DFS PORTION of FCC 47 CFR PART 15 SUBPART E
DFS PORTION of INDUSTRY CANADA RSS-247 ISSUE 2

CERTIFICATION TEST REPORT

FOR

USB WIRELESS AUDIO TRANSMITTER

MODEL NUMBER: TWFD-S001T

FCC ID: YZP-TWFDS001T
IC: 7414C-TWFDS001T

REPORT NUMBER: 12725680-E1V1

ISSUE DATE: MARCH 8, 2019

Prepared for
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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	3/8/19	Initial Issue	--

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: LG INNOTEK CO., LTD.
26, HANAMSANDAN 5BEON-RO
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EUT DESCRIPTION: WiSA USB WIRELESS AUDIO DONGLE

MODEL: TWFD-S001T

SERIAL NUMBER: 2C2BF93ACE23

DATE TESTED: FEBRUARY 07, 2019

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
DFS Portion of CFR 47 Part 15 Subpart E	Complies
DFS Portion of INDUSTRY CANADA RSS-247 Issue 2	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 UL, NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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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 and RSS-247 Issue 2.

3. REFERENCE DOCUMENTS

Measurements of transmitter parameters as referenced in this report are documented in ONETECH Corp. report number OT-18D-RWD-015.

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.

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

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

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%.

6. DYNAMIC FREQUENCY SELECTION

6.1. OVERVIEW

6.1.1. LIMITS

INDUSTRY CANADA

IC RSS-247 is closely harmonized with FCC Part 15 DFS rules. The deviations are as follows:

RSS-247 Issue 2

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

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

FCC

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

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

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

Table 2: Applicability of DFS requirements during normal operation

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

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

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

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

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

Table 4: DFS Response requirement values

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

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

Table 5 – Short Pulse Radar Test Waveforms

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

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

Table 6 – Long Pulse Radar Test Signal

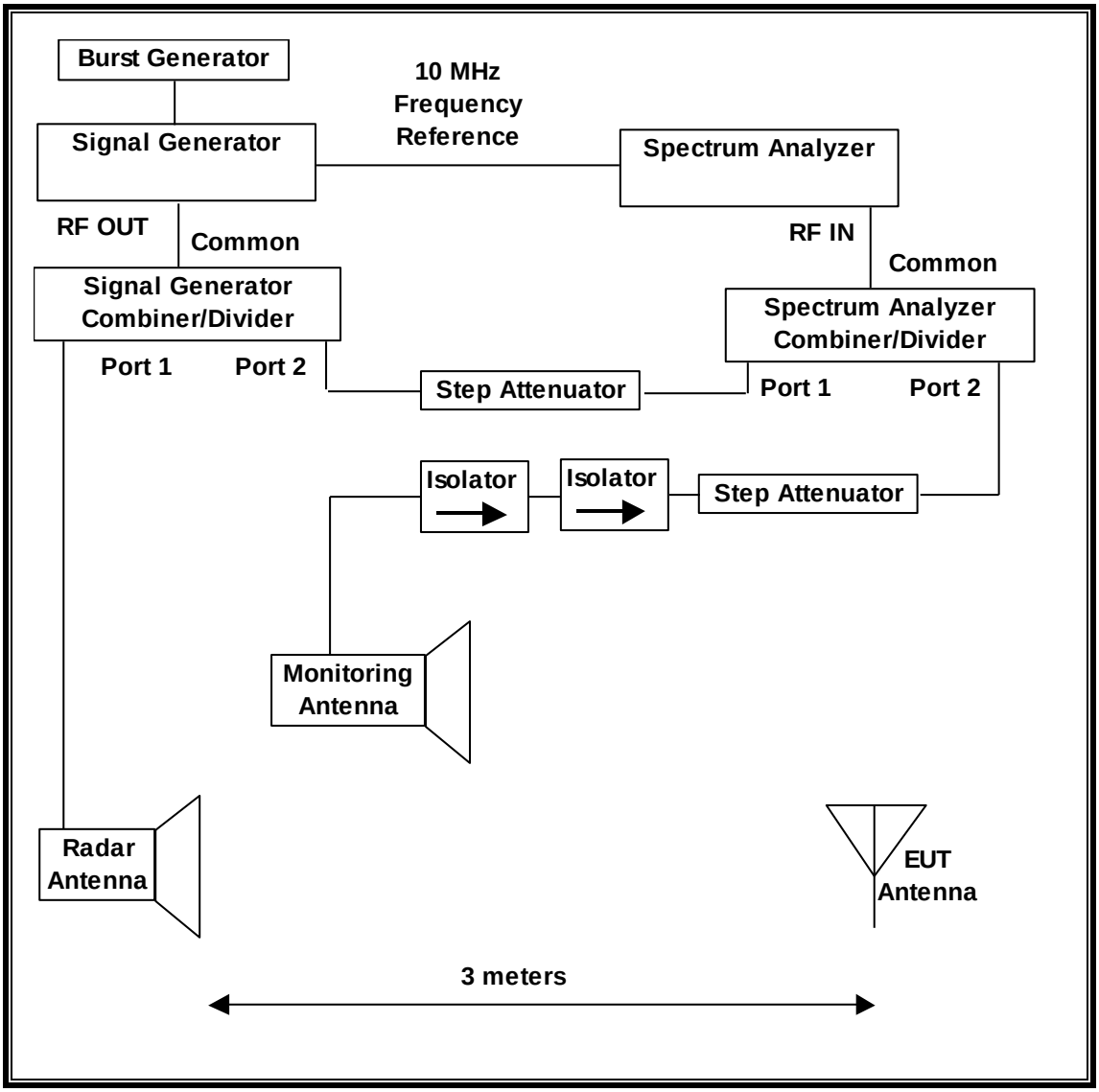
Radar Waveform Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 7 – Frequency Hopping Radar Test Signal

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

6.1.2. TEST AND MEASUREMENT SYSTEM

RADIATED METHOD SYSTEM BLOCK DIAGRAM



SYSTEM OVERVIEW

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

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

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

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

SYSTEM CALIBRATION

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

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

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

ADJUSTMENT OF DISPLAYED TRAFFIC LEVEL

A link is established between the Master and Slave and the distance between the units is adjusted as needed to provide a suitable received level at the Master and Slave devices. The NTIA audio test file "5_GHz_Audio_Test_File.Wav" is streamed from the Master device to the Slave device to generate WLAN traffic. The monitoring antenna is adjusted so that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold.

TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**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	T1134	04/23/19
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:

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

TEST ROOM ENVIRONMENT

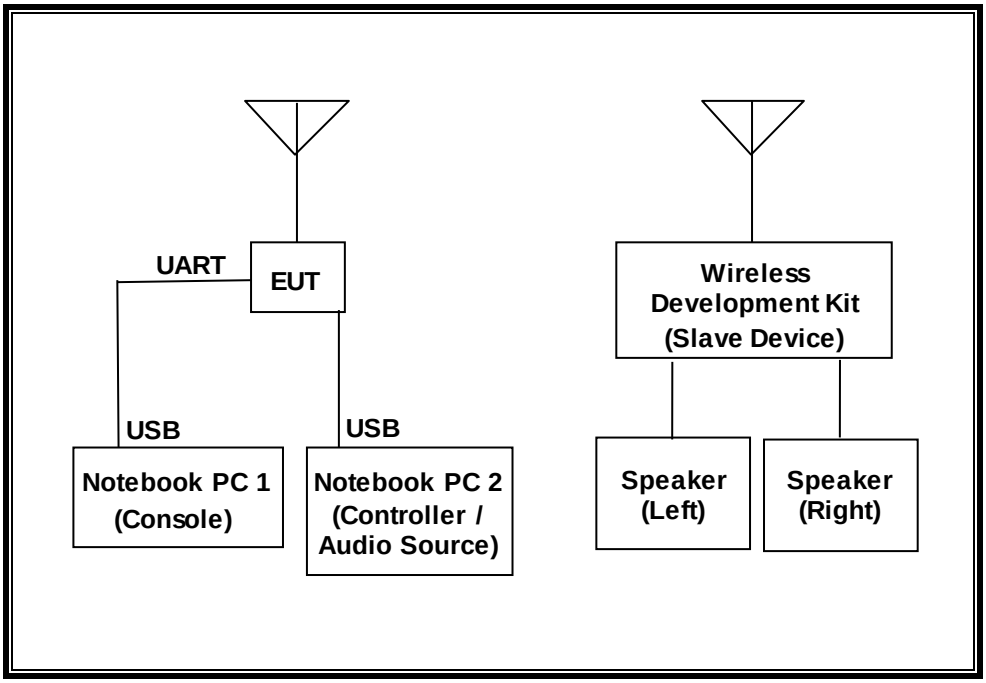
The test room temperature and humidity shall be maintained within normal temperature of 15~35 °C and normal humidity 20~75% (relative humidity).

ENVIRONMENT CONDITION

Parameter	Value
Temperature	24.0 °C
Humidity	26 %

6.1.4. SETUP OF EUT

RADIATED METHOD EUT TEST SETUP



SUPPORT EQUIPMENT

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

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Notebook PC 1 (EUT Console)	Dell	PP04X	CN-0GF470-48643-74S-1041	DoC
AC Adapter (Console PC)	Dell	FA90PEI-00	CN-0CM889-73245-968-4812-A01	DoC
Notebook PC 2 (EUT Controller/Audio Source)	Apple	A1425	C20LF15EFFRR	DoC
AC Adapter (Controller PC)	Apple	A1424	C06332504RFF8JHBE	DoC
Wireless Development Kit (Slave Device): Contains Athena 4XC Radio Chipset	Summit Semiconductor	444-2250	02EA3101A2A1	UA9601
Left and Right Speakers	Audio Source	Not Marked	None	DoC

6.1.5. DESCRIPTION OF EUT

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

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

The EUT is a Master Device.

The EUT uses one transmitter/receiver Working Radio chain and one Monitor Radio receive only chain, each connected to an antenna to perform radiated tests.

The transmit/receive antenna assembly utilized with the EUT has a gain of 0.91 dBi in the 5250-5350 MHz band and 1.44 dBi in the 5470-5725 MHz band.

The receive only antenna assembly utilized with the EUT has a gain of 0.91 dBi in the 5250-5350 MHz band and 1.44 dBi in the 5470-5725 MHz band.

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

The highest power level within these bands is 5.93 dBm EIRP in the 5250-5350 MHz band and 6.85 dBm EIRP in the 5470-5725 MHz band.

The rated output power of the Master unit is < 23dBm (EIRP). Therefore the required interference threshold level is –62 dBm. After correction for procedural adjustments, the required radiated threshold at the antenna port is –62 + 1 = -61 dBm.

The calibrated radiated DFS Detection Threshold level is set to –62 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

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 streaming the NTIA audio test file video file “5_GHz_Audio_Test_File.Wav” from the Master to the Slave.

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

The EUT utilizes the 802.11a/n architecture. One nominal channel bandwidth, 20 MHz, is implemented.

The software installed in the Master Device is version 207.3.

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 USB Wireless Audio Transmitter, FCC ID: YZP-TWFDS001T. The minimum antenna gain for the Master Device is 0.91 dBi.

The rated output power of the Master unit is < 23dBm (EIRP). Therefore the required interference threshold level is –62 dBm. After correction for procedural adjustments, the required radiated threshold at the antenna port is –62 + 1 = -61 dBm.

The calibrated radiated DFS Detection Threshold level is set to –62 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

The software installed in the Master Device is version 207.3.

