

PCTEST ENGINEERING LABORATORY, INC.

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# MEASUREMENT REPORT FCC PART 15.247 Bluetooth

#### **Applicant Name:**

LG Electronics MobileComm U.S.A 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States Date of Testing: 2/26 - 3/29/2018 Test Site/Location: PCTEST Lab. Columbia, MD, USA Test Report Serial No.: 1M1802260032-02-R1.ZNF

# FCC ID:

# ZNFG710VM

**APPLICANT:** 

# LG Electronics MobileComm U.S.A

Application Type: Model: Additional Model(s):

EUT Type: Max. RF Output Power: Frequency Range: Type of Modulation: FCC Classification: FCC Rule Part(s): Test Procedure(s): Certification LM-G710VM LMG710VM, G710VM, LG-G710PM, LGG710PM, G710PM, LG-G710ULM, LGG710ULM, G710ULM Portable Handset 22.208 mW (13.47 dBm) Peak Conducted 2402 – 2480MHz GFSK,  $\pi$ /4-DQPSK, 8DPSK FCC Part 15 Spread Spectrum Transmitter (DSS) Part 15 Subpart C (15.247) ANSI C63.10-2013, KDB 648474 D03 v01r04

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 ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1M1802260032-02-R1.ZNF) supersedes and replaces the previously issued test report (S/N: 1M1802260032-02.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.

Randy Ortanez President



FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dogo 1 of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 1 of 56
© 2018 PCTEST Engineering Laboratory, Inc.				V 7.5 2/14/2018



# TABLE OF CONTENTS

1.0	INTF	RODUCTION	3
	1.1	Scope	.3
	1.2	PCTEST Test Location	.3
	1.3	Test Facility / Accreditations	.3
2.0	PRO	DUCT INFORMATION	4
	2.1	Equipment Description	.4
	2.2	Device Capabilities	.4
	2.3	Test Configuration	.4
	2.4	EMI Suppression Device(s)/Modifications	.4
3.0	DES	CRIPTION OF TESTS	5
	3.1	Evaluation Procedure	.5
	3.2	AC Line Conducted Emissions	.5
	3.3	Radiated Emissions	.6
	3.4	Environmental Conditions	.6
4.0	ANT	ENNA REQUIREMENTS	7
5.0	MEA	SUREMENT UNCERTAINTY	8
6.0	TES	T EQUIPMENT CALIBRATION DATA	9
7.0	TES	T RESULTS1	0
	7.1	Summary	10
	7.2	20dB Bandwidth Measurement	11
	7.3	Output Power Measurement	17
	7.4	Band Edge Compliance	<u>28</u>
	7.5	Carrier Frequency Separation	31
	7.6	Time of Occupancy	33
	7.7	Number of Hopping Channels	35
	7.8	Conducted Spurious Emissions	37
	7.9	Radiated Spurious Emission Measurements – Above 1GHz	41
	7.10	Radiated Restricted Band Edge Measurements	48
	7.11	Radiated Spurious Emissions Measurements – Below 1GHz	
	7.12	Line Conducted Measurement Data	53
8.0	CON	ICLUSION	56

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 2 of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 2 of 56
© 2018 PCTEST Engineering Laboratory, Inc.				V 7.5 2/14/2018



# **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 Innovation, Science and Economic Development Canada.

# 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.

## **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 2041.01 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.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 2 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 3 of 56
© 2018 PCTEST Engineering Labo	ratory Inc			V 7 5 2/1//2018



# 2.0 PRODUCT INFORMATION

# 2.1 Equipment Description

The Equipment Under Test (EUT) is the **LG Portable Handset FCC ID: ZNFG710VM**. The test data contained in this report pertains only to the emissions due to the EUT's Bluetooth transmitter.

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
  - A) The hopping sequence is pseudorandom
  - B) All channels are used equally on average
  - C) The receiver input bandwidth equals the transmit bandwidth
  - D) The receiver hops in sequence with the transmit signal
- 15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
- 15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices
  operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the
  number of test channels from 79 channels to a minimum number of 20 channels.

# Test Device Serial No.: 07264, 07249, 07231

# 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 WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC, ANT+

Ch.	Frequency (MHz)			
00	2402			
-	:			
39	2441			
:	:			
78	2480			

Table 2-1. Frequency/ Channel Operations

**Note:** This device is capable of operating in hopping and non-hopping mode. The EUT can hop between 79 different channels in the 2400 – 2483.5MHz band.

# 2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013. ANSI C63.10-2013 was also used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, and 7.8 for antenna port conducted emissions test setups.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) Model: EP-NG930 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

# 2.4 EMI Suppression Device(s)/Modifications

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

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 4 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 4 of 56
© 2018 PCTEST Engineering Laboratory Inc			V 7 5 2/14/2018	



# 3.0 DESCRIPTION OF TESTS

# 3.1 Evaluation Procedure

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the EUT.

Deviation from measurement procedure.....None

# 3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz,  $50\Omega/50\mu$ H Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that the cables were not draped over the second LISN.

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 RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.12. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Daga E of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 5 of 56
© 2018 PCTEST Engineering Laboratory Inc				V 7 5 2/14/2018



# 3.3 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. 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. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal 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.

# 3.4 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: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 6 of E6
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 6 of 56
© 2018 PCTEST Engineering Laboratory Inc				V 7 5 2/14/2018



# 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 antennas of the EUT are permanently attached.
- There are no provisions for connection to an external antenna.

### Conclusion:

The EUT complies with the requirement of §15.203.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dogo 7 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 7 of 56
© 2018 PCTEST Engineering Labo	ratory. Inc.			V 7.5 2/14/2018



# 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 uncertainty shown below 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 (±dB)
Conducted Bench Top Measurements	1.13
Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dogo 9 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 8 of 56
© 2018 PCTEST Engineering Laboratory, Inc.				V 7.5 2/14/2018



# 6.0 TEST EQUIPMENT CALIBRATION DATA

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 C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	6/21/2017	Annual	6/21/2018	RE1
-	BT2	Bluetooth Cable Set	6/14/2017	Annual	6/14/2018	BT2
Agilent	N9020A	MXA Signal Analyzer	1/24/2018	Annual	1/24/2019	US46470561
Agilent	N4010A	Wireless Connectivity Test Set		N/A		GB46170464
Agilent	N9038A	MXE EMI Receiver	4/26/2017	Annual	4/26/2018	MY51210133
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	10/10/2017	Biennial	10/10/2019	121034
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	6/21/2017	Annual	6/21/2018	441119
EMCO	3160-09	Small Horn (18 - 26.5GHz)	8/23/2016	Biennial	8/23/2018	135427
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	12/1/2016	Biennial	12/1/2018	125518
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	12/27/2016	Biennial	12/27/2018	114451
Pasternack	NMLC-1	Line Conducted Emissions Cable (NM)	5/31/2017	Annual	5/31/2018	NMLC-1
PCTEST	-	EMC Switch System	6/21/2017	Annual	6/21/2018	NM2
Rohde & Schwarz	CMU200	Base Station Simulator		N/A		107826
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	4/19/2017	Annual	4/19/2018	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/31/2017	Annual	7/31/2018	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/11/2017	Annual	8/11/2018	103200
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/3/2017	Annual	7/3/2018	102135
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/3/2017	Annual	7/3/2018	102134
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	1/22/2018	Annual	1/22/2019	N/A
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	8/14/2017	Biennial	8/14/2019	310233
Sunol	DRH-118	Horn Antenna (1-18GHz)	8/11/2017	Biennial	8/11/2019	A050307

Table 6-1. Annual Test Equipment Calibration Schedule

## Notes:

Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dogo 0 of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 9 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



# 7.0 TEST RESULTS

# 7.1 Summary

Company Name:	LG Electronics MobileComm U.S.A
FCC ID:	ZNFG710VM
Method/System:	Frequency Hopping Spread Spectrum (FHSS)
Number of Channels:	<u>79</u>

