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ACCREDITED Testing Cert #:3902.01

TEST REPORT

For DFS

Report No. ..... :	**CHTW24080027**	Report Verification:
Project No.....:	**SHT2403050101W**	
FCC ID..... :	**TV7WAPGR52AX**	
Applicant's name..... :	**Mikrotikls SIA**	
Address.....:	Unijas 2, Riga, LV-1039, Latvia	
Product Name ..... :	**wAP ax**	
Trade Mark .....:	MIKROTIK	
Model No. .....:	wAPG-5HaxD2HaxD-US	
Listed Model(s) .....:	-	
Standard ..... :	**FCC CFR Title 47 Part 15 Subpart E Section 15.407**	
Date of receipt of test sample.....:	Mar.14, 2024	
Date of testing.....:	Mar.14, 2024 - Aug.13, 2024	
Date of issue.....:	Aug.14, 2024	
Result..... .....:	**PASS**	

Compiled by (position+printedname+signature)...:	File administrators Kiki Kong	Kiki Kong
Supervised by (position+printedname+signature)....:	Project Engineer Kiki Kong	Kiki Kong
Approved by (position+printedname+signature)....:	RF Manager Xu yang	Xu Yang

Testing Laboratory Name ..... :	**Shenzhen Huatongwei International Inspection Co., Ltd**
Address.....:	Building 7, Baiwang Idea Factory, No.1051, Songbai Road, Yangguang Community, Xili Subdistrict, Nanshan District, Shenzhen, Guangdong, China

Contents

1. TEST STANDARDS AND REPORT VERSION

1.1. Test Standards

The tests were performed according to following standards:
FCC Rules Part 15.407: General technical requirements.
KDB905462 D02 v02: COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION
KDB905462 D04 v01: OPERATIONAL MODES SUGGESTED FOR DFS TESTING

1.2. Report Version

Revision No.	Date of issue	Description
N/A	2024-08-14	Original

2. TEST DESCRIPTION

Report clause	Test Items	Standard Requirement	Result	Test Engineer
6.1	Radar Waveform Calibration	15.407(h)	PASS	Xiangyu Wei
6.2	Initial Channel Availability Check Time	15.407(h)	PASS	Xiangyu Wei
6.3	Beginning of the Channel Availability Check Time	15.407(h)	PASS	Xiangyu Wei
6.4	End of the Channel Availability Check Time	15.407(h)	PASS	Xiangyu Wei
6.5	Packet Transmissions Activity Ratio	15.407(h)	PASS	Xiangyu Wei
6.6	UNII Detection Bandwidth Measurement	15.407(h)	PASS	Xiangyu Wei
6.7	Statistical Performance Check	15.407(h)	PASS	Xiangyu Wei
6.8	Channel Move Time, Channel Closing Transmission Time	15.407(h)	PASS	Xiangyu Wei
6.9	Non-Occupancy Period	15.407(h)	PASS	Xiangyu Wei

3. SUMMARY

3.1. Client Information

Applicant:	Mikrotikls SIA
Address:	Unijas 2, Riga, LV-1039, Latvia
Manufacturer:	Mikrotikls SIA
Address:	Unijas 2, Riga, LV-1039, Latvia

3.2. Product Description

Main unit information:	
Product Name:	wAP ax
Trade Mark:	MIKROTIK
Model No.:	wAPG-5HaxD2HaxD-US
Listed Model(s):	-
Power supply:	DC 24V from adapter or DC 24V from POE
Hardware version:	r2
Software version:	ROS v7
Accessory unit information:	
Adapter information:	Model:SAW30-240-0800U Input:100-240Va.c., 50/60Hz 0.8A Output:24Vd.c., 800mA

3.3. Radio Specification Description

Support type*1	☒ 802.11a	☒ 802.11n(HT20)	☒ 802.11n(HT40)
	☒ 802.11ac(HT20)	☒ 802.11ac(HT40)	☒ 802.11ac(HT80)
	☒ 802.11ac(HT160)	☒ 802.11ax(HE20)	☒ 802.11ax(HE40)
	☒ 802.11ax(HE80)	☒ 802.11ax(HE160)	
Supported Bandwidth	20MHz:	802.11n,802.11a,802.11ac,802.11ax	
	40MHz:	802.11n,802.11ac,802.11ax	
	80MHz:	802.11n,802.11ac,802.11ax	
	160MHz:	802.11ac,802.11ax	
Operation frequency:	☒ U-NII-1 Band:	5150MHz~5250MHz	
	☒ U-NII-2A Band:	5250MHz~5350MHz	
	☒ U-NII-2C Band:	5470MHz~5725MHz	
	☒ U-NII-3 Band:	5725MHz~5850MHz	
Modulation:	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM		
Function:	☒ Outdoor AP	☒ Indoor AP	☐ Fixed P2P
	☐ Client		
DFS type:	☒ Master devices	☐ Slave devices with radar detection	☐ Slave devices without radar detection
Antenna technology:	☐ SISO	☒ MIMO	
Antenna Delivery:	☐ 1*TX+1*RX	☒ 2*TX+2*RX	☐ 3*TX+3*RX
Antenna type:	FPC Antenna		
Antenna gain:	Antenna 0: 7.00dBi Antenna 1: 7.00dBi		

Note:

*1: only show the RF function associated with this report.

3.4. Testing Laboratory Information

Laboratory Name	Shenzhen Huatongwei International Inspection Co., Ltd.	
Laboratory Location	Building 7, Baiwang Idea Factory, No.1051, Songbai Road, Yangguang Community, Xili Subdistrict, Nanshan District, Shenzhen, Guangdong, China	
Contact information:	Phone: 86-755-26715499 E-mail: cs@szhtw.com.cn http://www.szhtw.com.cn	
Qualifications	Type	Accreditation Number
	FCC Registration Number	762235
	FCC Designation Number	CN1181

4. TEST CONFIGURATION

4.1. DFS Working Frequencies

Band	20MHz		40MHz		80MHz		160MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
U-NII-2A	52	5260	54	5270	58	5290	50	5250
	56	5280						
	60	5300	62	5310				
	64	5320						
U-NII-2C	100	5500	102	5510	106	5530	114	5570
	104	5520						
	108	5540	110	5550				
	112	5560						
	116	5580	118	5590	122	5610		
	120	5600						
	124	5620	126	5630				
	128	5640						
	132	5660	134	5670	138	5690		
	136	5680						
	140	5700	142	5710				
	144	5720						

4.2. Test frequency and mode

Mode	Channel	Frequency (MHz)
802.11ax(HE20)	60	5300
802.11ax(HE40)	110	5550
802.11ax(HE80)	58	5290
802.11ax(HE160)	114	5570

4.3. Test sample information

Test item	HTW sample no.
DFS all test items	Please refer to the description in the appendix report

4.4. Support unit used in test configuration and system

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The following peripheral devices and interface cables were connected during the measurement:

Whether support unit is used?			
✓ No			
Item	Equipment	Trade Name	Model No.
1			
2			

4.5. Testing environmental condition

Type	Requirement	Actual
Temperature:	15~35°C	25°C
Relative Humidity:	25~75%	50%
Air Pressure:	860~1060mbar	1000mbar

4.6. Equipments Used during the Test

RF Connected Test					
Kind of Equipment	**Manufacturer**	**Type No.**	**Serial No.**	**Last calibration**	**Calibrated until**
Signal Analyzer	Agilent	N9020A	MY51510623	2024.02.23	2025.02.22
Signal Generator	Keysight	N5182B	MY57301448	2023.09.26	2024.09.25
Signal Analyzer	Agilent	N9020A	MY51510623	2024.02.23	2025.02.22
Power Divider	eastsheep	PD-0.5/0.6-2S	B519	2024.02.23	2025.02.22
Power Splitter	MINI-CIRCUITS	ZN2PD-9G	SF078500430	2024.02.23	2025.02.22
Attenuator	Agilent	8494B	DC-18G	2024.02.23	2025.02.22
Attenuator	Boyang	99899	DC-18G	2024.02.23	2025.02.22
Switch control box	MW	MW100-RFCB	N/A	N/A	N/A
Mobile phone	XIAO MI	12 Por	1125074010735	N.C.R	N.C.R
Temperature & Humidity	SW-108	SuWei	N/A	2024.03.15	2025.03.14
Test SW	MW	MTS 8310_2.0.0.0			

5. DFS TEST INFORMATION

5.1. DFS test requirement

The following table from FCC KDB905462 D02 UNII DFS Compliance procedures new rules list the applicable requirements for the DFS testing.

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

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

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.		

Master Devices

a) The Master Device will use DFS in order to detect Radar Waveforms with received signal strength above the DFS Detection Threshold in the 5250~5350 MHz and 5470~5725 MHz bands. DFS is not required in the 5150~5250 MHz or 5725~5825 MHz bands.

b) Before initiating a network on a Channel, the Master Device will perform a Channel Availability Check for a specified time duration (Channel Availability Check Time) to ensure that there is no radar system operating on the Channel, using DFS described under subsection a) above.

c) The Master Device initiates a U-NII network by transmitting control signals that will enable other U-NII devices to Associate with the Master Device.

d) During normal operation, the Master Device will monitor the Channel (In-Service Monitoring) to ensure that there is no radar system operating on the Channel, using DFS described under a).

e) If the Master Device has detected a Radar Waveform during In-Service Monitoring as described under d), the Operating Channel of the U-NII network is no longer an Available Channel. The Master Device will instruct all associated Client Device(s) to stop transmitting on this Channel within the Channel Move

Time. The transmissions during the Channel Move Time will be limited to the Channel Closing Transmission Time.

f) Once the Master Device has detected a Radar Waveform it will not utilize the Channel for the duration of the Non-Occupancy Period.

g) If the Master Device delegates the In-Service Monitoring to a Client Device, then the combination will be tested to the requirements described under d) through f) above.

Client Devices

a) A Client Device will not transmit before having received appropriate control signals from a Master Device.

b) A Client Device will stop all its transmissions whenever instructed by a Master Device to which it is associated and will meet the Channel Move Time and Channel Closing Transmission Time requirements. The Client Device will not resume any transmissions until it has again received control signals from a Master Device.

c) If a Client Device is performing In-Service Monitoring and detects a Radar Waveform above the DFS Detection Threshold, it will inform the Master Device. This is equivalent to the Master Device detecting the Radar Waveform and d) through f) of section 5.1.1 apply.

d) Irrespective of Client Device or Master Device detection the Channel Move Time and Channel Closing Transmission Time requirements remain the same.

e) The client test frequency must be monitored to ensure no transmission of any type has occurred for 30 minutes. Note: If the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear.

Table 4: DFS Response Requirement Values

Paramenter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 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 facilitating 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.	

5.2. DFS Detection Thresholds

Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-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 662911 D01.	

5.3. RADAR TEST WAVEFORMS

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

Table 5 Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-	200-500	16-18	60%	30
4	11-	200-500	12-16	60%	30
Aggregate (Radar Types 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.					

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

For example if in Short Pulse Radar Type 1 Test B a PRI of 3066 μsec is selected, the number of pulses would be Round up $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot10^6}{3066}\right)\right\}$ = Round up {17.2} = 18.

Table 5a - Pulse Repetition Intervals Values for Test A

Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (Microseconds)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Table 6 – Long Pulse Radar Test Waveform

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

The parameters for this waveforms are randomly chosen. Thirty unique waveforms are required for the Long Pulse Radar Type waveforms. If more than 30 waveforms are used for the Long Pulse Radar Type wave forms, then each additional waveform must also be unique and not repeated from the previous waveforms.

