

PCTEST ENGINEERING LABORATORY, INC.

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# MEASUREMENT REPORT FCC PART 15.247 Bluetooth

#### **Applicant Name:**

Samsung Electronics Co., Ltd. 129, Samsung-ro, Yeongtong-gu, Suwon-si Gyeonggi-do, 16677, Korea Date of Testing: 3/9 - 4/25/2018 Test Site/Location: PCTEST Lab. Columbia, MD, USA Test Report Serial No.: 1M1803090037-09.A3L

# FCC ID:

# A3LSMJ337P

APPLICANT:

# Samsung Electronics Co., Ltd.

Application Type: Model: EUT Type: Max. RF Output Power: Frequency Range: Type of Modulation: Classification: FCC Rule Part(s): Test Procedure(s): Certification SM-J337P Portable Handset 9.795 mW (9.91 dBm) Peak Conducted 2402 - 2480MHzGFSK,  $\pi/4$ -DQPSK, 8DPSK Part 15 Spread Spectrum Transmitter (DSS) Part 15 Subpart C (15.247) ANSI C63.10-2013

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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# **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 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 Rules and ISED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

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# 2.0 PRODUCT INFORMATION

# 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMJ337P**. 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.: 05814, 05808, 22535, 05807, 05813

# 2.2 Device Capabilities

This device contains the following capabilities:

850/1900 CDMA/EVDO, 850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n UNII, 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 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
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	6/21/2017	Annual	6/21/2018	RE1
Agilent	N9038A	MXE EMI Receiver	4/26/2017	Annual	4/26/2018	MY51210133
Agilent	N4010A	Wireless Connectivity Test Set	N/A		N/A	GB46170464
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	10/10/2017	Biennial	10/10/2019	121034
EMCO	3160-09	Small Horn (18 - 26.5GHz)	8/23/2016	Biennial	8/23/2018	135427
Rohde & Schwarz	CMU200	Base Station Simulator	4/11/2017	Annual	4/11/2018	836371/0079
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
Rohde & Schwarz	CMU200	Base Station Simulator	N/A		107826	
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/11/2017	Annual	8/11/2018	103200
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	CMU200	Base Station Simulator		N/A		836536/0005
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	5/11/2017	Annual	5/11/2018	100040
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/3/2017	Annual	7/3/2018	102133
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	8/14/2017	Biennial	8/14/2019	310233
Sunol	JB6	Bi-Log Antenna (30M - 6GHz)	9/27/2016	Biennial	9/27/2018	A082816
Sunol	DRH-118	Horn Antenna (1-18GHz)	8/11/2017	Biennial	8/11/2019	A050307

Table 6-1. Annual Test Equipment Calibration Schedule

## Notes:

- 1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.
- 2. 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:	Samsung Electronics Co., Ltd.
FCC ID:	A3LSMJ337P
Method/System:	Frequency Hopping Spread Spectrum (FHSS)
Number of Channels:	<u>79</u>

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	< 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**

- 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

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Frequency [MHz]	Data Rate [Mbps]	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	0	971.90
2441	1.0	39	1007.00
2480	1.0	78	961.90
2402	2.0	0	1304.00
2441	2.0	39	1336.00
2480	2.0	78	1322.00
2402	3.0	0	1307.00
2441	3.0	39	1345.00
2480	3.0	78	1298.00

Table 7-2. Conducted 20dB Bandwidth Measurements



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

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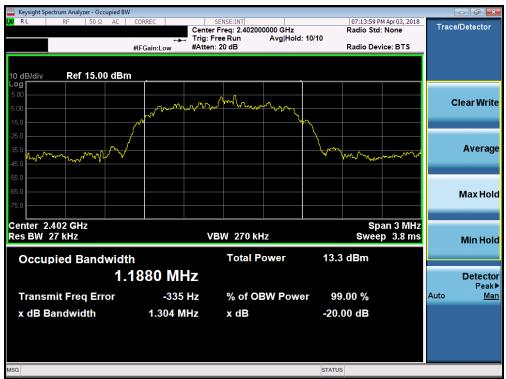
Plot 7-2. 20dB Bandwidth Plot (Bluetooth, 1Mbps - Ch. 39)



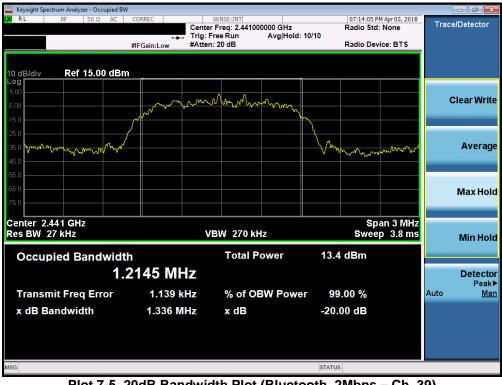
Plot 7-3. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78)

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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)



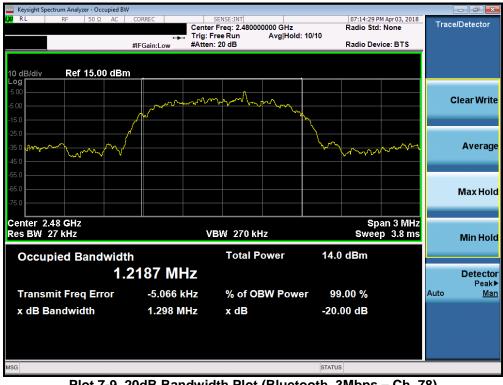
Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 0)

