RADIO TEST REPORT

For

MODEL NO.: 1868
FCC ID: C3K1868
IC ID: 3048A-1868

Test Report No. R-TR581-FCCISED-DFS-4
Issue Date: September 13, 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	08/22/2019	All	All	Version 1.0	Jems Pradhan
2.0	08/30/2019	Attestation	5	Test data leveraging statement updated	Daniel Salinas
3.0	09/10/2019	4.3	8	Antenna gains value corrected	Jems Pradhan
		8.2	27	Aggregate control signals value added	
4.0	09/13/2019	7.0	11	Added a statement on test method	Jems Pradhan

Table of Contents

Test Report Attestation

Microsoft Corporation
Model: 1868
FCC ID: C3K1868
IC ID: 3048A-1868

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.

Per the customer, models 1867, 1868, and 1872 are electrically equivalent except, contain the same radio module, and have the same software drivers and settings with respect to this test. Therefore, the data and test results in this report can be leveraged for models 1867 and 1872 as well.

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 previously issued report R-TR581-FCCISED-DFS-3 issued 09/10/2019

Written By:

Jems Pradhan
Radio Test Engineer

Reviewed/ Issued By:

Daniel Salinas
Radio Compliance 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:	Chaitrali Limaye
Functional Description of the EUT:	Portable computing device with IEEE 802.11a/b/g/n/ac/ax MIMO radio supporting 20/40/80/160 MHz bandwidths, Bluetooth 5.0.
Model:	1868
FCC ID:	C3K1868
IC ID:	3048A-1868
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 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 (DV)
Equipment Condition:	Good
Test Sample Details:	RF Conducted Test Sample: SN 007323692857

4.1 Test Configurations

The device was setup in normal operation and connected wirelessly to an 802.11 access point.

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 antenna Chain 1. DFS Radar signals were injected into 5GHz 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 0 Peak Gain (dBi)**	**Chain 1 Peak Gain (dBi)**
UNII Band 1- 5150 to 5250	3.6	2.2
UNII Band 2a – 5250 to 5350	**5.2**	**3.5**
UNII Band 2c – 5470 to 5725	**6.4**	**4.7**
UNII Band 3 – 5725 to 5850	7.8	4.5

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	3.0
UNII Band 2a – 5250 to 5350	**4.4**
UNII Band 2c – 5470 to 5725	**5.6**
UNII Band 3 – 5725 to 5850	6.5

4.4 Equipment Modifications

No modifications were made during testing.

4.5 Dates of Testing

Testing was performed from August 16rd – August 20th 2019 & September 9th 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	04/10/2020
Rohde & Schwarz	Vector Signal Generator	SMBV100A	RF-288	N/A	04/11/2020
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*
Madge Tech	Temp Meter	PRHTemp2000	EMC-679	N/A	11/14/2019
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.

Conducted tests were performed and a signal level of -63dBm/3MHz or lower was injected into the Radar Detection Device (RDD) Master Device as stated by the KDB. The antenna gain of the EUT is not critical for performing the test as this device is not the RDD. The antenna gain has no impact on the conducted measurements of the EUT and test results will be identical when tested with a different antenna assembly gain.

7.2 Test Setup Diagrams

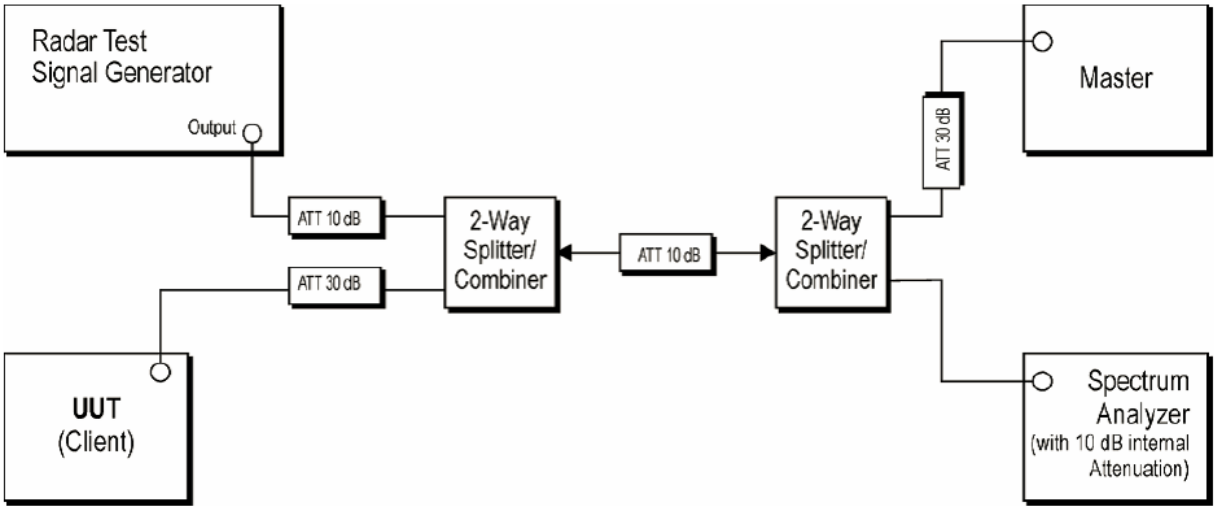


Figure 1. Test Setup for Antenna Port Conducted Measurements

7.3 Radar Waveform Verification

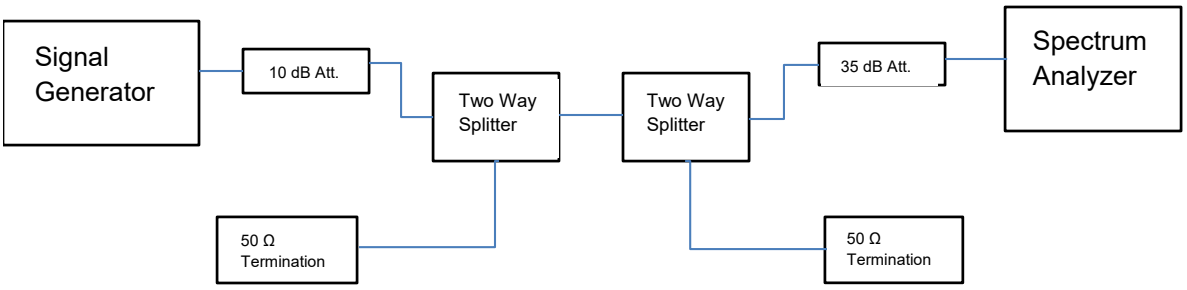


Figure 2. Test Setup for Conducted Measurement Radar Verification

Device Type	Device	Min. Output Power (dBm)	Max Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Required Radar Detection Threshold Level (dBm)
Master	Linksys WRT3200 ACM	12.10	23.97	5.1	29.07	-64
Client	Microsoft Model 1868	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	-63.70	18	1.026	1.428
0	5670	-63.56	18	1.028	1.428
0	5570	-63.93	18	1.024	1.428
0	5530	-64.25	18	1.024	1.428

