FCC Radio Test Report

FCC ID: VOB-P2897

This report concerns (check one): ☐**Original Grant** ☐**Class I Change** ☒**Class II Change**

Project No.	:	1602C038E
Equipment	:	SHIELD Android TV Game Console
Test Model	:	P2897
Series Model	:	N/A
Applicant	:	NVIDIA Corporation
Address	:	2788 San Tomas Expressway, Santa Clara, CA 95051, United States
Date of Receipt	:	Feb. 14, 2016 Oct. 31, 2017 Oct. 26, 2018
Date of Test	:	Feb. 14, 2016 ~ Jul. 11, 2016 Oct. 31, 2017 ~ Apr. 09, 2018 Oct. 30, 2018 ~ Mar. 18, 2019
Issued Date	:	Jun. 12, 2019
Tested by	:	BTL Inc.

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Certificate #5123.02

Declaration

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The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.
Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

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REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	This is a supplementary report to the original test report (BTL-FCCP-5-1602C038D). 1. The applicant and manufacturer address are changed. 2. RF chip changed from BCM4354 to CYW4356. 3. The CYW4356 is based on the BCM4354 and is pin-to-pin compatible. Both chipset possess the same Wi-Fi RF features and performance. 4. The CYW4356 removed the FM section, which was not used in originally released product. 5. The CYW4356 is capable of supporting Bluetooth v5.0, however none of Bluetooth 5.0 features have been incorporated into this product update. So the Maximum Output Power test items have been retested and recorded in this report. Other are kept same.	Jun. 11, 2019
R01	Updated the address of applicant and manufacturer.	Jun. 12, 2019

1. GENERAL SUMMARY

Equipment	:	SHIELD Android TV Game Console
Brand Name	:	NVIDIA
Test Model	:	P2897
Series Model	:	N/A
Applicant	:	NVIDIA Corporation
Manufacturer	:	NVIDIA Corporation
Address	:	2788 San Tomas Expressway, Santa Clara, CA 95051, United States
Date of Test	:	Feb. 14, 2016 ~ Jul. 11, 2016 Oct. 31, 2017 ~ Apr. 09, 2018 Oct. 30, 2018 ~ Mar. 18, 2019
Test Sample	:	Engineering Sample No.: D181009693
Standard(s)	:	FCC Part 15, Subpart E (Section 15.407) / FCC 06-96 FCC KDB 789033 D02 General U-NII Test Procedures New Rules v02r01 FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 FCC KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.
The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-5-1602C038E) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of A2LA according to the ISO/IEC 17025 quality assessment standard and technical standard(s).

Test results included in this report ire only for the UNII-2A, UNII-2C DFS Slave part.

2. EUT INFORMATION

2.1 EUT SPECIFICATION TABLE

Table 1: Specification of EUT

Product Name	SHIELD Android TV Game Console
Brand Name	NVIDIA
Test Model	P2897
Series Model	N/A
Model Difference(s)	N/A
Operational Mode	Slave
Operating Frequency Range	5250MHz~5350MHz & 5470MHz~5725MHz
Modulation	OFDM

Note: This device was functioned as a
☐Master ☒Slave device without radar detection ☐Slave device with radar detection

Note:
1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. Channel List:

IEEE 802.11a IEEE 802.11n (HT20) IEEE 802.11ac (VHT20)		IEEE 802.11n (HT40) IEEE 802.11ac (VHT40)		IEEE 802.11ac (VHT80)	
UNII-2A		UNII-2A		UNII-2A	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
52	5260	54	5270	58	5290
56	5280	62	5310		
60	5300				
64	5320				

IEEE 802.11a IEEE 802.11n (HT20) IEEE 802.11ac (VHT20)		IEEE 802.11n (HT40) IEEE 802.11ac (VHT40)		IEEE 802.11ac (VHT80)	
UNII-2C		UNII-2C		UNII-2C	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
100	5500	102	5510	106	5530
104	5520	110	5550	122	5610
108	5540	118	5590		
112	5560	126	5630		
116	5580	134	5670		
120	5600				
124	5620				
128	5640				
132	5660				
136	5680				
140	5700				

3. Antenna Specification:

Ant.	Brand/Mfr.	Model Name	Antenna Type	Connector	Gain (dBi)	Note
1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	4.31	UNII-2A
2	NVIDIA Corporation	N/A	Monopole Antenna	N/A	4.43	UNII-2A

Ant.	Brand/Mfr.	P/N	Antenna Type	Connector	Gain (dBi)	Note
1	NVIDIA Corporation	N/A	Monopole Antenna	IPEX	4.92	UNII-2C
2	NVIDIA Corporation	N/A	Monopole Antenna	N/A	6.57	UNII-2C

Note:

1. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and receivers (2T2R). all transmit signals are correlated, then, Direction gain = 10 log[$(10^{G1/20} + 10^{G2/20})^2$/N], that are
   UNII-2A Directional gain=10 log[$(10^{4.31/20} + 10^{4.43/20})^2$/2] = 7.39 dBi
   UNII-2C Directional gain=10 log[$(10^{4.92/20} + 10^{6.57/20})^2$/2] = 8.80 dBi

   The UNII-2A Output Power limit is 24-7.39+6=22.61 dBm
   The UNII-2C Output Power limit is 24-8.80+6=21.20 dBm

   The UNII-2A PSD limit is 11-7.39+6=9.61 dBm/MHz
   The UNII-2C PSD limit is 11-8.80+6=8.20 dBm/MHz

4.

