DFS PORTION of FCC 47 CFR PART 15 SUBPART E
DFS PORTION of INDUSTRY CANADA RSS-247 ISSUE 2

CERTIFICATION TEST REPORT

FOR

4X4 802.11a/b/g/n HT20 MASTER DEVICE

MODEL NUMBER: S16

FCC ID: SBVRM015
IC: 5373A-RM015

REPORT NUMBER: 12049380-E4V3

ISSUE DATE: OCTOBER 30, 2018

Prepared for
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614 CHAPALA STREET
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	10/03/18	Initial Issue	Conan Cheung
V2	10/11/18	Added Min. Ant. Gain of Master on Pg. 17	Doug Anderson
V3	10/30/18	Section 3 update	Henry Lau

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SONOS INC.
614 CHAPALA STREET
SANTA BARBARA, CA 93101, U.S.A.

EUT DESCRIPTION: 4X4 802.11a/b/g/n HT20 MASTER DEVICE

MODEL: S16

SERIAL NUMBER: 34-7E-5C-00-0F-C0: A (Master)
34-7E-5C-00-0F-B4:F (Slave)

DATE TESTED: AUGUST 13 and 15, 2018

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
DFS Portion of CFR 47 Part 15 Subpart E	Complies
DFS Portion of INDUSTRY CANADA RSS-247 Issue 2	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

CONAN CHEUNG
UL REVIEWER
UL Verification Services Inc.

Prepared By:

DOUG ANDERSON
EMC ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with the DFS portion of FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, KDB 905462 D02 and D03 and RSS-247 Issue 2.

3. REFERENCE DOCUMENTS

Measurements of transmitter parameters as referenced in this report are documented in UL Verification Services report number 12049380-E3V4.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty level has been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Time	± 0.02 %

The Uncertainty figure is valid to a confidence level of 95%.

6. DYNAMIC FREQUENCY SELECTION

6.1. OVERVIEW

6.1.1. LIMITS

INDUSTRY CANADA

IC RSS-247 is closely harmonized with FCC Part 15 DFS rules. The deviations are as follows:

RSS-247 Issue 2

Note: For the band 5600–5650 MHz, no operation is permitted.

Until further notice, devices subject to this annex shall not be capable of transmitting in the band 5600–5650 MHz. This restriction is for the protection of Environment Canada weather radars operating in this band.

FCC

§15.407 (h), FCC KDB 905462 D02 “COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION” and KDB 905462 D03 “U-NII CLIENT DEVICES WITHOUT RADAR DETECTION CAPABILITY”.

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	Client **(without DFS)**	Client **(with DFS)**
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required	Yes

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar DFS	Client (without DFS)
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 all 20 MHz channel blocks and a null frequency between the bonded 20 MHz channel blocks.		

Table 3: Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see notes)
E.I.R.P. ≥ 200 mill watt	-64 dBm
E.I.R.P. < 200 mill watt and power spectral density < 10 dBm/MHz	-62 dBm
E.I.R.P. < 200 mill watt that do not meet 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.
Note 3: E.I.R.P. 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	30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds (See Note 1)
Channel Closing Transmission Time	200 milliseconds + approx. 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.

Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (usec)	PRI (usec)	Pulses	Minimum Percentage of Successful Detection	Minimum 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: {(1/360) x (19 x 10^6 PRI_{usec})}	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 usec. With a minimum increment of 1 usec, 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.

Table 6 – Long Pulse Radar Test Signal

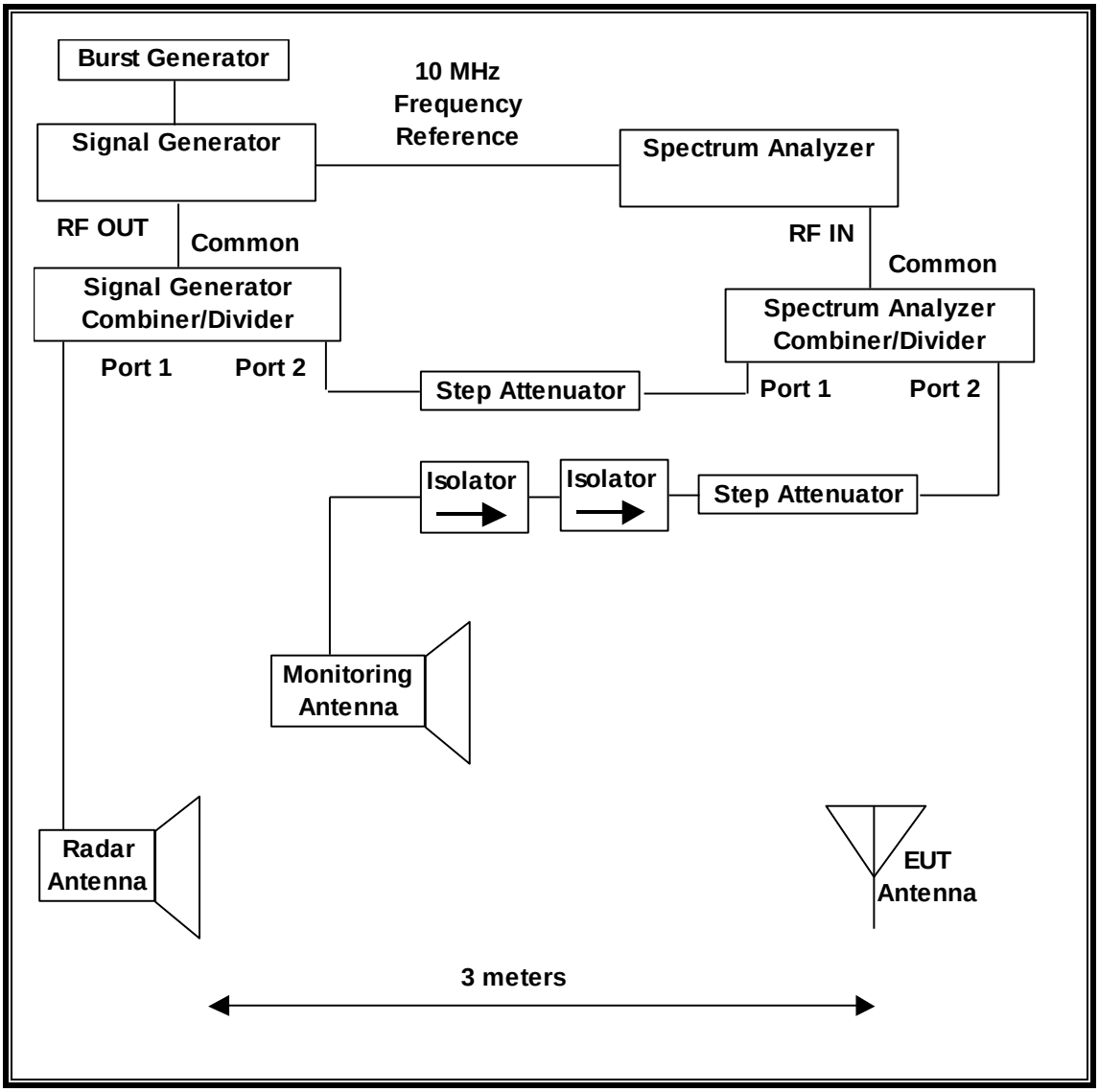
Radar Waveform Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 7 – Frequency Hopping Radar Test Signal

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

6.1.2. TEST AND MEASUREMENT SYSTEM

RADIATED METHOD SYSTEM BLOCK DIAGRAM



SYSTEM OVERVIEW

The short pulse and long pulse signal generating system utilizes the NTIA software. The Vector Signal Generator has been validated by the NTIA. The hopping signal generating system utilizes the CCS simulated hopping method and system, which has been validated by the DoD, FCC and NTIA. The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution.

The short pulse types 1, 2, 3 and 4, and the long pulse type 5 parameters are randomized at run-time.

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 Frequency Hopping Radar Waveform Generating Subsystem of KDB 905462 D02. The frequency of the signal generator is incremented in 1 MHz steps from F_L to F_H 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. 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.

SYSTEM CALIBRATION

A 50-ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected to a horn antenna via a coaxial cable, with the reference level offset set to (horn antenna gain – coaxial cable loss). The signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –64 dBm as measured on the spectrum analyzer.

Without changing any of the instrument settings, the spectrum analyzer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. The Reference Level Offset of the spectrum analyzer is adjusted so that the displayed amplitude of the signal is –64 dBm.

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 –64 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

ADJUSTMENT OF DISPLAYED TRAFFIC LEVEL

A link is established between the Master and Slave and the distance between the units is adjusted as needed to provide a suitable received level at the Master and Slave devices. For master testing, WLAN Traffic that meets or exceeds the minimum channel loading requirement is attained by streaming the FCC audio test file and client provided proprietary traffic generation software, “Cont Tx”, from the Master device to the Slave device. For slave testing, WLAN Traffic is attained by streaming the FCC audio test file from the Support Device to the Master Device on the 2.4GHz band and to the EUT on the 5GHz Band.

The monitoring antenna is adjusted so that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold.

TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the DFS tests documented in this report:

Master Device Testing

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**ID No.**	**Cal Due**
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T459	07/25/19
Signal Generator, MXG X-Series RF Vector	Agilent	N5182B	T1134	04/23/19
Arbitrary Waveform Generator	Agilent / HP	33220A	T190	04/23/19

Slave Device Testing

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**ID No.**	**Cal Due**
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T459	07/25/19
Signal Generator, MXG X-Series RF Vector	Agilent	N5182B	T1134	04/23/19

6.1.3. TEST AND MEASUREMENT SOFTWARE

The following test and measurement software was utilized for the tests documented in this report:

Master Device Testing

TEST SOFTWARE LIST		
Name	**Version**	**Test / Function**
Aggregate Time-PXA	3.1	Channel Loading and Aggregate Closing Time
FCC 2014 Detection Bandwidth-PXA	3.1.1	Detection Bandwidth in 5 MHz Steps
In Service Monitoring-PXA	3.3.4	In-Service Monitoring (Probability of Detection)
PXA Read	3.1	Signal Generator Screen Capture Utility
SGXProject.exe	1.7	Radar Waveform Generation and Download

Slave Device Testing

TEST SOFTWARE LIST		
Name	**Version**	**Test / Function**
Aggregate Time-PXA	3.1	Channel Loading and Aggregate Closing Time
PXA Read	3.1	Signal Generator Screen Capture Utility
SGXProject.exe	1.7	Radar Waveform Generation and Download

6.1.4. TEST ROOM ENVIRONMENT

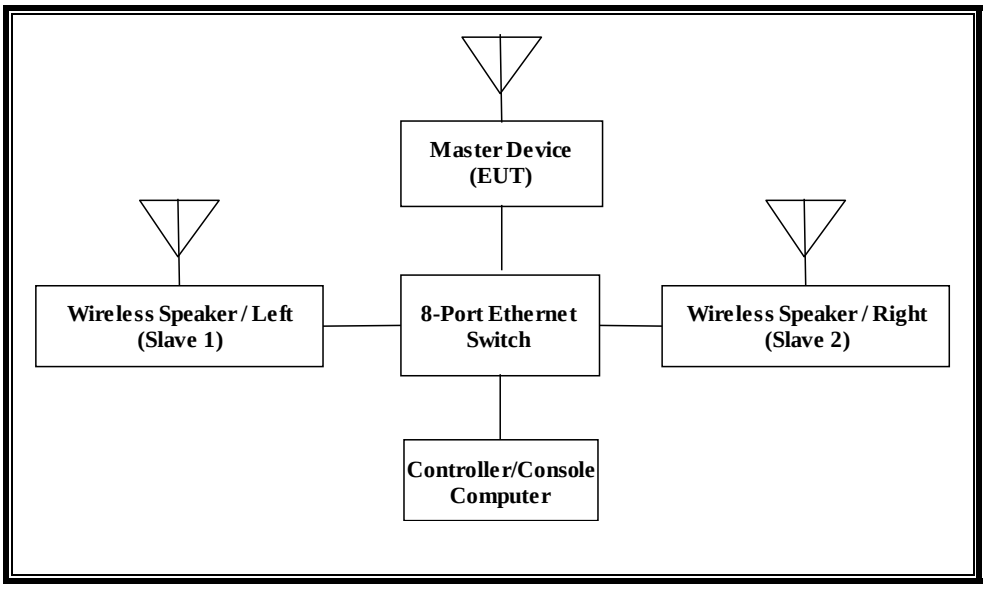
The test room temperature and humidity shall be maintained within normal temperature of 15~35 °C and normal humidity 20~75% (relative humidity).

ENVIRONMENT CONDITION

Parameter	Value
Temperature	24.8 and 24.2 °C
Humidity	41 and 40 %

6.1.5. SETUP OF EUT

MASTER DEVICE RADIATED METHOD EUT TEST SETUP

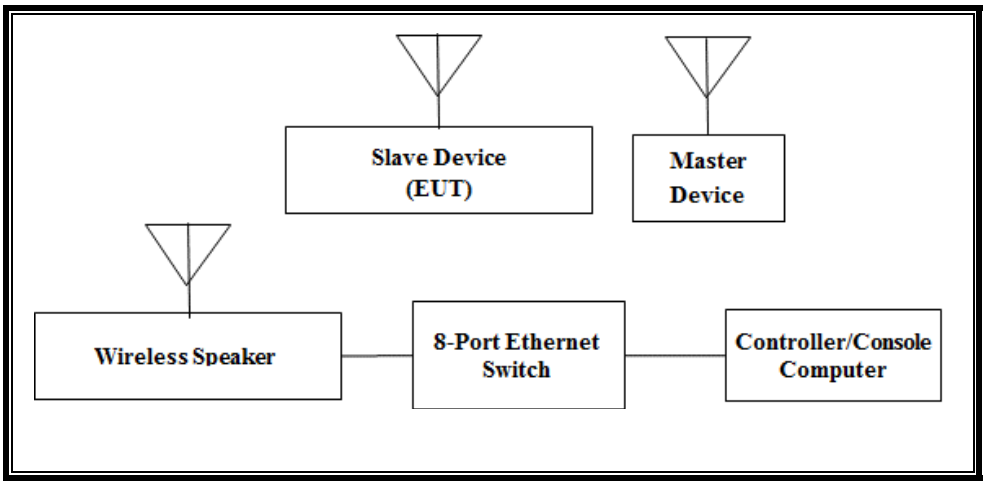


SUPPORT EQUIPMENT

The following support equipment was utilized for the DFS tests documented in this report:

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Wireless Smart Speaker / Left (Slave 1)	Sonos	Play:1	94-9F-3E-FB-32-64:4	SBVRM007
Wireless Smart Speaker / Right (Slave 2)	Sonos	Play:1	94-9F-3E-FB-32-9C:9	SBVRM007
Notebook PC (Controller)	Lenovo	Type 4319-64U	R9-BK0RH 11/02	DoC
AC Adapter (Controller PC)	Lenovo	45N0058	11S45N0058Z1ZJA40C1GXP	DoC
8-Port Gigabit Ethernet Switch	Netgear	GS108	2162423P58304	DoC
AC Adapter (Switch)	Netgear	AD810F10	31133219X1032916SX	DoC

SLAVE DEVICE RADIATED METHOD EUT TEST SETUP



SUPPORT EQUIPMENT

The following support equipment was utilized for the DFS tests documented in this report:

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Wireless Sound Bar (Master Device)	Sonos	Playbar	94-9F-3E-6E-DF-C0-9	SBVRM006
Notebook PC (Controller)	Lenovo	Type 4319-64U	R9-BK0RH 11/02	DoC
AC Adapter (Controller PC)	Lenovo	45N0058	11S45N0058Z1ZJA40C1 GXP	DoC
Wireless Smart Speaker	Sonos	Play:1	94-9F-3E-FB-32-9C:9	SBVRM07
8-Port Gigabit Ethernet Switch	Netgear	GS108	2162423P58304	DoC
AC Adapter (Switch)	Netgear	AD810F10	31133219X1032916SX	DoC

6.1.6. DESCRIPTION OF EUT

For FCC the EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges.

For IC the EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges, excluding the 5600-5650 MHz range.

The EUT can be configured as a Master Device or a Slave Device without Radar Detection.

For Radio 0, the highest power level within these bands is 25.14 dBm EIRP in the 5250-5350 MHz band and 24.81 dBm EIRP in the 5470-5725 MHz band.

For Radio 1, the highest power level within these bands is 23.74 dBm EIRP in the 5250-5350 MHz band and 23.64 dBm EIRP in the 5470-5725 MHz band.

The only antenna assembly utilized with the EUT is constructed with four antennas, each with respective gains of 4.62 dBi, 4.19 dBi, 3.85 dBi and 3.7 dBi in the 5 GHz band.

Four antennas are utilized to meet the diversity and MIMO operational requirements.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is –64 dBm. After correction for procedural adjustments, the required radiated threshold at the antenna port is –64 + 1 = -63 dBm.

The calibrated radiated DFS Detection Threshold level is set to –64 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

The EUT uses four transmitter/receiver chains, each connected to an antenna to perform radiated tests.

The Slave device associated with the EUT during these master testing does not have radar detection capability.

For master testing, WLAN Traffic that meets or exceeds the minimum channel loading requirement is attained by streaming the FCC audio test file and client provided proprietary traffic generation software, “Cont Tx”, from the Master device to the Slave device.

For slave testing, WLAN Traffic is attained by streaming the FCC audio test file from the Support Device to the Master Device on the 2.4GHz band and to the EUT on the 5GHz Band.

The maximum channel loading attainable as a slave device is 14.896%.

TPC is not required since the maximum EIRP is less than 500 mW (27 dBm).

The EUT utilizes the 802.11n architecture. One nominal channel bandwidth, 20 MHz, is implemented.

The software installed in the EUT during Master device testing is Sonos Controller for PC version 9.3 (build 47056050mcs9_dev_integ).

The software installed in the Master during Slave device testing is Sonos Controller for PC version 9.3 (build 47055224mainline_integ_int_release)

UNIFORM CHANNEL SPREADING

This function is not required per KDB 905462 for Master devices.

This is requirement not applicable to Slave Devices.

OVERVIEW OF MASTER DEVICE USED DURING SLAVE DEVICE TESTING WITH RESPECT TO §15.407 (h) REQUIREMENTS

The Master Device used during Slave Device testing is a Sonos, Inc. Playbar wireless sound bar, FCC ID:SBVRM006. The minimum antenna gain for the Master Device is 4 dBi.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is –64 dBm. After correction for procedural adjustments, the required radiated threshold at the antenna port is –64 + 1 = -63 dBm.

