



# Radio Frequency Exposure Evaluation Report

**FOR:**

CalAmp

Model Name:

LMU2650MB

Product Description:

Remote location monitoring unit.

FCC ID: APV-2650MB

IC: 5843C-2650MB

## **Applied Rules and Standards:**

CFR Part Part1 (1.1307 &1.1310), Part 2 (2.1091),  
FCC KDB 447498 D01 General RF Exposure Guidance v06  
ISED RSS-102 Issue 5

**Report number:** EMC\_CALAM-129-22001\_MPE\_Rev2

**DATE:** 3-30-2023



## **CETECOM Inc.**

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## 1 Assessment

This RF Exposure evaluation report provides evidence for compliance of the below identified device with the RF Exposure limits for mobile devices as defined in FCC CFR Part 1 (1.1307 & 1.1310), Part 2 (2.1091) and ISSED standard RSS-102 issue 5 under worst case conditions (measured or rated RF output power, antenna gain, distance towards human body, multiple transmitter information as presented by the applicant). In addition, maximum antenna gain or minimum distance towards the human body is calculated respectively, where relevant.

The device meets the limits as stipulated by the above given FCC and ISSED rule parts based on available specifications for worst-case conditions at 20 cm distance to the body.

Company	Description	Model #
CalAmp	Remote location monitoring unit	LMU2650MB

### Report reviewed by: TCB Evaluator

Arndt Stoecker

(Director of Regulatory Services)

3-30-2023

Compliance

Date

Section

Name

Signature

### Responsible for the Report:

Kris Lazarov

(Senior EMC Engineer)

3-30-2023

Compliance

Date

Section

Name

Signature

The test results of this test report relate exclusively to the test item specified in Section 3. CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the Test Report

<b>Company Name:</b>	CETECOM Inc.
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<b>Director of Regulatory Services:</b>	Arndt Stoecker
<b>Responsible Project Leader:</b>	Cathy Palacios

### 2.2 Identification of the Client / Manufacturer

<b>Client's Name:</b>	CalAmp
<b>Street Address:</b>	2200 Faraday Ave #220
<b>City/Zip Code</b>	Carlsbad, CA 92008
<b>Country</b>	USA

### 2.3 Identification of the Manufacturer

<b>Manufacturer's Name:</b>	Same as Client
<b>Manufacturers Address:</b>	
<b>City/Zip Code</b>	
<b>Country</b>	

### 3 Equipment under Assessment

<b>Marketing name:</b>	LMU2650MB
<b>HW Version :</b>	REV 3
<b>SW Version :</b>	3.16.1.3
<b>HVIN:</b>	LMU2650MB
<b>PMN:</b>	LMU2650 LTE CAT M1
<b>Regulatory Band:</b>	<p><b>Cellular Module:</b></p> <ul style="list-style-type: none"> <li>▪ GSM 850: 824.4 ~ 848.8 MHz</li> <li>▪ GSM 1900: 1850.2 ~ 1909.8 MHz</li> <li>▪ LTE BAND 2: 1850 ~ 1910 MHz</li> <li>▪ LTE BAND 4: 1710 ~ 1755 MHz</li> <li>▪ LTE BAND 5: 824 ~ 849 MHz</li> <li>▪ LTE BAND 12: 699 ~ 716 MHz</li> <li>▪ LTE BAND 13: 777 ~ 787 MHz</li> <li>▪ LTE BAND 25: 1850 ~ 1915MHz</li> <li>▪ LTE BAND 26: 814 ~ 849 MHz</li> </ul> <p><b>BLE:</b></p> <ul style="list-style-type: none"> <li>▪ Nominal band: 2400 MHz – 2483.5 MHz</li> </ul>
<b>Integrated Cellular Module Info:</b>	<p><b>Cellular:</b></p> <ul style="list-style-type: none"> <li>▪ Manufacture: Quectel</li> <li>▪ Module name/number: BG96MCE-12B-CAL</li> <li>▪ FCC ID: XMR201707BG96</li> <li>▪ IC: 10224A-201709BG96</li> </ul>
<b>Antenna Type:</b>	<p><b>Cellular:</b></p> <ul style="list-style-type: none"> <li>▪ Model Name : KYOCERA AVX' Universal Broadband FR4 Embedded LTE / LPWA Antenna</li> <li>▪ Part No. : 1004795</li> <li>▪ Max Gain : 3.1dBi</li> </ul> <p><b>BLE:</b></p> <ul style="list-style-type: none"> <li>▪ Type : Ceramic Antenna from Ethertronics</li> <li>▪ Part No: 1001312</li> <li>▪ Max Gain: 1.88 dBi</li> </ul>
<b>Maximum Conducted Output Power:</b>	<p><b>Cellular:</b></p> <p>From Modular Grant for FCC ID XMR201707BG96 from 03/28/2019</p> <ul style="list-style-type: none"> <li>▪ GSM 850: 624 mW</li> <li>▪ GSM 1900: 582 mW</li> <li>▪ LTE Band 2: 925 mW</li> <li>▪ LTE Band 4: 995 mW</li> <li>▪ LTE Band 5: 675 mW</li> <li>▪ LTE Band 12: 619 mW</li> <li>▪ LTE Band 13: 589 mW</li> <li>▪ LTE Band 25: 284 mW</li> </ul> <p>From Modular Grant for FCC ID XMR201707BG96 from 02/25/2019</p> <ul style="list-style-type: none"> <li>▪ LTE Band 26: 201 mW</li> </ul> <p><b>BLE:</b></p> <p>Declared in Operation Description:</p> <ul style="list-style-type: none"> <li>• 3 mW</li> </ul>
<b>Power Supply/ Rated Operating Voltage Range:</b>	Battery powered only: 9-30 VDC
<b>Operating Temperature Range:</b>	-30 C to 60 C
<b>Sample Revision:</b>	<input type="checkbox"/> Production Unit; <input checked="" type="checkbox"/> Pre-Production

