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# DFS TEST REPORT (Network mode)

**REPORT NO.:** RF140430E05B-3

**MODEL NO.:** 1653

**FCC ID:** C3K1653

**RECEIVED:** Apr. 30, 2014

**TESTED:** Aug. 05, 2014

**ISSUED:** Sep. 02, 2014

**APPLICANT:** Microsoft Corporation

**ADDRESS:** One Microsoft Way Redmond WA 98052

**ISSUED BY:** Bureau Veritas Consumer Products Services  
(H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory

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## RELEASE CONTROL RECORD

| ISSUE NO.      | REASON FOR CHANGE | DATE ISSUED   |
|----------------|-------------------|---------------|
| RF140430E05B-3 | Original release  | Sep. 02, 2014 |



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## 1. CERTIFICATION

**PRODUCT:** 802.11a/b/g/n 2T2R dual-band wireless LAN radio  
**BRAND NAME :** Microsoft  
**MODEL NO.:** 1653  
**TEST SAMPLE:** ENGINEERING SAMPLE  
**APPLICANT:** Microsoft Corporation  
**TESTED:** Aug. 05, 2014  
**STANDARDS:** FCC Part 15, Subpart E (Section 15.407)  
FCC KDB 905462 D02 v01

The above equipment (Model: 1653) has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and was in 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:** Sep. 02, 2014  
( Lori Chung, Specialist )

**APPROVED BY :**  , **DATE:** Sep. 02, 2014  
( May Chen, Manager )

## 2. EUT INFORMATION

### 2.1 OPERATING FREQUENCY BANDS AND MODE OF EUT

TABLE 1: OPERATING FREQUENCY BANDS AND MODE OF EUT

| OPERATIONAL MODE                                   | OPERATING FREQUENCY RANGE |              |
|--|---------------------------|--------------|
|  | 5250~5350MHz              | 5470~5725MHz |
| Client without radar detection and ad hoc function | ✓                         | ✓            |

### 2.2 EUT SOFTWARE AND FIRMWARE VERSION

TABLE 2: THE EUT SOFTWARE/FIRMWARE VERSION

| PLATFORM  | NO. | PRODUCT   | MODEL NO. | SOFTWARE/FIRMWARE VERSION |
|-----------|-----|---|-----------|---------------------------|
| Windows 8 | 1   | 802.11a/b/g/n 2T2R dual-band wireless LAN radio | 1653      | 2014/08/5<br>1.0.5.7      |

### 2.3 DESCRIPTION OF AVAILABLE ANTENNAS TO THE EUT

TABLE 3: ANTENNA LIST

| Accessory Radio |                     |           |  |  |                                |                |                   |
|-----------------|---------------------|-----------|--|--|--------------------------------|----------------|-------------------|
| Ant. No.        | Brand               | Model     | Ant. Gain(dBi)<br><including cable loss> | Frequency range<br>(GHz ~ GHz)           | Ant. Type                      | Connector Type | Cable Length (mm) |
| 1               | Microsoft           | NA        | 2.2                                      | 2.4~2.5                                  | PCB                            | i-PEX          | 295               |
|                 | Microsoft           | NA        | 3.14                                     | 5.15~5.85                                | PCB                            | i-PEX          | 295               |
| Network Radio   |                     |           |  |  |                                |                |                   |
| Ant. No.        | Transmitter Circuit | Brand     | Model                                    | Ant. Gain(dBi)<br><including cable loss> | Frequency range<br>(GHz ~ GHz) | Ant. Type      | Connector Type    |
| 1               | Chain (0)           | Microsoft | NA                                       | 4.79                                     | 2.4~2.5                        | PCB            | NA                |
|                 |                     |           |  | 3.49                                     | 5.15~5.85                      |                |                   |
| 2               | Chain (1)           | Microsoft | NA                                       | 1.87                                     | 2.4~2.5                        | PCB            | NA                |
|                 |                     |           |  | 2.63                                     | 5.15~5.85                      |                |                   |

## 2.4 EUT MAXIMUM CONDUCTED POWER

**TABLE 4: THE MEASURED CONDUCTED OUTPUT POWER**

### IEEE 802.11a

| Frequency Band(MHz) | MAX. Power        |                  |
|---------------------|-------------------|------------------|
|                     | Output Power(dBm) | Output Power(mW) |
| 5250~5350MHz        | 23.81             | 240.484          |
| 5470~5725MHz        | 23.82             | 240.731          |

### IEEE 802.11n (HT20)

| Frequency Band(MHz) | MAX. Power        |                  |
|---------------------|-------------------|------------------|
|                     | Output Power(dBm) | Output Power(mW) |
| 5250~5350MHz        | 23.81             | 240.473          |
| 5470~5725MHz        | 23.78             | 238.815          |

### IEEE 802.11n (HT40)

| Frequency Band(MHz) | MAX. Power        |                  |
|---------------------|-------------------|------------------|
|                     | Output Power(dBm) | Output Power(mW) |
| 5250~5350MHz        | 23.78             | 238.978          |
| 5470~5725MHz        | 23.81             | 240.203          |

## 2.5 EUT MAXIMUM EIRP POWER

**TABLE 5: THE EIRP OUTPUT POWER**

### IEEE 802.11a

| Frequency Band(MHz) | MAX. Power        |                  |
|---------------------|-------------------|------------------|
|                     | Output Power(dBm) | Output Power(mW) |
| 5250~5350MHz        | 27.30             | 537.138          |
| 5470~5725MHz        | 27.31             | 537.690          |

### IEEE 802.11n (HT20)

| Frequency Band(MHz) | MAX. Power        |                  |
|---------------------|-------------------|------------------|
|                     | Output Power(dBm) | Output Power(mW) |
| 5250~5350MHz        | 27.30             | 537.114          |
| 5470~5725MHz        | 27.27             | 533.411          |

### IEEE 802.11n (HT40)

| Frequency Band(MHz) | MAX. Power        |                  |
|---------------------|-------------------|------------------|
|                     | Output Power(dBm) | Output Power(mW) |
| 5250~5350MHz        | 27.27             | 533.775          |
| 5470~5725MHz        | 27.30             | 536.511          |

## 2.6 TRANSMIT POWER CONTROL (TPC)

U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an EIRP of less than 500 mW.

