 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 4.2.6.2.3. , 5.4.8.2.1.4.2 and 5.4.8.2.1.4.3.

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. | | |

**2.2 EUT Information**

**Operating Frequency Bands and Mode of EUT**

| Operational Mode | Operating Frequency Range | |
|---|---|---|
| | 5250~5350MHz | 5470~5725MHz |
| **Slave without Radar Detection** | ✓ | ✓ |

**EUT Software and Firmware Version**

| Platform | No. | Product | Model No. | Software/Firmware Version |
|---|---|---|---|---|
| Windows 8 | 1 | Wireless M.2 Type A/E with BLE Module | WLT674 | 2014/12/26 11.0.0.475 |

**Description of Available Antennas to the EUT**

| Transmitter Circuit | Brand | Model | Ant. Type | 2.4GHz Gain with cable loss (dBi) | 5GHz Gain with cable loss (dBi) | 2.4GHz Cable Loss (dBi) | 5G Cable Loss (dBi) | Connector Type | Cable Length (mm) |
|---|---|---|---|---|---|---|---|---|---|
| Chain (0) | WNC | 81-EBJ15.005 | PIFA | 3.00 | Band 1&2: 2.56 | 1.15 | Band 1&2: 1.70 | IPEX | 300 |
| | | | | | Band 3: 4.76 | | Band 3: 1.74 | | |
| | | | | | Band 4: 4.76 | | Band 4: 1.79 | | |
| Chain (1) | WNC | 81-EBJ15.005 | PIFA | 3.62 | Band 1&2: 3.08 | 1.15 | Band 1&2: 1.70 | IPEX | 300 |
| | | | | | Band 3: 3.31 | | Band 3: 1.74 | | |
| | | | | | Band 4: 2.42 | | Band 4: 1.79 | | |

Note: 1. Above antenna gains of antenna are Total (H+V).

## 2.3　Test Instruments

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|---|---|---|---|---|
| Spectrum Analyzer R&S | FSW8 | 101497 | Aug.06.2014 | Aug 05, 2015 |
| Signal generator | SMJ100A | 101878 | Aug. 12, 2014 | Aug. 11, 2015 |

## 2.4　Description of Support Units

| No. | Product | Brand | Model No. | Spec. |
|---|---|---|---|---|
| 1 | WIRELESS AC MODULE | ALPHA | WMC-AC01 | Maximum EIRP Spectral Density is 16.9dBm/MHz and antenna gain is 3.82dBi. |

**NOTE:** This device was functioned as a ☒Master ☐Slave device during the DFS test.

**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: This module WMC-AC01 was installed in the DIR-868L AP.

## 2.5    TEST PROCEDURE

The measured channel is 5300MHz, and 5500MHz in 20MHz Bandwidth and 5290MHz and 5530MHz in 80MHz Bandwidth. The radar signal was the same as transmitted channels, and injected into the antenna port of AP (master) with –60.18dBm power level, measured the channel shutdown. The slave transmitted the test data to master, the transmitted duty cycle is 33.388%.

**Duty Cycle**
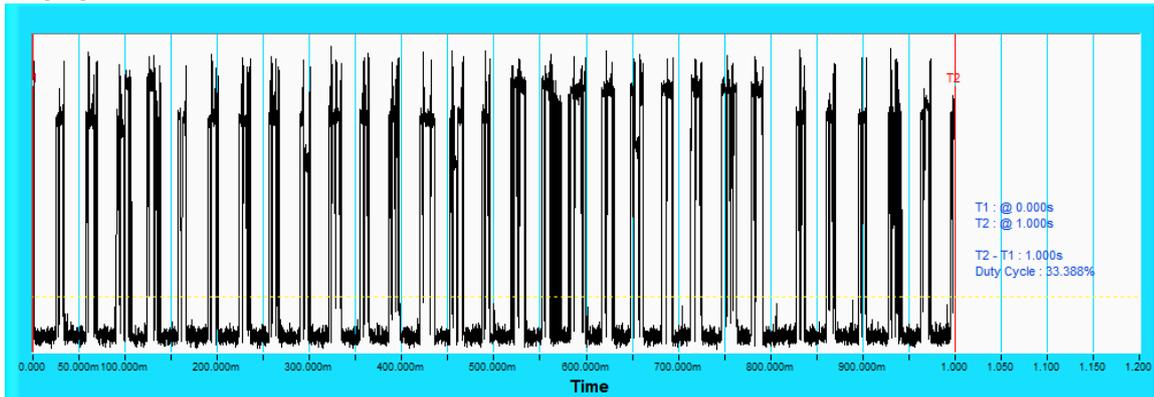


**NOTE:** T1 denotes the start of duty cycle period is $0^{th}$ second. T2 denotes the end of duty cycle period is $1^{th}$ second. T2 – T1= 1 seconds. Duty Cycle = 33.388%

Note: Traffic signal: from slave transmit to master.

