# FCC DFS TEST REPORT

| | | |
|---|---|---|
| Applicant | : | ELO TOUCH SOLUTIONS, INC. |
| Address | : | 670 N. McCarthy Blvd., Suite 100 Milpitas, CA 95035 USA |
| Equipment | : | Touch All-in-One Computer |
| Model No. | : | ESY10I1E, ESY15I1E, ESY22I1E |
| Trade Name | : | Elo or elo |
| FCC ID | : | RBWESYQC5 |

**I HEREBY CERTIFY THAT :**

**The sample was received on Jul. 19, 2024 and the testing was completed on Aug. 08, 2024 at Cerpass Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of Cerpass Technology Corp., the test report shall not be reproduced except in full.**

Approved by:

Mark Liao / Supervisor

Laboratory Accreditation:

Cerpass Technology Corporation Test Laboratory

## CONTENTS

## History of this test report

| Report No. | Issued Date | Description |
|---|---|---|
| 24070407-TRFCC05 | Nov. 18, 2024 | Original |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# 1. Summary of Test Procedure and Test Results

## 1.1. Applicable Standards

**ANSI C63.10:2013**

**FCC Rules and Regulations Part 15 Subpart E §15.407**

**KDB 789033**

**KDB 905462**

| FCC Rule | Description of Test | Result |
|---|---|---|
| 15.407 | Dynamic Frequency Selection | PASS |

*The lab has reduced the uncertainty risk factor from test equipment, environment and staff technicians which according to the standard on contract. Therefore, the test result will only be determined by standard requirement,measurement uncertainty evaluation is not considered.

# 2. Test Configuration of Equipment under Test

## 2.1. Feature of Equipment under Test

| | |
|---|---|
| Operation Frequency Range | BT / BLE: 2400-2483.5MHz<br>WLAN:802.11b/g/n/ax: 2400-2483.5MHz<br>5GHz:802.11a/n/ac/ax:5150-5250MHz, 5250-5350MHz,<br>5470-5725MHz, 5725-5875MHz<br>6GHz: 802.11a/ax: 5925MHz~6425MHz, 6425MHz~6525MHz<br>6525MHz~6875MHz, 6875MHz~7125MHz |
| Center Frequency Range | BT / BLE: 2402MHz-2480MHz<br>WLAN:802.11b/g/n/ax: 2412MHz-2462MHz<br>5GHz:802.11a/n/ac/ax:5180-5240MHz, 5260-5320MHz,<br>5500-5720MHz, 5745-5825MHz<br>6GHz: 802.11a/ax: 5955MHz~6415MHz, 6435MHz~6515MHz<br>6535MHz~6855MHz, 6875MHz~7115MHz |
| Modulation Type | BT: GFSK, $\pi$/4-DQPSK, 8DPSK<br>BLE: GFSK<br>WLAN:<br>2.4GHz:<br>802.11b: CCK, DQPSK, DBPSK<br>802.11g/n: BPSK, QPSK, 16QAM, 64QAM<br>802.11ax: BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM<br>5GHz:<br>802.11a/n: BPSK, QPSK, 16QAM, 64QAM<br>802.11ac: BPSK, QPSK, 16QAM, 64QAM, 256QAM<br>802.11ax: BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM<br>6GHz<br>802.11a: BPSK, QPSK, 16QAM, 64QAM<br>802.11ax: BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM |
| Modulation Technology | DSSS, OFDM, FHSS, DTS, OFDMA |
| Data Rate | BT:<br>GFSK: 1Mbps, $\pi$/4-DQPSK: 2Mbps, 8DPSK: 3Mbps<br>BLE:<br>GFSK: 1Mbps, 2Mbps<br>WLAN:<br>2.4GHz:<br>802.11b: 1, 2, 5.5, 11Mbps<br>802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps<br>802.11n: MCS0 – MCS15, HT20/40<br>802.11ax: MCS0 – MCS11, HE20/40<br>5GHz:<br>802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps<br>802.11n: MCS0 – MCS15, HT20/40<br>802.11ac: MCS0 – MCS9, VHT20/40/80/160<br>802.11ax: MCS0 – MCS11, HE20/40/80/160<br>6GHz<br>802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps<br>802.11ax: MCS0 – MCS11, HE20/40/80/160 |
| Antenna Type | PIFA Antenna |