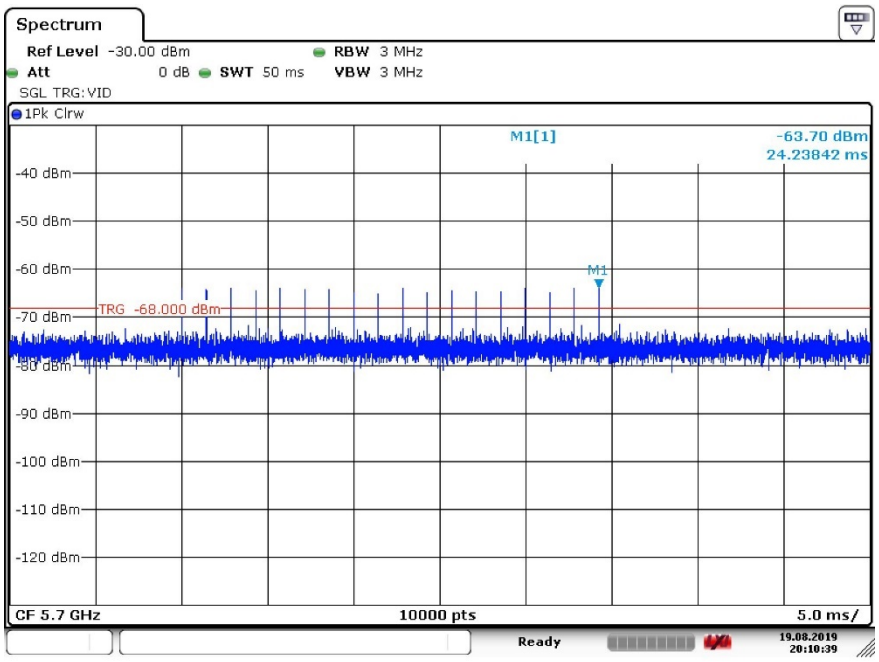


Figure 3. Radar Burst Level at -63dBm: Radar Type 0 (5700MHz, 20MHz BW)

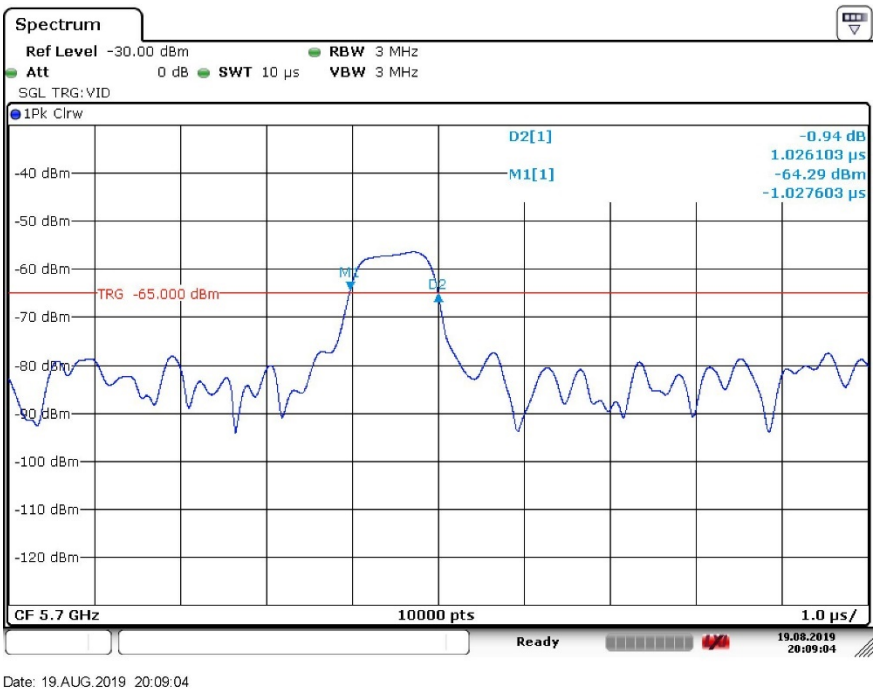


Figure 4. Radar Pulse width: Radar Type 0 (5700 MHz, 20MHz BW)

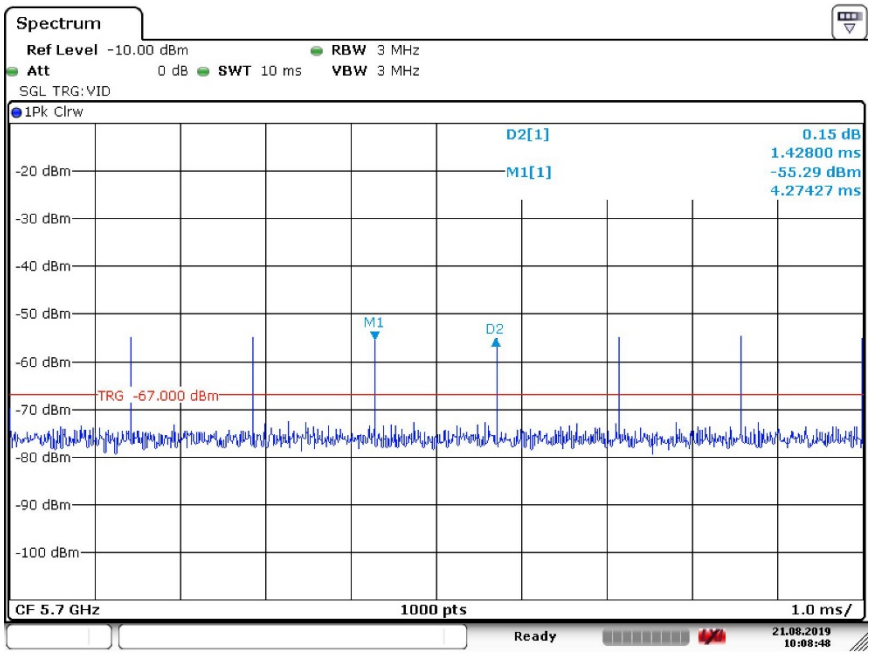


Figure 5. Radar Pulse Repetition Interval: Radar Type 0 (5700MHz, 20MHz BW)

