# TEST REPORT

## Test Report No. : UL-RPT-RP11838557JD10A

| | | |
|---|---|---|
| **Customer** | : | Apple Inc. |
| **Model No.** | : | A1862 |
| **FCC ID** | : | BCGA1862 |
| **Technology** | : | WLAN |
| **Test Standard(s)** | : | FCC Part 15.407(h)(2) |

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 1.0

**Date of Issue:** 20 November 2017

**Checked by:**

Sarah Williams
Senior Test Engineer, Radio Laboratory

**Company Signatory:**

Ian Watch
Senior Test Engineer, Radio Laboratory
UL VS LTD

**UL VS LTD**

**Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK**
**Telephone: +44 (0)1256 312000**
**Facsimile: +44 (0)1256 312001**

## Customer Information

| | |
|---|---|
| **Company Name:** | Apple Inc. |
| **Address:** | 1 Infinite Loop<br>Cupertino, CA 95014<br>U.S.A. |

## Report Revision History

| Version Number | Issue Date | Revision Details | Revised By |
|---|---|---|---|
| 1.0 | 20/11/2017 | Initial Version | Sarah Williams |

## Table of Contents

**Customer Information** ..... **2**

**Report Revision History** ..... **2**

**1. Attestation of Test Results** ..... **4**
1.1. Description of EUT 4
1.2. General Information 4
1.3. Summary of Test Results 4
1.4. Deviations from the Test Specification 4

**2. Summary of Testing** ..... **5**
2.1. Facilities and Accreditation 5
2.2. Methods and Procedures 5
2.3. Calibration and Uncertainty 5
2.4. Test and Measurement Equipment 6

**3. Equipment Under Test (EUT)** ..... **7**
3.1. Identification of Equipment Under Test (EUT) 7
3.2. Modifications Incorporated in the EUT 7
3.3. Additional Information Related to Testing 7
3.4. Description of Available Antennas 7
3.5. Description of Test Setup 8

**4. Test Results** ..... **12**
4.1. Channel Closing Transmission Time and Channel Move Time 12
4.2. Non-occupancy Period 17

**Appendix 1. Radar Type 0 Calibration** ..... **20**

**Appendix 2. Test Platform Approval email** ..... **21**

**Appendix 3. System Noise Floor Reference Plots** ..... **22**

**Appendix 4. Channel Loading** ..... **23**

**Appendix 5. Channel/Frequency plan** ..... **25**

# 1. Attestation of Test Results

## 1.1. Description of EUT

The Apple iMac Pro is a desktop computer, with 27-inch Retina display, storage media, multimedia functions, IEEE 802.11a/b/g/n/ac radio and Bluetooth radio.

## 1.2. General Information

| | |
|---|---|
| **Specification Reference:** | 47CFR15.407 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) - Section 15.407 |
| **Test Dates:** | 23 October 2017 to 24 October 2017 |

## 1.3. Summary of Test Results

| FCC Reference (47CFR) | Measurement | Note | Result |
|---|---|---|---|
| Part 15.407(h)(2)(iii) | Channel Closing Transmission Time and Channel Move Time | - | Complied |
| Part 15.407(h)(2)(iv) | Non-Occupancy Period | 2 | Complied |

**Note(s):**

1. The manufacturer confirms that the information regarding the parameters of the radar waveforms is not available to the end user.
2. This test is not required for a client without radar detection according to Tables 1 and 2 of KDB 905462 D02, however it was performed to show compliance with KDB 905462 D02 5.1.2 e) and KDB 905462 D03, section (b)(5) and (b)(6).

## 1.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

# 2. Summary of Testing

## 2.1. Facilities and Accreditation

The test site and measurement facilities used to collect data are located at Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom.

UL VS LTD is accredited by UKAS. The tests reported herein have been performed in accordance with its terms of accreditation.

## 2.2. Methods and Procedures

| | |
|---|---|
| **Reference:** | FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 (April 08, 2016) |
| **Title:** | Compliance Measurement Procedures for Unlicensed-National Information Infrastructure Devices Operating in the 5250-5350 MHz and 5470-5725 MHz Bands Incorporating Dynamic Frequency Selection |

## 2.3. Calibration and Uncertainty

### Measuring Instrument Calibration

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

### Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value measured (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

| Measurement Type | Confidence Level (%) | Calculated Uncertainty |
|---|---|---|
| DFS Channel Shutdown Timing | 95% | ±0.45 ms |
| DFS Non-Occupancy Timing | 95% | ±79.25 ms |
| DFS Radar Amplitude | 95% | ±2.17 dB |

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

## 2.4. Test and Measurement Equipment

### Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1631 | DFS Test System | Aeroflex | PXI 3000 | 300110/291 | Calibrated before use | - |
| M1883 | Signal Analyser | Rohde & Schwarz | FSV-30 | 103084 | 02 May 2018 | 12 |
| M1804 | Signal Generator | Rohde & Schwarz | SMP 22 | 100026 | 03 Feb 2018 | 24 |
| G0615 | Vector Signal Generator | Rohde & Schwarz | SMBV100A | 260473 | 08 May 2020 | 36 |
| A030 | Step Attenuator | Narda | 745-69 | 01544 | Calibrated before use | - |
| A163 | Step Attenuator | Narda | 743-80 | 01344 | Calibrated before use | - |
| A2181 | Coaxial Circulator 4 – 18 GHz | AtlantecRF | ACC-20130-SF-SF-SF | 120409229 | Calibrated before use | - |
| A2183 | Coaxial Circulator 4 – 18 GHz | AtlantecRF | ACC-20130-SF-SF-SF | 120409232 | Calibrated before use | - |
| A2884 | Power Splitter | Mini-Circuits | ZN2PD2-63-S+ | SUU474016 01#2 | Calibrated before use | - |
| A2097 | Power Splitter | Mini-Circuits | ZN4PD1-63W-S+ | SUU987012 06 | Calibrated before use | - |
| A2989 | 50Ω Termination | Not marked or stated | Not marked or stated | Not marked or stated | Calibrated before use | - |
| A2491 | 50Ω Termination | AtlantecRF | TA06W5-M | 121813#2 | Calibrated before use | - |
| A2555 | 50Ω Termination | Micronde | R404610 | Not marked or stated | Calibrated before use | - |
| M2028 | Network Analyser | Agilent | E5071C | MY46521873 | 21 Aug 2018 | 12 |
| M2005 | Thermohygrometer | Testo | 608-H1 | 45046700 | 22 Feb 2018 | 12 |

# 3. Equipment Under Test (EUT)

## 3.1. Identification of Equipment Under Test (EUT)

| | |
|---|---|
| **Brand Name:** | Apple |
| **Model Name or Number:** | A1862 |
| **Test Sample Serial Number:** | C02V3005J61C (*Conducted Sample*) |
| **Hardware Version:** | EVT |
| **Software Version:** | 9.30.121.42 |
| **FCC ID:** | BCGA1862 |

## 3.2. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

## 3.3. Additional Information Related to Testing

| | | |
|---|---|---|
| **Technology Tested:** | WLAN (IEEE 802.11a,n,ac) / U-NII | |
| **Type of Unit:** | Transceiver | |
| **Modulation Types:** | BPSK, QPSK, 16QAM, 64QAM & 256QAM | |
| **Transmit / Receive Frequency Range:** | 5250 to 5350 MHz<br>5470 to 5850 MHz | |
| **Transmit / Receive Channels Tested at 80 MHz Bandwidth setting:** | **Channel ID** | **Channel Centre Frequency (MHz)** |
| | 106 (Control Channel 100) | 5530 |