Maximum EIRP of this device is 537.690mW which more than 500mW, therefore it's require TPC function.

TPC is auto controlled by software to adjust power level when the TX power needs to increase or decrease. So it is automatic TPC.

## 2.7 STATEMENT OF MAUNFACTURER

This device (Client) is without radar detection, then the manufacturer statement confirming that information regarding the parameters of the detected Radar Waveforms is not available to the end user. **And the device doesn't have Ad Hoc mode on DFS frequency band.**



### 3. U-NII DFS RULE REQUIREMENTS

#### 3.1 WORKING MODES AND REQUIRED TEST ITEMS

The manufacturer shall state whether the UUT is capable of operating as a Master and/or a Client. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See tables 6 and 7 for the applicability of DFS requirements for each of the operational modes.

**TABLE 6: APPLICABILITY OF DFS REQUIREMENTS PRIOR TO USE A CHANNEL**

| Requirement                     | Operational Mode |                                |                             |
|---------------------------------|------------------|--------------------------------|-----------------------------|
|                                 | Master           | Client without radar detection | Client with radar detection |
| Non-Occupancy Period            | ✓                | Not required                   | ✓                           |
| DFS Detection Threshold         | ✓                | Not required                   | ✓                           |
| Channel Availability Check Time | ✓                | Not required                   | Not required                |
| U-NII Detection Bandwidth       | ✓                | Not required                   | ✓                           |

**TABLE 7: APPLICABILITY OF DFS REQUIREMENTS DURING NORMAL OPERATION**

| Requirement                       | Operational Mode                      |                                |
|-----------------------------------|---------------------------------------|--------------------------------|
|                                   | Master or Client with radar detection | Client without radar detection |
| DFS Detection Threshold           | ✓                                     | Not required                   |
| Channel Closing Transmission Time | ✓                                     | ✓                              |
| Channel Move Time                 | ✓                                     | ✓                              |
| U-NII Detection Bandwidth         | ✓                                     | Not required                   |

| Additional requirements for devices with multiple bandwidth modes  | Master or Client with radar detection | Client without radar detection                       |
|--|---------------------------------------|--|
| U-NII Detection Bandwidth and Statistical Performance Check  | All BW modes must be tested           | Not required   |
| Channel Move Time and Channel Closing Transmission Time  | Test using widest BW mode available   | Test using the widest BW mode available for the link |
| All other tests  | Any single BW mode                    | Not required   |
| <b>Note:</b> Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in all 20 MHz channel blocks and a null frequencies between the bonded 20 MHz channel blocks. |                                       |  |

## 3.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS

### DETECTION THRESHOLD VALUES

**TABLE 8: DFS DETECTION THRESHOLDS FOR MASTER DEVICES AND CLIENT DEVICES WITH RADAR DETECTION**

| Maximum Transmit Power  | Value<br>(See Notes 1, 2, and 3) |
|---|----------------------------------|
| EIRP $\geq$ 200 milliwatt   | -64 dBm                          |
| EIRP < 200 milliwatt and<br>power spectral density < 10 dBm/MHz   | -62 dBm                          |
| EIRP < 200 milliwatt that do not meet the<br>power spectral density requirement   | -64 dBm                          |
| <p><b>Note 1:</b> This is the level at the input of the receiver assuming a 0 dBi receive antenna.</p> <p><b>Note 2:</b> 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.</p> <p><b>Note3:</b> EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.</p> |                                  |

**TABLE 9: DFS RESPONSE REQUIREMENT VALUES**

| Parameter   | Value   |
|---|---|
| Non-occupancy period  | Minimum 30 minutes  |
| Channel Availability Check Time   | 60 seconds  |
| Channel Move Time   | 10 seconds<br>See Note 1.   |
| Channel Closing Transmission Time   | 200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period.<br>See Notes 1 and 2. |
| U-NII Detection Bandwidth   | Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3                                    |
| <p>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.</p> <p>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 signals will not count quiet periods in between transmissions.</p> <p>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.</p> |   |

**PARAMETERS OF DFS TEST SIGNALS**

Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.



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TABLE 10: SHORT PULSE RADAR TEST WAVEFORMS

| Radar Type  | Pulse Width (μsec) | PRI (μsec)  | Number of Pulses   | Minimum Percentage of Successful Detection | Minimum Number of Trials |
|---|--------------------|---|--|--|--------------------------|
| 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<br><br>-----<br>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 | $\text{Roundup} \left\{ \left( \frac{1}{360} \right) \cdot \left( \frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{SEC}}} \right) \right\}$ | 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 (Radar Types 1-4)   |                    |   |  | 80%  | 120                      |
| <b>Note 1:</b> Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests. |                    |   |  |  |                          |

**A D T****TABLE 11: LONG PULSE RADAR TEST WAVEFORM**

| RADAR TYPE | PULSE WIDTH (μsec) | CHIRP WIDTH (MHz) | PRI (μsec) | NUMBER OF PULSES PER BURST | NUMBER OF BURSTS | MINIMUM PERCENTAGE OF SUCCESSFUL DETECTION | MINIMUM NUMBER OF TRIALS |
|------------|--------------------|-------------------|------------|----------------------------|------------------|--|--------------------------|
| 5          | 50-100             | 5-20              | 1000-2000  | 1-3                        | 8-20             | 80%  | 30                       |

