# Dynamic Frequency Selection (DFS)

# Test Report

| | |
|---|---|
| Product Name | ROS Video DMA |
| Model No | 005-01004 |
| FCC ID | BJM-ROS1000A |

| | |
|---|---|
| Applicant | TATUNG CO. |
| Address | 22, Chungshan N. Rd., 3rd Sec. Taipei, Taiwan, 10451, R.O.C. |

| | |
|---|---|
| Date of Receipt | Apr. 01, 2010 |
| Issued Date | May. 19, 2010 |
| Report No. | 104110R-RFUSP32V01-A |
| Report Version | V1.0 |

# DFS Test Report

Issued Date: May. 19, 2010
Report No.: 104110R-RFUSP32V01-A

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| Product Name | ROS Video DMA |
| Applicant | TATUNG CO. |
| Address | 22, Chungshan N. Rd., 3rd Sec. Taipei, Taiwan, 10451, R.O.C. |
| Manufacturer | TATUNG CO. |
| Model No. | 005-01004 |
| FCC ID. | BJM-ROS1000A |
| EUT Rated Voltage | AC 100-240V, 50-60Hz |
| EUT Test Voltage | AC 120V/60Hz |
| Trade Name | Prodea Systems |
| Applicable Standard | FCC CFR Title 47 Part 15 Subpart E 15.407 (h): 2009<br>FCC 06-96 |
| Test Result | Complied |

NVLAP Lab Code: 200533-0

The Test Results relate only to the samples tested.
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This report must not be used to claim product endorsement by NVLAP any agency of the U.S. Government

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Testing Laboratory
0914

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# 1. GENERAL INFORMATION

## 1.1. EUT Description

| | |
|---|---|
| Product Name | ROS Video DMA |
| Trade Name | Prodea Systems |
| FCC ID. | BJM-ROS1000A |
| Model No. | 005-01004 |
| Frequency Range | 5180-5320MHz, 5500-5700MHz |
| Number of Channels | 802.11a/n-20MHz: 19; 802.11n-40MHz: 9 |
| Data Rate | 802.11a: 6-54Mbps<br>802.11n: 6.5-300Mbps |
| Channel Control | Auto |
| Type of Modulation | 802.11a/n:OFDM<br>BPSK, QPSK, 16QAM, 64QAM |
| Antenna type | PIFA |
| Antenna Gain | Refer to the table “Antenna List” |
| Power Adapter | MFR: UMEC, M/N: UP0251B-12PA<br>Input: AC 100-240V, 50-60Hz, 0.6A<br>Output: DC 12V, 2.1A, 25W<br>Cable Out: Non-Shielded, 1.7m |

**Antenna List**

| No. | Manufacturer | Part No. | Peak Gain |
|---|---|---|---|
| 1 | FAVORTRON | E773700180 (Main)<br>E773700180 (Aux)<br>E773700180 (MIMO) | 4.69dBi in 2.4 GHz<br>4.87dBi in 5GHz |

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

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|---|---|
| Channel 36: | 5180 MHz | Channel 40: | 5200 MHz | Channel 44: | 5220 MHz | Channel 48: | 5240 MHz |
| 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 | | |

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

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|---|---|
| Channel 38: | 5190 MHz | Channel 46: | 5230 MHz | 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 | | | | | | |

Note:

1. This device is a ROS Video DMA with a built-in WLAN transceiver.

| | |
|---|---|
| Test Mode | Mode 1: Transmit (802.11n-20BW)<br>Mode 2: Transmit (802.11n-40BW) |

## 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:

1. 5250-5350 MHz
2. 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 4.87dBi 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/b/g/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 media player with the V2.61 Codec package.

The master device is a Cisco Air-AP1131AG-A-K9 and the FCC ID is: LDK102054E.

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

## 1.4. Test Equipment

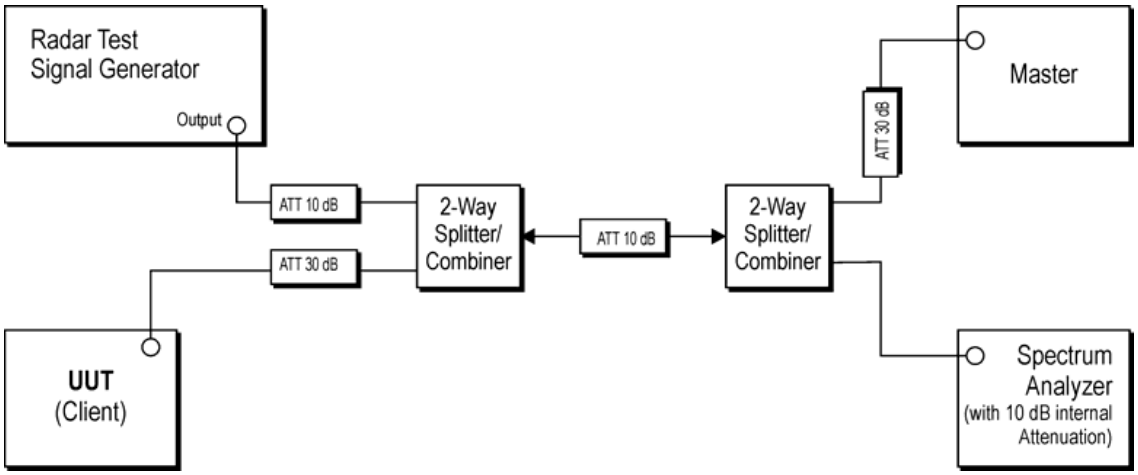
Dynamic Frequency Selection (DFS) / SR-7

