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

CERTIFICATION TEST REPORT

FOR

FIXED OUTDOOR POINT to MULTI-POINT SYSTEM

MODEL NUMBER: C058900C062A

FCC ID: Z8H89FT0015
IC: 109W-0015

REPORT NUMBER: 16N23157-E3V1

ISSUE DATE: MAY 6, 2016

Prepared for
CAMBIUM NETWORKS
3800 GOLF ROAD
ROLLING MEADOWS, IL 60008-4023, U.S.A.

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

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	05/06/16	Initial Issue	Conan Cheung

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CAMBIUM NETWORKS
3800 GOLF ROAD
ROLLING MEADOWS, IL 60008-4023, U.S.A.

EUT DESCRIPTION: FIXED OUTDOOR POINT to MULTI-POINT SYSTEM

MODEL: C058900C062A

SERIAL NUMBER: 00 04 56 F8 01 8D

DATE TESTED: MARCH 30 to APRIL 04, 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:

DOUG ANDERSON
EMC ENGINEER
UL Verification Services Inc.

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701J
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
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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%.

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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”.

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

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

Table 2: Applicability of DFS requirements during normal operation

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

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

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

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

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

Table 4: DFS Response requirement values

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

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

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Table 5 – Short Pulse Radar Test Waveforms

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

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

Table 6 – Long Pulse Radar Test Signal

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

Table 7 – Frequency Hopping Radar Test Signal

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

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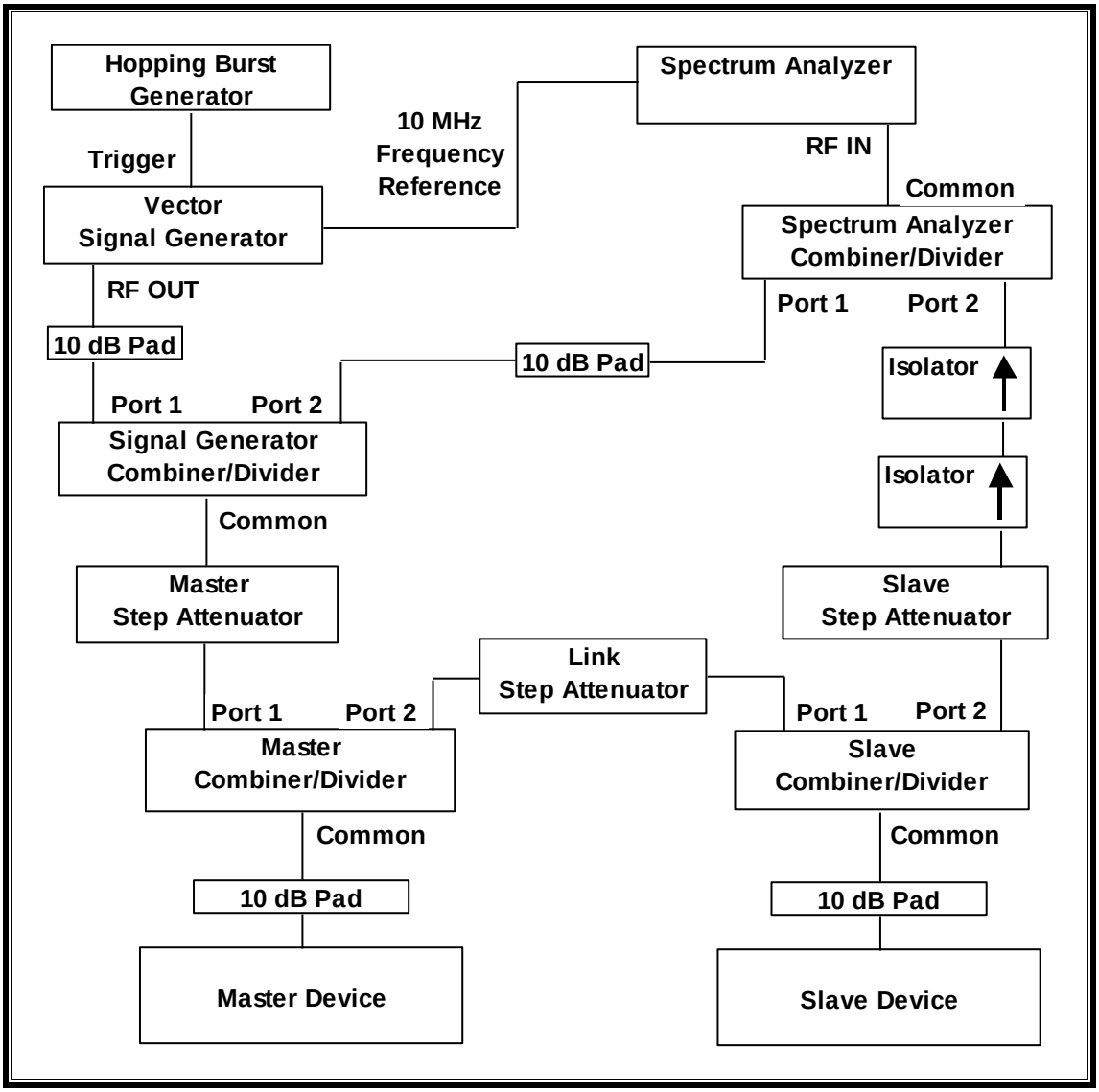
5.1.2. TEST AND MEASUREMENT SYSTEM

CONDUCTED METHOD SYSTEM BLOCK DIAGRAM



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SYSTEM OVERVIEW

The short pulse and long pulse signal generating system utilizes the NTIA software. The Vector Signal Generator has been validated by the NTIA. The hopping signal generating system utilizes the CCS simulated hopping method and system, which has been validated by the DoD, FCC and NTIA. The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution.

The short pulse types 1, 2, 3 and 4, and the long pulse type 5 parameters are randomized at run-time.

The hopping type 6 pulse parameters are fixed while the hopping sequence is based on the August 2005 NTIA Hopping Frequency List. The initial starting point randomized at run-time and each subsequent starting point is incremented by 475. Each frequency in the 100-length segment is compared to the boundaries of the EUT Detection Bandwidth and the software creates a hopping burst pattern in accordance with Section 7.4.1.3 Method #2 Simulated Frequency Hopping Radar Waveform Generating Subsystem of KDB 905462 D02. The frequency of the signal generator is incremented in 1 MHz steps from F_L to F_H for each successive trial. This incremental sequence is repeated as required to generate a minimum of 30 total trials and to maintain a uniform frequency distribution over the entire Detection Bandwidth.

The signal monitoring equipment consists of a spectrum analyzer. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), additional combiner/dividers are inserted between the Master Combiner/Divider and the pad connected to the Master Device (and/or between the Slave Combiner/Divider and the pad connected to the Slave Device). Additional pads are utilized such that there is one pad at each RF port on each EUT.

SYSTEM CALIBRATION

A 50-ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected in place of the master device. 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 Link Step Attenuator 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 WLAN traffic level, as displayed on the spectrum analyzer, is confirmed to be at lower amplitude than the radar detection threshold and is confirmed to be the Radar Detection Device rather than the associated device. If a different setting of the Master Step Attenuator is required to meet the above conditions, a new System Calibration is performed for the new Master Step Attenuator setting.

TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	US51350187	06/01/16
Signal Generator, MXG X-Series RF Vector	Agilent	N5172B	MY51350337	03/11/17
Arbitrary Waveform Generator	Agilent / HP	33220A	MY44037572	04/08/16

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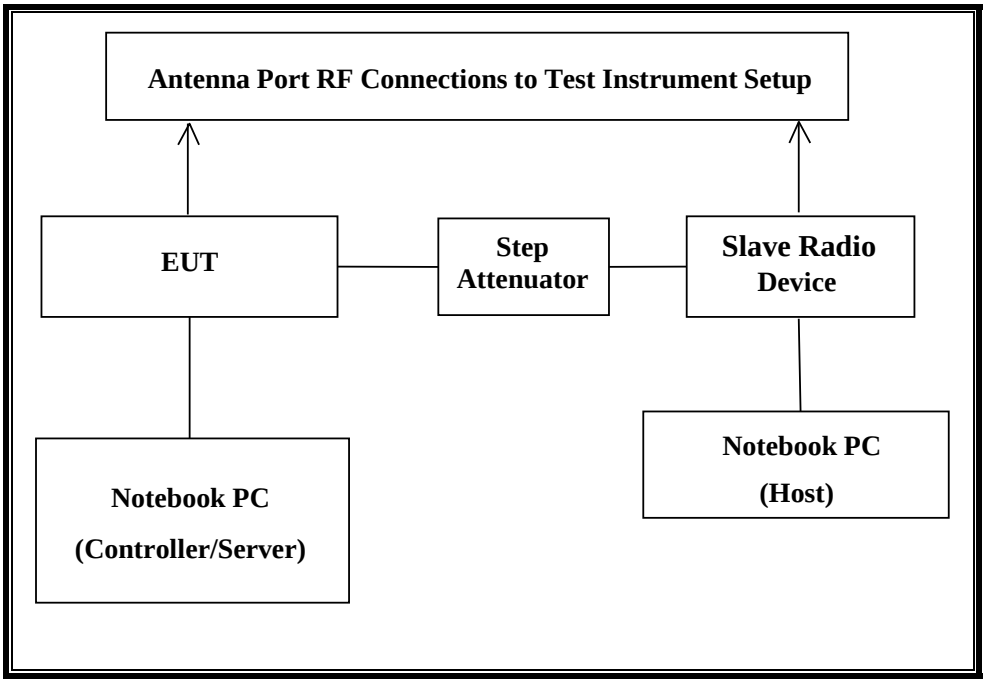
5.1.3. SETUP OF EUT

CONDUCTED 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**
P.O.E.Injector (EUT)	Phihong	PSA15M-300 (SM)	No Serial Number	DoC
Outdoor Point to Multi-Point System (Slave Device)	Cambium Networks	C058900C062A	04 04 56 F8 02 1F	Z8H89FT0015
P.O.E.Injector (Slave)	Phihong	PSA15M-300 (AP)	No Serial Number	DoC
Notebook PC (Controller/Server)	Motorola	HK1322	3433JC0021	DoC
AC Adapter (Controller/Server PC)	Motorola	AD-C019M-M	A050300091	DoC
Notebook PC (Host)	Motorola	ML900	3433FQ0285	DoC
AC Adapter (Hostt PC)	Hipro	HP-OW120F13	F3-070900274301	DoC

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5.1.4. DESCRIPTION OF EUT

For FCC the EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges.

For IC the EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges, excluding the 5600-5650 MHz range.

The EUT can be configured as a Master Device or a Slave Device without Radar Detection.

The highest power level within these bands is 30 dBm EIRP in the 5250-5350 MHz band and 30 dBm EIRP in the 5470-5725 MHz band.

The highest gain antenna assembly utilized with the EUT has a gain of 24 dBi in the 5250-5350 MHz band and 24 dBi in the 5470-5725 MHz band. The lowest gain antenna assembly utilized with the EUT has a gain of 2.2 dBi in the 5250-5350 MHz band and 2.2 dBi in the 5470-5725 MHz band.

Two identical orthogonally oriented antennas are utilized to meet the diversity and MIMO operational requirements.

The EUT was tested with a manufacturer declared gain of 24 dBi at a channel bandwidth of 10 MHz and 0 dBi at a channel bandwidth of 40 MHz.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is –64 dBm.

