PCTEL, Inc.

REVISED TEST REPORT TO 104484-28

Rugged 802.11ac WiFi Access Point
Model: AP-WIFI-1200-US

Tested to The Following Standards:

FCC Part 15 Subpart E Section(s)

15.407 (h)(2)
Radar Detection Function of Dynamic Frequency Selection (DFS)

Report No.: 104484-28A

Date of issue: May 18, 2021

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.01

Testing the Future
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ADMINISTRATIVE INFORMATION

Test Report Information

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Project Number: 104484

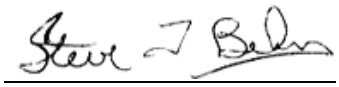
DATE OF EQUIPMENT RECEIPT: January 13, 2021
DATE(S) OF TESTING: January 13-16, 2021

Revision History

Original: Testing of the Rugged 802.11ac WiFi Access Point, Model: AP-WIFI-1200-US
Revision A: To update per FCC PBA instruction, added Radar waveform detail.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.19

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

SUMMARY OF RESULTS

Standard: FCC Part 15 Subpart E - 15.407(h)(2) (UNII) 5.25-5.35 GHz and 5.47-5.725 GHz bands

Requirement	Test Procedure Clause	Description	Mods	Results
15.407(h)(2)	7.5	DFS Detection Threshold (master & client with DFS)	NA	Pass
15.407(h)(2)	7.8.1	UNII Detection Bandwidth (master & client with DFS)	NA	Pass
15.407(h)(2)(i)(A) 15.407(h)(2)(ii)	7.8.2.1 7.8.2.2 7.8.2.3	Channel Availability Check Time. (master & client with DFS)	NA	Pass
15.407(h)(2)(i)(B) 15.407(h)(2)(iii)	7.8.3	Channel Move Time, Channel Closing Time (master, client with DFS, client)	NA	Pass
15.407(h)(2)(iv)	7.8.3	Non-Occupancy Period (master & client with DFS)	NA	Pass
5.1 Table 2*	7.8.4	Statistical Performance Check (master & client with DFS)	NA	Pass
7.7*	7.7	Channel Loading (master and client with radar detection)	NA	Pass

NA = Not Applicable
* KDB requirement.

ISO/IEC 17025 Decision Rule
The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

The EUT, an Access Point device operating as a DFS Master is placed on the test bench. Antenna 1, Antenna 2 ports are connected to several power dividers to enable communication with a Client, received injected Radar signal from a signal generator and provide timing feedback to a spectrum analyzer for evaluation of DFS parameter.
See Appendix A and B for Test Setup Block Diagrams

Test Procedure
The DFS testing presented in this report is perform in accordance with the following test procedure to meet the requirement 905462 D02 UNII DFS Compliance Procedures New Rules v02. April 8, 2016. Each clause of the test procedure is identified in specific section of this report.

EQUIPMENT UNDER TEST (EUT)

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Rugged 802.11ac WiFi Access Point	PCTEL, Inc.	AP-WIFI-1200-US	S4

Support Equipment:

Device	Manufacturer	Model #	S/N
POE	Phihong	POE29U-1A(PL)	NA
Laptop	Dell	E6430s	3ZQ24X1
Laptop	Lenovo	R61	L3—B7192
Laptop	Lenovo	E530	AN03319
Dual Speed Hub	Netgear	DS309	DS39A0800012
USB WiFi Adaptor	Netgear	AC1200	NA

General Product Information:

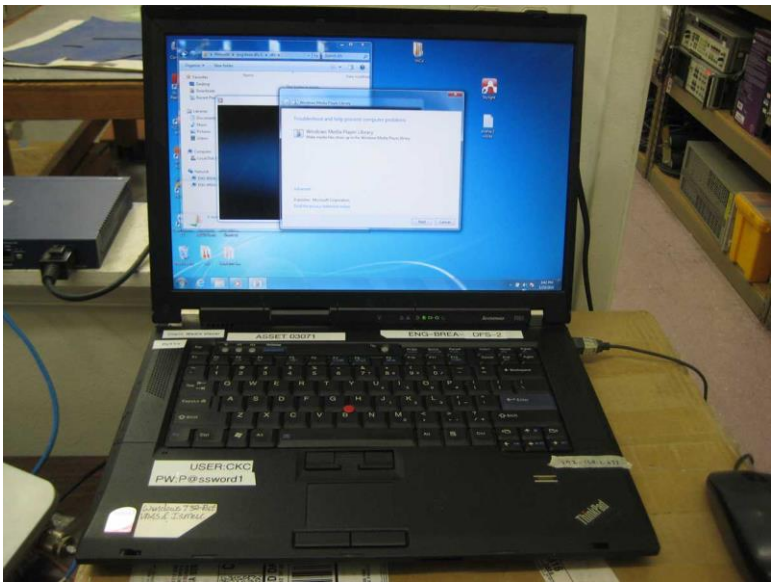
Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Operational Mode(s):	☒ Master
FCCID of Master Used for Testing:	Note the EUT is a Master FCCID: NYPWIFIAP1200
Network Type:	☒ Access Point
System Architecture:	802.11a, 802.11VHT20, 802.11 VHT40, 802.11 VHT80 *Non-H20T protocol is intended for beacon and NOT for data transfer.
Operating Frequency Range(s):	☒ 5150-5250 MHz ☒ 5250-5350 MHz ☒ 5470-5725 MHz ☒ 5725-5850 MHz
Modulation Type(s):	OFDM , BPSK,QPSK, 16QAM, 64QAM, 256QAM
Channel bandwidth(s):	☒ 20 MHz ☒ 40 MHz ☒ 80 MHz
Measured 99% BW:	5470-5725 MHz 802.11a :16.2 MHz 802.11VHT20 :17.4 MHz 802.11VHT40 :36.4 MHz 802.11VHT80 :75.2 MHz
Maximum Duty Cycle:	98%
Highest Power (EIRP, dBm/Watt):	29.8dBm
Lowest Power (EIRP, dBm/Watt):	21.7dBm
Number of TX/RX Chains:	2
Antenna Type(s) and Gain:	Omnidirectional Max: 7 dBi Min: 7 dBi
Antenna cable loss	0
Beamforming Capable:	Yes
Antenna Connection Type:	External Connector
Antenna Impedance (ohm):	50
Nominal Input Voltage:	POE 48V DC, 120/60Hz.
Boot up time from power cycle:	53 Seconds
Transmit Power Control (TPC):	Yes
Manufacturer Statement:	The manufacturer has confirmed that information regarding the parameters of the detected Radar Waveforms is not available to the end user.
Firmware / Software used for Test:	Linux version 4.4.60 (pctel@ubuntu) (gcc version 5.2.0 (OpenWrt GCC 5.2.0 361f3ad+r49254))

EUT and Support Equipment Photo(s)

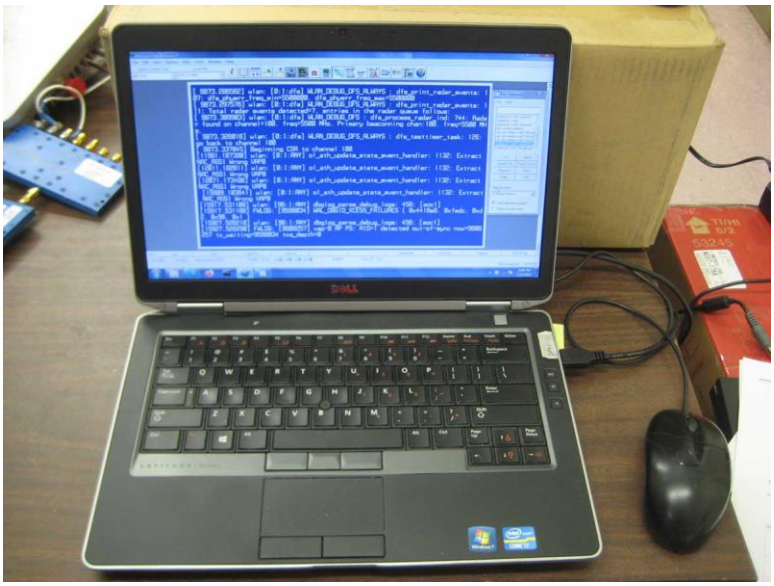
EUT Top Side

EUT Bottom Side

Laptop #1

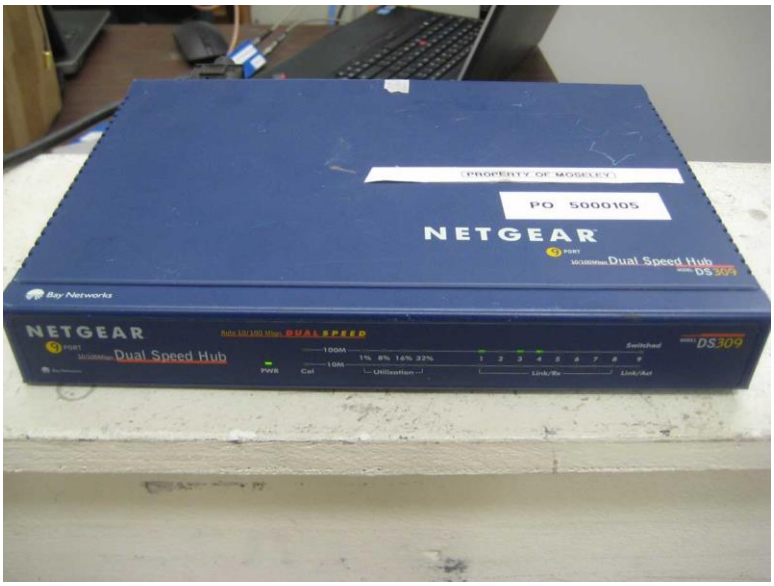


Laptop #2



Laptop #3

USB WiFi Adapter



Dual Speed Hub

POE

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02869	Spectrum Analyzer	Agilent	E4440A	8/3/2020	8/3/2021
03470	Spectrum Analyzer	Agilent	E4440A	5/2/2019	5/2/2021
07657	cable	Astrolab, Inc.	32022-29094K-29094K-24TC	7/30/2020	7/30/2022
03592	Vector Signal Generator	Keysight	N5182B	1/18/2020	1/18/2022
P07134	Attenuator	Weinschel	3M10	NCR	NCR
P07135	Attenuator	Weinschel	3M10	NCR	NCR
P07181	Attenuator	Weinschel	3M30	NCR	NCR
P07182	Attenuator	Weinschel	3M30	NCR	NCR
P06794	Splitter/Combiner	Anaren	41130	5/14/2019	5/14/2021
P07137	Power Divider	Anaren	41130	7/3/2019	7/3/2021
P07209	Power Divider	Anaren	40297	4/23/2019	4/23/2021
P07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	7/30/2020	7/30/2022
P07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	7/30/2020	7/30/2022

NCR = No Calibration Required

Environmental Conditions			
Temperature (ºC)	21	Relative Humidity (%):	24

Unless otherwise noted, all test performed under the listed environmental condition.

Waveform information.
The waveforms used are commercially available pre-defined DFS waveform per Agilent N7607B Signal Studio for DFS radar profile. The waveforms meeting the following requirement.
USA : FCC15.407, FCC-13-22

Requirements

Table 1: Applicability of DFS Requirements Prior to Use of a Channel

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

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

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

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
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. **Note3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

Table 4: DFS Response Requirement Values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
Note 1: *Channel Move Time* and the *Channel Closing Transmission Time* should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. **Note 2:** The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. **Note 3:** During the *U-NII Detection Bandwidth* detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

15.407(h)(2) DFS Detection Threshold

Test Setup/Conditions			
Test Location:	Brea Lab Bench	Test Engineer:	E. Wong
Test Method:	7.5	Test Date(s):	1/13/2021
Configuration:	1		
Test Setup:	Conducted DFS detection threshold is adjusted with test method as illustrated in test setup diagram. A spectrum analyzer with Peak detector activated, set at zero span and RBW and VBW >3 MHz was used for measurement of DFS detection threshold. Each Radar waveform is loaded into the Vector Signal Generator and triggered. The RF output level of the Signal generator with each waveform is adjust test until the measured signal level at measuring point to be injected to the antenna port of the master device reaches the required equivalent DFS detection threshold. All other ports of test system are terminated to 50-ohm load. The signal output level of the vector signal generator is recorded and used for regeneration of test level. Waveform 13-22		

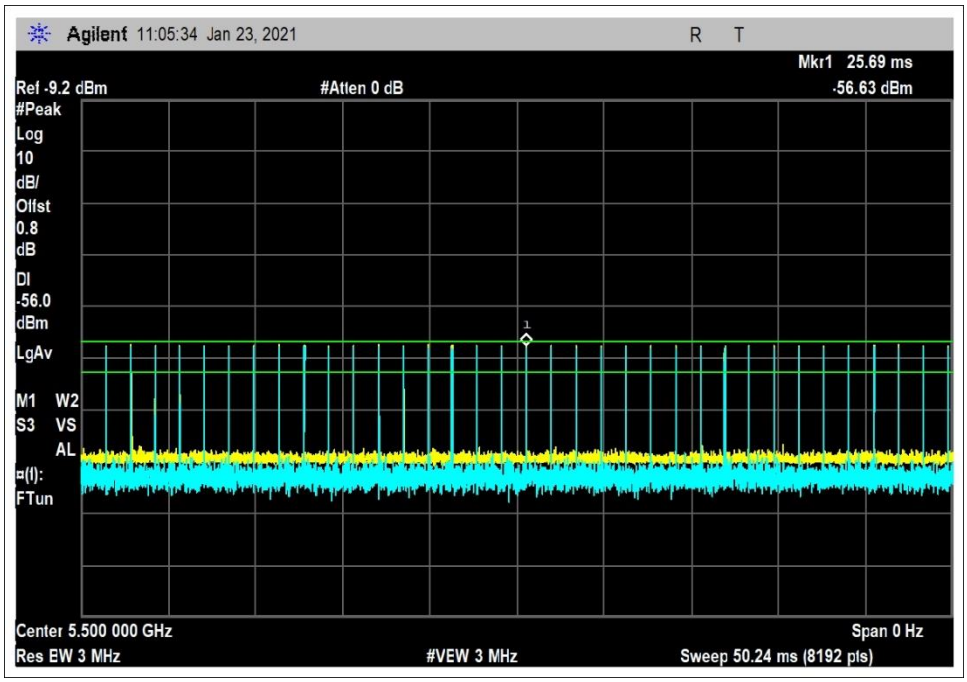
Calibration Data Summary

Antenna Port: 1 and 2

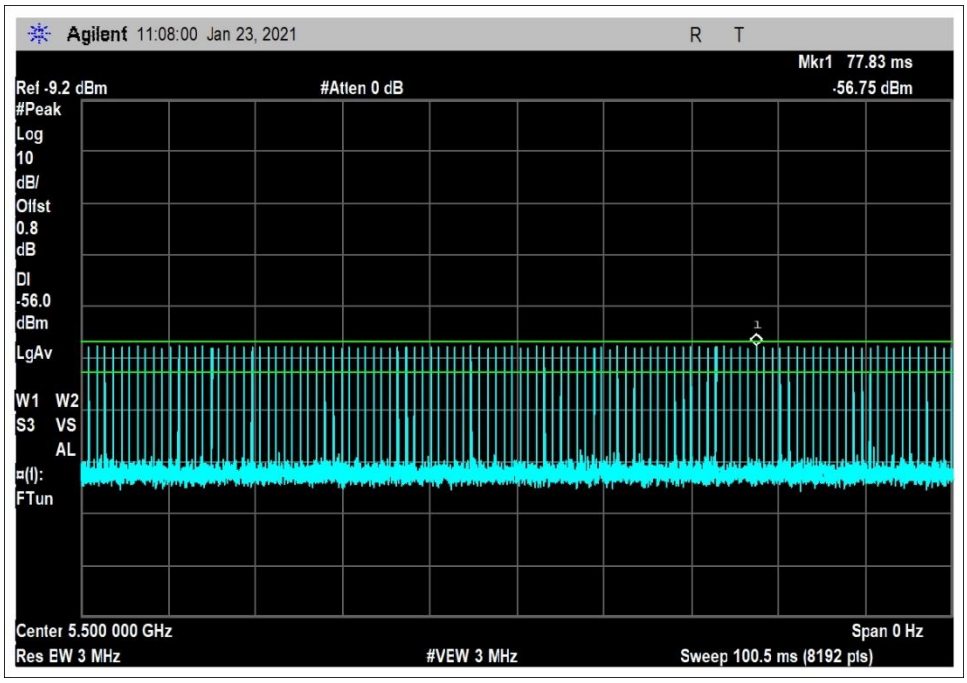
Frequency (MHz)	Waveform Type	Detection Threshold See note1 (dBm)	Min antenna Gain (dBi)	Max cable Loss (dB)	Additional level See note2 (dB)	Required Equivalent Threshold (dBm)	Measured Level (dBm)	Sig Gen Level (dBm)
5500	0	-64	7	0	1	-56	-56.60	-17.5
5500	1	-64	7	0	1	-56	-56.80	-17.5
5500	2	-64	7	0	1	-56	-56.10	-17.5
5500	3	-64	7	0	1	-56	-56.04	-17.5
5500	4	-64	7	0	1	-56	-56.03	-17.5
5500	5	-64	7	0	1	-56	-56.20	-17.5
5500	6	-64	7	0	1	-56	-56.80	-12.5