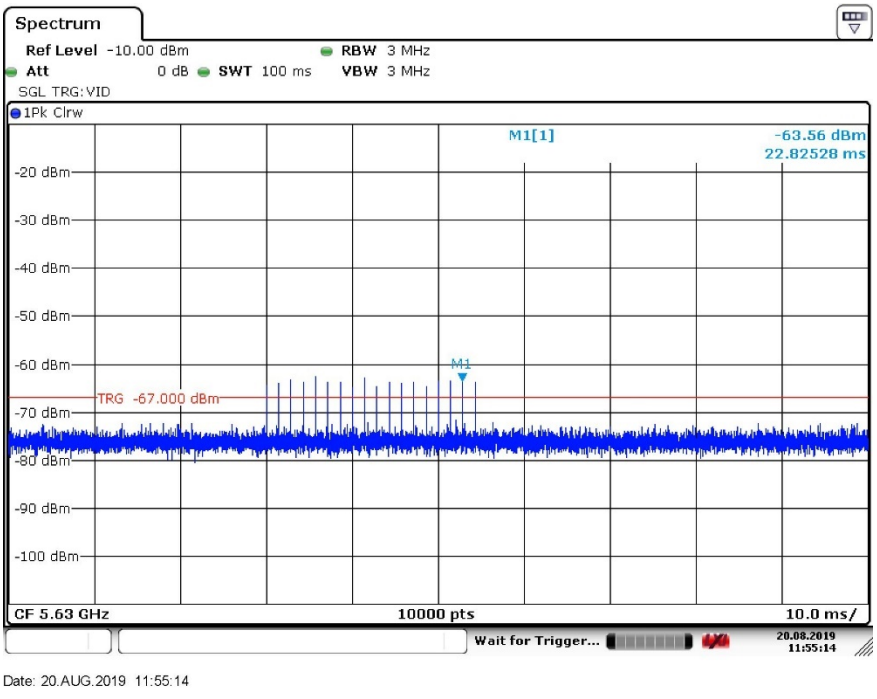
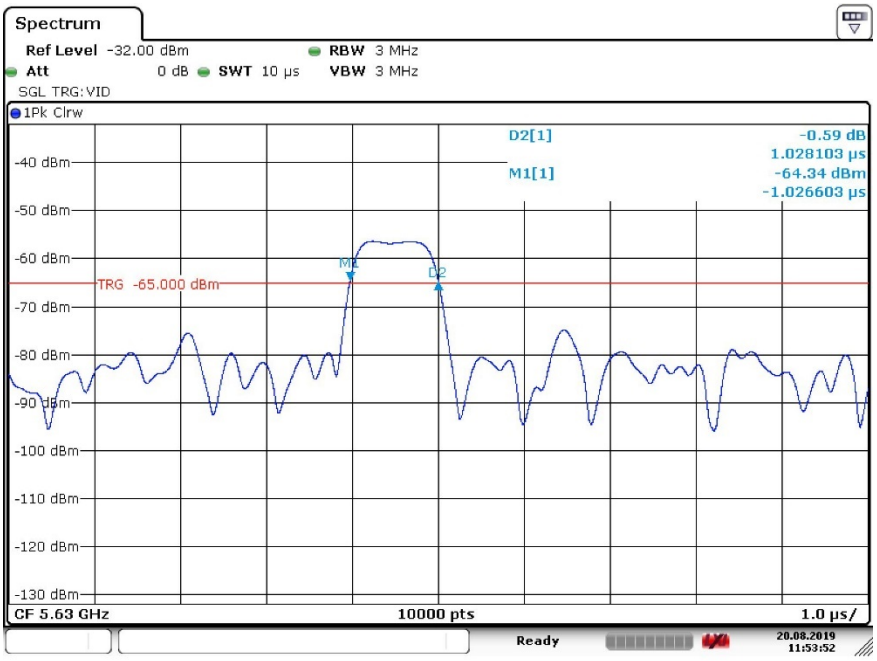
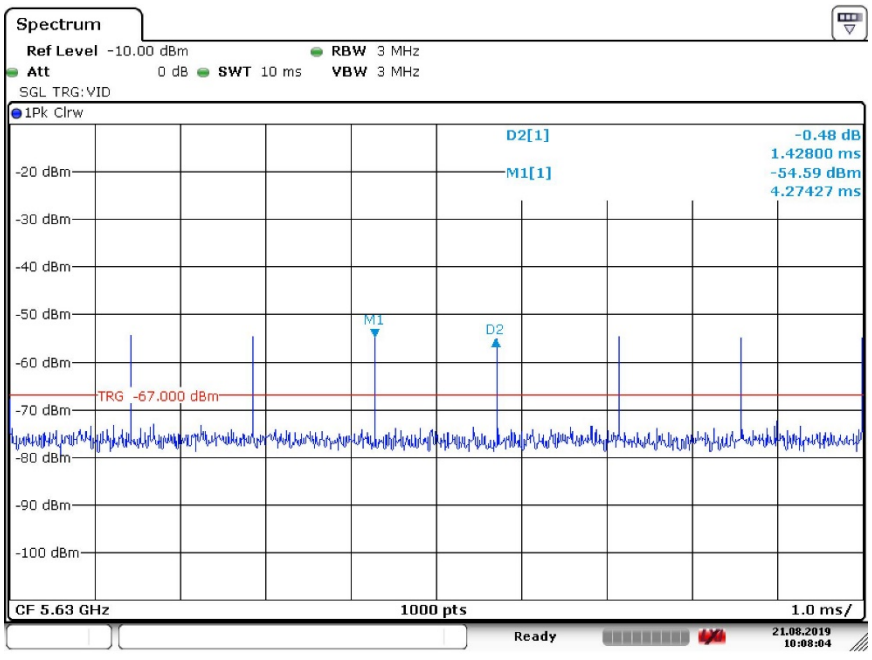


Figure 6. Radar Burst Level at -63dBm: Radar Type 0 (5630MHz, 40MHz BW)



Date: 20.AUG.2019 11:53:52

Figure 7. Radar Pulse width: Radar Type 0 (5630MHz, 40MHz BW)



Date: 21.AUG.2019 10:08:04

Figure 8. Radar Pulse Repetition Interval: Radar Type 0 (5630MHz, 40MHz BW)

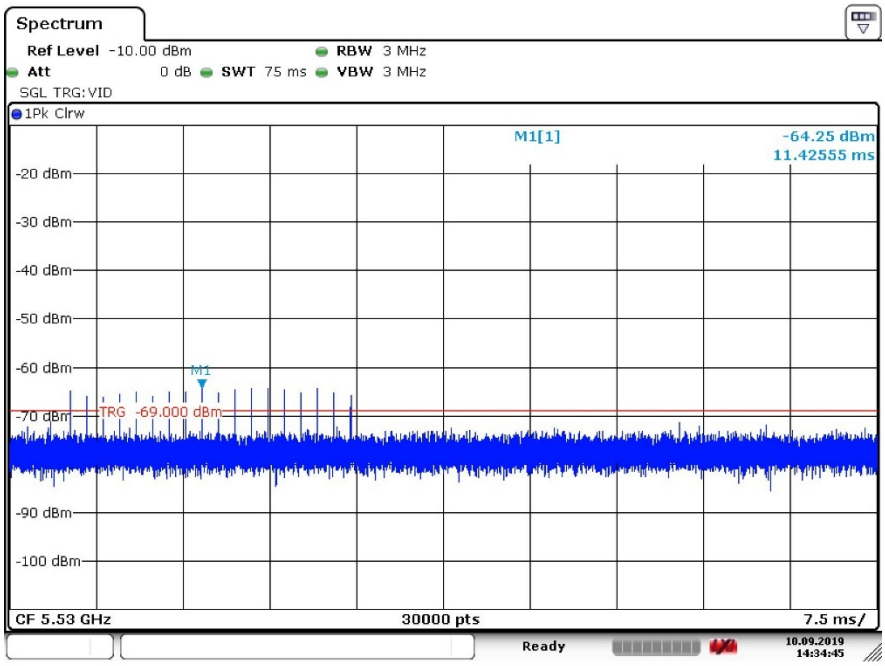


Figure 9. Radar Burst Level at -63dBm: Radar Type 0 (5530MHz, 80MHz BW)

