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

CERTIFICATION TEST REPORT

FOR

802.11a/b/g/n/ac WIRELESS ACCESS POINT

MODEL NUMBERS: MR20-HW

FCC ID: UDX-60066010
IC ID: 6961A-60066020

REPORT NUMBER: 11765639-E8V3

ISSUE DATE: JANUARY 12, 2018

Prepared for
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170 WEST TASMAN DRIVE
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	9/26/2017	Initial Issue	Conan Cheung
V2	1/08/2018	Removed model numbers and updated FCC ID	Henry Lau
V3	1/11/2018	Update FCC ID	Edgard Rincand
V4	1/12/2018	Update IC ID	Ayako Kanamatsu

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ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 802.11a/b/g/n/ac WIRELESS ACCESS POINT

MODEL: MR20-HW

SERIAL NUMBER: Q2VD-ZLHN-PTNL

DATE TESTED: JULY 14 – 17, 2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
DFS Portion of CFR 47 Part 15 Subpart E	Complies
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.

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1. 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.

2. 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. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

3. CALIBRATION AND UNCERTAINTY

3.1. 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.

3.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

3.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Time	± 0.02 %

Uncertainty figures are valid to a confidence level of 95%.

4. DYNAMIC FREQUENCY SELECTION

4.1. OVERVIEW

4.1.1. 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

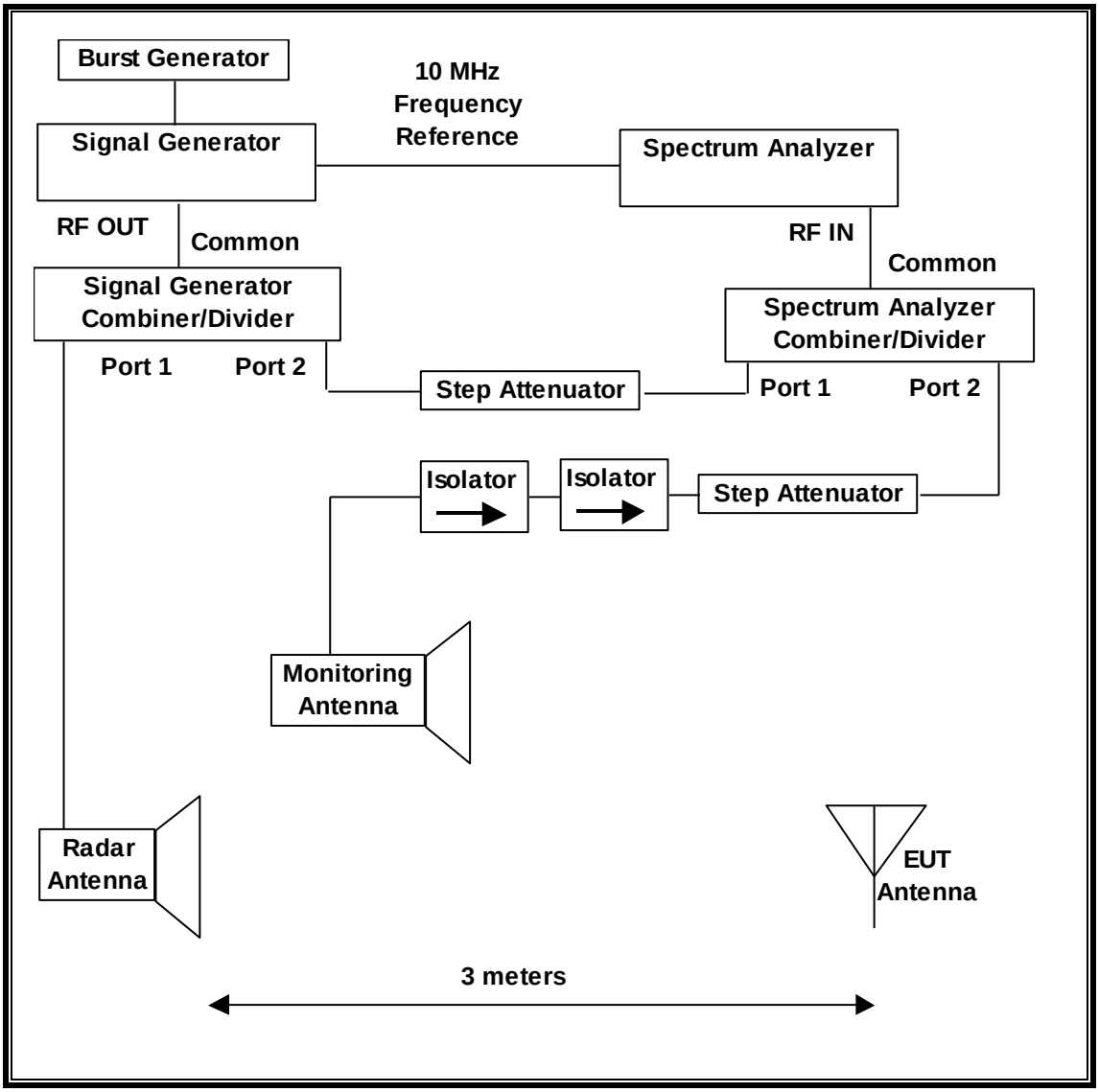
Radar Waveform Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

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

4.1.2. 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. Iperf is utilized to generate WLAN traffic. 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**	**Serial Number**	**Cal Due**
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	US51350187	06/22/18
Signal Generator, MXG X-Series RF Vector	Agilent	N5182B	MY51350337	04/21/18
Arbitrary Waveform Generator	Agilent / HP	33220A	MY44037572	04/06/18

4.1.3. 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	3.0	Channel Loading and Aggregate Closing Time
FCC 2006 Detection Bandwidth-PXA	3.0	Detection Bandwidth in 1 MHz Steps
FCC 2014 Detection Bandwidth-PXA	3.0	Detection Bandwidth in 5 MHz Steps
In Service Monitoring-PXA	3.0	In-Service Monitoring (Probability of Detection)
PXA Read	3.0.0.9	Signal Generator Screen Capture
SGXProject.exe	1.7	Radar Waveform Generation and Download

TEST ROOM ENVIRONMENT

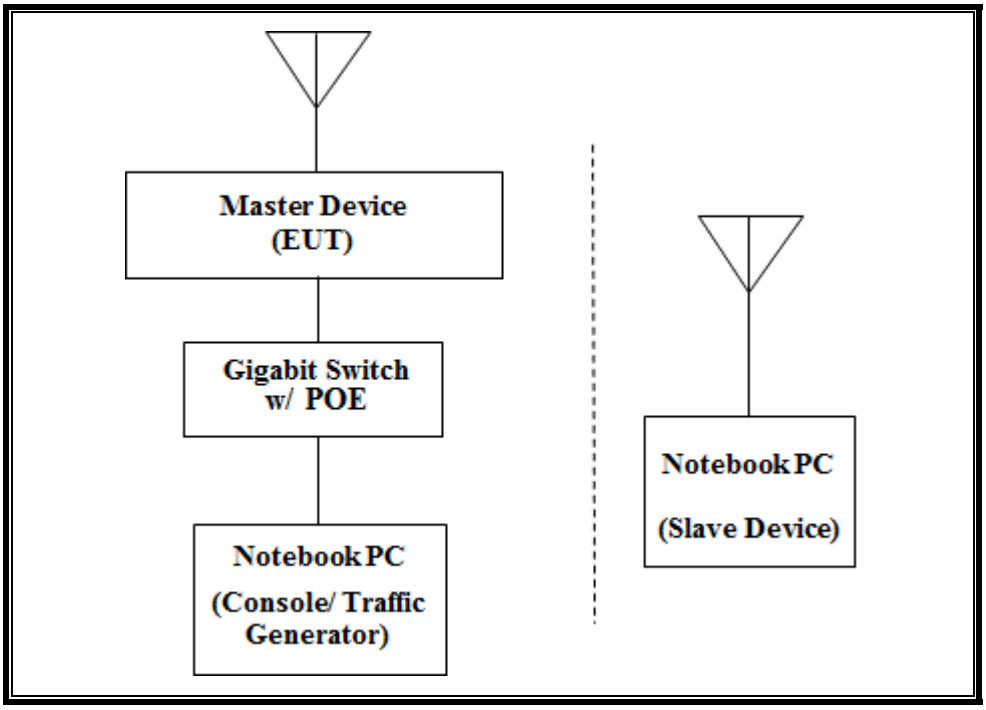
The test room temperature and humidity shall be maintained within normal temperature of 15~35 °C and normal humidity 20~75% (relative humidity).

ENVIRONMENT CONDITION

Parameter	Value
Temperature	21.6 °C
Humidity	31 %

4.1.4. 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 & Traffic Generator)	Apple	A1435	D39433601B4FTC0A1	DoC
Notebook PC (Slave Device)	Apple	A1465	C02KTGMPF5N7	QDS-BRCM1072
AC Adapter (Slave PC)	Apple	A1435	C04341216J2F288BT	DoC
Gigabit Switch with POE	Meraki	MS220-8P	Q2HP-DR3G-TQZS	DoC

4.1.5. DESCRIPTION OF EUT

The EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges, excluding operation in the band 5600 to 5650 MHz.

The EUT is a Master Device.

For non-beamforming, the highest power level within these bands is 28.94 dBm EIRP in the 5250-5350 MHz band and 29.28 dBm EIRP in the 5470-5725 MHz band.

For beamforming, the highest power level within these bands is 29.1 dBm EIRP in the 5250-5350 MHz band and 29.6 dBm EIRP in the 5470-5725 MHz band.

The only antenna assembly utilized with the EUT has a gain of 5.31 & 5.08 dBi.

Two PIFA 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 T-201705031157-G683acfdf-L01d52bf7-aacharya-flash.

The model tested was Model MR20-W with alternate back plate.

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 Access Point, FCC ID: UDX-60066010. The minimum antenna gain for the Master Device is 5.08 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.

4.2. RESULTS FOR 20 MHz BANDWIDTH

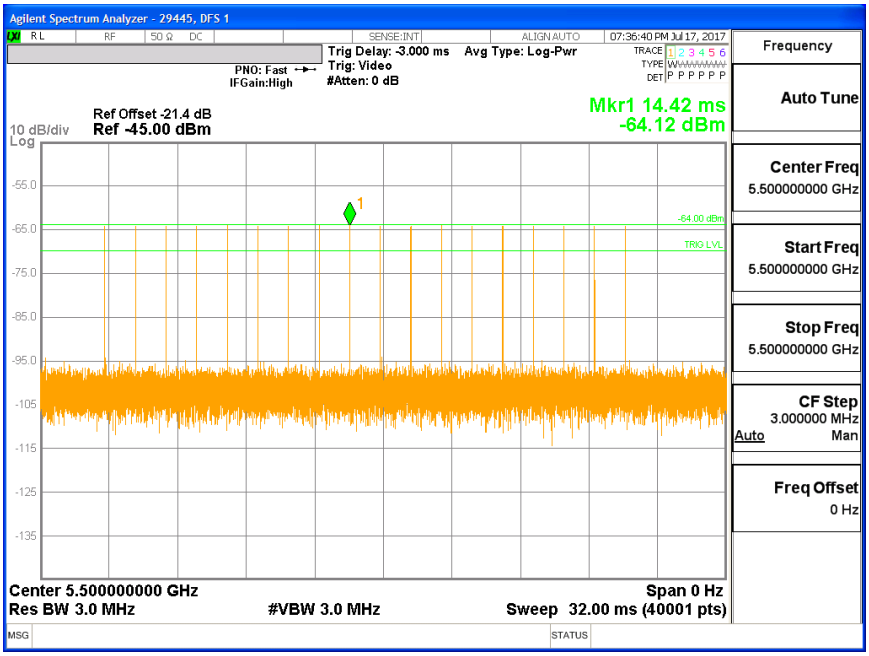
4.2.1. TEST CHANNEL

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

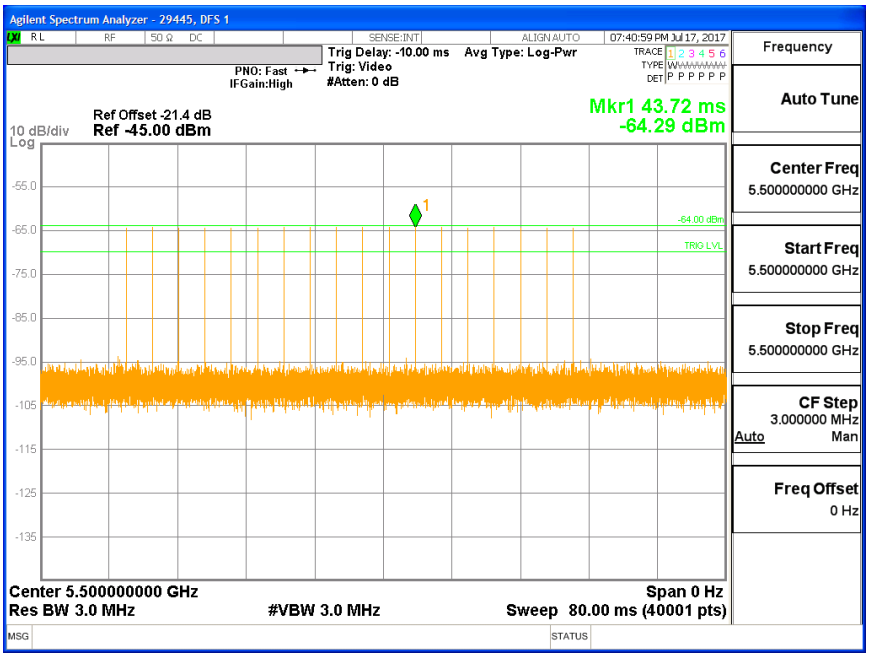
4.2.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

