RADIO TEST REPORT

For

MODEL NO.: 1843
FCC ID: C3K1843
IC ID: 3048A-1843

Test Report No. R-TR525-FCCISED-DFS-3
Issue Date: May 15, 2019

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	4/24/2019	All	All	Version 1.0	Jems Pradhan
2.0	5/14/2019	6 – 8.3	10 - 36	Included 160 MHz Bandwidth data	Daniel Salinas
3.0	5/15/2019	6	10	Updated Equipment list	Daniel Salinas

Table of Contents

Test Report Attestation

Microsoft Corporation
Model: 1843
FCC ID: C3K1843
IC ID: 3048A-1843

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.

This report replaces Report # R-TR525-FCCISED-DF-2 issue 05/14/2019.

Written By:

Jems Pradhan
Radio Test Engineer

Reviewed/ Issued By:

Daniel Salinas
RF Test Lead

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:	Choon Sian Ooi
Functional Description of the EUT:	Smart Display with IEEE 802.11a/b/g/n/ac MIMO radio supporting 20/40/80/160 MHz bandwidths, Bluetooth 5.0, and proximity sensor radio.
Model:	1843
FCC ID:	C3K1843
IC ID:	3048A-1843
Radio under test:	IEEE 802.11a/n/ac with 20MHz, 40MHz, 80MHz and 160MHz 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 implements 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 (EV4)
Equipment Condition:	Good
Test Sample Details:	RF Conducted Test Sample: SN 17588293000013M

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 also supports up 80 MHz and 160 MHz bandwidths, which were excluded from measurements (based on guidance from KDB 905462 D03 v01r02).

Iperf was used to generate continuous traffic to meet the channel loading conditions and allow for random pinging intervals and dynamically allocate the talk/listen ratio.

Measurements were performed on the Aux antenna. DFS Radar signals were injected into 5 GHz Tx/Rx port 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 Main MIMO Wi-Fi Antenna Peak Gain (dBi)**	**Chain Aux Main Antenna Wi-Fi Peak Gain (dBi)**
UNII Band 1- 5150 to 5250	4.2	4.7
UNII Band 2a – 5250 to 5350	**4.7**	**5**
UNII Band 2c – 5470 to 5725	**4.5**	**4.9**
UNII Band 3 – 5725 to 5850	3.6	4.3

Since the EUT supports simultaneous transmissions signals which are completely uncorrelated in regard 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	4.45
UNII Band 2a – 5250 to 5350	**4.85**
UNII Band 2c – 5470 to 5725	**4.70**
UNII Band 3 – 5725 to 5850	3.96

4.4 Equipment Modifications

No modifications were made during testing.

4.5 Dates of Testing

Testing was performed from April 3rd – April 5th 2019, and May 14th 2019.

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
Rohde & Schwarz	Analyzer	FSV40	RF-245	N/A	04/10/2019*
Rohde & Schwarz	Signal Analyzer	FSV40	RF-580	N/A	04/09/2020
Rohde & Schwarz	VSG	SMBC100A	RF-141	N/A	04/06/2019*
Rohde & Schwarz	Vector Signal Generator	SMBV100A	RF-288	N/A	04/11/2020
Cisco	Cisco Aironet ISO Access Point	AIR-AP1252AG-A-K9	RF-331	LDK 102061 LDK 102062	N/A*
Netgear	Nighthawk Access Point	X4S AC2600	N/A	PY3 15100319	N/A
Linksys	Access Point	WRT3200ACM	N/A	Q87-WRT3200ACM	N/A
L-Com	RF-Combiner	SC5802N	RF-048	N/A	N/A*
XMA	RF-Combiner	3082-6256-10	EMC-109	N/A	N/A*
Teledyne	Temp Meter	57500	EMC-1205	N/A	11/28/2019
L-Com	Attenuator	SC5802N	RF-049	N/A	N/A*
Pasternack	Attenuator	PE7087-10	RF-862	N/A	N/A*
Pasternack	Attenuator	PE7087-10	RF-861	N/A	N/A*
Pasternack	Filter	PE87FL1015	RF-649	N/A	N/A*
Pasternack	Cable	PE304-48	RF-665	N/A	N/A*
Rosenberger	Cable	L72-449-1830	RF-111	N/A	N/A*
Agrosy	Cable	ARL72-450-1830	EMC-316	N/A	N/A*
Micro-coax	Cable	Utiflex	RF-867	N/A	N/A*
Huber & Suhner	Cable	W49.30	RF-086	N/A	N/A*
Mouser	Cable	CabS02	RF-933	N/A	N/A*

Note*: Equipment was within calibration during test.

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, Radar Signal Generator, splitters/combiners (as necessary), attenuators, and pre-characterized RF cables.

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

Attenuation values were adjusted as necessary to ensure Radar, EUT and Access point signals are clearly distinguishable.

7.2 Test Setup Diagrams

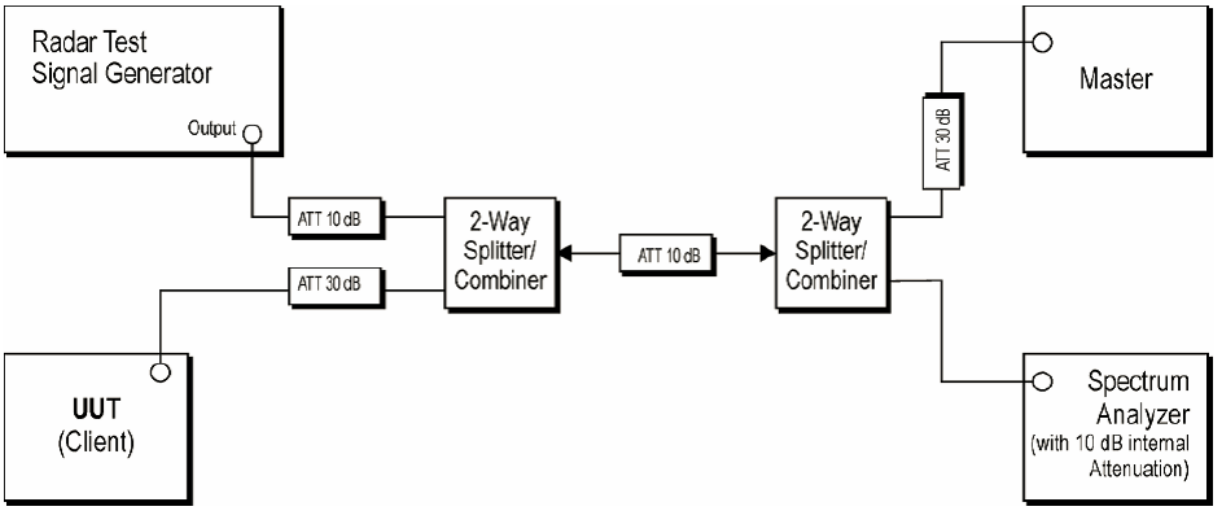


Figure 1. Test Setup for Antenna Port Conducted Measurements

7.3 Radar Waveform Verification

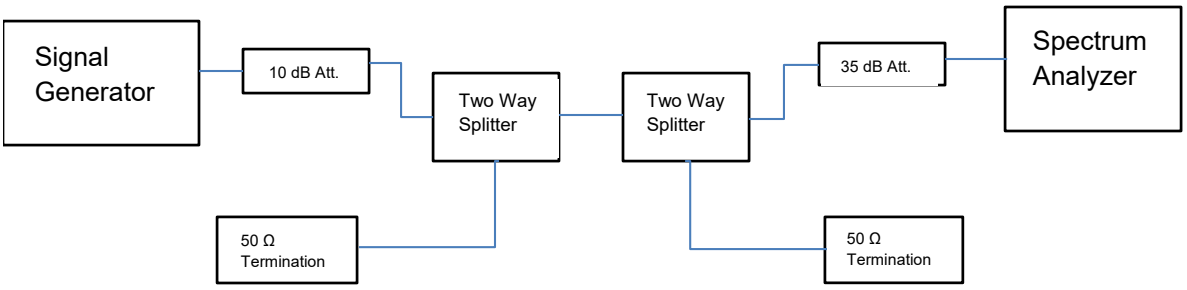


Figure 2. Test Setup for Conducted Measurement Radar Verification

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	-64
Master	Linksys WRT3200 ACM	12.10	23.97	5.1	29.07	-64
Master	Netgear X4S AC2600	23.86	23.86	1.61	25.47	-64
Client	Microsoft Model 1843	11.80	19.55	4.85	24.4	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	5270	-63.99	18	1.000	1.427
0	5670	-63.69	18	1.056	1.428
0	5570	-64.63	18	1.090	1.428
0	5530	-64.37	18	1.050	1.428

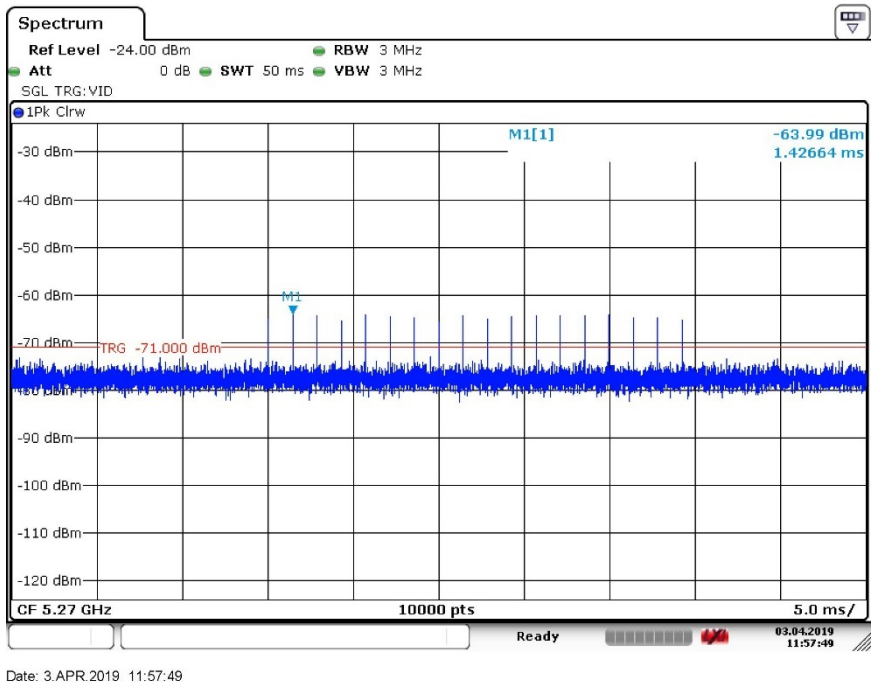


Figure 3. Radar Burst Level at -63dBm: Radar Type 0 (5270 MHz 40 MHz BW)

