

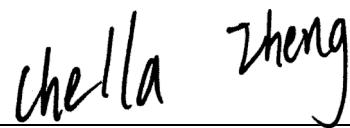
FCC DFS Test Report

FCC ID: ZMOSC138NA

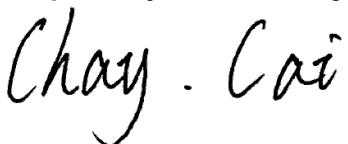
This report concerns: Original Grant

Project No. : 2111C042
Equipment : LTE Module
Brand Name : Fibocom
Test Model : SC138-NA
Series Model : N/A
Applicant : Fibocom Wireless Inc.
Address : 1101, Tower A, Building 6, Shenzhen International Innovation Valley, Dashi 1st Rd, Nanshan, Shenzhen, China
Manufacturer : Fibocom Wireless Inc.
Address : 1101, Tower A, Building 6, Shenzhen International Innovation Valley, Dashi 1st Rd, Nanshan, Shenzhen, China
Factory : Huizhou HYE Technology Co., Ltd.
Address : No. 237, Sanhe group, Sanhe village, Tonghu Town, Zhongkai hi tech Zone, Huizhou
Date of Receipt : Nov. 03, 2021
Date of Test : Nov. 15, 2021 ~ Dec. 07, 2021
Issued Date : Dec. 17, 2021
Report Version : R00
Test Sample : Engineering Sample No.: DG20211115166
Standard(s) : FCC CFR Title 47, Part 15, Subpart E
FCC KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02
FCC KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.



Prepared by : Chella Zheng



Approved by : Chay Cai



TESTING CERT #5123.02

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Declaration

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BTL's laboratory quality assurance procedures are in compliance with the **ISO/IEC 17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

BTL is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

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REPORT ISSUED HISTORY

| Report Version | Description | Issued Date |
|----------------|-----------------|---------------|
| R00 | Original Issue. | Dec. 17, 2021 |

1. TEST FACILITY

The test facilities used to collect the test data in this report is **TR12** at the location of No.3, Jinshagang 1st Road, Shixia, Dalang Town, Dongguan, Guangdong, China.

2. TEST ENVIRONMENT CONDITIONS

| Test Item | Temperature | Humidity | Test Voltage | Tested By |
|-----------------------------------|-------------|----------|--------------|------------|
| Dynamic Frequency Selection (DFS) | 25°C | 41% | DC 3.8V | Jesse Wang |

3. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

| FCC CFR Title 47, Part 15, Subpart E | | | | |
|--------------------------------------|---|-------------|----------|--------|
| Standard(s) Section | Test Item | Test Result | Judgment | Remark |
| FCC 15.407(h) | Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS) | ----- | PASS | ----- |

4. GENERAL INFORMATION

4.1 GENERAL DESCRIPTION OF EUT

| | |
|---------------------------------|---|
| Equipment | LTE Module |
| Brand Name | Fibocom |
| Test Model | SC138-NA |
| Series Model | N/A |
| Model Difference(s) | N/A |
| Hardware Version | SC138-NA |
| Software Version | SC138-NA-Q62.00.104 |
| Power Source | DC Voltage supplied from external power supply. |
| Power Rating | DC 3.5V ~ 4.2V |
| Operation Frequency Band(s) | UNII-2A: 5250 MHz ~ 5350 MHz UNII-2C: 5470 MHz ~ 5725 MHz |
| Modulation Type | IEEE 802.11a/n/ac: OFDM |
| Bit Rate of Transmitter | IEEE 802.11a: 54/48/36/24/18/12/9/6 Mbps IEEE 802.11n: up to 150 Mbps IEEE 802.11ac: up to 433.3 Mbps |
| Operating Mode(s) | <input type="checkbox"/> Master <input checked="" type="checkbox"/> Client device without radar detection <input type="checkbox"/> Client device with radar detection |
| Maximum Output Power UNII-2A | IEEE 802.11a: 19.57 dBm (0.0906 W) |
| Maximum Output Power UNII-2C | IEEE 802.11a: 19.43 dBm (0.0877 W) |

