

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

# **CERTIFICATION TEST REPORT**

**FOR** 

PORTABLE COMPUTING DEVICE

**MODEL NUMBER: 1873** 

FCC ID: C3K1873 IC: 3048A-1873

**REPORT NUMBER: 12857633-E5V3** 

**ISSUE DATE: SEPTEMBER 24, 2019** 

Prepared for

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Prepared by

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# **Revision History**

Rev.	lssue Date	Revisions	Revised By
V1	09/03/19	Initial Issue	
V2	09/16/19	Section 3: Version updated	Henry Lau
V3	09/24/19	Section 3: Version updated	Henry Lau

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** MICROSOFT CORPORATION

> ONE MICROSOFT WAY REDMOND, WA 98052-6399

U.S.A.

PORTABLE COMPUTING DEVICE **EUT DESCRIPTION:** 

MODEL: 1873

**SERIAL NUMBER:** 009052592757

**DATE TESTED:** AUGUST 12, 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 NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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CONSUMER TECHNOLOGY DIVISION

UL Verification Services Inc.

Douglas Combuser

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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 UL Verification Services report number 12857633-E4V3.

# 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 above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code: 2324A.

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%.

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# 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

Table 21 Applicability of 51 o requirements during normal epotation								
Requirement	Operationa	Operational Mode						
	Master	Client	Client					
		(without DFS)	(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	Master Device or Client with Radar DFS	Client (without DFS)
modes	All DW mades much be	Not required
U-NII Detection Bandwidth and	All BW modes must be	Not required
Statistical Performance Check	tested	
Channel Move Time and Channel	Test using widest BW mode	Test using the
Closing Transmission Time	available	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	-62 dBm
power spectral density < 10 dBm/MHz	
E.I.R.P. < 200 mill watt that do not meet power spectral	-64 dBm
density requirement	

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** 

rabic 4. Di e recoponice 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	Pulse	PRI	Pulses	Minimum	Minimum
Type	Width	(usec)		Percentage	Trials
	(usec)			of Successful	
				Detection	
0	1	1428	18	See Note 1	See Note
					1
1	1	Test A: 15 unique		60%	30
		PRI values randomly			
		selected from the list	Roundup:		
		of 23 PRI values in	{(1/360) x (19 x 10 <sup>6</sup> PRI <sub>usec</sub> )}		
		table 5a			
		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 T	ypes 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

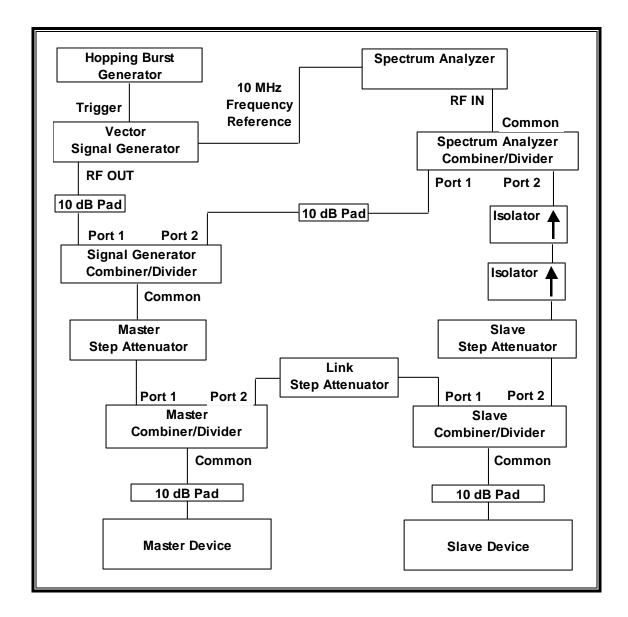
Radar	Pulse	Chirp	PRI	Pulses	Number	Minimum	Minimum
Waveform	Width	Width	(µsec)	per	of	Percentage	Trials
Type	(µsec)	(MHz)		Burst	Bursts	of Successful	
						Detection	
5	50-100	5-20	1000-	1-3	8-20	80%	30
			2000				

**Table 7 – Frequency Hopping Radar Test Signal** 

i abic i	rable 7 - Frequency Frepping Radar Feet eighar										
Radar	Pulse	PRI	Pulses	Hopping	Hopping	Minimum	Minimum				
Waveform	Width	(µsec)	per	Rate	Sequence	Percentage of	Trials				
Type	(µsec)		Hop	(kHz)	Length	Successful					
					(msec)	Detection					
6	1	333	9	0.333	300	70%	30				

#### 6.1.2. TEST AND MEASUREMENT SYSTEM

# CONDUCTED 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.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), additional combiner/dividers are inserted between the Master Combiner/Divider and the pad connected to the Master Device (and/or between the Slave Combiner/Divider and the pad connected to the Slave Device). Additional pads may be utilized such that there is one pad at each RF port on each EUT.

