DFS Test Report

Report No.:	RF160418C29B-1
FCC ID:	GZ5NVG4XXQ
Test Model:	NVG468MQ
Series Model:	NVG448BQ, NVG443BQ
Received Date:	Jun. 23, 2016
Test Date:	Dec. 12 ~ Dec. 15, 2016
Issued Date:	Dec. 16, 2016
Applicant:	ARRIS Group, Inc.
Address:	2500 Walsh Ave. Santa Clara, CA 95051,United State
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan, R.O.C.
Test Location:	No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)

Testing Laboratory
2021

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
RF160418C29B-1	Original release	Dec. 16, 2016

1 Certificate of Conformity

Product:	Ethernet and FTTH Gateway
Brand:	ARRIS
Test Model:	NVG468MQ
Series Model:	NVG448BQ, NVG443BQ
Sample Status:	Engineering Sample
Applicant:	ARRIS Group, Inc.
Test Date:	Dec. 12 ~ Dec. 15, 2016
Standards:	FCC Part 15, Subpart E (Section 15.407) KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** Dec. 16, 2016

Polly Chien / Specialist

Approved by : _____ , **Date:** Dec. 16, 2016

Ken Liu / Senior Manager

2 EUT Information

2.1 Operating Frequency Bands and Mode of EUT

Table 1: Operating Frequency Bands and Mode of EUT

Operational Mode	Operating Frequency Range	
	5250~5350MHz	5470~5725MHz
Master	✓	✓

2.2 EUT Software and Firmware Version

Table 2: The EUT Software/Firmware Version

No.	Product	Test Model No.	Software/Firmware Version
1	Ethernet and FTTH Gateway	NVG468MQ (Refer to note)	9.2.0h5d1

Note: All models are listed as below.

Brand	Model	Difference					
		Accessory			I/O port		
		Item	Brand	Model	Item	Number	Function
ARRIS	NVG468MQ	Switch Adapter Power cord: 1.8m non-shielded cable w/o ferrite core	Ktec	KSAS0361200250HU	MOCA 2.0	1	For Local Area Network
					USB 3.0	1	For Mass Storage
					LAN (RJ45)	4	For Local Area Network
		Stand	FOXCONN	447.00105.005	WAN (RJ45)	1	For Wild Area Network
		Ethernet Cable (2m non-shielded cable w/o ferrite core)	NIEN-YI	NYS1097	VOIP (RJ14)	1	For Internet Voice Phone
					DC JACK	1	For Power Supply Input
	NVG448BQ	Switch Adapter Power cord: 1.8m non-shielded cable w/o ferrite core	Ktec	KSAS0361200250HU	VDSL (RJ14)	1	For Wideband/Internet connection
					USB 3.0	1	For Mass Storage
					LAN (RJ45)	4	For Local Area Network
		Stand	FOXCONN	447.00105.005	WAN (RJ45)	1	For Wild Area Network
		Ethernet Cable (2m non-shielded cable w/o ferrite core)	NIEN-YI	NYS1097	VOIP (RJ14)	1	For Internet Voice Phone
		RJ14 Cable (4.5m non-shielded cable w/o ferrite core)	NIEN-YI	NYS1131	DC JACK	1	For Power Supply Input
	NVG443BQ	Switch Adapter Power cord: 1.8m non-shielded cable w/o ferrite core	Ktec	KSAS0361200250HU	VDSL (RJ14)	1	For Wideband/Internet connection
					USB 3.0	1	For Mass Storage
					LAN (RJ45)	4	For Local Area Network
		Stand	FOXCONN	447.00105.005	WAN (RJ45)	1	For Wild Area Network
		RJ14 Cable (4.5m non-shielded cable w/o ferrite core)	NIEN-YI	NYS1131	DC JACK	1	For Power Supply Input

* After the pretest, the model: NVG468MQ is found to be the worst case model and therefore all tests had been performed to this model.

2.3 Description of Available Antennas to the EUT

Table 3: Antenna List

ANT No.	Antenna Type	Operation Frequency Range (MHz)	Gain (dBi)
1.	PIFA	5250-5725	3.97
2.	PIFA	5250-5725	3.18
3.	PIFA	5250-5725	4.56
4.	PIFA	5250-5725	4.43

2.4 EUT Maximum Conducted Power

Table 4: The Measured Conducted Output Power

CDD Mode

802.11a

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	20.41	110.022	14.41	27.606
5470~5725	20.41	109.907	14.41	27.606

802.11n HT20

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	19.88	97.303	13.88	24.434
5470~5725	19.90	97.822	13.90	24.547

802.11n HT40

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	23.77	237.960	17.77	59.841
5470~5725	23.75	236.868	17.75	59.566

802.11ac VHT80

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	22.80	190.510	16.80	47.863
5470~5725	23.57	227.507	17.57	57.148

Beamfoming Mode

802.11n HT20

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	19.88	97.303	13.88	24.434
5470~5725	19.90	97.822	13.90	24.547

802.11n HT40

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	19.73	93.899	13.73	23.605
5470~5725	19.79	95.264	13.79	23.933

802.11ac VHT80

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	19.91	97.930	13.91	24.604
5470~5725	19.92	98.169	13.92	24.660

2.5 EUT Maximum E.I.R.P. Power

Table 5: The EIRP Output Power List

CDD Mode

802.11a

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	24.97	314.051	18.97	78.886
5470~5725	24.97	314.051	18.97	78.886

802.11n HT20

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	24.44	277.971	18.44	69.823
5470~5725	24.46	279.254	18.46	70.146

802.11n HT40

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	28.33	680.769	22.33	171.002
5470~5725	28.31	677.642	22.31	170.216

802.11ac VHT80

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	27.36	544.503	21.36	136.773
5470~5725	28.13	650.130	22.13	163.305

Beamfoming Mode

802.11n HT20

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	24.44	277.971	18.44	69.823
5470~5725	24.46	279.254	18.46	70.146

802.11n HT40

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	24.29	268.534	18.29	67.453
5470~5725	24.35	272.270	18.35	68.391

802.11ac VHT80

Frequency Band (MHz)	Max. Power		Min. Power	
	Output Power (dBm)	Output Power (mW)	Output Power (dBm)	Output Power (mW)
5250~5350	24.47	279.898	18.47	70.307
5470~5725	24.48	280.543	18.48	70.469

2.6 Transmit Power Control (TPC)

U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

Maximum EIRP of this device is 680.769mW which more than 500mW, therefore it's require TPC function.

The UUT can adjust a transmitter's output power based on the signal level present at the receiver.TPC is auto controlled by software

2.7 Statement of Manufacturer

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

3 U-NII DFS Rule Requirements

3.1 Working Modes and Required Test Items

The manufacturer shall state whether the UUT is capable of operating as a Master and/or a Client. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See tables 6 and 7 for the applicability of DFS requirements for each of the operational modes.

Table 6: Applicability of DFS Requirements Prior To Use a Channel

Requirement	Operational Mode		
	Master	Client without radar detection	Client with radar detection
Non-Occupancy Period	✓	✓ note	✓
DFS Detection Threshold	✓	Not required	✓
Channel Availability Check Time	✓	Not required	Not required
U-NII Detection Bandwidth	✓	Not required	✓
Note: Regarding KDB 905462 D03 Client Without DFS New Rules v01r01 section (b)(5/6), If the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear. An analyzer plot that contains a single 30-minute sweep on the original channel.			

Table 7: Applicability of DFS Requirements during Normal Operation.

Requirement	Operational Mode	
	Master or Client with radar detection	Client without radar detection
DFS Detection Threshold	✓	Not required
Channel Closing Transmission Time	✓	✓
Channel Move Time	✓	✓
U-NII Detection Bandwidth	✓	Not required

Additional requirements for devices with multiple bandwidth modes	Master 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.		

3.2 Test Limits and Radar Signal Parameters

Detection Threshold Values

Table 8: 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 9: 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.	

Parameters of DFS Test Signals

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.

Table 10: 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 --- Test B: 15 unique PRI values randomly selected within the range of 518-3066 μ sec, with a minimum increment of 1 μ sec, excluding PRI values selected in Test A	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.

Table 11: 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

Three subsets of trials will be performed with a minimum of ten trials per subset. The subset of trials differ in where the Long Pulse Type 5 Signal is tuned in frequency.

a) the Channel center frequency
b) tuned frequencies such that 90% of the Long Pulse Type 5 frequency modulation is within the low edge of the UUT Occupied Bandwidth
c) tuned frequencies such that 90% of the Long Pulse Type 5 frequency modulation is within the high edge of the UUT Occupied Bandwidth

It include 10 trails for every subset, the formula as below,

For subset case 1: the center frequency of the signal generator will remain fixed at the center of the UUT Channel.

For subset case 2: to retain 90% frequency overlap between the radar signal and the UUT Occupied Bandwidth, the center frequency of the signal generator will vary for each of the ten trials in subset case 2. The center frequency of the signal generator for each trial is calculated by:

$FL+(0.4*Chirp\ Width\ [in\ MHz])$

For subset case 3: to retain 90% frequency overlap between the radar signal and the UUT Occupied Bandwidth, the center frequency of the signal generator will vary for each of the ten trials in subset case 3. The center frequency of the signal generator for each trial is calculated by:

$FH-(0.4*Chirp\ Width\ [in\ MHz])$

Table 12: 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

4 Test & Support Equipment List

4.1 Test Instruments

Table 13: Test Instruments List

Description & Manufacturer	Model No.	Brand	Date Of Calibration	Due Date Of Calibration
R&S Spectrum analyzer	ESR	R&S	2016/02/02	2017/02/01
Signal generator	8645A	Agilent	2016/08/08	2017/08/07

4.2 Description of Support Units

Table 14: Support Unit Information.

No.	Product	Brand	Model No.	FCC ID
1	Intel Dual Band Wireless	Intel	AC7265	PD97265NG

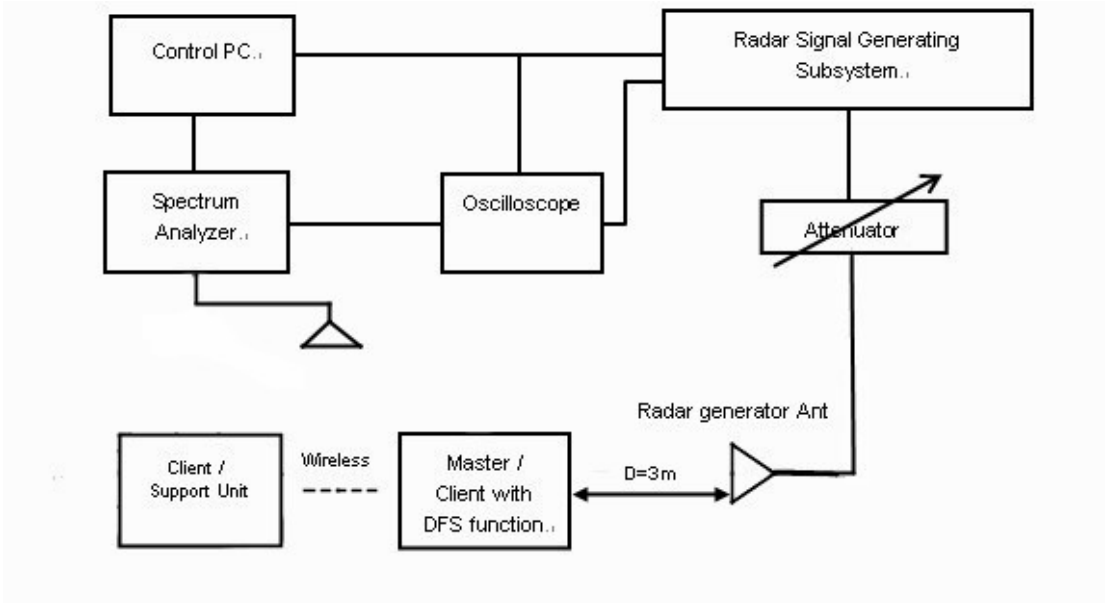
Note: This device was functioned as a ☐Master ☒Slave device during the DFS test.