| | |
|---|---|
| Antenna Gain<br>(ESY10I1E) | For BT / BLE:<br>2400-2500MHz: ANT A: 2.01dBi<br>For WLAN:<br>2400-2500MHz: ANT A: 2.01dBi, ANT B: 2.91dBi<br>5150-5250MHz: ANT A: 2.46dBi, ANT B: 2.22dBi<br>5250-5350MHz: ANT A: 2.19dBi, ANT B: 2.44dBi<br>5470-5725MHz: ANT A: 2.70dBi, ANT B: 2.38dBi<br>5725-5850MHz: ANT A: 2.70dBi, ANT B: 2.56dBi<br>5925~6425MHz:ANT A: 2.86dBi, ANT B: 2.54dBi<br>6425~6525MHz:ANT A: 2.72dBi, ANT B: 2.84dBi<br>6525~6875MHz:ANT A: 2.72dBi, ANT B: 2.84dBi<br>6875~7125MHz:ANT A: 2.46dBi, ANT B: 2.28dBi |
| Antenna Gain<br>(ESY15I1E) | For BT / BLE:<br>2400-2500MHz: ANT A: 2.72dBi<br>For WLAN:<br>2400-2500MHz: ANT A: 2.72dBi, ANT B: 2.42dBi<br>5150-5250MHz: ANT A: 2.44dBi, ANT B: 2.65dBi<br>5250-5350MHz: ANT A: 1.86dBi, ANT B: 2.69dBi<br>5470-5725MHz: ANT A: 2.83dBi, ANT B: 2.79dBi<br>5725-5850MHz: ANT A: 2.63dBi, ANT B: 2.79dBi<br>5925~6425MHz:ANT A: 2.53dBi, ANT B: 2.48dBi<br>6425~6525MHz:ANT A: 2.42dBi, ANT B: 2.44dBi<br>6525~6875MHz:ANT A: 2.42dBi, ANT B: 2.44dBi<br>6875~7125MHz:ANT A: 2.59dBi, ANT B: 2.44dBi |
| Antenna Gain<br>(ESY22I1E) | For BT / BLE:<br>2400-2500MHz: ANT A: 2.32dBi<br>For WLAN:<br>2400-2500MHz: ANT A: 2.32dBi, ANT B: 2.25dBi<br>5150-5250MHz: ANT A: 1.75dBi, ANT B: 2.17dBi<br>5250-5350MHz: ANT A: 2.34dBi, ANT B: 2.17dBi<br>5470-5725MHz: ANT A: 2.25dBi, ANT B: 2.35dBi<br>5725-5850MHz: ANT A: 2.65dBi, ANT B: 2.42dBi<br>5925~6425MHz:ANT A: 2.36dBi, ANT B: 2.58dBi<br>6425~6525MHz:ANT A: 2.38dBi, ANT B: 2.05dBi<br>6525~6875MHz:ANT A: 2.38dBi, ANT B: 2.47dBi<br>6875~7125MHz:ANT A: 2.28dBi, ANT B: 2.25dBi |

EUT powered by

| Adapter | ESY10I1E | ESY15I1E | ESY22I1E |
|---|---|---|---|
| Brand: Billion<br>Model: BA090-190474MBX | ☒ | ☒ | ☒ |
| Brand: Billion<br>Model: BA070-190342MBX | ☒ | ☒ | ☒ |
| Brand: Delta<br>Model: ADP-65JH HB | ☒ | ☒ | ☒ |

Flip Stand Without Panel powered by

| Adapter | ESY10I1E | ESY15I1E | ESY22I1E |
|---|---|---|---|
| Brand: Billion<br>Model: BS180-240625MBX | ☒ | ☒ | ☐ |
| Brand: Delta<br>Model: ADP-150EH B | ☒ | ☒ | ☐ |
| Brand: Billion<br>Model: BA090-240375MBX | ☒ | ☐ | ☐ |

| | |
|---|---|
| Power Cable(EU)*2 | Brand: I-SHENG<br>Model: CAB-PWR-EU-3 LOBE-1.8M-BLK-R |
| Power Cable(US)*2 | Brand: I-SHENG<br>Model: CAB-PWR-US-3 LOBE-1.8M-BLK-R |
| Flip Stand Without Panel<br>(For ESY10I1E) | Brand: ELO<br>Model: E554932 KIT, Z20-POS-STAND-GEN2-10 |
| Flip Stand Without Panel<br>(For ESY15I1E) | Brand: ELO<br>Model: E767356 KIT, Z20-POS-STAND-GEN2-15 |
| Type-C Cable | Brand: Hotron<br>Model: E113033 CAB, USB-C TO USB-C, Z20 Gen2 15,330mm,HT |
| Poe Module | Brand: ELO<br>Model: E669163, ELO-KIT-POE-ADAPTER-5.0 |
| Panel<br>(ESY10I1E) | Brand: BOE<br>Model: TV101WUM-NH3<br>Brand: AUO<br>Model: G101UAN4.0 |
| Panel<br>(ESY15I1E) | Brand: BOE<br>Model: BOE PV156FHM-N20<br>Brand: LG<br>Model: LP156WFC-SPDZ |
| Panel<br>(ESY22I1E) | Brand: LG<br>Model: M215WF3-SLS2<br>Brand: AUO<br>Model: M215HAN01.2 |

