



FCC PART 2.1091
ISED C RSS-102, ISSUE 5

RF EXPOSURE REPORT

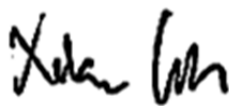
For

Samsung Electronics Co., Ltd.

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FCC ID: A3LSIP005AFS30
IC: 649E-SIP005AFS30

Report Type: Class II Permissive Change	Product Type: System-on-Module
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*” (Rev. 0)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1709282-MPE	Original	2017-10-17

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Samsung Electronics Co Ltd.*, and their product model: *SIP005AFS3*, FCC ID: *A3LSIP005AFS30*, IC: *649E-SIP005AFS30* or the “EUT” as referred to in this report. The product is a System-on-Module.

Note: Customer confirms that Zigbee radio works with another antenna port and will not be installed with Molex 47950-0001 antenna.

1.2 Objective

This report is prepared on behalf of *Samsung Electronics Co Ltd.*, in accordance with Part 1, Subpart I, Part 2, Subpart J and ISEDC RSS-102 Issue 5.

The objective is to determine compliance with FCC and ISEDC rules for Maximum Permissible RF Exposure,

This project is a Permissive Change II submission for the purpose of Adding Molex 47950-0001 Antenna.

1.3 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart C, Equipment DTS with FCC ID: A3LSIP005AFS30, IC: 649E-SIP005AFS30

FCC Part 15, Subpart C, Equipment DSS with FCC ID: A3LSIP005AFS30, IC: 649E-SIP005AFS30

FCC Part 15, Subpart E, Equipment NII with FCC ID: A3LSIP005AFS30, IC: 649E-SIP005AFS30

1.4 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 ° C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.5 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.6 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02), in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body

- - For the USA (Federal Communications Commission):

- 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
- 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
- 3- All Telephone Terminal Equipment within FCC Scope C.

- For the Canada (Industry Canada):

- 1- All Scope 1-Licence-Exempt Radio Frequency Devices;
- 2- All Scope 2-Licensed Personal Mobile Radio Services;
- 3- All Scope 3-Licensed General Mobile & Fixed Radio Services;
- 4- All Scope 4-Licensed Maritime & Aviation Radio Services;
- 5- All Scope 5-Licensed Fixed Microwave Radio Services
- 6- All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.

For Singapore (Info-Communications Development Authority (IDA)):

- 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2

- For the Hong Kong Special Administrative Region:

- 1 All Radio Equipment, per KHCA 10XX-series Specifications;
- 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
- 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.

- For Japan:

- 1 MIC Telecommunication Business Law (Terminal Equipment):
 - All Scope A1 - Terminal Equipment for the Purpose of Calls;
 - All Scope A2 - Other Terminal Equipment
- 2 Radio Law (Radio Equipment):
 - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
 - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
 - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.01) to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

- 1 Electronics and Office Equipment:
 - for Telephony (ver. 3.0)
 - for Audio/Video (ver. 3.0)
 - for Battery Charging Systems (ver. 1.1)
 - for Set-top Boxes & Cable Boxes (ver. 4.1)
 - for Televisions (ver. 6.1)
 - for Computers (ver. 6.0)
 - for Displays (ver. 6.0)
 - for Imaging Equipment (ver. 2.0)
 - for Computer Servers (ver. 2.0)
- 2 Commercial Food Service Equipment
 - for Commercial Dishwashers (ver. 2.0)
 - for Commercial Ice Machines (ver. 2.0)
 - for Commercial Ovens (ver. 2.1)
 - for Commercial Refrigerators and Freezers
- 3 Lighting Products
 - For Decorative Light Strings (ver. 1.5)
 - For Luminaires (including sub-components) and Lamps (ver. 1.2)
 - For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
 - For Integral LED Lamps (ver. 1.4)
- 4 Heating, Ventilation, and AC Products
 - for Residential Ceiling Fans (ver. 3.0)
 - for Residential Ventilating Fans (ver. 3.2)
- 5 Other
 - For Water Coolers (ver. 3.0)

D. A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Industry Canada - IC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
 - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
 - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
 - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)

- o Radio & Teleterminal Equipment (R&TTE) Directive 1995/5/EC US -EU EMC & Telecom MRA CAB (NB)
 - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
 - o Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Development Authority - IDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter
- USA:
 - o ENERGY STAR Recognized Test Laboratory – US EPA
 - o Telecommunications Certification Body (TCB) – US FCC;
 - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013, FCC KDB 558074 D01 DTS Meas Guidance v04 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04.