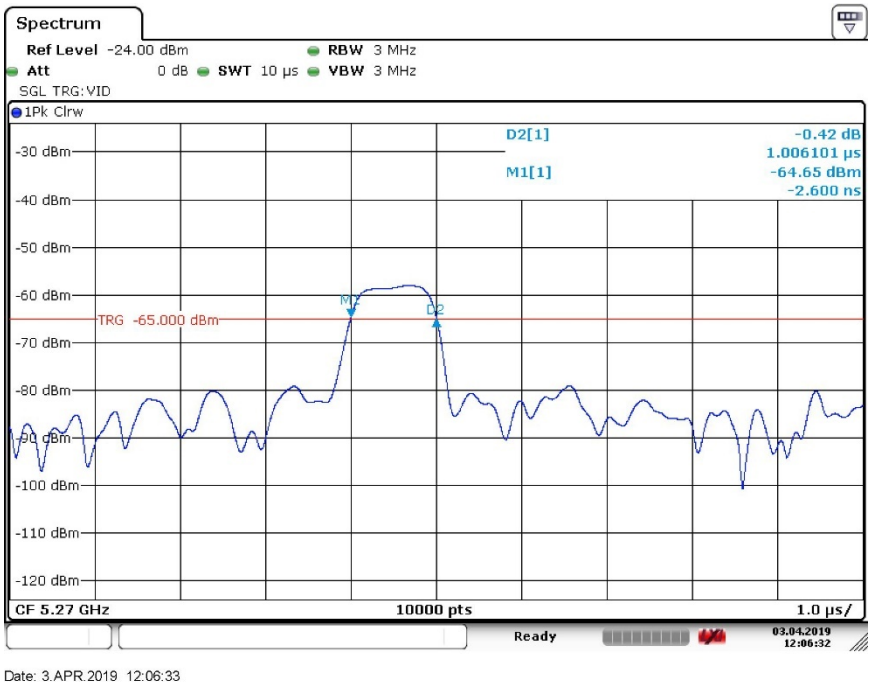


Figure 4. Radar Pulse width: Radar Type 0 (5270 MHz 40 MHz BW)

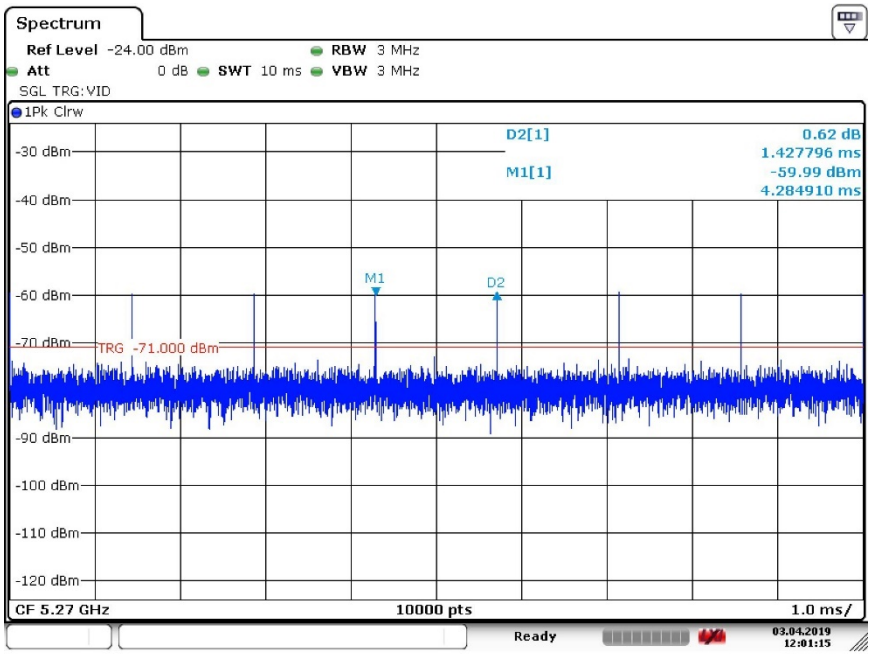


Figure 5. Radar Pulse Repetition Interval: Radar Type 0 (5270 MHz 40 MHz BW)

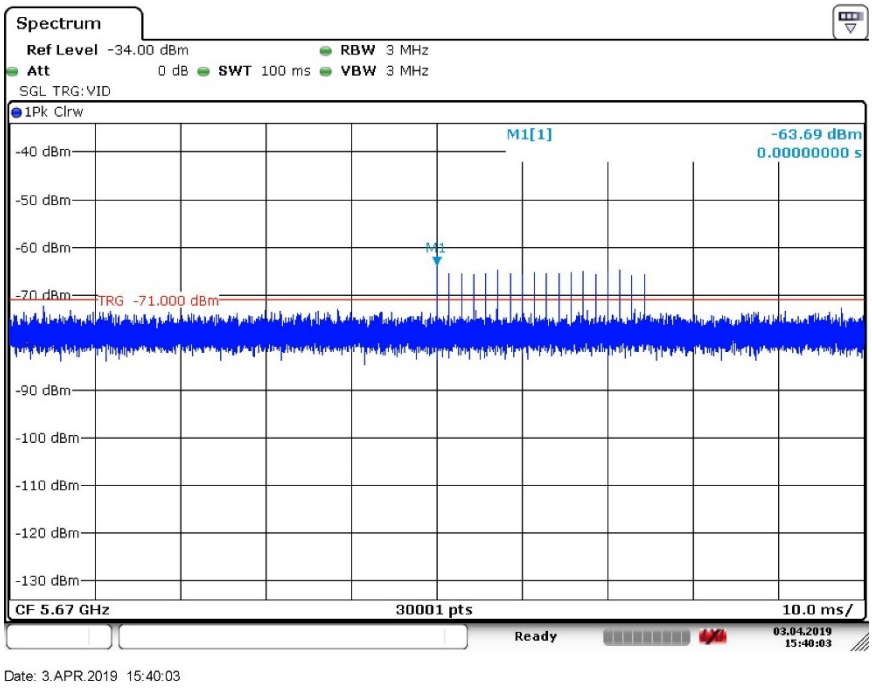
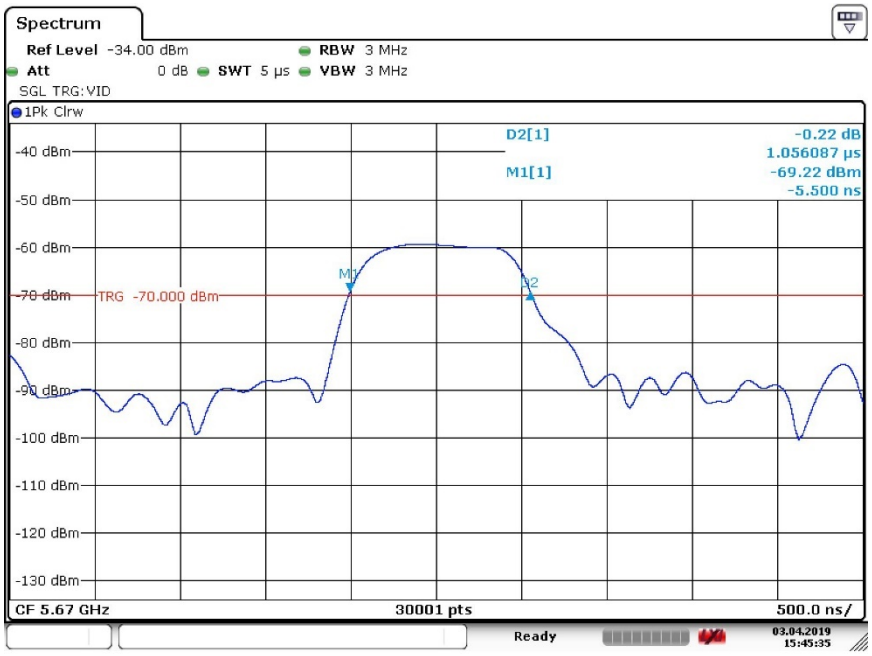


Figure 6. Radar Burst Level at -63dBm: Radar Type 0 (5670 MHz 40 MHz BW)



Date: 3.APR.2019 15:45:36

Figure 7. Radar Pulse width: Radar Type 0 (5670 MHz 40 MHz BW)

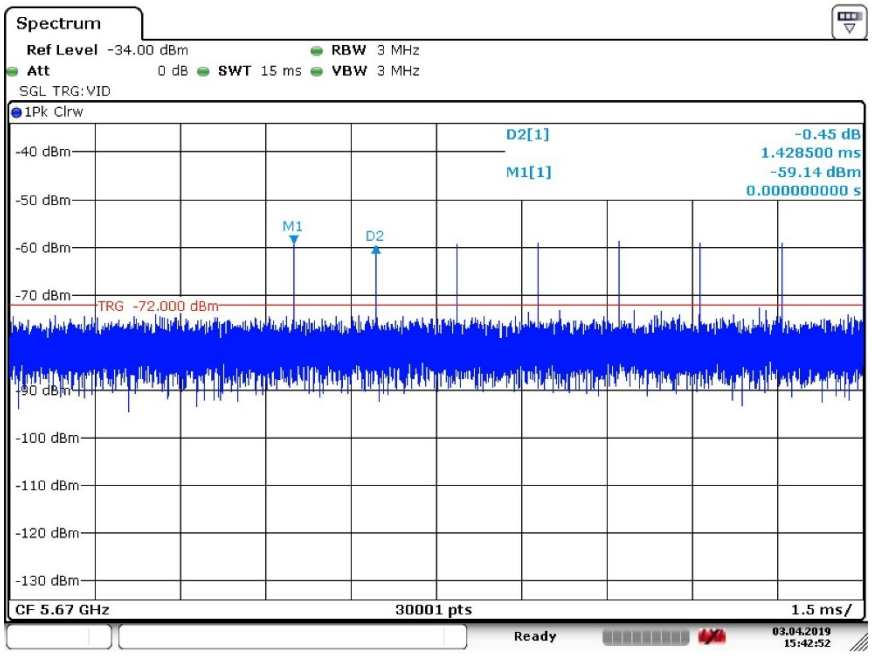


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Figure 8. Radar Pulse Repetition Interval: Radar Type 0 (5670 MHz 40 MHz BW)

