

September 9, 2019

Amimon  
26 Zarhin St, POBox 2308  
Raanana, 4366250, Israel

Dear Gabi Nocham,

Enclosed is the EMC Wireless test report for compliance testing of the Amimon, AMN42012 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15.407, Subpart E (UNII 2).

Thank you for using the services of Eurofins MET Labs, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,  
EUROFINS MET LABS, INC



Joel Huna  
Documentation Department

Reference: (\Amimon\EMC101258A-FCC407 UNII 2 DFS Rev. 2)

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## **Electromagnetic Compatibility Criteria Test Report**

for the

**Amimon  
Model AMN42012**

**Tested under**  
The FCC Certification Rules  
contained in  
Title 47 of the CFR  
15.407 Subpart E

**MET Report: EMC101258A-FCC407 UNII 2 DFS Rev. 2**

September 9, 2019

**Prepared For:**

**Amimon  
26 Zarhin St, POBox 2308  
Raanana, 4366250, Israel**

**Prepared By:**  
**Eurofins MET Labs, Inc**  
914 West Patapsco Avenue,  
Baltimore, MD 21230

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**Amimon**  
**Model AMN42012**

**Tested under**  
The FCC Certification Rules  
contained in  
Title 47 of the CFR  
15.407 Subpart E



Donald Salguero, Project Engineer  
Electromagnetic Compatibility Lab



Joel Huna  
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of 15.407 of the FCC Rules under normal use and maintenance.



Benjamin Taylor,  
Wireless Manager, Electromagnetic Compatibility Lab

## Report Status Sheet

| Revision | Report Date       | Reason for Revision        |
|----------|-------------------|----------------------------|
| Ø        | March 28, 2019    | Initial Issue.             |
| 1        | June 7, 2019      | Customer Requested Changes |
| 2        | September 9, 2019 | TCB Comments               |

## Table of Contents

|             |                                                                                               |           |
|-------------|-----------------------------------------------------------------------------------------------|-----------|
| <b>I.</b>   | <b>Executive Summary .....</b>                                                                | <b>1</b>  |
|             | A. Purpose of Test .....                                                                      | 2         |
|             | B. Executive Summary .....                                                                    | 2         |
| <b>II.</b>  | <b>Equipment Configuration .....</b>                                                          | <b>3</b>  |
|             | A. Overview .....                                                                             | 4         |
|             | B. References .....                                                                           | 5         |
|             | C. Test Site .....                                                                            | 5         |
|             | D. Description of Test Sample .....                                                           | 5         |
|             | E. Measurement Uncertainty .....                                                              | 6         |
|             | F. Equipment Configuration .....                                                              | 6         |
|             | G. Support Equipment .....                                                                    | 7         |
|             | H. Ports and Cabling Information .....                                                        | 7         |
|             | I. Mode of Operation .....                                                                    | 8         |
|             | J. Method of Monitoring EUT Operation .....                                                   | 8         |
|             | K. Modifications .....                                                                        | 8         |
|             | a) Modifications to EUT .....                                                                 | 8         |
|             | b) Modifications to Test Standard .....                                                       | 8         |
|             | L. Disposition of EUT .....                                                                   | 8         |
| <b>III.</b> | <b>DFS Requirements and Radar Waveform Description &amp; Calibration .....</b>                | <b>9</b>  |
|             | A. DFS Requirements .....                                                                     | 10        |
|             | B. Radar Test Waveforms .....                                                                 | 12        |
|             | C. Radar Waveform Calibration .....                                                           | 16        |
| <b>IV.</b>  | <b>DFS Test Procedure and Test Results .....</b>                                              | <b>20</b> |
|             | A. DFS Test Setup .....                                                                       | 21        |
|             | B. UNII Detection Bandwidth .....                                                             | 22        |
|             | C. Channel Availability Check Time .....                                                      | 24        |
|             | D. In-Service Monitoring for Channel Move Time, Channel Closing Time, and Non-Occupancy ..... | 26        |
|             | E. Statistical Performance Check .....                                                        | 28        |
| <b>V.</b>   | <b>Test Equipment .....</b>                                                                   | <b>36</b> |
| <b>VI.</b>  | <b>Certification &amp; User's Manual Information .....</b>                                    | <b>38</b> |
|             | A. Certification Information .....                                                            | 39        |
|             | B. Label and User's Manual Information .....                                                  | 43        |

## List of Tables

|                                                                                         |    |
|-----------------------------------------------------------------------------------------|----|
| Table 1. Executive Summary of EMC Part 15.407 Compliance Testing .....                  | 2  |
| Table 2. EUT Summary.....                                                               | 4  |
| Table 3. References .....                                                               | 5  |
| Table 4. Uncertainty Calculations Summary.....                                          | 6  |
| Table 5. Equipment Configuration .....                                                  | 6  |
| Table 6. Support Equipment.....                                                         | 7  |
| Table 7. Ports and Cabling Information .....                                            | 7  |
| Table 8. Applicability of DFS Requirements Prior to Use of a Channel.....               | 10 |
| Table 9. Applicability of DFS Requirements During Normal Operation .....                | 10 |
| Table 10. DFS Detection Thresholds for Master or Client Devices Incorporating DFS ..... | 11 |
| Table 11. DFS Response Requirement Values.....                                          | 11 |
| Table 12. Pulse Repetition Intervals Values for Test A .....                            | 13 |
| Table 13. DFS Channel Bandwidth, 5270 MHz, 40 MHz BW, Test Results.....                 | 23 |
| Table 14. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 1 .....           | 29 |
| Table 15. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 2.....            | 30 |
| Table 16. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 3.....            | 31 |
| Table 17. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 4.....            | 32 |
| Table 18. Statistical Performance Check, 5270 MHz, 40 MHz, Aggregate .....              | 33 |
| Table 19. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 5.....            | 34 |
| Table 20. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 6.....            | 35 |
| Table 21. Test Equipment List .....                                                     | 37 |

## List of Figures

|                                                       |    |
|-------------------------------------------------------|----|
| Figure 1. Block Diagram of Test Configuration.....    | 6  |
| Figure 2. Long Pulse Radar Test Signal Waveform.....  | 15 |
| Figure 3. Radiated DFS Calibration Block Diagram..... | 16 |
| Figure 4. Test Setup Diagram.....                     | 21 |

## List of Plots

|                                                                |    |
|----------------------------------------------------------------|----|
| Plot 1. Radar Waveform Calibration. Type 0, 5510 MHz.....      | 17 |
| Plot 2. Radar Waveform Calibration, Type 1, 5510 MHz.....      | 17 |
| Plot 3. Radar Waveform Calibration, Type 2, 5510 MHz.....      | 17 |
| Plot 4. Radar Waveform Calibration, Type 3, 5510 MHz.....      | 18 |
| Plot 5. Radar Waveform Calibration, Type 4, 5510 MHz.....      | 18 |
| Plot 6. Radar Waveform Calibration, Type 5, 5510 MHz.....      | 18 |
| Plot 7. Radar Waveform Calibration, Type 6, 5510 MHz.....      | 19 |
| Plot 8. Initial Channel Availability Check Time .....          | 25 |
| Plot 9. Channel Availability Check, Pulse Near Start .....     | 25 |
| Plot 10. Channel Availability Check Time, Pulse Near End ..... | 25 |
| Plot 11. Channel Move Time .....                               | 27 |
| Plot 12. Channel Close Time.....                               | 27 |
| Plot 13. Non-Occupancy Period.....                             | 27 |

## List of Terms and Abbreviations

|              |                                               |
|--------------|-----------------------------------------------|
| AC           | Alternating Current                           |
| ACF          | Antenna Correction Factor                     |
| Cal          | Calibration                                   |
| <i>d</i>     | Measurement Distance                          |
| dB           | Decibels                                      |
| dB $\mu$ A   | Decibels above one <b>microamp</b>            |
| dB $\mu$ V   | Decibels above one <b>microvolt</b>           |
| dB $\mu$ A/m | Decibels above one <b>microamp per meter</b>  |
| dB $\mu$ V/m | Decibels above one <b>microvolt per meter</b> |
| DC           | Direct Current                                |
| E            | Electric Field                                |
| DSL          | Digital Subscriber Line                       |
| ESD          | Electrostatic Discharge                       |
| EUT          | Equipment Under Test                          |
| <i>f</i>     | Frequency                                     |
| FCC          | Federal Communications Commission             |
| GRP          | Ground Reference Plane                        |
| H            | Magnetic Field                                |
| HCP          | Horizontal Coupling Plane                     |
| Hz           | Hertz                                         |
| IEC          | International Electrotechnical Commission     |
| kHz          | kilohertz                                     |
| kPa          | kilopascal                                    |
| kV           | kilovolt                                      |
| LISN         | Line Impedance Stabilization Network          |
| MHz          | Megahertz                                     |
| $\mu$ H      | <b>microhenry</b>                             |
| $\mu$        | <b>microfarad</b>                             |
| $\mu$ s      | <b>microseconds</b>                           |
| PRF          | Pulse Repetition Frequency                    |
| RF           | Radio Frequency                               |
| RMS          | Root-Mean-Square                              |
| TWT          | Traveling Wave Tube                           |
| V/m          | Volts <b>per meter</b>                        |
| VCP          | Vertical Coupling Plane                       |