## 3.4. Description of Available Antennas

The radio utilizes three integrated antennas of 50 Ω impedance. Maximum gains are shown below:

| **Frequency Band (MHz)** | **$G_{Antenna\ WF2}$ (dBi)** | **$G_{Antenna\ WF3}$ (dBi)** | **$G_{Antenna\ WF4}$ (dBi)** |
|---|---|---|---|
| 5150 to 5250 | 4.2 | 1.8 | 2.8 |
| 5250 to 5350 | 3.9 | 2.3 | 2.2 |
| 5470 to 5725 | 4.2 | 1.3 | 1.8 |
| 5725 to 5850 | 3.1 | 1.4 | 1.0 |

## 3.5. Description of Test Setup

### Support Equipment

The following support equipment was used to exercise the EUT during testing:

| | |
|---|---|
| **Description:** | Wireless Dual Band Router (DFS Master) |
| **Brand Name:** | Cisco |
| **Model Name or Number:** | AIR-CAP3702E-A-K9 V04 |
| **FCC ID:** | LDK102087 |
| **Serial Number:** | FJC1938F3G6 |

| | |
|---|---|
| **Description:** | Test Laptop |
| **Brand Name:** | Lenovo |
| **Model Name or Number:** | ThinkPad L440 |
| **Serial Number:** | R9-019EA0 |

| | |
|---|---|
| **Description:** | Test Laptop |
| **Brand Name:** | Apple |
| **Model Name or Number:** | MacBook Pro A1398 |
| **Serial Number:** | C2QLQ03XF9F2 |

| | |
|---|---|
| **Description:** | Client Device |
| **Brand Name:** | Apple |
| **Model Name or Number:** | A1625 |
| **Serial Number:** | C07PL01LGN7T |

### Operating Modes

The EUT was tested in the following operating modes, unless otherwise stated:

- Operating on the channel selected by the Master device in either band U-NII-2A or U-NII-2C.
- The Master device controls the channel bandwidth of the EUT. Both the Master and Client device were set to 802.11ac / MCS0x1 with 80 MHz channel bandwidth to ensure a stable channel loading.
- KDB 905462 D02 v02 *UNII DFS Compliance Procedures* states in Table 2 the EUT should be tested at maximum channel bandwidth (80 MHz for 802.11ac mode).
- For the required channel loading of >17% in KDB 905642 D02 7.7 c), a UDP data transfer of 6 Mbit/s was performed between a test computer connected to the DFS master router and the EUT. This gave a channel loading (duty cycle) of 59.2% at the modulation scheme and bandwidth above. This was again repeated with a UDP data transfer of 3 Mbit/s from EUT to client for direct client-to-client testing. This resulted in a channel loading of 30.9% See Appendix 4 *Channel Loading* for further details.

## Configuration and Peripherals

The EUT was tested in the following configuration(s):

- The EUT is a DFS Client without Radar Detection capability. It was tested in combination with an FCC approved Cisco DFS enabled router (FCC ID: LDK102087) being used as the Master. A Radar Type 0 was injected to the Master to test the Clients Channel Move Time and Channel Closing Transmission Time after receiving the channel shutdown command from the Master.
- All measurements were made using a conducted link. The EUT has one external antenna port fitted for test purposes. System losses for the interconnecting hardware were measured and taken into consideration.
- The Radar test platform used was the Aeroflex DFS Radar Simulator and Analyser which has been verified and accepted by Andrew Leimer of the FCC/NTIA on the 23rd of September 2011. Refer to Appendix 2 of this Test Report for the original confirmation email.
- The DFS detection threshold of -56.0 dBm (-62 + 1 dB + 5 dBi) was used at the Master device antenna port. Note this is not dependent on the EUT EIRP, Spectral Density or EUT Antenna Gain, only the antenna gain of the master device, as the EUT does not have radar detection. The Cisco DFS Master test router was configured with an internal setting for a 5 dBi antenna.

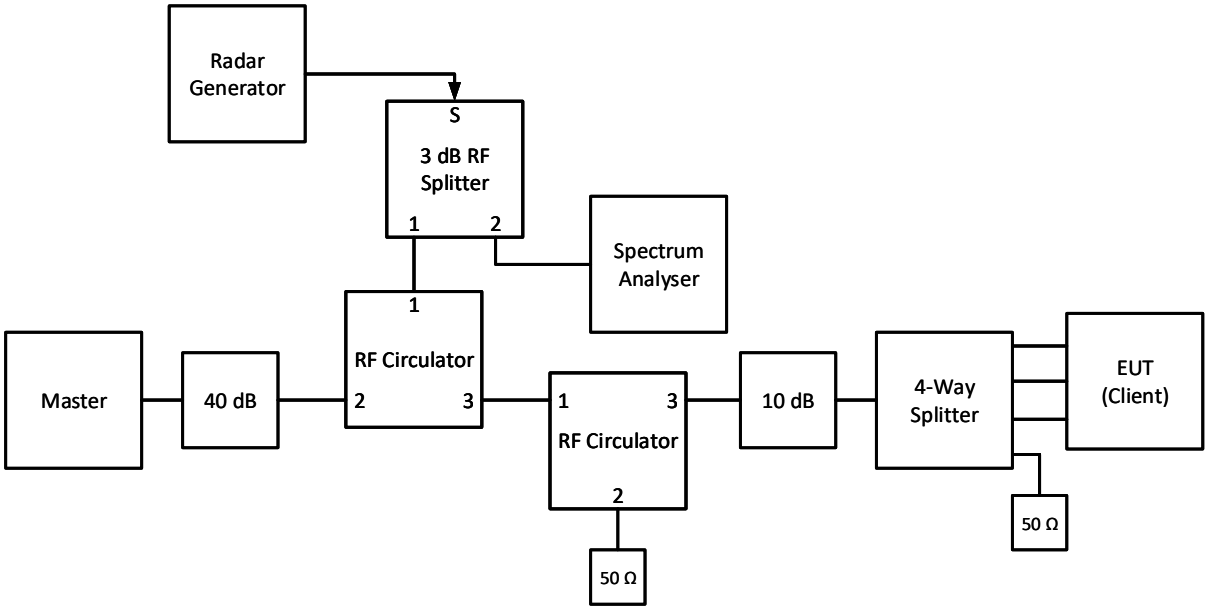
**KDB 905462 D02 Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection**

| Maximum Transmit Power | Value (see notes) |
|---|---|
| EIRP ≥ 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 1dB 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>**Note 3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01. | |

- The Master device used for test was set to 17 dBm / 50 mW with TPC enabled.
- Plots and data were captured using a Rohde and Schwarz FSV 30 Spectrum Analyser. The number of data points was increased to maximum and the trace data exported so it could be analysed in far greater detail than available on the built-in display.
- The Channel Move Time was the time taken from the end of the radar waveform to the time the Client ceased transmissions. The Channel Closing Transmission Time was calculated to the nearest sample from any additional pulses occurring >200 ms after the end of the radar.
- The EUT was also tested in a second setup where it was directly exchanging data with another client associated with the same network. Both setups are explained with diagrams in the following section.