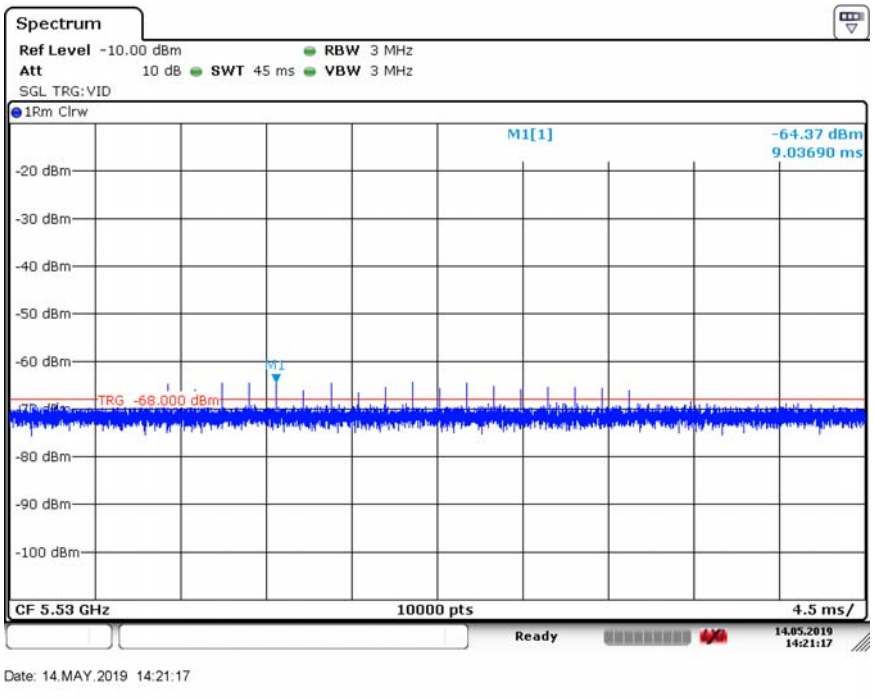

Figure 9 Radar Burst Level at -63dBm: Radar Type 0 (5530 MHz 80 MHz BW)

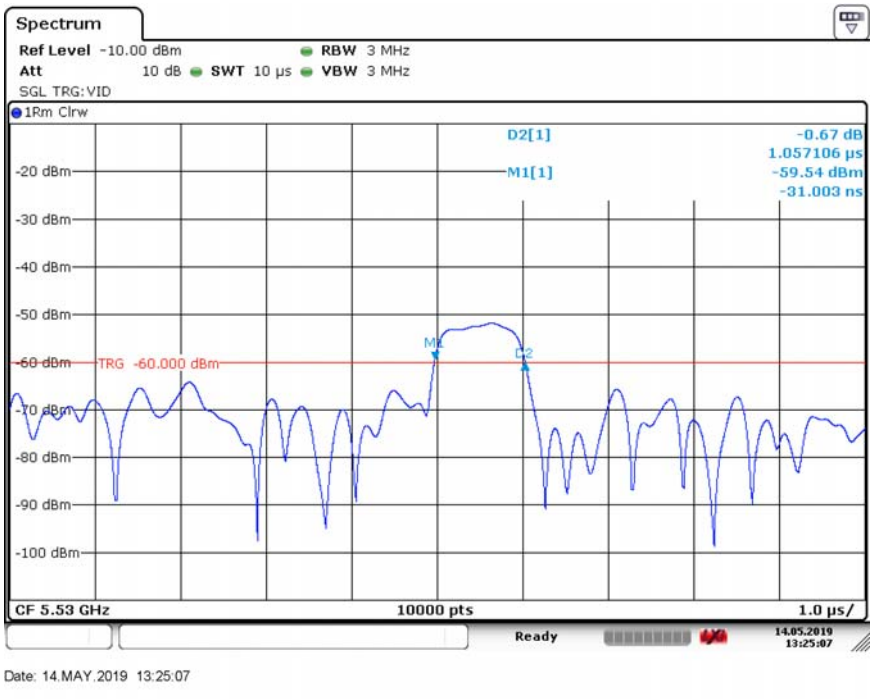

Figure 10 Radar Pulse width: Radar Type 0 (5530 MHz 80 MHz BW)

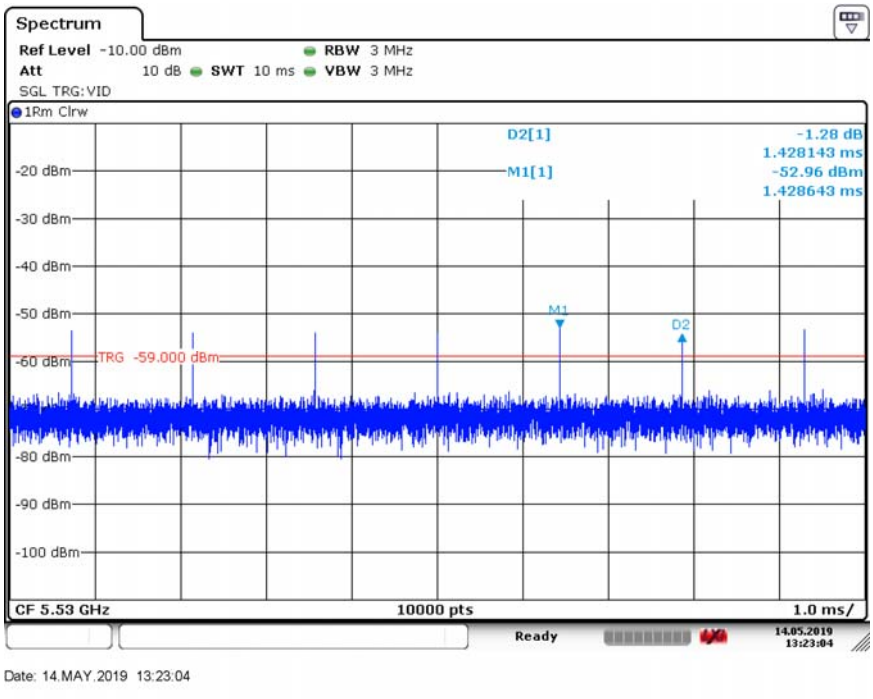

Figure 11 Radar Pulse Repetition Interval: Radar Type 0 (5530 MHz 80 MHz BW)

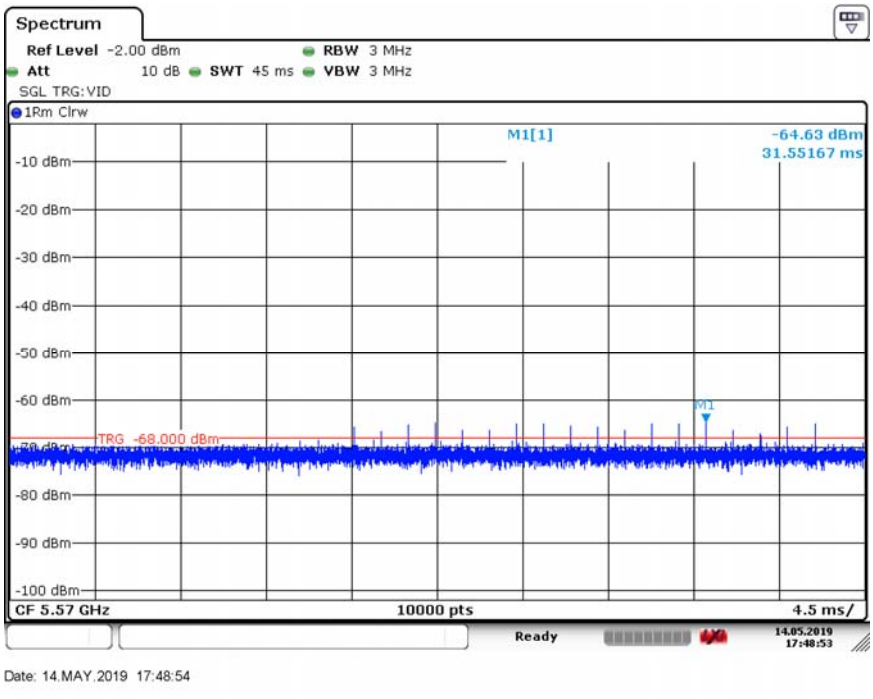

Figure 12 Radar Burst Level at -63dBm: Radar Type 0 (5570 MHz 160 MHz BW)

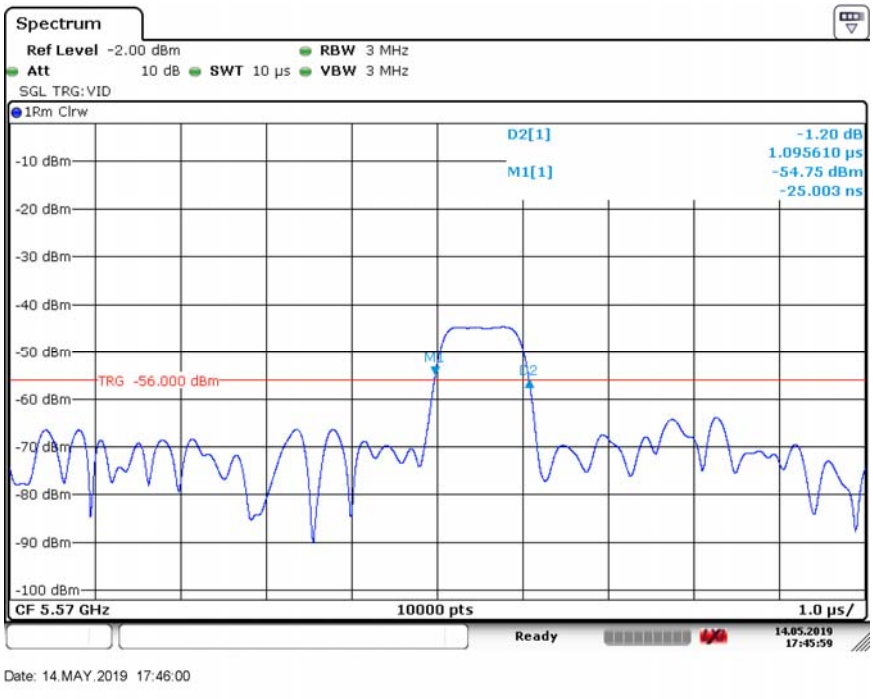

Figure 13 Radar Pulse width: Radar Type 0 (5570 MHz 160 MHz BW)

