

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: 10/25/2019 - 01/14/2020 Test Site/Location: PCTEST Lab. Columbia, MD, USA Test Report Serial No.: 1M1911140188-11.A3L

## FCC ID:

## A3LSMF700F

Certification

# APPLICANT:

# Samsung Electronics Co., Ltd.

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):

SM-F700F SM-F700F/DS, SCV47 Portable Handset 48.978 mW (16.9 dBm) Peak Conducted 2402 - 2480MHzGFSK,  $\pi/4$ -DQPSK, 8DPSK FCC Part 15 Spread Spectrum Transmitter (DSS) Part 15 Subpart C (15.247) ANSI C63.10-2013, KDB 558074 D01 v05r02, KDB 648474 D03 v01r04

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

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

Randy Ortanez President



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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 FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

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# 2.0 PRODUCT INFORMATION

## 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMF700F**. 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.: N/A

## 2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC, ANT+, Wireless Power Transfer

Frequency (MHz)			
2402			
:			
2441			
:			
2480			

Table 2-1. Frequency/ Channel Operations

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

## 2.3 Test Configuration

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

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) Model: EP-N5100 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

The EUT is capable of operating in folded closed and unfolded open configurations. The worst-case configuration for radiated emissions was determined from open and closed configurations in X, Y, and Z orientations for horizontal and vertical antenna polarizations. The worst case radiated emissions data is shown in this report.

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# 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 7.11. 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 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.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.

## 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  $U_{\text{CISPR}}$  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
-	BT1	Bluetooth Cable Set	6/3/2019	Annual	6/3/2020	BT1
-	BT2	Bluetooth Cable Set	6/5/2019	Annual	6/5/2020	BT2
Agilent	N4010A	Wireless Connectivity Test Set		N/A		GB46170464
Agilent	N9020A	MXA Signal Analyzer	4/20/2019	Annual	4/20/2020	US46470561
Agilent	N9038A	MXE EMI Receiver	7/17/2019	Annual	7/17/2020	MY51210133
Agilent	N9030A	PXA Signal Analyzer (44GHz)	6/12/2019	Annual	6/12/2020	MY52350166
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	5/10/2019	Annual	5/10/2020	441112
Emco	3116	Horn Antenna (18 - 40GHz)	6/7/2018	Triennial	6/7/2021	9203-2178
EMCO	3160-09	Small Horn (18 - 26.5GHz)	8/9/2018	Biennial	8/9/2020	135427
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	6/18/2018	Biennial	6/18/2020	114451
Keysight Technologies	N9020A	MXA Signal Analyzer	4/29/2019	Annual	4/29/2020	MY54500644
Pasternack	NMLC-2	Line Conducted Emissions Cable (NM)	6/3/2019	Annual	6/3/2020	NMLC-2
Rohde & Schwarz	CMU200	Base Station Simulator	N/A		836371/0079	
Rohde & Schwarz	CMU200	Base Station Simulator	N/A		836536/0005	
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	4/19/2018	Biennial	4/19/2020	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

#### Notes:

1. 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:	A3LSMF700F
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>&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
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen [8.8] limits)	LINE CONDUCTED	PASS	Section 7.11

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 3.5.
- 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 1.3.1.

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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	932.20
2441	1.0	39	931.40
2480	1.0	78	944.40
2402	2.0	0	1265.00
2441	2.0	39	1245.00
2480	2.0	78	1338.00
2402	3.0	0	1277.00
2441	3.0	39	1320.00
2480	3.0	78	1195.00

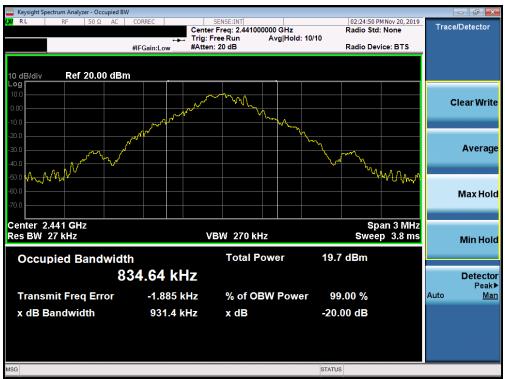
Table 7-2. Conducted 20dB Bandwidth Measurements



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

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



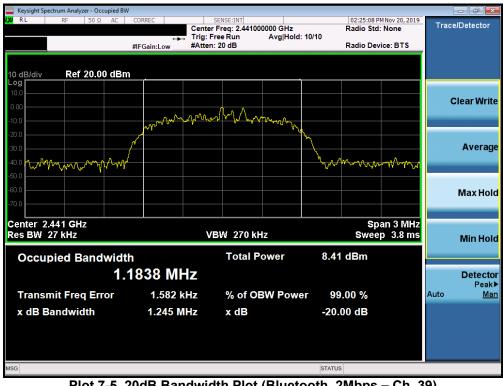
Plot 7-3. 20dB Bandwidth Plot (Bluetooth, 1Mbps - Ch. 78)

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



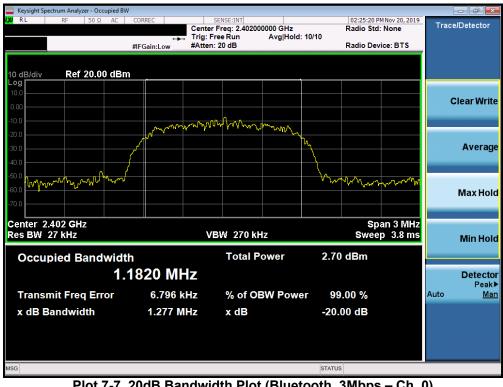
Plot 7-5. 20dB Bandwidth Plot (Bluetooth, 2Mbps - Ch. 39)

