RADIO TEST REPORT

For

MODEL NO.: 1793
FCC ID: C3K1793
IC ID: 3048A-1793

Test Report No. R-TR447-FCCISED-DFS-1
Issue Date: Sept 22, 2017

FCC CFR47 Part 15 Subpart E
Innovation, Science and Economic Development
Canada RSS-247 Issue 2

Prepared by
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ACCREDITED
TESTING CERT #3472.01

1 Record of Revisions

Revision	Date	Section	Page(s)	Summary of Changes	Author/Revised By:
1.0	09/22/2017	All	All	Version 1.0	Andy Shen

Table of Contents

Test Report Attestation

Microsoft Corporation
Model: 1793
FCC ID: C3K1793
IC ID: 3048A-1793

Applicable Standards

Specification	Test Result
FCC 47CFR Rule Parts 15.407 (DFS)	Pass
Innovation, Science and Economic Development Canada RSS-247 Issue 2 (DFS)	Pass

Microsoft EMC Laboratory attests that the product model identified in this report has been tested to and meets the requirements identified in the above standards. The test results in this report solely pertains to the specific sample tested, under the conditions and operating modes as provided by the customer.

This report shall not be used to claim product certification, approval, or endorsement by A2LA or any agency of any Government. Reproduction, duplication or publication of extracts from this test report is prohibited and requires prior written approval of Microsoft EMC Laboratory.

Written By: Andy Shen

Radio Test Engineer

Reviewed/ Issued By: Sajay Jose

EMC/RF Compliance Lab Manager

2 Deviations from Standards

None.

3 Facilities and Accreditations

3.1 Test Facility

All test facilities used to collect the test data are located at
Microsoft EMC Laboratory,
17760 NE 67th Ct,
Redmond WA, 98052, USA

3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.
A2LA Accredited Testing Certificate Number: 3472.01
FCC Registration Number: US1141
IC Site Registration Numbers: 3048A-3, 3048A-4

4 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Sahithi Kandula
Functional Description of the EUT:	Portable Computing Device with IEEE 802.11a/b/g/n/ac MIMO radio supporting 20/40/80 MHz bandwidths, Bluetooth 4.0 radio, and an additional 802.11n SISO radio supporting 20MHz bandwidth.
Model:	1793
FCC ID:	C3K1793
IC ID:	3048A-1793
Radio under test:	IEEE 802.11a/n/ac with 20MHz, 40MHz and 80MHz Signal Bandwidths
Modulation(s):	OFDM – BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
EUT Classification:	UNII Client Device without radar detection
RF Conducted port impedance:	50 Ω in the frequency range of operation
Antenna Gain Measurement Verification:	N/A – Measurements were performed using conducted test methods
Transmit Power Control:	The EUT does not implement TPC
Wireless Bridge or Mesh Capability:	The device does not implement bridge or mesh modes.
Power – Cycle Time:	N/A. The EUT is a client device without radar detection
Radar Waveform Information:	The EUT does not detect or store information regarding radar waveforms
Equipment Design State:	Prototype/Production Equivalent (EV3B)
Equipment Condition:	Good
Test Sample Details:	RF Conducted Test Sample Top SN: 009360372757; Base SN: 061236372654

4.1 Test Configurations

The device was setup in normal operation and connected wirelessly to an 802.11 access point on 40 MHz bandwidth channels. The EUT supports 80 MHz bandwidths, which were excluded from measurements (based on guidance from KDB 905462 D03 v01r02).

A host laptop was configured to transmit traffic by using an .MP4 video file to the EUT. Iperf was used to generate a continuous amount of traffic while the video was streamed simultaneously to meet channel loading conditions and allow for random pinging intervals and dynamically allocate the talk/listen ratio.

Aeroflex PXI 3001C DFS test system was used to monitor traffic and generate radar pulses. A spectrum analyzer was used for the 30-minute non-occupancy period test. Measurements were performed on the main antenna, Chain B of the EUT. DFS signals were injected into 5 GHz Tx/Rx port B of the Master device.

4.2 Environmental Conditions

Ambient air temperature of the test site was within the range of 10 °C to 40 °C (50 °F to 104 °F) unless the EUT specified testing over a different temperature range. Humidity levels were in the range of 10% to 90% relative humidity. Testing conditions were within tolerance and any deviations required from the EUT are reported.

4.3 Antenna Requirements

The antennas are internal, permanently attached and there are no provisions for connection to an external antenna.

Antenna Gain		
Frequency Band (MHz)	**Chain A MIMO Wi-Fi Antenna Peak Gain (dBi)**	**Chain B Main Antenna Wi-Fi Peak Gain (dBi)**
UNII Band 1- 5150 to 5250	3.95	2.53
UNII Band 2a – 5250 to 5350	3.95	2.53
UNII Band 2c – 5470 to 5725	3.12	3.68
UNII Band 3 – 5725 to 5850	3.00	1.69

Simultaneous transmission on both transmit chains was observed to be the worst-case mode of operation for all test cases. Since the transmit signals are completely uncorrelated in regards to transmit power, the combined gain is calculated using the following formula as specified in KDB 662911 D01 Multiple Transmitter Output v02r01:

Directional gain = 10log $[(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10})/N_{ANT}]$ dBi

Combined Directional Antenna Gain	
Frequency Band (MHz)	**Combined Directional Gain (dBi)**
UNII Band 1- 5150 to 5250	3.30
UNII Band 2a – 5250 to 5350	3.30
UNII Band 2c – 5470 to 5725	**3.41**
UNII Band 3 – 5725 to 5850	2.39

4.4 Equipment Modifications

No modifications were made during testing.

4.5 Dates of Testing

Testing was performed from September 11st – September 13nd, 2017.

5 Test Results Summary

Test Description	FCC CFR 47/ ISED Rule Part	Limit	Test Result
In-Service Monitoring	15.407(h)(2)(iv) RSS-247 [6.3]	Monitor Co-channel Radar	N/A*
Channel Availability Check	15.407 (h)(2)(ii) RSS-247 [6.3]	60s Detection	N/A*
Channel Move Time	15.407 (h)(2)(iii) RSS-247 [6.3]	10s	Pass
Channel Closing Transmission Time	15.407 (h)(2)(iii) RSS-247 [6.3]	200ms + Aggregate 60ms over remaining 10s period	Pass
Non-Occupancy Period	15.407 (h)(2)(iv) RSS-247 [6.3]	30 minutes	Pass

*Note: The EUT is a Client device without radar detection.

