

# QuickNav User Guide

Version A

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## REVISION HISTORY

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## REFERENCE DOCUMENTS

The latest revisions of the NAL documents are available from the NAL Research website at

<https://www.nalresearch.com/>

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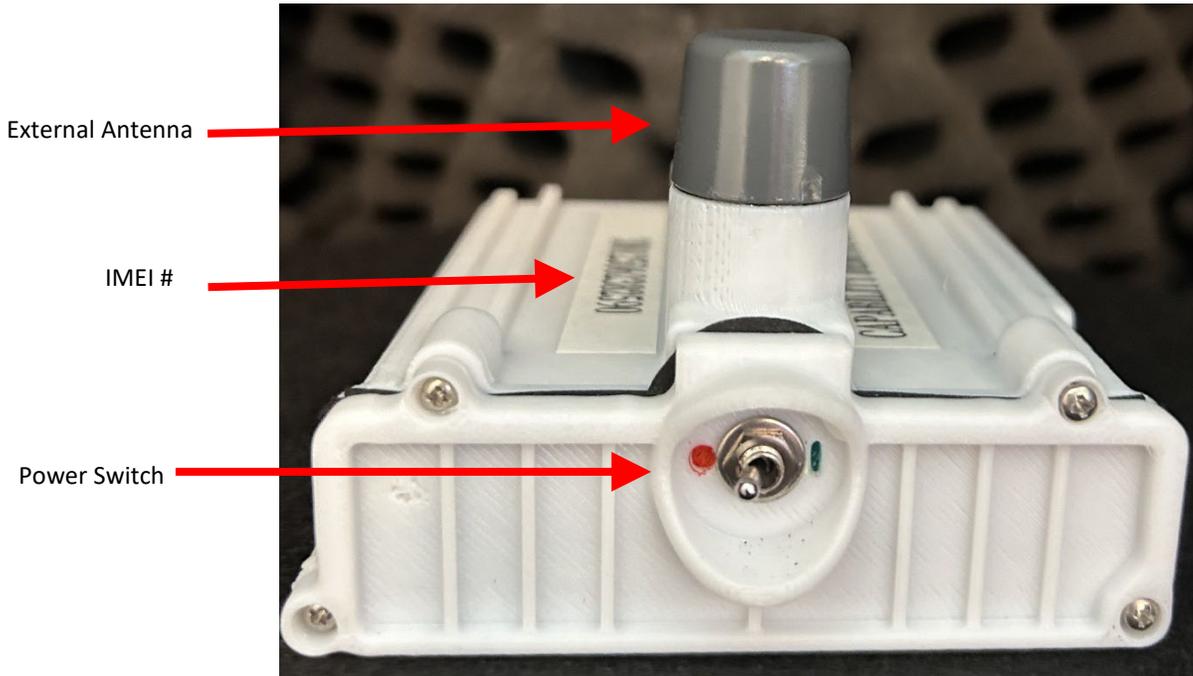
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# 1 INTRODUCTION

This document describes the electrical and mechanical interfaces of the Proof-of-Concept (POC) QuickNav device (see **Figure 1**). It is a lightweight water-resistant all-in-one enclosure that contains an external QuickLynk antenna and an internal GPS antenna and is powered by two (2) CR-123A non-rechargeable batteries. When you apply power QuickNav automatically connects, beacons, and transmits Mobile Originated (MO) encrypted Position Location Information (PLI) using QuickLynk service without an external device. QuickNav is mounted on an Uncrewed Aircraft Vehicle (UAV) that enables the user to view/track its movement on SkyRouter or Google Earth based map.



**Figure 1: QuickNav -Front**

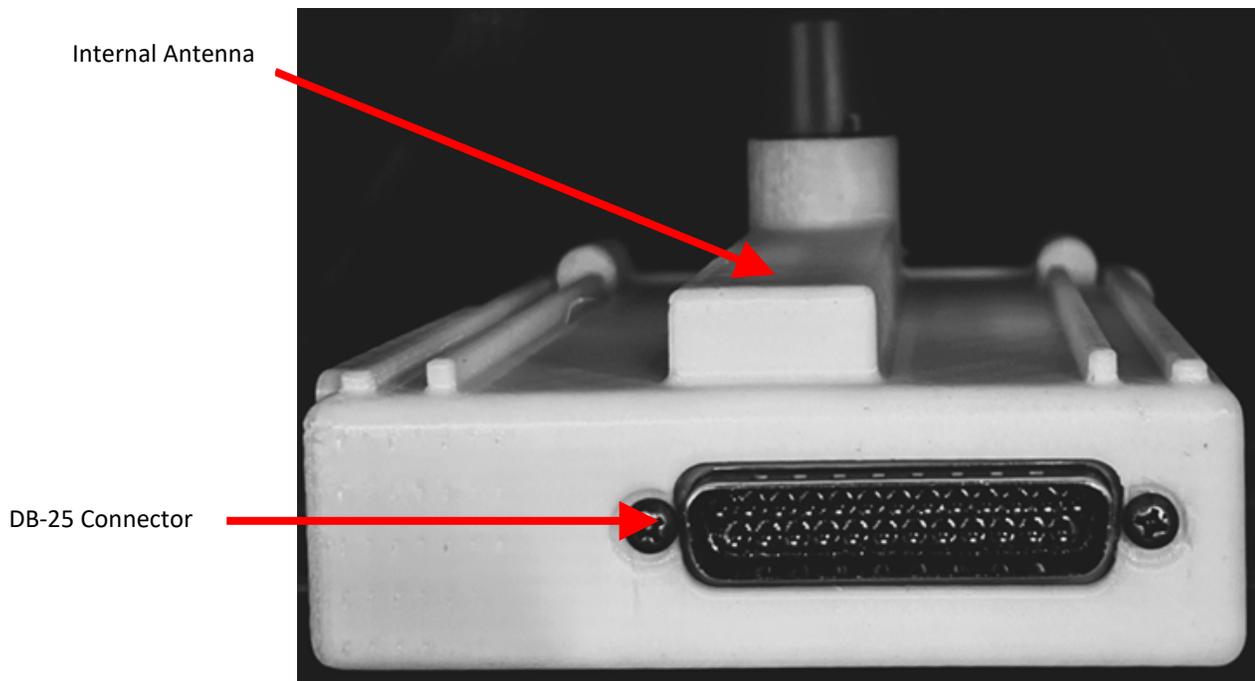


Figure 1: QuickNav -Back

**IMPORTANT! Do not disassemble QuickNav for repair or services. Return it to NAL Research for any services or firmware upgrade..**

NOTE: For this POC, QuickNav is fully provisioned for operations with a pre-installed SIM card and antennas (GPS/QuickLynk). QuickNav immediately starts to receive/transmit encrypted PLI data once power is applied.

