



Dynamic Frequency Selection (DFS) Test Report

FCC Part15 Subpart E

Product Name : WIRELESS-ABGN 2X2 NETWORK
MINI PCIE ADAPTER
Model No. : WLE250NX
FCC ID : TK4WLE250NX

Applicant : Compex Systems Pte Ltd
Address : 135 Joo Seng Road, #08-01 PM Industrial Building
Singapore 368363

Date of Receipt : 04/02/2013
Test Date : 05/02/2013~06/05/2013
Issued Date : 07/05/2013
Report No. : 132S009R-DFS-US-P08V01
Report Version : V1.0

This report was based on Quietek report No: 132S008R

The test results relate only to the samples tested.

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Applicant : Compex Systems Pte Ltd

Address : 135 Joo Seng Road, #08-01 PM Industrial Building Singapore 368363

Manufacturer : Compex Systems Pte Ltd

Address : 135 Joo Seng Road, #08-01 PM Industrial Building Singapore 368363

Model No. : WLE250NX

FCC ID : TK4WLE250NX

EUT Voltage : DC 3.3V

Trade Name : COMPEX

Applicable Standard : FCC CFR Title 47 Part 15 Subpart E: 2012
FCC OET Order 06-96A (2006)
FCC KDB 848637

Test Result : Pass

Performed Location : Suzhou EMC Laboratory
No.99 Hongye Rd., Suzhou Industrial Park Loufeng Hi-Tech Development
Zone., Suzhou, China
TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098
FCC Registration Number: 800392

Operation Mode : ☐ Master device
(5250~5350MHz, ☐ Slaver device with radar detection function
5470~5725MHz) ☒ Slaver device without radar detection function

Documented By : Alice Ni

Reviewed By : Jameyuan

Approved By : Robin Wu

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1. GENERAL INFORMATION

1.1. EUT Description

| | |
|---------------------|---|
| Product Name | WIRELESS-ABGN 2X2 NETWORK MINI PCIE ADAPTER |
| Applicant | Compex Systems Pte Ltd |
| Address | 135 Joo Seng Road, #08-01 PM Industrial Building Singapore 368363 |
| FCC ID. | TK4WLE250NX |
| Model No. | WLE250NX |
| DFS Frequency Range | 5250-5350MHz, 5470-5725MHz |
| Number of Channels | 802.11a/n-20 MHz: 15 802.11n-40 MHz: 7 |
| Data Rate | 802.11a: 6 - 54Mbps; 802.11n: up 300Mbps |
| Channel Control | Auto |
| Type of Modulation | 802.11a/n: OFDM |
| Antenna type | Reference to Antenna List |
| Peak Antenna Gain | Reference to Antenna List |

802.11a/n-20MHz Center Working Frequency of Each Channel:

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| Channel 52: | 5260 MHz | Channel 56: | 5280 MHz | Channel 60: | 5300 MHz | Channel 64: | 5320 MHz |
| Channel 100: | 5500 MHz | Channel 104: | 5520 MHz | Channel 108: | 5540 MHz | Channel 112: | 5560 MHz |
| Channel 116: | 5580 MHz | Channel 120: | 5600 MHz | Channel 124: | 5620 MHz | Channel 128: | 5640 MHz |
| Channel 132: | 5660 MHz | Channel 136: | 5680 MHz | Channel 140: | 5700 MHz | N/A | N/A |

802.11n-40MHz Center Working Frequency of Each Channel:

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| Channel 54: | 5270 MHz | Channel 62: | 5310 MHz | Channel 102: | 5510 MHz | Channel 110: | 5550 MHz |
| Channel 118: | 5590 MHz | Channel 126: | 5630 MHz | Channel 134: | 5670 MHz | N/A | N/A |

802.11a/b/g/n Antenna List

| Antenna | Manufacturer | M/N | Peak Gain |
|----------------|--|-----|----------------------------------|
| Panel Antenna | A*STAR Institute for Infocomm Research | N/A | 3dBi for 2.4GHz, 5dBi for 5GHz |
| Dipole Antenna | SmartAnt Telecom Co., Ltd. | N/A | 4.5dBi for 2.4GHz, 7dBi for 5GHz |
| Dipole Antenna | Kunshan Wavelink Electronic Co., Ltd. | N/A | 2dBi for 2.4GHz and 5GHz |

1.2. Standard Requirement

FCC Part 15.407:

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. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30dBm. A TPC mechanism is not required for systems with an E.I.R.P. of less than 500mW.

1.3. UNII Device Description

The UUT operates in the following band: 5250-5350MHz, 5470-5725 MHz

The UUT is a Client Device that does not have radar detection capability and ad-hoc function. The highest gain antenna assembly utilized with the EUT has a maximum gain of 7dBi in 5GHz frequency band. The 50-ohm Tx/Rx antenna port is connected to the test system to perform conducted tests. TPC is not required since the maximum EIRP is less than 500mW (27dBm).

The UUT utilizes 802.11a/n IP based architecture. Two nominal channel bandwidths, 20 MHz and 40MHz are implemented.

WLAN traffic is generated by streaming the video file "TestFile.mp2" from the Master device to the Slave device in full motion video mode using the "Nero Show Time 3" with the V3.0.1.3 Codec package.

The master device is a Cisco 802.11a/b/g/n Access Point. The Cisco Access Point FCC ID: LDK 102061.

The UUT is a client device without radar detection therefore the interference threshold level is not required.

Statement: Information regarding the parameters of the detected Radar Waveforms is not available to the end user.

1.4. Test Equipment

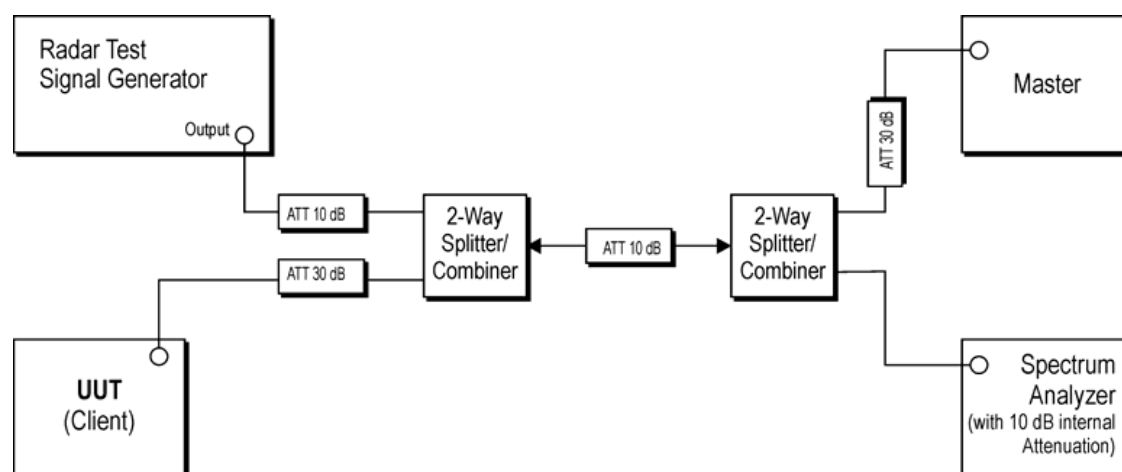
Dynamic Frequency Selection (DFS) / TR-8

| Instrument | Manufacturer | Type No. | Serial No | Cal. Date |
|-------------------------|--------------|----------|------------|------------|
| Spectrum Analyzer | Agilent | N9020A | MY49100159 | 2013.03.30 |
| Vector Signal Generator | Agilent | E4438C | MY49070163 | 2013.03.30 |

| Instrument | Manufacturer | Type No. | Serial No |
|----------------------------|---------------|----------------------|-----------------|
| Splitter/Combiner (Qty: 2) | Mini-Circuits | ZAPD-50W 4.2-6.0 GHz | NN256400424 |
| Splitter/Combiner (Qty: 2) | MCLI | PS3-7 | 4463/4464 |
| ATT (Qty: 1) | Mini-Circuits | VAT-30+ | 30912 |
| Laptop PC | Asus | N80V | 8BN0AS226971468 |
| RF Cable (Qty: 6) | Mini-Circuits | N/A | DFS-1~6 |

| Software | Manufacturer | Function |
|----------------|--------------|----------------------------------|
| Pulse Building | Agilent | Radar Signal Generation Software |
| DFS Tool | Agilent | DFS Test Software |

