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

CERTIFICATION TEST REPORT

FOR

LTE & WI-FI ROUTER

MODEL NUMBER: MX68CW-HW-NA

FCC ID: UDX-60076027
IC: 6961A-60076027

REPORT NUMBER: 12391259-E14V1

ISSUE DATE: NOVEMBER 27, 2018

Prepared for
CISCO SYSTEMS, INC.
170 WEST TASMAN DRIVE
SAN JOSE, CA 95134, U.S.A.

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	11/27/18	Initial Issue	Conan Cheung

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CISCO SYSTEMS, INC.
170 WEST TASMAN DRIVE
SAN JOSE, CA 95134, U.S.A.

EUT DESCRIPTION: LTE & WI-FI ROUTER

MODEL: MX68CW-HW-NA

SERIAL NUMBER: Q2MY-DQ3C-S5GF

DATE TESTED: OCTOBER 2 – OCTOBER 26, 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. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

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 the U.S. government.

Approved & Released For
UL Verification Services Inc. By:

Conan Cheung
UL REVIWER
UL Verification Services Inc.

Prepared By:

Henry Lau
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 Sporton Labs report number FR831635D.

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

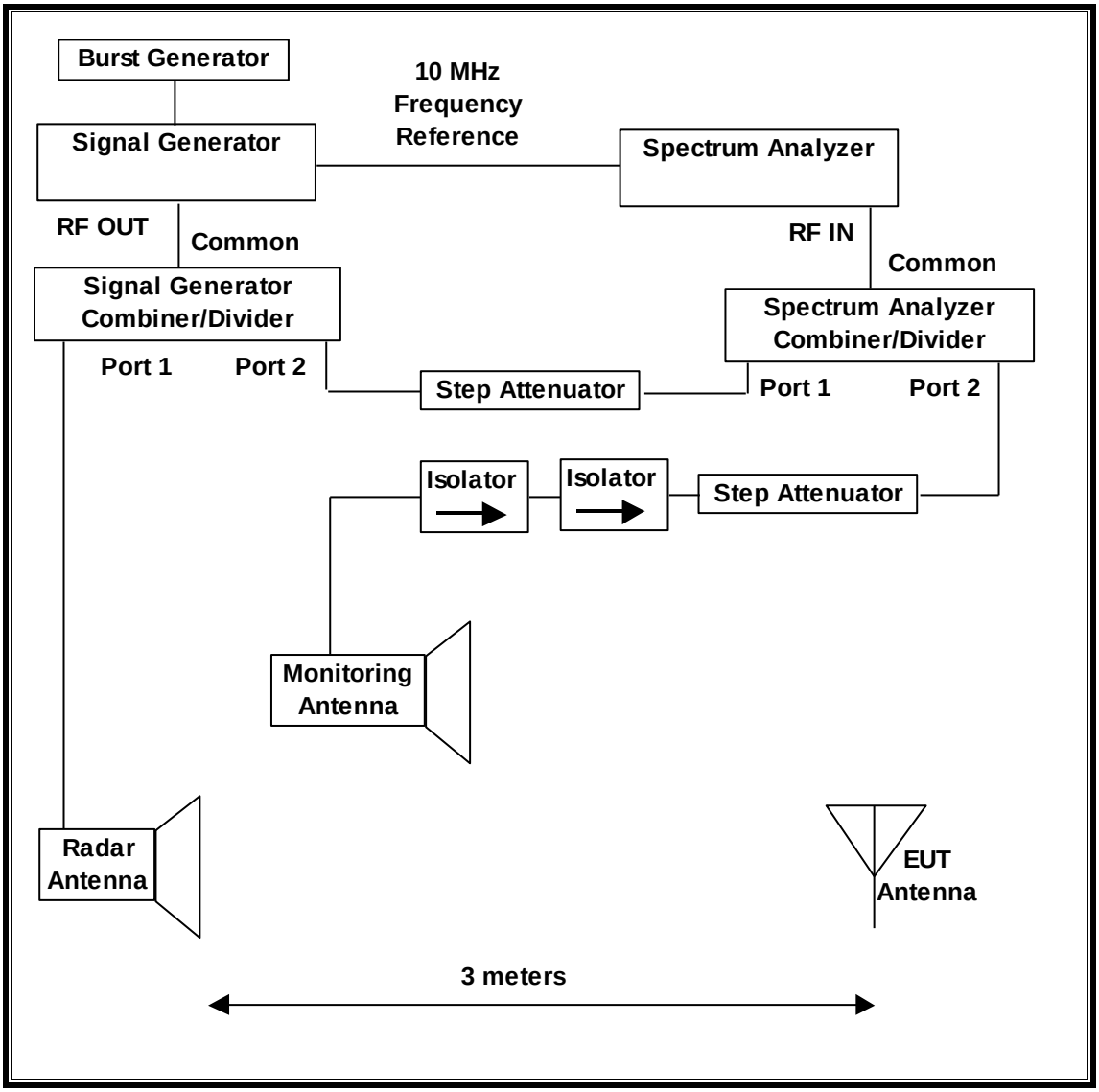
Radar Waveform Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

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. Traffic that meets or exceed the minimum loading requirement is streamed from the Master device to the Slave Device. 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:

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

6.1.1. TEST AND MEASUREMENT SOFTWARE

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

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

6.1.2. TEST ROOM ENVIRONMENT

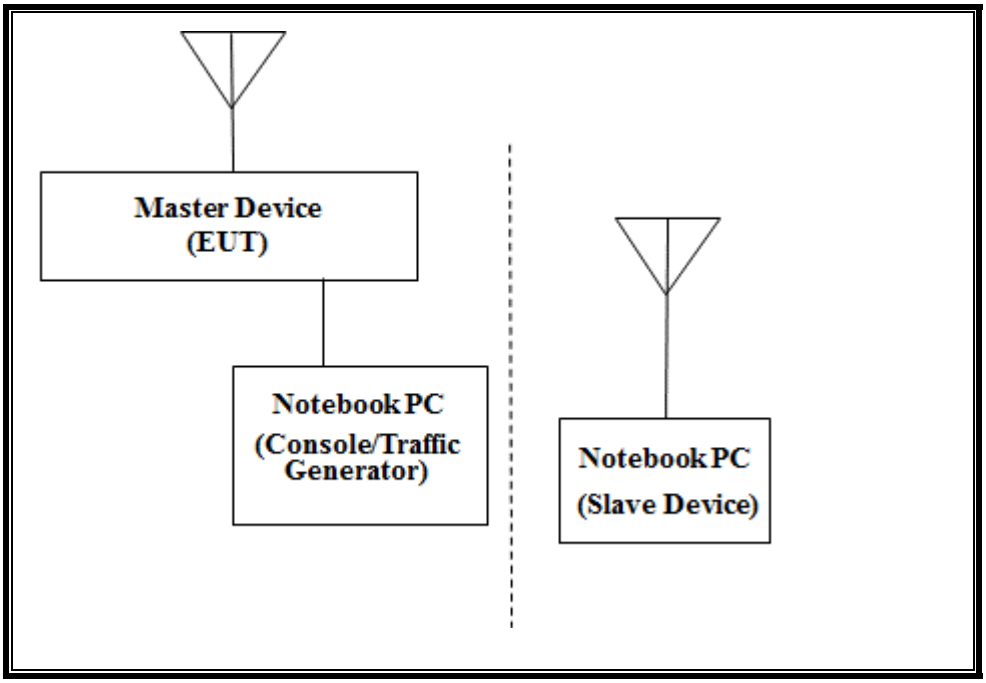
The test room temperature and humidity shall be maintained within normal temperature of 15~35 °C and normal humidity 20~75% (relative humidity).

ENVIRONMENT CONDITION

Parameter	Value
Temperature	24.3 °C
Humidity	47 %

6.1.3. SETUP OF EUT

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**
Notebook PC (Controller & Traffic Generator)	Apple	A1502	C02NT1VTG3QR	DoC
AC Adapter (Controller PC)	Apple	A1435	D39433601B4FTC0A1	DoC
Notebook PC (Slave Device)	Apple	A1465	C02KTGMPF5N7	QDS-BRCM1072
AC Adapter (Slave PC)	Apple	A1435	C04341216J2F288BT	DoC
AC Adapter (EUT)	Universal Microelectronics Co.	MA-PWR-100WAC	CS1400422 53G	DoC

6.1.4. 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 is a Master Device.

The highest power level within these bands is 27.54 dBm EIRP in the 5250-5350 MHz band and 27.52 dBm EIRP in the 5470-5725 MHz band.

The highest gain antenna assembly utilized with the EUT has a gain of 5.84 dBi. The lowest gain antenna assembly utilized with the EUT has a gain of 4.32

Two 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 two transmitter/receiver chains, each connected to an antenna to perform radiated tests.

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

WLAN traffic that meets or exceeds the minimum required loading was generated by transferring a data stream from the Master Device to the Slave Device using iPerf version 2.0.5 software package.

TPC is required since the maximum EIRP is greater than 500 mW (27 dBm).

The EUT utilizes the 802.11ac architecture. Three nominal channel bandwidths are implemented: 20 MHz, 40 MHz and 80 MHz.

The software installed in the EUT is firmware_wired_arm64_version T-201810180039-Ge0a1b713-L460d756cM-dhruvin-outcome.

UNIFORM CHANNEL SPREADING

This function is not required per KDB 905462.

OVERVIEW OF MASTER DEVICE WITH RESPECT TO §15.407 (h) REQUIREMENTS

The Master Device is a Cisco Meraki Access Point, FCC ID: UDX-60076027. The minimum antenna gain for the Master Device is 4.32 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. RESULTS FOR 20 MHz BANDWIDTH

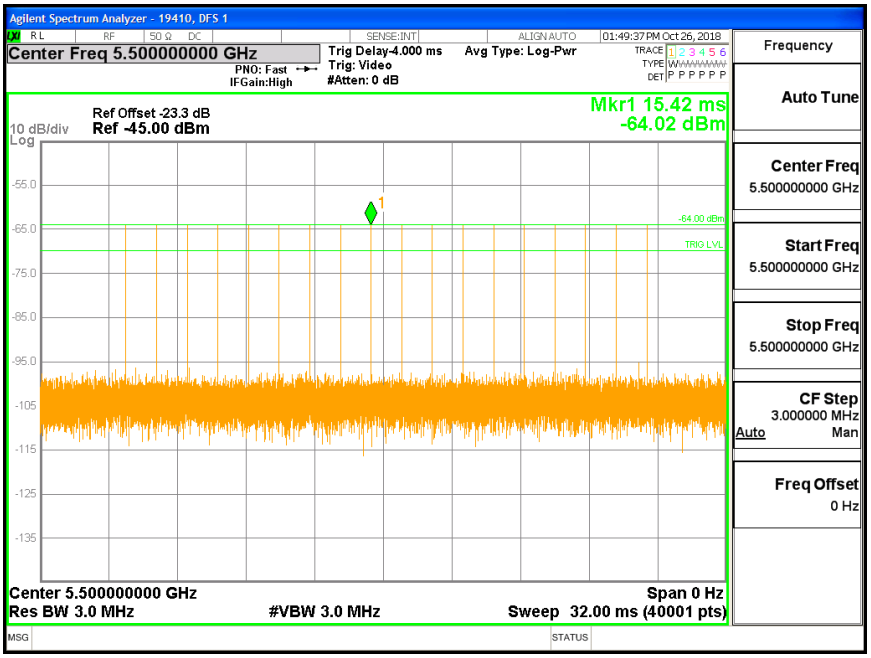
6.2.1. TEST CHANNEL

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

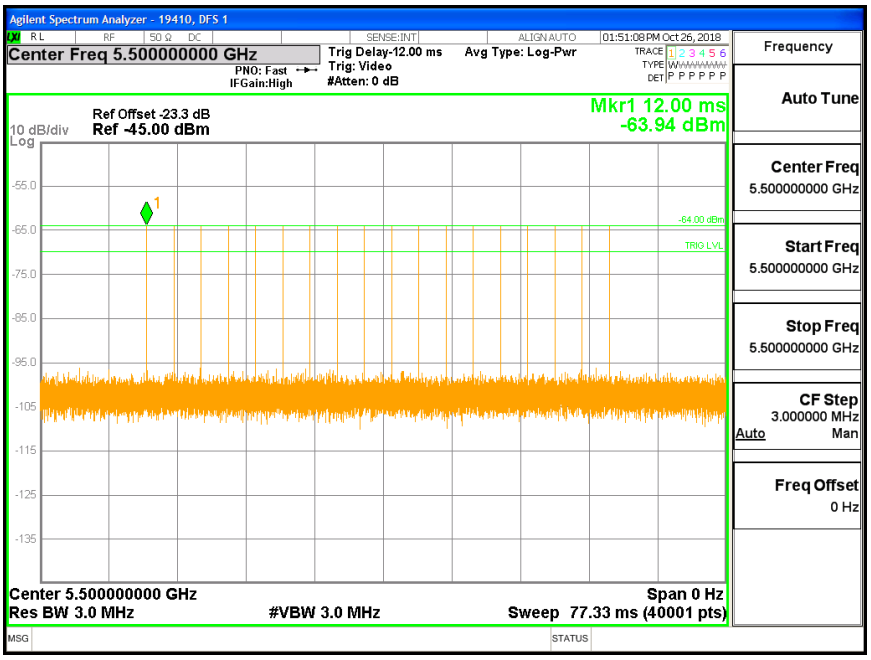
6.2.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