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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 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 ANSI C63.10-2013 – Section 11.9.2.3.2 method AVGPM-G

# 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

## Note

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:

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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		Peak Co Pov	nducted wer	Avg Conducted Power		
Frequency [MHz]	Rate [Mbps]	Channel No.	[dBm]	[mW]	[dBm]	[mW]	
2402	1.0	0	8.47	7.023	7.93	6.202	
2441	1.0	39	8.68	7.379	8.18	6.572	
2480	1.0	78	8.96	7.872	8.43	6.963	
2402	2.0	0	8.82	7.621	6.32	4.285	
2441	2.0	39	9.07	8.072	6.65	4.624	
2480	2.0	78	9.37	8.650	6.89	4.887	
2402	3.0	0	9.58	9.078	6.32	4.285	
2441	3.0	39	9.72	9.376	6.65	4.624	
2480	3.0	78	9.91	9.795	6.89	4.887	

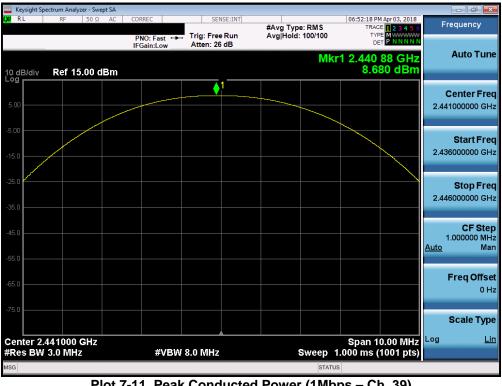
 Table 7-3. Conducted Output Power Measurements

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	Spectrum Analyzer								
L <mark>XI</mark> RL	RF 5	50 Ω AC	CORREC	SENSE	INT #Avg Typ	e: RMS	06:52:01 PM Apr 03 TRACE 1 2		Frequency
			PNO: Fast ++- IFGain:Low	Trig: Free Ro Atten: 26 d	un Avg Hold		TYPE MW	www.	
			IFGain:Low	Atten. 20 ul	1	Mkr1	2.401 87 0	245	Auto Tune
10 dB/div	Ref 15.0	0 dBm				WIKI I	8.465 d	Bm	
				<b>↓</b> 1					Center Freq
5.00								2	402000000 GHz
-5.00									Start Freq
-15.0								2.	397000000 GHz
-25.0									Stop Freq
								2.	407000000 GHz
-35.0									
45.0									CF Step
-45.0								0	1.000000 MHz
-55.0								Auto	<u>o</u> Man
-65.0									Freq Offset 0 Hz
									0112
-75.0									Scale Type
	2.402000 GI	Hz					Span 10.00	MHz Log	<u>Lin</u>
	₩ 3.0 MHz		#VBW	8.0 MHz			000 ms (1001	pts)	
MSG						STATUS			

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



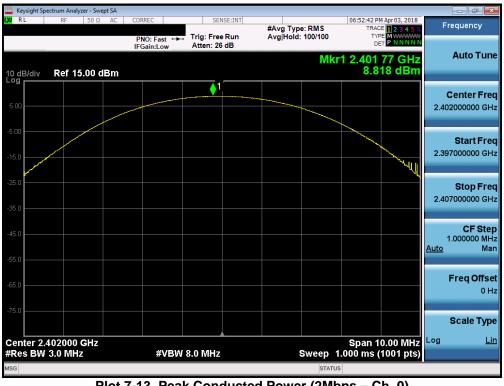
Plot 7-11. Peak Conducted Power (1Mbps - Ch. 39)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
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	ectrum Analyz												
(XI RL	RF	50 Ω	AC	CORREC		SE	NSE:INT	#Avg Typ	e: RMS	TRAC	M Apr 03, 2018	Fi	requency
				PNO: Fa	ast ↔⊷	Trig: Fre Atten: 20		Avg Hold	: 100/100	TYP			
				II Guille					Mk	r1 2.479	83 GHz		Auto Tune
10 dB/div	Ref 15	.00 dB	m							8.9	61 dBm		
						•	1						Center Freq
5.00													0000000 GHz
-5.00													Start Freq
-15.0												2.47	5000000 GHz
10.0													
-25.0													Stop Freq
												2.48	5000000 GHz
-35.0													
-45.0													CF Step
-40.0												Auto	000000 MHz. I Mar
-55.0												Auto	man
													Freq Offset
-65.0													0 Hz
-75.0													
-13.0													Scale Type
Conton	400000	011-								On on-4		Log	Lin
Center 2. #Res BW				#	VBW	8.0 MHz			Sweep	span 1 1.000 m <u>s (</u>	0.00 MHz 1001 pts)	209	En
MSG									STATU				

