

# RF Exposure Exemption Report

LB Foster

Model: Flood Master Node FLD-A-021-001

In accordance with FCC CFR 47 Pt 1.1307



Prepared for: LB Foster TEW Engineering LTD  
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## COMMERCIAL-IN-CONFIDENCE

FCC ID: Contains: 2ASEORFM95C, 2BDI4FLDA021

Document 75959548-06 Issue: 02

### SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	15 April 2024

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

### FCC Accreditation

294497/UK2010 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 Title 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	24-January-2024
2	Second Issue – Updated with new data from customer	15-April-2024

**Table 1**

## 1.2 Introduction

Applicant	LB Foster TEW Engineering Ltd
Manufacturer	LB Foster TEW Engineering Ltd
Model Number(s)	Flood Master Node: FLD-A-021-001
Hardware Version(s)	A
Software Version(s)	4.1.0
Specification/Issue/Date	FCC 47 CFR Part 1.1307: 2021
Order Number	P15072CND - QAF
Date	09-October-2023
Related Document(s)	<ul style="list-style-type: none"><li>• KDB 447498 D04 v01</li></ul>



### 1.3 **Brief Summary of Results**

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 Title 47 Part 1.1307.

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



**1.4 Application Form**

Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment)</i>	Master node unit which provides connectivity & live camera footage for the inline flood monitoring system in remote locations powered by battery with solar back up.
Manufacturer:	LB Foster
Model:	North America
Part Number:	FLD-A-021-001

If more than one frequency band is supported, please confirm which combinations of bands are capable of Simultaneous Transmit.	LoRa (915MHz) frequency band can simultaneously transmit with any of the LTE bands though only one LTE band will be in use at any one time.
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Frequency Band 1: 915MHz LoRa .

Antenna Model:	FWTR35292-SM-KR	
Antenna length:	15.15	cm
Bottom frequency:	137	MHz
Middle frequency:	578.5	MHz
Top frequency:	1020	MHz

Maximum power (input to the antenna including a tolerance):	20	dBm
Antenna gain (or maximum gain allowed):	1.5	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	>1000	cm
Transmitter Duty Cycle:	1	%

Frequency Band 2: LTE Band 2

Antenna Model:	2111520.80	
Antenna length:	30	cm
Bottom frequency:	1850	MHz
Middle frequency:	1900	MHz
Top frequency:	1990	MHz

Maximum power (input to the antenna including a tolerance):	23	dBm
Antenna gain (or maximum gain allowed):	4	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	>1000	cm
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Transmitter Duty Cycle:		%
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**Frequency Band 3: LTE Band 4**

Antenna Model:	2111520.80	
Antenna length:	30	cm
Bottom frequency:	1710	MHz
Middle frequency:	1923.5	MHz
Top frequency:	2155	MHz

Maximum power (input to the antenna including a tolerance):	23	dBm
Antenna gain (or maximum gain allowed):	4	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	>1000	cm
Transmitter Duty Cycle:		%

**Frequency Band 4: LTE Band 5**

Antenna Model:	2111520.80	
Antenna length:	30	cm
Bottom frequency:	824	MHz
Middle frequency:	850	MHz
Top frequency:	894	MHz

Maximum power (input to the antenna including a tolerance):	23	dBm
Antenna gain (or maximum gain allowed):	2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	>1000	cm
Transmitter Duty Cycle:		%



**Frequency Band 5: LTE Band 13**

Antenna Model:	2111520.80	
Antenna length:	30	cm
Bottom frequency:	777	MHz
Middle frequency:	782	MHz
Top frequency:	787	MHz

Maximum power (input to the antenna including a tolerance):	23	dBm
Antenna gain (or maximum gain allowed):	2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	>1000	cm
Transmitter Duty Cycle:		%

**Frequency Band 6: LTE Band 71.**

Antenna Model:	2111520.80	
Antenna length:	30	cm
Bottom frequency:	617	MHz
Middle frequency:	657.5	MHz
Top frequency:	698	MHz

Maximum power (input to the antenna including a tolerance):	23	dBm
Antenna gain (or maximum gain allowed):	2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander		cm
Transmitter Duty Cycle:		%

I hereby declare that the information supplied is correct and complete.

Name: Michael Cane  
 Position held: Senior Electronics Systems Engineer  
 Date: 15/12/2023



## 1.5 Product Information

### 1.5.1 Technical Description

The equipment under test (EUTs) were the LB Foster TEW Engineering Ltd Flood Pole, Model: FLD-A-001-001, FLD-A-013-001 and FLD-A-019-001 and Flood Master Node, Model: FLD-A-021-001.

The Master node unit provides connectivity & live camera footage for the inline flood monitoring system in remote locations powered by battery with solar back up.

### 1.5.2 Transmitter Description

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

Radio Access Technology	Frequency Band (MHz)	Minimum Transmission Frequency (MHz)	Output Power (dBm)	Duty Cycle (%)
915MHz LoRa	915	915	12.0	1
LTE Band 2	UL: 1850-1910 DL: 1930-1990	1850	25.0	100
LTE Band 4	UL: 1710-1755 DL: 2110-2155	1710	25.0	100
LTE Band 5	UL: 824-849 DL: 869-894	824	25.0	100
LTE Band 13	UL: 777-787 DL: 746-756	777	25.0	100
LTE Band 71	UL: 663-698 DL: 617-652	663	25.0	100

**Table 2 – Transmitter Description- FCC**

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





### 1.5.3 Antenna Description

The following antennas are supported by the equipment under test.