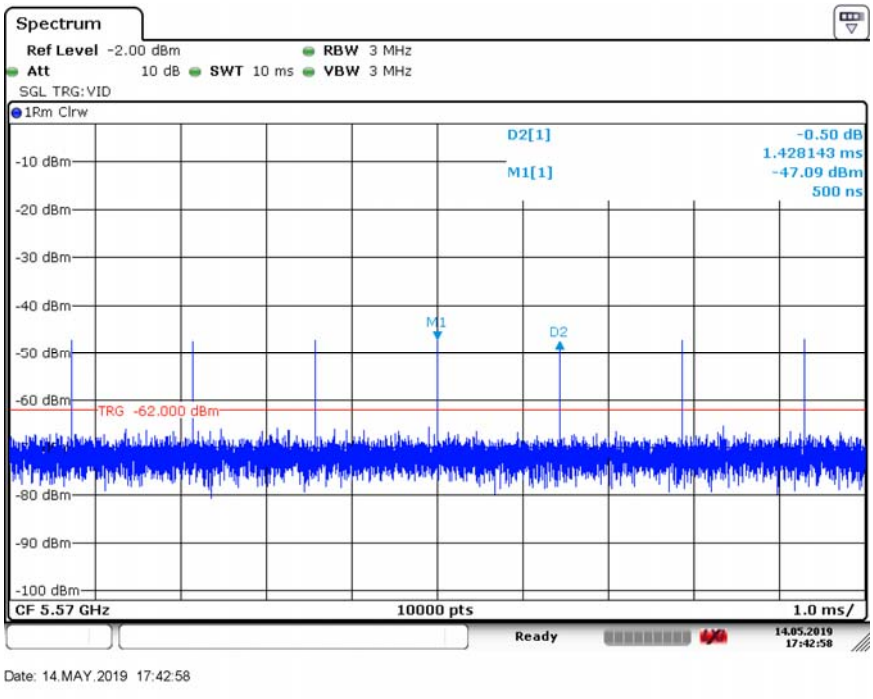

Figure 14 Radar Pulse Repetition Interval: Radar Type 0 (5570 MHz 160 MHz BW)

7.4 Channel Loading

7.4.1 Test Method

Channel Loading measurements were taken with a spectrum analyzer. CSV files were captured, and Channel Loading was calculated using that measured data. Channel Loading was measured and verified 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 (%)
5270	40	63.954	100	63.954
5670	40	23.030	100	23.030
5530	80	25.51	100	25.51
5570	160	49.95	100	49.95

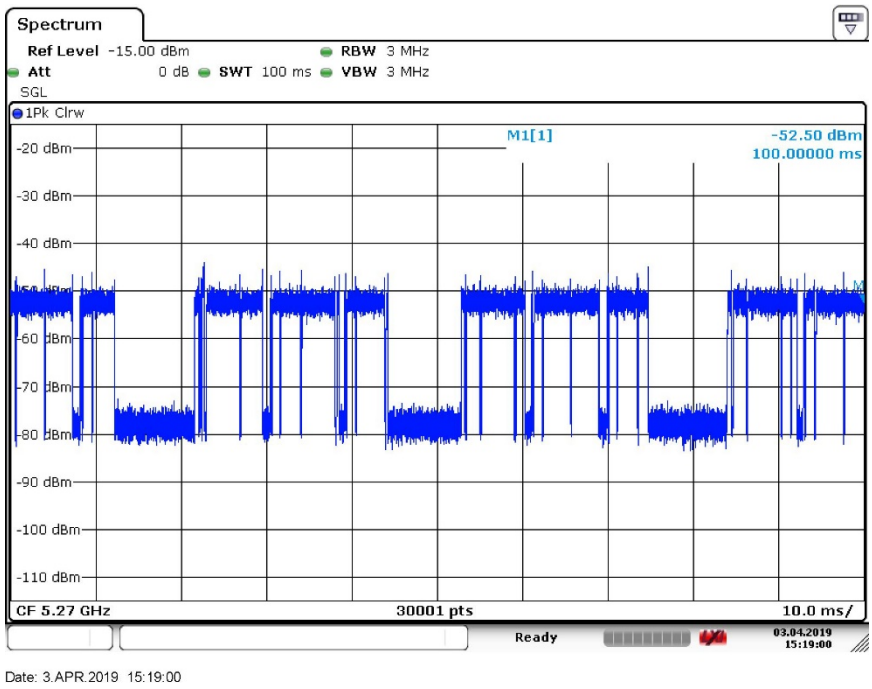

Figure 15. Channel Loading (5270 MHz 40 MHz BW)

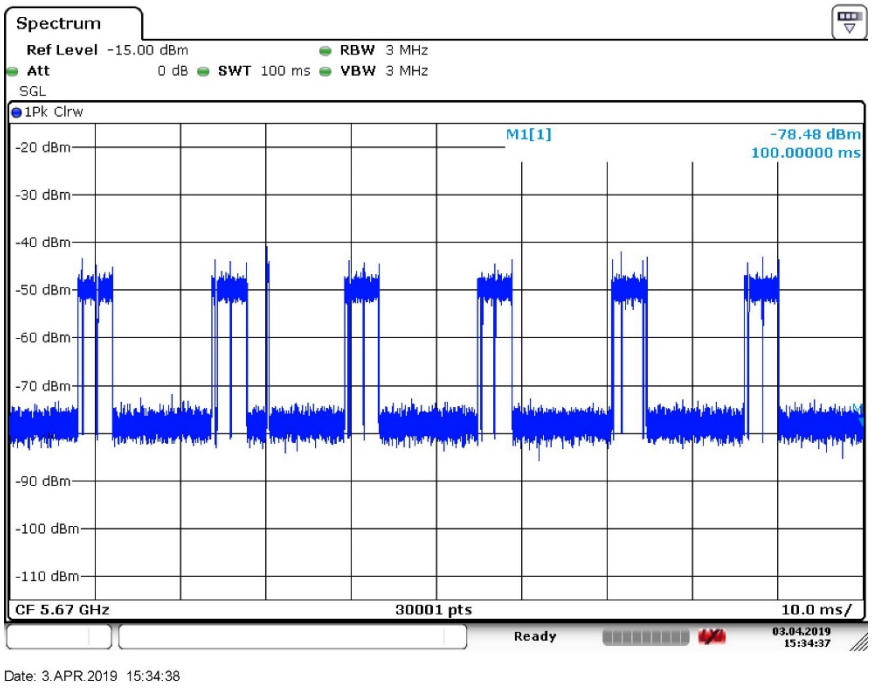

Figure 16. Channel Loading (5670 MHz 40 MHz BW)

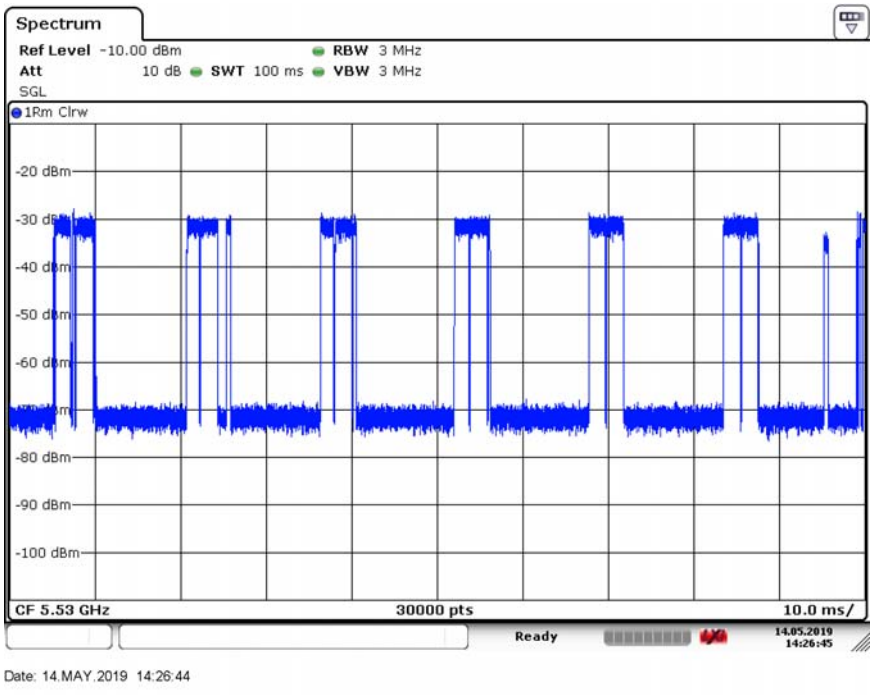

Figure 17 Channel Loading (5530 MHz 80 MHz BW)

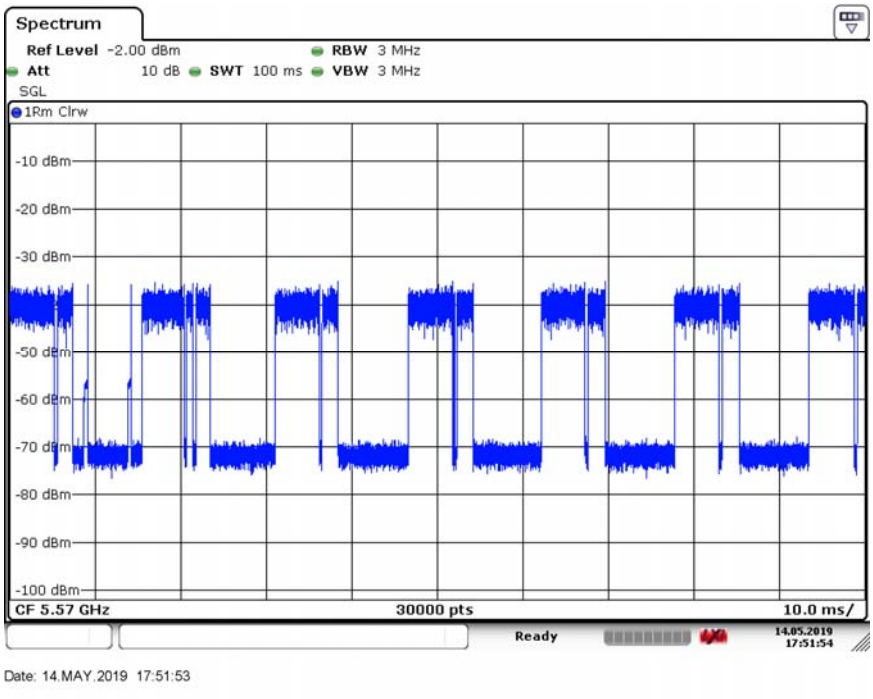

Figure 18 Channel Loading (5570 MHz 160 MHz BW)

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
5270	40	0.531	10	Pass
5670	40	0.578	10	Pass
5530	80	2.426	10	PASS
5570	160	2.109	10	PASS