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



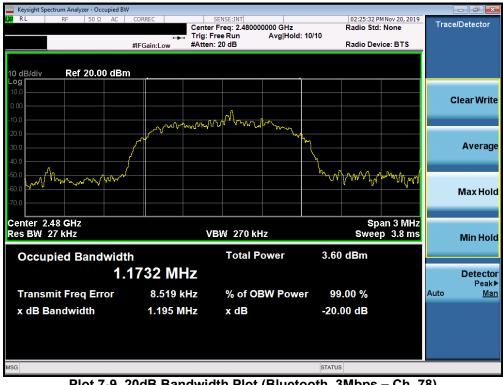
Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 0)

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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:

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

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	Data			nducted wer	Avg Cor Pov	nducted wer
Frequency [MHz]	Data Rate [Mbps]	Channel No.	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	15.27	33.667	14.40	27.552
2441	1.0	39	15.51	35.596	15.11	32.407
2480	1.0	78	13.95	24.837	13.53	22.517
2402	2.0	0	15.57	36.074	12.62	18.276
2441	2.0	39	16.53	44.978	13.47	22.246
2480	2.0	78	15.09	32.285	11.88	15.426
2402	3.0	0	16.07	40.495	12.64	18.367
2441	3.0	39	16.90	48.978	13.62	23.002
2480	3.0	78	15.79	37.905	12.11	16.263

Table 7-3. Conducted Output Power Measurements



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

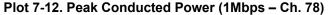
FCC ID: A3LSMF700F		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
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	ctrum Analyzer - Swe										
LX/IRL	RF 50 Ω	AC C	ORREC	SEN	ISE:INT	#Avg Typ	ALIGN AUTO		MDec 16, 2019	Fr	equency
			PNO: Fast ↔ FGain:Low	Trig: Free Atten: 32		Avg Hold:		TYP De			Auto Tune
10 dB/div Log	Ref 22.00 d	IBm					Mkr	1 2.441 15.5	07 GHz 14 dBm		Auto Tune
Log					<b>)</b> 1					C	enter Freq
12.0										2.44	1000000 GHz
2.00											Start Freq
-8.00										2.43	5000000 GHz
-18.0											Stop Freq
-28.0										2.44	5000000 GHz
-38.0											CF Step .000000 MHz
-48.0										<u>Auto</u>	Man
-58.0										I	Freq Offset 0 Hz
-68.0											0112
											Scale Type
Center 2.4 #Res BW	41000 GHz 3.0 MHz		#VB\	N 8.0 MHz			Sweep 1	Span 1 .000 ms (	0.00 MHz 1001 pts)	Log	Lin
MSG							STATUS				

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



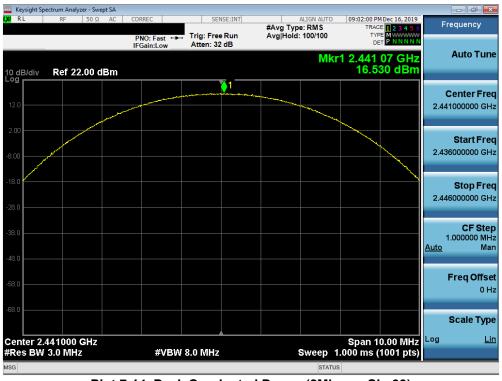


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	ectrum Analyzer - Sw										
LXU RL	RF 50 Ω	AC	CORREC	SEN	ISE:INT	#Avg Typ	ALIGN AUTO		Dec 16, 2019	Fr	equency
			PNO: Fast ++ IFGain:Low	Trig: Free Atten: 32		Avg Hold	: 100/100	TYP			Auto Tune
10 dB/div Log	Ref 22.00 (	dBm						15.5	72 dBm		
					<u> </u>						enter Freq
12.0										2.40	2000000 GHz
2.00											Start Freq
-8.00										2.39	7000000 GHz
-18.0											Stop Freq
-28.0										2.40	7000000 GHz
-38.0										1	CF Step
-48.0										<u>Auto</u>	Man
-58.0										I	Freq Offset
											0 Hz
-68.0											Scale Type
Center 2.	402000 GHz							Span 1	0.00 MHz	Log	<u>Lin</u>
#Res BW			#VBW	/ 8.0 MHz			Sweep 1	.000 ms (	1001 pts)		
MSG							STATUS	5			

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



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

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RL         RF         S0.0         ALC         CORREC         SENSE:NT         ALIGA NUTO         Desize op Moe: 16, 2019         Frequency           PND: Fast         PND: Fast         Trig: Free Run IFGaintLow         Aug Type: RMS Avg Hold: 100/100         Trace: 2430         Trace: 2430         Auto Tune           0 dE/div         Ref 22.00 dBm         IfGaintLow         Mkr1 2.479 87 GHz 15.090 dBm         Auto Tune           200         IfGaintLow         IfGaintLow<		ectrum Analyzer - Sw									_	
PRO: Fast         Trig: Free Run Hegain:Low         AvgiHoid: 100/100         Trig: Free Run Atten: 32 dB         AvgiHoid: 100/100         Trig: Free Run Her Statt         AvgiHoid: 100/100         Auto Tune           10 dB/div         Ref 22.00 dBm         Image: Auto Tune         Image	L <mark>XI</mark> RL	RF 50 Ω	2 AC	CORREC	SEN	SE:INT					Fr	equency
Log Log Log Log Log Log Log Log								100/100	TYP DE 1 2.479			Auto Tune
12.0       Center Freq         200       Start Freq         2.47500000 GHz       Start Freq         2.48500000 GHz       Start Freq         2.48500000 GHz       Start Freq         2.48500000 GHz       Start Freq         2.4850000 GHz       Start Fr	10 dB/div	Ref 22.00	dBm						15.0	90 dBm		
Start Freq 2.47500000 GHz -380 -380 -380 -380 -380 -380 -380 -380					<b></b>							•
-28.0 -28.0 -38.0 -68.0 Center 2.480000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Sweep 1.000 ms (1001 pts)											2.47	•
											2.48	
-58.0 -6												.000000 MHz
Center 2.480000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Sweep 1.000 ms (1001 pts)												•
#Res BW 3.0 MHz #VBW 8.0 MHz Sweep 1.000 ms (1001 pts)												
				#\/R\/	(80 MHz		_	Sween 1	Span 1	0.00 MHz	Log	Lin
		5.0 WIT2		# V D V	- 0.0-141112				uuuu iiis (	roo r ptsj		