5 Test Procedure

5.1 ADT DFS Measurement System

A complete ADT DFS Measurement System consists of two subsystems: (1) the Radar Signal Generating Subsystem and (2) the Traffic Monitoring Subsystem. The control PC is necessary for generating the Radar waveforms in Table 10, 11 and 12. The traffic monitoring subsystem is specified to the type of unit under test (UUT).

Radiated Setup Configuration of ADT DFS Measurement System



Note: The UUT main beam of the antenna is directly toward radar emitter during testing.

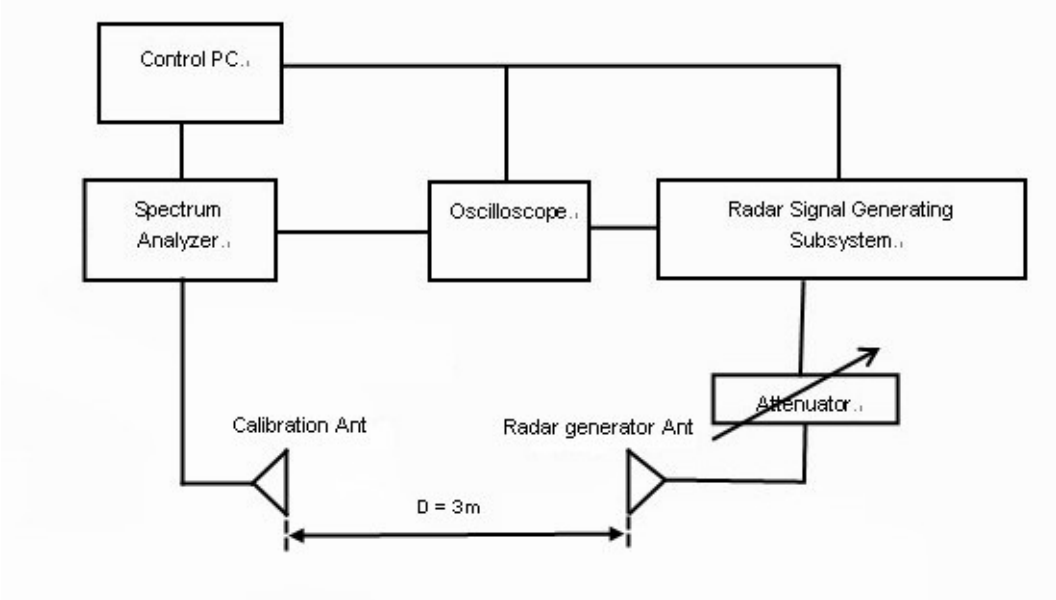
System testing will be performed with channel-loading using means appropriate to the data types that are used by the unlicensed device. The following requirements apply:

	a) The data file must be of a type that is typical for the device (i.e., MPEG-2, MPEG-4, WAV, MP3, MP4, AVI, etc.) and must generally be transmitting in a streaming mode.
	b) Software to ping the client is permitted to simulate data transfer but must have random ping intervals.
V	c) Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater.
	d) Unicast or Multicast protocols are preferable but other protocols may be used. The appropriate protocol used must be described in the test procedures.

5.2 Calibration of DFS Detection Threshold Level

The measured channel is 5500MHz, 5510MHz and 5530MHz. The radar signal was the same as transmitted channels, and injected into the antenna of AP (master) or Client Device with Radar Detection, measured the channel closing transmission time and channel move time. The calibrated detection threshold level is set to -64dBm. The tested level is lower than required level hence it provides margin to the limit.

Radiated Setup Configuration of Calibration of DFS Detection Threshold Level

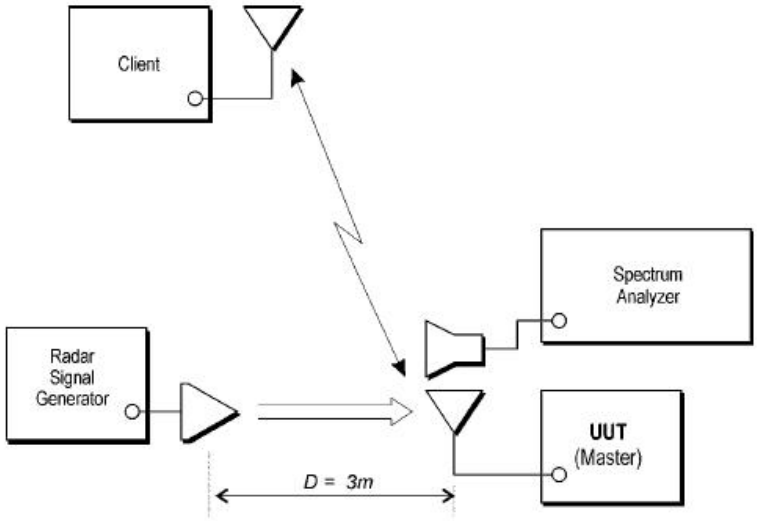


5.3 Deviation from Test Standard

No deviation.

5.4 Radiated Test Setup Configuration

5.4.1 Master Mode



The EUT is a U-NII Device operating in Master mode. The radar test signals are injected into the Master Device.

6 Test Results

6.1 Summary of Test Results

Clause	Test Parameter	Remarks	Pass/Fail
15.407	DFS Detection Threshold	Applicable	Pass
15.407	U-NII Detection Bandwidth	Applicable	Pass
15.407	Channel Availability Check Time	Applicable	Pass
15.407	Channel Move Time	Applicable	Pass
15.407	Channel Closing Transmission Time	Applicable	Pass
15.407	Non- Occupancy Period	Applicable	Pass
15.407	Uniform Spreading	Applicable	Pass

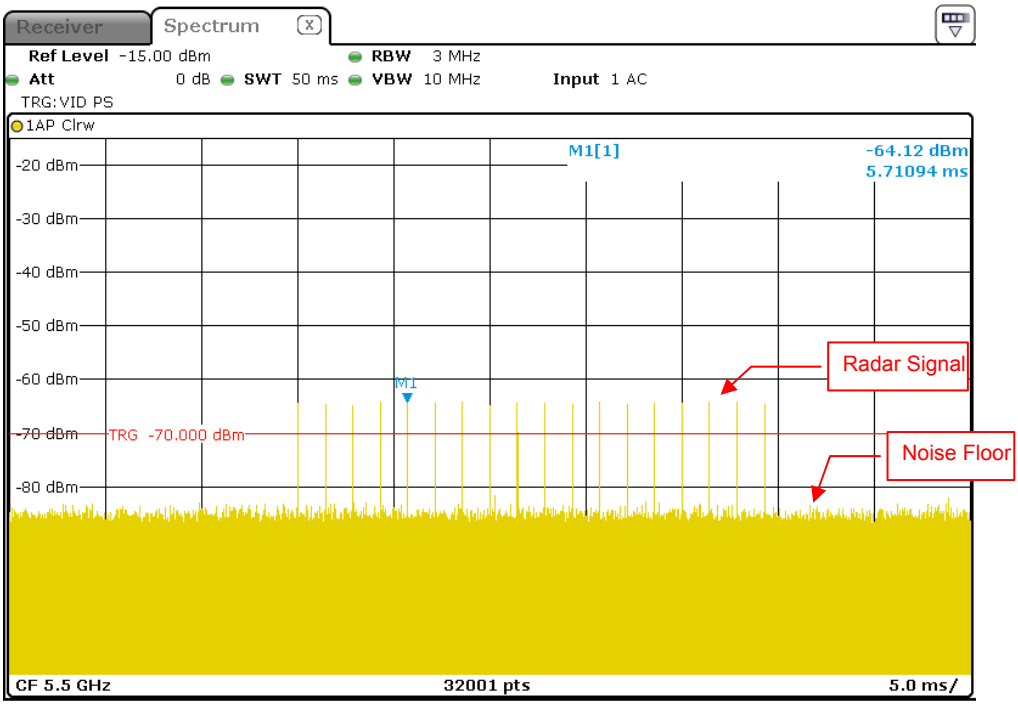
6.2 Test Results

6.2.1 Test Mode: Device Operating In Client without Radar Detection Mode.

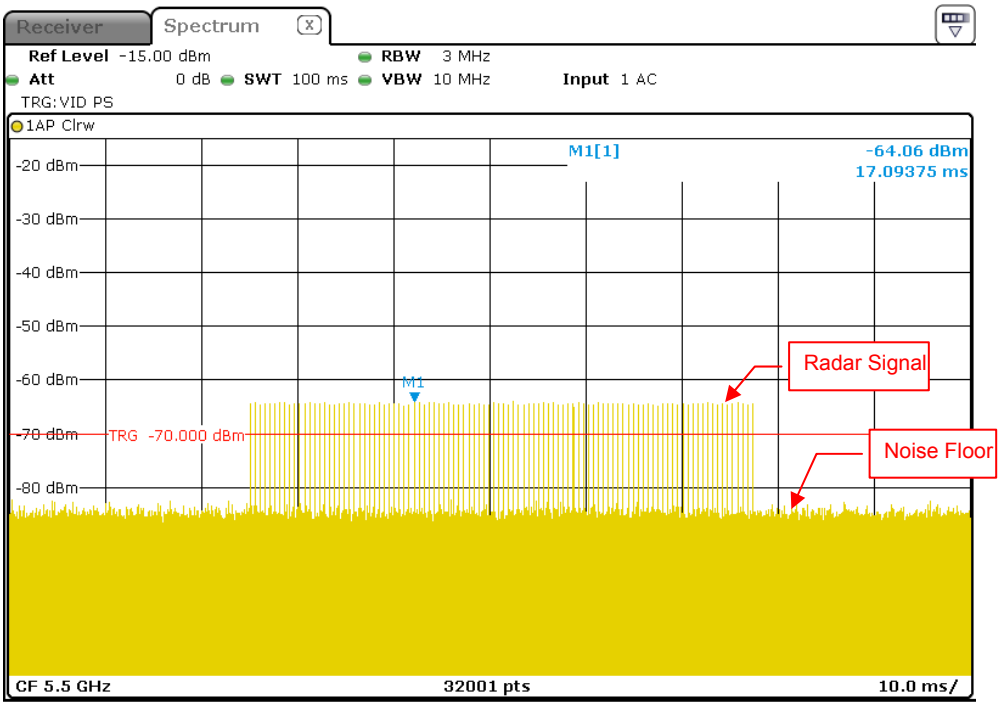
Master with injection at the Master. (Radar Test Waveforms are injected into the Master.)

DFS Detection Threshold

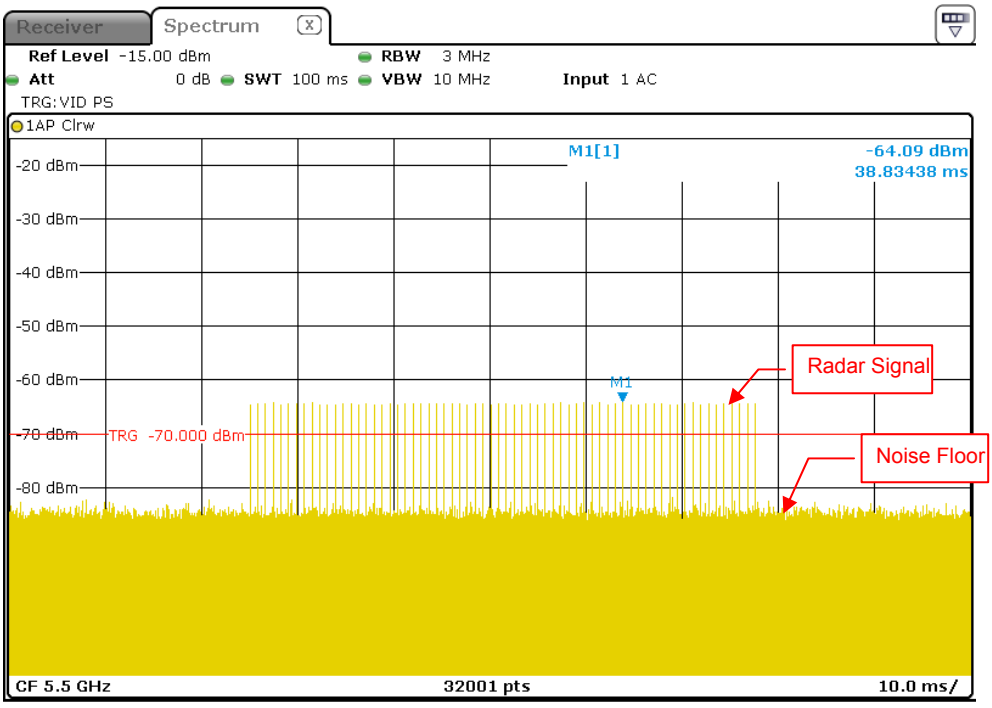
For a detection threshold level of -64dBm, the required signal strength at EUT antenna location is -64 dBm. The tested level is lower than required level hence it provides margin to the limit.



