Featherweight Swift User's Manual

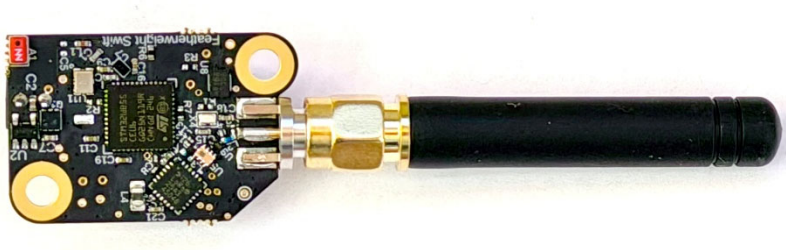
April 10 2026

Introduction

A Featherweight Global Positioning System (GPS) Tracking system consists of a tracker, which is located on the rocket or other object you want to locate, and the ground station (GS), which stays with you and forwards the long-range radio data from the tracker to your phone using Bluetooth.

Swift Tracker

Hardware Configuration and Installation



Early adopter edition Tracker

There are two slightly different versions of the Swift tracker hardware. The Early Adopter Edition units are slightly shorter, and its power terminal block faces away from the center of the board. Later units are 0.1" longer (though still shorter than the original Featherweight GPS tracker) so that the power connection is spaced farther from the GPS antenna. This allows the power wires to be routed toward the center of the board for more efficient packaging, while maintaining good GPS signal strength. The early edition mounting holes are 27.4mm center-to-center, or 24.0mm along the length of the tracker. The later production unit follows the original Tracker mounting hole locations of 1.0" apart along the length of the tracker and 0.5" apart in the width direction.

A step file for each version is available from the Swift tracking information page. The tracker mass with antenna but not battery is 15 grams.

The GPS receiver is the large, square ceramic part shown in the first photo. To receive GPS signals properly, it needs to be clear of metallic obstructions between it and the sky. The Featherweight tracking app provides information about GPS signal strength that can be used for validating an installation.

The antenna connector is an SMA (not reversed polarity). The antenna provides the best signal strength in the direction radiating from the side of the antenna, and worst signal strength in the direction pointing down the long end of the antenna. For best results when tracking, keep your ground station antenna horizontal rather than pointed in the direction of the rocket. A wire-whip antenna version is also available. The antenna performance is virtually identical to the tracker using the standard SMA antenna.

Swift Tracker Input Power

The Swift Tracker is powered through the screw terminal block. The allowable voltage range is from 3.4V to 4.5V. Voltage over 5.5V can cause damage. Carefully note the "+" and "-" polarity markings and follow them. The Featherweight Tracker can be damaged by reversing the power leads.

The recommended power source for flight is a lithium polymer, single-series battery (4.1V) with at least 150 mAhr capacity. A 400 mAhr battery is recommended. The Featherweight GPS Tracker consumes approximately 35 mA when not transmitting, and 210 mA when transmitting, for an average of approximately 76 mA. This current consumption is constant regardless of input voltage. If a 400 mAhr battery is used, that will provide around 5 hours of continuous use when communicating with the ground station. If the tracker loses contact with the ground station, it goes into an energy-saving mode. (feature planned but not yet implemented as of 4/9/2026) Battery voltage can be monitored from within the Featherweight tracking app.

Tracker LEDs

The red LED turns on whenever it is transmitting, which is once per second. The green LED turns on during packet reception. When full communication with the ground station is working properly, the tracker will flash one red flash and one green flash every second. The Blue LED flashes slowly when it is advertising over Bluetooth (no connection) and more quickly after it has a connection with the phone app.

All 3 tracker LEDs turn on at power-up during GPS initialization.

Ground Station

The Ground Station is a bridge between the tracker and your phone. It communicates to the tracker over the long-range LoRa protocol in the 915 MHz band. When it receives location data from a paired tracker, it passes that data along to your phone using Bluetooth, and also transmits an acknowledgement to the tracker over LoRa, so that the tracker can know it was heard.

Ground Station Power

Turning the Ground station on and off is now accomplished with a durable push button on the front panel. Push it once to turn it on. To turn it off, hold it down until all the LEDs light up, then let go.

The ground station ships with an 800-100 mAhr battery installed. The battery is charged via the USB-C connector. The internal battery's connector is accessible through a sliding battery door, though access shouldn't usually be necessary. Be sure to have a battery connected whenever the ground station is turned on. The charger provides approximately 300 mA to the ground station for charging and operation, so it can take approximately 3-4 hours to fully recharge a depleted 1000 mAhr battery.

The Swift ground station now has a second battery charger built in, with an external connector through the front panel. This is to make it convenient to charge a tracker battery from the same USB-C power input. Note that some batteries with JST 2mm plugs have the opposite polarity, so if you purchase a battery from a 3rd party, be sure to carefully compare the wire color to the wires on the battery that comes with the enclosure.

Both battery chargers have dual-color LEDs to indicate charge status. When power is connected, the red and green LEDs turn on together to make orange. When a battery is connected and charging, the red (green for Early Adopter edition) lights up. It changes to green (red for Early Adopter edition) when charging is complete.

USB-C data connection

The charging and data connection has been upgraded to USB-C, and the serial text output is much improved, with no raw binary output.

Ground Station LEDs

The Ground station has red, green, and blue LEDs in addition to the charge status LEDs. The red LED turns on whenever it is transmitting, which is once per second. The green LED turns on during packet reception. If a ground station starts to receive a packet but the transmission does not complete because of a LoRa radio drop-out, the green LED will stay on until it's time to listen for the next packet. When full communication with the tracker is working properly, the ground station will flash one red flash and one green flash every second. The Blue LED flashes slowly when it is advertising over Bluetooth (no connection) and more quickly after it has a connection with the phone app.

All 3 tracker LEDs turn on at power-up and when the power button has been held down long enough to turn the ground station off.