## Test Setup Diagrams

### Setup diagram for test of DFS Client without Radar Detection: Setup 1



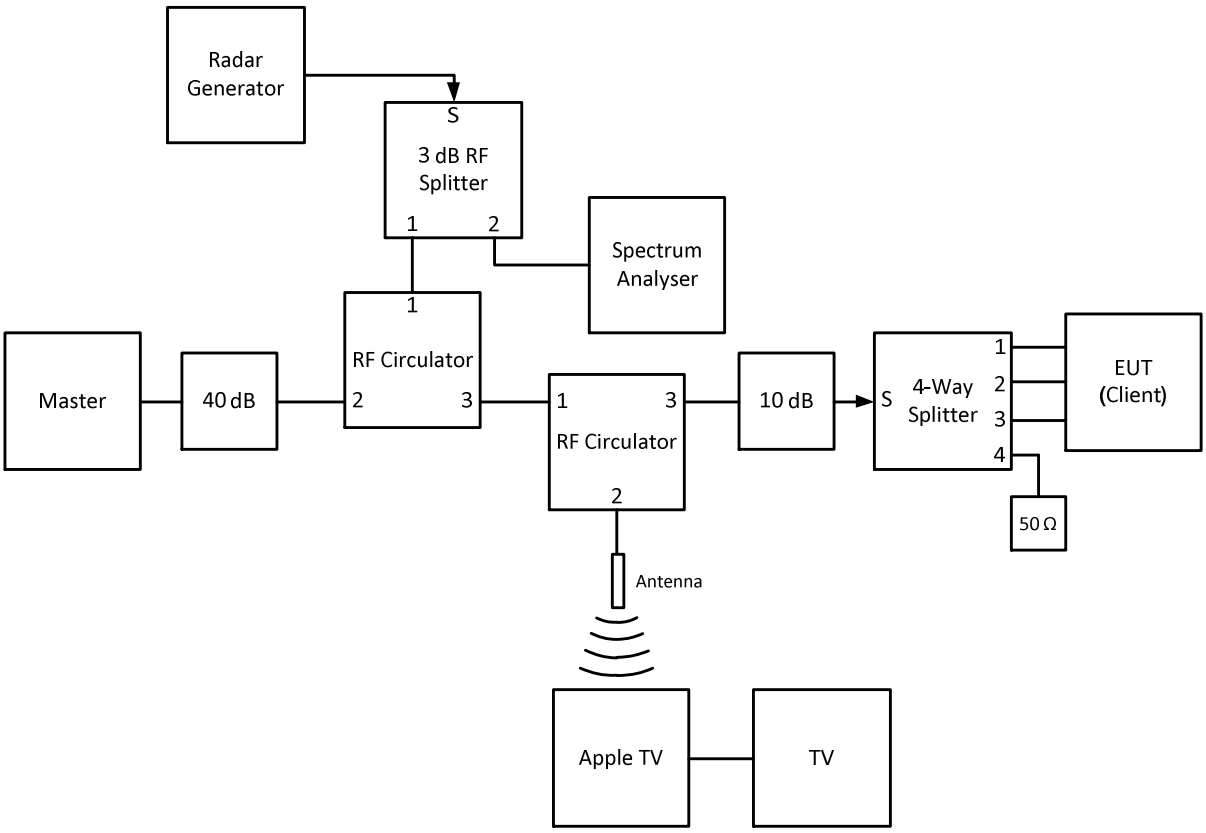

### Rationale

The setup shown above ensures the waveforms indicated on the spectrum analyser are in order of magnitude. The circulators have typically 18 dB attenuation in the reverse direction. The left-hand circulator directs the radar towards the master, ensuring there is not an overly large radar pulse into the client (EUT) even though there is the more attenuation between the circulator and the master. The right-hand circulator is to give the same path loss between master and client in both directions of the 802.11 communications link.

The Radar signal is most predominant on the spectrum analyser, coming straight through a 3 dB splitter. The client is 2nd largest, being attenuated by the 10 dB, and the (typically 18 dB) isolation from the directional 3 dB splitter. The smallest signal is the master, being attenuated by 40 dB from the attenuator and approximately 18 dB from the left-hand circulator and 18 dB across the splitter.

The RF path from the radar generator to the DFS Master crosses no isolated ports of any splitters or circulators and any change of impedance in load between calibration and test is isolated from any circulators by 50 Ω attenuators which further minimises mismatch. This setup therefore meets the requirements of KDB 905462 D02 clause 7.2 points (A) and (B) whilst providing greater radar generator amplitude headroom and lower radar signal at the client.

**Setup diagram for test of DFS Client without Radar Detection: Setup 2**




## Rationale

This setup is exactly the same as the previous one, except the EUT is also communicating with the Apple TV on the same network. The EUT transferred data directly to the Apple TV automatically using an iPerf UDP data stream. The Apple TV was placed close enough to the antenna to make sure that the link between EUT and the Apple TV is stronger than the link between the EUT and the Master device. This was also achieved by controlling the attenuation in the network.

# 4. Test Results

## 4.1. Channel Closing Transmission Time and Channel Move Time

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Philip Harrison | **Test Dates:** | 23 October 2017 & 24 October 2017 |
| **Test Sample Serial Number:** | C02V3005J61C | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.407(h)(2)(iii) |
| **Test Method Used:** | KDB 905462 D02 Section 7.8.3 |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 24 |
| **Relative Humidity (%):** | 59 |

### Note(s):

1. The channel move time is the time taken from the end of the radar burst to the ceasing of transmissions of the EUT.
2. The Total Aggregate Channel Closing Transmission Time shown in the table below was measured from 200 ms after the end of the radar burst and compared to the 60 ms limit.
3. Although the EUT and DFS master device 80 MHz operating channel was centred on 5530 MHz, the spectrum analyser was tuned to zero span at 5500 MHz. The radar was also fired at 5500 MHz. This was the control channel of the DFS master router, and hence any additional control signals seen would occur in this 20 MHz part of the channel bandwidth, along with any of the wider-band data transfer.
4. The smaller transmissions seen in the plot that are less than 0 dBm, come from either the Master device or the other Client for Client-to-Client testing and not from the EUT. These transmissions can be ignored for the below results.

### Results: Setup 1 - Channel Move Time

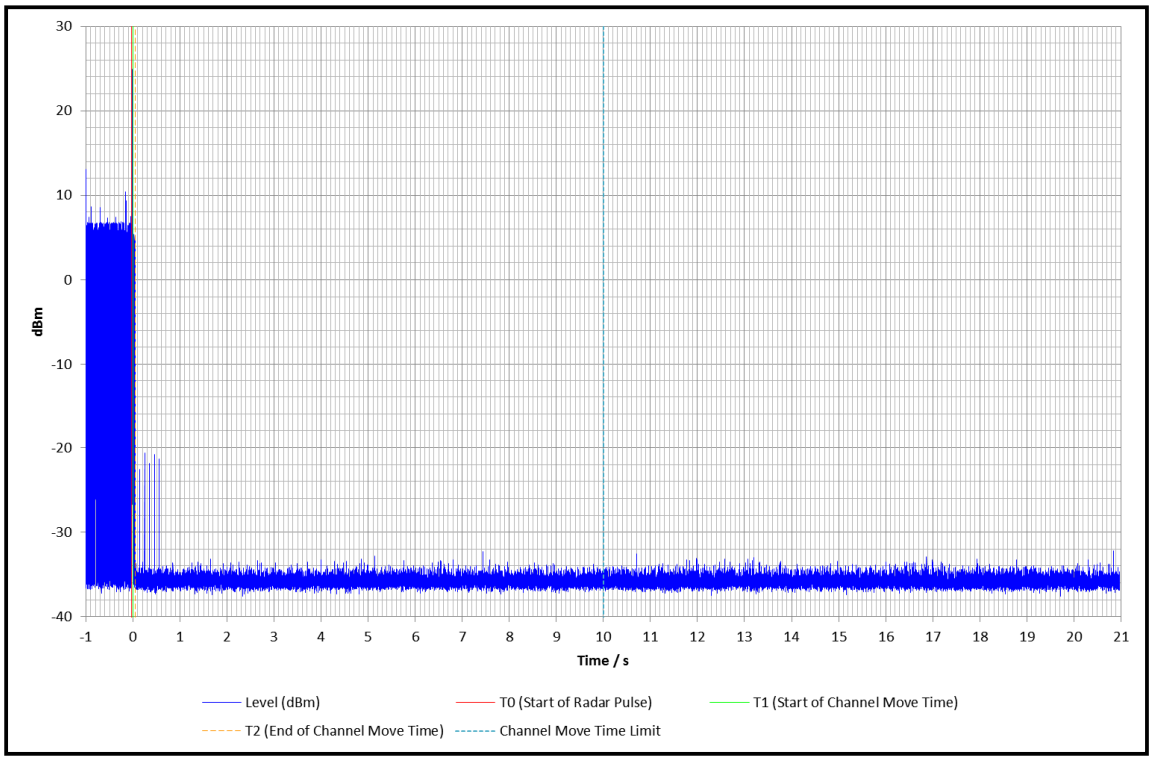
| Channel (MHz) | Move Time (ms) | Limit (ms) | Margin (ms) |
|---|---|---|---|
| 5530 | 44.7 | 10000 | 9955.3 |