Table 7 – Frequency Hopping Radar Test Waveform

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

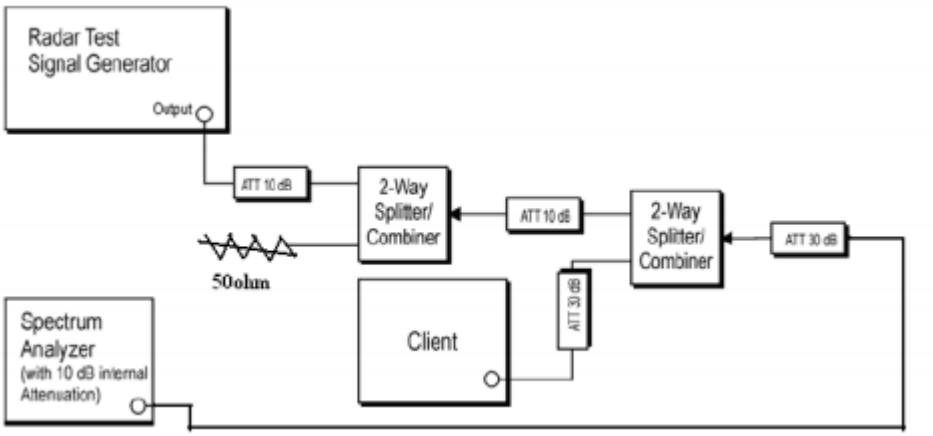
For the Frequency Hopping Radar Type, the same Burst parameters are used for each wave form. The hopping sequence is different for each wave form and a 100-length segment is selected from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250–5724MHz.Next,the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

6. TEST CONDITIONS AND RESULTS

6.1. Radar Waveform Calibration

TEST CONFIGURATION



TEST PROCEDURE

a) The Interference Radar Detection Threshold Level is (-64dBm) + (0) [dBi] + 1 dB= -63 dBm that had been taken into account the output power range and antenna gain.

b) The above equipment setup was used to calibrate the conducted Radar Waveform. A vector signal generator was utilized to establish the test signal level for each radar type. During this process there were replace 50ohm terminal form Master and Client device and no transmissions by either the Master or Client Device.

c) The spectrum analyzer was switched to the zero span (Time Domain) at the frequency of the Radar Waveform generator. Peak detection was used. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to at least 3MHz.

d) The vector signal generator amplitude was set so that the power level measured at the spectrum analyzer was (-64dBm) + (0) [dBi] + 1 dB= -63dBm.

e) Capture the spectrum analyzer plots on short pulse radar types, long pulse radar type and hopping radar waveform.

TEST RESULTS

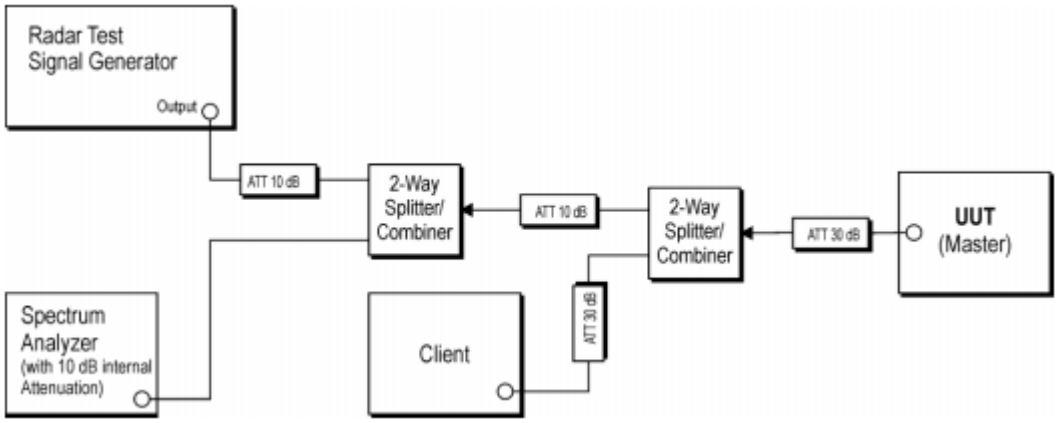
Refer to the appendix report on the section 9

6.2. Initial Channel Availability Check Time

TEST LIMIT

The EUT shall perform a Channel Availability Check to ensure that there is no radar operating on the channel. After power-up sequence, receive at least 1 minute on the intended operating frequency.

TEST CONFIGURATION



TEST PROCEDURE

a) The U-NII devices will be powered on and be instructed to operate on the appropriate U-NII Channel that must incorporate DFS functions. At the same time the EUT is powered on, the spectrum analyzer will be set to zero span mode with a 3 MHz RBW and 3 MHz VBW on the Channel occupied by the radar (Chr) with a 2.5 minute sweep time. The spectrum analyzer's sweep will be started at the same time power is applied to the U-NII device.

b) The EUT should not transmit any beacon or data transmissions until at least 1 minute after the completion of the power-on cycle.

c) Confirm that the EUT initiates transmission on the channel. Measurement system showing its nominal noise floor is marker1.

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

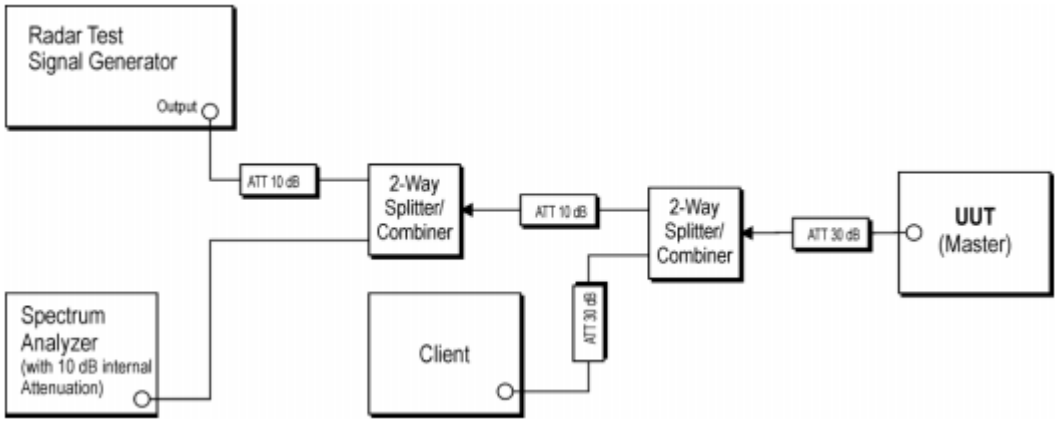
Refer to the appendix report on the section 9

6.3. Beginning of the Channel Availability Check Time

TEST LIMIT

In beginning of the Channel Availability Check (CAC) Time, radar is detected on this channel, select another intended channel and perform a CAC on that channel.

TEST CONFIGURATION



TEST PROCEDURE

a) The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the beginning of the Channel Availability Check Time.

b) The EUT is in completion power-up cycle (from T0 to T1). T1 denotes the instant when the EUT has completed its power-up sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner than T1 + 60 seconds. A single Burst of one of Short Pulse Radar Types 0-4 at DFS Detection Threshold + 1 dB will commence within a 6 second window starting at T1.

c) Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5300MHz (for 802.11a) will continue for 2.5 minutes after the radar Burst has been generated. Verify that during the 2.5 minutes measurement window no EUT transmissions occurred at 5300MHz (for 802.11a).

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

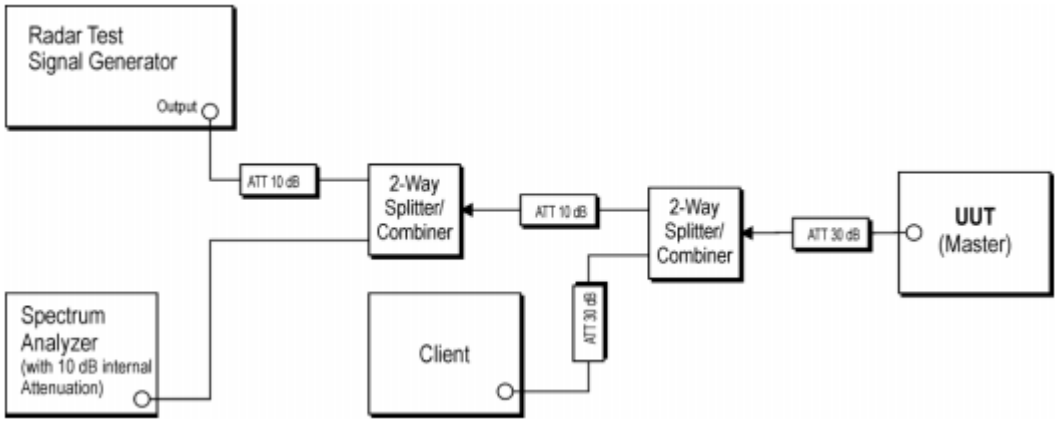
Refer to the appendix report on the section 9

6.4. End of the Channel Availability Check Time

TEST LIMIT

In the end of Channel Availability Check (CAC) Time, radar is detected on this channel, select another intended channel and perform a CAC on that channel.

TEST CONFIGURATION



TEST PROCEDURE

a) The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB occurs at the beginning of the Channel Availability Check Time.

b) The EUT is powered on at T0. T1 denotes the instant when the EUT has completed its power-up sequence. The Channel Availability Check Time commences at instant T1 and will end no sooner thanT1 + 60 seconds. A single Burst of one of Short Pulse Radar Types 0-4 at DFS Detection Threshold + 1 dB will commence within a 6 second window starting at T1+ 54 seconds.

c) Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5300MHz (for 802.11a) will continue for 2.5 minutes after the radar Burst has been generated. Verify that during the 2.5 minutes measurement window no EUT transmissions occurred at 5300MHz (for 802.11a).

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

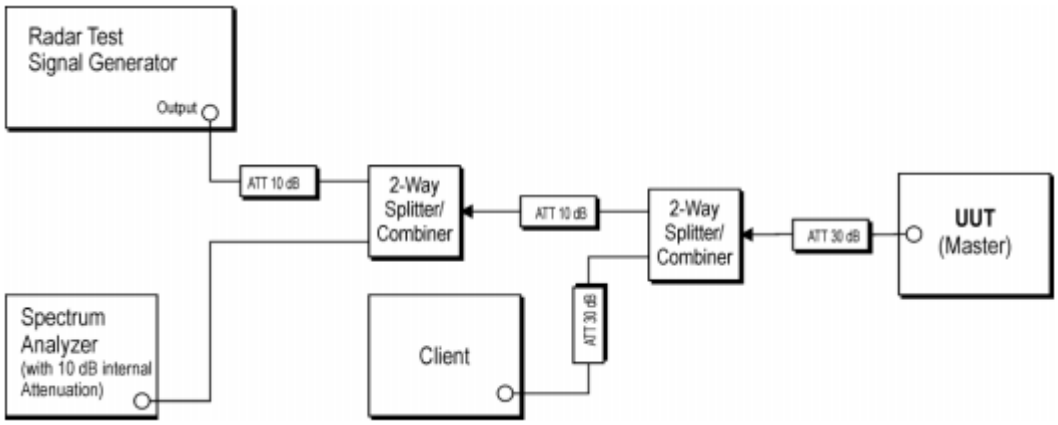
Refer to the appendix report on the section 9

6.5. Packet Transmissions Activity Ratio

TEST LIMIT

Packet Ratio >17%

TEST CONFIGURATION



TEST PROCEDURE

Using professional iperf tools, EUT sends packets to the accessory devices.

