

# FCC DFS Test Report

## FCC ID: M82-ARK1123

This report concerns (check one): Original Grant Class I Change Class II Change

**Project No.** : 1604060  
**Equipment** : Computer  
**Test Model** : ARK-1123H  
**Series Model** : ARK-1123H-U0A1E,  
ARK1123XXXXXXXXXXXXXX (where "X" may be  
any alphanumeric character, "-" or blank)  
**Applicant** : Advantech Co., Ltd.  
**Address** : No.1, Alley 20, Lane 26, Rueiguang Road, Neihu  
District, Taipei 11491, Taiwan, R.O.C.

**Date of Receipt** : Apr. 19, 2016  
**Date of Test** : Apr. 19, 2016 ~ Jun. 23, 2016  
**Issued Date** : Jun. 28, 2016  
**Tested by** : BTL Inc.

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**REPORT ISSUED HISTORY**

| Issued No.         | Description     | Issued Date   |
|--------------------|-----------------|---------------|
| BTL-FCCP-5-1604060 | Original Issue. | Jun. 28, 2016 |

## 1. CERTIFICATION

Equipment : Computer  
Brand Name : ADVANTECH  
Test Model : ARK-1123H  
Series Model : ARK-1123H-U0A1E, ARK1123XXXXXXXXXXXXXX (where "X" may be any alphanumeric character, "-" or blank)  
Applicant : Advantech Co., Ltd.  
Manufacturer : Advantech Co., Ltd.  
Address : No.1, Alley 20, Lane 26, Rueiguang Road, Neihu District, Taipei 11491, Taiwan, R.O.C.  
Date of Test : Apr. 19, 2016 ~ Jun. 23, 2016  
Test Sample : Production Unit  
Standard(s) : FCC Part 15, Subpart E (Section 15.407) FCC 06-96

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-5-1604060) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s).

**Test results included in this report is only for the DFS part.**

## 2. EUT INFORMATION

### 2.1 EUT SPECIFICATION TABLE

Table 1: Specification of EUT

|                                  |  |
|----------------------------------|--|
| <b>Product name</b>              | Computer   |
| <b>Brand Name</b>                | ADVANTECH  |
| <b>Test Model</b>                | ARK-1123H  |
| <b>Series Model</b>              | ARK-1123H-U0A1E, ARK1123XXXXXXXXXXXXXX (where "X" may be any alphanumeric character, "-" or blank) |
| <b>Operational Mode</b>          | Slave  |
| <b>Operating Frequency Range</b> | 5250MHz~5350MHz  |
| <b>Modulation</b>                | OFDM   |

**Note:** This device was functioned as a Master Slave device during the DFS

### 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 1 and 2 for the applicability of DFS requirements for each of the operational modes.

Table 5: Applicability of DFS requirements prior to use a channel

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

Table 6: Applicability of DFS requirements during normal operation.

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

### 3.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS

#### DETECTION THRESHOLD VALUES

Table 7: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection.

| Maximum Transmit Power | Value<br>(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 8: 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 UNII 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 signals 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.

## 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.

Table 9: 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   | Roundup $\left\lceil \left( \frac{1}{360} \right) \cdot \left( \frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right\rceil$ | 60%  | 30                       |
|   |                    | 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 |   |  |                          |
| 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                      |
| <p><b>Note 1:</b> Short Pulse Radar Type 0 shall only be used for the channel availability and detection bandwidth tests. It should be noted that any of the radar test waveforms 0 – 4 can be used for the channel availability and detection bandwidth tests.</p> |                    |   |   |  |                          |

Table 10: 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 11: Frequency Hopping 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 |
|------------|--------------------|-------------------|------------|----------------------------|------------------|--|--------------------------|
| 6          | 1                  | 333               | 9          | 0.333                      | 300              | 70%  | 30                       |

Note:

