

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: 11/10 - 11/29/2017 Test Site/Location: PCTEST Lab. Columbia, MD, USA Test Report Serial No.: 1M1711080291-06-R1.ZNF

FCC ID:

ZNFX210VPP

Certification

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):

LM-X210VPP LMX210VPP, X210VPP Portable Handset 13.017 mW (11.15 dBm) Peak Conducted 2402 – 2480MHz GFSK, π /4-DQPSK, 8DPSK FCC Part 15 Spread Spectrum Transmitter (DSS) Part 15 Subpart C (15.247) ANSI C63.10-2013

This revised Test Report (S/N: 1M1711080291-06-R1.ZNF) supersedes and replaces the previously issued test report (S/N: 1M1711080291-06.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.

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.

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



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 Image: Certification
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 EUT Type:

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 Portable Handset

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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 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 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 (22831) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **LG Portable Handset FCC ID: ZNFX210VPP**. 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.: 3740, 3617, 3708

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 CDMA (BC0, BC1), Multi-band LTE, 802.11b/g/n WLAN, Bluetooth (1x, EDR, LE)

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.

2.4 EMI Suppression Device(s)/Modifications

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

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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.

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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).

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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.

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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

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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
-	BT2	Bluetooth Cable Set	6/14/2017	Annual	6/14/2018	BT2
Agilent	N4010A	Wireless Connectivity Test Set		N/A		GB46170464
Agilent	N9020A	MXA Signal Analyzer	12/28/2016	Annual	12/28/2017	US46470561
Agilent	N9038A	MXE EMI Receiver	4/26/2017	Annual	4/26/2018	MY51210133
COM-Power	AL-130R	Active Loop Antenna	6/5/2017	Annual	6/5/2018	121085
Emco	3115	Horn Antenna (1-18GHz)	3/10/2016	Biennial	3/10/2018	9704-5182
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	3164-05	Quad Ridge Horn (Small) 2 - 18GHz	5/31/2016	Biennial	5/31/2018	208255
Huber+Suhner	Sucoflex 102A	40GHz Radiated Cable	5/19/2017	Annual	5/19/2018	251425001
Pasternack	NMLC-1	Line Conducted Emissions Cable (NM)	5/31/2017	Annual	5/31/2018	NMLC-1
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	102134
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/3/2017	Annual	7/3/2018	102133
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	3/7/2017	Annual	3/7/2018	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	5/11/2017	Annual	5/11/2018	100040
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/2/2016	Biennial	3/2/2018	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
Sunol Sciences	JB6	JB6 Antenna	9/27/2016	Biennial	9/27/2018	A082816

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

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

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7.0 TEST RESULTS

7.1 Summary

Company Name:	LG Electronics MobileComm U.S.A
FCC ID:	ZNFX210VPP
Method/System:	Frequency Hopping Spread Spectrum (FHSS)
Number of Channels:	79

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>></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.

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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

- 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.

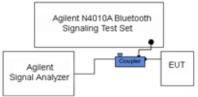


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None

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Frequency [MHz]	Data Rate [Mbps]	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	0	949.70
2441	1.0	39	940.80
2480	1.0	78	941.00
2402	2.0	0	1349.00
2441	2.0	39	1323.00
2480	2.0	78	1280.00
2402	3.0	0	1250.00
2441	3.0	39	1267.00
2480	3.0	78	1272.00

Table 7-2. Conducted 20dB Bandwidth Measurements



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

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



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

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



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

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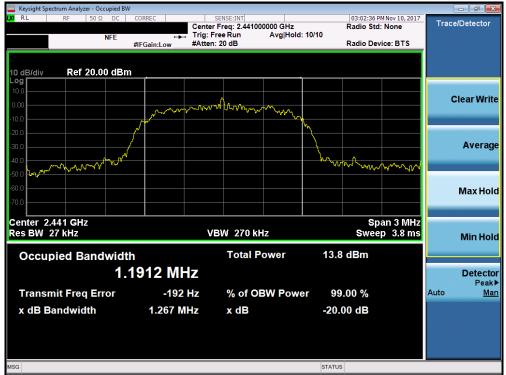
Plot 7-6. 20dB Bandwidth Plot (Bluetooth, 2Mbps - Ch. 78)



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

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Plot 7-8. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 39)



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

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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 data is provided to determine the need for Bluetooth SAR testing according to KDB 447498 D01 v06. 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

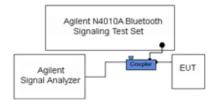
Test Settings

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.





<u>Note</u>

This unit was tested with all possible data rates and the highest peak power is reported with the unit transmitting at 1Mbps.

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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	0	Peak Co Pov	nducted wer	Avg Cor Pov	nducted wer
Frequency [MHz]	Rate [Mbps]	Channel No.	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	9.91	9.802	9.75	9.448
2441	1.0	39	11.15	13.017	10.98	12.536
2480	1.0	78	9.70	9.326	9.50	8.915
2402	2.0	0	8.96	7.861	6.17	4.141
2441	2.0	39	10.30	10.703	7.61	5.768
2480	2.0	78	8.77	7.525	6.05	4.031
2402	3.0	0	9.35	8.602	6.24	4.210
2441	3.0	39	10.70	11.754	7.68	5.859
2480	3.0	78	9.16	8.239	6.12	4.095

