



# PCTEST ENGINEERING LABORATORY, INC.

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## RF EXPOSURE EVALUATION Maximal Permissible Exposure [MPE]

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**Date of Testing:**  
7/1/2019-7/29/2019  
**Test Site/Location:**  
PCTEST Lab. Columbia, MD, USA  
**Test Report Serial No.:**  
1M1907220128-03.A3L

<b>FCC ID:</b>	<b>A3LMT6402-48A</b>
<b>APPLICANT:</b>	<b>Samsung Electronics Co., Ltd.</b>



<b>EUT Type:</b>	Massive MIMO CBSD
<b>Model:</b>	MT3204-48A
<b>FCC Classification:</b>	Citizens Band Category B Devices (CBD)
<b>FCC Rule Part:</b>	FCC Part 1 (§1.1310)
<b>Test Procedure(s):</b>	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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# 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 <sup>2</sup> )	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: A3LMT6402-48A** is a 64-port device which supports single, two, and three carrier configurations (1CC, 2CC, 3CC). Each carrier operates using 10 or 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 16 beams in the following modes:

1. User-Beam Operation:

a) 16-User Beam Mode:



In this mode, all ports transmit at maximum power to form sixteen 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

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:

- **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.
- **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: A3LMT6402-48A** is a fixed mounted base station and MPE is evaluated to the General Population/Uncontrolled Exposure limits per 1.1310.

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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 for the safe distance which must be maintained during installation based on maximum power and antenna gain.

### Friis Transmission Formula

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

Where,

$P_d$  = Power Density (mW/cm<sup>2</sup>)

$\pi$  = 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 the safe distance which must be maintained during installation based on maximum power and antenna gain.

The highest MIMO power from the DUT was 37.61dBm generated from a 3CC 60MHz total band width channel, where each carrier was 20MHz wide.

<b>Frequency</b>	3680 MHz		
<b>Limit</b>	1.000 mW/cm <sup>2</sup>		
<b>Power (dBm), P =</b>	37.61 dBm	5767.66 mW	
<b>TX Ant Gain (dBi), G =</b>	23.5 dBi		
<b>Power Density (S) =</b>	256.880 mW/cm <sup>2</sup>	(at 20cm)	
<b>Minimum Distance =</b>	320.5 cm		

**Table 1-2. Calculated MPE Data for 16-User Beam (16UE) Mode**



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## 1.5 Summary of Results

Mode of Operation	Power Density @ 20 cms [mW/cm <sup>2</sup> ]	Maximum Antenna Gain [dBi]	Minimum Safe Distance @ 1.0 mW/cm <sup>2</sup> [cm]
16 User Beam (16UE)	256.880	23.5	320.5



**Table 1-3. Maximum Permissible Exposure Summary Table**

Note: The 16-User Beam (16UE) mode is the worst case highest power density at 3.205m. Hence, this mode determines the minimum safe distance. A minimum safe distance 3.205 m for MPE compliance with FCC Limit.

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## 2.0 CONCLUSION

The device meets the MPE Compliance requirements of the FCC Rules and Regulations with minimum safe distance of 3.205m for operation. An appropriate RF exposure compliance statement will be placed in the user's manual.

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