## 2.6    DEVIATION FROM TEST STANDARD

No deviation.

## 2.7    TEST SETUP CONFIGURATION
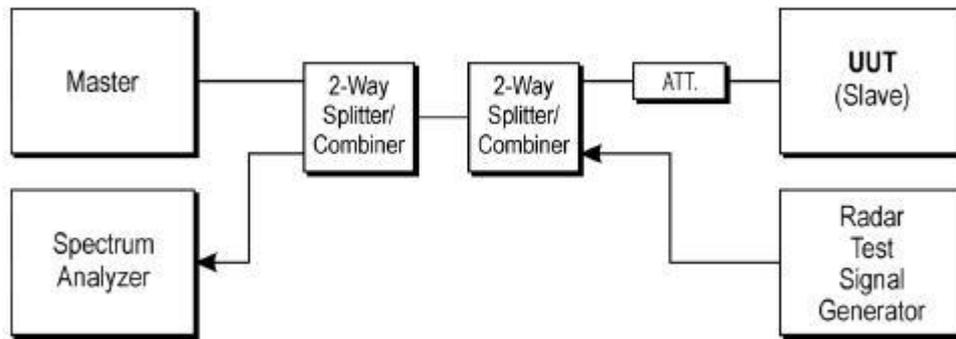


The UUT is a RLAN device operating in slave mode, without Radar Interference Detection function. The radar test signals are injected into the master device.

## 2.8 LIST OF MEASUREMENTS

| Clause | Test Parameter | Remarks | Pass/Fail |
|--------|----------------|---------|-----------|
| 4.2.6.2.2 | Channel Availability Check Time | Not Applicable | NA |
| 4.2.6.2.3 | Off-Channel CAC | Not implemented | NA |
| 4.2.6.2.4 | In-Service Monitoring | Not Applicable | NA |
| 4.2.6.2.5 | Channel Shutdown | Applicable | Pass |
| 4.2.6.2.6 | Non- Occupancy Period | Not Applicable | NA |
| 4.2.6.2.7 | Uniform Spreading | Not Applicable | NA |

## 2.9 TEST RESULT

### 2.9.1 Interference Threshold Values Injected into AP

The AP Maximum EIRP Spectral Density is 16.9dBm/MHz and antenna gain is 4dBi, cable loss is 0.18.
DFS Detection Threshold = -62 + 10 - EIRP Spectral Density (16.9dBm/MHz) + G (0dBi) = –68.9dBm.
For an interference threshold level of –64dBm and the AP net gain is 3.82dBi. Then the radar Burst signal level to the AP connector is –60.18dBm.
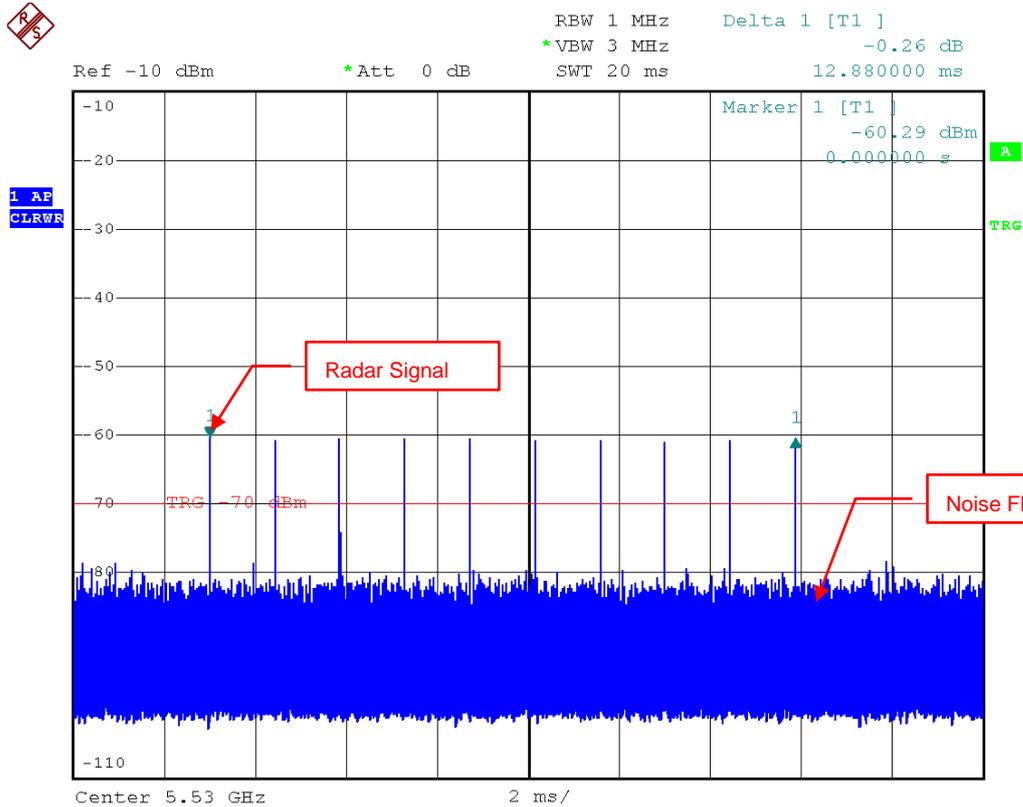