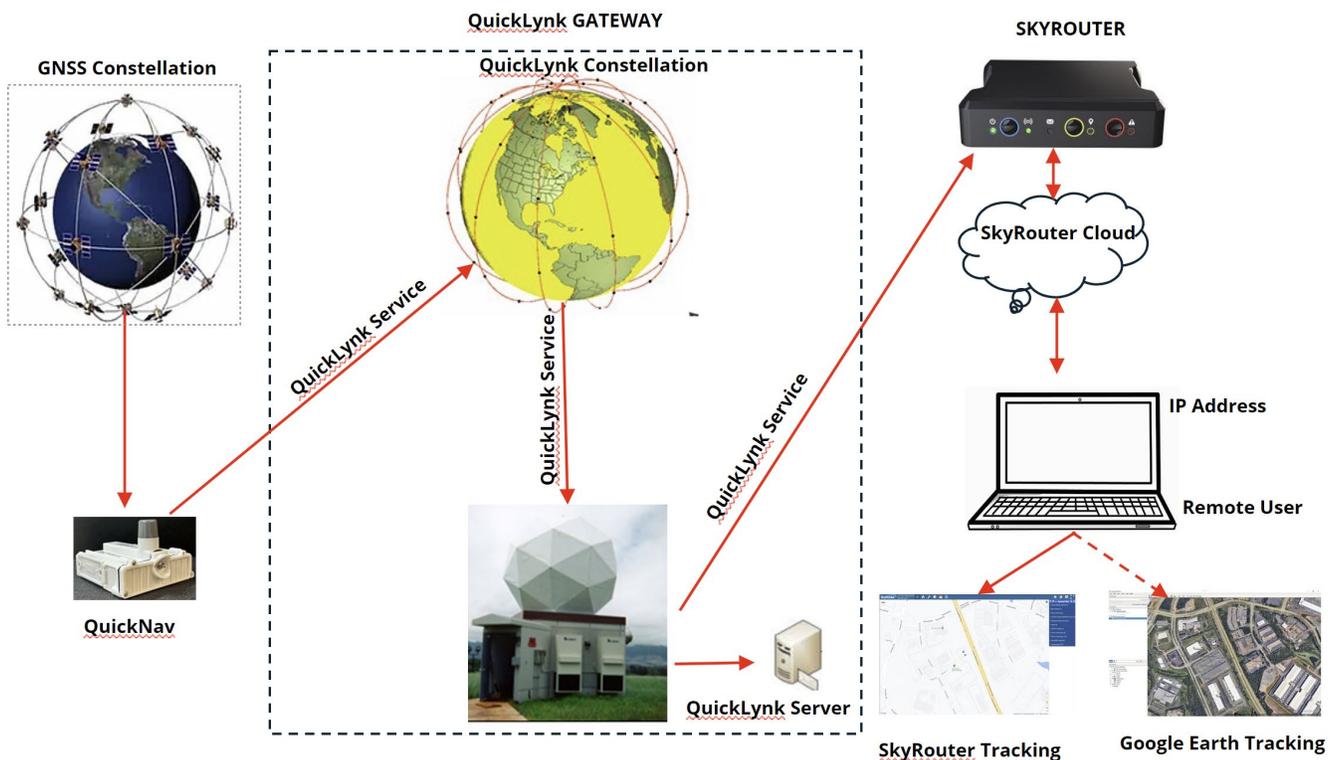
## 1.1 WHAT'S IN THE ALL-IN-ONE BOX

The user will find the following components in the box:

- QuickNav device
- Two (2) CR123A batteries
- User Guide

## 2 SYSTEM DESCRIPTION

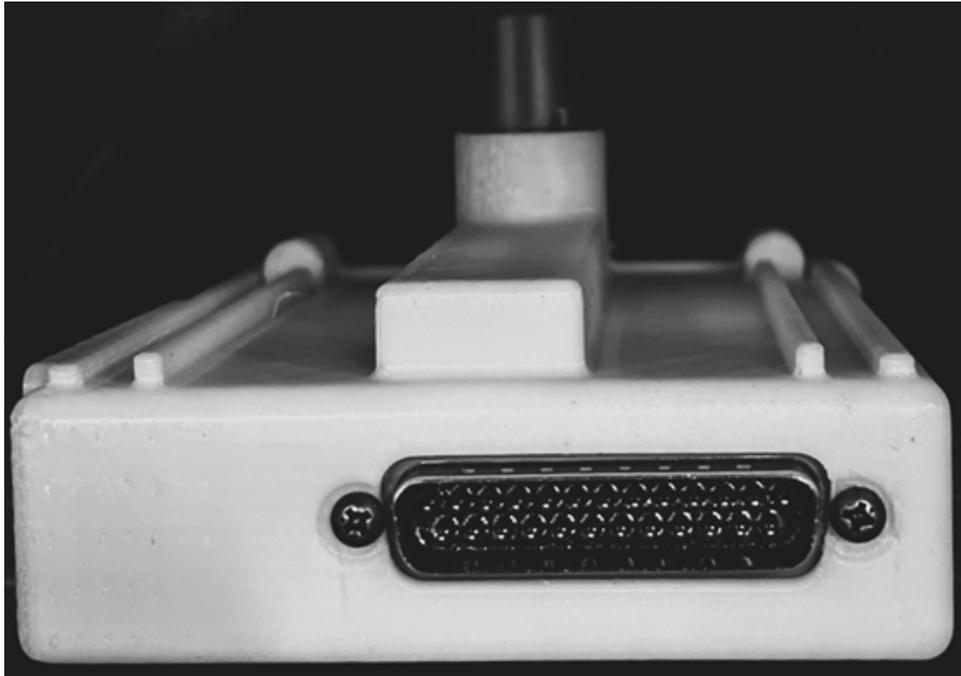
QuickNav includes: A3LA, external QuickLynk antenna and an internal GPS antenna, and (2) internal CR-123A non-rechargeable batteries. QuickNav receives and processes GPS PLI data from the GNSS constellation and continuously transmits via QuickLynk service encrypted PLI data at a rate of 1 per second to the QuickLynk service (see **Figure 2**). Typical PLI delivery is under 2 seconds with some variability depending on signal conditions. The satellite network (Gateway) transmits the encrypted PLI data using satellite downlinks to a ground-based operations center. The Gateway provides an open connection for QuickNav to send encrypted PLI data to BSN’s SkyRouter common operating picture (COP). For this POC, SkyRouter unencrypts PLI data and saves it to the SkyRouter database and automatically displays asset tracking on the SkyRouter map. In addition, the user can switch to Google Earth to view the asset tracks. NOTE: The CR123A batteries are non-rechargeable and have a 45-60 minute continuous mission life.



**Figure 2: System Overview**

## 2.1 DB-25 CONNECTOR

For the proof-of-concept, the DB-25 connector is for NAL use only. The DB-25 connector (see **Figure 3**) on the QuickNav back panel is a male 25-pin miniature D-sub connector used to send and receive data and configure QuickNav using NAL's SatTerm application.



**Figure 3: DB-25 Connector**

## 2.2 SIM CARD INTERFACE

The Proof-of-Concept QuickNav datalink is provisioned with a pre-installed SIM card. QuickNav uses and requires a QuickLynk SIM card for operation. NOTE: Installing/removing a SIM card from QuickNav is a future feature.

## 2.3 LED DISPLAY

QuickNav has four (4) status LEDs (see **Figure 4**) depicted as *P* for power indicator, *I* for QuickLynk satellite signal strength, *S* for status, and *G* for GPS signal strength, and (see **Table 2.1**). They provide a quick visual check to ensure proper modem operations, as well as to optimize antenna locations during field installation. These LEDs provide the following information as noted in **Table 2.1**.

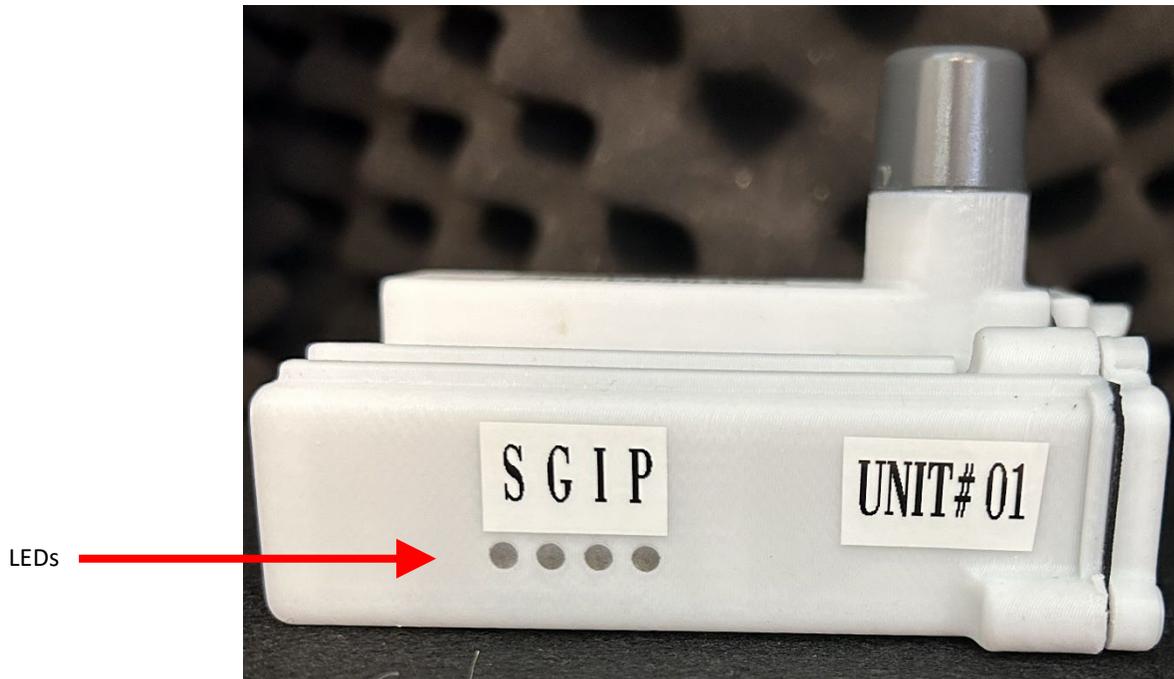


Figure 4: LED Display

Table 2.1: LED Status

| LED Status | Description   |
|------------|---|
| <b>P</b>   | LED lights up solid red when power is provided to QuickNav. As the batteries get depleted in their capacity, due to the nature of large load pulse when QuickLynk transmissions happen, the Power LED will blink fast dim followed by a slow brighten, which can be interpreted as an indicator that the batteries are nearing end of life. |
| <b>I</b>   | LED stays solid when the signal strength is between 3–5, blinks when the signal strength is between 1–2 and is off when signal strength is 0.   |
| <b>G</b>   | LED stays solid when there is a valid GPS position fix (usually with at least 4 satellites), blinks when there is only a 2D fix or using dead reckoning (usually with 3 satellites or less) and stays off when unable to obtain a position fix.   |
| <b>S</b>   | LED lights up when QuickNav is in data mode. Data mode means a connection is in progress. Once connection is established this LED lights up solid green.  |

## 2.4 AES-256 BIT ENCRYPTION

The QuickNav modem has a built-in AES-256 encryption software module and transmits encrypted PLI data to SkyRouter (see **Figure 2**).

