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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:

01/08 - 02/12/2021 **Test Site/Location:** PCTEST Lab. Columbia, MD, USA **Test Report Serial No.:** 1M2101040001-11-R1.A3L

FCC ID:

A3LSMA426U

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):

Certification SM-A426U SM-A426U1/DS, SM-S426DL, SM-A426U1 Portable Handset 42.073 mW (16.24 dBm) Peak Conducted 2402 – 2480MHz GFSK, π /4-DQPSK, 8DPSK FCC Part 15 Spread Spectrum Transmitter (DSS) Part 15 Subpart C (15.247) ANSI C63.10-2013, KDB 558074 D01 v05r02

Note: This revised Test Report (S/N:1M2101040001-11-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

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

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 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 located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2017 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: A3LSMA426U**. 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.: 02063, 02055, 02048, 02022, 02030, 02014

2.2 Device Capabilities

This device contains the following capabilities:

800/850/1900 CDMA/EvDO Rev0/A, 1x Advanced (BC0, BC1, BC10), 850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (n5, n71, n41, n66, n2, n25, n77, n260, n261), 802.11b/g/n WLAN, 802.11a/n/ac UNII (5GHz), Bluetooth (1x, EDR, LE), NFC

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

Following antenna was used for the testing.

Frequency [GHz]	Antenna Gain (dBi)
2.4	-1.3

Table 2-2. Antenna Peak Gain

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.

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2.4 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 AC Line Conducted Emissions 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.

2.5 Software and Firmware

The test was conducted with firmware version A426UOYN0ATL5 installed on the EUT.

2.6 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 ground plane. 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 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 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 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_{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
-	WL25-1	Conducted Cable Set (25GHz)	9/16/2020	Annual	9/16/2021	WL25-1
-	WL40-1	WLAN Cable Set (40GHz)	9/16/2020	Annual	9/16/2021	WL40-1
Agilent	N5183A	MXG Analog Signal Generator	1/21/2021	Annual	1/21/2022	MY50141900
Anritsu	ML2495A	Power Meter	1/18/2021	Annual	1/18/2022	941001
Anritsu	MA2411B	Pulse Power Sensor	9/22/2020	Annual	9/22/2021	1315051
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	10/10/2019	Biennial	10/10/2021	121034
Emco	3115	Horn Antenna (1-18GHz)	6/18/2020	Biennial	6/18/2022	9704-5182
Emco	3116	Horn Antenna (18 - 40GHz)	8/7/2018	Triennial	8/7/2021	9203-2178
Espec	ESX-2CA	Environmental Chamber	8/27/2020	Biennial	8/27/2022	17620
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	2/14/2019	Biennial	2/14/2021	125518
ETS-Lindgren	3816/2NM	LISN	7/9/2020	Biennial	7/9/2022	114451
ETS-Lindgren	3115	Double Ridged Guide Horn 750MHz - 18GHz	3/12/2020	Biennial	3/12/2022	150693
Keysight Technologies	N9020A	MXA Signal Analyzer	8/14/2020	Annual	8/14/2021	US46470561
Keysight Technologies	N9038A	MXE EMI Receiver	8/11/2020	Annual	8/11/2021	MY51210133
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	8/17/2020	Annual	8/17/2021	MY52350166
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/3/2020	Annual	3/3/2021	100040
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	7/15/2020	Annual	7/15/2021	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	9/9/2020	Annual	9/9/2021	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/10/2020	Annual	8/10/2021	103200
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2/10/2020	Annual	2/10/2021	102134
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	10/1/2019	Biennial	10/1/2021	310233
Sunol	DRH-118	Horn Antenna (1-18GHz)	10/3/2019	Biennial	10/3/2021	A050307
Sunol Science	JB5	Bi-Log Antenna (30M - 5GHz)	7/27/2020	Biennial	7/27/2022	A051107

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.

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7.0 TEST RESULTS

7.1 Summary

Company Name:	Samsung Electronics Co., Ltd.
FCC ID:	A3LSMA426U
Method/System:	Frequency Hopping Spread Spectrum (FHSS)
Number of Channels:	<u>79</u>

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

Table 7-1. Summary of Test Results

Notes:

- 1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst-case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
- 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	938.30
2441	1.0	39	944.40
2480	1.0	78	935.90
2402	2.0	0	1285.00
2441	2.0	39	1280.00
2480	2.0	78	1282.00
2402	3.0	0	1264.00
2441	3.0	39	1270.00
2480	3.0	78	1284.00

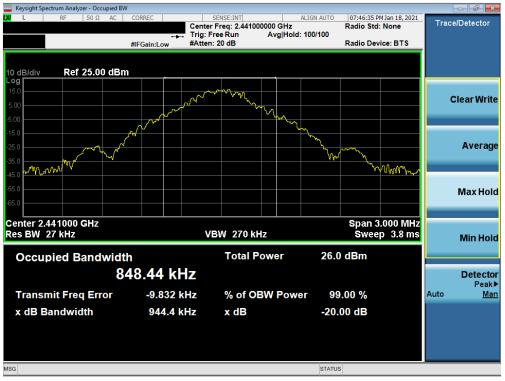
Table 7-2. Conducted 20dB Bandwidth Measurements

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



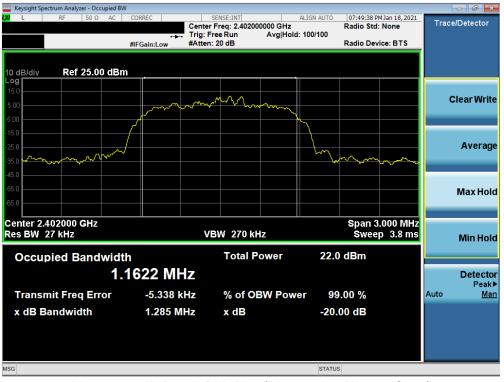
Plot 7-2. 20dB Bandwidth Plot (Bluetooth, 1Mbps - Ch. 39)

