DFS PORTION of FCC 47 CFR PART 15 SUBPART E
DFS PORTION of INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

802.11n 2x2 ACCESS POINT

MODEL NUMBER: BSAP 1920

FCC ID: HDCWLAN192XF1
IC: 2250A-WLAN192XF1

REPORT NUMBER: 14U19446-2, Revision A

ISSUE DATE: June 4, 2015, 2015

Prepared for
ADTRAN, INC.
901 EXPLORER BLVD
HUNTSVILLE, AL 35806
U.S.A.

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/20/15	Initial Issue	C. Cheung
A	06/04/15	Revised customers address	G. Rincand

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ADTRAN, INC.
901 EXPLORER BLVD
HUNTSVILLE, AL 35806
U.S.A.

EUT DESCRIPTION: 802.11n 2x2 ACCESS POINT

MODEL: BSAP 1920

SERIAL NUMBER: 19204614052013

DATE TESTED: APRIL 14 to 15 and MAY 11, 2015

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
DFS Portion of CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-GEN Issue 8	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
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UL Verification Services Inc.

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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-GEN Issue 8.

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-210 is closely harmonized with FCC Part 15 DFS rules. The deviations are as follows:

RSS-210 Issue 8 A9.3

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

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

FCC

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

Table 1: Applicability of DFS requirements prior to use of a channel

Requirement	Operational Mode		
	Master	Client (without radar detection)	Client (with radar detection)
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation

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

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar DFS	Client (without DFS)
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in all 20 MHz channel blocks and a null frequency between the bonded 20 MHz channel blocks.		

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

Maximum Transmit Power	Value (see notes)
E.I.R.P. ≥ 200 mill watt	-64 dBm
E.I.R.P. < 200 mill watt and power spectral density < 10 dBm/MHz	-62 dBm
E.I.R.P. < 200 mill watt that do not meet power spectral density requirement	-64 dBm

Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna
Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.
Note 3: E.I.R.P. is based on the highest antenna gain. For MIMO devices refer to KDB publication 662911 D01.

Table 4: DFS Response requirement values

Parameter	Value
Non-occupancy period	30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds (See Note 1)
Channel Closing Transmission Time	200 milliseconds + approx. 60 milliseconds over remaining 10 second period. (See Notes 1 and 2)
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. (See Note 3)

Note 1: *Channel Move Time* and the *Channel Closing Transmission Time* should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.
Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.
Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (usec)	PRI (usec)	Pulses	Minimum Percentage of Successful Detection	Minimum Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in table 5a	Roundup: {(1/360) x (19 x 10^6 PRI_{usec})}	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 usec. With a minimum increment of 1 usec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

Note 1: Short Pulse Radar Type 0 should be used for the *Detection Bandwidth* test, *Channel Move Time*, and *Channel Closing Time* tests.

Table 6 – Long Pulse Radar Test Signal

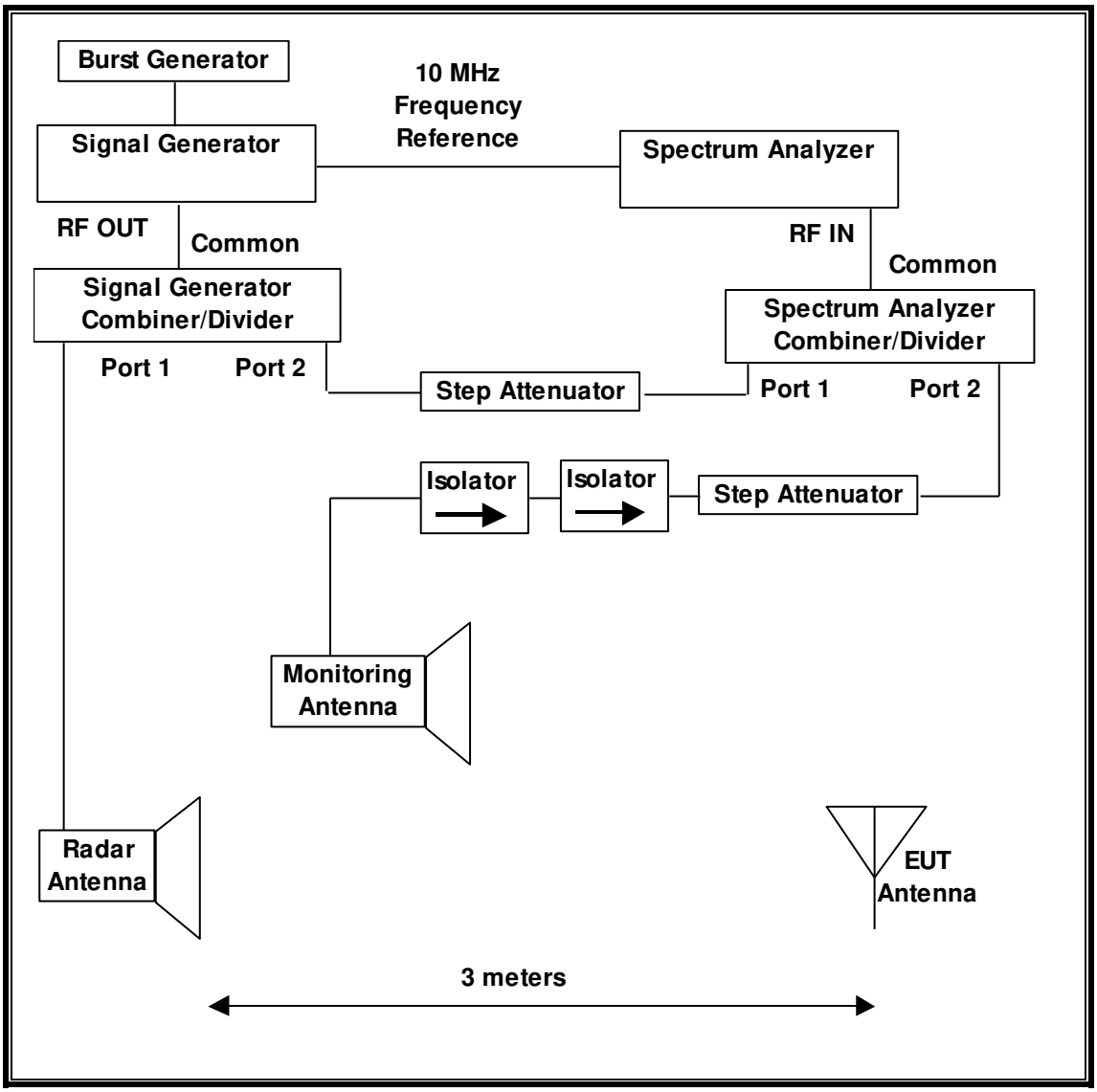
Radar Waveform Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 7 – Frequency Hopping Radar Test Signal

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

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.

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.

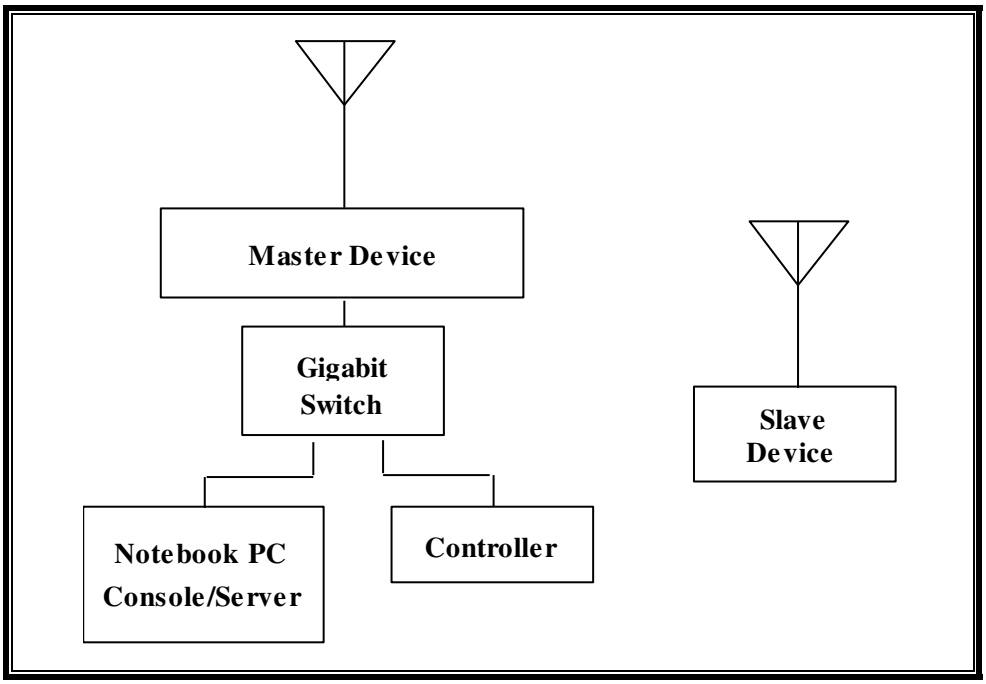
TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset Number**	**Cal Due**
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01178	09/05/15
Vector Signal Generator, 20GHz	Agilent / HP	E8267C	C01066	09/03/15
Arbitrary Waveform Generator	Agilent / HP	33220A	C01146	04/08/16

5.1.1. 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**
AC Adapter (EUT)	Powertron Corp.	PA1024-120HUB200	No Serial Number	DoC
Notebook PC (Slave Device)	HP	Elitebook 8460p	CNU2359KXV	PD962205ANHU
AC Adapter (Slave PC)	Chicony Power Technology	PPP12H-S	F12941226036826	DoC
Notebook PC (Console/Server)	Dell	P05G	J9VBWM1	DoC
AC Adapter (Console PC)	HP	PA-1900-18H2	597950ALLUDC4B	DoC
Controller	Adtran	Bluesocket	A91000000000021	DoC
AC Adapter (Controller)	Wearnes Global Co. Ltd.	WDS060122	1408Y0008732	DoC
Gigabit Switch	Netgear	GS105	GS12154DB047636	DoC
AC Adapter (Switch)	Netgear	DSA-0131F-12	No Serial Number	DoC

5.1.2. 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 21 dBm EIRP in the 5250-5350 MHz band and 24 dBm EIRP in the 5470-5725 MHz band.

The only antenna assembly utilized with the EUT has a gain of 4.0 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, 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 controller/server PC to the EUT using iPerf version 2.0.5 software package.

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

The EUT utilizes the 802.11a/n architecture. Two nominal channel bandwidths are implemented: 20 MHz and 40 MHz.

The software installed in the EUT is revision 7.0.

UNIFORM CHANNEL SPREADING

This function is not required per KDB 905462.

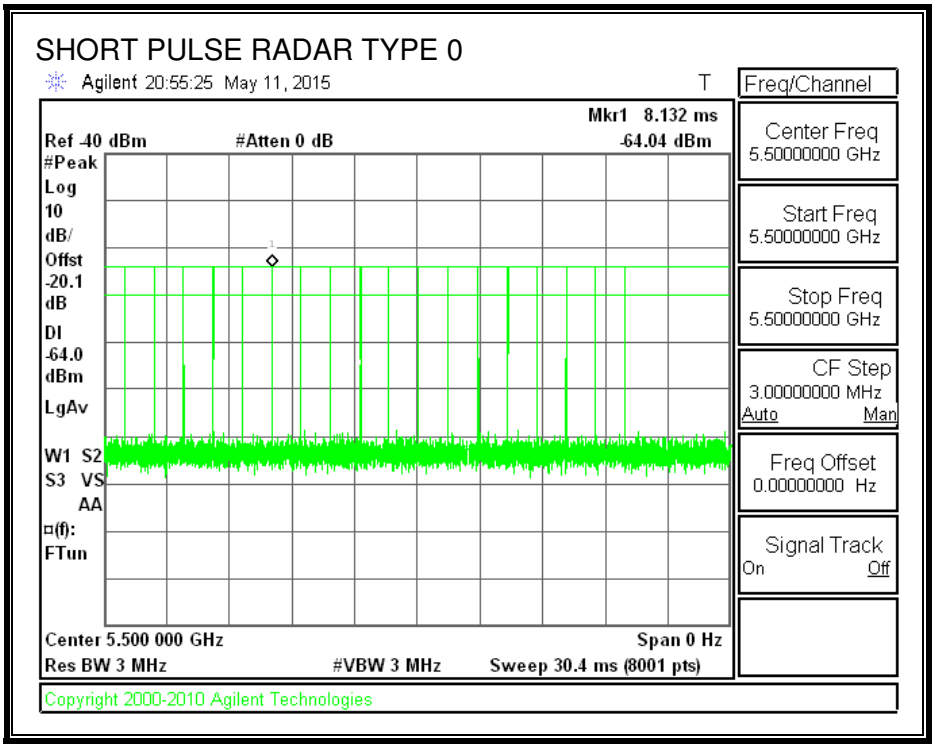
5.2. RESULTS FOR 20 MHz BANDWIDTH

5.2.1. TEST CHANNEL

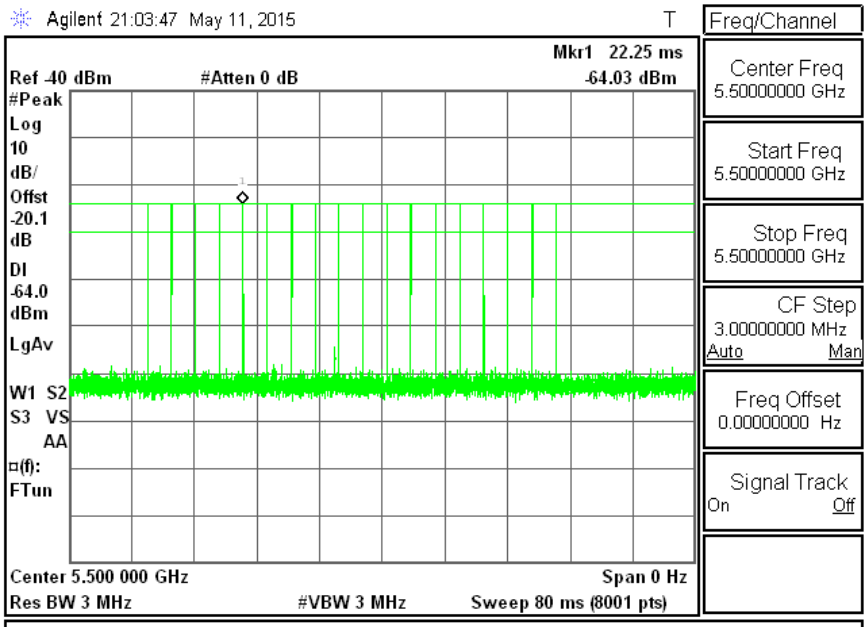
All tests were performed at a channel center frequency of 5500 MHz.

