



FCC TEST REPORT

Test report
On Behalf of
EMBUX Technology Co. Ltd.
For
Industrial dual band Wi-Fi radio module
Model No.: MWF220HDB

FCC ID: 2AVW3-MWF220HDB

Prepared for : **EMBUX Technology Co. Ltd.**
13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City 23586, Taiwan

Prepared By : **Shenzhen Tongzhou Testing Co.,Ltd**
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Date of Test: **Jan. 11, 2020 ~ Mar. 03, 2020**

Date of Report: **Mar. 03, 2020**

Report Number: **TZ200301248-E**



TEST RESULT CERTIFICATION

Applicant's name.....: EMBUX Technology Co. Ltd.
Address: 13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City
23586, Taiwan
Manufacture's Name: EMBUX Technology Co. Ltd.
Address: 13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City
23586, Taiwan

Product description

Trade Mark: EMBUX
Product name: Industrial dual band Wi-Fi radio module
Model No: MWF220HDB
Standards: FCC Rules and Regulations Part 15 Subpart C Section 15.247
ANSI C63.10: 2013

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Date of Test..... :
Date (s) of performance of tests: 2020/1/11~ 2020/3/03
Date of Issue: 2020/3/03
Test Result: PASS

Testing Engineer : Anna Hu
(Anna Hu)
Technical Manager : Hugo Chen
(Hugo Chen)
Authorized Signatory : Andy Zhang
(Andy Zhang)



Revision History

Revision	Issue Date	Revisions	Revised By
00	2020/3/03	Initial Issue	Andy Zhang



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1 General Description

1.1 Applicant

EMBUX Technology Co. Ltd.

13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City 23586, Taiwan

1.2 Manufacturer

EMBUX Technology Co. Ltd.

13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City 23586, Taiwan

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	Industrial dual band Wi-Fi radio module
Brand Name	EMBUX
Model Name	MWF220HDB
FCC ID	2AVW3-MWF220HDB
EUT supports Radios application	WLAN 11a/n HT20/HT40
HW Version	V2.0
SW Version	V2.0
EUT Stage	Production Unit

Remark: 1.above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

2.This device is not support TPC.

3.Auxiliary device of master is a NIGHTHAWK X4S SMARTWIFI GAMING ROUTER, It is FCC ID: PY315100319 .

4.We use software to control the auxiliary equipment and EUT transmit the same channel

1.4 Product Specification of Equipment Under Test

Product Specification subjective to this standard	
DFS Function	Client without radar detection function
Tx/Rx Channel Frequency Range	<5250 MHz ~ 5350 MHz> 802.11a/n HT20/HT40 <5470 MHz ~ 5725 MHz> 802.11a/n HT20/HT40
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5250-5350 MHz Band 2 (U-NII-2A)	52	5260	60	5300
	54	5270	62	5310
	56	5280	64	5320
	58	5290		

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5470-5725 MHz Band 3 (U-NII-2C)	100	5500	122	5610
	102	5510	124	5620
	104	5520	126	5630
	106	5530	128	5640
	108	5540	130	5650
	110	5550	132	5660
	112	5560	134	5670
	114	5570	136	5680
	116	5580	138	5690
	118	5590	140	5700
	120	5600		



1.5 Testing Site

Test Site	Shenzhen Tongzhou Testing Co.,Ltd
Test Site Location	1th Floor, Building 1, Haomai High-tech Park, Huating Road 387, Dalang street, Longhua, Shenzhen, China

1.6 Applied Standards

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

- ☒ FCC Part 15 Subpart E
- ☒ FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02
- ☒ FCC KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.



2 Requirements and Parameters for DFS Test

2.1 Applicability of DFS Requirements

EUT is client and operates as client without radar detection function.

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	Client Without Radar Detection	Client With Radar
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
Client Beacon Test	N/A	Yes	Yes



Additional requirements for devices with multiple bandwidth modes	Operational Mode	
	Master 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.		



2.2 Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see notes 1, 2, and 3)
EIRP $\geq$ 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
<p>Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.</p> <p>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.</p> <p>Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.</p>	

The radar *Detection Threshold*, lowest antenna gain is the parameter of Interference *radar DFS detection threshold*, The Interference *Detection Threshold* is the (-62dBm) + (0) [dBi]+ 1 dB= -61 dBm.