At a channel bandwidth of 10 MHz, after correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is –64 + 0 + 1 = -63 dBm.

At a channel bandwidth of 40 MHz, after correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is –64 + 24 + 1 = -39 dBm.

The calibrated conducted DFS Detection Threshold level is set to –63 dBm.

The EUT uses two transmitter/receiver chains, each connected to a 50-ohm coaxial antenna port. All antenna ports are connected to the test system via a power divider to perform conducted tests.

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

WLAN traffic is generated by streaming the video file TestFile.mp2 “6 ½ Magic Hours” from the Master to the Slave in full motion video mode using the media player with the V2.61 Codec package.

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

The EUT utilizes a proprietary wireless architecture. Two nominal channel bandwidths of 10 MHz and 40 MHz are implemented.

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The software installed in the access point is revision 2.6.1-RC10.

UNIFORM CHANNEL SPREADING

This function is not required per KDB 905462.

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5.1. RESULTS FOR 10 MHz BANDWIDTH

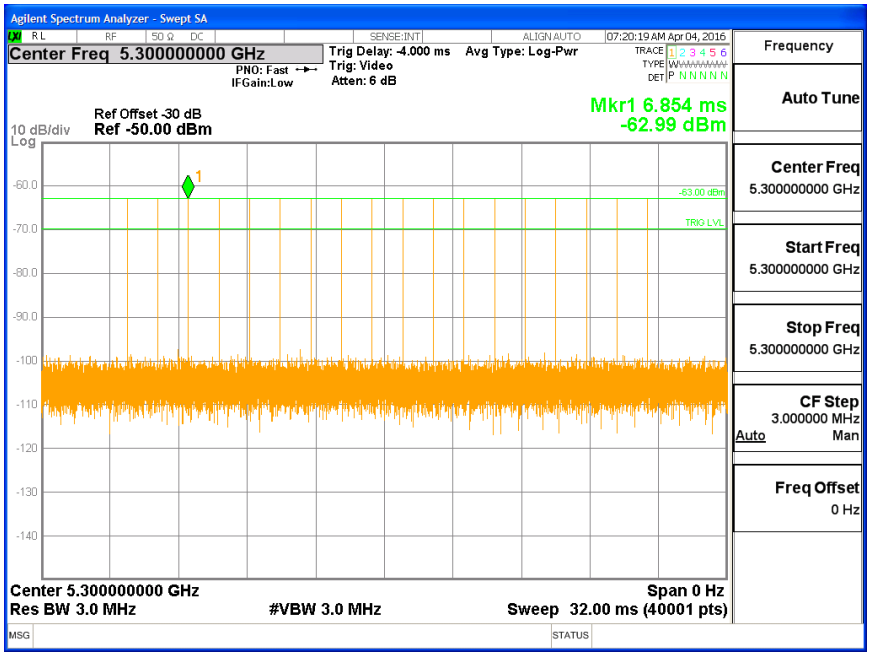
5.1.1. TEST CHANNEL

All tests were performed at a channel center frequency of 5300 MHz.

5.1.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

SHORT PULSE RADAR TYPE 0



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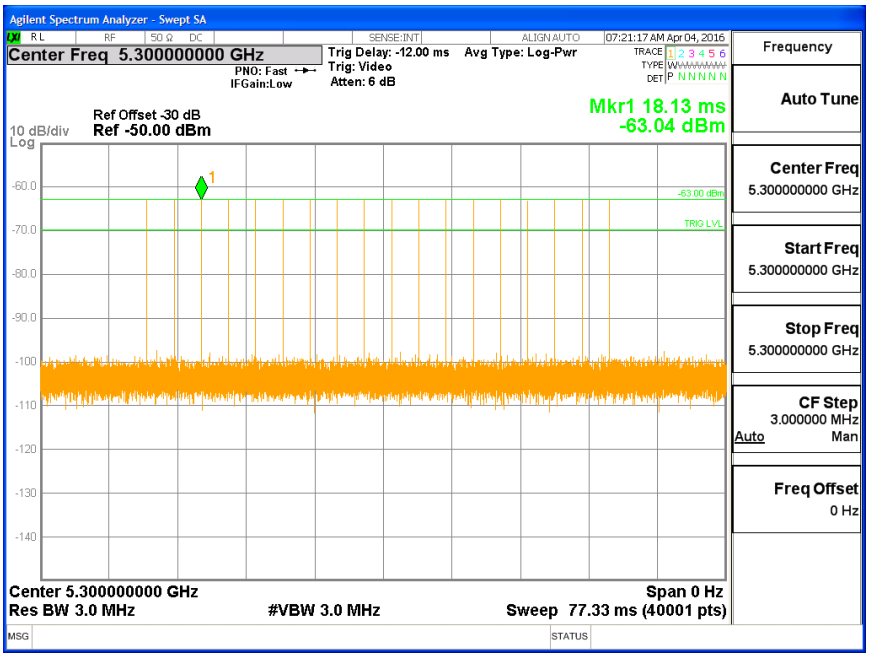
SAMPLE OF RADAR TYPE 1



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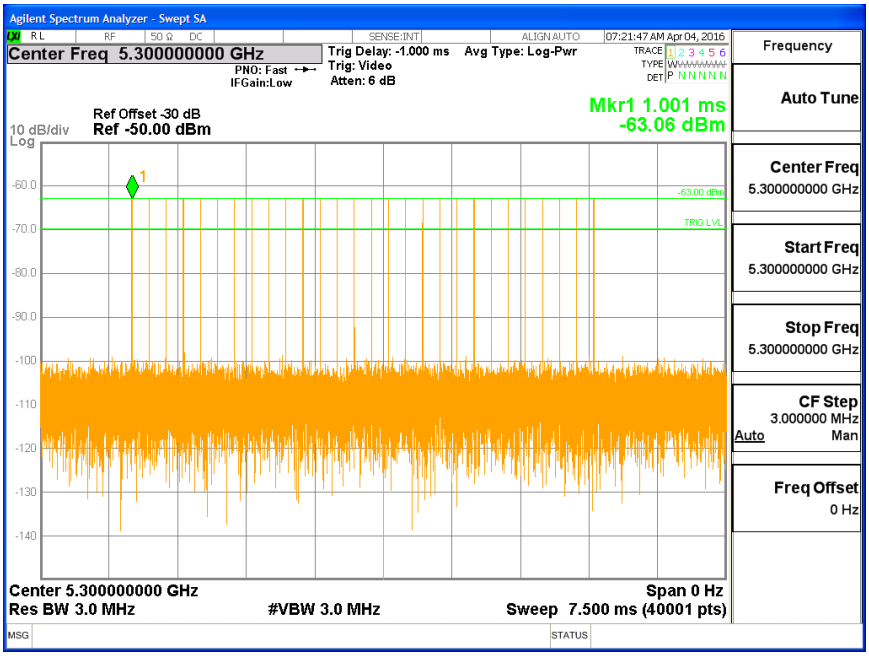
SAMPLE OF RADAR TYPE 2



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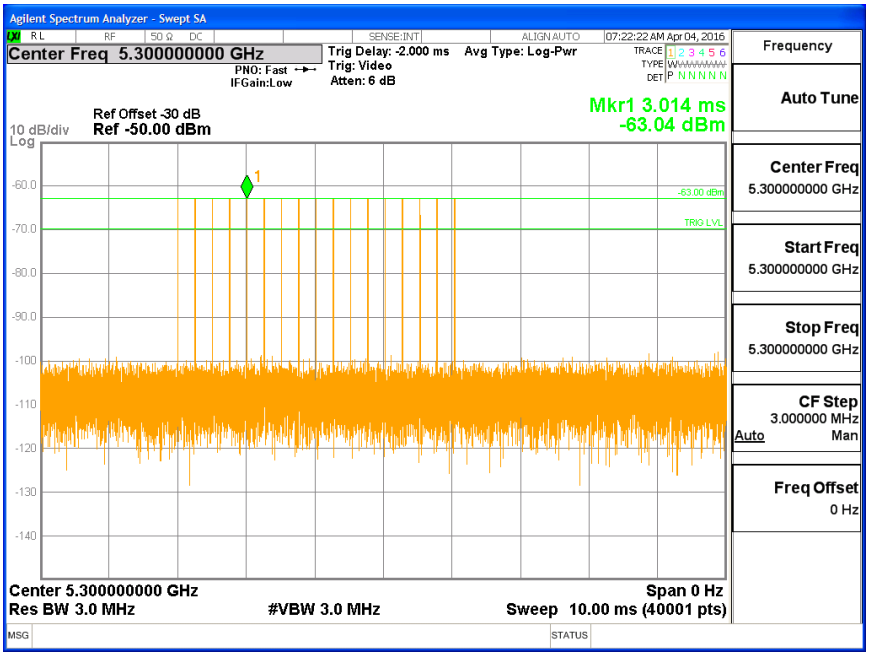
SAMPLE OF RADAR TYPE 3



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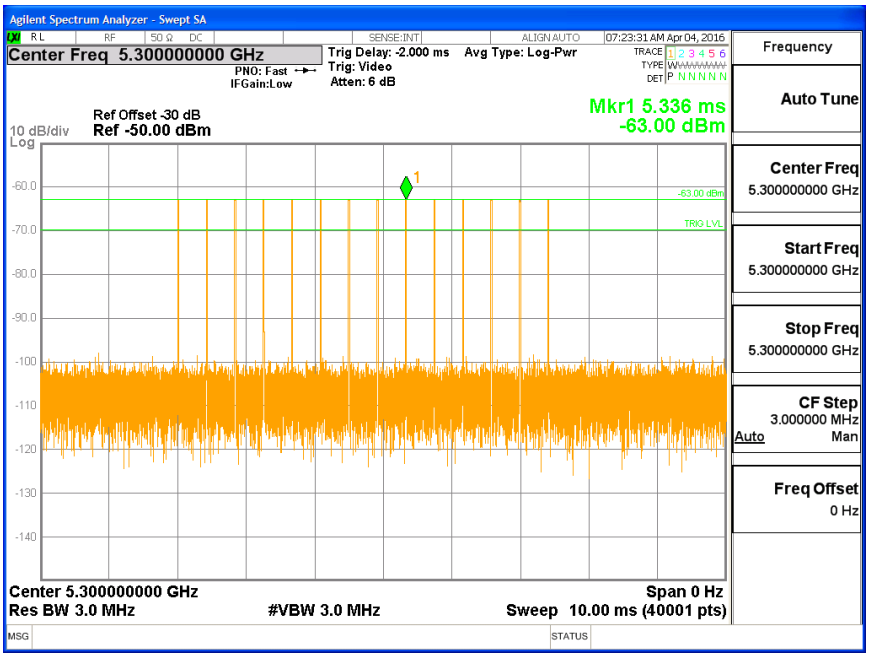
SAMPLE OF RADAR TYPE 4