#### SYSTEM CALIBRATION

A 50-ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected in place of the master device. 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 Link Step Attenuator between the units is adjusted as needed to provide a suitable received level at the Master and Slave devices. Traffic that meets or exceed the minimum loading requirement is streamed from the Master device to the Slave Device. The WLAN traffic level, as displayed on the spectrum analyzer, is confirmed to be at lower amplitude than the radar detection threshold and is confirmed to be the Radar Detection Device rather than the associated device. If a different setting of the Master Step Attenuator is required to meet the above conditions, a new System Calibration is performed for the new Master Step Attenuator setting.

#### TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST									
Description Manufacturer Model ID No. Cal Du									
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T459	01/24/20					
Signal Generator, MXG X-Series RF Vector	Agilent	N5182B	T1633	02/08/20					

#### 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
PXA Read	3.1	Signal Generator Screen Capture
SGXProject.exe	1.7	Radar Waveform Generation and Download

#### **6.1.4. TEST ROOM ENVIRONMENT**

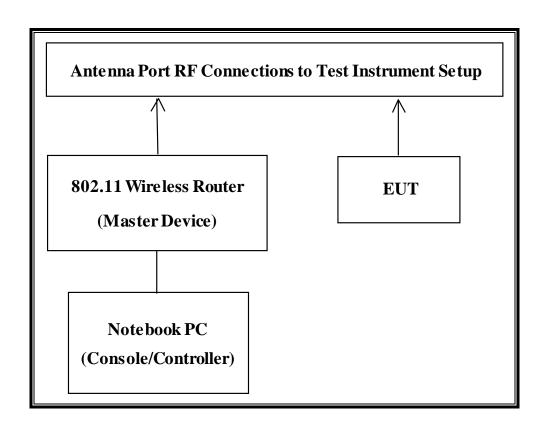
The test room temperature and humidity shall be maintained within normal temperature of 15~35 °C and normal humidity 20~75% (relative humidity).

# **ENVIRONMENT CONDITION**

Parameter	Value
Temperature	24.2 °C
Humidity	48 %

# **6.1.5. SETUP OF EUT**

# **CONDUCTED METHOD EUT TEST SETUP**



#### **SUPPORT EQUIPMENT**

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

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Adapter (EUT)	Microsoft	Microsoft	0D130P00RSY95	DoC
Mu-MIMO Gigabit WiFi Router (Master Device)	Linksys	WRT3200ACM	1981160C801108	Q87-WRT3200ACM
AC Adapter (Router)	Linksys	MU42-3120300- A1	25.14231.001184800 3875	DoC
Notebook PC (Console/Controller)	Lenovo	T410	F0 DE F1 2E BA 16	DoC
AC Adapter (Notebook PC)	Lenovo	42T4430	11S42T4430Z1ZGW E07R8U4	DoC

#### 6.1.6. DESCRIPTION OF EUT

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

The EUT is a Slave Device without Radar Detection.

The highest power level within these bands is 25.8 dBm EIRP in the 5250-5350 MHz band and 26.48 dBm EIRP in the 5470-5725 MHz band.

The highest gain antenna assembly utilized with the EUT has a gain of 8.4 dBi in the 5250-5350 MHz band and 7.9 dBi in the 5470-5725 MHz band. The lowest gain antenna assembly utilized with the EUT has a gain of 2.9 dBi in the 5250-5350 MHz band and 4.9 dBi in the 5470-5725 MHz band.

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

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is -64 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is -64 + 1.41 + 1 = -61.59 dBm.

The calibrated conducted DFS Detection Threshold level is set to –62.59 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

The EUT uses two transmitter/receiver chains, each connected to a 50-ohm coaxial antenna port. All antenna ports are connected to the test system via a power divider to perform conducted tests.

