# Dynamic Frequency Selection (DFS)

# Test Report

| | |
|---|---|
| Product Name | Full HD Video Wireless Transmitter Module |
| Model No | ZRF-31100 |
| FCC ID | YG7ZRF31100 |
| End Product | Full HD Video Wireless Transmitter |

| | |
|---|---|
| Applicant | ZINWELL CORPORATION |
| Address | 7F 512, Yuan Shan Road, Chung Ho City, 235, Taipei Hsien, Taiwan |

| | |
|---|---|
| Date of Receipt | June 01, 2010 |
| Issued Date | Aug. 24, 2010 |
| Report No. | 106228R-RFUSP46V01-A |
| Report Version | V1.0 |

# DFS Test Report

Issued Date: Aug. 24, 2010
Report No.: 106228R-RFUSP46V01-A

| | |
|---|---|
| Product Name | Full HD Video Wireless Transmitter Module |
| Applicant | ZINWELL CORPORATION |
| Address | 7F 512, Yuan Shan Road, Chung Ho City, 235, Taipei Hsien, Taiwan |
| Manufacturer | ZINWELL CORPORATION |
| Model No. | ZRF-31100 |
| FCC ID. | YG7ZRF31100 |
| EUT Rated Voltage | AC 100-240V, 50-60Hz |
| EUT Test Voltage | AC 120V/60Hz |
| Trade Name | ZINWELL® |
| Applicable Standard | FCC CFR Title 47 Part 15 Subpart E 15.407 (h): 2009<br>FCC 06-96<br>RSS-210 Issue 7 A9.4<br>NVLAP Lab Code: 200533-0 |
| Test Result | Complied |

The Test Results relate only to the samples tested.
The test report shall not be reproduced except in full without the written approval of QuieTek Corporation.
This report must not be used to claim product endorsement by NVLAP any agency of the U.S. Government

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( Manager / Vincent Lin )

Testing Laboratory
0914

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Attachment 1: EUT Test Photographs

# 1. GENERAL INFORMATION

## 1.1. 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.

U-NII devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

## 1.2. EUT Description

| | |
|---|---|
| Product Name | Full HD Video Wireless Transmitter Module |
| Trade Name | ZINWELL® |
| FCC ID. | YG7ZRF31100 |
| Model No. | ZRF-31100 |
| Frequency Range | 5270-5310MHz, 5510-5670MHz |
| Number of Channels | 5CH |
| Channel Control | Auto |
| Type of Modulation | OFDM (BPSK, QPSK, 16QAM, 64QAM) |
| Channel Bandwidth | 40MHz |
| DFS Function | ☐ Master ■ Slave |
| TPC Function | ■ <500mW not required ☐ ≧ 500mW employ a TPC |
| Communication Mode | ☐ IP Based Systems ☐ Frame Based System ■ *Other System |
| Antenna type | PIFA |
| Antenna Gain | Refer to the table “Antenna List” |
| Power Adapter | MFR: SINO-American, M/N: SA115B-05-A<br>Input: AC 100-240V, 50-60Hz, 0.4A<br>Output: DC 5V, 3A<br>Cable out: Non-Shielded, 1.8m, with one ferrite core bonded. |

***Note:** The EUT is a Full HD Video Wireless Transmitter Module with a built-in 5GHz transceiver.

**Antenna List**

| | Manufacturer | Model No. | Peak Gain |
|---|---|---|---|
| Internal | ZINWELL | N/A | 3.47dBi for 5.25~5.725GHz |
| External | INVAX | NB0169-B | 0.07dBi for 5.25~5.725GHz |

NOTE: External Antenna only uses in receive mode.

All testing are use external antenna.

Center Working Frequency of Each Channel:

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|---|---|
| Channel 03: | 5270 MHz | Channel 04: | 5310 MHz | Channel 05: | 5510 MHz | Channel 06: | 5550 MHz |
| Channel 07: | 5670 MHz | | | | | | |

| | |
|---|---|
| Test Mode | Mode 1: Transmit |

## 1.3. UNII Device Description

(1) The EUT operates in the following DFS band:

1. 5250-5350 MHz
2. 5470-5725 MHz

(2) The maximum EIRP of the 5GHz equipment is 20.16dBm.

Below are the available 50 ohm antenna assemblies and their corresponding gains. 0dBi gain was used to set the -63 dBm threshold level (-64dBm +1 dB) during calibration of the test setup.

| Manufacturer | Model No. | Peak Gain |
|---|---|---|
| ZINWELL | N/A | 3.47dBi for 5.25~5.725GHz |

(3) DFS operation description:

If the EUT confronts the interference of radar signal during the period of transmitting the video signal, "Full HD video receiver (Master)" will notify "Full HD Video transmitter (slave)" to stop transmitting the video signal.

(4) This device does not exceed 27dBm eirp, so no transmit power control is implemented.

(6) The master device is a Full HD Video Wireless Receiver. The Full HD Video Wireless Receiver FCC ID : YG7ZRF32100.

## 1.4. Test Equipment

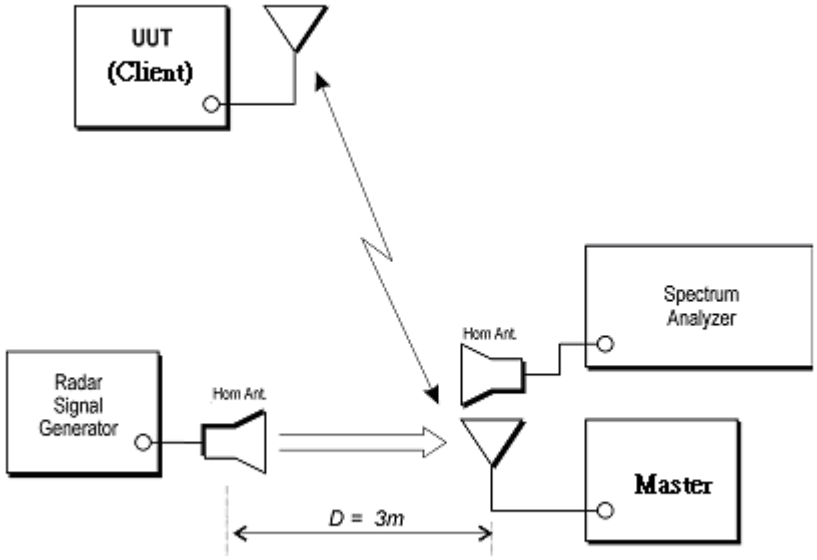
Dynamic Frequency Selection (DFS) / CTR

| Instrument | Manufacturer | Type No. | Serial No | Cal. Date |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4440A | MY46185846 | Oct, 21, 2009 |
| Vector Signal Generator | Agilent | E4438C | MY49070137 | Apr, 01, 2010 |

| Instrument | Manufacturer | Type No. | Serial No |
|---|---|---|---|
| Notebook Pc | Hp | HSTNN-155C | CNU8476RVZ |
| Notebook Pc | Compaq | CPQ511VT5870Q4X320MIBNCN2Pa | CNU0060M23 |
| Notebook Pc | Dell | PPO4X | 30403692208 |
| DVD Player | YAWAHA | DVD-S1700 | Z067697Y0 |
| Horn Antenna | ETS | 3115 | 6348 |
| Horn Antenna | ETS | 3115 | 0005-6160 |
| RF Cable | SUHNER | SUCOFLEX 104 | 309180/4 |
| RF Cable | SUHNER | SUCOFLEX 106 | 3474516 |
| LCD Monitor | LG | W2261VT | 907YHCA07299 |
| Full HD Video Wireless Receiver | ZINWELL | ZWD-xy22R (x can be 0~9 , y can be 0~9), 27771,AR1875R | 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 |

## 1.5. Test Setup




## 1.6. DFS Detection Thresholds

**(1) 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.

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.

**(2) 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) |
| U-NII Detection Bandwidth | Minimum 80% of the 99% power bandwidth See Note 3. |

Note1:

The instant that the Channel Move Time and the Channel Closing Transmission Time begins is as follows:

- For the short pulse radar test signals this instant is the end of the burst.
- For the frequency hopping radar test signal, this instant is the end of the last radar burst generated
- For the long pulse radar test signal this instant is the end of the 12 seconds period defining the radar transmission.

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.

Note 3:

During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.

## 1.7. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. 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.

**(1) Short Pulse Radar Test Waveforms**

| Radar Type | Pulse Width (usec) | PRI (usec) | 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.

**(2) Long Pulse Radar Test Signal**

| Radar Waveform | Bursts | Pulses Per Burst | Pulse Width (usec) | Chirp Width (MHz) | PRI (usec) | 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.