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. Channel List:

| IEEE 802.11a IEEE 802.11n(HT20) IEEE 802.11ac(VHT20) | | IEEE 802.11n(HT40) IEEE 802.11ac(VHT40) | | IEEE 802.11ac(VHT80) | |
|--|-----------------|--|-----------------|----------------------|-----------------|
| UNII-2A | | UNII-2A | | UNII-2A | |
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 52 | 5260 | 54 | 5270 | 58 | 5290 |
| 56 | 5280 | 62 | 5310 | | |
| 60 | 5300 | | | | |
| 64 | 5320 | | | | |

| IEEE 802.11a IEEE 802.11n(HT20) IEEE 802.11ac(VHT20) | | IEEE 802.11n(HT40) IEEE 802.11ac(VHT40) | | IEEE 802.11ac(VHT80) | |
|--|-----------------|--|-----------------|----------------------|-----------------|
| UNII-2C | | UNII-2C | | UNII-2C | |
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 100 | 5500 | 102 | 5510 | 106 | 5530 |
| 104 | 5520 | 110 | 5550 | 122 | 5610 |
| 108 | 5540 | 118 | 5590 | | |
| 112 | 5560 | 126 | 5630 | | |
| 116 | 5580 | 134 | 5670 | | |
| 120 | 5600 | | | | |
| 124 | 5620 | | | | |
| 128 | 5640 | | | | |
| 132 | 5660 | | | | |
| 136 | 5680 | | | | |
| 140 | 5700 | | | | |

3. Antenna Specification:

| Ant. | Brand | Model Name | Antenna Type | Connector | Gain (dBi) |
|------|-------|------------|--------------|-----------|------------|
| 1 | N/A | N/A | Dipole | SMA | 2 |

Note:

- 1) The antenna gain is provided by the manufacturer.

4.2 MAXIMUM OUTPUT POWER AND E.I.R.P.

| Frequency Band (MHz) | Max Output Power (dBm) | Antenna Gain (dBi) | Max. e.i.r.p. (dBm) | Max. e.i.r.p. (mW) |
|----------------------|------------------------|--------------------|---------------------|--------------------|
| 5250~5350 | 19.57 | 2 | 21.57 | 143.5489 |
| 5470~5725 | 19.43 | 2 | 21.43 | 138.9953 |

Note:

- 1) U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

4.3 DESCRIPTION OF TEST MODES

| Test Mode | Description |
|-----------|-------------------------------|
| Mode 1 | IEEE 802.11ac(VHT80): 5530MHz |

5. U-NII DFS RULE REQUIREMENTS

5.1 WORKING MODES AND REQUIRED TEST ITEMS

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 below for the applicability of DFS requirements for each of the operational modes.

Applicability of DFS requirements prior to use a channel

| Requirement | Operational Mode | | |
|---------------------------------|------------------|--------------------------------|-----------------------------|
| | Master | Client without radar detection | Client with radar detection |
| Non-Occupancy Period | √ | √ | √ |
| DFS Detection Threshold | √ | Not required | √ |
| Channel Availability Check Time | √ | Not required | Not required |
| U-NII Detection Bandwidth | √ | Not required | √ |

Applicability of DFS requirements during normal operation

| Requirement | Operational Mode | | |
|-----------------------------------|------------------|--------------------------------|-----------------------------|
| | Master | Client without radar detection | Client with radar detection |
| DFS Detection Threshold | √ | Not required | √ |
| Channel Closing Transmission Time | √ | √ | √ |
| Channel Move Time | √ | √ | √ |
| U-NII Detection Bandwidth | √ | 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 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.

5.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS

DETECTION THRESHOLD VALUES

DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

| Maximum Transmit Power | Value (See Notes 1, 2 and 3) |
|--|---------------------------------|
| e.i.r.p. \geq 200 milliwatt | -64 dBm |
| e.i.r.p. $<$ 200 milliwatt and power spectral density $<$ 10 dBm/MHz | -62 dBm |
| e.i.r.p. $<$ 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.

Note 3: e.i.r.p. is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.

TEST LIMIT

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.

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 |

Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.