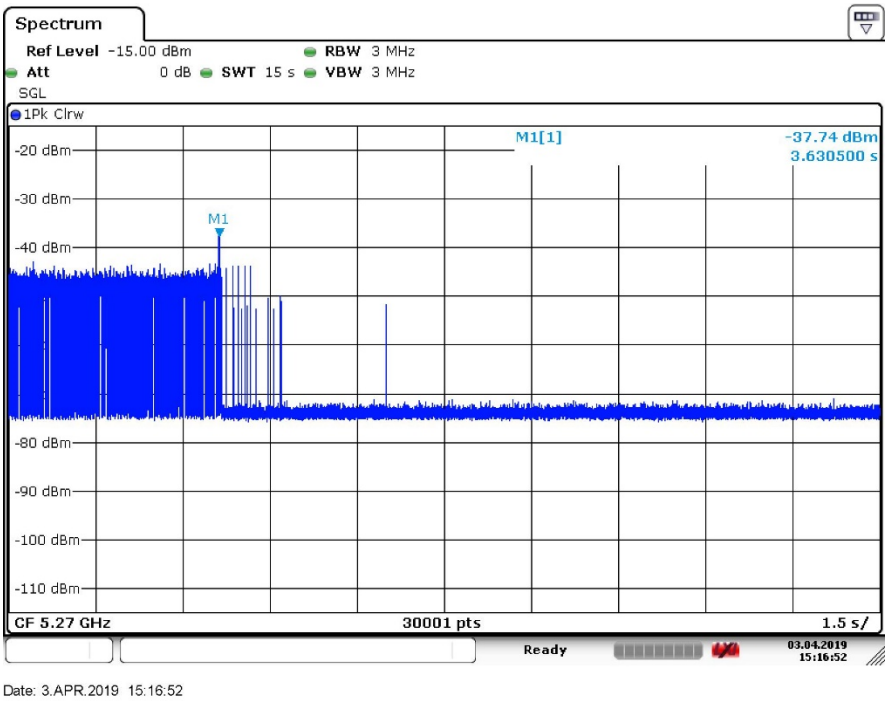

Figure 19. DFS Radar Detection Plot 5270 MHz

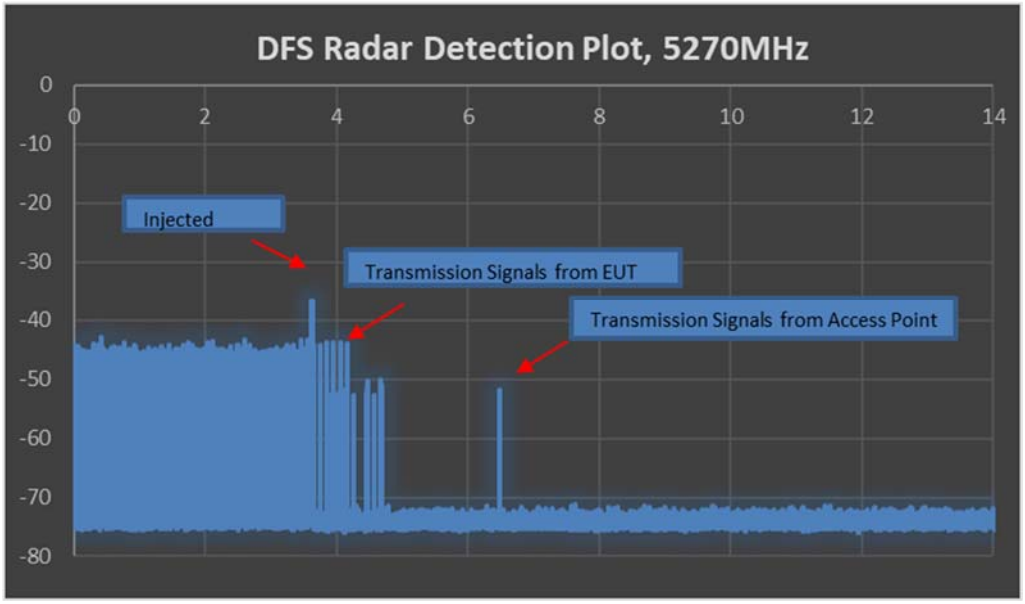

Figure 20. DFS Radar Detection Plot 5270 MHz

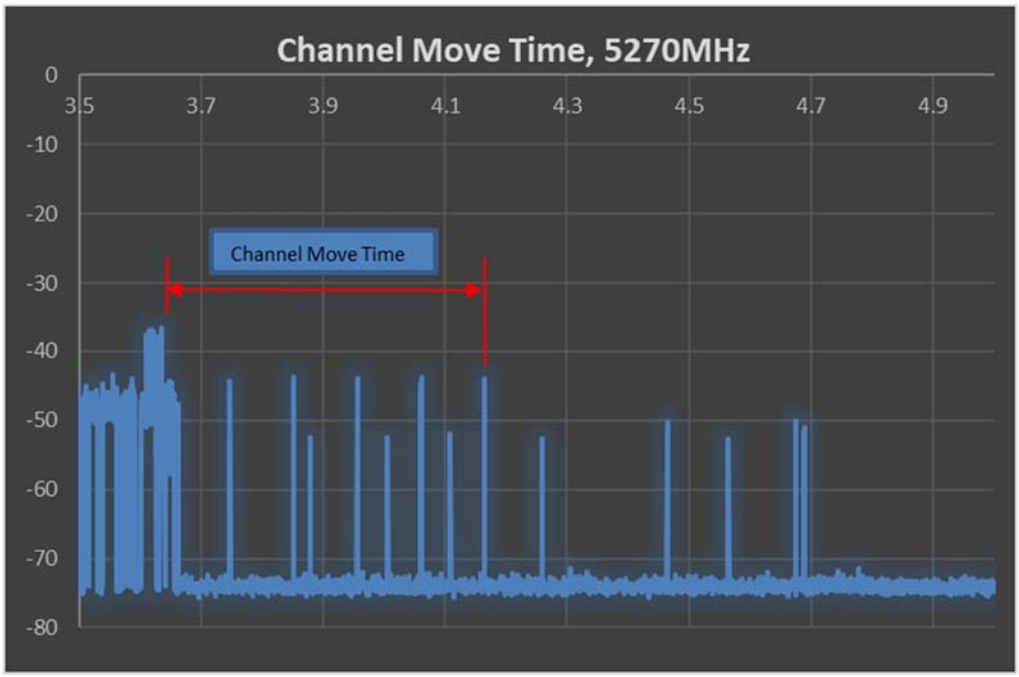

Figure 21. Channel Move Time 5270 MHz

Figure 21 is a zoomed plot of Figure 19 to show the Channel Move Time for Channel 5270MHz.