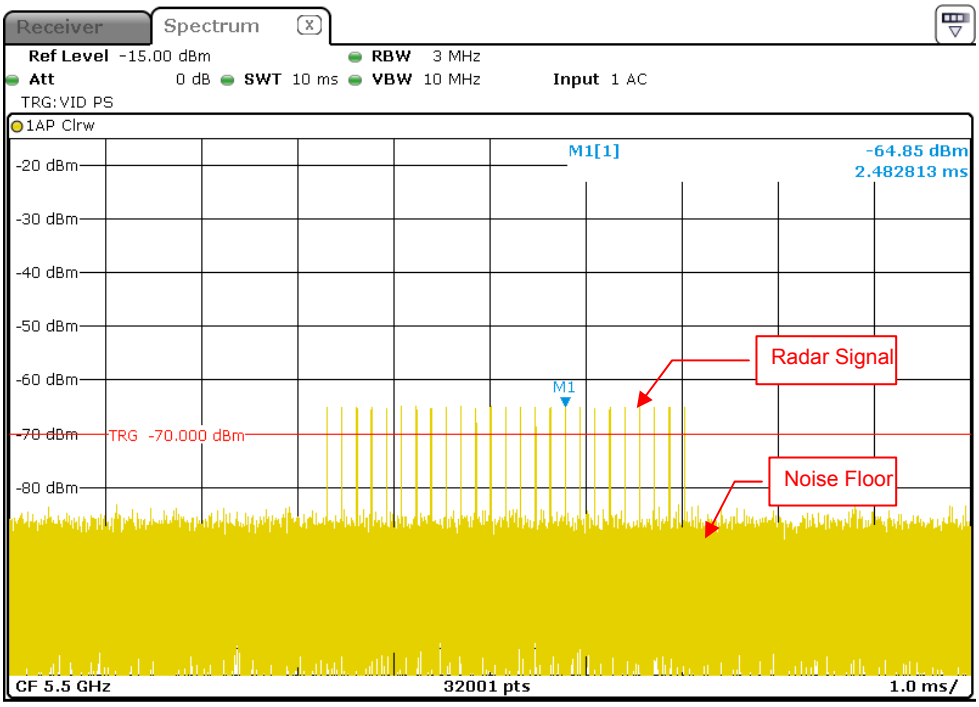
Radar Signal 0



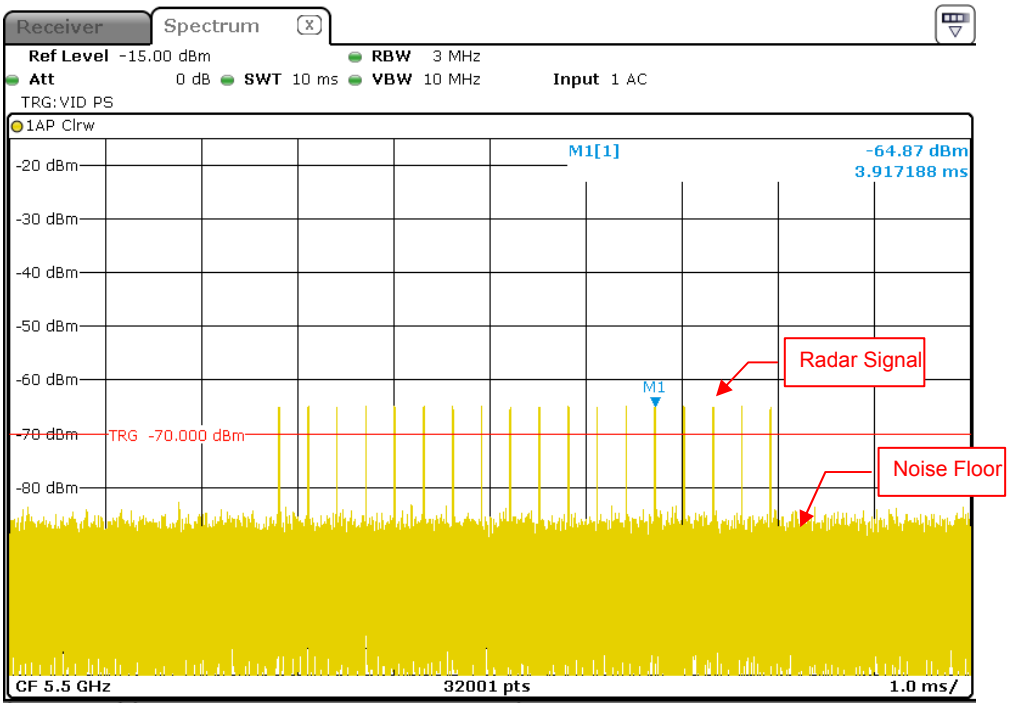
Radar Signal 1 (Test A)



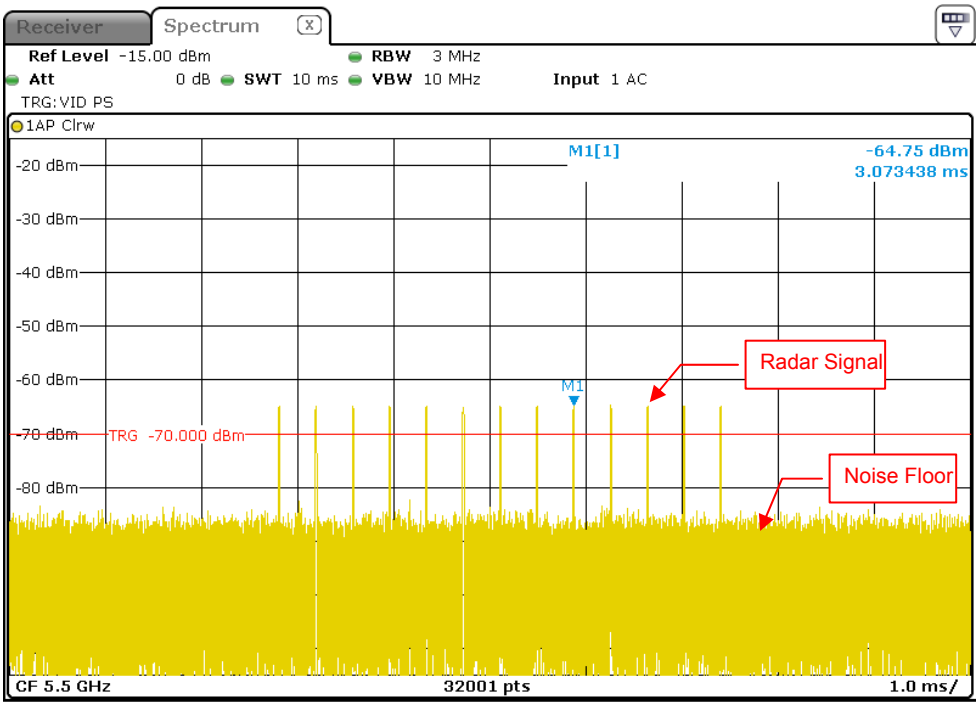
Radar Signal 1 (Test B)