6 Test Equipment List

Manufacturer	Description	Model #	Asset #	FCC ID	Calibration Due
Aeroflex	PXI Chassis	3001C	RF-132	N/A	05/27/2018
Cisco	Cisco Aironet ISO Access Point	AIR-AP1252AG-A-K9	RF-331	LDK 102061, LDK 102062	N/A*
Agilent	Spectrum Analyzer	N9030A	EMC-605	N/A	08/08/2018
Murata	RF Cable	MXHQ87WA3000	RF-456	N/A	N/A*
Murata	RF Cable	MXHQ87WA3000	RF-588	N/A	N/A*
Rosenberger	RF Cable	L72-449-915	EMC-154	N/A	N/A*
MegaPhase	RF Cable	L72-450-915	EMC-312	N/A	N/A*
Pasternack	RF-Cable	PE304-16	RF-620	N/A	N/A*
Pasternack	RF-Cable	PE302-48	RF-659	N/A	N/A*
Pasternack	3dB Attenuator	7087-3	RF-438	N/A	N/A*
Pasternack	3dB Attenuator	7087-3	RF-337	N/A	N/A*
Pasternack	30dB Attenuator	7092-30	RF-149	N/A	N/A*
Pasternack	20dB Attenuator	PE7087-20	RF-129	N/A	N/A*
Pasternack	10dB Attenuator	PE7087-10	RF-557	N/A	N/A*
L-Com	RF Combiner	SC5802N	RF-048	N/A	N/A*
L-Com	RF Combiner	SC5802N	RF-049	N/A	N/A*
Madge Tech	THP Monitor	PRHTemp2000	EMC-680	N/A	10/25/2017

Note: Equipment with Calibration Due Date of “N/A*” are functionally verified or characterized before test.

7 Test Method

7.1 Antenna port conducted measurements

Antenna port conducted measurements were performed on a bench-top setup consisting of a spectrum analyzer, splitters/combiners (as necessary), attenuators, and pre-characterized RF cables. The Aeroflex PXI 3001C DFS test system monitored traffic and generated radar bursts.

The correction factors between the EUT, support equipment, radar test generator and the spectrum analyzer are added internally in the Aeroflex test system.

7.2 Test Setup Diagrams

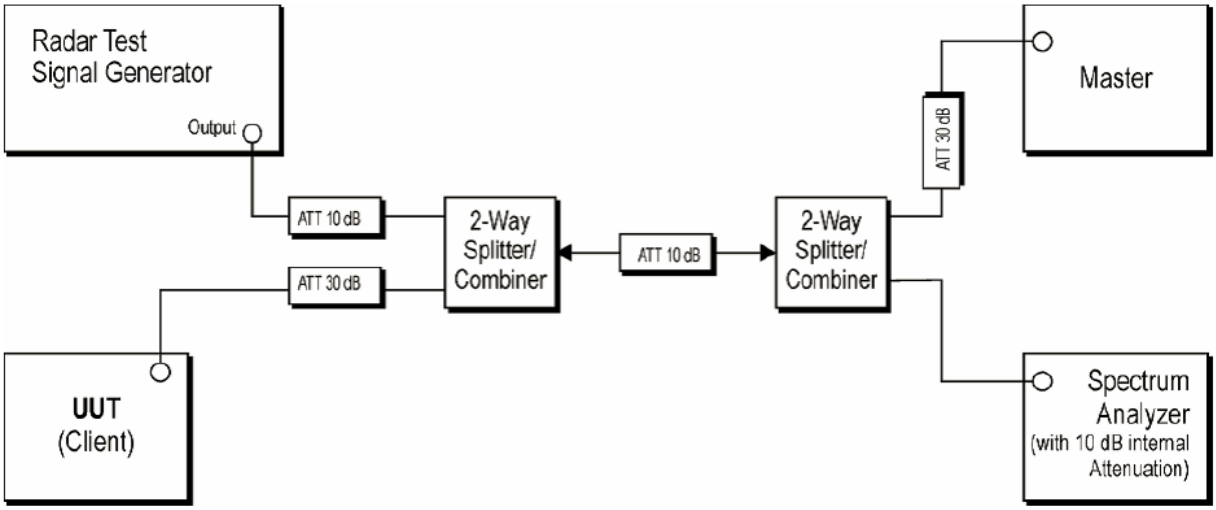

Figure 1. Test Setup for Antenna Port Conducted Measurements

7.3 Radar Waveform Verification

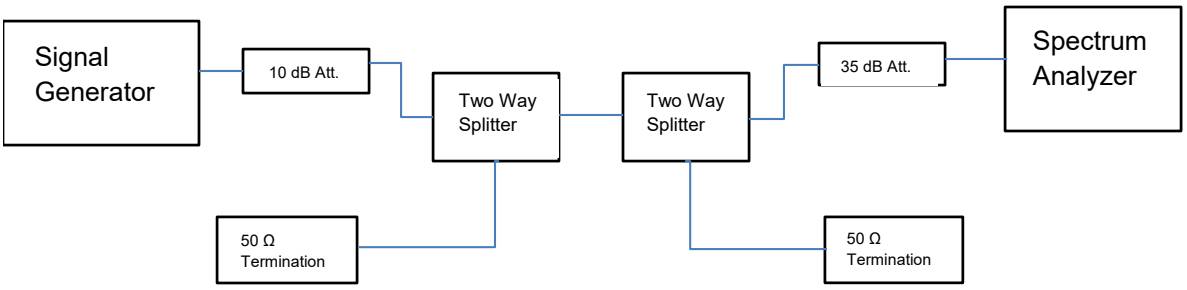

Figure 2. Test Setup for Conducted Measurement Radar Verification

Device Type	Device	Min. Output Power (dBm)	Max Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Required Radar Detection Threshold Level (dBm)
Master	CISCO AIR-AP1252AG-A-K9	-1	20	6	26	-63
Client	Microsoft Model 1793	13.64	15.12	3.41	18.42	N/A

DFS Measurement	Radar Type
Channel Move Time	0
Channel Closing Transmission Time	0
Non-Occupancy Period	0

Rader Type	Frequency (MHz)	Level (dBm)	Pulse count	Pulse width (µs)	Pulse Repetition Interval (ms)
0	5310	-63.063	18	1.00	1.428
0	5510	-63.109	18	1.00	1.428

Note: 80 MHz bandwidths were not tested, due to the lack of 80 MHz Master devices available on the market (allowed based on guidance from KDB 905462 D03 v01r02).