**TABLE 12: FREQUENCY HOPPING RADAR TEST WAVEFORM**

| RADAR TYPE | PULSE WIDTH (μsec) | PRI (μsec) | PULSES PER HOP | 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. TEST & SUPPORT EQUIPMENT LIST

### 4.1 TEST INSTRUMENTS

TABLE 13: TEST INSTRUMENTS LIST.

| DESCRIPTION & MANUFACTURER  | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|-----------------------------|-----------|------------|-----------------|------------------|
| Spectrum Analyzer R&S       | FSW8      | 101497     | Aug. 07, 2013   | Aug. 06, 2014    |
| Vector Signal Generator R&S | SMJ100A   | 101878     | Aug. 13, 2013   | Aug. 12, 2014    |

### 4.2 DESCRIPTION OF SUPPORT UNITS

TABLE 14: SUPPORT UNIT INFORMATION.

| NO. | PRODUCT          | BRAND    | MODEL NO. | ID         | SPEC.  |
|-----|------------------|----------|-----------|------------|--|
| 1   | 11n Access-Point | MOTOROLA | AP-7131N  | UZ7AP7131N | The maximum EIRP is 13.6 dBm, Antenna Gain is -3.38dBi |

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

TABLE 15: SOFTWARE/FIRMWARE INFORMATION.

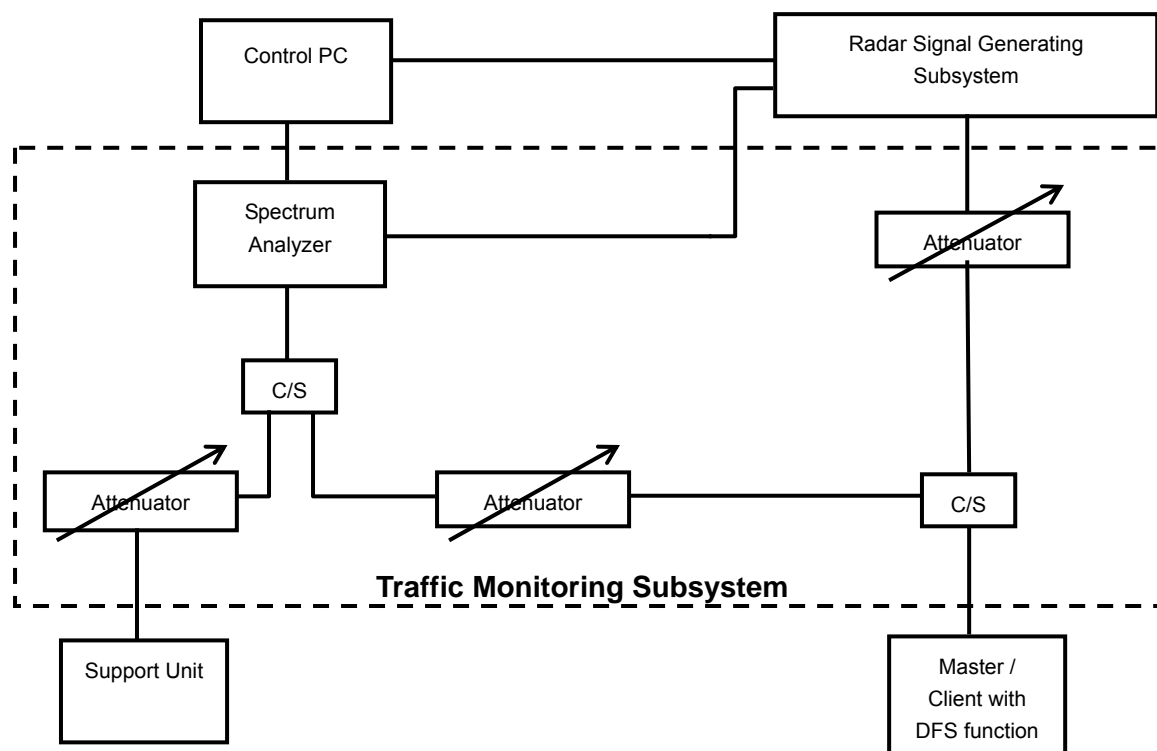
| NO. | PRODUCT          | MODEL NO. | SOFTWARE/FIRMWARE VERSION |
|-----|------------------|-----------|---------------------------|
| 1.  | 11n Access-Point | AP-7131N  | 4.1.5.0-004R              |

## 5. TEST PROCEDURE

### 5.1 BVADT DFS MEASUREMENT SYSTEM:

A complete BVADT DFS Measurement System consists of two subsystems: (1) the Radar Signal Generating Subsystem and (2) the Traffic Monitoring Subsystem. The control PC is necessary for generating the Radar waveforms in Table 10, 11 and 12. The traffic monitoring subsystem is specified to the type of unit under test (UUT).

