DFS PORTION of NCC LP0002

CERTIFICATION TEST REPORT

FOR

8x8 802.11a/b/g/n/ac/ax Access Point

MODEL NUMBER: MR55-HW

BRAND NAME: CISCO

REPORT NUMBER: 12659286-E3V2

ISSUE DATE: APRIL 25, 2019

Prepared for
CISCO SYSTEMS, INC.
170 WEST TASMAN DRIVE
SAN JOSE, CA 95134, U.S.A.

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	03/15/19	Initial Issue	Conan Cheung
V2	04/25/19	Section 6, LP0002 fixed. Cisco brand name added	Henry Lau

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 8x8 802.11a/b/g/n/ac/ax Access Point

MODEL: MR55-HW

BRAND NAME: CISCO

SERIAL NUMBER: Q2ZD-5Q2S-BSF4

DATE TESTED: FEBRUARY 13 - 22, 2019

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
DFS Portion of NCC LP0002	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

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 the U.S. government.

Approved & Released For
UL Verification Services Inc. By:

Conan Cheung
UL Reviewer
CONSUMER TECHNOLOGY DIVISION
UL Verification Services Inc.

Prepared By:

Henry Lau
Test Engineer
CONSUMER TECHNOLOGY DIVISION
UL Verification Services Inc.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with the DFS portion of NCC LP0002, ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, KDB 905462 D02 and D03.

3. REFERENCE DOCUMENTS

Measurements of transmitter parameters as referenced in this report are documented in Bureau Veritas Consumer Products Services report number RF180704E02F-1.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Specific facilities are also identified in the test results sections.

The test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers are covered under Industry Canada company address and respective code.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

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5. CALIBRATION AND UNCERTAINTY

5.1. 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.

5.2. SAMPLE CALCULATION

RADIATED EMISSIONS

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty level has been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Time	± 0.02 %

The Uncertainty figure is valid to a confidence level of 95%.

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6. DYNAMIC FREQUENCY SELECTION

6.1. OVERVIEW

6.1.1. LIMITS

NCC

NCC LP0002 is harmonized with FCC Part 15 DFS rules.

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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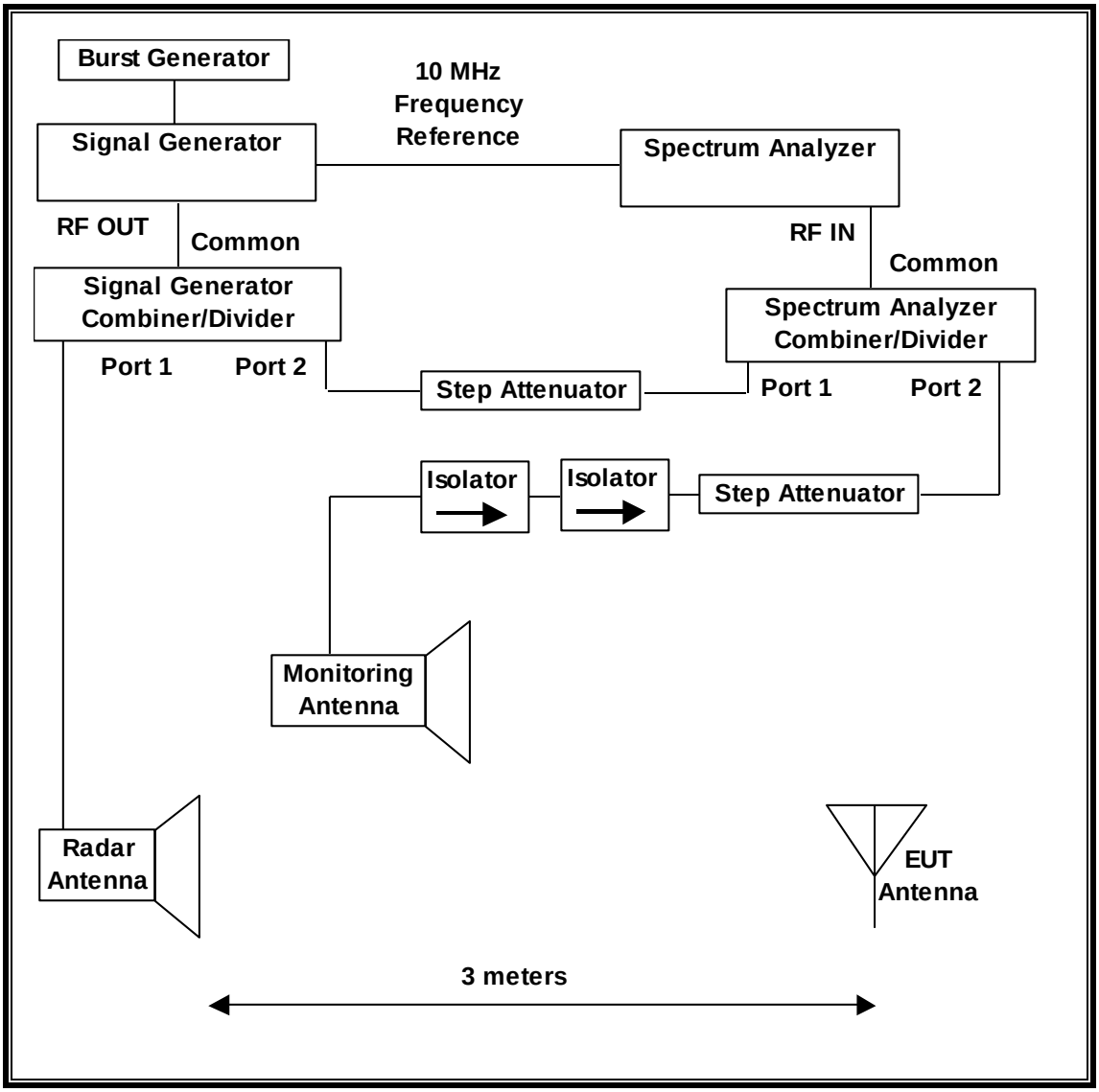
6.1.2. TEST AND MEASUREMENT SYSTEM

RADIATED METHOD SYSTEM BLOCK DIAGRAM



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SYSTEM OVERVIEW

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

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

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

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

SYSTEM CALIBRATION

A 50-ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected to a horn antenna via a coaxial cable, with the reference level offset set to (horn antenna gain – coaxial cable loss). The signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –64 dBm as measured on the spectrum analyzer.

Without changing any of the instrument settings, the spectrum analyzer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. The Reference Level Offset of the spectrum analyzer is adjusted so that the displayed amplitude of the signal is –64 dBm.

The spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device. The interference detection threshold may be varied from the calibrated value of –64 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

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ADJUSTMENT OF DISPLAYED TRAFFIC LEVEL

A link is established between the Master and Slave and the distance between the units is adjusted as needed to provide a suitable received level at the Master and Slave devices. Iperf is utilized to generate WLAN traffic that meets or exceed the minimum loading requirement. 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**	**ID No.**	**Cal Due**
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T459	01/24/20
Signal Generator, MXG X-Series RF Vector	Agilent	N5182B	T1633	02/08/20
Arbitrary Waveform Generator	Agilent / HP	33220A	T175	01/30/20

6.1.3. TEST AND MEASUREMENT SOFTWARE

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

Master Device Testing

TEST SOFTWARE LIST		
Name	**Version**	**Test / Function**
Aggregate Time-PXA	3.1	Channel Loading and Aggregate Closing Time
FCC 2014 Detection Bandwidth-PXA	3.1.1	Detection Bandwidth in 5 MHz Steps
In Service Monitoring-PXA	3.3.4	In-Service Monitoring (Probability of Detection)
PXA Read	3.1	Signal Generator Screen Capture Utility
SGXProject.exe	1.7	Radar Waveform Generation and Download

6.1.4. TEST ROOM ENVIRONMENT

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

ENVIRONMENT CONDITION

Parameter	Value
Temperature	25.4 °C
Humidity	33 %

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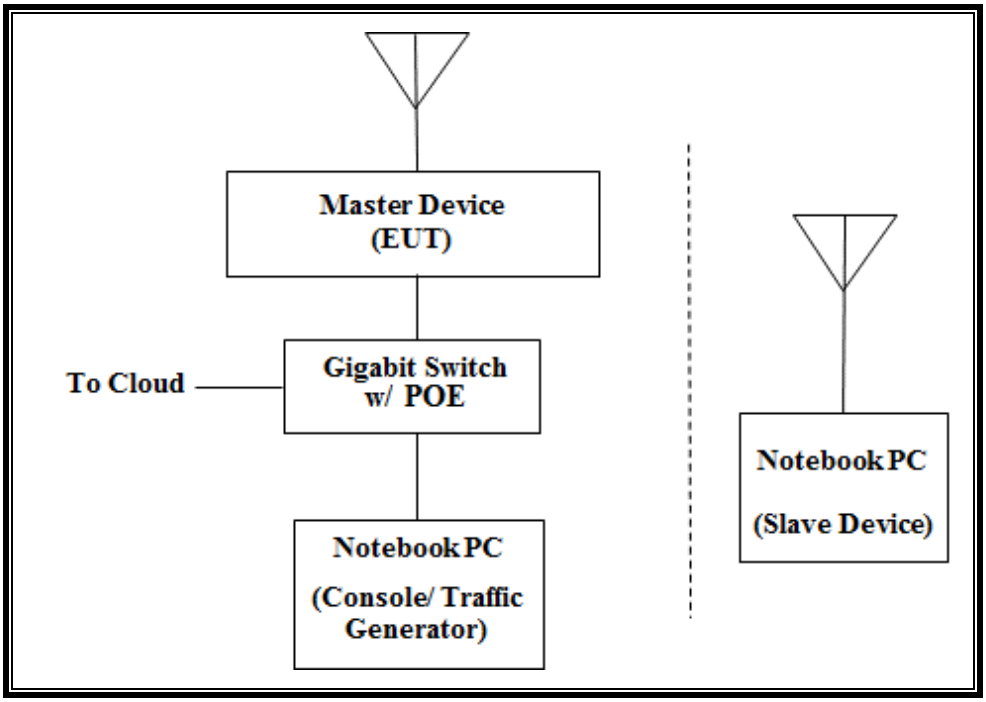
6.1.5. SETUP OF EUT

RADIATED METHOD EUT TEST SETUP



SUPPORT EQUIPMENT

The following support equipment was utilized for the DFS tests documented in this report:

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Notebook PC (Controller & Traffic Generator)	Lenovo	TYPE 20F6-005HUS	PC-0D9Y3U 16/06	DoC
AC Adapter (Controller PC & Traffic Generator)	Lenovo	ADLX45NDC2A	8SSA10E75790D1SG76K04T5	DoC
Notebook PC (Slave Device)	Lenovo	TYPE 20CM-0046US	PC-082D5Y 15/10	DoC
AC Adapter (Slave PC)	Lenovo	ADLX45DLC2A	8SSA10E75792L1CZ73D0N4C	DoC
Gigabit Switch	Meraki	MS220-8P	Q2HP-DR3G-TQZS	DoC

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6.1.6. DESCRIPTION OF EUT

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

The EUT is a Master Device.

The highest power level within these bands is 29.93 dBm EIRP in the 5250-5350 MHz band and 29.95 dBm EIRP in the 5470-5725 MHz band.

The highest gain antenna assembly utilized with the EUT has a gain of 6.44 dBi in the 5250-5350 MHz band and 5.8 dBi in the 5470-5725 MHz band. The lowest gain antenna assembly utilized with the EUT has a gain of 4.97 dBi in the 5250-5350 MHz band and 4.27 dBi in the 5470-5725 MHz band.

Eight 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 eight transmitter/receiver chains and one receiver chain, each connected to an antenna to perform radiated tests.

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

WLAN traffic that meets or exceeds the minimum required loading was generated by transferring a data stream from the Master Device to the Slave Device using iPerf version 2.0.5 software package.

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

The EUT utilizes the 802.11ax architecture. Three nominal channel bandwidths are implemented: 20 MHz, 40 MHz and 80 MHz.

The software installed in the EUT is firmware_axe_version T-201902051155-Gee535ce1-L6012e5e5-samrat-riser.

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UNIFORM CHANNEL SPREADING

This function is not required per KDB 905462.

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

The Master Device is a Cisco Meraki Access Point, FCC ID: UDX-60083010. The minimum antenna gain for the Master Device is 4.27 dBi.

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

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

The software installed in the access point is firmware_axe_version T-201902051155-Gee535ce1-L6012e5e5-samrat-riser.

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6.2. RESULTS FOR 20 MHz BANDWIDTH

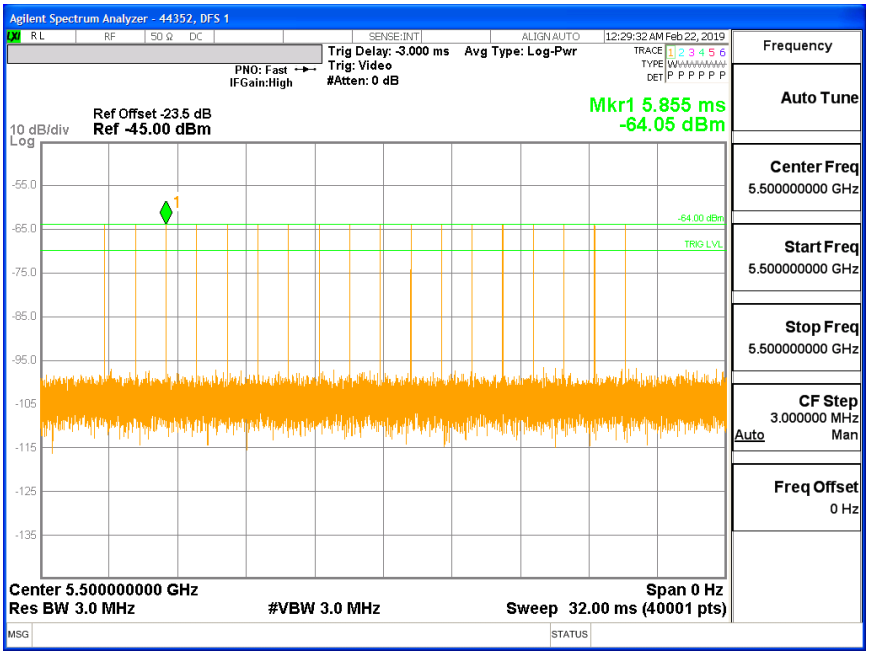
6.2.1. TEST CHANNEL

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

6.2.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

SHORT PULSE RADAR TYPE 0



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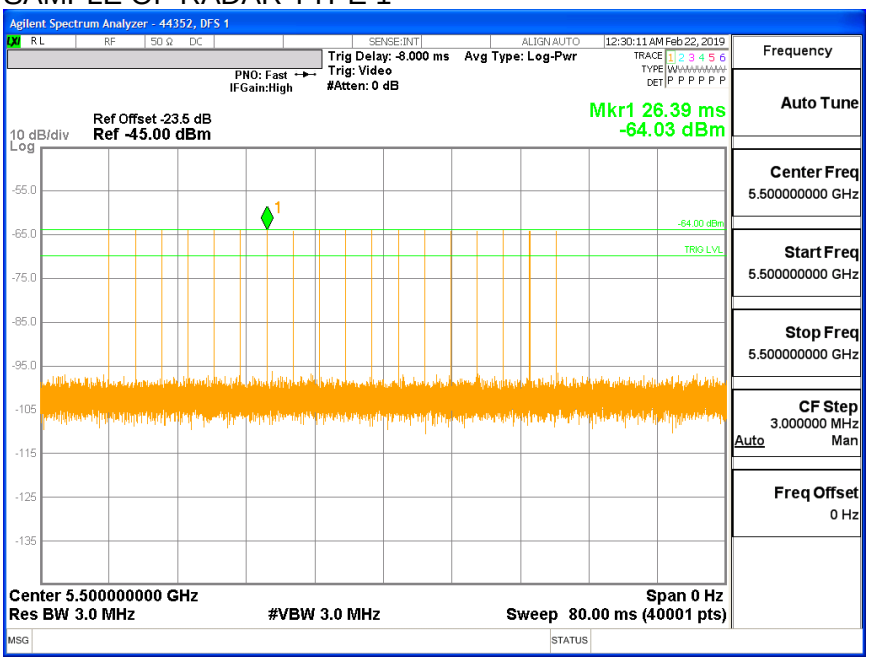
SAMPLE OF RADAR TYPE 1



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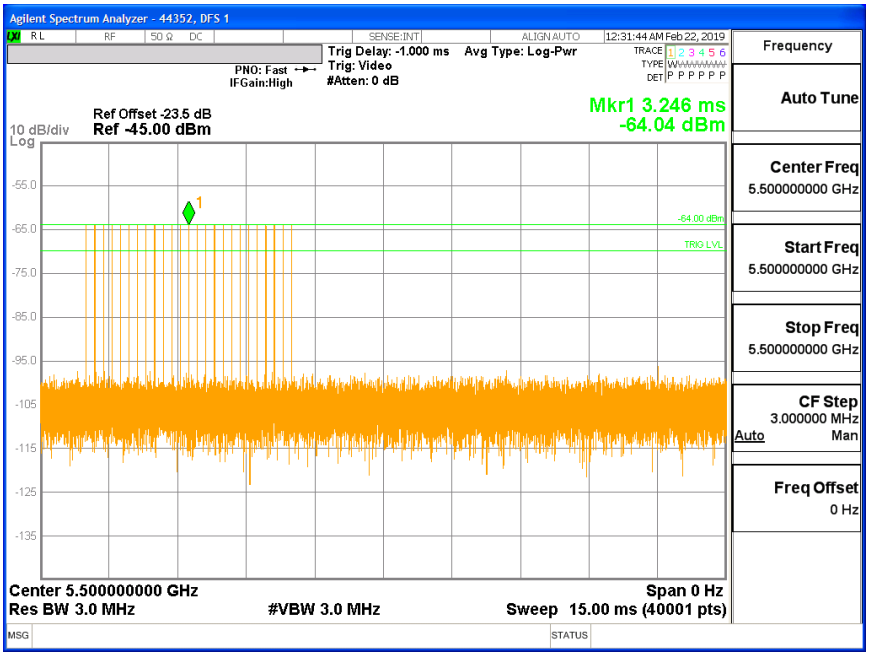
SAMPLE OF RADAR TYPE 2