| Instrument | Manufacturer | Type No. | Serial No | Cal. Date |
|---|---|---|---|---|
| Signal Analyzer | Agilent | N9010A | MY48030495 | Apr, 23, 2010 |
| Vector Signal Generator | Agilent | E4438C | MY49070137 | Apr, 02, 2010 |

| Instrument | Manufacturer | Type No. | Serial No |
|---|---|---|---|
| Splitter/Combiner (Qty: 2) | Mini-Circuits | ZFRSC-123-S+ | SN331000910 |
| ATT (Qty: 2) | Mini-Circuits | 15542 | 30912 |
| ATT (Qty: 2) | Mini-Circuits | 15542 | 30909 |
| Aironet Access Point | 3 Com | WL-605 | N/A |
| PC | Dell | OPTIPLEX 960 | W724KA01 |
| RF Cable (Qty: 4) | GORE | C86 | N/A |

| Software | Manufacturer | Function |
|---|---|---|
| Agilent Signal Studio for Pulse Building V1.3.13.0 | Agilent | Radar Signal Generation Software |
| Agilent DFS_TEST V1.0.0.73 | Agilent | Radar Signal Generation Software |
| Media Player Classic v6.4.8.6 | Gabest.org | Multimedia Player |

## 1.5. Test Setup



## 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 |
| 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. | |

**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<br>(See Notes 1 and 2) |
| Note1: The instant that the Channel Move Time and the Channel Closing Transmission Time begins is as follows:<br>For the short pulse radar test signals this instant is the end of the burst.<br>For the frequency hopping radar test signal, this instant is the end of the last radar burst generated<br>For the long pulse radar test signal this instant is the end of the 12 seconds period defining the radar transmission.<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 facilitating channel changes (an aggregate of approximately 60 milliseconds) during the remainder of the 10 seconds period. The aggregate duration of control signals will not count quiet periods in between transmissions. | |

**Short Pulse Radar Test Waveforms**

| Radar Type | Pulse Width ($\mu$sec) | PRI ($\mu$sec) | 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 ($\mu$sec) | Chirp Width (MHz) | PRI ($\mu$sec) | 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 ($\mu$sec) | PRI ($\mu$sec) | 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 |

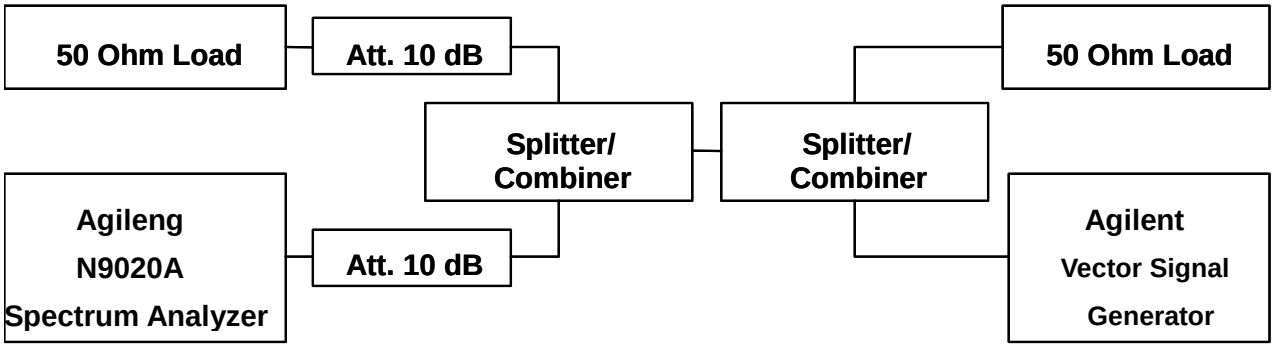
For the frequency hopping radar type, the same burst parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence.