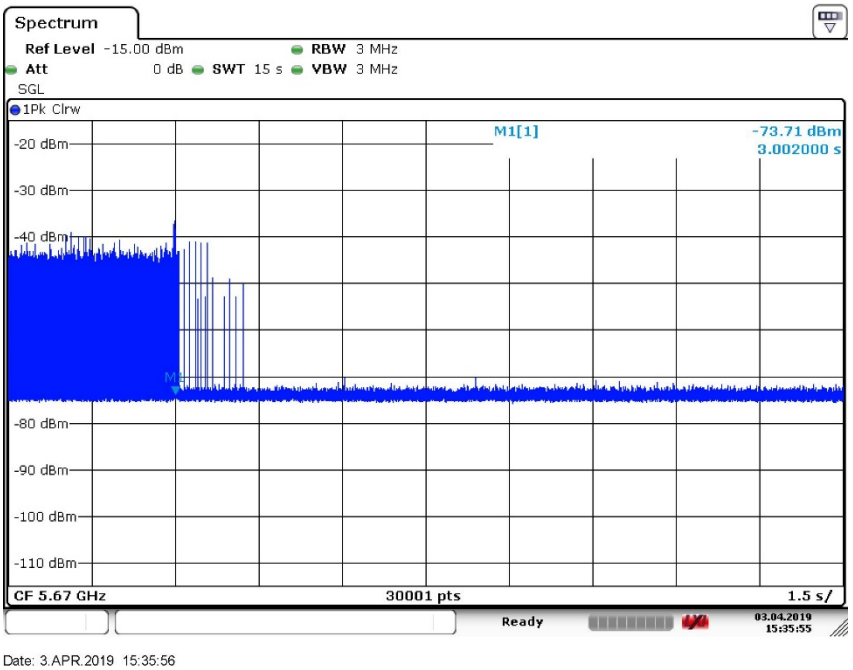

Figure 22. Channel Move Time 5670 MHz

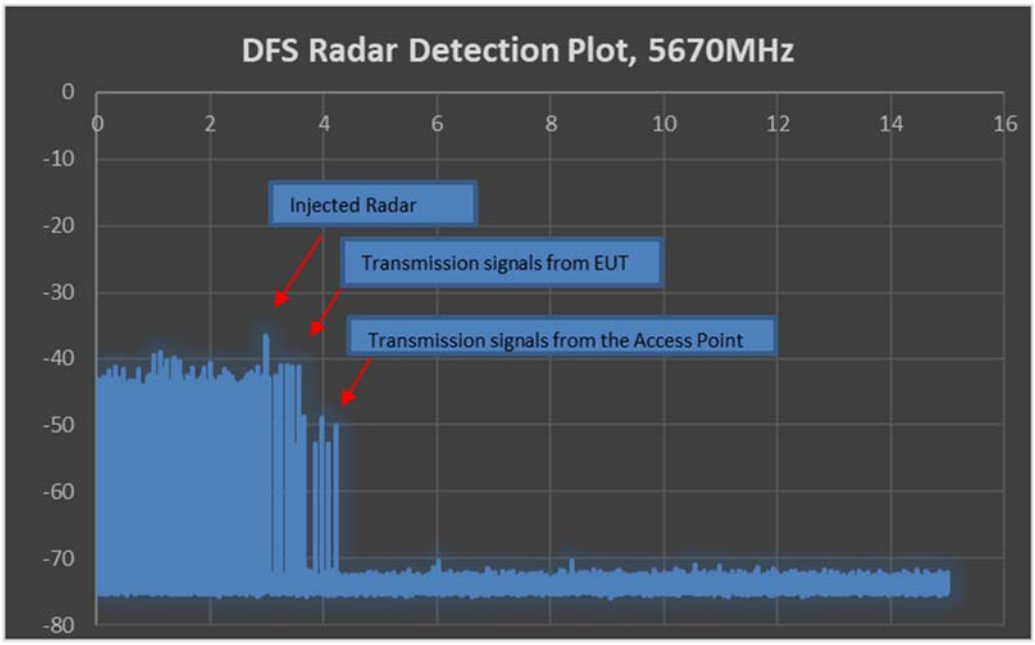

Figure 23 DFS Radar Detection Plot 5670 MHz

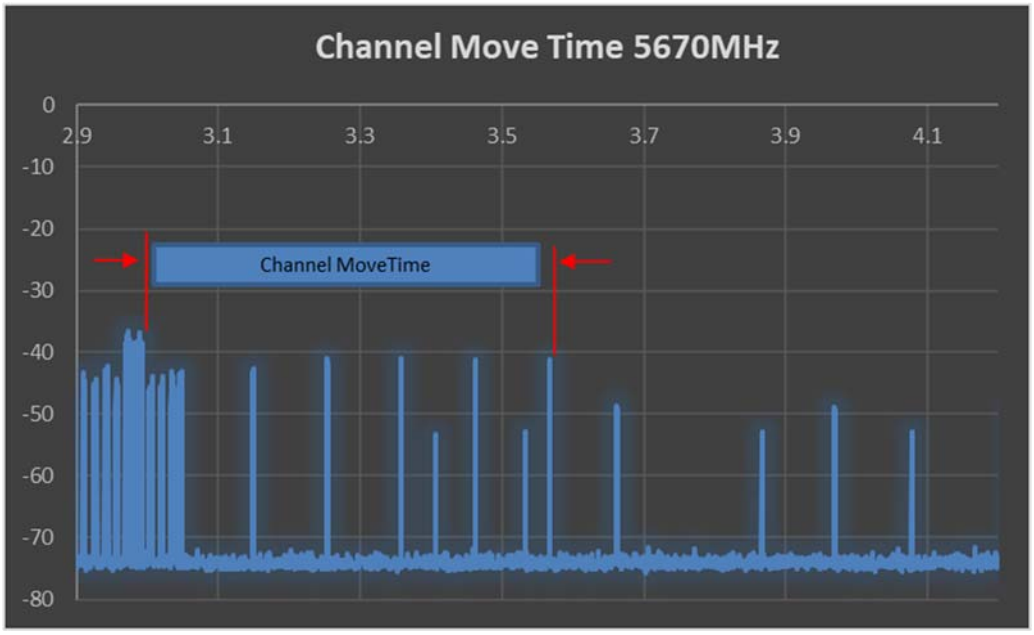

Figure 24 Channel Move Time 5670 MHz

Figure 24 is a zoomed plot of Figure 22 which shows the Channel Move Time for 5670MHz.

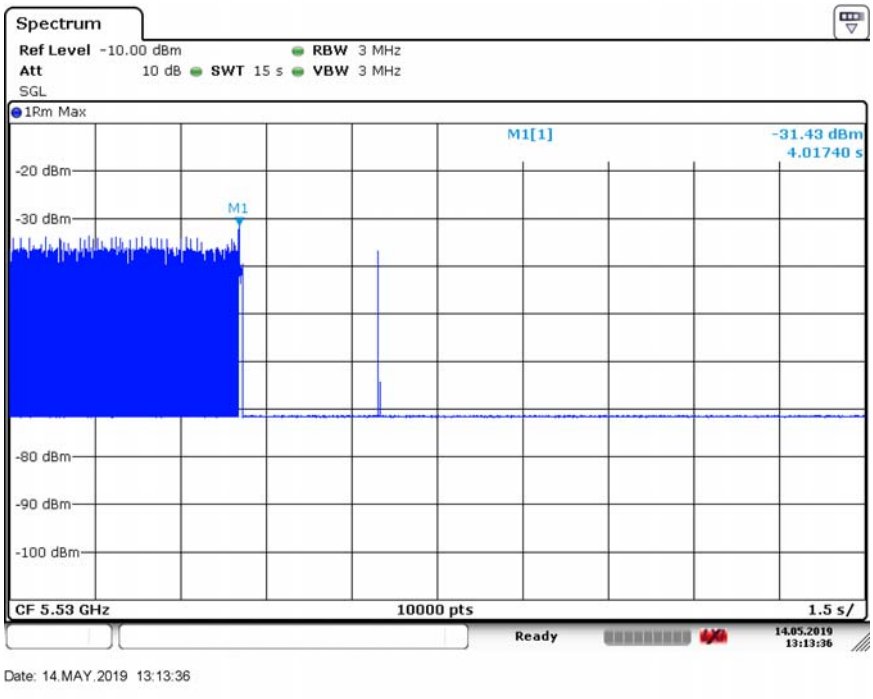

Figure 25 Channel Move Time 5530 MHz 80 MHz

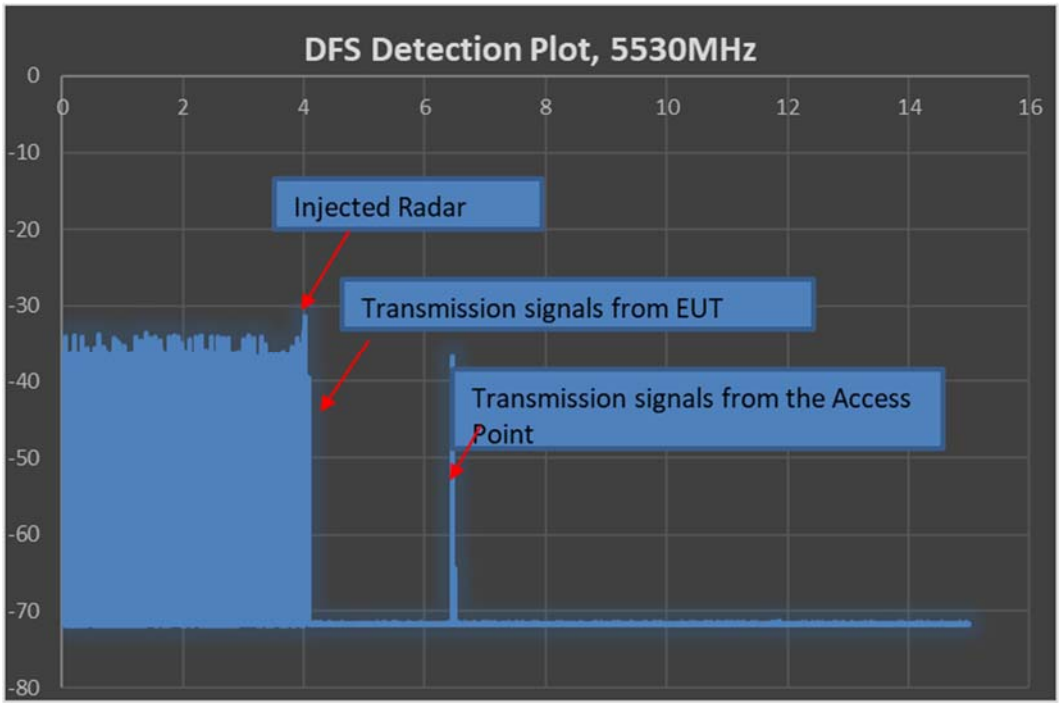

Figure 26 DFS Radar Detection Plot 5530 MHz

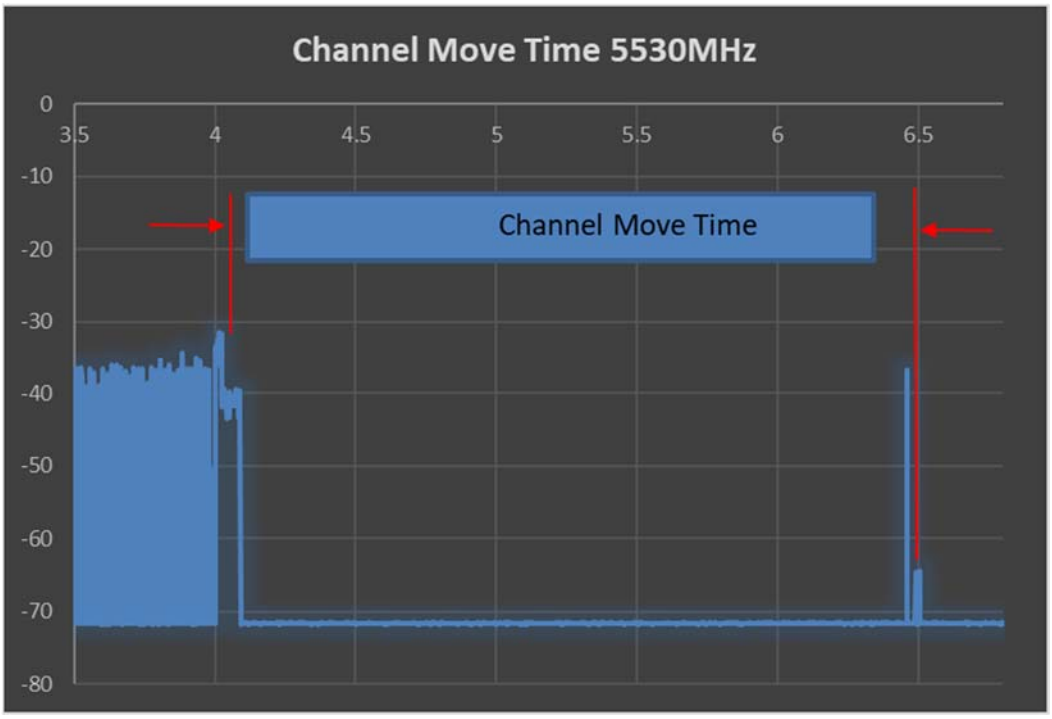

Figure 27 Channel Move Time 5530 MHz

Figure 27 is a zoomed plot of Figure 25 which shows the Channel Move Time for 5530MHz.