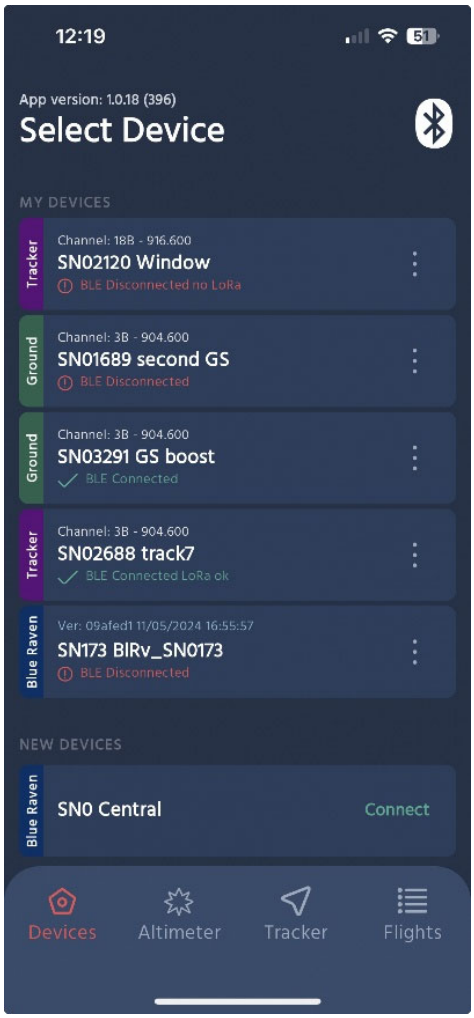
Featherweight User Interface Phone App

The Featherweight UI can be downloaded from the Apple or Google Play app stores and searching for "Featherweight UI." This is the same app that is used for other Featherweight Bluetooth-enabled products, such as the Blue Raven and Blue Jay altimeters.

Important note about firmware for the Swift early adopter edition

As of April 10, 2026, the version of the Featherweight UI phone app that supports the Swift (at least build 465) has not yet been released. It should be available soon, but you will not be able to operate the Swift until it is available. In the meantime, earlier versions of the app will not function correctly with the Swift. Do not attempt to update the Swift firmware with an older app versions, as it can only attempt to update it to a Blue Raven's firmware, which will prevent further over-the-air updates.

The Devices Screen



The devices screen displays the names and serial numbers of two lists of Featherweight devices. The devices in the New Devices list are ones that the app has discovered which you can connect to. When you are starting with a new installation, turn on both the tracker and the ground station while running the Featherweight UI app, and you should see both units in the "New Devices" list. For your devices, click on the device and select "connect" when the dialog box pops up. If you see someone else's device in the New Devices list, do not connect to it without their permission.

Once the app has connected to a Featherweight device, it will shows up in the "My Devices" list and stay there even after it has been disconnected. To remove a device from the "My devices" list, click the three dots to the right of the device and select "forget device." This also resets the Bluetooth connection to the device, which can be useful if there is a problem with the Bluetooth connection with the phone. Forgetting a device does not delete any downloaded flight data.

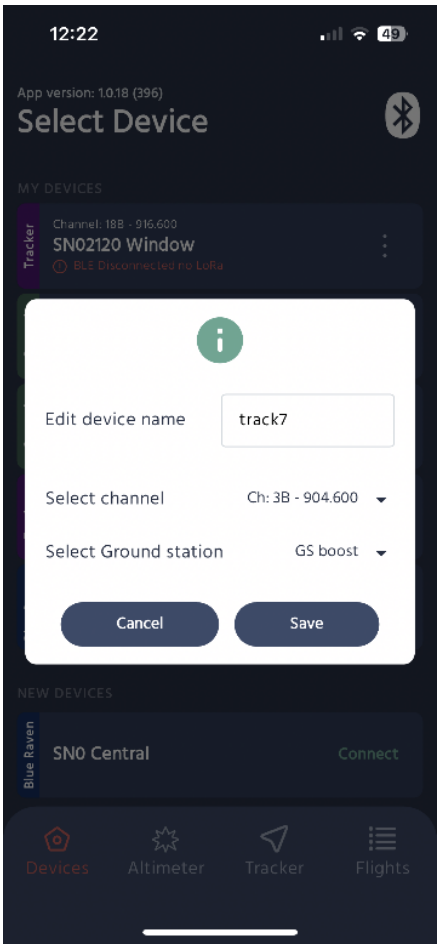
Any Featherweight device can be renamed by clicking on the three dots to the right of the device and selecting "Edit name." This does not affect the serial number, which is permanently assigned during manufacturing.

Assigning a channel to a Tracker

Featherweight Ground Stations and Trackers show their operating channel on the devices page. There are 28 frequencies to choose from, and two channels per frequency, for a total of 56 operating channels. The channel is assigned to a Tracker unit, and the Ground Station is assigned to follow the channel of a tracker. To change the tracker's channel, click the three dots to the right of the Tracker in the devices page, select "Edit" and select a channel if you don't like the one that was randomly assigned before shipment. Here you can also change the name of your tracker. This name will be used in voice telemetry call-out and will show up for other Featherweight users. You should also select the ground station that you want to use for this tracker if it's not selected already. Click "Save" to exit.

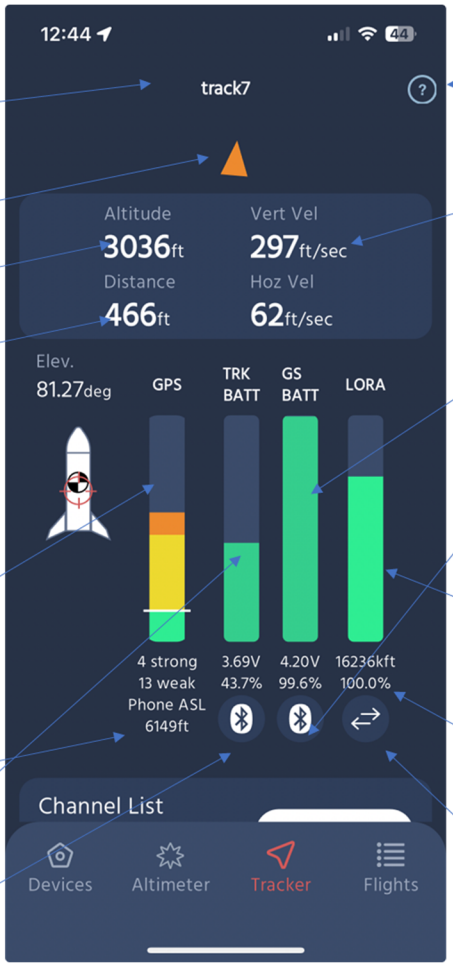
Editing the Ground Station

The Ground Station and the tracker must be on the same channel for the long-range (LoRa) radio connection to work. Click the three dots to the right of your Ground station, select “Edit” and then you can edit the name of your ground station (used in identifying ground station logs), and the tracker that it should follow. When a GS is following a tracker, changing the tracker channel will also change the channel used in the Ground Station. Click “Save” to exit.