5.2.2. RADAR WAVEFORMS AND TRAFFIC

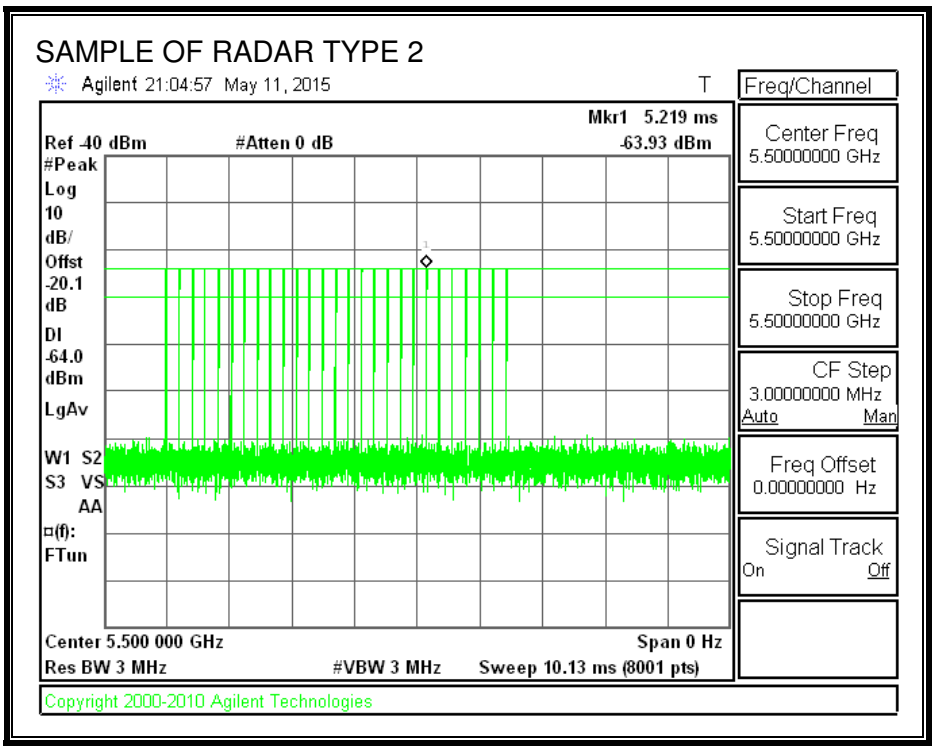
RADAR WAVEFORMS

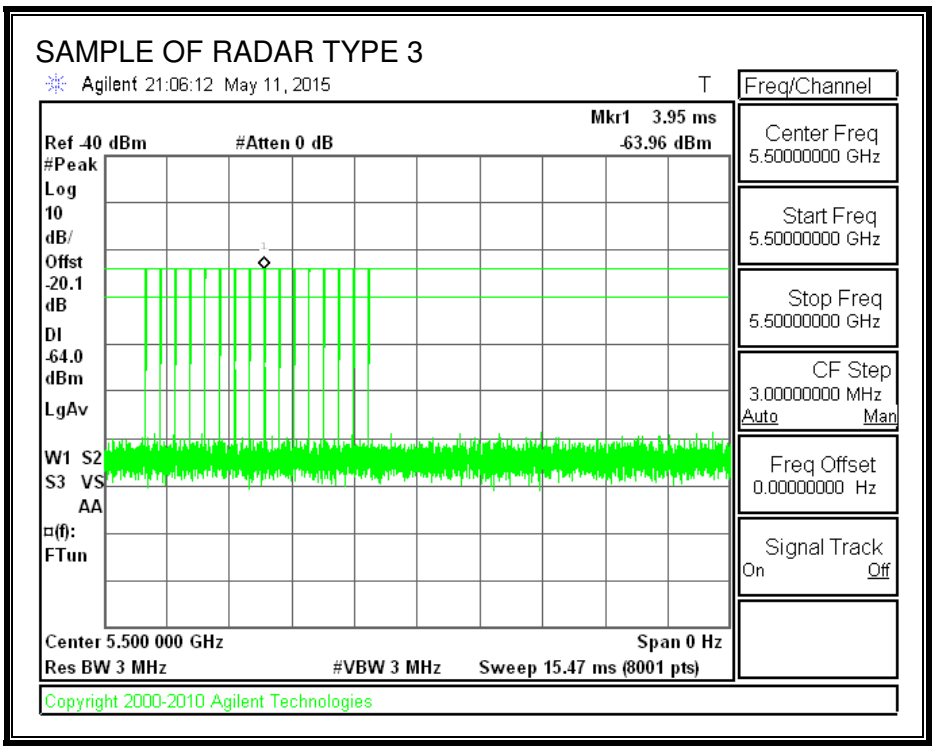


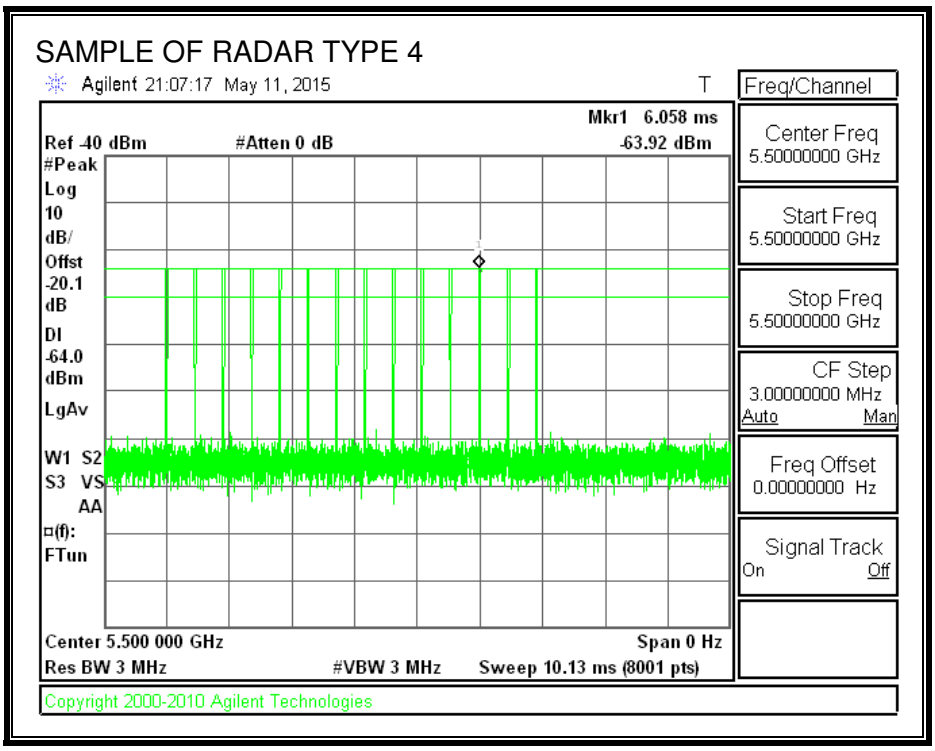
SAMPLE OF RADAR TYPE 1

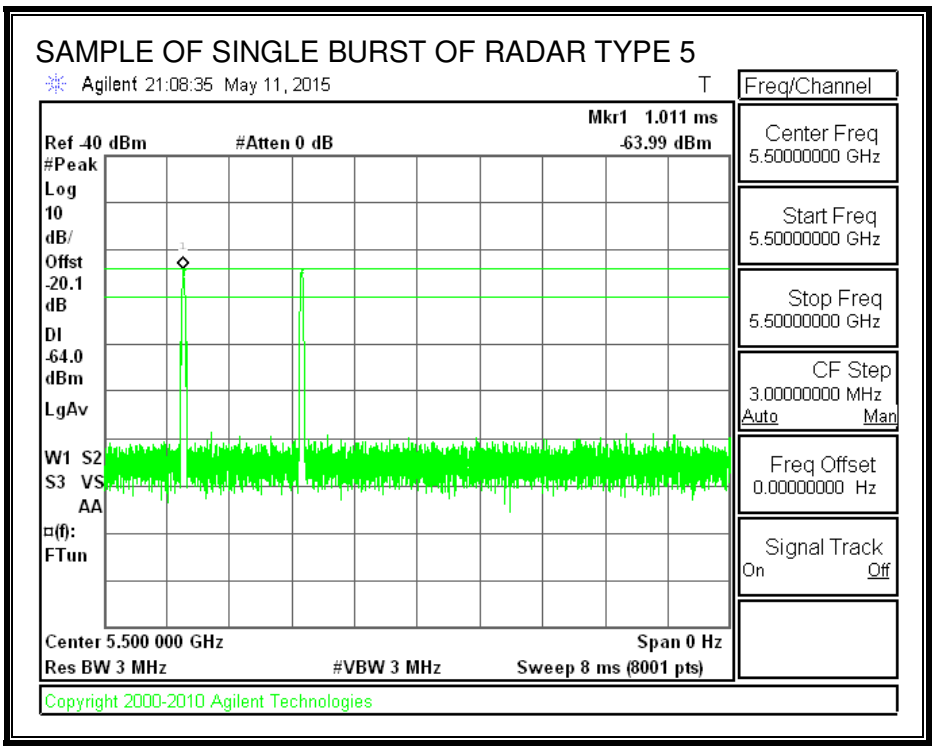


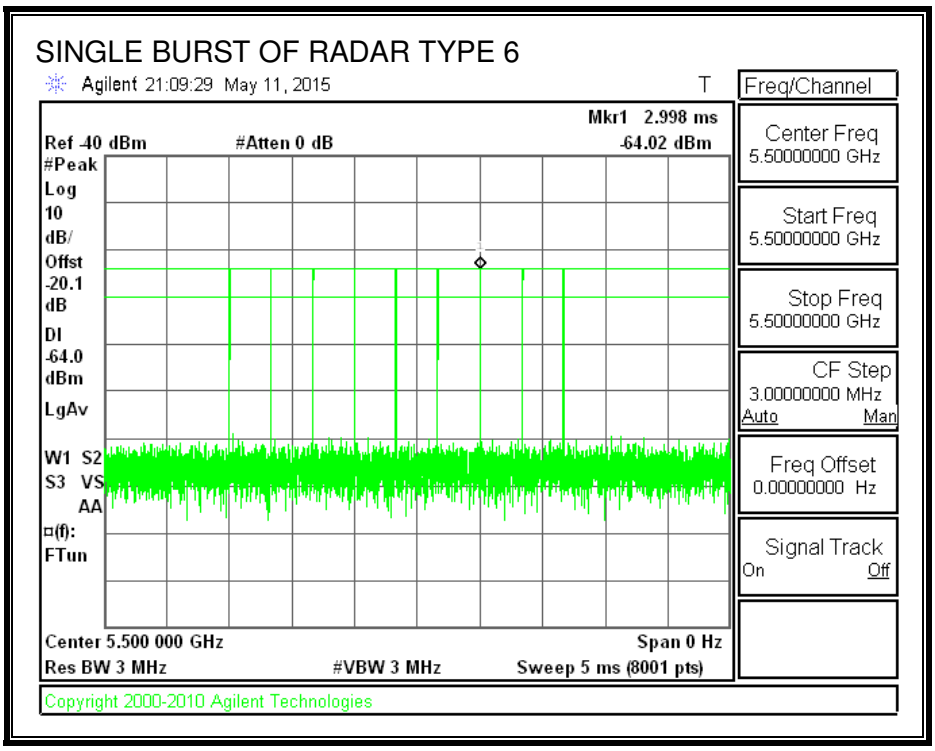
SAMPLE OF RADAR TYPE 2



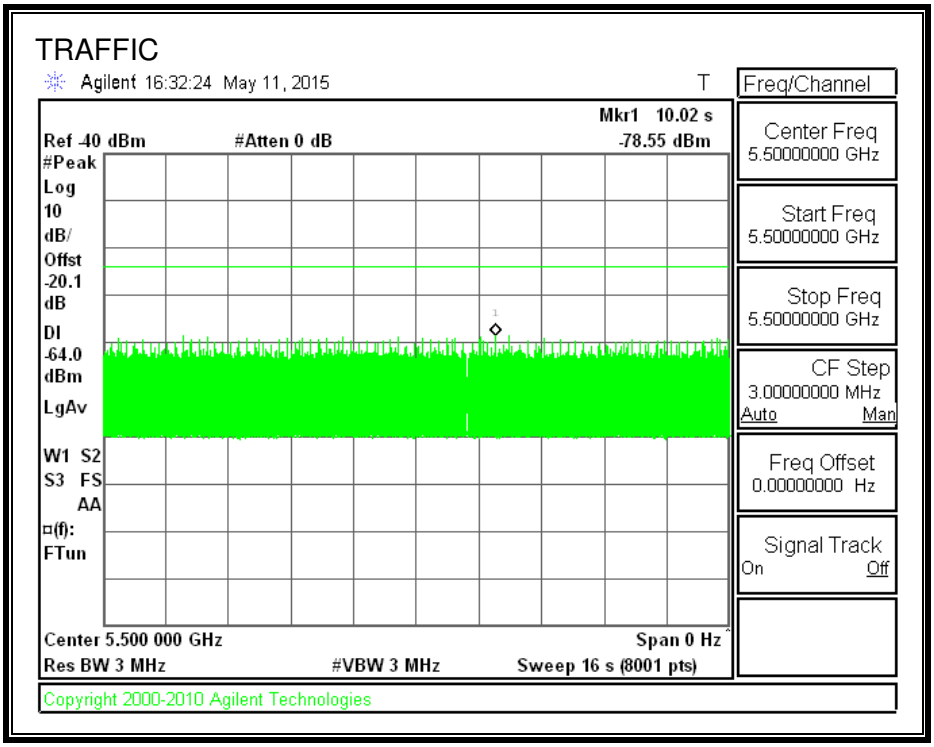




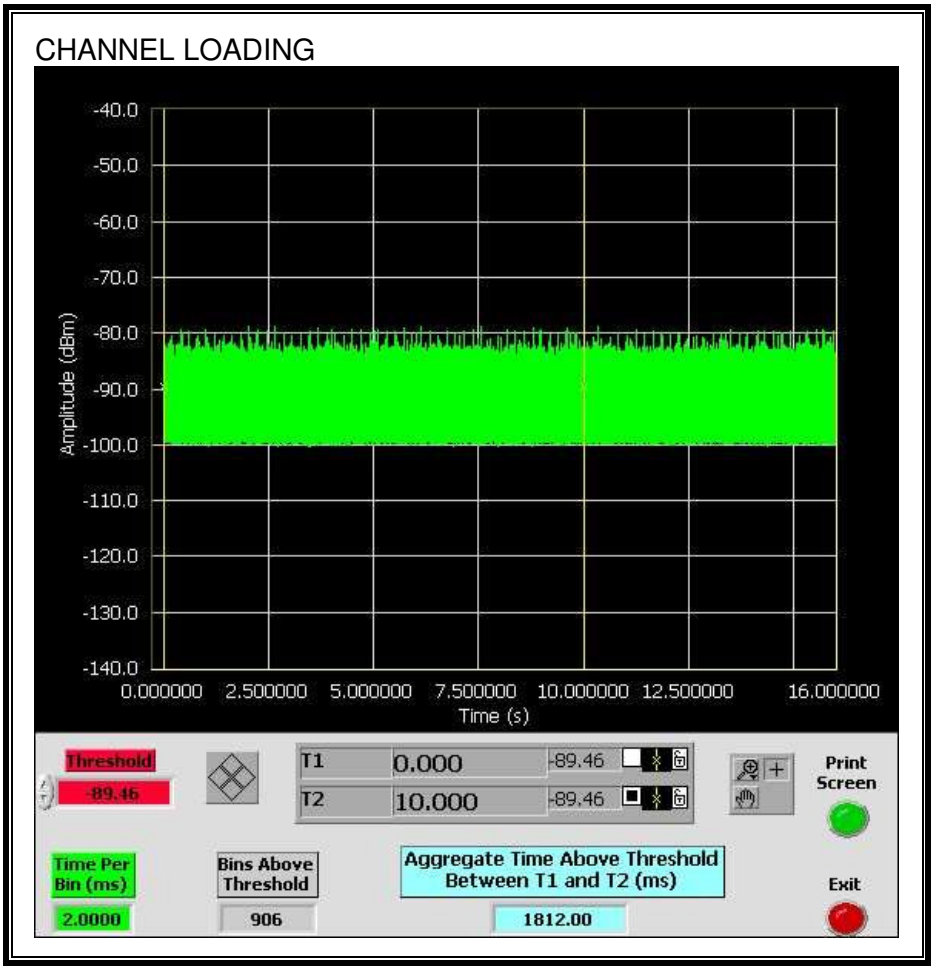




TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 18.12%

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.

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)
30.38	174.5	144.1	84.1

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)
29.93	114.5	84.6	0.4

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)