DFS Detection Thresholds	
Maximum Transmit Power	**Value** **(See Notes 1, 2, and 3)**
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
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. Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

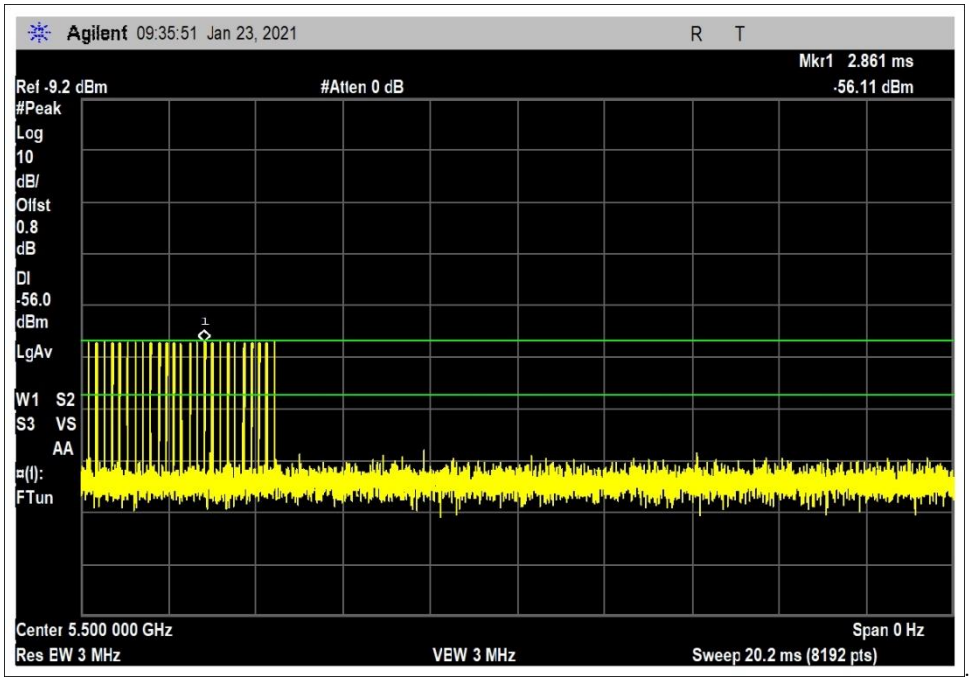
Plot(s)



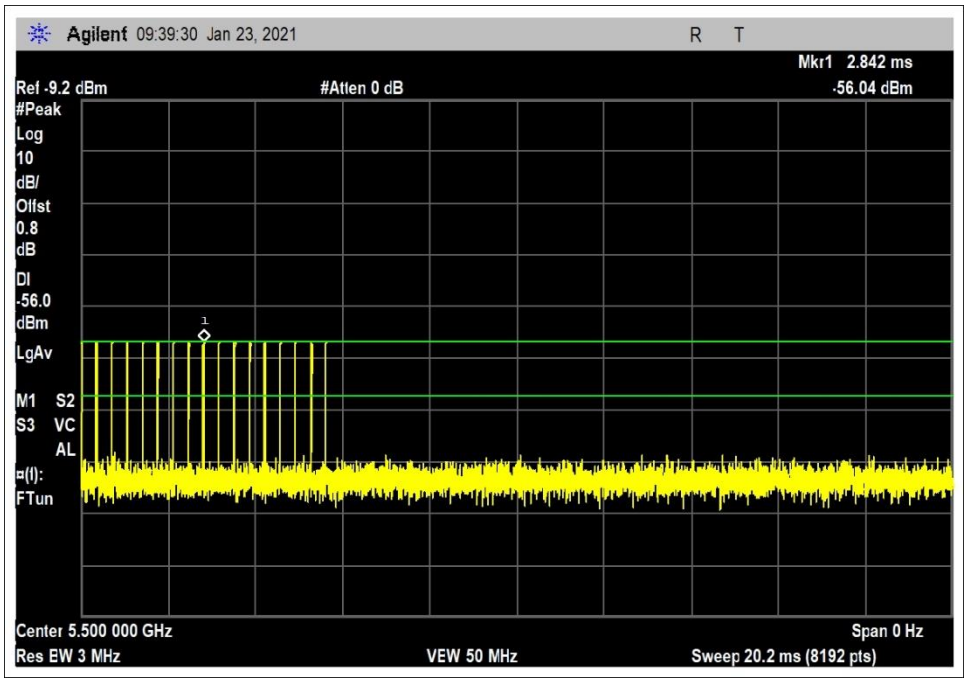
Type 0: Short Pulse Radar Type



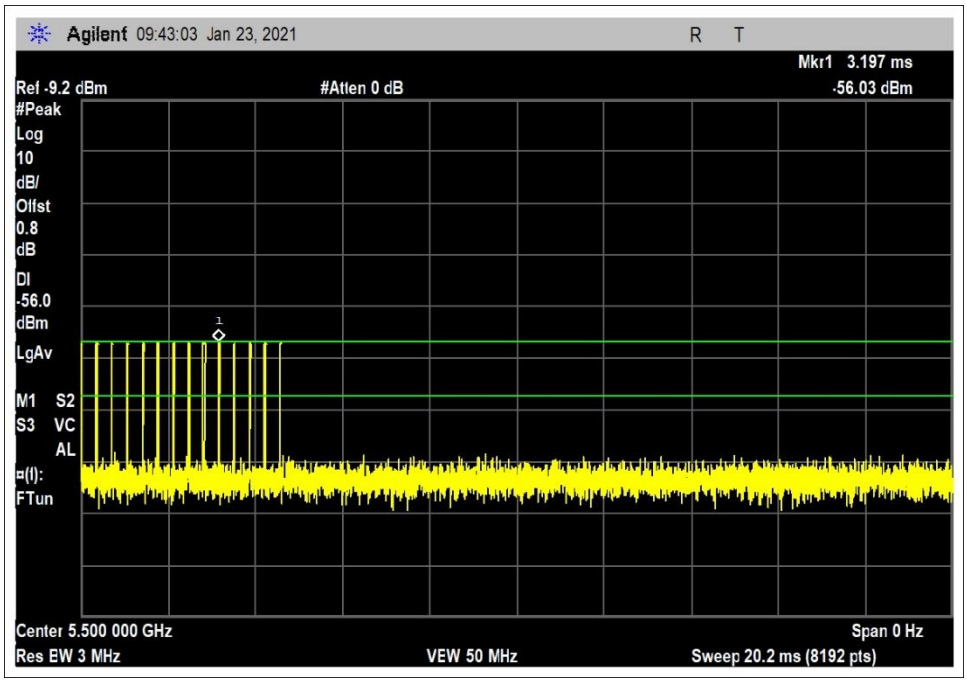
Type 1: Short Pulse Radar Type



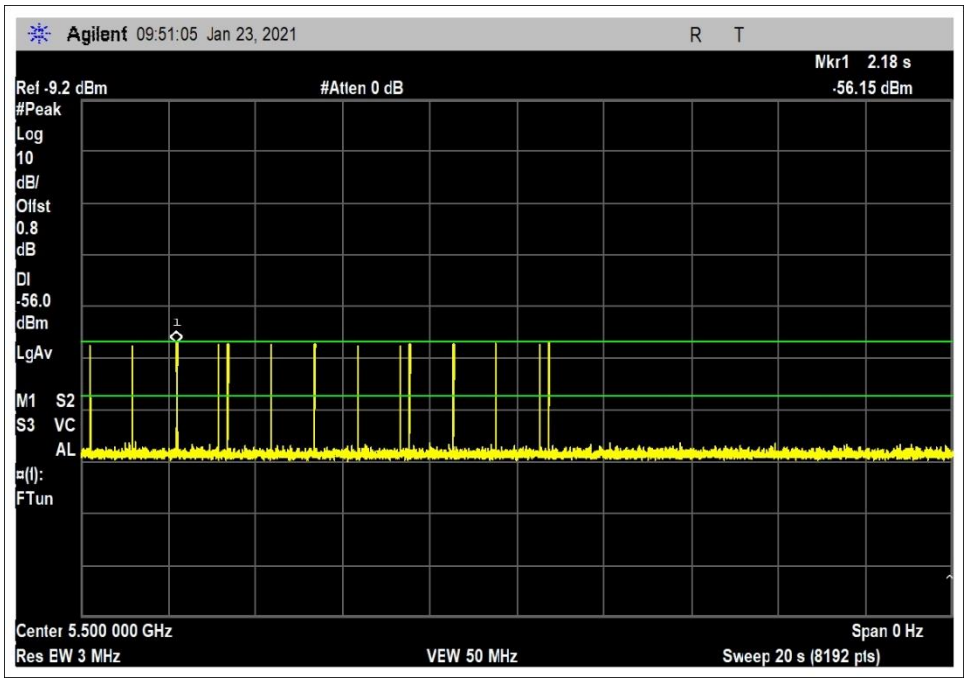
Type 2: Short Pulse Radar Types



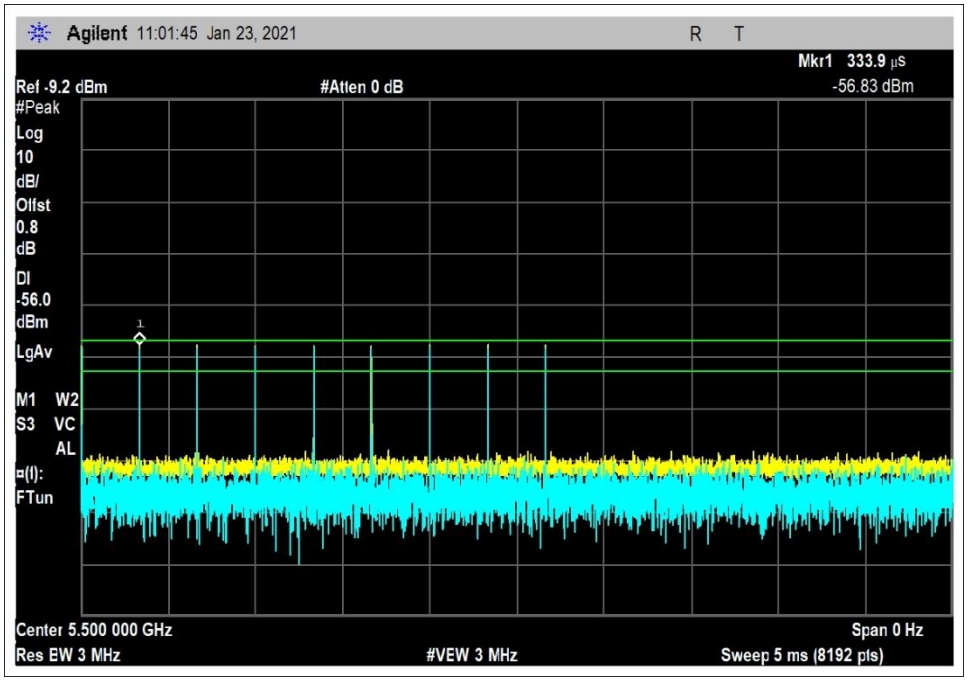
Type 3: Short Pulse Radar Type.



Type 4: Short Pulse Radar Types



Type 5: Long Pulse Radar Type, plot of a single burst (1-3 pulses) on the Channel frequency should be provided.



Type 6: Frequency Hopping waveform, a plot showing 9 pulses on one frequency within the UNII Detection Bandwidth should be provided.

15.407(h)(2) UNII Detection Bandwidth

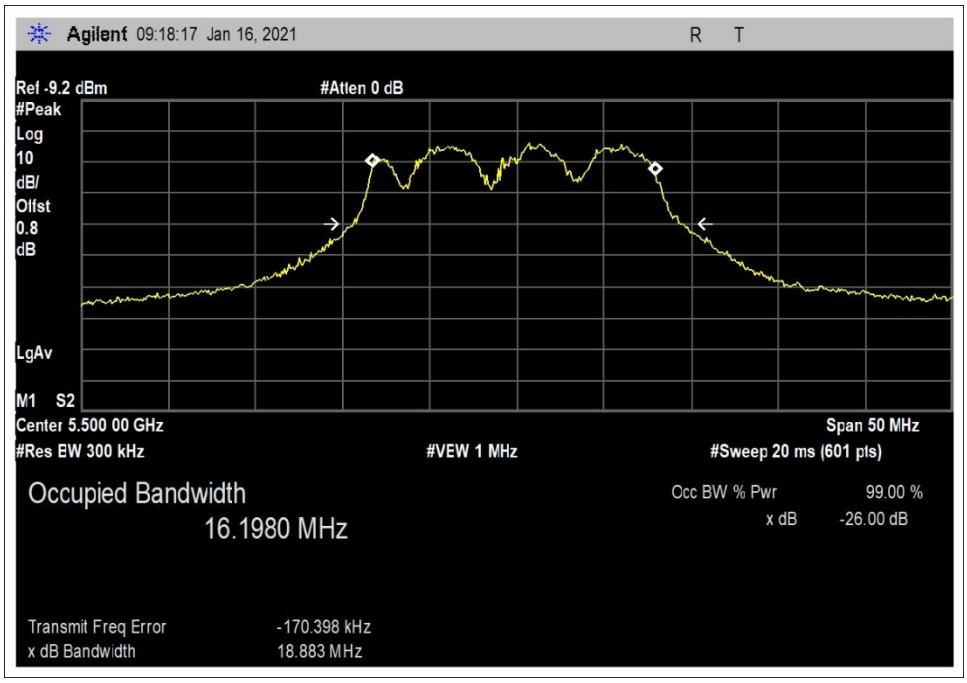
Test Setup/Conditions			
Test Location:	Brea Lab Bench	Test Engineer:	E. Wong
Test Method:	7.8.1	Test Date(s):	1/14/2021
Configuration:	1		
Test Setup:	Conducted UNII detection was measured as illustrated in setup diagram. The EUT is set up as a standalone device (no associated Client or Master, as appropriate) and no traffic. Frame based systems is set to a talk/listen ratio reflecting the worst case (maximum) that is user configurable during this test as applicable. UNII detection bandwidth of each protocol was evaluated. Response of the EUT is monitored by Laptop #3 which is connected to the Master via Comm port. The response of the EUT to radar detection is monitored Terminal emulator program PuTTY installed. Test performed for all available BW modes.		