**Table 5a - Pulse Repetition Intervals Values for Test A**

| Pulse Repetition Frequency Number | Pulse Repetition Frequency (Pulses Per Second) | Pulse Repetition Interval (Microseconds) |
|-----------------------------------|--|--|
| 1                                 | 1930.5   | 518                                      |
| 2                                 | 1858.7   | 538                                      |
| 3                                 | 1792.1   | 558                                      |
| 4                                 | 1730.1   | 578                                      |
| 5                                 | 1672.2   | 598                                      |
| 6                                 | 1618.1   | 618                                      |
| 7                                 | 1567.4   | 638                                      |
| 8                                 | 1519.8   | 658                                      |
| 9                                 | 1474.9   | 678                                      |
| 10                                | 1432.7   | 698                                      |
| 11                                | 1392.8   | 718                                      |
| 12                                | 1355   | 738                                      |
| 13                                | 1319.3   | 758                                      |
| 14                                | 1285.3   | 778                                      |
| 15                                | 1253.1   | 798                                      |
| 16                                | 1222.5   | 818                                      |
| 17                                | 1193.3   | 838                                      |
| 18                                | 1165.6   | 858                                      |
| 19                                | 1139   | 878                                      |
| 20                                | 1113.6   | 898                                      |
| 21                                | 1089.3   | 918                                      |
| 22                                | 1066.1   | 938                                      |
| 23                                | 326.2  | 3066                                     |

#### 4. TEST INSTRUMENTS

Table 1: Test instruments list.

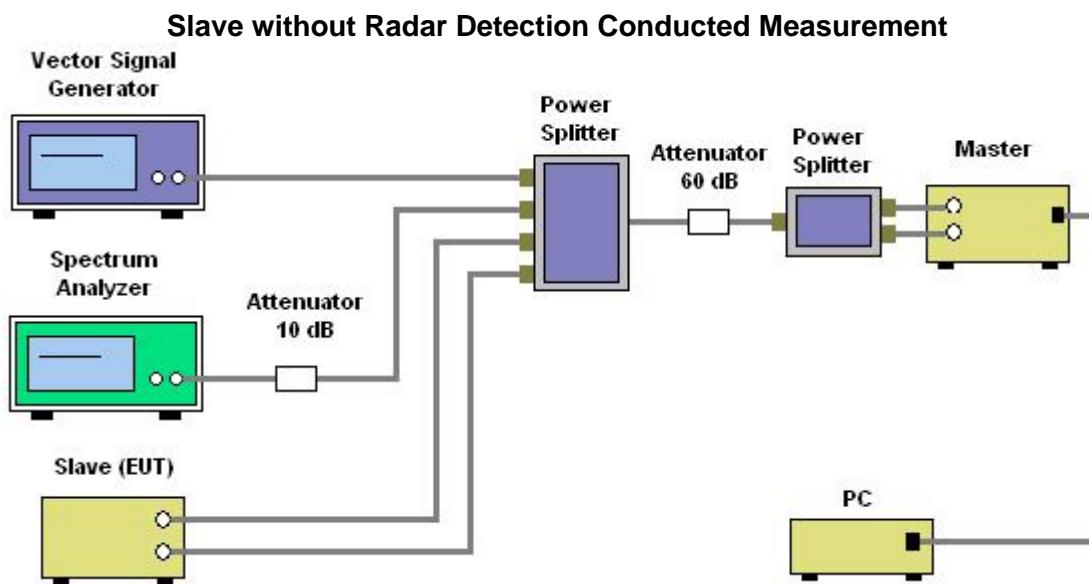
| DESCRIPTION                 | MANUFACTURER  | MODEL NO.    | Serial No  | Calibration Until |
|-----------------------------|---------------|--------------|------------|-------------------|
| Spectrum Analyzer           | Agilent       | N9020A       | MY51160196 | Jul. 22, 2016     |
| MXG Vector Signal Generator | Agilent       | N5182B       | MY51350711 | May 28, 2017      |
| 10dB Attenuators            | Mini-Circuits | VAT-10+      | N/A        | May 16, 2017      |
| 10dB Attenuators            | Mini-Circuits | VAT-10+      | N/A        | May 16, 2017      |
| 30dB Attenuators            | Mini-Circuits | VAT-30+      | N/A        | May 16, 2017      |
| 30dB Attenuators            | Mini-Circuits | VAT-30+      | N/A        | May 16, 2017      |
| POWER SPLITTER              | Mini-Circuits | ZFRSC-123-S+ | N/A        | May 16, 2017      |
| POWER SPLITTER              | Mini-Circuits | ZFRSC-123-S+ | N/A        | May 16, 2017      |

Note: Calibration interval of instruments listed above is one year.