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Amimon AMN42012, with the requirements of Part 15, §15.407. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the AMN42012. Amimon should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the AMN42012, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.407, in accordance with Amimon, purchase order number 18000496. All tests were conducted using measurement procedure KDB 905462 D02.

| FCC Reference     | Description                     | Results   |
|-------------------|---------------------------------|-----------|
| 15.40 (h)(2)      | U-NII Detection Bandwidth       | Compliant |
| 15.407(h)(2)(ii)  | Channel Availability Check Time | Compliant |
| 15.407(h)(2)(iv)  | Non Occupancy Period            | Compliant |
| 15.407(h)(2)(iii) | Channel Move/Close Time         | Compliant |
| 15.407(h)(2)      | Statistical Performance Check   | Compliant |

**Table 1. Executive Summary of EMC Part 15.407 Compliance Testing**

## **II. Equipment Configuration**

## A. Overview

Eurofins MET Labs, Inc was contracted by Amimon to perform testing on the AMN42012, under Amimon's purchase order number 18000496.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Amimon AMN42012.

The results obtained relate only to the item(s) tested.

|                                       |                                                         |                                                                                 |  |
|---------------------------------------|---------------------------------------------------------|---------------------------------------------------------------------------------|--|
| <b>Model(s) Tested:</b>               | AMN42012                                                |                                                                                 |  |
| <b>Model(s) Covered:</b>              | AMN42012                                                |                                                                                 |  |
| <b>EUT Specifications:</b>            | Primary Power: 5 VDC                                    |                                                                                 |  |
|                                       | FCC ID: VQSAMN42012                                     |                                                                                 |  |
|                                       | Type of Modulations:                                    | OFDM, 16QAM, QPSK                                                               |  |
|                                       | Equipment Code:                                         | NII                                                                             |  |
|                                       | EIRP:                                                   | 23.84 dBm; 2dBi antenna configuration<br>29.73 dBm; 11dBi antenna configuration |  |
|                                       | EUT Frequency Ranges:                                   | 5250-5350MHz 5470-5725 MHz                                                      |  |
| <b>Analysis:</b>                      | The results obtained relate only to the item(s) tested. |                                                                                 |  |
| <b>Environmental Test Conditions:</b> | Temperature: 15-35° C                                   |                                                                                 |  |
|                                       | Relative Humidity: 30-60%                               |                                                                                 |  |
|                                       | Barometric Pressure: 860-1060 mbar                      |                                                                                 |  |
| <b>Type of Filing:</b>                | Original                                                |                                                                                 |  |
| <b>Evaluated by:</b>                  | Donald Salguero                                         |                                                                                 |  |
| <b>Report Date(s):</b>                | June 7, 2019                                            |                                                                                 |  |

**Table 2. EUT Summary**

## B. References

|                                                                 |                                                                                                                                                                                               |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CFR 47, Part 15, Subpart E</b>                               | Unlicensed National Information Infrastructure Devices (UNII)                                                                                                                                 |
| <b>ANSI C63.4:2014</b>                                          | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz                                                        |
| <b>ISO/IEC 17025:2017</b>                                       | General Requirements for the Competence of Testing and Calibration Laboratories                                                                                                               |
| <b>ANSI C63.10-2013</b>                                         | American National Standard for Testing Unlicensed Wireless Devices                                                                                                                            |
| <b>789033 D02 General UNII Test Procedures New Rules v02r01</b> | Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E                                                                        |
| <b>905462 DO2 UNII DFS Compliance Procedures New Rules v02</b>  | Compliance Measurement Procedures for Unlicensed-National Information Infrastructure Devices Operating in the 5250-5350 MHz and 5470-5725 MHz Bands Incorporating Dynamic Frequency Selection |

**Table 3. References**

## C. Test Site

All testing was performed at Eurofins MET Labs, Inc, 914 West Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Description of Test Sample

The Amimon AMN42012, Equipment Under Test (EUT), is a wireless HD Video system at 5GHz with zero-latency. It consists of 2 companion devices:

VDU – Video Display Unit.

The VDU receives the 5GHz signal and down-converts it to a HDMI, SDI or other video signal.

The devices operates at 40MHz

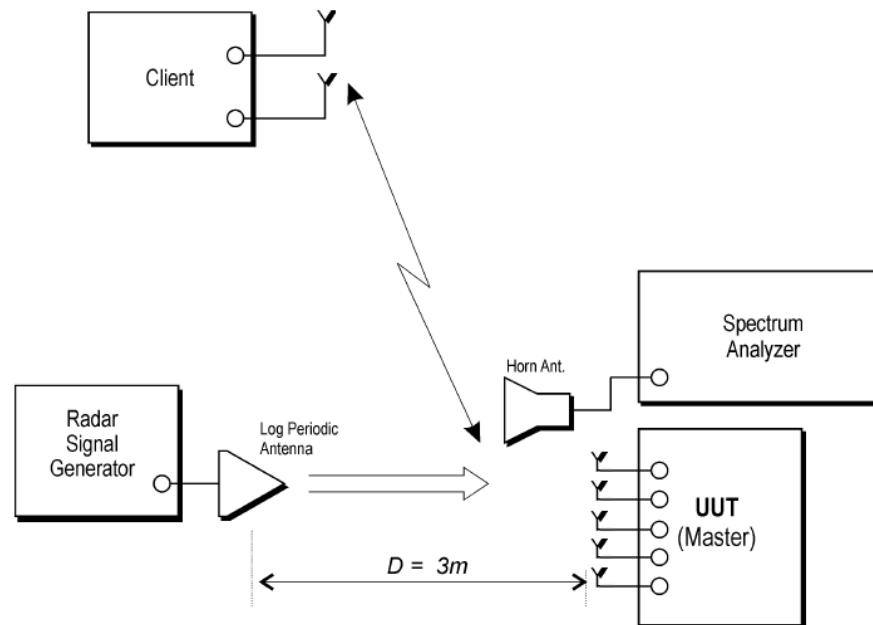


Figure 1. Block Diagram of Test Configuration

## E. Measurement Uncertainty

| Test Method                           | Typical Expanded Uncertainty | K | Confidence Level |
|---------------------------------------|------------------------------|---|------------------|
| RF Frequencies                        | $\pm 4.52$ Hz                | 2 | 95%              |
| RF Power Conducted Emissions          | $\pm 2.32$ dB                | 2 | 95%              |
| RF Power Conducted Spurious Emissions | $\pm 2.25$ dB                | 2 | 95%              |
| RF Power Radiated Emissions           | $\pm 3.01$ dB                | 2 | 95%              |

Table 4. Uncertainty Calculations Summary

## F. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

| Ref. ID  | Slot # | Name / Description        | Model Number | Part Number | Serial Number | Rev. # |
|----------|--------|---------------------------|--------------|-------------|---------------|--------|
| AMN42012 |        | AMN42012                  | AMN42012     |             |               |        |
| WSS002   |        | *2dBi omni dipole Antenna | WSS002       |             |               |        |
| AMN5330  |        | 11dBi directional Antenna | AMN5330      |             |               |        |

Table 5. Equipment Configuration

\* Antenna used during DFS testing.

## G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

| Ref. ID                                                                                                                                                                | Name / Description          | Manufacturer | Model Number | *Customer Supplied Calibration Data |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------|--------------|-------------------------------------|
|                                                                                                                                                                        | 1dB cable UFL to RP-SMA     |              |              |                                     |
|                                                                                                                                                                        | 5V AC adapter               |              |              |                                     |
|                                                                                                                                                                        | HDMI cables                 |              |              |                                     |
|                                                                                                                                                                        | Draco Tx Balcony            |              |              |                                     |
|                                                                                                                                                                        | AMN42012 Balcony            |              |              |                                     |
|                                                                                                                                                                        | Video generator             |              |              |                                     |
|                                                                                                                                                                        | screen                      |              |              |                                     |
|                                                                                                                                                                        | 12V AC adapter              |              |              |                                     |
|                                                                                                                                                                        | USB cables (long and short) |              |              |                                     |
|                                                                                                                                                                        | Debug board TX              |              |              |                                     |
|                                                                                                                                                                        | Debug board RX              |              |              |                                     |
|                                                                                                                                                                        | Laptop                      |              |              |                                     |
|                                                                                                                                                                        | SMA to RP-SMA adapters      |              |              |                                     |
| The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer. |                             |              |              |                                     |

**Table 6. Support Equipment**

## H. Ports and Cabling Information

| Ref. ID | Port name on EUT   | Cable Description or reason for no cable        | Qty | Length as tested (m) | Max Length (m) | Shielded? (Y/N) | Termination Box ID & Port Name |
|---------|--------------------|-------------------------------------------------|-----|----------------------|----------------|-----------------|--------------------------------|
| 1       | J1, J2, J3, J4, J6 | UFL connectors for RF ports                     | 5   |                      |                |                 |                                |
| 2       | J38                | Board to board interface connector (to balcony) | 1   |                      |                |                 |                                |
| 3       | J37                | Debug connector                                 | 1   |                      |                |                 |                                |
| 4       |                    | Balcony board connecting to J38                 |     |                      |                |                 |                                |
| 5       |                    | UFL to RP-SMA cables                            | 5   | 10cm                 |                | Yes             |                                |
| 6       |                    | Debug board connecting to J37                   |     |                      |                |                 |                                |

**Table 7. Ports and Cabling Information**

**I. Mode of Operation**

For conducted measurements and DFS it is suggested to use with the balcony board to enable use of video and ease of testing.

