



# FCC PART 15.407

# DYNAMIC FREQUENCY SELECTION TEST REPORT

For

# **Thundercomm Technology Co., Ltd**

Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China

# FCC ID: 2AOHHTURBOXC610

| Report Type:POriginal ReportTr |  | <b>Product Type:</b><br>TurboX C610 SOM |  |
|--------------------------------|--|---|--|
| Report Number:                 | RSZ200929001-00  |   |  |
| Report Date:                   | 2020-11-11   |   |  |
| Reviewed By:                   | Gavin Xu<br>RF Engineer  | Gavin Xu                                |  |
| Test Laboratory:               | Bay Area Compliance Laboratories Corp. (Dongguan)<br>No.69 Pulongcun, Puxinhu Industry Area,<br>Tangxia, Dongguan, Guangdong, China<br>Tel: +86-769-86858888<br>Fax: +86-769-86858891<br>www.baclcorp.com.cn |   |  |

# TABLE OF CONTENTS

| GENERAL INFORMATION                                     | 3  |
|---|----|
| PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)      | 3  |
| OBJECTIVE   | 3  |
| Test Methodology  | 3  |
| Test Facility   | 3  |
| DECLARATIONS  | 4  |
| SYSTEM TEST CONFIGURATION                               | 5  |
| DESCRIPTION OF TEST CONFIGURATION                       | 5  |
| EUT Exercise Software                                   | 5  |
| Equipment Modifications                                 | 5  |
| SUPPORT EQUIPMENT LIST AND DETAILS                      | 5  |
| External Cable  | 5  |
| SUMMARY OF TEST RESULTS                                 | 6  |
| APPLICABLE STANDARDS                                    | 7  |
| DFS REQUIREMENT   | 7  |
| DFS MEASUREMENT SYSTEM                                  | 11 |
| System Block Diagram                                    | 11 |
| CONDUCTED METHOD  | 12 |
| RADIATED METHOD   |    |
| TEST PROCEDURE  | 13 |
| TEST RESULTS  | 14 |
| DESCRIPTION OF EUT                                      | 14 |
| Test Equipment List and Details                         | 14 |
| RADAR WAVEFORM CALIBRATION                              | 14 |
| TEST ENVIRONMENTAL CONDITIONS                           | 15 |
| CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME | 16 |
| Test Procedure  | 16 |
| TEST RESULTS  | 16 |
| NON-OCCUPANCY PERIOD                                    | 19 |
| Test Procedure  | 19 |
| TEST RESULT   | 19 |

#### **GENERAL INFORMATION**

# **Product Description for Equipment under Test (EUT)**

| EUT Name:            | TurboX C610 SOM     |
|----------------------|---------------------|
| EUT Model:           | TurboX C610         |
| Rated Input Voltage: | DC 12V from adapter |
| Serial Number:       | RSZ200929001-RF-S1  |
| EUT Received Date:   | 2020.10.09          |
| EUT Received Status: | Good                |

#### Objective

This report is prepared on behalf of *Thundercomm Technology Co., Ltd* in accordance with Part 2-Subpart J, Part 15-Subparts E of the Federal Communications Commission's rules.

The objective is to determine compliance with Dynamic Frequency Selection (DFS) of the FCC Part 15, Subpart E, section 15.407.

#### **Test Methodology**

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

#### **Test Facility**

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

# Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol " $\triangle$ ". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

This report cannot be reproduced except in full, without prior written approval of the Company.

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA, or any agency of the U.S. Government.

This report may contain data that are not covered by the accreditation scope and shall be marked with an asterisk " $\bigstar$ ".

# SYSTEM TEST CONFIGURATION

# **Description of Test Configuration**

The EUT was configured for testing in an engineering mode which was provided by the manufacturer.

# **EUT Exercise Software**

No Software was used in test.

# **Equipment Modifications**

N/A

# **Support Equipment List and Details**

| Manufacturer | Description     | Model    | Serial Number        |
|--------------|-----------------|----------|----------------------|
| Lenovo       | Notebook        | E450     | PF-0MRADG 16/08      |
| Huawei       | Wireless Router | HG8245Q2 | 2102311RGB6RH1000087 |

Note: The mater AP model: HG8245Q2, FCC ID: QISHG8245Q2

# **External Cable**

| Cable Description | Shielding<br>Type | Ferrite Core | Length<br>(m) | From Port | То                 |
|-------------------|-------------------|--------------|---------------|-----------|--------------------|
| RJ45 Cable        | No                | No           | 10            | Laptop    | Wireless<br>Router |