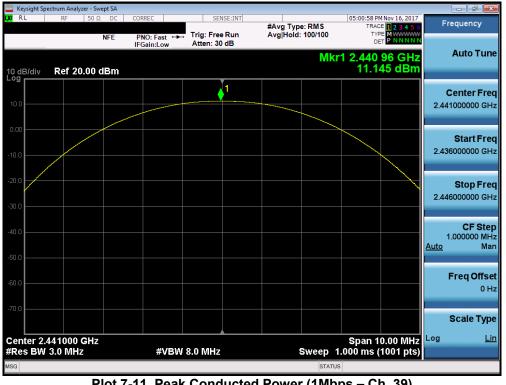
 Table 7-3. Conducted Output Power Measurements

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	pectrum Analyze							
LXI RL	RF	50 Ω DC	CORREC	SENSE:I	#Avg Type	E: RMS TR	PM Nov 16, 2017 ACE 1 2 3 4 5 6	Frequency
		NFE	PNO: Fast ↔ IFGain:Low	Atten: 30 dB	n Avginoid.	100/100		
10 dB/div	Ref 20.	00 dBm				Mkr1 2.40 9.	2 05 GHz 913 dBm	Auto Tune
10.0				1				Center Freq 2.402000000 GHz
0.00								2.402000000 GH2
-10.0								Start Freq 2.397000000 GHz
-20.0								Ctop From
-30.0								Stop Fred 2.407000000 GHz
-40.0								CF Step 1.000000 MHz
-50.0								Auto Mar
-60.0								Freq Offse
-70.0								
								Scale Type
	402000 G 3.0 MHz	Hz	#VBI	V 8.0 MHz		Span Sweep 1.000 ms	10.00 MHz 5 (1001 pts)	Log <u>Lin</u>
MSG						STATUS		

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





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	pectrum Analyz							
L <mark>XI</mark> RL	RF	50 Ω DC	CORREC	SENSE:I	#Avg Type	RMS TR	PM Nov 16, 2017 ACE 1 2 3 4 5 6 YPE M WWW	Frequency
		NFE	PNO: Fast + IFGain:Low	Atten: 30 dB				Auto Tune
10 dB/div Log	Ref 20.	.00 dBm				Mkr1 2.479 9.1	9 92 GHz 697 dBm	AutoTune
				1				Center Fred
10.0								2.480000000 GHz
0.00								Start Fred
-10.0								2.475000000 GHz
-20.0								Stop Free
-30.0								2.485000000 GH:
-40.0								CF Step 1.000000 MH
-50.0								<u>Auto</u> Mar
-60.0								Freq Offse
-70.0								0 H:
								Scale Type
	.480000 C		#VB	W 8.0 MHz		Span Sweep 1.000 ms	10.00 10112	Log <u>Lir</u>
MSG						STATUS	(1997) (1997)	

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



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

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	ectrum Analyz						
LXU RL	RF	50 Ω DC	CORREC	SENSE:INT	#Avg Type: RMS Avg Hold: 100/100	05:01:29 PM Nov 16, 2017 TRACE 1 2 3 4 5 6 TYPE MWWWW DET P N N N N N	Frequency
			IFGain:Low	Atten: 30 dB	Mki	1 2.440 92 GHz	Auto Tune
10 dB/div Log	Ref 20.	.00 dBm				10.295 dBm	
				1			Center Freq
10.0							2.441000000 GHz
0.00							Start Freq
-10.0							2.436000000 GHz
-20.0							Stop Fred
-30.0							2.446000000 GHz
-40.0							CF Step 1.000000 MH
-50.0							Auto Mar
-30.0							Freq Offset
-60.0							0 Hz
-70.0							Scale Type
Center 2. #Res BW			#VBW	8.0 MHz	Sweep 1	Span 10.00 MHz I.000 ms (1001 pts)	Log <u>Lin</u>
MSG					STATU		

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



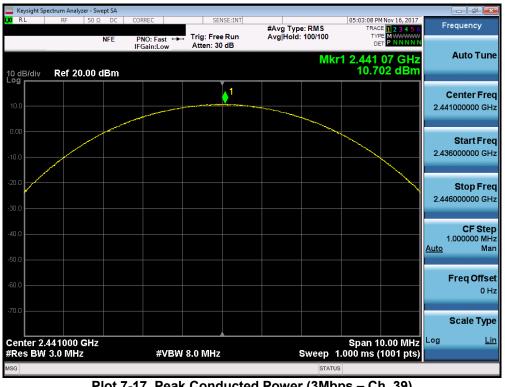
Plot 7-15. Peak Conducted Power (2Mbps - Ch. 78)

FCC ID: ZNFX210VPP		MEASUREMENT REPORT (CERTIFICATION)	💽 LG	Approved by: Quality Manager
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	pectrum Analyze						
LXI RL	RF	50 Ω DC	CORREC	SENSE:INT	#Avg Type: RMS Avg Hold: 100/100	05:02:57 PM Nov 16, 2017 TRACE 1 2 3 4 5 6	Frequency
	-	NFE	PNO: Fast ↔ IFGain:Low	Atten: 30 dB		TYPE MWWWW DET PNNNNN	
10 dB/div Log	Ref 20.	00 dBm			Mki	1 2.402 09 GHz 9.346 dBm	Auto Tune
				1			Center Fred
10.0							2.402000000 GHz
0.00			<u> </u>				Start Fred
-10.0							2.397000000 GHz
-20.0							Stop Fred
-30.0							2.407000000 GHz
-40.0							CF Step 1.000000 MH
-50.0							<u>Auto</u> Mar
-60.0							Freq Offse
							0 H:
-70.0							Scale Type
	.402000 G / 3.0 MHz	Hz	#\/D\	N 8.0 MHz		opun 10.00 minz	Log <u>Lir</u>
	5.0 MHZ		#VB	N 8.0 MHZ	Sweep	1.000 ms (1001 pts)	