WLAN traffic that meets or exceeds the minimum required loading was generated by transferring a data stream from the Master Device to the Slave Device using iPerf version 2.0.5 software package.

TPC is not required since the maximum EIRP is less than 500 mW (27 dBm), however TPC is implemented for 11n and 11ac modes.

The EUT utilizes the 802.11ac architecture. Three nominal channel bandwidths are implemented: 20 MHz, 40 MHz and 80 MHz.

The software installed in the EUT is Microsoft Windows 10 Pro version 01903, build 18362.267.

The software installed in the access point is version 1.0.6.186168.

#### **UNIFORM CHANNEL SPREADING**

This requirement is not applicable to Slave Devices.

#### OVERVIEW OF MASTER DEVICE WITH RESPECT TO §15.407 (h) REQUIREMENTS

The Master Device is a Linksys Mu-Mimo Gigabit Router, FCC ID: Q87-WRT3200ACM. The minimum antenna gain for the Master Device is 1.41 dBi.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is -64 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is -64 + 1.41 + 1 = -61.59dBm.

The calibrated radiated DFS Detection Threshold level is set to -62.59 dBm. The tested level is lower than the required level hence it provides a margin to the limit.

The software installed in the access point is version 1.0.6.186168.

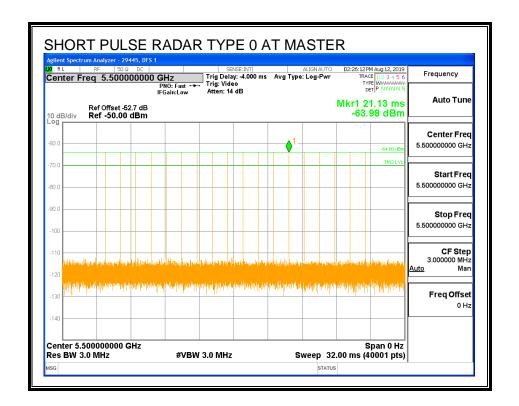
#### 6.2. **RESULTS FOR 20 MHz BANDWIDTH**

# 6.2.1. TEST CHANNEL

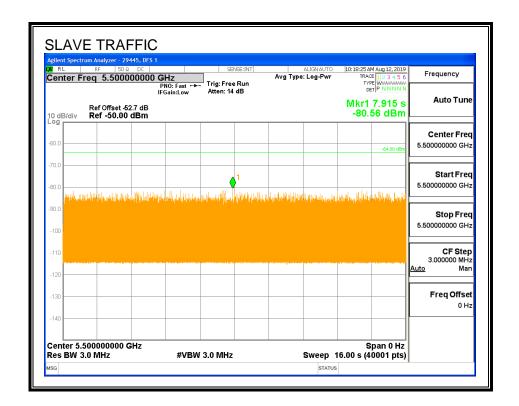
All tests were performed at a channel center frequency of 5500 MHz.

#### 6.2.2. RADAR WAVEFORM AND TRAFFIC

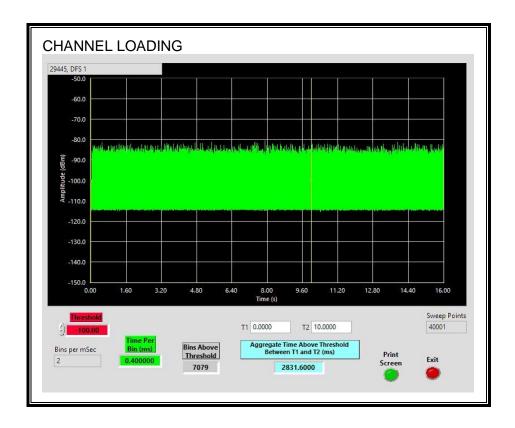
#### RADAR WAVEFORM



# **TRAFFIC**



#### **CHANNEL LOADING**



The level of traffic loading on the channel by the EUT is 28.31%

#### 6.2.3. OVERLAPPING CHANNEL TESTS

# **RESULTS**

These tests are not applicable.