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(1)(iii)	RSS-247 [5.1(1)]	20dB Bandwidth	N/A		PASS	Section 7.2
15.247(b)(1)	RSS-247 [5.4(2)]	Peak Transmitter Output Power	< 1 Watt if <u>&gt;</u> 75 non- overlapping channels used		PASS	Section 7.3
15.247(a)(1)	RSS-247 [5.1(2)]	Channel Separation	> 2/3 of 20 dB BW for systems with Output Power < 125mW	CONDUCTED	PASS	Section 7.5
15.247(a)(1)(iii)	RSS-247 [5.1(4)]	Number of Channels	> 15 Channels		PASS	Section 7.7
15.247(a)(1)(iii)	RSS-247 [5.1(4)]	Time of Occupancy	< 0.4 sec in 31.6 sec period		PASS	Section 7.6
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	Conducted > 20dBc		PASS	Section 7.4, Section 7.8
15.205 15.209	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-247 limits)	RADIATED	PASS	Section 7.9, Section 7.10, Section 7.11
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen [8.8] limits)	LINE CONDUCTED	PASS	Section 7.12

Table 7-1. Summary of Test Results

### Notes:

- 1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
- 4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "BT Auto," Version 3.3.
- 5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.1.5.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 10 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 10 of 56
© 2018 PCTEST Engineering Laboratory. Inc.				V 7.5 2/14/2018



## 7.2 20dB Bandwidth Measurement §15.247 (a.1.iii); RSS-247 [5.1(1)]

### **Test Overview and Limit**

The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

### Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2

#### **Test Settings**

- 1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 20dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 20. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
- 2. RBW = 1 5% OBW
- 3. VBW  $\geq$  3 x RBW
- 4. Reference level set to keep signal from exceeding maximum input mixer level for linear operation.
- 5. Detector = Peak
- 6. Trace mode = max hold
- 7. Sweep = auto couple
- 8. The trace was allowed to stabilize

#### **Test Setup**

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

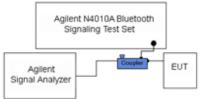


Figure 7-1. Test Instrument & Measurement Setup

#### **Test Notes**

None

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🔁 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 11 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 11 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



Frequency [MHz]	Data Rate [Mbps]	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	0	939.0
2441	1.0	39	917.6
2480	1.0	78	931.6
2402	2.0	0	1297
2441	2.0	39	1326
2480	2.0	78	1319
2402	3.0	0	1344
2441	3.0	39	1278
2480	3.0	78	1324

Table 7-2. Conducted 20dB Bandwidth Measurements



Plot 7-1. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 10 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 12 of 56
© 2018 PCTEST Engineering Laboratory. Inc.				V 7.5 2/14/2018





Plot 7-2. 20dB Bandwidth Plot (Bluetooth, 1Mbps - Ch. 39)



Plot 7-3. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 12 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset	Page 13 c	
© 2018 PCTEST Engineering Laboratory, Inc.				V 7.5 2/14/2018





Plot 7-4. 20dB Bandwidth Plot (Bluetooth, 2Mbps - Ch. 0)



Plot 7-5. 20dB Bandwidth Plot (Bluetooth, 2Mbps - Ch. 39)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕑 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 14 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 14 of 56
© 2018 PCTEST Engineering Laboratory, Inc.				V 7.5 2/14/2018



🔤 Keysight Spectrum Analyzer - Occupied BW						- F <b>X</b>
XVIRL RF 50Ω AC		SENSE:INT er Freq: 2.480000000 GHz Free Run Avg Hold	Radio Std	M Feb 27, 2018 : None	Trace	/Detector
NFE		en: 20 dB	Radio Dev	vice: BTS		
10 dB/div Ref 20.00 dBm						
Log 10.0						
0.00					С	lear Write
-10.0	Amman	man many have				
-20.0	A Contraction of the second se	· ``	<u></u>			
-30.0	<i>Г</i> <sup></sup>					Average
-40.0			home the			
-40.0 -50.0 Wyr mar Man			month property and a set of the s	wwwww		
-60.0						Max Hold
-70.0						maxinora
Center 2.48 GHz Res BW 27 kHz		VBW 270 kHz		an 3 MHz p 3.8 ms		
						Min Hold
Occupied Bandwidth	า	Total Power	9.24 dBm			
1.1	879 MHz					Detector
			00 00 V		A 4 -	Peak▶
Transmit Freq Error	4.544 kHz	% of OBW Pow			Auto	Man
x dB Bandwidth	1.319 MHz	x dB	-20.00 dB			
MSG			STATUS			

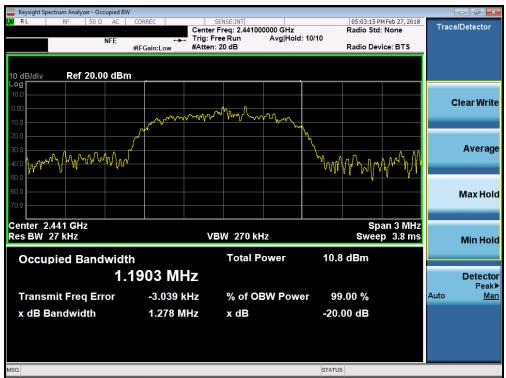
Plot 7-6. 20dB Bandwidth Plot (Bluetooth, 2Mbps - Ch. 78)



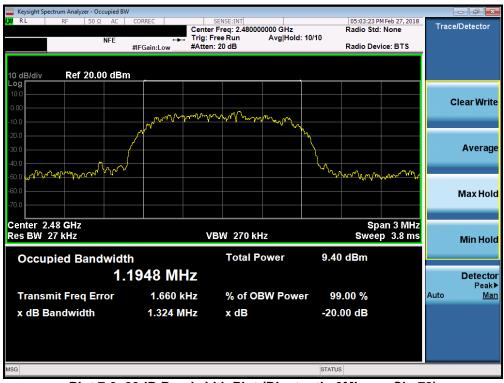
Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 0)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕑 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 15 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 15 of 56
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Plot 7-8. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 39)



Plot 7-9. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	💽 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 10 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 16 of 56
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# 7.3 Output Power Measurement §15.247 (b.1); RSS-247 [5.4(2)]

# Test Overview and Limits

Measurement is made while the EUT is operating in non-hopping transmission mode. The powers shown below were measured using a spectrum analyzer with a Bluetooth signaling test set (Agilent Model: N4010A) used only to maintain a Bluetooth link with the EUT. Average power measurements are performed using the analyzer's "burst power" function with RBW = 3MHz. The burst power function triggers on a single set burst set to maximum power and measures the maximum average power on the on-time.

## The maximum permissible output power is 1 Watt.

# **Test Procedure Used**

ANSI C63.10-2013 - Section 7.8.5

# **Test Settings**

### Peak Power Measurement

- 1. Span = approximately 5x 20dB bandwidth, centered on hopping channel
- 2. RBW > 20dB bandwidth of emission being measured
- 3. VBW ≥ RBW
- 4. Sweep = auto
- 5. Detector = peak
- 6. Trace mode = max hold
- 7. The trace was allowed to stabilize

### Test Setup

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

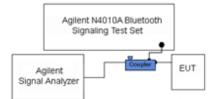


Figure 7-2. Test Instrument & Measurement Setup

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	G	Approved by: Quality Manager					
Test Report S/N:	Test Dates:	EUT Type:		Dage 17 of 50					
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 17 of 56					
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# <u>Note</u>

This unit was tested with all possible data rates and the highest peak power is reported with the unit transmitting at 3Mbps.

