DFS PORTION of FCC 47 CFR PART 15 SUBPART E
DFS PORTION of INDUSTRY CANADA RSS-247 ISSUE 1

CERTIFICATION TEST REPORT

FOR

802.11a/b/g/n/ac Wireless Access Point

MODEL NUMBER: MR53-HW

FCC ID: UDX-60042010
IC: 6961A-60042010

REPORT NUMBER: 16U23081-E2V3

ISSUE DATE: AUGUST 01, 2016

Prepared for
CISCO SYSTEMS, INC.
170 WEST TASMAN DRIVE
SAN JOSE, CA, 95134, USA

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	04/18/16	Initial Issue	Conan Cheung
V2	07/29/16	Test and Measurement Equipment updated	Conan Cheung
V3	08/01/16	Add Testing Software Information	Conan Cheung

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ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 802.11a/b/g/n/ac Wireless Access Point

MODEL: MR53-HW

SERIAL NUMBER: Q2MD-MTMZ-VY5M

DATE TESTED: APRIL 7 – APRIL 14, 2016

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
DFS Portion of CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-247 Issue 1	Pass

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

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

Approved & Released For
UL Verification Services Inc. By:

CONAN CHEUNG
PROJECT LEAD
UL Verification Services Inc.

Prepared By:

HENRY LAU
EMC ENGINEER
UL Verification Services Inc.

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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, ANSI C63.10-2013, RSS-247 Issue 1.

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
Conducted Disturbance, 0.15 to 30 MHz	± 3.52 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.94 dB
Radiated Disturbance, 1 to 6 GHz	± 3.86 dB
Radiated Disturbance, 6 to 18 GHz	± 4.23 dB
Radiated Disturbance, 18 to 26 GHz	± 5.30 dB
Radiated Disturbance, 26 to 40 GHz	± 5.23 dB

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

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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 1

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”.

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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.		

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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.

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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

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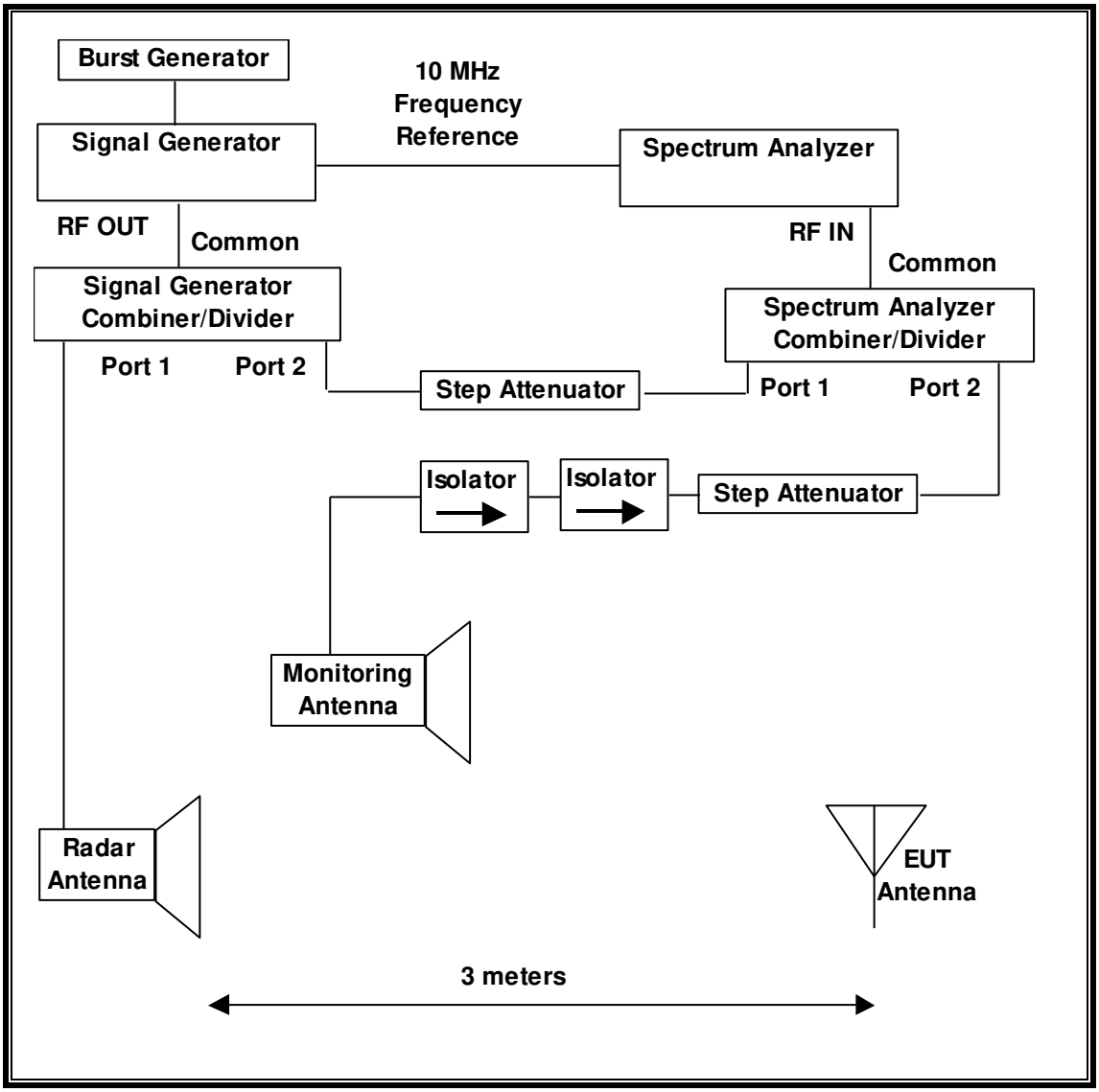
4.1.2. TEST AND MEASUREMENT SYSTEM

RADIATED METHOD SYSTEM BLOCK DIAGRAM



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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.

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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. The video test file is streamed 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	06/01/16
Signal Generator, MXG X-Series RF Vector	Agilent	N5172B	MY51350337	03/11/17
Arbitrary Waveform Generator	Agilent / HP	33220A	MY44026694	09/25/16

4.1.1. 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	2.0.0.6	Channel Loading and Aggregate Closing Time
FCC 2006 Detection	2.0.0.2	Detection Bandwidth in 1 MHz Steps
FCC 2014 Detection	2.0.0.2	Detection Bandwidth in 5 MHz Steps
In Service Monitoring-PXA	2	In-Service Monitoring (Probability of Detection)
PXA Read	3.0.0.7	Signal Generator Screen Capture
SGXProject.exe	2	Radar Waveform Generation and Download

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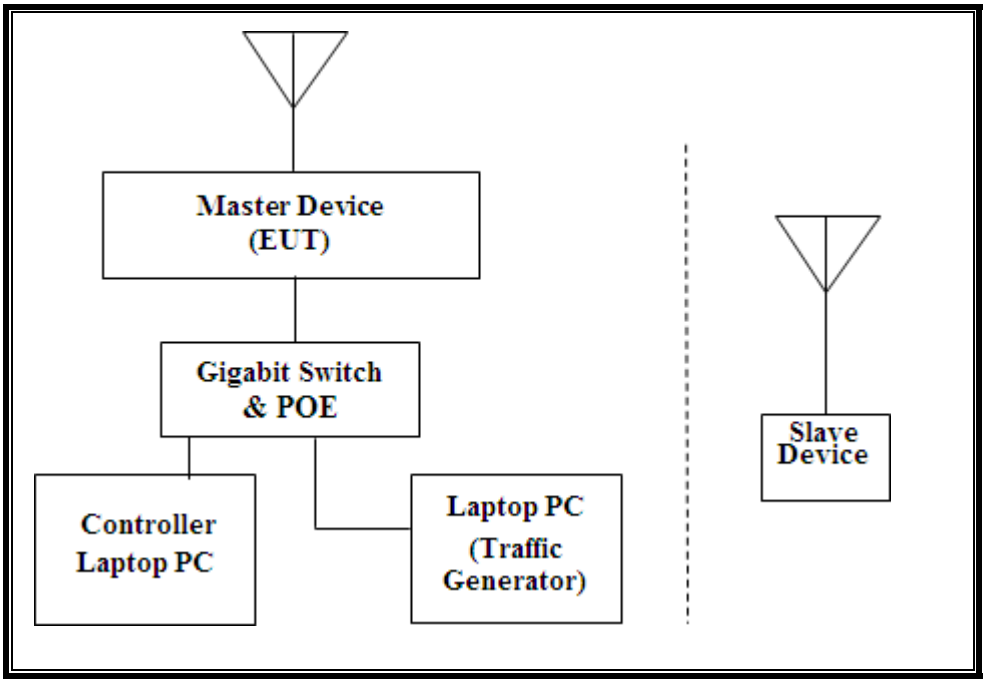
4.1.2. SETUP OF EUT

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**
Laptop PC (Controller)	Apple	A1502	C02NT1VTG3QR	QDS-BRCM1069
AC Adapter (Controller)	Apple	A1435	D39433601B4FTC0A1	DoC
Gigabit Switch	Meraki	MS220-8P	Q2HP-DR3G-TQZS	DoC
Laptop PC (Slave Device)	Apple	A1465	C02KTGMPF5N7	QDS-BRCM1072
AC Adapter (Slave Device)	Apple	A1435	C04341216J2F288BT	DoC
Laptop PC (Traffic Generator)	Lenovo	TYPE 4287-5TU	R9-PLM9D 12/06	QDS-BRCM1046
AC Adapter (Traffic Generator)	Lenovo	45N0121	11S45N0121Z1ZHXU213DMG	DoC

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4.1.3. 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 29.44 dBm EIRP in the 5250-5350 MHz band and 29.69 dBm EIRP in the 5470-5725 MHz band.

The highest gain antenna assembly utilized with the EUT has a gain of 5.68 dBi in the 5250-5350 MHz band and 6.5 dBi in the 5470-5725 MHz band. The lowest gain antenna assembly utilized with the EUT has a gain of 3.64 dBi in the 5250-5350 MHz band and 4.75 dBi in the 5470-5725 MHz band.

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

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

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

The EUT uses four transmitter/receiver chains and one receive only chain, 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_cryptid_version T-196147M-g37eb64c9-aacharya.

UNIFORM CHANNEL SPREADING

This function is not required per KDB 905462.

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4.2. RESULTS FOR 20 MHz BANDWIDTH

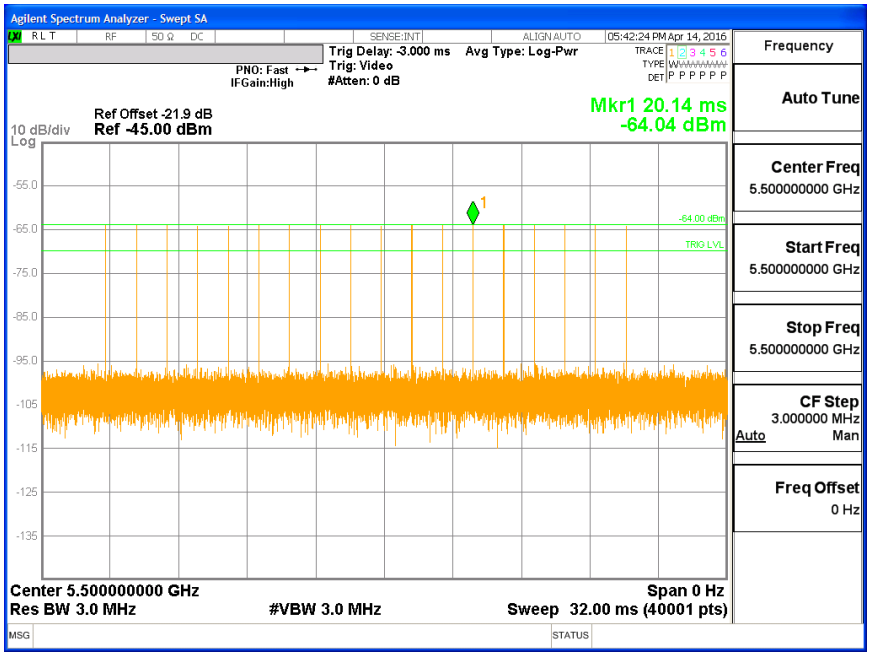
4.2.1. TEST CHANNEL

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



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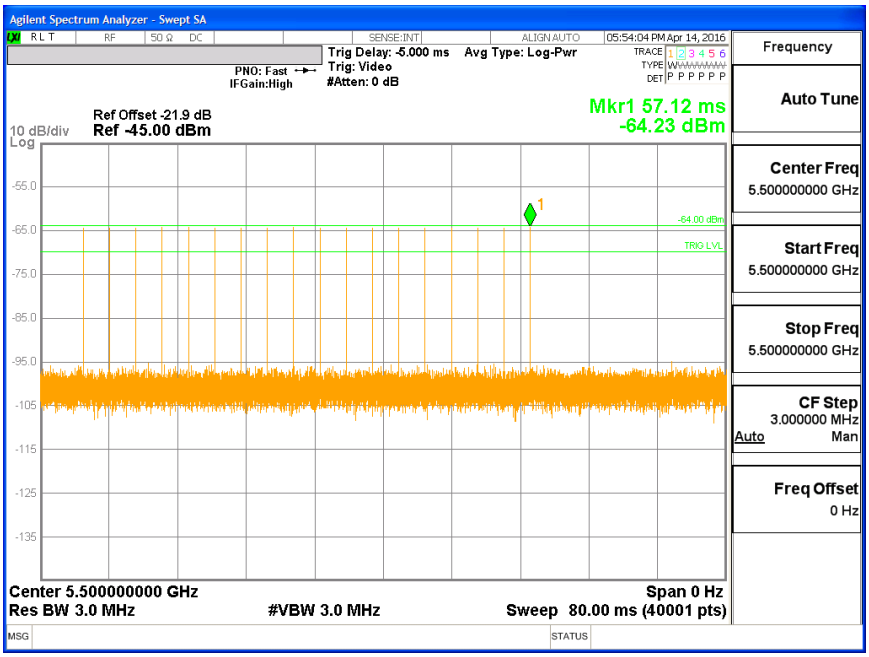
SAMPLE OF RADAR TYPE 1



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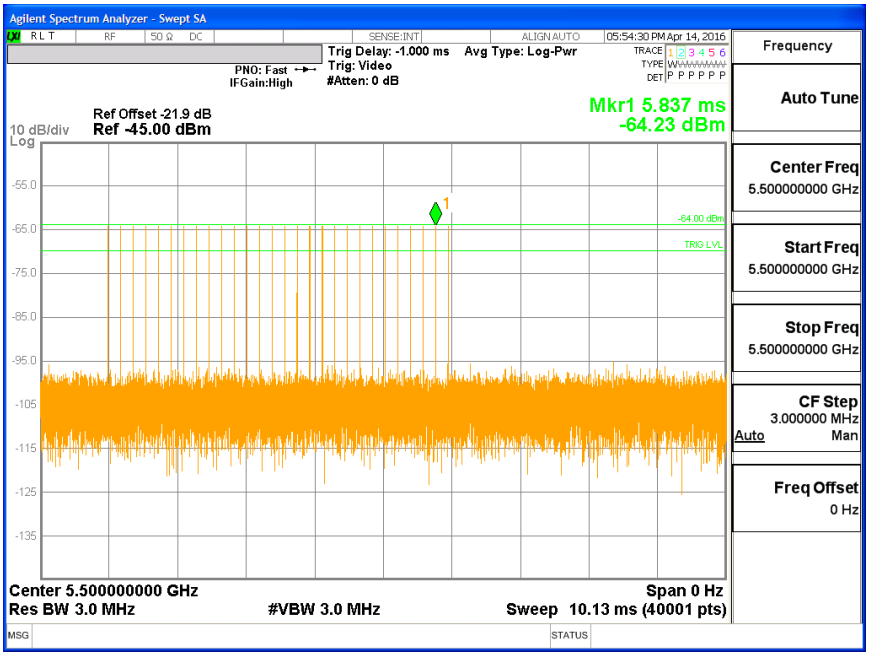
SAMPLE OF RADAR TYPE 2



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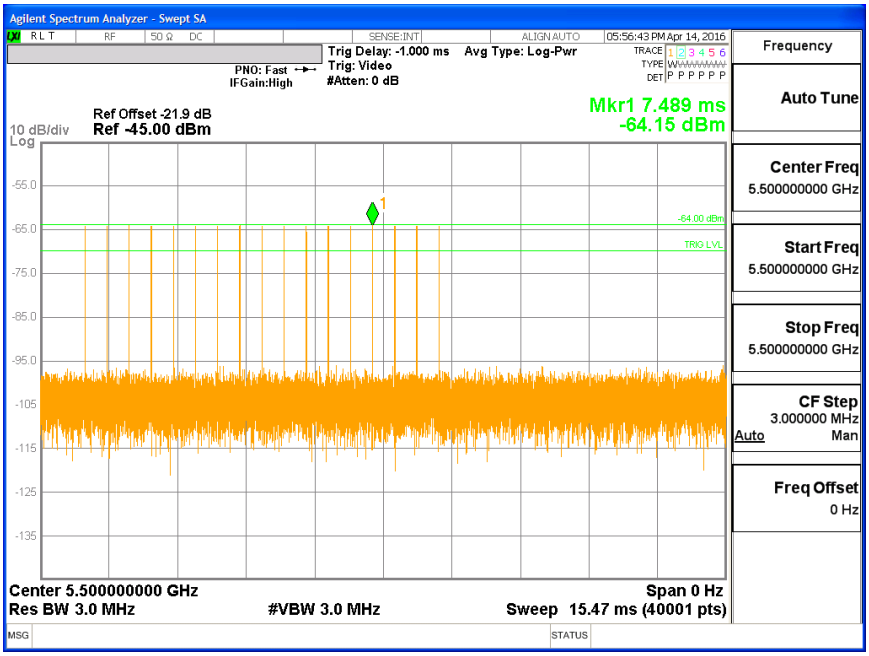
SAMPLE OF RADAR TYPE 3