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



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

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	ctrum Analyzer - Swe									_	
LXI RL	RF 50 Ω	AC	CORREC	SEN	ISE:INT	#Avg Typ	ALIGN AUTO e: RMS		MDec 16, 2019	Fr	equency
			PNO: Fast ↔ IFGain:Low	Trig: Free Atten: 32		Avg Hold:		TYF DE			
10 dB/div Log	Ref 22.00 d	Bm					Mkr	1 2.441 16.9	13 GHz 00 dBm		Auto Tune
12.0					<b>≬</b> 1		and the second sec				<b>Center Freq</b> 1000000 GHz
-8.00										2.43	Start Freq 6000000 GHz
-18.0										2.44	Stop Freq 6000000 GHz
-38.0										Auto <sup>1</sup>	CF Step .000000 MHz Man
-58.0											Freq Offset 0 Hz
-68.0										Log	Scale Type Lin
Center 2.4 #Res BW	41000 GHz 3.0 MHz		#VBW	/ 8.0 MHz			Sweep_1	Span 1 .000 m <u>s (</u>	0.00 MHz 1001 pts)	LUg	
MSG							STATUS				

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



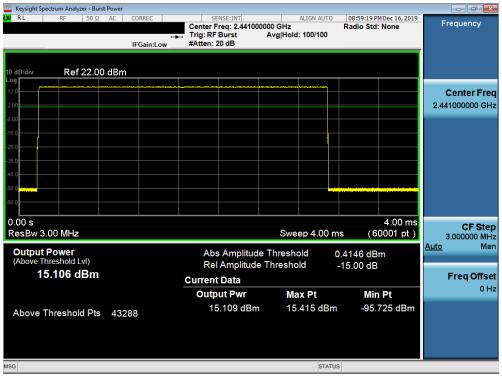
Plot 7-18. Peak Conducted Power (3Mbps – Ch. 78)

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🧱 Keysight Spectrum Analyzer - Burst Power							
(X) RL RF 50 Ω AC	CORREC	SENSE:INT Center Freq: 2. Trig: RF Burst #Atten: 18 dB		ALIGN AUTO	08:58:54 PI Radio Std:	MDec 16, 2019 None	Frequency
10 dB/div Ref 22.00 dBm							
2.00							Center Freq 2.402000000 GHz
-8.00							
-38.0							
-68.0							
0.00 s ResBw 3.00 MHz			Swe	ep 4.00 n	ns (61	4.00 ms 0001 pt)	CF Step 3.000000 MHz Auto Man
Output Power (Above Threshold Lvl) 14.402 dBm		Rel Amp	litude Thresho litude Thresho		0.3368 dB -15.00 dB	m	<u>Auto</u> Man Freq Offset
14.402 abiii		Current Data Output Pv		x Pt	Min	Pf	0 Hz
Above Threshold Pts 432	88	14.393		.663 dBm		.83 dBm	
MSG				STATU	JS		

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



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

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🔤 Keysight Spectrum Analyzer - Burst Power					
UX RL RF 50Ω AC	CORREC	SENSE:INT Center Freq: 2.48000 Trig: RF Burst #Atten: 18 dB	ALIGN AUTO 0000 GHz Avg Hold: 100/100	08:59:30 PM Dec 16, 2019 Radio Std: None	Frequency
10 dB/div Ref 22.00 dBm					
12.0 2.00 -8.00					Center Freq 2.480000000 GHz
-18.0					
-38.0 -48.0 -58.0					
-68.0					
0.00 s ResBw 3.00 MHz			Sweep 4.00 r	4.00 ms ms (60001 pt)	CF Step 3.000000 MHz
Output Power (Above Threshold Lvl) 13.525 dBm		Abs Amplitud Rel Amplitude Current Data		-1.181 dBm -15.00 dB	<u>Auto</u> Man Freq Offset
Above Threshold Pts 432	88	Output Pwr 13.523 dBm	Max Pt 13.819 dBn	<b>Min Pt</b> n -101.36 dBm	0 Hz
MSG			STATU	JS	

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



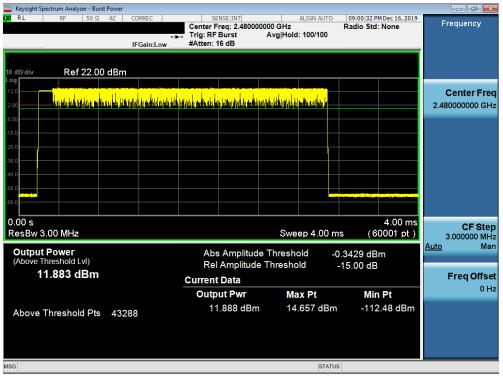
Plot 7-22. Average Conducted Power (2Mbps - Ch. 0)

FCC ID: A3LSMF700F		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager	
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IXI RF 50Ω AC CORREC IFGain:Low	SENSE:INT Center Freq: 2.441000000 GHz Trig: RF Burst Avg Ho #Atten: 18 dB	ALIGN AUTO 09:00:01 Radio St d: 100/100	PMDec 16, 2019 d: None Frequency
10 dB/div Ref 22.00 dBm			
12.0 2.00	<mark>istatele auficate las tatentindele auficare sebuildans</mark> tat	il with a cular is	2.441000000 GHz
-8.0			
-48.0			
-58.0			
0.00 s ResBw 3.00 MHz	Sw	eep 4.00 ms (	4.00 ms 60001 pt ) 3.000000 MHz Auto Man
Output Power (Above Threshold Lvl) 13.473 dBm	Abs Amplitude Thresi Rel Amplitude Thresh		Bm
	Current Data Output Pwr	ax Pt M	in Pt
Above Threshold Pts 43292	13.474 dBm 1	6.207 dBm -10	08.35 dBm
MSG		STATUS	