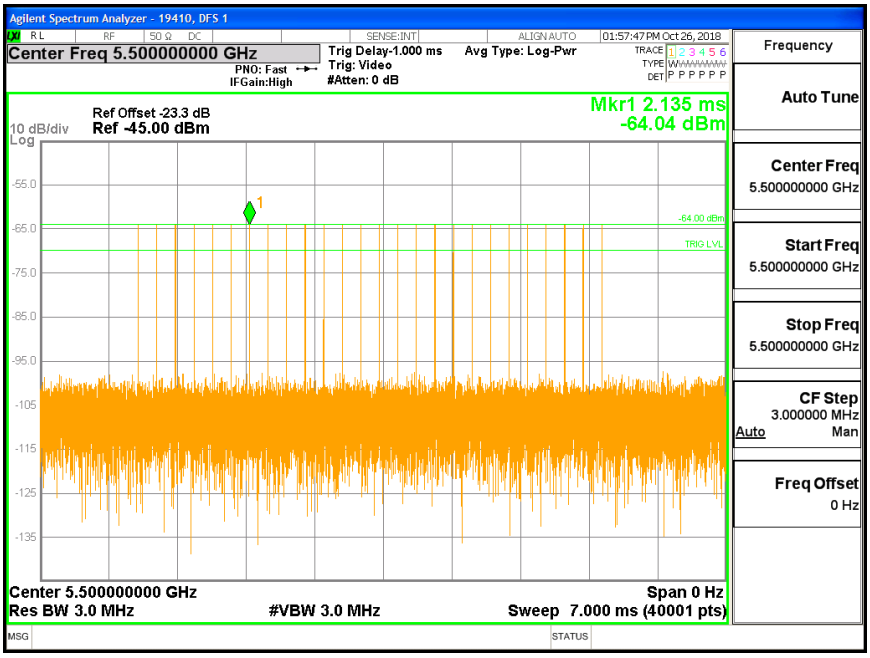
SHORT PULSE RADAR TYPE 0



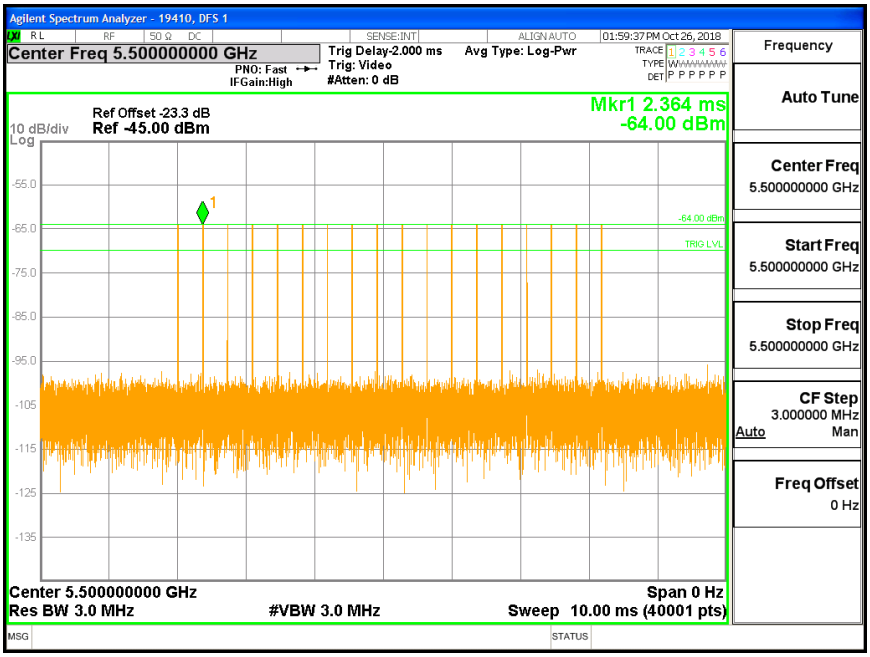
SAMPLE OF RADAR TYPE 1



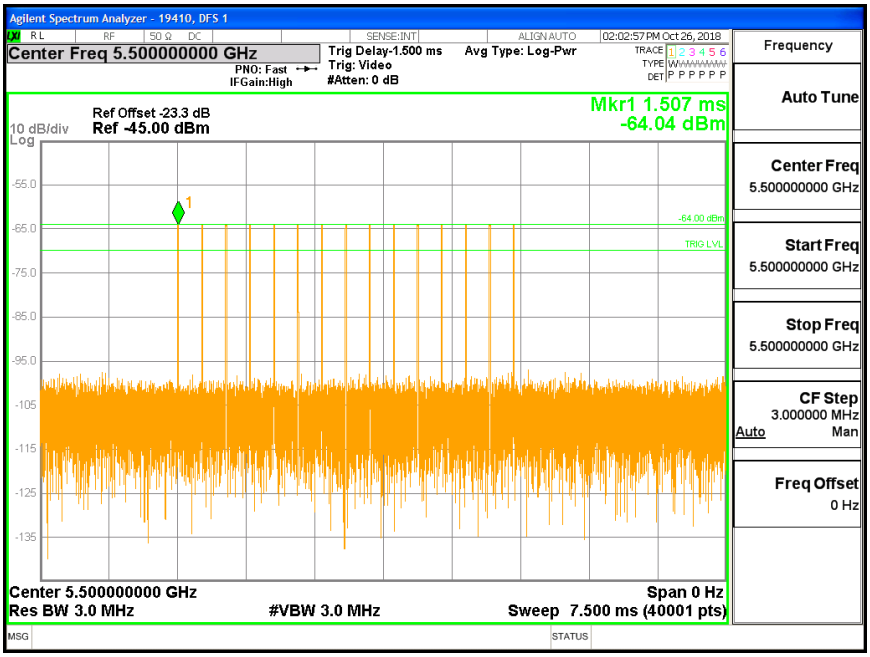
SAMPLE OF RADAR TYPE 2



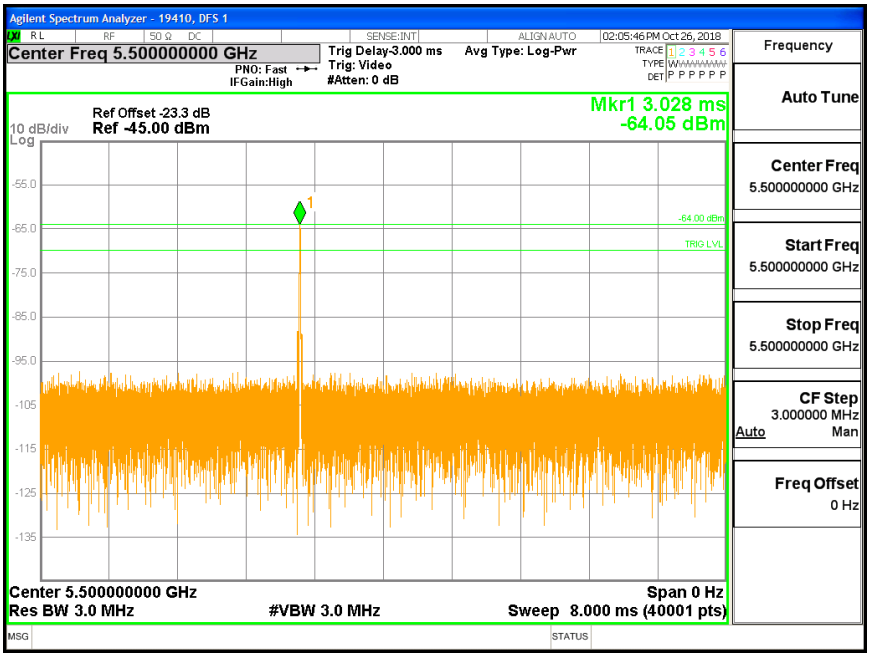
SAMPLE OF RADAR TYPE 3



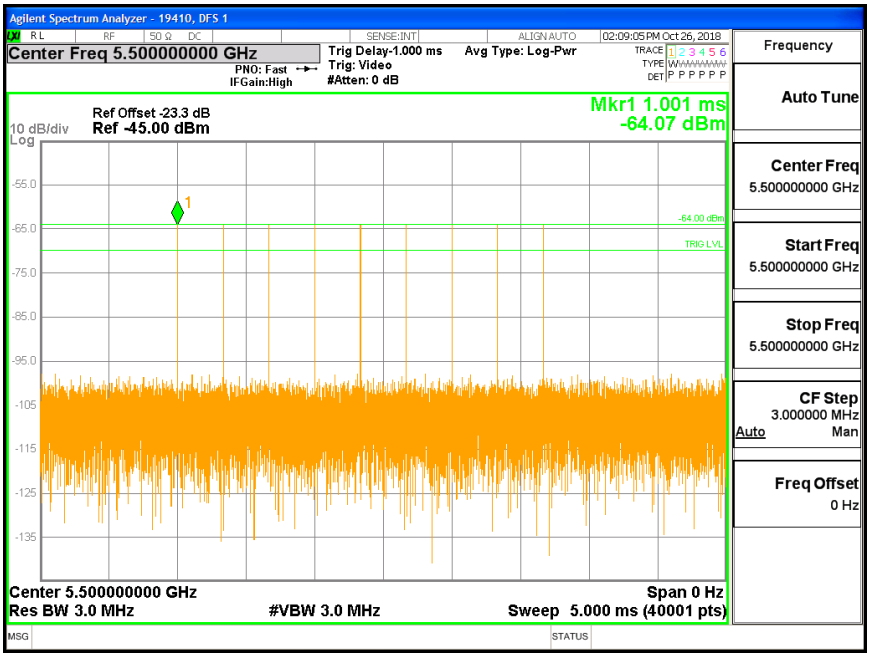
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

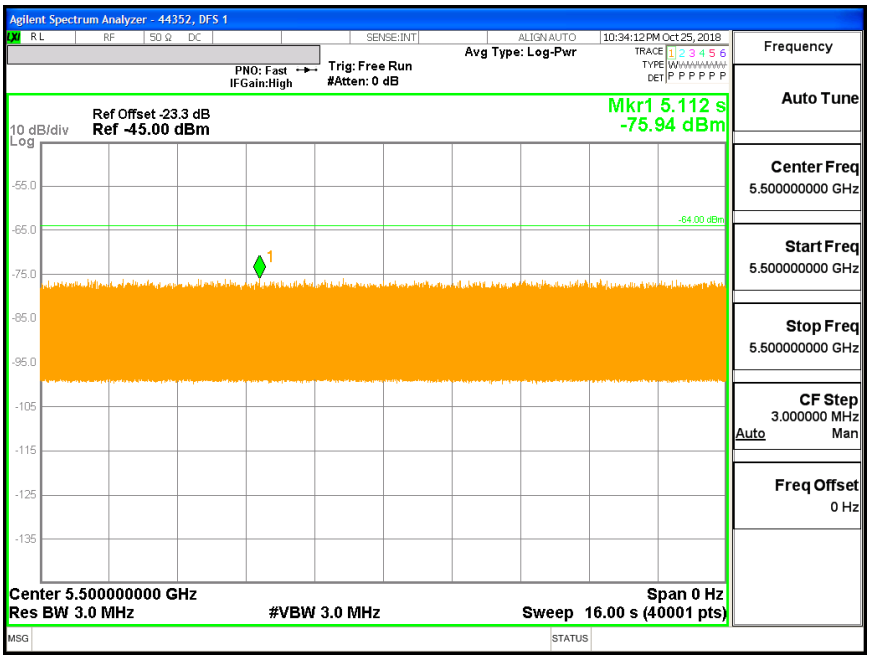


SINGLE BURST OF RADAR TYPE 6

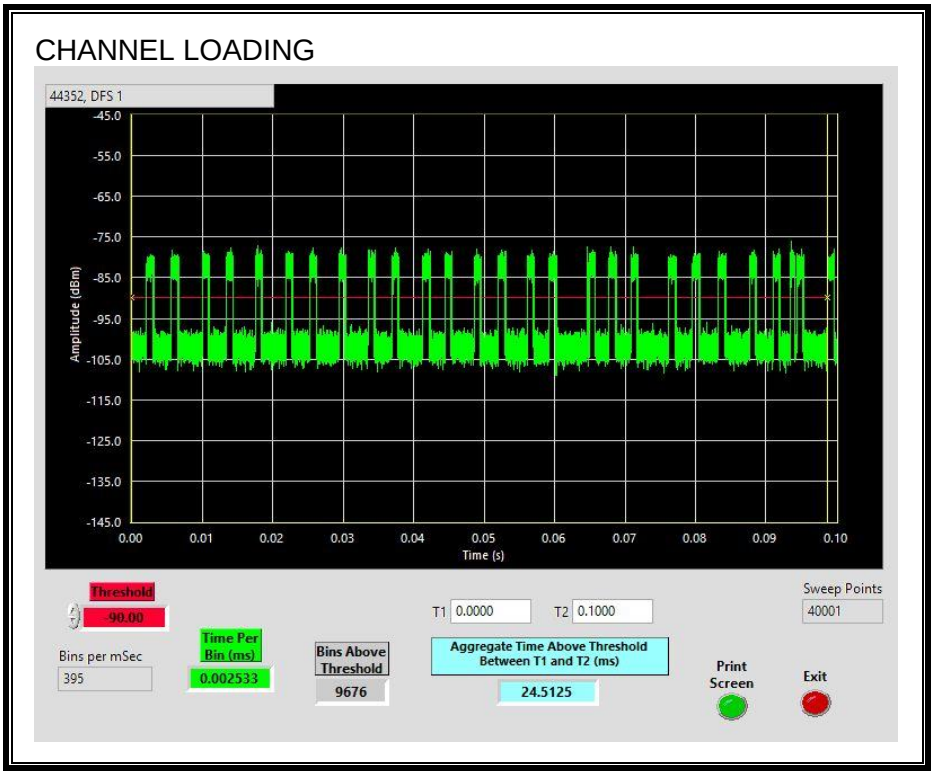


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 24.5125%.

6.2.3. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

A link was established on channel then the EUT was rebooted. The time from the cessation of traffic to the re-initialization of traffic was measured as the time required for the EUT to complete the total power-up cycle. The time to complete the initial power-up period is 60 seconds less than this total power-up time.

PROCEDURE FOR TIMING OF RADAR BURST

With a link established on channel, the EUT was rebooted. A radar signal was triggered within 0 to 6 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

The Non-Occupancy list was cleared. With a link established on channel, the EUT was rebooted. A radar signal was triggered within 54 to 60 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.58	178.4	147.8	87.8

Radar Near Beginning of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.61	121.4	90.8	3.0

Radar Near End of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.38	175.9	145.5	57.7

QUALITATIVE RESULTS

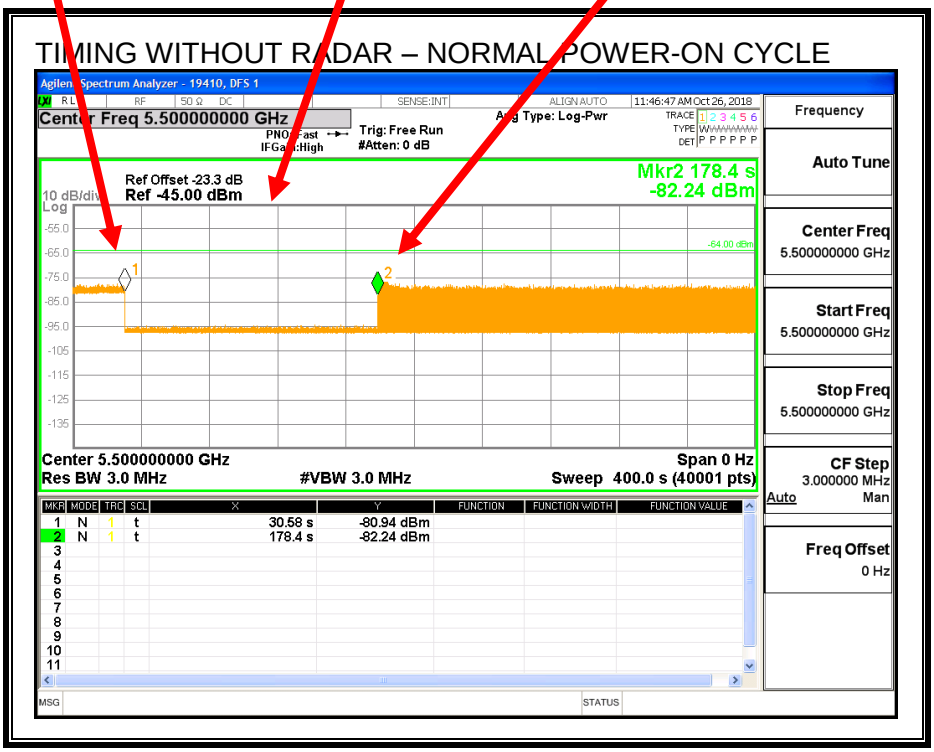
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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

TIMING WITHOUT RADAR DURING CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

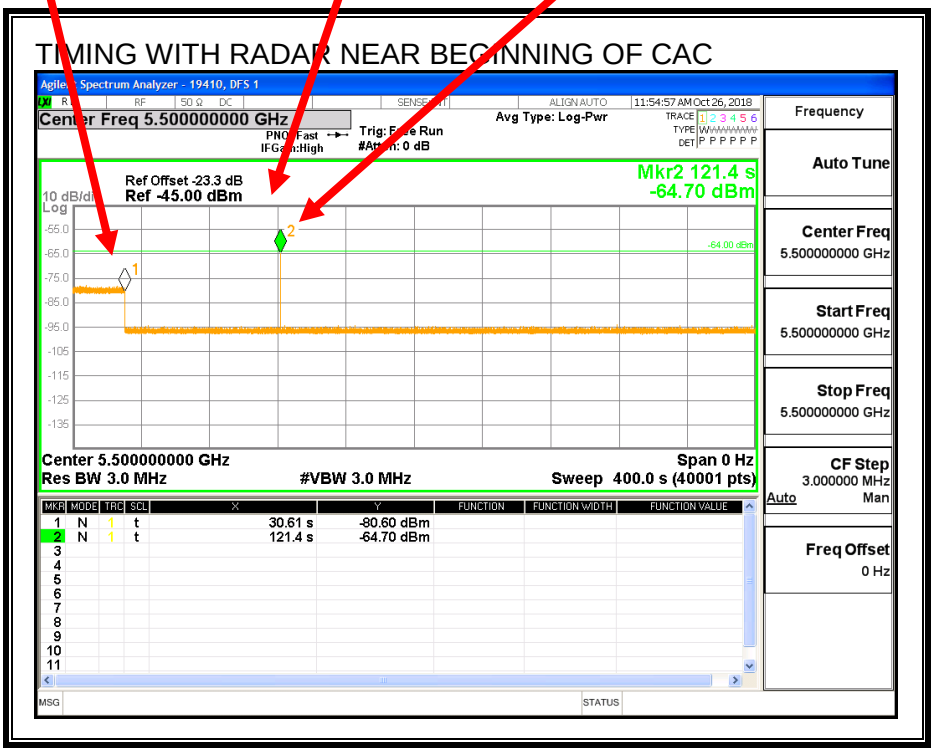
End of CAC
Traffic is Initiated



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

TIMING WITH RADAR NEAR BEGINNING OF CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle
End of Initial Power-up cycle
Start of CAC
Radar Signal Applied



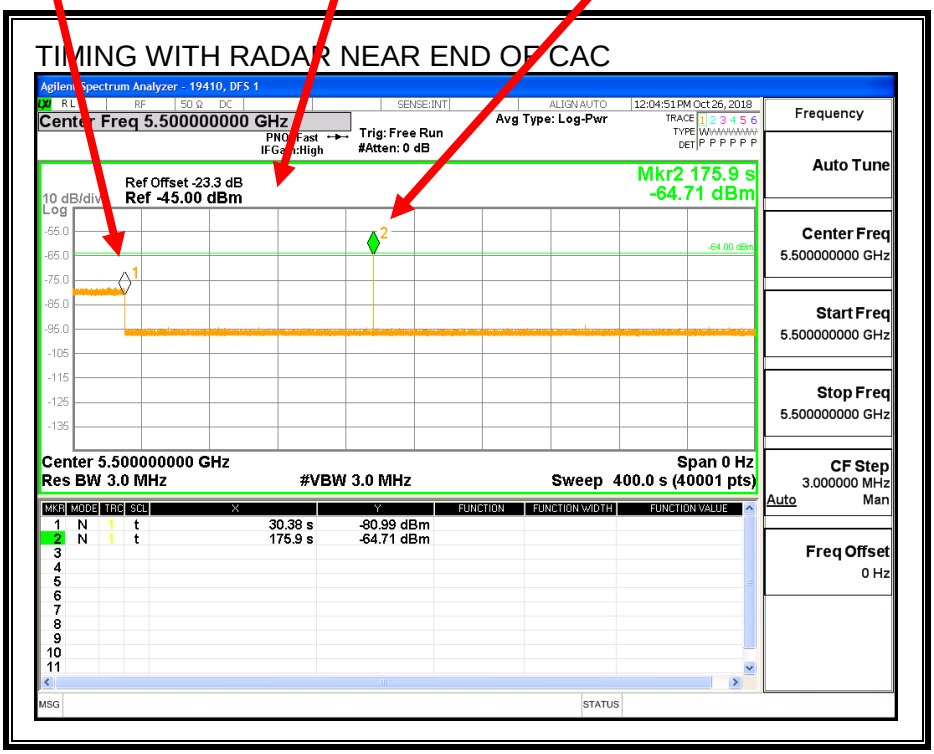
No EUT transmissions were observed after the radar signal.

TIMING WITH RADAR NEAR END OF CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



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.

These tests are not applicable.

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).

