



# Swarm Asset Tracker PRODUCT MANUAL

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## Revision History

Revision	Date	Comment	Firmware Version
1.00	09/16/22	Swarm Asset Tracker Product Manual - Initial Release	
1.10	10/13/22	Formatting Updates Updated Sections 1 and 4 Added Sections 7 and 8 Added FCC Statement of Compliance	3.0.0
1.11	10/27/22	Added FTDI Pinout to Section 4.3 Added USB Charging Note to Section 4.4	
1.20	01/26/23	Updated Sections 4.3 and 7.1	3.0.1

## Additional Resources:

Please visit our developer tools webpage for quickstart guides and other helpful resources:

<https://swarm.space/documentation-swarm>

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# 1 Product Overview

The Swarm Asset Tracker is an end-to-end solution for tracking equipment, vehicles, and other remote assets. The Swarm Asset Tracker functions anywhere in the world using Swarm's global satellite network, and is ideally suited for remote locations that lack terrestrial network coverage.

The Swarm Asset Tracker is an out-of-the-box commercial product that can be set up within minutes to transmit its GPS information and internal battery voltage.

Category	Description
Components	GPS, VHF radio with integrated ground plane, Integrated rechargeable Lithium-Ion battery, indicator LEDs, 3.3V serial interface, USB interface
Onboard Sensors	uBLOX GPS (lat/lon/alt), CPU Temperature, Motion wake/sleep triggers
Dimensions and Mass	120 mm x 120 mm x 45 mm, 227 g
Power	Rechargeable Lithium-Ion battery M8 - External DC Power Connection (6-28V)
Environment	IP67 - Dust and Waterproof Operational: -40 C to +60 C Storage: -40 C to +85 C
Configuration	1 GPS acquisition every 2 hours with 1 transmissions per 2 hour window Motion detection enabled
Battery Lifetime	40+ days, or longer depending on transmit interval and motion when not connected to external power
Data rate	1 kbps (1-way)

**Table 1:** Overview of the Swarm Asset Tracker.

## 2 Device Registration

Create your Swarm Hive account at <https://bumblebee.hive.swarm.space/hive/ui/sign-up> and sign into your account. Navigate to the [Register Device](#) page:

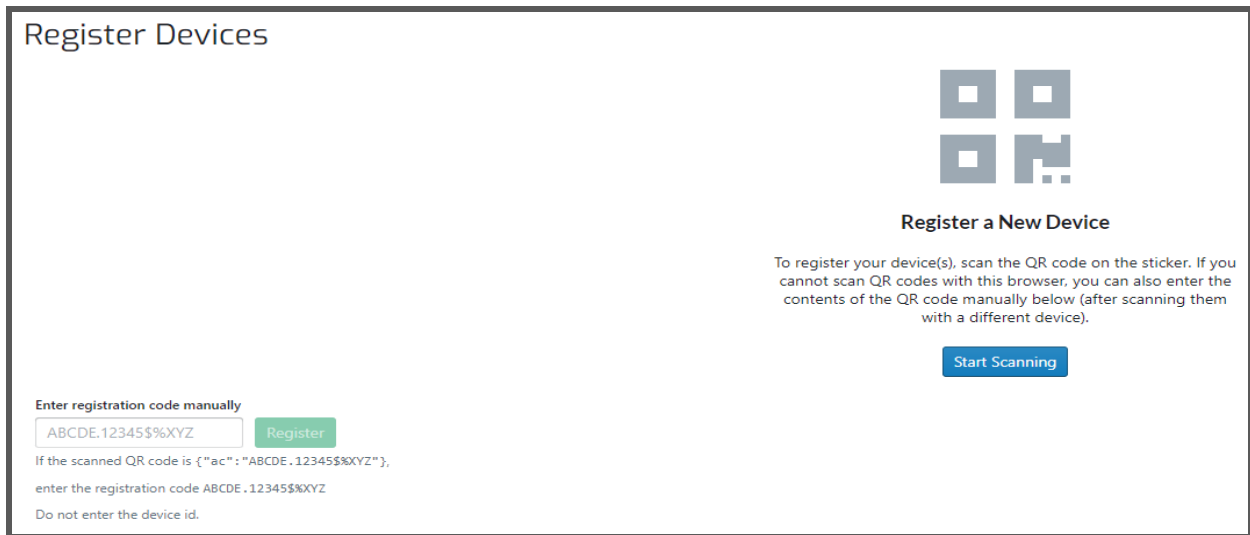


Figure 1: Swarm Hive Register Device Page.