Final results were obtained using calibrated couplers, attenuators and cables. The following formula was used:

Output Power (dBm) = Raw Analyzer Level (dBm) + Cable Loss (dB) + Loss in Directional Coupler/Insertion Loss (dB)

_	Data			nducted wer	Avg Cor Pov	nducted wer
Frequency [MHz]	Rate [Mbps]	Channel No.	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	12.02	15.915	11.81	15.163
2441	1.0	39	11.86	15.350	11.67	14.693
2480	1.0	78	11.81	15.153	11.56	14.327
2402	2.0	0	13.02	20.031	11.14	13.009
2441	2.0	39	13.21	20.956	11.04	12.696
2480	2.0	78	13.01	20.012	10.93	12.393
2402	3.0	0	13.18	20.792	11.20	13.180
2441	3.0	39	13.47	22.208	11.10	12.895
2480	3.0	78	13.23	21.028	10.99	12.551

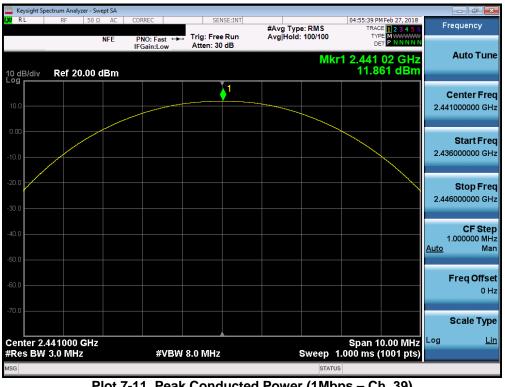
Table 7-3. Conducted Output Power Measurements

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Dage 19 of 50				
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 18 of 56				
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	ectrum Analyz	er - Swept SA									
L <mark>XI</mark> RL	RF	50 Ω AC	CORREC	SEN	ISE:INT	#Avg Typ	e: RMS		MFeb 27, 2018	F	requency
		NFE	PNO: Fast ↔ IFGain:Low	. Trig: Free Atten: 30		Avg Hold:	100/100	TYF De			
10 dB/div Log	Ref 20	.00 dBm					Mk	r1 2.402 12.0	21 GHz 18 dBm		Auto Tune
10.0					<b>●</b> <sup>1</sup>						<b>Center Freq</b> 02000000 GHz
-10.0										2.39	Start Freq 97000000 GHz
-20.0										2.40	Stop Freq 07000000 GHz
-40.0										<u>Auto</u>	<b>CF Step</b> 1.000000 MHz Man
-60.0											Freq Offset 0 Hz
-70.0											Scale Type
Center 2.4 #Res BW			#VBW	/ 8.0 MHz			Sweep	Span 1 1.000 ms (	0.00 191112	Log	<u>Lin</u>
MSG							STATU	JS			

Plot 7-10. Peak Conducted Power (1Mbps - Ch. 0)



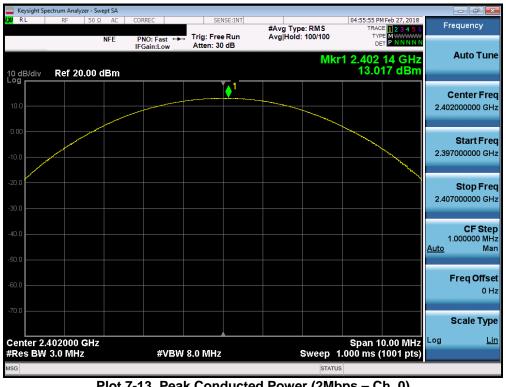
Plot 7-11. Peak Conducted Power (1Mbps - Ch. 39)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Dage 10 of EC				
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 19 of 56				
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	Spectrum Analy									
LX/ RL	RF	50 Ω AC	CORREC	SENSE	#Avg Ty	pe: RMS		MFeb 27, 2018	Fre	quency
		NFE	PNO: Fast ↔ IFGain:Low	Trig: Free R Atten: 30 d	un Avg Hol	d: 100/100	TYP			
			IFGain:Low	Atten: 30 u	5	Mk	r1 2.479	25 CH7		Auto Tune
10 dB/div	Ref 20	.00 dBm					11.8	05 dBm		
				<b>1</b>					с	enter Freg
10.0										000000 GHz
									2.100	
0.00										Start Freq
-10.0									2.475	000000 GHz
-20.0										Stop Freq
									2.485	000000 GHz
-30.0										
-40.0										CF Step
									1. Auto	000000 MHz Man
-50.0										
									F	reg Offset
-60.0										0 Hz
-70.0										
10.0									S	Scale Type
	100000						0		Log	Lin
	2.480000 N 3.0 MH;		#VBV	V 8.0 MHz		Sweep	span 1 1.000 ms (	0.00 MHz 1001 pts)	-	<u></u>
MSG						STATU				

Plot 7-12. Peak Conducted Power (1Mbps - Ch. 78)



Plot 7-13. Peak Conducted Power (2Mbps - Ch. 0)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of 50				
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 20 of 56				
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	ctrum Analyze						
LXI RL	RF	50 Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	04:56:04 PM Feb 27, 2018 TRACE 1 2 3 4 5 6	Frequency
		NFE	PNO:Fast ↔ IFGain:Low	Trig: Free Run Atten: 30 dB	Avg Hold: 100/100		
10 dB/div Log	Ref 20.	00 dBm			Mk	r1 2.441 08 GHz 13.213 dBm	Auto Tune
10.0							Center Freq 2.441000000 GHz
-10.0							<b>Start Freq</b> 2.436000000 GHz
-20.0							<b>Stop Freq</b> 2.446000000 GHz
-40.0							<b>CF St</b> ep 1.000000 MHz <u>Auto</u> Mar
-60.0							Freq Offset 0 Hz
-70.0							Scale Type
Center 2.4 #Res BW		Hz	#VB\	№ 8.0 MHz	Sweep	Span 10.00 MHz 1.000 ms (1001 pts)	Log <u>Lin</u>
MSG					STATI	JS	

Plot 7-14. Peak Conducted Power (2Mbps - Ch. 39)



Plot 7-15. Peak Conducted Power (2Mbps - Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 01 of 50	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 21 of 56	
© 2018 PCTEST Engineering Labo	ratory Inc	·		V 7 5 2/14/2018	



		zer - Swept SA					
LXI RL	RF	50 Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	04:56:23 PM Feb 27, 2018 TRACE 1 2 3 4 5 6	Frequency
		NFE	PNO: Fast ← IFGain:Low	Trig: Free Run Atten: 30 dB	Avg Hold: 100/100	TYPE MWWWWW DET P NNNNN	
			II Gam.Low		М	kr1 2.401 96 GHz	Auto Tune
10 dB/div	Ref 20	.00 dBm				13.179 dBm	
				1			Center Freq
10.0							2.402000000 GHz
0.00							Start Freq
-10.0							2.397000000 GHz
-20.0							Stop Freq
-30.0							2.407000000 GHz
-30.0							
-40.0							CF Step 1.000000 MHz
							Auto Man
-50.0							
-60.0							Freq Offset
							0 Hz
-70.0							0
							Scale Type
Center 2.4						Span 10.00 MHz	Log <u>Lin</u>
#Res BW	3.0 MHz		#VB	W 8.0 MHz		1.000 ms (1001 pts)	
MSG					STA	TUS	

Plot 7-16. Peak Conducted Power (3Mbps - Ch. 0)



Plot 7-17. Peak Conducted Power (3Mbps - Ch. 39)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Dage 22 of 56				
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 22 of 56				
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		zer - Swept SA					
L <mark>XI</mark> RL	RF	50 Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	04:56:41 PM Feb 27, 2018 TRACE 1 2 3 4 5 6	Frequency
		NFE	PNO: Fast ↔ IFGain:Low	Trig: Free Run Atten: 30 dB	Avg Hold: 100/100		
10 dB/div Log	Ref 20	.00 dBm			Mkı	1 2.479 99 GHz 13.228 dBm	Auto Tune
10.0							Center Freq 2.480000000 GHz
-10.0							Start Freq 2.475000000 GHz
-20.0							<b>Stop Freq</b> 2.485000000 GHz
-40.0							CF Step 1.000000 MHz <u>Auto</u> Man
-60.0							Freq Offset 0 Hz
-70.0							Scale Type
Center 2. #Res BW			#VBW	8.0 MHz	Sweep	Span 10.00 MHz I.000 ms (1001 pts)	Log <u>Lin</u>
MSG					STATU	S	