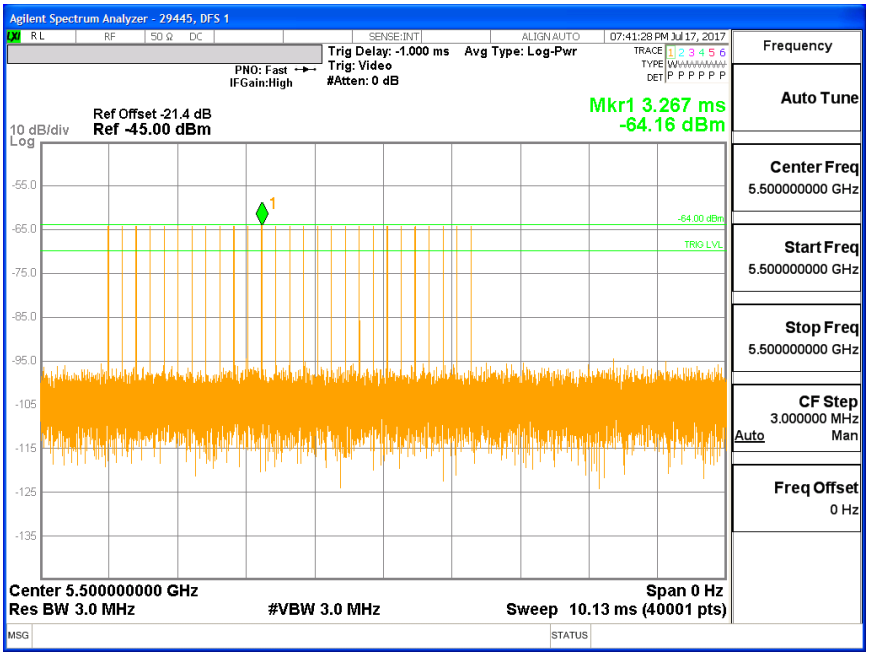
SHORT PULSE RADAR TYPE 0



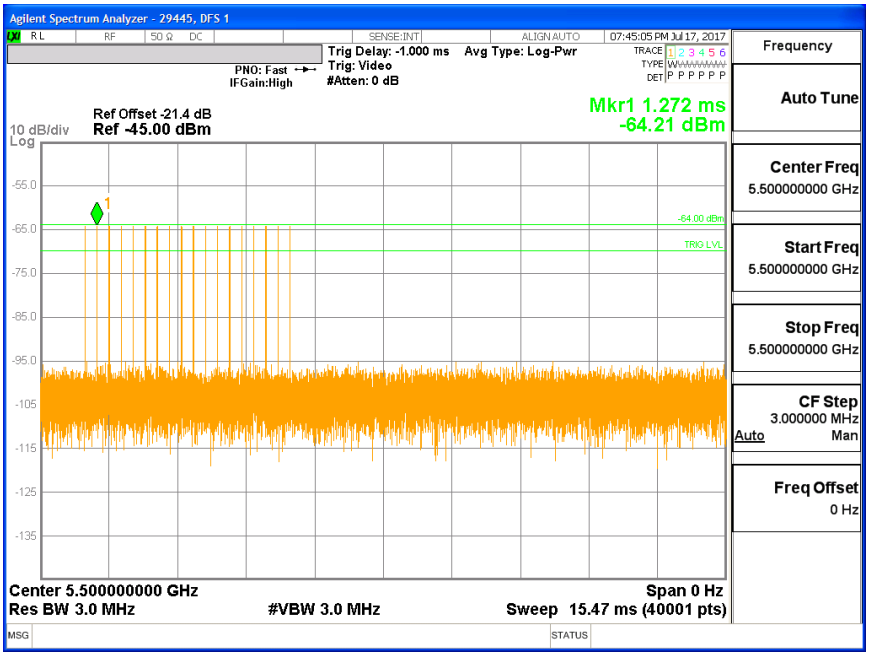
SAMPLE OF RADAR TYPE 1



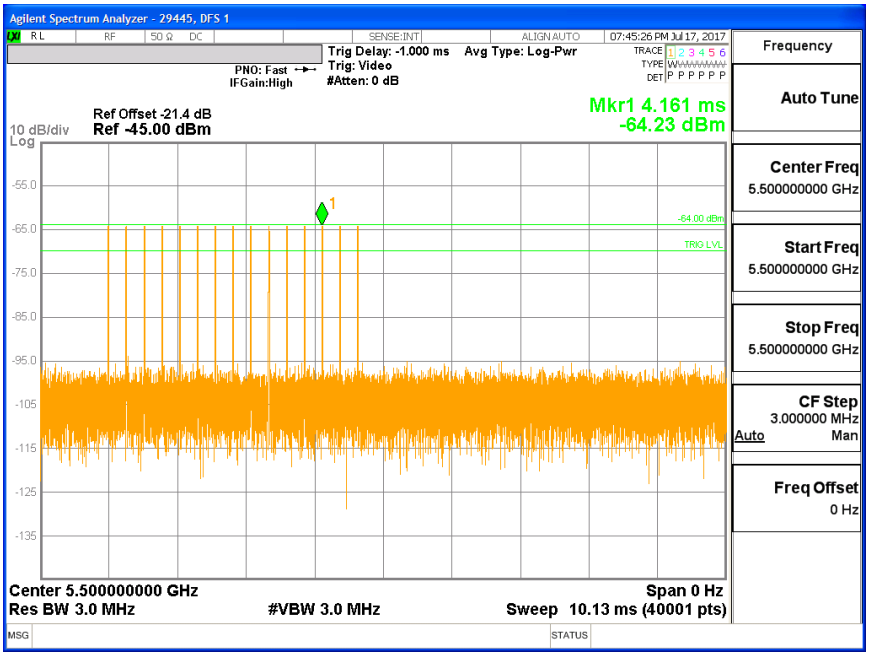
SAMPLE OF RADAR TYPE 2



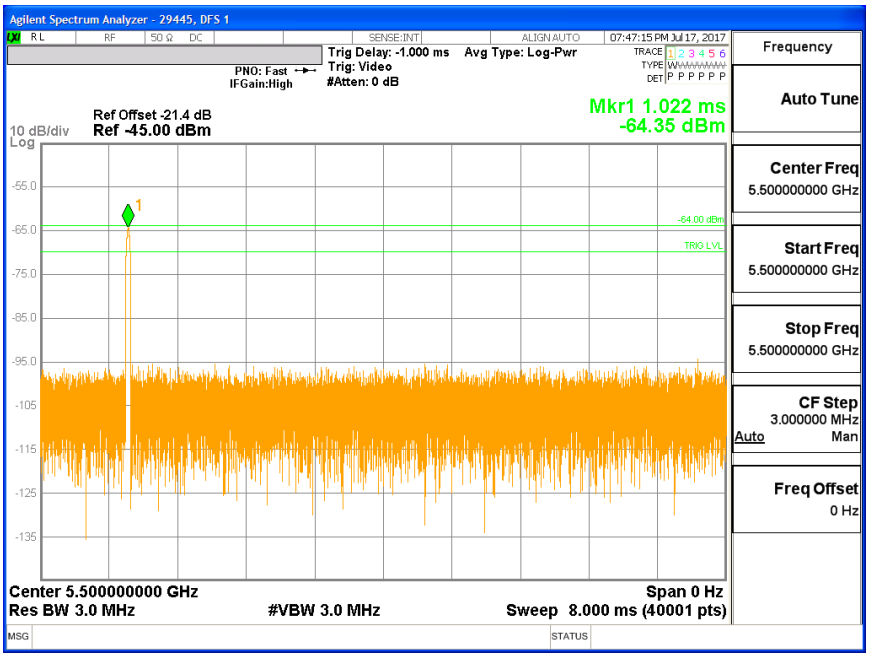
SAMPLE OF RADAR TYPE 3



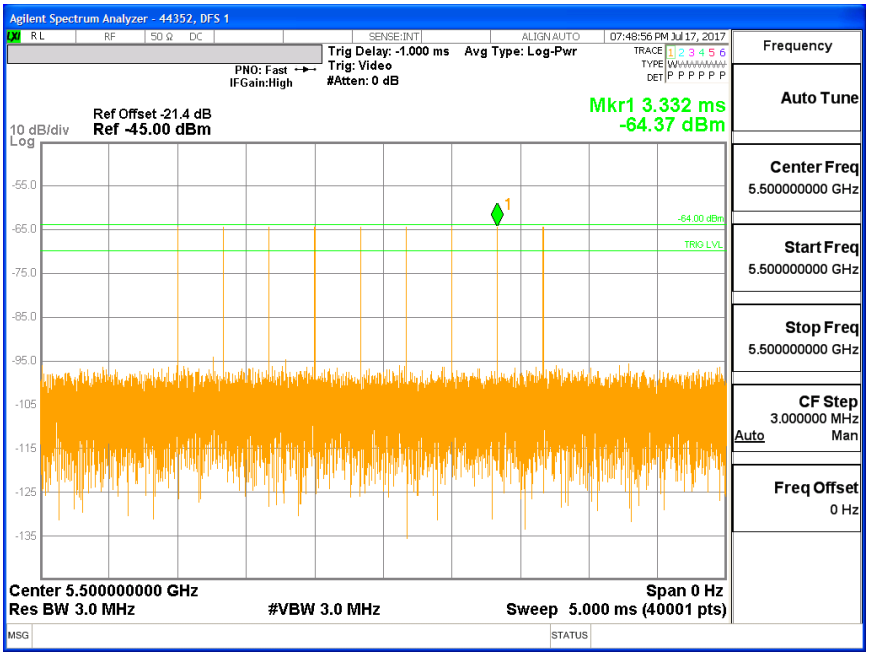
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

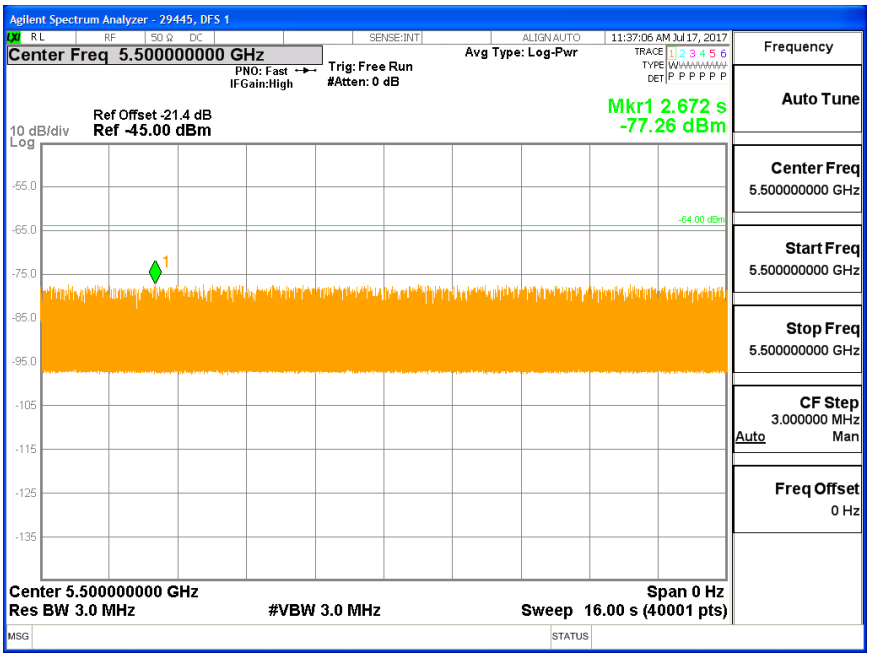


SINGLE BURST OF RADAR TYPE 6

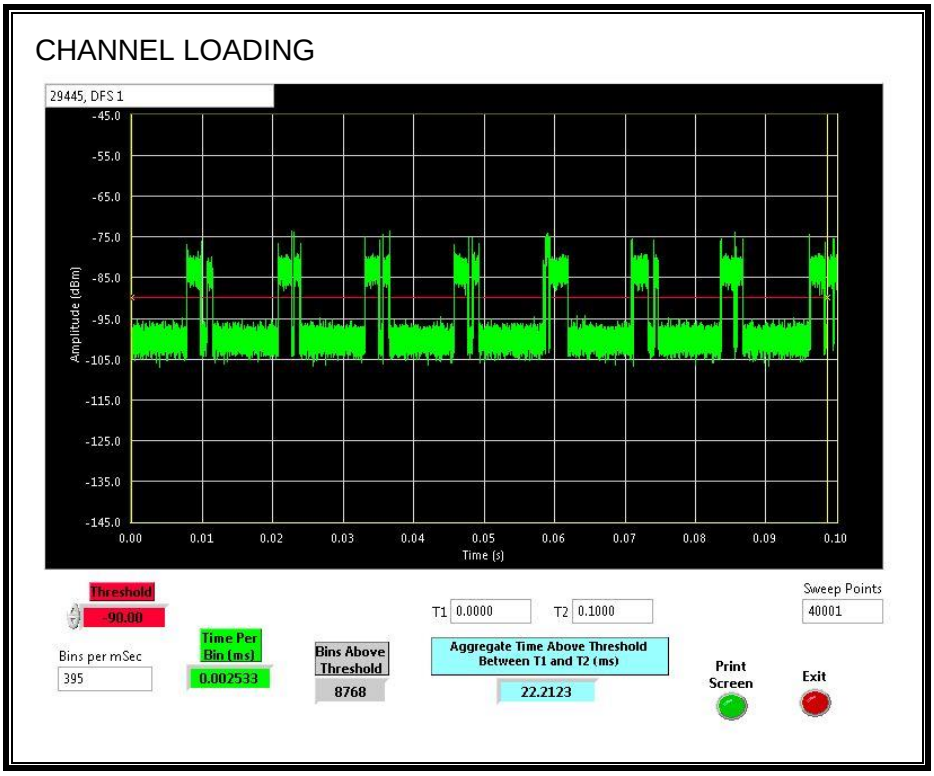


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 22.21%

4.2.3. 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)
30.16	209.5	179.3	119.3

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)
30.05	150.4	120.4	1.0

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)
30.08	207.4	177.3	58.0

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

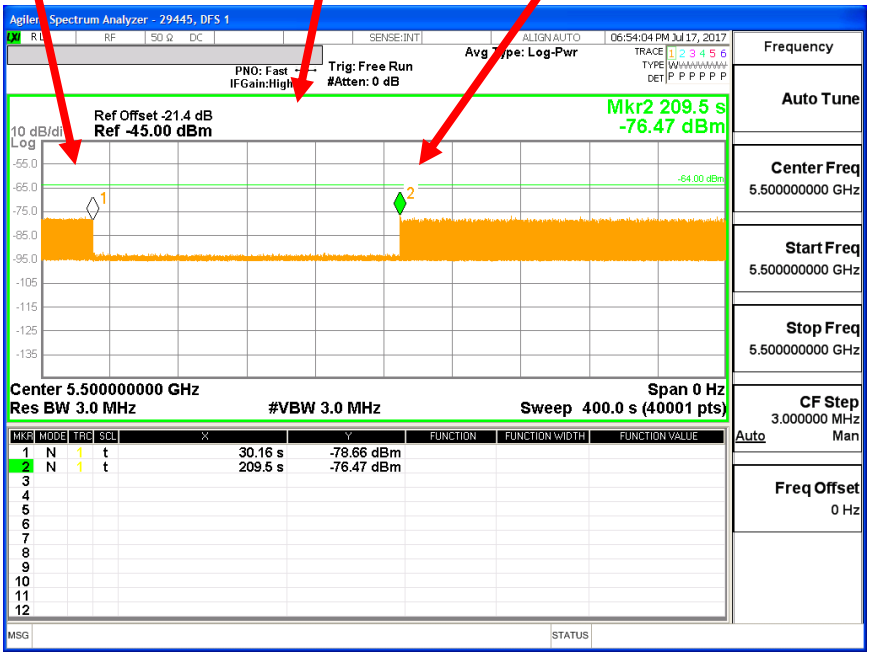
TIMING WITHOUT RADAR DURING CAC

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



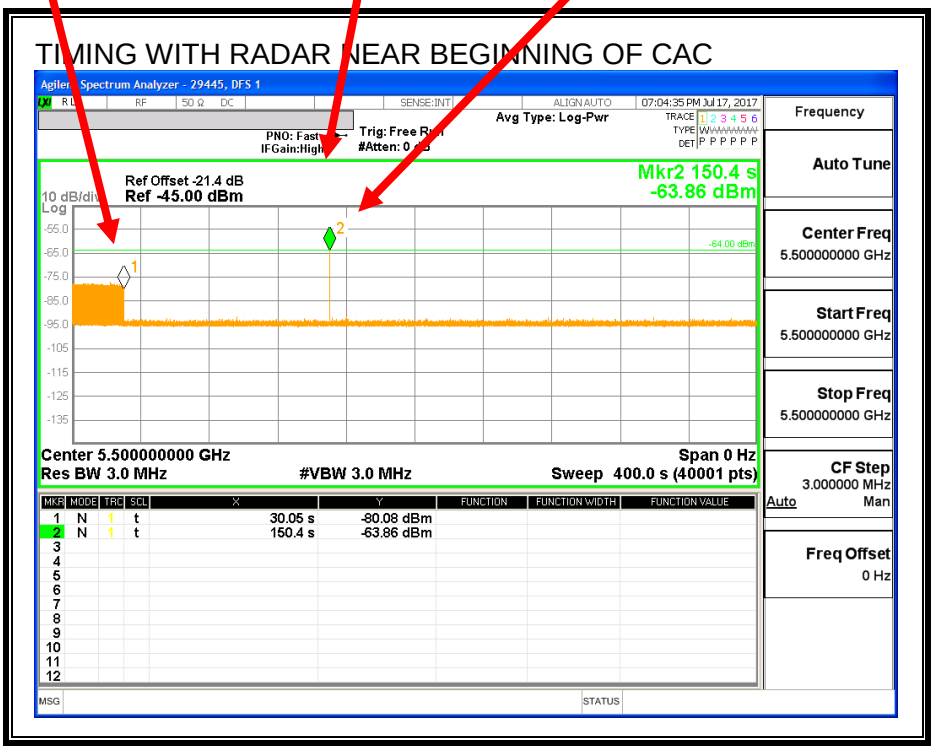
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

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



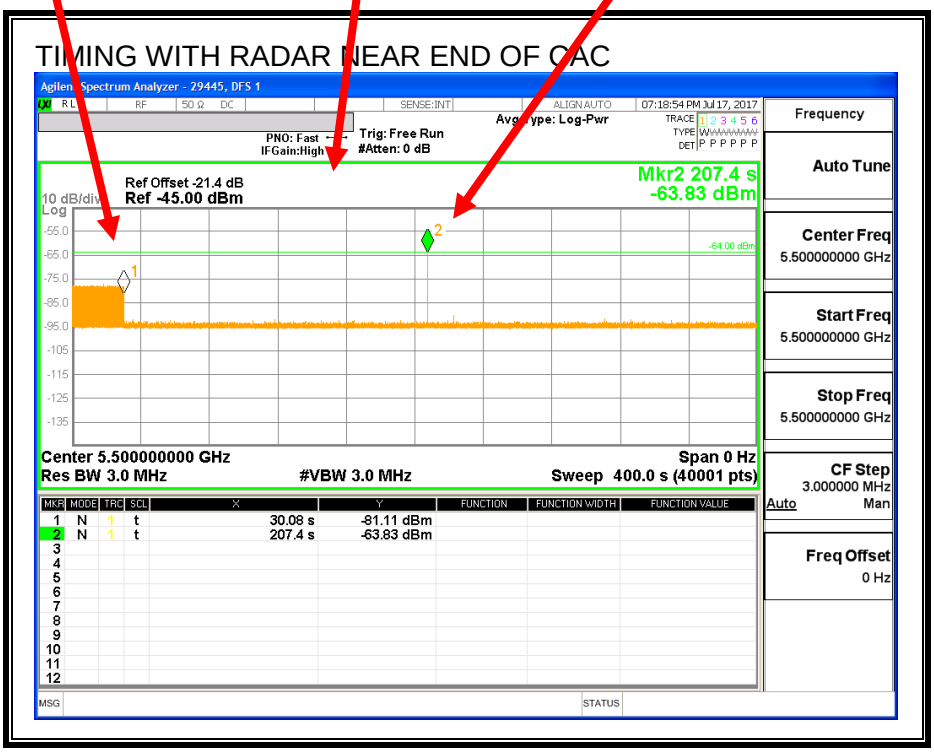
No EUT transmissions were observed after the radar signal.

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.

4.2.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

4.2.5. 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).