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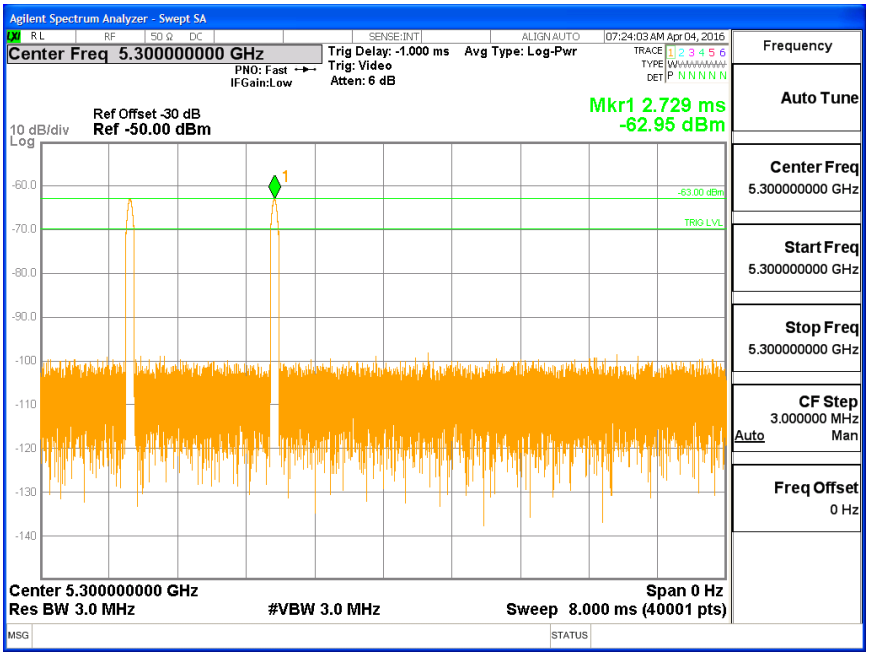
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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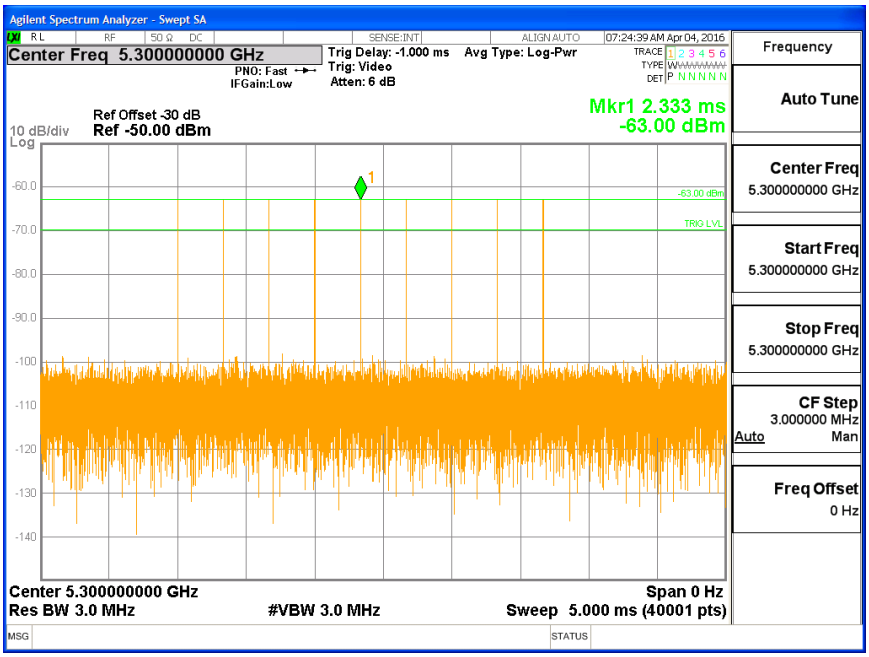
SINGLE BURST OF RADAR TYPE 6



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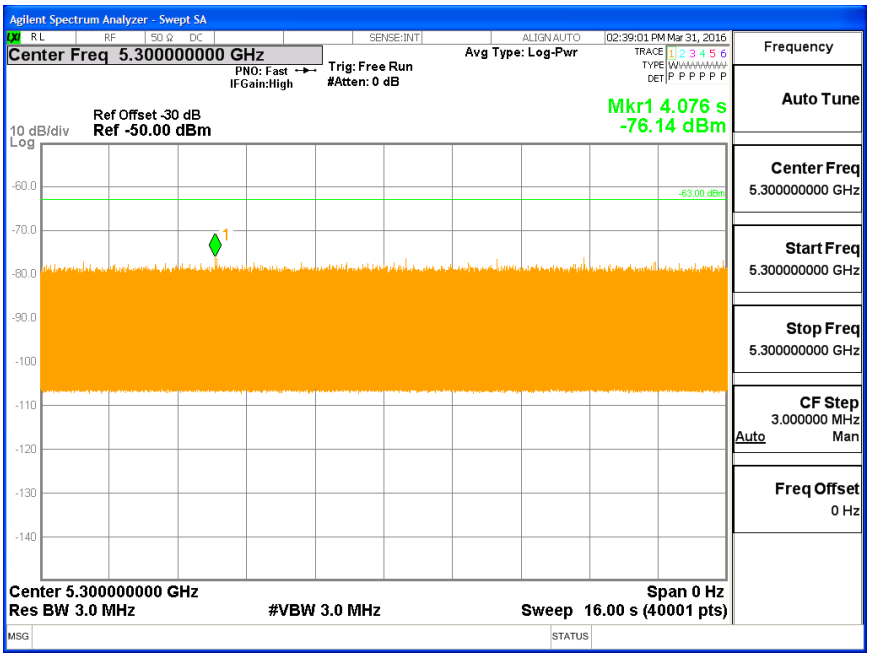
TRAFFIC

TRAFFIC



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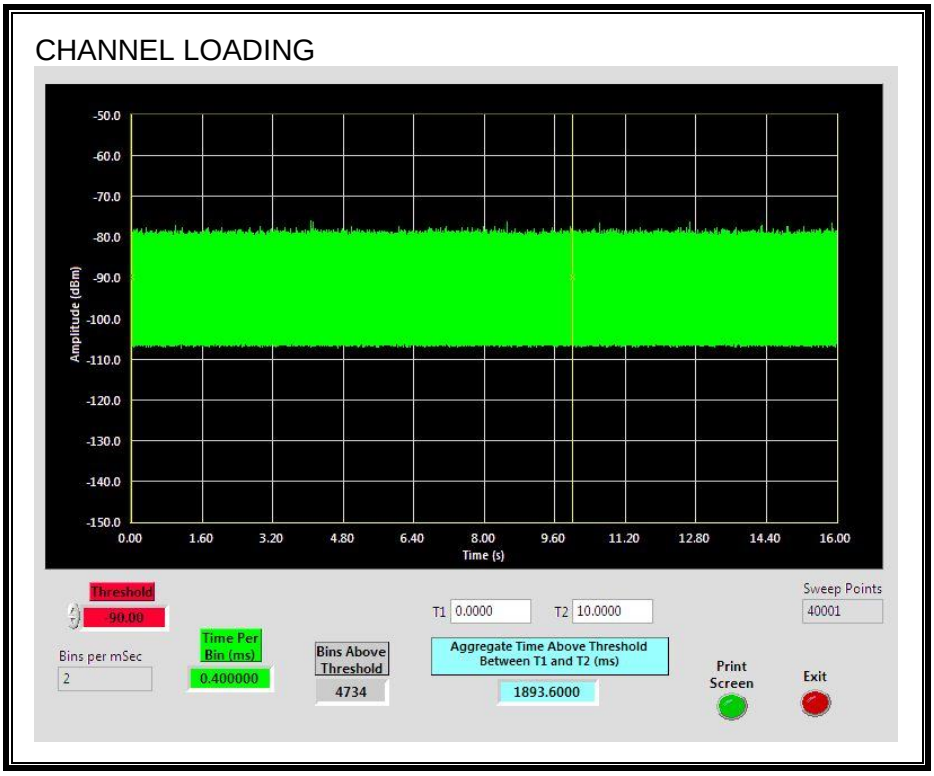
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 23.99%

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5.1.1. CHANNEL AVAILABILITY CHECK TIME

This test is not required for this channel bandwidth per table two, page five of KDB 905462, therefore it has not been performed.

5.1.1. OVERLAPPING CHANNEL TESTS

RESULTS

The EUT has only three channels enabled at any one time. The channels are intentionally selected so that they can't overlap. Therefore the EUT does not have an overlapping channel plan.

5.1.2. MOVE AND CLOSING TIME

This test is not required for this channel bandwidth per table two, page five of KDB 905462, therefore it has not been performed.

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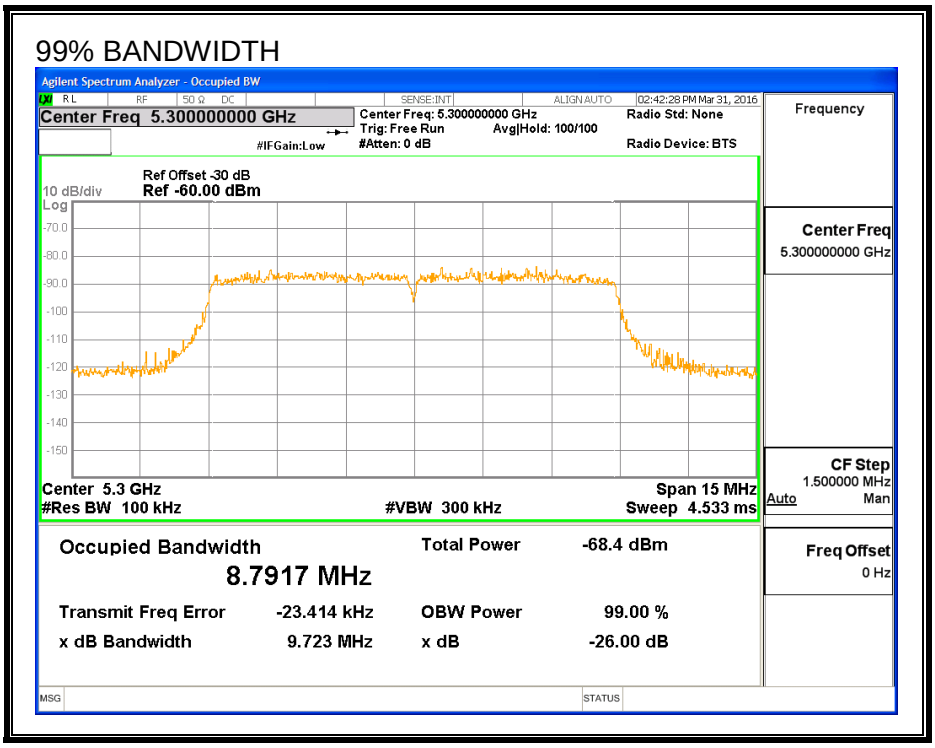
5.1.3. DETECTION BANDWIDTH

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 (%)
5295	5305	10	8.7917	113.7	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results				
FCC Type 0 Waveform: 1 us Pulse Width, 1428 us PRI, 18 Pulses per Burst				
Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5295	10	9	90	FL
5300	10	10	100	
5301	10	10	100	
5302	10	10	100	
5303	10	10	100	
5304	10	10	100	
5305	10	10	100	FH

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5.1.4. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth		80% of Det BW	
					FL	FH	FL5	FH5
FCC Short Pulse Type 1	30	90.00	60	Pass	5295	5305		
FCC Short Pulse Type 2	30	60.00	60	Pass	5295	5305		
FCC Short Pulse Type 3	30	90.00	60	Pass	5295	5305		
FCC Short Pulse Type 4	30	93.33	60	Pass	5295	5305		
Aggregate		83.33	80	Pass				
FCC Long Pulse Type 5	30	83.33	80	Pass	5295	5305	5296	5304
FCC Hopping Type 6	33	90.91	70	Pass	5295	5305		

Note: Random radar frequencies with at least one trial at the channel center frequency were tested for FCC Types 1-4 at client request.