## 5. EMC EMISSION TEST

### 5.1 DFS MEASUREMENT SYSTEM:

#### CONDUCTED METHOD SYSTEM BLOCK DIAGRAM



#### SYSTEM OVERVIEW

The short pulse and long pulse signal generating system utilizes the NTIA software. The Vector Signal Generator has been validated by the NTIA. The hopping signal generating system utilizes the CCS simulated hopping method and system, which has been validated by the DoD, FCC and NTIA. 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, and the long pulse type 5 parameters are randomized at run-time.

The hopping type 6 pulse parameters are fixed while the hopping sequence is based on the August 2005 NTIA Hopping Frequency List. The initial starting point randomized at run-time and each subsequent starting point is incremented by 475. Each frequency in the 100-length segment is compared to the boundaries of the EUT Detection Bandwidth and the software creates a hopping burst pattern in accordance with Section 7.4.1.3 Method #2 Simulated Frequency Hopping Radar Waveform Generating Subsystem of FCC 06-96. The frequency of the signal generator is incremented in 1 MHz steps from FL to FH for each successive trial. This incremental sequence is repeated as required to generate a minimum of 30 total trials and to maintain a uniform frequency distribution over the entire Detection Bandwidth.

The signal monitoring equipment consists of a spectrum analyzer set to display 8001 bins on the horizontal axis. The time-domain resolution is 2 msec / bin with a 16 second sweep time, meeting the 10 second 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 and max hold.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), additional combiner/dividers are inserted between the Master Combiner/Divider and the pad connected to the Master Device (and/or between the Slave Combiner/Divider and the pad connected to the Slave Device). Additional pads are utilized such that there is one pad at each RF port on each EUT.

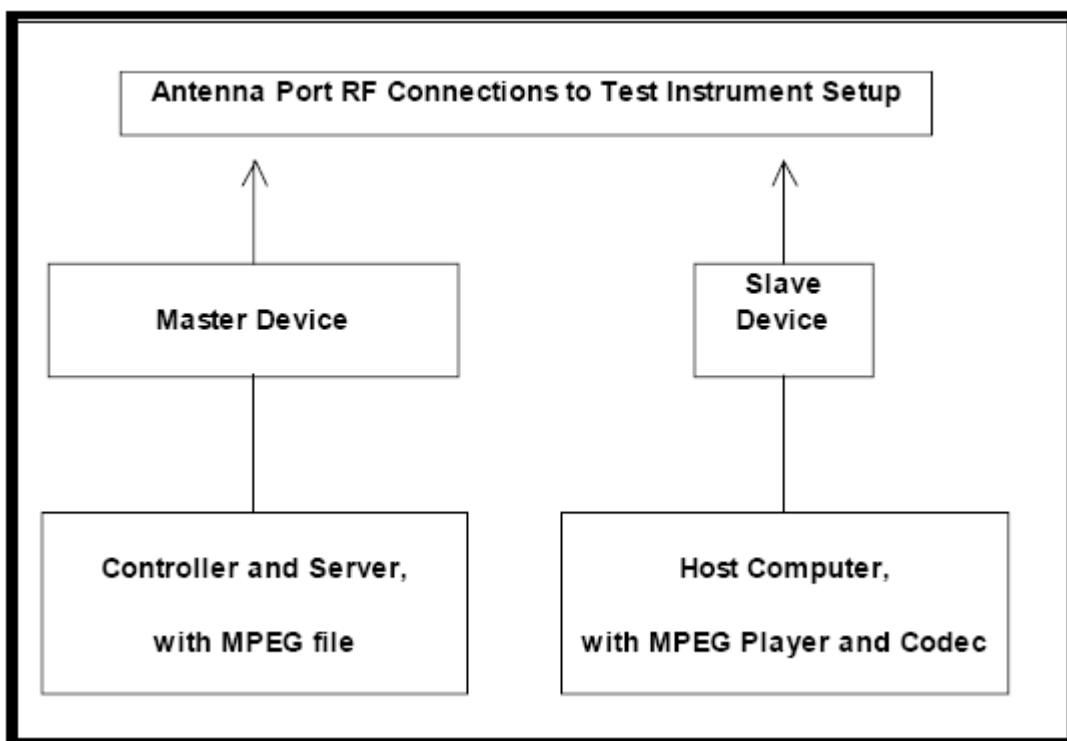
## 5.2 CALIBRATION OF DFS DETECTION THRESHOLD LEVEL

A 50 ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected in place of the master device and the signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of -62 dBm as measured on the spectrum analyzer.