TECH mode is enabled by simple GUI provided by AMIMON's 'AppCom' Tool or TechTool.

The tool enables setting the EUT to Transmit or Receive modes. It controls the center channel frequency, the operating channel bandwidth, and the TX channel power.

A complete description of operation is detailed in 'How to use AppCom Regulation control.doc' file.

**J. Method of Monitoring EUT Operation**

For DFS a link of video data will be produced.

Feedback from the debug window can provide information on device performance

**K. Modifications****a) Modifications to EUT**

No modifications were made to the EUT.

**b) Modifications to Test Standard**

No modifications were made to the test standard.

**L. Disposition of EUT**

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Amimon upon completion of testing.

### **III. DFS Requirements and Radar Waveform Description & Calibration**

## A. DFS Requirements

| Requirement                            | Operational Mode |                                |                             |
|----------------------------------------|------------------|--------------------------------|-----------------------------|
|                                        | Master           | Client Without Radar Detection | Client With Radar Detection |
| <i>Non-Occupancy Period</i>            | Yes              | Not required                   | Yes                         |
| <i>DFS Detection Threshold</i>         | Yes              | Not required                   | Yes                         |
| <i>Channel Availability Check Time</i> | Yes              | Not required                   | Not required                |
| <i>U-NII Detection Bandwidth</i>       | Yes              | Not required                   | Yes                         |

Table 8. Applicability of DFS Requirements Prior to Use of a Channel

| Requirement                                                                                                                                                                                                                                                                                                                                                  | Operational Mode                                    |                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                              | Master Device or Client with Radar Detection        | Client Without Radar Detection                       |
| <i>DFS Detection Threshold</i>                                                                                                                                                                                                                                                                                                                               | Yes                                                 | Not required                                         |
| <i>Channel Closing Transmission Time</i>                                                                                                                                                                                                                                                                                                                     | Yes                                                 | Yes                                                  |
| <i>Channel Move Time</i>                                                                                                                                                                                                                                                                                                                                     | Yes                                                 | Yes                                                  |
| <i>U-NII Detection Bandwidth</i>                                                                                                                                                                                                                                                                                                                             | Yes                                                 | Not required                                         |
| <b>Additional requirements for devices with multiple bandwidth modes</b>                                                                                                                                                                                                                                                                                     | <b>Master Device or Client with Radar Detection</b> | <b>Client Without Radar Detection</b>                |
| <i>U-NII Detection Bandwidth and Statistical Performance Check</i>                                                                                                                                                                                                                                                                                           | All BW modes must be tested                         | Not required                                         |
| <i>Channel Move Time and Channel Closing Transmission Time</i>                                                                                                                                                                                                                                                                                               | Test using widest BW mode available                 | Test using the widest BW mode available for the link |
| <i>All other tests</i>                                                                                                                                                                                                                                                                                                                                       | 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 each of the bonded 20 MHz channels and the channel center frequency. |                                                     |                                                      |

Table 9. Applicability of DFS Requirements During Normal Operation

| 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 power spectral<br>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 10. DFS Detection Thresholds for Master or Client Devices Incorporating DFS

| Parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Value                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <i>Non-occupancy period</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Minimum 30 minutes                                                                                                    |
| <i>Channel Availability Check Time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 60 seconds                                                                                                            |
| <i>Channel Move Time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 10 seconds<br>See Note 1.                                                                                             |
| <i>Channel Closing Transmission Time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 200 milliseconds + an<br>aggregate of 60<br>milliseconds over<br>remaining 10 second<br>period.<br>See Notes 1 and 2. |
| <i>U-NII Detection Bandwidth</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Minimum 100% of the U-<br>NII 99% transmission<br>power bandwidth. See<br>Note 3.                                     |
| <p><b>Note 1:</b> <i>Channel Move Time</i> and the <i>Channel Closing Transmission Time</i> should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.</p> <p><b>Note 2:</b> The <i>Channel Closing Transmission Time</i> is comprised of 200 milliseconds starting at the beginning of the <i>Channel Move Time</i> plus any additional intermittent control signals required to facilitate a <i>Channel</i> 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><b>Note 3:</b> During the <i>U-NII Detection Bandwidth</i> 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 11. DFS Response Requirement Values

## B. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. 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.

### 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 $\left\{ \left( \frac{1}{360} \right) \cdot \left( \frac{19 \cdot 10^6}{PRI_{\mu sec}} \right) \right\}$ | 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                      |
| <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 minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. If more than 30 waveforms are used for short pulse radar types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

| 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 12. Pulse Repetition Intervals Values for Test A

### Long Pulse Radar Test Waveform

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

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse radar test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

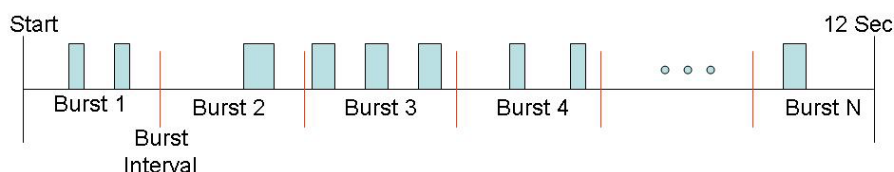
Each waveform is defined as follows:

- 1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
- 2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst\_Count.
- 3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
- 4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
- 5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a Burst will have the same chirp width. Pulses in different Bursts may have different chirp widths. The chirp is centered on the pulse. For example, with radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
- 6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
- 7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst\_Count. Each interval is of length  $(12,000,000 / \text{Burst\_Count})$  microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and  $[(12,000,000 / \text{Burst\_Count}) - (\text{Total Burst Length}) + (\text{One Random PRI Interval})]$  microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen independently.

### A representative example of a Long Pulse radar test waveform:

- 1) The total test signal length is 12 seconds.
- 2) 8 Bursts are randomly generated for the Burst\_Count.
- 3) Burst 1 has 2 randomly generated pulses.
- 4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
- 5) The PRI is randomly selected to be at 1213 microseconds.
- 6) Bursts 2 through 8 are generated using steps 3 – 5.
- 7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range).

Long Pulse Radar Test Signal Waveform  
 12 Second Transmission



**Figure 2. Long Pulse Radar Test Signal Waveform**

#### 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 Trials |
|------------|--------------------|------------|----------------|--------------------|--------------------------------|--------------------------------------------|----------------|
| 6          | 1                  | 333        | 9              | .333               | 300                            | 70%                                        | 30             |

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected<sup>1</sup> from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

### C. Radar Waveform Calibration

Calibration of the DFS test was done using a radiated method. A signal generator capable of producing all radar pulse types (0-6) was connected to a transmitting antenna. A receive antenna, through an external pre-amp was connected to a spectrum analyzer. The spectrum analyzer was set to a zero span with a peak detector and an RBW and VBW of 3 MHz. The transmit and receive antennas were vertically polarized during this calibration.

With the signal generator and spectrum analyzer tuned to the test frequency, each radar pulse was triggered and observed on the spectrum analyzer. The DFS Detection Threshold was verified for each radar pulse type (0-6).

During this process there were no transmissions by either the Master or Client Device.