2.3 DFS Response requirement values

Parameter	Value
<i>Non-occupancy period</i>	Minimum 30 minutes
<i>Channel Availability Check Time</i>	60 seconds
<i>Channel Move Time</i>	10 seconds See Note 1.
<i>Channel Closing Transmission Time</i>	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
<i>U-NII Detection Bandwidth</i>	Minimum 100% of the 99% power bandwidth See Note 3.

Note 1: The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short pulse radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.

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

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



2.4 Short Pulse Radar Test Waveforms

As the EUT is a Client Device with no Radar Detection, only one type radar pulse is required for the testing. Radar Pulse type 0 was used in the evaluation of the Client device for the purpose of measuring the Channel Move Time and the Channel Closing Transmission Time.

Radar Type	Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	0	1	1428 18	60% 30	30
	1	Test A Test B	Roundup $\left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{PRI_{\mu sec}} \right) \right\}$	60% 30	
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

Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a

Test B: 15 unique PRI values randomly selected within the range of 518-3066 μ sec, with a minimum increment of 1 μ sec, excluding PRI values selected in Test A

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. For short pulse radar type 1, the same waveform is used a minimum of 30 times. 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.

The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

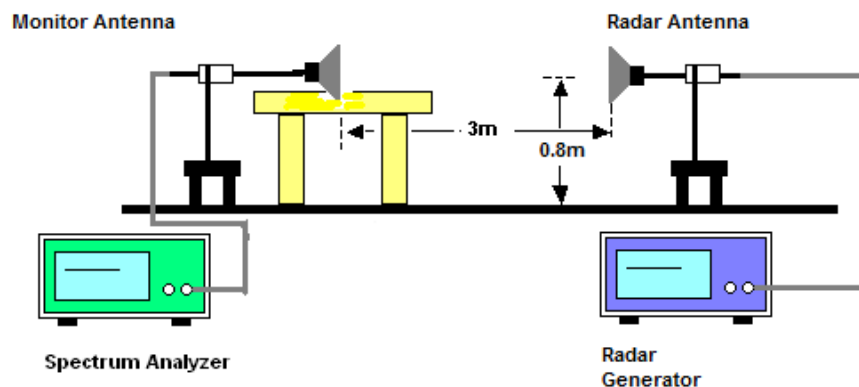
3 Calibration Setup and DFS Test Results

3.1 Calibration of Radar Waveform

3.1.1 Radar Waveform Calibration Procedure

The Interference **Radar Detection Threshold Level** is $(-62\text{dBm}) + (0) [\text{dBi}] + 1 \text{ dB} = -61\text{dBm}$ that had been taken into account the output power range and antenna gain. The following equipment setup was used to calibrate the radiated Radar Waveform. A vector signal generator was utilized to establish the test signal level for radar type 0. During this process there were no transmissions by either the Master or Client Device. 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 3 MHz to measure the type 0 radar waveform. The spectrum analyzer had offset -8.26dB to compensate receiving horn antenna gain 11.80dBi and RF cable loss 3.54dB. The vector signal generator amplitude was set so that the power level measured at the spectrum analyzer was $(-62\text{dBm}) + (0) [\text{dBi}] + 1 \text{ dB} = -61 \text{ dBm}$. Capture the spectrum analyzer plots on short pulse radar waveform.