The calibrated radiated DFS Detection Threshold level is set to –64 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

6.2. MASTER CONFIGURATION RESULTS FOR 20 MHz BANDWIDTH

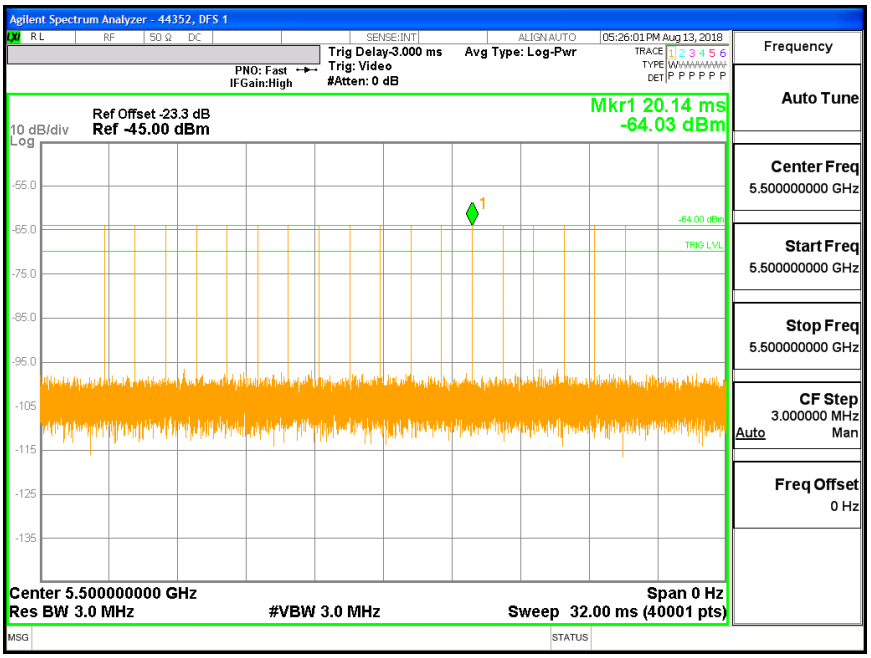
6.2.1. TEST CHANNEL

All tests were performed at a channel center frequency of 5500 MHz.

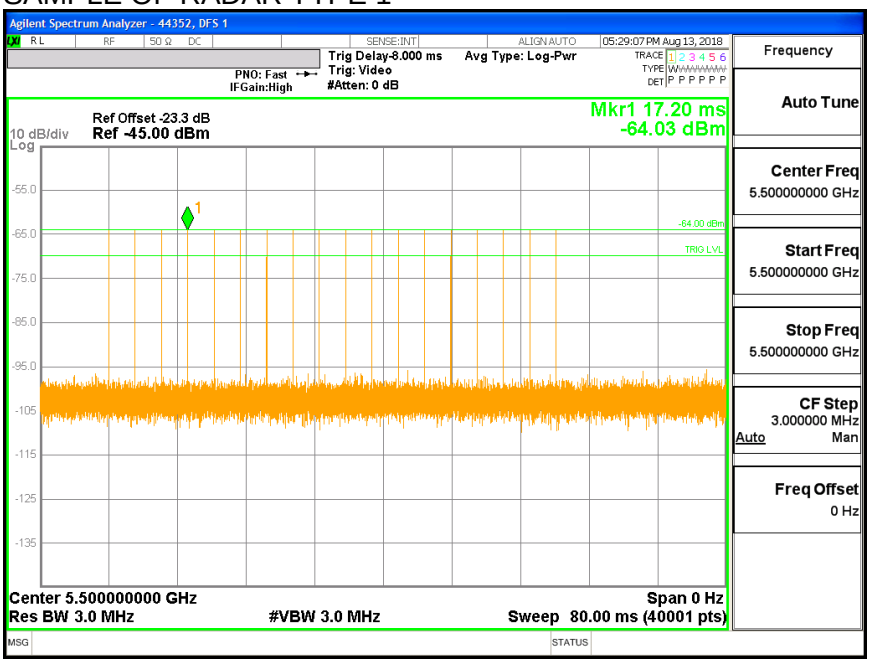
6.2.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

SHORT PULSE RADAR TYPE 0



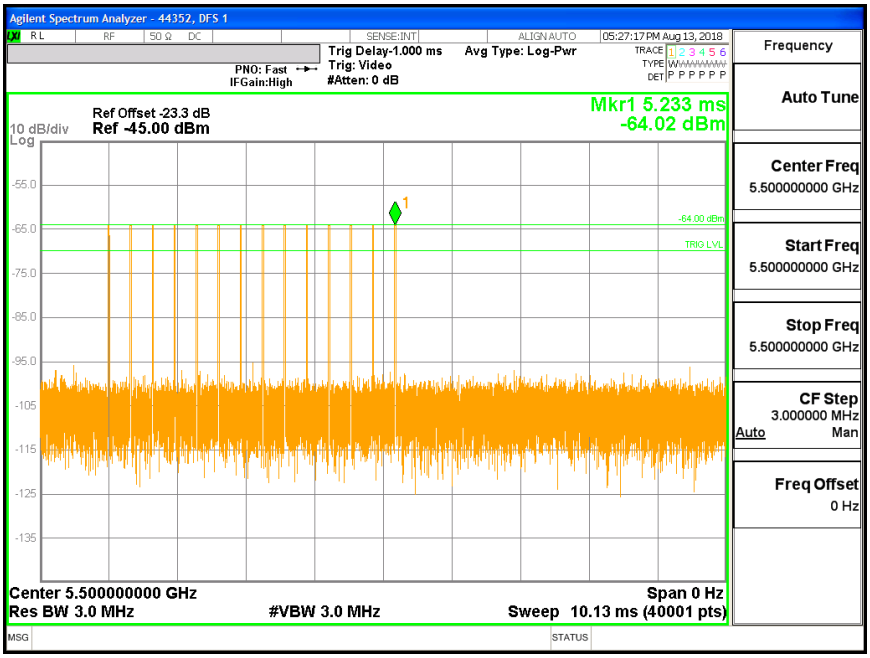
SAMPLE OF RADAR TYPE 1



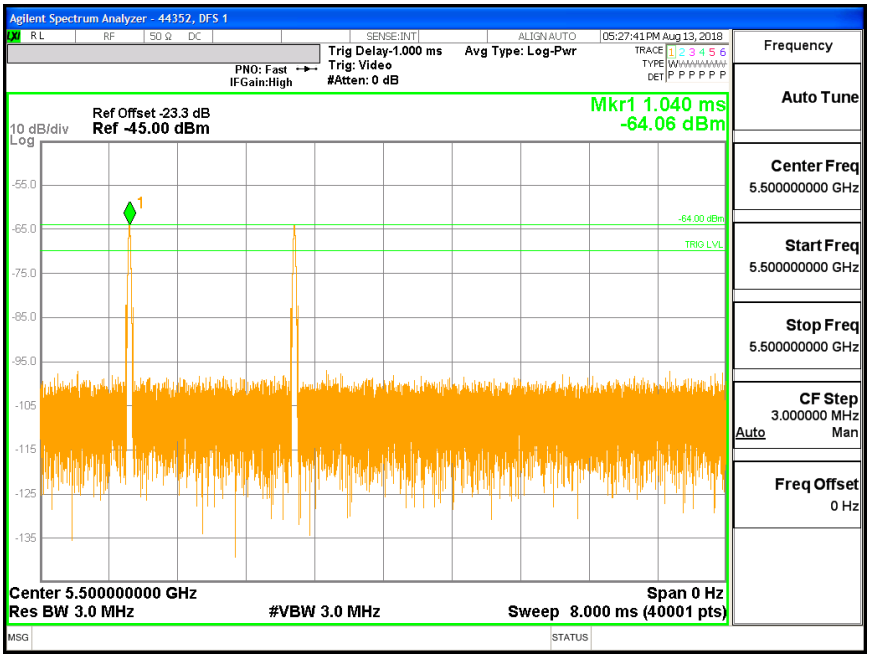
SAMPLE OF RADAR TYPE 2

SAMPLE OF RADAR TYPE 3

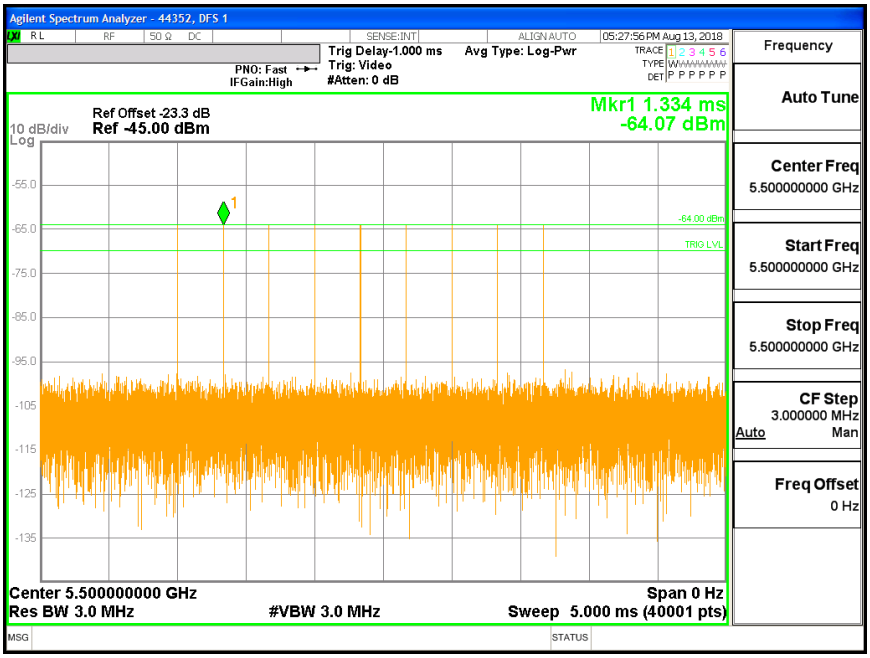
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