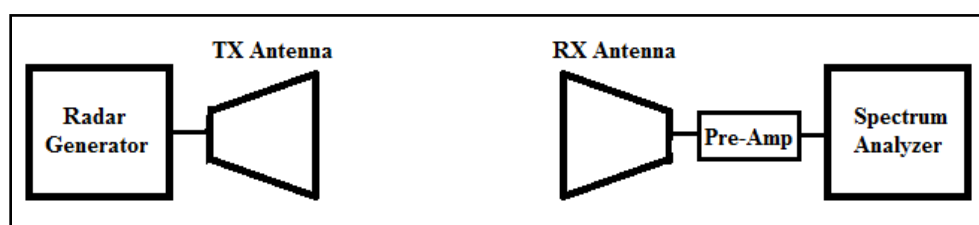
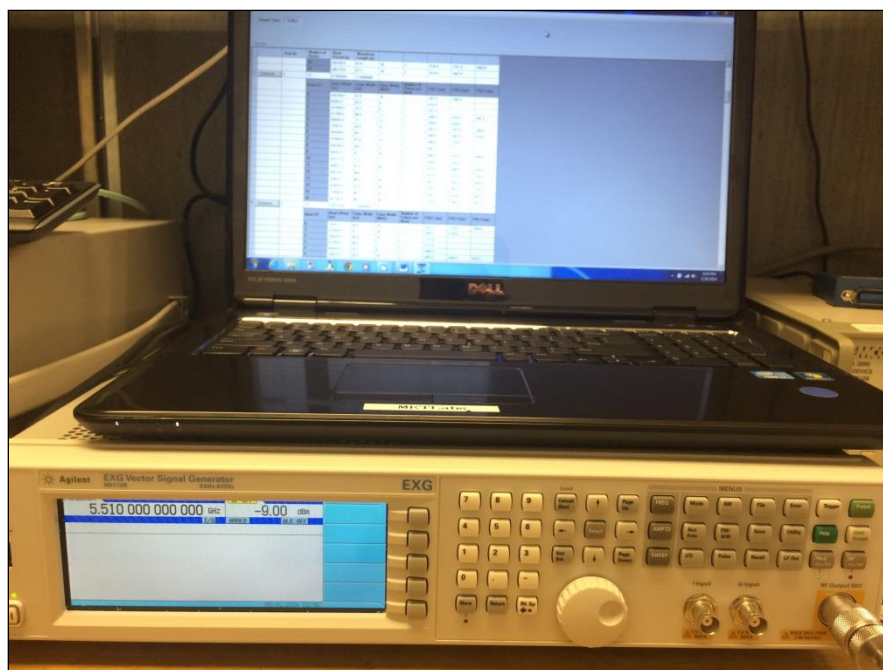
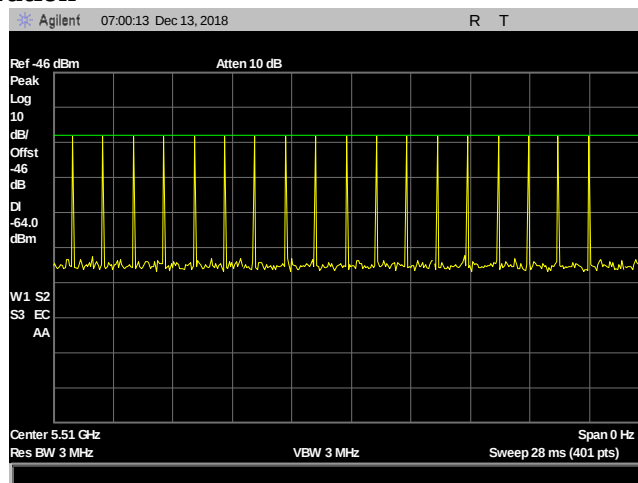


Figure 3. Radiated DFS Calibration Block Diagram

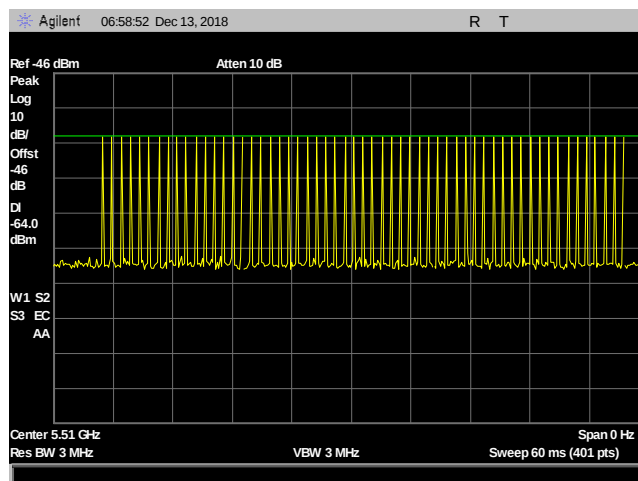


Photograph 1. DFS Radar Test Signal Generator

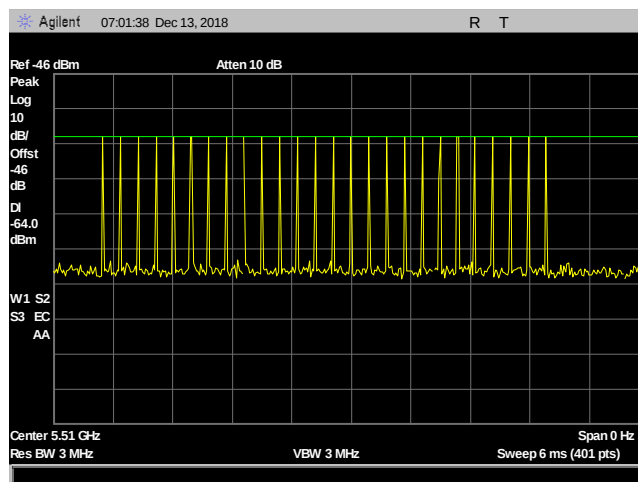
## Radar Waveform Calibration



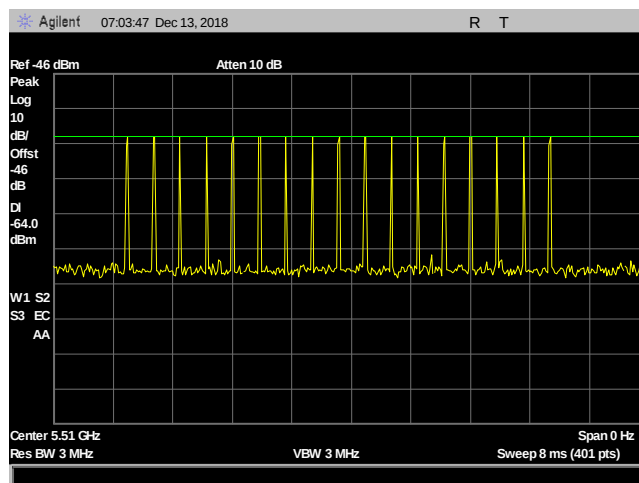
Plot 1. Radar Waveform Calibration. Type 0, 5510 MHz



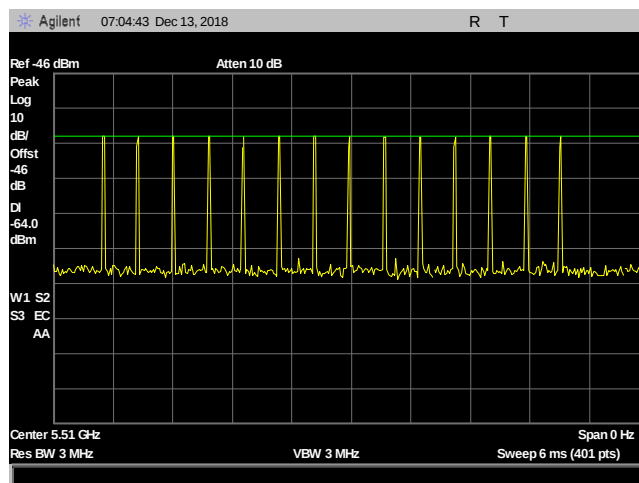
Plot 2. Radar Waveform Calibration, Type 1, 5510 MHz



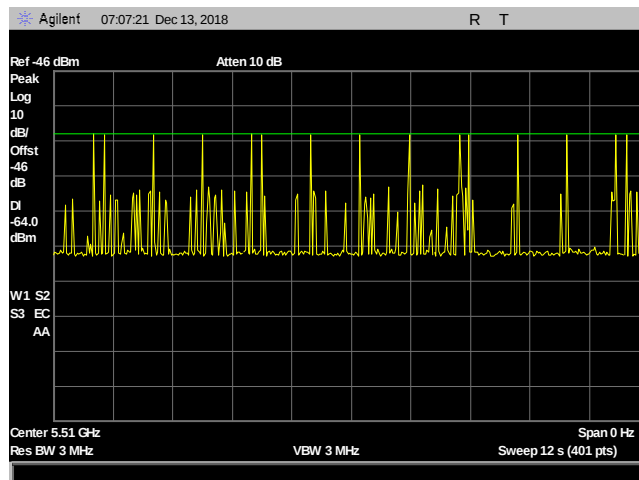
Plot 3. Radar Waveform Calibration, Type 2, 5510 MHz