### CONDUCTED SETUP CONFIGURATION OF ADT DFS MEASUREMENT SYSTEM



#### Channel Loading

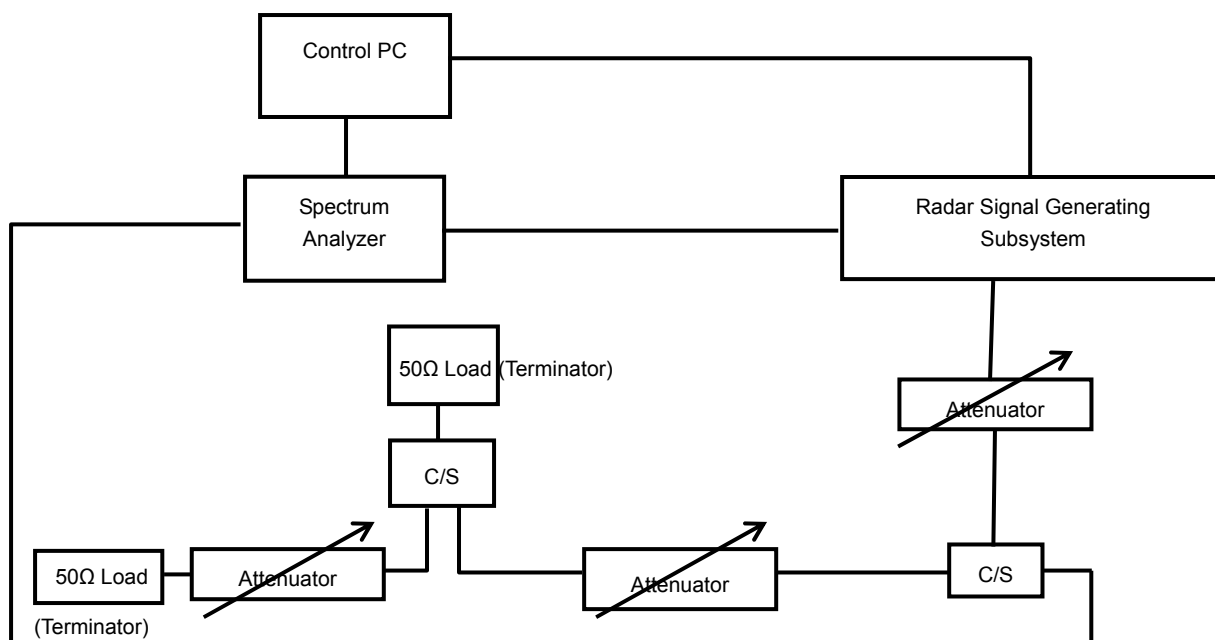
System testing will be performed with channel-loading using means appropriate to the data types that are used by the unlicensed device. The following requirements apply:

|    |   |   |
|----|---|---|
| a) | The data file must be of a type that is typical for the device (i.e., MPEG-2, MPEG-4, WAV, MP3, MP4, AVI, etc.) and must generally be transmitting in a streaming mode. |   |
| b) | Software to ping the client is permitted to simulate data transfer but must have random ping intervals.   |   |
| c) | Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater.  | ✓ |
| d) | Unicast or Multicast protocols are preferable but other protocols may be used. The appropriate protocol used must be described in the test procedures.                  |   |

## 5.2 CALIBRATION OF DFS DETECTION THRESHOLD LEVEL:

The measured channel is 5500 MHz in 20MHz Bandwidth, 5510MHz in 40MHz Bandwidth. The radar signal was the same as transmitted channels, and injected into the antenna port of AP (master) or Client Device with Radar Detection, measured the channel closing transmission time and channel move time. The Master antenna gain is -3.38dBi and required detection threshold is -64.38dBm (= -62 +1 -3.38). The calibrated conducted detection threshold level is set to -64.38 dBm.

### CONDUCTED SETUP CONFIGURATION OF CALIBRATION OF DFS DETECTION THRESHOLD LEVEL



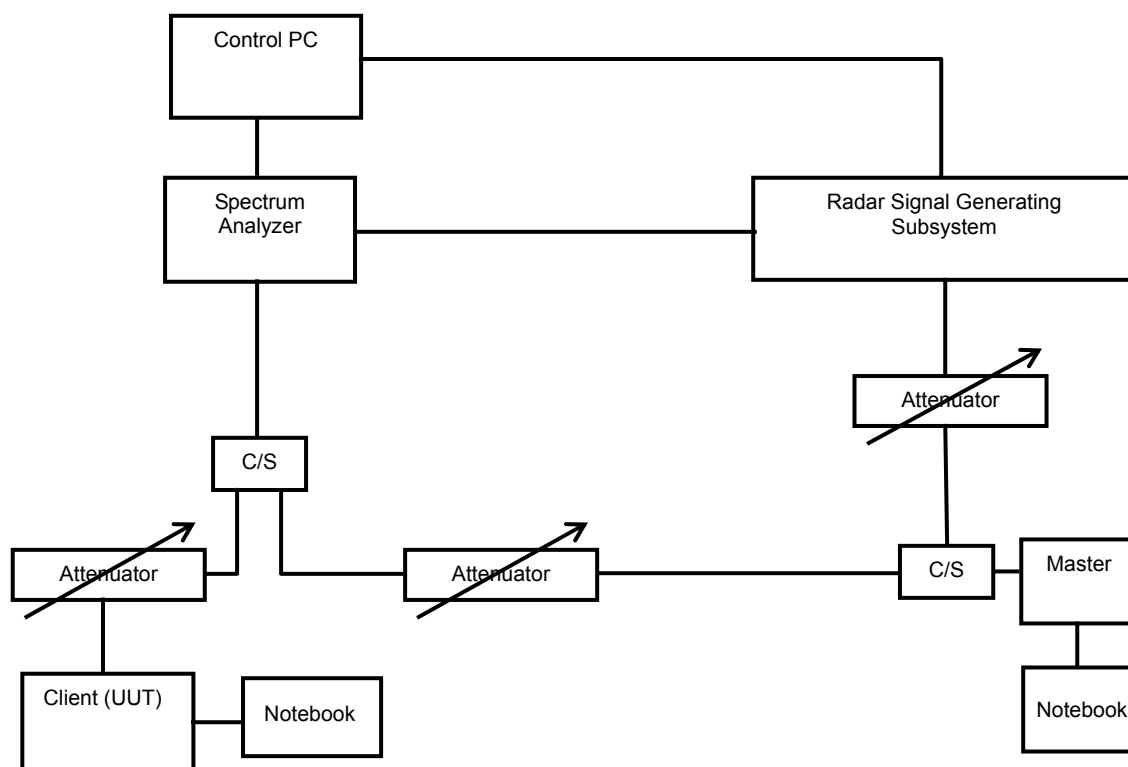


### 5.3 DEVIATION FROM TEST STANDARD

No deviation.

