

DFS TEST REPORT

Applicant: Balena Ltd.

Address of Applicant: 6th Floor, One London Wall London, London, EC2Y 5EB
United Kingdom

Equipment Under Test (EUT)

Product Name: balenaFin

Model No.: v1.1

Trade mark: balenaFin

Applicable standards: ETSI EN 301 893 V 2.1.1 (2017-05)

Date of sample receipt: 23 Aug., 2019

Date of Test: 24 Aug., 2019 to 03 Aug., 2020

Date of report issued: 24 Aug., 2020

Test Result: PASS*

*In the configuration tested, the EUT complied with the standards specified above.

The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EC Declaration of Conformity and compliance with all relevant EC Directives. The protection requirements with respect to electromagnetic compatibility contained in Directive 2014/53/EU are considered.



Bruce Zhang
Laboratory Manager



This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the CCIS product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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2 Version

Version No.	Date	Description
00	05 Aug., 2020	Original
01	24 Aug., 2020	Update Page 5

Tested by: Carey Chen
Test Engineer

Date: 24 Aug., 2020

Reviewed by: Winner Zhang
Project Engineer

Date: 24 Aug., 2020

3 Contents

	Page
1 COVER PAGE.....	1
2 VERSION	2
3 CONTENTS	3
4 TEST SUMMARY	4
5 GENERAL INFORMATION.....	5
5.1 CLIENT INFORMATION	5
5.2 GENERAL DESCRIPTION OF E.U.T.	5
5.3 TEST ENVIRONMENT AND TEST MODE	6
5.4 DESCRIPTION OF SUPPORT UNITS.....	6
5.5 LABORATORY FACILITY	6
5.6 LABORATORY LOCATION	6
5.7 TEST INSTRUMENTS LIST.....	6
6 DFS TECHNICAL REQUIREMENTS.....	7
6.1 DFS PARAMETERS	7
6.2 DFS TECHNICAL REQUIREMENTS	10
6.3 DFS THRESHOLD LEVEL	10
6.4 TEST SETUP BLOCK.....	10
6.5 EUT CONFIGURATION FOR DFS TEST	11
7 TEST RESULT	12
7.1 VERIFICATION OF RADAR TYPE AND LEVEL	12
7.2 CHANNEL SHUTDOWN AND Non-OCCUPANCY PERIOD.....	14
8 TEST SETUP PHOTO	16
9 EUT CONSTRUCTIONAL DETAILS	17

4 Test Summary

Test Item	Test Requirement	Test method	Result
ETSI EN 301 893 V 2.1.1			
Channel Availability Check	Clause 4.2.6.2.2	Clause 5.4.8.2.1.2	N/A
Radar Detection Threshold	Clause 4.2.6.2.2	Clause 5.4.8.2.1.3	N/A
Off-Channel CAC	Clause 4.2.6.2.3	Clause 5.4.8.2.1.4	N/A
In-Service Monitoring	Clause 4.2.6.2.4	Clause 5.4.8.2.1.5	N/A
Channel Shutdown	Clause 4.2.6.2.5	Clause 5.4.8.2.1.6	Pass
Non-Occupancy Period	Clause 4.2.6.2.6	Clause 5.4.8.2.1.6	N/A
Uniform Spreading	Clause 4.2.6.2.7	/	N/A
User Access Restriction	Clause 4.2.9	/	N/A
Note: 1. Pass means meet the requirements, N/A means not applicable 2. The cable insertion loss used by "RF Output Power" and other conduction measurement items is 0.5dB (provided by the customer).			

5 General Information

5.1 Client Information

Applicant:	Balena Ltd.
Address:	6th Floor, One London Wall London, London, EC2Y 5EB United Kingdom
Manufacturer:	Balena Ltd.
Address:	6th Floor, One London Wall London, London, EC2Y 5EB United Kingdom
Factory:	Fae Technology S.p.a.
Address:	Via C. Battisti, 136 Gazzaniga (BG) 24025 - Italia

5.2 General Description of E.U.T.

Product Name:	balenaFin
Model No.:	v1.1
Transmitter frequency range:	5150MHz~5350MHz, 5470MHz~5725MHz
Hardware version:	v10
Software version:	v2.51
Modulation type:	OFDM
Antenna Type:	Internal Antenna External Antenna
Antenna Gain:	Internal Antenna: 1dBi External Antenna: 2dBi
DFS Operation Type:	<input type="checkbox"/> Master Device <input type="checkbox"/> Slaver Device with Radar detection function <input checked="" type="checkbox"/> Slaver Device without Radar detection function
Power supply:	DC6V-30V

5.3 Test Environment and test mode

Temperature:	20 ~ 25 °C
Humidity:	60% ~ 65%
Atmospheric pressure:	1012 kPa
Test mode:	Keep the EUT in normal operation mode.

5.4 Description of Support Units

Manufacturer	Description	Model	Serial Number
LENOVO	Laptop	SL510	2847A65
WAVLINK	WiFi Router	WL-WN575A2	WL1512260097

5.5 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **FCC - Designation No.: CN1211**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been accredited as a testing laboratory by FCC(Federal Communications Commission). The test firm Registration No. is 727551.

● **ISED – CAB identifier.: CN0021**

The 3m Semi-anechoic chamber of Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

● **A2LA - Registration No.: 4346.01**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: <https://portal.a2la.org/scopepdf/4346-01.pdf>

5.6 Laboratory Location

Shenzhen Zhongjian Nanfang Testing Co., Ltd.