Test Data Summary

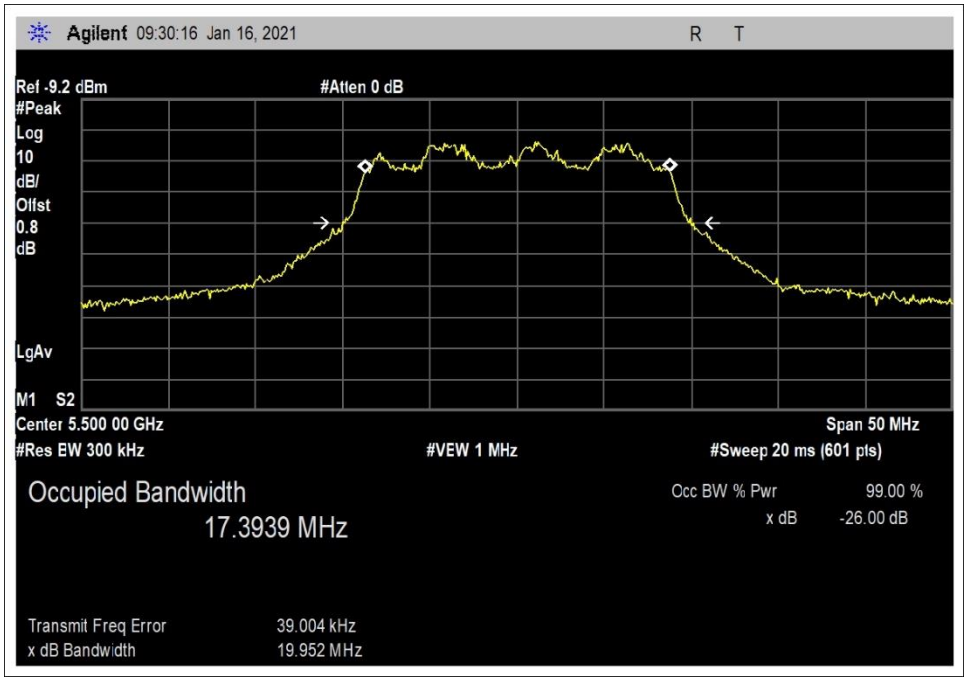
Radar Waveform Type: 0

Fl (MHz)	Fh (MHz)	Protocol	Detection BW (MHz)	99% BW (MHz)	Ratio BW (%)	Limit (%)	Results
5490	5510	802.11a	20	16.2	123.5	>100	Pass
5490	5510	802.11VHT20	20	17.4	114.9	>100	Pass
5490	5530	802.11VHT40	40	36.4	109.9	>100	Pass
5490	5570	802.11VHT80	80	75.2	106.4	>100	Pass

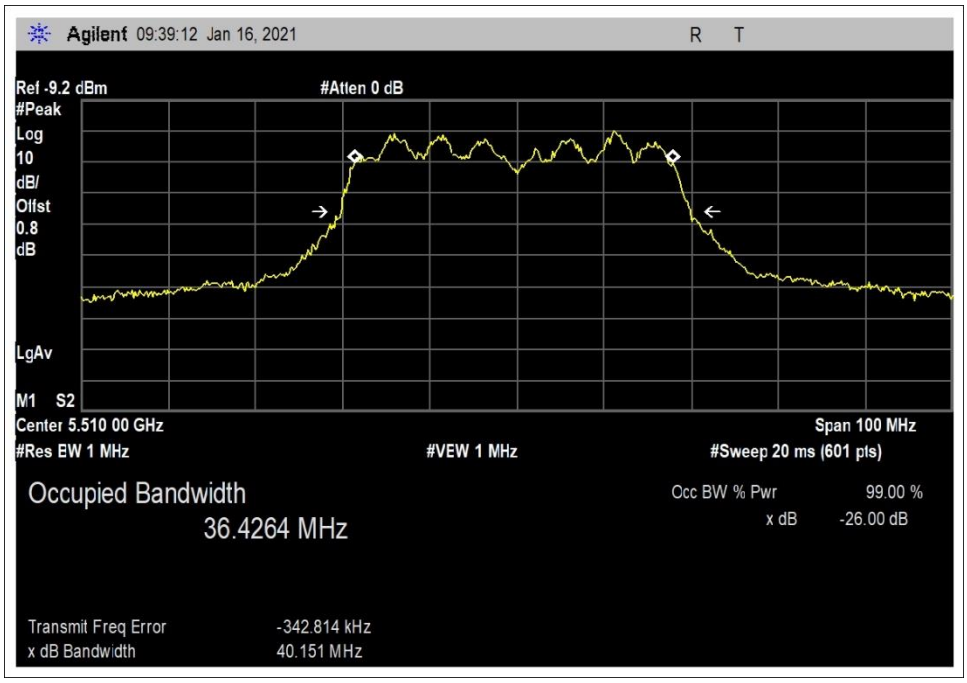
Plot(s)



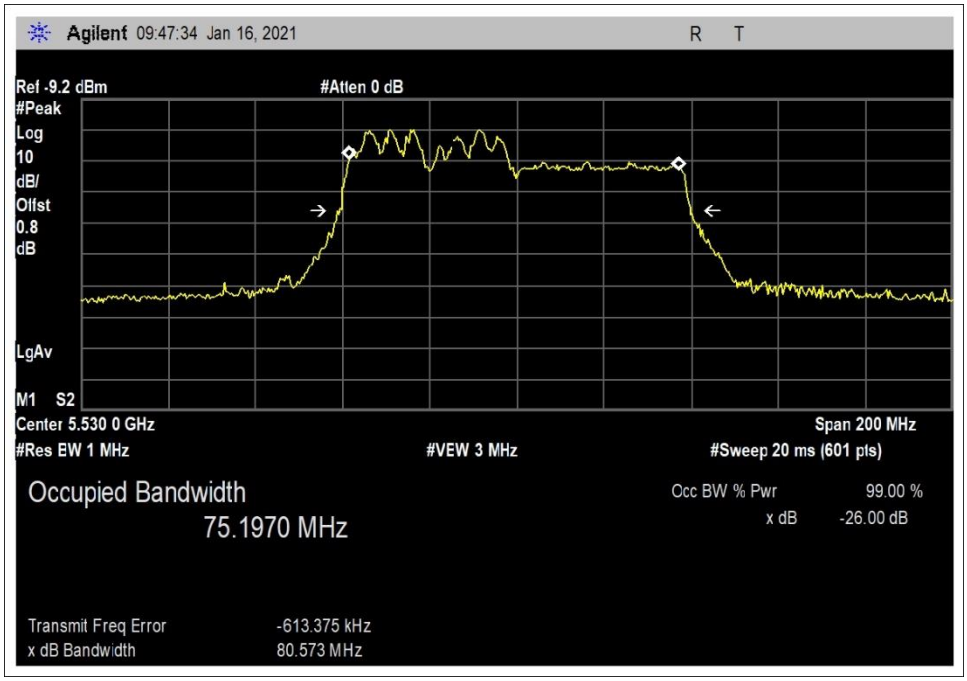
99% BW 802.11A



99%BW 802.11VHT20



99%BW 802.11VHT40



99%BW 802.11VHT80

Test Results

Result: 802.11a			
Fl	(90% success rate)	5490	MHz
Fh	(90% success rate)	5510	MHz
Measured 99% Bandwidth	=	16.2	MHz
Detection Bandwidth (Fh -Fl)		20	MHz
(Detection BW / 99% BW) %		123.5	%
Requirement: % of detection BW > 100%		Pass	

Result: 802.11 HT20			
Fl	(90% success rate)	5490	MHz
Fh	(90% success rate)	5510	MHz
Measured 99% Bandwidth	=	17.4	MHz
Detection Bandwidth (Fh -Fl)		20	MHz
(Detection BW / 99% BW) %		114.9	%
Requirement: % of detection BW > 100%		Pass	

Result: 802.11 HT40			
Fl	(90% success rate)	5490	MHz
Fh	(90% success rate)	5530	MHz
Measured 99% Bandwidth	=	36.4	MHz
Detection Bandwidth (Fh -Fl)		40	MHz
(Detection BW / 99% BW) %		109.9	%
Requirement: % of detection BW > 100%		Pass	

Result: 802.11 HT80			
Fl	(90% success rate)	5490	MHz
Fh	(90% success rate)	5570	MHz
Measured 99% Bandwidth	=	75.2	MHz
Detection Bandwidth (Fh -Fl)		80	MHz
(Detection BW / 99% BW) %		106.4	%
Requirement: % of detection BW > 100%		Pass	

Protocal : 802.11 a											
EUT Operating Freq(MHz)=			5500								
Radar Waveform Type =			1								
	DFS Detection Trial (1 = detection , 0= no detection)										Detection rate
Radar Freq (MHz)	1	2	3	4	5	6	7	8	9	10	%
5470											0
5485	0	0	0	0	0	0	0	0	0	0	0
5486	0	0	0	0	0	0	0	0	0	0	0
5487	0	0	0	0	0	0	0	0	0	0	0
5488	0	0	0	0	0	0	0	0	0	0	0
5489	0	0	0	0	0	0	0	0	0	0	0
5490	1	1	1	1	1	1	1	1	1	1	100
5491											0
5492											0
5493											0
5494											0
5495	1	1	1	1	1	1	1	1	1	1	100
5496											0
5497											0
5498											0
5499											0
5500	1	1	1	1	1	1	1	1	1	1	100
5501											0
5502											0
5503											0
5504											0
5505	1	1	1	1	1	1	1	1	1	1	100
5506											0
5507											0
5508											0
5509											0
5510	1	1	1	1	1	1	1	1	1	1	100
5511	0	0	0	0	0	0	0	0	0	0	0
5512	0	0	0	0	0	0	0	0	0	0	0
5513	0	0	0	0	0	0	0	0	0	0	0
5514	0	0	0	0	0	0	0	0	0	0	0
5515	0	0	0	0	0	0	0	0	0	0	0
5550											0

Protocal : 802.11 HT20											
EUT Operating Freq(MHz)=			**5500**								
Radar Waveform Type =			1								
	DFS Detection Trial (1 = detection , 0= no detection)										Detection rate
Radar Freq (MHz)	1	2	3	4	5	6	7	8	9	10	%
5450											0
5485	0	0	0	0	0	0	0	0	0	0	0
5486	0	0	0	0	0	0	0	0	0	0	0
5487	0	0	0	0	0	0	0	0	0	0	0
5488	0	0	0	0	0	0	0	0	0	0	0
5489	0	0	0	0	0	0	0	0	0	0	0
5490	1	1	1	1	1	1	1	1	1	1	100
5491											0
5492											0
5493											0
5494											0
5495	1	1	1	1	1	1	1	1	1	1	100
5496											0
5497											0
5498											0
5499											0
5500	1	1	1	1	1	1	1	1	1	1	100
5501											0
5502											0
5503											0
5504											0
5505	1	1	1	1	1	1	1	1	1	1	100
5506											0
5507											0
5508											0
5509											0
5510	1	1	1	1	1	1	1	1	1	1	100
5511	0	0	0	0	0	0	0	0	0	0	0
5512	0	0	0	0	0	0	0	0	0	0	0
5513	0	0	0	0	0	0	0	0	0	0	0
5514	0	0	0	0	0	0	0	0	0	0	0
5515	0	0	0	0	0	0	0	0	0	0	0
5550											0

Protocal : 802.11 HT40

EUT Operating Freq(MHz)=			5510								
Radar Waveform Type =			1								
	DFS Detection Trial (1 = detection , 0= no detection)										Detection rate
Radar Freq (MHz)	1	2	3	4	5	6	7	8	9	10	%
5460											0
5485	0	0	0	0	0	0	0	0	0	0	0
5486	0	0	0	0	0	0	0	0	0	0	0
5487	0	0	0	0	0	0	0	0	0	0	0
5488	0	0	0	0	0	0	0	0	0	0	0
5489	0	0	0	0	0	0	0	0	0	0	0
5490	1	1	1	1	1	1	1	1	1	1	100
5491											0
5492											0
5493											0
5494											0
5495	1	1	1	1	1	1	1	1	1	1	100
5496											0
5497											0
5498											0
5499											0
5500	1	1	1	1	1	1	1	1	1	1	100
5501											0
5502											0
5503											0
5504											0
5505	1	1	1	1	1	1	1	1	1	1	100
5506											0
5507											0
5508											0
5509											0
5510	1	1	1	1	1	1	1	1	1	1	100
5511											0
5512											0
5513											0
5514											0
5515	1	1	1	1	1	1	1	1	1	1	100
5516											0
5517											0
5518											0
5519											0
5520	1	1	1	1	1	1	1	1	1	1	100
5521											0
5522											0
5523											0
5524											0
5525	1	1	1	1	1	1	1	1	1	1	100
5526											0
5527											0
5528											0
5529											0
5530	1	1	1	1	1	1	1	1	1	1	100
5531	0	0	0	0	0	0	0	0	0	0	0
5532	0	0	0	0	0	0	0	0	0	0	0
5533	0	0	0	0	0	0	0	0	0	0	0
5534	0	0	0	0	0	0	0	0	0	0	0
5535	0	0	0	0	0	0	0	0	0	0	0
5560											0

Protocal : 802.11 HT8											
EUT Operating Freq(MHz)=			5530								
Radar Waveform Type =			1								
	DFS Detection Trial (1 = detection , 0= no detection)										Detection rate
Radar Freq (MHz)	1	2	3	4	5	6	7	8	9	10	%
5480											0
5485	0	0	0	0	0	0	0	0	0	0	0
5486	0	0	0	0	0	0	0	0	0	0	0
5487	0	0	0	0	0	0	0	0	0	0	0
5488	0	0	0	0	0	0	0	0	0	0	0
5489	0	0	0	0	0	0	0	0	0	0	0
5490	1	1	1	1	1	1	1	1	1	1	100
5491											0
5492											0
5493											0
5494											0
5495	1	1	1	1	1	1	1	1	1	1	100
5496											0
5497											0
5498											0
5499											0
5500	1	1	1	1	1	1	1	1	1	1	100
5501											0
5502											0
5503											0
5504											0
5505	1	1	1	1	1	1	1	1	1	1	100
5506											0
5507											0
5508											0
5509											0
5510	1	1	1	1	1	1	1	1	1	1	100
5511											0
5512											0
5513											0
5514											0
5515	1	1	1	1	1	1	1	1	1	1	100
5516											0
5517											0
5518											0
5519											0
5520	1	1	1	1	1	1	1	1	1	1	100
5521											0
5522											0
5523											0
5524											0
5525	1	1	1	1	1	1	1	1	1	1	100
5526											0
5527											0
5528											0
5529											0
5530	1	1	1	1	1	1	1	1	1	1	100
5531											0
5532											0
5533											0
5534											0
5535	1	1	1	1	1	1	1	1	1	1	100

5536											0
5537											0
5538											0
5539											0
5540	1	1	1	1	1	1	1	1	1	1	100
5541											0
5542											0
5543											0
5544											0
5545	1	1	1	1	1	1	1	1	1	1	100
5546											0
5547											0
5548											0
5549											0
5550	1	1	1	1	1	1	1	1	1	1	100
5551											0
5552											0
5553											0
5554											0
5555	1	1	1	1	1	1	1	1	1	1	100
5556											0
5557											0
5558											0
5559											0
5560	1	1	1	1	1	1	1	1	1	1	100
5561											0
5562											0
5563											0
5564											0
5565	1	1	1	1	1	1	1	1	1	1	100
5566											0
5567											0
5568											0
5569											0
5570	1	1	1	1	1	1	1	1	1	1	100
5571	0	0	0	0	0	0	0	0	0	0	0
5572	0	0	0	0	0	0	0	0	0	0	0
5573	0	0	0	0	0	0	0	0	0	0	0
5574	0	0	0	0	0	0	0	0	0	0	0
5575	0	0	0	0	0	0	0	0	0	0	0
5580											0

15.407(h)(2)(i)(A) Channel Availability Check Time

Nominal Noise Floor - Master/ Client with Radar Detection

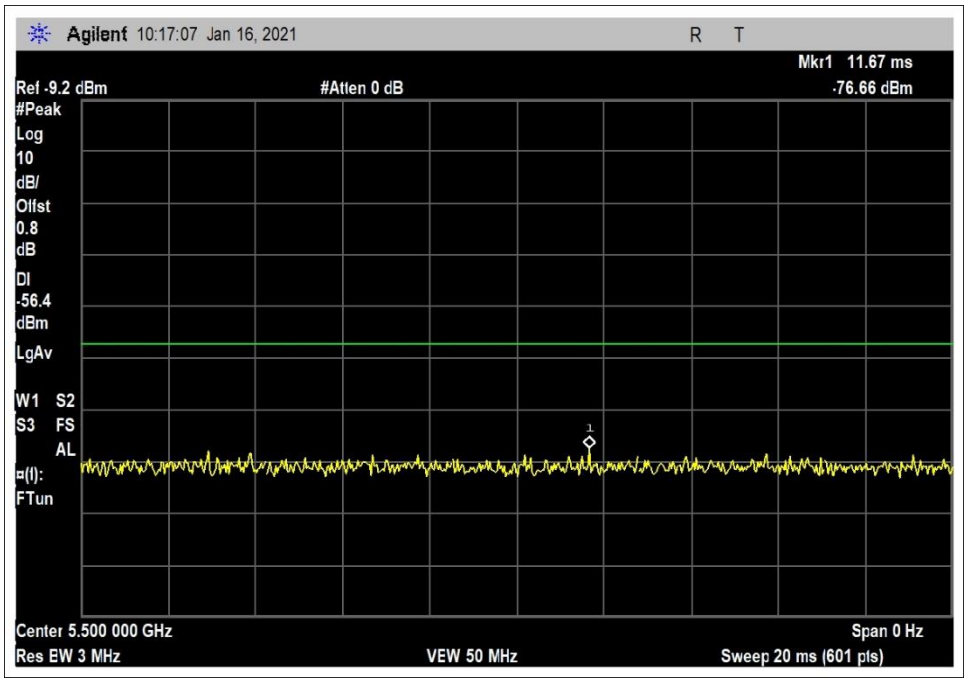
Applies to Channel availability check, Initial radar bursts, in-service monitoring and 30-minute non-occupancy period tests.

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	7.8.2.1, 7.8.2.2, 7.8.2.3	Test Date(s):	1/16/2021
Configuration:	1		
Test Setup:	Conducted Nominal Noise floor measurement of the system was measured with test method as illustrated in test setup diagram. A spectrum analyzer with Peak detector activated and RBW and VBW >3 MHz was used for measurement of DFS detection threshold. The span is set to the bandwidth of the signal protocol to be used for Channel availability measurement IAW plot requirement of clause 8.3, d) 3) the Master and Client are not transmitting, the Radar signal is turned off.		