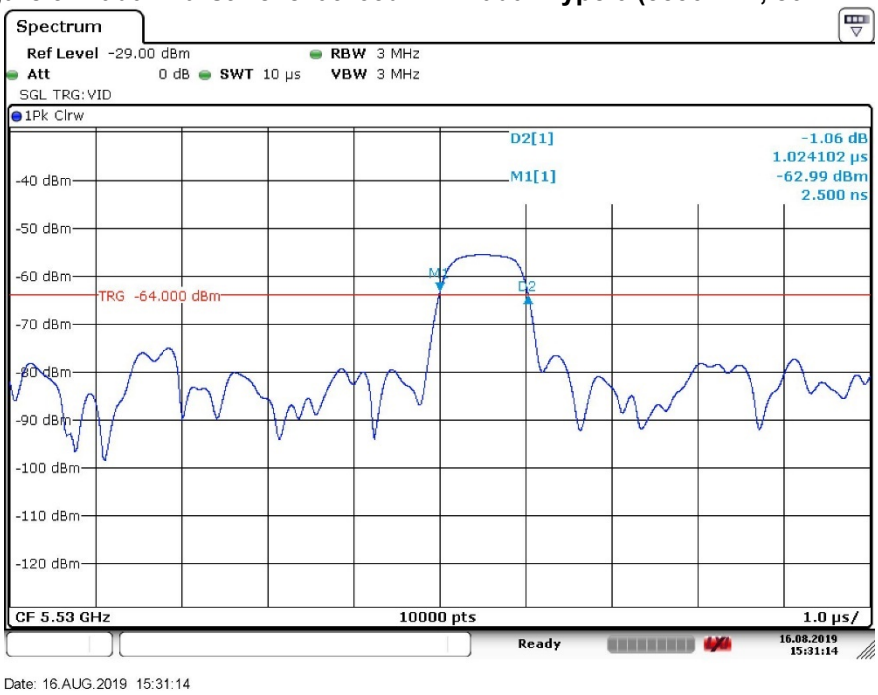
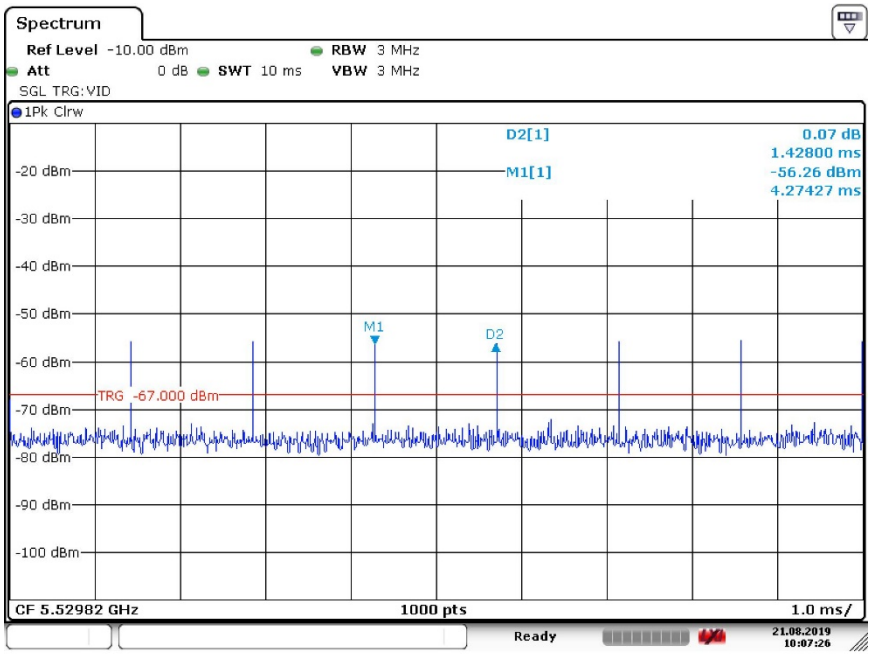
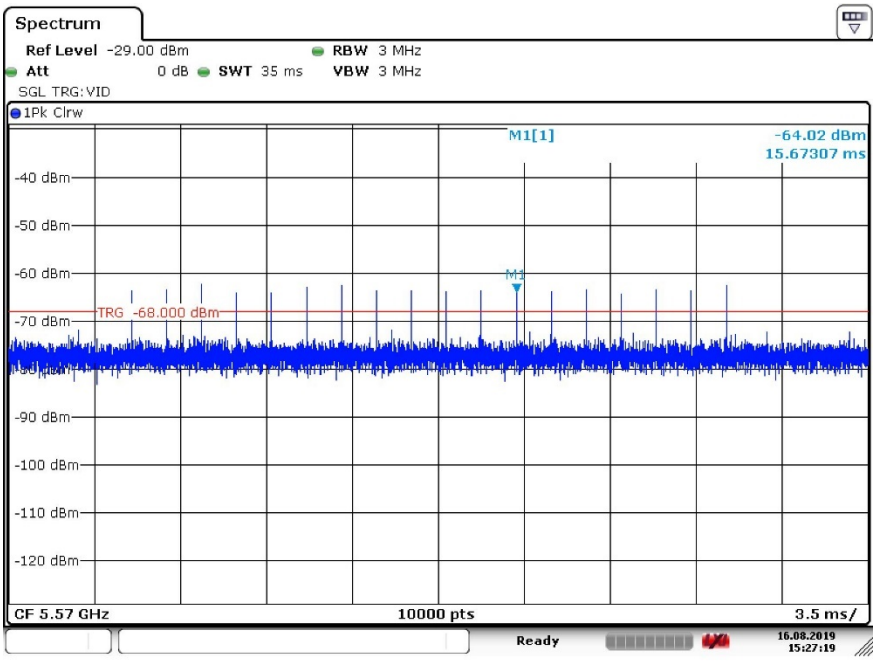


Figure 10. Radar Pulse width: Radar Type 0 (5530MHz, 80 MHz BW)



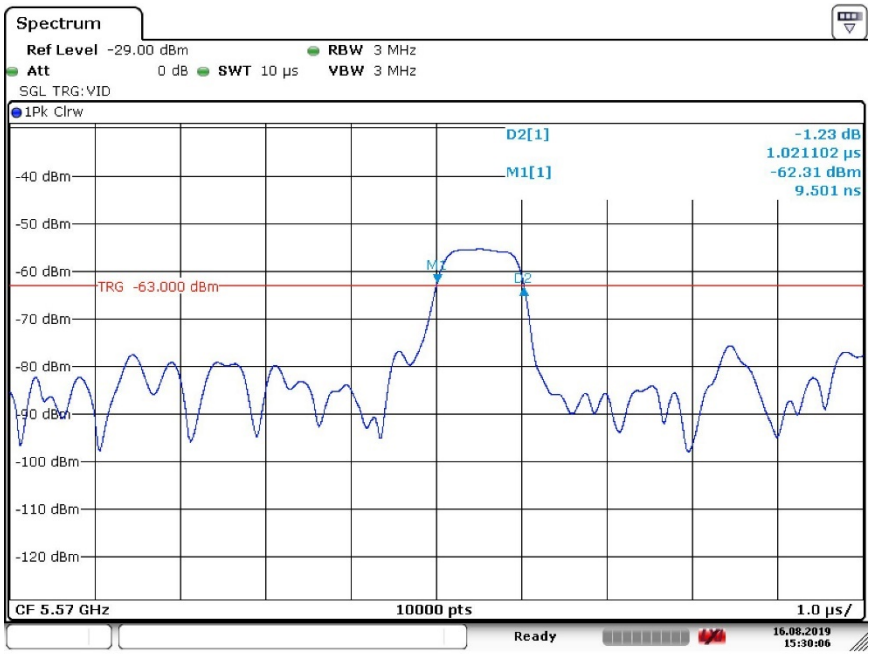
Date: 21.AUG.2019 10:07:27

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



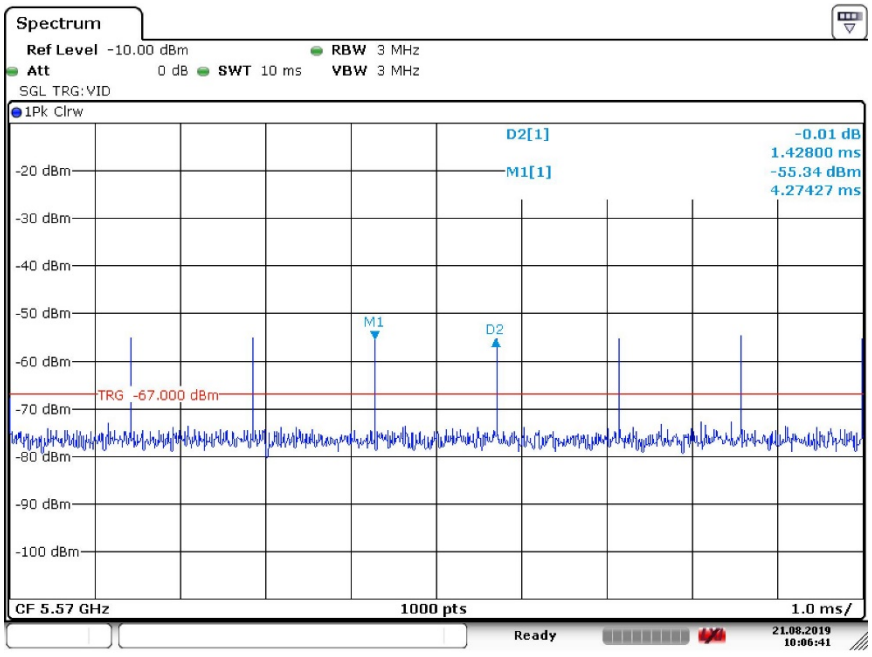
Date: 16.AUG.2019 15:27:20

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



Date: 16.AUG.2019 15:30:06

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



Date: 21.AUG.2019 10:06:40

Figure 14. Radar Pulse Repetition Interval: Radar Type 0 (5570MHz, 160MHz 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 (%)
5700	20	34.71	100	34.71
5630	40	243.27	500	48.65
5530	80	61.59	100	61.59
5570	160	19.39	100	19.39