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



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

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🔤 Keysight Spectrum Analyzer - Burst Power				
M2 RL RF 50Ω AC CORREC → IFGain:Low	SENSE:INT Center Freq: 2.402000000 GHz Trig: RF Burst Avg Ho #Atten: 16 dB		:49 PM Dec 16, 2019 Std: None	Frequency
10 dB/div Ref 22.00 dBm				
				Center Freq 2.402000000 GHz
-18.0				
-48.0 -58.0 -68.0				
0.00 s ResBw 3.00 MHz	Sv	veep 4.00 ms	4.00 ms (60001 pt )	CF Step 3.000000 MHz
Output Power (Above Threshold Lvl) 12.640 dBm	Abs Amplitude Thres Rel Amplitude Thres Current Data		dBm	Auto Man Freq Offset
Above Threshold Pts 42603	Output Pwr		<b>Min Pt</b> 106.41 dBm	0 Hz
MSG		STATUS		

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



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

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Upd RL RF 50Ω AC CORREC →→ IFGain:Low	SENSE:INT ALIGN Center Freq: 2.48000000 GHz Trig: RF Burst Avg Hold: 100/ #Atten: 20 dB	Radio Std: None	Frequency
10 dB/div Ref 22.00 dBm			
		2.	Center Freq 480000000 GHz
-28 0			
-48.0 -59.0			
0.00 s ResBw 3.00 MHz	Sweep 4		CF Step 3.000000 MHz
Output Power (Above Threshold Lvl) 12.112 dBm	Abs Amplitude Threshold Rel Amplitude Threshold Current Data	0.2345 dBm -15.00 dB	Man Freq Offset
Above Threshold Pts 42582	Output Pwr Max Pt 12.074 dBm 15.235		0 Hz
MSG		STATUS	

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.



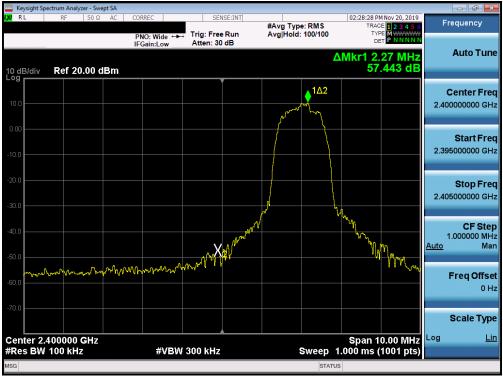
Figure 7-3. Test Instrument & Measurement Setup

#### **Test Notes**

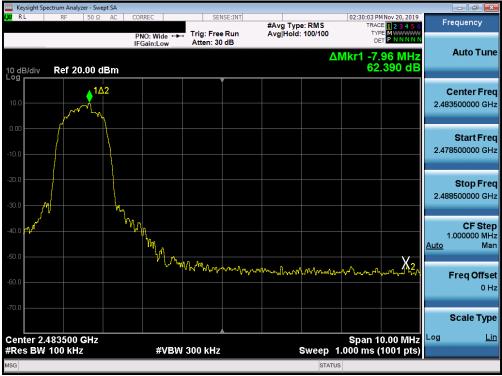
Out of band conducted spurious emissions at the band edge were investigated for all data rates in hopping and non-hopping modes. The worst case emissions were found with the EUT transmitting at 3 Mbps. Band edge emissions were also investigated with the EUT transmitting in all data rates. Plots of the 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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	ectrum Analyz											_	
X/RL	RF	50 Ω	AC	CORREC			SENSE:INT	#Avg Typ		TRAC	MNov 20, 2019	F	requency
				PNO: IFGair	Wide ↔ n:Low		Free Run 1: 30 dB	Avg Hold		TYF DE			Auto Tuno
10 dB/div Log	Ref 20	.00 di	3m						<i>L</i>	14 Mkr1 3. 62	88 MHz .561 dB		Auto Tune
10.0							Ĭ			1∆2			Center Freq
								~~~~	www.www	han han	᠕᠕᠕	2.4	00000000 GHz
0.00												23	Start Freq
-10.0												2.0	
-20.0												2.4	Stop Freq
-30.0								A					
-40.0							- n/	bl.				Auto	CF Step 1.000000 MHz Mar
-50.0	man		- An -0	m - 1) r <sup>er</sup>	10 f) _ 0 Doi	X2	And M						
-60.0		~~~~	10 10.	······································	0 8 LO N P	y a como							Freq Offset 0 Hz
-70.0													Scale Type
Center 2.4	400000 <b>(</b>	GHz								Span 1	0.00 MHz	Log	Lin
#Res BW					#VBW	/ 300 k	Hz		Sweep 1	1.000 ms (	1001 pts)		
//SG									STATU	s			

Plot 7-30. 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

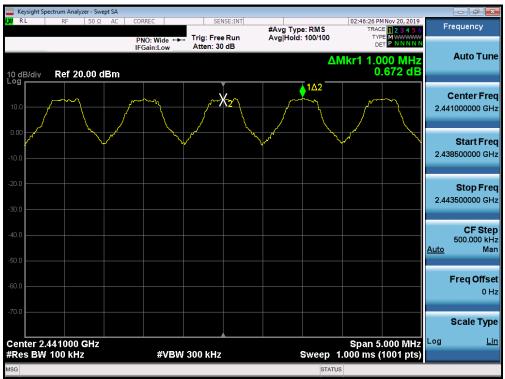
The EUT complies with the minimum channel separation requirement when it is operating in 1x/EDR mode using 79 channels and when operating in AFH mode using 20 channels.

