Shenzhen Huaxin Information Technology Service Co., Ltd

FCC TEST REPORT

On Behalf of

FCC ID: UCC-M360-X

Altai Technologies Limited

Industrial Dual-Band Wi-Fi 6 CPE/AP

Model No.: M360-X

Prepared for	:	Altai Technologies Limited
Address	:	Unit 209, 2/F, Lakeside 2, 10 Science Park West Avenue, HK Science Park, Shatin, Hong Kong

Prepared By	:	Shenzhen Huaxin Information Technology Service Co., Ltd
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Report Number	:	HX240327R003
Date of Receipt	:	Mar 2th,2024
Date of Test	:	Mar 4th,2024 ~ Mar 27th,2024
Date of Report	:	Mar 27th, 2024
Version Number	:	V0

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TEST REPORT DECLARATION

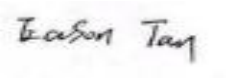
Applicant	:	Altai Technologies Limited
Address	:	Unit 209, 2/F, Lakeside 2, 10 Science Park West Avenue, HK Science Park, Shatin, Hong Kong
Manufacturer	:	Altai Technologies Limited
Address	:	Unit 209, 2/F, Lakeside 2, 10 Science Park West Avenue, HK Science Park, Shatin, Hong Kong
EUT Description	:	Industrial Dual-Band Wi-Fi 6 CPE/AP
	(A) Model No.	: M360-X
	(B) Trademark	: N/A

Measurement Standard Used:

FCC Part 15 Subpart E（15.407）

The device described above is tested by Shenzhen Huaxin Information Technology Service Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC limits. The test results are contained in this test report and Shenzhen Huaxin Information Technology Service Co.,Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.
After the test, our opinion is that EUT compliance with the requirement of the above standards.

This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Shenzhen Huaxin Information Technology Service Co., Ltd.

Tested by (name + signature).....:	Eason Tan Test Engineer	
Approved by (name + signature).....:	Michael Wu Project Manager	
Date of issue.....:	Mar 27th, 2024	

Revision History

Revision	Issue Date	Revisions	Revised By
V0	Mar 27th, 2024	Initial released Issue	Eason Tan

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT Name	:	Industrial Dual-Band Wi-Fi 6 CPE/AP
Model No.	:	M360-X
DIFF.	:	/
Power supply	:	DC12V-48V or Passive PoE 48V
Radio Technology	:	5G WIFI
Operation Frequency	:	IEEE802.11a: 5180-5240MHz,5260-5320MHz,5500-5700MHz,5745-5825MHz IEEE 802.11n HT20: 5180-5240MHz,5260-5320MHz,5500-5700MHz,5745-5825MHz IEEE 802.11n HT40: 5190-5230MHz,5270-5310MHz,5510-5670MHz,5755-5795MHz IEEE 802. 11ac20: 5180-5240MHz,5260-5320MHz,5500-5700MHz,5745-5825MHz IEEE 802. 11ac40: 5190-5230MHz,5270-5310MHz,5510-5670MHz,5755-5795MHz IEEE 802. 11ac80: 5210MHz,5290MHz,5530MHz,5610MHz,5775MHz IEEE 802. 11ac160: 5250MHz,5570MHz IEEE 802. 11ax20: 5180-5240MHz,5260-5320MHz,5500-5700MHz,5745-5825MHz IEEE 802. 11ax40: 5190-5230MHz,5270-5310MHz,5510-5670MHz,5755-5795MHz IEEE 802. 11ax80: 5210MHz,5290MHz,5530MHz,5610MHz,5775MHz IEEE 802. 11ax160: 5250MHz,5570MHz
Channel No.	:	4 Channels for 20MHz bandwidth(5180-5240MHz) 4 Channels for 20MHz bandwidth(5260-5320MHz) 11 Channels for 20MHz bandwidth(5500-5700MHz) 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 2 channels for 40MHz bandwidth(5270~5310MHz) 5 Channels for 40MHz bandwidth(5510-5670MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channel for 80MHz bandwidth(5210MHz) 1 channel for 80MHz bandwidth(5290MHz) 2 Channels for 80MHz bandwidth(5530MHz,5610MHz) 1 channel for 80MHz bandwidth(5775MHz) 1 Channel for 160MHz bandwidth(5250MHz) 1 channel for 160MHz bandwidth(5570MHz)
Modulation	:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11ac20/40/80/160: OFDM(64QAM, 16QAM, QPSK, BPSK,256QAM) IEEE 802.11ax20/40/80/160: OFDM(64QAM, 16QAM, QPSK, BPSK,256QAM,1024QAM)

TPC	:	☑NO ☐Yes
Antenna Type	:	External antenna1, Maximum Gain is 3.0dBi. External antenna2, Maximum Gain is 3.0dBi.
Software version	:	11.4cs2
Hardware version	:	1.0
Intend use environment	:	Residential, commercial and light industrial environment
Note	:	Antenna information is provided by applicant. Testing lab is not responsible for the accuracy of the information.

