

Report No.: FZ8D2029



FCC DFS TEST REPORT

FCC ID : TLZ-CB250NF

: IEEE 802.11 2x2 MU-MIMO a/b/g/n/ac Wireless LAN Equipment

+ Bluetooth 5.0 M.2 2230 Module

Brand Name : AzureWave

Model Name : AW-CB250NF

: AzureWave Technologies, Inc. Applicant

8F., No.94, Baozhong Rd., Xindian Dist., New Taipei

City 23144, Taiwan

: AzureWave Technologies, Inc. Manufacturer

8F., No.94, Baozhong Rd., Xindian Dist., New Taipei

City 23144, Taiwan

: 47 CFR FCC Part 15.407 Standard

The product was received on Jun. 07, 2019, and testing was started from Jul. 16, 2019 and completed on Jul. 16, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 and shown compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

TEL: 886-3-656-9065 FAX: 886-3-656-9085

Report Template No.: CB-A12_3 Ver1.0

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Report Version : 02

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Appendix A. Test Photos

Photographs of EUT v01

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History of this test report

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Report No.	Version	Description	Issued Date
FZ8D2029	01	Initial issue of report	Nov. 22, 2019
FZ8D2029	02	Modifying the antenna information Part No. of Ant.2.	Nov. 28, 2019

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Summary of Test Result

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Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.3	FCC KDB 905462 7.8.3	DFS: In-Service Monitoring for Channel Move Time (CMT)	PASS	-
3.3	FCC KDB 905462 7.8.3	DFS: In-Service Monitoring for Channel Closing Transmission Time (CCTT)	PASS	-
3.3	FCC KDB 905462 7.8.3	DFS: In-Service Monitoring for Non-Occupancy Period (NOP)	PASS	-

Note: Since the product is client without radar detection function, only Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period are required to perform.

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Sam Chen Report Producer: Wendy Pan

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General Description

1.1 Information

RF General Information 1.1.1

Specification Items	Description			
Frequency Range	5250 MHz – 5350 MHz			
	5470 MHz – 5725 MHz			
Power Type	From host system			
Channel Bandwidth	20/40/80 MHz operating channel band	lwidth		
	☐ Master			
Operating Mode	☐ Client with radar detection			
Communication Mode		☐ Frame Based		
TPC Function	With TPC	☐ Without TPC		
Weather Band (5600~5650MHz)	⊠ With 5600~5650MHz	☐ Without 5600~5650MHz		
Software / Firmware Version	PCIE8997-16.68.1.p70-C3X16C193-G	SPL-(FP68)		
 11a, HT20 and HT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation. VHT20, VHT40, VHT80 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 25 modulation. 				

EUT employ a TPC mechanism and TPC have the capability to operate at least 6 dB below highest RF output power.

Note: The above information was declared by manufacturer.

TPC Power Result

Mode	Min Power	Max Power	Min EIRP	Max EIRP
	(dBm)	(dBm)	(dBm)	(dBm)
802.11a_Nss1,(6Mbps)_2TX	-	-	-	-
5.25-5.35GHz	16.72	22.72	20.33	26.33
5.47-5.725GHz	12.93	18.93	16.54	22.54
802.11ac VHT20_Nss1,(MCS0)_2TX	-	-	-	=
5.25-5.35GHz	16.80	22.80	20.41	26.41
5.47-5.725GHz	13.09	19.09	16.70	22.70
802.11ac VHT40_Nss1,(MCS0)_2TX	-	-	-	=
5.25-5.35GHz	14.79	20.79	18.40	24.40
5.47-5.725GHz	11.76	17.76	15.37	21.37
802.11ac VHT80_Nss1,(MCS0)_2TX	-	-	-	=
5.25-5.35GHz	8.53	14.53	12.14	18.14
5.47-5.725GHz	9.35	15.35	12.96	18.96

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1.1.2 Antenna Information

ĺ	Ant.	Port			Brand	Part No.	Antenna	Connector	Gai	n (dBi)	
		2.4GHz	5GHz	вт	Dialiu	rait No.	Type	Connector	2.4GHz	5GHz	вт
	1	1, 2	1, 2	1	MAG.LAYERS	MSA-4008-25GC1 -A2	PIFA Antenna	I-PEX	2.98	5.16	2.98
	2	1, 2	1, 2	1	Cortec	AN2450-5511BRS -SMASFR8-3100 B-4AX00I	Dipole Antenna	I-PEX	2.14	3.61	2.14

Note: The above information was declared by manufacturer.