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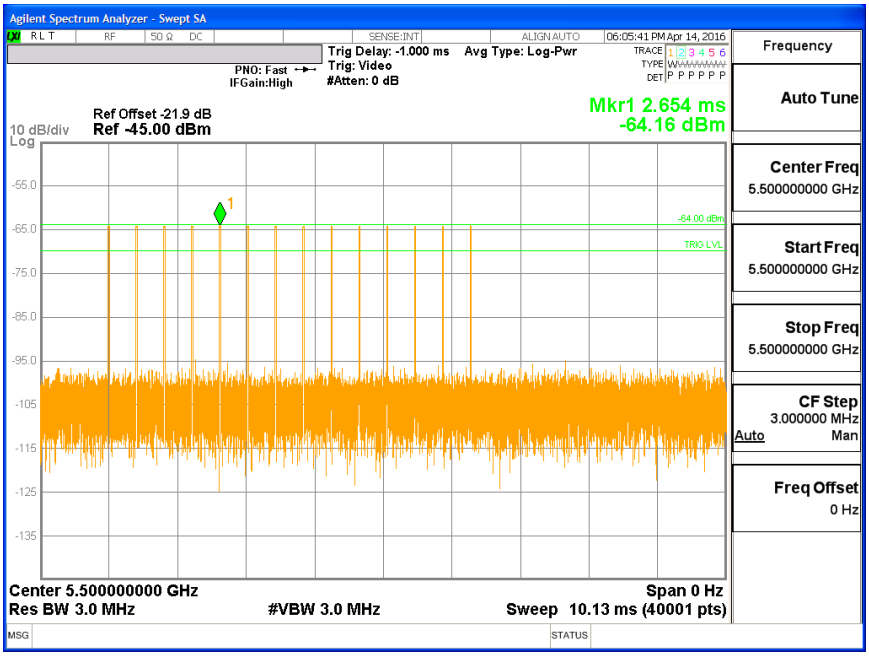
SAMPLE OF RADAR TYPE 4



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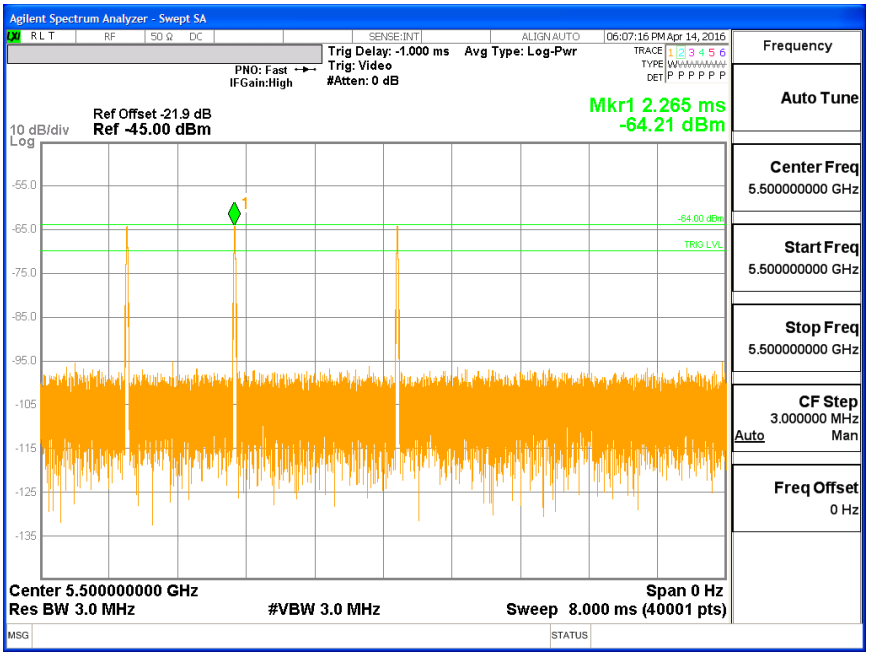
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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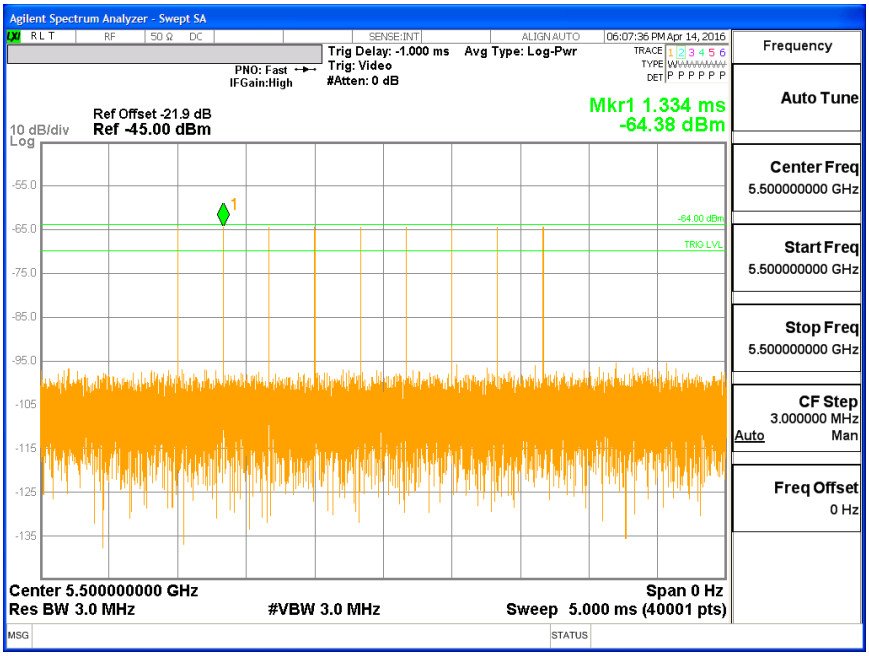
SINGLE BURST OF RADAR TYPE 6



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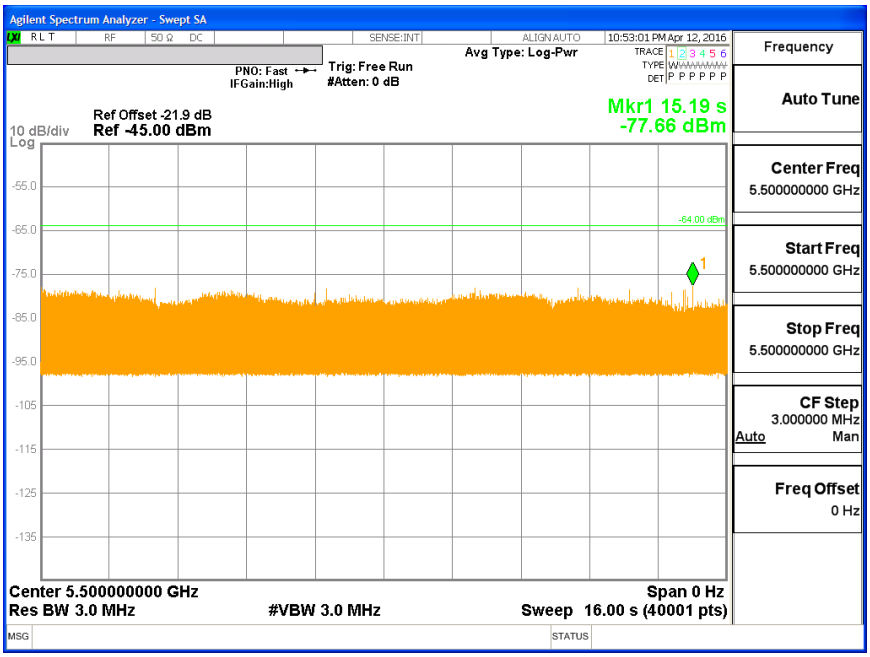
TRAFFIC

TRAFFIC



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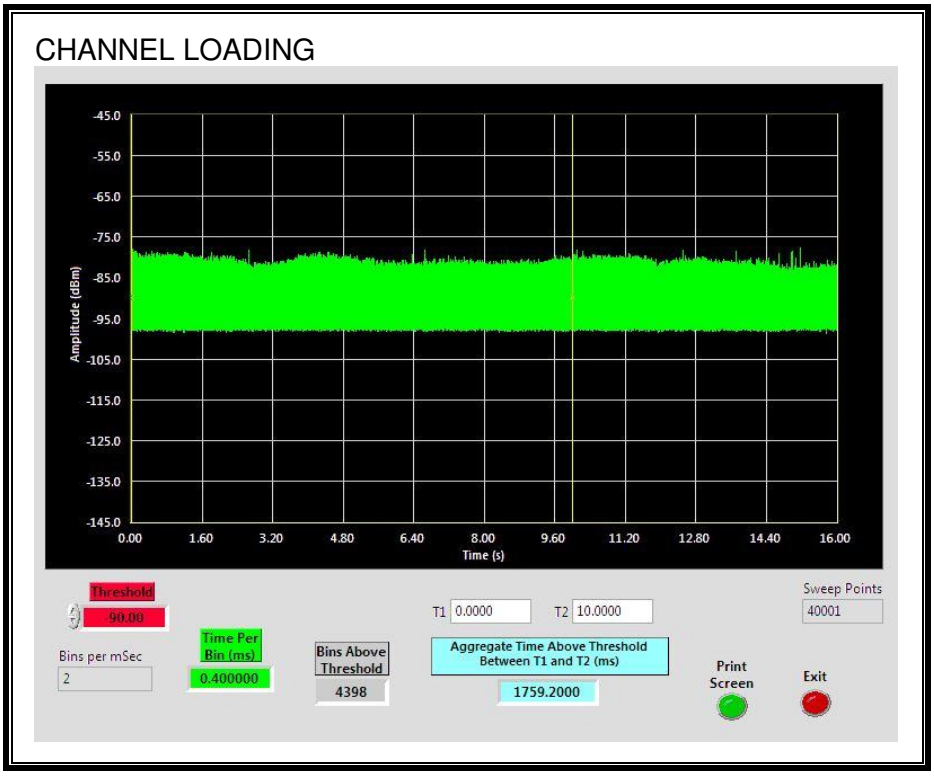
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 17.592%

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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.

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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)
30.18	186.4	156.2	96.2

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)
30.09	127.3	97.2	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)
30.37	185.4	155.0	58.8

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

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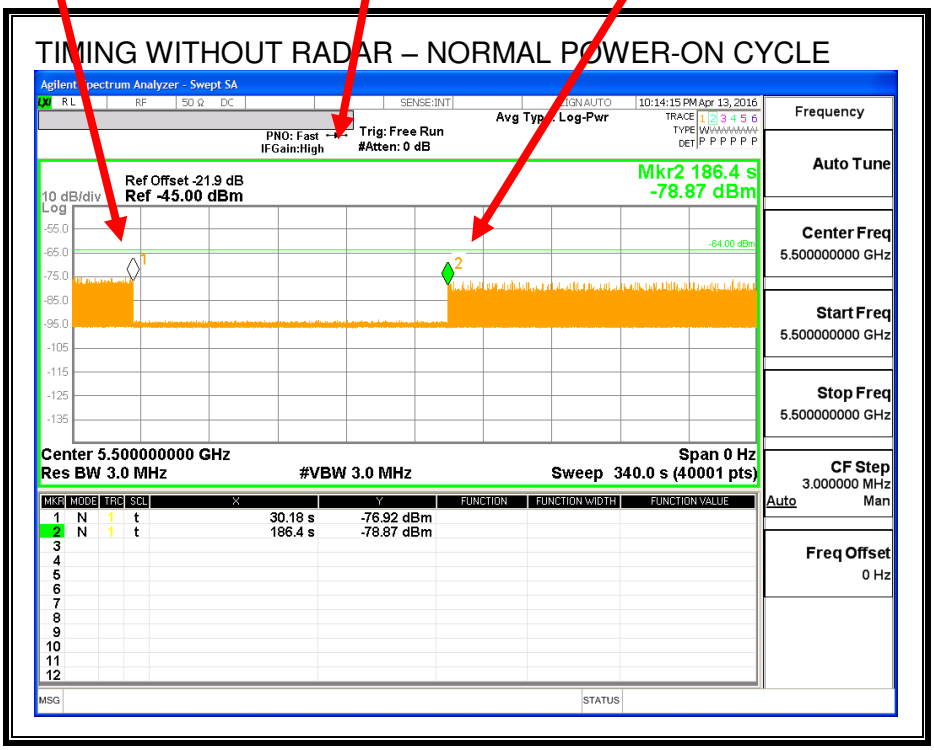
TIMING WITHOUT RADAR DURING CAC

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.

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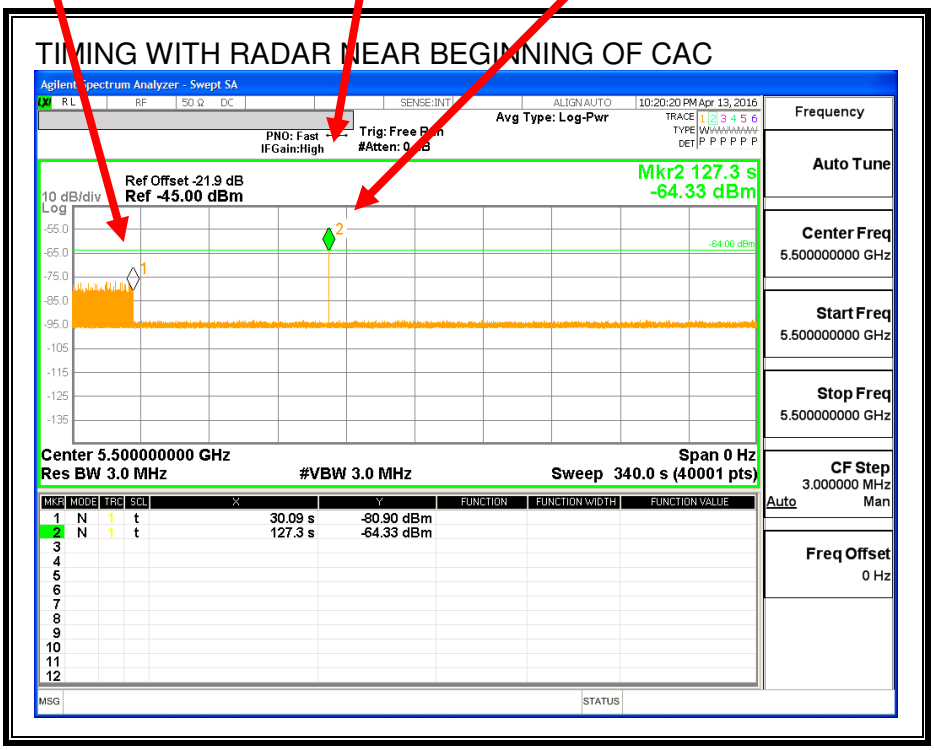
TIMING WITH RADAR NEAR BEGINNING OF CAC

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.

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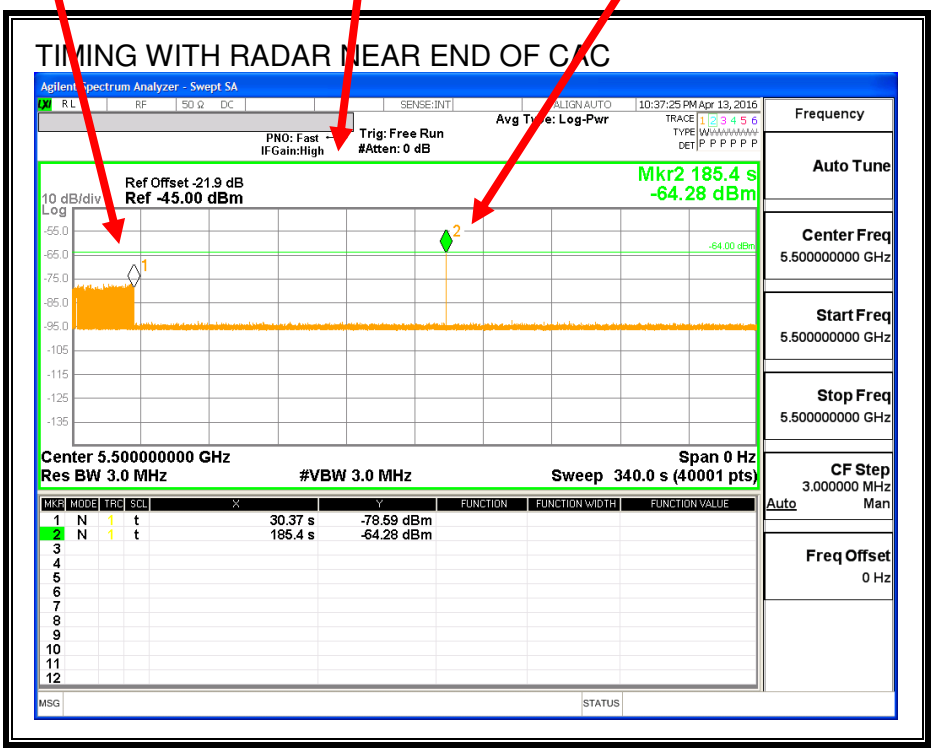
TIMING WITH RADAR NEAR END OF CAC

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.

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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.

These tests are not applicable.

