FCC and Industry Canada Testing of the Siemens AG Access Point, Model: MSN65-W1-M12-E2 In accordance with FCC 47 CFR Part 15E and Industry Canada RSS-247

Prepared for: Siemens AG
76181
Karlsruhe
Germany

FCC ID: LYHMSN65V1
IC: 267AA-MSN65V1

Product Service

Choose certainty.
Add value.

COMMERCIAL-IN-CONFIDENCE

Date: July 2017
Document Number: 75938097-01 | Issue: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Steven White	05 July 2017	
Authorised Signatory	Simon Bennett	05 July 2017	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT
The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15E and Industry Canada RSS-247. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Matthew Russell	05 July 2017	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation
IC2932B-1 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY
A sample of this product was tested and found to be in compliance with FCC 47 CFR Part 15E: 2016 and Industry Canada RSS-247: Issue 2 (2017-02)

DISCLAIMER AND COPYRIGHT
This non-binding report has been prepared by TÜV SÜD Product Service with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD Product Service. No part of this document may be reproduced without the prior written approval of TÜV SÜD Product Service. © 2017 TÜV SÜD Product Service.

ACCREDITATION
Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

TÜV SÜD Product Service
is a trading name of TUV SUD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

TÜV SÜD Product Service
Octagon House
Concorde Way
Fareham
Hampshire PO15 5RL
United Kingdom

Contents

1 Report Summary 2

1.1 Report Modification Record 2
1.2 Introduction 2
1.3 Brief Summary of Results 3
1.4 Application Form 5
1.5 Product Information 8
1.6 Deviations from the Standard 9
1.7 EUT Modification Record 9
1.8 Test Location 10

2 Test Details 11

2.1 Calibration of Test Setup 11
2.2 U-NII Detection Bandwidth 41
2.3 Initial Channel Availability Check 46
2.4 Radar Burst at the Beginning of the Channel Availability Check Time 50
2.5 Radar Burst at the End of the Channel Availability Check Time 54
2.6 In-Service Monitoring 58
2.7 Statistical Performance Check 72

3 Measurement Uncertainty 92

4 DFS Test Equipment 93

ANNEX A Test Waveforms Used **A.2**

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	05 July 2017

Table 1

1.2 Introduction

Applicant	Siemens Karlsruhe
Manufacturer	Siemens AG
Model Number(s)	MSN65-W1-M12-E2
Serial Number(s)	Not Serialised (75938097-TSR0001) Not Serialised (75938097-TSR0002)
Hardware Version(s)	1
Software Version(s)	6.1
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15E: 2016 Industry Canada RSS-247: Issue 2 (2017-02)
Order Number Date	PTP 20-February-2017
Date of Receipt of EUT	20-February-2017
Start of Test	22-February-2017
Finish of Test	02-March-2017
Name of Engineer(s)	Matthew Russell
Related Document(s)	KDB 662911 D01 v02r01 KDB 905462 D02 v02 KDB 905462 D04 v01 KDB 905462 D06 v02 KDB 789033 D02 v01r03

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15E and Industry Canada RSS-247 is shown in the table below.

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 15E	RSS-247			
Configuration and Mode: Client Without Radar Detection - 802.11a					
2.6	15.407 (h)(2)(iii)(iv)	6.3	In-Service Monitoring	Pass	KDB 905462 D02 v02
Configuration and Mode: Client Without Radar Detection - 802.11n 40 MHz Bandwidth					
2.6	15.407 (h)(2)(iii)(iv)	6.3	In-Service Monitoring	Pass	KDB 905462 D02 v02
Configuration and Mode: Master - 802.11a					
2.2	15.407 (h)(2)	6.3	U-NII Detection Bandwidth	Pass	KDB 905462 D02 v02
2.3	15.407 (h)(2)(ii)	6.3	Initial Channel Availability Check	Pass	KDB 905462 D02 v02
2.4	15.407 (h)(2)(ii)	6.3	Radar Burst at the Beginning of the Channel Availability Check Time	Pass	KDB 905462 D02 v02
2.5	15.407 (h)(2)(ii)	6.3	Radar Burst at the End of the Channel Availability Check Time	Pass	KDB 905462 D02 v02
2.6	15.407 (h)(2)(iii)(iv)	6.3	In-Service Monitoring	Pass	KDB 905462 D02 v02
2.7	15.407 (h)(2)	6.3	Statistical Performance Check	Pass	KDB 905462 D02 v02
2.8	15.407 (h)(2)	6.3	Uniform Spreading	Declaration	KDB 905462 D02 v02
Configuration and Mode: Master - 802.11n 20 MHz Bandwidth					
2.2	15.407 (h)(2)	6.3	U-NII Detection Bandwidth	Pass	KDB 905462 D02 v02
2.7	15.407 (h)(2)	6.3	Statistical Performance Check	Pass	KDB 905462 D02 v02
2.8	15.407 (h)(2)	6.3	Uniform Spreading	Declaration	KDB 905462 D02 v02

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 15E	RSS-247			
Configuration and Mode: Master - 802.11n 40 MHz Bandwidth					
2.2	15.407 (h)(2)	6.3	U-NII Detection Bandwidth	Pass	KDB 905462 D02 v02
2.3	15.407 (h)(2)(ii)	6.3	Initial Channel Availability Check	Pass	KDB 905462 D02 v02
2.4	15.407 (h)(2)(ii)	6.3	Radar Burst at the Beginning of the Channel Availability Check Time	Pass	KDB 905462 D02 v02
2.5	15.407 (h)(2)(ii)	6.3	Radar Burst at the End of the Channel Availability Check Time	Pass	KDB 905462 D02 v02
2.6	15.407 (h)(2)(iii)(iv)	6.3	In-Service Monitoring	Pass	KDB 905462 D02 v02
2.7	15.407 (h)(2)	6.3	Statistical Performance Check	Pass	KDB 905462 D02 v02
2.8	15.407 (h)(2)	6.3	Uniform Spreading	Declaration	KDB 905462 D02 v02

Table 2

1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	MSN65-W1-M12-E2
Part Number	
Hardware Version	1
Software Version	6.1
FCC ID	LYHMSN65V1
Technical Description (Please provide a brief description of the intended use of the equipment)	802.11 a/b/g/n Wi-Fi Access Point. EUT can be operated in either Master or Client mode depending on firmware configuration. EUT supports 20 MHz and 40 MHz bandwidths and 2x2 MIMO data rates (MCS0-7 and MCS 8-15).

TYPE OF EQUIPMENT (TICK ALL THAT APPLY)	
☒	Master
☐	Client with Radar Detection
☒	Client without Radar Detection
☐	Wi-Fi Direct Support

TRANSMITTER TECHNICAL CHARACTERISTICS	
FREQUENCY CHARACTERISTICS	
☒	5.150 GHz to 5.250 GHz
☒	5.250 GHz to 5.350 GHz
☒	5.470 GHz to 5.725 GHz
☒	5.725 GHz to 5.825 GHz
☐	EUT can operate in the frequency band 5600 – 5650 MHz
Note: DFS is not required in the ranges 5.15 – 5.25 GHz and 5.725 – 5.825 GHz	

TRANSMITTER RF POWER CHARACTERISTICS		
Maximum rated transmitter output power as stated by manufacturer		
Conducted Power	14 dBm	
Maximum Antenna Gain	14.2 dBi	
EIRP	28.2 dBm	
Minimum rated transmitter output power as stated by manufacturer (if applicable)		
Conducted Power	5 dBm	
Maximum Antenna Gain	0 dBi	
EIRP	5 dBm	
Is TPC supported?	☒ Yes	☐ No
If Yes, provide a description of operation.		
Power control only through manual power setting. No automatic TPC		

POWER SOURCE		
☐ AC mains supply		State voltage
AC supply frequency	(Hz)	VAC
☒ DC supply		
Nominal voltage	24	

SYSTEM ARCHITECTURE			
☒	Frame Based		
☒	IP Based		
☐	Other	If other please state	
☒	802.11(a)	Receiver Bandwidth:	20 MHz
☒	802.11(n) – 20 MHz	Receiver Bandwidth:	20 MHz
☒	802.11(n) – 40 MHz	Receiver Bandwidth:	40 MHz
☐	802.11(ac) – 20 MHz	Receiver Bandwidth:	MHz
☐	802.11(ac) – 40 MHz	Receiver Bandwidth:	MHz
☐	802.11(ac) – 80 MHz	Receiver Bandwidth:	MHz

DECLARATION			
No parameter or information relating to the detected radar waveforms is available or accessible to the end user.			
☒	True	☐	False

MISCELLANEOUS (Master Device Only)	
Power-on cycle time*	33 -41 s
* Time from switching on the UUT to the point at which Channel Availability Check (CAC) commences	

UNIFORM SPREADING (Master Device Only)
Describe how the meter provides, on aggregate, uniform channel loading of the spectrum across all channels.
1st channel can be set either manually or randomly in the GUI

ANTENNA OPTIONS	
Antenna 1	
Antenna Description:	Please see attached Antenna List
Antenna Model:	
Antenna Maximum Gain:	
Antenna Frequency Range:	
Antenna 2	
Antenna Description:	
Antenna Model:	
Antenna Maximum Gain:	
Antenna Frequency Range:	
Antenna 3	
Antenna Description:	
Antenna Model:	
Antenna Maximum Gain:	
Antenna Frequency Range:	
Antenna 4	
Antenna Description:	
Antenna Model:	
Antenna Maximum Gain:	
Antenna Frequency Range:	
Antenna 5	
Antenna Description:	
Antenna Model:	
Antenna Maximum Gain:	
Antenna Frequency Range:	

I hereby declare that that the information supplied is correct and complete.

Name: Malgorzata Janson Position held: Project Manager
Date: 29.05.2017

1.5 Product Information

1.5.1 Technical Description

802.11 a/b/g/n Wi-Fi Access Point. EUT can be operated in either Master or Client mode depending on firmware configuration. EUT supports 20 MHz and 40 MHz bandwidths and 2x2 MiMo data rates (MCS0-7 and MCS8-15).

1.5.2 Antenna Configuration

Below is a full list of all the antennas which may be supplied with the product. DFS testing was performed conducted using the lowest gain antenna which is 0 dBi.

No.	Manufacturer Number	Radiation Pattern	Model Number	Connector	Band	Gain @2.4 GHz [dBi]	Gain @5 GHz [dBi]	Cable Loss	Effective Gain
1	6GK5793-8DK00-0AA0	Directed	ANT793-8DK	N	5 GHz	--	23	8.8	14.2
2	6GK5793-8DJ00-0AA0	Directed	ANT793-8DJ	N	5 GHz	--	18	4.4	13.6
3	6GK5793-8DL00-0AA0	Directed	ANT793-8DL	N	5 GHz	--	14		
4	6GK5793-8DP00-0AA0	Directed	ANT793-8DP	N	5 GHz	--	13.5		
5	6GK5795-6DC00-0AA0	Sector	ANT795-6DC	N	2.4 GHz + 5 GHz	9	9		
6	6GK5793-6DG00-0AA0	Sector	ANT793-6DG	N	5 GHz	--	9		
7	6GK5795-6MN10-0AA6	Omni	ANT795-6MN	N	2.4 GHz + 5 GHz	6	8		
8	6GK5793-6DT00-0AA0	Sector	ANT793-6DT	QMA	5 GHz	--	8		
9	6GK5896-6MM00-0AA0	Omni	ANT896-6MM	QMA	2.4 GHz + 5 GHz	6	7		
10	6GK5795-6MP00-0AA0	Omni	ANT795-6MP	N	2.4 GHz + 5 GHz	5	7		
11	6GK5793-4MN00-0AA6	Omni	ANT793-4MN	N	5 GHz	--	6		
12	6GK5795-6MT00-0AA0	Omni	ANT795-6MT	QMA	2.4 GHz + 5 GHz	4	6		
13	6GK5793-6MN00-0AA6	Omni	ANT793-6MN	N	5 GHz	--	5		
14	6GK5795-4MA00-0AA3	Omni	ANT795-4MA	R-SMA	2.4 GHz + 5 GHz	3	5		
15	6GK5795-4MC00-0AA3	Omni	ANT795-4MC	N	2.4 GHz + 5 GHz	3	5		
16	6GK5795-4MD00-0AA3	Omni	ANT795-4MD	N	2.4 GHz + 5 GHz	3	5		
17	6GK5795-4MB00-0AA0	Omni	ANT795-4MB	R-SMA	2.4 GHz + 5 GHz	2	3		

18	6GK5795-4MX00-0AA0	Omni	ANT795-4MX	N	2.4 GHz + 5 GHz	2	2.5		
19	6XV1875-2D	Omni	IWLAN Rcoax Cable	N	5 GHz	--	0		
22	6GK5792-6MN00-0AA6	Omni	ANT792-6MN	N	2.4 GHz	6	--		
21	6GK5792-4DN00-0AA6	Omni	ANT792-4DN	N	2.4 GHz	4	--		
22	6XV1875-2A	Omni	IWLAN Rcoax Cable	N	2.4 GHz	0	--		

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: Not Stated			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: Not Stated			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Client Without Radar Detection - 802.11a		
In-Service Monitoring	Matthew Russell	UKAS
Configuration and Mode: Client Without Radar Detection - 802.11n 40 MHz Bandwidth		
In-Service Monitoring	Matthew Russell	UKAS
Configuration and Mode: Master - 802.11a		
U-NII Detection Bandwidth	Matthew Russell	UKAS
Initial Channel Availability Check	Matthew Russell	UKAS
Radar Burst at the Beginning of the Channel Availability Check Time	Matthew Russell	UKAS
Radar Burst at the End of the Channel Availability Check Time	Matthew Russell	UKAS
In-Service Monitoring	Matthew Russell	UKAS
Statistical Performance Check	Matthew Russell	UKAS
Configuration and Mode: Master - 802.11n 20 MHz Bandwidth		
U-NII Detection Bandwidth	Matthew Russell	UKAS
Configuration and Mode: Master - 802.11n 40 MHz Bandwidth		
U-NII Detection Bandwidth	Matthew Russell	UKAS
Initial Channel Availability Check	Matthew Russell	UKAS
Radar Burst at the Beginning of the Channel Availability Check Time	Matthew Russell	UKAS
Radar Burst at the End of the Channel Availability Check Time	Matthew Russell	UKAS
In-Service Monitoring	Matthew Russell	UKAS
Statistical Performance Check	Matthew Russell	UKAS
U-NII Detection Bandwidth	Matthew Russell	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Calibration of Test Setup

2.1.1 Specification Reference

FCC 47 CFR Part 15E
Industry Canada RSS-247

2.1.2 Equipment Under Test and Modification State

Master Device:
MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) - Modification State 0

Client Without Radar Detection Device:
MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0002) - Modification State 0

2.1.3 Date of Test

22-February-2017 to 02-March-2017

2.1.4 Environmental Conditions

Ambient Temperature	20.6 - 21.2 °C
Relative Humidity	29.4 - 36.8 %

2.1.5 Test Results

DFS Measurement Instrumentation

The Aeroflex Dynamic Frequency Selection Radar Simulation and Analyser Test Suite was utilised. This test system consists of hardware and software; which comprises of a radar test signal generator and a test signal analyser.

The DFS test system utilises a PXI chassis with PXI instruments populating this chassis; which allows all instrumentation to communicate on a common bus. The following PXI instruments are populated in the PXI chassis; PC with a dual core processor, Frequency References, Vector Signal Generator and a Digitiser.

The test signal and analysis software is run on the PC and controls all of the instruments such that the required test signals are generated and analysed using test sequences in the test software application. The specific test utilisation of this system is described within applicable measurement procedures.

Test Signal Generator

The PXI Vector Signal Generator is capable of generating all test signals required by the relevant test specification and is driven using the Aeroflex DFS Simulation and Analyser Test Suite on the PXI PC. An external trigger is also provided at the SMB output of the signal generator which is employed when an external spectrum analyser is utilised for DFS measurements instead of the Aeroflex Digitiser.

Test Signal Analyser

The PXI Digitiser is used for channel monitoring during DFS testing and is capable of capturing measurement sweeps with sample rates of 5 M samples/s and 2.5 M samples/s with sweep times of 12 s and 24 s respectively.

Various markers are contained within the generated test signals. The markers are used to trigger the Signal Analyser at the correct points. Once a measurement sweep has completed, the signal analyser software evaluates the data according the relevant test requirement.

Test Channel, Channel Bandwidth and Data Rate Selection

In accordance with Industry Canada RSS-247, clause 6.2.3, this device does not have the ability to operate on channels within the 5600 MHz to 5650 MHz. These channels are always prohibited by the EUT regardless of whether the EUT is operating in the US or Canada.

In cases where the fundamental emission channel bandwidth exceeds DFS band edges and where it is not possible to select a channel that has the entire emission bandwidth within the DFS band (e.g. 802.11ac 160 MHz), specific requirements and procedures are detailed further in the relevant test sections.

A single test channel was selected for each channel bandwidth of every mode. Where applicable, the control channels were identified. The following channels and data rates were utilised during testing:

Mode	Channel Bandwidth (MHz)	Data Rate (Mbps)	Fundamental Emission		Control Channel	
			Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
802.11a	20	24	64	5320	64	5320
802.11n	20	24	64	5320	64	5320
802.11n	40	27	62	5310	60	5300

Table 5 - Test Chanel and Data Rate Selection

Test Signal Selection and Calibration

The test signal calibration was completed using the calibration procedure as described in KDB 905462 D02, clause 7.5.

The EUT can be configured as a master mode device employing a radar detection with the following power and antenna assembly characteristics. Other antennas are supplied by the manufacturer with the product but were not selected for testing. Details of all antennas can be found in section 1.5.2.

Antenna Description	Tx Power Setting (dBm)	Antenna Gain (dBi)	Maximum EIRP (dBm)
ANT795-6MT	20.0	6.0	26.0
ANT793-6DG	17.0	9.0	26.0
ANT793-8DK + 10m Cable	14.0	14.2	28.2

Table 6 - EUT Antenna and Power Configurations

Note that the maximum EIRP is based on the highest antenna gain. In the cases of MIMO devices, the maximum EIRP has been obtained according to KDB 662911 D01.

Noise Floor Characterisation

The noise floor of the spectrum analyser was characterised for each for comparative use with Availability Check, initial radar bursts, In-Service Monitoring, and 30 minute Non-Occupancy Period tests to determine whether any observed transmissions were from the EUT.

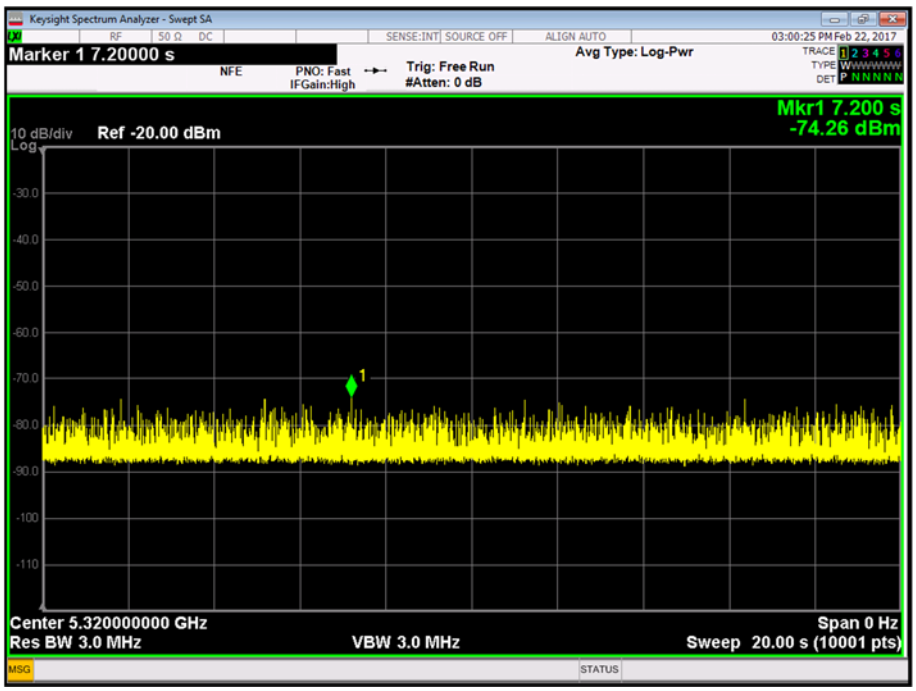

Figure 1 - Noise Floor Characterisation Plot

Master - 802.11a

The test was performed in the conducted test configuration as shown in the diagram below and that specified in KDB 905462, clause 7.2.1.

The client device used during test was a MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0002).

A laptop was connected via an Ethernet connection to each of the master and client devices. The FCC designated MPEG test file was then streamed from the master to the client device using the codec specified on the NTIA web site.

To verify the radar type 0 signal used during testing, the master device was replaced with a spectrum analyser. The level was then adjusted to a level of -63 dBm and the number of pulses was verified as 18.

The channel loading was determined using the methods described in FCC 789033 D02 General UNII Test Procedures Effective 2014 DR02-41759, Clause II.B. A spectrum analyser in zero-span mode was employed, a sweep duration of 1 second was required in order to get a repeatable result due to the random nature of the transmissions. An average detector was utilised with 8 MHz resolution and video bandwidths. The measurement sweep trace showing transmissions on the channel frequency was exported to a data file and then analysed. An amplitude threshold was applied to the trace data in the file, such that the total number of sweep points that exceeded this threshold was determined. The duration of each sweep point was calculated by dividing the sweep time by the number of sweep points. The channel loading was calculated by multiplying this total number of sweep points by the time duration of each sweep point.

Maximum Transmit Power	Value (Notes 1 and 2)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 7 - DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