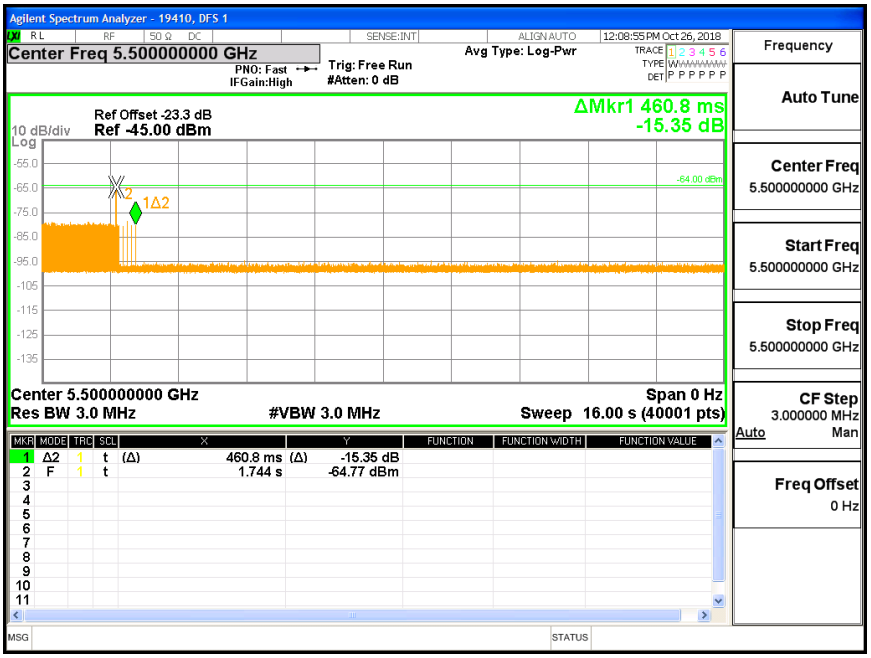
RESULTS

Channel Move Time (sec)	Limit (sec)
0.461	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
2.4	60

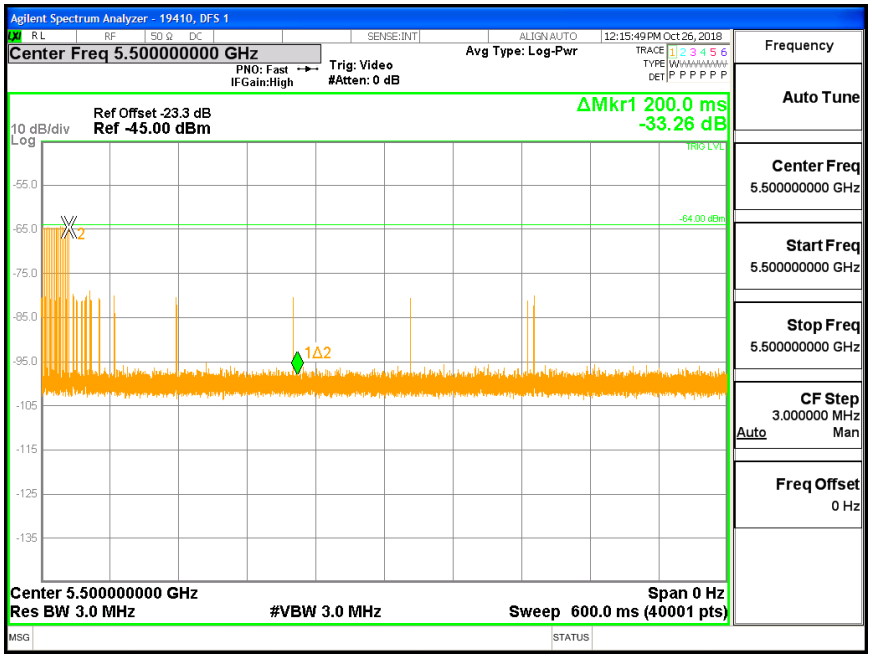
MOVE TIME

MOVE TIME



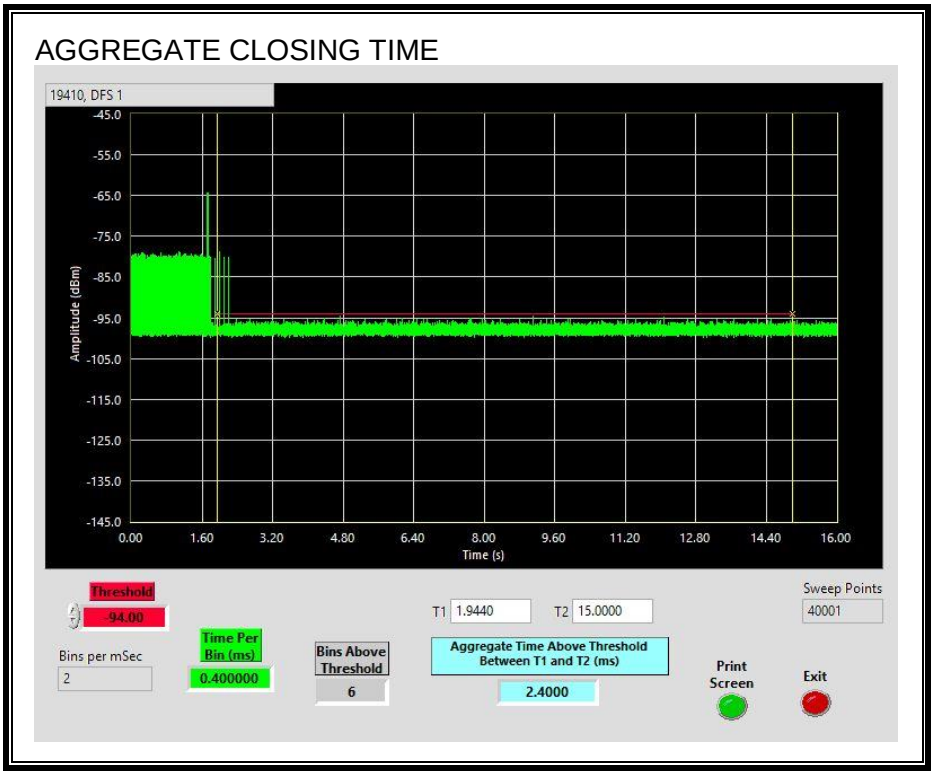
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

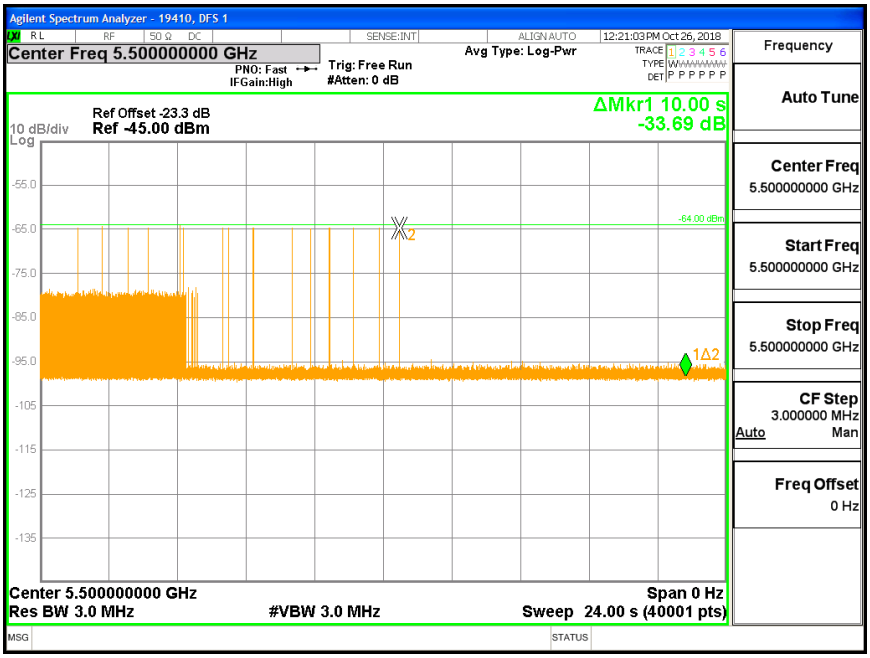
Only intermittent transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

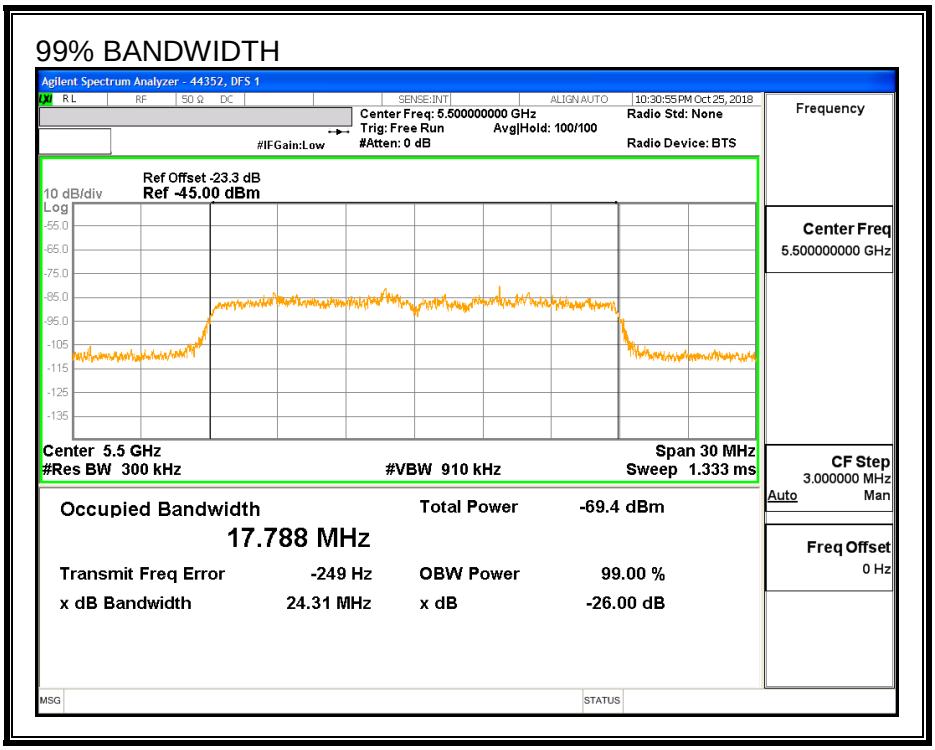
The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR



6.2.6. 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	17.788	112.4	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 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
5489	10	0	0	
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	FH
5511	10	0	0	

6.2.7. 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	96.67	60	Pass	5490	5510	17.79	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 2	30	96.67	60	Pass	5490	5510	17.79	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 3	30	96.67	60	Pass	5490	5510	17.79	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 4	30	93.33	60	Pass	5490	5510	17.79	DFS 1	44352	Version 3.3.4
Aggregate		95.83	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5510	17.79	DFS 1	44352	Version 3.3.4
FCC Hopping Type 6	42	100.00	70	Pass	5490	5510		DFS 1	44352	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	5496	Yes
1002	1	798	67	A	5496	Yes
1003	1	898	59	A	5509	Yes
1004	1	738	72	A	5500	Yes
1005	1	878	61	A	5490	Yes
1006	1	538	99	A	5508	Yes
1007	1	678	78	A	5505	Yes
1008	1	778	68	A	5498	Yes
1009	1	918	58	A	5503	Yes
1010	1	858	62	A	5505	Yes
1011	1	698	76	A	5507	Yes
1012	1	938	57	A	5504	Yes
1013	1	598	89	A	5497	Yes
1014	1	558	95	A	5503	Yes
1015	1	818	65	A	5507	Yes
1016	1	2186	25	B	5496	Yes
1017	1	3013	18	B	5506	No
1018	1	1775	30	B	5505	Yes
1019	1	2731	20	B	5501	Yes
1020	1	1622	33	B	5499	Yes
1021	1	1513	35	B	5503	Yes
1022	1	533	100	B	5494	Yes
1023	1	553	96	B	5498	Yes
1024	1	2251	24	B	5505	Yes
1025	1	1207	44	B	5509	Yes
1026	1	1839	29	B	5503	Yes
1027	1	924	58	B	5499	Yes
1028	1	1686	32	B	5503	Yes
1029	1	901	59	B	5504	Yes
1030	1	1295	41	B	5494	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	1.6	189	26	5506	Yes
2002	2.5	183	25	5501	Yes
2003	5	230	24	5506	Yes
2004	4.1	190	23	5497	Yes
2005	2.7	203	23	5501	Yes
2006	2.1	167	26	5508	Yes
2007	3.1	184	29	5496	Yes
2008	4.8	152	27	5499	Yes
2009	1.9	217	23	5495	No
2010	3.9	151	27	5492	Yes
2011	3.4	219	24	5498	Yes
2012	1.4	158	26	5503	Yes
2013	1.1	150	27	5496	Yes
2014	3.5	216	29	5507	Yes
2015	1.5	212	23	5499	Yes
2016	2.1	201	29	5495	Yes
2017	4.4	163	24	5494	Yes
2018	1.2	157	23	5493	Yes
2019	3.7	166	29	5505	Yes
2020	2.8	164	28	5492	Yes
2021	1.4	177	27	5496	Yes
2022	4.9	222	24	5491	Yes
2023	4	158	27	5500	Yes
2024	3.5	170	24	5506	Yes
2025	4.7	191	28	5495	Yes
2026	2.6	206	25	5494	Yes
2027	2.1	194	29	5496	Yes
2028	4.2	213	27	5505	Yes
2029	3.9	205	25	5491	Yes
2030	2.2	190	26	5501	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	9.3	363	18	5508	Yes
3002	9.9	331	17	5498	Yes
3003	8.1	464	18	5499	Yes
3004	9	445	18	5496	Yes
3005	7.4	473	17	5496	Yes
3006	6.5	466	16	5500	Yes
3007	7.3	256	18	5508	Yes
3008	8.6	395	18	5497	Yes
3009	7.7	449	17	5506	Yes
3010	7.2	483	18	5501	Yes
3011	8.4	299	17	5493	Yes
3012	6.3	346	16	5502	Yes
3013	9.9	307	16	5508	No
3014	7.9	367	17	5509	Yes
3015	7.6	342	18	5497	Yes
3016	10	297	18	5509	Yes
3017	8	284	17	5503	Yes
3018	8.6	252	16	5495	Yes
3019	6.8	385	17	5500	Yes
3020	7.7	498	18	5494	Yes
3021	6.1	393	16	5491	Yes
3022	9.3	269	18	5502	Yes
3023	6	427	17	5492	Yes
3024	9.5	316	16	5495	Yes
3025	6.4	370	16	5505	Yes
3026	6	404	17	5505	Yes
3027	9.3	470	16	5499	Yes
3028	9.1	267	16	5494	Yes
3029	8.6	479	18	5510	Yes
3030	6.7	288	16	5491	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	11.8	262	15	5496	Yes
4002	12.8	468	14	5506	Yes
4003	12.6	455	12	5510	Yes
4004	14.1	423	16	5502	Yes
4005	19.1	305	15	5503	Yes
4006	12	419	15	5509	Yes
4007	13.2	314	16	5498	Yes
4008	15.6	441	14	5500	Yes
4009	17.3	348	13	5506	Yes
4010	15.9	487	16	5491	Yes
4011	18.1	423	15	5490	Yes
4012	17.2	325	13	5499	Yes
4013	15.5	391	16	5503	Yes
4014	15.1	438	16	5503	Yes
4015	13.9	400	14	5496	Yes
4016	18.7	460	15	5497	Yes
4017	18	434	13	5504	Yes
4018	19	389	12	5499	No
4019	18.8	258	13	5498	Yes
4020	11.2	477	15	5503	Yes
4021	16.2	477	14	5507	Yes
4022	18.2	340	13	5507	Yes
4023	19.4	485	15	5492	Yes
4024	12.7	361	12	5493	No
4025	14.4	269	16	5497	Yes
4026	13.1	290	14	5493	Yes
4027	15.2	344	14	5503	Yes
4028	14.3	496	16	5504	Yes
4029	12.7	445	14	5492	Yes
4030	12.2	359	15	5505	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	Yes
10	5500	Yes
11	5496	Yes
12	5499	Yes
13	5498	Yes
14	5499	Yes
15	5494	Yes
16	5496	Yes
17	5498	Yes
18	5496	Yes
19	5499	Yes
20	5498	Yes
21	5501	Yes
22	5506	Yes
23	5504	Yes
24	5502	Yes
25	5504	Yes
26	5502	Yes
27	5503	Yes
28	5503	Yes
29	5502	Yes
30	5505	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	333	5490	2	Yes
2	808	5491	2	Yes
3	1283	5492	7	Yes
4	1758	5493	7	Yes
5	2233	5494	6	Yes
6	2708	5495	2	Yes
7	3183	5496	3	Yes
8	3658	5497	4	Yes
9	4133	5498	4	Yes
10	4608	5499	2	Yes
11	5083	5500	2	Yes
12	5558	5501	1	Yes
13	6033	5502	3	Yes
14	6508	5503	6	Yes
15	6983	5504	1	Yes
16	7458	5505	4	Yes
17	7933	5506	1	Yes
18	8408	5507	4	Yes
19	8883	5508	6	Yes
20	9358	5509	4	Yes
21	9833	5510	4	Yes
22	10308	5490	5	Yes
23	10783	5491	4	Yes
24	11258	5492	5	Yes
25	11733	5493	4	Yes
26	12208	5494	4	Yes
27	12683	5495	4	Yes
28	13158	5496	3	Yes
29	13633	5497	3	Yes
30	14108	5498	6	Yes
31	14583	5499	3	Yes
32	15058	5500	5	Yes
33	15533	5501	2	Yes
34	16008	5502	4	Yes
35	16483	5503	7	Yes
36	16958	5504	3	Yes
37	17433	5505	4	Yes
38	17908	5506	2	Yes
39	18383	5507	2	Yes
40	18858	5508	6	Yes
41	19333	5509	4	Yes
42	19808	5510	6	Yes

6.3. RESULTS FOR 40 MHz BANDWIDTH

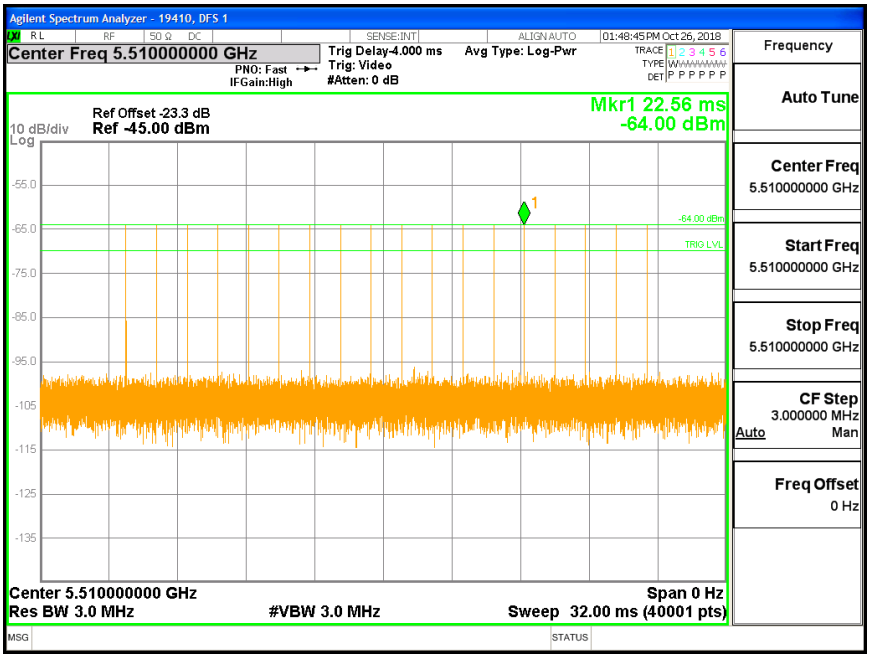
6.3.1. TEST CHANNEL

All tests were performed at a channel center frequency of 5510 MHz.