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)
0.435	10

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

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MOVE TIME

MOVE TIME

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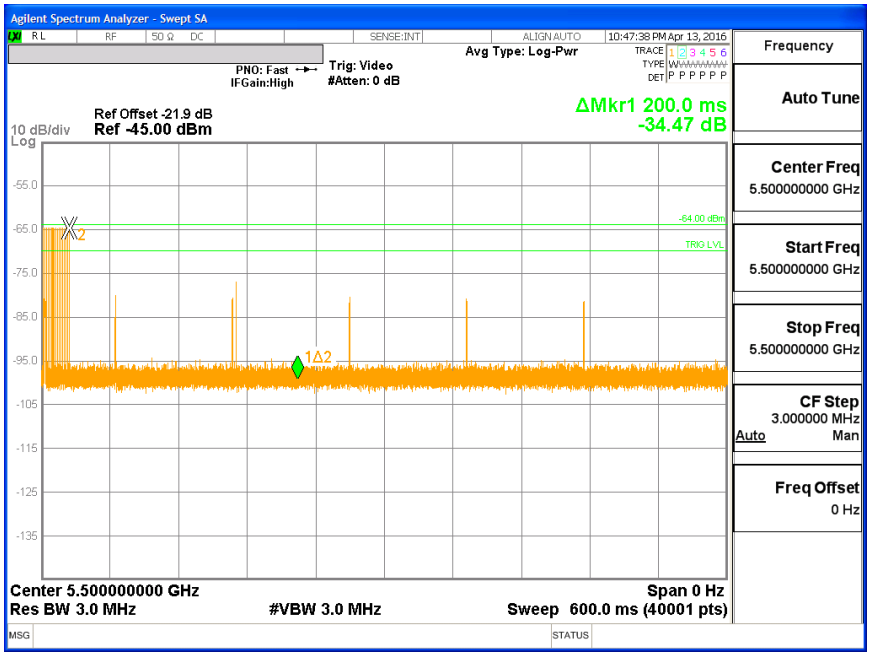
CHANNEL CLOSING TIME

CLOSING TIME



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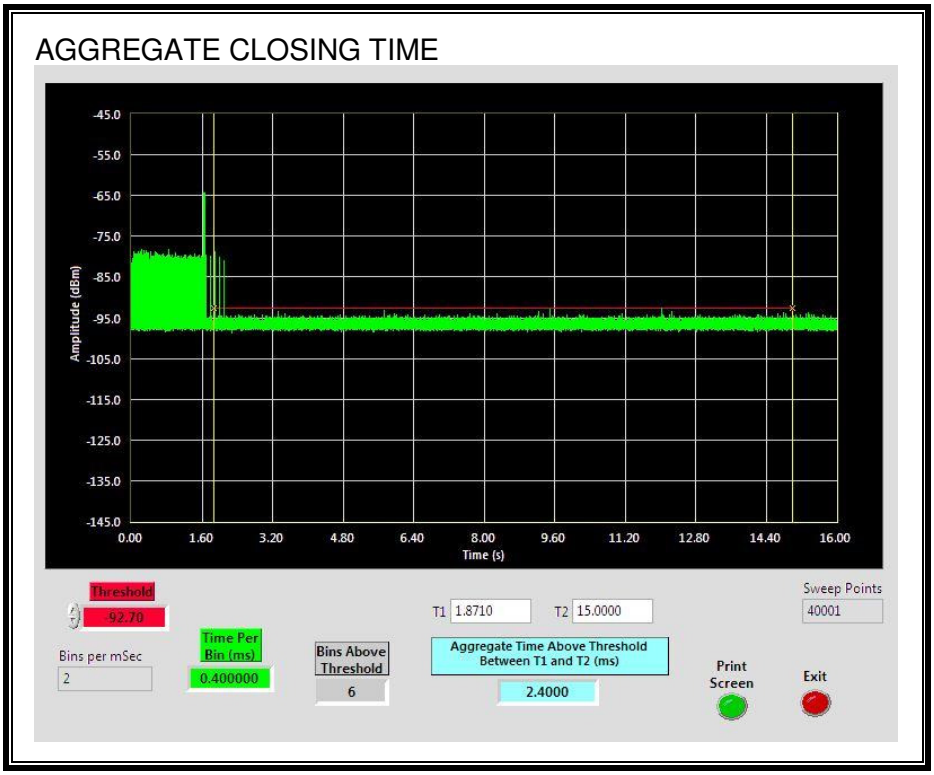
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.



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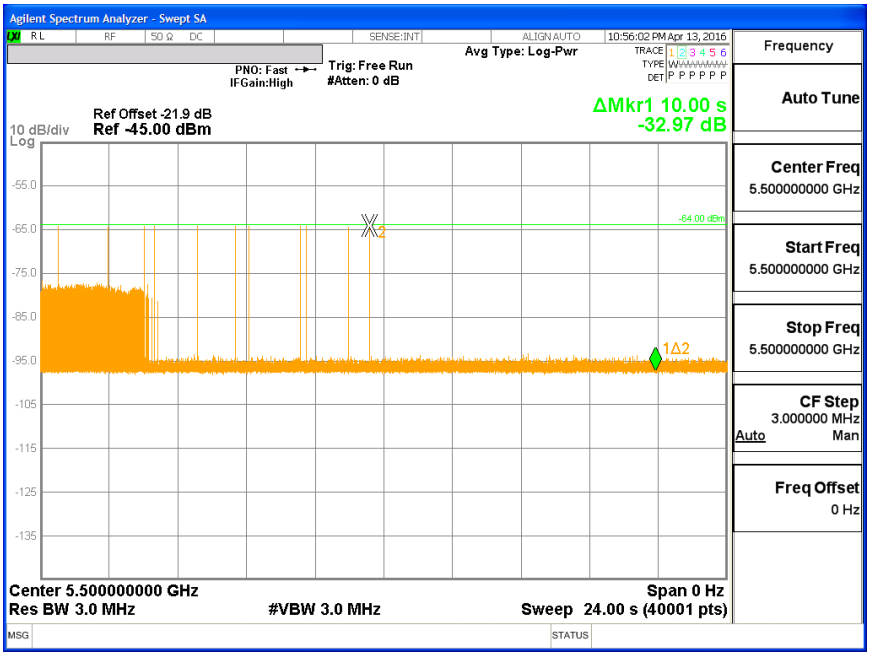
LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR



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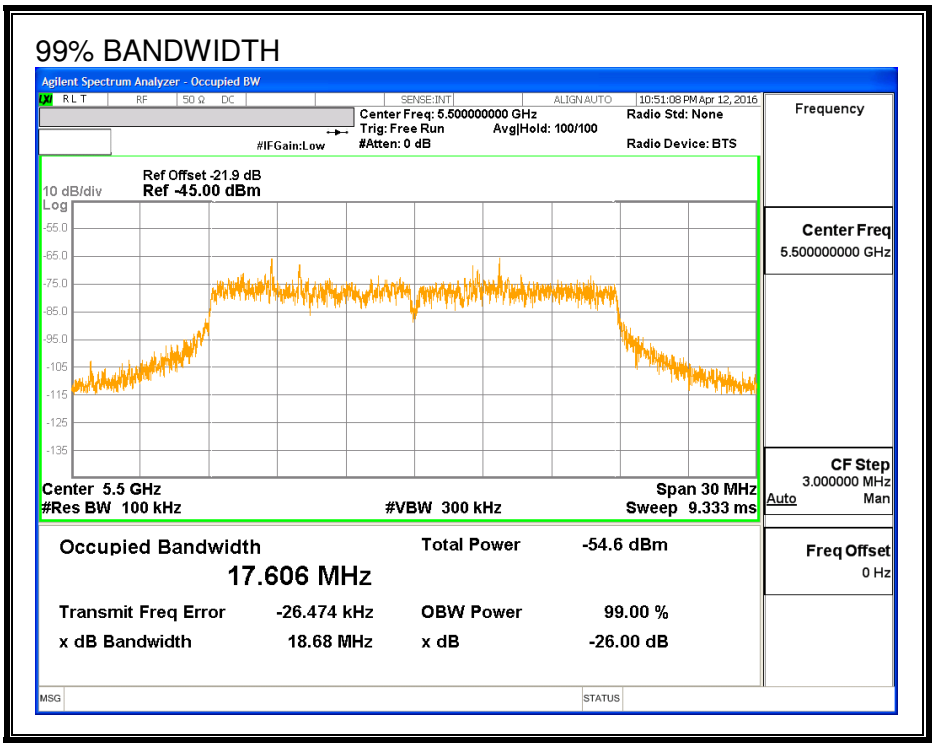
4.2.6. DETECTION BANDWIDTH

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	17.606	113.6	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results				
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	

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4.2.7. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth		80% of Det BW	
					FL	FH	FL5	FH5
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5510		
FCC Short Pulse Type 2	30	96.67	60	Pass	5490	5510		
FCC Short Pulse Type 3	30	86.67	60	Pass	5490	5510		
FCC Short Pulse Type 4	30	80.00	60	Pass	5490	5510		
Aggregate		90.83	80	Pass				
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5510	5492	5508
FCC Hopping Type 6	42	100.00	70	Pass	5490	5510		

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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	5500	Yes
1002	1	598	89	A	5500	Yes
1003	1	938	57	A	5500	Yes
1004	1	898	59	A	5500	Yes
1005	1	838	63	A	5500	Yes
1006	1	558	95	A	5500	Yes
1007	1	798	67	A	5500	Yes
1008	1	778	68	A	5500	Yes
1009	1	618	86	A	5500	Yes
1010	1	918	58	A	5500	Yes
1011	1	738	72	A	5500	Yes
1012	1	638	83	A	5500	Yes
1013	1	578	92	A	5500	Yes
1014	1	538	99	A	5500	Yes
1015	1	678	78	A	5500	Yes
1016	1	1483	36	B	5500	Yes
1017	1	1245	43	B	5500	Yes
1018	1	1330	40	B	5500	Yes
1019	1	1221	44	B	5500	Yes
1020	1	2789	19	B	5500	Yes
1021	1	2810	19	B	5500	Yes
1022	1	765	69	B	5500	Yes
1023	1	2268	24	B	5500	Yes
1024	1	1548	35	B	5500	Yes
1025	1	633	84	B	5500	Yes
1026	1	1395	38	B	5500	Yes
1027	1	1962	27	B	5500	Yes
1028	1	2854	19	B	5500	Yes
1029	1	1003	53	B	5500	Yes
1030	1	830	64	B	5500	Yes

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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	1.3	186	28	5500	Yes
2002	3.6	228	29	5500	Yes
2003	4.5	222	28	5500	Yes
2004	2.9	150	27	5500	Yes
2005	2	229	24	5500	Yes
2006	2.8	161	23	5500	Yes
2007	4.1	206	23	5500	Yes
2008	3.2	224	26	5500	Yes
2009	2.7	154	23	5500	Yes
2010	3.9	175	26	5500	Yes
2011	1.8	190	24	5500	Yes
2012	1.3	178	24	5500	Yes
2013	3.4	197	26	5500	Yes
2014	3.1	189	23	5500	Yes
2015	1.4	175	29	5500	Yes
2016	3.5	170	26	5500	Yes
2017	4.1	160	25	5500	Yes
2018	2.3	203	27	5500	Yes
2019	3.2	159	23	5500	Yes
2020	1.6	206	25	5500	Yes
2021	4.8	166	28	5500	Yes
2022	1.5	217	27	5500	Yes
2023	5	181	24	5500	Yes
2024	1.9	198	24	5500	No
2025	1.4	209	28	5500	Yes
2026	4.8	150	24	5500	Yes
2027	4.6	165	25	5500	Yes
2028	4.1	152	29	5500	Yes
2029	2.1	172	24	5500	Yes
2030	1.8	163	28	5500	Yes

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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	6.6	499	17	5500	Yes
3002	6.5	486	16	5500	Yes
3003	7.3	453	16	5500	Yes
3004	5	335	18	5500	No
3005	6.1	449	18	5500	Yes
3006	6.8	344	16	5500	Yes
3007	8.2	471	17	5500	Yes
3008	9.1	378	17	5500	Yes
3009	8.4	267	18	5500	Yes
3010	9.6	454	18	5500	Yes
3011	9.1	355	17	5500	Yes
3012	8.1	421	18	5500	Yes
3013	7.9	469	16	5500	Yes
3014	7.2	430	17	5500	Yes
3015	9.9	490	18	5500	Yes
3016	9.5	464	17	5500	Yes
3017	5	419	16	5500	No
3018	10	289	17	5500	Yes
3019	5.7	256	18	5500	No
3020	8.5	256	17	5500	Yes
3021	9.6	370	17	5500	Yes
3022	5.2	265	18	5500	No
3023	6.6	391	16	5500	Yes
3024	7.5	299	16	5500	Yes
3025	6.7	321	17	5500	Yes
3026	8	374	17	5500	Yes
3027	7.4	275	16	5500	Yes
3028	6.5	475	17	5500	Yes
3029	6.3	389	18	5500	Yes
3030	5.6	351	17	5500	Yes

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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	16.6	411	14	5500	Yes
4002	11.1	267	12	5500	No
4003	17	340	16	5500	Yes
4004	12	460	12	5500	Yes
4005	18.3	428	16	5500	Yes
4006	13.8	310	13	5500	Yes
4007	16	291	12	5500	Yes
4008	17.4	436	16	5500	Yes
4009	10	312	16	5500	No
4010	11.9	353	15	5500	Yes
4011	10.3	492	13	5500	No
4012	12.7	295	13	5500	No
4013	11.7	447	13	5500	Yes
4014	20	396	13	5500	No
4015	19.5	310	14	5500	Yes
4016	18.2	271	12	5500	No
4017	13.4	464	13	5500	Yes
4018	18	439	13	5500	Yes
4019	13.8	260	15	5500	Yes
4020	18.9	381	16	5500	Yes
4021	15.1	349	15	5500	Yes
4022	10.6	482	16	5500	Yes
4023	18.2	462	16	5500	Yes
4024	14.2	357	15	5500	Yes
4025	16.9	484	14	5500	Yes
4026	18.8	273	14	5500	Yes
4027	17.2	413	16	5500	Yes
4028	19.6	466	16	5500	Yes
4029	18.6	368	12	5500	Yes
4030	16.8	316	16	5500	Yes

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TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5504	Yes
2	5497	Yes
3	5507	Yes
4	5496	Yes
5	5507	Yes
6	5499	Yes
7	5507	Yes
8	5503	Yes
9	5495	Yes
10	5496	Yes
11	5501	Yes
12	5503	Yes
13	5501	Yes
14	5505	Yes
15	5504	Yes
16	5497	Yes
17	5495	Yes
18	5504	Yes
19	5495	Yes
20	5499	Yes
21	5501	Yes
22	5492	Yes
23	5499	Yes
24	5506	Yes
25	5498	Yes
26	5497	Yes
27	5496	Yes
28	5503	Yes
29	5495	Yes
30	5494	Yes

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

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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	206	5490	6	Yes
2	681	5491	6	Yes
3	1156	5492	2	Yes
4	1631	5493	1	Yes
5	2106	5494	3	Yes
6	2581	5495	5	Yes
7	3056	5496	4	Yes
8	3531	5497	5	Yes
9	4006	5498	5	Yes
10	4481	5499	6	Yes
11	4956	5500	5	Yes
12	5431	5501	7	Yes
13	5906	5502	5	Yes
14	6381	5503	4	Yes
15	6856	5504	2	Yes
16	7331	5505	6	Yes
17	7806	5506	6	Yes
18	8281	5507	4	Yes
19	8756	5508	4	Yes
20	9231	5509	3	Yes
21	9706	5510	2	Yes
22	10181	5490	3	Yes
23	10656	5491	5	Yes
24	11131	5492	2	Yes
25	11606	5493	5	Yes
26	12081	5494	1	Yes
27	12556	5495	5	Yes
28	13031	5496	4	Yes
29	13506	5497	3	Yes
30	13981	5498	6	Yes
31	14456	5499	3	Yes
32	14931	5500	3	Yes
33	15406	5501	6	Yes
34	15881	5502	4	Yes
35	16356	5503	3	Yes
36	16831	5504	4	Yes
37	17306	5505	3	Yes
38	17781	5506	3	Yes
39	18256	5507	4	Yes
40	18731	5508	3	Yes
41	19206	5509	5	Yes
42	19681	5510	5	Yes

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4.3. RESULTS FOR 40 MHz BANDWIDTH

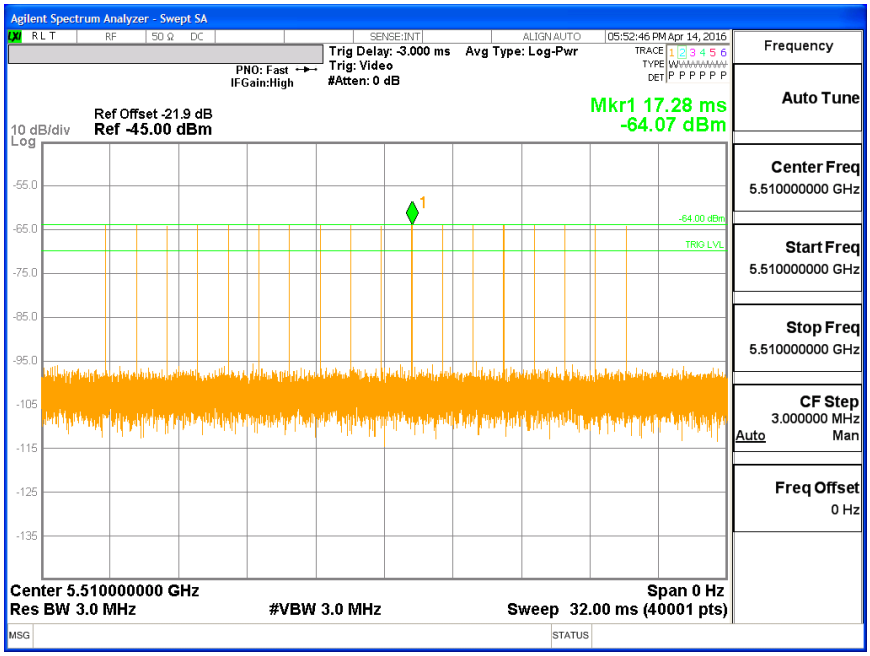
4.3.1. TEST CHANNEL

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



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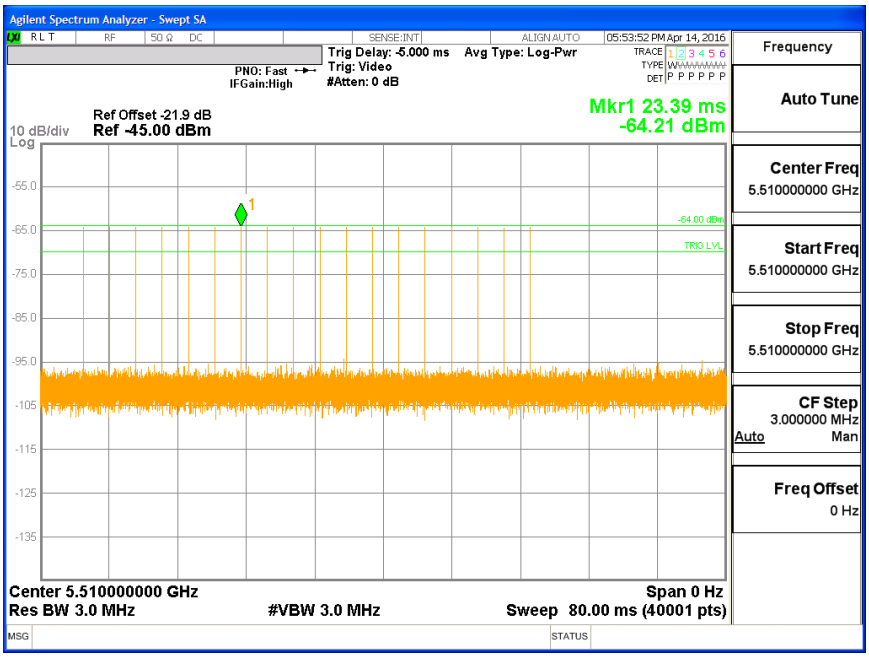
SAMPLE OF RADAR TYPE 1