30.19	173.0	142.8	58.7

QUALITATIVE RESULTS

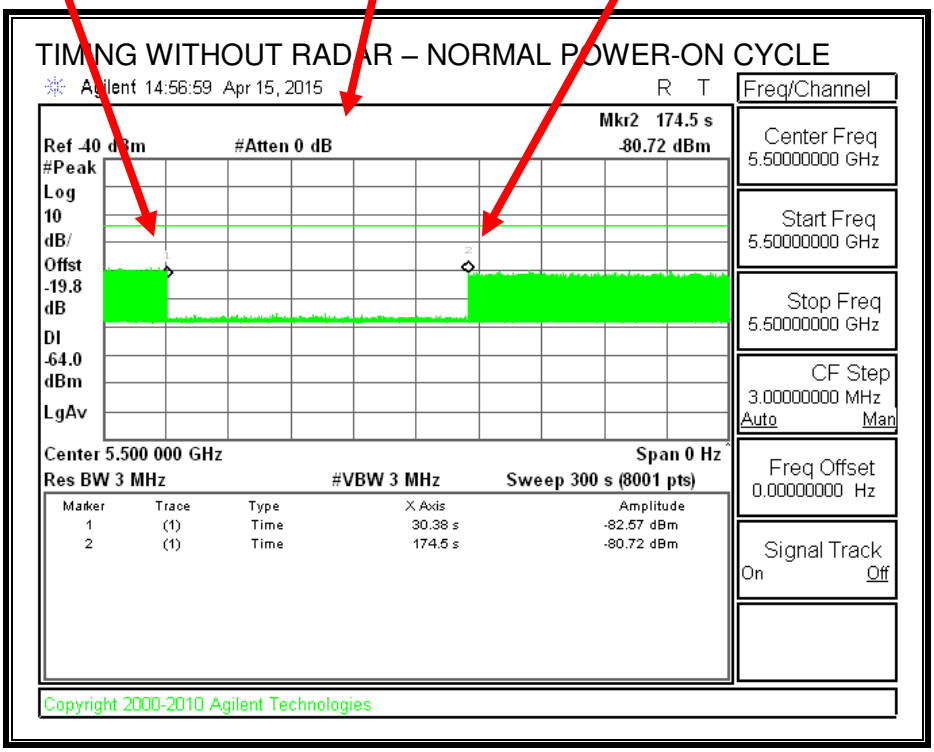
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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

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



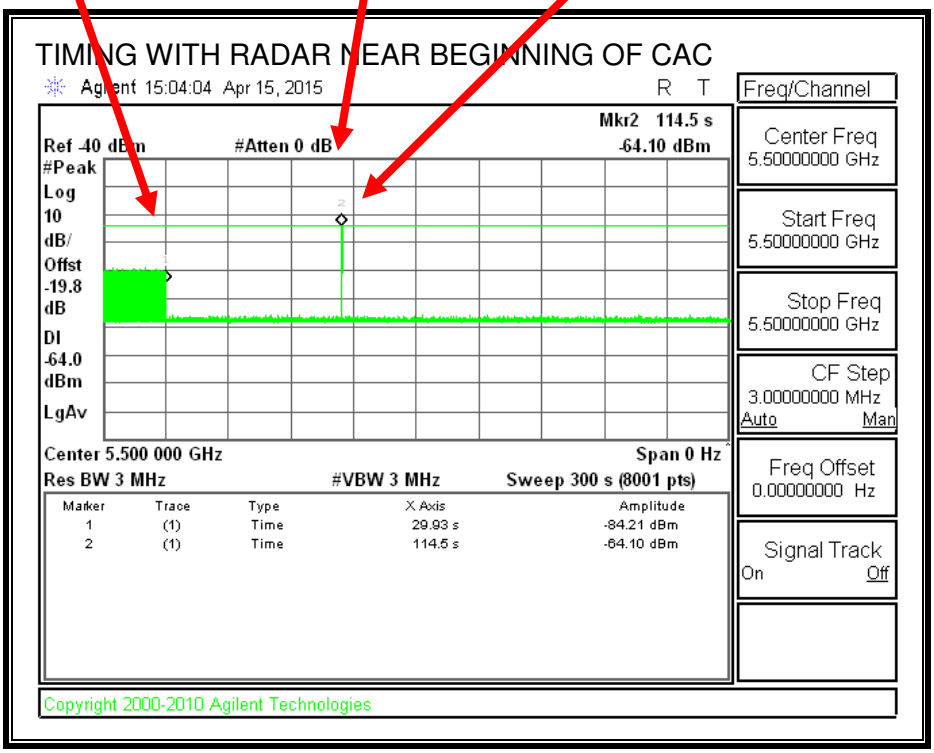
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

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



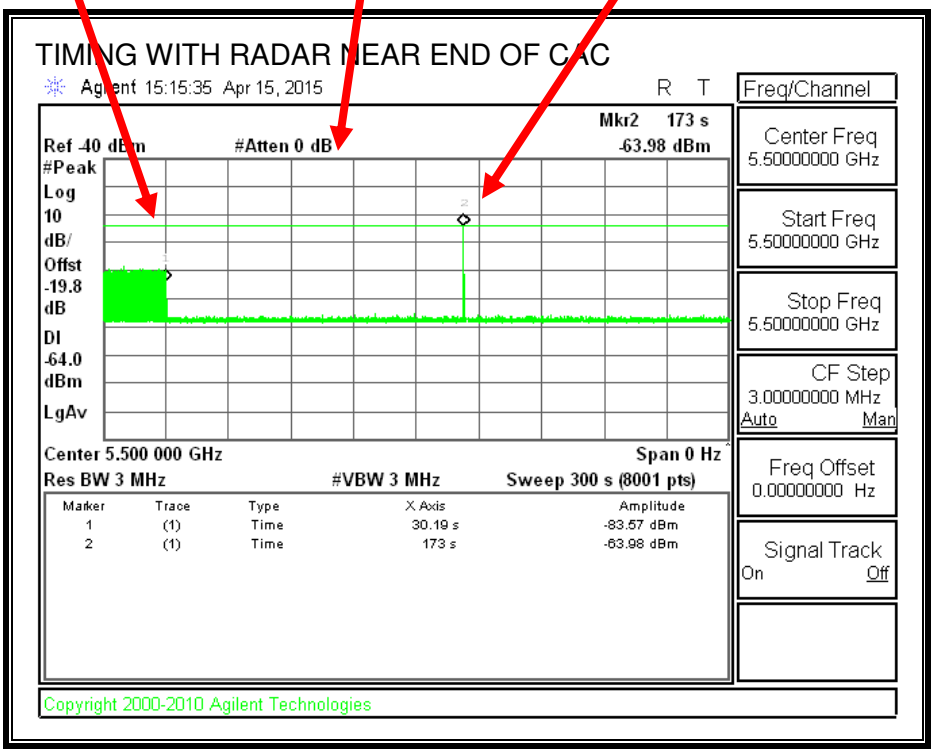
No EUT transmissions were observed after the radar signal.

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.

5.2.4. 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)

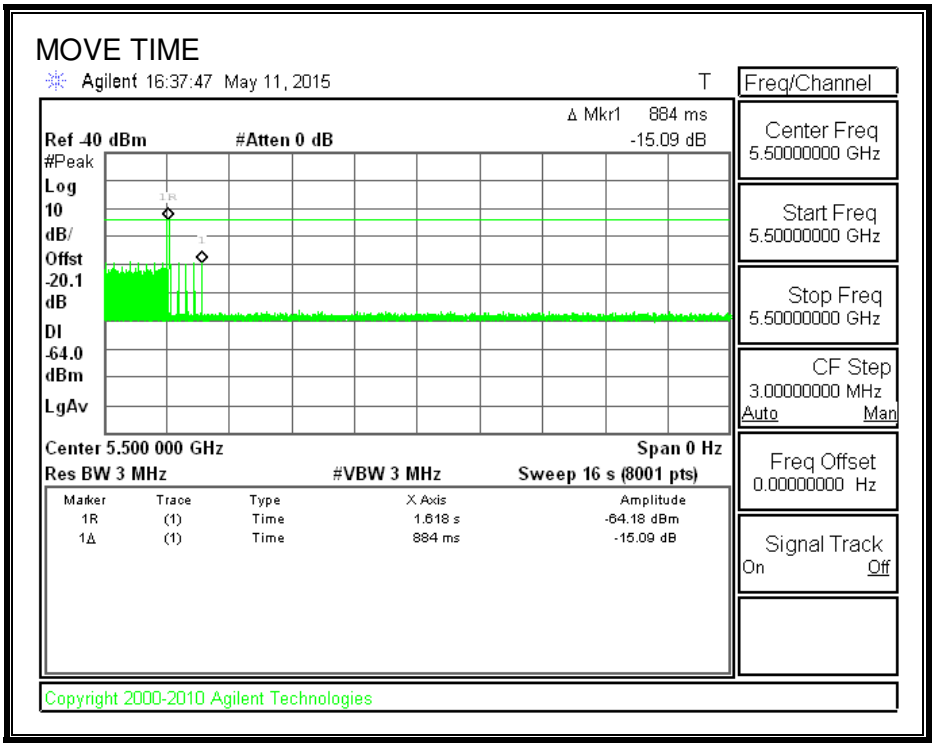
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

