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

CERTIFICATION TEST REPORT

FOR

WIRELESS 802.11 ABGN/AC INDOOR AP

MODEL NUMBER: MR30H-HW

FCC ID: UDX-60051010
IC: 6961A-60051010

REPORT NUMBER: 11445065-E3V1

ISSUE DATE: NOVEMBER 28, 2016

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

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	11/28/16	Initial Issue	Conan Cheung

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: WIRELESS 802.11 ABGN/AC INDOOR AP

MODEL: MR30H-HW

SERIAL NUMBER: Q2RD-RM3Z-U8LX

DATE TESTED: SEPTEMBER 22 – NOVEMBER 15, 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.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with the DFS portion of FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, KDB 905462 D02 and D03, ANSI C63.10-2013, RSS-247 Issue 1.

3. 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.

4. CALIBRATION AND UNCERTAINTY

4.1. 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.

4.2. 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

4.3. 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%.

5. DYNAMIC FREQUENCY SELECTION

5.1. OVERVIEW

5.1.1. 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”.

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.

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

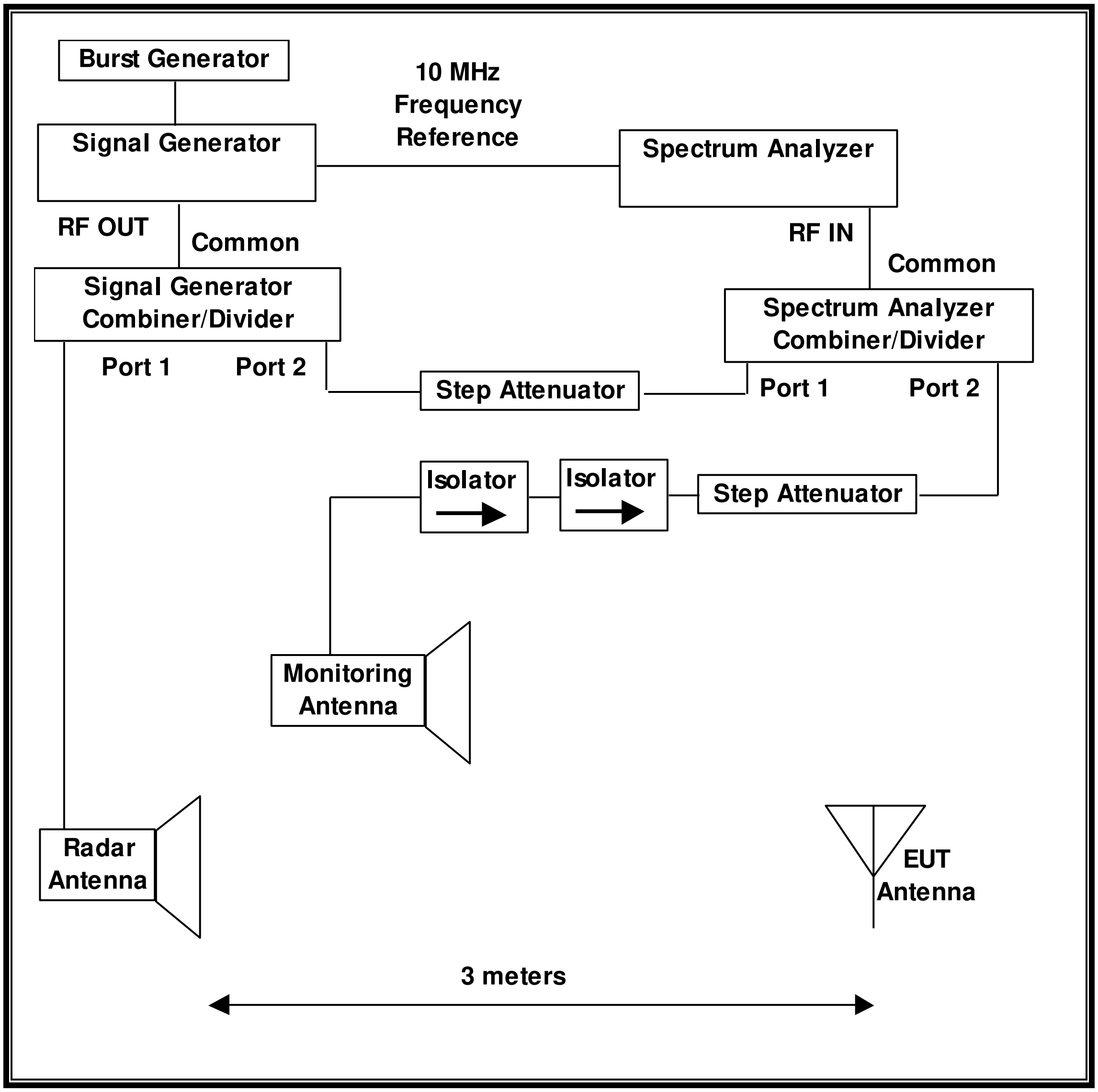
Radar Waveform Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

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

5.1.2. 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.

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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	06/13/17
Signal Generator, MXG X-Series RF Vector	Agilent	N5182B	MY51350337	03/11/17
Arbitrary Waveform Generator	Agilent / HP	33220A	MY44037572	04/11/17

5.1.3. 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 2014 Detection	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

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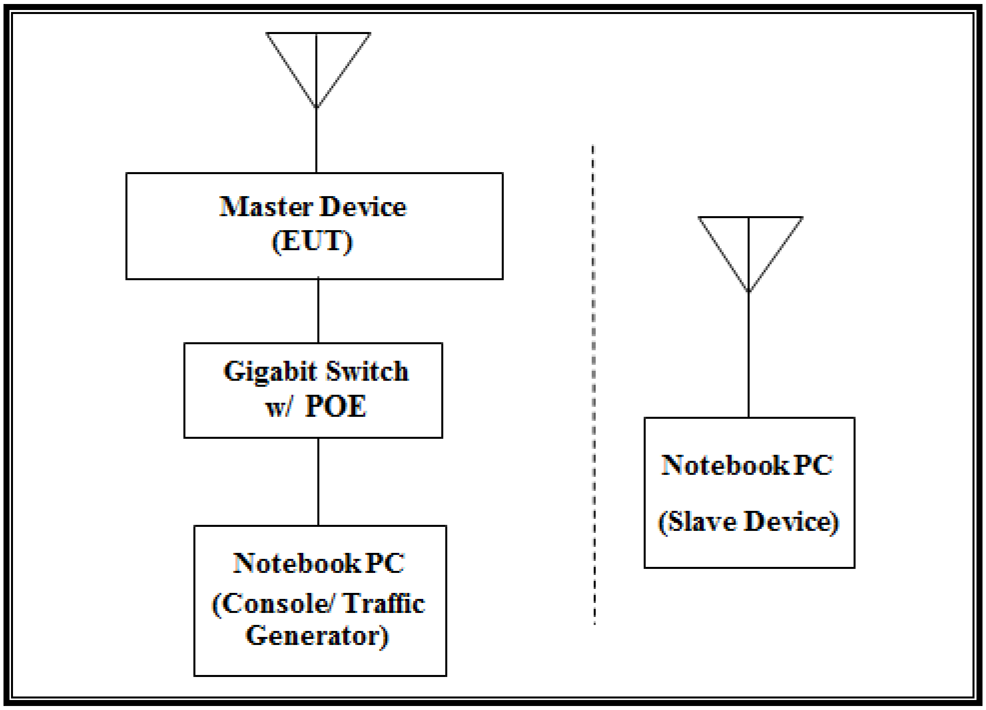
5.1.4. SETUP OF EUT

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

5.1.5. 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.

The highest power level within these bands is 29.77 dBm EIRP in the 5250-5350 MHz band and 29.81 dBm EIRP in the 5470-5725 MHz band.

The only antenna assembly utilized with the EUT has a gain of 4.84 dBi, 4.87 dBi, and 5.18 dBi.

Two 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 two 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_insect_version T-201610271804-Gf01d5fb0-Lfc56584bM-dhruvin.

UNIFORM CHANNEL SPREADING

This function is not required per KDB 905462.

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

The Master Device is a Cisco Meraki Access Point, FCC ID: UDX-60051010. The minimum antenna gain for the Master Device is 4.84 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.

5.2. RESULTS FOR 20 MHz BANDWIDTH

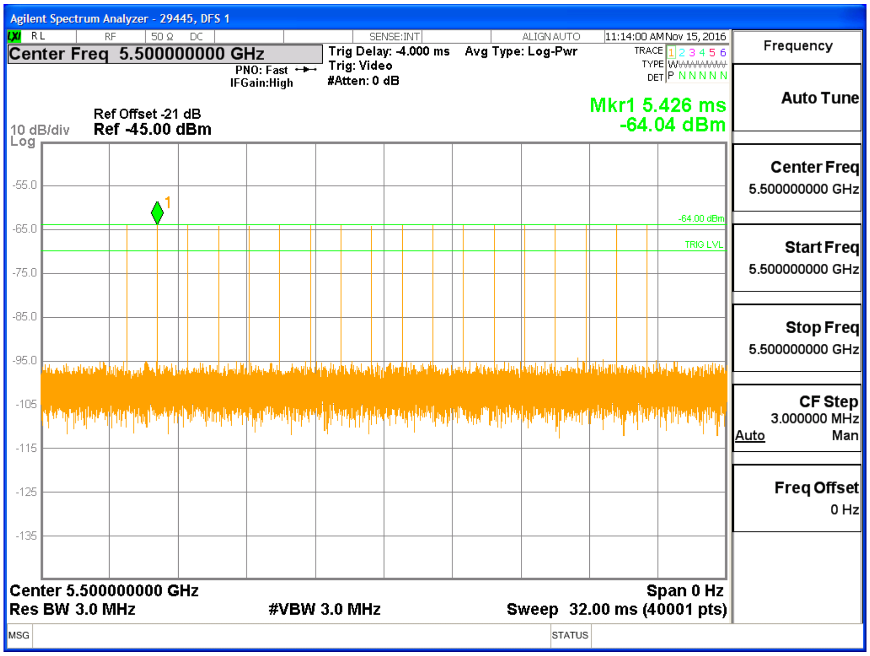
5.2.1. TEST CHANNEL

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

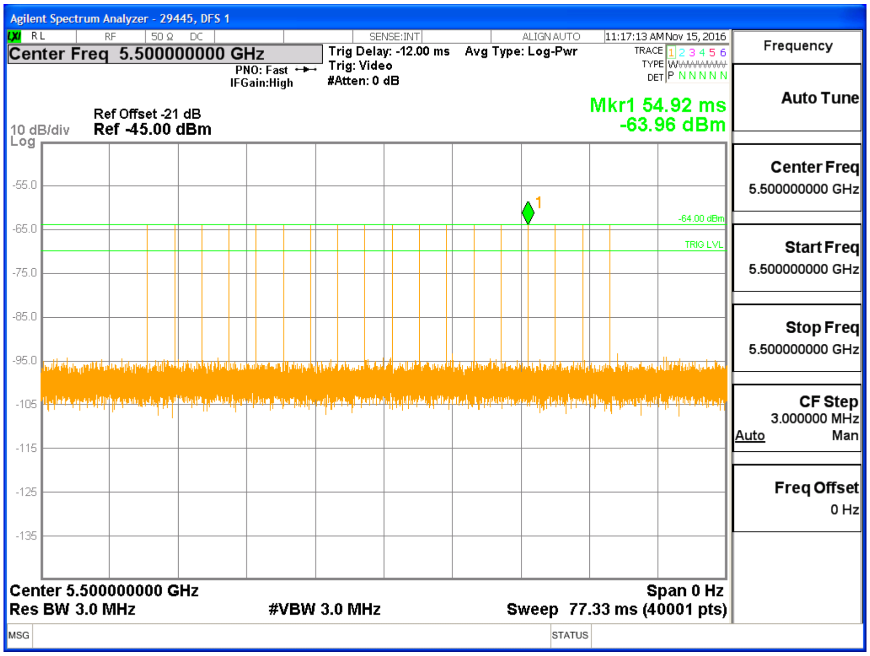
5.2.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