## 2.5 QUICKLYNK

The QuickLynk network can utilize a US DoD or Commercial satellite gateway. The network is constructed with a constellation of 66 satellites in low-earth orbit (LEO).

When a QuickNav datalink places a session to the QuickLynk server located at the QuickLynk Gateway, the QuickLynk server connects the session to a predefined IP address, allowing an end-to-end IP connection between the host application and the QuickNav.

QuickLynk Gateway makes calculations of the geographical location (geolocation) of the QuickNav. The technique employed to determine the geolocation of the QuickNav is based on measurements of the QuickNav and satellite propagation delay and Doppler frequency shift. These measurements are used to estimate cosines of spherical angles that identify the QuickNav's location relative to the satellite by the gateway.

## 2.6 GOOGLE EARTH

Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GPS data onto a 3D globe, allowing users to see cities and landscapes from various angles. There are many different views in Google Earth. QuickNav can be viewed in Google Earth Satellite/Street View. For detailed information on how to use Google Earth, refer to Section 3.3.3.

## 2.7 SKYROUTER

SkyRouter is a cloud-based Common Operational Picture that can track, monitor, and provide communications for all your assets, anywhere in the world, from one interface. SkyRouter communicates with devices to provide a secure web interface that displays positions on various overlay maps. It also handles two-way message traffic, events, alerts, and telematic data. SkyRouter lets you monitor, control, interact, and communicate with your assets in real-time, from anywhere.

For a copy of the SkyRouter user guide:

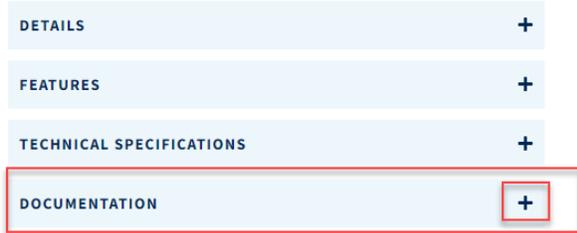
1. Select [Aircraft Tracking & Vessel Tracking | SkyRouter | Blue Sky Network](#).

2. Select **Documentation +**.

## SkyRouter

### SKYROUTER

The industry-leading fleet tracking and communication tool to manage your fleet, lower operating costs, and improve safety.



3. Select **User Guide**.



A PDF version of the SkyRouter User Guide displays.

To view SkyRouter training video, launch the following link:

<https://blueskynetwork.com/help-center/skyrouter-training/>

## 3 QUICKNAV OPERATIONS

**IMPORTANT! Temperature Advisory –QuickNav operates between 10C to 50C. Do not operate QuickNav out of this range.**

### 3.1 HOW TO MOUNT QUICKNAV

Mount QuickNav to the UAV using Velcro tape or alternative non-damaging securable method that does not impede functionality.

NOTE: Ensure QuickNav is skyward pointed and doesn't obstruct any mechanical or electrical devices such as the UAV internal GPS antenna.

### 3.2 HOW TO START QUICKNAV

QuickNav is provisioned to receive GPS PLI data and transmit encrypted PLI data at <2 seconds to the SkyRouter once you apply power to QuickNav.

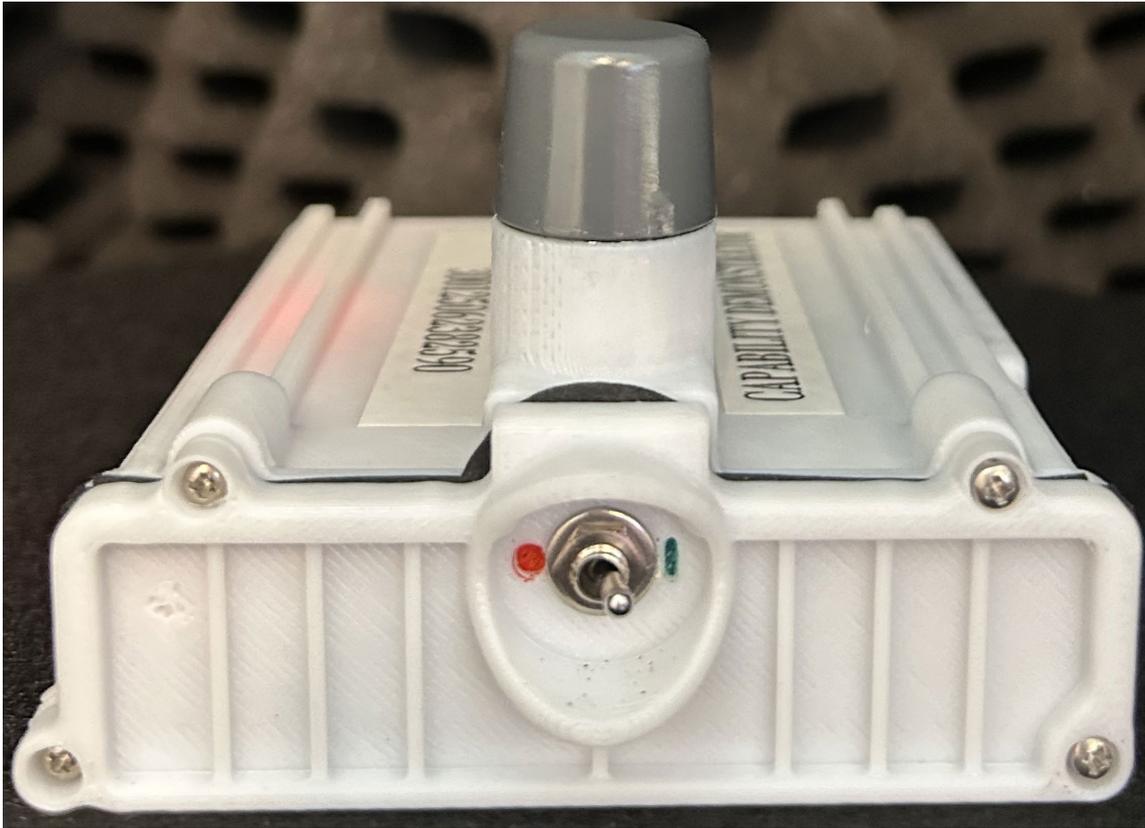
**IMPORTANT! Toggle the power switch to the LEFT (OFF) position when not in use.**