1.5. Test Setup



DFS Set-up Photo: Slave and Spectrum Analyzer



1.6. Limits

According to §15.407(h) and FCC 06-96 APPENDIX “COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION”.

Applicability of DFS requirements prior to use of a channel

| Requirement | Operational Mode | | |
|---------------------------------|------------------|-------------------------------|----------------------------------|
| | Master | Client (with radar detection) | Client (without radar detection) |
| Non-Occupancy Period | Yes | Yes | Yes |
| DFS Detection Threshold | Yes | Yes | Not Required |
| Channel Availability Check Time | Yes | Not Required | Not Required |
| Uniform Spreading | Yes | Not Required | Not Required |
| U-NII Detection Bandwidth | Yes | Yes | Not Required |

Applicability of DFS requirements during normal operation

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

Interference Threshold value, Master or Client incorporating In-Service Monitoring

| Maximum Transmit Power | Value (see note) |
|---|------------------|
| ≥ 200 milliwatt | -64 dBm |
| < 200 milliwatt | -62 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> | |

DFS Response requirement values

| Parameter | Value |
|---|--|
| Non-Occupancy Period | 30 Minutes |
| Channel Availability Check Time | 60 Seconds |
| Channel Move Time | 10 Seconds |
| Channel Closing Transmission Time | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period (See Notes 1 and 2) |
| <p>Note1: The instant that the Channel Move Time and the Channel Closing Transmission Time begins is as follows:</p> <p>For the short pulse radar test signals this instant is the end of the burst.</p> <p>For the frequency hopping radar test signal, this instant is the end of the last radar burst generated</p> <p>For the long pulse radar test signal this instant is the end of the 12 seconds period defining the radar transmission.</p> <p>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 facilitating channel changes (an aggregate of approximately 60 milliseconds) during the remainder of the 10 seconds period.</p> <p>The aggregate duration of control signals will not count quiet periods in between transmissions.</p> | |

Short Pulse Radar Test Waveforms

| Radar Type | Pulse Width (μsec) | PRI (μsec) | Pulses | Minimum Percentage of Successful Detection | Minimum Trials |
|-----------------------------|---------------------------------|-------------------------|--------|--|----------------|
| 1 | 1 | 1428 | 18 | 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 |

A minimum of 30 unique waveforms is required for each of the short pulse radar type 2 through 4. For short pulse radar type 1, then same waveform is used a minimum of 30 times. If more than 30 waveforms are used for short pulse radar type 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of short pulse radar type 1-4.

Long Pulse Radar Test Signal

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

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the long pulse radar test signal. If more than 30 waveforms are used for the long pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

Frequency Hopping Radar Test Signal

| Radar Waveform | Pulse Width (μsec) | PRI (μsec) | Hopping Sequence Length (msec) | Pulses Per Hop | Hopping Rate (kHz) | Minimum Percentage of Successful Detection | Minimum Trials |
|----------------|---------------------------------|-------------------------|--------------------------------|----------------|--------------------|--|----------------|
| 6 | 1 | 333 | 300 | 9 | .333 | 70% | 30 |

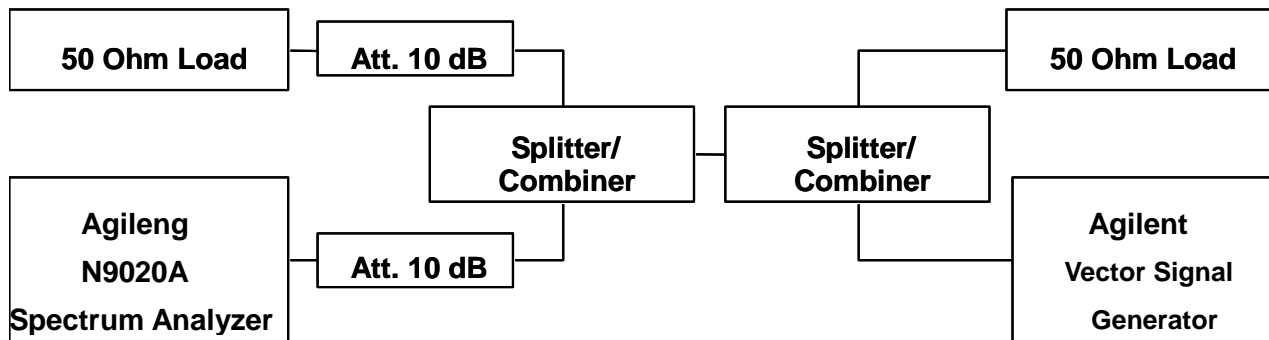
For the frequency hopping radar type, the same burst parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence.

1.7. Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted radar waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were replace 50ohm terminal from master and client device and 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 utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3MHz and 3 MHz.

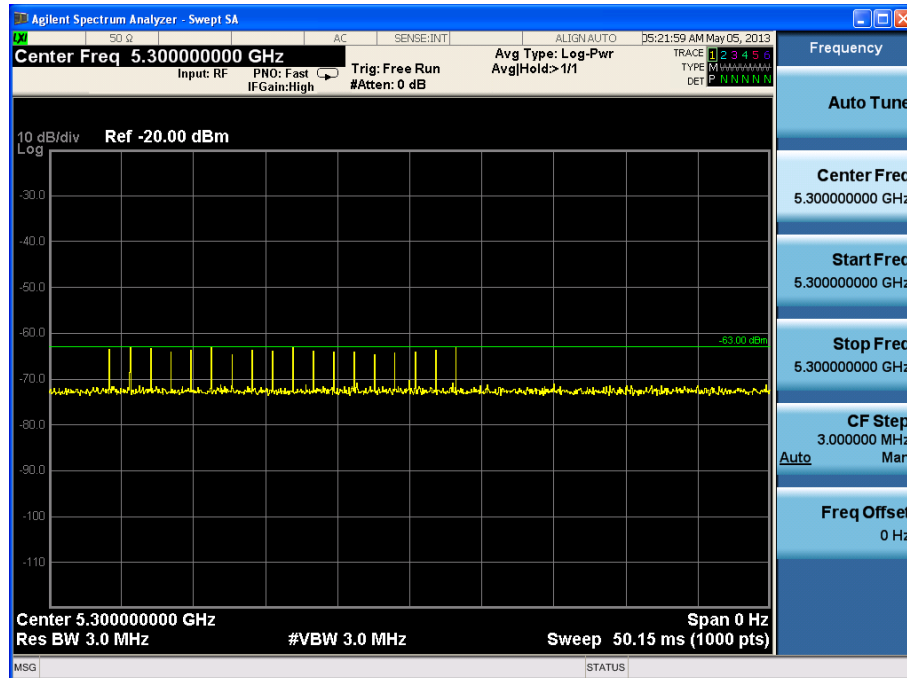
The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -61dBm due to the interference threshold level is not required.