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

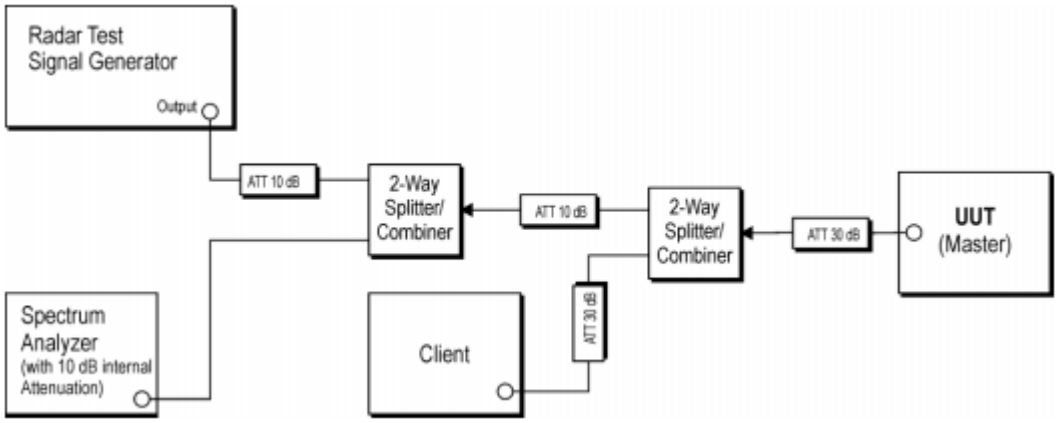
Refer to the appendix report on the section 9

6.6. UNII Detection Bandwidth Measurement

TEST LIMIT

Minimum 100% of the UNII 99% transmission power bandwidth. During the U-NII Detection Bandwidth detection test, each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

TEST CONFIGURATION



TEST PROCEDURE

a) Adjust the equipment to produce a single Burst of any one of the Short Pulse Radar Types 0-4 in Table 5 at the center frequency of the EUT Operating Channel at the specified DFS Detection Threshold level.

b) The EUT is set up as a stand-alone device (no associated Client or Master, as appropriate) and no traffic. Frame based systems will be set to a talk/listen ratio reflecting the worst case (maximum) that is user configurable during this test.

c) Generate a single radar Burst, and note the response of the EUT. Repeat for a minimum of 10 trials. The EUT must detect the Radar Waveform using the specified U-NII Detection Bandwidth criterion shown in Table 5. In cases where the channel bandwidth may exceed past the DFS band edge on specific channels (i.e., 802.11ac or wideband frame based systems) select a channel that has the entire emission bandwidth within the DFS band. If this is not possible, test the detection BW to the DFS band edge.

d) Starting at the center frequency of the UUT operating Channel, increase the radar frequency in 5 MHz steps, repeating the above test sequence, until the detection rate falls below the U-NII Detection Bandwidth criterion specified in Table 4. Repeat this measurement in 1MHz steps at frequencies 5 MHz below where the detection rate begins to fall. Record the highest frequency (denote as FH) at which detection is greater than or equal to the U-NII Detection Bandwidth criterion. Recording the detection rate at frequencies above FH is not required to demonstrate compliance.

e) Starting at the center frequency of the EUT operating Channel, decrease the radar frequency in 1 MHz steps, repeating the above item d) test sequence, until the detection rate falls below the U-NII Detection Bandwidth criterion. Record the lowest frequency (denote as FL) at which detection is

greater than or equal to the U-NII Detection Bandwidth criterion. Recording the detection rate at frequencies below FL is not required to demonstrate compliance.

f) The U-NII Detection Bandwidth is calculated as follows: U-NII Detection Bandwidth = FH – FL

g) The U-NII Detection Bandwidth must be at least 100% of the EUT transmitter 99% power, otherwise, the EUT does not comply with DFS requirements.

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on the section 9

6.7. Statistical Performance Check

TEST LIMIT

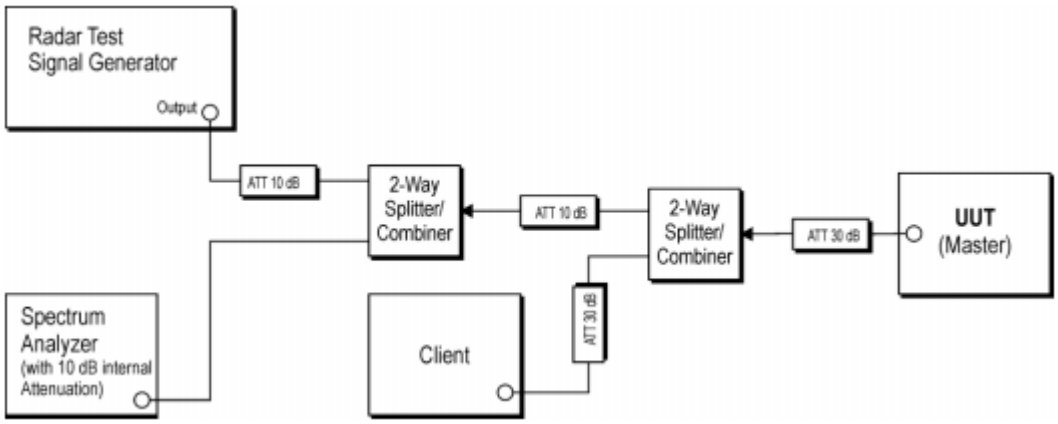
The minimum percentage of successful detection requirements found in below table when a radar burst with a level equal to the DFS Detection Threshold + 1dB is generated on the Operating Channel of the U-NII device (In- Service Monitoring).

Radar Type	Minimum Number of Trails	Detection Probability
1	30	60%
2	30	60%
3	30	60%
4	30	60%
Aggregate (Radar Types 1-4)	120	80%
5	30	80%
6	30	70%

The percentage of successful detection is calculated by:

(Total Waveform Detections / Total Waveform Trails) * 100 = Probability of Detection Radar Waveform In addition an aggregate minimum percentage of successful detection across all Short Pulse Radar Types 1-4 is required and is calculated as follows: (Pd1 + Pd2 + Pd3 + Pd4) / 4.

TEST CONFIGURATION



TEST PROCEDURE

h) Stream the MPEG test file from the Master Device to the Client Device on the test Channel for the entire period of the test.

i) At time T0 the Radar Waveform generator sends the individual waveform for each of the Radar Types 1-6, at levels equal to the DFS Detection Threshold + 1dB, on the Operating Channel.

j) Observe the transmissions of the EUT at the end of the Burst on the Operating Channel for duration greater than 10 seconds for Short Pulse Radar Types 0 to ensure detection occurs.

k) Observe the transmissions of the EUT at the end of the Burst on the Operating Channel for duration greater than 22 seconds for Long Pulse Radar Type 5 to ensure detection occurs.

l) The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs.

m) The Minimum number of trails, minimum percentage of successful detection and the average minimum percentage of successful detection are found in below table.

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

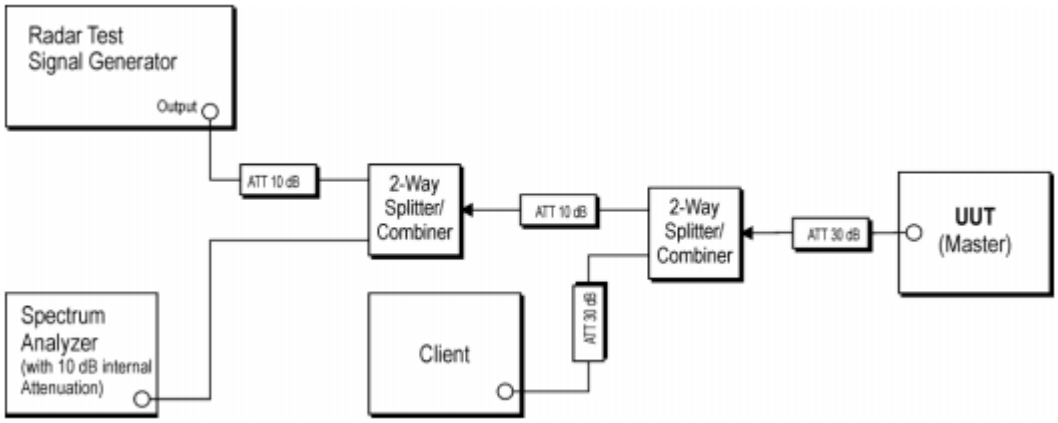
Refer to the appendix report on the section 9

6.8. Channel Move Time, Channel Closing Transmission Time

TEST LIMIT

The EUT has In-Service Monitoring function to continuously monitor the radar signals. If the radar is detected, must leave the channel (Shutdown). The Channel Move Time to cease all transmissions on the current channel upon detection of a Radar Waveform above the DFS Detection Threshold within 10 sec. The total duration of Channel Closing Transmission Time is 260ms, consisting of data signals and the aggregate of control signals, by a U-NII device during the Channel Move Time.

TEST CONFIGURATION



TEST PROCEDURE

a) The test should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0.

b) When the radar burst with a level equal to the DFS Detection Threshold + 1dB is generated on the Operating Channel of the U-NII device. A U-NII device operating as a Master Device will associate with the Client Device at Channel. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test. At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types at Detection Threshold + 1dB.

c) Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel. Measure and record the transmissions from the EUT during the observation time (Channel Move Time).

d) Measurement of the aggregate duration of the Channel Closing Transmission Time method. With the spectrum analyzer set to zero span tuned to the center frequency of the EUT operating channel at the radar simulated frequency, peak detection, and max hold, the dwell time per bin is given by: Dwell (1.5ms) = S (12 sec) / B (8000); where Dwell is the dwell time per spectrum analyzer sampling bin, S is the sweep time and B is the number of spectrum analyzer sampling bins. An upper bound of the aggregate duration of the intermittent control signals of Channel Closing Transmission Time is calculated by: 80MHz: C = N X Dwell; where C is the Closing Time, N is the number of spectrum analyzer sampling bins showing a U-NII transmission and Dwell is the dwell time per bin.

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

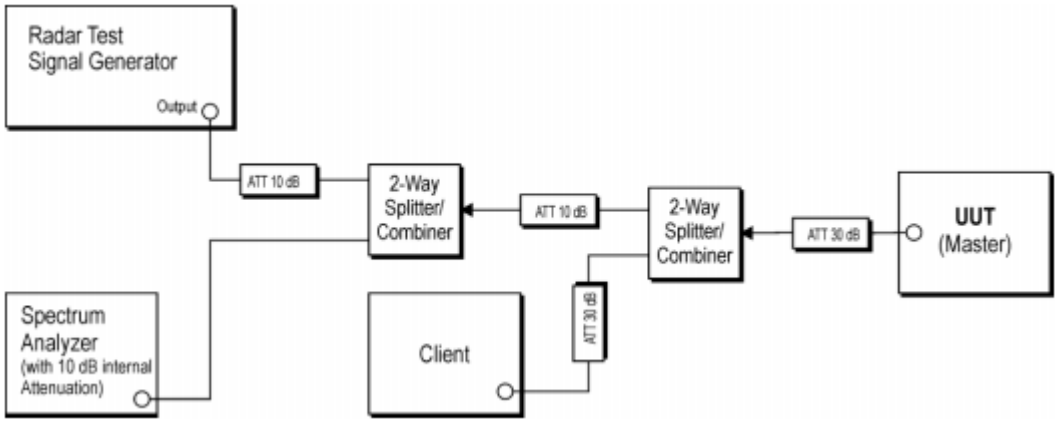
Refer to the appendix report on the section 9

6.9. Non-Occupancy Period

TEST LIMIT

The Non-Occupancy Period time is 30 minute during which a Channel will not be utilized after a Radar Waveform is detected on that Channel.

TEST CONFIGURATION



TEST PROCEDURE

a) The test should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0.

b) When the radar burst with a level equal to the DFS Detection Threshold + 1dB is generated on the Operating Channel of the U-NII device. A U-NII device operating as a Master Device will associate with the Client Device at Channel. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test. At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types at Detection Threshold + 1dB.

c) Measure the EUT for more than 30 minutes following the channel close/move time to verify that the EUT does not resume any transmissions on this Channel.