NOTE: The figure below depicts the QuickNav in the **OFF** position



**Figure 5: Power Switch Off**

1. Toggle the Power switch to the **Right** position (see **Figure 6.**).



**Figure 6: Power Switch On**

2. Verify the LED status on the QuickNav device 'P' LED shows solid red.

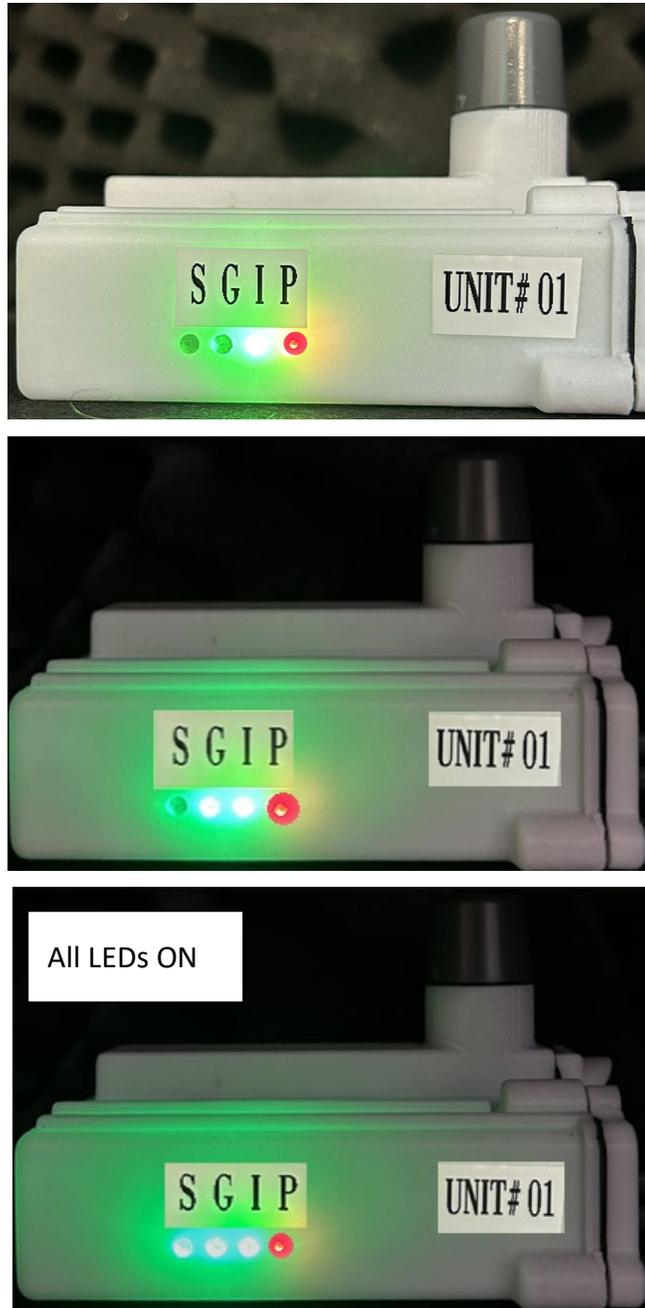


**Figure 7: Power LED Status**

3. Verify you have sufficient signal strength for both QuickLynk and GPS and a connection is established.

- The 'I' LED and 'G' LED shows solid green.
- 'S' LED shows solid when connection has been established.
- When all three (3) LEDs show solid green your QuickNav device is ready.

**NOTE:** Figure 8 below illustrates the LED boot-up sequence.



**Figure 8: Power LED Boot-Up Sequence**

### 3.3 HOW TO VIEW QUICKNAV TRACKING

After successfully logging into SkyRouter, you will see your asset tracked on the SkyRouter map.

1. Double-click the SkyRouter URL: <https://dev-skyrouter.com>.

NOTE: This POC uses the SkyRouter development environment. Please double-check for proper URL.

The SkyRouter Login screen displays (see **Figure 9**).



**Figure 9: SkyRouter Login**

2. Log on to SkyRouter:
  - a. Enter your username in the Username field.
  - b. Enter your password in the *Password* field.
  - c. Optionally, select language from the *Language* drop-down list.
  - d. Select **Sign In**.

NOTE: The following figures illustrate movement/tracking of the QuickNav device (see **Figure 10**, **Figure 11** and **Figure 12**).

