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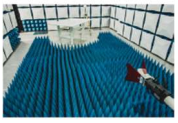

MEASUREMENT REPORT
Bluetooth (Low Energy)

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
05/13/2021 - 06/01/2021
Test Site/Location:
PCTEST Lab. Yongin-Si, Gyeonggi-do,
South Korea
Test Report Serial No.:
1K2106030020-02.A3L

FCC ID:	**A3LSMA127M**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-A127M/DS
Additional Model(s):	SM-A127M
EUT Type:	Portable Handset
Max. RF Output Power:	7.406 mW (8.70 dBm) Peak Conducted
Frequency Range:	2402 – 2480MHz
FCC Classification:	Digital Transmission System (DTS)
Test Procedure(s):	ANSI C63.10-2013, KDB 558074 D01 v05r02

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 §2.947. 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.

Prepared by

Reviewed by

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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 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 16954. 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 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 16954 South Korea.

- PCTEST is an ISO 17025-2017 accredited test facility under the National Voluntary Laboratory Accreditation Program (NVLAP) with Certificate number 600143-0 for Specific Absorption Rate (SAR), and Electromagnetic Compatibility (EMC) & Telecommunications testing for FCC and Innovation, Science, and Economic Development Canada (ISED) 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 (26168) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMA127M**. The data found in this test report was taken with the EUT operating in Bluetooth low energy mode. While in low energy mode, the Bluetooth transmitter hops pseudo-randomly between 40 channels, three of which are "advertising channels". When the transmitter is hopping only between the three advertising channels, the EUT does not fall under the category of a "hopper" as defined in 15.247(a)(iii) which states that a "frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels." As operation on only the advertising channels does not qualify the EUT as a hopper, the EUT is certified as a DTS device in this mode. The data found in this report is representative of the device when it transmits on its advertising channels. Typical Bluetooth operation is covered under the DSS report found with this application.

Test Device Serial No.: 1149M, 2950M, 2866M, 2891M

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, Bluetooth (1x, EDR, LE)

Ch.	Frequency (MHz)
0	2402
:	:
19	2440
:	:
39	2480

Table 2-1. Frequency / Channel Operations

2.3 Antenna Description

Following antenna was used for the testing.

Frequency [GHz]	Antenna Gain (dBi)
2.4	-4.75

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.

2.4 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v05r02. ANSI C63.10-2013 was 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, and 7.6 for antenna port conducted emissions test setups.

2.5 Software and Firmware

The test was conducted with firmware version A127FXXE0AUE7 installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v05r02 were 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 SY cooperation RF Enclosures. The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. 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, 50Ω/50μH 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 that 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 7.9. The EMI Receiver mode of the R&S ESW was used to perform AC line conducted emissions testing. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.20.01.

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 Styrofoam is placed on top of the turn table. For measurements above 1GHz, an additional styrofoam table 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 414788 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).

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 antenna(s) 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.

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	1.20
Line Conducted Disturbance	3.07
Radiated Disturbance (<1GHz)	3.01
Radiated Disturbance (>1GHz)	5.56
Radiated Disturbance (>18GHz)	3.16

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
Agilent	N9030A	PXA Signal Analyzer	6/29/2020	Annual	6/28/2021	MY49432391
Antritsu	S820E	Cable and Antenna Analyzer	6/29/2020	Annual	6/28/2021	1839097
Antritsu	MA24106A	USB Power Sensor	6/29/2020	Annual	6/28/2021	1244512
Com-Power	AL-130R	Active Loop Antenna	10/29/2020	Biennial	10/28/2022	10160045
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	7/9/2019	Biennial	7/8/2021	9162-217
Sunol Sciences	DRH-118	Horn Antenna	8/9/2019	Biennial	8/8/2021	A102416-1
Keysight Technologies	N9030B	PXA Signal Analyzer	5/1/2021	Annual	4/30/2022	MY57142018
Mini-Circuits	ZHDC-16-63-S+	Coupler	6/29/2020	Annual	6/28/2021	F709401716
Mini-Circuits	ZNDC-18-2G-S+	Coupler	6/29/2020	Annual	6/28/2021	F280401542
Mini-Circuits	BW-N10W5+	Attenuator	6/29/2020	Annual	6/28/2021	1607
Mini-Circuits	BW-N10W5+	Attenuator	6/29/2020	Annual	6/28/2021	1607
Rohde & Schwarz	TS-PR18	Preamplifier	6/29/2020	Annual	6/28/2021	102141
Rohde & Schwarz	TS-PR1840	Preamplifier	6/29/2020	Annual	6/28/2021	100049
Rohde & Schwarz	ENV216	Two-Line V-Network	5/24/2021	Annual	5/23/2022	101319
Rohde & Schwarz	FSW43	Signal & Spectrum Analyzer	9/17/2020	Annual	9/16/2021	101250
Rohde & Schwarz	TS-SFUNIT-Rx	Shielded Filter Unit	2/19/2021	Annual	2/18/2022	102131

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

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.