TEST MODE:

Please refer to the clause 4.2

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST DATA

Refer to the appendix report on the section 9

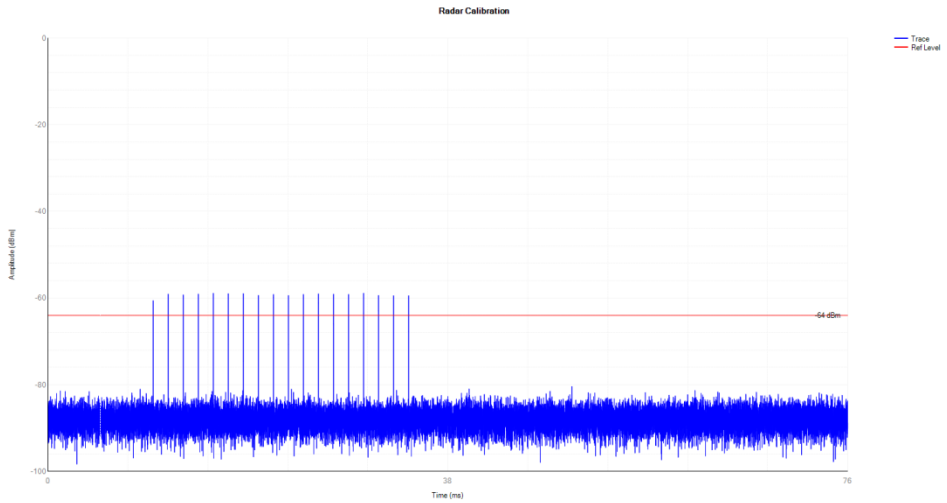
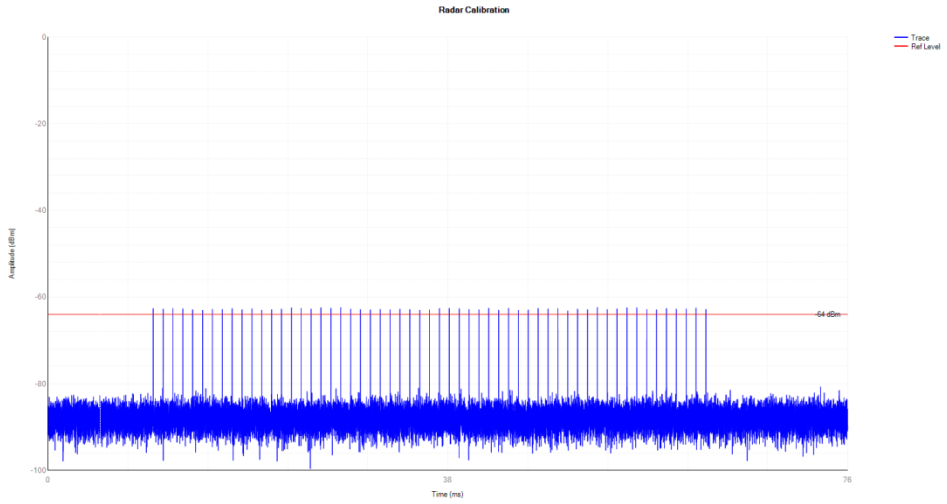
7 . APPENDIX REPORT

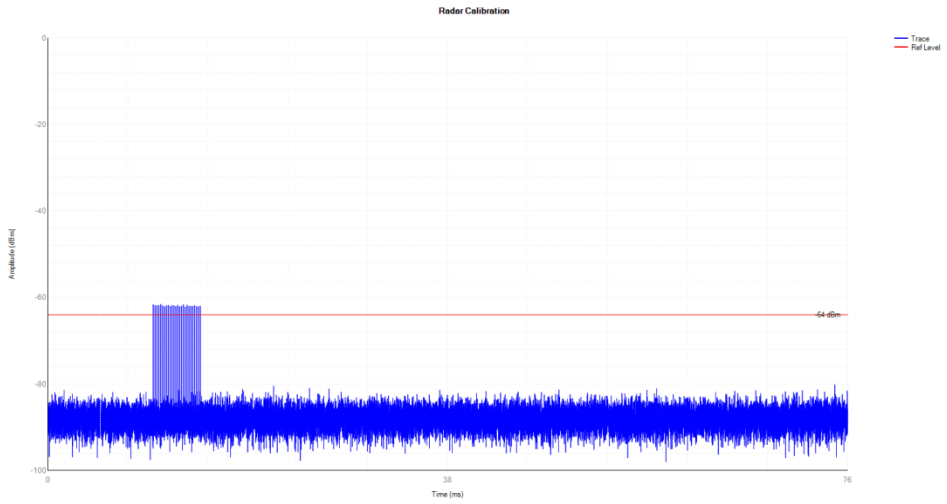
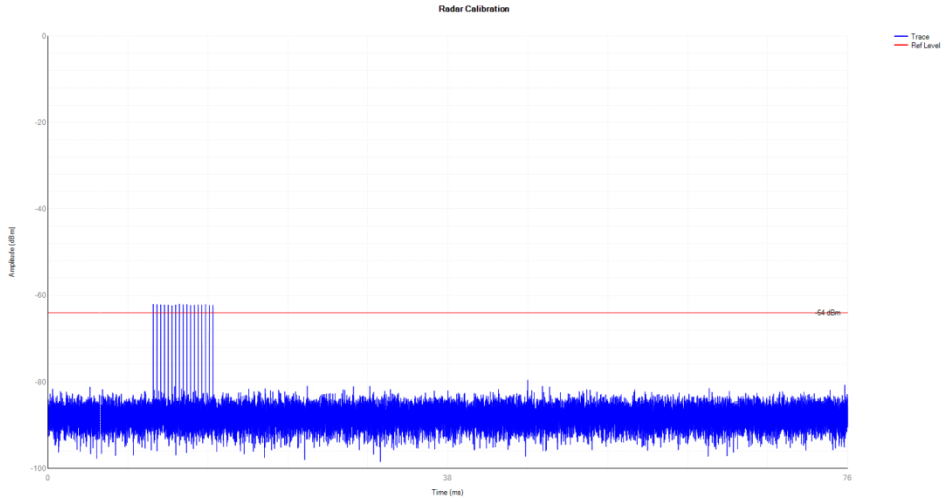
APPENDIX REPORT

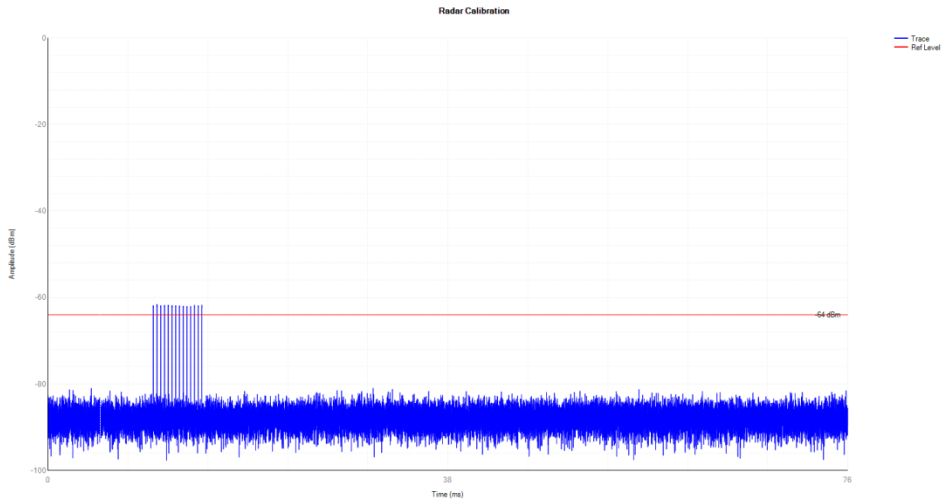
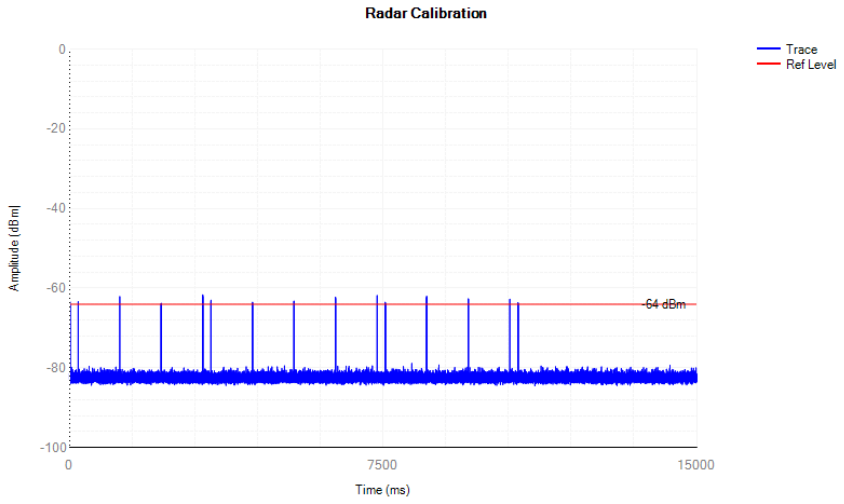
Project No.	SHT2403050101W	Radio Specification	DFS
Test sample No.	YPHT24030501001_01	Model No.	wAPG-5HaxD2HaxD-US
Start test date	2024-08-05	Finish date	2024-08-09
Temperature	24.5℃	Humidity	52%
Test Engineer	Xiangyu Wei	Auditor	Xiaodong Zhao

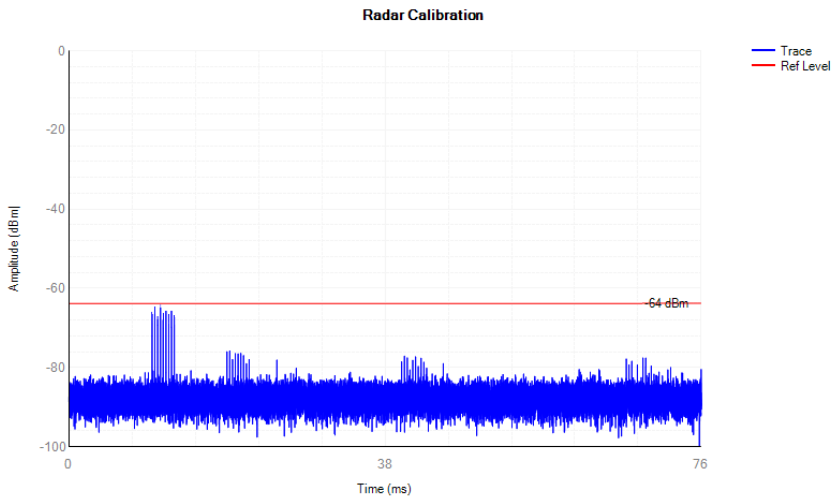
Appendix clause	Test item	Result
A	Radar Waveform Calibration	PASS
B	Channel Availability Check Time	PASS
C	Packet Transmissions Activity Ratio	PASS
D	UNII Detection Bandwidth Measurement	PASS
E	Statistical Performance Check	PASS
F	Channel Move Time, Channel Closing Transmission Time	PASS
G	Non-Occupancy Period	PASS

