

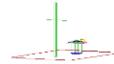


# PCTEST ENGINEERING LABORATORY, INC.

7185 Oakland Mills Road, Columbia, MD 21046 USA

Tel. 410.290.6652 / Fax 410.290.6654

<http://www.pctestlab.com>



## MEASUREMENT REPORT FCC PART 15.247 Bluetooth (Low Energy)

**Applicant Name:**

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

**Date of Testing:**

8/8-8/2016

**Test Site/Location:**

PCTEST Lab, Columbia, MD, USA

**Test Report Serial No.:**

0Y1608121347.ZNF

**FCC ID:** ZNFLS997

**APPLICANT:** LG Electronics MobileComm U.S.A

**Application Type:** Class II Permissive Change

**Model:** LG-LS997, LGLS997, LS997

**EUT Type:** Portable Handset

**Frequency Range:** 2402 - 2480 MHz

**FCC Classification:** Digital Transmission System (DTS)

**FCC Rule Part(s):** Part 15.247

**Test Procedure(s):** KDB 558074 D01 v03r05

**Class II Permissive Change:** Please see FCC change document

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 558074 D01 v03r05. Test results reported herein relate only to the item(s) tested.

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.



Randy Ortanez  
President



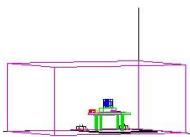
FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/2016	EUT Type: Portable Handset		Page 1 of 18

## T A B L E   O F   C O N T E N T S

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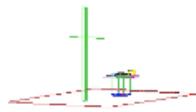
FCC PART 15.247 MEASUREMENT REPORT .....	3
1.0 INTRODUCTION.....	4
1.1 Scope .....	4
1.2 PCTEST Test Location.....	4
2.0 PRODUCT INFORMATION .....	5
2.1 Equipment Description .....	5
2.2 Device Capabilities.....	5
2.3 Test Configuration.....	5
2.4 EMI Suppression Device(s)/Modifications .....	5
3.0 DESCRIPTION OF TESTS .....	6
3.1 Evaluation Procedure .....	6
3.2 Radiated Emissions.....	6
3.3 Environmental Conditions .....	6
4.0 ANTENNA REQUIREMENTS.....	7
5.0 MEASUREMENT UNCERTAINTY .....	8
6.0 TEST EQUIPMENT CALIBRATION DATA.....	9
7.0 TEST RESULTS .....	10
7.1 Summary.....	10
7.2 Radiated Spurious Emission Measurements.....	11
7.3 Radiated Restricted Band Edge Measurements .....	15
8.0 CONCLUSION .....	18

FCC ID: ZNFLS997	 <b>FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT</b> (CLASS II PERMISSIVE CHANGE)	 <b>LG</b> Reviewed by: Quality Manager	
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset	Page 2 of 18



# MEASUREMENT REPORT

## FCC Part 15.247

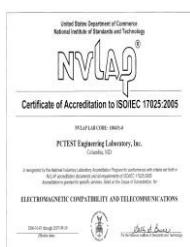


### § 2.1033 General Information

**APPLICANT:** LG Electronics MobileComm U.S.A  
**APPLICANT ADDRESS:** 1000 Sylvan Avenue  
 Englewood Cliffs, NJ 07632, United States  
**TEST SITE:** PCTEST ENGINEERING LABORATORY, INC.  
**TEST SITE ADDRESS:** 7185 Oakland Mills Road, Columbia, MD 21046 USA  
**FCC RULE PART(S):** Part 15.247  
**BASE MODEL:** LG-LS997  
**FCC ID:** ZNFLS997  
**FCC CLASSIFICATION:** Digital Transmission System (DTS)  
**Test Device Serial No.:** 07797  Production  Pre-Production  Engineering  
**DATE(S) OF TEST:** 8/8-8/19/2016  
**TEST REPORT S/N:** 0Y1608121347.ZNF

### Test Facility / Accreditations

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



- PCTEST facility is an FCC registered (PCTEST Reg. No. 159966) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (2451B-1).
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing Aid Compatibility (HAC) testing, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (2451B-1) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS, CDMA, and EvDO wireless devices and for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO, and CDMA 1xRTT.

