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MEASUREMENT REPORT **FCC PART 15.407 DFS**

Applicant Name:

LG Electronics MobileComm U.S.A 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States

Date of Testing: 3/22-5/17/2018 **Test Site/Location:** PCTEST Lab. Columbia, MD, USA **Test Report Serial No.:** 1M1804240083-11-R1.ZNF

FCC ID:

ZNFQ710AL

APPLICANT:

LG Electronics MobileComm U.S.A

Application Type:	Certification
Model:	LG-Q710AL
Additional Model(s):	LGQ710AL, Q710AL, LG-Q710PL, LGQ710PL, Q710PL
EUT Type:	Client Only Device, No Radar Detection Capability
Max. RF Output Power:	72.946 mW (18.63 dBm) Conducted
	(802.11a UNII Band 2A)
	72.611 mW (18.61 dBm) Conducted
	(802.11n UNII Band 2C)
Frequency Range:	5260 – 5320 MHz (UNII-2A Band)
	5500 – 5720 MHz (UNII-2C Band)
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15.407(UNII)
Test Procedure(s):	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.

This revised Test Report (S/N: 1M1804240083-11-R1.ZNF) supersedes and replaces the previously issued test report (S/N: 1M1804240083-11.ZNF) 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.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



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1.0 INTRODUCTION

Scope 1.1

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: ZNFQ710AL. 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 MobileComm U.S.A.

1.2 Evaluation Procedure

Conducted test methodology was used for the DFS evaluation procedure of the EUT. No deviations to the test procedure and test methods occurred during the evaluation of the EUT.

1.3 Summary of Test Results

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. The following table lists the measured parameters. The actual data and plots can be found in Section 5 and 6 of this report.

	Parameter	Measured	Limit	Result
MHz and	Channel Move Time	1.70s	10 seconds	Pass
– 5320 MH ₃ – 2A Band	Channel Closing Transmission Time	< 200ms + 5.00ms (aggregate)	200ms + aggregate of 60ms over remaining 10 second period	Pass
5260 UNII	Client beacon test	Monitored for 10 minutes with no client transmission	No client transmission occurred	Pass
MHz and	Channel Move Time	5.94s	10 seconds	Pass
– 5725 MH: – 2C Band	Channel Closing Transmission Time	< 200ms + 8.23ms (aggregate)	200ms + aggregate of 60ms over remaining 10 second period	Pass
5470 UNII	Client beacon test	Monitored for 10 minutes with no client transmission	No client transmission occurred	Pass

Table 1-1. DFS Test Results Summary

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the LG Portable Handset FCC ID: ZNFQ710AL.

Mode of Operation:

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

Parameters of EUT:	
Frequency	5260 – 5320 MHz 5500 – 5720 MHz
Output Power:	72.946 mW (18.63 dBm) Conducted (802.11a UNII Band 2A) 72.611 mW (18.61 dBm) Conducted (802.11n UNII Band 2C)
Modulation:	OFDM
Channel Bandwidth:	20, 40, 80 MHz

Table 2-1. Parameters of EUT

Test Device Serial No.: 01046

2.2 EUT Capabilities

This device contains the following capabilities:

850/1900 CDMA (BC0, BC1, BC10), 850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE)

2.3 Modifications

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

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3.0 DESCRIPTION OF DYNAMIC FREQUENCY SELECTION TEST

3.1 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	
Uniform Spreading	Yes	Not required	Not required	
U-NII Detection Bandwidth	Yes	Not required	Yes	

Table 3-1. DFS Applicability

Requirement	Operational Mode		
	Master	Client 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
Client Beacon Test	N/A	Yes	Yes

Table 3-2. DFS Applicability During Normal Operation

3.2 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.

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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.

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 Channel Closing Transmission Time	10 seconds See Note 1. 200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 80% of the U- NII 99% transmission power bandwidth. See Note 3.

Note 1: 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 second period defining the Radar Waveform.

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 1 is used and for each**

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

Table 3-3: DFS Response Requirements

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3.3 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 O. Throughout these test presedures on additional 4 dD has been	u a dala da da a suculturala af			

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 3-4: Detection Thresholds for Master Devices and Client Devices with Radar Detection

3.4 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 3-5 lists the parameters for the Short Pulse Radar Waveforms. A plot of the Radar Pulse Type 1 used for testing is included in Section 5.0 of this report.

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of 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 (Ra	adar Types 1-4)	80%	120		

Table 3-5: 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>Burst</i> s	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50 - 100	5 - 20	5 – 20	1 - 3	8 - 20	60%	30

Table 3-6. Parameters for Long Pulse Radar Waveforms

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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 3-7. Parameters for Frequency Hopping Radar Waveforms

3.5 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 3-1 shows the typical test setup. In Band 2A, one channel selected between 5260 and 5350 MHz is chosen for the testing. In Band 2C, one channel selected between 5500 and 5700 MHz was chosen for testing.