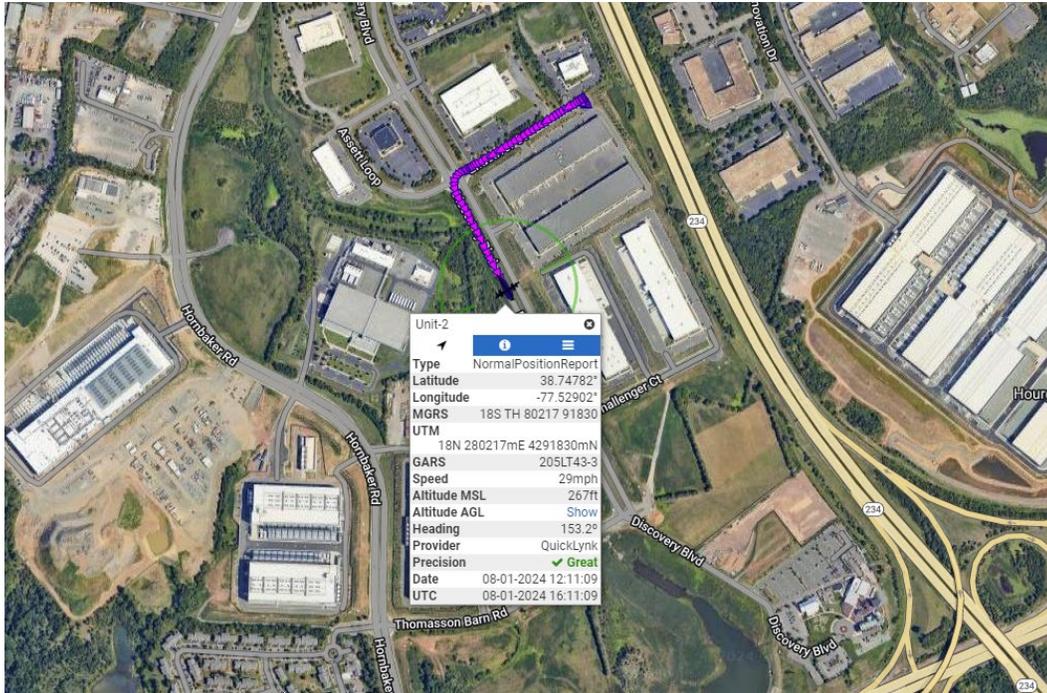


Figure 10: QuickNav Tracking 1-3

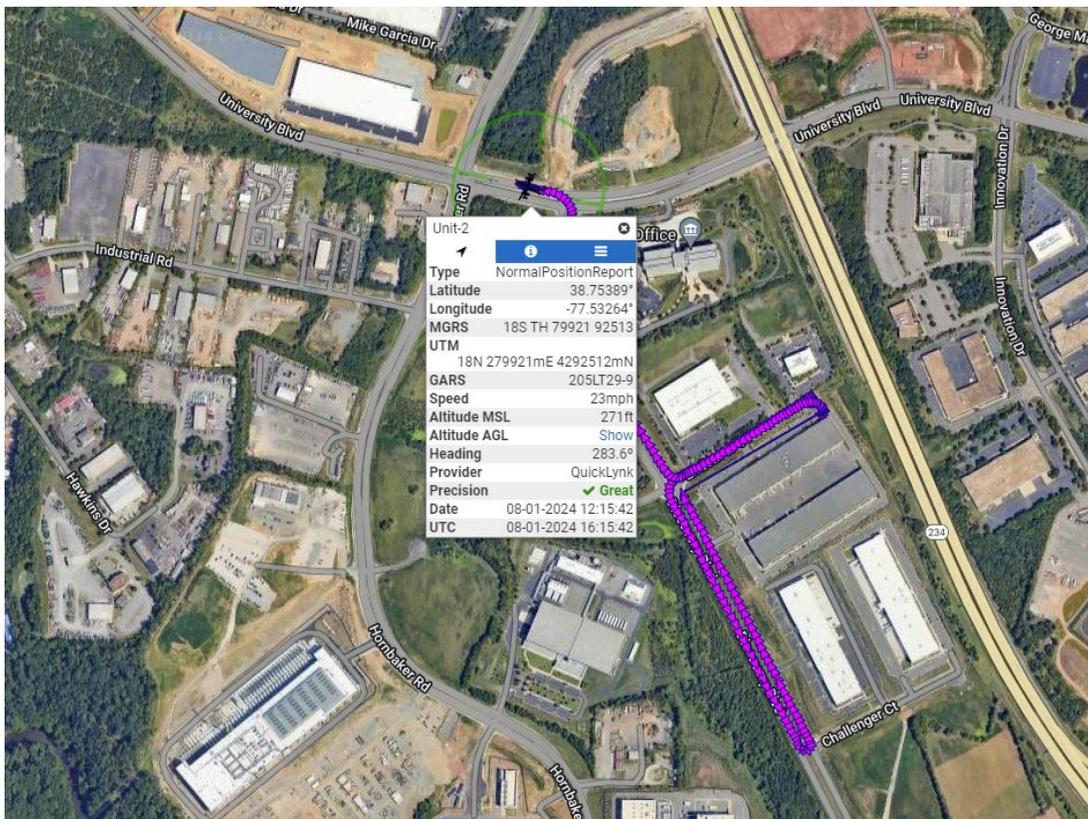


Figure 11: QuickNav Tracking 2-3

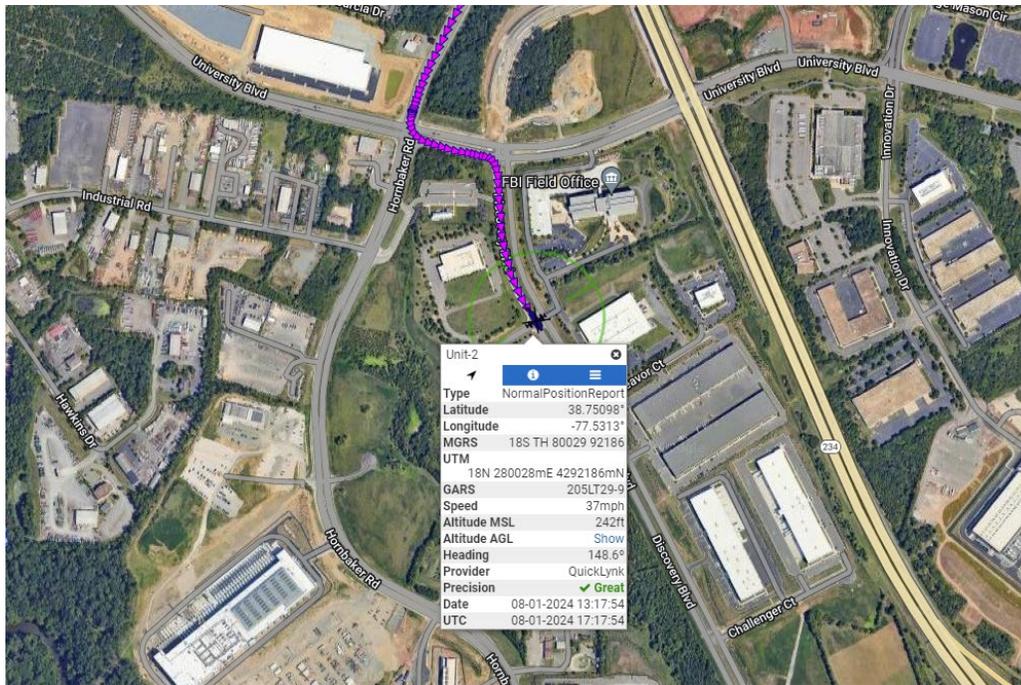


Figure 12: QuickNav Tracking 3-3

### 3.3.1 GPS INFORMATION

The *GPS Information* tab shows the most recent GPS fixed data that was sent from QuickNav to SkyRouter, as shown in the previous figure in the red box and in the figure below. By default the GPS Information pop-up window displays. If in another tab, select the **GPS formation** tab (see **Figure 13**).

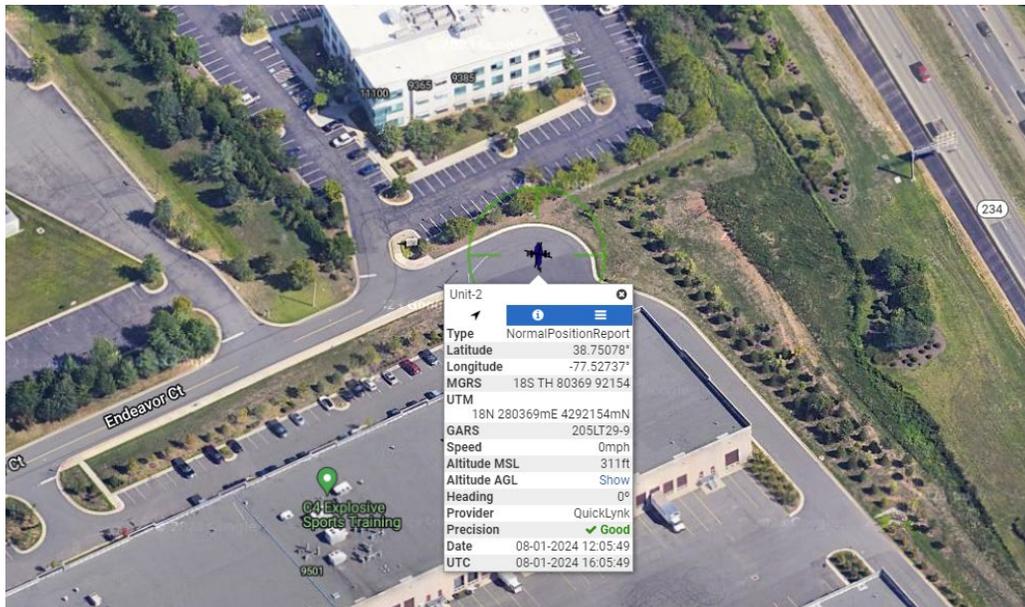
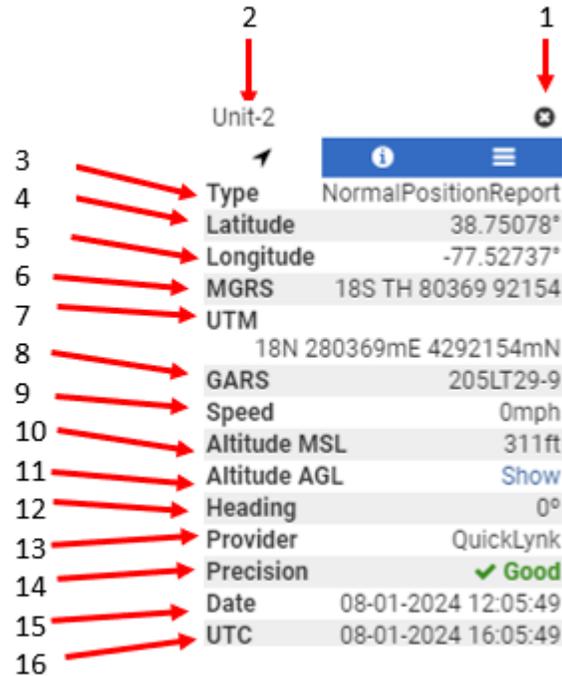


Figure 13: GPS Information

NOTE: the following is an explanation of each specification noted in the GPS Information window.

1. **Close** – Close the tooltip.
2. **Asset Name** – The Asset name as defined on the Manage > Devices page.
3. **Type** – The most recent position report type or Event received from the device.
4. **Latitude** – GPS Latitude data.

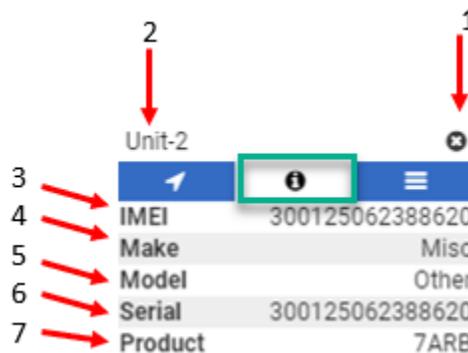
5. **Longitude** – GPS longitude data.
6. **MGRS** – GPS data represents in Military Grid Reference System coordinate.
7. **UTM** – GPS data represents in Universal Transverse Mercator coordinate.
8. **GARS** – GPS data represents in Global Area Reference System coordinate.
9. **Speed** – GPS ground speed data.
10. **Altitude MSL** – GPS altitude mean sea level data.
11. **Altitude AGL** – GPS altitude above ground level.
12. **Heading** – GPS heading data.
13. **Provider** – The transport network that the most recent report or Event was sent over (e.g. QuickLynk, GSM).
14. **Precision** – Status label that defines the accuracy of the GPS data.
15. **Date** - Current date/time in your configured local time - zone.
16. **UTC** – Current date/time in UTC (Coordinated Universal Time).

