RADIO TEST REPORT

For

MODEL NO.: 1855
FCC ID: C3K1855
IC ID: 3048A-1855

Test Report No. R-TR516-FCCISED-DFS-3
Issue Date: July 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	06/07/19	All	All	Version 1.0	Jems Pradhan
2.0	07/03/19	4	8	Removed Main and MIMO antenna designation	Daniel Salinas
3.0	07/15/19	4	7	Corrected Typo in IC ID	Daniel Salinas

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Test Report Attestation

Microsoft Corporation
Model: 1855
FCC ID: C3K1855
IC ID: 3048A-1855

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 previously issued report number R-TR516-FCCISED-DFS-2 issued 07/03/2019.

Written By:

Jems Pradhan

Radio Compliance Test Engineer

Reviewed/ Issued By: Daniel Salinas

Radio Compliance Lab Technical 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:	Chaitrali Limaye
Functional Description of the EUT:	Radio transceiver with 802.11a/b/g/n/ac MIMO radio supporting 20/40/80MHz bandwidths, Bluetooth 5.0
Model:	1855
FCC ID:	C3K1855
IC ID:	3048A-1855
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 (EV3)
Equipment Condition:	Good
Test Sample Details:	RF Conducted Test Sample: SN: M1042497-004

4.1 Test Configurations

The device was setup in normal operation and connected wirelessly to an 802.11 access point on 40 MHz and 80 MHz bandwidth channels.

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

Measurements were performed on Chain 0 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)	**Wi-Fi Chain 0 Antenna Peak Gain (dBi)**	**Wi-Fi Chain 1 Antenna Peak Gain (dBi)**
UNII Band 1- 5150 to 5250	4.3	5.7
UNII Band 2a – 5250 to 5350	4.3	6
UNII Band 2c – 5470 to 5725	5.2	6.6
UNII Band 3 – 5725 to 5850	3.0	3.2

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

Combined Directional Antenna Gain	
Frequency Band (MHz)	**Uncorrelated Combined Directional Gain (dBi)**
UNII Band 1- 5150 to 5250	5.06
UNII Band 2a – 5250 to 5350	5.23
UNII Band 2c – 5470 to 5725	5.96
UNII Band 3 – 5725 to 5850	3.10

4.4 Equipment Modifications

No modifications were made during testing.

4.5 Dates of Testing

Testing was performed from March 22nd – May24th, 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	VSG	SMBV100A	RF-141	N/A	04/12/2020
Cisco	Cisco Aironet ISO Access Point	AIR-AP1252AG-A-K9	RF-331	LDK 102061, LDK 102062	N/A*
Rohde & Schwarz	Signal Analyzer	FSV40	RF-245	N/A	04/12/2020
L-Com	RF Combiner	SC5802N	RF-048	N/A	N/A*
L-Com	RF Combiner	SC5802N	RF-049	N/A	N/A*
Agilent	DC power Supply	E3632A	EMC-1152	N/A	N/A*
Pasternack	LPF DC to 7GHz	PE87FL1015	RF-649	N/A	N/A*
Pasternack	Attenuator	PE7087-10	RF-862	N/A	N/A*
XMA	Attenuator	3082-6156-10	EMC-109	N/A	N/A*
Pasternack	Attenuator	PE7005-20	RF-083	N/A	N/A*
Pasternack	Attenuator	PE7087-10	RF-555	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*
Nokia	Cable	0730231	RF-715	N/A	N/A*
Argosy	Cable	ARL72-450-1830	EMC-316	N/A	N/A*
Micro-tronics	Notch Filter	BRM50702	RF-056	N/A	N/A*
Murata	Cable	MXJA01JA1000	RF-883	N/A	N/A*