# **SUMMARY OF TEST RESULTS**

The following result table represents the list of measurements required under the CFR §47 Part 15.407(h), KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v02

| Items                                | Description of Test                           | Result         |
|--------------------------------------|---|----------------|
| Detection<br>Bandwidth               | UNII Detection Bandwidth                      | Not applicable |
| D.C.                                 | Initial Channel Availability Check Time (CAC) | Not applicable |
| Performance<br>Requirements<br>Check | Radar Burst at the Beginning of the CAC       | Not applicable |
|                                      | Radar Burst at the End of the CAC             | Not applicable |
|                                      | Channel Move Time                             | Compliance     |
| In-Service<br>Monitoring             | Channel Closing Transmission Time             | Compliance     |
|                                      | Non-Occupancy Period                          | Compliance     |
| Radar Detection                      | Statistical Performance Check                 | Not applicable |

Note:

1) Not applicable: the EUT is a client unit without radar detection.

# **APPLICABLE STANDARDS**

# **DFS Requirement**

CFR §47 Part 15.407(h)

FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

| Requirement                     | Operational Mode |   |                                      |
|---------------------------------|------------------|---|--------------------------------------|
|                                 | Master           | Client<br>Without<br>Radar<br>Detection | Client<br>With<br>Radar<br>Detection |
| Non-Occupancy Period            | Yes              | Not<br>required                         | Yes                                  |
| DFS Detection Threshold         | Yes              | Not<br>required                         | Yes                                  |
| Channel Availability Check Time | Yes              | Not<br>required                         | Not<br>required                      |
| U-NII Detection Bandwidth       | Yes              | Not<br>required                         | Yes                                  |

# Table 1: Applicability of DFS Requirements Prior to Use of a Channel

#### Table 2: Applicability of DFS requirements during normal operation

| Requirement                       | Operational Mode        |                                   |  |
|-----------------------------------|-------------------------|-----------------------------------|--|
|                                   | Master Device or Client | Client Without<br>Redex Detection |  |
|                                   | with Kanar Detection    | Kadar Detection                   |  |
| DFS Detection Threshold           | Yes                     | Not required                      |  |
| Channel Closing Transmission Time | Yes                     | Yes                               |  |
| Channel Move Time                 | Yes                     | Yes                               |  |
| U-NII Detection Bandwidth         | Yes                     | Not required                      |  |

| Additional requirements for devices<br>with multiple bandwidth modes                        | Master Device or Client<br>with Radar Detection | Client Without<br>Radar Detection |  |
|---|---|-----------------------------------|--|
| U-NII Detection Bandwidth and   | All BW modes must be                            | Not required                      |  |
| Statistical Performance Check   | tested  |                                   |  |
| Channel Move Time and Channel   | Test using widest BW mode                       | Test using the widest             |  |
| Closing Transmission Time   | available                                       | 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                         |   |                                   |  |

FCC Part 15.407 DFS Test Report

#### Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

| Maximum Transmit Power  | Value                   |  |
|---|-------------------------|--|
|   | (See Notes 1, 2, and 3) |  |
| $EIRP \ge 200 \text{ milliwatt}$  | -64 dBm                 |  |
| EIRP < 200 milliwatt and  | -62 dBm                 |  |
| power spectral density < 10 dBm/MHz   |                         |  |
| EIRP < 200 milliwatt that do not meet the power spectral  | -64 dBm                 |  |
| density requirement   |                         |  |
| 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 MIMO devices refer to KDB Publication 6629        |                         |  |
| D01.  |                         |  |

| Table 4: DFS | 8 Response | Requirement | Values |
|--------------|------------|-------------|--------|
|--------------|------------|-------------|--------|

| Value                  |
|------------------------|
| Minimum 30 minutes     |
| 60 seconds             |
| 10 seconds             |
| See Note 1.            |
| 200 milliseconds + an  |
| aggregate of 60        |
| milliseconds over      |
| remaining 10 second    |
| period.                |
| See Notes 1 and 2.     |
| 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.