Address: No.110~116, Building B, Jinyuan Business Building, Xixiang Road, Bao'an District, Shenzhen, Guangdong, China

Tel: +86-755-23118282, Fax: +86-755-23116366

Email: info@ccis-cb.com, Website: <http://www.ccis-cb.com>

5.7 Test Instruments list

Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
Spectrum Analyser	Agilent	N9020A	MY50510123	11-18-2019	11-17- 2020
Vector Signal Generator	Agilent	N5182A	MY49060014	11-18-2019	11-17- 2020
RF Switch Unit	Ascentest	AT890-RFB	--	--	--
DFS Test Software	MWRFTTEST	MTS 8310	Version: 2.0.0.0		
N7607B Signal Studio	KEYSIGHT	--	Version: 2.0.0.1		

6 DFS Technical Requirements

6.1 DFS Parameters

DFS parameters in EN 301 893 V2.1.1

Table D.1: DFS requirement values	
Parameter	Value
Channel Availability Check Time	60 s (see note 1)
Minimum Off-Channel CAC Time	6 minutes (see note 2)
Maximum Off-Channel CAC Time	4 hours (see note 2)
Channel Move Time	10 s
Channel Closing Transmission Time	1 s
Non-Occupancy Time	30 minutes
Note 1: For channels whose nominal bandwidth falls completely or partly within the band 5 600 MHz to 5 650 MHz, the <i>Channel Availability Check Time</i> shall be 10 minutes.	
Note 2: For channels whose nominal bandwidth falls completely or partly within the band 5 600 MHz to 5 650 MHz, the <i>Off-Channel CAC Time</i> shall be within the range 1 hour to 24 hours.	

Table D.2: Interference threshold values	
e.i.r.p. Spectral Density (dBm/MHz)	Value (see note 1 and 2)
10	-62 dBm
Note 1: This is the level at the input of the receiver of an RLAN device with a maximum e.i.r.p. density of 10 dBm/MHz and assuming a 0 dBi receive antenna. For devices employing different e.i.r.p. spectral density and/or a different receive antenna gain G (dBi) the DFS threshold level at the receiver input follows the following relationship: DFS Detection Threshold (dBm) = -62 + 10 · e.i.r.p. Spectral Density (dBm/MHz) + G (dBi); however the DFS threshold level shall not be less than -64 dBm assuming a 0 dBi receive antenna gain.	
Note 2: Slave devices with a maximum e.i.r.p. of less than 23 dBm do not have to implement radar detection unless these devices are used in fixed outdoor point to point or fixed outdoor point to multipoint applications (see clause 4.7.1.3).	

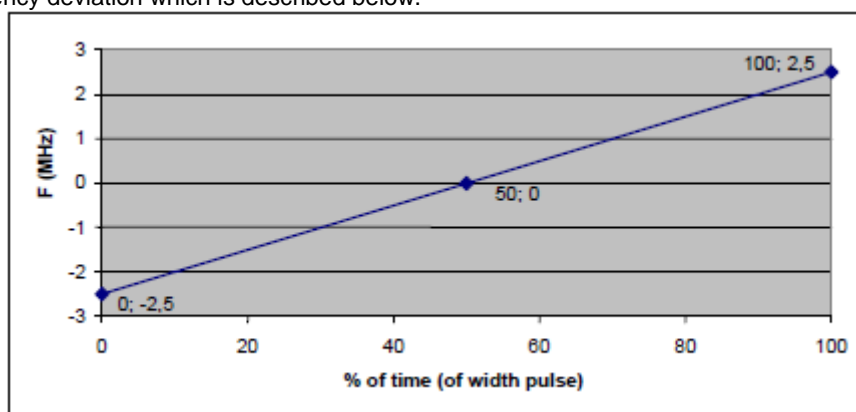
Table D.3: Parameters of the reference DFS test signal		
Pulse width W [μs]	Pulse repetition frequency PRF [PPS]	Pulses per burst [PPB]
1	700	18

Table D.4: DFS requirement values

Radar test signal # (see note 1 to 3)	Pulse width W [μ s]		Pulse repetition frequency PRF (PPS)		Number of Different PRFs	Pulses per burst for each PRF (PPB) (see note 5)
	Min	Max	Min	Max		
1	0.5	5	200	1000	1	10 (see note 6)
2	0.5	15	200	1600	1	15 (see note 6)
3	0.5	15	2300	4000	1	25
4	20	30	2000	4000	1	20
5	0.5	2	300	400	2/3	10 (see note 6)
6	0.5	2	400	1200	2/3	15 (see note 6)

Note 1: Radar test signals #1 to #4 are constant PRF based signals. See figure D.1. These radar test signals are intended to simulate also radars using a packet based Staggered PRF. See figure D.2.

Note 2: Radar test signal #4 is a modulated radar test signal. The modulation to be used is a chirp modulation with a $\pm 2,5$ MHz frequency deviation which is described below.



Note 3: Radar test signals #5 and #6 are single pulse based Staggered PRF radar test signals using 2 or 3 different PRF values. For radar test signal #5, the difference between the PRF values chosen shall be between 20 PPS and 50 PPS. For radar test signal #6, the difference between the PRF values chosen shall be between 80 PPS and 400 PPS. See figure D.3.

Note 4: Apart for the Off-Channel CAC testing, the radar test signals above shall only contain a single burst of pulses. See figure D.1, figure D.3 and figure D.4. For the Off-Channel CAC testing, repetitive bursts shall be used for the total duration of the test. See figure D.2 and figure D.5. See also clause 4.7.2.3, clause 5.3.8.2.1.4.2 and clause 5.3.8.2.1.4.3.

Note 5: The total number of pulses in a burst is equal to the number of pulses for a single PRF multiplied by the number of different PRFs used.

Note 6: For the CAC and Off-Channel CAC requirements, the minimum number of pulses (for each PRF) for any of the radar test signals to be detected in the band 5 600 MHz to 5 650 MHz shall be 18.

