



## **Maximum Permissible Exposure Evaluation**

**For the  
EATON'S Cooper Power Systems  
LCR6700 RFN  
FCC ID: P9X- LCR6700RFN  
IC: 6766A- LCR6700RFN**

**WLL Report: 15354-02-MPE Rev 1  
February 16, 2018**

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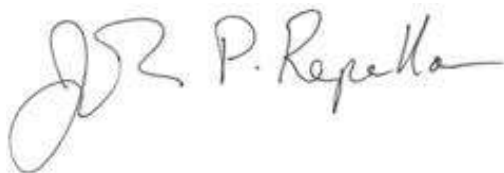


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## Abstract

This report has been prepared on behalf of EATON'S Cooper Power Systems to document the findings of the maximum permissible exposure evaluation on the LCR6700 RFN. The purpose of this evaluation is to establish a minimum safe distance as per the RF exposure requirements as defined in FCC §1.1307, §1.1310 & Industry Canada RSS-102 issue 5.

This report documents the results of testing to the requirements of:

- CFR Title 47 Volume 1 Practice and Procedure; (1.1307) Environmental Assessments
- RSS-102 Issue 5 March 2015 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

The Evaluation was performed by Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited by ANAB under Testing Certificate AT-1448.

Revision History	Reason	Date
Rev 0	Initial Release	November 2, 2017
Rev 1	Update to address additional requirements	February 16, 2018

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## 1 Introduction

This report has been prepared on behalf of EATON'S Cooper Power Systems LCR6700 RFN Transmitter to show compliance with the RF exposure requirements as defined in FCC §1.1307 and RSS-102 Issue 5.

Testing supporting this evaluation was performed at Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited with ANAB under Testing Certificate AT-1448.

## 2 Requirements

Three different categories of transmitters are defined by the FCC in OET Bulletin 65. These categories are fixed installation, mobile, and portable. Additionally, the FCC categorizes the use of the devices based on the user's awareness and the ability to exercise control over his or her exposure. The two categories are defined as Occupational/Controlled Exposure and General Population/Uncontrolled Exposure.

### 2.1 Transmitter Categories

#### 2.1.1 Fixed Installations

A fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.

#### 2.1.2 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.

#### 2.1.3 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).

### 2.2 Exposure Categories

The limits for exposure are determined by the type of situation the individual is exposed to. Table 1 lists the limits for the particular environment.

### 2.2.1 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.

### 2.2.2 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.

**Table 1: FCC MPE Limits (General Population/Uncontrolled Exposure)**

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300	61.4	0.163	1	6
300–1500	N/A	N/A	f/300	6
1500–100,000	N/A	N/A	5	6
(B) 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 <sup>2</sup> )	30
30–300	27.5	0.073	0.2	30
300–1500	N/A	N/A	f/1500	30
1500–100,000	N/A	N/A	1	30

**Table 2: ISED MPE Limits (General Population/Uncontrolled Exposure)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Reference Period (minutes)
0.003-10 <sup>21</sup>	83	90	-	Instantaneous*
0.1-10	-	0.73/ $f$	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10 <sup>-4</sup> $f^{0.5}$	6.67 x 10 <sup>-5</sup> $f$	616000/ $f^{1.2}$
<p>Note: <math>f</math> is frequency in MHz.</p> <p>*Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).</p>				

### 3 Device Summary

Table 1 below summarizes the criteria used to evaluate the LCR6700 RFN.

