

DFS Test Report

Applicant : Redpine Signals, Inc.
Product Type : Dual Band 802.11 a/b/g/n, Bluetooth 5.0, ZigBee Module
Trade Name : Redpine Signals Inc
Model Number : M7DB6
Applicable Standard : FCC 47 CFR PART 15 SUBPART E
ANSI C63.10:2013
Receive Date : Oct. 24, 2018
Test Period : Jan. 08, 2019
Issue Date : Jan. 19, 2019

Issue by

A Test Lab Techno Corp.
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Taiwan Accreditation Foundation accreditation number: 1330
Test Firm MRA designation number: TW0010

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Revision History

| Rev. | Issue Date | Revisions | Revised By |
|------|---------------|----------------------------|------------|
| 00 | Jan. 14, 2019 | Initial Issue | Nina Lin |
| 01 | Jan. 19, 2019 | Revised report information | Nina Lin |
| | | | |
| | | | |

Verification of Compliance

Issued Date: Jan. 19, 2019

Applicant : Redpine Signals, Inc.
Product Type : Dual Band 802.11 a/b/g/n, Bluetooth 5.0, ZigBee Module
Trade Name : Redpine Signals Inc
Model Number : M7DB6
FCC ID : XF6-M7DB6
EUT Rated Voltage : DC 1.8 V, 0.4 A / DC 3.3 V, 0.4 A
Test Voltage : DC 3.3 V
Applicable Standard : FCC 47 CFR PART 15 SUBPART E
ANSI C63.10:2013
Test Result : Complied

Performing Lab. : A Test Lab Techno Corp.
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<http://www.atl-lab.com.tw/e-index.htm>



A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : Fly Lu Reviewed By : Eric Ou Yang
(Manager) (Fly Lu) (Testing Engineer) (Eric Ou Yang)

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1 EUT Description

| | | | | | | |
|-----------------------------------|--|-------------------|-------------|-----------------------|--------------------|--|
| Applicant | Redpine Signals, Inc. 2107 N.First Street, Suite 680, San Jose, California, 95131-2019, United States | | | | | |
| Manufacturer | Redpine Signals, Inc. 2107 N.First Street, Suite 680, San Jose, California, 95131-2019, United States | | | | | |
| Product Type | Dual Band 802.11 a/b/g/n, Bluetooth 5.0, ZigBee Module | | | | | |
| Trade Name | Redpine Signals Inc | | | | | |
| Model Number | M7DB6 | | | | | |
| FCC ID | XF6-M7DB6 | | | | | |
| Operate Frequency | Frequency Band | | | Frequency Range (MHz) | Number of Channels | |
| | | | | | | |
| | IEEE 802.11a | U-NII Band II-A | 5260 – 5320 | 4 | | |
| | | U-NII Band II-C | 5500 – 5700 | 8 | | |
| | IEEE 802.11n 5 GHz 20 MHz | U-NII Band II-A | 5260 – 5320 | 4 | | |
| | | U-NII Band II-C | 5500 – 5700 | 8 | | |
| | IEEE 802.11n 5 GHz 40 MHz | U-NII Band II-A | 5270 – 5310 | 2 | | |
| U-NII Band II-C | | 5510 – 5670 | 3 | | | |
| Modulation Type | OFDM | | | | | |
| Equipment Type (DFS) | Client without radar detection | | | | | |
| Antenna information | Model | Type | Connector | Max. Gain (dBi) | | |
| | RSIA7 | PCB Trace Antenna | Internal | 1.25 | | |
| | GW.71.5153 | Dipole Antenna | SMA Reverse | Straight | 4.9 | |
| | | | | Bent | 5.5 | |
| Antenna Delivery | 1TX | | | | | |
| Frequency Stability Specification | ± 20 ppm | | | | | |
| Operate Temp. Range | -40 ~ +85 °C | | | | | |