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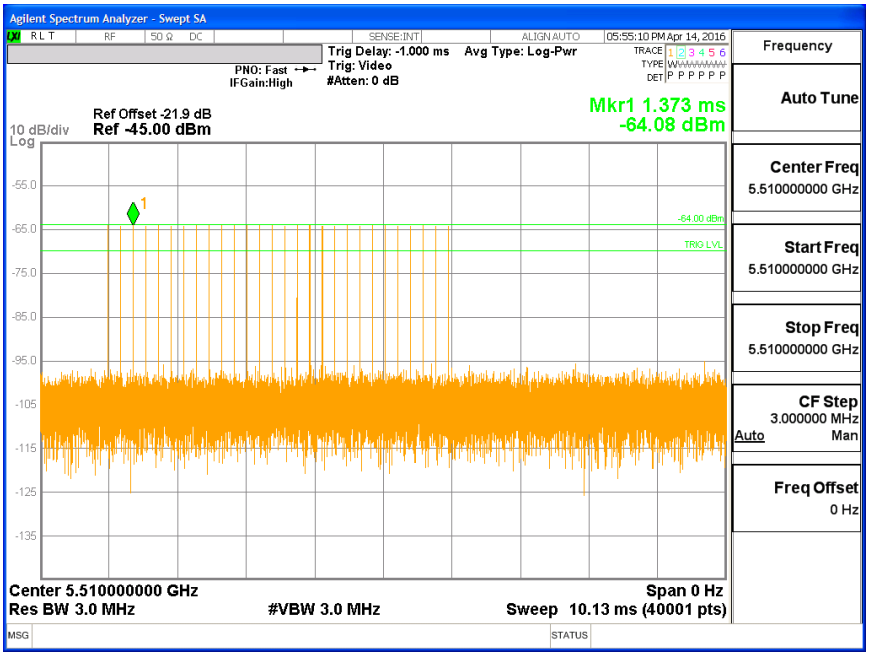
SAMPLE OF RADAR TYPE 2



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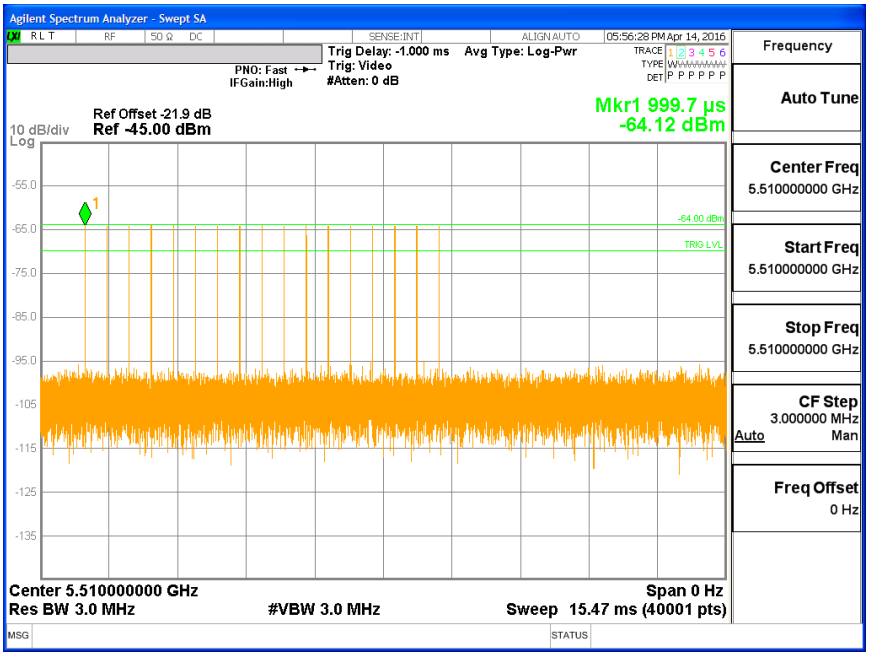
SAMPLE OF RADAR TYPE 3



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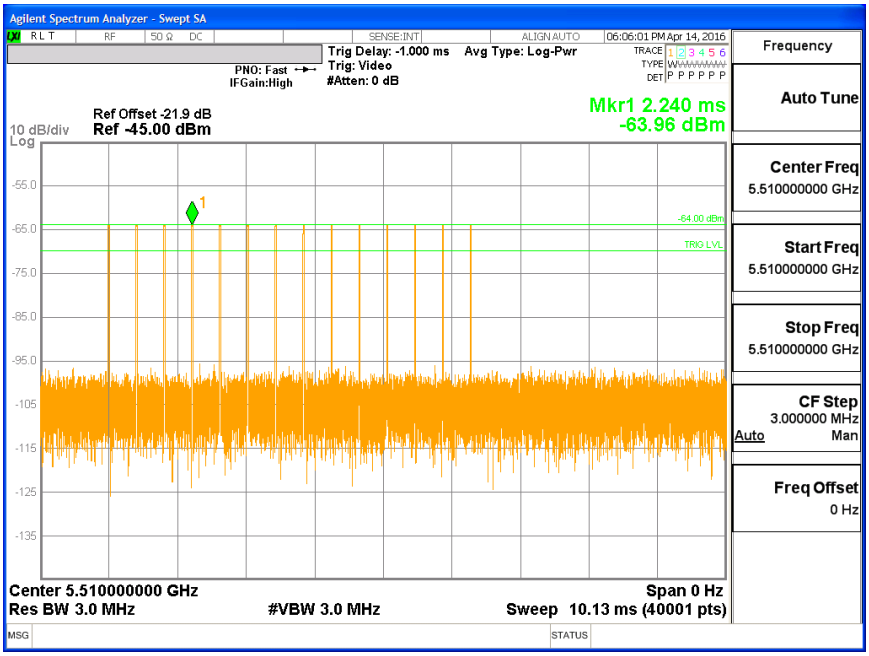
SAMPLE OF RADAR TYPE 4



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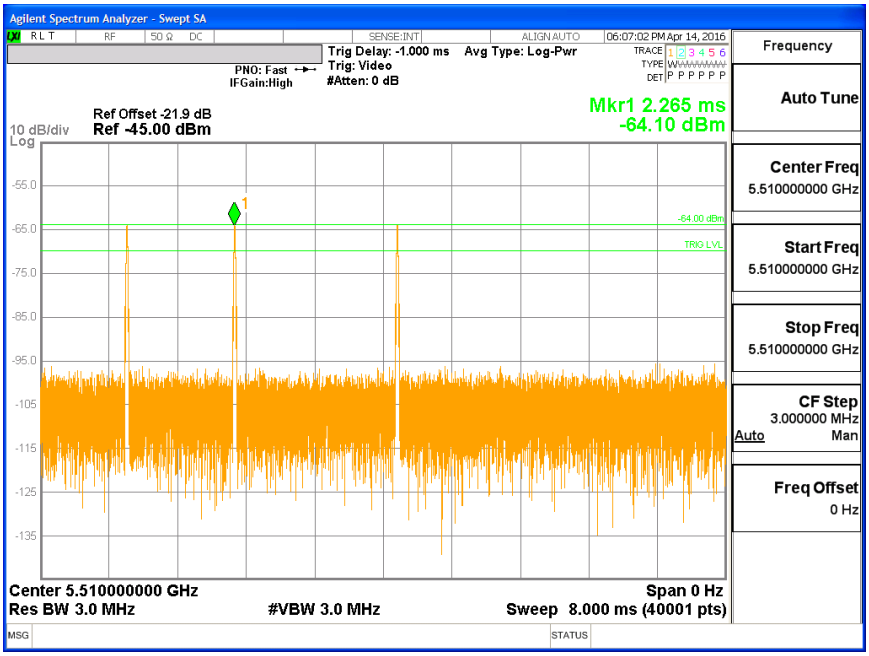
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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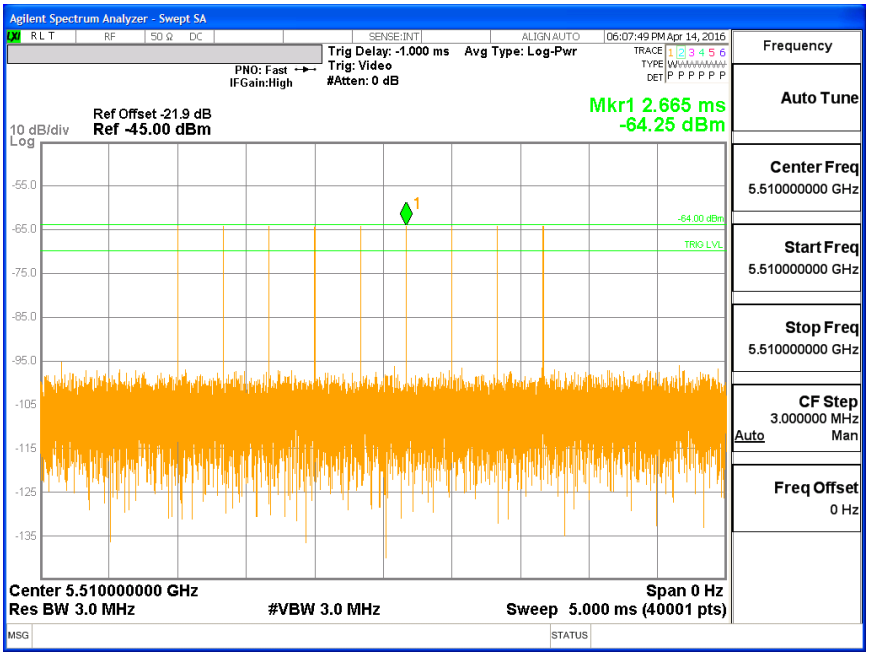
SINGLE BURST OF RADAR TYPE 6



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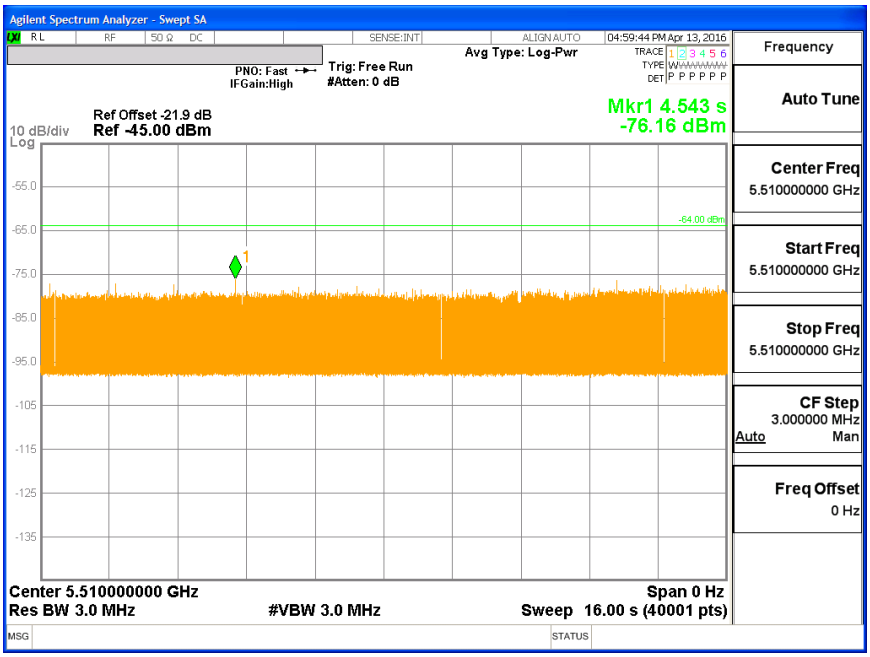
TRAFFIC

TRAFFIC



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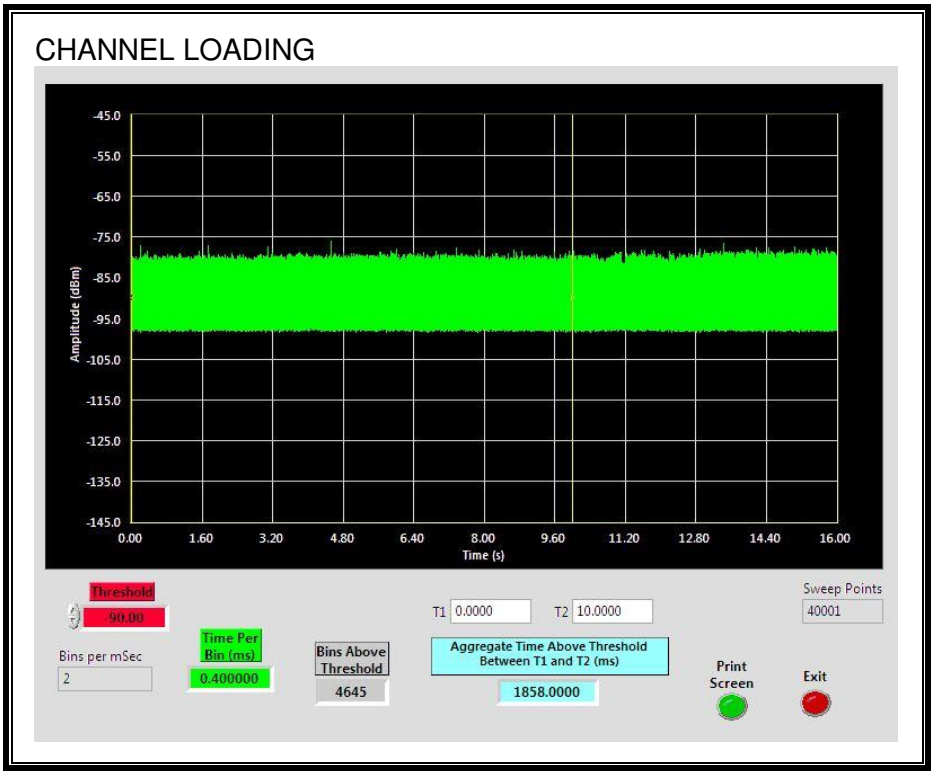
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 18.58%

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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.

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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)
30.33	185.8	155.5	95.5

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)
29.89	126.4	96.5	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)
30.22	184.4	154.2	58.7

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

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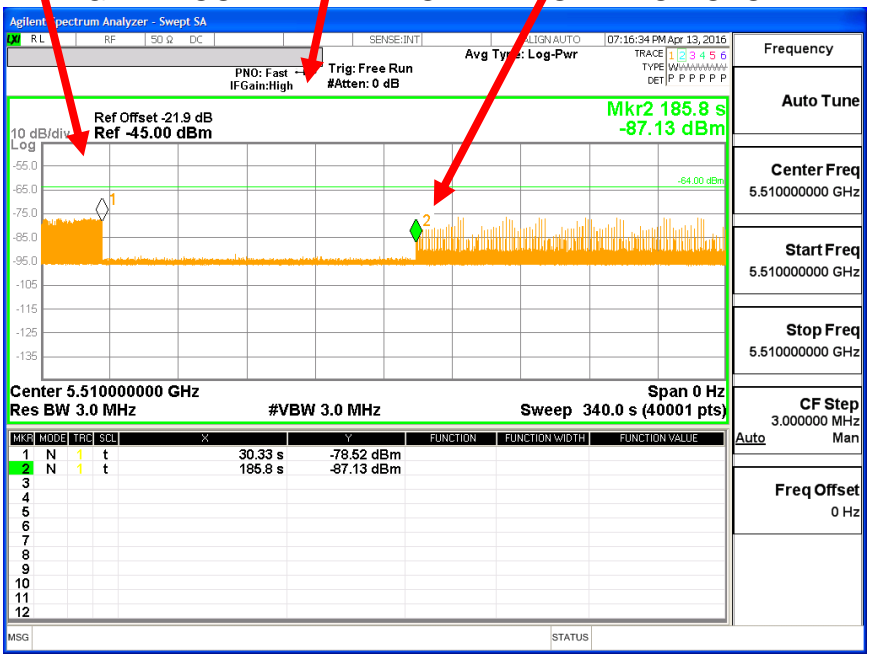
TIMING WITHOUT RADAR DURING CAC

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.