6. MEASUREMENT INSTRUMENTS LIST

| Kind of Equipment | Manufacturer | Type No. | Serial No. | Calibrated until |
|-----------------------|---------------|---------------|---------------|------------------|
| Signal Generator | Agilent | E4438C | MY49071316 | Feb. 27, 2022 |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50520044 | Feb. 28, 2022 |
| POWER SPLITTER | Mini-Circuits | ZN4PD1-63-S+ | SF9335D1045-1 | Feb. 27, 2022 |
| POWER SPLITTER | Mini-Circuits | ZFRSC-123-S+ | 331000910-1 | Feb. 27, 2022 |
| Attenuator | WOKEN | 6SM3502 | VAS1214NL | Feb. 07, 2022 |
| Wi-Fi Router | tp-link | Archer AX6000 | N/A | N/A |

Remark: "N/A" denotes no model name, serial no. or calibration specified.

All calibration period of equipment list is one year.

Wi-Fi Router's FCC ID: TE7AX6000

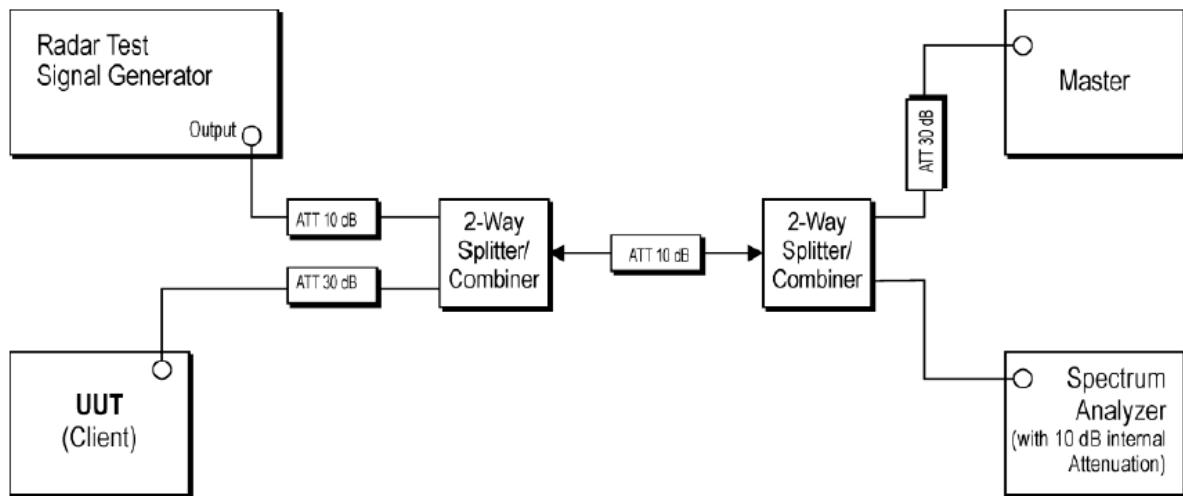
7. DYNAMIC FREQUENCY SELECTION (DFS)

7.1 DFS MEASUREMENT SYSTEM

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 test" to reach 17% channel loading as below.

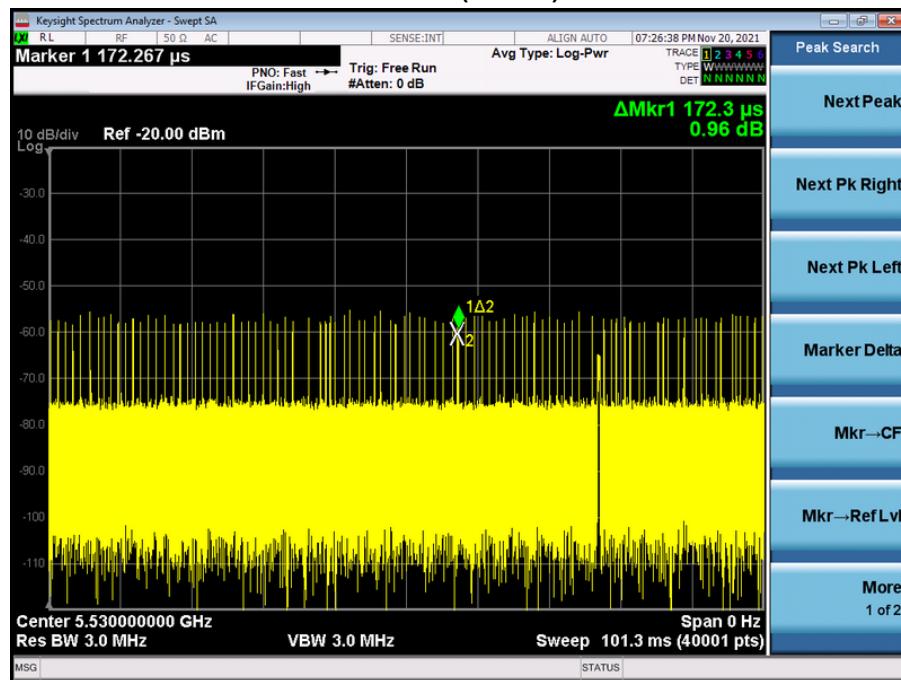
Setup for Client with injection at the Master