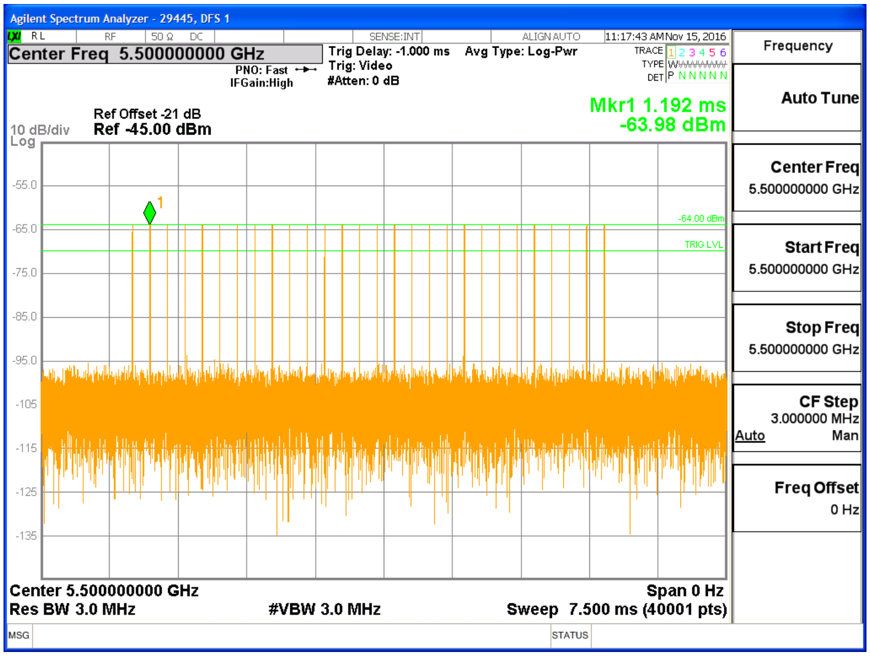
SHORT PULSE RADAR TYPE 0



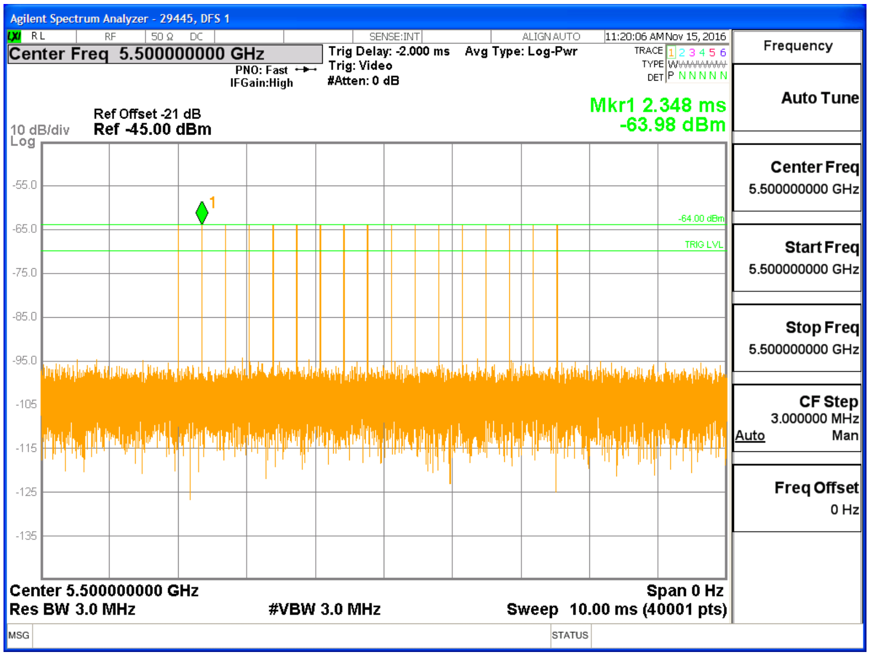
SAMPLE OF RADAR TYPE 1



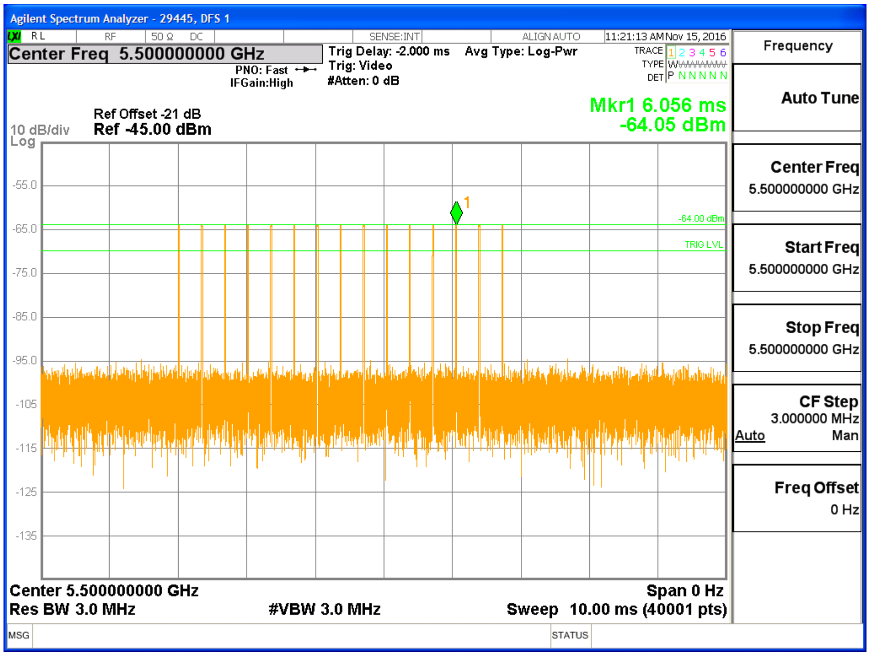
SAMPLE OF RADAR TYPE 2



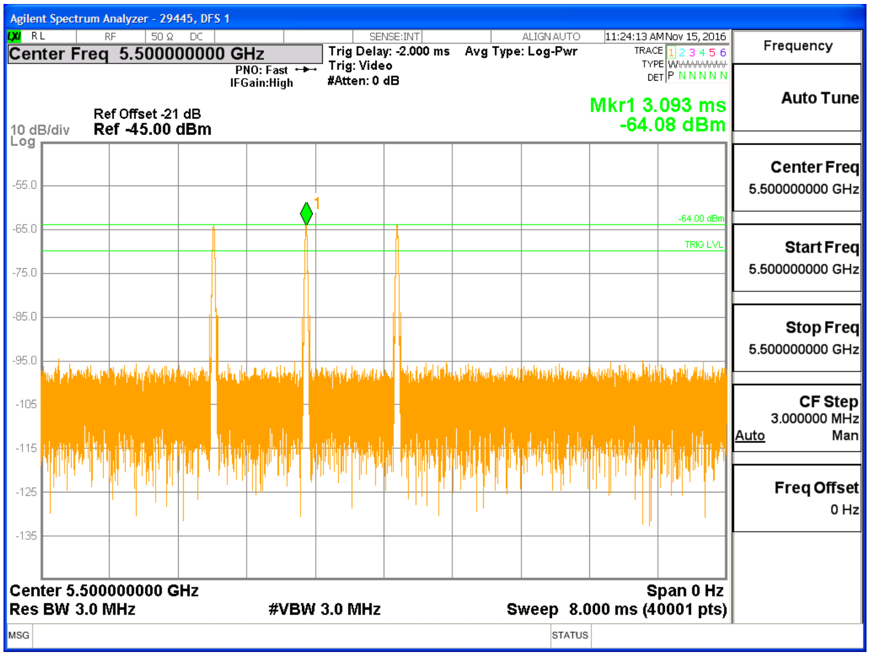
SAMPLE OF RADAR TYPE 3



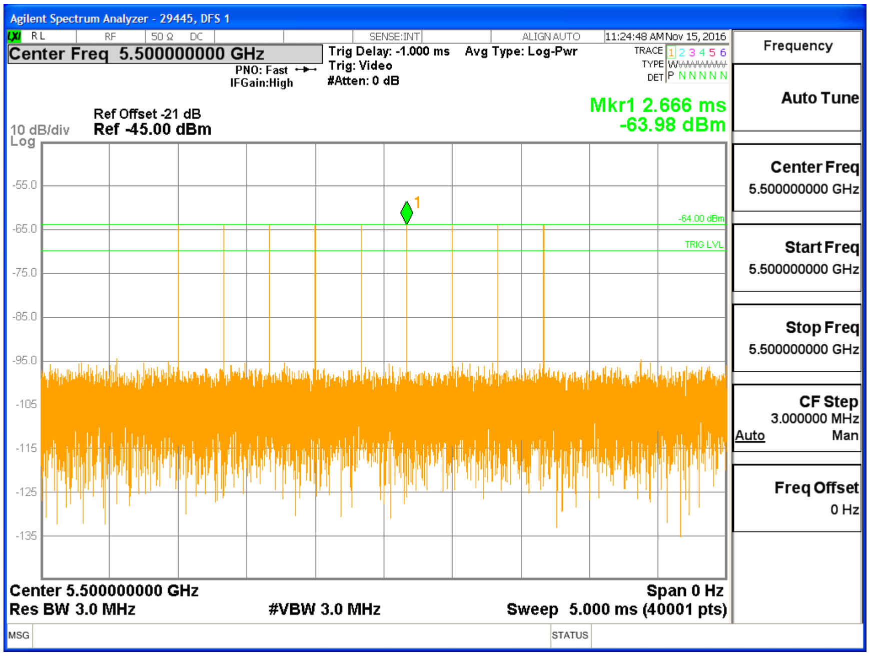
SAMPLE OF RADAR TYPE 4



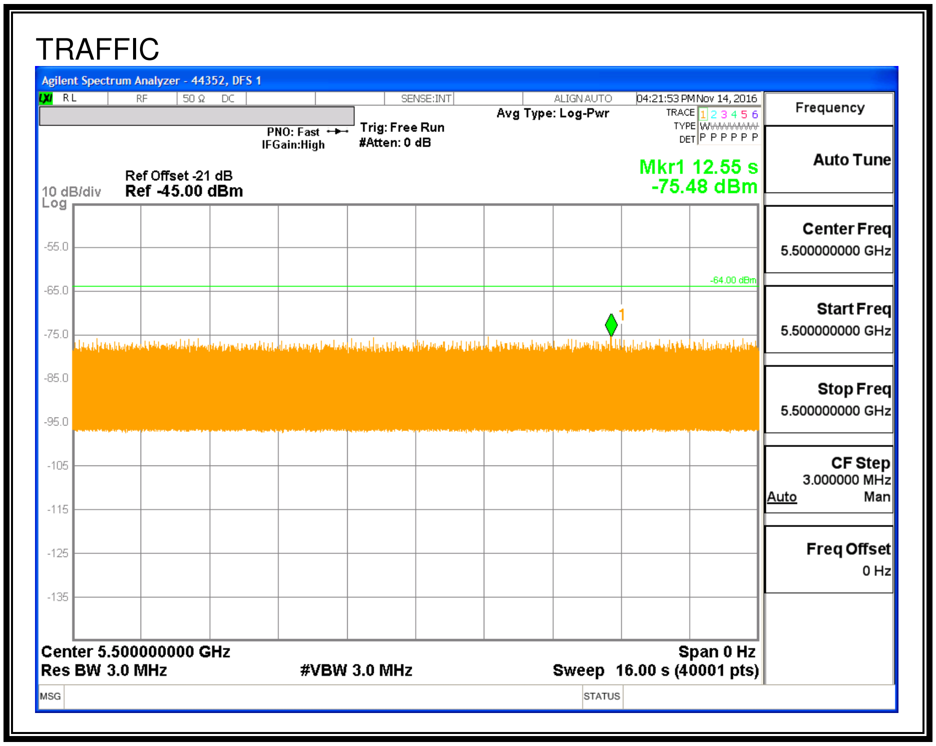
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



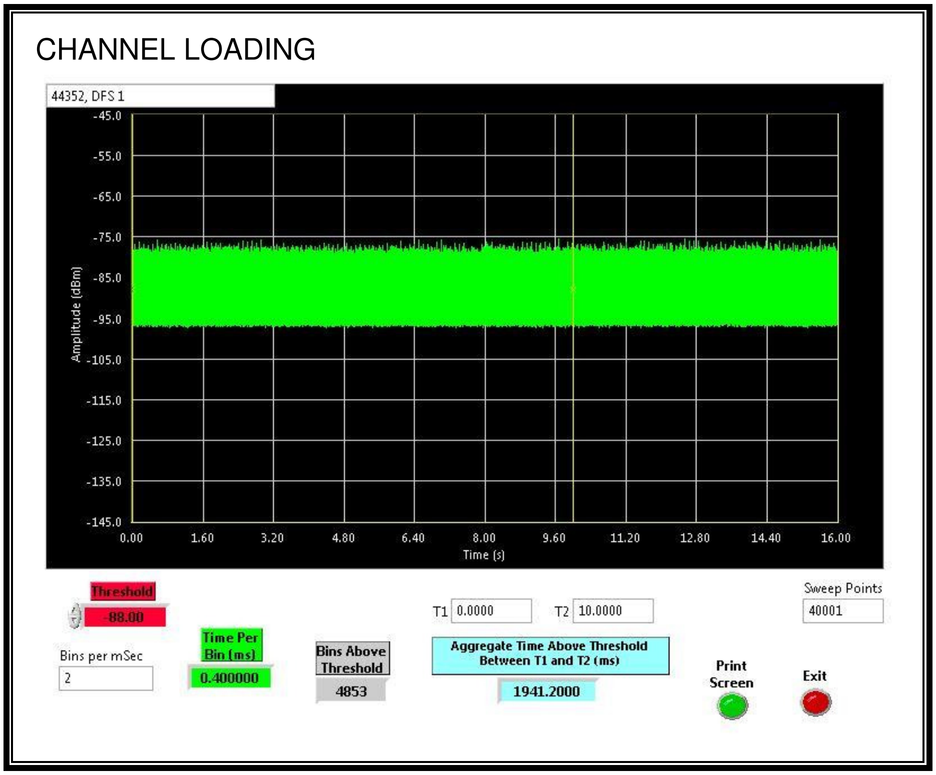
SINGLE BURST OF RADAR TYPE 6



TRAFFIC


TRAFFIC
Agilent Spectrum Analyzer - 44352, DFS 1
SENSE:INT
ALIGN AUTO
04:21:53 PM Nov 14, 2016
Avg Type: Log-Pwr
PNO: Fast
IFGain:High
Trig: Free Run
#Atten: 0 dB
Ref Offset -21 dB
Ref -45.00 dBm
10 dB/div
Log
Mkr1 12.55 s
-75.48 dBm
-64.00 dBm
Center 5.500000000 GHz
Res BW 3.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 16.00 s (40001 pts)
Frequency
Auto Tune
Center Freq
5.500000000 GHz
Start Freq
5.500000000 GHz
Stop Freq
5.500000000 GHz
CF Step
3.000000 MHz
Auto
Man
Freq Offset
0 Hz

CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 19.412%

5.2.3. 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)
29.05	204.60	175.6	115.6

Radar Near Beginning of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
29.98	147.5	117.5	2.0

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)
30.47	202.3	171.8	56.3

QUALITATIVE RESULTS

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

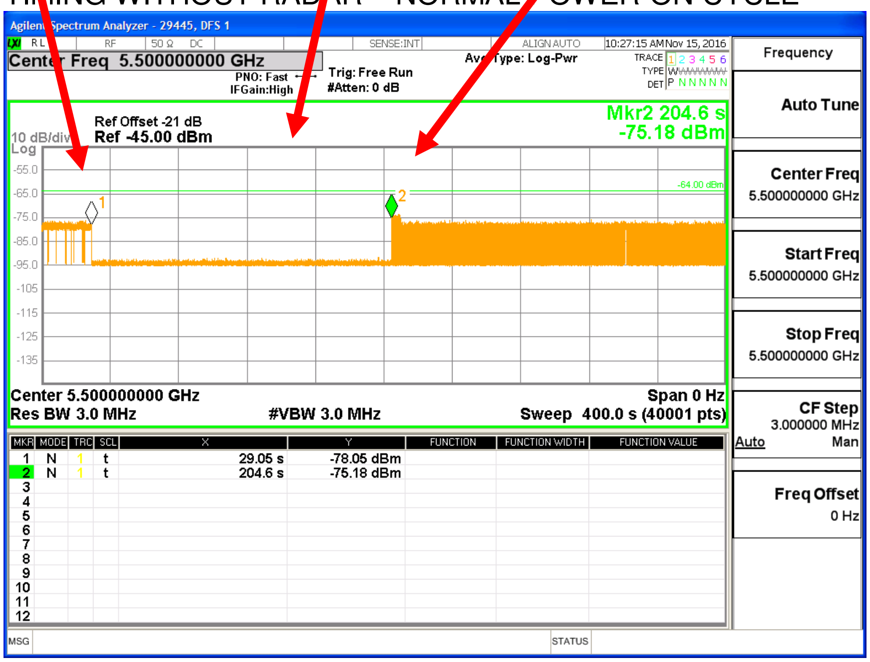
TIMING WITHOUT RADAR DURING CAC

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

End of Initial Power-up cycle
Start of CAC

End of CAC
Traffic is Initiated

TIMING WITHOUT RADAR – NORMAL POWER-ON CYCLE



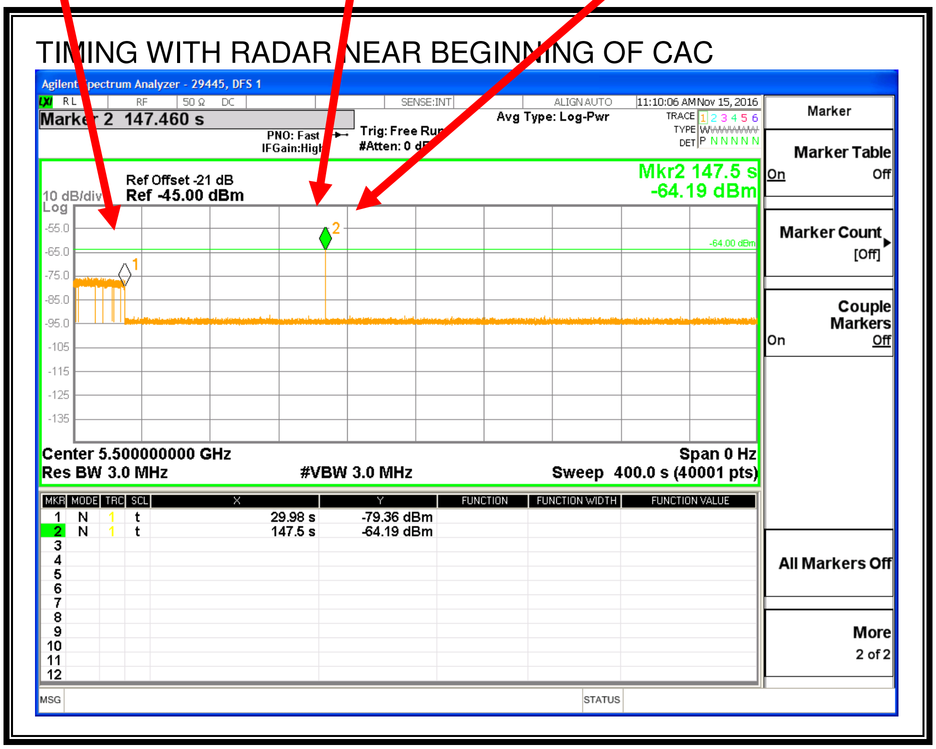
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

TIMING WITH RADAR NEAR BEGINNING OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



MKR	MODE	TRC	SCL	X	Y
1	N	1	t	29.98 s	-79.36 dBm
2	N	1	t	147.5 s	-64.19 dBm

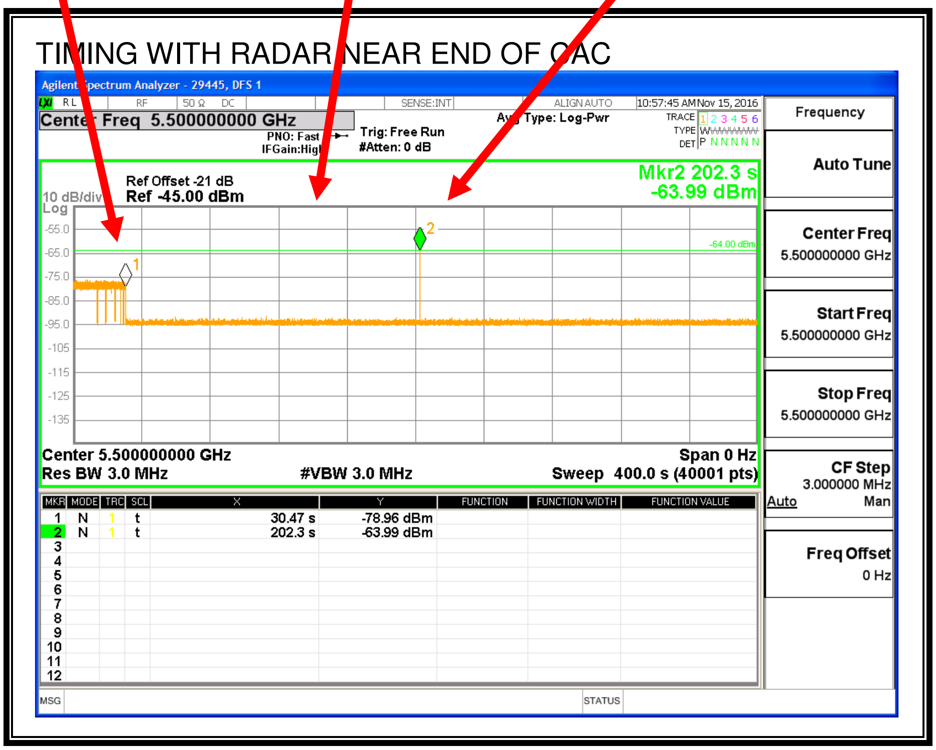
No EUT transmissions were observed after the radar signal.

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.

5.2.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

5.2.5. 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).

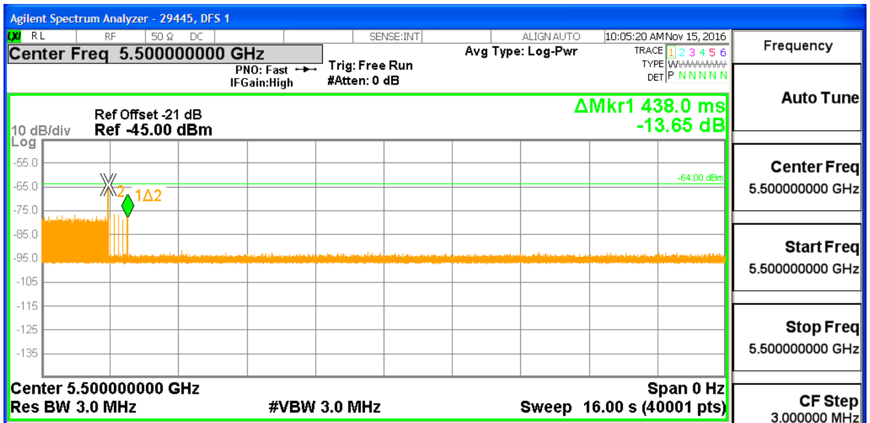
RESULTS

Channel Move Time (sec)	Limit (sec)
0.438	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
6.0	60

MOVE TIME

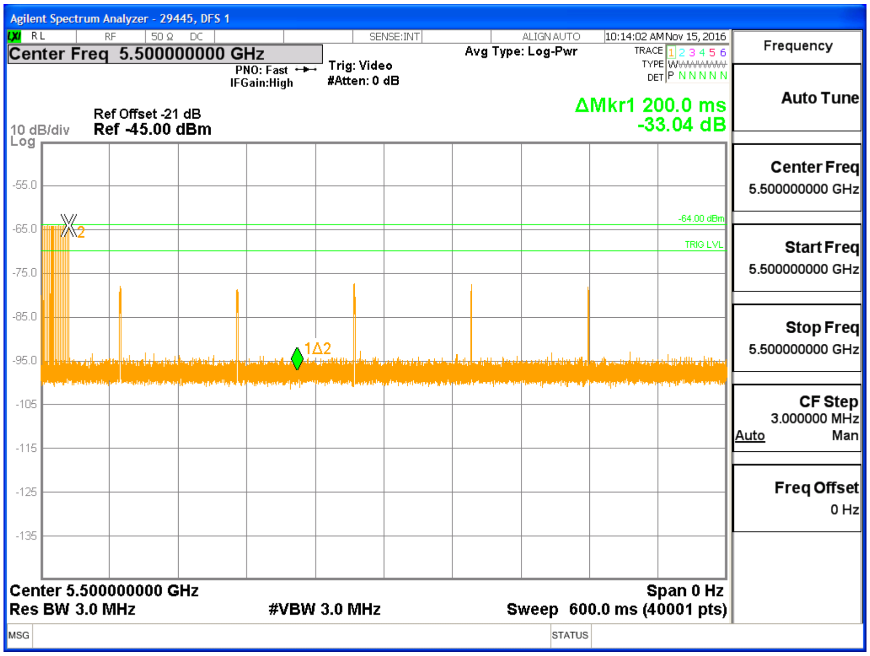
MOVE TIME



MKR	MODE	TRC	SCL	X		Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	Δ2	1	t	(Δ)	438.0 ms	(Δ) -13.65 dB			
2	F	1	t		1.562 s	-64.31 dBm			
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