Antenna 2 is the lowest antenna gain in DFS band so that chose it as the representative as the worst case to test.

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For 2.4GHz WLAN function:

For IEEE 802.11b/g/n mode (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna.

Port 1 and Port 2 could transmit/receive simultaneously.

For 5GHz WLAN function:

For IEEE 802.11a/n/ac mode (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna.

Port 1 and Port 2 could transmit/receive simultaneously.

For Bluetooth function: (1TX/1RX):

Only Port 1 can be used as transmitting/receiving antenna.

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1.1.3 DFS Band Carrier Frequencies

There are three bandwidth systems.

For 20MHz bandwidth systems, use Channel 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140.

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For 40MHz bandwidth systems, use Channel 54, 62, 102, 110, 118, 126, 134.

For 80MHz bandwidth systems, use Channel 58, 106, 122.

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
	52	5260 MHz	60	5300 MHz
5250~5350 MHz	54	5270 MHz	62	5310 MHz
Band 2	56	5280 MHz	64	5320 MHz
	58	5290 MHz	-	-
	100	5500 MHz	120	5600 MHz
	102	5510 MHz	122	5610 MHz
	104	5520 MHz	124	5620 MHz
5470~5725 MHz	106	5530 MHz	126	5630 MHz
5470~5725 MH2 Band 3	108	5540 MHz	128	5640 MHz
Ballu 3	110	5550 MHz	132	5660 MHz
	112	5560 MHz	134	5670 MHz
	116	5580 MHz	136	5680 MHz
	118	5590 MHz	140	5700 MHz

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1.2 Accessories

N/A

1.3 Support Equipment

	Support Equipment							
No.	Equipment	Brand Name	Model Name	FCC ID				
Α	Notebook DELL		E4300	N/A				
В	Notebook	Notebook DELL		N/A				
С	C Test fixture AzureWave AW-CB162NF N/A		N/A					
S	WLAN AP	D-LINK	DIR860L	KA2IR860LA1				

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1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

1.5 Testing Location Information

	Testing Location						
	HWA YA	ADE) :	: No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)			n (R.O.C.)
		TEL	:	886-3-327-345	6 FAX : 886	6-3-327-0973	
\boxtimes	JHUBEI	ADE) :	No.8, Lane 724	, Bo-ai St., Jhubei Cit	y, HsinChu County 302	2, Taiwan, R.O.C.
		TEL	:	: 886-3-656-9065 FAX : 886-3-656-9085			
Test Condition Test Site No. Test E		Test Engineer	Test Environment	Test Date			
	DFS Site			DF01-CB	Nyle Chang	22~24°C / 50~60%	Jul. 16, 2019

Test site Designation No. TW0006 with FCC

Test site registered number IC 4086D with Industry Canada.

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2 Test Configuration of EUT

2.1 Test Channel Frequencies Configuration

Test Channel Frequencies Configuration				
IEEE Std.	Test Channel Freq. (MHz)			
802.11ac (VHT80)	5530 MHz			

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2.2 The Worst Case Measurement Configuration

Th	The Worst Case Mode for Following Conformance Tests				
Tests Item Dynamic Frequency Selection (DFS)					
Test Condition	Radiated measurement The EUT shall be configured to operate at the highest transmitter output power setting. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the lowest gain shall be used. The DFS radar test signals have been aligned to the direction corresponding to the EUT's maximum antenna gain.				
Modulation Mode	802.11ac (VHT80)				

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3 Dynamic Frequency Selection (DFS) Test Result

3.1 General DFS Information

3.1.1 DFS Parameters

Table D.1: DFS requirement values					
Parameter	Value				
Non-occupancy period	Minimum 30 minutes				
Channel Availability Check Time	60 seconds				
Channel Move Time	10 seconds (Note 1).				
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second periods. (Notes 1 and 2).				
U-NII Detection Bandwidth	Minimum 100% of the 99% power bandwidth (Note 3).				