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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	5296	Yes
1002	1	838	63	A	5305	No
1003	1	778	68	A	5299	Yes
1004	1	898	59	A	5300	Yes
1005	1	858	62	A	5300	Yes
1006	1	578	92	A	5304	Yes
1007	1	558	95	A	5297	Yes
1008	1	518	102	A	5302	Yes
1009	1	538	99	A	5300	Yes
1010	1	798	67	A	5300	Yes
1011	1	878	61	A	5305	Yes
1012	1	698	76	A	5301	Yes
1013	1	638	83	A	5303	Yes
1014	1	918	58	A	5303	Yes
1015	1	598	89	A	5296	Yes
1016	1	956	56	B	5302	Yes
1017	1	717	74	B	5300	Yes
1018	1	2156	25	B	5300	Yes
1019	1	2047	26	B	5295	No
1020	1	2262	24	B	5296	Yes
1021	1	1088	49	B	5298	Yes
1022	1	2786	19	B	5301	Yes
1023	1	1741	31	B	5298	Yes
1024	1	2374	23	B	5304	Yes
1025	1	1459	37	B	5296	Yes
1026	1	2221	24	B	5297	Yes
1027	1	1435	37	B	5296	Yes
1028	1	1132	47	B	5300	Yes
1029	1	1829	29	B	5305	No
1030	1	2850	19	B	5298	Yes

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TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
2001	1.4	187	28	5302	No
2002	3.7	230	29	5304	No
2003	4.6	224	29	5295	Yes
2004	3	152	27	5297	Yes
2005	2.1	150	24	5299	Yes
2006	2.9	163	23	5305	No
2007	4.2	208	23	5305	Yes
2008	3.2	225	26	5296	Yes
2009	2.8	155	23	5303	No
2010	4	177	27	5296	Yes
2011	1.9	192	24	5303	No
2012	1.3	179	25	5303	No
2013	3.5	199	26	5304	No
2014	3.2	190	23	5302	No
2015	1.5	176	29	5298	Yes
2016	3.5	172	27	5303	Yes
2017	4.2	161	25	5305	No
2018	2.4	204	27	5300	Yes
2019	3.3	160	23	5304	Yes
2020	1.7	207	25	5298	No
2021	4.9	167	28	5302	Yes
2022	1.6	218	28	5298	Yes
2023	1	182	24	5304	Yes
2024	1.9	199	24	5297	Yes
2025	1.5	211	28	5302	No
2026	4.9	151	24	5302	No
2027	4.7	166	26	5298	Yes
2028	4.1	154	29	5297	Yes
2029	2.2	173	24	5303	Yes
2030	1.9	165	28	5301	Yes

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TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	6.7	252	17	5302	Yes
3002	6.6	490	16	5297	Yes
3003	7.4	458	16	5304	Yes
3004	5.1	340	18	5304	Yes
3005	6.2	454	18	5303	Yes
3006	6.9	348	16	5303	No
3007	8.3	475	17	5302	Yes
3008	9.2	383	17	5299	Yes
3009	8.4	271	18	5296	Yes
3010	9.7	458	18	5300	Yes
3011	9.1	359	17	5300	Yes
3012	8.2	426	18	5305	Yes
3013	8	473	16	5304	Yes
3014	7.3	434	18	5295	Yes
3015	10	494	18	5301	Yes
3016	9.6	468	17	5302	Yes
3017	5.1	424	16	5300	No
3018	5	293	17	5304	Yes
3019	5.8	261	18	5302	Yes
3020	8.6	260	17	5299	No
3021	9.7	374	17	5299	Yes
3022	5.3	269	18	5299	Yes
3023	6.7	396	16	5301	Yes
3024	7.6	303	16	5303	Yes
3025	6.8	325	17	5305	Yes
3026	8.1	379	17	5297	Yes
3027	7.5	280	16	5297	Yes
3028	6.6	479	17	5298	Yes
3029	6.3	393	18	5299	Yes
3030	5.7	355	17	5305	Yes

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TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
4001	16.8	415	14	5295	Yes
4002	11.3	271	12	5297	Yes
4003	17.1	344	16	5297	Yes
4004	12.1	464	12	5300	Yes
4005	18.5	432	12	5299	Yes
4006	14	314	13	5302	Yes
4007	16.2	295	12	5299	Yes
4008	17.6	441	16	5296	Yes
4009	10.1	316	16	5299	Yes
4010	12	357	15	5301	Yes
4011	10.5	497	13	5301	Yes
4012	12.9	299	13	5298	Yes
4013	11.9	451	13	5303	Yes
4014	10	400	13	5304	Yes
4015	19.6	314	14	5302	Yes
4016	18.3	275	12	5299	Yes
4017	13.6	469	13	5302	Yes
4018	18.2	443	13	5304	Yes
4019	13.9	265	15	5297	Yes
4020	19	385	16	5299	Yes
4021	15.3	353	15	5299	Yes
4022	10.8	486	16	5298	Yes
4023	18.3	466	16	5304	Yes
4024	14.4	361	15	5296	Yes
4025	17	488	14	5296	Yes
4026	18.9	278	14	5300	No
4027	17.4	417	16	5297	Yes
4028	19.8	471	16	5299	Yes
4029	18.8	372	12	5297	Yes
4030	17	321	12	5302	No

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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	5301	Yes
2	5302	Yes
3	5299	Yes
4	5303	Yes
5	5302	Yes
6	5299	Yes
7	5302	Yes
8	5302	Yes
9	5304	Yes
10	5302	Yes
11	5301	Yes
12	5303	Yes
13	5297	Yes
14	5302	Yes
15	5302	No
16	5298	No
17	5297	No
18	5303	No
19	5299	Yes
20	5301	Yes
21	5303	Yes
22	5302	Yes
23	5302	Yes
24	5300	Yes
25	5297	Yes
26	5296	No
27	5299	Yes
28	5299	Yes
29	5297	Yes
30	5296	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	125	5295	3	Yes
2	600	5296	2	Yes
3	1550	5297	4	Yes
4	2025	5298	5	Yes
5	2975	5299	3	Yes
6	3450	5300	1	No
7	3925	5301	2	Yes
8	4400	5302	1	Yes
9	4875	5303	3	Yes
10	5350	5304	1	Yes
11	5825	5305	1	No
12	6300	5295	2	No
13	6775	5296	2	Yes
14	7250	5297	1	Yes
15	7725	5298	4	Yes
16	8675	5299	3	Yes
17	9150	5300	1	Yes
18	9625	5301	2	Yes
19	10100	5302	2	Yes
20	10575	5303	2	Yes
21	11050	5304	3	Yes
22	11525	5305	1	Yes
23	12000	5295	2	Yes
24	12475	5296	3	Yes
25	13425	5297	3	Yes
26	13900	5298	4	Yes
27	14375	5299	3	Yes
28	14850	5300	2	Yes
29	15325	5301	3	Yes
30	15800	5302	4	Yes
31	16275	5303	1	Yes
32	16750	5304	2	Yes
33	17225	5305	1	Yes

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5.2. RESULTS FOR 40 MHz BANDWIDTH

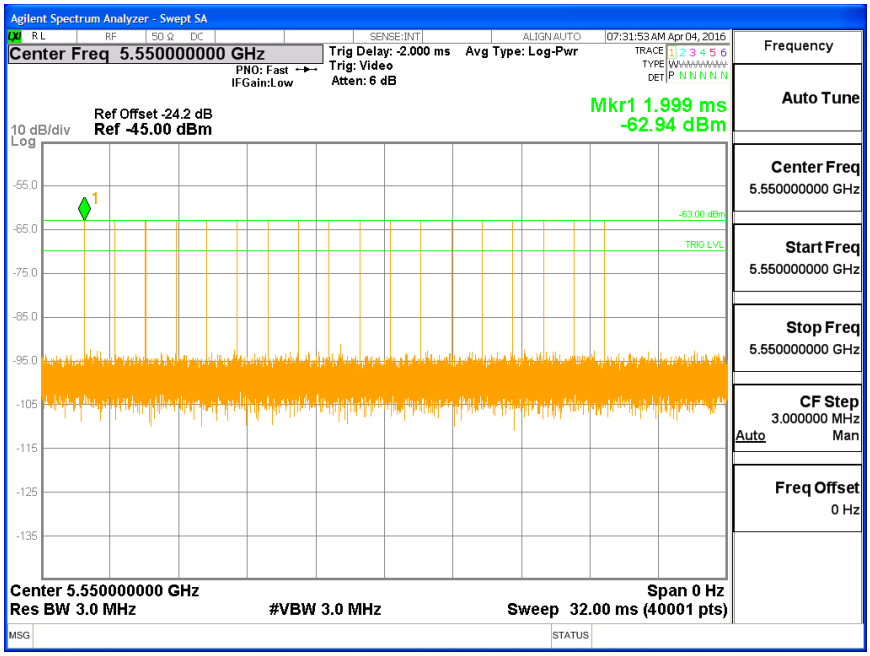
5.2.1. TEST CHANNEL

All tests were performed at a channel center frequency of 5550 MHz.

5.2.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

SHORT PULSE RADAR TYPE 0



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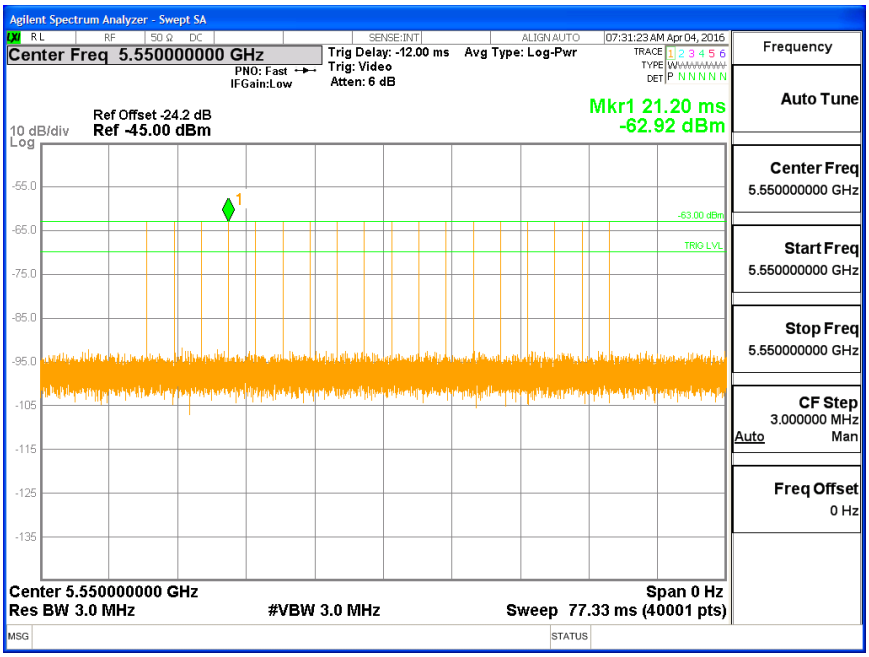
SAMPLE OF RADAR TYPE 1