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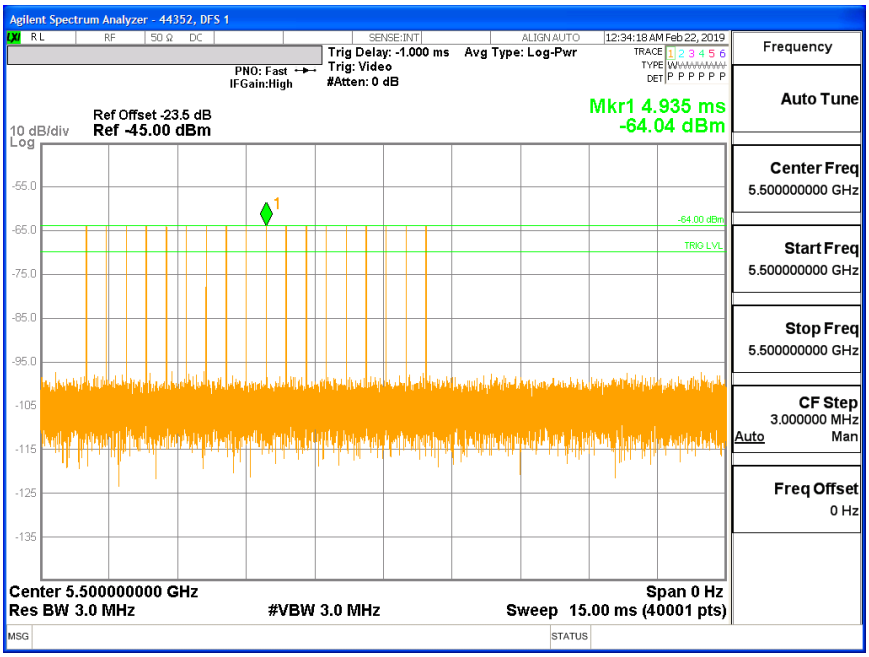
SAMPLE OF RADAR TYPE 3



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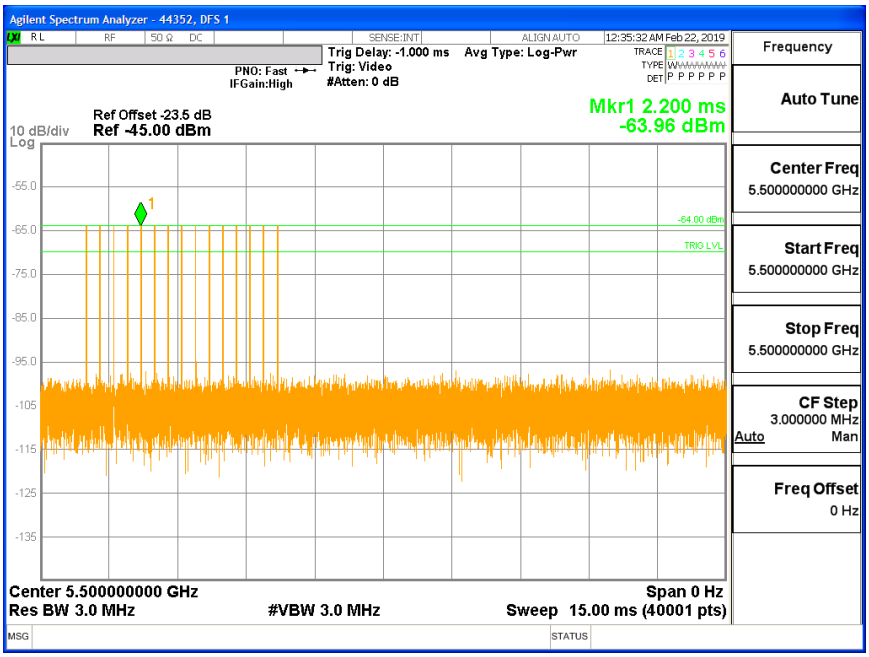
SAMPLE OF RADAR TYPE 4



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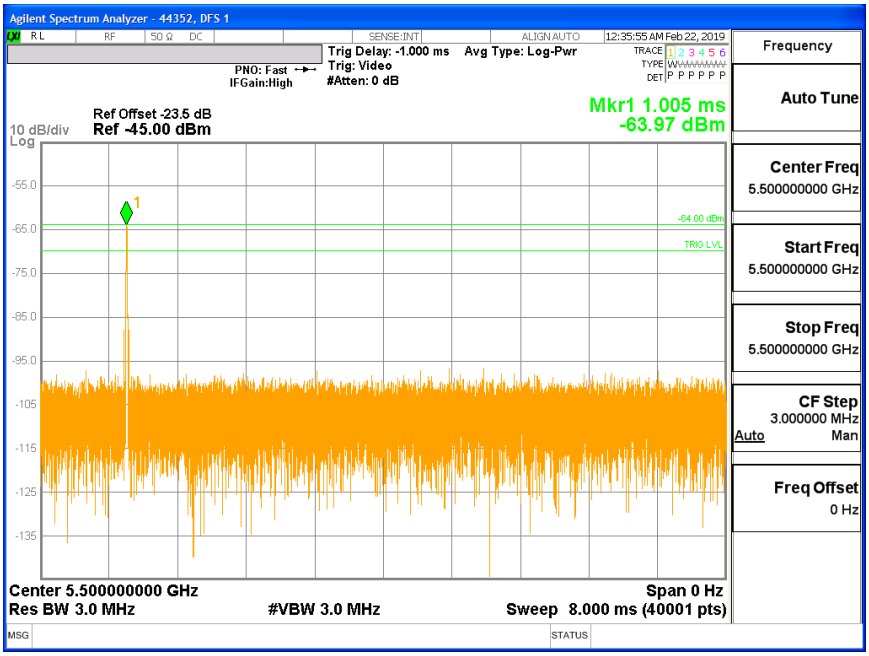
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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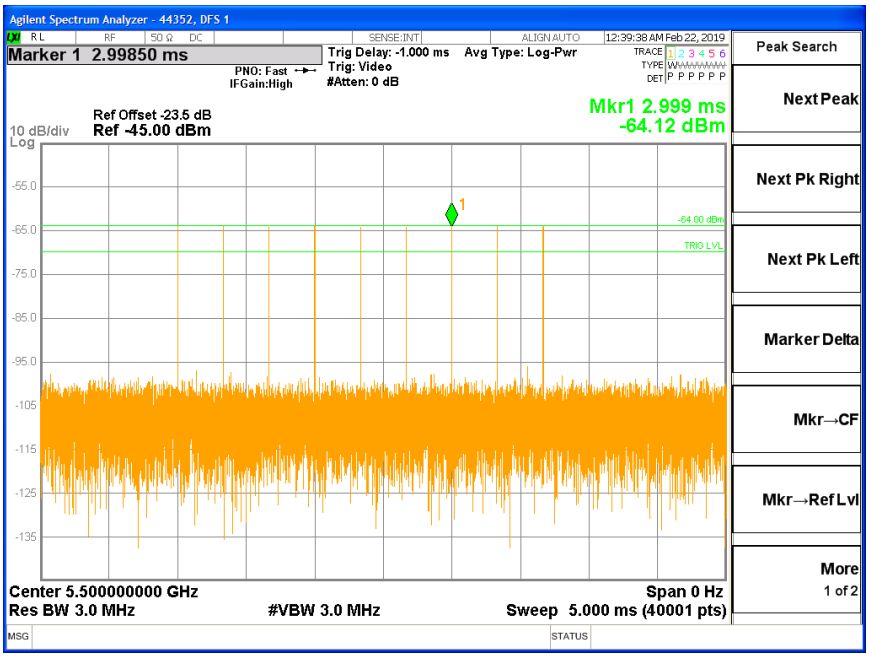
SINGLE BURST OF RADAR TYPE 6



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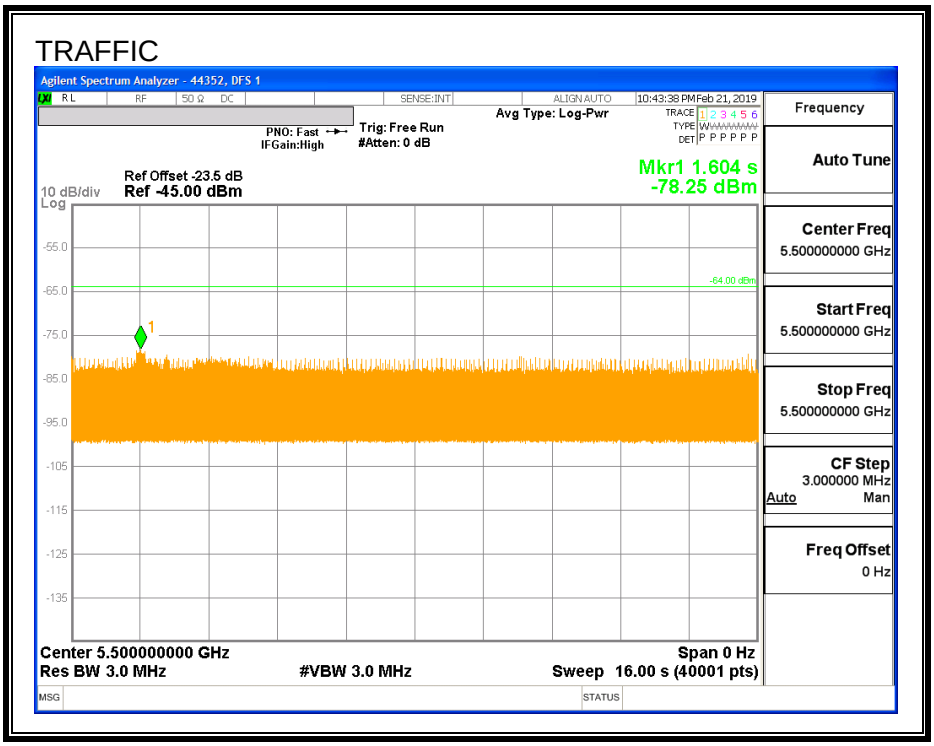
TRAFFIC



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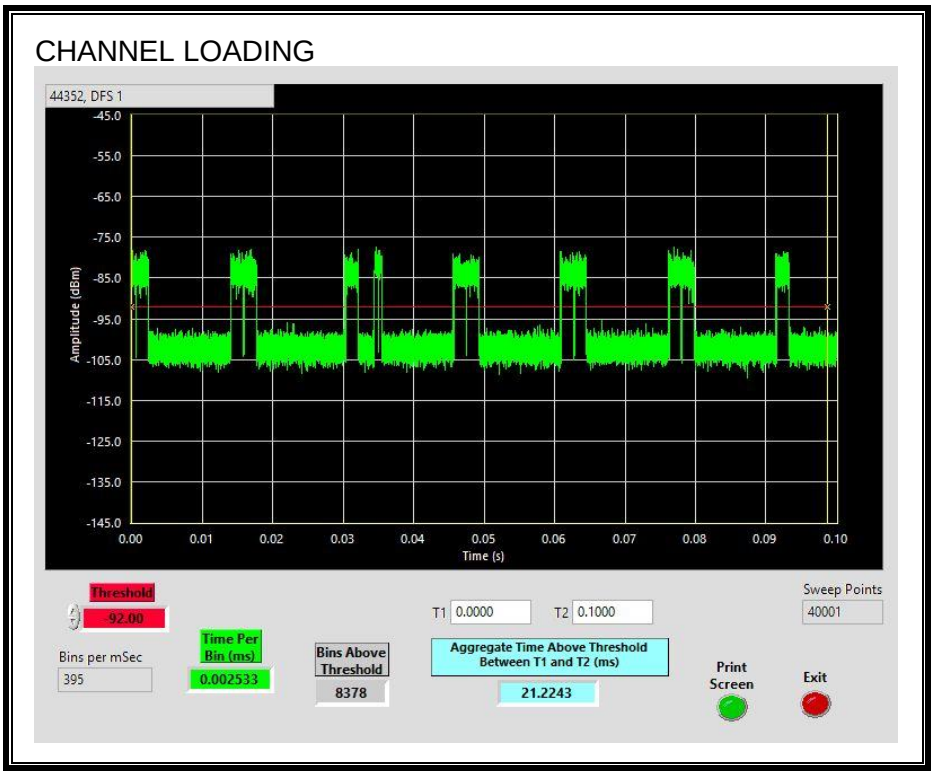
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 21.2243%.

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6.2.3. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

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

PROCEDURE FOR TIMING OF RADAR BURST

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

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

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QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.3	175.6	145.3	85.3

Radar Near Beginning of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.15	116.7	86.6	1.3

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)
30.25	173.1	142.9	57.6

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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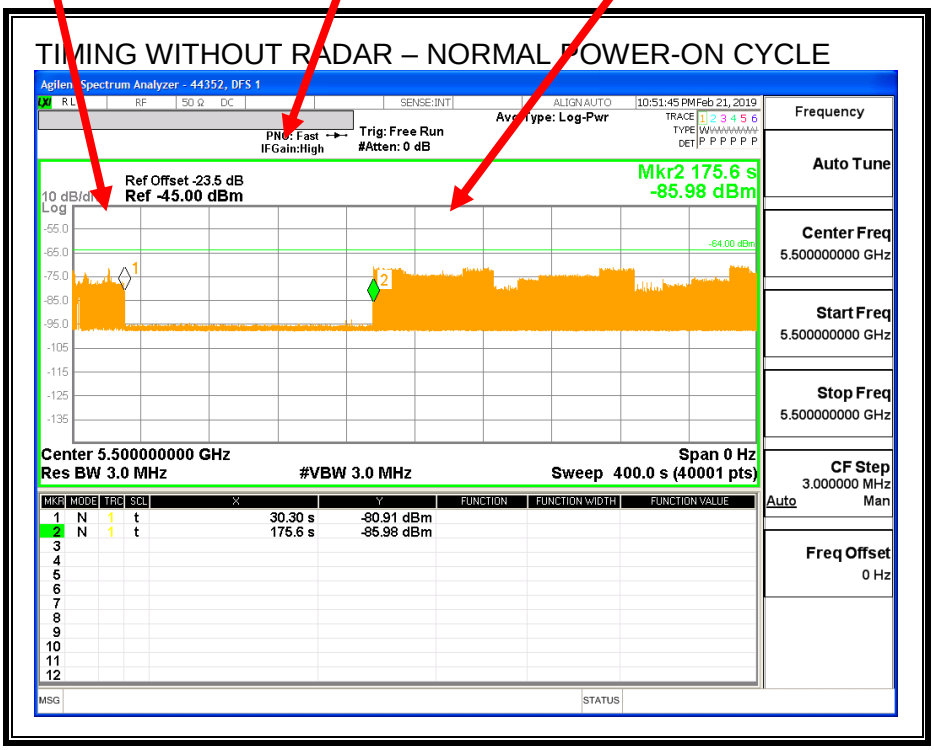
TIMING WITHOUT RADAR DURING CAC

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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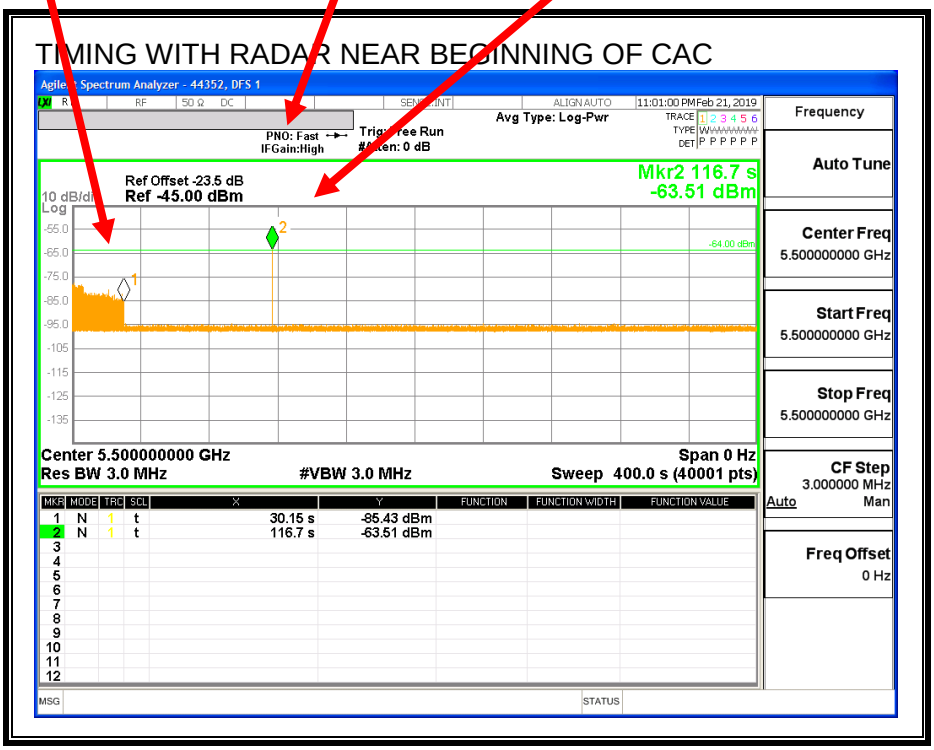
TIMING WITH RADAR NEAR BEGINNING OF CAC

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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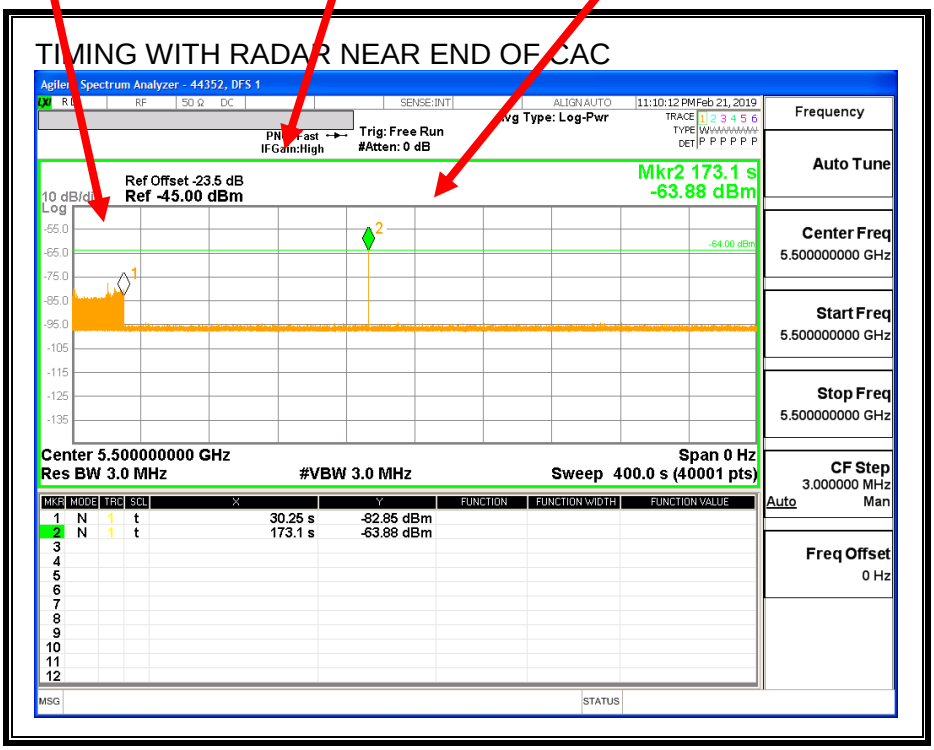
TIMING WITH RADAR NEAR END OF CAC

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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6.2.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

These tests are not applicable.