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Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	Min. Channel Separation [MHz]
2402	1.0	GFSK	0	0.621
2441	1.0	GFSK	39	0.621
2480	1.0	GFSK	78	0.630
2402	2.0	π/4-DQPSK	0	0.843
2441	2.0	π/4-DQPSK	39	0.830
2480	2.0	π/4-DQPSK	78	0.903
2402	3.0	8DPSK	0	0.883
2441	3.0	8DPSK	39	0.880
2480	3.0	8DPSK	78	0.797

Table 7-4. Minimum Channel Separation



Plot 7-32. Channel Spacing Plot (Bluetooth)

FCC ID: A3LSMF700F		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
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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 Spectrum Analyzer - Swept SA					
	PNO: Fast	SENSE:INT Trig Delay-499.0 µs Trig: Video Atten: 30 dB	#Avg Type: RMS	02:44:01 PM Nov 20, 2019 TRACE 1 2 3 4 5 6 TYPE WWWWW DET P N N N N N	Frequency
10 dB/div Ref 20.00 dBm	IFGain:Low	Atten: 00 dB	4	Mkr1 2.910 ms -5.69 dB	Auto Tune
10.0				TRIG LVL	Center Freq 2.441000000 GHz
-10.0					<b>Start Freq</b> 2.441000000 GHz
-20 0 X2			1Δ2		<b>Stop Freq</b> 2.441000000 GHz
-40.0 -50.0 Milling/			Muselyhetterte	alihan tan lini di na mana di tana di t	CF Step 1.000000 MHz <u>Auto</u> Man
-60.0					Freq Offset 0 Hz
Center 2.441000000 GHz Res BW 1.0 MHz	#VBW 3	: 0 MHz	Sweep 5	Span 0 Hz 5.000 ms (1001 pts)	Scale Type Log <u>Lin</u>
MSG	~10110		STATUS		

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 2.910 ms/channel = 310.40 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)
- 53.34 hops x 2.910 ms/channel = 155.21 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

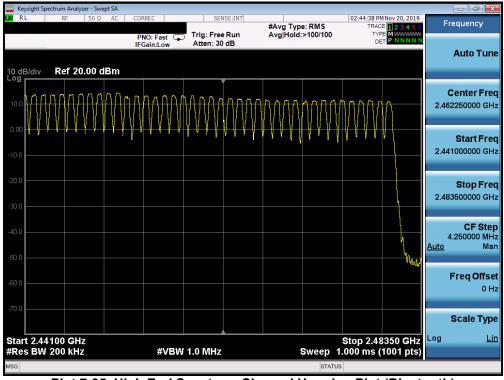
The frequency spectrum was broken up into two sub-ranges to clearly show all of the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.

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		Analyzer - Sw											
L <mark>XI</mark> RL	RF	50 Ω	AC	CORREC		SEN	SE:INT	#Avg Typ	e: RMS		MNov 20, 2019	Fr	equency
				PNO: Fast		: Free en: 30		Avg Hold		TYP			
				IFGain:Low	Att	en: 30	ab						Auto Tune
10 dB/div	. Dof	20.00	- Bro										
	KEI	20.00											
				^ N N N N	~~~	лn	որոր	0 0 0 0	กกกก		nnnn	C	enter Freq
10.0	ANA	ANN	ΗH	AAAAP	1111				H			2.420	500000 GHz
0.00	/		V V I	₩₩₩₩			\ \ \	₩₩₩₩	1111	V	VVV		
0.00		YYY	110	• • • F	***	ľ			8 Y Y Y	7 7 7 Y U	1		Start Freq
-10.0												2.400	0000000 GHz
-20.0													Stop Freq
												2.44	1000000 GHz
-30.0													
													CF Step
-40.0													.100000 MHz
-50.0												<u>Auto</u>	Man
-30.0													
-60.0												F	req Offset
													0 Hz
-70.0													
													Scale Type
Start 2.4	40000	GHz								Stop 2.44	100 GHz	Log	Lin
#Res B				#VE	SW 1.0	VIHz			Sweep	1.000 ms (	1001 pts)		
MSG									STATU	JS			

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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LXI RL	RF 50 Ω	AC	CORREC	SE	NCEATNE					
			PNO: Fast		NSE:INT	#Avg Typ	e: RMS	TRA	MNov 20, 2019 DE 1 2 3 4 5 6 PE MWWWWW T P N N N N N	Frequency
10 dB/div	Ref 20.00 d	Bm	IFGain:Low	Atten: 30			ľ	/kr1 3.26		Auto Tun
10.0										<b>Center Fre</b> 5.015000000 GH
-10.0									DL1 -8.53 dBm	Start Free 30.000000 MH
-20.0										Stop Free 10.000000000 GH
-40.0	يى بىرى ئەركى بىرى بىرى بىرى بىرى بىرى بىرى بىرى ب			and distant in surgery and days	and the second se	e and faithing and f	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	uteras (p. 4), constitu <sup>1</sup> († 24) Najvarjanja († 20)	a pala se tri king dan sepat	CF Step 997.000000 MH <u>Auto</u> Ma
-60.0	are, russial to an article and			<mark>le de la cala y tales a <sub>la cala d</sub>a tala.</mark>						Freq Offse 0 H
-70.0								Stop 10	.000 GHz	Scale Type
#Res BW 1			#VB	W 3.0 MHz		s		18.00 ms (3 τυς	0001 pts)	