Test Data Summary		
Frequency (MHz)	**Channel bandwidth (MHz)**	**Nominal Noise Floor (dBm)**
5500	20	-76.8

* No limit, however, must be below the Radar signal

Plot(s)


Agilent 10:17:07 Jan 16, 2021
R T
Mkr1 11.67 ms
Ref -9.2 dBm
#Atten 0 dB
-76.66 dBm
#Peak
Log
10
dB/
Offst
0.8
dB
Dl
-56.4
dBm
LgAv
W1 S2
S3 FS
AL
¤(!):
FTun
Center 5.500 000 GHz
Span 0 Hz
Res BW 3 MHz
VBW 50 MHz
Sweep 20 ms (601 pts)

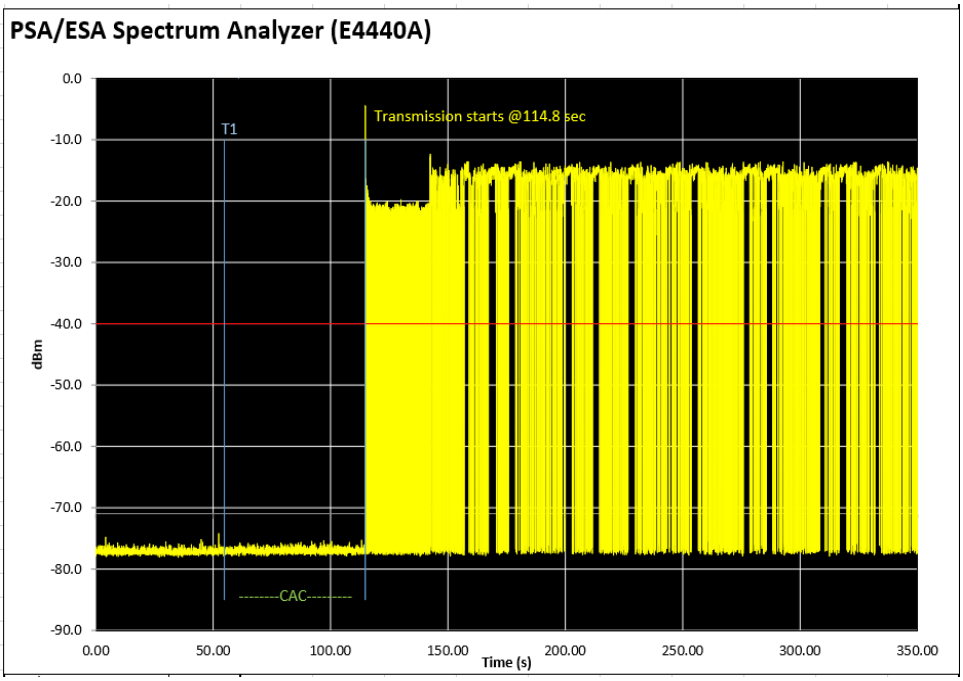
Initial Channel Availability Check Time -- Master

Test Setup/Conditions			
Test Location:	Brea Lab Bench	Test Engineer:	E. Wong
Test Method:	7.8.2.1	Test Date(s):	1/16/2021
Configuration:	1		
Test Setup:	Conducted Initial Channel Availability Check time was measured as illustrated in test setup diagram. A spectrum analyzer with Peak detector activated, set at zero span and RBW and VBW >3 MHz. Initial Channel Availability time was evaluated with Widest bandwidth mode. The spectrum analyzer is tuned to Channel occupied by the radar with minimum sweep time of 2.5minute. Test performed using one representative BW mode.		

Test Data Summary				
Frequency (MHz)	**Protocol**	**CAC Time (sec)**	**Limit (sec)**	**Results**
5500	802.11VHT20	60.2	> 60	Pass

Note: Manufacturers firmware reported 62sec

Plot(s)


PSA/ESA Spectrum Analyzer (E4440A)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
dBm
T1
Transmission starts @114.8 sec
--------CAC---------
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
Time (s)

Radar Burst Near Channel Availability Check Time -- Master

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	7.8.2.2, 7.8.2.3	Test Date(s):	1/16/2021
Configuration:	1		
Test Setup:	Conducted Initial Channel Availability Check time was measured as illustrated in test setup diagram. A spectrum analyzer with Peak detector activated, set at zero span and RBW and VBW >3 MHz. Radar Burst at the Beginning of the Channel Availability Check Time was evaluated with the Widest bandwidth mode. The spectrum analyzer is tuned to Channel occupied by the radar with minimum sweep time of 2.5minute. Observation of EUT emission continues 2.5 minutes /150sec after radar burst has been generated. For test at Start of CAC, Radar burst Triggered within 6 second window starting at T1 For test at End of CAC, Radar burst triggered within 6 second window starting at T1 +54 seconds. Test performed using one representative BW mode.		

Timing Summary					
Test	**Reboot time (s)**	**Start of Traffic (s)**	**Radar Timing T1 (s)**	**Radar Timing (Rel to Reboot 0 – 6 sec T1+54 sec**	**Radar Timing (Rel to CAC)**
No Radar Triggered	56.5	114			
Radar Near Start of CAC	56.5		54	54- 60	57.8
Radar Near End of CAC	56.5		54	108-114	109.5

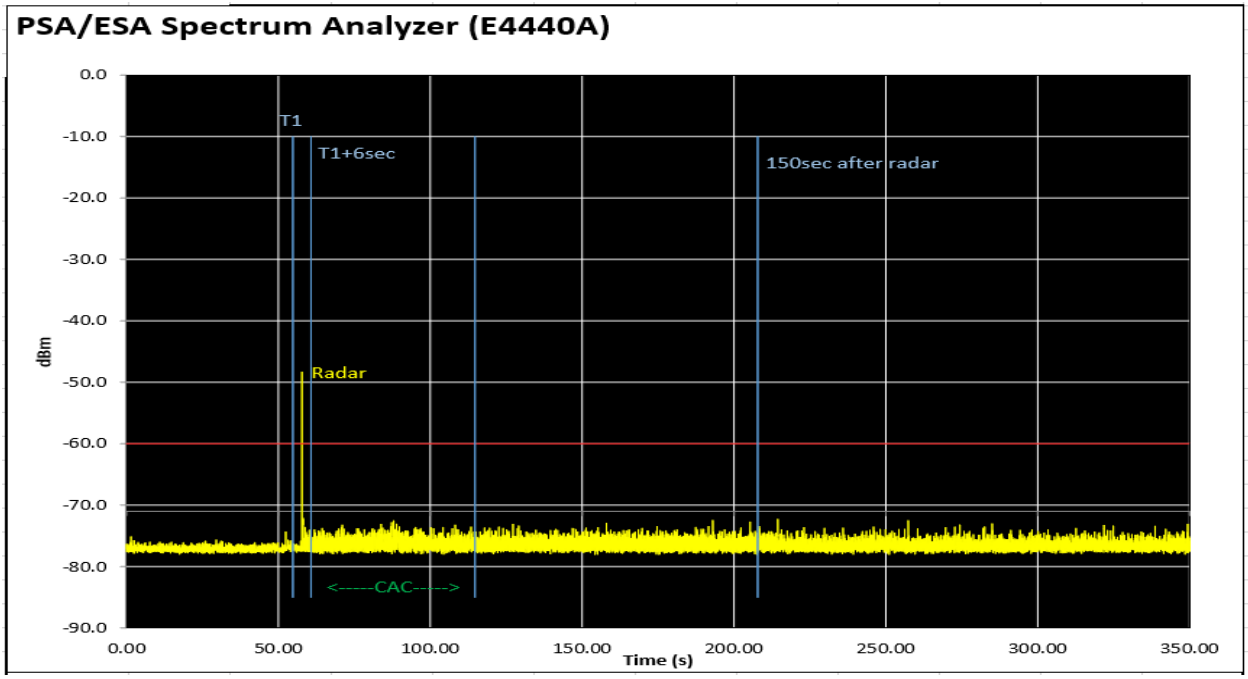
Test Data Summary					
Frequency (MHz)	**Protocol / Modulation**	**Waveform Type**	**Timing**	**Limit**	**Results**
5500	802.11HT20	0	Start	No transmission within 2.5 minute /150 sec after radar burst.	Pass
5500	802.11HT20	0	End		Pass

Fail: Transmission detected by the spectrum analyzer within observation period and the Master device indicates Radar was detected

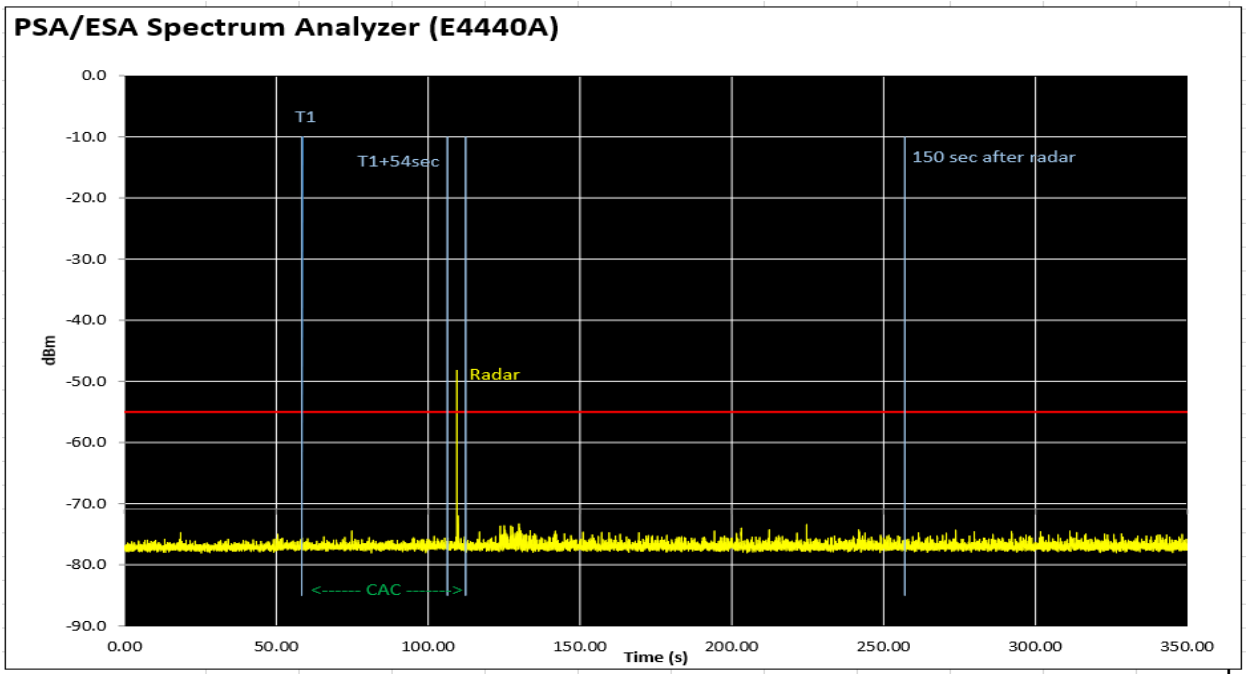
Pass: No Transmission detected by the spectrum analyzer within observation period, nor the Master device indicates Radar was detected.

Plot(s)

Initial Channel Availability Check time



Radar Burst at the beginning of the Channel Availability Check time



Radar Burst at the end of the Channel Availability Check time

15.407(h)(2)(i)(B) Channel Move Time, Channel Closing Time
15.407(h)(2)(iv) Non-Occupancy Period

Channel Move / Closing Time and Non-Occupancy Period

Master/ Client with Radar Detection/ Client without Radar Detection

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	7.8.3	Test Date(s):	1/16/2021
Configuration:	1		
Test Setup:	Conducted In-Service Monitoring was evaluated as illustrated in test setup diagram. The Test frequency contains control signals. A spectrum analyzer with Peak detector activated, set at zero span and RBW and VBW >3 MHz. In-Service monitoring was evaluated with the Widest bandwidth mode. Radar burst at required test level was triggered and the time to vacate the channel and remained unoccupied was evaluated. Plot and Spectrum analyzer trace data was captured with maximum available BIN, the trace data is imported to Analysis application to detect channel move time and channel closing time. Time above Threshold (T1 to T1+200ms) and (T1+200ms to Ts+10s) meet required maximum timing requirements. Test performed with widest BW mode available. (see table a2) 802.11HT80, radar inject and monitored at 5500MHz, the service channel of 802,11HT80 is at 5500MHz. Start of radar pulse T0 = 499.4ms End of radar pulse T1=523.8ms For Channel move and Channel closing time Sweep at 11sec, there was no transmission detected after 1 second, second acquisition performed at 2 second sweep time. Time analyses perform with 2 sec sweep. For Non-Occupancy time, a second spectrum analyzer was connected to the power splitter at the EUT antenna port, tuned to the channel under investigation with 1 second sweep time and set in max hold. Transmission trace way verified prior to testing.		

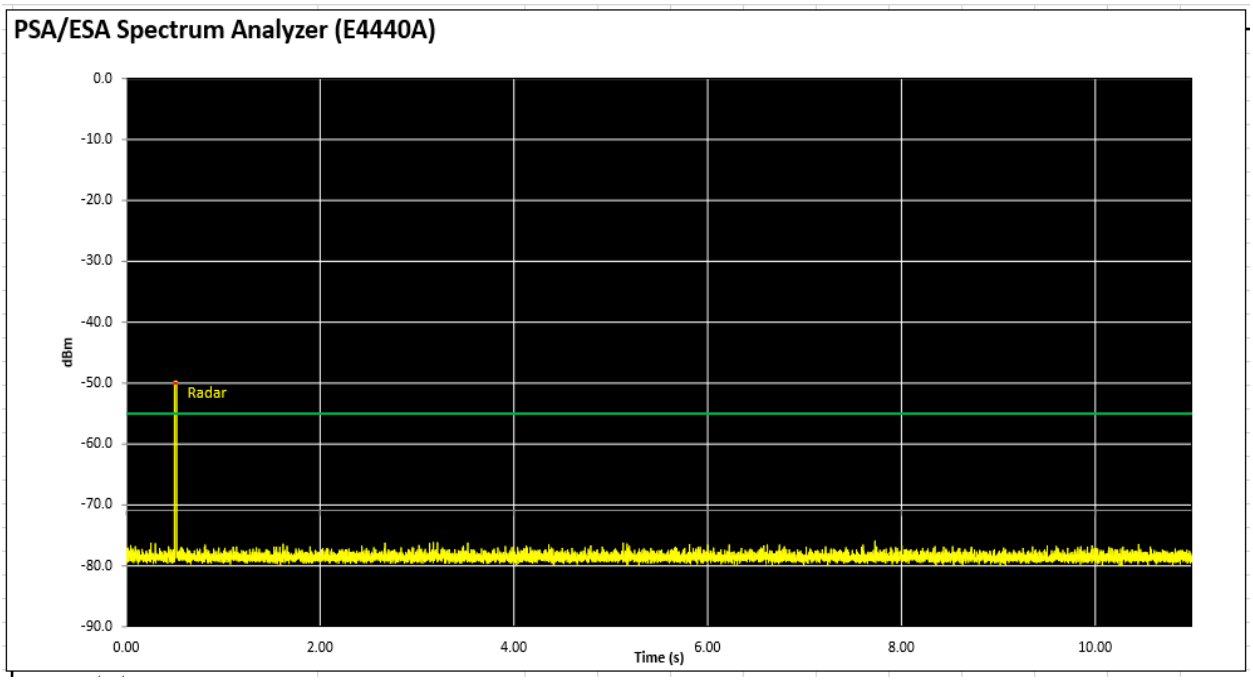
Test Data Summary						
Frequency (MHz)	**Protocol**	**Waveform Type**	**Channel Test**	**Measured Time**	**Limit**	**Results**
5500	802.11VHT80	0	Move[1]	3.7 ms	<10 s	Pass
5500	802.11VHT80	0	T1 - Closing[1,2]	1.5ms	<200ms	Pass
5500	802.11VHT80	0	CS - Closing[1,2]	2.2ms	<60 ms/10s	Pass
5500	802.11VHT20	0	Non-Occupancy[3]	NA	>30 s	

Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.
Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.
Note 3. This test is required for Master and Client with Radar Detection.