The Tracker Main Screen

To see the data from a Tracker, click on the tracker in the Devices page, or click the “Tracker” button at the bottom. If you have more than one tracker or even multiple pairs of Trackers/GS, you can select the tracker you want to watch from the devices page.



User-entered Tracker name. Edit the name or select a different tracker to watch from the Devices page.

Live pointer points to your rocket no matter how your phone is oriented

Rocket altitude above the ground

Rocket distance along the ground

Rocket elevation angle in the sky. The phone tilt matches the rocket elevation when the cross-hairs are aligned.

Live GPS signal strength. Signal strength of at least green or blue is needed to get a GPS lock from a cold start. Weaker satellites in orange and yellow can be tracked while in GPS lock.

Altitude above sea level of the phone. Used for computing rocket altitude above the ground

Tracker battery state of charge

Status of tracker’s Bluetooth connection to the phone. Normally disconnected at long range.

Help icon. Click here to see the tool tips for the different parts of the screen

Vertical velocity shows you whether the chute is deployed even if it’s out of sight

Ground station battery state of charge

Ground station Bluetooth connection to the phone. This bluetooth connection is needed for long-range tracking.

Relative signal strength of the LoRa radio. Should be in the green range before launch.

Available tracking range under current radio conditions. Valid when the distance between phone and ground station is at least 60 feet

LoRa connection status between tracker and ground station

Tracker pointer and elevation cross-hairs

The phone uses its built-in magnetic compass and gyroscopes to calculate how the phone is oriented, and it uses that information to generate the orange pointing arrow and the red cross-hair that are used point to the rocket real-time. The orange arrow shows the azimuth toward the tracker, and turns green when the phone is pointed within a few degrees of the tracker azimuth.

For best pointing accuracy, make sure the phone is away from permanent magnets. Sometimes the iron of a vehicle can also disturb the compass function, so if spurious pointing results are seen, try again from outside the vehicle.

The cross-hairs indicate the tilt angle of the phone. When the cross-hairs are aligned with the CG icon of the rocket icon on the left, the long edge of the phone has the same elevation angle as your rocket does in the sky. This makes it easier to find your rocket in the sky if it is still in the visible range.

Current tracker position and velocity

Just below the pointer is the numeric information including the current altitude above the phone, the horizontal distance from the phone, the vertical velocity (very useful for confirming that the deployments were successful) and the horizontal velocity (ground track velocity)

GPS bar graph

The colored bar shows how many satellites are being tracked (The whole outlined box represents 24 satellites), and how strong the signal is to each satellite.

The table below explains the color code.

Color bar	Signal Strength (dB-Hz)	Signal Quality
Orange	Less than 24	Weak, can result in 10s of meters horiz. error
Yellow	24 to 32	O.k. Can track after the satellite has been locked
Green	32 to 40	Good Signal, strong enough to acquire the satellite in a cold start.
Blue	40 and Over	Very good. Acquisition possible with margin

Both the number of satellites and how strong they are can affect how accurate the GPS solution is, and how robust it is to sudden accelerations like launch. Good GPS performance will have 10 or more satellites, with about half or more of those as green or blue signal strength. Don't worry if the weakest satellites are yellow or orange; the receiver will prioritize its stronger satellites in its solution. This graph is useful for evaluating whether your rocket materials and/or paint might be reducing your available GPS performance, for example a carbon fiber airframe. If your GPS page is showing only orange and yellow signal strengths, or no lock at all, your setup is likely to lose GPS fix at launch, and may have trouble getting a fix again after launch. This can be corrected by moving your tracker in your rocket to a location that has an RF-transparent portion of the airframe, such as cardboard or fiberglass. For carbon-fiber airframes, an RF-transparent window of fiberglass can be used if the carbon fiber cutout dimension is at least 1" x 1", centered over the GPS antenna, with less attenuation for larger sizes.

LoRa Information

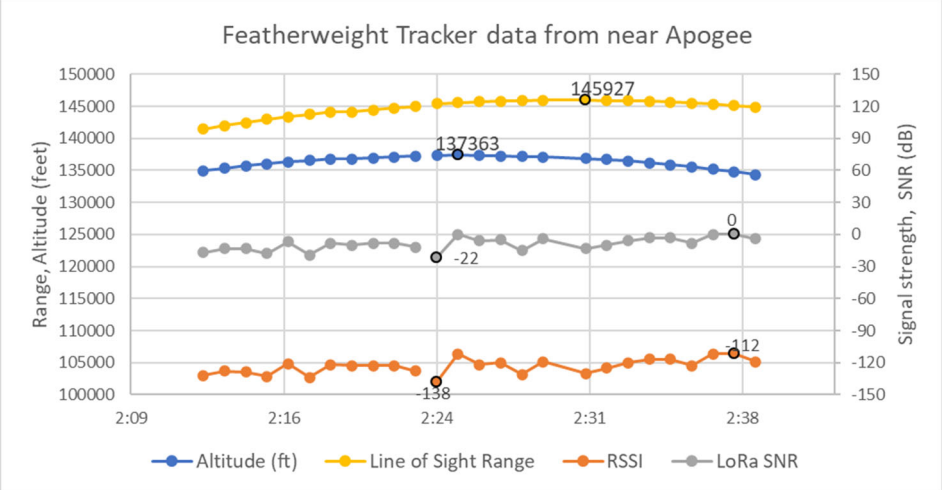
The right-most bar graph indicates the relative strength of the LoRa (Long-Range) signal between the tracker and the Ground Station (GS). When the tracker and GS are close to each other and the signal is strong, the bar graph is green. It can turn yellow or orange when the signal strength gets low due to long range or obstructions. Before launch, with a clear line of sight to the rocket, the signal strength should be in the green.