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





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	ectrum Analy	zer - Swept	t SA									_	
X/RL	RF	50 Ω		CORREC				#Avg Typ Avg Hold:		TRA	M Nov 16, 2017 CE 1 2 3 4 5 6 PE M MAAAAAAAAA	Fr	equency
		N	FE	PNO: Fa	ast ⊶⊷ .ow	Atten: 3		Avginoid	. 100/100	D	PE MWWWWW ET P N N N N N		
10 dB/div	Ref 20).00 dE	3m						Mk	r1 2.480 9.1	07 GHz 59 dBm		Auto Tune
							<u>1</u>						Center Freq
10.0												2.48	0000000 GHz
0.00			and the second										
-10.0												2.47	Start Freq 5000000 GHz
-20.0											- Non	2.48	Stop Freq
-30.0													
-40.0													CF Step .000000 MHz
-50.0												<u>Auto</u>	Mar
-60.0												I	Freq Offset
-70.0													0 Hz
-70.0													Scale Type
Center 2.						0.0.0411	A			Span 1	0.00 MHz	Log	Lin
#Res BW	3.0 MHz	2		#	#VBW	8.0 MHz					(1001 pts)		
MSG									STATU	5			

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



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

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Keysight Spec	trum Analyzer - B RF 50 !	Ω DC C	CORREC FGain:Low	SENSE:INT Center Freq: 2.441000000 GHz Trig: RF Burst Avg Hold: 100/100 #Atten: 16 dB					5:05:01 Pi idio Std:	M Nov 16, 2017 None	Frequency
10 dB/div Log	Ref 20.0	00 dBm									
0.00											Center Free 2.441000000 GH
-10.0											
-30.0											
-50.0											
- ^{70.0}										4.00 ms	
ResBw 3.0	00 MHz					Swe	ep 4.00	ms	(6	0001 pt)	CF Step 3.000000 MH
	ower reshold Lvl) .982 dBrr	h		Rel	Abs Amplitude Threshold Rel Amplitude Threshold				95 dB .00 dB	m	Auto Man Freq Offset
				Current Outp	t Data out Pwr	Ма	x Pt		Min	Pt	0 H
Above Ti	hreshold Pt	is 4328	8).982 dBm		.105 dE	ßm		.09 dBm	
ISG							STA	TUS			

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



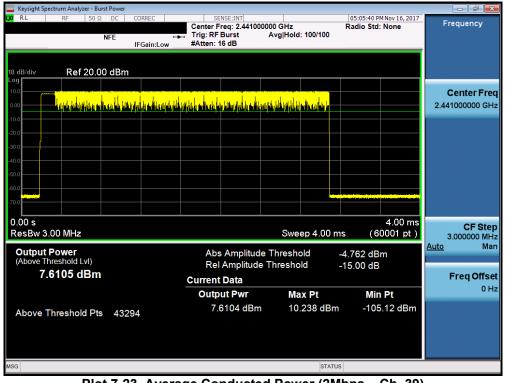
Plot 7-21. Average Conducted Power (1Mbps - Ch. 78)

FCC ID: ZNFX210VPP		MEASUREMENT REPORT (CERTIFICATION)	💽 LG	Approved by: Quality Manager
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Keysight Spec	trum Analyzer - Bi		ORREC	SE	ENSE:INT			05:05:29	PM Nov 16, 2017		
110	10 503	NFE			req: 2.40200 Burst	00000 GHz Avg Hold	: 100/100	Radio Sto		Frequency	У
10 dB/div Log	Ref 20.0	00 dBm									
0.00	Legislada de la competencia de la comp	The state of the state of the	<mark>dia kanaka</mark>	<mark>I hijilili odinalu</mark> l	<mark>iy kiteri iyalah sa</mark> dik	weekste pristan	nin au in i			Center I 2.402000000	
-10.0											
40.0											
-60.0											
0.00 s ResBw 3.0	00 MHz					Swe	ep 4.00 r	ns (f	4.00 ms 50001 pt)	CF \$ 3.000000	
	reshold Lvl)				s Amplitud I Amplitude			-6.216 dE -15.00 dE		<u>Auto</u>	Ma
0.1	1713 dBm			Current	t Data out Pwr	Ma	x Pt		n Pt	Freq O	ffse 0 H
Above TI	hreshold Pt	s 4330	1		1693 dBm		839 dBn		1.10 dBm		
SG							STAT	US			

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



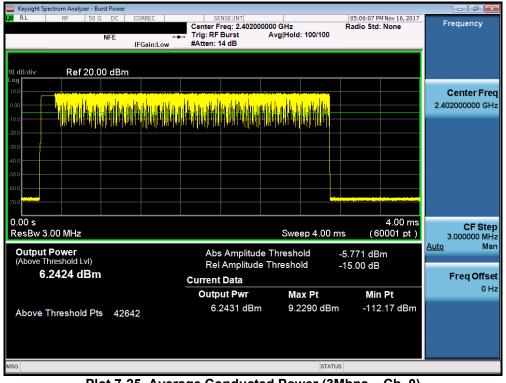
Plot 7-23. Average Conducted Power (2Mbps - Ch. 39)