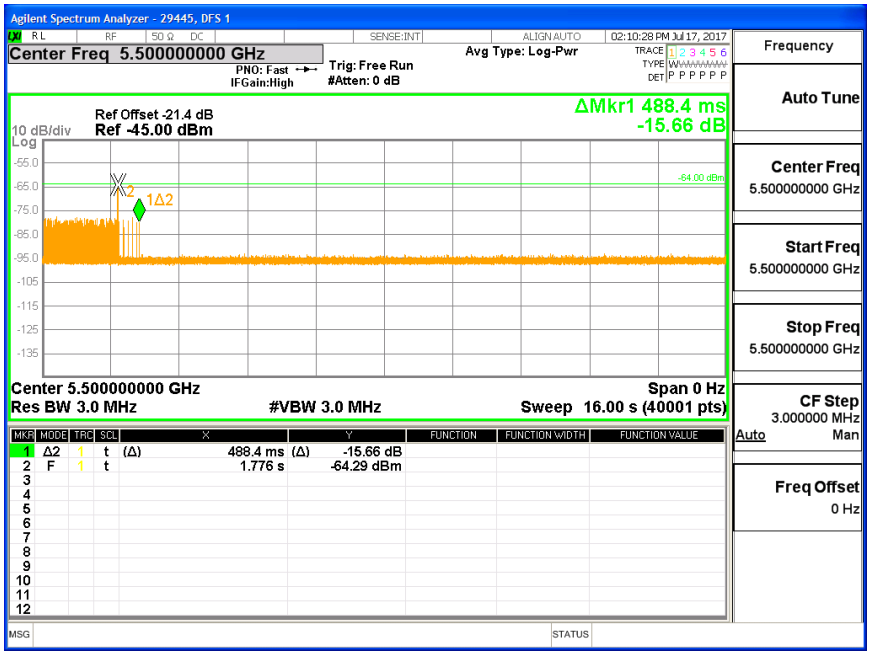
RESULTS

Channel Move Time (sec)	Limit (sec)
0.4884	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
5.2	60

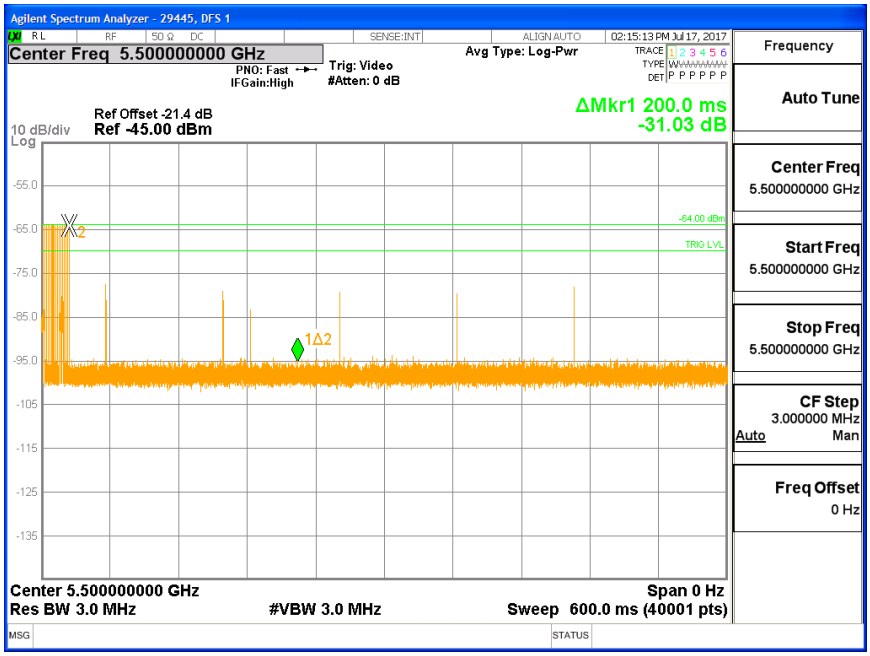
MOVE TIME

MOVE TIME



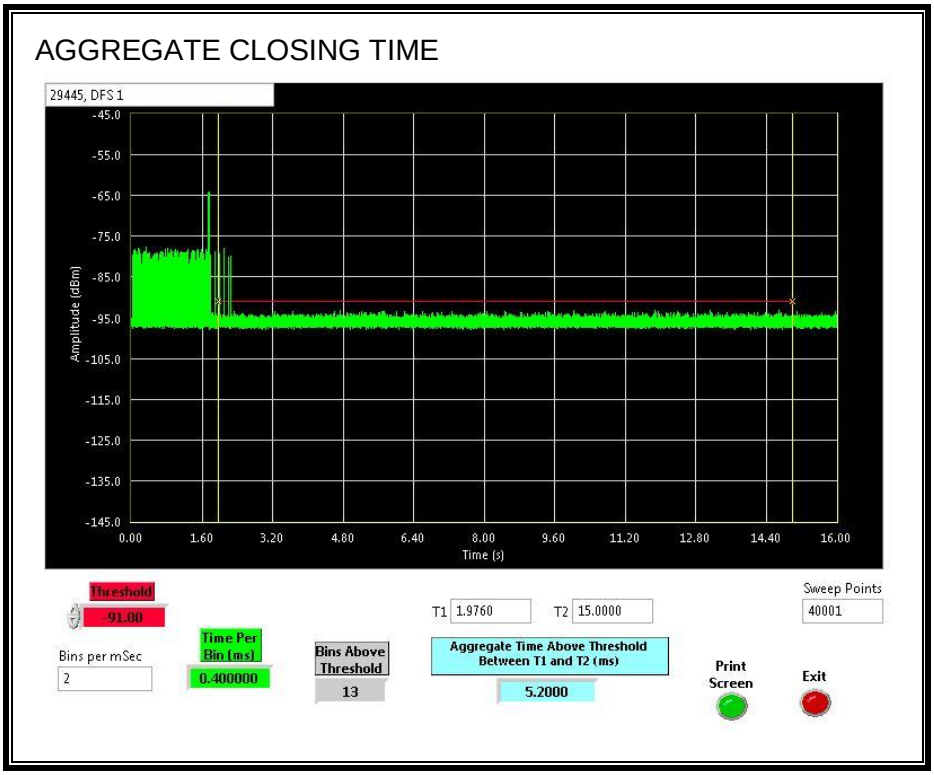
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

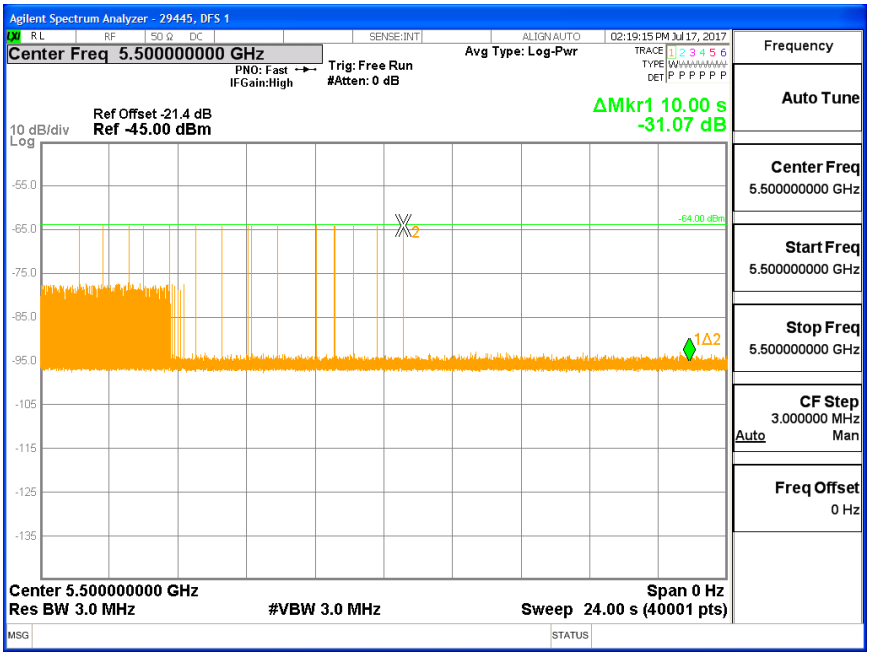
Only intermittent transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

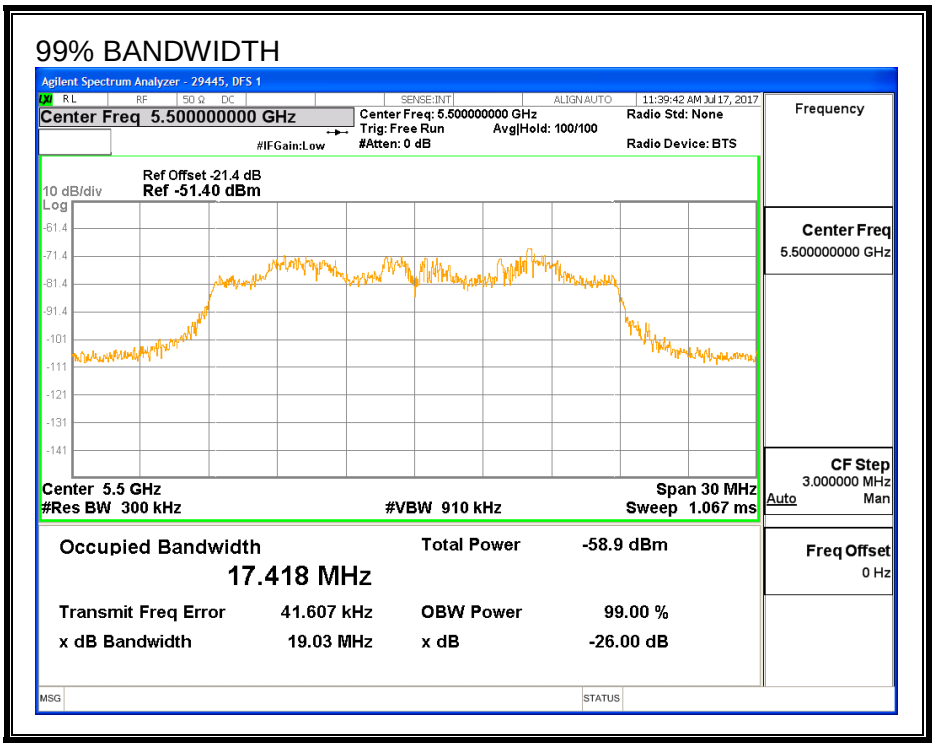
The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR



4.2.6. 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	17.418	114.8	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

4.2.7. 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	17.42	DFS 1	29445	Version 3.0
FCC Short Pulse Type 2	30	83.33	60	Pass	5490	5510	17.42	DFS 1	29445	Version 3.0
FCC Short Pulse Type 3	30	90.00	60	Pass	5490	5510	17.42	DFS 1	29445	Version 3.0
FCC Short Pulse Type 4	30	70.00	60	Pass	5490	5510	17.42	DFS 1	29445	Version 3.0
Aggregate		85.00	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5510	17.42	DFS 1	29445	Version 3.0
FCC Hopping Type 6	42	97.62	70	Pass	5490	5510		DFS 1	29445	Version 3.0

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	5506	Yes
1002	1	898	59	A	5505	Yes
1003	1	578	92	A	5499	Yes
1004	1	678	78	A	5506	Yes
1005	1	838	63	A	5503	Yes
1006	1	518	102	A	5492	Yes
1007	1	918	58	A	5500	Yes
1008	1	618	86	A	5500	Yes
1009	1	858	62	A	5499	Yes
1010	1	818	65	A	5502	Yes
1011	1	638	83	A	5509	Yes
1012	1	938	57	A	5506	Yes
1013	1	758	70	A	5504	Yes
1014	1	698	76	A	5498	Yes
1015	1	658	81	A	5499	Yes
1016	1	2039	26	B	5508	Yes
1017	1	3060	18	B	5506	Yes
1018	1	2692	20	B	5500	Yes
1019	1	2648	20	B	5506	Yes
1020	1	2409	22	B	5507	Yes
1021	1	2495	22	B	5497	No
1022	1	2386	23	B	5504	Yes
1023	1	1406	38	B	5492	Yes
1024	1	1427	37	B	5498	Yes
1025	1	735	72	B	5500	Yes
1026	1	885	60	B	5501	Yes
1027	1	1518	35	B	5498	Yes
1028	1	603	88	B	5508	Yes
1029	1	1365	39	B	5507	Yes
1030	1	1933	28	B	5499	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	2.7	206	27	5503	Yes
2002	4.8	225	28	5505	Yes
2003	4.5	217	26	5502	Yes
2004	5	202	24	5504	Yes
2005	4.9	160	26	5505	Yes
2006	1.4	150	28	5498	Yes
2007	3.7	150	26	5498	Yes
2008	4.6	186	25	5509	Yes
2009	1.1	152	27	5493	Yes
2010	2.1	193	24	5499	Yes
2011	2.9	163	23	5496	Yes
2012	2.3	170	27	5498	Yes
2013	3.3	188	26	5506	Yes
2014	2.8	156	23	5490	Yes
2015	2.1	220	27	5493	No
2016	1.9	192	28	5501	Yes
2017	1.4	180	25	5504	Yes
2018	3.5	199	26	5499	Yes
2019	1.3	153	23	5495	Yes
2020	3.7	177	29	5496	Yes
2021	1.7	215	23	5492	No
2022	4.2	205	29	5502	Yes
2023	2.4	167	24	5506	No
2024	3.3	161	23	5505	No
2025	3.9	208	29	5505	Yes
2026	4.9	168	25	5496	Yes
2027	3.8	224	24	5491	Yes
2028	3.2	188	28	5491	Yes
2029	4.1	205	28	5505	Yes
2030	3.7	173	28	5507	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	8	272	18	5506	Yes
3002	7.8	437	18	5506	Yes
3003	7.3	398	17	5500	Yes
3004	9.4	340	18	5492	Yes
3005	7.2	315	18	5503	Yes
3006	9.6	387	16	5497	Yes
3007	7.5	257	16	5501	Yes
3008	6	475	16	5494	Yes
3009	8.3	357	17	5495	Yes
3010	7.3	338	16	5506	No
3011	9.7	484	16	5498	Yes
3012	6.7	359	16	5504	No
3013	7.5	400	18	5495	Yes
3014	6.9	289	17	5507	Yes
3015	7.8	342	17	5507	Yes
3016	7.4	495	17	5501	Yes
3017	6.7	443	17	5497	Yes
3018	8.7	490	17	5497	Yes
3019	8.1	319	16	5497	Yes
3020	8.1	261	17	5495	Yes
3021	10	486	17	5499	Yes
3022	8.3	308	18	5492	Yes
3023	6.2	428	16	5493	Yes
3024	8.8	396	18	5491	Yes
3025	9.2	278	16	5492	No
3026	6	259	18	5509	Yes
3027	8.4	404	18	5498	Yes
3028	7.6	280	18	5496	Yes
3029	6.2	321	17	5503	Yes
3030	9.7	460	16	5494	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	12.3	263	15	5495	Yes
4002	16.2	415	12	5496	Yes
4003	18.8	364	15	5505	Yes
4004	14.1	411	13	5501	Yes
4005	12.9	372	16	5493	Yes
4006	17.7	432	12	5490	Yes
4007	17	407	13	5501	No
4008	13.2	362	14	5510	Yes
4009	17.8	349	15	5501	Yes
4010	19.3	317	14	5499	Yes
4011	15.3	450	15	5500	Yes
4012	17.2	430	15	5504	Yes
4013	13.6	458	14	5502	Yes
4014	11.8	452	14	5496	Yes
4015	17.7	492	13	5495	No
4016	16.3	381	16	5499	No
4017	14.2	434	13	5493	No
4018	13.3	469	16	5505	Yes
4019	15.9	284	13	5500	Yes
4020	11.2	332	12	5506	No
4021	19.1	293	14	5508	No
4022	14.9	353	13	5494	Yes
4023	14.2	327	16	5500	Yes
4024	19.4	282	12	5494	No
4025	14.9	269	13	5496	Yes
4026	16.4	488	13	5492	Yes
4027	12.4	370	14	5492	Yes
4028	14.3	351	13	5496	No
4029	19.8	379	12	5503	Yes
4030	18	372	15	5501	No

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	5495	Yes
12	5499	Yes
13	5494	Yes
14	5495	Yes
15	5495	Yes
16	5499	Yes
17	5494	Yes
18	5495	Yes
19	5494	Yes
20	5499	Yes
21	5504	Yes
22	5502	Yes
23	5506	Yes
24	5506	Yes
25	5501	Yes
26	5501	Yes
27	5506	Yes
28	5504	Yes
29	5501	Yes
30	5503	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	95	5490	2	Yes
2	570	5491	6	Yes
3	1045	5492	5	Yes
4	1520	5493	2	Yes
5	1995	5494	4	Yes
6	2470	5495	8	Yes
7	2945	5496	6	Yes
8	3420	5497	1	Yes
9	3895	5498	3	Yes
10	4370	5499	4	Yes
11	4845	5500	5	Yes
12	5320	5501	6	Yes
13	5795	5502	2	Yes
14	6270	5503	7	Yes
15	6745	5504	4	Yes
16	7220	5505	2	Yes
17	7695	5506	4	Yes
18	8170	5507	4	Yes
19	8645	5508	3	Yes
20	9120	5509	3	Yes
21	9595	5510	6	Yes
22	10070	5490	4	Yes
23	10545	5491	2	Yes
24	11020	5492	6	Yes
25	11495	5493	4	Yes
26	11970	5494	10	Yes
27	12445	5495	3	Yes
28	12920	5496	7	Yes
29	13395	5497	9	Yes
30	13870	5498	2	Yes
31	14345	5499	4	Yes
32	14820	5500	3	Yes
33	15295	5501	4	Yes
34	15770	5502	3	Yes
35	16245	5503	1	No
36	16720	5504	6	Yes
37	17195	5505	5	Yes
38	17670	5506	5	Yes
39	18145	5507	7	Yes
40	18620	5508	4	Yes
41	19095	5509	5	Yes
42	19570	5510	3	Yes