Just below the bar graph is a real-time estimate of your maximum tracking range, in thousands of feet. It is calculated using the current GPS-based distance between the GS and tracker, and the measured signal strength. It converts the signal strength margin into a ratio of how much farther the GS and tracker can be compared to how far they are, while still transmitting data. For this measurement to be valid, the GS and tracker have to be far enough apart (> 100 feet) for the normal GPS location errors to

be insignificant. This information can be very valuable for identifying antenna or interference problems before flight, and for evaluating configurations where antenna performance is intentionally compromised for packaging benefits. When the system is at the maximum range, the fraction of packets that are successfully transmitted will drop, but should still stay above 50%.

A small hand-held yagi antenna can add around 6-8 dB to this budget, which translates to a factor of 2-3 in available range. However, for all but the highest of amateur flights, the included stub antennas are sufficient.

As an example, a Featherweight GPS tracker was used to track a rocket to over 137,000 feet altitude and 145,900 feet total range in September 2017 above the Black Rock Desert using just the standard stub antennas that are included with the standard products, as shown in the plot below.



Standard output power and standard stub antennas were used at both ends of the link, and the tracker installation configuration (duck taped to a central threaded rod inside the nosecone) was far from ideal. Even so, the signal strength information indicated that there was still substantial margin available for even longer range, even out to the edge of space (100 Km). As long as there is a clear line of sight between you and tracker, your Featherweight GPS Tracker will have enough range to communicate. After landing, however, it is common for the signal to be lost because of terrain interrupting the line of sight. In these cases, just track to the last location and the signal can be automatically re-acquired. The Featherweight GPS system is unique in providing another way to receive your rocket's landed location, even over the horizon: The lost rocket feature which is described later.

Below the LoRa maximum range estimate is the packet success rate, expressed as a percentage, based on the last 50 packets. It's normal for the success rate to be less than 100%

Below the packet success rate percentage is the LoRa connection status icon. When the GS and tracker are correctly configured, the status icon is a 2-way arrow as shown in the example. This indicates that the tracker packets are being received by the ground station, and that the ground station's acknowledgement transmissions back to the tracker are being received. One arrow indicates that the tracker is not receiving or accepting acknowledgement packets from the GS, and the tracker

configuration should be updated in the Devices page to select the GS that is in use. Two-way communication is necessary for the tracker to know that it is being heard, to avoid going into the lost rocket mode unnecessarily.

Tracker and GS battery and Bluetooth status

The tracker and GS battery voltage and Bluetooth connection status are each shown in the middle of the screen. The battery voltage is shown with a bar graph as well as a voltage and state of charge percentage underneath the graph.

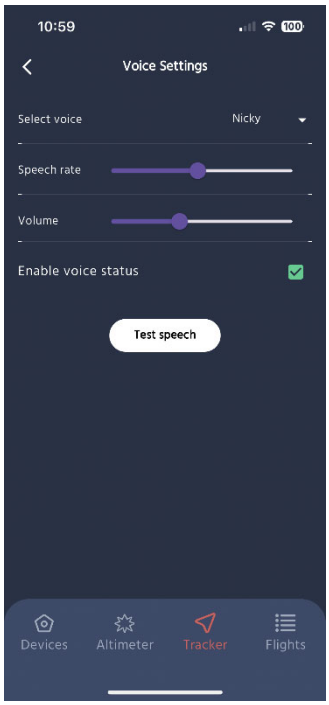
Below the battery voltage information is the Bluetooth connection status. The Ground Station should always be kept nearby to the phone when it is on, so that it can always be connected to the phone over Bluetooth for relaying data from the Tracker. The Bluetooth connection from the phone to the tracker is not necessary except for configuring the tracker and downloading recorded data, and it is normally out of Bluetooth range once you leave the rocket at the pad.

Spoken voice launch readiness status

Clicking in the middle of the main tracker screen prompts the app to provide the launch readiness status in spoken form. If the tracker, GS, LoRa connection and GPS status are all nominal, app will say that the rocket is go for launch. If there is a problem, the spoken status will let you know what it is. This feature is also a useful way to make sure that your phone is ready for voice telemetry during the flight, with silent mode off and the volume voice settings the way you want them.

Voice settings

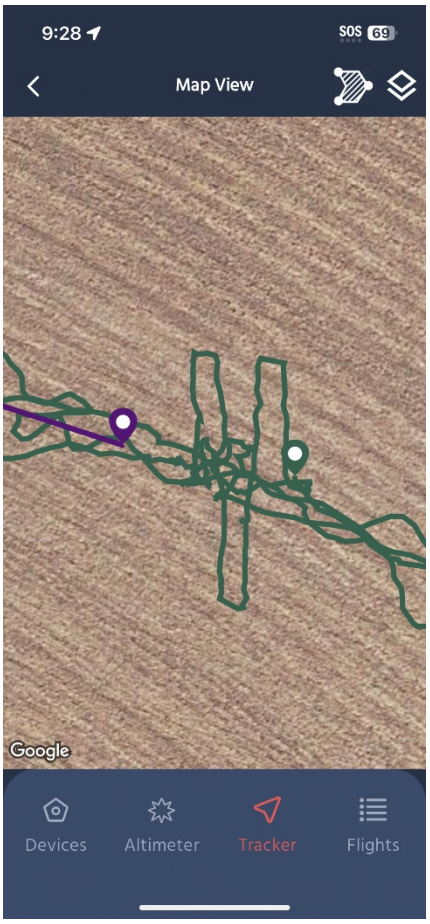
Click on the “Voice settings” button and you can customize the voice, volume, and even the speech rate. Here you can also disable the voice status.