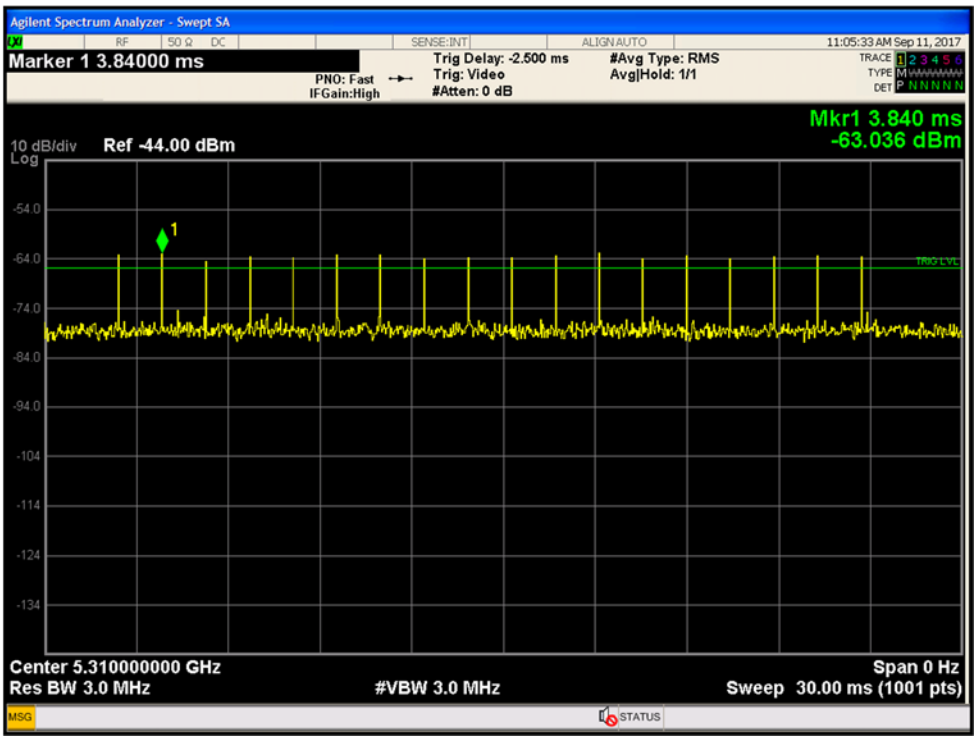

Figure 3. Radar Burst Level at -63dBm: Radar Type 0 (5310 MHz 40 MHz BW)

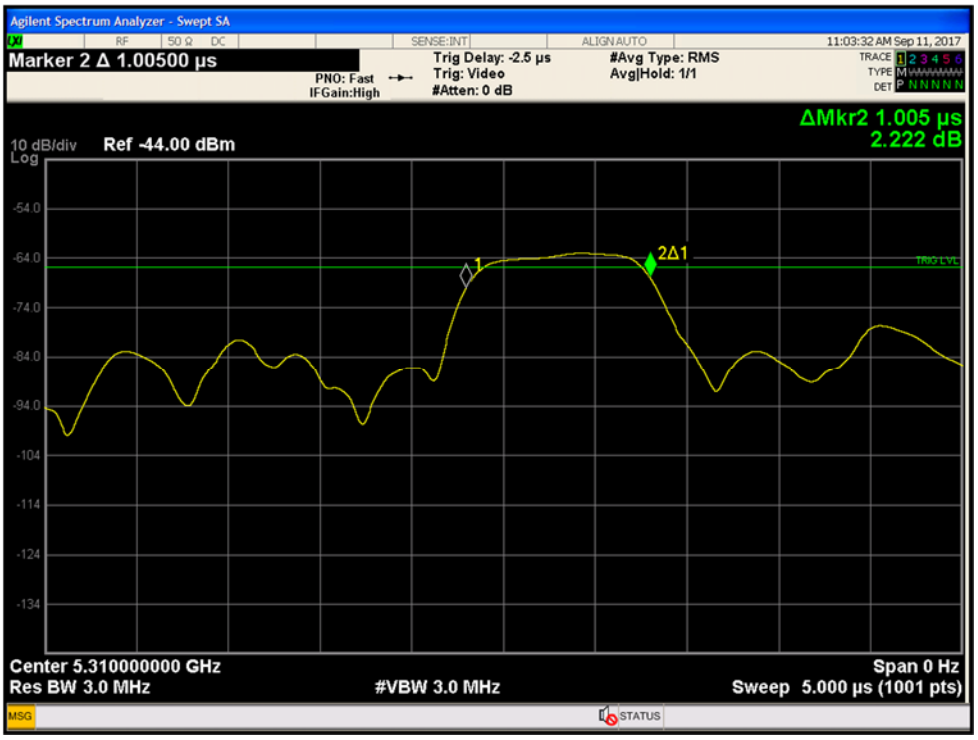

Figure 4. Radar Pulse width: Radar Type 0 (5310 MHz 40 MHz BW)

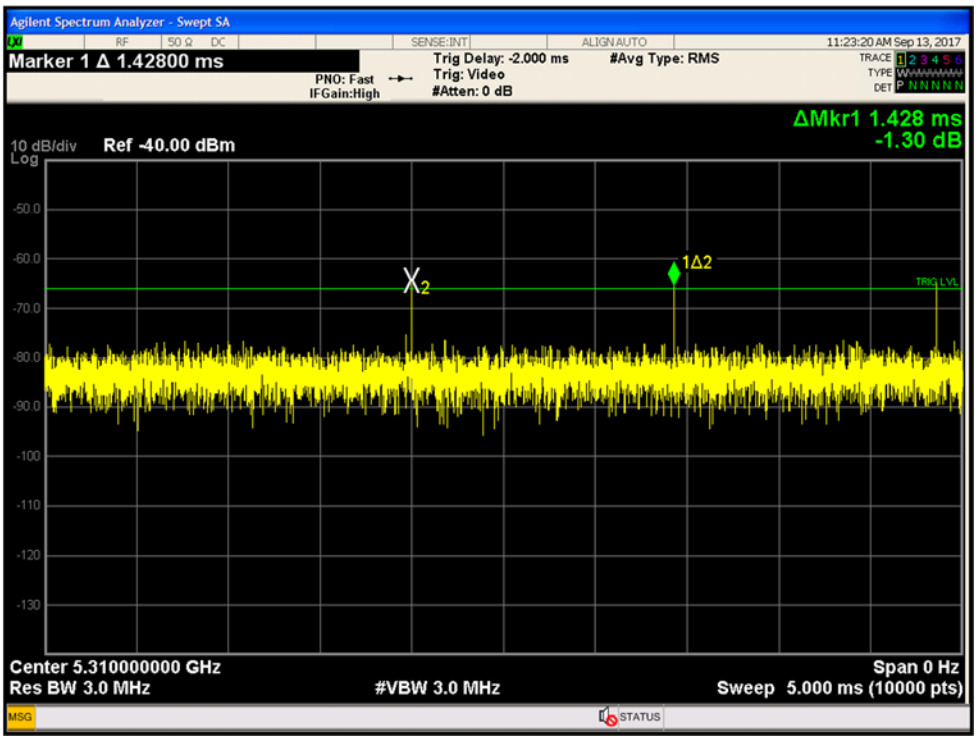

Figure 5. Radar Pulse Repetition Interval: Radar Type 0 (5310 MHz 40 MHz BW)