## 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.

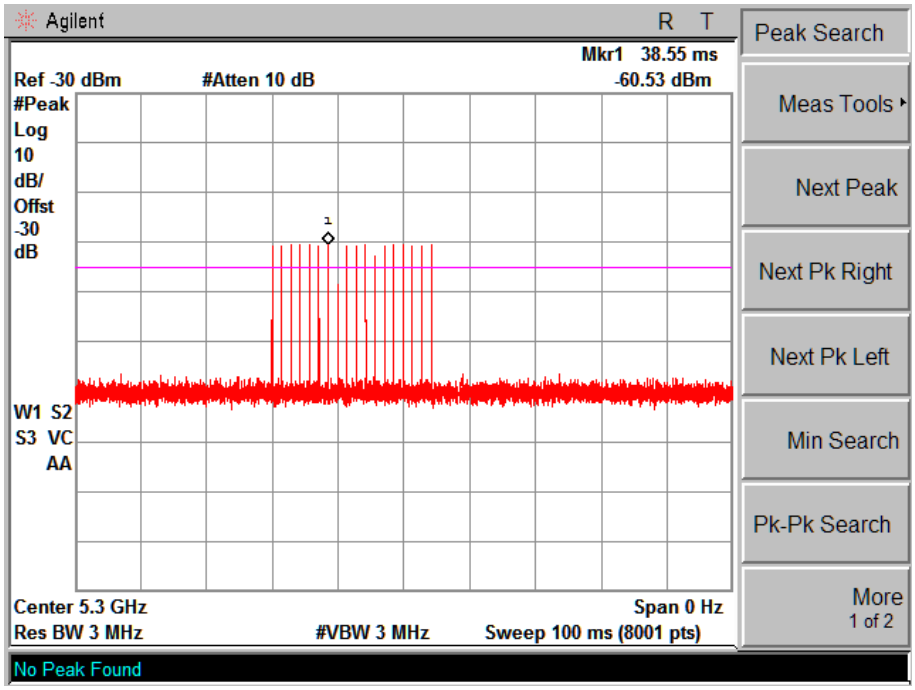
The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -62dBm due to the interference threshold level is not required.

Conducted Calibration Setup

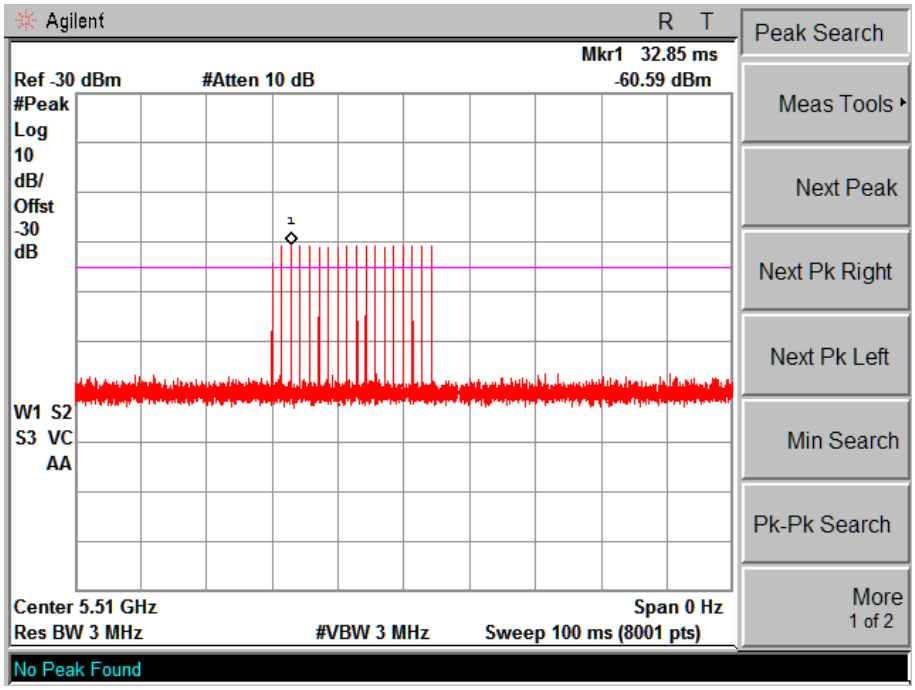


## 1.8. Radar Waveform Calibration Result

### Radar Type 1 Calibration Plot (5300MHz)




### Radar Type 1 Calibration Plot (5510MHz)



# 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 -62dBm 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 5300MHz for 20MHz channel bandwidth and 5510MHz channel bandwidth.