RESULTS

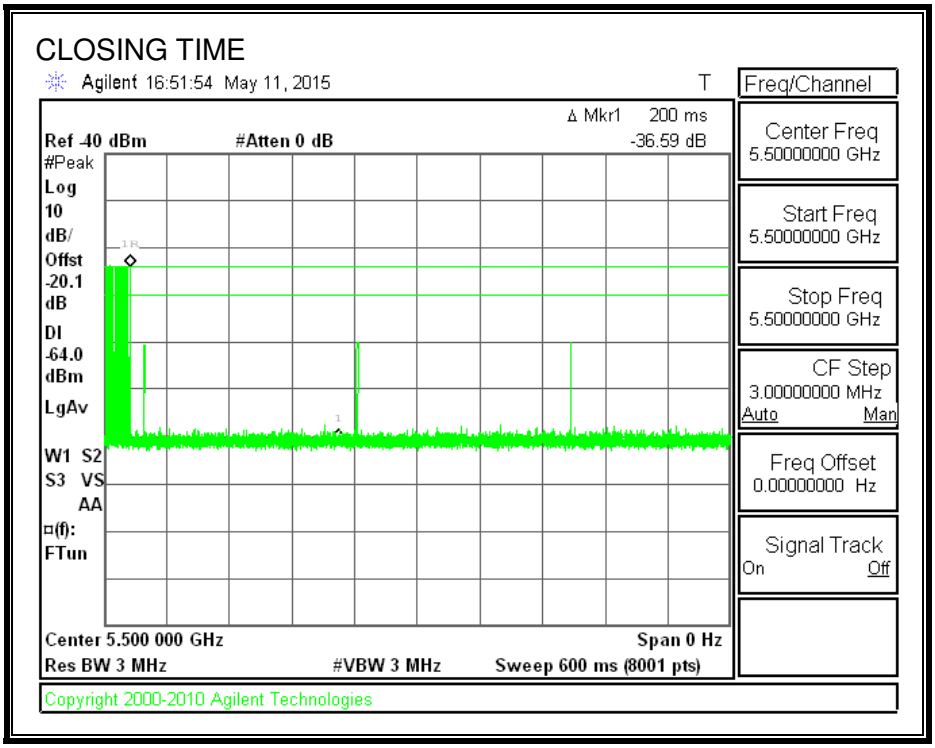
Channel Move Time (sec)	Limit (sec)
0.884	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
10.0	60

MOVE TIME

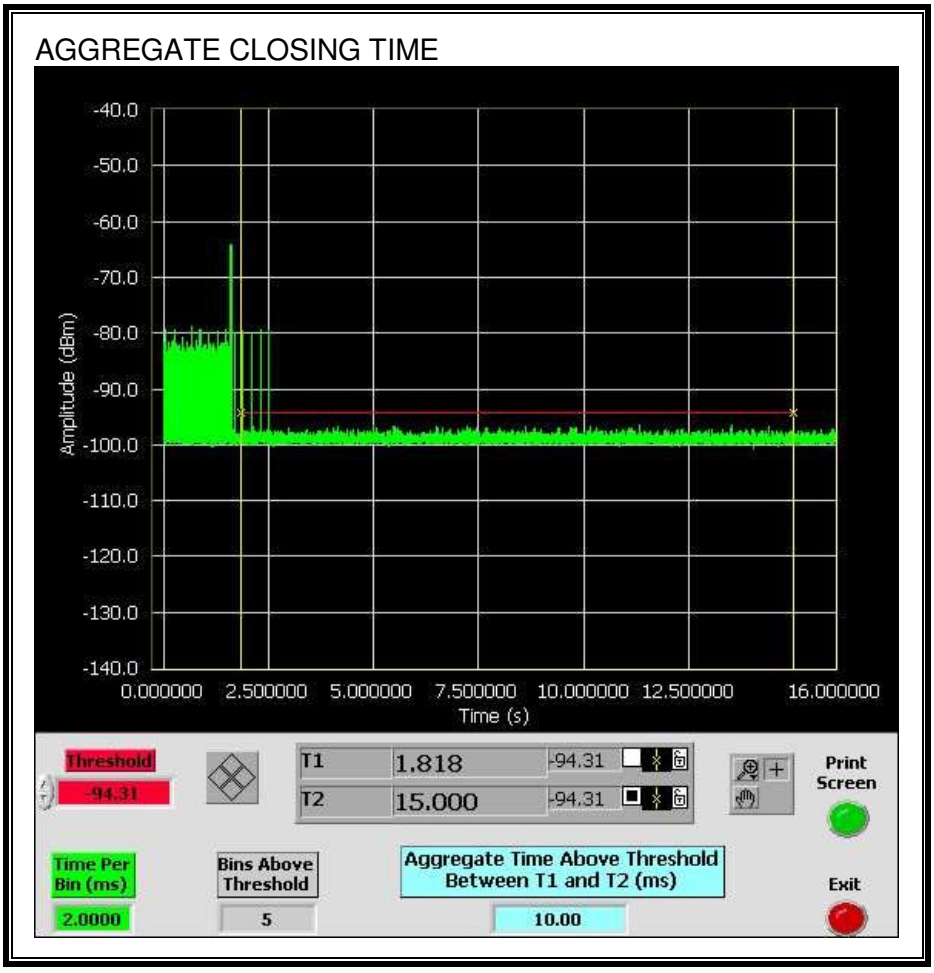


CHANNEL CLOSING TIME



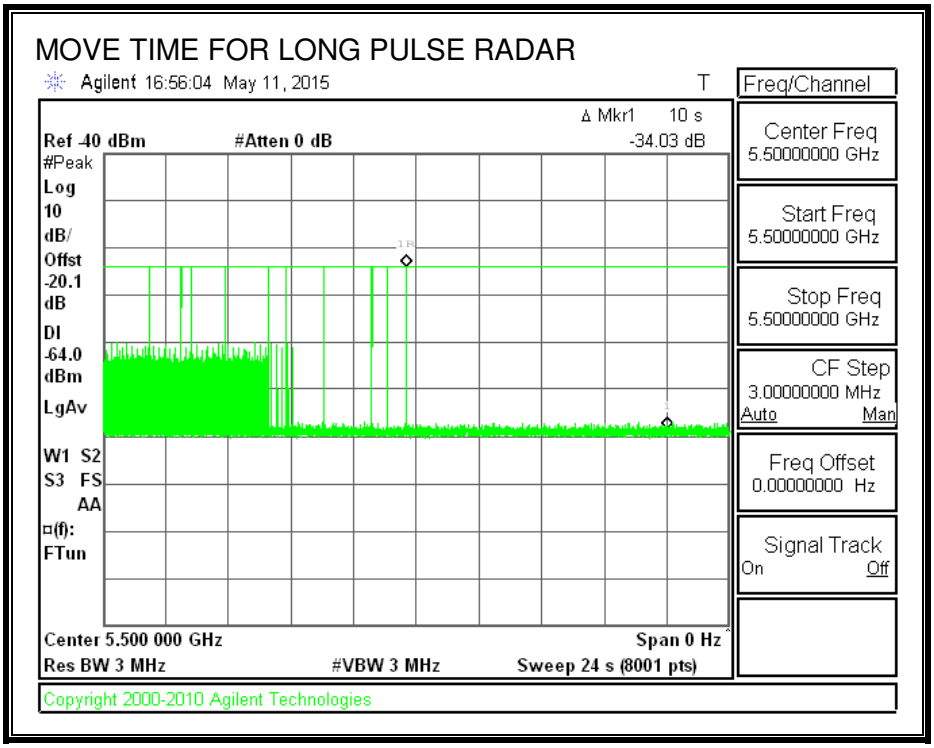
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.



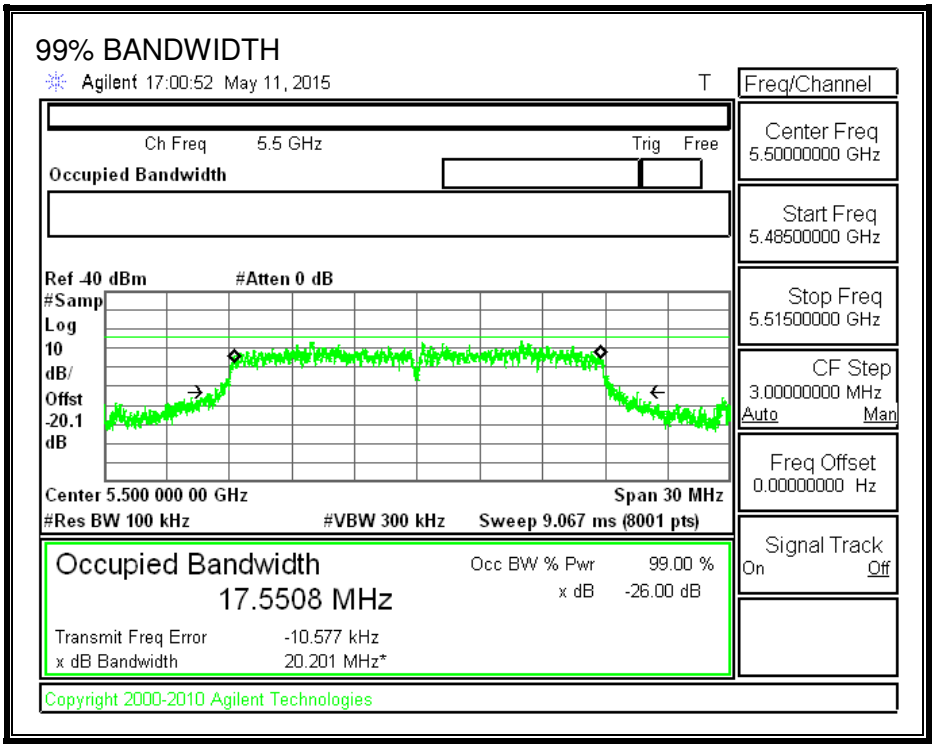
LONG PULSE CHANNEL MOVE TIME

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



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 (%)
5491	5509	18	17.551	102.6	100

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
5491	10	10	100	FL
5492	10	10	100	
5493	10	10	100	
5494	10	10	100	
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5506	10	10	100	
5507	10	10	100	
5508	10	10	100	
5509	10	10	100	FH

5.2.7. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary				
Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail
FCC Short Pulse Type 1	30	100.00	60	Pass
FCC Short Pulse Type 2	30	100.00	60	Pass
FCC Short Pulse Type 3	30	100.00	60	Pass
FCC Short Pulse Type 4	30	100.00	60	Pass
Aggregate		100.00	80	Pass
FCC Long Pulse Type 5	30	100.00	80	Pass
FCC Long Pulse Type 5 (Lower Detection BW Edge)	30	83.33	80	Pass
FCC Long Pulse Type 5 (Upper Detection BW Edge)	30	100.00	80	Pass
FCC Hopping Type 6	38	100.00	70	Pass

TYPE 1 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 1				
1 us Pulse Width				
Waveform	PRI (us)	Pulses Per Burst	Test (A/B)	Successful Detection (Yes/No)
1001	3066	18	A	Yes
1002	678	78	A	Yes
1003	538	99	A	Yes
1004	698	76	A	Yes
1005	798	67	A	Yes
1006	598	89	A	Yes
1007	578	92	A	Yes
1008	858	62	A	Yes
1009	618	86	A	Yes
1010	558	95	A	Yes
1011	758	70	A	Yes
1012	518	102	A	Yes
1013	778	68	A	Yes
1014	718	74	A	Yes
1015	878	61	A	Yes
1016	898	59	B	Yes
1017	1224	44	B	Yes
1018	2886	19	B	Yes
1019	2802	19	B	Yes
1020	652	81	B	Yes
1021	2206	24	B	Yes
1022	1712	31	B	Yes
1023	1205	44	B	Yes
1024	1210	44	B	Yes
1025	1658	32	B	Yes
1026	784	68	B	Yes
1027	1407	38	B	Yes
1028	2642	20	B	Yes
1029	969	55	B	Yes
1030	2508	22	B	Yes

TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2				
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Successful Detection (Yes/No)
2001	1.6	211.00	27	Yes
2002	4.7	154.00	26	Yes
2003	1	163.00	27	Yes
2004	4	225.00	28	Yes
2005	2.3	155.00	28	Yes
2006	3	193.00	25	Yes
2007	3.5	222.00	25	Yes
2008	2.9	160.00	29	Yes
2009	4.7	230.00	29	Yes
2010	2.5	207.00	29	Yes
2011	1.7	227.00	29	Yes
2012	2.3	218.00	24	Yes
2013	1.9	200.00	27	Yes
2014	1.3	196.00	23	Yes
2015	4.9	151.00	26	Yes
2016	2	205.00	27	Yes
2017	3.7	176.00	29	Yes
2018	2.8	184.00	28	Yes
2019	2	155.00	29	Yes
2020	1.6	156.00	27	Yes
2021	2	214.00	28	Yes
2022	2.8	228.00	27	Yes
2023	1.4	164.00	29	Yes
2024	3.8	157.00	25	Yes
2025	5	222.00	27	Yes
2026	3.3	164.00	26	Yes
2027	4.4	201.00	27	Yes
2028	2.5	151.00	28	Yes
2029	4.2	186.00	23	Yes
2030	1.7	230.00	23	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3				
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Successful Detection (Yes/No)
3001	7.3	369.00	16	Yes
3002	7.1	444.00	16	Yes
3003	5.5	329.00	18	Yes
3004	7.1	259.00	16	Yes
3005	9.5	272.00	17	Yes
3006	9.4	495.00	17	Yes
3007	7.5	317.00	18	Yes
3008	9.8	439.00	16	Yes
3009	9.5	350.00	16	Yes
3010	5.9	491.00	16	Yes
3011	6.4	406.00	17	Yes
3012	9.1	283.00	18	Yes
3013	6.8	314.00	17	Yes
3014	6.8	377.00	18	Yes
3015	9.8	457.00	16	Yes
3016	9.1	484.00	18	Yes
3017	9.1	461.00	16	Yes
3018	10	265.00	16	Yes
3019	7.2	268.00	16	Yes
3020	8.2	305.00	16	Yes
3021	6.1	472.00	18	Yes
3022	6.5	500.00	18	Yes
3023	5	448.00	18	Yes
3024	8.3	334.00	18	Yes
3025	7.4	457.00	18	Yes
3026	9.9	488.00	18	Yes
3027	6.8	453.00	18	Yes
3028	9.1	333.00	18	Yes
3029	7.9	399	18	Yes
3030	6.6	303	16	Yes

TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4				
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Successful Detection (Yes/No)
4001	10.3	460.00	14	Yes
4002	15.3	403.00	14	Yes
4003	17.1	286.00	16	Yes
4004	10.6	374.00	12	Yes
4005	14.6	408.00	15	Yes
4006	11.8	340.00	13	Yes
4007	14.8	470.00	13	Yes
4008	13.5	454.00	14	Yes
4009	10.2	440.00	16	Yes
4010	12.4	327.00	15	Yes
4011	19.1	258.00	14	Yes
4012	13.8	347.00	14	Yes
4013	17.7	319.00	15	Yes
4014	15.6	472.00	15	Yes
4015	15.7	419.00	12	Yes
4016	11.3	431.00	12	Yes
4017	16.3	480.00	14	Yes
4018	19.6	422.00	12	Yes
4019	12.7	330.00	13	Yes
4020	13.2	446.00	14	Yes
4021	12.3	276.00	15	Yes
4022	15.6	467.00	15	Yes
4023	18.9	495.00	13	Yes
4024	19.3	407.00	15	Yes
4025	10.8	341.00	14	Yes
4026	10.6	251.00	13	Yes
4027	10.4	463.00	12	Yes
4028	13.4	402.00	12	Yes
4029	16.3	376.00	12	Yes
4030	16.6	384.00	14	Yes

TYPE 5 DETECTION PROBABILITY AT THE CHANNEL CENTER FREQUENCY

Data Sheet for FCC Long Pulse Radar Type 5	
Trial	Successful Detection (Yes/No)
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	Yes
9	Yes
10	Yes
11	Yes
12	Yes
13	Yes
14	Yes
15	Yes
16	Yes
17	Yes
18	Yes
19	Yes
20	Yes
21	Yes
22	Yes
23	Yes
24	Yes
25	Yes
26	Yes
27	Yes
28	Yes
29	Yes
30	Yes

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

TYPE 5 DETECTION PROBABILITY AT THE LOWEST EUT DETECTION BANDWIDTH FREQUENCY

Data Sheet for FCC Long Pulse Radar Type 5	
Trial	Successful Detection (Yes/No)
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	No
9	Yes
10	Yes
11	Yes
12	Yes
13	Yes
14	Yes
15	No
16	Yes
17	Yes
18	Yes
19	Yes
20	Yes
21	Yes
22	Yes
23	No
24	No
25	Yes
26	Yes
27	No
28	Yes
29	Yes
30	Yes

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

TYPE 5 DETECTION PROBABILITY AT THE HIGHEST EUT DETECTION BANDWIDTH FREQUENCY

Data Sheet for FCC Long Pulse Radar Type 5	
Trial	Successful Detection (Yes/No)
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	Yes
9	Yes
10	Yes
11	Yes
12	Yes
13	Yes
14	Yes
15	Yes
16	Yes
17	Yes
18	Yes
19	Yes
20	Yes
21	Yes
22	Yes
23	Yes
24	Yes
25	Yes
26	Yes
27	Yes
28	Yes
29	Yes
30	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	105	5491	1	Yes
2	580	5492	5	Yes
3	1055	5493	4	Yes
4	1530	5494	2	Yes
5	2005	5495	4	Yes
6	2480	5496	6	Yes
7	2955	5497	6	Yes
8	3430	5498	1	Yes
9	3905	5499	3	Yes
10	4380	5500	4	Yes
11	4855	5501	7	Yes
12	5330	5502	5	Yes
13	5805	5503	3	Yes
14	6280	5504	6	Yes
15	6755	5505	5	Yes
16	7230	5506	1	Yes
17	7705	5507	4	Yes
18	8180	5508	5	Yes
19	8655	5509	3	Yes
20	9130	5491	5	Yes
21	9605	5492	7	Yes
22	10080	5493	4	Yes
23	10555	5494	3	Yes
24	11030	5495	6	Yes
25	11505	5496	5	Yes
26	11980	5497	11	Yes
27	12455	5498	3	Yes
28	12930	5499	8	Yes
29	13405	5500	7	Yes
30	13880	5501	2	Yes
31	14355	5502	4	Yes
32	14830	5503	2	Yes
33	15305	5504	3	Yes
34	15780	5505	4	Yes
35	16255	5506	1	Yes
36	16730	5507	4	Yes
37	17205	5508	5	Yes
38	17680	5509	5	Yes

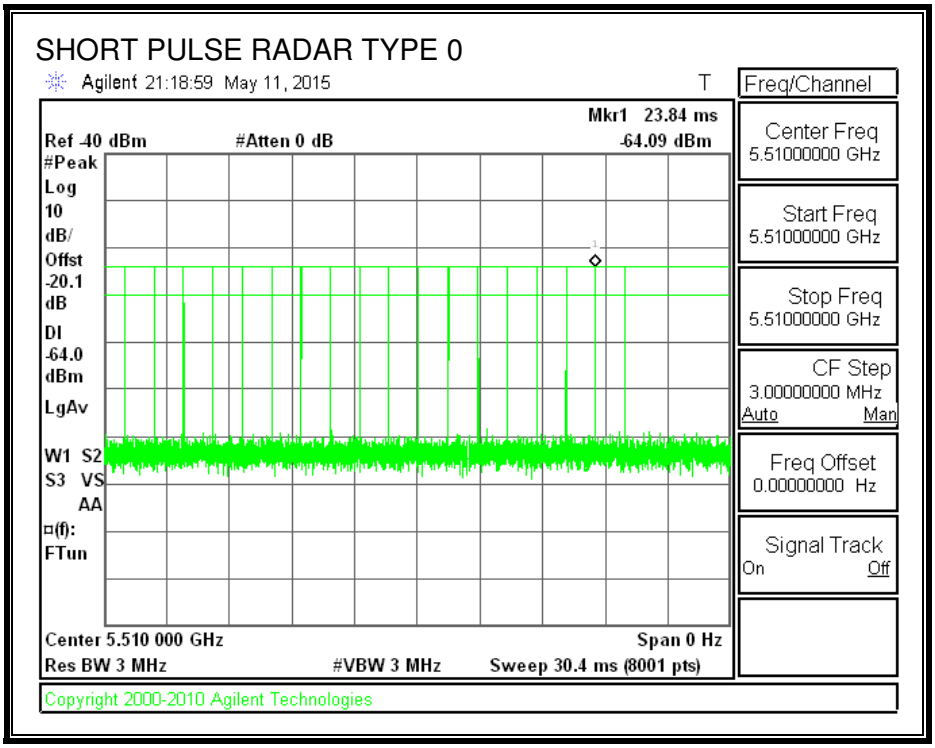
5.3. RESULTS FOR 40 MHz BANDWIDTH

5.3.1. TEST CHANNEL

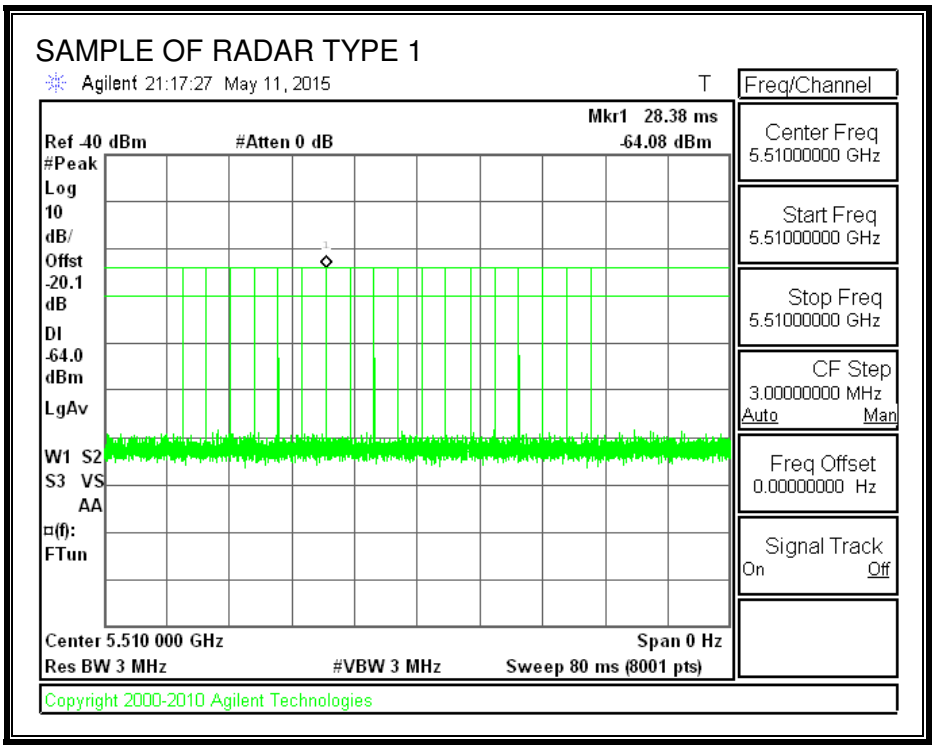
All tests were performed at a channel center frequency of 5510 MHz.