6.2.5. 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)
1.070	10

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

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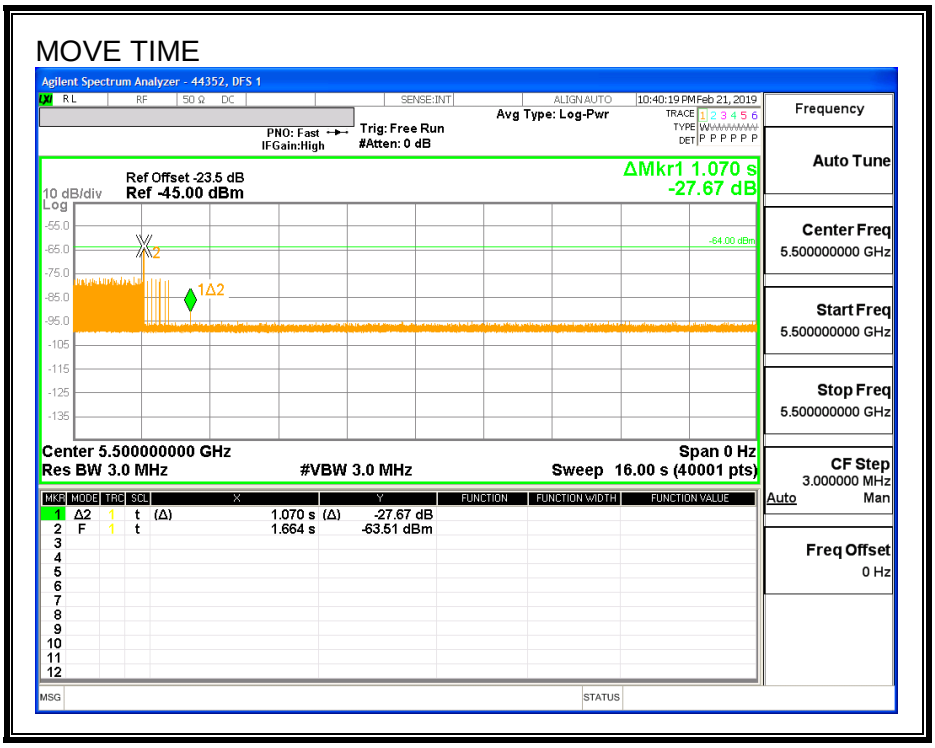
MOVE TIME



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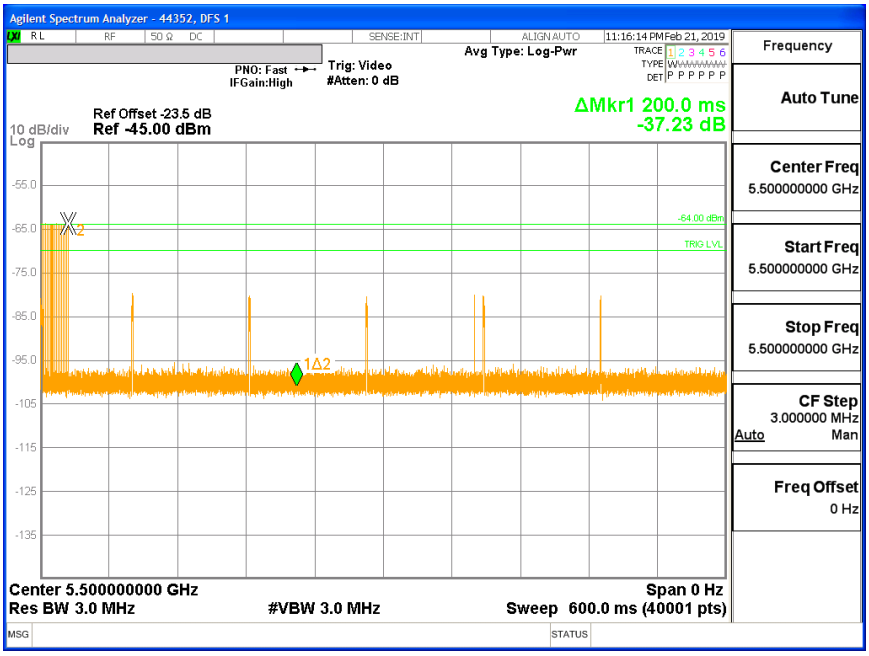
CHANNEL CLOSING TIME

CLOSING TIME



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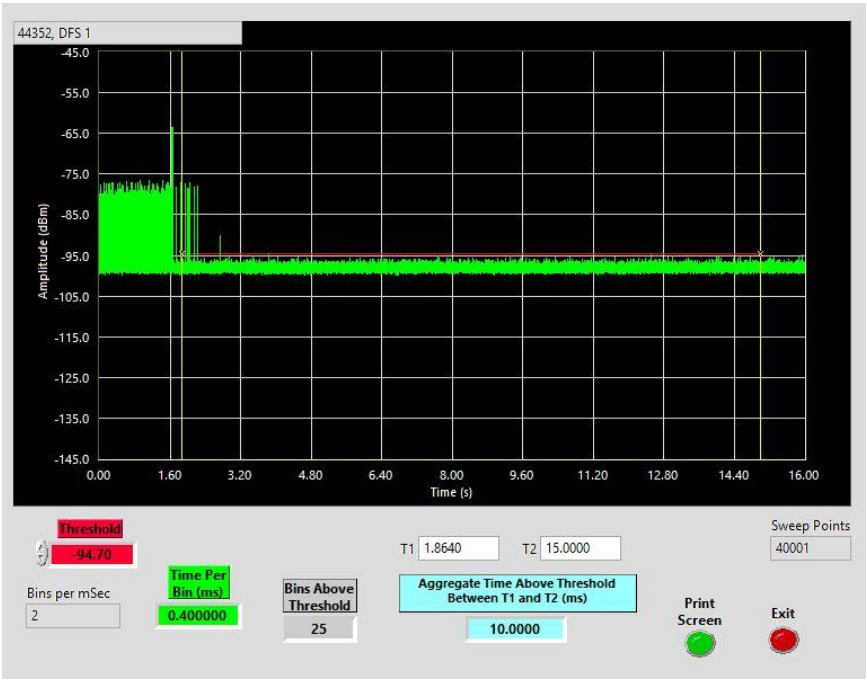
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.

AGGREGATE CLOSING TIME



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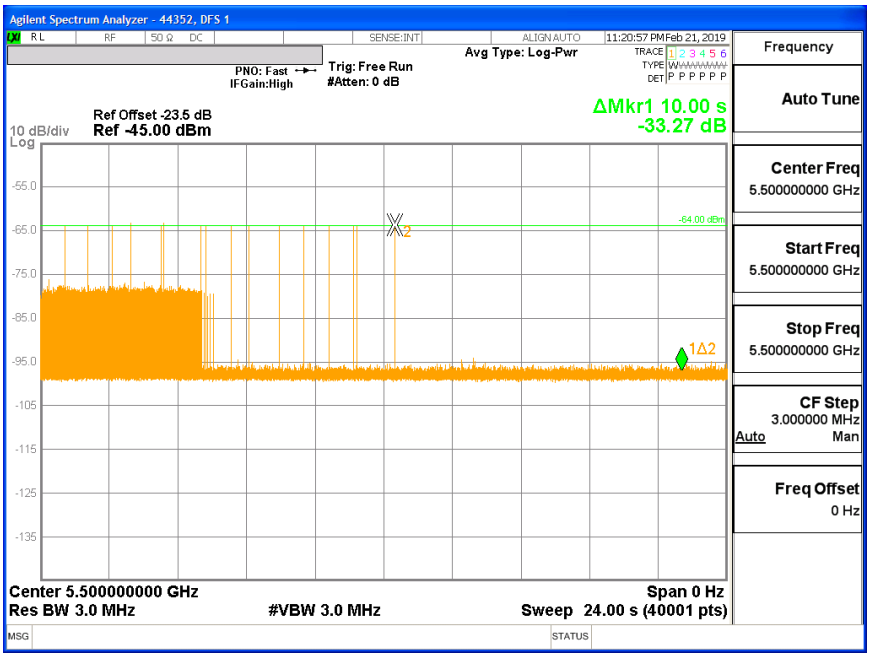
LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR



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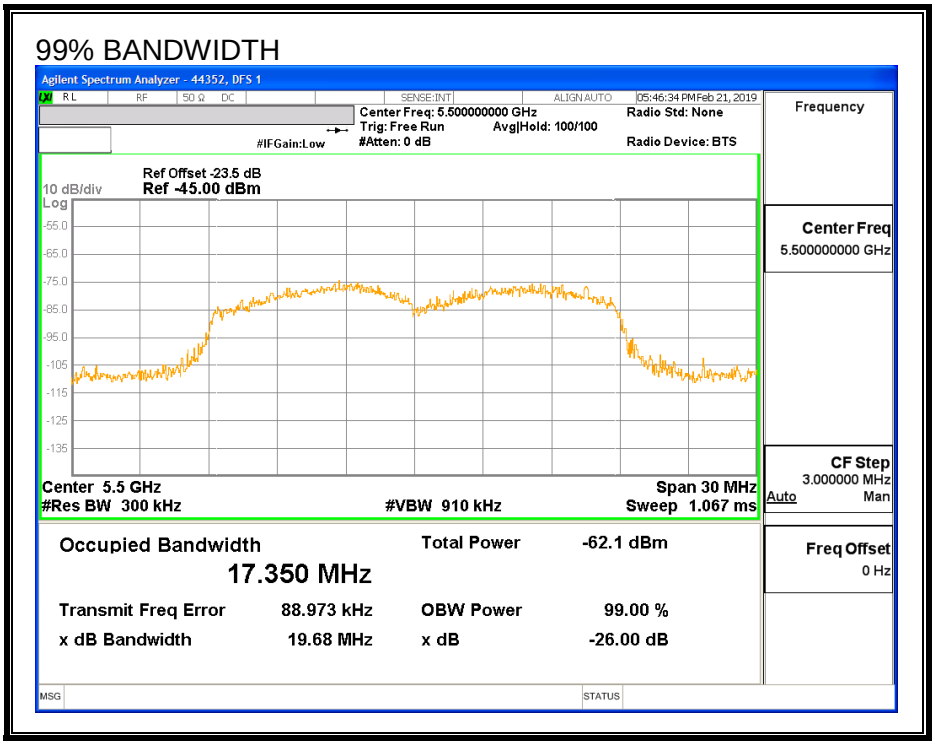
6.2.6. DETECTION BANDWIDTH

REFERENCE PLOT OF 99% POWER BANDWIDTH



RESULTS

FL (MHz)	FH (MHz)	Detection Bandwidth (MHz)	99% Power Bandwidth (MHz)	Ratio of Detection BW to 99% Power BW (%)	Minimum Limit (%)
5490	5510	20	17.350	115.3	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 DFS 1

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

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

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6.2.7. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth FL	Detection Bandwidth FH	OBW	Test Location	Employee Number	In-Service Monitoring Version
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5510	17.35	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 2	30	96.67	60	Pass	5490	5510	17.35	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 3	30	100.00	60	Pass	5490	5510	17.35	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 4	30	93.33	60	Pass	5490	5510	17.35	DFS 1	44352	Version 3.3.4
Aggregate		97.50	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5510	17.35	DFS 1	44352	Version 3.3.4
FCC Hopping Type 6	42	97.62	70	Pass	5490	5510		DFS 1	44352	Version 3.3.4

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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	5509	Yes
1002	1	798	67	A	5491	Yes
1003	1	758	70	A	5504	Yes
1004	1	578	92	A	5499	Yes
1005	1	558	95	A	5491	Yes
1006	1	598	89	A	5503	Yes
1007	1	818	65	A	5490	Yes
1008	1	678	78	A	5498	Yes
1009	1	938	57	A	5509	Yes
1010	1	618	86	A	5497	Yes
1011	1	898	59	A	5496	Yes
1012	1	878	61	A	5505	Yes
1013	1	838	63	A	5508	Yes
1014	1	518	102	A	5496	Yes
1015	1	698	76	A	5507	Yes
1016	1	1210	44	B	5505	Yes
1017	1	1166	46	B	5492	Yes
1018	1	2122	25	B	5503	Yes
1019	1	1013	53	B	5500	Yes
1020	1	904	59	B	5505	Yes
1021	1	2472	22	B	5509	Yes
1022	1	2493	22	B	5492	Yes
1023	1	2996	18	B	5491	Yes
1024	1	1231	43	B	5499	Yes
1025	1	2864	19	B	5507	Yes
1026	1	1078	49	B	5492	Yes
1027	1	1645	33	B	5494	Yes
1028	1	2537	21	B	5492	Yes
1029	1	686	77	B	5496	Yes
1030	1	3061	18	B	5496	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	2.9	187	25	5505	Yes
2002	2.6	179	29	5497	Yes
2003	3.1	164	28	5508	Yes
2004	3	160	26	5506	Yes
2005	3.6	150	24	5492	Yes
2006	1.8	193	23	5499	No
2007	2.7	230	29	5496	Yes
2008	3.2	196	24	5498	Yes
2009	4.3	155	28	5501	Yes
2010	1	207	27	5495	Yes
2011	4.5	171	23	5501	Yes
2012	1.4	150	23	5500	Yes
2013	5	199	27	5510	Yes
2014	4.3	220	23	5497	Yes
2015	4.1	155	25	5490	Yes
2016	3.6	223	28	5498	Yes
2017	1.6	162	23	5492	Yes
2018	1.3	153	27	5505	Yes
2019	1.8	220	26	5492	Yes
2020	1.7	178	27	5496	Yes
2021	2.3	167	29	5500	Yes
2022	4.6	167	28	5501	Yes
2023	1.4	204	27	5496	Yes
2024	2	170	29	5490	Yes
2025	3	211	25	5501	Yes
2026	3.8	181	24	5495	Yes
2027	3.2	188	28	5502	Yes
2028	4.2	205	28	5496	Yes
2029	3.7	173	25	5498	Yes
2030	3	157	28	5497	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	7.8	437	18	5492	Yes
3002	7.3	399	17	5507	Yes
3003	9.4	459	18	5494	Yes
3004	7.2	315	17	5498	Yes
3005	9.6	388	16	5510	Yes
3006	7.5	257	16	5506	Yes
3007	6	476	16	5492	Yes
3008	8.3	358	17	5496	Yes
3009	9.2	339	16	5506	Yes
3010	9.8	484	16	5498	Yes
3011	6.7	360	16	5498	Yes
3012	7.5	401	18	5504	Yes
3013	6.9	289	17	5499	Yes
3014	7.9	343	17	5502	Yes
3015	7.4	495	17	5493	Yes
3016	8.9	326	16	5501	Yes
3017	8.7	491	16	5496	Yes
3018	8.1	453	18	5510	Yes
3019	6.2	395	18	5504	Yes
3020	8.1	369	16	5492	Yes
3021	6.4	442	17	5492	Yes
3022	8.4	311	17	5506	Yes
3023	6.9	279	17	5498	Yes
3024	9.2	412	17	5491	Yes
3025	8.2	393	17	5508	Yes
3026	6.5	287	17	5504	Yes
3027	7.6	414	16	5506	Yes
3028	8.4	455	16	5499	Yes
3029	7.8	343	18	5503	Yes
3030	8.7	397	17	5502	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	16.2	298	15	5494	Yes
4002	14.6	498	15	5495	Yes
4003	18.9	294	16	5501	Yes
4004	17.8	373	14	5503	Yes
4005	17.8	315	15	5501	Yes
4006	12.8	290	15	5503	No
4007	18.1	362	12	5490	Yes
4008	13.6	483	13	5497	Yes
4009	19.3	451	12	5505	Yes
4010	11	333	13	5508	Yes
4011	13	313	13	5503	Yes
4012	18.5	459	12	5504	Yes
4013	16.6	335	16	5508	Yes
4014	13.5	375	16	5494	Yes
4015	12.1	264	13	5499	No
4016	14.3	318	16	5509	Yes
4017	18.2	470	14	5496	Yes
4018	11.7	418	16	5496	Yes
4019	16.1	466	14	5493	Yes
4020	14.9	427	12	5506	Yes
4021	19.7	487	13	5502	Yes
4022	19	461	14	5494	Yes
4023	15.2	416	15	5509	Yes
4024	19.8	403	16	5498	Yes
4025	12.2	371	15	5496	Yes
4026	17.2	253	16	5493	Yes
4027	19.2	485	16	5506	Yes
4028	15.6	262	15	5496	Yes
4029	13.7	255	15	5492	Yes
4030	19.7	296	14	5505	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	5500	Yes
2	5500	Yes
3	5500	Yes
4	5500	Yes
5	5500	Yes
6	5500	Yes
7	5500	Yes
8	5500	Yes
9	5500	Yes
10	5500	Yes
11	5500	Yes
12	5496	Yes
13	5495	Yes
14	5499	Yes
15	5498	Yes
16	5499	Yes
17	5495	Yes
18	5500	Yes
19	5494	Yes
20	5499	Yes
21	5505	Yes
22	5505	Yes
23	5503	Yes
24	5503	Yes
25	5505	Yes
26	5501	Yes
27	5505	Yes
28	5506	Yes
29	5500	Yes
30	5505	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	147	5490	3	Yes
2	622	5491	6	Yes
3	1097	5492	3	Yes
4	1572	5493	2	Yes
5	2047	5494	4	Yes
6	2522	5495	4	Yes
7	2997	5496	2	Yes
8	3472	5497	4	Yes
9	3947	5498	6	Yes
10	4422	5499	3	Yes
11	4897	5500	8	Yes
12	5372	5501	6	Yes
13	5847	5502	7	Yes
14	6322	5503	3	Yes
15	6797	5504	4	Yes
16	7272	5505	5	Yes
17	7747	5506	5	Yes
18	8222	5507	6	Yes
19	8697	5508	5	No
20	9172	5509	5	Yes
21	9647	5510	5	Yes
22	10122	5490	2	Yes
23	10597	5491	4	Yes
24	11072	5492	5	Yes
25	11547	5493	4	Yes
26	12022	5494	6	Yes
27	12497	5495	6	Yes
28	12972	5496	8	Yes
29	13447	5497	6	Yes
30	13922	5498	2	Yes
31	14397	5499	2	Yes
32	14872	5500	3	Yes
33	15347	5501	4	Yes
34	15822	5502	3	Yes
35	16297	5503	2	Yes
36	16772	5504	6	Yes
37	17247	5505	4	Yes
38	17722	5506	7	Yes
39	18197	5507	8	Yes
40	18672	5508	5	Yes
41	19147	5509	7	Yes
42	19622	5510	3	Yes

