FCC Part 15 Subpart E §15.407

DFS Test Report

Equipment Under Test	**Car Infotainment**
Model Name	**DGU-7T45-A170SA**
Variant Model Name	**DGU-7T45-A170SA-1**
FCC ID	**2AE77DGU7T45A170SA**
Applicant	**DIGEN**
Manufacturer	**Car Infotainment**
Date of Test(s)	**2017. 11. 28**
Date of Issue	**2017. 12. 11**

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

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

Revision history

Revision	Date of issue	Description	Revised by
--	Dec 11, 2017	Initial	--

Table of contents

1. Attestation of test result

1.1.   Details of applicant and manufacturer

Applicant	:	DIGEN
Address	:	89, Seongseo4chacheomdan-ro, Dalseo-gu, Daegu, 704-801, Korea
Contact Person	:	Jun Kim
Telephone	:	+82-70-4850-3311
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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:
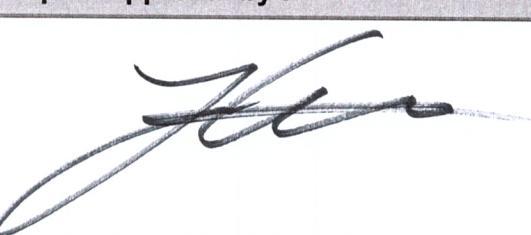
FCC Public Notice KDB905462 D02 v02

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 :
Kin Son Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	Car Infotainment
Model Name	DGU-7T45-A170SA
Variant Model Name	DGU-7T45-A170SA-1
FCC ID	2AE77DGU7T45A170SA
Serial Number	N/A
Power supply	DC 13.5V
Frequency range	UNII-1 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n_HT20) 5 190 ㎒ ~ 5 230 ㎒ (802.11an_HT40) 5 210 ㎒ (802.11ac_VHT80) UNII-2A 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n _HT20) 5 270 ㎒ ~ 5 310 ㎒ (802.11an _HT40) 5 290 ㎒ (802.11ac_VHT80) UNII-2C 5 500 ㎒ ~ 5 620 ㎒ (802.11a/n _HT20) 5 510 ㎒ ~ 5 590 ㎒ (802.11an _HT40) 5 530 ㎒ ~ 5 610 ㎒ (802.11ac_VHT80) UNII-3 5 745 ㎒ ~ 5 805 ㎒ (802.11a/n _HT20) 5 755 ㎒ ~ 5 795 ㎒ (802.11an _HT40) 5 775 ㎒ (802.11ac_VHT80)
Modulation technique	OFDM
Number of channels	UNII-1 5 180 ㎒ ~ 5 240 ㎒ (4ch) 5 190 ㎒ ~ 5 230 ㎒ (2ch) 5 210 ㎒ (1ch) UNII-2A 5 260 ㎒ ~ 5 320 ㎒ (4ch) 5 270 ㎒ ~ 5 310 ㎒ (2ch) 5 290 ㎒ (1ch) UNII-2C 5 500 ㎒ ~ 5 620 ㎒ (7ch) 5 510 ㎒ ~ 5 590 ㎒ (3ch) 5 530 ㎒ ~ 5 610 ㎒ (2ch) UNII-3 5 745 ㎒ ~ 5 805 ㎒ (4ch) 5 755 ㎒ ~ 5 795 ㎒ (2ch) 5 775 ㎒ (1ch)
Antenna gain	3.36 ㏈ 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 802.11an_HT40 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	100832	1 year	2018-05-30
Power Meter	Agilent	E4416A	GB41290645	1 year	2018-05-30
Power Sensor	Agilent	9327A	US40441490	1 year	2018-05-30
Horn Antenna	R&S	HF906	100236	2 year	2019-04-25
Double-ridged horn antenna	ETS LINDGREN	3115	00066157	2 year	2017-12-24
Horn Antenna	AH Systems	SAS-572	269	2 year	2019-08-01
TRILOG Supper Broadband test Antenna	SCHWARZBECK	SAS-521-7	9161-4159	2 year	2018-06-14
Power Amplifier	MITEQ	AM-1431	1497315	1 year	2018-05-30
Power Amplifier	MITEQ	AFS43-01002600	1374382	1 year	2018-11-03
Band Rejection Filter	Micro-Tonics	BRM50702	064	1 year	2018-05-30
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	TESTEK	TK-PA6S	140009	1 year	2017-12-08
Low Noise Amplifier	TESTEK	TK-PA18H	170013-L	1 year	2018-06-02
Test Receiver	R&S	ESVS30	829673/015	1 year	2017-12-09