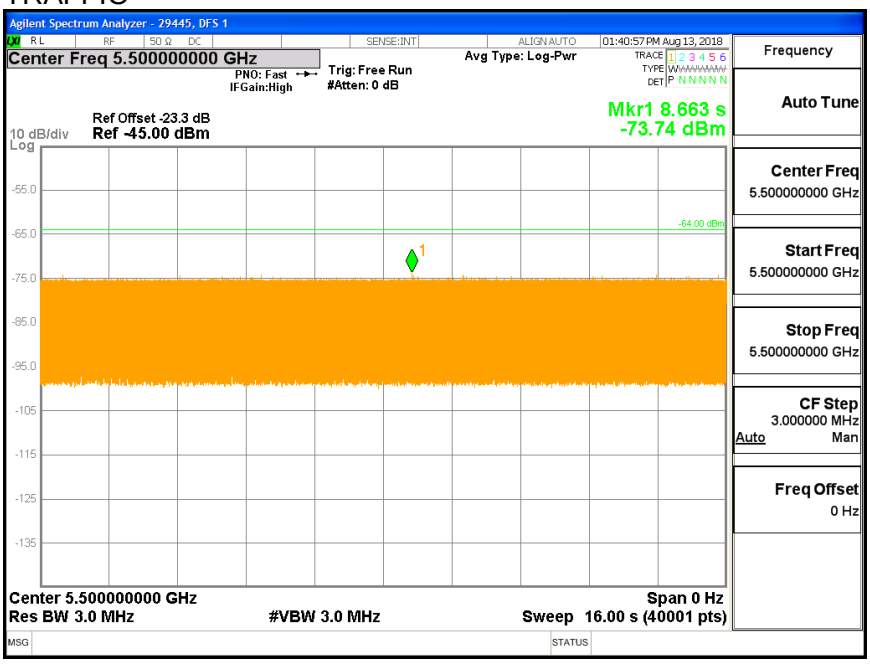


SINGLE BURST OF RADAR TYPE 6

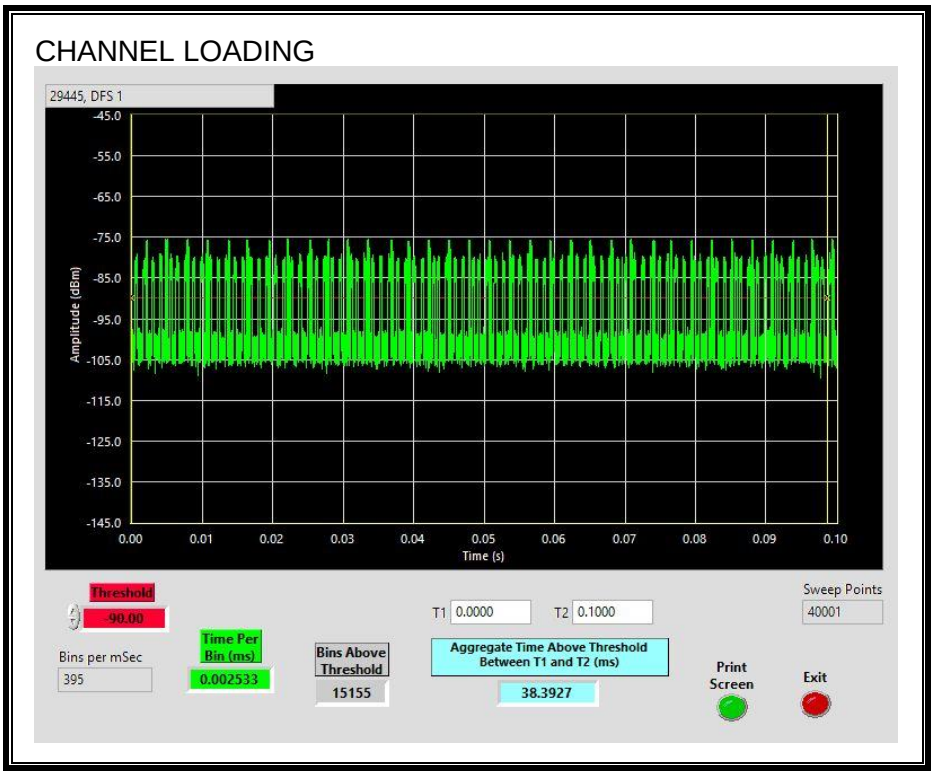


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 38.39%

6.2.3. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

A link was established on a non-DFS channel then a software command was issued to the EUT to change to the test channel. The time from the software command to the re-initialization of traffic was measured as the time required for the EUT to complete the CAC period.

PROCEDURE FOR TIMING OF RADAR BURST

A link was established on a non-DFS channel then a software command was issued to the EUT to change to the test channel. A radar signal was triggered within 0 to 6 seconds after the beginning of the CAC period. Transmissions on the channel were monitored on the spectrum analyzer and a plot was captured

The Non-Occupancy list was cleared. A link was established on a non-DFS channel then a software command was issued to the EUT. to change to the test channel. A radar signal was triggered within 54 to 60 seconds after the beginning of the CAC period. Transmissions on the channel were monitored on the spectrum analyzer and a plot was captured

QUANTITATIVE RESULTS

No Radar Triggered

Timing of Software Command (sec)	Timing of Start of Traffic (sec)	Total CAC Period (sec)
0	60.13	60.13

Radar Near Beginning of CAC

Timing of Software Command (sec)	Timing of Radar Burst (sec)	Radar Relative to Beginning of CAC (sec)
0	0.96	0.96

Radar Near End of CAC

Timing of Software Command (sec)	Timing of Radar Burst (sec)	Radar Relative to Beginning of CAC (sec)
0	58.42	58.42

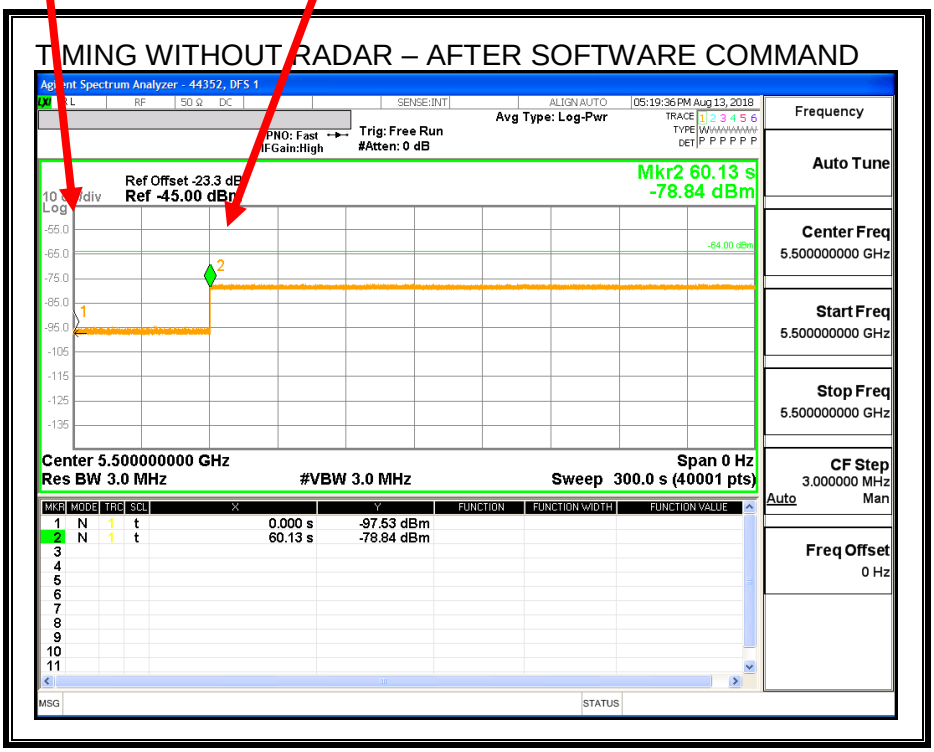
QUALITATIVE RESULTS

Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within 54 to 60 second window	EUT indicates radar detected	No transmissions on channel