| Items | Description | |
|--------------------------------|--|---|
| Communication Mode | <input checked="" type="checkbox"/> IP Based (Load Based) | <input type="checkbox"/> Frame Based |
| TPC Function | <input type="checkbox"/> With TPC | <input checked="" type="checkbox"/> Without TPC |
| Weather Band (5600 ~ 5650 MHz) | <input type="checkbox"/> With 5600 ~ 5650 MHz | <input checked="" type="checkbox"/> Without 5600 ~ 5650 MHz |
| Beamforming Function | <input type="checkbox"/> With Beamforming | <input checked="" type="checkbox"/> Without Beamforming |
| Equipment Type | <input type="checkbox"/> Outdoor access point | |
| | <input type="checkbox"/> Indoor access point | |
| | <input type="checkbox"/> Fixed point-to-point access points | |
| | <input checked="" type="checkbox"/> Client devices | |
| Operating mode | <input type="checkbox"/> Master | |
| | <input type="checkbox"/> Client with radar detection | |
| | <input checked="" type="checkbox"/> Client without radar detection | |
| | <input type="checkbox"/> Ad-Hoc | |
| | <input type="checkbox"/> Bridge | |
| | <input type="checkbox"/> MESH | |
| Test AP FCC ID | PY315100319 | |

Note : DFS controls (hardware or software) related to radar detection are NOT accessible to the user.

Manufacturer statement confirming that information regarding the parameters of the detected Radar Waveforms is not available to the end user.



2 Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

The tests documented in this report were performed in accordance with FCC KDB request:

- FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02
- FCC KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02

3 Dynamic Frequency Selection

3.1. Limits

§15.407 (h) and FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 Compliance measurement procedures for unlicensed-national information infrastructure devcies operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection.

| Table 1: Applicability of DFS Requirements Prior to Use of a Channel | | | |
|--|------------------|---|----------------------------------|
| Requirement | Operational Mode | | |
| | Master | Client (without radar detection) | Client (with radar detection) |
| Non-Occupancy Period | Yes | Not required | Yes |
| DFS Detection Threshold | Yes | Not required | Yes |
| Channel Availability Check Time | Yes | Not required | Not required |
| U-NII Detection Bandwidth | Yes | Not required | Yes |

| Table 2: Applicability of DFS requirements during normal operation | | |
|--|---|--------------------------------|
| Requirement | Operational Mode | |
| | Master Device or Client With Radar Detection | Client without Radar Detection |
| DFS Detection Threshold | Yes | Not required |
| Channel Closing Transmission Time | Yes | Yes |
| Channel Move Time | Yes | Yes |
| U-NII Detection Bandwidth | Yes | Not required |

| Additional requirements for devices with multiple bandwidth modes | Master Device 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 |
| Note : 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 | | |

**Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection**

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

Table 4: 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 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> | |



| Table 5: 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 | <p>Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a</p> <p>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</p> | $\text{Roundup} \left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right\}$ | 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 |
| Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests. | | | | | |

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 |

Table 6 – Long Pulse Radar Test Signal

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

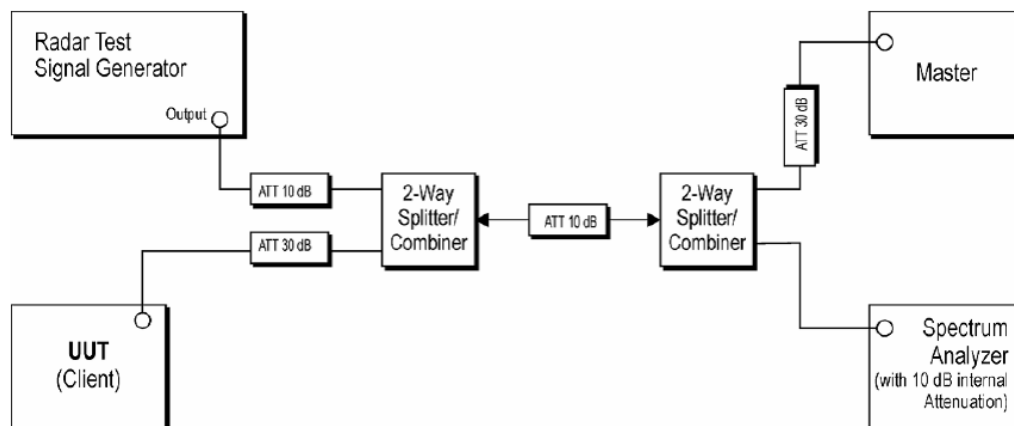
Table 7 – Frequency Hopping Radar Test Signal