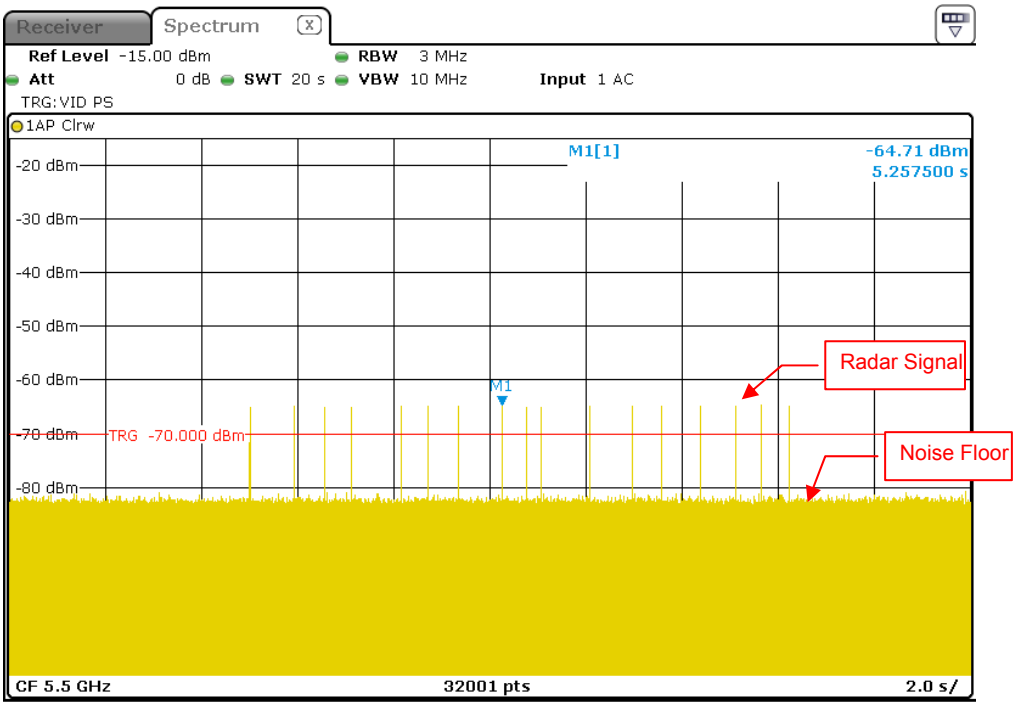
Radar Signal 2



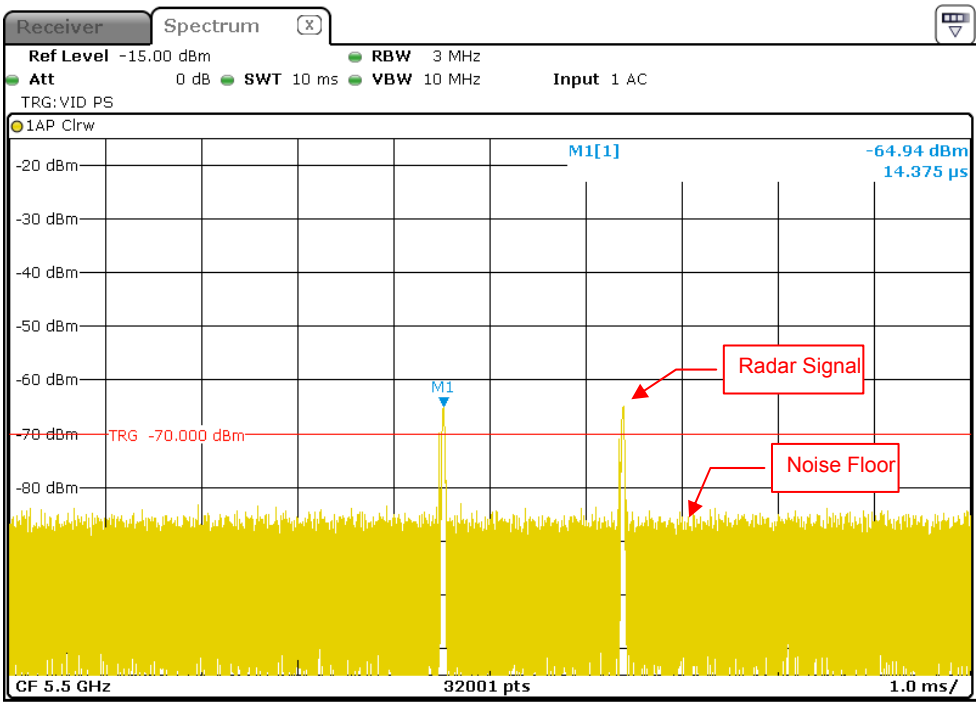
Radar Signal 3



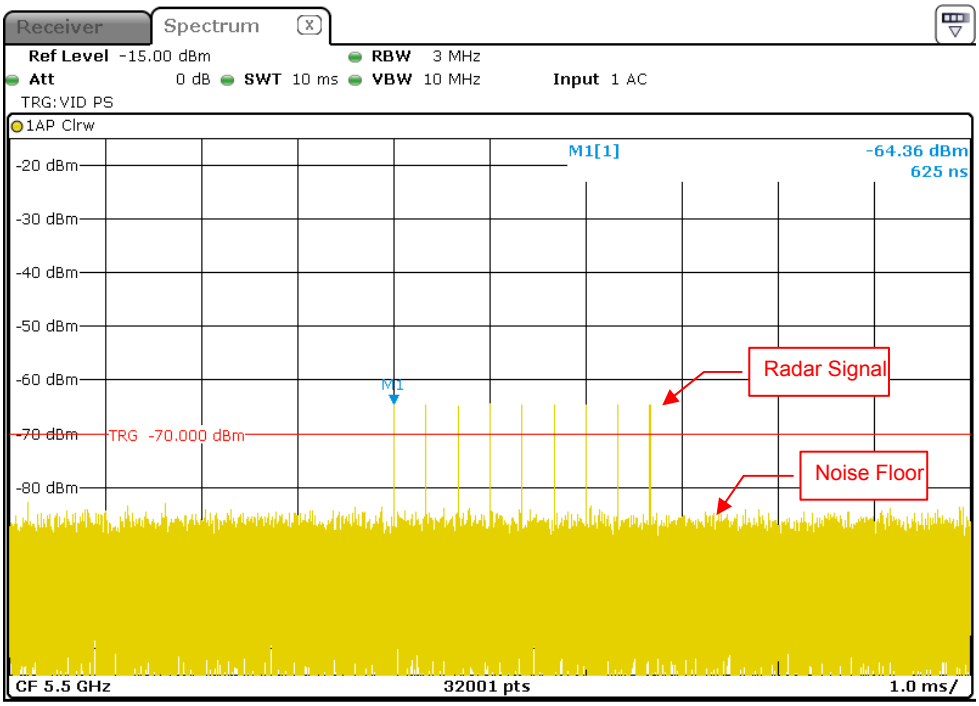
Radar Signal 4



Radar Signal 5



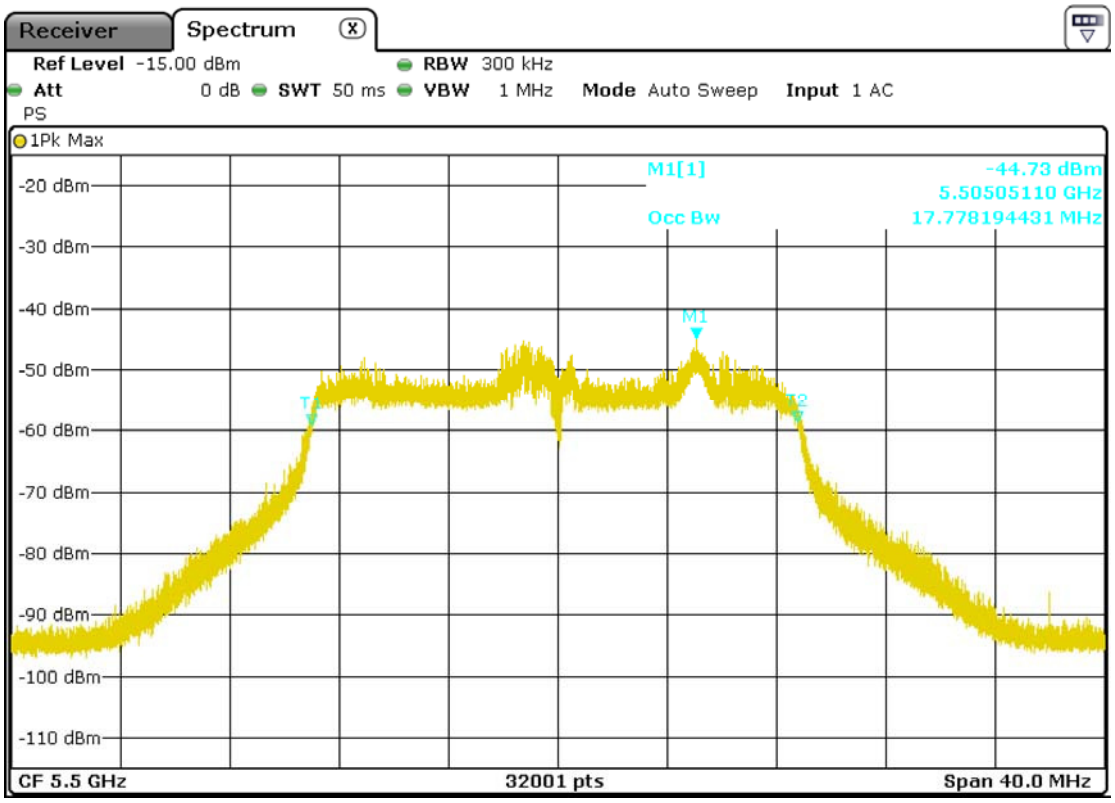
Single Burst of Radar Signal 5



Radar Signal 6

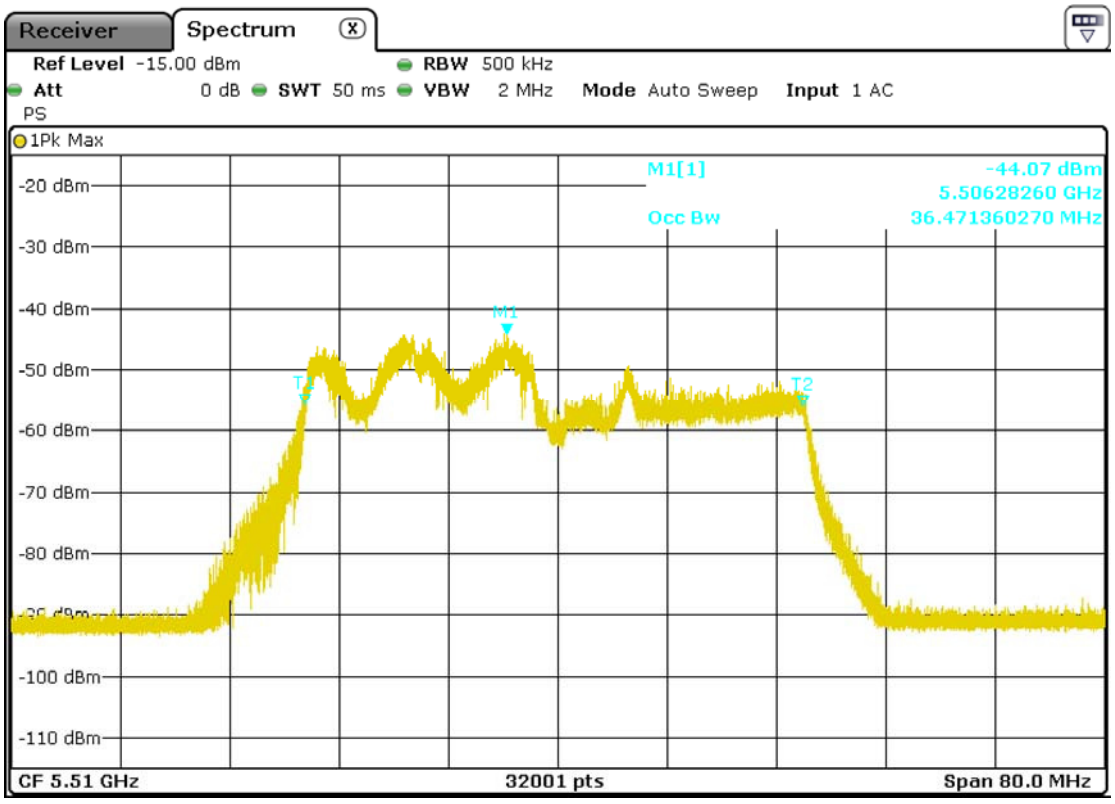
6.2.2 U-NII Detection Bandwidth

802.11n HT20



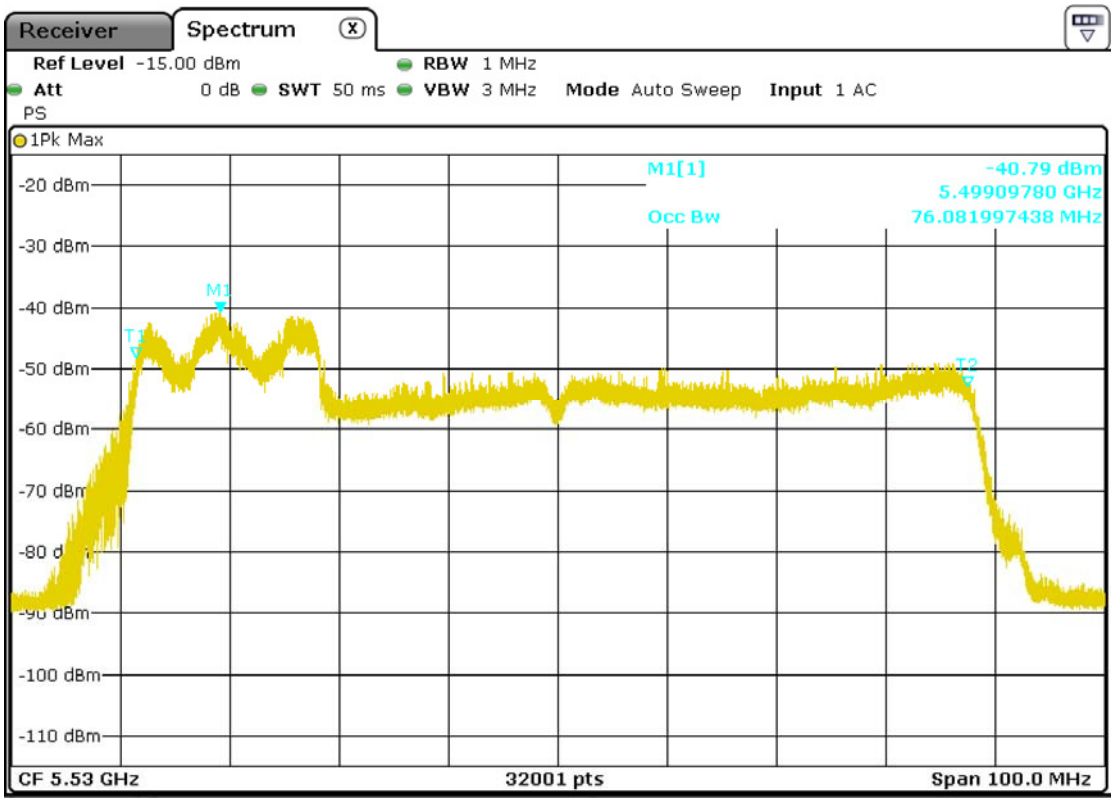
U-NII 99% Channel bandwidth

802.11n HT40



U-NII 99% Channel bandwidth

802.11ac VHT80



U-NII 99% Channel bandwidth

Detection Bandwidth Test - IEEE 802.11n (HT20)											
Radar Type 0 EUT Frequency: 5500MHz EUT 99% Power bandwidth: 17.77MHz Detection bandwidth limit (100% of EUT 99% Power bandwidth): 17.77MHz Detection bandwidth (5510(FH) – 5490(FL)) : 20MHz Test Result : PASS											
Radar Frequency	Trial Number / Detection										Detection
(MHz)	1	2	3	4	5	6	7	8	9	10	Rate (%)
5489	N	N	N	N	N	N	N	N	N	N	0
5490(FL)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5491	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5492	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5493	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5494	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5495	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5496	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5497	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5498	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5499	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5501	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5502	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5503	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5504	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5505	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5506	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5507	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5508	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5509	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5510(FH)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5511	N	N	N	N	N	N	N	N	N	N	0

