

**Table 5 – Short Pulse Radar Test Waveforms**

| Radar Type                                                                                                                                                        | Pulse Width (usec) | PRI (usec)                                                                                                                                                    | Pulses                                                                      | Minimum Percentage of Successful Detection | Minimum 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:<br>$\{(1/360) \times (19 \times 10^6 \text{ PRI}_{\text{usec}})\}$ | 60%                                        | 30             |
|                                                                                                                                                                   |                    | Test B: 15 unique PRI values randomly selected within the range of 518-3066 usec. With a minimum increment of 1 usec, 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            |
| <b>Note 1:</b> Short Pulse Radar Type 0 should be used for the <i>Detection Bandwidth</i> test, <i>Channel Move Time</i> , and <i>Channel Closing Time</i> tests. |                    |                                                                                                                                                               |                                                                             |                                            |                |

*Table 6 – Long Pulse Radar Test Signal*

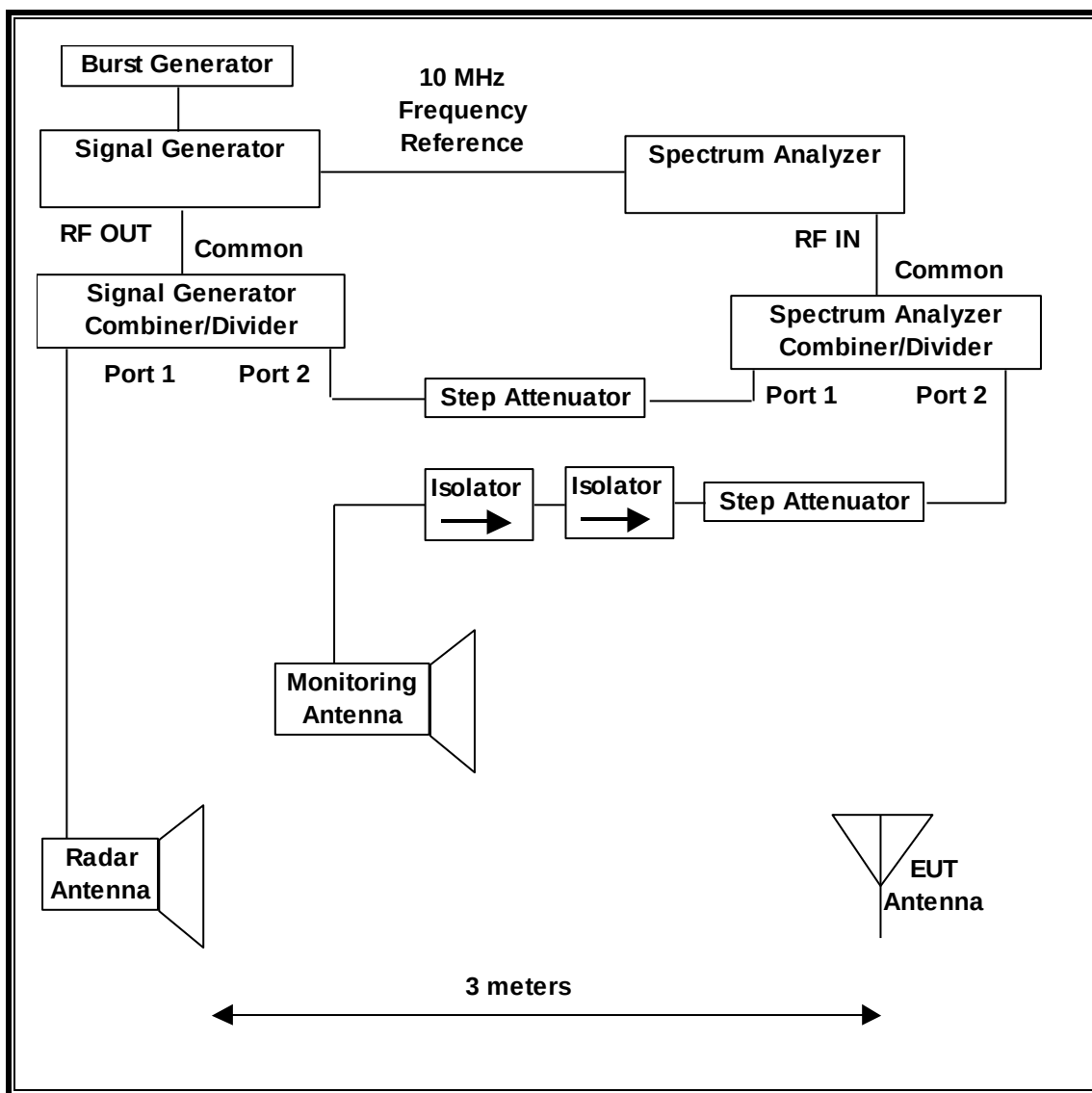
| Radar Waveform Type | Pulse Width (μsec) | Chirp Width (MHz) | PRI (μsec) | Pulses per Burst | Number of Bursts | Minimum Percentage of Successful Detection | Minimum Trials |
|---------------------|--------------------|-------------------|------------|------------------|------------------|--------------------------------------------|----------------|
| 5                   | 50-100             | 5-20              | 1000-2000  | 1-3              | 8-20             | 80%                                        | 30             |

**Table 7 – Frequency Hopping Radar Test Signal**

| Radar Waveform Type | Pulse Width (μsec) | PRI (μsec) | Pulses per Hop | Hopping Rate (kHz) | Hopping Sequence Length (msec) | Minimum Percentage of Successful Detection | Minimum Trials |
|---------------------|--------------------|------------|----------------|--------------------|--------------------------------|--------------------------------------------|----------------|
| 6                   | 1                  | 333        | 9              | 0.333              | 300                            | 70%                                        | 30             |

## 10.2.2. TEST AND MEASUREMENT SYSTEM

### RADIATED 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 1, 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 KDB 905462 D02. The frequency of the signal generator is incremented in 1 MHz steps from  $F_L$  to  $F_H$  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. 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.

## **SYSTEM CALIBRATION**

A 50-ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected to a horn antenna via a coaxial cable, with the reference level offset set to (horn antenna gain – coaxial cable loss). The signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –64 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. The Reference Level Offset of the spectrum analyzer is adjusted so that the displayed amplitude of the signal is  $-64$  dBm.

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  $-64$  dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

### **ADJUSTMENT OF DISPLAYED TRAFFIC LEVEL**

A link is established between the Master and Slave and the distance between the units is adjusted as needed to provide a suitable received level at the Master and Slave devices. The video test file is streamed to generate WLAN traffic. The monitoring antenna is adjusted so that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold.