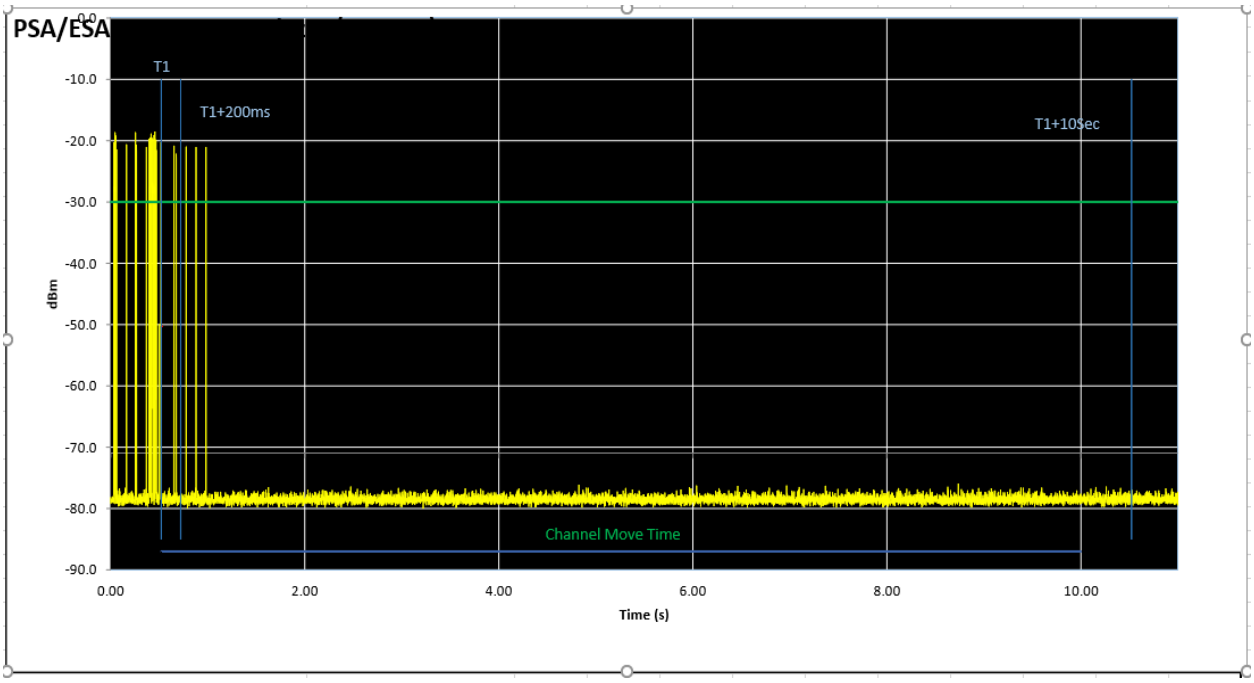
Fail: Transmission detected within 30 minutes after Radar burst.

Pass: No transmission within 30 minutes after Radar burst.

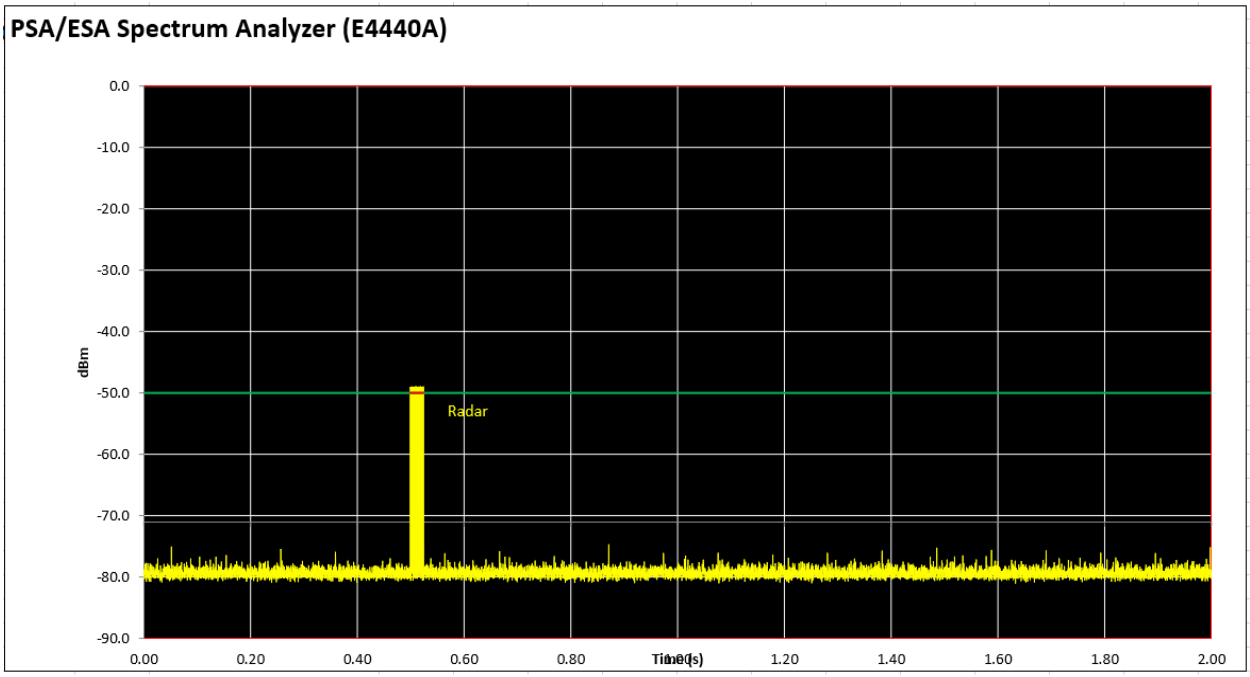
Plot(s)



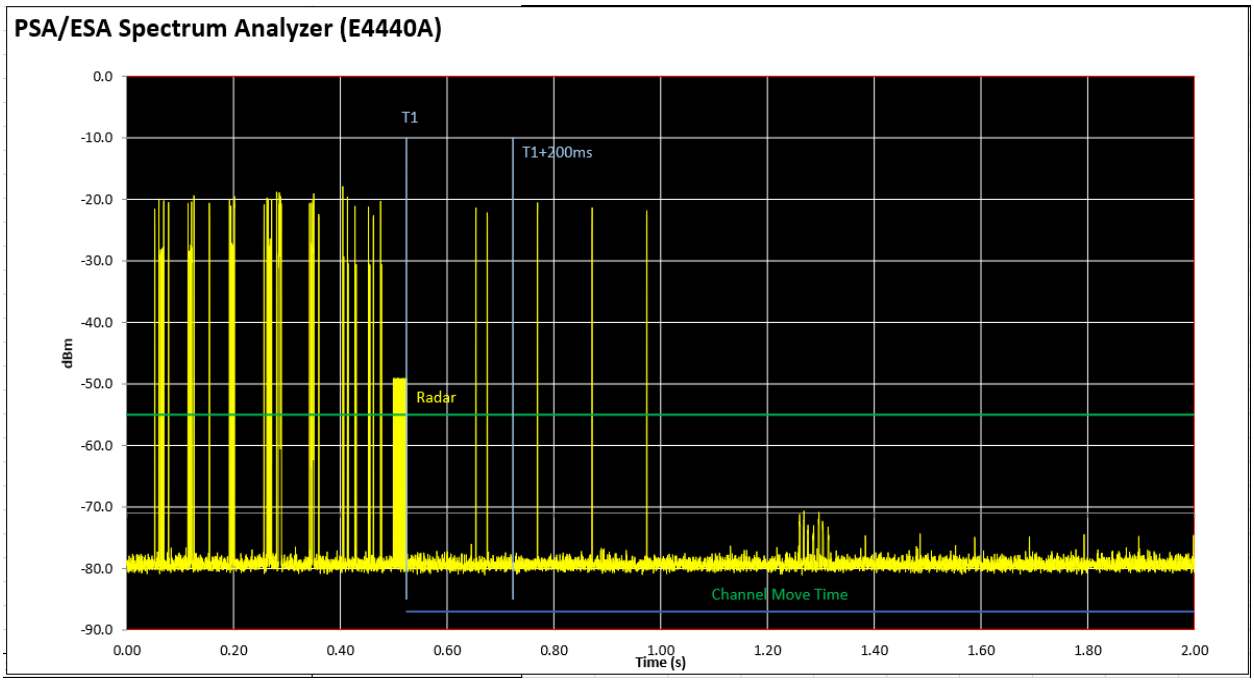
Radar pulse at 500ms, 10 sec sweep



Transmission with radar pulse at 500ms, 10 sec sweep

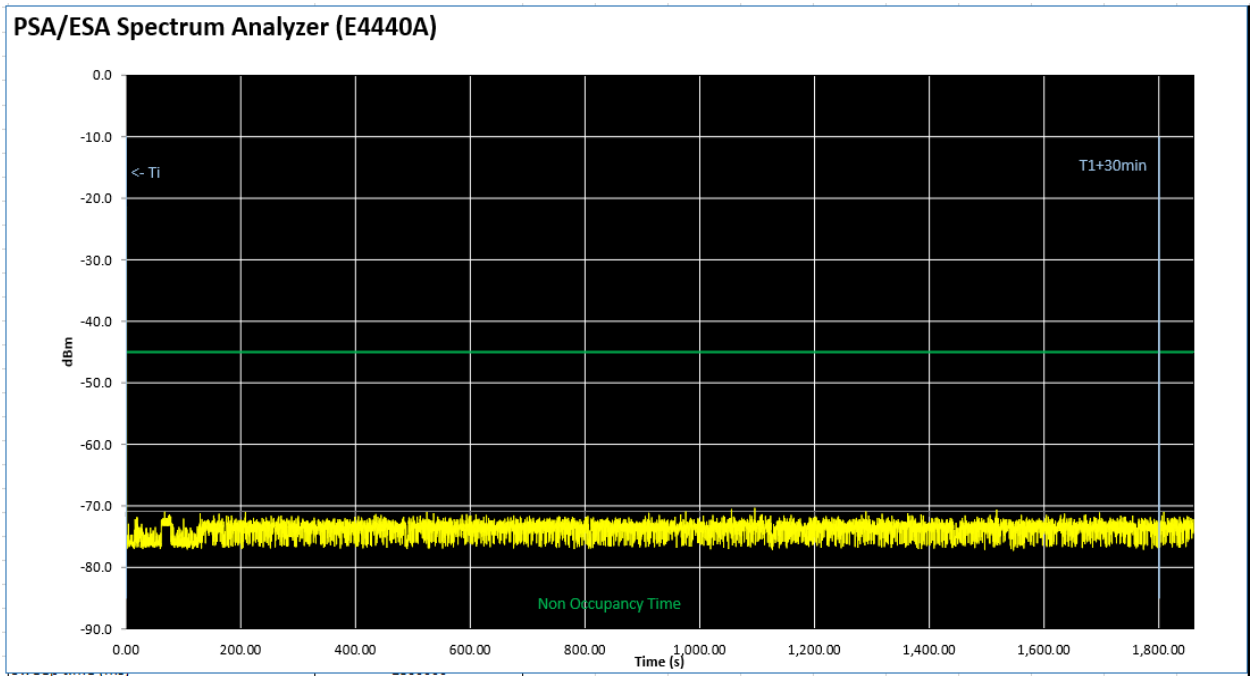


Radar pulse at 500ms, 2 sec sweep



Transmission with radar pulse at 500ms 2 sec sweep

BIN T1+200ms	6
Time T1+200ms ms	1.5
BIN after T1+200ms to 10sec	9
Aggregate time (T1+200ms, to 10 sec) ms	2.2



Non-Occupancy time

5.1 Table 2 – Statistical Performance Check

Test Setup/Conditions			
Test Location:	Brea Lab Bench	Test Engineer:	E. Wong
Test Method:	7.8.4	Test Date(s):	1/15/2021
Configuration:	1		
Test Setup:	Conducted Statistical Performance Check was evaluated as illustrated in test setup diagram. Initial check: Radar burst at required test level was triggered. Transmissions of the EUT was observed at the end of the Burst on the Operating Channel for duration greater than 10 seconds for Radar Type 0 to ensure detection occurs. Transmissions of the EUT was observed at the end of the Burst on the Operating Channel for duration greater than 22 seconds for Long Pulse Radar Type 5 to ensure detection occurs. Statistical Performance of each protocol was evaluated with Radar burst triggered at required test level. Frequencies selected for statistical performance check include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices, it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency. Video file of various channel loading meeting channel loading of at least 17 % were used		

Test Data Summary

802.11a				
		Detection	Limit	Pass/Fail
Waveform	Number of trial	%	%	
Short Pulse				
Waveform 1	30	90.0	60	Pass
Waveform 2	30	80.0	60	Pass
Waveform 3	30	93.3	60	Pass
Waveform 4	30	86.7	60	Pass
Aggregate	120	87.5	80	Pass
Long Pulse				
Waveform 5	30	83.3	80	Pass
Waveform 6	30	100.0	70	Pass

802.11VHT20				
		Detection	Limit	Pass/Fail
Waveform	Number of trial	%	%	
Short Pulse				
Waveform 1	30	80.0	60	Pass
Waveform 2	30	80.0	60	Pass
Waveform 3	30	80.0	60	Pass
Waveform 4	30	86.7	60	Pass
Aggregate	120	81.7	80	Pass
Long Pulse				
Waveform 5	30	86.7	80	Pass
Waveform 6	30	100.0	70	Pass

		802.11VHT40		
		Detection	Limit	Pass/Fail
Waveform	Number of trial	%	%	
Short Pulse				
Waveform 1	30	96.7	60	Pass
Waveform 2	30	83.3	60	Pass
Waveform 3	30	73.3	60	Pass
Waveform 4	30	83.3	60	Pass
Aggregate	120	84.2	80	Pass
Long Pulse				
Waveform 5	30	93.3	80	Pass
Waveform 6	30	100.0	70	Pass

802.1VHT80				
		Detection	Limit	Pass/Fail
Waveform	Number of trial	%	%	
Short Pulse				
Waveform 1	30	96.7	60	Pass
Waveform 2	30	90.0	60	Pass
Waveform 3	30	90.0	60	Pass
Waveform 4	30	76.7	60	Pass
Aggregate	120	88.3	80	Pass
Long Pulse				
Waveform 5	30	96.7	80	Pass
Waveform 6	30	100.0	70	Pass

Test Data

Waveform Type 1 For 20MHz, 40 MHz, 80MHz See appendix D for Waveform detail				5500MHz 5Mbps 802.11a	5500MHz 10Mbps 802.11VHT20	5510MHz 10Mbps 802.11VHT40	5530MHz 10Mbps 802.11 VHT80
Trial	Pulse/burst	Pulse width us	PRI (us)	Detection 1=Yes,0=No	Detection 1=Yes,0=No	Detection 1=Yes,0=No	Detection 1=Yes,0=No
0	57	1	938	1	0	1	1
1	76	1	698	1	1	1	1
2	86	1	618	1	1	1	1
3	99	1	538	1	1	1	1
4	61	1	878	1	0	1	1
5	18	1	3066	1	1	1	1
6	83	1	638	0	1	1	1
7	58	1	918	1	1	1	1
8	63	1	838	1	0	1	1
9	62	1	858	1	0	1	1
10	67	1	798	1	1	1	1
11	74	1	718	0	0	0	0
12	92	1	578	1	1	1	1
13	89	1	598	1	1	1	1
14	95	1	558	1	1	1	1
15	21	1	2536	1	1	1	1
16	55	1	966	1	1	1	1
17	64	1	827	1	1	1	1
18	22	1	2501	1	1	1	1
19	21	1	2595	1	1	1	1
20	48	1	1114	1	1	1	1
21	41	1	1302	1	0	1	1
22	18	1	3045	1	1	1	1
23	33	1	1624	1	1	1	1
24	19	1	2878	1	1	1	1
25	52	1	1027	1	1	1	1
26	22	1	2485	1	1	1	1
27	33	1	1600	0	1	1	1
28	46	1	1172	1	1	1	1
29	45	1	1177	1	1	1	1
Statistic Performance (%)				90.0	80.0	96.7	96.7

Waveform Type 2 For 20MHz, 40 MHz, 80MHz See appendix D for Waveform detail				5Mbps	5Mbps	10Mbps	10Mbps
				5500MHz	5500MHz	5510MHz	5530MHz
				802.11a	802.11VHT20	802.11VHT40	802.11VHT80
Trial	Pulse/burst	Pulse width	PRI	Detection	Detection	Detection	Detection
		us	(us)	1=Yes,0=No	1=Yes,0=No	1=Yes,0=No	1=Yes,0=No
0	26	3.2	179	1	1	1`	0
1	23	1.1	207	1	0	0	1
2	24	2.1	230	1	0	1	1
3	29	4.8	200	1	1	0	1
4	28	3.9	214	1	1	1	1
5	26	2.9	222	1	1	1	1
6	26	3.2	204	0	0	1	1
7	25	2.5	192	1	1	1	1
8	26	3.1	164	1	1	1	1
9	23	1.2	156	1	1	1	1
10	27	3.9	210	1	1	1	1
11	29	4.6	201	1	1	1	1
12	26	3.2	162	1	0	1	1
13	25	2.2	197	0	1	1	1
14	29	4.5	163	1	1	1	1
15	26	3	203	0	0	0	1
16	29	5	168	1	1	1	1
17	25	2.4	217	0	1	1	0
18	26	2.9	191	1	0	1	1
19	25	2.3	166	1	1	1	1
20	27	3.7	150	1	1	1	1
21	25	2.2	176	1	1	1	1
22	29	4.9	195	1	1	1	1
23	26	2.9	202	1	1	1	1
24	25	2.5	178	1	1	1	1
25	23	1.1	206	1	1	1	0
26	27	3.8	155	0	1	0	1
27	29	4.7	157	1	1	1	1
28	25	2.4	224	1	1	1	1
29	28	4.2	159	0	1	1	1
Statistic Performance (%)				80.0	80.0	83.3	90.0