## 4 RF Exposure Evaluation Methods

### 4.1 RF Exposure Test Exemptions for Single Source

#### 4.1.1 FCC § 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

Single RF sources as defined in paragraph (b)(2) of FCC § 2.1091 is exempt if the ERP (watts) is no more than the calculated value prescribed for that frequency. General frequency and separation-distance dependent MPE-based effective radiated power ERP thresholds are in Table B.1 [Table 1 of § 1.1307(b)(3)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES  
 SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source Frequency			Minimum Distance			Threshold ERP
$f_L$ MHz		$f_H$ MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R <sup>2</sup>
1.34	–	30	35.6 m	–	1.6 m	3,450 R <sup>2</sup> /f <sup>2</sup>
30	–	300	1.6 m	–	159 mm	3.83 R <sup>2</sup>
300	–	1,500	159 mm	–	31.8 mm	0.0128 R <sup>2</sup> f
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R <sup>2</sup>

Subscripts L and H are low and high;  $\lambda$  is wavelength.  
 From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.

#### 4.1.2 Exemption Limits for Routine Evaluation to RSS-102 2.5.2

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 at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum EIRP 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;

### 4.2 RF Exposure Test Exemptions for Simultaneous Transmission Sources

Multiple RF sources are exempt if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where:

$a$  = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for  $P_{th}$ , including existing exempt transmitters and those being added.

$b$  = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

$c$  = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

$P_i$  = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source  $i$  at a distance between 0.5 cm and 40 cm (inclusive).

$P_{th,i}$  = the exemption threshold power ( $P_{th}$ ) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source  $i$ .

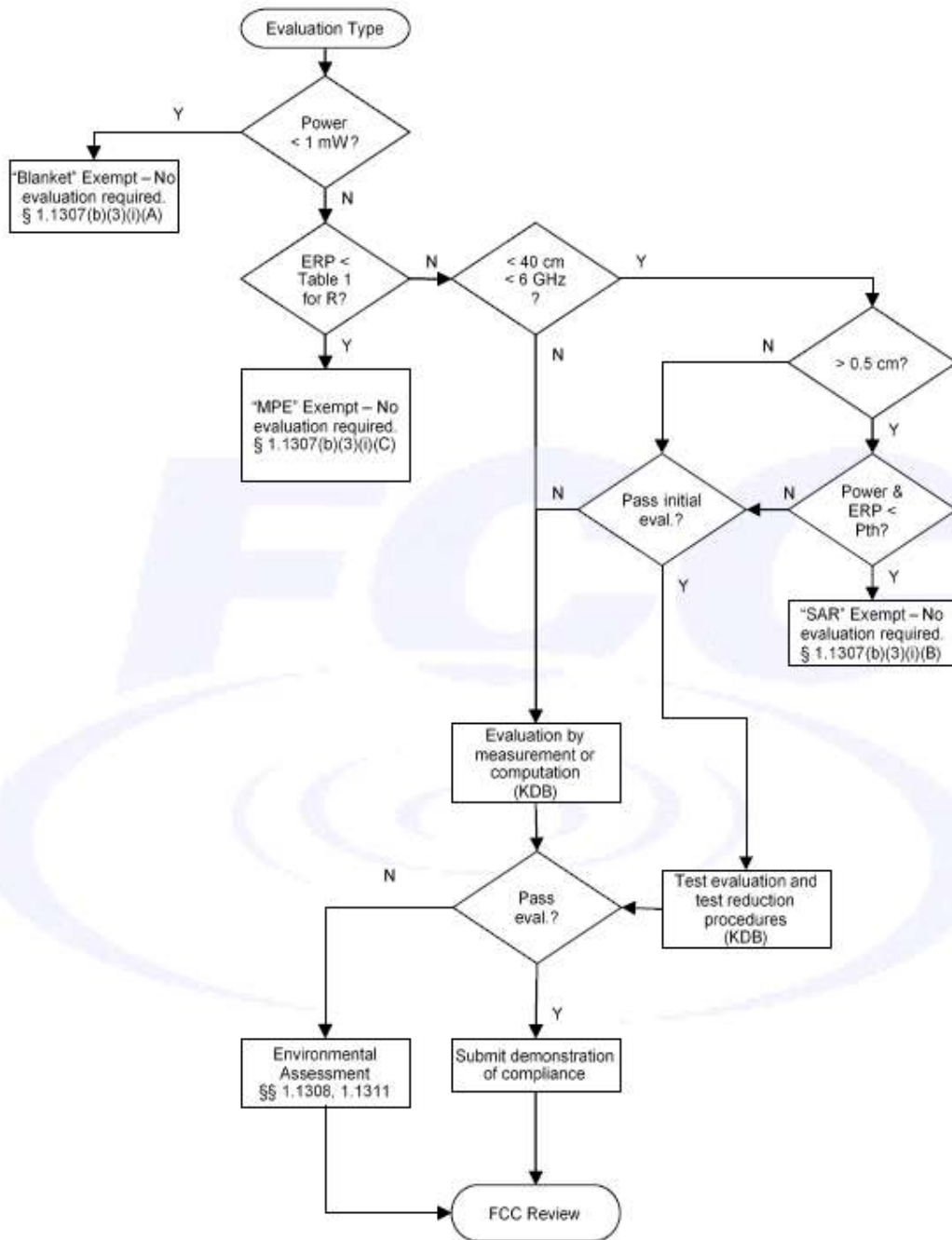
$ERP_j$  = the ERP of fixed, mobile, or portable RF source  $j$ .