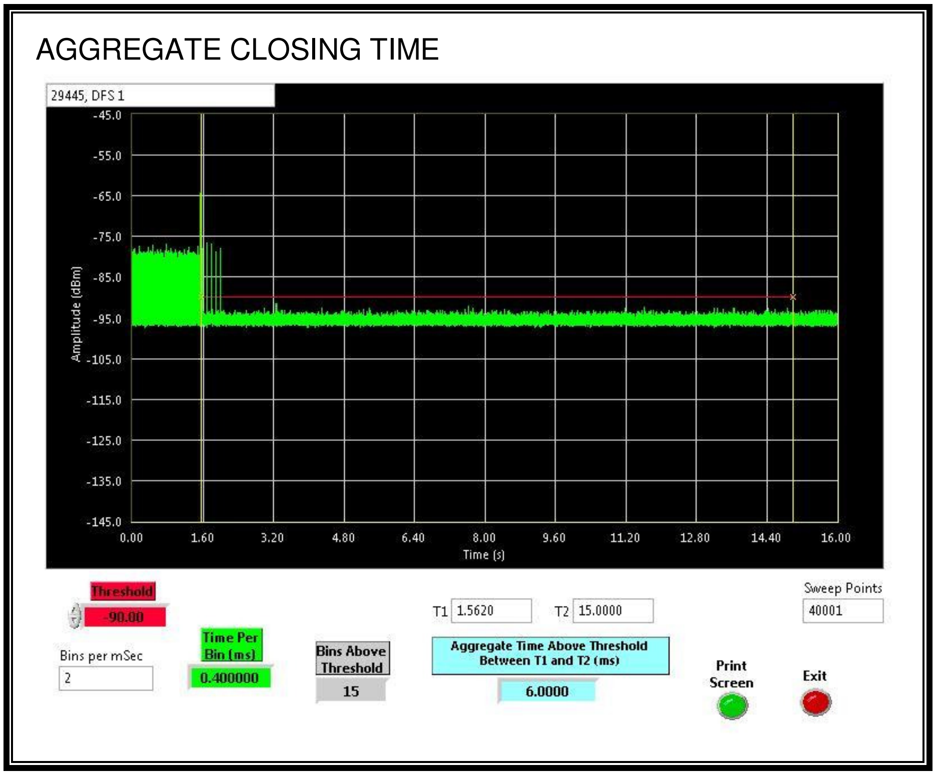
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

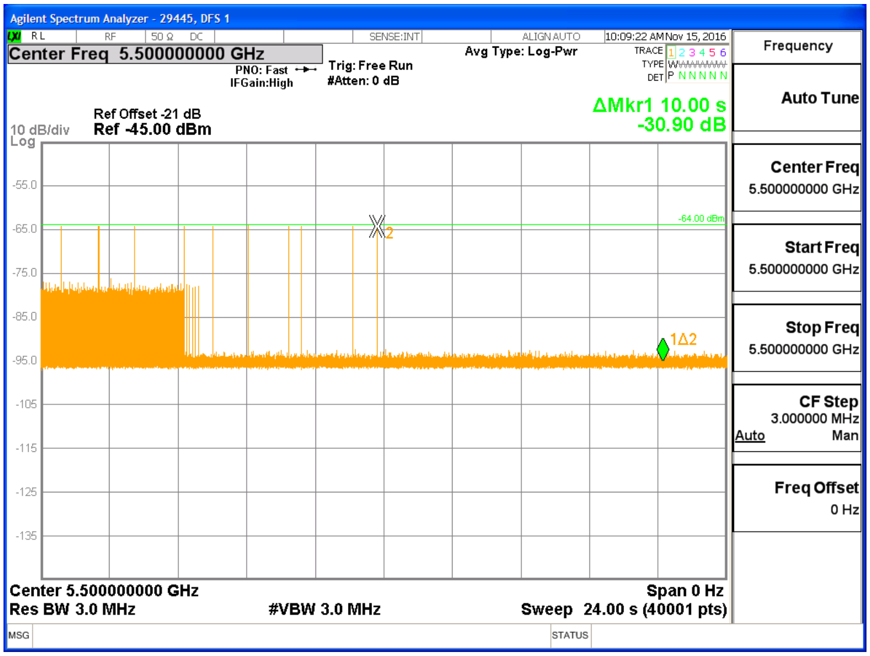
Only intermittent transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

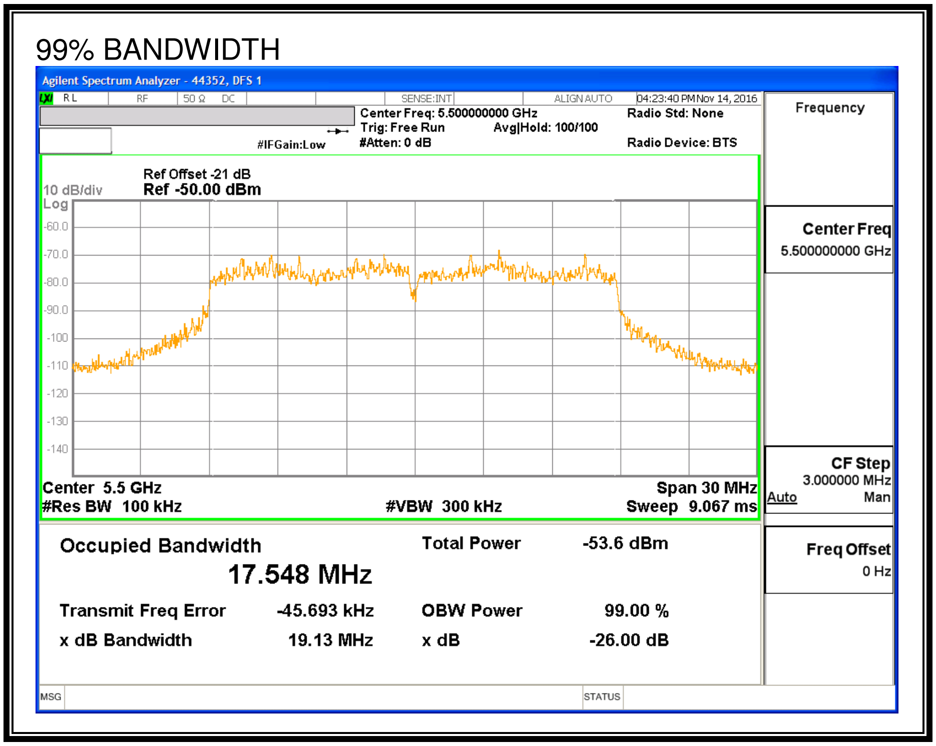
The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR



5.2.6. 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	17.548	114.0	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 DFS 1

FCC Type 0 Waveform: 1 us Pulse Width, 1428 us PRI, 18 Pulses per Burst

Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	FH
5511	10	0	0	

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5.2.7. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth		80% of Det BW		OBW	Test Location	Employee Number	In-Service Monitoring Version
					FL	FH	FL5	FH5				
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5510			17.55	DFS 1	44352	Version 3.0
FCC Short Pulse Type 2	30	100.00	60	Pass	5490	5510			17.55	DFS 1	44352	Version 3.0
FCC Short Pulse Type 3	30	86.67	60	Pass	5490	5510			17.55	DFS 1	44352	Version 3.0
FCC Short Pulse Type 4	30	100.00	60	Pass	5490	5510			17.55	DFS 1	44352	Version 3.0
Aggregate		96.67	80	Pass								
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5510	5492	5508	17.55	DFS 1	44352	Version 3.0
FCC Hopping Type 6	42	100.00	70	Pass	5490	5510				DFS 1	44352	Version 3.0

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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	678	78	A	5500	Yes
1003	1	658	81	A	5500	Yes
1004	1	798	67	A	5500	Yes
1005	1	778	68	A	5500	Yes
1006	1	738	72	A	5500	Yes
1007	1	758	70	A	5500	Yes
1008	1	578	92	A	5500	Yes
1009	1	918	58	A	5500	Yes
1010	1	638	83	A	5500	Yes
1011	1	878	61	A	5500	Yes
1012	1	698	76	A	5500	Yes
1013	1	818	65	A	5500	Yes
1014	1	558	95	A	5500	Yes
1015	1	598	89	A	5500	Yes
1016	1	2386	23	B	5500	Yes
1017	1	1535	35	B	5500	Yes
1018	1	3039	18	B	5500	Yes
1019	1	1123	47	B	5500	Yes
1020	1	2756	20	B	5500	Yes
1021	1	971	55	B	5500	Yes
1022	1	2733	20	B	5500	Yes
1023	1	2430	22	B	5500	Yes
1024	1	579	92	B	5500	Yes
1025	1	1600	33	B	5500	Yes
1026	1	1232	43	B	5500	Yes
1027	1	1188	45	B	5500	Yes
1028	1	2144	25	B	5500	Yes
1029	1	1035	51	B	5500	Yes
1030	1	926	57	B	5500	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	3	191	28	5500	Yes
2002	4.1	151	27	5500	Yes
2003	4.9	165	26	5500	Yes
2004	4.3	210	23	5500	Yes
2005	1.1	227	29	5500	Yes
2006	4.8	195	23	5500	Yes
2007	4.1	178	23	5500	Yes
2008	3.9	151	24	5500	Yes
2009	3.4	219	28	5500	Yes
2010	1.4	201	23	5500	Yes
2011	3.3	192	24	5500	Yes
2012	1.6	216	25	5500	Yes
2013	3.6	174	27	5500	Yes
2014	2.1	163	26	5500	Yes
2015	4.4	206	27	5500	Yes
2016	3.4	200	27	5500	Yes
2017	1.7	166	25	5500	Yes
2018	2.8	207	25	5500	Yes
2019	3.6	220	24	5500	Yes
2020	3	184	28	5500	Yes
2021	4	201	27	5500	Yes
2022	3.5	169	28	5500	Yes
2023	2.8	153	28	5500	Yes
2024	4.8	168	29	5500	Yes
2025	4.2	194	26	5500	Yes
2026	4.2	175	27	5500	Yes
2027	2	167	28	5500	Yes
2028	4.4	190	23	5500	Yes
2029	2.3	229	24	5500	Yes
2030	4.9	219	23	5500	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	5.2	345	17	5500	Yes
3002	6.3	326	16	5500	Yes
3003	9.4	472	16	5500	Yes
3004	8.4	347	16	5500	Yes
3005	6.6	388	18	5500	Yes
3006	5.8	277	17	5500	Yes
3007	7.1	330	18	5500	Yes
3008	9.3	482	17	5500	Yes
3009	5.6	431	18	5500	No
3010	8.1	478	17	5500	Yes
3011	7.4	440	16	5500	Yes
3012	5	500	17	5500	No
3013	9.7	474	17	5500	Yes
3014	7.6	429	18	5500	Yes
3015	5.1	416	18	5500	No
3016	5.9	384	18	5500	Yes
3017	8.7	266	16	5500	Yes
3018	9.8	498	18	5500	Yes
3019	7.8	275	18	5500	Yes
3020	6.8	268	18	5500	Yes
3021	5	309	17	5500	No
3022	9.3	448	16	5500	Yes
3023	8.2	251	17	5500	Yes
3024	7.6	285	16	5500	Yes
3025	9.1	352	17	5500	Yes
3026	6.5	399	16	5500	Yes
3027	5.8	360	18	5500	Yes
3028	8.5	420	17	5500	Yes
3029	8.1	395	16	5500	Yes
3030	6	350	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	17.1	337	15	5500	Yes
4002	18.7	304	14	5500	Yes
4003	14.2	438	15	5500	Yes
4004	16.4	418	15	5500	Yes
4005	12.4	446	14	5500	Yes
4006	10.4	440	16	5500	Yes
4007	12.3	480	16	5500	Yes
4008	15.4	369	16	5500	Yes
4009	13.1	422	13	5500	Yes
4010	12.1	457	16	5500	Yes
4011	15	272	13	5500	Yes
4012	19.8	320	16	5500	Yes
4013	18.6	281	12	5500	Yes
4014	13.8	341	13	5500	Yes
4015	13	315	16	5500	Yes
4016	18.9	270	15	5500	Yes
4017	13.9	257	13	5500	Yes
4018	15.5	476	12	5500	Yes
4019	11	358	14	5500	Yes
4020	13.2	472	16	5500	Yes
4021	19.3	367	12	5500	Yes
4022	17.3	493	15	5500	Yes
4023	19.2	401	14	5500	Yes
4024	17.6	289	12	5500	Yes
4025	20	343	16	5500	Yes
4026	19	378	14	5500	Yes
4027	17.2	444	12	5500	Yes
4028	16.7	491	12	5500	Yes
4029	15.4	453	15	5500	Yes
4030	10.6	262	16	5500	Yes

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5

Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5500	Yes
2	5500	Yes
3	5500	Yes
4	5500	Yes
5	5500	Yes
6	5500	Yes
7	5500	Yes
8	5500	Yes
9	5500	Yes
10	5500	Yes
11	5495	Yes
12	5494	Yes
13	5495	Yes
14	5494	Yes
15	5495	Yes
16	5494	Yes
17	5495	Yes
18	5494	Yes
19	5498	Yes
20	5499	Yes
21	5502	Yes
22	5502	Yes
23	5504	Yes
24	5506	Yes
25	5501	Yes
26	5502	Yes
27	5502	Yes
28	5504	Yes
29	5506	Yes
30	5502	Yes

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

TYPE 6 DETECTION PROBABILITY

Data Sheet for FCC Hopping Radar Type 6				
1 us Pulse Width, 333 us PRI, 9 Pulses per Burst, 1 Burst per Hop				
NTIA August 2005 Hopping Sequence				
Trial	Starting Index Within Sequence	Signal Generator Frequency (MHz)	Hops within Detection BW	Successful Detection (Yes/No)
1	86	5490	2	Yes
2	561	5491	6	Yes
3	1036	5492	5	Yes
4	1511	5493	3	Yes
5	1986	5494	4	Yes
6	2461	5495	9	Yes
7	2936	5496	6	Yes
8	3411	5497	1	Yes
9	3886	5498	4	Yes
10	4361	5499	4	Yes
11	4836	5500	6	Yes
12	5311	5501	6	Yes
13	5786	5502	2	Yes
14	6261	5503	6	Yes
15	6736	5504	3	Yes
16	7211	5505	3	Yes
17	7686	5506	4	Yes
18	8161	5507	4	Yes
19	8636	5508	4	Yes
20	9111	5509	4	Yes
21	9586	5510	5	Yes
22	10061	5490	4	Yes
23	10536	5491	1	Yes
24	11011	5492	4	Yes
25	11486	5493	4	Yes
26	11961	5494	11	Yes
27	12436	5495	3	Yes
28	12911	5496	6	Yes
29	13386	5497	8	Yes
30	13861	5498	2	Yes
31	14336	5499	5	Yes
32	14811	5500	2	Yes
33	15286	5501	4	Yes
34	15761	5502	3	Yes
35	16236	5503	2	Yes
36	16711	5504	5	Yes
37	17186	5505	4	Yes
38	17661	5506	4	Yes
39	18136	5507	6	Yes
40	18611	5508	3	Yes
41	19086	5509	2	Yes
42	19561	5510	3	Yes

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5.3. RESULTS FOR 40 MHz BANDWIDTH

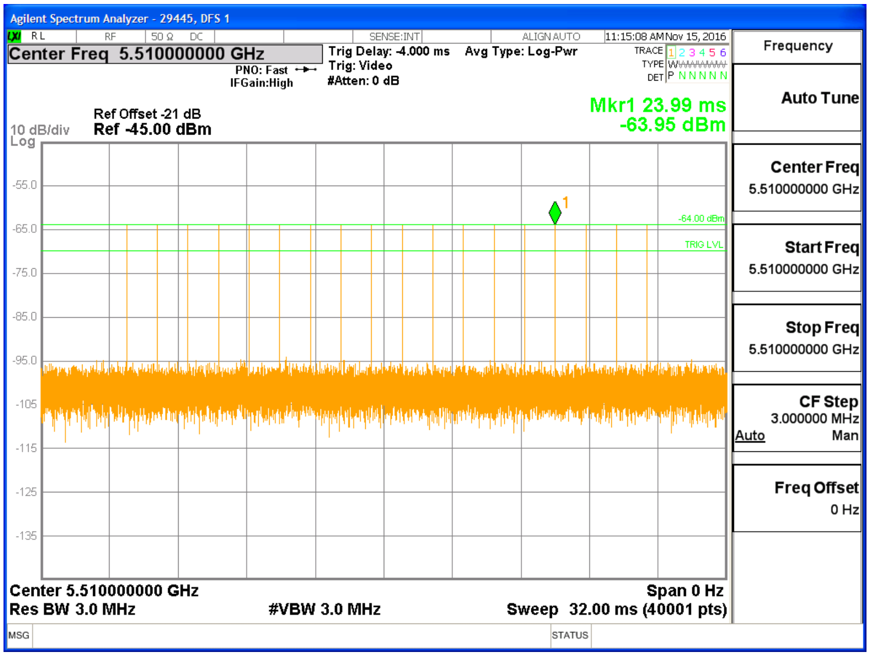
5.3.1. TEST CHANNEL

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

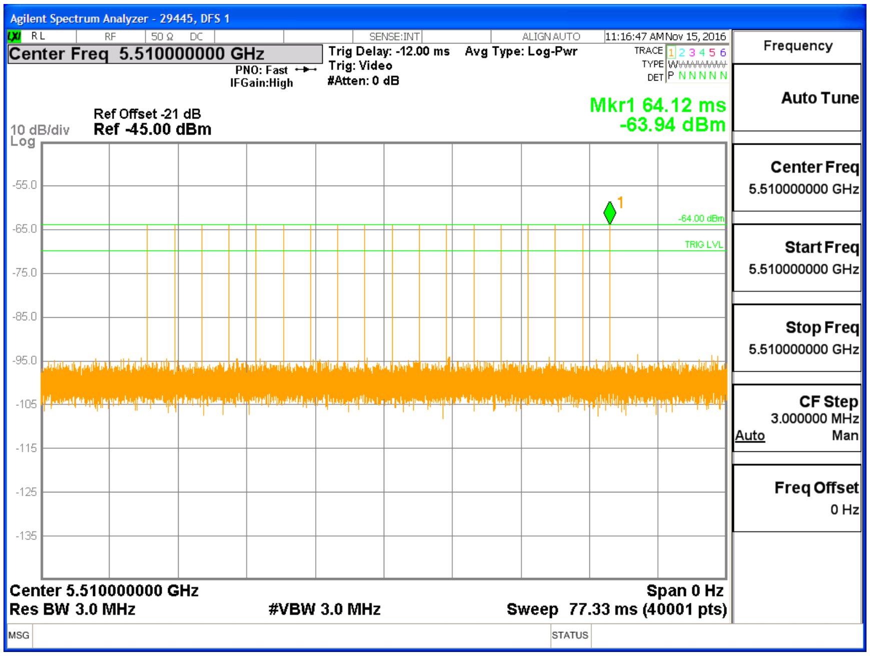
5.3.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