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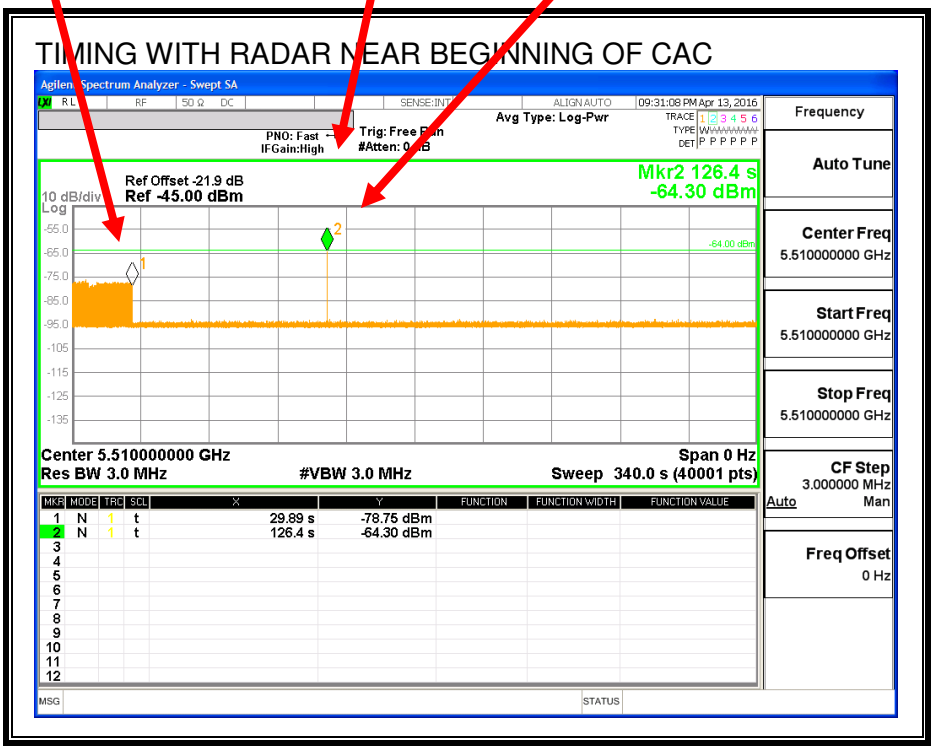
TIMING WITH RADAR NEAR BEGINNING OF CAC

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.

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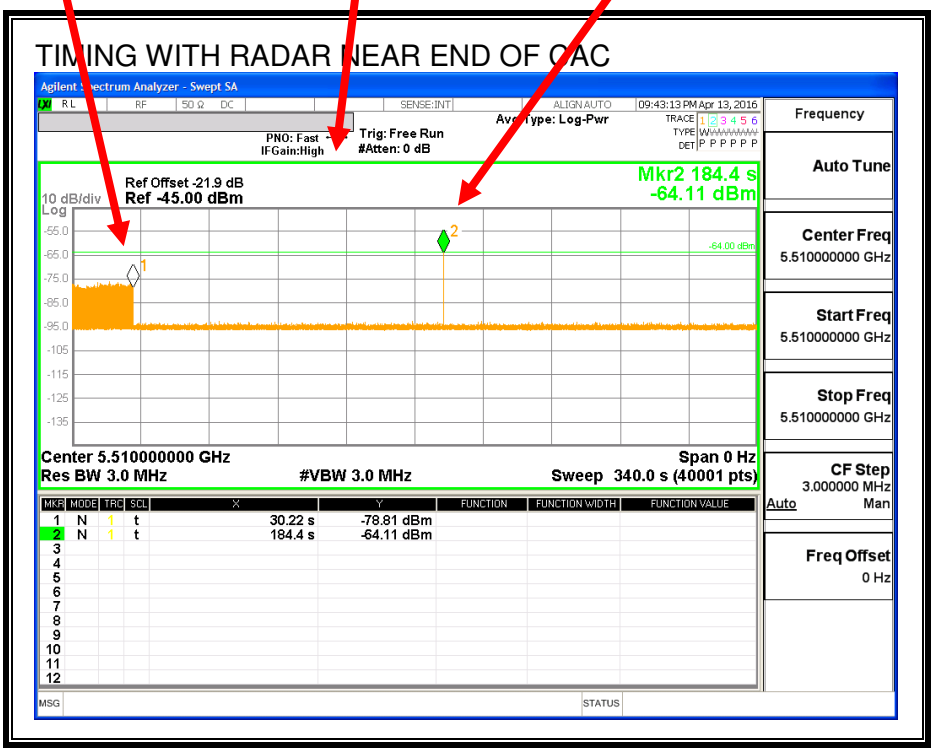
TIMING WITH RADAR NEAR END OF CAC

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.

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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.

These tests are not applicable.

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)
0.494	10

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

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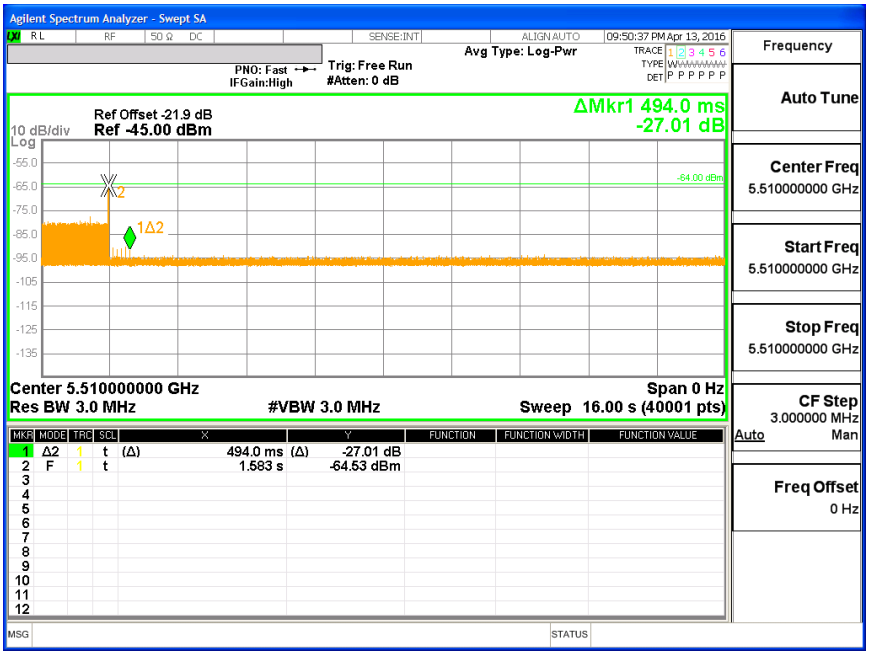
MOVE TIME

MOVE TIME



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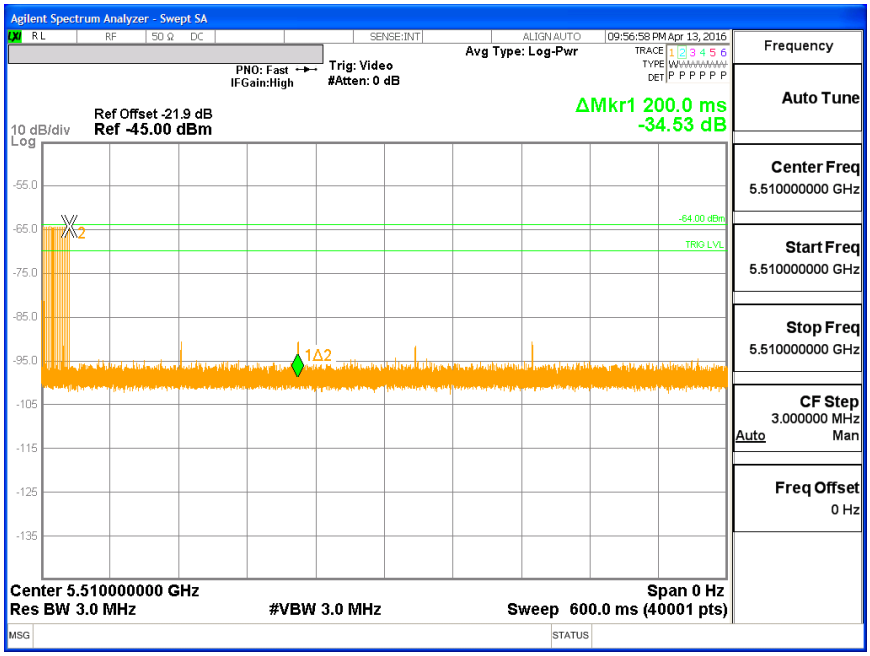
CHANNEL CLOSING TIME

CLOSING TIME



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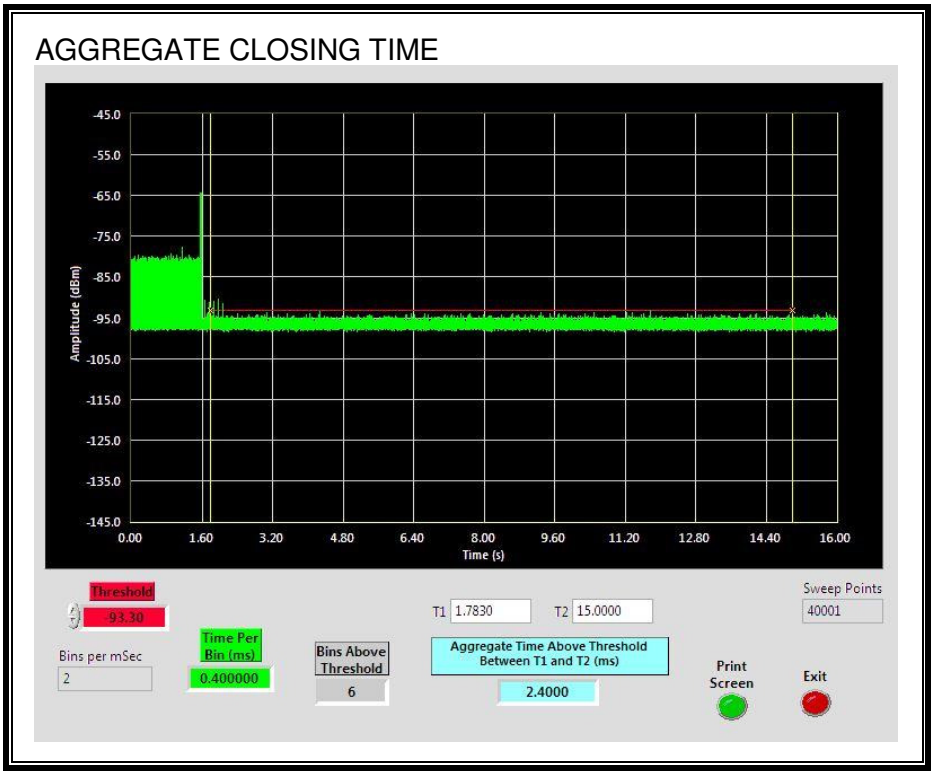
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.



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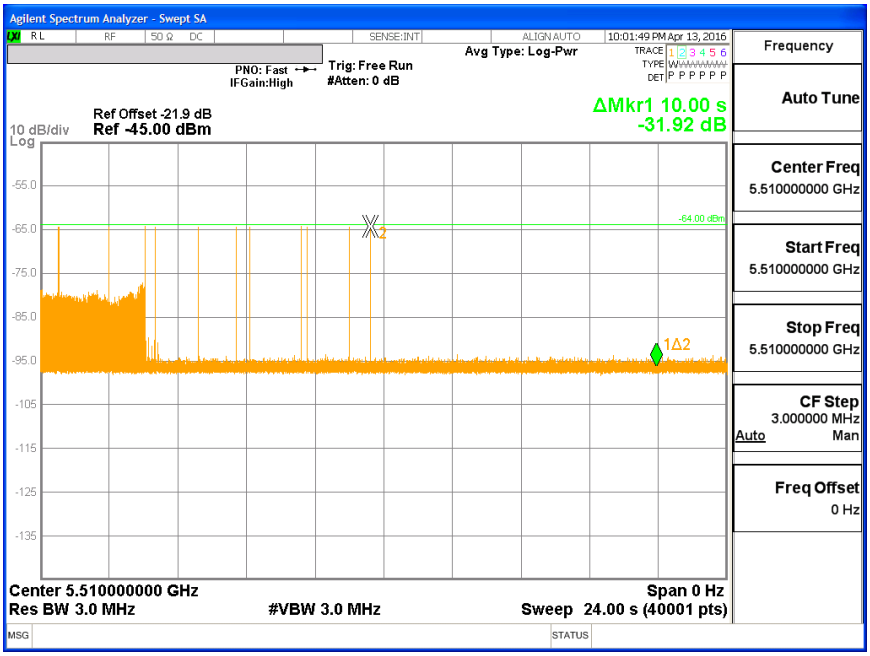
LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR



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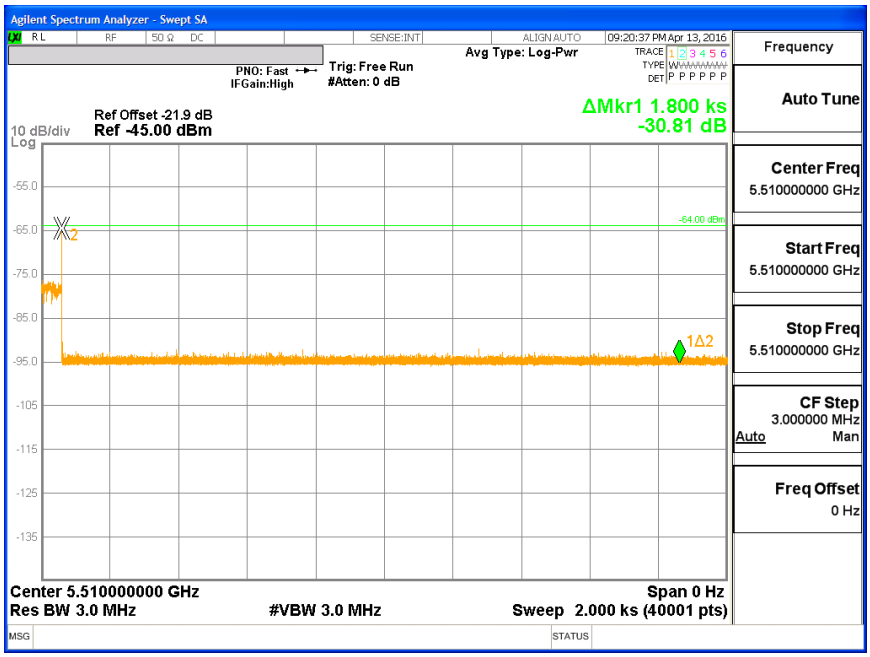
4.3.1. NON-OCCUPANCY PERIOD

RESULTS

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

NON-OCCUPANCY PERIOD



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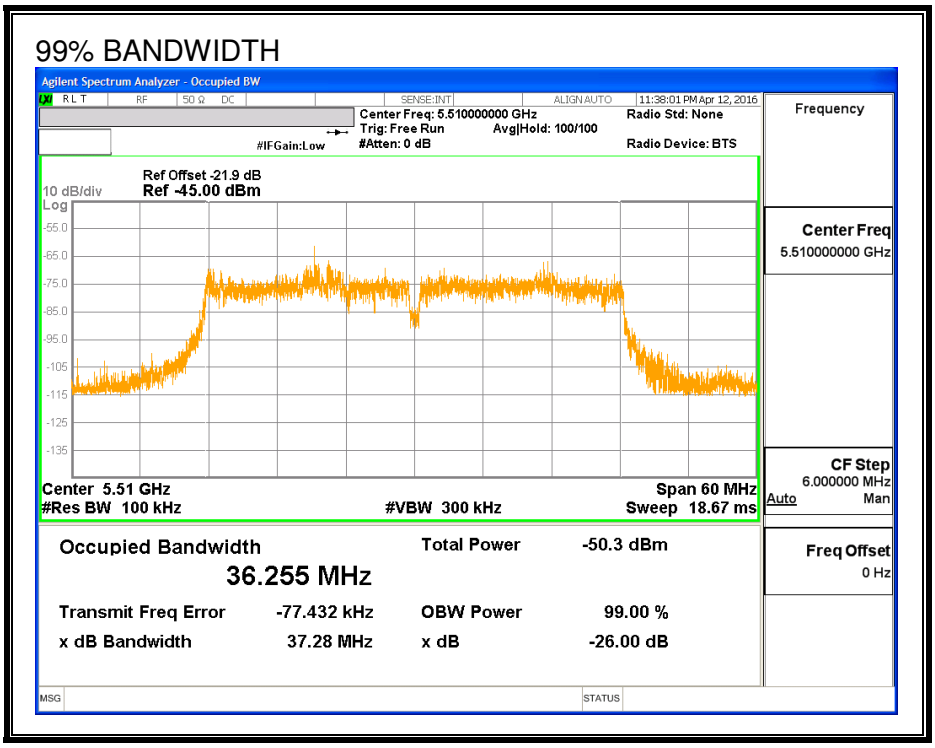
4.3.2. DETECTION BANDWIDTH

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	5530	40	36.255	110.3	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results				
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	

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4.3.3. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth		80% of Det BW	
					FL	FH	FL5	FH5
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5530		
FCC Short Pulse Type 2	30	93.33	60	Pass	5490	5530		
FCC Short Pulse Type 3	30	86.67	60	Pass	5490	5530		
FCC Short Pulse Type 4	30	93.33	60	Pass	5490	5530		
Aggregate		93.33	80	Pass				
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5530	5494	5526
FCC Hopping Type 6	41	100.00	70	Pass	5490	5530		