Plot 7-18. Peak Conducted Power (3Mbps - Ch. 78)



Plot 7-19. Average Conducted Power (1Mbps - Ch. 0)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 22 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 23 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



	ctrum Analyzer				I			-						d X
XI RL	RF	50 Ω AC NFE		ORREC	→ w	Center F		0000 GHz Avg Hold	: 100/100		04:57:13 P adio Std:	M Feb 27, 2018 None	Frequen	icy
10 dB/div Log	Ref 2	0.00 dE	3m											
0.00													Cente 2.44100000	
-10.0 -20.0 -30.0														
-40.0														
-70.0														
0.00 s ResBw 3.0	DO MHz							Swe	ep 4.00	ms	(6	4.00 ms 0001 pt)	3.00000	
Output F (Above Th 11							Amplitud Amplitude Data				161 dB 5.00 dB		Auto Freq	
Above T	hreshold	Pts 4	3289			Outp	ut <b>Pwr</b> I.674 dBm		i <b>x Pt</b> .839 dB	m	<b>Min</b> -106	90 dBm		0 H
ISG									STA	TUS				

Plot 7-20. Average Conducted Power (1Mbps – Ch. 39)



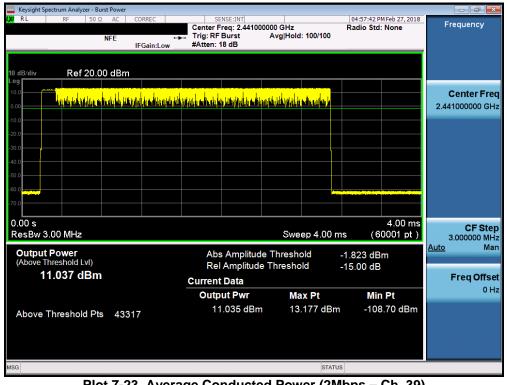
Plot 7-21. Average Conducted Power (1Mbps - Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 24 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 24 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



E Keysight Spec	ctrum Analyzer - RF 50	Burst Power Ω AC	CORREC			SE:INT					M Feb 27, 2018		
		NFE	IFGain:L	T	enter Fre rig: RF B Atten: 16	urst	000000 GHz Avg Ho	ld: 100/100		Radio Std	: None	Freque	ency
10 dB/div Log	Ref 20	.00 dBm											
0.00	Legeligiski piljina	<mark>na linaku lah sis</mark>	<mark>udal kandu</mark>	upited all the	<mark>u andinaku kuy k</mark>	Hayliydd, la sa	Non-phylic pigal	<mark>, tel public, a cel</mark> par d				Cent 2.402000	er Fred 000 GH:
-10.0													
-40.0													
-60.0													
0.00 s ResBw 3.0	00 MHz						Sw	eep 4.0(	) ms	(6	4.00 ms ;0001 pt)	3.000	CF Ste
	Power reshold LvI) .143 dBr	n		-	Rel A	mplitud	de Thresl de Thresh			.051 dB 5.00 dB		Auto Free	Ma Offse
				C	urrent D Outpu		N	lax Pt		Mir	n Pt	1100	0 H
Above TI	hreshold P	ts 433	17			131 dBi		2.949 dE	Зm		7.90 dBm		
ISG								ST	ATUS				

Plot 7-22. Average Conducted Power (2Mbps - Ch. 0)



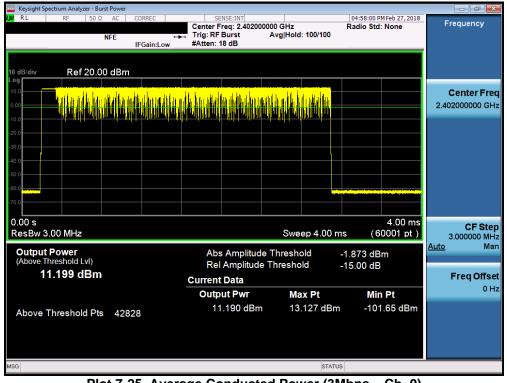
Plot 7-23. Average Conducted Power (2Mbps – Ch. 39)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 25 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 25 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



w Keysight Sp K R L	pectrum Analyze RF		AC C	ORREC		Center F	inse:INT req: 2.48000 Burst	00000 GHz Avg Hold	: 100/100		04:57:52 P adio Std	MFeb 27, 2018 : <b>None</b>	Frequ	
10 dB/div Log	Ref	20.00	1	FGain:L	ow	#Atten: 1	l6 dB							
10.0	l a pile de la	<mark>lig m</mark> ins	<mark>u II. Man</mark> i	d <mark>ili mili</mark> da	<mark>urpila, ki la</mark> jei	i <u>nih m<sup>i</sup>nah</u> ik	<mark>y kiterologiala, maha</mark>	<mark>an Philippini</mark>	<mark>ndia ang k</mark> a k				Cen 2.480000	ter Fred
-20.0														
-40.0														
-70.0												4.00 ms		
ResBw 3	3.00 MHz					Abs	Amplitud	Swe le Thresho	ep 4.00 old		(6 056 dB	0001 pt )		CF Stej 0000 MH Ma
	Threshold Ly 0.932 dl					Rel Current	Amplitud Data	e Thresho	old	-15	.00 dB		Fre	q Offse
Above	Threshold	Pts	4331	7			<b>ut Pwr</b> ).919 dBn		<b>ix Pt</b> .944 dB	m	<b>Min</b> -108	<b>9 Pt</b> 8.35 dBm		011
ISG									STA	TUS				

Plot 7-24. Average Conducted Power (2Mbps - Ch. 78)



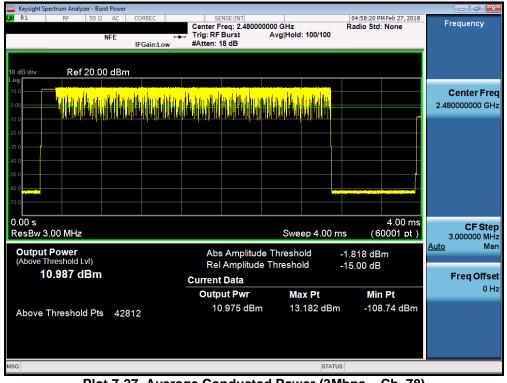
Plot 7-25. Average Conducted Power (3Mbps - Ch. 0)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 26 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 26 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



E Keysight Spec	ctrum Analyzer - B RF 50 9		ORREC		NSE:INT					M Feb 27, 2018		
		NFE	Gain:Low	Total DE		00000 GHz Avg Hold	: 100/100		Radio Std	: None	Frequer	icy
10 dB/div Log	Ref 20.0	00 dBm					1					
10.0											Cente 2.4410000	
-20.0												
-40.0												
-70.0												
0.00 s ResBw 3.(						Swe	ep 4.00	ms	(6	4.00 ms 0001 pt)	CF 3.00000 Auto	F Ste D0 MH Ma
	Power reshold Lvl) .104 dBm	n		Rel	Amplitud	le Thresho e Thresho			.541 dB 5.00 dB		Freq	
				Current Outp	ut Pwr	Ма	x Pt		Mir	Pt		0 H
Above T	hreshold Pt	s 42766			l.093 dBn		.459 dB	m		.46 dBm		
ISG							STA	TUS				

Plot 7-26. Average Conducted Power (3Mbps - Ch. 39)



Plot 7-27. Average Conducted Power (3Mbps - Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 07 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 27 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



## 7.4 Band Edge Compliance §15.247 (d); RSS-247 [5.5]

### **Test Overview and Limits**

EUT operates in hopping and non-hopping transmission mode. Measurement is taken at the highest point located outside of the emission bandwidth. *The maximum permissible out-of-band emission level is 20 dBc.* 