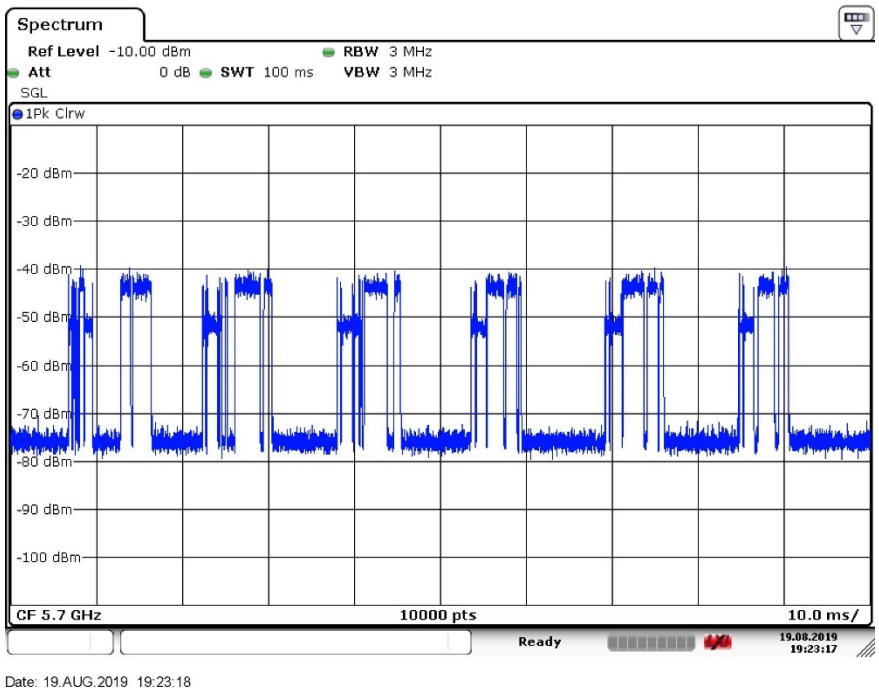
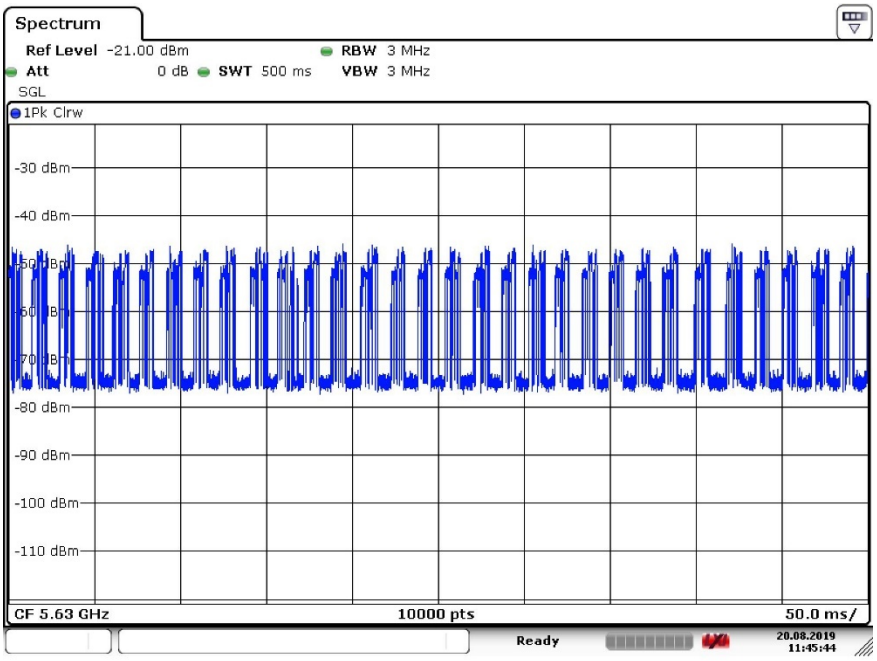
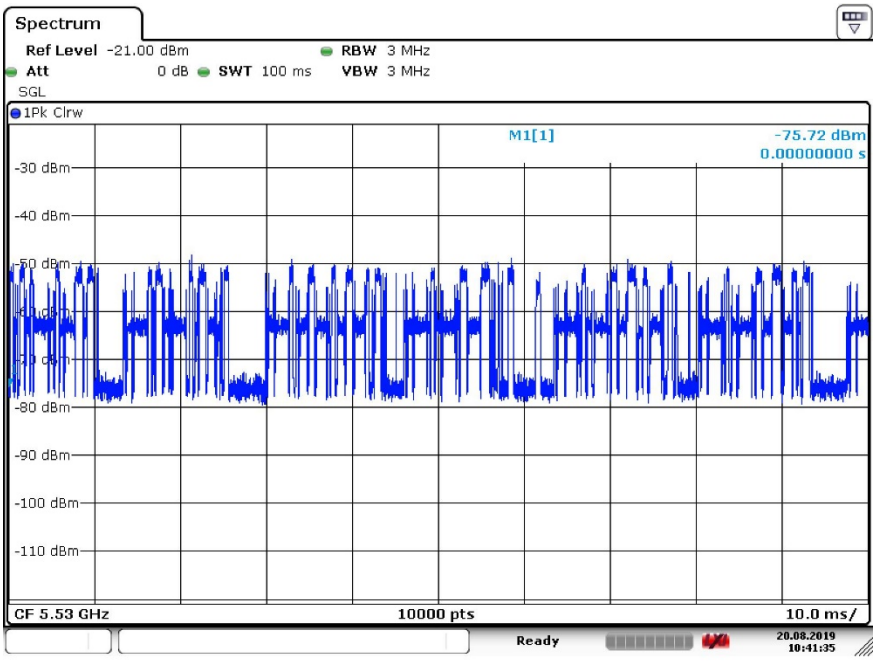


Figure 15. Channel Loading (5700MHz, 20MHz BW)



Date: 20.AUG.2019 11:45:44

Figure 16. Channel Loading (5630MHz, 40MHz BW)



Date: 20.AUG.2019 10:41:35

Figure 17. Channel Loading (5530MHz, 80MHz BW)

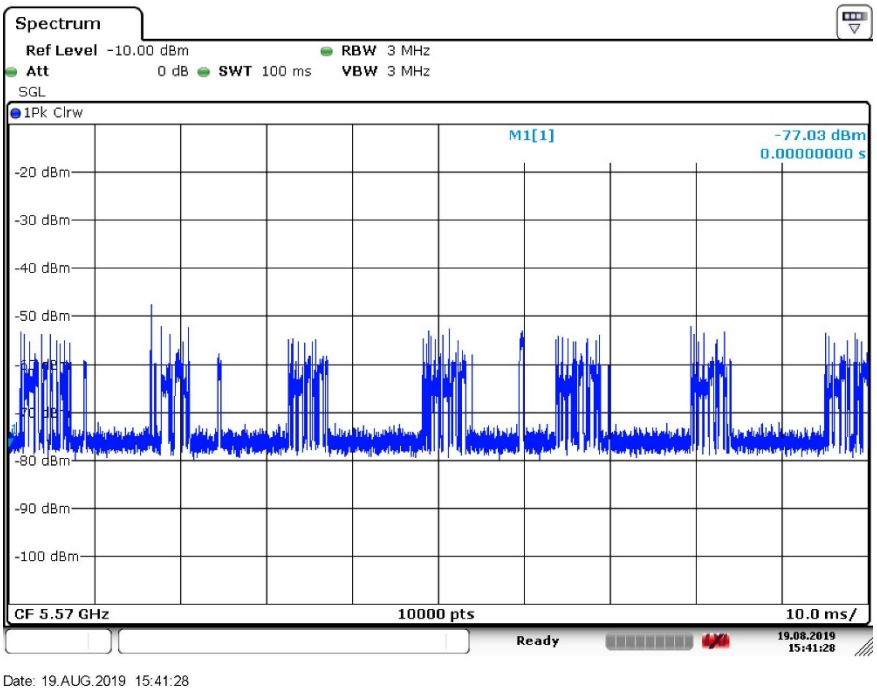


Figure 18. Channel Loading (5570MHz, 160 MHz BW)

