

RF Test Report

Applicant: Quectel Wireless Solutions Co., Ltd.

Address: Building 5, Shanghai Business Park Phase III (Area B), No.1016
Tianlin Road, Minhang District, Shanghai, 200233, China

Product: Wi-Fi & Bluetooth Module

Model No.: FCS852R

Brand Name: QUECTEL

FCC ID: XMR2023FCS852R

Standards: FCC CFR47 Part 15C

Report No.: PD20230218RF12

Issue Date: 2024/03/01

Test Result: PASS *

* The above equipment has been tested and compliance with the requirement of the relative standards by Hefei Panwin Technology Co., Ltd.



Reviewed By: Charlie Wang



Approved By: Alec Yang

Hefei Panwin Technology Co., Ltd.

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Test Report

Report No.: PD20230218RF12
Report Version: 01

Revision History

Report No.	Version	Description	Issue Date	Note
PD20230218RF12	01	Initial Report	2024/03/01	Valid

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Test Summary

No.	Test Case	Clause in FCC rules	Verdict
1	DFS Detection Threshold	15.407/KDB 905462 5.2	PASS
2	Channel Move Time	15.407/KDB 905462 7.8.3	PASS
3	Channel Closing Transmission Time	15.407/KDB 905462 7.8.3	PASS
4	Non-Occupancy Period(NOP)	15.407/KDB 905462 7.8.3	PASS
Date of Testing:2023/12/16 to 2023/12/28 Date of Sample Received: 2023/12/07			
- We, Hefei Panwin Technology Co., Ltd., would like to declare that the tested sample has been evaluated in accordance with the procedures given in applied standard(s) in Section 2.3 of this report and shown compliance with the applicable technical standards. - All indications of PASS/FAIL in this report are based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

1 Test Laboratory

1.1 Notes of the Test Report

This report is invalid without signature of auditor and approver or with any alterations. The report shall not be partially reproduced without written approval of the testing company. Entrusted test results are only responsible for incoming samples. If there is any objection to the testing report, it shall be raised to the testing company within 15 days from the date of receiving the report. In the test results, "NA" means "not applicable", and the test items marked with "Δ" are subcontracted projects.

1.2 Test Facility

FCC (Designation number: CN1361, Test Firm Registration Number: 473156)

Hefei Panwin Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

A2LA (Certificate Number: 6849.01)

Hefei Panwin Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

1.3 Testing Laboratory

Company Name	Hefei Panwin Technology Co., Ltd.
Address	Floor 1, Zone E, Plant 2#, Mingzhu Industrial Park, No.106 Chuangxin Avenue, High-tech Zone, Hefei City, Anhui Province, China
Telephone	+86-0551-63811775
Post Code	230031

2 General Description of Equipment under Test

2.1 Details of Application

Applicant	Quectel Wireless Solutions Co., Ltd.
Applicant Address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, 200233, China
Manufacturer	Quectel Wireless Solutions Co., Ltd.
Manufacturer Address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, 200233, China

2.2 Details of EUT

Product	Wi-Fi & Bluetooth Module
Model	FCS852R
SN	E1823K90Q000124
HW Version	R1.0
SW Version	NA
Antenna Type	External Antenna
Operating Frequency Range(s)	U-NII-2A: 5250MHZ-5350MHz U-NI-2C: 5470MHZ-5725MHz
Modulation Type	WLAN 802.11a/n/ac:BPSK,QPSK,16QAM,64QAM,256QAM
Operating Mode	☐ Master ☐ Slave with radar detection ☒ Slave without radar detection
Note: The declared of product specification for EUT and/or Antenna presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.	

2.3 Applied Standards

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

Test standards:

- FCC CFR47 Part 15E Unlicensed National Information Infrastructure Devices

Reference standard:

- FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

3 Test Condition

3.1 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 $\geq$ 200 milliwatt	-64dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64dBm

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 MMO devices refer to KDB Publication 662911 D01.

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 Note1
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second periods see Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.

Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.

Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

3.2 Radar Test Waveforms

Table 5 Short Pulse Radar Test Waveforms

Radar type	Pulse Width W (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	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.					

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

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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 Radar Types1-4. 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%

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. 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.

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 waveform. The hopping sequence is different for each waveform 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 - 5724 MHz. 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.

3.3 Test setups

Setup for Master with Injection at the Master

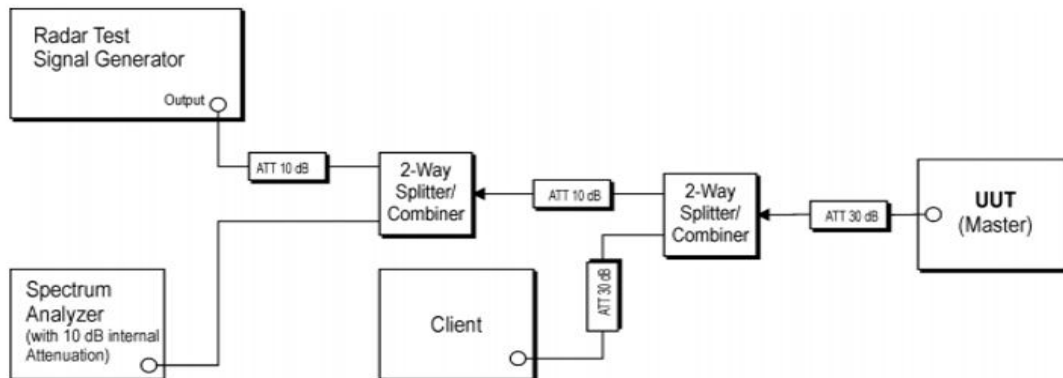


Figure 2: Example Conducted Setup where UUT is a Master and Radar Test Waveforms are injected into the Master

Setup for Client with Injection at the Master

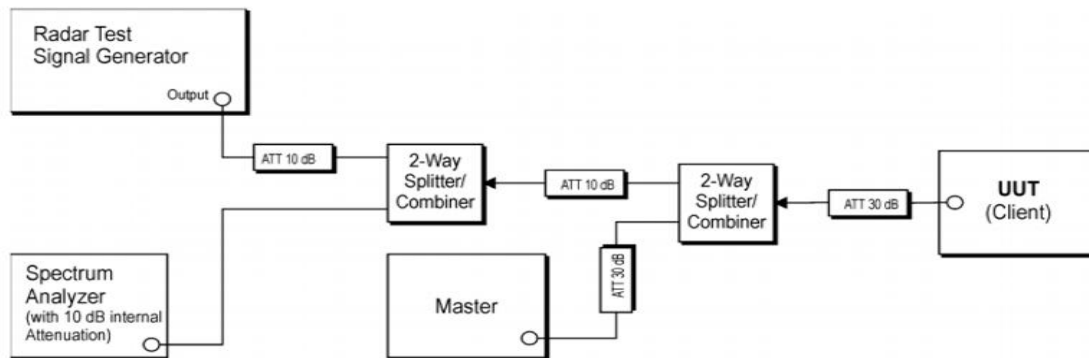


Figure 3: Example Conducted Setup where UUT is a Client and Radar Test Waveforms are injected into the Master