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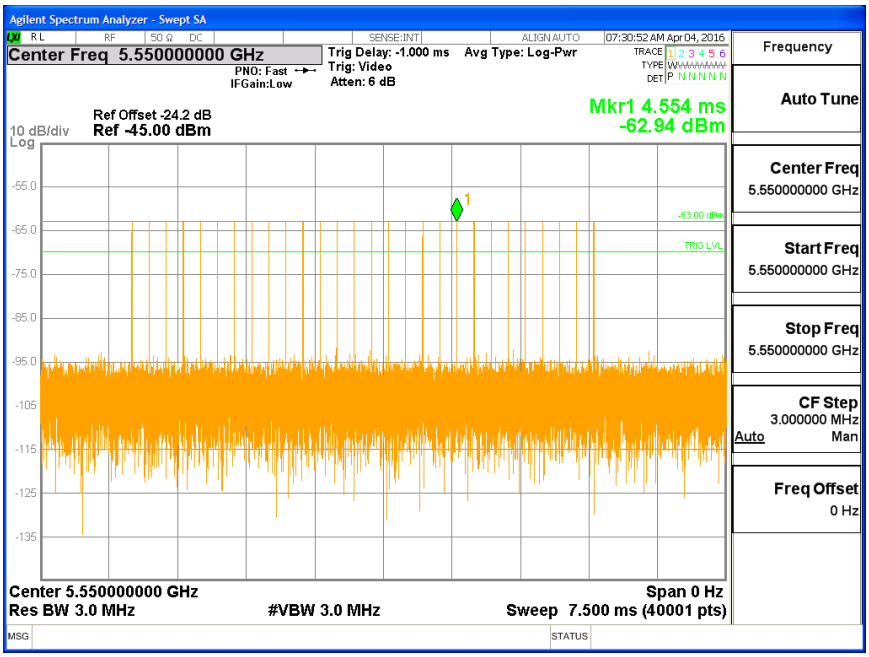
SAMPLE OF RADAR TYPE 2



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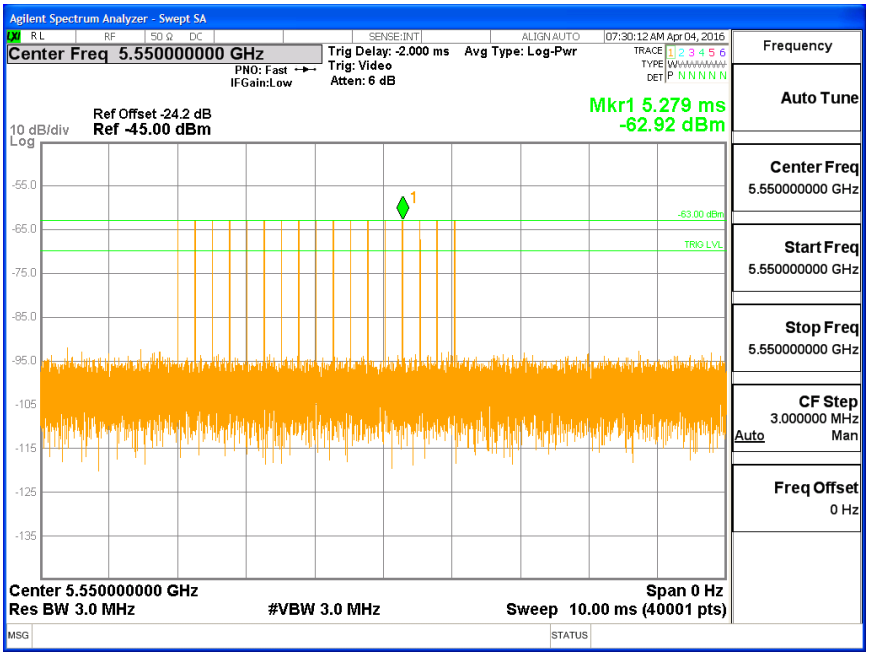
SAMPLE OF RADAR TYPE 3



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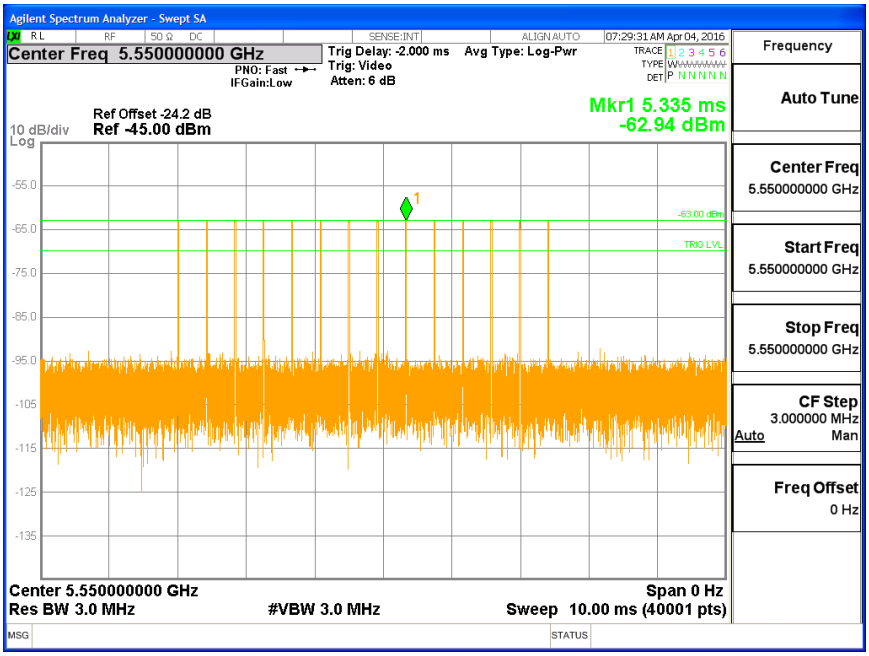
SAMPLE OF RADAR TYPE 4



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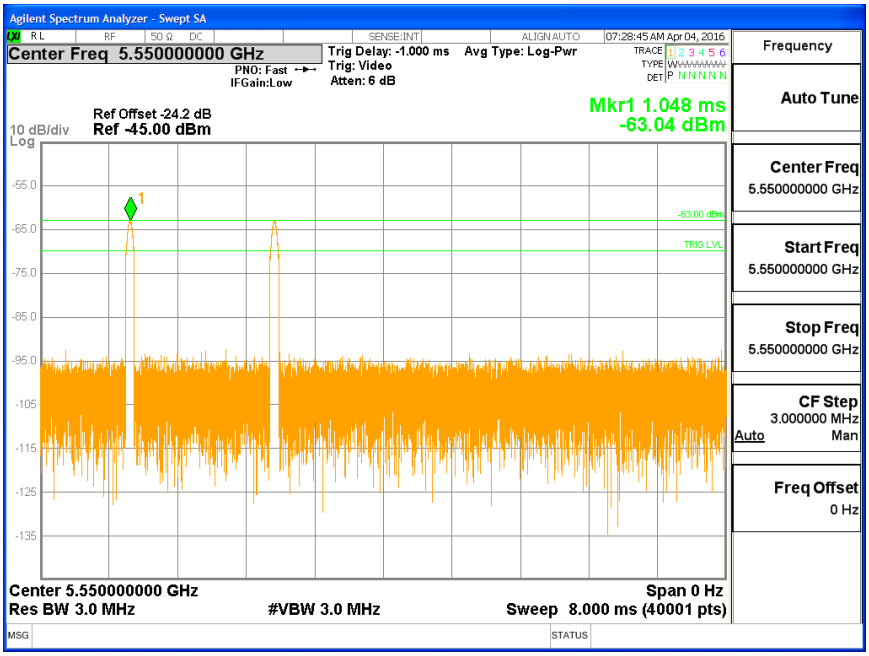
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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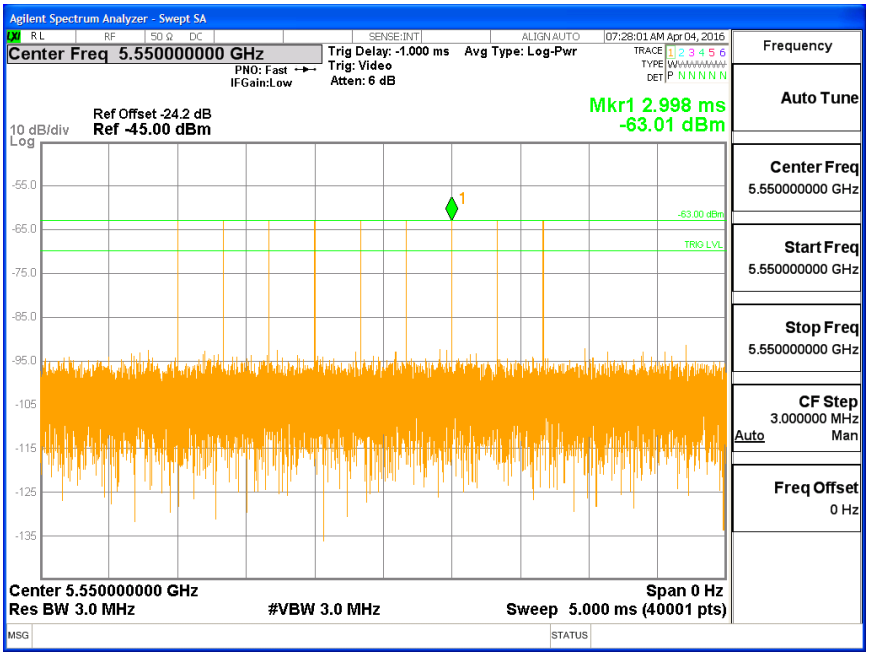
SINGLE BURST OF RADAR TYPE 6



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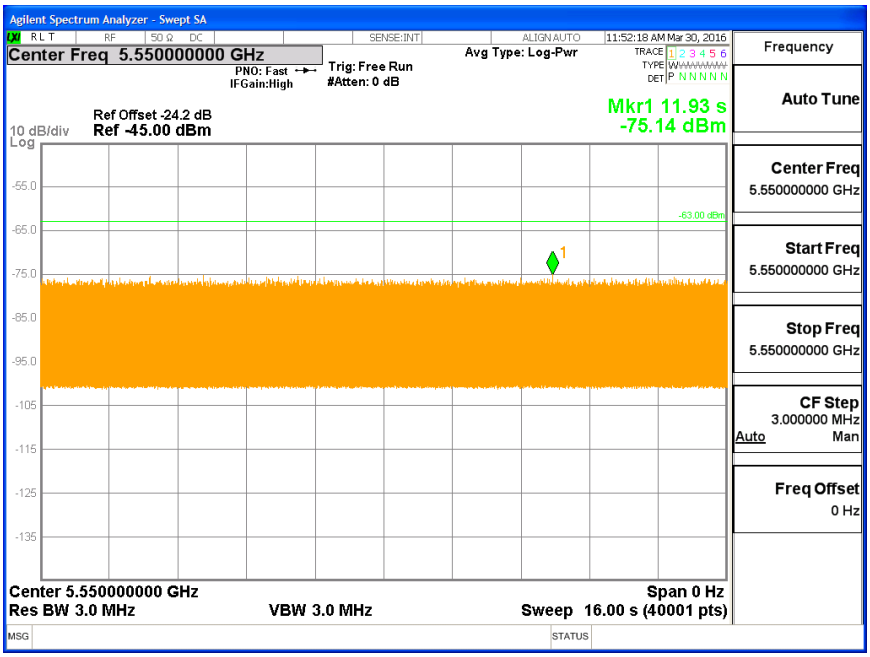
TRAFFIC