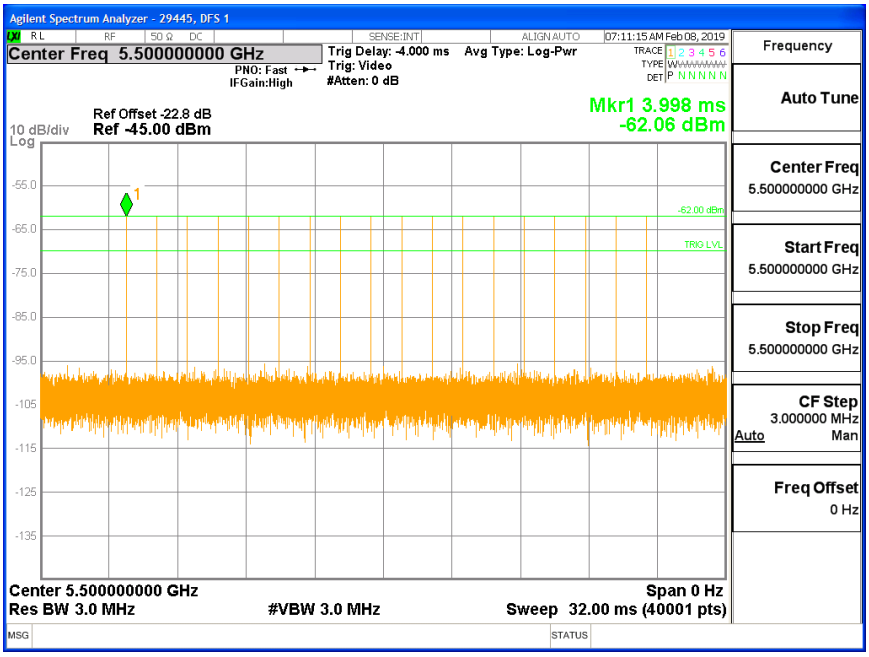
6.2. TEST CHANNEL

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

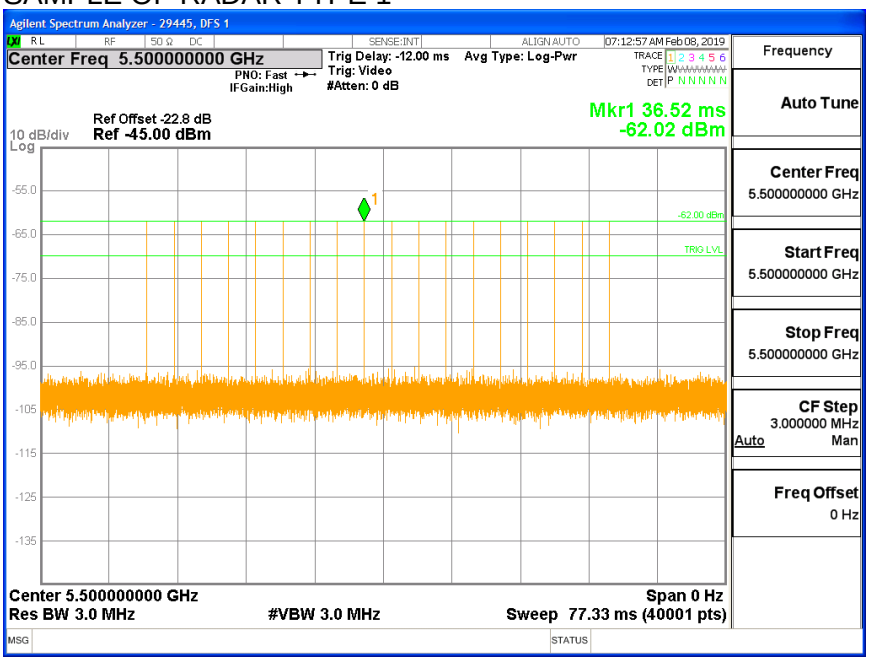
6.3. RADAR WAVEFORMS

RADAR WAVEFORMS

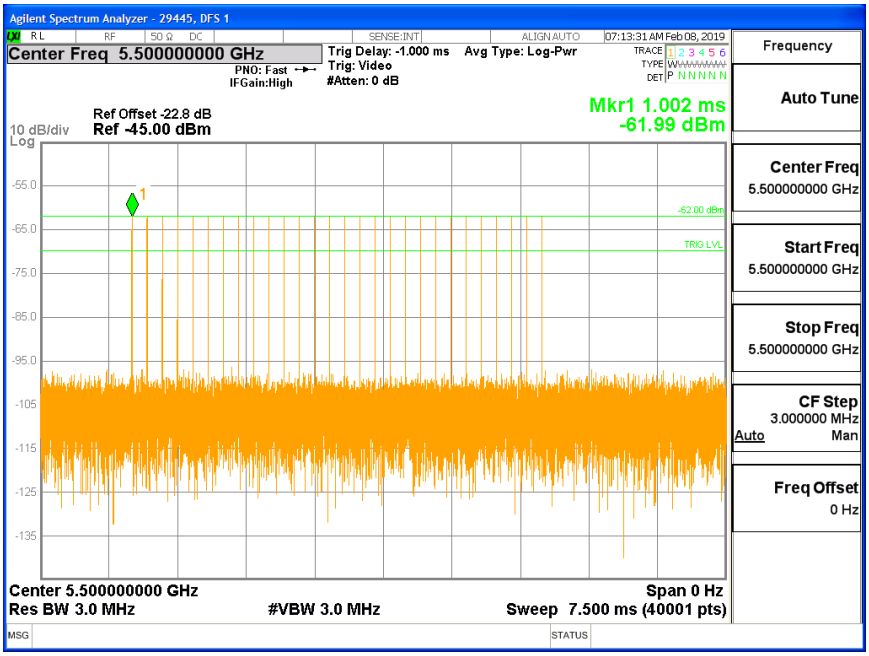
SHORT PULSE RADAR TYPE 0



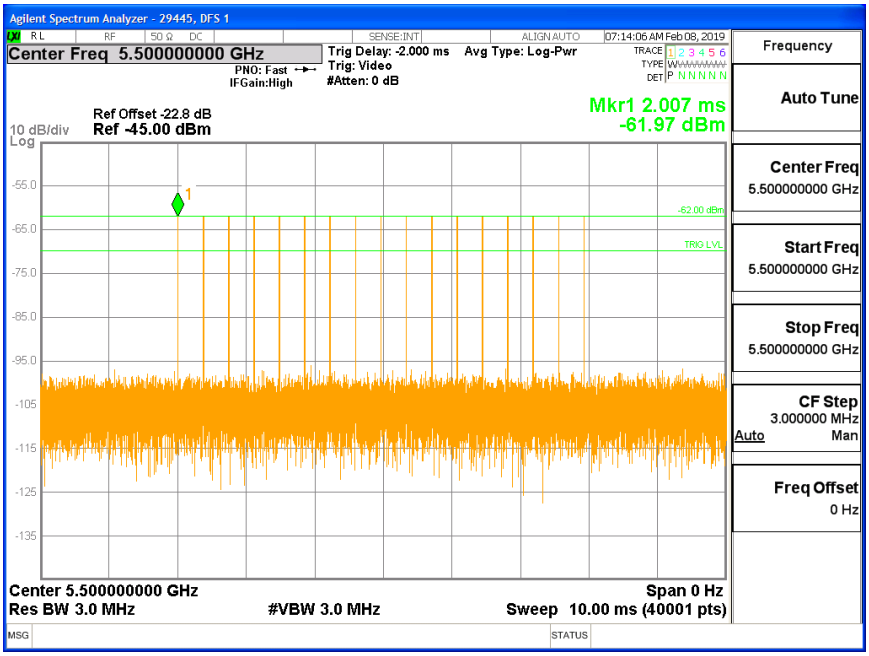
SAMPLE OF RADAR TYPE 1



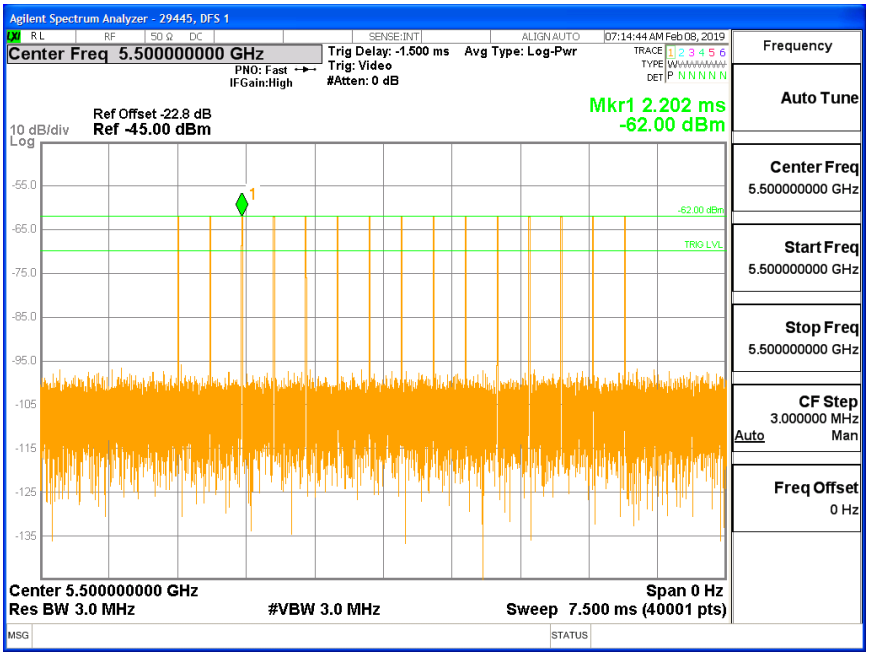
SAMPLE OF RADAR TYPE 2



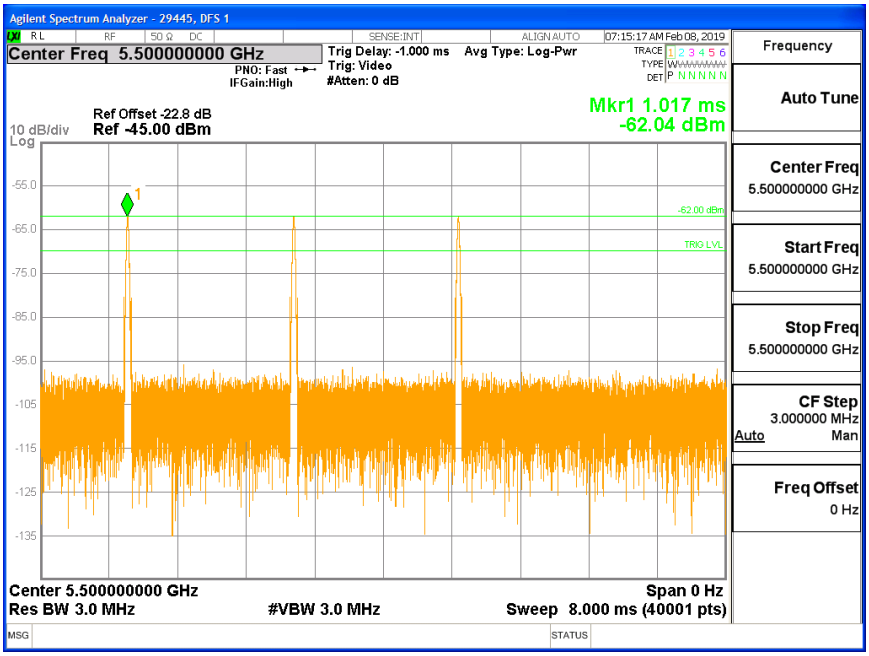
SAMPLE OF RADAR TYPE 3



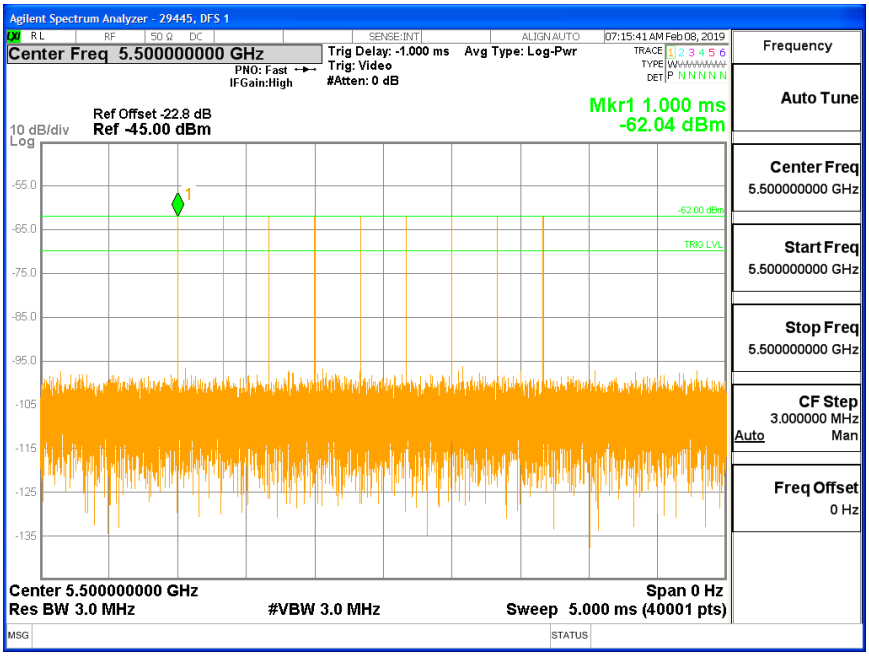
SAMPLE OF RADAR TYPE 4



SAMPLE OF SINGLE BURST OF RADAR TYPE 5



SINGLE BURST OF RADAR TYPE 6

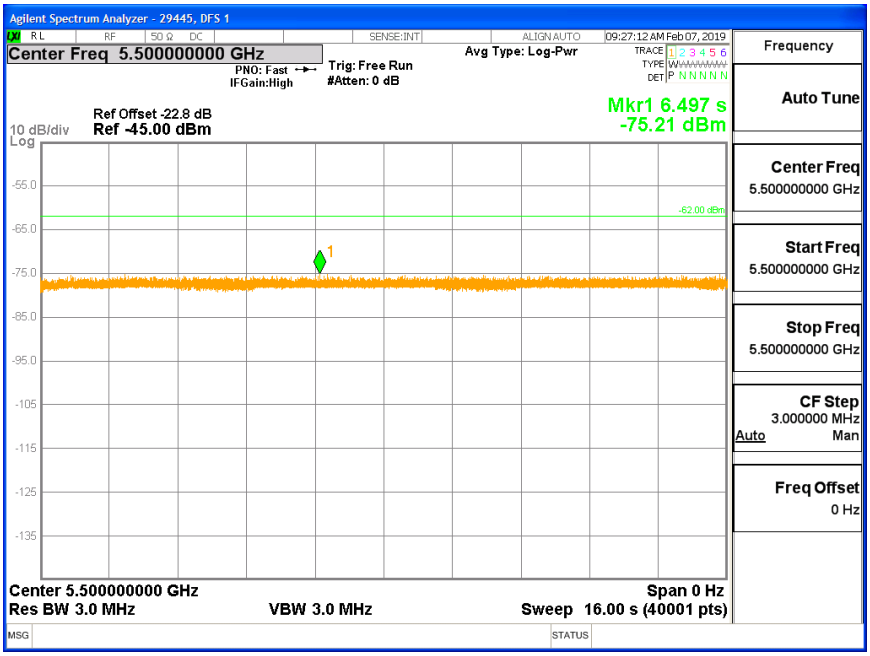


6.4. WORKING RADIO RESULTS FOR 20 MHz BANDWIDTH / 48 kHz SAMPLE RATE

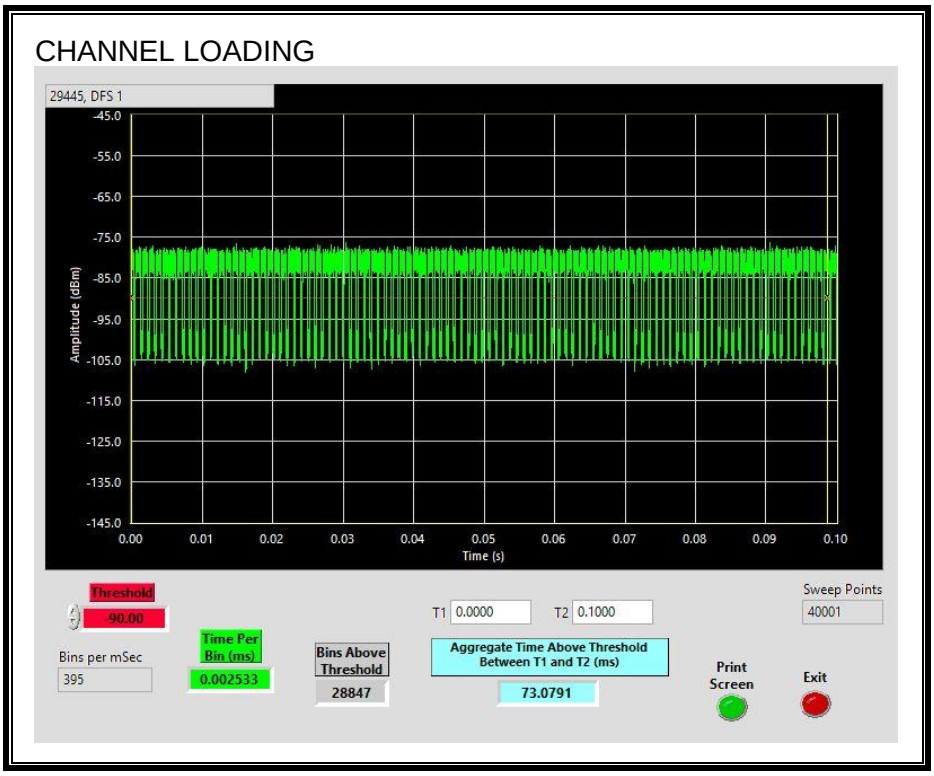
6.4.1. TRAFFIC AND CHANNEL LOADING

TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 73.07%

6.4.2. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

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

PROCEDURE FOR TIMING OF RADAR BURST

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

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

QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