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 3 of 18

## 1.0 INTRODUCTION

### 1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

### 1.2 PCTEST Test Location

The map below shows the location of the PCTEST LABORATORY, its proximity to the FCC Laboratory, the Columbia vicinity are, the Baltimore-Washington Interntl (BWI) airport, the city of Baltimore and the Washington, DC area. (See Figure 1-1).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The site coordinates are 39° 10'23" N latitude and 76° 49'50" W longitude. The facility is 0.4 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2014 on January 22, 2015.

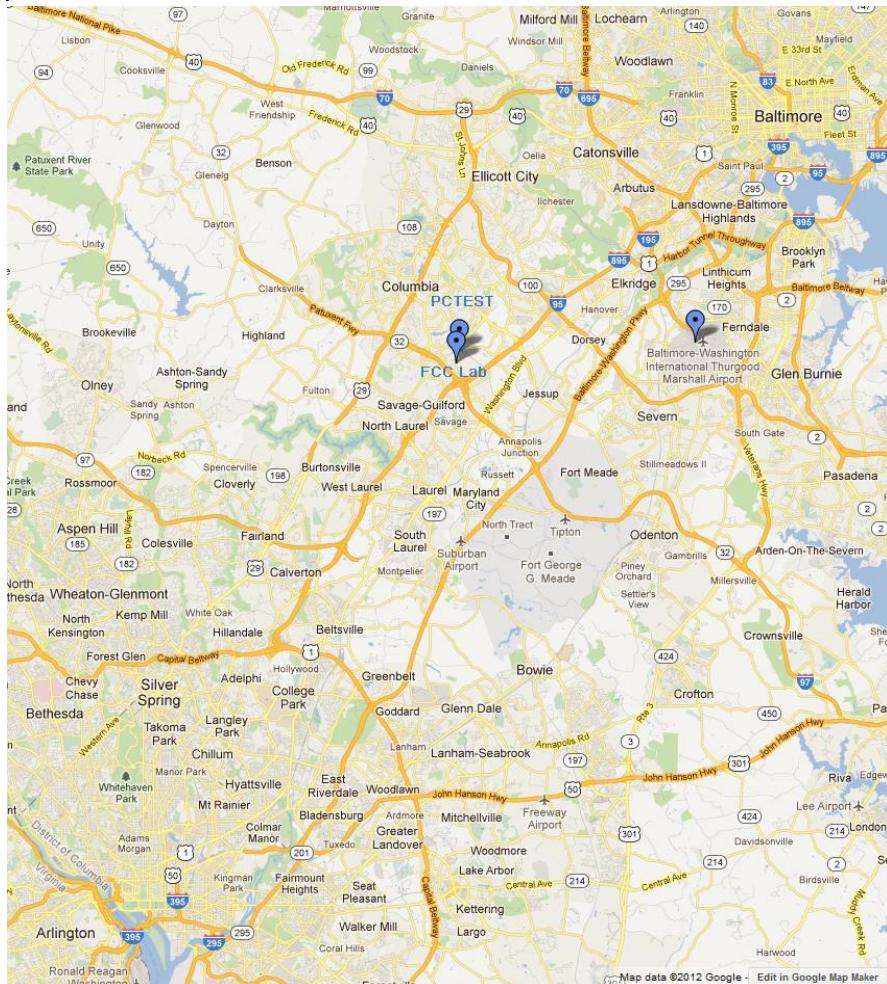


Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 4 of 18



## 2.0 PRODUCT INFORMATION

### 2.1 Equipment Description

The Equipment Under Test (EUT) is the **LG Portable Handset FCC ID: ZNFLS997**. The data found in this test report was taken with the EUT operating in Bluetooth low energy mode. While in low energy mode, the Bluetooth transmitter hops pseudo-randomly between 40 channels, three of which are “advertising channels”. When the transmitter is hopping only between the three advertising channels, the EUT does not fall under the category of a “hopper” as defined in 15.247(a)(iii) which states that a “frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.” As operation on only the advertising channels does not qualify the EUT as a hopper, the EUT is certified as a DTS device in this mode. The data found in this report is representative of the device when it transmits on its advertising channels. Typical Bluetooth operation is covered under the DSS report found with this application.