TRAFFIC



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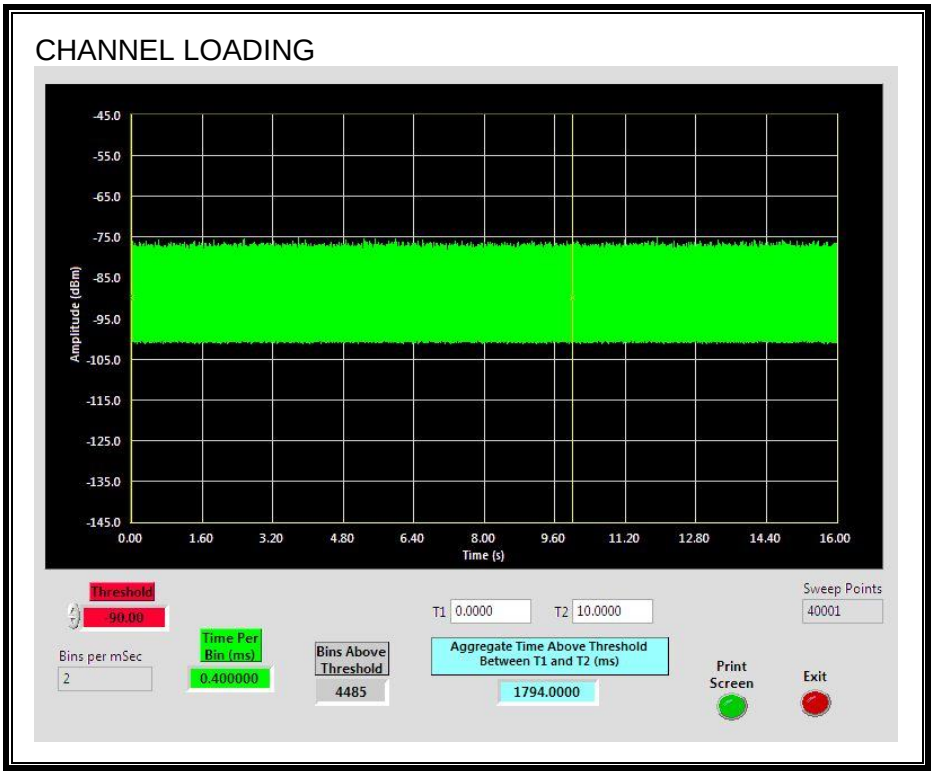
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 17.94%

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5.2.1. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

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

PROCEDURE FOR TIMING OF RADAR BURST

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

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

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QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.29	127.2	96.9	36.9

Radar Near Beginning of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.54	70.44	39.9	3.0

Radar Near End of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.53	124.9	94.4	57.5

QUALITATIVE RESULTS

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

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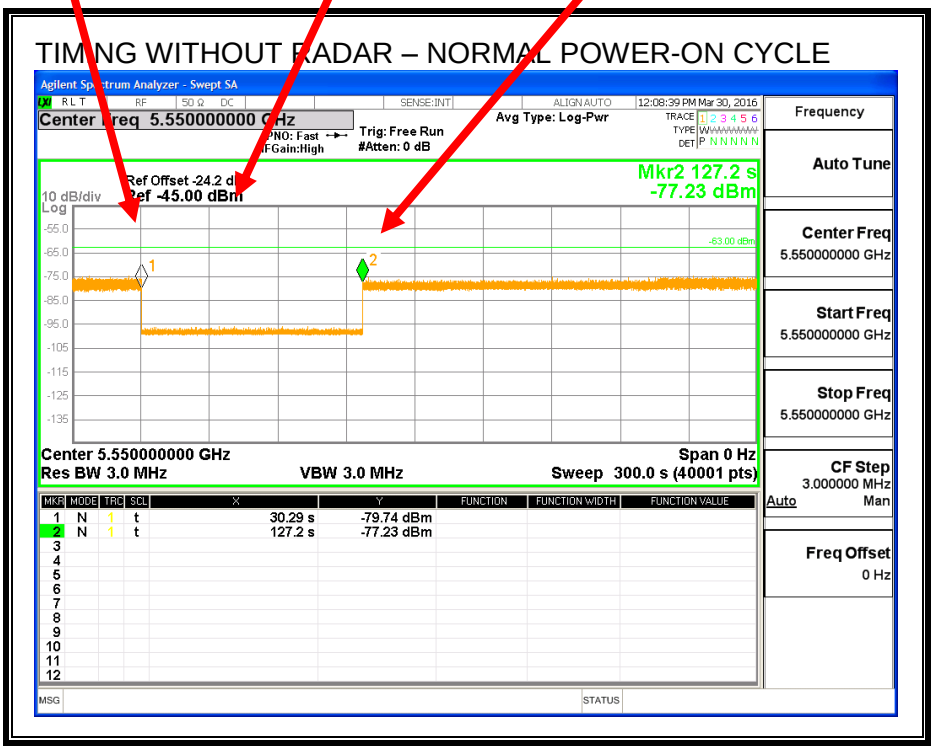
TIMING WITHOUT RADAR DURING CAC

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

End of Initial Power-up cycle
Start of CAC

End of CAC
Traffic is Initiated



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

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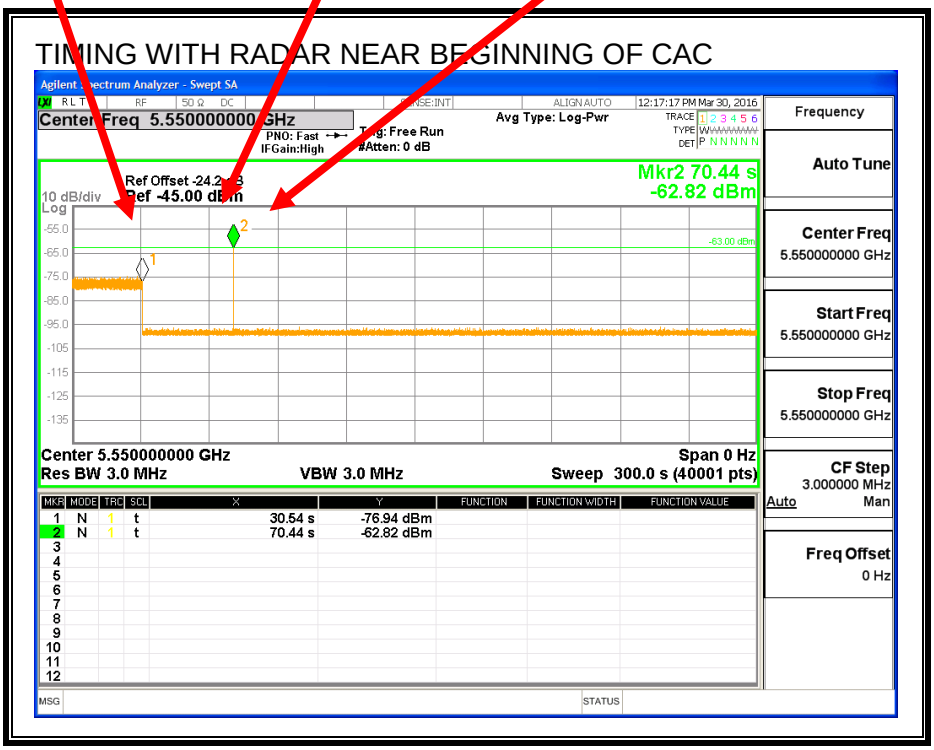
TIMING WITH RADAR NEAR BEGINNING OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

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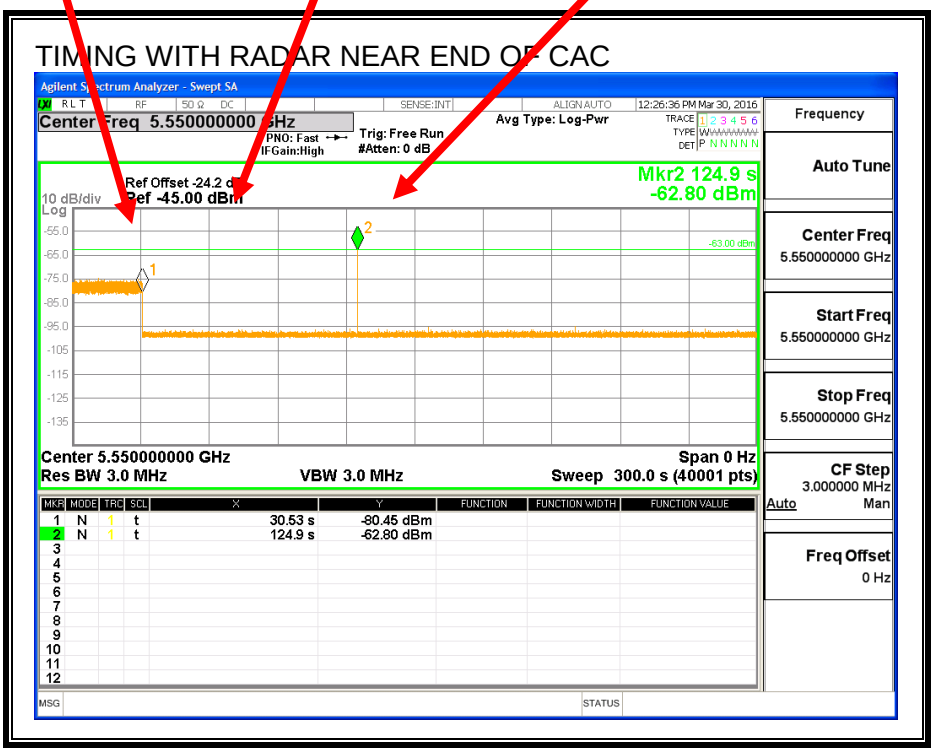
TIMING WITH RADAR NEAR END OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

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5.2.2. OVERLAPPING CHANNEL TESTS

RESULTS

The EUT has only three channels enabled at any one time. The channels are intentionally selected so that they can't overlap. Therefore the EUT does not have an overlapping channel plan.