31.22	104.6	73.4	13.4

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)
30.75	47.5	16.8	3.4

Radar Near End of CAC

Timing of Reboot (sec)	Timing of Radar Burst (sec)	Radar Relative to Reboot (sec)	Radar Relative to Start of CAC (sec)
30.42	100.9	70.5	57.1

QUALITATIVE RESULTS

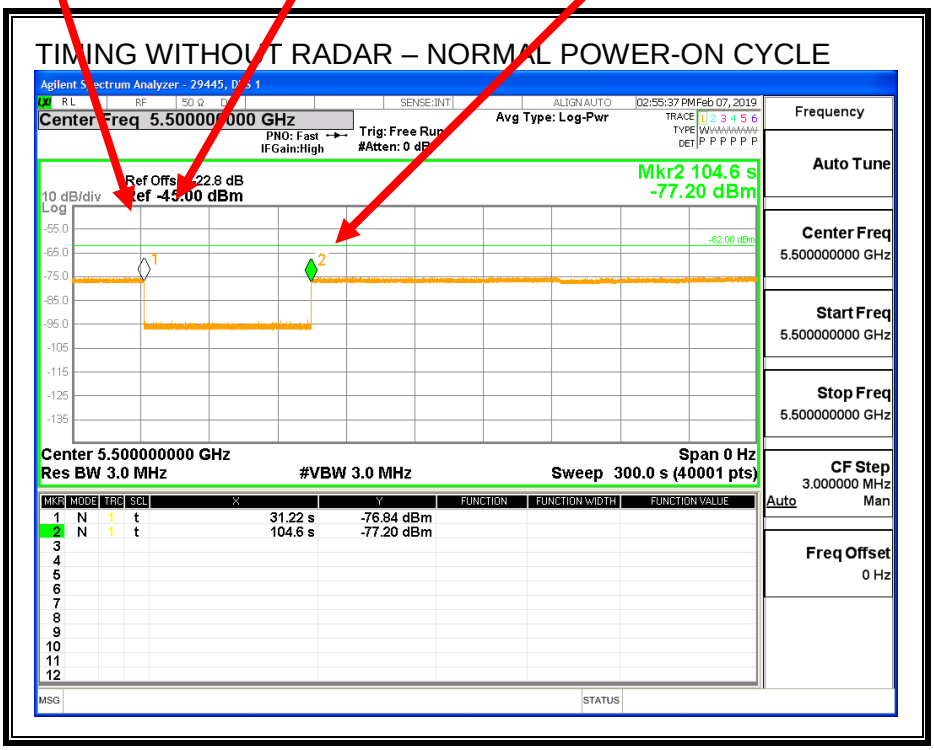
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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

TIMING WITHOUT RADAR DURING CAC

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

End of Initial Power-up cycle
Start of CAC

End of CAC
Traffic is Initiated



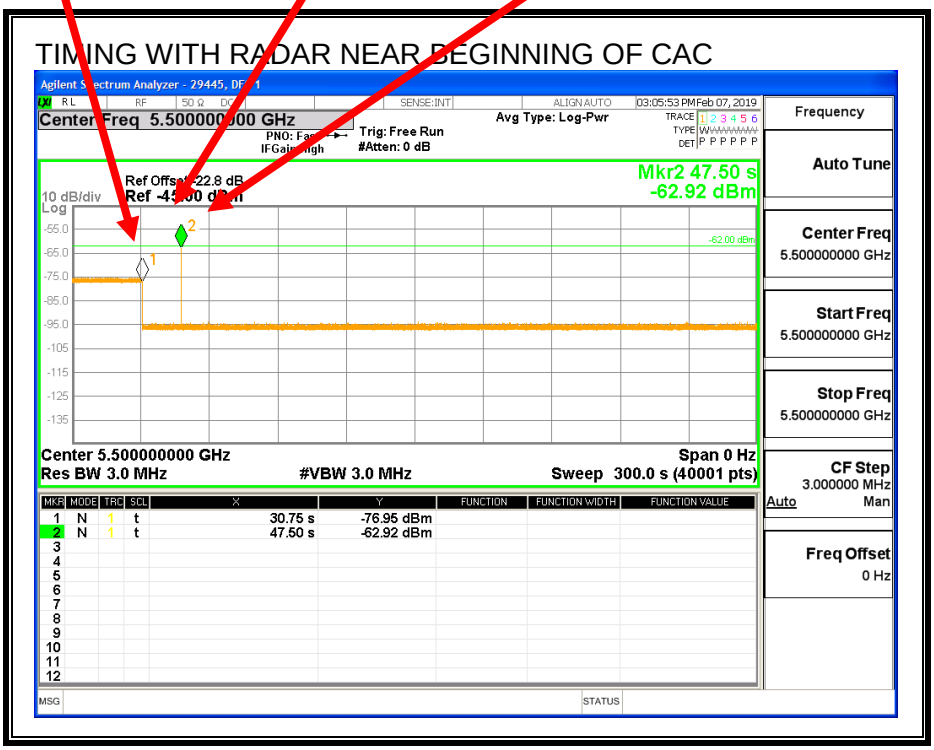
Transmissions begin on channel after completion of the initial power-up cycle and the CAC.

TIMING WITH RADAR NEAR BEGINNING OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



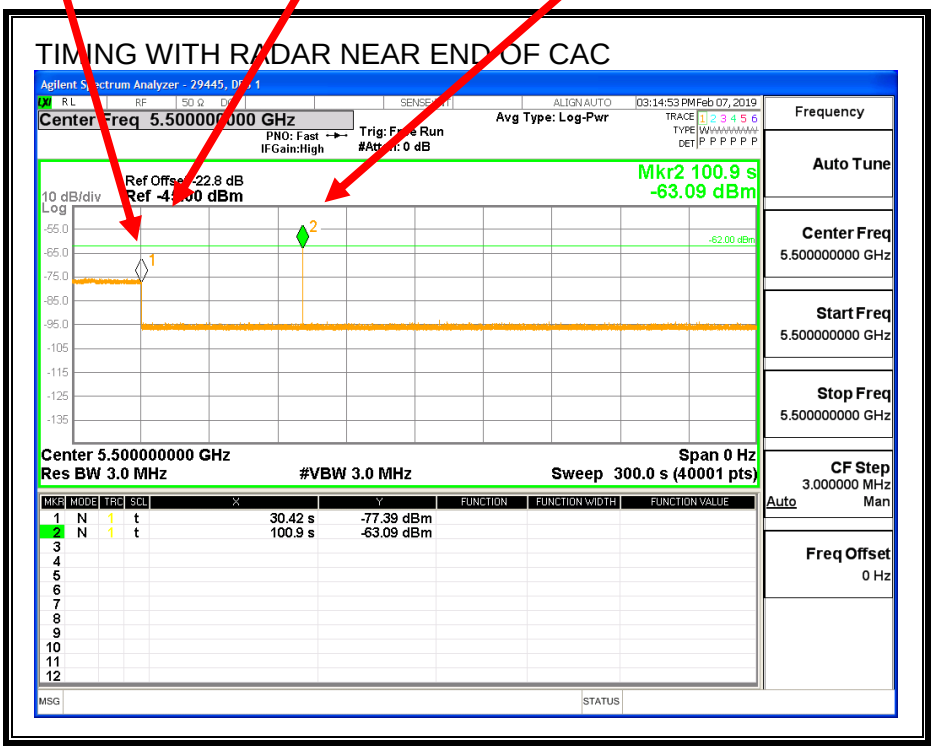
No EUT transmissions were observed after the radar signal.

TIMING WITH RADAR NEAR END OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

6.4.3. OVERLAPPING CHANNEL TESTS

RESULTS

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

6.4.4. 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).