### 5.4 CONDUCTED TEST SETUP CONFIGURATION

#### 5.4.1 CLIENT WITHOUT RADAR DETECTION MODE



The UUT is a U-NII Device operating in Client mode without radar detection. The radar test signals are injected into the Master Device.



## 6. TEST RESULTS

### 6.1 SUMMARY OF TEST RESULTS

| CLAUSE | TEST PARAMETER                    | REMARKS        | PASS/FAIL |
|--------|-----------------------------------|----------------|-----------|
| 15.407 | DFS Detection Threshold           | Not Applicable | NA        |
| 15.407 | Channel Availability Check Time   | Not Applicable | NA        |
| 15.407 | Channel Move Time                 | Applicable     | Pass      |
| 15.407 | Channel Closing Transmission Time | Applicable     | Pass      |
| 15.407 | Non- Occupancy Period             | Applicable     | Pass      |
| 15.407 | U-NII Detection Bandwidth         | Not Applicable | NA        |
| 15.407 | Non-associated test               | Applicable     | Pass      |
| 15.407 | Non-Co-Channel test               | Applicable     | Pass      |

## 6.2 DETAILED TEST RESULTS

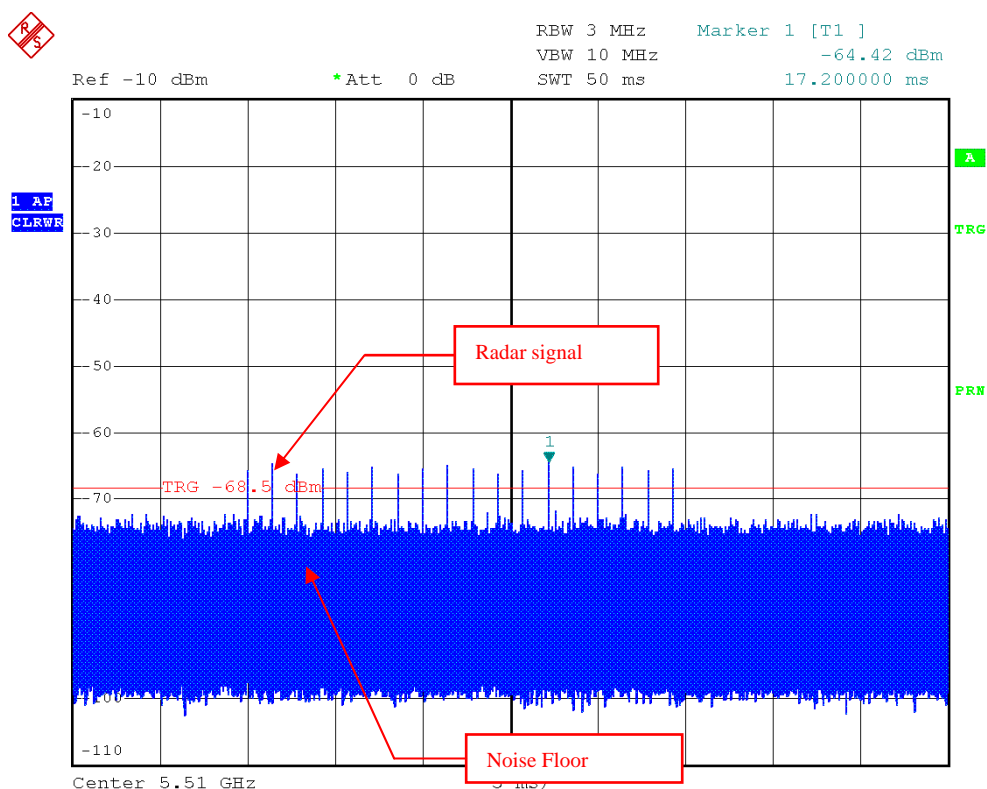
### 6.2.1 TEST MODE: DEVICE OPERATING IN CLIENT WITHOUT RADAR DETECTION MODE.

The radar test signals are injected into the Master Device.

This test was investigated for different bandwidth (20MHz 、 40MHz). The following plots was done on 40MHz as a representative