Map View

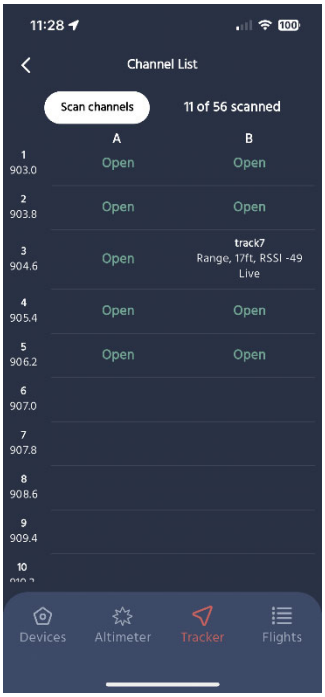
Click on the “Map View” button and the app will show the location of your ground station(s) and tracker(s) on a Google Maps view. Your location with the ground station is shown in green, and the tracker is shown in purple. Click on the marker and the latitude and longitude are displayed, along with an icon that copies those coordinates. If you want to delete a track, just click on it and a dialog box will pop up asking to confirm the deletion. The layer button in the upper right will toggle between satellite view and road view.

The ground station and tracker ground tracks are both shown on the map, which can make it easier to find the tracker, even in a case where the tracker is destroyed on impact after a deployment failure. In the images below, a stuck nosecone resulted in a ballistic impact with a plowed field. The purple line shows the location of the last tracker packet, just before impact. The green lines show the search pattern that was used to find the rocket, and the green marker shows the impact location.



Channel List and Scanning Feature

Click on the Channel List button, and the channel list will appear. The channel list shows all the channels, with the tracker names populating the active channels. Click the “Scan channels” button to use your ground station to listen to each of the channels and determine if they are used or unused. Channels that have been scanned as unused have the green “Open” label.



You can click on an active channel that’s not your own to monitor that channel in a listen-only mode. Click on your own tracker in the devices page or in the channel list to get your GS to listen to your own tracker again in 2-way mode.

Flight Simulation (not yet implemented for the Swift as of 4/9/2026)

The Featherweight GPS Tracker system includes a flight simulation capability that allows you to try out the tracker, ground station, and the phone app in a flight-like way without actually flying your rocket. On the main tracker page toward the bottom, click the Start Simulation button to bring up the simulation launch conditions. Default values are shown in the screen capture to the right, which result in a simulated flight of about 4000 feet.

Click the Start Simulation button to simulate the start of the launch. This commands the tracker to run an internal simulation of the flight, adding the vertical and horizontal velocity and position to its real position, and recording the flight internally as it would do for a real flight. If the phone is set up for voice telemetry, the telemetry call-outs will happen the way they do in a real flight.

After the flight, the phone app will automatically download the data that is recorded on-board the tracker at 10 samples per second (vs. 1 sample per second that is transmitted live and recorded in the ground station logs). That data can be exported like a regular flight, including the .kml file that shows the flight path in 3D in Google Earth. (tip: If you have downloaded Google Earth Pro, you can double-click on the .kml attachment to automatically bring up the 3D view of the flight in Google Earth)

Featherweight Lost Rocket Relay

The Featherweight GPS tracking system offers a unique feature. When a rocket lands beyond the line of sight to the ground station, because of terrain features or the Earth's curvature, LoRa communication is blocked, and the user would need to go near the location of the last in-flight packet to re-establish communications. However, a Featherweight GPS tracker can send its location data via other rockets that are in the air, over a common lost-and-found channel, and the airborne tracker can forward the location back to the owner's ground station.

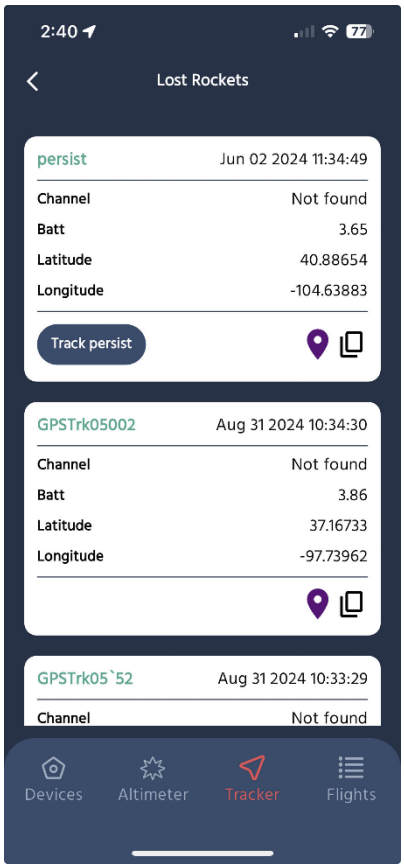
A GPS tracker goes into lost rocket mode in the following conditions:

- Launch and landing are detected (see onboard data logging section)
- No ground station acks received by the tracker for 5 minutes after landing
- No Bluetooth communication for 5 minutes after landing

Lost trackers extend their battery life by using a special wakeup sequence. A lost tracker will wake up, wait a few seconds for GPS lock, transmit once on its paired channel, listen for a response, then transmit once on the lost rocket channel before going back to sleep. The sleep mode duration starts out at 8 seconds, and gets progressively longer as time goes on, up to about 1 minute after a day.

As an example, let's say you launch your rocket and it lands over a ridge, where no direct communication back to your ground station is possible. Five minutes after landing, it will start transmitting on the lost and found channels. When another Featherweight user launches their rocket, it

will quickly get high enough to have a direct line of sight to your rocket, and it will easily be able to receive your lost rocket's location. Then it sends all of its normal data together with the lost rocket location and other information back to its ground station. The ground station transmits this information back to the other Featherweight ground stations, at the launch site, including yours!



Clicking on the "Lost Rockets" button on the tracker page brings up the screen shown toward the right. For rockets that are in your devices list, there is a button to track to the lost rocket location. You can also copy the coordinates or view the location in the map view.