Report No.: RSZ200929001-00

| Table 5 – Short Pulse Kadar Test waveforms |                |  |   |                  |            |  |
|--|----------------|--|---|------------------|------------|--|
| Radar                                      | Pulse          | PRI  | Number of Pulses  | Minimum          | Minimum    |  |
| Type                                       | Width          | (µsec)   |   | Percentage of    | Number     |  |
|  | (µsec)         |  |   | Successful       | of         |  |
|  |                |  |   | Detection        | Trials     |  |
| 0  | 1              | 1428   | 18  | See Note 1       | See Note   |  |
|  |                |  |   |                  | 1          |  |
| 1  | 1              | Test A: 15 unique<br>PRI values<br>randomly selected<br>from the list of 23<br>PRI values in<br>Table 5a<br>Test B: 15 unique<br>PRI values<br>randomly selected<br>within the range<br>of 518-3066 µsec,<br>with a minimum<br>increment of 1<br>µsec, excluding<br>PRI values<br>selected in Test A | $\operatorname{Roundup} \left\{ \begin{array}{l} \left(\frac{1}{360}\right) \\ \left(\frac{19 \cdot 10^6}{\operatorname{PRI}_{\mu \operatorname{sec}}}\right) \end{array} \right\}$ | 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        |  |
| Note 1: She                                | ort Pulse Rada | r Type 0 should be u   | sed for the detection ba  | ndwidth test, ch | annel move |  |
| time, and cl                               | hannel closing | , time tests.  |   |                  |            |  |

| able | 5 – | Short | Pulse | Radar | Test | Waveform |
|------|-----|-------|-------|-------|------|----------|
|      |     |       |       |       |      |          |

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.

For example if in Short Pulse Radar Type 1 Test B a PRI of 3066 usec is selected, the number of pulses

would be Roundup  $\left\{ \left(\frac{1}{360}\right) \cdot \left(\frac{19 \cdot 10^6}{3066}\right) \right\} = \text{Roundup}\{17.2\} = 18.$ 

| Pulse Repetition<br>Frequency<br>Number | Pulse Repetition Frequency<br>(Pulses Per Second) | Pulse Repetition<br>Interval<br>(Microseconds) |
|---|---|--|
| 1                                       | 1930.5  | 518  |
| 2                                       | 1858.7  | 538  |
| 3                                       | 1792.1  | 558  |
| 4                                       | 1730.1  | 578  |
| 5                                       | 1672.2  | 598  |
| б                                       | 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   |

| Table 5a - Pulse Repetition Intervals V | alues for | Test A |
|---|-----------|--------|
|---|-----------|--------|

The aggregate is the average of the percentage of successful detections of Short Pulse Radar Types 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 | Minimum Percentage |  |  |
|---|------------------|----------------------|--------------------|--|--|
|   |                  | Detections           | 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% |                  |                      |                    |  |  |

| Radar | Pulse  | Chirp | PRI    | Number    | Number    | Minimum       | Minimum   |
|-------|--------|-------|--------|-----------|-----------|---------------|-----------|
| Type  | Width  | Width | (µsec) | of Pulses | of Bursts | Percentage of | Number of |
|       | (µsec) | (MHz) |        | per Burst |           | Successful    | Trials    |
|       |        |       |        | _         |           | Detection     |           |
| 5     | 50-100 | 5-20  | 1000-  | 1-3       | 8-20      | 80%           | 30        |
|       |        |       | 2000   |           |           |               |           |

# Table 6 – Long Pulse Radar Test Waveform

|       | Table 7 – I requency hopping Radar Test waveform |        |        |         |          |               |           |  |  |
|-------|--|--------|--------|---------|----------|---------------|-----------|--|--|
| Radar | Pulse  | PRI    | Pulses | Hopping | Hopping  | Minimum       | Minimum   |  |  |
| Type  | Width  | (µsec) | per    | Rate    | Sequence | Percentage of | Number of |  |  |
|       | (µsec)   |        | Hop    | (kHz)   | Length   | Successful    | Trials    |  |  |
|       |  |        |        |         | (msec)   | Detection     |           |  |  |
| 6     | 1  | 333    | 9      | 0.333   | 300      | 70%           | 30        |  |  |

#### Table 7 – Frequency Hopping Radar Test Waveform

# **DFS Measurement System**

BACL DFS measurement system consists of two subsystems: (1) The radar signal generating subsystem and (2) the traffic monitoring subsystem.

#### System Block Diagram



FCC Part 15.407 DFS Test Report

Report No.: RSZ200929001-00

# **Conducted Method**







#### Report No.: RSZ200929001-00







#### **Test Procedure**

A spectrum analyzer is used as a monitor verifies that the EUT status including Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the diction and Channel move.

# TEST RESULTS

# **Description of EUT**

The calibrated radiated DFS detection threshold level is set to -64 dBm is more stringent.