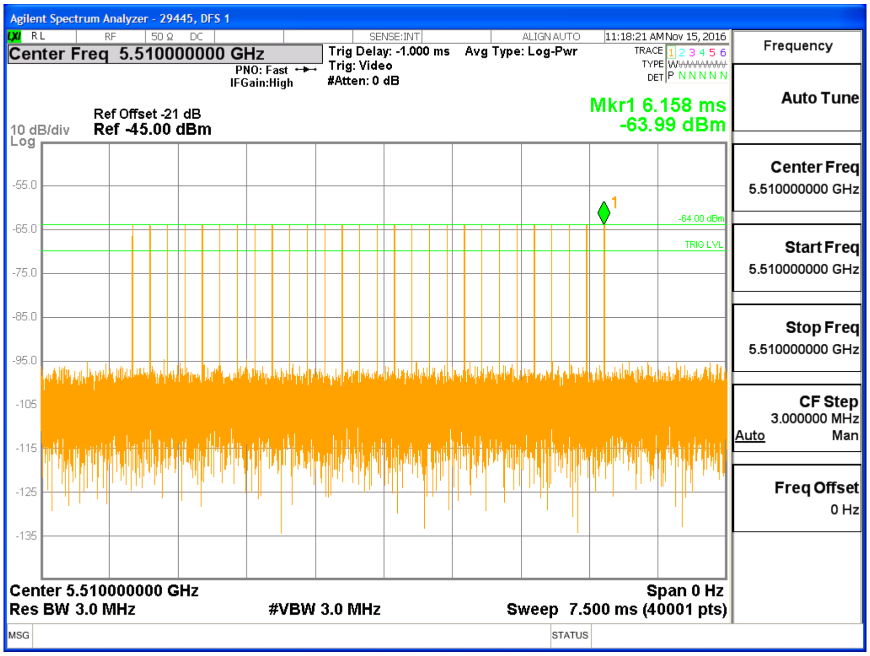
SHORT PULSE RADAR TYPE 0



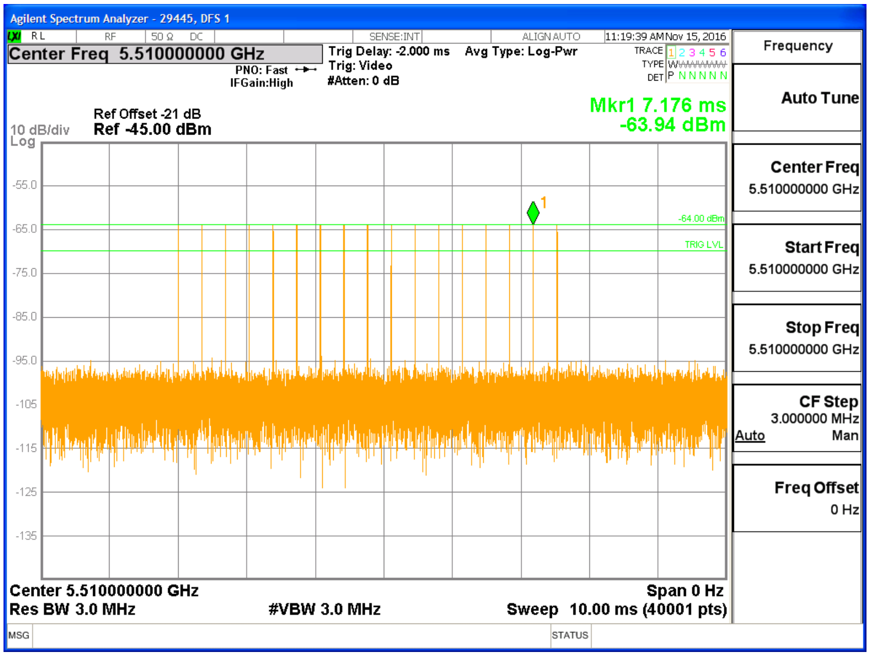
SAMPLE OF RADAR TYPE 1



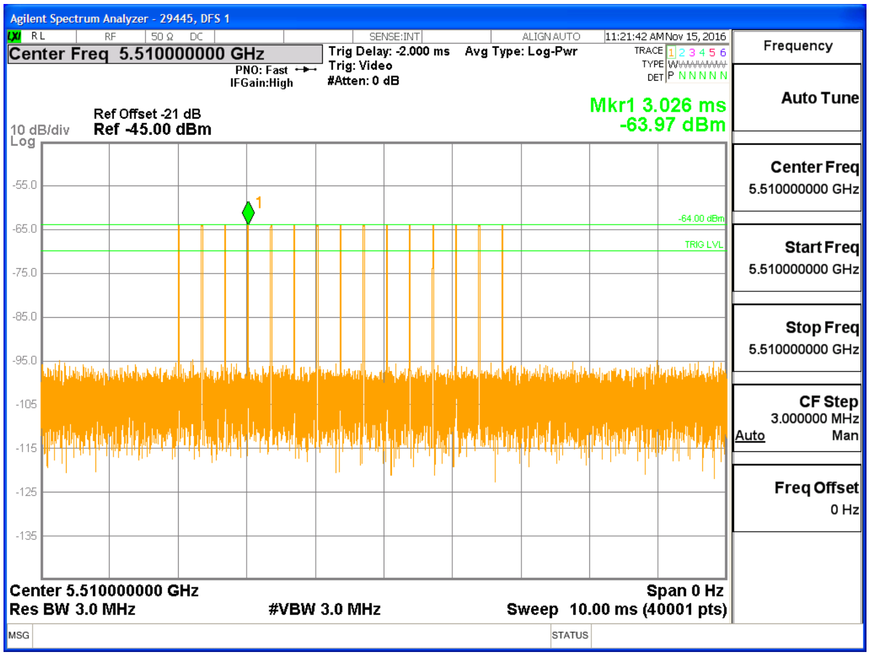
SAMPLE OF RADAR TYPE 2



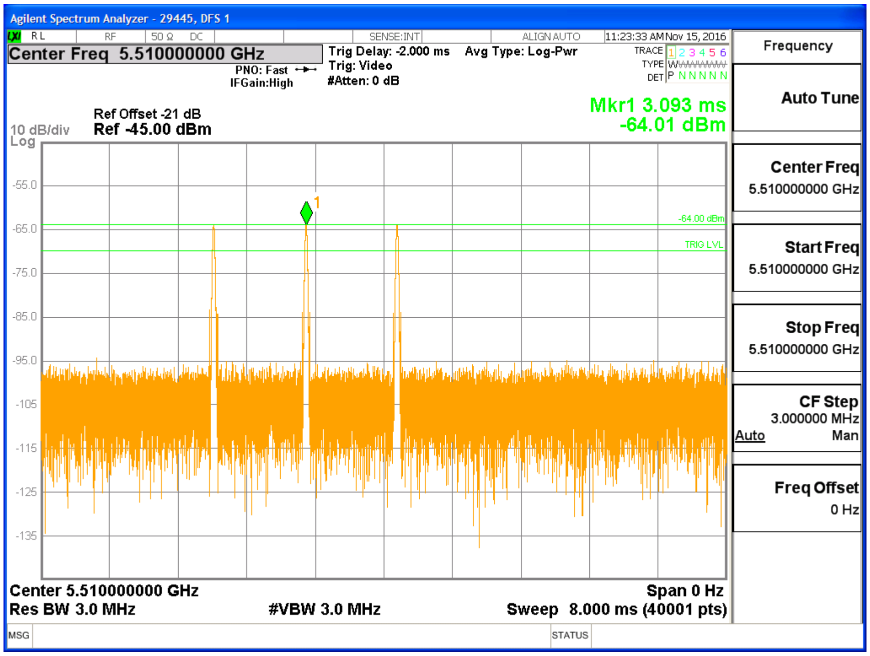
SAMPLE OF RADAR TYPE 3



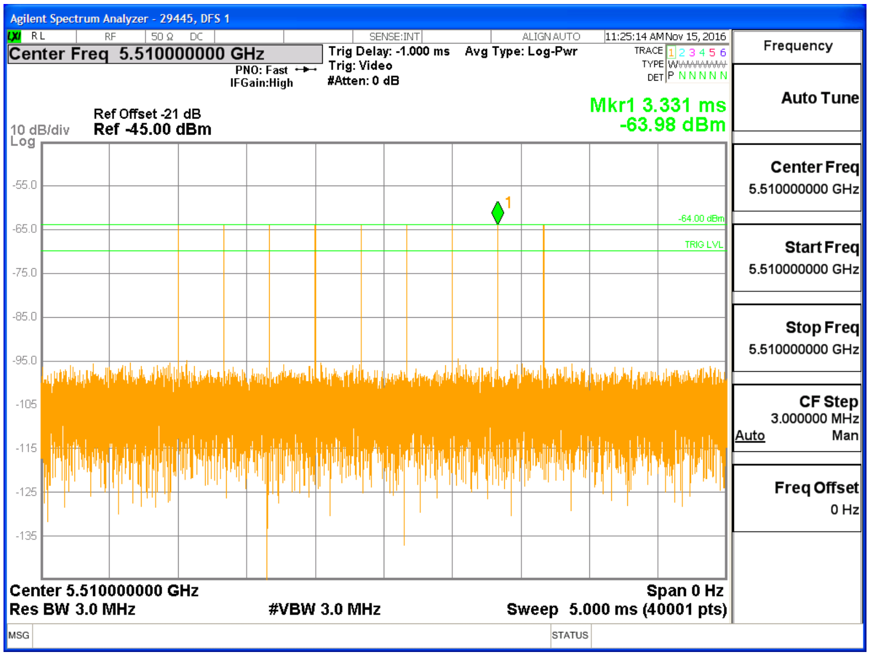
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5

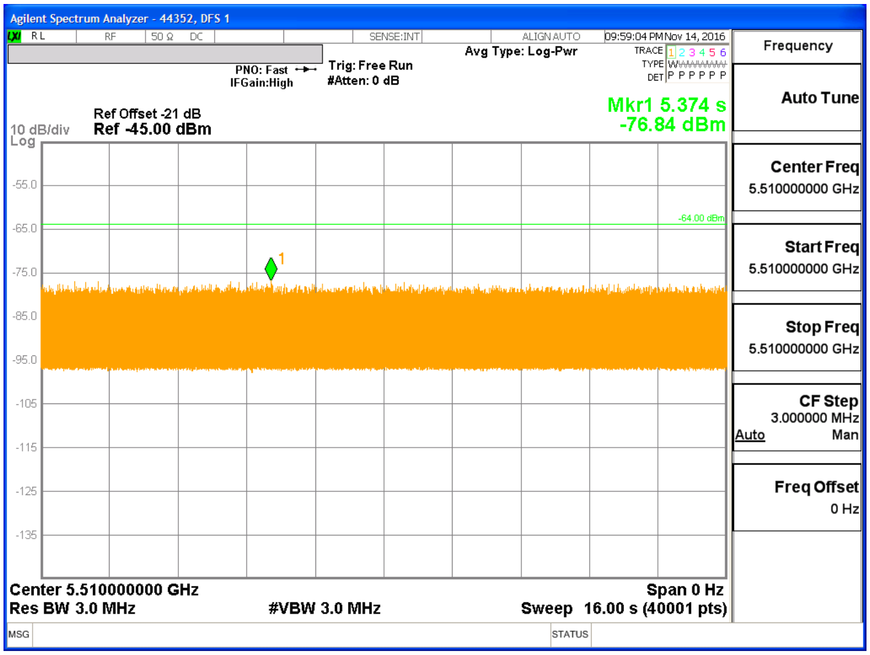


SINGLE BURST OF RADAR TYPE 6

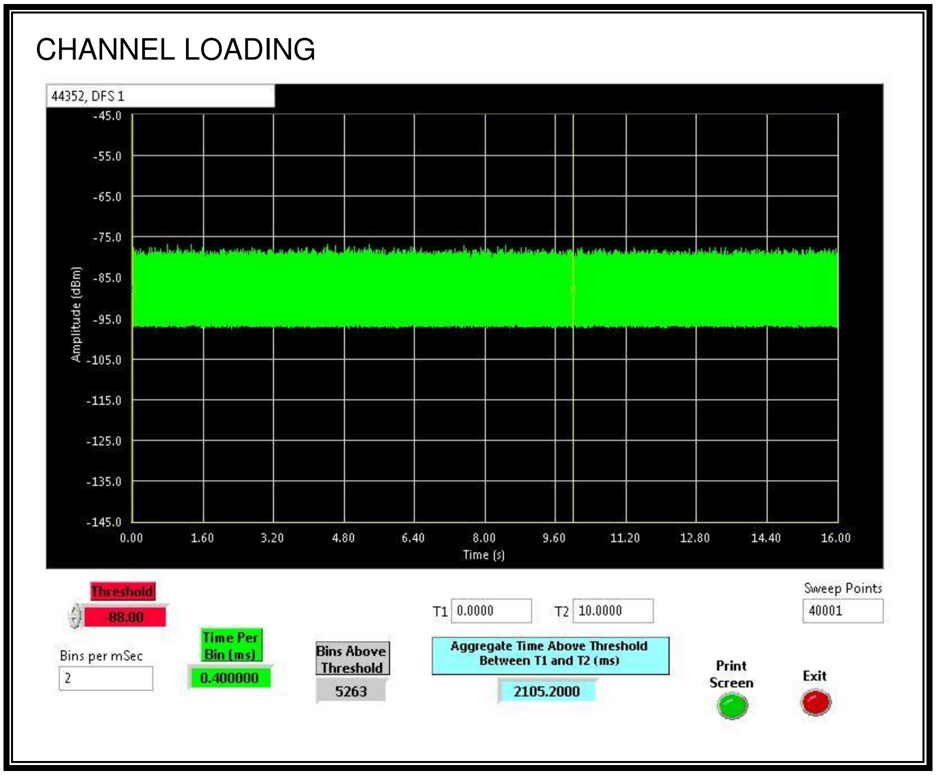


TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 21.052%

5.3.3. 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)
29.97	208.7	178.7	118.7

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)
30.16	152.5	122.3	3.6

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)
30.34	206.4	176.1	57.3

QUALITATIVE RESULTS

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

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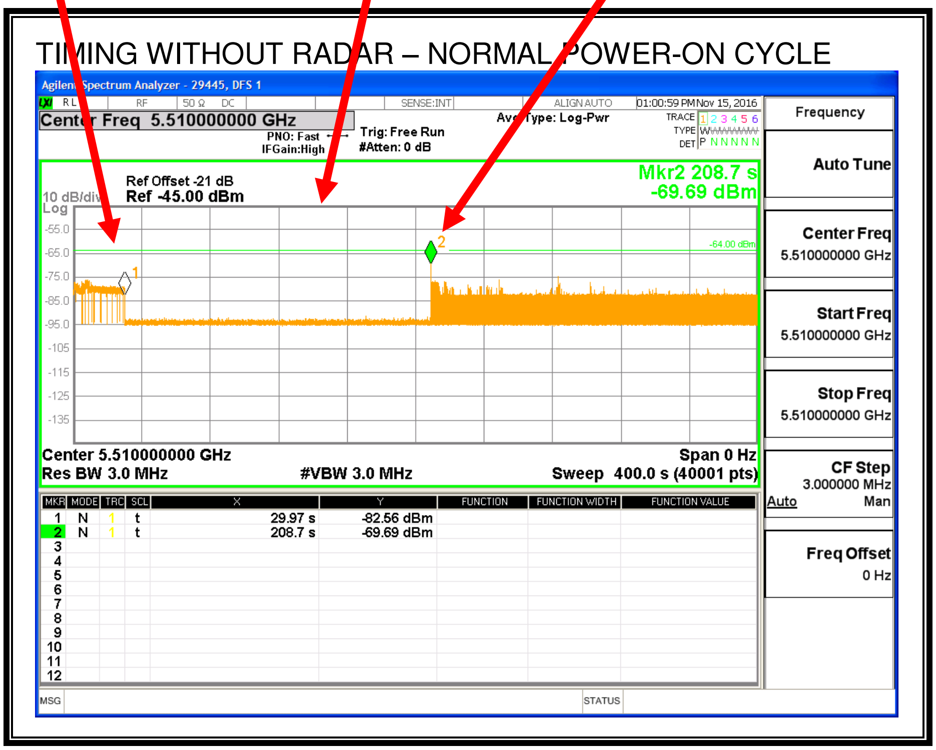
TIMING WITHOUT RADAR DURING CAC

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



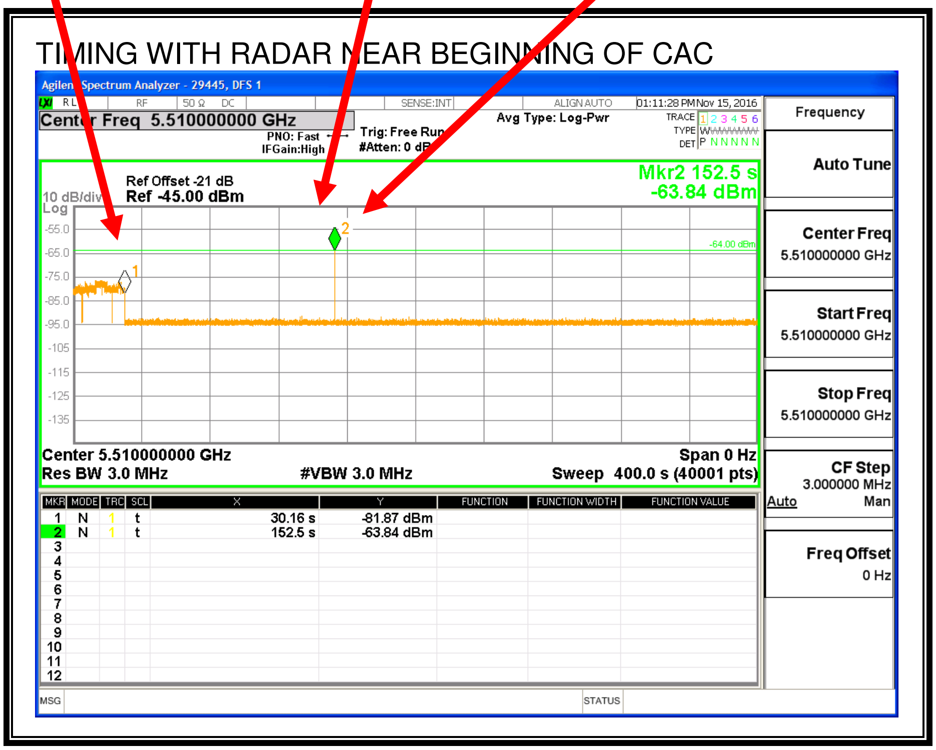
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

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



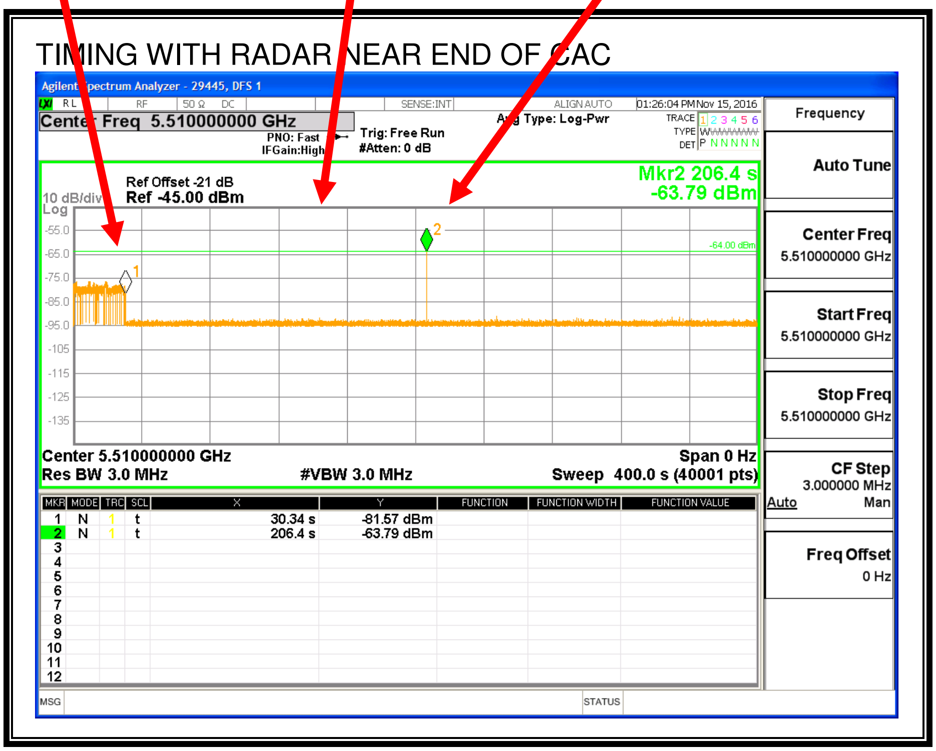
No EUT transmissions were observed after the radar signal.