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

7.2 Test Setup Diagrams

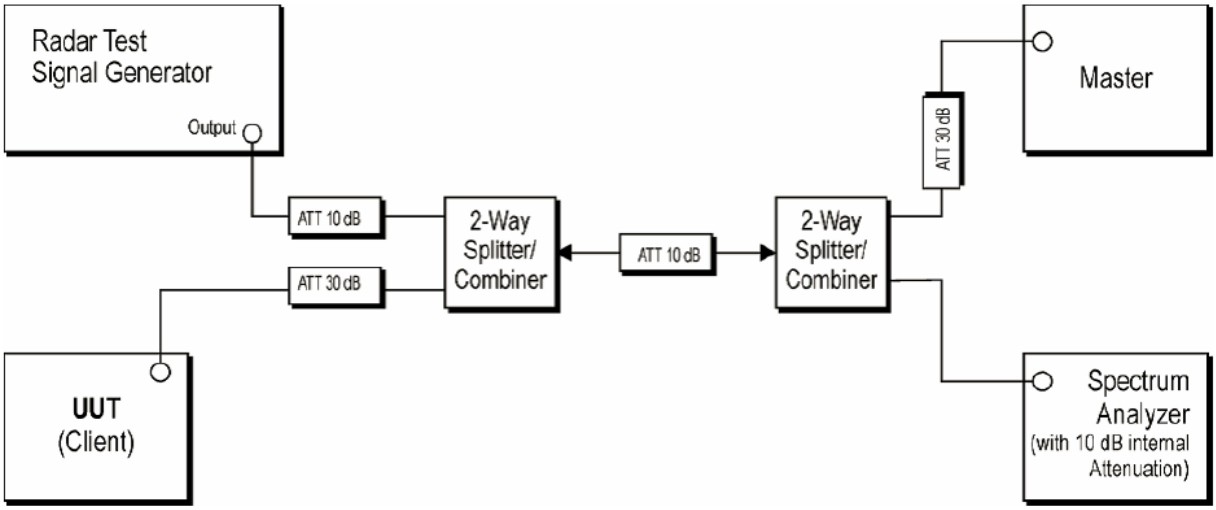


Figure 1. Test Setup for Antenna Port Conducted Measurements

7.3 Radar Waveform Verification

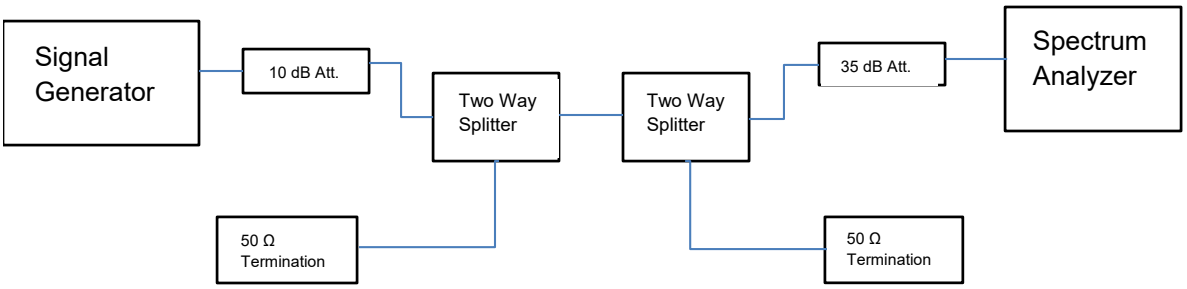


Figure 2. Test Setup for Conducted Measurement Radar Verification

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	-64
Master	Linksys WRT3200 ACM	12.10	23.97	5.1	29.07	-64
Client	Microsoft Model 1855	14.68	20.05	5.96	26.01	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	5550	-63.91	18	1.00	1.416
0	5610	-63.93	18	1.00	1.417

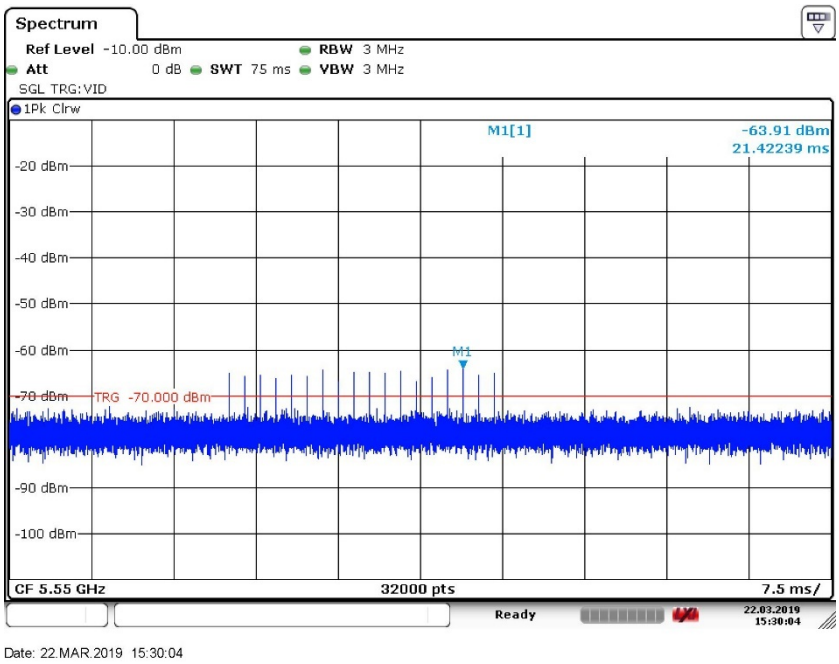


Figure 3. Radar Burst Level at -64dBm: Radar Type 0 (5550 MHz 40 MHz BW)

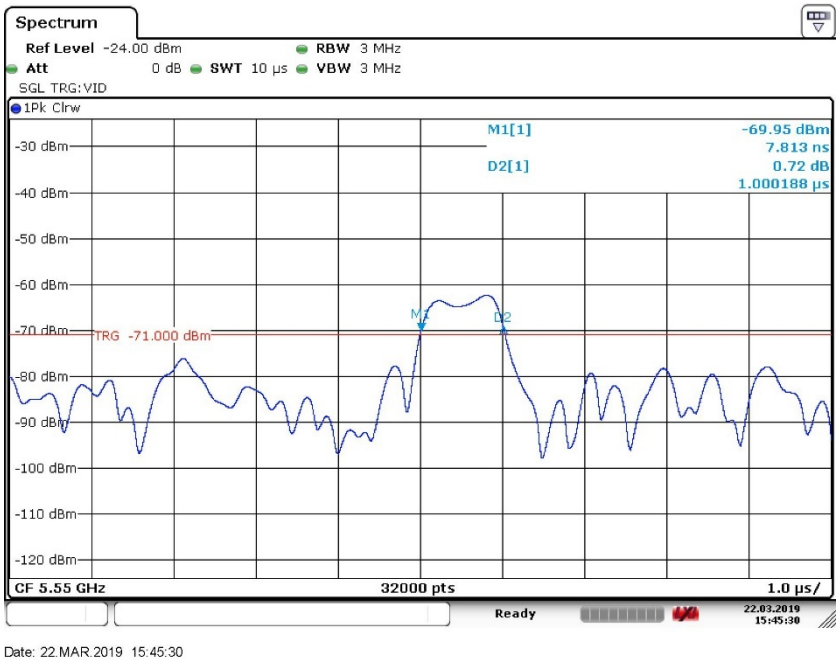


Figure 4. Radar Pulse width: Radar Type 0 (5550 MHz 40 MHz BW)