### Results: Setup 1 - Channel Closing Transmission Time

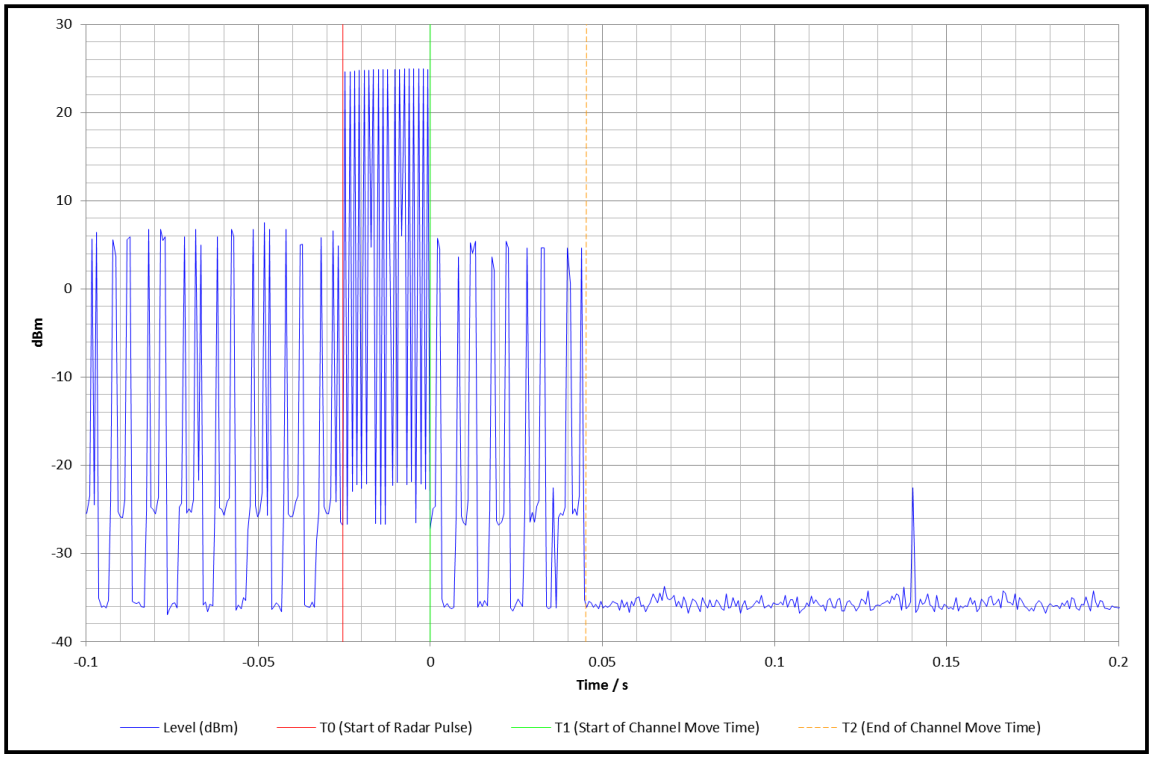
| Channel (MHz) | Total Aggregate Tx Time Occurring After time [$t_1$+200 ms] (ms) | Limit (ms) | Margin (ms) |
|---|---|---|---|
| 5530 | 0.0 | 60.0 | 60.0 |

## Channel Closing Transmission Time and Channel Move Time (continued)

## Results: Setup 1 / 80 MHz EUT to Master




**Plot showing the full 10 second shutdown limit**




**Zoomed plot showing the first 200 ms after the end of the type 0 radar burst**

## Channel Closing Transmission Time and Channel Move Time (continued)

### Results: Setup 2 - Channel Move Time

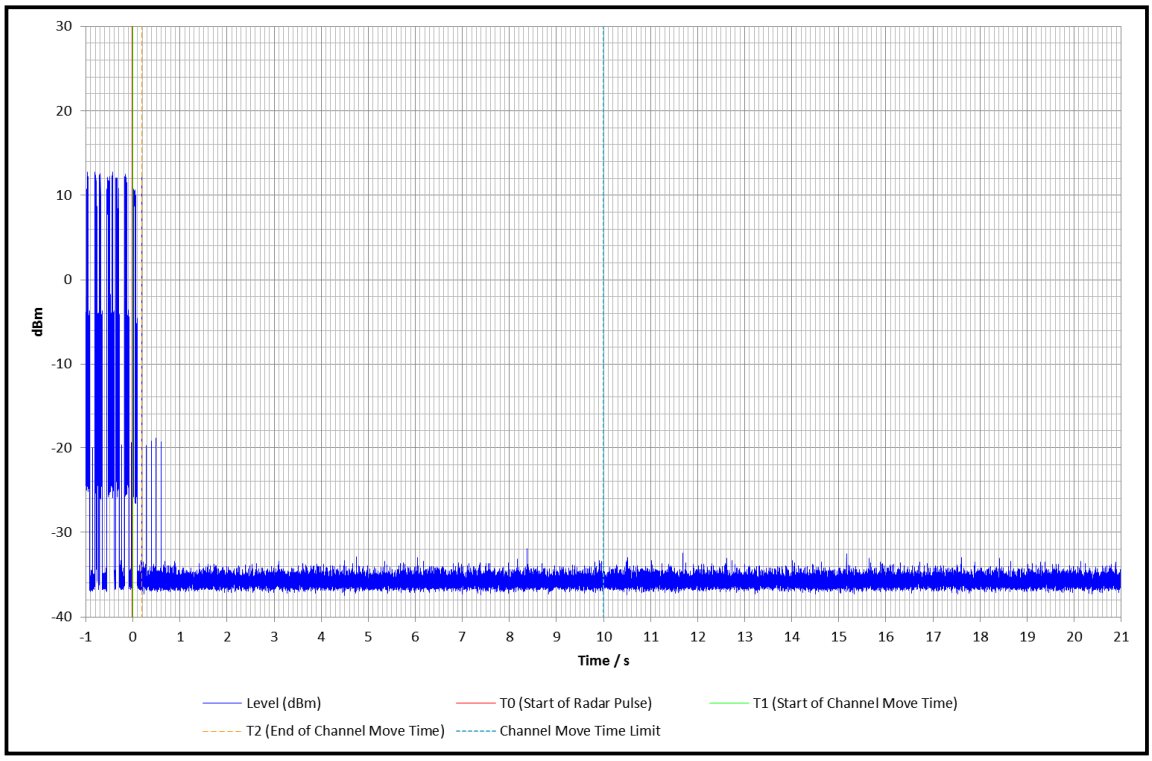
| Channel (MHz) | Move Time (ms) | Limit (ms) | Margin (ms) |
|---|---|---|---|
| 5530 | 193.9 | 10000 | 9806.1 |