Detection Bandwidth Test - IEEE 802.11n (HT40)											
Radar Type 0 EUT Frequency: 5510MHz EUT 99% Power bandwidth: 36.47MHz Detection bandwidth limit (100% of EUT 99% Power bandwidth): 36.47MHz Detection bandwidth (5530(FH) – 5490(FL)) : 40MHz Test Result : PASS											
Radar Frequency (MHz)	Trial Number / Detection										Detection Rate (%)
	1	2	3	4	5	6	7	8	9	10	
5489	N	N	N	Y	N	N	N	N	N	N	0
5490(FL)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5491	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5492	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5493	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5494	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5495	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5496	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5497	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5498	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5499	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5501	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5502	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5503	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5504	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5505	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5506	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5507	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5508	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5509	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5510	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5511	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5512	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5513	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5514	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5515	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5516	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5517	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5518	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5519	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5520	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5521	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5522	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5523	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5524	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5525	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5526	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5528	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5529	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5530(FH)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5531	N	N	N	N	N	N	N	N	N	N	0

Detection Bandwidth Test - IEEE 802.11ac (VHT80)											
Radar Type 0 EUT Frequency: 5530MHz EUT 99% Power bandwidth: 76.08MHz Detection bandwidth limit (100% of EUT 99% Power bandwidth): 76.08MHz Detection bandwidth (5570(FH) – 5490(FL)) : 80MHz Test Result : PASS											
Radar Frequency	Trial Number / Detection										Detection
(MHz)	1	2	3	4	5	6	7	8	9	10	Rate (%)
5489	N	N	N	N	N	N	N	N	N	N	0
5490(FL)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5491	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5492	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5493	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5494	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5495	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5496	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5497	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5498	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5499	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5500	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5501	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5502	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5503	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5504	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5505	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5506	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5507	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5508	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5509	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5510	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5511	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5512	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5513	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5514	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5515	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5516	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5517	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5518	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5519	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5520	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5521	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5522	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5523	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5524	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5525	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5526	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5528	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5529	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5530	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5531	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5532	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5533	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5534	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100

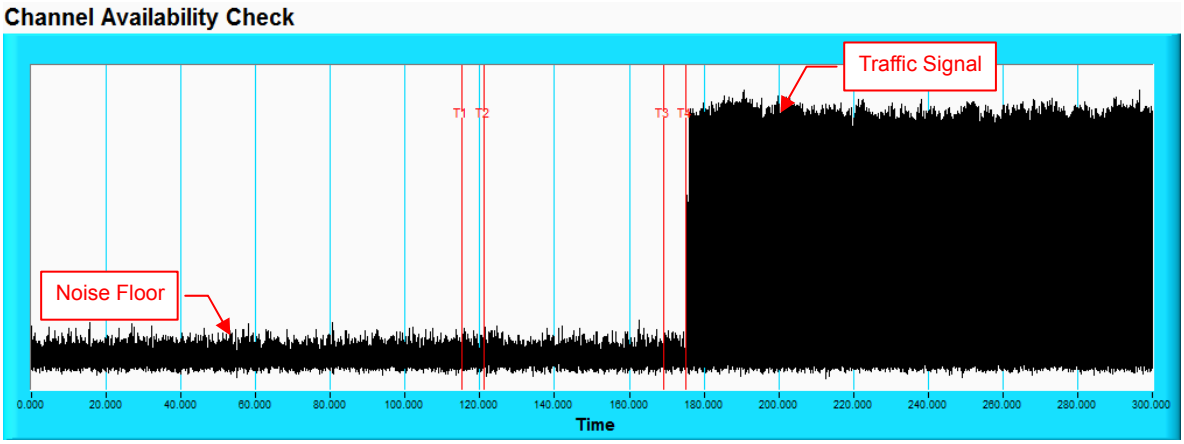
Radar Frequency (MHz)	Trial Number / Detection										Detection Rate (%)
	1	2	3	4	5	6	7	8	9	10	
5535	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5536	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5537	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5538	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5539	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5540	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5541	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5542	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5543	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5544	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5545	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5546	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5547	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5548	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5549	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5550	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5551	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5552	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5553	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5554	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5555	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5556	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5557	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5558	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5559	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5560	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5561	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5562	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5563	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5564	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5565	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5566	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5567	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5568	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5569	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5570(FH)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
5571	N	N	N	N	N	N	N	N	N	N	0

6.1.1 Channel Availability Check Time

If the EUT successfully detected the radar burst, it should be observed as the EUT has no transmissions occurred until the EUT starts transmitting on another channel.

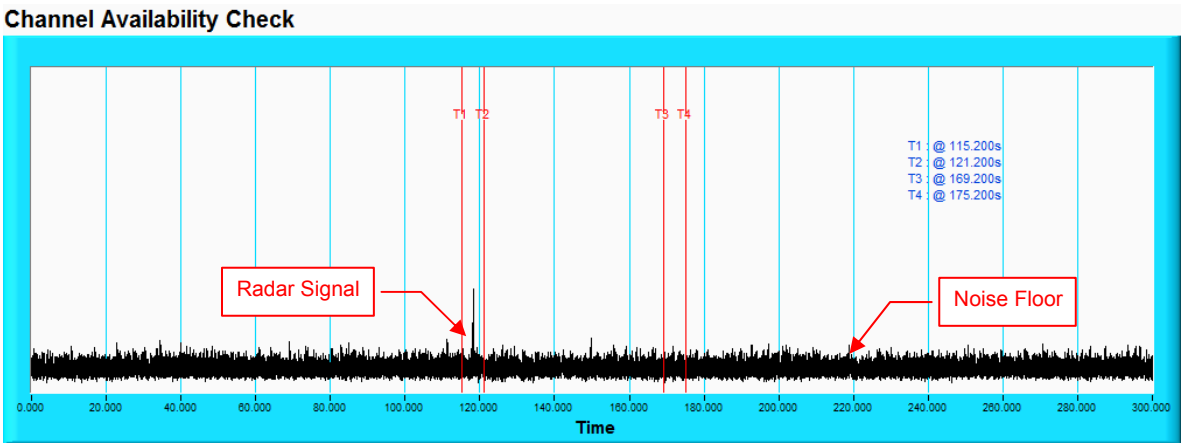
Timing of Radar Signal	Observation	
	EUT	Spectrum Analyzer
Within 1 to 6 second	Detected	No transmissions
Within 54 to 60 second	Detected	No transmissions

Initial Channel Availability Check Time



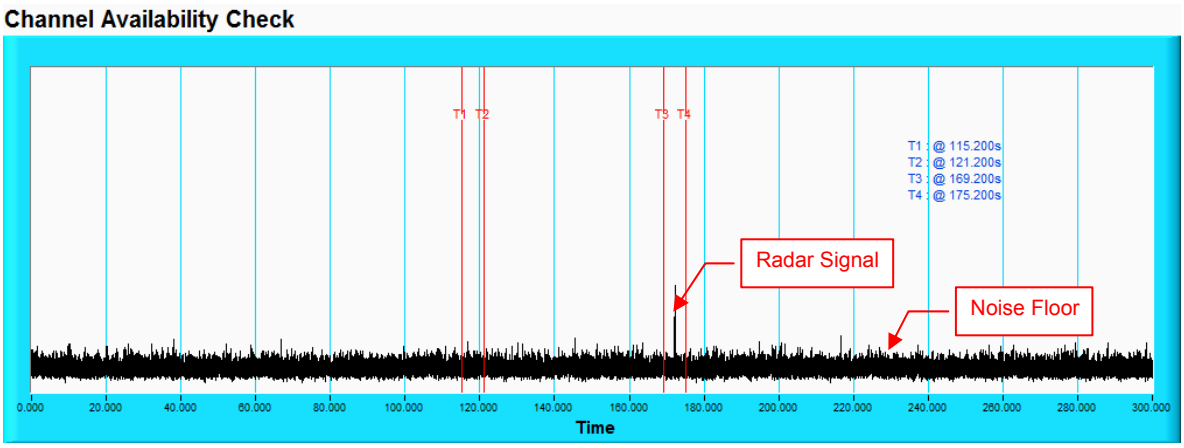
NOTE: T1 denotes the end of power-up time period is 115.2 second. T4 denotes the end of Channel Availability Check time is 175.2 second. Channel Availability Check time is equal to (T4 – T1) 60 seconds.

Radar Burst at the Beginning of the Channel Availability Check Time



NOTE: T1 denotes the end of power up time period is 115.2 second. T2 denotes 121.2 second, the radar burst was commenced within a 6 second window starting from the end of power-up sequence. T4 denotes the 175.2 second.

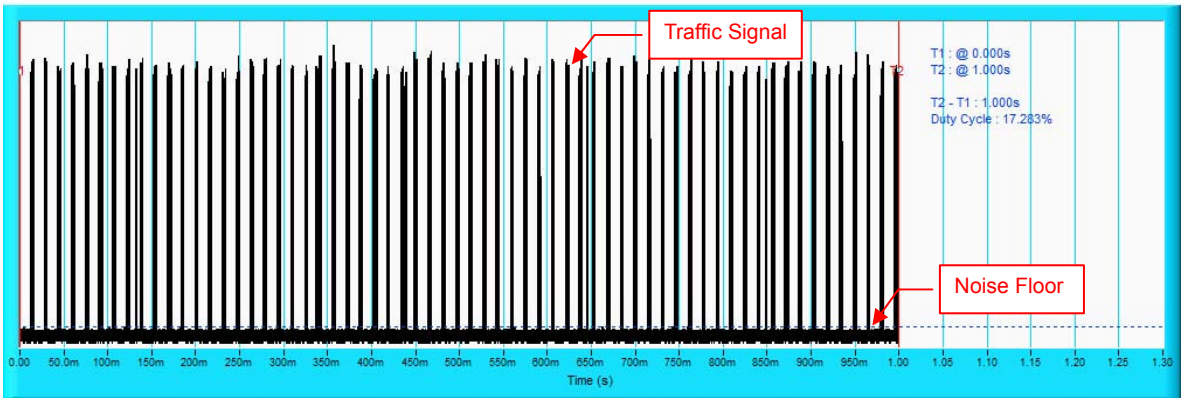
Radar Burst at the End of the Channel Availability Check Time



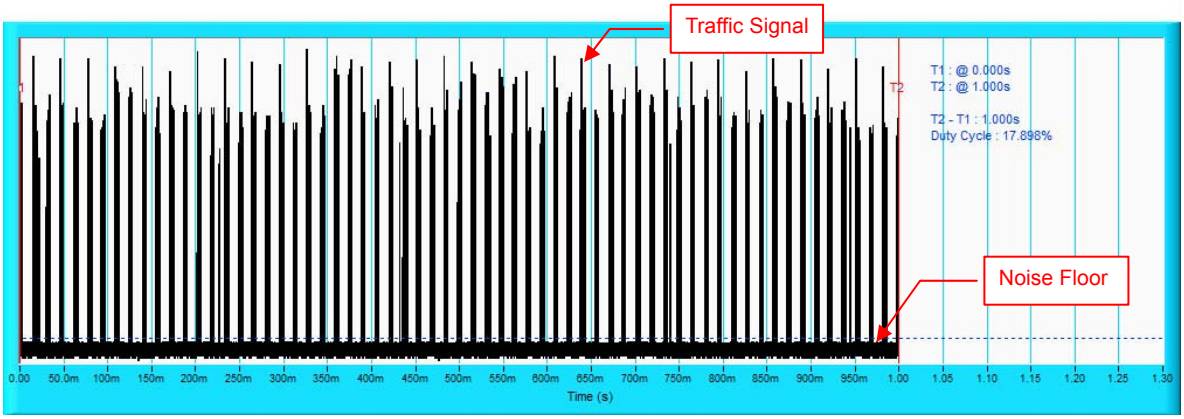
NOTE: T1 denotes the end of power up time period is 115.2 second. T3 denotes 169.2 second and radar burst was commenced within 54th second to 60th second window starting from the end of power-up sequence. T4 denotes the 175.2 second.