TIMING WITHOUT RADAR DURING CAC

Software Command Issued
Start of CAC Period

End of CAC Period

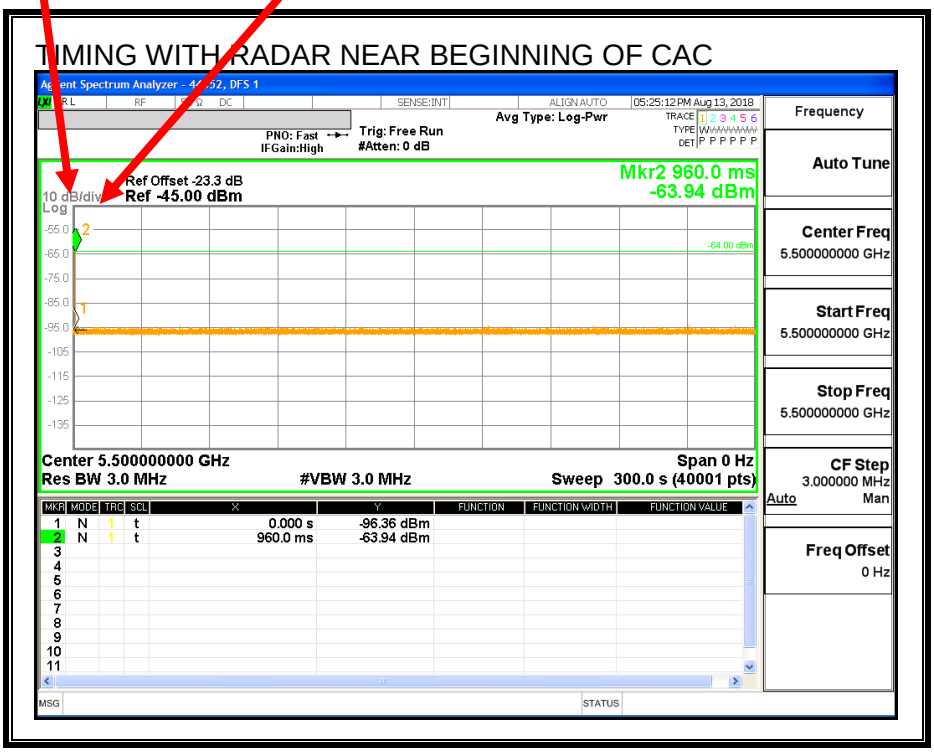


Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

TIMING WITH RADAR NEAR BEGINNING OF CAC

Software Command Issued
Start of CAC Period

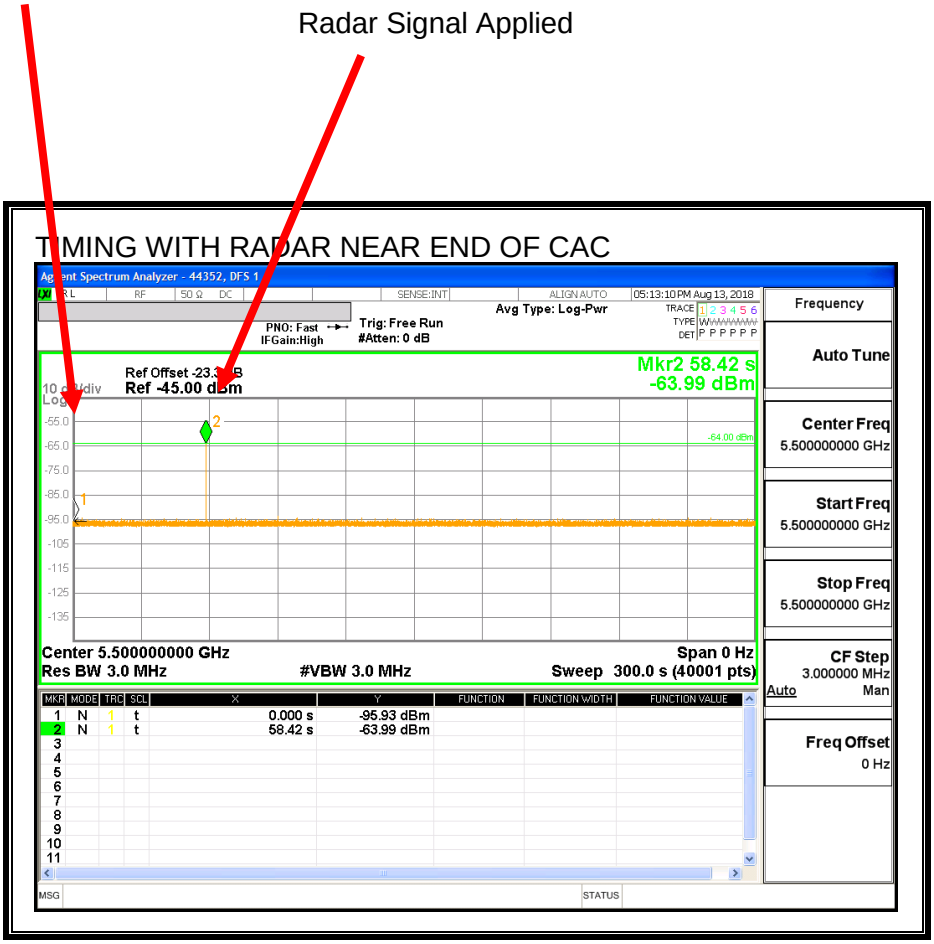
Radar Signal Applied



No EUT transmissions were observed after the radar signal.

TIMING WITH RADAR NEAR END OF CAC

Software Command Issued
Start of CAC Period



No EUT transmissions were observed after the radar signal.

6.2.4. OVERLAPPING CHANNEL TESTS

RESULTS

The channel spacing is not less than the channel bandwidth therefore the EUT does not have an overlapping channel plan.

6.2.5. MOVE AND CLOSING TIME

REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =
(Number of analyzer bins showing transmission) * (dwell time per bin)

The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

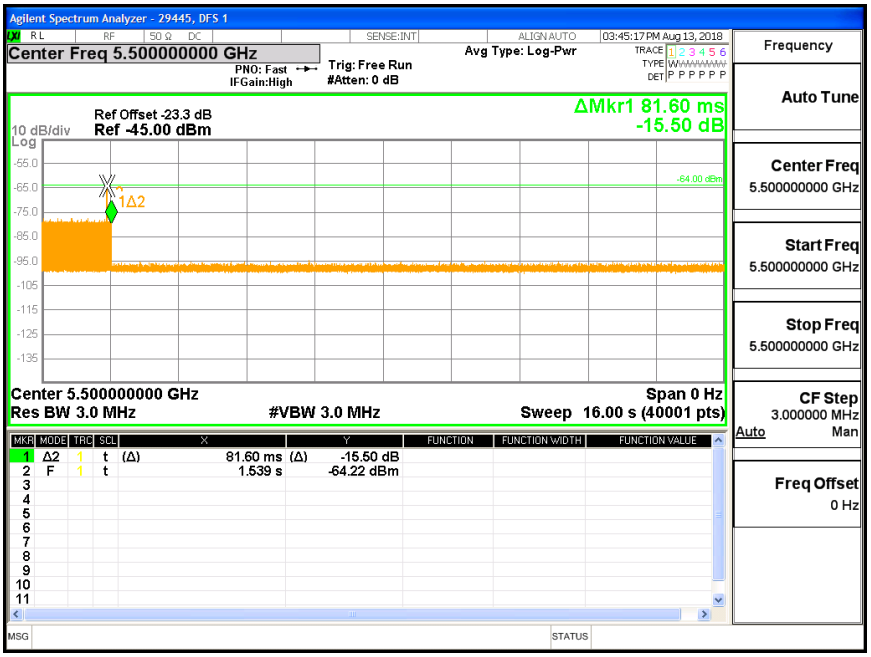
RESULTS

Channel Move Time (sec)	Limit (sec)
0.0816	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
0.0	60

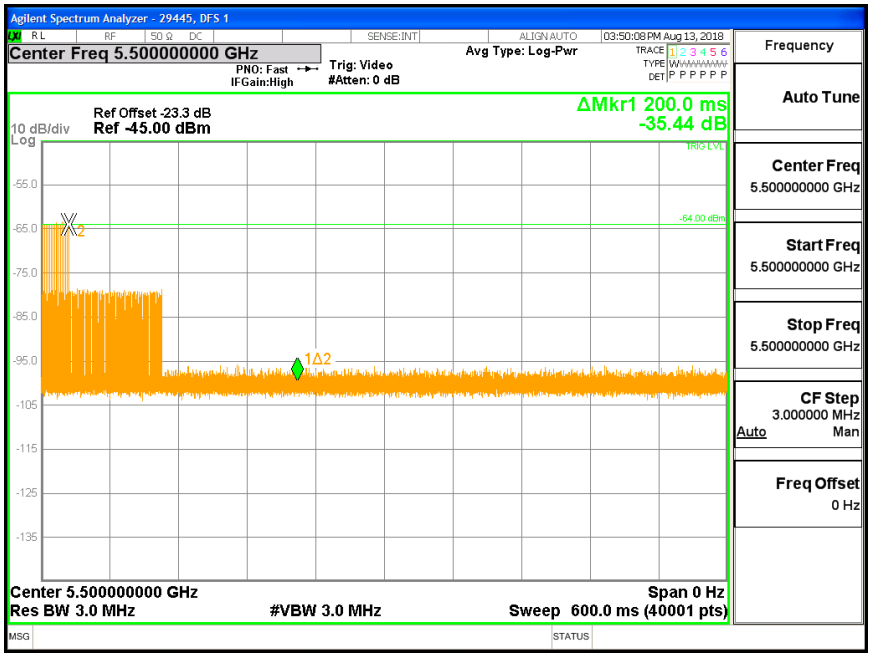
MOVE TIME

MOVE TIME



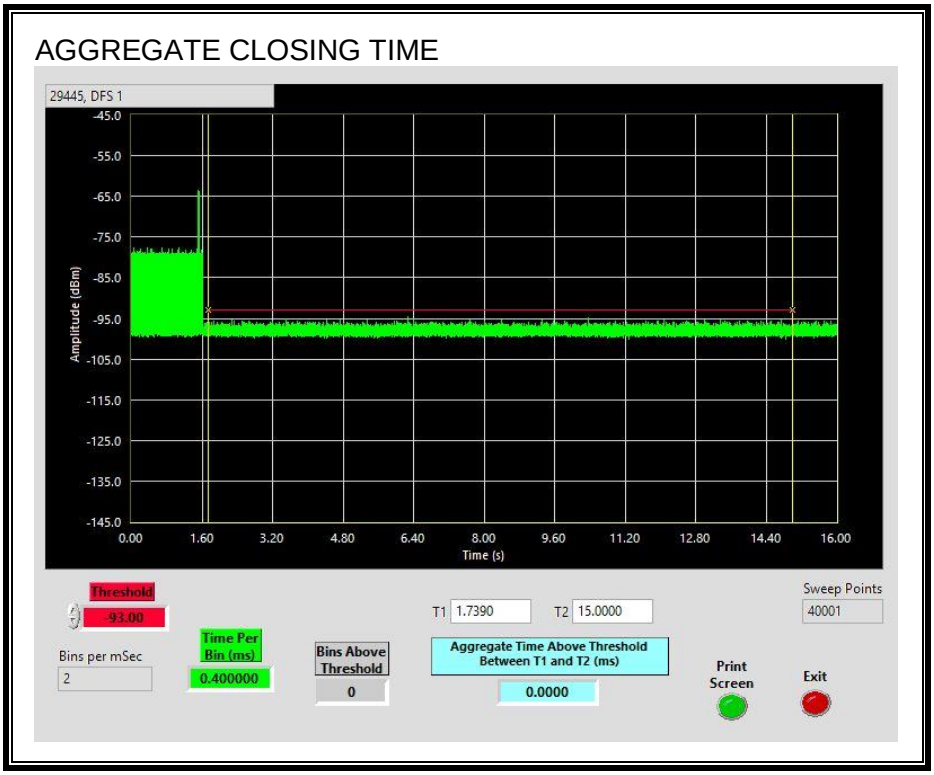
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