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

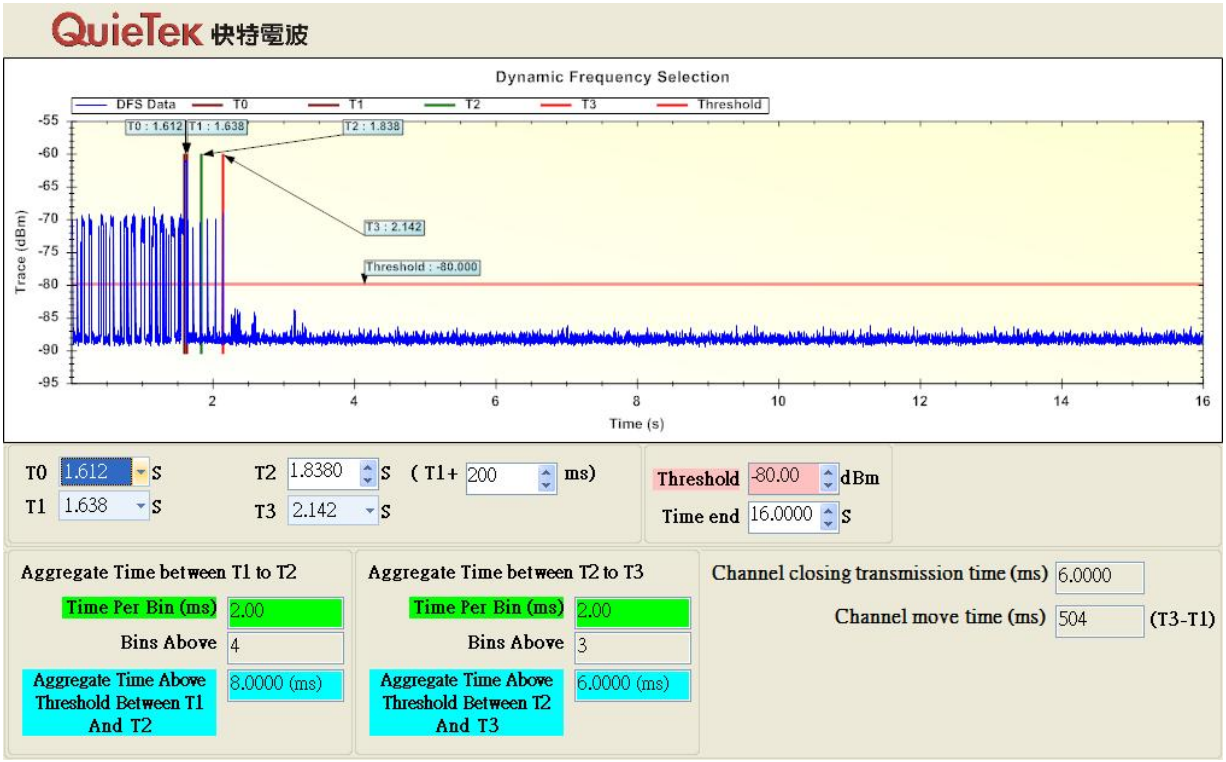
Product : ROS Video DMA

Test Item : Channel Move Time

Radar Type : Type 1

Test Mode : Mode 1: Transmit (802.11n-20BW)