1.2.Accessories of Device (EUT)

Accessories : /

Manufacturer : /

Model : /

Ratings : /

1.3.Tested Supporting System Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDoC
1.	Notebook PC	Dell	Inspiron 5539	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
Note: master ping IP 192.168.1.1 for salve.					

1.4. Test Conditions

Items	Required	Actual
Temperature range:	15-35℃	25℃
Humidity range:	25-75%	56%
Pressure range:	86-106kPa	101kPa

1.5.Test Facility

Shenzhen Huaxin Information Technology Service Co., Ltd
101, R & D Building, No.3 guansheng 4th Road, Luhu Community， Guanhu Street, Longhua District, Shenzhen, Guangdong, China

FCC Test Firm Registration Number: 932271
Designation Number: CN1344
CAB ID ：CN0147
ISED#：31786

1.6. Measurement Uncertainty (95% confidence levels, k=2)

Item	MU	Remark
Conducted Emission（9K～0.15MHz）	2.18dB	
Conducted Emission（0.15M～30MHz）	2.17dB	
Radiation Emission ,3m (30MHz～1GHz)	4.45 dB	Polarize: V
	2.76 dB	Polarize: H
Radiation Emission, 3m (1GHz～6GHz)	4.02 dB	
Radiation Emission ,3m (6GHz～18GHz)	4.30 dB	
RF output power (conducted)	0.41 dB	
Power Spectral Density (conducted)	0.39 dB	
Spurious emissions (conducted)	0.59 dB	
Occupied Channel Bandwidth (conducted)	4.22%	

2. EQUIPMENT LIST

Equipment	Manufacturer	Model No.	Firmware version	Serial No.	Last cal.	Cal. Due day
9*6*6 anechoic chamber	Mao Rui	9*6*6m	/	N/A	2022.06.15	2025.06.14
EMI receiver	R&S	ESR7	5.812	102543	2023.10.20	2024.10.19
Spectrum analyzer	R&S	FSV40-N	V7.0-4-62-2	101795	2023.09.19	2024.09.18
Pre-amplifier	HP	8447D	/	1616A02061	2023.04.15	2024.04.14
Pre-amplifier	Agilent	8449B	/	9008A00551	2023.04.15	2024.04.14
Bilog Antenna	Schwarzbeck	VULB 9168	/	/	2022.06.19	2024.06.18
Horn antenna	A.H. System, Inc	SAS-571	/	915	2023.06.17	2024.06.16
Loop Antenna	Schwarzbeck	FMZB 1519B	/	/	2023.06.17	2024.06.16
LISN	R&S	ENV216		101291	2023.06.17	2024.06.16
LISN	R&S	ESH3-Z5		894981/024	2023.06.17	2024.06.16
Analog signal Generato	Agilent	N5181A	A.01.87	MY47421151	2023.09.17	2024.09.16
Vector Signal Generator	Keysight	N5182A	A.01.87	MY50140428	2023.09.17	2024.09.16
Wideband Radio communication tester	R&S	CMW500	V3.7.22	157762	2023.09.17	2024.09.16
Spectrum analyzer	Agilent	N9020A	A.14.16	MY51280803	2023.04.15	2024.04.14
RF Cable	/	(10G)9m	/	/	2023.09.17	2024.09.16
RF Cable	/	(10G)10m	/	/	2023.09.17	2024.09.16
RF Cable	/	(18G)10m	/	/	2023.09.17	2024.09.16
attenuation pad	/	6dB	/	/	2023.09.17	2024.09.16
attenuation pad	/	10dB	/	16280012	2023.09.17	2024.09.16

Software Information			
Test Item	Software Name	Manufacturer	Version
RE	EMC-I	SKET	V1.4.0.1
CE	EMC-I	SKET	V1.4.0.1
RF-CE	RTS	TACHOY	V1.0.0

3. Summary of Test Results

Clause	Test Parameter	Remarks	Pass/Fail
§ 15.407	DFS Detection Threshold	Required	Pass
§ 15.407	Channel Availability Check Time	Required	Pass
§ 15.407	Channel Move Time	Required	Pass
§ 15.407	Channel Closing Transmission Time	Required	Pass
§ 15.407	Non- Occupancy Period	Required	Pass
§ 15.407	Statistical Performance Check	Required	Pass
§ 15.407	U-NII Detection Bandwidth	Required	Pass
Test Mode			
Device operating in master mode. Master with injection at the Master. (Radar Test Waveforms are injected into the Master)			

4. U-NII DFS Rule Requirements

Applicability of DFS requirements

The manufacturer shall state whether the UUT is capable of operating as a Master and/or a Client. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See tables 1 and 2 for the applicability of DFS requirements for each of the operational modes.