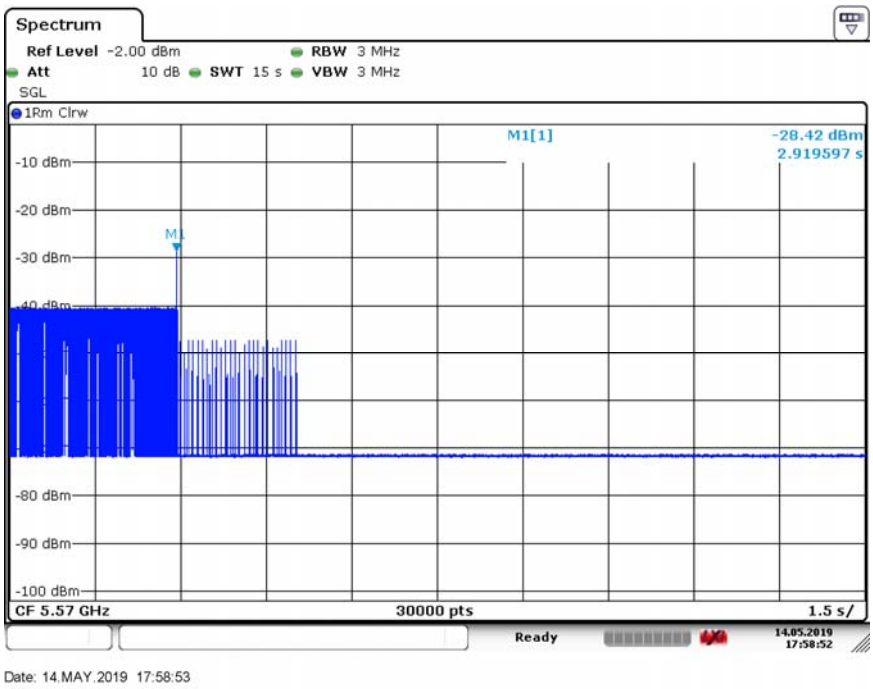

Figure 28 Channel Move Time 5570 MHz 160 MHz

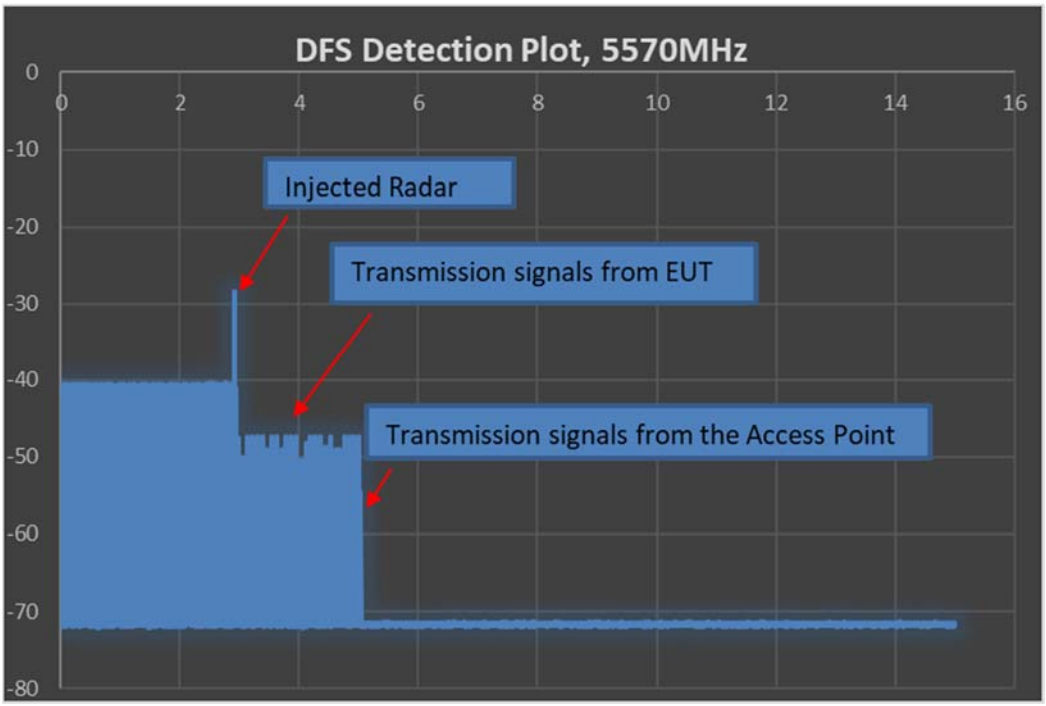

Figure 29 DFS Radar Detection Plot 5570 MHz

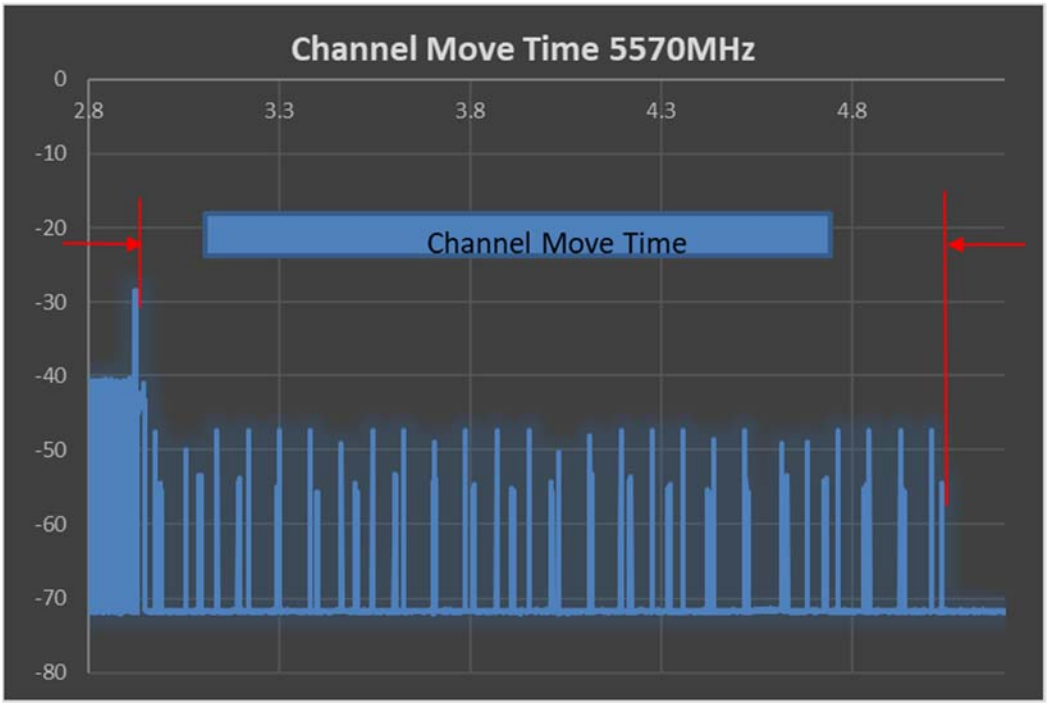

Figure 30 Channel Move Time 5570 MHz

Figure 30 is a zoomed plot of Figure 28 which shows the Channel Move Time for 5570MHz.

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
5270	40	2.55	200 +60	Pass
5670	40	2.45	200 +60	Pass
5530	80	72.01	200 +60	Pass
5570	160	48.50	200 +60	Pass

Note: Channel Closing Transmission time reported above include aggregate control signals.

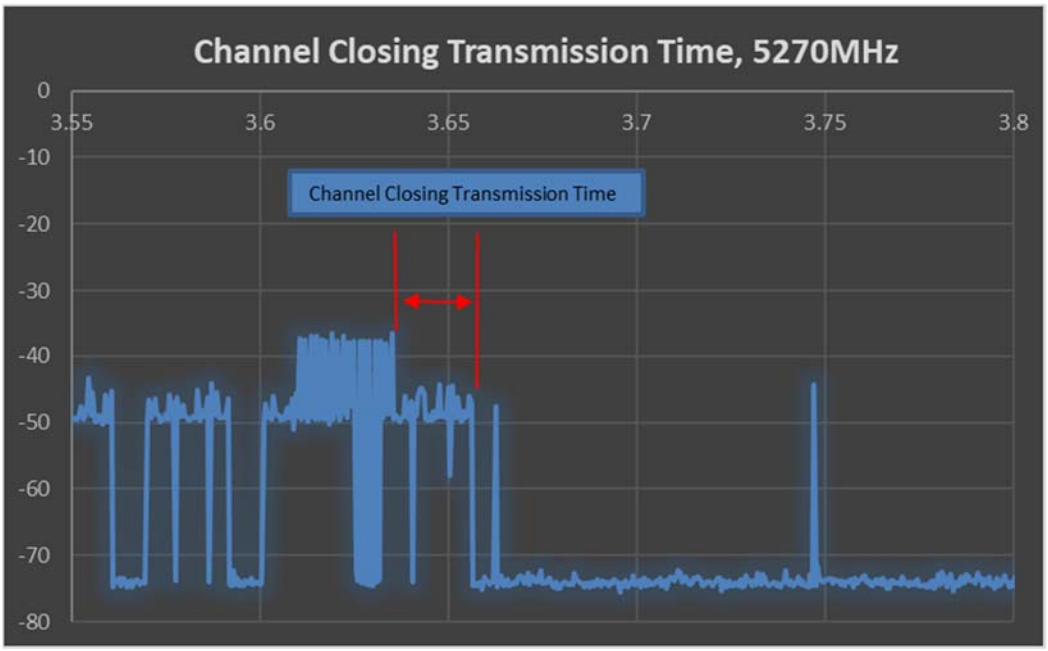

Figure 31 Channel Closing Transmission Time (5270 MHz)

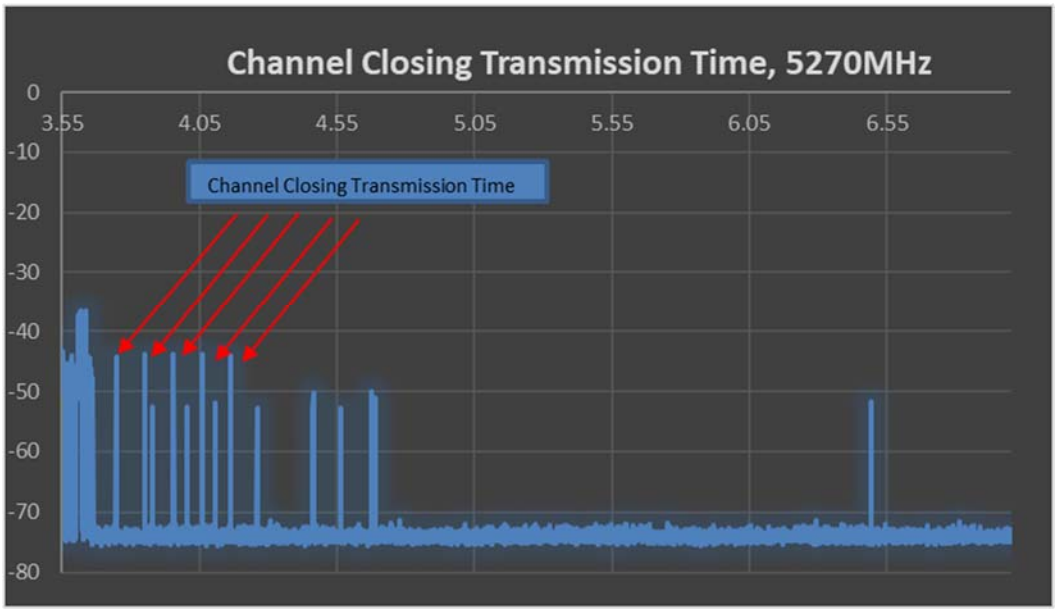

Figure 32 Channel Closing Transmission Time Control Signals (5270 MHz)

Figure 31 and Figure 32 is a zoomed plot of Figure 19 which shows the start point for Channel Closing Transmission Time and transmission signals from the EUT which is accounted for calculating the Channel Closing Transmission Time.