5.2.3. 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)
0.0060	10

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

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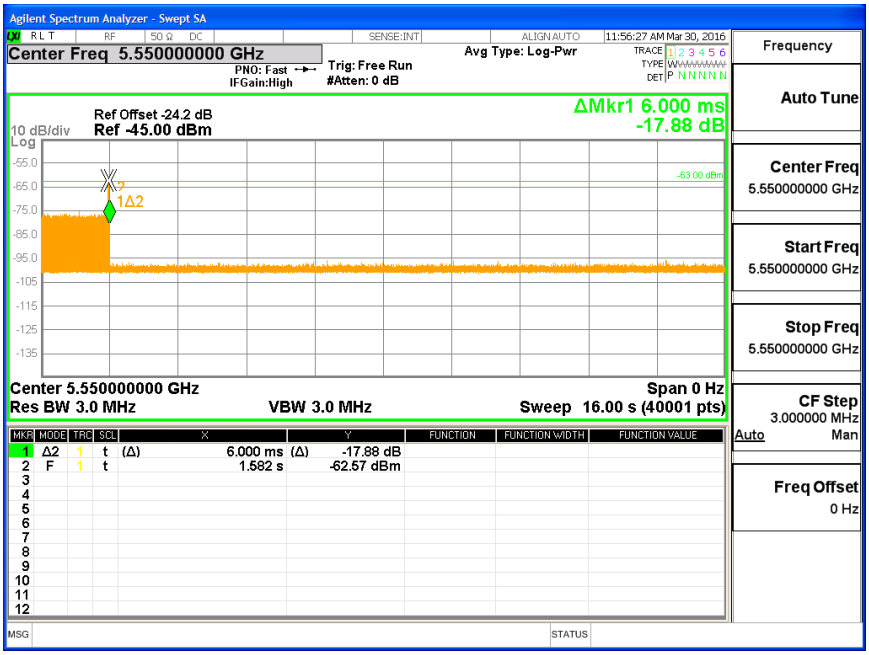
MOVE TIME

MOVE TIME



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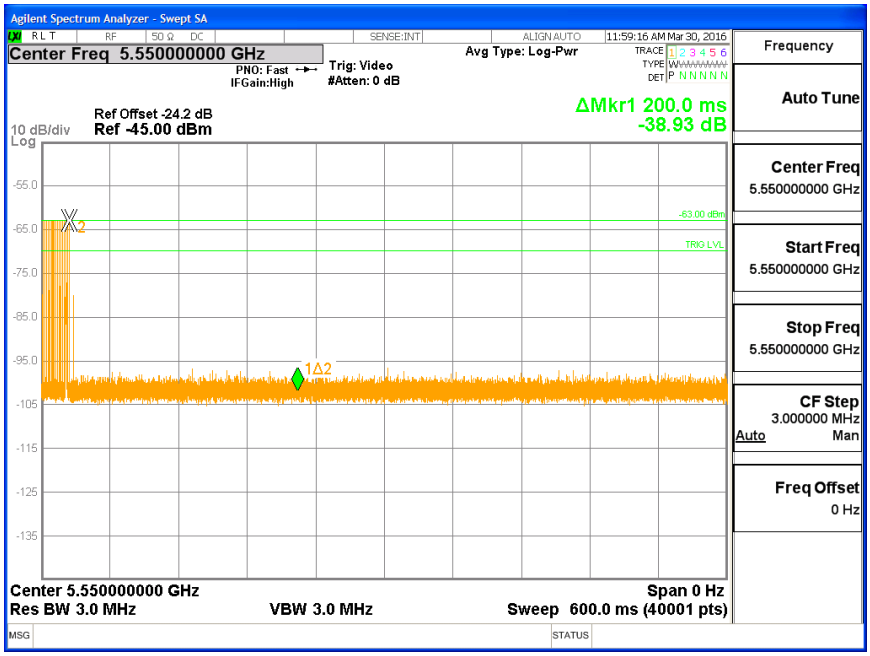
CHANNEL CLOSING TIME

CLOSING TIME



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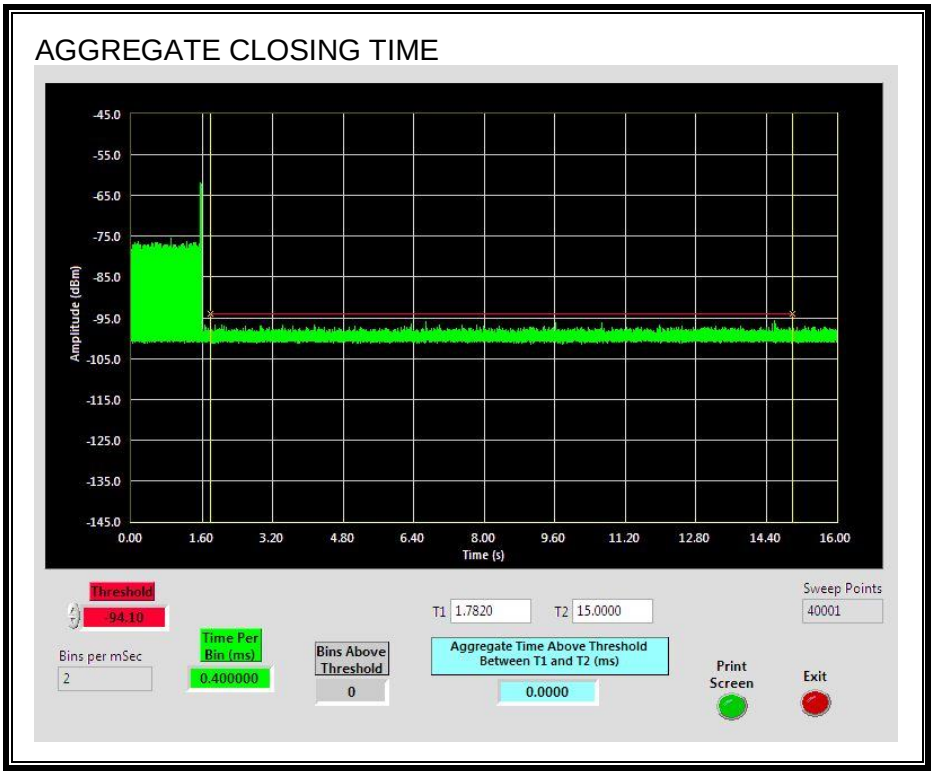
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

No transmissions are observed during the aggregate monitoring period.



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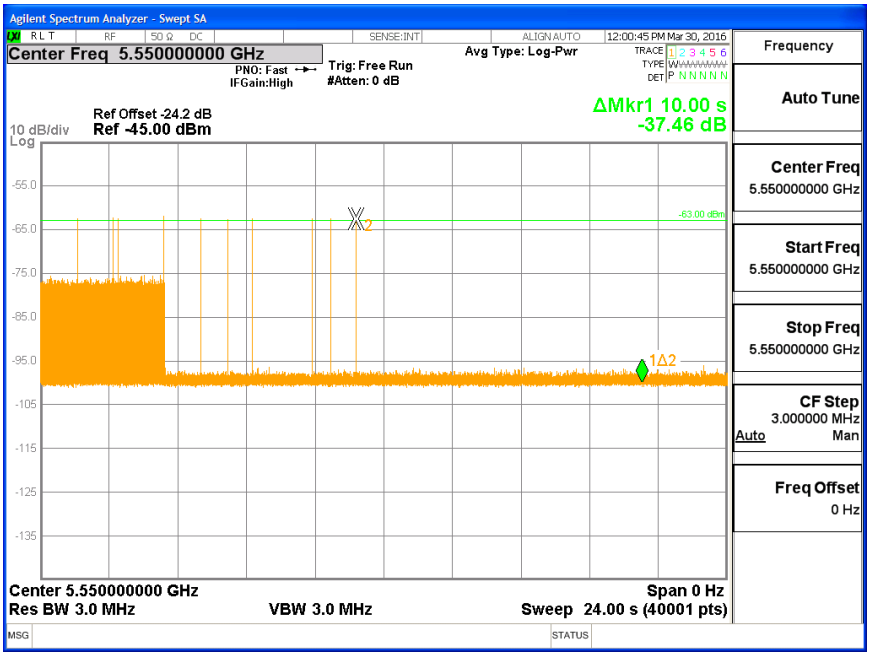
LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR



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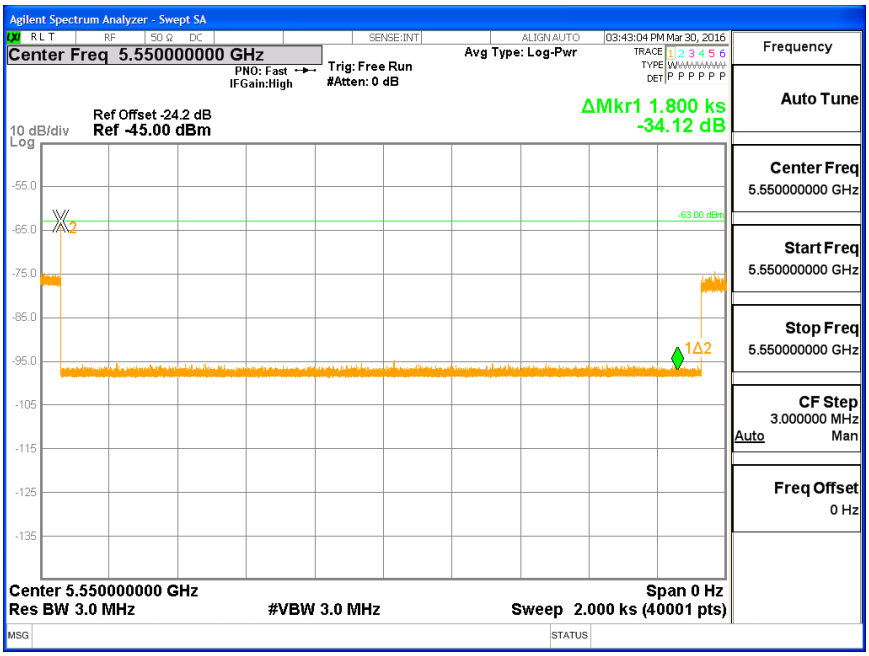
5.2.1. NON-OCCUPANCY PERIOD

RESULTS

No EUT transmissions were observed on the test channel during the 30-minute observation time. After the 30-minute non-occupancy period the EUT performed a new CAC, then resumed transmissions upon detecting no radar during this CAC period.

NON-OCCUPANCY PERIOD



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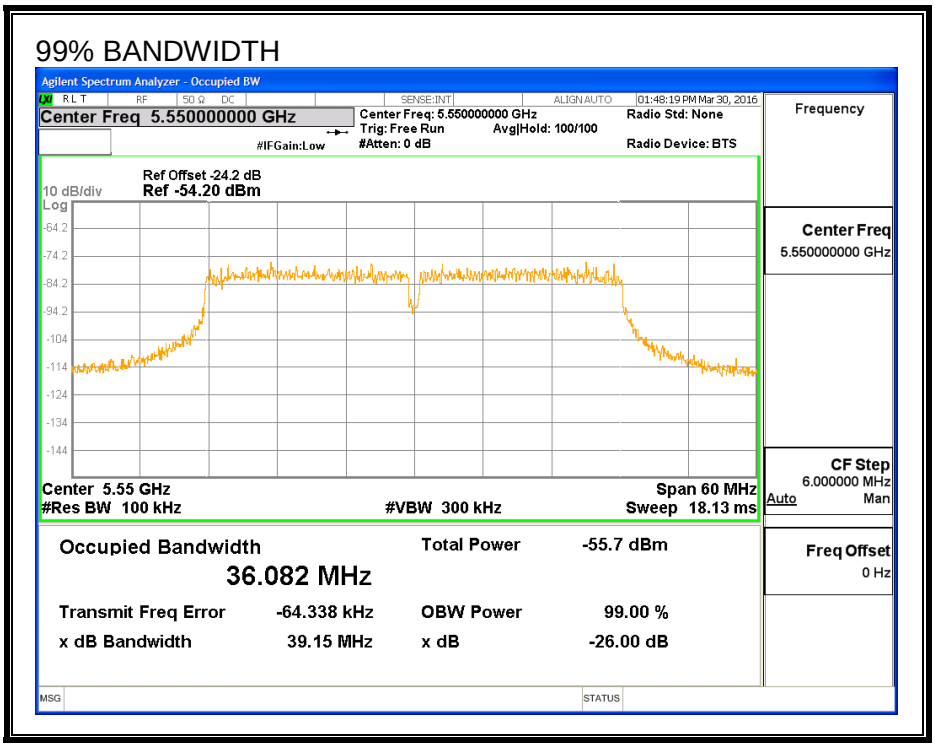
5.2.2. DETECTION BANDWIDTH

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 (%)
5530	5570	40	36.082	110.9	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results				
FCC Type 0 Waveform: 1 us Pulse Width, 1428 us PRI, 18 Pulses per Burst				
Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5530	10	9	90	FL
5535	30	27	90	
5540	10	9	90	
5545	10	9	90	
5550	10	10	100	
5555	10	10	100	
5560	10	9	90	
5565	10	10	100	
5570	10	9	90	FH

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5.2.3. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth		80% of Det BW	
					FL	FH	FL5	FH5
FCC Short Pulse Type 1	30	100.00	60	Pass	5530	5570		
FCC Short Pulse Type 2	30	83.33	60	Pass	5530	5570		
FCC Short Pulse Type 3	30	100.00	60	Pass	5530	5570		
FCC Short Pulse Type 4	30	96.67	60	Pass	5530	5570		
Aggregate		95.00	80	Pass				
FCC Long Pulse Type 5	30	100.00	80	Pass	5530	5570	5534	5566
FCC Hopping Type 6	41	100.00	70	Pass	5530	5570		

Note: Random radar frequencies with at least one trial at the channel center frequency were tested for FCC Types 1-4 at client request.