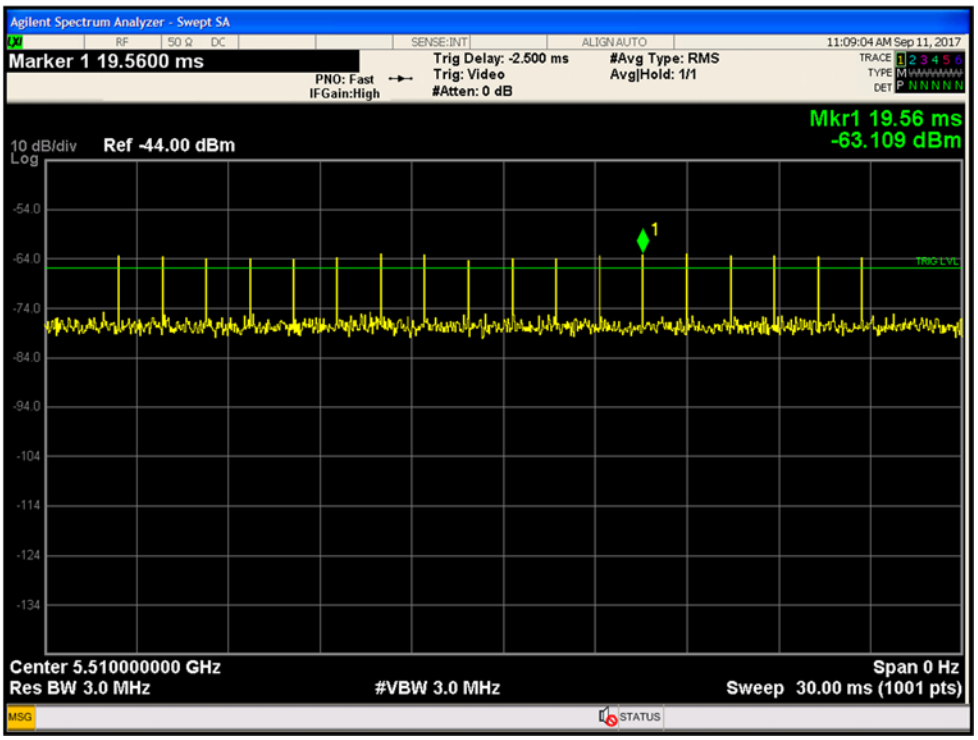

Figure 6. Radar Burst Level at -63dBm: Radar Type 0 (5510 MHz 40 MHz BW)

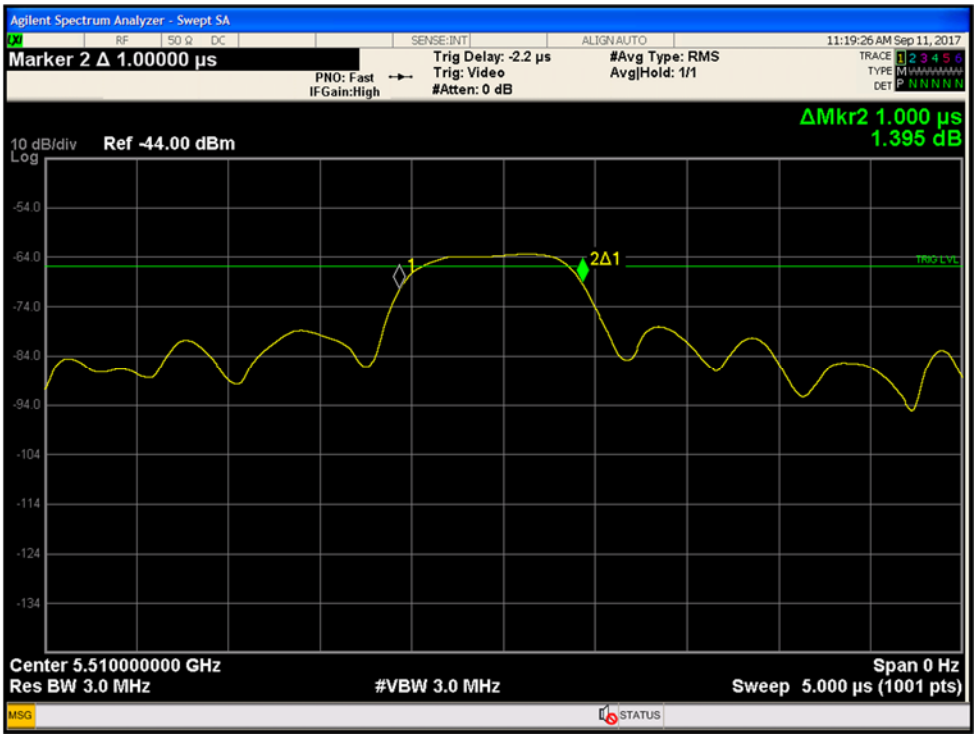

Figure 7. Radar Pulse width: Radar Type 0 (5510 MHz 40 MHz BW)

