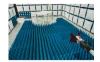


PCTEST ENGINEERING LABORATORY, INC.

7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. 410.290.6652 / Fax 410.290.6654 http://www.pctest.com



MEASUREMENT REPORT FCC PART 15.407 / ISED RSS-247 DFS

Applicant Name:

LG Electronics USA, Inc. 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States

Date of Testing: 7/8 - 8/2/2019 **Test Site/Location:** PCTEST Lab. Columbia, MD, USA **Test Report Serial No.:** 1M1907080114-08-R1.ZNF

FCC ID:

ZNFQ720AM

APPLICANT:

LG Electronics USA, Inc.

Application Type: Model: Additional Model(s): EUT Type: Max. RF Output Power:

Frequency Range: FCC Classification: FCC Rule Part(s): **Test Procedure(s):**

Certification LM-Q720AM LMQ720AM, Q720AM Client Only Device, No Radar Detection Capability 80.353 mW (19.05 dBm) Conducted Power (802.11a UNII Band 2C) 5500 - 5700 MHz (UNII-2C Band) Unlicensed National Information Infrastructure (UNII) Part 15.407(UNII) KDB 905462 D02 v02

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 905462 D02 v02 Compliance Measurement Procedures for Unlicensed-National Information Infrastructure Devices Operating in the 5.25 - 5.35 GHz and 5.47 - 5.725 GHz Bands Incorporating Dynamic Frequency Selection. Test results reported herein relate only to the item(s) tested.

Note: This revised Test Report (S/N: 1M1907080114-08-R1.ZNF) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.





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1.0 INTRODUCTION

1.1 Scope

This report has been prepared to demonstrate compliance with the requirements for Dynamic Frequency Selection (DFS) as stated in KDB 905462 D02 v02. Testing was performed on the LG Portable Handset FCC ID: ZNFQ720AM. As of July 20, 2007 all devices operating in the 5250 - 5350 MHz and/or the 5470 - 5725 MHz bands must comply with the DFS requirements. As the EUT does not have radar detection capability it was evaluated as a Client Only Device. All test results reported herein are applicable to the sample selected for testing. The unit used for testing was supplied by LG Electronics USA, Inc..

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 **Equipment Description**

The Equipment Under Test (EUT) is the LG Portable Handset FCC ID: ZNFQ720AM.

Mode of Operation:

Master Device	
Client Device (No radar detection)	\boxtimes
Client Device with Radar Detection	

Test Device Serial No.: 06779

2.2 **EUT Capabilities**

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC

Band 2A

Band 2C

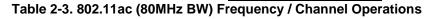
Ch.	Frequency (MHz)		Ch.	Frequency (MHz)		
52	5260		100	5500		
:	:		•	:		
56	5280		120	5600		
:	:		:	:		
64	5320		140	5700		
44-10	00 44- 1000 44			F		

Table 2-1. 802.11a / 802.11n / 802.11ac (20MHz) Frequency / Channel Operations

	Band 2A		Band 2C
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
54	5270	102	5510
:	:	:	:
62	5310	118	5590
			:
		134	5670

Table 2-2. 802.11n / 802.11ac (40MHz BW) Frequency / Channel Operations

	Band 2A		Band 2C
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
58	5290	106	5530
		:	:
		122	5610



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2.3 **Modifications**

No modifications to the EUT were required in order to comply with the DFS specifications.

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3.0 TEST EQUIPMENT

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2006.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Aeroflex	PXI 82531	PXI RF Synthesizer	2/18/2019	Biennial	2/18/2021	1082329
Agilent	N9038A	MXE EMI Receiver	7/17/2019	Annual	7/17/2020	MY51210133

Table 3-1. Annual Test Equipment Calibration Schedule

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

3.1 Additional Equipment

The following equipment was used in support of the DFS testing.

Device	Manufacturer	Model/Description	Model/Description Description	
Montor	Somoling	WEA453e	Access Point	2XLU060011P
Master Samsung	WEC8050	Controller	2XGV250016L	

Table 3-2. Support Equipment

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4.0 DESCRIPTION OF DYNAMIC FREQUENCY SELECTION TEST

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.

	Operational Mode			
Requirement	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 4-1. DFS Applicability

Requirement	Operational Mode			
	Master Without Radar Detection		Client With Radar Detection	
DFS Detection Threshold	Yes	Not required	Yes	
Channel Closing Transmission Time	Yes	Yes	Yes	
Channel Move Time	Yes	Yes	Yes	
U-NII Detection Bandwidth	Yes	Not required	Yes	

Table 4-2. DFS Applicability During Normal Operation

	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.

Table 4-3. Additional Requirement for Devices with Multiple Bandwidth Modes

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4.2 Requirements

Per 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 nonoccupancy period test. For devices that shutdown (rather than moving channels), no beacons should appear.

Channel Move Time and Channel Closing Transmission Time requirements are listed in the following table.

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 Note 3.
Note 1: Channel Move Time and the Channel Closing	Transmission Time should be performed with Radar

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.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

Table 4-4: DFS Response Requirements

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4.3 DFS Detection Threshold Values

The DFS detection thresholds are defined for Master devices and Client Devices with In-service monitoring. These detection thresholds are listed in the following table.