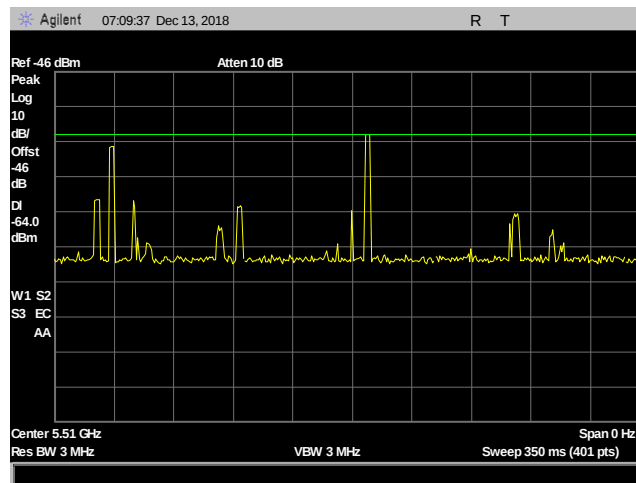
Plot 4. Radar Waveform Calibration, Type 3, 5510 MHz



Plot 5. Radar Waveform Calibration, Type 4, 5510 MHz



Plot 6. Radar Waveform Calibration, Type 5, 5510 MHz

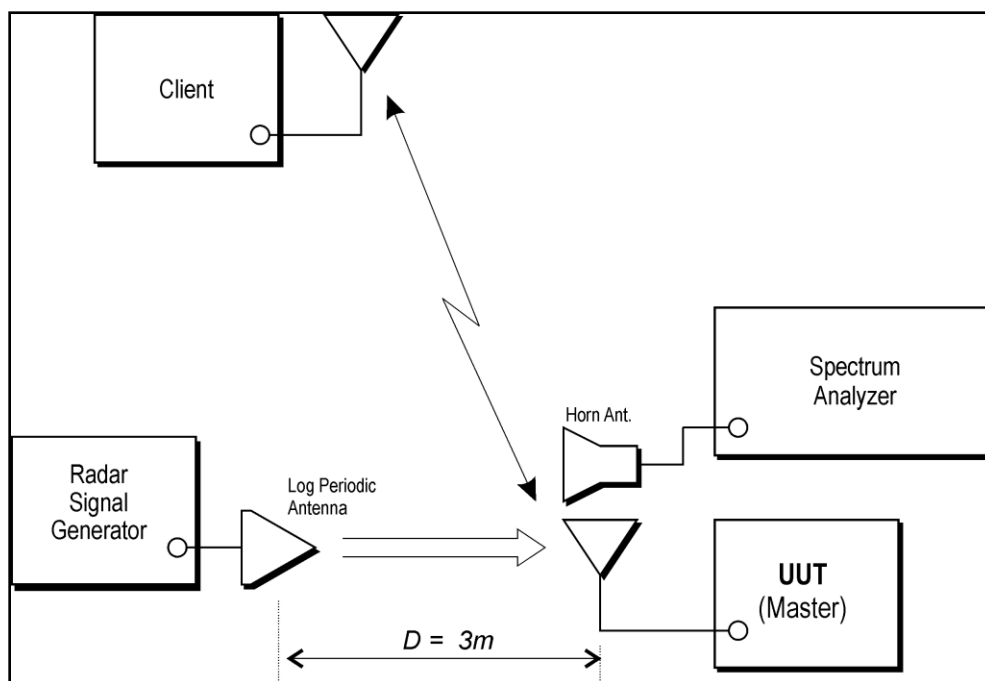


Plot 7. Radar Waveform Calibration, Type 6, 5510 MHz

## **IV. DFS Test Procedure and Test Results**

## A. DFS Test Setup

1. A spectrum analyzer is used as a monitor to verify that the Unit Under Test (EUT) has vacated the Channel within the Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the detection and subsequent Channel move. It is also used to monitor EUT transmissions during the Channel Availability Check Time.
2. The test setup, which consists of test equipment and equipment under test (EUT), is diagrammed in Figure 4.



**Figure 4. Test Setup Diagram**

**B. UNII Detection Bandwidth**

**Test Requirement(s):** KDB 905462 §5.1 All BW modes must be tested.

§5.3 A minimum 100% detection rate is required across a EUT's 99% bandwidth.

**Test Procedure:** The EUT was set up as a standalone device (no associated Client or Master, as appropriate) and no traffic.

A single radar burst of type 0 and the center frequency was generated and the response of the EUT was noted. This was repeated for a minimum of 10 trials. The minimum percentage of detection was 90%, as per the KDB 905462.

Starting at the center frequency of the EUT operating Channel, the radar frequency was increased in 5 MHz steps, repeating the minimum of 10 trials, until the detection rate fell below the U-NII Detection Bandwidth criterion (90%). The measurement was repeated in 1MHz steps at frequencies 5 MHz below where the detection rate began to fall. The highest frequency (denoted as F<sub>H</sub>) at which detection was greater or equal than the U-NII Detection Bandwidth criterion (90%) was recorded.

Starting at the center frequency of the EUT operating Channel, the radar frequency was decreased in 5 MHz steps, repeating the minimum of 10 trials, until the detection rate fell below the U-NII Detection Bandwidth criterion (90%). The measurement was repeated in 1MHz steps at frequencies 5 MHz below where the detection rate began to fall. The lowest frequency (denoted as F<sub>L</sub>) at which detection was greater or equal than the U-NII Detection Bandwidth criterion (90%) was recorded.

The U-NII Detection Bandwidth was calculated as follow:

U-NII Detection Bandwidth = F<sub>H</sub> – F<sub>L</sub>

**Test Results:** The EUT was compliant with the requirements of this section.

**Test Engineer:** Donald Salguero

**Test Date:** December 18, 2018

| EUT Configuration – 5510MHz 40MHz BW                                                     |                                                     |          |          |          |          |          |          |          |          |          |                    |
|------------------------------------------------------------------------------------------|-----------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|
| Radar Frequency<br>(MHz)                                                                 | DFS Detection Trials (1=Detection, 0= No Detection) |          |          |          |          |          |          |          |          |          | Detection Rate (%) |
|                                                                                          | 1                                                   | 2        | 3        | 4        | 5        | 6        | 7        | 8        | 9        | 10       |                    |
| 5250                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| 5255                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| 5260                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| 5265                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| <b>Center 5270</b>                                                                       | <b>1</b>                                            | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>100</b>         |
| 5275                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| 5280                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| 5285                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| 5290                                                                                     | 1                                                   | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 100                |
| Detection Percentage                                                                     |                                                     |          |          |          |          |          |          |          |          |          | 100%               |
| Detection Bandwidth = $f_h - f_l = 5290 \text{ MHz} - 5250 \text{ MHz} = 40 \text{ MHz}$ |                                                     |          |          |          |          |          |          |          |          |          |                    |
| EUT 99% Bandwidth = 34MHz                                                                |                                                     |          |          |          |          |          |          |          |          |          |                    |

**Table 13. DFS Channel Bandwidth, 5270 MHz, 40 MHz BW, Test Results**

## C. Channel Availability Check Time

**Test Requirements:** §15.407(h)(2)(ii) A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this section, is detected within 60 seconds.

**Test Procedure:** The spectrum analyzer was set to a zero span mode with a 3 MHz RBW and 3 MHz VBW on the test channel with a 2 minute sweep time. The spectrum analyzer's sweep was started at the same time power was applied to the U-NII device.

For the initial Channel Availability Check Time no radar burst was generated and the EUT was monitored for how long after startup transmission started.

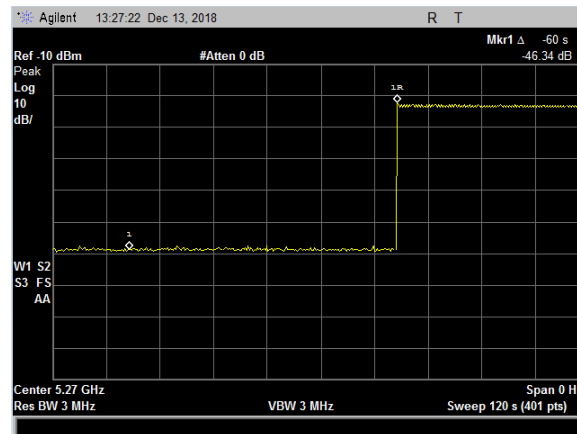
For radar burst at the beginning of the Channel Availability Check Time a short pulse radar type (0-4) with a level equal to the DFS Detection Threshold + 1 dB was generated within the first 6 seconds of the EUT's channel availability check. The EUT was monitored to ensure that it did not start transmitting on the channel.

For radar burst at the end of the Channel Availability Check Time a short pulse radar type (0-4) with a level equal to the DFS Detection Threshold + 1 dB was generated within the last 6 seconds of the EUT's channel availability check. The EUT was monitored to ensure that it did not start transmitting on the channel.