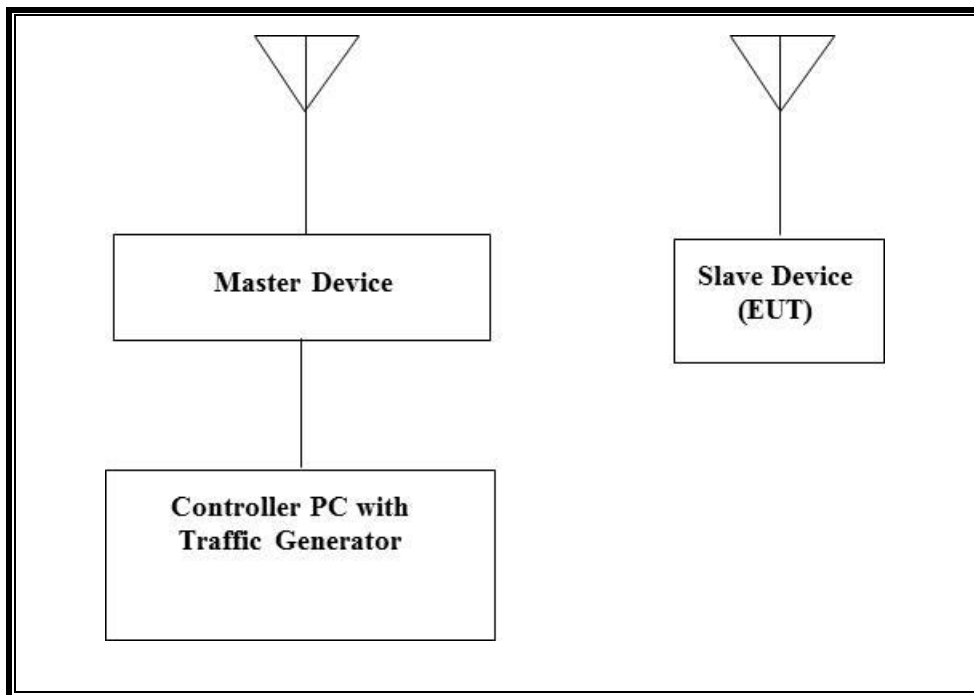
### **TEST AND MEASUREMENT EQUIPMENT**

The following test and measurement equipment was utilized for the DFS tests documented in this report:

| TEST EQUIPMENT LIST                      |              |        |              |          |
|------------------------------------------|--------------|--------|--------------|----------|
| Description                              | Manufacturer | Model  | Asset Number | Cal Due  |
| Spectrum Analyzer, PXA, 3Hz to 50GHz     | Agilent      | N9030A | MY52350671   | 06/26/15 |
| Signal Generator, MXG X-Series RF Vector | Agilent      | N5172B | MY51350337   | 02/17/18 |

### 10.2.3. SETUP OF EUT

#### RADIATED METHOD EUT TEST SETUP



#### SUPPORT EQUIPMENT

The following support equipment was utilized for the DFS tests documented in this report:

| PERIPHERAL SUPPORT EQUIPMENT LIST        |              |                   |                             |           |
|------------------------------------------|--------------|-------------------|-----------------------------|-----------|
| Description                              | Manufacturer | Model             | Serial Number               | FCC ID    |
| 802.11ac Dual Band Wireless Access Point | Cisco        | AIR-CAP3702E-A-K9 | FTX181570A6                 | LDK102087 |
| P.O.E. Injector                          | Phihong      | POE30U-560(G)     | PHI170102N2                 | DoC       |
| Notebook PC (Controller/Server)          | Lenovo       | Type 4236-B92     | PB-HEX04 12/05              | DoC       |
| AC Adapter (Controller/Server PC)        | Lenovo       | 42T4418           | 11S42T4418Z1ZGWWG08<br>R90M | DoC       |

#### **10.2.4. DESCRIPTION OF EUT**

For FCC the EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges.

For IC the EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges, excluding the 5600-5650 MHz range.

The EUT is a Slave Device without Radar Detection.

The highest power level within these bands is 13.02 dBm EIRP in the 5250-5350 MHz band and 13.83 dBm EIRP in the 5470-5725 MHz band.

The rated output power of the Master unit is  $> 23\text{dBm}$  (EIRP). Therefore the required interference threshold level is  $-64\text{ dBm}$ . After correction for procedural adjustments, the required radiated threshold at the antenna port is  $-64 + 1 = -63\text{ dBm}$ .

The calibrated radiated DFS Detection Threshold level is set to  $-64\text{ dBm}$ . The tested level is lower than the required level hence it provides a margin to the limit.

WLAN traffic is generated by streaming the video file TestFile 841.wmv "6 ½ Magic Hours" from the Master to the Slave in full motion video mode using the Android Media Player.

TPC is not required since the maximum EIRP is less than 500 mW (27 dBm).

The EUT utilizes the 802.11ac architecture. Three nominal channel bandwidths are implemented: 20 MHz, 40 MHz and 80 MHz.

The software installed in the EUT is Android 5.1.1

### **UNIFORM CHANNEL SPREADING**

This is requirement not applicable to Slave Devices.

### **OVERVIEW OF MASTER DEVICE WITH RESPECT TO §15.407 (h) REQUIREMENTS**

The Master Device is a Cisco Access Point, FCC ID: LDK102087. The minimum antenna gain for the Master Device is 6 dBi.

The rated output power of the Master unit is  $> 23\text{dBm}$  (EIRP). Therefore the required interference threshold level is  $-64\text{ dBm}$ . After correction for procedural adjustments, the required radiated threshold at the antenna port is  $-64 + 1 = -63\text{ dBm}$ .

The calibrated radiated DFS Detection Threshold level is set to  $-64\text{ dBm}$ . The tested level is lower than the required level hence it provides a margin to the limit.