Conducted Calibration Setup

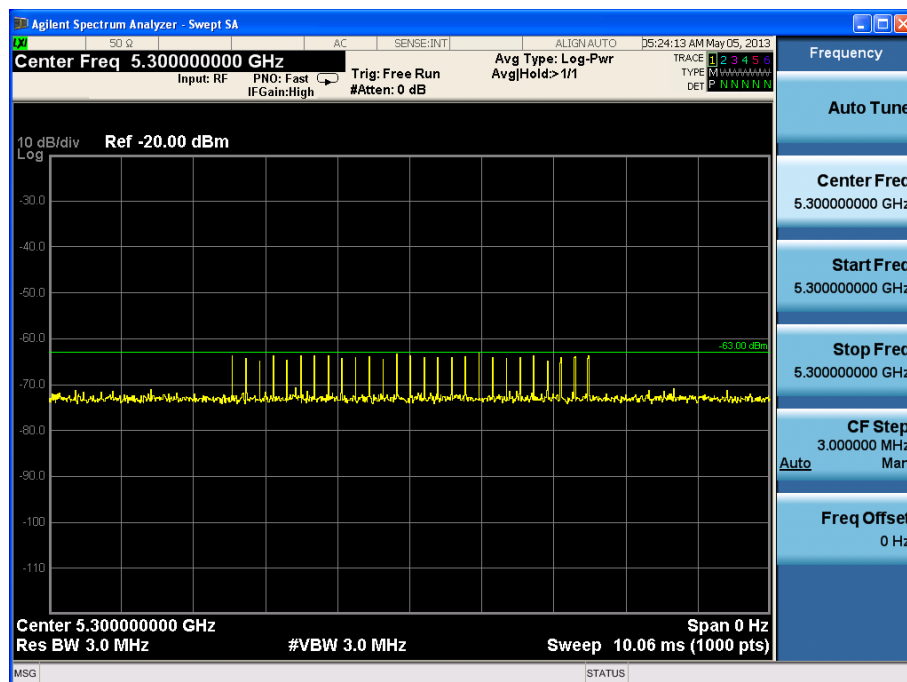


1.8. Radar Waveform Calibration Result

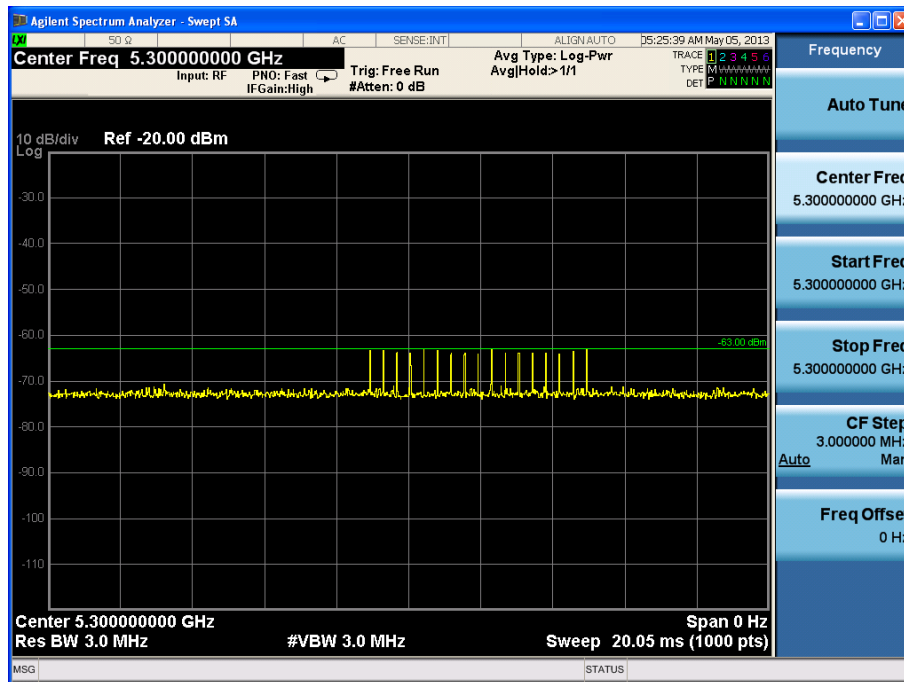
Radar Type 1 Calibration Plot



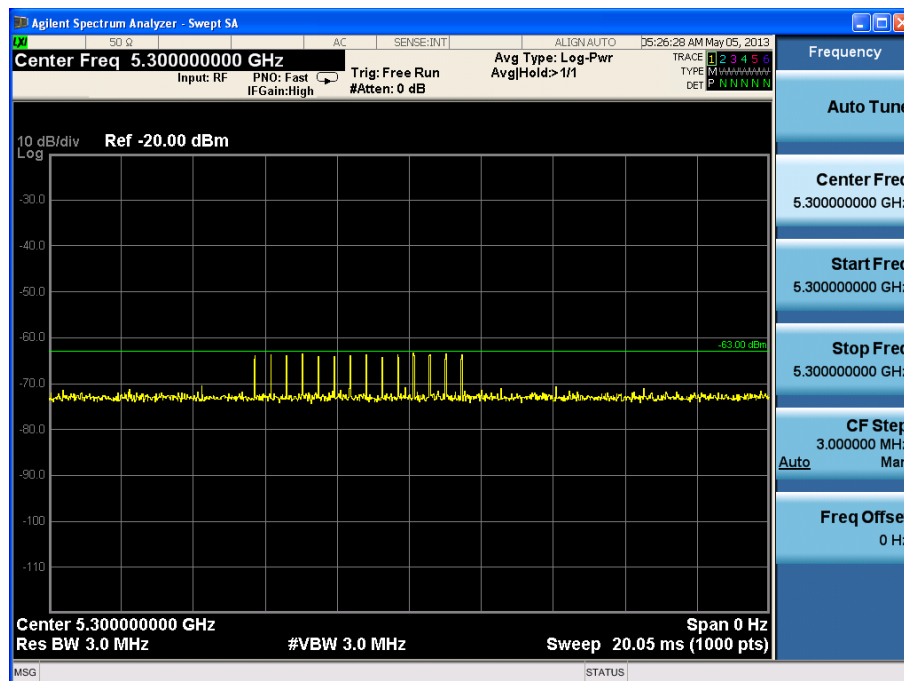
Radar Type 2 Calibration Plot



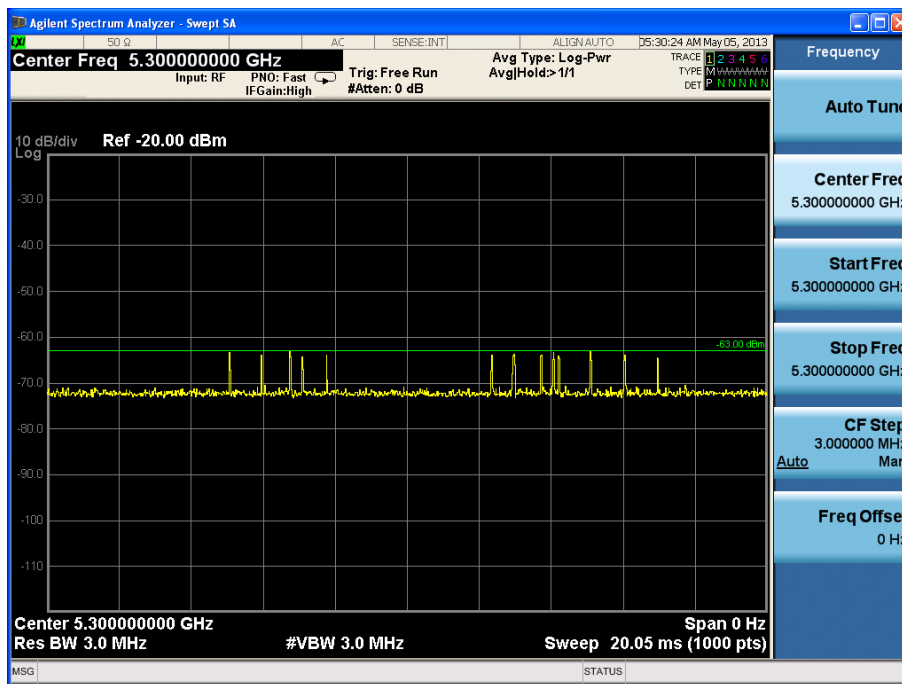
Radar Type 3 Calibration Plot



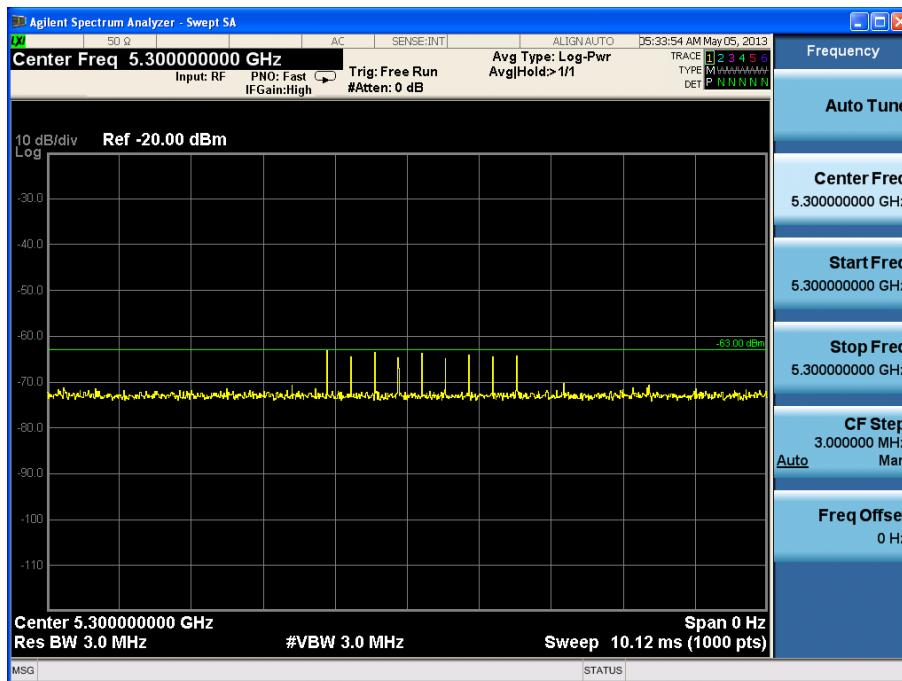
Radar Type 4 Calibration Plot



Radar Type 5 Calibration Plot



Radar Type 6 Calibration Plot



2. Channel Move Time and Channel Closing Transmission Time

2.1. Test Procedure

These tests define how the following DFS parameters are verified during In-Service Monitoring; Channel Closing Transmission Time and Channel Move Time.

The steps below define the procedure to determine the above mentioned parameters when a radar burst with a level -61dBm is generated on the operating channel of the U-NII device.

A U-NII device operating as a Client device will associate with the Master device at 5500MHz.

During the in-service monitoring detection probability and channel moving tests the system was configured with a streaming video file from the master device (sourced by the PC connected to the master device via an Ethernet interface) to the client device. The streamed file was the "FCC" test file and the client device was using Media Player Classic as required by FCC Part 15 Subpart E.

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 spectrum analyzer during the observation time (Channel Move Time). Compare the channel move time and channel closing transmission time results to the limits defined in the DFS Response requirement values table.

2.2. Test Requirement

| Parameter | Value |
|-----------------------------------|---|
| Channel Move Time | 10 Seconds |
| Channel Closing Transmission Time | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period |