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6.3. RESULTS FOR 40 MHz BANDWIDTH

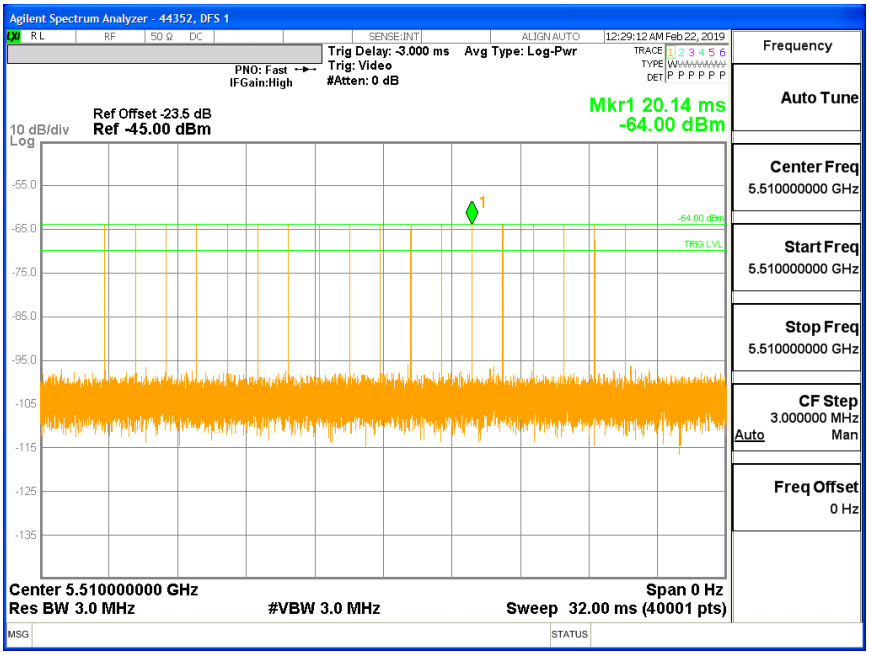
6.3.1. TEST CHANNEL

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

6.3.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

SHORT PULSE RADAR TYPE 0



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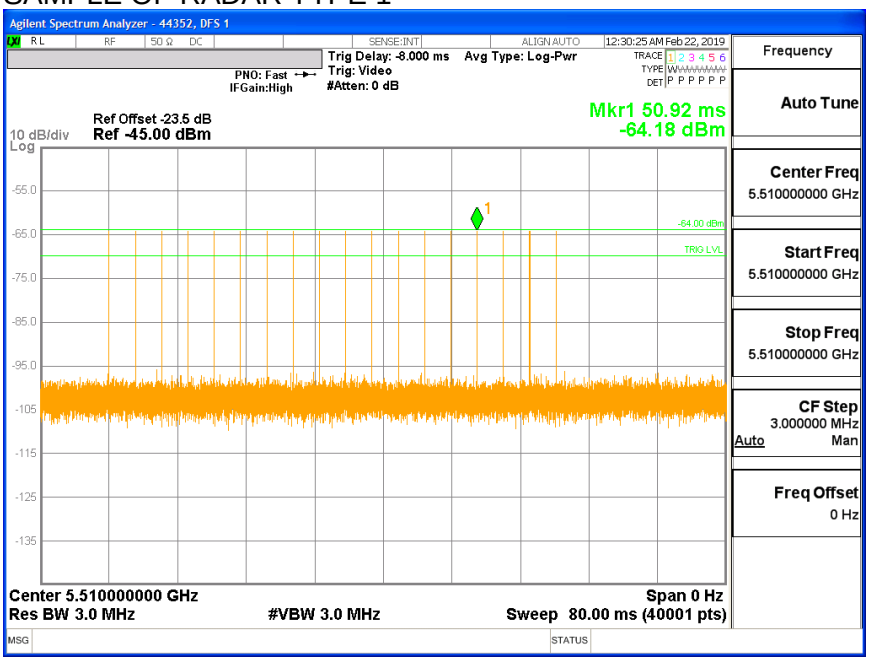
SAMPLE OF RADAR TYPE 1



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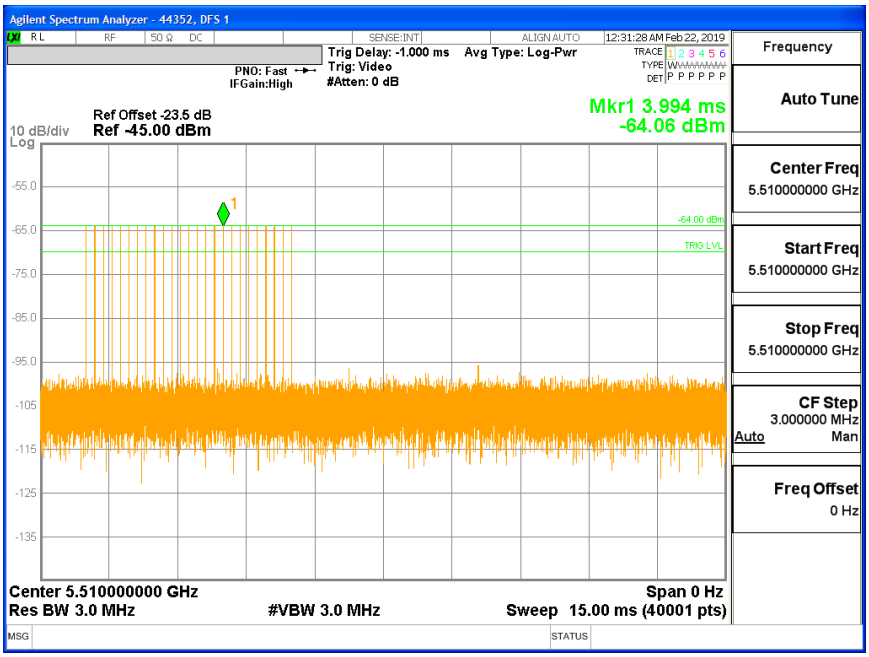
SAMPLE OF RADAR TYPE 2



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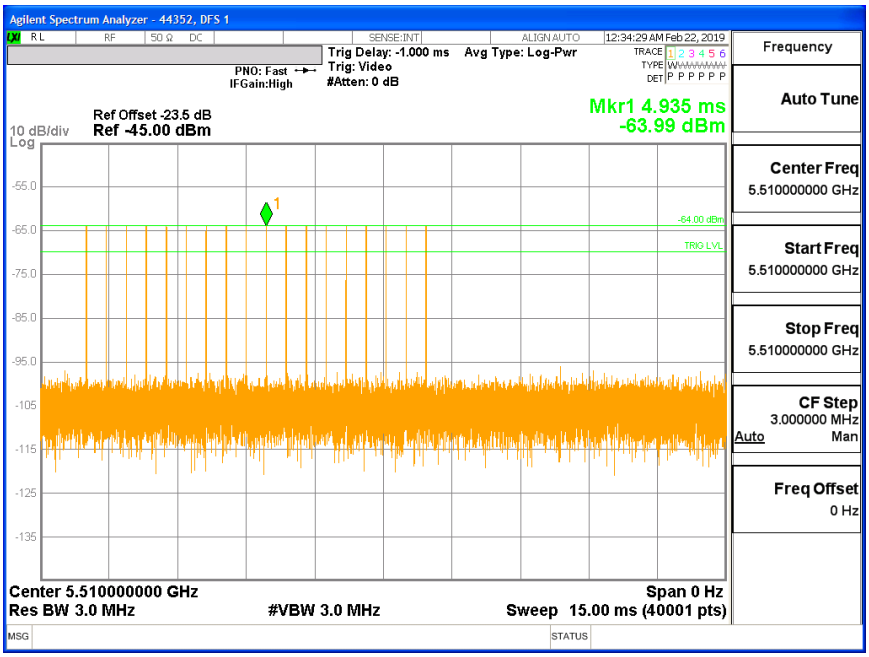
SAMPLE OF RADAR TYPE 3



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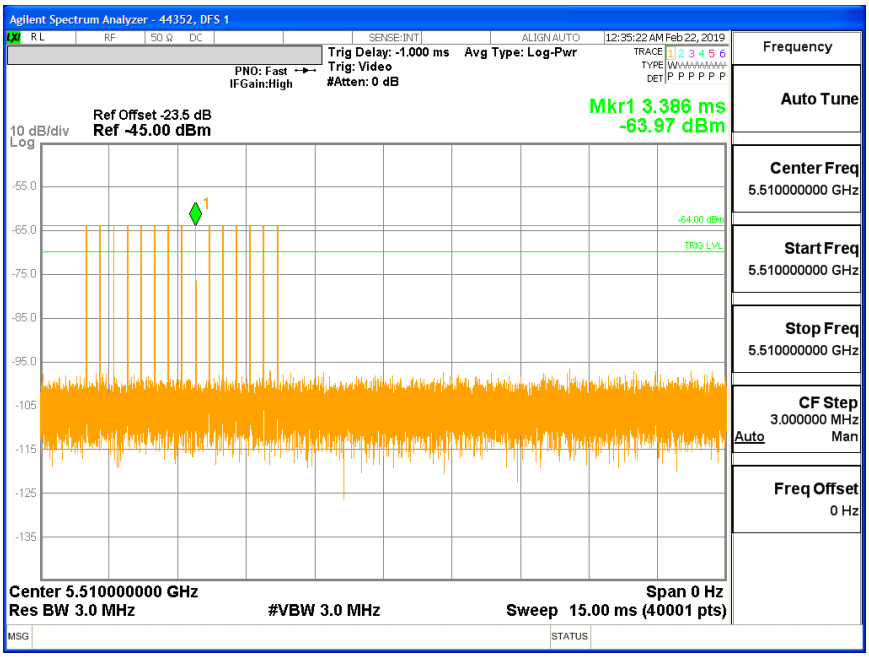
SAMPLE OF RADAR TYPE 4



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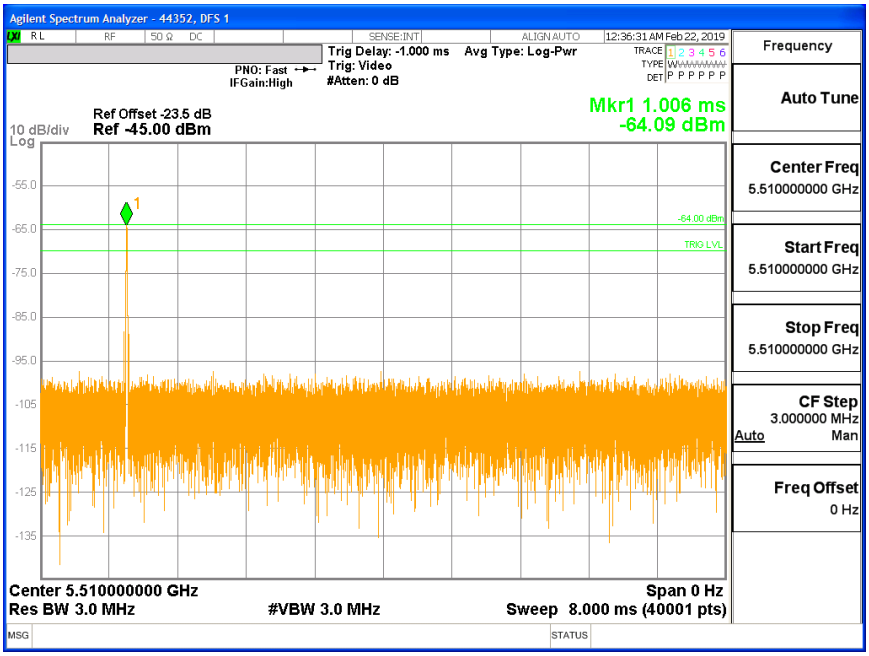
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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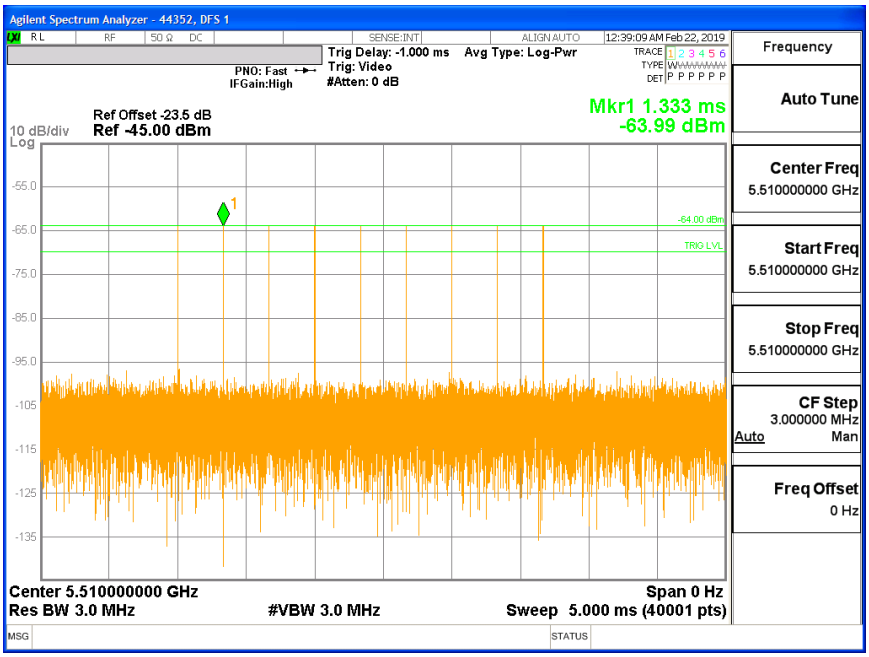
SINGLE BURST OF RADAR TYPE 6



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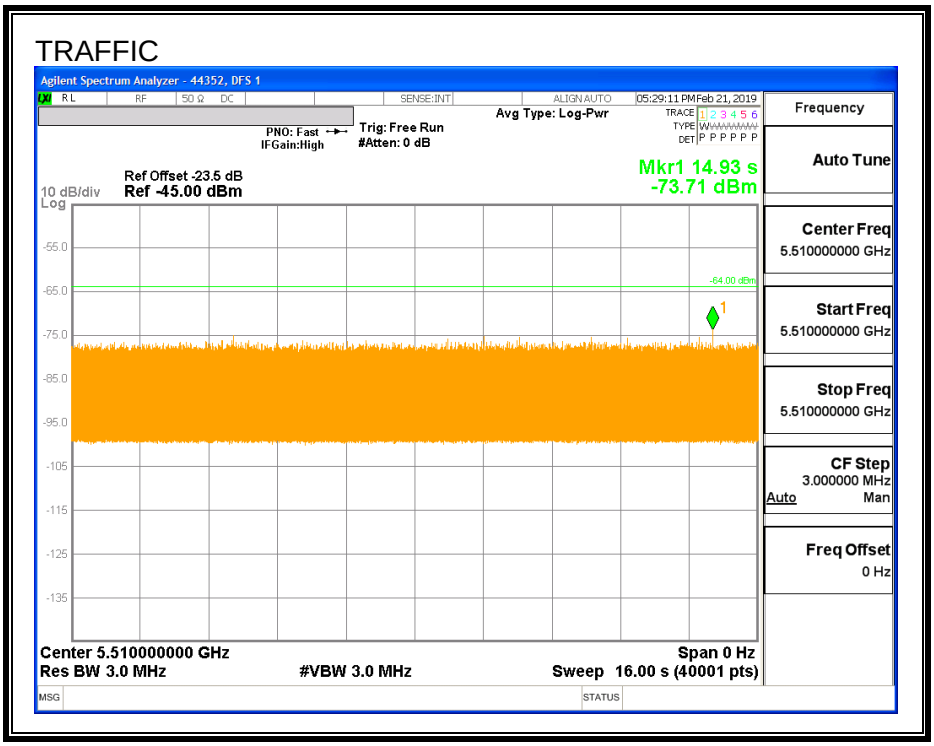
TRAFFIC



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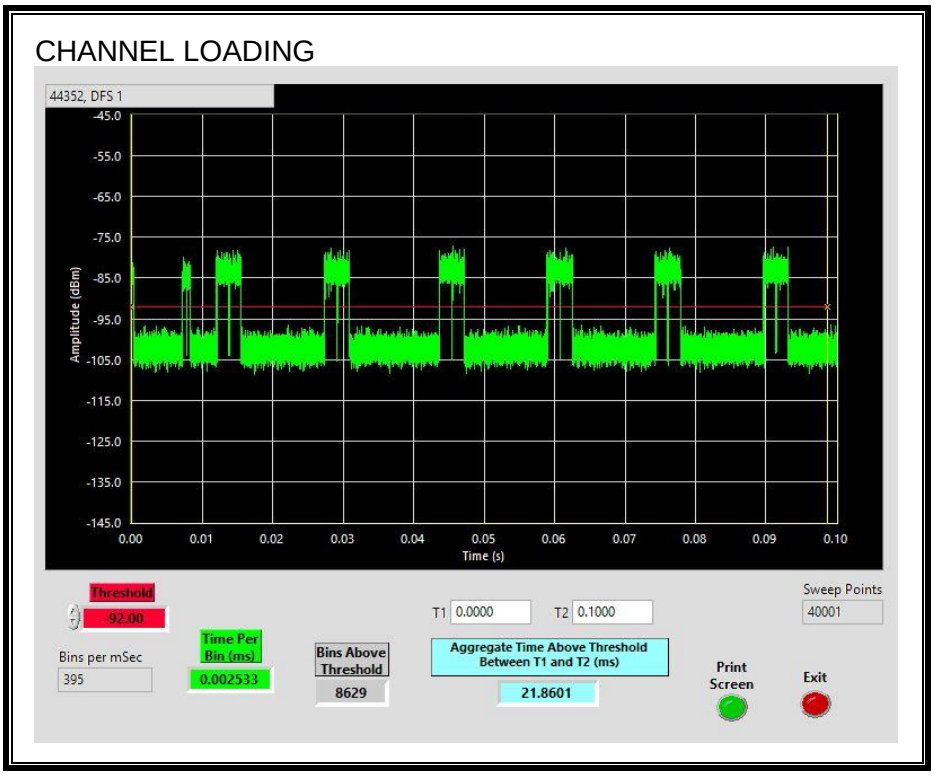
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 21.8601%.