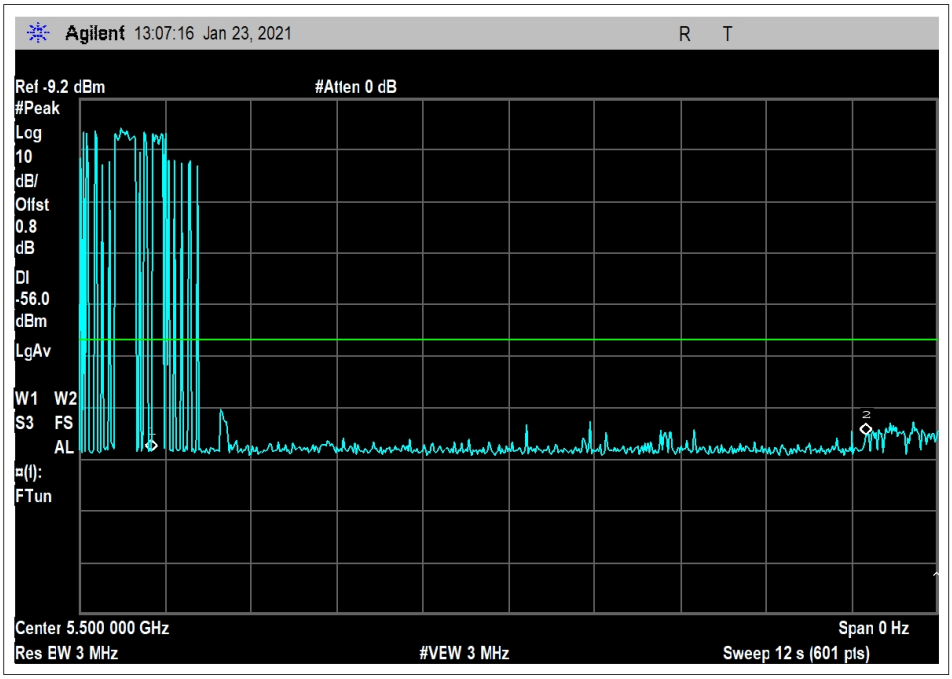
Waveform Type 3 For 20MHz, 40 MHz, 80MHz See appendix D for Waveform detail				5Mbps	10Mbps	10Mbps	10Mbps
				5500MHz	5500MHz	5510MHz	5530MHz
				802.11a	802.11VHT20	802.11VHT40	802.11VHT80
Trial	Pulse/burst	Pulse width	PRI	Detection	Detection	Detection	Detection
		us	(us)	1=Yes,0=No	1=Yes,0=No	1=Yes,0=No	1=Yes,0=No
0	17	8.2	355	1	1	1	0
1	16	6.1	487	1	0	1	1
2	16	7.1	344	1	1	1	1
3	18	9.8	288	1	1	0	1
4	18	8.9	230	1	0	0	1
5	17	7.9	432	0	1	0	1
6	17	8.2	207	1	0	1	1
7	17	7.5	443	1	1	0	1
8	17	8.1	439	1	1	1	1
9	16	6.2	223	1	0	1	1
10	18	8.9	208	1	1	1	1
11	18	9.6	463	1	1	1	1
12	17	8.2	441	0	1	1	1
13	16	7.2	323	1	1	1	1
14	18	9.5	297	1	1	0	1
15	17	8	412	1	1	1	0
16	18	10	324	1	1	1	1
17	17	7.4	271	1	0	1	1
18	17	7.9	349	1	1	1	1
19	16	7.3	409	1	0	1	1
20	18	8.7	373	1	1	1	1
21	16	7.2	254	1	1	1	1
22	18	9.9	274	1	1	1	1
23	17	7.9	278	1	1	1	1
24	17	7.5	317	1	1	0	1
25	16	6.1	260	1	1	0	1
26	18	8.8	211	1	1	1	1
27	18	9.7	272	1	1	0	1
28	17	7.4	264	1	1	1	0
29	18	9.2	284	1	1	1	1
Statistic Performance (%)				93.3	80.0	73.3	90.0

Waveform Type 4 For 20MHz, 40 MHz, 80MHz See appendix D for Waveform detail				5Mbps 5500MHz 802.11a	5Mbps 5500MHz 802.11VHT20	10Mbps 5510MHz 802.11VHT40	10Mbps 5530MHz 802.11 VHT80
Trial	Pulse/burst	Pulse width us	PRI (us)	Detection 1=Yes,0=No	Detection 1=Yes,0=No	Detection 1=Yes,0=No	Detection 1=Yes,0=No
0	14	16	355	1	1	1	0
1	12	11.3	487	1	1	1	1
2	13	13.5	344	0	1	1	1
3	16	19.4	288	1	1	1	0
4	15	17.5	230	0	1	1	1
5	14	15.3	432	1	1	0	0
6	14	15.9	207	1	1	0	1
7	13	14.3	443	1	1	1	1
8	14	15.8	439	1	1	1	1
9	12	11.5	223	1	1	1	1
10	15	17.4	208	0	0	0	1
11	16	19	463	1	0	1	1
12	14	16	441	1	1	1	0
13	13	13.8	323	1	0	1	0
14	16	18.9	297	1	1	1	1
15	14	15.5	412	1	1	1	1
16	16	19.9	324	1	1	1	0
17	13	14.1	271	1	1	1	1
18	14	15.2	349	1	1	1	1
19	13	13.8	409	1	1	1	1
20	15	17.1	373	1	1	1	1
21	13	13.8	254	0	1	0	1
22	16	19.8	274	1	1	1	1
23	14	15.3	278	1	0	1	0
24	13	14.5	317	1	1	0	1
25	12	11.3	260	1	1	1	1
26	15	17.3	211	1	1	1	1
27	16	19.2	272	1	1	1	1
28	13	14.2	264	1	1	1	1
29	15	18.2	284	1	1	1	1
Statistic Performance (%)				86.7	86.7	83.3	76.7

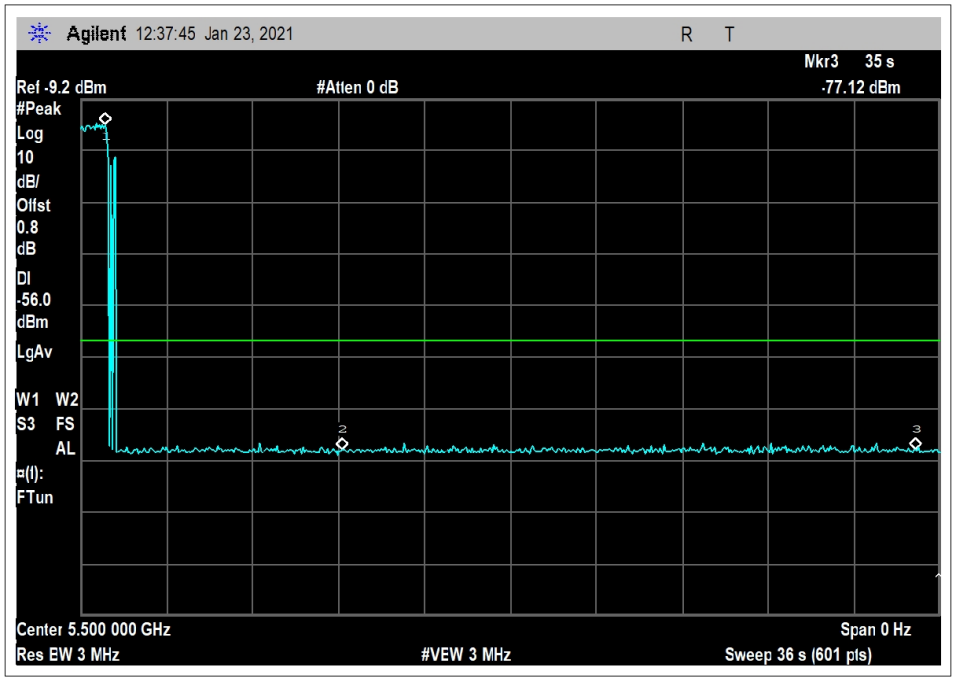
Waveform Type 5 For 20MHz, 40 MHz, 80MHz See appendix D for Waveform detail		5Mbps	10Mbps	10Mbps	10Mbps
		5500MHz	5500MHz	5510MHz	5530MHz
		802.11a	802.11VHT20	802.11VHT40	802.11 VHT80
Trial		**Detection**	**Detection**	**Detection**	**Detection**
		1=Yes,0=No	**1=Yes,0=No**	**1=Yes,0=No**	**1=Yes,0=No**
0	FCC Waveform 5 Test 0	1	1	1	1
1	FCC Waveform 5 Test 1	1	0	1	1
2	FCC Waveform 5 Test 2	0	1	1	1
3	FCC Waveform 5 Test 3	1	1	1	1
4	FCC Waveform 5 Test 4	1	1	1	1
5	FCC Waveform 5 Test 5	1	1	1	1
6	FCC Waveform 5 Test 6	1	1	1	1
7	FCC Waveform 5 Test 7	1	1	1	1
8	FCC Waveform 5 Test 8	1	1	1	1
9	FCC Waveform 5 Test 9	0	1	0	1
10	FCC Waveform 5 Test 10	1	1	1	1
11	FCC Waveform 5 Test 11	1	1	1	1
12	FCC Waveform 5 Test 12	1	1	1	1
13	FCC Waveform 5 Test 13	1	1	1	0
14	FCC Waveform 5 Test 14	1	1	0	1
15	FCC Waveform 5 Test 15	1	1	1	1
16	FCC Waveform 5 Test 16	1	1	1	1
17	FCC Waveform 5 Test 17	0	1	1	1
18	FCC Waveform 5 Test 18	1	1	1	1
19	FCC Waveform 5 Test 19	0	1	1	1
20	FCC Waveform 5 Test 20	1	0	1	1
21	FCC Waveform 5 Test 21	1	0	1	1
22	FCC Waveform 5 Test 22	1	1	1	1
23	FCC Waveform 5 Test 23	1	1	1	1
24	FCC Waveform 5 Test 24	1	1	1	1
25	FCC Waveform 5 Test 25	0	1	1	1
26	FCC Waveform 5 Test 26	1	1	1	1
27	FCC Waveform 5 Test 27	1	1	1	1
28	FCC Waveform 5 Test 28	1	1	1	1
29	FCC Waveform 5 Test 29	1	0	1	1
Statistic Performance (%)		83.3	86.7	93.3	96.7

Waveform Type 6 For 20MHz, 40 MHz, 80MHz See appendix D for Waveform detail		5Mbps	10Mbps	10Mbps	8Mbps
		5500MHz	5500MHz	5510MHz	5530MHz
		802.11a	802.11VHT20	802.11VHT40	802.11VHT80
Trial		**Detection**	**Detection**	**Detection**	**Detection**
		1=Yes,0=No	**1=Yes,0=No**	**1=Yes,0=No**	**1=Yes,0=No**
0	FCC Waveform 6 Test 0	1	1	1	1
1	FCC Waveform 6 Test 1	1	1	1	1
2	FCC Waveform 6 Test 2	1	1	1	1
3	FCC Waveform 6 Test 3	1	1	1	1
4	FCC Waveform 6 Test 4	1	1	1	1
5	FCC Waveform 6 Test 5	1	1	1	1
6	FCC Waveform 6 Test 6	1	1	1	1
7	FCC Waveform 6 Test 7	1	1	1	1
8	FCC Waveform 6 Test 8	1	1	1	1
9	FCC Waveform 6 Test 9	1	1	1	1
10	FCC Waveform 6 Test 10	1	1	1	1
11	FCC Waveform 6 Test 11	1	1	1	1
12	FCC Waveform 6 Test 12	1	1	1	1
13	FCC Waveform 6 Test 13	1	1	1	1
14	FCC Waveform 6 Test 14	1	1	1	1
15	FCC Waveform 6 Test 15	1	1	1	1
16	FCC Waveform 6 Test 16	1	1	1	1
17	FCC Waveform 6 Test 17	1	1	1	1
18	FCC Waveform 6 Test 18	1	1	1	1
19	FCC Waveform 6 Test 19	1	1	1	1
20	FCC Waveform 6 Test 20	1	1	1	1
21	FCC Waveform 6 Test 21	1	1	1	1
22	FCC Waveform 6 Test 22	1	1	1	1
23	FCC Waveform 6 Test 23	1	1	1	1
24	FCC Waveform 6 Test 24	1	1	1	1
25	FCC Waveform 6 Test 25	1	1	1	1
26	FCC Waveform 6 Test 26	1	1	1	1
27	FCC Waveform 6 Test 27	1	1	1	1
28	FCC Waveform 6 Test 28	1	1	1	1
29	FCC Waveform 6 Test 29	1	1	1	1
Statistic Performance (%)		100.0	100.0	100.0	100.0

Plot(s)



10 second plot Radar Type 0 response



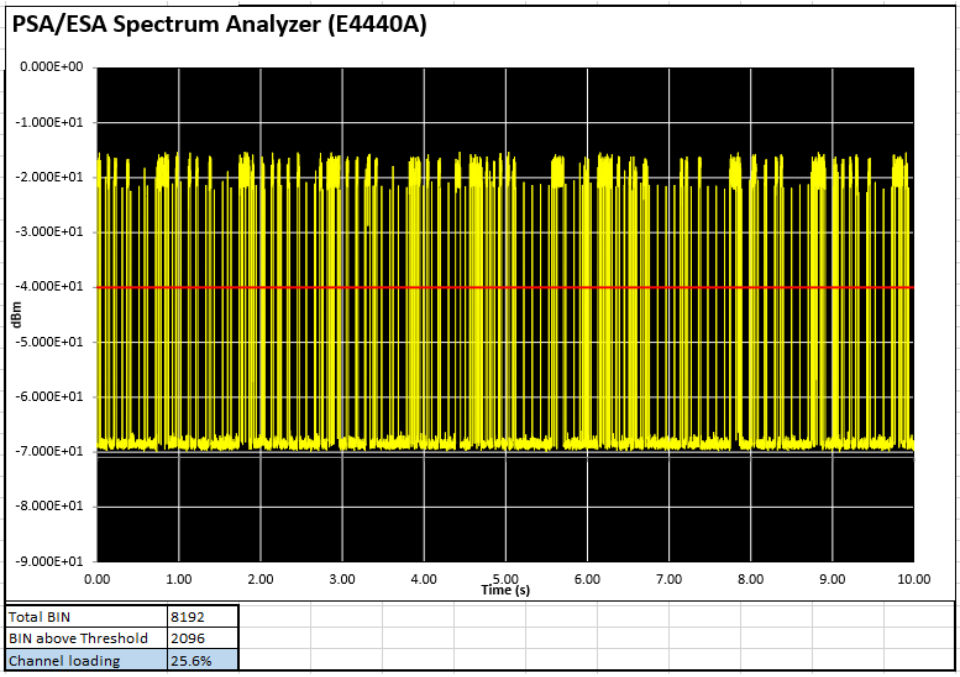
22 second plot Radar Type 5 response

Channel Loading

Test Setup/Conditions			
Test Location:	Brea Lab Bench	Test Engineer:	E. Wong
Test Method:	7.7	Test Date(s):	1/14/2021
Configuration:	1		
Test Setup:	Conducted Channel loading was measured as illustrated in test setup diagram. A spectrum analyzer with Peak detector activated, set at zero span and RBW and VBW >3 MHz. Channel loading of each protocol is evaluated. Data transfer: MPEG file is loaded on Laptop1 which is connected to the Ethernet port of the Master device. Laptop 2 is connected to the client device via Ethernet port. Communication established between the master and client, Window Media Player with V2.61 Codec package installed in Laptop2 (client device) plays the MPEG file stored in laptop1 (Master device) via steaming mode. Filename: DFS Video 5 Mbps, 8 Mbps, 10Mbps, Trace captured and analyzed with excel spread sheet. Channel loading is measured by Time On/ (Time On + Time Off), equivalently (BIN above Threshold/ total BIN)		