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

3.2. Test and Measurement System

3.2.1. Setup for Client with injection at the Master

Example Radiated Setup where UUT is a Client and Radar Test Waveforms are injected into the Master



Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

| | Product | Manufacturer | Model No. | ID |
|----|----------------------|--------------|----------------|------------------|
| 1. | Netgear Access Point | Netgear | R7800 | FCC : PY35100319 |
| 2. | Notebook | ASUS | P2430U | --- |
| 3. | Notebook Adapter | ASUS | ADP-65GD B | --- |
| 4. | Notebook | DELL | LATITUDE E6440 | --- |
| 5. | Notebook Adapter | DELL | HA65NM130 | --- |

3.2.2. System Calibration

The short pulse types 0,1,2, 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 May 2014 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 KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 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. 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.



3.2.3. System Calibration

The Interference Radar Detection Threshold Level is (-64 dBm), The above equipment setup was used to calibrate the radiated Radar Waveform. A vector signal generator was utilized to establish the test signal level for each radar type. During this process there were replace 50 ohm terminal form Master and Client device and no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) at the frequency of the Radar Waveform generator. Peak detection was used. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to at least 3 MHz.

The vector signal generator amplitude was set so that the power level measured at the spectrum analyzer was (-64 dBm). Capture the spectrum analyzer plots on short pulse radar types, long pulse radar type and hopping radar waveform.

3.2.4. 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. Software to ping the client is permitted to simulate data transfer but must have random ping intervals. 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.

3.3. Test Instruments

Test Period: Jan. 08, 2019

| Equipment | Manufacturer | Model Number | Serial Number | Cal. Date | Remark |
|---------------------------------------|--------------|--------------|---------------|------------|--------|
| Spectrum Analyzer (20 Hz~26.5 GHz) | Agilent | N9020A | US47520902 | 09/24/2018 | 1 year |
| Signal Generator | Agilent | N5182B | MY53050382 | 05/24/2018 | 1 year |

Note N.C.R. = No Calibration Request.

4 Test Methodology

4.1. Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

| Test Mode |
|--|
| Mode 1: IEEE 802.11n 5 GHz 40 MHz Continuous TX mode |

IEEE 802.11n 5 GHz 40 MHz Continuous TX mode

Unless otherwise noted, all tests were performed with the radar burst at the channel center frequency of 5550 MHz.