# 6.2.4. 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)

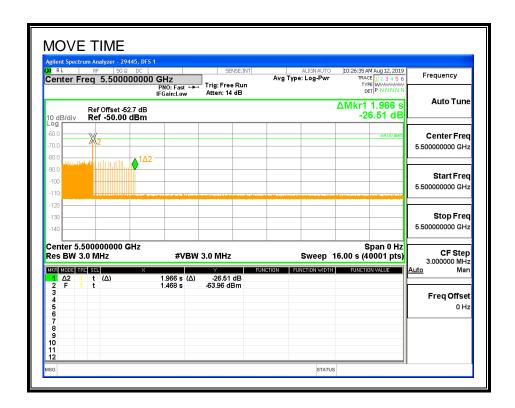
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

#### **RESULTS**

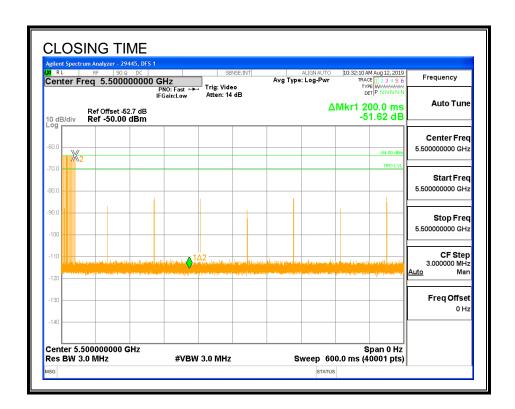
Channel Move Time	Limit
(sec)	(sec)
1.966	10

Aggregate Channel Closing Transmission Time	Limit
(msec)	(msec)
19.6	60

# **MOVE TIME**

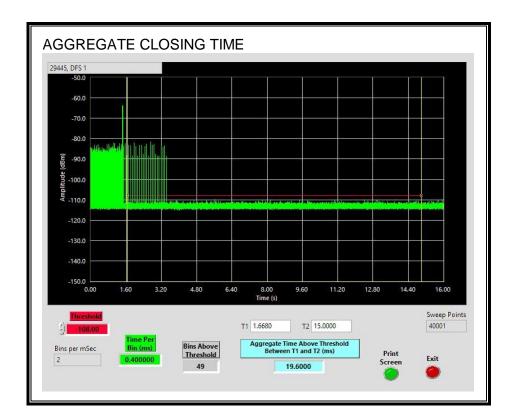


#### **CHANNEL CLOSING TIME**



# AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.



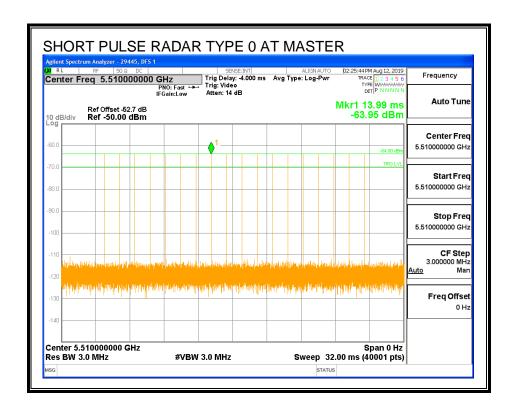
# 6.3. RESULTS FOR 40 MHz BANDWIDTH

# 6.3.1. TEST CHANNEL

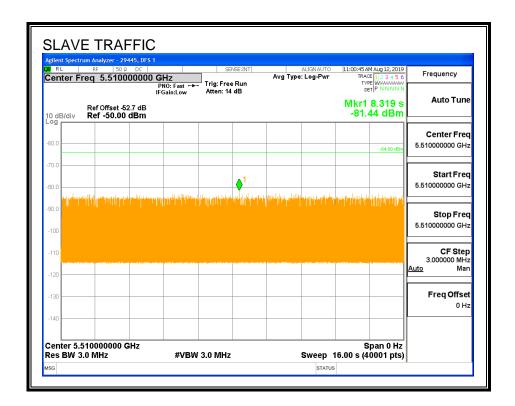
All tests were performed at a channel center frequency of 5510 MHz.