**Channel Move Time for Radar Test Type 1 at 5300 MHz**



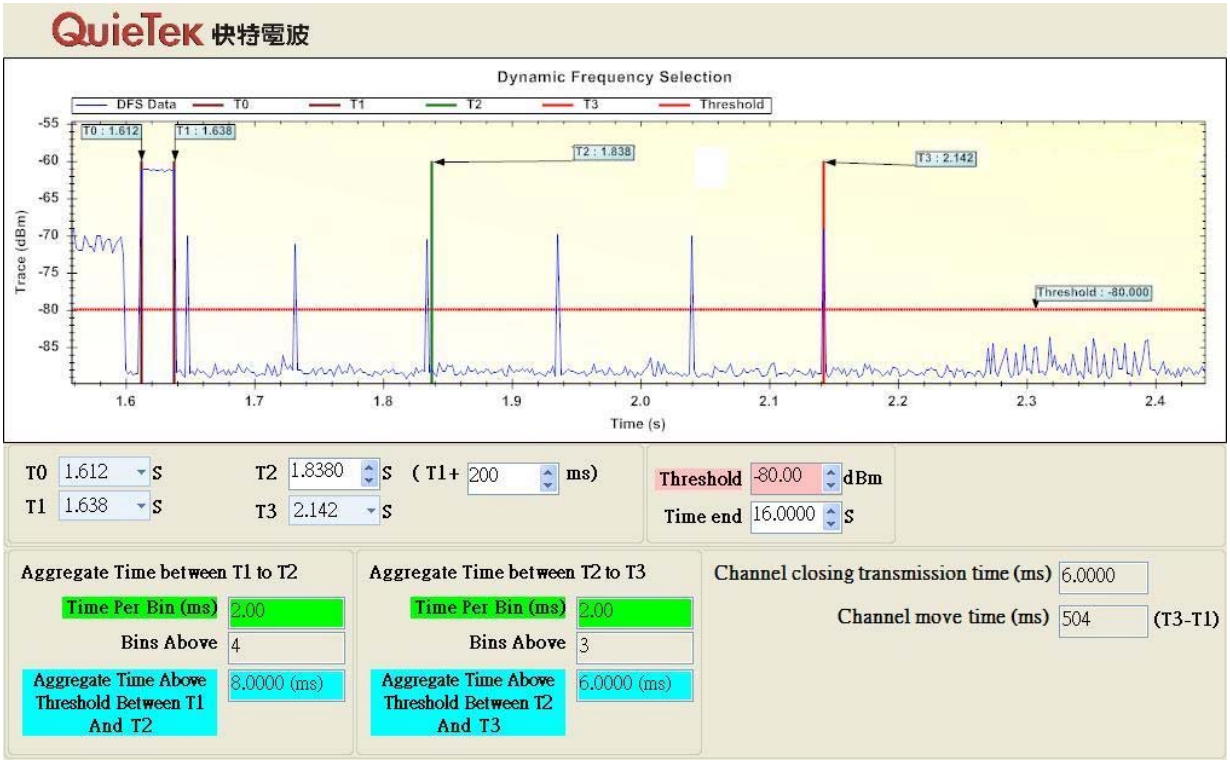

| Test Item | Measure Level (ms) | Limit | Results |
|---|---|---|---|
| Channel Move Time | 504 | 10 Seconds | Pass |

Note:

1. The results showed that after radar signal injected the channel move time was less than 10 seconds.

Product : ROS Video DMA
Test Item : Channel Closing Transmission Time
Radar Type : Type 1
Test Mode : Mode 1: Transmit (802.11n-20BW)

**Channel Closing Transmission Time for Radar Test Type 1 at 5300 MHz**



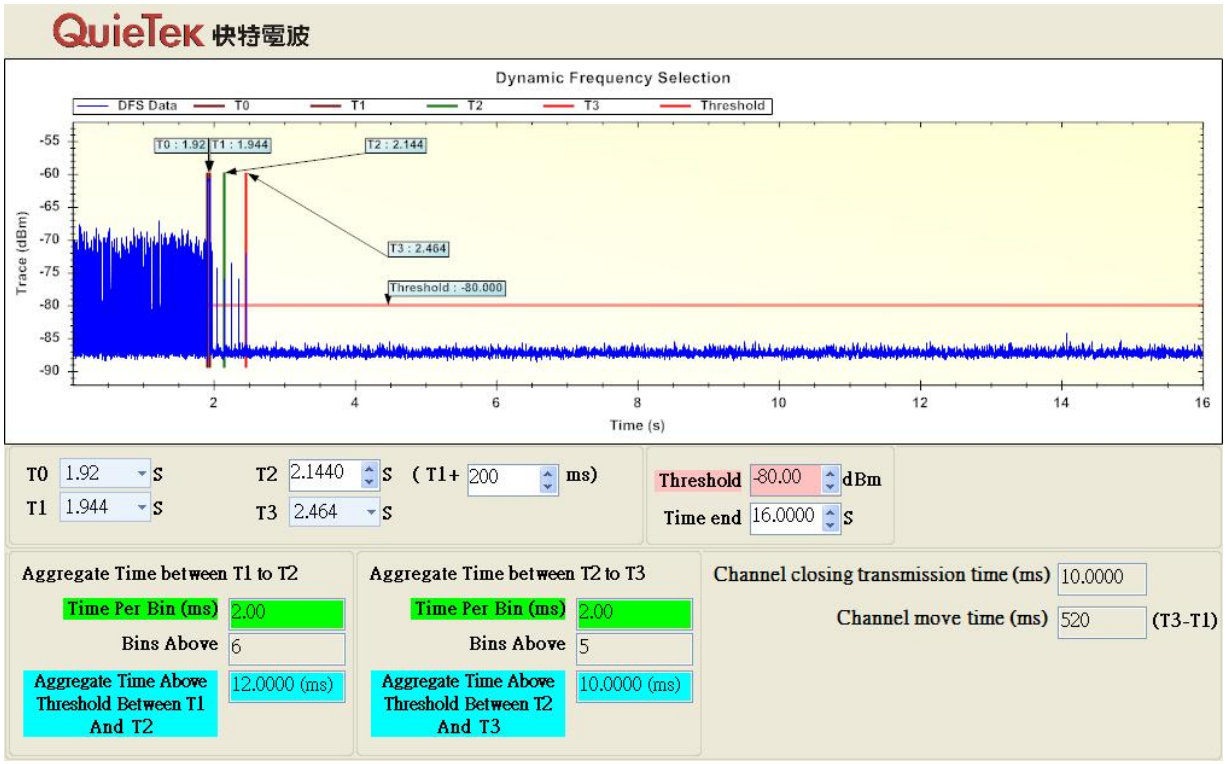

| Test Item | Measure Level (ms) | Limit | Results |
|---|---|---|---|
| Channel Closing Transmission Time | 6 | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period | Pass |