How the Featherweight network works

While the Featherweight GPS tracker system works great on its own, it also offers unique benefits at launch events when it automatically coordinates with other Featherweight users. This coordination takes place after each communication from your tracker to your ground station has been confirmed. The tracker transmits a packet of data to its paired ground station once each second. Then the ground station responds with an acknowledgement packet of its own back to the tracker to let the tracker know that its communication was successful. This all takes place in a fraction of a second. For the remainder of the second, the tracker and ground station both switch their LoRa radios to special dedicated frequencies used by all Featherweight users to exchange information. The tracker listens for lost rockets on a "lost and found" channel, and the ground station listens and transmits on a ground station coordination channel. Then at the start of the next second, the Tracker and Ground Station switch back to their paired communication channel.

All the ground stations listen on the ground station coordination channel except for a small fraction randomly selected to transmit. These transmissions usually contain just the tracker name and the channel being used. If a lost rocket has been found, this transmission also includes the lost rocket information.

Spoken Telemetry

The Featherweight GPS Tracker phone application provides live spoken updates for the telemetry throughout the flight. During ascent, the altitude is spoken as the rocket passes through round-number altitudes. The apogee altitude is also spoken. After apogee, the vertical velocity is spoken 3 times to provide immediate feedback about whether the apogee deployment was successful. During descent, the altitude and velocity are both spoken, so that you can tell without looking at the phone whether deployments were successful. A variety of voices and accents are available to choose from under More/Settings. Be sure to take your phone out of silent mode in order to use this feature. You can try out this feature before launch day using the simulated Flight capability or by just clicking the main page to get the launch readiness status via voice

Data Logging (not yet implemented for the Swift as of 4/9/2026)

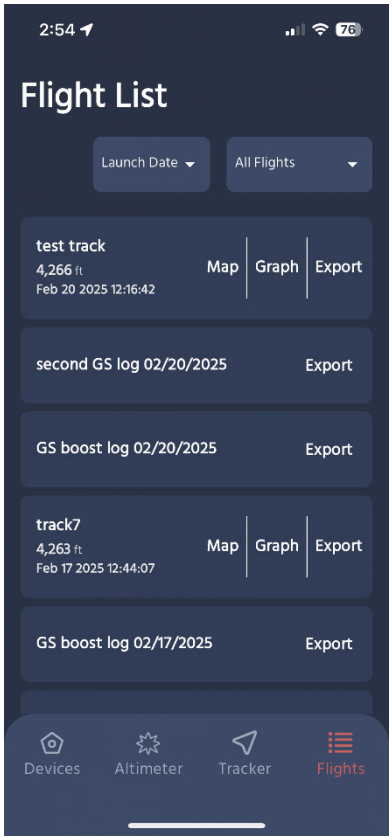
The Featherweight GPS Tracker detects launch automatically, and logs data internally from the ascent at 10 samples per second, and then after apogee, switches to 1 sample per second during the descent. This internal data records up to 6144 samples from the flight.

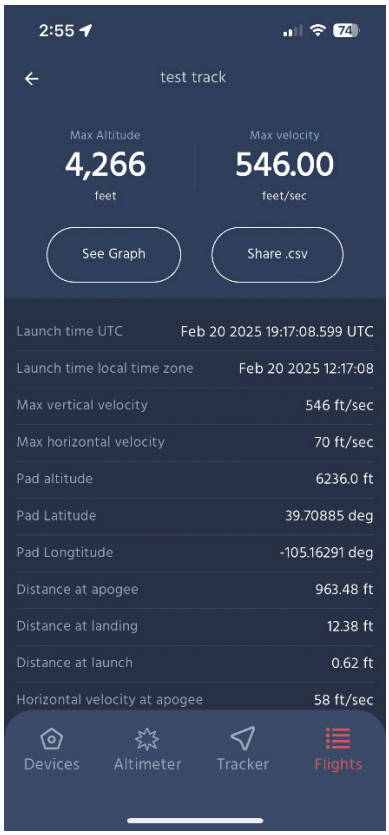
Due to storage limitations within the tracker, only the most recent flight is recorded. After landing, no new flights are recorded until either the data download is complete, or the tracker has its power cycled. The storage space used for the flight data is also used for the firmware update process, so be sure to download flight data before a new firmware update may need to be installed.

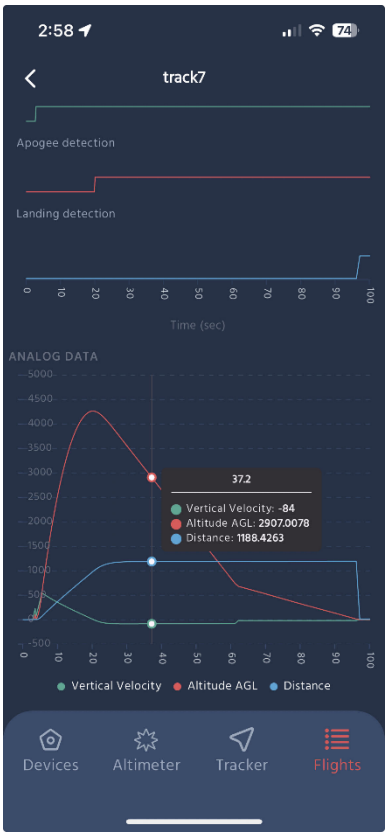
The tracker uses a sophisticated algorithm to detect both launch and landing from the GPS data, which is tolerant to potential dropouts in the GPS fix during high performance flights. Only data with a valid GPS fix is recorded in the internal data storage.

To download the internal recorded data after the flight, click on the Flights icon at the bottom of all the screens.

Clicking on a flight brings up a screen with flight summary information. You can also click on the graph icon to bring up a plot of the data. Click on Parameter Selection at the top to select the different traces that you are interested in. Clicking in the middle of the graph will display the numeric values of the selected traces at that time. You can zoom in on the time of interest using 2 fingers in the analog graph area and then the flight events will follow the same time scale.