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with the second	ctrum Analyzer - RF 5	Burst Power 0 Ω DC	CORREC	Cen	SENSE:INT	00000 GHz		05:05:53	PM Nov 16, 2017 d: None	Frequenc	
		NFE	IFGain:L): RF Burst ten: 14 dB	Avg Hold	: 100/100				
10 dB/div	Ref 20).00 dBr	n								
10.0										Center	
-10.0	tariyidarija	<u>h n İttiriyi</u>		<u>a debidi nijite ni</u>	<mark>ia dia kina kilina dipila ja an</mark> i					2.48000000	0 GHz
-20.0											
-30.0											
-50.0											
-60.0											
									1.00		
0.00 s ResBw 3.4	00 MHz					Swe	ep 4.00 r	ns (6	4.00 ms 60001 pt)	3.000000	
Output I (Above Th	Power reshold Lvl)				Abs Amplitue			-6.283 dE		<u>Auto</u>	Ma
	0546 dB			Cur	Rel Amplitud rent Data	le i nresno		-15.00 dE	3	Freq O	ffse
					output Pwr	Ma	x Pt	Mi	n Pt		0 H
Above T	hreshold I	Pts 43	298		6.0521 dBr	n 8.7	175 dBm	n -11	6.63 dBm		
ISG							STATU	JS			

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



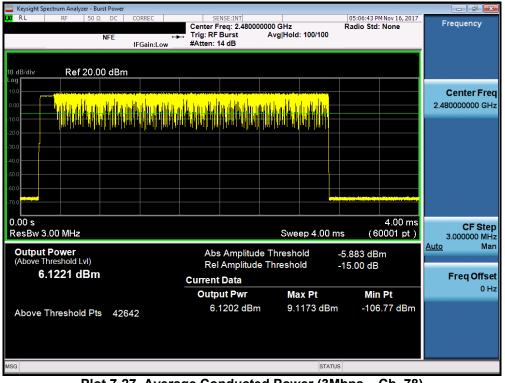
Plot 7-25. Average Conducted Power (3Mbps - Ch. 0)

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Keysight Spectrum Analyzer - Burst Power K RL RF 50 Ω CORREC	SENSE:INT	05:06:31 PM Nov 16, 2017	Frequency			
NEL						
IFGain:Low	#Atten: 16 dB					
10 dB/div Ref 20.00 dBm						
			Center Freq			
	n i k, hor pli a the date plan and the date by		2.441000000 GHz			
-20.0						
-40.0						
-50.0						
-60.0						
		4.00 ms				
0.00 s ResBw 3.00 MHz	Sweep 4.00		CF Step 3.000000 MHz			
Output Power	Abs Amplitude Threshold	-4.325 dBm	<u>Auto</u> Man			
(Above Threshold Lvl) 7.6782 dBm	Rel Amplitude Threshold	-15.00 dB	Ener Offerst			
	Current Data	Min D4	Freq Offset 0 Hz			
	Output Pwr Max Pt 7.6747 dBm 10.675 dBr	Min Pt m -103.62 dBm				
Above Threshold Pts 42667						
MSG	STAT	US				

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



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

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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.

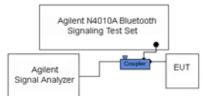


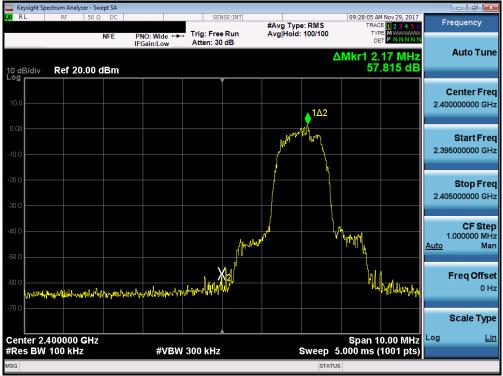
Figure 7-3. Test Instrument & Measurement Setup

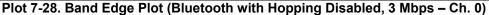
Test Notes

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.

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

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Plot 7-30. Band Edge Plot (Bluetooth with Hopping Enabled, 3 Mbps)



Plot 7-31. Band Edge Plot (Bluetooth with Hopping Enabled, 3 Mbps)

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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.

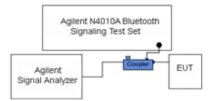


Figure 7-4. Test Instrument & Measurement Setup

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.

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Frequency [MHz]	Data Rate [Mbps]	Channel No.	Min. Channel Separation [MHz]
2402	1.0	0	0.633
2441	1.0	39	0.629
2480	1.0	78	0.627
2402	2.0	0	0.899
2441	2.0	39	0.882
2480	2.0	78	0.853
2402	3.0	0	0.833
2441	3.0	39	0.845
2480	3.0	78	0.848

Table 7-4. Minimum Channel Separation



Plot 7-32. Channel Spacing Plot (Bluetooth)

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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.