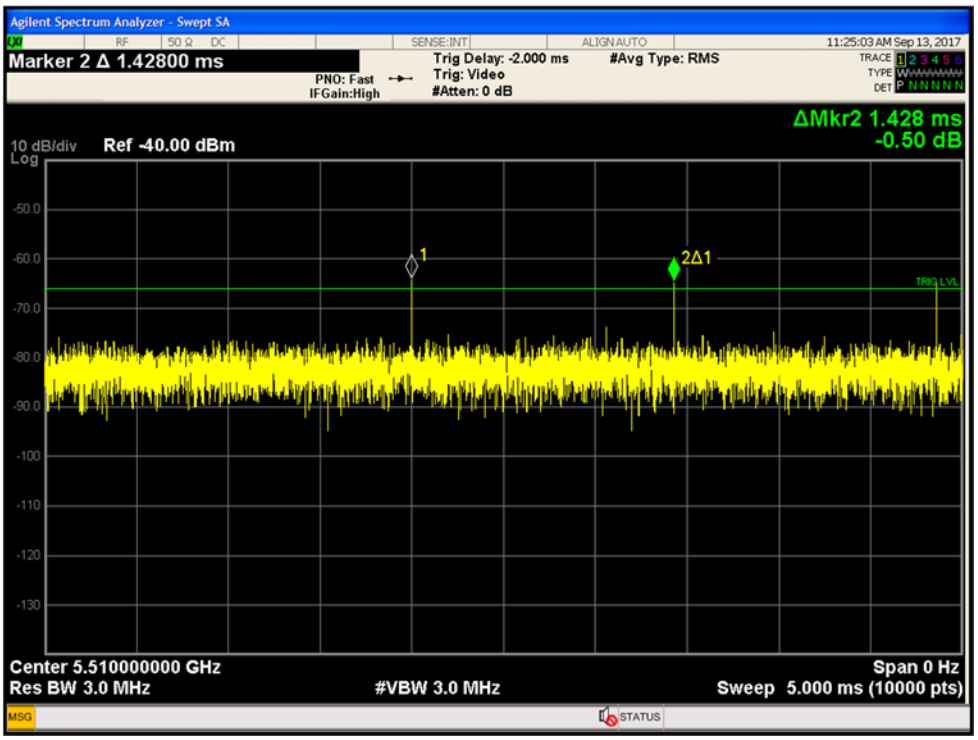

Figure 8. Radar Pulse Repetition Interval: Radar Type 0 (5510 MHz 40 MHz BW)

7.4 Channel Loading

7.4.1 Test Method

Channel Loading measurements were taken with a spectrum analyzer. CSV files were generated, and Channel Loading was calculated using that measured data. Channel Loading was measured to be > 17%.

Channel Loading is calculated using the following formula:

$$Channel\ Loading\ (\%) = \frac{On\ Time}{(On\ Time + Off\ Time)} \times 100$$

Frequency (MHz)	Signal Bandwidth (MHz)	Total On Time (ms)	On Time + Off Time (ms)	Channel Loading (%)
5310	40	0.626	100	62.6
5510	40	0.674	100	67.4

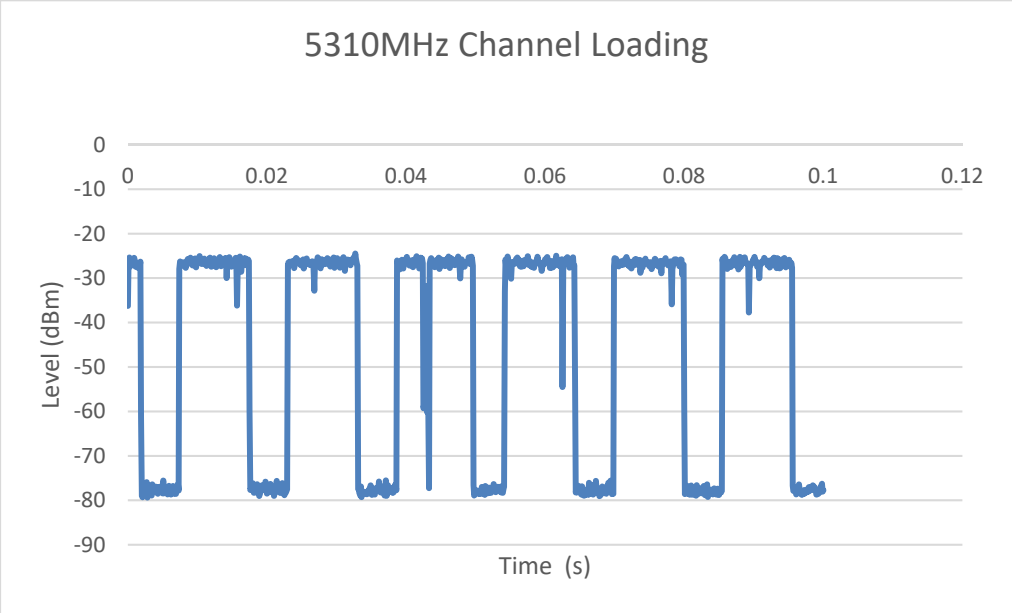

Figure 9. Channel Loading (5310 MHz 40 MHz BW)

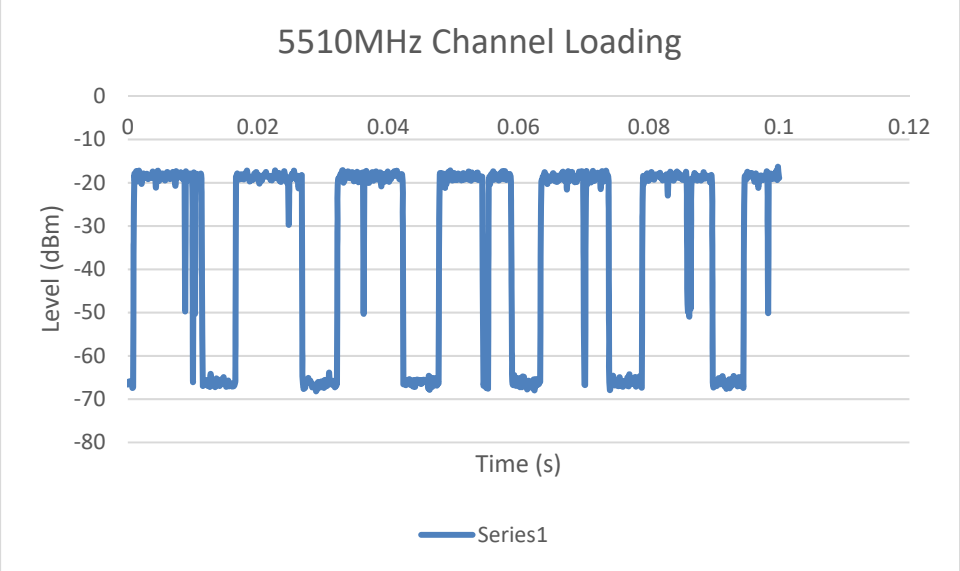

Figure 10. Channel Loading (5510 MHz 40 MHz BW)

8 Test Results

8.1 Channel Move Time

8.1.1 Test Requirement:

FCC CFR 47 Rule Part 15.407 (h)(2)(iv)

ISED Canada RSS-247 [6.3]

8.1.2 Test Method:

Measurements were performed according to the procedures defined in KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02.

8.1.3 Limits:

After a radar signal is detected, the device shall cease all transmissions on the operating channel within 10 seconds.