Note:
1. EUT support TPC Function.
2. EUT supports DFS Client Mode, without radar detection.
3. WLAN and BT can simultaneously transmission.
4. The device not support Channel Puncturing or Bandwidth Reduction mechanisms supported
5. 802.11ax EUT Only Support Full RU
6. EUT Operating mode : Indoor Client.
7. For more details, please refer to the User's manual of the EUT.

Difference description:

| Model No. | Remark |
|---|---|
| ESY10I1E | Only different sizes, other circuits, layout, product specifications are all the same. |
| ESY15I1E | |
| ESY22I1E | |

Note: After engineering evaluation ,Model: ESY22I1E is worst case.

## 2.2. Description of Test System

| Equipment | Brand | Model | Length/Type | Power cord/Length/Type | FCC ID |
|---|---|---|---|---|---|
| Notebook | Lenovo | S2292L | N/A | Adapter / 1.8m / NS | |
| RJ45 Cable | TE CONNECTIVITY | CAT5E | 1.2m / NS | N/A | |
| AP | NETGEAR | RAXE500 | N/A | Adapter / 1.5m / NS | PY320300508 |

## 2.3. General Information of Test

| | | |
|---|---|---|
| ☒ Test Site | Cerpass Technology Corporation Test Laboratory<br>Address: No.10, Ln. 2, Lianfu St., Luzhu Dist., Taoyuan City 33848, Taiwan (R.O.C.)<br>Tel: +886-3-3226-888<br>Fax: +886-3-3226-881 | |
| | FCC | TW1439, TW1079 |
| | IC | 4934E-1, 4934E-2 |
| Frequency Range Investigated | Conducted: from 150kHz to 30 MHz<br>Radiation: from 30 MHz to 40,000MHz | |
| Test Distance | The test distance of radiated emission from antenna to EUT is 3 M. | |

| Test Item | Test Site | Test period | Environmental Conditions | Tested By |
|---|---|---|---|---|
| DFS | RFDFS01-NK | 2024/08/08 | 24.9℃ / 42% | Eason Hsu |

## 2.4. Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

| Measurement Item | Uncertainty |
|---|---|
| Channel Move Time | ±5.6% |
| Channel Closing Transmission Time | ±7.4% |
| Threshold | ±2.5dB |

## 3. Test Equipment and Ancillaries Used for Tests

| Test Item | DFS | | | | |
|---|---|---|---|---|---|
| Test Site | RFDFS01-NK | | | | |
| Instrument | Manufacturer | Model No | Serial No | Calibration Date | Valid Date |
| CAX Signal Analyzer | KEYSIGHT | N9000B | MY57100291 | 2023/10/11 | 2024/10/10 |
| MXG-B RF Vector Signal Generator + Frequency Extender | KEYSIGHT | N5182B+ N5182BX07 | MY53051383+ MY59362519 | 2024/02/16 | 2025/02/15 |
| Control BOX | World-pallas | AD222 | L4490A | NA | NA |
| IOT0047A | KEYSIGHT | V23.9.1.10 | NA | NA | NA |
| N7607C Signal Studio | KEYSIGHT | v1.5.5.0 | NA | NA | NA |
| InServiceMonitorUtility | Theda | v10.0.0.0 | NA | NA | NA |