Without changing any of the instrument settings, the spectrum analyzer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. Measure the amplitude and calculate the difference from -62 dBm. Adjust the Reference Level Offset of the spectrum analyzer to this difference.

The spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device. The interference detection threshold may be varied from the calibrated value of -62 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

Set the signal generator to produce a radar waveform, trigger a burst manually and measure the level 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.



## 5.3 DEVIATION FROM TEST STANDARD

No deviation.

## 6. TEST RESULTS

### 6.1 SUMMARY OF TEST RESULT

| Clause | Test Parameter                    | Remarks        | Pass/Fail |
|--------|-----------------------------------|----------------|-----------|
| 15.407 | DFS Detection Threshold           | No Applicable  | N/A       |
| 15.407 | Channel Availability Check Time   | Not Applicable | N/A       |
| 15.407 | Channel Move Time                 | Applicable     | Pass      |
| 15.407 | Channel Closing Transmission Time | Applicable     | Pass      |
| 15.407 | Non- Occupancy Period             | Applicable     | Pass      |
| 15.407 | Uniform Spreading                 | Not Applicable | N/A       |
| 15.407 | U-NII Detection Bandwidth         | Not Applicable | N/A       |

## 6.2 DETELED TEST RESULTS

| Clause | Test Parameter                    | Remarks        | Pass/Fail |
|--------|-----------------------------------|----------------|-----------|
| 15.407 | DFS Detection Threshold           | No Applicable  | N/A       |
| 15.407 | Channel Availability Check Time   | Not Applicable | N/A       |
| 15.407 | Channel Move Time                 | Applicable     | Pass      |
| 15.407 | Channel Closing Transmission Time | Applicable     | Pass      |
| 15.407 | Non- Occupancy Period             | Applicable     | Pass      |
| 15.407 | Uniform Spreading                 | Not Applicable | N/A       |
| 15.407 | U-NII Detection Bandwidth         | Not Applicable | N/A       |

### 6.2.1 TEST MODE: DEVICE OPERATING IN MASTER MODE.

The EUT is slave equipment, it need a master device when testing.

Master with injection at the Master. (Radar Test Waveforms are injected into the Master)

### 6.2.2 DFS DETECTION THRESHOLD

Calibration:

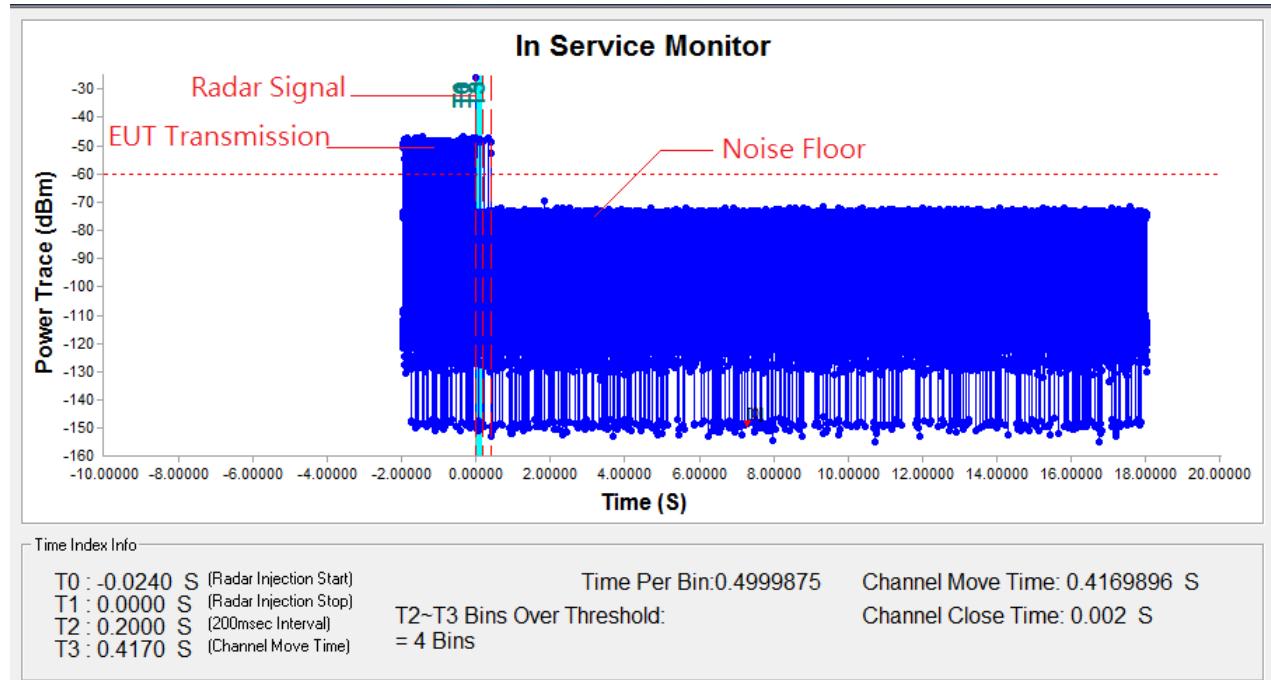
The EUT is slave equipment and it with a max gain is 5.21 dBi.