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.

5.3.1. OVERLAPPING CHANNEL TESTS

RESULTS

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

5.3.2. 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)

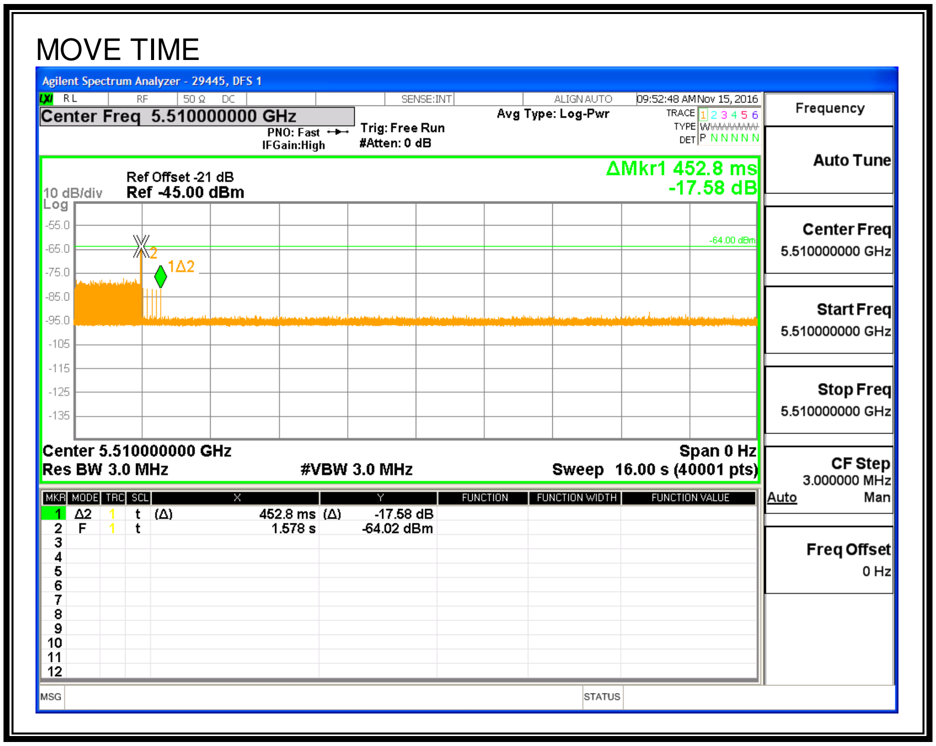
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

RESULTS

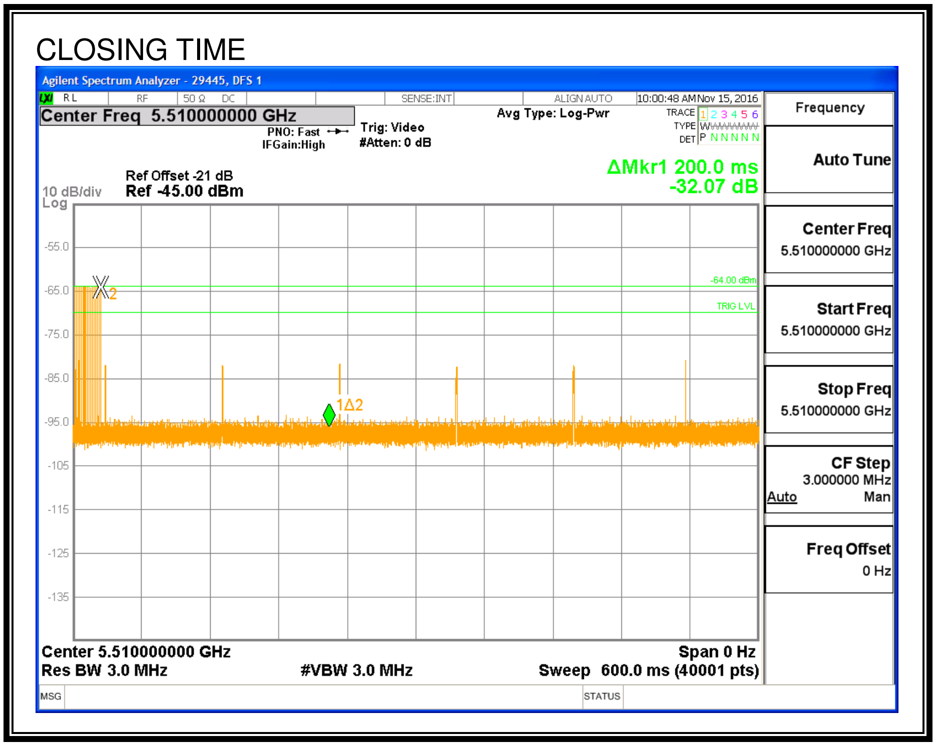
Channel Move Time (sec)	Limit (sec)
0.4528	10

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

MOVE TIME

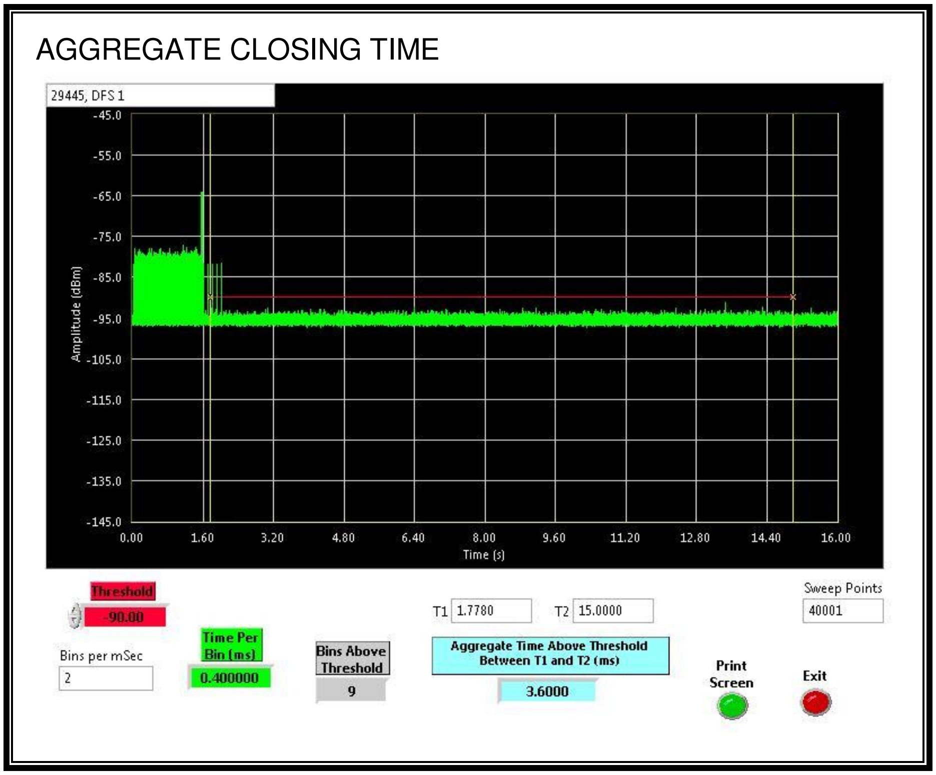

MOVE TIME
Agilent Spectrum Analyzer - 29445, DFS 1
Center Freq 5.510000000 GHz
Avg Type: Log-Pwr
Trig: Free Run
#Atten: 0 dB
PNO: Fast
IFGain:High
09:52:48 AM Nov 15, 2016
Ref Offset -21 dB
10 dB/div
Ref -45.00 dBm
ΔMkr1 452.8 ms
-17.58 dB
-64.00 dBm
Center 5.510000000 GHz
Span 0 Hz
Res BW 3.0 MHz
#VBW 3.0 MHz
Sweep 16.00 s (40001 pts)
1 Δ2 1 t (Δ) 452.8 ms (Δ) -17.58 dB
2 F 1 t 1.578 s -64.02 dBm
Frequency
Auto Tune
Center Freq 5.510000000 GHz
Start Freq 5.510000000 GHz
Stop Freq 5.510000000 GHz
CF Step 3.000000 MHz
Auto Man
Freq Offset 0 Hz

CHANNEL CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

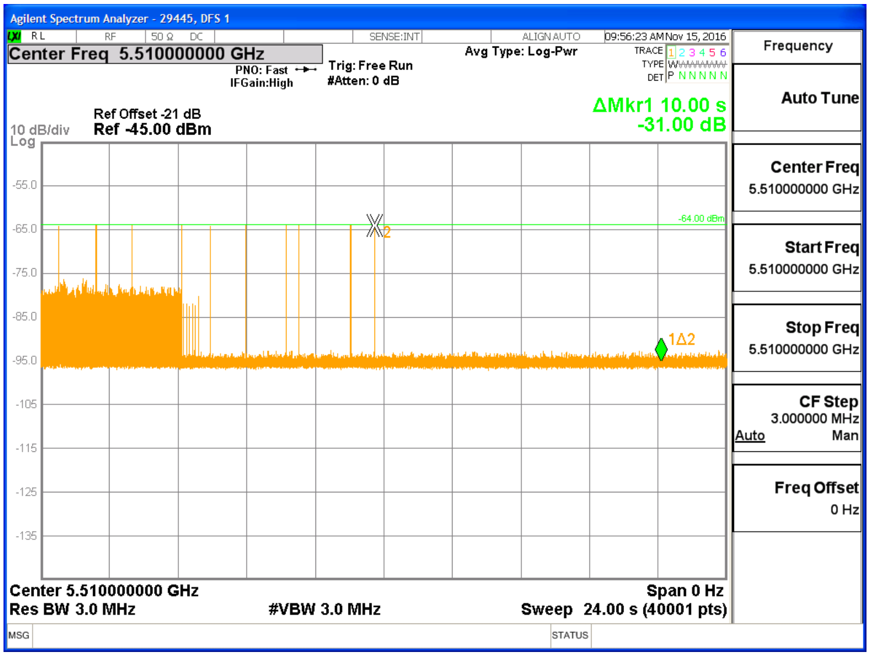
Only intermittent transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

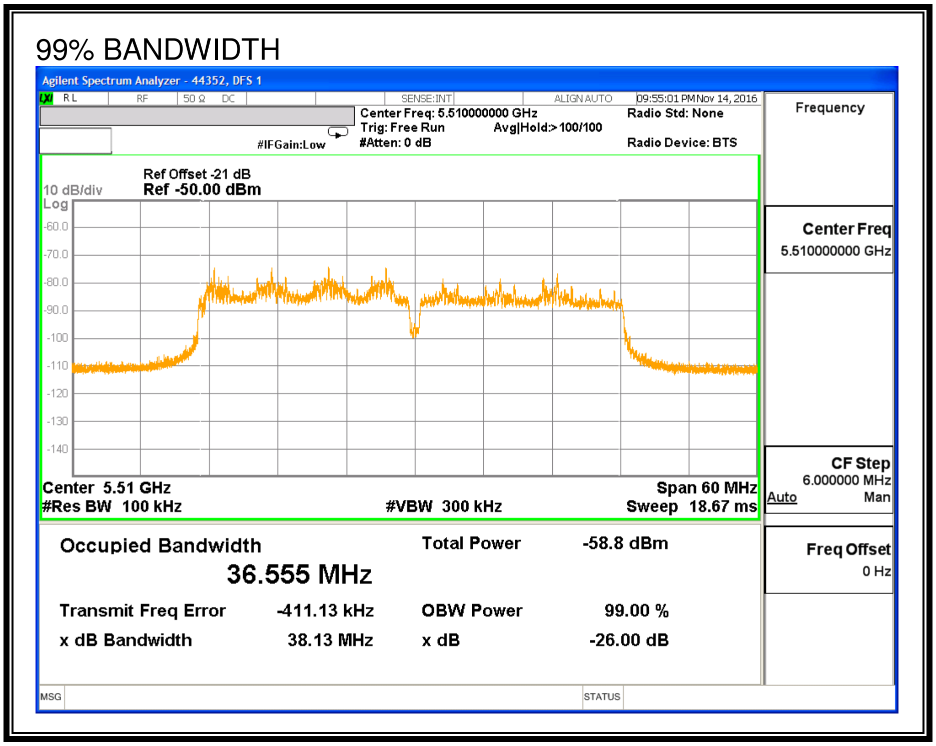
The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR



5.3.3. 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	36.555	109.4	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 DFS 1

