# FCC Part 15 Subpart E §15.407

# DFS Test Report

| | |
|---|---|
| **Equipment Under Test** | **Car Infotainment** |
| **Model Name** | **DGU-8745-Y400SA** |
| **Variant Model Name** | **DGU-8745-Y400SA-1, DGU-8745-Q200SA, DGU-8745-Q200SA-1** |
| **FCC ID** | **2AE77DGU8745Y400SA** |
| **Applicant** | **DIGEN CO., LTD.** |
| **Manufacturer** | **DIGEN CO., LTD.** |
| **Date of Test(s)** | **2017. 01. 23 ~ 2017. 02. 09** |
| **Date of Issue** | **2017. 02. 15** |

In the configuration tested, the EUT complied with the standards specified above.

| Issue to | Issue by |
|---|---|
| **DIGEN**<br>89, Seongseo4chacheomdan-ro,<br>Dalseo-gu, Daegu, 704-801, Korea<br><br>Tel.: +82-70-4850-3322<br>Fax: +82-2-532-8811 | **MOVON CORPORATION**<br>498-2, Geumeo-ro, Pogok-eup,<br>Cheoin-gu, Yongin-si, Gyeonggi-do,<br>Korea, 449-812<br><br>Tel.: +82-31-338-8837<br>Fax: +82-31-338-8847 |

# Revision history

| Revision | Date of issue | Description | Revised by |
|---|---|---|---|
| -- | Feb 15, 2017 | Initial | -- |

# Table of contents

# 1. Attestation of test result

## 1.1. Details of applicant and manufacturer

| | | |
|---|---|---|
| Applicant | : | DIGEN CO., LTD. |
| Address | : | 89, Seongseo4chacheomdan-ro, Dalseo-gu, Daegu, 704-801, Korea |
| Contact Person | : | Jong-Sun Park |
| Telephone | : | +82-70-4850-3311 |
| Fax | : | +82-2-532-8811 |

## 1.2. Summary of test results

The EUT has been tested according to the following specifications;

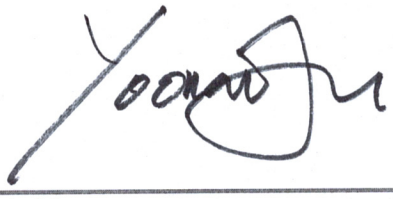
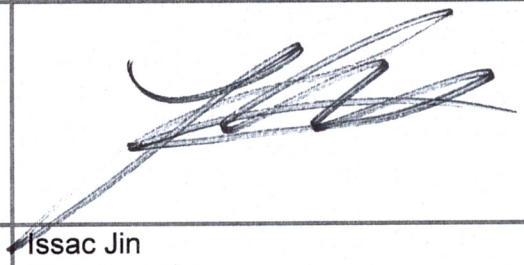
| Section in FCC part 15 | Description | Result |
|---|---|---|
| §15.407(h) | Dynamic Frequency Selection(DFS) (Channel Closing Transmission Time & Cannel Move Time) | C |

*The sample was tested according to the following specification:*
***FCC Public Notice KDB905462 D02 v02***
*TEST SITE REGISTRATION NUMBER:* ***FCC(KR0151)***

**※ Abbreviation**

C Complied
N/A Not applicable
F Fail

**Approval Signatories**

| Test and Report Completed by : | Report Approval by : |
|---|---|
|  |  |
| Nanju Yoo<br>Test Engineer<br>MOVON CORPORATION | Issac Jin<br>Technical Manager<br>MOVON CORPORATION |