For a detection threshold level of -62dBm and the master (Brand: Alcatel-Lucent, Model: G-240W-B, FCC ID: 2ADZRG240WB) antenna gain is 2.90 dBi, required detection threshold is -59.10 dBm (= -62+2.90).

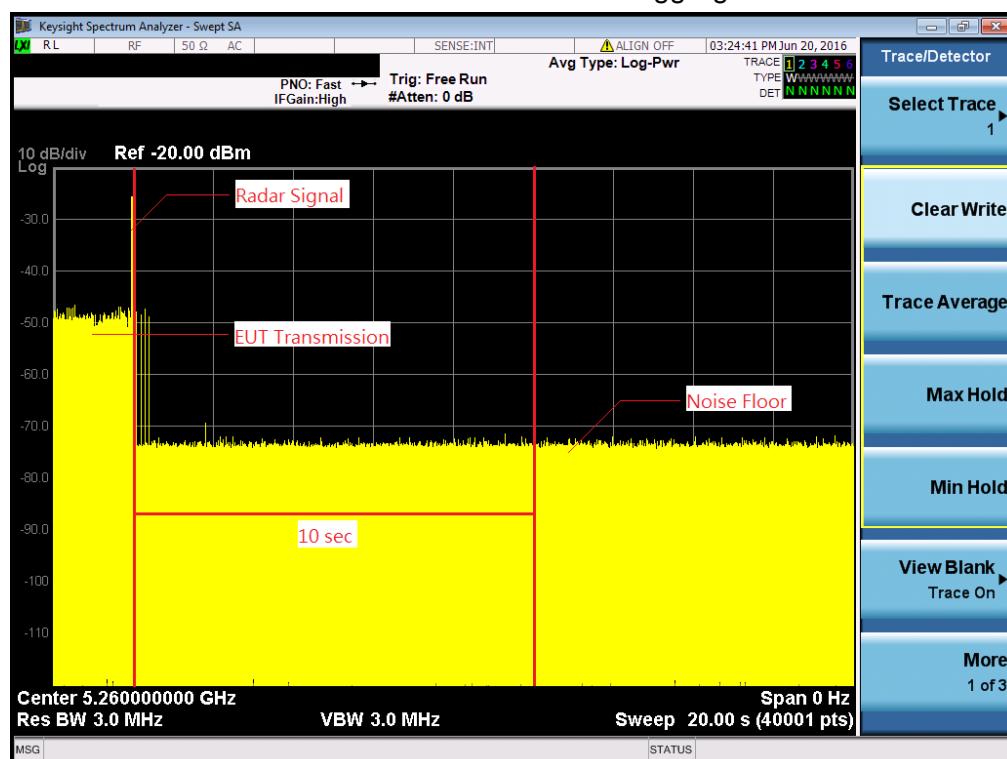
Note: Maximum Transmit Power is less than 200 milliwatt in this report, so detection threshold level is -62dBm.