FCC Type 0 Waveform: 1 us Pulse Width, 1428 us PRI, 18 Pulses per Burst

Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	
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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5.3.4. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth FL	Detection Bandwidth FH	80% of Det BW FL5	80% of Det BW FH5	OBW	Test Location	Employee Number	In-Service Monitoring Version
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5530			36.55	DFS 1	44352	Version 3.0
FCC Short Pulse Type 2	30	100.00	60	Pass	5490	5530			36.55	DFS 1	44352	Version 3.0
FCC Short Pulse Type 3	30	80.00	60	Pass	5490	5530			36.55	DFS 1	44352	Version 3.0
FCC Short Pulse Type 4	30	100.00	60	Pass	5490	5530			36.55	DFS 1	44352	Version 3.0
Aggregate		95.00	80	Pass								
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5530	5494	5526	36.55	DFS 1	44352	Version 3.0
FCC Hopping Type 6	41	100.00	70	Pass	5490	5530				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	5510	Yes
1002	1	678	78	A	5510	Yes
1003	1	658	81	A	5510	Yes
1004	1	798	67	A	5510	Yes
1005	1	778	68	A	5510	Yes
1006	1	738	72	A	5510	Yes
1007	1	758	70	A	5510	Yes
1008	1	578	92	A	5510	Yes
1009	1	918	58	A	5510	Yes
1010	1	638	83	A	5510	Yes
1011	1	878	61	A	5510	Yes
1012	1	698	76	A	5510	Yes
1013	1	818	65	A	5510	Yes
1014	1	558	95	A	5510	Yes
1015	1	598	89	A	5510	Yes
1016	1	2386	23	B	5510	Yes
1017	1	1535	35	B	5510	Yes
1018	1	3039	18	B	5510	Yes
1019	1	1123	47	B	5510	Yes
1020	1	2756	20	B	5510	Yes
1021	1	971	55	B	5510	Yes
1022	1	2733	20	B	5510	Yes
1023	1	2430	22	B	5510	Yes
1024	1	579	92	B	5510	Yes
1025	1	1600	33	B	5510	Yes
1026	1	1232	43	B	5510	Yes
1027	1	1188	45	B	5510	Yes
1028	1	2144	25	B	5510	Yes
1029	1	1035	51	B	5510	Yes
1030	1	926	57	B	5510	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	3	191	28	5510	Yes
2002	4.1	151	27	5510	Yes
2003	4.9	165	26	5510	Yes
2004	4.3	210	23	5510	Yes
2005	1.1	227	29	5510	Yes
2006	4.8	195	23	5510	Yes
2007	4.1	178	23	5510	Yes
2008	3.9	151	24	5510	Yes
2009	3.4	219	28	5510	Yes
2010	1.4	201	23	5510	Yes
2011	3.3	192	24	5510	Yes
2012	1.6	216	25	5510	Yes
2013	3.6	174	27	5510	Yes
2014	2.1	163	26	5510	Yes
2015	4.4	206	27	5510	Yes
2016	3.4	200	27	5510	Yes
2017	1.7	166	25	5510	Yes
2018	2.8	207	25	5510	Yes
2019	3.6	220	24	5510	Yes
2020	3	184	28	5510	Yes
2021	4	201	27	5510	Yes
2022	3.5	169	28	5510	Yes
2023	2.8	153	28	5510	Yes
2024	4.8	168	29	5510	Yes
2025	4.2	194	26	5510	Yes
2026	4.2	175	27	5510	Yes
2027	2	167	28	5510	Yes
2028	4.4	190	23	5510	Yes
2029	2.3	229	24	5510	Yes
2030	4.9	219	23	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	5.2	345	17	5510	No
3002	6.3	326	16	5510	Yes
3003	9.4	472	16	5510	Yes
3004	8.4	347	16	5510	Yes
3005	6.6	388	18	5510	Yes
3006	5.8	277	17	5510	Yes
3007	7.1	330	18	5510	Yes
3008	9.3	482	17	5510	Yes
3009	5.6	431	18	5510	No
3010	8.1	478	17	5510	Yes
3011	7.4	440	16	5510	Yes
3012	5	500	17	5510	No
3013	9.7	474	17	5510	Yes
3014	7.6	429	18	5510	Yes
3015	5.1	416	18	5510	No
3016	5.9	384	18	5510	Yes
3017	8.7	266	16	5510	Yes
3018	9.8	498	18	5510	Yes
3019	7.8	275	18	5510	Yes
3020	6.8	268	18	5510	Yes
3021	5	309	17	5510	No
3022	9.3	448	16	5510	Yes
3023	8.2	251	17	5510	Yes
3024	7.6	285	16	5510	Yes
3025	9.1	352	17	5510	Yes
3026	6.5	399	16	5510	Yes
3027	5.8	360	18	5510	No
3028	8.5	420	17	5510	Yes
3029	8.1	395	16	5510	Yes
3030	6	350	17	5510	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	17.1	337	15	5510	Yes
4002	18.7	304	14	5510	Yes
4003	14.2	438	15	5510	Yes
4004	16.4	418	15	5510	Yes
4005	12.4	446	14	5510	Yes
4006	10.4	440	16	5510	Yes
4007	12.3	480	16	5510	Yes
4008	15.4	369	16	5510	Yes
4009	13.1	422	13	5510	Yes
4010	12.1	457	16	5510	Yes
4011	15	272	13	5510	Yes
4012	19.8	320	16	5510	Yes
4013	18.6	281	12	5510	Yes
4014	13.8	341	13	5510	Yes
4015	13	315	16	5510	Yes
4016	18.9	270	15	5510	Yes
4017	13.9	257	13	5510	Yes
4018	15.5	476	12	5510	Yes
4019	11	358	14	5510	Yes
4020	13.2	472	16	5510	Yes
4021	19.3	367	12	5510	Yes
4022	17.3	493	15	5510	Yes
4023	19.2	401	14	5510	Yes
4024	17.6	289	12	5510	Yes
4025	20	343	16	5510	Yes
4026	19	378	14	5510	Yes
4027	17.2	444	12	5510	Yes
4028	16.7	491	12	5510	Yes
4029	15.4	453	15	5510	Yes
4030	10.6	262	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	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	5494	Yes
13	5496	Yes
14	5494	Yes
15	5496	Yes
16	5494	Yes
17	5496	Yes
18	5494	Yes
19	5498	Yes
20	5499	Yes
21	5522	Yes
22	5522	Yes
23	5523	Yes
24	5526	Yes
25	5521	Yes
26	5522	Yes
27	5522	Yes
28	5523	Yes
29	5526	Yes
30	5521	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	309	5490	8	Yes
2	784	5491	4	Yes
3	1259	5492	11	Yes
4	1734	5493	7	Yes
5	2209	5494	8	Yes
6	2684	5495	7	Yes
7	3159	5496	9	Yes
8	3634	5497	7	Yes
9	4109	5498	8	Yes
10	4584	5499	2	Yes
11	5059	5500	4	Yes
12	5534	5501	9	Yes
13	6009	5502	7	Yes
14	6484	5503	6	Yes
15	6959	5504	11	Yes
16	7434	5505	8	Yes
17	7909	5506	6	Yes
18	8384	5507	7	Yes
19	8859	5508	12	Yes
20	9334	5509	11	Yes
21	9809	5510	10	Yes
22	10284	5511	9	Yes
23	10759	5512	8	Yes
24	11234	5513	12	Yes
25	11709	5514	5	Yes
26	12184	5515	9	Yes
27	12659	5516	12	Yes
28	13134	5517	7	Yes
29	13609	5518	6	Yes
30	14084	5519	10	Yes
31	14559	5520	7	Yes
32	15034	5521	10	Yes
33	15509	5522	9	Yes
34	15984	5523	7	Yes
35	16459	5524	10	Yes
36	16934	5525	5	Yes
37	17409	5526	8	Yes
38	17884	5527	8	Yes
39	18359	5528	7	Yes
40	18834	5529	7	Yes
41	19309	5530	10	Yes

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5.4. RESULTS FOR 80 MHz BANDWIDTH

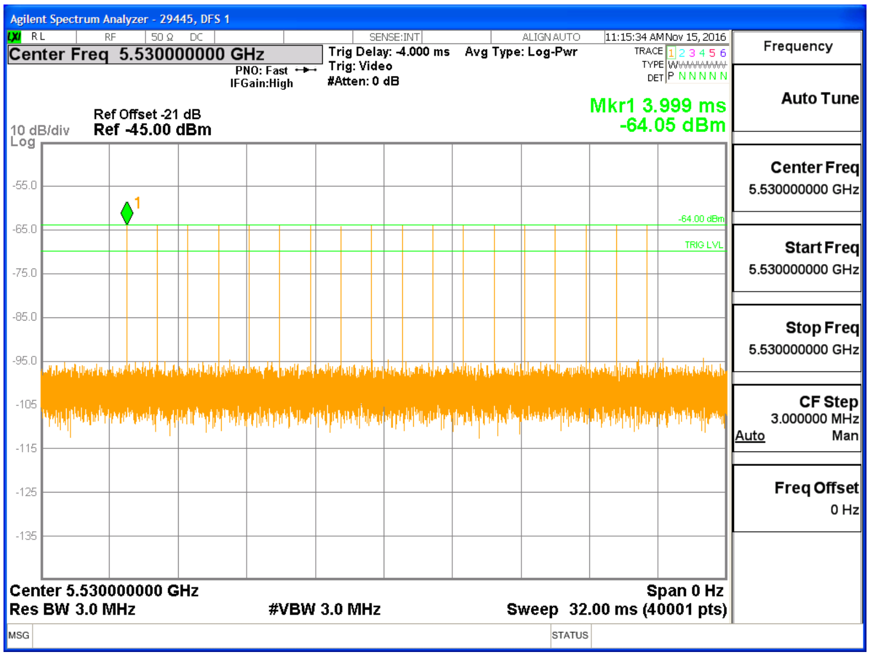
5.4.1. TEST CHANNEL

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

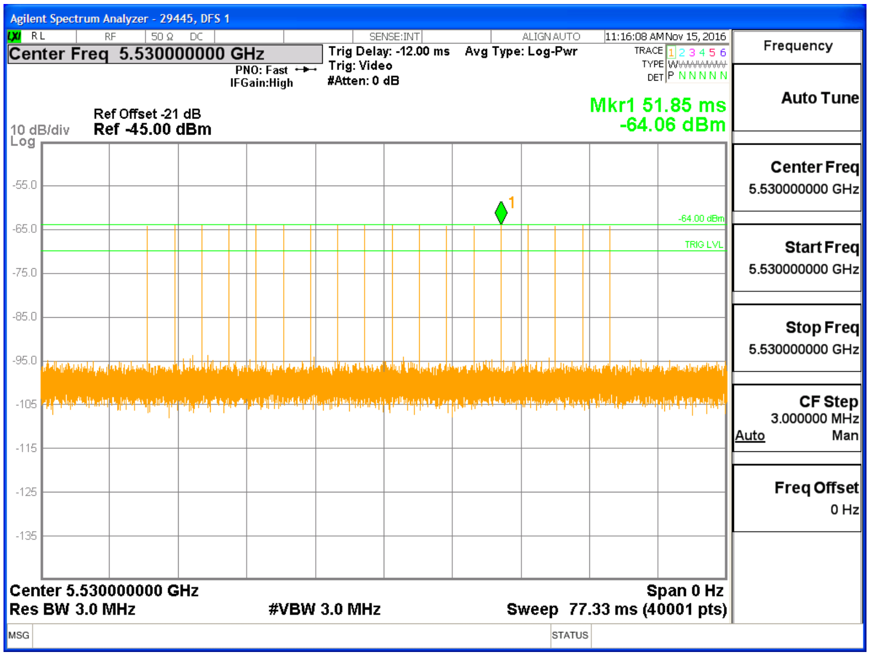
5.4.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

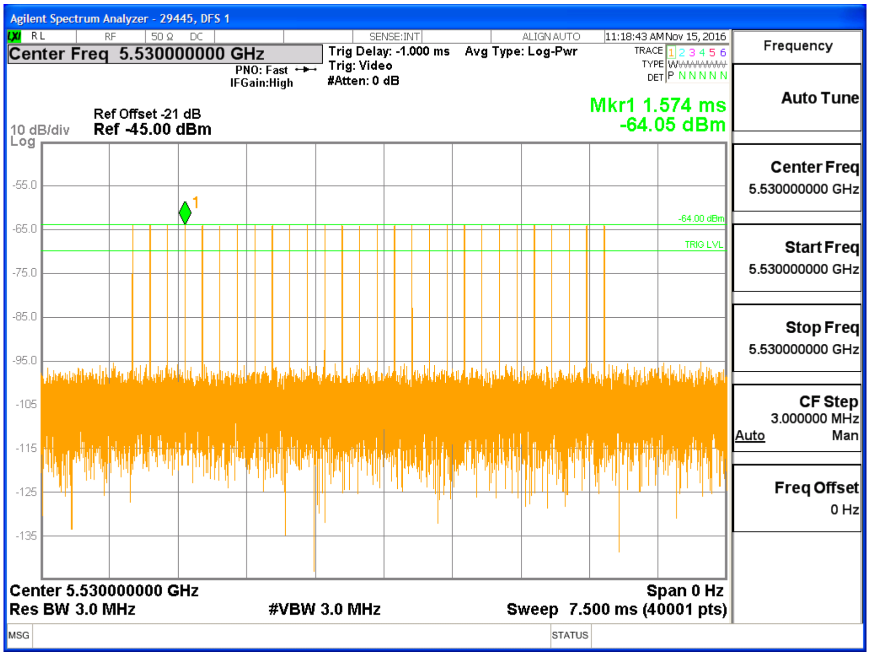
SHORT PULSE RADAR TYPE 0



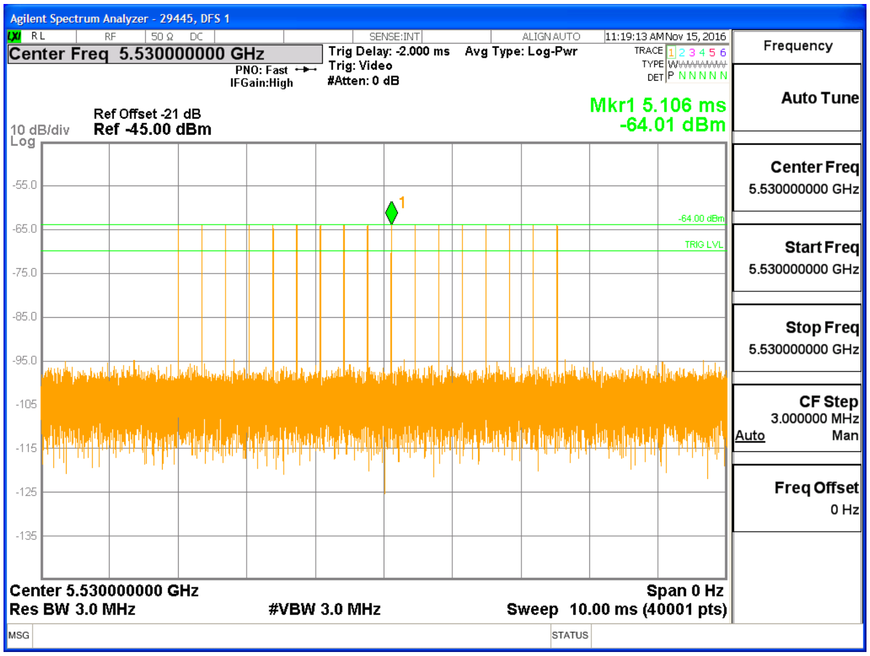
SAMPLE OF RADAR TYPE 1



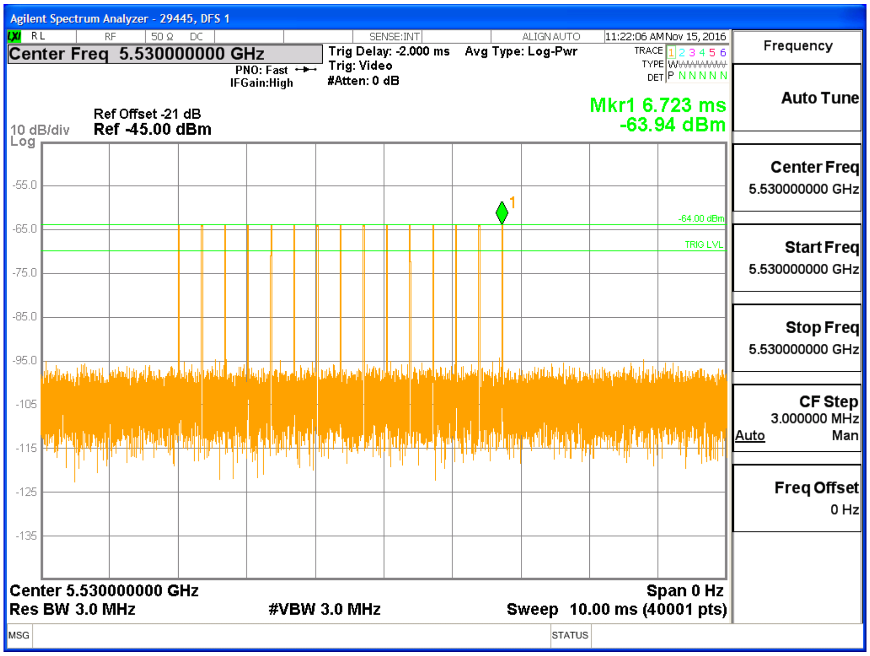
SAMPLE OF RADAR TYPE 2



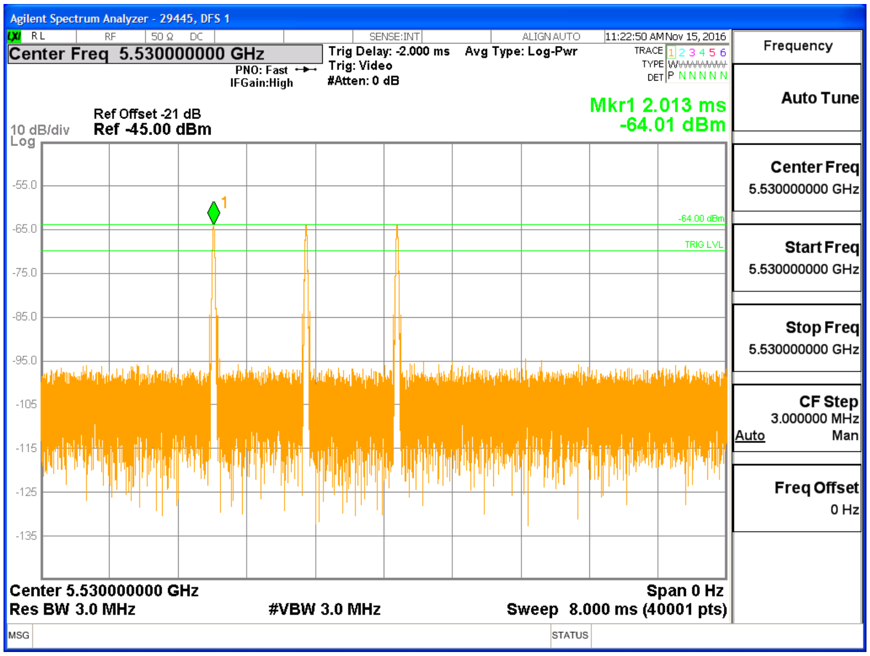
SAMPLE OF RADAR TYPE 3



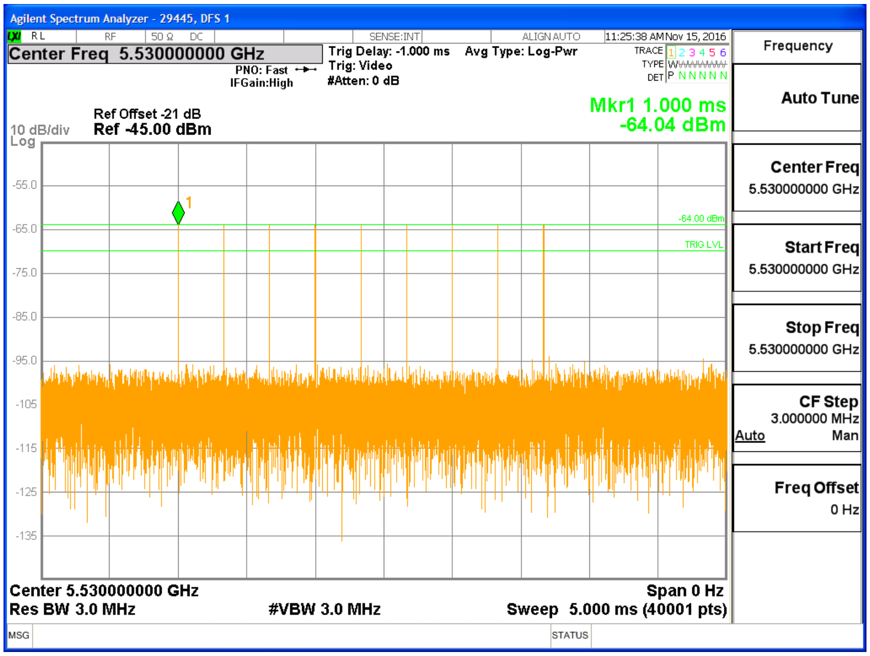
SAMPLE OF RADAR TYPE 4



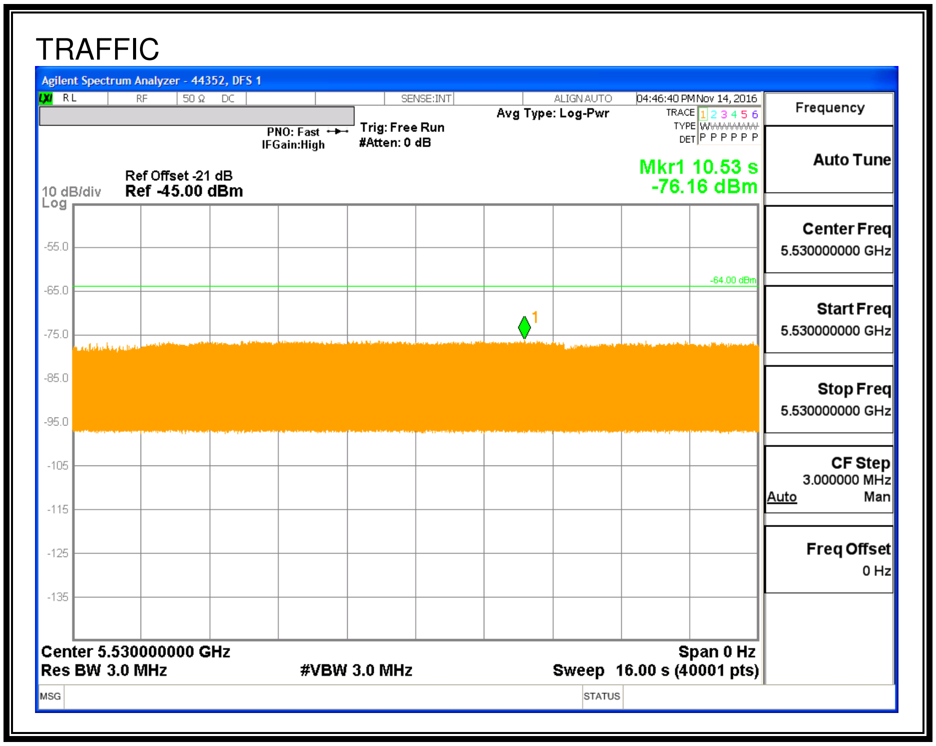
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