4.3. RESULTS FOR 40 MHz BANDWIDTH

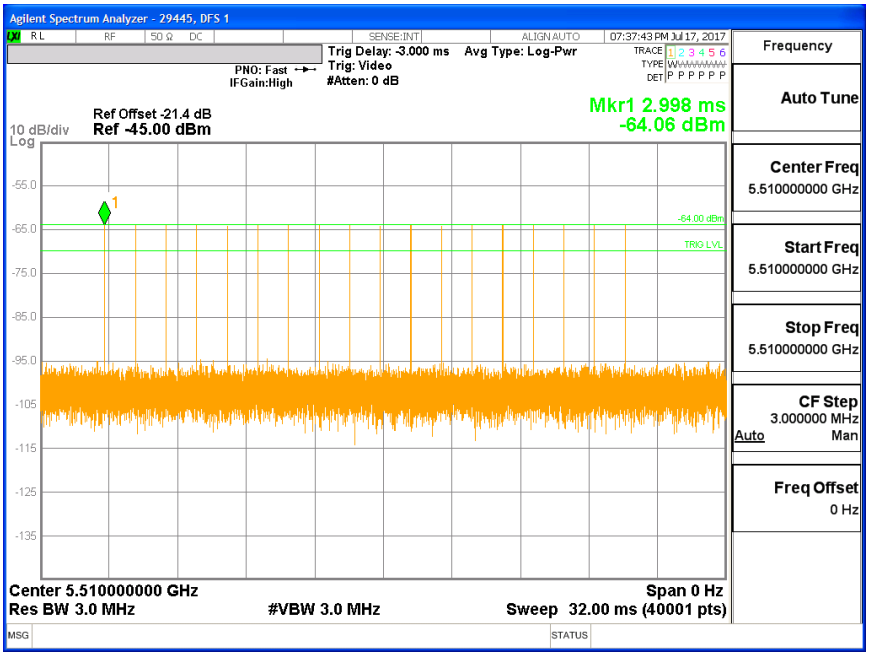
4.3.1. TEST CHANNEL

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

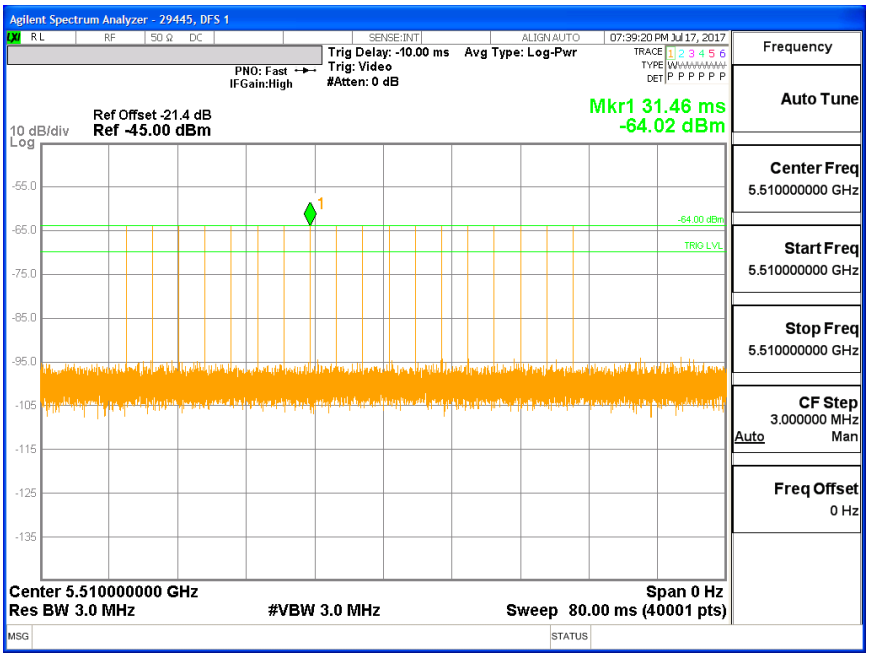
4.3.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

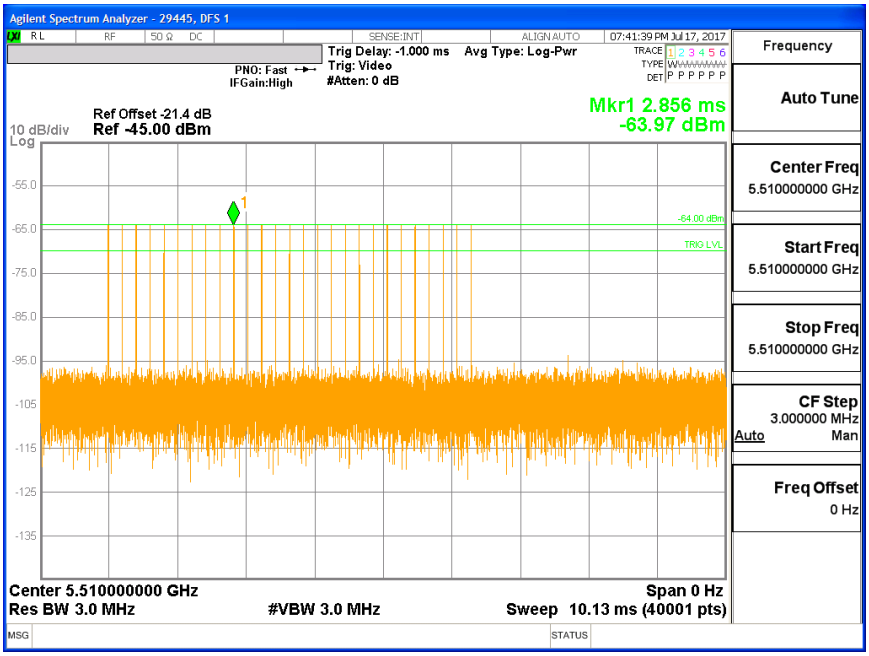
SHORT PULSE RADAR TYPE 0



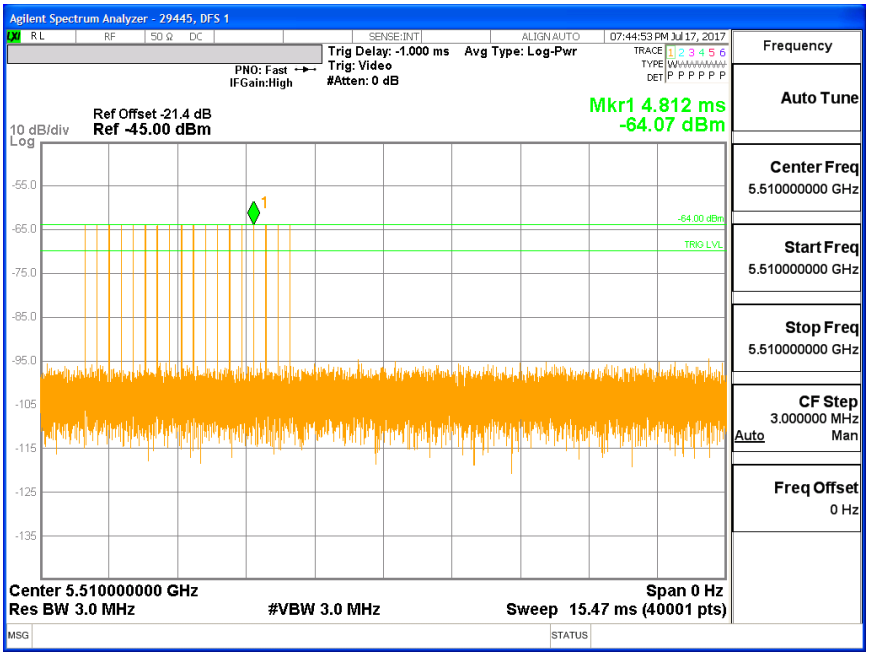
SAMPLE OF RADAR TYPE 1



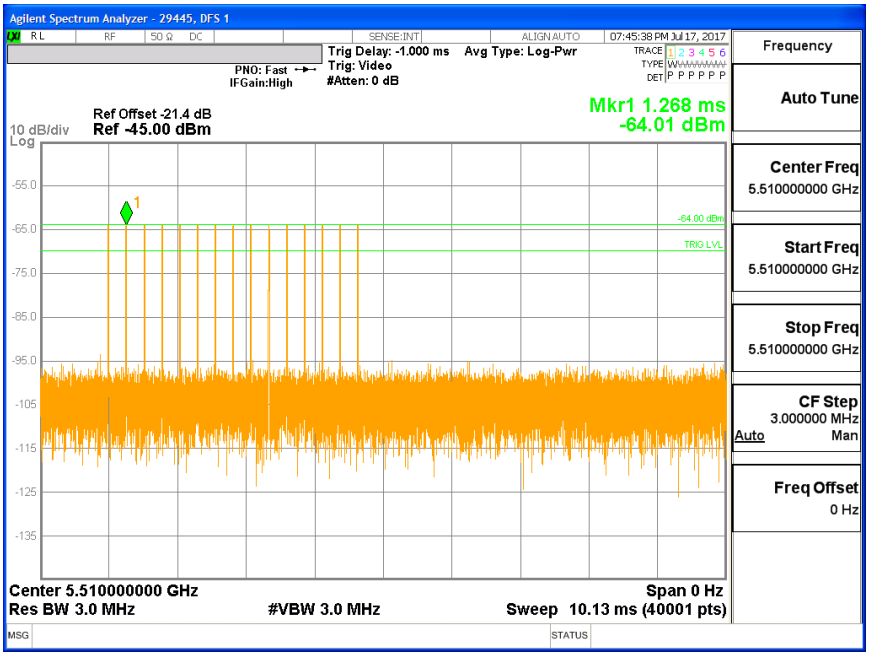
SAMPLE OF RADAR TYPE 2



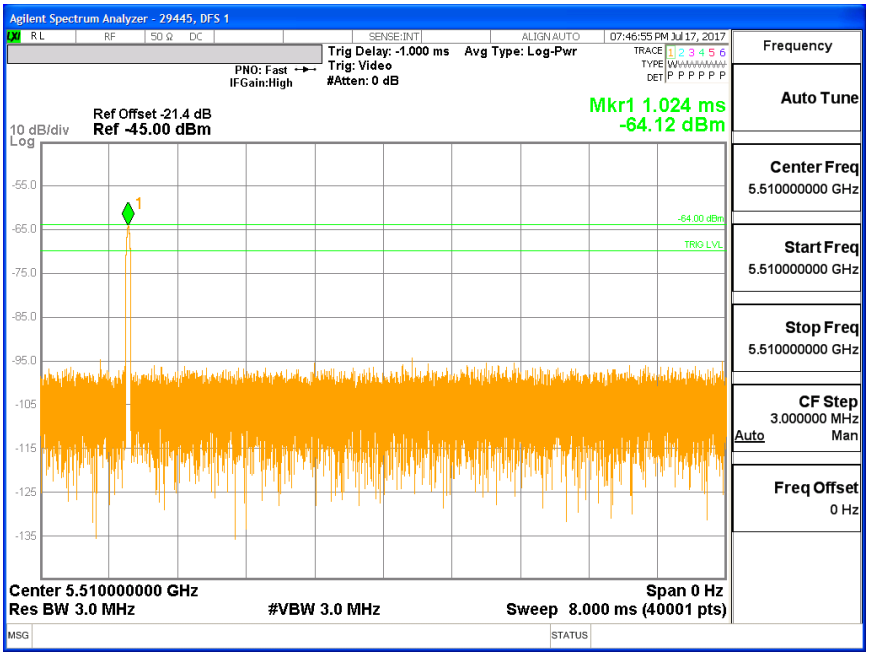
SAMPLE OF RADAR TYPE 3



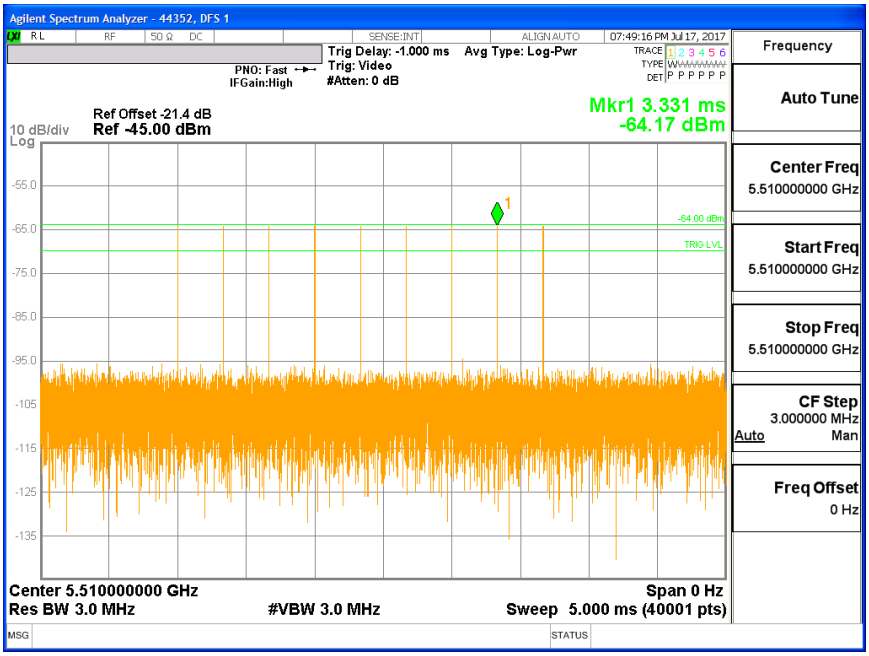
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

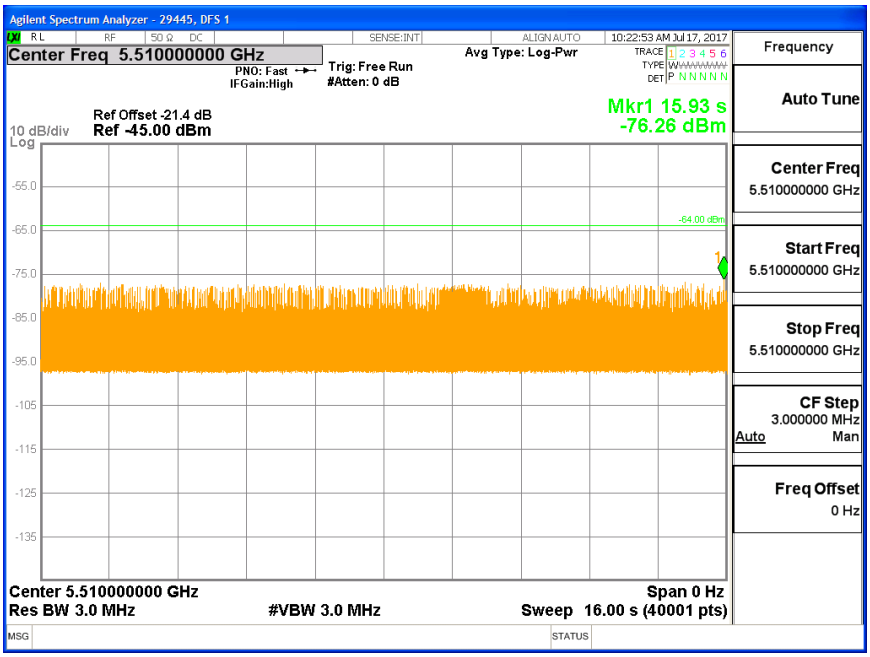


SINGLE BURST OF RADAR TYPE 6

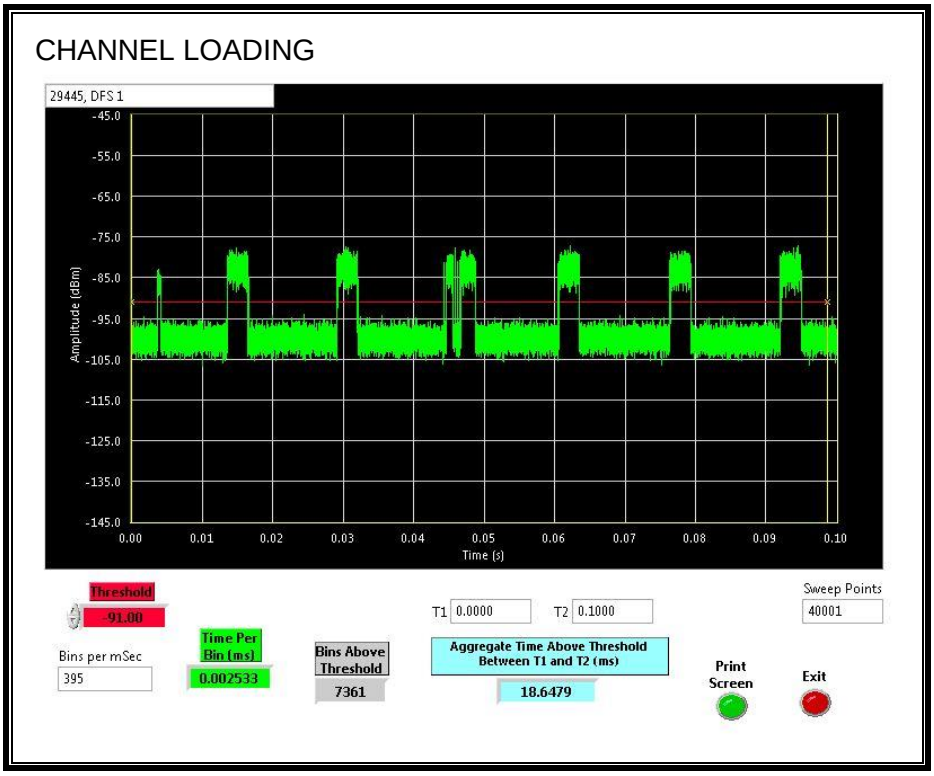


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 18.64%

4.3.3. 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)
30.15	210.4	180.3	120.3