8.1.4 Test Results:

Pass.

The EUT ceased transmission on the channel within 200 ms and there was less than an aggregate of 60ms transmission time in a 10s period.

8.1.5 Test Data

8.1.5.1 Channel Move Time

Frequency (MHz)	Signal Bandwidth (MHz)	Channel Move Time (s)	Limit (s)	Result
5310	40	0.638	10	Pass
5510	40	0.614	10	Pass

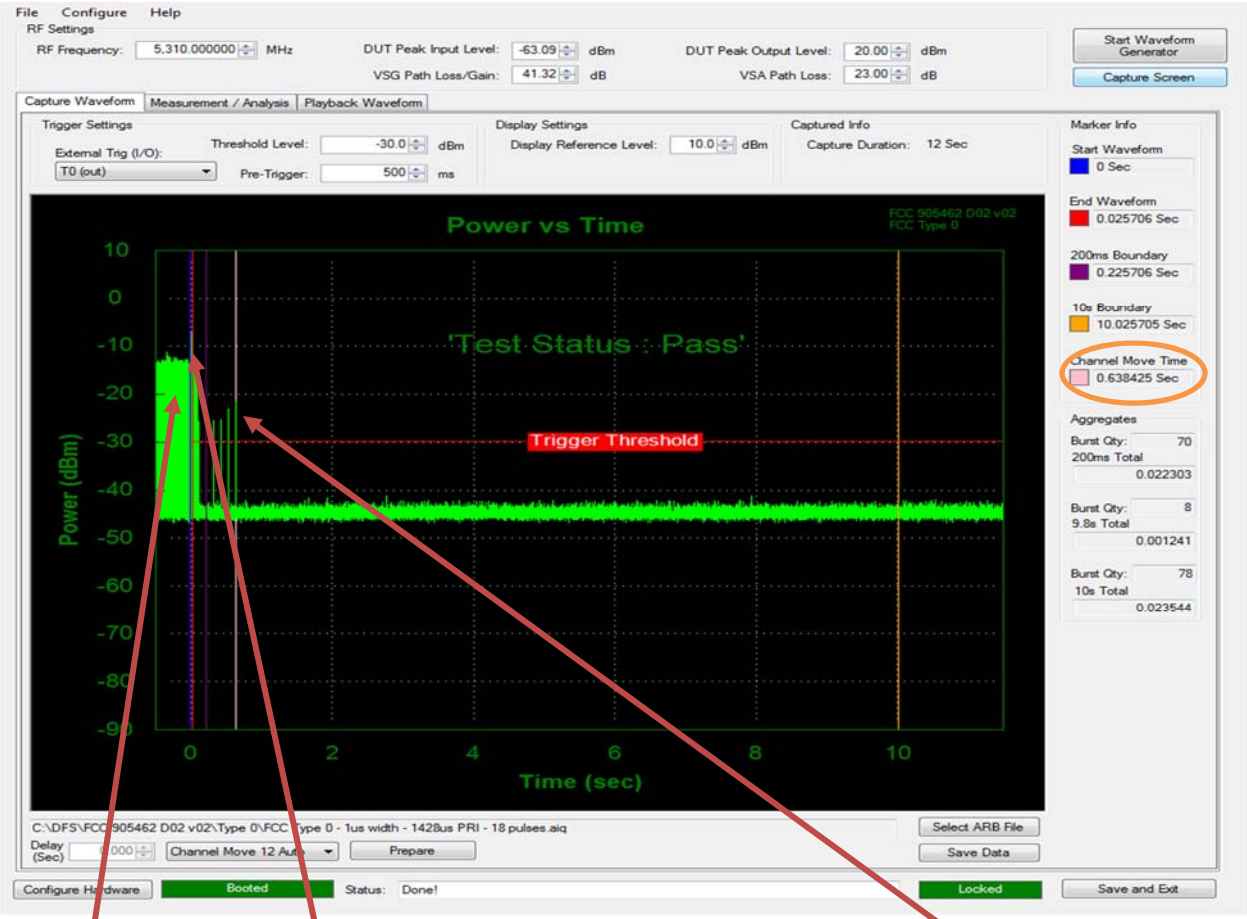

Figure 11. Channel Move Time 5310 MHz

Traffic

Radar

Master Device

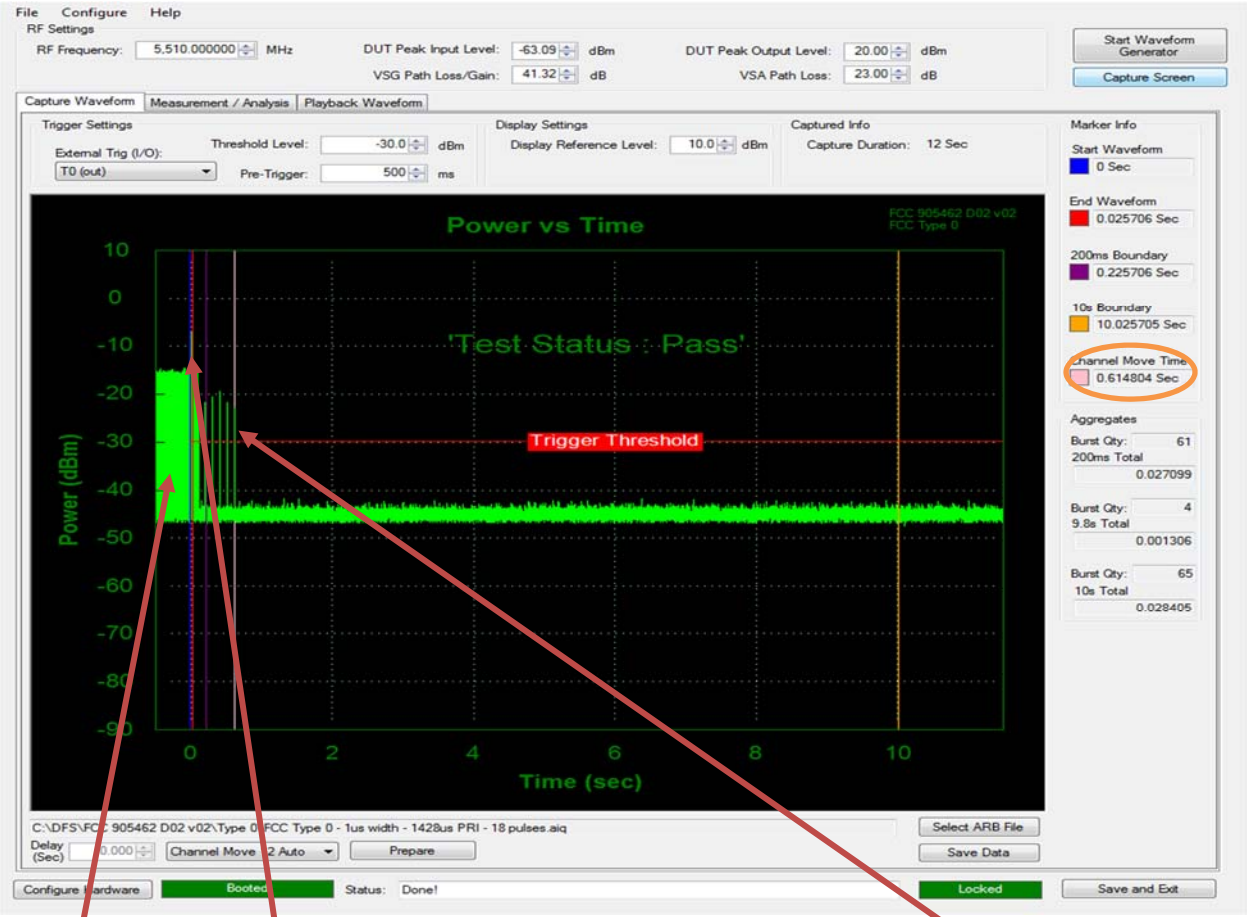

Figure 12. Channel Move Time 5510 MHz

Traffic

Radar

Master Device

8.2 Channel Closing Transmission Time

8.2.1 Test Requirement:

FCC CFR 47 Rule Part 15.407 (h)(2)(iii)

ISED Canada RSS-247 [6.3]

8.2.2 Test Method:

Measurements were performed according to the procedures defined in KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02.