Setup for Client with Injection at the Client

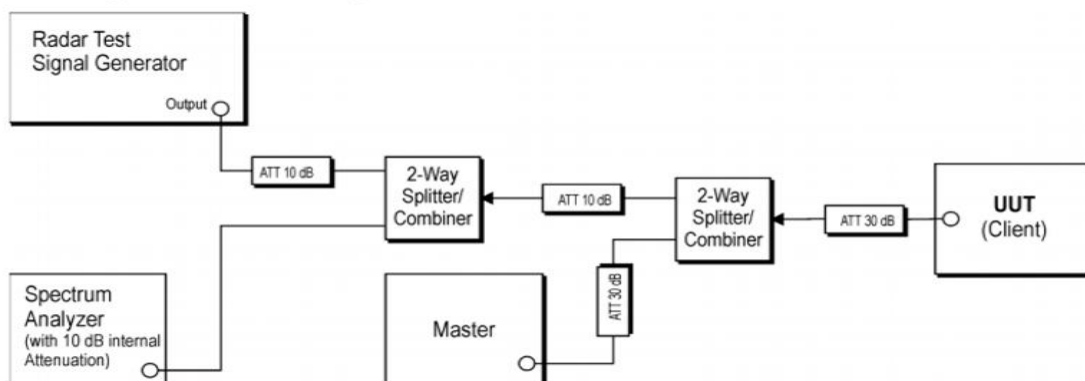


Figure 4: Example Conducted Setup where UUT is a Client and Radar Test Waveforms are injected into the Client

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3.4 Equipment List

Instrument	Manufacturer	Model	Asset No.	Cal. Interval	Cal. Due Date
Spectrum Analyzer	R&S	FSV3044	PWC0009	1 Year	2024/10/11
Vector Signal Generator	R&S	SMBV100B	PWC0011	1 Year	2024/10/11
Power Meter Unit	Tonscend	JS0806-2-8CH	PWC0013	1 Year	2024/10/13
DC Power	KEYSIGHT	E3640A	PWC0046	1 Year	2024/10/11
Shielded Chamber	MIX-BEP	SR 433	PWC0001	3 Years	2024/08/08
Test Software	Tonsecod	JS1120-3 V3.2.22	/	/	/

3.5 Support Equipment List

Equipment	Manufacturer	Description	Model	Serial Number
EVb	QUECTEL	/	/	/
USB Cable	/	/	/	/
Adapter	Xiamen Xinsenhai Electronics Co., Ltd	Output:12V 60W	P60EB120500	/
Router	ASUS	Frequency:2.4/5GHz	RT-AX88U	MBIG39002452JZX

4 Test Items Description

Ambient condition

Shielded Chamber

Temperature [°C]	21.1 to 25.1
Humidity [%RH]	25 to 33
Pressure [kPa]	101.4 to 103.2

4.1. DFS Detection Thresholds

Methods of Measurement

Client with injection at the Master.

For a detection threshold level of -64dBm, the required signal strength at EUT antenna location is -64dBm, the tested level is lower than required level hence it provides margin to the limit.

Frequency of Calibration	
Bandwidth	Central Frequency
20MHz	5260
	5500
40MHz	5270
	5510
80MHz	5290
	5610

Test Results:

See Appendix A.1.

4.2 Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period

Methods of Measurement

These tests define how the following DFS parameters are verified during In-Service Monitoring:

- Channel Closing Transmission Time
- Channel Move Time
- Non-Occupancy Period

The steps below define the procedure to determine the above mentioned parameters 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).

1. One frequency will be chosen from the Operating Channels of the EUT within the 5250-5350 MHz or 5470-5725 MHz bands. For 802.11 devices, the test frequency must contain control signals. This can be verified by disabling channel loading and monitoring the spectrum analyzer. If no control signals are detected, another frequency must be selected within the emission bandwidth where control signals are detected.
2. In case the EUT is a U-NII device operating as a Client Device (with or without DFS), a U-NII device operating as a Master Device will be used to allow the EUT (Client device) to Associate with the Master Device. In case the EUT is a Master Device, a U-NII device operating as a Client Device will be used and it is assumed that the Client will Associate with the EUT (Master). In both cases for conducted tests, the Radar Waveform generator will be connected to the Master Device. For radiated tests, the emissions of the Radar Waveform generator will be directed towards the Master Device. If the Master Device has antenna gain, the main beam of the antenna will be directed toward the radar emitter. Vertical polarization is used for testing.
3. Stream the channel loading test file from the Master Device to the Client Device on the test Channel for the entire period of the test.
4. At time T_0 the Radar Waveform generator sends a Burst of pulses for one of the Radar Type 0 in Table 5 at levels defined in Table 3, on the Operating Channel. An additional 1 dB is added to the radar test signal to ensure it is at or above the DFS Detection Threshold, accounting for equipment variations/errors.
5. 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). Measure and record the Channel Move Time and Channel Closing Transmission Time if radar detection occurs. Figure 17 illustrates Channel Closing Transmission Time.
6. When operating as a Master Device, monitor the EUT for more than 30 minutes following instant T_2 to verify that the EUT does not resume any transmissions on this Channel. Perform this test once and record the measurement result.
7. In case the EUT is a U-NII device operating as a Client Device with In-Service Monitoring, perform steps 1 to 6.