# 4. Antenna Requirements

## 4.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.407 (a), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

## 4.2. Antenna Construction and Directional Gain

| Antenna Type | PIFA Antenna |
|---|---|
| Antenna Gain (ESY10I1E) | 5150-5250MHz: ANT A: 2.46dBi, ANT B: 2.22dBi<br>5250-5350MHz: ANT A: 2.19dBi, ANT B: 2.44dBi<br>5470-5725MHz: ANT A: 2.70dBi, ANT B: 2.38dBi<br>5725-5850MHz: ANT A: 2.70dBi, ANT B: 2.56dBi |
| Antenna Gain (ESY15I1E) | 5150-5250MHz: ANT A: 2.44dBi, ANT B: 2.65dBi<br>5250-5350MHz: ANT A: 1.86dBi, ANT B: 2.69dBi<br>5470-5725MHz: ANT A: 2.83dBi, ANT B: 2.79dBi<br>5725-5850MHz: ANT A: 2.63dBi, ANT B: 2.79dBi |
| Antenna Gain (ESY22I1E) | 5150-5250MHz: ANT A: 1.75dBi, ANT B: 2.17dBi<br>5250-5350MHz: ANT A: 2.34dBi, ANT B: 2.17dBi<br>5470-5725MHz: ANT A: 2.25dBi, ANT B: 2.35dBi<br>5725-5850MHz: ANT A: 2.65dBi, ANT B: 2.42dBi |

# 5. Dynamic Frequency Selection

## 5.1. List of Measurement and Examinations

**EUT Applicability of DFS requirements and Frequency Range**

| Operation Mode | | Operating Frequency Range | |
|---|---|---|---|
| | | 5250-5350MHz | 5470-5725MHz (Support 5600MHz-5650MHz) |
| Master | -- | -- | -- |
| Client without radar detection | √ | √ | √ |
| Client with radar detection | -- | -- | -- |

**DEVICES WITH RADAR DETECTION**

| MAXIMUM TRANSMIT POWER | VALUE (SEE Note 1 and 2) |
|---|---|
| ≥ 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 |
| Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.<br>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.<br>Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 | |

**Table1: Applicability of DFS requirements prior to use of a channel**

| REQUIREMENT RADAR | OPERATIONAL MODE | | |
|---|---|---|---|
| | MASTER | CLIENT WITHOUT RADAR DETECTION | CLIENT WITH RADAR DETECTION |
| Non-Occupancy Period | V | Not required | V |
| DFS Detection Threshold | V | Not required | V |
| Channel Availability Check Time | V | Not required | Not required |
| U-NII Detection Bandwidth | V | Not required | V |

**Table2: Applicability of DFS requirements during normal operation**

| REQUIREMENT<br>RADAR | OPERATIONAL MODE | | |
|---|---|---|---|
| | MASTER | CLIENT WITHOUT RADAR DETECTION | CLIENT WITH RADAR DETECTION |
| DFS Detection Threshold | V | Not required | V |
| Channel Closing Transmission Time | V | V | V |
| Channel Move Time | V | V | V |
| U-NII Detection Bandwidth | V | Not required | V |

| | | |
|---|---|---|
| Additional requirements for devices with multiple bandwidth modes | 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 | 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. | | |

## 5.2. Test Setup

### Setup for Master with injection at the Master

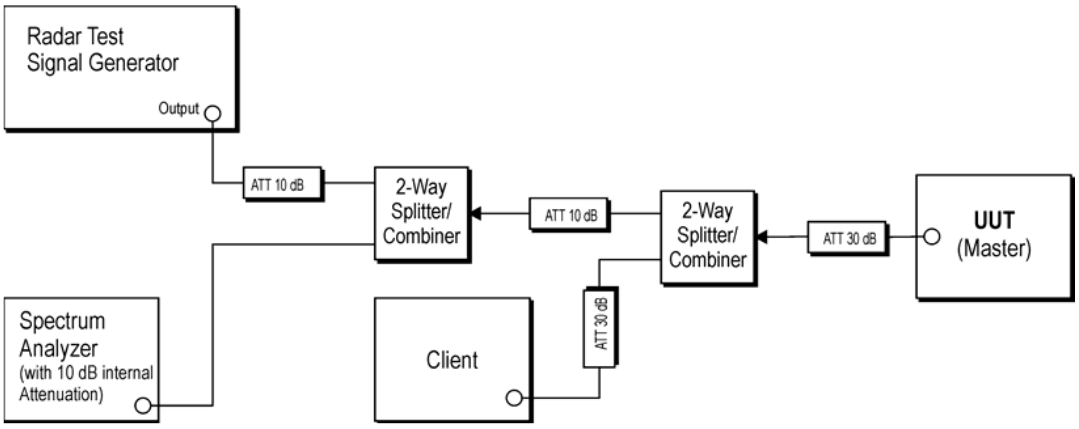



Figure 1: Example Conducted Setup where UUT is a Master and Radar Test Waveforms are injected into the Master