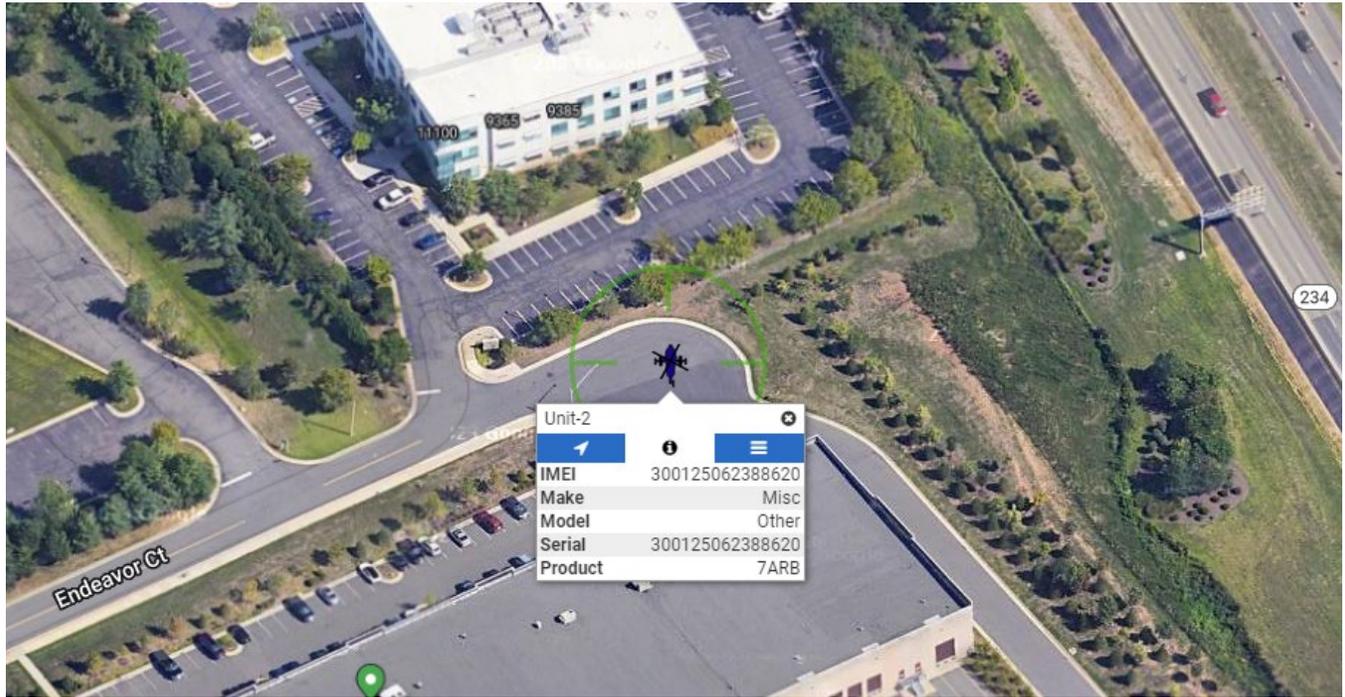
### 3.3.2 ASSET INFORMATION

The *Asset Information* tab displays QuickNav Asset-specific information.

1. Select the **Asset Information** tab (see **Figure 14**: Asset Information – red box).

The Asset Information window displays.





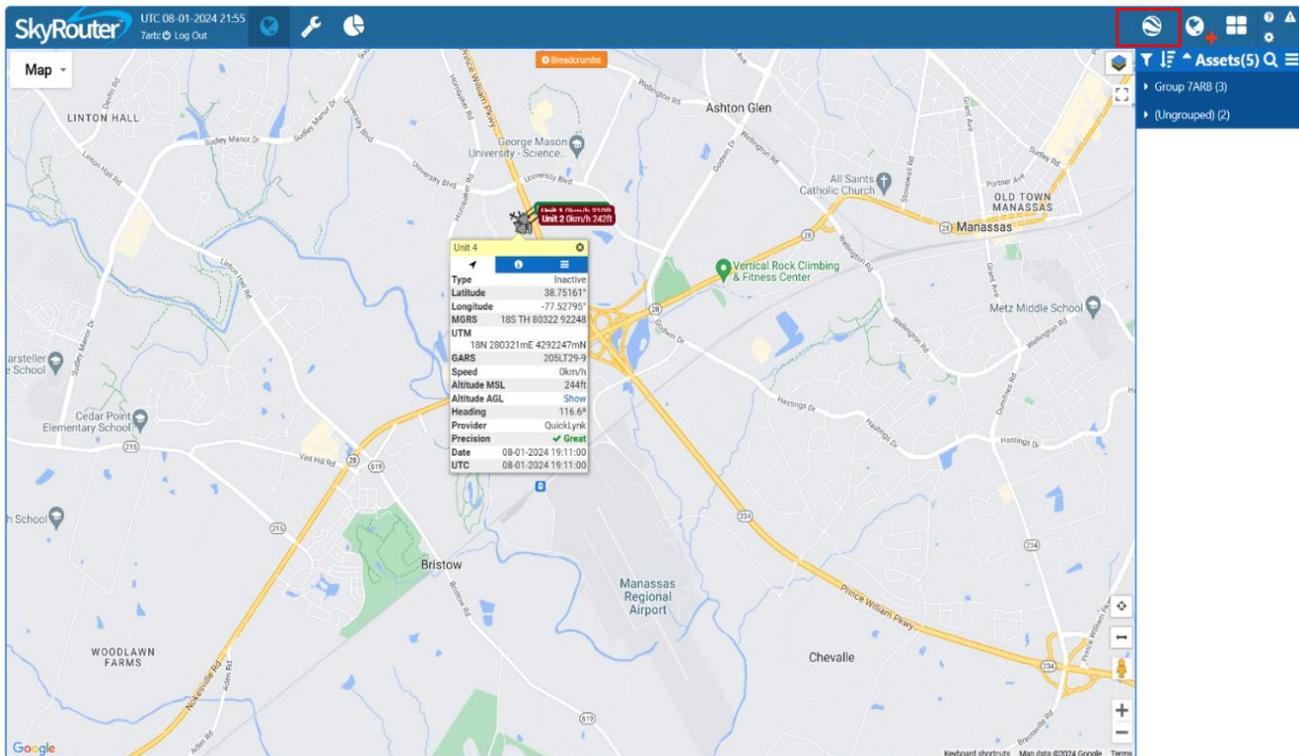
**Figure 14: Asset Information**

The following is an explanation of each specification noted in the GPS Information window.

1. **Close** – Close the tooltip
2. **Asset Name** – The Asset name as defined on the Manage > Devices page.
3. **IMEI Number** – Device IMEI or 'International Mobile Equipment Identity' (a unique 15 - digit identifier assigned to the tracking device)
4. **Make** – The aircraft manufacturer
5. **Model** – The aircraft model
6. **Serial** – The device serial number
7. **Product** – The tracking device model.

### 3.3.3 VIEW QUICKNAV IN GOOGLE EARTH

1. From the SkyRouter screen, select the **Google Earth** icon (see **Figure 15** and **Figure 16**).

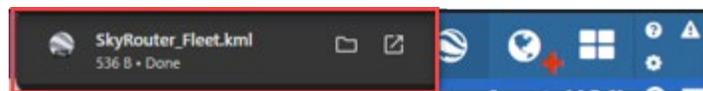


**Figure 15: SkyRouter Map – Icons Upper-Righthand Corner**



**Figure 16: Google Earth Icon**

A **KML** file pop-up window (link) displays at the top of the map adjacent to the Google Earth icon (see **Figure 17**).



**Figure 17: KML File Link**

2. Select the **KML** file link (see **Figure 17**)

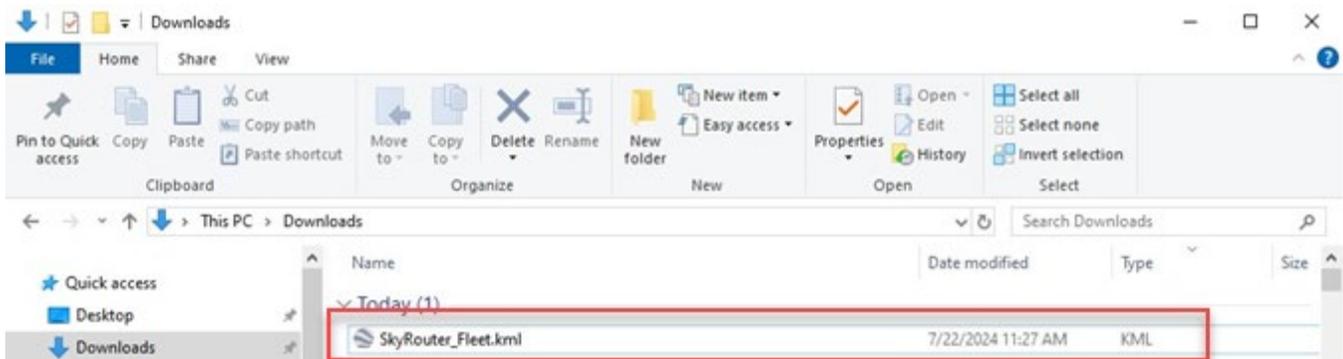
File Explorer displays.