Operating Mode / TX Mode	1TX	2TX
802.11a	V (ANT 1 or ANT 2)	-
802.11n (20MHz)	-	V (ANT 1+ANT 2)
802.11n (40MHz)	-	V (ANT 1+ANT 2)
802.11ac (20MHz)	-	V (ANT 1+ANT 2)
802.11ac (40MHz)	-	V (ANT 1+ANT 2)
802.11ac (80MHz)	-	V (ANT 1+ANT 2)

2.2 CONDUCTED OUTPUT POWER AND EIRP

Table 2: The Maximum Output Power and EIRP List

Mode: TX (11a)				
Frequency Band (MHz)	**Max Output Power (dBm)**	**Antenna Gain**	**Max EIRP (dBm)**	**Max EIRP (mW)**
5250~5350	19.47	4.31	23.78	238.781
5470~5725	19.52	4.92	24.44	277.971

Mode: TX (11n 40MHz)				
Frequency Band (MHz)	**Max Output Power (dBm)**	**Directional Gain**	**Max EIRP (dBm)**	**Max EIRP (mW)**
5250~5350	19.45	7.39	26.84	483.059
5470~5725	19.15	8.80	27.95	623.735

Mode: TX (11ac 80MHz)				
Frequency Band (MHz)	**Max Output Power (dBm)**	**Directional Gain**	**Max EIRP (dBm)**	**Max EIRP (mW)**
5250~5350	13.04	7.39	20.43	110.408
5470~5725	17.99	8.80	26.79	477.529

3. U-NII DFS RULE REQUIREMENTS

3.1 WORKING MODES AND REQUIRED TEST ITEMS

The manufacturer shall state whether the EUT is capable of operating as a Master and/or a Client. If the EUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See tables 3 and 4 for the applicability of DFS requirements for each of the operational modes.

Table 3: Applicability of DFS requirements prior to use a channel

Requirement	Operational Mode		
	Master	Client without radar detection	Client with radar detection
Non-Occupancy Period	✓	✓	✓
DFS Detection Threshold	✓	Not required	✓
Channel Availability Check Time	✓	Not required	Not required
Uniform Spreading	✓	Not required	Not required
U-NII Detection Bandwidth	✓	Not required	✓

Table 4: Applicability of DFS requirements during normal operation.

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

3.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS

DETECTION THRESHOLD VALUES

Table 5: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection.

Maximum □ransmit Power	Value (See Notes 1 and 2)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and Power pectral 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 6: 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 80% of the UNII 99% transmission power bandwidth. See Note 3.

Note 1: The instant that the Channel Move Time and the Channel Closing Transmission Time begins is as follows:
• For the Short Pulse Radar Test Signals this instant is the end of the Burst.
• For the Frequency Hopping radar Test Signal, this instant is the end of the last radar Burst generated.
• For the Long Pulse Radar Test Signal this instant is the end of the 12 second period defining the Radar Waveform.

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 1 is used and 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 7: 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	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	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 shall only be used for the channel availability and detection bandwidth tests. It should be noted that any of the radar test waveforms 0 – 4 can be used for the channel availability and detection bandwidth tests.

Table 8: Long Pulse Radar Test Waveform

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

Table 9: Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Numberof Pulsesper Burst	Numberof Bursts	Minimum Percentage of Successful Detection	Minimum Number ofTrials
6	1	333	9	0.333	300	70%	30

Note:

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

4. TEST INSTRUMENTS

Table 10: Test instruments list.

DESCRIPTION	MANUFACTURER	MODEL NO.	Serial No	Calibration Until
EXA Spectrum Analyzer	Agilent	N9010A	MY50520044	Mar. 11, 2019
Signal Generator	Agilent	E4438C	MY49071316	Mar. 11, 2019
POWER SPLITTER	Mini-Circuits	ZFRSC-123-S+	331000910-1	Feb. 24, 2019
POWER SPLITTER	Mini-Circuits	ZN4PD1-63-S+	SF9335D1045-1	Feb. 21, 2019
Attenuator	WOKEN	6SM3502	VAS1214NL	Mar. 11, 2019

Note: Calibration interval of instruments listed above is one year.