Table D.5: Detection probability

Parameter	Detection Probability (Pd)	
	Channels whose nominal bandwidth falls partly or completely within the 5 600 MHz to 5 650 MHz band	Other channels
CAC, Off-Channel CAC	99.99%	60%
In-Service Monitoring	60%	60%

Note: Pd gives the probability of detection per simulated radar burst and represents a minimum level of detection performance under defined conditions. Therefore Pd does not represent the overall detection probability for any particular radar under real life conditions.

Figure D.1: General structure of a single burst/constant PRF based radar test signal

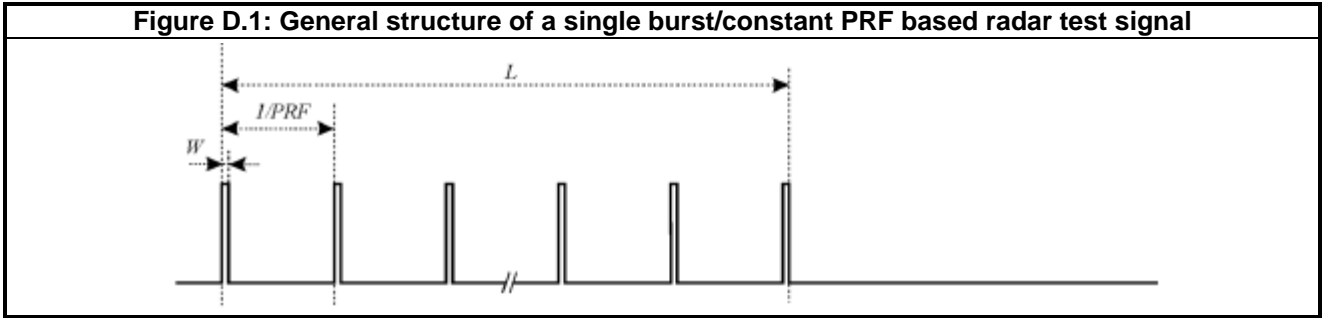


Figure D.2: General structure of a multiple burst/constant PRF based radar test signal

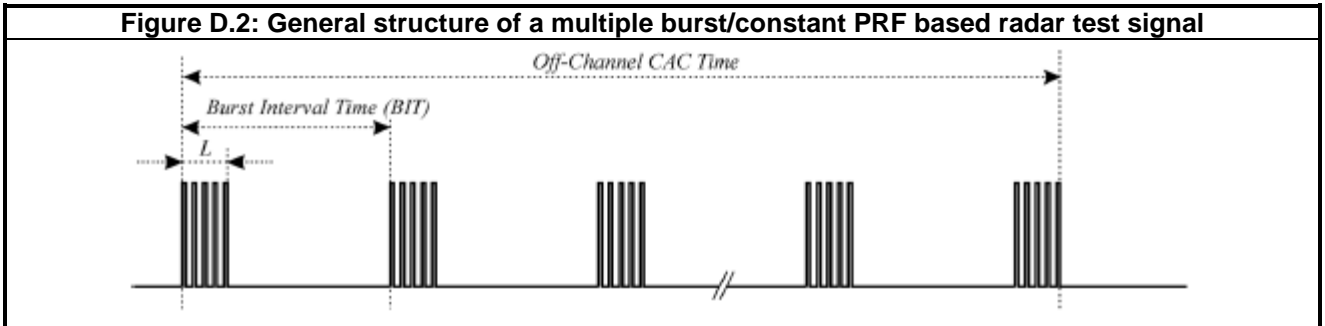


Figure D.3: General structure of a single burst/single pulse based staggered PRF radar test signal

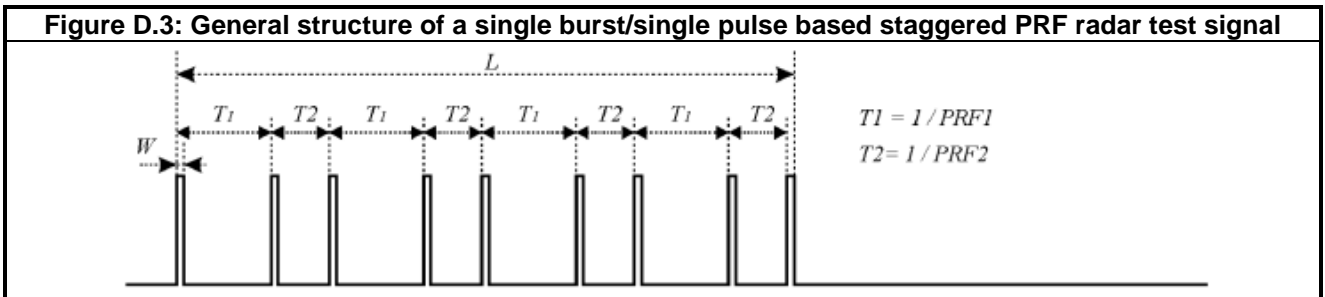


Figure D.4: General structure of a single burst/packet based staggered PRF radar test signal

