



PCTEST ENGINEERING LABORATORY, INC.

7185 Oakland Mills Road, Columbia, MD 21046 USA

Tel. 410.290.6652 / Fax 410.290.6654

<http://www.pctest.com>



RF EXPOSURE EVALUATION Maximal Permissible Exposure [MPE]

Applicant Name:

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

Date of Testing:

01/23/2019 - 02/28/2019

Test Site/Location:

PCTEST Lab. Columbia, MD, USA

Test Report Serial No.:

1M1901240015-03.A3L

FCC ID:

A3LMT3204-48A

APPLICANT:

Samsung Electronics Co., Ltd.

EUT Type:

Massive MIMO CBSD

Model:

MT3204-48A

FCC Classification:

Citizens Band Category B Devices (CBD)

FCC Rule Part:

FCC Part 1 (§1.1310) and Part 2 (§2.1091)

Test Procedure(s):

KDB 447498 D01

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 FCC KDB 447498 D01. 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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V 8.8 11/19/2018

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1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Introduction

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

Table 1-1. Limits for Maximum Permissible Exposure (MPE)

1.2 EUT Description

The **Samsung Massive MIMO CBSD FCC ID: A3LMT3204-48A** is a 32-port device which supports single and two carrier configurations (1CC and 2CC). Each carrier operates using 20MHz bandwidth. It supports the following modulation schemes: QPSK, 16-QAM, 64-QAM and 256-QAM.

The EUT can operate with up to a maximum of 8 beams in the following modes:

1. User-Beam Operation:

a) 8-User Beam Mode:

In this mode, all ports transmit at maximum power to form eight beams.

b) Single User Beam (UE0) Mode:

All ports form one single user beam, and transmit power varies per port.

2. Common Beam Operation:

This mode uses weighted beam forming technique. The transmit power per port is governed by a weighting factor.

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1.3 MPE Requirements Overview

Two different categories of transmitters are defined by the FCC KDB 447498 D01. These categories are mobile and portable and are defined as follows:

- o **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.
- o **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

- o **Occupational/Controlled Exposure:** In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.
- o **General Population/Uncontrolled Exposure:** The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

The **Samsung Massive MIMO CBSD FCC ID: A3LMT3204-48A** is evaluated to the Mobile Device requirements and is considered a device to be used by the General Population/Uncontrolled Exposure.

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1.4 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements.

The power generated by each operating mode used in this product was initially measured with a spectrum analyzer and the powers were recorded. Through use of the Friis transmission formula and knowledge of the maximum antenna gain to be used, the power density level is calculated at a distance of 20cm.

Friis Transmission Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4\pi r^2)$

Where,

P_d = Power Density (mW/cm²)

π = 3.1416

P_{out} = output power to antenna (mW)

r = distance between observation point and center of the radiator (cm)

G = gain of antenna in linear scale

Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1.

There is no co-location between the electric fields of any two transmitters therefore following power densities are calculated for each individual transmitter by frequency at 20cm spacing:

Frequency	3625 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	36.04 dBm	4017.91 mW	
TX Ant Gain (dBi), G =	21.5 dBi		
Power Density (S) =	112.909 mW/cm ²	(at 20cm)	
Minimum Distance =	212.5 cm		

Table 1-2. Calculated MPE Data for 8-User Beam (8UE) Mode

Frequency	3625 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	30.36 dBm	1086.43 mW	
TX Ant Gain (dBi), G =	21.5 dBi		
Power Density (S) =	30.530 mW/cm ²	(at 20cm)	
Minimum Distance =	110.5 cm		

Table 1-3. Calculated MPE Data for Single User Beam (UE0) Mode

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Frequency	3625 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	34.04 dBm	2535.13 mW	
TX Ant Gain (dBi), G =	16.4 dBi		
Power Density (S) =	22.016 mW/cm ²	(at 20cm)	
Minimum Distance =	93.8 cm		

Table 1-4. Calculated MPE Data for Common Beam Mode

1.5 Summary of Results

Mode of Operation	Power Density @ 20 cms [mW/cm ²]	Maximum Antenna Gain [dBi]	Minimum Safe Distance @ 1.0 mW/cm ² [cm]
8 User Beam (8UE)	112.909	21.5	212.5
Single User Beam (UE0)	30.530	21.5	110.5
Common Beam	22.016	16.4	93.8

Table 1-5. Maximum Permissible Exposure Summary Table

Note: The 8-User Beam (8UE) mode is the worst case highest power density at 20cm. Hence, this mode determines the minimum safe distance. A minimum safe distance 2.125 m for MPE compliance with FCC Limit.

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2.0 CONCLUSION

The device meets the MPE Compliance requirement as specified in §2.1091 of the FCC Rules and Regulations with minimum safe distance of 2.125m for operation. An appropriate RF exposure compliance statement will be placed in the user's manual.

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