4.2. EUT Test Step

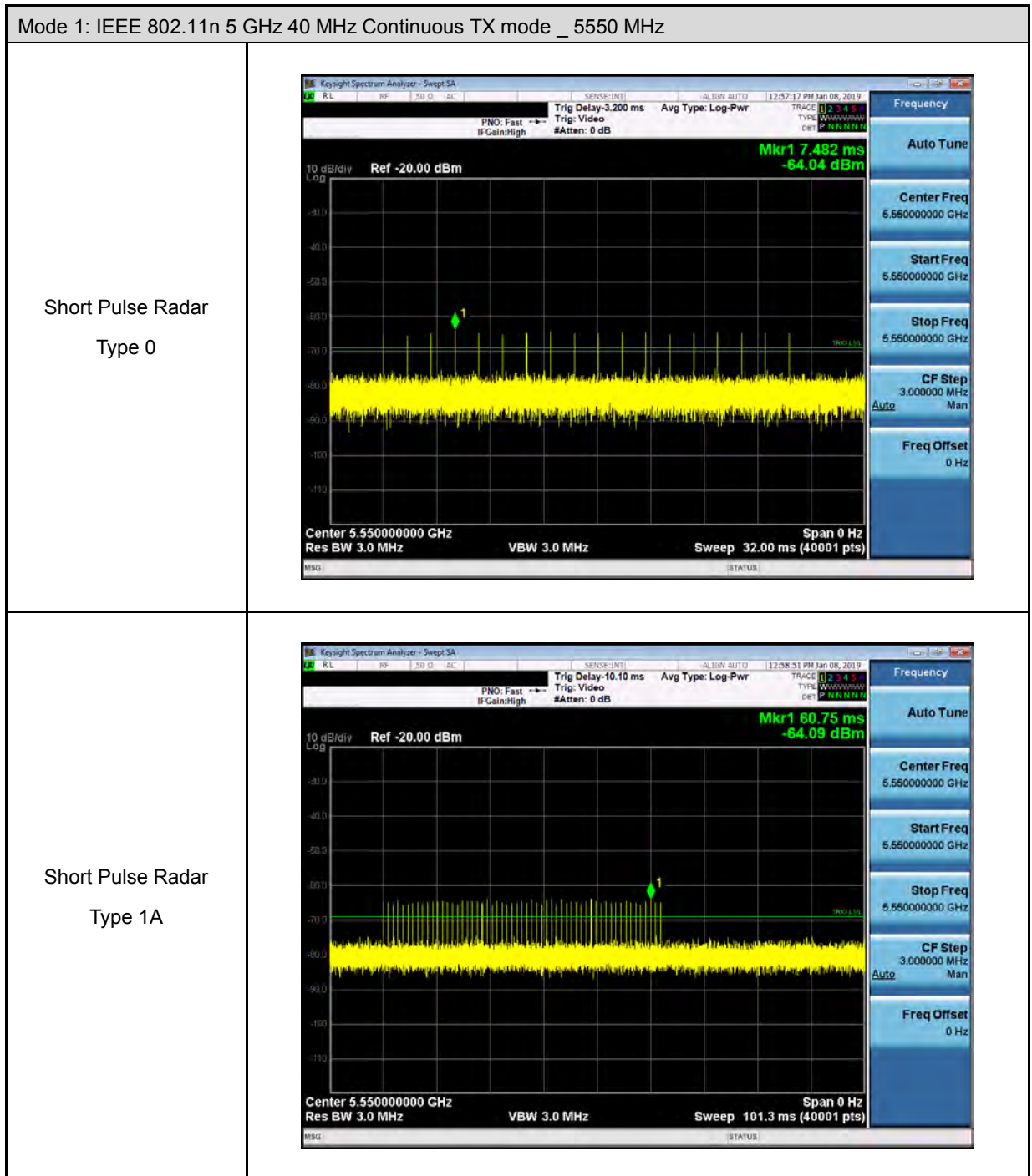
| | |
|----|--|
| 1. | Setup the EUT shown on 3.2.1 |
| 2. | Turn on the power of all equipment. |
| 3. | Turn on Wi-Fi function link to Notebook. |
| 4. | The EUT is operated in the engineering mode to fix the TX frequency for the purposes of measurement. |