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



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

FCC ID: A3LSMA426U	PCTEST Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-5. 20dB Bandwidth Plot (Bluetooth, 2Mbps - Ch. 39)



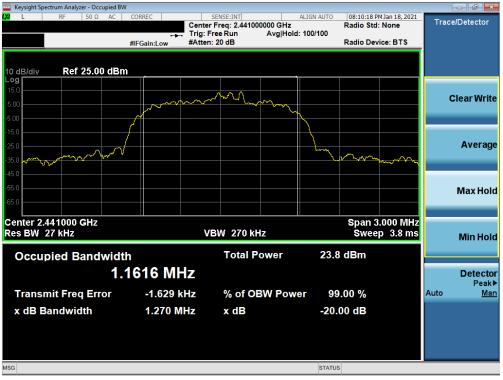


FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 10 of 50
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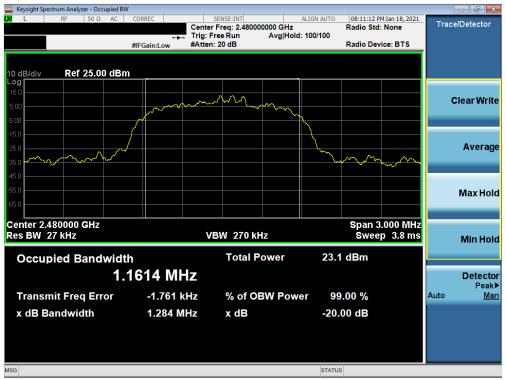
Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 0)



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

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
Test Report S/N:	Test Dates:	EUT Type:	Dage 17 of 50	
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Plot 7-9. 20dB Bandwidth Plot (Bluetooth, 3Mbps - Ch. 78)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 10 of 50
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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

<u>Test Settings</u> Peak Power Measurement

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

Test Setup

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



Figure 7-2. Test Instrument & Measurement Setup

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
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<u>Note</u>

This unit was tested with all possible data rates and the highest peak power is reported with the unit transmitting at 1Mbps. Final results were obtained using calibrated couplers, attenuators and cables. The following formula was used:

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

	Data				nducted wer	Avg Conducted Power	
Frequency [MHz]	· · · Rate		Channel No.	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	GFSK	0	14.65	29.174	14.42	27.638
2441	1.0	GFSK	39	16.24	42.073	15.91	38.958
2480	1.0	GFSK	78	15.36	34.324	15.26	33.566
2402	2.0	π/4-DQPSK	0	12.51	17.820	9.19	8.292
2441	2.0	π/4-DQPSK	39	13.91	24.609	10.56	11.384
2480	2.0	π/4-DQPSK	78	13.21	20.927	9.76	9.456
2402	3.0	8DPSK	0	13.14	20.616	9.20	8.322
2441	3.0	8DPSK	39	14.66	29.255	10.70	11.741
2480	3.0	8DPSK	78	13.74	23.632	9.85	9.659

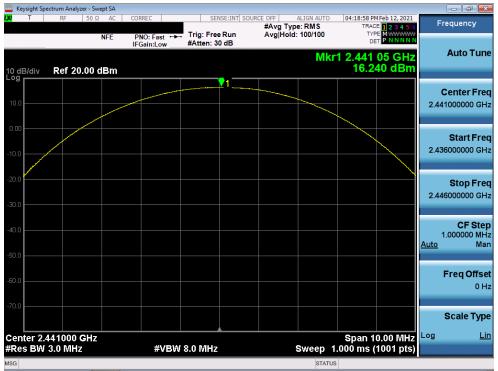
Table 7-3. Conducted Output Power Measurements

FCC ID: A3LSMA426U	PCTEST* Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 20 of 59
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	ctrum Analyzer -									
IXI T	RF 50		CORREC		NSE:INT SOU	#Avg Typ		TRAC	M Feb 12, 2021 DE 1 2 3 4 5 6 PE M WWWWW	Amplitude
		NFE	PNO: Fast ++ IFGain:Low	#Atten: 2		Avg Hold	: 100/100	DI	PNNNNN	Ref Lev
10 dB/div	Ref 16.00	dBm					Mkı	1 2.402 1 ⁻¹ 14.6	22 GHz 50 dBm	16.00 dB
				+	1					
6.00										Attenuation [26 dB]
1.00										
-4.00										Scale/D
-14.0										10 d
-24.0										Scale Typ
										Log L
-34.0										
-44.0										Presel Cent
-54.0										
										Presel Adju
-64.0										0 +
-74.0										
										Moi 1 of
Center 2.4 #Res BW	02000 GH	Z	#\/B\/	/ 8.0 MHz			Sween 1	Span 1	0.00 MHz (1001 pts)	
MSG	5.0 WINZ		#VDV	- 6.0 WH2			Sweep		(too r pis)	