Click Start Scanning to scan your Swarm Asset Tracker's QR Code that is located on the sticker affixed to the enclosure. If you are unable to use the browser-based scanner, you can also use your camera app to scan the Asset Tracker QR code, and enter the auth code in the Hive manually. See example below:



Figure 2: Sample Device Registration Process.



## 3 Mechanical Specification

### 3.1 Dimensions

The overall dimensions of the Asset Tracker and its weight are summarized below.

Parameter	Value
Length	120.0 mm
Width	120.0 mm
Height with Antenna	250 mm
Weight	227 g

**Table 2:** Modem Mechanical Dimensions and Weight.

For detailed dimensional drawings of the Asset Tracker's enclosure, please refer to the drawings available [here](#) for Hammond P/N 1557D.

### 3.2 Environmental

The environmental specifications of the Asset Tracker are summarized below.

Parameter	Value
Operating Temperature Range	-40 °C to +60 °C
Storage Temperature Range	-40 °C to +85 °C
Operating Humidity Range	0% to 95%, non-condensing
Storage Humidity Range	0% to 95%, non-condensing
Ingress Protection	IP67 - Dust and Waterproof

**Table 3:** Environmental Specifications.

### 3.3 Torque Specifications

The torque specifications for the Asset Tracker are summarized below.

Parameter	Recommended Value
Enclosure screws kit	78 ozf-in
Antenna SMA connector	10 in-lbs
M8 power connector	8.8 in-lbs

**Table 4:** Torque Specifications.

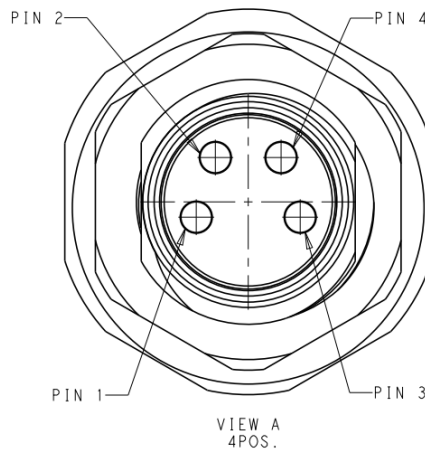
## 4 Electrical Interfaces

The following subsections contain information for the electrical interfaces of the Modem.

### 4.1 DC Power Interface and Charging

External DC voltage can be supplied from the asset via an onboard male M8 circular connector pictured below. The asset should be capable of supplying the required current in order to recharge the onboard batteries. The Asset Tracker can also be charged via micro-usb, see [Section 4.5](#) for more details. **The unit will ONLY charge between -10C and +50C.** All other functions will work uninterrupted across the operating temperature range.

Asset Tracker Connector Pinout	Function	Internal Wire Color
3,4	6-28 VDC	BLUE, GRAY
1,2	GND	RED, BLACK