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
5700	20	2.04	10	Pass
5630	40	2.09	10	Pass
5530	80	7.85	10	Pass
5570	160	2.08	10	Pass

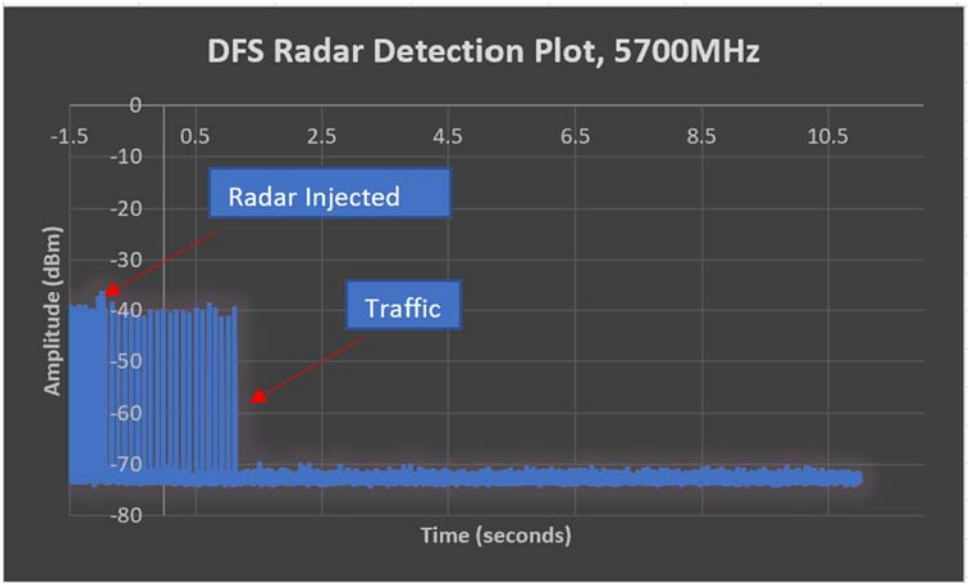


Figure 19. DFS Radar Detection Plot 5700 MHz

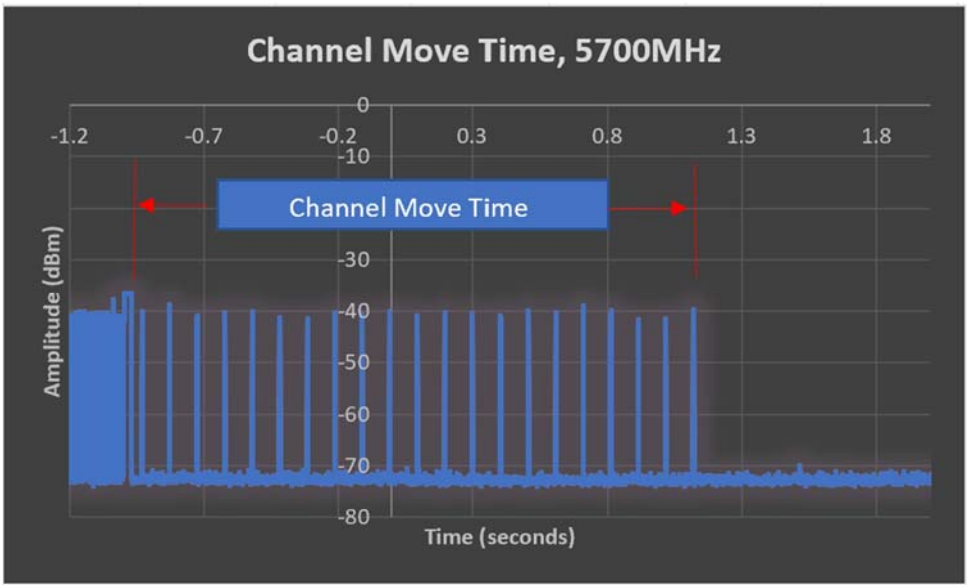


Figure 20. Channel Move Time 5700 MHz

Figure 20 is a zoomed plot of Figure 19 to show the Channel Move Time for Channel 5700MHz.

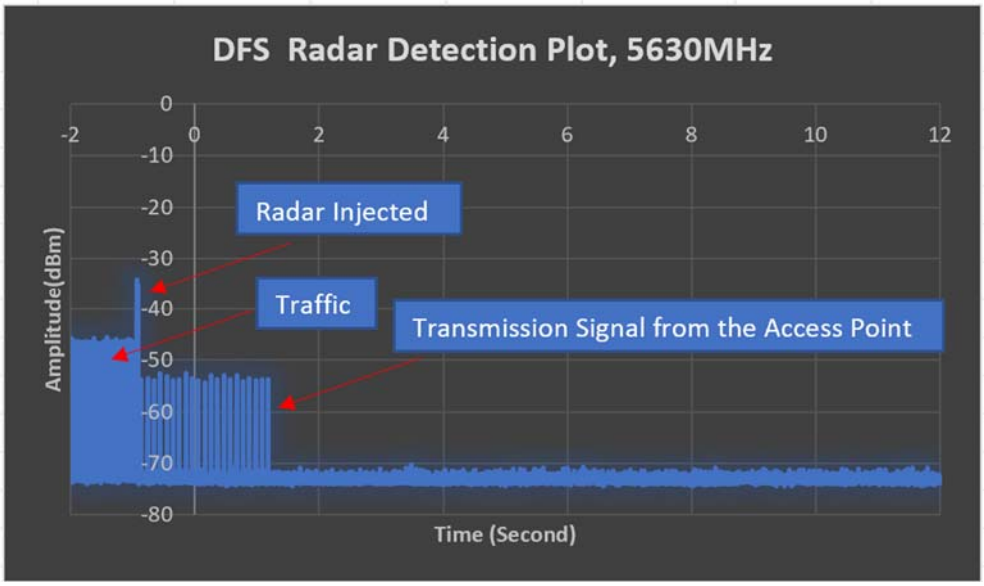


Figure 21. Channel Move Time 5630 MHz

Figure 22. DFS Radar Detection Plot 5630 MHz

Figure 22 is a zoomed plot of Figure 21 which shows the Channel Move Time for 5630MHz.