Radar Test Waveforms are injected into the Master.

Channel Loading

IEEE 802.11ac(VHT80) Mode



| Frequency (MHz) | Marker Delta (ms) | Number | On Time (ms) | Total Time (ms) | Duty cycle (%) | Limit (%) |
|-----------------|-------------------|--------|--------------|-----------------|----------------|-----------|
| 5530 | 0.172 | 105 | 18.06 | 101.3 | 17.83 | 17.00 |

The signal monitoring equipment consists of a spectrum analyzer set to display 8001 bins on the horizontal axis. The time-domain resolution is 2 msec / bin with a 16 second sweep time, meeting the 10 second short pulse reporting criteria. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), additional combiner/dividers are inserted between the Master Combiner/Divider and the pad connected to the Master Device (and/or between the Slave Combiner/Divider and the pad connected to the Slave Device). Additional pads are utilized such that there is one pad at each RF port on each EUT.

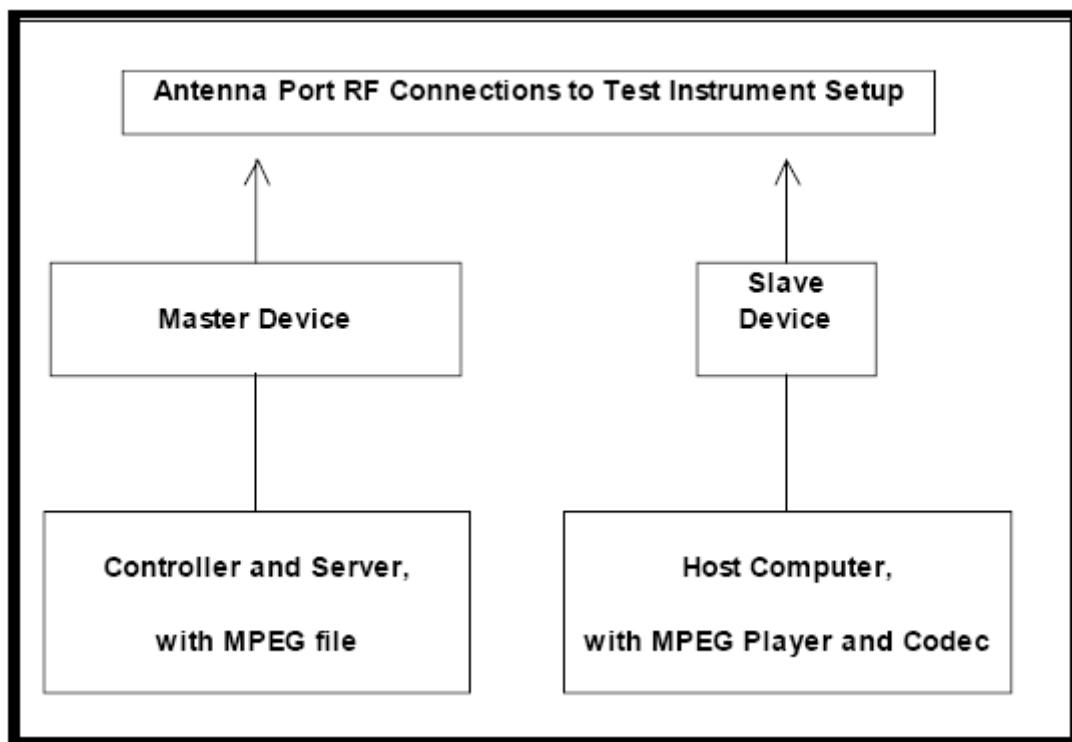
7.2 CALIBRATION OF DFS DETECTION THRESHOLD LEVEL

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 -64dBm as measured on the spectrum analyzer.