4.3. Test Site Environment

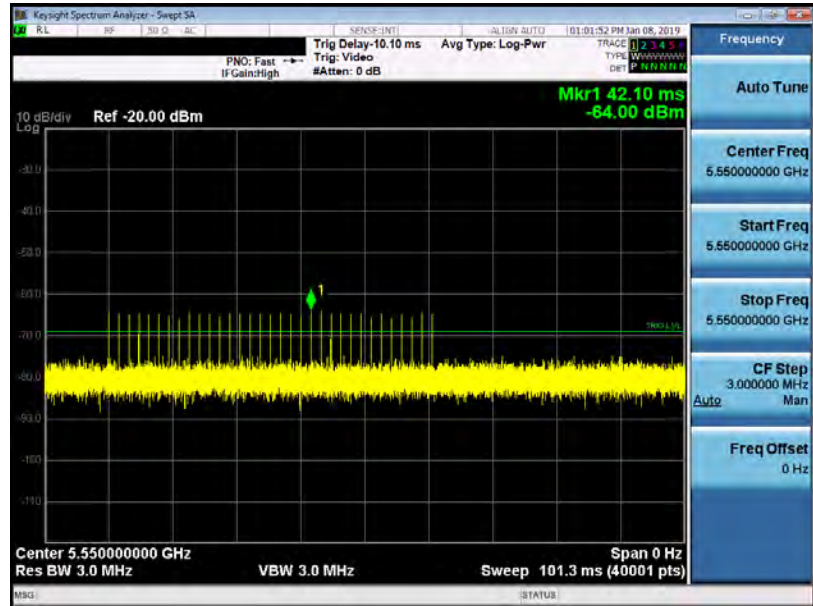
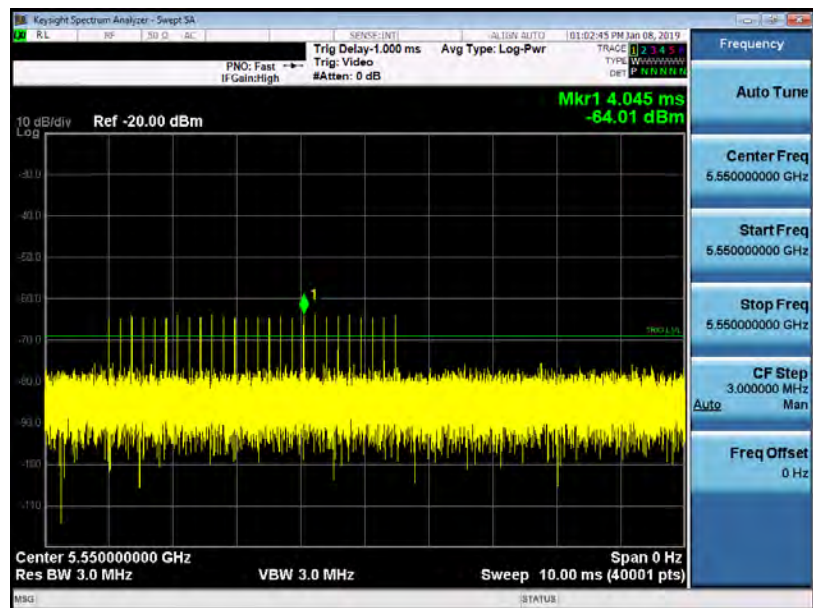
| Items | Required (IEC 60068-1) | Actual |
|----------------------------|------------------------|--------|
| Temperature (°C) | 15-35 | 26 |
| Humidity (%RH) | 25-75 | 60 |
| Barometric pressure (mbar) | 860-1060 | 990 |

5 Test Results

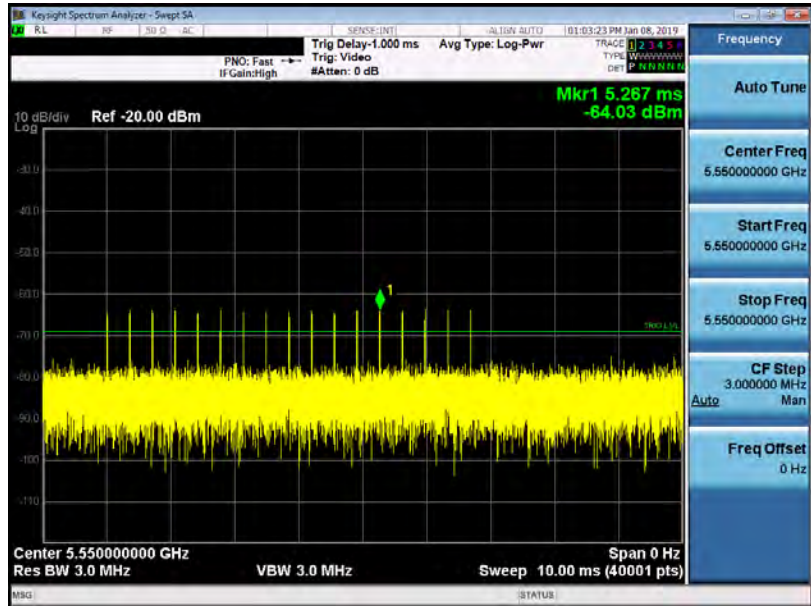
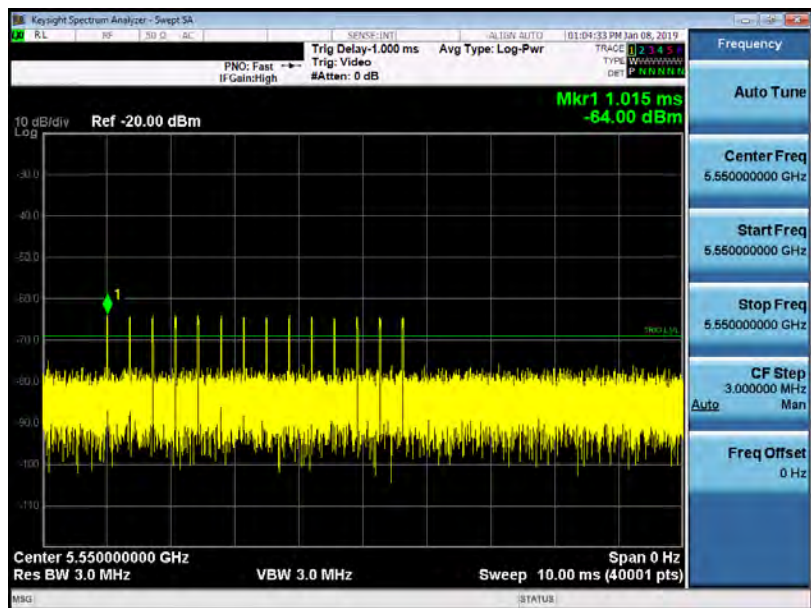
5.1. Radar Waveforms and Traffic