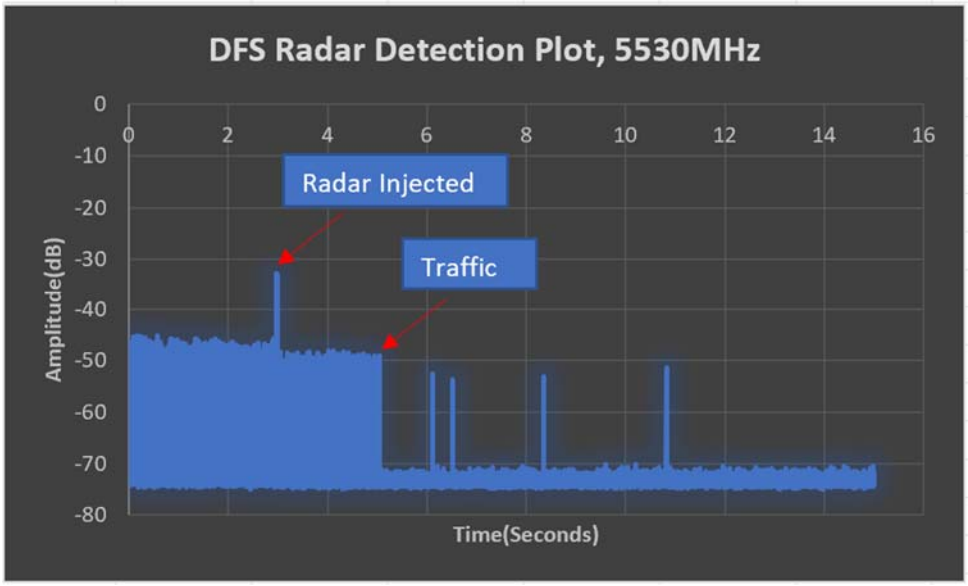


Figure 23. Channel Move Time 5530 MHz

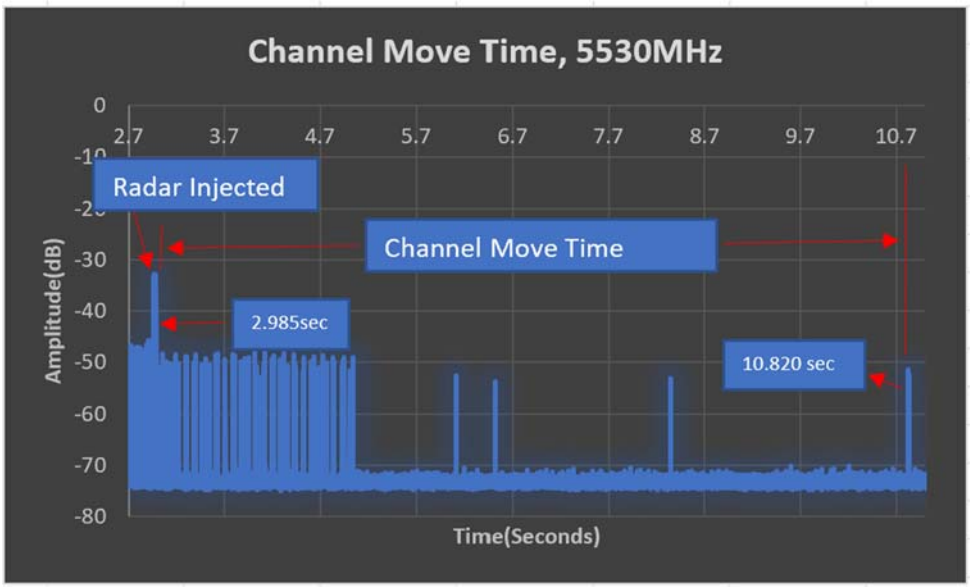


Figure 24. DFS Radar Detection Plot 5530 MHz

Figure 24 is a zoomed plot of Figure 23 which shows the Channel Move Time for 5530MHz.

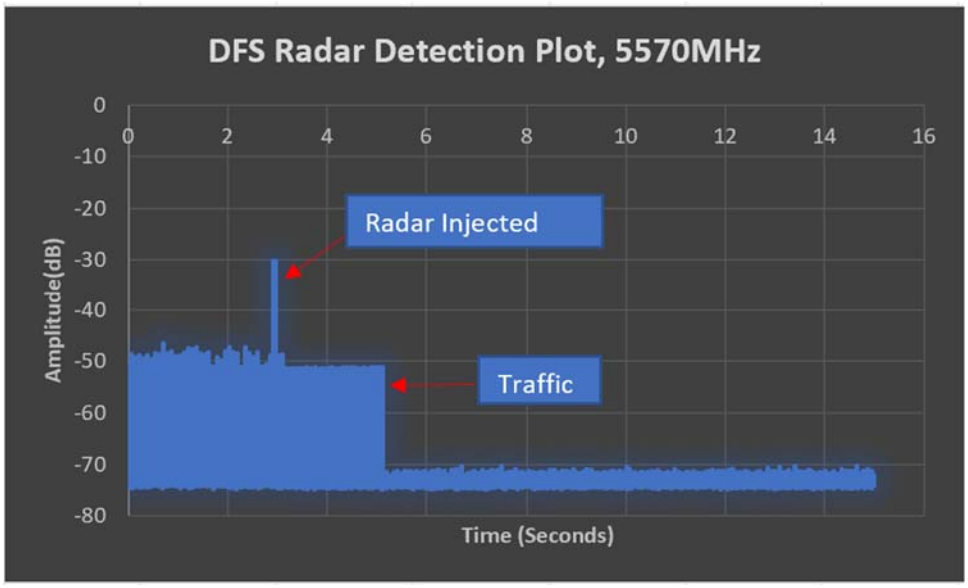


Figure 25. Channel Move Time 5570 MHz, 160 MHz Bandwidth

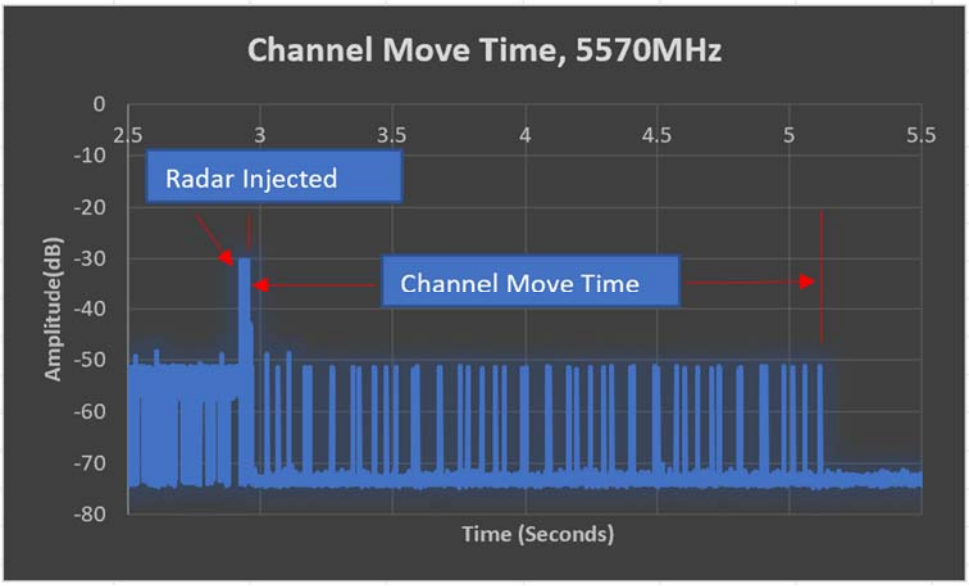


Figure 26. DFS Radar Detection Plot 5570 MHz, 160MHz Bandwidth

Figure 26 is a zoomed plot of Figure 25 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)	Total Channel Closing Transmission Time (ms)	Aggregate Control Signaling Time after 200ms	Channel Closing Transmission Time Limit + Aggregate Control Signaling Time Limit (ms)	Result
5700	20	76.51	9.00	200 +60	Pass
5630	40	40.50	9.09	200 +60	Pass
5530	80	51.50	45.50	200 +60	Pass
5570	160	68.50	31.50	200 +60	Pass

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

Figure 27. Channel Closing Transmission Time (5700MHz), 20MHz Bandwidth

Figure 27 is a zoomed plot of Figure 19 which shows the Channel Closing Transmission Time and transmission signals from the EUT which is accounted for calculating the Channel Closing Transmission Time.