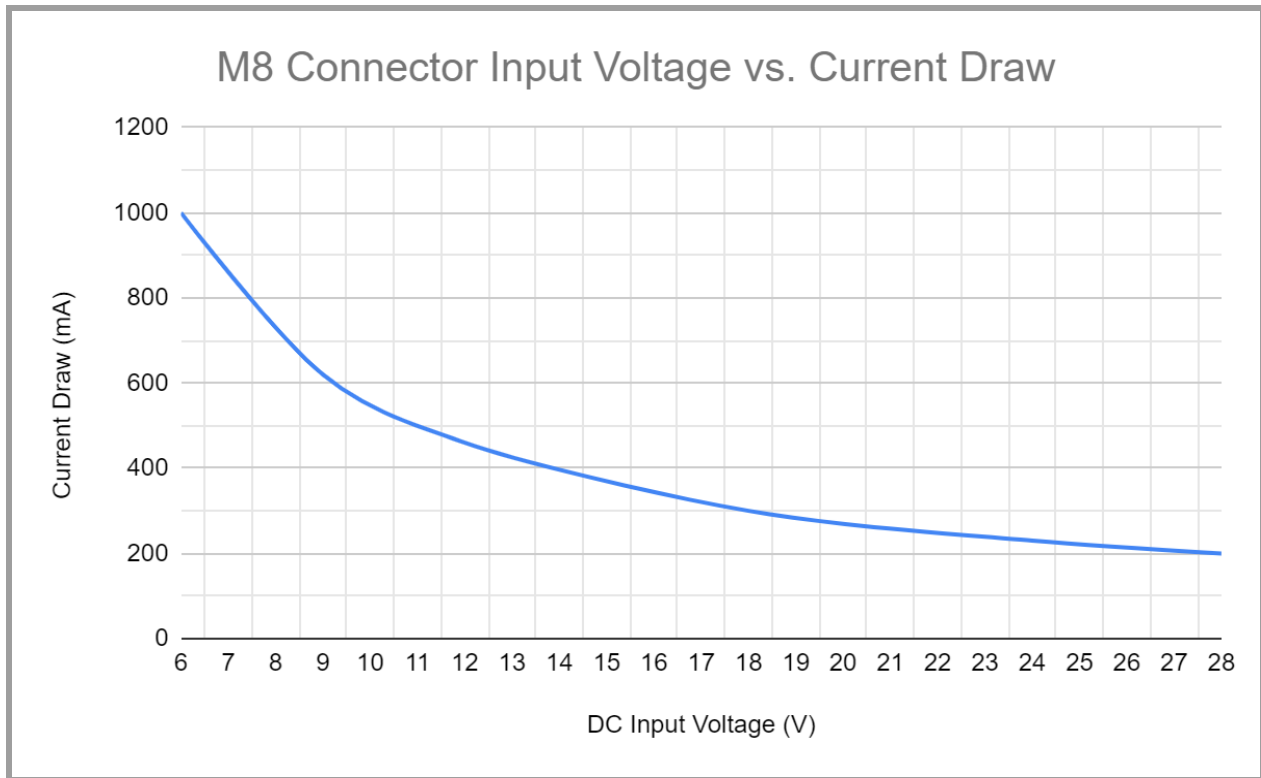
**Figure 3:** External View of the Asset Tracker's M8 Connector.

<b>Example Mating Connector</b>
TE: <a href="#">T4010008041-000</a>

<b>Example Power Cable</b>
FESTO: <a href="#">NEBB-M8G4-P-5-LE4</a>

Input Voltage [VDC]	Typical Current Draw [mA]
6	1000
9	620
12	460
18	300
24	230
28	200