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMA127M

FCC Classification: Digital Transmission System (DTS)

Number of Channels: 40

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2]	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	RSS-247 [5.4(4)]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Sections 7.5, 7.6
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-Gen [8.9])	RADIATED	PASS	Sections 7.7, 7.8
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	LINE CONDUCTED	PASS	Section 7.9

Table 7-1. Summary of Test Results

Notes:

1. All modes of operation 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 and attenuators used as part of the system to connect the EUT to the analyzer 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 and attenuators.
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 "Bluetooth LE Automation," Version 3.6.
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.

7.2 6dB Bandwidth Measurement – Bluetooth (LE)

§15.247(a.2); RSS-247 [5.2]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 11.8.2 Option 2
KDB 558074 D01 v05r02 – Section 8.2

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = 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 7-1. Test Instrument & Measurement Setup

Test Notes

None

Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	125 kbps	0	LE	661.7	500	Pass
2440	125 kbps	19	LE	633.0	500	Pass
2480	125 kbps	39	LE	661.2	500	Pass
2402	500 kbps	0	LE	718.0	500	Pass
2440	500 kbps	19	LE	718.5	500	Pass
2480	500 kbps	39	LE	718.6	500	Pass
2402	1 Mbps	0	LE	745.1	500	Pass
2440	1 Mbps	19	LE	735.1	500	Pass
2480	1 Mbps	39	LE	741.8	500	Pass
2402	2 Mbps	0	LE	1279	500	Pass
2440	2 Mbps	19	LE	1272	500	Pass
2480	2 Mbps	39	LE	1278	500	Pass

Table 7-2. Conducted Bandwidth Measurements

Plot 7-1. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 0)

Plot 7-2. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 19)

Plot 7-3. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 39)

Plot 7-4. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 0)

Plot 7-5. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 19)

Plot 7-6. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 39)

Plot 7-7. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0)

Plot 7-8. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19)

Plot 7-9. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39)

Plot 7-10. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0)

Plot 7-11. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19)

Plot 7-12. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39)

7.3 Output Power Measurement – Bluetooth (LE)

§15.247(b.3); RSS-247 [5.4(4)]

Test Overview and Limits

The transmitter antenna terminal of the EUT is connected to the input of a spectrum analyzer. Measurements are made while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

Test Procedure Used

ANSI C63.10-2013 – Section 11.9.1.1
KDB 558074 D01 v05r02 – Section 8.3.1.1

Test Settings

1. RBW = 3MHz
2. VBW = 50MHz
3. Span ≥ 3 x RBW
4. Sweep = auto couple
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

Test Notes

None

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power	
				[dBm]	[mW]
2402	125 kbps	0	LE	4.95	3.122
2440	125 kbps	19	LE	3.48	2.228
2480	125 kbps	39	LE	5.36	3.435
2402	500 kbps	0	LE	5.02	3.176
2440	500 kbps	19	LE	3.50	2.238
2480	500 kbps	39	LE	5.49	3.537
2402	1 Mbps	0	LE	5.08	3.224
2440	1 Mbps	19	LE	3.53	2.254
2480	1 Mbps	39	LE	5.39	3.457
2402	2 Mbps	0	LE	8.70	7.406
2440	2 Mbps	19	LE	6.96	4.964
2480	2 Mbps	39	LE	8.69	7.394

Table 7-3. Conducted Output Power Measurements (Bluetooth (LE))

Plot 7-13. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 0)

Plot 7-14. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 19)

Plot 7-15. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 39)

Plot 7-16. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 0)

Plot 7-17. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 19)

Plot 7-18. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 39)

Plot 7-19. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0)

Plot 7-20. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19)

Plot 7-21. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39)

Plot 7-22. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0)

Plot 7-23. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19)

Plot 7-24. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39)