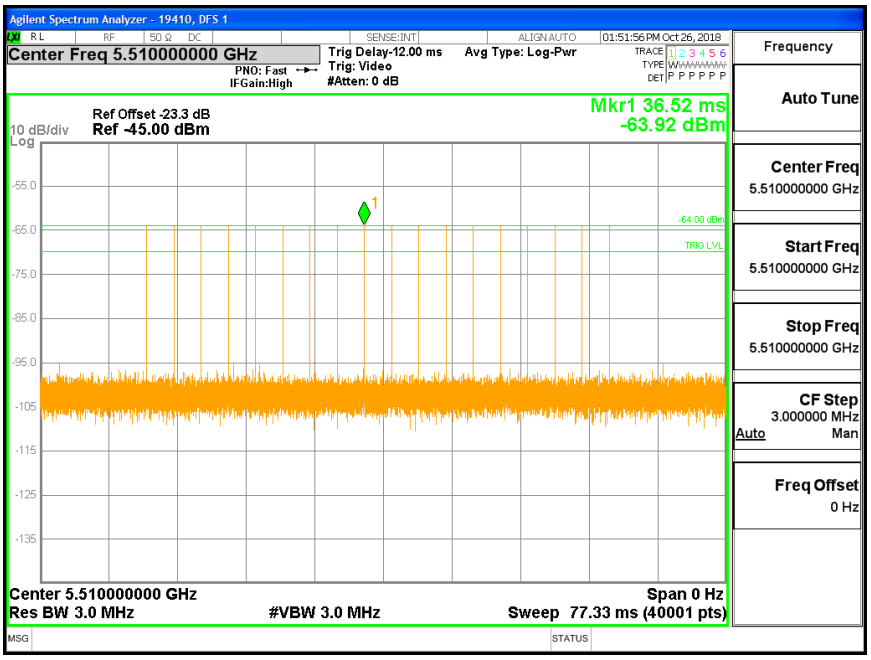
6.3.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

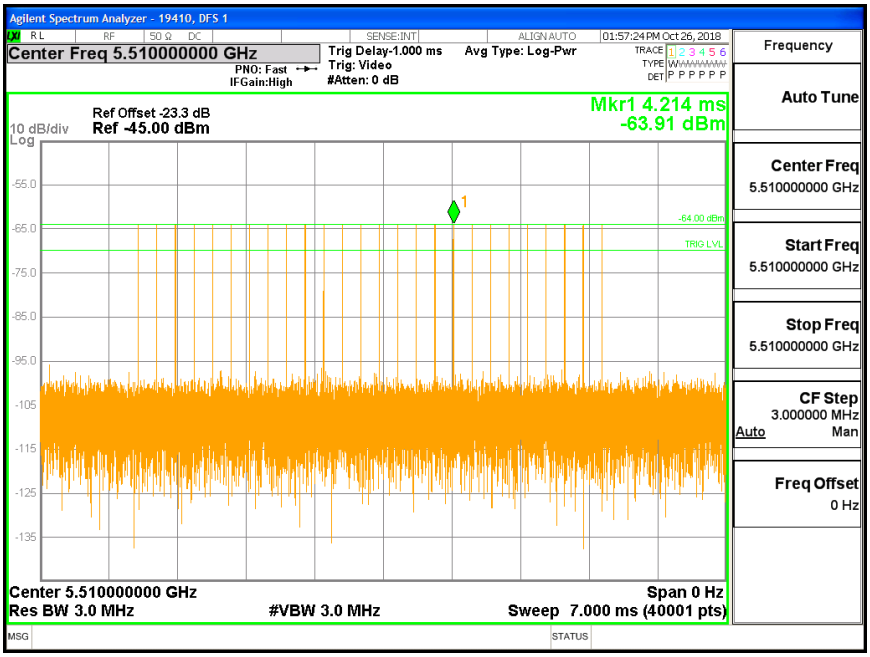
SHORT PULSE RADAR TYPE 0



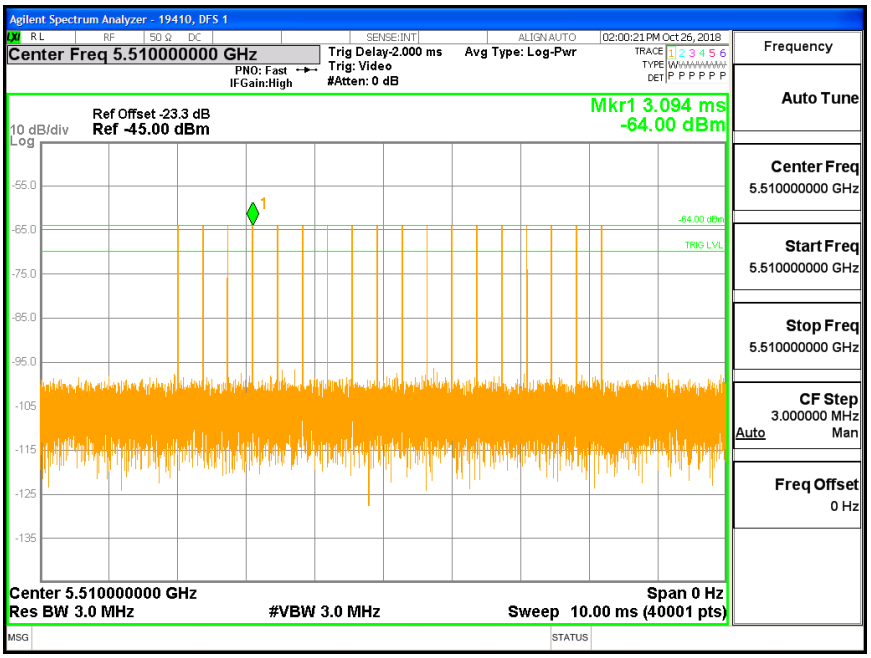
SAMPLE OF RADAR TYPE 1



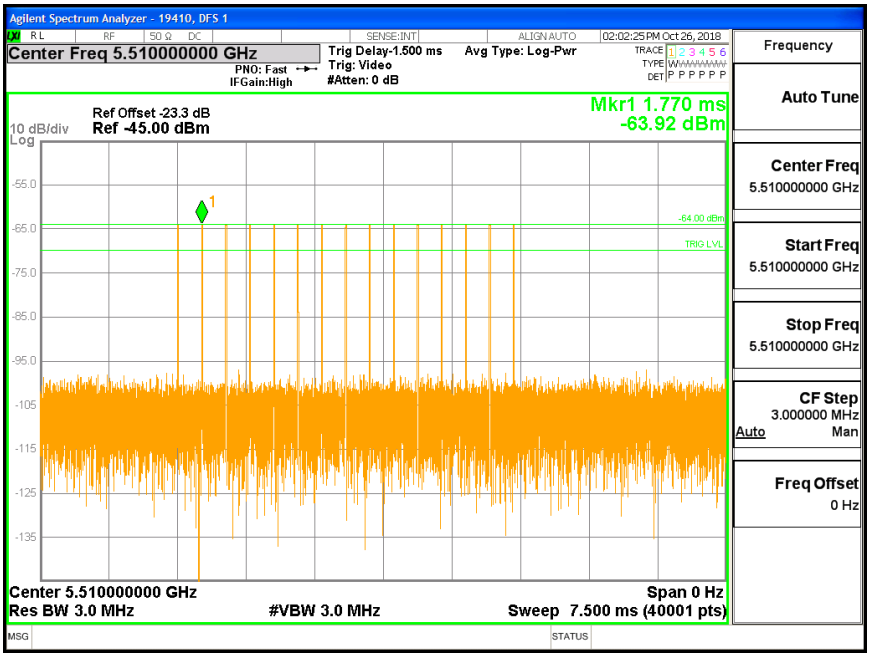
SAMPLE OF RADAR TYPE 2



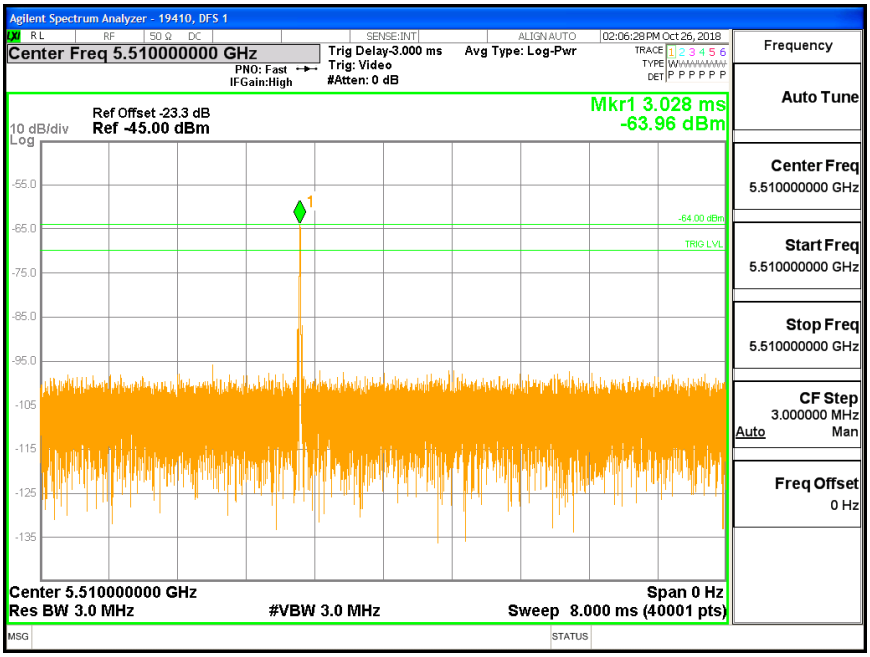
SAMPLE OF RADAR TYPE 3



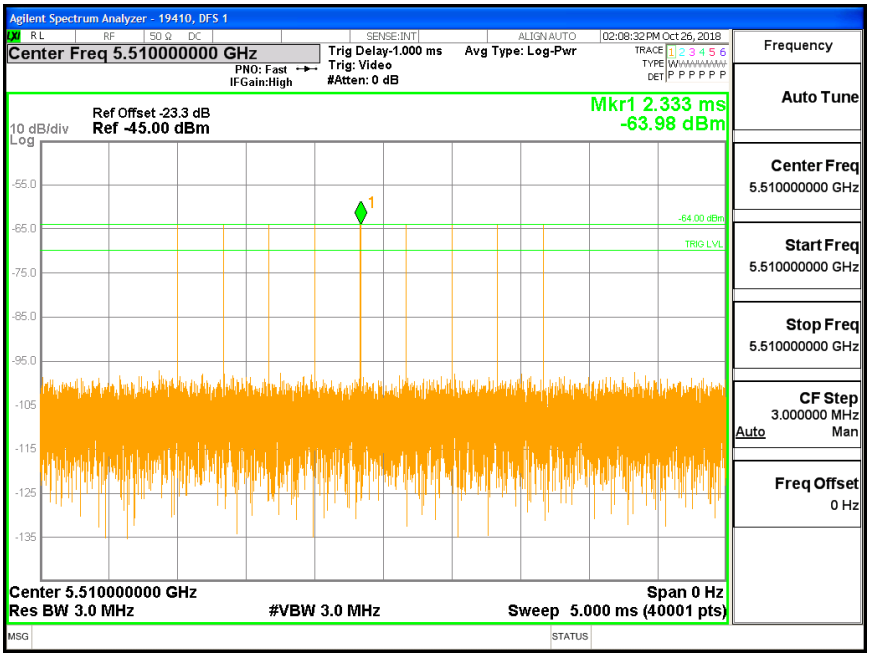
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

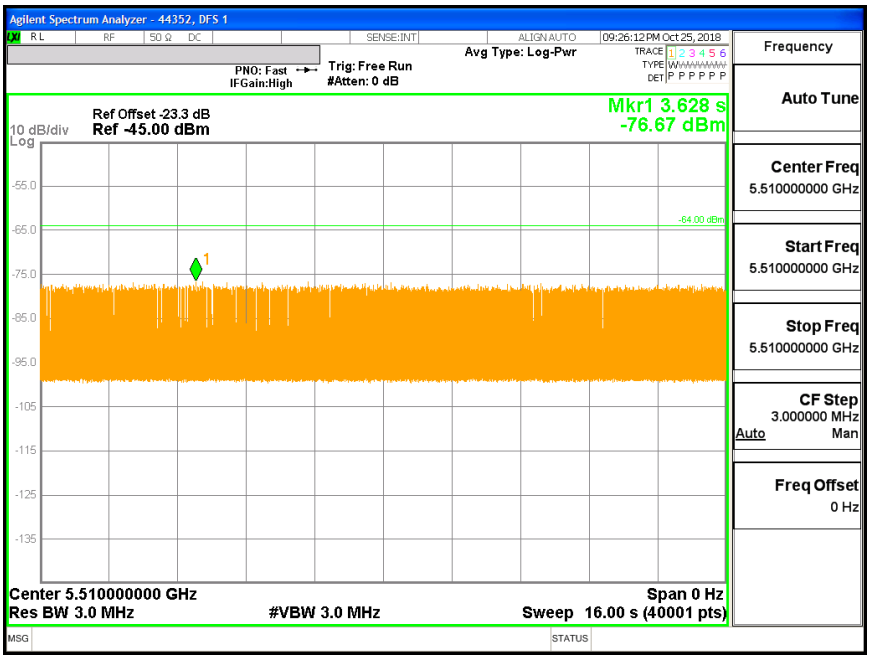


SINGLE BURST OF RADAR TYPE 6

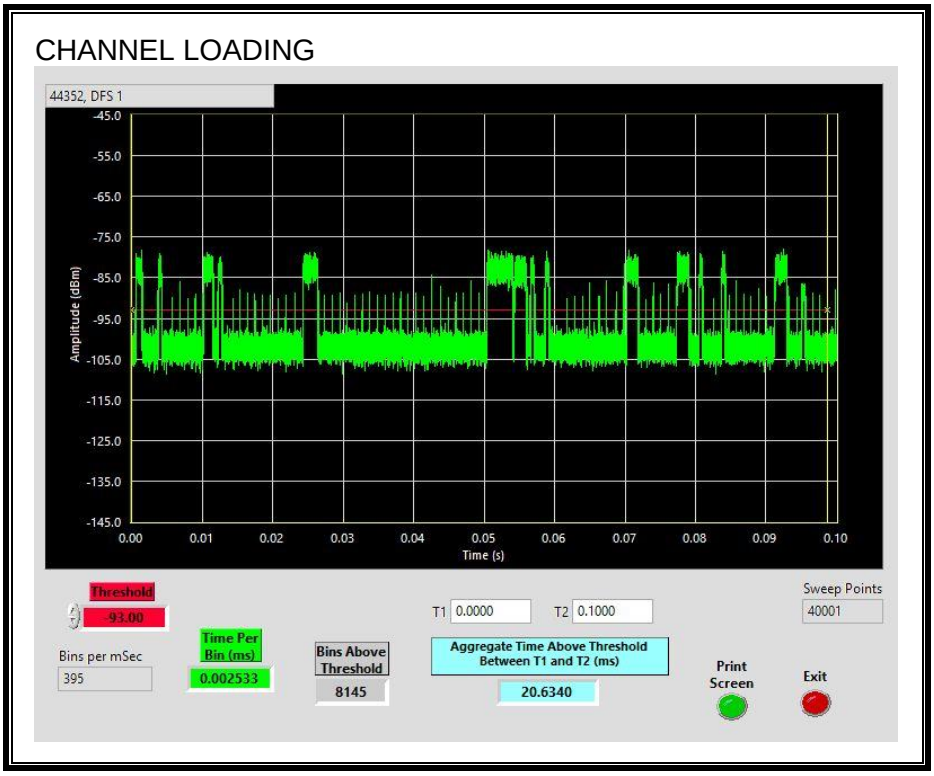


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 20.634%.

6.3.3. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

A link was established on channel then the EUT was rebooted. The time from the cessation of traffic to the re-initialization of traffic was measured as the time required for the EUT to complete the total power-up cycle. The time to complete the initial power-up period is 60 seconds less than this total power-up time.