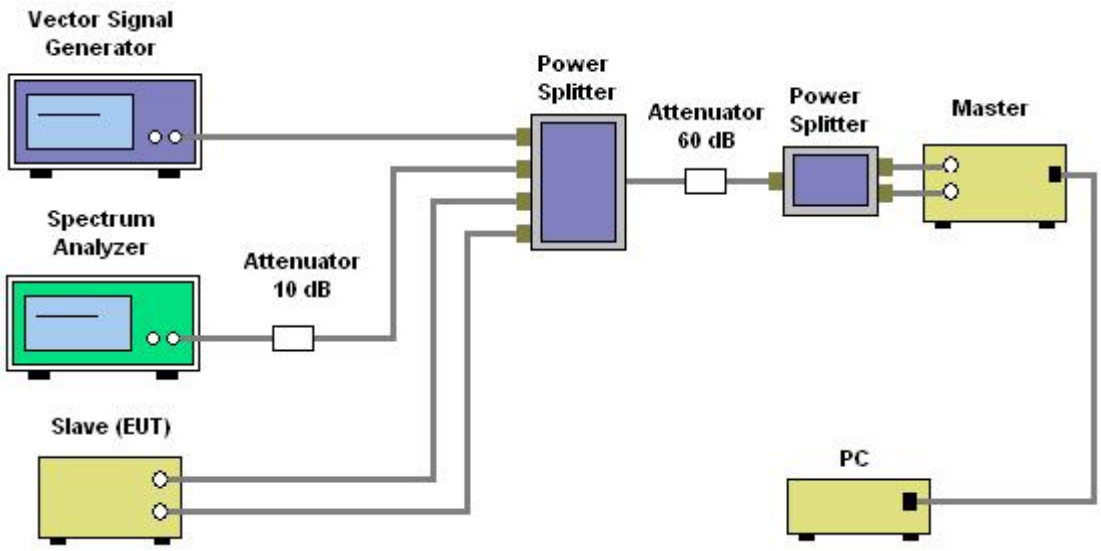
5. EMC EMISSION TEST

5.1 DFS MEASUREMENT SYSTEM:

Test Precedure

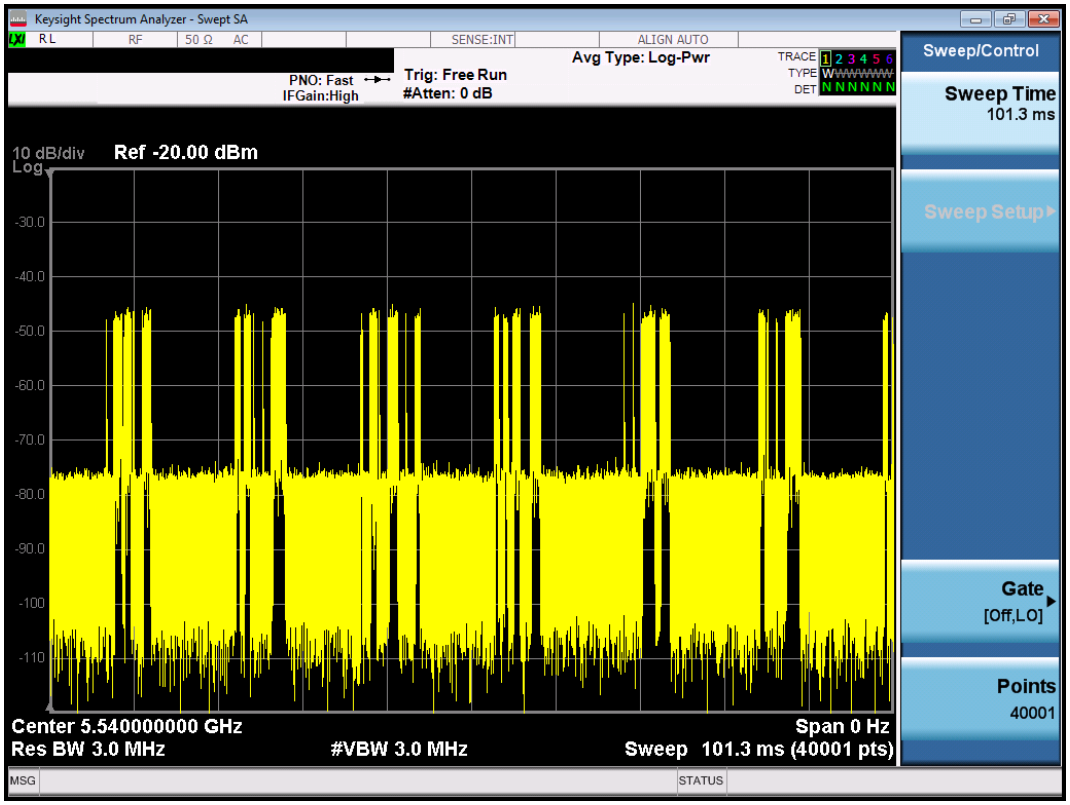
1. Master device and client device are set up by conduction method as the following configuration.
2. The client device is connected to notebook and to access a IP address on wireless connection with the master device.
3. Then the master device is connected to another notebook to access a IP address.
4. Finally, let the two IP addresses run traffic with each other through the Run flow software “Lan test” to reach 17% channel loading as below