## Test Procedure Used

ANSI C63.10-2013 - Section 6.10.4

# Test Settings

- 1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
- 2. Span was set large enough so as to capture all out of band emissions near the band edge
- 3. RBW = 100kHz
- 4. VBW = 300kHz
- 5. Detector = Peak
- 6. Number of sweep points  $\geq 2 \times \text{Span/RBW}$
- 7. Trace mode = max hold
- 8. Sweep time = auto couple
- 9. The trace was allowed to stabilize

### Test Setup

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

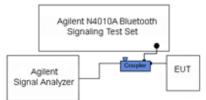


Figure 7-3. Test Instrument & Measurement Setup

## Test Notes

Out of band conducted spurious emissions at the band edge were investigated for all data rates in hopping and non-hopping modes. The worst case emissions were found with the EUT transmitting at 3 Mbps. Band edge emissions were also investigated with the EUT transmitting in all data rates. Plots of the worst case emissions are shown below.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 28 of 56
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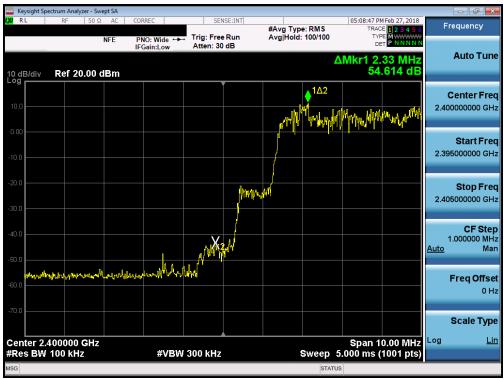




Plot 7-29. Band Edge Plot (Bluetooth with Hopping Disabled, 3 Mbps - Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of FC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 29 of 56
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Plot 7-30. Band Edge Plot (Bluetooth with Hopping Enabled, 3 Mbps)





FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 30 of 56
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7.5 Carrier Frequency Separation §15.247 (a.1); RSS-247 [5.1(2)]

## **Test Overview and Limit**

Measurement is made with EUT operating in hopping mode. The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.

### Test Procedure Used

ANSI C63.10-2013 - Section 7.8.2

### **Test Settings**

- 1. Span = Wide enough to capture peaks of two adjacent channels
- 2. RBW = 30% of channel spacing. Adjust as necessary to best identify center of each individual channel
- 3. VBW ≥ RBW
- 4. Sweep = Auto
- 5. Detector = Peak
- 6. Trace mode = max hold
- 7. The trace was allowed to stabilize.
- 8. Marker-delta function used to determine separation between peaks of the adjacent channels

### Test Setup

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

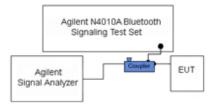


Figure 7-4. Test Instrument & Measurement Setup

### Test Notes

The EUT complies with the minimum channel separation requirement when it is operating in 1x/EDR mode using 79 channels and when operating in AFH mode using 20 channels.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 21 of 50	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 31 of 56	
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018				



Frequency [MHz]	Data Rate [Mbps]	Channel No.	Min. Channel Separation [MHz]
2402	1.0	0	0.626
2441	1.0	39	0.613
2480	1.0	78	0.621
2402	2.0	0	0.865
2441	2.0	39	0.884
2480	2.0	78	0.900
2402	3.0	0	0.888
2441	3.0	39	0.852
2480	3.0	78	0.898

Table 7-4. Minimum Channel Separation



Plot 7-32. Channel Spacing Plot (Bluetooth)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 32 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset	e Handset	
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## 7.6 Time of Occupancy §15.247 (a.1.iii); RSS-247 [5.1(4)]

### **Test Overview and Limit**

Measurement is made while EUT is operating in hopping mode with the spectrum analyzer set to zero span. *The maximum permissible time of occupancy is 400 ms within a period of 400ms multiplied by the number of hopping channels employed.* 

### **Test Procedure Used**

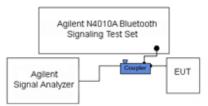
ANSI C63.10-2013 - Section 7.8.4

# **Test Settings**

- 1. Span = zero span, centered on a hopping channel
- 2. RBW  $\leq$  channel spacing and >> 1/T, where T is expected dwell time per channel
- 3. Sweep = as necessary to capture entire dwell time. Second plot may be required to demonstrate two successive hops on a channel
- 4. Trigger is set with appropriate trigger delay to place pulse near the center of the plot
- 5. Detector = peak
- 6. Trace mode = max hold
- 7. Marker-delta function used to determine transmit time per hop

### Test Setup

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



## Figure 7-5. Test Instrument & Measurement Setup

### Test Notes

None

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 22 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 33 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



🧧 Keysight Spectrum Analyzer - Swept SA													
<b>l,XI</b> R		RF	50 Ω A	C COF	REC		vse:INT y-1.000 ms	#Avg Typ	e: RMS	TRAC	MFeb 27, 2018	Fr	equency
			NFE		IO: Wide ↔ Gain:Low	<ul> <li>Trig: Vide Atten: 30</li> </ul>				TYP			
										ΔMkr1 2	.890 ms		Auto Tune
10 dE Log	3/div	Ref 20.0	00 dBr	n						-4	2.38 dB		
LOGA													Center Freq
10.0													1000000 GHz
			. 1910	- All and a second s	بالعد ببيانية	محاصرة المعرو	www.	wayan marang	Warang	,			
0.00			X1										Start Freq
-10.0												2.44	1000000 GHz
-20.0													Stop Freq
											TRIG LVL	2.44	1000000 GHz
-30.0													
-40.0										1Δ2			CF Step
									`			1 Auto	.000000 MHz Man
-50.0	Mit Mit k	w Ny .	ha M							during a	dha hababa		
	, ku ti h	L It . It .								A. Landarda	in i diadila i		Freq Offset
-60.0													0 Hz
-70.0													
													Scale Type
Cen	ter 2.44	4100000	0 GHz							s	pan 0 Hz	Log	Lin
	BW 1.				#VBW	3.0 MHz			Sweep	5.000 ms (	1001 pts)		
MSG									STA	TUS			

Plot 7-33. Time of Occupancy Plot (Bluetooth)

# Bluetooth Time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/EDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of 1600 / 6 = 266.67 hops/s/slot

- 400ms x 79 hopping channels = 31.6 sec (Time of Occupancy Limit)
- Worst case BT has 266.67 hops/second (for 1x/EDR modes with DH5 operation)
- 266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.890 ms/channel = 308.27 ms (worst case dwell time for one channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800 hops/s. AFH mode also uses 6 total slots so the Bluetooth transmitter hops at a rate of 800 / 6 = 133.3 hops/s/slot

- 400ms x 20 hopping channels = 8 sec (Time of Occupancy Limit)
- Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)
- 133.3 hops/s / 20 channels = 6.67 hops/second (# of hops/second on one channel)
- 6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over an 8 second period)
- 53.34 hops x 2.890 ms/channel = 154.15 ms (worst case dwell time for one channel in AFH mode)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 24 of 56	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 34 of 56	
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018				



7.7 Number of Hopping Channels §15.247 (a.1.iii); RSS-247 [5.1(4)]

## **Test Overview and Limit**

Measurement is made while EUT is operating in hopping mode. This frequency hopping system must employ a minimum of 15 hopping channels.