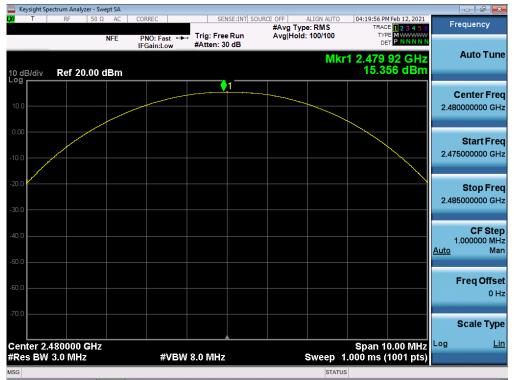




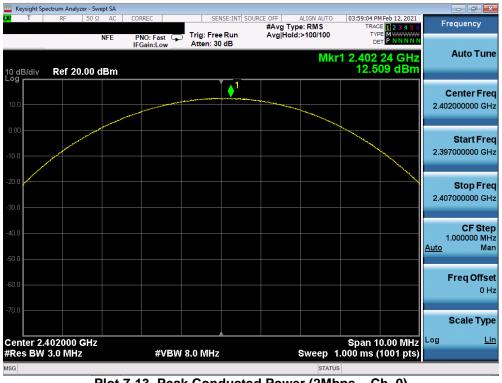
Plot 7-11. Peak Conducted Power (1Mbps – Ch. 39)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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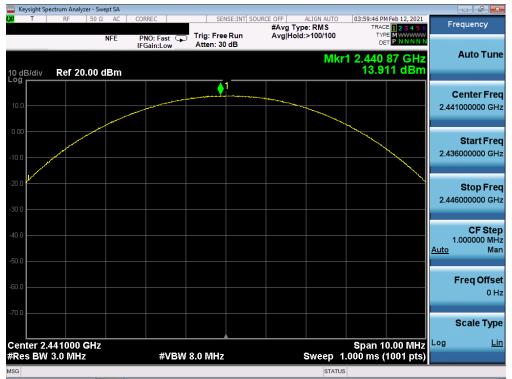
Plot 7-12. Peak Conducted Power (1Mbps – Ch. 78)



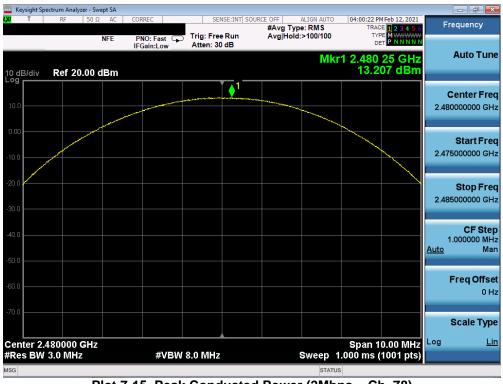
Plot 7-13. Peak Conducted Power (2Mbps - Ch. 0)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
Test Report S/N:	Test Dates:	EUT Type:	Dage 22 of 59	
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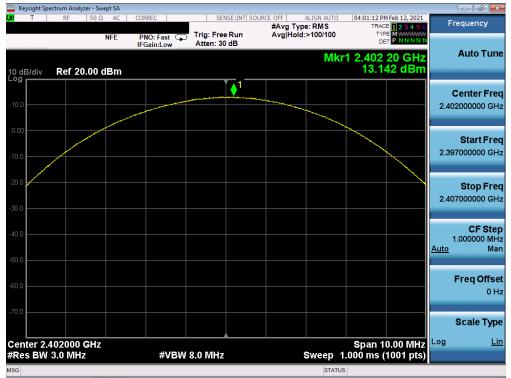
Plot 7-14. Peak Conducted Power (2Mbps - Ch. 39)



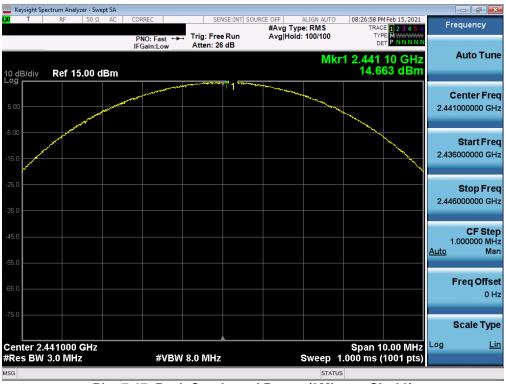
Plot 7-15. Peak Conducted Power (2Mbps – Ch. 78)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
Test Report S/N:	Test Dates:	EUT Type:	Dage 22 of 50	
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Plot 7-16. Peak Conducted Power (3Mbps - Ch. 0)



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

FCC ID: A3LSMA426U	PCTEST Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
Test Report S/N:	Test Dates:	EUT Type:	Dogo 24 of 59	
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🔤 Keysight Sp	ectrum Analyzer - Sw									
L <mark>XI</mark> T	RF 50 Ω	2 AC	CORREC	SENS	E:INT SOURCE OF #A	F ALIGN AUTO		M Feb 15, 2021	Fr	equency
			PNO: Fast ↔ IFGain:Low	Atten: 26 o	Run Av	g Hold: 100/100	TY D			
10 dB/div Log	Ref 15.00	dBm				M	(r1 2.480 13.7	07 GHz 35 dBm		Auto Tune
5.00		- and a second			1					Center Freq 0000000 GHz
-5.00								A A A A	2.47	Start Freq 5000000 GHz
-25.0									2.48	Stop Freq 5000000 GHz
-45.0									1 <u>Auto</u>	CF Step .000000 MHz Man
-65.0									1	F req Offset 0 Hz
-75.0										Scale Type
Center 2. #Res BW	480000 GHz		#\/P\/	V 8.0 MHz		Swoon	Span 1 1.000 ms	0.00 MHz	Log	Lin
	3.0 19172		#VDV	V 0.0 IVINZ				(1001 pis)		
MSG						STAT	05			





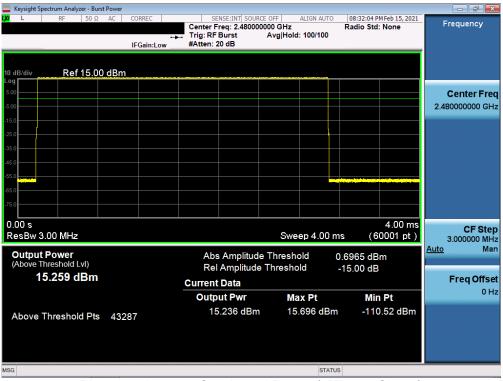
Plot 7-19. Average Conducted Power (1Mbps – Ch. 0)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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🔤 Keysight Spect	rum Analyzer - B									
()X(L	RF 50 !	NFE	CORREC	+++ Trig:	SENSE:INT SOUF Freq: 2.44100 RF Burst n: 18 dB		ALIGN AUTO	04:04:49 P Radio Std	M Feb 12, 2021 : None	Frequency
10 dB/div Log	Ref 20.0	00 dBm								
10.0 0.00										Center Freq 2.441000000 GHz
-10.0										
-40.0										
-60.0										
0.00 s ResBw 3.0						Swe	ep 4.00 r	ns (6	4.00 ms 0001 pt)	CF Step 3.000000 MHz Auto Man
Output P (Above Thr	ower eshold Lvl) 906 dBm	•		F	bs Amplitud Rel Amplitud			1.270 dB -15.00 dB		Freq Offset
					ent Data Itput Pwr	Ма	x Pt	Mir	1 Pt	0 Hz
Above Th	ireshold Pt	s 4328	7		15.909 dBm		.270 dBm		9.23 dBm	
MSG							STATU	IS		