Table 1: Applicability of DFS requirements prior to use 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	□ 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 Detection
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 widest BW mode available
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 20MHz channels and the channel center frequency.		

Test Limits and Radar Signal Parameters

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 pectral 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: E.I.R.P is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.

Calibration:

For a detection threshold level of -62dBm and the max antenna gain is 3 dBi required

detection threshold is -59dBm=(-62+3)dBm.

To meet the stringent requirement, the DFS test used the detection threshold level of -62dBm.

Note: EIRP < 200 milliwatt and Power pectral density < 10 dBm/MHz in this report, so detection threshold level is -62dB

Table 4: DFS Response Requirement Values

Parameter	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 UNII 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.

PARAMETERS OF DFS TEST SIGNALS

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	Roundup $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	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	6-10	200-500	16-18	60%	30
4	11-20	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.

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

The aggregate is the average of the percentage of successful detections of Short Pulse RadarTypes 1-4.
For example, the following table indicates how to compute the aggregate of percentage of successful detections.

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	35	29	82.9%
2	30	18	60%
3	30	27	90%
4	50	44	88%
Aggregate (82.9% + 60% + 90% + 88%)/4 = 80.2%			

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 waveform are randomly chosen（The center frequency for each of the 30 trials of the Bin 5 radar shall be randomly selected within 80% of the Occupied Bandwidth.）

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 waveforms, then each additional waveform must also be unique and not repeated from the previous waveforms.

Figure 1 provides a graphical representation of the Long Pulse Radar Test Waveform.