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



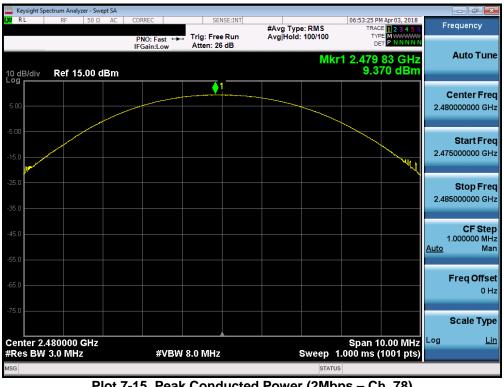
Plot 7-13. Peak Conducted Power (2Mbps - Ch. 0)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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	pectrum Analyzer - S						
LXU RL	RF 50	Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	06:52:53 PM Apr 03, 2018 TRACE 1 2 3 4 5 6	Frequency
			PNO: Fast ++-	Trig: Free Run Atten: 26 dB	Avg Hold: 100/100	DET P NNNN	
			II GUILLON		Mkı	1 2.441 03 GHz	Auto Tune
10 dB/div Log	Ref 15.00	dBm				9.068 dBm	
				1			Center Freq
5.00							2.441000000 GHz
-5.00	and the second sec						Start Freq
-15.0							2.436000000 GHz
la serie de la constance							
-25.0							Stop Freq
-35.0							2.446000000 GHz
-55.0							
-45.0							CF Step 1.000000 MHz
							<u>Auto</u> Man
-55.0							
-65.0							Freq Offset
							0 Hz
-75.0							Scale Type
	.441000 GHz	z		0.0.00		Span 10.00 MHz	Log <u>Lin</u>
	/ 3.0 MHz		#VBW	8.0 MHz	-	l.000 ms (1001 pts)	
MSG					STATU	2	

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



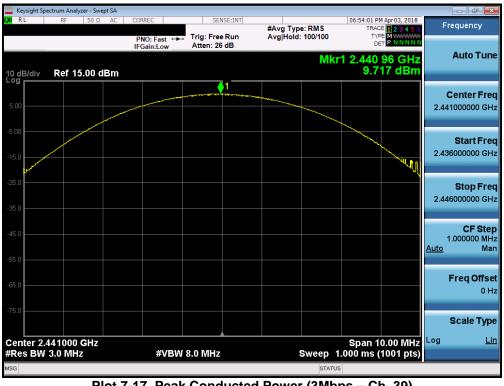
Plot 7-15. Peak Conducted Power (2Mbps - Ch. 78)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Dage 21 of 50				
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	pectrum Analyze						
LX/IRL	RF	50 Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	06:53:48 PM Apr 03, 2018 TRACE 1 2 3 4 5 6	Frequency
			PNO: Fast ++ IFGain:Low	<ul> <li>Trig: Free Run Atten: 26 dB</li> </ul>	Avg Hold: 100/100	DET P NNNN	
			IFGail.Low	Attent 20 ab	Mk	r1 2.401 91 GHz	Auto Tune
10 dB/div	Ref 15.	00 dBm				9.579 dBm	
				<u>1</u>			Center Freq
5.00			and the second s				2.402000000 GHz
							2.402000000 0112
-5.00							Start Freq
-15.0							2.397000000 GHz
-15.0							
-25.0							Otop From
							<b>Stop Freq</b> 2.407000000 GHz
-35.0							
							CF Step
-45.0							1.000000 MHz
-55.0							<u>Auto</u> Man
-65.0							Freq Offset 0 Hz
							0 H2
-75.0							Scale Type
	402000 G	Hz	41/01/	0.0.0.00	0		Log <u>Lin</u>
#Res BW	3.0 MHZ		#VBV	/ 8.0 MHz		1.000 ms (1001 pts)	
MSG					STATU	15	

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



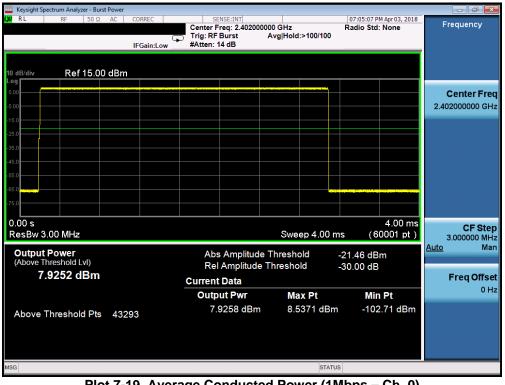
Plot 7-17. Peak Conducted Power (3Mbps - Ch. 39)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
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	pectrum Analyz											_	
L <mark>XI</mark> RL	RF	50 Ω A	AC	CORREC		SEN	ISE:INT	#Avg Typ	e: RMS		M Apr 03, 2018	Fr	requency
				PNO: Fa	ast ↔	Trig: Free Atten: 26		Avg Hold:	100/100	TYP			
				II Outilite					Mki	1 2.479	94 GHz		Auto Tune
10 dB/div	Ref 15.	.00 dBi	m							9.9	09 dBm		
							1						Center Freq
5.00													0000000 GHz
-5.00													Start Freq
-15.0												2.47	5000000 GHz
10.0											MAN NO		
-25.0													Stop Freq
												2.48	5000000 GHz
-35.0													
-45.0													CF Step
10.0												1 Auto	000000 MHz. I.00000 MHz.
-55.0													
													Freq Offset
-65.0													0 Hz
-75.0													
													Scale Type
Center 2.	480000 0	GHz								Span 1	0.00 MHz	Log	Lin
#Res BW				#	¢VB₩	8.0 MHz			Sweep 1	1.000 ms (	1001 pts)		
MSG									STATU	s			