### 2.2 Device Capabilities

This device contains the following capabilities:

850/1900 CDMA/EvDO Rev0/A, 1x Advanced (BC0, BC1, BC10), 850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n/ac WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC

### 2.3 Test Configuration

The LG Portable Handset FCC ID: ZNFLS997 was tested per the guidance of KDB 558074 D01 v03r05. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing. See Section 3.2 for radiated emissions test setups.

### 2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 5 of 18

## 3.0 DESCRIPTION OF TESTS

### 3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v03r05 were used in the measurement of the **LG Portable Handset FCC ID: ZNFLS997**.

**Deviation from measurement procedure.....** **None**

### 3.2 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. A raised turntable is used for radiated measurement. It is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. A 72.4cm high PVC support structure is placed on top of the turntable. A 3" (~7.6cm) sheet of high density polystyrene is used as the table top and is placed on top of the PVC supports to bring the total height of the table to 80cm. For measurements above 1GHz, a high density expanded polystyrene block is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

### 3.3 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 6 of 18

## 4.0 ANTENNA REQUIREMENTS

### Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna(s) of the Portable Handset are **permanently attached**.
- There are no provisions for connection to an external antenna.

### Conclusion:

The **LG Portable Handset FCC ID: ZNFLS997** unit complies with the requirement of §15.203.

Ch.	Frequency (MHz)
0	2402
:	:
19	2440
:	:
39	2480

**Table 4-1. Frequency / Channel Operations**

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)	 LG	Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 7 of 18

## 5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of  $k = 2$  to indicate a 95% level of confidence. The measurement data shown herein meets or exceeds the  $U_{CISPR}$  measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty ( $\pm$ dB)
Conducted Bench Top Measurements	1.13
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)	 LG	Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 8 of 18

## 6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST).

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	7/11/2016	Annual	7/11/2017	RE1
Emco	3116	Horn Antenna (18 - 40GHz)	3/27/2015	Triennial	3/27/2018	9203-2178
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/26/2016	Biennial	4/26/2018	125518
PCTEST	-	EMC Switch System	7/6/2016	Annual	7/6/2017	NM2
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/15/2016	Annual	7/15/2017	100348
VWR	FSW67	Signal / Spectrum Analyzer	7/27/2016	Annual	7/27/2017	103200
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/7/2016	Annual	3/7/2017	100040
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/2/2016	Biennial	3/2/2018	N/A
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	3/14/2016	Biennial	3/14/2018	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 9 of 18

## 7.0 TEST RESULTS

### 7.1 Summary

Company Name: LG Electronics MobileComm U.S.A

FCC ID: ZNFLS997

FCC Classification: Digital Transmission System (DTS)

Number of Channels: 40

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
<b>TRANSMITTER MODE (TX)</b>					
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	RADIATED	PASS	Sections 7.2, 0

**Table 7-1. Summary of Test Results**

**Notes:**

1. All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 10 of 18



## 7.2 Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d)

### Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

***All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-2 per Section 15.209.***

Frequency	Field Strength [ $\mu$ V/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

**Table 7-2. Radiated Limits**

### Test Procedures Used

KDB 558074 D01 v03r05 – Section 12.1, 12.2.7

### Test Settings

#### Average Field Strength Measurements per Section 12.2.5.3 of KDB 558074 D01 v03r05

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3kHz > 1/T
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to run for at least 50 times (1/duty cycle) traces