Reference DFS test signal

### 2.9.2  Channel Shutdown

## 802.11n (HT20) mode



**Channel Closing Transmission Time & Channel Move Time @ CH60**
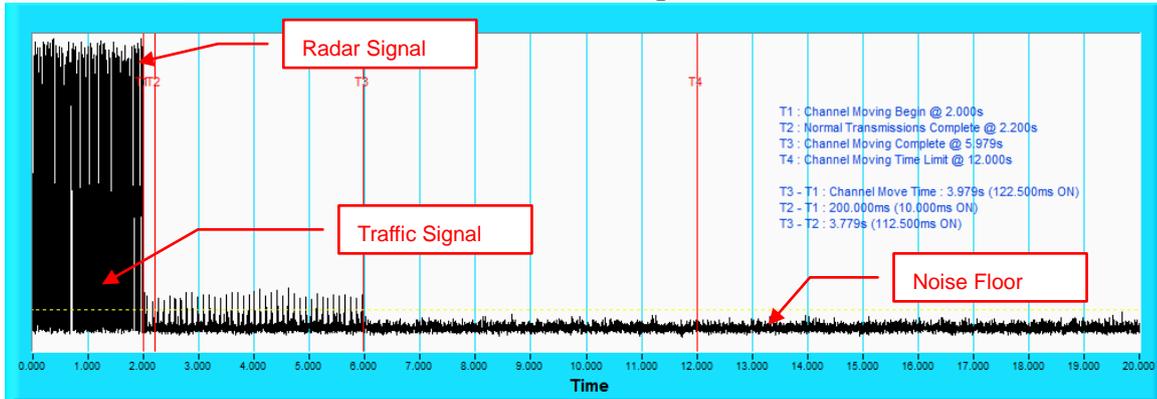
T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.200s
T3 : Channel Moving Complete @ 5.979s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 3.979s (122.500ms ON)
T2 - T1 : 200.000ms (10.000ms ON)
T3 - T2 : 3.779s (112.500ms ON)