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



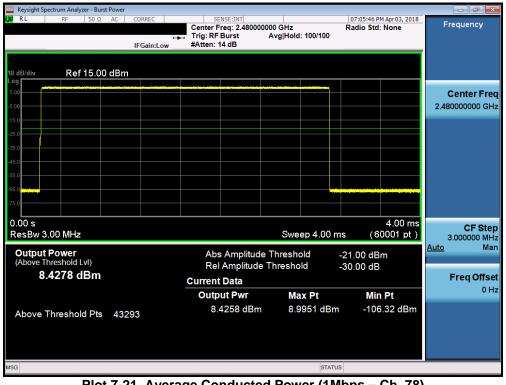
Plot 7-19. Average Conducted Power (1Mbps - Ch. 0)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager					
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🔤 Keysight Spe 🚺 R L	ctrum Analyzo RF	er - Burs 50 Ω	AC	CORREC			ENSE:INT					M Apr 03, 2018		
				IFGain	Low			0000 GHz Avg Hold	: 100/100		io Std:	None	Frequer	ıcy
10 dB/div Log	Ref	15.00	) dBm				1							
-5.00								<b></b>					Cente 2.4410000	
-15.0														
-35.0														
-65.0														
0.00 s ResBw 3.0	00 MHz							Swe	ep 4.00	ms	(6)	4.00 ms 0001 pt)	CF 3.0000	= Step
Output F (Above Th	reshold Ly						s Amplitud I Amplitude				26 dB 00 dB	m	<u>Auto</u>	Mar
8.1	1768 dl	∃m				Curren	t Data out Pwr	Ma	x Pt		Min	Df	Freq	Offse 0 Hi
Above T	hreshold	Pts	432	93			1766 dBm		'364 dB	m		.78 dBm		
ISG									STA	TUS				

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



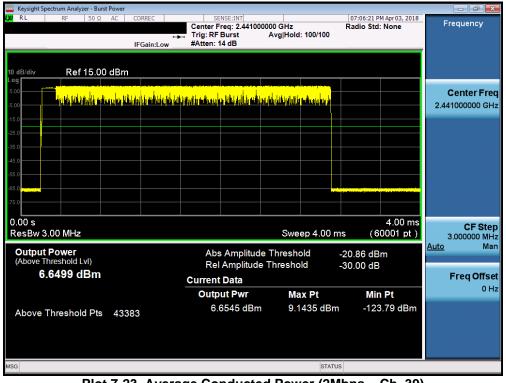
Plot 7-21. Average Conducted Power (1Mbps - Ch. 78)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
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Keysight Spe	ectrum Analyze RF	er - Bun 50 Ω	AC	CORREC	- 				d: 100/100		59 PM Apr 03, 2018 Std: None	Frequency
10 dB/div Log	Ref	15.00	) dBm									
-5.00	Applek jurk jer	Willier	legy <mark>hey bla</mark>	ladad <mark>lata and</mark>	ulin ulin u	<mark>t hiller in die een s</mark>	<u>h u kilulidulit, tu sad</u>	idente, felegikt felgefel)	le talin quinte h			Center Free 2.402000000 GH
-25.0												
-45.0 -55.0												
-65.0												
0.00 s ResBw 3.	.00 MHz							Swe	eep 4.00	ms	4.00 ms (60001 pt )	CF Step 3.000000 MH Auto Mai
	Power preshold Ly 3206 dl					Ab Re Curren	Amplitud	de Thresh de Thresh	old old	-21.08 -30.00		Freq Offse
Above T	hreshold	l Pts	433	83		Out	o <b>ut Pwr</b> .3147 dBr		<b>ax Pt</b> 9238 dB		<b>Min Pt</b> 109.29 dBm	ОН
MSG									STA	TUS		

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



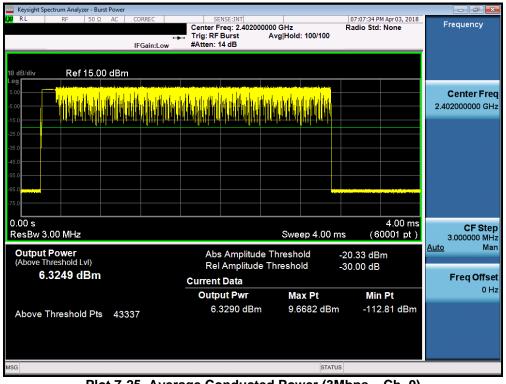
Plot 7-23. Average Conducted Power (2Mbps – Ch. 39)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
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Keysight Spr K	ectrum Analyz RF	er - Burs 50 Ω	AC	CORREC	 Center F			i: 100/100	07:06:32 Radio St	2 PM Apr 03, 2018 td: None	Frequency
10 dB/div Log 5.00			) dBm	l dal su mi	Jähollin index son	u klicija, pro	Have the letter provide	i taliya ju			Center Fre 2.48000000 GH
-15.0 -25.0 -35.0 -45.0											
-55.0 -65.0 -75.0											
0.00 s ResBw 3 Output						A 15		ep 4.00	,	4.00 ms 60001 pt) -	<b>CF Ste</b> 3.000000 MH <u>Auto</u> Ma
(Above Th	hreshold L 8884 d				Re Curren	I Amplitud	de Thresh e Thresho	old	-20.62 d -30.00 d		Freq Offse
Above T	Threshold	l Pts	433	32		out Pwr 8818 dBr		a <b>x Pt</b> 3773 dBi		<b>in Pt</b> 04.64 dBm	ΟH
MSG								STAT	rus		