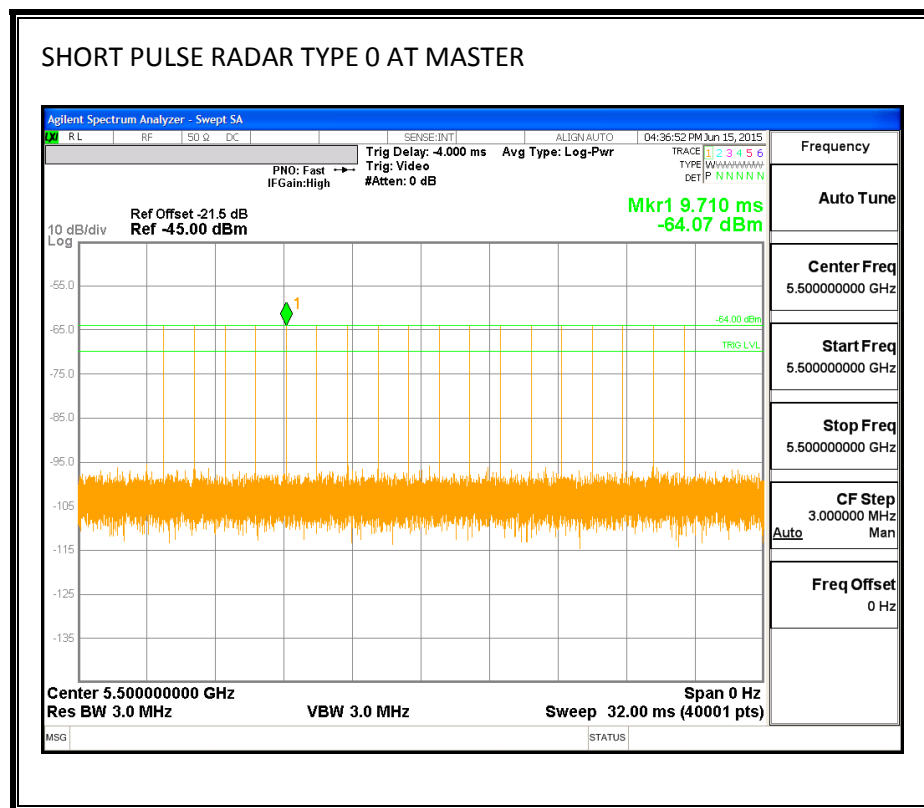
## 10.3. RESULTS FOR 20 MHz BANDWIDTH

### 10.3.1. TEST CHANNEL

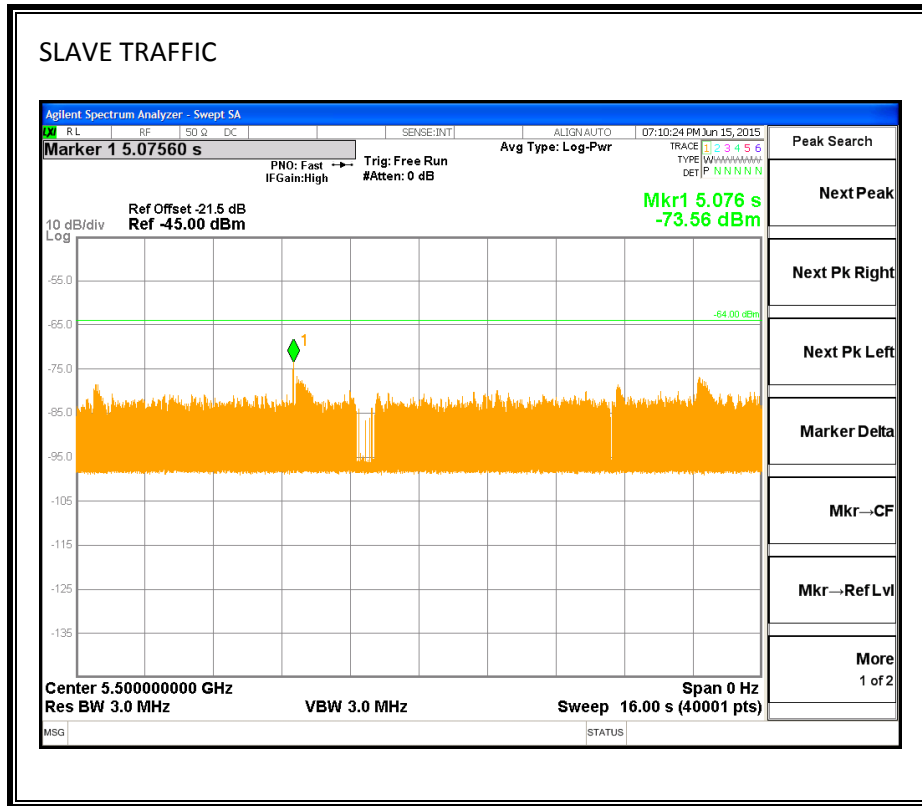
All tests were performed at a channel center frequency of 5500 MHz.

### 10.3.2. RADAR WAVEFORM AND TRAFFIC

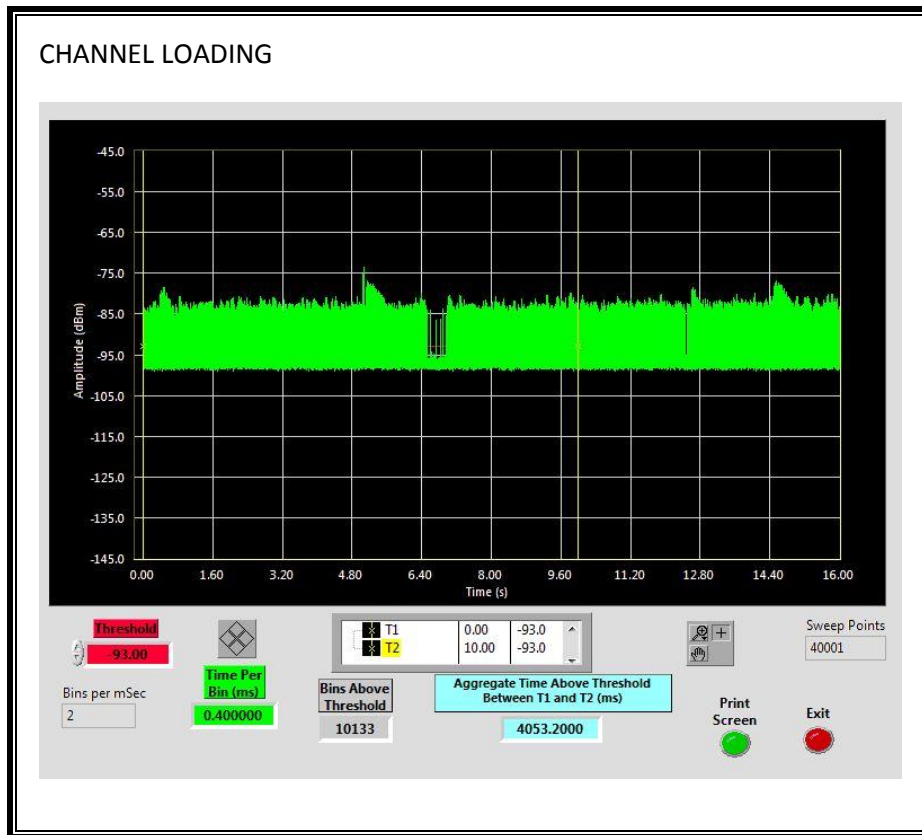
#### RADAR WAVEFORM



**TRAFFIC**



## CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 40.532%

### 10.3.3. OVERLAPPING CHANNEL TESTS

#### RESULTS

These tests are not applicable.

### 10.3.4. MOVE AND CLOSING TIME

#### REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =

(Number of analyzer bins showing transmission) \* (dwell time per bin)

The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

#### RESULTS

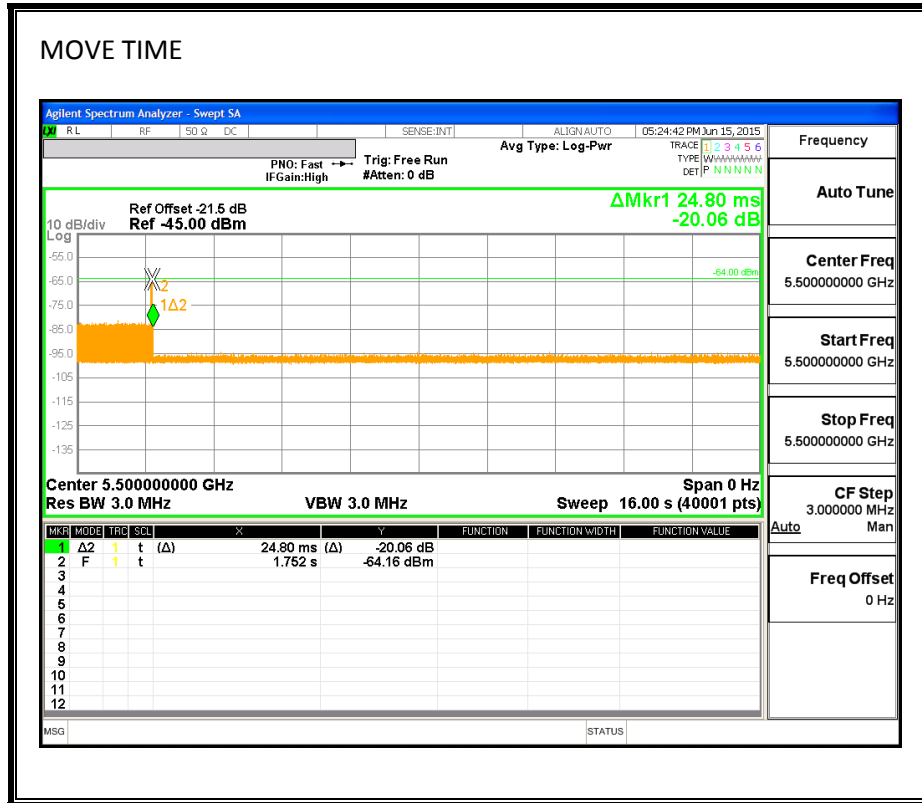
| Channel Move Time<br>(sec) | Limit<br>(sec) |
|----------------------------|----------------|
| 0.025                      | 10             |

| Aggregate Channel Closing Transmission Time<br>(msec) | Limit<br>(msec) |
|-------------------------------------------------------|-----------------|
| 0.0                                                   | 60              |