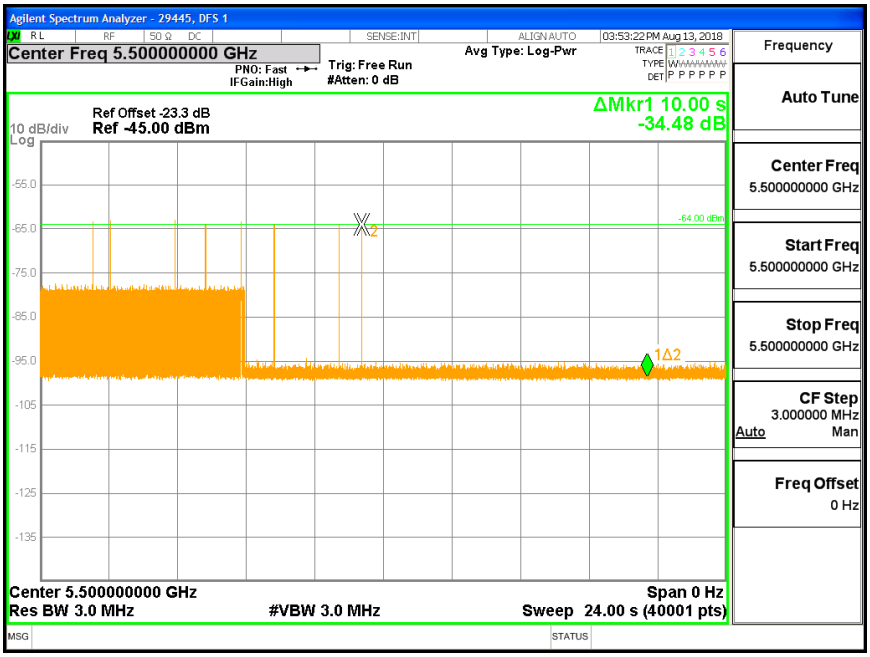
No transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR

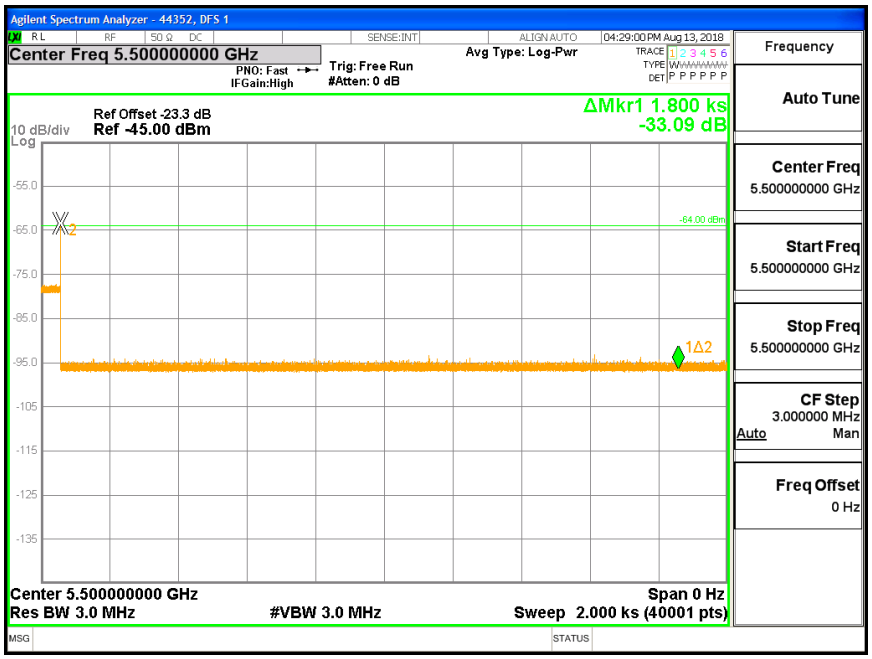


6.2.6. NON-OCCUPANCY PERIOD

RESULTS

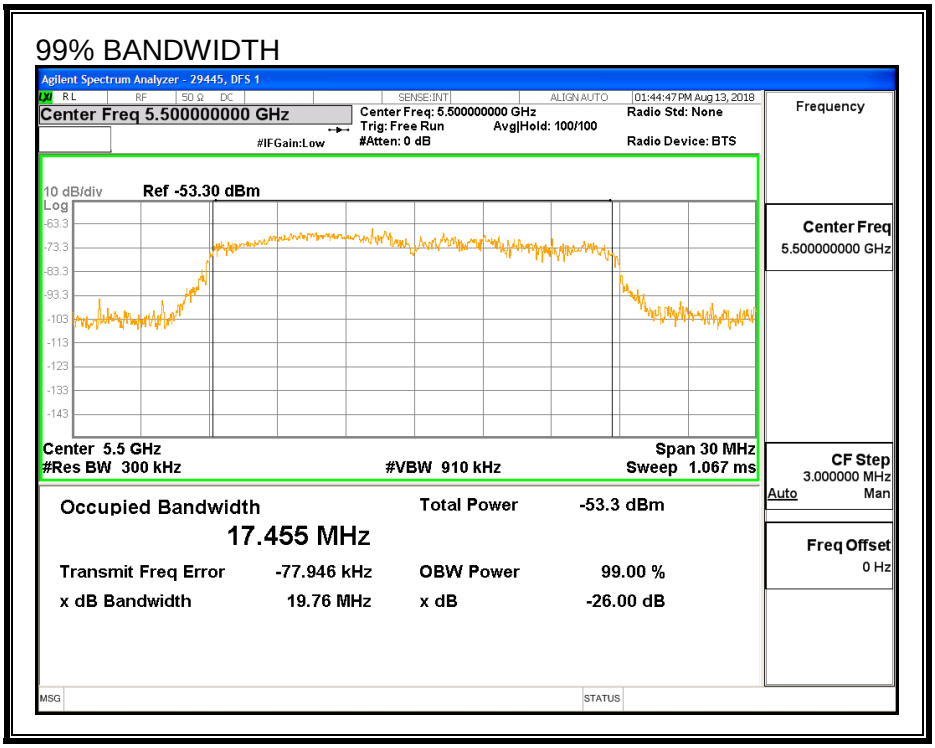
No EUT transmissions were observed on the test channel during the 30-minute observation time.

NON-OCCUPANCY PERIOD



6.2.7. DETECTION BANDWIDTH

REFERENCE PLOT OF 99% POWER BANDWIDTH



RESULTS

FL (MHz)	FH (MHz)	Detection Bandwidth (MHz)	99% Power Bandwidth (MHz)	Ratio of Detection BW to 99% Power BW (%)	Minimum Limit (%)
5490	5510	20	17.455	114.6	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results		29445	DFS 1	
FCC Type 0 Waveform: 1 us Pulse Width, 1428 us PRI, 18 Pulses per Burst				
Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	FH

6.2.8. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth FL	Detection Bandwidth FH	OBW	Test Location	Employee Number	In-Service Monitoring Version
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5510	17.45	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 2	30	93.33	60	Pass	5490	5510	17.45	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 3	30	76.67	60	Pass	5490	5510	17.45	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 4	30	83.33	60	Pass	5490	5510	17.45	DFS 1	29445	Version 3.3.4
Aggregate		88.33	80	Pass						
FCC Long Pulse Type 5	30	93.33	80	Pass	5490	5510	17.45	DFS 1	29445	Version 3.3.4
FCC Hopping Type 6	42	100.00	70	Pass	5490	5510		DFS 1	29445	Version 3.3.4

TYPE 1 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 1						
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Test (A/B)	Frequency (MHz)	Successful Detection (Yes/No)
1001	1	3066	18	A	5491	Yes
1002	1	578	92	A	5498	Yes
1003	1	838	63	A	5494	Yes
1004	1	698	76	A	5508	Yes
1005	1	558	95	A	5509	Yes
1006	1	678	78	A	5499	Yes
1007	1	778	68	A	5509	Yes
1008	1	938	57	A	5501	Yes
1009	1	618	86	A	5495	Yes
1010	1	718	74	A	5494	Yes
1011	1	918	58	A	5505	Yes
1012	1	898	59	A	5503	Yes
1013	1	738	72	A	5499	Yes
1014	1	598	89	A	5503	Yes
1015	1	858	62	A	5503	Yes
1016	1	600	88	B	5500	Yes
1017	1	2233	24	B	5499	Yes
1018	1	2995	18	B	5507	Yes
1019	1	2210	24	B	5502	Yes
1020	1	1907	28	B	5493	Yes
1021	1	2604	21	B	5494	Yes
1022	1	1077	50	B	5508	Yes
1023	1	709	75	B	5493	Yes
1024	1	665	80	B	5492	Yes
1025	1	1621	33	B	5495	Yes
1026	1	3060	18	B	5499	Yes
1027	1	2951	18	B	5494	Yes
1028	1	1971	27	B	5499	Yes
1029	1	1992	27	B	5495	Yes
1030	1	2495	22	B	5491	Yes

TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
2001	4.5	158	28	5501	No
2002	1.1	171	27	5507	Yes
2003	4.6	216	24	5496	Yes
2004	1.5	152	23	5493	Yes
2005	1.1	202	24	5509	Yes
2006	4.4	185	24	5498	Yes
2007	4.2	157	25	5506	Yes
2008	3.7	226	29	5493	Yes
2009	1.8	207	23	5510	Yes
2010	3.6	199	24	5504	Yes
2011	1.9	222	26	5493	Yes
2012	4	180	27	5504	Yes
2013	2.5	170	26	5501	Yes
2014	4.7	213	28	5509	Yes
2015	3.7	206	27	5493	Yes
2016	2.1	172	26	5502	Yes
2017	3.2	213	26	5490	Yes
2018	3.9	227	25	5505	Yes
2019	3.3	191	28	5509	Yes
2020	4.3	208	28	5493	Yes
2021	3.9	176	29	5510	Yes
2022	3.1	159	28	5508	Yes
2023	1	175	23	5497	Yes
2024	4.6	200	26	5510	No
2025	4.6	182	28	5499	Yes
2026	2.3	173	29	5495	Yes
2027	4.7	197	24	5501	Yes
2028	2.7	154	25	5501	Yes
2029	1.2	225	24	5507	Yes
2030	1.5	187	26	5491	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	7.4	346	17	5500	Yes
3002	9.9	492	16	5509	Yes
3003	9	368	16	5494	Yes
3004	7.6	409	18	5503	Yes
3005	7	297	17	5509	Yes
3006	8	351	18	5508	Yes
3007	9.7	252	17	5507	No
3008	6.8	452	16	5507	Yes
3009	8.8	499	18	5494	Yes
3010	8.3	460	16	5491	No
3011	6.3	269	17	5490	Yes
3012	6	495	17	5502	Yes
3013	8.4	450	18	5508	Yes
3014	6.4	437	16	5505	No
3015	7	404	18	5503	No
3016	9.3	286	16	5491	Yes
3017	6.1	267	16	5503	Yes
3018	8.6	295	18	5492	No
3019	7.7	288	18	5506	Yes
3020	6.3	329	18	5500	Yes
3021	9.8	469	16	5506	Yes
3022	8.9	271	17	5495	Yes
3023	8.4	306	16	5507	No
3024	9.6	372	18	5501	No
3025	7.5	419	17	5510	Yes
3026	7	381	18	5502	Yes
3027	9.1	441	18	5509	Yes
3028	8.8	415	16	5504	Yes
3029	7.1	370	17	5492	Yes
3030	9.2	357	18	5500	Yes

TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
4001	19.6	325	14	5502	Yes
4002	15.6	458	16	5507	Yes
4003	17.5	439	15	5501	Yes
4004	13.9	467	14	5496	No
4005	12.1	460	12	5492	Yes
4006	13.8	250	16	5495	Yes
4007	16.6	389	16	5503	Yes
4008	14.5	443	13	5501	No
4009	13.6	477	16	5491	No
4010	16.3	293	14	5499	Yes
4011	11.5	340	12	5492	Yes
4012	19.4	302	12	5497	Yes
4013	15.2	362	13	5508	Yes
4014	14.5	336	16	5509	Yes
4015	19.8	291	15	5506	Yes
4016	15.2	278	14	5499	Yes
4017	16.7	497	13	5491	Yes
4018	12.7	379	14	5496	Yes
4019	14.6	493	16	5510	No
4020	11	387	13	5505	Yes
4021	18.3	263	15	5496	Yes
4022	20	422	14	5509	Yes
4023	18.6	310	12	5508	Yes
4024	11.7	364	12	5508	Yes
4025	19.8	398	14	5504	Yes
4026	18.2	464	12	5492	No
4027	17.7	261	13	5494	Yes
4028	16.6	473	16	5509	Yes
4029	12.3	282	12	5504	Yes
4030	11.6	256	15	5501	Yes

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5500	Yes
2	5500	Yes
3	5500	Yes
4	5500	Yes
5	5500	Yes
6	5500	Yes
7	5500	Yes
8	5500	Yes
9	5500	No
10	5500	Yes
11	5499	Yes
12	5494	Yes
13	5498	Yes
14	5498	Yes
15	5499	Yes
16	5497	Yes
17	5494	Yes
18	5500	Yes
19	5495	Yes
20	5496	Yes
21	5505	Yes
22	5502	Yes
23	5504	Yes
24	5503	Yes
25	5503	Yes
26	5502	Yes
27	5505	Yes
28	5502	No
29	5505	Yes
30	5502	Yes

Note: The Type 5 randomized parameters tested are shown in a separate document.

TYPE 6 DETECTION PROBABILITY

Data Sheet for FCC Hopping Radar Type 6				
1 us Pulse Width, 333 us PRI, 9 Pulses per Burst, 1 Burst per Hop				
NTIA August 2005 Hopping Sequence				
Trial	Starting Index Within Sequence	Signal Generator Frequency (MHz)	Hops within Detection BW	Successful Detection (Yes/No)
1	215	5490	7	Yes
2	690	5491	5	Yes
3	1165	5492	3	Yes
4	1640	5493	1	Yes
5	2115	5494	2	Yes
6	2590	5495	5	Yes
7	3065	5496	5	Yes
8	3540	5497	5	Yes
9	4015	5498	5	Yes
10	4490	5499	6	Yes
11	4965	5500	5	Yes
12	5440	5501	7	Yes
13	5915	5502	5	Yes
14	6390	5503	4	Yes
15	6865	5504	2	Yes
16	7340	5505	5	Yes
17	7815	5506	5	Yes
18	8290	5507	4	Yes
19	8765	5508	3	Yes
20	9240	5509	2	Yes
21	9715	5510	2	Yes
22	10190	5490	3	Yes
23	10665	5491	4	Yes
24	11140	5492	2	Yes
25	11615	5493	4	Yes
26	12090	5494	1	Yes
27	12565	5495	3	Yes
28	13040	5496	5	Yes
29	13515	5497	2	Yes
30	13990	5498	6	Yes
31	14465	5499	4	Yes
32	14940	5500	3	Yes
33	15415	5501	6	Yes
34	15890	5502	5	Yes
35	16365	5503	3	Yes
36	16840	5504	4	Yes
37	17315	5505	3	Yes
38	17790	5506	4	Yes
39	18265	5507	4	Yes
40	18740	5508	3	Yes
41	19215	5509	4	Yes
42	19690	5510	5	Yes

6.3. BRIDGE MODE RESULTS

Per KDB 905462, Section 5.1 (footnote 1):

Networks Access Points with Bridge and/or MESH modes of operation are permitted to operate in the DFS bands but must employ a DFS function. The functionality of the Bridge mode as specified in §15.403(a) must be validated in the DFS test report. Devices operating as relays must also employ DFS function. The method used to validate the functionality must be documented and validation data must be documented. Bridge mode can be validated by performing a test statistical performance check (Section 7.8.4) on any one of the radar types. This is an abbreviated test to verify DFS functionality. MESH mode operational methodology must be submitted in the application for certification for evaluation by the FCC.

This device does not support Bridge Mode therefore this test was not performed.

6.4. SLAVE CONFIGURATION RESULTS FOR 20 MHz BANDWIDTH

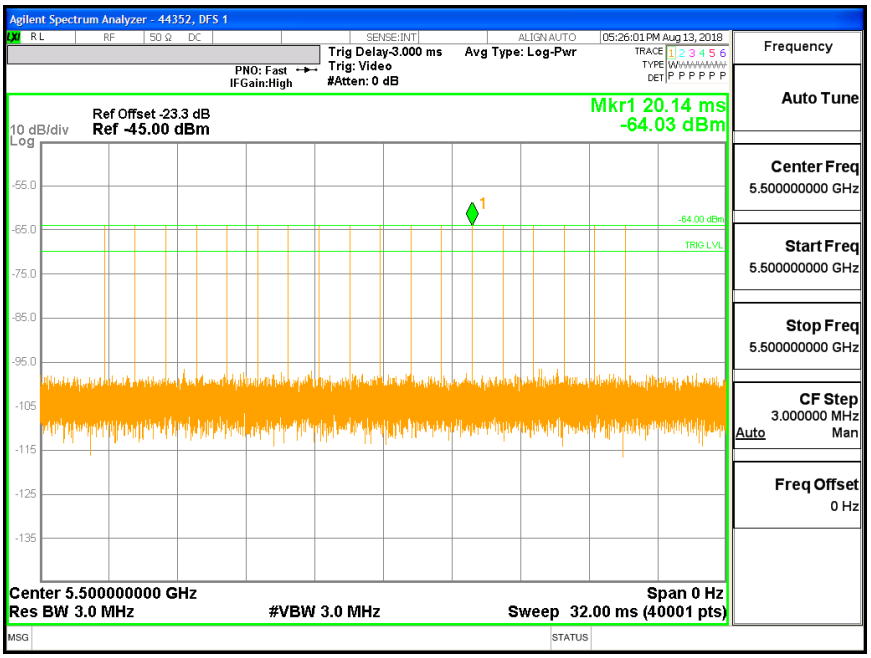
6.4.1. TEST CHANNEL

All tests were performed at a channel center frequency of 5500 MHz.