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



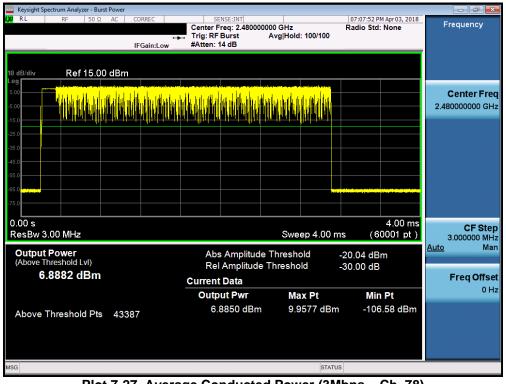
Plot 7-25. Average Conducted Power (3Mbps - Ch. 0)

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
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w Keysight Sp	ectrum Analyzo RF	er - Bur 50 Ω		CORREC	- 		Burst	000000 GHz Avg Hold	I: 100/100		07:07:43 P Radio Std	M Apr 03, 2018 : None	-	uency
10 dB/div Log	Ref <sup>-</sup>	15.0	0 dBm	IFGain	Low	#Atten: 1	14 dB							
-5.00														<b>nter Freq</b> 00000 GHz
-25.0														
-55.0														
0.00 s ResBw 3	.00 MHz							Swe	ep 4.00	ms	6 (6	4.00 ms 0001 pt)		CF Step D0000 MH
	Power hreshold Ly .6512 dl						Amplitud	de Thresh de Thresho			20.21 dB 30.00 dB		Auto Fr	Mar eq Offse
Above	Threshold	l Pts	4338	36		Outp	o <b>ut Pwr</b> 6492 dBi		<b>ax Pt</b> 7924 dB	m	<b>Min</b> -118	1 <b>Pt</b> 3.78 dBm		0 H;
ISG									STA	TUS				

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



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

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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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.



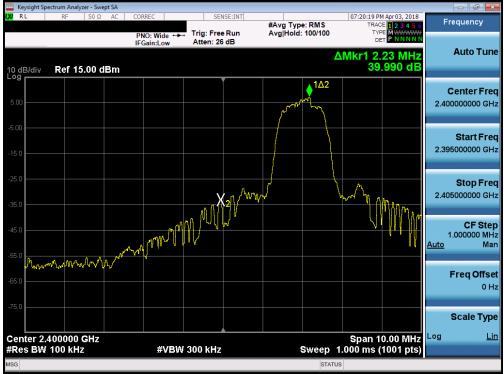
Figure 7-3. Test Instrument & Measurement Setup

## 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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Keysight Spectrum Analyzer - Swept SA				
LXX RL RF 50Ω AC	CORREC SENSE:INT	#Avg Type: RMS	07:21:50 PM Apr 03, 2018 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 15.00 dBm	PNO: Wide ↔ Trig: Free Run IFGain:Low Atten: 26 dB	Avg Hold: 100/100	TYPE NNNNN DET NNNNN Mkr1 4.83 MHz 46.173 dB	Auto Tune
5.00		Jan Marine	1Δ2 <sup>1</sup> ληνη ν <sub>ν</sub> ννη	Center Freq 2.400000000 GHz
-5.00				<b>Start Freq</b> 2.395000000 GHz
-25.0	May			<b>Stop Freq</b> 2.405000000 GHz
-45 0 -55 0 -65 0	mand walker of			CF Step 1.000000 MHz <u>Auto</u> Man
-66.0				<b>Freq Offset</b> 0 Hz
Center 2.400000 GHz			Span 10.00 MHz	Scale Type
#Res BW 100 kHz	#VBW 300 kHz	Sweep 1.	000 ms (1001 pts)	
MSG		STATUS		

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



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

FCC ID: A3LSMJ337P		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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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

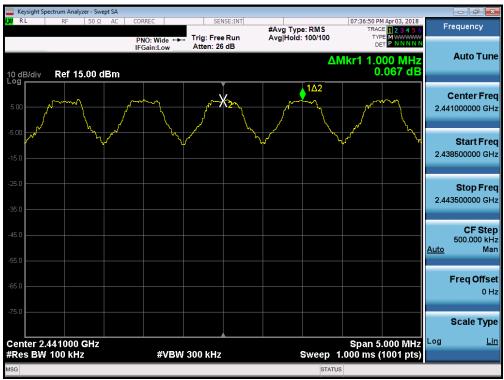
The EUT complies with the minimum channel separation requirement when it is operating in 1x/EDR mode using 79 channels and when operating in AFH mode using 20 channels.