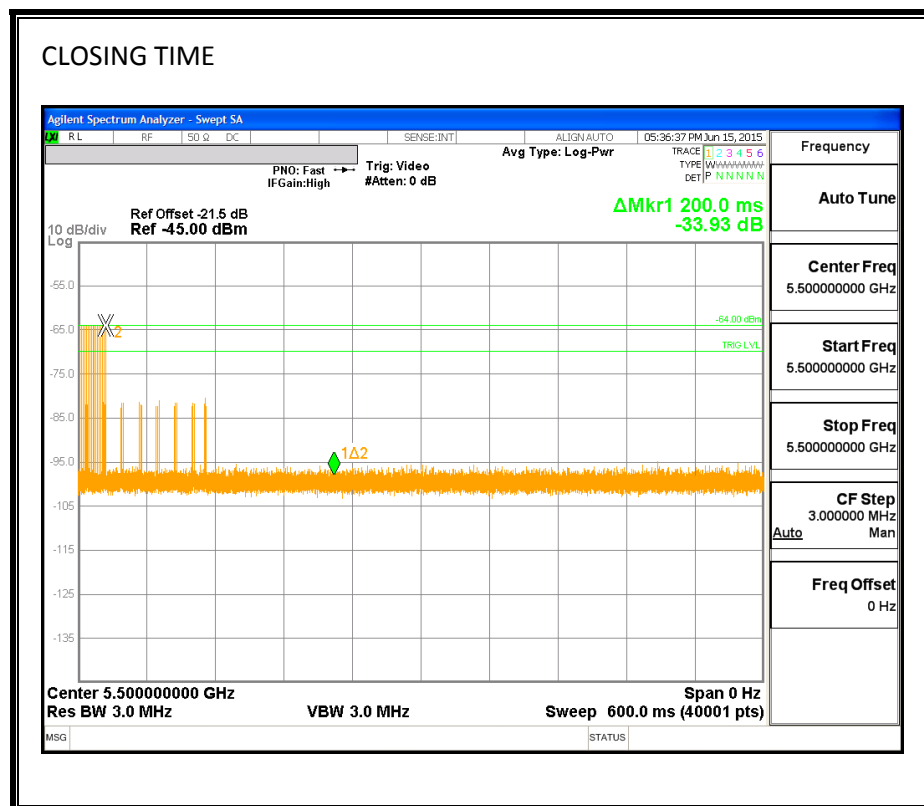
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**MOVE TIME**

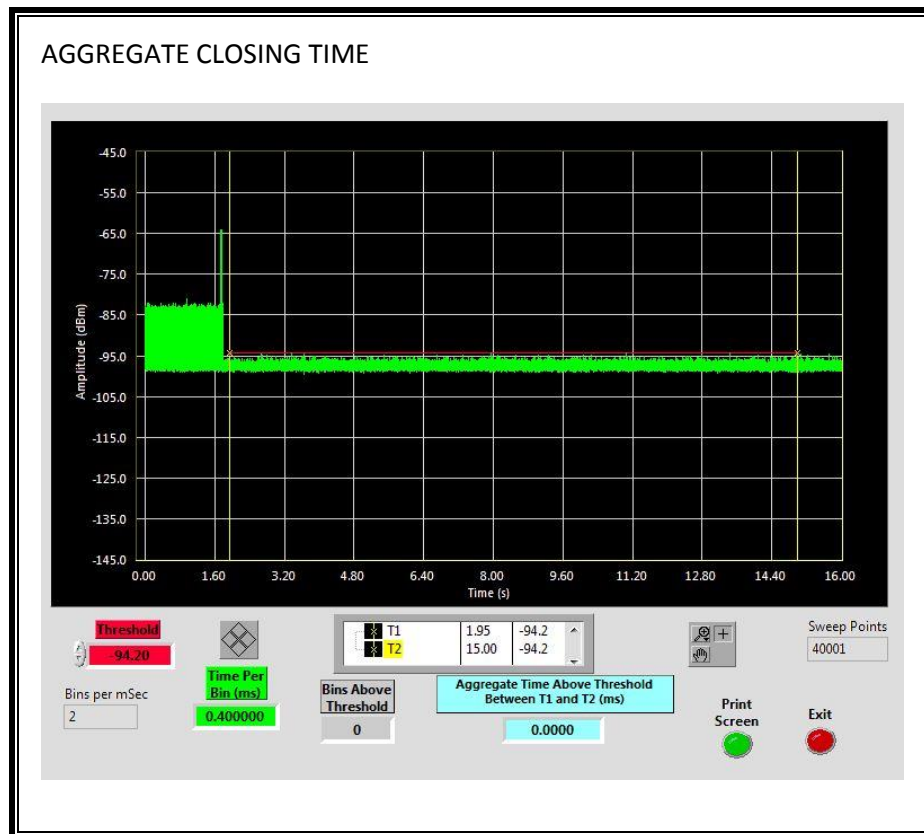


## CLOSING TIME



### AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

No transmissions are observed during the aggregate monitoring period.



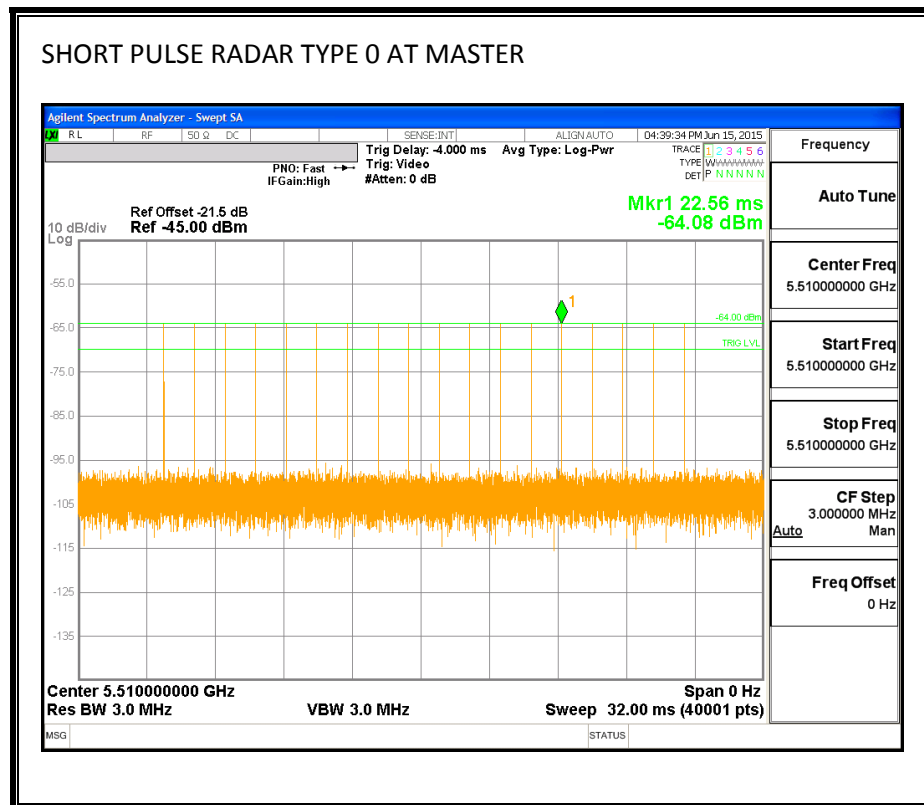
## 10.4. RESULTS FOR 40 MHz BANDWIDTH

### 10.4.1. TEST CHANNEL

All tests were performed at a channel center frequency of 5510 MHz.