#### 6.3.2. RADAR WAVEFORM AND TRAFFIC

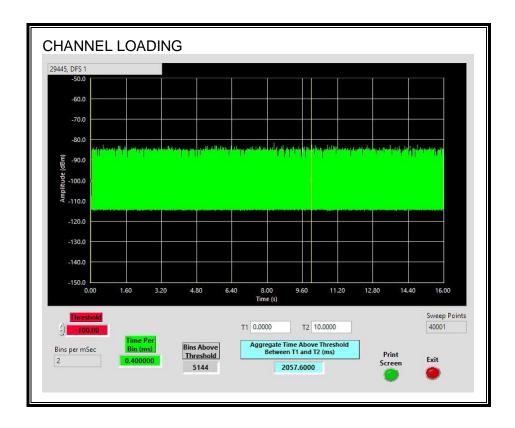
# **RADAR WAVEFORM**



# **TRAFFIC**



# **CHANNEL LOADING**



The level of traffic loading on the channel by the EUT is 20.57%

#### 6.3.3. OVERLAPPING CHANNEL TESTS

# **RESULTS**

These tests are not applicable.

# 6.3.4. 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)

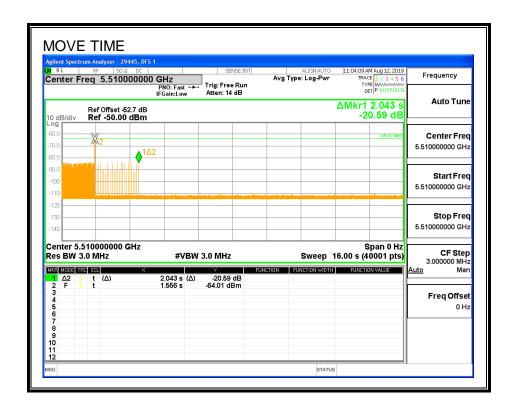
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

#### **RESULTS**

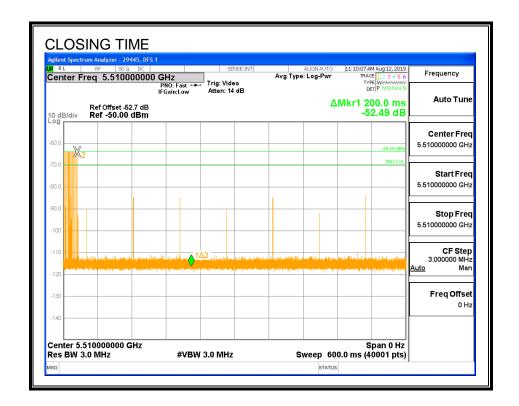
Channel Move Time	Limit
(sec)	(sec)
2.043	10

Aggregate Channel Closing Transmission Time	Limit
(msec)	(msec)
14.8	60

# **MOVE TIME**

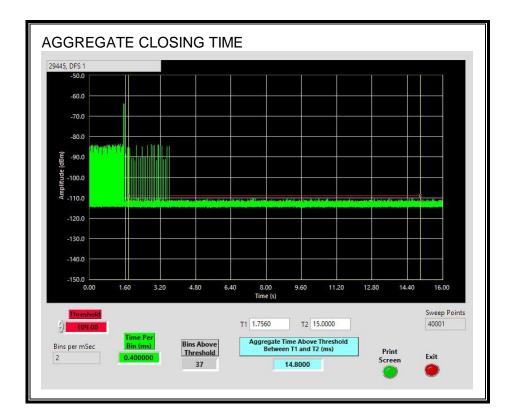


#### **CHANNEL CLOSING TIME**



# AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.



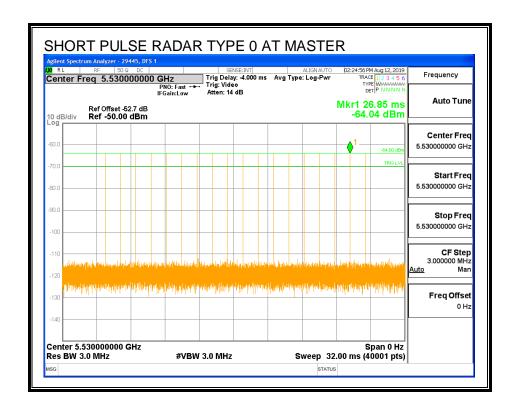
#### 6.4. **RESULTS FOR 80 MHz BANDWIDTH**

# 6.4.1. TEST CHANNEL

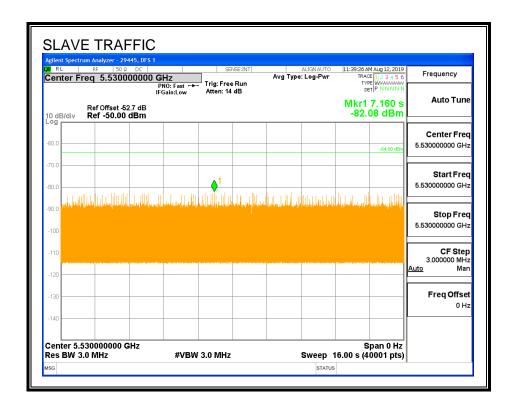
All tests were performed at a channel center frequency of 5530 MHz.