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



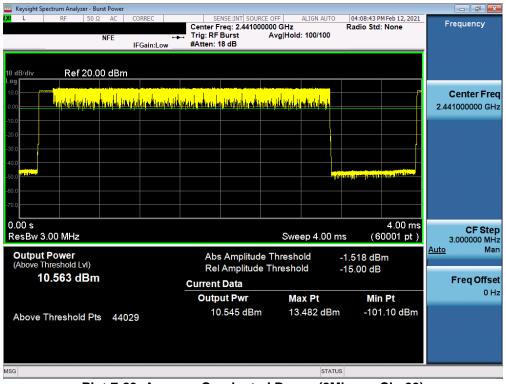
Plot 7-21. Average Conducted Power (1Mbps - Ch. 78)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Daga 26 of 58
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Correction Analyzer - Burst Power Δ L RF 50 Ω AC CORREC	Center Freq: 2.402000000 GHz	IGN AUTO 08:36:59 PM Feb 15, 2021 Radio Std: None	Frequency
⊢ IFGain:Low	Trig: RF Burst Avg Hold: 1 #Atten: 20 dB	00/100	
10 dB/div Ref 15.00 dBm			
			Center Freq
	<mark>, tell park de sen der sekten bliken blike an die ben seks bilde beilige i det sekten bilde beilige i det sekte Bilder beilige der sekten bilden bilde bilde beilige bilde bilde bilde bilde bilde bilde bilde bilde bilde bilde</mark>		2.402000000 GHz
-15.0			
-25.0			
-35.0			
-45.0			
-55.0			
-75.0			
0.00 s		4.00 ms	
ResBw 3.00 MHz	Sweep	4.00 ms 4.00 ms (60001 pt)	CF Step 3.000000 MHz
Output Power	Abs Amplitude Threshold	d -2.750 dBm	<u>Auto</u> Man
(Above Threshold Lvl)	Rel Amplitude Threshold		
9.1868 dBm	Current Data		Freq Offset
	Output Pwr Max	Pt Min Pt	0 Hz
Above Threshold Pts 44022	9.1939 dBm 12.2	50 dBm -101.51 dBm	
MSG		STATUS	
Nig		514105	





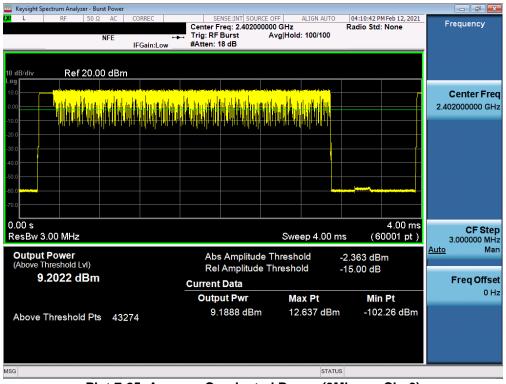
Plot 7-23. Average Conducted Power (2Mbps – Ch. 39)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 27 of 59
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Keysight Spectrum Analyzer - Burst Power K L RF 50 Ω AC CORREC F IFGain:Low	SENSE:INT SOURCE OF Center Freq: 2.480000000 Trig: RF Burst Av #Atten: 20 dB		08:38:55 PM Feb 15, 2021 adio Std: None	Frequency
10 dB/div Ref 15.00 dBm				
500 500 500 1500	<mark>iljech, ada ee hey bilandijelej, ander bereis,</mark> d	da hajali jala na da aku kas k		Center Freq 2.48000000 GHz
-25.0				
-45 0 -55 0 -65 0				
0.00 s			4.00 ms	CF Step
ResBw 3.00 MHz Output Power (Above Threshold LvI)	Abs Amplitude Th Rel Amplitude Th		(60001 pt) 173 dBm .00 dB	3.000000 MHz <u>Auto</u> Man
9.7572 dBm	Current Data Output Pwr	Max Pt	Min Pt	Freq Offset 0 Hz
Above Threshold Pts 44021	9.7503 dBm	12.827 dBm	-106.37 dBm	
MSG		STATUS		

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



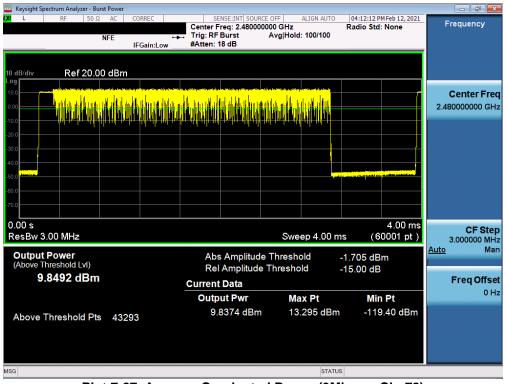
Plot 7-25. Average Conducted Power (3Mbps - Ch. 0)