PROCEDURE FOR TIMING OF RADAR BURST

With a link established on channel, the EUT was rebooted. A radar signal was triggered within 0 to 6 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

The Non-Occupancy list was cleared. With a link established on channel, the EUT was rebooted. A radar signal was triggered within 54 to 60 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.53	178.4	147.9	87.9

Radar Near Beginning of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.73	121.1	90.4	2.5

Radar Near End of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.53	175.7	145.2	57.3

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

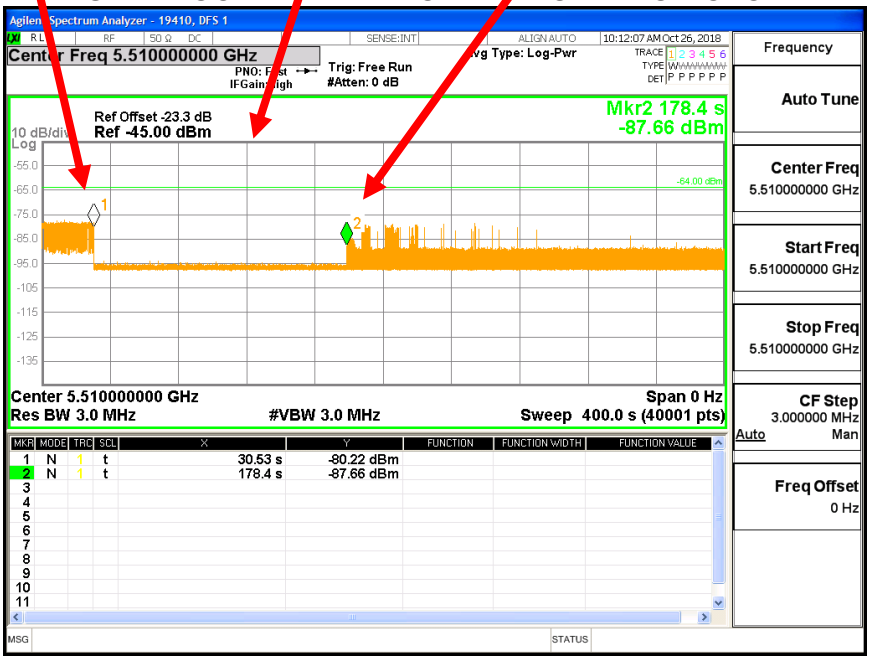
TIMING WITHOUT RADAR DURING CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

End of CAC
Traffic is Initiated

TIMING WITHOUT RADAR – NORMAL POWER-ON CYCLE



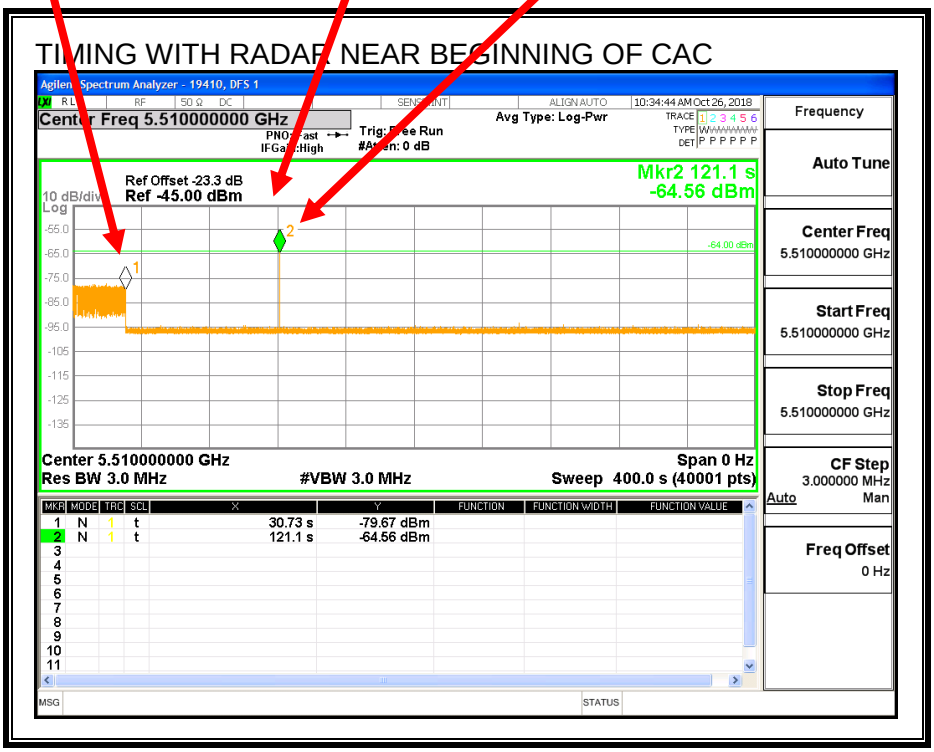
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

TIMING WITH RADAR NEAR BEGINNING OF CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



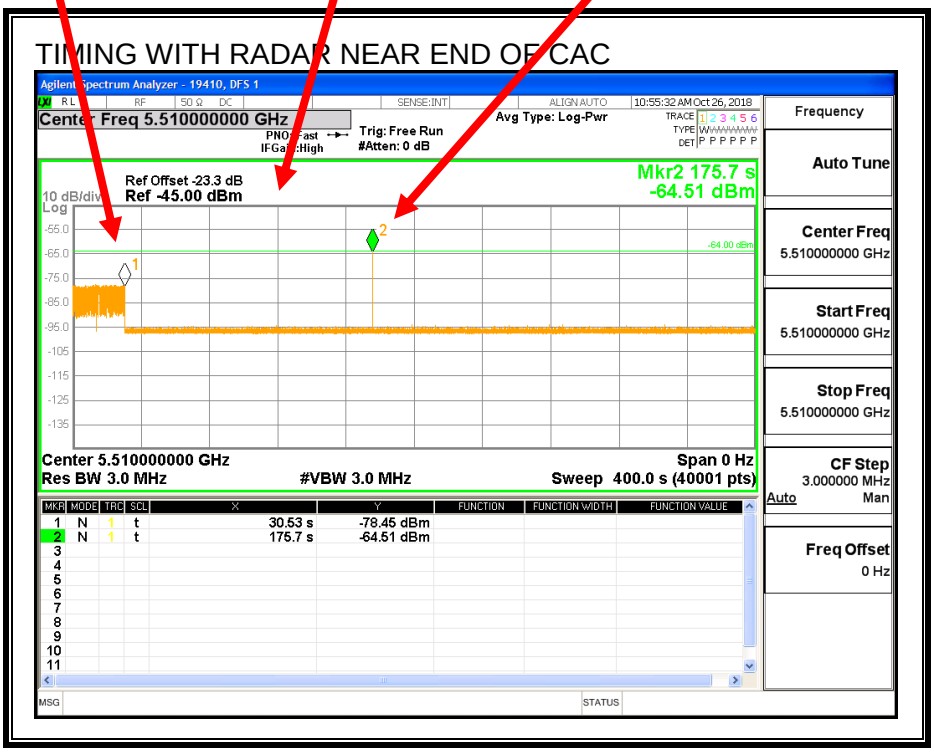
No EUT transmissions were observed after the radar signal.

TIMING WITH RADAR NEAR END OF CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

6.3.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

These tests are not applicable.

6.3.5. 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).

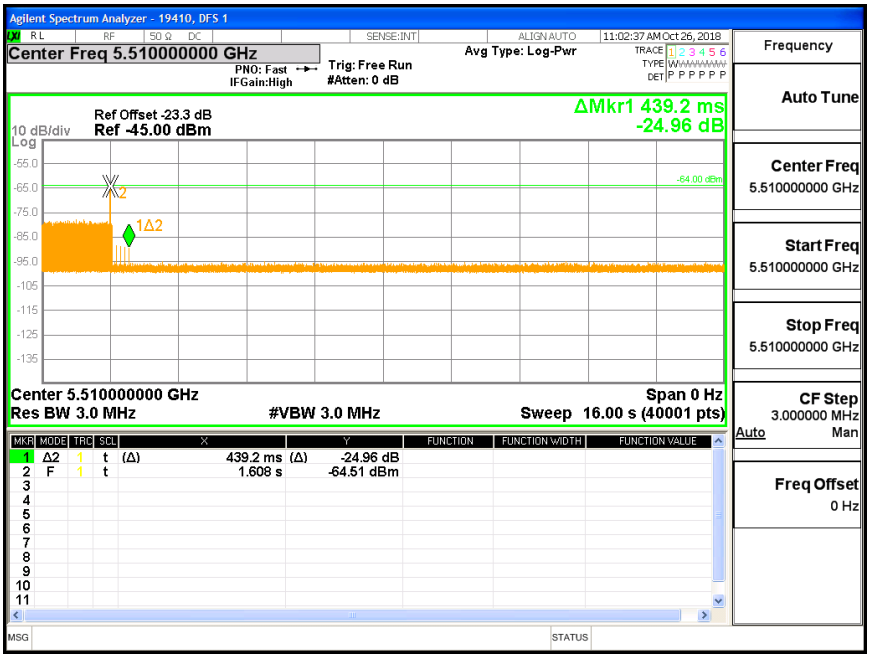
RESULTS

Channel Move Time (sec)	Limit (sec)
0.439	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
3.6	60

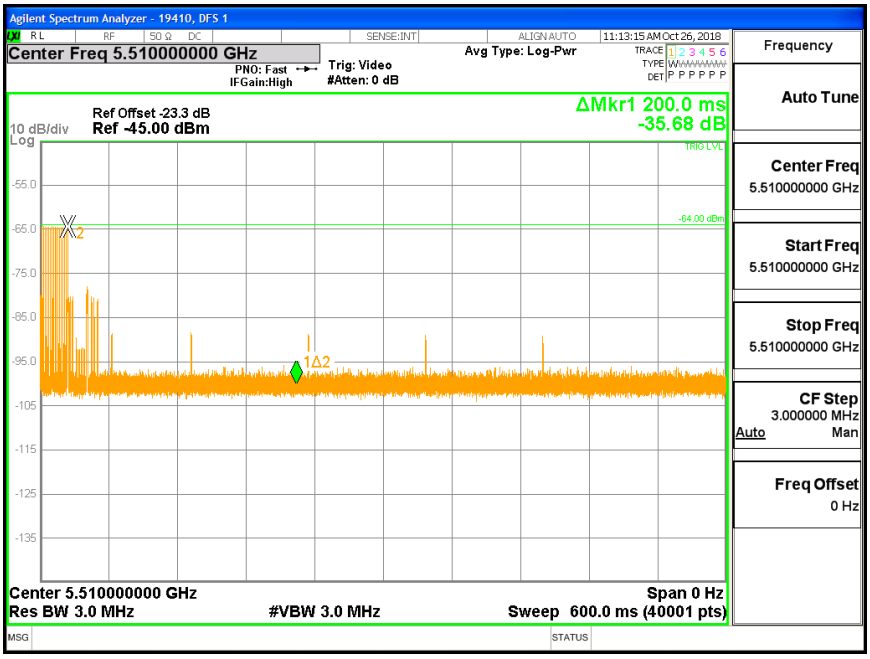
MOVE TIME

MOVE TIME



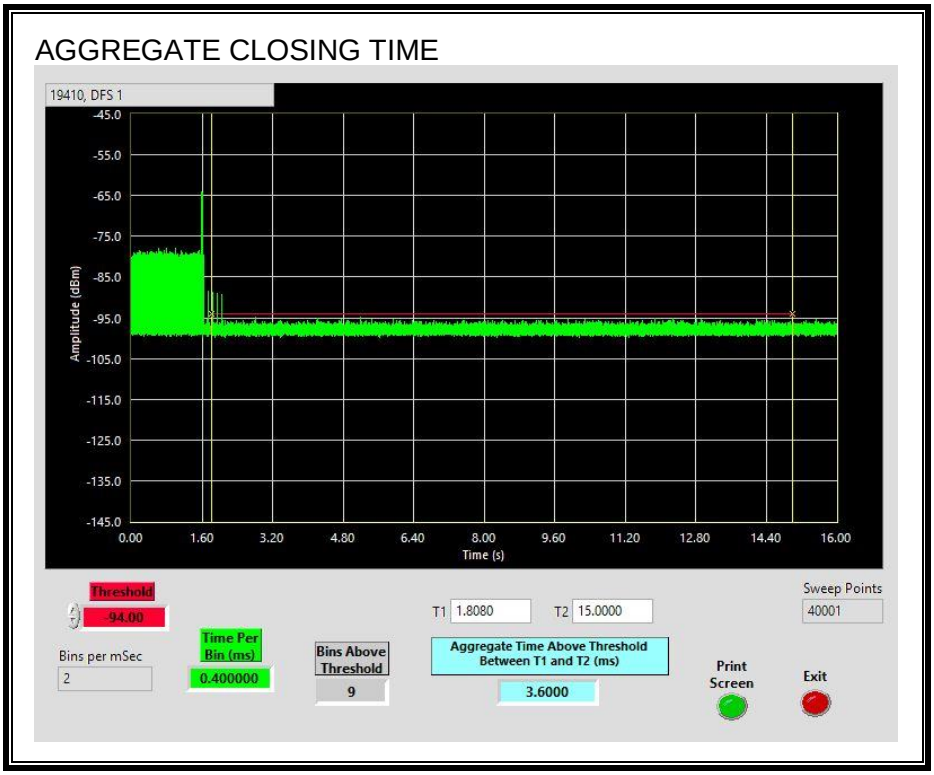
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

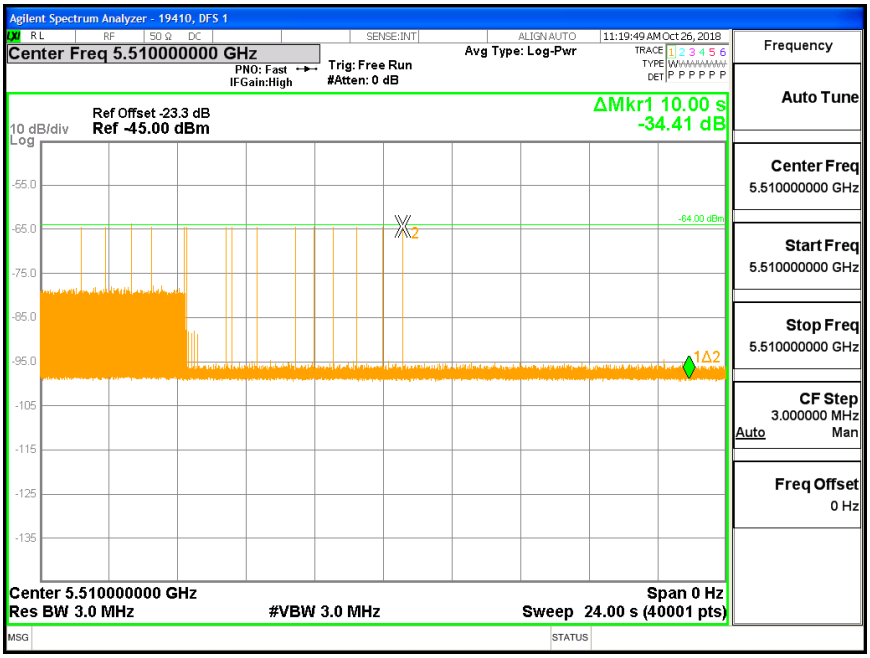
Only intermittent transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

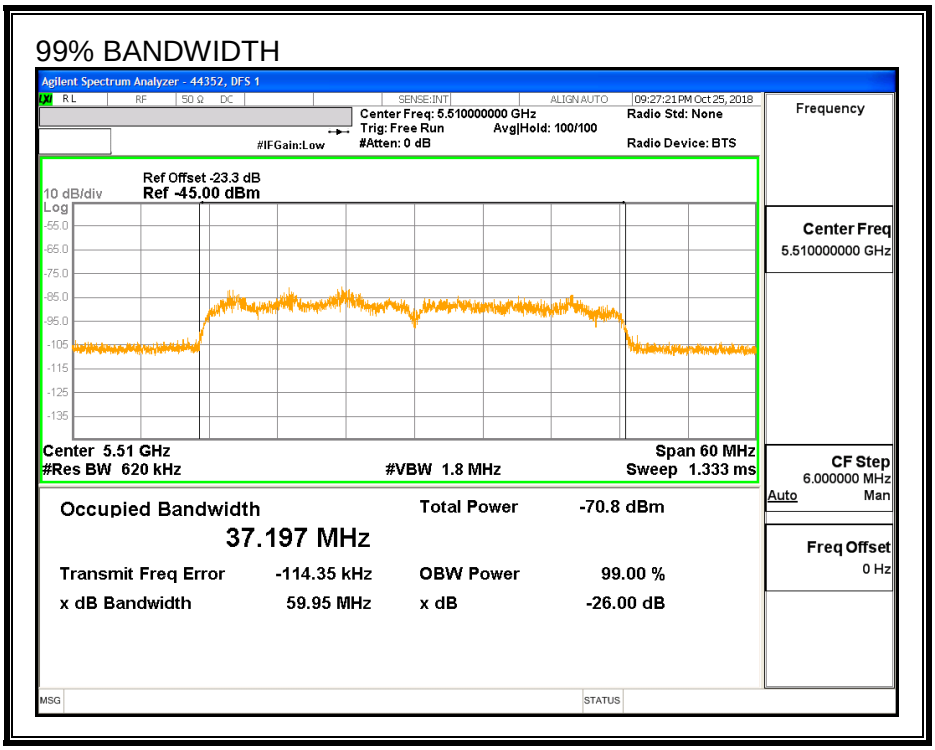
The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR



6.3.6. 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	5530	40	37.197	107.5	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 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
5489	10	0	0	
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	
5515	10	10	100	
5520	10	10	100	
5525	10	10	100	
5530	10	10	100	FH
5531	10	0	0	