Setup

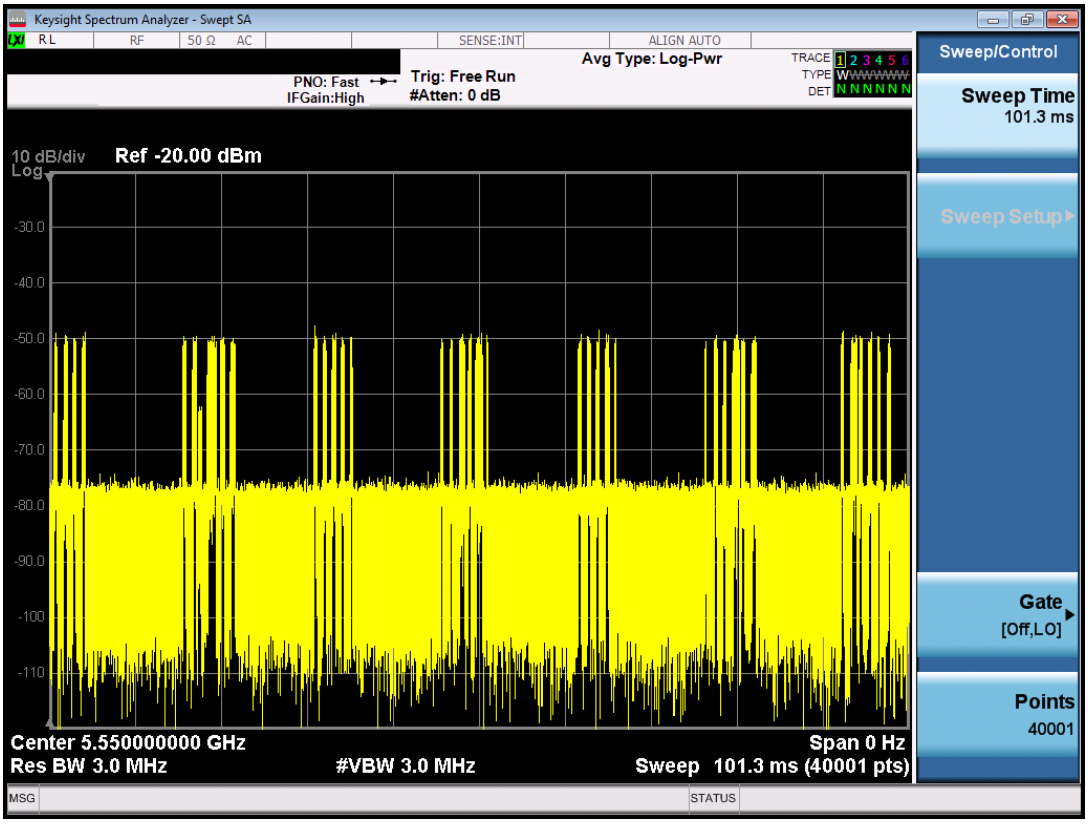


Channel Loading

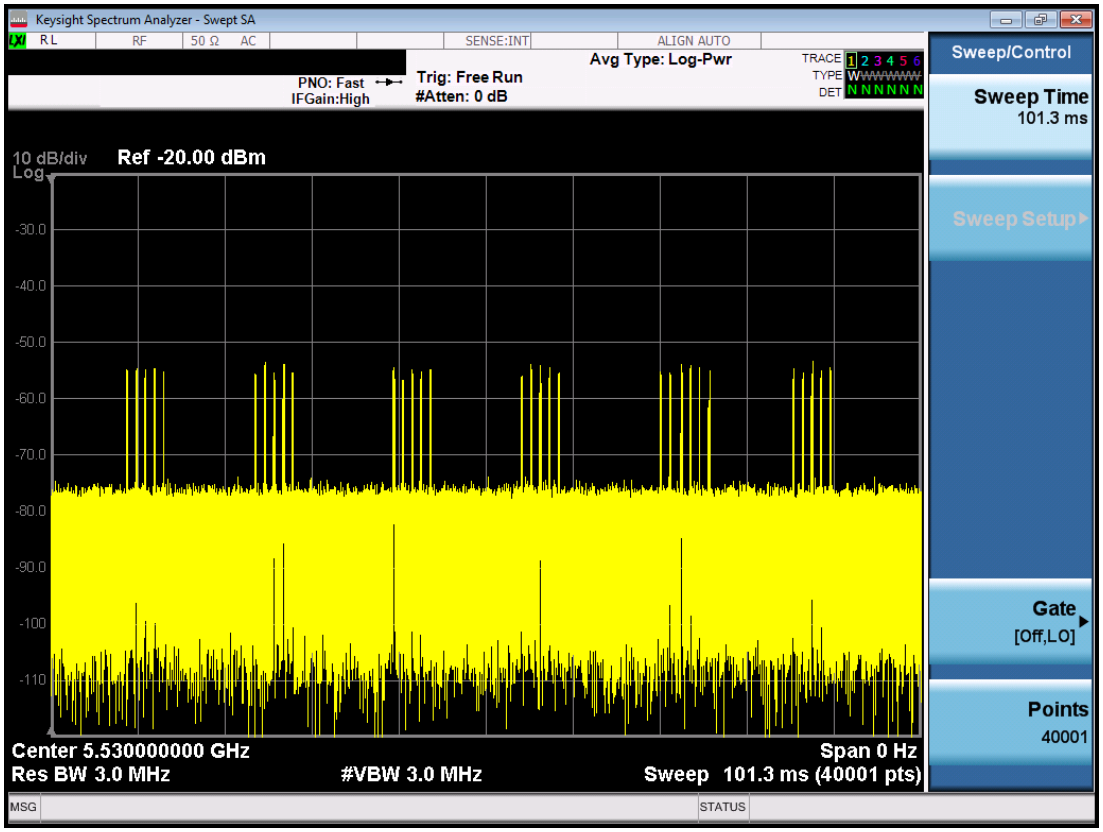
11a Mode



11n 40MHz Mode



11ac 80MHz Mode



The hopping type 6 pulse parameters are fixed while the hopping sequence is based on the August 2005 NTIA Hopping Frequency List. The initial starting point randomized at run-time and each subsequent starting point is incremented by 475. Each frequency in the 100-length segment is compared to the boundaries of the EUT Detection Bandwidth and the software creates a hopping burst pattern in accordance with Section 7.4.1.3 Method #2 Simulated Freqeuncy Hopping Radar Waveform Generating Subsystem of FCC 06-96. The frequency of the signal generator is incremented in 1 MHz steps from FL to FH for each successive trial. This incremental sequence is repeated as required to generate a minimum of 30 total trials and to maintain a uniform frequency distribution over the entire Detection Bandwidth.

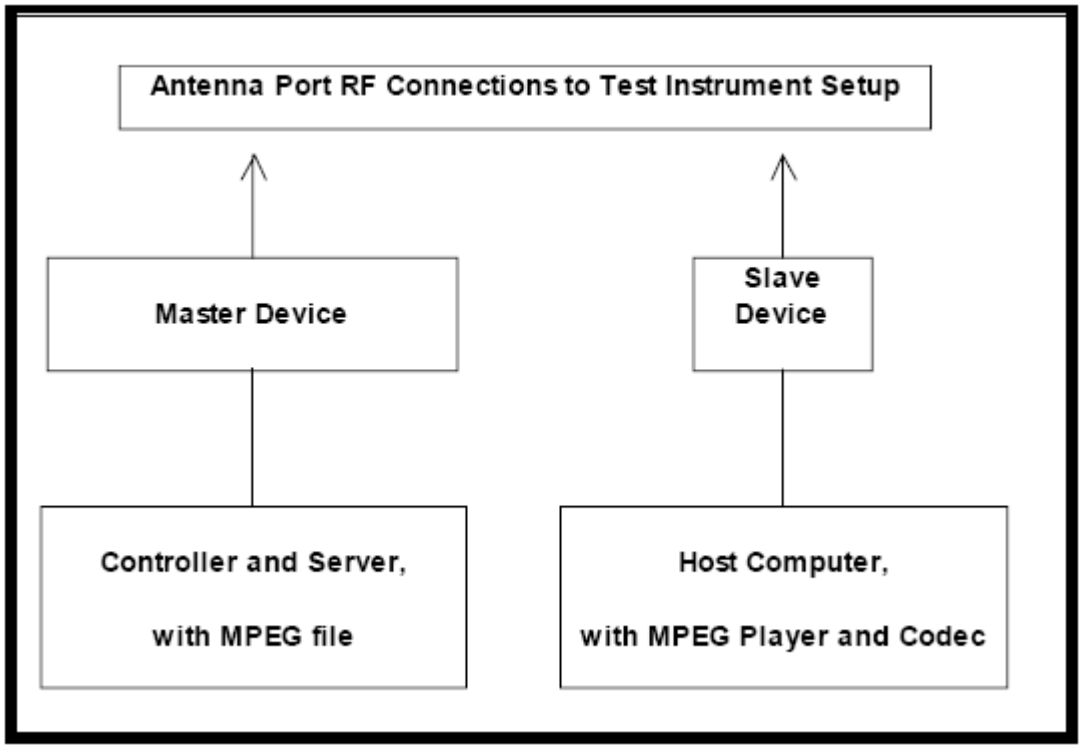
The signal monitoring equipment consists of a spectrum analyzer set to display 8001 bins on the horizontal axis. The time-domain resolution is 2 msec / bin with a 16 second sweep time, meeting the 10 second short pulse reporting criteria. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), additional combiner/dividers are inserted between the Master Combiner/Divider and the pad connected to the Master Device (and/or between the Slave Combiner/Divider and the pad connected to the Slave Device). Additional pads are utilized such that there is one pad at each RF port on each EUT.

5.2 CALIBRATION OF DFS DETECTION THRESHOLD LEVEL:

A 50 ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected in place of the master device and the signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –62 dBm as measured on the spectrum analyzer.