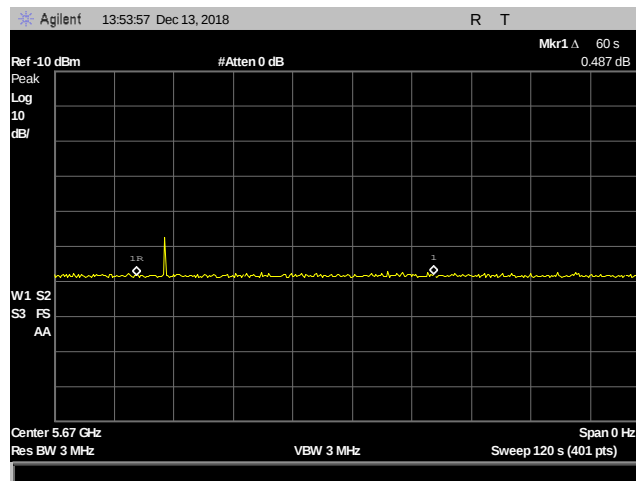
**Test Results:** The EUT was compliant with the requirements of this section.

**Test Engineer:** Donald Salguero

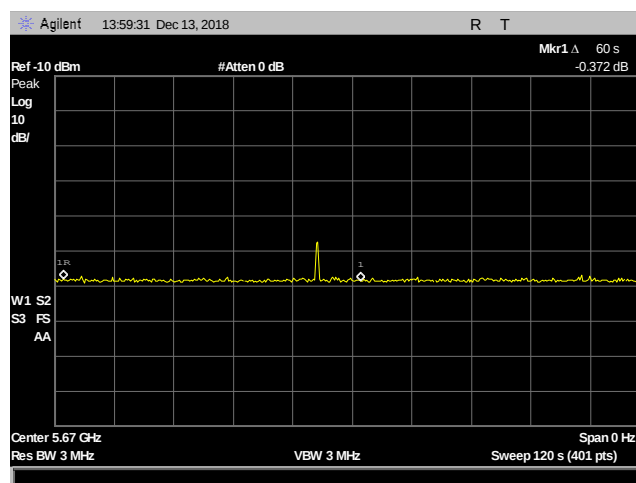
**Test Date:** December 18, 2018



Plot 8. Initial Channel Availability Check Time



Plot 9. Channel Availability Check, Pulse Near Start



Plot 10. Channel Availability Check Time, Pulse Near End

## **D. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time, and Non-Occupancy Period**

**Test Requirements:**      **§15.407(h)(2)(iii)** Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

**§15.407(h)(2)(iv)** Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

**KDB 905462 §5.1** Test using widest BW mode available.

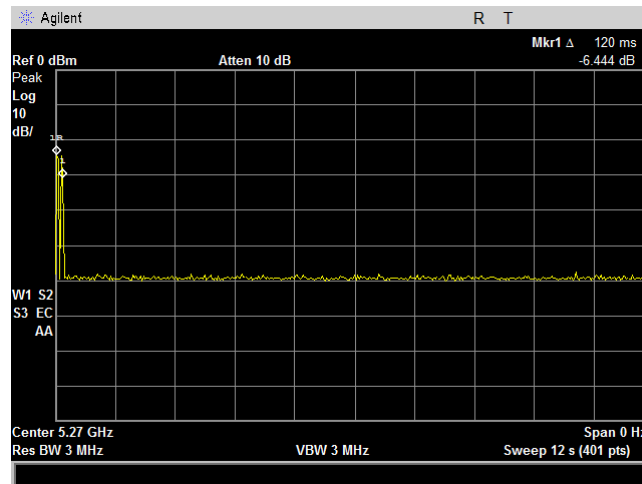
**Test Procedure:**      The EUT was setup as a Master device with an associated client device. A test file was streamed from the Master device to the Client device for the entire period of the test. A Radar Burst of type 0 with a level equal to the DFS Detection Threshold + 1 dB was used.

A radar pulse was generated while the EUT was transmitting. A spectrum analyzer set to a zero span was used to observe the transmission of the EUT at the end of the burst.

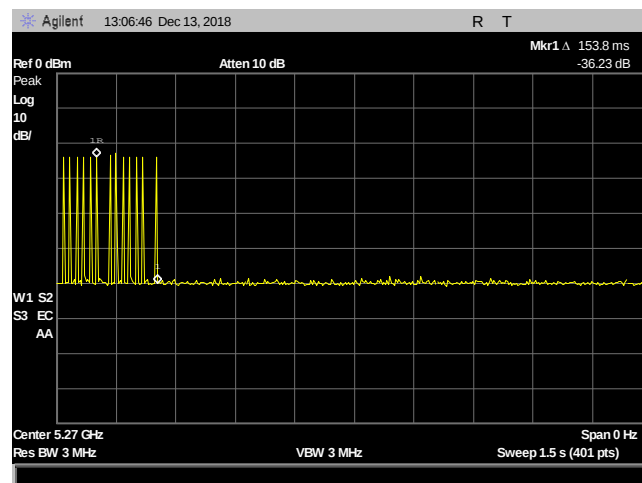
**Test Results:**      The EUT was compliant with the requirements of this section. The channel move time was determined to be compliant by adding the burst time values (the aggregate value is less than 250ms).

**Test Engineer(s):**      Donald Salguero

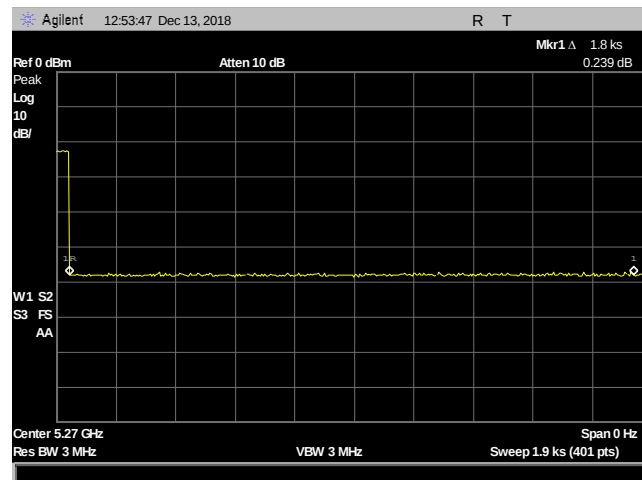
**Test Date(s):**      December 18, 2019



Plot 11. Channel Move Time



Plot 12. Channel Close Time



Plot 13. Non-Occupancy Period

## E. Statistical Performance Check

**Test Requirements:** KDB 905462 §5.1 All BW modes must be tested.

**KDB 905462:** Each of the Radar Pulse types requires a minimum percentage of detections while the EUT is transmitting and listening for potential radar systems operating within the DFS Detection Bandwidth.

For Short Pulse Radar types the aggregate minimum percentage of detections is 80 percent.

For the Long Pulse Radar types the minimum percentage of detections is 80 percent.

For the Frequency Hopping Radar type the minimum percentage of detections is 70 percent.

**Test Procedure:** The EUT was setup as a Master device and associated with a Client device. A test file was streamed from the Master device to the Client device for the entire period of the test. The EUT was also set to a test mode as to demonstrate when the detection occurred without resetting the device between trials.

A Radar Burst of each type (1-6) with a level equal to the DFS Detection Threshold + 1 dB was used. The frequencies selected for the radar burst included several frequencies within the DFS Detection Bandwidth and frequencies near the edge of the bandwidth.

For Short Pulse Radar types, an observation of the EUT's transmission was made for duration greater than 10 seconds after the burst to ensure detection occurred.

For Long Pulse Radar types, an observation of the EUT's transmission was made for duration greater than 22 seconds after the burst to ensure detection occurred. Also, center frequencies for the 30 trials were randomly selected within 90% of the Occupied Bandwidth.

Once the performance check was completed, statistical data was gathered as to determine the ability of the EUT to detect radar waveforms. An aggregate total for the Short Pulse Radar detections was calculated.