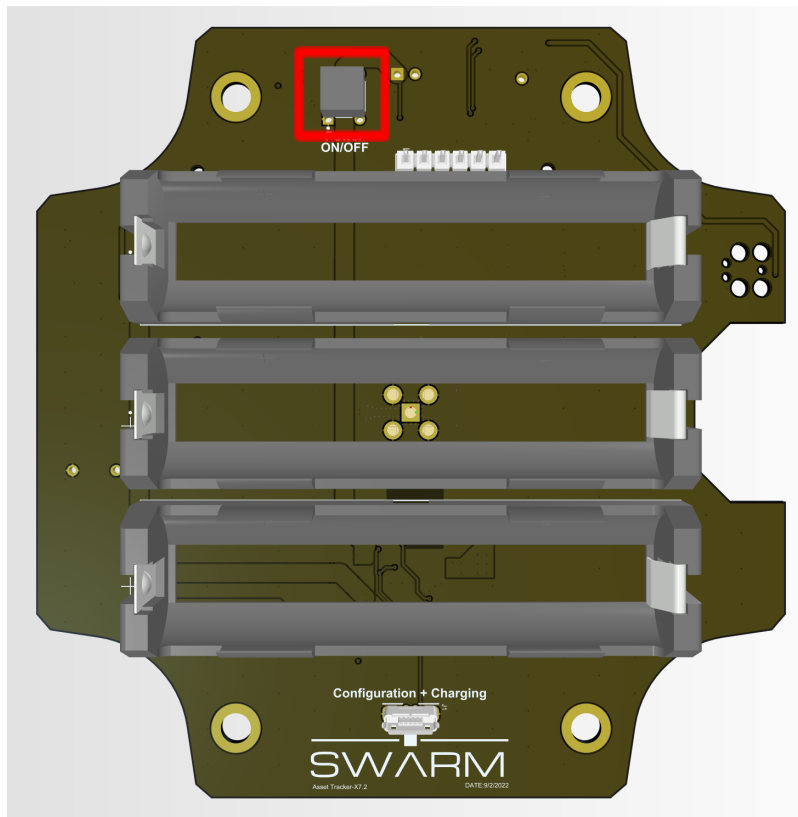
**Table 5:** External Power Current Draw.



**Figure 4:** DC Input Voltage vs. Current Draw.

## 4.2 Power On/Off Control

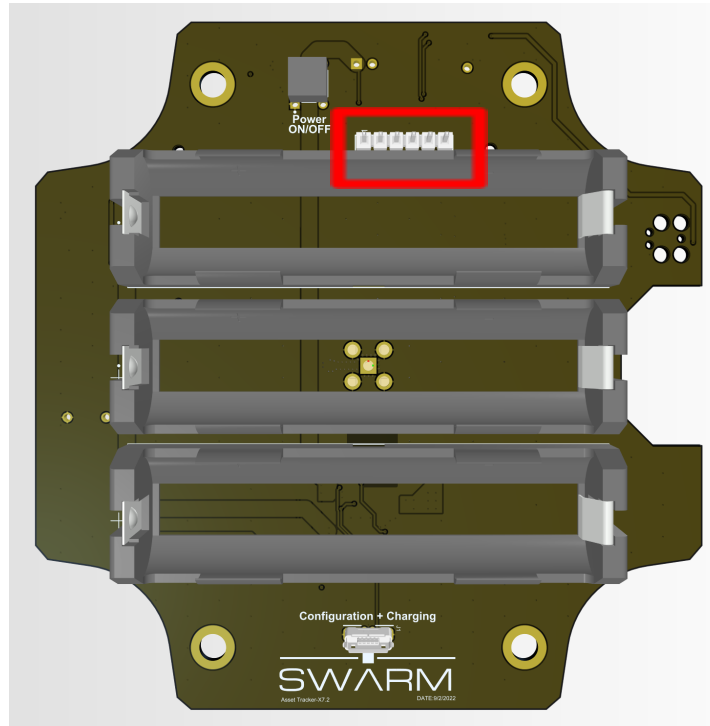
In order to power the Asset Tracker ON, press the ON/OFF button once. You'll see dim lights around the edge of the PCB light up. In order to power the Asset Tracker OFF, press the ON/OFF button again.



**Figure 5:** Power On/Off Button.

### 4.3 Serial Data Interface

The serial data interface is a CMOS serial UART 3-wire (serial Rx, serial Tx, and ground) interface at 3.3V digital signal levels over which the Modem transfers commands, responses, and message data. The FTDI header for the serial data interface is accessible inside the enclosure after removing the 4 screws at the bottom. The serial communication parameters can be found below.



**Figure 6:** Serial Data Interface.

Pin Number	Function
1	GND
2	N.C
3	N.C
4	Asset Tracker Rx
5	Asset Tracker Tx
6	N.C

**Table 6:** FTDI Serial Header Pinout

Parameter	Value
Baud Rate	115200
Data Bits	8 Bits
Parity	None
Stop bits	1 Bit
Flow Control	None

**Table 7:** Serial Data Interface Specifications.

In addition, the electrical characteristics for SERIAL\_RX, SERIAL\_TX can be found below.