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6.3.3. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

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

PROCEDURE FOR TIMING OF RADAR BURST

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

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

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QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.27	175.3	145.0	85.0

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)
30.22	117.4	87.2	2.2

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)
30.25	173.1	142.9	57.8

QUALITATIVE RESULTS

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

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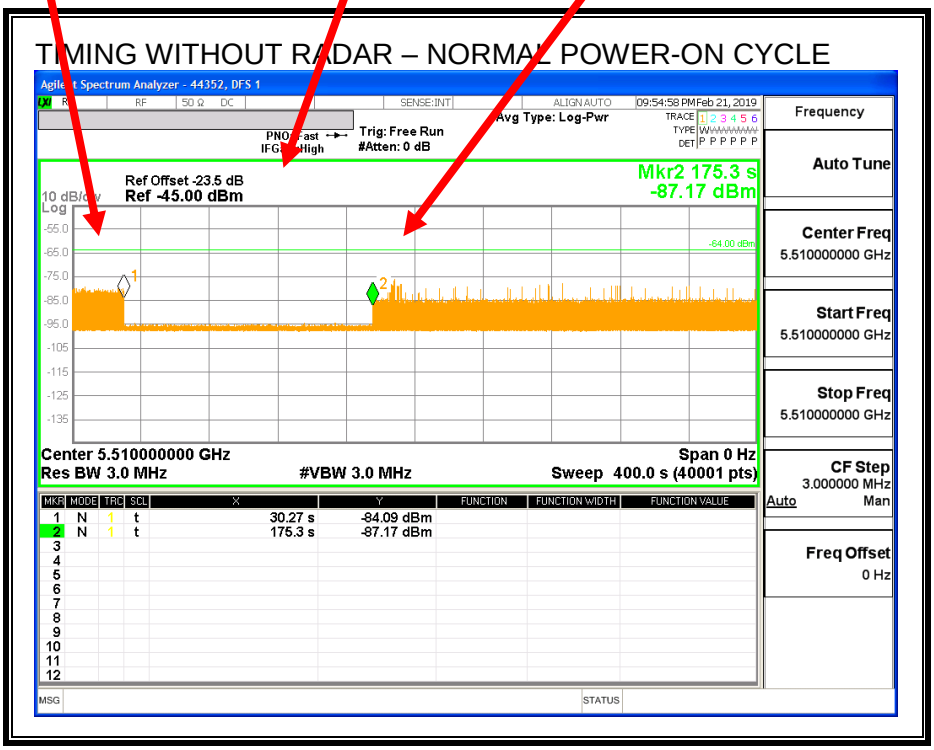
TIMING WITHOUT RADAR DURING CAC

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

End of Initial Power-up cycle
Start of CAC

End of CAC
Traffic is Initiated



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

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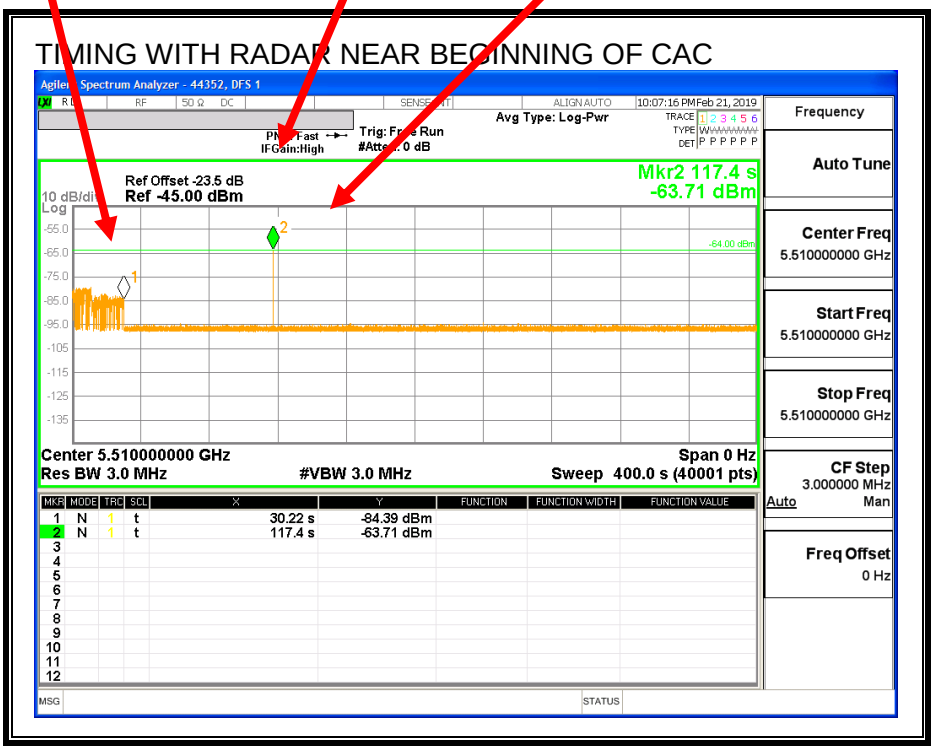
TIMING WITH RADAR NEAR BEGINNING OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

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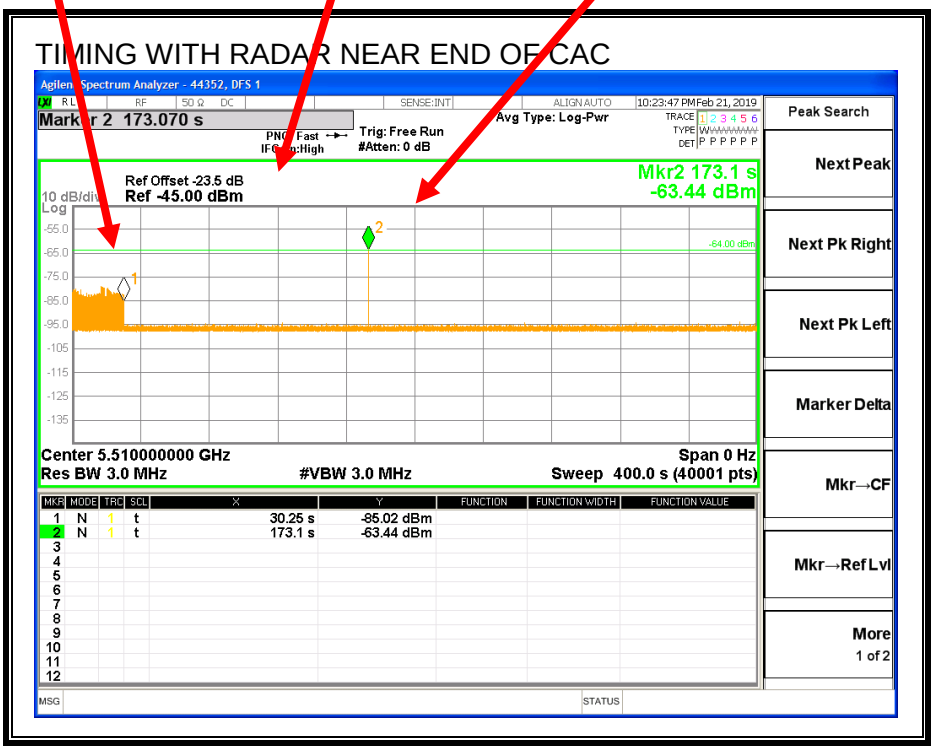
TIMING WITH RADAR NEAR END OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

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6.3.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

These tests are not applicable.

6.3.5. 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)
0.425	10

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

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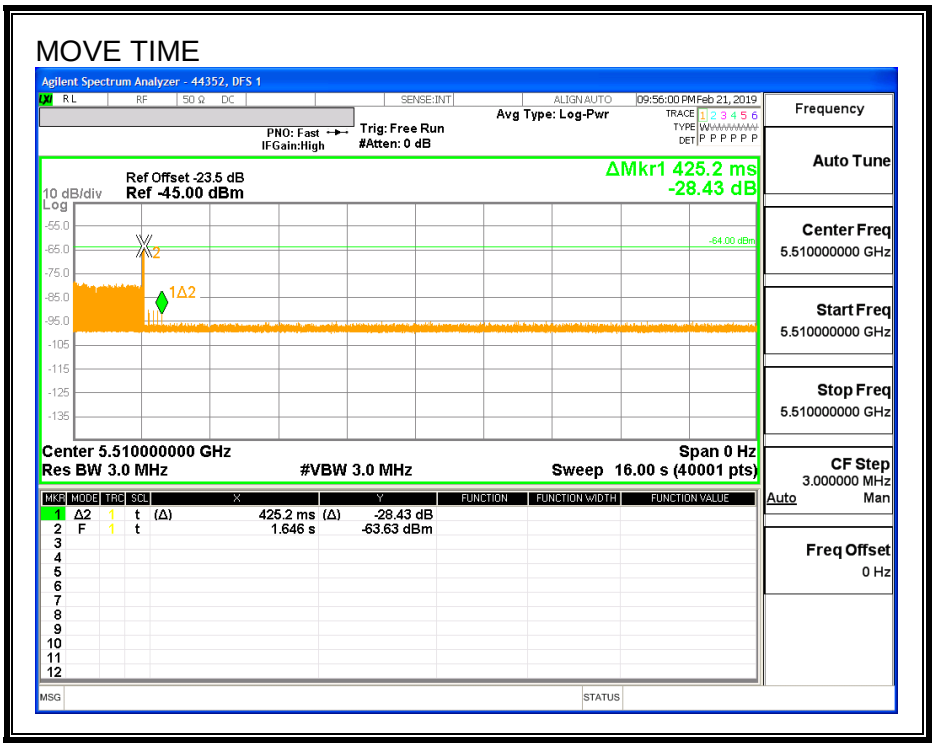
MOVE TIME



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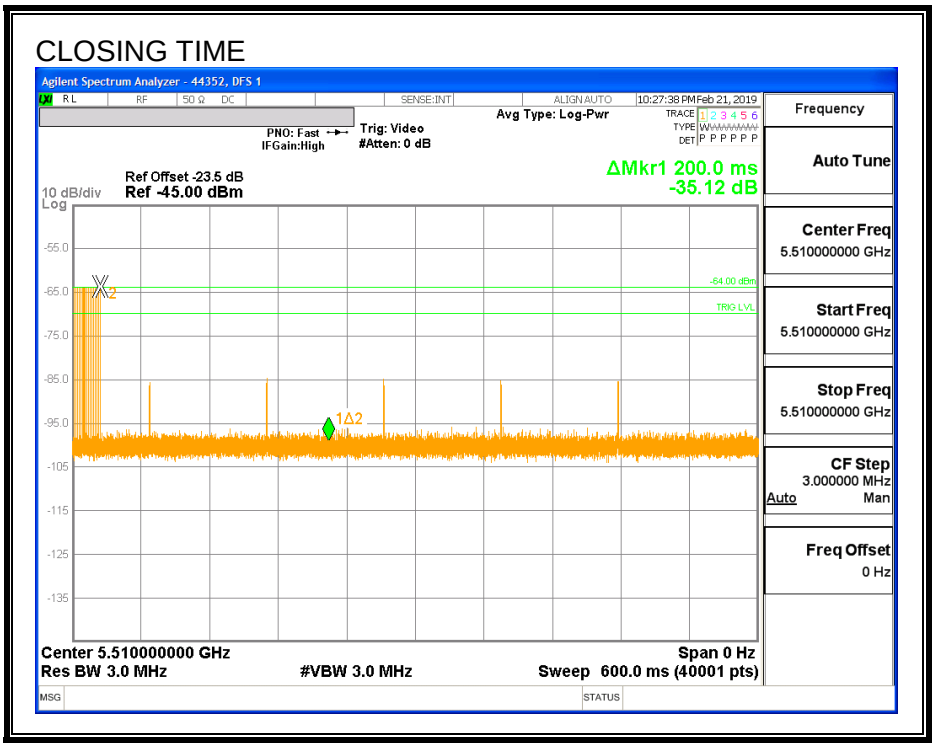
CHANNEL CLOSING TIME



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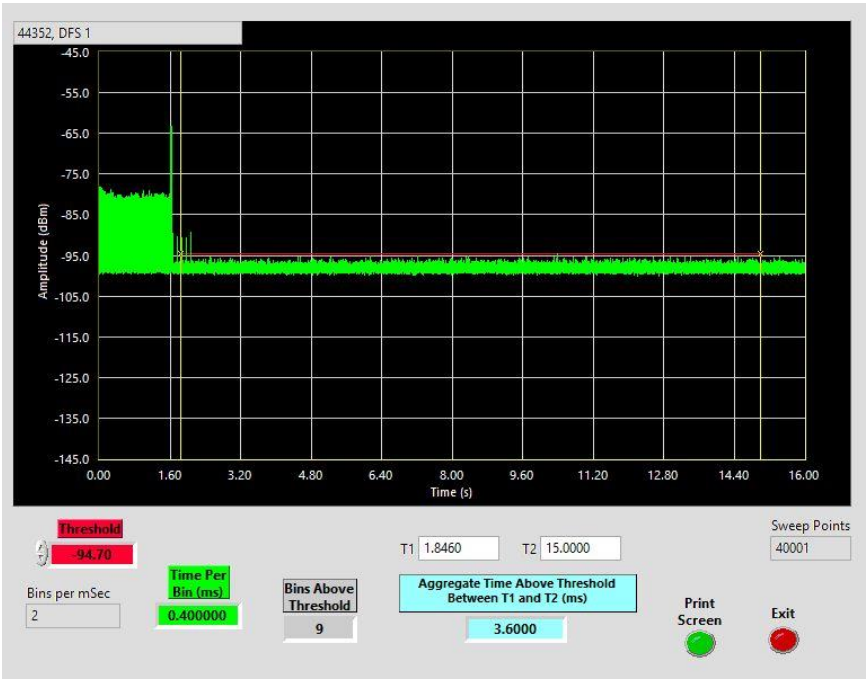
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.

AGGREGATE CLOSING TIME



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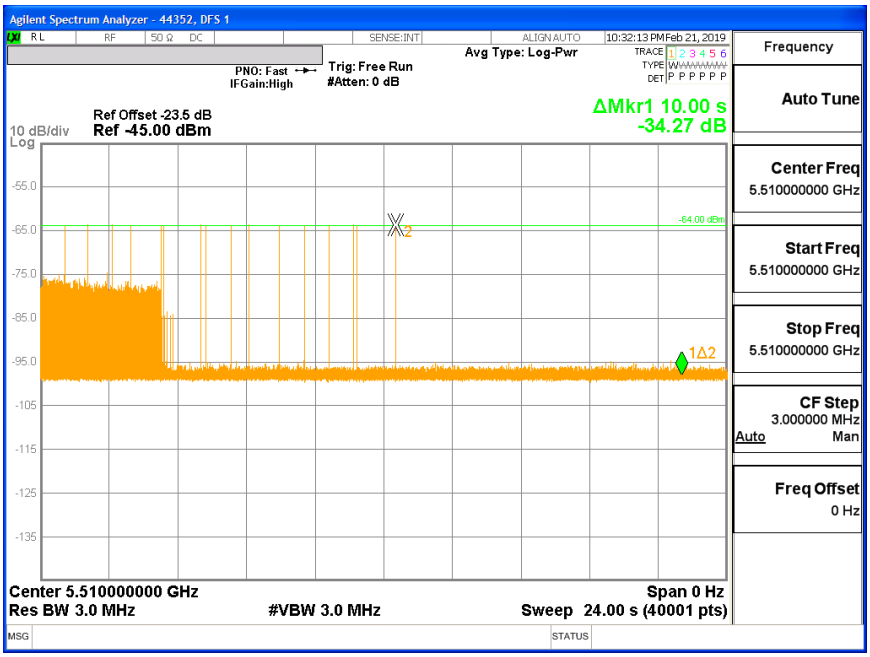
LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR



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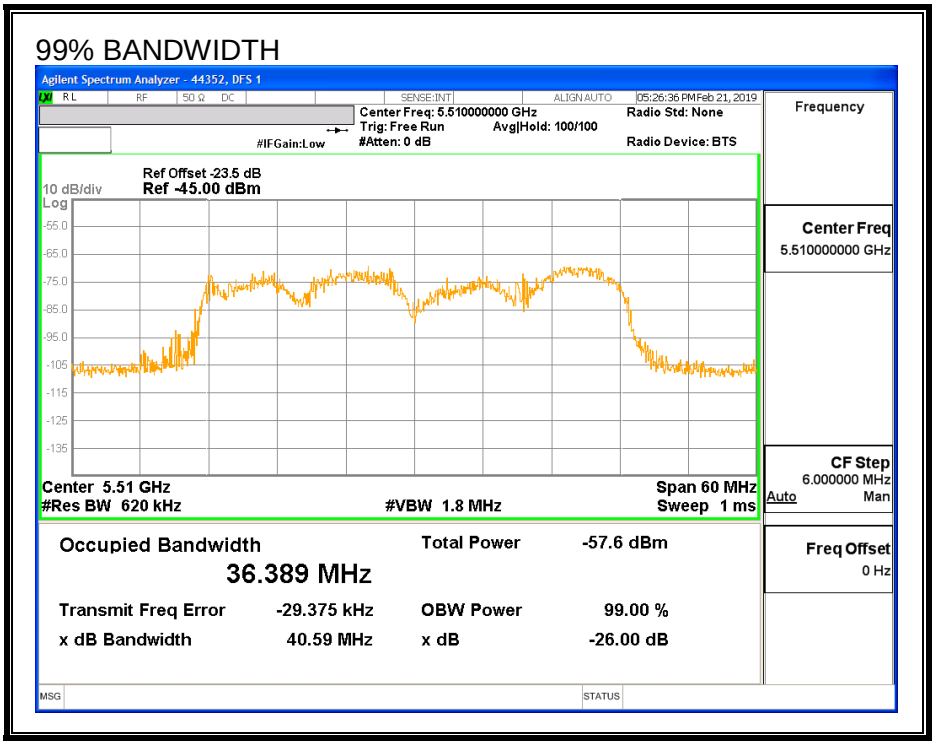
6.3.6. DETECTION BANDWIDTH

REFERENCE PLOT OF 99% POWER BANDWIDTH



RESULTS

FL (MHz)	FH (MHz)	Detection Bandwidth (MHz)	99% Power Bandwidth (MHz)	Ratio of Detection BW to 99% Power BW (%)	Minimum Limit (%)
5490	5530	40	36.389	109.9	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 44352 DFS 1

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

Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5489	10	0	0	
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	
5515	10	10	100	
5520	10	10	100	
5525	10	10	100	
5530	10	10	100	FH
5531	10	0	0	

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6.3.7. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth FL	Detection Bandwidth FH	OBW	Test Location	Employee Number	In-Service Monitoring Version
FCC Short Pulse Type 1	30	100.00	60	Pass	5490	5530	36.39	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 2	30	93.33	60	Pass	5490	5530	36.39	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 3	30	93.33	60	Pass	5490	5530	36.39	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 4	30	93.33	60	Pass	5490	5530	36.39	DFS 1	44352	Version 3.3.4
Aggregate		95.00	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5530	36.39	DFS 1	44352	Version 3.3.4
FCC Hopping Type 6	41	100.00	70	Pass	5490	5530		DFS 1	44352	Version 3.3.4