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)
29.88	150.9	121.0	0.8

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)
30.22	208.4	178.2	57.9

QUALITATIVE RESULTS

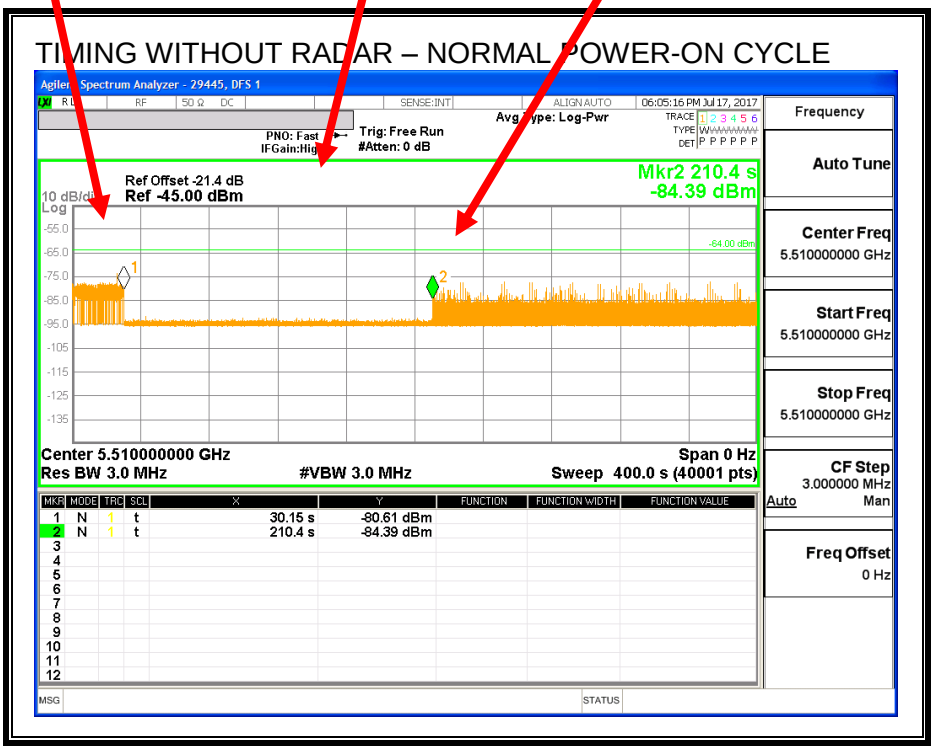
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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

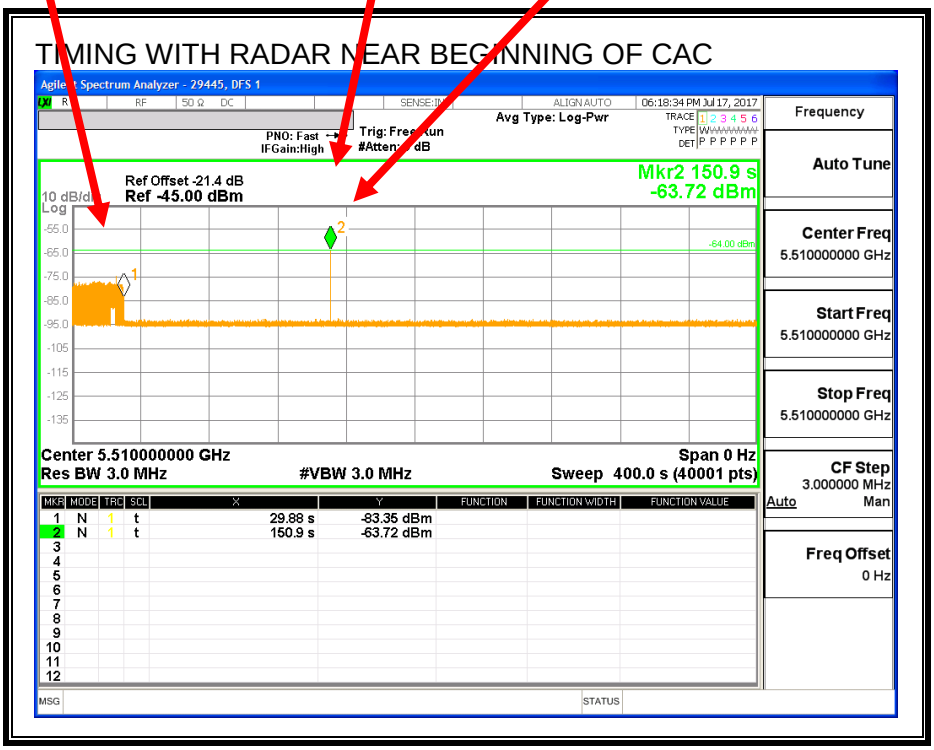
End of CAC
Traffic is Initiated



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



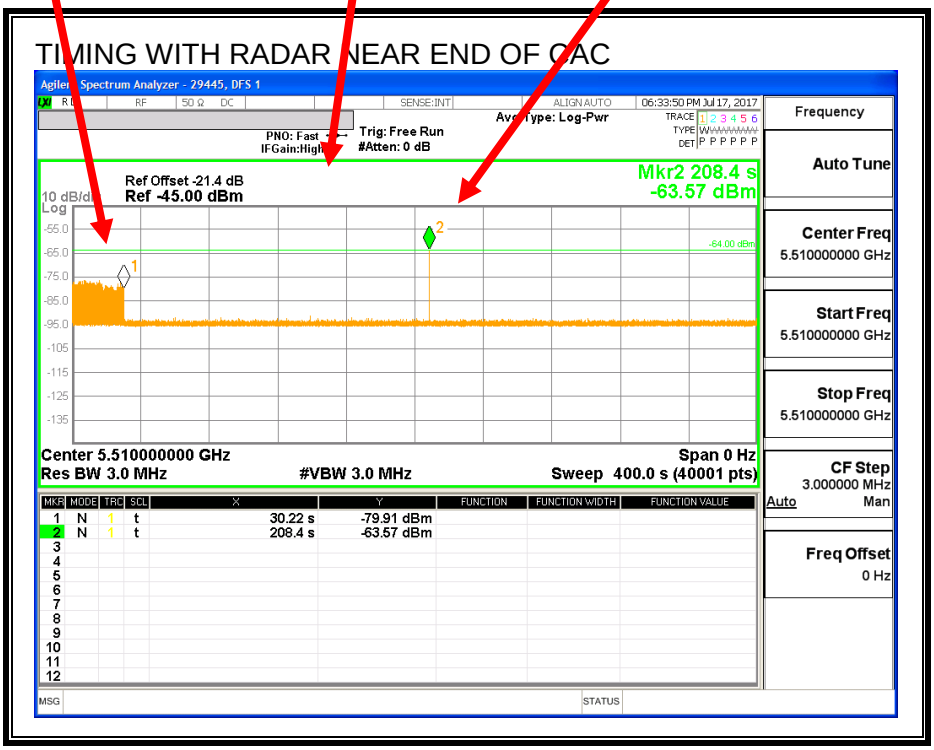
No EUT transmissions were observed after the radar signal.

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.

4.3.1. OVERLAPPING CHANNEL TESTS

RESULTS

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

4.3.2. 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).

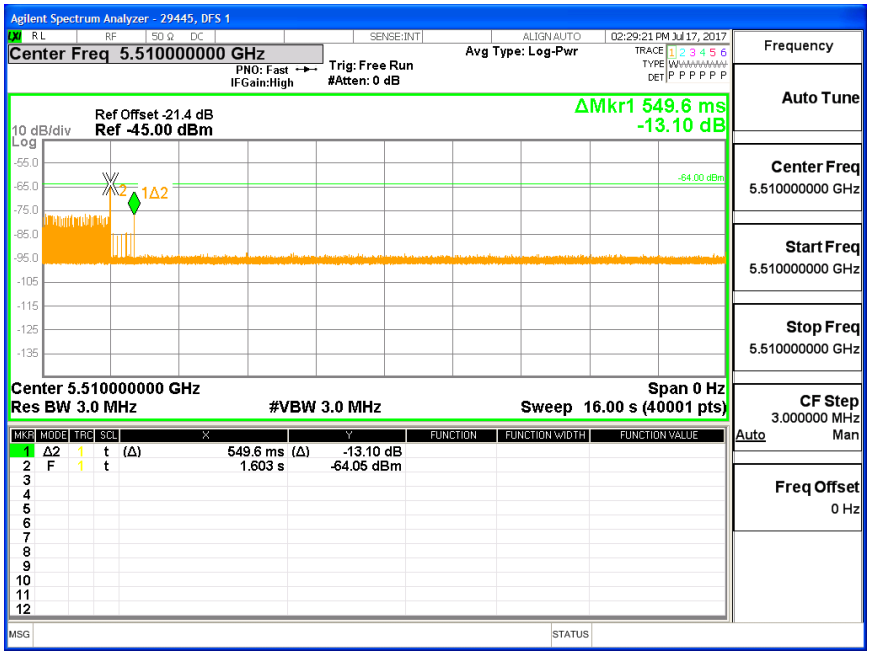
RESULTS

Channel Move Time (sec)	Limit (sec)
0.5496	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
5.6	60

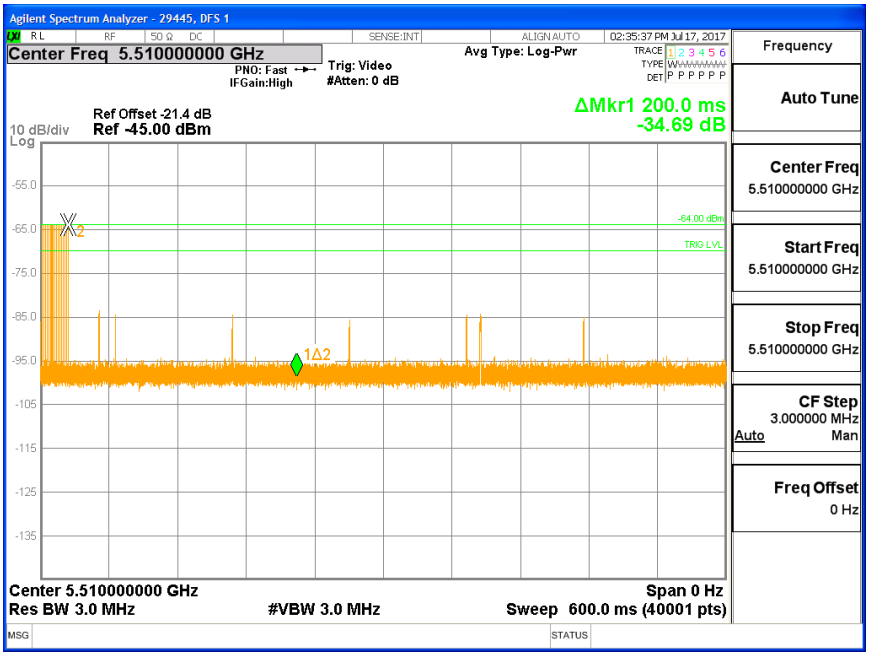
MOVE TIME

MOVE TIME



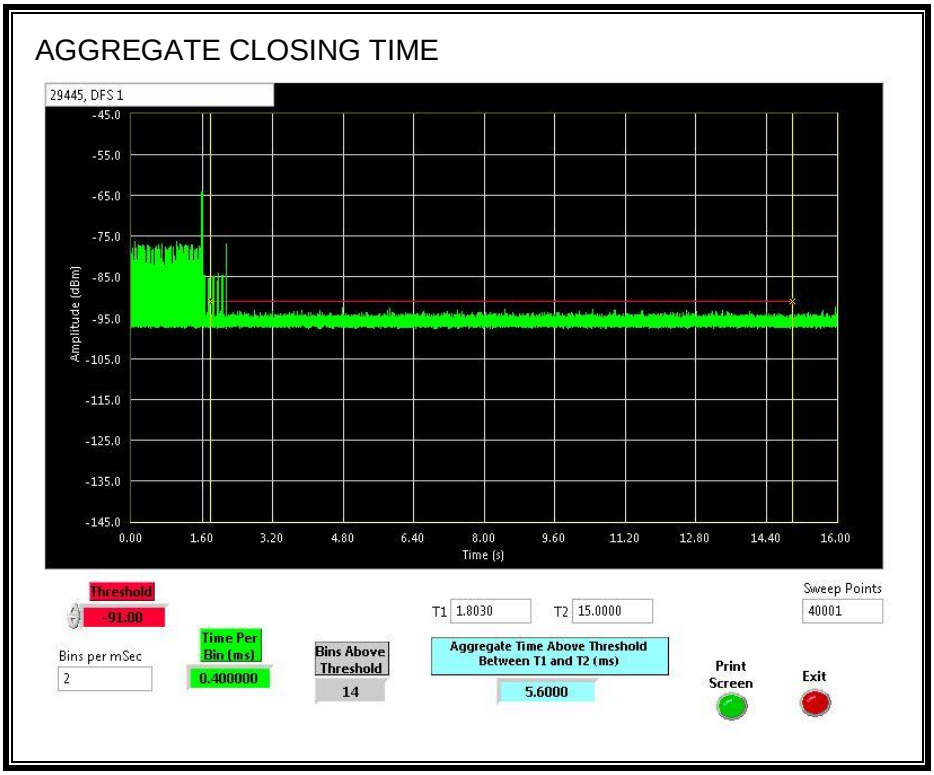
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

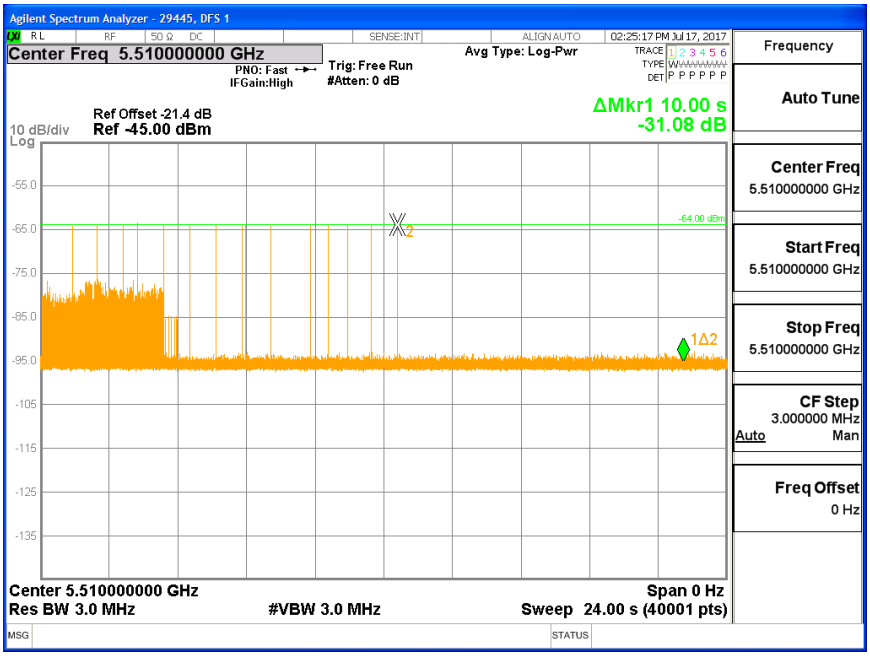
Only intermittent transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

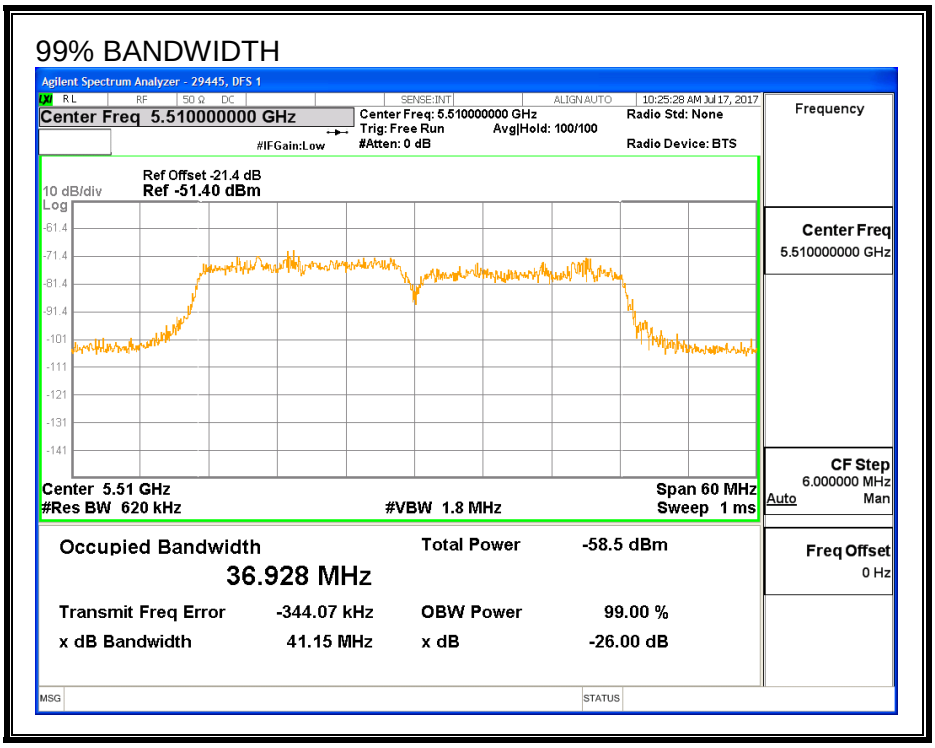
The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR



4.3.3. 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	36.928	108.3	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	
5515	10	10	100	
5520	10	10	100	
5525	10	10	100	
5530	10	10	100	FH

4.3.1. 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	36.93	DFS 1	29445	Version 3.0
FCC Short Pulse Type 2	30	100.00	60	Pass	5490	5530	36.93	DFS 1	29445	Version 3.0
FCC Short Pulse Type 3	30	86.67	60	Pass	5490	5530	36.93	DFS 1	29445	Version 3.0
FCC Short Pulse Type 4	30	73.33	60	Pass	5490	5530	36.93	DFS 1	29445	Version 3.0
Aggregate		90.00	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5530	36.93	DFS 1	29445	Version 3.0
FCC Hopping Type 6	41	100.00	70	Pass	5490	5530		DFS 1	29445	Version 3.0