### Setup for Client with injection at the Master

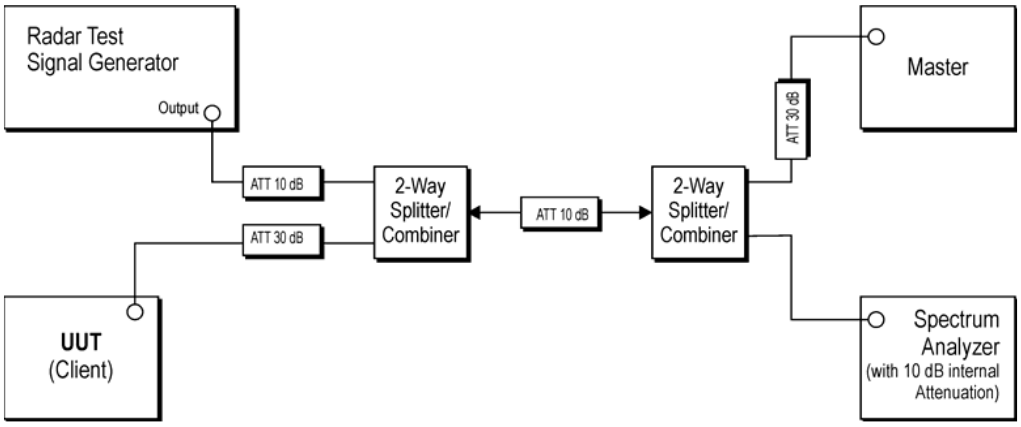



Figure 2: Example Conducted Setup where UUT is a Client and Radar Test Waveforms are injected into the Master

**Setup for Client with injection at the Client**

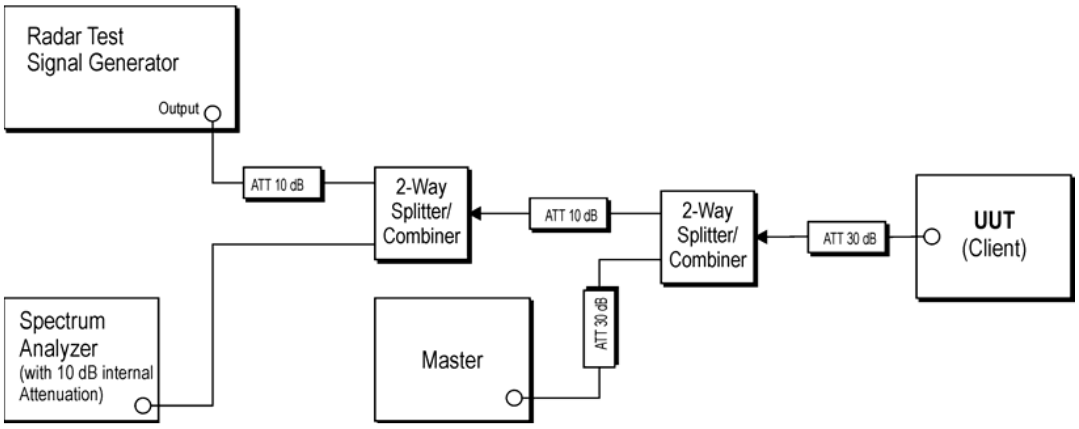



Figure 3: Example Conducted Setup where UUT is a Client and Radar Test Waveforms are injected into the Client

## 5.3. DFS Detection Threshold

DFS Detection Threshold is the level used by the DFS mechanism to detect radar interference.

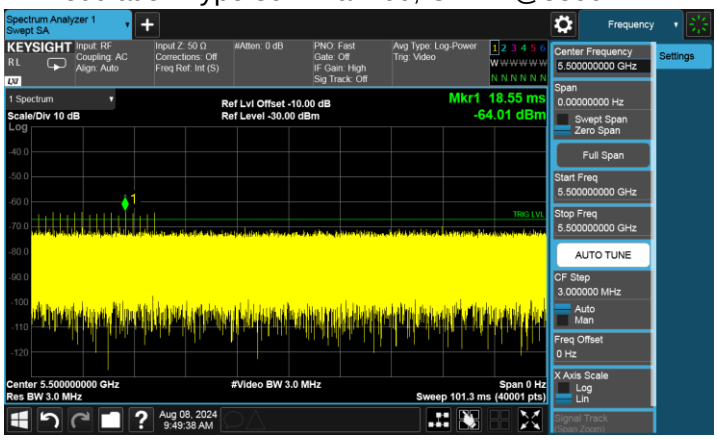
### 5.3.1. Test Limit

Limits Clause 4.7.2.1.2
DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

| MAXIMUM TRANSMIT POWER | VALUE (SEE Note 1 and 2) |
|---|---|
| ≥ 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 |
| Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.<br>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.<br>Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 | |