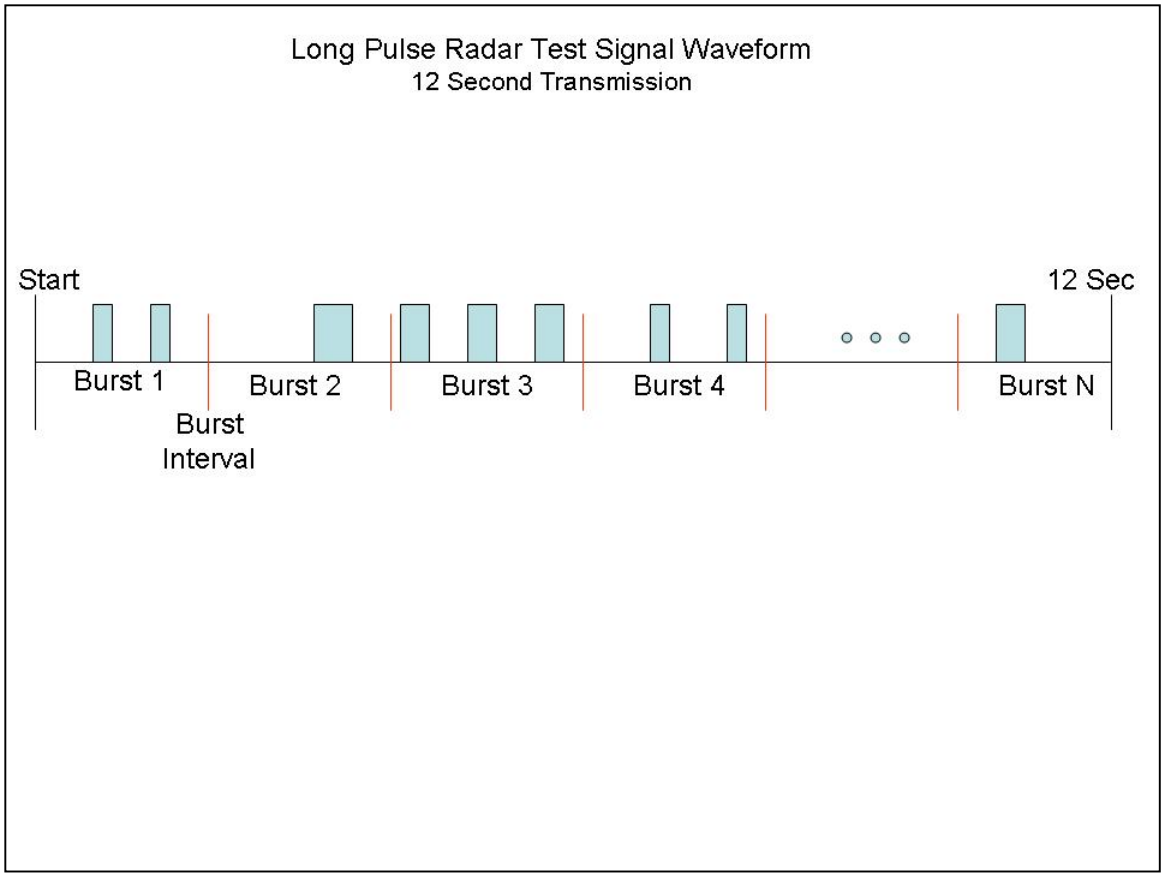
Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst_Count.
3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a Burst will have the same chirp width. Pulses in different Bursts may have different chirp widths. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst_Count. Each interval is of length (12,000,000 / Burst_Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst_Count) – (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen independently.

**A representative example of a Long Pulse radar test waveform:**

1) The total test signal length is 12 seconds.
2) 8 Bursts are randomly generated for the Burst_Count.
3) Burst 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) Bursts 2 through 8 are generated using steps 3 – 5.
7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range).

***Graphical Representation of a Long Pulse radar Test Waveform***




**(3) 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 | 0.333 | 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[1] from the hopping sequence defined by the following algorithm:

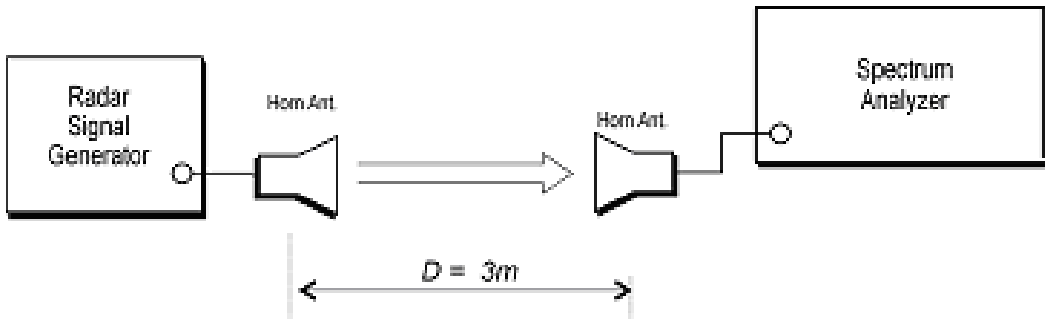
The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

## 1.8. 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.

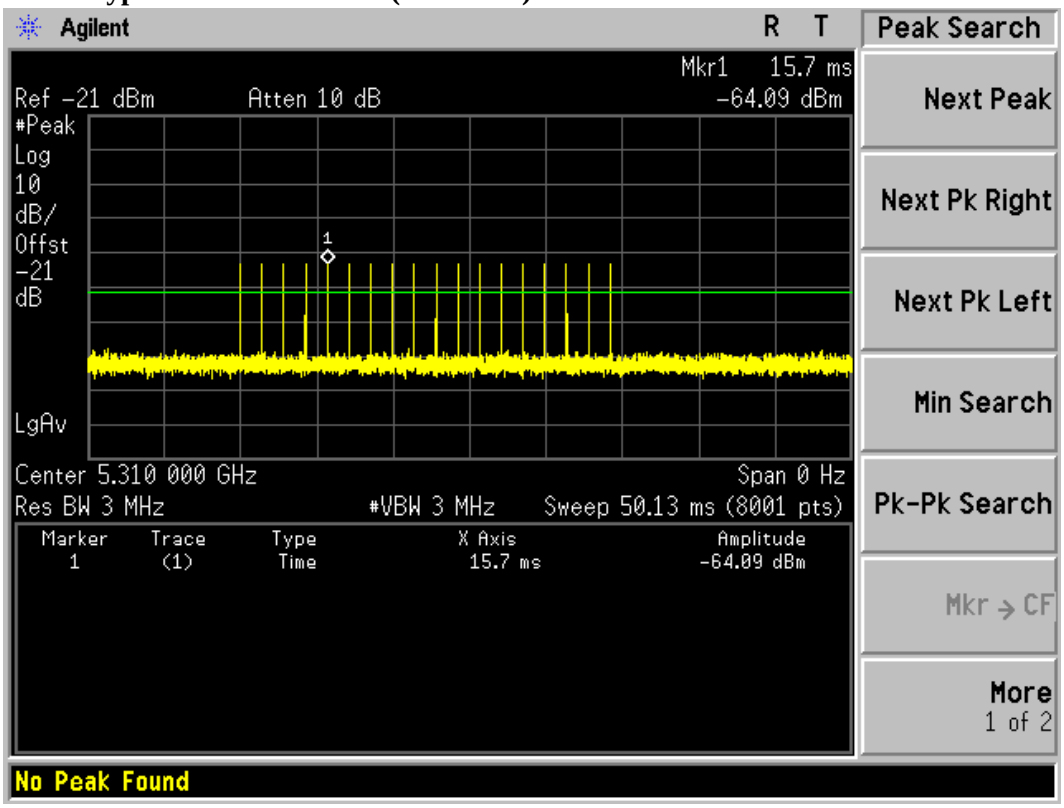
The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -63dBm due to the interference threshold level is not required.