# Test Procedure Used

ANSI C63.10-2013 - Section 7.8.3

### **Test Settings**

- 1. Span = frequency of band of operation (divided into two plots)
- 2. RBW < 30% of channel spacing or 20dB bandwidth, whichever is smaller.
- 3. VBW ≥ RBW
- 4. Sweep = auto
- 5. Detector = peak
- 6. Trace mode = max hold
- 7. Trace was allowed to stabilize

### Test Setup

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

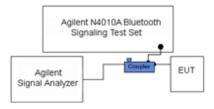


Figure 7-6. Test Instrument & Measurement Setup

### Test Notes

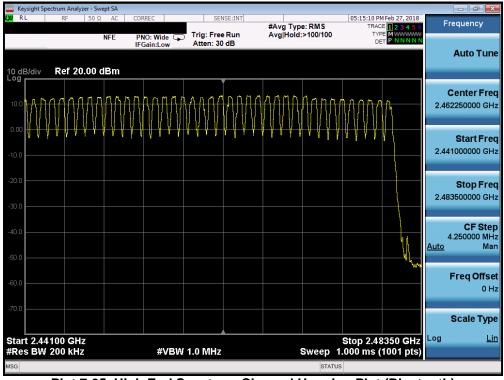
The frequency spectrum was broken up into two sub-ranges to clearly show all of the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 25 of 50	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 35 of 56	
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018				



	ht Spectrum Ar											
(X/RL	RF	50 Ω	AC	CORREC	SEI	NSE:INT	#Avg Type	e: RMS		Feb 27, 2018	Frequer	псу
			NFE	PNO: Wide 🖵	Trig: Free Atten: 30		Avg Hold:		TYP			
				IFGain:Low	Atten: 30	db					Auto	Tune
10 dB/d	Dof	20.00 d	IB ma									
	IV Rei	20.00 0			, ,	v						
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-10.0											2.4000000	00 GHz
10.0												
-20.0											Sto	p Freq
											2.4410000	
-30.0												
1											C	F Step
-40.0											4.1000	00 MHz
-50.0											Auto	Man
-50.0												
-60.0											Freq	Offset
												0 Hz
-70.0												
											Scale	е Туре
Start_2	.40000 G	Hz							Stop 2.44	100 GHz	Log	Lin
	3W 200 k			#VBW	1.0 MHz		\$	Sweep 1	1.000 ms (	1001 pts)		
MSG								STATU	S			

Plot 7-34. Low End Spectrum Channel Hopping Plot (Bluetooth)



Plot 7-35. High End Spectrum Channel Hopping Plot (Bluetooth)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 26 of 56	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 36 of 56	
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018				



### 7.8 Conducted Spurious Emissions §15.247 (d); RSS-247 [5.5]

### **Test Overview and Limit**

Conducted out-of-band spurious emissions were investigated from 30MHz up to 25GHz to include the 10<sup>th</sup> harmonic of the fundamental transmit frequency. *The maximum permissible out-of-band emission level is 20 dBc.* 

### **Test Procedure Used**

ANSI C63.10-2013 - Section 7.8.8

#### **Test Settings**

- 1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
- 2. RBW = 1MHz\* (See note below)
- 3. VBW = 3MHz
- 4. Detector = Peak
- 5. Trace mode = max hold
- 6. Sweep time = auto couple
- 7. The trace was allowed to stabilize

#### **Test Setup**

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

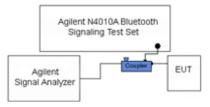


Figure 7-7. Test Instrument & Measurement Setup

### **Test Notes**

Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at 3Mbps. The display line shown in the following plots is the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, the traces in the following plots are measured with a 1MHz RBW to reduce test time, so the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 27 of 56	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 37 of 56	
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NFE         PNO: Fast         Trig: Free Run Atten: 30 dB         Trig: Free Run 30 dB         Trig: Free Run 40 dB         Trig: Free Run 40 dB		ectrum Analy	zer - Swept	SA									ð 🔀
IFGain:Low       Atten: 30 dB       Def Lattation         Mkr1 9,648 4 GHz -34.79 dBm       Auto         10 dB/div       Ref 20.00 dBm       -34.79 dBm         20 db/div       Ref 20.00 dBm	KU RL	RF						#Avg Typ	e: RMS	TRAC		Frequen	су
Center Control Control Contro		Ref 20		IF	Gain:Low	Atten: 30	) dB		Mk			Auto	Tun
10.0       0.1 - 3.52 dtm       0.1 - 3.52 dtm       30.00000         20.0       10.0       10.0       10.0       10.0       10.0       10.0         30.0       10.0       10.0       10.0       10.0       10.0       10.0       10.0000000         40.0       10.0       10.0       10.0       10.0       10.0000000       10.0000000       10.0000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.000000000       10.000000000       10.000000000       10.000000000       10.000000000       10.000000000       10.000000000       10.000000000       10.000000000       10.000000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.000000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.00000000       10.000000000       10.000000000       10.0000													
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tart 30 MHz Stop 10.000 GHz	60.0											Freq	Offse 0⊢
		WHz								Stop <u>10</u>	.000 GHz		e Typ Li
Res BW 1.0 MHz #VBW 3.0 MHz Sweep 18.00 ms (30001 pts)		1.0 MHz	z		#VBV	V 3.0 MHz		s		.00 ms (3	0001 pts)		

Plot 7-36. Conducted Spurious Plot (Bluetooth, 3Mbps - Ch. 0)



Plot 7-37. Conducted Spurious Plot (Bluetooth, 3Mbps - Ch. 0)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕑 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dega 20 of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 38 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			



	ectrum Analy		A									
XI RL	RF	50 Ω A	C COP	REC		SENSE:INT	#Avg Typ	e: RMS	TRA	M Feb 27, 2018 CE <b>1 2 3 4 5 6</b>	Frequ	iency
		NFE		NO:Fast G Gain:Low		Free Run :: 30 dB			TY D			
								M	kr1 9.58	0 9 GHz	Αι	ito Tune
10 dB/div Log	Ref 20	.00 dBr	n						-35.	01 dBm		
						Ĭ					Cer	nter Freq
10.0											5.01500	0000 GHz
0.00												
0.00												tart Freq
-10.0										DL1 -8.96 dBm	30.00	0000 MHz
-20.0												top Fred
-30.0										1-	10.00000	0000 GHz
							الايم بيد وبياد	a the state of the	بالأقراب المترجب	all and the state of the		CF Step
-40.0		And a start of the	المع باللي	MANUN N						No. of the local division of the local divis	997.00	0000 мні
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Contraction of the											Ere	q Offsel
-60.0											FIG	0 Hz
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Start 30 I	VIH 7								Stop 40	.000 GHz	Log	Lin
#Res BW		z		#VB	V 3.0 M	Hz	S	weep 1	8.00 ms (3	30001 pts)		
ISG								STATU				

Plot 7-38. Conducted Spurious Plot (Bluetooth, 3Mbps - Ch. 39)



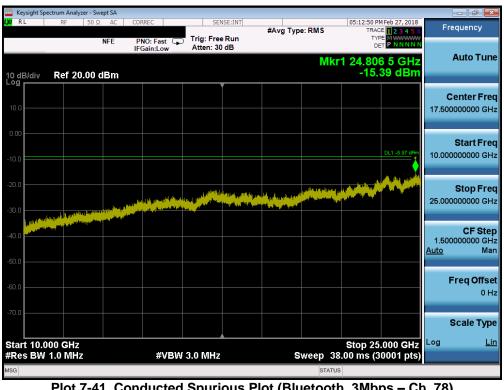
Plot 7-39. Conducted Spurious Plot (Bluetooth, 3Mbps - Ch. 39)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 39 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			





Plot 7-40. Conducted Spurious Plot (Bluetooth, 3Mbps - Ch. 78)



Plot 7-41. Conducted Spurious Plot (Bluetooth, 3Mbps – Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕕 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 40 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 40 of 56
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## 7.9 Radiated Spurious Emission Measurements – Above 1GHz §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

### **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 and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-5 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [µV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-5. Radiated Limits

### Test Procedure Used

ANSI C63.10-2013 – Section 6.6.4.3

#### Test Settings Average Field Strength Measurements per Section 4.1.4.2.3 of ANSI C63.10-2013

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW = 1MHz
- 3. VBW = 1kHz  $\ge$  1/ $\tau$  Hz, where  $\tau$  = pulse width in seconds
- 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 stabilize

### Peak Field Strength Measurements per Section 4.1.4.2.2 of ANSI C63.10-2013

- 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 7-6 below
- 3. VBW = 3MHz
- 4. Detector = peak
- 5. Sweep time = auto couple
- 6. Trace mode = max hold
- 7. Trace was allowed to stabilize