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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	5494	Yes
1002	1	798	67	A	5509	Yes
1003	1	758	70	A	5490	Yes
1004	1	578	92	A	5529	Yes
1005	1	558	95	A	5491	Yes
1006	1	598	89	A	5530	Yes
1007	1	818	65	A	5507	Yes
1008	1	678	78	A	5524	Yes
1009	1	938	57	A	5512	Yes
1010	1	618	86	A	5510	Yes
1011	1	898	59	A	5524	Yes
1012	1	878	61	A	5509	Yes
1013	1	838	63	A	5529	Yes
1014	1	518	102	A	5527	Yes
1015	1	698	76	A	5493	Yes
1016	1	1210	44	B	5510	Yes
1017	1	1166	46	B	5514	Yes
1018	1	2122	25	B	5499	Yes
1019	1	1013	53	B	5527	Yes
1020	1	904	59	B	5522	Yes
1021	1	2472	22	B	5518	Yes
1022	1	2493	22	B	5491	Yes
1023	1	2996	18	B	5512	Yes
1024	1	1231	43	B	5511	Yes
1025	1	2864	19	B	5518	Yes
1026	1	1078	49	B	5517	Yes
1027	1	1645	33	B	5504	Yes
1028	1	2537	21	B	5491	Yes
1029	1	686	77	B	5526	Yes
1030	1	3061	18	B	5496	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	2.9	187	25	5497	Yes
2002	2.6	179	29	5513	Yes
2003	3.1	164	28	5511	No
2004	3	160	26	5522	Yes
2005	3.6	150	24	5501	Yes
2006	1.8	193	23	5507	Yes
2007	2.7	230	29	5528	Yes
2008	3.2	196	24	5498	Yes
2009	4.3	155	28	5503	Yes
2010	1	207	27	5498	Yes
2011	4.5	171	23	5500	Yes
2012	1.4	150	23	5524	Yes
2013	5	199	27	5501	Yes
2014	4.3	220	23	5525	Yes
2015	4.1	155	25	5516	No
2016	3.6	223	28	5494	Yes
2017	1.6	162	23	5508	Yes
2018	1.3	153	27	5506	Yes
2019	1.8	220	26	5513	Yes
2020	1.7	178	27	5511	Yes
2021	2.3	167	29	5529	Yes
2022	4.6	167	28	5511	Yes
2023	1.4	204	27	5521	Yes
2024	2	170	29	5496	Yes
2025	3	211	25	5505	Yes
2026	3.8	181	24	5506	Yes
2027	3.2	188	28	5508	Yes
2028	4.2	205	28	5516	Yes
2029	3.7	173	25	5526	Yes
2030	3	157	28	5522	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	7.8	437	18	5507	Yes
3002	7.3	399	17	5491	Yes
3003	9.4	459	18	5516	Yes
3004	7.2	315	17	5515	Yes
3005	9.6	388	16	5507	No
3006	7.5	257	16	5512	Yes
3007	6	476	16	5492	Yes
3008	8.3	358	17	5502	Yes
3009	9.2	339	16	5520	Yes
3010	9.8	484	16	5497	Yes
3011	6.7	360	16	5505	Yes
3012	7.5	401	18	5510	Yes
3013	6.9	289	17	5524	No
3014	7.9	343	17	5496	Yes
3015	7.4	495	17	5502	Yes
3016	8.9	326	16	5510	Yes
3017	8.7	491	16	5503	Yes
3018	8.1	453	18	5529	Yes
3019	6.2	395	18	5494	Yes
3020	8.1	369	16	5514	Yes
3021	6.4	442	17	5493	Yes
3022	8.4	311	17	5512	Yes
3023	6.9	279	17	5518	Yes
3024	9.2	412	17	5527	Yes
3025	8.2	393	17	5519	Yes
3026	6.5	287	17	5510	Yes
3027	7.6	414	16	5500	Yes
3028	8.4	455	16	5525	Yes
3029	7.8	343	18	5527	Yes
3030	8.7	397	17	5519	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	16.2	298	15	5530	Yes
4002	14.6	498	15	5525	Yes
4003	18.9	294	16	5494	Yes
4004	17.8	373	14	5511	Yes
4005	17.8	315	15	5509	Yes
4006	12.8	290	15	5508	Yes
4007	18.1	362	12	5515	Yes
4008	13.6	483	13	5516	Yes
4009	19.3	451	12	5507	Yes
4010	11	333	13	5513	Yes
4011	13	313	13	5516	No
4012	18.5	459	12	5511	No
4013	16.6	335	16	5524	Yes
4014	13.5	375	16	5491	Yes
4015	12.1	264	13	5490	Yes
4016	14.3	318	16	5515	Yes
4017	18.2	470	14	5523	Yes
4018	11.7	418	16	5523	Yes
4019	16.1	466	14	5529	Yes
4020	14.9	427	12	5497	Yes
4021	19.7	487	13	5525	Yes
4022	19	461	14	5511	Yes
4023	15.2	416	15	5503	Yes
4024	19.8	403	16	5522	Yes
4025	12.2	371	15	5516	Yes
4026	17.2	253	16	5515	Yes
4027	19.2	485	16	5519	Yes
4028	15.6	262	15	5524	Yes
4029	13.7	255	15	5518	Yes
4030	19.7	296	14	5519	Yes

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TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5510	Yes
2	5510	Yes
3	5510	Yes
4	5510	Yes
5	5510	Yes
6	5510	Yes
7	5510	Yes
8	5510	Yes
9	5510	Yes
10	5510	Yes
11	5500	Yes
12	5496	Yes
13	5496	Yes
14	5499	Yes
15	5499	Yes
16	5499	Yes
17	5496	Yes
18	5500	Yes
19	5494	Yes
20	5500	Yes
21	5525	Yes
22	5525	Yes
23	5523	Yes
24	5522	Yes
25	5525	Yes
26	5520	Yes
27	5525	Yes
28	5525	Yes
29	5520	Yes
30	5525	Yes

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

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TYPE 6 DETECTION PROBABILITY

Data Sheet for FCC Hopping Radar Type 6				
1 us Pulse Width, 333 us PRI, 9 Pulses per Burst, 1 Burst per Hop				
NTIA August 2005 Hopping Sequence				
Trial	Starting Index Within Sequence	Signal Generator Frequency (MHz)	Hops within Detection BW	Successful Detection (Yes/No)
1	244	5490	9	Yes
2	719	5491	10	Yes
3	1194	5492	10	Yes
4	1669	5493	5	Yes
5	2144	5494	2	Yes
6	2619	5495	10	Yes
7	3094	5496	11	Yes
8	3569	5497	6	Yes
9	4044	5498	5	Yes
10	4519	5499	10	Yes
11	4994	5500	6	Yes
12	5469	5501	12	Yes
13	5944	5502	5	Yes
14	6419	5503	7	Yes
15	6894	5504	10	Yes
16	7369	5505	8	Yes
17	7844	5506	13	Yes
18	8319	5507	8	Yes
19	8794	5508	6	Yes
20	9269	5509	5	Yes
21	9744	5510	14	Yes
22	10219	5511	10	Yes
23	10694	5512	9	Yes
24	11169	5513	8	Yes
25	11644	5514	11	Yes
26	12119	5515	6	Yes
27	12594	5516	5	Yes
28	13069	5517	9	Yes
29	13544	5518	2	Yes
30	14019	5519	10	Yes
31	14494	5520	8	Yes
32	14969	5521	7	Yes
33	15444	5522	8	Yes
34	15919	5523	8	Yes
35	16394	5524	8	Yes
36	16869	5525	8	Yes
37	17344	5526	9	Yes
38	17819	5527	11	Yes
39	18294	5528	5	Yes
40	18769	5529	4	Yes
41	19244	5530	9	Yes

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6.4. RESULTS FOR 80 MHz BANDWIDTH

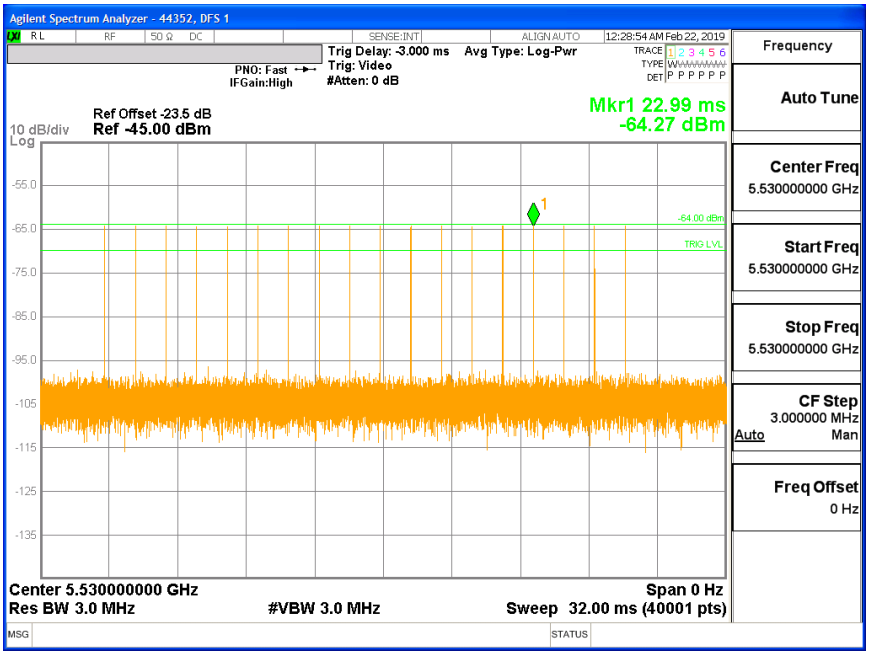
6.4.1. TEST CHANNEL

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

6.4.2. RADAR WAVEFORMS AND TRAFFIC

RADAR WAVEFORMS

SHORT PULSE RADAR TYPE 0



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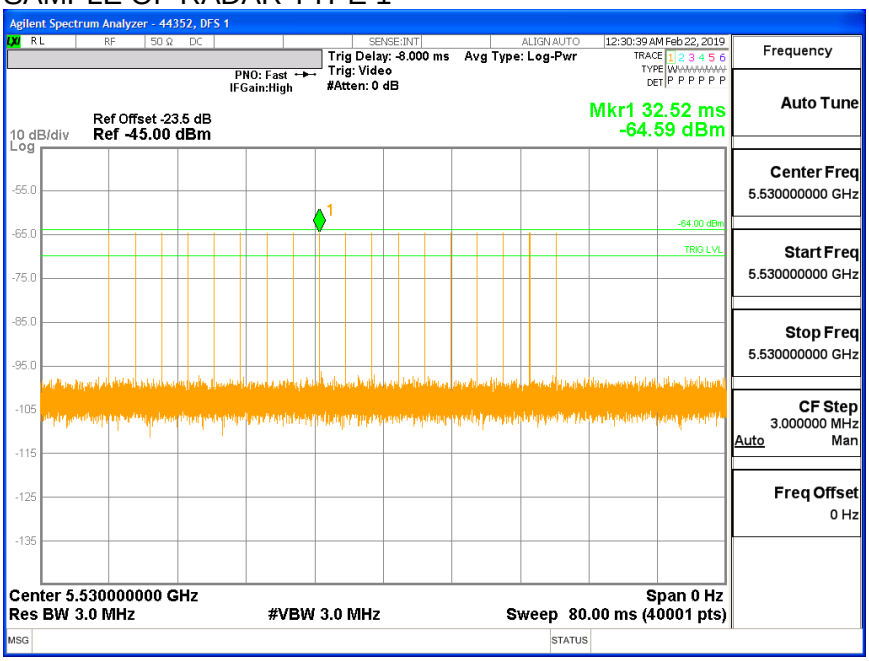
SAMPLE OF RADAR TYPE 1



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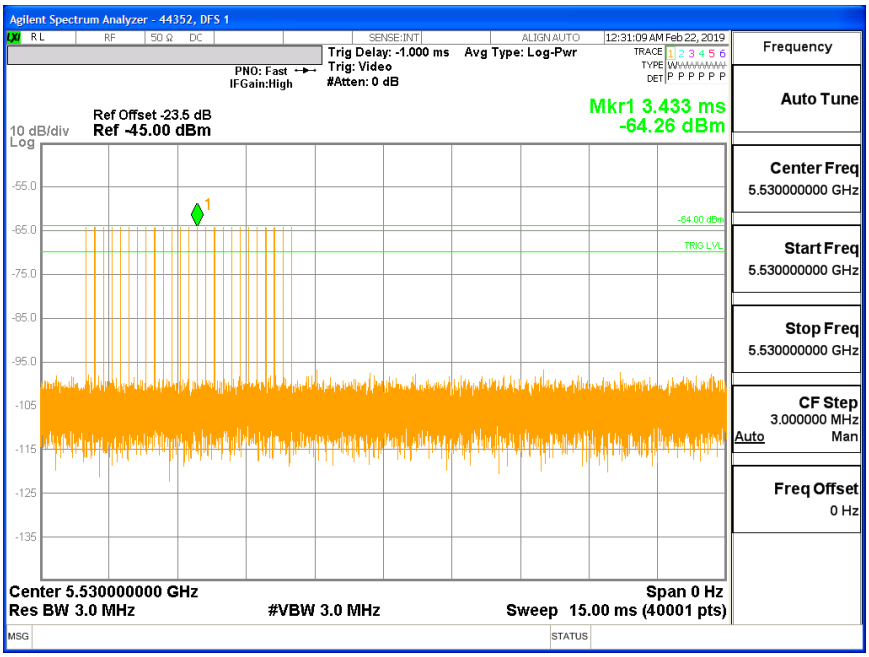
SAMPLE OF RADAR TYPE 2



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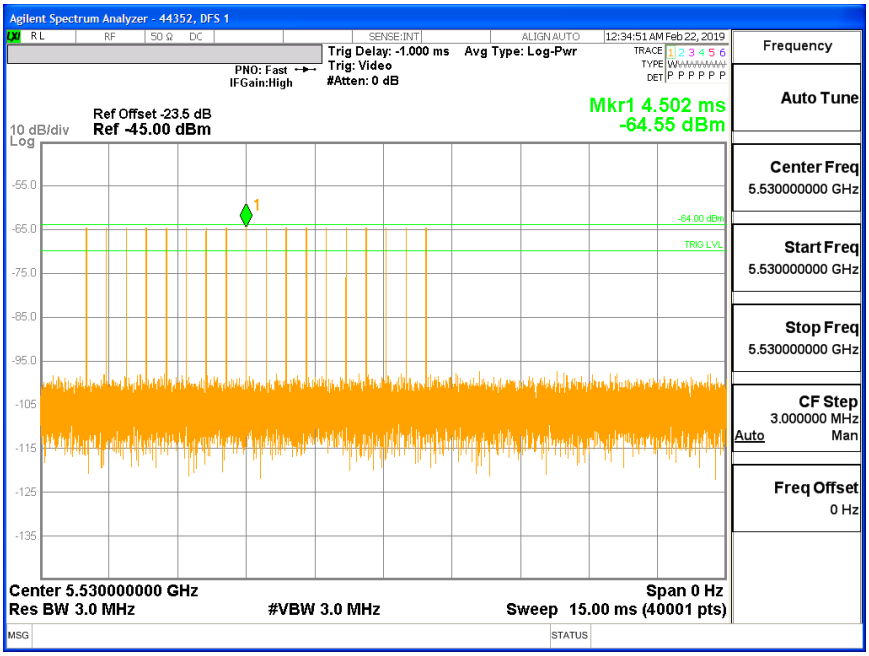
SAMPLE OF RADAR TYPE 3



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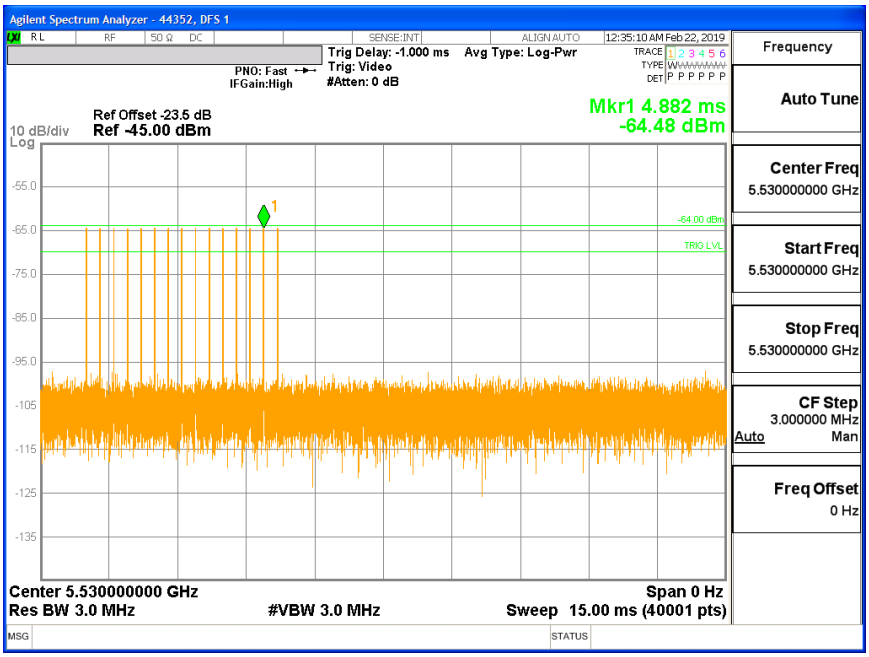
SAMPLE OF RADAR TYPE 4



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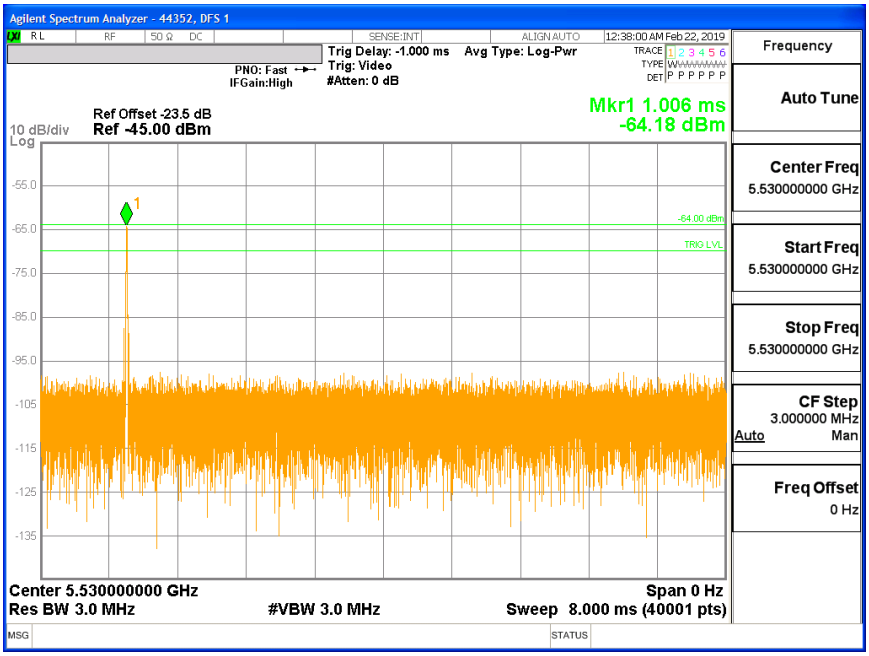
SAMPLE OF SINGLE BURST OF RADAR TYPE 5