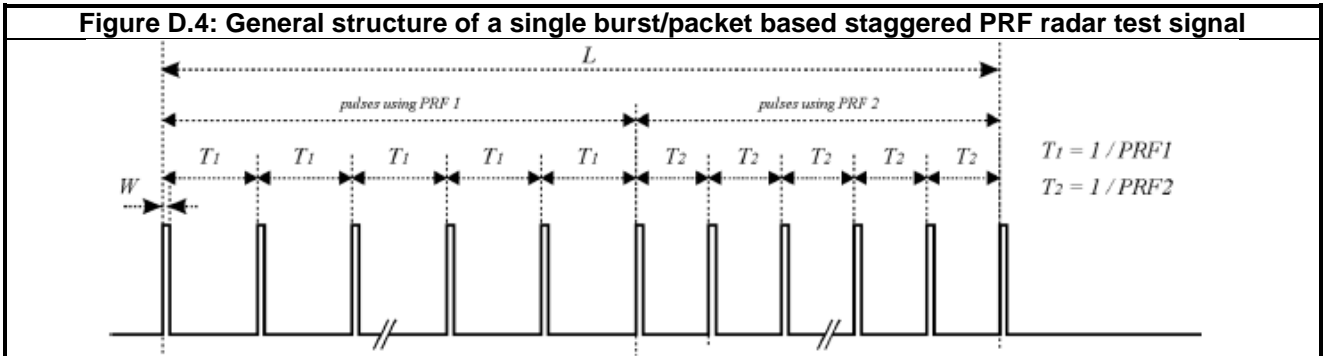
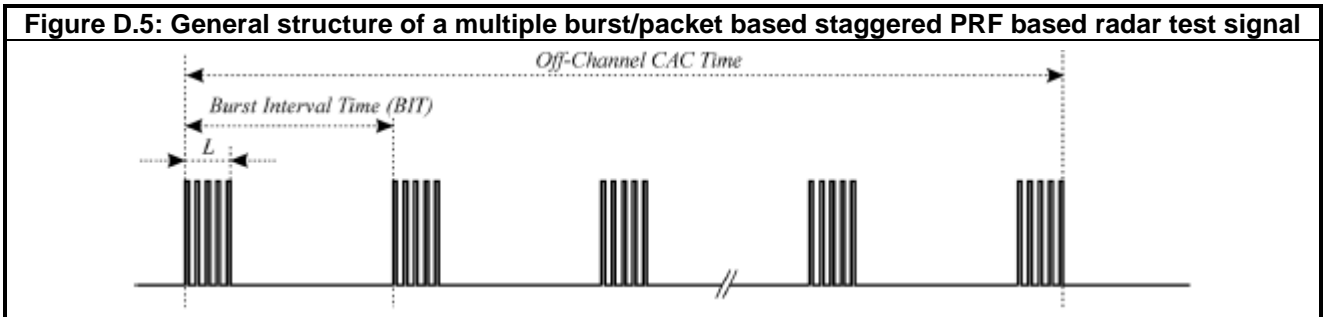


Figure D.5: General structure of a multiple burst/packet based staggered PRF based radar test signal



6.2 DFS Technical Requirements

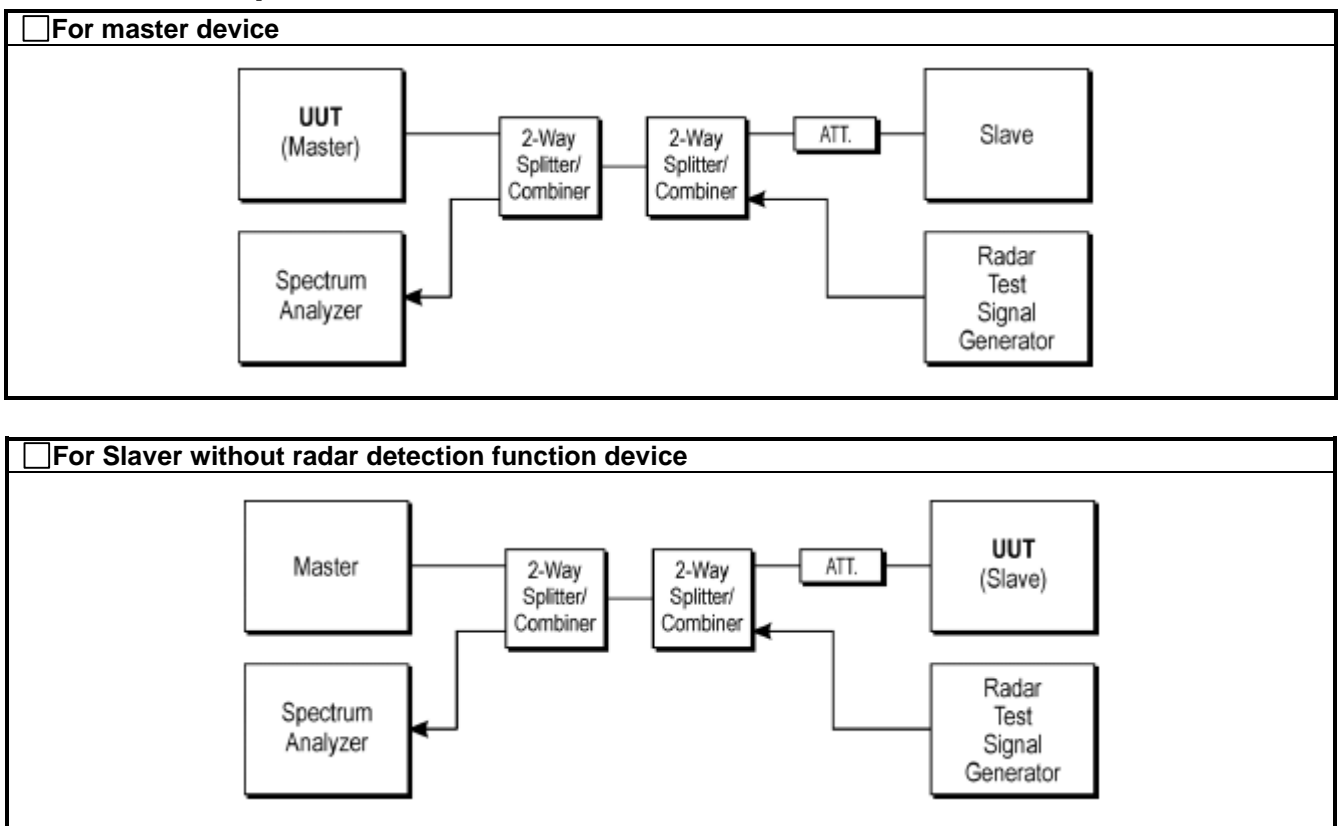
Requirement	DFS Operational mode		
	Master	Slave without Radar Detection (see note 2)	Slave with Radar Detection(see note 2)
Channel Availability Check	√	Not Required	√ (see note 2)
Off-channel CAC (see note 1)	√	Not Required	√ (see note 2)
In-Service Monitoring	√	Not Required	√
Channel Shutdown	√	√	√
Non-occupancy period	√	Not Required	√
Uniform Spreading	√	Not Required	Not Required