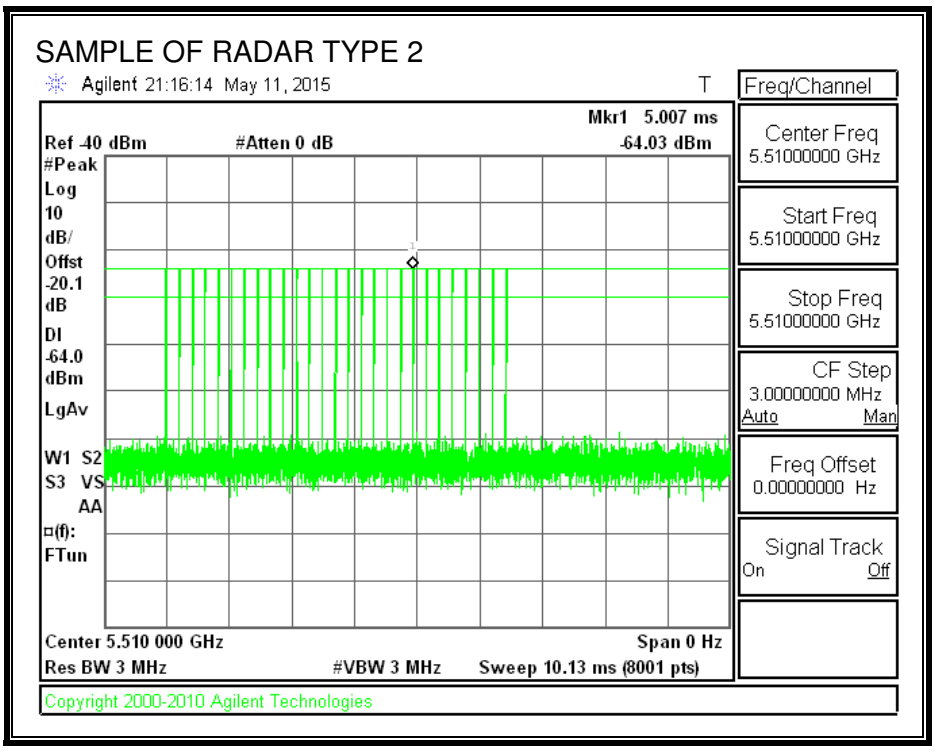
5.3.2. RADAR WAVEFORMS AND TRAFFIC

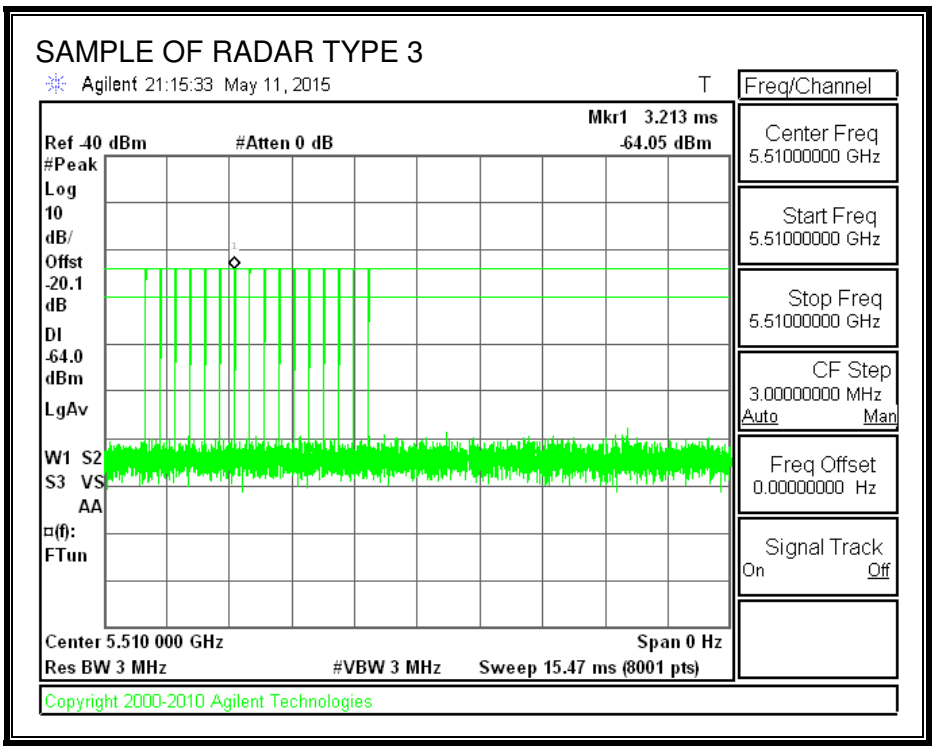
RADAR WAVEFORMS

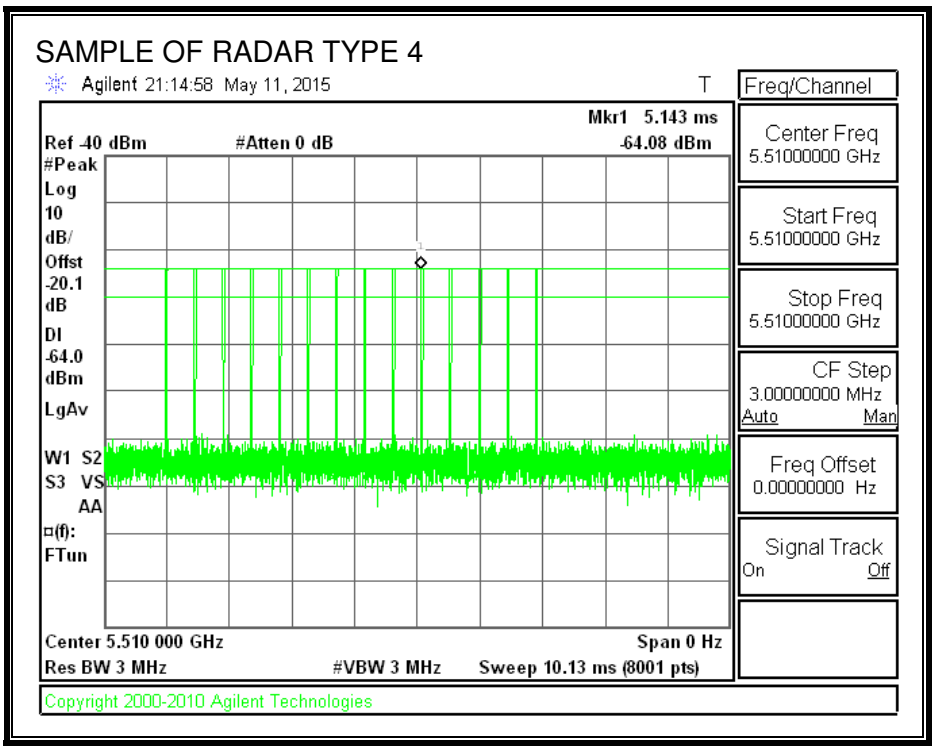


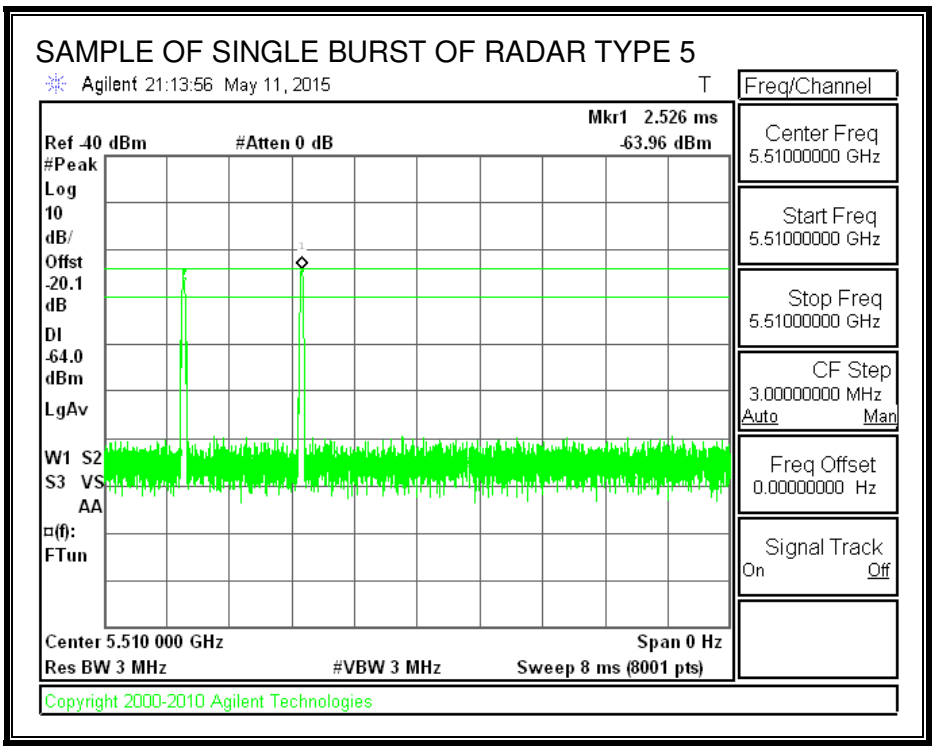
SAMPLE OF RADAR TYPE 1

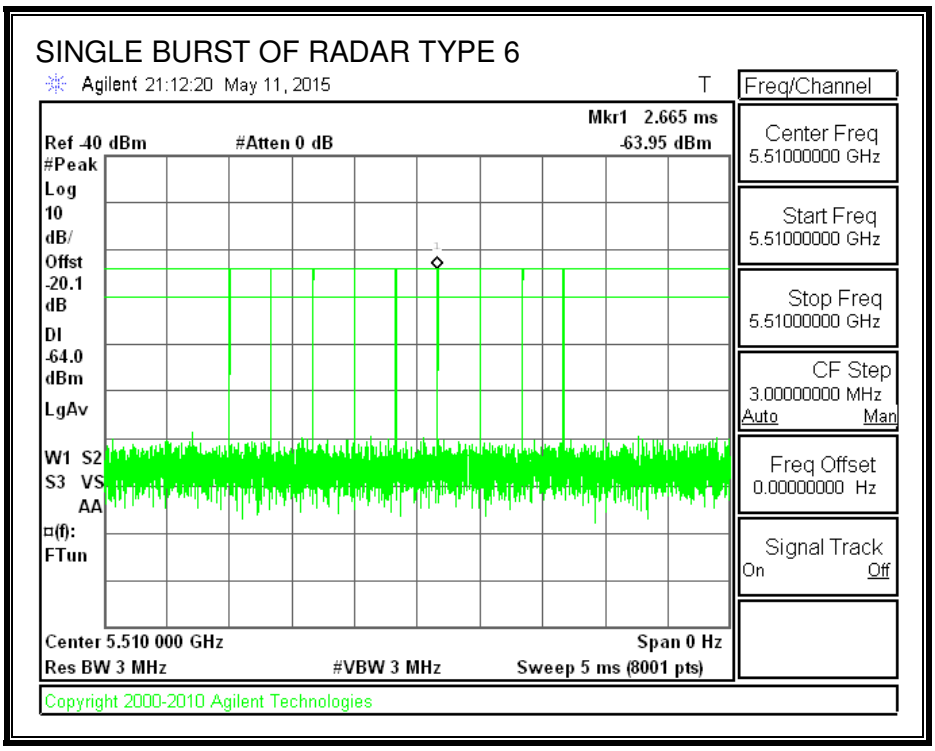




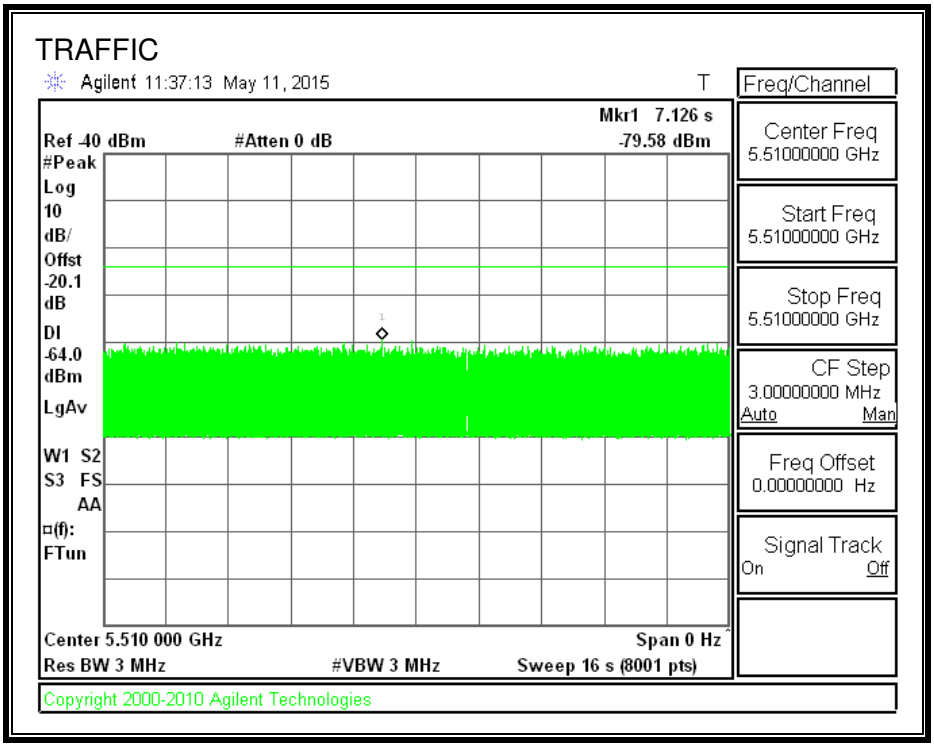




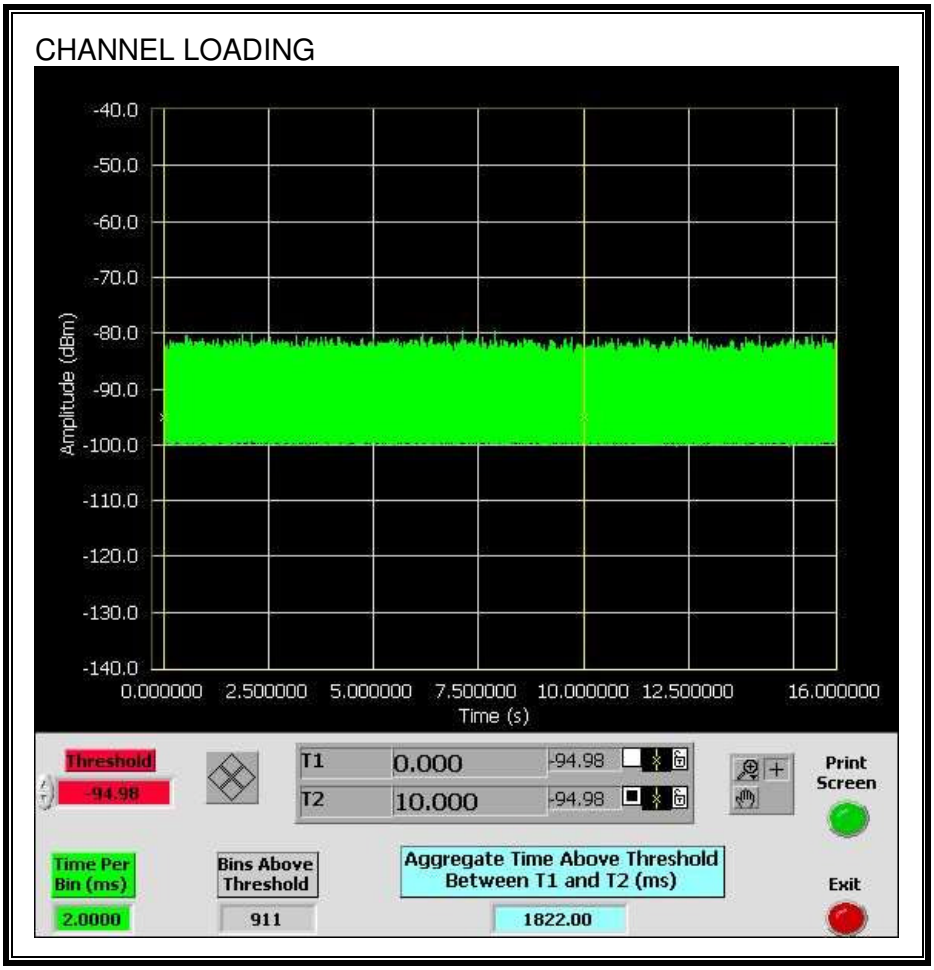




TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 18.22%

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)
30.34	173.9	143.6	83.6

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)
29.7	113.5	83.8	0.2

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)
30.26	172.1	141.8	58.3

QUALITATIVE RESULTS

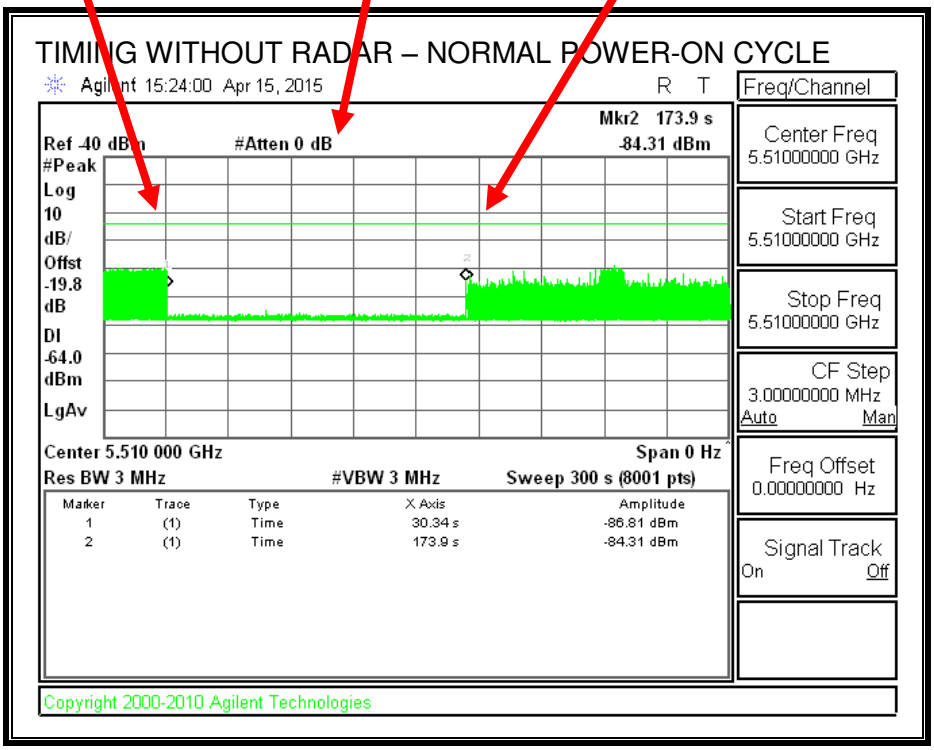
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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