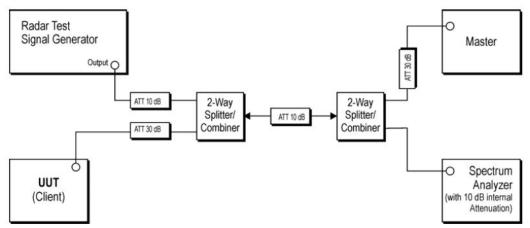


Figure 3-1. Conducted Test Setup for DFS

- 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 3-1 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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4.0 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	9/22/2016	Biennial	9/22/2018	1082329
Aeroflex	PXI 82531	PXI DFS Radar Simulator & Analyzer	9/22/2016	Biennial	9/22/2018	1082329
Agilent	N9020A	MXA Signal Analyzer	1/24/2018	Annual	1/24/2019	US46470561
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	1/22/2018	Annual	1/22/2019	N/A

Table 4-1. Annual Test Equipment Calibration Schedule

4.1 Additional Equipment

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

Device	Manufacturer	Model/Description	Description	S/N:
Maatar	Master Cisco Systems	AIR-CAP2702E-A-K9	Access Point	FTX1834S05B
Master		AIR-CT2504-K9 V03	Controller	PSZ18381P6K

Table 4-2. Support Equipment

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5.0 TEST RESULTS

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.

Agilent Spectrum Analyzer - Swept SA				
🗶 🛛 RF PRESEL 50 Ω AC	SENSE:IN		09:39:13 PM Apr 26, 2018	Frequency
	PNO: Fast ↔ Trig: Free Ru IFGain:Low Atten: 10 dB	#Avg Type: RMS n	TRACE 123456 TYPE WWWWWW DET PNNNNN	
10 dB/div Ref 0.00 dBm			∆Mkr3 170.0 µs 2.61 dB	Auto Tune
-10.0 -20.0 -30.0				Center Freq 5.260000000 GHz
-40.0		<u>r</u> n ₩		Start Freq 5.260000000 GHz
-70.0 -80.0 1	vernapulyzeren VNW Menerske		applation paper and a state of the second	Stop Freq 5.260000000 GHz
Center 5.260000000 GHz Res BW 1.0 MHz	#VBW 3.0 MHz	Sweep 5	Span 0 Hz .000 ms (1001 pts)	CF Step 1.000000 MHz Auto Man
MKR MODE TRC SCL X	3.085 ms -77.70 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Mar
2 Δ1 1 t (Δ) 3 Δ1 1 t (Δ) 4 5	115.0 μs (Δ) 1.44 dB 170.0 μs (Δ) 2.61 dB			Freq Offset 0 Hz
6 7 8 9				
10 11 11			~	
ISG		STATU	3	

Figure 5-1. Band 2A Channel Loading Time

Channel Loading = Pulse Width / Period = 115µs / 170µs = 68%

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Agilent Spectrum Analyzer - Swept SA				
LXI RF PRESEL 50 Ω AC	BNO: East Trig: Free Run	ALIGN AUTO #Avg Type: RMS	09:31:25 PM Apr 26, 2018 TRACE 1 2 3 4 5 6 TYPE WWWWWW	Frequency
10 dB/div Ref 0.00 dBm	PNO: Fast ++ Trig: Free Run IFGain:Low Atten: 10 dB		Mkr1 3.246 ms -75.44 dBm	Auto Tune
Log -10.0 -20.0 -30.0				Center Freq 5.540000000 GHz
-40.0		2M ² Δ1		Start Freq 5.540000000 GHz
-70.0 -80.0 -90.0	เราให้ปัญหลงให้ทำสารแรงการการการการการการการการการการการการการก	2.08.92. Yurrukanyalikuda Ukraktarulta	njuni linatori nati njunanan	Stop Freq 5.540000000 GHz
Center 5.540000000 GHz Res BW 1.0 MHz		Sweep 6.	Span 0 Hz 000 ms (1001 pts) FUNCTION VALUE	CF Step 1.000000 MHz <u>Auto</u> Man
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	3.246 ms -75.44 dBm 48.00 μs (Δ) -1.87 dB 234.0 μs (Δ) 0.48 dB			Freq Offset 0 Hz
7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9				
MSG		STATUS	>	

Figure 5-2. Band 2C Channel Loading Time

Channel Loading = Pulse Width / Period = 48μ s / 234μ s = 20.5%

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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.