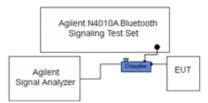


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

None

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	ectrum Analyzer						
LXU RL	RF	50 Ω DC	CORREC	SENSE:INT Trig Delay-499.0 µs Trig: Video	#Avg Type: RMS	03:22:19 PM Nov 10, 2017 TRACE 1 2 3 4 5 6 TYPE WWWWW DET P N N N N	Frequency
10 dB/div Log	Ref 20.0	00 dBm	IFGain:Low	Atten: 30 dB		∆Mkr1 2.895 ms -2.27 dB	Auto Tune
10.0		~~~~·					Center Freq 2.441000000 GHz
-10.0							Start Freq 2.441000000 GHz
-20.0	X ₂				1∆2		Stop Freq 2.441000000 GHz
-40.0							CF Step 1.000000 MHz <u>Auto</u> Man
-50.0	γŴ				how the state of t	han an a	Freq Offset 0 Hz
-70.0							Scale Type
Center 2.4 Res BW 1		0 GHz	#VBW	3.0 MHz	Sweep	Span 0 Hz 5.000 ms (1001 pts)	Log <u>Lin</u>
MSG					STATU		

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)
- o 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.895 ms/channel = 308.80 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)
- o 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 a 8 second period)
- o 53.34 hops x 2.895 ms/channel = 154.41 ms (worst case dwell time for one channel in AFH mode)

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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.

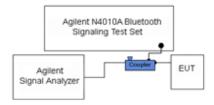


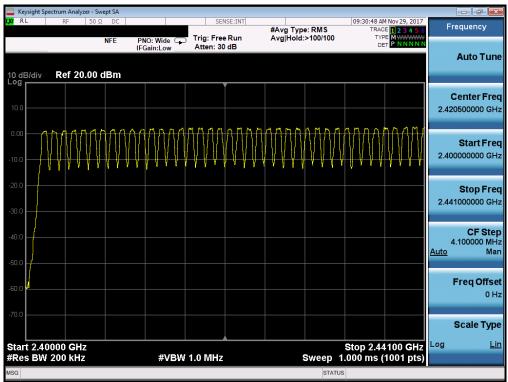
Figure 7-6. Test Instrument & Measurement Setup

Test Notes

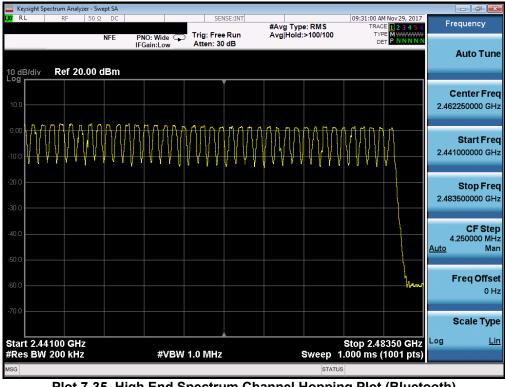
The frequency spectrum was broken up into two sub-ranges to clearly show all of the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.

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



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

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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 10th 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.

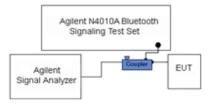


Figure 7-7. Test Instrument & Measurement Setup

Test Notes

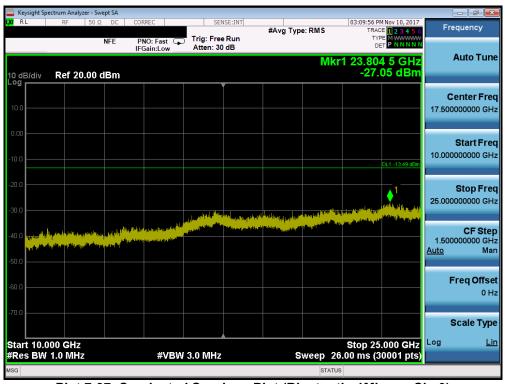
Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at 1Mbps. The display line shown in the following plots is the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, the 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.

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🔤 Keysight Sp	pectrum Analyz	zer - Swept SA										X
LX/ RL	RF	50 Ω DC NFE	PNC): Fast 🗔	Trig: Fre		#Avg Typ	e: RMS	TRA	M Nov 10, 2017 CE 1 2 3 4 5 6 PE M WWWWW ET P N N N N N	Frequency	
10 dB/div Log	Ref 20	.00 dBm		iin:Low	Atten: 30) dB		М	kr1 8.89	7 3 GHz 03 dBm	Auto T	une
10.0											Center F 5.015000000	
.00										DL1 -13.49 dBm	Start F 30.000000 1	
30.0											Stop F 10.000000000	
40.0	all sector and all s	and the first state	ana didak atai ti				p ^{a th} lighteatin (special) air th lighteatin (special)	ر میردا رود میرد. بر طالام بازی میرا	political approximation	an a	CF S 997.000000 I <u>Auto</u>	
50.0 Martin		A CONTRACTOR OF CONTRACTOR									Freq Ofi	fse 0 H
-70.0									Stop 10	.000 GHz	Scale T	'yp Li
#Res BW	1.0 MHz	2		#VBW	3.0 MHz		S	weep 1	8.00 ms (3	10001 pts)		

Plot 7-36. Conducted Spurious Plot (Bluetooth, 1Mbps - Ch. 0)



Plot 7-37. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 0)