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 -64 dBm. Adjust the Reference Level Offset of the spectrum analyzer to this difference.

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 -64 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

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.



7.3 DEVIATION FROM TEST STANDARD

No deviation.

8. TEST RESULTS

8.1 SUMMARY OF DFS TEST RESULT

| Clause | Test Parameter | Remarks | Result |
|------------|-----------------------------------|------------|--------|
| FCC 15.407 | Channel Move Time | Applicable | Pass |
| | Channel Closing Transmission Time | Applicable | Pass |
| | Non-Occupancy Period | Applicable | Pass |

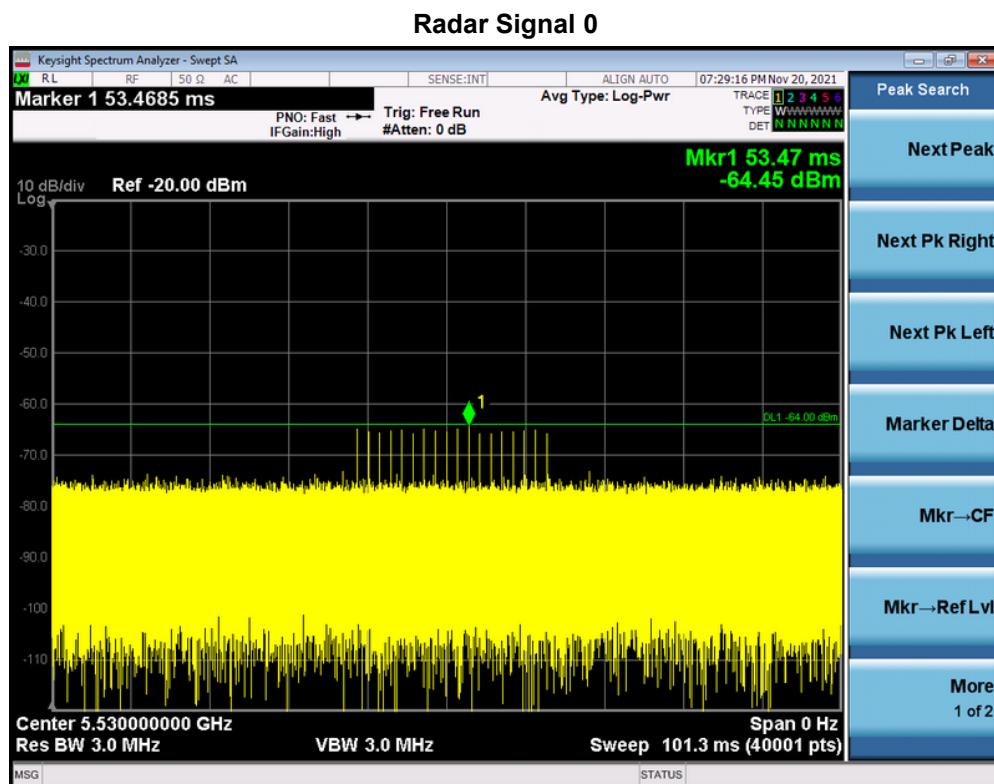
8.2 DFS DETECTION THRESHOLD

Calibration:

The EUT is slave equipment and it with a lowest gain is 2dBi.

For a detection threshold level of -62dBm and the master antenna gain is 2.90 dBi, required detection threshold is -59.10 dBm (= -62+2.90).

