

**RF EXPOSURE EVALUATION**  
**Maximum Permissible Exposure (MPE)**

**Applicant Name:**  
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**Date of Testing:**  
 01/06/2023 – 01/23/2023  
**Test Report Issue Date:**  
 02/23/2023  
**Test Site/Location:**  
 Element Lab. Columbia, MD, USA  
**Test Report Serial No.:**  
 1M2212270143-05.2A93U

<b>FCC ID:</b>	<b>2A93U-55041-402</b>
<b>APPLICANT:</b>	<b>Centum Research &amp; Technology</b>

**Application Type:** Certification  
**EUT Type:** Geolocation System  
**FCC Classifications:** PCS Licensed Transmitter (PCB)  
**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.



**RJ Ortanez**  
 Executive Vice 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 and RSS-102 of Industry Canada.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310 and RSS-102: 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 Equipment Under Test (EUT) is the **Centum Geolocation System FCC ID: 2A93U-55041-402**. The EUT can transmit two different LTE band signals at the same time with its multiple antenna port. EUT was set up to operate as shown below with a 12 VDC power source with current limitation of 10A. Server equipment was used to control the RF functions of the EUT.

The EUT supports two output antennas and is capable of transmitting simultaneously on both antennas though not on the same band.

The EUT supports operation in the following LTE Bands:

- B2 (1930 - 1990MHz)
- B12 (729 - 746 MHz)
- B13 (746 - 756 MHz)
- B26 (859 - 894 MHz)
- B66 (2110 - 2180 MHz)

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### 1.3 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 transmitter used in this product was initially measured by a power meter or 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/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.

Additionally, a calculation for MPE is included to account for the worst-case simultaneous operation of LTE B12 & B13 since these low frequency bands have tighter limits and hence represents the worst-case for RF Exposure.


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:

<b>Frequency</b>	869 MHz		
<b>Limit</b>	0.579 mW/cm <sup>2</sup>		
<b>Distance (cm), R =</b>	20 cm		
<b>Power (dBm), P =</b>	23 dBm	199.53 mW	
<b>TX Ant Gain (dBi), G =</b>	0.82 dBi		
<b>Power Density (S) =</b>	<b>0.048</b> mW/cm <sup>2</sup>	(at 20cm)	
<b>Minimum Distance =</b>	<b>5.8</b> cm		

Table 1-2. Calculated MPE Data for LTE B26 (869- 894MHz)

<b>Frequency:</b>	1960 MHz		
<b>Limit:</b>	1.000 mW/cm <sup>2</sup>		
<b>Distance (cm), R =</b>	20 cm		
<b>Power (dBm), P =</b>	23 dBm	199.53 mW	
<b>TX Ant Gain (dBi), G =</b>	1.52 dBi		
<b>Power Density (S) =</b>	<b>0.056</b> mW/cm <sup>2</sup>	(at 20cm)	
<b>Minimum Distance =</b>	<b>4.7</b> cm		

Table 1-3. Calculated MPE Data for LTE B2

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Frequency:	729 MHz		
Limit:	0.486 mW/cm <sup>2</sup>		
Distance (cm), R =	20 cm		
Power (dBm), P =	24 dBm	251.19 mW	
TX Ant Gain (dBi), G =	0.62 dBi		
Power Density (S) =	0.058 mW/cm <sup>2</sup>	(at 20cm)	
Minimum Distance =	6.9 cm		

Table 1-4. Calculated MPE Data for LTE B12

Frequency:	746 MHz		
Limit:	0.497 mW/cm <sup>2</sup>		
Distance (cm), R =	20 cm		
Power (dBm), P =	23 dBm	199.53 mW	
TX Ant Gain (dBi), G =	0.62 dBi		
Power Density (S) =	0.046 mW/cm <sup>2</sup>	(at 20cm)	
Minimum Distance =	6.1 cm		

Table 1-5. Calculated MPE Data for LTE B13

Frequency	2155 MHz		
Limit	1.000 mW/cm <sup>2</sup>		
Distance (cm), R =	20 cm		
Power (dBm), P =	23 dBm	199.53 mW	
TX Ant Gain (dB), G =	2.8 dBi		
Power Density (S) =	0.076 mW/cm <sup>2</sup>	(at 20cm)	
Minimum Distance =	5.5 cm		


Table 1-6. Calculated MPE Data for LTE B66

Frequency	859 MHz		
Limit	0.573 mW/cm <sup>2</sup>		
Distance (cm), R =	20 cm		
Power (dBm), P =	23 dBm	199.53 mW	
TX Ant Gain (dB), G =	0.82 dBi		
Power Density (S) =	0.048 mW/cm <sup>2</sup>	(at 20cm)	
Minimum Distance =	5.8 cm		

Table 1-7. Calculated MPE Data for LTE B26 (859- 869MHz)


	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Percent MPE Used (%)
Transmitter #1 (LTE B12)	0.058	0.486	11.86
Transmitter #2 (LTE B13)	0.046	0.497	9.21
Total			21.07

Table 1-8. Calculated MPE Data for Simultaneous Tx. (LTE B12 + LTE B13)

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## 2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations. An appropriate RF exposure compliance statement will be placed in the user's manual.

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