**NOTE:** T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.



**Channel Closing Transmission Time & Channel Move Time @ CH100**

T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.200s
T3 : Channel Moving Complete @ 6.149s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 4.149s (120.000ms ON)
T2 - T1 : 200.000ms (17.500ms ON)
T3 - T2 : 3.949s (102.500ms ON)
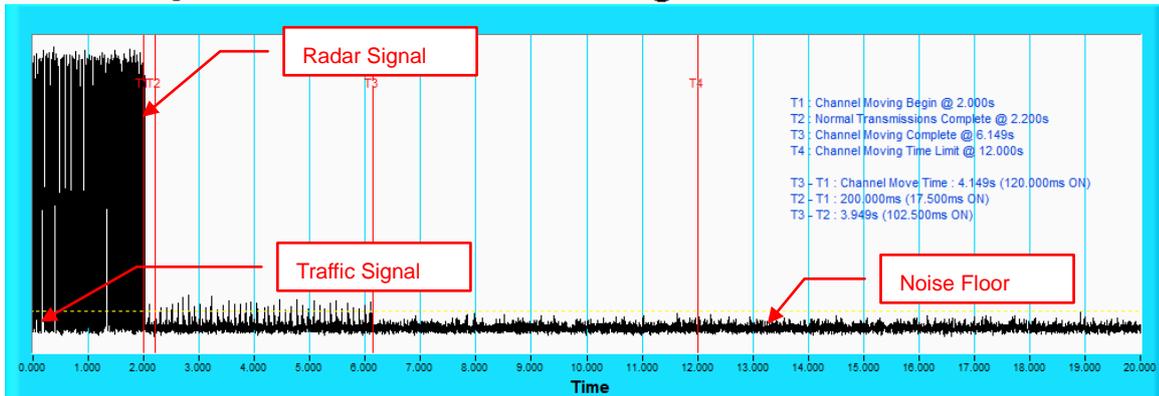
**NOTE:** T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

## 802.11ac (VHT80) mode

**Channel Closing Transmission Time & Channel Move Time @ CH58**
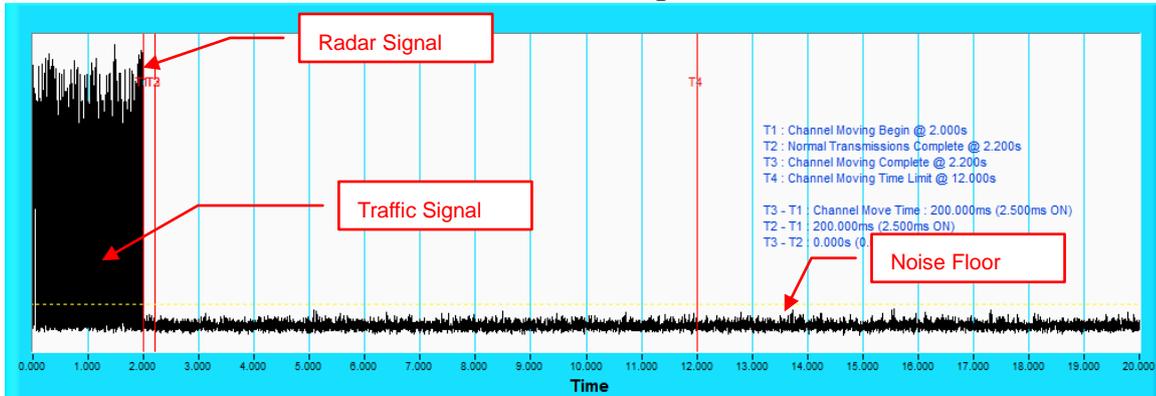


T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.200s
T3 : Channel Moving Complete @ 2.200s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 200.000ms (2.500ms ON)
T2 - T1 : 200.000ms (2.500ms ON)
T3 - T2 : 0.000s (0...)

**NOTE:** T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

**Channel Closing Transmission Time & Channel Move Time @ CH106**



T1 : Channel Moving Begin @ 2.000s
T2 : Normal Transmissions Complete @ 2.200s
T3 : Channel Moving Complete @ 6.170s
T4 : Channel Moving Time Limit @ 12.000s

T3 - T1 : Channel Move Time : 4.170s (30.000ms ON)
T2 - T1 : 200.000ms (22.500ms ON)
T3 - T2 : 3.970s (7.500ms ON)
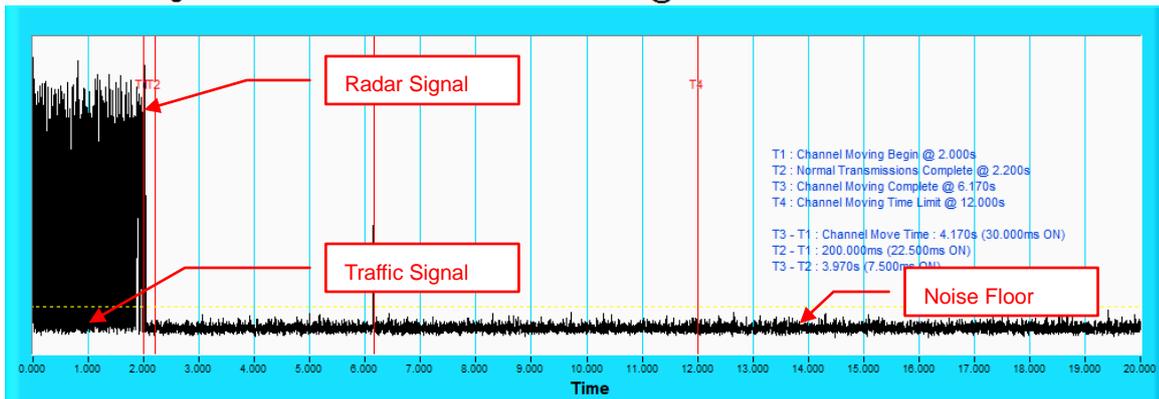
**NOTE:** T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