The flight data logging is approved by Tripoli records committee for use in Tripoli altitude records. It includes the following data:

- UTC Time
- UNIX Time
- Altitude (ASL, Feet)
- Latitude
- Longitude
- Total number of satellites
- GPS location fix flag
- Horizontal velocity (feet/second)
- Vertical velocity (feet/second)
- Heading (degrees from North)
- GPS quality flags
- Number of GPS satellites with > 40 signal strength
- Number of GPS satellites with > 32 signal strength
- Number of GPS satellites with > 24 signal strength
- LoRa radio signal strength of ground station ack packets
- Tracker battery voltage
- Altitude above ground level
- Launch detection flag
- Apogee detection flag
- Landing detection flag
- Horizontal distance

Troubleshooting

Ground station is resetting every few seconds

1. Make sure that a battery is connected to the internal battery connector, accessible through the battery sliding door. It needs battery power, and not just a USB connection, to transmit acknowledgements back to the tracker.

Units not seen in My Devices list or New Devices list

1. Make sure that both units are powered. Verify by watching for LEDs. The tracker red LED should flash once per second and the GS will flash both LEDs every 45 seconds even if it's not receiving data from a Tracker.
2. Verify that the phone's Bluetooth is on (look for the black Bluetooth icon in the upper right of the screen).
3. Make sure that no other phone or app within your phone is using the connection. If you have the older iFIP app, make sure that it is not running in the background. Make sure that no one else in the vicinity has connected to the device (it can only connect to one phone at a time)
4. Make sure that the phone is within ~30 feet of the units and they aren't sealed inside a metallic or carbon fiber airframe.

, or a device in the My Devices list shows BLE disconnected

Tracker is on but shows “no LoRa” in the devices list

1. Make sure that both devices are on the same channel. At least one GS should have that tracker selected in the GS edit screen, available in the devices page.
2. Make sure both units have antennas connected
3. Make sure that the tracker does not show up on the Devices screen as a ground station. If it does, click the three dots and select “Change mode”. When it is in tracker mode, it will flash the red LED once per second even if a ground station is not receiving the data.
4. If the ground station is showing green flashes approx. once per second, the LoRa data link is working, so verify the BlueTooth (see above)

Units are communicating (data is updating in the tracker window) but the GPS information is grayed out

1. The GPS receiver is not getting an adequate signal. Move objects away from the antenna and move to an open location with a clear view of the sky. No metallic object should be within 0.75” of the front of the antenna or within 0.3” of the sides.
2. GPS acquisition can take up to a minute in good signal conditions, or several minutes in a location without a good view of the sky.

Units are communicating and the GPS information is showing satellites and is updating, but the direction arrow on the tracking page seems wrong

1. The GPS location in each unit has some uncertainty, and so if the units are too close to each other, the normal uncertainties can lead to large pointing errors. Try again with both units outside and at least 30-50 feet apart.
2. The pointing in the tracking page depends on the phone’s compass. Make sure there are no magnets, iron or steel near the phone (including a car) and move the phone in a figure 8 motion to get it to re-calibrate.
3. Make sure you’re using a phone that has a magnetic compass and GPS included. This is not the case for many iPads or some basic model Android phones.

Appendix A: Serial commands and data for version 2 ground stations

Version 2 of the ground station adds the capability to communicate to a computer over USB as a serial port. This data can be viewed in a terminal emulator program like putty or RealTerm, or any other software, including custom software, that can access serial port data. This feature is intended for advanced users who are comfortable working with serial data and UART protocol. The serial port settings are as follows:

- 115200 bits per second
- 8 data bits
- 1 stop bit
- No parity
- No hardware flow control

The UART serial port used by the USB is also used for communication between the LoRa microcontroller and the Bluetooth microcontroller.

Telemetry

The LoRa microcontroller sends out binary data to the Bluetooth microcontroller to pass along to the phone, and also ASCII text formatted data which is ignored by the BT microcontroller. The binary data packets, which start with ASCII FWT, are not intended to be user-accessible and should be ignored.

The formatted text packets start with a "@" sync character and start with the format of the example below:

Sync Char	Parse type	Packet Length	Year	Month	Date	Time
@	GPS_STAT	203	2020	3	16	22:44:18.419

The last entry of each packet is a 16-bit Cyclic Redundancy Check (CRC) checksum which uses the CRC-16/BUYPASS calculation. The calculation is for a text packet starting with the left most character in the packet which is the '@' symbol and up to the last non-space character before the "CRC:" data header in the text packet.

See the embedded Excel file for details of the relevant GS telemetry packets, below:

Software ICD_FW.xlsx

Commands

There are 4 commands that are available to the ground station:

command strncmp	Description	Example w arg	Example Response
set TrackerID	Sets the ID string for the hardware	set TrackerID My_Rocket01	<none>
?state	Set the flight state (00: GS default, 01-07 reserved 08: monitor (no acks) 09-10: reserved 11: Monitor only coordination channel)	?state 08	+state
?save	Saves the flight state used the next time the unit boots	?save 01	+save
set freq	Sets the frequency	set freq 915000000	RX_TMOUT packet

		2	9	4	5	3	3	19																											
GPS_STAT	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check	GPS Unit Type		Altitude ASL		Latitude		Longitude			Horiz. Velocity	Horizonal Heading	Upward Velocity		Satellite Fix Type		Total Sats	Sats >24 dB Strength	Sats >32dB Strength	Sats >40dB Strength	1st Sat Info	2nd Sat Info	3rd Sat Info	4th Sat Info	5th Sat Info		
Periodic output	Example Data:	@	GPS_STAT	203	2020	11	15	01:20:21.986	CRC_OK	TRK	secondTrk	Alt	5655	lt	39.55612	ln	-105.1032	Vel	0	-155	0	Fix	3	#	9	4	2	0	000_00_00	000_00_00	000_00_00	000_00_00	000_00_00	CRC:	6A1D
	Unit			Bytes								Feet		Decimal Degrees		Decimal Degrees		feet/sec	degrees	feet/second			Count	Count	Count	Count							hex		
										TRK	Used for GPS status of a tracker (direct connection or via GS)										0	No Fix					Satellite Triplets: Azimuth (deg) _ Elevation (deg) _ Strength (dB)								
	Notes									GS:	Used for local GPS status of a Ground Station (GS)										2	2-D Fix					Note: Any "_00" strength satellite is tied in strength with previous								
										FND	Used for GPS status of lost rocket, for arrival directly or via relay and GS										3	3D Fix													