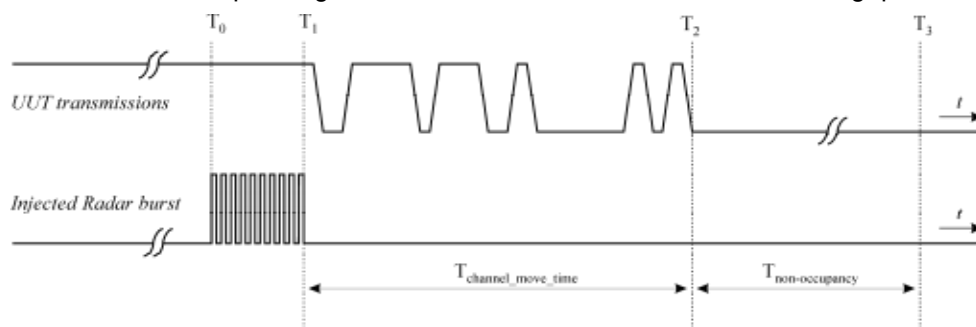


Figure 17: Example of Channel Closing Transmission Time & Channel Closing Time

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Limits

Channel Move Time	$\leq 10s$
Channel Closing Transmission Time	$\leq 200ms + 60ms$ (over remaining 10s period)
Non-Occupancy Period	$\geq 30min$

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 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.

Test Results:

See Appendix A.2.