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



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

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	pectrum Analy:	zer - Swept S	A								
L <mark>X/</mark> RL	RF	50 Ω A		REC			#Avg Typ	e: RMS	TR	PM Nov 20, 2019 ACE 1 2 3 4 5 6	Frequency
10 dB/div Log	Ref 20	).00 dBr	IFC	NO:Fast G Gain:Low	Atten: 30				Mkr1 3.29	95 2 GHz	Auto Tu
10.0											<b>Center Fr</b> 5.015000000 G
.00										DL1 -6.62 dBm	<b>Start Fr</b> 30.000000 M
30.0											<b>Stop Fr</b> 10.000000000 G
40.0	ار میں بر اور اور اور اور اور اور اور اور اور او			and the second population	lai dan kalangan sakana	And Address of the local sectors of the local secto	te a statistica de la compañecia de la comp		n an	a company in the second of	CF St 997.000000 M <u>Auto</u> M
60.0											Freq Offs 0
-70.0	МНт								Stop 1	0.000 GHz	Scale Ty
	/ 1.0 MHz	2		#VB۱	N 3.0 MHz		S	weep	18.00 ms (	(30001 pts)	
ISG								ST/	TUS		

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



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

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🔤 Keysight Sp	ectrum Analy	zer - Swept	t SA										ð 🗙
XI RL	RF	50 Ω	AC	CORREC			ISE:INT	#Avg Typ	e: RMS	TR	PM Nov 20, 2019 ACE 1 2 3 4 5 6	Frequer	псу
				PNO: F IFGain:	ast ⊊ Low	Trig: Free Atten: 30				Т			
10 dB/div Log	Ref 20	0.00 dE	3m						N	/kr1 5.82 -40	20 6 GHz .88 dBm	Auto	Tune
10.0												Cente 5.0150000	
-10.0											DL1 -9.10 dBm	Stai 30.0000	t <b>Fre</b> o 00 MH
-20.0												<b>Sto</b> 10.0000000	<b>р Fre</b> 00 GH
-40.0	Algo Albert Provident			Haratan States	and a filler	n post for <sub>i na s</sub> a cita a		ang p <sup>ula</sup> t to jest part fo	un, e filligi y tu	ang tang tang tang tang tang tang tang t	Manetialia (Aliana) waa	CI 997.0000 <u>Auto</u>	F Stej 00 MH Ma
-50.0												Freq	Offse 0 H
-70.0												Scale	e Type Lii
Start 30 M #Res BW		z			#VBW	3.0 MHz		s	weep	Stop 1 18.00 ms (	0.000 GHz 30001 pts)	-	
MSG									STA	TUS			

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							

#### 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.

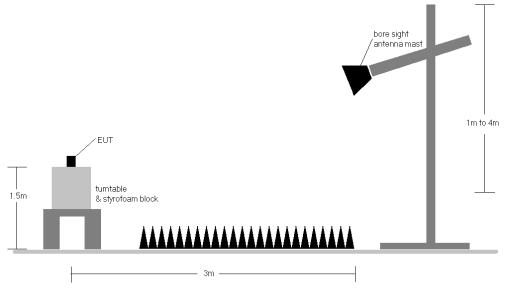


Figure 7-8. Radiated Test Setup >1GHz

## 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 [dBμV/m] Limit [dBμV/m]

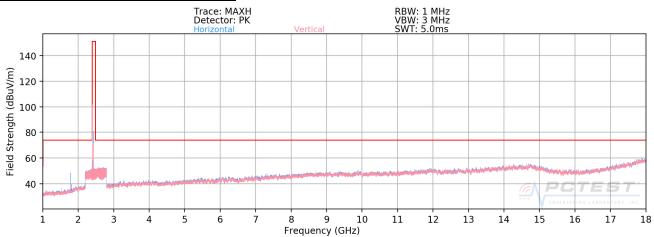
### **Duty Cycle Correction Factor Calculation**

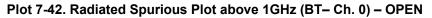
- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50 x 20 channels = 150 ms
- Number of times transmitter hits on one channel = 100 ms / 150 ms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

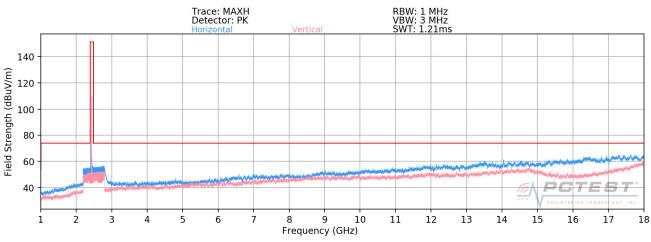
FCC ID: A3LSMF700F		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
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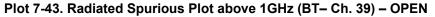


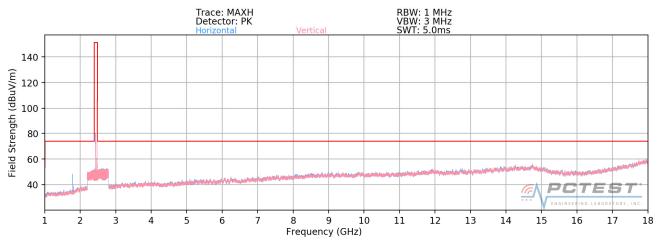
# Radiated Spurious Emission Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]







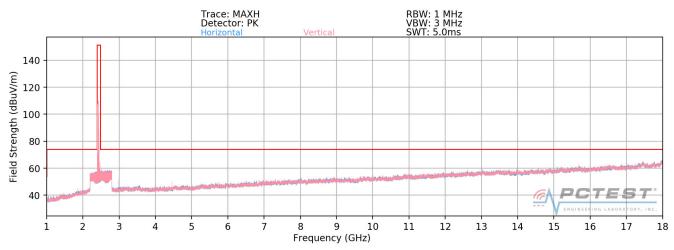


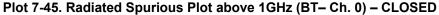


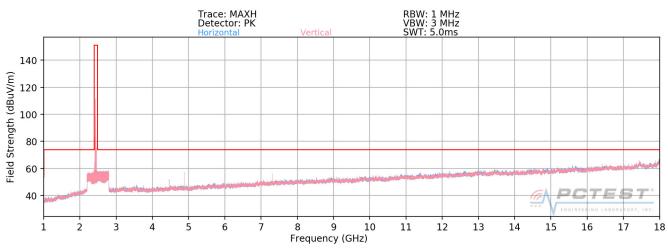
### Plot 7-44. Radiated Spurious Plot above 1GHz (BT- Ch. 78) - OPEN