3. Select the **Download** folder in Explorer.

A list of downloaded files display.

4. Optionally, user can change the *refresh interval* between 1 to 55 seconds.

- a. Right click to edit on the **SkyRouter\_Fleet.kml** file (see **Figure 18**).
  - b. Locate these two rows.
    - i. `<href>https://test.skyrouter.com/BsnWebApi/kml/live/data?refreshInterval=55</href>`
    - ii. `<refreshInterval>55</refreshInterval>`
  - c. Update the integer value to 1 for the fastest updates.
  - d. Save and close the file in XML format.
5. Double-click the **SkyRouter Fleet.kml** file to view the asset in Google Earth.



**Figure 18: SkyRouter Fleet.KML File**

Google Earth displays with login screen (see **Figure 19**).

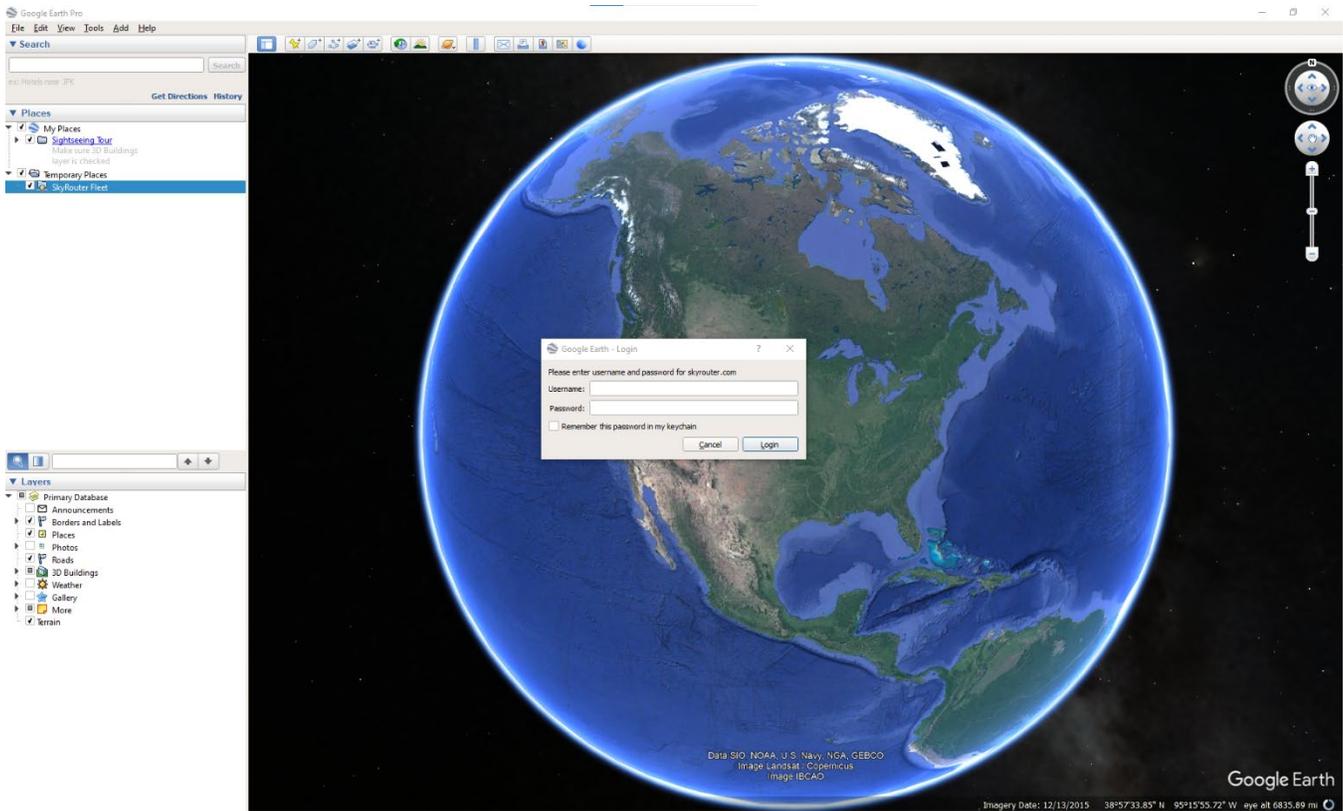


Figure 19: Google Earth Login Screen

6. Enter your username in the *Username* field.
7. Enter your password in the *Password* field.
8. Select **Login**.

The *Login* popup window no longer displays.

9. Zoom to the QuickNav location (see **Figure 20**).

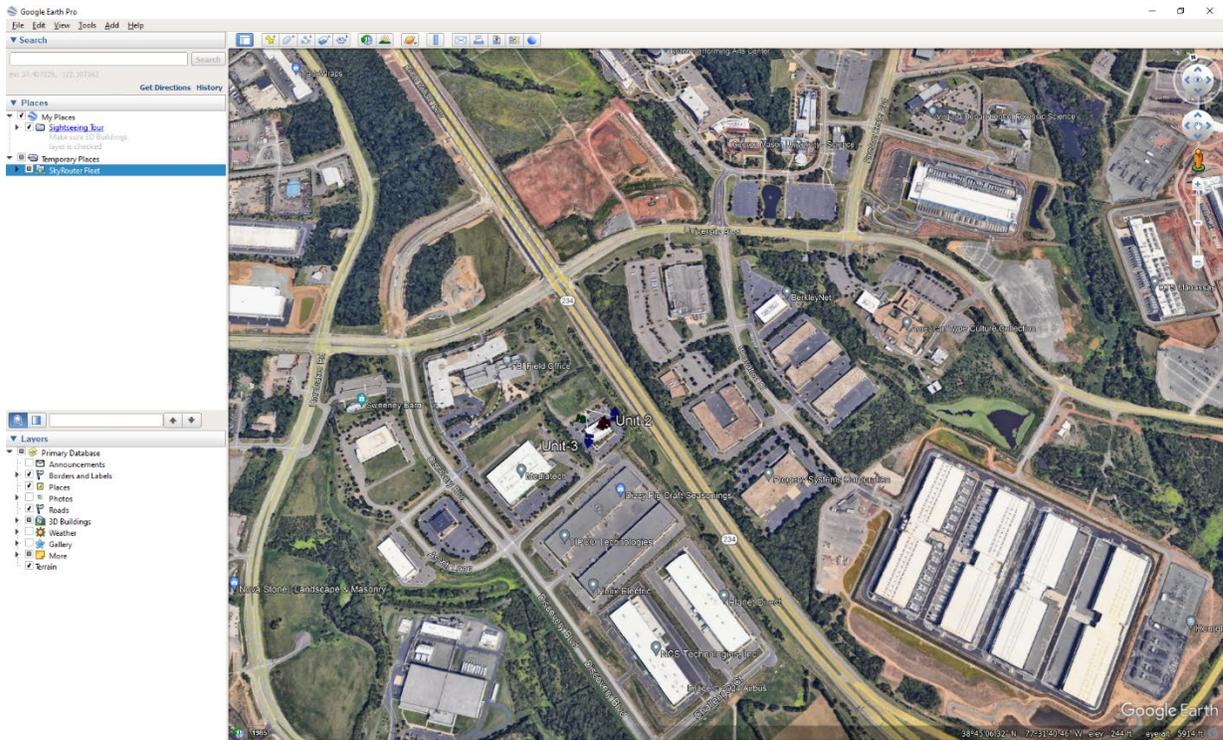


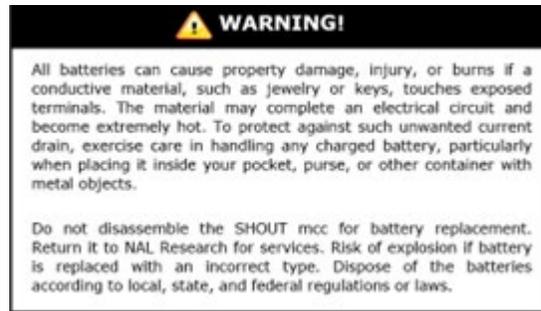
Figure 20: Google Earth – QuickNav

### 3.4 HOW TO REPLACE QUICKNAV BATTERIES

QuickNav uses two (2) non-rechargeable CR123A batteries, which mount inside the QuickNav enclosure. Before replacing depleted batteries with fresh new batteries, verify them with a battery tester. NAL recommends the following vendors when buying new CR123A batteries:

- Panasonic CR123A
- FDK
  - CR17335E-R
  - CR17335EG
- Energizer 30039800100635

**IMPORTANT! You will need to replace the batteries when the Power LED blinks with a fast dim followed by a slow brightening as this is an indicator of battery end-of-life. The life expectancy of the CR123A batteries is approximately 45-60 minutes of continuous usage.**



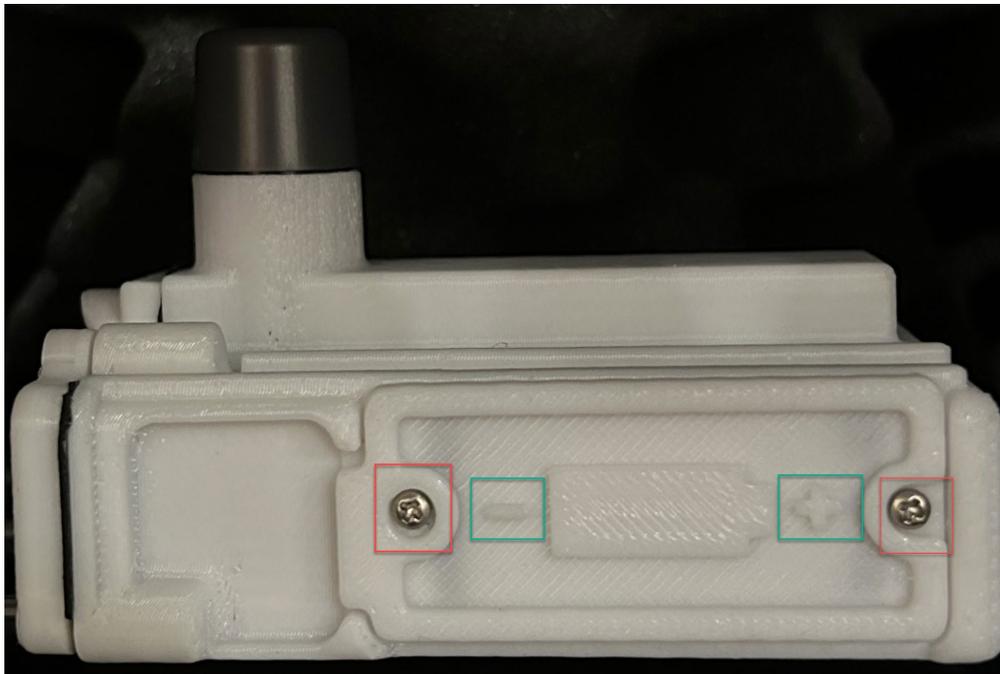
1. Verify freshness of the replacement CR123A batteries using an appropriate battery tester.

NOTE: A battery is considered fresh, if a single cell open circuit voltage is  $>3.2V$ .

2. Verify QuickNav is powered off and the LEDs not lit.

3. Remove the battery cover by unscrewing two (2) thumbscrews (see **Figure 21**).

NOTE: Battery Polarity (+/-) is noted in the green boxes, and Battery Cover screws are noted in Red boxes (see **Figure 21**).



**Figure 21: Battery Cover/Polarity**

4. Remove the two (2) CR123A batteries from the battery case (see **Figure 22: Opened Battery Case**).



Figure 22: Opened Battery Case

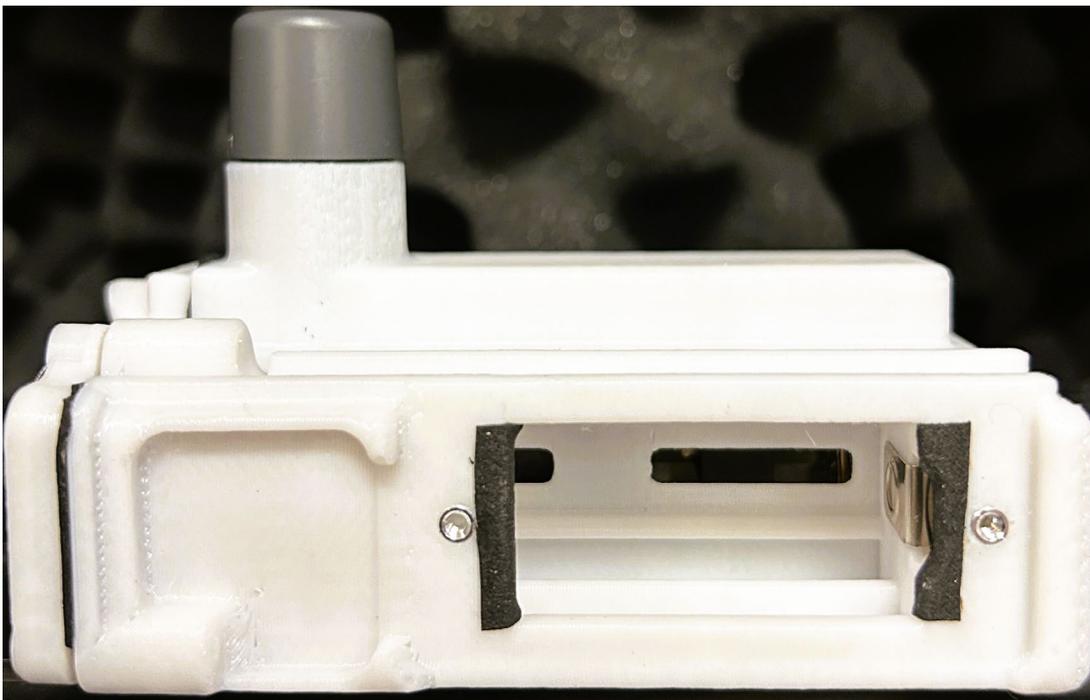


Figure 23: Empty Battery Case

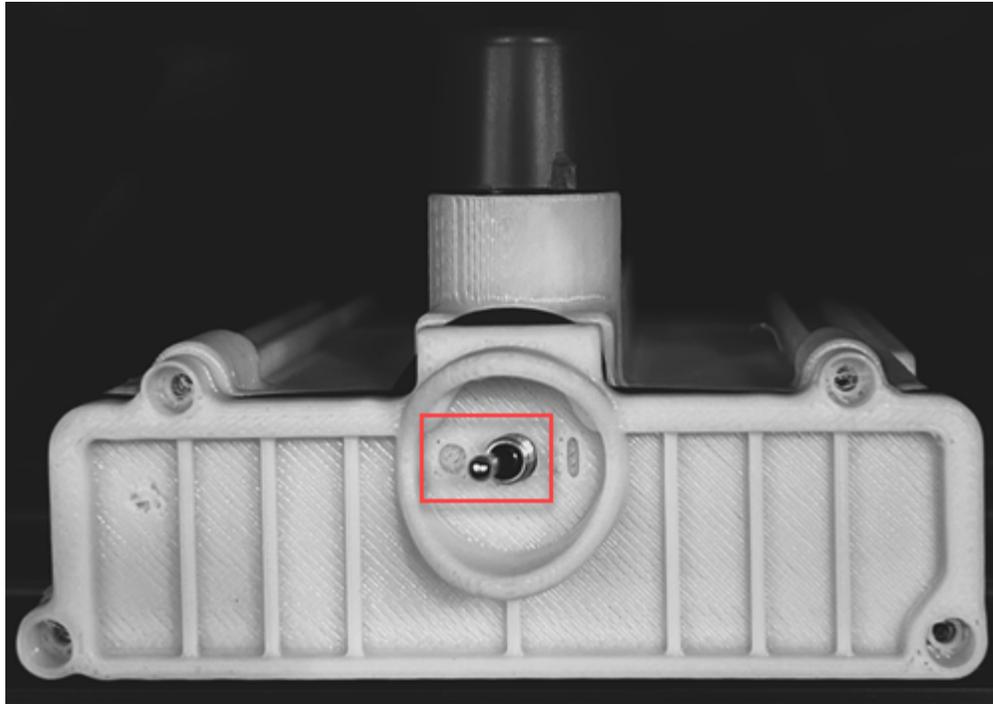
5. Insert two (2) CR123A fresh tested batteries into the battery case ensuring the polarity (+/-) is correct (see **Figure 24**).

NOTE: The polarity (+/-) displays on the Battery Cover (as shown in **Figure 21**).

6. Re-install the cover using the thumbscrews battery cover.

NOTE: QuickNav has polarity protection. If fresh batteries are inserted and it does not power on, check the polarity installation.

**IMPORTANT! Turn off QuickNav by toggling the power switch to off (down) position when not in use. It is recommended to use new fresh batteries for prolonged test durations.**



**Figure 3: Power Switch Down Position**