FCC ID: A3LSMA426U	PCTEST Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
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weysight Spectrum Analyzer - Burst Power		
M2 L RF 50Ω AC CORREC NFE → IFGain:Low	SENSE:INT SOURCE OFF ALIGN AUTO Center Freq: 2.441000000 GHz Trig: RF Burst Avg Hold: 100/100 #Atten: 18 dB	04:11:30 PM Feb 12, 2021 Radio Std: None Frequency
10 dB/div Ref 20.00 dBm		
	<mark>i kan sa kalakatan sa kana kana kana kana kana kana kana</mark>	Center Freq 2.441000000 GHz
-60 0		
-70.0		4.00 ms CF Step
ResBw 3.00 MHz Output Power (Above Threshold Lvl)		s (60001 pt) 3.000000 MHz .8477 dBm
10.697 dBm	Rel Amplitude Threshold - Current Data - Output Pwr Max Pt	15.00 dB Freq Offset 0 Hz
Above Threshold Pts 43294	10.683 dBm 14.152 dBm	-109.20 dBm
MSG	STATUS	

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



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

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical 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 x Span/RBW
- 7. Trace mode = max hold
- 8. Sweep time = auto couple
- 9. The trace was allowed to stabilize

Test Setup

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



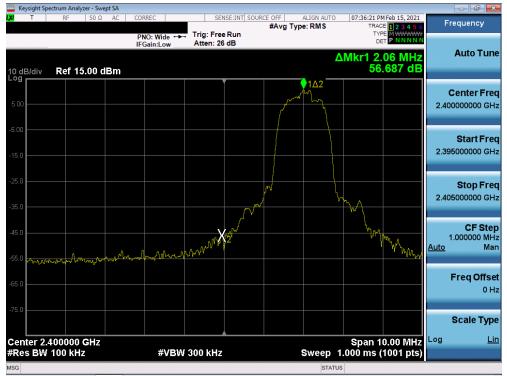
Figure 7-3. Test Instrument & Measurement Setup

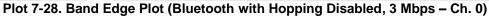
Test Notes

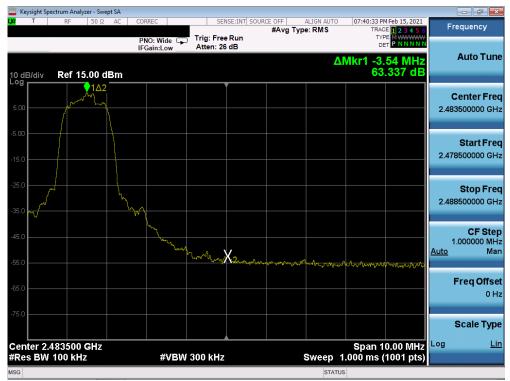
Out of band conducted spurious emissions at the band edge were investigated for all data rates in hopping and non-hopping modes. The worst case emissions were found with the EUT transmitting at 3 Mbps. Band edge emissions were also investigated with the EUT transmitting in all data rates. Plots of the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

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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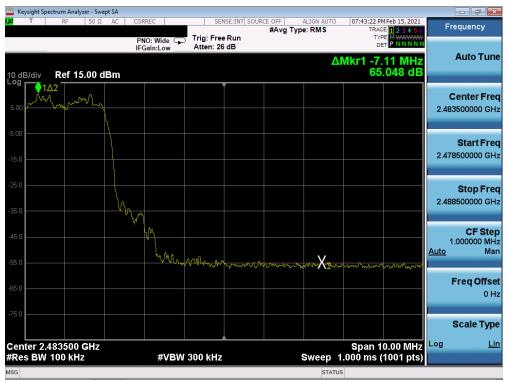
Plot 7-29. Band Edge Plot (Bluetooth with Hopping Disabled, 3 Mbps – Ch. 78)

FCC ID: A3LSMA426U	PCTEST Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Keysight Spectrum Analyzer - Swept SA				
XI T RF 50 Ω AC	CORREC SENS	EE:INT SOURCE OFF ALIGN AUT #Avg Type: RMS Run	07:49:01 PM Feb 15, 2021 TRACE 1 2 3 4 5 6 TYPE MWWWW DET P N N N N N	Frequency
10 dB/div Ref 15.00 dBm	IFGain:Low Atten: 26		ΔMkr1 3.11 MHz 55.644 dB	Auto Tune
5.00		man	102	Center Freq 2.400000000 GHz
-5.0				Start Freq 2.395000000 GHz
-35.0				Stop Freq 2.405000000 GHz
-45.0	Anno and a far a f	2		CF Step 1.000000 MHz <u>Auto</u> Man
-65.0				Freq Offset 0 Hz
Center 2.400000 GHz #Res BW 100 kHz	#VBW 300 kHz	Sween	Span 10.00 MHz 1.000 ms (1001 pts)	Scale Type
MSG	#VEW 300 KH2	-		

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: A3LSMA426U	PCTEST Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical 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

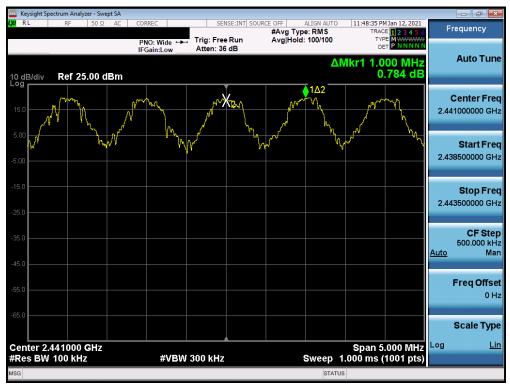
The EUT complies with the minimum channel separation requirement when it is operating in 1x/EDR mode using 79 channels and when operating in AFH mode using 20 channels.