6.1.2 Channel Closing Transmission and Channel Move Time

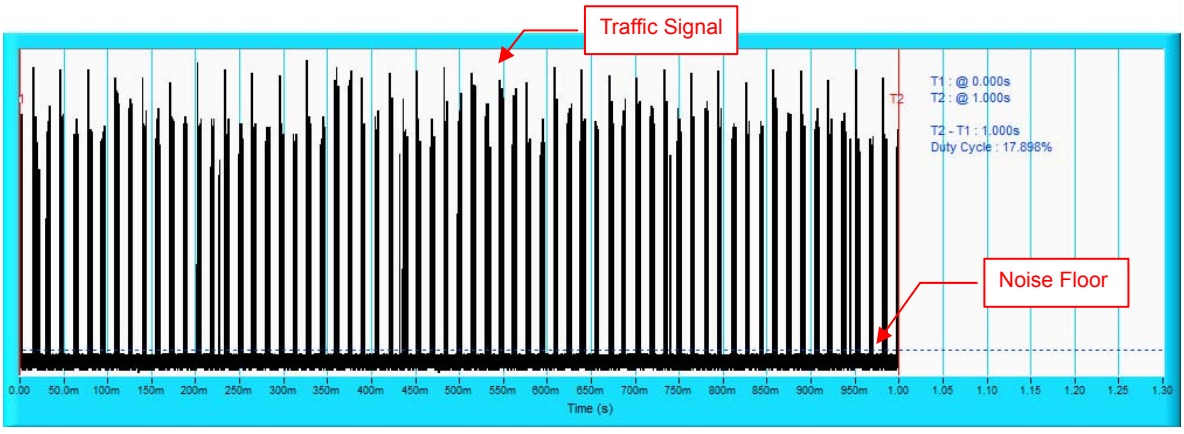
Wireless Traffic Loading
IEEE 802.11n (HT20)



IEEE 802.11n (HT40)



IEEE 802.11ac VHT80



IEEE 802.11n (HT20)

Table 1: Short Pulse Radar Test Waveforms.

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Number of Trials (Times)	Percentage of Successful Detection (%)
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	30	96.7
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μ sec, with a minimum increment of 1 μ sec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	30	93.3
3	6-10	200-500	16-18	30	93.3
4	11-20	200-500	12-16	30	80.0
Aggregate (Radar Types 1-4)				120	90.825

Table 2: Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Number of Trials(Times)	Percentage of Successful Detection (%)
5	50-100	5-20	1000-2000	1-3	8-20	30	83.3

Table 3: Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Number of Trials(Times)	Percentage of Successful Detection (%)
6	1	333	9	0.333	300	30	100

The Detailed Radar pattern and Statistical Performance showed in Annex A.

IEEE 802.11n (HT40)

Table 1: Short Pulse Radar Test Waveforms.

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Number of Trials (Times)	Percentage of Successful Detection (%)
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	30	93.3
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μ sec, with a minimum increment of 1 μ sec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	30	86.7
3	6-10	200-500	16-18	30	90.0
4	11-20	200-500	12-16	30	93.3
Aggregate (Radar Types 1-4)				120	90.825

Table 2: Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Number of Trials(Times)	Percentage of Successful Detection (%)
5	50-100	5-20	1000-2000	1-3	8-20	30	86.7

Table 3: Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Number of Trials(Times)	Percentage of Successful Detection (%)
6	1	333	9	0.333	300	30	100

The Detailed Radar pattern and Statistical Performance showed in Annex A.

IEEE 802.11ac (VHT80)

Table 1: Short Pulse Radar Test Waveforms.

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Number of Trials (Times)	Percentage of Successful Detection (%)
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	30	96.7
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μ sec, with a minimum increment of 1 μ sec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	30	96.7
3	6-10	200-500	16-18	30	100
4	11-20	200-500	12-16	30	90.0
Aggregate (Radar Types 1-4)				120	95.85

Table 2: Long Pulse Radar Test Waveform

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

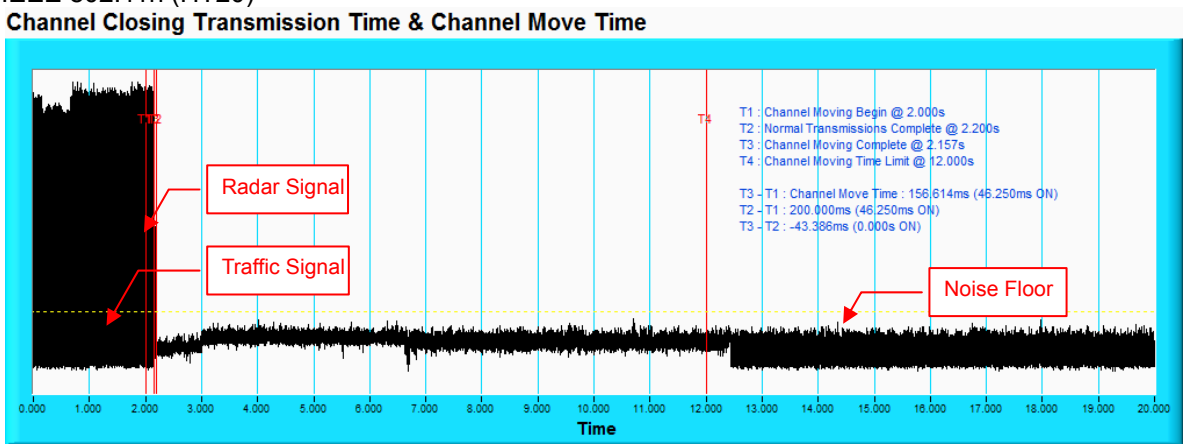
Table 3: Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Number of Trials(Times)	Percentage of Successful Detection (%)
6	1	333	9	0.333	300	30	100

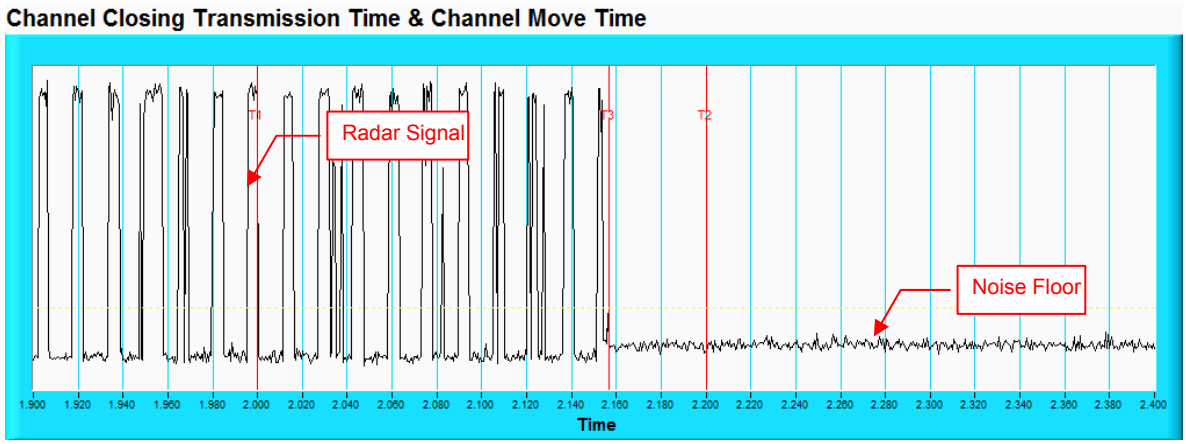
The Detailed Radar pattern and Statistical Performance showed in Annex A.

Radar signal 0

IEEE 802.11n (HT20)

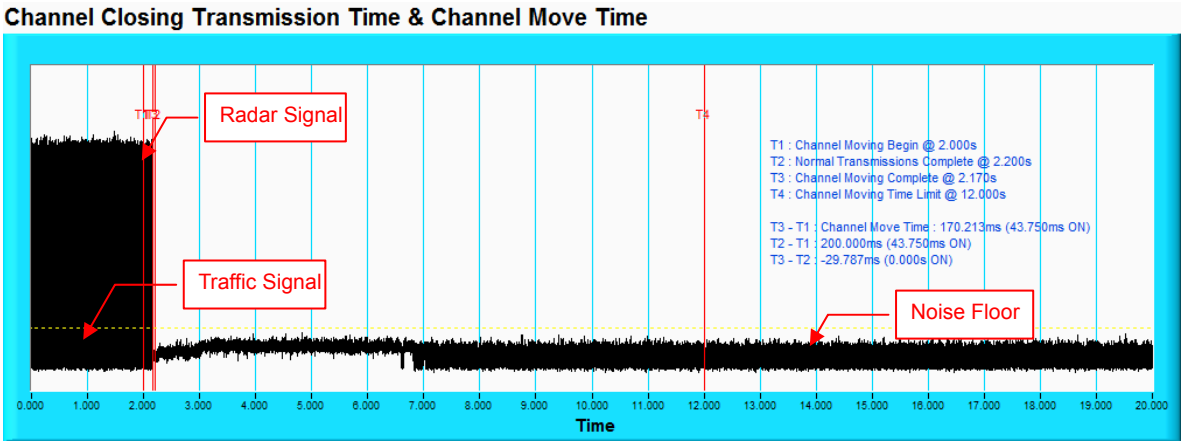


NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

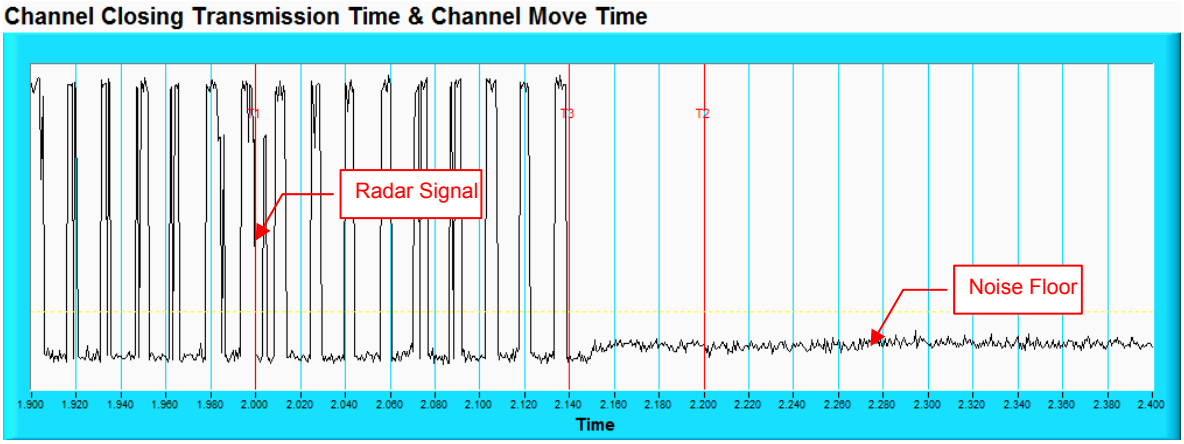


NOTE: Room-in of the first 500ms after radar signal applied.

Radar signal 1
IEEE 802.11n (HT20)

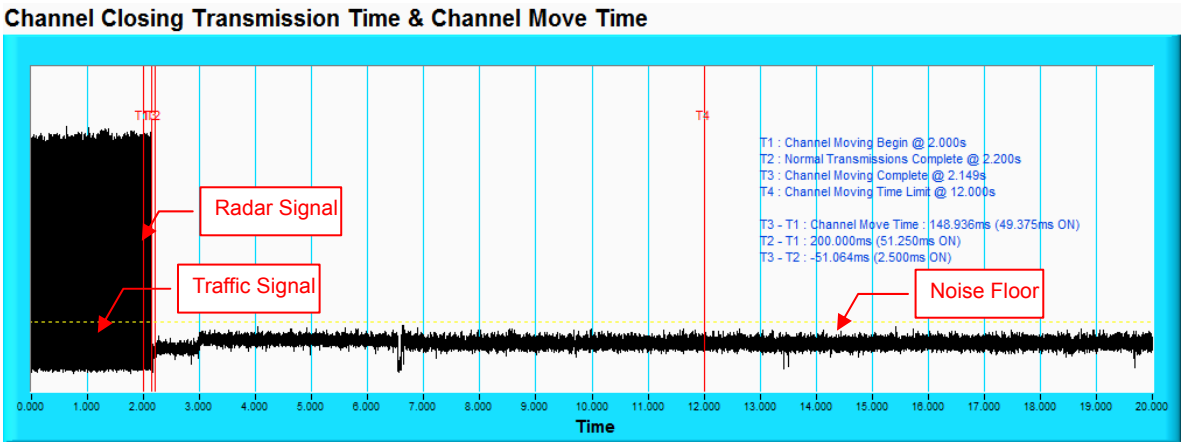


NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

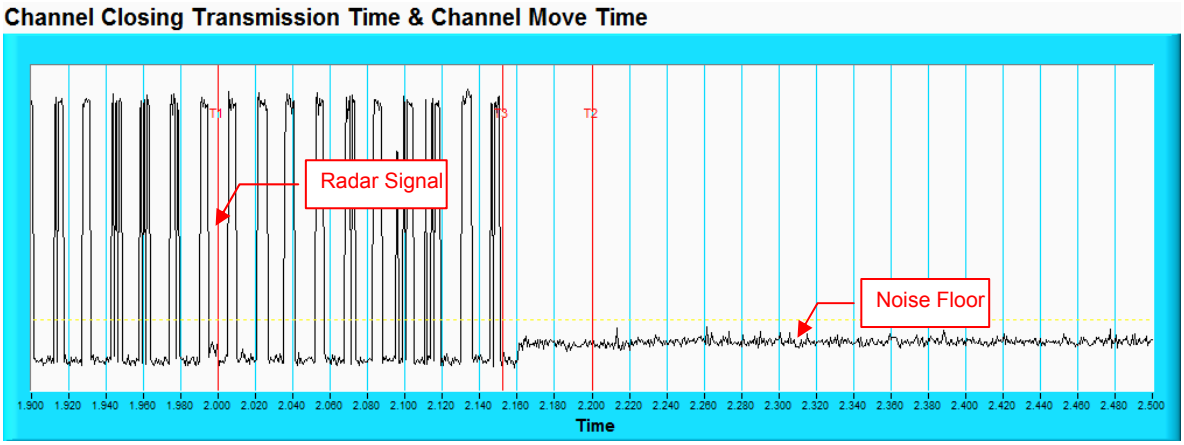


NOTE: Room-in of the first 500ms after radar signal applied.