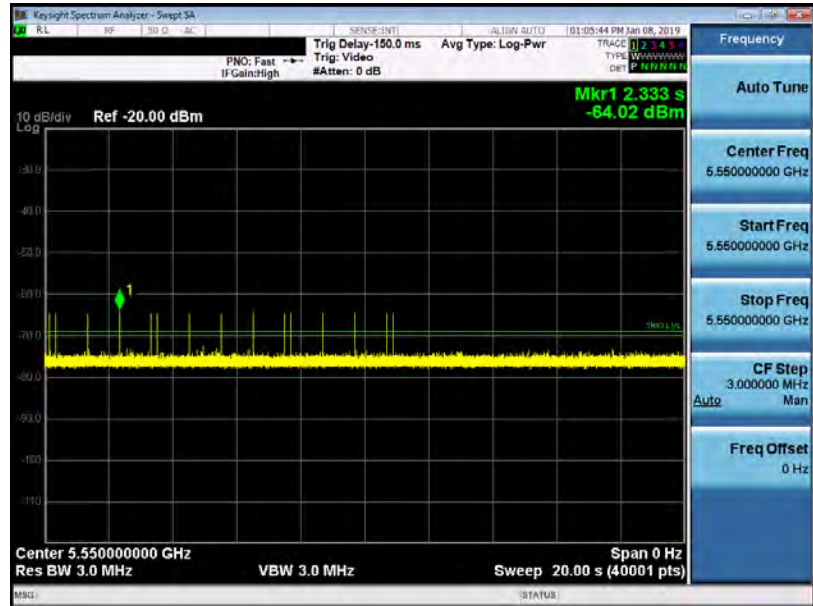
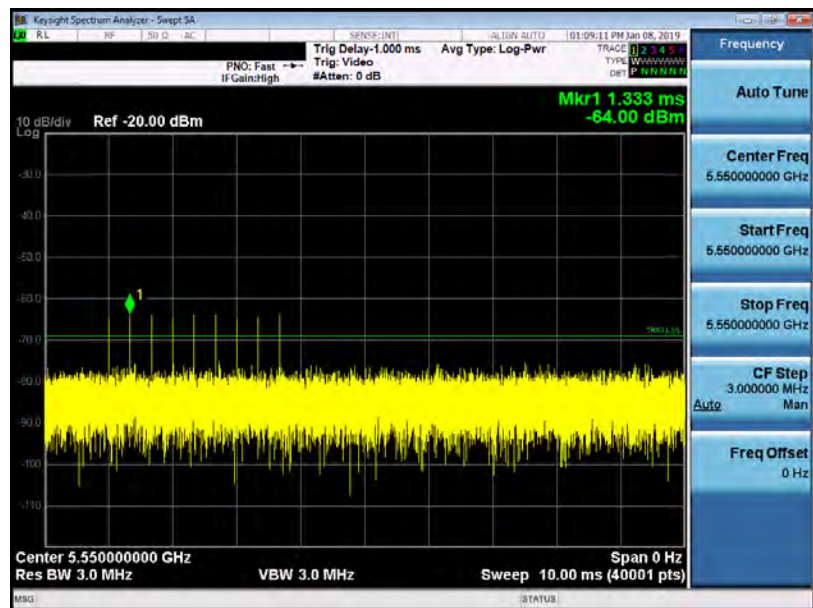
Mode 1: IEEE 802.11n 5 GHz 40 MHz Continuous TX mode _ 5550 MHz