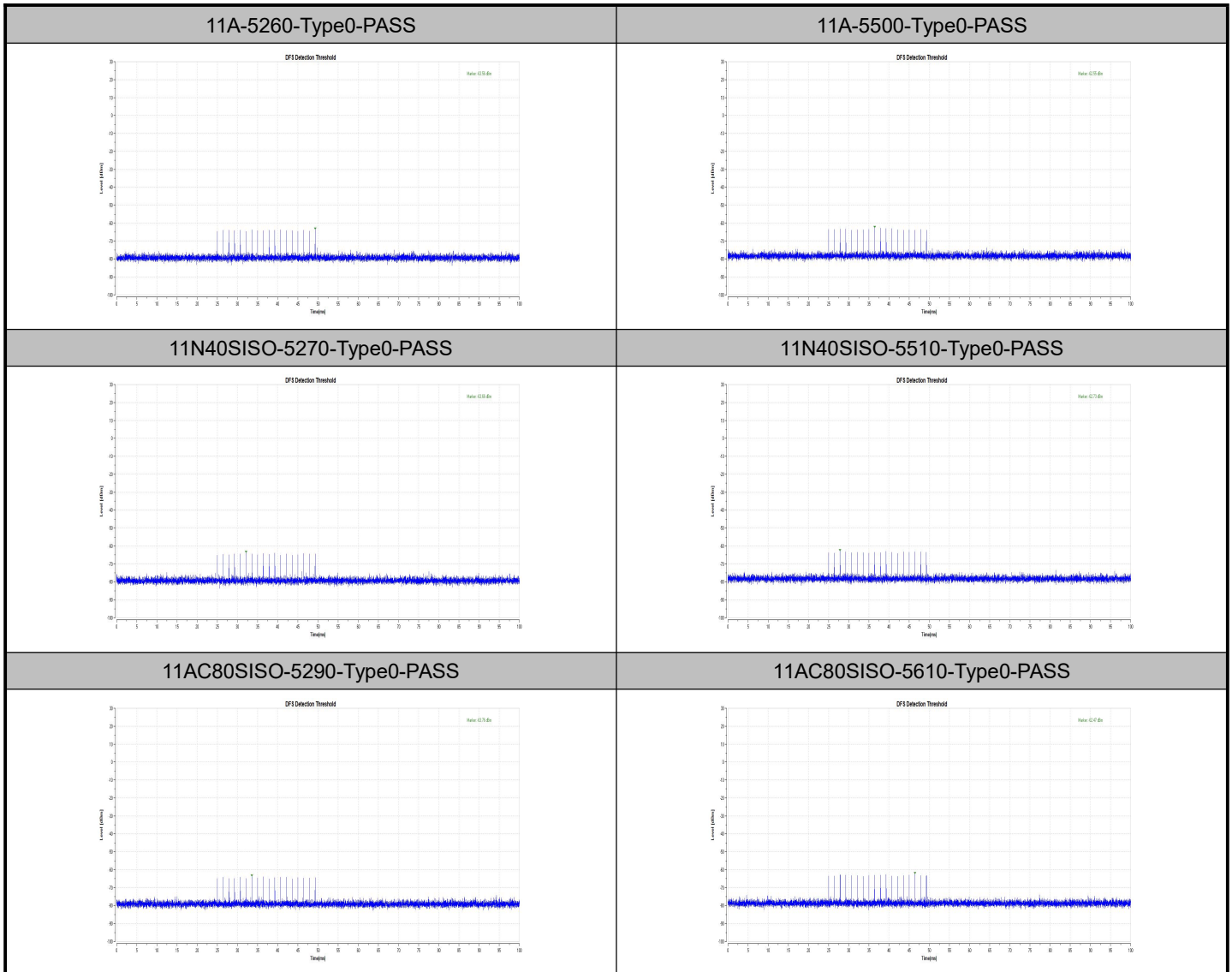
Appendix A – Test Results of Conducted Test

A.1. DFS Detection Thresholds

Test Result

Test Mode	Frequency[MHz]	Radar Type	Result	Limit[dBm]	Verdict
11A	5260	Type0	-63.56	-63.40	PASS
11A	5500	Type0	-62.55	-62.30	PASS
11N40SISO	5270	Type0	-63.66	-63.40	PASS
11N40SISO	5510	Type0	-62.73	-62.30	PASS
11AC80SISO	5290	Type0	-63.76	-63.40	PASS
11AC80SISO	5610	Type0	-62.47	-62.30	PASS