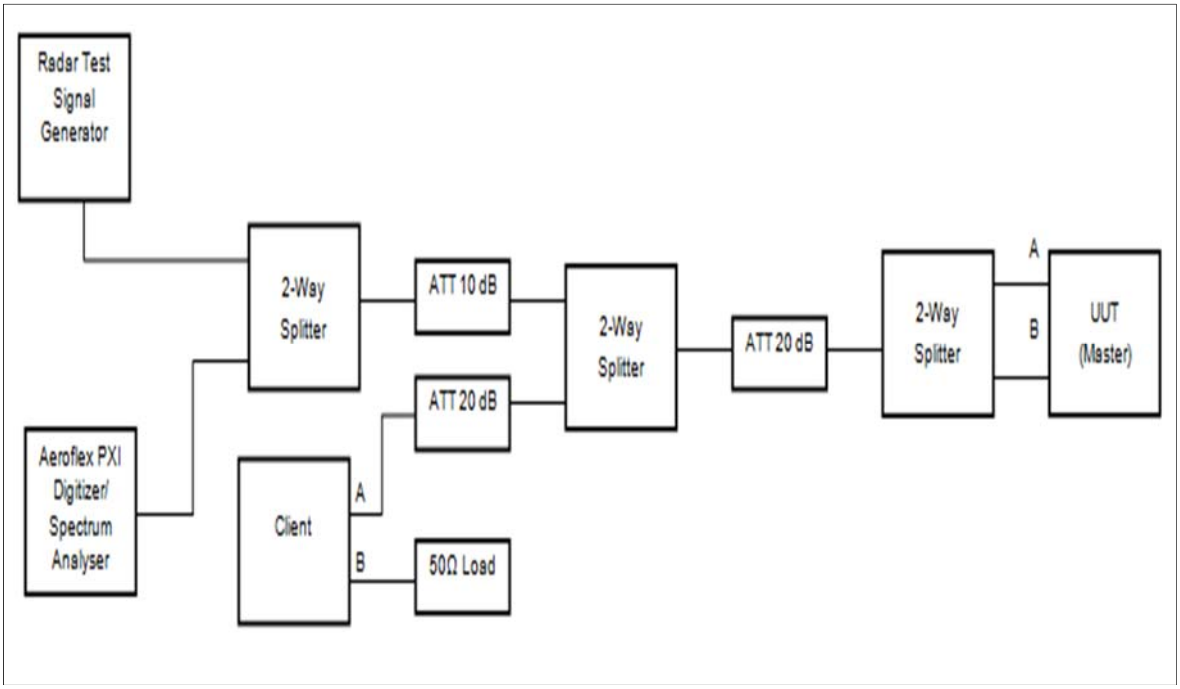

Figure 2 - Test Equipment Setup for Master with Injection at the Master

Radar Type	Pulse Width (µs)	PRI (µs)	Number of Pulses
0	1	1428	18

Table 8 - Radar Pulse Type 0 Characteristics

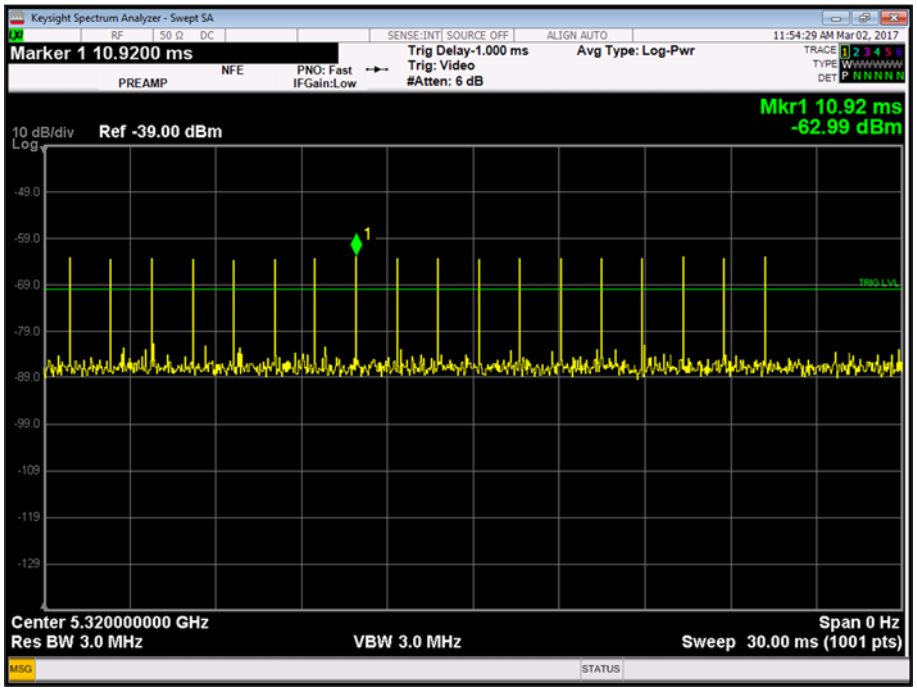

Figure 3 - Verification of Radar Type 0

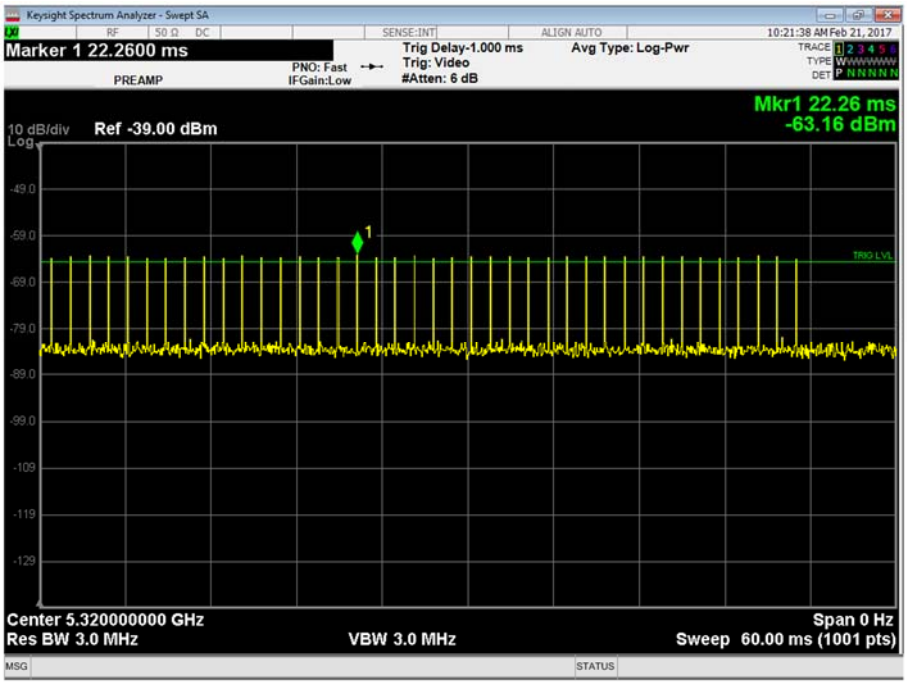

Figure 4 - Verification of Radar Type 1

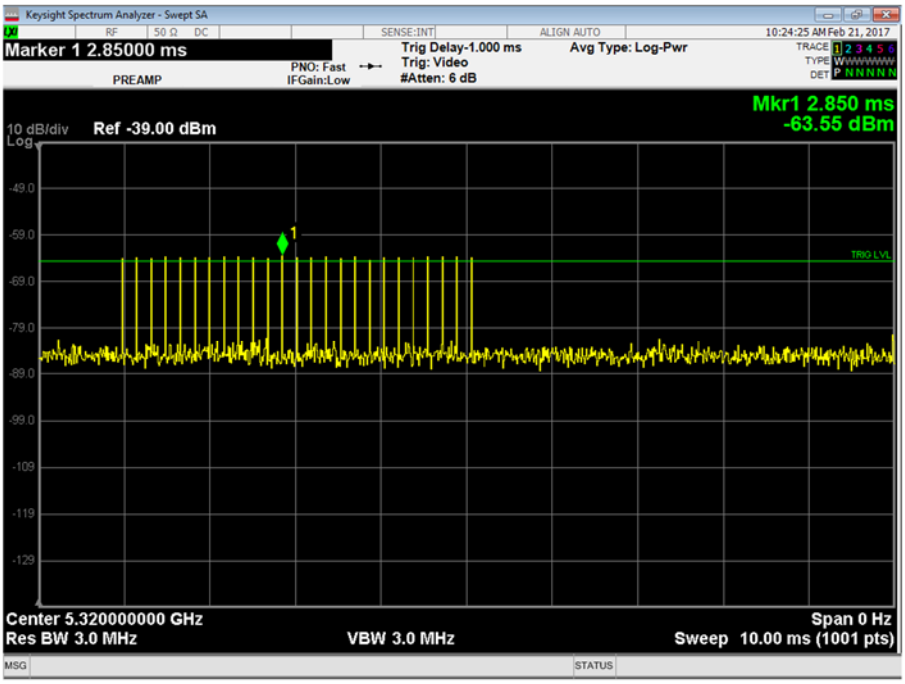

Figure 5 - Verification of Radar Type 2

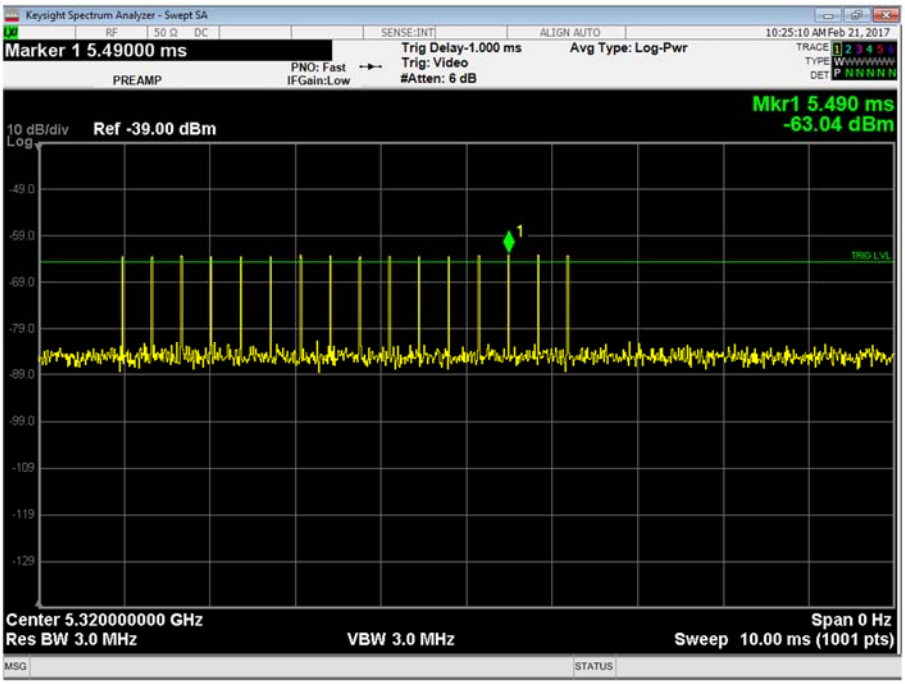

Figure 6 - Verification of Radar Type 3

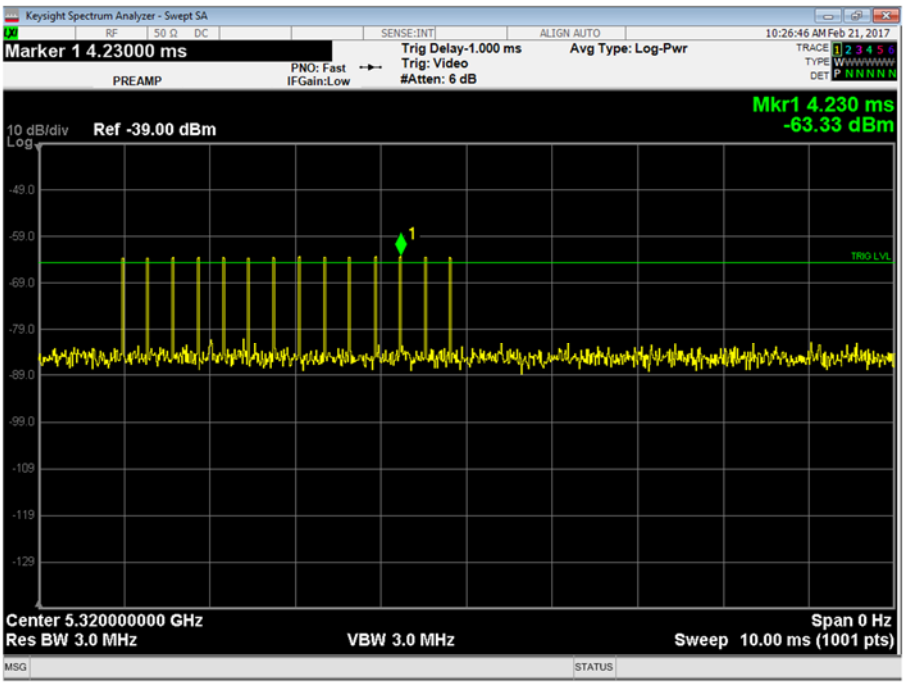

Figure 7 - Verification of Radar Type 4

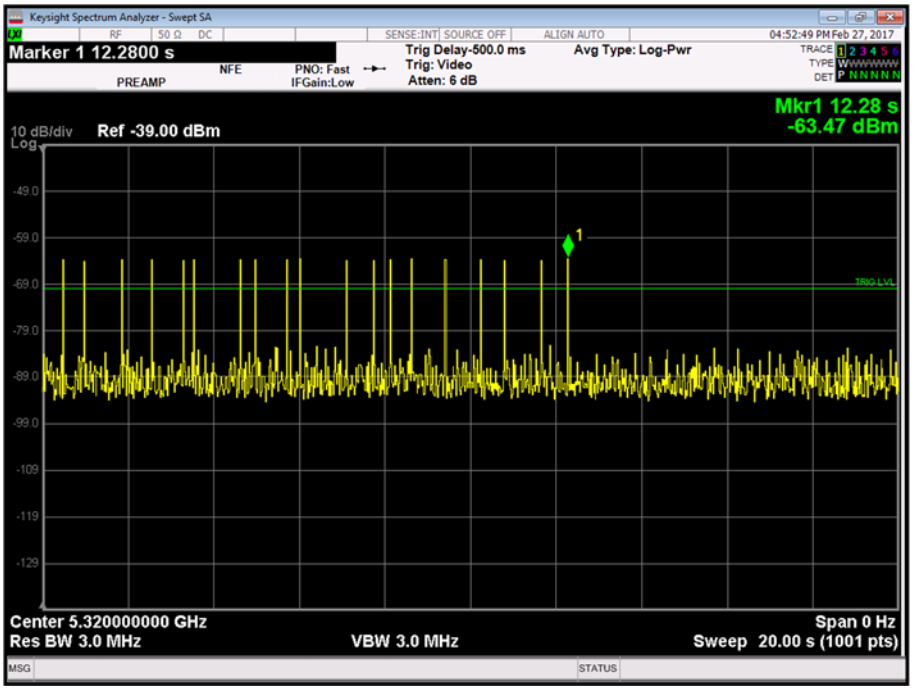

Figure 8 - Verification of Radar Type 5

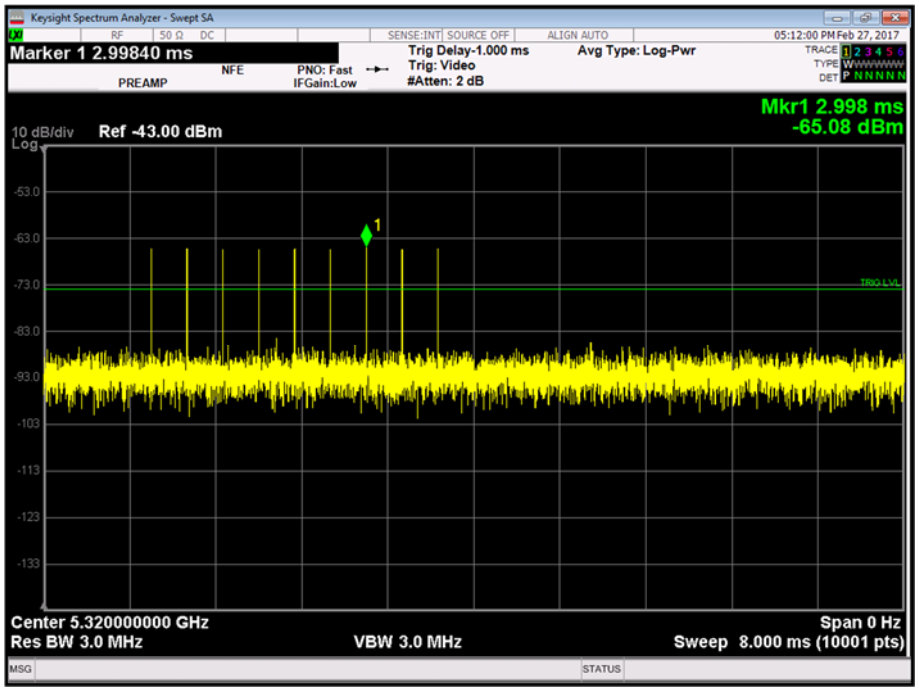

Figure 9 - Verification of Radar Type 6

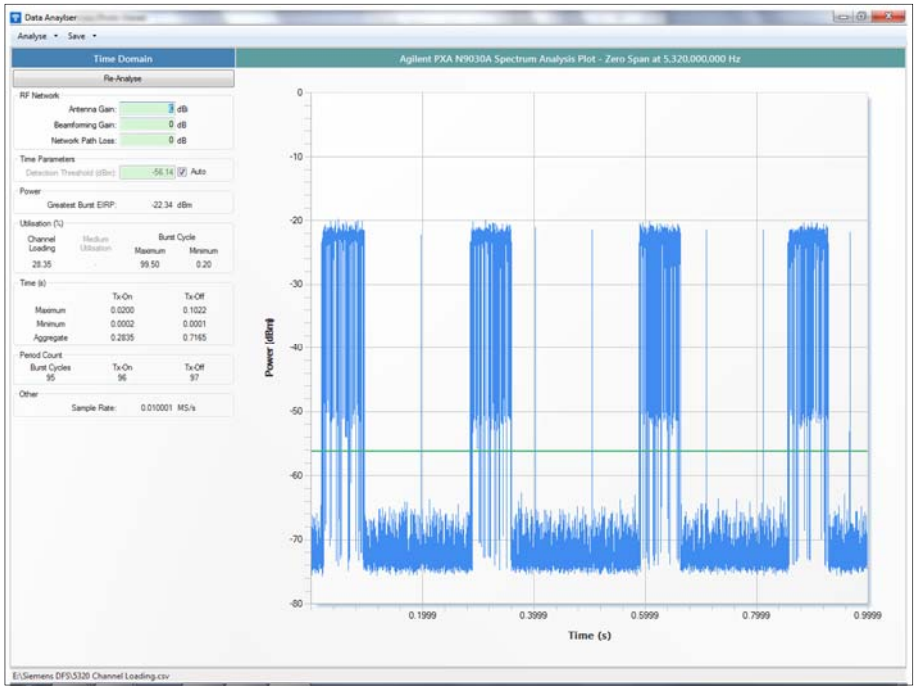

Figure 10 - Channel Loading

The channel loading was measured as 28.35% In order to achieve this channel loading a data rate of 24 Mbps was used.

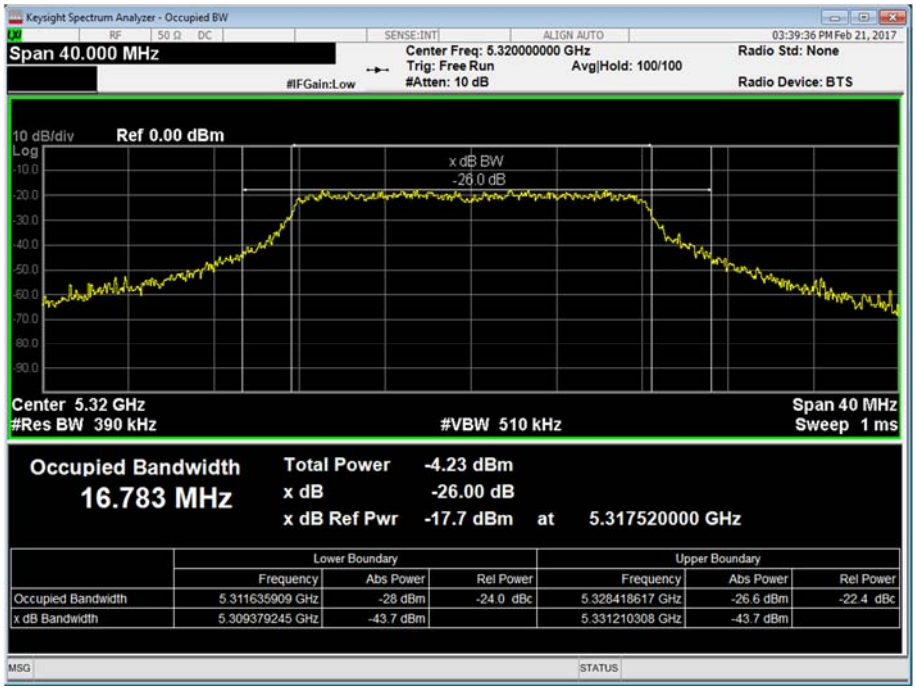

Figure 11 - Occupied Bandwidth

The Occupied Bandwidth was measured in order to determine the pass/fail criterion of the U-NII Detection Bandwidth. In addition to this the points F_{OBL} and F_{OBH} were determined in order to calculate the point F_{C5} for use with the statistical performance check for Radar Type 5.

Occupied Bandwidth	16.783 MHz
FOBL	5309.379 MHz
FOBH	5331.210 MHz

Table 9 - Occupied Bandwidth Results

Master - 802.11n 20 MHz Bandwidth

As per KDB 905462 D02, only the U-NII Detection Bandwidth and Statistical Performance Check was performed in this bandwidth configuration.

The test was performed in the conducted test configuration as shown in the diagram below and that specified in KDB 905462, clause 7.2.1.

The client device used during test was a MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0002).

A laptop was connected via an Ethernet connection to each of the master and client devices. The FCC designated MPEG test file was then streamed from the master to the client device using the codec specified on the NTIA web site.

To verify the radar type 0 signal used during testing, the master device was replaced with a spectrum analyser. The level was then adjusted to a level of -63 dBm and the number of pulses was verified as 18.

The channel loading was determined using the methods described in KDB 789033, Clause II.B. A spectrum analyser in zero-span mode was employed, a sweep duration of 1 second was required in order to get a repeatable result due to the random nature of the transmissions. An average detector was utilised with 8 MHz resolution and video bandwidths. The measurement sweep trace showing transmissions on the channel frequency was exported to a data file and then analysed. An amplitude threshold was applied to the trace data in the file, such that the total number of sweep points that exceeded this threshold was determined. The duration of each sweep point was calculated by dividing the sweep time by the number of sweep points. The channel loading was calculated by multiplying this total number of sweep points by the time duration of each sweep point.

Maximum Transmit Power	Value (Notes 1 and 2)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 10 - DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