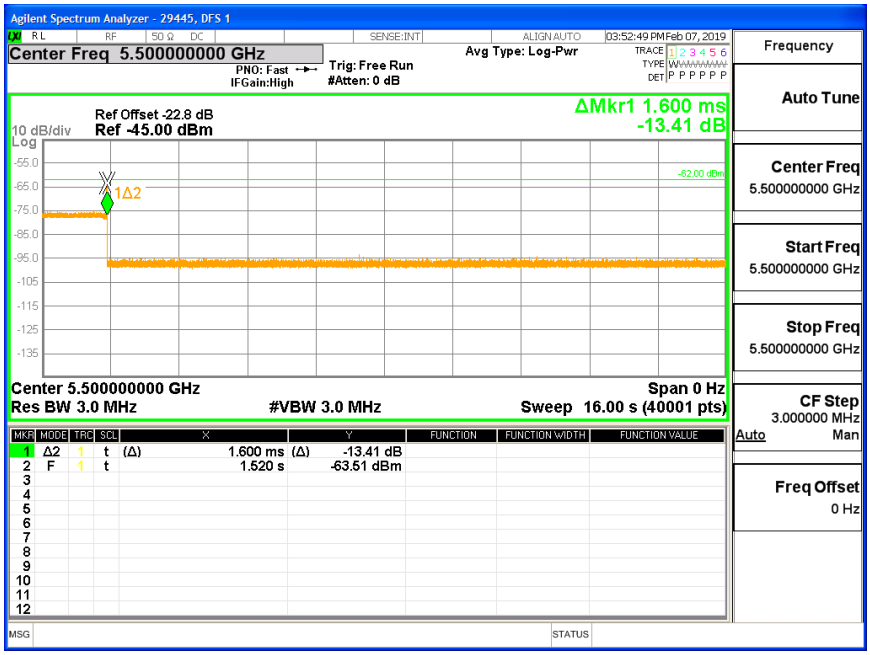
RESULTS

Channel Move Time (sec)	Limit (sec)
0.0016	10

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

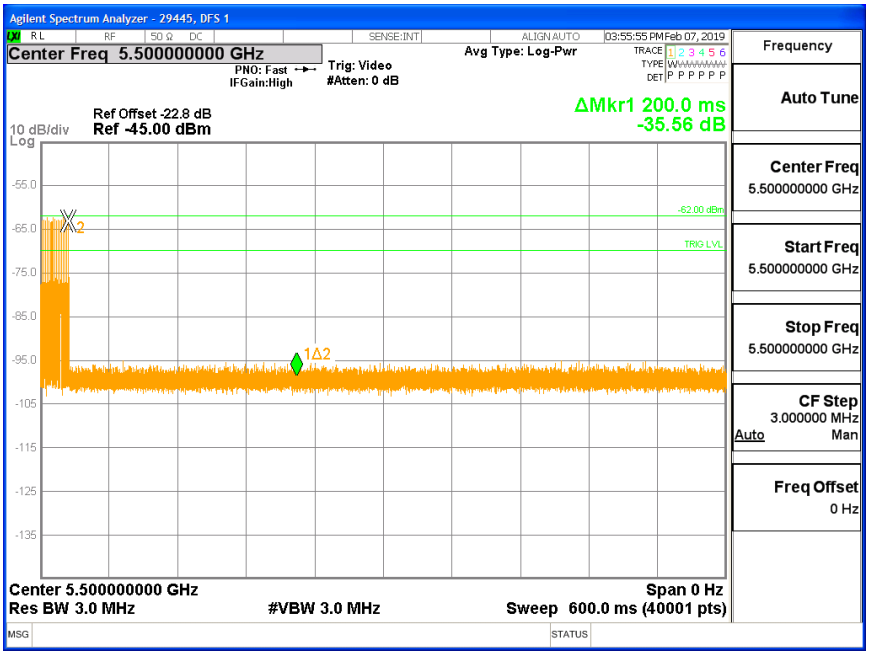
MOVE TIME

MOVE TIME



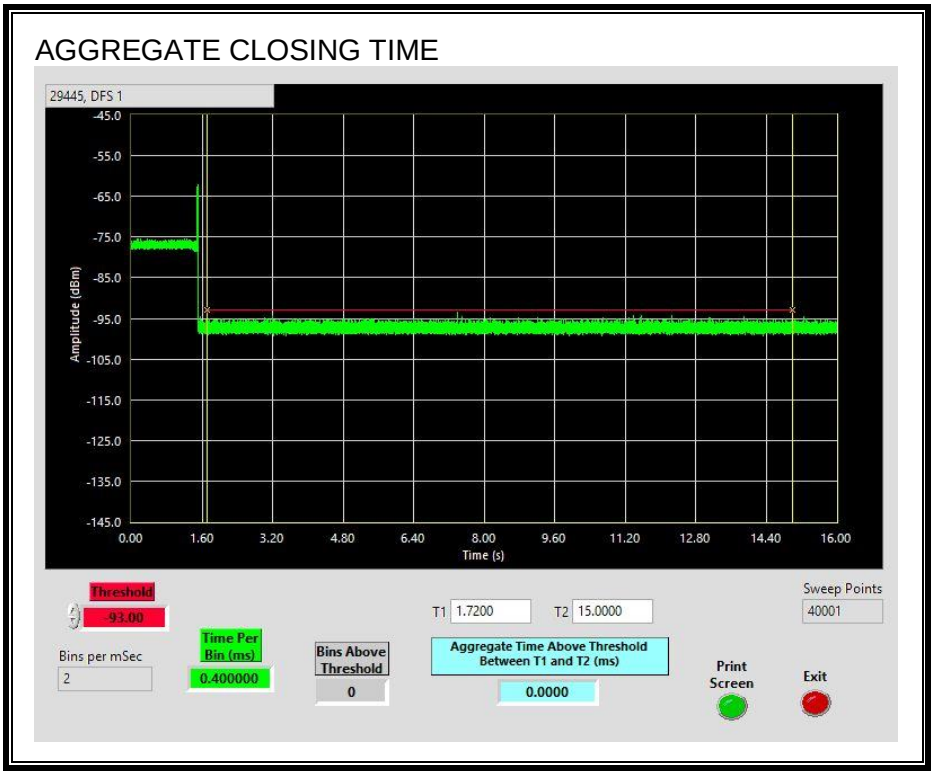
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

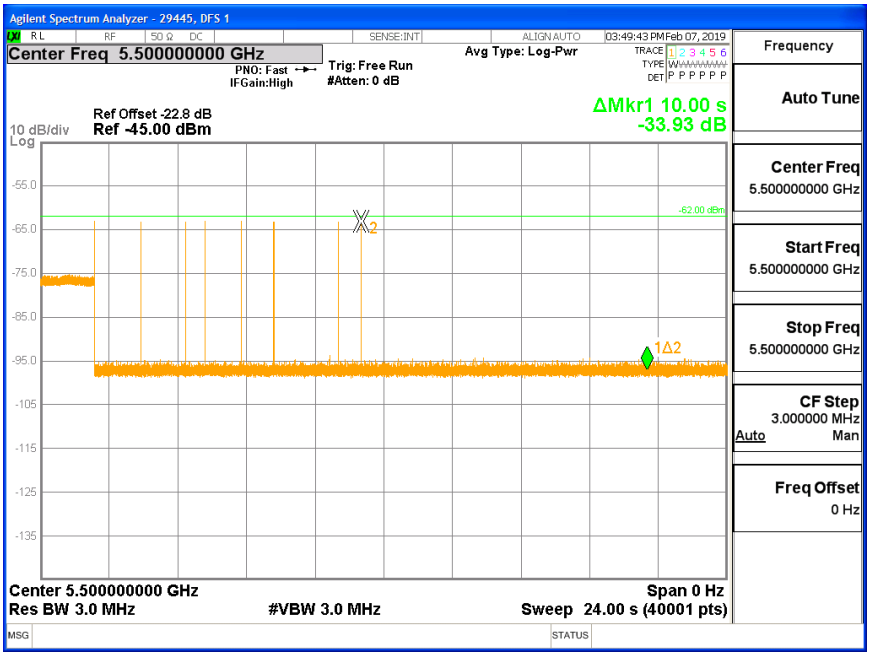
No transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

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

MOVE TIME FOR LONG PULSE RADAR

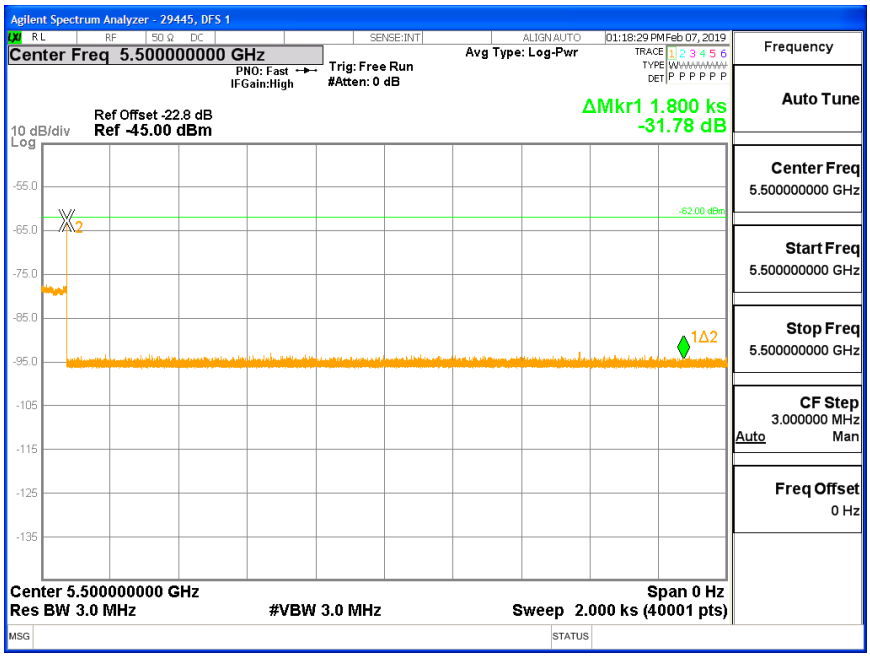


6.4.5. NON-OCCUPANCY PERIOD

RESULTS

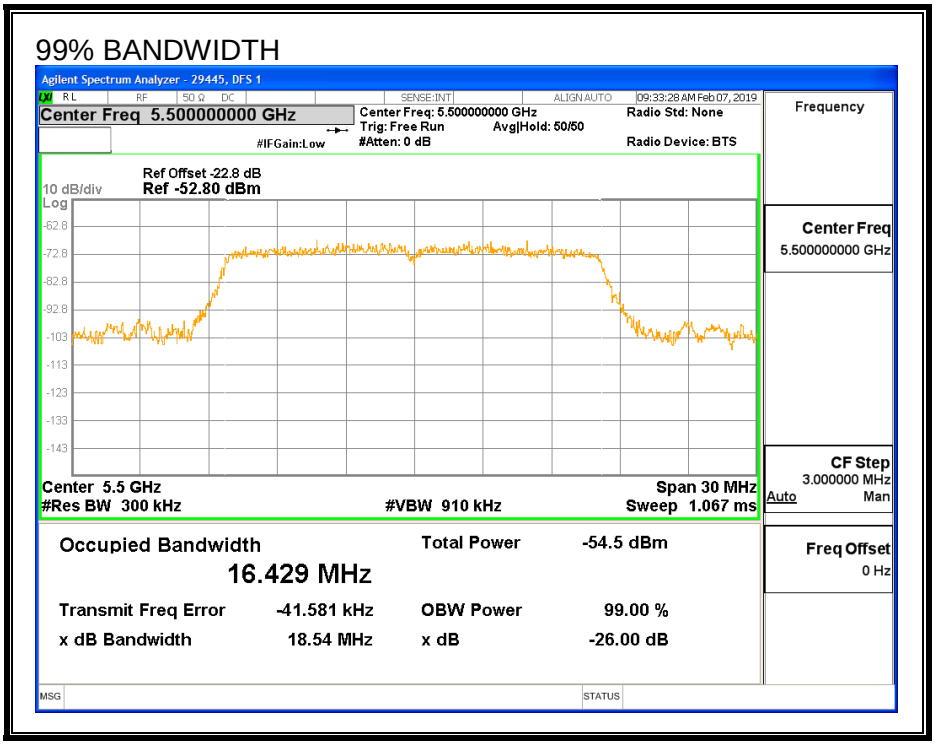
No EUT transmissions were observed on the test channel during the 30-minute observation time.

NON-OCCUPANCY PERIOD



6.4.6. 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	16.429	121.7	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results		29445	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
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	FH

6.4.7. 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	96.67	60	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 2	30	96.67	60	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 3	30	100.00	60	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 4	30	80.00	60	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
Aggregate		93.33	80	Pass						
FCC Long Pulse Type 5	30	100.00	80	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
FCC Hopping Type 6	42	100.00	70	Pass	5490	5510		DFS 1	29445	Version 3.3.4

TYPE 1 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 1

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Test (A/B)	Frequency (MHz)	Successful Detection (Yes/No)
1001	1	3066	18	A	5500	Yes
1002	1	858	62	A	5499	Yes
1003	1	778	68	A	5501	Yes
1004	1	658	81	A	5495	Yes
1005	1	938	57	A	5506	Yes
1006	1	638	83	A	5505	Yes
1007	1	718	74	A	5501	Yes
1008	1	878	61	A	5491	Yes
1009	1	558	95	A	5493	Yes
1010	1	538	99	A	5494	Yes
1011	1	678	78	A	5506	Yes
1012	1	618	86	A	5497	Yes
1013	1	898	59	A	5496	Yes
1014	1	698	76	A	5509	Yes
1015	1	798	67	A	5492	Yes
1016	1	2849	19	B	5508	Yes
1017	1	1933	28	B	5494	Yes
1018	1	2696	20	B	5496	Yes
1019	1	1910	28	B	5507	Yes
1020	1	1607	33	B	5508	Yes
1021	1	2304	23	B	5504	Yes
1022	1	777	68	B	5492	Yes
1023	1	2957	18	B	5494	No
1024	1	2913	19	B	5494	Yes
1025	1	1322	40	B	5500	Yes
1026	1	2760	20	B	5491	Yes
1027	1	2651	20	B	5509	Yes
1028	1	1672	32	B	5493	Yes
1029	1	1692	32	B	5504	Yes
1030	1	2195	25	B	5491	Yes

TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
2001	4.9	166	28	5500	Yes
2002	1.5	179	27	5494	Yes
2003	5	224	24	5494	Yes
2004	1.9	160	24	5493	No
2005	1.5	209	24	5506	Yes
2006	4.8	193	24	5494	Yes
2007	4.6	165	25	5495	Yes
2008	4.1	153	29	5508	Yes
2009	2.2	215	24	5508	Yes
2010	4	207	25	5496	Yes
2011	2.3	230	27	5503	Yes
2012	4.4	188	28	5509	Yes
2013	2.9	177	27	5492	Yes
2014	1	220	29	5493	Yes
2015	4.1	214	28	5508	Yes
2016	2.5	180	27	5498	Yes
2017	3.6	221	26	5497	Yes
2018	4.3	153	25	5505	Yes
2019	3.7	198	29	5495	Yes
2020	4.7	216	28	5490	Yes
2021	4.3	184	29	5500	Yes
2022	3.5	167	29	5509	Yes
2023	1.4	182	23	5501	Yes
2024	5	208	27	5492	Yes
2025	5	189	29	5509	Yes
2026	2.7	181	23	5508	Yes
2027	1	204	24	5492	Yes
2028	3.1	162	26	5505	Yes
2029	1.6	152	25	5504	Yes
2030	1.9	195	26	5510	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	7.8	370	17	5492	Yes
3002	6.2	265	16	5497	Yes
3003	9.4	392	16	5501	Yes
3004	8	433	16	5497	Yes
3005	7.4	321	17	5496	Yes
3006	8.4	375	16	5509	Yes
3007	6	276	17	5500	Yes
3008	7.2	476	16	5496	Yes
3009	9.2	272	18	5509	Yes
3010	8.7	484	17	5492	Yes
3011	6.7	293	17	5502	Yes
3012	6.4	268	18	5507	Yes
3013	8.8	474	18	5500	Yes
3014	6.8	461	16	5505	Yes
3015	7.4	428	18	5498	Yes
3016	9.7	310	16	5494	Yes
3017	6.5	291	16	5506	Yes
3018	9	319	18	5492	Yes
3019	8.1	312	18	5491	Yes
3020	6.7	353	18	5495	Yes
3021	6.1	493	16	5500	Yes
3022	9.3	295	18	5505	Yes
3023	8.8	330	16	5502	Yes
3024	10	396	18	5503	Yes
3025	7.9	443	17	5507	Yes
3026	7.4	405	16	5491	Yes
3027	9.5	465	18	5510	Yes
3028	9.2	439	17	5506	Yes
3029	7.5	394	17	5499	Yes
3030	9.6	381	18	5493	Yes

TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
4001	11.4	349	15	5494	Yes
4002	16.4	482	16	5494	Yes
4003	18.4	463	16	5494	Yes
4004	14.8	491	15	5493	No
4005	12.9	484	12	5506	Yes
4006	14.6	274	16	5509	Yes
4007	17.5	413	16	5501	Yes
4008	15.4	467	14	5510	No
4009	14.5	250	12	5505	Yes
4010	17.1	317	14	5492	Yes
4011	12.4	364	12	5497	Yes
4012	11.2	326	13	5508	Yes
4013	16	386	14	5502	Yes
4014	15.3	360	12	5507	Yes
4015	11.5	315	16	5496	Yes
4016	16.1	302	14	5500	Yes
4017	17.6	270	13	5492	Yes
4018	13.5	403	14	5503	Yes
4019	15.5	266	12	5494	Yes
4020	11.9	411	13	5510	Yes
4021	19.1	287	15	5500	Yes
4022	11.8	446	15	5506	Yes
4023	19.5	334	12	5507	No
4024	12.5	388	12	5509	No
4025	11.6	422	15	5496	Yes
4026	19.1	488	13	5491	No
4027	18.6	285	13	5497	No
4028	17.4	497	16	5499	Yes
4029	13.2	306	12	5510	Yes
4030	12.5	280	15	5491	Yes

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5500	Yes
2	5500	Yes
3	5500	Yes
4	5500	Yes
5	5500	Yes
6	5500	Yes
7	5500	Yes
8	5500	Yes
9	5500	Yes
10	5500	Yes
11	5499	Yes
12	5497	Yes
13	5495	Yes
14	5494	Yes
15	5499	Yes
16	5497	Yes
17	5500	Yes
18	5495	Yes
19	5495	Yes
20	5499	Yes
21	5505	Yes
22	5501	Yes
23	5505	Yes
24	5501	Yes
25	5505	Yes
26	5501	Yes
27	5505	Yes
28	5501	Yes
29	5505	Yes
30	5501	Yes

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

TYPE 6 DETECTION PROBABILITY

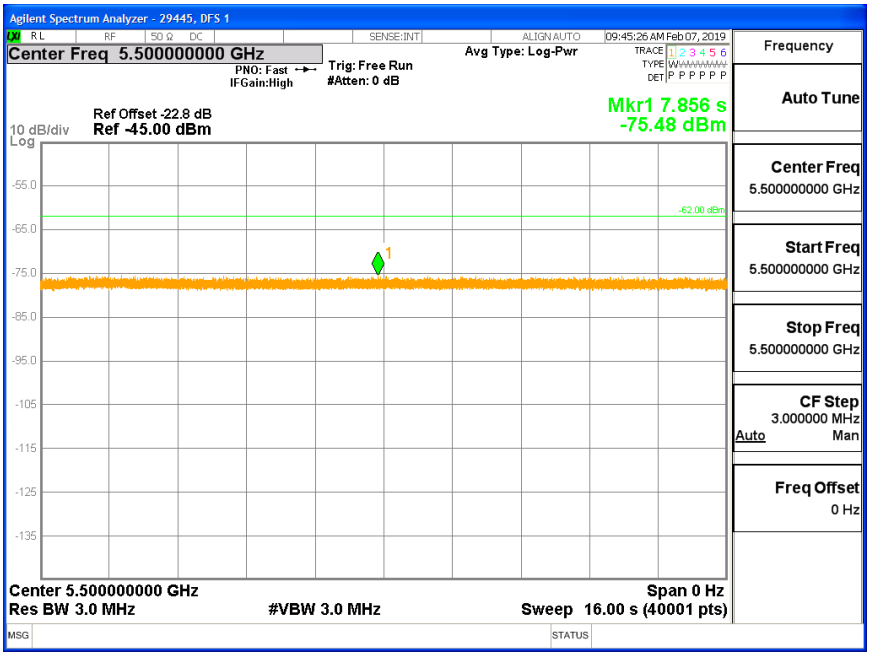
Data Sheet for FCC Hopping Radar Type 6				
1 us Pulse Width, 333 us PRI, 9 Pulses per Burst, 1 Burst per Hop				
NTIA August 2005 Hopping Sequence				
Trial	Starting Index Within Sequence	Signal Generator Frequency (MHz)	Hops within Detection BW	Successful Detection (Yes/No)
1	117	5490	1	Yes
2	592	5491	5	Yes
3	1067	5492	3	Yes
4	1542	5493	2	Yes
5	2017	5494	4	Yes
6	2492	5495	5	Yes
7	2967	5496	5	Yes
8	3442	5497	2	Yes
9	3917	5498	2	Yes
10	4392	5499	4	Yes
11	4867	5500	7	Yes
12	5342	5501	5	Yes
13	5817	5502	3	Yes
14	6292	5503	5	Yes
15	6767	5504	5	Yes
16	7242	5505	2	Yes
17	7717	5506	5	Yes
18	8192	5507	5	Yes
19	8667	5508	3	Yes
20	9142	5509	6	Yes
21	9617	5510	7	Yes
22	10092	5490	3	Yes
23	10567	5491	3	Yes
24	11042	5492	6	Yes
25	11517	5493	6	Yes
26	11992	5494	9	Yes
27	12467	5495	6	Yes
28	12942	5496	8	Yes
29	13417	5497	9	Yes
30	13892	5498	3	Yes
31	14367	5499	4	Yes
32	14842	5500	2	Yes
33	15317	5501	3	Yes
34	15792	5502	3	Yes
35	16267	5503	1	Yes
36	16742	5504	6	Yes
37	17217	5505	4	Yes
38	17692	5506	4	Yes
39	18167	5507	7	Yes
40	18642	5508	4	Yes
41	19117	5509	6	Yes
42	19592	5510	2	Yes

6.5. WORKING RADIO RESULTS FOR 20 MHz BANDWIDTH / 96 kHz SAMPLE RATE

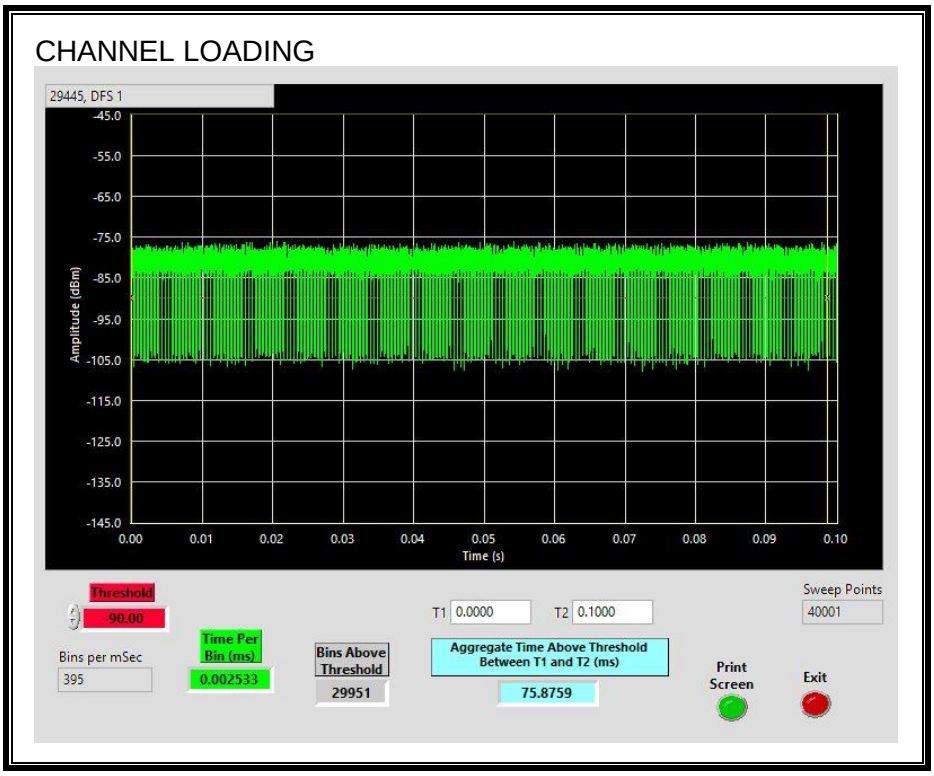
6.5.1. TRAFFIC AND CHANNEL LOADING

TRAFFIC

TRAFFIC



CHANNEL LOADING



The level of traffic loading on the channel by the EUT is 75.87%

6.5.2. CHANNEL AVAILABILITY CHECK TIME

PROCEDURE TO DETERMINE INITIAL POWER-UP CYCLE TIME

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

PROCEDURE FOR TIMING OF RADAR BURST

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

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

QUANTITATIVE RESULTS

No Radar Triggered

Timing of Reboot (sec)	Timing of Start of Traffic (sec)	Total Power-up Cycle Time (sec)	Initial Power-up Cycle Time (sec)
30.53	103.9	73.4	13.4

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)
30.56	46.9	16.3	2.9

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)
30.56	100.7	70.1	56.8

QUALITATIVE RESULTS

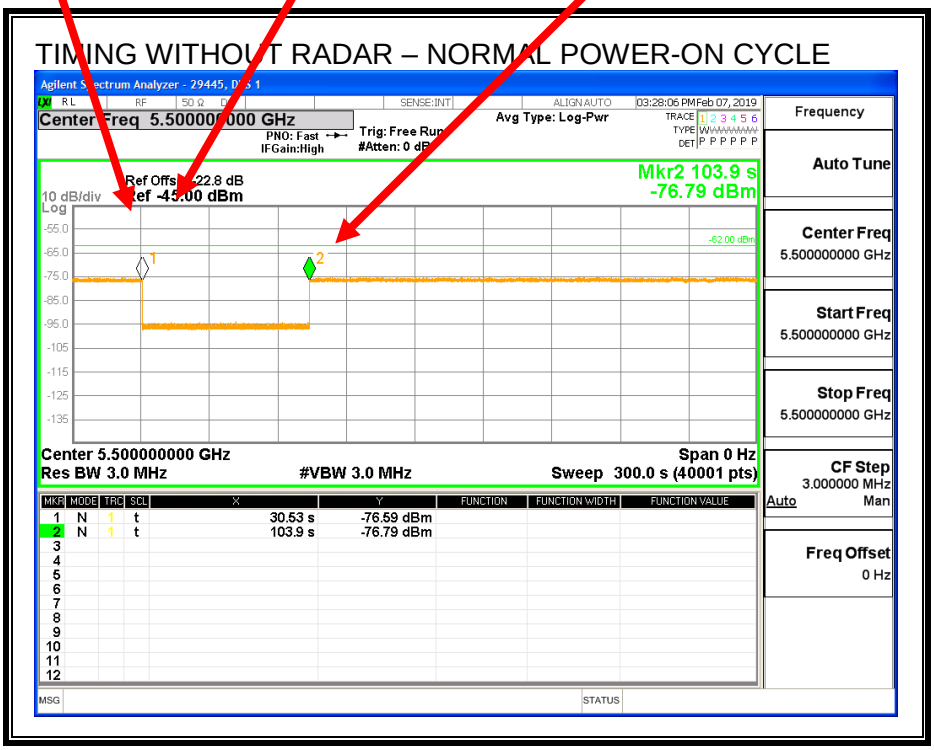
Timing of Radar Burst	Display on Control Computer	Spectrum Analyzer Display
No Radar Triggered	EUT marks Channel as active	Transmissions begin on channel after completion of the initial power-up cycle and the CAC
Within 0 to 6 second window	EUT indicates radar detected	No transmissions on channel
Within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

TIMING WITHOUT RADAR DURING CAC

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

End of Initial Power-up cycle
Start of CAC

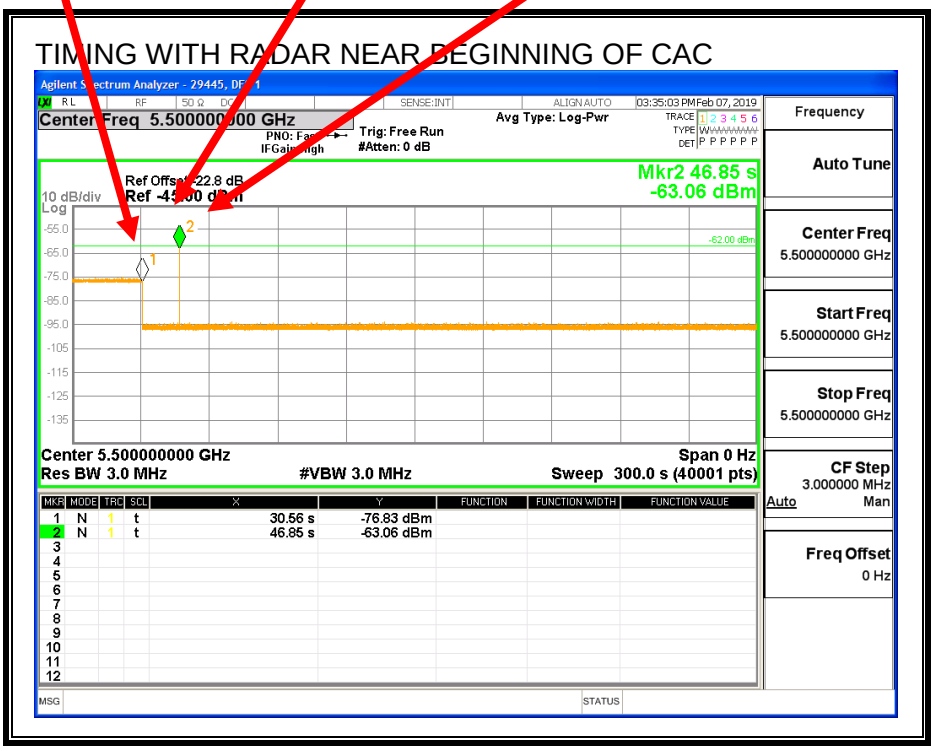
End of CAC
Traffic is Initiated



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

TIMING WITH RADAR NEAR BEGINNING OF CAC

AP is rebooted
Traffic ceases
Start of Initial Power-up cycle
End of Initial Power-up cycle
Start of CAC
Radar Signal Applied