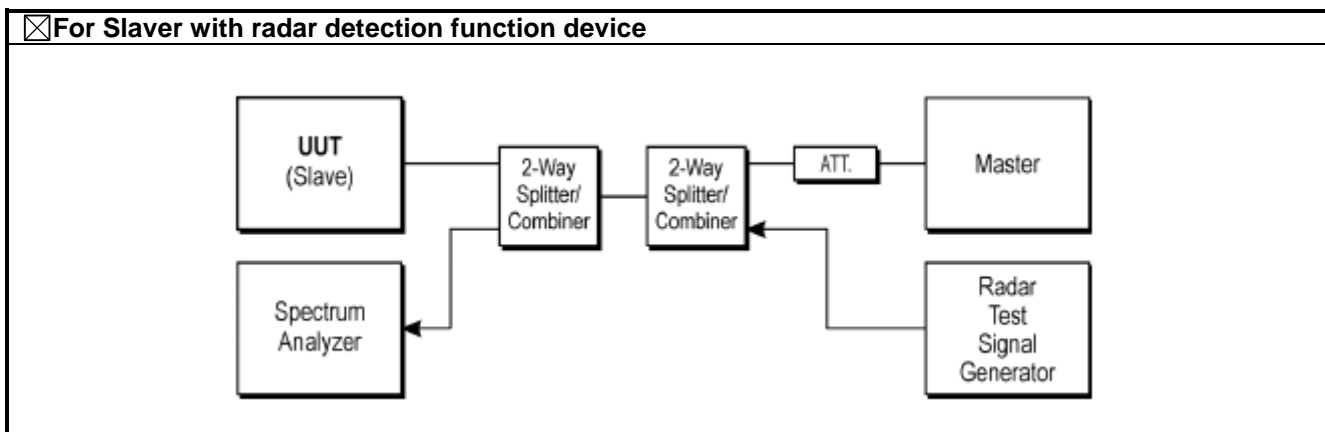
Note 1: Where implemented by the manufacturer.
 Note 2: A slave with radar detection is not required to perform a CAC or Off-Channel CAC at initial use of the channel but only after the slave has detected a radar signal on the Operating Channel by In-Service Monitoring.

6.3 DFS Threshold Level

DFS Threshold Level	
5470MHz ~ 5725MHz	-62 dBm @ antenna connector
Note: The worst case level was selected to perform the test.	