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 41 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 41 of 56
© 2018 PCTEST Engineering Labo	V 7 5 2/14/2018			



Frequency	RBW				
9 – 150kHz	200 – 300Hz				
0.15 – 30MHz	9 – 10kHz				
30 – 1000MHz	100 – 120kHz				
> 1000MHz	1MHz				
Table 7-6 PBW as a Eurotion of Frequency					

#### Table 7-6. RBW as a Function of Frequency

### Test Setup

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

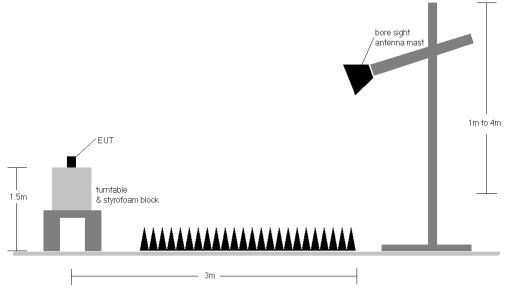


Figure 7-8. Radiated Test Setup >1GHz

### Test Notes

- 1. All emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-5.
- 2. No significant radiated emissions were found in the 2310 2390MHz restricted band.
- 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 10<sup>th</sup> harmonic and the worst-case emissions are reported.
- 6. The duty cycle correction factor was not applied to noise floor measurements.
- 7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
- 8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dogo 42 of 56	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 42 of 56	
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### Sample Calculation

- ο Field Strength Level [dBµV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + Duty Cycle Correction [dB]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB]
- Margin [dB] = Field Strength Level  $[dB_{\mu}V/m]$  Limit  $[dB_{\mu}V/m]$

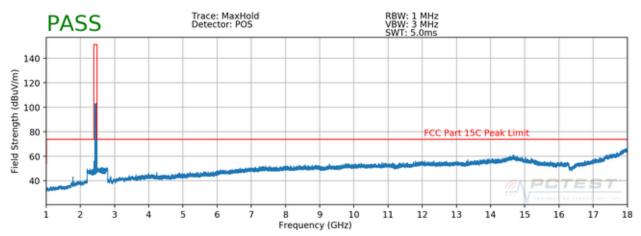
### **Duty Cycle Correction Factor Calculation**

- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50 x 20 channels = 150 ms
- Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
- Worst case dwell time = 7.5 ms
- Duty cycle correction factor = 20log<sub>10</sub>(7.5ms/100ms) = -22.5 dB

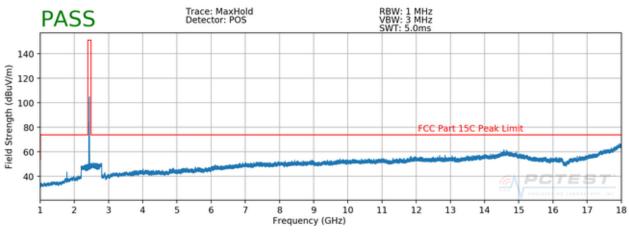
FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 42 of EG	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 43 of 56	
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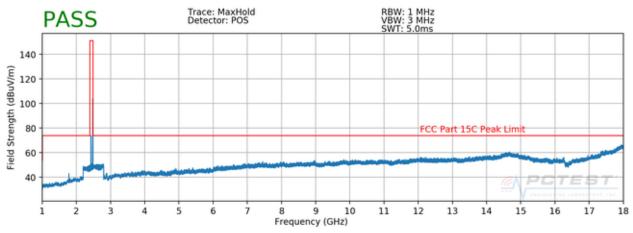
### Radiated Spurious Emission Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]









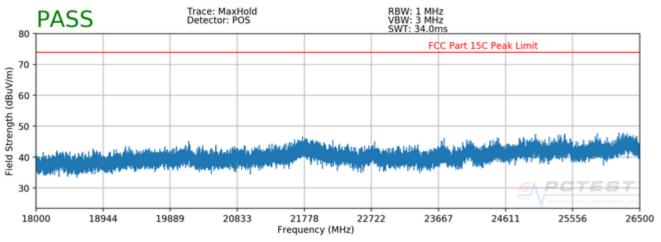


### Plot 7-44. Radiated Spurious Plot above 1GHz (BT - Ch. 78)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	💽 LG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 44 of 56	
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 44 of 56	
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### Radiated Spurious Emissions Measurements (Above 18GHz) §15.209; RSS-Gen [8.9]



Plot 7-45. Radiated Spurious Plot above 18GHz

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 45 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 45 of 56
© 2018 PCTEST Engineering Labo	ratory, Inc.	•		V 7.5 2/14/2018



# Radiated Spurious Emission Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	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 [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	Н	-	-	-78.35	2.42	31.07	53.98	-22.90
4804.00	Peak	Н	-	-	-64.88	2.42	44.54	73.98	-29.43
12010.00	Avg	Н	-	-	-79.92	13.48	40.56	53.98	-13.42
12010.00	Peak	Н	-	-	-67.96	13.48	52.52	73.98	-21.46

Table 7-7. Radiated Measurements

Worst Case Mode:				
Worst Case Data Rate:				
Measurement Distance:				
Operating Frequency:				
Channel:				

Bluetooth
1 Mbps
3 Meters
2441MHz
39

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Avg	н	-	-	-78.45	3.36	31.91	53.98	-22.07
4882.00	Peak	Н	-	-	-65.05	3.36	45.31	73.98	-28.67
7323.00	Avg	Н	-	-	-79.93	9.71	36.78	53.98	-17.20
7323.00	Peak	Н	-	-	-67.49	9.71	49.22	73.98	-24.76
12205.00	Avg	н	-	-	-80.25	13.88	40.63	53.98	-13.35
12205.00	Peak	н	-	-	-68.11	13.88	52.77	73.98	-21.21

 Table 7-8. Radiated Measurements

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dago 46 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 46 of 56
© 2019 DOTEST Engineering Labo	roton/ Inc			V 7 E 2/11/2019



# Radiated Spurious Emission Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	н	-	-	-78.63	2.62	30.99	53.98	-22.99
4960.00	Peak	н	-	-	-66.34	2.62	43.28	73.98	-30.70
7440.00	Avg	н	-	-	-79.47	9.48	37.01	53.98	-16.97
7440.00	Peak	н	-	-	-67.10	9.48	49.38	73.98	-24.60
12400.00	Avg	н	-	-	-80.45	12.93	39.48	53.98	-14.50
12400.00	Peak	н	-	-	-67.67	12.93	52.26	73.98	-21.72

 Table 7-9. Radiated Measurements

Worst Case Mode: Worst Case Data Rate: Measurement Distance: Operating Frequency: Channel:

Bluetooth	
1 Mbps	
3 Meters	
2441MHz	
39	

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Avg	Н	-	-	-78.15	3.36	32.21	53.98	-21.77
4882.00	Peak	н	-	-	-66.86	3.36	43.50	73.98	-30.48
7323.00	Avg	Н	-	-	-80.04	9.71	36.67	53.98	-17.31
7323.00	Peak	Н	-	-	-68.15	9.71	48.56	73.98	-25.42
12205.00	Avg	Н	-	-	-81.36	13.88	39.52	53.98	-14.46
12205.00	Peak	н	-	-	-68.68	13.88	52.20	73.98	-21.78

### Table 7-10. Radiated Measurements with WCP

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 47 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 47 of 56
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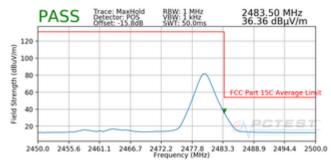
### 7.10 Radiated Restricted Band Edge Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting. Two different amplitude offsets were used depending on whether peak or average measurements were measured. The average measurements use a duty cycle correction factor (DCCF).