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- 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 Channel changes (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 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.

Table D.2: Interference threshold values				
Maximum Transmit Power Value (see note)				
EIRP≥200 mW	-64 dBm			
EIRP < 200 mW and PSD < 10dBm/MHz	-62 dBm			
EIRP < 200 mW and PSD >= 10dBm/MHz	-64 dBm			

- 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.
- Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911D01.

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3.1.2 Applicability of DFS Requirements Prior to Use of a Channel

	DFS Operational mode				
Requirement	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		

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3.1.3 Applicability of DFS Requirements during Normal Operation

	DFS Operational mode				
Requirement	Master	Client without radar detection	Client with radar detection		
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 modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the 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 each of the bonded 20 MHz channels and the channel center frequency.

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3.2 Radar Test Waveform Calibration

3.2.1 Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
0	1	1428	18	See Note 1	See Note 1
1A	1	15 unique PRI in KDB 905462 D02 Table 5a	[(1) (19×10 ⁶)]	60%	15
1B	1	15 unique PRI within 518-3066, Excluding 1A PRI	$Roundup \left\{ \left(\frac{1}{360} \right) \times \left(\frac{19 \times 10^6}{PRI} \right) \right\}$	60%	15
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
Aggrega	ate (Radar Type	80%	120		

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Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.

A minimum of 30 unique waveforms are required for each of the short pulse radar types 1 through 4. If more than 30 waveforms are used for short pulse radar types 1 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

3.2.2 Long Pulse Radar Test Waveform

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

Each waveform is defined as follows:

- The transmission period for the Long Pulse Radar test signal is 12 seconds.
- There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen.
 This number is Burst Count.
- Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
- The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
- Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a transmission period will have the same chirp width. The chirp is centered on the pulse. For

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example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.

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- If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
- The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst Count. Each interval is of length (12,000,000 / Burst Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst Count) (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen independently.

3.2.3 Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (ms)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	0.333	300	70%	30

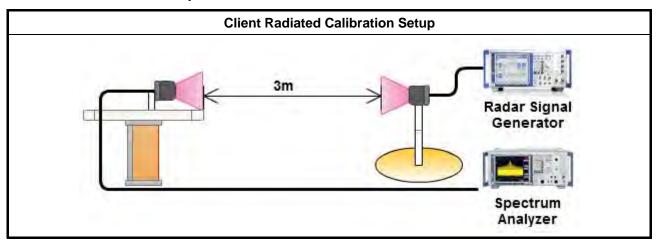
The FCC Type 6 waveform uses a static waveform with 100 bursts in the instruments ARB. In addition, the RF list mode is operated with a list containing 100 frequencies from a randomly generated list and it had be ensured that at least one of the random frequencies falls into the UNII Detection Bandwidth of the DUT. Each burst from the waveform file initiates a trigger pulse at the beginning that switches the RF list from one item to the next one.

3.2.4 DFS Threshold Level

DFS Threshold Level					
DFS Threshold level: -	-63	dBm	at the antenna connector		
			in front of the antenna		
The Interference Radar Detection Threshold Level is is -64 dBm + 0 [dBi] + 1 dB = -63 dBm. That had been taken into account the output power range and antenna gain.					

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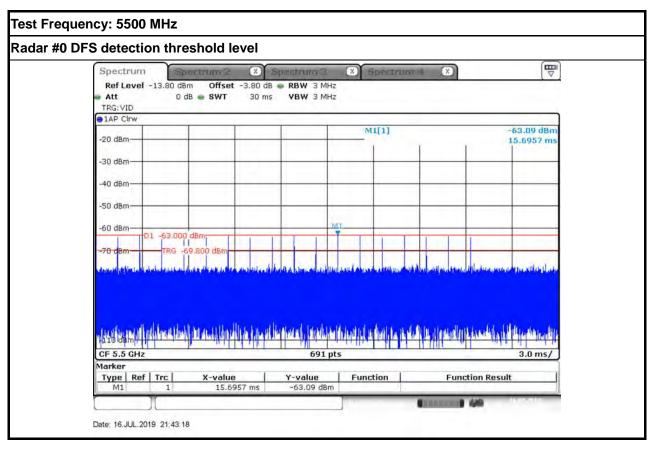
3.2.5 Calibration Setup