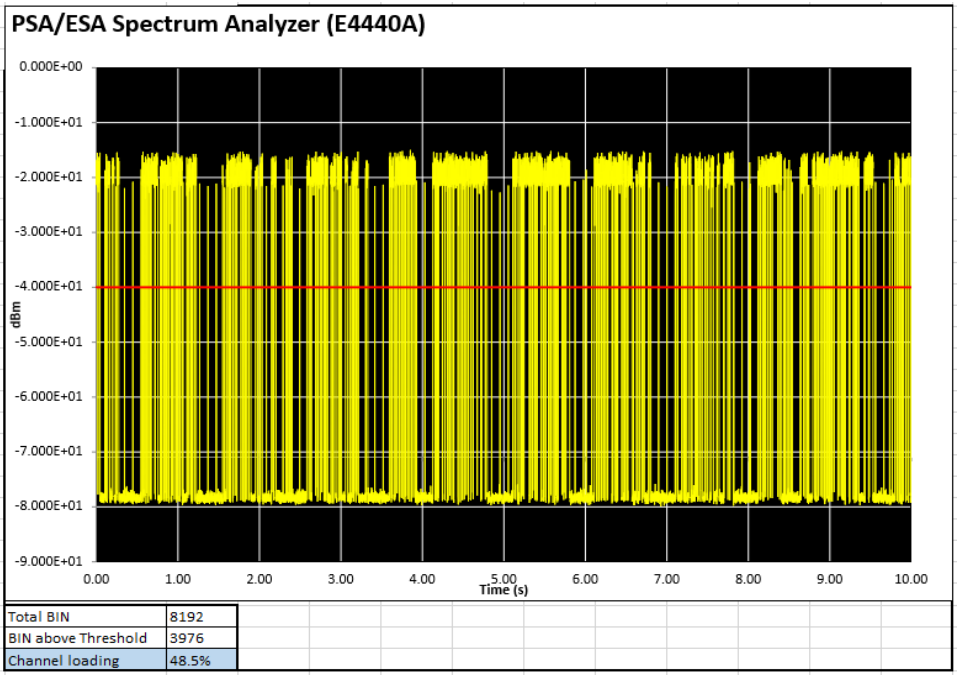
Test Data Summary				
Frequency (MHz)	**Protocol**	**Loading (%)**	**Limit (%)**	**Results**
5500	802.11a, 5Mbps	25.6	> 17	Pass
5500	802.11a, 10Mbps	48.5	> 17	Pass
5500	802.11VHT20, 5Mbps	19.4	> 17	Pass
5500	802.11VHT20, 10Mbps	28.0	> 17	Pass
5510	802.11VHT40, 10Mbps	28.0	> 17	Pass
5530	802.11VHT80, 8Mbps	17.8	> 17	Pass
5530	802.11VHT80, 10Mbps	20.3	> 17	Pass

Plot(s)



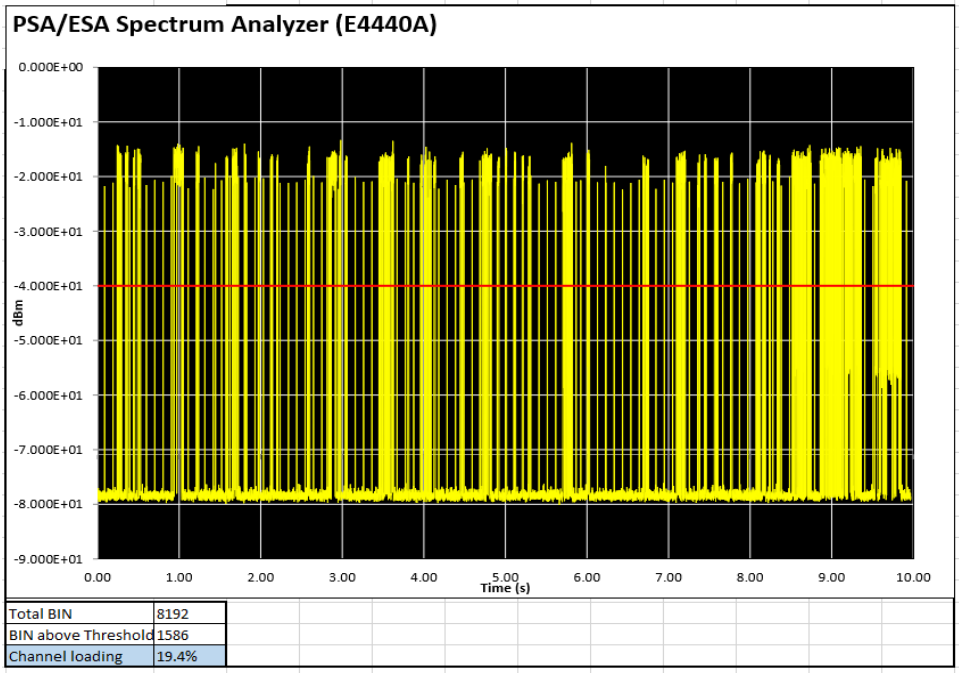
Total BIN	8192
BIN above Threshold	2096
Channel loading	25.6%

7.7 Channel Loading_801.11a_8192pt_5Mbps

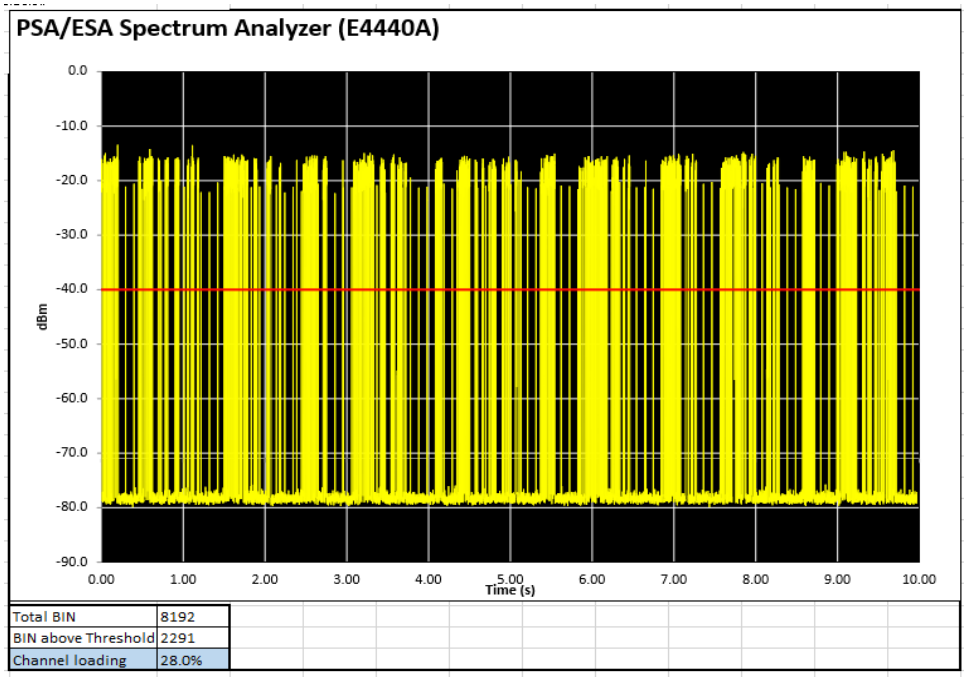


Total BIN	8192
BIN above Threshold	3976
Channel loading	48.5%

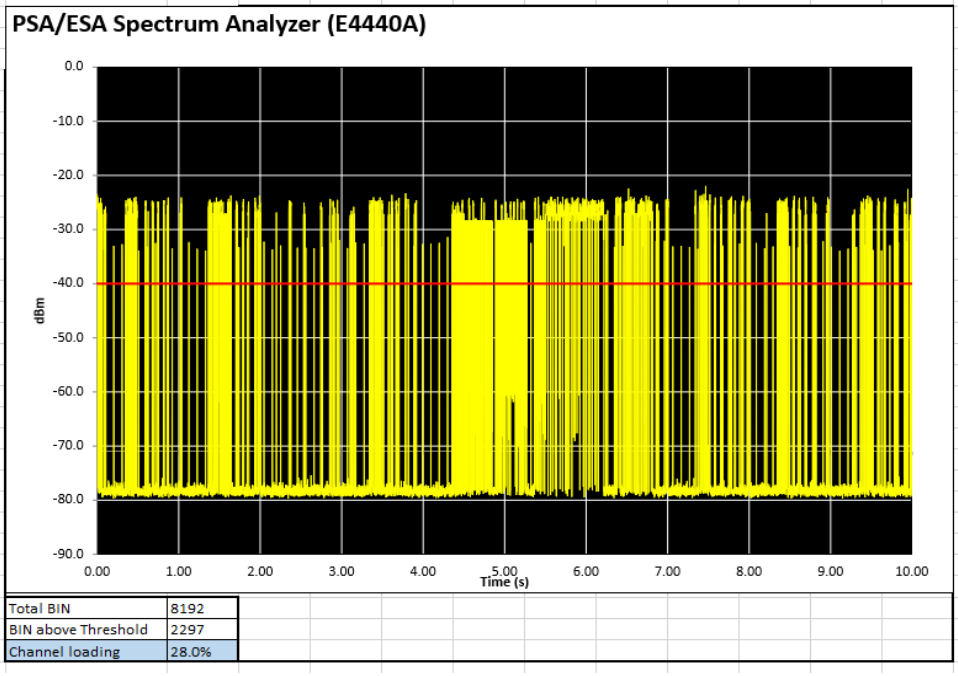
7.7 Channel Loading_801.11a_8192pt_10Mbps



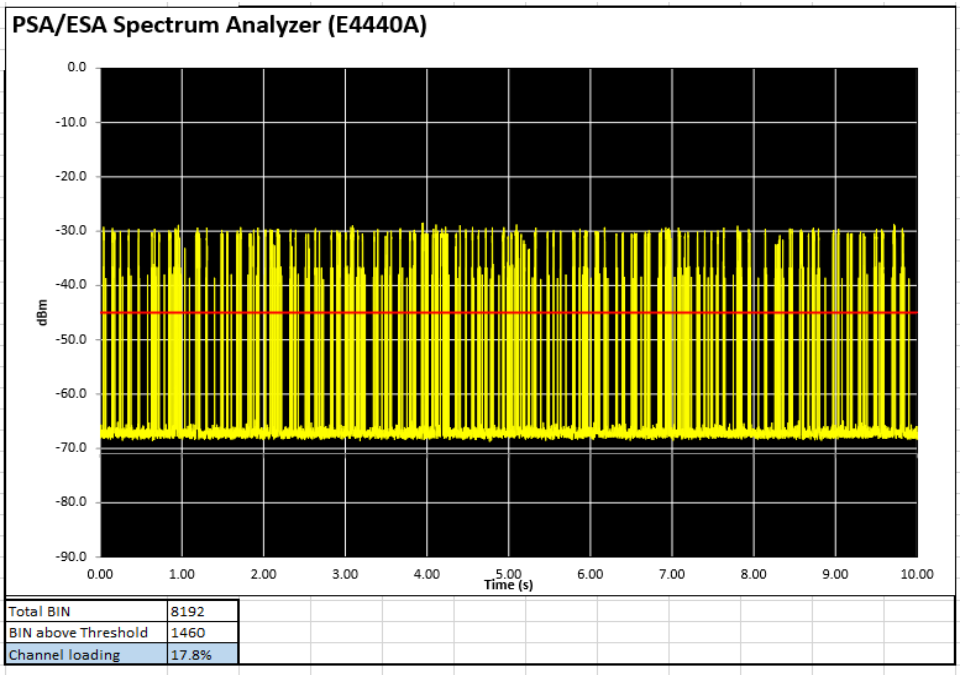
7.7 Channel Loading_801.11HT20_8192pt_5Mbps



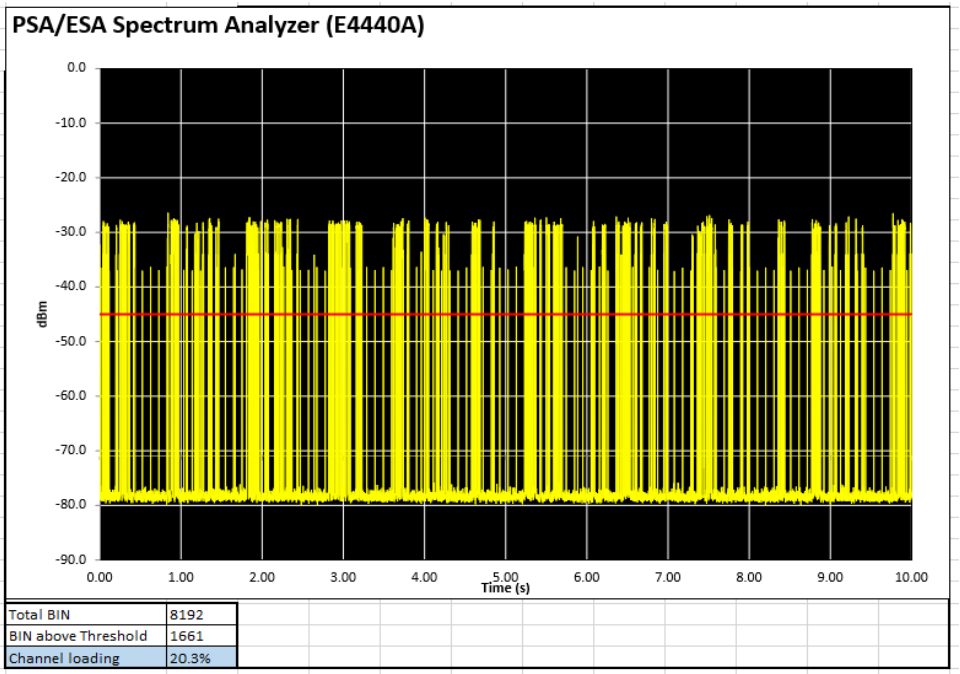
7.7 Channel Loading_801.11HT20_8192pt_10Mbps



7.7 Channel Loading_801.11HT40_8192pt_10Mbps

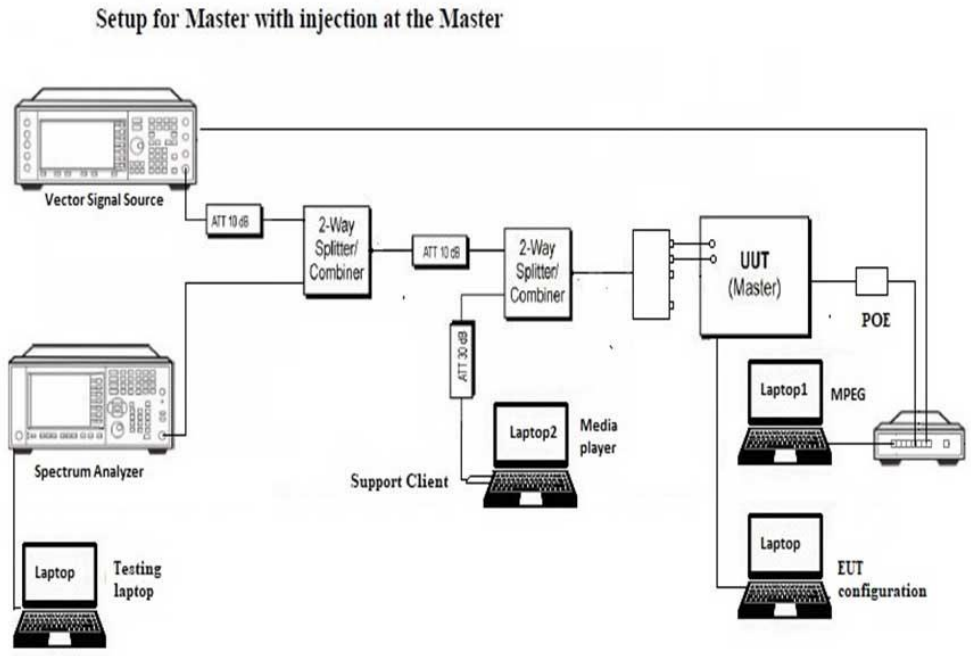


7.7 Channel Loading_801.11HT80_8192pt_8Mbps



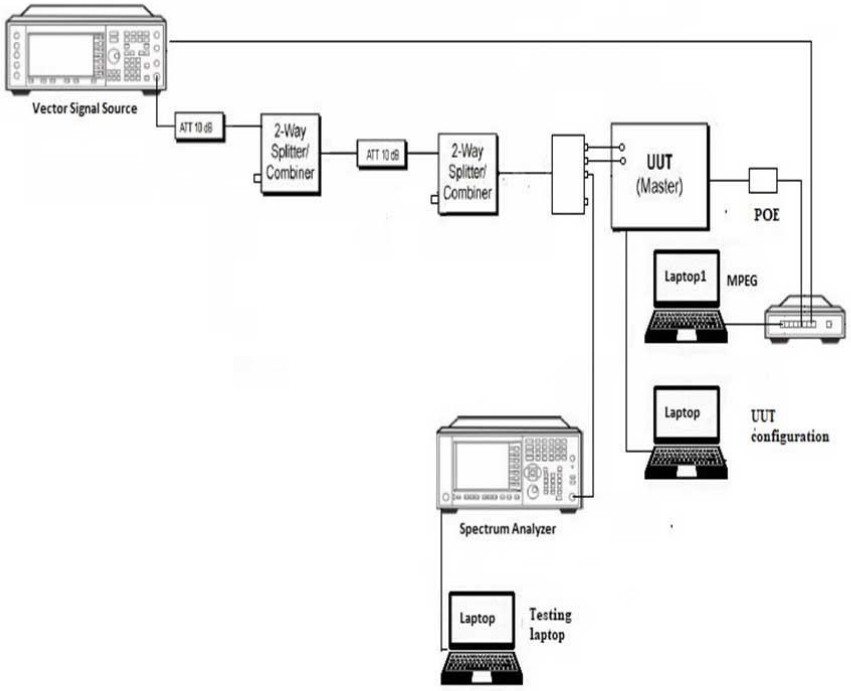
7.7 Channel Loading_801.11HT80_8192pt_8Mbps