Test Graphs

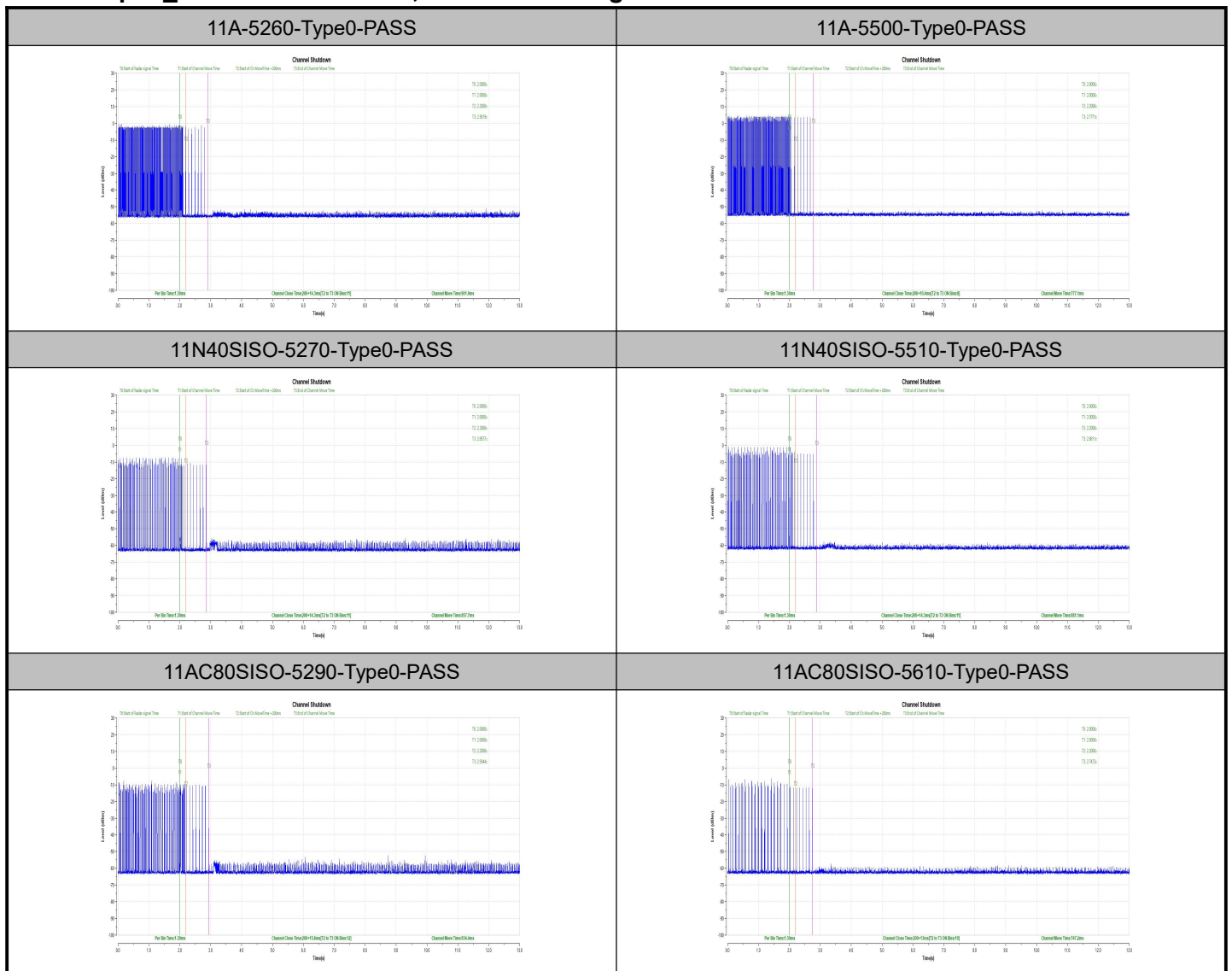


A.2 Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period

Test Result_Channel Move Time, Channel Closing Transmission Time

Test Mode	Frequency[MHz]	CCTT[ms]	Limit[ms]	CMT[ms]	Limit[ms]	Verdict
11A	5260	200+14.3	200+60	901.9	10000	PASS
11A	5500	200+10.4	200+60	777.1	10000	PASS
11N40SISO	5270	200+14.3	200+60	857.7	10000	PASS
11N40SISO	5510	200+14.3	200+60	881.1	10000	PASS
11AC80SISO	5290	200+15.6	200+60	934.4	10000	PASS
11AC80SISO	5610	200+13	200+60	747.2	10000	PASS