**Test Results:** The EUT was compliant with the requirements of this section.

**Test Engineer:** Donald Salguero

**Test Date:** December 18, 2019

| Radar Type           | Trial # | Pulses Repetition<br>Frequency Number<br>(1-23) | Pulse<br>Repetition<br>Frequency<br>(Pulses Per<br>Second) | Pulse<br>Repetition<br>Interval (µsec) | Detection       |
|----------------------|---------|-------------------------------------------------|------------------------------------------------------------|----------------------------------------|-----------------|
|                      |         |                                                 |                                                            |                                        | 1 = Yes, 0 = No |
| 1                    | 1       | 19                                              | 1139.0                                                     | 878                                    | 1               |
|                      | 2       | 7                                               | 1567.4                                                     | 638                                    | 1               |
|                      | 3       | 3                                               | 1792.1                                                     | 558                                    | 1               |
|                      | 4       | 18                                              | 1165.6                                                     | 858                                    | 1               |
|                      | 5       | 15                                              | 1253.1                                                     | 798                                    | 0               |
|                      | 6       | 8                                               | 1519.8                                                     | 658                                    | 1               |
|                      | 7       | 10                                              | 1432.7                                                     | 698                                    | 1               |
|                      | 8       | 4                                               | 1730.1                                                     | 578                                    | 1               |
|                      | 9       | 6                                               | 1618.1                                                     | 618                                    | 1               |
|                      | 10      | 13                                              | 1319.3                                                     | 758                                    | 1               |
|                      | 11      | 2                                               | 1858.7                                                     | 538                                    | 1               |
|                      | 12      | 16                                              | 1222.5                                                     | 818                                    | 1               |
|                      | 13      | 17                                              | 1193.3                                                     | 838                                    | 1               |
|                      | 14      | 23                                              | 326.2                                                      | 3066                                   | 0               |
|                      | 15      | 12                                              | 1355.0                                                     | 738                                    | 1               |
|                      | 16      | n/a                                             | 545.3                                                      | 1834                                   | 1               |
|                      | 17      | n/a                                             | 445.0                                                      | 2247                                   | 1               |
|                      | 18      | n/a                                             | 522.7                                                      | 1913                                   | 1               |
|                      | 19      | n/a                                             | 441.9                                                      | 2263                                   | 0               |
|                      | 20      | n/a                                             | 1455.6                                                     | 687                                    | 0               |
|                      | 21      | n/a                                             | 397.1                                                      | 2518                                   | 0               |
|                      | 22      | n/a                                             | 362.8                                                      | 2756                                   | 1               |
|                      | 23      | n/a                                             | 1572.3                                                     | 636                                    | 1               |
|                      | 24      | n/a                                             | 564.0                                                      | 1773                                   | 1               |
|                      | 25      | n/a                                             | 335.6                                                      | 2980                                   | 0               |
|                      | 26      | n/a                                             | 390.5                                                      | 2561                                   | 1               |
|                      | 27      | n/a                                             | 459.3                                                      | 2177                                   | 1               |
|                      | 28      | n/a                                             | 371.6                                                      | 2691                                   | 1               |
|                      | 29      | n/a                                             | 457.5                                                      | 2186                                   | 1               |
|                      | 30      | n/a                                             | 563.1                                                      | 1776                                   | 1               |
| Detection Percentage |         |                                                 |                                                            |                                        | 80% (> 60%)     |
| EUT Frequency        |         |                                                 |                                                            |                                        | 5270 MHz        |
| Radar Frequency      |         |                                                 |                                                            |                                        | 5252 - 5288 MHz |

**Table 14. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 1**

| Radar Type           | Trial # | Pulse Width<br>1- 5 µsec | PRI 150-230 µsec | Number of Pulses<br>23-29 | Detection       |
|----------------------|---------|--------------------------|------------------|---------------------------|-----------------|
|                      |         |                          |                  |                           | 1 = Yes, 0 = No |
| 2                    | 1       | 2                        | 171              | 24                        | 1               |
|                      | 2       | 1.4                      | 170              | 23                        | 1               |
|                      | 3       | 2.9                      | 174              | 26                        | 1               |
|                      | 4       | 4.1                      | 185              | 28                        | 1               |
|                      | 5       | 3.6                      | 187              | 27                        | 1               |
|                      | 6       | 2.7                      | 195              | 26                        | 1               |
|                      | 7       | 2.4                      | 203              | 25                        | 1               |
|                      | 8       | 4.8                      | 181              | 29                        | 1               |
|                      | 9       | 1.4                      | 213              | 23                        | 1               |
|                      | 10      | 3.6                      | 155              | 27                        | 1               |
|                      | 11      | 1.1                      | 180              | 23                        | 1               |
|                      | 12      | 2                        | 218              | 24                        | 1               |
|                      | 13      | 2.3                      | 226              | 25                        | 1               |
|                      | 14      | 5                        | 167              | 29                        | 1               |
|                      | 15      | 3.7                      | 217              | 27                        | 1               |
|                      | 16      | 3.6                      | 229              | 27                        | 1               |
|                      | 17      | 2.1                      | 211              | 24                        | 1               |
|                      | 18      | 3.5                      | 186              | 27                        | 1               |
|                      | 19      | 3.8                      | 161              | 27                        | 1               |
|                      | 20      | 3.8                      | 157              | 27                        | 1               |
|                      | 21      | 4.8                      | 193              | 29                        | 1               |
|                      | 22      | 1.3                      | 194              | 23                        | 1               |
|                      | 23      | 1.6                      | 177              | 24                        | 1               |
|                      | 24      | 2.5                      | 225              | 25                        | 1               |
|                      | 25      | 4.2                      | 230              | 28                        | 1               |
|                      | 26      | 1.6                      | 150              | 24                        | 1               |
|                      | 27      | 4.2                      | 206              | 28                        | 1               |
|                      | 28      | 2.2                      | 163              | 25                        | 1               |
|                      | 29      | 4.3                      | 158              | 28                        | 1               |
|                      | 30      | 4.6                      | 209              | 29                        | 1               |
| Detection Percentage |         |                          |                  |                           | 100% ( >60%)    |
| EUT Frequency        |         |                          |                  |                           | 5270 MHz        |
| Radar Frequency      |         |                          |                  |                           | 5252 - 5288 MHz |

Table 15. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 2

| Radar Type           | Trial # | Pulse Width<br>6-10 µsec | PRI 200-500 µsec | Number of Pulses<br>16-18 | Detection       |
|----------------------|---------|--------------------------|------------------|---------------------------|-----------------|
|                      |         |                          |                  |                           | 1 = Yes, 0 = No |
| 3                    | 1       | 7                        | 418              | 16                        | 1               |
|                      | 2       | 6.4                      | 308              | 16                        | 1               |
|                      | 3       | 7.9                      | 392              | 17                        | 1               |
|                      | 4       | 9.1                      | 478              | 18                        | 1               |
|                      | 5       | 8.6                      | 306              | 17                        | 1               |
|                      | 6       | 7.7                      | 235              | 17                        | 1               |
|                      | 7       | 7.4                      | 404              | 17                        | 1               |
|                      | 8       | 9.8                      | 435              | 18                        | 1               |
|                      | 9       | 6.4                      | 469              | 16                        | 1               |
|                      | 10      | 8.6                      | 461              | 17                        | 1               |
|                      | 11      | 6.1                      | 423              | 16                        | 1               |
|                      | 12      | 7                        | 428              | 16                        | 1               |
|                      | 13      | 7.3                      | 349              | 16                        | 1               |
|                      | 14      | 10                       | 348              | 18                        | 1               |
|                      | 15      | 8.7                      | 463              | 18                        | 1               |
|                      | 16      | 8.6                      | 380              | 17                        | 1               |
|                      | 17      | 7.1                      | 383              | 16                        | 1               |
|                      | 18      | 8.5                      | 249              | 17                        | 1               |
|                      | 19      | 8.8                      | 270              | 18                        | 1               |
|                      | 20      | 8.8                      | 210              | 18                        | 1               |
|                      | 21      | 9.8                      | 477              | 18                        | 1               |
|                      | 22      | 6.3                      | 389              | 16                        | 1               |
|                      | 23      | 6.6                      | 370              | 16                        | 1               |
|                      | 24      | 7.5                      | 449              | 17                        | 1               |
|                      | 25      | 9.2                      | 322              | 18                        | 1               |
|                      | 26      | 6.6                      | 361              | 16                        | 1               |
|                      | 27      | 9.2                      | 204              | 18                        | 1               |
|                      | 28      | 7.2                      | 395              | 16                        | 1               |
|                      | 29      | 9.3                      | 298              | 18                        | 1               |
|                      | 30      | 9.6                      | 236              | 18                        | 1               |
| Detection Percentage |         |                          |                  |                           | 100% ( >60%)    |
| EUT Frequency        |         |                          |                  |                           | 5270 MHz        |
| Radar Frequency      |         |                          |                  |                           | 5252 - 5288 MHz |