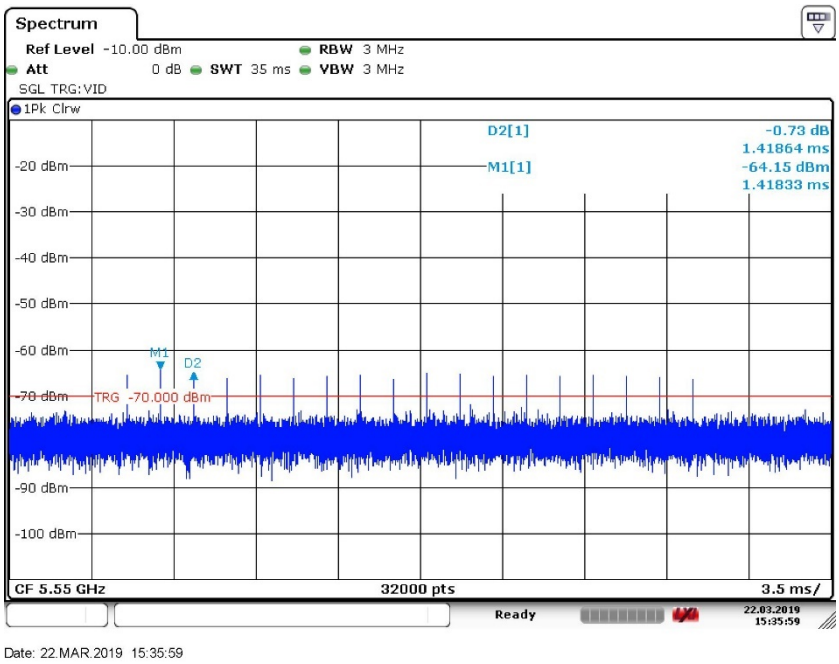


Figure 5. Radar Pulse Repetition Interval: Radar Type 0 (5550 MHz 40 MHz BW)

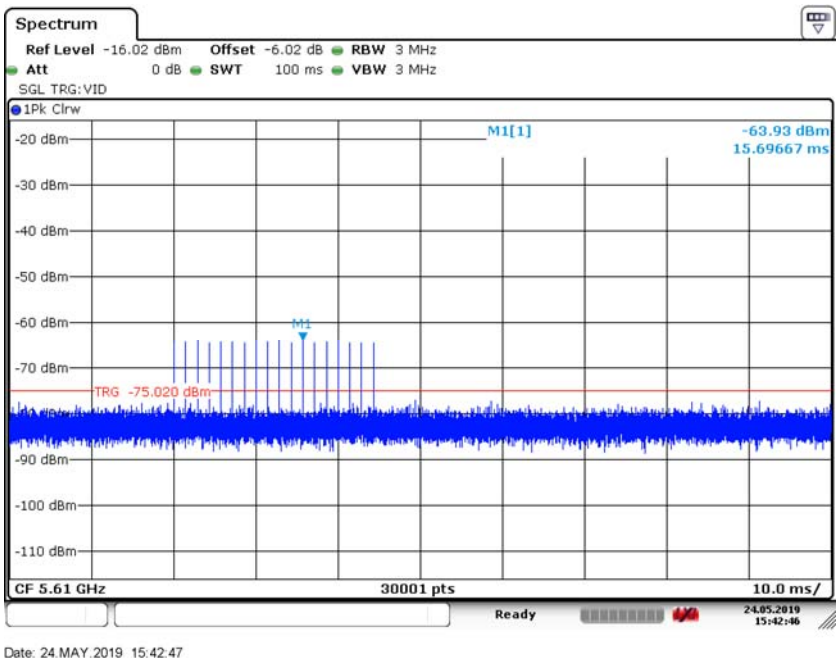
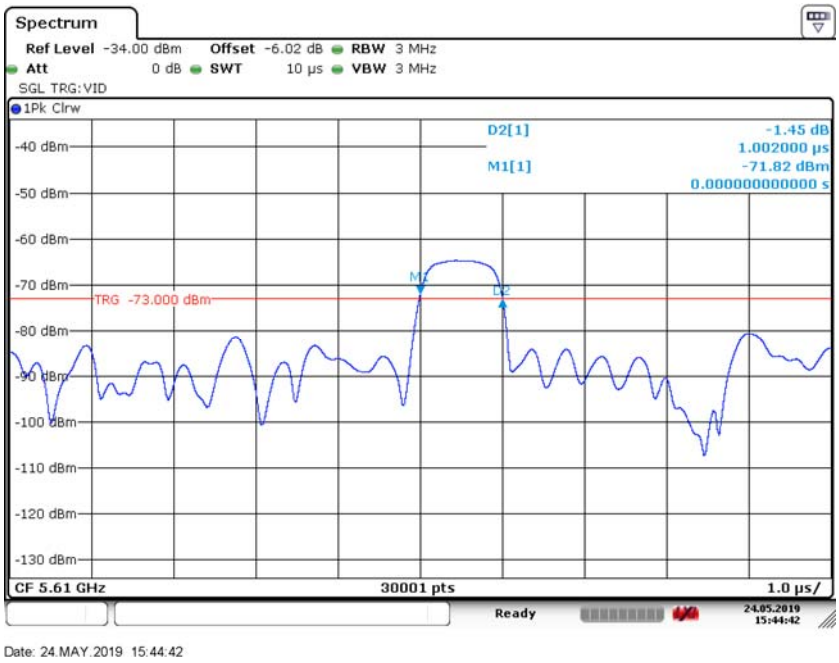
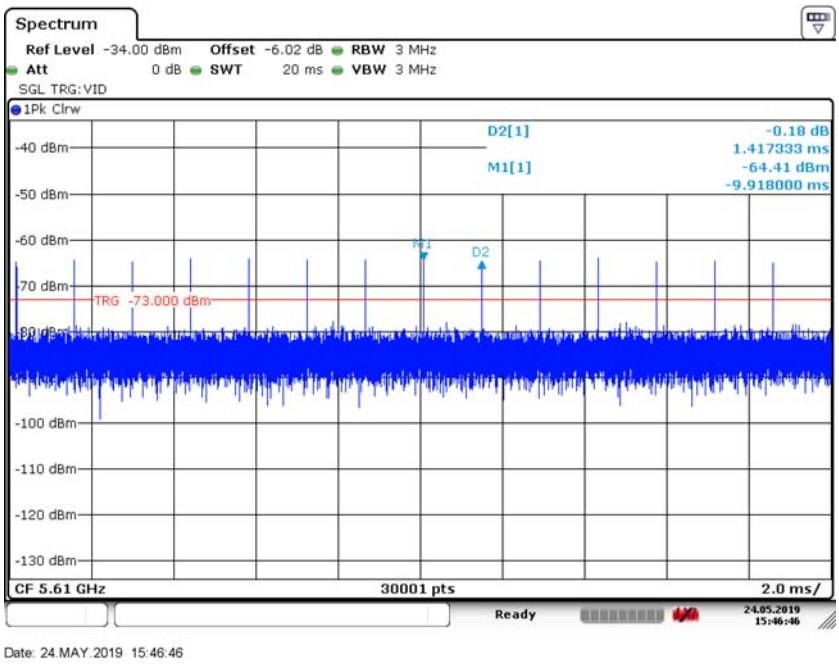