Without changing any of the instrument settings, the spectrum analyer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. Measure the amplitude and calculate the difference from –62 dBm. Adjust the Reference Level Offset of the spectrum analyzer to this difference.
The spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device. The interference detection threshold may be varied from the calibrated value of –62 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.
Set the signal generator to produce a radar waveform, trigger a burst manually and measure the level on the spectrum analyzer. Readjust the amplitude of the signal generator as required so that the peak level of the waveform is at a displayed level equal to the required or desired interference detection threshold. Separate signal generator amplitude settings are determined as required for each radar type.



5.3 DEVIATION FROM TEST STANDARD

No deviation.

6. TEST RESULTS

6.1 SUMMARY OF TEST RESULT

Clause	Test Parameter	Remarks	Pass/Fail
15.407	DFS Detection Threshold	No Applicable	N/A
15.407	Channel Availability Check Time	Not Applicable	N/A
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	Not Applicable	N/A
15.407	U-NII Detection Bandwidth	Not Applicable	N/A

6.2 TEST MODE: DEVICE OPERATING IN MASTER MODE

The EUT is slave equipment, it need a master device when testing.
Master with injection at the Master. (Radar Test Waveforms are injected into the Master)

6.3 DFS DETECTION THRESHOLD

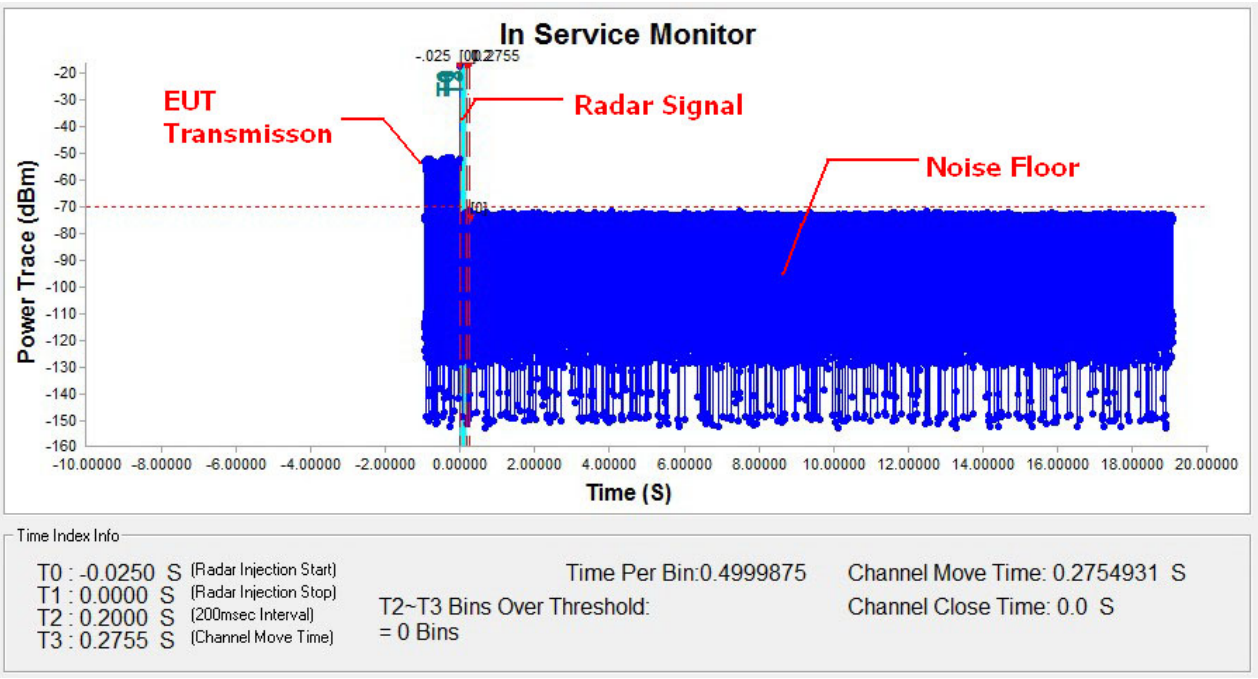
Calibration:

The EUT is slave equipment with a max gain is 6.57 dBi.
For a detection threshold level of -62dBm and the master (Brand: GPON ONU, Model: G-240W-B, FCC ID: 2ADZRG240WB) antenna gain is 2.90 dBi, required detection threshold is -59.10 dBm (= -62+2.90).

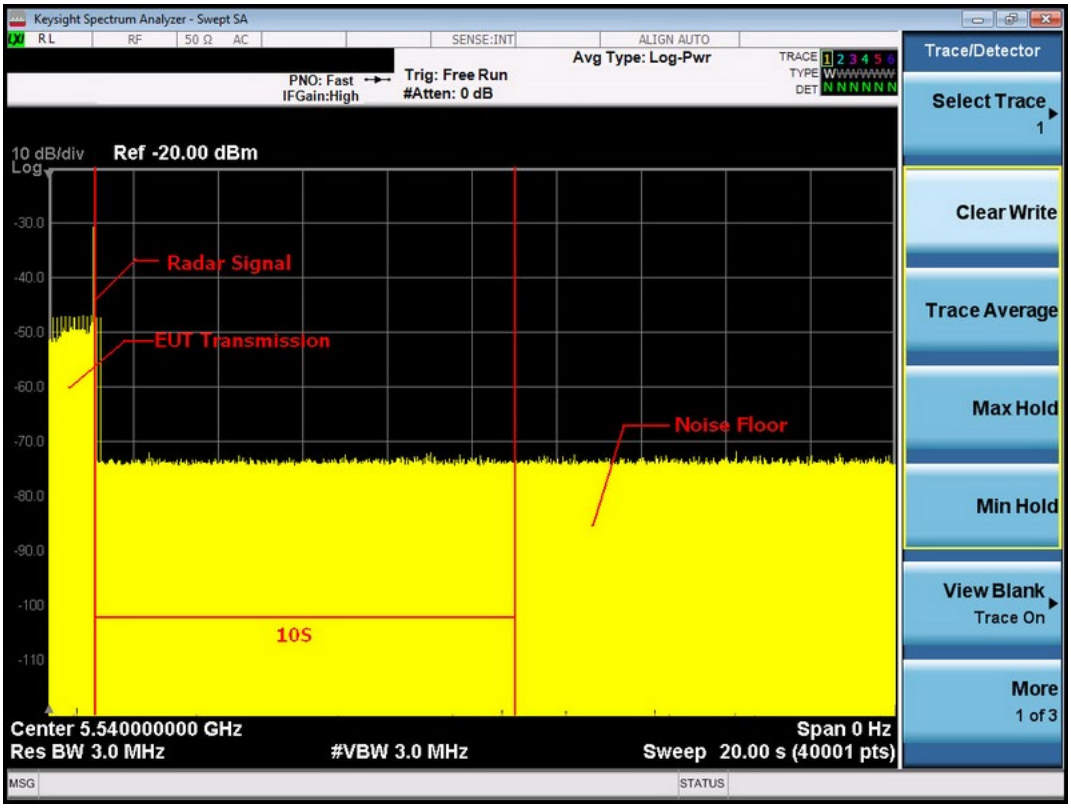
Note: Maximum Transmit Power is less than 200 milliwatt in this report, so detection threshold level is -62dBm.