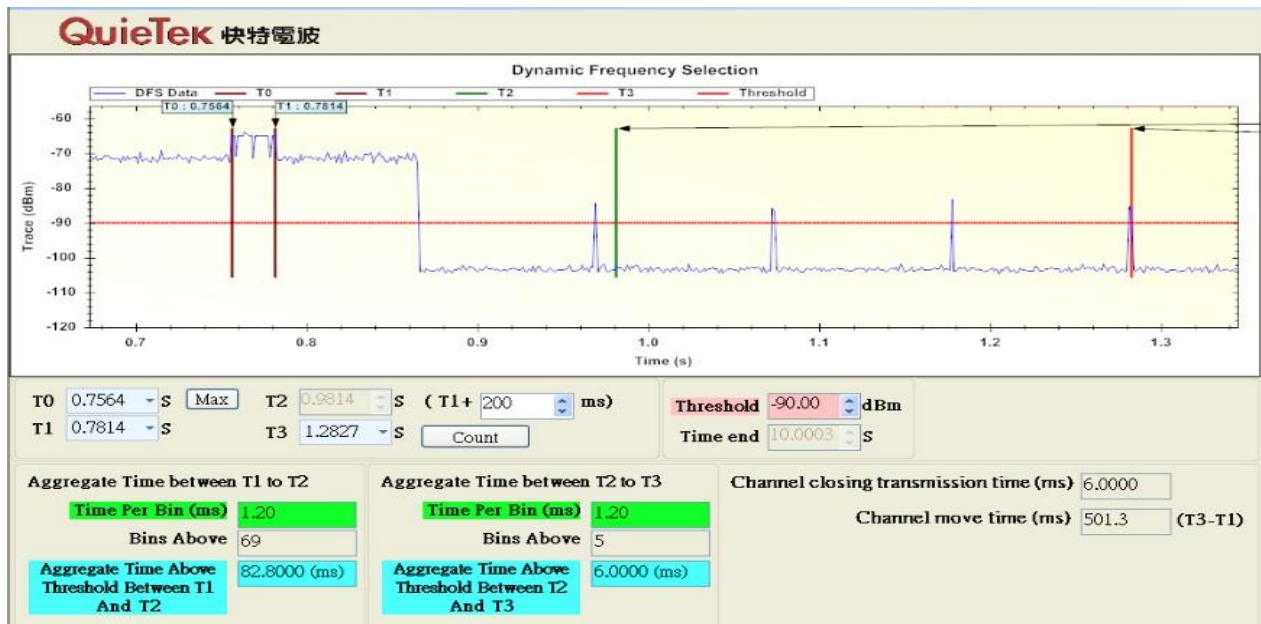
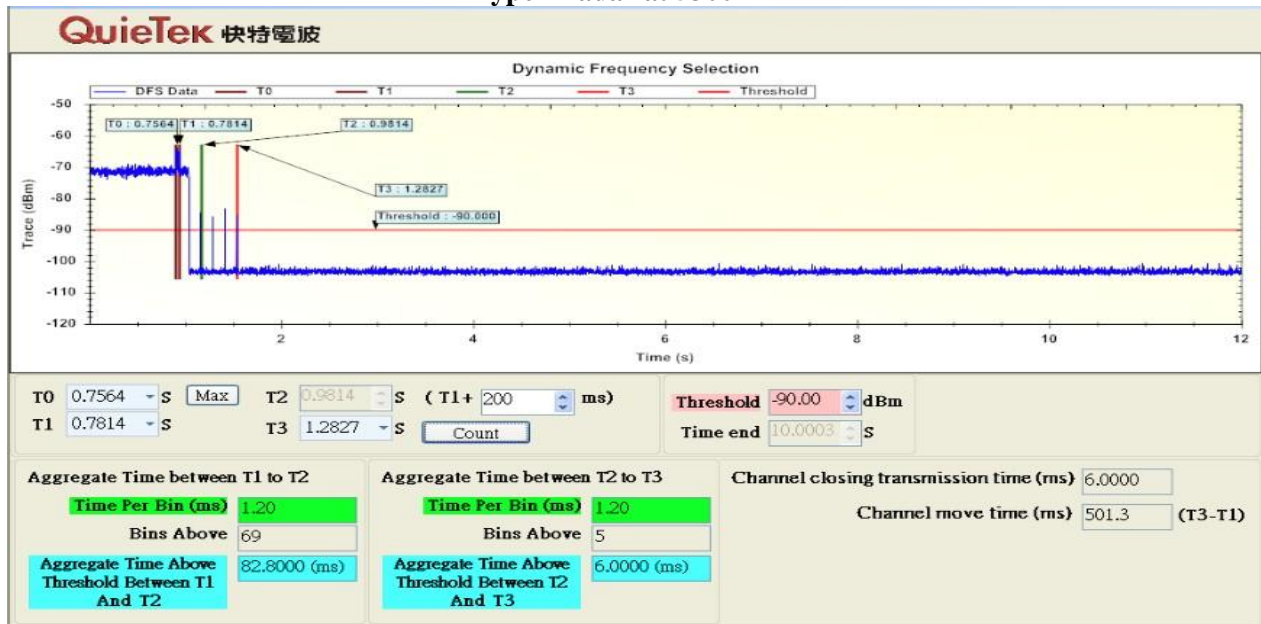
2.3. Uncertainty

± 1ms.

2.4. Test Result of Channel Move Time and Channel Closing Transmission Time

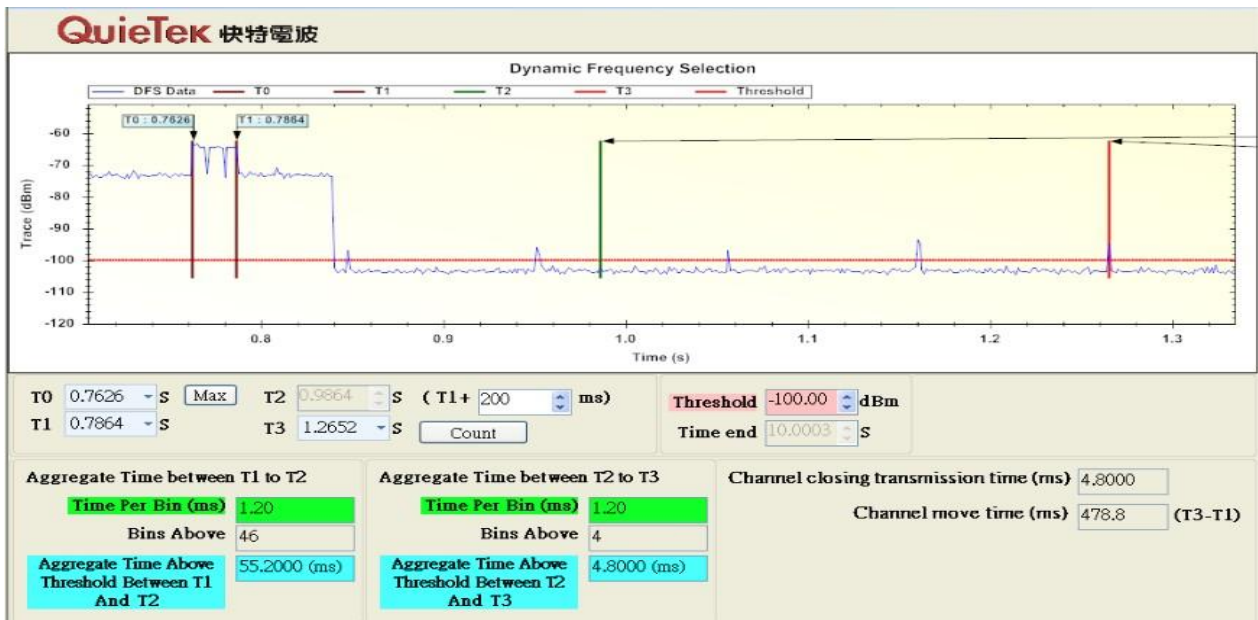
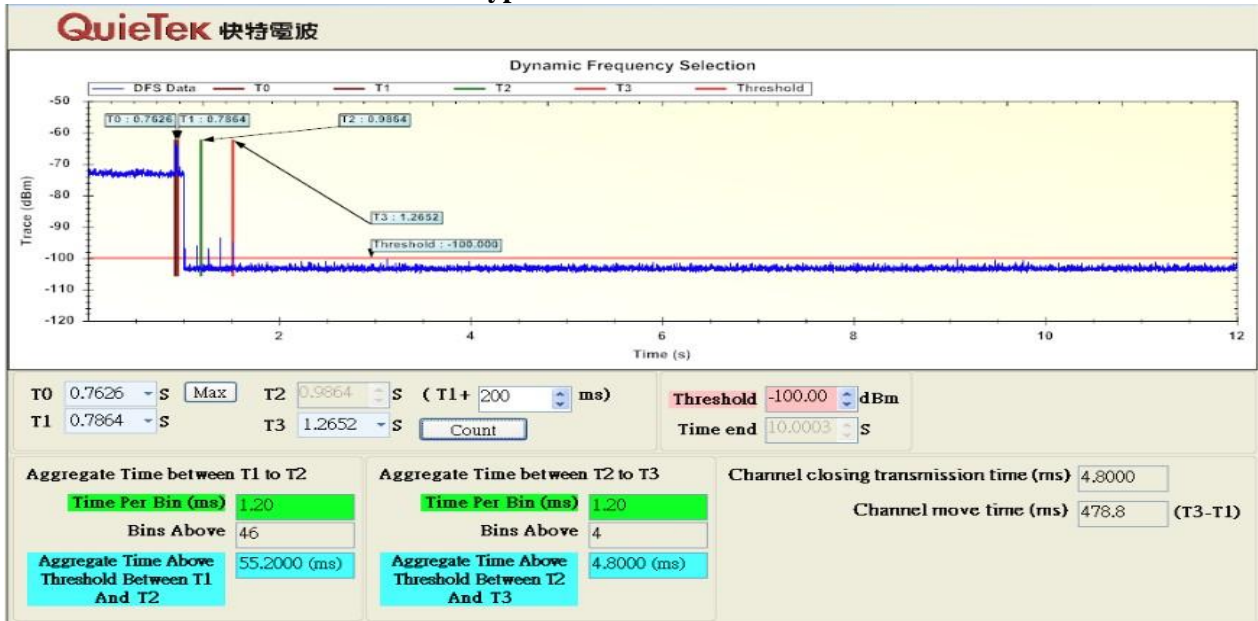
Product : WIRELESS-ABGN 2X2 NETWORK MINI PCIE ADAPTER