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3.2.6 Radar Waveform calibration Plot



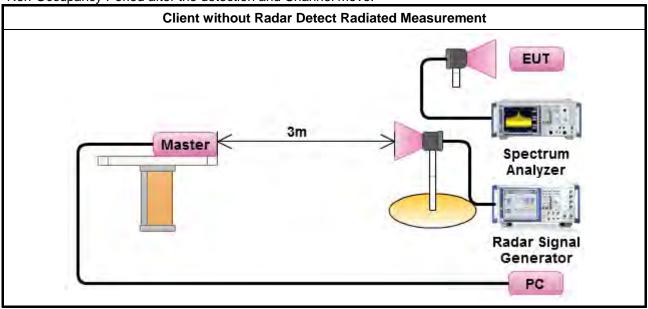
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3.2.7 Test Setup

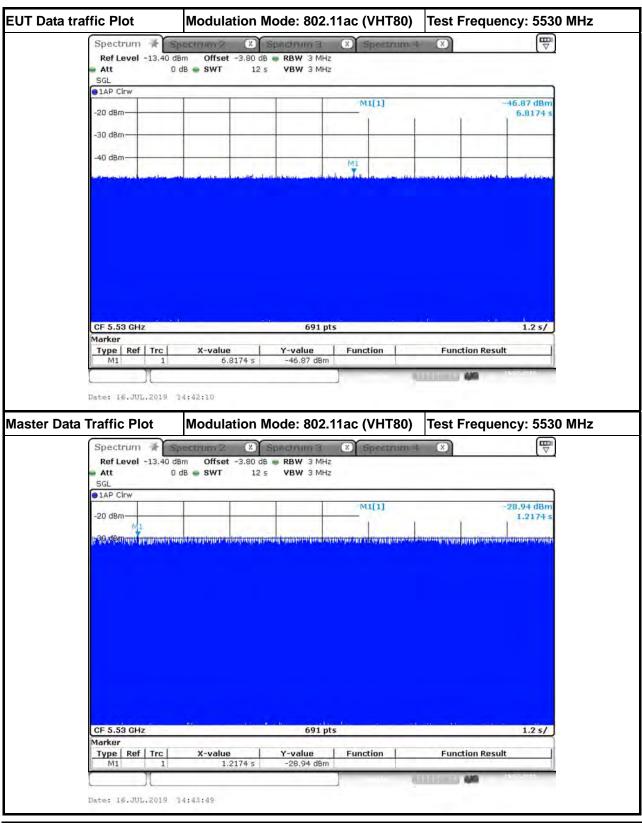
A spectrum analyzer is used as a monitor to verify that the EUT has vacated the Channel within the (Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the detection and Channel move.

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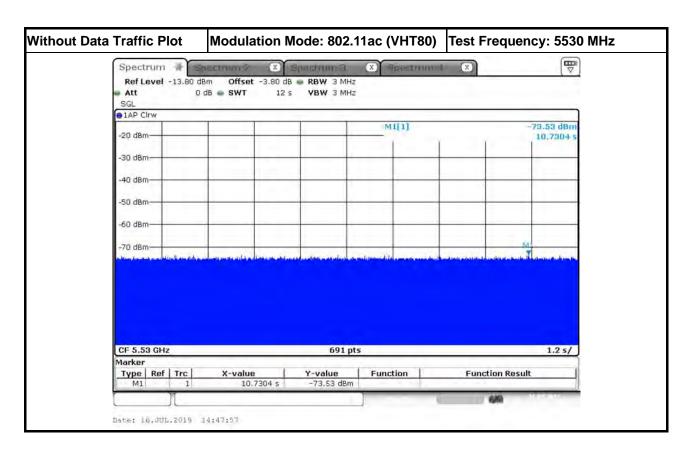
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3.2.8 Data traffic Plot