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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	5510	Yes
1002	1	598	89	A	5510	Yes
1003	1	938	57	A	5510	Yes
1004	1	898	59	A	5510	Yes
1005	1	838	63	A	5510	Yes
1006	1	558	95	A	5510	Yes
1007	1	798	67	A	5510	Yes
1008	1	778	68	A	5510	Yes
1009	1	618	86	A	5510	Yes
1010	1	918	58	A	5510	Yes
1011	1	738	72	A	5510	Yes
1012	1	638	83	A	5510	Yes
1013	1	578	92	A	5510	Yes
1014	1	538	99	A	5510	Yes
1015	1	678	78	A	5510	Yes
1016	1	1483	36	B	5510	Yes
1017	1	1245	43	B	5510	Yes
1018	1	1330	40	B	5510	Yes
1019	1	1221	44	B	5510	Yes
1020	1	2789	19	B	5510	Yes
1021	1	2810	19	B	5510	Yes
1022	1	765	69	B	5510	Yes
1023	1	2268	24	B	5510	Yes
1024	1	1548	35	B	5510	Yes
1025	1	633	84	B	5510	Yes
1026	1	1395	38	B	5510	Yes
1027	1	1962	27	B	5510	Yes
1028	1	2854	19	B	5510	Yes
1029	1	1003	53	B	5510	Yes
1030	1	830	64	B	5510	Yes

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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	1.3	186	28	5510	Yes
2002	3.6	228	29	5510	Yes
2003	4.5	222	28	5510	Yes
2004	2.9	150	27	5510	Yes
2005	2	229	24	5510	Yes
2006	2.8	161	23	5510	Yes
2007	4.1	206	23	5510	Yes
2008	3.2	224	26	5510	Yes
2009	2.7	154	23	5510	Yes
2010	3.9	175	26	5510	Yes
2011	1.8	190	24	5510	Yes
2012	1.3	178	24	5510	Yes
2013	3.4	197	26	5510	Yes
2014	3.1	189	23	5510	Yes
2015	1.4	175	29	5510	Yes
2016	3.5	170	26	5510	Yes
2017	4.1	160	25	5510	No
2018	2.3	203	27	5510	Yes
2019	3.2	159	23	5510	Yes
2020	1.6	206	25	5510	Yes
2021	4.8	166	28	5510	Yes
2022	1.5	217	27	5510	Yes
2023	5	181	24	5510	Yes
2024	1.9	198	24	5510	Yes
2025	1.4	209	28	5510	Yes
2026	4.8	150	24	5510	No
2027	4.6	165	25	5510	Yes
2028	4.1	152	29	5510	Yes
2029	2.1	172	24	5510	Yes
2030	1.8	163	28	5510	Yes

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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	6.6	499	17	5510	Yes
3002	6.5	486	16	5510	Yes
3003	7.3	453	16	5510	Yes
3004	5	335	18	5510	No
3005	6.1	449	18	5510	Yes
3006	6.8	344	16	5510	No
3007	8.2	471	17	5510	Yes
3008	9.1	378	17	5510	Yes
3009	8.4	267	18	5510	Yes
3010	9.6	454	18	5510	Yes
3011	9.1	355	17	5510	Yes
3012	8.1	421	18	5510	Yes
3013	7.9	469	16	5510	Yes
3014	7.2	430	17	5510	Yes
3015	9.9	490	18	5510	Yes
3016	9.5	464	17	5510	Yes
3017	5	419	16	5510	No
3018	10	289	17	5510	Yes
3019	5.7	256	18	5510	Yes
3020	8.5	256	17	5510	Yes
3021	9.6	370	17	5510	Yes
3022	5.2	265	18	5510	No
3023	6.6	391	16	5510	Yes
3024	7.5	299	16	5510	Yes
3025	6.7	321	17	5510	Yes
3026	8	374	17	5510	Yes
3027	7.4	275	16	5510	Yes
3028	6.5	475	17	5510	Yes
3029	6.3	389	18	5510	Yes
3030	5.6	351	17	5510	Yes

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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	16.6	411	14	5510	Yes
4002	11.1	267	12	5510	No
4003	17	340	16	5510	Yes
4004	12	460	12	5510	Yes
4005	18.3	428	16	5510	Yes
4006	13.8	310	13	5510	Yes
4007	16	291	12	5510	Yes
4008	17.4	436	16	5510	Yes
4009	10	312	16	5510	Yes
4010	11.9	353	15	5510	Yes
4011	10.3	492	13	5510	Yes
4012	12.7	295	13	5510	Yes
4013	11.7	447	13	5510	Yes
4014	20	396	13	5510	Yes
4015	19.5	310	14	5510	Yes
4016	18.2	271	12	5510	No
4017	13.4	464	13	5510	Yes
4018	18	439	13	5510	Yes
4019	13.8	260	15	5510	Yes
4020	18.9	381	16	5510	Yes
4021	15.1	349	15	5510	Yes
4022	10.6	482	16	5510	Yes
4023	18.2	462	16	5510	Yes
4024	14.2	357	15	5510	Yes
4025	16.9	484	14	5510	Yes
4026	18.8	273	14	5510	Yes
4027	17.2	413	16	5510	Yes
4028	19.6	466	16	5510	Yes
4029	18.6	368	12	5510	Yes
4030	16.8	316	16	5510	Yes

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TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5512	Yes
2	5514	Yes
3	5507	Yes
4	5496	Yes
5	5525	Yes
6	5511	Yes
7	5509	Yes
8	5495	Yes
9	5510	Yes
10	5509	Yes
11	5508	Yes
12	5505	Yes
13	5519	Yes
14	5502	Yes
15	5502	Yes
16	5525	Yes
17	5513	Yes
18	5507	Yes
19	5504	Yes
20	5499	Yes
21	5526	Yes
22	5496	Yes
23	5514	Yes
24	5502	Yes
25	5520	Yes
26	5516	Yes
27	5517	Yes
28	5523	Yes
29	5512	Yes
30	5525	Yes

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

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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	17	5490	13	Yes
2	492	5491	10	Yes
3	967	5492	7	Yes
4	1442	5493	11	Yes
5	1917	5494	15	Yes
6	2392	5495	11	Yes
7	2867	5496	8	Yes
8	3342	5497	8	Yes
9	3817	5498	12	Yes
10	4292	5499	8	Yes
11	4767	5500	7	Yes
12	5242	5501	6	Yes
13	5717	5502	6	Yes
14	6192	5503	12	Yes
15	6667	5504	8	Yes
16	7142	5505	9	Yes
17	7617	5506	13	Yes
18	8092	5507	5	Yes
19	8567	5508	7	Yes
20	9042	5509	8	Yes
21	9517	5510	7	Yes
22	9992	5511	7	Yes
23	10467	5512	7	Yes
24	10942	5513	8	Yes
25	11417	5514	7	Yes
26	11892	5515	6	Yes
27	12367	5516	6	Yes
28	12842	5517	6	Yes
29	13317	5518	10	Yes
30	13792	5519	6	Yes
31	14267	5520	8	Yes
32	14742	5521	11	Yes
33	15217	5522	7	Yes
34	15692	5523	11	Yes
35	16167	5524	9	Yes
36	16642	5525	7	Yes
37	17117	5526	10	Yes
38	17592	5527	12	Yes
39	18067	5528	9	Yes
40	18542	5529	10	Yes
41	19017	5530	5	Yes

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4.4. RESULTS FOR 80 MHz BANDWIDTH

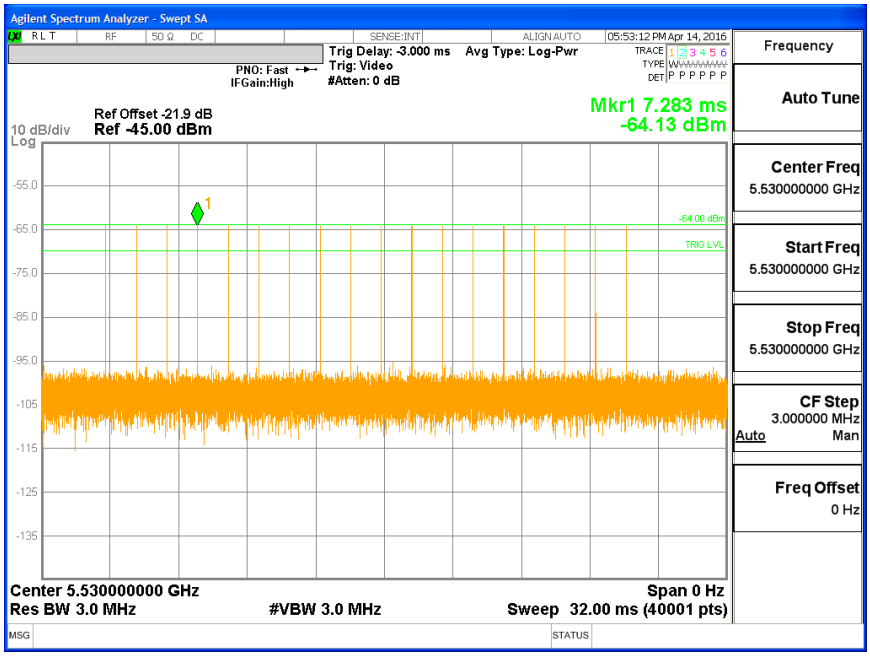
4.4.1. TEST CHANNEL

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



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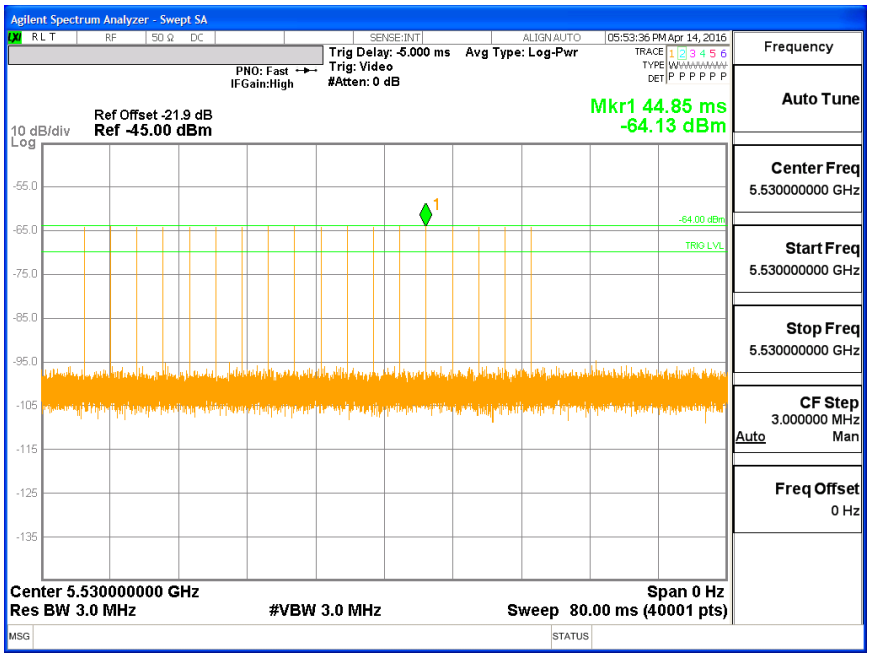
SAMPLE OF RADAR TYPE 1



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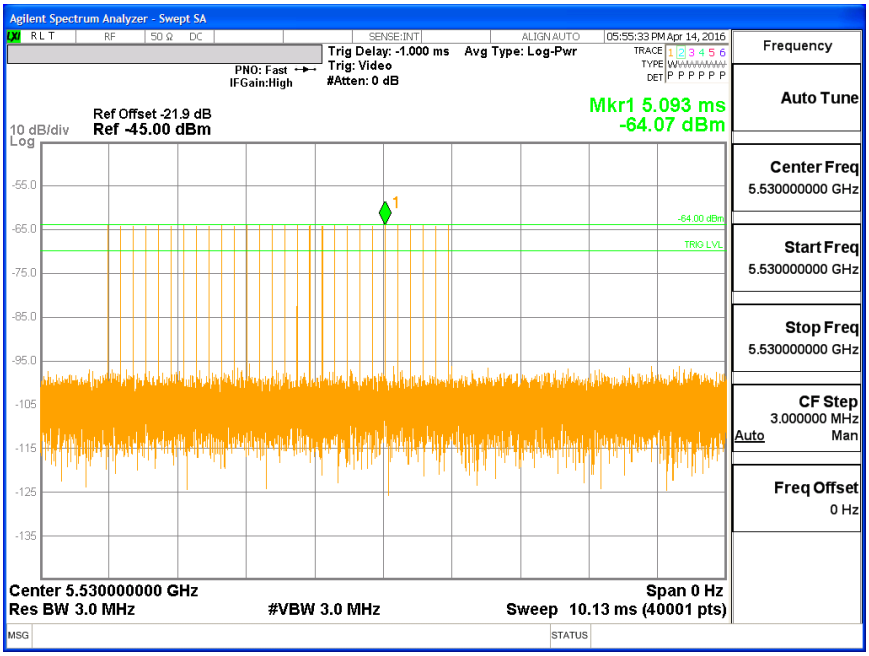
SAMPLE OF RADAR TYPE 2



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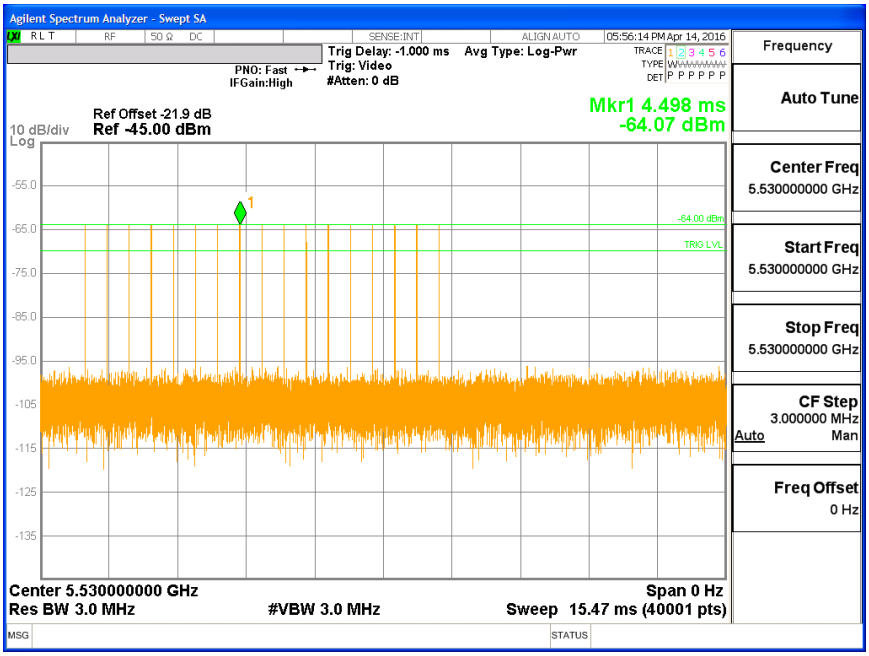
SAMPLE OF RADAR TYPE 3



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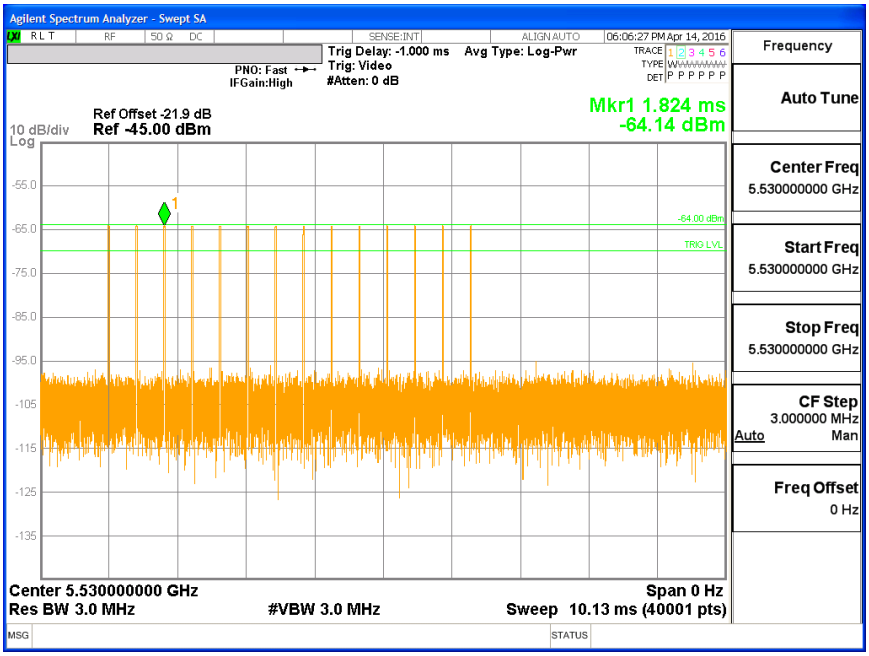
SAMPLE OF RADAR TYPE 4