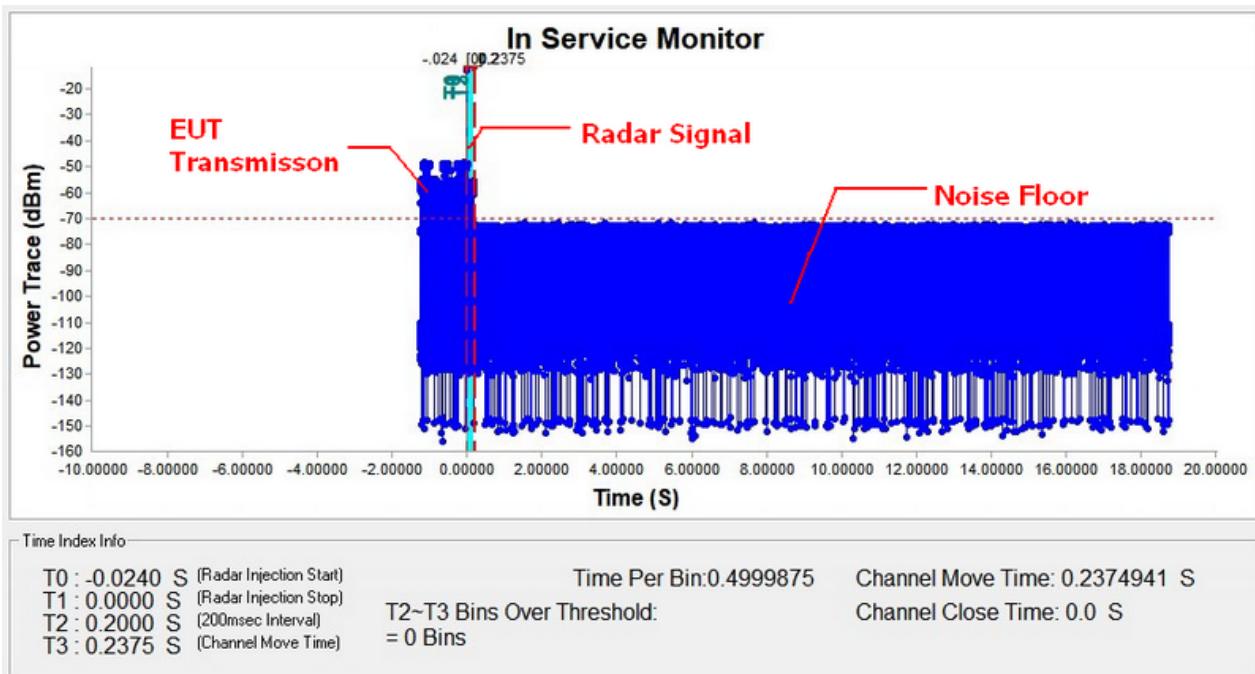
Note: Maximum Transmit Power is less than 200 milliwatt in this report, so detection threshold level is -62dBm.



8.3 CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME

TX (IEEE 802.11ac(VHT80) Mode)