FCC ID: A3LSMA426U	PCTEST* Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
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Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	Min. Channel Separation [MHz]
2402	1.0	GFSK	0	0.626
2441	1.0	GFSK	39	0.630
2480	1.0	GFSK	78	0.624
2402	2.0	π/4-DQPSK	0	0.857
2441	2.0	π/4-DQPSK	39	0.853
2480	2.0	π/4-DQPSK	78	0.855
2402	3.0	8DPSK	0	0.843
2441	3.0	8DPSK	39	0.847
2480	3.0	8DPSK	78	0.856

Table 7-4. Minimum Channel Separation



Plot 7-32. Channel Spacing Plot (Bluetooth)

FCC ID: A3LSMA426U	Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical 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 👘				
LXX RL RF 50Ω AC	Trig Delay-99	NT SOURCE OFF ALIGN AUTO 9.0 µs #Avg Type: RMS	11:47:42 PM Jan 12, 2021 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 25.00 dBm	PNO: Fast Trig: Video IFGain:Low Atten: 36 dB	Δ	Mkr2 2.900 ms -0.35 dB	Auto Tune
15.0				Center Freq 2.441000000 GHz
-5.00				Start Freq 2.441000000 GHz
-15.0		\$ ²		Stop Freq 2.441000000 GHz
-35.0 -45.0			aphininggaddyniain	CF Step 1.000000 MHz <u>Auto</u> Man
-55.0				Freq Offset 0 Hz
				Scale Type
Center 2.441000000 GHz Res BW 1.0 MHz	#VBW 3.0 MHz	Sweep 5	Span 0 Hz .000 ms (1001 pts)	Log <u>Lin</u>
MSG		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 2.900 ms/channel = 309.34 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 2.900 ms/channel = 154.68 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

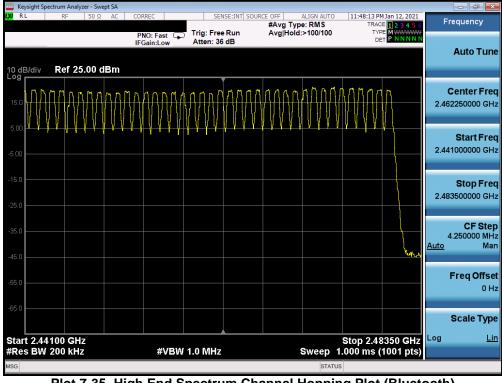
The frequency spectrum was broken up into two sub-ranges to clearly show all the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.

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	ectrum Analyzer - Sw	•						
LXI RL	RF 50 Ω	AC (CORREC	SEN	SE:INT SOUR	CE OFF ALIGN AL #Avg Type: RMS		Frequency
			PNO: Fast 😱	Trig: Free Atten: 36		Avg Hold:>100/1		
			IFGalli.LOW	Atten: 00	45			Auto Tune
10 dB/div Log	Ref 25.00	dBm						
	n a m h d		ллапа	ጣ ካ ካ ጠ	ппл А	лллалли	והתהתהתהה	Center Freq
15.0	H/ H H H	$\{1,1,1\}$	<u>AAAAAA</u>	HHAH	АННА	\mathbb{H}		2.420500000 GHz
5.00		$\{ \{ \} \} \in \{ \} $	V V V V V	$(\{ (((((((((((((((((($		/ V V V V V V	VVVVVVVVV	
5.00	* 1 * * * *	1 1 1 1						Start Freq
-5.00								2.40000000 GHz
-15.0								Stop Freq
								2.441000000 GHz
-25.0								
-35.0								CF Step
s, s								4.100000 MHz <u>Auto</u> Man
-45.0								
								Freq Offset
-55.0								0 Hz
-65.0								
								Scale Type
Start 2.40	000 GHz						Stop 2.44100 GHz	Log <u>Lin</u>
#Res BW			#VBW	1.0 MHz		Swee	p 1.000 ms (1001 pts)	
MSG						s	FATUS	

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



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

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

Test Overview and Limit

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

Test Procedure Used

ANSI C63.10-2013 - Section 7.8.8

Test Settings

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

Test Setup

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



Figure 7-7. Test Instrument & Measurement Setup

Test Notes

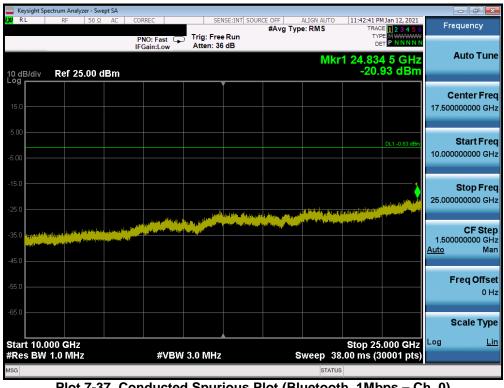
Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at 1Mbps. The display line shown in the following plots is the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, the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

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Keysight Spectrum										- ē -
l,XI RL F	F 50 Ω	AC COF	RREC	SEN	SE:INT SOUR	#Avg Typ	ALIGN AUTO e: RMS	TRAC	4 Jan 12, 2021 E 1 2 3 4 5 6	Frequency
		IF	NO: Fast 🕞 Gain:Low	Trig: Free Atten: 36			Mk	DE	2 6 GHz 84 dBm	Auto Tun
10 dB/div Re	ef 25.00 dE							-02.		Center Fre 5.015000000 GH
-5.00									DL1 -0.83 dBm	Start Fre 30.000000 MH
-15.0										Stop Fre 10.000000000 GH
-35.0		and a set of the set of the		Provide Landson and Paral Pro-		ىلىرىيى ئىردۇر مەلىرىي ئەربىيە يەترىكى	an all an	po ^{na d} i tene tribugi pi ingel po ^{na di} tene di tenegoni pada pad		CF Ste 997.000000 MH <u>Auto</u> Ma
-45.0										Freq Offse 0 H
-65.0										Scale Typ
Start 30 MHz #Res BW 1.0			#VBW	3.0 MHz		s	weep 18	Stop 10 .00 ms (3	.000 GHz 0001 pts)	Log <u>Li</u>
MSG							STATUS			

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



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

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	ectrum Analyzer										
LX/RL	RF 5	50Ω AC	CORREC	SE	NSE:INT SOURCE	AL	IGN AUTO		MJan 12, 2021	Frequ	ency
10 dB/div	Ref 25.0	0 dBm	PNO: Fast (IFGain:Low _	Trig: Fre Atten: 36	e Run			TYF DE	9 9 GHz 23 dBm	Au	to Tune
15.0											ter Freq 1000 GHz
-5.00									DL1 0.19 dBm		art Freq 1000 MHz
-15.0										St 10.000000	op Freq 0000 GHz
-35.0	and a local data and					والم بينية الم المالية والم	and apply the support of	u (vinger (I verget) grig vi ^j vinger (I verget)			CF Step 0000 MHz Man
-55.0										Fre	q Offset 0 Hz
-65.0											ale Type
Start 30 I #Res BW			#VB	W 3.0 MHz		Sw	/eep 18	Stop 10 00 ms (3.	.000 GHz 0001 pts)	Log	Lin
MSG							STATUS				