Type 1 radar at 5300MHz



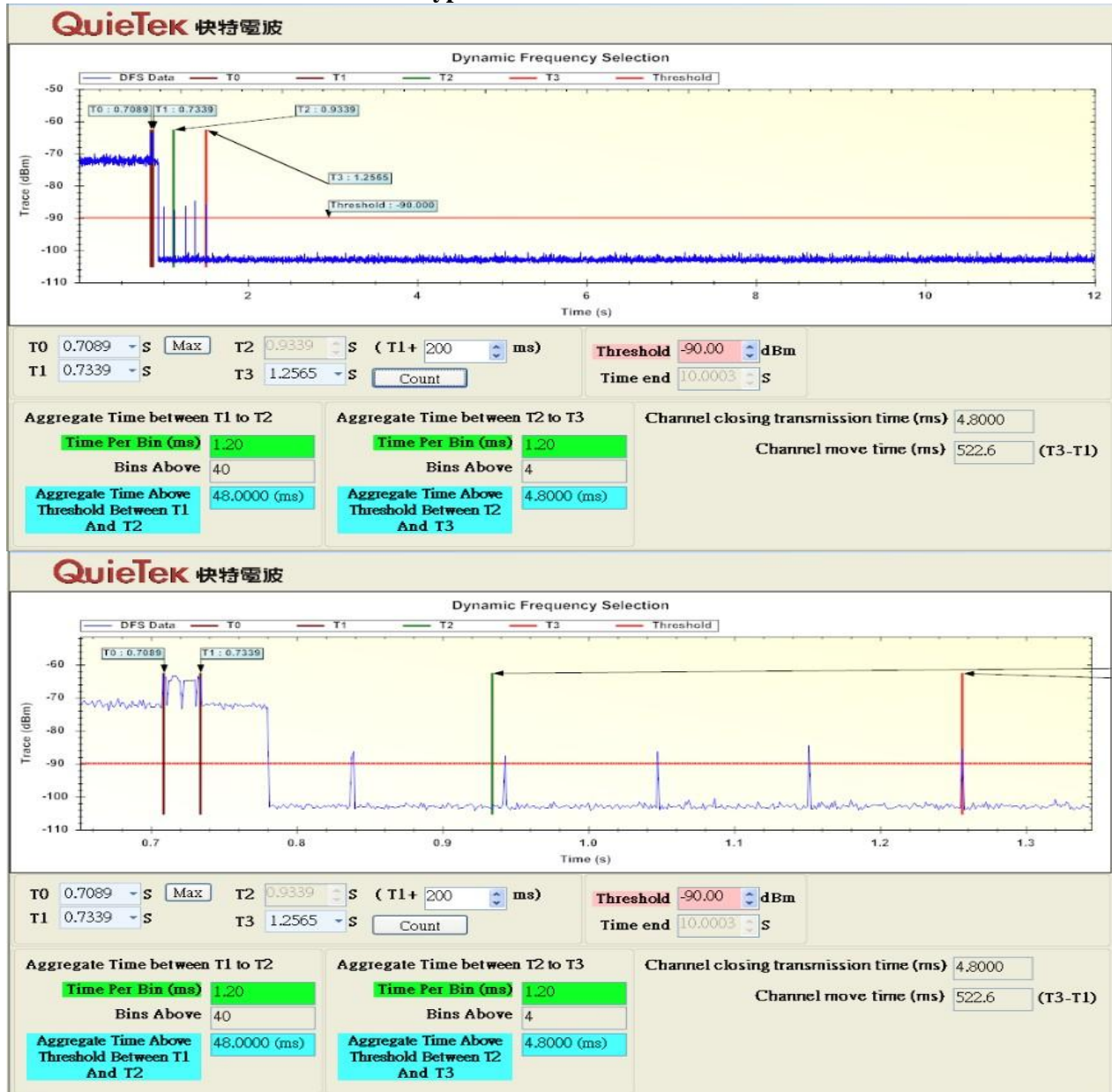
| Test Item | Limit | Results |
|-----------------------------------|---|---------|
| Channel Move Time | 10 s | Pass |
| Channel Closing Transmission Time | 200ms + an aggregate of 60ms over remaining 10 second period. | Pass |