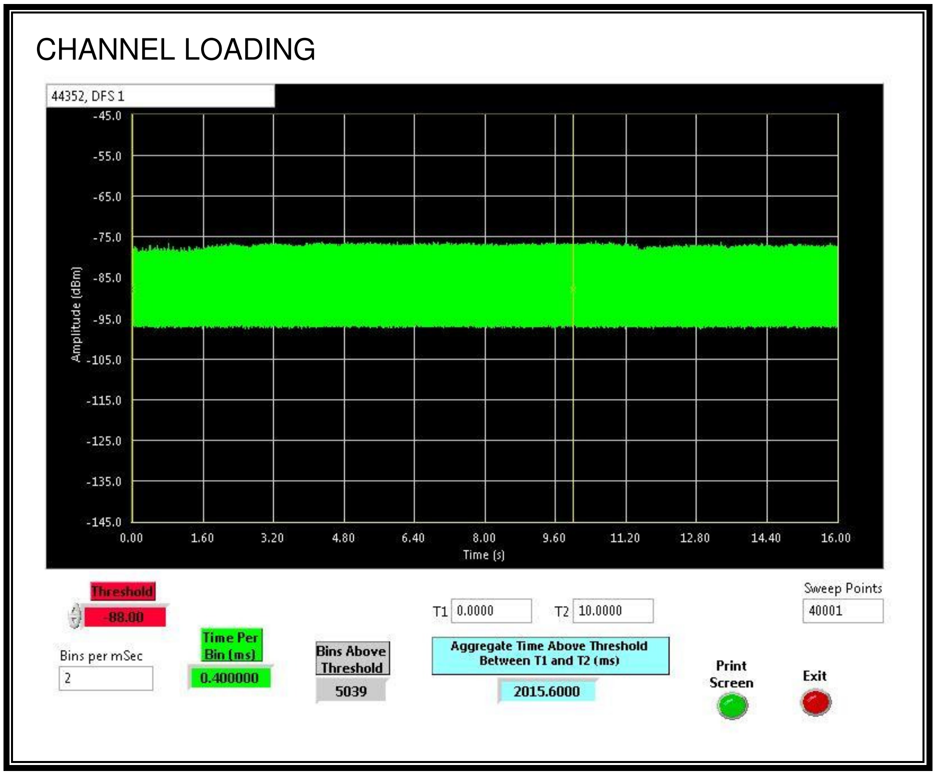
SINGLE BURST OF RADAR TYPE 6



TRAFFIC


TRAFFIC
Agilent Spectrum Analyzer - 44352, DFS 1
04:46:40 PM Nov 14, 2016
Avg Type: Log-Pwr
PNO: Fast
IFGain:High
Trig: Free Run
#Atten: 0 dB
Frequency
Auto Tune
Center Freq
5.530000000 GHz
Start Freq
5.530000000 GHz
Stop Freq
5.530000000 GHz
CF Step
3.000000 MHz
Auto
Man
Freq Offset
0 Hz
Ref Offset -21 dB
Ref -45.00 dBm
10 dB/div
Log
Mkr1 10.53 s
-76.16 dBm
-64.00 dBm
Center 5.530000000 GHz
Span 0 Hz
Res BW 3.0 MHz
#VBW 3.0 MHz
Sweep 16.00 s (40001 pts)

CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 20.156%

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5.4.1. 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)
30.09	209.6	179.5	119.5

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)
29.98	150.7	120.7	1.2

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)
30.12	208.4	178.3	58.8

QUALITATIVE RESULTS

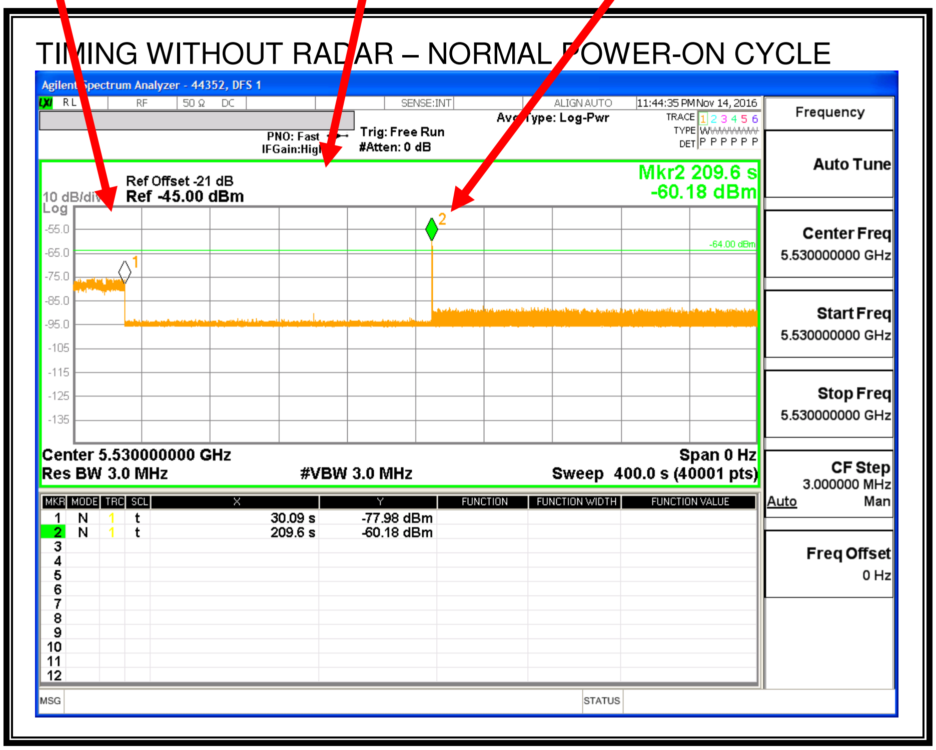
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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

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



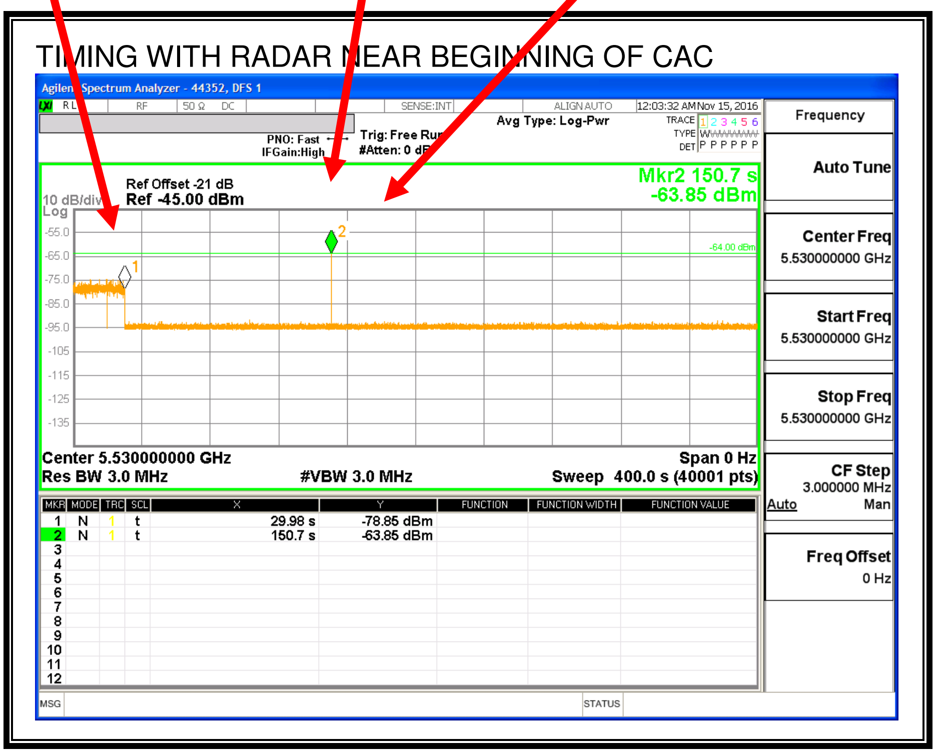
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

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



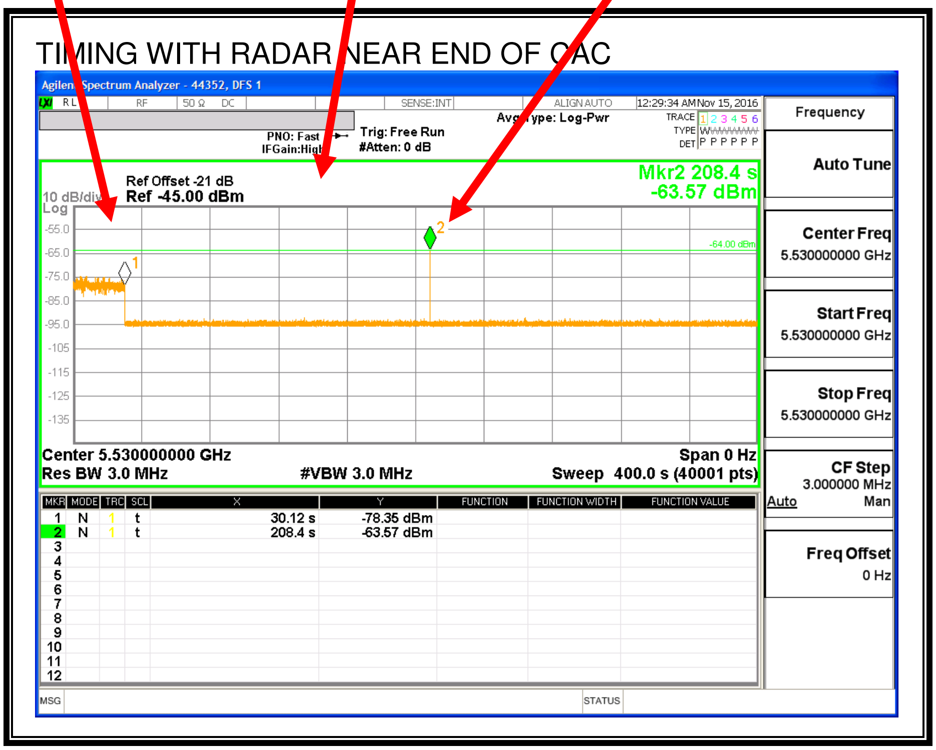
No EUT transmissions were observed after the radar signal.

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.

5.4.2. OVERLAPPING CHANNEL TESTS

RESULTS

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

5.4.3. 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).

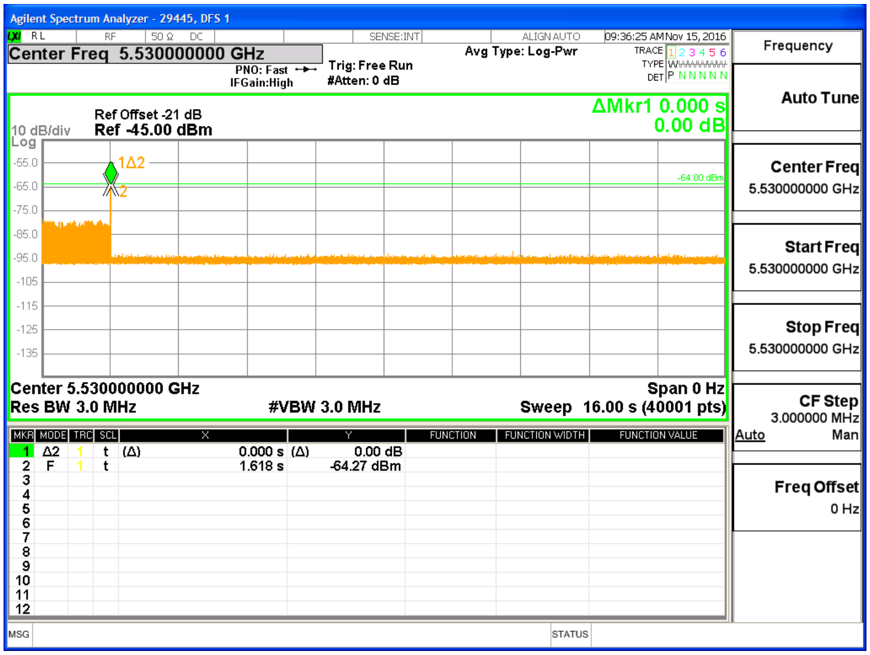
RESULTS

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

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

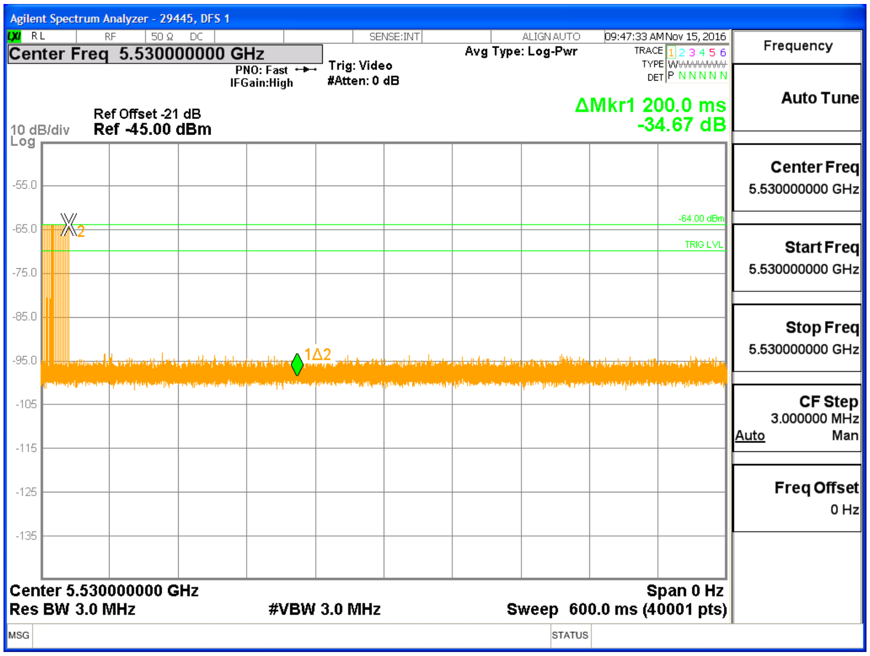
MOVE TIME

MOVE TIME



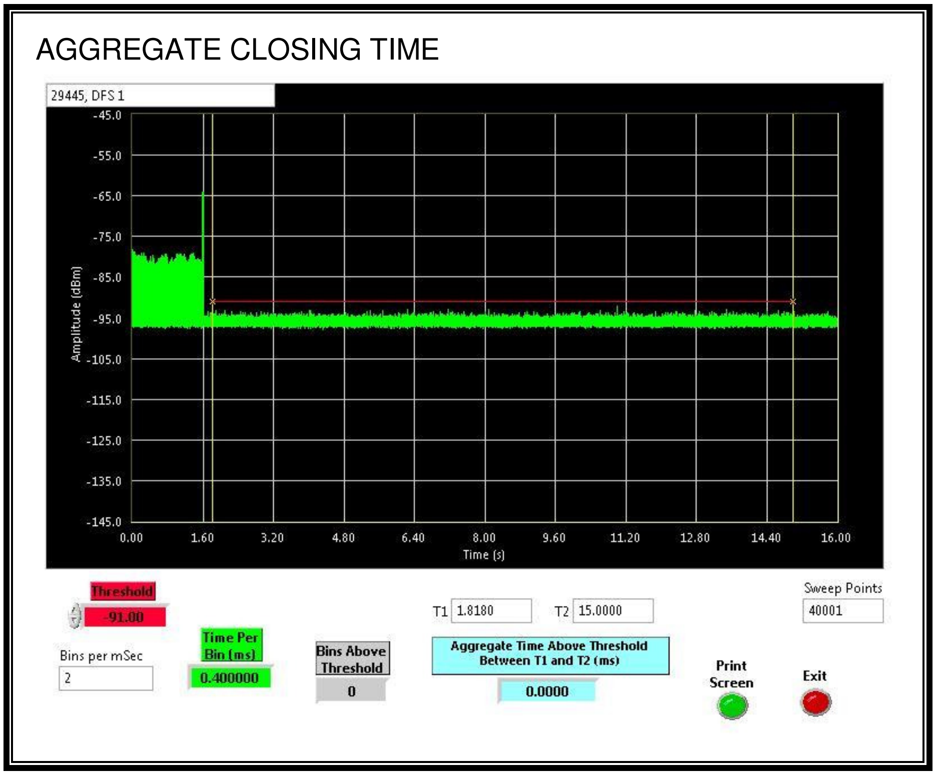
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

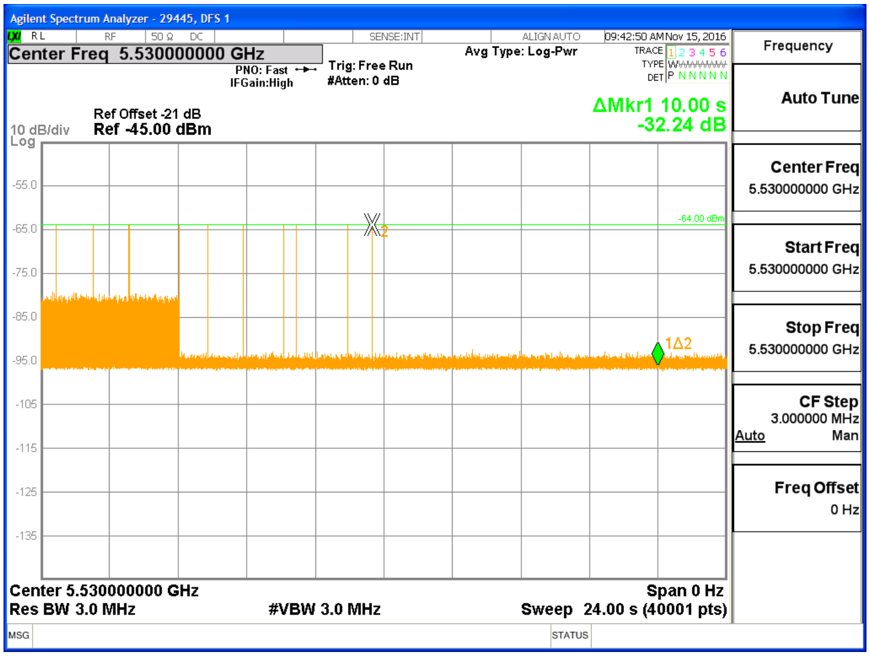
No transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR

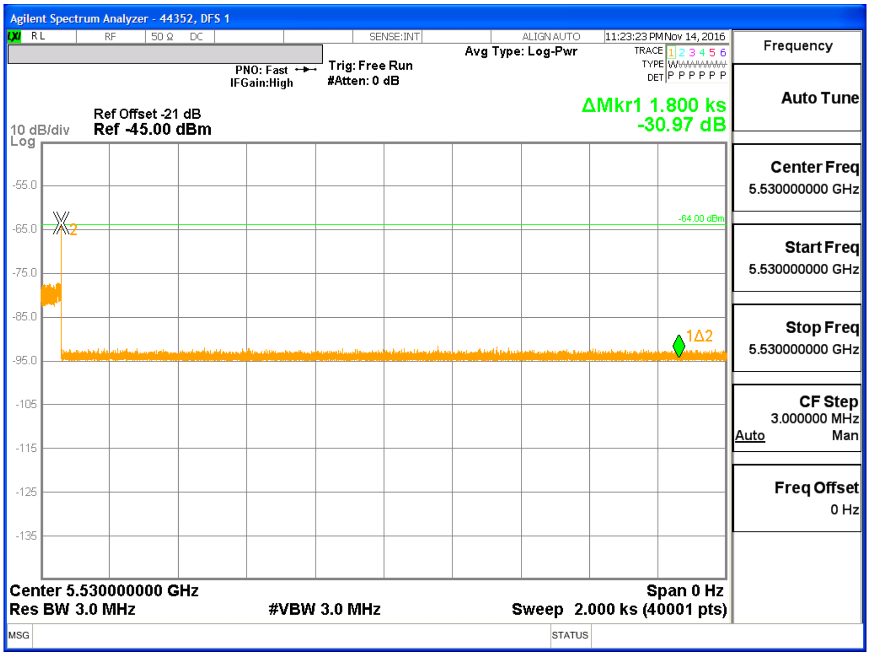


5.4.1. NON-OCCUPANCY PERIOD

RESULTS

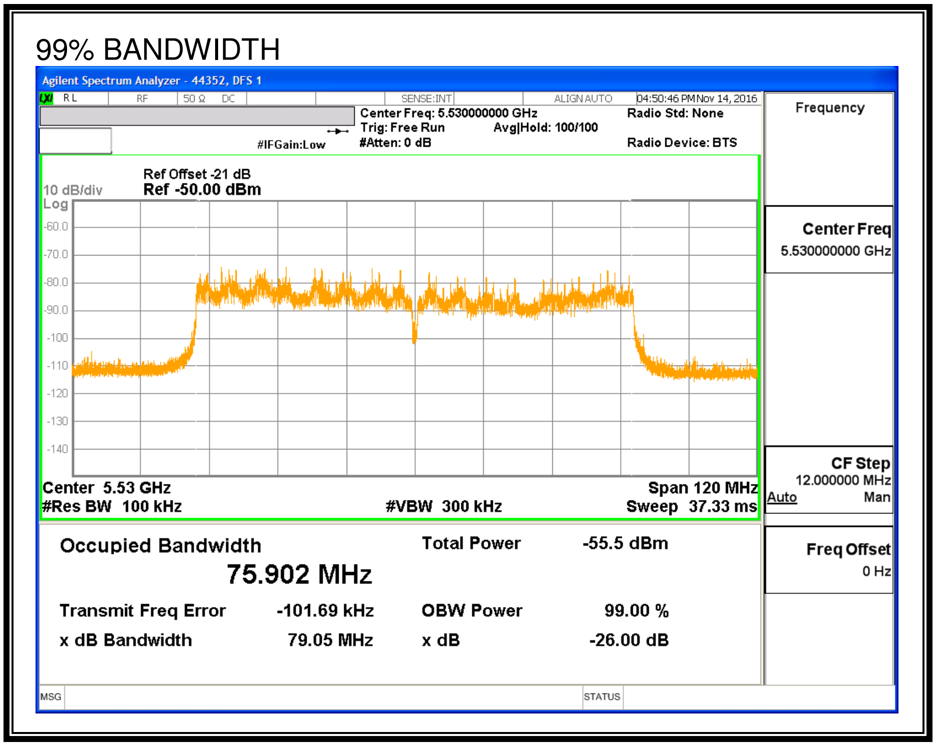
No EUT transmissions were observed on the test channel during the 30-minute observation time.

NON-OCCUPANCY PERIOD



5.4.2. 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	75.902	105.4	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 DFS 1

FCC Type 0 Waveform: 1 us Pulse Width, 1428 us PRI, 18 Pulses per Burst

Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	
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	

5.4.3. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth		80% of Det BW		OBW	Test Location	Employee Number	In-Service Monitoring Version
					FL	FH	FL5	FH5				
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5570			75.9	DFS 1	44352	Version 3.0
FCC Short Pulse Type 2	30	100.00	60	Pass	5490	5570			75.9	DFS 1	44352	Version 3.0
FCC Short Pulse Type 3	30	86.67	60	Pass	5490	5570			75.9	DFS 1	44352	Version 3.0
FCC Short Pulse Type 4	30	90.00	60	Pass	5490	5570			75.9	DFS 1	44352	Version 3.0
Aggregate		94.17	80	Pass								
FCC Long Pulse Type 5	30	96.67	80	Pass	5490	5570	5498	5562	75.9	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	5530	Yes
1002	1	678	78	A	5530	Yes
1003	1	658	81	A	5530	Yes
1004	1	798	67	A	5530	Yes
1005	1	778	68	A	5530	Yes
1006	1	738	72	A	5530	Yes
1007	1	758	70	A	5530	Yes
1008	1	578	92	A	5530	Yes
1009	1	918	58	A	5530	Yes
1010	1	638	83	A	5530	Yes
1011	1	878	61	A	5530	Yes
1012	1	698	76	A	5530	Yes
1013	1	818	65	A	5530	Yes
1014	1	558	95	A	5530	Yes
1015	1	598	89	A	5530	Yes
1016	1	2386	23	B	5530	Yes
1017	1	1535	35	B	5530	Yes
1018	1	3039	18	B	5530	Yes
1019	1	1123	47	B	5530	Yes
1020	1	2756	20	B	5530	Yes
1021	1	971	55	B	5530	Yes
1022	1	2733	20	B	5530	Yes
1023	1	2430	22	B	5530	Yes
1024	1	579	92	B	5530	Yes
1025	1	1600	33	B	5530	Yes
1026	1	1232	43	B	5530	Yes
1027	1	1188	45	B	5530	Yes
1028	1	2144	25	B	5530	Yes
1029	1	1035	51	B	5530	Yes
1030	1	926	57	B	5530	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	3	191	28	5530	Yes
2002	4.1	151	27	5530	Yes
2003	4.9	165	26	5530	Yes
2004	4.3	210	23	5530	Yes
2005	1.1	227	29	5530	Yes
2006	4.8	195	23	5530	Yes
2007	4.1	178	23	5530	Yes
2008	3.9	151	24	5530	Yes
2009	3.4	219	28	5530	Yes
2010	1.4	201	23	5530	Yes
2011	3.3	192	24	5530	Yes
2012	1.6	216	25	5530	Yes
2013	3.6	174	27	5530	Yes
2014	2.1	163	26	5530	Yes
2015	4.4	206	27	5530	Yes
2016	3.4	200	27	5530	Yes
2017	1.7	166	25	5530	Yes
2018	2.8	207	25	5530	Yes
2019	3.6	220	24	5530	Yes
2020	3	184	28	5530	Yes
2021	4	201	27	5530	Yes
2022	3.5	169	28	5530	Yes
2023	2.8	153	28	5530	Yes
2024	4.8	168	29	5530	Yes
2025	4.2	194	26	5530	Yes
2026	4.2	175	27	5530	Yes
2027	2	167	28	5530	Yes
2028	4.4	190	23	5530	Yes
2029	2.3	229	24	5530	Yes
2030	4.9	219	23	5530	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	5.2	345	17	5530	No
3002	6.3	326	16	5530	Yes
3003	9.4	472	16	5530	Yes
3004	8.4	347	16	5530	Yes
3005	6.6	388	18	5530	Yes
3006	5.8	277	17	5530	Yes
3007	7.1	330	18	5530	Yes
3008	9.3	482	17	5530	Yes
3009	5.6	431	18	5530	Yes
3010	8.1	478	17	5530	Yes
3011	7.4	440	16	5530	Yes
3012	5	500	17	5530	No
3013	9.7	474	17	5530	Yes
3014	7.6	429	18	5530	Yes
3015	5.1	416	18	5530	No
3016	5.9	384	18	5530	Yes
3017	8.7	266	16	5530	Yes
3018	9.8	498	18	5530	Yes
3019	7.8	275	18	5530	Yes
3020	6.8	268	18	5530	Yes
3021	5	309	17	5530	No
3022	9.3	448	16	5530	Yes
3023	8.2	251	17	5530	Yes
3024	7.6	285	16	5530	Yes
3025	9.1	352	17	5530	Yes
3026	6.5	399	16	5530	Yes
3027	5.8	360	18	5530	Yes
3028	8.5	420	17	5530	Yes
3029	8.1	395	16	5530	Yes
3030	6	350	17	5530	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	17.1	337	15	5530	Yes
4002	18.7	304	14	5530	Yes
4003	14.2	438	15	5530	Yes
4004	16.4	418	15	5530	Yes
4005	12.4	446	14	5530	Yes
4006	10.4	440	16	5530	Yes
4007	12.3	480	16	5530	Yes
4008	15.4	369	16	5530	Yes
4009	13.1	422	13	5530	No
4010	12.1	457	16	5530	Yes
4011	15	272	13	5530	Yes
4012	19.8	320	16	5530	Yes
4013	18.6	281	12	5530	Yes
4014	13.8	341	13	5530	Yes
4015	13	315	16	5530	Yes
4016	18.9	270	15	5530	Yes
4017	13.9	257	13	5530	Yes
4018	15.5	476	12	5530	Yes
4019	11	358	14	5530	Yes
4020	13.2	472	16	5530	Yes
4021	19.3	367	12	5530	Yes
4022	17.3	493	15	5530	Yes
4023	19.2	401	14	5530	Yes
4024	17.6	289	12	5530	No
4025	20	343	16	5530	Yes
4026	19	378	14	5530	Yes
4027	17.2	444	12	5530	Yes
4028	16.7	491	12	5530	Yes
4029	15.4	453	15	5530	Yes
4030	10.6	262	16	5530	No

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5

Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5530	Yes
2	5530	Yes
3	5530	Yes
4	5530	Yes
5	5530	Yes
6	5530	Yes
7	5530	Yes
8	5530	Yes
9	5530	No
10	5530	Yes
11	5496	Yes
12	5495	Yes
13	5496	Yes
14	5495	Yes
15	5496	Yes
16	5495	Yes
17	5496	Yes
18	5495	Yes
19	5499	Yes
20	5499	Yes
21	5562	Yes
22	5562	Yes
23	5563	Yes
24	5566	Yes
25	5560	Yes
26	5562	Yes
27	5562	Yes
28	5563	Yes
29	5566	Yes
30	5561	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	142	5490	23	Yes
2	617	5491	21	Yes
3	1092	5492	11	Yes
4	1567	5493	17	Yes
5	2042	5494	14	Yes
6	2517	5495	19	Yes
7	2992	5496	14	Yes
8	3467	5497	17	Yes
9	3942	5498	13	Yes
10	4417	5499	20	Yes
11	4892	5500	18	Yes
12	5367	5501	16	Yes
13	5842	5502	17	Yes
14	6317	5503	14	Yes
15	6792	5504	17	Yes
16	7267	5505	17	Yes
17	7742	5506	14	Yes
18	8217	5507	20	Yes
19	8692	5508	18	Yes
20	9167	5509	28	Yes
21	9642	5510	16	Yes
22	10117	5511	8	Yes
23	10592	5512	16	Yes
24	11067	5513	15	Yes
25	11542	5514	18	Yes
26	12017	5515	18	Yes
27	12492	5516	16	Yes
28	12967	5517	25	Yes
29	13442	5518	17	Yes
30	13917	5519	9	Yes
31	14392	5520	19	Yes
32	14867	5521	22	Yes
33	15342	5522	15	Yes
34	15817	5523	15	Yes
35	16292	5524	16	Yes
36	16767	5525	15	Yes
37	17242	5526	18	Yes
38	17717	5527	19	Yes

TYPE 6 DETECTION PROBABILITY (CONTINUED)

39	18192	5528	22	Yes
40	18667	5529	17	Yes
41	19142	5530	18	Yes
42	19617	5531	15	Yes
43	20092	5532	22	Yes
44	20567	5533	14	Yes
45	21042	5534	10	Yes
46	21517	5535	16	Yes
47	21992	5536	17	Yes
48	22467	5537	22	Yes
49	22942	5538	17	Yes
50	23417	5539	12	Yes
51	23892	5540	13	Yes
52	24367	5541	17	Yes
53	24842	5542	18	Yes
54	25317	5543	15	Yes
55	25792	5544	22	Yes
56	26267	5545	16	Yes
57	26742	5546	18	Yes
58	27217	5547	10	Yes
59	27692	5548	13	Yes
60	28167	5549	17	Yes
61	28642	5550	19	Yes
62	29117	5551	16	Yes
63	29592	5552	9	Yes
64	30067	5553	15	Yes
65	30542	5554	15	Yes
66	31017	5555	15	Yes
67	31492	5556	21	Yes
68	31967	5557	13	Yes
69	32442	5558	14	Yes
70	32917	5559	20	Yes
71	33392	5560	10	Yes
72	33867	5561	11	Yes
73	34342	5562	18	Yes
74	34817	5563	17	Yes
75	35292	5564	14	Yes
76	35767	5565	11	Yes
77	36242	5566	23	Yes
78	36717	5567	20	Yes
79	37192	5568	17	Yes
80	37667	5569	14	Yes
81	38142	5570	13	Yes

5.5. BRIDGE MODE RESULTS

Per KDB 905462, Section 5.1 (footnote 1):

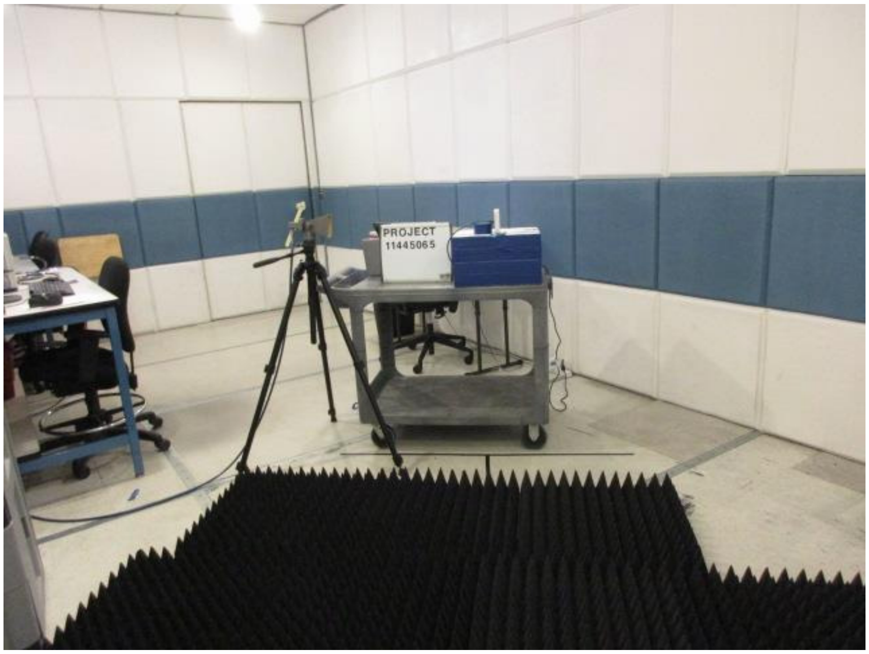
Networks Access Points with Bridge and/or MESH modes of operation are permitted to operate in the DFS bands but must employ a DFS function. The functionality of the Bridge mode as specified in §15.403(a) must be validated in the DFS test report. Devices operating as relays must also employ DFS function. 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.

6. SETUP PHOTOS

DYNAMIC FREQUENCY SELECTION MEASUREMENT SETUP

DFS FRONT PHOTO



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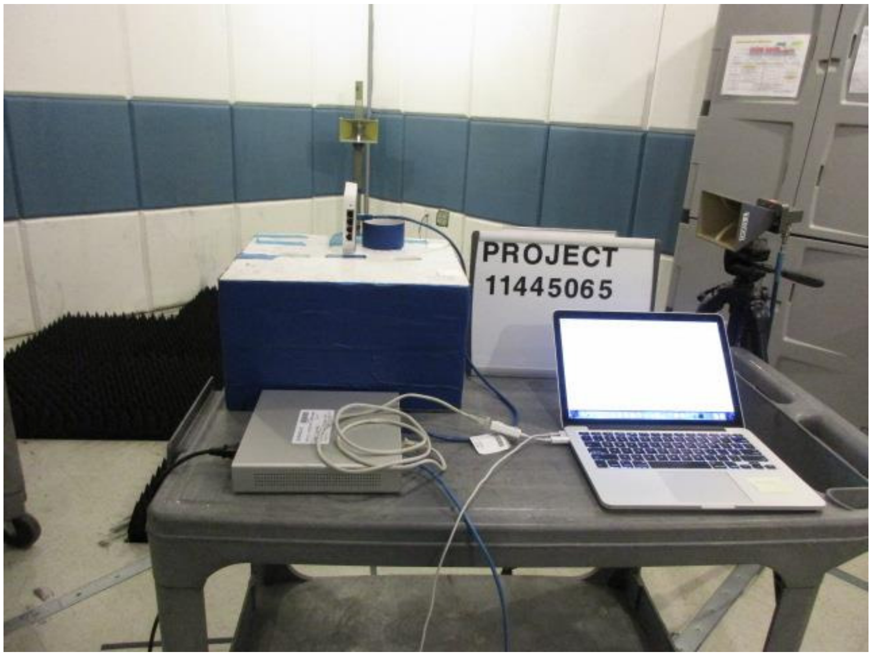
DFS BACK PHOTO



END OF REPORT