## 2. EUT Description

| | |
|---|---|
| **Kind of product** | Car Infotainment |
| **Model Name** | DGU-8745-Y400SA |
| **Variant Model Name** | DGU-8745-Y400SA-1, DGU-8745-Q200SA, DGU-8745-Q200SA-1 |
| **FCC ID** | 2AE77DGU8745Y400SA |
| **Serial Number** | N/A |
| **Power supply** | DC 13.5V |
| **Frequency range** | UNII-1<br>5 180 ㎒ ~ 5 240 ㎒ (802.11a/n_HT20)<br>5 190 ㎒ ~ 5 230 ㎒ (802.11an_HT40)<br>5 210 ㎒ (802.11ac_VHT80)<br>UNII-2A<br>5 260 ㎒ ~ 5 320 ㎒ (802.11a/n _HT20)<br>5 270 ㎒ ~ 5 310 ㎒ (802.11an _HT40)<br>5 290 ㎒ (802.11ac_VHT80)<br>UNII-2C<br>5 500 ㎒ ~ 5 620 ㎒ (802.11a/n _HT20)<br>5 510 ㎒ ~ 5 590 ㎒ (802.11an _HT40)<br>5 530 ㎒ ~ 5 610 ㎒ (802.11ac_VHT80)<br>UNII-3<br>5 745 ㎒ ~ 5 805 ㎒ (802.11a/n _HT20)<br>5 755 ㎒ ~ 5 795 ㎒ (802.11an _HT40)<br>5 775 ㎒ (802.11ac_VHT80) |
| **Modulation technique** | OFDM |
| **Number of channels** | UNII-1<br>5 180 ㎒ ~ 5 240 ㎒ (4ch)<br>5 190 ㎒ ~ 5 230 ㎒ (2ch)<br>5 210 ㎒ (1ch)<br>UNII-2A<br>5 260 ㎒ ~ 5 320 ㎒ (4ch)<br>5 270 ㎒ ~ 5 310 ㎒ (2ch)<br>5 290 ㎒ (1ch)<br>UNII-2C<br>5 500 ㎒ ~ 5 620 ㎒ (7ch)<br>5 510 ㎒ ~ 5 590 ㎒ (3ch)<br>5 530 ㎒ ~ 5 610 ㎒ (2ch)<br>UNII-3<br>5 745 ㎒ ~ 5 805 ㎒ (4ch)<br>5 755 ㎒ ~ 5 795 ㎒ (2ch)<br>5 775 ㎒ (1ch) |
| **Antenna gain** | 0.00 ㏈i (Max.) |
| **Test Site Registration Number** | FCC(KR0151) |

### 2.1. Declarations by the manufacturer

None

## 2.2. Details of modification

None

## 2.3 Test Mode

| UNII-2A | | UNII-2C | |
|---|---|---|---|
| CH. | Frequency(㎒) | CH. | Frequency(㎒) |
| 52 | 5 260 | 100 | 5 500 |
| 60 | 5 300 | 112 | 5 560 |
| 64 | 5 320 | 124 | 5 620 |

**(802.11a/n_HT20)**

| UNII-2A | | UNII-2C | |
|---|---|---|---|
| CH. | Frequency(㎒) | CH. | Frequency(㎒) |
| 54 | 5 270 | 102 | 5 510 |
| 62 | 5 310 | 110 | 5 550 |
| | | 118 | 5 590 |

**(802.11an_HT40)**

| UNII-2A | | UNII-2C | |
|---|---|---|---|
| CH. | Frequency(㎒) | CH. | Frequency(㎒) |
| 58 | 5 290 | 106 | 5 530 |
| | | 122 | 5 610 |

**(802.11an_VHT80)**

## 2.4. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission.
The data rate shown in the table below is the worst-case rate with respect to the specific test item.
Investigation has been done on all the possible configurations for searching the worst cases.
The following table is a list of the test modes shown in this test report.

| Test Mode | Data rate (Worst case) |
|---|---|
| 802.11a | 6 Mbps |
| 802.11an_HT20<br>802.11an_HT40<br>802.11ac_VHT80 | MCS0 |