TX_STAT	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time		APID Transmitted			Tx Airtime Duration			Spreading Factor	Frequency			
At the start of each transmission	Example Data:	@	TX_STAT	91	2019	11	27	00:16:49.800	Tx	Apid	11	Tx	dur:	371	msec.	SF12	Freq	926800000	CRC:	B4E3
	Unit			Bytes						Code				msec		Code		Hz		hex
	Notes									APID content given in APID tab										

FRST_FIX	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time		Time to first fix, msec			
After the first GPS fix per wakeup or reset	Example Data:	@	FRST_FIX	73	2020	11	15	03:10:42.478	####Time2FF:	3630	####	CRC:	5E+53
	Unit												hex

RX_TMOUT	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time					Spreading Factor		
When GS resets LoRa after Receive Timeout	Example Data:	@	RX_TMOUT	62	2019	12	17	1.70602E-05	Rx	Timeout	:(	SF:	12	CRC:	B4E3
	Unit														hex

RLY_DIST	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check		LoRa ID of sender		Relay Signal Strength		Relay delta Altitude		Relay horiz distance		EDM battery voltage		Relay battey voltage		Relay Temperature		
After receiving a packet that has lost rocket info	Example Data:	@	RLY_DIST	141	2020	2	17	32:16.9	CRC_OK	Relay:	EDM_SN06	RSSI	-14	Relay_dAlt	193	Relay_Dist:	113	ft	Fnd_mv:	4092	Rly_mV:	4812	31	degc	CRC:	6F6F
	Unit												dBm		ft		ft			mV		mV	hex			

RX_FOUND	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check	LoRa ID of sender		GS Received counter		Relay Sent counter		Signal Strength		Ack counter		Ack Sent Counter		Ack RSSI	EDM LoRa ID		EDM Received by relay Counter		EDM Sent Counter		Found RSSI		Spreading Factor			
When GS receives a packet with found data	Example Data:	@	RX_FOUND	213	2020	2	17	32:15.9	CRC_OK	FthrWt00658	PkRx	7	PkSnt	43	p_RSSI	-36	AckRx	0	AckSnt	0	a_RSSI	-50	EDM_SN06	FndRx	32768	FndSnt	1775	f_RSSI	-14	SF	11	f	907000000	CRC:
	Unit															dBm						dBm							dBm					

RX_NOMTK	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check			LoRa ID of sender		tlm Packets Received		Tlm Packets Sent		Rx Signal Strength		Rx SNR		Ack Receive Counter		Ack Tx counter		Ack RSSI		Ack SNR		Spreading Factor		Frequency		Tracker Batt V	Relay Temperature			
LoRa info from Tracker packet reception	Example Data:	@	RX_NOMTK	202	2020	6	17	50:56.9	CRC_ERR	Rx	NomTrk	RLY-19-Whip	PkRx	143	PkTx	38	RSSI	-124	SNR	-20	AckRx	0	AckTx	0	RSSI	-50	SNR	+0	SF	11	frq	908599976	trk_B_V	4102	-69	C	CRC:	EFD0
	Unit																																					

RX_COORD	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check			LoRa ID of sender		Rx Signal Strength		Rx SNR		Spreading Factor		Coord Freq		
Received channel coordination data from other nearby GS	Example Data:	@	RX_COORD	121	2020	11	15	08:49.7	CRC_OK	Rx	GS_Coord	secondTrk	RSSI	-115	SNR	-5	SF	:07	freq	925600000	CRC:	428A
	Unit																					

RX_CRDFD	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check			LoRa ID of sender		Rx Signal Strength		Rx SNR		Spreading Factor		Coord Freq		
Received found rocket data from other GS	Example Data:	@	RX_CRDFD	123	2020	11	15	08:51.6	CRC_OK	Rx	CoordFound	secondTrk	RSSI	-115	SNR	-5	SF	:07	freq	925600000	CRC:	FA92
	Unit																					

GS_COORD	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check	LoRa ID of occupied Channel		Channel		A (even) B (odd)		Coordination text string		
channel coordination data from other nearby GS	Example Data:	@	GS_COORD	96	2020	11	15	0.131130822	CRC_OK	secondTrk	Ch	11	odd:	1	PSA:	Tst_PSA	CRC:	767
	Unit																	

COORDFND	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	CRC Check			LoRa ID of lost rocket			Found Rkt Batt V	Tlm Packets Sent	
Received found rocket data from other nearby GS	Example Data:	@	COORDFND	99	2020	11	15	0.131153171	CRC_OK	Lost	Trk	lostexample	Found!	Fnd_mV:	4123	CRC:	AE4D
	Unit																

FS_CHNGE	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time		Change Type			New State		
Response to a valid flight state change command	Example Data:	@	FS_CHNGE	81	2020	1	15	59:54.1	New	commanded	flight	state:	0	CRC:	4777
	Unit									commanded or automatic					hex

BATT_BLE	Field Description:	Sync Char	Parse type	Packet Length	Year	Month	Date	Time	Battery Voltage	BLE Status	Module temperature				UART Packet CRC
Response to status update from BLE module	Example Data:	@	BATT_BLE	68	2020	5	17	0.176433519	4189	BLE+	36	degC	CRC:	3176	6C19
	Unit								mVolts	+ = connected	deg C				
										- = disconnected					

?DT4 response	Example Data				
Build date and time	+DT4	Nov	7	2020	0.75674769
Frequency, Hz	Current	freq:	923000000		
LoRa Spreading Factor	SF:	7			
LoRa Bandwidth	BW:	9			
LoRa ID	lora_ID:	lostexample			
Ground Station Serial Number	GS_SN:	-928045422			
Operation Mode	opmode:	0			
Flight State	flt_state:	11			
N/A	wakeup_int:	0			
N/A	wakekup_off:	0			
N/A	saved_state:	11			
Channel A (even) or B (odd)	channel_is_odd:	1			
GPS module found	has_gps:	0			