AppendixA:Radar Waveform Calibration

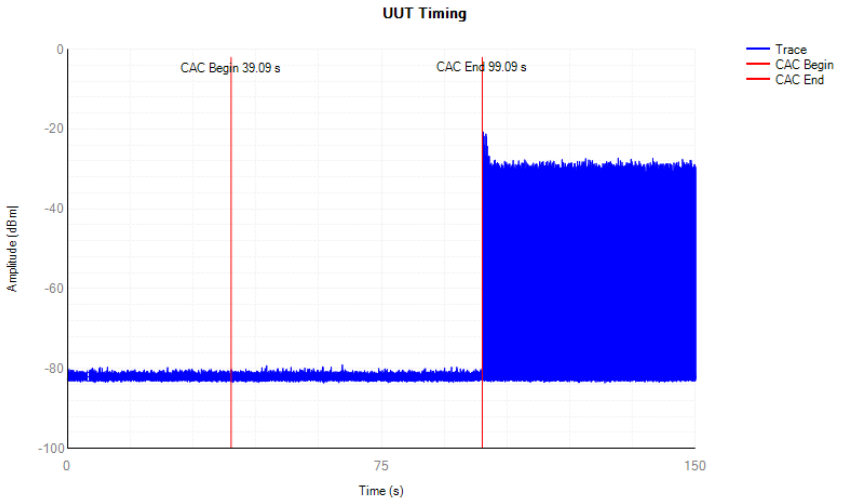
Radar Type	Test Graphs
Radar Type 0	
Radar Type 1	

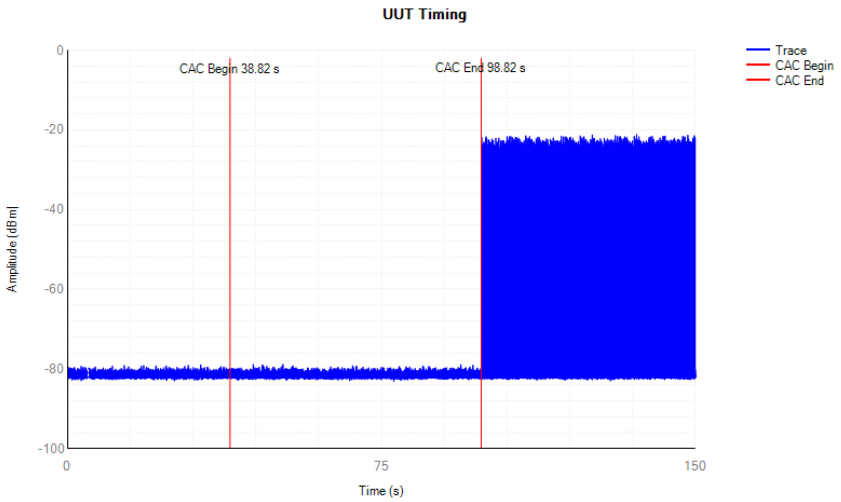
Radar Type	Test Graphs
Radar Type 2	
Radar Type 3	

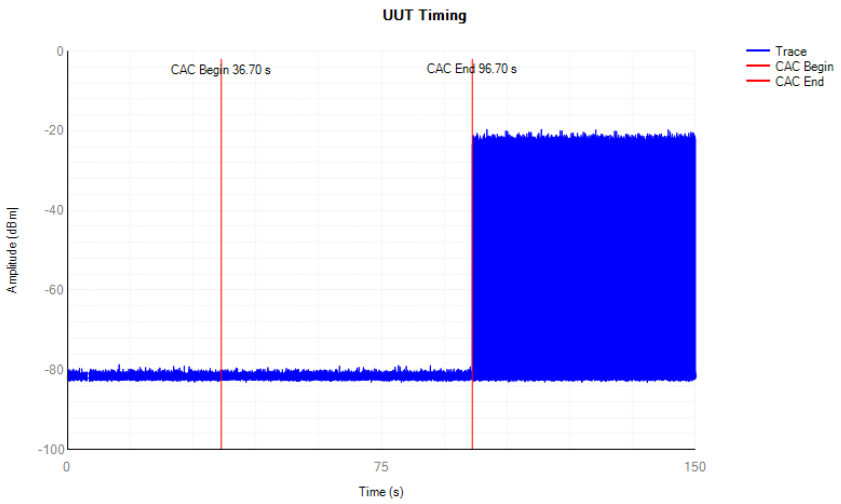
Radar Type	Test Graphs
Radar Type 4	
Radar Type 5	

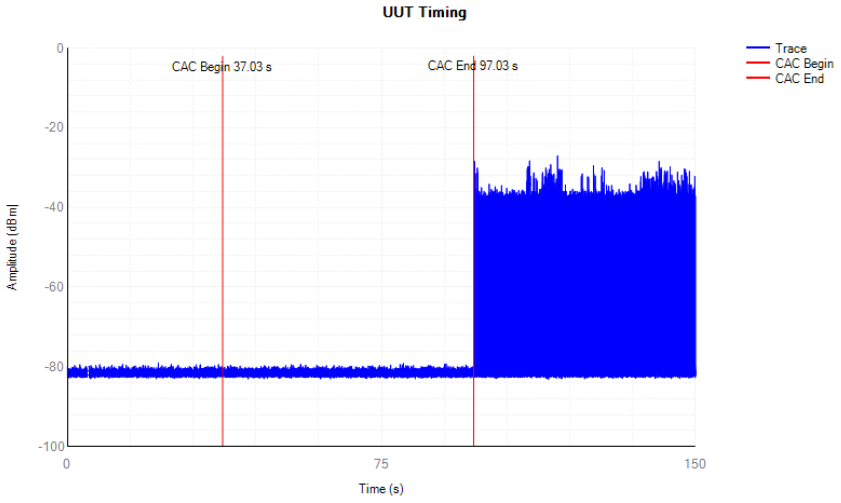
Radar Type	Test Graphs
Radar Type 6	

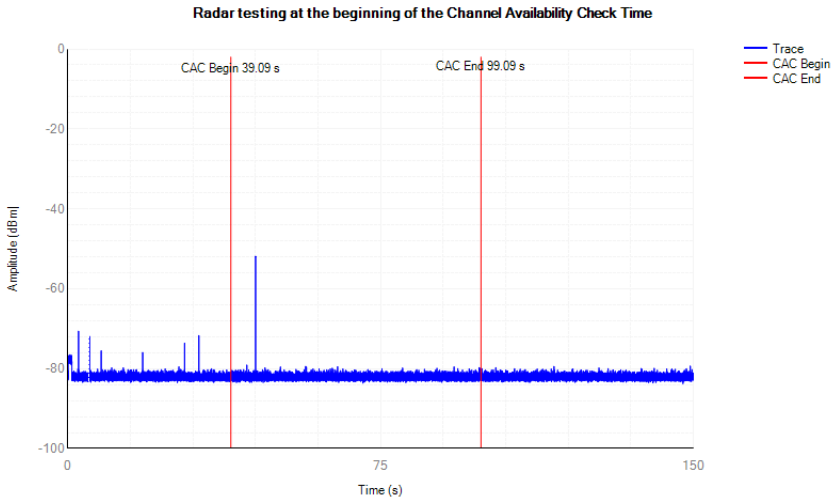
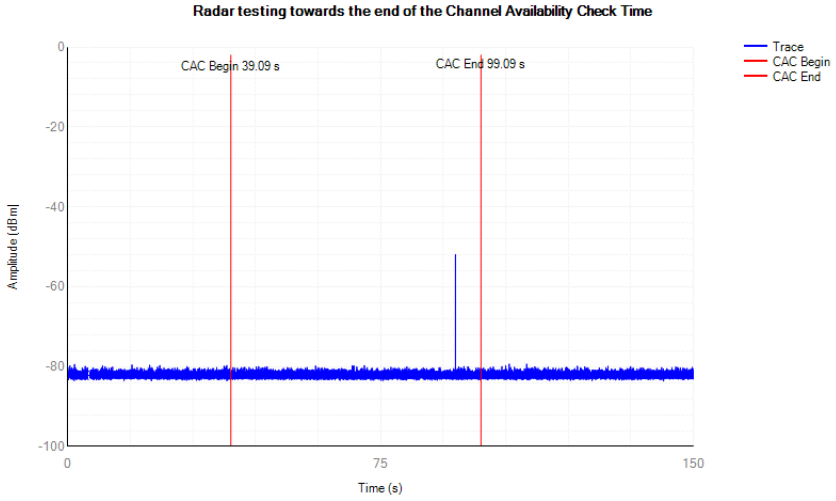
AppendixB: Channel Availability Check Time

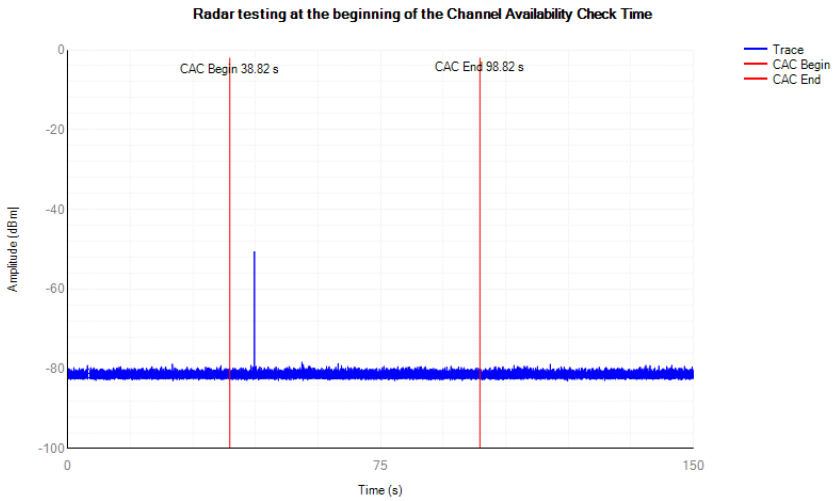
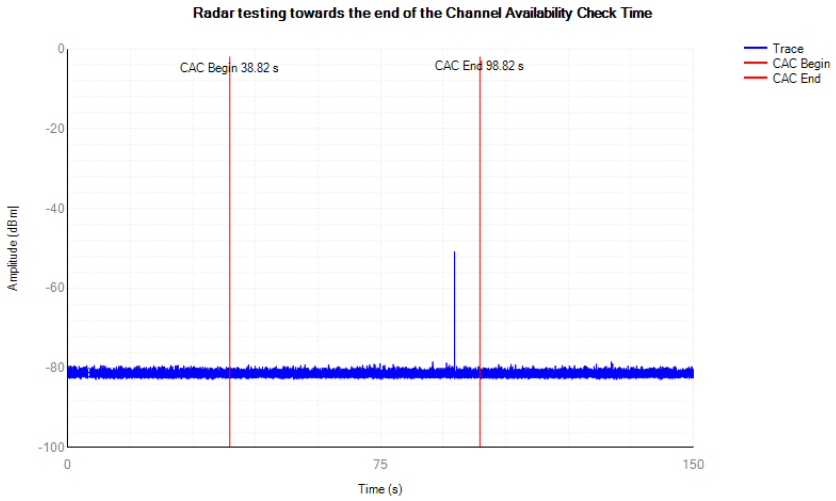
Test mode:	802.11ax160	Test frequency:	5570MHz
Power on time			