Radio Access Technology	Antenna Model	Gain (dBi)	Antenna length (cm)	Minimum Separation Distance (mm)
915MHz LoRa	FWTR35292-SM-KR	1.5	15.15	200
LTE	2111520.80	4 (Bands 2, 4) 2 (Bands 5, 13, 71)	30	200

**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. 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.

### 1.5.4 Equipment Configuration

Simultaneous transmission for LoRa and one LTE Band. For the calculations in this report, Band 71 was chosen for LTE as it has the lowest transmit frequency and thus the worst case result.



## 2 Assessment Details

### 2.1 Single RF Source options for determination of exemption.

Option	Reference	RF Exposure Test Exemptions for Single Source												
A (1-mW Test Exemption)	FCC 1.1307(b)(3)(i)(A)	The available maximum time averaged power is no more than 1 mW, regardless of separation distance.												
B (SAR-Based Exemption)	FCC 1.1307(b)(3)(i)(B)	<p>The available maximum timeaveraged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P<sub>th</sub> (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). P<sub>th</sub> is given by:</p> $P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$ <p>Where</p> $x = -\log_{10} \left( \frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$ <p>and</p> $ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$ <p><i>d</i> = the separation distance (cm);</p>												
C (MPE-Based Exemption)	FCC 1.1307(b)(3)(i)(C)	<p>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).</p> <p><b>TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION</b></p> <table border="1"> <thead> <tr> <th>RF Source frequency (MHz)</th> <th>Threshold ERP (watts)</th> </tr> </thead> <tbody> <tr> <td>0.3–1.34 .....</td> <td>1,920 R<sup>2</sup>.</td> </tr> <tr> <td>1.34–30 .....</td> <td>3,450 R<sup>2</sup>/f<sup>2</sup>.</td> </tr> <tr> <td>30–300 .....</td> <td>3.83 R<sup>2</sup>.</td> </tr> <tr> <td>300–1,500 .....</td> <td>0.0128 R<sup>2</sup>f.</td> </tr> <tr> <td>1,500–100,000 .....</td> <td>19.2R<sup>2</sup>.</td> </tr> </tbody> </table>	RF Source frequency (MHz)	Threshold ERP (watts)	0.3–1.34 .....	1,920 R <sup>2</sup> .	1.34–30 .....	3,450 R <sup>2</sup> /f <sup>2</sup> .	30–300 .....	3.83 R <sup>2</sup> .	300–1,500 .....	0.0128 R <sup>2</sup> f.	1,500–100,000 .....	19.2R <sup>2</sup> .
RF Source frequency (MHz)	Threshold ERP (watts)													
0.3–1.34 .....	1,920 R <sup>2</sup> .													
1.34–30 .....	3,450 R <sup>2</sup> /f <sup>2</sup> .													
30–300 .....	3.83 R <sup>2</sup> .													
300–1,500 .....	0.0128 R <sup>2</sup> f.													
1,500–100,000 .....	19.2R <sup>2</sup> .													



**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 Single Source Calculation of Exposure at Specified Separation Distance FCC 1.1307 (b)(3)(i)(A) ‘Option A’**

RAT	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Separation Distance	1.1307(b)(3)(i)(A) Exemption (Yes/No)
915MHz LoRa	915	15.8	1	0.158	200	Yes

**Table 4 –Transmitter Result**

The calculations show that the individual transmitters comply with FCC 1.1307(b)(3)(i)(A) 1 mW based exception.

**2.3.2 Single Source Calculation of Exposure at Specified Separation Distance FCC 1.1307(b)(3)(i)(C) ‘Option C’ (MPE Based Exemption)**

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 separation distance for MPE evaluation $\lambda/2$ $\pi$ mm	Actual Distance (mm)	Threshold ERP (mW)	1.1307(b)(3)(i)(C) Exemption (Yes/No) (300 kHz to 100 GHz)
LTE Band 2	1850	316.2	100	316.2	2.512	794.2944	484.33	25.8	200	768	Yes
LTE Band 4	1710	316.2	100	316.2	2.512	794.2944	484.33	27.9	200	768	Yes
LTE Band 5	824	316.2	100	316.2	1.585	501.177	305.60	57.9	200	421.9	Yes
LTE Band 13	777	316.2	100	316.2	1.585	501.177	305.60	61.4	200	397.8	Yes
LTE Band 71	663	316.2	100	316.2	1.585	501.177	305.60	72.0	200	339.5	Yes

**Table 5 –Transmitter Result**

The calculations show that the individual transmitters comply with FCC 1.1307(b)(3)(i)(C) MPE-based exception at a minimum distance of 200 mm.



**2.4 Combined Antenna Port RF Exposure Results FCC 1.1307(b)(3)(ii)(B)**

**2.4.1 Option C Summation**

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	Test Separation Distance (mm)	ERPj / ERPth,j	Sum of the fractional contributions to the applicable thresholds is less than or equal to 1. Compliant? (Yes/No)
915MHz LoRa	915	15.8	1	0.158	1.413	0.223254	0.14	200	0.000291	Yes
LTE Band 71	663	316.2	100	316.2	1.585	501.177	305.60	200	0.900251	Yes
Calculated RF exposure level at minimum compliance boundary of 0.2 m as a fraction of the limit									0.900542	Yes

**Table 6 –Transmitter Result**

The calculations show that the multiple transmitters comply with FCC 1.1307(b)(3)(ii)(B) summation-based exemption.