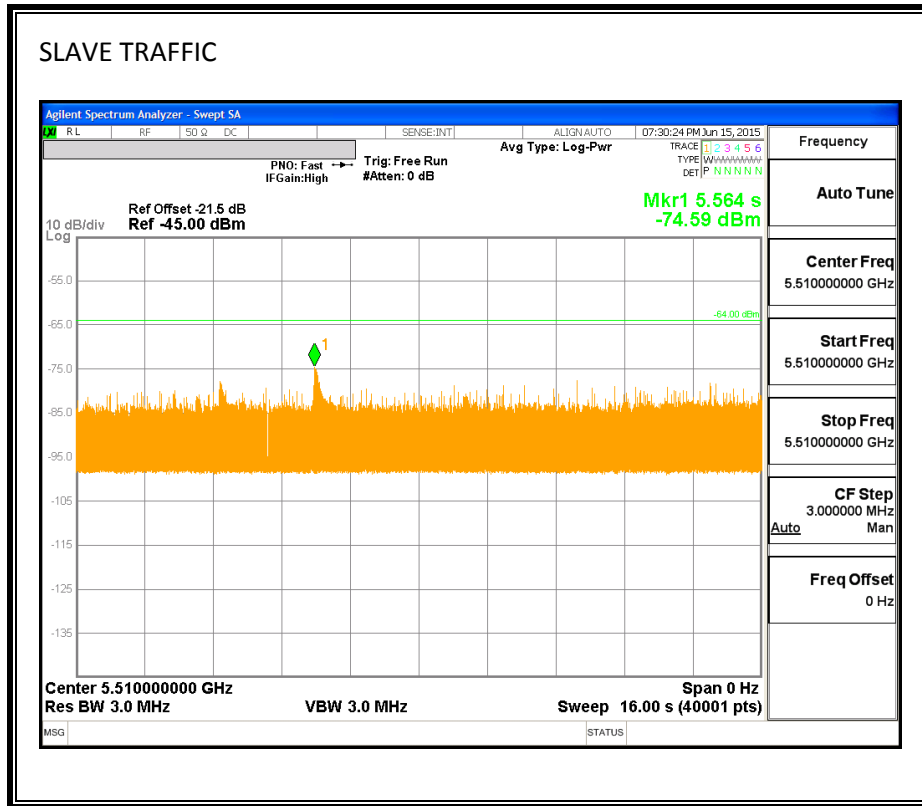
### 10.4.2. RADAR WAVEFORM AND TRAFFIC

#### RADAR WAVEFORM

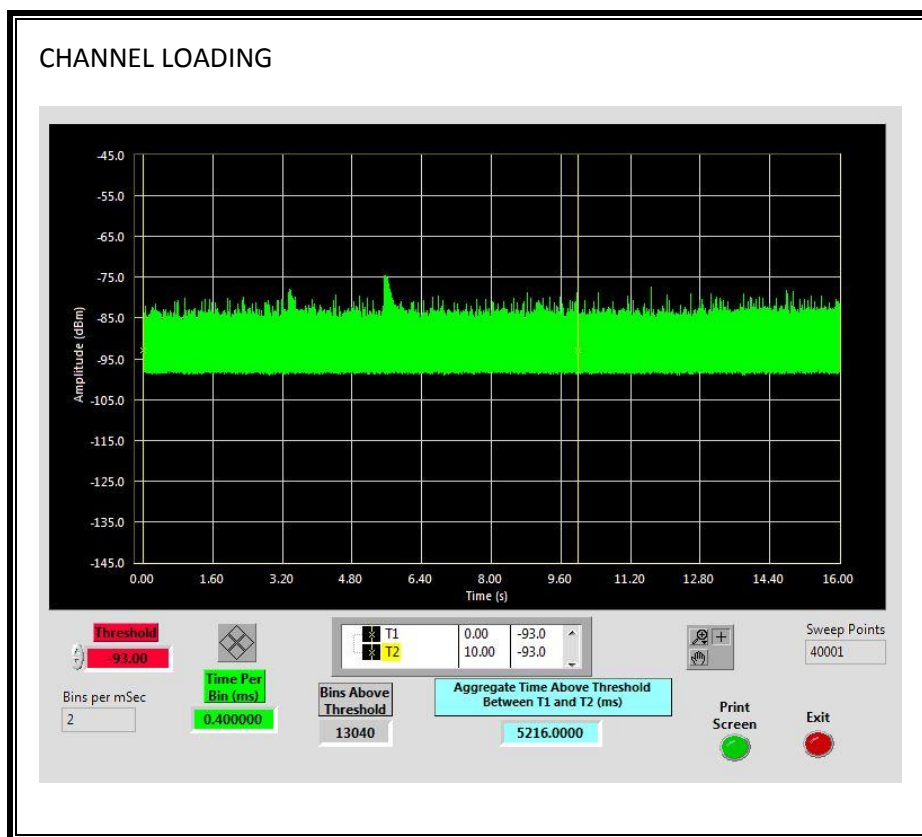




**TRAFFIC**



## CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 52.16%

### 10.4.3. OVERLAPPING CHANNEL TESTS

#### RESULTS

These tests are not applicable.

### 10.4.4. MOVE AND CLOSING TIME

#### REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =

(Number of analyzer bins showing transmission) \* (dwell time per bin)

The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

#### RESULTS

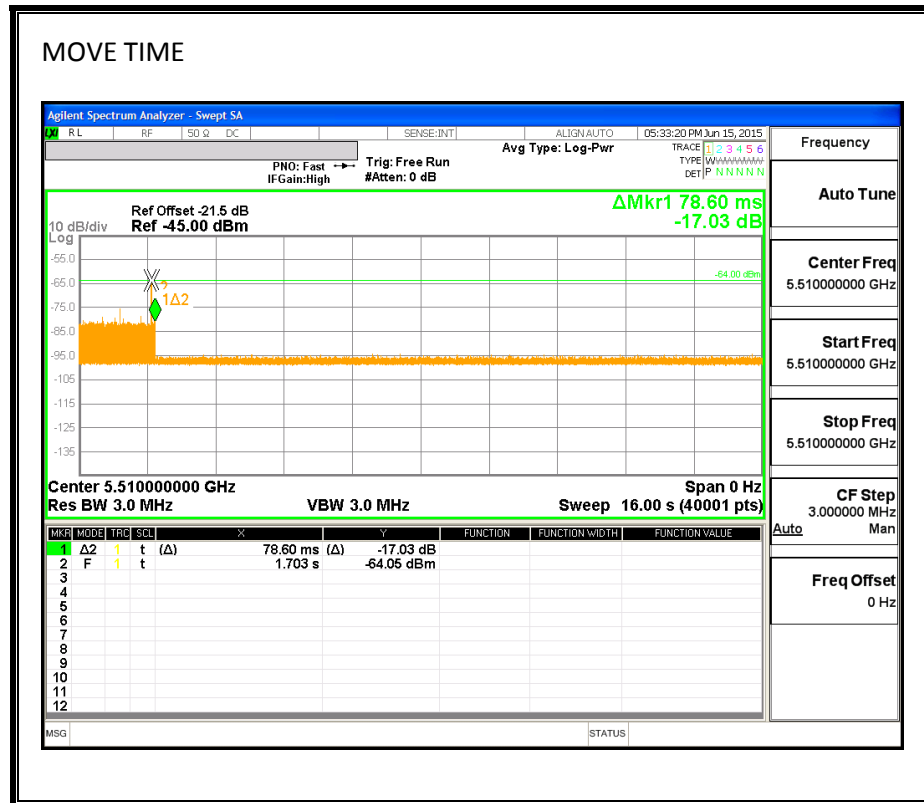
| Channel Move Time<br>(sec) | Limit<br>(sec) |
|----------------------------|----------------|
| 0.079                      | 10             |