**Table 3: Device Summary of the LCR6700 RFN**

<b>Model Evaluated:</b>	LCR6700 RFN
<b>Transmitter Category:</b>	Mobile
<b>Exposure Category:</b>	General Population/Uncontrolled Exposure
<b>Maximum Antenna Gain:</b>	2.4dBi
<b>Maximum Power Output (dBm):</b>	30.0dBm
<b>Evaluation Distance:</b>	20cm
<b>Frequency Range:</b>	902.75-927.25MHz
<b>Duty Cycle Correction:</b>	-3.956dB
<b>FCC Limit:</b>	0.610mW/cm <sup>2</sup>
<b>Minimum Required Separation Distance (FCC)</b>	9.62cm
<b>ISED Limit:</b>	0.2766mW/cm <sup>2</sup>
<b>Minimum Required Separation Distance (ISED)</b>	14.25cm



## 4 Radio Frequency Radiation Exposure Evaluation

The highest RF output power of the unit was measured and recorded. According to §1.1310 of the FCC rules, the power density limit for General Population/Uncontrolled Exposure is Power Density (mW/cm<sup>2</sup>) = f/1500.

Where f = frequency in MHz of the maximum power measurement

Therefore:

$$\begin{aligned}\text{Power Density (mW/cm}^2\text{)} &= 902.75/1500 \\ &= 0.6018\text{mW/cm}^2\end{aligned}$$

According to ISSED RSS-102 Issue 5, the power density limit for General Population/Uncontrolled Exposure for the frequency range 300-6000MHz is  $0.02619f^{0.6834}$ .

Therefore:

$$\begin{aligned}\text{Power Density (W/m}^2\text{)} &= 0.02619f^{0.6834} \\ &= 0.02619*(902.75)^{0.6834} \\ &= 2.741 \text{ or } (0.2741\text{mW/cm}^2)\end{aligned}$$

### 4.1 Exposure Calculations

As stated in the manufacturer's tune-up procedure, the max power is set at 29dBm + 1dB for the radio. With consideration to the above tolerances the data in Table 4 will be used in the calculations below:

LCR6700 RFN: Max Power of 29.97dBm @ 902.75MHz

**Table 4: Duty Cycle Summary (All Data Rates)**

Data Rate (kbps)	Medium Utilization (%)	Duty Cycle (%)	Min. Gap Time (ms)	Max. Sequence Time (ms)	Max. Sequence Time (100ms)
9.6	0.970	46.096	29.189	40.184	40.184
19.2	0.973	47.768	15.617	20.106	40.208
38.4	0.805	46.771	15.755	19.684	39.368
76.8	0.760	41.226	2.202	9.917	39.647
153.6	0.875	41.795	12.829	9.216	36.853

The duty cycle correction factor is calculated by:

$$10 \times \log^*(\text{dwell time}/100\text{ms})$$

The following table and figures show the data for the occupancy time for the transmitter. Based on this information, the dwell time per hop is 20.106ms. The maximum total dwell time per 100ms is 40.208ms (this is 2 hops per 100ms, not channel dwell time). This corresponds to a duty cycle correction/reduction of 3.956dB for the power measurements.

The MPE shall be calculated at 20cm to show compliance with the power density limit. The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = Power Density

P = Output Power at the Antenna Terminals

G = Gain of Transmit Antenna (linear gain-isotropic)

R = Distance from Transmitting Antenna

**Table 5: Transmitter FCC MPE Calculation Summary**

One Transmitter		
Frequency	902.75	MHz
Limit	0.602	mW/cm <sup>2</sup>
Distance (cm), R =	20	cm
Power (dBm), P =	26.044	dBm
TX Ant Gain (dBi), G =	2.4	dB
<b>Power Density:</b>	0.14	mW/cm <sup>2</sup> Separation<20 cm
<b>Minimum Distance:</b>	9.62	cm

**Table 6: Transmitter ISSED MPE Calculation Summary**

One Transmitter		
Frequency	902.75	MHz
Limit	0.274	mW/cm <sup>2</sup>
Distance (cm), R =	20	cm
Power (dBm), P =	26.044	dBm
TX Ant Gain (dBi), G =	2.4	dB
<b>Power Density:</b>	0.14	mW/cm <sup>2</sup> Separation<20 cm
<b>Minimum Distance:</b>	14.25	cm