6.4 CHANNEL CLOSING TRANSMISSION AND CHANNEL MOVE TIME WLAN TRAFFIC

TX (11a Mode)

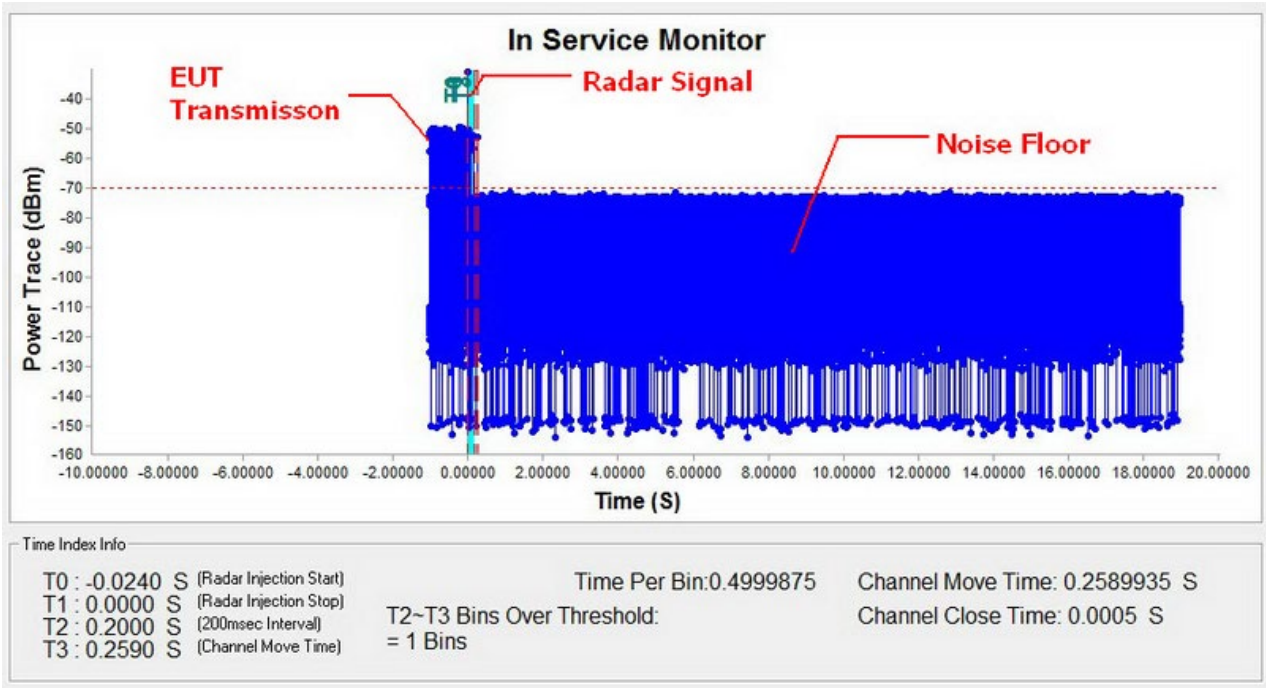


Note: T0 denotes the start of Channel Move Time upon the end of the last Radar burst.
T1 denotes the data transmission time of 200ms from T1.
T2 denotes the end of Channel Move Time.
T3 denotes the 10 second from T0 to observe the aggregate duration of transmissions.

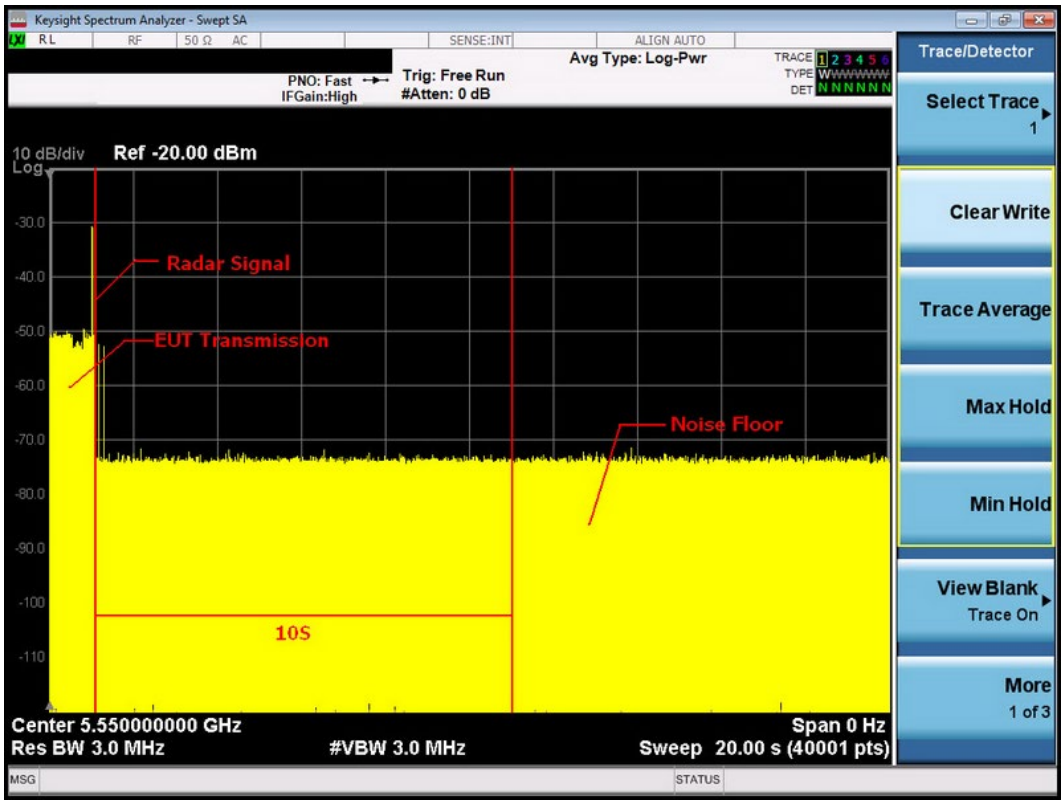


Note: An expanded plot for the device vacates the channel in the required 500ms

TX (11n 40MHz Mode)