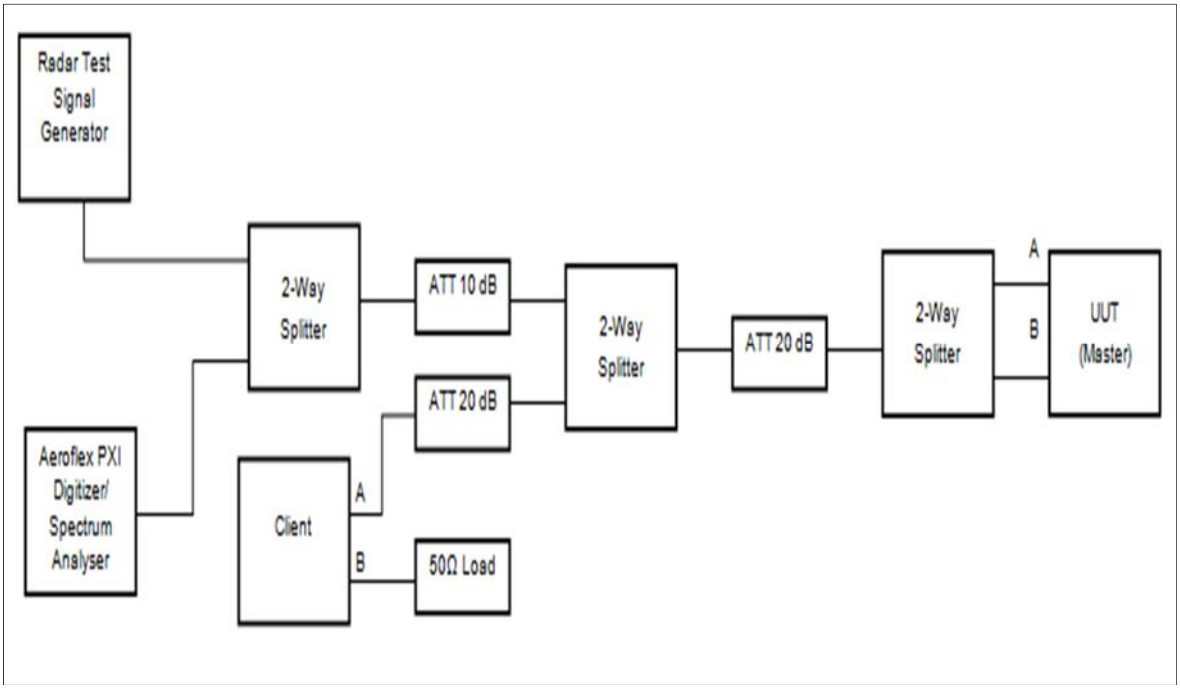

Figure 12 - Test Equipment Setup for Master with Injection at the Master

Radar Type	Pulse Width (µs)	PRI (µs)	Number of Pulses
0	1	1428	18

Table 11 - Radar Pulse Type 0 Characteristics

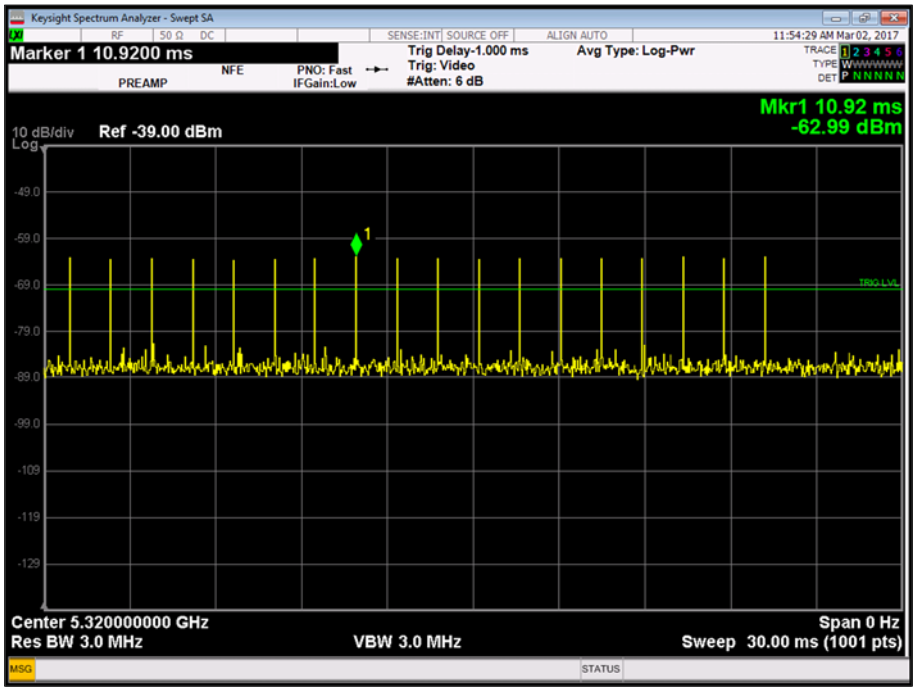

Figure 13 - Verification of Radar Type 0

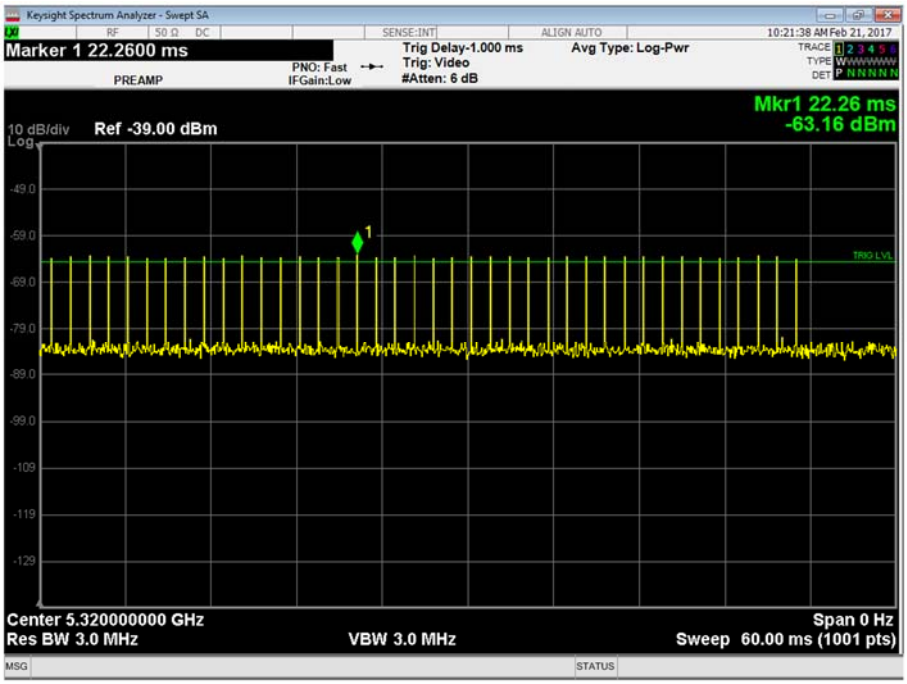

Figure 14 - Verification of Radar Type 1

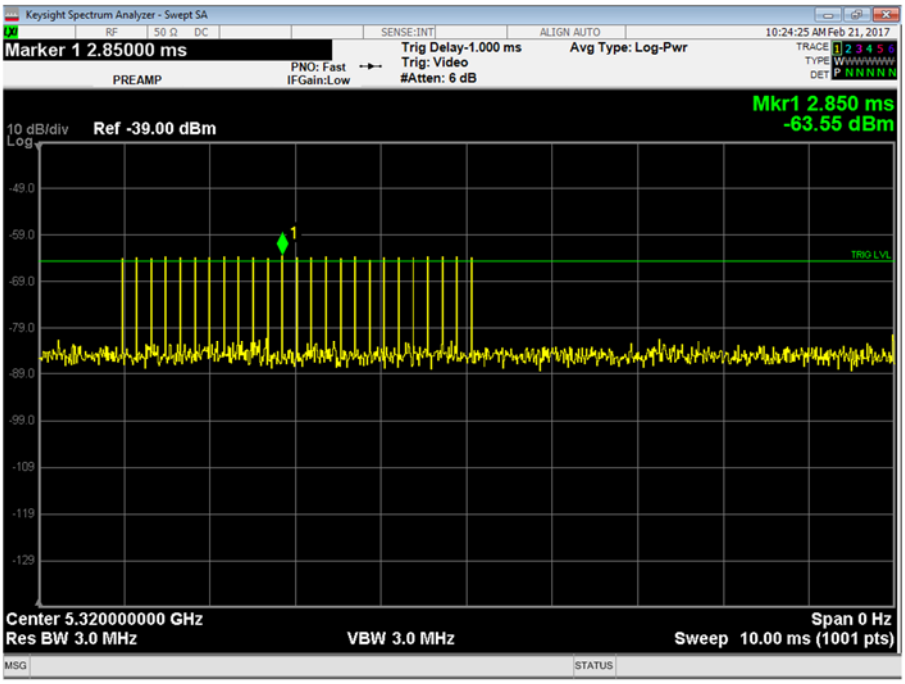

Figure 15 - Verification of Radar Type 2

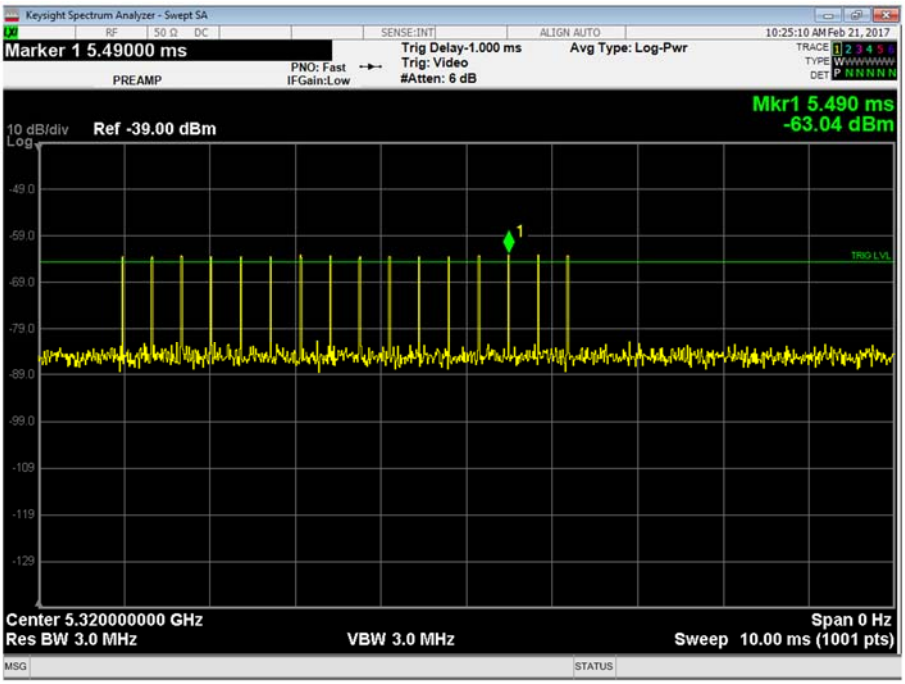

Figure 16 - Verification of Radar Type 3

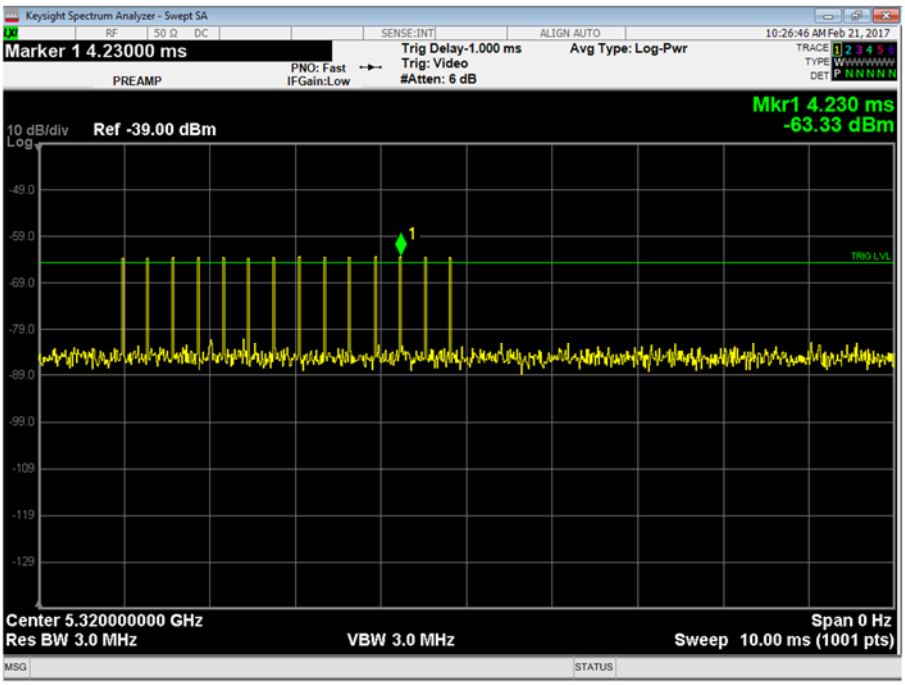

Figure 17 - Verification of Radar Type 4

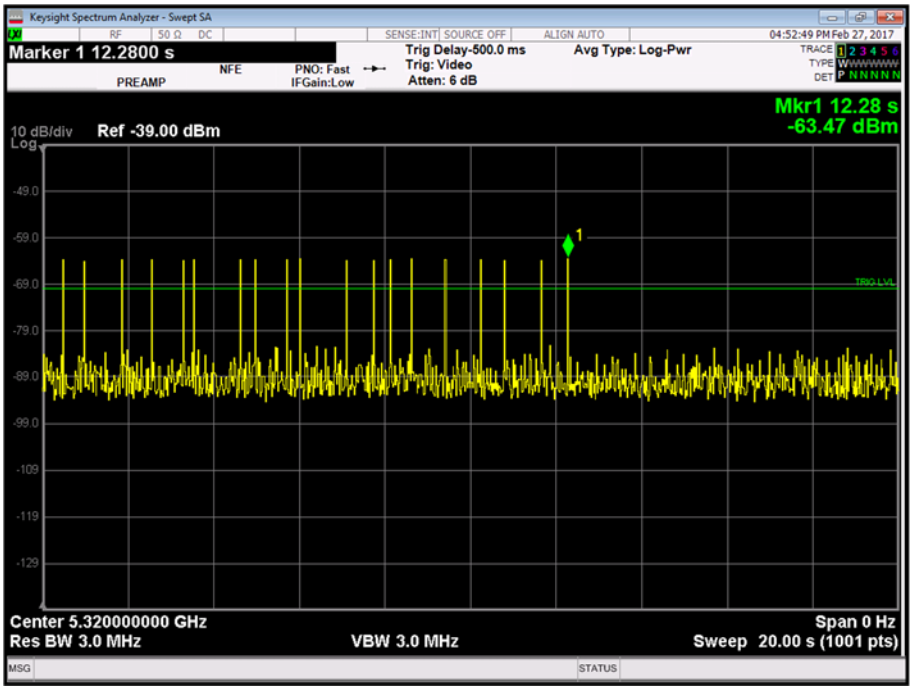

Figure 18 - Verification of Radar Type 5

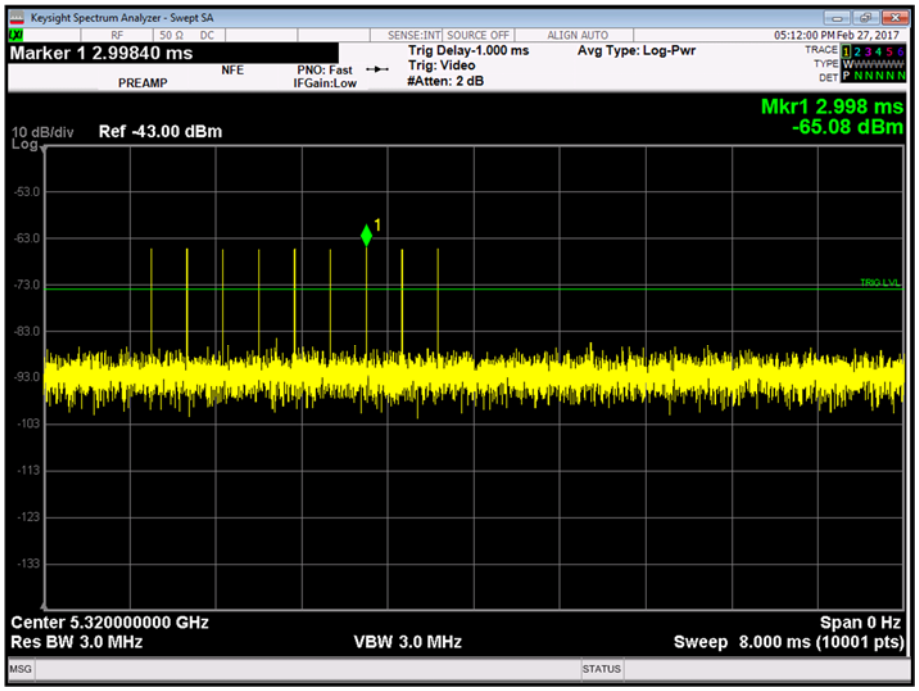

Figure 19 - Verification of Radar Type 6

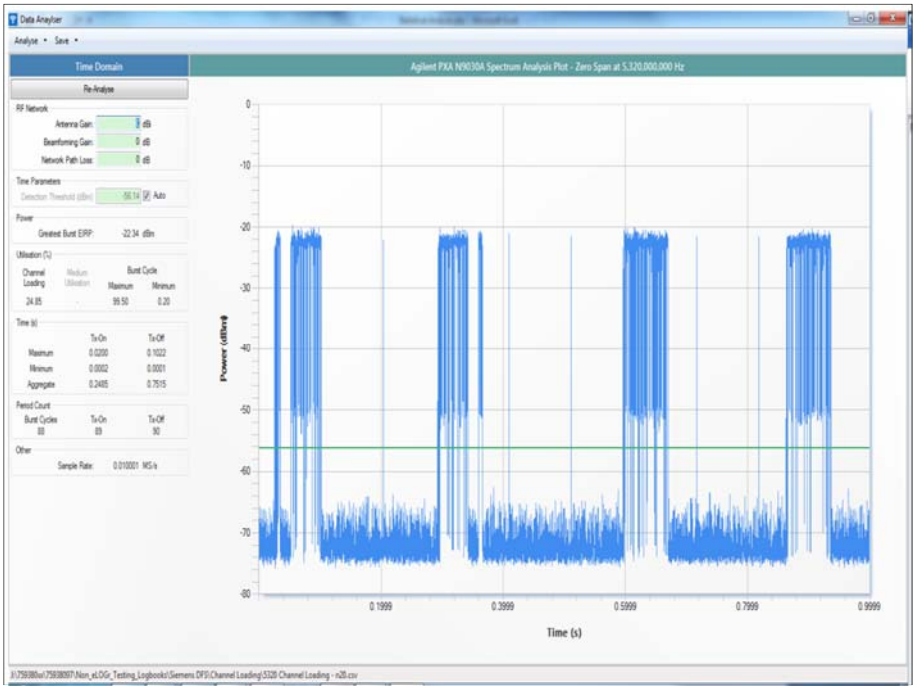

Figure 20 - Channel Loading

The channel loading was measured as 24.85% In order to achieve this channel loading a data rate of 26 Mbps was used.

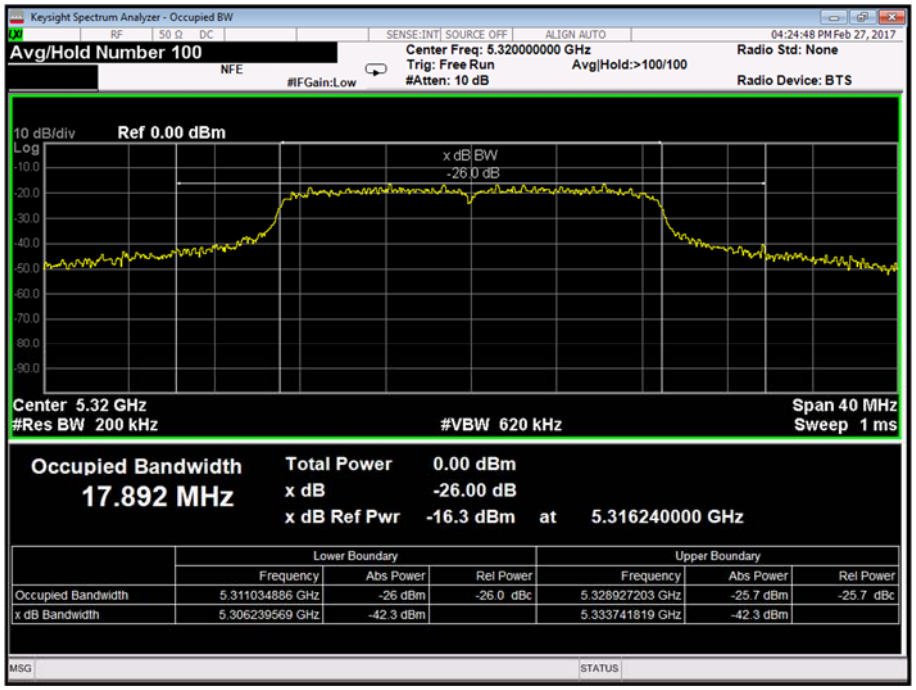

Figure 21 - Occupied Bandwidth

The Occupied Bandwidth was measured in order to determine the pass/fail criterion of the U-NII Detection Bandwidth. In addition to this the points F_{OBL} and F_{OBH} were determined in order to calculate the point F_{C5} for use with the statistical performance check for Radar Type 5.

Occupied Bandwidth	17.892 MHz
FOBL	5306.240 MHz
FOBH	5333.742 MHz

Table 12 - Occupied Bandwidth ResultsTable 13 - Occupied Bandwidth Results

Master - 802.11n 40 MHz Bandwidth

The test was performed in the conducted test configuration as shown in the diagram below and that specified in KDB 905462, clause 7.2.1.

The client device used during test was a MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0002).

A laptop was connected via an Ethernet connection to each of the master and client devices. The FCC designated MPEG test file was then streamed from the master to the client device using the codec specified on the NTIA web site.

To verify the radar type 0 signal used during testing, the master device was replaced with a spectrum analyser. The level was then adjusted to a level of -63 dBm and the number of pulses was verified as 18.

The channel loading was determined using the methods described in KDB 789033 D02, Clause II.B. A spectrum analyser in zero-span mode was employed, a sweep duration of 1 second was required in order to get a repeatable result due to the random nature of the transmissions. An average detector was utilised with 8 MHz resolution and video bandwidths. The measurement sweep trace showing transmissions on the channel frequency was exported to a data file and then analysed. An amplitude threshold was applied to the trace data in the file, such that the total number of sweep points that exceeded this threshold was determined. The duration of each sweep point was calculated by dividing the sweep time by the number of sweep points. The channel loading was calculated by multiplying this total number of sweep points by the time duration of each sweep point.

Maximum Transmit Power	Value (Notes 1 and 2)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 14 - DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

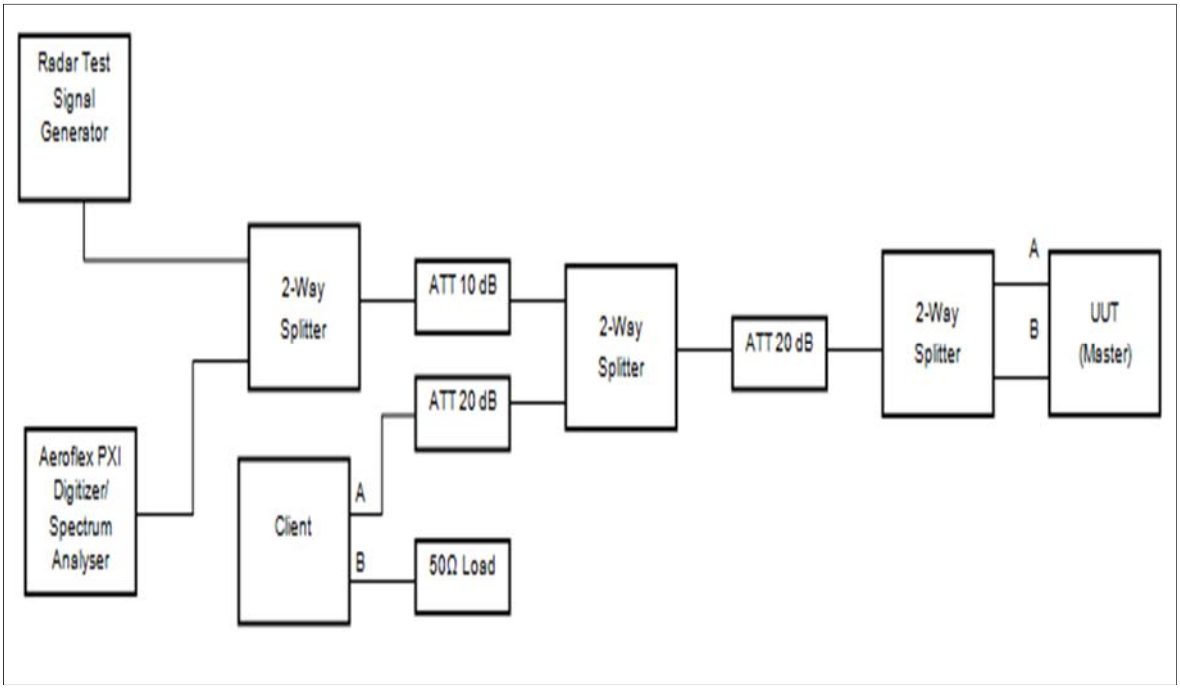

Figure 22 - Test Equipment Setup for Master with Injection at the Master

Radar Type	Pulse Width (µs)	PRI (µs)	Number of Pulses
0	1	1428	18

Table 15 - Radar Pulse Type 0 Characteristics

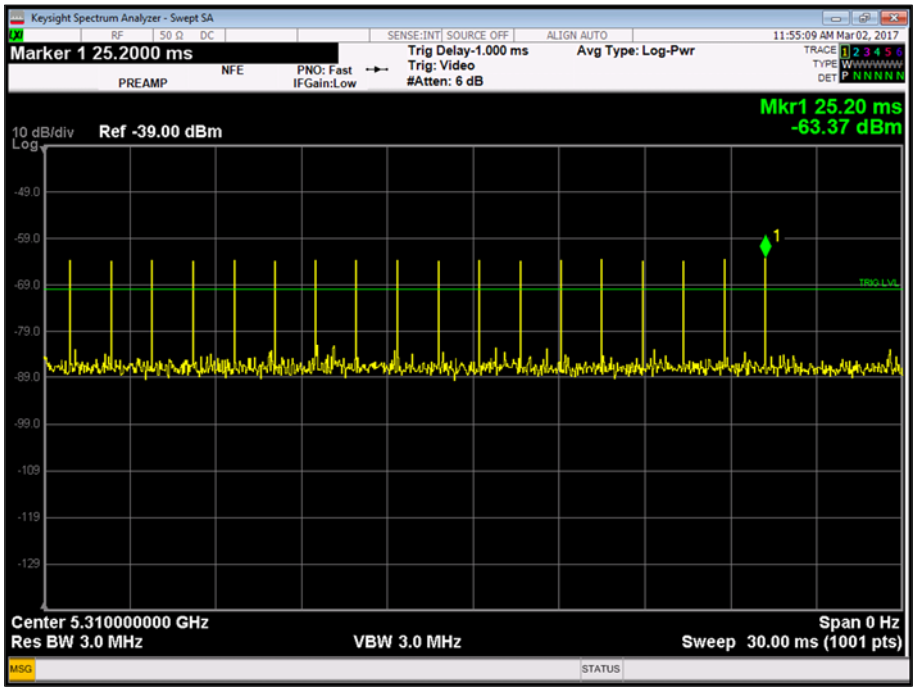

Figure 23 - Verification of Radar Type 0

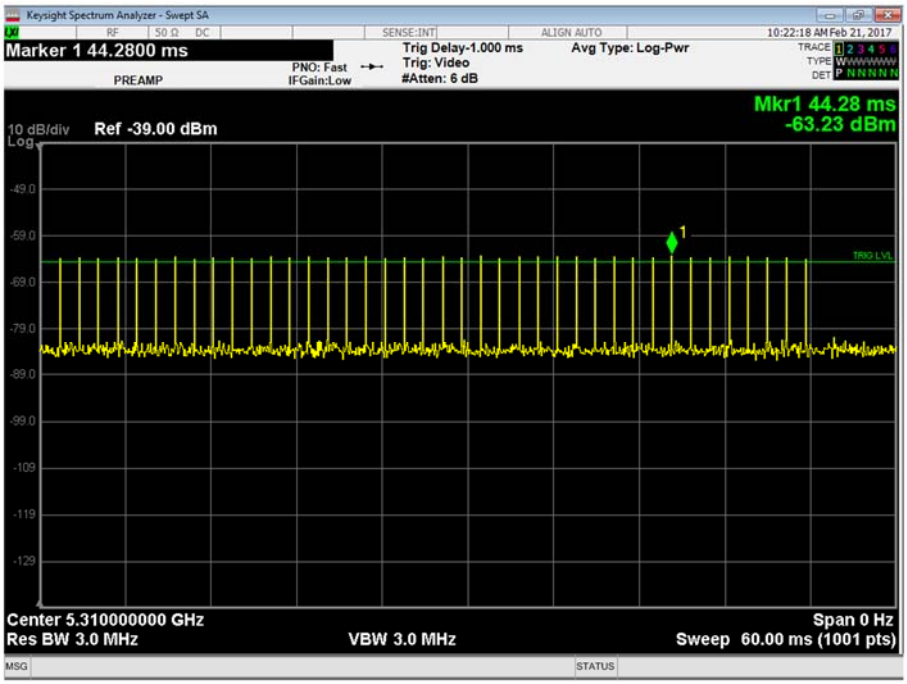

Figure 24 - Verification of Radar Type 1

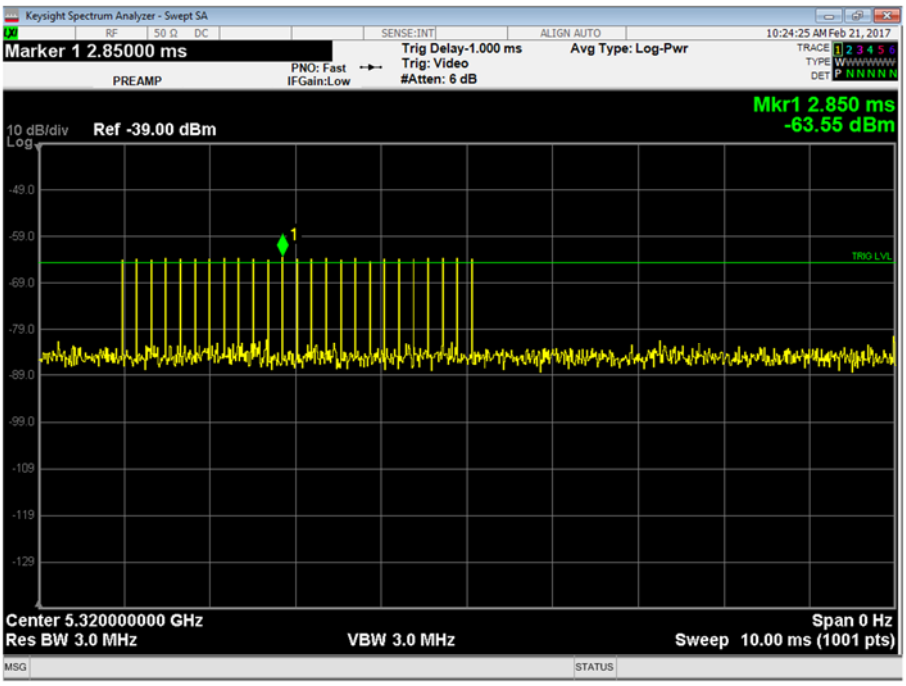

Figure 25 - Verification of Radar Type 2

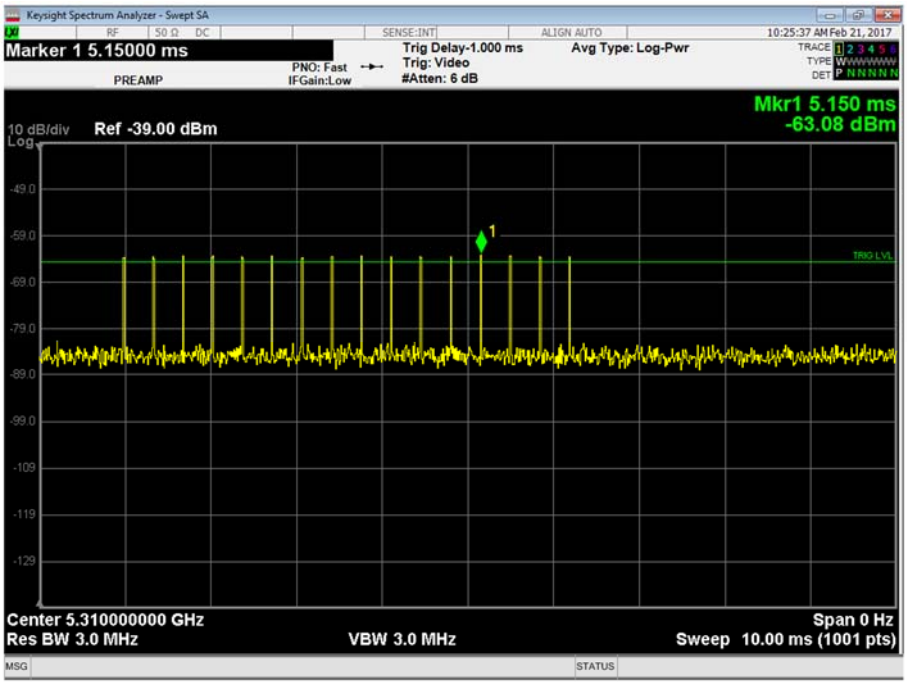

Figure 26 - Verification of Radar Type 3

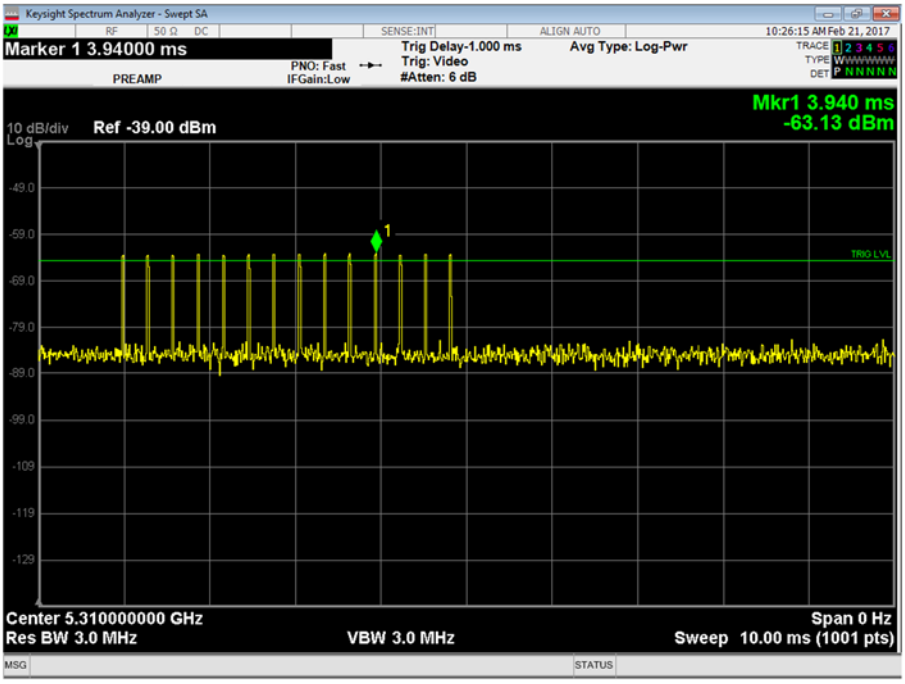

Figure 27 - Verification of Radar Type 4

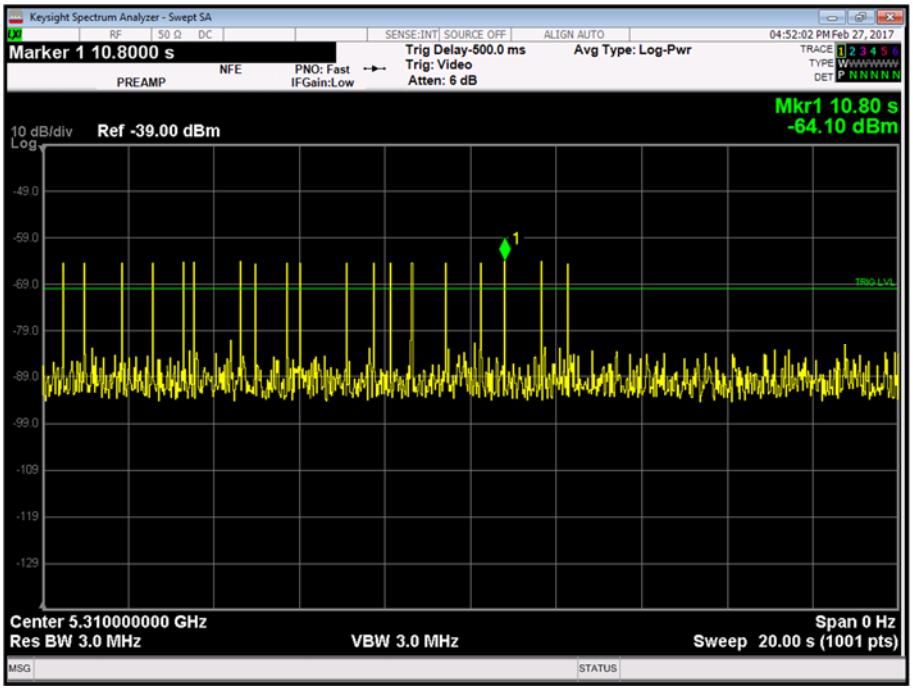

Figure 28 - Verification of Radar Type 5

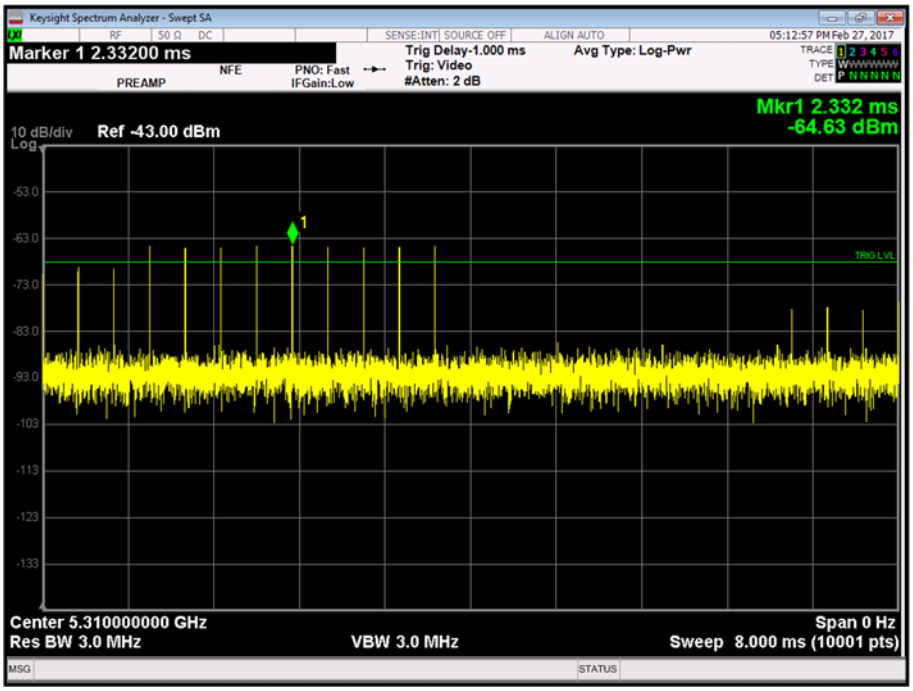

Figure 29 - Verification of Radar Type 6

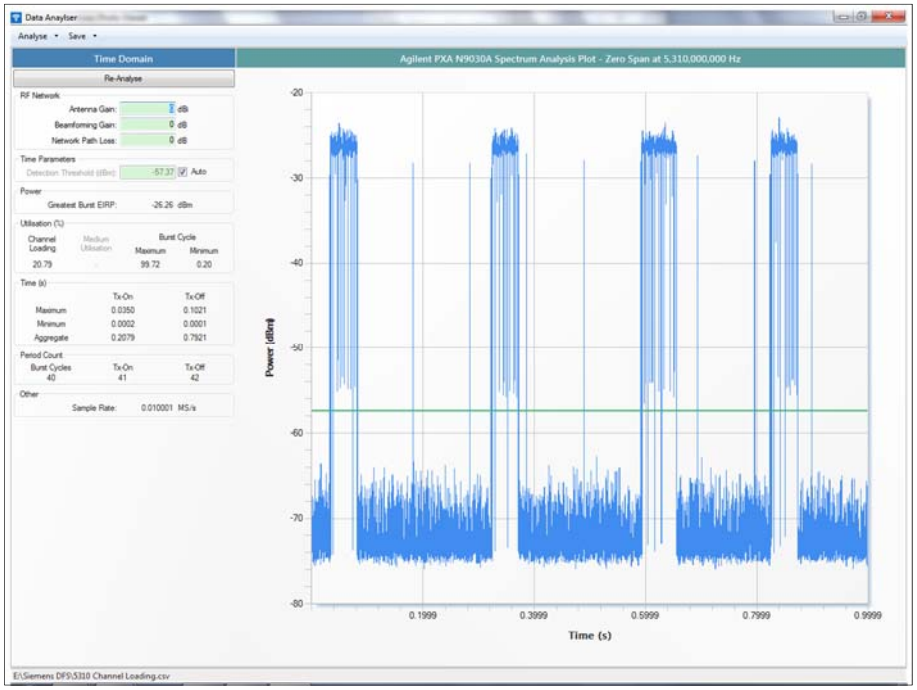

Figure 30 - Channel Loading

The channel loading was measured as 20.79% In order to achieve this channel loading a data rate of 27 Mbps was used.

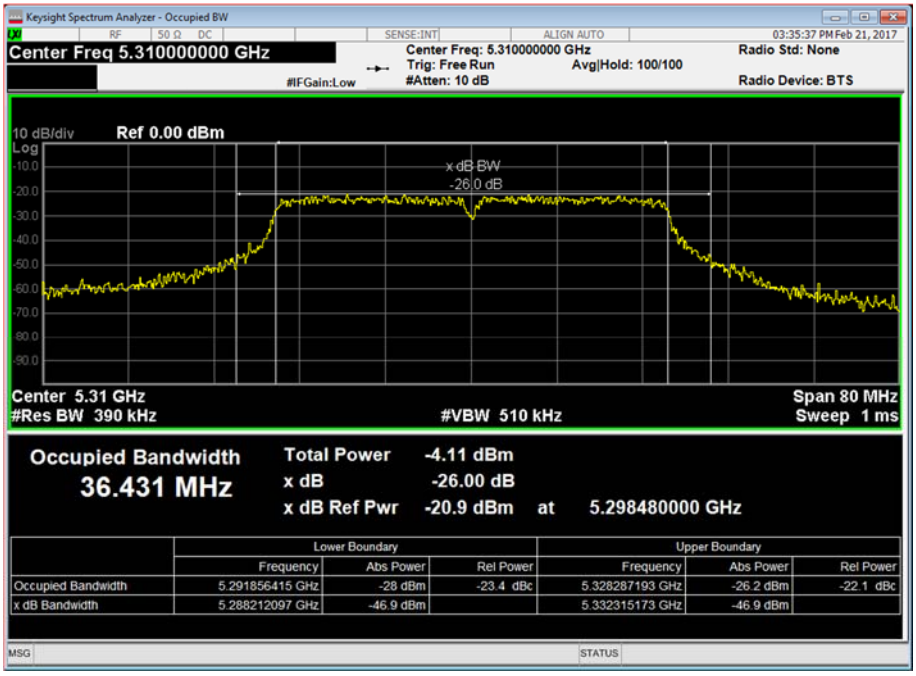

Figure 31 - Occupied Bandwidth

The Occupied Bandwidth was measured in order to determine the pass/fail criterion of the U-NII Detection Bandwidth. In addition to this the points F_{OBL} and F_{OBH} were determined in order to calculate the point F_{C5} for use with the statistical performance check for Radar Type 5.