6.4 Test Setup Block



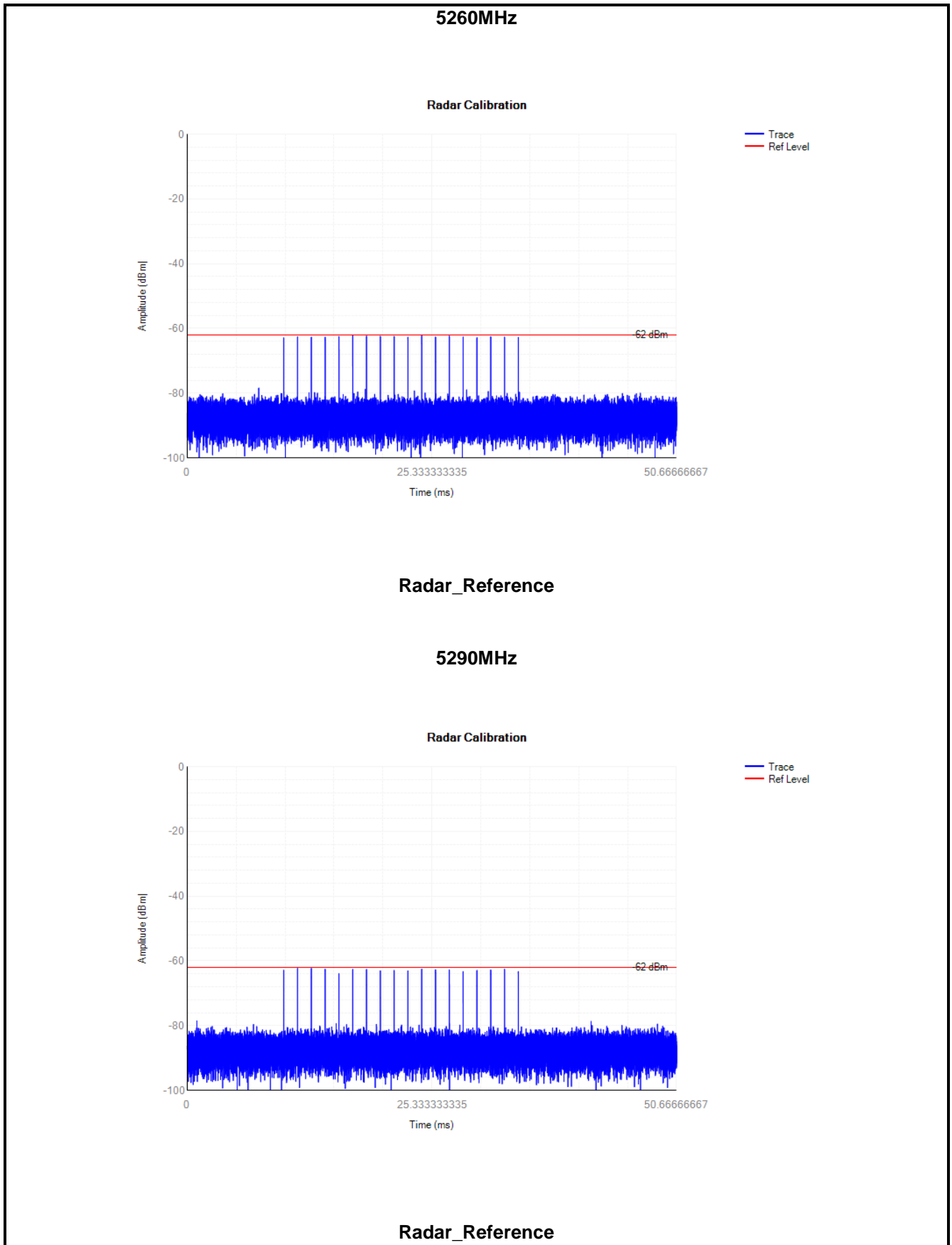


6.5 EUT Configuration for DFS Test

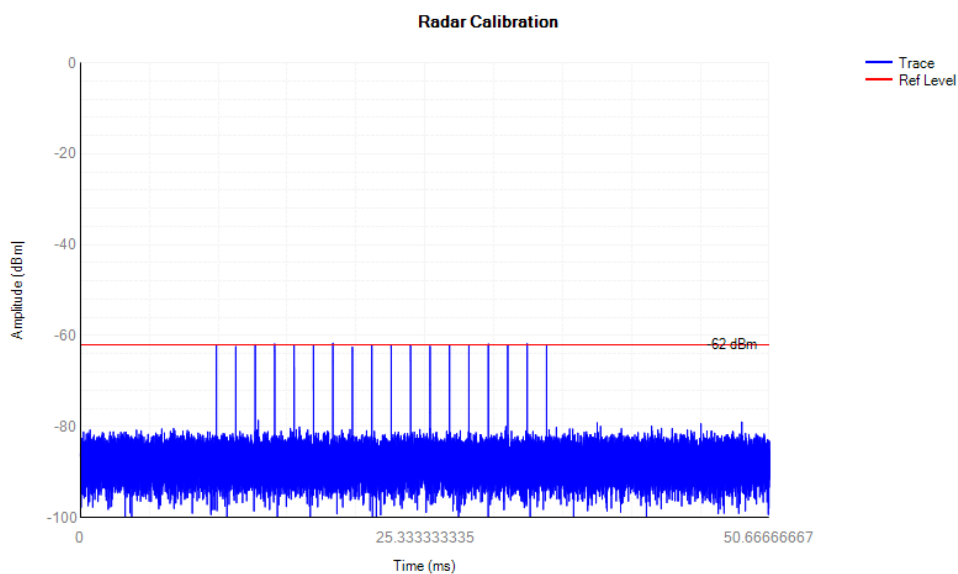
Test Items	Channel Frequency	Operation mode
Channel Shutdown	5260MHz, 5290MHz 5500MHz, 5610MHz	802.11a, 802.11ac