Table 16. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 3

| Radar Type           | Trial # | Pulse Width<br>11-20 $\mu$ sec | PRI<br>200-500 $\mu$ sec | Number of Pulses<br>12-16 | Detection       |
|----------------------|---------|--------------------------------|--------------------------|---------------------------|-----------------|
|                      |         |                                |                          |                           | 1 = Yes, 0 = No |
| 4                    | 1       | 13.2                           | 418                      | 13                        | 1               |
|                      | 2       | 12                             | 308                      | 12                        | 1               |
|                      | 3       | 15.2                           | 392                      | 14                        | 1               |
|                      | 4       | 18                             | 478                      | 15                        | 1               |
|                      | 5       | 16.9                           | 306                      | 15                        | 1               |
|                      | 6       | 14.9                           | 235                      | 14                        | 1               |
|                      | 7       | 14.2                           | 404                      | 13                        | 1               |
|                      | 8       | 19.5                           | 435                      | 16                        | 1               |
|                      | 9       | 11.9                           | 469                      | 12                        | 1               |
|                      | 10      | 16.8                           | 461                      | 15                        | 1               |
|                      | 11      | 11.2                           | 423                      | 12                        | 1               |
|                      | 12      | 13.2                           | 428                      | 13                        | 1               |
|                      | 13      | 13.9                           | 349                      | 13                        | 1               |
|                      | 14      | 20                             | 348                      | 16                        | 1               |
|                      | 15      | 17.2                           | 463                      | 15                        | 1               |
|                      | 16      | 16.9                           | 380                      | 15                        | 1               |
|                      | 17      | 13.5                           | 383                      | 13                        | 1               |
|                      | 18      | 16.5                           | 249                      | 15                        | 1               |
|                      | 19      | 17.4                           | 270                      | 15                        | 1               |
|                      | 20      | 17.3                           | 210                      | 15                        | 1               |
|                      | 21      | 19.6                           | 477                      | 16                        | 1               |
|                      | 22      | 11.8                           | 389                      | 12                        | 1               |
|                      | 23      | 12.4                           | 370                      | 12                        | 1               |
|                      | 24      | 14.4                           | 449                      | 13                        | 1               |
|                      | 25      | 18.2                           | 322                      | 15                        | 1               |
|                      | 26      | 12.5                           | 361                      | 12                        | 1               |
|                      | 27      | 18.2                           | 204                      | 15                        | 1               |
|                      | 28      | 13.7                           | 395                      | 13                        | 1               |
|                      | 29      | 18.4                           | 298                      | 16                        | 1               |
|                      | 30      | 18.2                           | 284                      | 15                        | 1               |
| Detection Percentage |         |                                |                          |                           | 100% (> 60%)    |
| EUT Frequency        |         |                                |                          |                           | 5270 MHz        |
| Radar Frequency      |         |                                |                          |                           | 5252 - 5288 MHz |

Table 17. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 4

Aggregate

| Radar Type                                     | Number of Trials | Number of Successful<br>Detections | Minimum Percentage of<br>Successful Detections |
|------------------------------------------------|------------------|------------------------------------|------------------------------------------------|
| 1                                              | 24               | 30                                 | 80%                                            |
| 2                                              | 30               | 30                                 | 100%                                           |
| 3                                              | 30               | 30                                 | 100%                                           |
| 4                                              | 30               | 30                                 | 100%                                           |
| Aggregate = (80% + 100% + 100% + 100%)/4 = 95% |                  |                                    |                                                |

Table 18. Statistical Performance Check, 5270 MHz, 40 MHz, Aggregate

| Radar Type           | Trial # | Pulse Width (µsec)<br>50-100 | PRI (µsec)<br>1000-2000    | Chirp Width (MHz)<br>5 -20 | Number of Bursts<br>8-20 | Detection       |
|----------------------|---------|------------------------------|----------------------------|----------------------------|--------------------------|-----------------|
|                      |         |                              |                            |                            |                          | 1 = Yes, 0 = No |
| 5                    | 1       | 77.8                         | 1665.0                     | 13                         | 15                       | 1               |
|                      | 2       | 75.0                         | 1880.0                     | 12                         | 8                        | 1               |
|                      | 3       | 73.8                         | 1806.0                     | 12                         | 11                       | 1               |
|                      | 4       | 68.1                         | 1339.0                     | 10                         | 20                       | 1               |
|                      | 5       | 67.9                         | 1320.0                     | 10                         | 17                       | 1               |
|                      | 6       | 92.9                         | 1085.0                     | 18                         | 14                       | 1               |
|                      | 7       | 96.6                         | 1182.0                     | 19                         | 15                       | 1               |
|                      | 8       | 526.                         | 1210.0                     | 5                          | 12                       | 1               |
|                      | 9       | 54.1                         | 1415.0                     | 6                          | 14                       | 1               |
|                      | 10      | 63.4                         | 1043.0                     | 9                          | 8                        | 1               |
|                      | 11      | 73.7                         | 1208.0                     | 12                         | 17                       | 1               |
|                      | 12      | 98.9                         | 1381.0                     | 20                         | 19                       | 1               |
|                      | 13      | 58.1                         | 1929.0                     | 7                          | 15                       | 1               |
|                      | 14      | 75.3                         | 1994.0                     | 13                         | 12                       | 1               |
|                      | 15      | 93.9                         | 1983.0                     | 18                         | 19                       | 1               |
|                      | 16      | 76.9                         | 1110.0                     | 13                         | 14                       | 1               |
|                      | 17      | 87.6                         | 1565.0                     | 17                         | 20                       | 1               |
|                      | 18      | 86.4                         | 1259.0                     | 16                         | 12                       | 1               |
|                      | 19      | 55.3                         | 1920.0                     | 6                          | 14                       | 1               |
|                      | 20      | 88.6                         | 1501.0                     | 17                         | 12                       | 1               |
|                      | 21      | 74.7                         | 1619.0                     | 12                         | 16                       | 1               |
|                      | 22      | 78.5                         | 1653.0                     | 14                         | 12                       | 1               |
|                      | 23      | 77.0                         | 1191.0                     | 13                         | 20                       | 1               |
|                      | 24      | 50.1                         | 1841.0                     | 5                          | 14                       | 1               |
|                      | 25      | 94.0                         | 1643.0                     | 19                         | 13                       | 1               |
|                      | 26      | 68.6                         | 1306.0                     | 10                         | 8                        | 1               |
|                      | 27      | 83.6                         | 1632.0                     | 15                         | 17                       | 1               |
|                      | 28      | 85.6                         | 1946.0                     | 16                         | 19                       | 1               |
|                      | 29      | 50.5                         | 1857.0                     | 5                          | 12                       | 1               |
|                      | 30      | 83.4                         | 1454.0                     | 15                         | 18                       | 1               |
| Detection Percentage |         |                              |                            |                            |                          | 100% (> 80%)    |
| EUT Frequency        |         |                              |                            |                            |                          | 5270 MHz        |
| Radar Frequency      |         |                              | Fl + 0.4*Chirp Width (MHz) |                            |                          | 5254 – 5286 MHz |
|                      |         |                              | Fh – 0.4*Chirp Width (MHz) |                            |                          |                 |

Table 19. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 5

| Radar Type           | Trial # | Hopping<br>Sequence<br>Length (ms) | Pulses per Hop | Pulse Width<br>(µsec) | PRI (µsec) | Detection       |
|----------------------|---------|------------------------------------|----------------|-----------------------|------------|-----------------|
|                      |         |                                    |                |                       |            | 1 = Yes, 0 = No |
| 6                    | 1       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 2       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 3       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 4       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 5       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 6       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 7       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 8       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 9       | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 10      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 11      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 12      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 13      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 14      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 15      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 16      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 17      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 18      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 19      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 20      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 21      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 22      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 23      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 24      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 25      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 26      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 27      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 28      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 29      | 300.00                             | 9              | 1                     | 333        | 1               |
|                      | 30      | 300.00                             | 9              | 1                     | 333        | 1               |
| Detection Percentage |         |                                    |                |                       |            | 100% (> 70%)    |
| EUT Frequency        |         |                                    |                |                       |            | 5270 MHz        |
| Radar Frequency      |         |                                    |                |                       |            | 5250 - 5724 MHz |

Table 20. Statistical Performance Check, 5270 MHz, 40 MHz, Radar Type 6

## V. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

| MET Asset # | Equipment                          | Manufacturer            | Model   | Calibration Date | Calibration Due Date |
|-------------|------------------------------------|-------------------------|---------|------------------|----------------------|
| 1T2665      | Antenna; Horn                      | EMCO                    | 3115    | 6/22/2017        | 6/22/2019            |
| 1T8371      | Double Ridge Guide<br>Horn Antenna | A.H. Systems,<br>Inc.   | SAS-571 | 3/28/2017        | 3/28/2019            |
| 1T6658      | Spectrum Analyzer                  | Agilent<br>Technologies | E4407B  | 4/23/2018        | 4/23/2019            |
| 1T4871      | Vector Signal Generator            | Agilent<br>Technologies | N5172B  | 1/5/2018         | 7/5/2019             |

**Table 21. Test Equipment List**

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

## **VI. Certification & User's Manual Information**

## Certification & User's Manual Information

### M. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

#### § 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

- (a) The various types of radio communication transmitting devices described throughout this chapter.
- (b) *The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*
- (c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.
- (d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

#### § 2.803 Marketing of radio frequency devices prior to equipment authorization.

- (a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:
  - (1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or
  - (2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.
- (d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

- (e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:
- (i) *Compliance testing*;
  - (ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;
  - (iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;
  - (iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or
  - (v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.
- (e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.
- (f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

## Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

### § 2.901 Basis and Purpose

- (a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.<sup>1</sup> *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.*
- (b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

### § 2.907 Certification.

- (a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.
- (b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

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<sup>1</sup> In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

## Certification & User's Manual Information

### § 2.948 Description of measurement facilities.

- (a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.
  - (1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.
    - (i) *If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*
    - (ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.
  - (2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

## Certification & User's Manual Information

### Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

#### § 15.19 Labeling requirements.

(a) *In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:*

- (1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

- (2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

- (3) All other devices shall bear the following statement in a conspicuous location on the device:

*This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

- (4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

- (5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

#### § 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

### § 15.105 Information to the user.

- (a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

- (b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.