※ **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 See Note 1.
Channel Closing Transmission Time	200 milliseconds + an Aggregate of 60 milliseconds over remaining 10 second period. 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. **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. **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: $\{(1/360)*(19*10^6 \text{ PRI}_{µsec})\}$	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
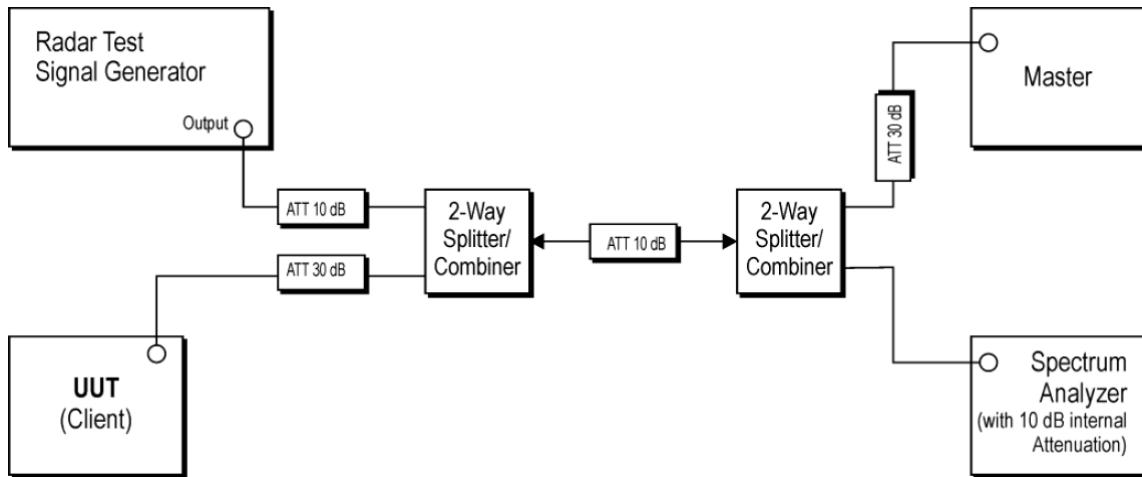
Figure 1: Conducted Test Setup for DFS

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 ㎒

<p align="center">Channel closing transmission time / Channel move time</p>
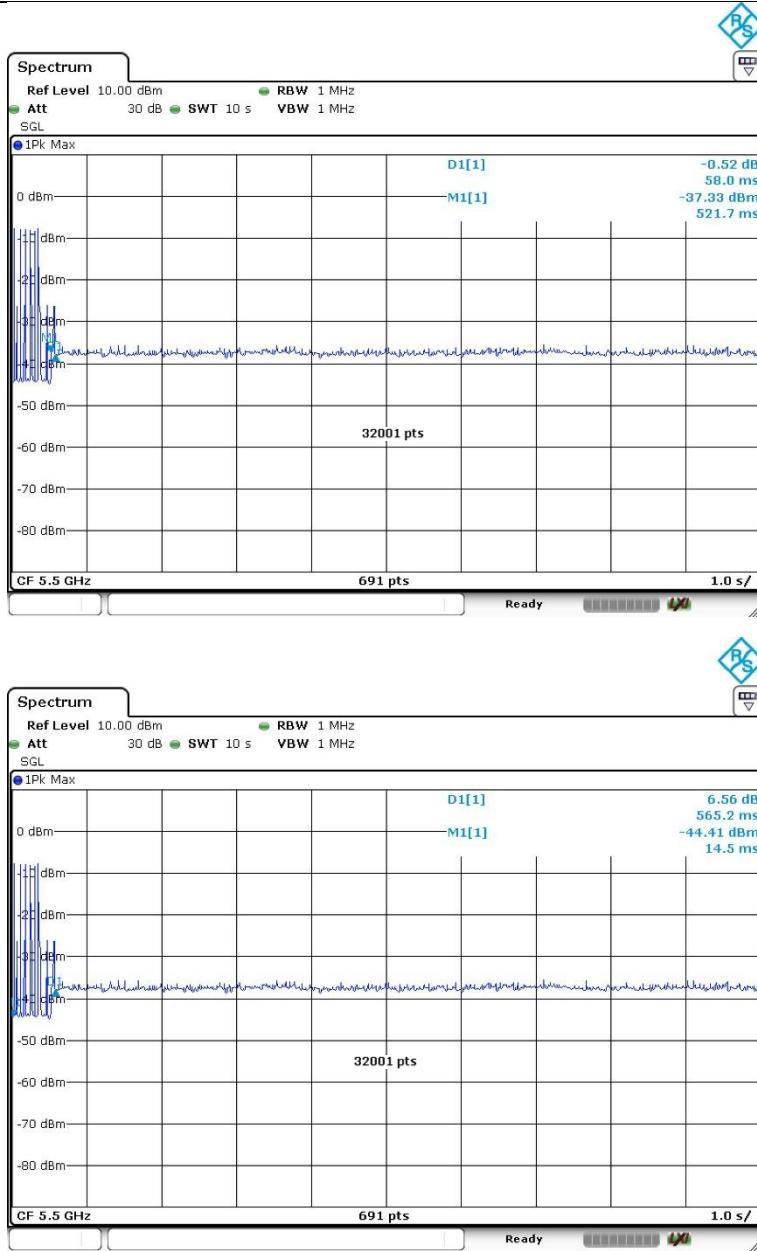
Parameter	Test Result
Channel closing transmission time(C)	0.058 s
Channel move time	0.565 s

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.