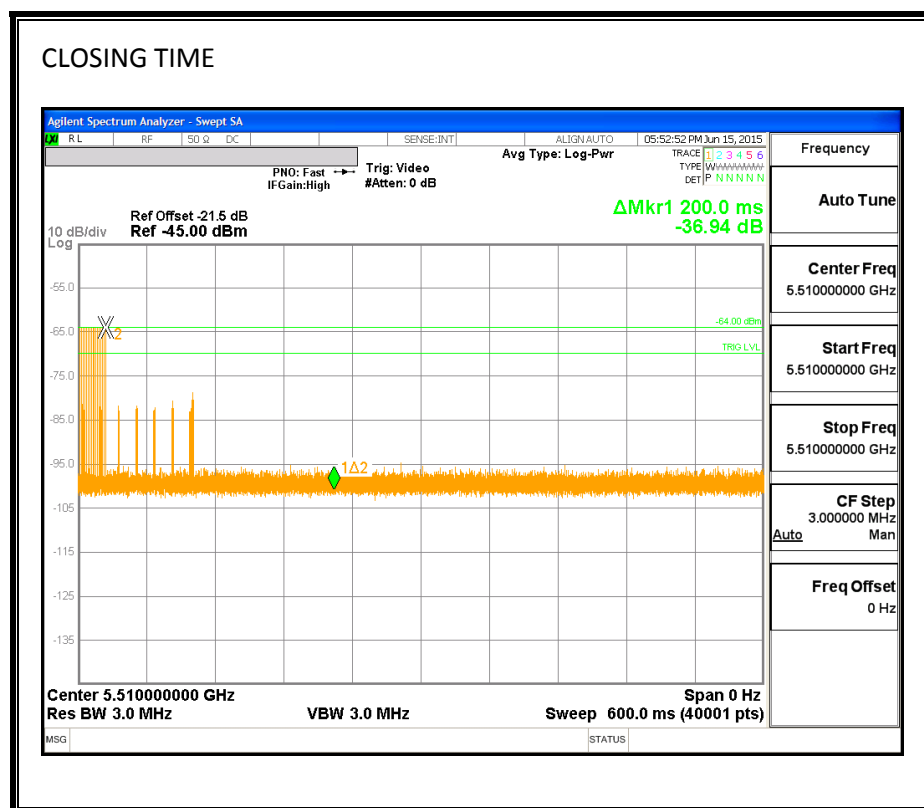
| Aggregate Channel Closing Transmission Time<br>(msec) | Limit<br>(msec) |
|-------------------------------------------------------|-----------------|
| 0.0                                                   | 60              |

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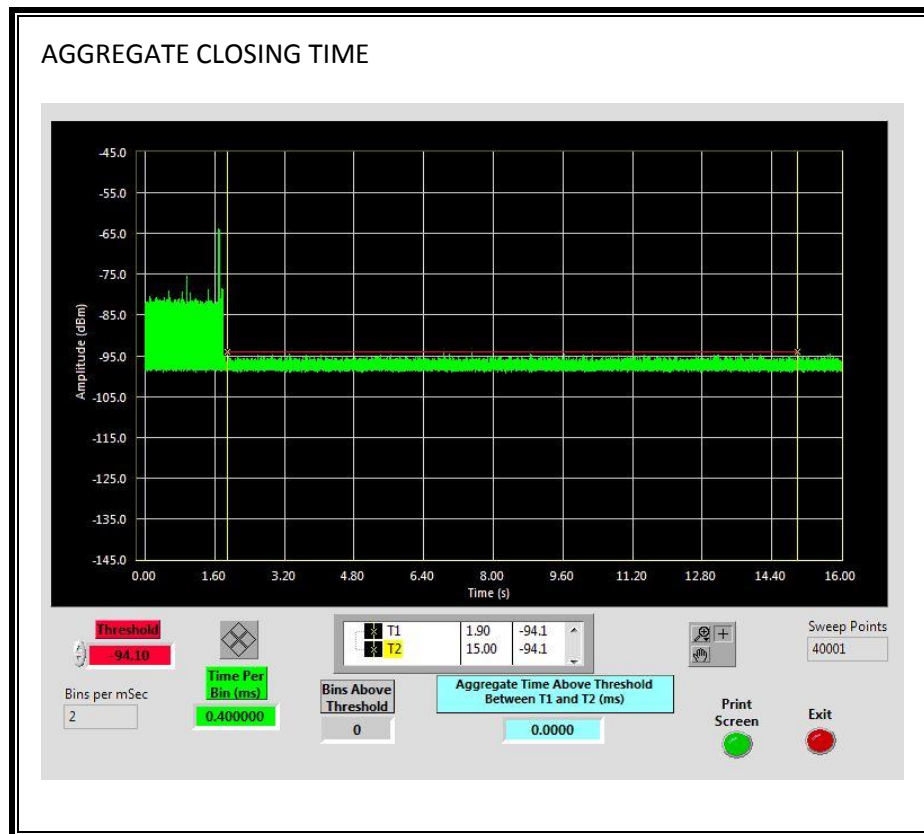
**MOVE TIME**





### AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

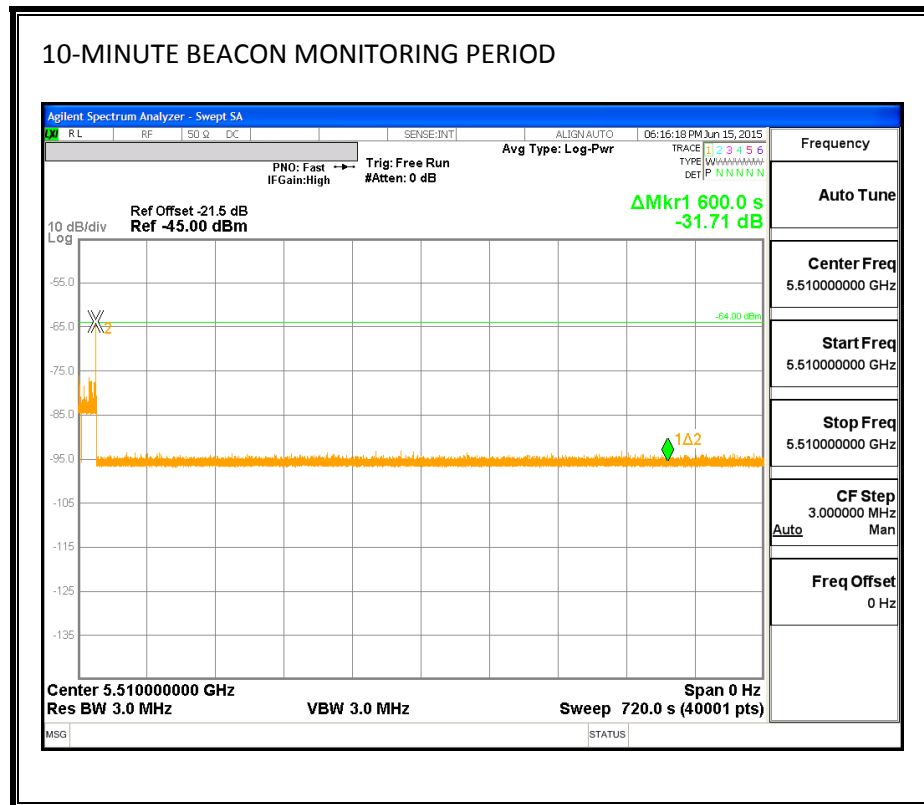
No transmissions are observed during the aggregate monitoring period.



## 10.4.5. 10-MINUTE BEACON MONITORING PERIOD

### RESULTS

No EUT transmissions were observed on the test channel during the 10-minute observation time.



