RF Exposure Exemption Report

em-trak Marine Electronics Limited
Model: X100

In accordance with FCC CFR 47 Pt 1.1307

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FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY
The wireless devices described within this report are compliant with the exemption criteria related to human exposure to electromagnetic fields laid out in FCC CFR 47 Part 1.1307.

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	13-Sept-2024
2	Update to model number	16-October-2024

Table 1

1.2 Introduction

Applicant	em-trak Marine Electronics Limited
Manufacturer	em-trak Marine Electronics Limited
Model Number(s)	X100
Hardware Version(s)	1.0
Software Version(s)	220200.01 - Radio 220400.01 - Network
Specification/Issue/Date	FCC 47 CFR Part 1.1307: 2021
Order Number	POR102360
Related Document(s)	KDB 447498 D04 v01

1.3 Brief Summary of Results

The wireless device described within this report was compliant with the restrictions related to human exposure to electromagnetic fields for both general public and worker/occupational exposures for separation distances of 3 m for the VHF transmitter and 20 cm for the 2.4 GHz WLAN transmitter.

The calculations shown in this report were made in accordance with the procedures specified in the applied test specification(s).

1.4 Product Information

1.4.1 Technical Description

VHF Radio with DSC Class D and AIS Class B SOTDMA.

1.4.2 Transmitter Description

The following radio access technologies and frequency bands are supported by the equipment under test.

Radio Access Technology	Frequency Band (MHz)	Minimum Frequency (MHz)	Output Power (dBm)	Duty Cycle (%)
VHF	155.5 – 162.5	155.5	44.0	100
2.4 GHz WLAN	2400-2483.5	2412	20.5	100

Table 2 – Transmitter Description

Note: Transmitter power includes upper bounds of uncertainty therefore maximum values are used.

1.4.3 Antenna Description

The following antennas are supported by the equipment under test.

Radio Access Technology	Antenna Model	Gain (dBi)	Antenna length (mm)	Minimum Separation Distance (cm)
VHF	VHF Marine vertical	3	900	300
2.4 GHz WLAN	External 2.4GHz WiFi antenna	2	80	20

Table 3 – Antenna Description

In the case of more than one type of antenna being supported by the equipment, the calculation is based on the maximum of the antenna gains for the defined Radia Access Technology. If other antennas can be used that have greater gains, the minimum separation distances will need to be recalculated.

Note: Antenna gain includes upper bounds of uncertainty therefore maximum values are used.

1.4.4 Equipment Configuration

Whilst the product can simultaniously transmit the antennas are not co-located and therefore calculations are based only on single tranmitters.

2 Assessment Details

2.1 Single RF Source options for determination of exemption.

<table>
<tr><th>Option</th><th>Reference</th><th>RF Exposure Test Exemptions for Single Source</th></tr>
<tr><td>A
(1-mW Test Exemption)</td><td>FCC
1.1307(b)(3)(i)(A)</td><td>The available maximum time averaged power is no more than 1 mW, regardless of separation distance.</td></tr>
<tr><td>B
(SAR-Based Exemption)</td><td>FCC
1.1307(b)(3)(i)(B)</td><td>The available maximum timeaveraged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:
$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$
Where
$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right)$$ and f is in GHz;
and
$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$
d = the separation distance (cm);</td></tr>
<tr><td>C
(MPE-Based Exemption)</td><td>FCC
1.1307(b)(3)(i)(C)</td><td>Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).
TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION
<table>
<tr><th>RF Source frequency (MHz)</th><th>Threshold ERP (watts)</th></tr>
<tr><td>0.3–1.34</td><td>1,920 R^2.</td></tr>
<tr><td>1.34–30</td><td>3,450 R^2/f^2.</td></tr>
<tr><td>30–300</td><td>3.83 R^2.</td></tr>
<tr><td>300–1,500</td><td>0.0128 R^2f.</td></tr>
<tr><td>1,500–100,000</td><td>19.2R^2.</td></tr>
</table></td></tr>
</table>

2.2 Multiple RF Sources options for determination of exemption.

Option	Reference	
A 1-mW Test Exemption for Multiple Sources	FCC 1.1307(b)(3)(ii)(A)	The available maximum time averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
B Simultaneous Transmission with both SAR-based and MPE-Based Test Exemptions	FCC 1.1307(b)(3)(ii)(B)	in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation. $\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$

2.3 Individual Antenna Port Exposure Results

2.3.1 Calculation of Exposure at Specified Separation Distance

The frequencies shown in the tables below have been chosen based on the lowest possible frequency that the EUT can transmit.

RAT	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Minimum Antenna to User Separation Distance (mm)	Pth (mW) 1.1307(b)(3)(i)(C))	Greater of Max time averaged conducted power or ERP?	1.1307(b)(3)(i)(C) Exemption (Yes/No) (300 kHz to 100 GHz)
VHF	155.5	25118.86	100	25118.86	2.046	51393.20	31337.31	3000	34470	31337.31	Yes
2.4 GHz WLAN	2412	112.20	100	112.20	1.585	177.83	108.43	200	768	112.20	Yes

Table 4 –Transmitter Result

The calculations show that the individual transmitters comply with FCC 1.1307(b)(3)(i)(C) MPE exemption at a minimum distances of:-

- VHF Transmitter - 3 m.
- 2.4GHz WLAN Transmitter - 20cm