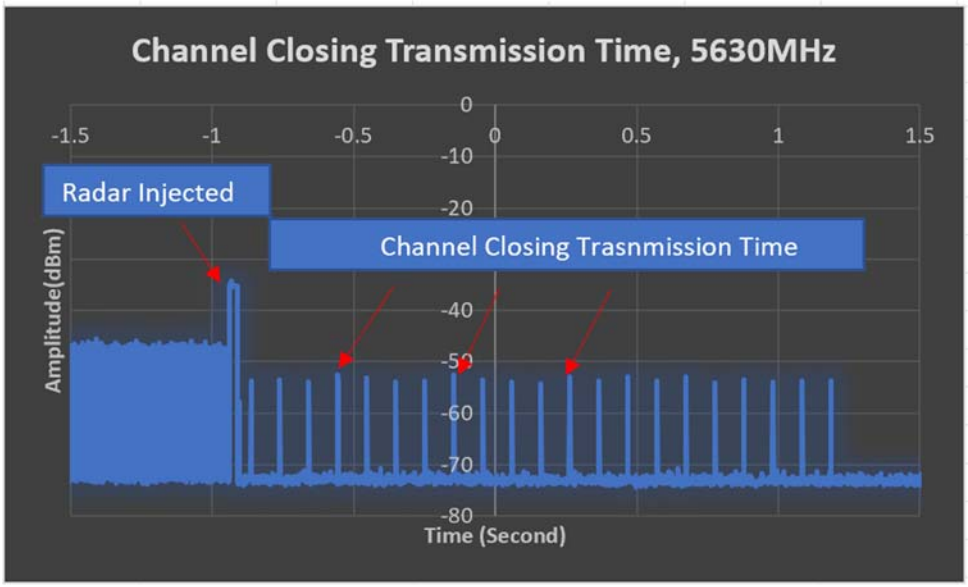


Figure 28. Channel Closing Transmission Time Control Signals (5630MHz), 40MHz Bandwidth

Figure 28 is a zoomed plot of Figure 21 which shows the Channel Closing Transmission Time and transmission signals from the Access Point which is accounted for calculating the Channel Closing Transmission Time.

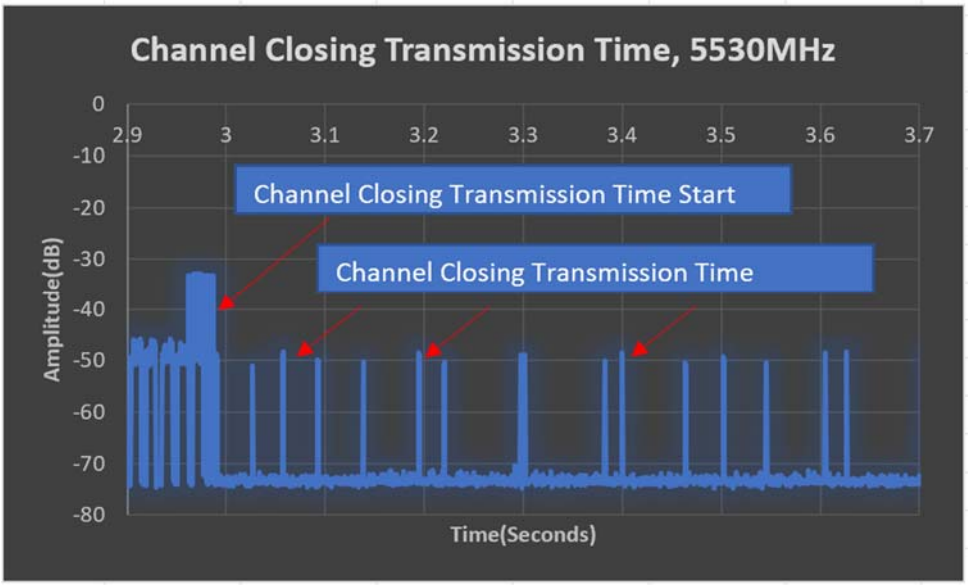


Figure 29. Channel Closing Transmission Time (5530 MHz), 80MHz Bandwidth

Figure 29 is a zoomed plot of Figure 23 which shows the Channel Closing Transmission Time and transmission signals from the EUT which is accounted for calculating the Channel Closing Transmission Time.

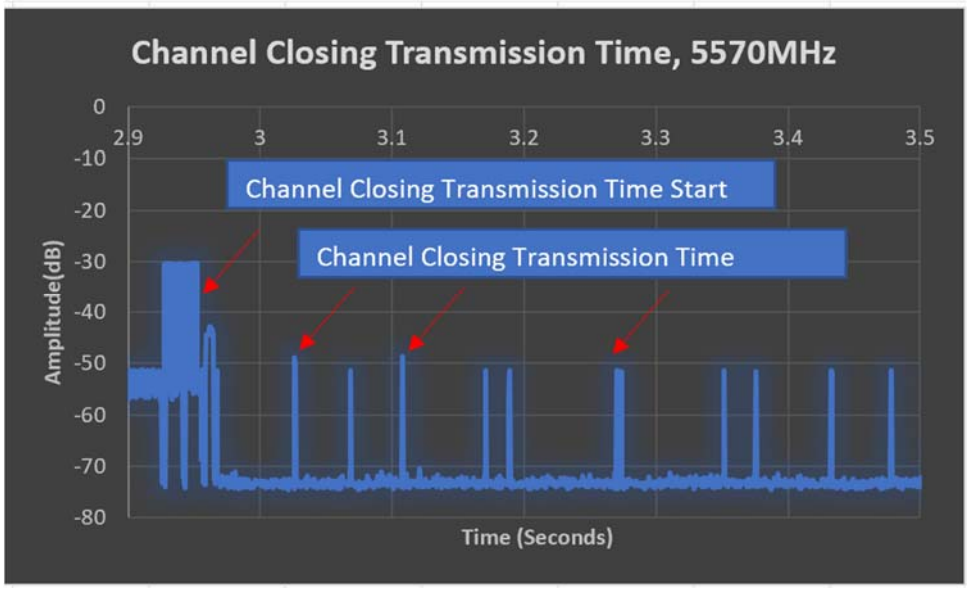


Figure 30. Channel Closing Transmission Time (5570 MHz), 160MHz Bandwidth

Figure 30 is a zoomed plot of Figure 25 which shows the 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.

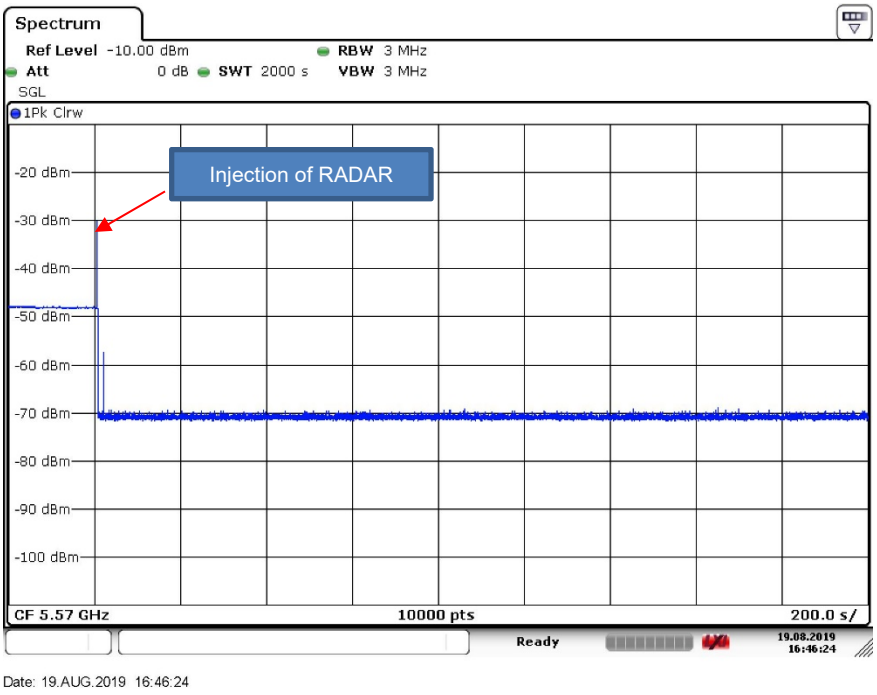


Figure 31. 30 Minute Non-Occupancy Period (5670 MHz)

End of Report