Figure 6. Radar Burst Level at -64dBm: Radar Type 0 (5610 MHz 80 MHz BW)



Date: 24.MAY.2019 15:44:42

Figure 7. Radar Pulse width: Radar Type 0 (5610 MHz 80 MHz BW)



Date: 24.MAY.2019 15:46:46

Figure 8. Radar Pulse Repetition Interval: Radar Type 0 (5610 MHz 80 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 (%)
5550	40	95.867	500	19.17
5610	80	122.283	500	24.66

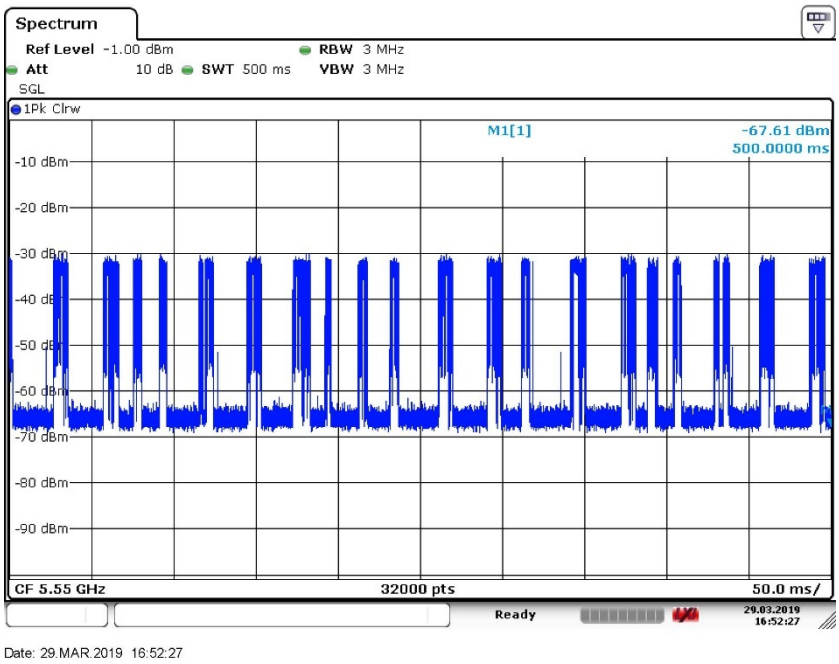


Figure 9. Channel Loading (5550 MHz 40 MHz BW)

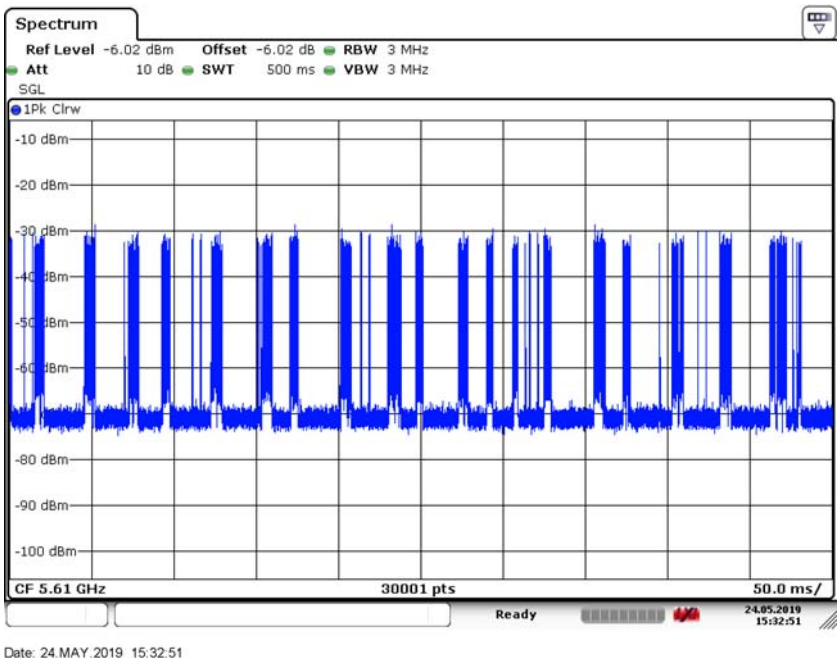


Figure 10. Channel Loading (5610 MHz 80 MHz BW)

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 200ms 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
5550	40	0.052	10	Pass
5610	80	2.107	10	Pass