Conducted Calibration Setup

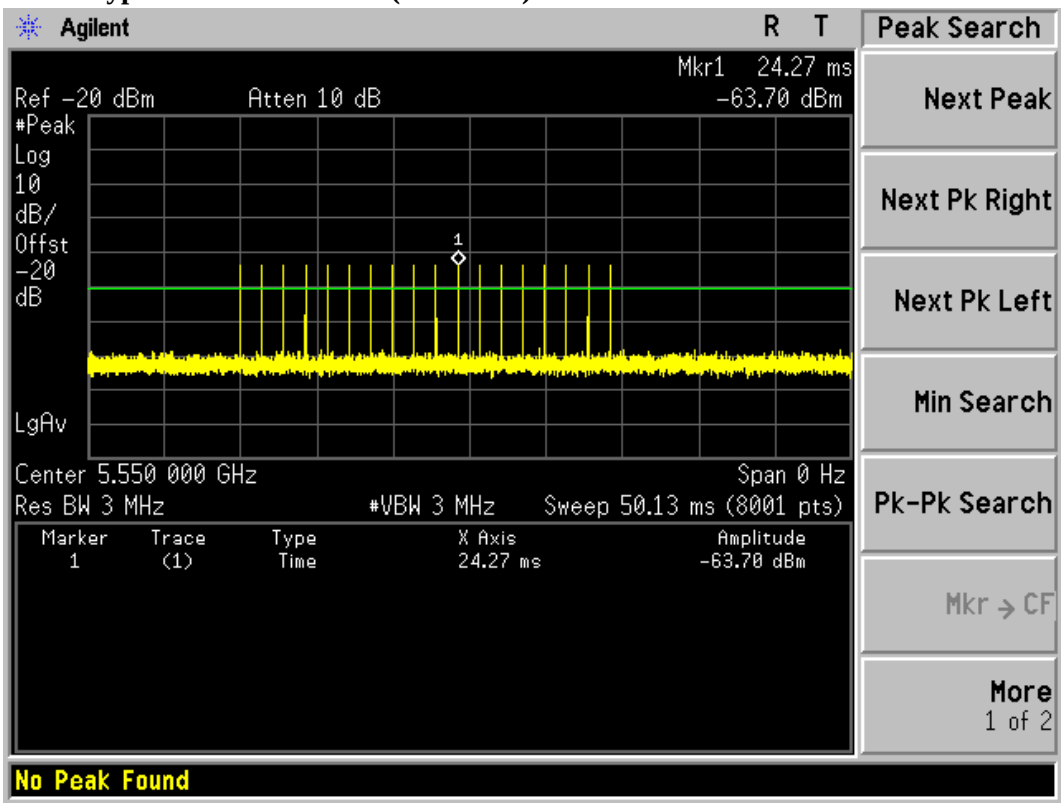


## 1.9. Radar Waveform Calibration Result

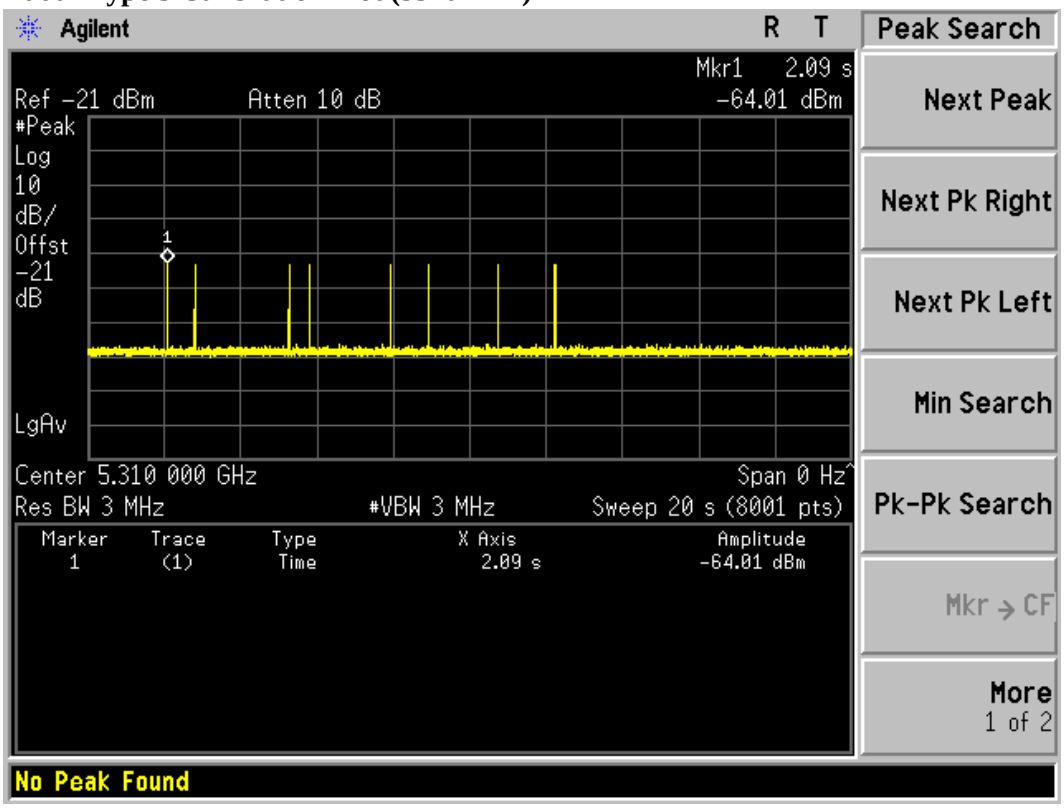
**Radar Type 1 Calibration Plot (5310MHz)**