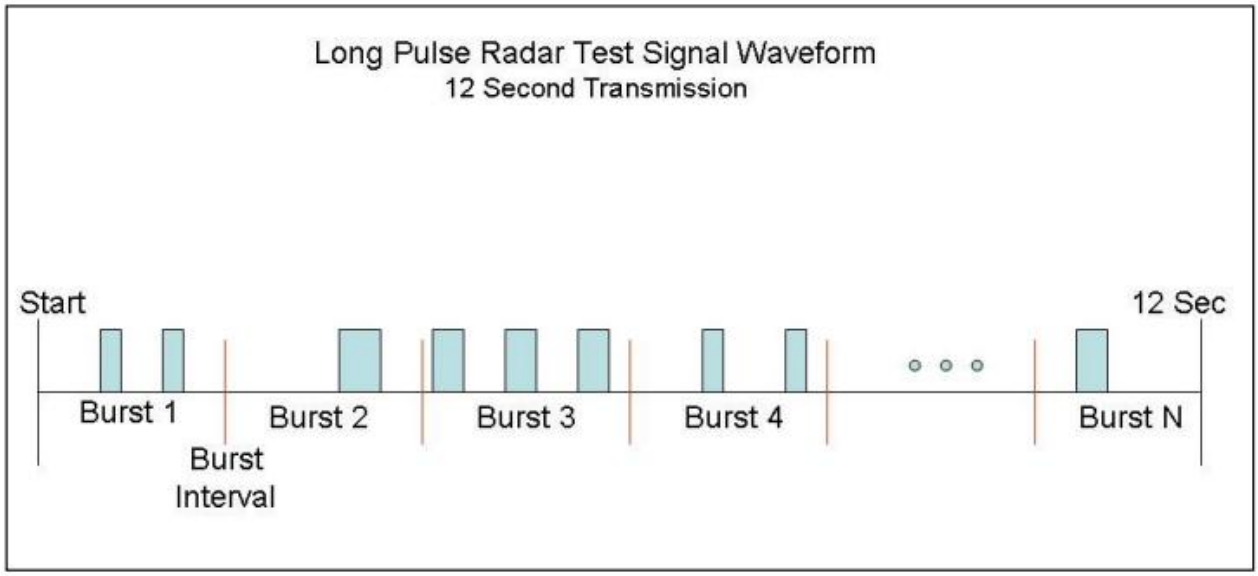


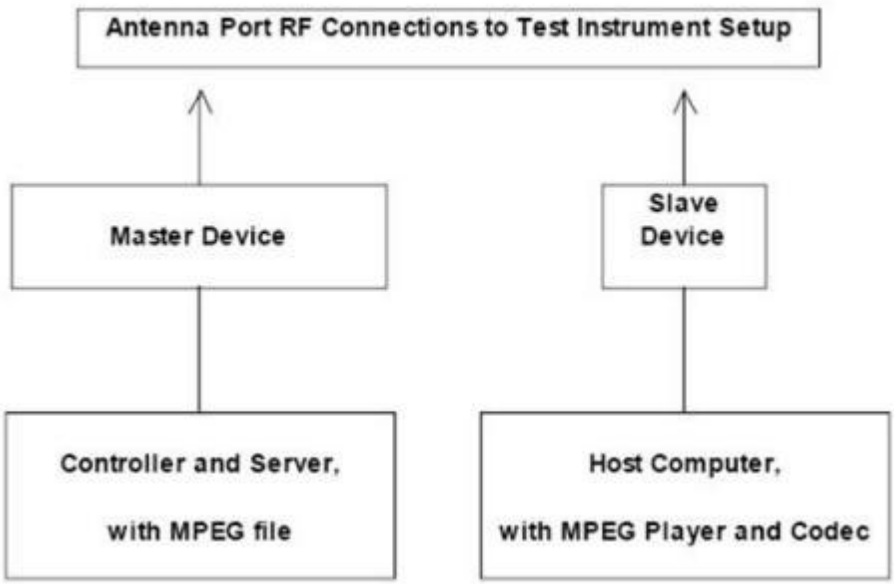
Table 7: Frequency Hopping Radar Test Waveform

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
6	1	333	9	0.333	300	70%	30

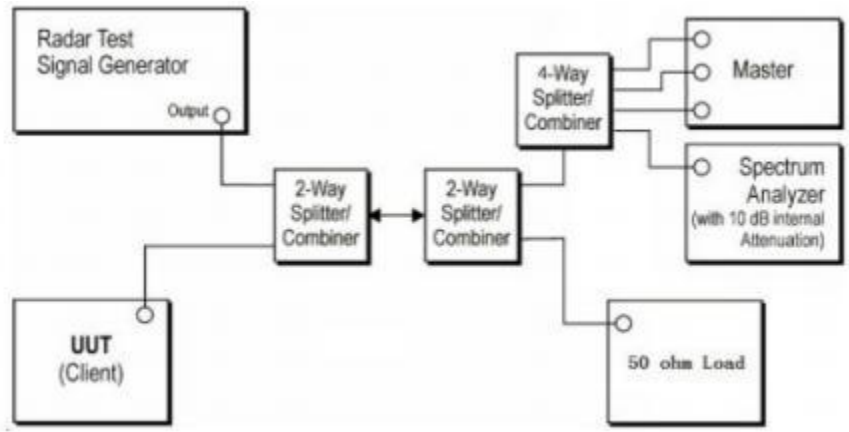
5. Calibration of Radar Waveform

Test Procedure

1. A 50 ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected in place of the master device and the signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –62dBm as measured on the spectrum analyzer.
2. Without changing any of the instrument settings, the spectrum analyzer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. Measure the amplitude and calculate the difference from –62dBm. Adjust the Reference Level Offset of the spectrum analyzer to this difference.
3. 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 –62dBm and the spectrum analyzer will still indicate the level as received by the Master Device.
4. Set the signal generator to produce a radar waveform, trigger a burst manually and measure the level on the spectrum analyzer. Readjust the amplitude of the signal generator as required so that the peak level of the waveform is at a displayed level equal to the required or desired interference detection threshold. Separate signal generator amplitude settings are determined as required for each radar type.