#### 6.4.2. RADAR WAVEFORM AND TRAFFIC

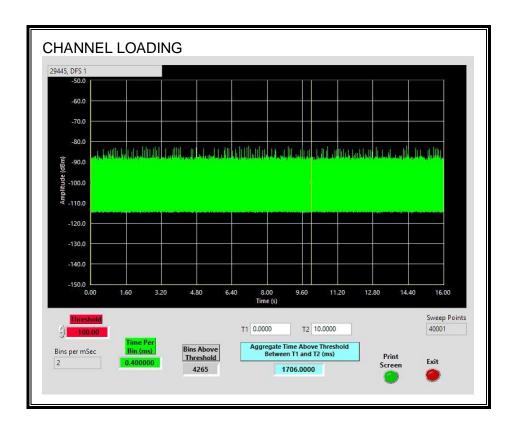
#### RADAR WAVEFORM



# **TRAFFIC**



#### **CHANNEL LOADING**



The level of traffic loading on the channel by the EUT is 17.06%

#### 6.4.3. OVERLAPPING CHANNEL TESTS

# **RESULTS**

These tests are not applicable.

# 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)

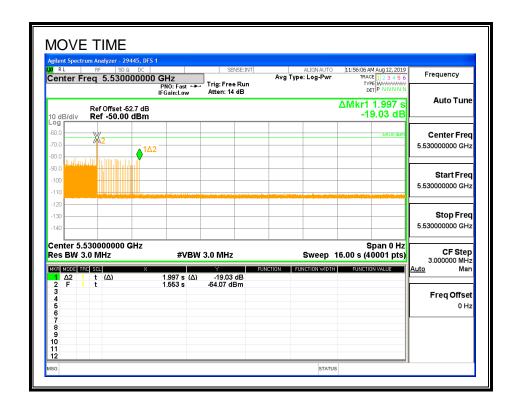
The observation period over which the aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

#### **RESULTS**

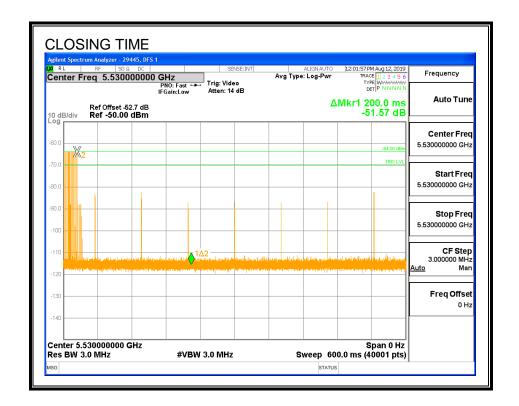
Channel Move Time	Limit
(sec)	(sec)
1.997	10

Aggregate Channel Closing Transmission Time	Limit
(msec)	(msec)
18.8	60

# **MOVE TIME**

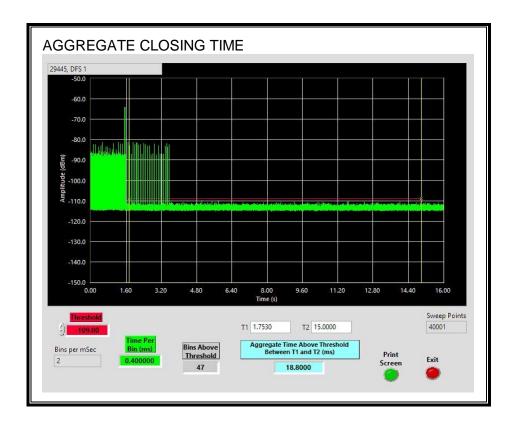


#### **CHANNEL CLOSING TIME**



# AGGREGATE CHANNEL CLOSING TRANSMISSION TIME

Only intermittent transmissions are observed during the aggregate monitoring period.



#### 6.4.5. 30-MINUTE NON-OCCUPANCY PERIOD

# **RESULTS**

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