Symbol	Parameter	Min	Typ.	Max	Unit
VIL	I/O input low level voltage	-0.3	-	0.3*3.3V	V
VIH	I/O input high level voltage	0.7*3.3V	-	3.3V	V

**Table 8:** Electrical characteristics for SERIAL\_RX, SERIAL\_TX.

## 4.4 USB Power and Data Interface

A USB interface is provided via a micro-usb connector accessible inside the enclosure after removing the 4 screws at the bottom. The connector can be used to charge the Asset Tracker and for configuration of the Asset Tracker. **The unit will ONLY charge between -10C and +50C.** All other functions will work uninterrupted across the operating temperature range. The current consumption during USB charging is **500mA**.

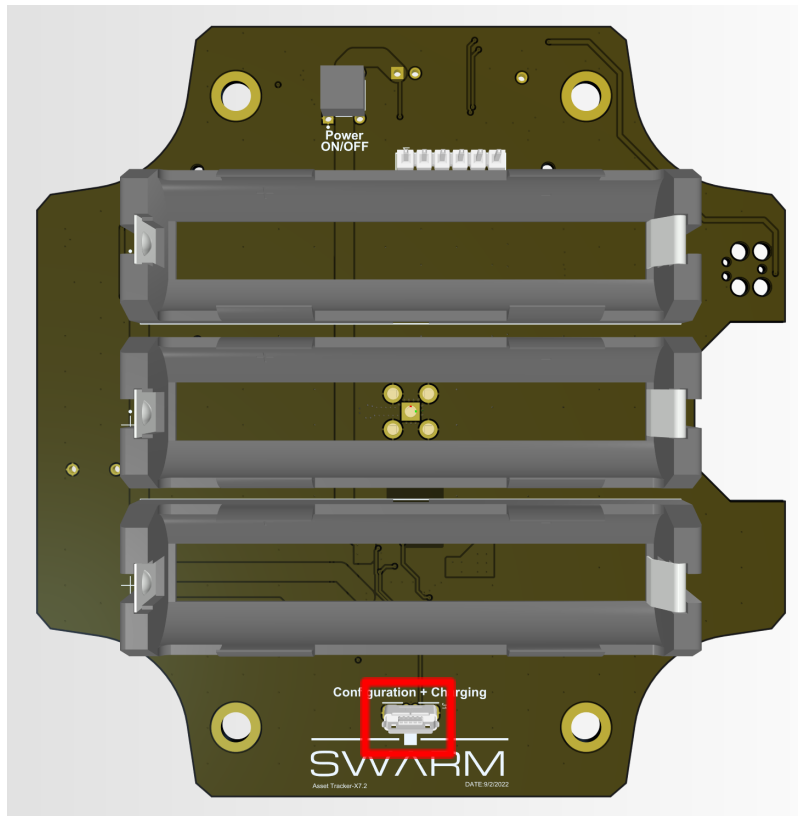


Figure 7: USB Power and Data Interface.

### Notes:

The Asset Tracker should be in its OFF state with the VHF antenna removed while charging the batteries via the micro-USB connector.



## 5 Mounting Guidance

This section describes the **recommended** mounting practices for successful deployment of the Swarm Asset Tracker.

### 5.1 Mounting Feet

Please refer to [this document](#) on Hammond's website for instructions on how to install the enclosure mounting feet.

### 5.2 Magnet Mounts

Magnet mounting can also be utilized. A total of 4 magnets per Asset Tracker are recommended for reliable mounting of the device. An example magnet part number is provided below along with the recommended screw part number.

Example Magnet Mounts
McMaster Carr: <a href="#">7132T27</a>

Example Screws for Magnet Mounts
McMaster Carr: <a href="#">91292A108</a>

### 5.3 VHB Tape

The Asset Tracker can also be mounted using double sided Very-High-Bond (VHB) tape. A link is included below for a variety of VHB tape options that can be selected and used based on the specific requirements of the user application and deployment environment.