### 5.3.2. Test Result of DFS Detection Threshold

Modulation Type:802.11ax160, CH114@5500MHz



## 5.4. In-Service Monitoring

The In-Service Monitoring is defined as the process by which an RLAN monitors the Operating Channel for the presence of radar signals.

| | | |
|---|---|---|
| Additional requirements for devices with multiple bandwidth modes | 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 | 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. | | |

### 5.4.1. Test Limit

| Parameter | Value |
|---|---|
| Channel Move Time | < 10 s (See Note 1) |
| Channel Closing Transmission Time | < 200 ms+ an aggregate of 60 milliseconds over remaining 10 second period. (See Notes 1 and Notes 2.) |
| 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.<br>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. | |

Limits Clause 4.7.2.2.2

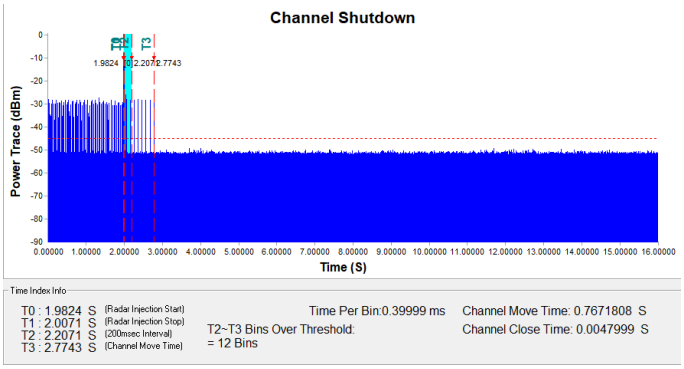
The In-Service Monitoring shall be used to continuously monitor an Operating Channel.

The In-Service-Monitoring shall start immediately after the RLAN has started transmissions on an Operating Channel.

### 5.4.2. Test Result of In-Service Monitoring

| | Value | Limit |
|---|---|---|
| Channel Move Time | 0.7671808 | <10 s |
| Channel Closing Transmission Time | 4.7999 | < 60 ms |

Modulation Type:802.11ax160, CH114@5500MHz



## 5.5. Non-Occupancy Period

The Channel Shutdown is defined as the process initiated by the RLAN device immediately after a radar signal has been detected on an Operating Channel.
The master device shall instruct all associated slave devices to stop transmitting on this channel, which they shall do within the Channel Move Time.
Slave devices with a Radar Interference Detection function, shall stop their own transmissions within the Channel Move Time.
The aggregate duration of all transmissions of the RLAN device on this channel during the Channel Move Time shall be limited to the Channel Closing Transmission Time. The aggregate duration of all transmissions shall not include quiet periods in between transmissions.

### 5.5.1. Test Limit

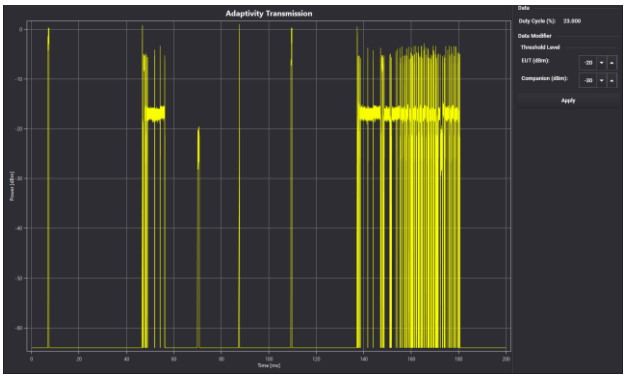
| Radar Test Signal | Master (min) | Client (min) |
|---|---|---|
| 0 | > 30 | > 30 |

### 5.5.2. Channel Loading

A link is established between the Control BOX. Use IOT0047A ver.23.9.1.10 Software to simulate data transfer is streamed to generate WLAN traffic.

Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, channel loading can be estimated by setting the spectrum analyzer for zero span and approximate the Time On/ (Time On + Off Time). This can be done with any appropriate channel BW and modulation type

Modulation Type:802.11ax160
Time On/ (Time On + Off Time) =23%



### 5.5.3. Test Result of Non-Occupancy Period

Modulation Type:802.11ax160, CH114@5500MHz


**----------THE END OF REPORT----------**