Occupied Bandwidth	36.431 MHz
FOBL	5288.212 MHz
FOBH	5332.315 MHz

Table 16 - Occupied Bandwidth Results

Client Without Radar Detection - 802.11a

The test was performed in the conducted test configuration as shown in the diagram below and that specified in KDB 905462, clause 7.2.2.

The master device used during test was a MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) as tested in the present document.

A laptop was connected via an Ethernet connection to each of the master and client devices. The FCC designated MPEG test file was then streamed from the master to the client device using the codec specified on the NTIA web site.

To verify the radar type 0 signal used during testing, the master device was replaced with a spectrum analyser. The level was then adjusted to a level of -63 dBm and the number of pulses was verified as 18.

The channel loading was determined using the methods described in KDB 789033 D02, Clause II.B. A spectrum analyser in zero-span mode was employed, a sweep duration of 1 second was required in order to get a repeatable result due to the random nature of the transmissions. An average detector was utilised with 8 MHz resolution and video bandwidths. The measurement sweep trace showing transmissions on the channel frequency was exported to a data file and then analysed. An amplitude threshold was applied to the trace data in the file, such that the total number of sweep points that exceeded this threshold was determined. The duration of each sweep point was calculated by dividing the sweep time by the number of sweep points. The channel loading was calculated by multiplying this total number of sweep points by the time duration of each sweep point.

Maximum Transmit Power	Value (Notes 1 and 2)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 17 - DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

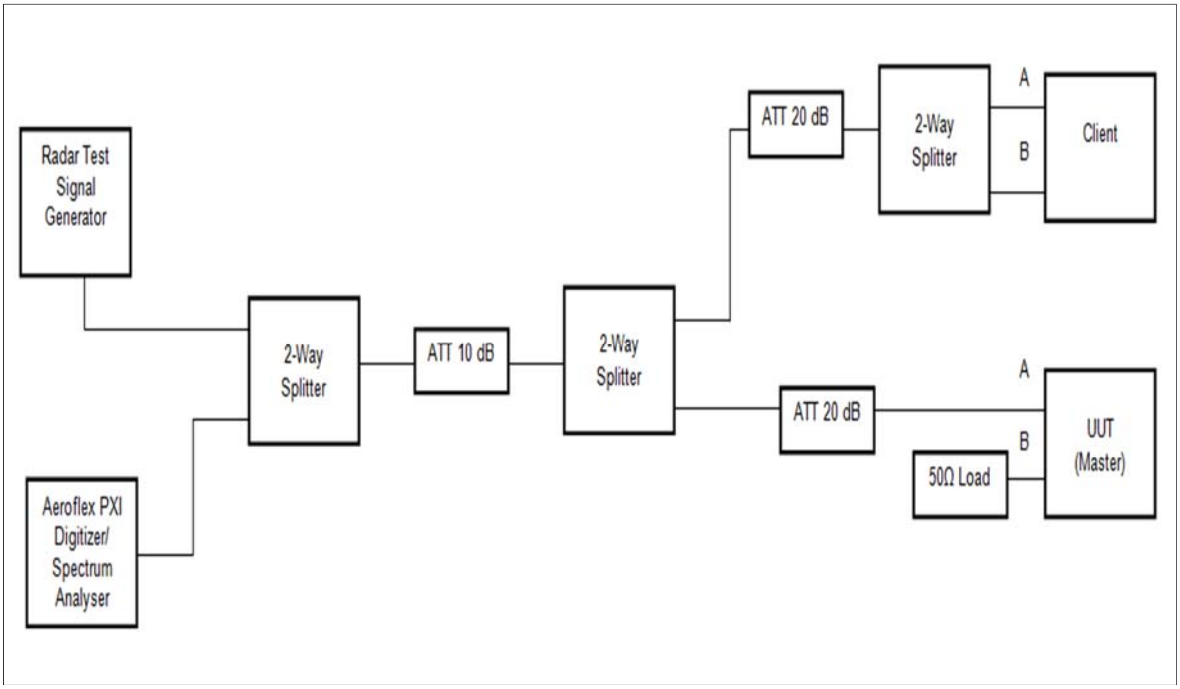

Figure 32 - Test Equipment Setup for Client Without Radar Detection with Injection at the Master

Radar Type	Pulse Width (µs)	PRI (µs)	Number of Pulses
0	1	1428	18

Table 18 - Radar Pulse Type 0 Characteristics

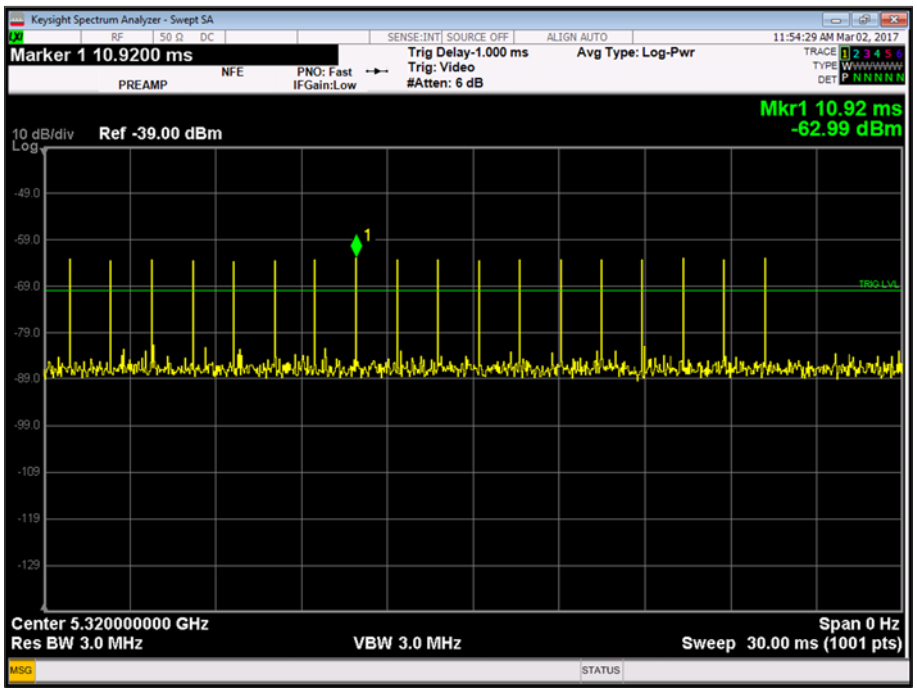

Figure 33 - Verification of Radar Type 0

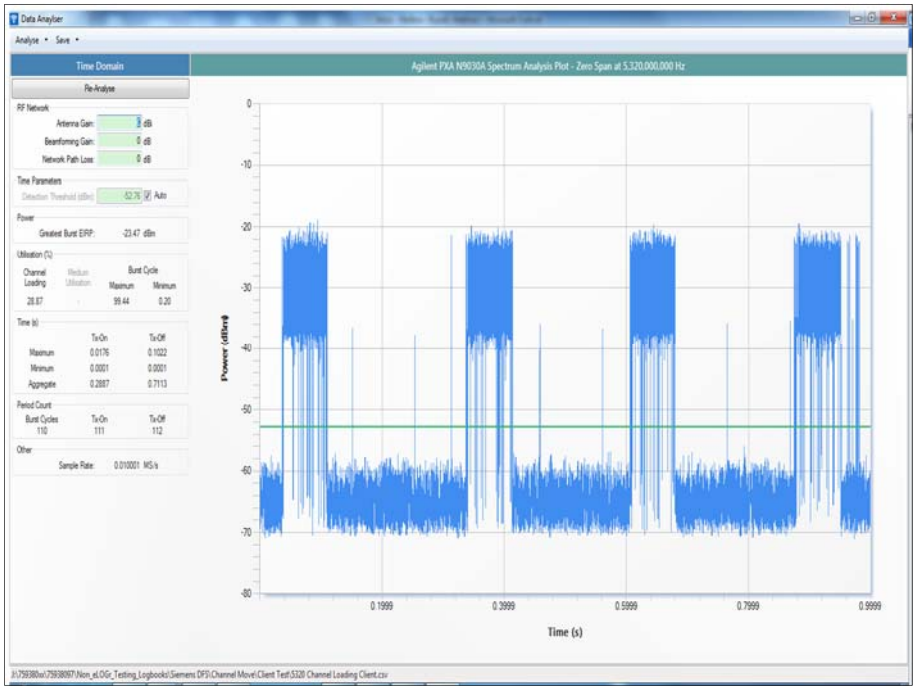

Figure 34 - Channel Loading

The channel loading was measured as 28.87% In order to achieve this channel loading a data rate of 24 Mbps was used.

Client Without Radar Detection - 802.11n 40 MHz Bandwidth

The test was performed in the conducted test configuration as shown in the diagram below and that specified in KDB 905462, clause 7.2.2.

The master device used during test was a MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) as tested in the present document.

A laptop was connected via an Ethernet connection to each of the master and client devices. The FCC designated MPEG test file was then streamed from the master to the client device using the codec specified on the NTIA web site.

To verify the radar type 0 signal used during testing, the master device was replaced with a spectrum analyser. The level was then adjusted to a level of -63 dBm and the number of pulses was verified as 18.

The channel loading was determined using the methods described in KDB 789033 D02, Clause II.B. A spectrum analyser in zero-span mode was employed, a sweep duration of 1 second was required in order to get a repeatable result due to the random nature of the transmissions. An average detector was utilised with 8 MHz resolution and video bandwidths. The measurement sweep trace showing transmissions on the channel frequency was exported to a data file and then analysed. An amplitude threshold was applied to the trace data in the file, such that the total number of sweep points that exceeded this threshold was determined. The duration of each sweep point was calculated by dividing the sweep time by the number of sweep points. The channel loading was calculated by multiplying this total number of sweep points by the time duration of each sweep point.

Maximum Transmit Power	Value (Notes 1 and 2)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 19 - DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

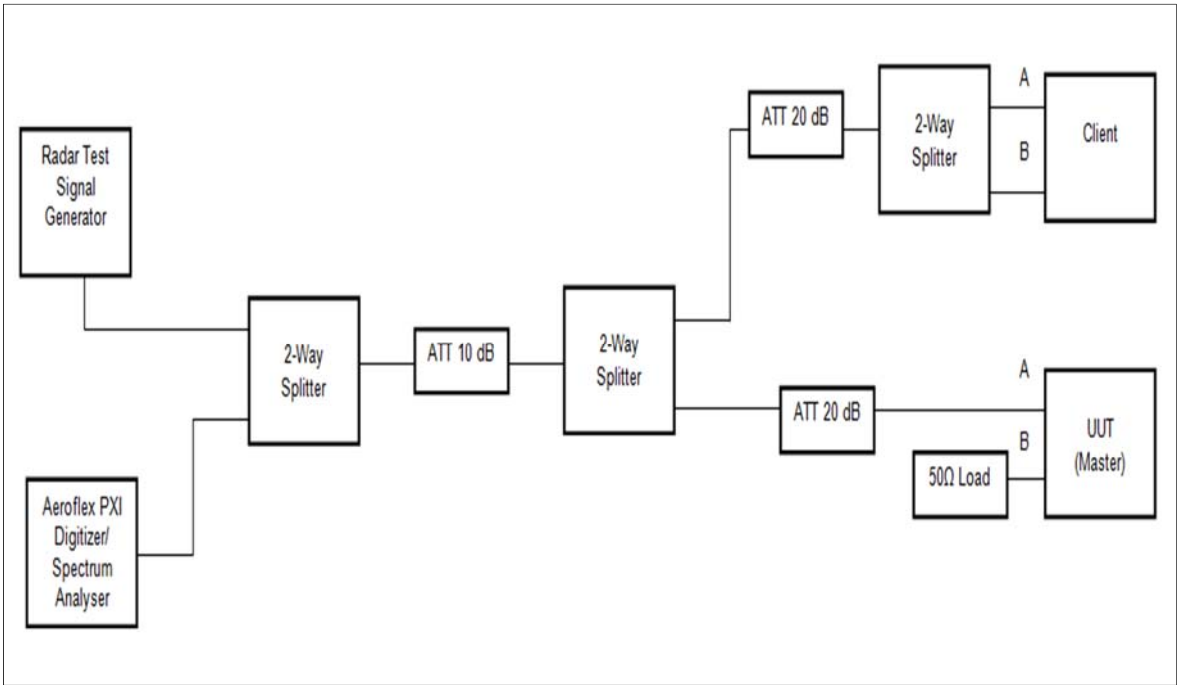

Figure 35 - Test Equipment Setup for Client Without Radar Detection with Injection at the Master

Radar Type	Pulse Width (µs)	PRI (µs)	Number of Pulses
0	1	1428	18

Table 20 - Radar Pulse Type 0 Characteristics

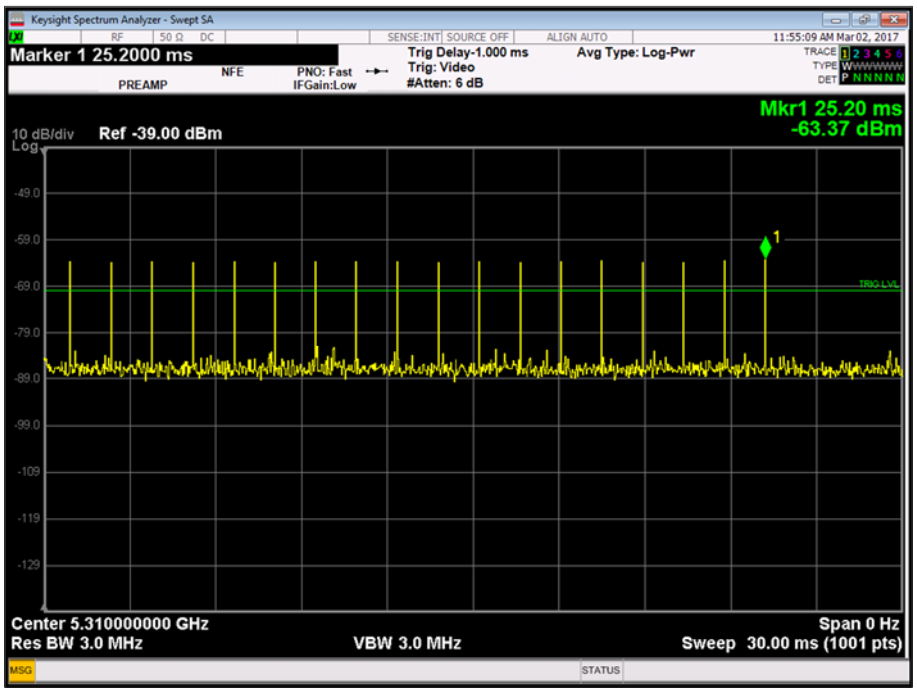

Figure 36 - Verification of Radar Type 0

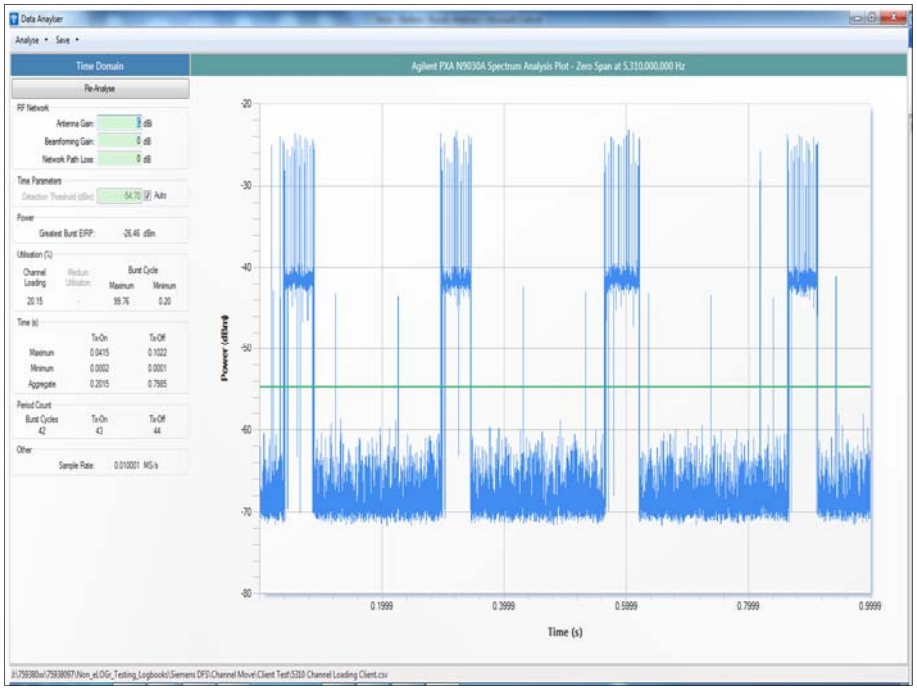

Figure 37 - Channel Loading

The channel loading was measured as 20.15% In order to achieve this channel loading a data rate of 27 Mbps was used.

2.2 U-NII Detection Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15E, Clause 15.407 (h)(2)(iii)(iv)
Industry Canada RSS-247, Clause 6.3.

2.2.2 Equipment Under Test and Modification State

MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) - Modification State 0

2.2.3 Date of Test

22-February-2017 to 02-March-2017

2.2.4 Test Method

To determine the required detection bandwidth, the 99% occupied bandwidth was measured in accordance with the occupied bandwidth measurement method described in KDB 789033 D02 as shown in the Calibration of Test Setup section of this report.

The U-NII Detection Bandwidth was measured according to the method described in KDB 905462 D02, clause 7.8.1.

The EUT was configured as a standalone device with no associations with any other devices and with no channel loading. Starting at the centre frequency of the EUT operating channel, a single radar burst of a short pulse radar test signal (Type 0) was produced with a level of the required DFS detection threshold, at the antenna port of the EUT. The EUT response from this radar test signal was noted.

This procedure was repeated for a minimum of 10 trials, while adjusting the radar test signal frequency in ±5 MHz steps until the detection rate fell below the U-NII Detection Bandwidth criterion. At this point the previous procedure was repeated in 1 MHz steps until the highest and lowest frequencies were determined by the points at which detection was greater than or equal to the U-NII Detection Bandwidth criterion.

2.2.5 Environmental Conditions

Ambient Temperature	22.6 °C
Relative Humidity	33.7 %

2.2.6 Test Results

The specific parameters of the waveforms used during these measurements are detailed in Appendix A of this report.

802.11a

The highest detection frequency is 5331 MHz and the lowest detection frequency is 5309 MHz, yielding a Detection Bandwidth of 22 MHz. The specific measurements are detailed below.

Radar Waveform	Radar Frequency (MHz)	Number of Detections	Number of Non-detections	Detection Rate (%)
FCC Short Pulse Radar (Type 0)	5308	0	10	0
	5309	10	0	100
	5310	10	0	100
	5315	10	0	100
	5320	10	0	100
	5325	10	0	100
	5330	10	0	100
	5331	9	1	90
	5332	0	10	0

Figure 38 - U-NII Detection Bandwidth Results

FCC Part 15E Limit Clause 15.407(h)(2)

The device must sense for radar signals at 100 percent of its emissions bandwidth.

Industry Canada RSS-247, Limit Clause

None Specified

KDB 905462 D02, Limit Clause 5.3

Minimum 100% of the U-NII 99% transmission power bandwidth.

802.11n 20 MHz Bandwidth

The highest detection frequency is 5331 MHz and the lowest detection frequency is 5309 MHz, yielding a Detection Bandwidth of 22 MHz. The specific measurements are detailed below.

Radar Waveform	Radar Frequency (MHz)	Number of Detections	Number of Non-detections	Detection Rate (%)
FCC Short Pulse Radar (Type 0)	5308	0	10	0
	5309	10	0	100
	5310	10	0	100
	5315	10	0	100
	5320	10	0	100
	5325	10	0	100
	5330	9	1	90
	5331	10	0	100
	5332	0	10	0

Figure 39 - U-NII Detection Bandwidth Results

FCC Part 15E Limit Clause 15.407(h)(2)

The device must sense for radar signals at 100 percent of its emissions bandwidth.

Industry Canada RSS-247, Limit Clause

None Specified

KDB 905462 D02, Limit Clause 5.3

Minimum 100% of the U-NII 99% transmission power bandwidth.

802.11n 40 MHz Bandwidth

The highest detection frequency is 5330 MHz and the lowest detection frequency is 5290 MHz, yielding a Detection Bandwidth of 40 MHz. The specific measurements are detailed below.

Radar Waveform	Radar Frequency (MHz)	Number of Detections	Number of Non-detections	Detection Rate (%)
FCC Short Pulse Radar (Type 0)	5288	0	10	0
	5289	10	0	100
	5295	10	0	100
	5300	10	0	100
	5305	10	0	100
	5310	9	1	90
	5315	9	1	90
	5320	10	0	100
	5325	10	0	100
	5330	10	0	100
	5331	0	10	0

Figure 40 - U-NII Detection Bandwidth Results

FCC Part 15E Limit Clause 15.407(h)(2)

The device must sense for radar signals at 100 percent of its emissions bandwidth.

Industry Canada RSS-247, Limit Clause

None Specified

KDB 905462 D02, Limit Clause 5.3

Minimum 100% of the U-NII 99% transmission power bandwidth.

2.2.7 Test Location

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2017
20dB/2W Attenuator	Narda	4772-20	462	-	TU
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
PXI RF Digitizer	Aeroflex	3035	4012	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3010	4013	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3011	4014	24	29-Jan-2018
PXI Digital RF Signal Generator	Aeroflex	3025	4015	24	29-Jan-2018
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	12-Aug-2017
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	12-Aug-2017

Table 21

TU - Traceability Unscheduled
O/P Mon - Output Monitored using calibrated equipment

2.3 Initial Channel Availability Check

2.3.1 Specification Reference

FCC 47 CFR Part 15E, Clause 15.407 (h)(2)(ii)
Industry Canada RSS-247, Clause 6.3.

2.3.2 Equipment Under Test and Modification State

MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) - Modification State 0

2.3.3 Date of Test

22-February-2017

2.3.4 Test Method

This test was performed in accordance with KDB 905462 D02, clause 7.8.2.1. This test does not use any Radar Waveforms and was only performed once for each mode and test frequency.

A spectrum analyser was used for measurements. The spectrum analyser centre frequency was set to the intended test frequency and utilised a peak detector with resolution and video bandwidths of 3 MHz. During the channel availability testing a measurement sweep duration of 2.5 minutes was set. The spectrum analyser sweep was started at the same time that power was applied to the EUT.

The measurement procedure defined in KDB 905462 D02, clause 7.8.2.1 was used to determine the power on sequence time. Transmissions on the channel started after approximately 100 seconds, therefore the channel power sequence was estimated to have completed 60 seconds prior to this resulting in a power on sequence time of approximately 40 seconds.

When performing channel availability check measurements, the EUT was pre-configured to operate in each mode and set to operate on the test frequency before commencing the Channel Availability Check. Upon the EUT CAC being started, the spectrum analyser sweep was triggered whereby the channel activity was monitored. Using delta markers on the measurement sweep, the channel availability check time was determined as shown by the delta markers on the plots below. The start of sweep, (0 seconds), was the beginning of the power on sequence.

The spectrum analyser nominal noise floor was characterised with a 20 second sweep time before testing, using the same resolution and video bandwidths utilised during testing. During this process, there were no transmissions by the EUT or companion devices.

2.3.5 Environmental Conditions

Ambient Temperature	23.9 °C
Relative Humidity	36.8 %

2.3.6 Test Results

802.11a

The initial channel availability check time was 60 seconds.

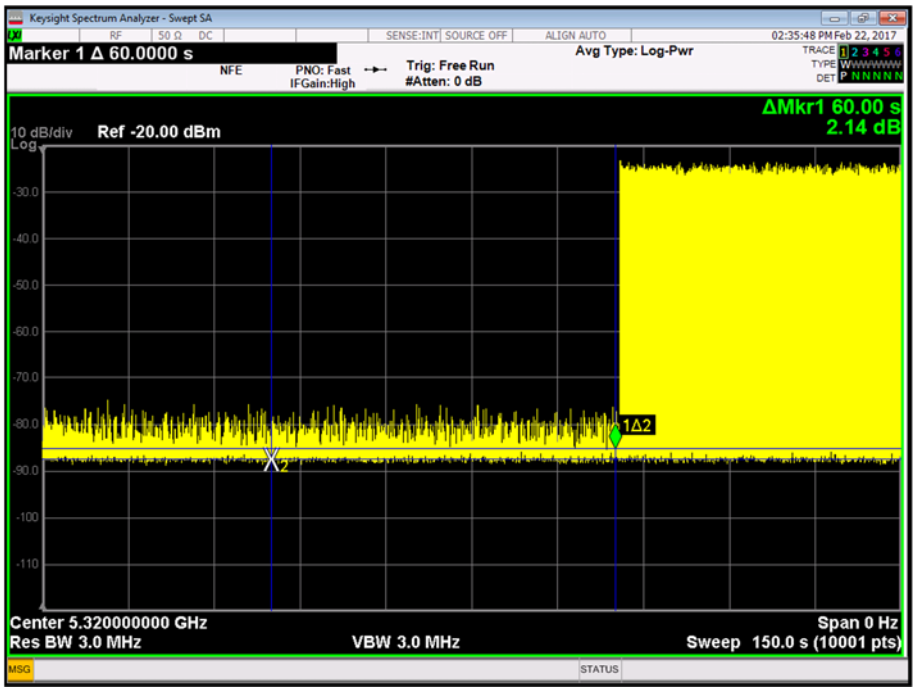

Figure 41 - Initial Channel Availability Check Time

FCC Part 15E, Limit Clause 15.407(h)(2)(ii)

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 the test specification, is detected within 60 seconds.

Industry Canada RSS-247, Limit Clause 6.3 (2)(ii)

The device shall check whether there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in Section 6.3(1) above is detected within 60 seconds.

KDB 905462 D02, Limit Clause 5.3

The channel availability check shall be performed for a minimum of 60 seconds.

802.11n 40 MHz Bandwidth

The initial channel availability check time was 60 seconds.

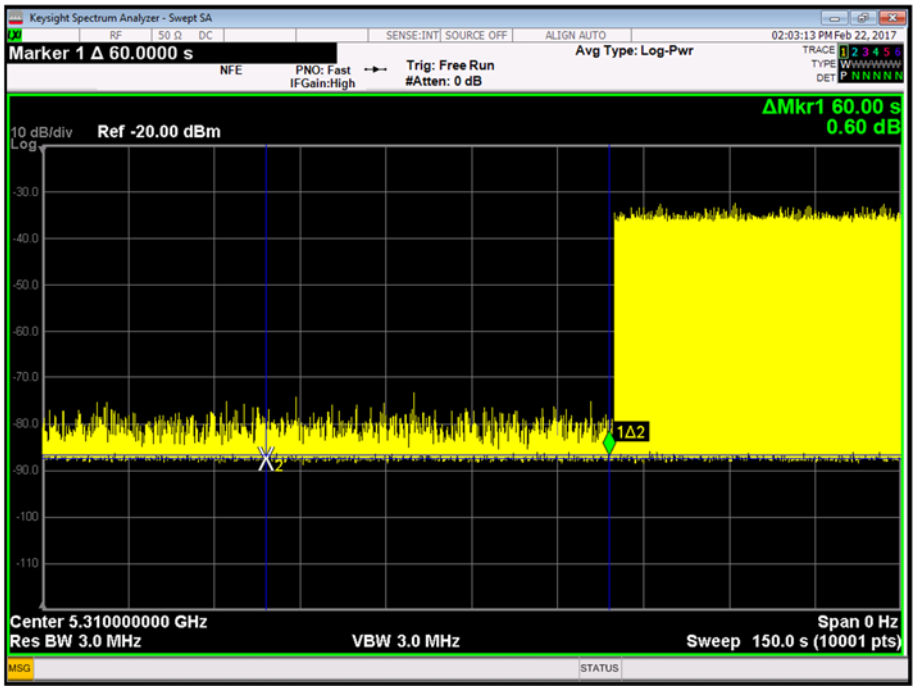

Figure 42 - Initial Channel Availability Check Time

FCC Part 15E, Limit Clause 15.407(h)(2)(ii)

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 the test specification, is detected within 60 seconds.

Industry Canada RSS-247, Limit Clause 6.3 (2)(ii)

The device shall check whether there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in Section 6.3(1) above is detected within 60 seconds.

KDB 905462 D02, Limit Clause 5.3

The channel availability check shall be performed for a minimum of 60 seconds.

2.3.7 Test Location

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2017
20dB/2W Attenuator	Narda	4772-20	462	-	TU
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
PXI RF Digitizer	Aeroflex	3035	4012	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3010	4013	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3011	4014	24	29-Jan-2018
PXI Digital RF Signal Generator	Aeroflex	3025	4015	24	29-Jan-2018
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	12-Aug-2017
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	12-Aug-2017

Table 22

TU - Traceability Unscheduled
O/P Mon - Output Monitored using calibrated equipment

2.4 Radar Burst at the Beginning of the Channel Availability Check Time

2.4.1 Specification Reference

FCC 47 CFR Part 15E, Clause 15.407 (h)(2)(ii)
Industry Canada RSS-247, Clause 6.3.