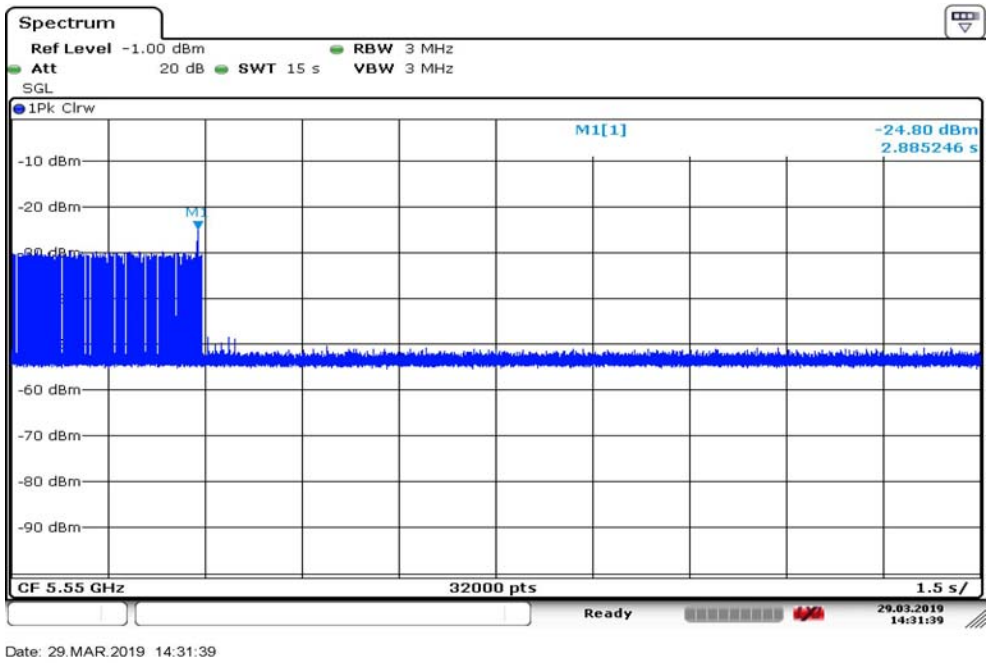


Figure 11. DFS Radar Detection Plot Channel 5550 MHz

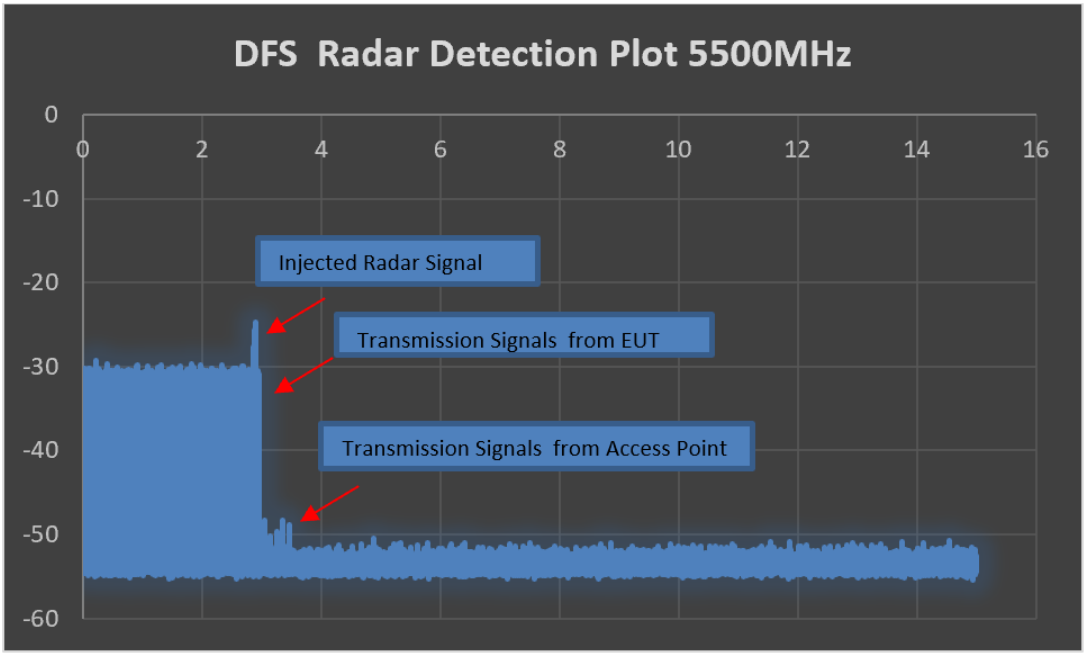


Figure 12. DFS Radar Detection Plot Channel 5550 MHz

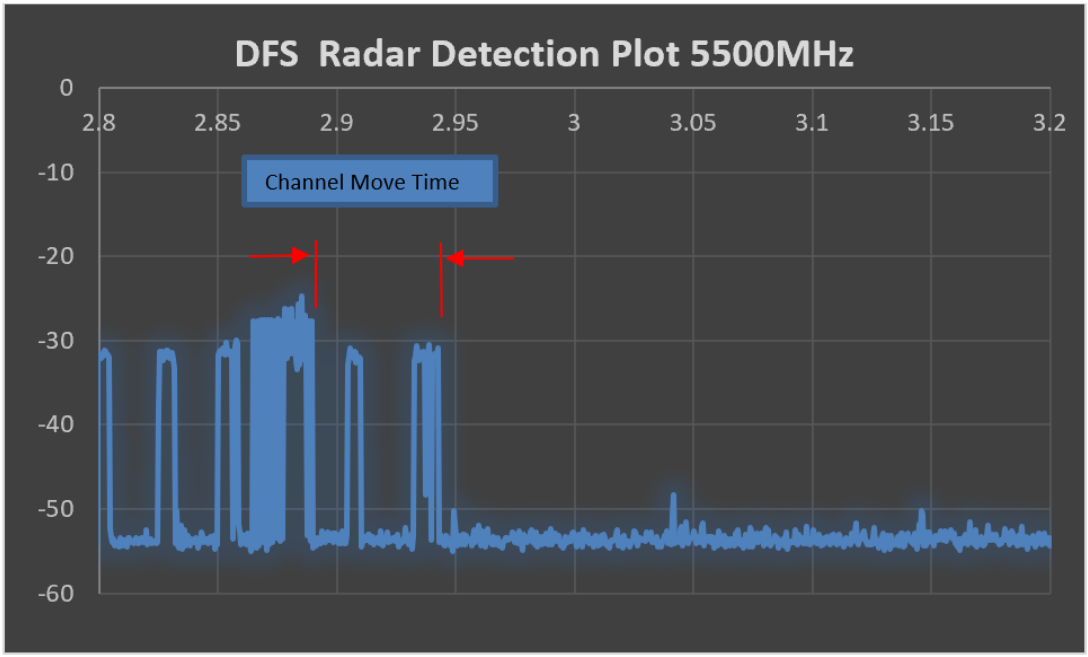


Figure 13. Channel Move Time 5550 MHz

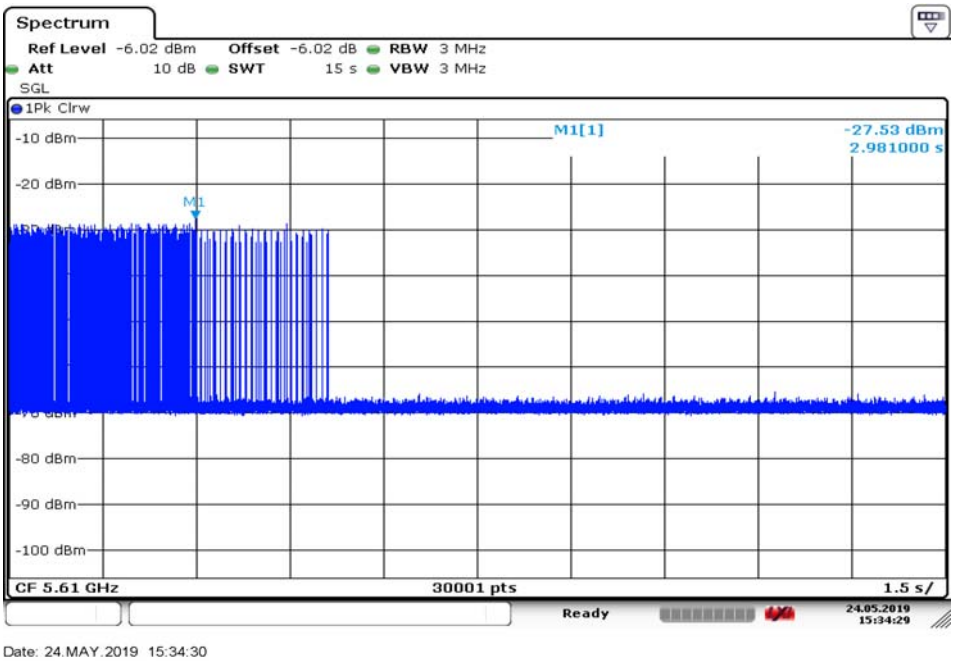