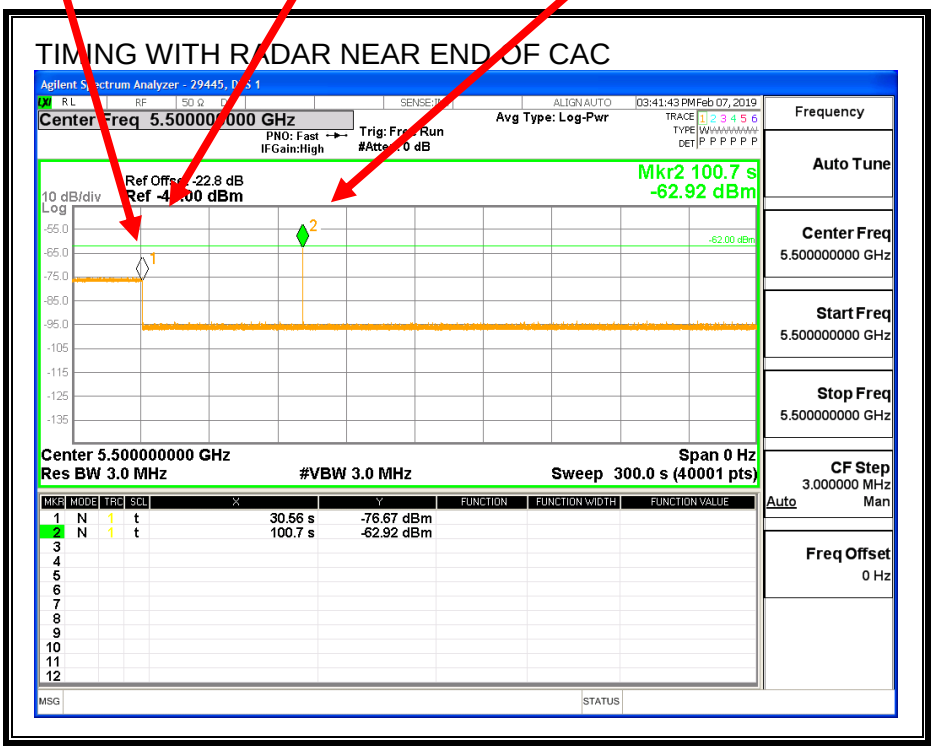
No EUT transmissions were observed after the radar signal.

TIMING WITH RADAR NEAR END OF CAC

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

End of Initial Power-up cycle
Start of CAC

Radar Signal Applied



No EUT transmissions were observed after the radar signal.

6.5.3. OVERLAPPING CHANNEL TESTS

RESULTS

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

6.5.4. MOVE AND CLOSING TIME

REPORTING NOTES

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

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

The aggregate channel closing transmission time is calculated as follows:

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

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

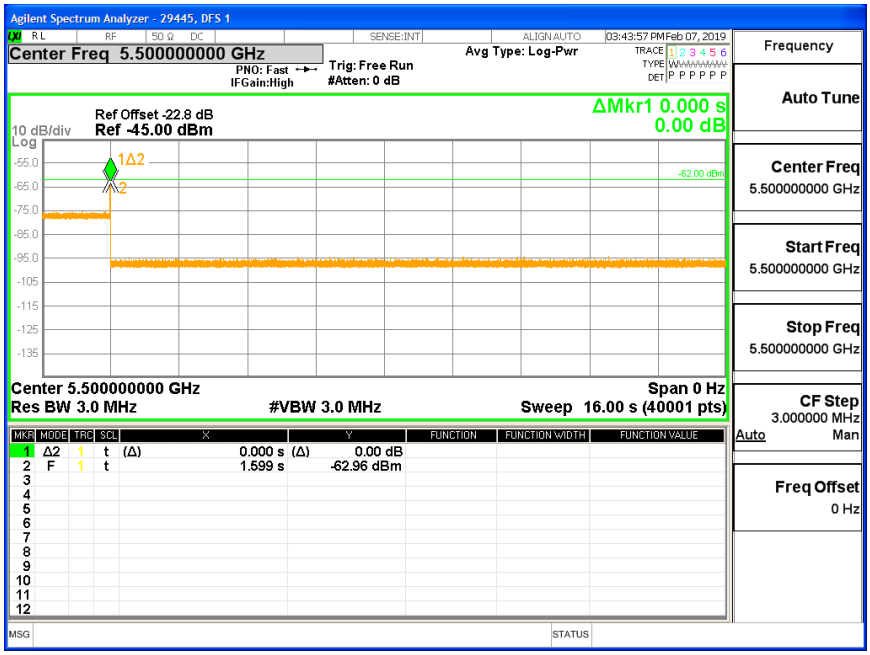
RESULTS

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

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

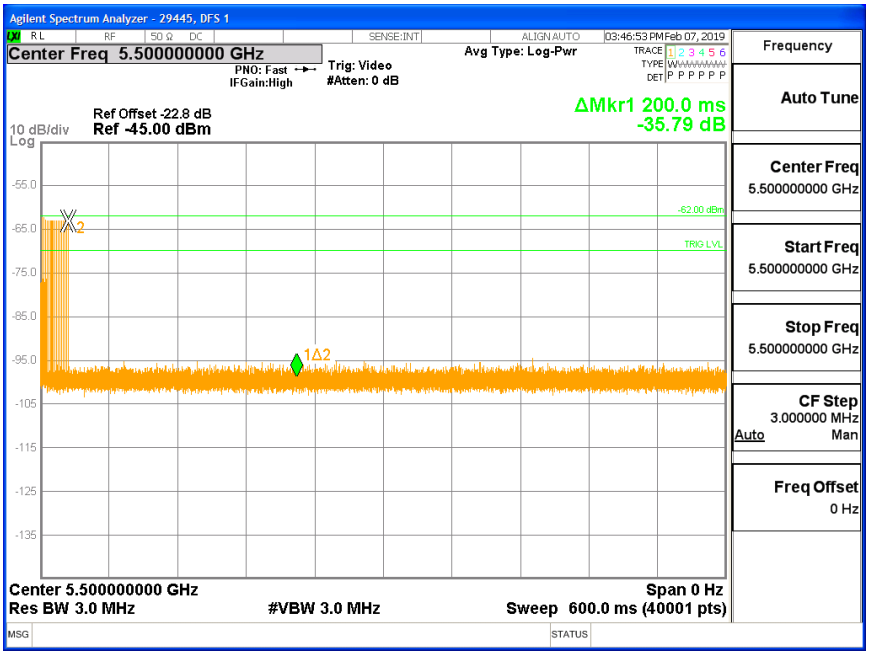
MOVE TIME

MOVE TIME



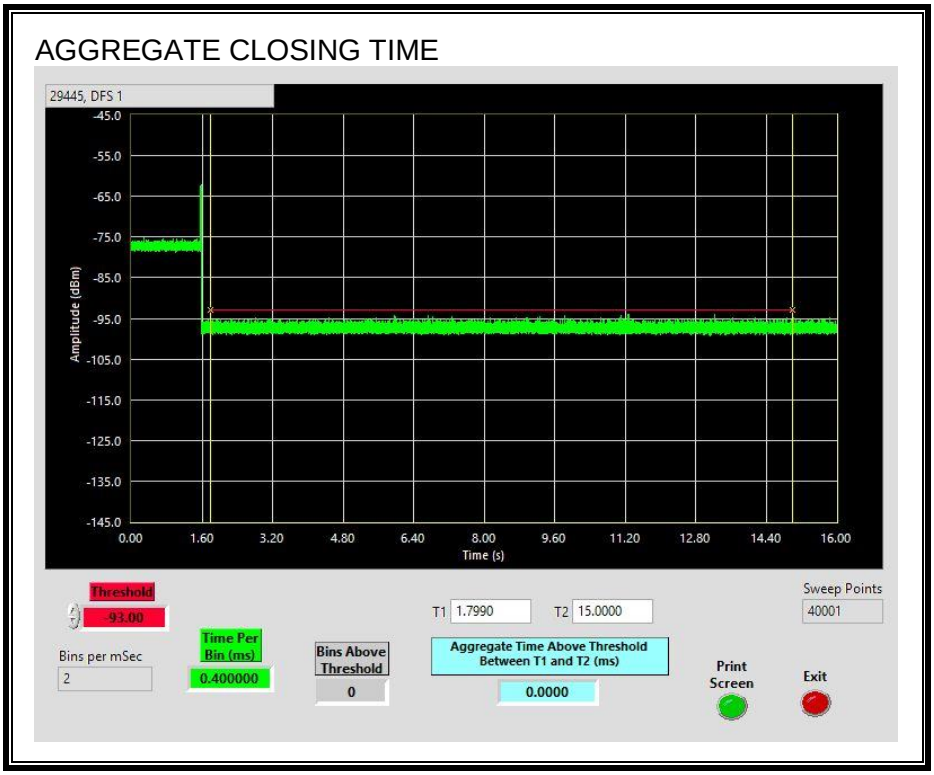
CHANNEL CLOSING TIME

CLOSING TIME



AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

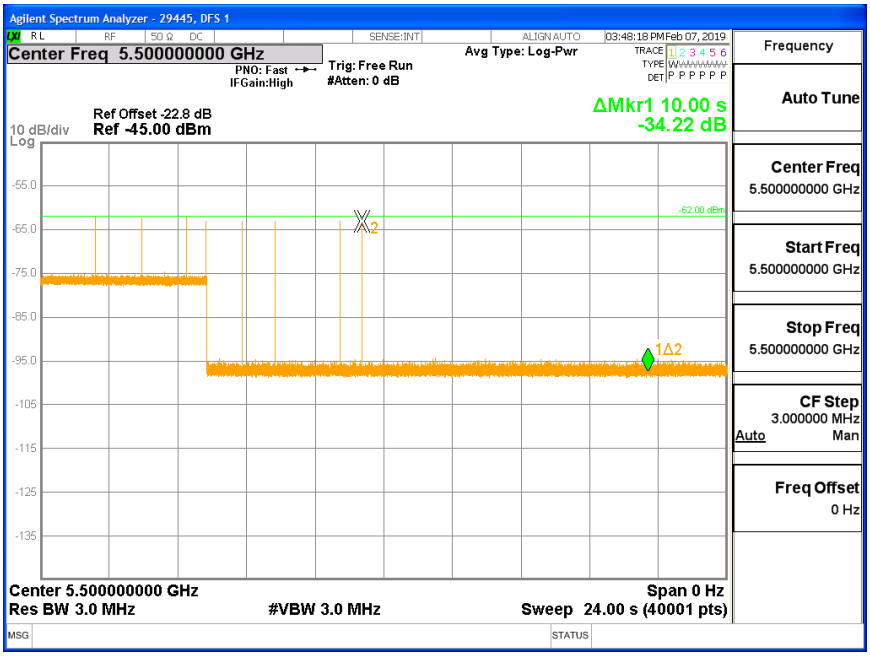
No transmissions are observed during the aggregate monitoring period.



LONG PULSE CHANNEL MOVE TIME

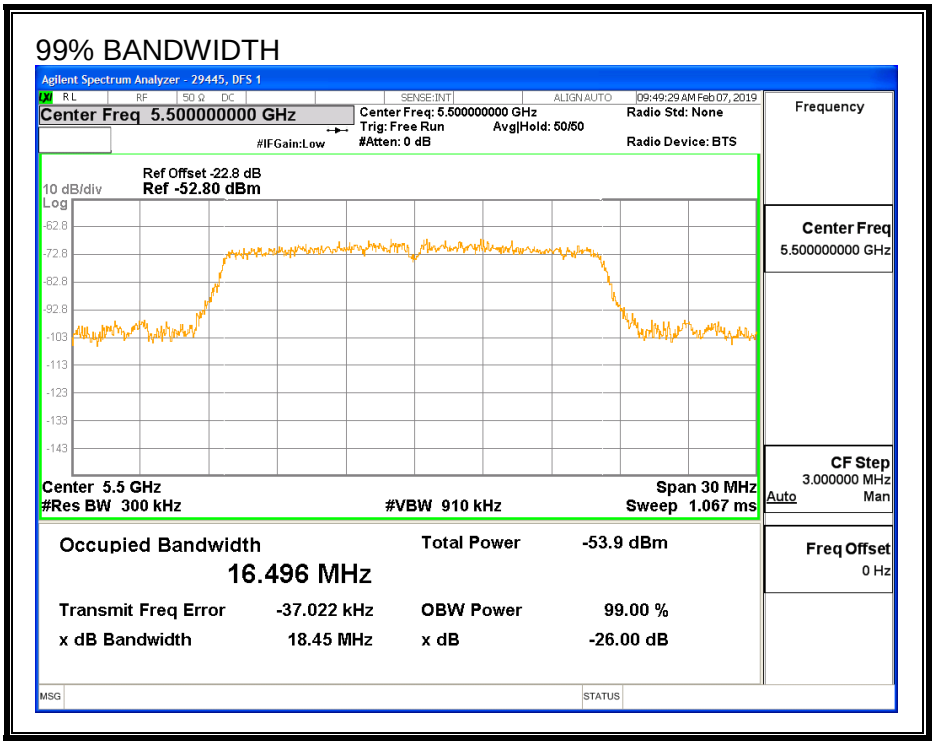
The traffic ceases prior to 10 seconds after the end of the radar waveform.