Short Pulse Radar
Type 1B

Short Pulse Radar
Type 2


Mode 1: IEEE 802.11n 5 GHz 40 MHz Continuous TX mode _ 5550 MHz

Short Pulse Radar
Type 3

Short Pulse Radar
Type 4


Mode 1: IEEE 802.11n 5 GHz 40 MHz Continuous TX mode _ 5550 MHz

Short Pulse Radar
Type 5

Short Pulse Radar
Type 6




5.2. Channel Move Time and Channel Closing Transmission Time

5.2.1. 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:

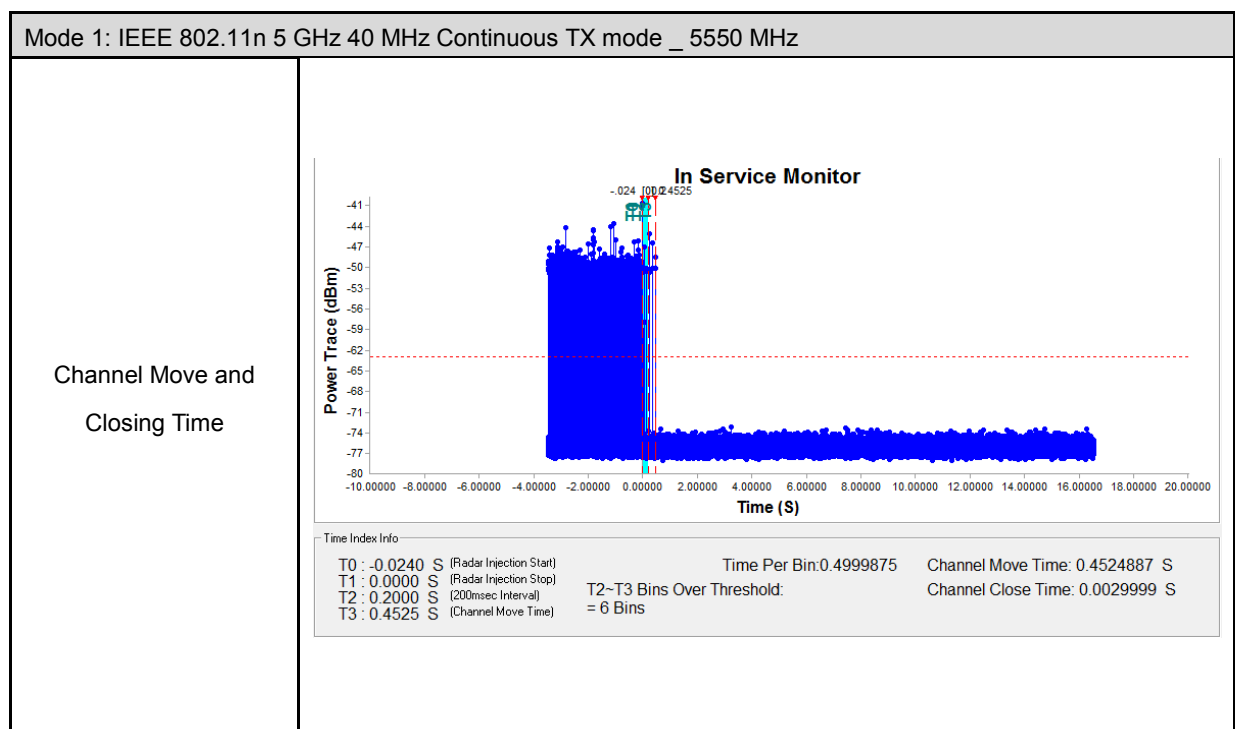
Aggregate Transmission Time = (Number of analyzer bins showing transmission) * (dwell time per bin)

The 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.