### 6.2.3 CHANNEL CLOSING TRANSMISSION AND CHANNEL MOVE TIME WLAN TRAFFIC

TX N20 Mode

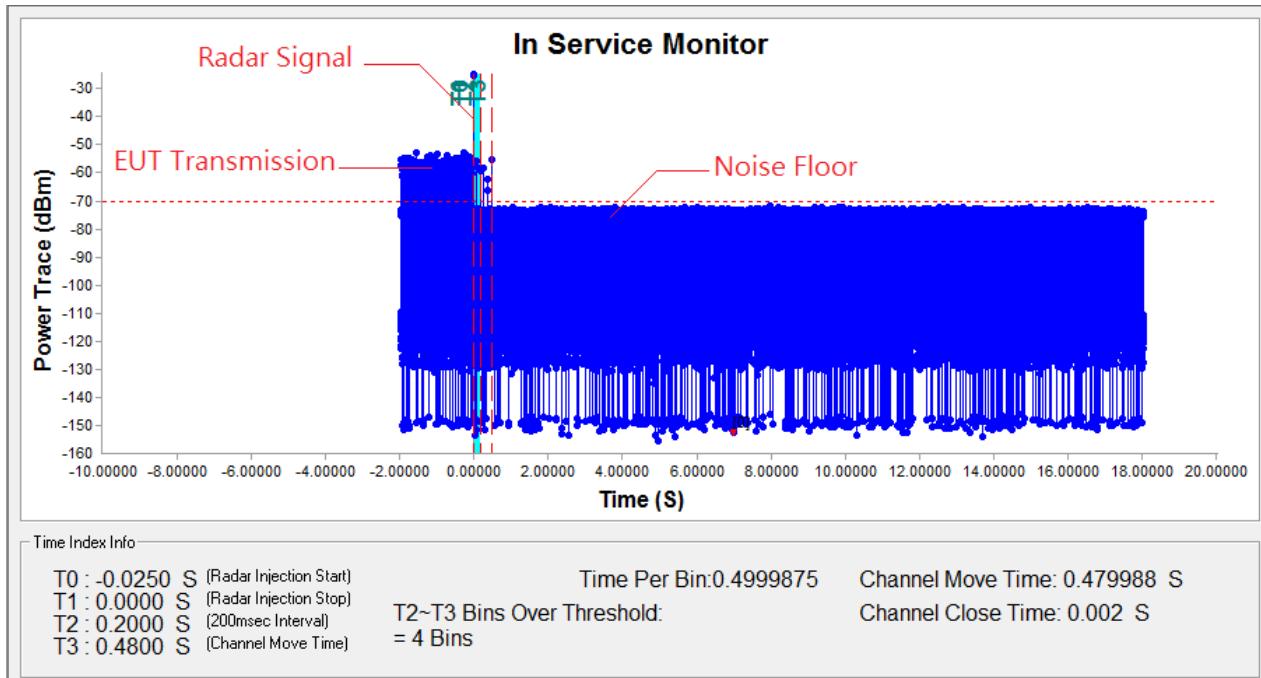


**Note:** T0 denotes the start of Channel Move Time upon the end of the last Radar burst.  
 T1 denotes the data transmission time of 200ms from T0.  
 T2 denotes the end of Channel Move Time.  
 T3 denotes the 10 second from T0 to observe the aggregate duration of transmissions.