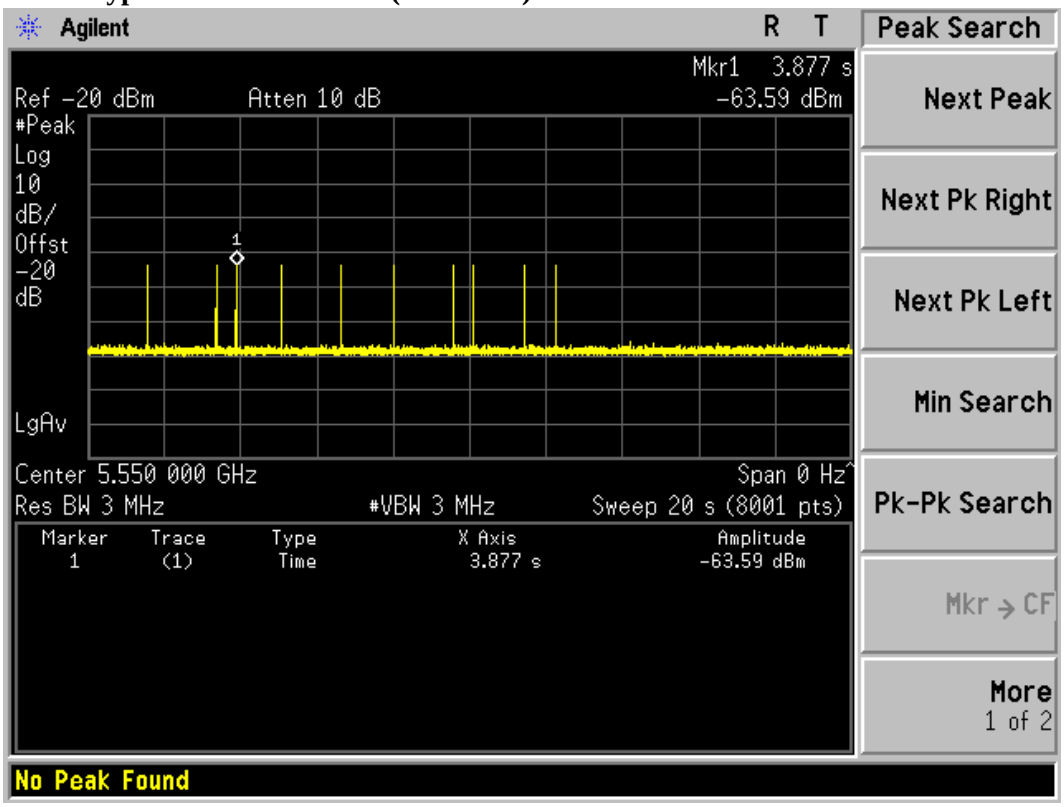

**Radar Type 1 Calibration Plot (5550MHz)**



**Radar Type 5 Calibration Plot (5310MHz)**

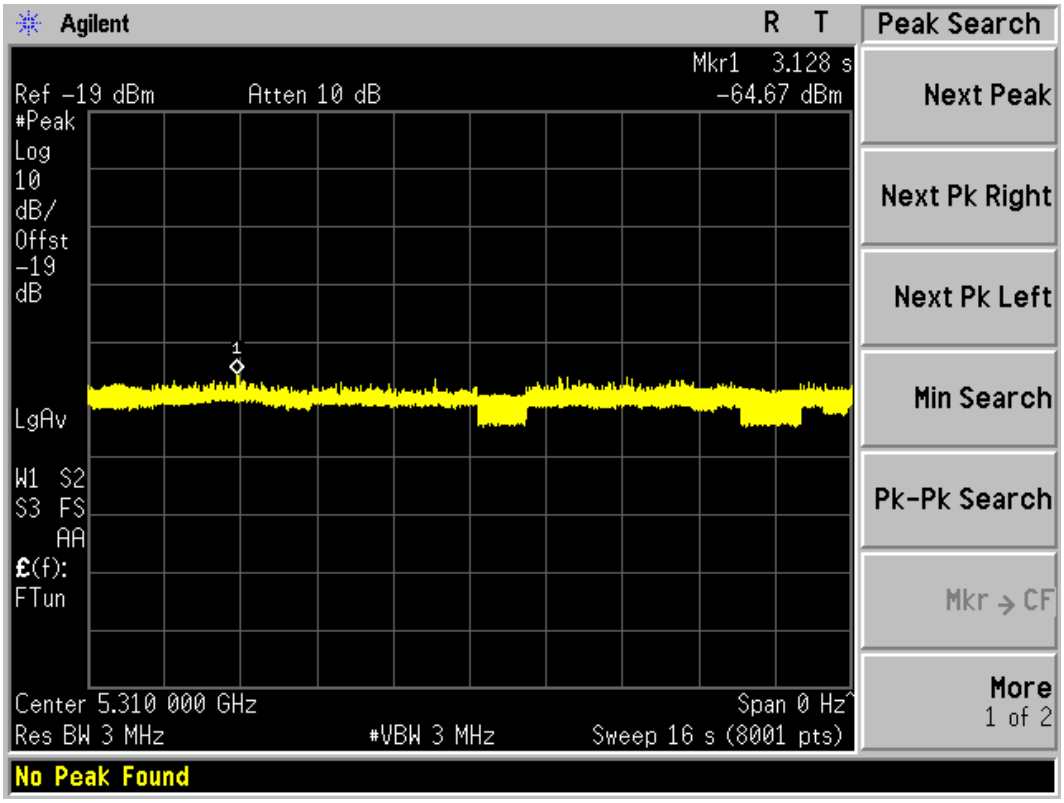



**Radar Type 5 Calibration Plot (5550MHz)**

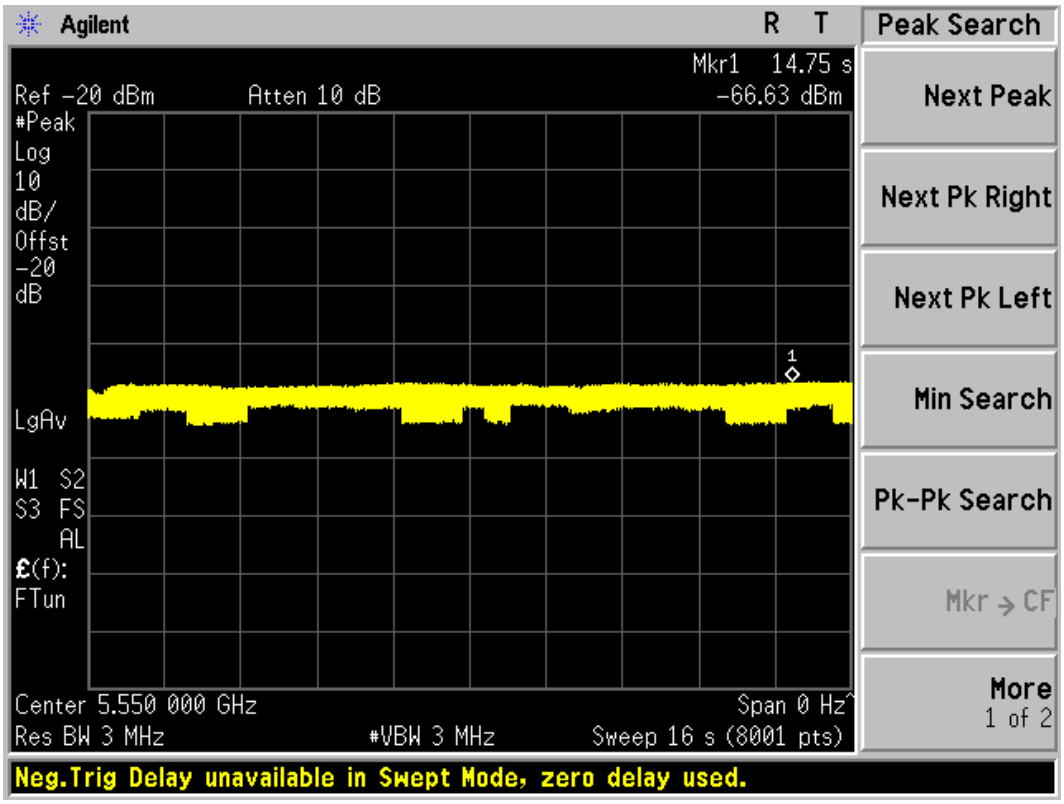


## 1.10. Master Data Traffic Plot Result

### Plot of Master Traffic at 5310MHz




### Plot of Master Traffic at 5550MHz



# 2. In-Service Monitoring for Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

## 2.1. Test Procedure

These tests define how the following DFS parameters are verified during In-Service Monitoring;

Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period.. The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB (-63dBm) is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Master Device will associate with the UUT (Client) at 5310 MHz and 5550MHz.

Stream the MPEG test file from the Client (TX) Device to the Master (RX) Device on the selected Channel for the entire period of the test.

At time $T_0$ the Radar Waveform generator sends a Burst of pulses for each of the radar types at -63dBm.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT 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.

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

## 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 |
| Non-Occupancy Period | Minimum 30 minutes |

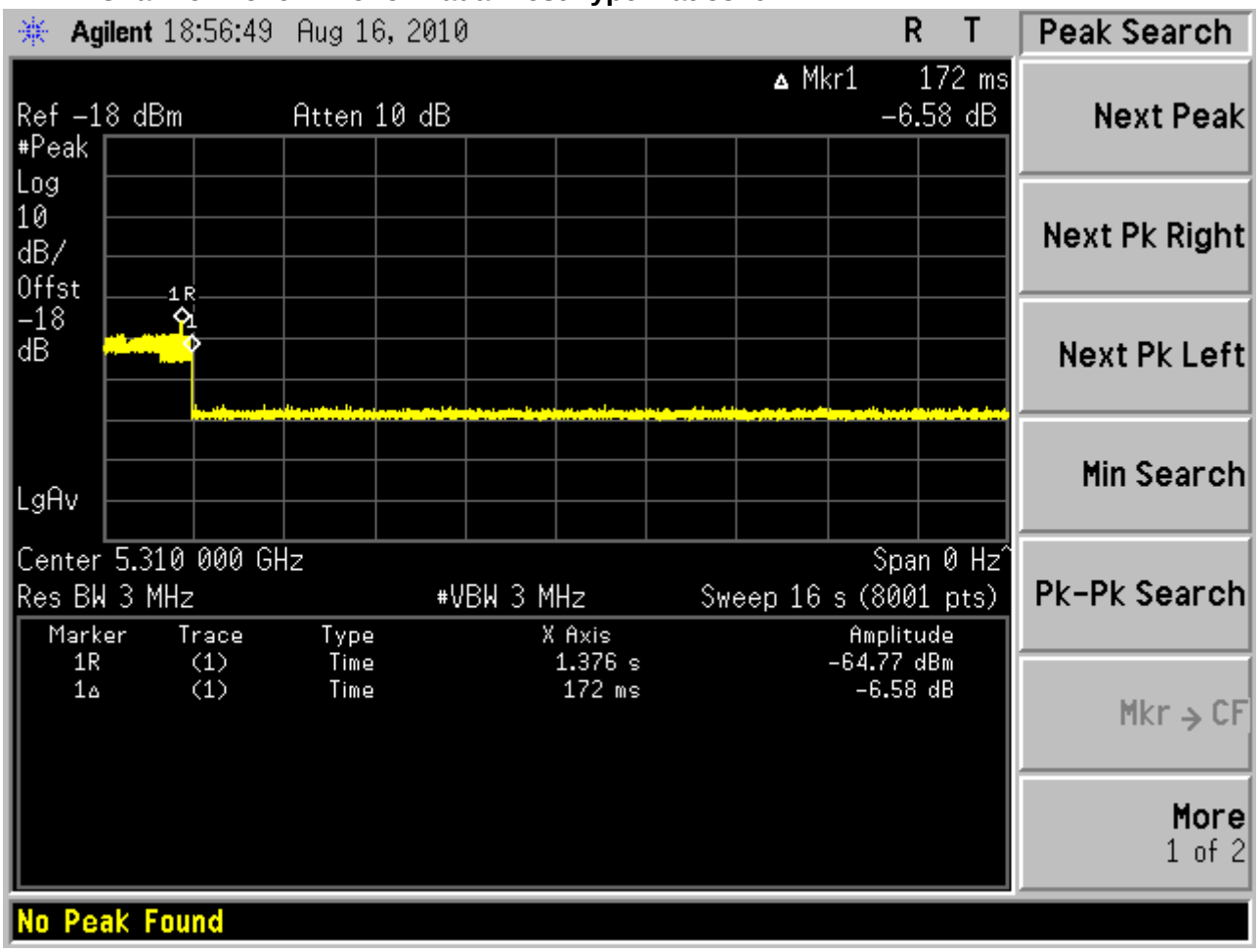
## 2.3. Uncertainty

± 1ms.

## 2.4. Test Result of Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

| | | |
|---|---|---|
| Product | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Move Time Test |
| Radar Type | : | Type 1 |
| Test Mode | : | Mode 1: Transmit |

**Channel Move Time for Radar Test Type 1 at 5310MHz**

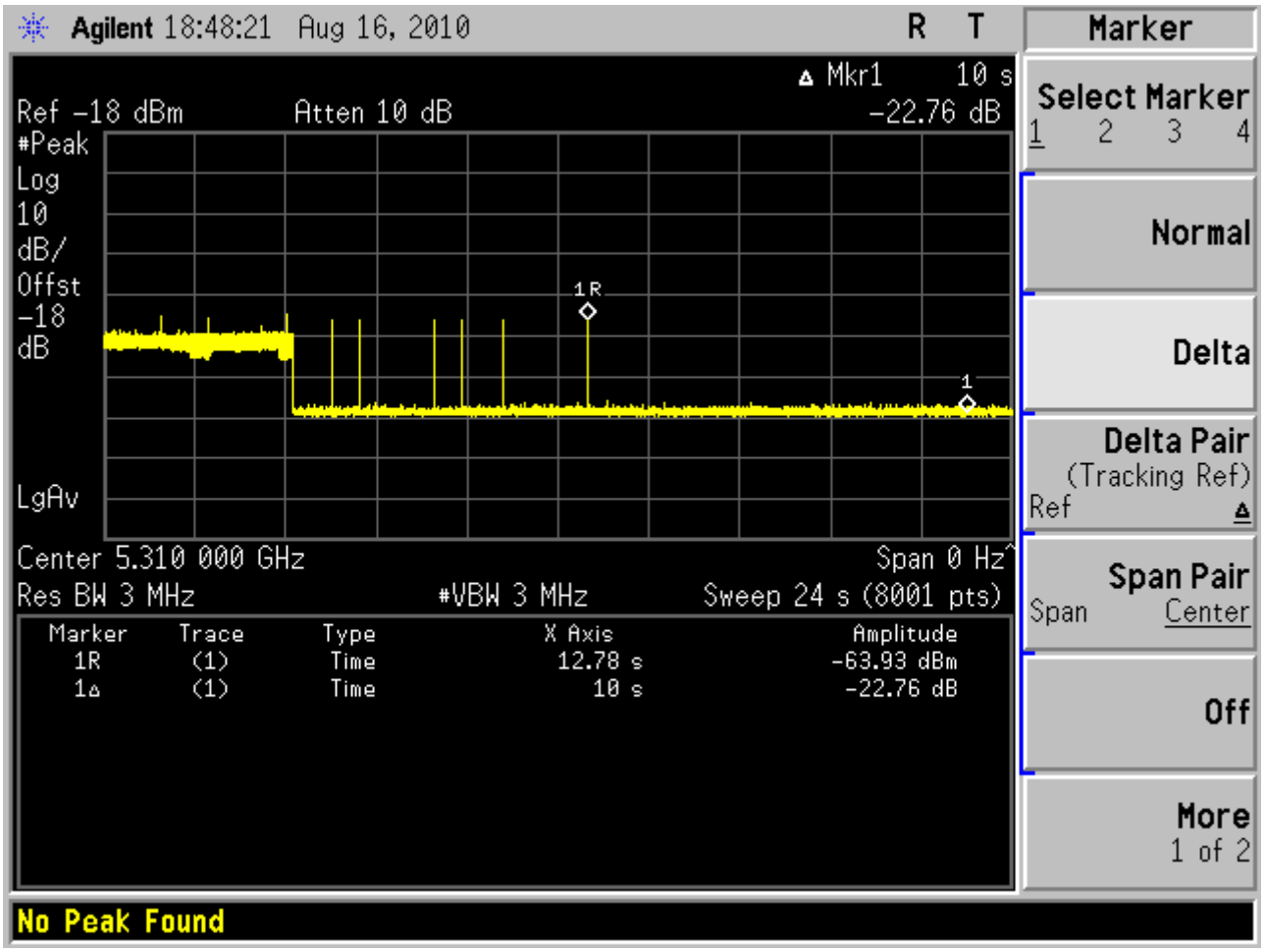



| Test Item | Test Result (Sec) | Limit (Sec) |
|---|---|---|
| Channel Move Time | 0.172 | 10 |

