

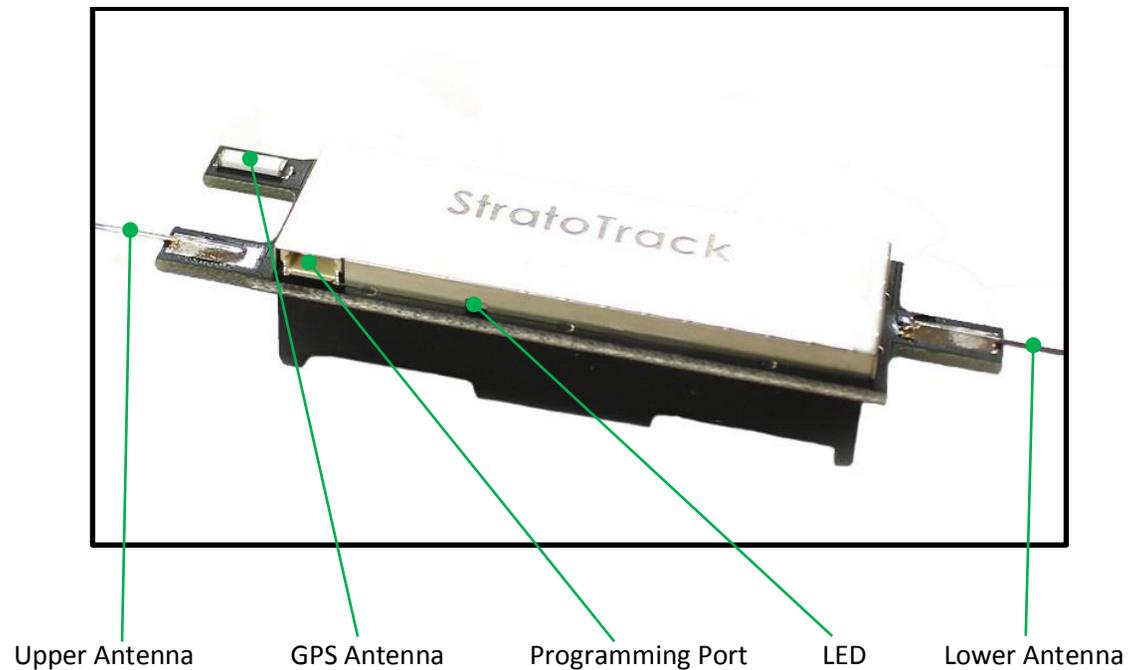
StratoTrack by StratoGear

Reliable Worldwide APRS Tracking at Any Altitude



The StratoTrack is one of the smallest and most reliable APRS trackers ever developed for the High Altitude Ballooning Community. Key features include:

1. Light weight – your StratoTrack weighs only 30 g (1 oz), including battery and antenna!
2. Small size – the entire tracker circuitry fits on the back side of a single AA battery case.
3. 20 dBm transmitter – allows for most APRS stations within line-of-sight to receive your tracker's signal. It is not uncommon to see APRS ground stations over 400 km (250 miles) pick up your signal when flying in the stratosphere.
4. Easy to use – no wiring required. Simply insert a single AA battery and launch.
5. Easy to fly – since it is so light, simply suspend it directly below your parachute on the flight line. No need to reconfigure your payload.
6. Smart frequency – your StratoTrack automatically knows what frequency to use based on its geographical location. There is no need to program the frequency.
7. Low power modes – the StratoTrack can transmit for up to one week, day and night, on a single AA battery. This allows for easy tracking of endurance flights.
8. Sensor suite – your StratoTrack has a temperature sensor for studying the upper atmosphere as well as a voltage sensor for monitoring your battery health.