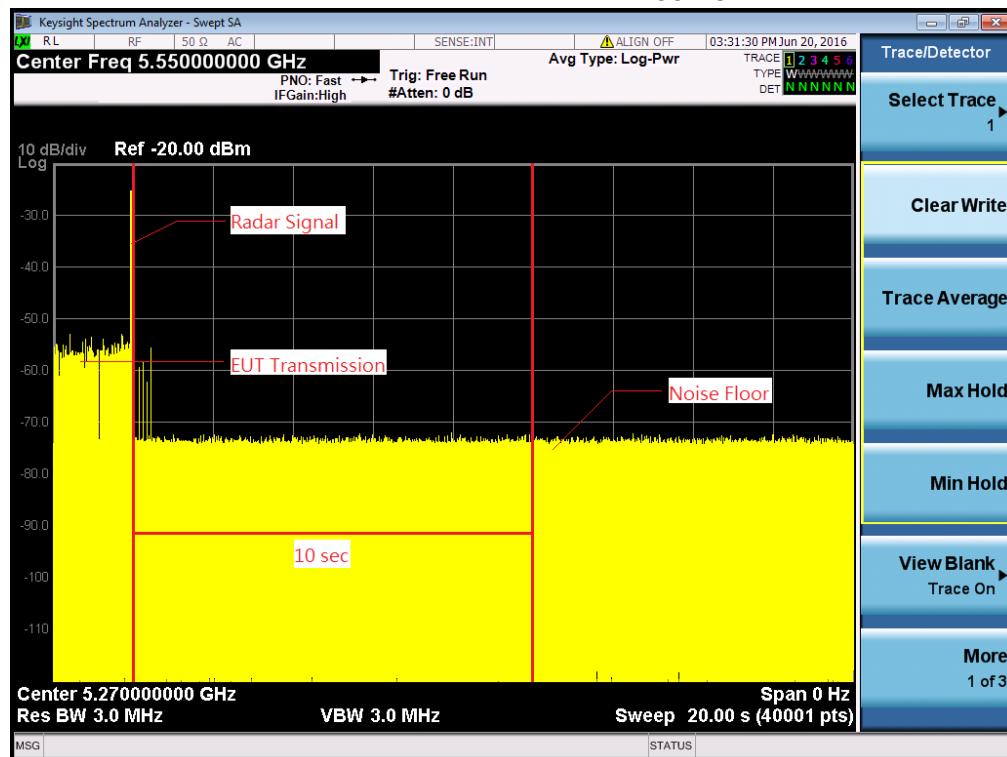


**Note:** An expanded plot for the device vacates the channel in the required 500ms

## TX N40 Mode



**Note:** T0 denotes the start of Channel Move Time upon the end of the last Radar burst.  
 T1 denotes the data transmission time of 200ms from T0.  
 T2 denotes the end of Channel Move Time.  
 T3 denotes the 10 second from T0 to observe the aggregate duration of transmissions.

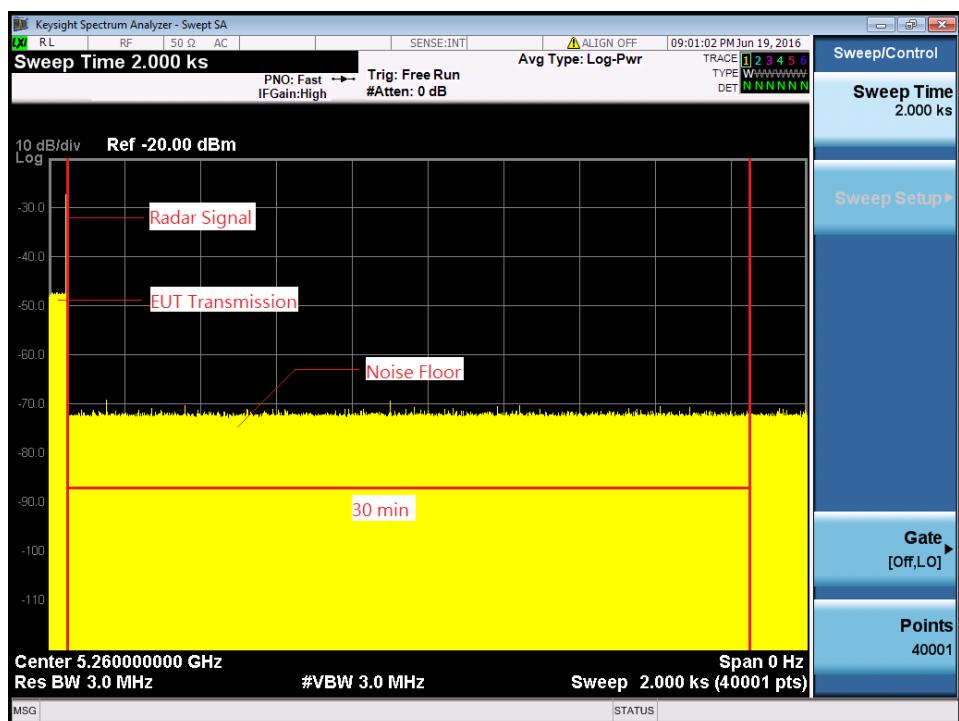


**Note:** An expanded plot for the device vacates the channel in the required 500ms

#### 6.2.4 NON- OCCUPANCY PERIOD

During the 30 minutes observation time, UUT did not make any transmissions on a channel after a radar signal was detected on that channel by either the Channel Availability Check or the In-Service Monitoring.

TX N20 Mode



TX N40 Mode