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Frequency [MHz]	Data Rate [Mbps]	Channel No.	Min. Channel Separation [MHz]
2402	1.0	0	0.648
2441	1.0	39	0.671
2480	1.0	78	0.641
2402	2.0	0	0.869
2441	2.0	39	0.891
2480	2.0	78	0.881
2402	3.0	0	0.871
2441	3.0	39	0.897
2480	3.0	78	0.865

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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🔤 Keysight Sp			ot SA									
LXI RL	RF	50 Ω	AC	CORREC PNO: Fa	st ↔→		#Avg Typ	pe: RMS	TRAC	M Apr 03, 2018 E <b>1 2 3 4 5</b> 6 E WWWWWWW T P N N N N N	F	requency
10 dB/div Log	Ref 1	5.00 dE	Зm	II Gam.L					ΔMkr1 2 -2	.895 ms 7.04 dB		Auto Tune
5.00										TRIG LVL		Center Freq 1000000 GHz
-5.00											2.44	Start Freq 1000000 GHz
-25.0	X <sub>2</sub>										2.44	Stop Freq 1000000 GHz
-45.0 -55.0	¥4								ka,hiliyyyy,ade,eshil	ult af the state	<u>Auto</u>	<b>CF Step</b> 1.000000 MHz Man
-65.0								<u>'</u>				Freq Offset 0 Hz
Center 2.4	441000	000 GH	-lz						s	pan 0 Hz	Log	Scale Type <u>Lin</u>
Res BW 1				#	VBW	3.0 MHz		Sweep	5.000 ms (	1001 pts)		
MSG								STAT	US			

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 2.895 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)
- 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

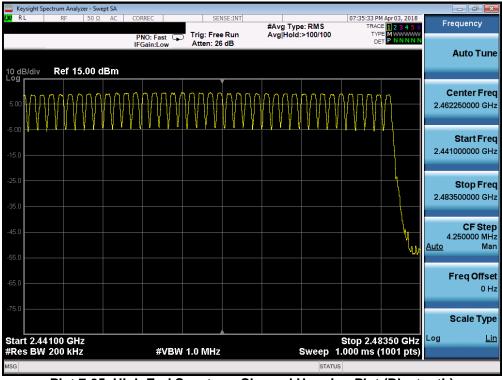
The frequency spectrum was broken up into two sub-ranges to clearly show all of the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.

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	nt Spectrum		Swept	t SA														
L <mark>XI</mark> RL	R	50	Ω	AC	CORRE	C		SE	NSE:IN	Г	#Avg 1	Type	RMS	0		M Apr 03, 2018 CE 1 2 3 4 5 6		Frequency
						:Fast 🖵 n:Low		g: Fre ten: 2	e Run 6 dB		Avg H	old:>	>100/100		TΥ			
					II Out													Auto Tune
10 dB/di Log	iv Re	f 15.00	) dE	3m														
5.00					$\mathcal{M}$				M	M		N					2.4	Center Freq 20500000 GHz
-5.00		¥ (		_ ¥ ¥	• •	1 * 9		<u> </u>		Y V			<u> </u>	-#¥-	<u> </u>		2.4	Start Freq 00000000 GHz
-25.0																	2.4	Stop Freq 41000000 GHz
-45.0																	Auto	CF Step 4.100000 MHz Man
-65.0																		Freq Offset 0 Hz
-75.0																		Scale Type
Start 2. #Res B						#VBW	1.0	MHz	:			s	Sweep	Sto 1.00	op 2.4 0 ms	4100 GHz (1001 pts)	Log	<u>Lin</u>
MSG													STAT	US				

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 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.

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	ectrum Analy:	zer - Swept							-0	
LXI RL	RF	50 Ω	PNO: Fast		#Avg Typ	e: RMS	TRA	M Apr 03, 2018 CE 1 2 3 4 5 6 PE M WWWWW ET P N N N N N	Frequ	ency
10 dB/div Log	Ref 15	.00 dB	FGain:Low	Atten: 20		M	kr1 8.67	8 0 GHz 40 dBm	Au	to Tune
5.00										<b>ter Freq</b> 0000 GHz
-5.00								DL1 -12.05 dBm		art Freq 0000 MHz
-25.0							1		St 10.000000	op Freq 0000 GHz
-45.0		an i je filosof <sup>kand</sup> i			a <mark>ha da kada asalahi</mark> 1909 - Marina Katalari	nad Mithinsol Albed yr	spekka halmaniy			CF Step 0000 MHz Man
-65.0									Fre	<b>q Offset</b> 0 Hz
-75.0										ale Type
Start 30 N #Res BW		2	#VBV	/ 3.0 MHz	s	weep 18	Stop 10 3.00 ms (3	.000 GHz 30001 pts)	Log	<u>Lin</u>
MSG						STATUS	5			

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



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

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🔤 Keysight Sp	ectrum Analyzer - Swep	ot SA									- 6 ×
Center F	RF 50 Ω req 5.015000	0000 GH	NO: Fast 🛛 🖵	Trig: Free		#Avg Typ	e: RMS	TRAC	M Apr 03, 2018 DE <b>1 2 3 4 5 6</b> PE M WWWWWW T P N N N N N	Fre	quency
10 dB/div	Ref 15.00 dl		Gain:Low	Atten: 26	dB		Μ	kr1 8.66			Auto Tune
5.00											enter Freq 000000 GHz
-5.00									DL1 -11.75 dBm		<b>Start Freq</b> 000000 MHz
-25.0								1-			<b>Stop Freq</b> 000000 GHz
-45.0			art dan da Maria ara	an parting to a particular de la companya de la com		hayad bi di panganda d na ganta di kangada di d	a da se fa de la companya de la comp			997.0 <u>Auto</u>	CF Step 000000 MHz Man
-65.0										F	<b>req Offset</b> 0 Hz
-75.0											cale Type
Start 30 N #Res BW			#VBW	3.0 MHz		s	weep 1	Stop 10 8.00 ms (3	.000 GHz 0001 pts)	Log	<u>Lin</u>
мsg 🧼 Poin	ts changed; all tr	aces clear	ed				STATU	JS			