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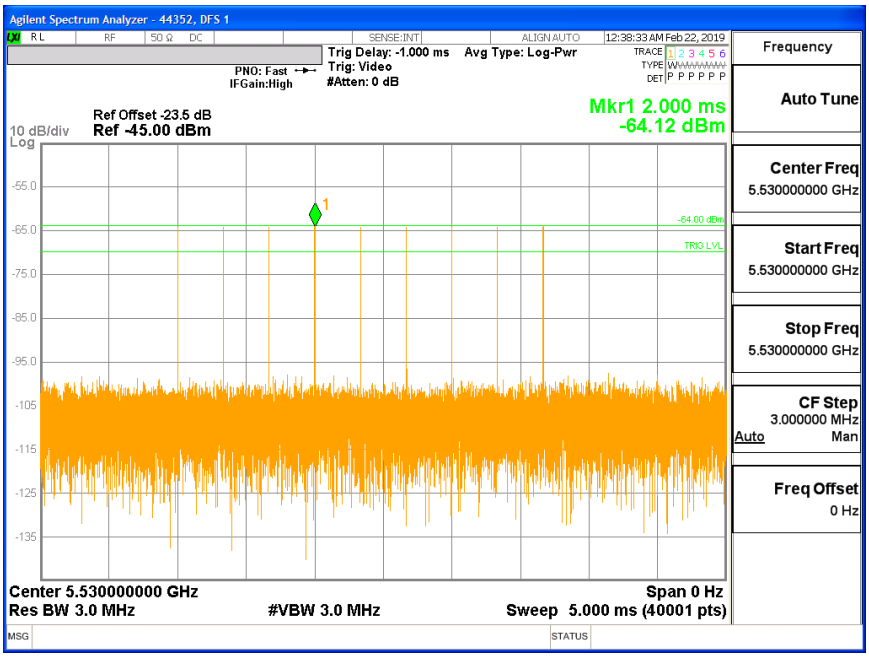
SINGLE BURST OF RADAR TYPE 6



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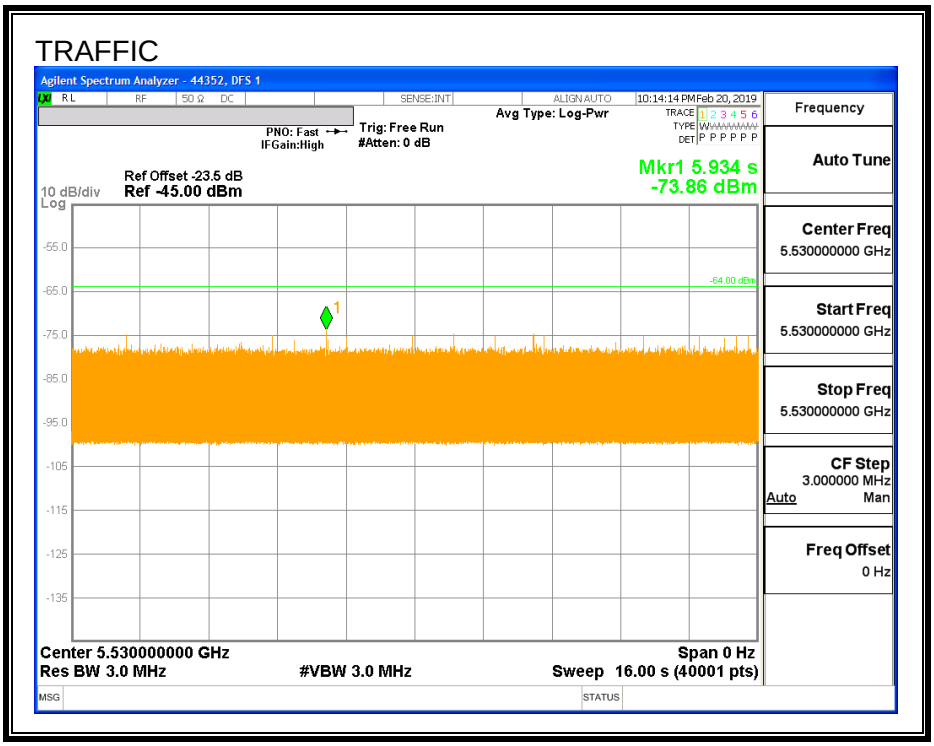
TRAFFIC



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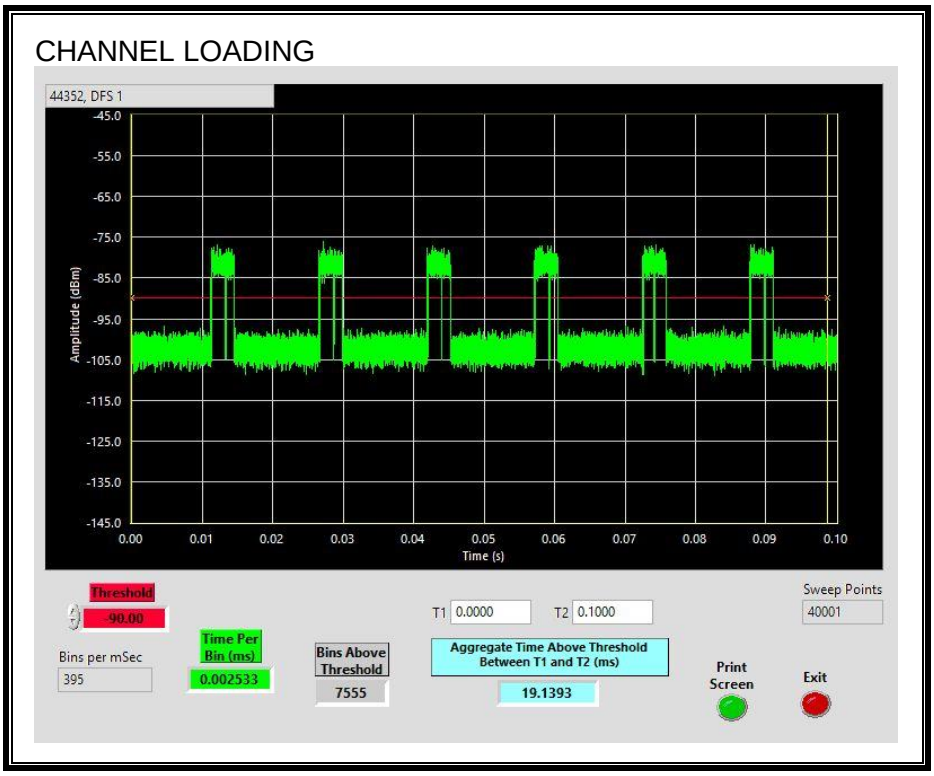
CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 19.1393%.

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6.4.3. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

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

PROCEDURE FOR TIMING OF RADAR BURST

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

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

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QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.33	175.9	145.6	85.6

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)
30.14	117.4	87.3	1.7

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)
30.16	174.0	143.8	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

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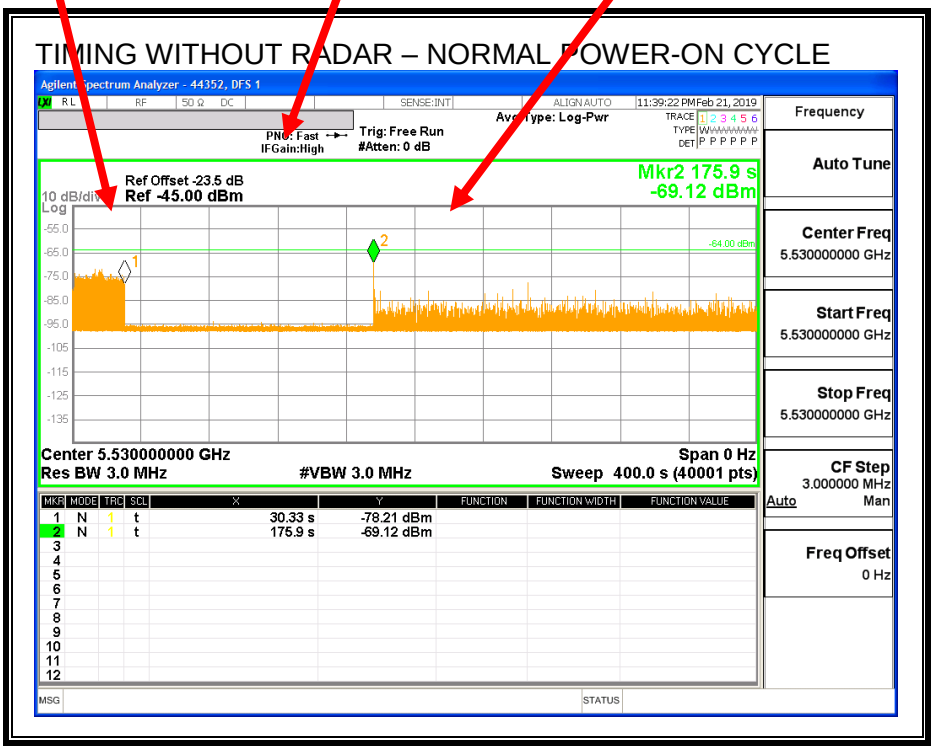
TIMING WITHOUT RADAR DURING CAC

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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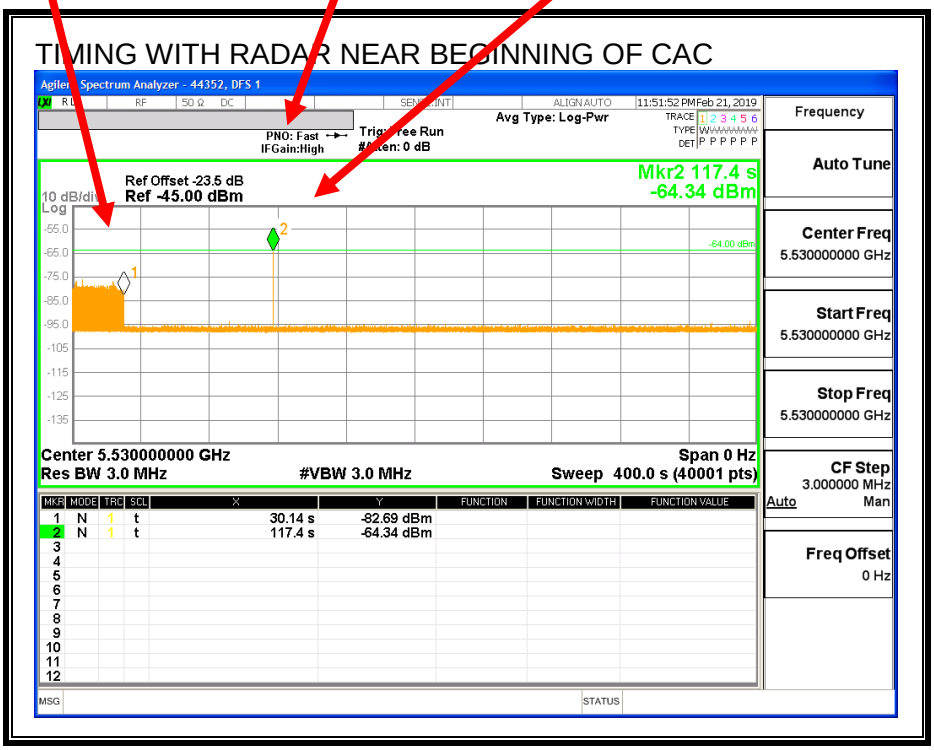
TIMING WITH RADAR NEAR BEGINNING OF CAC

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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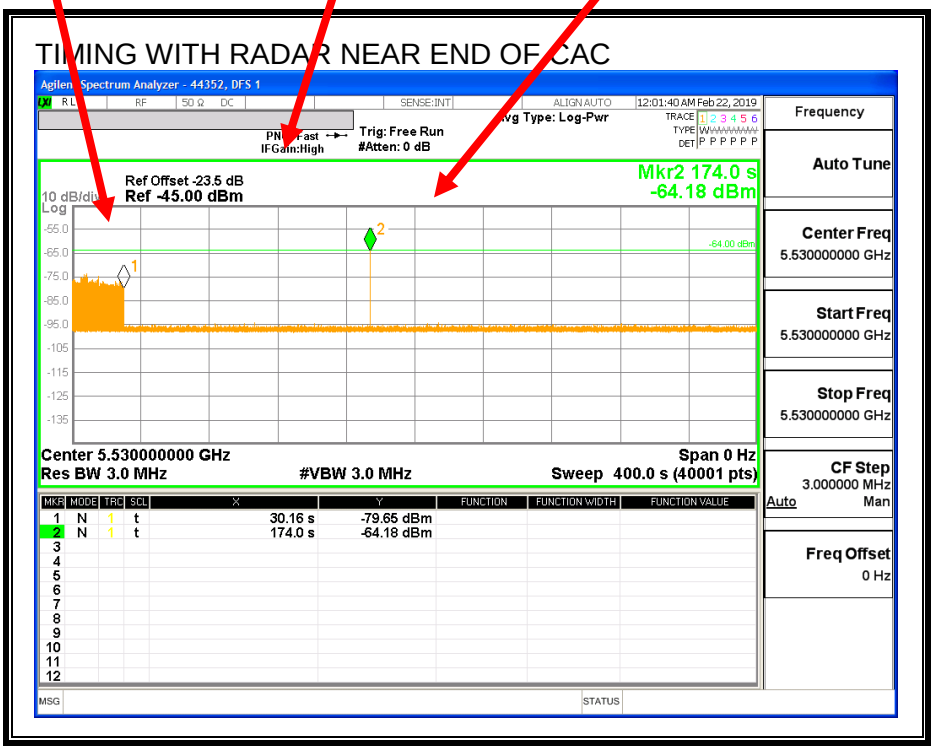
TIMING WITH RADAR NEAR END OF CAC

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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6.4.4. OVERLAPPING CHANNEL TESTS

RESULTS

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

These tests are not applicable.

6.4.5. 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)
0.000	10

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

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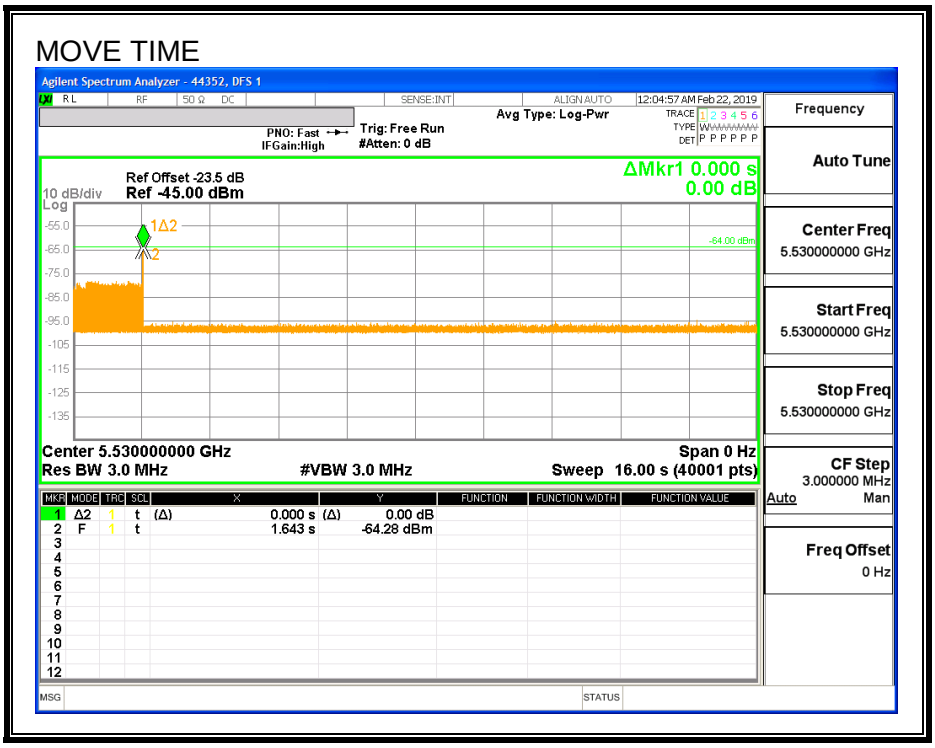
MOVE TIME



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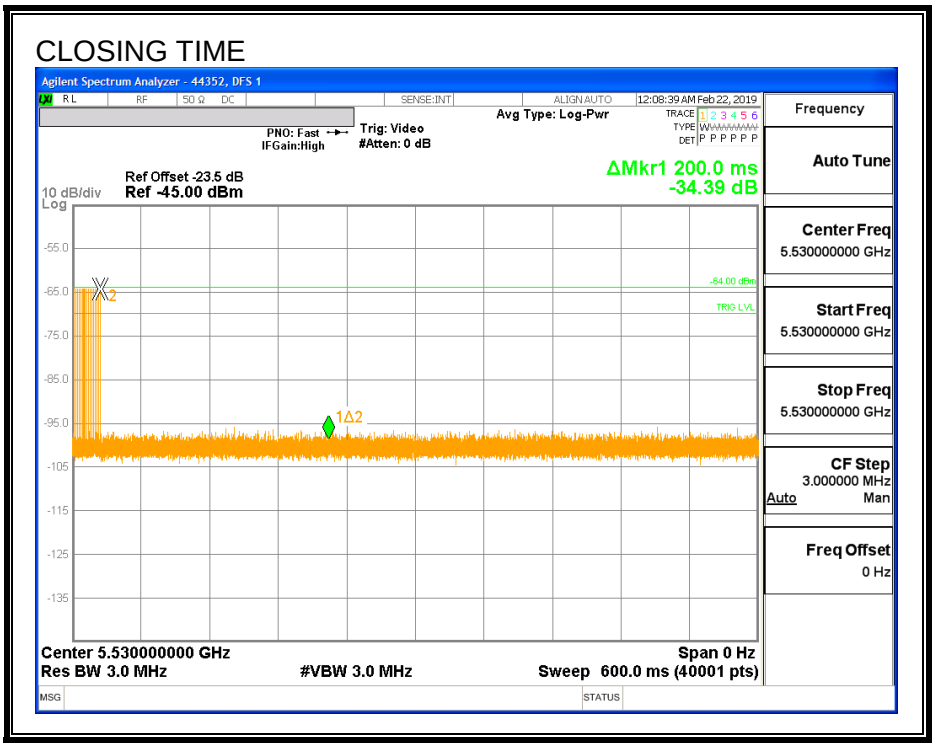
CHANNEL CLOSING TIME



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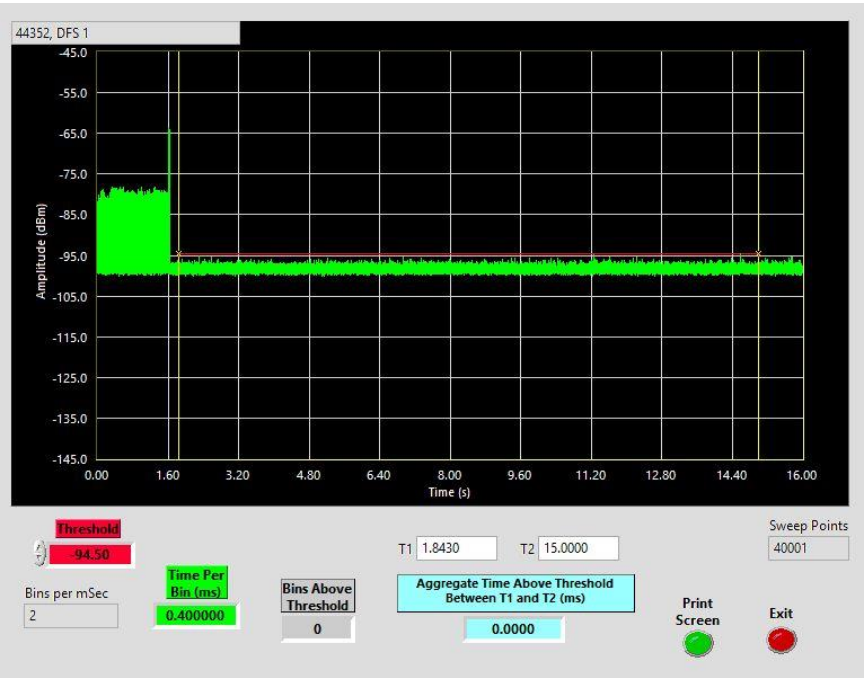
AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

No transmissions are observed during the aggregate monitoring period.