7 Test Result

7.1 Verification of Radar Type and Level

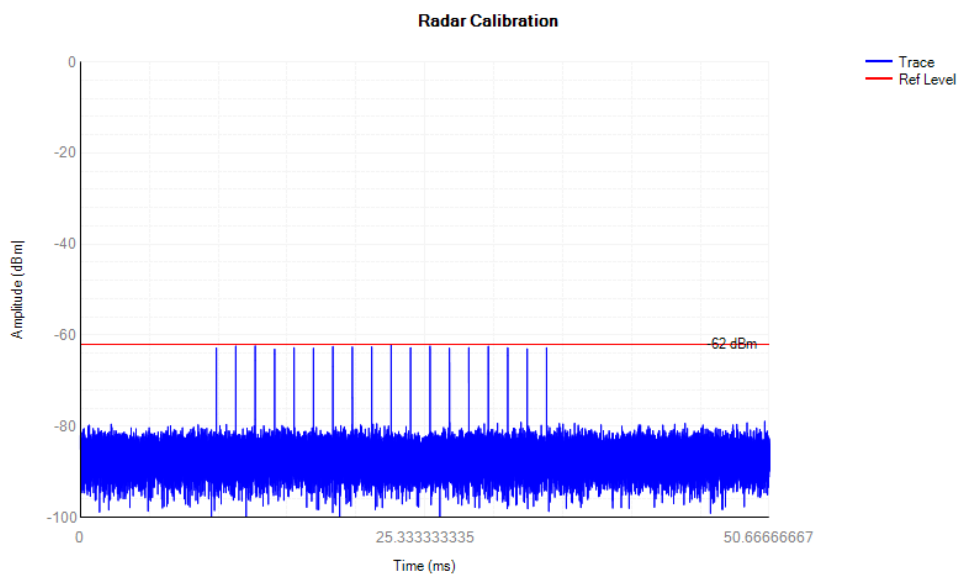


5500MHz



Radar_Reference

5610MHz

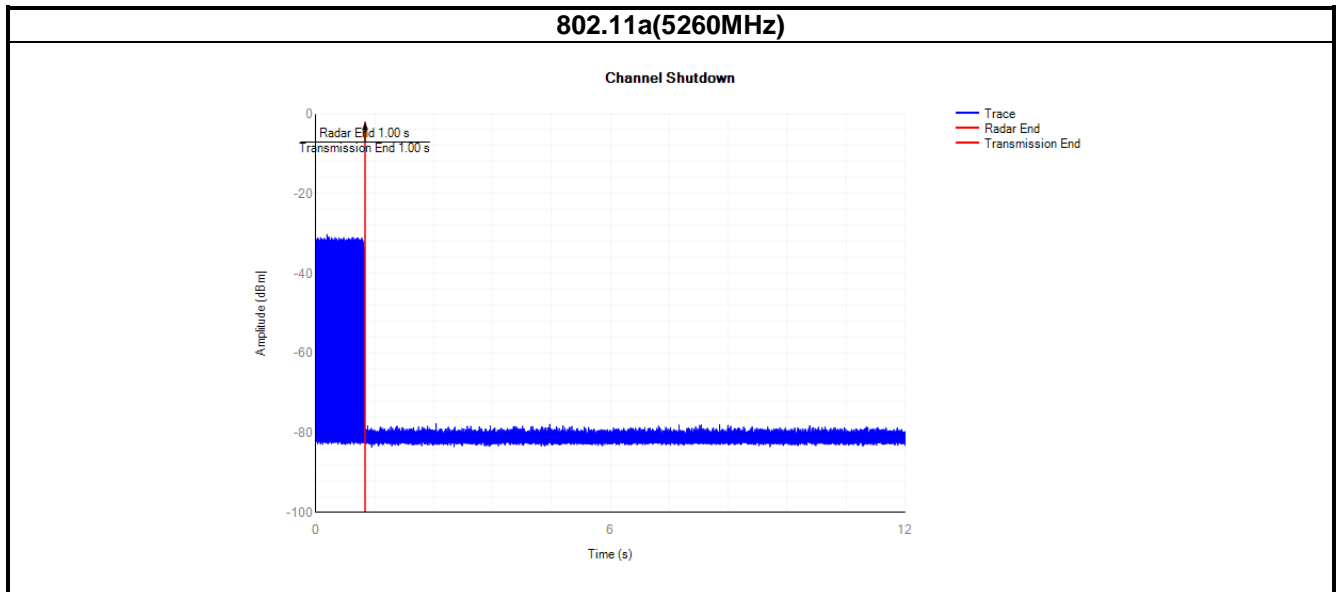


Radar_Reference

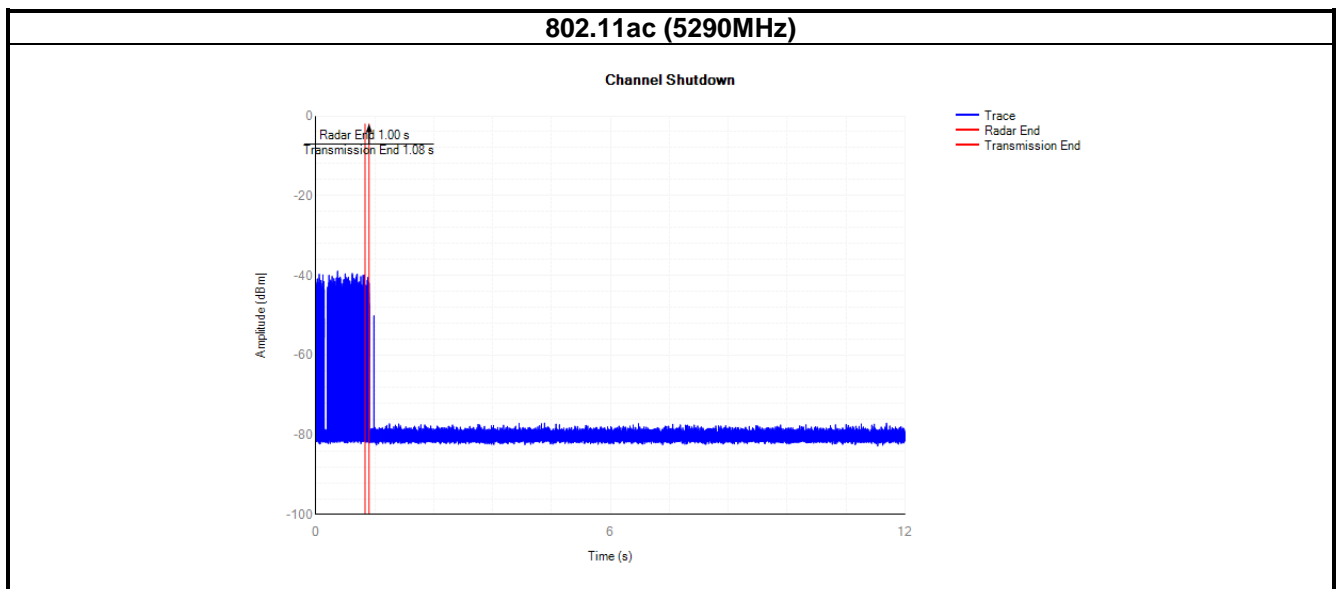
7.2 Channel Shutdown and Non-Occupancy Period

Channel Closing Transmission Time and Channel Move Time

EN 301 893 V2.1.1

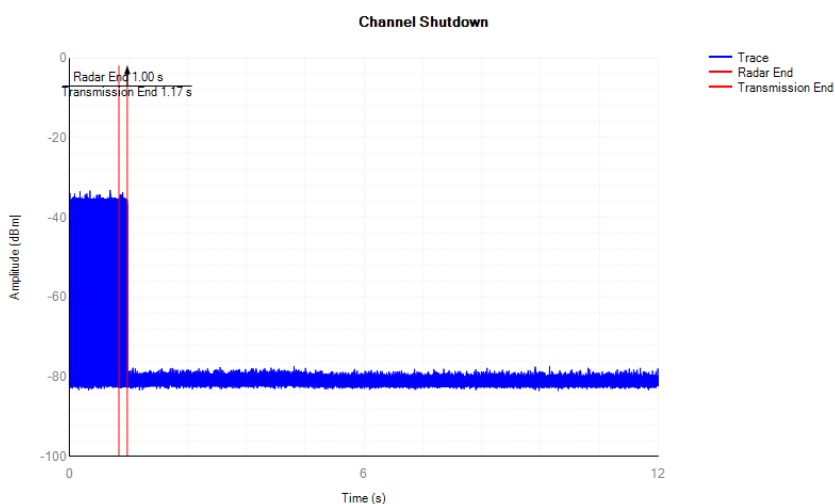


Test Items	Value	Limit
Channel Closing Transmission Time	0 ms	1 s
Channel Move Time	0 ms	10 s