Example Screws for Magnet Mounts
McMaster Carr: <a href="#">VHB Tape Options</a>

## 5.4 Pole Mounting Kit

Pole mounting kits can be purchased from Hammond Manufacturing at [this link](#). The mounting kit can be used to secure the Asset Tracker to a variety of surfaces quickly and securely. Please refer to [this document](#) on the Hammond website for mounting instructions.

### Recommended Pole Mounting Kit

Hammond: [PMB Series](#)

## 6 RF Interfaces

This section describes the physical characteristics of the RF connectors and specifications of the RF Interface.

### 6.1 RF Antenna

For illustrative purposes, a picture of the Swarm  $\frac{1}{4}$ -wave antenna is shown in **Figure 9**.



**Figure 8:** Swarm Coiled  $\frac{1}{4}$  Wave Antenna.

### 6.1.1 Antenna Characteristics

The Modem is certified with the following antenna as described below. No power reduction compensation is required for use with this antenna.

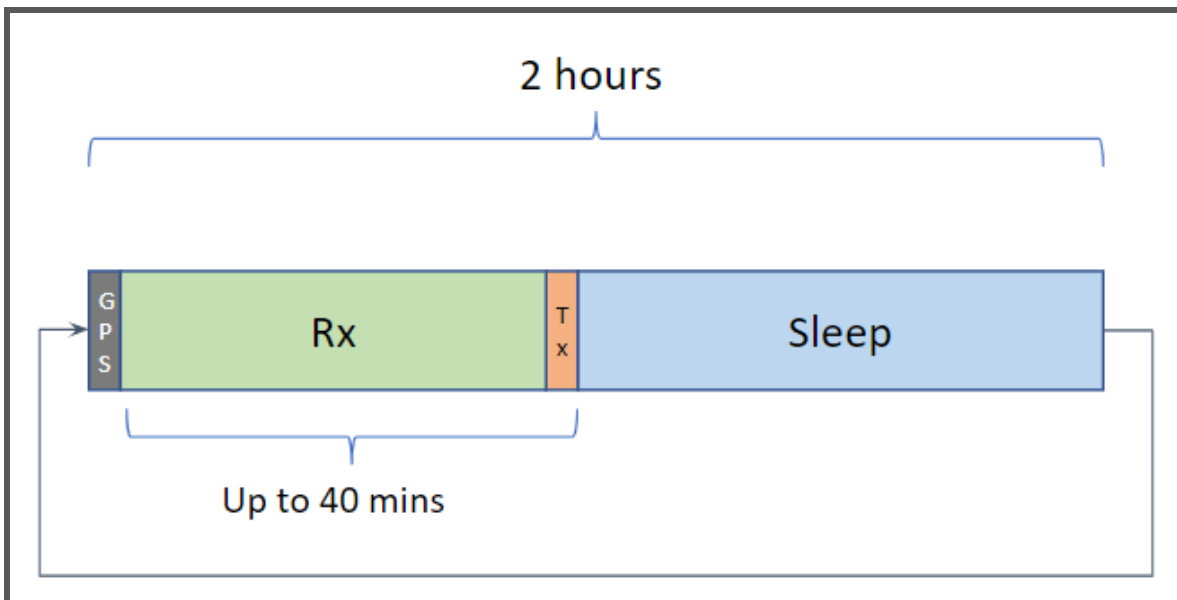
Swarm Coiled ¼ Wave Antenna	
Parameter	Value
Length	22.0 cm
Diameter (Connector)	11.2 mm
Diameter (along major length)	7.6 mm
Weight	31.5 g
Operating Temperature	-55 °C to +130 °C
Operating Humidity	0-100% humidity, condensable
Impedance	50 Ohms nominal
Polarization	Linearly Polarized
VSWR (between Swarm Bands)	Max $\Delta < 0.5$
Gain	2.0 dBi
Nominal Output Power	30 dBm (Declared)
Frequency	137.000-138.000 MHz (Rx) 148.000-150.000 MHz (Tx)
Connector	SMA male (U.FL to SMA female cable required)
Antenna Ground Plane	<b>Required</b> , integrated into the Asset Tracker
Antenna Height Requirement	1m above the ground/solid surfaces
Antenna Classification	Mobile, Fixed
Minimum separation distance from body	36 cm