## *3.* Measurement Equipment

| Equipment | Manufacturer | Model | Serial number | Calibration Interval | Calibration due. |
|---|---|---|---|---|---|
| Test Receiver | R&S | ESVS30 | 829673/015 | 1 year | 2017-12-09 |
| Signal Generator | R&S | SMA100A | 102188 | 1 year | 2017-12-09 |
| Spectrum Analyzer | R&S | FSV-40 | 257379 | 1 year | 2017-06-28 |
| Vector Signal Generator | R&S | SMBV100A | GB41290645 | 1 year | 2017-06-28 |
| Power Divider | HP | 11636B | 06793 | 1 year | 2017-06-29 |
| Power Divider | HP | 11636B | 12481 | 1 year | 2017-06-29 |
| Power Divider | HP | 11636B | 50387 | 1 year | 2017-06-29 |
| Step Attenuator | Agilent | 8494B | US37181955 | 1 year | 2017-06-28 |
| Step Attenuator | Agilent | 8495D | 2817A00649 | 1 year | 2017-06-29 |
| Step Attenuator | Agilent | 8496B | US39212569 | 1 year | 2017-06-28 |
| Fixed Attenuator | Weinschel | 74-30-11 | 798 | 1 year | 2017-06-29 |
| Power Amplifier | MITEQ | AM-1431 | 1497315 | 1 year | 2017-06-28 |
| Power Amplifier | MITEQ | AFS43-01002600 | 1374382 | 1 year | 2017-11-03 |
| High Pass Filter | Wainwright | WHK3.0/18G-10SS | 508 | 1 year | 2017-06-29 |
| Controller | INNCO | CO2000 | co200/064/6961003/L | N/A | N/A |
| Antenna Master | INNCO | MA4000 | MA4000/038/6961003/L | N/A | N/A |
| Loop Antenna | ETS LINDGREN | 6502 | 00118166 | 2 year | 2018-02-23 |
| TWO LINE-V-NETWORK | R&S | ESH3-Z5 | 100296 | 1 year | 2017-12-09 |
| Power Amplifier | MITEQ | AFS43-01002600 | 1374382 | 1 year | 2017-11-03 |

**※Remark;**
**Support equipment**

| Description | Manufacturer | Model | Serial number |
|---|---|---|---|
| Notebook computer | DELL | Lattitude D510 | - |
| Network Access Point | NETGEAR | WNDAP360 | 2EJ3235P002F1 |

# 4. DFS(Dynamic Frequency Selection) test description

## 4.1. Applicability

The following table from KDB 905462 D02 v02 lists the applicable requirements for the DFS testing. The device evaluated in this report is considered a client device without radar detection capability

| Requirement | Operational Mode | | |
|---|---|---|---|
| | Master | Client Without Radar Detection | Client With Radar Detection |
| *Non-Occupancy Period* | Yes | Not required | Yes |
| *DFS Detection Threshold* | Yes | Not required | Yes |
| *Channel Availability Check Time* | Yes | Not required | Not required |
| *U-NII Detection Bandwidth* | Yes | Not required | Yes |

Table 1. DFS Applicability

| Requirement | Operational Mode | |
|---|---|---|
| | Master Device or Client with Radar Detection | Client Without Radar Detection |
| *DFS Detection Threshold* | Yes | Not required |
| *Channel Closing Transmission Time* | Yes | Yes |
| *Channel Move Time* | Yes | Yes |
| *U-NII Detection Bandwidth* | Yes | Not required |

| Additional requirements for devices with multiple bandwidth modes | Master Device or Client with Radar Detection | Client Without Radar Detection |
|---|---|---|
| *U-NII Detection Bandwidth and Statistical Performance Check* | All BW modes must be tested | Not required |
| *Channel Move Time and Channel Closing Transmission Time* | Test using widest BW mode available | Test using the widest BW mode available for the link |
| *All other tests* | Any single BW mode | Not required |
| **Note:** Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency. | | |

Table1.1 DFS During normal operation

## 4.2. Requirements

KDB 905462 D02 v02 the following are the requirements for Client Devices:

a) A Client Device will not transmit before having received appropriate control signals from a Master Device.