Radar signal 2
IEEE 802.11n (HT20)

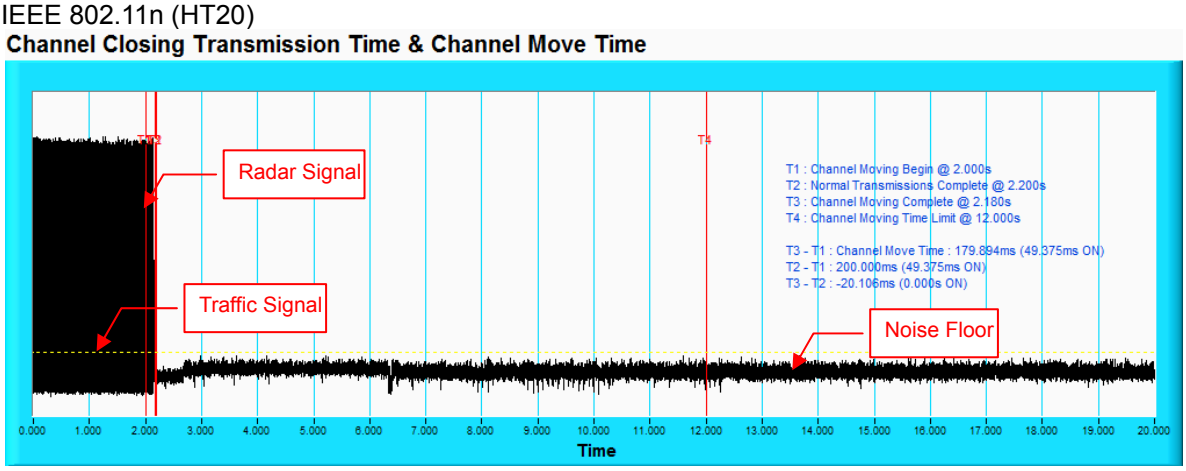


NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

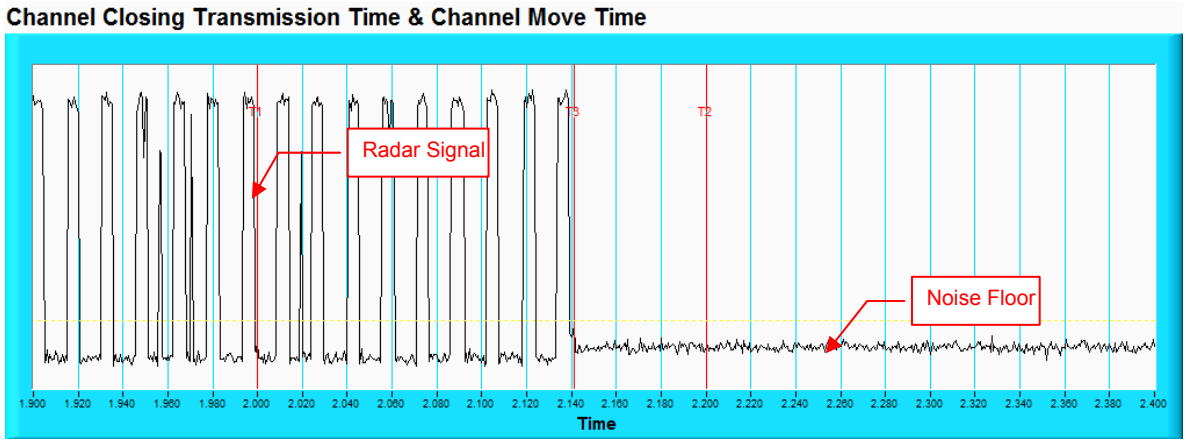


NOTE: Room-in of the first 500ms after radar signal applied.

Radar signal 3
IEEE 802.11n (HT20)

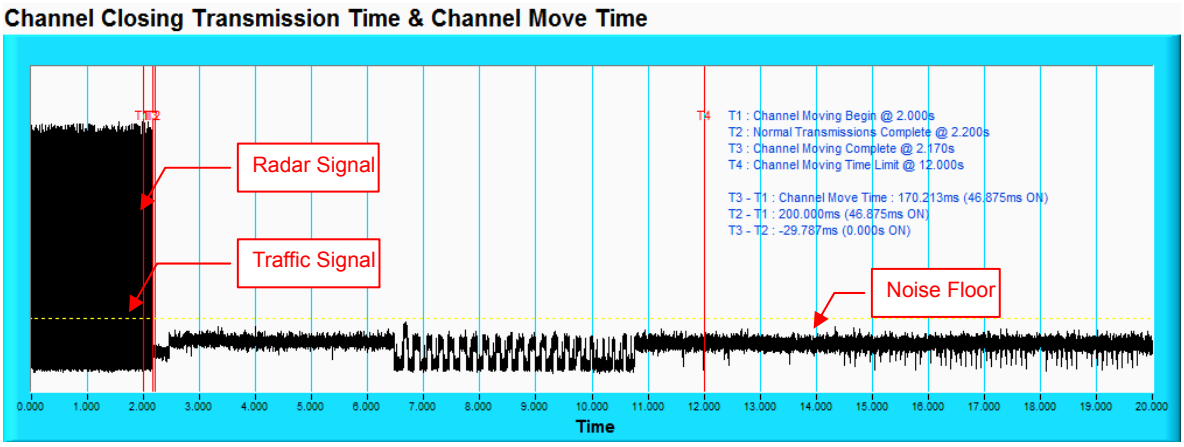


NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.

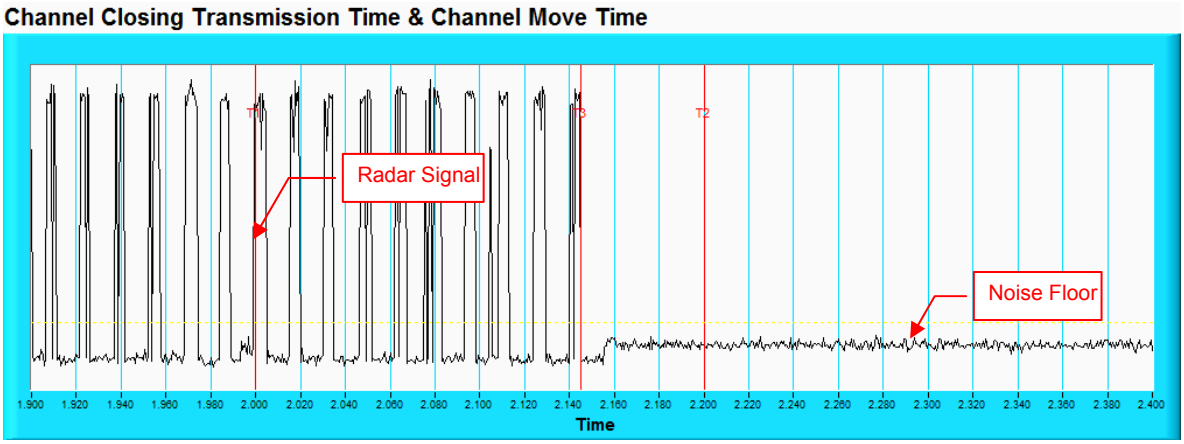


NOTE: Room-in of the first 500ms after radar signal applied.

Radar signal 4
IEEE 802.11n (HT20)



NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of Channel Move Time. T4 denotes the 10 second from T1 to observe the aggregate duration of transmissions.



NOTE: Room-in of the first 500ms after radar signal applied.

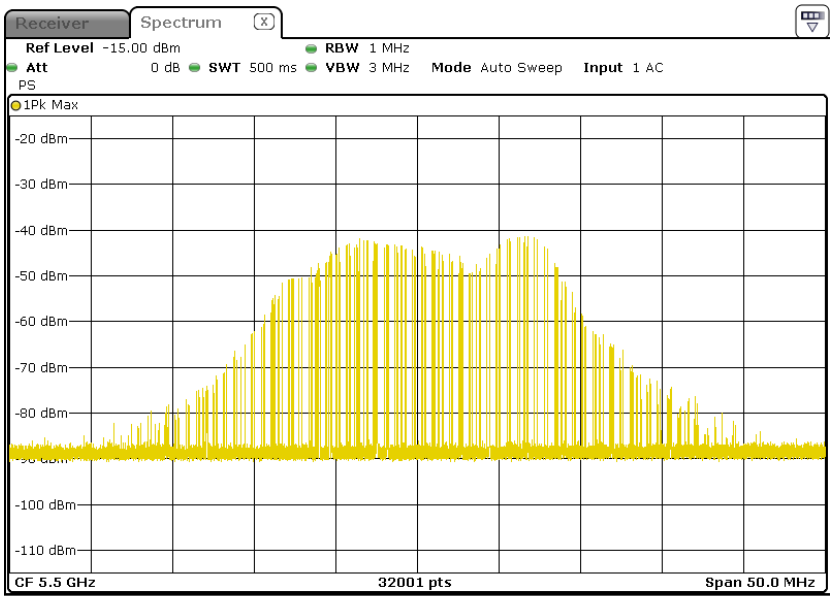
6.2.3 Non-Occupancy Period

Associate test:

During the 30 minutes observation time, UUT did not make any transmissions on a channel after a radar signal was detected on that channel by either the Channel Availability Check or the In-Service Monitoring.

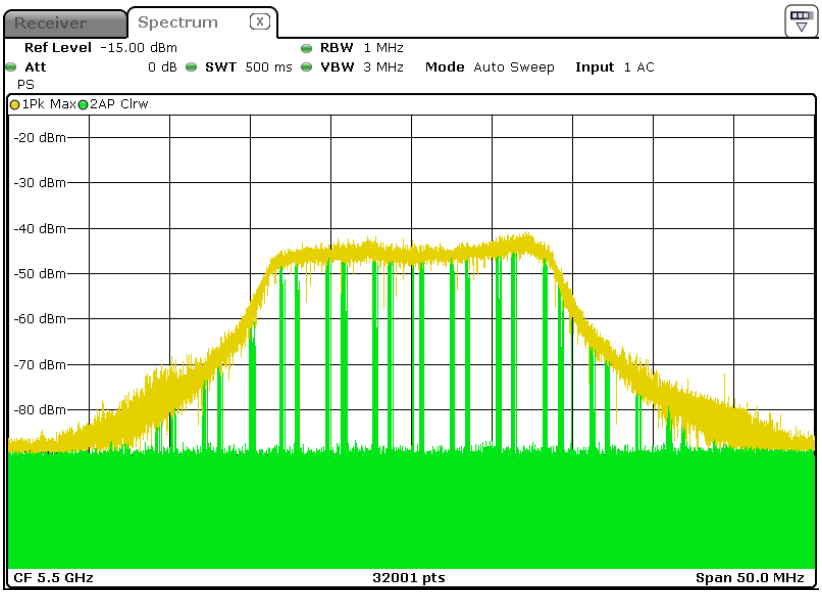
1) EUT (Client) links with master on 5500MHz.