**Table 9:** Antenna Characteristics for Swarm Coiled ¼ Wave Antenna.

# 7 Message Transmission

## 7.1 Motion Detection Disabled

The Swarm Asset Tracker will acquire 1 GPS acquisition every 2 hours with 1 message transmission per 2 hour window. A visual representation of the Asset Tracker configuration is shown in Figure 9 below. Motion detection is enabled for all units, and acts as a modifier for the configuration shown in this section. More information regarding motion detection can be found in [Section 7.2](#).



**Figure 9:** Visual Representation of the Swarm Asset Tracker's Configuration.

In the first GPS state, the Asset Tracker will attempt to acquire a GPS fix for up to 4 minutes. The acquired data will be queued for transmission. Once a GPS fix is acquired, the Asset Tracker will transition to its receiver state (Rx) for up to 40 minutes where it will listen for satellite beacons to trigger a transmission (Tx). The Asset Tracker will then transition to its sleep mode as soon as the queued message is transmitted, or if 40 minutes have passed. It will remain in its sleep mode until 2 hours have passed since its initial power-on time, and it will then repeat the same sequence.

## 7.2 Motion Detection Enabled

When motion detection is enabled, it acts as a modifier for the profile described in [Section 7.1](#).

If motion is detected while the Asset Tracker is awake and not in its sleep mode, there will be no change to the configured profile.

There are two possible scenarios that could occur if motion is detected while the Asset Tracker is in its sleep mode. If the motion event occurs **before** the next scheduled normal wake time, then the Asset Tracker will go back into its sleep mode until the next regularly scheduled wake time. If the motion event occurs **after** the next scheduled normal wake time, then the Asset Tracker will wake immediately and start a new acquisition cycle.

The Asset Tracker will continue to follow its profile configuration while it still has messages that are queued for transmission if motion is detected when the device is ready to transition into its sleep mode. When the transmission queue is empty after following the profile configuration, the device will enter its sleep mode indefinitely until a new motion event is detected.

For all profile configurations, regardless of whether motion detection is enabled or not, the Asset Tracker will return to its sleep mode early if all queued messages are transmitted.

## 8 Transmitted Data

### 8.1 Description of Transmitted Parameters

Identifier	Description	Units
dt	GPS date/time of sample at time of packet creation	<a href="#">Epoch seconds</a>
lt	GPS latitude	Degrees
ln	GPS longitude	Degrees
al	GPS altitude	Meters
sp	GPS speed	m/s
hd	GPS heading	Degrees
bv	Battery voltage	mV
tp	CPU temperature	°C
rs	Background RSSI at time of packet creation	dB
tr	RSSI of most recent satellite beacon	dB
ts	SNR of most recent satellite beacon	dB
td	GPS date/time of most recent satellite beacon	<a href="#">Epoch seconds</a>
gj*	GPS jamming level*	N/A
gs*	GPS spoofing indicator*	N/A
hp*	Horizontal dilution of precision*	N/A
vp*	Vertical dilution of precision*	N/A
tf*	Time to fix*	N/A

**Table 10:** Description of Transmitted Parameters.

\*These parameters are Swarm specific and subject to change.