Figure 14. DFS Radar Detection Plot Channel 5610 MHz

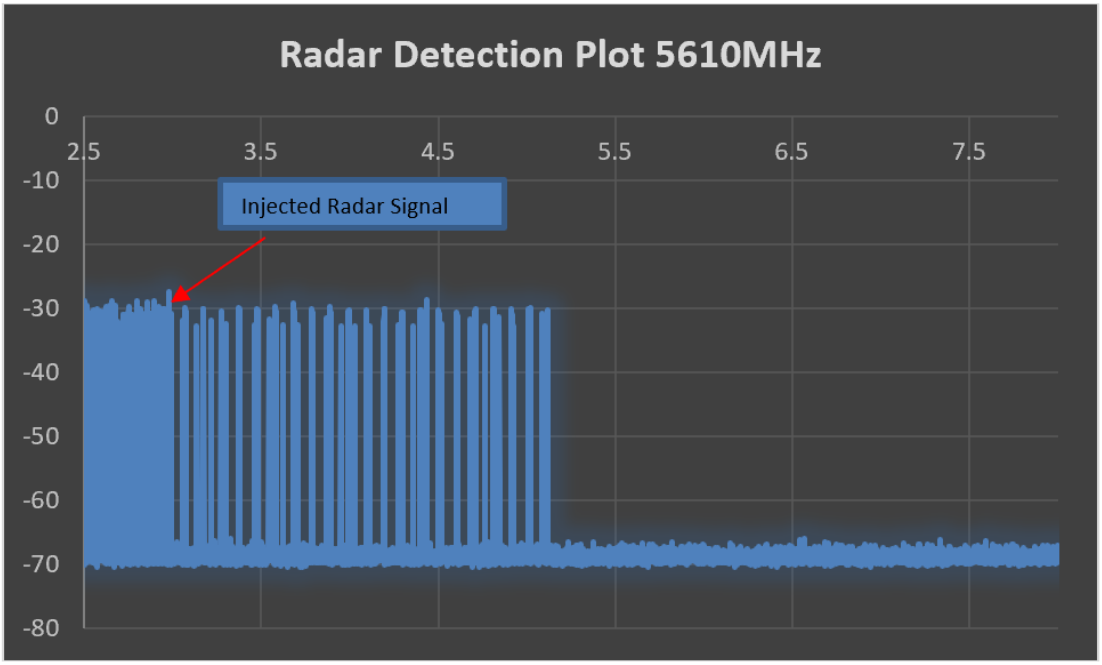


Figure 15. DFS Radar Detection Plot Channel 5610 MHz

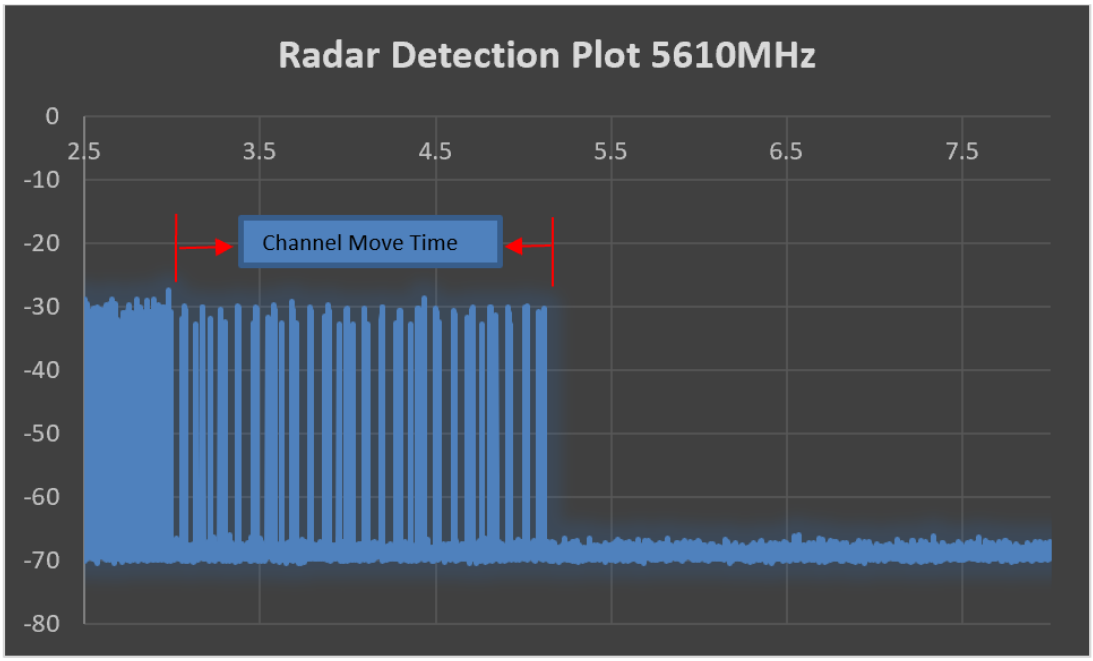


Figure 16. Channel Move Time 5610 MHz

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 200ms starting at the beginning