Waveform of EUT links up with Master



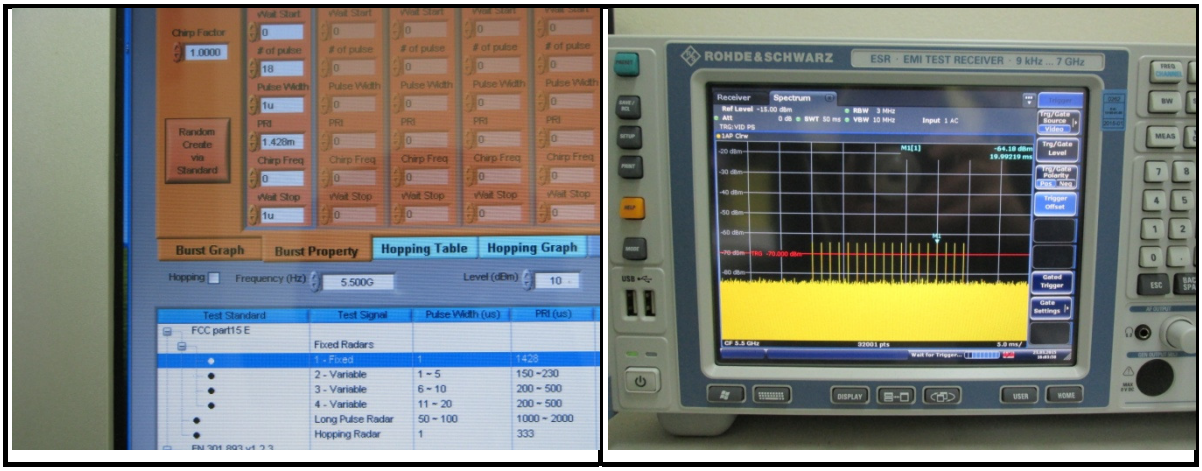
2) Client plays specified files via master.

Waveform of transmission

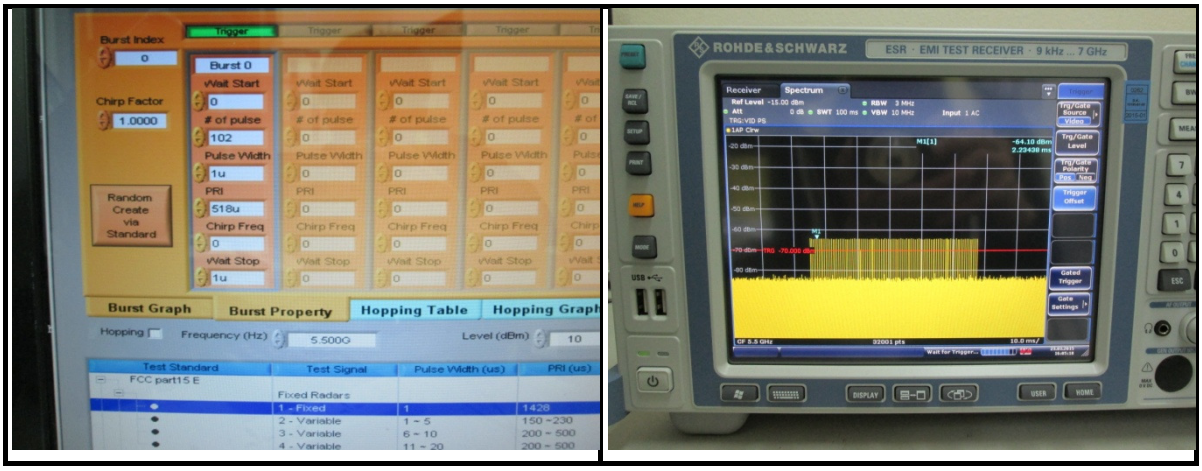


3) Radar signal is applied to the Master device and WiFi traffic signal stop immediately.

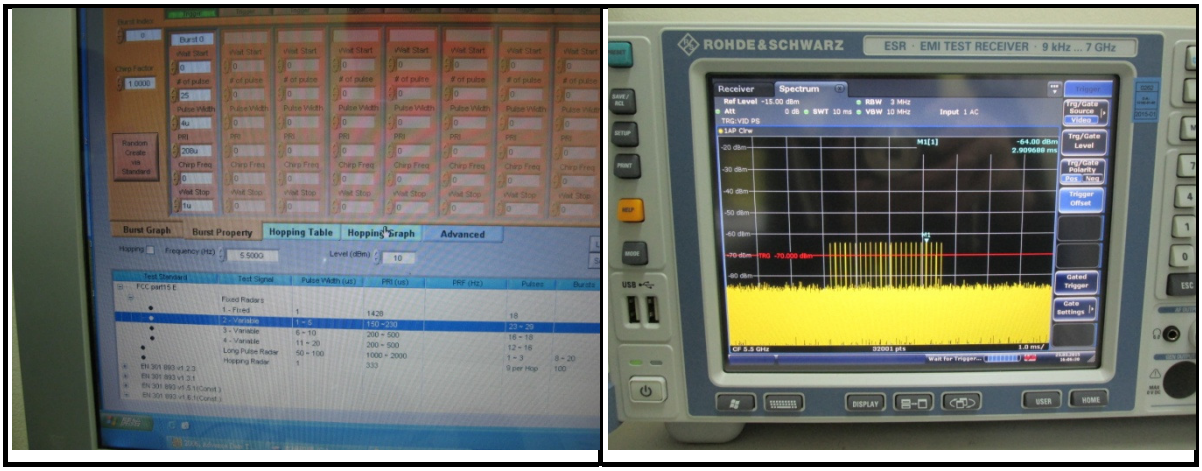
Radar 0



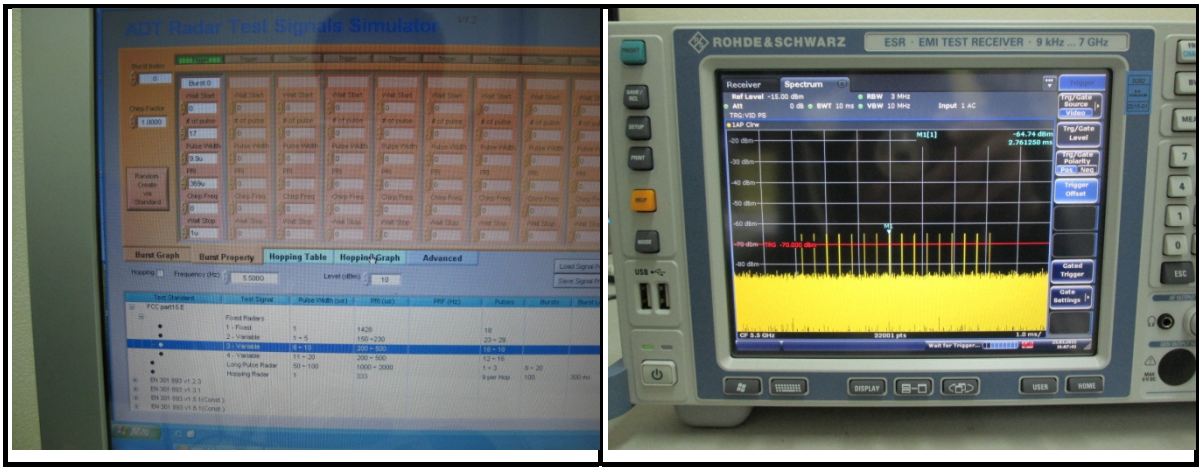
Radar 1



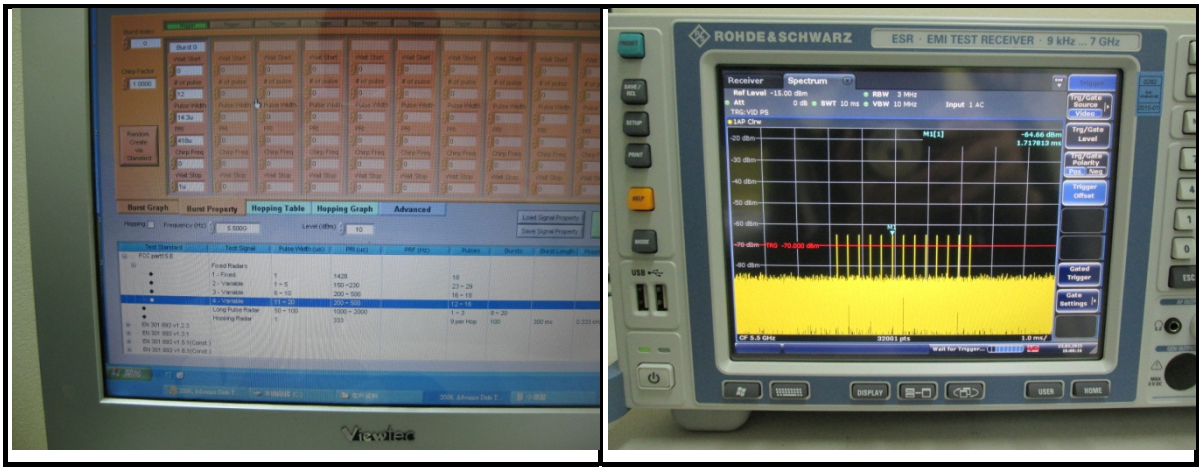
Radar 2



Radar 3



Radar 4



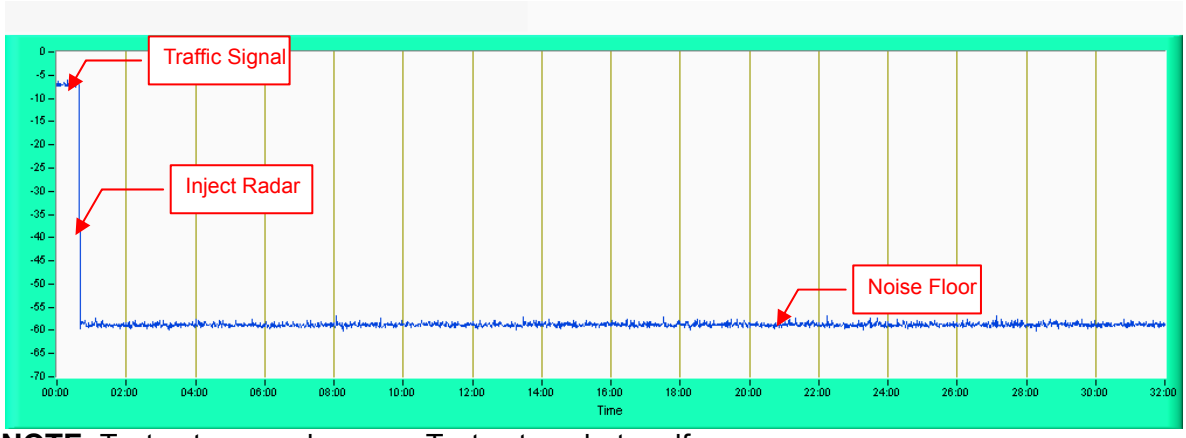
Radar 5

Radar 6

4) 5500MHz has been monitored in 30 minutes period. In this period, no any transmission occurs.

Plot of 30minutes period

802.11n HT20



NOTE: Test setup are shown on Test setup photo.pdf

6.2.4 Uniform Spreading

The intention of the uniform spreading is to provide, on aggregate, a uniform loading of the spectrum. The EUT randomly select next output channel without any bias or fixed pattern, so that all channels in DFS bands (5250 to 5350MHz and 5470 to 5725 MHz) will be used equally.

6.2.5 Transmit power control (TPC)

TPC	E.I.R.P	FCC 15.407(h)(1)
√	> 500mW	The TPC mechanism is required for system with an E.I.R.P. of above 500mW
	< 500mW	The TPC mechanism is not required for system with an E.I.R.P. of less 500mW

7 Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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