8.2.3 Limits:

After the radar burst has been applied, the EUT shall cease normal transmission on the channel within 200 ms starting at the beginning of the channel move time. Control signaling required to facilitate a channel move (an aggregate of 60 ms) over the remaining 10-second period of the channel move time is permissible.

8.2.4 Test Results:

Pass.

The EUT ceased transmission on the channel within the allotted time.

8.2.5 Test Data

Carrier Frequency (MHz)	Channel Bandwidth (MHz)	Channel Closing Transmission Time (ms)	Channel Closing Transmission Time Limit + Aggregate Control Signaling Time Limit (ms)	Result
5310	40	23	200 +60	Pass
5510	40	28	200 +60	Pass

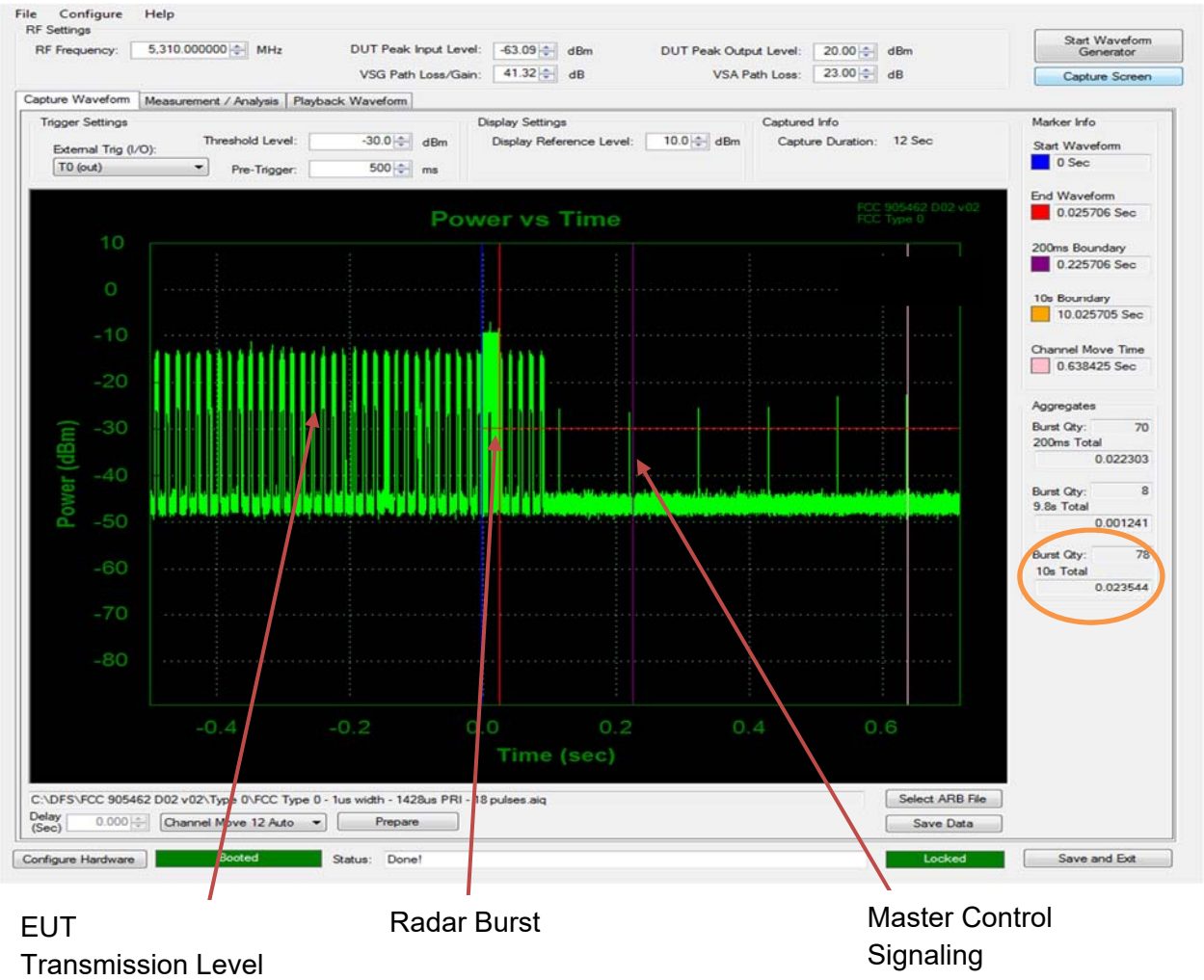

Figure 13. Channel Closing Transmission Time (5310 MHz)