b) A Client Device will stop all its transmissions whenever instructed by a Master Device to which it is associated and will meet the Channel Move Time and Channel Closing Transmission Time requirements. The Client Device will not resume any transmissions until it has again received control signals from a Master Device.

c) If a Client Device is performing In-Service Monitoring and detects a Radar Waveform above the DFS Detection Threshold, it will inform the Master Device. This is equivalent to the Master Device detecting the Radar Waveform and d) through f) of section 5.1.1 apply.

d) Irrespective of Client Device or Master Device detection the Channel Move Time and Channel Closing Transmission Time requirements remain the same.

e) The client test frequency must be monitored to ensure no transmission of any type has occurred for 30 minutes.
Note: If the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shutdown (rather than moving channels), no beacons should appear

| Parameter | Value |
|---|---|
| Non-occupancy period | Minimum 30 minutes |
| Channel Availability Check Time | 60 seconds |
| Channel Move Time | 10 seconds<br>See Note 1. |
| Channel Closing Transmission Time | 200 milliseconds + an<br>Aggregate of 60 milliseconds over remaining 10 second period.<br>See Notes 1 and 2. |
| U-NII Detection Bandwidth | Minimum 100% of the U-NII 99% transmission power bandwidth. See Note3. |
| **Note 1:** Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.<br>**Note 2:** The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (and 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.<br>**Note 3:** During the U-NII Detection Bandwidth detection test, radar type 0 should the used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic. | |

Table.1.2 DFS Response Requirement Values

### 4.3 Parameters of DFS Test Signals

As the EUT is a Client Device with no Radar Detection only Zero type radar pulse is required for the testing. Radar Pulse type 0 was used in the evaluation of the Client device for the purpose of measuring the channel Move Time and the Channel Closing Transmission Time.

| Radar Type | Pulse Width (μsec) | PRI (μsec) | Number of Pulses | Minimum Percentage of Successful Detection | Mnimum Number of Trials |
|---|---|---|---|---|---|
| 0 | 1 | 1428 | 18 | See Note 1 | See Note 1 |
| 1 | 1 | Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a | Roundup: {(1/360)*(19*10$^6$ PRI μsec)} | 60% | 30 |
| | | Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A | | | |
| 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 |
| **Note 1:** Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests. | | | | | |

Table1.3 Short Pulse Radar Test Waveforms

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

Table1.4 Long Pulse Radar Test Waveforms

| Radar Type | Pulse Width (μsec) | PRI (μsec) | Pulses Per Hop | Hopping Rate (kHz) | Hopping Sequence Length (msec) | Minimum Percentage of Successful Detection | Minimum Trials |
|---|---|---|---|---|---|---|---|
| 6 | 1 | 333 | 9 | 0.333 | 300 | 70% | 30 |