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3.3 In-service Monitoring

3.3.1 In-service Monitoring Limit

In-service Monitoring Limit				
Channel Move Time	10 sec			
Channel Closing Transmission Time	200 ms + an aggregate of 60 ms over remaining 10 sec periods.			
Non-occupancy period	Minimum 30 minutes			

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3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

Test Method

- ✓ Verified during In-Service Monitoring; Channel Closing Transmission Time, Channel Move Time. Client Device will associate with the EUT. Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the EUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing Transmission Time limits.
- ✓ Verified during In-Service Monitoring; Channel Closing Transmission Time, Channel Move Time. One 12 sec plot needs to be reported for the Short Pulse Radar Types 0. And zoom-in a 60 ms plot verified channel closing time for the aggregate transmission time starting from 200ms after the end of the radar signal to the completion of the channel move.
- ✓ Verified during In-Service Monitoring; Non-Occupancy Period. Client Device will associate with the EUT. Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the EUT during the observation time (Non-Occupancy Period). Compare the Non-Occupancy Period limits.

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3.3.4 Test Result of Channel Move Time

Modulation Mode: 802.11ac (VHT80)

Parameter	Test Result	Limit	
Farameter	Туре 0		
Test Channel (MHz)	5530 MHz	-	
Channel Move Time (sec.)	4.002	< 10s	

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Date: 16.JUL.Z019 11:52:19

Modulation Mode Radar Type Freq. 802.11ac (VHT80) 5530 MHz 0 Spectrum 2 W(X) Ref Level -10.00 dBm Offset -3.80 dB - RBW 3 MHz Att 0 dB . SWT 12 s VBW 3 MHz TRG: EXT Radar 1AP Clrw -55.64 dBn 4,002750 s -31.05 dBn 0.000000 M2[1] -20 dBm M1[1] 30 dBm **EUT signal** T1 CF 5.53 GHz 32001 pts 1.2 s/
 Type
 Ref
 Trc

 M1
 1

 M2
 1

 M3
 1
 Y-value -31.05 dBm -55.64 dBm -72.88 dBm **Function Result** Function 0.0 s 4.00275 s 10.0 s

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3.3.5 Test Result of Channel Closing Transmission Time

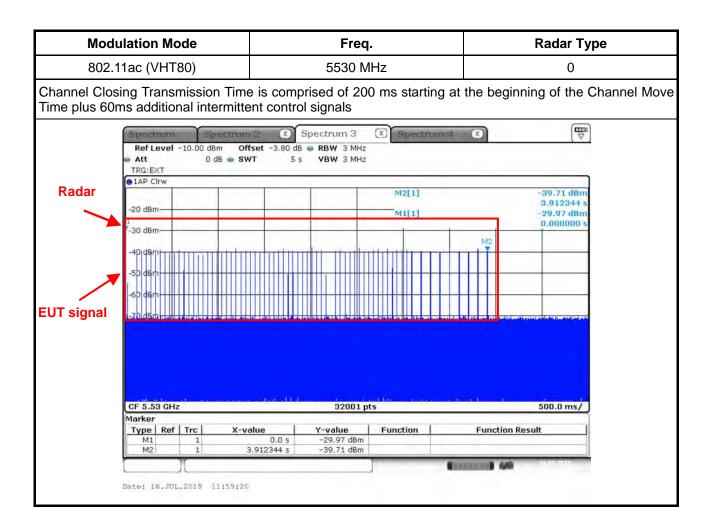
Modulation Mode: 802.11ac (VHT80)

Parameter	Test Result	Limit	
Farameter	Туре 0		
Test Channel (MHz)	5530 MHz	-	
Channel Closing Transmission Time (ms) (Note)	40.468	< 60ms	

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Note: 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 seconds period. The aggregate duration of control signals will not count quiet periods in between transmissions.

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Dwell is the dwell time per spectrum analyzer sampling bin.