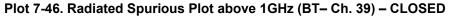
FCC ID: A3LSMF700F		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
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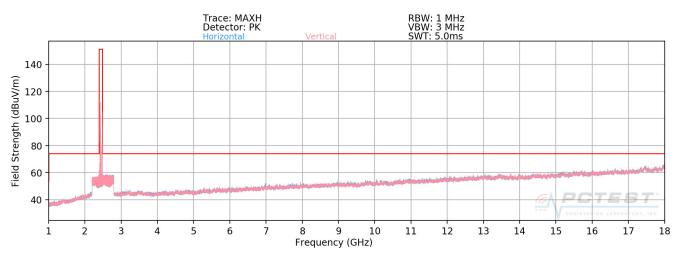


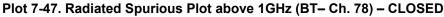








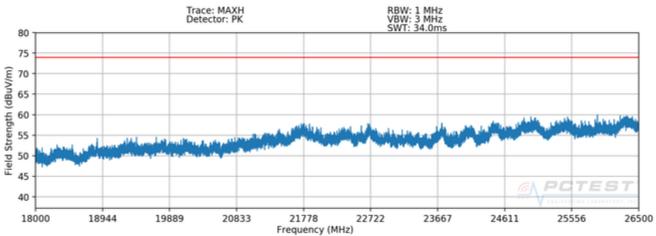




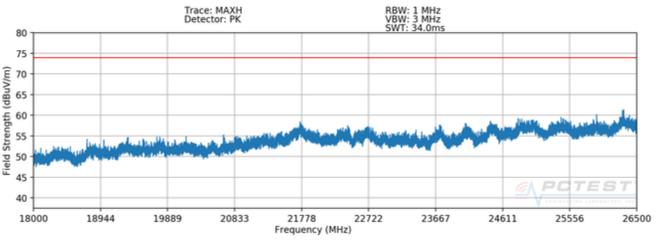
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# Radiated Spurious Emissions Measurements (Above 18GHz) §15.209; RSS-Gen [8.9]



Plot 7-48. Radiated Spurious Plot above 18GHz (Horizontal) – OPEN



Plot 7-49. Radiated Spurious Plot above 18GHz (Vertical) – OPEN

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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	102	301	-80.51	8.59	35.08	53.98	-18.90
4804.00	Peak	н	102	301	-69.14	8.59	46.45	73.98	-27.53
12010.00	Avg	н	-	-	-84.44	20.89	43.45	53.98	-10.53
12010.00	Peak	Н	-	-	-72.97	20.89	54.92	73.98	-19.06

# 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	-	-	-80.70	8.58	34.88	53.98	-19.09
4882.00	Peak	н	-	-	-69.88	8.58	45.70	73.98	-28.27
7323.00	Avg	н	-	-	-82.80	13.14	37.34	53.98	-16.64
7323.00	Peak	Н	-	-	-71.84	13.14	48.30	73.98	-25.68
12205.00	Avg	Н	-	-	-84.49	21.69	44.20	53.98	-9.78
12205.00	Peak	Н	-	-	-73.00	21.69	55.69	73.98	-18.29

### 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	-	-	-80.95	8.18	34.23	53.98	-19.75
4960.00	Peak	Н	-	-	-69.62	8.18	45.56	73.98	-28.42
7440.00	Avg	Н	-	-	-82.53	13.61	38.08	53.98	-15.90
7440.00	Peak	н	-	-	-72.06	13.61	48.55	73.98	-25.43
12400.00	Avg	Н	-	-	-84.28	22.25	44.97	53.98	-9.01
12400.00	Peak	Н	-	-	-72.57	22.25	56.68	73.98	-17.30

Table 7-9. Radiated Measurements

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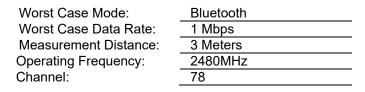


# 7.10 Radiated Restricted Band Edge Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

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.

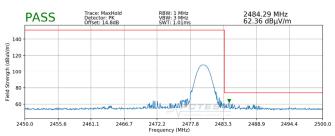
The amplitude offset shown in the following plots for average measurements was calculated using the formula:

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

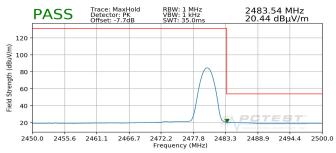




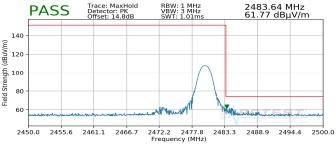
Plot 7-50. Radiated Restricted Upper Band Edge Measurement (Average)



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







Plot 7-53. Radiated Restricted Upper Band Edge Measurement with WCP (Peak)

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# 7.11 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 I	₋imit (dBμV)
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-10. 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

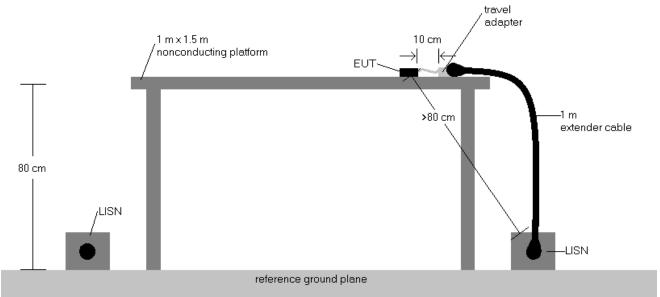
- 1. Analyzer center frequency was set to the frequency of the spurious emission of interest
- 2. RBW = 9kHz (for emissions from 150kHz 30MHz)
- 3. Detector = RMS
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