Table1.5 Frequency Hopping Radar Test Waveforms

## 4.4 Test Setup

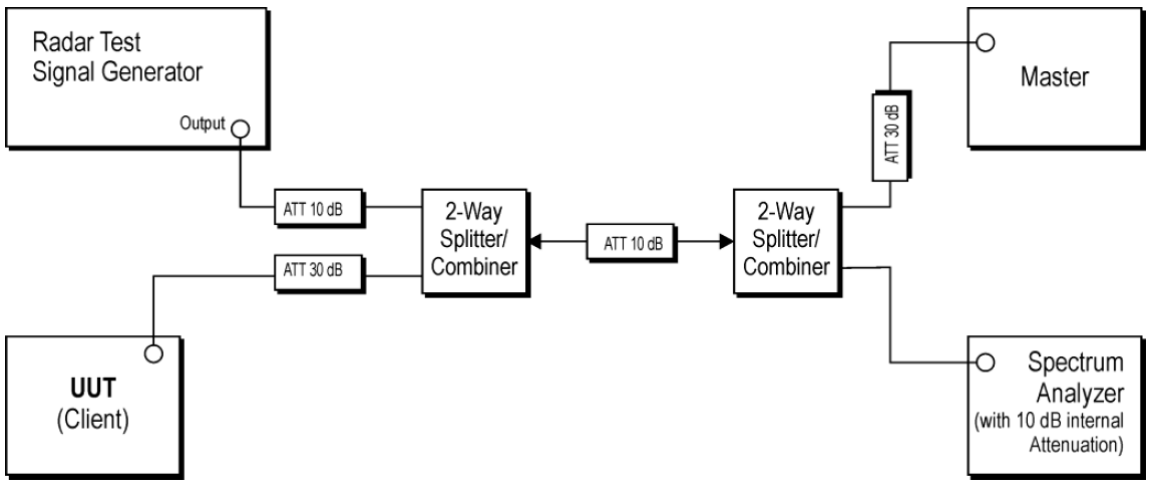



Figure 1: Conducted Test Setup for DFS

**Test procedure**

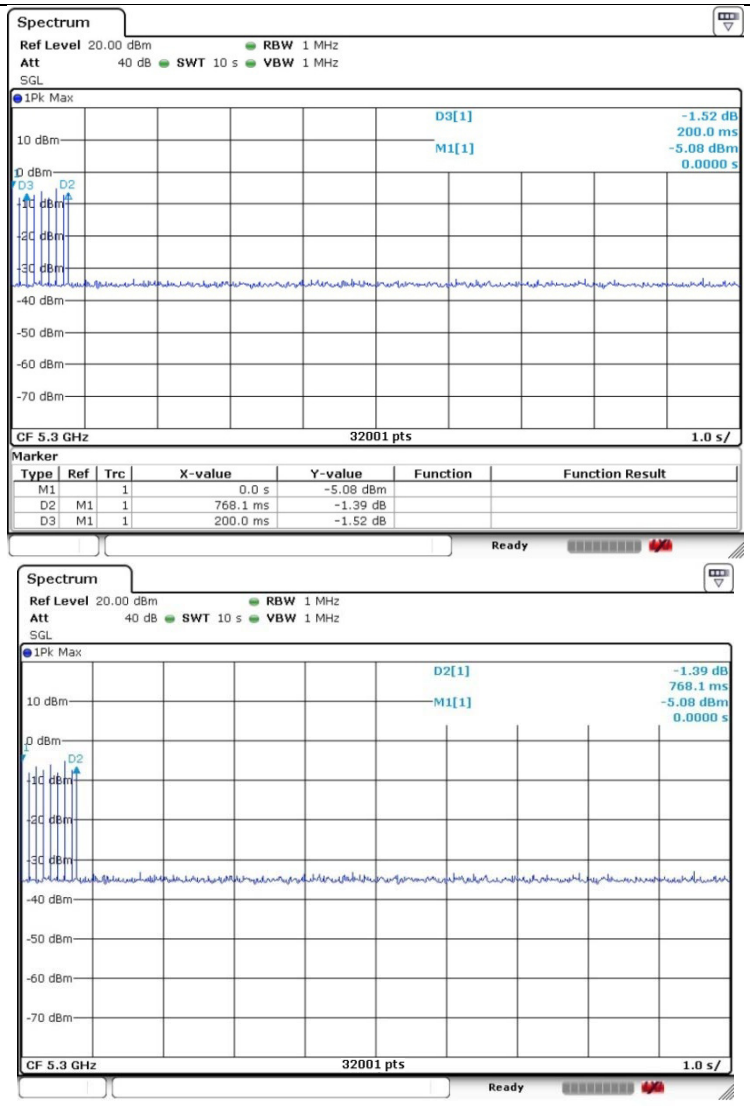
KDB 905462 D02 v02 describes a radiated test setup and a conducted test setup. The conducted test setup was used for this testing. Figure 1 shows the typical test setup.

1. One frequency will be chosen from the Operating Channels of the UUT within the 5250 ~5350 ㎒ or 5470 ~5725 ㎒ bands.
2. The Client Device (EUT) is setup per the diagram in Firure1 and communications between the Master device and the Client is established.
3. An MPEG or data file that is typical for the device is streamed from the Master to the Client to properly load the network.