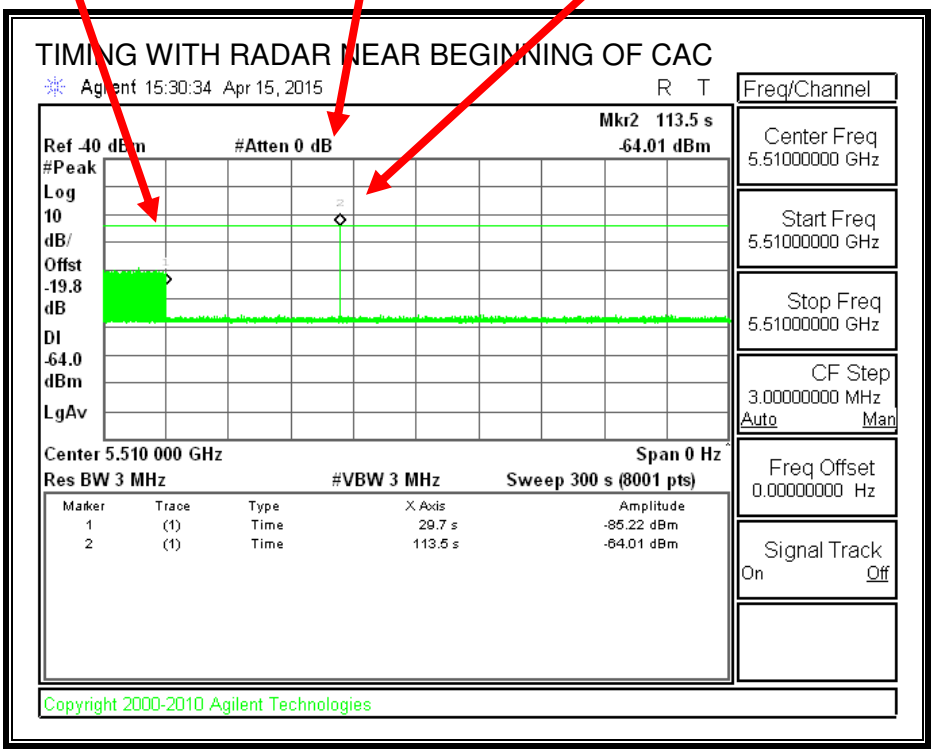
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

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



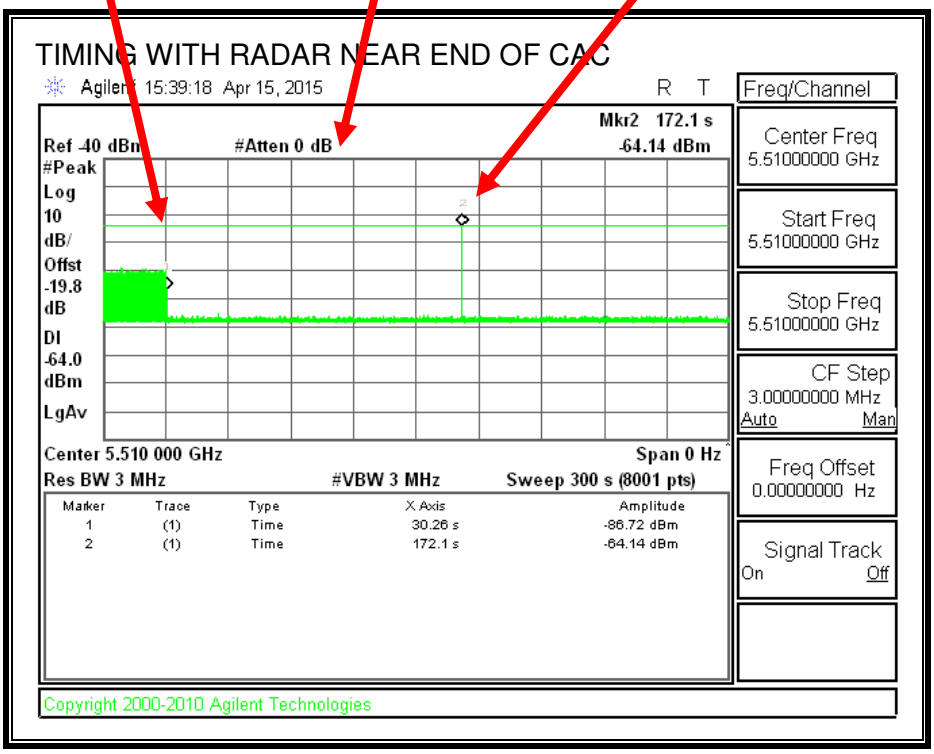
No EUT transmissions were observed after the radar signal.

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.

5.3.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

5.3.5. MOVE AND CLOSING TIME

REPORTING NOTES

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

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

The aggregate channel closing transmission time is calculated as follows:

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

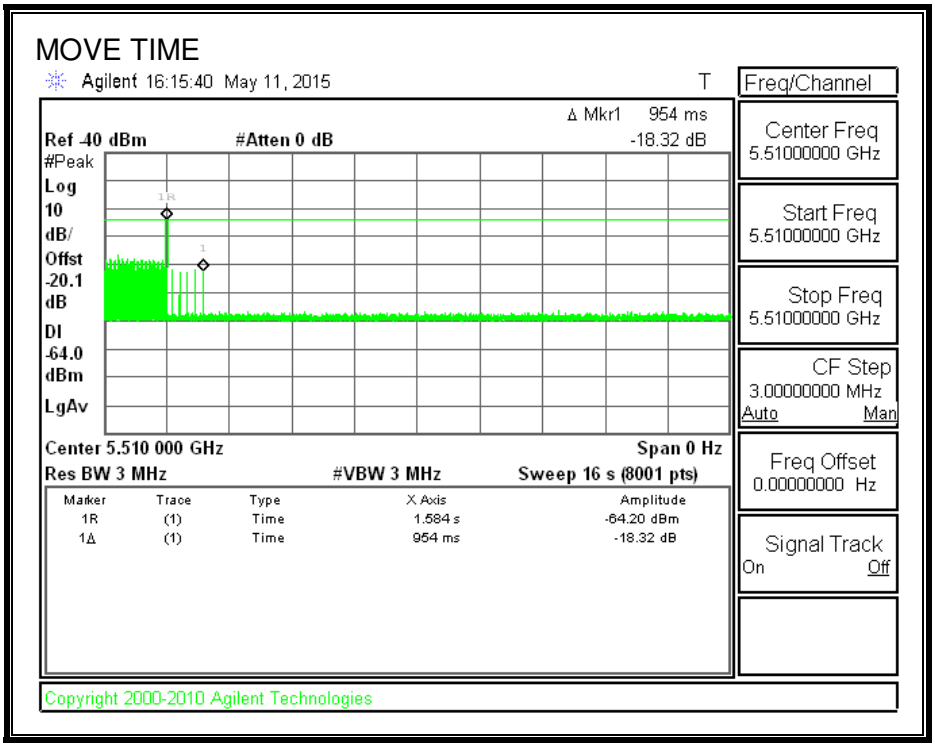
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

RESULTS

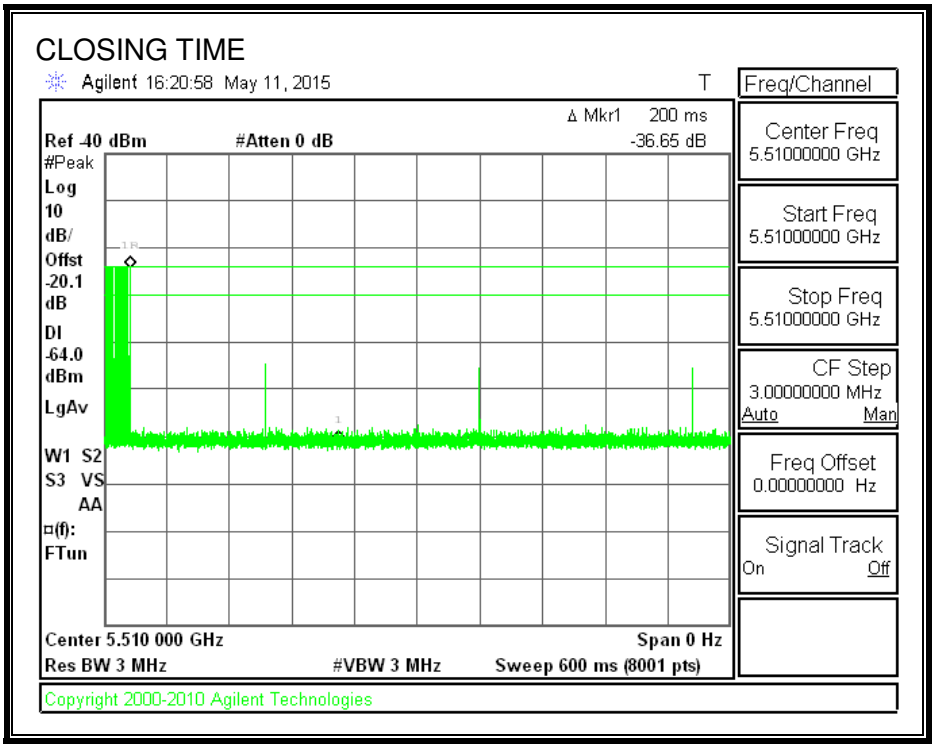
Channel Move Time (sec)	Limit (sec)
0.954	10

Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
8.0	60

MOVE TIME

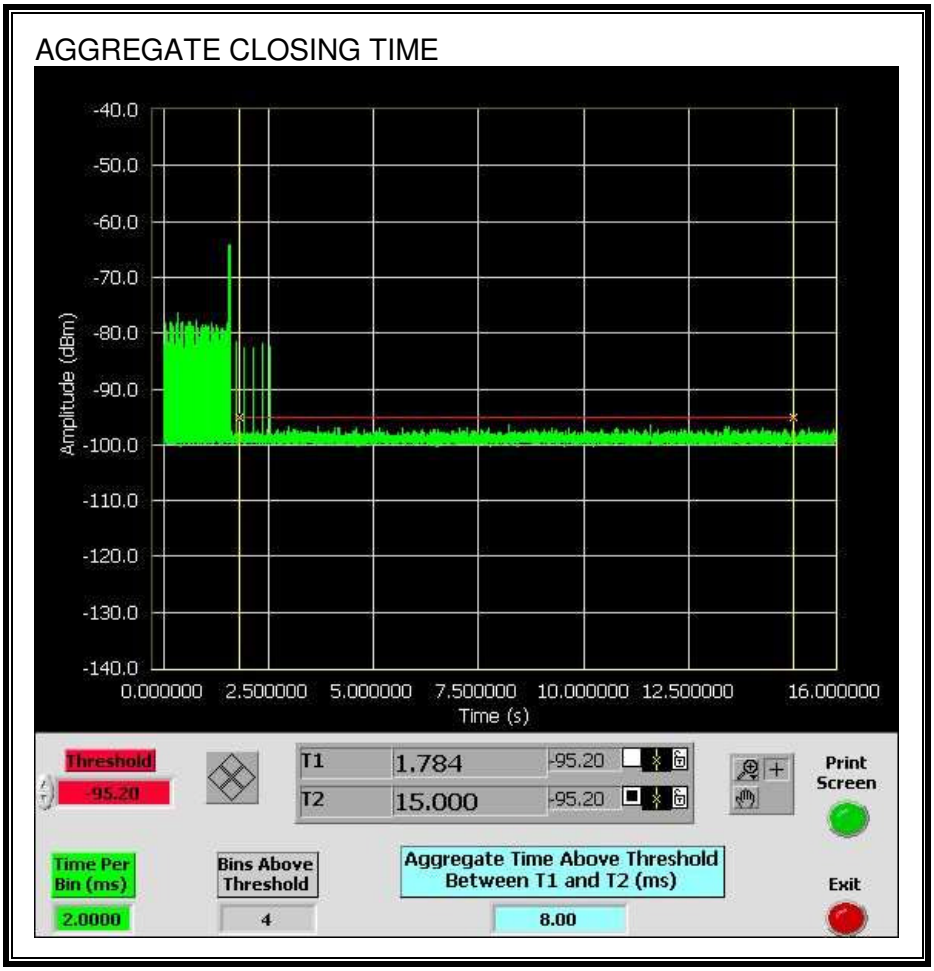


CHANNEL CLOSING TIME



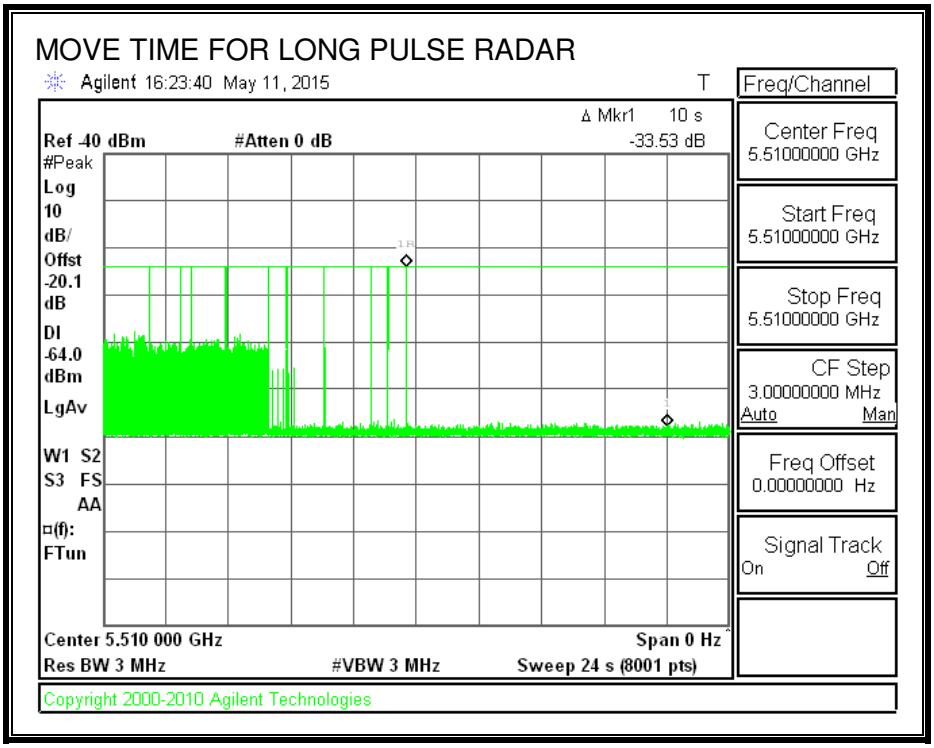
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