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	ctrum Analyze											7 ×
LXI RL	RF	50 Ω DC	C COF	RREC		NSE:INT	#Avg Typ	e: RMS	TRAC	MNov 10, 2017 CE 1 2 3 4 5 6	Frequenc	су
		NFE		NO:Fast 🕞 Gain:Low	Trig: Fre Atten: 3				TYP	PE M WWWWW ET P N N N N N		
			IIV	Sum.Low				Mk	r1 8.64	2 8 GHz	Auto	Tune
10 dB/div	Ref 20.	00 dBn	n						-38.	87 dBm		
						Ĭ					Center	Erog
10.0											5.01500000	
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											30.00000	
-10.0										DL1 -12.05 dBm		
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and the state of the	A DESCRIPTION OF THE OWNER OF THE										FreqC	ffeat
-60.0											riequ	0 Hz
-70.0												
-70.0											Scale	Туре
											Log	Lin
Start 30 N #Res BW				#VBV	/ 3.0 MHz		s	weep 18	Stop 10 .00 ms_(3	.000 GHz 0001 pts)	209	
ISG								STATUS		e e e proy		

Plot 7-38. Conducted Spurious Plot (Bluetooth, 1Mbps - Ch. 39)



Plot 7-39. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 39)

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	oectrum Analyzer - 1									
LXI RL	RF 50	Ω DC NFE	CORREC PNO: Fast		ree Run	#Avg Type	e: RMS	TRAC	INOV 10, 2017 E 1 2 3 4 5 6 E M WWWWWW T P N N N N N	Frequency
10 dB/div Log	Ref 20.00) dBm	IFGain:Lov	v Atten	30 dB		M	kr1 9.258		Auto Tun
10.0										Center Fre 5.015000000 GH
-10.0									DL1 -14.05 dBm	Start Fre 30.000000 M⊦
-20.0									4	Stop Fre 10.000000000 G⊦
-40.0		Jacob Constanting	nanang sa ^{panta} ng sa p		arritegen Maltinger f	and the part of the line of th	gyn Cyster yn Per y diwr aidwrai'r y	an a	n the transition	CF Ste 997.000000 M⊢ <u>Auto</u> Ma
-60.0	and an a state of the state of									Freq Offse 0 ⊦
-70.0 Start 30 I	MHz							Stop 10.	000 GHz	Scale Typ
	1.0 MHz		#\	/BW 3.0 MI	łz	S	weep 1	8.00 ms (3	0001 pts)	

Plot 7-40. Conducted Spurious Plot (Bluetooth, 1Mbps - Ch. 78)



Plot 7-41. Conducted Spurious Plot (Bluetooth, 1Mbps - Ch. 78)

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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/ τ Hz, where τ = 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

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

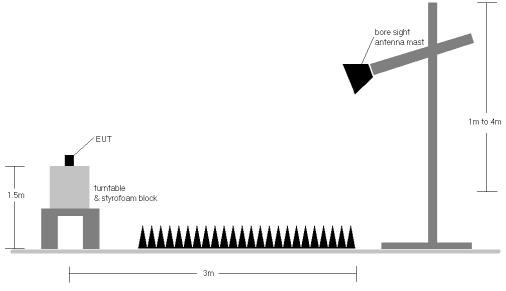


Figure 7-8. Radiated Test Setup >1GHz

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 10th 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.

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Sample Calculation

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

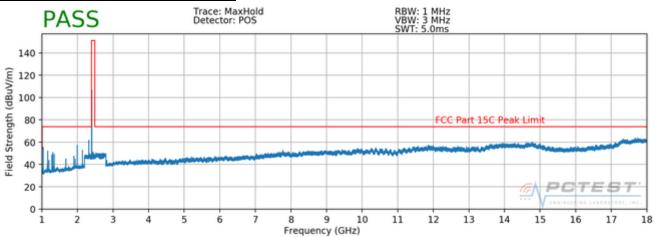
Duty Cycle Correction Factor Calculation

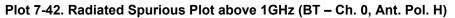
- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50 x 20 channels = 150 ms
- Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
- Worst case dwell time = 7.5 ms
- Duty cycle correction factor = 20log₁₀(7.5ms/100ms) = -22.5 dB

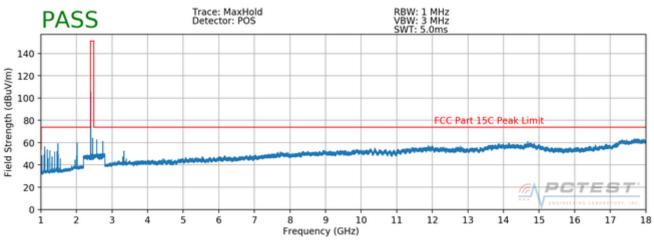
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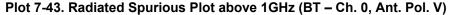


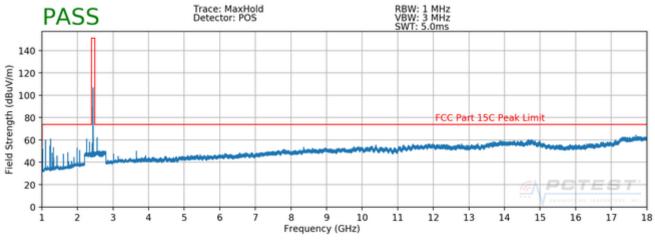
Radiated Spurious Emission Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]