## 4.5. Test result

Ambient temperature: 20℃
Relative humidity: 45% R.H.

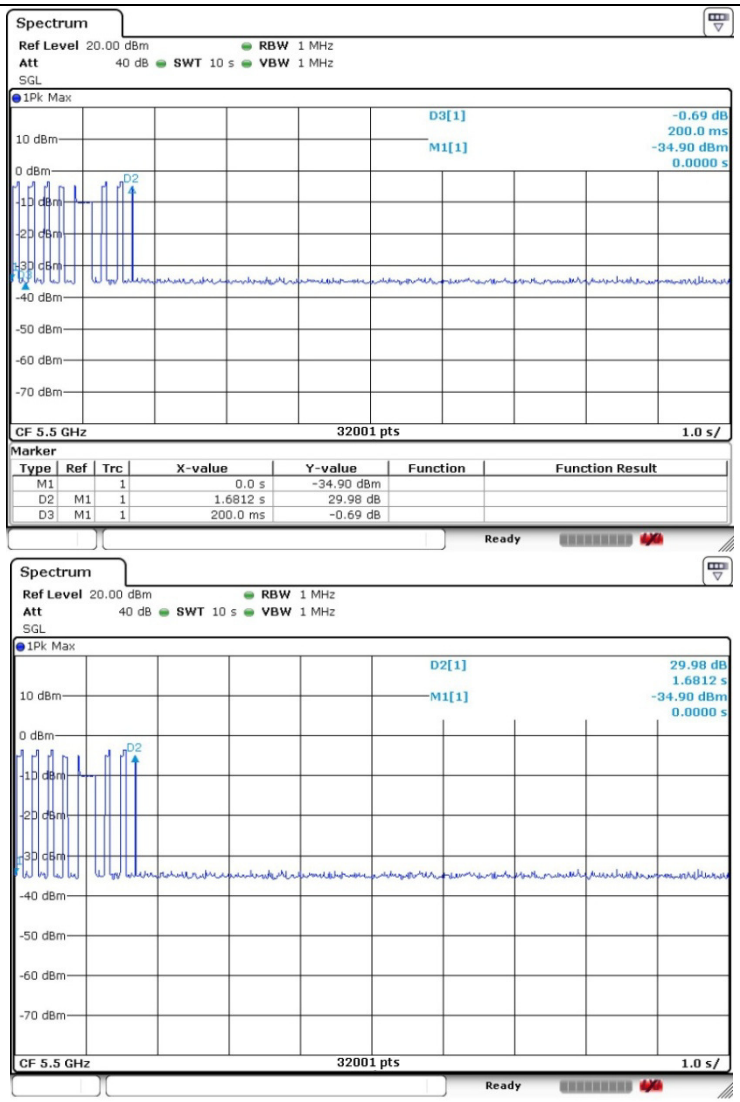
**Mode: 802.11a (UNII-2A) / *Client without Radar Detection***
**operating frequency: 5 300 ㎒**
**Channel closing transmission time / Channel move time**




| Parameter | Test Result |
|---|---|
| Channel closing transmission time(C) | 0.001 560 s |
| Channel move time | 0.768 s |

**Mode: 802.11a (UNII-2C) / *Client without Radar Detection***
**operating frequency: 5 500 ㎒**

**Channel closing transmission time / Channel move time**




| Parameter | Test Result |
|---|---|
| Channel closing transmission time(C) | 0.001 87 s |
| Channel move time | 1.681 2 s |

Note.
Dwell = S / B
where **Dwell** is the dwell time per spectrum analyzer sampling bin, **S** is the sweep time and **B** is the number of spectrum analyzer sampling bins.
An upper bound of the aggregate duration of the *Channel Closing Transmission Time* is calculated by:
C = N * Dwell
where **C** is the Closing Time, **N** is the number of spectrum analyzer sampling bins showing a U-NII transmission and **Dwell** is the dwell time per bin.