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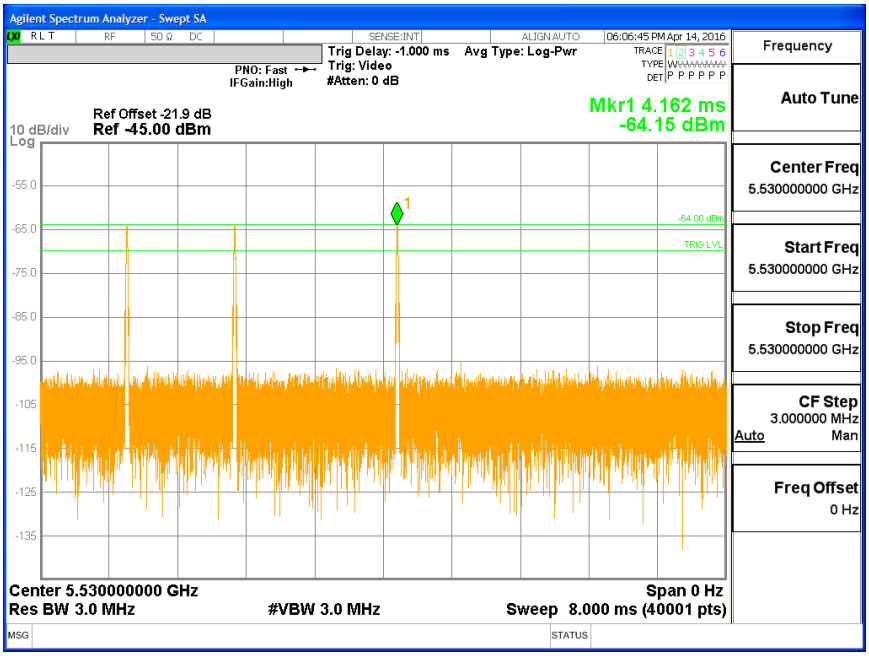
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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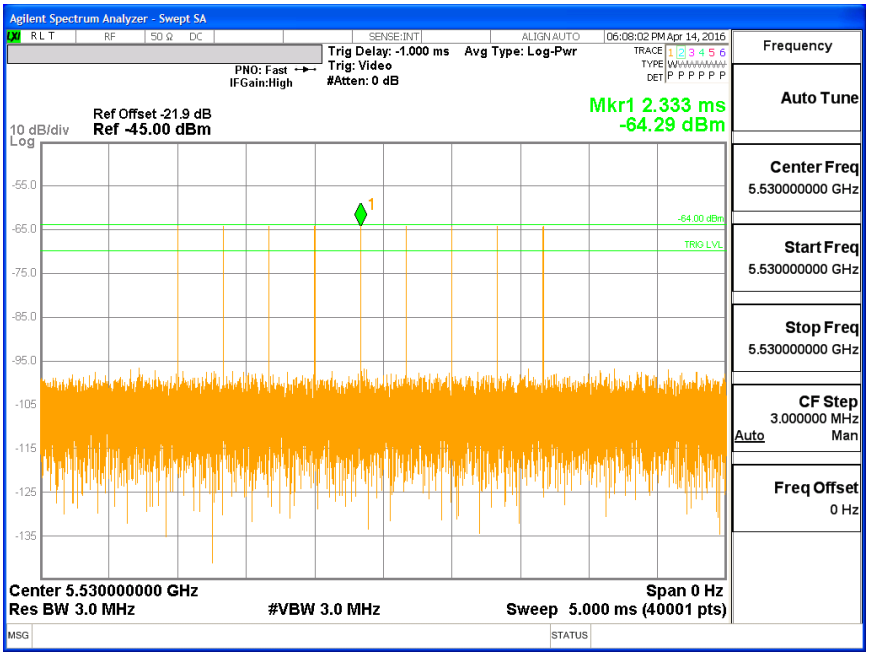
SINGLE BURST OF RADAR TYPE 6



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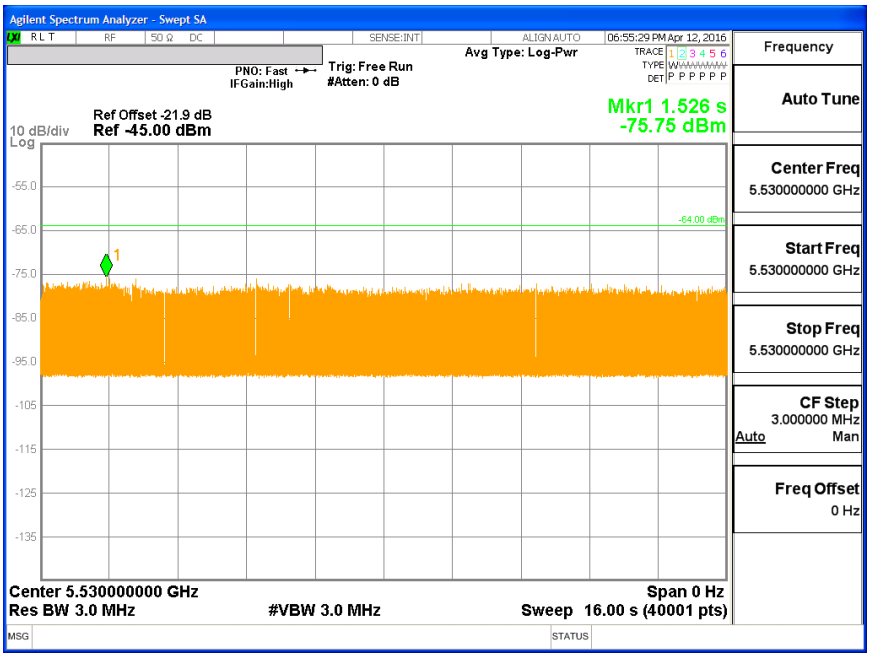
TRAFFIC

TRAFFIC



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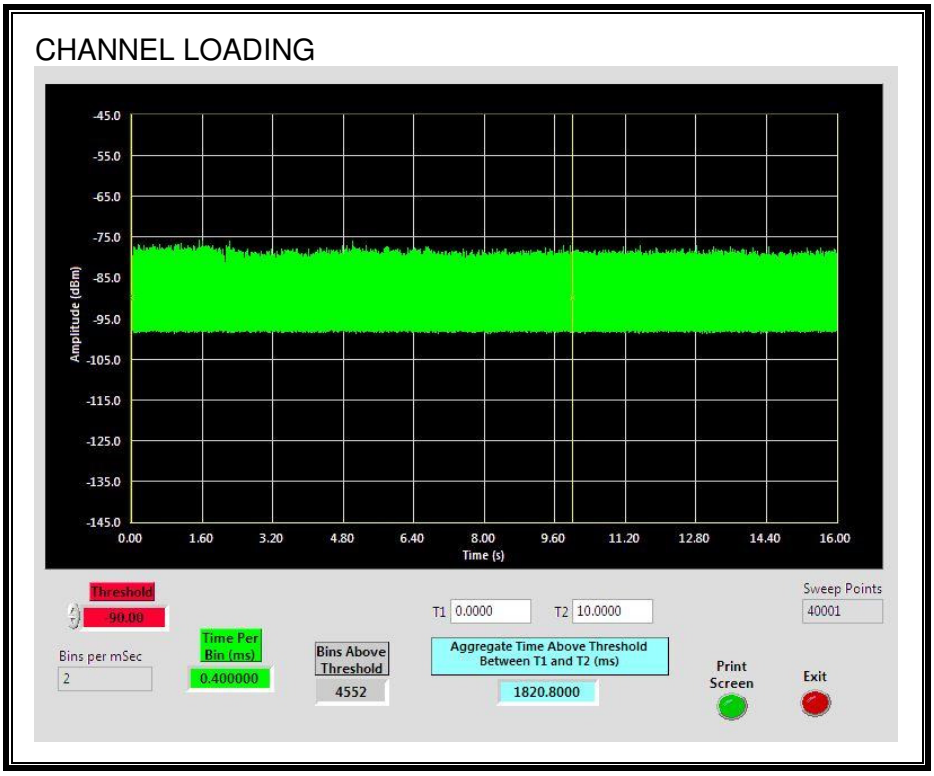
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 18.208%

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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.

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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)
30.35	186.5	156.2	96.2

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)
30.12	127.3	97.2	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)
29.84	184.9	155.1	58.9

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

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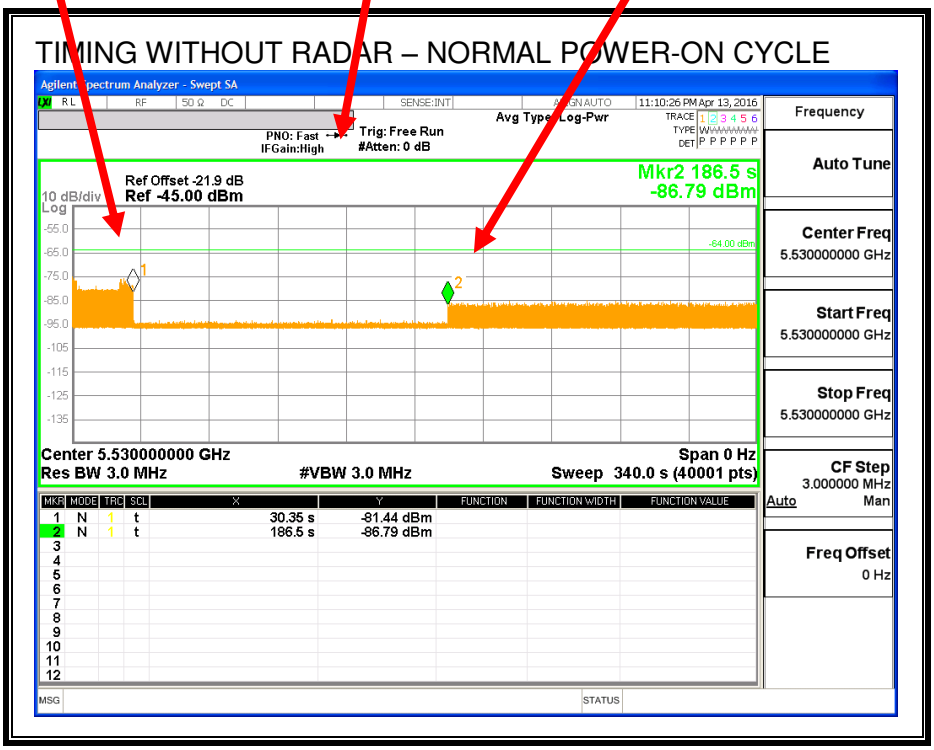
TIMING WITHOUT RADAR DURING CAC

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.

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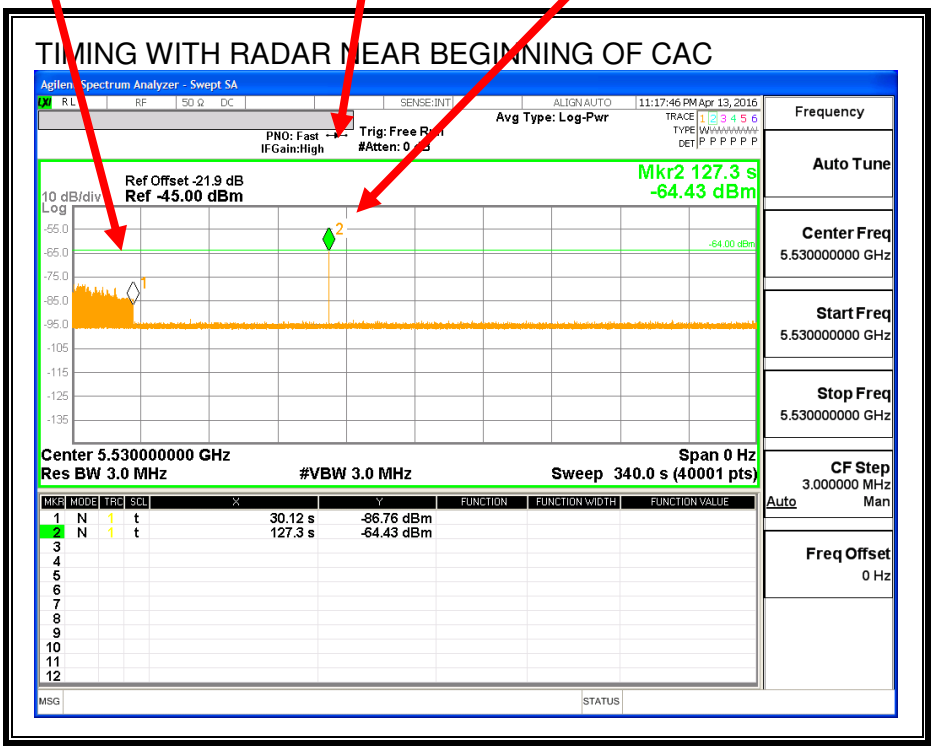
TIMING WITH RADAR NEAR BEGINNING OF CAC

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.

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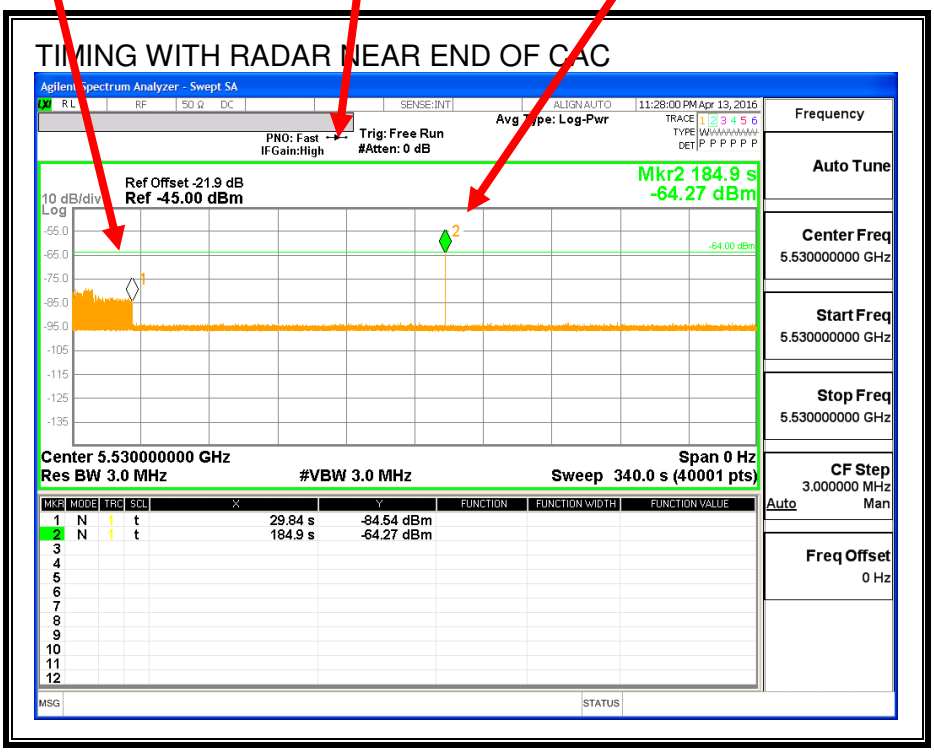
TIMING WITH RADAR NEAR END OF CAC

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.

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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.

These tests are not applicable.

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)
0.000	10

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

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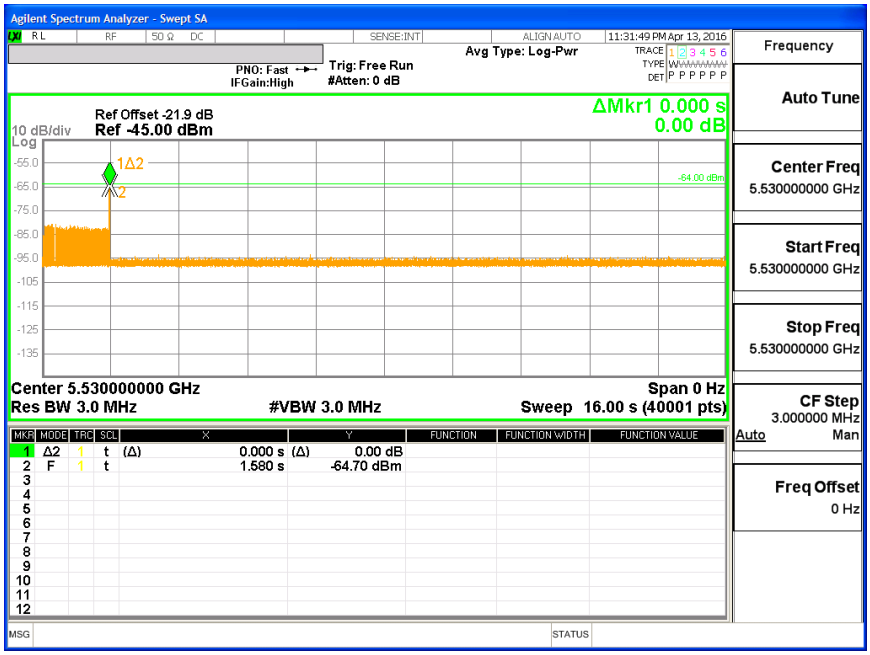
MOVE TIME

MOVE TIME



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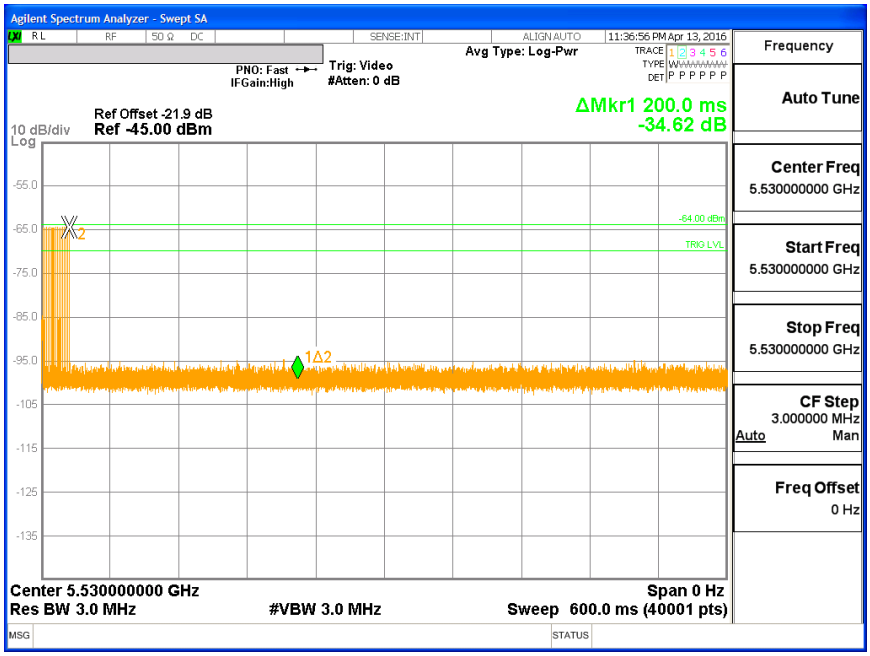
CHANNEL CLOSING TIME

CLOSING TIME



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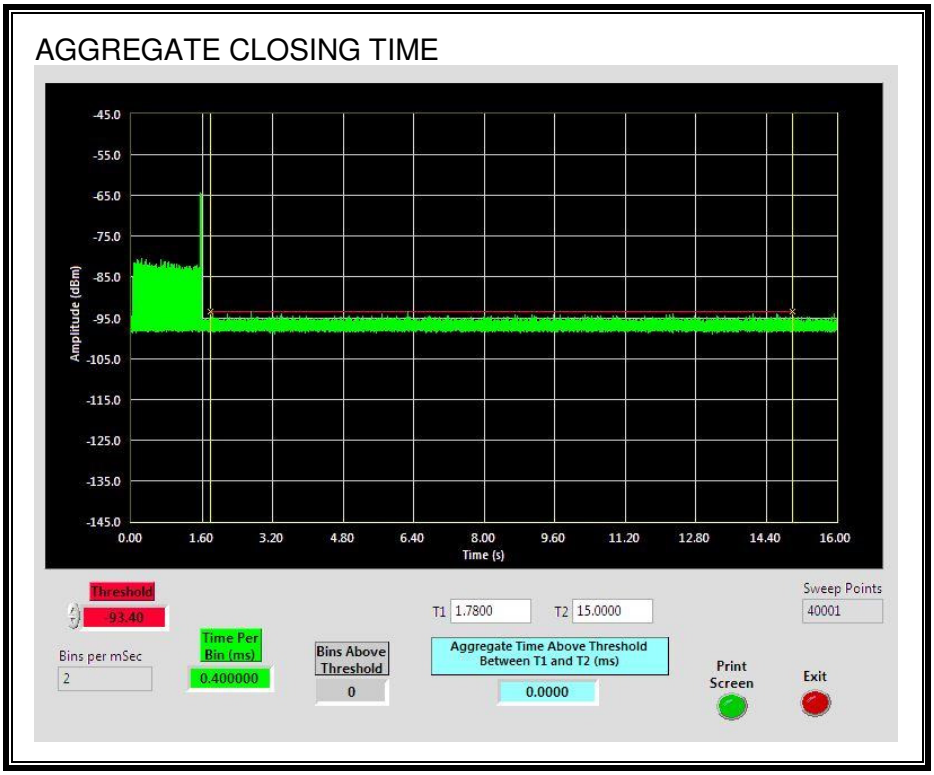
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

No transmissions are observed during the aggregate monitoring period.