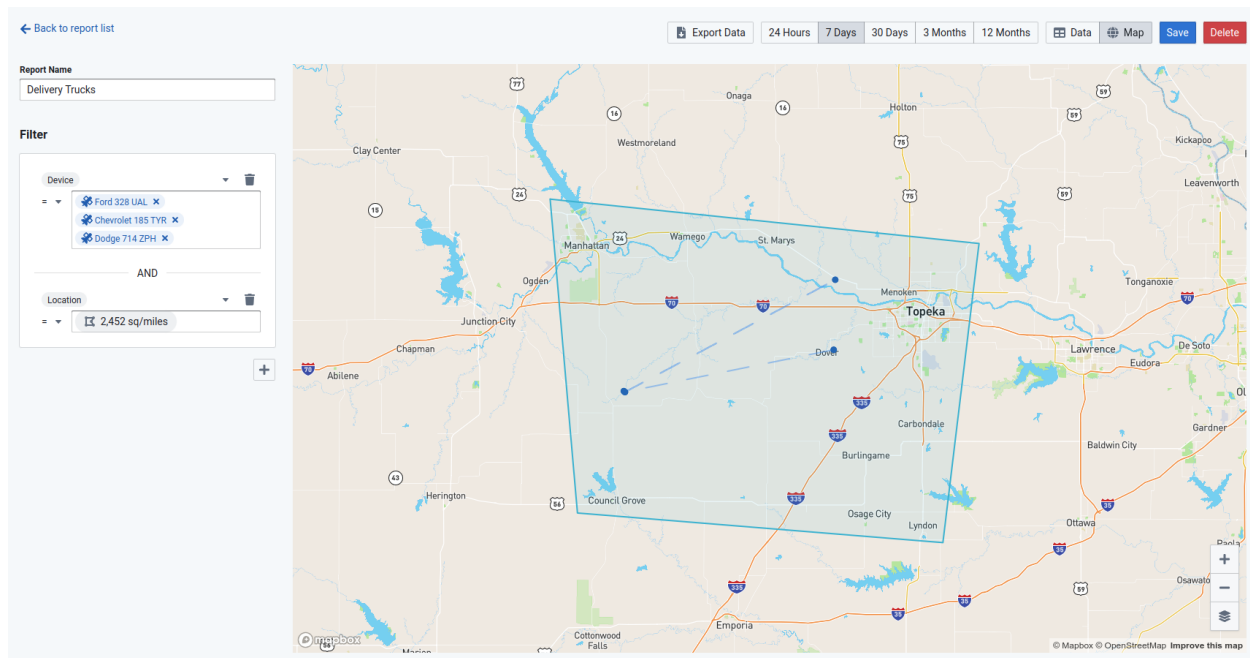
## 8.2 Accessing Transmitted Data using the [Swarm Hive](#)

### 8.2.1 Map Page

The [Map Page](#) on the Swarm Hive will show the last known location of the device along with historical data. After logging in, the user can navigate to this page and filter devices using the Device ID of the Asset Tracker.

### 8.2.2 Reports Page

The Swarm Hive can be used to generate reports for Asset Tracker data. Reports can be configured using the [Reports Page](#) after logging into the Swarm Hive. The reports can be customized by using the provided filters for device ID, date, and location. The data for each report can be viewed on a map, and also in tabular format. The data from each report can also be exported and downloaded as a CSV file.



**Figure 10:** Map View Example of a Report Generated on the Swarm Hive.



### 8.2.3 REST API

Customers can extract data from the Swarm Hive by using the provided REST API. Documentation for the REST API can be found on the Swarm Hive's API Docs page [linked here](#). The API Docs page provides a list of REST endpoints that are available from Swarm for customers to use. Each endpoint can be tested using the interactive API Docs page to test the functionality and also view the expected response.

### 8.2.4 Delivery Webhooks

Customers can choose to have transmitted data automatically pushed to their own backend server using the Swarm Hive's webhook functionality. Webhooks can be configured using the Delivery Page on the Swarm Hive that is [linked here](#). Each delivery method can be customized using the parameters provided, and existing delivery methods can also be edited as required.

## 9 FCC Statement of Compliance

Swarm Technologies, Inc.  
435 N. Whisman Rd.  
Ste 100  
Mountain View, CA 94043  
**Model: ATM138**

**Contains FCC ID: 2AVE9-M138**

**Contains IC: 25817-M138**

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:  
(1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This Class B digital apparatus complies with Canadian ICES-003.  
Cet appareil numérique de la classe B est conforme à la norme NMB-003 Canada