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



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

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	Spectrum Ana											
L <mark>XI</mark> RL	RF	50 Ω	AC	CORREC	C	SEI	ISE:INT SOUR	CE OFF #Avg Typ	ALIGN AUTO e: RMS		M Jan 12, 2021	Frequency
				PNO: IFGair	:Fast 🖵 n:Low) Trig: Free Atten: 36			M	۲۷۱ ام kr1 3.17		Auto Tune
10 dB/div	Ref 2	25.00 d	Bm							-32.	65 dBm	
15.0												Center Free 5.015000000 GH
-5.00											DL1 0.14 dBm	Start Free 30.000000 MH
-15.0												Stop Free 10.000000000 GH
-35.0						ال المراجع ومعاريق المراجع ومعارية		a grape di ta je gana je ta kan sa kata 1993 - Nicelan ya kata sa kata	a and the product of the party of			CF Step 997.000000 MH <u>Auto</u> Mar
-45.0												Freq Offse 0 H
-65.0												Scale Type
Start 30 #Res BV		łz			#VBW	3.0 MHz		s	weep 1	Stop 10 8.00 ms (3	.000 GHz 0001 pts)	Log <u>Lir</u>
MSG									STATI	US		

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



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

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7.9 Radiated Spurious Emission Measurements – Above 1GHz §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Test Overview and Limit

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

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-5 per Section 15.209 and RSS-Gen (8.9).

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

Table 7-5. Radiated Limits

Test Procedure Used

ANSI C63.10-2013 – Section 6.6.4.3

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

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW = 1MHz
- 3. VBW = $1kHz \ge 1/\tau Hz$, where τ = pulse width in seconds
- 4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
- 5. Detector = peak
- 6. Sweep time = auto
- 7. Trace mode = max hold
- 8. Trace was allowed to stabilize

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

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

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

Test Setup

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

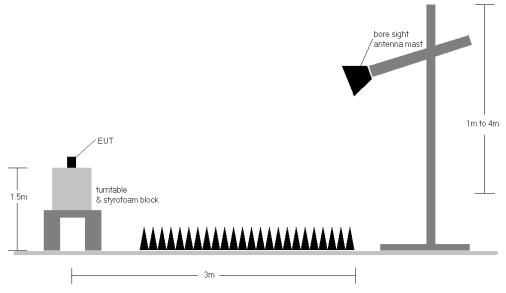


Figure 7-8. Radiated Test Setup >1GHz

Test Notes

- 1. All emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-5.
- 2. No significant radiated emissions were found in the 2310 2390MHz restricted band.
- 3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
- 4. This unit was tested with its standard battery.
- 5. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.
- 6. The duty cycle correction factor was not applied to noise floor measurements.
- 7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
- 8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

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Sample Calculation

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

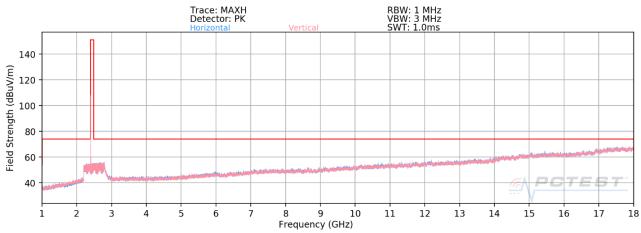
Duty Cycle Correction Factor Calculation

- 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 = 7.50×20 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 = $20\log_{10}(7.5\text{ms}/100\text{ms}) = -22.5 \text{ dB}$

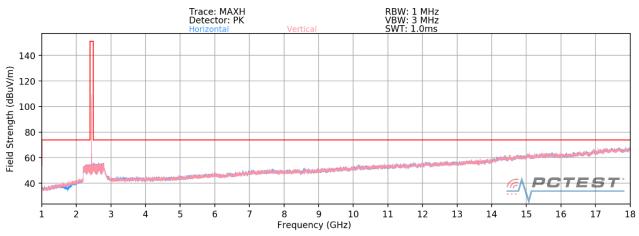
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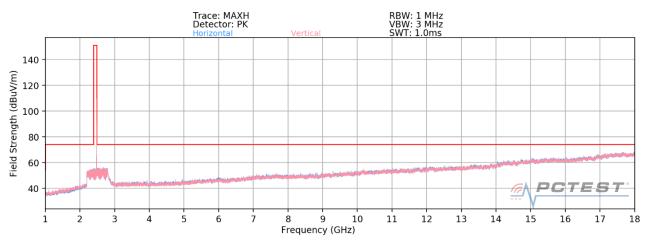
Radiated Spurious Emission Measurements §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]









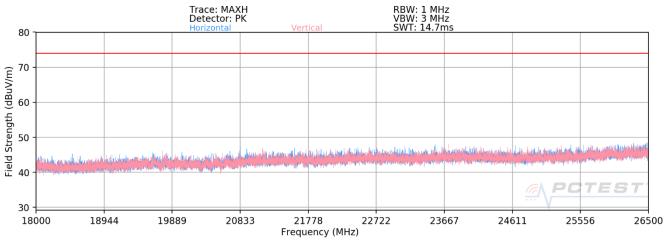


Plot 7-44. Radiated Spurious Plot above 1GHz (BT- Ch. 78)

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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	V	-	-	-79.27	6.96	34.69	53.98	-19.29
4804.00	Peak	V	-	-	-66.86	6.96	47.10	73.98	-26.88
12010.00	Avg	V	-	-	-81.18	17.42	43.24	53.98	-10.74
12010.00	Peak	V	-	-	-68.10	17.42	56.32	73.98	-17.66