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 11 of 18

## Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 D01 v03r05

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in Table 7-3 below
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Frequency	RBW
9 – 150kHz	200 – 300Hz
0.15 – 30MHz	9 – 10kHz
30 – 1000MHz	100 – 120kHz
> 1000MHz	1MHz

Table 7-3. RBW as a Function of Frequency

### Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

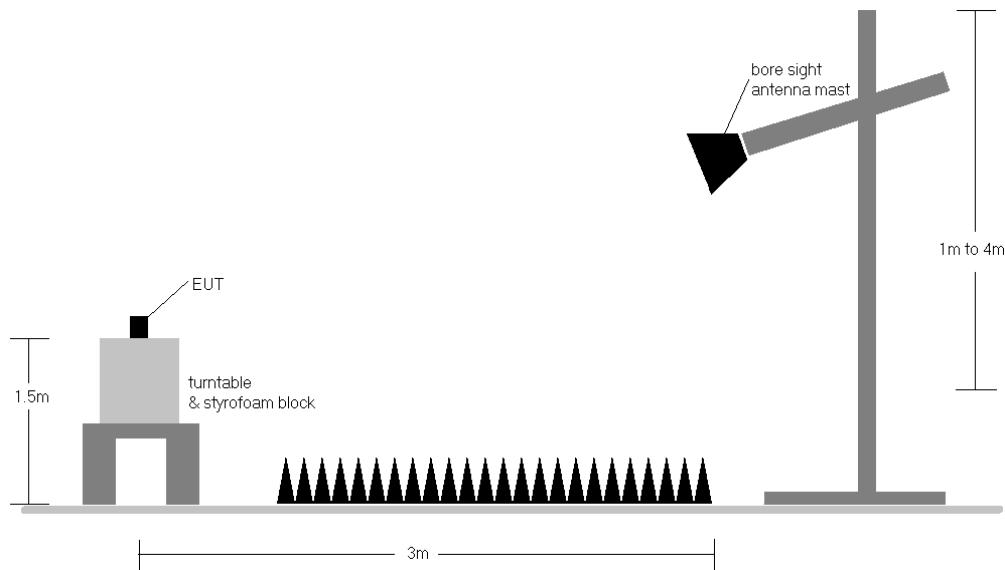


Figure 7-1. Radiated Test Setup >1GHz

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)	 LG	Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 12 of 18

## Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of KDB 558074 D01 v03r05 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-2.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. Average measurements were recorded using a VBW of 3kHz, per Section 12.2.5.3 of KDB 558074 D01 v03r05, since 1/T is equal to just under 3kHz. This method was used because the EUT could not be configured to operate with a duty cycle > 98%. Both average and peak measurements were made using a peak detector
7. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
8. No significant radiated band edge emissions were found in the 2310 – 2390MHz restricted band.
9. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

## Sample Calculations

### Determining Spurious Emissions Levels

- Field Strength Level  $[\text{dB}_{\mu\text{V/m}}] = \text{Analyzer Level } [\text{dBm}] + 107 + \text{AFCL } [\text{dB/m}]$
- AFCL  $[\text{dB/m}] = \text{Antenna Factor } [\text{dB/m}] + \text{Cable Loss } [\text{dB}]$
- Margin  $[\text{dB}] = \text{Field Strength Level } [\text{dB}_{\mu\text{V/m}}] - \text{Limit } [\text{dB}_{\mu\text{V/m}}]$

### Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 7.2 was calculated using the formula:

$$\text{Offset (dB)} = (\text{Antenna Factor} + \text{Cable Loss} + 10 \text{ dB Attenuator}) - \text{Preamplifier Gain}$$

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 13 of 18



## Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d)

Bluetooth Mode: LE  
 Distance of Measurements: 3 Meters  
 Operating Frequency: 2402MHz  
 Channel: 0