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



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

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	ectrum Analyz											o X
XIRL	RF	50Ω A	AC CO	RREC		NSE:INT	#Avg Typ	e: RMS	TRAC	M Apr 03, 2018	Freque	ency
			P	NO: Fast 🖵 Gain:Low	Trig: Free Atten: 26				TYI Di			
								Mk	r1 8.68	7 9 GHz	Aut	to Tune
10 dB/div Log	Ref 15.	.00 dBi	m						-40.	63 dBm		
						Í					Cent	er Freg
5.00											5.015000	
-5.00											Sta	art Freq
-15.0										DL1 -11.51 dBm		000 MHz
10.0												
-25.0											Ste	op Freq
											10.000000	
-35.0									↓ 1			
-45.0			1,144	Astron		and the second	ار الحمار واحدة مير. الحديد معالمات من	and the stand of the state of the	distantian Prop	a shouth a loop ye		CF Step
المعربي وال	فالطعمين أدالوان	Print of Party States	and and all a				أساداعهم بقاقماهمي	, here this is a fifty or to the			997.000 Auto	000 MHz Man
-55.0	A DESCRIPTION OF THE OWNER OF THE											
											Free	Offset
-65.0												0 Hz
-75.0												
											Sca	le Туре
Start 30 M	ЛНz								Stop 10	.000 GHz	Log	Lin
#Res BW				#VBW	3.0 MHz		s	weep 18	.00 ms (3	0001 pts)		
MSG								STATUS				

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



Plot 7-41. Conducted Spurious Plot (Bluetooth, 3Mbps - 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/ $\tau$  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

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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.

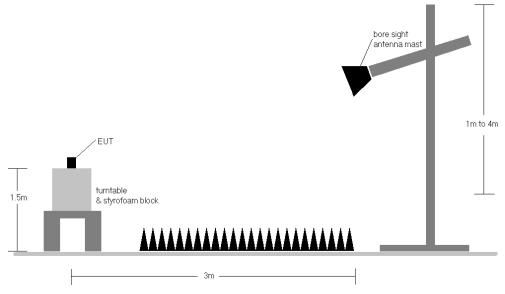


Figure 7-8. Radiated Test Setup >1GHz

### 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 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.

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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  $[dB\mu V/m]$

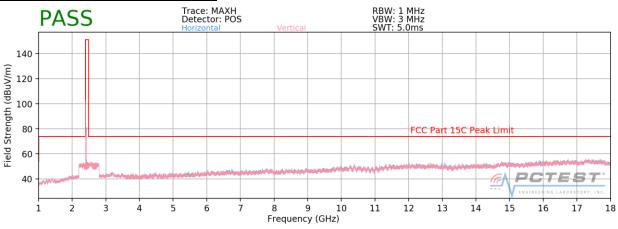
### **Duty Cycle Correction Factor Calculation**

- 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

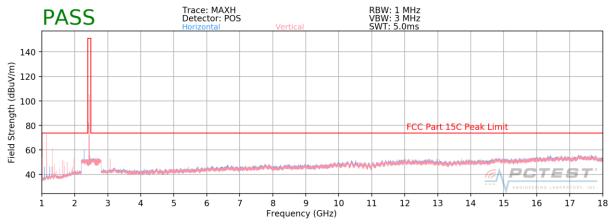
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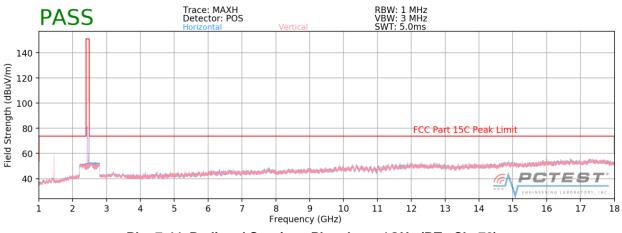
### Radiated Spurious Emission Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]









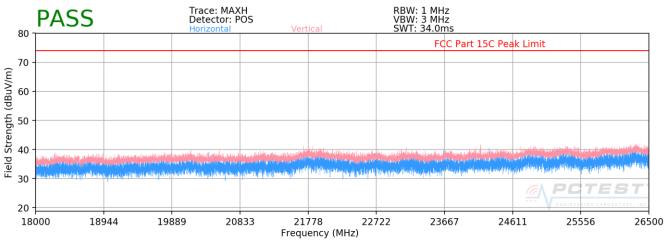


Plot 7-44. Radiated Spurious Plot above 1GHz (BT- Ch. 78)

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



Plot 7-45. Radiated Spurious Plot above 18GHz

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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	-	-	-78.57	3.44	31.87	53.98	-22.11
4804.00	Peak	Н	-	-	-66.98	3.44	43.46	73.98	-30.52
12010.00	Avg	Н	-	-	-82.57	15.94	40.37	53.98	-13.61
12010.00	Peak	Н	-	-	-71.01	15.94	51.93	73.98	-22.05