Type 1 radar at 5310MHz



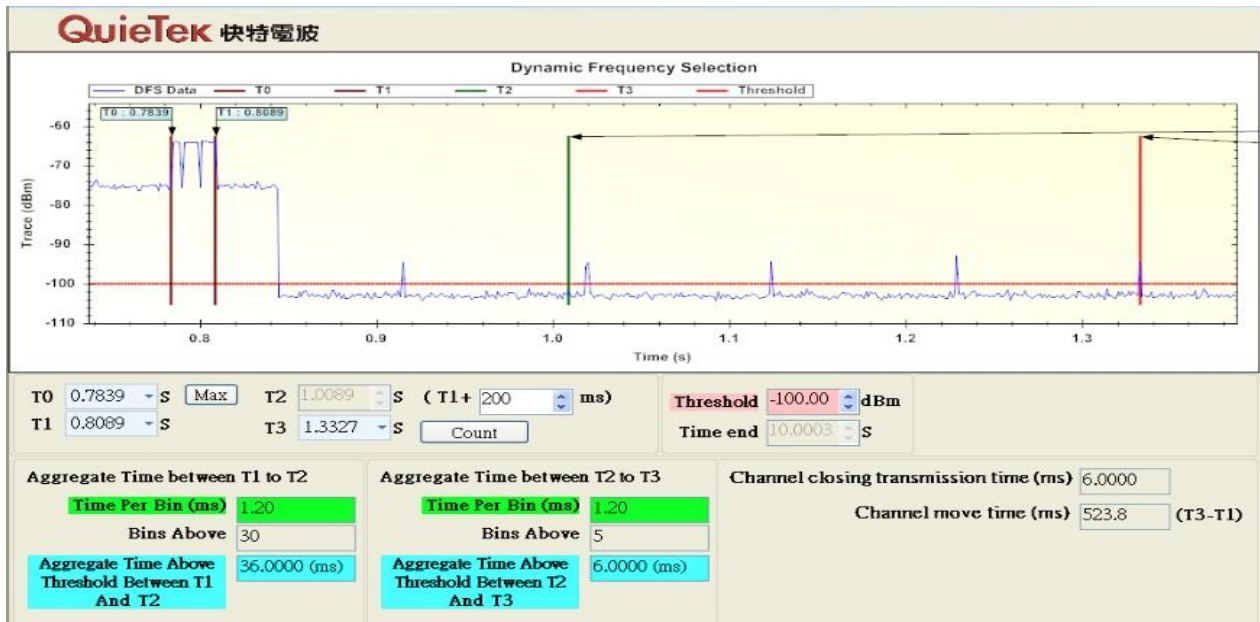
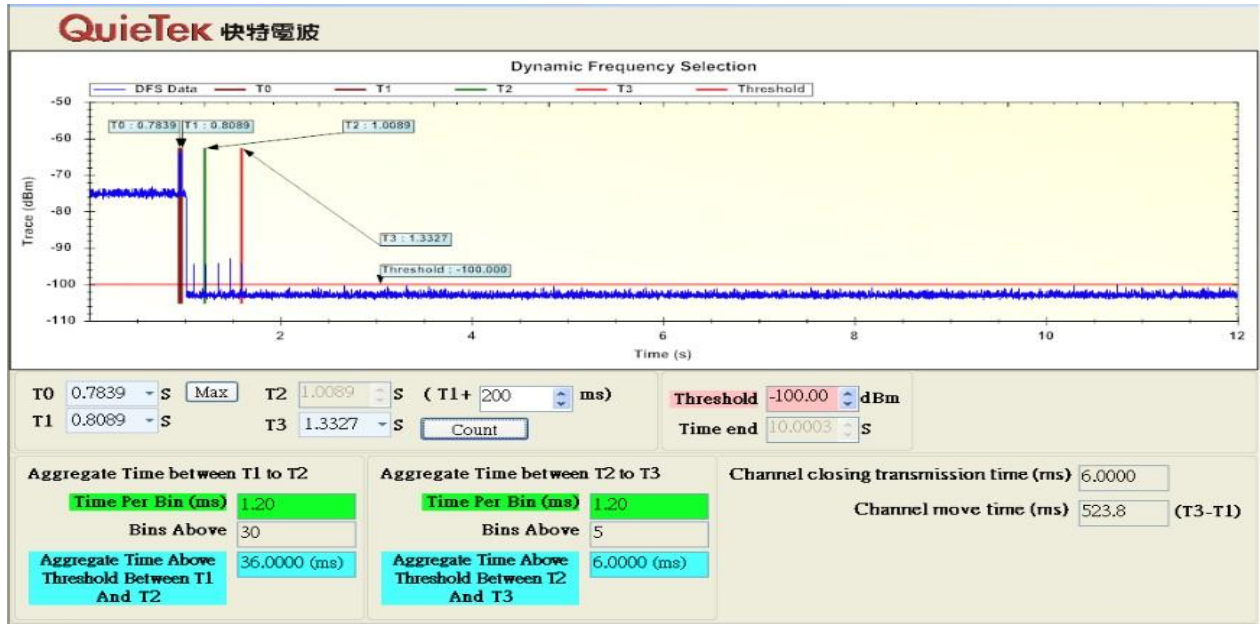
| Test Item | Limit | Results |
|-----------------------------------|---|---------|
| Channel Move Time | 10 s | Pass |
| Channel Closing Transmission Time | 200ms + an aggregate of 60ms over remaining 10 second period. | Pass |

Type 1 radar at 5500MHz



| Test Item | Limit | Results |
|-----------------------------------|---|---------|
| Channel Move Time | 10 s | Pass |
| Channel Closing Transmission Time | 200ms + an aggregate of 60ms over remaining 10 second period. | Pass |

Type 1 radar at 5510MHz



| Test Item | Limit | Results |
|-----------------------------------|---|---------|
| Channel Move Time | 10 s | Pass |
| Channel Closing Transmission Time | 200ms + an aggregate of 60ms over remaining 10 second period. | Pass |

3. Non-Occupancy Period

3.1. Test Procedur

Measure the EUT for more than 30 minutes following the channel close/move time to verify that the UUT does not resume any transmissions on this channel.

3.2. Test Requirement

| Parameter | Value |
|----------------------|------------|
| Non-Occupancy Period | 30 Minutes |