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]
4804.00	Avg	H	-	-	-78.66	7.50	35.84	53.98	-18.14
4804.00	Peak	H	-	-	-65.95	7.50	48.55	73.98	-25.43
12010.00	Avg	H	-	-	-79.96	23.07	50.11	53.98	-3.87
12010.00	Peak	H	-	-	-68.02	23.07	62.05	73.98	-11.93

**Table 7-4. Radiated Measurements @ 3 meters**

Bluetooth Mode: LE  
 Distance of Measurements: 3 Meters  
 Operating Frequency: 2440MHz  
 Channel: 19

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]
4880.00	Avg	H	-	-	-78.40	7.61	36.21	53.98	-17.77
4880.00	Peak	H	-	-	-66.16	7.61	48.45	73.98	-25.53
7320.00	Avg	H	-	-	-79.53	14.80	42.27	53.98	-11.71
7320.00	Peak	H	-	-	-67.36	14.80	54.44	73.98	-19.54
12200.00	Avg	H	-	-	-80.54	23.77	50.23	53.98	-3.75
12200.00	Peak	H	-	-	-68.76	23.77	62.01	73.98	-11.97

**Table 7-5. Radiated Measurements @ 3 meters**

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 14 of 18



## Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d)

Bluetooth Mode: LE  
Distance of Measurements: 3 Meters  
Operating Frequency: 2480MHz  
Channel: 39

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]
4960.00	Avg	H	-	-	-78.92	7.91	35.99	53.98	-17.98
4960.00	Peak	H	-	-	-66.40	7.91	48.51	73.98	-25.46
7440.00	Avg	H	-	-	-80.09	15.35	42.26	53.98	-11.72
7440.00	Peak	H	-	-	-67.86	15.35	54.49	73.98	-19.49
12400.00	Avg	H	-	-	-80.26	21.65	48.39	53.98	-5.59
12400.00	Peak	H	-	-	-68.14	21.65	60.51	73.98	-13.47

Table 7-6. Radiated Measurements @ 3 meters

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 15 of 18

### 7.3 Radiated Restricted Band Edge Measurements

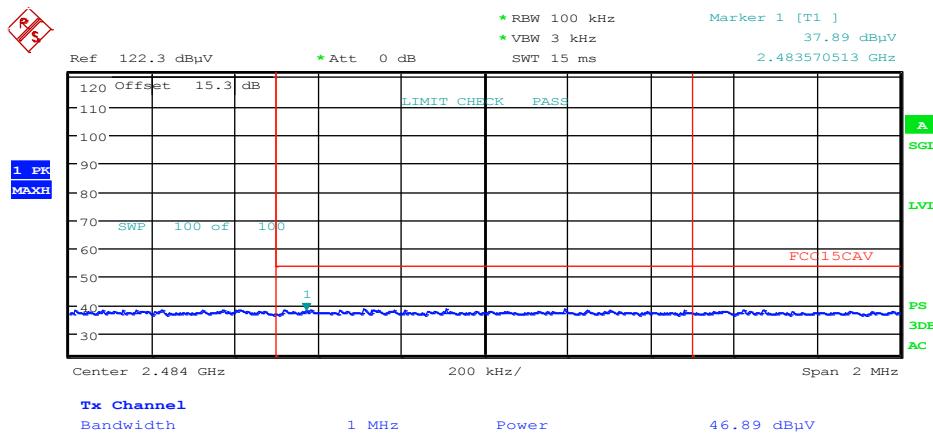
[\\$15.205](#) [\\$15.209](#)

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

The amplitude offset shown in the following plots for average measurements was calculated using the formula:

Offset (dB) = (Antenna Factor + Cable Loss + 10 dB Attenuator) – Preamplifier Gain

Bluetooth Mode: LE  
 Measurement Distance: 3 Meters  
 Operating Frequency: 2480MHz  
 Channel: 39



Date: 11.AUG.2016 12:11:57

**Plot 7-1. Radiated Restricted Upper Band Edge Measurement (Average)**

**Note:**

A channel integration method was used to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v03r05 Section 13.3.3, a measurement was performed using a RBW of 100kHz at the 2483.5MHz band edge. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.