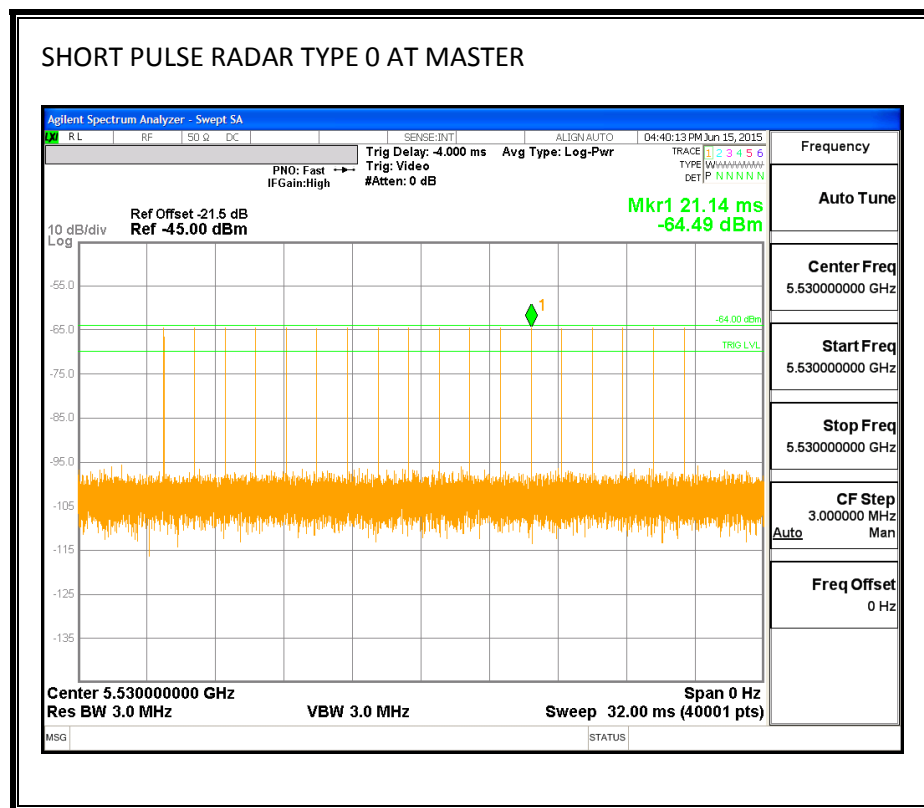
## 10.5. RESULTS FOR 80 MHz BANDWIDTH

### 10.5.1. TEST CHANNEL

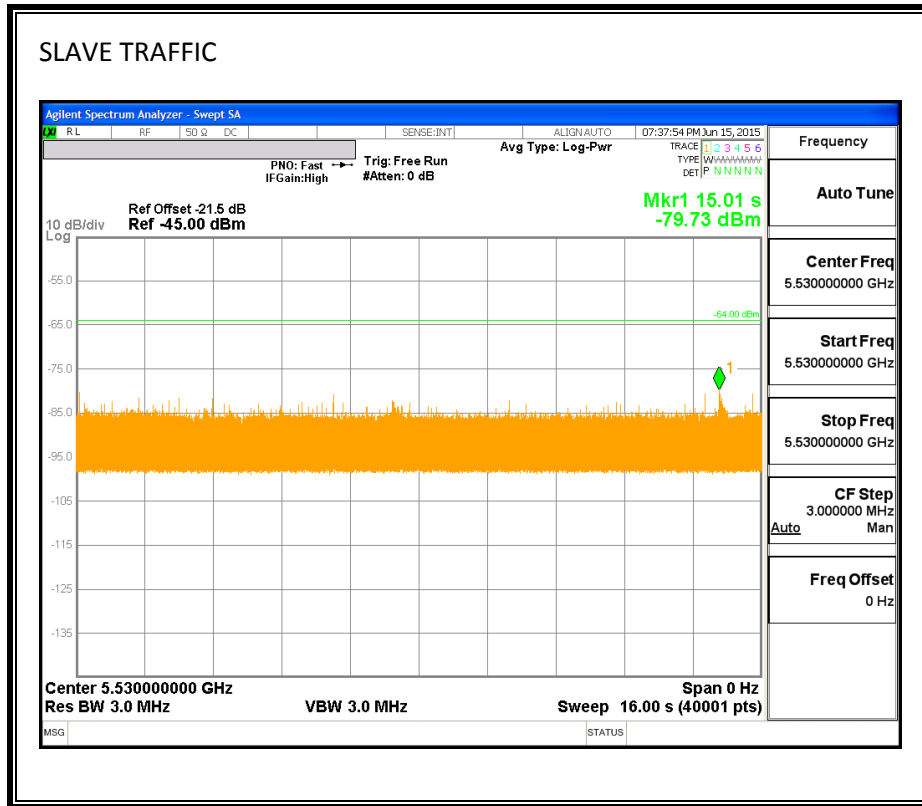
All tests were performed at a channel center frequency of 5530 MHz.

### 10.5.2. RADAR WAVEFORM AND TRAFFIC

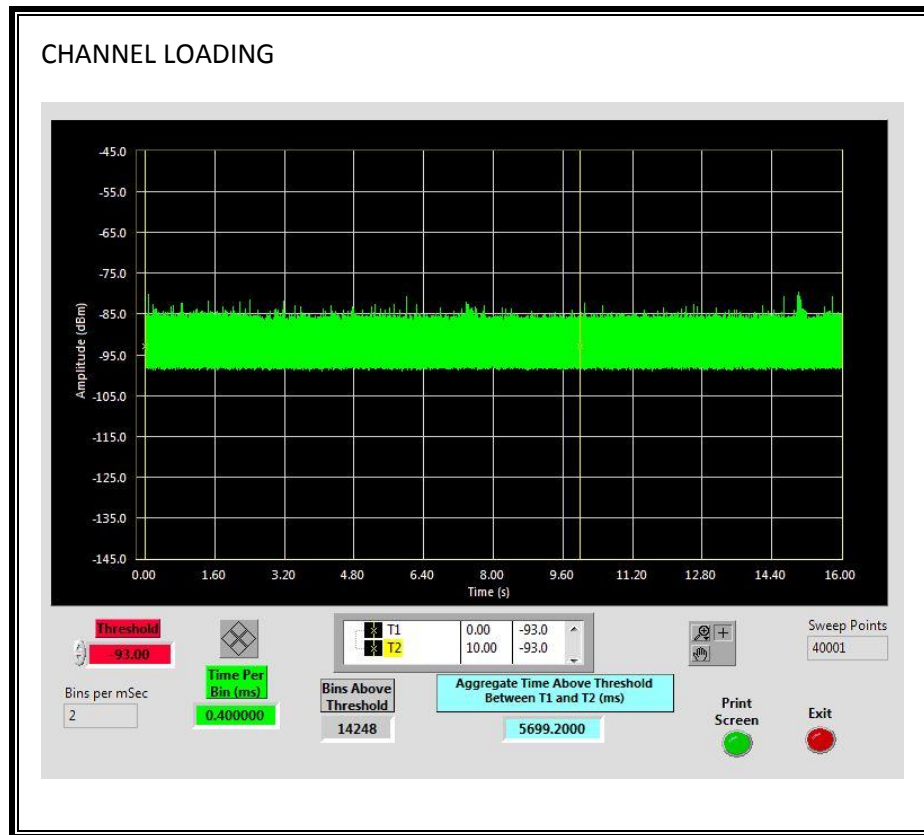
#### RADAR WAVEFORM



**TRAFFIC**



## CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 56.992%

### 10.5.3. OVERLAPPING CHANNEL TESTS

#### RESULTS

These tests are not applicable.