Conducted Calibration Test Setup



Deviation from Test Standard

No Deviation

Radar Waveform Calibration Result

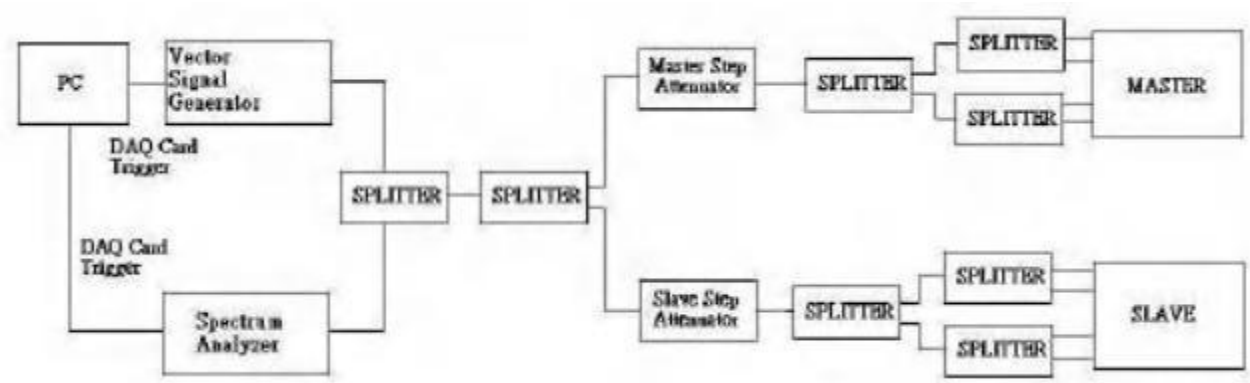
Please refer to separated files for APPENDIX I TEST RESULTS.

6. U-NII DFS Testing

Test Procedure

1. Master device and client device are set up by conduction method as the following configuration.
2. The client device is connected to notebook and to access a IP address on wireless connection with the master device.
3. Then the master device is connected to another notebook to access a IP address.
4. Finally, let the two IP addresses run traffic with each other through the Run flow software “Lan test20” to reach 17% channel loading as below:

Test Setup



Channel Loading

Please refer to separated files for APPENDIX I TEST RESULTS.

7. Testing Results

7.1 Channel Availability Check Time

If the UUT successfully detected the radar burst, it should be observed as the UUT has no transmissions occurred until the UUT starts transmitting on another channel.

Test Result

Please refer to separated files for APPENDIX I TEST RESULTS.（CAC Initial, CAC Begin and CAC End）

7.2 Statistical Performance check

Test Result

Please refer to separated files for APPENDIX I TEST RESULTS.

7.3 Non-occupancy Period

Test Result

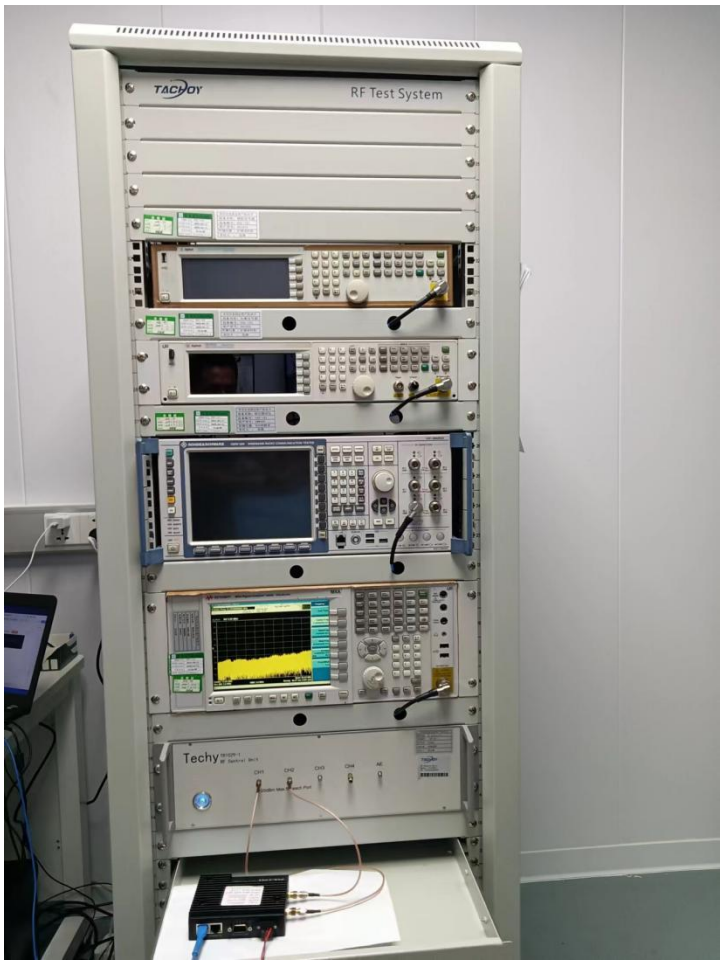
Please refer to separated files for APPENDIX I TEST RESULTS.(Shutdown&Non-Occupancy)

7.4 U-NII Detection Bandwidth

Test Result

Please refer to separated files for APPENDIX I TEST RESULTS.

8. Test Setup Photos of the EUT



9. Photos of the EUT

Please refer to separated files for APPENDIX II External Photos and APPENDIX III Internal Photos.

********** End of Report **********