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	898	59	A	5496	Yes
1003	1	578	92	A	5514	Yes
1004	1	678	78	A	5518	Yes
1005	1	838	63	A	5519	Yes
1006	1	518	102	A	5501	Yes
1007	1	918	58	A	5515	Yes
1008	1	618	86	A	5504	Yes
1009	1	858	62	A	5509	Yes
1010	1	818	65	A	5505	Yes
1011	1	638	83	A	5517	Yes
1012	1	938	57	A	5514	Yes
1013	1	758	70	A	5500	Yes
1014	1	698	76	A	5514	Yes
1015	1	658	81	A	5503	Yes
1016	1	2039	26	B	5497	Yes
1017	1	3060	18	B	5528	Yes
1018	1	2692	20	B	5504	Yes
1019	1	2648	20	B	5527	Yes
1020	1	2409	22	B	5526	Yes
1021	1	2495	22	B	5509	Yes
1022	1	2386	23	B	5500	Yes
1023	1	1406	38	B	5524	Yes
1024	1	1427	37	B	5499	Yes
1025	1	735	72	B	5499	Yes
1026	1	885	60	B	5524	Yes
1027	1	1518	35	B	5508	Yes
1028	1	603	88	B	5510	Yes
1029	1	1365	39	B	5516	Yes
1030	1	1933	28	B	5521	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	2.7	206	27	5522	Yes
2002	4.8	225	28	5520	Yes
2003	4.5	217	26	5511	Yes
2004	5	202	24	5508	Yes
2005	4.9	160	26	5499	Yes
2006	1.4	150	28	5523	Yes
2007	3.7	150	26	5527	Yes
2008	4.6	186	25	5504	Yes
2009	1.1	152	27	5521	Yes
2010	2.1	193	24	5523	Yes
2011	2.9	163	23	5513	Yes
2012	2.3	170	27	5510	Yes
2013	3.3	188	26	5493	Yes
2014	2.8	156	23	5519	Yes
2015	2.1	220	27	5518	Yes
2016	1.9	192	28	5521	Yes
2017	1.4	180	25	5503	Yes
2018	3.5	199	26	5508	Yes
2019	1.3	153	23	5496	Yes
2020	3.7	177	29	5493	Yes
2021	1.7	215	23	5523	Yes
2022	4.2	205	29	5520	Yes
2023	2.4	167	24	5510	Yes
2024	3.3	161	23	5528	Yes
2025	3.9	208	29	5521	Yes
2026	4.9	168	25	5490	Yes
2027	3.8	224	24	5525	Yes
2028	3.2	188	28	5520	Yes
2029	4.1	205	28	5497	Yes
2030	3.7	173	28	5524	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	8	272	18	5501	Yes
3002	7.8	437	18	5496	Yes
3003	7.3	398	17	5500	Yes
3004	9.4	340	18	5530	Yes
3005	7.2	315	18	5526	Yes
3006	9.6	387	16	5519	No
3007	7.5	257	16	5510	Yes
3008	6	475	16	5498	Yes
3009	8.3	357	17	5491	No
3010	7.3	338	16	5498	Yes
3011	9.7	484	16	5519	Yes
3012	6.7	359	16	5503	Yes
3013	7.5	400	18	5499	Yes
3014	6.9	289	17	5500	Yes
3015	7.8	342	17	5494	Yes
3016	7.4	495	17	5514	Yes
3017	6.7	443	17	5513	Yes
3018	8.7	490	17	5519	Yes
3019	8.1	319	16	5505	Yes
3020	8.1	261	17	5501	Yes
3021	10	486	17	5526	Yes
3022	8.3	308	18	5513	Yes
3023	6.2	428	16	5512	No
3024	8.8	396	18	5509	Yes
3025	9.2	278	16	5515	Yes
3026	6	259	18	5496	Yes
3027	8.4	404	18	5507	Yes
3028	7.6	280	18	5526	No
3029	6.2	321	17	5499	Yes
3030	9.7	460	16	5516	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	12.3	263	15	5513	Yes
4002	16.2	415	12	5517	Yes
4003	18.8	364	15	5526	Yes
4004	14.1	411	13	5526	No
4005	12.9	372	16	5498	Yes
4006	17.7	432	12	5491	No
4007	17	407	13	5524	No
4008	13.2	362	14	5501	Yes
4009	17.8	349	15	5497	Yes
4010	19.3	317	14	5515	Yes
4011	15.3	450	15	5501	No
4012	17.2	430	15	5512	Yes
4013	13.6	458	14	5514	Yes
4014	11.8	452	14	5498	Yes
4015	17.7	492	13	5518	Yes
4016	16.3	381	16	5512	Yes
4017	14.2	434	13	5502	Yes
4018	13.3	469	16	5491	Yes
4019	15.9	284	13	5492	No
4020	11.2	332	12	5518	Yes
4021	19.1	293	14	5515	No
4022	14.9	353	13	5513	Yes
4023	14.2	327	16	5510	Yes
4024	19.4	282	12	5491	Yes
4025	14.9	269	13	5512	No
4026	16.4	488	13	5509	Yes
4027	12.4	370	14	5498	Yes
4028	14.3	351	13	5493	Yes
4029	19.8	379	12	5494	No
4030	18	372	15	5513	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	5495	Yes
14	5495	Yes
15	5496	Yes
16	5499	Yes
17	5495	Yes
18	5495	Yes
19	5494	Yes
20	5500	Yes
21	5524	Yes
22	5521	Yes
23	5526	Yes
24	5525	Yes
25	5521	Yes
26	5521	Yes
27	5526	Yes
28	5524	Yes
29	5520	Yes
30	5522	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	328	5490	5	Yes
2	803	5491	3	Yes
3	1278	5492	10	Yes
4	1753	5493	8	Yes
5	2228	5494	9	Yes
6	2703	5495	6	Yes
7	3178	5496	8	Yes
8	3653	5497	9	Yes
9	4128	5498	6	Yes
10	4603	5499	5	Yes
11	5078	5500	6	Yes
12	5553	5501	6	Yes
13	6028	5502	7	Yes
14	6503	5503	7	Yes
15	6978	5504	9	Yes
16	7453	5505	7	Yes
17	7928	5506	4	Yes
18	8403	5507	8	Yes
19	8878	5508	11	Yes
20	9353	5509	8	Yes
21	9828	5510	6	Yes
22	10303	5511	8	Yes
23	10778	5512	7	Yes
24	11253	5513	12	Yes
25	11728	5514	6	Yes
26	12203	5515	11	Yes
27	12678	5516	13	Yes
28	13153	5517	6	Yes
29	13628	5518	7	Yes
30	14103	5519	11	Yes
31	14578	5520	6	Yes
32	15053	5521	10	Yes
33	15528	5522	9	Yes
34	16003	5523	8	Yes
35	16478	5524	10	Yes
36	16953	5525	6	Yes
37	17428	5526	6	Yes
38	17903	5527	3	Yes
39	18378	5528	5	Yes
40	18853	5529	10	Yes
41	19328	5530	10	Yes

4.4. RESULTS FOR 80 MHz BANDWIDTH

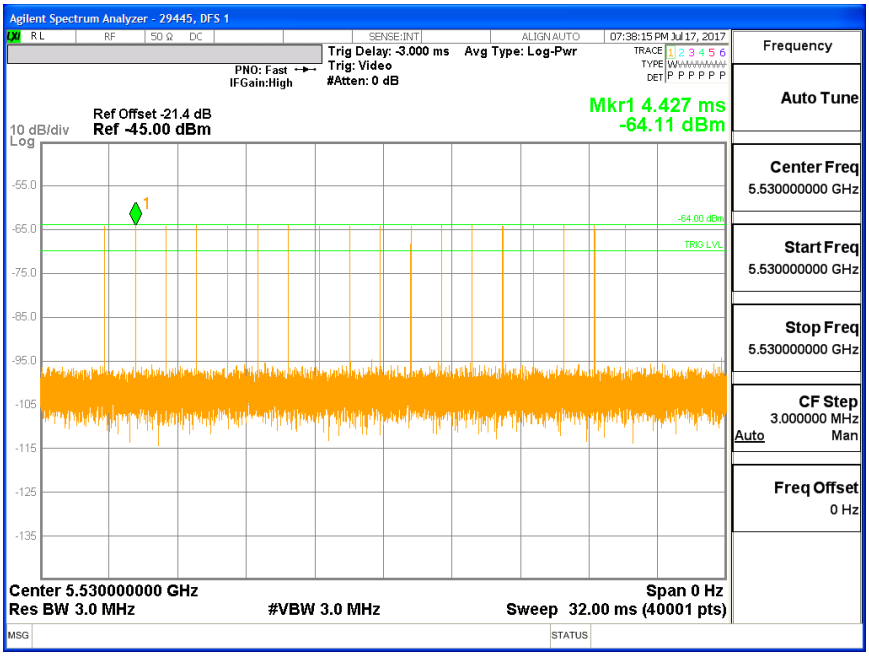
4.4.1. TEST CHANNEL

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

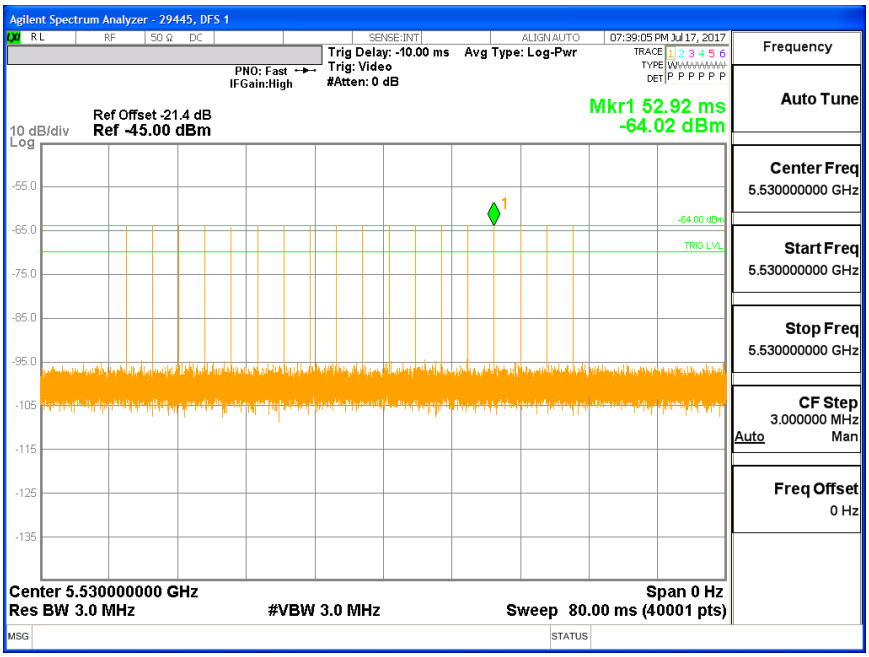
4.4.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