Maximum Transmit Power	Value (See Notes 1 and 2)
≥ 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.

Table 4-5: Detection Thresholds for Master Devices and Client Devices with Radar Detection

4.1 **DFS** Response Requirements

DFS response requirements for Master and Client Devices are listed in the following table.

Parameter	Value		
Non-occupancy period	Minimum 30 minutes		
Channel Availability Check Time	60 seconds		
Channel Move Time	10 seconds See Note1		
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Note 1 and 2.		
U-NII Detection Bandwidth	Minimum 100% of the U- NII 99% transmission powe bandwidth. See Note 3.		

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.

frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

Table 4-6: DFS Response Requirements

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4.2 Parameters of DFS Test Signals

As the EUT is a Client Device with no Radar Detection only one type radar pulse is required for the testing. Radar Pulse type 1 was used in the evaluation of the Client device for the purpose of measuring the Channel Move Time and the Channel Closing Transmission Time. Table 4-7 lists the parameters for the Short Pulse Radar Waveforms. A plot of the Radar Pulse Type 1 used for testing is included in Section Error! Reference source not found. of this report.

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1425	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 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	$Roundup\left\{\left(\frac{1}{360}\right) \\ \cdot \left(\frac{19 \cdot 10^{6}}{PRI_{\mu sec}}\right)\right\}$	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 (Ra	adar 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.

Table 4-7: Parameters for Short Pulse Radar Waveforms

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

Table 4-8. Parameters for Long Pulse Radar Waveforms

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

Table 4-9. Parameters for Frequency Hopping Radar Waveforms

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Procedure 4.3

DFS Test Setup:

Radiated DFS Test Setup	
Conducted DFS Test Setup	\boxtimes

KDB 905462 D02 v02 describes a radiated test setup and a conducted test setup. The conducted test setup was used for this testing. Figure 4-1 shows the typical test setup. In Band 2C, one channel selected between 5500 and 5700 MHz was chosen for testing.

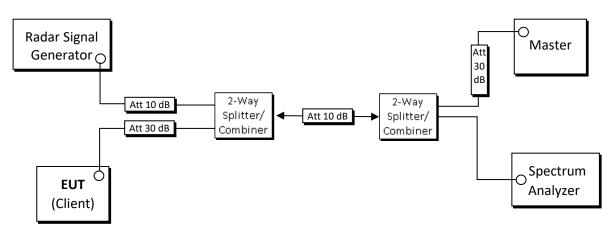


Figure 4-1. Conducted Test Setup for DFS

- 1. The "Aeroflex PXI DFS Radar Simulator and Analyzer Test Suite" is setup to provide a simulated radar pulse at the frequency that the Master and Client are operating. A Type 0 radar pulse was used.
- 2. The Client Device (EUT) is set up per the diagram in Figure 4-1 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. The "Aeroflex PXI DFS Radar Simulator and Analyzer Test Suite" is set to record and display 12 seconds of time, starting from where the simulated radar is generated. This time domain plot captures any transmissions occurring up to and after 10sec. Aggregate time is computed to ensure compliance. (Note: the channel may be different since the Master and Client have changed channels due to the detection of the initial radar pulse.)
- 5. After the initial radar burst the channel is monitored for 10 minutes to ensure no transmissions or beacons occur. A second monitoring setup is used to verify that the Master and Client have both moved to different channels.

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EUT TEST SETUP 5.0

Client is connected to Master (AP) via WLAN network and plays a video test file "6 1/2 Magic Hours" in a Server (Laptop). This Server is connected to the Master (AP) via ethernet cable. The Vivaldi antenna is adjusted so that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold.

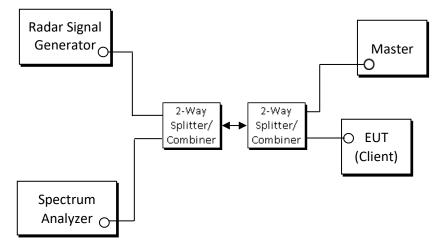


Figure 5-1. Test Setup

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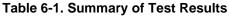
TEST RESULTS 6.0

6.1 Summary

LG Electronics USA, Inc.

Company Name: FCC ID: ZNFQ720AM FCC Classification: Unlicensed National Information Infrastructure (UNII)

	Parameter	Measured	Limit	Result
5725 MHz 2C Band	Channel Move Time	0.24 s	10 seconds	Pass
	Channel Closing Transmission Time	< 200ms + 0.01 ms (aggregate)	200ms + aggregate of 60ms over remaining 10 second period	Pass
5470 UNII	Client beacon test	Monitored for 30 minutes with no client transmission	No client transmission occurred	Pass



Notes:

- 1) The EUT was found to be compliant with the requirements for DFS as required for a Client Device per Part 15.407(h), RSS-247 and KDB 905462 D02 v02.
- 2) Automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The list is given below,
 - DFS Radar Simulator and Analyzer v2.8 (Aeroflex Inc.) •
 - iPerf Software

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6.2 Channel Loading

Channel Loading Notes:

Per KDB 905462 D02 v02, timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, you can zero span the spectrum analyzer and approximate the transmission time.