3.1.2 Radiated Calibration Setup



3.1.3 Calibration Deviation

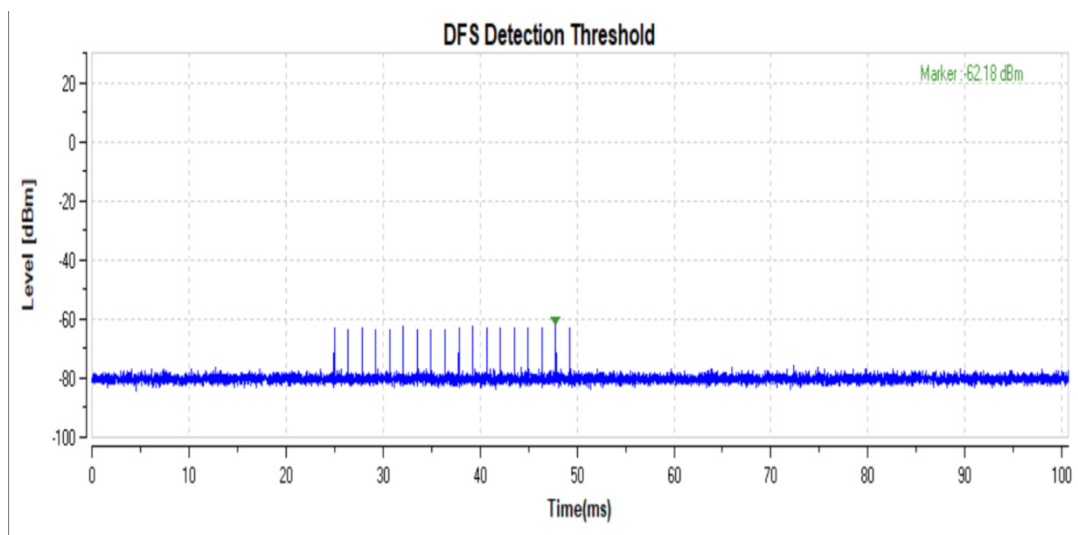
There is no deviation with the original standard.



3.1.4 Radar Waveform Calibration Result

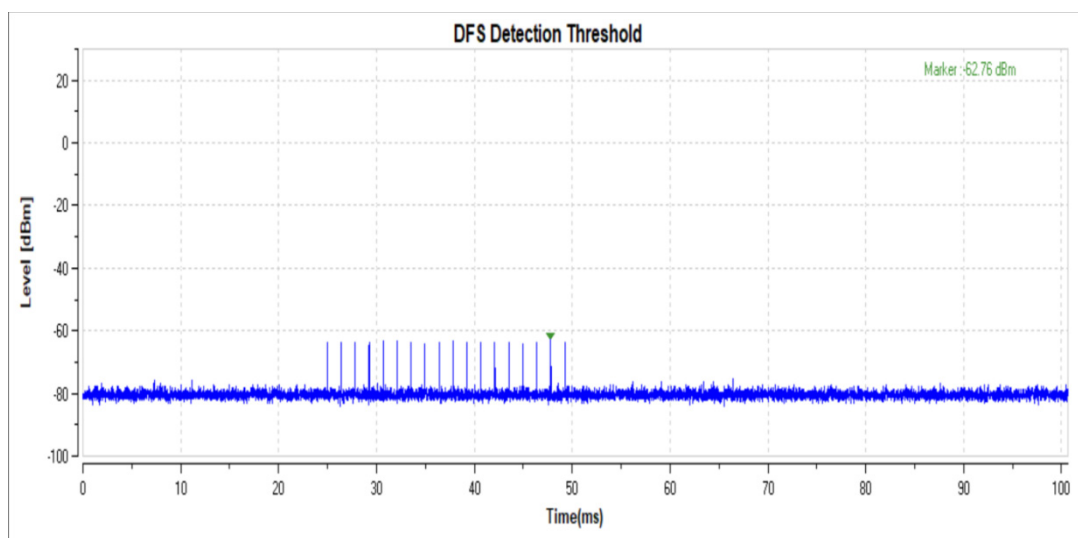
<40MHz / 5270 MHz> In-Service Monitoring

Radar / DFS detection threshold level and the burst of pulses on the Channel frequency



<40MHz / 5510 MHz> In-Service Monitoring

Radar / DFS detection threshold level and the burst of pulses on the Channel frequency



Note: All the test modes completed for test. The worst case of Ant 1; the test data of this mode was reported.



3.2 In-Service Monitoring: Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period

3.2.1 Limit of In-Service Monitoring

The EUT has In-Service Monitoring function to continuously monitor the radar signals, If radar is detected, it 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 comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate *Channel* changes (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Non-Occupancy Period time is 30 minute during which a Channel will not be utilized after a Radar Waveform is detected on that Channel. The non-associated Client Beacon Test is during the 30 minutes observation time. The EUT should not make any transmissions in the DFS band after EUT power up.