### Results: Setup 2 - Channel Closing Transmission Time

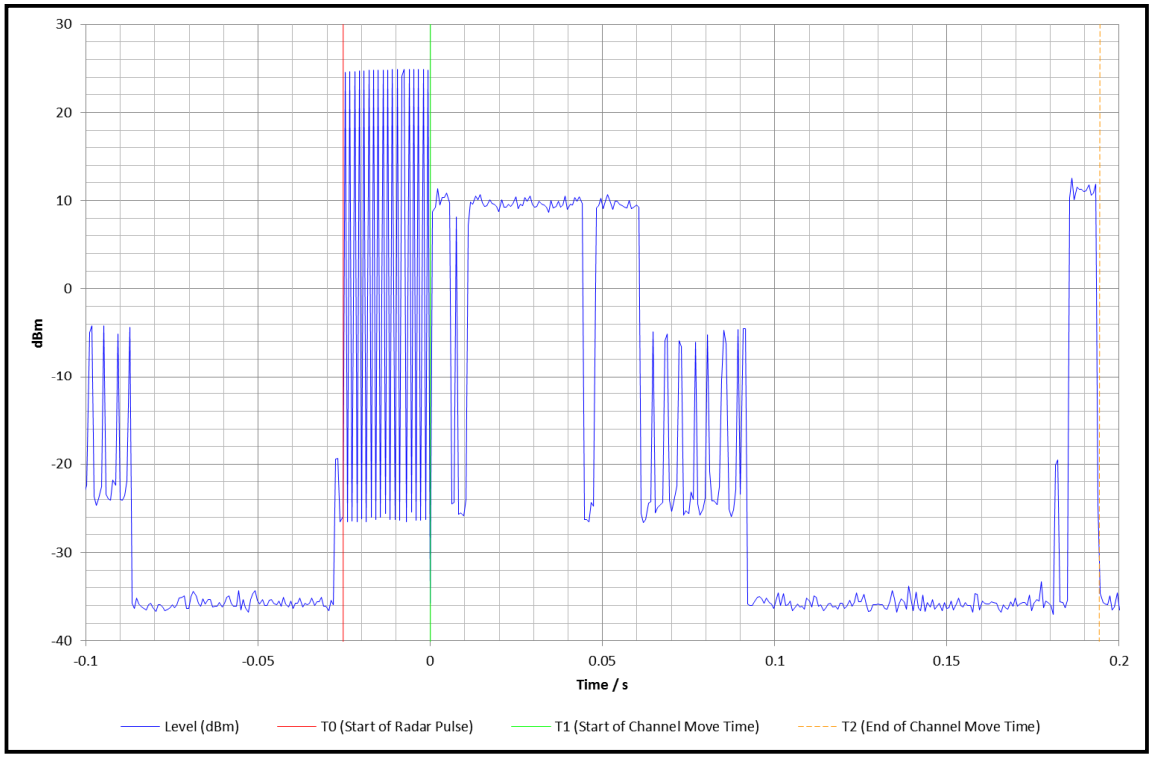
| Channel (MHz) | Total Aggregate Tx Time Occurring After time [$t_1$+200 ms] (ms) | Limit (ms) | Margin (ms) |
|---|---|---|---|
| 5530 | 0.0 | 60.0 | 60.0 |

## Channel Closing Transmission Time and Channel Move Time (continued)

## Results: Setup 2 / 80 MHz Client-to-Client, Radar at Master




**Plot showing the full 10 second shutdown limit**




**Zoomed plot showing the first 200 ms after the end of the type 0 radar burst**

## Channel Closing Transmission Time and Channel Move Time (continued)

## Limits:

### Part 15.407(h)(2)(iii)

After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

### KDB 905462 D02 Table 4: DFS Response Requirement Values

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

**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.

## 4.2. Non-occupancy Period

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Philip Harrison | **Test Date:** | 24 October 2017 |
| **Test Sample Serial Number:** | C02V3005J61C | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.407(h)(2)(iv) |
| **Test Method Used:** | KDB 905462 D02 Section 7.8.3 |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 |
| **Relative Humidity (%):** | 59 |

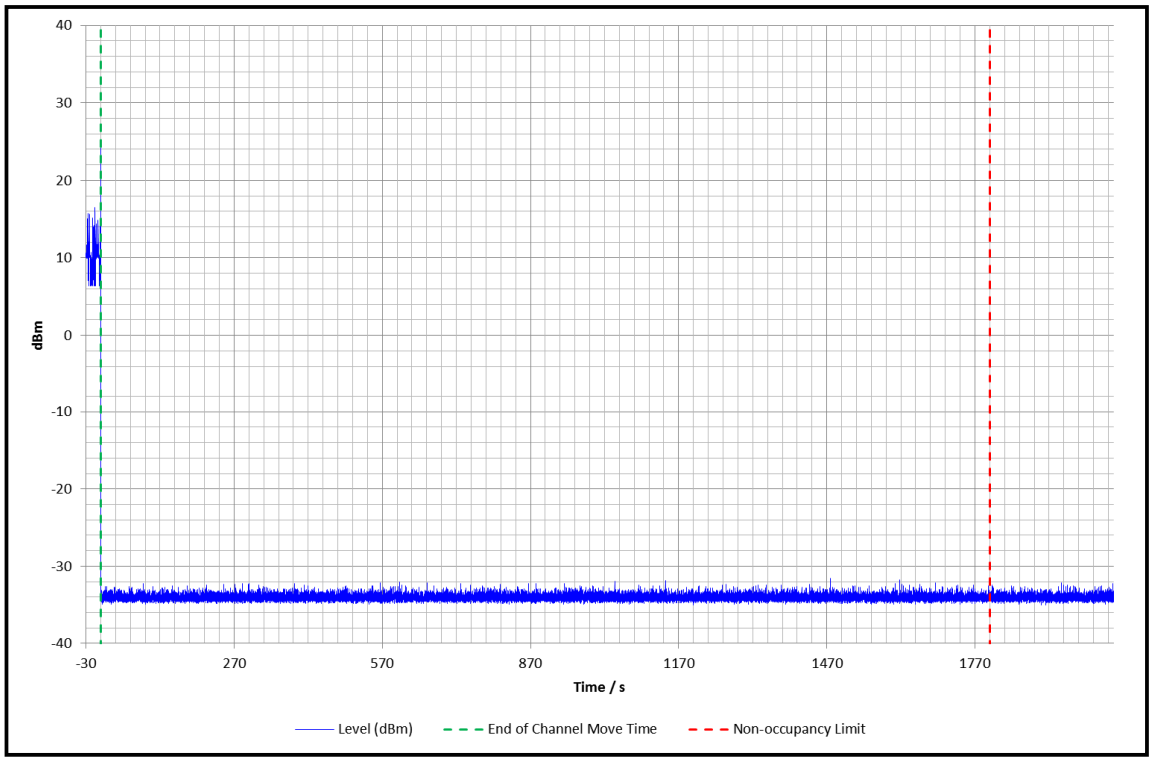
### Notes:

1. This test is not required for a client without radar detection according to Tables 1 and 2 of KDB 905462 D02, however it was performed to show compliance with KDB 905462 D02 5.1.2 e) and KDB 905462 D03, section (b)(5) and (b)(6). Therefore no specified bandwidth requirement is given and so was performed using an 80 MHz channel bandwidth; as used for *Channel Closing Transmission Time and Channel Move Time*.
2. Radar burst type 0 was detected and the channel was vacated for >1800 seconds. Since the client has no radar detection and is therefore not performing an 'intelligent' blacklisting of the channel, the device was shown not to transmit for greater than 30 minutes after its own shutdown time, not the shutdown of the DFS master or the second client in the peer-to-peer set-up.
3. The noise floor remains below the -27 dBm/MHz spurious limit for the 30 minute (1800 second) non-occupancy period. Therefore the EUT is deemed to comply.