Results

| Frequency (MHz) | Radar Type | Channel Move Time (msec) | Limit (sec) |
|-----------------|------------|--------------------------|-------------|
| 5550 | Type 0 | 452.4887 | 10 |

| Frequency (MHz) | Radar Type | Aggregate Channel Closing Transmission Time (msec) | Limit (msec) |
|-----------------|------------|--|--------------|
| 5550 | Type 0 | 2.9999 | 60 |

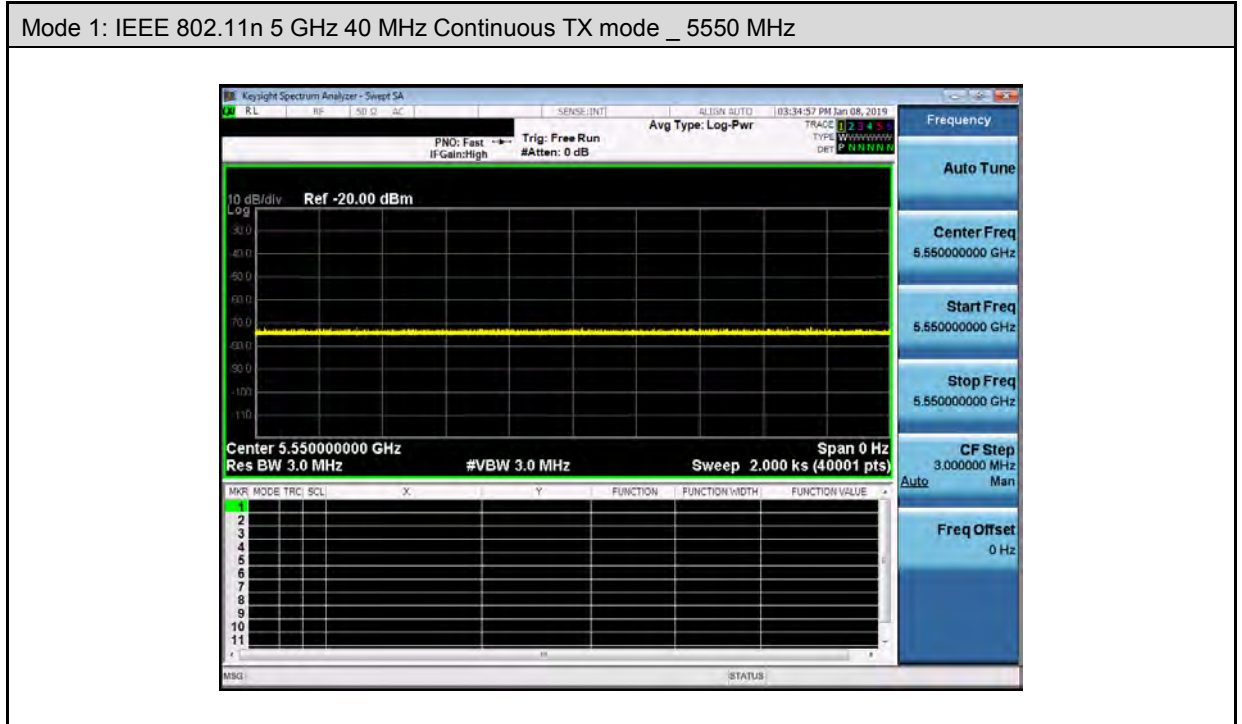




Note: Non-Occupancy Period time is 30 minute during which a Channel will not be utilized after a Radar Waveform is detected on that Channel.



5.4. Non-Associated Test



Note: The non-associated Client Beacon Test is during the 30 minutes observation time. The EUT should not make any transmissions in the DFS band after EUT power up.