3.2.2 Test Procedures

1. The radar pulse generator is setup to provide a pulse at frequency that the Master and Client are operating. A type 0 radar pulse with a 1us pulse width and a 1428 us PRI is used for the testing.
2. The vector signal generator is adjusted to provide the radar burst (18 pulses) at a level of approximately -62dBm at the antenna of the Master device.
3. A trigger is provided from the pulse generator to the DFS monitoring system in order to capture the traffic and the occurrence of the radar pulse.
4. A U-NII device operating as a Client Device will associate with the Master at Channel. The MPEG file “TestFile.mpg” specified by the FCC is streamed from the “file computer” through the Master to the Client Device and played in full motion video using Media Player Classic Ver.

6.4.8.6 in order to properly load the network for the entire period of the test.

5. 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. At time T0 the Radar Waveform generator sends a Burst of pulse of the radar waveform at Detection Threshold + 1dB.
6. 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). One 12 seconds plot is reported for the Short Pulse Radar Types 1. The plot for the Short Pulse Radar Types start at the end of the radar burst. The Channel Move Time will be calculated based on the zoom in 600ms plot of the Short Pulse Radar Type.

7. 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 (0.4ms) = S (12000ms) / B (30000)**; 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

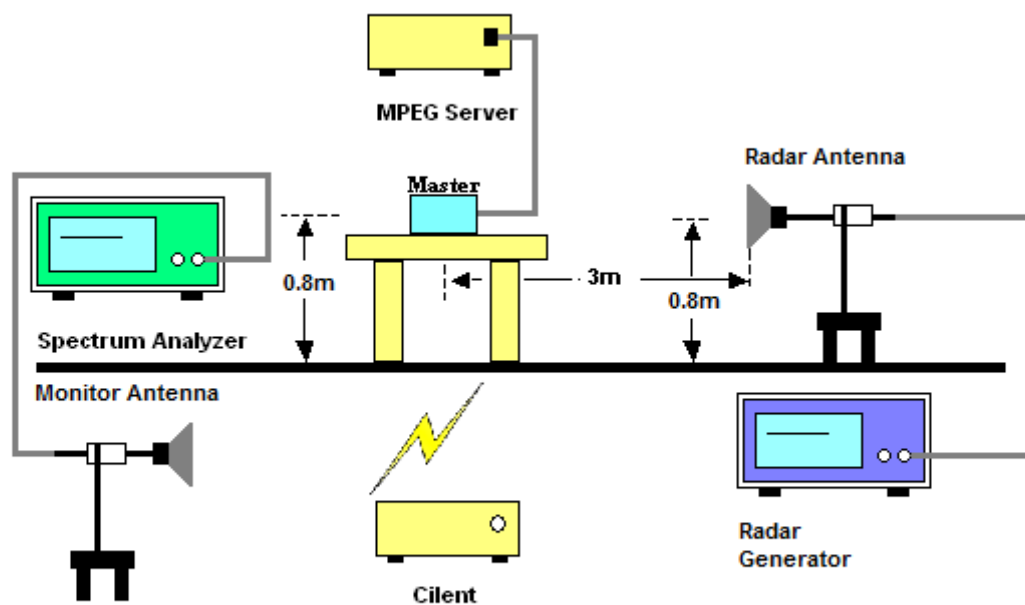


calculated by: **C (ms) = N X Dwell (0.4 ms)**; where C is the Closing Time, N is the number of spectrum analyzer sampling bins (intermittent control signals) showing a U-NII transmission and Dwell is the dwell time per bin.

8. Measure the EUT for more than 30 minutes following the channel move time to verify that no transmissions or beacons occur on this Channel.

3.2.3 Test Setup

Radiated Test Setup Photo



3.2.4 Test Deviation

There is no deviation with the original standard.