MOVE TIME FOR LONG PULSE RADAR



6.5.5. 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	16.496	121.2	100

DETECTION BANDWIDTH PROBABILITY

DETECTION BANDWIDTH PROBABILITY RESULTS

Detection Bandwidth Test Results		29445	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
5490	10	10	100	FL
5495	10	10	100	
5500	10	10	100	
5505	10	10	100	
5510	10	10	100	FH

6.5.6. 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	16.5	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 2	30	96.67	60	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 3	30	96.67	60	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 4	30	86.67	60	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
Aggregate		95.00	80	Pass						
FCC Long Pulse Type 5	30	96.67	80	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
FCC Hopping Type 6	42	97.62	70	Pass	5490	5510		DFS 1	29445	Version 3.3.4

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	5505	Yes
1002	1	858	62	A	5509	Yes
1003	1	778	68	A	5504	Yes
1004	1	658	81	A	5499	Yes
1005	1	938	57	A	5504	Yes
1006	1	638	83	A	5506	Yes
1007	1	718	74	A	5492	Yes
1008	1	878	61	A	5490	Yes
1009	1	558	95	A	5504	Yes
1010	1	538	99	A	5492	Yes
1011	1	678	78	A	5504	Yes
1012	1	618	86	A	5501	Yes
1013	1	898	59	A	5499	Yes
1014	1	698	76	A	5491	Yes
1015	1	798	67	A	5502	Yes
1016	1	2849	19	B	5502	Yes
1017	1	1933	28	B	5499	Yes
1018	1	2696	20	B	5495	Yes
1019	1	1910	28	B	5496	Yes
1020	1	1607	33	B	5509	Yes
1021	1	2304	23	B	5498	Yes
1022	1	777	68	B	5500	Yes
1023	1	2957	18	B	5499	Yes
1024	1	2913	19	B	5503	Yes
1025	1	1322	40	B	5501	Yes
1026	1	2760	20	B	5506	Yes
1027	1	2651	20	B	5505	Yes
1028	1	1672	32	B	5493	Yes
1029	1	1692	32	B	5505	Yes
1030	1	2195	25	B	5493	Yes

TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
2001	4.9	166	28	5504	Yes
2002	1.5	179	27	5504	Yes
2003	5	224	24	5491	Yes
2004	1.9	160	24	5495	Yes
2005	1.5	209	24	5504	Yes
2006	4.8	193	24	5497	Yes
2007	4.6	165	25	5494	Yes
2008	4.1	153	29	5508	Yes
2009	2.2	215	24	5506	Yes
2010	4	207	25	5501	Yes
2011	2.3	230	27	5500	No
2012	4.4	188	28	5497	Yes
2013	2.9	177	27	5507	Yes
2014	1	220	29	5502	Yes
2015	4.1	214	28	5490	Yes
2016	2.5	180	27	5501	Yes
2017	3.6	221	26	5510	Yes
2018	4.3	153	25	5494	Yes
2019	3.7	198	29	5492	Yes
2020	4.7	216	28	5506	Yes
2021	4.3	184	29	5500	Yes
2022	3.5	167	29	5502	Yes
2023	1.4	182	23	5499	Yes
2024	5	208	27	5507	Yes
2025	5	189	29	5502	Yes
2026	2.7	181	23	5509	Yes
2027	1	204	24	5505	Yes
2028	3.1	162	26	5502	Yes
2029	1.6	152	25	5509	Yes
2030	1.9	195	26	5497	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3

Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	7.8	370	17	5500	Yes
3002	6.2	265	16	5508	Yes
3003	9.4	392	16	5509	Yes
3004	8	433	16	5503	Yes
3005	7.4	321	17	5500	Yes
3006	8.4	375	16	5508	Yes
3007	6	276	17	5505	Yes
3008	7.2	476	16	5506	Yes
3009	9.2	272	18	5497	Yes
3010	8.7	484	17	5495	Yes
3011	6.7	293	17	5495	Yes
3012	6.4	268	18	5500	Yes
3013	8.8	474	18	5501	Yes
3014	6.8	461	16	5494	No
3015	7.4	428	18	5493	Yes
3016	9.7	310	16	5506	Yes
3017	6.5	291	16	5503	Yes
3018	9	319	18	5508	Yes
3019	8.1	312	18	5492	Yes
3020	6.7	353	18	5508	Yes
3021	6.1	493	16	5501	Yes
3022	9.3	295	18	5500	Yes
3023	8.8	330	16	5499	Yes
3024	10	396	18	5491	Yes
3025	7.9	443	17	5491	Yes
3026	7.4	405	16	5507	Yes
3027	9.5	465	18	5500	Yes
3028	9.2	439	17	5506	Yes
3029	7.5	394	17	5507	Yes
3030	9.6	381	18	5510	Yes

TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
4001	11.4	349	15	5509	Yes
4002	16.4	482	16	5509	Yes
4003	18.4	463	16	5510	Yes
4004	14.8	491	15	5504	No
4005	12.9	484	12	5498	No
4006	14.6	274	16	5506	Yes
4007	17.5	413	16	5491	Yes
4008	15.4	467	14	5496	Yes
4009	14.5	250	12	5495	Yes
4010	17.1	317	14	5510	Yes
4011	12.4	364	12	5510	Yes
4012	11.2	326	13	5508	Yes
4013	16	386	14	5506	Yes
4014	15.3	360	12	5491	Yes
4015	11.5	315	16	5503	Yes
4016	16.1	302	14	5497	Yes
4017	17.6	270	13	5510	Yes
4018	13.5	403	14	5510	Yes
4019	15.5	266	12	5505	Yes
4020	11.9	411	13	5490	Yes
4021	19.1	287	15	5493	No
4022	11.8	446	15	5497	Yes
4023	19.5	334	12	5490	Yes
4024	12.5	388	12	5509	Yes
4025	11.6	422	15	5499	Yes
4026	19.1	488	13	5501	No
4027	18.6	285	13	5490	Yes
4028	17.4	497	16	5507	Yes
4029	13.2	306	12	5498	Yes
4030	12.5	280	15	5491	Yes

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5500	No
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	5499	Yes
12	5497	Yes
13	5495	Yes
14	5494	Yes
15	5499	Yes
16	5497	Yes
17	5500	Yes
18	5495	Yes
19	5495	Yes
20	5499	Yes
21	5505	Yes
22	5501	Yes
23	5505	Yes
24	5501	Yes
25	5505	Yes
26	5501	Yes
27	5505	Yes
28	5501	Yes
29	5505	Yes
30	5501	Yes

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

TYPE 6 DETECTION PROBABILITY

Data Sheet for FCC Hopping Radar Type 6				
1 us Pulse Width, 333 us PRI, 9 Pulses per Burst, 1 Burst per Hop				
NTIA August 2005 Hopping Sequence				
Trial	Starting Index Within Sequence	Signal Generator Frequency (MHz)	Hops within Detection BW	Successful Detection (Yes/No)
1	370	5490	2	Yes
2	845	5491	3	Yes
3	1320	5492	8	Yes
4	1795	5493	5	Yes
5	2270	5494	5	Yes
6	2745	5495	1	Yes
7	3695	5496	4	Yes
8	4170	5497	3	Yes
9	4645	5498	3	Yes
10	5120	5499	2	Yes
11	5595	5500	1	Yes
12	6070	5501	5	Yes
13	6545	5502	3	Yes
14	7020	5503	4	Yes
15	7495	5504	4	Yes
16	7970	5505	2	No
17	8445	5506	4	Yes
18	8920	5507	7	Yes
19	9395	5508	7	Yes
20	9870	5509	3	Yes
21	10345	5510	4	Yes
22	10820	5490	6	Yes
23	11295	5491	6	Yes
24	11770	5492	4	Yes
25	12245	5493	2	Yes
26	12720	5494	5	Yes
27	13195	5495	2	Yes
28	13670	5496	2	Yes
29	14145	5497	7	Yes
30	14620	5498	5	Yes
31	15095	5499	6	Yes
32	15570	5500	3	Yes
33	16045	5501	3	Yes
34	16520	5502	10	Yes
35	16995	5503	5	Yes
36	17470	5504	4	Yes
37	17945	5505	2	Yes
38	18420	5506	1	Yes
39	18895	5507	4	Yes
40	19370	5508	4	Yes
41	19845	5509	6	Yes
42	20320	5510	2	Yes

6.6. MONITOR RADIO RESULTS FOR 20 MHz BANDWIDTH / 48 kHz SAMPLE RATE

6.6.1. TRAFFIC AND CHANNEL LOADING

The Monitor Radio is a listen only device. It never transmits control signals or data. It is used to establish the availability of the initial DFS working channel and then pre-screen a second working channel as a back-up in the event that the initial working channel is taken out of service.

6.6.2. OVERLAPPING CHANNEL TESTS

RESULTS

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

6.6.3. MOVE AND CLOSING TIME

The Monitor Radio is a listen only device that never transmits control signals or data therefore this test is not required.

6.6.4. DETECTION BANDWIDTH

The manufacturer declares that the radio module, antenna and software used with the Monitor Radio are identical to the Working Radio. Therefore the 99% Power Bandwidth and Detection Bandwidth values of the Monitor Radio are equivalent to the Working Radio values found in section 6.4.6. Those values are used to perform In-Service Monitoring tests for the Monitor Radio.

6.6.5. CHANNEL AND NETWORK CONFIGURATION FOR DETECTION TESTS

In-Service Monitoring tests were performed on the Monitor Radio at a channel center frequency of 5500 MHz, with a fully operational link established between the Working Radio and the Slave Devices at a channel center frequency of 5540 MHz, thus the channel separation between the Working and Monitor Radios was at the design minimum in accordance with KDB 437887.

6.6.6. 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	16.43	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 2	30	100.00	60	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 3	30	96.67	60	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 4	30	70.00	60	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
Aggregate		91.67	80	Pass						
FCC Long Pulse Type 5	30	93.33	80	Pass	5490	5510	16.43	DFS 1	29445	Version 3.3.4
FCC Hopping Type 6	42	100.00	70	Pass	5490	5510		DFS 1	29445	Version 3.3.4

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	5492	Yes
1002	1	858	62	A	5505	Yes
1003	1	778	68	A	5502	Yes
1004	1	658	81	A	5491	Yes
1005	1	938	57	A	5502	Yes
1006	1	638	83	A	5501	Yes
1007	1	718	74	A	5500	Yes
1008	1	878	61	A	5491	Yes
1009	1	558	95	A	5504	Yes
1010	1	538	99	A	5505	Yes
1011	1	678	78	A	5491	Yes
1012	1	618	86	A	5493	Yes
1013	1	898	59	A	5503	Yes
1014	1	698	76	A	5497	Yes
1015	1	798	67	A	5501	Yes
1016	1	2849	19	B	5498	Yes
1017	1	1933	28	B	5492	Yes
1018	1	2696	20	B	5498	Yes
1019	1	1910	28	B	5499	Yes
1020	1	1607	33	B	5497	Yes
1021	1	2304	23	B	5502	Yes
1022	1	777	68	B	5497	Yes
1023	1	2957	18	B	5503	Yes
1024	1	2913	19	B	5493	Yes
1025	1	1322	40	B	5509	Yes
1026	1	2760	20	B	5503	Yes
1027	1	2651	20	B	5503	Yes
1028	1	1672	32	B	5499	Yes
1029	1	1692	32	B	5507	Yes
1030	1	2195	25	B	5503	Yes

TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
2001	4.9	166	28	5498	Yes
2002	1.5	179	27	5508	Yes
2003	5	224	24	5508	Yes
2004	1.9	160	24	5509	Yes
2005	1.5	209	24	5490	Yes
2006	4.8	193	24	5502	Yes
2007	4.6	165	25	5491	Yes
2008	4.1	153	29	5504	Yes
2009	2.2	215	24	5497	Yes
2010	4	207	25	5497	Yes
2011	2.3	230	27	5498	Yes
2012	4.4	188	28	5495	Yes
2013	2.9	177	27	5495	Yes
2014	1	220	29	5510	Yes
2015	4.1	214	28	5507	Yes
2016	2.5	180	27	5496	Yes
2017	3.6	221	26	5507	Yes
2018	4.3	153	25	5492	Yes
2019	3.7	198	29	5495	Yes
2020	4.7	216	28	5498	Yes
2021	4.3	184	29	5499	Yes
2022	3.5	167	29	5495	Yes
2023	1.4	182	23	5497	Yes
2024	5	208	27	5493	Yes
2025	5	189	29	5502	Yes
2026	2.7	181	23	5501	Yes
2027	1	204	24	5502	Yes
2028	3.1	162	26	5504	Yes
2029	1.6	152	25	5497	Yes
2030	1.9	195	26	5499	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	7.8	370	17	5509	Yes
3002	6.2	265	16	5490	Yes
3003	9.4	392	16	5508	Yes
3004	8	433	16	5491	Yes
3005	7.4	321	17	5498	No
3006	8.4	375	16	5497	Yes
3007	6	276	17	5505	Yes
3008	7.2	476	16	5507	Yes
3009	9.2	272	18	5499	Yes
3010	8.7	484	17	5498	Yes
3011	6.7	293	17	5494	Yes
3012	6.4	268	18	5508	Yes
3013	8.8	474	18	5493	Yes
3014	6.8	461	16	5508	Yes
3015	7.4	428	18	5509	Yes
3016	9.7	310	16	5509	Yes
3017	6.5	291	16	5497	Yes
3018	9	319	18	5496	Yes
3019	8.1	312	18	5491	Yes
3020	6.7	353	18	5501	Yes
3021	6.1	493	16	5497	Yes
3022	9.3	295	18	5495	Yes
3023	8.8	330	16	5508	Yes
3024	10	396	18	5492	Yes
3025	7.9	443	17	5506	Yes
3026	7.4	405	16	5495	Yes
3027	9.5	465	18	5508	Yes
3028	9.2	439	17	5502	Yes
3029	7.5	394	17	5492	Yes
3030	9.6	381	18	5498	Yes

TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
4001	11.4	349	15	5492	Yes
4002	16.4	482	16	5492	No
4003	18.4	463	16	5503	No
4004	14.8	491	15	5499	No
4005	12.9	484	12	5498	Yes
4006	14.6	274	16	5502	Yes
4007	17.5	413	16	5502	Yes
4008	15.4	467	14	5499	Yes
4009	14.5	250	12	5494	Yes
4010	17.1	317	14	5506	Yes
4011	12.4	364	12	5507	Yes
4012	11.2	326	13	5510	No
4013	16	386	14	5504	Yes
4014	15.3	360	12	5491	No
4015	11.5	315	16	5497	Yes
4016	16.1	302	14	5507	Yes
4017	17.6	270	13	5500	Yes
4018	13.5	403	14	5509	Yes
4019	15.5	266	12	5510	Yes
4020	11.9	411	13	5500	Yes
4021	19.1	287	15	5498	Yes
4022	11.8	446	15	5508	No
4023	19.5	334	12	5504	No
4024	12.5	388	12	5506	Yes
4025	11.6	422	15	5490	Yes
4026	19.1	488	13	5494	No
4027	18.6	285	13	5496	No
4028	17.4	497	16	5502	Yes
4029	13.2	306	12	5509	Yes
4030	12.5	280	15	5501	Yes

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5500	No
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	5499	Yes
12	5497	Yes
13	5495	Yes
14	5494	Yes
15	5499	Yes
16	5497	Yes
17	5500	Yes
18	5495	Yes
19	5495	Yes
20	5499	Yes
21	5505	Yes
22	5501	Yes
23	5505	Yes
24	5501	Yes
25	5505	Yes
26	5501	No
27	5505	Yes
28	5501	Yes
29	5505	Yes
30	5501	Yes

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

TYPE 6 DETECTION PROBABILITY

Data Sheet for FCC Hopping Radar Type 6				
1 us Pulse Width, 333 us PRI, 9 Pulses per Burst, 1 Burst per Hop				
NTIA August 2005 Hopping Sequence				
Trial	Starting Index Within Sequence	Signal Generator Frequency (MHz)	Hops within Detection BW	Successful Detection (Yes/No)
1	80	5490	3	Yes
2	555	5491	7	Yes
3	1030	5492	4	Yes
4	1505	5493	3	Yes
5	1980	5494	4	Yes
6	2455	5495	8	Yes
7	2930	5496	6	Yes
8	3405	5497	1	Yes
9	3880	5498	4	Yes
10	4355	5499	4	Yes
11	4830	5500	5	Yes
12	5305	5501	6	Yes
13	5780	5502	3	Yes
14	6255	5503	6	Yes
15	6730	5504	3	Yes
16	7205	5505	4	Yes
17	7680	5506	4	Yes
18	8155	5507	4	Yes
19	8630	5508	4	Yes
20	9105	5509	5	Yes
21	9580	5510	4	Yes
22	10055	5490	5	Yes
23	10530	5491	1	Yes
24	11005	5492	5	Yes
25	11480	5493	5	Yes
26	11955	5494	11	Yes
27	12430	5495	3	Yes
28	12905	5496	7	Yes
29	13380	5497	8	Yes
30	13855	5498	2	Yes
31	14330	5499	4	Yes
32	14805	5500	2	Yes
33	15280	5501	4	Yes
34	15755	5502	3	Yes
35	16230	5503	2	Yes
36	16705	5504	5	Yes
37	17180	5505	4	Yes
38	17655	5506	4	Yes
39	18130	5507	6	Yes
40	18605	5508	4	Yes
41	19080	5509	2	Yes
42	19555	5510	3	Yes

6.7. MONITOR RADIO RESULTS FOR 20 MHz BANDWIDTH / 96 kHz SAMPLE RATE

6.7.1. TRAFFIC AND CHANNEL LOADING

The Monitor Radio is a listen only device. It never transmits control signals or data. It is used to establish the availability of the initial DFS working channel and then pre-screen a second working channel as a back-up in the event that the initial working channel is taken out of service.

6.7.2. OVERLAPPING CHANNEL TESTS

RESULTS

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

6.7.3. MOVE AND CLOSING TIME

The Monitor Radio is a listen only device that never transmits control signals or data therefore this test is not required.

6.7.4. DETECTION BANDWIDTH

The manufacturer declares that the radio module, antenna and software used with the Monitor Radio are identical to the Working Radio. Therefore the 99% Power Bandwidth and Detection Bandwidth values of the Monitor Radio are equivalent to the Working Radio values found in section 6.5.5. Those values are used to perform In-Service Monitoring tests for the Monitor Radio.

6.7.5. CHANNEL AND NETWORK CONFIGURATION FOR DETECTION TESTS

In-Service Monitoring tests were performed on the Monitor Radio at a channel center frequency of 5500 MHz, with a fully operational link established between the Working Radio and the Slave Devices at a channel center frequency of 5540 MHz, thus the channel separation between the Working and Monitor Radios was at the design minimum in accordance with KDB 437887.

6.7.6. 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	16.5	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 2	30	100.00	60	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 3	30	96.67	60	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
FCC Short Pulse Type 4	30	86.67	60	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
Aggregate		95.83	80	Pass						
FCC Long Pulse Type 5	30	96.67	80	Pass	5490	5510	16.5	DFS 1	29445	Version 3.3.4
FCC Hopping Type 6	42	95.24	70	Pass	5490	5510		DFS 1	29445	Version 3.3.4

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	5496	Yes
1002	1	858	62	A	5499	Yes
1003	1	778	68	A	5495	Yes
1004	1	658	81	A	5494	Yes
1005	1	938	57	A	5496	Yes
1006	1	638	83	A	5492	Yes
1007	1	718	74	A	5504	Yes
1008	1	878	61	A	5492	Yes
1009	1	558	95	A	5493	Yes
1010	1	538	99	A	5500	Yes
1011	1	678	78	A	5510	Yes
1012	1	618	86	A	5499	Yes
1013	1	898	59	A	5495	Yes
1014	1	698	76	A	5508	Yes
1015	1	798	67	A	5495	Yes
1016	1	2849	19	B	5506	Yes
1017	1	1933	28	B	5508	Yes
1018	1	2696	20	B	5494	Yes
1019	1	1910	28	B	5501	Yes
1020	1	1607	33	B	5503	Yes
1021	1	2304	23	B	5496	Yes
1022	1	777	68	B	5505	Yes
1023	1	2957	18	B	5495	Yes
1024	1	2913	19	B	5501	Yes
1025	1	1322	40	B	5497	Yes
1026	1	2760	20	B	5502	Yes
1027	1	2651	20	B	5505	Yes
1028	1	1672	32	B	5502	Yes
1029	1	1692	32	B	5493	Yes
1030	1	2195	25	B	5507	Yes

TYPE 2 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 2					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
2001	4.9	166	28	5509	Yes
2002	1.5	179	27	5494	Yes
2003	5	224	24	5492	Yes
2004	1.9	160	24	5498	Yes
2005	1.5	209	24	5495	Yes
2006	4.8	193	24	5497	Yes
2007	4.6	165	25	5508	Yes
2008	4.1	153	29	5506	Yes
2009	2.2	215	24	5501	Yes
2010	4	207	25	5492	Yes
2011	2.3	230	27	5491	Yes
2012	4.4	188	28	5501	Yes
2013	2.9	177	27	5493	Yes
2014	1	220	29	5490	Yes
2015	4.1	214	28	5503	Yes
2016	2.5	180	27	5496	Yes
2017	3.6	221	26	5507	Yes
2018	4.3	153	25	5498	Yes
2019	3.7	198	29	5510	Yes
2020	4.7	216	28	5499	Yes
2021	4.3	184	29	5492	Yes
2022	3.5	167	29	5498	Yes
2023	1.4	182	23	5501	Yes
2024	5	208	27	5500	Yes
2025	5	189	29	5509	Yes
2026	2.7	181	23	5497	Yes
2027	1	204	24	5497	Yes
2028	3.1	162	26	5504	Yes
2029	1.6	152	25	5494	Yes
2030	1.9	195	26	5506	Yes

TYPE 3 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 3					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
3001	7.8	370	17	5507	Yes
3002	6.2	265	16	5490	Yes
3003	9.4	392	16	5505	Yes
3004	8	433	16	5504	Yes
3005	7.4	321	17	5505	Yes
3006	8.4	375	16	5493	Yes
3007	6	276	17	5500	Yes
3008	7.2	476	16	5497	Yes
3009	9.2	272	18	5502	Yes
3010	8.7	484	17	5510	Yes
3011	6.7	293	17	5495	Yes
3012	6.4	268	18	5490	Yes
3013	8.8	474	18	5494	Yes
3014	6.8	461	16	5507	No
3015	7.4	428	18	5508	Yes
3016	9.7	310	16	5506	Yes
3017	6.5	291	16	5498	Yes
3018	9	319	18	5496	Yes
3019	8.1	312	18	5504	Yes
3020	6.7	353	18	5509	Yes
3021	6.1	493	16	5508	Yes
3022	9.3	295	18	5493	Yes
3023	8.8	330	16	5491	Yes
3024	10	396	18	5499	Yes
3025	7.9	443	17	5492	Yes
3026	7.4	405	16	5506	Yes
3027	9.5	465	18	5502	Yes
3028	9.2	439	17	5494	Yes
3029	7.5	394	17	5496	Yes
3030	9.6	381	18	5507	Yes

TYPE 4 DETECTION PROBABILITY

Data Sheet for FCC Short Pulse Radar Type 4					
Waveform	Pulse Width (us)	PRI (us)	Pulses Per Burst	Frequency (MHz)	Successful Detection (Yes/No)
4001	11.4	349	15	5501	Yes
4002	16.4	482	16	5508	Yes
4003	18.4	463	16	5498	Yes
4004	14.8	491	15	5494	Yes
4005	12.9	484	12	5499	No
4006	14.6	274	16	5505	Yes
4007	17.5	413	16	5502	Yes
4008	15.4	467	14	5506	Yes
4009	14.5	250	12	5501	Yes
4010	17.1	317	14	5509	Yes
4011	12.4	364	12	5505	Yes
4012	11.2	326	13	5494	Yes
4013	16	386	14	5493	Yes
4014	15.3	360	12	5493	Yes
4015	11.5	315	16	5509	Yes
4016	16.1	302	14	5504	Yes
4017	17.6	270	13	5503	No
4018	13.5	403	14	5508	Yes
4019	15.5	266	12	5501	Yes
4020	11.9	411	13	5493	Yes
4021	19.1	287	15	5490	Yes
4022	11.8	446	15	5497	Yes
4023	19.5	334	12	5492	Yes
4024	12.5	388	12	5498	Yes
4025	11.6	422	15	5495	Yes
4026	19.1	488	13	5494	No
4027	18.6	285	13	5503	Yes
4028	17.4	497	16	5506	No
4029	13.2	306	12	5510	Yes
4030	12.5	280	15	5509	Yes

TYPE 5 DETECTION PROBABILITY

Data Sheet for FCC Long Pulse Radar Type 5		
Trial	Frequency (MHz)	Successful Detection (Yes/No)
1	5500	Yes
2	5500	Yes
3	5500	Yes
4	5500	Yes
5	5500	Yes
6	5500	No
7	5500	Yes
8	5500	Yes
9	5500	Yes
10	5500	Yes
11	5499	Yes
12	5497	Yes
13	5495	Yes
14	5494	Yes
15	5499	Yes
16	5497	Yes
17	5500	Yes
18	5495	Yes
19	5495	Yes
20	5499	Yes
21	5505	Yes
22	5501	Yes
23	5505	Yes
24	5501	Yes
25	5505	Yes
26	5501	Yes
27	5505	Yes
28	5501	Yes
29	5505	Yes
30	5501	Yes

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

TYPE 6 DETECTION PROBABILITY

Data Sheet for FCC Hopping Radar Type 6
1 us Pulse Width, 333 us PRI, 9 Pulses per Burst, 1 Burst per Hop
NTIA August 2005 Hopping Sequence

Trial	Starting Index Within Sequence	Signal Generator Frequency (MHz)	Hops within Detection BW	Successful Detection (Yes/No)
1	308	5490	4	Yes
2	783	5491	1	Yes
3	1258	5492	5	Yes
4	1733	5493	5	Yes
5	2208	5494	5	Yes
6	2683	5495	3	Yes
7	3158	5496	3	Yes
8	3633	5497	4	Yes
9	4108	5498	5	Yes
10	4583	5499	1	Yes
11	5058	5500	1	No
12	5533	5501	3	Yes
13	6008	5502	3	Yes
14	6483	5503	4	Yes
15	6958	5504	4	Yes
16	7433	5505	4	Yes
17	7908	5506	2	Yes
18	8383	5507	3	Yes
19	8858	5508	5	Yes
20	9333	5509	6	Yes
21	9808	5510	4	Yes
22	10283	5490	4	Yes
23	10758	5491	6	Yes
24	11233	5492	4	Yes
25	11708	5493	3	Yes
26	12183	5494	4	Yes
27	12658	5495	3	Yes
28	13133	5496	3	Yes
29	13608	5497	3	Yes
30	14083	5498	3	Yes
31	14558	5499	5	Yes
32	15033	5500	5	Yes
33	15508	5501	4	Yes
34	15983	5502	5	Yes
35	16458	5503	6	Yes
36	16933	5504	3	Yes
37	17408	5505	5	Yes
38	17883	5506	3	No
39	18358	5507	3	Yes
40	18833	5508	4	Yes
41	19308	5509	3	Yes
42	19783	5510	4	Yes

6.8. 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.