AGGREGATE CLOSING TIME



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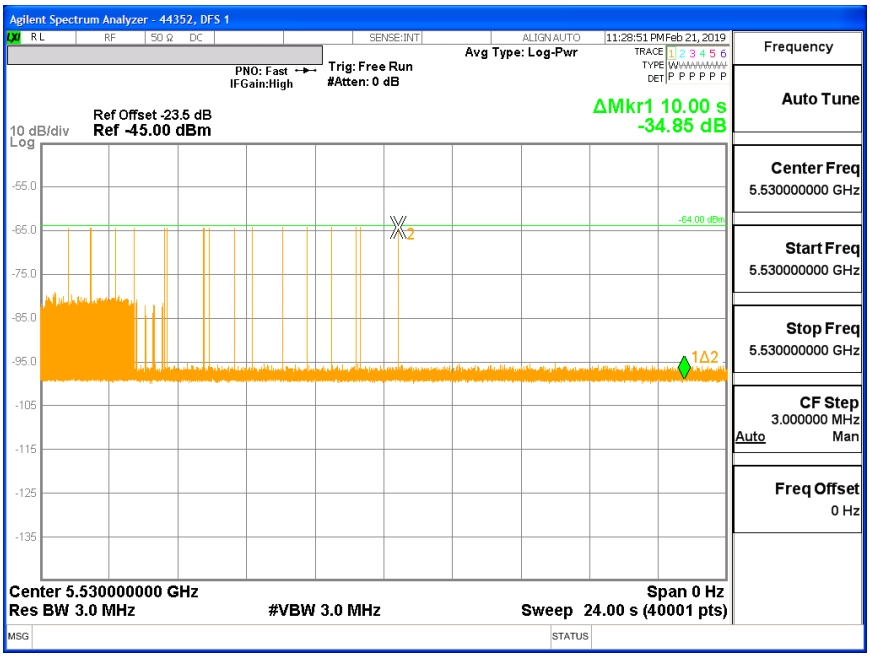
LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR



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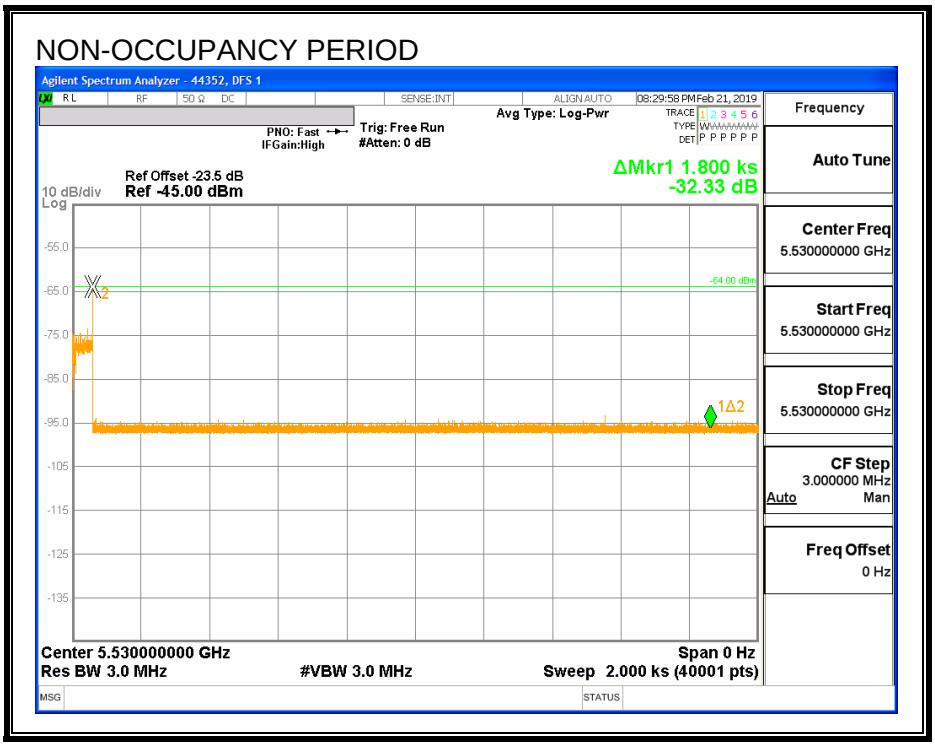
6.4.6. NON-OCCUPANCY PERIOD

RESULTS

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



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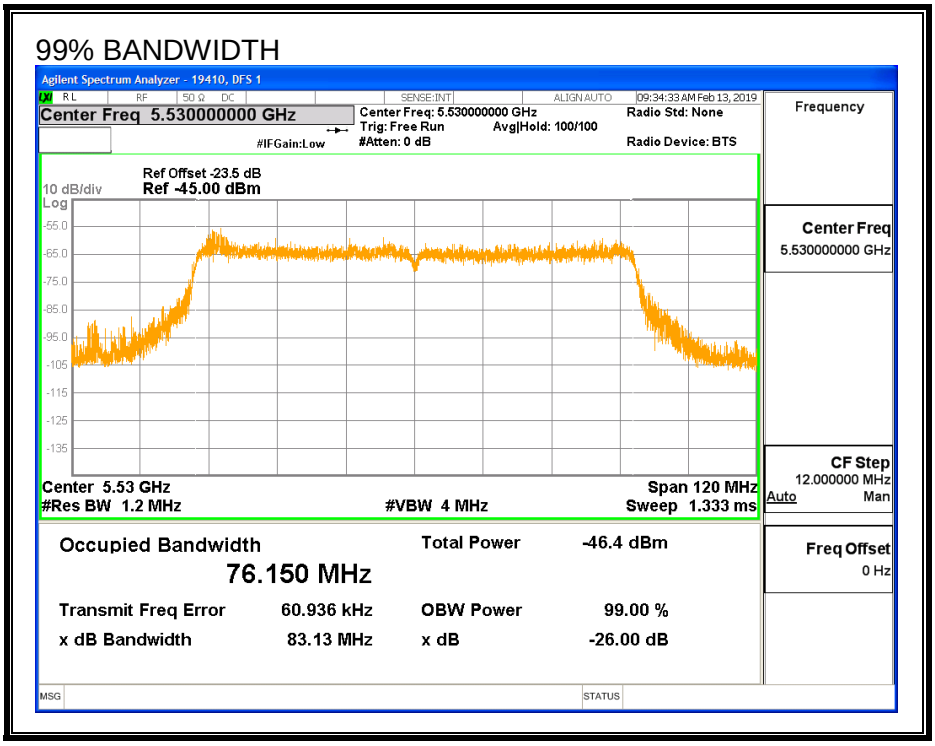
6.4.7. DETECTION BANDWIDTH

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 (%)
5493	5570	77	76.150	101.1	100

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DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results 19410 DFS 1

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

Frequency (MHz)	Number of Trials	Number Detected	Detection (%)	Mark
5492	10	3	30	
5493	10	10	100	FL
5494	10	10	100	
5495	10	9	90	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	
5515	10	10	100	
5520	10	10	100	
5525	10	10	100	
5530	10	10	100	
5535	10	10	100	
5540	10	10	100	
5545	10	10	100	
5550	10	10	100	
5555	10	10	100	
5560	10	10	100	
5565	10	10	100	
5570	10	10	100	FH
5571	10	0	0	

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6.4.8. IN-SERVICE MONITORING

RESULTS

FCC Radar Test Summary

Signal Type	Number of Trials	Detection (%)	Limit (%)	Pass/Fail	Detection Bandwidth FL	Detection Bandwidth FH	OBW	Test Location	Employee Number	In-Service Monitoring Version
FCC Short Pulse Type 1	30	96.67	60	Pass	5493	5570	76.15	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 2	30	86.67	60	Pass	5493	5570	76.15	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 3	30	93.33	60	Pass	5493	5570	76.15	DFS 1	44352	Version 3.3.4
FCC Short Pulse Type 4	30	83.33	60	Pass	5493	5570	76.15	DFS 1	44352	Version 3.3.4
Aggregate		90.00	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5493	5570	76.15	DFS 1	44352	Version 3.3.4
FCC Hopping Type 6	78	100.00	70	Pass	5493	5570		DFS 1	44352	Version 3.3.4

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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	5555	Yes
1002	1	798	67	A	5566	Yes
1003	1	758	70	A	5498	Yes
1004	1	578	92	A	5499	Yes
1005	1	558	95	A	5523	Yes
1006	1	598	89	A	5515	Yes
1007	1	818	65	A	5501	Yes
1008	1	678	78	A	5541	Yes
1009	1	938	57	A	5530	Yes
1010	1	618	86	A	5517	Yes
1011	1	898	59	A	5567	Yes
1012	1	878	61	A	5544	Yes
1013	1	838	63	A	5506	Yes
1014	1	518	102	A	5543	Yes
1015	1	698	76	A	5565	Yes
1016	1	1210	44	B	5566	Yes
1017	1	1166	46	B	5515	Yes
1018	1	2122	25	B	5567	Yes
1019	1	1013	53	B	5529	Yes
1020	1	904	59	B	5523	Yes
1021	1	2472	22	B	5503	Yes
1022	1	2493	22	B	5506	Yes
1023	1	2996	18	B	5539	Yes
1024	1	1231	43	B	5523	Yes
1025	1	2864	19	B	5551	Yes
1026	1	1078	49	B	5544	No
1027	1	1645	33	B	5555	Yes
1028	1	2537	21	B	5570	Yes
1029	1	686	77	B	5517	Yes
1030	1	3061	18	B	5567	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	2.9	187	25	5564	Yes
2002	2.6	179	29	5506	No
2003	3.1	164	28	5504	Yes
2004	3	160	26	5521	Yes
2005	3.6	150	24	5556	Yes
2006	1.8	193	23	5543	Yes
2007	2.7	230	29	5513	Yes
2008	3.2	196	24	5536	Yes
2009	4.3	155	28	5558	Yes
2010	1	207	27	5557	Yes
2011	4.5	171	23	5499	No
2012	1.4	150	23	5498	Yes
2013	5	199	27	5514	Yes
2014	4.3	220	23	5560	Yes
2015	4.1	155	25	5566	Yes
2016	3.6	223	28	5512	Yes
2017	1.6	162	23	5550	Yes
2018	1.3	153	27	5558	Yes
2019	1.8	220	26	5496	No
2020	1.7	178	27	5508	Yes
2021	2.3	167	29	5513	Yes
2022	4.6	167	28	5546	Yes
2023	1.4	204	27	5524	Yes
2024	2	170	29	5509	Yes
2025	3	211	25	5540	Yes
2026	3.8	181	24	5516	Yes
2027	3.2	188	28	5567	No
2028	4.2	205	28	5536	Yes
2029	3.7	173	25	5521	Yes
2030	3	157	28	5517	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	7.8	437	18	5513	Yes
3002	7.3	399	17	5563	Yes
3003	9.4	459	18	5495	No
3004	7.2	315	17	5542	Yes
3005	9.6	388	16	5536	Yes
3006	7.5	257	16	5561	Yes
3007	6	476	16	5551	Yes
3008	8.3	358	17	5546	Yes
3009	9.2	339	16	5556	Yes
3010	9.8	484	16	5551	Yes
3011	6.7	360	16	5512	Yes
3012	7.5	401	18	5550	Yes
3013	6.9	289	17	5502	Yes
3014	7.9	343	17	5530	Yes
3015	7.4	495	17	5532	Yes
3016	8.9	326	16	5510	Yes
3017	8.7	491	16	5539	Yes
3018	8.1	453	18	5504	Yes
3019	6.2	395	18	5567	Yes
3020	8.1	369	16	5537	Yes
3021	6.4	442	17	5512	Yes
3022	8.4	311	17	5560	Yes
3023	6.9	279	17	5518	No
3024	9.2	412	17	5547	Yes
3025	8.2	393	17	5527	Yes
3026	6.5	287	17	5569	Yes
3027	7.6	414	16	5511	Yes
3028	8.4	455	16	5502	Yes
3029	7.8	343	18	5564	Yes
3030	8.7	397	17	5547	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	16.2	298	15	5506	Yes
4002	14.6	498	15	5554	Yes
4003	18.9	294	16	5510	Yes
4004	17.8	373	14	5558	No
4005	17.8	315	15	5564	Yes
4006	12.8	290	15	5522	Yes
4007	18.1	362	12	5559	No
4008	13.6	483	13	5520	Yes
4009	19.3	451	12	5506	Yes
4010	11	333	13	5516	No
4011	13	313	13	5542	No
4012	18.5	459	12	5534	No
4013	16.6	335	16	5511	Yes
4014	13.5	375	16	5557	Yes
4015	12.1	264	13	5568	Yes
4016	14.3	318	16	5508	Yes
4017	18.2	470	14	5544	Yes
4018	11.7	418	16	5519	Yes
4019	16.1	466	14	5566	Yes
4020	14.9	427	12	5539	Yes
4021	19.7	487	13	5534	Yes
4022	19	461	14	5539	Yes
4023	15.2	416	15	5513	Yes
4024	19.8	403	16	5523	Yes
4025	12.2	371	15	5555	Yes
4026	17.2	253	16	5531	Yes
4027	19.2	485	16	5530	Yes
4028	15.6	262	15	5534	Yes
4029	13.7	255	15	5537	Yes
4030	19.7	296	14	5504	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	5530	Yes
2	5530	Yes
3	5530	Yes
4	5530	Yes
5	5530	Yes
6	5530	Yes
7	5530	Yes
8	5530	Yes
9	5530	Yes
10	5530	Yes
11	5500	Yes
12	5497	Yes
13	5496	Yes
14	5499	Yes
15	5499	Yes
16	5499	Yes
17	5496	Yes
18	5500	Yes
19	5495	Yes
20	5500	Yes
21	5564	Yes
22	5564	Yes
23	5562	Yes
24	5562	Yes
25	5564	Yes
26	5560	Yes
27	5564	Yes
28	5565	Yes
29	5560	Yes
30	5565	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	348	5493	10	Yes
2	823	5494	15	Yes
3	1298	5495	19	Yes
4	1773	5496	20	Yes
5	2248	5497	19	Yes
6	2723	5498	15	Yes
7	3198	5499	13	Yes
8	3673	5500	12	Yes
9	4148	5501	19	Yes
10	4623	5502	16	Yes
11	5098	5503	13	Yes
12	5573	5504	14	Yes
13	6048	5505	12	Yes
14	6523	5506	17	Yes
15	6998	5507	15	Yes
16	7473	5508	14	Yes
17	7948	5509	13	Yes
18	8423	5510	18	Yes
19	8898	5511	24	Yes
20	9373	5512	14	Yes
21	9848	5513	12	Yes
22	10323	5514	19	Yes
23	10798	5515	20	Yes
24	11273	5516	17	Yes
25	11748	5517	13	Yes
26	12223	5518	13	Yes
27	12698	5519	25	Yes
28	13173	5520	17	Yes
29	13648	5521	12	Yes
30	14123	5522	17	Yes
31	14598	5523	12	Yes
32	15073	5524	14	Yes
33	15548	5525	15	Yes
34	16023	5526	19	Yes
35	16498	5527	19	Yes
36	16973	5528	16	Yes
37	17448	5529	14	Yes

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TYPE 6 DETECTION PROBABILITY (CONTINUED)

38	17923	5530	16	Yes
39	18398	5531	14	Yes
40	18873	5532	17	Yes
41	19348	5533	20	Yes
42	19823	5534	17	Yes
43	20298	5535	14	Yes
44	20773	5536	9	Yes
45	21248	5537	19	Yes
46	21723	5538	17	Yes
47	22198	5539	10	Yes
48	22673	5540	14	Yes
49	23148	5541	13	Yes
50	23623	5542	15	Yes
51	24098	5543	16	Yes
52	24573	5544	15	Yes
53	25048	5545	16	Yes
54	25523	5546	19	Yes
55	25998	5547	17	Yes
56	26473	5548	17	Yes
57	26948	5549	13	Yes
58	27423	5550	18	Yes
59	27898	5551	21	Yes
60	28373	5552	15	Yes
61	28848	5553	17	Yes
62	29323	5554	19	Yes
63	29798	5555	13	Yes
64	30273	5556	15	Yes
65	30748	5557	15	Yes
66	31223	5558	18	Yes
67	31698	5559	16	Yes
68	32173	5560	19	Yes
69	32648	5561	22	Yes
70	33123	5562	17	Yes
71	33598	5563	20	Yes
72	34073	5564	20	Yes
73	34548	5565	14	Yes
74	35023	5566	23	Yes
75	35498	5567	19	Yes
76	35973	5568	25	Yes
77	36448	5569	14	Yes
78	36923	5570	16	Yes

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6.5. BRIDGE MODE RESULTS

Per KDB 905462, Section 5.1 (footnote 1):

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

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

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