2.4.2 Equipment Under Test and Modification State

MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) - Modification State 0

2.4.3 Date of Test

22-February-2017

2.4.4 Test Method

This test was performed in accordance with KDB 905462 D02, clause 7.8.2.2.

A spectrum analyser was used for measurements. The spectrum analyser centre frequency was set to the intended test frequency and utilised a peak detector with resolution and video bandwidths of 3 MHz.

When performing channel availability check measurements, the EUT was pre-configured to operate in each mode and set to operate on the test frequency before commencing the Channel Availability Check. Upon the EUT CAC being started, the spectrum analyser sweep was triggered whereby the channel activity was monitored. Using delta markers on the measurement sweep, the Radar signal injection time was indicated. The start of sweep, (0 seconds), was the beginning of the power on sequence. The EUT CAC period is shown by the time lines on the plots below.

A single short pulse radar type 0 was applied to the EUT receiver within 6 seconds of the beginning of the channel availability check time, at a level equal to the detection threshold level + 1 dB, accounting for equipment variation/errors.

The measurement observation period was no less than 2.5 minutes proceeding the time at which the radar test signal was generated. It was verified that no EUT transmissions occurred on the test channel during this 2.5 minutes measurement period.

2.4.5 Environmental Conditions

Ambient Temperature	23.9 °C
Relative Humidity	36.8 %

2.4.6 Test Results

802.11a

It was verified that no transmissions were produced from the EUT on the test channel during the channel availability check time.

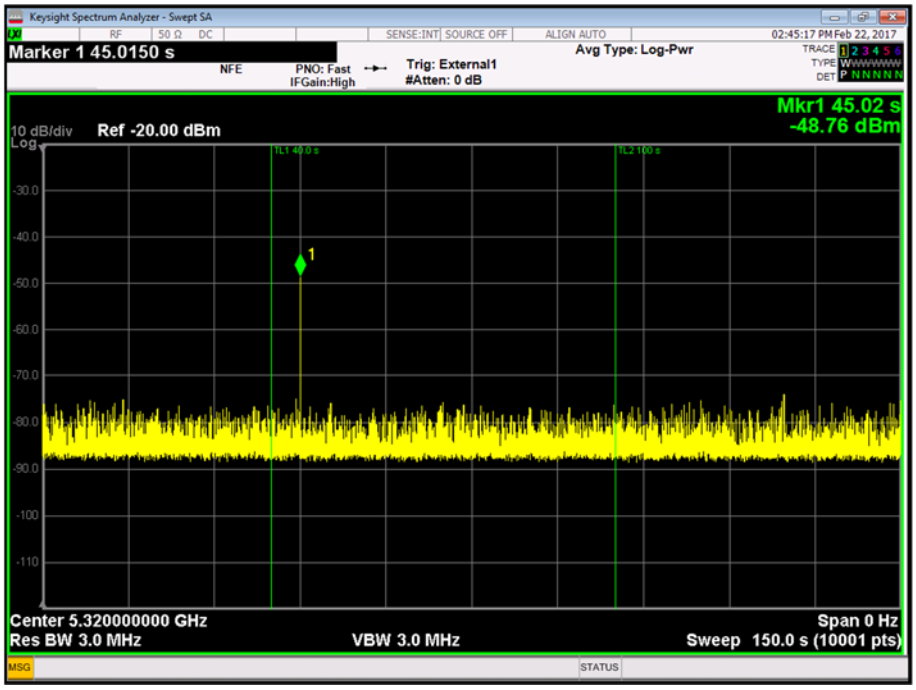

Figure 43 - Radar Injected at the Beginning of the Channel Availability Check

Note: T_L1 denotes start of 60 second CAC period and T_L2 denotes the end of the 60 second CAC period. The marker shows the time at which the radar burst was injected. This was within 6 seconds of the beginning of the EUT's CAC period.

FCC Part 15E, Limit Clause 15.407(h)(2)(ii)

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 the test specification, is detected within 60 seconds.

Industry Canada RSS-247, Limit Clause 6.3 (2)(ii)

The device shall check whether there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in Section 6.3(1) above is detected within 60 seconds.

KDB 905462 D02, Limit Clause 5.3

The channel availability check shall be performed for a minimum of 60 seconds.

802.11n 40 MHz Bandwidth

It was verified that no transmissions were produced from the EUT on the test channel during the channel availability check time.

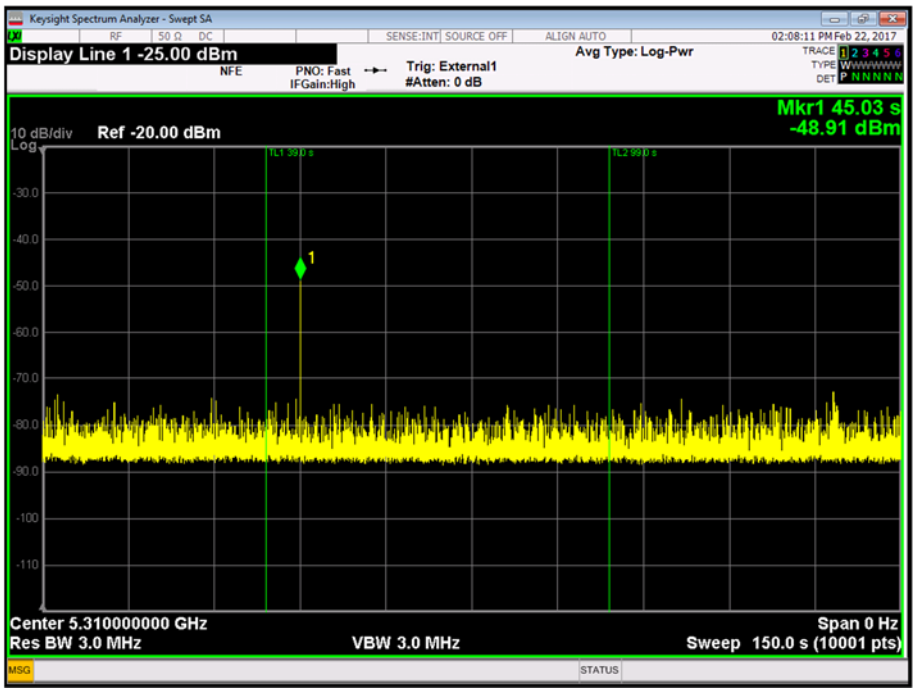

Figure 44 - Radar Injected at the Beginning of the Channel Availability Check

Note: T_L1 denotes start of 60 second CAC period and T_L2 denotes the end of the 60 second CAC period. The marker shows the time at which the radar burst was injected. This was within 6 seconds of the beginning of the EUT's CAC period.

FCC Part 15E, Limit Clause 15.407(h)(2)(ii)

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 the test specification, is detected within 60 seconds.

Industry Canada RSS-247, Limit Clause 6.3 (2)(ii)

The device shall check whether there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in Section 6.3(1) above is detected within 60 seconds.

KDB 905462 D02, Limit Clause 5.3

The channel availability check shall be performed for a minimum of 60 seconds.

2.4.7 Test Location

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2017
20dB/2W Attenuator	Narda	4772-20	462	-	TU
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
PXI RF Digitizer	Aeroflex	3035	4012	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3010	4013	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3011	4014	24	29-Jan-2018
PXI Digital RF Signal Generator	Aeroflex	3025	4015	24	29-Jan-2018
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	12-Aug-2017
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	12-Aug-2017

Table 23

TU - Traceability Unscheduled
O/P Mon - Output Monitored using calibrated equipment

2.5 Radar Burst at the End of the Channel Availability Check Time

2.5.1 Specification Reference

FCC 47 CFR Part 15E, Clause 15.407 (h)(2)(iii)(iv)
Industry Canada RSS-247, Clause 6.3.

2.5.2 Equipment Under Test and Modification State

MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) - Modification State 0

2.5.3 Date of Test

22-February-2017

2.5.4 Test Method

This test was performed in accordance with KDB 905462 D02, clause 7.8.2.3.

A spectrum analyser was used for measurements. The spectrum analyser centre frequency was set to the intended test frequency and utilised a peak detector with resolution and video bandwidths of 3 MHz.

When performing channel availability check measurements, the EUT was pre-configured to operate in each mode and set to operate on the test frequency before commencing the Channel Availability Check. Upon the EUT CAC being started, the spectrum analyser sweep was triggered whereby the channel activity was monitored. Using delta markers on the measurement sweep, the Radar signal injection time was indicated. The start of sweep, (0 seconds), was the start of the EUT's power on sequence.

A single short pulse radar type 0 was applied to the EUT receiver within 6 seconds of the end of the channel availability check time, at a level equal to the detection threshold level + 1 dB, accounting for equipment variation/errors.

The measurement observation period was no less than 2.5 minutes proceeding the time at which the radar test signal was generated. It was verified that no EUT transmissions occurred on the test channel during this 2.5 minutes measurement period.

2.5.5 Environmental Conditions

Ambient Temperature	20.6 - 21.2 °C
Relative Humidity	29.4 - 36.8 %

2.5.6 Test Results

802.11a

It was verified that no transmissions were produced from the EUT on the test channel during the channel availability check time.

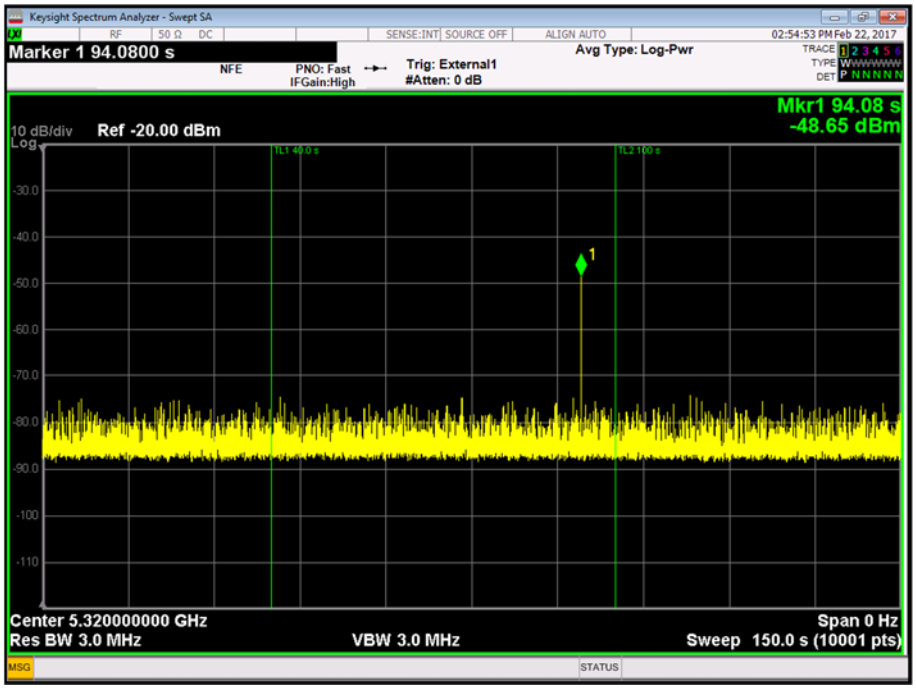

Figure 45 - Radar Injected at the end of the Channel Availability Check

Note: T_L1 denotes start of 60 second CAC period and T_L2 denotes the end of the 60 second CAC period. The marker shows the time at which the radar burst was injected. This was within 6 seconds of the end of the EUT's CAC period.

FCC Part 15E, Limit Clause 15.407(h)(2)(ii)

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 the test specification, is detected within 60 seconds.

Industry Canada RSS-247, Limit Clause 6.3 (2)(ii)

The device shall check whether there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in Section 6.3(1) above is detected within 60 seconds.

KDB 905462 D02, Limit Clause 5.3

The channel availability check shall be performed for a minimum of 60 seconds.

802.11n 40 MHz Bandwidth

It was verified that no transmissions were produced from the EUT on the test channel during the channel availability check time.

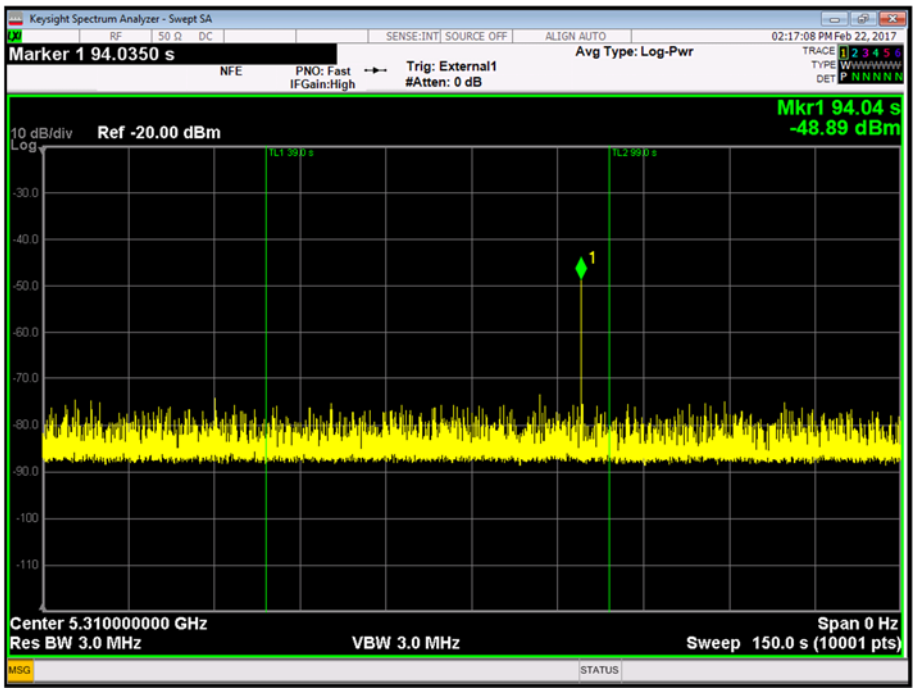

Figure 46 - Radar Injected at the end of the Channel Availability Check

Note: T_L1 denotes start of 60 second CAC period and T_L2 denotes the end of the 60 second CAC period. The marker shows the time at which the radar burst was injected. This was within 6 seconds of the end of the EUT's CAC period.

FCC Part 15E, Limit Clause 15.407(h)(2)(ii)

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 the test specification, is detected within 60 seconds.

Industry Canada RSS-247, Limit Clause 6.3 (2)(ii)

The device shall check whether there is a radar system already operating on the channel before it initiates a transmission on a channel and when it moves to a channel. The device may start using the channel if no radar signal with a power level greater than the interference threshold value specified in Section 6.3(1) above is detected within 60 seconds.

KDB 905462 D02, Limit Clause 5.3

The channel availability check shall be performed for a minimum of 60 seconds.

2.5.7 Test Location

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2017
20dB/2W Attenuator	Narda	4772-20	462	-	TU
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
PXI RF Digitizer	Aeroflex	3035	4012	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3010	4013	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3011	4014	24	29-Jan-2018
PXI Digital RF Signal Generator	Aeroflex	3025	4015	24	29-Jan-2018
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	12-Aug-2017
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	12-Aug-2017

Table 24

TU - Traceability Unscheduled
O/P Mon - Output Monitored using calibrated equipment

2.6 In-Service Monitoring

2.6.1 Specification Reference

FCC 47 CFR Part 15E, Clause 15.407 (h)(2)(iii)(iv)
Industry Canada RSS-247, Clause 6.3

2.6.2 Equipment Under Test and Modification State

Master Device:
MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) - Modification State 0

Client Without Radar Detection Device:
MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0002) - Modification State 0

2.6.3 Date of Test

22-February-2017 to 02-March-2017

2.6.4 Test Method

This test was performed in accordance with FCC KDB 905462 D02, clause 7.8.3.

A computer was connected via an Ethernet cable to the Master device and the defined audio/video file was streamed to the Client device using the supplied codec player.

Radar Pulse Type 0 was then transmitted and the Spectrum monitored. The transmissions from the UUT were observed for a period of 12 seconds after the final injected Radar Pulse.

It was checked that all transmissions stopped within the 10 second period defined from the point of the end of the final Radar pulse + 10 seconds. In addition, the aggregate on time during the first 200ms and the following 9.8 seconds of the Channel Move Time was computed by the Aeroflex DFS Software.

The markers on the trace data correspond to the following time periods:

Red - End of Radar Burst, (T0)

Purple - End of 200ms Period, (T0 + 200 ms)

Orange - End of Channel Move Time, (T0 + 10 seconds)

To verify the non-occupancy period, the PXI digitiser was replaced with a Spectrum Analyser. The external trigger from the Aeroflex DFS test system was used to trigger a 30 minute sweep from the moment the radar burst sequence was injected. It was verified that no transmissions occurred on the test channel during this time period.

2.6.5 Environmental Conditions

Ambient Temperature	20.6 - 21.2 °C
Relative Humidity	29.4 - 36.8 %

2.6.6 Test Results

Master - 802.11a

Test Parameter	Result
Channel Move Time	0.463 s
Channel Closing Time (Aggregate Time During 200 ms)	0.672 ms
Channel Closing Time (Aggregate Time During 200 ms to 10 s)	1.008 ms
Channel Closing Time (Aggregate Time During 10 s)	1.680 ms
Transmission Observed During Non-Occupancy Period	None

Table 25 - In-Service Monitoring Test Results

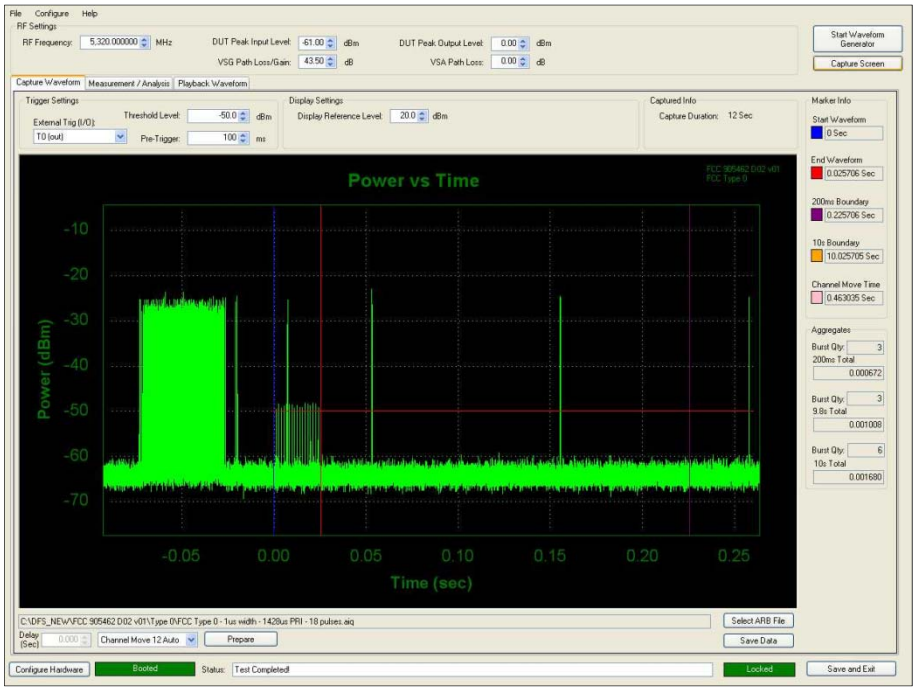

Figure 47 - First 200 ms of Channel Shutdown Period

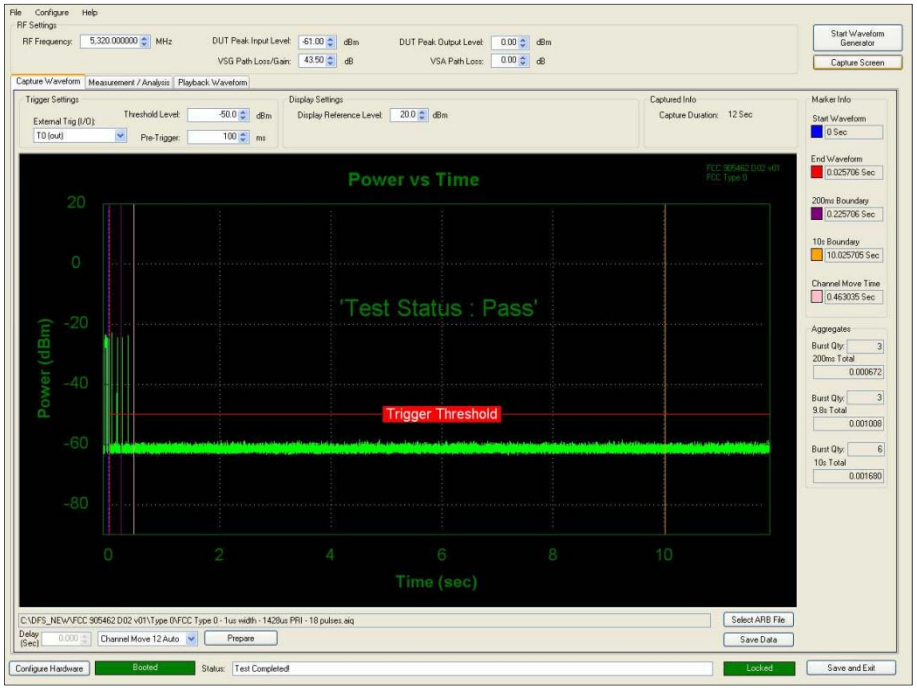

Figure 48 - 10 s Channel Shutdown

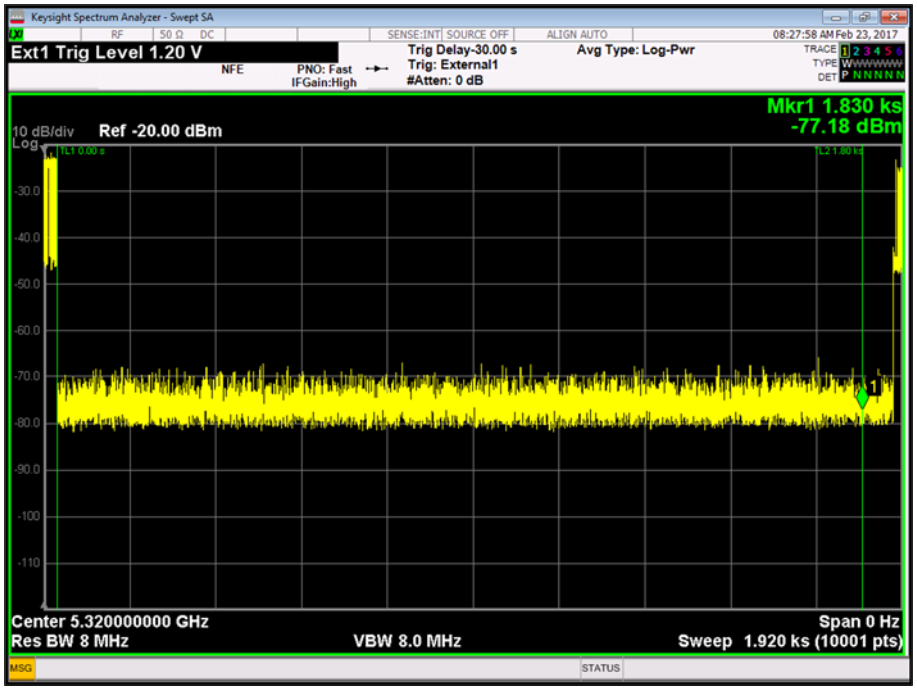

Figure 49 - Non-Occupancy Period

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iii)

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iv)

Non-occupancy Period	> 30 minutes

Industry Canada RSS-247, Limit Clause 6.3(iii)(iv)(v)

Channel move time: after a radar signal is detected, the device shall cease all transmissions on the operating channel within 10 seconds.

Channel closing transmission time: is comprised of 200 ms starting at the beginning of the channel move time plus any additional intermittent control signals required to facilitate a channel move (an aggregate of 60 ms) over the remaining 10-second period of the channel move time.

Non-occupancy period: a channel that has been flagged as containing a radar signal, either by a channel availability check or in-service monitoring, is subject to a 30-minute non-occupancy period where the channel cannot be used by the LE-LAN device. The non-occupancy period starts from the time that the radar signal is detected.

KDB 905462 D02, Limit Clause 5.3

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms
Non-occupancy Period	> 30 minutes

Master - 802.11n 40 MHz Bandwidth

Test Parameter	Result
Channel Move Time	0.527 s
Channel Closing Time (Aggregate Time During 200 ms)	0.512 ms
Channel Closing Time (Aggregate Time During 200 ms to 10 s)	0.740 ms
Channel Closing Time (Aggregate Time During 10 s)	1.252 ms
Transmission Observed During Non-Occupancy Period	None

Table 26 - In-Service Monitoring Test Results

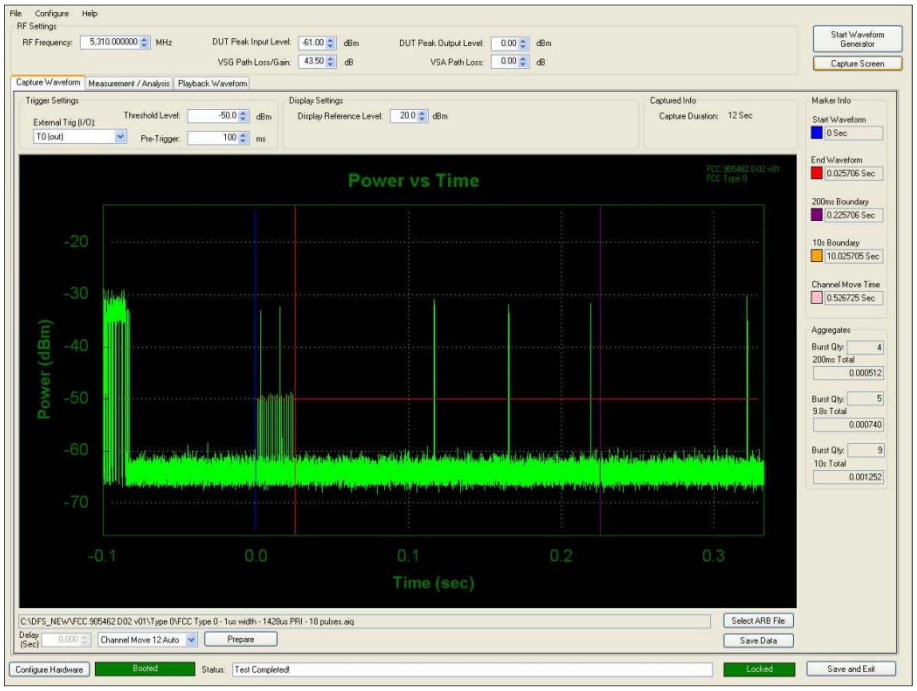

Figure 50 - First 200 ms of Channel Shutdown Period

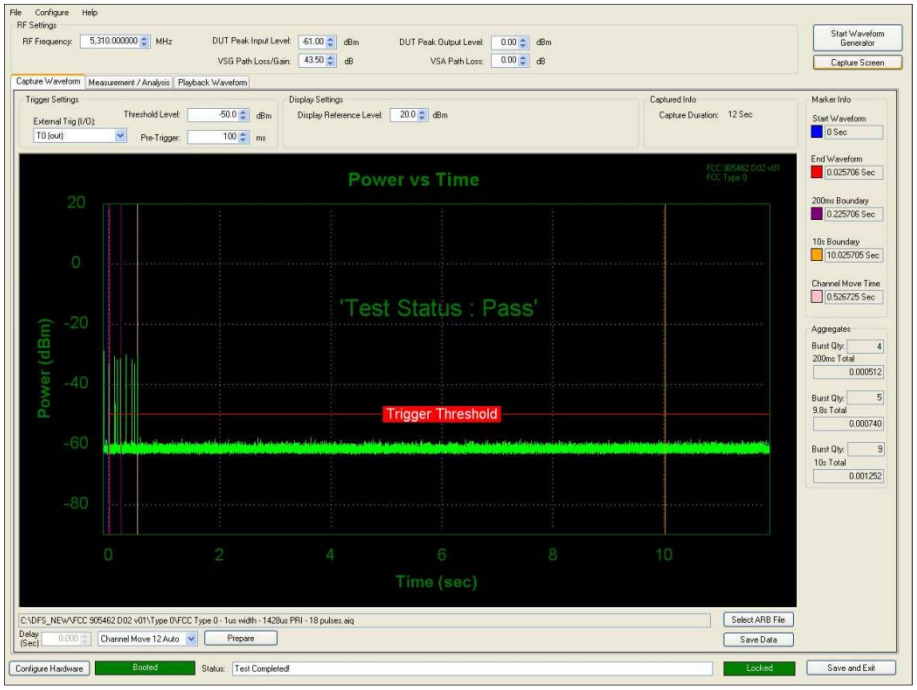

Figure 51 - 10 s Channel Shutdown

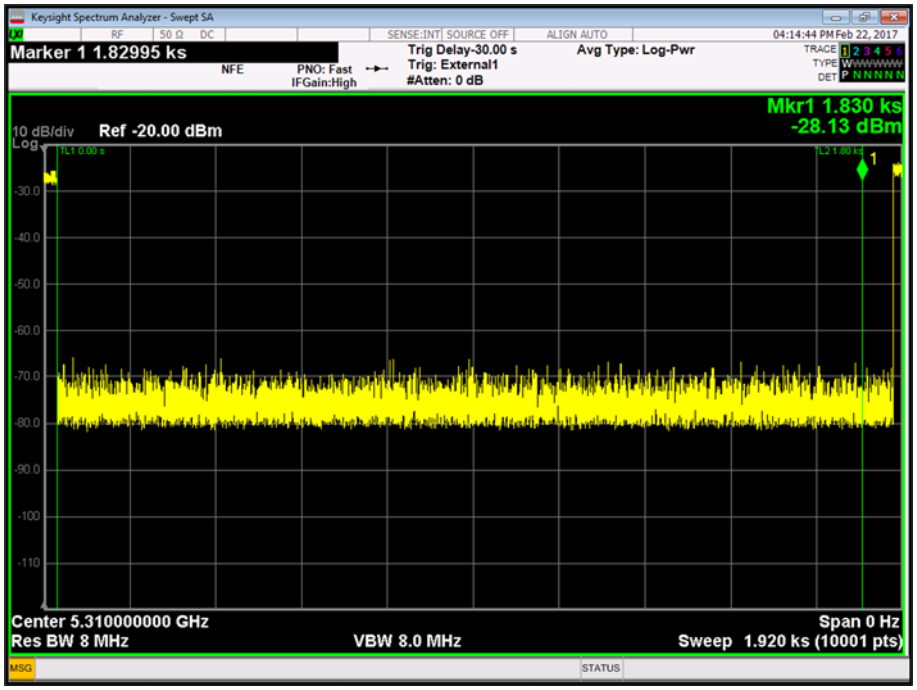

Figure 52 - Non-Occupancy Period

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iii)

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iv)

Non-occupancy Period	> 30 minutes

Industry Canada RSS-247, Limit Clause 6.3(iii)(iv)(v)

Channel move time: after a radar signal is detected, the device shall cease all transmissions on the operating channel within 10 seconds.