## Non-occupancy Period (continued)

## Results: Setup 1

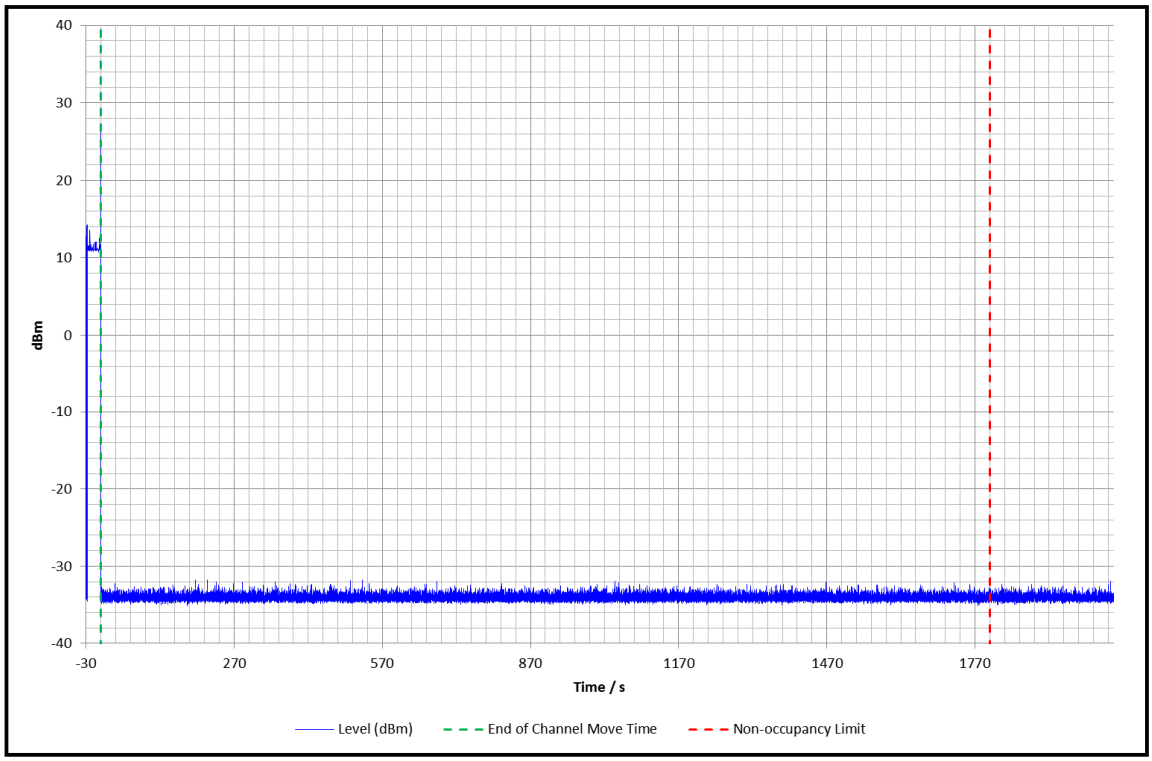
| Channel (MHz) | Non-Occ (min) | Limit (min) | Margin (min) | Result |
|---|---|---|---|---|
| 5500 | >34.3 | 30 | >4.3 | Complied |



## Non-occupancy Period (continued)

## Results: Setup 2

| Channel (MHz) | Non-Occ (min) | Limit (min) | Margin (min) | Result |
|---|---|---|---|---|
| 5530 | >34.2 | 30 | >4.2 | Complied |




## Limits:
## Part 15.407(h)(2)(iv)

A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

### KDB 905462 D02 Table 4: DFS Response Requirement Values

| Parameter | Value |
|---|---|
| Non-occupancy period | Minimum 30 minutes |

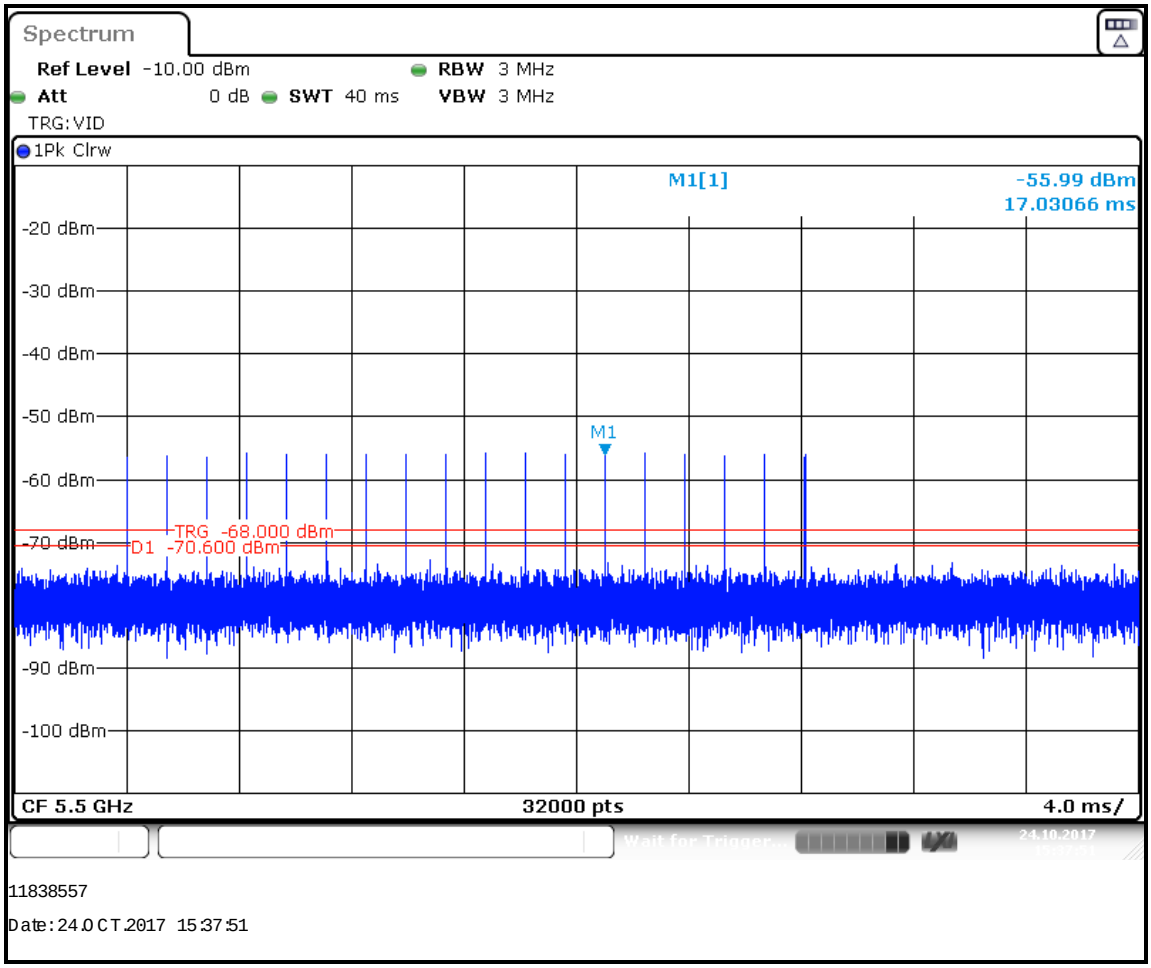
# Appendix 1. Radar Type 0 Calibration

## Radar calibration procedure.

The system was configured as shown in section 3.5, but with the spectrum analyser port terminated into a 50Ω load, and a spectrum analyser connected to the master port. The radar was then replayed by the Aeroflex DFS test system, the waveform captured, and the amplitude adjusted until correct.