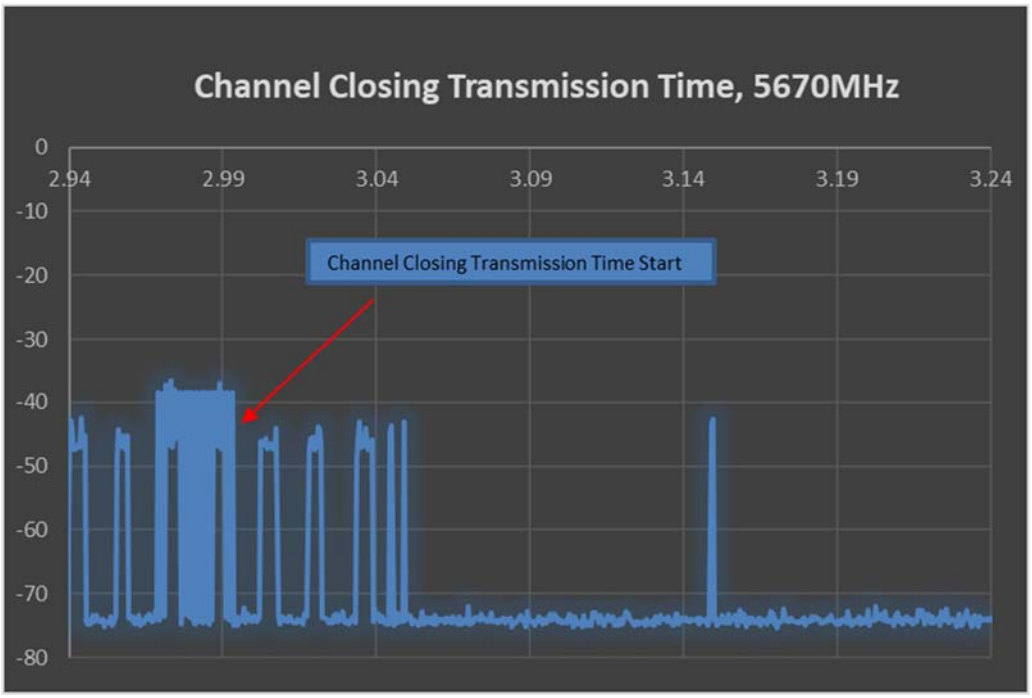

Figure 33 Channel Closing Transmission Time (5670 MHz)

Figure 34 Channel Closing Transmission Time Control Signals (5670 MHz)

Figure 33 and Figure 34 is a zoomed plot of Figure 22 which shows the start point for Channel Closing Transmission Time and transmission signals from the EUT which is accounted for calculating the Channel Closing Transmission Time.

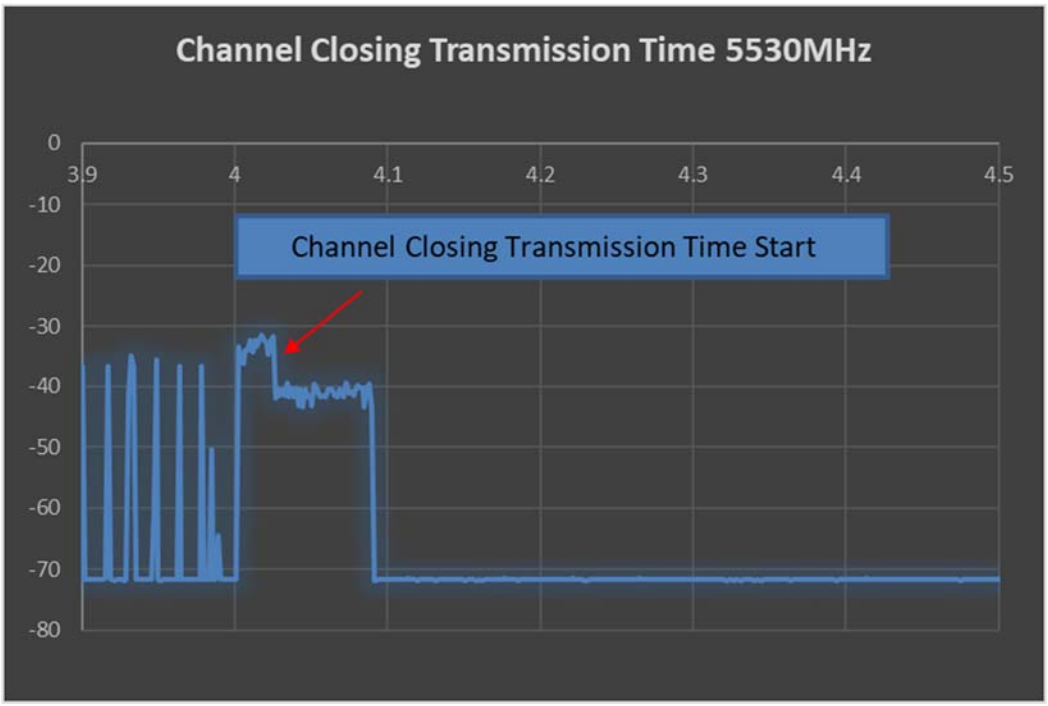

Figure 35 Channel Closing Transmission Time (5530 MHz)

Figure 36 Channel Closing Transmission Time Control Signals (5530 MHz)

Figure 35 and Figure 36 is a zoomed plot of Figure 25 which shows the start point for Channel Closing Transmission Time and transmission signals from the EUT which is accounted for calculating the Channel Closing Transmission Time.

Figure 37 Channel Closing Transmission Time (5570 MHz)

Figure 38 Channel Closing Transmission Time Control Signals (5570 MHz)

Figure 37 and Figure 38 is a zoomed plot of Figure 28 which shows the start point for Channel Closing Transmission Time and transmission signals from the EUT which is accounted for calculating the Channel Closing Transmission Time.

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.

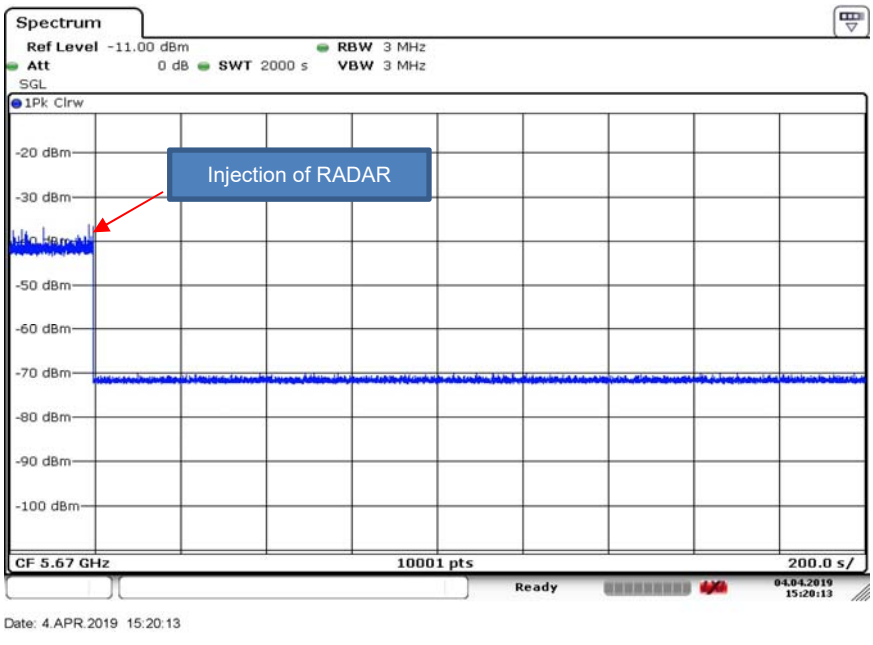

Figure 21. 30 Minute Non-Occupancy Period (5670 MHz)

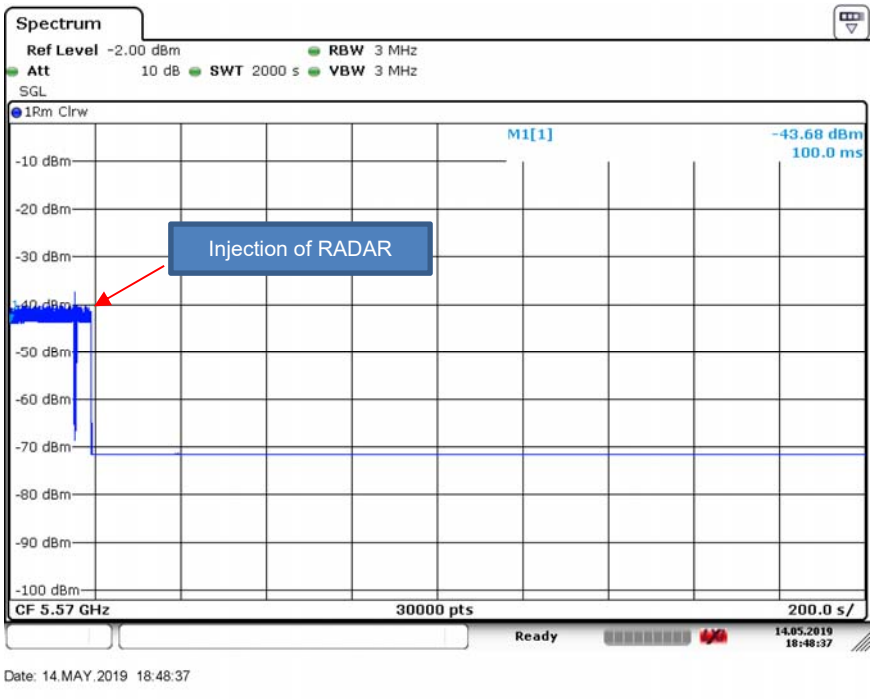

Figure 39 30 Minute Non-Occupancy Period (5570 MHz)

End of Report