6.3.7. 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	5530	37.2	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 2	30	100.00	60	Pass	5490	5530	37.2	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 3	30	83.33	60	Pass	5490	5530	37.2	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 4	30	63.33	60	Pass	5490	5530	37.2	DFS 1	44352	Version 3.3.4
Aggregate		86.67	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5530	37.2	DFS 1	44352	Version 3.3.4
FCC Hopping Type 6	41	100.00	70	Pass	5490	5530		DFS 1	44352	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	5514	Yes
1002	1	798	67	A	5514	Yes
1003	1	898	59	A	5522	Yes
1004	1	738	72	A	5513	Yes
1005	1	878	61	A	5498	Yes
1006	1	538	99	A	5505	Yes
1007	1	678	78	A	5500	Yes
1008	1	778	68	A	5517	Yes
1009	1	918	58	A	5501	Yes
1010	1	858	62	A	5492	Yes
1011	1	698	76	A	5515	Yes
1012	1	938	57	A	5518	Yes
1013	1	598	89	A	5517	Yes
1014	1	558	95	A	5521	Yes
1015	1	818	65	A	5513	Yes
1016	1	2186	25	B	5514	Yes
1017	1	3013	18	B	5522	Yes
1018	1	1775	30	B	5493	Yes
1019	1	2731	20	B	5514	Yes
1020	1	1622	33	B	5521	Yes
1021	1	1513	35	B	5529	Yes
1022	1	533	100	B	5520	Yes
1023	1	553	96	B	5516	Yes
1024	1	2251	24	B	5526	Yes
1025	1	1207	44	B	5530	Yes
1026	1	1839	29	B	5495	Yes
1027	1	924	58	B	5524	Yes
1028	1	1686	32	B	5516	Yes
1029	1	901	59	B	5512	Yes
1030	1	1295	41	B	5508	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	1.6	189	26	5494	Yes
2002	2.5	183	25	5508	Yes
2003	5	230	24	5509	Yes
2004	4.1	190	23	5500	Yes
2005	2.7	203	23	5512	Yes
2006	2.1	167	26	5528	Yes
2007	3.1	184	29	5496	Yes
2008	4.8	152	27	5498	Yes
2009	1.9	217	23	5524	Yes
2010	3.9	151	27	5510	Yes
2011	3.4	219	24	5509	Yes
2012	1.4	158	26	5513	Yes
2013	1.1	150	27	5497	Yes
2014	3.5	216	29	5509	Yes
2015	1.5	212	23	5497	Yes
2016	2.1	201	29	5503	Yes
2017	4.4	163	24	5504	Yes
2018	1.2	157	23	5492	Yes
2019	3.7	166	29	5521	Yes
2020	2.8	164	28	5490	Yes
2021	1.4	177	27	5519	Yes
2022	4.9	222	24	5509	Yes
2023	4	158	27	5497	Yes
2024	3.5	170	24	5504	Yes
2025	4.7	191	28	5495	Yes
2026	2.6	206	25	5520	Yes
2027	2.1	194	29	5502	Yes
2028	4.2	213	27	5522	Yes
2029	3.9	205	25	5499	Yes
2030	2.2	190	26	5500	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	9.3	363	18	5503	No
3002	9.9	331	17	5503	Yes
3003	8.1	464	18	5525	Yes
3004	9	445	18	5527	Yes
3005	7.4	473	17	5502	Yes
3006	6.5	466	16	5528	Yes
3007	7.3	256	18	5518	Yes
3008	8.6	395	18	5504	Yes
3009	7.7	449	17	5492	Yes
3010	7.2	483	18	5518	Yes
3011	8.4	299	17	5501	Yes
3012	6.3	346	16	5515	No
3013	9.9	307	16	5526	Yes
3014	7.9	367	17	5502	Yes
3015	7.6	342	18	5522	Yes
3016	10	297	18	5526	No
3017	8	284	17	5525	Yes
3018	8.6	252	16	5498	Yes
3019	6.8	385	17	5520	Yes
3020	7.7	498	18	5509	Yes
3021	6.1	393	16	5500	Yes
3022	9.3	269	18	5492	Yes
3023	6	427	17	5524	Yes
3024	9.5	316	16	5512	Yes
3025	6.4	370	16	5492	Yes
3026	6	404	17	5509	No
3027	9.3	470	16	5492	No
3028	9.1	267	16	5500	Yes
3029	8.6	479	18	5524	Yes
3030	6.7	288	16	5501	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	11.8	262	15	5496	No
4002	12.8	468	14	5504	No
4003	12.6	455	12	5496	Yes
4004	14.1	423	16	5518	Yes
4005	19.1	305	15	5523	Yes
4006	12	419	15	5511	No
4007	13.2	314	16	5521	Yes
4008	15.6	441	14	5519	No
4009	17.3	348	13	5509	Yes
4010	15.9	487	16	5525	Yes
4011	18.1	423	15	5519	Yes
4012	17.2	325	13	5516	No
4013	15.5	391	16	5522	Yes
4014	15.1	438	16	5500	Yes
4015	13.9	400	14	5509	Yes
4016	18.7	460	15	5525	No
4017	18	434	13	5494	No
4018	19	389	12	5520	No
4019	18.8	258	13	5497	Yes
4020	11.2	477	15	5502	Yes
4021	16.2	477	14	5518	No
4022	18.2	340	13	5499	Yes
4023	19.4	485	15	5511	Yes
4024	12.7	361	12	5499	No
4025	14.4	269	16	5528	Yes
4026	13.1	290	14	5515	No
4027	15.2	344	14	5527	Yes
4028	14.3	496	16	5497	Yes
4029	12.7	445	14	5501	Yes
4030	12.2	359	15	5516	Yes

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	**Frequency (MHz)**	**Successful Detection (Yes/No)**
1	5510	Yes
2	5510	Yes
3	5510	Yes
4	5510	Yes
5	5510	Yes
6	5510	Yes
7	5510	Yes
8	5510	Yes
9	5510	Yes
10	5510	Yes
11	5496	Yes
12	5499	Yes
13	5498	Yes
14	5499	Yes
15	5494	Yes
16	5496	Yes
17	5498	Yes
18	5496	Yes
19	5499	Yes
20	5498	Yes
21	5521	Yes
22	5526	Yes
23	5524	Yes
24	5522	Yes
25	5524	Yes
26	5521	Yes
27	5523	Yes
28	5523	Yes
29	5522	Yes
30	5525	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	292	5490	8	Yes
2	767	5491	8	Yes
3	1242	5492	13	Yes
4	1717	5493	6	Yes
5	2192	5494	5	Yes
6	2667	5495	11	Yes
7	3142	5496	9	Yes
8	3617	5497	9	Yes
9	4092	5498	8	Yes
10	4567	5499	4	Yes
11	5042	5500	5	Yes
12	5517	5501	11	Yes
13	5992	5502	7	Yes
14	6467	5503	7	Yes
15	6942	5504	9	Yes
16	7417	5505	8	Yes
17	7892	5506	9	Yes
18	8367	5507	7	Yes
19	8842	5508	10	Yes
20	9317	5509	10	Yes
21	9792	5510	10	Yes
22	10267	5511	10	Yes
23	10742	5512	7	Yes
24	11217	5513	13	Yes
25	11692	5514	6	Yes
26	12167	5515	10	Yes
27	12642	5516	7	Yes
28	13117	5517	7	Yes
29	13592	5518	7	Yes
30	14067	5519	11	Yes
31	14542	5520	6	Yes
32	15017	5521	7	Yes
33	15492	5522	8	Yes
34	15967	5523	9	Yes
35	16442	5524	9	Yes
36	16917	5525	7	Yes
37	17392	5526	8	Yes
38	17867	5527	12	Yes
39	18342	5528	7	Yes
40	18817	5529	6	Yes
41	19292	5530	9	Yes

6.4. RESULTS FOR 80 MHz BANDWIDTH

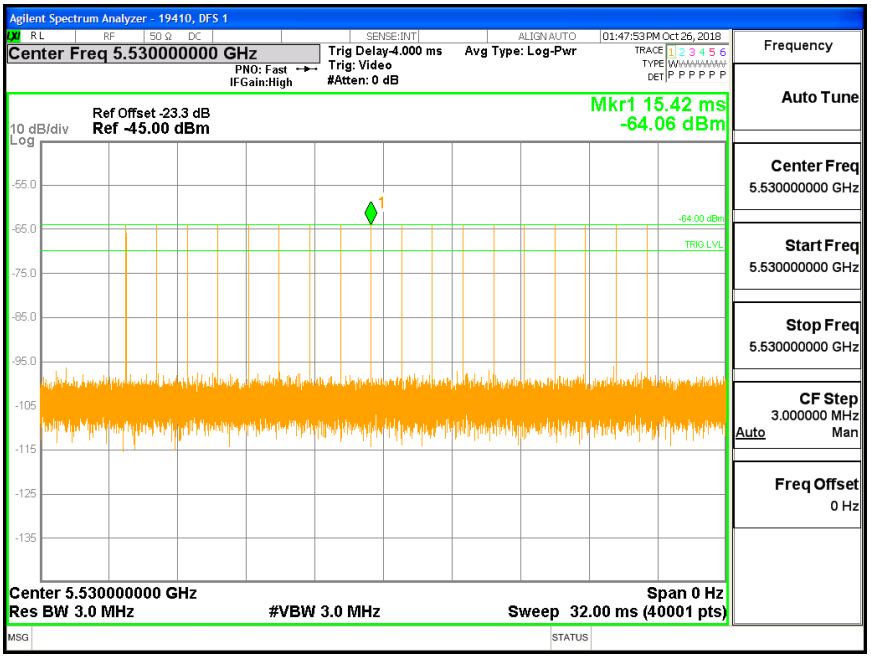
6.4.1. TEST CHANNEL

All tests were performed at a channel center frequency of 5530 MHz.

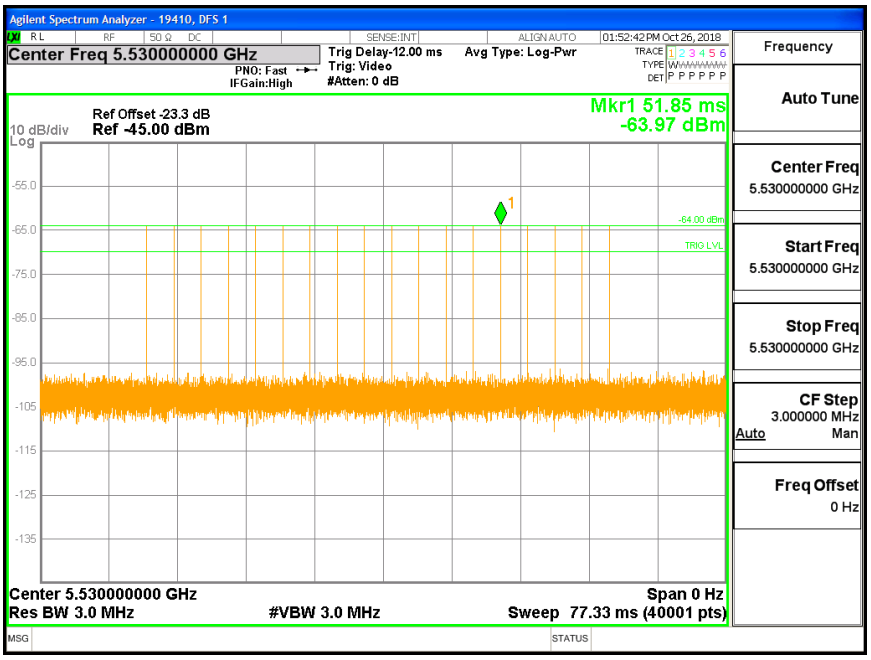
6.4.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

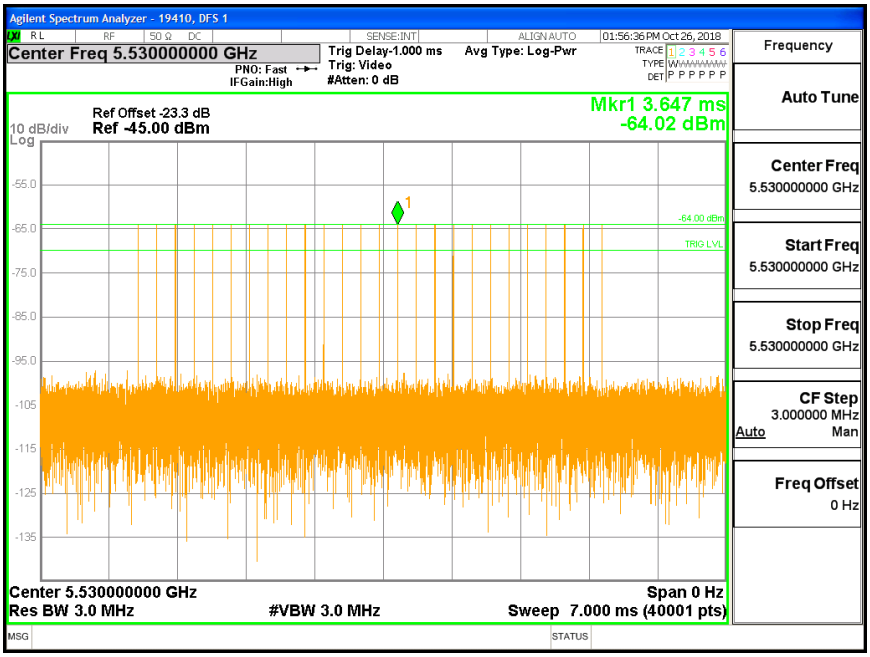
SHORT PULSE RADAR TYPE 0



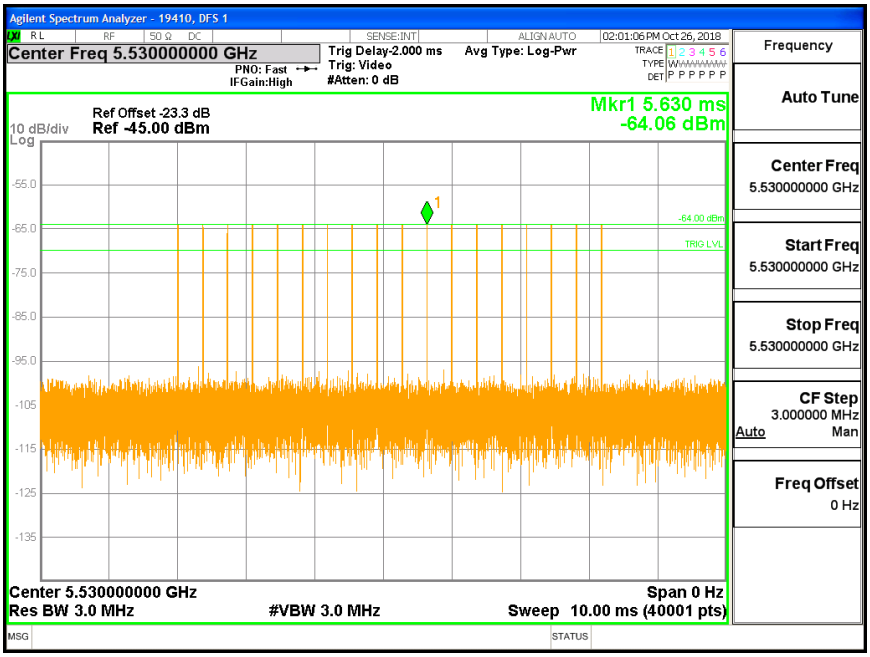
SAMPLE OF RADAR TYPE 1



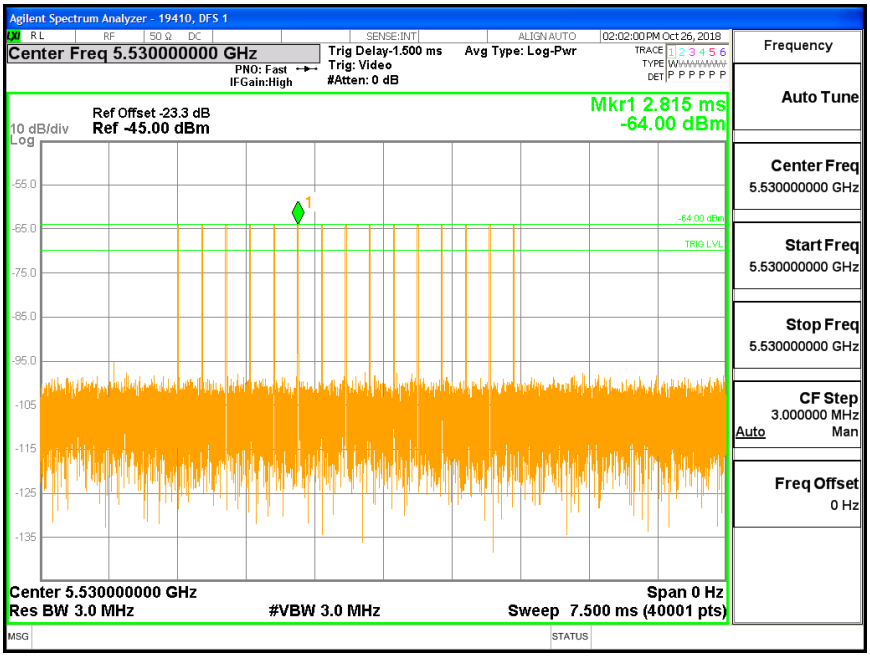
SAMPLE OF RADAR TYPE 2



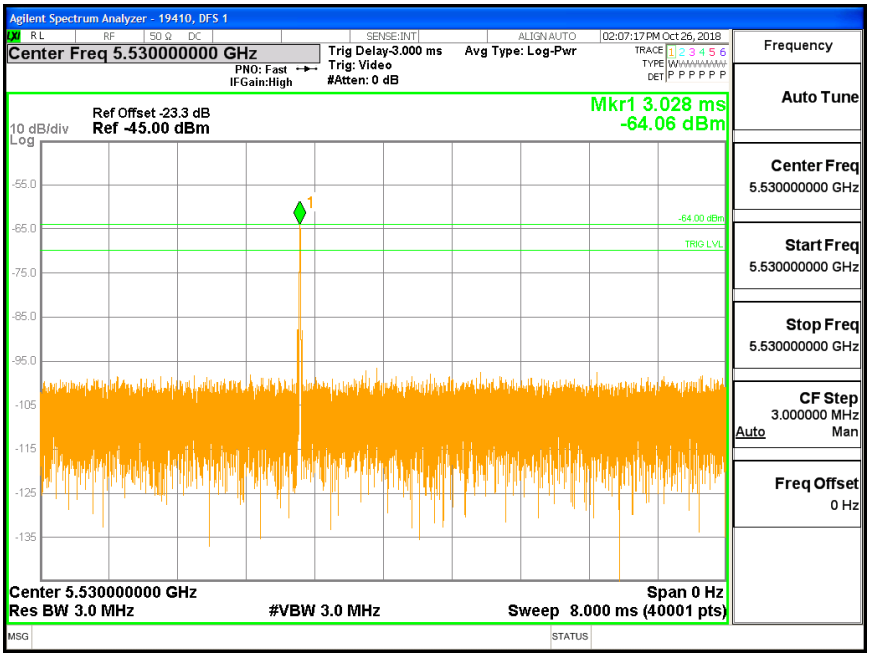
SAMPLE OF RADAR TYPE 3



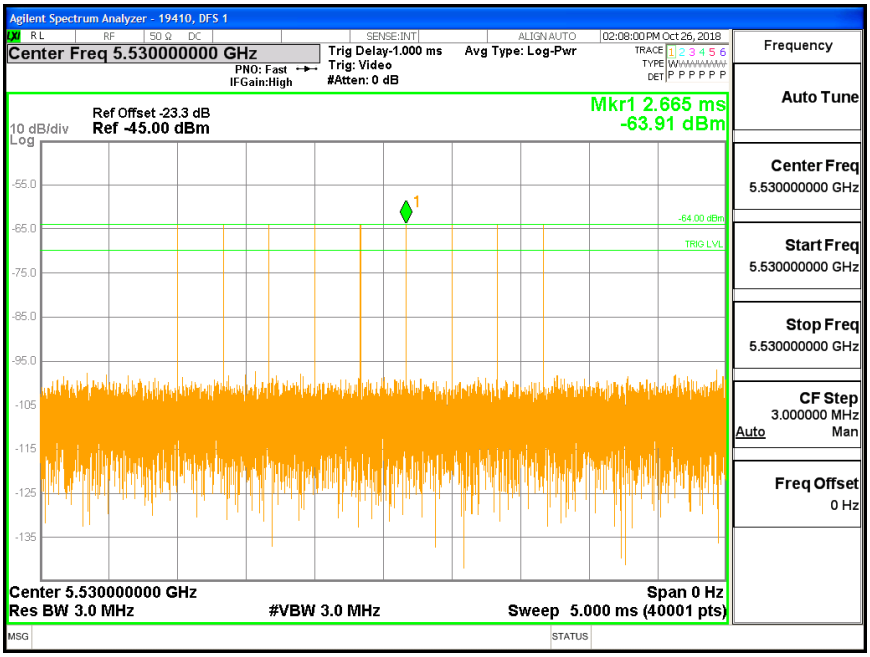
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