Channel closing transmission time: is comprised of 200 ms starting at the beginning of the channel move time plus any additional intermittent control signals required to facilitate a channel move (an aggregate of 60 ms) over the remaining 10-second period of the channel move time.

Non-occupancy period: a channel that has been flagged as containing a radar signal, either by a channel availability check or in-service monitoring, is subject to a 30-minute non-occupancy period where the channel cannot be used by the LE-LAN device. The non-occupancy period starts from the time that the radar signal is detected.

KDB 905462 D02, Limit Clause 5.3

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms
Non-occupancy Period	> 30 minutes

Client Without Radar Detection - 802.11a

Test Parameter	Result
Channel Move Time	0.011 s
Channel Closing Time (Aggregate Time During 200 ms)	0 ms
Channel Closing Time (Aggregate Time During 200 ms to 10 s)	0 ms
Channel Closing Time (Aggregate Time During 10 s)	0 ms
Transmission Observed During Non-Occupancy Period	None

Table 27 - In-Service Monitoring Test Results

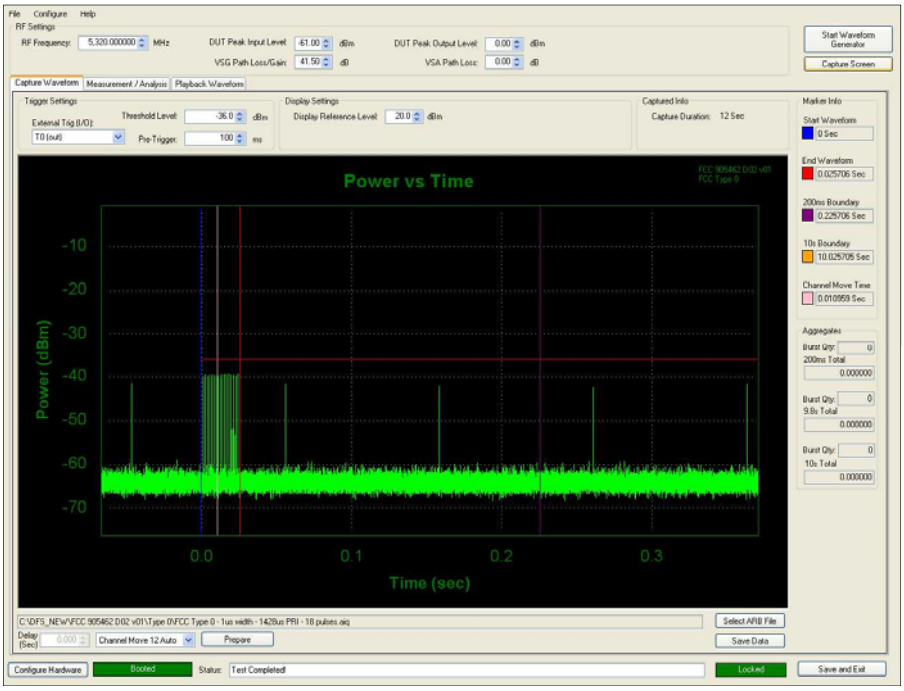

Figure 53 - First 200 ms of Channel Shutdown Period

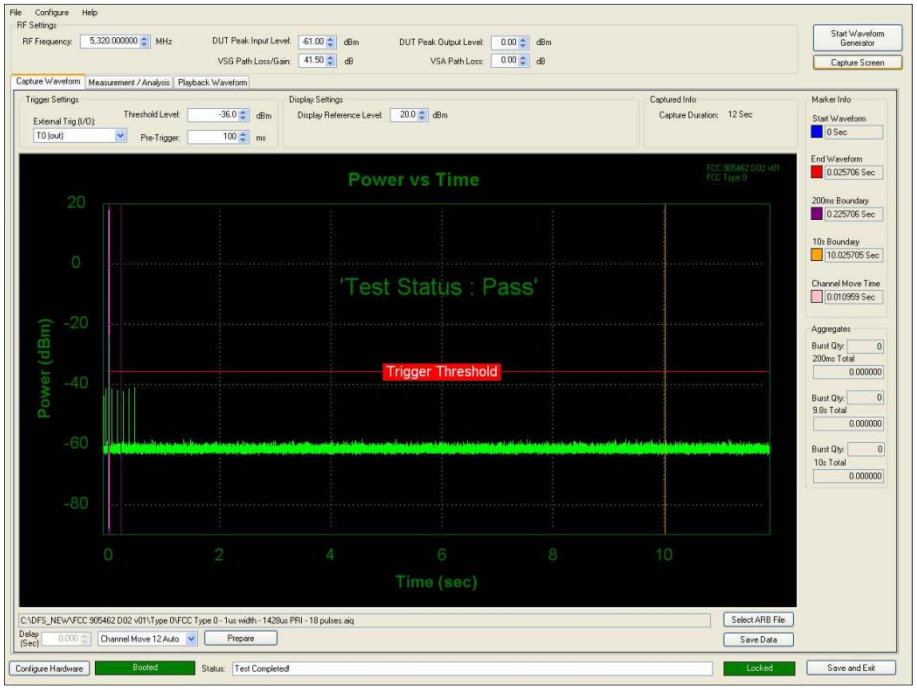

Figure 54 - 10 s Channel Shutdown

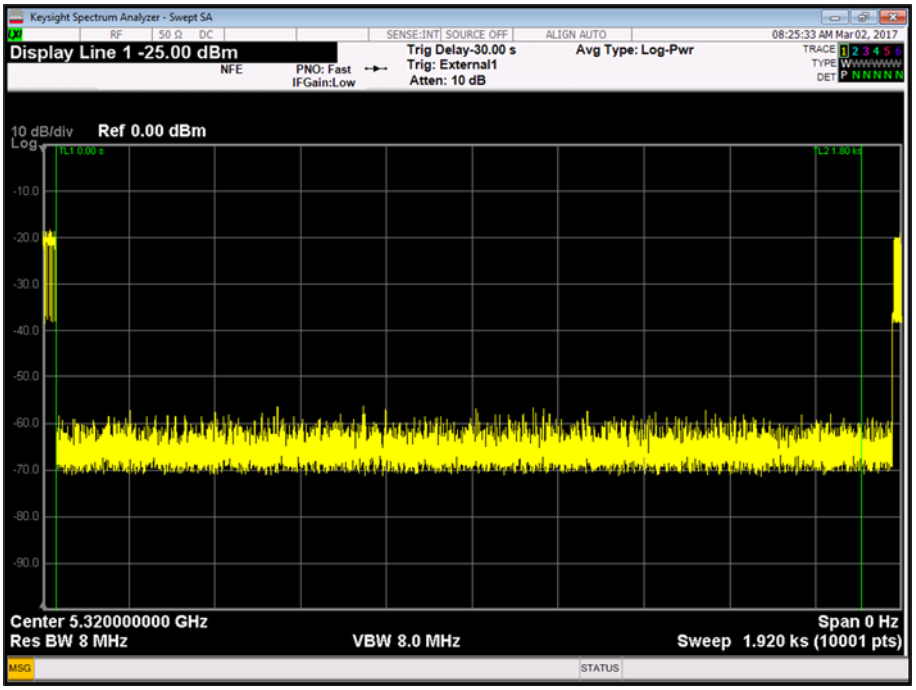

Figure 55 - Non-Occupancy Period

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iii)

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iv)

Non-occupancy Period	> 30 minutes

Industry Canada RSS-247, Limit Clause 6.3(iii)(iv)(v)

Channel move time: after a radar signal is detected, the device shall cease all transmissions on the operating channel within 10 seconds.

Channel closing transmission time: is comprised of 200 ms starting at the beginning of the channel move time plus any additional intermittent control signals required to facilitate a channel move (an aggregate of 60 ms) over the remaining 10-second period of the channel move time.

Non-occupancy period: a channel that has been flagged as containing a radar signal, either by a channel availability check or in-service monitoring, is subject to a 30-minute non-occupancy period where the channel cannot be used by the LE-LAN device. The non-occupancy period starts from the time that the radar signal is detected.

KDB 905462 D02, Limit Clause 5.3

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms
Non-occupancy Period	> 30 minutes

Client Without Radar Detection - 802.11n 40 MHz Bandwidth

Test Parameter	Result
Channel Move Time	0.008 s
Channel Closing Time (Aggregate Time During 200 ms)	0 ms
Channel Closing Time (Aggregate Time During 200 ms to 10 s)	0 ms
Channel Closing Time (Aggregate Time During 10 s)	0 ms
Transmission Observed During Non-Occupancy Period	None

Table 28 - In-Service Monitoring Test Results

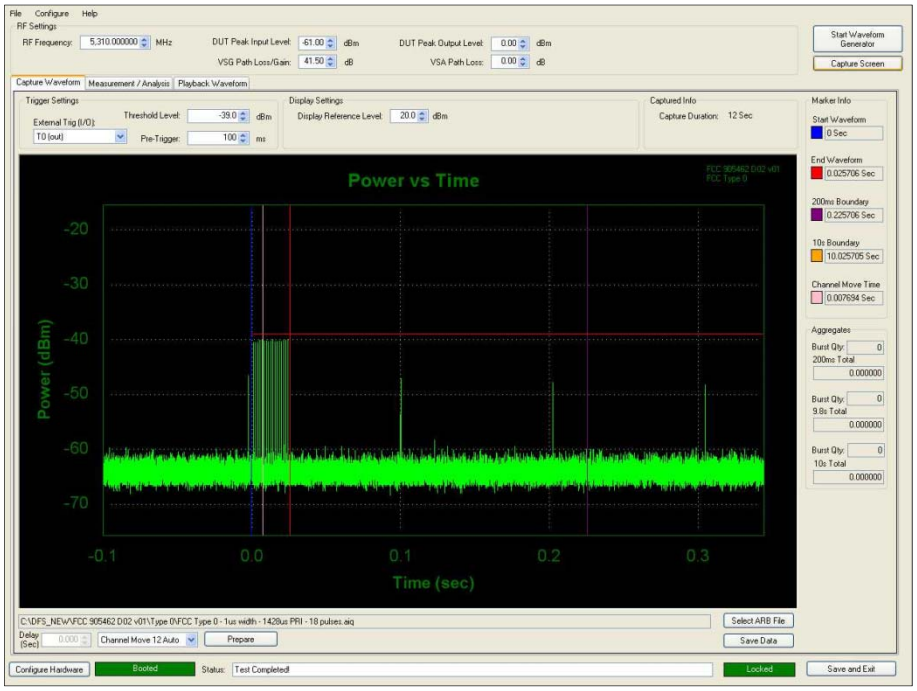

Figure 56 - First 200 ms of Channel Shutdown Period

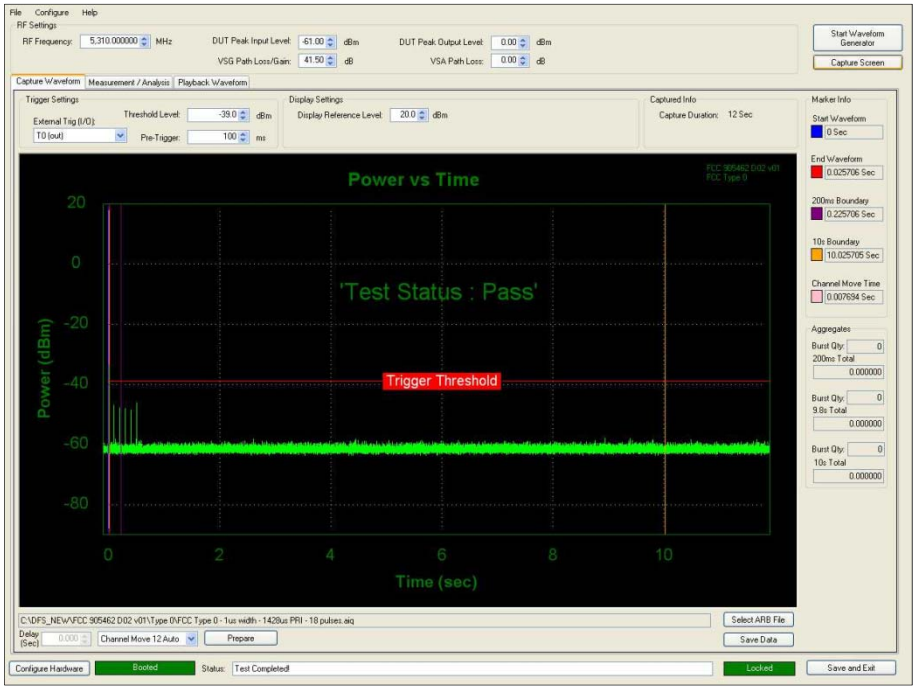

Figure 57 - 10 s Channel Shutdown

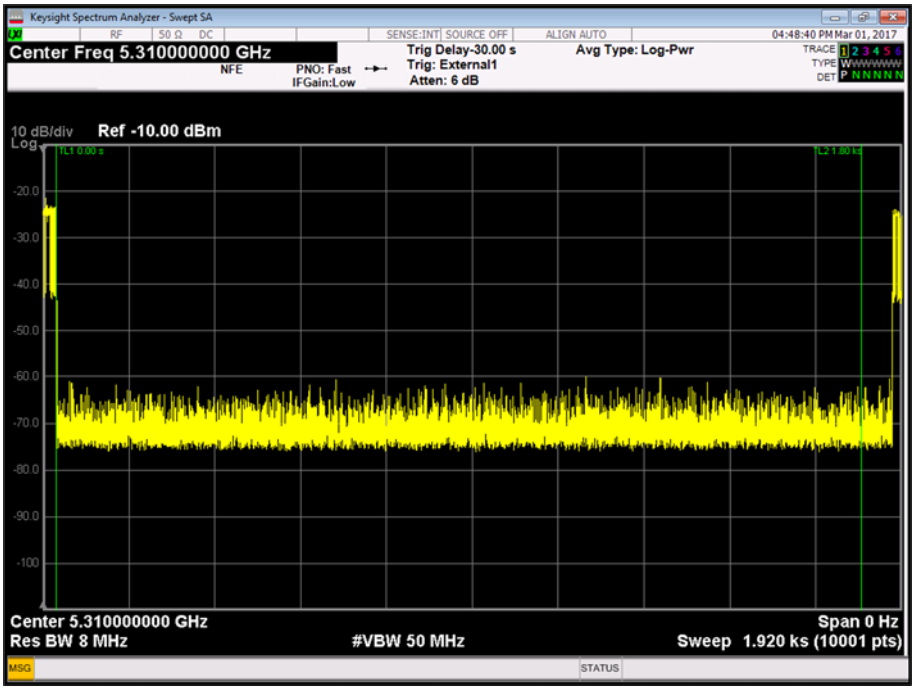

Figure 58 - Non-Occupancy Period

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iii)

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms

FCC 47 CFR Part 15, Limit Clause 15.407 (h)(2)(iv)

Non-occupancy Period	> 30 minutes

Industry Canada RSS-247, Limit Clause 6.3(iii)(iv)(v)

Channel move time: after a radar signal is detected, the device shall cease all transmissions on the operating channel within 10 seconds.

Channel closing transmission time: is comprised of 200 ms starting at the beginning of the channel move time plus any additional intermittent control signals required to facilitate a channel move (an aggregate of 60 ms) over the remaining 10-second period of the channel move time.

Non-occupancy period: a channel that has been flagged as containing a radar signal, either by a channel availability check or in-service monitoring, is subject to a 30-minute non-occupancy period where the channel cannot be used by the LE-LAN device. The non-occupancy period starts from the time that the radar signal is detected.

KDB 905462 D02, Limit Clause 5.3

Channel Move Time	<10 s
Channel Closing Time (Aggregate Time During 200ms)	<200 ms
Channel Closing Time (Aggregate Time During +200ms to 10s)	<60 ms
Non-occupancy Period	> 30 minutes

2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2017
20dB/2W Attenuator	Narda	4772-20	462	-	TU
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
PXI RF Digitizer	Aeroflex	3035	4012	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3010	4013	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3011	4014	24	29-Jan-2018
PXI Digital RF Signal Generator	Aeroflex	3025	4015	24	29-Jan-2018
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	12-Aug-2017
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	12-Aug-2017

Table 29

TU - Traceability Unscheduled
O/P Mon - Output Monitored using calibrated equipment

2.7 Statistical Performance Check

2.7.1 Specification Reference

FCC 47 CFR Part 15E, Clause 15.407 (h)(2)(iii)(iv)
Industry Canada RSS-247, Clause 6.3.

2.7.2 Equipment Under Test and Modification State

MSN65-W1-M12-E2, S/N: Not Serialised (75938097-TSR0001) - Modification State 0

2.7.3 Date of Test

27-February-2017

2.7.4 Test Method

This test was performed in accordance with KDB 905462 D02, clause 7.8.4.

Details of the EUT configurations and radar test signals can be found in the Calibration of Test Setup section of this report.

Radar types 1-6 were individually applied to the EUT, at a level equal to the detection threshold + 1 dB, accounting for equipment variation/errors.

The test frequency was observed for at least 10 seconds after generating each short pulse radar test signal to ensure detection had occurred. The test frequency was observed for at least 22 seconds after generating each long pulse radar test signal to ensure detection had occurred.

As specified in KDB 905462 D04, the EUT was configured so that upon radar detection, the test mode disabled the 30 minute non-occupancy period and returns the device to the original test frequency. The channel move mechanism was also disabled whilst in test mode to keep the device on the test frequency. Upon successful detection of a radar signal a message was displayed showing that a radar signal was detected.

2.7.5 Environmental Conditions

Ambient Temperature	20.6 - 21.2 °C
Relative Humidity	29.4 - 36.8 %

2.7.6 Test Results

802.11a

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
1	1	5310.000	Y	16	5320.000	Y
	2	5310.000	Y	17	5320.000	Y
	3	5310.000	N	18	5320.000	Y
	4	5310.000	Y	19	5320.000	Y
	5	5310.000	Y	20	5320.000	Y
	6	5313.000	Y	21	5326.000	Y
	7	5313.000	Y	22	5326.000	Y
	8	5313.000	Y	23	5326.000	Y
	9	5313.000	Y	24	5326.000	N
	10	5313.000	Y	25	5326.000	Y
	11	5318.000	Y	26	5329.000	N
	12	5318.000	Y	27	5329.000	Y
	13	5318.000	Y	28	5329.000	Y
	14	5318.000	Y	29	5329.000	Y
	15	5318.000	Y	30	5329.000	Y
EUT Test Frequency : 5320 MHz				Total Detected		27 (90.00 %)

Table 30 - Statistical Analysis for Radar Type 1

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
2	1	5310.000	Y	16	5320.000	Y
	2	5310.000	N	17	5320.000	Y
	3	5310.000	Y	18	5320.000	Y
	4	5310.000	N	19	5320.000	Y
	5	5310.000	N	20	5320.000	Y
	6	5313.000	N	21	5326.000	Y
	7	5313.000	Y	22	5326.000	Y
	8	5313.000	Y	23	5326.000	Y
	9	5313.000	Y	24	5326.000	Y
	10	5313.000	Y	25	5326.000	N
	11	5318.000	Y	26	5329.000	Y
	12	5318.000	Y	27	5329.000	Y
	13	5318.000	Y	28	5329.000	Y
	14	5318.000	N	29	5329.000	Y
	15	5318.000	N	30	5329.000	N
EUT Test Frequency : 5320 MHz				Total Detected		22 (73.33 %)

Table 31 - Statistical Analysis for Radar Type 2

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
3	1	5310.000	Y	16	5320.000	Y
	2	5310.000	Y	17	5320.000	Y
	3	5310.000	N	18	5320.000	Y
	4	5310.000	Y	19	5320.000	Y
	5	5310.000	N	20	5320.000	Y
	6	5313.000	Y	21	5326.000	Y
	7	5313.000	Y	22	5326.000	Y
	8	5313.000	Y	23	5326.000	Y
	9	5313.000	Y	24	5326.000	N
	10	5313.000	Y	25	5326.000	N
	11	5318.000	Y	26	5329.000	Y
	12	5318.000	Y	27	5329.000	Y
	13	5318.000	Y	28	5329.000	Y
	14	5318.000	Y	29	5329.000	N
	15	5318.000	Y	30	5329.000	Y
EUT Test Frequency : 5320 MHz				Total Detected		25 (83.33 %)

Table 32 - Statistical Analysis for Radar Type 3

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
4	1	5310.000	Y	16	5320.000	Y
	2	5310.000	Y	17	5320.000	N
	3	5310.000	N	18	5320.000	Y
	4	5310.000	Y	19	5320.000	Y
	5	5310.000	Y	20	5320.000	N
	6	5313.000	Y	21	5326.000	Y
	7	5313.000	Y	22	5326.000	N
	8	5313.000	Y	23	5326.000	Y
	9	5313.000	Y	24	5326.000	N
	10	5313.000	Y	25	5326.000	Y
	11	5318.000	Y	26	5329.000	Y
	12	5318.000	N	27	5329.000	Y
	13	5318.000	Y	28	5329.000	Y
	14	5318.000	N	29	5329.000	Y
	15	5318.000	Y	30	5329.000	Y
EUT Test Frequency : 5320 MHz				Total Detected		23 (76.67 %)

Table 33 - Statistical Analysis for Radar Type 4

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	30	27	90.00 %
2	30	22	73.33 %
3	30	25	83.33 %
4	30	23	76.67 %
Aggregate (90.00 % + 73.33 % + 83.33 % + 76.67 %) / 4 = 80.83 % (Verdict = Pass)			

Table 34 – Overall Statistical Analysis Short Radar Types 1 to 4

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
5	1	5320.000	Y	16	5319.612	Y
	2	5320.000	Y	17	5319.612	Y
	3	5320.000	Y	18	5318.812	Y
	4	5320.000	Y	19	5319.212	Y
	5	5320.000	Y	20	5319.612	Y
	6	5320.000	Y	21	5320.776	Y
	7	5320.000	Y	22	5320.776	Y
	8	5320.000	Y	23	5320.376	Y
	9	5320.000	Y	24	5320.376	Y
	10	5320.000	Y	25	5321.176	Y
	11	5319.612	Y	26	5320.776	Y
	12	5318.412	Y	27	5320.376	Y
	13	5319.612	Y	28	5320.376	Y
	14	5319.612	Y	29	5320.376	Y
	15	5318.412	Y	30	5320.376	Y
EUT Test Frequency : 5320 MHz				Total Detected		30 (100.00 %)

Table 35 - Statistical Analysis for Radar Type 5

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
6	1	Frequency Hopping	N	16	Frequency Hopping	Y
	2	Frequency Hopping	Y	17	Frequency Hopping	Y
	3	Frequency Hopping	Y	18	Frequency Hopping	Y
	4	Frequency Hopping	Y	19	Frequency Hopping	Y
	5	Frequency Hopping	Y	20	Frequency Hopping	Y
	6	Frequency Hopping	Y	21	Frequency Hopping	Y
	7	Frequency Hopping	Y	22	Frequency Hopping	Y
	8	Frequency Hopping	Y	23	Frequency Hopping	Y
	9	Frequency Hopping	Y	24	Frequency Hopping	Y
	10	Frequency Hopping	N	25	Frequency Hopping	Y
	11	Frequency Hopping	Y	26	Frequency Hopping	Y
	12	Frequency Hopping	Y	27	Frequency Hopping	Y
	13	Frequency Hopping	Y	28	Frequency Hopping	Y
	14	Frequency Hopping	Y	29	Frequency Hopping	Y
	15	Frequency Hopping	Y	30	Frequency Hopping	Y
EUT Test Frequency : 5320 MHz				Total Detected		28 (93.33 %)

Table 36 - Statistical Analysis for Radar Type 6

FCC Part 15E, Limit Clause

None Specified

Industry Canada RSS-247, Limit Clause

None Specified

KDB 905462 D02, Limit Clause 6

Radar Type	Pulse Length Type	Minimum Percentage of Successful Detection (%)	Minimum Number of Trials
0	Short Pulse	-	-
1	Short Pulse	60	30
2	Short Pulse	60	30
3	Short Pulse	60	30
4	Short Pulse	60	30
Aggregate (1-4)	Short Pulse	80	120
5	Long Pulse	80	30
6	Frequency Hopping	70	30

802.11n 20 MHz Bandwidth

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
1	1	5291.000	Y	16	5312.000	Y
	2	5291.000	Y	17	5312.000	Y
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	Y
	5	5291.000	Y	20	5312.000	Y
	6	5297.000	Y	21	5319.000	N
	7	5297.000	Y	22	5319.000	Y
	8	5297.000	N	23	5319.000	Y
	9	5297.000	Y	24	5319.000	Y
	10	5297.000	Y	25	5319.000	N
	11	5310.000	Y	26	5330.000	Y
	12	5310.000	Y	27	5330.000	Y
	13	5310.000	N	28	5330.000	Y
	14	5310.000	Y	29	5330.000	Y
	15	5310.000	Y	30	5330.000	Y
EUT Test Frequency : 5320.000 MHz				Total Detected		26 (86.67 %)

Table 37 - Statistical Analysis for Radar Type 1

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
2	1	5291.000	Y	16	5312.000	Y
	2	5291.000	Y	17	5312.000	Y
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	Y
	5	5291.000	Y	20	5312.000	Y
	6	5297.000	N	21	5319.000	Y
	7	5297.000	Y	22	5319.000	Y
	8	5297.000	N	23	5319.000	Y
	9	5297.000	Y	24	5319.000	N
	10	5297.000	Y	25	5319.000	Y
	11	5310.000	Y	26	5330.000	N
	12	5310.000	Y	27	5330.000	Y
	13	5310.000	Y	28	5330.000	Y
	14	5310.000	N	29	5330.000	N
	15	5310.000	N	30	5330.000	Y
EUT Test Frequency : 5320.000 MHz				Total Detected		23 (76.67 %)

Table 38 - Statistical Analysis for Radar Type 2

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
3	1	5291.000	Y	16	5312.000	Y
	2	5291.000	Y	17	5312.000	Y
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	N
	5	5291.000	Y	20	5312.000	Y
	6	5297.000	N	21	5319.000	Y
	7	5297.000	Y	22	5319.000	Y
	8	5297.000	Y	23	5319.000	N
	9	5297.000	Y	24	5319.000	Y
	10	5297.000	Y	25	5319.000	Y
	11	5310.000	Y	26	5330.000	Y
	12	5310.000	Y	27	5330.000	Y
	13	5310.000	Y	28	5330.000	Y
	14	5310.000	N	29	5330.000	N
	15	5310.000	Y	30	5330.000	Y
EUT Test Frequency : 5320.000 MHz				Total Detected		25 (83.33 %)

Table 39 - Statistical Analysis for Radar Type 3

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
4	1	5291.000	Y	16	5312.000	N
	2	5291.000	Y	17	5312.000	Y
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	Y
	5	5291.000	Y	20	5312.000	Y
	6	5297.000	Y	21	5319.000	Y
	7	5297.000	Y	22	5319.000	N
	8	5297.000	Y	23	5319.000	Y
	9	5297.000	N	24	5319.000	Y
	10	5297.000	Y	25	5319.000	Y
	11	5310.000	Y	26	5330.000	N
	12	5310.000	Y	27	5330.000	Y
	13	5310.000	Y	28	5330.000	Y
	14	5310.000	N	29	5330.000	Y
	15	5310.000	Y	30	5330.000	Y
EUT Test Frequency : 5320.000 MHz				Total Detected		25 (83.33 %)

Table 40 - Statistical Analysis for Radar Type 4

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	30	26	86.67 %
2	30	23	76.67 %
3	30	25	83.33 %
4	30	25	83.33 %
Aggregate (86.67 % + 76.67 % + 83.33 % + 83.33 %) / 4 = 82.50 %			