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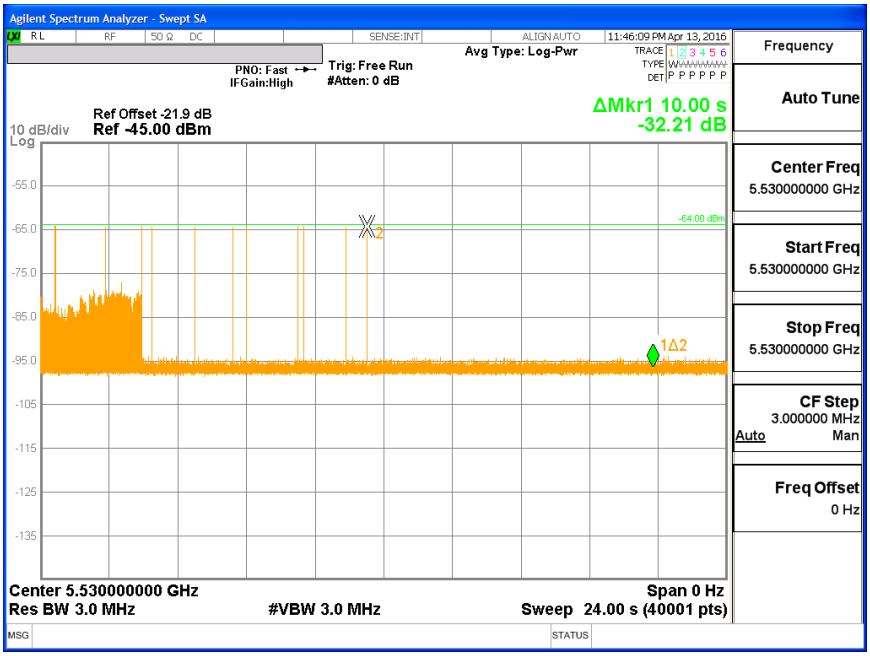
LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR



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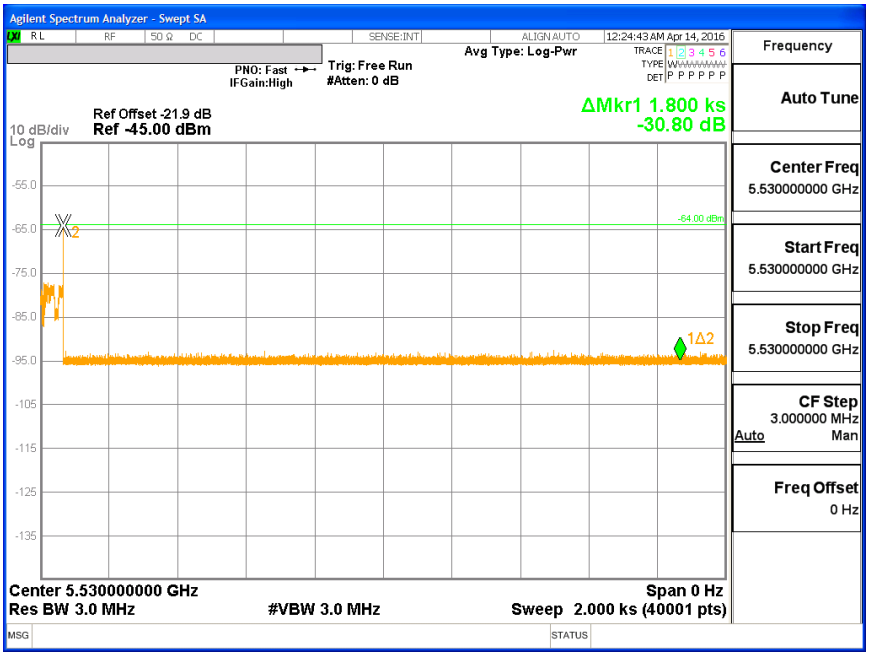
4.4.1. NON-OCCUPANCY PERIOD

RESULTS

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

NON-OCCUPANCY PERIOD



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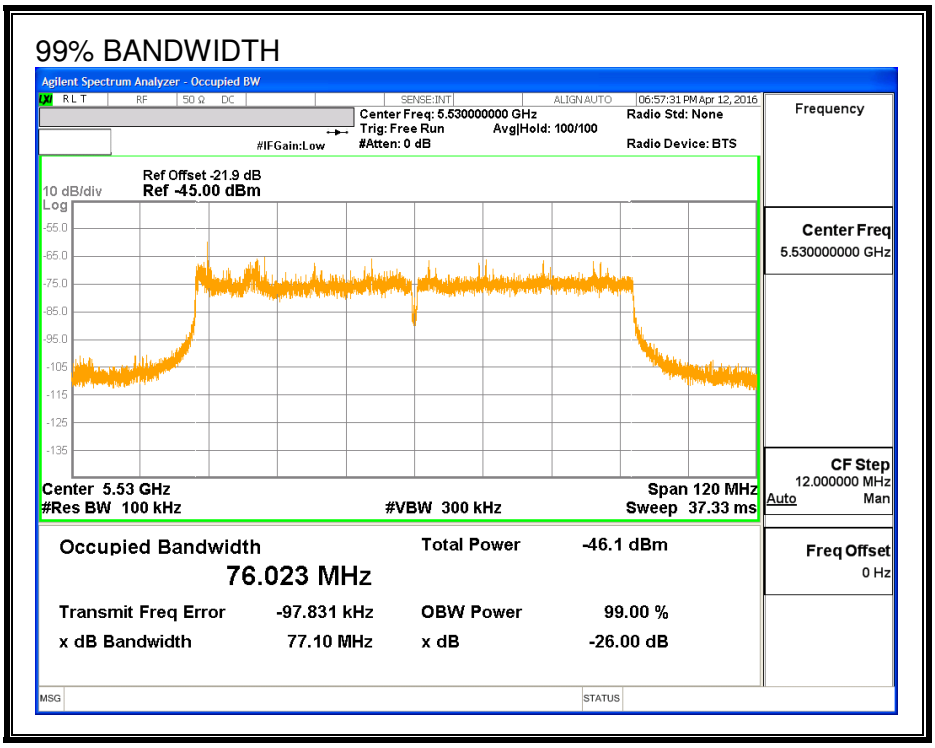
4.4.2. DETECTION BANDWIDTH

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	76.023	105.2	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results				
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	

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4.4.3. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth		80% of Det BW	
					FL	FH	FL5	FH5
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5570		
FCC Short Pulse Type 2	30	90.00	60	Pass	5490	5570		
FCC Short Pulse Type 3	30	90.00	60	Pass	5490	5570		
FCC Short Pulse Type 4	30	100.00	60	Pass	5490	5570		
Aggregate		95.00	80	Pass				
FCC Long Pulse Type 5	30	96.67	80	Pass	5490	5570	5498	5562
FCC Hopping Type 6	81	100.00	70	Pass	5490	5570		

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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	5530	Yes
1002	1	598	89	A	5530	Yes
1003	1	938	57	A	5530	Yes
1004	1	898	59	A	5530	Yes
1005	1	838	63	A	5530	Yes
1006	1	558	95	A	5530	Yes
1007	1	798	67	A	5530	Yes
1008	1	778	68	A	5530	Yes
1009	1	618	86	A	5530	Yes
1010	1	918	58	A	5530	Yes
1011	1	738	72	A	5530	Yes
1012	1	638	83	A	5530	Yes
1013	1	578	92	A	5530	Yes
1014	1	538	99	A	5530	Yes
1015	1	678	78	A	5530	Yes
1016	1	1483	36	B	5530	Yes
1017	1	1245	43	B	5530	Yes
1018	1	1330	40	B	5530	Yes
1019	1	1221	44	B	5530	Yes
1020	1	2789	19	B	5530	Yes
1021	1	2810	19	B	5530	Yes
1022	1	765	69	B	5530	Yes
1023	1	2268	24	B	5530	Yes
1024	1	1548	35	B	5530	Yes
1025	1	633	84	B	5530	Yes
1026	1	1395	38	B	5530	Yes
1027	1	1962	27	B	5530	Yes
1028	1	2854	19	B	5530	Yes
1029	1	1003	53	B	5530	Yes
1030	1	830	64	B	5530	Yes

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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	1.3	186	28	5530	Yes
2002	3.6	228	29	5530	Yes
2003	4.5	222	28	5530	Yes
2004	2.9	150	27	5530	Yes
2005	2	229	24	5530	Yes
2006	2.8	161	23	5530	Yes
2007	4.1	206	23	5530	Yes
2008	3.2	224	26	5530	Yes
2009	2.7	154	23	5530	Yes
2010	3.9	175	26	5530	Yes
2011	1.8	190	24	5530	No
2012	1.3	178	24	5530	No
2013	3.4	197	26	5530	Yes
2014	3.1	189	23	5530	No
2015	1.4	175	29	5530	Yes
2016	3.5	170	26	5530	Yes
2017	4.1	160	25	5530	Yes
2018	2.3	203	27	5530	Yes
2019	3.2	159	23	5530	Yes
2020	1.6	206	25	5530	Yes
2021	4.8	166	28	5530	Yes
2022	1.5	217	27	5530	Yes
2023	5	181	24	5530	Yes
2024	1.9	198	24	5530	Yes
2025	1.4	209	28	5530	Yes
2026	4.8	150	24	5530	Yes
2027	4.6	165	25	5530	Yes
2028	4.1	152	29	5530	Yes
2029	2.1	172	24	5530	Yes
2030	1.8	163	28	5530	Yes

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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	6.6	499	17	5530	Yes
3002	6.5	486	16	5530	Yes
3003	7.3	453	16	5530	Yes
3004	5	335	18	5530	No
3005	6.1	449	18	5530	Yes
3006	6.8	344	16	5530	Yes
3007	8.2	471	17	5530	Yes
3008	9.1	378	17	5530	Yes
3009	8.4	267	18	5530	Yes
3010	9.6	454	18	5530	Yes
3011	9.1	355	17	5530	Yes
3012	8.1	421	18	5530	No
3013	7.9	469	16	5530	Yes
3014	7.2	430	17	5530	Yes
3015	9.9	490	18	5530	Yes
3016	9.5	464	17	5530	Yes
3017	5	419	16	5530	No
3018	10	289	17	5530	Yes
3019	5.7	256	18	5530	Yes
3020	8.5	256	17	5530	Yes
3021	9.6	370	17	5530	Yes
3022	5.2	265	18	5530	Yes
3023	6.6	391	16	5530	Yes
3024	7.5	299	16	5530	Yes
3025	6.7	321	17	5530	Yes
3026	8	374	17	5530	Yes
3027	7.4	275	16	5530	Yes
3028	6.5	475	17	5530	Yes
3029	6.3	389	18	5530	Yes
3030	5.6	351	17	5530	Yes

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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	16.6	411	14	5530	Yes
4002	11.1	267	12	5530	Yes
4003	17	340	16	5530	Yes
4004	12	460	12	5530	Yes
4005	18.3	428	16	5530	Yes
4006	13.8	310	13	5530	Yes
4007	16	291	12	5530	Yes
4008	17.4	436	16	5530	Yes
4009	10	312	16	5530	Yes
4010	11.9	353	15	5530	Yes
4011	10.3	492	13	5530	Yes
4012	12.7	295	13	5530	Yes
4013	11.7	447	13	5530	Yes
4014	20	396	13	5530	Yes
4015	19.5	310	14	5530	Yes
4016	18.2	271	12	5530	Yes
4017	13.4	464	13	5530	Yes
4018	18	439	13	5530	Yes
4019	13.8	260	15	5530	Yes
4020	18.9	381	16	5530	Yes
4021	15.1	349	15	5530	Yes
4022	10.6	482	16	5530	Yes
4023	18.2	462	16	5530	Yes
4024	14.2	357	15	5530	Yes
4025	16.9	484	14	5530	Yes
4026	18.8	273	14	5530	Yes
4027	17.2	413	16	5530	Yes
4028	19.6	466	16	5530	Yes
4029	18.6	368	12	5530	Yes
4030	16.8	316	16	5530	Yes

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TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5515	Yes
2	5557	Yes
3	5534	Yes
4	5524	Yes
5	5534	Yes
6	5545	Yes
7	5516	Yes
8	5515	Yes
9	5536	Yes
10	5534	Yes
11	5538	Yes
12	5555	Yes
13	5507	Yes
14	5498	Yes
15	5527	Yes
16	5515	Yes
17	5528	Yes
18	5542	Yes
19	5558	No
20	5505	Yes
21	5557	Yes
22	5528	Yes
23	5531	Yes
24	5502	Yes
25	5544	Yes
26	5518	Yes
27	5548	Yes
28	5539	Yes
29	5528	Yes
30	5536	Yes

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

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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	104	5490	16	Yes
2	579	5491	21	Yes
3	1054	5492	13	Yes
4	1529	5493	18	Yes
5	2004	5494	14	Yes
6	2479	5495	19	Yes
7	2954	5496	17	Yes
8	3429	5497	18	Yes
9	3904	5498	12	Yes
10	4379	5499	16	Yes
11	4854	5500	15	Yes
12	5329	5501	18	Yes
13	5804	5502	20	Yes
14	6279	5503	18	Yes
15	6754	5504	16	Yes
16	7229	5505	14	Yes
17	7704	5506	12	Yes
18	8179	5507	21	Yes
19	8654	5508	17	Yes
20	9129	5509	24	Yes
21	9604	5510	20	Yes
22	10079	5511	15	Yes
23	10554	5512	19	Yes
24	11029	5513	16	Yes
25	11504	5514	18	Yes
26	11979	5515	19	Yes
27	12454	5516	16	Yes
28	12929	5517	25	Yes
29	13404	5518	19	Yes
30	13879	5519	13	Yes
31	14354	5520	16	Yes
32	14829	5521	13	Yes
33	15304	5522	18	Yes
34	15779	5523	15	Yes

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TYPE 6 DETECTION PROBABILITY (CONTINUED)

35	16254	5524	11	Yes
36	16729	5525	19	Yes
37	17204	5526	16	Yes
38	17679	5527	18	Yes
39	18154	5528	22	Yes
40	18629	5529	18	Yes
41	19104	5530	14	Yes
42	19579	5531	11	Yes
43	20054	5532	19	Yes
44	20529	5533	23	Yes
45	21004	5534	17	Yes
46	21479	5535	22	Yes
47	21954	5536	21	Yes
48	22429	5537	19	Yes
49	22904	5538	19	Yes
50	23379	5539	14	Yes
51	23854	5540	13	Yes
52	24329	5541	26	Yes
53	24804	5542	21	Yes
54	25279	5543	17	Yes
55	25754	5544	21	Yes
56	26229	5545	15	Yes
57	26704	5546	20	Yes
58	27179	5547	11	Yes
59	27654	5548	15	Yes
60	28129	5549	15	Yes
61	28604	5550	18	Yes
62	29079	5551	8	Yes
63	29554	5552	13	Yes
64	30029	5553	18	Yes
65	30504	5554	16	Yes
66	30979	5555	13	Yes
67	31454	5556	21	Yes
68	31929	5557	16	Yes
69	32404	5558	15	Yes
70	32879	5559	15	Yes
71	33354	5560	10	Yes
72	33829	5561	16	Yes
73	34304	5562	15	Yes
74	34779	5563	15	Yes

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TYPE 6 DETECTION PROBABILITY (CONTINUED)

75	35254	5564	18	Yes
76	35729	5565	10	Yes
77	36204	5566	19	Yes
78	36679	5567	24	Yes
79	37154	5568	19	Yes
80	37629	5569	15	Yes
81	38104	5570	18	Yes

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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.

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