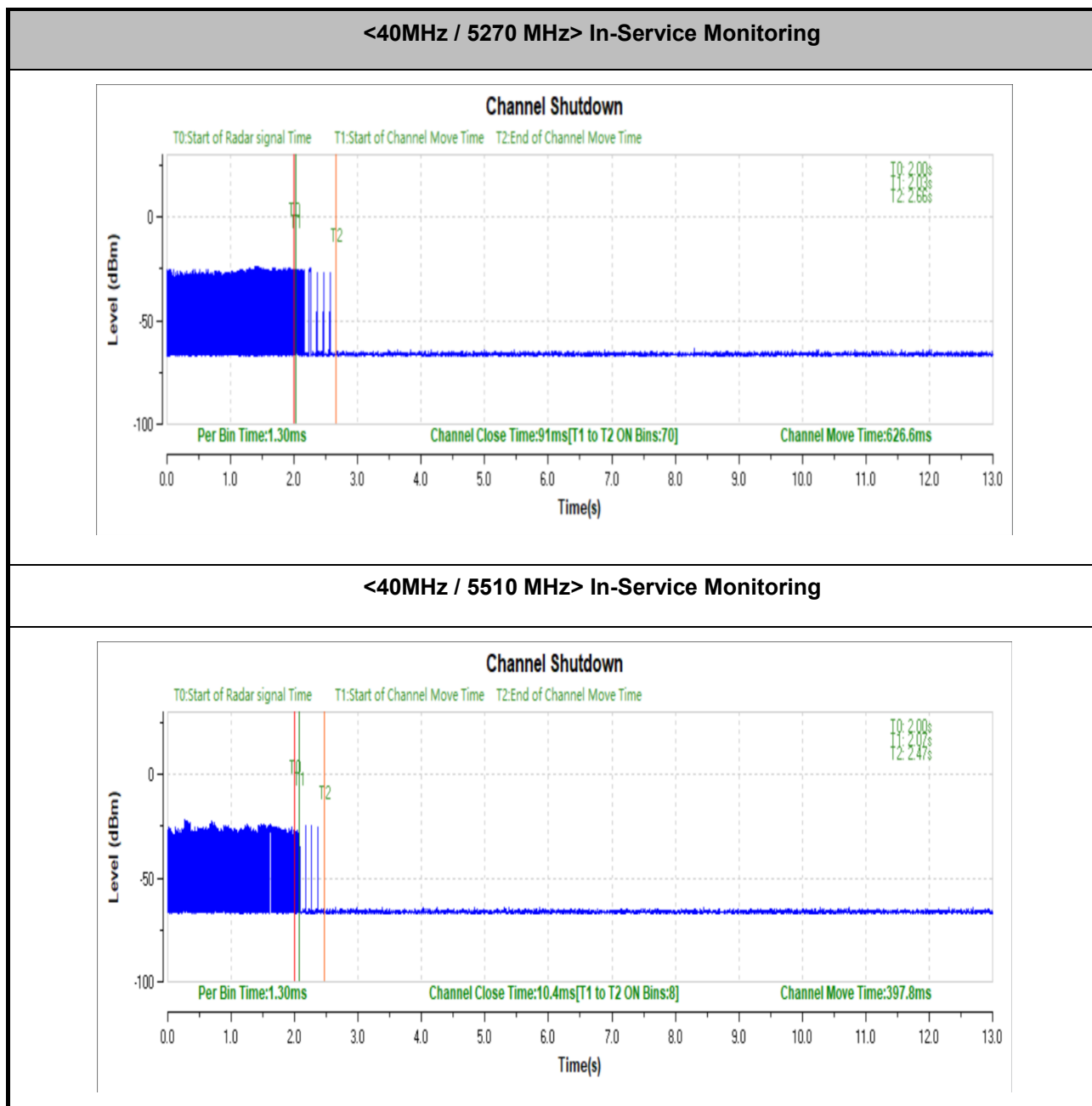


3.2.5 Result of Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period for Client Beacon Test

BW / Channel	Test Item	Test Result	Limit	Pass/Fail
40MHz / 5270 MHz	Channel Move Time	0.6s	< 10s	Pass
	Channel Closing Transmission Time	91ms	< 260ms	Pass
	Non-Occupancy Period	≥ 30	≥ 30 min	Pass
40MHz / 5510 MHz	Channel Move Time	0.4s	< 10s	Pass
	Channel Closing Transmission Time	10.4ms	< 260ms	Pass
	Non-Occupancy Period	≥ 30	≥ 30 min	Pass



3.2.6 Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period for Client Beacon Test Plots