#### 6.2.1.1 DFS DETECTION THRESHOLD

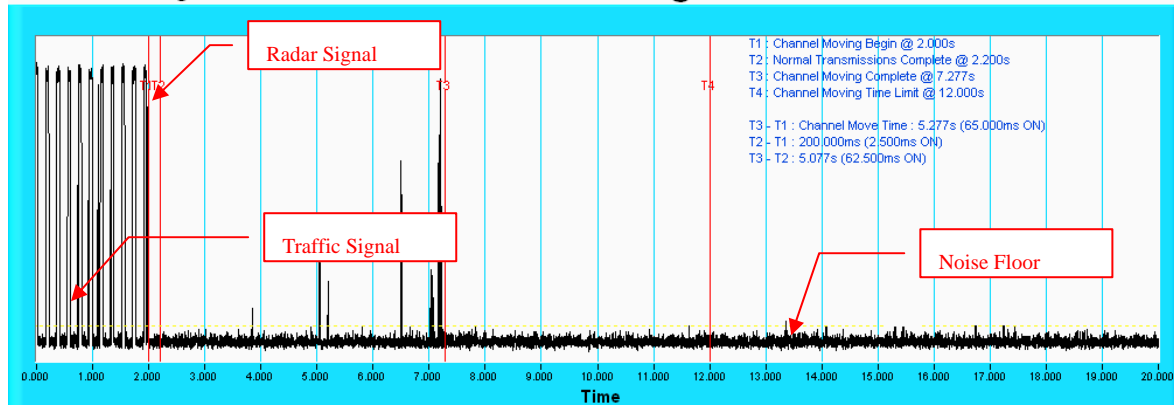
The Required detection threshold is -64.38dBm (= -62 +1 -3.38). The conducted radar burst level is set to -64.38dBm.