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

| | | |
|---|---|---|
| Product | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Move Time Test |
| Radar Type | : | Type 5 |
| Test Mode | : | Mode 1: Transmit |

**Channel Move Time for Radar Test Type 5 at 5310MHz**

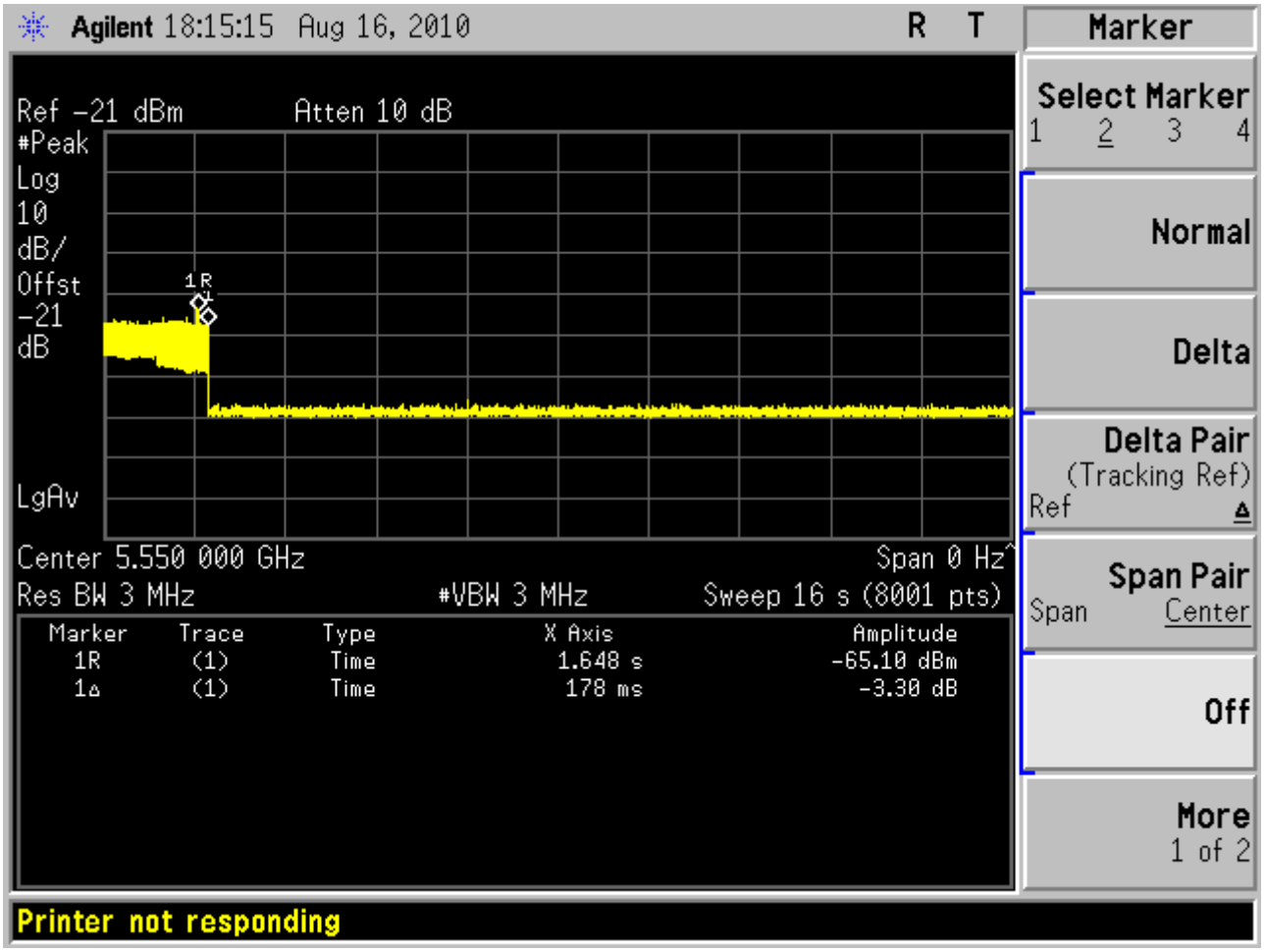



| Test Item | Test Result (Sec) | Limit (Sec) |
|---|---|---|
| Channel Move Time | 0 | 10 |

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

| | | |
|---|---|---|
| Product | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Move Time |
| Radar Type | : | Type 1 |
| Test Mode | : | Mode 1: Transmit |

**Channel Move Time for Radar Test Type 1 at 5550MHz**

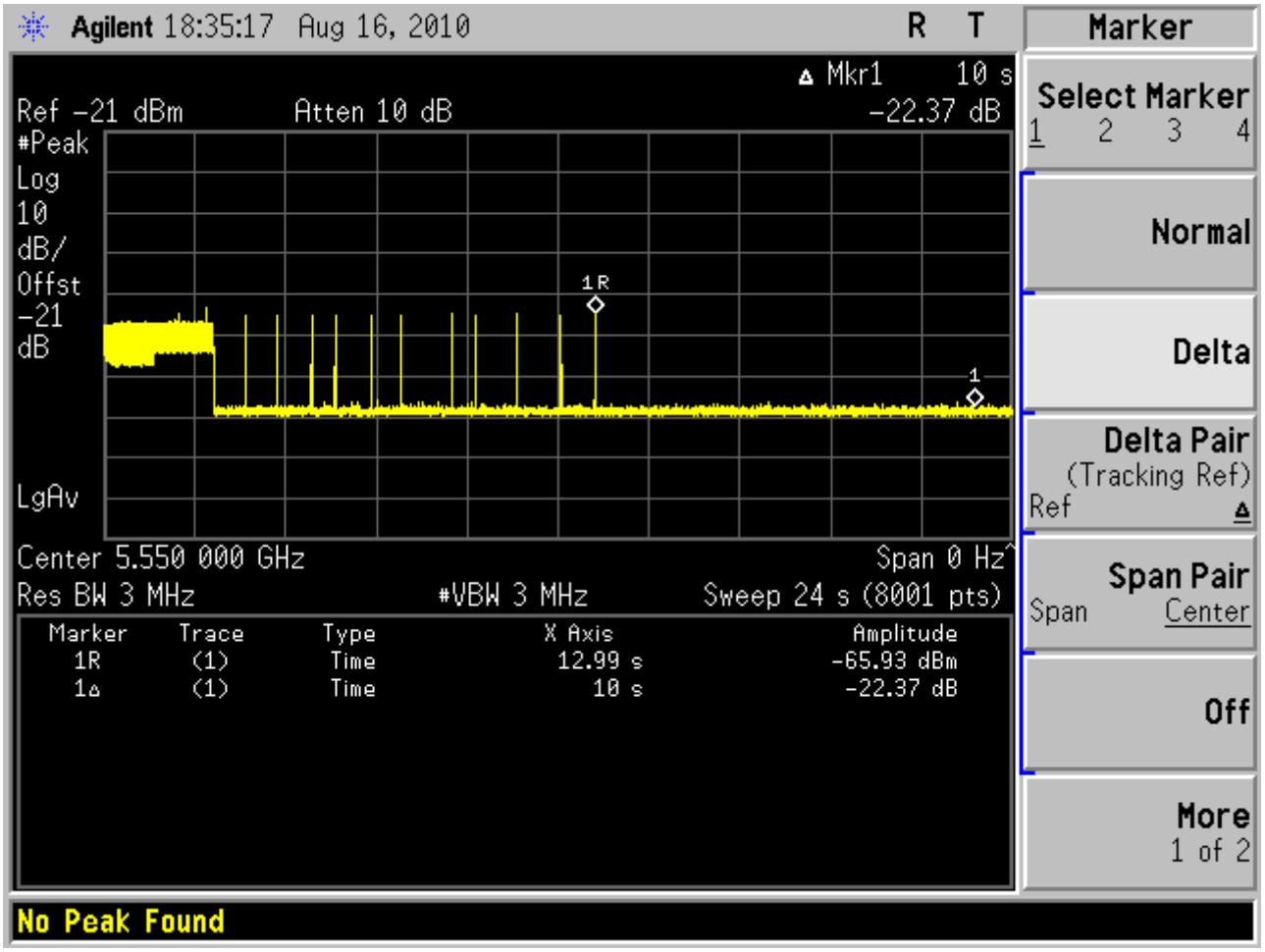



| Test Item | Test Result (Sec) | Limit (Sec) |
|---|---|---|
| Channel Move Time | 0.178 | 10 |