Note:

1. The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

Product : ROS Video DMA
Test Item : Channel Move Time
Radar Type : Type 1
Test Mode : Mode 2: Transmit (802.11n-40BW)

**Channel Move Time for Radar Test Type 1 at 5510 MHz**



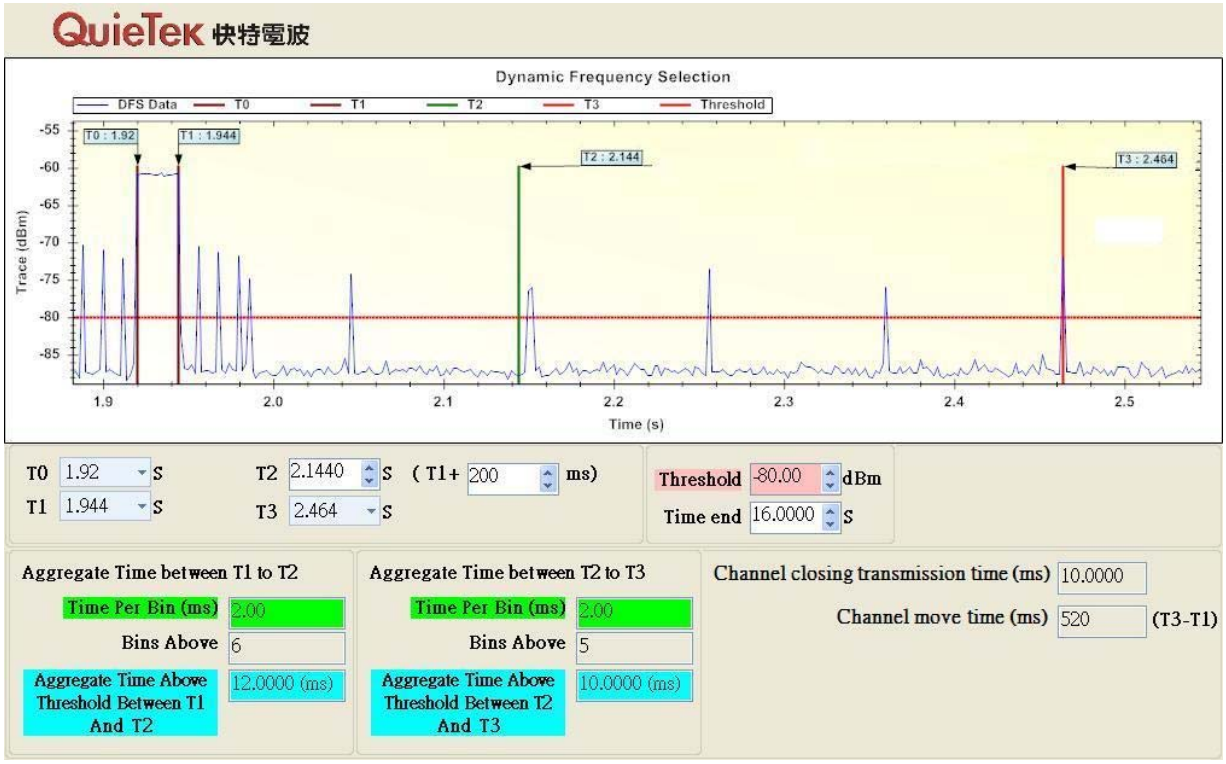

| Test Item | Measure Level (ms) | Limit | Results |
|---|---|---|---|
| Channel Move Time | 520 | 10 Seconds | Pass |

Note:

1. The results showed that after radar signal injected the channel move time was less than 10 seconds.

Product : ROS Video DMA
Test Item : Channel Closing Transmission Time
Radar Type : Type 1
Test Mode : Mode 2: Transmit (802.11n-40BW)

**Channel Closing Transmission Time for Radar Test Type 1 at 5510 MHz**




| Test Item | Measure Level (ms) | Limit | Results |
|---|---|---|---|
| Channel Closing Transmission Time | 10 | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period | Pass |

Note:

1. The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

# 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

± 1ms.