Radar signal 0

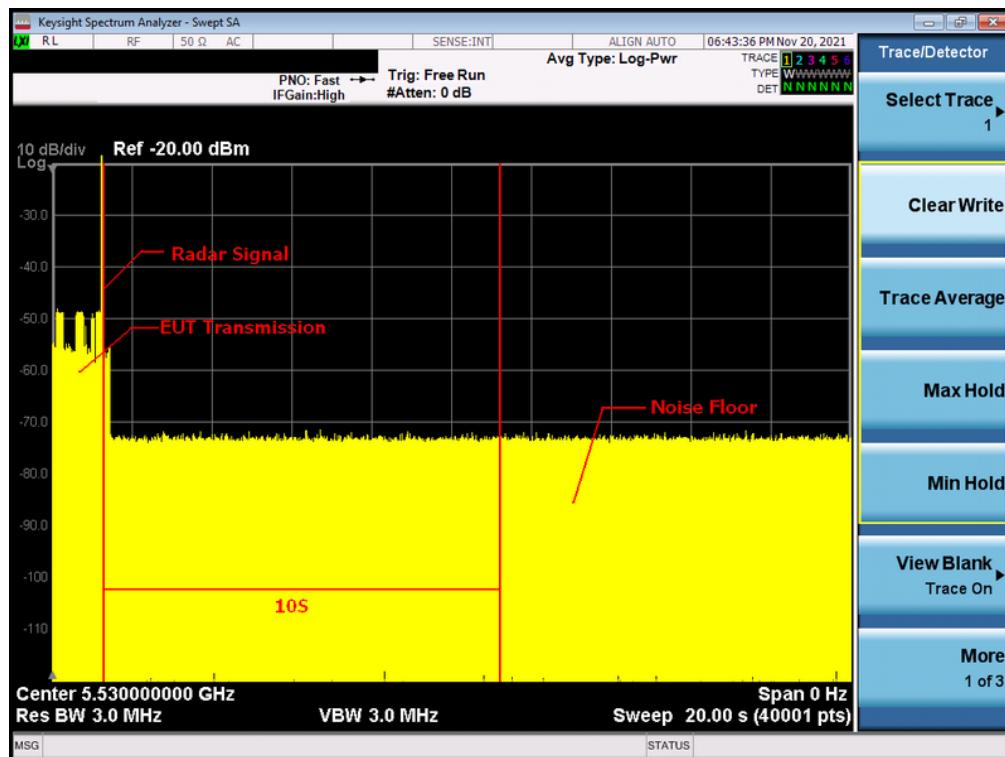


Note: T0 denotes the Radar Injection Start.

T1 denotes the start of Channel Move Time upon the end of the last Radar burst.

T2 denotes the data transmission time of 200ms from T1.

T3 denotes the end of Channel Move Time.



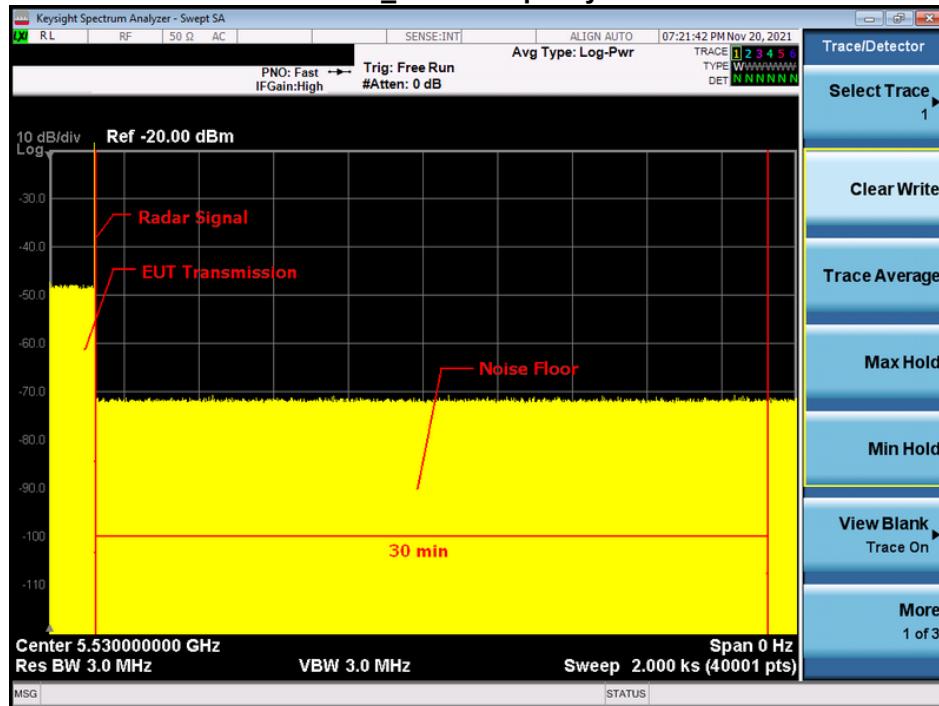
Note: An expanded plot for the device vacates the channel in the required 500ms

| IEEE 802.11ac(VHT80) Mode | | |
|---------------------------|-------------------|---|
| Item | Measured Value(s) | Limit(s) |
| Channel Move Time | 0.2374941 | 10 |
| Channel Close Time | 0.0 | 200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. |

8.4 NON-OCCUPANCY PERIOD

During the 30 minutes observation time, UUT did not make any transmissions on a channel after a radar signal was detected on that channel by either the Channel Availability Check or the In-Service Monitoring.

TX (IEEE 802.11ac(VHT80) Mode) 5530MHz_Non-Occupancy Period



9. EUT TEST PHOTO**End of Test Report**