S is the sweep time

B is the number of spectrum analyzer sampling bins

C is the intermittent control signals of Channel Closing Transmission Time

N is the number of spectrum analyzer sampling bins (intermittent control signals) showing a U-NII transmission

Dwell (0.516 ms)= S (5000 ms) / B (32000)

C (40.468 ms) = N (259) X Dwell (0.516 ms)

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3.3.6 Test Result of Non-Occupancy Period

Modulation Mode: 802.11ac (VHT80)

Parameter	Test Result	Limit	
Farameter	Туре 0		
Test Channel (MHz)	5530 MHz	-	
Non-Occupancy Period (min.)	≧30	≧ 30 min	

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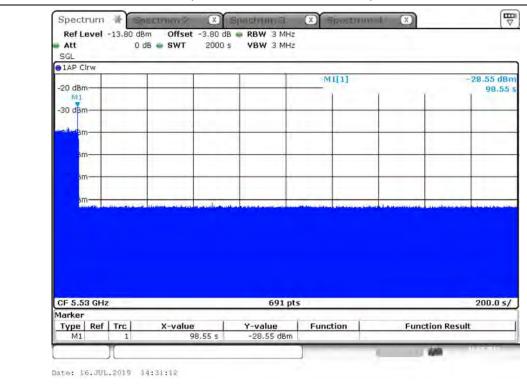
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Modulation Mode	Freq.
802.11ac (VHT80)	5530 MHz

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Non-Occupancy Period

During the 30 minutes observation time, UUT did not make any transmissions on a channel after a radar signal was detected on that channel by either the Channel Availability Check or the In-Service Monitoring.



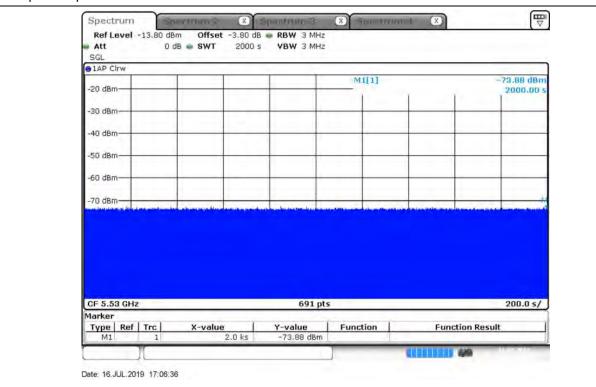
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Non-associated test

Master was off.

During the 30 minutes observation time, The UUT did not make any transmissions in the DFS band after UUT power up.

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4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101026	9kHz~40GHz	Sep. 28, 2018	Sep. 27, 2019	Radiated (DF01-CB)
Vector Signal generator	R&S	SMU200A	102782	100kHz-6GHz	Jan. 16, 2019	Jan. 15, 2020	Radiated (DF01-CB)
Horn Antenna	COM-POWER	AH-118	071187	1GHz – 18GHz	Jul. 02, 2019	Jul. 01, 2020	Radiated (DF01-CB)
Horn Antenna	COM-POWER	AH-118	071042	1GHz – 18GHz	Dec. 24, 2018	Dec. 23, 2019	Radiated (DF01-CB)
RF Power Divider	ANAREN	2 Way	DFS-01-DV-02	1GHz ~ 6GHz	Oct. 08, 2018	Oct. 07, 2019	Radiated (DF01-CB)
RF Power Divider	MTJ	2 Way	DFS-01-DV-03	1GHz ~ 6GHz	Oct. 08, 2018	Oct. 07, 2019	Radiated (DF01-CB)
RF Power Divider	ANAREN	4 Way	DFS-01-DV-01	1GHz ~ 6GHz	Oct. 08, 2018	Oct. 07, 2019	Radiated (DF01-CB)
RF Cable-high	Woken	RG402	High Cable-57	1 GHz –18 GHz	Oct. 08, 2018	Oct. 07, 2019	Radiated (DF01-CB)
RF Cable-high	Woken	RG402	High Cable-58	1 GHz –18 GHz	Oct. 08, 2018	Oct. 07, 2019	Radiated (DF01-CB)

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Note: Calibration Interval of instruments listed above is one year.

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5 Measurement Uncertainty

Test Items	Uncertainty	Remark
Radiated Emission	3.4 dB	Confidence levels of 95%

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