## 4. Test Result of Non-Occupancy Period

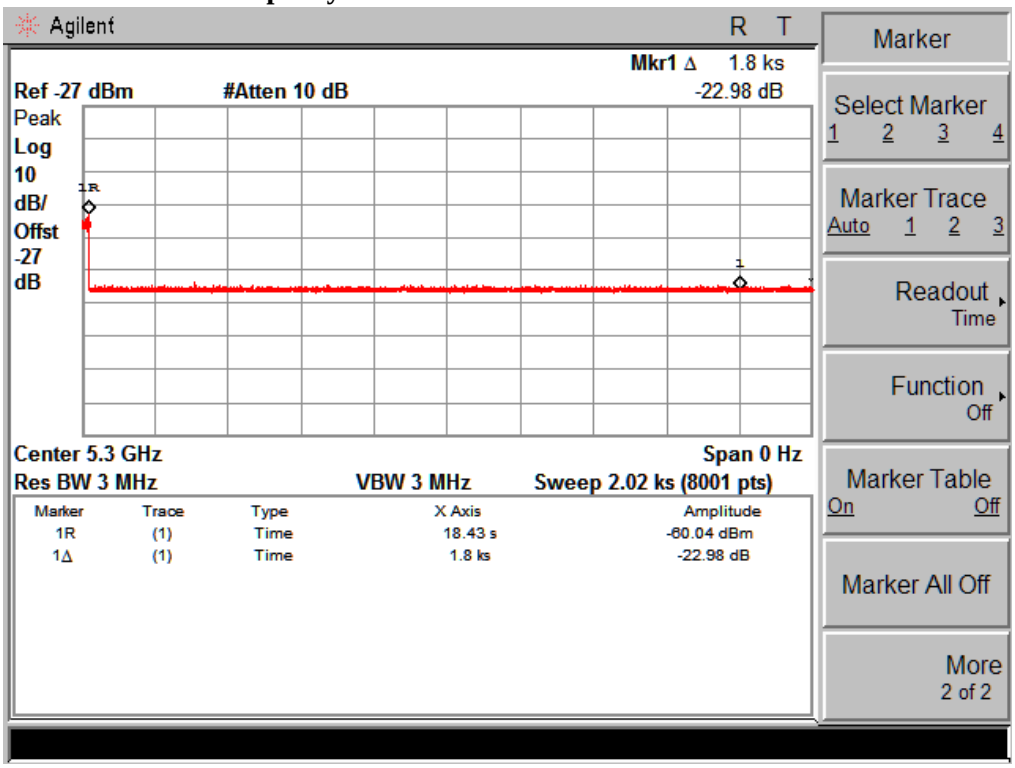
Product : ROS Video DMA

Test Item : Non-Occupancy Period

Radar Type : Type 1

Test Mode : Mode 1: Transmit (802.11n-20BW)

**30 Minute Non-Occupancy Period at 5300 MHz**

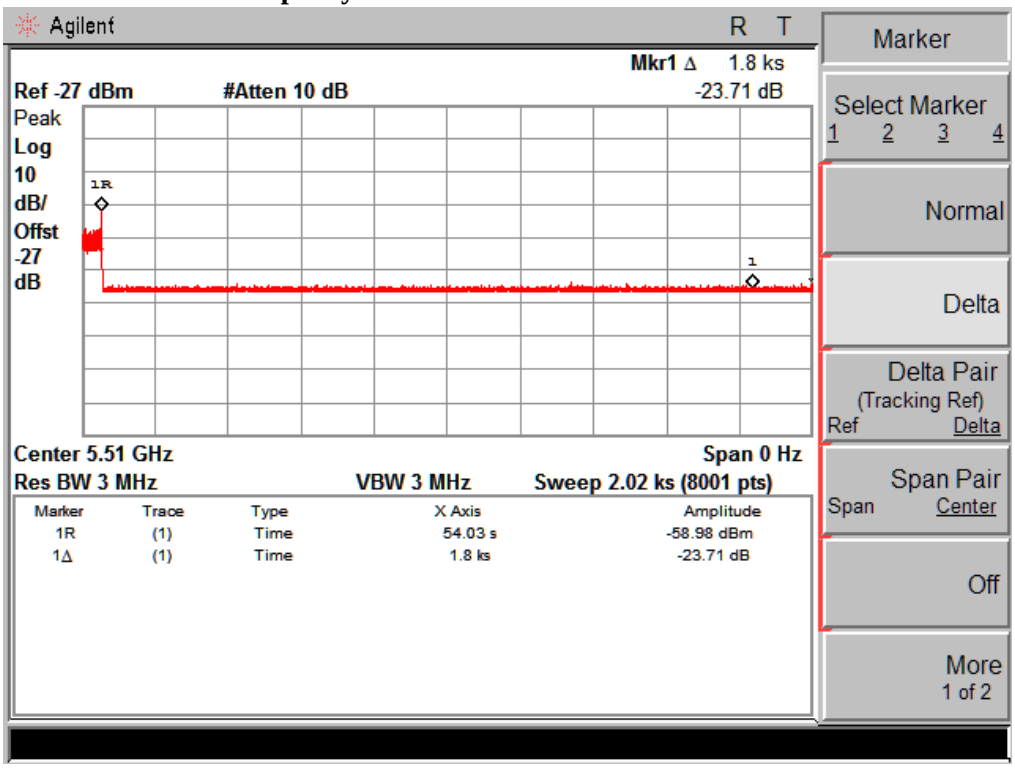



| Test Item | Limit | Results |
|---|---|---|
| Non-Occupancy Period | 30 Minutes | Pass |

