



# Radio Frequency Exposure Evaluation Report

For:

Astronautics

Model Name:

AEC115

Product Description:

The AEC115 is an air vehicle equipment for recording and transferring of collected data via cellular and Wi-Fi radio while the vehicle is on the ground.

Applied Rules and Standards:  
CFR Part 1.1307 & 1.1310, Part 2.1091  
ISED RSS-102 Issue 5

Report number: EMC\_ASTRO-019-22001\_FCC\_MPE\_Rev2  
DATE: 1-27-2023



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## 1. Assessment

This RF Exposure evaluation report provides information about 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 ISEDC standard RSS-102, under given 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/ISEDC rule parts based on available specifications.

Company Name	Product Description	Model #
Astronautics	The AEC115 is an air vehicle equipment for recording and transferring of collected data via cellular and Wi-Fi radio while the vehicle is on the ground. The UNII1 band 5150-5250 is disabled for ISED.	AEC115

### Responsible for Testing Laboratory:

		Arndt Stoecker	
1-27-2023	Compliance	(Director of Regulatory Services)	
Date	Section	Name	Signature

### Responsible for the Report:

		Kris Lazarov	
1-27-2023	Compliance	(Senior EMC Engineer)	
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.

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## 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

<b>Applicant's Name:</b>	Astronautics
<b>Street Address:</b>	135 W Forest Hill Avenue
<b>City/Zip Code</b>	Oak Creek, WI 53154-0121
<b>Country</b>	United States

### 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>Model No</b>	AEC115
<b>HW Version</b>	282300
<b>SW Version</b>	282283
<b>Cellular Module</b>	FCC ID: N7NEM75 / ISED ID: 2417C-EM75
<b>WLAN Module</b>	FCC ID: RYK-WPEQ256ACN / ISED ID: 6158A-WPEQ256ACN
<b>Product Description</b>	The AEC115 is an air vehicle equipment for recording and transferring of collected data via cellular and Wi-Fi radio while the vehicle is on the ground.
<b>Transceiver Technology</b>	- UMTS Bands II, IV, V - LTE Bands 2, 4, 5, 12, 13, 26, 29, 41, 66 - 802.11a/b/g/n/ac 2.4 GHz; UNII-1; UNII-3 – See Note
<b>Co-located Transmitters/ Antennas?</b>	Cellular with WLAN can transmit simultaneously
<b>Power Supply/ Rated Operating Voltage Range</b>	28VDC
<b>Operating Temperature Range</b>	-40 °C to 55 °C
<b>Sample Revision</b>	<input type="checkbox"/> Prototype <input checked="" type="checkbox"/> Production <input type="checkbox"/> Pre-Production
<b>Device Category</b>	<input type="checkbox"/> Fixed Installation <input checked="" type="checkbox"/> Mobile <input type="checkbox"/> Portable
<b>Exposure Category</b>	<input type="checkbox"/> Occupational/ Controlled <input checked="" type="checkbox"/> General Population/ Uncontrolled

**Note:** The UNII1 band 5150-5250 is disabled for ISED.

Radio Technology	Maximum Power (dBm)	Peak Gain (dBi)
LTE Bands 2, 4, 5, 12, 13, 26, 66	23 ± 1	6
LTE Bands 41	22 ± 1	6
UMTS Bands II, IV, V	23 ± 1	6
WLAN 2.4GHz, 2.4 - 2.48GHz	20 ± 2	4
WLAN 5GHz, 5.15 – 5.25GHz	16 ± 2	6.11
WLAN 5GHz, 5.735 – 5.815GHz	16 ± 2	6.11

**Note:** The power and antenna gain information were provided by the customer in Document No: 284826-USG-A

## 4. RF Exposure Evaluation Methods

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

#### 1.4.1. 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.

#### 2.4.1. 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.

## 5. Evaluations

### 5.1. Compliance with MPE (Power Density) limits

Power Density Calculation						
Band of Operation MHz	EIRP dBm	Maximum Duty Cycle %	Power Density mW/cm <sup>2</sup>	ISED Limit mW/cm <sup>2</sup>	FCC Limit mW/cm <sup>2</sup>	Verdict
FDD II	30	1:1	0.109	0.458	1.000	Pass
FDD IV	30	1:1	0.109	0.432	1.000	Pass
FDD V	30	1:1	0.109	0.263	0.566	Pass
LTE 2	30	1:1	0.109	0.458	1.000	Pass
LTE 4	30	1:1	0.109	0.432	1.000	Pass
LTE 5	30	1:1	0.109	0.263	0.566	Pass
LTE 12	30	1:1	0.109	0.234	0.477	Pass
LTE 13	30	1:1	0.109	0.250	0.525	Pass
LTE 26	30	1:1	0.109	0.263	0.566	Pass
LTE 41	29	1:1	0.087	0.578	1.000	Pass
LTE 66	30	1:1	0.109	0.432	1.000	Pass
802.11 2.4 GHz	26	1:1	0.045	0.547	1.000	Pass
802.11 5 GHz	24.11	1:1	0.028	0.992	1.000	Pass

**Note 1:** All calculations are with the manufacturer declared minimum of 27cm distance between the antenna and the human body.

**Note 2:** LTE Band 29 is a downlink only band and is excluded from this evaluation.

#### Conclusion:

- The equipment fulfills the MPE limits for the minimum 27cm distance between the antenna and the human body

### 5.2. Routine Environmental Evaluation Applicability Simultaneous Transmission

- Theoretically the worst case of simultaneous transmission is with the three transmitters operating at the highest output power mode, within the nearest frequency bands (Wi-Fi 2.4 + LTE B4).

Transmission Mode	Sum of the ratios for the highest Power Densities	Limits for the Highest Combined Ratio	Exempt from Routine evaluation
2xWi-Fi + LTE B2	$0.05 + 0.2 = 0.25$	< 1	Yes

Note: Power Density to Applicable limit for Stand Alone Operation are derived from table in section 5.1

#### Conclusion:

- The equipment is excluded from simultaneous transmission MPE test.

## 6. Revision History

<b>Date</b>	<b>Report Name</b>	<b>Changes to report</b>	<b>Report prepared by</b>
6-10-2022	EMC_ASTRO-019-22001_FCC_MPE	Initial Version	Kris Lazarov
11-28-2022	EMC_ASTRO-019-22001_FCC_MPE_Rev1	Corrected the UNII antenna gain in section 3; Corrected the UNII calculation in table 5.1	Kris Lazarov
1-27-2023	EMC_ASTRO-019-22001_FCC_MPE_Rev2	Added note that UNII1 is disabled for ISED	Kris Lazarov

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