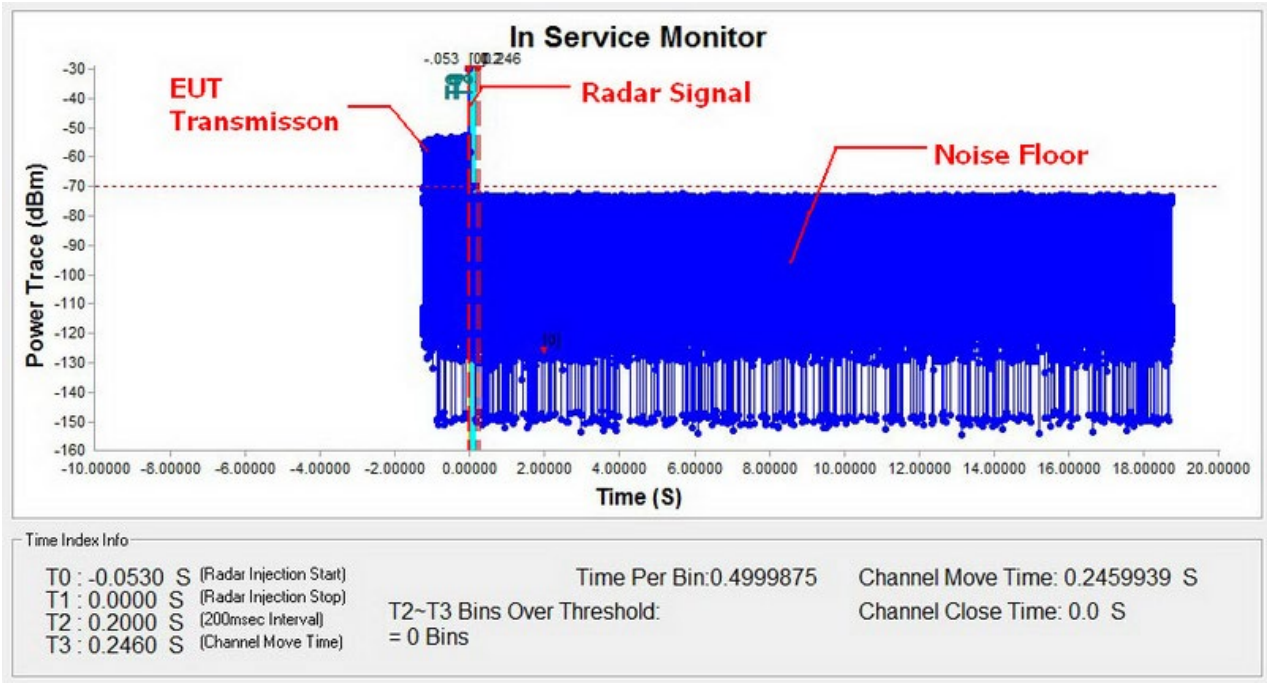


Note: T0 denotes the start of Channel Move Time upon the end of the last Radar burst.
T1 denotes the data transmission time of 200ms from T1.
T2 denotes the end of Channel Move Time.
T3 denotes the 10 second from T0 to observe the aggregate duration of transmissions.

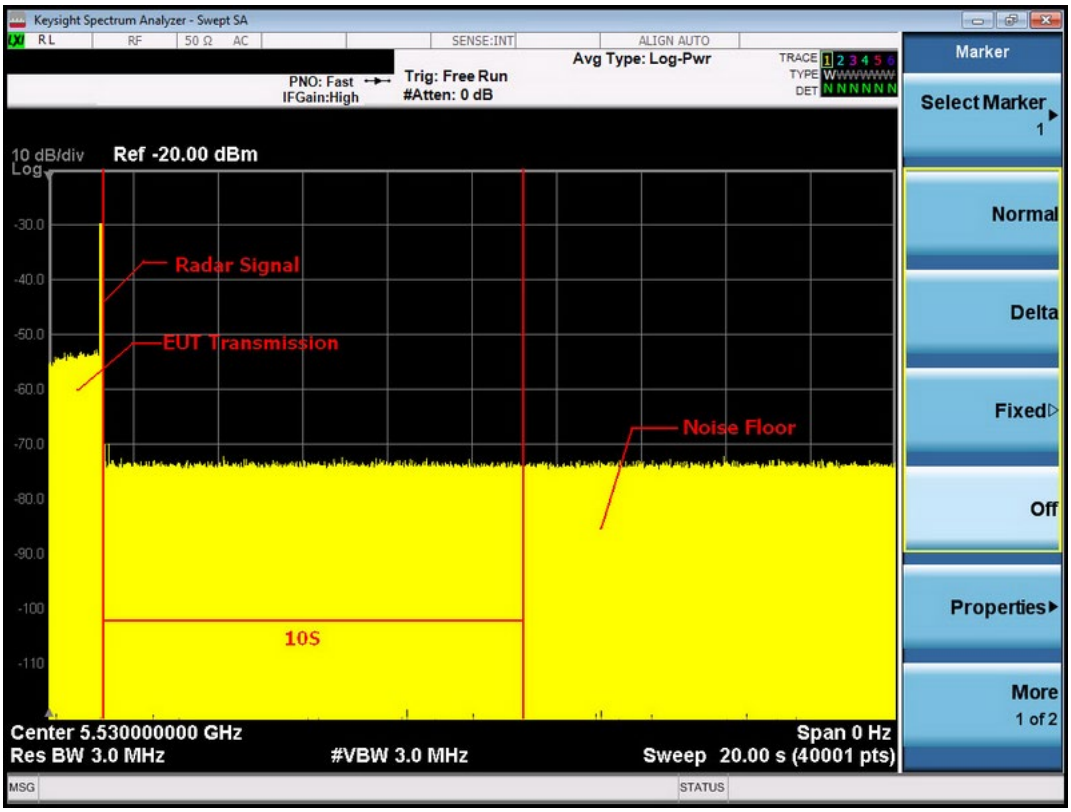


Note: An expanded plot for the device vacates the channel in the required 500ms

TX (11ac 80MHz Mode)