$ERP_{th,j}$  = exemption threshold ERP for fixed, mobile, or portable RF source  $j$ , at a distance of at least  $\lambda/2\pi$  according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

$Evaluated_k$  = the maximum reported SAR or MPE of fixed, mobile, or portable RF source  $k$  either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure Limit_k$  = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source  $k$ , as applicable from § 1.1310 of this chapter.

### 4.3 RF Exposure evaluation flow chart



**Figure A.1 – General Sequence for Determination of Procedure (exemption or evaluation) to Establish Compliance with Exposure Limits for a Single RF Source<sup>39</sup>**

## 5. Evaluations

### 5.1. RF Exposure Test Exemptions for Single Source

Compliance with FCC Table 1 of § 1.1307(b)(3)(i)(C) and RSS-102 2.5.2 exemption limits								
Band of Operation	Frequency (GHz)	ERP (mW)	EIRP (mW)	FCC Pth Threshold (mW)	ISED Threshold EIRP (mW)	FCC ERP/PTH Ratio	ISED EIRP / Limit Ratio	MPE Exempt No evaluation required Ratios < 1
GSM 850	0.848	624	1024	1680.96	1290	0.37	0.79	Yes
GSM 1900	1.910	582	955	3060.00	2240	0.19	0.43	Yes
LTE 2	1.910	925	1518	3060.00	2240	0.30	0.68	Yes
LTE 4	1.755	995	1632	3060.00	2120	0.33	0.77	Yes
LTE 5	0.849	675	1107	1680.96	1290	0.40	0.86	Yes
LTE 12	0.716	619	1015	1425.96	1150	0.43	0.88	Yes
LTE 13	0.787	589	966	1585.08	1240	0.37	0.78	Yes
LTE 25	1.915	284	466	3060.00	1290	0.09	0.36	Yes
LTE 26	0.849	201	330	1680.96	1150	0.12	0.27	Yes
BT	2.483	1.01	3.16	3060.00	2675	0.001	0.001	Yes

**Note 1:** All calculations are with the manufacturer declared distance  $R = 20$  cm minimum separation between the antenna and the human body.

**Note 2:** The ERP values were obtained as described in the table in section 3

**Note 3:** The EIRP values were calculated from the ERP values using the following formula:

$$\text{EIRP (dBm)} = \text{ERP (dBm)} + 2.15$$

### Conclusion:

- The maximum RF emissions from this equipment fulfills the MPE exclusion threshold limits for separation distance between the antenna and the human body greater than 20 cm. No MPE evaluation is required.

### 5.2. RF Exposure Test Exemptions for Simultaneous Transmission Sources

- Theoretically, the worst case of simultaneous transmission is with the LTE B12 and BLE transmitters operating at the highest output power mode, within the nearest frequency bands.

Regulation Authority	Applicable Simultaneous Transmission Sources	Sum of the ratios of the applicable terms	Limit	MPE Exempt No evaluation required
FCC	LTE 12 + BLE	$0.43 + 0.001 = 0.431$	< 1	Yes
ISED	LTE 12 + BLE	$0.88 + 0.001 = 0.881$	< 1	Yes

### Conclusion:

- The equipment is excluded from simultaneous transmission MPE test.

## 5 Revision History

Date	Report Name	Changes to report	Prepared by
3-17-2023	EMC_CALAM-129-22001_MPE	Initial Release	Kris Lazarov
3-27-2023	EMC_CALAM-129-22001_MPE_Rev1	Corrected the power levels for B12, and B26 in sections 3 and 5	Kris Lazarov
3-30-2023	EMC_CALAM-129-22001_MPE_Rev2	Clarified the source of Maximum Conducted Output Power info in table section3; Added noted to the evaluation table in section 5.1	Kris Lazarov

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