Table 41 – Overall Statistical Analysis for Short Radar Types 1 to 4

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
5	1	5310.000	Y	16	5299.856	Y
	2	5310.000	Y	17	5299.856	Y
	3	5310.000	Y	18	5299.056	Y
	4	5310.000	Y	19	5299.456	Y
	5	5310.000	Y	20	5299.856	Y
	6	5310.000	Y	21	5320.687	Y
	7	5310.000	Y	22	5320.687	Y
	8	5310.000	Y	23	5320.287	Y
	9	5310.000	Y	24	5320.287	Y
	10	5310.000	Y	25	5321.087	Y
	11	5299.856	Y	26	5320.687	Y
	12	5298.656	Y	27	5320.287	Y
	13	5299.856	Y	28	5320.287	Y
	14	5299.856	Y	29	5320.287	Y
	15	5298.656	Y	30	5320.287	Y
EUT Test Frequency : 5320.000 MHz				Total Detected		30 (100 %)

Table 42 - Statistical Analysis for Radar Type 5

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
6	1	Frequency Hopping	Y	16	Frequency Hopping	Y
	2	Frequency Hopping	Y	17	Frequency Hopping	Y
	3	Frequency Hopping	Y	18	Frequency Hopping	Y
	4	Frequency Hopping	Y	19	Frequency Hopping	Y
	5	Frequency Hopping	Y	20	Frequency Hopping	Y
	6	Frequency Hopping	Y	21	Frequency Hopping	Y
	7	Frequency Hopping	Y	22	Frequency Hopping	Y
	8	Frequency Hopping	Y	23	Frequency Hopping	Y
	9	Frequency Hopping	Y	24	Frequency Hopping	N
	10	Frequency Hopping	Y	25	Frequency Hopping	Y
	11	Frequency Hopping	Y	26	Frequency Hopping	Y
	12	Frequency Hopping	Y	27	Frequency Hopping	Y
	13	Frequency Hopping	Y	28	Frequency Hopping	Y
	14	Frequency Hopping	Y	29	Frequency Hopping	Y
	15	Frequency Hopping	Y	30	Frequency Hopping	Y
EUT Test Frequency : 5320.000 MHz				Total Detected		28 (93.33 %)

Table 43 - Statistical Analysis for Radar Type 6

FCC Part 15E, Limit Clause

None Specified

Industry Canada RSS-247, Limit Clause

None Specified

KDB 905462 D02, Limit Clause 6

Radar Type	Pulse Length Type	Minimum Percentage of Successful Detection (%)	Minimum Number of Trials
0	Short Pulse	-	-
1	Short Pulse	60	30
2	Short Pulse	60	30
3	Short Pulse	60	30
4	Short Pulse	60	30
Aggregate (1-4)	Short Pulse	80	120
5	Long Pulse	80	30
6	Frequency Hopping	70	30

802.11n 40 MHz Bandwidth

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
1	1	5291.000	Y	16	5312.000	Y
	2	5291.000	Y	17	5312.000	Y
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	Y
	5	5291.000	Y	20	5312.000	Y
	6	5297.000	Y	21	5319.000	Y
	7	5297.000	N	22	5319.000	Y
	8	5297.000	Y	23	5319.000	Y
	9	5297.000	Y	24	5319.000	Y
	10	5297.000	Y	25	5319.000	Y
	11	5310.000	Y	26	5330.000	Y
	12	5310.000	Y	27	5330.000	Y
	13	5310.000	Y	28	5330.000	Y
	14	5310.000	Y	29	5330.000	Y
	15	5310.000	Y	30	5330.000	Y
EUT Test Frequency : 5310.000 MHz				Total Detected		29 (96.67 %)

Table 44 - Statistical Analysis for Radar Type 1

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
2	1	5291.000	Y	16	5312.000	Y
	2	5291.000	Y	17	5312.000	Y
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	Y
	5	5291.000	Y	20	5312.000	N
	6	5297.000	Y	21	5319.000	Y
	7	5297.000	N	22	5319.000	Y
	8	5297.000	Y	23	5319.000	Y
	9	5297.000	Y	24	5319.000	Y
	10	5297.000	Y	25	5319.000	Y
	11	5310.000	Y	26	5330.000	Y
	12	5310.000	Y	27	5330.000	Y
	13	5310.000	Y	28	5330.000	Y
	14	5310.000	Y	29	5330.000	Y
	15	5310.000	Y	30	5330.000	Y
EUT Test Frequency : 5310.000 MHz				Total Detected		28 (93.33 %)

Table 45 - Statistical Analysis for Radar Type 2

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
3	1	5291.000	Y	16	5312.000	Y
	2	5291.000	Y	17	5312.000	Y
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	N
	5	5291.000	Y	20	5312.000	Y
	6	5297.000	Y	21	5319.000	Y
	7	5297.000	Y	22	5319.000	Y
	8	5297.000	Y	23	5319.000	N
	9	5297.000	Y	24	5319.000	Y
	10	5297.000	Y	25	5319.000	Y
	11	5310.000	Y	26	5330.000	Y
	12	5310.000	Y	27	5330.000	Y
	13	5310.000	Y	28	5330.000	N
	14	5310.000	Y	29	5330.000	Y
	15	5310.000	Y	30	5330.000	Y
EUT Test Frequency : 5310.000 MHz				Total Detected		27 (90.00 %)

Table 46 - Statistical Analysis for Radar Type 3

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
4	1	5291.000	Y	16	5312.000	Y
	2	5291.000	N	17	5312.000	N
	3	5291.000	Y	18	5312.000	Y
	4	5291.000	Y	19	5312.000	Y
	5	5291.000	Y	20	5312.000	Y
	6	5297.000	Y	21	5319.000	N
	7	5297.000	Y	22	5319.000	Y
	8	5297.000	Y	23	5319.000	Y
	9	5297.000	N	24	5319.000	Y
	10	5297.000	N	25	5319.000	Y
	11	5310.000	Y	26	5330.000	Y
	12	5310.000	N	27	5330.000	Y
	13	5310.000	Y	28	5330.000	Y
	14	5310.000	Y	29	5330.000	Y
	15	5310.000	Y	30	5330.000	Y
EUT Test Frequency : 5310.000 MHz				Total Detected		24 (80.00%)

Table 47 - Statistical Analysis for Radar Type 4

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	30	29	96.67 %
2	30	28	93.33 %
3	30	27	90.00 %
4	30	24	80.00 %
Aggregate (96.67 % + 93.33 % + 90.00 % + 80.00 %) / 4 = 90.00 %			

Table 48 – Overall Statistical Analysis for Short Radar Types 1 to 4

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
5	1	5310.000	Y	16	5299.856	Y
	2	5310.000	Y	17	5299.856	Y
	3	5310.000	Y	18	5299.056	Y
	4	5310.000	Y	19	5299.456	Y
	5	5310.000	Y	20	5299.856	Y
	6	5310.000	Y	21	5320.687	Y
	7	5310.000	Y	22	5320.687	Y
	8	5310.000	Y	23	5320.287	Y
	9	5310.000	Y	24	5320.287	Y
	10	5310.000	Y	25	5321.087	Y
	11	5299.856	Y	26	5320.687	Y
	12	5298.656	Y	27	5320.287	Y
	13	5299.856	Y	28	5320.287	Y
	14	5299.856	Y	29	5320.287	Y
	15	5298.656	Y	30	5320.287	Y
EUT Test Frequency : 5310.000 MHz				Total Detected		30 (100 %)

Table 49 - Statistical Analysis for Radar Type 5

Radar Type	Trial No	Frequency (MHz)	Detection (Y/N)	Trial No	Frequency (MHz)	Detection (Y/N)
6	1	Frequency Hopping	N	16	Frequency Hopping	Y
	2	Frequency Hopping	Y	17	Frequency Hopping	Y
	3	Frequency Hopping	Y	18	Frequency Hopping	Y
	4	Frequency Hopping	Y	19	Frequency Hopping	Y
	5	Frequency Hopping	Y	20	Frequency Hopping	Y
	6	Frequency Hopping	Y	21	Frequency Hopping	Y
	7	Frequency Hopping	Y	22	Frequency Hopping	Y
	8	Frequency Hopping	Y	23	Frequency Hopping	Y
	9	Frequency Hopping	Y	24	Frequency Hopping	Y
	10	Frequency Hopping	N	25	Frequency Hopping	Y
	11	Frequency Hopping	Y	26	Frequency Hopping	Y
	12	Frequency Hopping	Y	27	Frequency Hopping	Y
	13	Frequency Hopping	Y	28	Frequency Hopping	Y
	14	Frequency Hopping	Y	29	Frequency Hopping	Y
	15	Frequency Hopping	Y	30	Frequency Hopping	Y
EUT Test Frequency : 5310.000 MHz				Total Detected		28 (93.33%)

Table 50 - Statistical Analysis for Radar Type 6

FCC Part 15E, Limit Clause

None Specified

Industry Canada RSS-247, Limit Clause

None Specified

KDB 905462 D02, Limit Clause 6

Radar Type	Pulse Length Type	Minimum Percentage of Successful Detection (%)	Minimum Number of Trials
0	Short Pulse	-	-
1	Short Pulse	60	30
2	Short Pulse	60	30
3	Short Pulse	60	30
4	Short Pulse	60	30
Aggregate (1-4)	Short Pulse	80	120
5	Long Pulse	80	30
6	Frequency Hopping	70	30

2.7.7 Test Location

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2017
20dB/2W Attenuator	Narda	4772-20	462	-	TU
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
PXI RF Digitizer	Aeroflex	3035	4012	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3010	4013	24	29-Jan-2018
PXI RF Synthesizer	Aeroflex	3011	4014	24	29-Jan-2018
PXI Digital RF Signal Generator	Aeroflex	3025	4015	24	29-Jan-2018
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	12-Aug-2017
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	12-Aug-2017

Table 51

TU - Traceability Unscheduled
O/P Mon - Output Monitored using calibrated equipment

3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Calibration of Test Setup	N/A
U-NII Detection Bandwidth	Radar Level: ± 1.29 dB
Initial Channel Availability Check	Time: ± 0.47 %
Radar Burst at the Beginning of the Channel Availability Check Time	Time: ± 0.47 %
Radar Burst at the Beginning of the Channel Availability Check Time	Time: ± 0.47 %
In-Service Monitoring	Time: ± 0.47 % Radar Level: ± 1.29 dB
Statistical Performance Check	Radar Level: ± 1.29 dB

Table 52

4 DFS Test Equipment

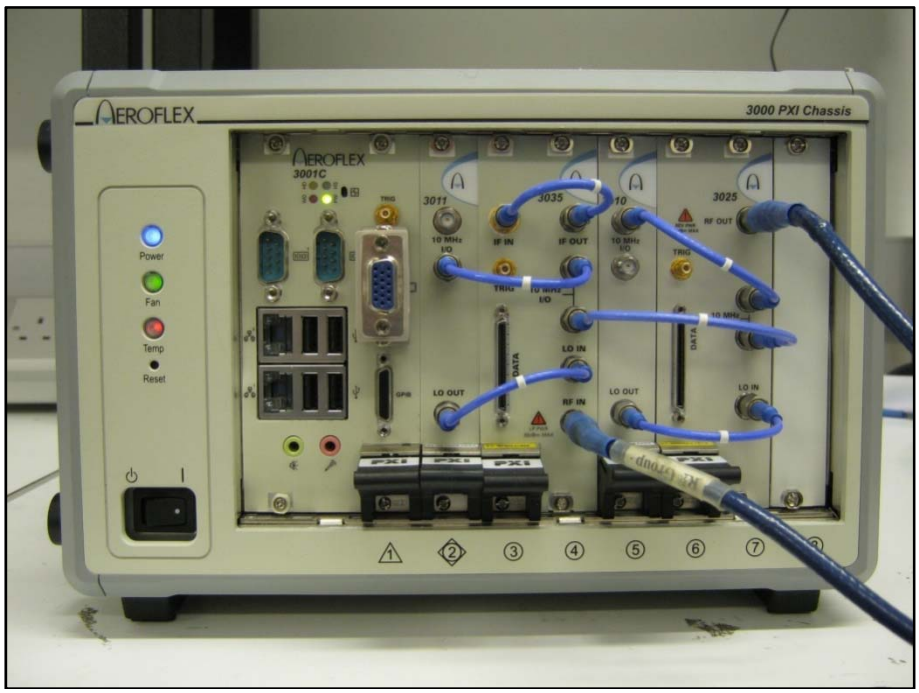

Figure 59 - Test Set Up

ANNEX A

TEST WAVEFORMS USED

Type 0 Waveforms

Pulse Width (µsec)	Number of Pulses	Pulse Repetition Interval (µsec)
1	18	1428

Type 1 Waveforms

Trial Number	Pulse Width (µsec)	Number of Pulses	Pulse Repetition Interval (µsec)
1	1	83	638
2	1	59	898
3	1	95	558
4	1	99	538
5	1	72	738
6	1	92	578
7	1	57	938
8	1	58	918
9	1	67	798
10	1	62	858
11	1	89	598
12	1	63	838
13	1	78	678
14	1	68	778
15	1	81	658
16	1	23	2387
17	1	92	576
18	1	21	2602
19	1	21	2638
20	1	75	713
21	1	28	1899
22	1	93	573
23	1	40	1337
24	1	25	2173
25	1	19	2778
26	1	23	2337
27	1	29	1877
28	1	57	937
29	1	21	2527
30	1	22	2450

Type 2 Waveforms

Trial Number	Pulse Width (µsec)	Number of Pulses	Pulse Repetition Interval (µsec)
1	3.5	25	200
2	2.9	25	229
3	2.0	29	186
4	2.9	27	201
5	4.1	27	224
6	2.0	23	172
7	4.9	23	210
8	1.4	28	154
9	1.2	26	172
10	1.7	26	170
11	3.6	23	195
12	3.5	29	172
13	1.7	29	179
14	1.0	26	188
15	4.3	26	178
16	4.9	25	170
17	4.9	26	201
18	2.6	23	165
19	3.5	26	191
20	3.3	27	183
21	4.4	24	156
22	3.2	23	217
23	2.8	27	161
24	3.7	29	155
25	1.8	24	226
26	3.3	27	173
27	2.5	23	158
28	1.1	27	166
29	1.0	25	170
30	1.3	28	150

Type 3 Waveforms

Trial Number	Pulse Width (µsec)	Number of Pulses	Pulse Repetition Interval (µsec)
1	7.7	18	382
2	6.8	17	252
3	7.5	17	281
4	7.5	16	357
5	9.1	17	289
6	8.1	16	253
7	9.1	16	214
8	9.5	16	259
9	8.7	18	441
10	8.3	17	362
11	8.8	16	305
12	9.6	17	272
13	9.9	18	200
14	9.5	16	261
15	6.8	17	202
16	9.7	18	284
17	6.2	16	347
18	6.4	18	295
19	8.2	17	374
20	8.6	17	361
21	8.1	18	437
22	9.7	16	402
23	9.9	16	466
24	6.4	16	368
25	7.9	18	471
26	6.8	16	397
27	8.9	17	428
28	9.9	16	357
29	8.1	16	374
30	6.7	17	304

Type 4 Waveforms

Trial Number	Pulse Width (µsec)	Number of Pulses	Pulse Repetition Interval (µsec)
1	11.4	14	295
2	14.6	14	304
3	13.6	13	282
4	14.7	13	486
5	18.7	16	486
6	19.1	14	390
7	11.9	16	302
8	12.9	15	478
9	18.7	13	366
10	17.2	12	322
11	12.2	14	434
12	14.6	13	215
13	17.4	14	226
14	14.9	13	471
15	18.7	16	293
16	12.1	14	236
17	12.0	16	386
18	16.5	12	224
19	17.7	13	451
20	17.2	15	364
21	12.3	16	383
22	13.2	12	280
23	18.8	16	335
24	17.2	14	256
25	18.8	14	403
26	15.9	15	308
27	19.8	14	418
28	17.3	15	369
29	12.3	15	358
30	15.8	13	398

Type 5 Waveforms

Trial Number 1				
Number of Segments: 19				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	17	0	0	179393
1	14	0	0	27754
2	15	1608	0	272476
2	17	1334	0	357725
1	17	0	0	453667
3	12	978	1011	62437
3	10	1719	1607	525273
1	6	0	0	247942
1	16	0	0	358883
1	17	0	0	15913
1	16	0	0	487066
1	12	0	0	471123
1	16	0	0	251338
3	11	1451	1240	99512
3	20	1502	1174	250690
2	11	1113	0	455849
1	10	0	0	380501
2	16	1260	0	611266
1	10	0	0	590427

Trial Number 2				
Number of Segments: 17				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	16	1496	1833	418571
1	7	0	0	368950
3	13	1036	1293	80073
1	9	0	0	16172
3	10	1700	1311	232323
3	10	1916	1517	386348
1	11	0	0	83853
3	13	1495	1414	664548
1	16	0	0	275756
2	5	1775	0	636931
3	19	1854	1889	643061
3	14	1828	1022	655860
1	10	0	0	691602
3	8	1072	1744	8783
3	19	1632	1451	53655
1	6	0	0	102112
2	17	1472	0	100816

Trial Number 3				
Number of Segments: 20				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	5	1240	0	575902
3	5	938	1819	230340
2	20	1703	0	418494
1	9	0	0	225773
3	11	1768	1074	368726
3	12	1036	1099	483318
3	8	933	1015	315662
1	7	0	0	541086
3	16	1524	1186	71357
2	20	1853	0	139232
3	8	1718	1127	98138
2	12	1462	0	523802
3	14	1825	1671	455821
2	17	1164	0	149006
1	16	0	0	82647
2	16	1510	0	406994
1	14	0	0	41975
3	8	1781	1264	421313
1	10	0	0	494961
3	5	1310	1315	354289

Trial Number 4				
Number of Segments: 10				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	20	1459	0	1014761
3	6	1582	1942	223377
3	16	1344	907	603610
1	13	0	0	859101
1	6	0	0	714392
3	17	939	1413	1178725
1	12	0	0	838412
1	13	0	0	1193197
1	17	0	0	874774
3	17	1371	991	609106

Trial Number 5				
Number of Segments: 9				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	14	971	0	619454
1	19	0	0	1230023
1	9	0	0	83052
1	18	0	0	1218514
2	10	1366	0	1267956
1	11	0	0	1230256
2	6	1772	0	361934
2	19	1907	0	907190
3	5	1343	1847	874090

Trial Number 6				
Number of Segments: 16				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	19	1669	1531	523140
1	6	0	0	42258
1	14	0	0	176472
1	13	0	0	601348
3	6	1740	1301	724287
1	10	0	0	102132
3	14	1354	1693	240839
1	13	0	0	143846
3	20	1915	1095	415757
1	11	0	0	334556
3	12	1573	1093	602939
2	18	1858	0	434118
2	20	1807	0	562887
2	19	1167	0	43320
3	10	1885	1089	668189
1	18	0	0	614694

Trial Number 7				
Number of Segments: 20				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	12	1549	1755	569708
1	17	0	0	71763
2	14	1356	0	161758
3	11	1038	1372	167633
1	19	0	0	140492
1	5	0	0	547328
2	5	1019	0	386855
2	13	1156	0	540333
2	20	1404	0	561490
2	16	1428	0	522587
3	8	1644	1292	390133
2	14	1335	0	423947
1	5	0	0	190207
3	13	1896	1713	466006
2	13	1493	0	579636
1	12	0	0	322412
3	8	1072	1919	295231
1	16	0	0	595294
1	20	0	0	492238
1	8	0	0	565409

Trial Number 8				
Number of Segments: 10				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	19	0	0	928110
3	12	1019	1654	185253
2	20	976	0	39411
2	5	1039	0	62018
3	7	1760	1897	906883
3	6	1253	1260	904687
2	8	1513	0	1008152
2	5	1441	0	504867
2	9	1580	0	71063
3	7	1793	1101	130255

Trial Number 9				
Number of Segments: 19				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	18	1008	0	504503
3	20	937	1314	515586
3	12	1766	1395	501790
3	5	1458	1322	49525
1	10	0	0	441349
3	19	1361	1058	406785
2	13	1712	0	471859
3	16	1464	1343	53893
1	15	0	0	378373
1	11	0	0	133906
2	10	1885	0	376954
3	12	1184	1388	248063
1	15	0	0	12619
2	9	1611	0	31120
3	9	1946	1931	623184
3	16	1001	1608	67422
2	13	1531	0	69774
1	20	0	0	137658
2	9	1082	0	193045

Trial Number 10				
Number of Segments: 9				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	6	1227	0	1155908
3	10	1507	1683	474158
3	6	1500	1682	214551
3	14	1648	1104	569879
2	10	1662	0	1107086
2	5	1762	0	900270
3	10	1548	1739	1114071
1	18	0	0	1253824
3	9	1258	1773	848750

Trial Number 11				
Number of Segments: 15				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	18	0	0	561700
2	7	1602	0	196481
2	13	1829	0	624102
3	9	1684	936	173563
1	19	0	0	782526
2	8	1492	0	535840
3	18	1094	1780	551038
2	20	1313	0	509467
1	13	0	0	226193
1	20	0	0	126698
1	5	0	0	470327
3	12	1660	1529	700711
1	8	0	0	460712
1	14	0	0	183849
1	6	0	0	175308

Trial Number 12				
Number of Segments: 14				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	10	0	0	14191
1	15	0	0	645368
3	6	1370	1327	668622
2	17	1384	0	822018
3	16	1773	1360	533844
3	16	1942	1313	833685
1	16	0	0	596964
1	11	0	0	182693
3	7	1423	1619	130612
1	15	0	0	180261
1	14	0	0	111245
1	14	0	0	443583
3	9	1669	1877	646537
2	5	1468	0	583164

Trial Number 13				
Number of Segments: 9				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	10	0	0	294420
1	20	0	0	238904
1	13	0	0	459498
2	17	1759	0	540944
3	10	1013	1646	688772
1	7	0	0	20353
2	18	1095	0	730331
3	6	1616	1086	464852
1	11	0	0	565946

Trial Number 14				
Number of Segments: 13				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	20	1241	1367	908356
2	6	1903	0	310854
3	5	1286	1243	810510
3	5	1204	1030	888887
2	11	983	0	614284
1	8	0	0	864514
3	18	1069	1882	768876
2	14	1271	0	80502
2	14	1585	0	630497
3	8	1392	1738	349400
1	19	0	0	475791
2	19	1836	0	394639
1	11	0	0	299970

Trial Number 15				
Number of Segments: 9				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	10	0	0	59817
2	12	1884	0	31769
2	8	1651	0	519758
3	15	1721	1097	383829
1	8	0	0	575822
1	12	0	0	923857
3	17	1066	1181	759218
2	15	1073	0	91474
2	7	1465	0	689440

Trial Number 16				
Number of Segments: 9				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	13	0	0	23061
2	20	1175	0	27315
3	20	1836	1637	651068
3	5	1051	1496	539369
3	19	1211	1291	380855
3	10	942	1597	527001
3	8	1848	1562	375799
2	19	1148	0	505529
2	16	1337	0	146854
3	7	1363	1876	679822
2	15	1706	0	43947
1	15	0	0	497824
3	9	1070	1680	505230
3	13	1744	1712	607111
3	10	1605	1537	68812
2	8	1791	0	191881

Trial Number 17				
Number of Segments: 18				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	6	1241	1821	295077
1	9	0	0	383617
3	9	1540	1611	344866
3	14	1571	1115	64499
3	9	1000	1365	624059
3	11	1900	926	345380
1	14	0	0	333105
1	12	0	0	157146
2	16	1030	0	255190
1	20	0	0	566491
1	15	0	0	404511
3	11	950	1723	662397
2	11	1051	0	539354
1	10	0	0	357346
3	18	1452	1060	617570
2	19	1109	0	464895
2	17	1918	0	162095
3	19	1385	1155	115513

Trial Number 18				
Number of Segments: 13				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	6	1432	0	139487
3	18	1513	1556	811423
1	10	0	0	687923
2	9	1254	0	465104
3	13	1793	1901	382844
3	18	1808	1851	286436
3	11	1387	964	409195
2	5	1272	0	83796
3	16	1525	1798	897496
3	8	1825	1608	546964
1	9	0	0	488793
3	17	1918	1692	686222
2	11	1861	0	283507

Trial Number 19				
Number of Segments: 14				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	16	0	0	394739
2	17	1158	0	204854
3	6	1933	1575	602793
2	11	1114	0	778787
3	15	1419	1149	325548
2	6	1323	0	197831
3	11	920	1243	124315
1	8	0	0	647022
1	19	0	0	56503
3	6	940	1045	235319
3	11	1653	1229	188420
1	6	0	0	585868
3	18	1522	1007	380083
2	11	1199	0	733864

Trial Number 20				
Number of Segments: 12				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	15	1568	1668	447405
2	8	931	0	922101
1	8	0	0	270328
2	6	1835	0	991832
3	5	1841	1348	345500
1	11	0	0	500520
2	11	1540	0	833830
1	16	0	0	495800
3	16	1376	1649	217255
3	18	1109	1867	929591
1	18	0	0	361436
2	17	1142	0	377648

Trial Number 21				
Number of Segments: 13				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	16	0	0	313111
1	15	0	0	328824
1	20	0	0	563946
1	8	0	0	91419
1	15	0	0	36497
1	12	0	0	524280
2	13	1197	0	431582
1	12	0	0	108643
1	16	0	0	678562
2	6	1611	0	475980
1	19	0	0	610115
1	7	0	0	247364
3	13	1285	1266	233581

Trial Number 22				
Number of Segments: 14				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	13	0	0	109823
2	19	1215	0	428923
2	5	1398	0	311324
3	14	1293	1535	784842
1	16	0	0	246038
1	8	0	0	231925
1	17	0	0	9415
1	14	0	0	379012
2	9	1531	0	197286
1	7	0	0	347751
2	19	1859	0	449193
3	16	1236	1280	448842
1	6	0	0	191109
3	6	1462	1632	684302

Trial Number 23				
Number of Segments: 20				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	12	0	0	559073
2	20	1635	0	70089
1	19	0	0	305555
2	10	1633	0	598085
3	16	1782	988	131765
2	6	1848	0	349676
3	12	1509	1502	224375
1	14	0	0	198899
3	15	1175	1245	394752
2	16	1312	0	189163
2	19	1420	0	105999
2	8	1502	0	460928
3	6	1130	1250	63987
1	7	0	0	105967
3	15	1855	1526	59417
2	13	1874	0	159060
2	9	1469	0	207906
2	11	1904	0	232437
1	13	0	0	548584
3	6	951	1477	63720

Trial Number 24				
Number of Segments: 16				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	12	1224	0	656053
3	6	1736	911	505633
2	15	1419	0	624787
2	13	1072	0	368920
1	14	0	0	74925
1	19	0	0	417376
2	5	1768	0	440719
3	17	1195	1404	415922
1	7	0	0	285532
2	5	1219	0	140011
3	6	1925	1865	137362
2	18	1113	0	575990
3	13	1276	1264	501271
3	18	1063	939	278868
2	20	1100	0	30664
2	16	999	0	529633

Trial Number 25				
Number of Segments: 17				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	14	956	1864	284687
2	19	982	0	494614
2	18	1743	0	47114
3	7	1350	947	473009
1	20	0	0	675829
1	5	0	0	593180
2	9	1216	0	473849
1	15	0	0	606736
2	9	1030	0	207545
3	17	1257	1168	239296
1	19	0	0	195856
3	20	972	954	674762
2	19	990	0	435780
3	18	1085	1473	262594
1	15	0	0	645725
3	17	1730	1477	107811
3	15	1653	1279	569561

Trial Number 26				
Number of Segments: 8				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	14	1588	0	972696
3	19	1308	961	1012534
3	18	1122	1646	1447379
3	7	1293	1842	913025
1	20	0	0	1207881
3	5	1287	1191	258089
1	9	0	0	393248
3	15	1413	1280	612968

Trial Number 27				
Number of Segments: 15				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	11	0	0	177700
2	16	1745	0	760012
2	16	1804	0	48267
2	6	1413	0	589495
1	11	0	0	501314
3	13	1357	1172	242806
2	5	1411	0	49848
1	6	0	0	466484
1	12	0	0	449208
1	14	0	0	440512
3	9	1337	1684	16541
2	19	1645	0	305181
2	20	1922	0	364140
2	16	1579	0	162886
3	8	1016	1414	262095

Trial Number 28				
Number of Segments: 12				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
2	6	1935	0	317703
1	8	0	0	986872
3	17	1291	1160	153958
2	14	944	0	147712
2	5	1872	0	888764
3	20	1187	974	281723
1	9	0	0	587798
3	11	1059	1341	231094
3	14	1535	1912	266888
3	13	1313	1412	474913
1	15	0	0	28922
1	10	0	0	777719

Trial Number 29				
Number of Segments: 18				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
3	15	1471	973	80137
2	17	1370	0	317427
2	14	1473	0	295562
1	15	0	0	261795
1	15	0	0	524060
3	9	1887	1725	332564
1	15	0	0	272638
3	20	962	1837	97668
1	17	0	0	640334
1	9	0	0	243859
1	18	0	0	127511
3	13	1202	1231	557313
3	18	1622	1445	173527
1	20	0	0	338064
3	12	1224	1941	357588
1	19	0	0	456285
3	8	1815	1812	143598
3	6	1205	1803	333517

Trial Number 30				
Number of Segments: 10				
Number of Pulses	Chirp Width (MHz)	Pulse 1 to 2 spacing (µsec)	Pulse 2 to 3 spacing (µsec)	Starting Location Within Interval (µsec)
1	10	0	0	362579
2	13	1731	0	381481
3	13	923	1031	659353
1	9	0	0	751832
2	6	1841	0	376403
3	9	1497	942	720703
3	10	1738	1242	62080
2	13	1040	0	504110
3	20	1417	1316	1070472
1	19	0	0	1151572