The accuracy of the radars pulses themselves and the software which creates them have already been approved by the FCC and NTIA. See Appendix 2 for details.

Below is an example plot of the type 0 radar burst at the DFS master port of the attenuation network. The Aeroflex signal generator was set to –56.0 dBm output and the correct path loss offset applied.




**Radar Type 0 – full 18 pulse waveform**

# Appendix 2. Test Platform Approval email

From: Andrew Leimer [mailto:Andrew.Leimer@fcc.gov]
Sent: Friday, September 23, 2011 4:24 PM
To: Chisham, Steve
Cc: Carey, Tim; Hack, Barry; Rashmi Doshi; Joe Dichoso
Subject: RE: Certification for Aeroflex DFS solution

Hello Steve,

The Aeroflex "DXI based DFS test solution" system used for DFS alternative radar signal generation has been approved by the FCC and NTIA.

This approval permits the system to be used by labs in the testing of DFS devices for equipment authorization Certification. It is recommended that applicants that use your system for testing include a statement in the Test Report or a Letter Exhibit stating that the system has FCC and NTIA approval. This E-mail is your record of this approval.
Note that the appropriate term for your system is Approved as the term Certification is reserved for devices gaining equipment authorization through the FCC or a TCB.

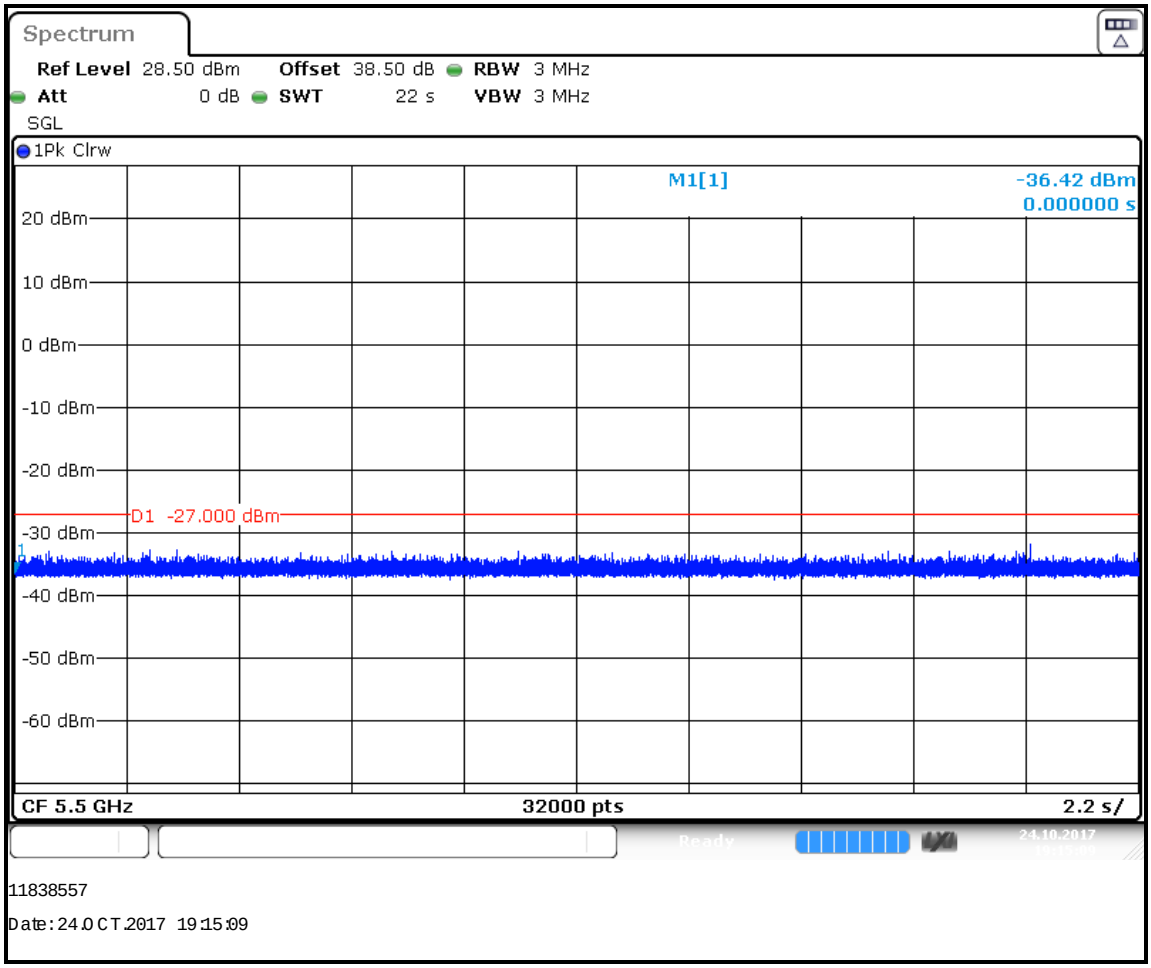
Regards,

Andy Leimer

FCC/OET/EACB

# Appendix 3. System Noise Floor Reference Plots

As required by Section 8.3 d)3) and 8.3 g) of KDB 905462 D02, the following plot shows the reference noise floor of the system used during measurement. The test network path loss from EUT to spectrum analyser was measured as 39.1 dB. The EUTs highest antenna gain of 4.2 dBi was also added to this figure since the spurious limit is an EIRP. In addition, since the EUT transmission signal is wideband and >3 MHz wide, a correction factor to compensate from the 3 MHz RBW used in KDB 905462, and the dBm/MHz limit of FCC 15.407 to which the noise floor should be compared was also added. This combined correction of 38.5 dB was added as a reference level offset to the analyser.