3.3. Uncertainty

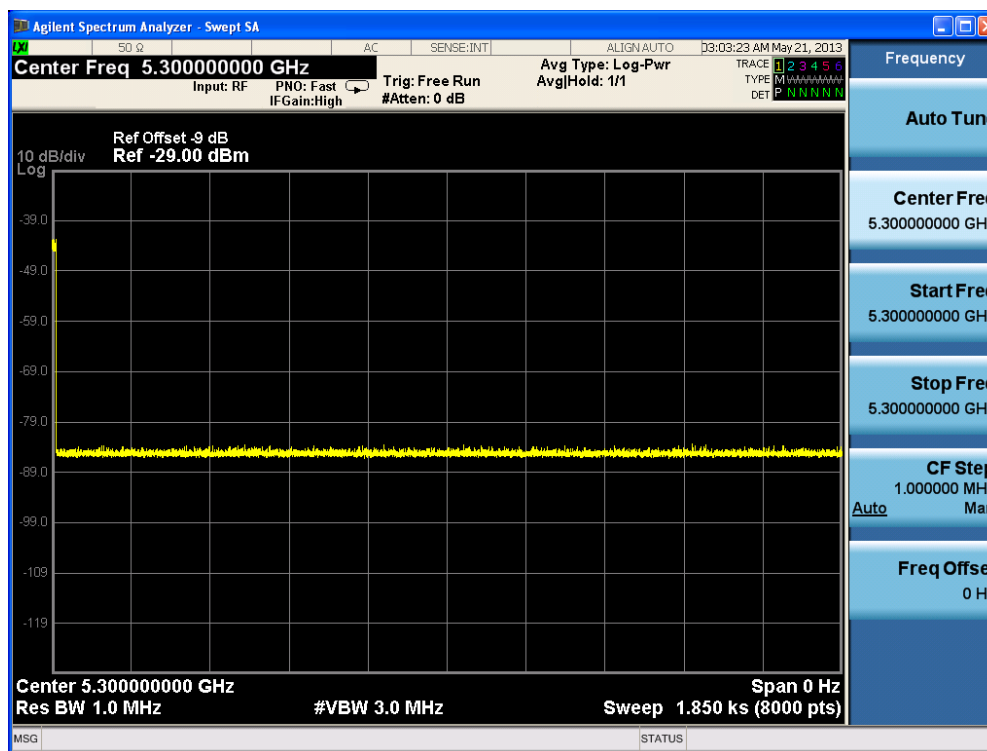
$\pm 1\text{ms.}$

3.4. Test Result of Non-Occupancy Period

Product : WIRELESS-ABGN 2X2 NETWORK MINI PCIE ADAPTER

Radar Type : Type 1

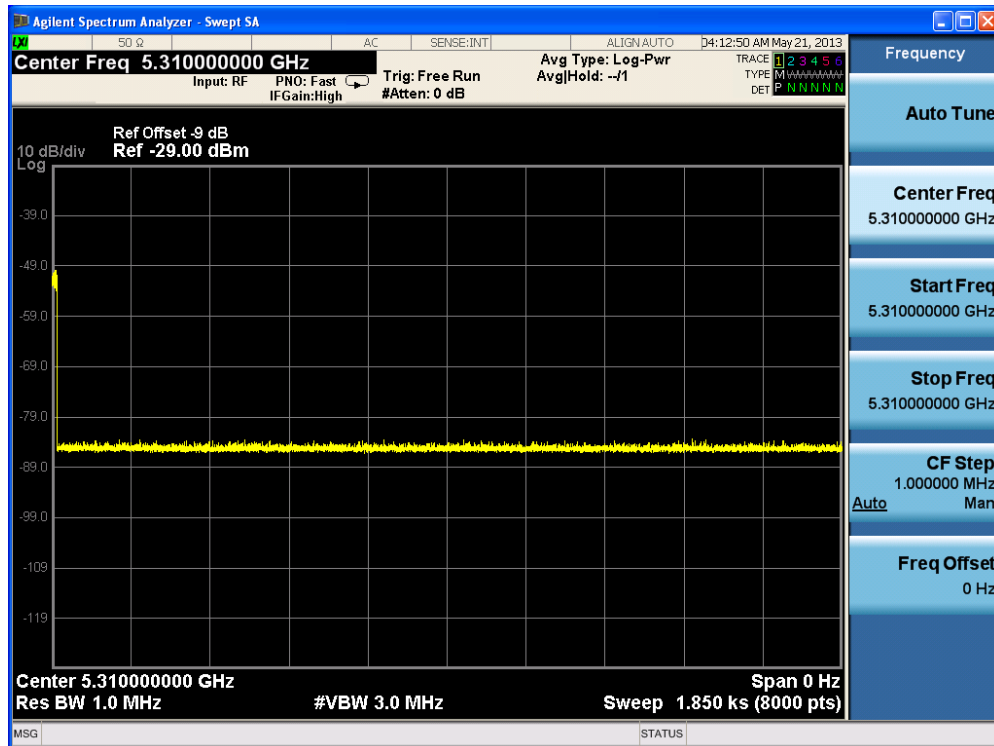
30 Minute Non-Occupancy Period at 5300 MHz



| Test Item | Limit | Results |
|----------------------|------------|---------|
| Non-Occupancy Period | 30 Minutes | Pass |

No EUT transmissions were observed on the test channel during 30 minutes observation time.

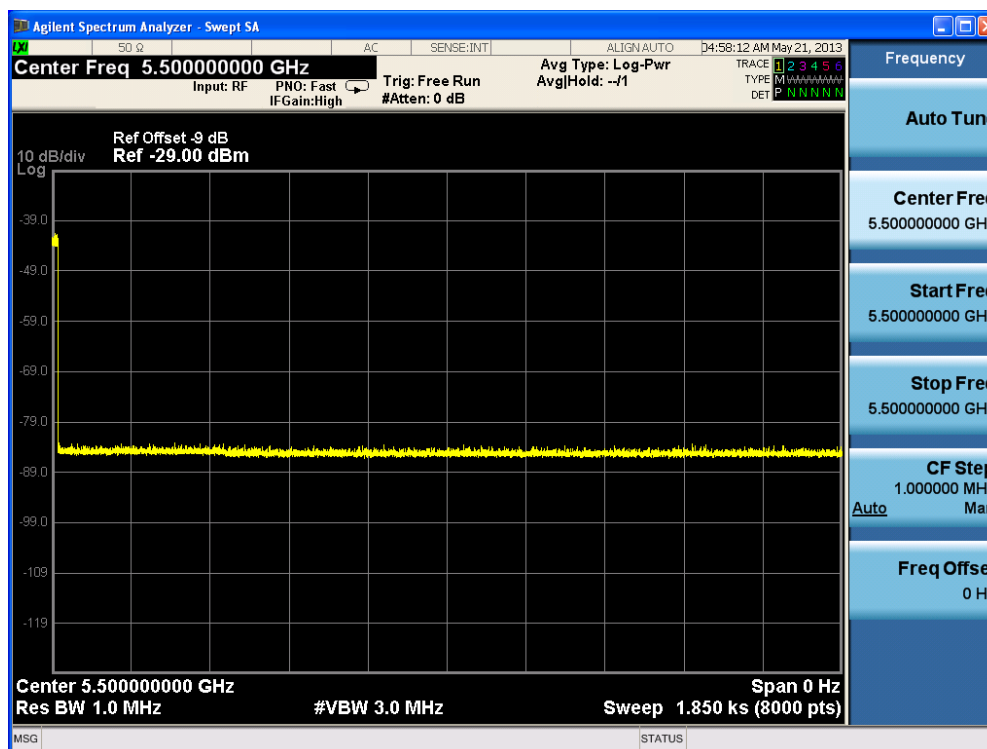
30 Minute Non-Occupancy Period at 5310 MHz



| Test Item | Limit | Results |
|----------------------|------------|---------|
| Non-Occupancy Period | 30 Minutes | Pass |

No EUT transmissions were observed on the test channel during 30 minutes observation time.

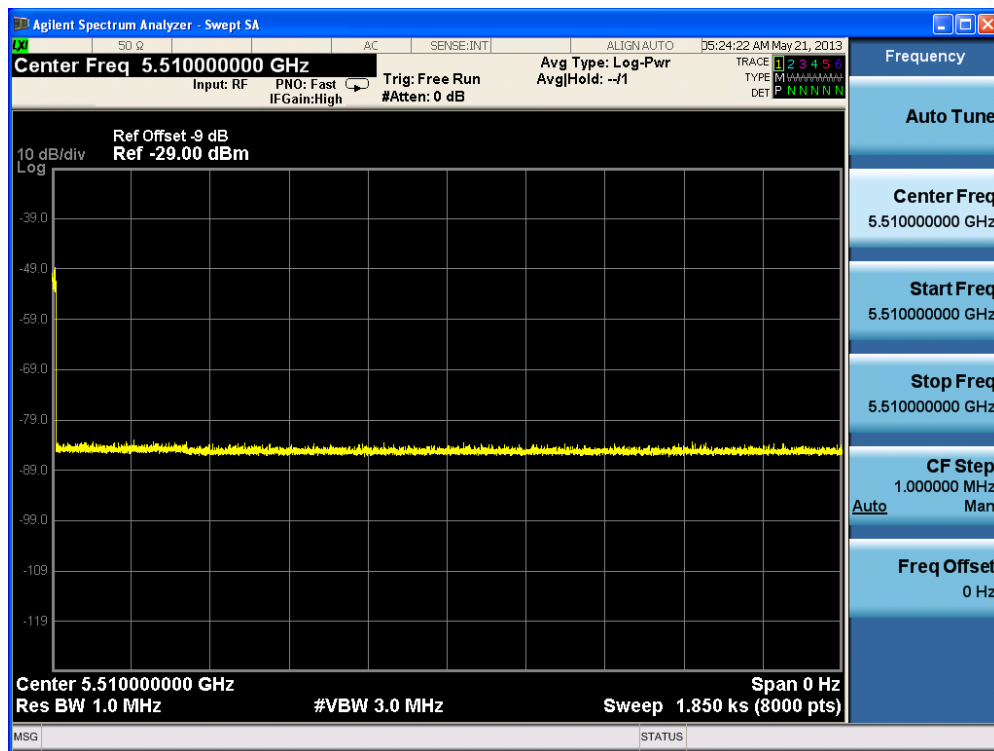
30 Minute Non-Occupancy Period at 5500 MHz



| Test Item | Limit | Results |
|----------------------|------------|---------|
| Non-Occupancy Period | 30 Minutes | Pass |

No EUT transmissions were observed on the test channel during 30 minutes observation time.

30 Minute Non-Occupancy Period at 5510 MHz



| Test Item | Limit | Results |
|----------------------|------------|---------|
| Non-Occupancy Period | 30 Minutes | Pass |

No EUT transmissions were observed on the test channel during 30 minutes observation time.

The End