Radar Signal 0

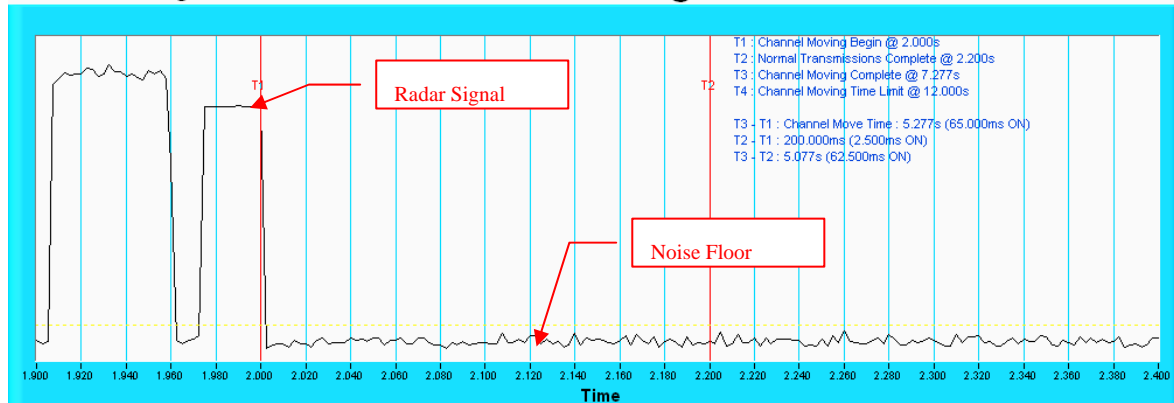
## 6.2.1.2 CHANNEL CLOSING TRANSMISSION AND CHANNEL MOVE TIME

Channel Closing Transmission Time & Channel Move Time @ CH102 - 5510MHz



**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. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

Channel Closing Transmission Time & Channel Move Time @ CH102 - 5510MHz

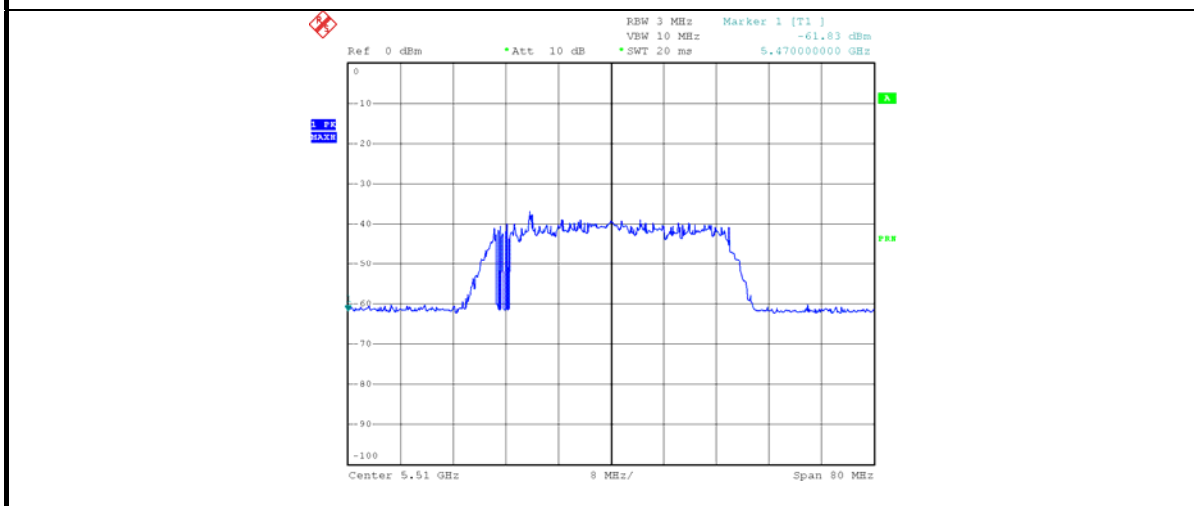


**NOTE:** An expanded plot for the device vacates the channel in the required 500ms.

### 6.2.1.3 NON- OCCUPANCY PERIOD

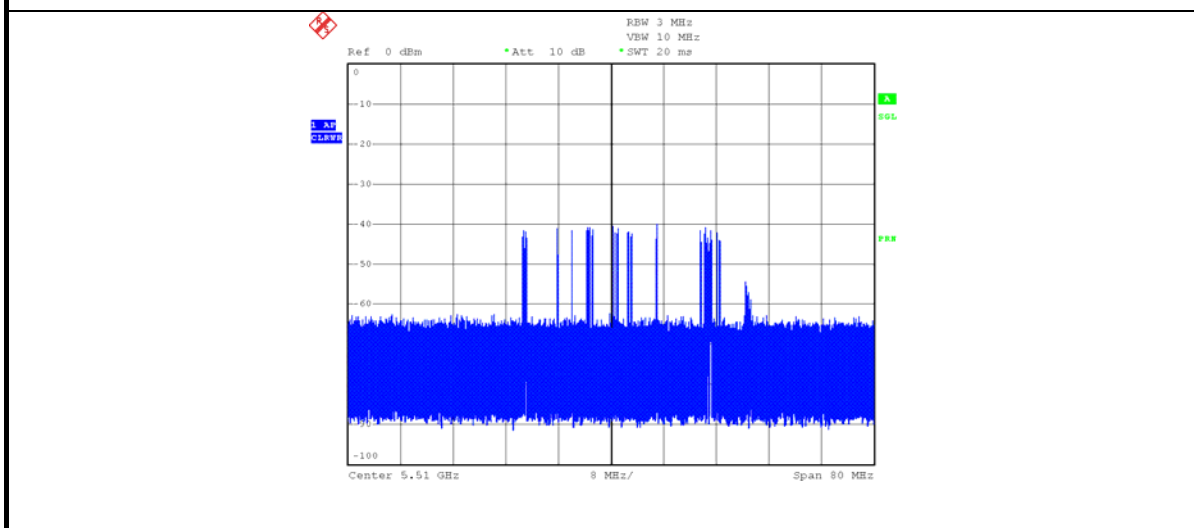
#### ASSOCIATED TEST

1) Test results demonstrating an associated client link is established with the master on a test frequency.



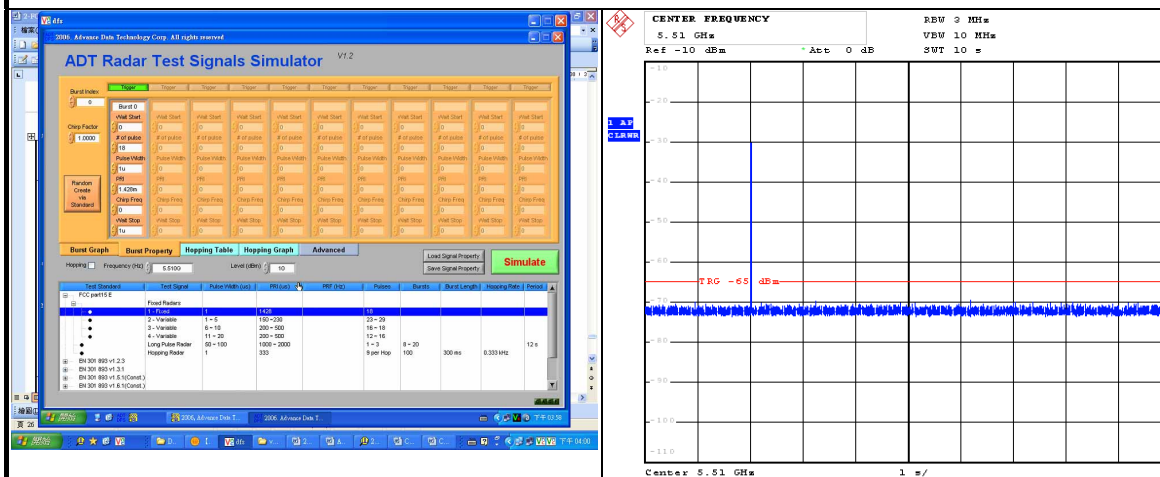
EUT (Client ) links with master on 5510MHz

2) The master and DFS-certified client device are associated, and system testing will be performed with channel-loading using means appropriate to the data types for a non-occupancy period test.



Client plays a specified files via master.

3). The device transmits one type of radar as specified in the DFS Order.

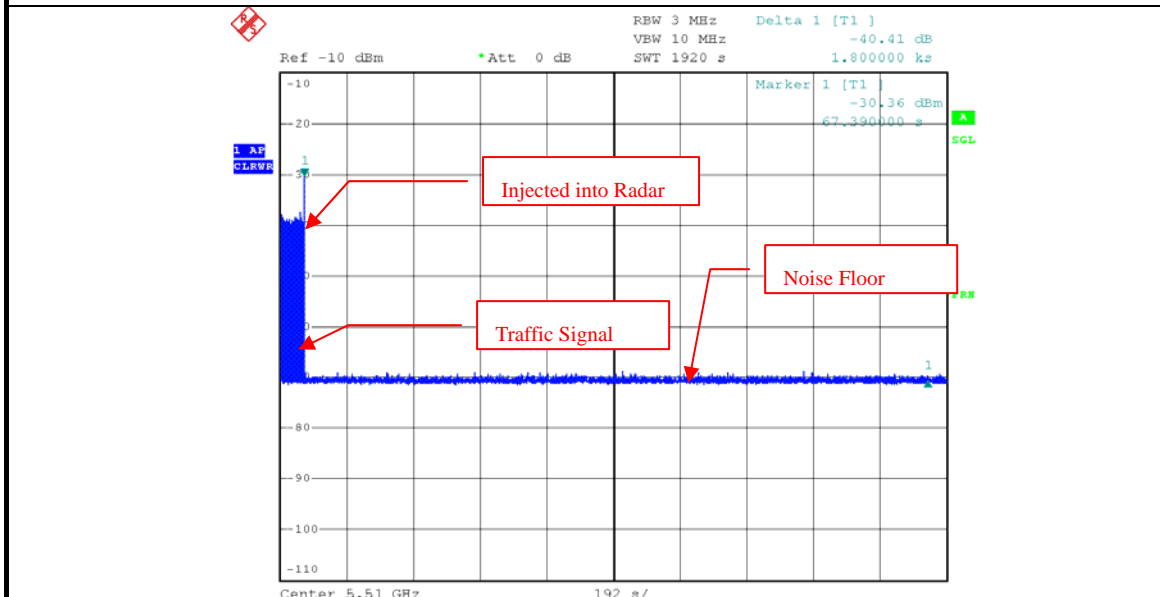


Radar 0 is used to test during DFS testing.