2.2 EUT Exercise Software

The test firmware used was Marvell 8997 Labtool provided by *Whisker Labs, Inc.* The software is compliant with the standard requirements being tested against.

2.3 Equipment Modifications

No modifications to the EUT were made.

2.4 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410
Netgear	Router	WNR2020

2.5 Support Equipment

There was no support equipment included, or intended for use with EUT during these tests.

2.6 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Ethernet Cable	2 m	Laptop	Router
Ethernet Cable	7 m	Router	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISED Rules	Description of Test	Results
FCC §2.1091, §15.247(i), §15.407(f), ISED RSS-102	RF Exposure Evaluation	Compliant

4 FCC §2.1091, §15.247(i), §15.407(f) & ISED RSS-102 - RF Exposure

4.1 Applicable Standards

According to FCC §15.247(i), §15.407(f) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* (180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Before equipment certification is granted, the procedure of ISED RSS-102 must be followed concerning the exposure of humans to RF field

According to ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz⁶ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

4.3 MPE Results

2.4 GHz Wi-Fi

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>15.5</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>35.48</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2412</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3.0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.995</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0141</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

BLE

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>6.0</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>3.98</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2402</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3.0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.995</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0016</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

Bluetooth

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>7.0</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>5.01</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2402</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3.0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.995</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.002</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

ZigBee

<u>GMaximum peak output power at antenna input terminal (dBm):</u>	<u>16.5</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>44.67</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2405</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>1.43</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.39</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0124</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

5 GHz band

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>13.5</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>22.39</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5510</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>4.6</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2.884</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0128</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

Multi Transmitter MPE Evaluation

2.4 GHz Wi-Fi+BLE+Bluetooth+ZigBee = $0.0141/1+0.0016/1+0.002/1+0.0124/1=0.0301 <1.0$

5 GHz Wi-Fi+BLE+Bluetooth+ZigBee = $0.0128/1+0.0016/1+0.002/1+0.0124/1=0.0288 <1.0$

Conclusion

The device is compliant with the requirement MPE limit for uncontrolled exposure. All transceiver modules must be installed with a separation distance of no less than **20** cm from all persons.

4.4 RF exposure evaluation exemption for IC

2.4 GHz Wi-Fi: $15.5+3 \text{ dBi} = 18.5 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 2.684 \text{ W} = 34.3 \text{ dBm}$

BLE: $6.0+3 \text{ dBi} = 9.0 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 2.676 \text{ W} = 34.3 \text{ dBm}$

Bluetooth: $7.0+3 \text{ dBi} = 10.0 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 2.679 \text{ W} = 34.3 \text{ dBm}$

ZigBee: $16.5+1.43 \text{ dBi} = 17.93 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 2.676 \text{ W} = 34.3 \text{ dBm}$

5 GHz Wi-Fi band: $13.5+4.6 \text{ dBi} = 18.1 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 4.72 \text{ W} = 36.7 \text{ dBm}$

Multi Transmitter RF exposure Evaluation

2.4 GHz Wi-Fi+BLE+Bluetooth+ZigBee = 21.78 dBm < 34.3 dBm

5 GHz Wi-Fi+BLE+Bluetooth+ZigBee = 21.6 dBm < 34.3 dBm

Conclusion

Therefore the RF exposure is not required. All transceiver modules must be installed with a separation distance of no less than **20** cm from all persons.

--- END OF REPORT ---