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

| | | |
|---|---|---|
| Product | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Move Time |
| Radar Type | : | Type 5 |
| Test Mode | : | Mode 1: Transmit |

**Channel Move Time for Radar Test Type 5 at 5550MHz**

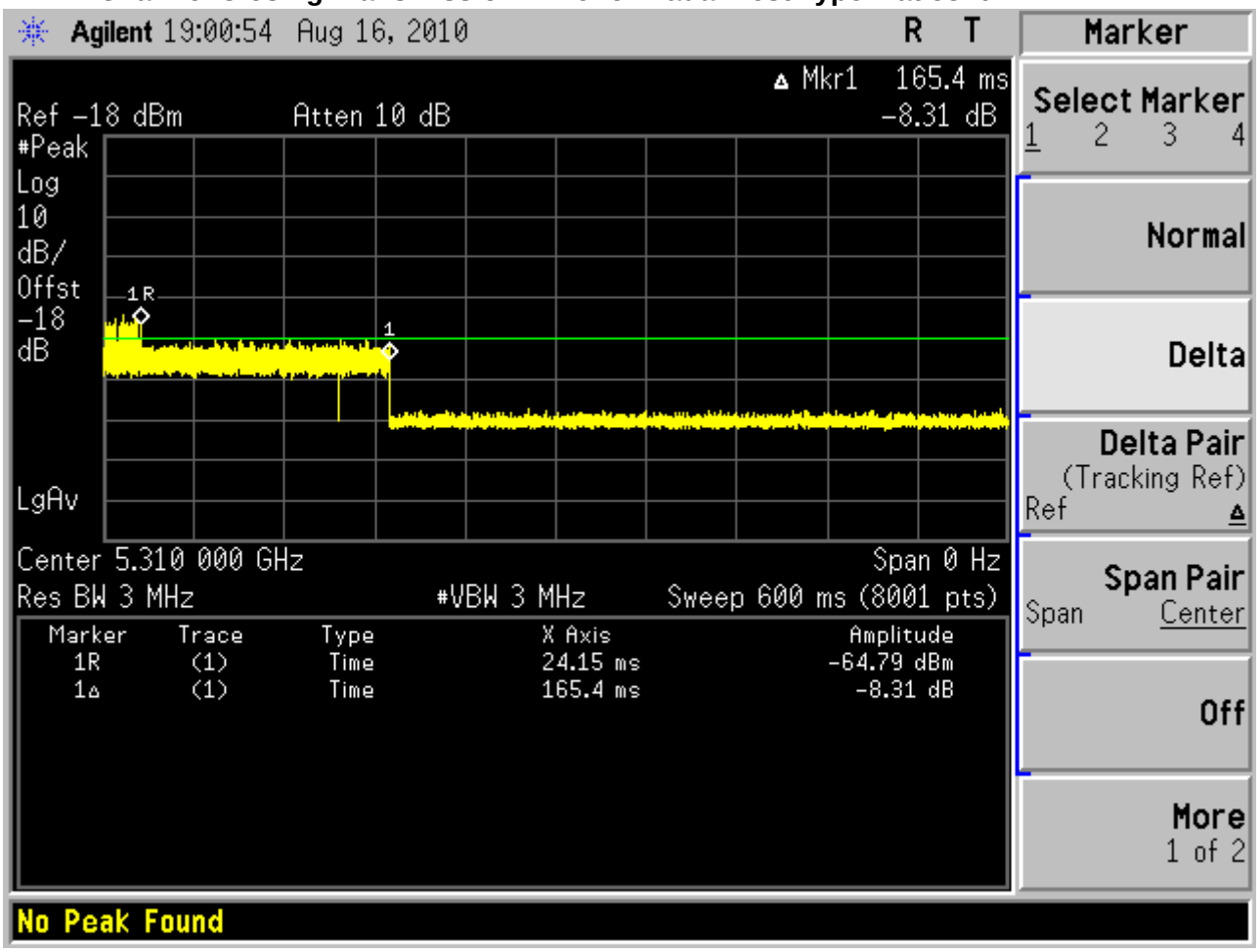



| Test Item | Test Result (Sec) | Limit (Sec) |
|---|---|---|
| Channel Move Time | 0 | 10 |

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

| | | |
|---|---|---|
| Product | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Closing Transmission Time Test |
| Radar Type | : | Type 1 |
| Test Mode | : | Mode 1: Transmit |

**Channel Closing Transmission Time for Radar Test Type 1 at 5310 MHz**

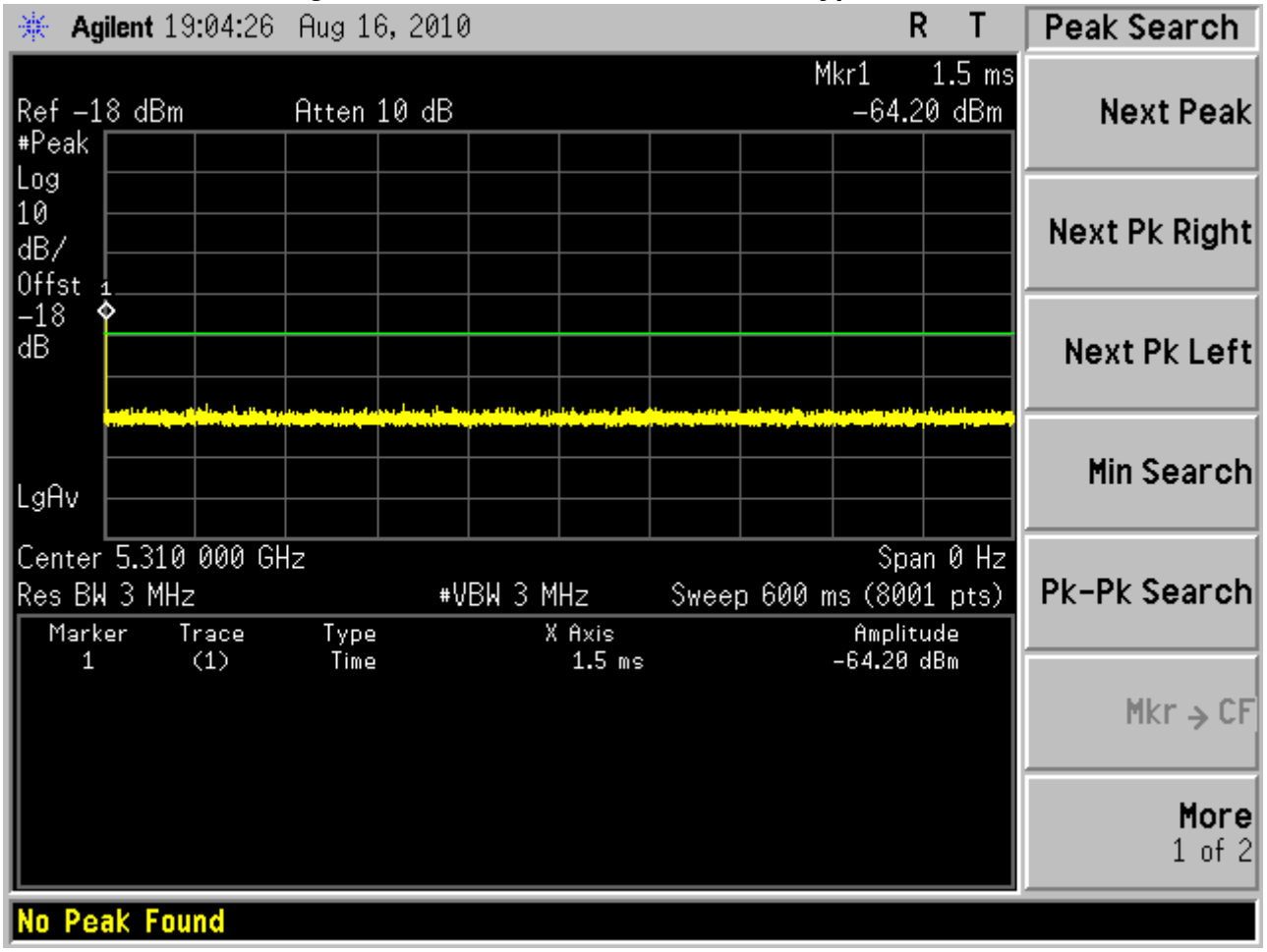



| Test Item | Test Result (ms) | Limit (ms) |
|---|---|---|
| Channel Closing Transmission | *0 | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period |

*Note: 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 | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Closing Transmission Time Test |
| Radar Type | : | Type 5 |
| Test Mode | : | Mode 1: Transmit |