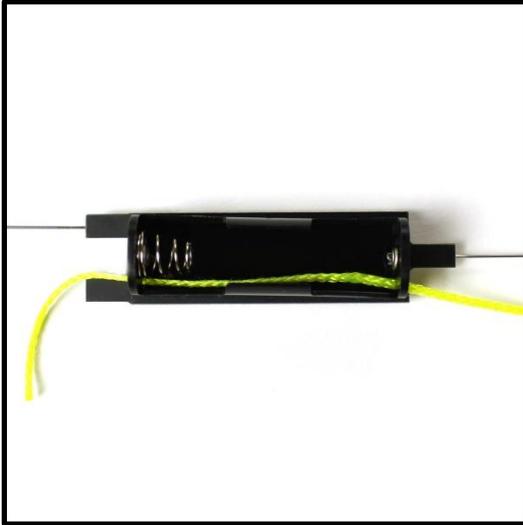


Important Operational Notes

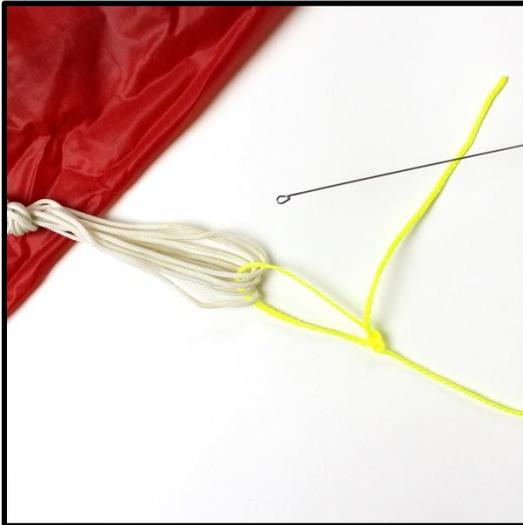
To ensure the successful operation of your StratoTrack always do the following:

1. Only use AA Energizer Ultimate Lithium batteries to power your StratoTrack. Other types of batteries cannot handle the extreme cold environment of the upper atmosphere.
2. Always mount your StratoTrack to the flight line directly below your parachute and at least 4 m (12 ft) above your payload. Mounting the StratoTrack less than 4 m above your payload will interfere with the antenna's ability to transmit efficiently. Electronics in your payload can also interfere with the StratoTrack's sensitive high altitude GPS.
3. Never suspend your StratoTrack below your payload. It will get whipped around by your payload in turbulence, damaging both your tracker and your payload.
4. Never fly your StratoTrack in any kind of precipitation. The StratoTrack is not waterproof. Any water damage will void the warranty.
5. Always verify that the StratoTrack LED has two green flashes once per TX period (every 1, 5, or 15 minutes) before launch. The first green flash indicates good GPS lock. The second green flash indicates good battery voltage. If any of these two flashes is red, do not launch.
6. Never rely on the StratoTrack to locate your payload once it has landed. Regardless of how powerful any APRS transmitter is, if it lands with the antenna on the ground in a valley away from digipeaters and IGates (APRS ground stations), your signal will not get through and you will not know the final coordinates of your landing site. We always recommend flying a satellite tracker on your payload whenever you want to recover your payload.
7. Never insert the battery backwards. Doing so may damage the StratoTrack's electronics.
8. Do not be too concerned if the antenna wires become slightly bent. Simply try to bend them as straight as possible and make sure they are pointing in opposite directions.