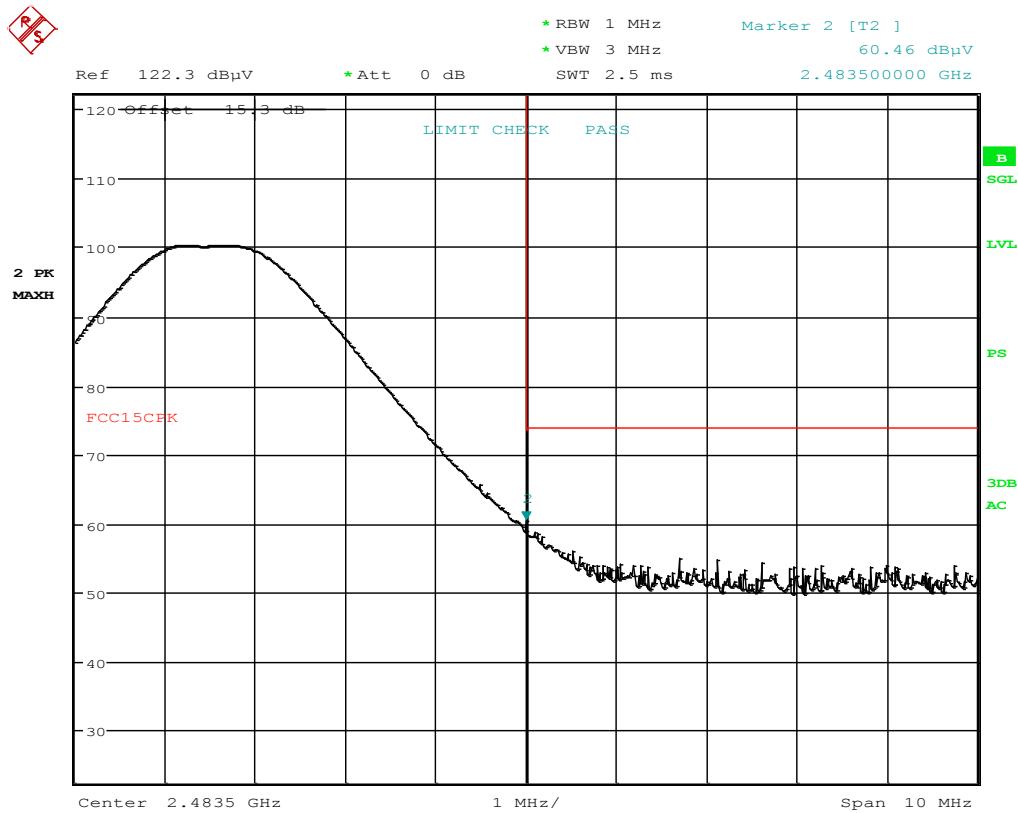
FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 16 of 18

## Radiated Restricted Band Edge Measurements

### §15.205 §15.209

The amplitude offset shown in the following plots for average measurements was calculated using the formula:

$$\text{Offset (dB)} = (\text{Antenna Factor} + \text{Cable Loss} + 10 \text{ dB Attenuator}) - \text{Preamplifier Gain}$$



Date: 11.AUG.2016 12:12:18

**Plot 7-2. Radiated Restricted Upper Band Edge Measurement (Peak)**

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 17 of 18



## 8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **LG Portable Handset** **FCC ID: ZNFLS997** is in compliance with Part 15C of the FCC Rules.

FCC ID: ZNFLS997		FCC Pt. 15.247 BLUETOOTH (LE) TEST REPORT (CLASS II PERMISSIVE CHANGE)		Reviewed by: Quality Manager
Test Report S/N: 0Y1608121347.ZNF	Test Dates: 8/8-8/19/2016	EUT Type: Portable Handset		Page 18 of 18