### 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	-	-	-79.92	5.26	32.34	53.98	-21.64
4882.00	Peak	н	-	-	-67.41	5.26	44.85	73.98	-29.13
7323.00	Avg	н	-	-	-81.08	8.23	34.15	53.98	-19.83
7323.00	Peak	н	-	-	-68.67	8.23	46.56	73.98	-27.42
12205.00	Avg	н	-	-	-82.78	15.41	39.63	53.98	-14.35
12205.00	Peak	н	-	-	-70.75	15.41	51.66	73.98	-22.32

### **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	-	-	-80.16	5.66	32.50	53.98	-21.47
4960.00	Peak	Н	-	-	-67.19	5.66	45.47	73.98	-28.50
7440.00	Avg	Н	-	-	-81.61	7.96	33.35	53.98	-20.63
7440.00	Peak	Н	-	-	-67.52	7.96	47.44	73.98	-26.54
12400.00	Avg	Н	-	-	-82.74	16.24	40.50	53.98	-13.48
12400.00	Peak	н	-	-	-70.51	16.24	52.73	73.98	-21.25

Table 7-9. Radiated Measurements

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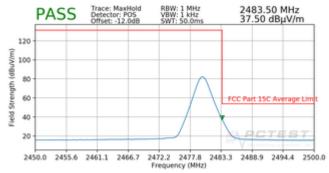
### 7.10 Radiated Restricted Band Edge Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

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).

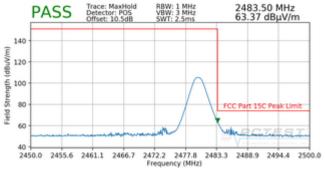
The amplitude offset shown in the following plots for average measurements was calculated using the formula:

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



Plot 7-47. 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.

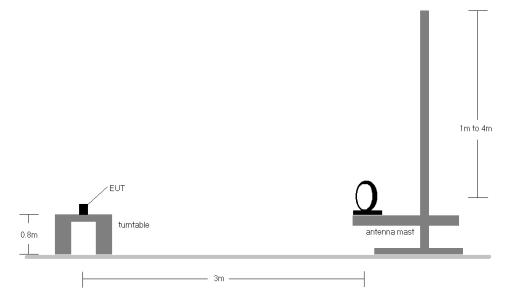
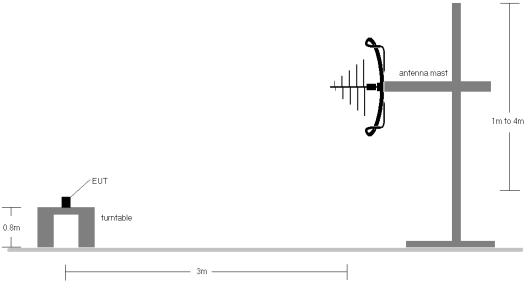
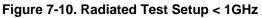


Figure 7-9. Radiated Test Setup < 30Mhz





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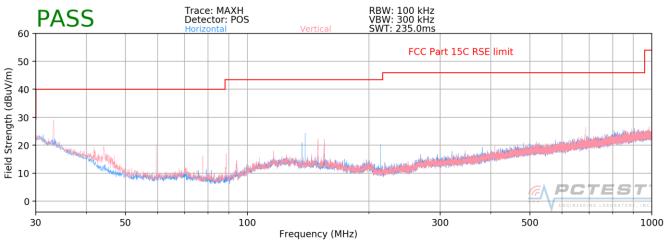


- 1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen (8.10) are below the limit shown in Table 7-10.
- 2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
- 3. 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 7-48. Radiated Spurious Plot below 1GHz GFSK ePA

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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

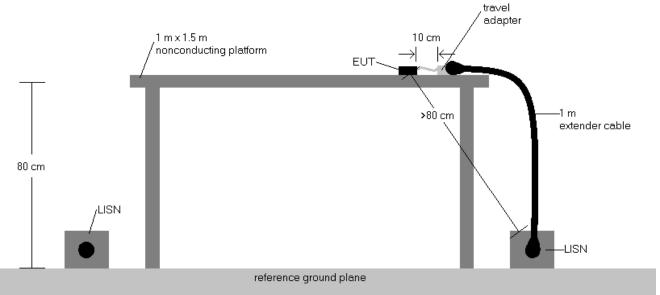
- 1. Analyzer center frequency was set to the frequency of the spurious emission of interest
- 2. RBW = 9kHz (for emissions from 150kHz 30MHz)
- 3. Detector = RMS
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

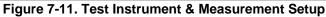
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### Test Setup

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





### Test Notes

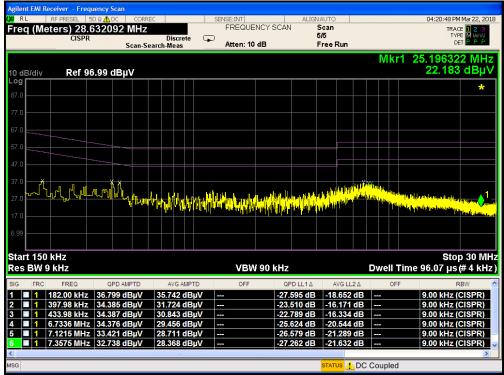
- All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
- 2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
- 3. Corr. (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.

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Plot 7-49. Line-Conducted Test Plot (L1)





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### 8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMJ337P** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

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