Note: T0 denotes the start of Channel Move Time upon the end of the last Radar burst.
T1 denotes the data transmission time of 200ms from T1.
T2 denotes the end of Channel Move Time.
T3 denotes the 10 second from T0 to observe the aggregate duration of transmissions.



Note: An expanded plot for the device vacates the channel in the required 500ms

11a Mode		
Item	Measured Value(s)	Limit(s)
Channel Move Time	0.2754931	10
Channel Close Time	0.0	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period

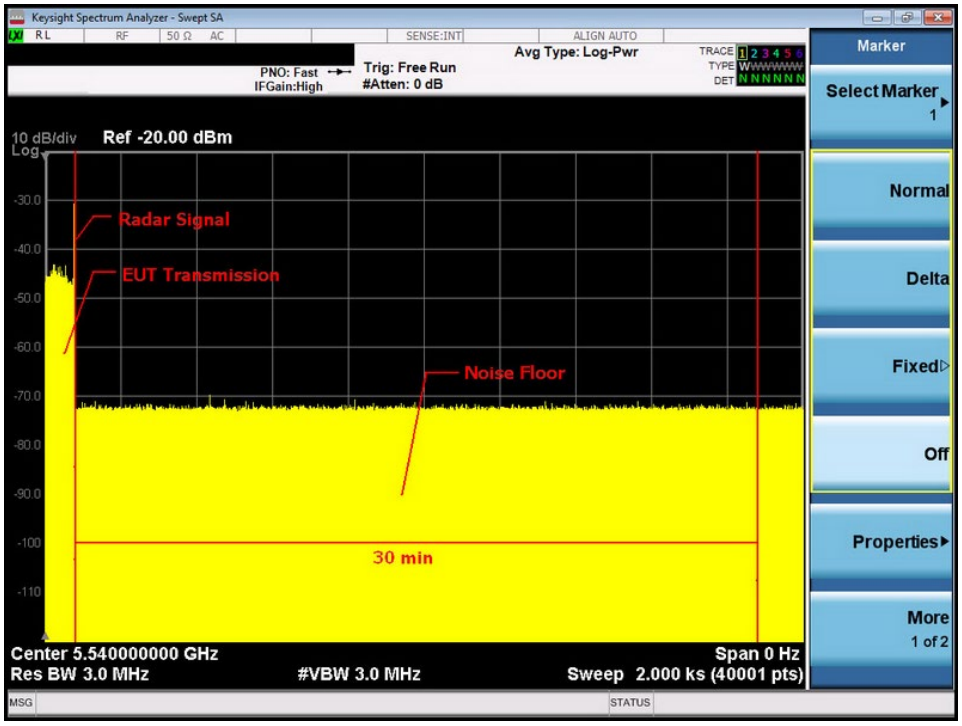
11n 40MHz Mode		
Item	Measured Value(s)	Limit(s)
Channel Move Time	0.2589935	10
Channel Close Time	0.0005	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period

11ac 80MHz Mode		
Item	Measured Value(s)	Limit(s)
Channel Move Time	0.2459939	10
Channel Close Time	0.0	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period

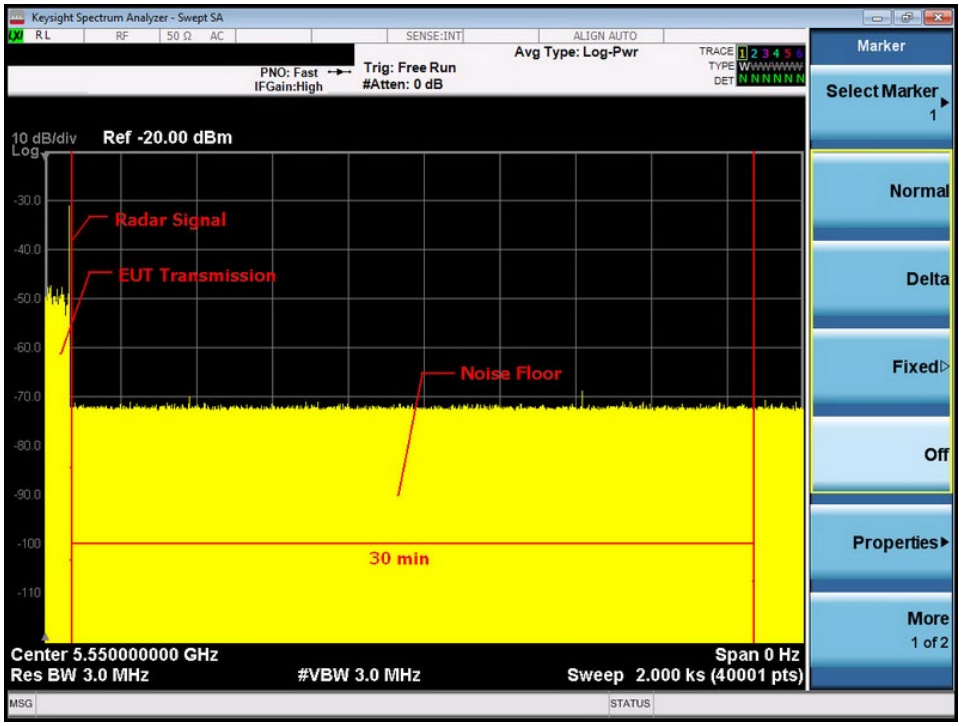
6.5 NON- OCCUPANCY PERIOD

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.

TX (11a Mode)



TX (11n 40MHz Mode)



TX (11ac 80MHz Mode)