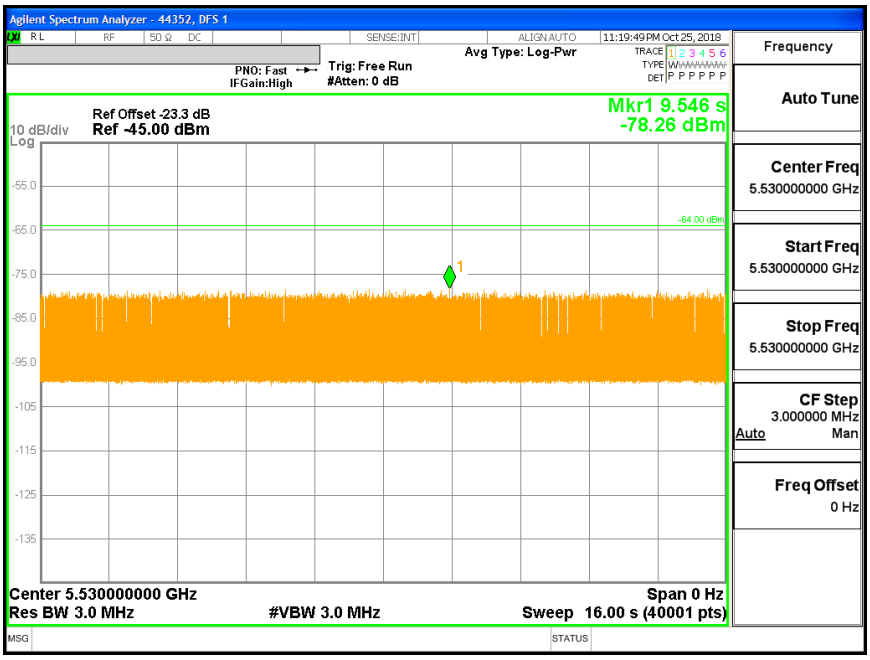


SINGLE BURST OF RADAR TYPE 6

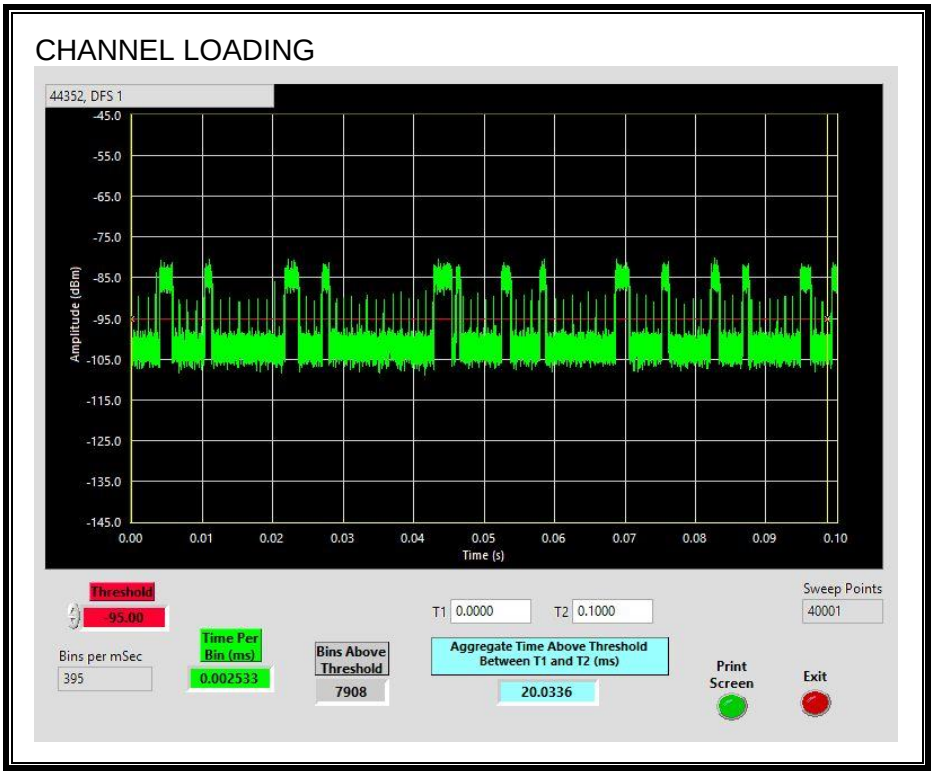


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 20.0336%.

6.4.3. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

A link was established on channel then the EUT was rebooted. The time from the cessation of traffic to the re-initialization of traffic was measured as the time required for the EUT to complete the total power-up cycle. The time to complete the initial power-up period is 60 seconds less than this total power-up time.

PROCEDURE FOR TIMING OF RADAR BURST

With a link established on channel, the EUT was rebooted. A radar signal was triggered within 0 to 6 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

The Non-Occupancy list was cleared. With a link established on channel, the EUT was rebooted. A radar signal was triggered within 54 to 60 seconds after the initial power-up period, and transmissions on the channel were monitored on the spectrum analyzer.

QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.42	179.0	148.6	88.6

Radar Near Beginning of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.49	120.4	89.9	1.3

Radar Near End of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.73	176.0	145.3	56.7

QUALITATIVE RESULTS

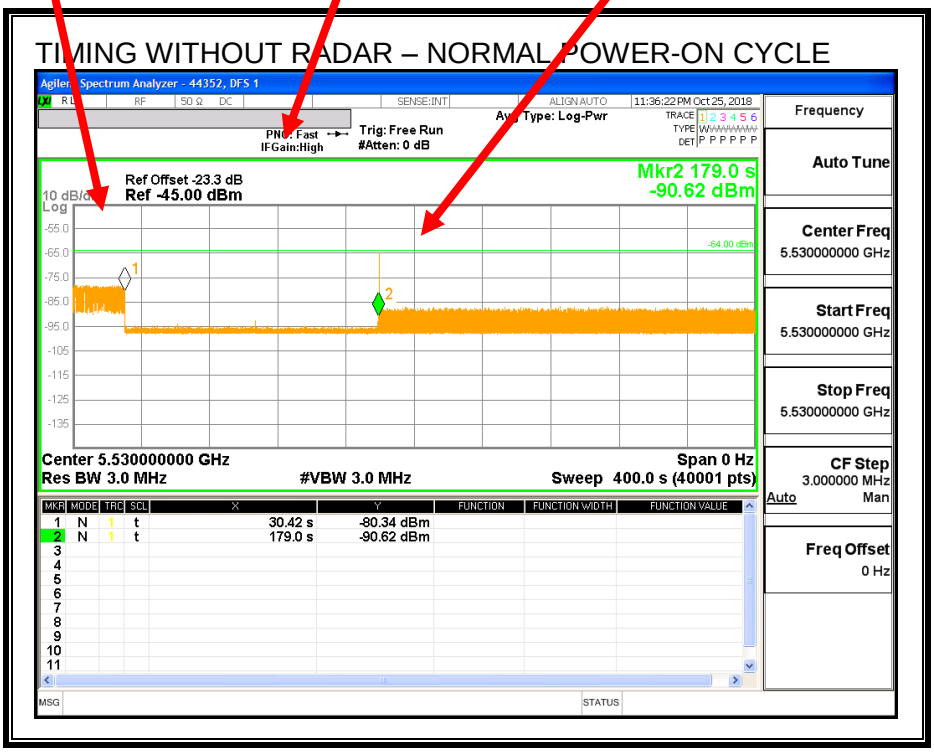
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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

TIMING WITHOUT RADAR DURING CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

End of CAC
Traffic is Initiated



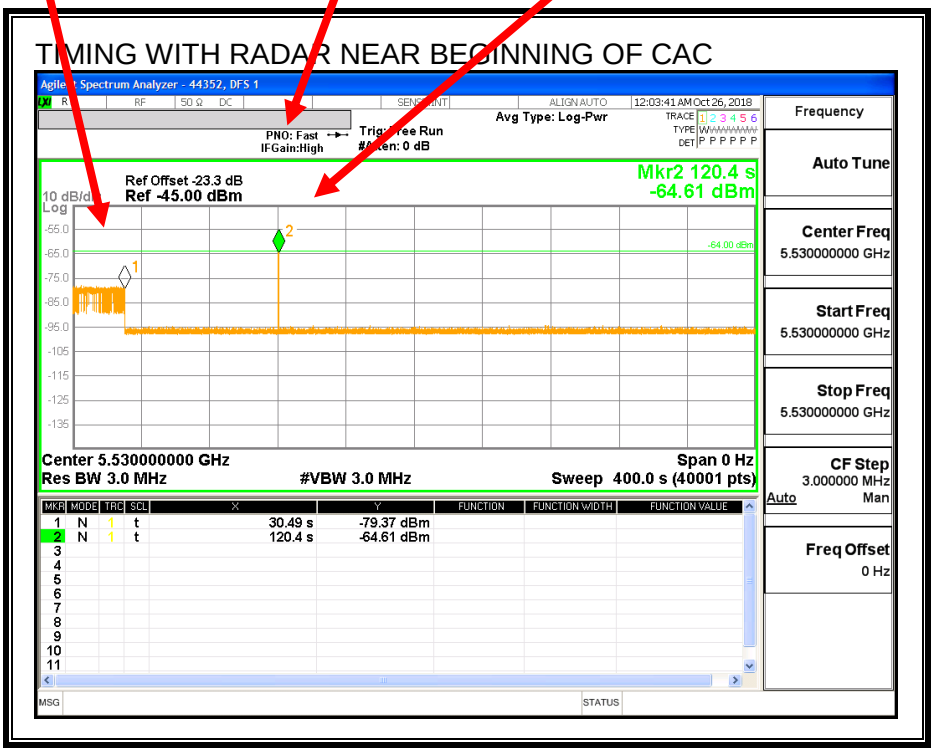
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

TIMING WITH RADAR NEAR BEGINNING OF CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



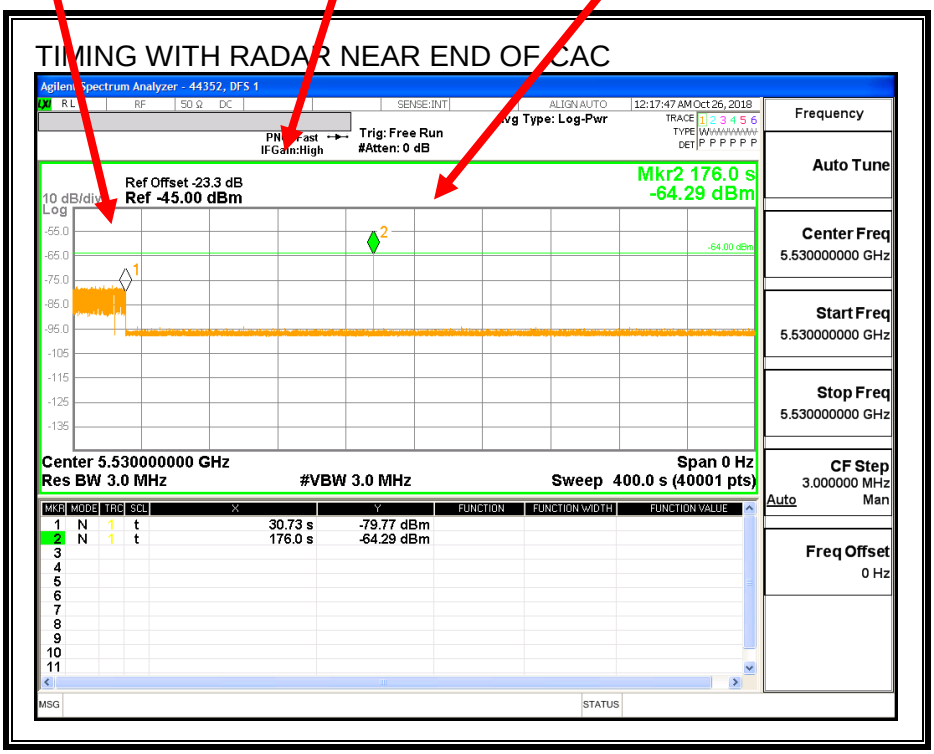
No EUT transmissions were observed after the radar signal.

TIMING WITH RADAR NEAR END OF CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

6.4.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

These tests are not applicable.

6.4.5. 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).

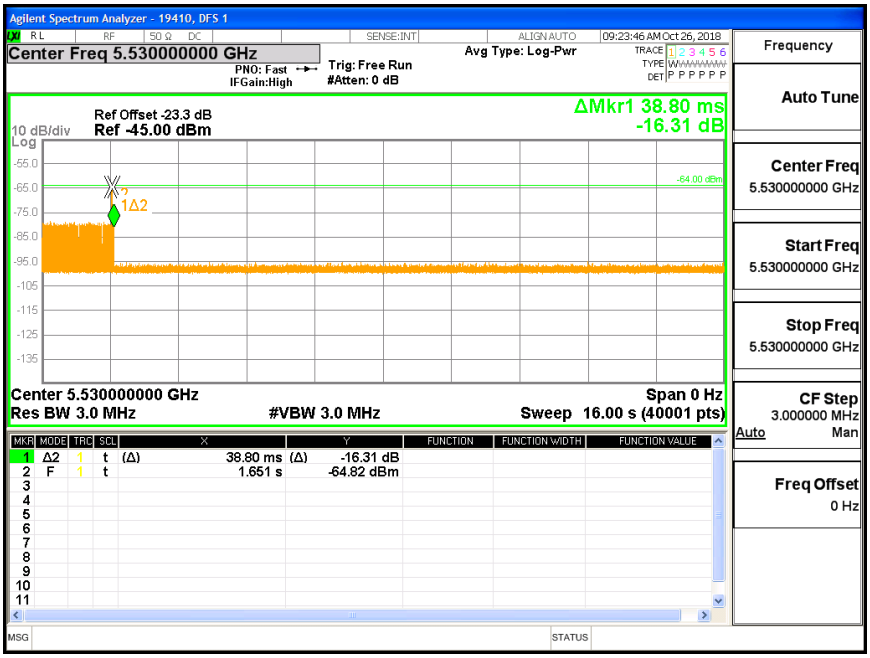
RESULTS

Channel Move Time (sec)	Limit (sec)
0.0388	10

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

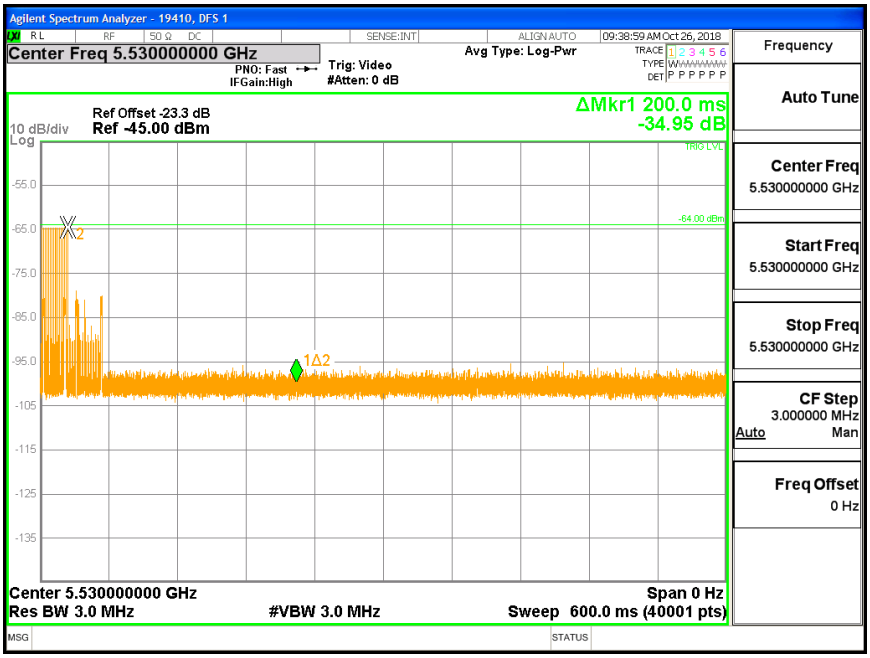
MOVE TIME

MOVE TIME



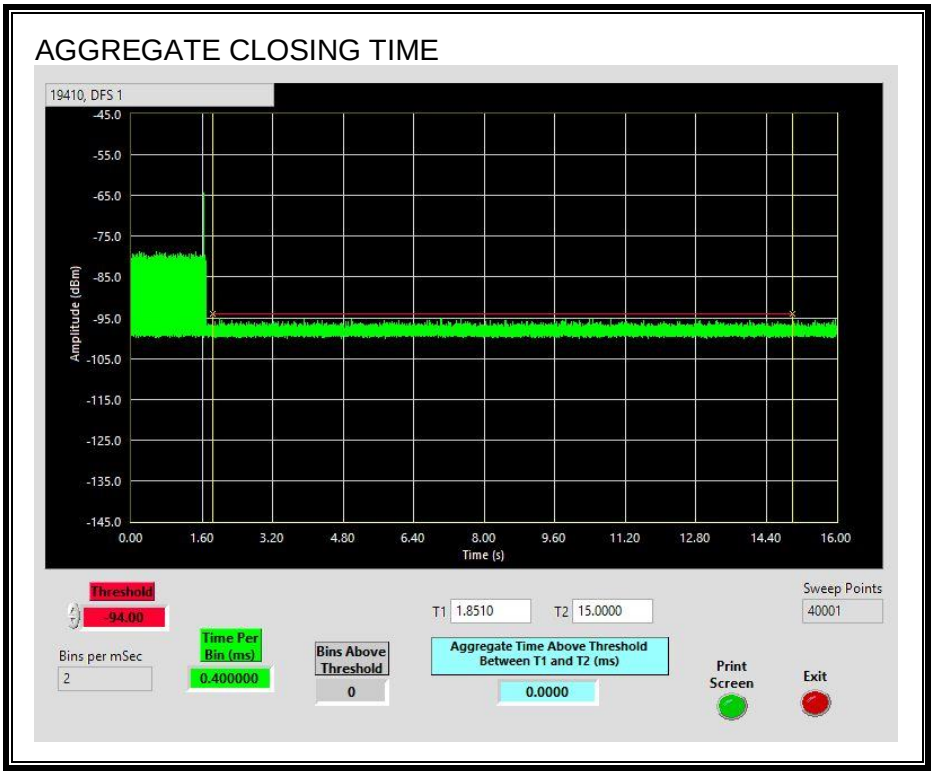
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