Appendix A: Test Equipment Setup Block Diagram

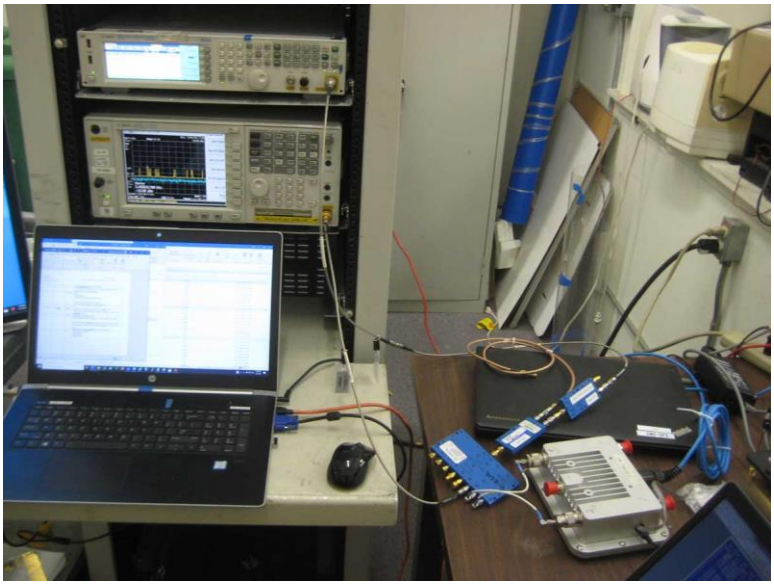


Appendix B: Detection Threshold Diagram

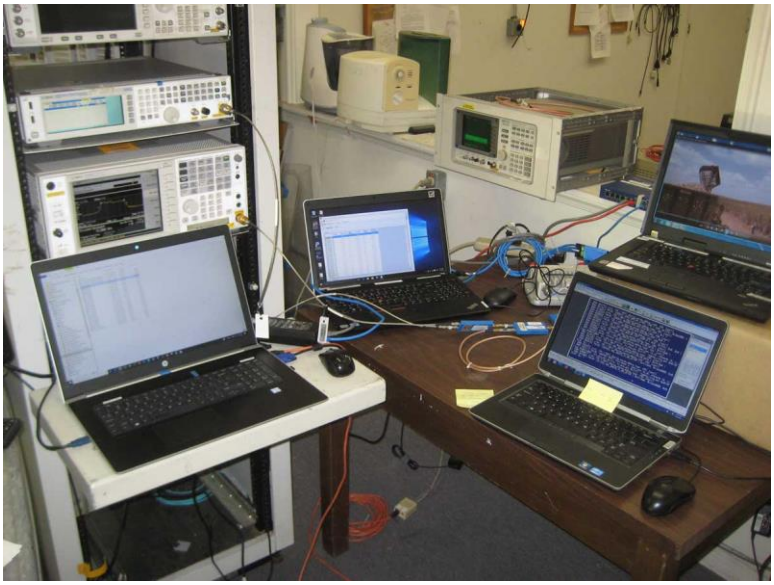
Setup for Master with injection at the Master



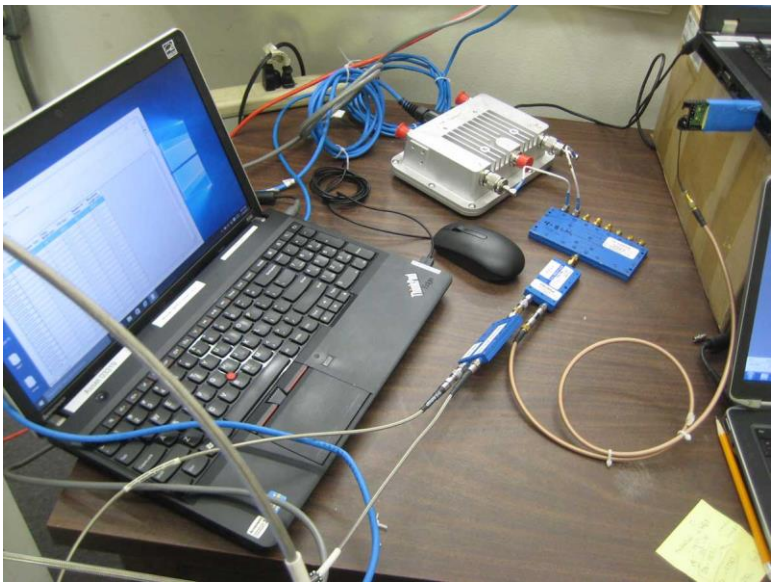
Appendix C: Test Setup Photos



Radar Signal Calibration



Test Setup



Test Setup Close-up

Appendix D: Statistical Performance Test Waveform Radar Type 1-6

Short Pulse Radar: Waveform Type 1				
Trial	Pulse width (µs)	PRI (µs)	Number of Pulses	Waveform Length (µs)
0	1	938	57	53466.0
1	1	698	76	53048.0
2	1	618	86	53148.0
3	1	538	99	53262.0
4	1	878	61	53558.0
5	1	3066	18	55188.0
6	1	638	83	52954.0
7	1	918	58	53244.0
8	1	838	63	52794.0
9	1	858	62	53196.0
10	1	798	67	53466.0
11	1	718	74	53132.0
12	1	578	92	53176.0
13	1	598	89	53222.0
14	1	558	95	53010.0
15	1	2536	21	53256.0
16	1	966	55	53130.0
17	1	827	64	52928.0
18	1	2501	22	55022.0
19	1	2595	21	54495.0
20	1	1114	48	53472.0
21	1	1302	41	53382.0
22	1	3045	18	54810.0
23	1	1624	33	53592.0
24	1	2878	19	54682.0
25	1	1027	52	53404.0
26	1	2485	22	54670.0
27	1	1600	33	52800.0
28	1	1172	46	53912.0
29	1	1177	45	52965.0

Short Pulse Radar: Waveform Type 2				
Trial	Pulse width (µs)	PRI (µs)	Number of Pulses	Waveform Length (µs)
0	3.2	179	26	4654.0
1	1.1	207	23	4761.0
2	2.1	230	24	5520.0
3	4.8	200	29	5800.0
4	3.9	214	28	5992.0
5	2.9	222	26	5772.0
6	3.2	204	26	5304.0
7	2.5	192	25	4800.0
8	3.1	164	26	4264.0
9	1.2	156	23	3588.0
10	3.9	210	27	5670.0
11	4.6	201	29	5829.0
12	3.2	162	26	4212.0
13	2.2	197	25	4925.0
14	4.5	163	29	4727.0
15	3.0	203	26	5278.0
16	5.0	168	29	4872.0
17	2.4	217	25	5425.0
18	2.9	191	26	4966.0
19	2.3	166	25	4150.0
20	3.7	150	27	4050.0
21	2.2	176	25	4400.0
22	4.9	195	29	5655.0
23	2.9	202	26	5252.0
24	2.5	178	25	4450.0
25	1.1	206	23	4738.0
26	3.8	155	27	4185.0
27	4.7	157	29	4553.0
28	2.4	224	25	5600.0
29	4.2	159	28	4452.0

Short Pulse Radar: Waveform Type 3				
Trial	Pulse width (µs)	PRI (µs)	Number of Pulses	Waveform Length (µs)
0	8.2	355	17	6035.0
1	6.1	487	16	7792.0
2	7.1	344	16	5504.0
3	9.8	288	18	5184.0
4	8.9	230	18	4140.0
5	7.9	432	17	7344.0
6	8.2	207	17	3519.0
7	7.5	443	17	7531.0
8	8.1	439	17	7463.0
9	6.2	223	16	3568.0
10	8.9	208	18	3744.0
11	9.6	463	18	8334.0
12	8.2	441	17	7497.0
13	7.2	323	16	5168.0
14	9.5	297	18	5346.0
15	8.0	412	17	7004.0
16	10.0	324	18	5832.0
17	7.4	271	17	4607.0
18	7.9	349	17	5933.0
19	7.3	409	16	6544.0
20	8.7	373	18	6714.0
21	7.2	254	16	4064.0
22	9.9	274	18	4932.0
23	7.9	278	17	4726.0
24	7.5	317	17	5389.0
25	6.1	260	16	4160.0
26	8.8	211	18	3798.0
27	9.7	272	18	4896.0
28	7.4	264	17	4488.0
29	9.2	284	18	5112.0

Short Pulse Radar: Waveform Type 4				
Trial	Pulse width (µs)	PRI (µs)	Number of Pulses	Waveform Length (µs)
0	16	355	14	4970.0
1	11.3	487	12	5844.0
2	13.5	344	13	4472.0
3	19.4	288	16	4608.0
4	17.5	230	15	3450.0
5	15.3	432	14	6048.0
6	15.9	207	14	2898.0
7	14.3	443	13	5759.0
8	15.8	439	14	6146.0
9	11.5	223	12	2676.0
10	17.4	208	15	3120.0
11	19.0	463	16	7408.0
12	16.0	441	14	6174.0
13	13.8	323	13	4199.0
14	18.9	297	16	4752.0
15	15.5	412	14	5768.0
16	19.9	324	16	5184.0
17	14.1	271	13	3523.0
18	15.2	349	14	4886.0
19	13.8	409	13	5317.0
20	17.1	373	15	5595.0
21	13.8	254	13	3302.0
22	19.8	274	16	4384.0
23	15.3	278	14	3892.0
24	14.5	317	13	4121.0
25	11.3	260	12	3120.0
26	17.3	211	15	3165.0
27	19.2	272	16	4352.0
28	14.2	264	13	3432.0
29	18.2	284	15	4260.0

Long Pulse Radar: Waveform Type 5			
Trial ID	**Number of Bursts**	**Burst Period(s)**	**Wave Length (s)**
0	15	0.8000000	12
1	8	1.5000000	12
2	11	1.0909091	12
3	20	0.6000000	12
4	17	0.7058824	12
5	14	0.8571429	12
6	15	0.8000000	12
7	12	1.0000000	12
8	14	0.8571429	12
9	8	1.5000000	12
10	17	0.7058824	12
11	19	0.6315789	12
12	15	0.8000000	12
13	12	1.0000000	12
14	19	0.6315789	12
15	14	0.8571429	12
16	20	0.6000000	12
17	12	1.0000000	12
18	14	0.8571429	12
19	12	1.0000000	12
20	16	0.7500000	12
21	12	1.0000000	12
22	20	0.6000000	12
23	14	0.8571429	12
24	13	0.9230769	12
25	8	1.5000000	12
26	17	0.7058824	12
27	19	0.6315789	12
28	12	1.0000000	12
29	18	0.6666667	12

Long Pulse Radar: Waveform Type 6						
Trial ID	**Pulse Width (µs)**	**PRI (µs)**	**Pulse Per Hop**	**Hopping Rate(kHz)**	**Hopping Length(ms)**	**Visible Frequency Number**
0	1.0	333.3	9	0.3333	300.000000	5
1	1.0	333.3	9	0.3333	300.000000	1
2	1.0	333.3	9	0.3333	300.000000	4
3	1.0	333.3	9	0.3333	300.000000	6
4	1.0	333.3	9	0.3333	300.000000	2
5	1.0	333.3	9	0.3333	300.000000	1
6	1.0	333.3	9	0.3333	300.000000	4
7	1.0	333.3	9	0.3333	300.000000	6
8	1.0	333.3	9	0.3333	300.000000	5
9	1.0	333.3	9	0.3333	300.000000	1
10	1.0	333.3	9	0.3333	300.000000	4
11	1.0	333.3	9	0.3333	300.000000	8
12	1.0	333.3	9	0.3333	300.000000	5
13	1.0	333.3	9	0.3333	300.000000	5
14	1.0	333.3	9	0.3333	300.000000	4
15	1.0	333.3	9	0.3333	300.000000	6
16	1.0	333.3	9	0.3333	300.000000	2
17	1.0	333.3	9	0.3333	300.000000	5
18	1.0	333.3	9	0.3333	300.000000	4
19	1.0	333.3	9	0.3333	300.000000	5
20	1.0	333.3	9	0.3333	300.000000	5
21	1.0	333.3	9	0.3333	300.000000	8
22	1.0	333.3	9	0.3333	300.000000	5
23	1.0	333.3	9	0.3333	300.000000	2
24	1.0	333.3	9	0.3333	300.000000	3
25	1.0	333.3	9	0.3333	300.000000	3
26	1.0	333.3	9	0.3333	300.000000	4
27	1.0	333.3	9	0.3333	300.000000	5
28	1.0	333.3	9	0.3333	300.000000	7
29	1.0	333.3	9	0.3333	300.000000	3

Appendix E: Radar Waveform Requirement

The Waveform used for testing meets FCC requirement in accordance with section 6 of 905462 D02 UNII DFS Compliance Procedures New Rules v02

RADAR TEST WAVEFORMS

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

6.1 Short Pulse Radar Test Waveforms

Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.
For example if in Short Pulse Radar Type 1 Test B a PRI of 3066 µsec is selected, the number of pulses would be =

$$\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^{6}}{3066}\right)\right\} = \text{Round up } \{17.2\} = 18.$$

Table 5a - Pulse Repetition Intervals Values for Test A

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

The aggregate is the average of the percentage of successful detections of Short Pulse Radar Types 1-4.
For example, the following table indicates how to compute the aggregate of percentage of successful detections.

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	35	29	82.9%
2	30	18	60%
3	30	27	90%
4	50	44	88%
Aggregate (82.9% + 60% + 90% + 88%)/4 = 80.2%			

6.2 Long Pulse Radar Test Waveform

Table 6 – Long Pulse Radar Test Waveform

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

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

Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.

2) There are a total of 8 to 20 *Bursts* in the 12 second period, with the number of *Bursts* being randomly chosen. This number is *Burst Count*.

3) Each *Burst* consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each *Burst* within the 12 second sequence may have a different number of pulses.

4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a *Burst* will have the same pulse width. Pulses in different *Bursts* may have different pulse widths.

5) Each pulse has a linear frequency modulated chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a *transmission period* will have the same chirp width. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.

6) If more than one pulse is present in a *Burst*, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a *Burst*, the random time interval between the first and second pulses is chosen independently of the random time interval between the second and third pulses.

7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to *Burst Count*. Each interval is of length (12,000,000 / *Burst Count*) microseconds. Each interval contains one *Burst*. The start time for the *Burst*, relative to the beginning of the interval, is between 1 and [(12,000,000 / *Burst Count*) – (Total *Burst* Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each *Burst* is chosen randomly.

A representative example of a Long Pulse Radar Type waveform:

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

Figure 1 provides a graphical representation of the Long Pulse Radar Test Waveform.

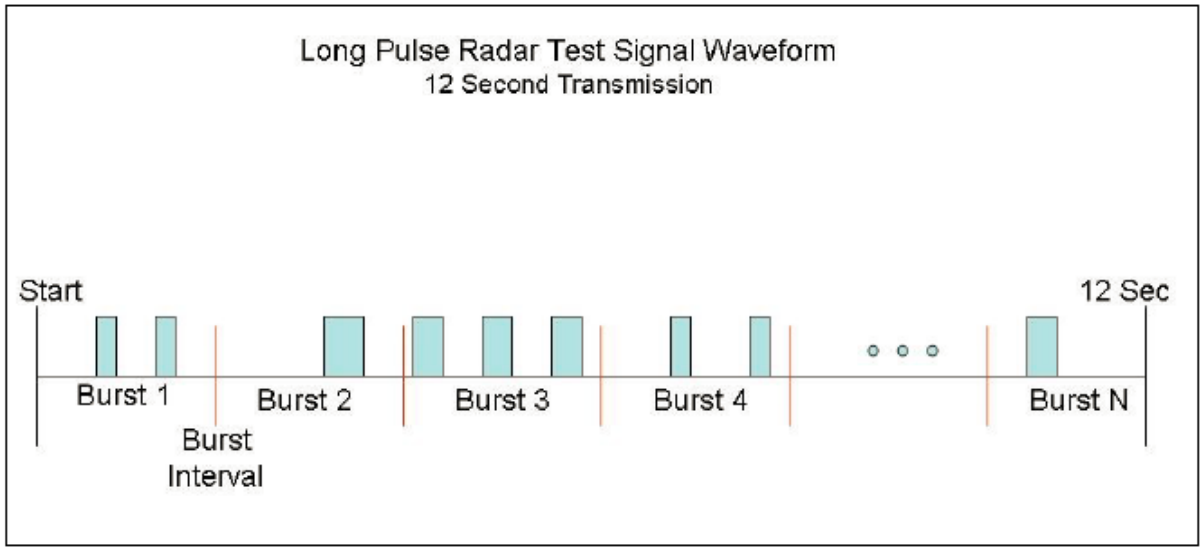


Figure 1: Graphical Representation of a Long Pulse Radar Type Waveform

6.3 Frequency Hopping Radar Test Waveform

Table 7 – Frequency Hopping Radar Test Waveform

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

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined by the following algorithm: [4]

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

[4] If a segment does not contain at least 1 frequency within the *UNII Detection Bandwidth* of the UUT, then that segment is not used.

Appendix F: Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2.