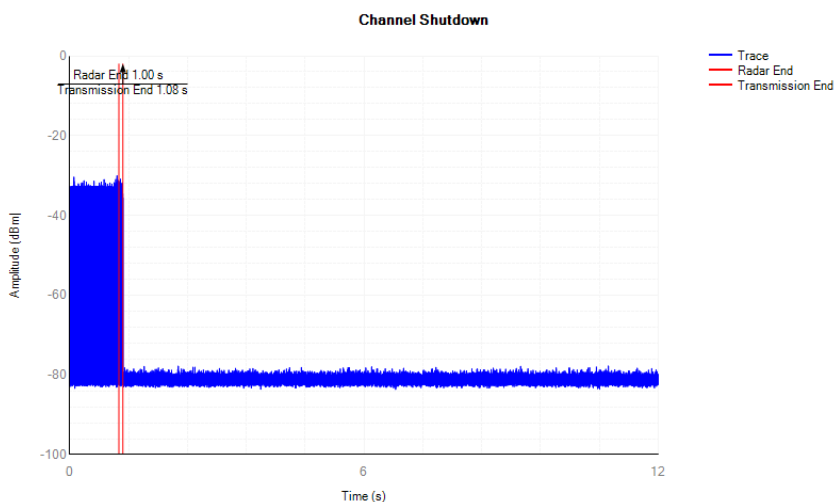
Test Items	Value	Limit
Channel Closing Transmission Time	24 ms	1 s
Channel Move Time	85 ms	10 s

802.11a(5500MHz)



Test Items	Value	Limit
Channel Closing Transmission Time	29 ms	1 s
Channel Move Time	178 ms	10 s

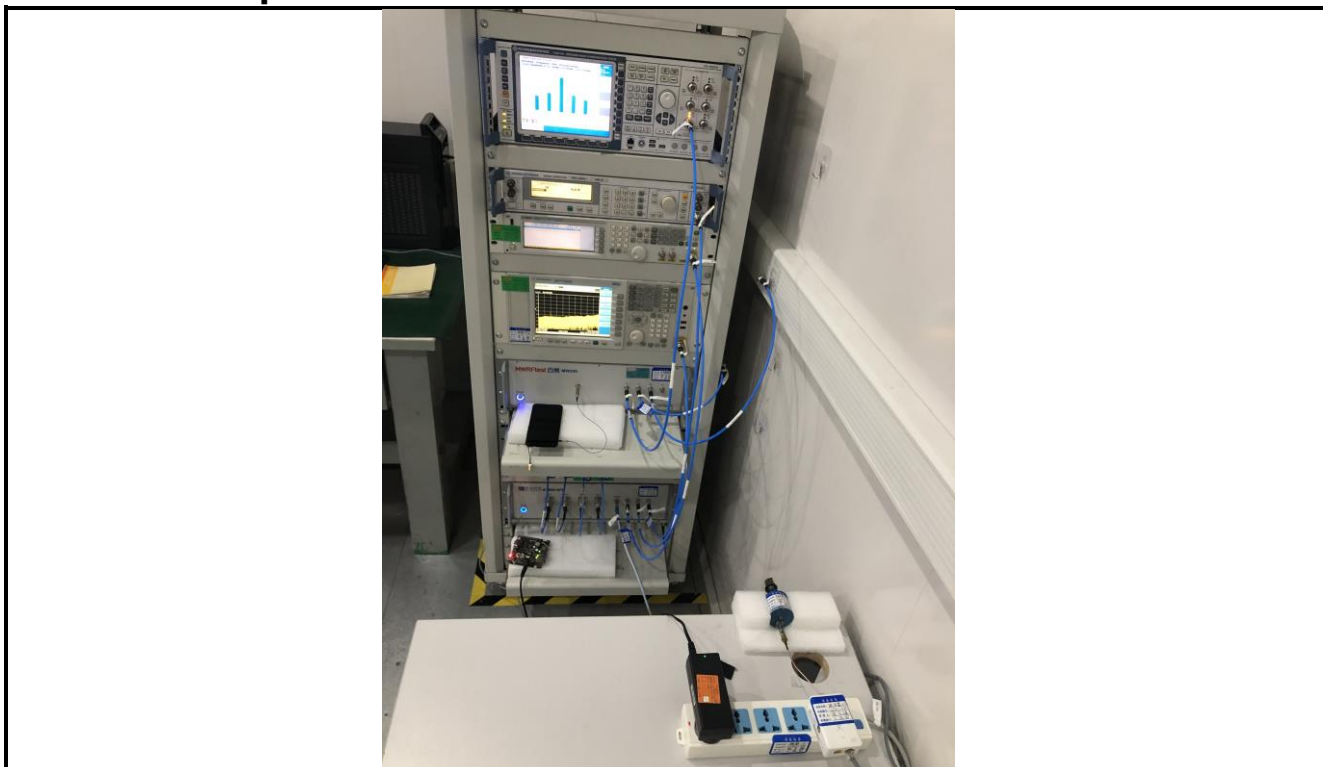
802.11ac(5290MHz)



Test Items	Value	Limit
Channel Closing Transmission Time	24 ms	1 s
Channel Move Time	86 ms	10 s

Test Result: Pass

8 Test Setup Photo



9 EUT Constructional Details

Reference to the test report No. CCISE190807901.

----- End of report -----