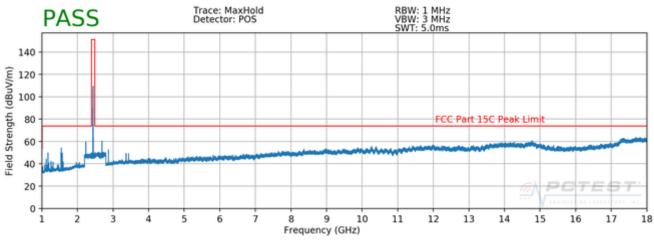




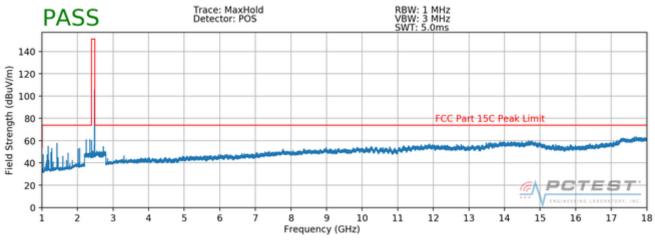
Plot 7-44. Radiated Spurious Plot above 1GHz (BT - Ch. 39, Ant. Pol. H)

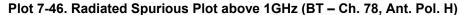
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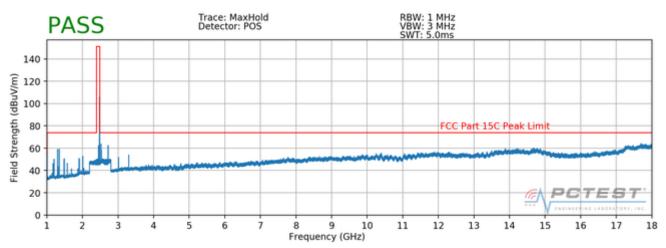










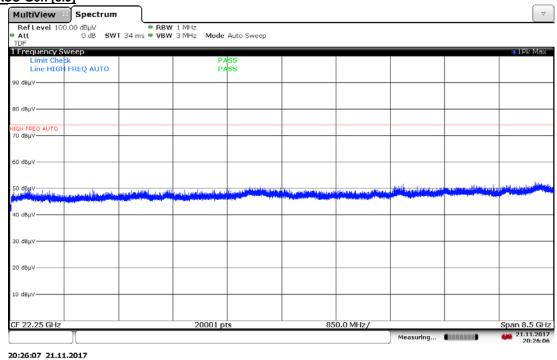


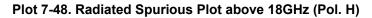


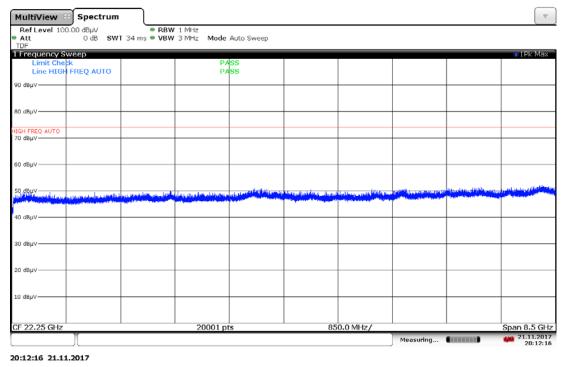
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Radiated Spurious Emissions Measurements (Above 18GHz) §15.209; RSS-Gen [8.9]









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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	-	-	-75.76	2.01	33.25	53.98	-20.73
4804.00	Peak	Н	-	-	-62.53	2.01	46.48	73.98	-27.50
12010.00	Avg	н	-	-	-76.46	13.12	43.66	53.98	-10.32
12010.00	Peak	Н	-	-	-64.14	13.12	55.98	73.98	-18.00

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	-	-	-75.68	2.84	34.16	53.98	-19.82
4882.00	Peak	Н	-	-	-62.92	2.84	46.92	73.98	-27.06
7323.00	Avg	Н	-	-	-76.69	9.22	39.53	53.98	-14.45
7323.00	Peak	Н	-	-	-64.42	9.22	51.80	73.98	-22.18
12205.00	Avg	н	-	-	-76.48	13.55	44.07	53.98	-9.91
12205.00	Peak	Н	-	-	-64.32	13.55	56.23	73.98	-17.75

Table 7-8. Radiated Measurements

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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	-	-	-75.82	2.46	33.64	53.98	-20.34
4960.00	Peak	н	-	-	-63.78	2.46	45.68	73.98	-28.30
7440.00	Avg	Н	-	-	-76.73	9.29	39.56	53.98	-14.42
7440.00	Peak	н	-	-	-76.30	9.29	39.99	73.98	-33.99
12400.00	Avg	Н	-	-	-76.76	13.29	43.53	53.98	-10.45
12400.00	Peak	н	-	-	-64.32	13.29	55.97	73.98	-18.01

Table 7-9. Radiated Measurements

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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).

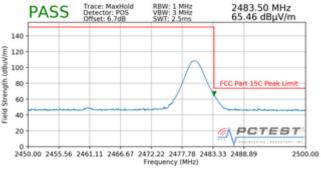
The amplitude offset shown in the following plots for average measurements was calculated using the formula:

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 7-50. Radiated Restricted Upper Band Edge Measurement (Average)



Plot 7-51. Radiated Restricted Upper Band Edge Measurement (Peak)

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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 7-10 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 7-10. 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