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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	5566	Yes
1002	1	838	63	A	5538	Yes
1003	1	778	68	A	5554	Yes
1004	1	898	59	A	5552	Yes
1005	1	858	62	A	5550	Yes
1006	1	578	92	A	5565	Yes
1007	1	558	95	A	5544	Yes
1008	1	518	102	A	5536	Yes
1009	1	538	99	A	5564	Yes
1010	1	798	67	A	5559	Yes
1011	1	878	61	A	5540	Yes
1012	1	698	76	A	5559	Yes
1013	1	638	83	A	5532	Yes
1014	1	918	58	A	5546	Yes
1015	1	598	89	A	5568	Yes
1016	1	956	56	B	5545	Yes
1017	1	717	74	B	5561	Yes
1018	1	2156	25	B	5560	Yes
1019	1	2047	26	B	5558	Yes
1020	1	2262	24	B	5566	Yes
1021	1	1088	49	B	5565	Yes
1022	1	2786	19	B	5545	Yes
1023	1	1741	31	B	5540	Yes
1024	1	2374	23	B	5550	Yes
1025	1	1459	37	B	5545	Yes
1026	1	2221	24	B	5532	Yes
1027	1	1435	37	B	5533	Yes
1028	1	1132	47	B	5562	Yes
1029	1	1829	29	B	5544	Yes
1030	1	2850	19	B	5544	Yes

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TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
2001	1.4	187	28	5542	Yes
2002	3.7	230	29	5552	Yes
2003	4.6	224	29	5544	Yes
2004	3	152	27	5554	Yes
2005	2.1	150	24	5566	No
2006	2.9	163	23	5531	Yes
2007	4.2	208	23	5551	Yes
2008	3.2	225	26	5553	Yes
2009	2.8	155	23	5537	Yes
2010	4	177	27	5553	Yes
2011	1.9	192	24	5538	Yes
2012	1.3	179	25	5568	No
2013	3.5	199	26	5541	Yes
2014	3.2	190	23	5563	Yes
2015	1.5	176	29	5538	No
2016	3.5	172	27	5543	Yes
2017	4.2	161	25	5542	Yes
2018	2.4	204	27	5569	Yes
2019	3.3	160	23	5569	Yes
2020	1.7	207	25	5554	No
2021	4.9	167	28	5548	Yes
2022	1.6	218	28	5541	Yes
2023	1	182	24	5558	Yes
2024	1.9	199	24	5550	No
2025	1.5	211	28	5532	Yes
2026	4.9	151	24	5554	Yes
2027	4.7	166	26	5548	Yes
2028	4.1	154	29	5550	Yes
2029	2.2	173	24	5566	Yes
2030	1.9	165	28	5531	Yes

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TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	6.7	252	17	5543	Yes
3002	6.6	490	16	5548	Yes
3003	7.4	458	16	5564	Yes
3004	5.1	340	18	5550	Yes
3005	6.2	454	18	5539	Yes
3006	6.9	348	16	5546	Yes
3007	8.3	475	17	5561	Yes
3008	9.2	383	17	5541	Yes
3009	8.4	271	18	5566	Yes
3010	9.7	458	18	5560	Yes
3011	9.1	359	17	5554	Yes
3012	8.2	426	18	5533	Yes
3013	8	473	16	5566	Yes
3014	7.3	434	18	5561	Yes
3015	10	494	18	5563	Yes
3016	9.6	468	17	5546	Yes
3017	5.1	424	16	5565	Yes
3018	5	293	17	5559	Yes
3019	5.8	261	18	5542	Yes
3020	8.6	260	17	5537	Yes
3021	9.7	374	17	5556	Yes
3022	5.3	269	18	5564	Yes
3023	6.7	396	16	5557	Yes
3024	7.6	303	16	5545	Yes
3025	6.8	325	17	5554	Yes
3026	8.1	379	17	5540	Yes
3027	7.5	280	16	5554	Yes
3028	6.6	479	17	5568	Yes
3029	6.3	393	18	5537	Yes
3030	5.7	355	17	5561	Yes

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TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
4001	16.8	415	14	5553	Yes
4002	11.3	271	12	5551	Yes
4003	17.1	344	16	5546	Yes
4004	12.1	464	12	5557	Yes
4005	18.5	432	12	5569	Yes
4006	14	314	13	5558	Yes
4007	16.2	295	12	5550	Yes
4008	17.6	441	16	5558	Yes
4009	10.1	316	16	5568	Yes
4010	12	357	15	5536	Yes
4011	10.5	497	13	5551	No
4012	12.9	299	13	5532	Yes
4013	11.9	451	13	5539	Yes
4014	10	400	13	5537	Yes
4015	19.6	314	14	5539	Yes
4016	18.3	275	12	5566	Yes
4017	13.6	469	13	5546	Yes
4018	18.2	443	13	5533	Yes
4019	13.9	265	15	5550	Yes
4020	19	385	16	5534	Yes
4021	15.3	353	15	5569	Yes
4022	10.8	486	16	5557	Yes
4023	18.3	466	16	5535	Yes
4024	14.4	361	15	5557	Yes
4025	17	488	14	5553	Yes
4026	18.9	278	14	5548	Yes
4027	17.4	417	16	5569	Yes
4028	19.8	471	16	5531	Yes
4029	18.8	372	12	5552	Yes
4030	17	321	12	5532	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	5548	Yes
2	5561	Yes
3	5558	Yes
4	5535	Yes
5	5544	Yes
6	5562	Yes
7	5554	Yes
8	5559	Yes
9	5565	Yes
10	5542	Yes
11	5535	Yes
12	5563	Yes
13	5544	Yes
14	5543	Yes
15	5548	Yes
16	5565	Yes
17	5544	Yes
18	5557	Yes
19	5565	Yes
20	5562	Yes
21	5565	Yes
22	5538	Yes
23	5561	Yes
24	5549	Yes
25	5541	Yes
26	5539	Yes
27	5552	Yes
28	5557	Yes
29	5553	Yes
30	5551	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	317	5530	5	Yes
2	792	5531	12	Yes
3	1267	5532	10	Yes
4	1742	5533	14	Yes
5	2217	5534	10	Yes
6	2692	5535	7	Yes
7	3167	5536	5	Yes
8	3642	5537	3	Yes
9	4117	5538	10	Yes
10	4592	5539	8	Yes
11	5067	5540	5	Yes
12	5542	5541	6	Yes
13	6017	5542	6	Yes
14	6492	5543	8	Yes
15	6967	5544	8	Yes
16	7442	5545	10	Yes
17	7917	5546	13	Yes
18	8392	5547	8	Yes
19	8867	5548	12	Yes
20	9342	5549	6	Yes
21	9817	5550	11	Yes
22	10292	5551	12	Yes
23	10767	5552	9	Yes
24	11242	5553	9	Yes
25	11717	5554	6	Yes
26	12192	5555	5	Yes
27	12667	5556	11	Yes
28	13142	5557	8	Yes
29	13617	5558	7	Yes
30	14092	5559	10	Yes
31	14567	5560	5	Yes
32	15042	5561	6	Yes
33	15517	5562	5	Yes
34	15992	5563	9	Yes
35	16467	5564	6	Yes
36	16942	5565	6	Yes
37	17417	5566	4	Yes
38	17892	5567	7	Yes
39	18367	5568	10	Yes
40	18842	5569	11	Yes
41	19317	5570	10	Yes

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5.3. BRIDGE MODE RESULTS

Per KDB 905462, Section 5.1 (footnote 1):

Networks Access Points with Bridge and/or MESH modes of operation are permitted to operate in the DFS bands but must employ a DFS function. The functionality of the Bridge mode as specified in §15.403(a) must be validated in the DFS test report. Devices operating as relays must also employ DFS function. The method used to validate the functionality must be documented and validation data must be documented. Bridge mode can be validated by performing a test statistical performance check (Section 7.8.4) on any one of the radar types. This is an abbreviated test to verify DFS functionality. MESH mode operational methodology must be submitted in the application for certification for evaluation by the FCC.

This device does not support Bridge Mode therefore this test was not performed.

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6. SETUP PHOTOS

DYNAMIC FREQUENCY SELECTION MEASUREMENT SETUP

DFS FRONT PHOTO

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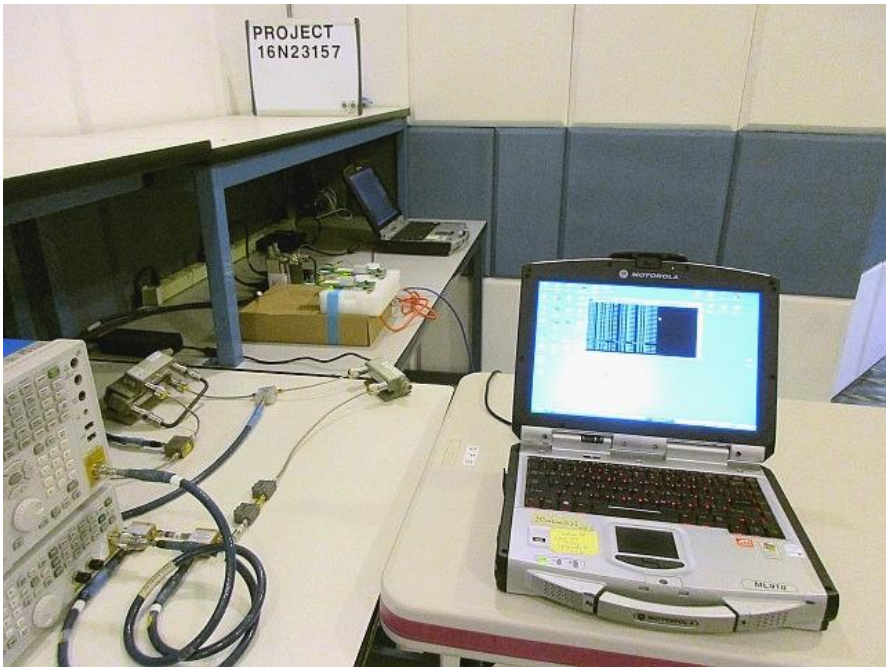
DFS BACK PHOTO



END OF REPORT

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