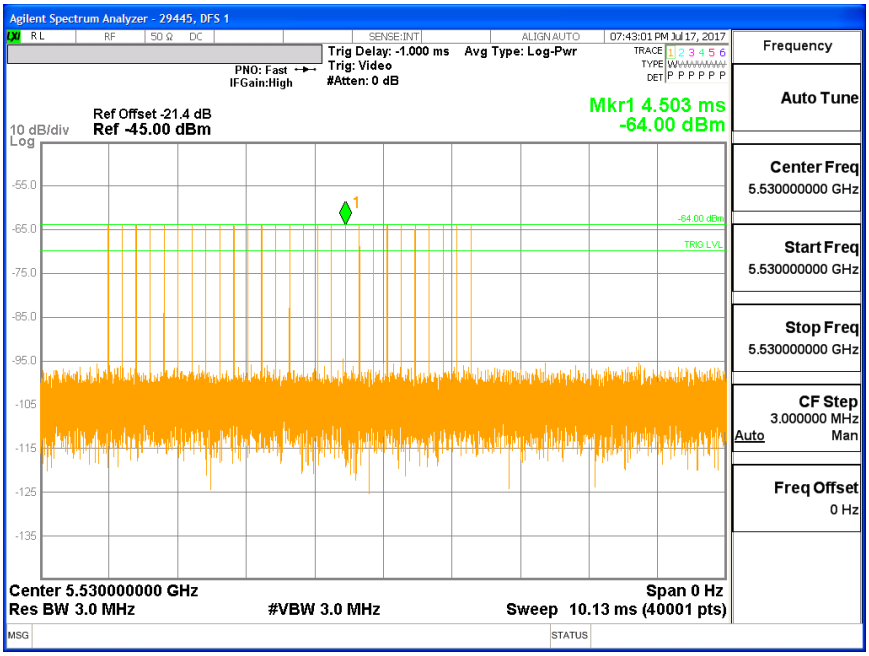
SHORT PULSE RADAR TYPE 0



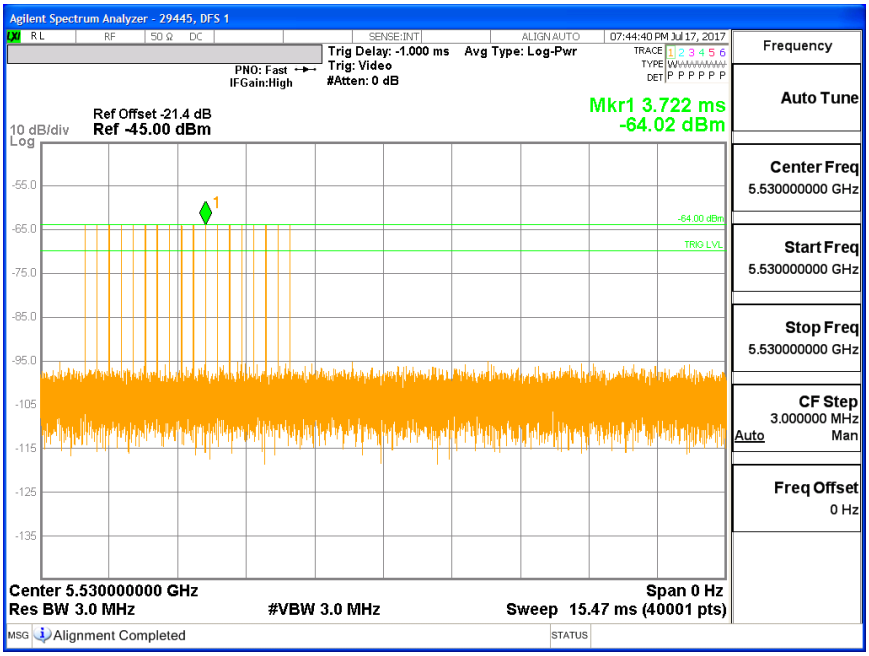
SAMPLE OF RADAR TYPE 1



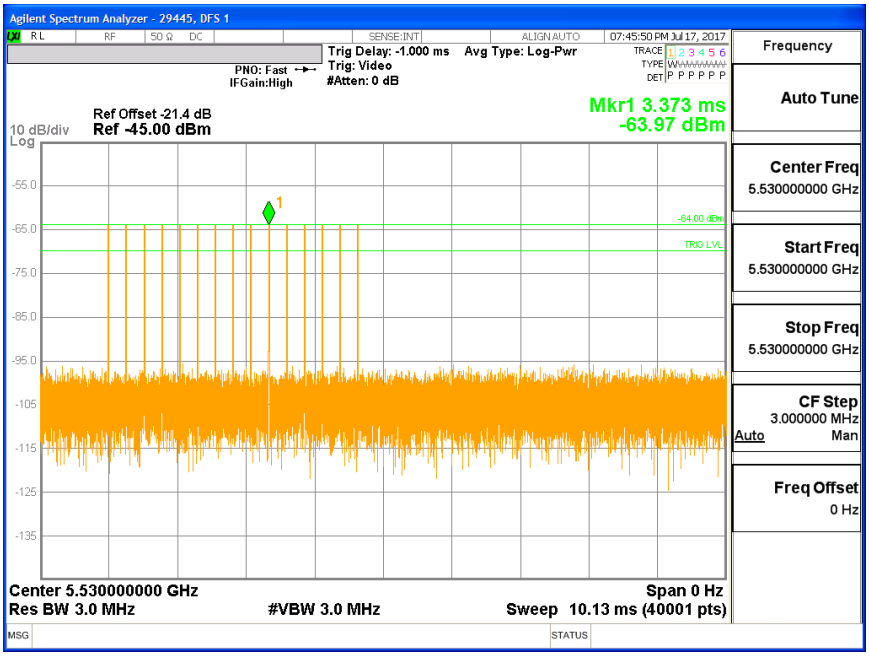
SAMPLE OF RADAR TYPE 2



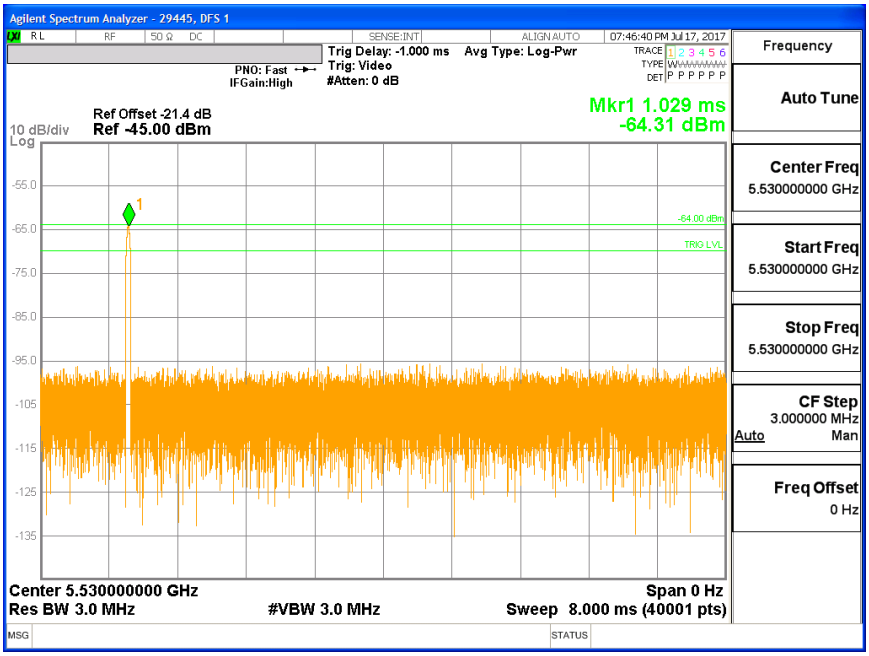
SAMPLE OF RADAR TYPE 3



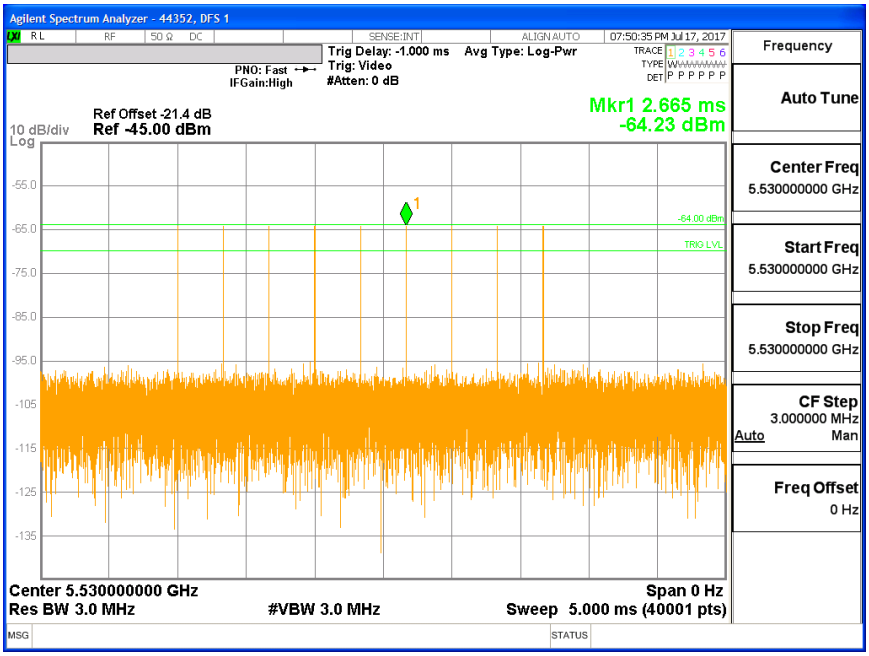
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

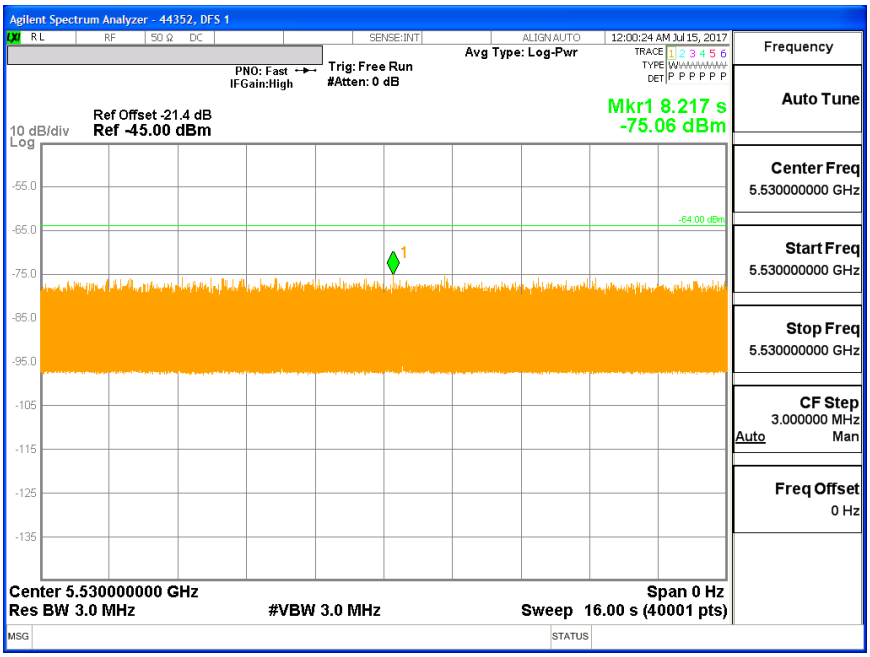


SINGLE BURST OF RADAR TYPE 6

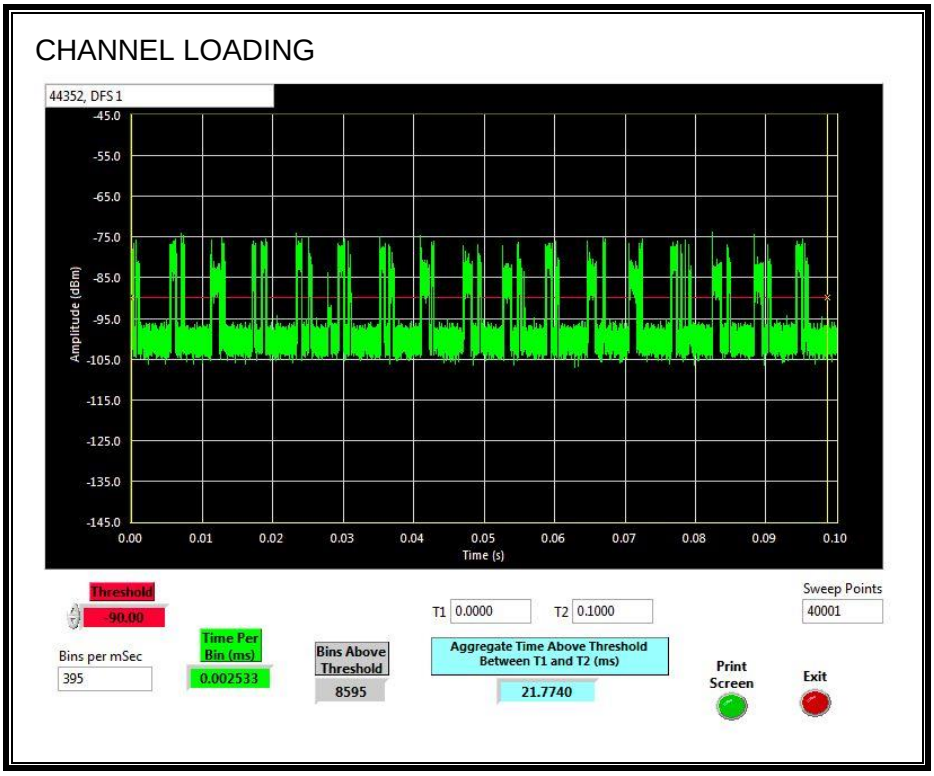


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 21.774%

4.4.1. 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)
29.99	220.9	190.9	130.9

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)
29.72	163.5	133.8	2.9

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)
30.65	218.4	187.8	56.8

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

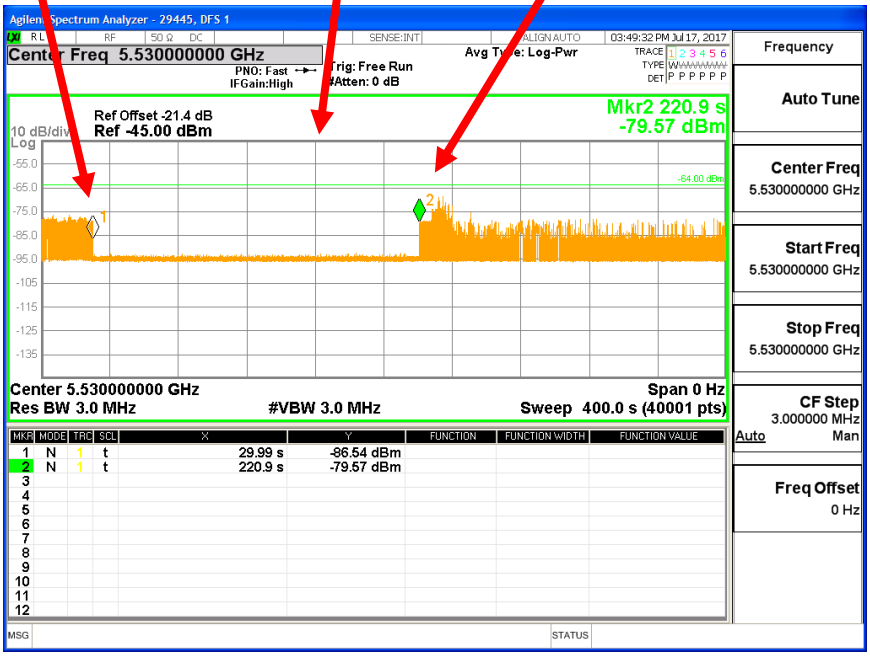
TIMING WITHOUT RADAR DURING CAC

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

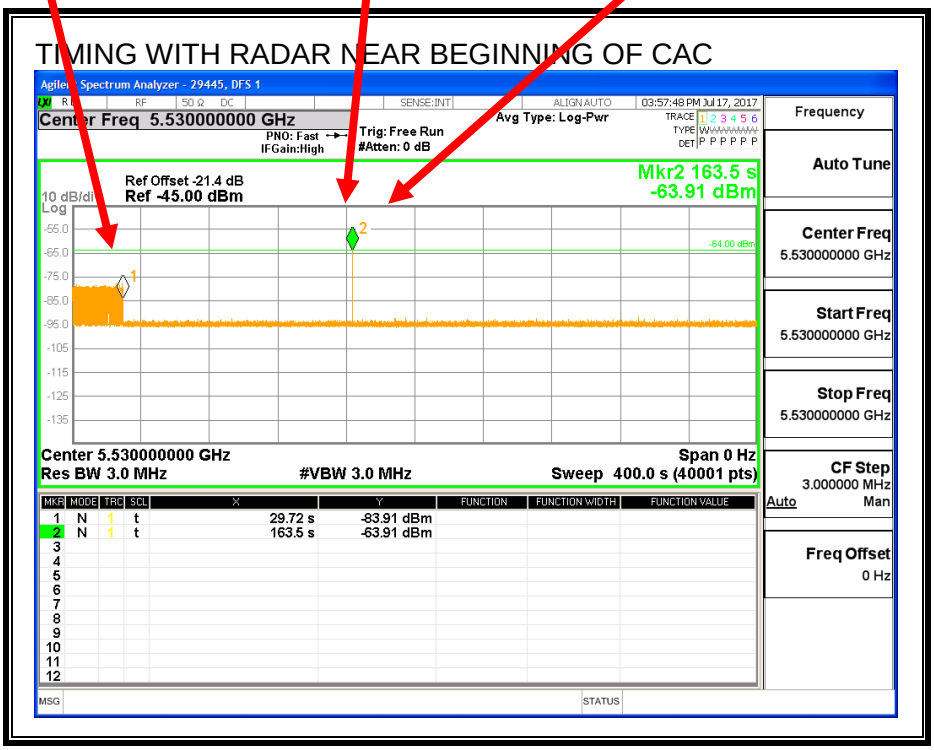
TIMING WITHOUT RADAR – NORMAL POWER-ON CYCLE



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



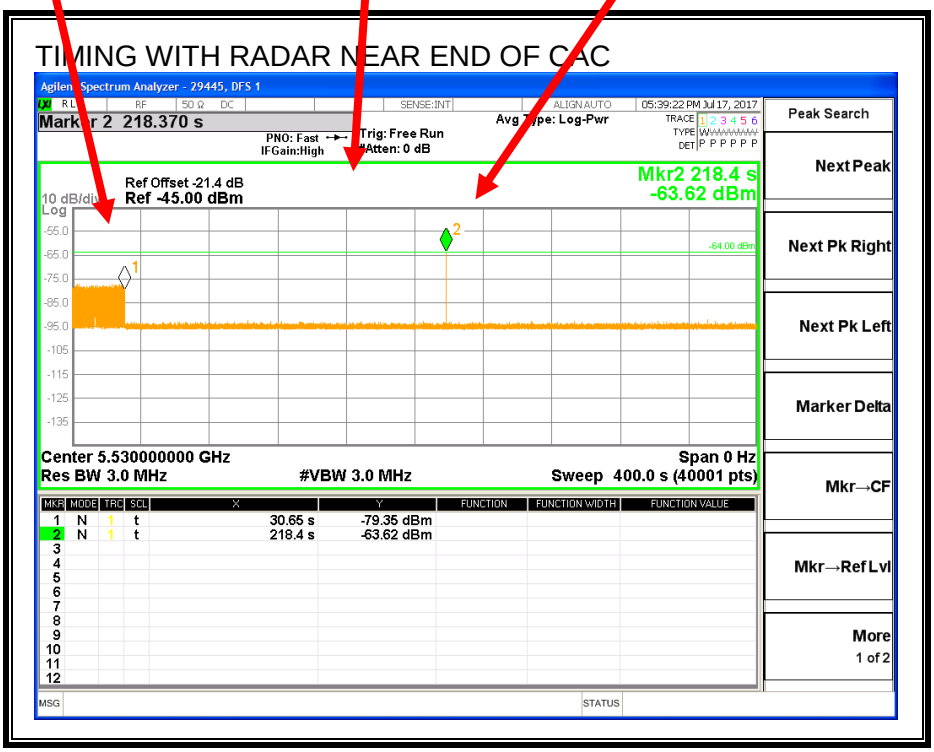
No EUT transmissions were observed after the radar signal.

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.

4.4.2. OVERLAPPING CHANNEL TESTS

RESULTS

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

4.4.3. 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).

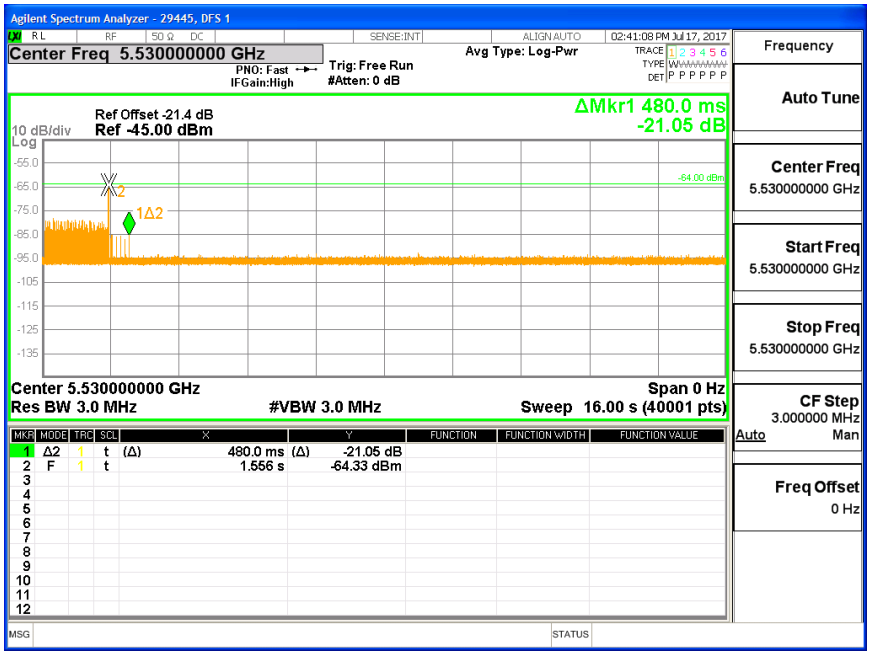
RESULTS

Channel Move Time (sec)	Limit (sec)
0.480	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
1.2	60