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Test Setup

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

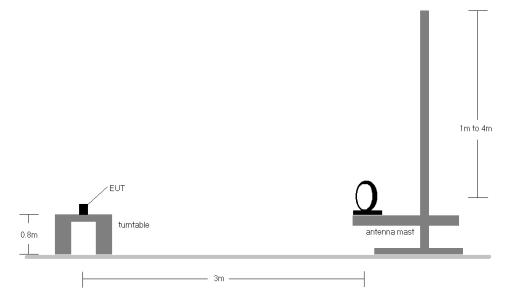
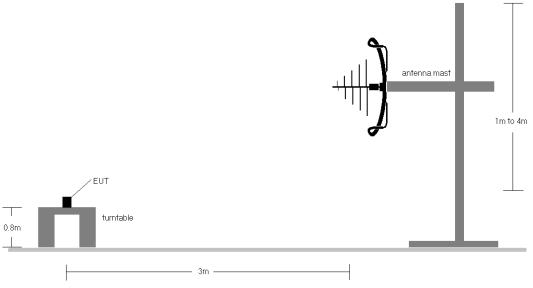
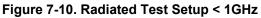


Figure 7-9. Radiated Test Setup < 30Mhz





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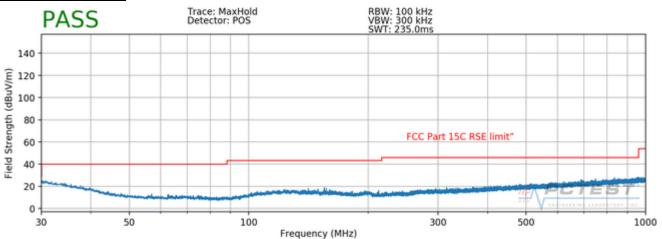


- 1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen (8.10) are below the limit shown in Table 7-10.
- 2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
- 3. 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.

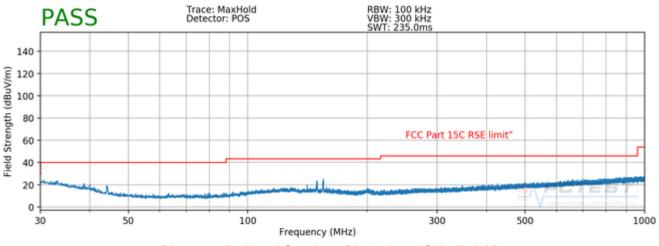
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Radiated Spurious Emissions Measurements (Below 1GHz) §15.209; RSS-Gen [8.9]







Plot 7-53. Radiated Spurious Plot below 1GHz (Pol. V)

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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 7-11. 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

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Test Setup

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

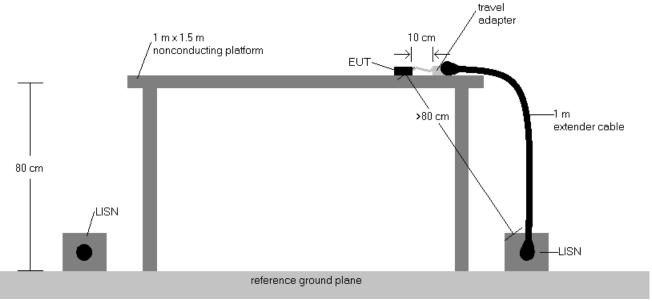


Figure 7-11. Test Instrument & Measurement Setup

Test Notes

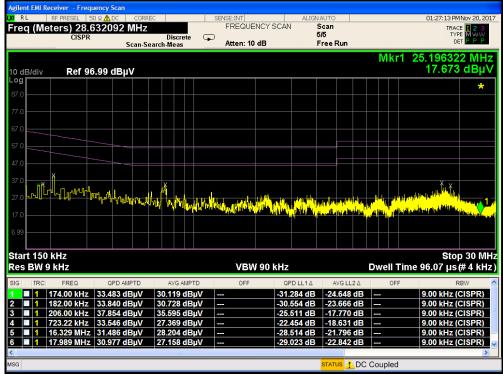
- 1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
- 2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
- 3.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

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Agilent EMI Receiver - Frequency Scan	CORREC	CENCENT			01:30:11 PM Nov 20, 2017
Freq (Meters) 28.632092	ЛНz	FREQUENCY SCAN	ALIGNAUTO Scan 5/5		TRACE 2 3 TYPE M WAW
CISPR	Discrete 🕞 can-Search-Meas	Atten: 10 dB	Free Run		DET P P
				Mkr1 2	5.196322 MHz
10 dB/div Ref 96.99 dBµ\	1				21.917 dBµV
87.0					*
77.0					
67.0					
57.0					
47.0					
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	and W. With Million				
17.0	• 1 . 1.0			<mark>le divendent</mark>	The state of the second
6.99					
Start 150 kHz					Stop 30 MHz
Res BW 9 kHz		VBW 90 kHz		Dwell Time	96.07 µs(#4 kHz)
SIG TRC FREQ QPD AMP			DLL1A AVG LL2A	OFF	RBW 🔷
1 1 206.00 kHz 36.792 dE			73 dB -18.578 dB 02 dB -23.793 dB		9.00 kHz (CISPR) 9.00 kHz (CISPR)
3 🔳 1 709.96 kHz 37.155 dE	30.918 dBµV	18.8	45 dB -15.082 dB		9.00 kHz (CISPR)
4 1 725.96 kHz 37.200 dE 5 1 17.057 MHz 30.422 dE			00 dB -14.061 dB		9.00 kHz (CISPR)
6 1 17.057 MHZ 30.422 dE			78 dB -23.614 dB		9.00 kHz (CISPR) 9.00 kHz (CISPR)
<					>
MSG			<mark>status</mark> 🦺 DC	C Coupled	

Plot 7-54. Line-Conducted Test Plot (L1)



Plot 7-55. Line-Conducted Test Plot (N)

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **LG Portable Handset FCC ID: ZNFX210VPP** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

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