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

Product : ROS Video DMA
Test Item : Non-Occupancy Period
Radar Type : Type 1
Test Mode : Mode 2: Transmit (802.11n-40BW)

**30 Minute Non-Occupancy Period at 5510 MHz**

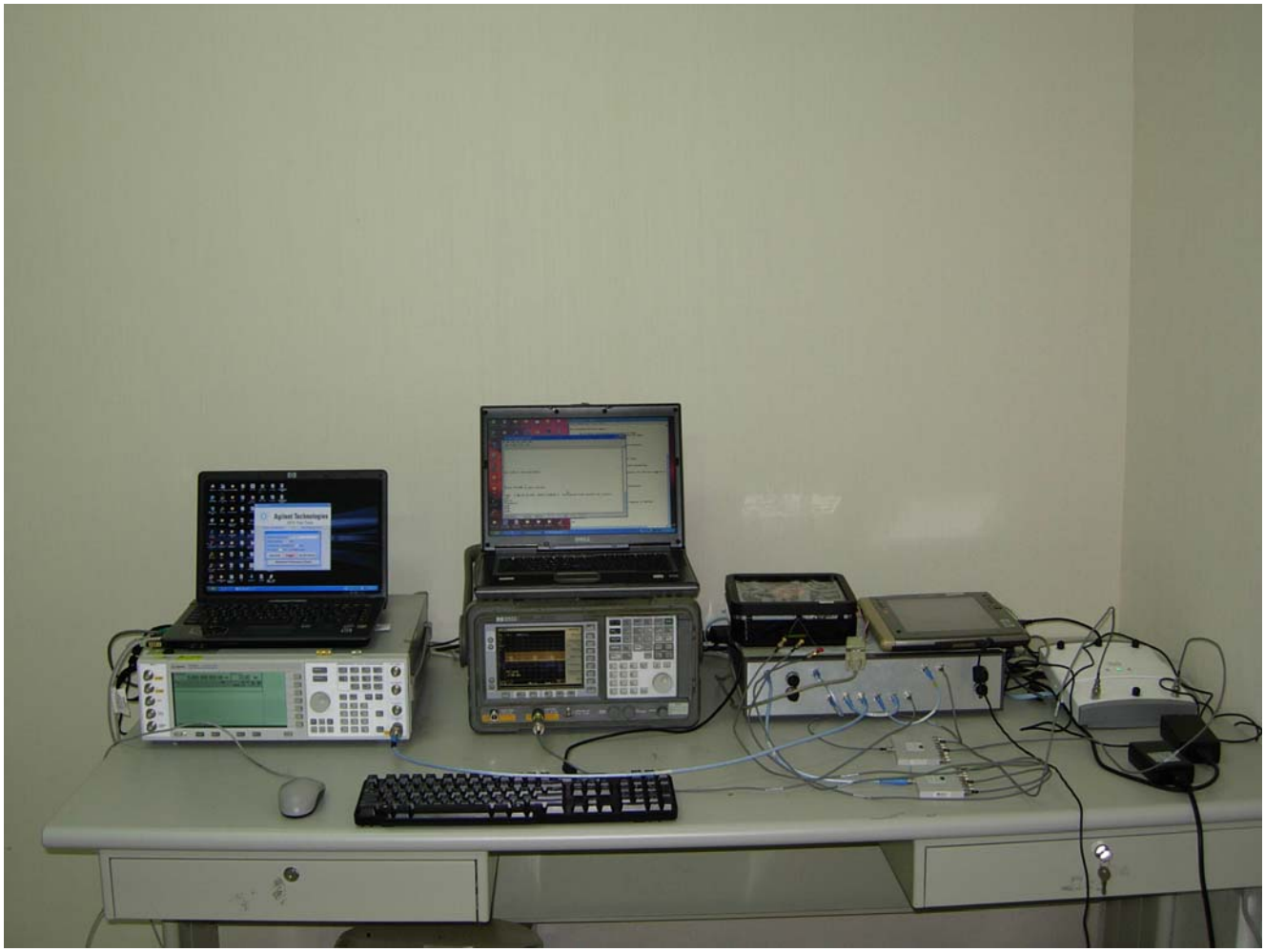



| Test Item | Limit | Results |
|---|---|---|
| Non-Occupancy Period | 30 Minutes | Pass |

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

# 5. DFS Test Setup Photo

## Full DFS Test Setup Photo



## DFS Set-up Photo: Spectrum Analyzer and Radar Generator

## DFS Set-up Photo: Master and Client