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# Test Setup

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



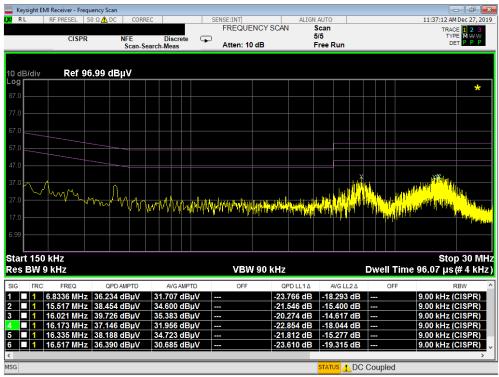


## Test Notes

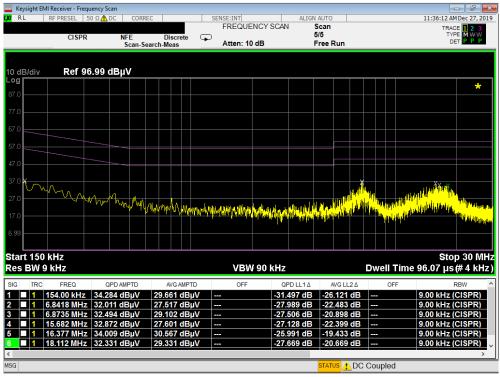
- 1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
- 2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
- 3.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

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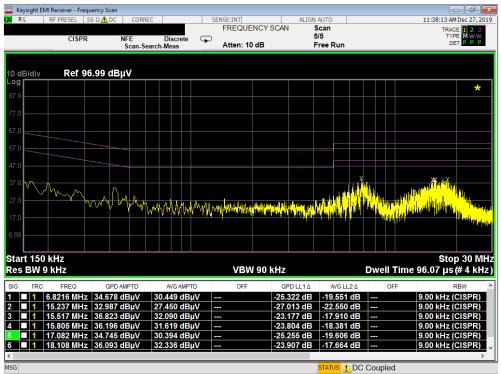




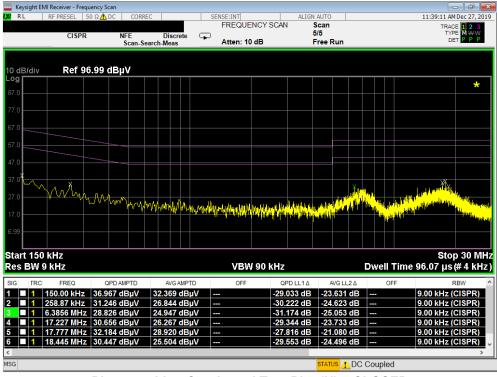


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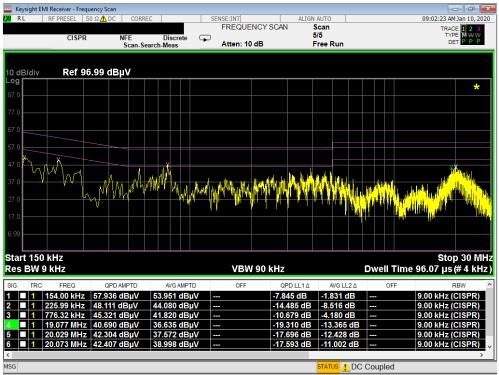
Plot 7-56. Line-Conducted Test Plot (L1) – CLOSED



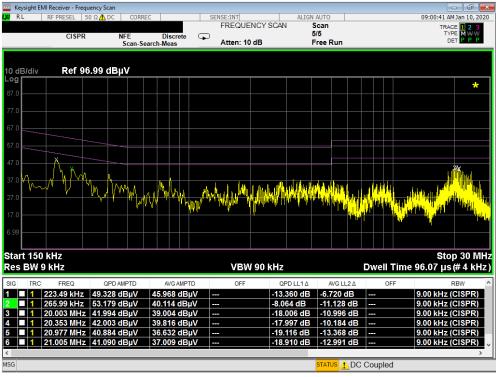
Plot 7-57. Line-Conducted Test Plot (N) – CLOSED

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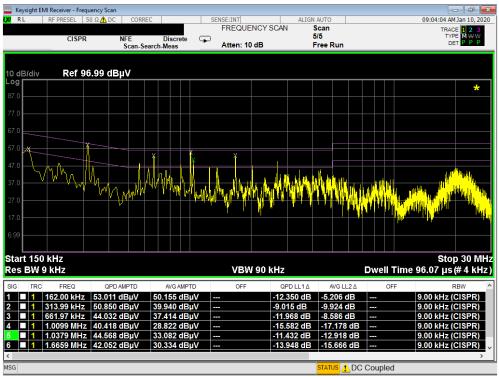
Plot 7-58. Line-Conducted Test Plot (L1) - OPEN with WCP



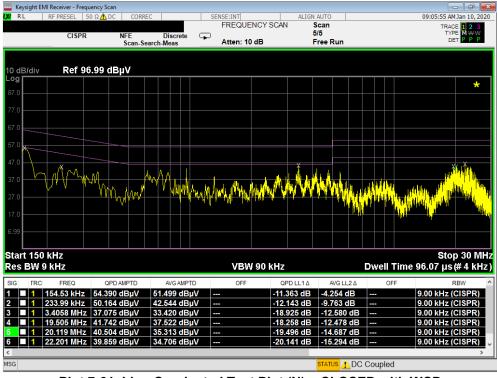
Plot 7-59. Line-Conducted Test Plot (N) – OPEN with WCP

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Plot 7-60. Line-Conducted Test Plot (L1) - CLOSED with WCP





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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: A3LSMF700F** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

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