of the channel move time. Control signaling required to facilitate a channel move (an aggregate of 60ms) 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
5510	40	0.016	200 +60	Pass
5610	80	3.5	200 +60	Pass

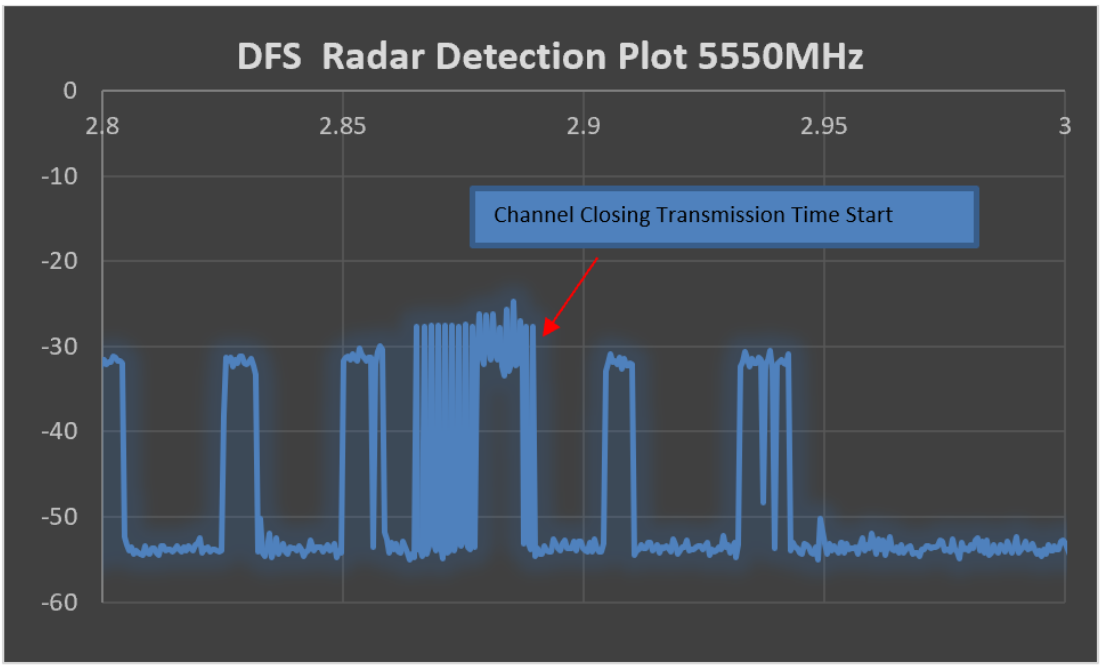


Figure 17. Channel Closing Transmission Time (5550 MHz)