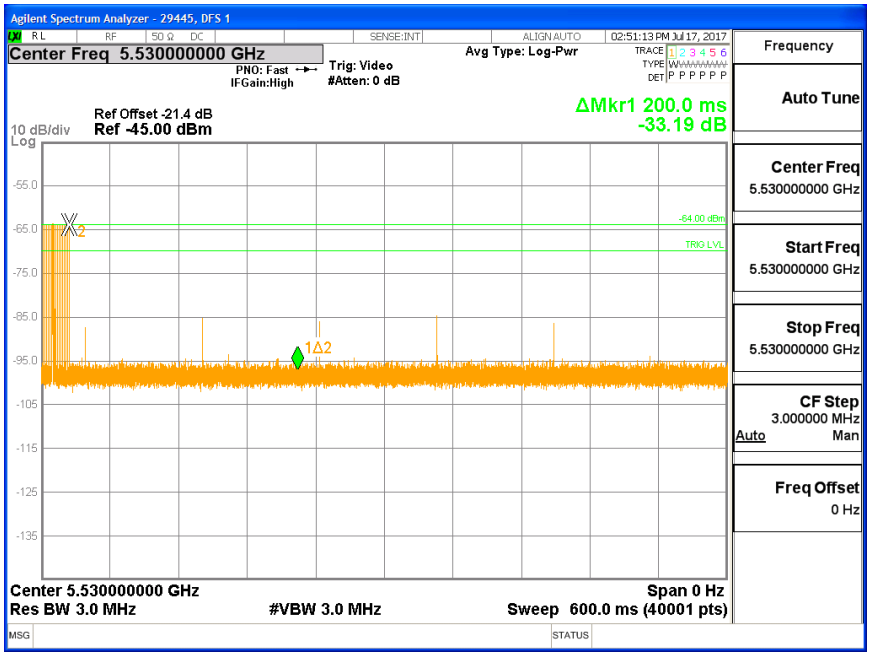
MOVE TIME

MOVE TIME



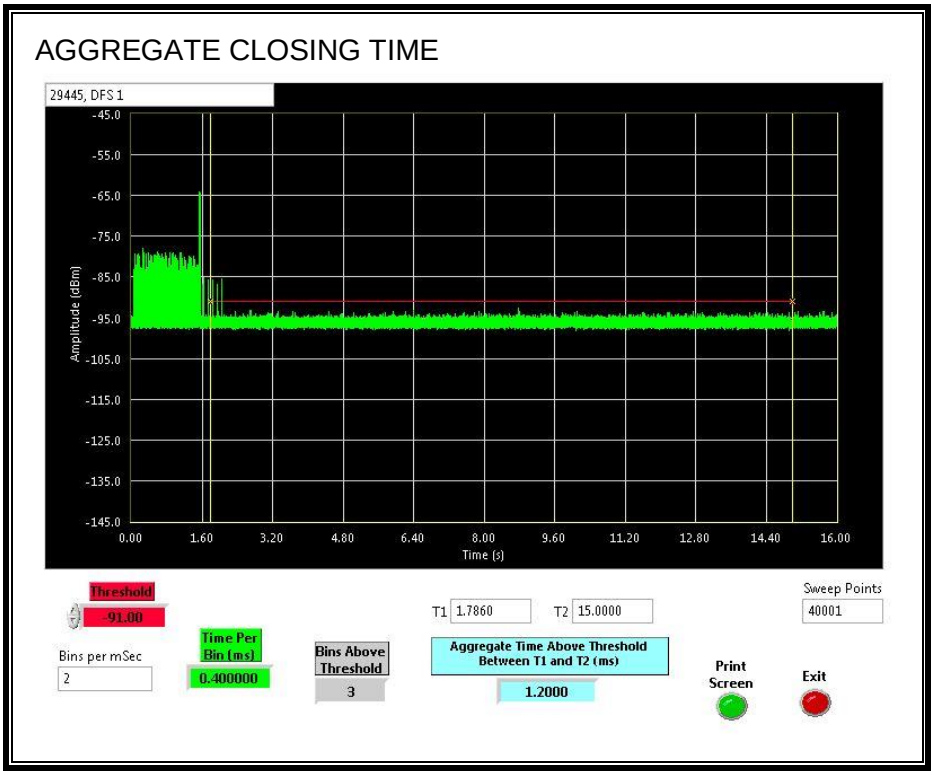
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

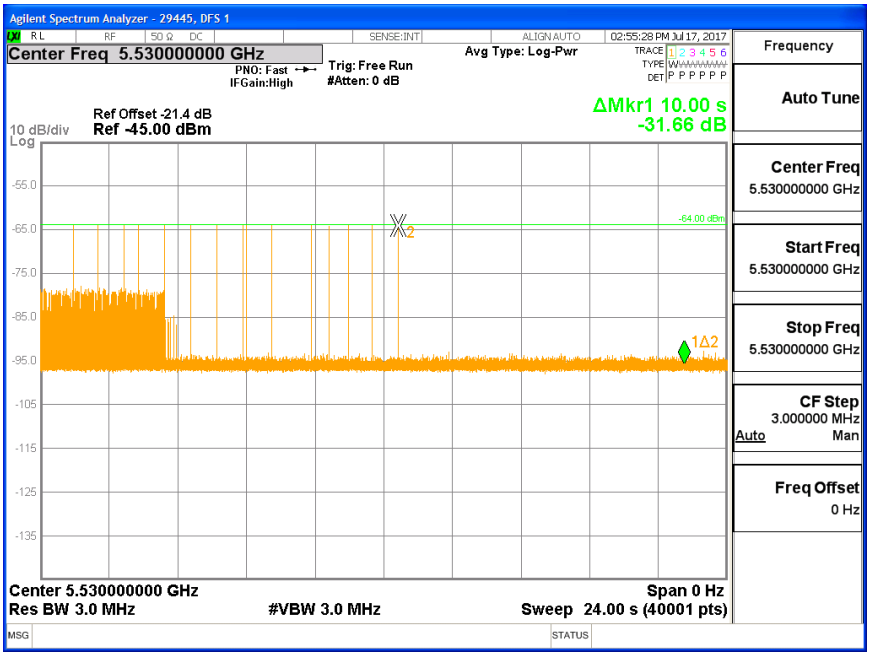
Only intermittent transmissions are observed during the aggregate monitoring period.



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

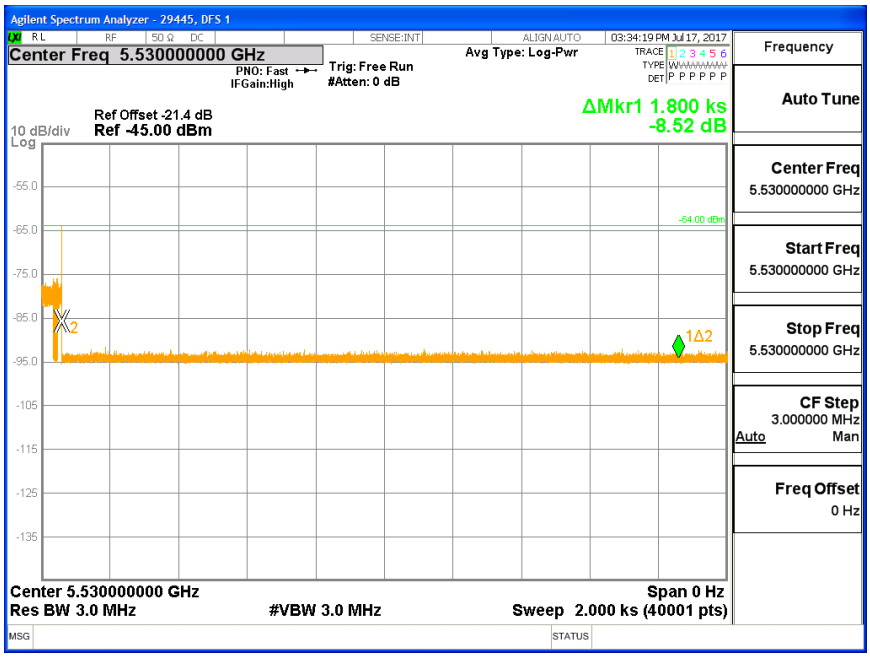


4.4.1. NON-OCCUPANCY PERIOD

RESULTS

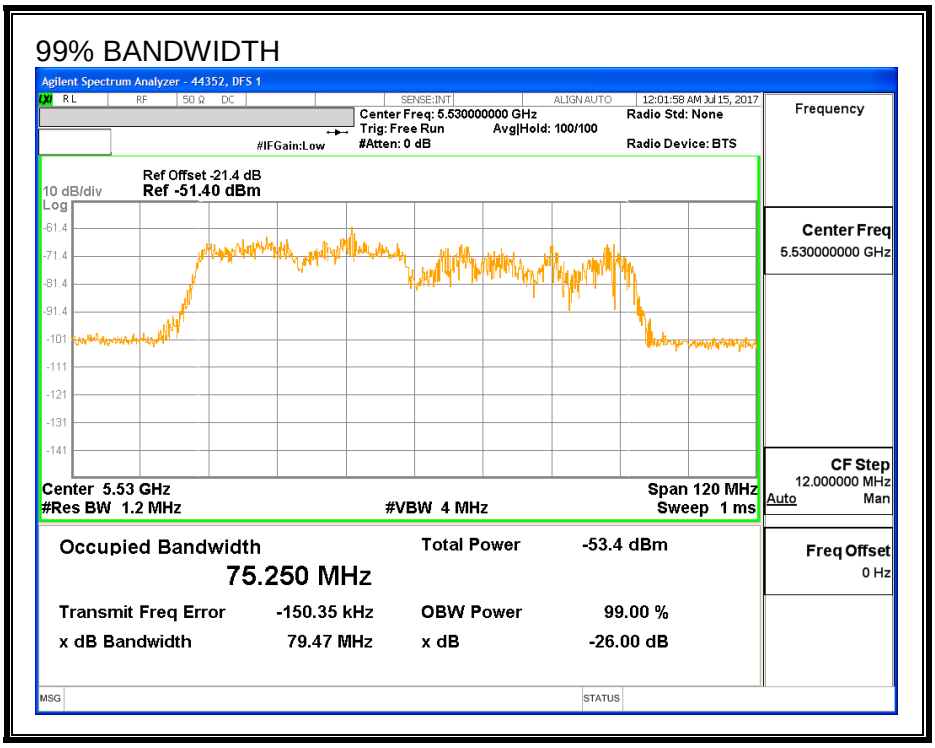
No EUT transmissions were observed on the test channel during the 30-minute observation time.

NON-OCCUPANCY PERIOD



4.4.2. 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	75.250	106.3	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	9	90	
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	

4.4.3. 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	75.25	DFS 1	44352	Version 3.0
FCC Short Pulse Type 2	30	96.67	60	Pass	5490	5570	75.25	DFS 1	44352	Version 3.0
FCC Short Pulse Type 3	30	93.33	60	Pass	5490	5570	75.25	DFS 1	44352	Version 3.0
FCC Short Pulse Type 4	30	86.67	60	Pass	5490	5570	75.25	DFS 1	44352	Version 3.0
Aggregate		94.17	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5570	75.25	DFS 1	44352	Version 3.0
FCC Hopping Type 6	81	100.00	70	Pass	5490	5570		DFS 1	44352	Version 3.0

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	5493	Yes
1002	1	898	59	A	5529	Yes
1003	1	578	92	A	5565	Yes
1004	1	678	78	A	5520	Yes
1005	1	838	63	A	5535	Yes
1006	1	518	102	A	5491	Yes
1007	1	918	58	A	5556	Yes
1008	1	618	86	A	5554	Yes
1009	1	858	62	A	5510	Yes
1010	1	818	65	A	5533	Yes
1011	1	638	83	A	5527	Yes
1012	1	938	57	A	5517	Yes
1013	1	758	70	A	5547	Yes
1014	1	698	76	A	5502	Yes
1015	1	658	81	A	5563	Yes
1016	1	2039	26	B	5515	Yes
1017	1	3060	18	B	5504	Yes
1018	1	2692	20	B	5530	Yes
1019	1	2648	20	B	5505	Yes
1020	1	2409	22	B	5507	Yes
1021	1	2495	22	B	5568	Yes
1022	1	2386	23	B	5517	Yes
1023	1	1406	38	B	5532	Yes
1024	1	1427	37	B	5552	Yes
1025	1	735	72	B	5543	Yes
1026	1	885	60	B	5540	Yes
1027	1	1518	35	B	5527	Yes
1028	1	603	88	B	5549	Yes
1029	1	1365	39	B	5522	Yes
1030	1	1933	28	B	5518	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	2.7	206	27	5570	Yes
2002	4.8	225	28	5510	Yes
2003	4.5	217	26	5548	Yes
2004	5	202	24	5533	Yes
2005	4.9	160	26	5512	Yes
2006	1.4	150	28	5533	Yes
2007	3.7	150	26	5504	Yes
2008	4.6	186	25	5552	Yes
2009	1.1	152	27	5521	Yes
2010	2.1	193	24	5530	Yes
2011	2.9	163	23	5530	Yes
2012	2.3	170	27	5495	Yes
2013	3.3	188	26	5499	Yes
2014	2.8	156	23	5500	Yes
2015	2.1	220	27	5495	Yes
2016	1.9	192	28	5495	Yes
2017	1.4	180	25	5545	Yes
2018	3.5	199	26	5497	Yes
2019	1.3	153	23	5514	Yes
2020	3.7	177	29	5511	Yes
2021	1.7	215	23	5543	Yes
2022	4.2	205	29	5500	Yes
2023	2.4	167	24	5503	Yes
2024	3.3	161	23	5499	No
2025	3.9	208	29	5502	Yes
2026	4.9	168	25	5540	Yes
2027	3.8	224	24	5514	Yes
2028	3.2	188	28	5525	Yes
2029	4.1	205	28	5557	Yes
2030	3.7	173	28	5520	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	8	272	18	5528	Yes
3002	7.8	437	18	5570	Yes
3003	7.3	398	17	5527	Yes
3004	9.4	340	18	5543	Yes
3005	7.2	315	18	5508	Yes
3006	9.6	387	16	5519	Yes
3007	7.5	257	16	5493	Yes
3008	6	475	16	5561	Yes
3009	8.3	357	17	5509	Yes
3010	7.3	338	16	5522	No
3011	9.7	484	16	5527	Yes
3012	6.7	359	16	5538	Yes
3013	7.5	400	18	5525	Yes
3014	6.9	289	17	5541	Yes
3015	7.8	342	17	5563	Yes
3016	7.4	495	17	5544	Yes
3017	6.7	443	17	5542	Yes
3018	8.7	490	17	5507	Yes
3019	8.1	319	16	5496	No
3020	8.1	261	17	5513	Yes
3021	10	486	17	5560	Yes
3022	8.3	308	18	5493	Yes
3023	6.2	428	16	5553	Yes
3024	8.8	396	18	5528	Yes
3025	9.2	278	16	5550	Yes
3026	6	259	18	5519	Yes
3027	8.4	404	18	5541	Yes
3028	7.6	280	18	5561	Yes
3029	6.2	321	17	5516	Yes
3030	9.7	460	16	5513	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	12.3	263	15	5506	Yes
4002	16.2	415	12	5501	Yes
4003	18.8	364	15	5533	Yes
4004	14.1	411	13	5506	Yes
4005	12.9	372	16	5513	Yes
4006	17.7	432	12	5527	Yes
4007	17	407	13	5536	Yes
4008	13.2	362	14	5495	No
4009	17.8	349	15	5540	Yes
4010	19.3	317	14	5552	Yes
4011	15.3	450	15	5544	Yes
4012	17.2	430	15	5510	Yes
4013	13.6	458	14	5532	Yes
4014	11.8	452	14	5537	Yes
4015	17.7	492	13	5510	Yes
4016	16.3	381	16	5543	Yes
4017	14.2	434	13	5492	No
4018	13.3	469	16	5562	Yes
4019	15.9	284	13	5570	No
4020	11.2	332	12	5514	Yes
4021	19.1	293	14	5559	No
4022	14.9	353	13	5557	Yes
4023	14.2	327	16	5528	Yes
4024	19.4	282	12	5531	Yes
4025	14.9	269	13	5543	Yes
4026	16.4	488	13	5536	Yes
4027	12.4	370	14	5556	Yes
4028	14.3	351	13	5534	Yes
4029	19.8	379	12	5524	Yes
4030	18	372	15	5515	Yes

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	5495	Yes
14	5496	Yes
15	5497	Yes
16	5500	Yes
17	5495	Yes
18	5496	Yes
19	5495	Yes
20	5501	Yes
21	5563	Yes
22	5560	Yes
23	5565	Yes
24	5564	Yes
25	5560	Yes
26	5560	Yes
27	5565	Yes
28	5563	Yes
29	5560	Yes
30	5562	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	327	5490	9	Yes
2	802	5491	15	Yes
3	1277	5492	22	Yes
4	1752	5493	23	Yes
5	2227	5494	22	Yes
6	2702	5495	13	Yes
7	3177	5496	13	Yes
8	3652	5497	12	Yes
9	4127	5498	14	Yes
10	4602	5499	13	Yes
11	5077	5500	9	Yes
12	5552	5501	15	Yes
13	6027	5502	13	Yes
14	6502	5503	15	Yes
15	6977	5504	18	Yes
16	7452	5505	16	Yes
17	7927	5506	13	Yes
18	8402	5507	15	Yes
19	8877	5508	25	Yes
20	9352	5509	14	Yes
21	9827	5510	16	Yes
22	10302	5511	20	Yes
23	10777	5512	19	Yes
24	11252	5513	20	Yes
25	11727	5514	11	Yes
26	12202	5515	15	Yes
27	12677	5516	22	Yes
28	13152	5517	14	Yes
29	13627	5518	12	Yes
30	14102	5519	21	Yes
31	14577	5520	11	Yes
32	15052	5521	15	Yes
33	15527	5522	15	Yes
34	16002	5523	17	Yes
35	16477	5524	16	Yes
36	16952	5525	10	Yes
37	17427	5526	10	Yes
38	17902	5527	13	Yes

TYPE 6 DETECTION PROBABILITY (CONTINUED)

39	18377	5528	13	Yes
40	18852	5529	19	Yes
41	19327	5530	20	Yes
42	19802	5531	18	Yes
43	20277	5532	17	Yes
44	20752	5533	11	Yes
45	21227	5534	22	Yes
46	21702	5535	17	Yes
47	22177	5536	13	Yes
48	22652	5537	19	Yes
49	23127	5538	15	Yes
50	23602	5539	16	Yes
51	24077	5540	13	Yes
52	24552	5541	12	Yes
53	25027	5542	18	Yes
54	25502	5543	16	Yes
55	25977	5544	12	Yes
56	26452	5545	16	Yes
57	26927	5546	17	Yes
58	27402	5547	22	Yes
59	27877	5548	15	Yes
60	28352	5549	21	Yes
61	28827	5550	20	Yes
62	29302	5551	17	Yes
63	29777	5552	12	Yes
64	30252	5553	14	Yes
65	30727	5554	14	Yes
66	31202	5555	18	Yes
67	31677	5556	12	Yes
68	32152	5557	21	Yes
69	32627	5558	16	Yes
70	33102	5559	19	Yes
71	33577	5560	20	Yes
72	34052	5561	22	Yes
73	34527	5562	14	Yes
74	35002	5563	23	Yes
75	35477	5564	19	Yes
76	35952	5565	23	Yes
77	36427	5566	17	Yes
78	36902	5567	19	Yes
79	37377	5568	18	Yes
80	37852	5569	19	Yes
81	38327	5570	16	Yes

4.5. 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.