### 10.5.4. MOVE AND CLOSING TIME

#### REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =

(Number of analyzer bins showing transmission) \* (dwell time per bin)

The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

#### RESULTS

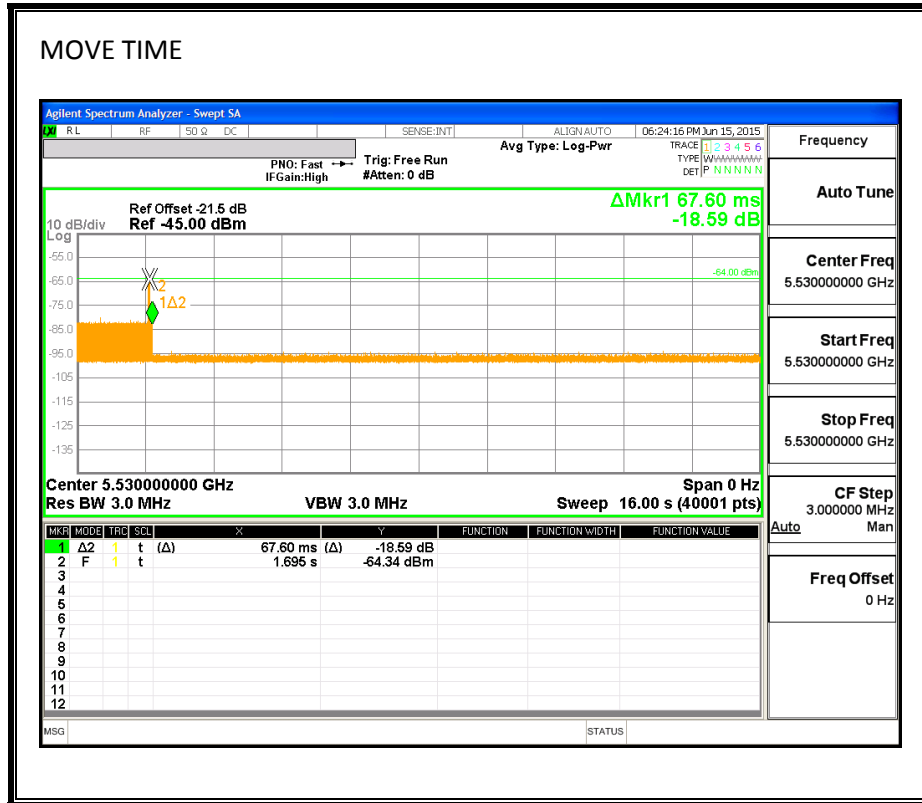
| Channel Move Time<br>(sec) | Limit<br>(sec) |
|----------------------------|----------------|
| 0.068                      | 10             |

| Aggregate Channel Closing Transmission Time<br>(msec) | Limit<br>(msec) |
|-------------------------------------------------------|-----------------|
| 0.0                                                   | 60              |

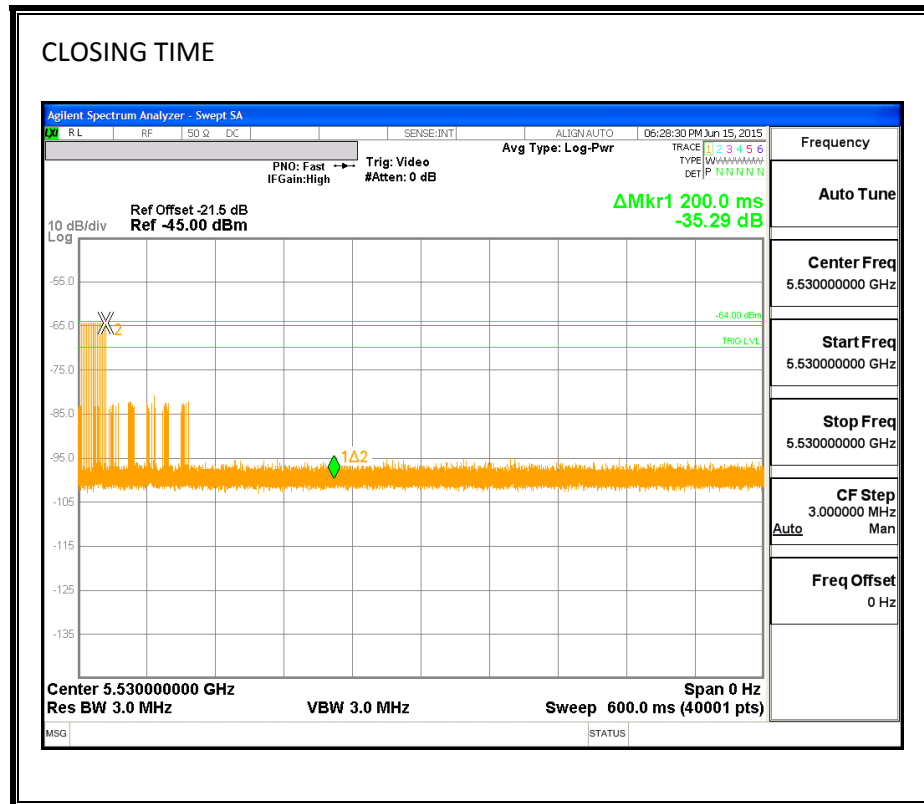
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**MOVE TIME**

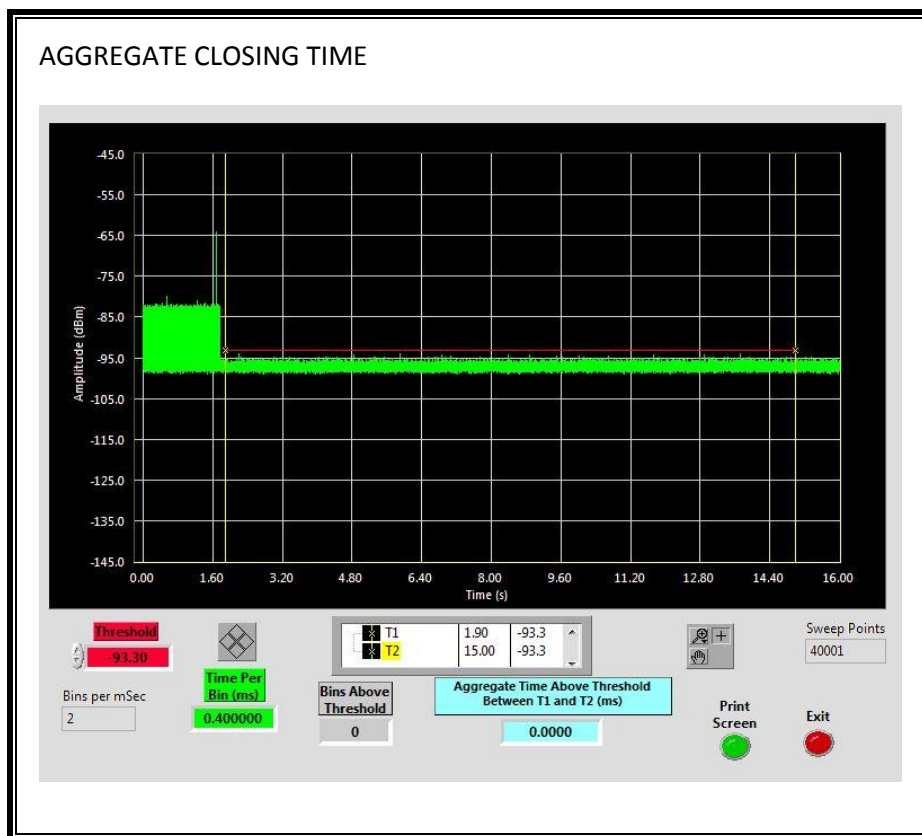


**CHANNEL CLOSING TIME**



### AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

No transmissions are observed during the aggregate monitoring period.



## 10.5.5. 10-MINUTE BEACON MONITORING PERIOD

### RESULTS

No EUT transmissions were observed on the test channel during the 10-minute observation time.