4) The test frequency has been monitored to ensure no transmission of any type has occurred for 30 minutes;

Note: If the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear;

5)An analyzer plot that contains a single 30-minute sweep on the original test frequency.

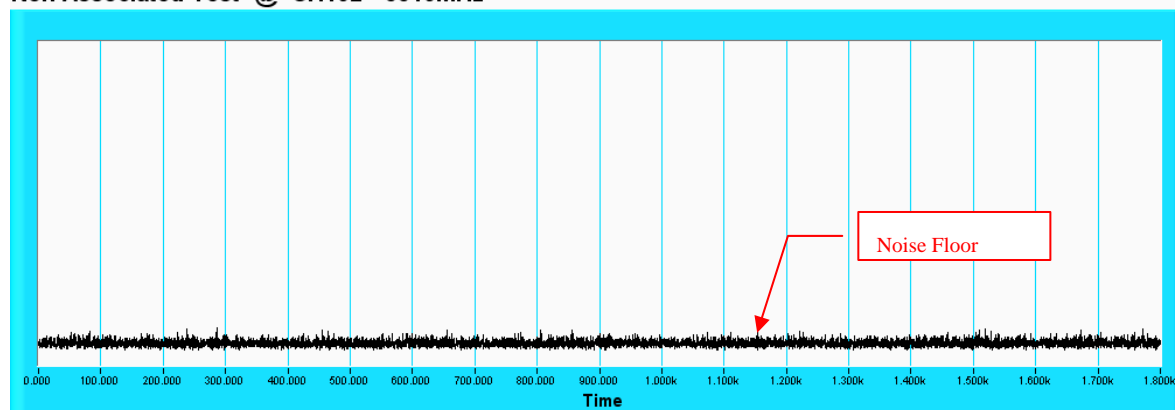


#### 6.2.1.4 NON-ASSOCIATED TEST

Master was off.

During the 30 minutes observation time, The UUT did not make any transmissions in the DFS band after UUT power up.

##### Non Associated Test @ CH102 - 5510MHz



#### 6.2.1.5 NON- CO-CHANNEL TEST

The UUT was investigated after radar was detected the channel and made sure no co-channel operation with radars.



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## 7. 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:**

Tel: 886-2-26052180

Fax: 886-2-26052943

**Hsin Chu EMC/RF Lab:**

Tel: 886-3-5935343

Fax: 886-3-5935342

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**Email:** [service.adt@tw.bureauveritas.com](mailto:service.adt@tw.bureauveritas.com)

**Web Site:** [www.bureauveritas-adt.com](http://www.bureauveritas-adt.com)

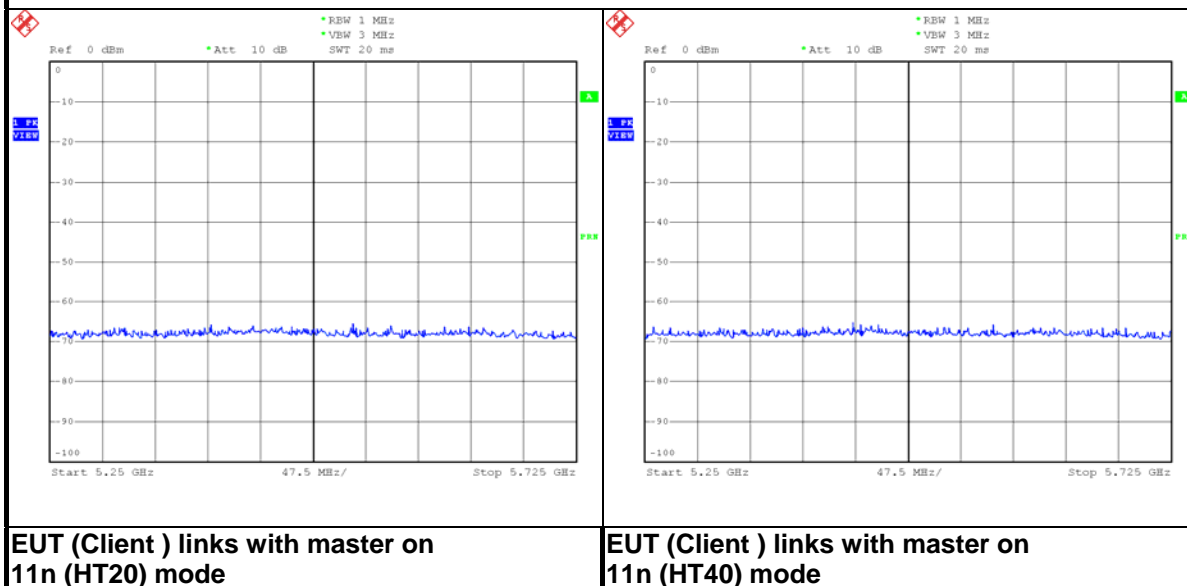
The address and road map of all our labs can be found in our web site also.



## 8. APPENDIX-A

### NON BEACON ON DFS BAND

- 1) Test results demonstrating no any beacon on DFS band after power up.
- 2) Observation time is 10min after power up.





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## **9. APPENDIX B - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB**

No modifications were made to the EUT by the lab during the test.

**--- END ---**