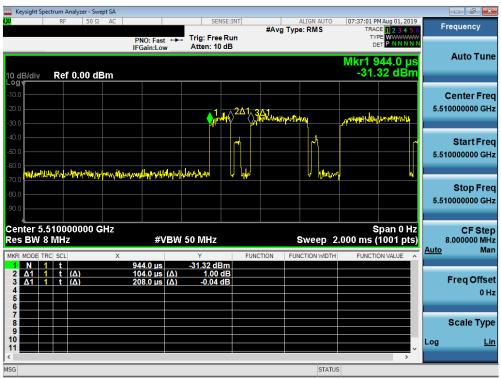


Figure 6-1. Band 2C Pulse Width and Period

Channel Loading = Pulse Width / Period = 104 µs / 208 µs = 50%

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6.3 Channel Move/ Closing Transmission Time

Move Time and Aggregate Time Notes:

- 1. Trigger Threshold was configured to only capture client pulses. The pulses shown in the plots below have been determined to be from the Master AP.
- 2. Marker Info and Aggregate time results are shown on the right side of the plots below.



Figure 6-2. Band 2C Move Time and Aggregate Time

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6.4 Non-Occupancy Period

Notes:

No frequency transmission detected during the Non-Occupancy Period of 30 minutes monitoring.

PNO: Fast Trig: Free Run Trace II 2 3 4 50 000 fm Frequency Auto Tur Auto Tur Auto Tur Auto Tur dB/div Ref 0.00 dBm -0.25 dB Center Fr 00 -0.25 dB -0.25 dB Start Fr 00 -0.25 dB -0.25 dB Start Fr 00 -0.25 dB -0.25 dB -0.25 dB Start Fr 00 -0.25 dB -0.25 dB -0.25 dB Start Fr 00 -0.25 dB -0.25 dB -0.25 dB Start Fr 00 -0.25 dB -0.25 dB -0.25 dB Start Fr 00 -0.25 dB -0.25 dB -0.25 dB Start Fr 00 -0.25 dB -0.25 dB -0.25 dB -0.25 dB 00 -0.25 dB -0.25 dB -0.25 dB -0.25 dB 00 -0.25 dB -0.25 dB -0.25 dB -0.25 dB 00 -0.25 dB -0.25 dB -0.25 dB -0.25 dB 00 -0.25 dB -0.25 dB -0.25 dB -0.25 dB 00 -0.25 dB -0.25 dB -0.25 dB -0.25	Keysight Spe	ectrum Analyzer - Swept SA					
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Center Fr 5.51000000 G Center Fr 5.510000000 G Center Fr 5.51000000 G Center Fr 5.510000000 G Center Fr 5.51000000 G Center Fr 5.5100000 G Center Fr 5.5100000 G Center Fr 5.5100000 G Center Fr 5.5100000 G Center Fr 5.5100000 G Center Fr 5.5100000 G Center Fr 5.510000 G Center Fr 5.510000 G Center Fr 5.510000 G Center Fr 5.510000 G Center Fr 5.510000 G Center Fr 5.5100 Center Fr 5.5100 Center Fr 5.5100 Center Fr 5.5100 Center Fr 5.510 Center Fr 5.5100 Center Fr 5.510) dB/div	Ref 0.00 dBm	IFGain:Low	Atten: 10 dB		ΔMkr1 1.800 ks	Auto Tur
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1.000000 M 1.0000000 M 1.00000000 M 1.0000000 M 1.000000 M 1.000000 M 1.0000 M 1.0000 M	0.0 						Stop Fre 5.510000000 G
Enter 5.510000000 GHz Span 0 Hz		مى بىرىكى مەركىيى دىرىما يەركىيى بەركىيى تەركىيى تەركىيى تەركىيى تەركىيى تەركىيى تەركىيى تەركىيى تەركىيى تەركى	ngelezione fignet la secte fignere de	nine and a single material and		102 ympawei wrain, rwd weilwern yw i	CF Ste 1.000000 Mi <u>Auto</u> Ma
enter 5.510000000 GHz Span 0 Hz	0.0						Freq Offs 0 I
es BW 1.0 MHz Sweep 1.900 ks (1001 pts)	enter 5.5	510000000 G <u>Hz</u>				Span <u>0 Hz</u>	Scale Tyj Log <u>L</u>
			VBW 1	.0 MHz	Sweep	1.900 ks (1001 pts)	

Figure 6-3. Band 2C Client Beacon Test – Monitoring live spectrum – Elapse time 30 minutes

FCC ID: ZNFQ720AM		MEASUREMENT REPORT (CERTIFICATION)	🕑 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		
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7.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the LG Portable Handset FCC ID: ZNFQ720AM is in compliance with the DFS requirements for a Client Device without radar detection in accordance with Part 15.407 of the FCC Rules.

FCC ID: ZNFQ720AM		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:	Dogo 17 of 17		
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