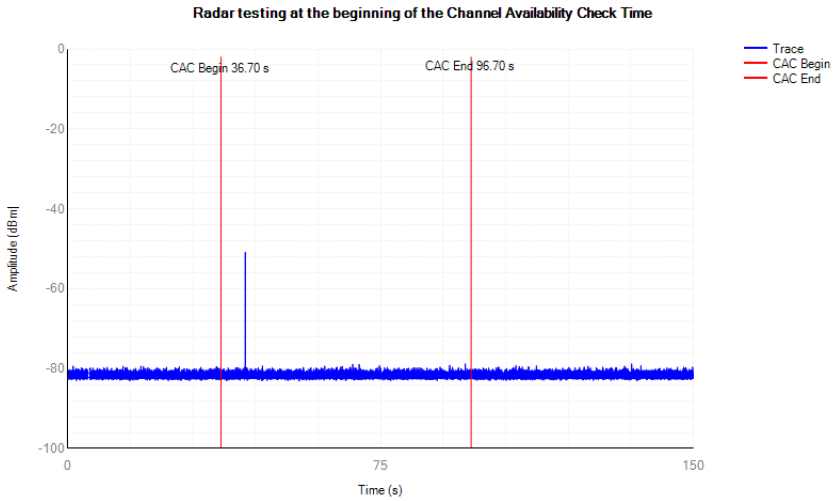
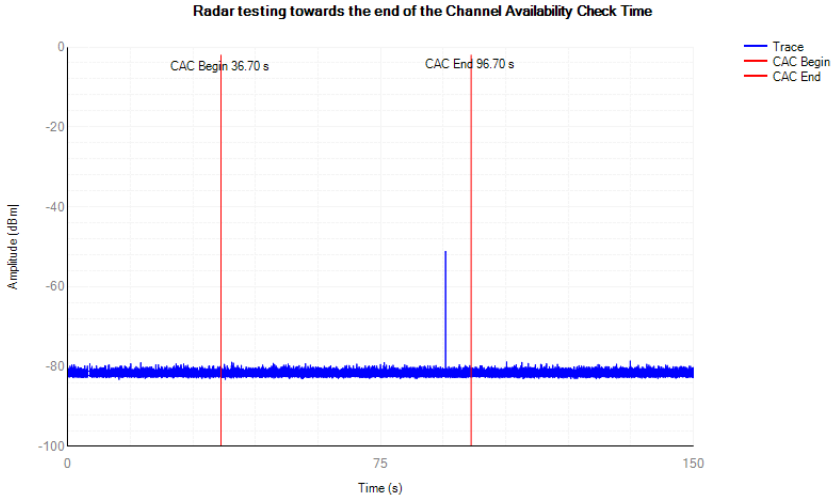
Test mode:	802.11ax20	Test frequency:	5300MHz
Power on time			

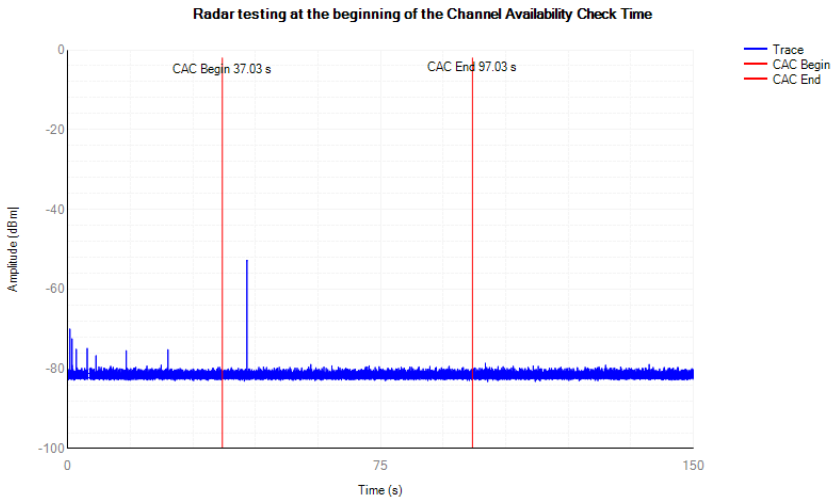
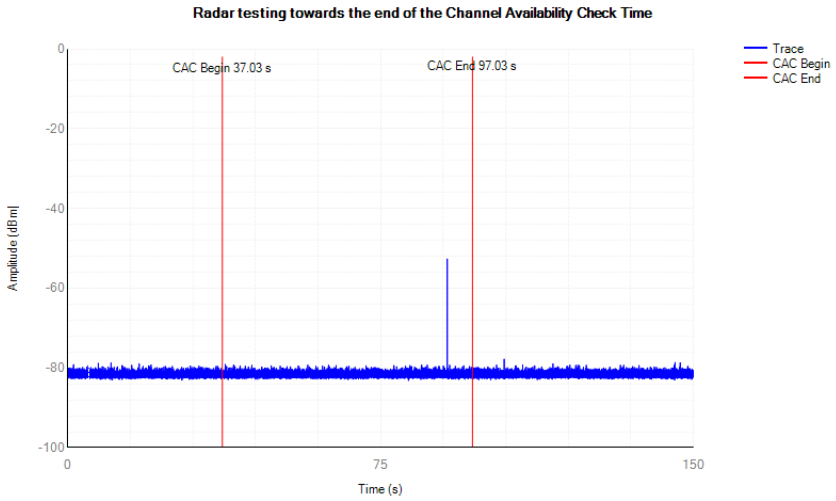
Test mode:	802.11ax40	Test frequency:	5500MHz
Power on time			

Test mode:	802.11ax80	Test frequency:	5290MHz
Power on time			

Test mode:	802.11ax160	Test frequency:	5570MHz
Beginning of CAC			
End of CAC			

Test mode:	802.11ax20	Test frequency:	5300MHz
Beginning of CAC			
End of CAC			

Test mode:	802.11ax40	Test frequency:	5500MHz
Beginning of CAC			
End of CAC			

Test mode:	802.11ax80	Test frequency:	5290MHz
Beginning of CAC			
End of CAC			

AppendixC: Packet Transmissions Activity Ratio

Test Mode	Test Frequency	Packet Ratio	Requirement ratio	Test Result
802.11ax-HE20	5300 MHz	20.34%	⩾17%	Pass
802.11ax-HE40	5500 MHz	19.61%	⩾17%	Pass
802.11ax-HE80	5290 MHz	24.58%	⩾17%	Pass
802.11ax-HE160	5570 MHz	27.96%	⩾17%	Pass
Note: Packet Ratio = Time On / (Time On + Off Time)				

AppendixD:UNII Detection Bandwidth Measurement

Detection Bandwidth Test Transmission											
EUT Frequency:	802.11ax-HE20 mode - 5300 MHz										
Test Radar Type:	Type 0										
Detection Bandwidth:	20 MHz										
Detection Bandwidth Min. Limit:	18.8138 MHz										
Test Result:	Pass										
Radar Frequency (MHz)	DFS Detection Trials (1=Detection, 0 = No Detection)										
	1	2	3	4	5	6	7	8	9	10	Detection Rate(%)
5289	1	1	0	1	0	1	0	0	0	0	40%
5290 FL	1	1	1	1	1	1	1	1	1	1	100%
5291	1	1	1	1	1	1	1	1	1	1	100%
5292	1	1	1	1	1	1	1	1	1	1	100%
5293	1	1	1	1	1	1	1	1	1	1	100%
5294	1	1	1	1	1	1	1	1	1	1	100%
5295	1	1	1	1	1	1	1	1	1	1	100%
5296	1	1	1	1	1	1	1	1	1	1	100%
5300	1	1	1	1	1	1	1	1	1	1	100%
5305	1	1	1	1	1	1	1	1	1	1	100%
5306	1	1	1	1	1	1	1	1	1	1	100%
5307	1	1	1	1	1	1	1	1	1	1	100%
5308	1	1	1	1	1	1	1	1	1	1	100%
5309	1	1	1	1	1	1	1	1	1	1	100%
5310 FH	1	1	1	1	1	1	1	1	1	1	100%
5311	1	1	1	0	1	0	0	1	0	0	50%

Note 1: All NII channels for this device have identical Channel bandwidths. Therefore, all DFS testing was done at 5300MHz.
Note 2: Detection Bandwidth = FH - FL
Note 3: Detection Bandwidth Min. Limit = 100% of the U-NII 99% power bandwidth

Detection Bandwidth Test Transmission											
EUT Frequency:	802.11ax-HE40 mode - 5500 MHz										
Test Radar Type:	Type 0										
Detection Bandwidth:	40 MHz										
Detection Bandwidth Min. Limit:	37.822 MHz										
Test Result:	Pass										
Radar Frequency (MHz)	DFS Detection Trials (1=Detection, 0 = No Detection)										
	1	2	3	4	5	6	7	8	9	10	Detection Rate(%)
5489	0	1	1	0	1	0	1	0	0	0	40%
5490 FL	1	1	1	1	1	1	1	1	1	1	100%
5491	1	1	1	1	1	1	1	1	1	1	100%
5492	1	1	1	1	1	1	1	1	1	1	100%
5493	1	1	1	1	1	1	1	1	1	1	100%
5494	1	1	1	1	1	1	1	1	1	1	100%
5495	1	1	1	1	1	1	1	1	1	1	100%
5496	1	1	1	1	1	1	1	1	1	1	100%
5500	1	1	1	1	1	1	1	1	1	1	100%
5505	1	1	1	1	1	1	1	1	1	1	100%
5506	1	1	1	1	1	1	1	1	1	1	100%
5507	1	1	1	1	1	1	1	1	1	1	100%
5508	1	1	1	1	1	1	1	1	1	1	100%
5509	1	1	1	1	1	1	1	1	1	1	100%
5510 FH	1	1	1	1	1	1	1	1	1	1	100%
5511	1	0	1	0	1	0	1	1	0	1	60%
Note 1: All NII channels for this device have identical Channel bandwidths. Therefore, all DFS testing was done at 5500MHz. Note 2: Detection Bandwidth = FH - FL Note 3: Detection Bandwidth Min. Limit = 100% of the U-NII 99% power bandwidth											

Detection Bandwidth Test Transmission											
EUT Frequency:	802.11ax-HE80 mode - 5290 MHz										
Test Radar Type:	Type 0										
Detection Bandwidth:	80 MHz										
Detection Bandwidth Min. Limit:	76.7195 MHz										
Test Result:	Pass										
Radar Frequency (MHz)	DFS Detection Trials (1=Detection, 0 = No Detection)										
	1	2	3	4	5	6	7	8	9	10	Detection Rate(%)
5249	1	0	0	1	0	1	0	1	0	0	40%
5250 FL	1	1	1	1	1	1	1	1	1	1	100%
5252	1	1	1	1	1	1	1	1	1	1	100%
5253	1	1	1	1	1	1	1	1	1	1	100%
5254	1	1	1	1	1	1	1	1	1	1	100%
5260	1	1	1	1	1	1	1	1	1	1	100%
5270	1	1	1	1	1	1	1	1	1	1	100%
5275	1	1	1	1	1	1	1	1	1	1	100%
5280	1	1	1	1	1	1	1	1	1	1	100%
5285	1	1	1	1	1	1	1	1	1	1	100%
5290	1	1	1	1	1	1	1	1	1	1	100%
5295	1	1	1	1	1	1	1	1	1	1	100%
5300	1	1	1	1	1	1	1	1	1	1	100%
5305	1	1	1	1	1	1	1	1	1	1	100%
5310	1	1	1	1	1	1	1	1	1	1	100%
5315	1	1	1	1	1	1	1	1	1	1	100%
5320	1	1	1	1	1	1	1	1	1	1	100%
5325	1	1	1	1	1	1	1	1	1	1	100%
5326	1	1	1	1	1	1	1	1	1	1	100%
5327	1	1	1	1	1	1	1	1	1	1	100%
5328	1	1	1	1	1	1	1	1	1	1	100%
5330 FH	1	1	1	1	1	1	1	1	1	1	100%
5331	0	1	1	1	0	1	0	1	1	0	60%

Note 1: All NII channels for this device have identical Channel bandwidths. Therefore, all DFS testing was done at 5290MHz.