## 3    Photographs of the Test Configuration
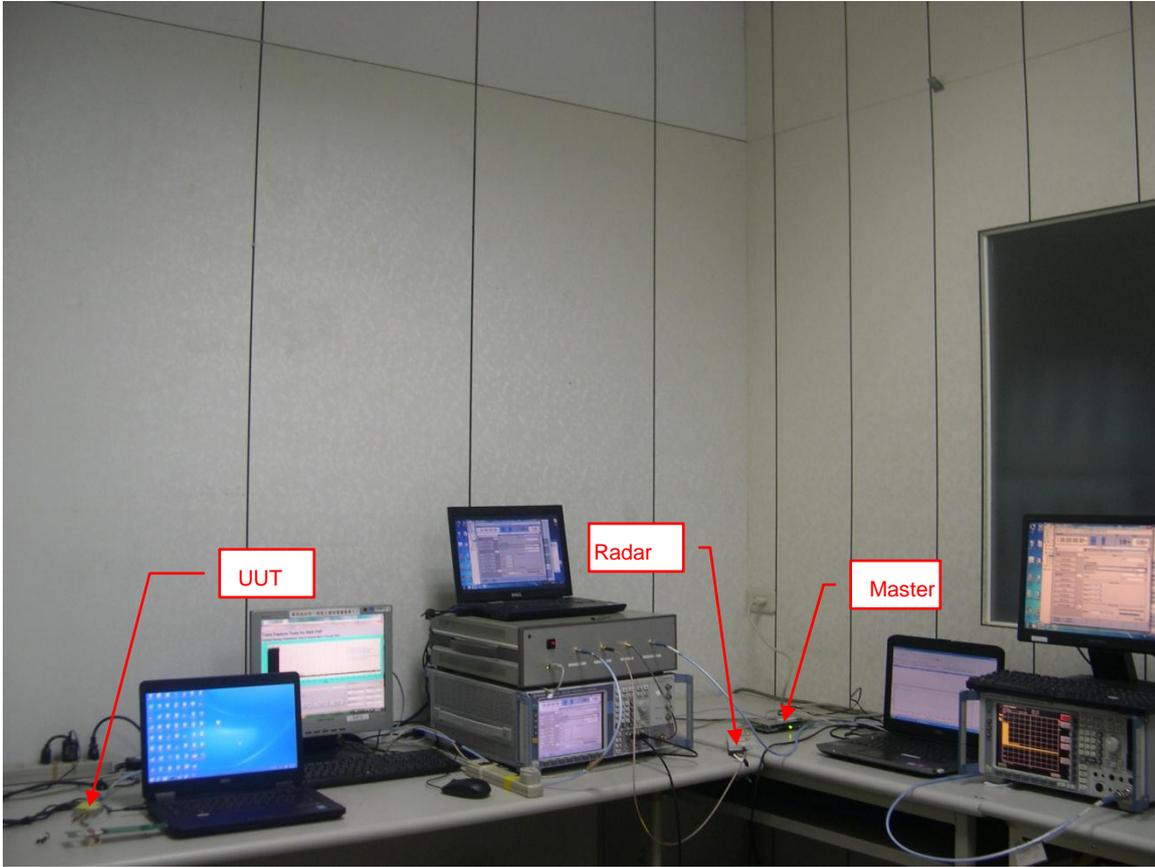
**Appendix - Information on the Testing Laboratories**

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:

| | |
|---|---|
| **Linko EMC/RF Lab** | **Hsin Chu EMC/RF/Telecom Lab** |
| Tel: 886-2-26052180 | Tel: 886-3-6668565 |
| Fax: 886-2-26051924 | 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.

**--- END ---**