**Channel Closing Transmission Time for Radar Test Type 5 at 5310 MHz**



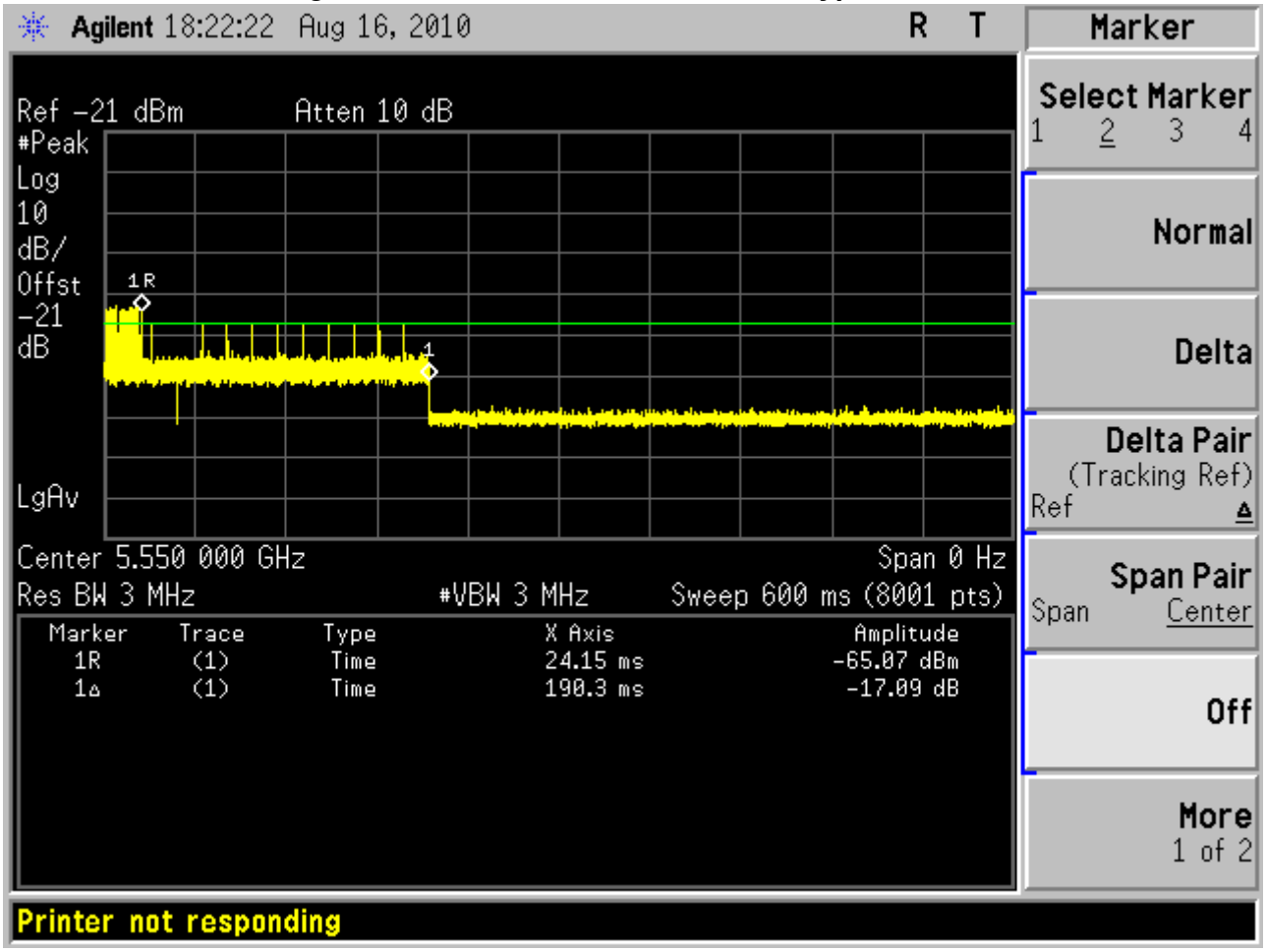

| Test Item | Test Result (ms) | Limit (ms) |
|---|---|---|
| Channel Closing Transmission | *0 | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period |

*Note: The test result is “bin number X time per bin (600 ms / 8000)”

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 | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Closing Transmission Time Test |
| Radar Type | : | Type 1 |
| Test Mode | : | Mode 1: Transmit |

**Channel Closing Transmission Time for Radar Test Type 1 at 5550 MHz**

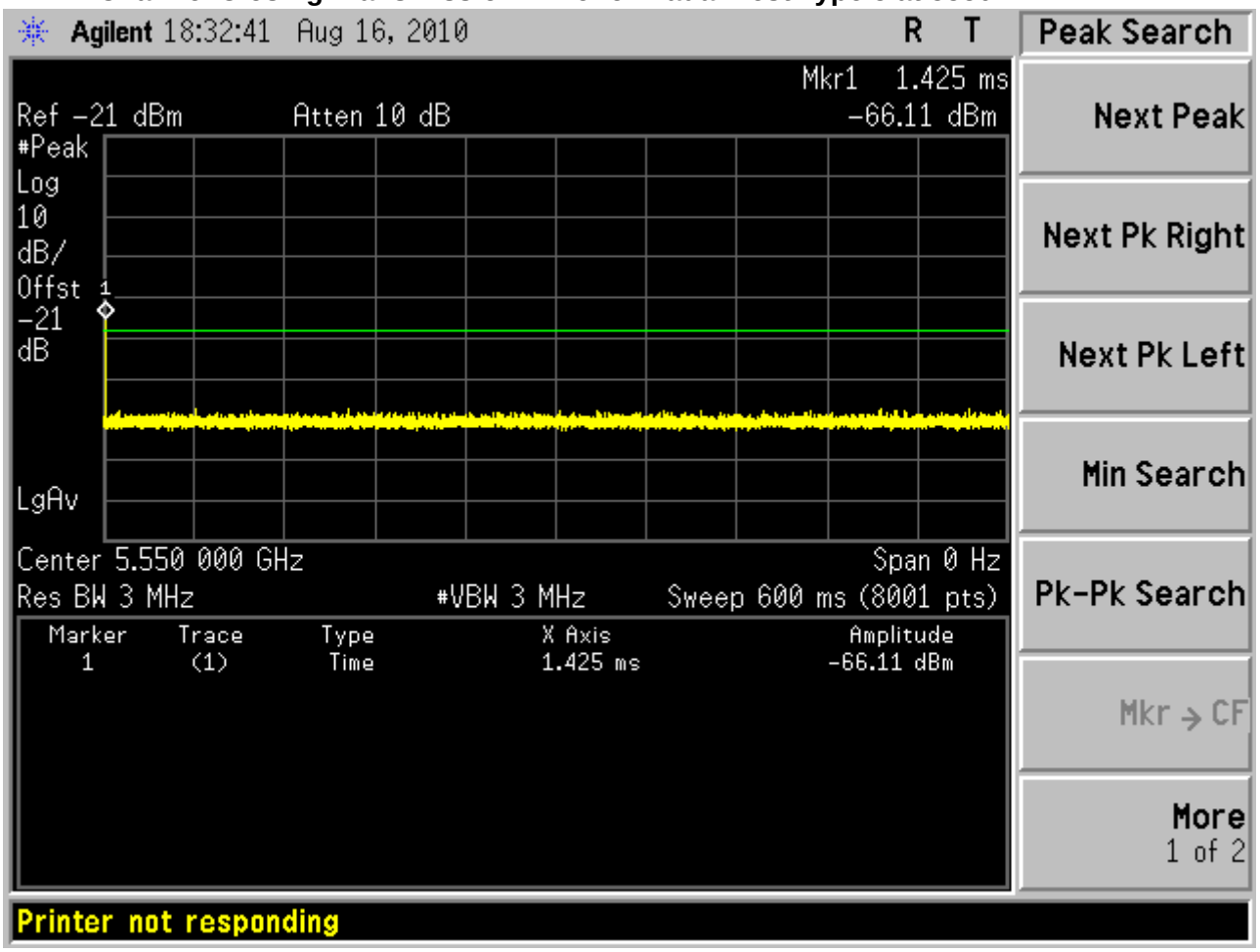



| Test Item | Test Result (ms) | Limit (ms) |
|---|---|---|
| Channel Closing Transmission | *0 | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period |

*Note: 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 | : | Full HD Video Wireless Transmitter Module |
| Test Item | : | Channel Closing Transmission Time Test |
| Radar Type | : | Type 5 |
| Test Mode | : | Mode 1: Transmit |