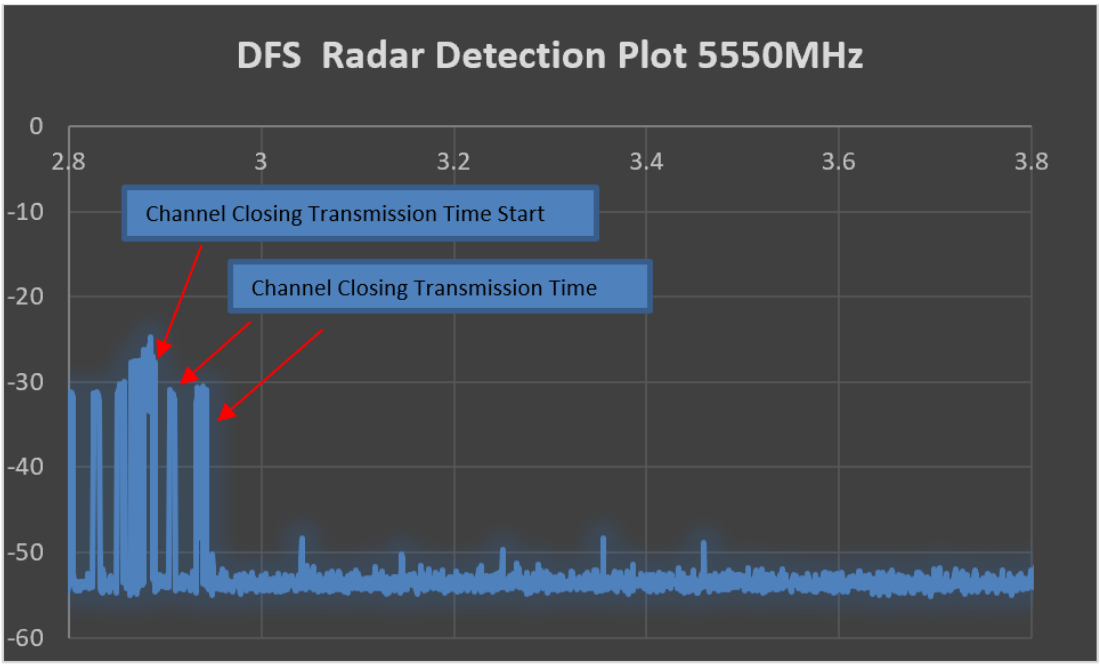


Figure 18. Channel Closing Transmission Time (5550 MHz)

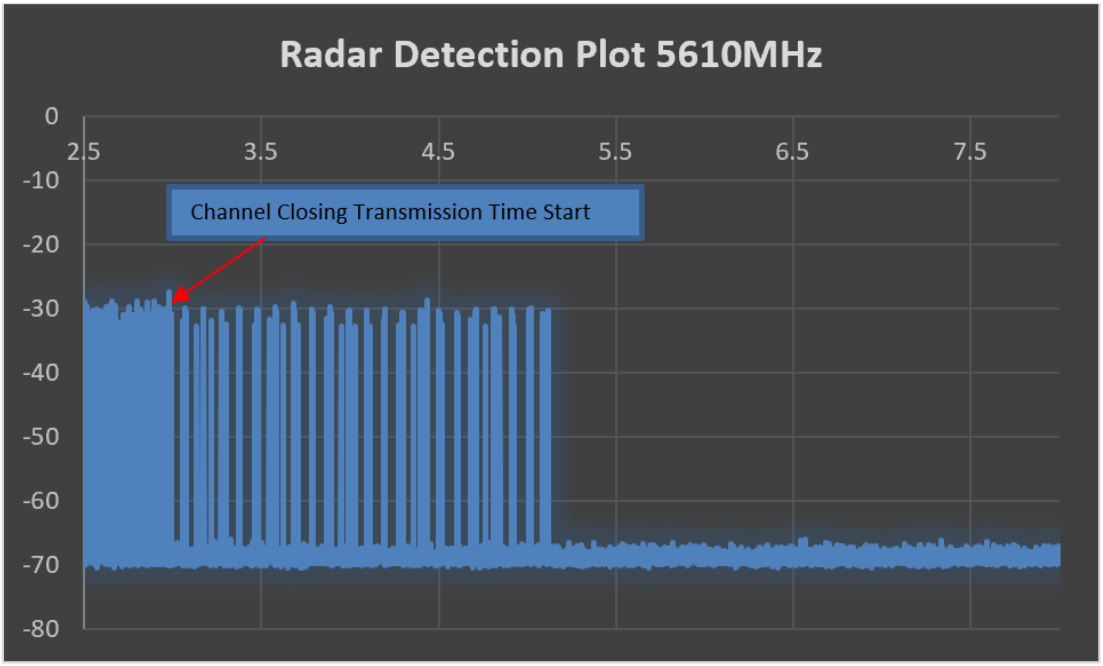


Figure 19. Channel Closing Transmission Time (5610 MHz)

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.

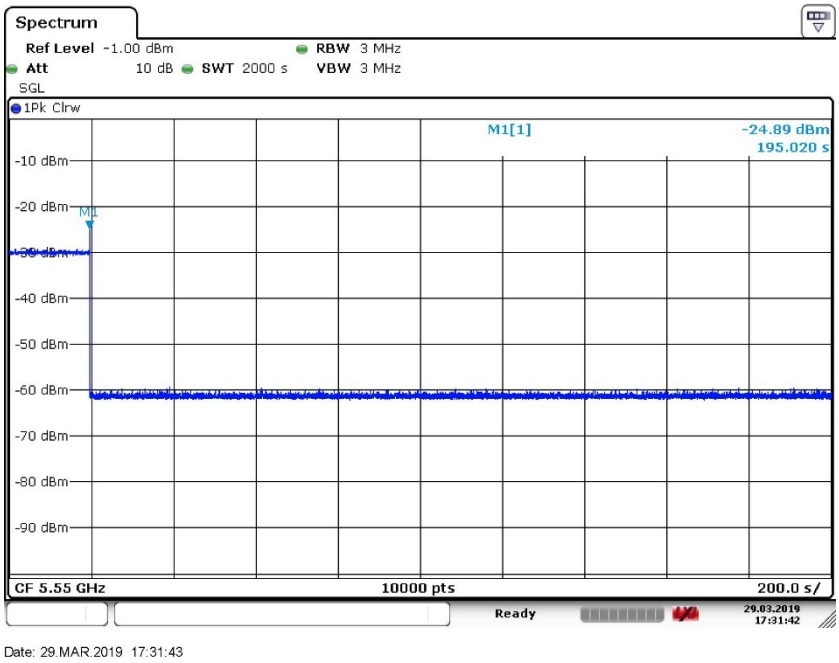


Figure 21. 30 Minute Non-Occupancy Period (5550 MHz)

End of Report