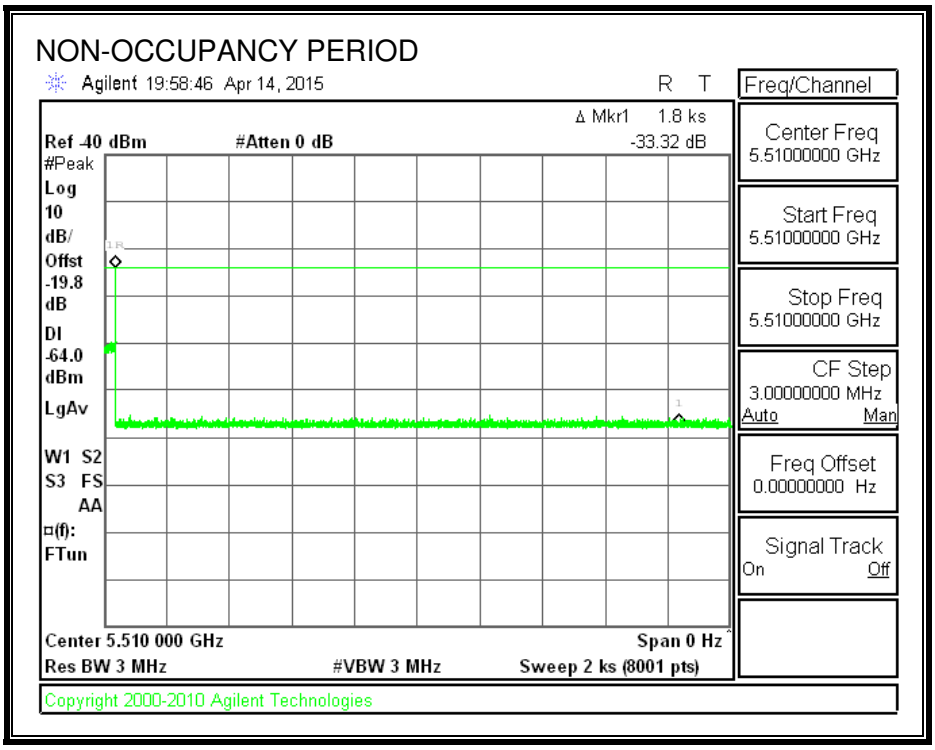
The traffic ceases prior to 10 seconds after the end of the radar waveform.



5.3.6. NON-OCCUPANCY PERIOD

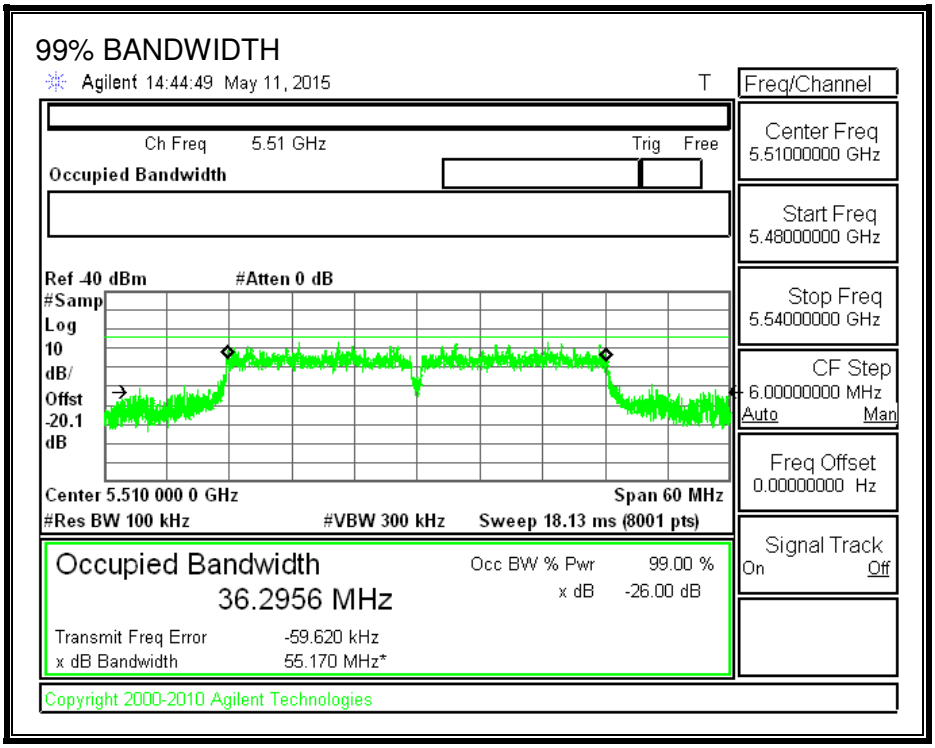
RESULTS

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



5.3.7. DETECTION BANDWIDTH

REFERENCE PLOT OF 99% POWER BANDWIDTH



RESULTS

FL (MHz)	FH (MHz)	Detection Bandwidth (MHz)	99% Power Bandwidth (MHz)	Ratio of Detection BW to 99% Power BW (%)	Minimum Limit (%)
5491	5529	38	36.296	104.7	100

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
5491	10	10	100	FL
5492	10	10	100	
5493	10	10	100	
5494	10	10	100	
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	
5526	10	10	100	
5527	10	10	100	
5528	10	10	100	
5529	10	10	100	FH

5.3.8. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary				
Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail
FCC Short Pulse Type 1	30	100.00	60	Pass
FCC Short Pulse Type 2	30	100.00	60	Pass
FCC Short Pulse Type 3	30	96.67	60	Pass
FCC Short Pulse Type 4	30	96.67	60	Pass
Aggregate		98.33	80	Pass
FCC Long Pulse Type 5	30	100.00	80	Pass
FCC Long Pulse Type 5 (Lower Detection BW Edge)	30	83.33	80	Pass
FCC Long Pulse Type 5 (Upper Detection BW Edge)	30	100.00	80	Pass
FCC Hopping Type 6	39	100.00	70	Pass

TYPE 1 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 1				
1 us Pulse Width				
Waveform	PRI (us)	Pulses Per Burst	Test (A/B)	Successful Detection (Yes/No)
1001	3066	18	A	Yes
1002	678	78	A	Yes
1003	538	99	A	Yes
1004	698	76	A	Yes
1005	798	67	A	Yes
1006	598	89	A	Yes
1007	578	92	A	Yes
1008	858	62	A	Yes
1009	618	86	A	Yes
1010	558	95	A	Yes
1011	758	70	A	Yes
1012	518	102	A	Yes
1013	778	68	A	Yes
1014	718	74	A	Yes
1015	878	61	A	Yes
1016	898	59	B	Yes
1017	1224	44	B	Yes
1018	2886	19	B	Yes
1019	2802	19	B	Yes
1020	652	81	B	Yes
1021	2206	24	B	Yes
1022	1712	31	B	Yes
1023	1205	44	B	Yes
1024	1210	44	B	Yes
1025	1658	32	B	Yes
1026	784	68	B	Yes
1027	1407	38	B	Yes
1028	2642	20	B	Yes
1029	969	55	B	Yes
1030	2508	22	B	Yes

TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2				
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Successful Detection (Yes/No)
2001	1.6	211.00	27	Yes
2002	4.7	154.00	26	Yes
2003	1	163.00	27	Yes
2004	4	225.00	28	Yes
2005	2.3	155.00	28	Yes
2006	3	193.00	25	Yes
2007	3.5	222.00	25	Yes
2008	2.9	160.00	29	Yes
2009	4.7	230.00	29	Yes
2010	2.5	207.00	29	Yes
2011	1.7	227.00	29	Yes
2012	2.3	218.00	24	Yes
2013	1.9	200.00	27	Yes
2014	1.3	196.00	23	Yes
2015	4.9	151.00	26	Yes
2016	2	205.00	27	Yes
2017	3.7	176.00	29	Yes
2018	2.8	184.00	28	Yes
2019	2	155.00	29	Yes
2020	1.6	156.00	27	Yes
2021	2	214.00	28	Yes
2022	2.8	228.00	27	Yes
2023	1.4	164.00	29	Yes
2024	3.8	157.00	25	Yes
2025	5	222.00	27	Yes
2026	3.3	164.00	26	Yes
2027	4.4	201.00	27	Yes
2028	2.5	151.00	28	Yes
2029	4.2	186.00	23	Yes
2030	1.7	230.00	23	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3				
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Successful Detection (Yes/No)
3001	7.3	369.00	16	Yes
3002	7.1	444.00	16	Yes
3003	5.5	329.00	18	Yes
3004	7.1	259.00	16	Yes
3005	9.5	272.00	17	Yes
3006	9.4	495.00	17	Yes
3007	7.5	317.00	18	Yes
3008	9.8	439.00	16	Yes
3009	9.5	350.00	16	Yes
3010	5.9	491.00	16	Yes
3011	6.4	406.00	17	Yes
3012	9.1	283.00	18	Yes
3013	6.8	314.00	17	Yes
3014	6.8	377.00	18	Yes
3015	9.8	457.00	16	Yes
3016	9.1	484.00	18	Yes
3017	9.1	461.00	16	Yes
3018	10	265.00	16	Yes
3019	7.2	268.00	16	Yes
3020	8.2	305.00	16	Yes
3021	6.1	472.00	18	Yes
3022	6.5	500.00	18	No
3023	5	448.00	18	Yes
3024	8.3	334.00	18	Yes
3025	7.4	457.00	18	Yes
3026	9.9	488.00	18	Yes
3027	6.8	453.00	18	Yes
3028	9.1	333.00	18	Yes
3029	7.9	399	18	Yes
3030	6.6	303	16	Yes

TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4				
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Successful Detection (Yes/No)
4001	10.3	460.00	14	Yes
4002	15.3	403.00	14	Yes
4003	17.1	286.00	16	Yes
4004	10.6	374.00	12	Yes
4005	14.6	408.00	15	Yes
4006	11.8	340.00	13	Yes
4007	14.8	470.00	13	Yes
4008	13.5	454.00	14	Yes
4009	10.2	440.00	16	Yes
4010	12.4	327.00	15	Yes
4011	19.1	258.00	14	Yes
4012	13.8	347.00	14	Yes
4013	17.7	319.00	15	Yes
4014	15.6	472.00	15	Yes
4015	15.7	419.00	12	Yes
4016	11.3	431.00	12	Yes
4017	16.3	480.00	14	Yes
4018	19.6	422.00	12	Yes
4019	12.7	330.00	13	Yes
4020	13.2	446.00	14	Yes
4021	12.3	276.00	15	Yes
4022	15.6	467.00	15	Yes
4023	18.9	495.00	13	Yes
4024	19.3	407.00	15	No
4025	10.8	341.00	14	Yes
4026	10.6	251.00	13	Yes
4027	10.4	463.00	12	Yes
4028	13.4	402.00	12	Yes
4029	16.3	376.00	12	Yes
4030	16.6	384.00	14	Yes

TYPE 5 DETECTION PROBABILITY AT THE CHANNEL CENTER FREQUENCY

Data Sheet for FCC Long Pulse Radar Type 5	
Trial	Successful Detection (Yes/No)
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	Yes
9	Yes
10	Yes
11	Yes
12	Yes
13	Yes
14	Yes
15	Yes
16	Yes
17	Yes
18	Yes
19	Yes
20	Yes
21	Yes
22	Yes
23	Yes
24	Yes
25	Yes
26	Yes
27	Yes
28	Yes
29	Yes
30	Yes

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

TYPE 5 DETECTION PROBABILITY AT THE LOWEST EUT DETECTION BANDWIDTH FREQUENCY

Data Sheet for FCC Long Pulse Radar Type 5	
Trial	Successful Detection (Yes/No)
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	No
9	Yes
10	Yes
11	Yes
12	Yes
13	No
14	Yes
15	Yes
16	Yes
17	Yes
18	Yes
19	Yes
20	Yes
21	Yes
22	Yes
23	Yes
24	No
25	Yes
26	No
27	No
28	Yes
29	Yes
30	Yes

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

TYPE 5 DETECTION PROBABILITY AT THE HIGHEST EUT DETECTION BANDWIDTH FREQUENCY

Data Sheet for FCC Long Pulse Radar Type 5	
Trial	Successful Detection (Yes/No)
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	Yes
9	Yes
10	Yes
11	Yes
12	Yes
13	Yes
14	Yes
15	Yes
16	Yes
17	Yes
18	Yes
19	Yes
20	Yes
21	Yes
22	Yes
23	Yes
24	Yes
25	Yes
26	Yes
27	Yes
28	Yes
29	Yes
30	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	181	5491	7	Yes
2	656	5492	8	Yes
3	1131	5493	8	Yes
4	1606	5494	5	Yes
5	2081	5495	8	Yes
6	2556	5496	6	Yes
7	3031	5497	7	Yes
8	3506	5498	10	Yes
9	3981	5499	6	Yes
10	4456	5500	10	Yes
11	4931	5501	10	Yes
12	5406	5502	10	Yes
13	5881	5503	8	Yes
14	6356	5504	6	Yes
15	6831	5505	9	Yes
16	7306	5506	11	Yes
17	7781	5507	11	Yes
18	8256	5508	6	Yes
19	8731	5509	8	Yes
20	9206	5510	7	Yes
21	9681	5511	8	Yes
22	10156	5512	5	Yes
23	10631	5513	7	Yes
24	11106	5514	8	Yes
25	11581	5515	10	Yes
26	12056	5516	4	Yes
27	12531	5517	8	Yes
28	13006	5518	9	Yes
29	13481	5519	6	Yes
30	13956	5520	6	Yes
31	14431	5521	9	Yes
32	14906	5522	10	Yes
33	15381	5523	9	Yes
34	15856	5524	6	Yes
35	16331	5525	6	Yes
36	16806	5526	7	Yes
37	17281	5527	5	Yes
38	17756	5528	8	Yes
39	18231	5529	8	Yes