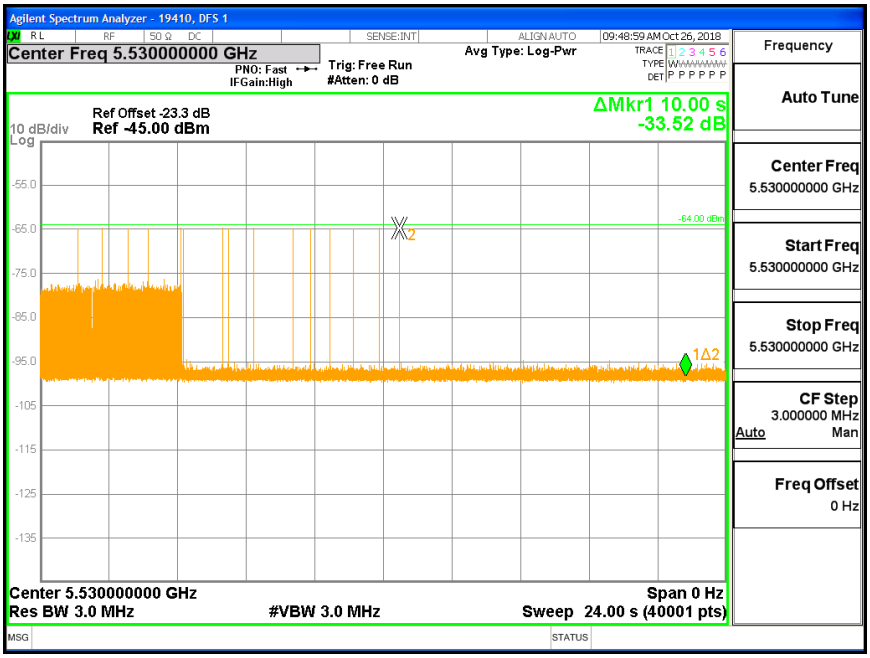
No transmissions are observed during the aggregate monitoring period.



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

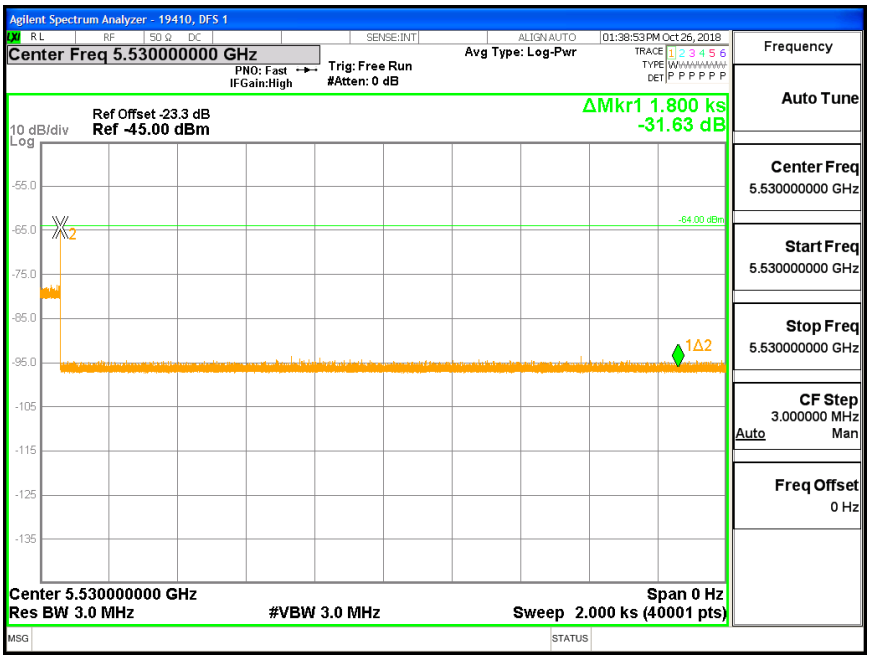


6.4.6. NON-OCCUPANCY PERIOD

RESULTS

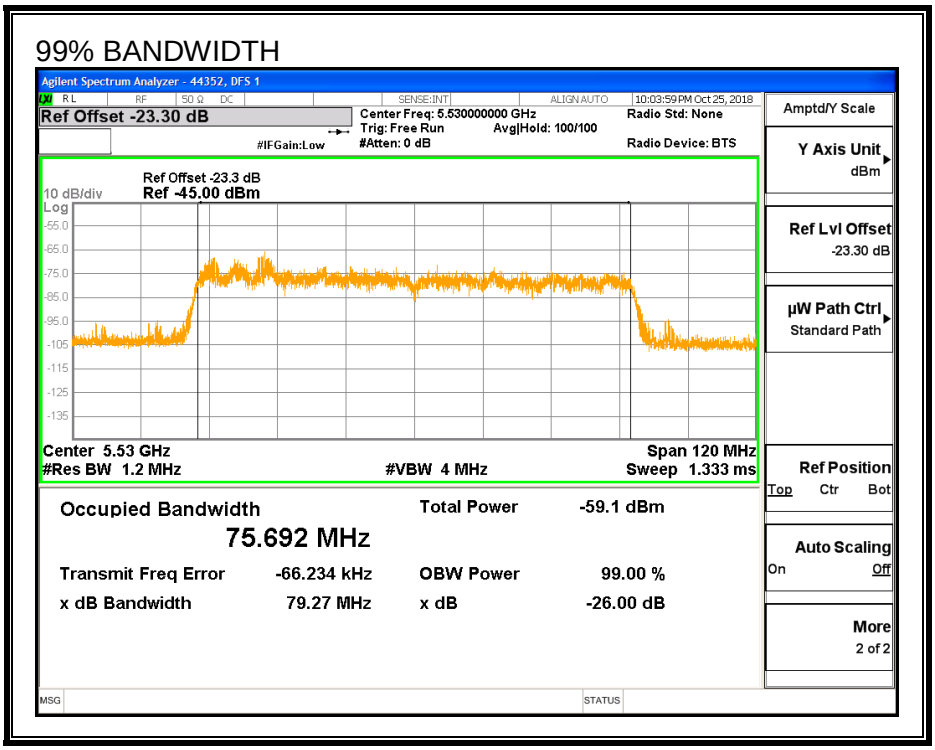
No EUT transmissions were observed on the test channel during the 30-minute observation time.

NON-OCCUPANCY PERIOD



6.4.7. 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	5570	80	75.692	105.7	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 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
5489	10	0	0	
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	
5515	10	10	100	
5520	10	10	100	
5525	10	10	100	
5530	10	10	100	
5535	10	10	100	
5540	10	10	100	
5545	10	10	100	
5550	10	10	100	
5555	10	10	100	
5560	10	10	100	
5565	10	10	100	
5570	10	10	100	FH
5571	10	0	0	

6.4.8. 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	5570	75.69	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 2	30	83.33	60	Pass	5490	5570	75.69	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 3	30	83.33	60	Pass	5490	5570	75.69	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 4	30	73.33	60	Pass	5490	5570	75.69	DFS 1	44352	Version 3.3.4
Aggregate		85.00	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5570	75.69	DFS 1	44352	Version 3.3.4
FCC Hopping Type 6	81	100.00	70	Pass	5490	5570		DFS 1	44352	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	5564	Yes
1002	1	798	67	A	5535	Yes
1003	1	898	59	A	5529	Yes
1004	1	738	72	A	5538	Yes
1005	1	878	61	A	5532	Yes
1006	1	538	99	A	5509	Yes
1007	1	678	78	A	5563	Yes
1008	1	778	68	A	5529	Yes
1009	1	918	58	A	5516	Yes
1010	1	858	62	A	5501	Yes
1011	1	698	76	A	5524	Yes
1012	1	938	57	A	5540	Yes
1013	1	598	89	A	5563	Yes
1014	1	558	95	A	5525	Yes
1015	1	818	65	A	5508	Yes
1016	1	2186	25	B	5566	Yes
1017	1	3013	18	B	5569	Yes
1018	1	1775	30	B	5495	Yes
1019	1	2731	20	B	5520	Yes
1020	1	1622	33	B	5526	Yes
1021	1	1513	35	B	5493	Yes
1022	1	533	100	B	5554	Yes
1023	1	553	96	B	5555	Yes
1024	1	2251	24	B	5561	Yes
1025	1	1207	44	B	5496	Yes
1026	1	1839	29	B	5538	Yes
1027	1	924	58	B	5532	Yes
1028	1	1686	32	B	5528	Yes
1029	1	901	59	B	5515	Yes
1030	1	1295	41	B	5508	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	1.6	189	26	5531	Yes
2002	2.5	183	25	5549	Yes
2003	5	230	24	5499	Yes
2004	4.1	190	23	5550	Yes
2005	2.7	203	23	5527	No
2006	2.1	167	26	5527	No
2007	3.1	184	29	5532	Yes
2008	4.8	152	27	5494	Yes
2009	1.9	217	23	5507	Yes
2010	3.9	151	27	5533	Yes
2011	3.4	219	24	5543	Yes
2012	1.4	158	26	5535	Yes
2013	1.1	150	27	5518	Yes
2014	3.5	216	29	5537	Yes
2015	1.5	212	23	5509	Yes
2016	2.1	201	29	5568	Yes
2017	4.4	163	24	5533	Yes
2018	1.2	157	23	5526	Yes
2019	3.7	166	29	5569	Yes
2020	2.8	164	28	5519	Yes
2021	1.4	177	27	5526	Yes
2022	4.9	222	24	5536	Yes
2023	4	158	27	5529	Yes
2024	3.5	170	24	5555	Yes
2025	4.7	191	28	5509	No
2026	2.6	206	25	5494	Yes
2027	2.1	194	29	5536	No
2028	4.2	213	27	5496	Yes
2029	3.9	205	25	5533	Yes
2030	2.2	190	26	5559	No

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	9.3	363	18	5551	Yes
3002	9.9	331	17	5551	Yes
3003	8.1	464	18	5501	Yes
3004	9	445	18	5548	Yes
3005	7.4	473	17	5512	Yes
3006	6.5	466	16	5503	Yes
3007	7.3	256	18	5529	No
3008	8.6	395	18	5492	No
3009	7.7	449	17	5493	Yes
3010	7.2	483	18	5533	Yes
3011	8.4	299	17	5544	Yes
3012	6.3	346	16	5494	Yes
3013	9.9	307	16	5541	Yes
3014	7.9	367	17	5564	Yes
3015	7.6	342	18	5548	Yes
3016	10	297	18	5563	Yes
3017	8	284	17	5519	Yes
3018	8.6	252	16	5496	Yes
3019	6.8	385	17	5534	Yes
3020	7.7	498	18	5557	No
3021	6.1	393	16	5554	Yes
3022	9.3	269	18	5545	No
3023	6	427	17	5508	Yes
3024	9.5	316	16	5541	Yes
3025	6.4	370	16	5556	Yes
3026	6	404	17	5540	Yes
3027	9.3	470	16	5519	Yes
3028	9.1	267	16	5547	No
3029	8.6	479	18	5529	Yes
3030	6.7	288	16	5534	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	11.8	262	15	5531	Yes
4002	12.8	468	14	5543	Yes
4003	12.6	455	12	5542	Yes
4004	14.1	423	16	5565	Yes
4005	19.1	305	15	5536	Yes
4006	12	419	15	5508	Yes
4007	13.2	314	16	5496	No
4008	15.6	441	14	5527	Yes
4009	17.3	348	13	5549	Yes
4010	15.9	487	16	5492	Yes
4011	18.1	423	15	5491	No
4012	17.2	325	13	5542	Yes
4013	15.5	391	16	5492	Yes
4014	15.1	438	16	5504	Yes
4015	13.9	400	14	5514	No
4016	18.7	460	15	5533	No
4017	18	434	13	5533	No
4018	19	389	12	5497	Yes
4019	18.8	258	13	5506	Yes
4020	11.2	477	15	5521	Yes
4021	16.2	477	14	5522	No
4022	18.2	340	13	5540	Yes
4023	19.4	485	15	5507	Yes
4024	12.7	361	12	5502	Yes
4025	14.4	269	16	5540	Yes
4026	13.1	290	14	5560	No
4027	15.2	344	14	5551	Yes
4028	14.3	496	16	5559	Yes
4029	12.7	445	14	5511	Yes
4030	12.2	359	15	5535	No

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	**Frequency (MHz)**	**Successful Detection (Yes/No)**
1	5530	Yes
2	5530	Yes
3	5530	Yes
4	5530	Yes
5	5530	Yes
6	5530	Yes
7	5530	Yes
8	5530	Yes
9	5530	Yes
10	5530	Yes
11	5497	Yes
12	5500	Yes
13	5499	Yes
14	5500	Yes
15	5495	Yes
16	5497	Yes
17	5499	Yes
18	5497	Yes
19	5500	Yes
20	5499	Yes
21	5560	Yes
22	5565	Yes
23	5563	Yes
24	5561	Yes
25	5563	Yes
26	5561	Yes
27	5562	Yes
28	5562	Yes
29	5561	Yes
30	5564	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	348	5490	10	Yes
2	823	5491	15	Yes
3	1298	5492	21	Yes
4	1773	5493	21	Yes
5	2248	5494	19	Yes
6	2723	5495	15	Yes
7	3198	5496	13	Yes
8	3673	5497	12	Yes
9	4148	5498	19	Yes
10	4623	5499	16	Yes
11	5098	5500	13	Yes
12	5573	5501	15	Yes
13	6048	5502	13	Yes
14	6523	5503	18	Yes
15	6998	5504	15	Yes
16	7473	5505	14	Yes
17	7948	5506	13	Yes
18	8423	5507	18	Yes
19	8898	5508	26	Yes
20	9373	5509	14	Yes
21	9848	5510	12	Yes
22	10323	5511	20	Yes
23	10798	5512	20	Yes
24	11273	5513	17	Yes
25	11748	5514	13	Yes
26	12223	5515	15	Yes
27	12698	5516	26	Yes
28	13173	5517	17	Yes
29	13648	5518	12	Yes
30	14123	5519	18	Yes
31	14598	5520	12	Yes
32	15073	5521	14	Yes
33	15548	5522	15	Yes
34	16023	5523	19	Yes
35	16498	5524	20	Yes
36	16973	5525	17	Yes
37	17448	5526	15	Yes

TYPE 6 DETECTION PROBABILITY (CONTINUED)

38	17923	5527	16	Yes
39	18398	5528	14	Yes
40	18873	5529	17	Yes
41	19348	5530	21	Yes
42	19823	5531	17	Yes
43	20298	5532	14	Yes
44	20773	5533	9	Yes
45	21248	5534	20	Yes
46	21723	5535	18	Yes
47	22198	5536	11	Yes
48	22673	5537	14	Yes
49	23148	5538	14	Yes
50	23623	5539	15	Yes
51	24098	5540	16	Yes
52	24573	5541	18	Yes
53	25048	5542	16	Yes
54	25523	5543	19	Yes
55	25998	5544	17	Yes
56	26473	5545	17	Yes
57	26948	5546	14	Yes
58	27423	5547	19	Yes
59	27898	5548	22	Yes
60	28373	5549	15	Yes
61	28848	5550	17	Yes
62	29323	5551	20	Yes
63	29798	5552	13	Yes
64	30273	5553	17	Yes
65	30748	5554	15	Yes
66	31223	5555	20	Yes
67	31698	5556	16	Yes
68	32173	5557	20	Yes
69	32648	5558	22	Yes
70	33123	5559	18	Yes
71	33598	5560	20	Yes
72	34073	5561	21	Yes
73	34548	5562	15	Yes
74	35023	5563	23	Yes
75	35498	5564	20	Yes
76	35973	5565	25	Yes
77	36448	5566	14	Yes
78	36923	5567	16	Yes
79	37398	5568	17	Yes
80	37873	5569	17	Yes
81	38348	5570	15	Yes

6.5. 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.