6.4.2. RADAR WAVEFORM AND TRAFFIC

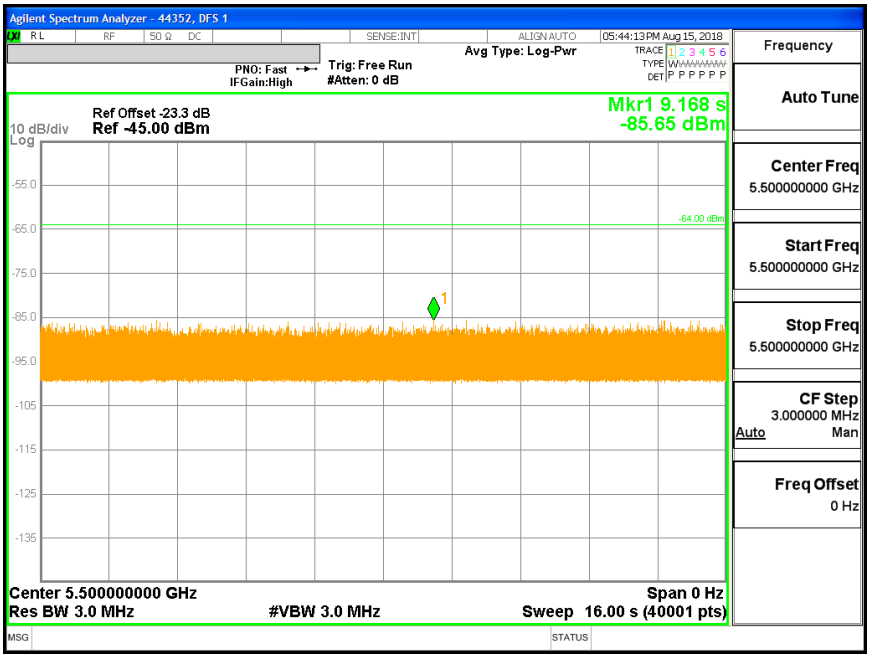
RADAR WAVEFORM

SHORT PULSE RADAR TYPE 0 AT MASTER

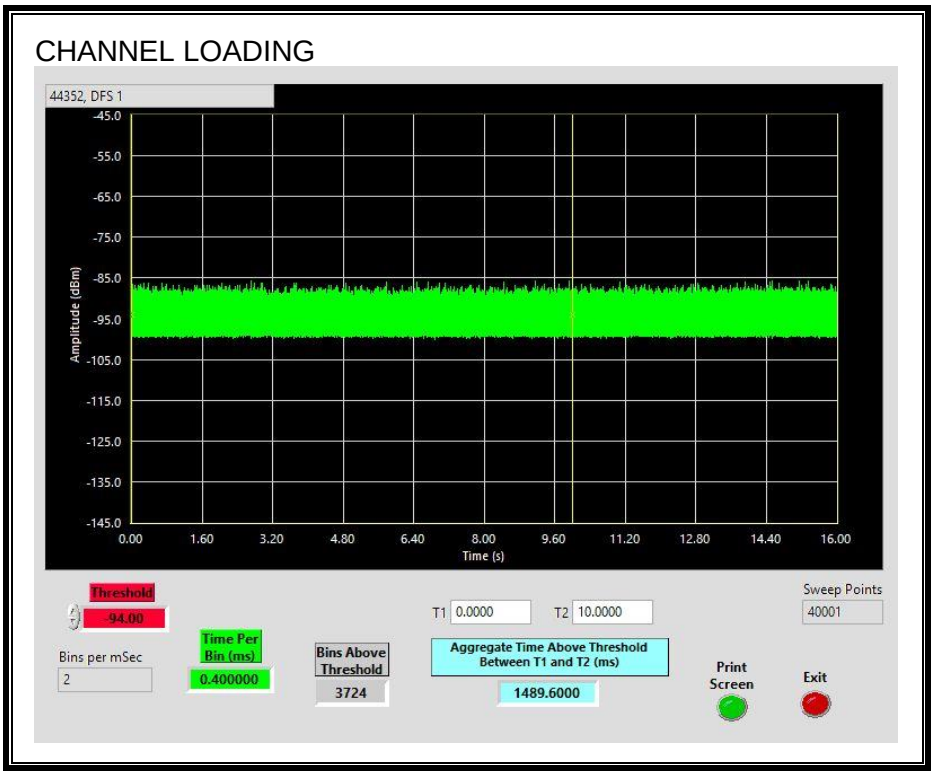


TRAFFIC

SLAVE TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 14.896%.

6.4.3. OVERLAPPING CHANNEL TESTS

RESULTS

These tests are not applicable.

6.4.4. MOVE AND CLOSING TIME

REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =
(Number of analyzer bins showing transmission) * (dwell time per bin)

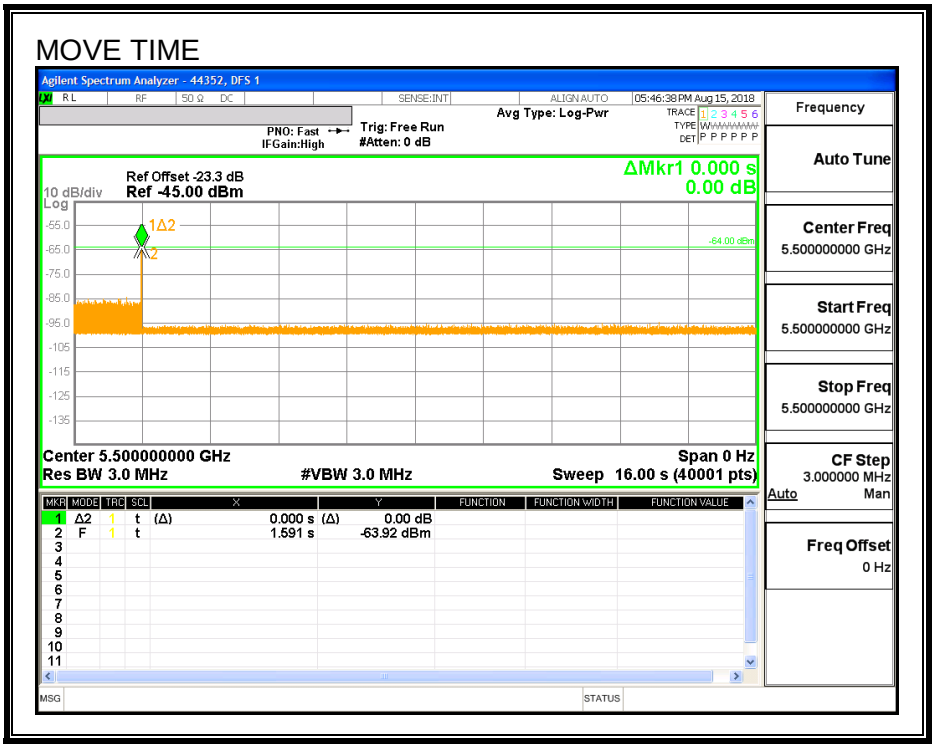
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

RESULTS

Channel Move Time (sec)	Limit (sec)
0.000	10

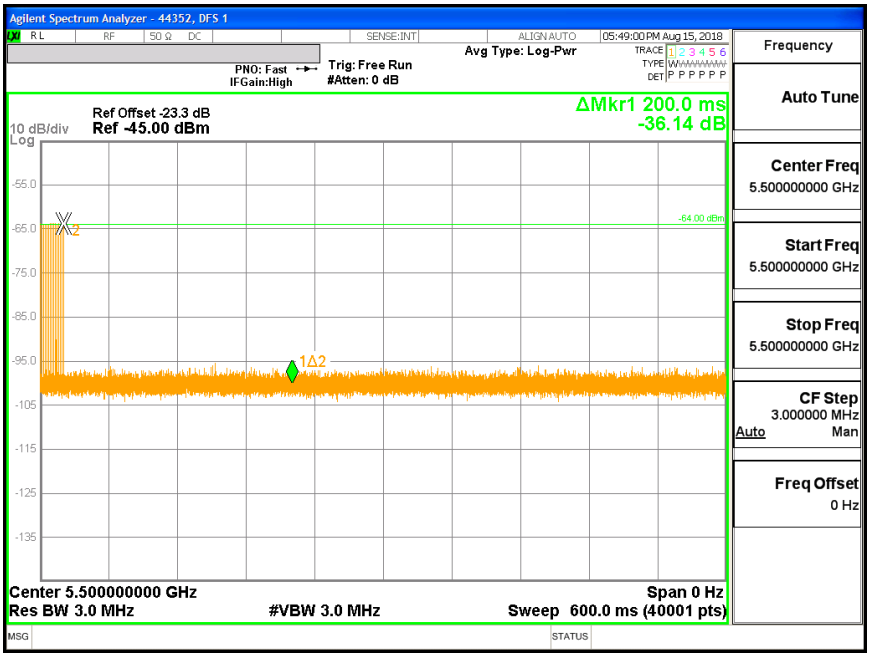
Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
0.0	60

MOVE TIME



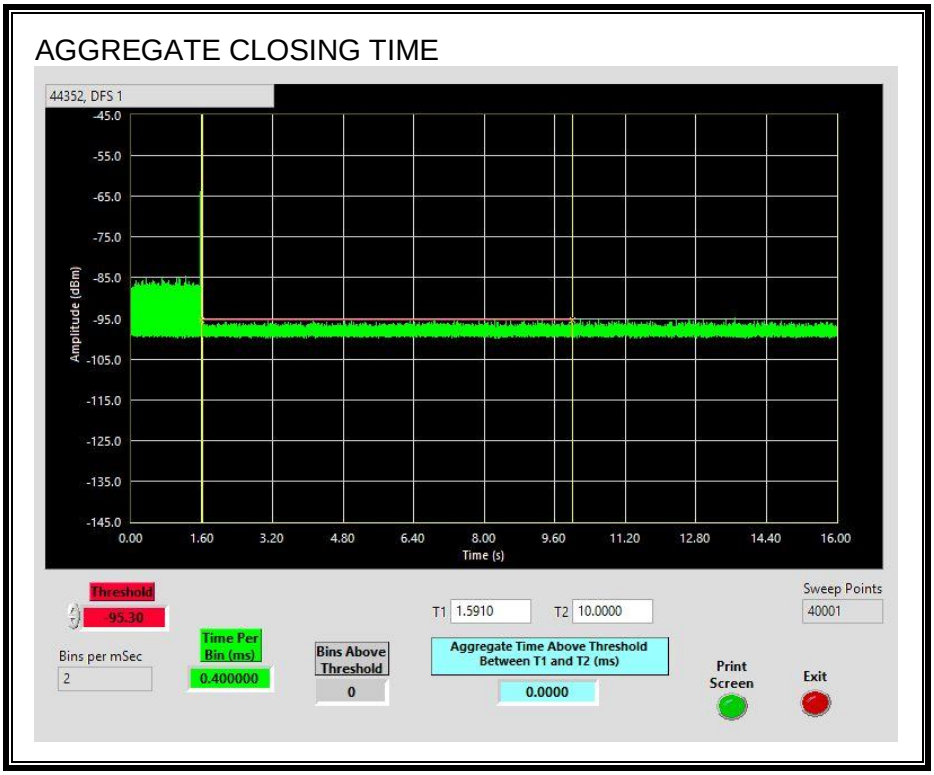
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

No transmissions are observed during the aggregate monitoring period.



6.4.5. 30-MINUTE NON-OCCUPANCY PERIOD

RESULTS

No EUT transmissions were observed on the test channel during the 30-minute observation time.

30-MINUTE NON-OCCUPANCY PERIOD