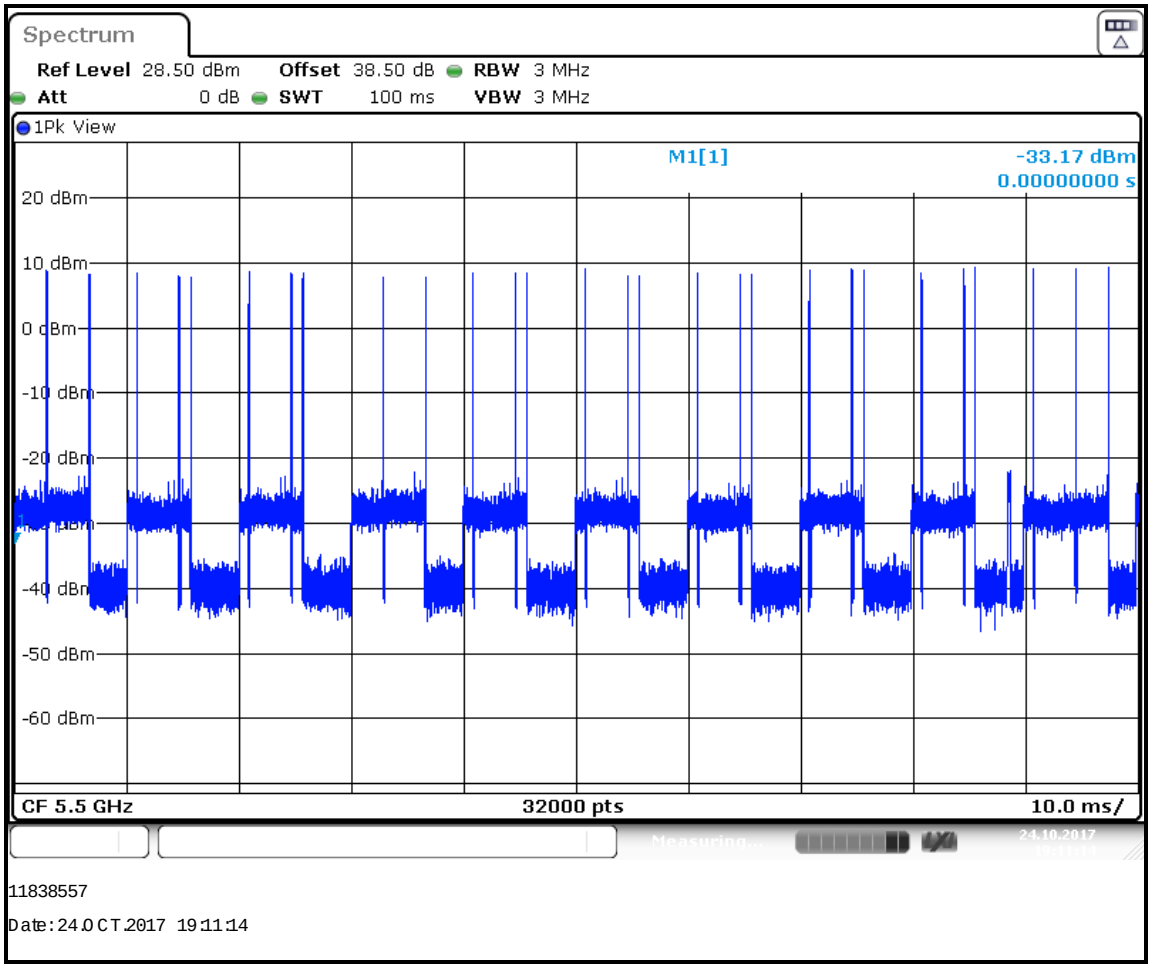

**Noise Floor of Spectrum Analyser**

# Appendix 4. Channel Loading

As required by Section 8.3. 3 f) of KDB 605642 D02, the following plot and calculations shows the duty cycle of the channel used during testing.

Streaming representative file types as defined in Section 7.7 a) of KDB 605642 D02, were found not to produce a high enough duty cycle of >17%, as required by 7.7 c), on a 80 MHz channel bandwidth, and gave very irregular loading due to large video buffers. This included lowest data rate with modulation coding scheme MCS0, maximum video size (1080p) and the minimum video compression ratio during encoding. Therefore and alternative UDP pseudo-random data transfer as per 7.7 b) was streamed to simulate data transfer. A suitable duty cycle was obtained with the link using MCS0 and a throughput-limited transfer.

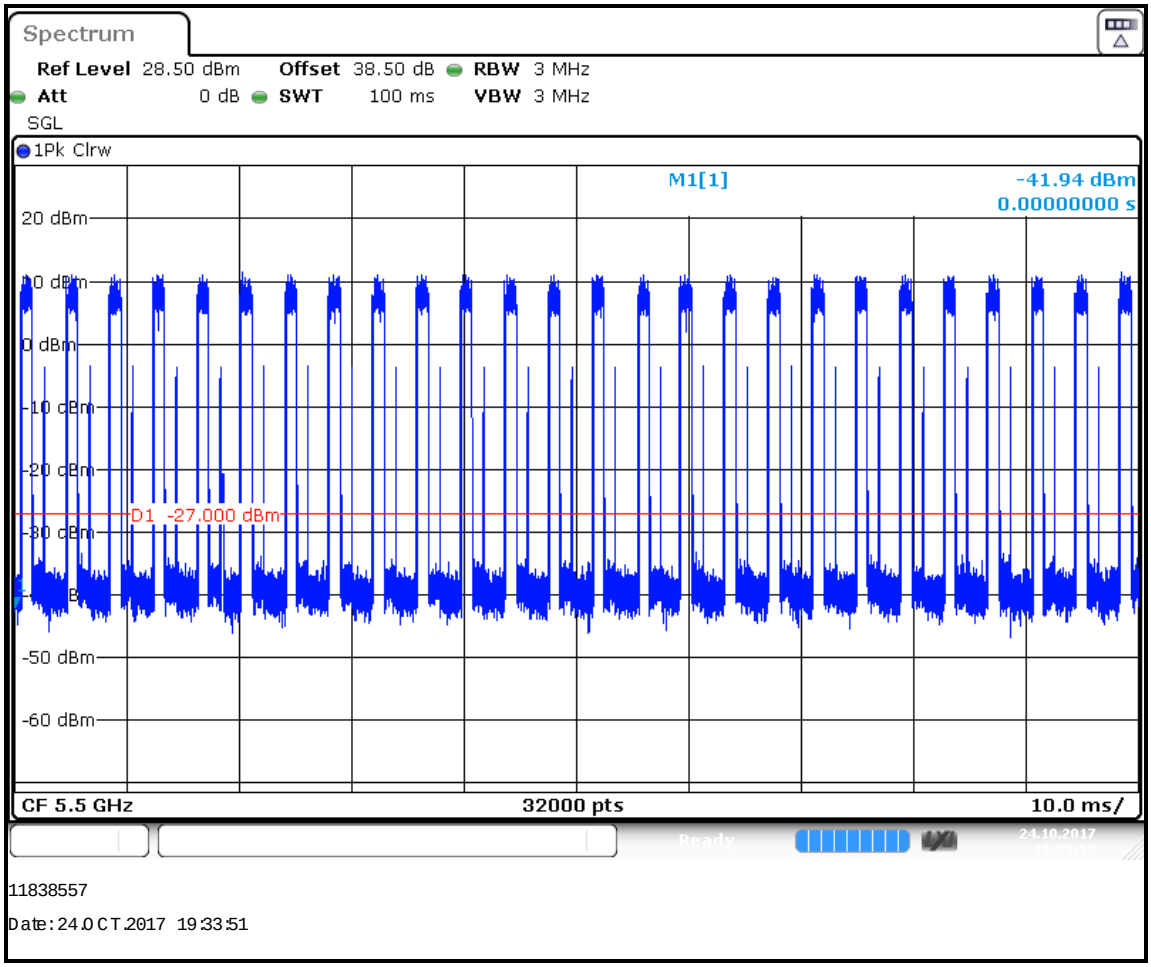
The duty cycle was calculated over 100 milliseconds. This was captured on a spectrum analyser in the time domain using a 0 Hz span and 32000 sweep points to ensure it included any longer term variations, whilst maintaining accurate to a 3.125 µs sample size.




The number of samples greater than -34 dBm was compared to the total number of samples to calculate the duty cycle. The EUT and test router were found to be transmitting above this threshold for 59.2 % of the total, and hence meeting the requirement of greater than 17 % channel loading.

## Appendix 4. Channel Loading (continued)

This channel loading was then repeated for the client-to-client testing.




The number of samples greater than -34 dBm was compared to the total number of samples to calculate the duty cycle. The EUT and test router were found to be transmitting above this threshold for 30.9 % of the total, and hence meeting the requirement of greater than 17 % channel loading.

# Appendix 5. Channel/Frequency plan

| Wi-Fi Supported Channels | | | |
|---|---|---|---|
| **Country** | **Channels** | | |
| | 20 MHz | 40 MHz | 80 MHz |
| United States<br>Canada | 1 - 13<br>36 - 48<br>52 – 64<br>100 – 144<br>149 - 165 | 38 – 46<br>54 – 62<br>102 – 142<br>151 - 159 | 42 – 58<br>106 -138<br>155 |

**Note(s):**

1. Channels 120 – 128: Only used if DFS Master allows
2. Channels 36 – 64: Set to Indoor use only for Canada
3. The following channels are set to Active/Passive in FCC domain:

**2.4 GHz Band**
Channels 1 – 11: Active
Channels 12 – 13: Passive

**5 GHz Band**
Channels 36 – 48: Active
Channels 52 – 144: Passive DFS
Channels 149 – 165: Active

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