Note 2: Detection Bandwidth = FH - FL

Note 3: Detection Bandwidth Min. Limit = 100% of the U-NII 99% power bandwidth

Detection Bandwidth Test Transmission											
EUT Frequency:	802.11ax-HE160 mode - 5570 MHz										
Test Radar Type:	Type 0										
Detection Bandwidth:	160 MHz										
Detection Bandwidth Min. Limit:	155.1646 MHz										
Test Result:	Pass										
Radar Frequency (MHz)	DFS Detection Trials (1=Detection, 0 = No Detection)										
	1	2	3	4	5	6	7	8	9	10	Detection Rate(%)
5489	0	1	0	0	0	1	0	0	0	0	20%
5490 FL	1	1	1	1	1	0	1	1	1	1	90%
5492	1	1	1	1	1	1	1	1	1	1	100%
5493	1	1	1	1	1	1	1	1	1	1	100%
5494	1	1	1	1	1	1	1	1	1	1	100%
5495	1	1	1	1	1	1	1	1	1	1	100%
5500	1	1	1	1	1	1	1	1	1	1	100%
5505	1	1	1	1	1	1	1	1	1	1	100%
5510	1	1	1	1	1	1	1	1	1	1	100%
5515	1	1	1	1	1	1	1	1	1	1	100%
5520	1	1	1	1	1	1	1	1	1	1	100%
5525	1	1	1	1	1	1	1	1	1	1	100%
5530	1	1	1	1	1	1	1	1	1	1	100%
5535	1	1	1	1	1	1	1	1	1	1	100%
5540	1	1	1	1	1	1	1	1	1	1	100%
5545	1	1	1	1	1	1	1	1	1	1	100%
5550	1	1	1	1	1	1	1	1	1	1	100%
5555	1	1	1	1	1	1	1	1	1	1	100%
5560	1	1	1	1	1	1	1	1	1	1	100%
5565	1	1	1	1	1	1	1	1	1	1	100%
5570	1	1	1	1	1	1	1	1	1	1	100%
5575	1	1	1	1	1	1	1	1	1	1	100%
5580	1	1	1	1	1	1	1	1	1	1	100%
5585	1	1	1	1	1	1	1	1	1	1	100%
5590	1	1	1	1	1	1	1	1	1	1	100%
5595	1	1	1	1	1	1	1	1	1	1	100%
5600	1	1	1	1	1	1	1	1	1	1	100%
5605	1	1	1	1	1	1	1	1	1	1	100%
5610	1	1	1	1	1	1	1	1	1	1	100%
5615	1	1	1	1	1	1	1	1	1	1	100%
5620	1	1	1	1	1	1	1	1	1	1	100%
5625	1	1	1	1	1	1	1	1	1	1	100%
5630	1	1	1	1	1	1	1	1	1	1	100%
5635	1	1	1	1	1	1	1	1	1	1	100%
5640	1	1	1	1	1	1	1	1	1	1	100%
5645	1	1	1	1	1	1	1	1	1	1	100%

5646	1	1	1	1	1	1	1	1	1	100%
5647	1	1	1	1	1	1	1	1	1	100%
5648	1	1	1	1	1	1	1	1	1	100%
5650 FH	1	0	1	1	1	1	1	1	1	90%
5651	1	0	0	1	1	0	1	0	0	1	50%

Note 1: All NII channels for this device have identical Channel bandwidths. Therefore, all DFS testing was done at 5570MHz.
Note 2: Detection Bandwidth = FH - FL
Note 3: Detection Bandwidth Min. Limit = 100% of the U-NII 99% power bandwidth

AppendixE: Statistical Performance Check

Radar Statistical Performance Check					
802.11ax-HE20 - 5300 MHz					
Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection	Limit	Results
1	30	27	90.00%	⩾60%	Pass
2	30	25	83.33%	⩾60%	Pass
3	30	26	86.67%	⩾60%	Pass
4	30	27	90.00%	⩾60%	Pass
Aggregate	120	87.50%		⩾80%	Pass
5	30	24	80.00%	⩾80%	Pass
6	30	26	86.67%	⩾70%	Pass
Note: Aggregate (Radar Types 1-4) = (Pd1+Pd2+Pd3+Pd4)/4					

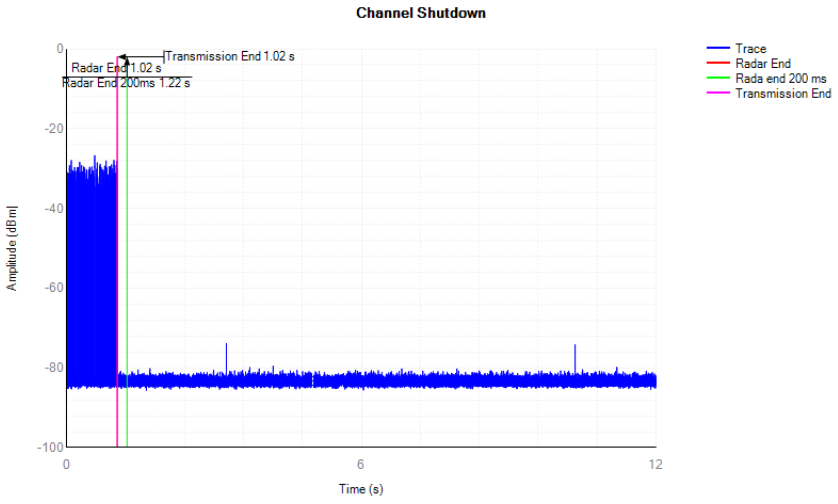
Radar Statistical Performance Check					
802.11ax-HE40 - 5500 MHz					
Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection	Limit	Results
1	30	27	90.00%	⩾60%	Pass
2	30	25	83.33%	⩾60%	Pass
3	30	26	86.67%	⩾60%	Pass
4	30	27	90.00%	⩾60%	Pass
Aggregate	120	87.50%		⩾80%	Pass
5	30	28	93.33%	⩾80%	Pass
6	30	26	86.67%	⩾70%	Pass
Note: Aggregate (Radar Types 1-4) = (Pd1+Pd2+Pd3+Pd4)/4					

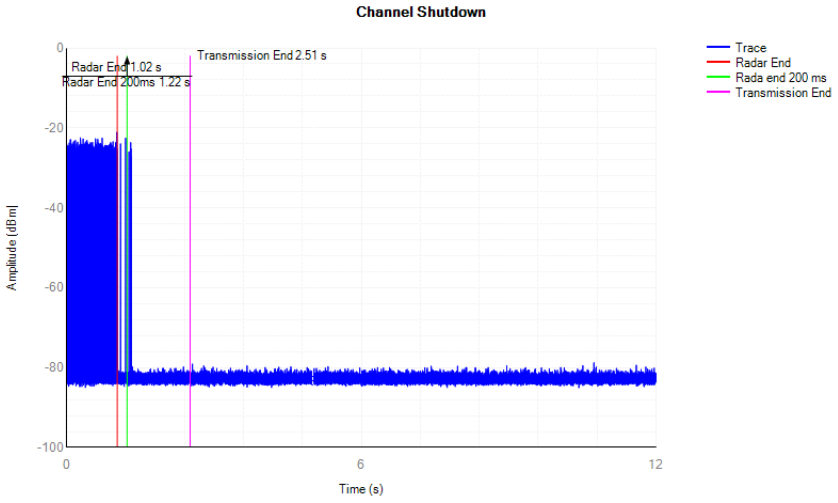
Radar Statistical Performance Check					
802.11ax-HE80 - 5290 MHz					
Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection	Limit	Results
1	30	25	83.33%	⩾60%	Pass
2	30	26	86.67%	⩾60%	Pass
3	30	27	90.00%	⩾60%	Pass
4	30	27	90.00%	⩾60%	Pass
Aggregate	120	87.50%		⩾80%	Pass
5	30	26	86.67%	⩾80%	Pass
6	30	28	93.33%	⩾70%	Pass
Note: Aggregate (Radar Types 1-4) = (Pd1+Pd2+Pd3+Pd4)/4					

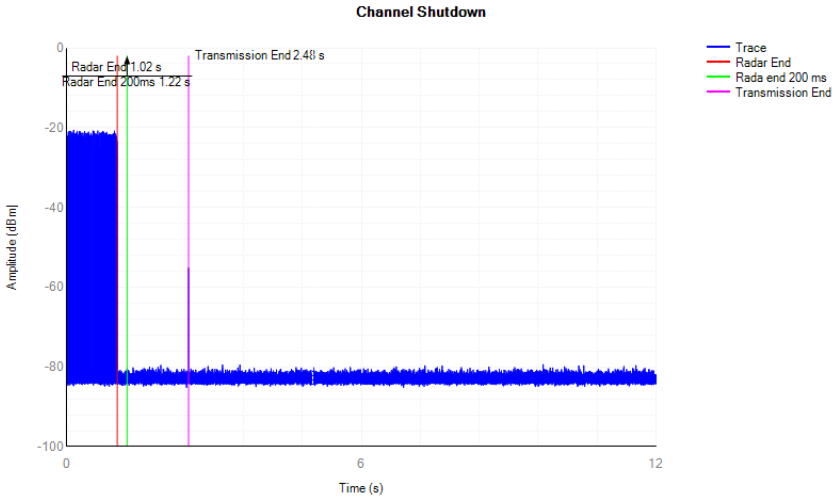
Radar Statistical Performance Check					
802.11ax-HE160 - 5570 MHz					
Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection	Limit	Results
1	30	27	90.00%	⩾60%	Pass
2	30	28	93.33%	⩾60%	Pass
3	30	25	83.33%	⩾60%	Pass
4	30	26	86.67%	⩾60%	Pass
Aggregate	120	88.33%		⩾80%	Pass
5	30	27	90.00%	⩾80%	Pass
6	30	26	86.67%	⩾70%	Pass
Note: Aggregate (Radar Types 1-4) = (Pd1+Pd2+Pd3+Pd4)/4					

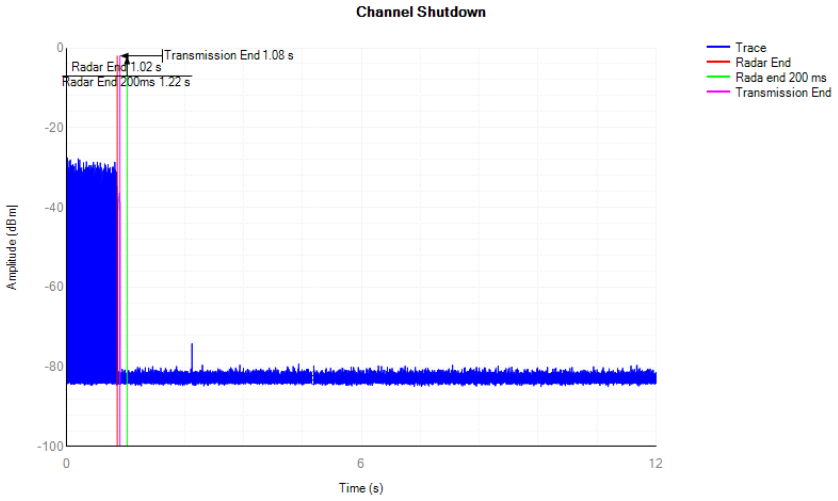
AppendixF:Channel Move Time, Channel Closing Transmission Time

Mode	Frequency (MHz)	Channel Move Time (s)	Limit Channel Move Time (s)	Close Transmission Time (s)	Limit Close Transmission Time (s)	Close Transmission Time after 200ms(s)	Limit Close Transmission Time after 200ms (s)	Verdict
ax160	5570	0.0001	<=10	0.0004	<=0.26	0.0001	<=0.06	Pass
ax20	5300	1.4845	<=10	0.0056	<=0.26	0.0032	<=0.06	Pass
ax40	5500	1.4521	<=10	0.0004	<=0.26	0.0004	<=0.06	Pass
ax80	5290	0.0533	<=10	0.0044	<=0.26	0.0001	<=0.06	Pass

Test item	Test Graphs
Single pulse (802.11ax160 5570MHz)	