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	V	-	-	-79.22	7.44	35.22	53.98	-18.76
4882.00	Peak	V	-	-	-66.84	7.44	47.60	73.98	-26.38
7323.00	Avg	V	-	-	-80.11	11.88	38.77	53.98	-15.21
7323.00	Peak	V	-	-	-67.20	11.88	51.68	73.98	-22.30
12205.00	Avg	V	-	-	-81.02	18.28	44.26	53.98	-9.72
12205.00	Peak	V	-	-	-67.91	18.28	57.37	73.98	-16.61

Table 7-8. Radiated Measurements

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

uetooth
Vbps
Veters
80MHz

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	V	-	-	-79.03	6.91	34.88	53.98	-19.10
4960.00	Peak	V	-	-	-66.05	6.91	47.86	73.98	-26.12
7440.00	Avg	V	-	-	-79.99	12.00	39.01	53.98	-14.97
7440.00	Peak	V	-	-	-67.33	12.00	51.67	73.98	-22.31
12400.00	Avg	V	-	-	-81.60	18.00	43.40	53.98	-10.58
12400.00	Peak	V	-	-	-68.62	18.00	56.38	73.98	-17.60

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]

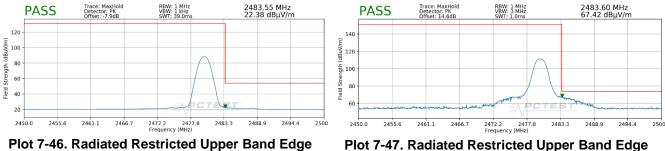
The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting. Two different amplitude offsets were used depending on whether peak or average measurements were measured. The average measurements use a duty cycle correction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

Bluetooth
1 Mbps
3 Meters
2480MHz
78

Measurement (Average)



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.

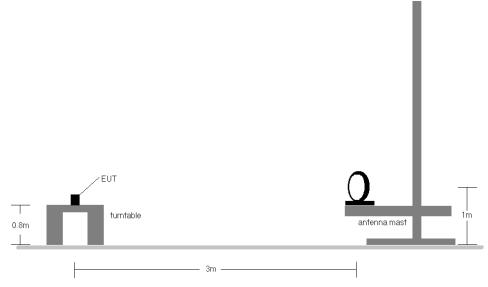
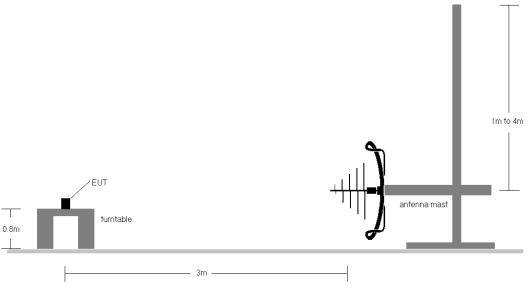


Figure 7-9. Radiated Test Setup < 30Mhz





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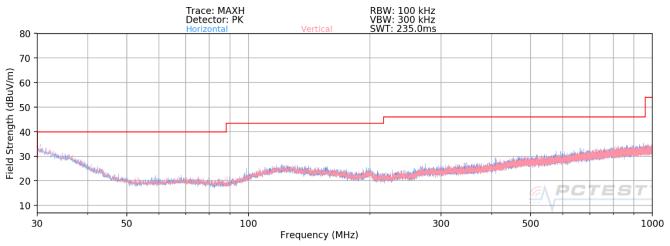
Test Notes

- 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

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

Table 7-11. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

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

Average Field Strength Measurements

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

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Test Setup

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

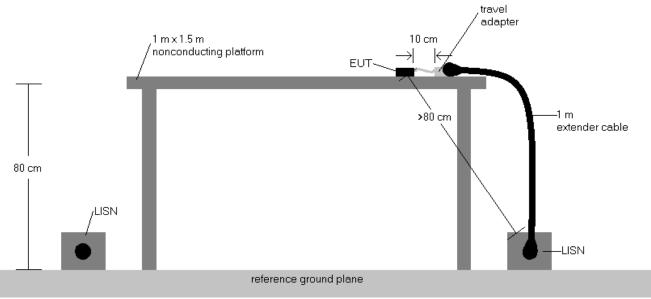


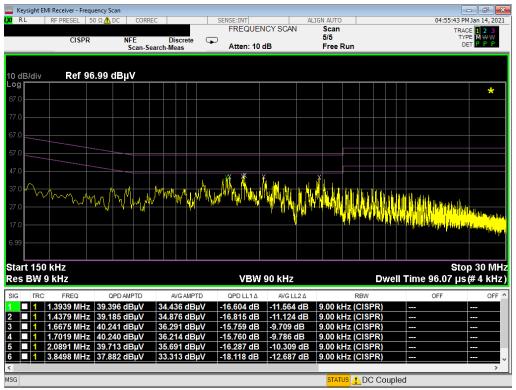
Figure 7-11. Test Instrument & Measurement Setup

Test Notes

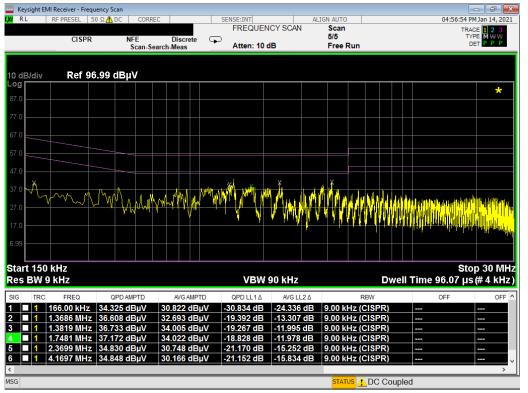
- 1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
- 2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
- 3.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

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



Plot 7-50. Line-Conducted Test Plot (N)

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMA426U** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

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