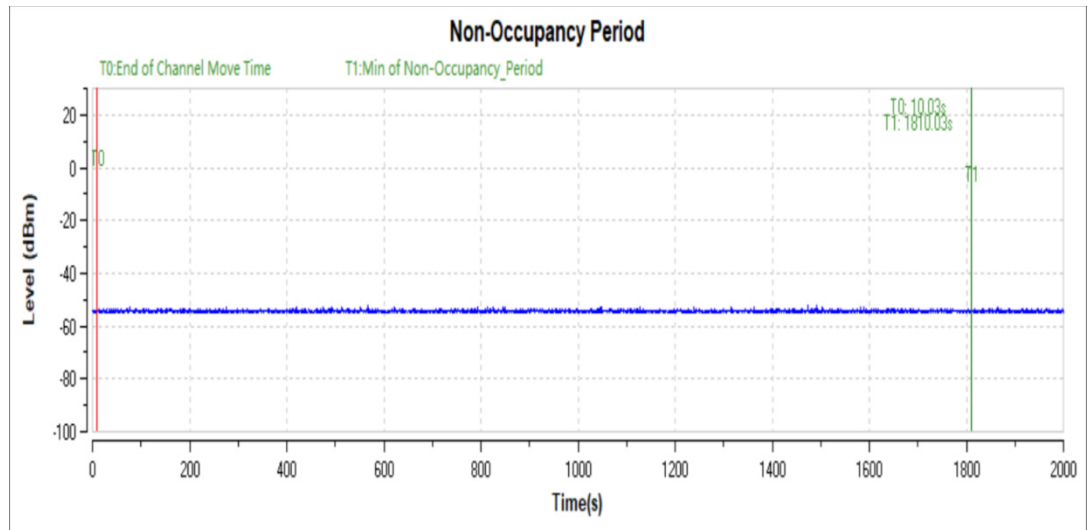
Note: All the test modes completed for test. The worst case of Ant 1; the test data of this mode was reported



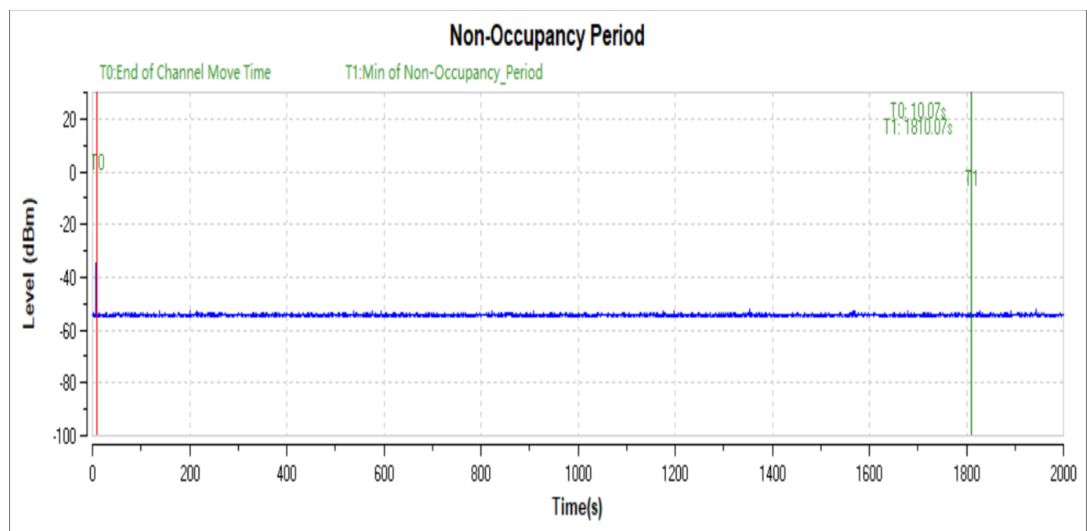
3.2.7 Data Traffic and Noise Floor Plots

Noise Floor (No transmission)

<40MHz / 5270 MHz>



<40MHz / 5510 MHz>



Note: All the test modes completed for test. The worst case of Ant 1; the test data of this mode was reported.



4 List of Measuring Equipment

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	MXA Signal Analyzer	Keysight	N9020A	MY52091623	2020/1/2	2021/1/1
2	Horn Antenna	schwarzbeck	9120D-1141	1574	2019/11/16	2022/11/15
3	Horn Antenna	schwarzbeck	9120D-1141	1574	2019/11/16	2022/11/15
4	Signal generator	Agilent	N5183A	958	2019/11/16	2022/11/15

————END OF REPORT————