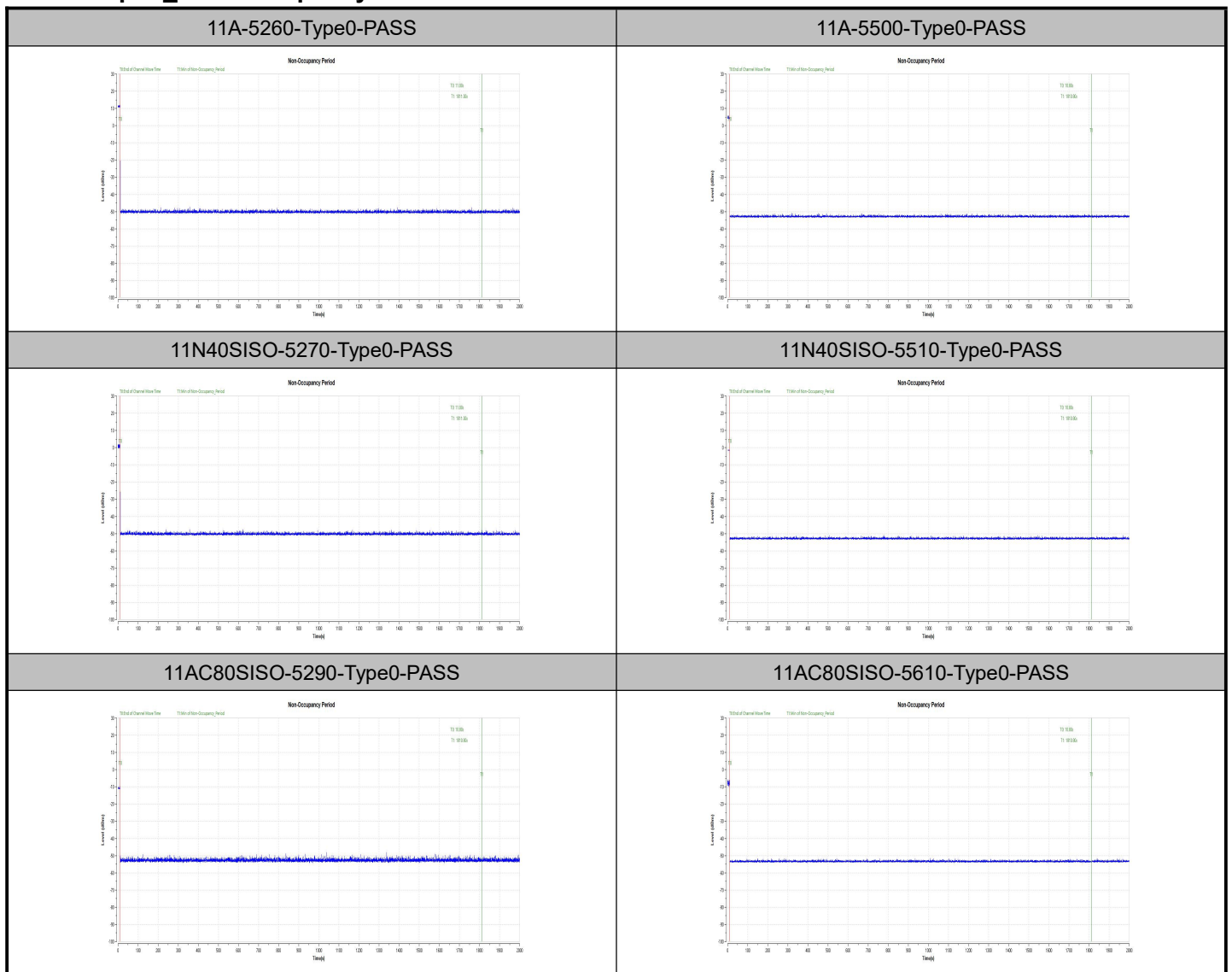
Test Graphs_Channel Move Time, Channel Closing Transmission Time



Test Result_Non-Occupancy Period

Test Mode	Frequency[MHz]	Result	Limit[s]	Verdict
11A	5260	see test graph	≥ 1800	PASS
11A	5500	see test graph	≥ 1800	PASS
11N40SISO	5270	see test graph	≥ 1800	PASS
11N40SISO	5510	see test graph	≥ 1800	PASS
11AC80SISO	5290	see test graph	≥ 1800	PASS
11AC80SISO	5610	see test graph	≥ 1800	PASS

Test Graphs_Non-Occupancy Period



Appendix B – The EUT Appearance

Refer to “Attachment 1: External Photograph” and “ Attachment 2: Internal Photograph” file.

Appendix C – Test Setup Photograph

Refer to “Attachment 5: RF Test Setup Photograph” file.

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