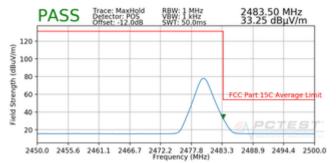
The amplitude offset shown in the following plots for average measurements was calculated using the formula:

Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) - Preamplifier Gain + DCCF

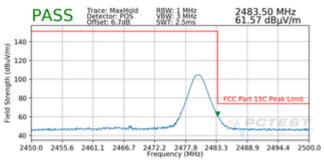
Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



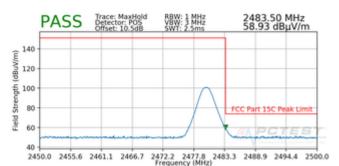
Plot 7-46. Radiated Restricted Upper Band Edge Measurement (Average)



Plot 7-48. Radiated Restricted Upper Band Edge Measurement with WCP (Average)



Plot 7-47. Radiated Restricted Upper Band Edge Measurement (Peak)



Plot 7-49. Radiated Restricted Upper Band Edge Measurement with WCP (Peak)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 49 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset	Page 48 of 56	
© 2018 PCTEST Engineering Labo	ratory Inc	-		V 7 5 2/14/2018



### 7.11 Radiated Spurious Emissions Measurements – Below 1GHz §15.209; RSS-Gen [8.9]

### **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 its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. 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 and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-11 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [μV/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 7-11. Radiated Limits

### **Test Procedures Used**

ANSI C63.10-2013

### **Test Settings**

### **Quasi-Peak Field Strength Measurements**

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW = 120kHz (for emissions from 30MHz 1GHz)
- 3. Detector = quasi-peak
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 40 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset	Page 49 of 56	
© 2018 PCTEST Engineering Labo	ratory. Inc.			V 7.5 2/14/2018



### Test Setup

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

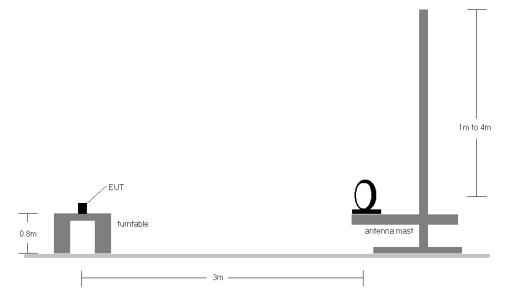
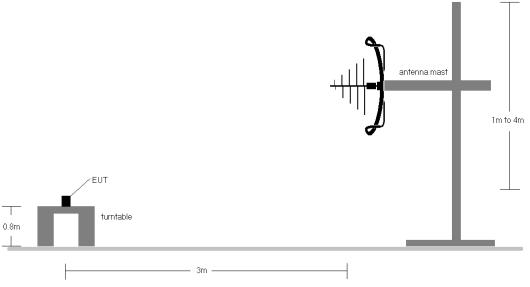
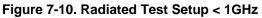


Figure 7-9. Radiated Test Setup < 30Mhz





FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🔁 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Daga 50 of 50
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 50 of 56
© 2018 PCTEST Engineering Labo	V 7.5 2/14/2018			

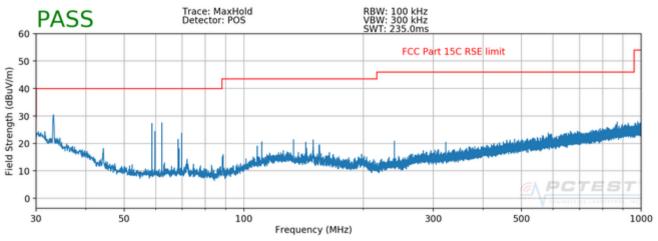


- 1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen (8.10) are below the limit shown in Table 7-11.
- 2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
- 3. This unit was tested with its standard battery.
- 4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
- 5. Emissions were measured at a 3 meter test distance.
- 6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
- 7. No spurious emissions were detected within 20dB of the limit below 30MHz.
- 8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
- The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage E1 of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset	Page 51 of 56	
© 2018 PCTEST Engineering Labo	ratory Inc			V 7 5 2/1//2018



### Radiated Spurious Emissions Measurements (Below 1GHz) §15.209; RSS-Gen [8.9]



Plot 7-50. Radiated Spurious Plot below 1GHz (Pol. H)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 52 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset	Page 52 of 56
© 2018 PCTEST Engineering Labo	ratory. Inc.		V 7.5 2/14/2018



### 7.12 Line Conducted Measurement Data §15.207; RSS-Gen [8.8]

### Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

### All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

Frequency of emission (MHz)	Conducted Limit (dBµV)						
	Quasi-peak	Average					
0.15 – 0.5	66 to 56*	56 to 46*					
0.5 – 5	56	46					
5 – 30	60	50					

Table 7-12. Conducted Limits

\*Decreases with the logarithm of the frequency.

### **Test Procedures Used**

ANSI C63.10-2013, Section 6.2

#### Test Settings

#### **Quasi-Peak Field Strength Measurements**

- 1. Analyzer center frequency was set to the frequency of the spurious emission of interest
- 2. RBW = 9kHz (for emissions from 150kHz 30MHz)
- 3. Detector = quasi-peak
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

### Average Field Strength Measurements

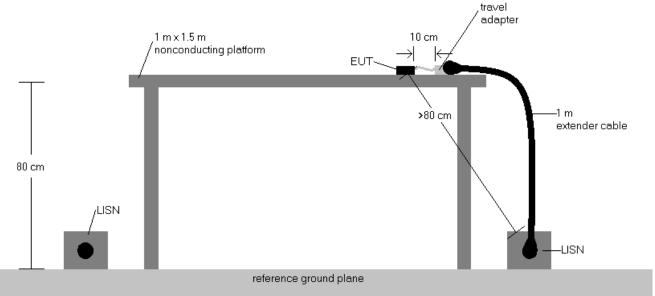
- 1. Analyzer center frequency was set to the frequency of the spurious emission of interest
- 2. RBW = 9kHz (for emissions from 150kHz 30MHz)
- 3. Detector = RMS
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕕 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Daga 52 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 53 of 56
© 2018 PCTEST Engineering Labo	pratory Inc.			V 7 5 2/14/2018



### Test Setup

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





### Test Notes

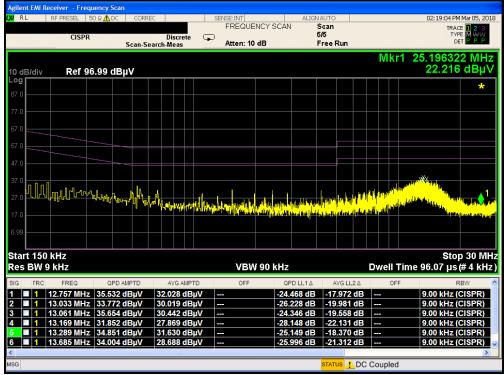
- 1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
- 2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
- 3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
- 4. QP/AV Level (dB $\mu$ V) = QP/AV Analyzer/Receiver Level (dB $\mu$ V) + Corr. (dB)
- 5. Margin (dB) = QP/AV Limit (dB $\mu$ V) QP/AV Level (dB $\mu$ V)
- 6. Traces shown in plot are made using a peak detector.
- 7. Deviations to the Specifications: None.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Daga E4 of EC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 54 of 56
© 2018 PCTEST Engineering Labo	ratory, Inc.			V 7.5 2/14/2018



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3 4	1 12.7	01 MHz 97 MHz	35.2	13 dB	μV	30.63 35.01	7 dB	μV				-24.7	066 dB 787 dB	-14	.361 .983	dB				9.00 kH	iz (CISP iz (CISP	R)
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Plot 7-51. Line-Conducted Test Plot (L1)



Plot 7-52. Line-Conducted Test Plot (N)

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage FE of FC
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		Page 55 of 56
© 2018 PCTEST Engineering Labo	ratory. Inc.	·		V 7.5 2/14/2018



### 8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the LG Portable Handset FCC ID: ZNFG710VM is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

FCC ID: ZNFG710VM		MEASUREMENT REPORT (CERTIFICATION)	🕒 LG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 56 of 56
1M1802260032-02-R1.ZNF	2/26 - 3/29/2018	Portable Handset		
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