**Channel Closing Transmission Time for Radar Test Type 5 at 5550 MHz**



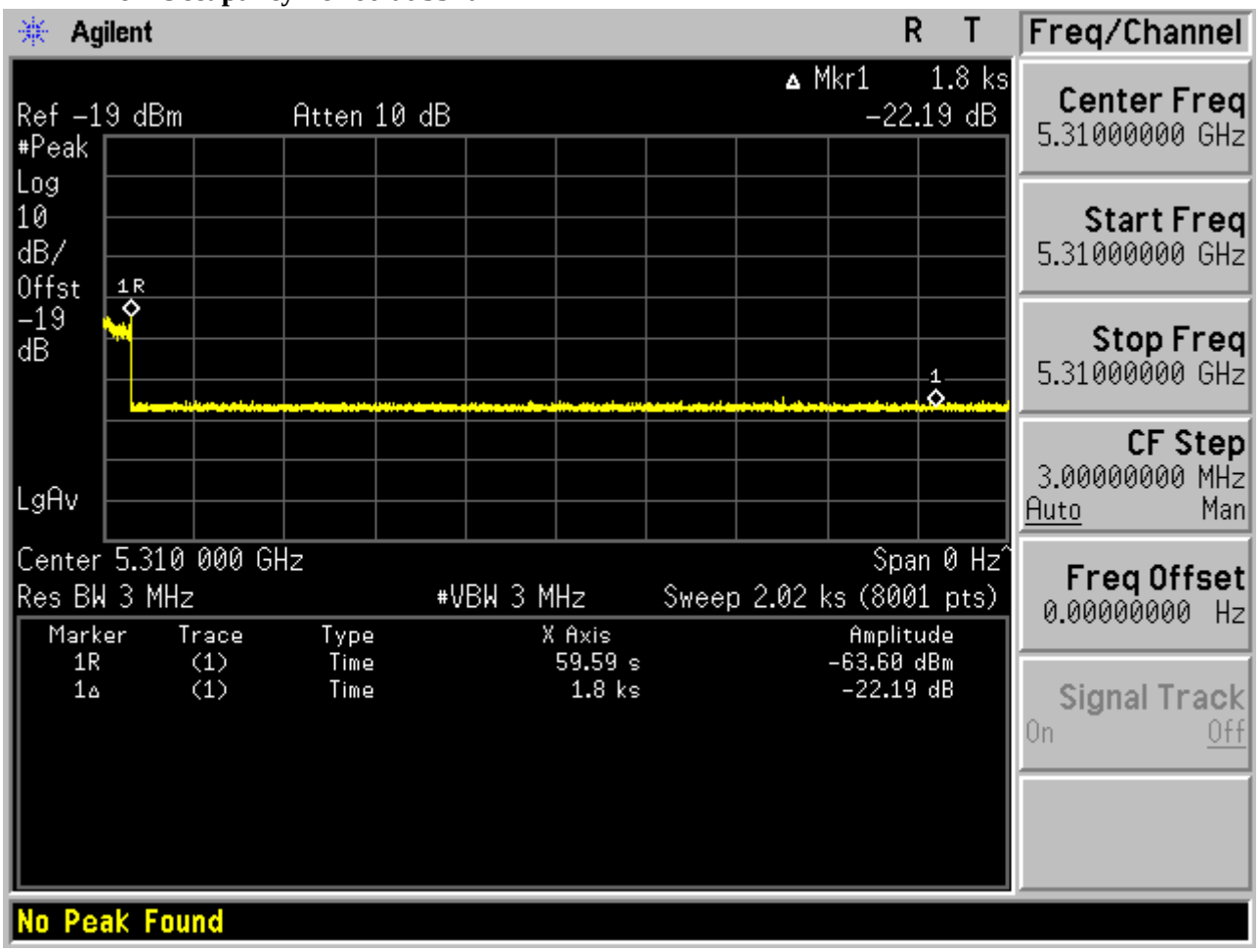

| Test Item | Test Result (ms) | Limit (ms) |
|---|---|---|
| Channel Closing Transmission | *0 | 200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period |

*Note: The test result is “bin number X time per bin (600 ms / 8000)”

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 : Full HD Video Wireless Transmitter Module
Test Item : Non-Occupancy Period
Radar Type : Type 1
Test Mode : Mode 1: Transmit

**Non-Occupancy Period at 5310 MHz**

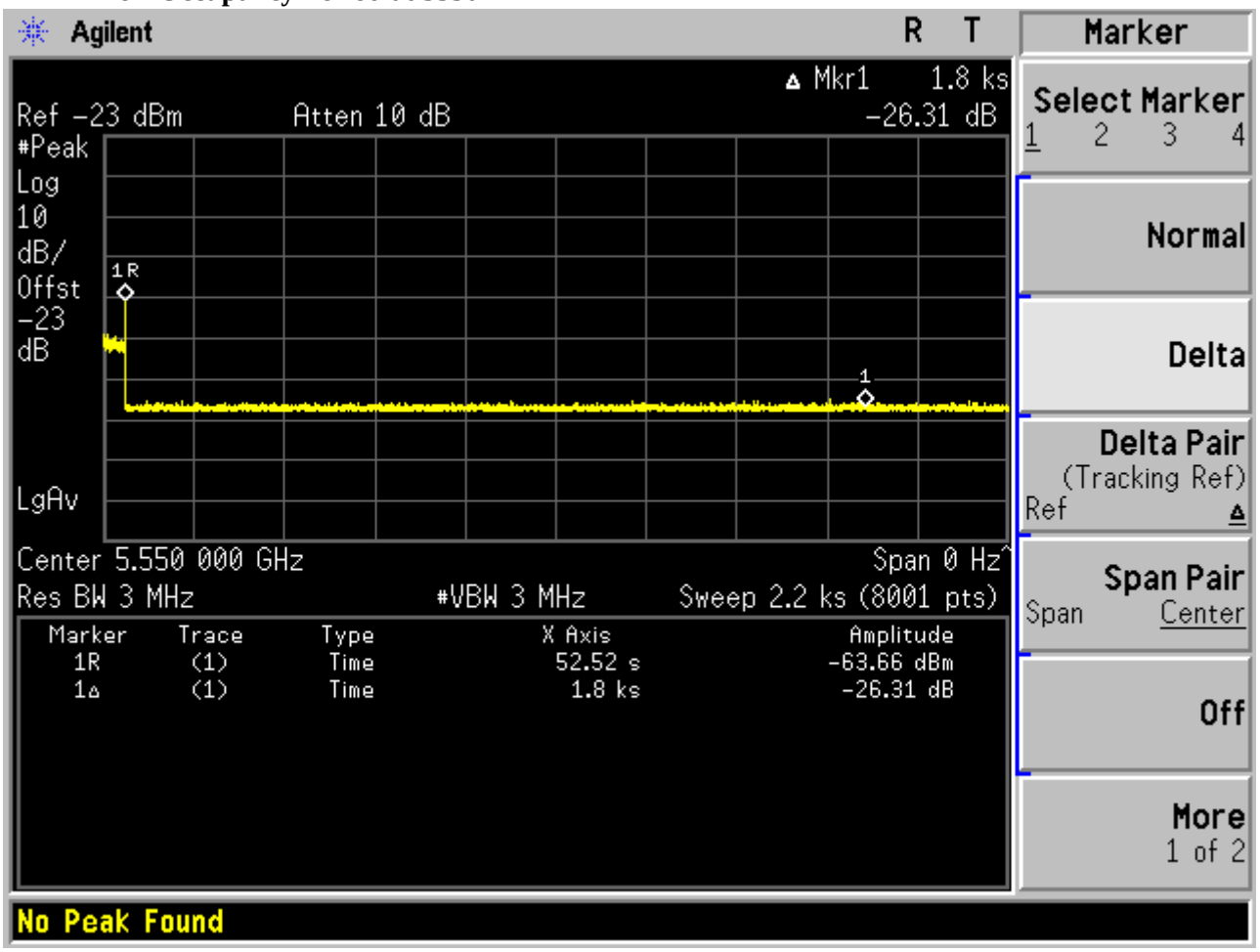



| Test Item | Test Result (Minutes) | Limit (Minutes) |
|---|---|---|
| Non-Occupancy Period | >30 | ≧30 |

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

Product : Full HD Video Wireless Transmitter Module
Test Item : Non-Occupancy Period
Radar Type : Type 1
Test Mode : Mode 1: Transmit

**Non-Occupancy Period at 5550 MHz**




| Test Item | Test Result (Minutes) | Limit (Minutes) |
|---|---|---|
| Non-Occupancy Period | >30 | >30 |

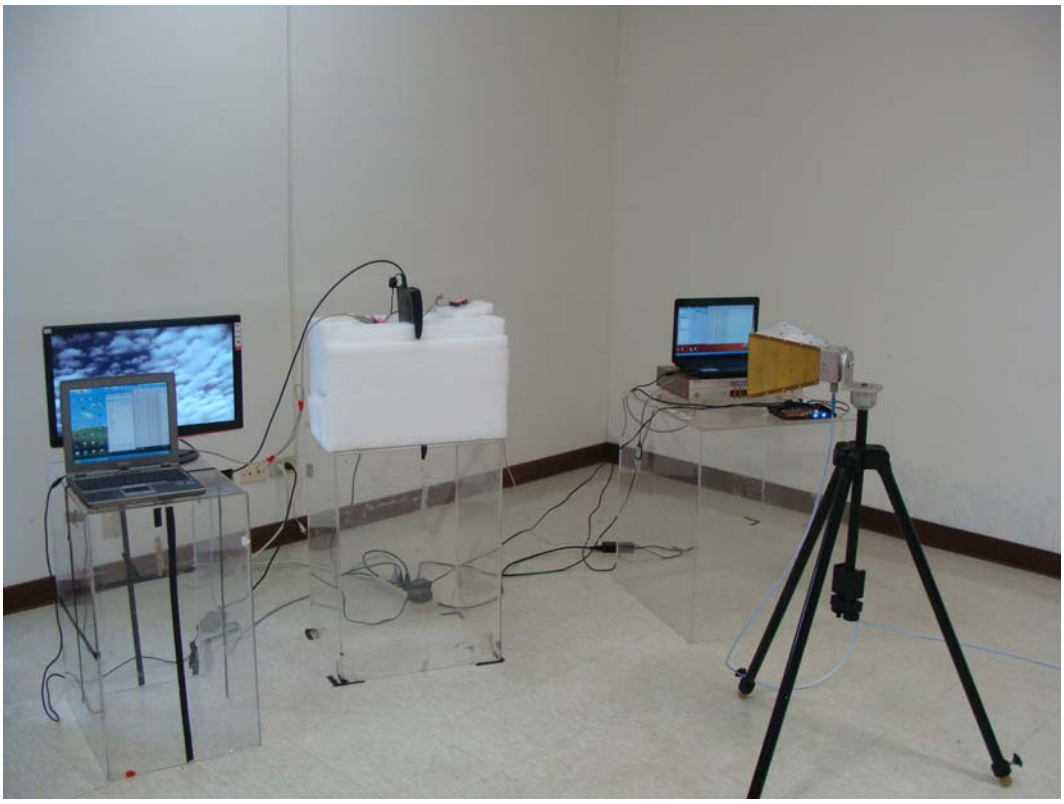
No EUT transmissions were observed on the test channel during 30 minutes observation time.

# 3. DFS Test Setup Photo

**Full DFS Test Setup Photo**

**DFS Set-up Photo: Spectrum Analyzer, EUT and Radar Generator**

**DFS Set-up Photo: Master**



**DFS Set-up Photo: Slave**