Frequency: 5	5,260.000000 🛨 MHz	DUT Peak Input Lev VSG Path Loss/Ga		IT Peak Output Level: 50.0 VSA Path Loss: 40.0		Start Waveforr Generator
Ire Waveform I N	Measurement / Analysis Play	12020004600000000		*341 direbss. [40.0		Capture Scree
igger Settings	reasonement / Analysis 1 lay		Display Settings	Captured Info		Marker Info
External Trig (1/0): Threshold Level:	0.0 🛨 dBm	Display Reference Level: 50.	0 📑 dBm 🛛 Capture Du	ration: 12 Sec	Start Waveform
T1 (out)	Pre-Trigger:	1000 🛨 ms				0 Sec
		F	ower vs Time		FCC 905462 D02 v02 FCC Type 0	End Waveform
						200ms Boundary
			Test Status Pas			0.225706 Sec
291						10s Boundary 10.025706 Sec
(mg	1048/05/ ******		Trigger Threshold	l		[][10.025706 Sec
(mgp) -20	lei dine de la Stati d'Antonio de la construcción		ad or below here the test to the test to be the test of the test			Channel Move Time
Mod 140 1.2.						
						Aggregates Burst Qty: 2
						200ms Total
					NICESCON DEFENSE	0.001009
					10	Burst Qty: 92 9.8s Total
					12	0.004997
)ES\ECC 905462	2 D02 v02\Type 0\FCC Type	0 - 1us width - 1428u≈ PBL	- 18 nulses ain		Select ARB File	Burst Qty: 11: 10s Total
	Channel Move 12 Auto	- 1			Save Data	0.006000

Figure 5-3. Band 2A Move Time and Aggregate Time

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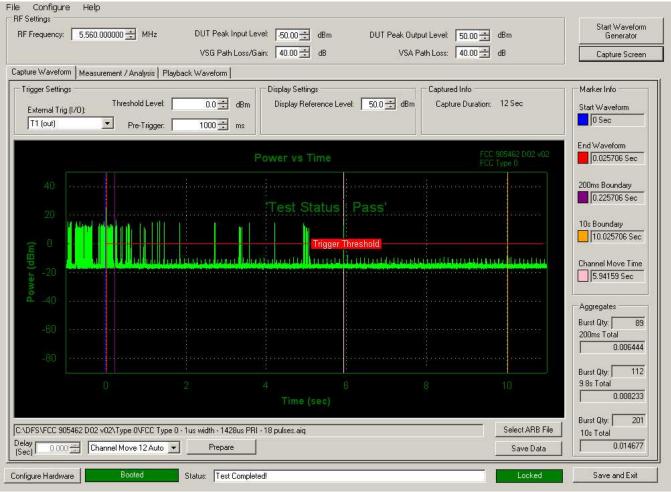


Figure 5-4. Band 2C Move Time and Aggregate Time

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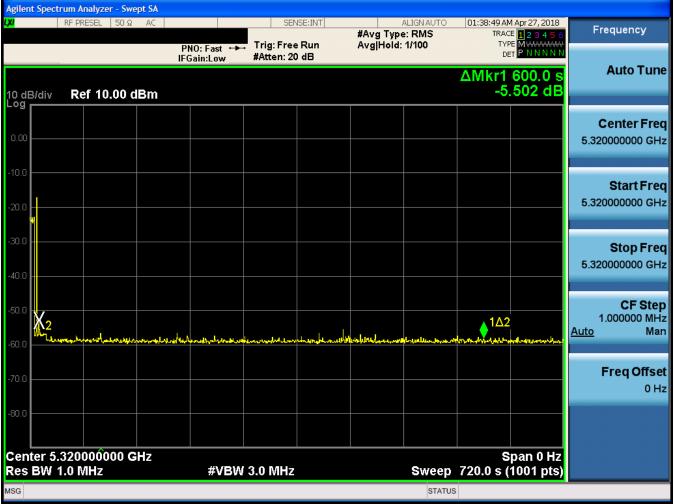


Figure 5-5. Band 2A Client Beacon Test – Monitoring live spectrum – Elapse time 10 minutes

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	u <mark>m Analyzer - S</mark> RF PRESEL 50			SEN	ISE:INT		ALIGN AUTO		1 Apr 27, 2018	Frequency
			PNO: Fast ↔→ IFGain:Low	Trig: Free #Atten: 20		#Avg Type Avg Hold:		TYF DE	E 123456 PE M WWWWW T P N N N N N	
10 dB/div	Ref 10.00	dBm						ΔMkr1 -0	600.0 s .445 dB	Auto Tune
- og 0.00										Center Frec 5.520000000 GH:
20.0										Start Free 5.520000000 GH:
40.0										Stop Fre 5.520000000 GH
50.0 X:<u>7</u> 60.0		der-training and the	.Manadatation	walfderpellowerdag	(mentfallet) (Manufallet)	hand and the state	anha al Mandy (, munituringuling	1. fruiten proveden	CF Step 1.000000 MH <u>Auto</u> Mar
70.0										Freq Offse 0 H
	520000000 .0 MHz	GHz	#VBW	3.0 MHz			Sweep	S 720.0 s (pan 0 Hz 1001 pts)	
SG							STATUS			

Figure 5-6. Band 2C Client Beacon Test – Monitoring live spectrum – Elapse time 10 minutes

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6.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the LG Portable Handset FCC ID: ZNFQ710AL is in compliance with the DFS requirements for a Client Device without radar detection in accordance with Part 15.407 of the FCC Rules.

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