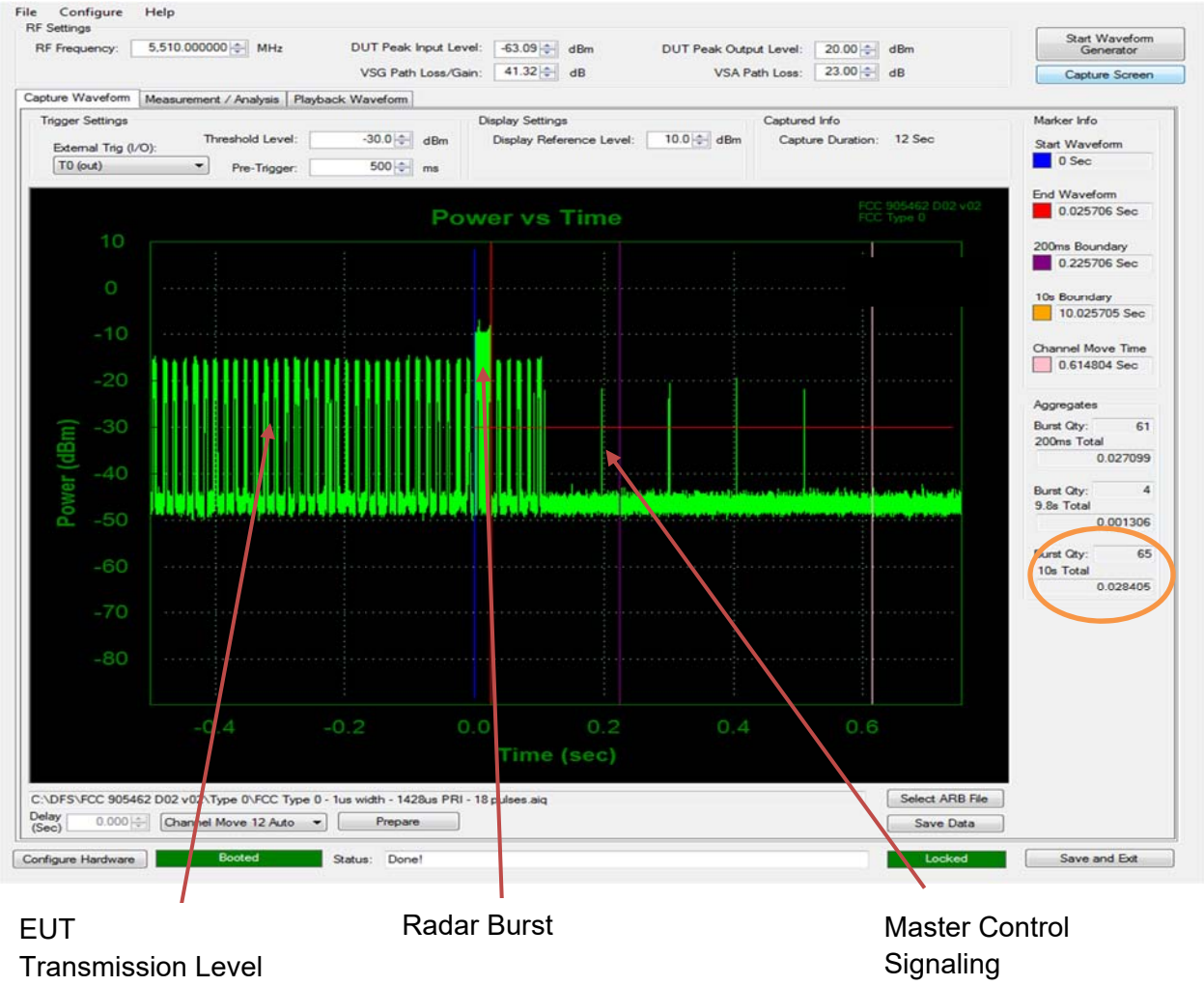

Figure 14. Channel Closing Transmission Time (5510 MHz)

8.3 Non-Occupancy Period

8.3.1 Test Requirement:

FCC CFR 47 Rule Part 15.407 (h)(2)(iv)

ISED Canada RSS-247 [6.3]

8.3.2 Test Method:

Measurements were performed according to the procedures defined in KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02.

8.3.3 Limits:

A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

8.3.4 Test Results:

Pass.

After radar was detected by the master device, the EUT did not transmit on the tested channel for at least 30 minutes.

8.3.5 Test Data:

Plot shown for 2000 second sweep time.

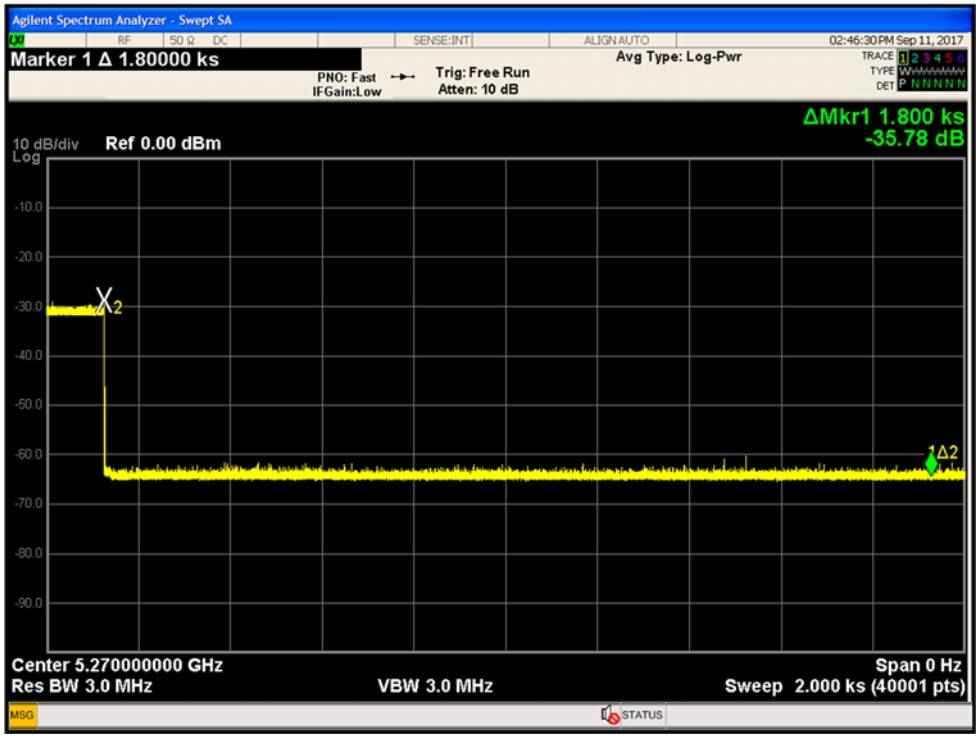

Figure 15. 30 Minute Non-Occupancy Period (5270 MHz)

End of Report