Test item	Test Graphs
Single pulse (802.11ax20 5300MHz)	

Test item	Test Graphs
Single pulse (802.11ax40 5500MHz)	

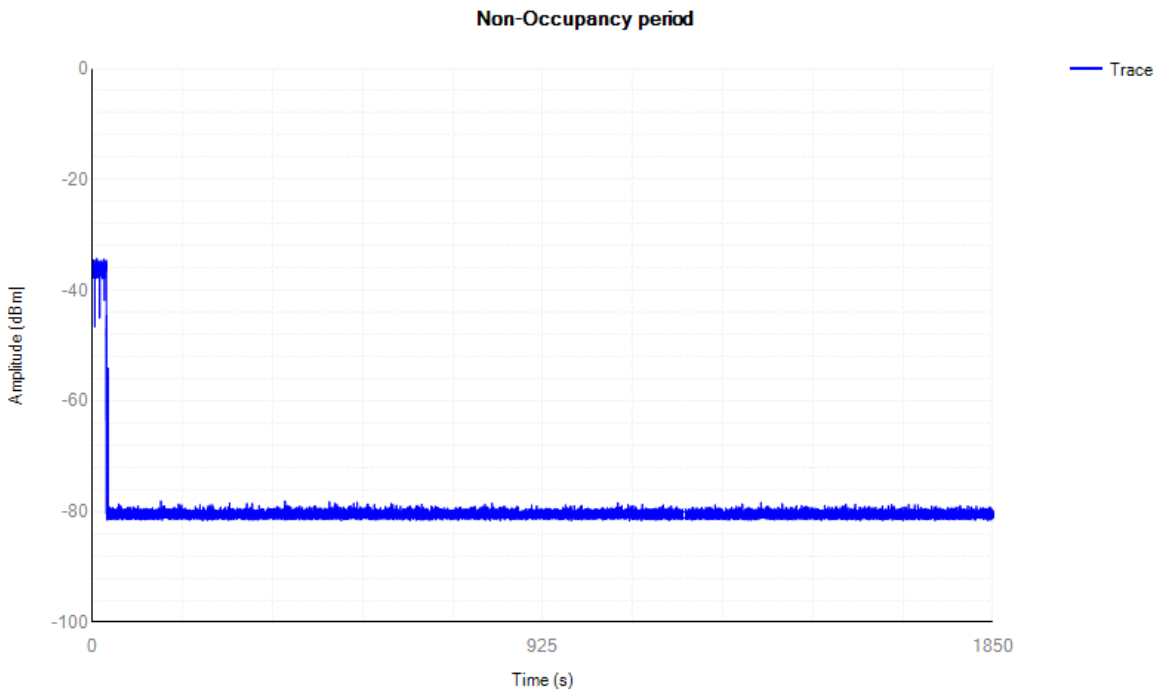
Test item	Test Graphs
Single pulse (802.11ax80 5290MHz)	

AppendixG:Non-Occupancy Period

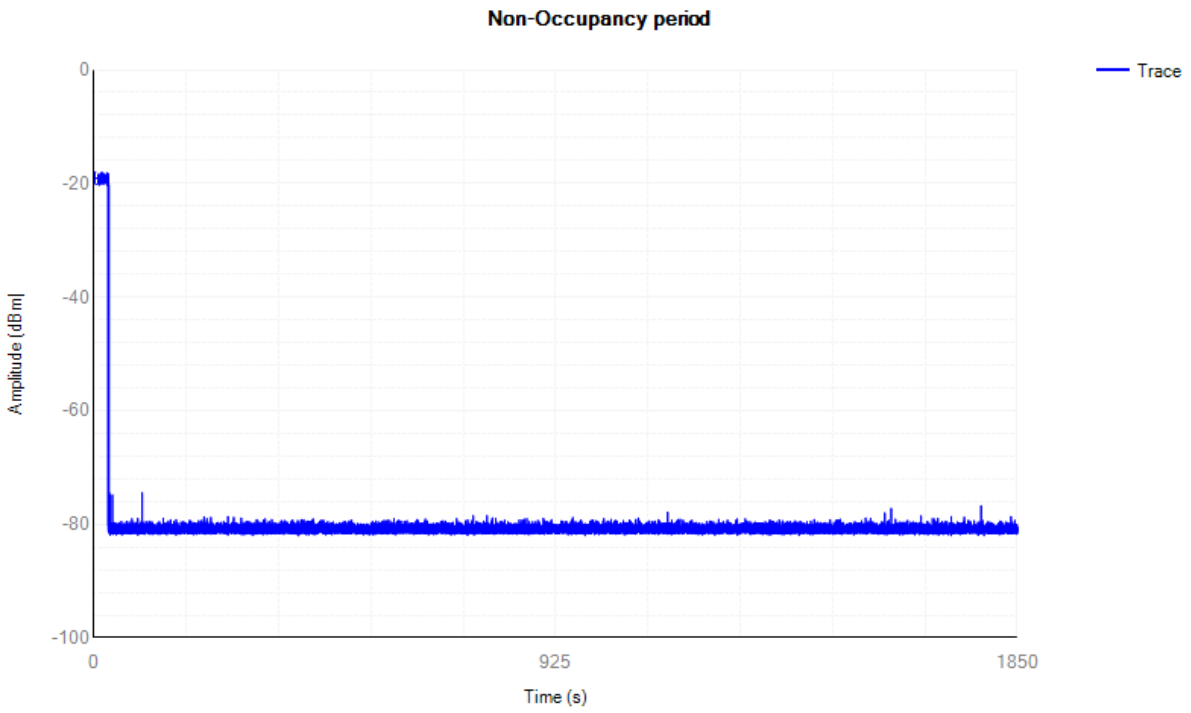
Mode	Frequency (MHz)	Injection into radar Time (s)	Close Transmission Time (s)	Total Sweep Time (s)	Non-Occupancy Time (s)	Non-Occupancy Limit Time(s)	Verdict
ax160	5570	30	0.0004	1850	1819.9996	> 1800	Pass
ax20	5300	30	0.0056	1850	1819.9944	> 1800	Pass
ax40	5500	30	0.0004	1850	1819.9996	> 1800	Pass
ax80	5290	30	0.0044	1850	1819.9956	> 1800	Pass

Test Graphs

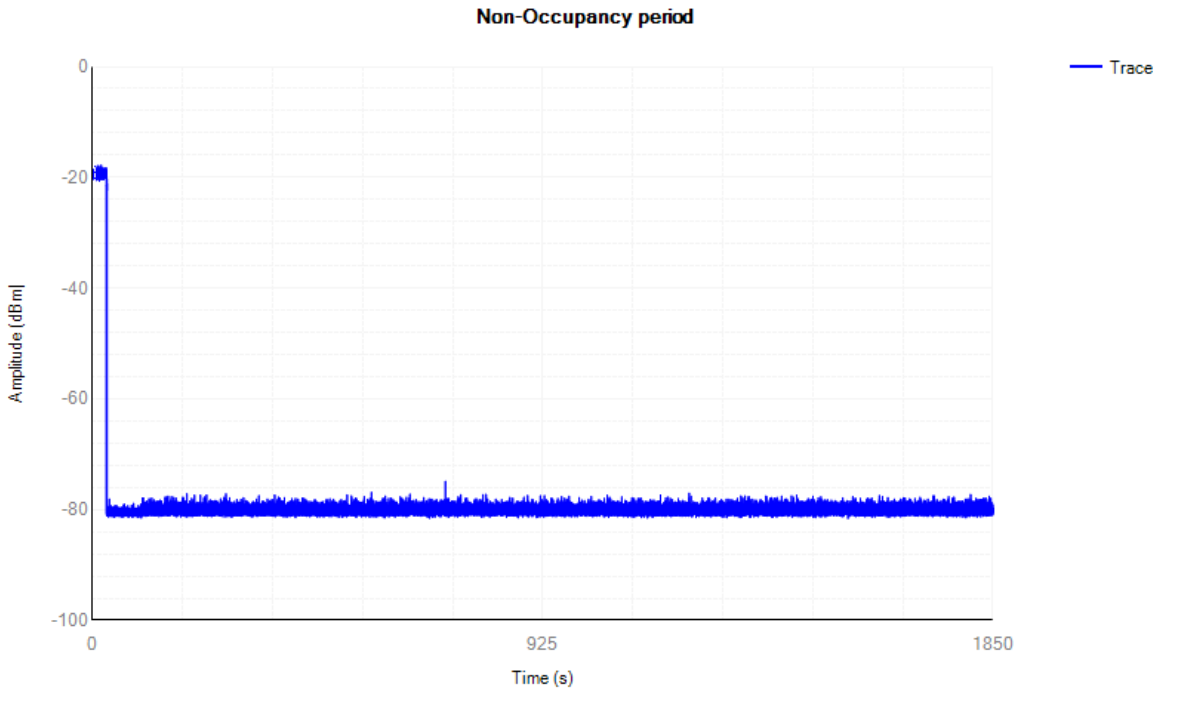
ax160 5570MHz Non-Occupancy



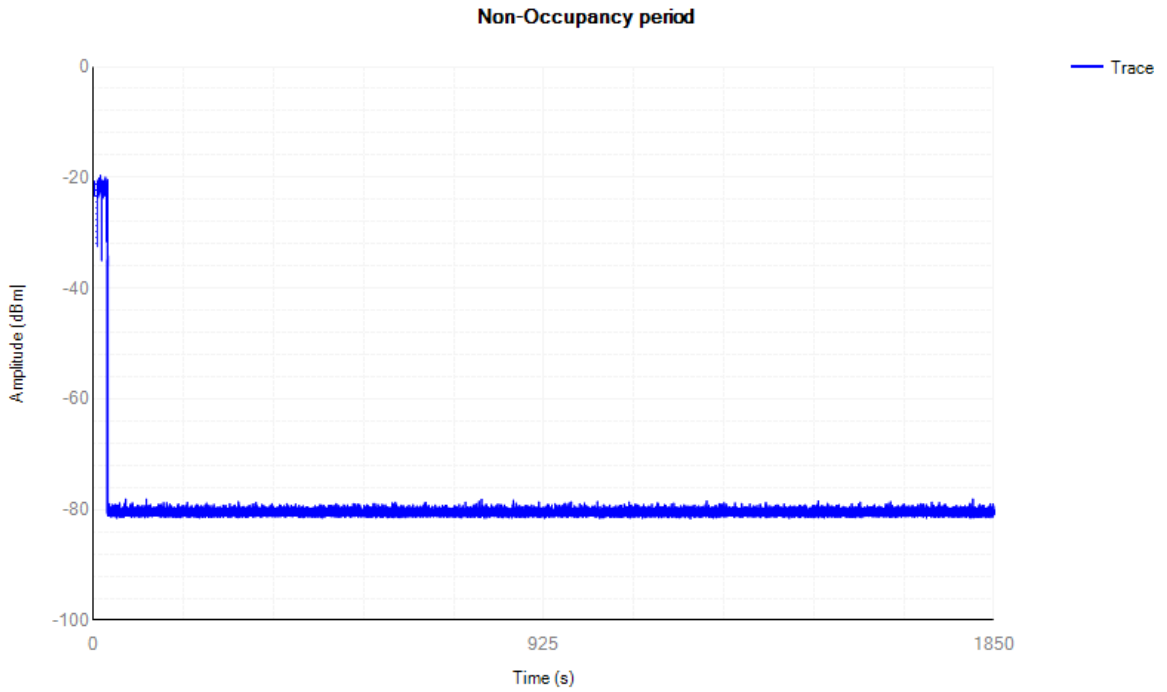
ax20 5300MHz Non-Occupancy



ax40 5500MHz Non-Occupancy



ax80 5290MHz Non-Occupancy



--------End of Report--------