Type 6 Waveforms

Trial #	Hopping Frequency List (MHz)
1	5713, 5359, 5329, 5539, 5282, 5393, 5268, 5424, 5629, 5495, 5691, 5625, 5590, 5338, 5301, 5335, 5341, 5626, 5486, 5515, 5678, 5617, 5498, 5684, 5607, 5546, 5688, 5641, 5509, 5677, 5349, 5469, 5308, 5555, 5598, 5449, 5332, 5350, 5372, 5605, 5536, 5663, 5587, 5528, 5483, 5284, 5597, 5635, 5431, 5583, 5394, 5547, 5416, 5277, 5345, 5585, 5370, 5656, 5461, 5429, 5351, 5639, 5395, 5471, 5566, 5285, 5464, 5576, 5252, 5715, 5504, 5703, 5265, 5280, 5695, 5451, 5573, 5673, 5302, 5460, 5410, 5343, 5679, 5647, 5527, 5502, 5588, 5687, 5418, 5636, 5425, 5435, 5273, 5382, 5261, 5442, 5562, 5420, 5579, 5346.
2	5593, 5614, 5666, 5437, 5262, 5315, 5615, 5644, 5333, 5512, 5377, 5478, 5583, 5440, 5549, 5673, 5482, 5687, 5713, 5290, 5546, 5429, 5518, 5716, 5369, 5562, 5439, 5380, 5360, 5606, 5314, 5475, 5705, 5430, 5515, 5697, 5293, 5335, 5373, 5298, 5544, 5519, 5302, 5667, 5436, 5494, 5330.000, 5458, 5590, 5306, 5296, 5271, 5486, 5643, 5270, 5670, 5303, 5454, 5677, 5402, 5495, 5258, 5414, 5358, 5375, 5568, 5493, 5691, 5500, 5265, 5721, 5461, 5469, 5381, 5698, 5447, 5317, 5619, 5252, 5611, 5280, 5398, 5511, 5491, 5563, 5383, 5696, 5528, 5536, 5354, 5668, 5541, 5592, 5250, 5363, 5682, 5574, 5309, 5560, 5526.
3	5355, 5669, 5548, 5603, 5408, 5451, 5316, 5371, 5346, 5717, 5406, 5653, 5331, 5349, 5706, 5446, 5259, 5407, 5327, 5498, 5577, 5412, 5342, 5373, 5328, 5384, 5610, 5642, 5440, 5416, 5673, 5594, 5492, 5364, 5566, 5671, 5612, 5485, 5362, 5317, 5574, 5431, 5543, 5264, 5459, 5493, 5268, 5641, 5477, 5626, 5482, 5277, 5502, 5506, 5456, 5479, 5330.000, 5430, 5454, 5631, 5551, 5457, 5309, 5564, 5710, 5390, 5500, 5586, 5295, 5260, 5649, 5396, 5393, 5358, 5616, 5592, 5251, 5491, 5663, 5297.000, 5361, 5464, 5465, 5383, 5404, 5611, 5369, 5524, 5716, 5680, 5619, 5508, 5391, 5552, 5580, 5471, 5353, 5356, 5637, 5312.000.
4	5355, 5669, 5548, 5603, 5408, 5451, 5316, 5371, 5346, 5717, 5406, 5653, 5331, 5349, 5706, 5446, 5259, 5407, 5327, 5498, 5577, 5412, 5342, 5373, 5328, 5384, 5610, 5642, 5440, 5416, 5673, 5594, 5492, 5364, 5566, 5671, 5612, 5485, 5362, 5317, 5574, 5431, 5543, 5264, 5459, 5493, 5268, 5641, 5477, 5626, 5482, 5277, 5502, 5506, 5456, 5479, 5330.000, 5430, 5454, 5631, 5551, 5457, 5309, 5564, 5710, 5390, 5500, 5586, 5295, 5260, 5649, 5396, 5393, 5358, 5616, 5592, 5251, 5491, 5663, 5297.000, 5361, 5464, 5465, 5383, 5404, 5611, 5369, 5524, 5716, 5680, 5619, 5508, 5391, 5552, 5580, 5471, 5353, 5356, 5637, 5312.000.
5	5545, 5305, 5344, 5385, 5365, 5350, 5704, 5356, 5516, 5426, 5621, 5544, 5586, 5655, 5577, 5601, 5564, 5526, 5713, 5512, 5447, 5626, 5455, 5573, 5252, 5486, 5640, 5387, 5493, 5697, 5484, 5474, 5376, 5433, 5313, 5658, 5559, 5531, 5407, 5352, 5596, 5296, 5614, 5616, 5597, 5397, 5346, 5472, 5521, 5722, 5347, 5404, 5613, 5536, 5363, 5589, 5694, 5272, 5550, 5649, 5692, 5351, 5431, 5653, 5393, 5537, 5630, 5691, 5532, 5290, 5523, 5584, 5527, 5362, 5552, 5274, 5514, 5505, 5475, 5306, 5696, 5502, 5695, 5468, 5259, 5384, 5671, 5329, 5513, 5476, 5687, 5453, 5441, 5339, 5440, 5605, 5279, 5258, 5250, 5286.
6	5288, 5430, 5651, 5294, 5423, 5635, 5589, 5305, 5682, 5573, 5284, 5334, 5721, 5687, 5522, 5631, 5637, 5448, 5325, 5312.000, 5310.000, 5486, 5314, 5694, 5691, 5296, 5319.000, 5341, 5516, 5493, 5544, 5659, 5554, 5457, 5482, 5498, 5418, 5648, 5421, 5254, 5605, 5550, 5356, 5509, 5376, 5642, 5400, 5609, 5366, 5535, 5402, 5685, 5700, 5369, 5414, 5705, 5454, 5669, 5542, 5710, 5591, 5307, 5515, 5311, 5507, 5693, 5424, 5488, 5389, 5280, 5649, 5629, 5661, 5434, 5564, 5379, 5644, 5456, 5399, 5392, 5698, 5435, 5292, 5502, 5293, 5474, 5388, 5548, 5283, 5566, 5447, 5594, 5673, 5371, 5702, 5505, 5477, 5306, 5663, 5478.

Trial #	Hopping Frequency List (MHz)
7	5350, 5643, 5654, 5476, 5364, 5677, 5546, 5603, 5634, 5330.000, 5423, 5638, 5328, 5685, 5510, 5359, 5661, 5662, 5354, 5585, 5346, 5296, 5257, 5637, 5647, 5517, 5454, 5349, 5541, 5589, 5560, 5258, 5719, 5696, 5578, 5511, 5389, 5485, 5550, 5347, 5583, 5373, 5718, 5453, 5365, 5395, 5434, 5372, 5554, 5288, 5297.000, 5468, 5599, 5356, 5652, 5304, 5636, 5266, 5571, 5472, 5447, 5312.000, 5294, 5494, 5415, 5644, 5357, 5724, 5695, 5425, 5361, 5256, 5252, 5697, 5302, 5528, 5522, 5501, 5333, 5331, 5519, 5502, 5542, 5342, 5383, 5612, 5293, 5524, 5656, 5703, 5600, 5385, 5311, 5674, 5683, 5675, 5326, 5265, 5555, 5318.
8	5596, 5357, 5592, 5354, 5680, 5251, 5358, 5469, 5302, 5488, 5391, 5652, 5534, 5477, 5402, 5281, 5313, 5557, 5374, 5572, 5494, 5382, 5381, 5591, 5635, 5353, 5569, 5275, 5256, 5316, 5689, 5434, 5670, 5710, 5516, 5508, 5338, 5522, 5491, 5628, 5603, 5464, 5458, 5502, 5446, 5531, 5643, 5445, 5263, 5432, 5430, 5470, 5351, 5699, 5461, 5294, 5623, 5513, 5622, 5276, 5482, 5324, 5687, 5349, 5532, 5417, 5490, 5497, 5700, 5284, 5607, 5668, 5615, 5647, 5383, 5632, 5288, 5653, 5555, 5718, 5608, 5509, 5568, 5260, 5304, 5270, 5624, 5702, 5577, 5707, 5384, 5496, 5403, 5639, 5363, 5672, 5287, 5397, 5547, 5526.
9	5460, 5305, 5538, 5355, 5636, 5715, 5475, 5693, 5446, 5489, 5441, 5428, 5385, 5688, 5406, 5436, 5476, 5655, 5630, 5662, 5288, 5660, 5513, 5611, 5704, 5718, 5649, 5501, 5607, 5680, 5461, 5686, 5412, 5358, 5491, 5640, 5383, 5634, 5477, 5287, 5380, 5468, 5667, 5318, 5268, 5675, 5682, 5691, 5445, 5357, 5262, 5642, 5589, 5422, 5370, 5275, 5656, 5722, 5551, 5564, 5533, 5466, 5697, 5580, 5451, 5669, 5561, 5522, 5402, 5624, 5633, 5442, 5570, 5543, 5292, 5535, 5411, 5573, 5448, 5294, 5547, 5560, 5465, 5421, 5651, 5571, 5540, 5659, 5576, 5295, 5345, 5480, 5271, 5608, 5559, 5511, 5689, 5514, 5652, 5430.
10	5650, 5695, 5680, 5584, 5631, 5403, 5685, 5506, 5422, 5399, 5644, 5616, 5454, 5390, 5320, 5564, 5476, 5303, 5342, 5508, 5607, 5691, 5640, 5671, 5461, 5513, 5527, 5263, 5662, 5529, 5583, 5396, 5632, 5285, 5495, 5481, 5681, 5316, 5664, 5387, 5698, 5431, 5404, 5620, 5426, 5589, 5542, 5468, 5488, 5672, 5636, 5421, 5394, 5547, 5684, 5305, 5258, 5373, 5367, 5601, 5569, 5618, 5541, 5497, 5708, 5418, 5608, 5409, 5363, 5534, 5425, 5536, 5269, 5596, 5696, 5309, 5499, 5714, 5515, 5700, 5463, 5668, 5546, 5510, 5276, 5587, 5511, 5329, 5653, 5605, 5572, 5649, 5313, 5578, 5522, 5466, 5372, 5397, 5501, 5579.
11	5650, 5695, 5680, 5584, 5631, 5403, 5685, 5506, 5422, 5399, 5644, 5616, 5454, 5390, 5320, 5564, 5476, 5303, 5342, 5508, 5607, 5691, 5640, 5671, 5461, 5513, 5527, 5263, 5662, 5529, 5583, 5396, 5632, 5285, 5495, 5481, 5681, 5316, 5664, 5387, 5698, 5431, 5404, 5620, 5426, 5589, 5542, 5468, 5488, 5672, 5636, 5421, 5394, 5547, 5684, 5305, 5258, 5373, 5367, 5601, 5569, 5618, 5541, 5497, 5708, 5418, 5608, 5409, 5363, 5534, 5425, 5536, 5269, 5596, 5696, 5309, 5499, 5714, 5515, 5700, 5463, 5668, 5546, 5510, 5276, 5587, 5511, 5329, 5653, 5605, 5572, 5649, 5313, 5578, 5522, 5466, 5372, 5397, 5501, 5579.
12	5352, 5594, 5522, 5470, 5680, 5334, 5387, 5660, 5465, 5542, 5419, 5507, 5562, 5275, 5665, 5567, 5715, 5573, 5461, 5574, 5651, 5661, 5399, 5483, 5629, 5340, 5389, 5390, 5434, 5416, 5400, 5693, 5579, 5258, 5409, 5459, 5380, 5385, 5417, 5488, 5511, 5378, 5362, 5705, 5296, 5326, 5534, 5372, 5345, 5646, 5547, 5330.000, 5572, 5653, 5415, 5445, 5288, 5566, 5589, 5669, 5722, 5476, 5299, 5391, 5450, 5554, 5590, 5455, 5436, 5405, 5697, 5313, 5549, 5437, 5552, 5531, 5266, 5295, 5512, 5630, 5577, 5613, 5256, 5719, 5263, 5341, 5544, 5553, 5543, 5514, 5626, 5563, 5570, 5397, 5704, 5506, 5614, 5656, 5392, 5357.
13	5509, 5380, 5591, 5276, 5576, 5263, 5307, 5653, 5676, 5689, 5393, 5539, 5562, 5647, 5474, 5596, 5442, 5345, 5285, 5577, 5404, 5523, 5621, 5485, 5580, 5552, 5406, 5303, 5699, 5435, 5505, 5472, 5674, 5377, 5712, 5489, 5531, 5495, 5615, 5563, 5662, 5645, 5274, 5258, 5475, 5480, 5634, 5422, 5364, 5678, 5710, 5483, 5355, 5420, 5583, 5417, 5520, 5635, 5419, 5353, 5306, 5425, 5524, 5468, 5454, 5478, 5332, 5513, 5685, 5684, 5565, 5556, 5582, 5654, 5322, 5709, 5663, 5327, 5620, 5551, 5486, 5441, 5272, 5541, 5504, 5672, 5264, 5448, 5293, 5300, 5680, 5415, 5692, 5508, 5392, 5457, 5275, 5515, 5589, 5408.
14	5566, 5535, 5696, 5341, 5458, 5480, 5664, 5332, 5446, 5637, 5326, 5531, 5317, 5315, 5642, 5658, 5339, 5636, 5631, 5604, 5366, 5410, 5266, 5405, 5660, 5412, 5386, 5460, 5482, 5677, 5377, 5267, 5581, 5607, 5304, 5384, 5436, 5360, 5597, 5694, 5432, 5585, 5389, 5349, 5358, 5590, 5425, 5678, 5470, 5300, 5292, 5518, 5541, 5406, 5295, 5343, 5453, 5415, 5689, 5685, 5673, 5513, 5461, 5433, 5409, 5680, 5449, 5435, 5493, 5441, 5686, 5697, 5324, 5273, 5286, 5352, 5302, 5306, 5724, 5692, 5538, 5451, 5688, 5487, 5702, 5391, 5632, 5254, 5344, 5483, 5321, 5652, 5641, 5710, 5469, 5478, 5285, 5523, 5556, 5568.
15	5332, 5272, 5307, 5350, 5362, 5632, 5685, 5292, 5546, 5647, 5706, 5446, 5366, 5703, 5308, 5586, 5310.000, 5436, 5592, 5463, 5252, 5345, 5369, 5404, 5316, 5561, 5495, 5595, 5410, 5265, 5487, 5381, 5643, 5619, 5368, 5295, 5531, 5320, 5346, 5384, 5441, 5500, 5254, 5659, 5476, 5593, 5491, 5420, 5678, 5670, 5462, 5502, 5689, 5355, 5330.000, 5651, 5662, 5671, 5321, 5439, 5422, 5385, 5469, 5314, 5448, 5333, 5664, 5286, 5305, 5715, 5340, 5458, 5434, 5652, 5447, 5319.000, 5325, 5641, 5465, 5527, 5710, 5416, 5538, 5539, 5358, 5584, 5274, 5275, 5669, 5268, 5365, 5347, 5440, 5412, 5395, 5408, 5480, 5615, 5472, 5411.
16	5481, 5332, 5578, 5561, 5477, 5269, 5572, 5251, 5364, 5505, 5645, 5354, 5484, 5622, 5634, 5518, 5473, 5653, 5445, 5690, 5315, 5513, 5253, 5361, 5717, 5719, 5490, 5302, 5636, 5569, 5250, 5575, 5304, 5548, 5660, 5456, 5685, 5605, 5565, 5427, 5273, 5554, 5488, 5444, 5680, 5514, 5485, 5614, 5257, 5712, 5420, 5507, 5346, 5692, 5328, 5467, 5568, 5483, 5504, 5520, 5340, 5519, 5319.000, 5299, 5661, 5687, 5428, 5557, 5592, 5298, 5604, 5291.000, 5684, 5641, 5288, 5700, 5541, 5271, 5562, 5262, 5405, 5522, 5451, 5377, 5468, 5286, 5372, 5311, 5631, 5658, 5284, 5707, 5374, 5668, 5552, 5306, 5389, 5664, 5540, 5305.

Trial #	Hopping Frequency List (MHz)
17	5258, 5563, 5550, 5568, 5444, 5528, 5703, 5318, 5682, 5493, 5639, 5502, 5460, 5719, 5301, 5339, 5556, 5650, 5543, 5606, 5358, 5649, 5507, 5516, 5307, 5269, 5398, 5485, 5690, 5422, 5322, 5589, 5395, 5683, 5538, 5643, 5443, 5652, 5653, 5590, 5327, 5464, 5415, 5534, 5557, 5254, 5692, 5558, 5263, 5721, 5363, 5672, 5333, 5305, 5283, 5511, 5425, 5380, 5467, 5353, 5509, 5420, 5299, 5699, 5314, 5285, 5487, 5723, 5286, 5677, 5572, 5292, 5306, 5616, 5565, 5480, 5722, 5309, 5593, 5414, 5448, 5600, 5483, 5609, 5656, 5477, 5376, 5435, 5486, 5542, 5294, 5410, 5441, 5469, 5521, 5492, 5265, 5685, 5429, 5702.
18	5620, 5690, 5540, 5712, 5355, 5644, 5360, 5431, 5534, 5590, 5410, 5254, 5536, 5495, 5634, 5491, 5256, 5279, 5623, 5621, 5424, 5715, 5294, 5713, 5450, 5394, 5633, 5269, 5363, 5469, 5632, 5286, 5512, 5561, 5448, 5381, 5622, 5821,5703, 5603, 5487, 5710, 5263, 5494, 5300, 5422, 5457, 5265, 5330.000, 5445, 5699, 5496, 5629, 5499, 5316, 5523, 5530, 5571, 5297.000, 5509, 5708, 5322, 5292, 5600, 5314, 5642, 5517, 5361, 5476, 5465, 5525, 5582, 5334, 5631, 5454, 5551, 5565, 5537, 5315, 5449, 5372, 5592, 5430, 5352, 5282, 5312.000, 5702, 5594, 5510, 5601, 547, 5325, 5675, 5412, 5653, 5587, 5562, 5497, 5413, 5368,
19	5516, 5666, 5445, 5250, 5391, 5305, 5327, 5553, 5421, 5257, 5567, 5373, 5258, 5446, 5462, 5414, 5329, 5595, 5498, 5384, 5512, 5264, 5604, 5458, 5273, 5555, 5503, 5388, 5637, 5674, 5477, 5677, 5312.000, 5253, 5326, 5488, 5632, 5281, 5646, 5647, 5290, 5338, 5695, 5283, 5424, 5316, 5479, 5675, 5508, 5692, 5723, 5279, 5581, 5501, 5711, 5701, 5561, 5526, 5664, 5641, 5472, 5504, 5615, 5310.000, 5254, 5369, 5698, 5507, 5298, 5576, 5381, 5471, 5650, 5633, 5425, 5574, 5489, 5274, 5438, 5398, 5416, 5510, 5678, 5397, 5550, 5426, 5645, 5304, 5335, 5370, 5313, 5374, 5591, 5441, 5392, 5363, 5311, 5360, 5706, 5460.
20	5267, 5397, 5622, 5360, 5575, 5403, 5536, 5377, 5321, 5502, 5476, 5492, 5306, 5718, 5661, 5277, 5582, 5544, 5521, 5586, 5588, 5455, 5317, 5347, 5309, 5442, 5282, 5460, 5427, 5639, 5461, 5416, 5681, 5530, 5385, 5286, 5700, 5273, 5359, 5651, 5263, 5593, 5562, 5606, 5535, 5447, 5336, 5453, 5540, 5430, 5369, 5466, 5404, 5667, 5554, 5262, 5516, 5685, 5503, 5642, 5619, 5264, 5325, 5349, 5475, 5381, 5616, 5546, 5568, 5498, 5477, 5316, 5480, 5465, 5720, 5551, 5373, 5698, 5348, 5281, 5297.000, 5464, 5338, 5556, 5433, 5312.000, 5581, 5259, 5368, 5255, 5547, 5435, 5696, 5324, 5445, 5632, 5697, 5657, 5617, 5400.
21	5553, 5330.000, 5324, 5522, 5267, 5690, 5676, 5518, 5645, 5489, 5708, 5278, 5610, 5386, 5517, 5310.000, 5384, 5435, 5621, 5307, 5456, 5580, 5657, 5660, 5313, 5273, 5477, 5653, 5315, 5376, 5349, 5404, 5509, 5508, 5481, 5476, 5416, 5347, 5629, 5465, 5447, 5490, 5564, 5502, 5549, 5560, 5532, 5385, 5360, 5562, 5471, 5721, 5343, 5474, 5392, 5586, 5679, 5667, 5449, 5590, 5363, 5608, 5598, 5546, 5601, 5259, 5295, 5693, 5337, 5716, 5566, 5258, 5340, 5342, 5407, 5488, 5438, 5669, 5680, 5539, 5602, 5408, 5695, 5412, 5283, 5338, 5614, 5461, 5429, 5600, 5592, 5377, 5628, 5253, 5683, 5523, 5556, 5593, 5383, 5254.
22	5501, 5338, 5384, 5300, 5428, 5441, 5479, 5504, 5322, 5624, 5549, 5256, 5440, 5576, 5439, 5700, 5465, 5405, 5481, 5658, 5536, 5691, 5390, 5687, 5386, 5485, 5396, 5686, 5615, 5670, 5468, 5403, 5443, 5324, 5623, 5288, 5436, 5270, 5650, 5527, 5693, 5552, 5674, 5437, 5401, 5494, 5547, 5341, 5634, 5361, 5450, 5442, 5535, 5672, 5421, 5638, 5649, 5681, 5724, 5358, 5360, 5259, 5603, 5512, 5286, 5382, 5364, 5327, 5426, 5694, 5461, 5257, 5611, 5413, 5422, 5385, 5316, 5333, 5710, 5574, 5595, 5705, 5558, 5268, 5685, 5633, 5376, 5451, 5375, 5511, 5314, 5541, 5417, 5683, 5673, 5411, 5269, 5379, 5470, 5639.
23	5306, 5476, 5292, 5317, 5351, 5267, 5692, 5645, 5440, 5430, 5656, 5479, 5303, 5547, 5519, 5595, 5628, 5516, 5300, 5667, 5408, 5673, 5591, 5265, 5385, 5436, 5681, 5410, 5324, 5606, 5553, 5633, 5500, 5418, 5331, 5339, 5523, 5406, 5610, 5613, 5510, 5654, 5486, 5586, 5468, 5325, 5262, 5485, 5539, 5557, 5437, 5471, 5721, 5290, 5358, 5609, 5276, 5657, 5639, 5310.000, 5532, 5571, 5558, 5602, 5272, 5703, 5466, 5429, 5322, 5472, 5631, 5411, 5452, 5268, 5355, 5404, 5641, 5361, 5668, 5649, 5299, 5365, 5412, 5503, 5377, 5697, 5454, 5496, 5473, 5695, 5552, 5702, 5360, 5346, 5563, 5489, 5439, 5521, 5305, 5467.
24	5334, 5531, 5309, 5565, 5563, 5339, 5504, 5596, 5265, 5527, 5366, 5608, 5310.000, 5508, 5486, 5584, 5450, 5482, 5493, 5700, 5550, 5723, 5660, 5428, 5341, 5647, 5470, 5566, 5401, 5397, 5594, 5293, 5689, 5558, 5353, 5663, 5538, 5675, 5625, 5458, 5417, 5435, 5344, 5300, 5562, 5373, 5703, 5289, 5681, 5277, 5330.000, 5641, 5336, 5386, 5472, 5416, 5283, 5280, 5588, 5605, 5694, 5263, 5266, 5544, 5652, 5481, 5511, 5669, 5610, 5274, 5650, 5515, 5492, 5398, 5333, 5290, 5335, 5347, 5587, 5362, 5690, 5369, 5514, 5377, 5603, 5687, 5628, 5316, 5442, 5537, 5466, 5331, 5267, 5445, 5503, 5262, 5392, 5305, 5716, 5545.
25	5353, 5302, 5431, 5330.000, 5660, 5418, 5476, 5640, 5574, 5474, 5614, 5665, 5690, 5578, 5709, 5602, 5358, 5305, 5645, 5680, 5656, 5252, 5256, 5317, 5627, 5365, 5583, 5677, 5702, 5458, 5385, 5307, 5576, 5609, 5361, 5705, 5426, 5367, 5621, 5616, 5581, 5394, 5327, 5479, 5618, 5518, 5384, 5699, 5672, 5625, 5397, 5370, 5299, 5425, 5262, 5283, 5303, 5617, 5687, 5597, 5265, 5608, 5356, 5484, 5718, 5306, 5377, 5604, 5527, 5308, 5289, 5395, 5587, 5715, 5398, 5471, 5315, 5542, 5253, 5511, 5449, 5407, 5435, 5455, 5424, 5434, 5348, 5373, 5475, 5658, 5269, 5566, 5444, 5372, 5391, 5642, 5545, 5347, 5338, 5629.
26	5563, 5272, 5610, 5557, 5552, 5395, 5593, 5479, 5279, 5450, 5646, 5521, 5309, 5534, 5682, 5430, 5481, 5302, 5375, 5269, 5554, 5671, 5275, 5579, 5281, 5401, 5335, 5691, 5392, 5346, 5374, 5520, 5595, 5326, 5311, 5541, 5647, 5513, 5336, 5718, 5451, 5344, 5699, 5581, 5685, 5365, 5550, 5295, 5688, 5324, 5616, 5476, 5585, 5702, 5507, 5611, 5391, 5549, 5397, 5514, 5663, 5605, 5368, 5665, 5379, 5586, 5467, 5527, 5548, 5484, 5307, 5544, 5575, 5567, 5264, 5382, 5313, 5446, 5704, 5376, 5519, 5618, 5724, 5577, 5627, 5672, 5434, 5642, 5329, 5721, 5640, 5352, 5442, 5582, 5555, 5673, 5286, 5463, 5423, 5381.

Trial #	Hopping Frequency List (MHz)
27	5662, 5293, 5376, 5416, 5333, 5318, 5683, 5280, 5641, 5351, 5253, 5316, 5699, 5644, 5311, 5675, 5646, 5536, 5597, 5627, 5296, 5578, 5682, 5349, 5595, 5588, 5399, 5415, 5345, 5637, 5486, 5610, 5680, 5451, 5461, 5366, 5684, 5298, 5330.000, 5508, 5636, 5285, 5467, 5663, 5493, 5723, 5365, 5656, 5591, 5521, 5335, 5336, 5276, 5385, 5462, 5454, 5533, 5378, 5476, 5256, 5341, 5695, 5283, 5356, 5473, 5434, 5672, 5480, 5668, 5722, 5498, 5424, 5437, 5719, 5650, 5631, 5628, 5299, 5414, 5549, 5401, 5527, 5593, 5325, 5400, 5645, 5579, 5502, 5545, 5314, 5255, 5629, 5386, 5499, 5655, 708, 5361, 5337, 5560, 5564.
28	5662, 5293, 5376, 5416, 5333, 5318, 5683, 5280, 5641, 5351, 5253, 5316, 5699, 5644, 5311, 5675, 5646, 5536, 5597, 5627, 5296, 5578, 5682, 5349, 5595, 5588, 5399, 5415, 5345, 5637, 5486, 5610, 5680, 5451, 5461, 5366, 5684, 5298, 5330.000, 5508, 5636, 5285, 5467, 5663, 5493, 5723, 5365, 5656, 5591, 5521, 5335, 5336, 5276, 5385, 5462, 5454, 5533, 5378, 5476, 5256, 5341, 5695, 5283, 5356, 5473, 5434, 5672, 5480, 5668, 5722, 5498, 5424, 5437, 5719, 5650, 5631, 5628, 5299, 5414, 5549, 5401, 5527, 5593, 5325, 5400, 5645, 5579, 5502, 5545, 5314, 5255, 5629, 5386, 5499, 5655, 5708, 5361, 5337, 5560, 5564.
29	5390, 5334, 5528, 5627, 5474, 5426, 5566, 5294, 5396, 5310.000, 5481, 5487, 5299, 5359, 5546, 5567, 5517, 5327, 5644, 5647, 5617, 5655, 5373, 5270, 5495, 5378, 5369, 5431, 5659, 5695, 5314, 5692, 5681, 5585, 5291.000, 5497, 5421, 5402, 5660, 5500, 5642, 5669, 5398, 5623, 5449, 5411, 5518, 5260, 5641, 5715, 5671, 5460, 5686, 5507, 5382, 5345, 5307, 5385, 5360, 5721, 5513, 5531, 5439, 5425, 5505, 5458, 5631, 5491, 5711, 5366, 5262, 5428, 5597, 5596, 5653, 5547, 5269, 5391, 5634, 5304, 5301, 5691, 5638, 5448, 5329, 5576, 5365, 5325, 5525, 5466, 5672, 5609, 5342, 5371, 5309, 5290, 5354, 5399, 5253, 5554.
30	5448, 5507, 5635, 5511, 5416, 5484, 5365, 5693, 5517, 5667, 5462, 5564, 5526, 5701, 5425, 5607, 5629, 5555, 5395, 5436, 5521, 5481, 5712, 5503, 5643, 5426, 5363, 5331, 5593, 5674, 5626, 5688, 5333, 5250, 5546, 5665, 5579, 5633, 5585, 5409, 5421, 5255, 5396, 5502, 5458, 5394, 5455, 5427, 5386, 5523, 5254, 5542, 5578, 5652, 5276, 5648, 5257, 5497, 5307, 5251, 5611, 5717, 5561, 5601, 5443, 5700, 5603, 5666, 5300, 5647, 5534, 5529, 5572, 5476, 5565, 5435, 5281, 5457, 5401, 5622, 5479, 5323, 5520, 5267, 5385, 5528, 5408, 5275, 5262, 5560, 5265, 5419, 5576, 5486, 5336, 5600, 5444, 5515, 5299, 5330.000.