WLAN traffic is generated by software "Tfgen", software is used by IP and Frame based systems for loading the test channel during the In-service compliance testing of the U-NII device. Datapakge streamed from the Access Point to the Client using the software "Tfgen".

| Manufacturer         | Description                     | Model    | Serial<br>Number | Calibration<br>Date | Calibration<br>Due Date |
|----------------------|---------------------------------|----------|------------------|---------------------|-------------------------|
| National Instruments | NI PXI-1042 8-Slot<br>chassis   | PXI-1042 | VOBX40FBD        | N/A                 | N/A                     |
| National Instruments | Arbitrary Waveform<br>Generator | PXI-5421 | N/A              | N/A                 | N/A                     |
| National Instruments | RF Upconverter                  | PXI-5610 | N/A              | N/A                 | N/A                     |
| ASCOR                | Upconverter                     | AS-7202  | N/A              | N/A                 | N/A                     |
| Agilent              | Spectrum Analyzer               | E4440A   | SG43360054       | 2020-01-04          | 2021-01-04              |
| Ditorn               | Splitter/Combiner               | D3C4080  | SN2244           | N/A                 | N/A                     |
| TDK RF               | horn antenna                    | HRN-0118 | 130 084          | 2018-10-12          | 2021-10-12              |
| ETS LINDGREN         | horn antenna                    | 3115     | 000 527 35       | 2018-10-12          | 2021-10-12              |

# **Test Equipment List and Details**

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

#### **Radar Waveform Calibration**



# **Test Environmental Conditions**

| Temperature:              | 25.8~26.7°C           |
|---------------------------|-----------------------|
| <b>Relative Humidity:</b> | 39~42 %               |
| <b>ATM Pressure:</b>      | 101.1~101.3kPa        |
| Tester:                   | Chris Mo              |
| Test Date:                | 2020-10-29~2020-11-10 |

Plots of Radar Waveforms

| ★ Agilent 06:43:03 Oct 29, 2020  | Peak Search    |
|--|----------------|
| Mkr1 12.48 ms<br>Ref -11.5 dBm Atten 10 dB -64.01 dBm<br>Norm  | Next Peak      |
| Log<br>10<br>dB/<br>offet  | Next Pk Right  |
| -11.5<br>dB<br>DI  | Next Pk Left   |
| -64.0<br>dBm 1<br>LgAv   | Min Search     |
| W1 S2<br>S3 VC<br>PP   | Pk-Pk Search   |
| £(f): Marker<br>FTun 12.47520000 ms  | Mkr → CF       |
| <b>-64.01 dBm</b><br>Center 5.530 000 GHz Span 0 Hz<br>Res BW 3 MHz #VBW 3 MHz Sweep 100.5 ms (8192 pts) | More<br>1 of 2 |

# 5530 MHz: Radar Type 0

# CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME

#### **Test Procedure**

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. repeat using a long pulse radar type5 waveform.

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.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = N\*Dwell Time

N is the number of spectrum analyzer bins showing a device transmission Dwell Time is the dwell time per bin (i.e. Dwell Time = S/B, S is the sweep time and B is the number of bin, i.e. 8192)

#### **Test Results**

| Frequency<br>(MHz) | Bandwidth<br>(MHz) | Radar Type | Results    |
|--------------------|--------------------|------------|------------|
| 5530               | 80                 | Type 0     | Compliance |

Please refer to the following tables and plots.

#### 5530 MHz

Type 0 radar channel move time result:



| Ty | pe0 | radar | channel | closing | transmission | time result: |
|----|-----|-------|---------|---------|--------------|--------------|
| _  |     |       |         |         |              |              |

| Transmission<br>After 200ms | Aggregate<br>Transmission Time<br>After 200ms Delay<br>(ms) | Limit for Aggregate<br>Transmission Time<br>After 200ms Delay<br>(ms) | Result |
|-----------------------------|---|---|--------|
| Yes                         | 7.324   | 60  | Pass   |



| - Total On Time [s] 🖃 | 🖂 Total On Time After Delay [s] 🛛 🛥 |
|-----------------------|-------------------------------------|
| 19.53m                | 7.324m                              |

# **NON-OCCUPANCY PERIOD**

#### **Test Procedure**

Measure the EUT for more than 30 minutes following the channel close/move time to very that the EUT does not resume any transmissions on this channel. Provide one plot to demonstrate no transmission on the channel for the non-occupancy period (30 minutes observation time)

#### **Test Result**

| Frequency(MHz) | Bandwidth<br>(MHz) | Spectrum Analyzer Display         |
|----------------|--------------------|-----------------------------------|
| 5530           | 80                 | No transmission within 30 minutes |

Please refer to the following plots.



#### 5530 MHz

#### \*\*\*\*\* END OF REPORT \*\*\*\*\*