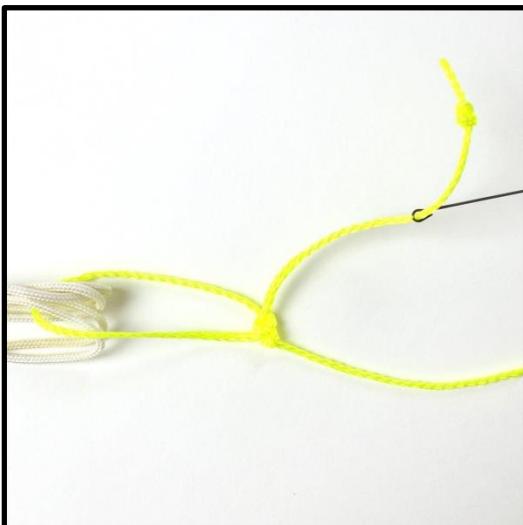
Mounting Procedure



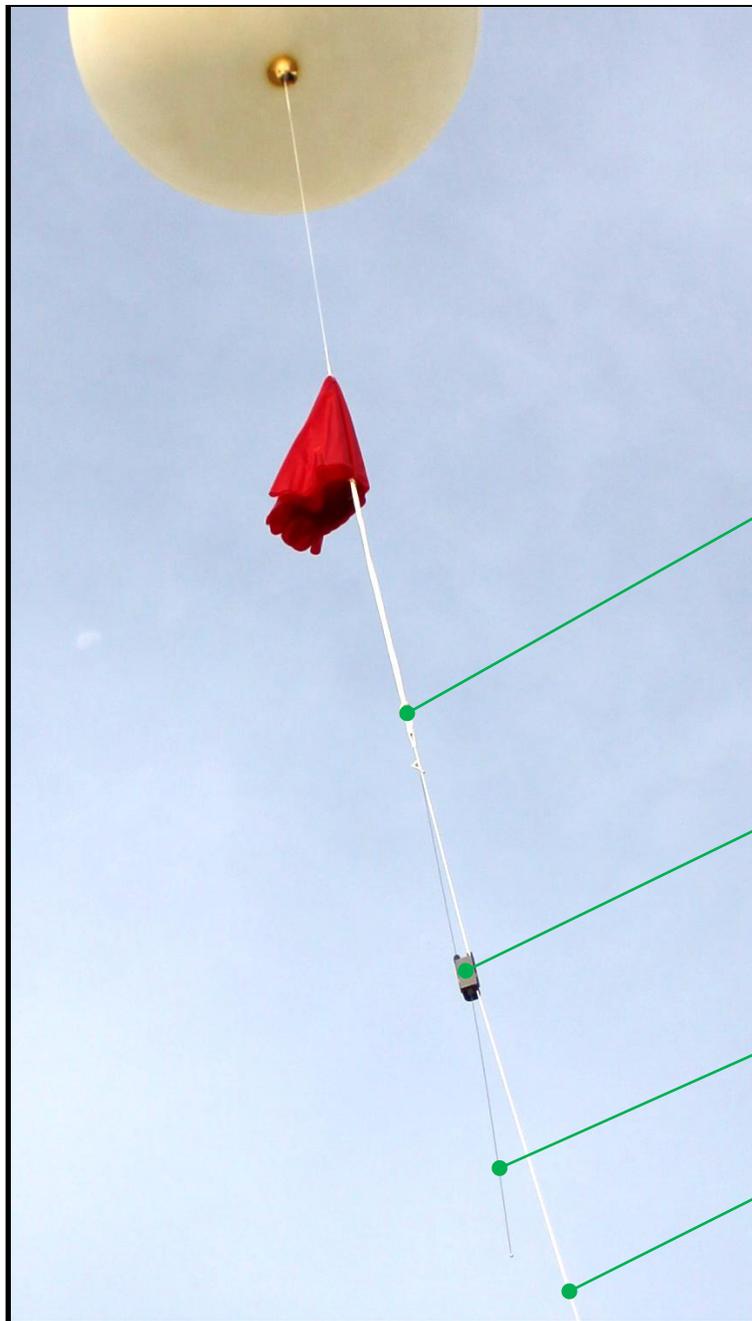
Step 1 - feed your flight line through the two round holes in the ends of the battery case. Make sure you feed it through the bottom hole first and then the upper hole (the hole by the GPS antenna). It is easiest to perform this step with the battery removed.



Step 2 - tie your flight line to the parachute riser attachment point as you normally would. Our favorite knot to use here is the bowline knot. If you normally use a swivel at this attachment point, we recommend placing it at the opposite end of the flight line (the payload end).



Step 3 – feed the remainder of the flight line through the loop in the upper antenna wire and tie a stopper knot. Our favorite stopper knot is the figure-eight knot. Make sure the stopper knot can't pull through the loop in the end of the antenna wire. If it does, use thicker flight line. This keeps the StratoTrack from sliding down the flight line towards the payload. Verify that the GPS antenna is pointing up and not down when the balloon lifts the flight line vertical.



Loop in upper antenna wire used to secure StratoTrack to parachute riser attachment point.

Flight line passing through battery case.

Lower antenna wire hanging free. Do not secure it to the flight line in any way.

Flight line continues down to swivel and payload. Distance to payload should be at least 4 meters (12 ft).

Important Mounting Notes!

- Make sure there is at least 4 m (12 ft) between the lower antenna and the payload. This allows the antenna to transmit efficiently. It also keeps the GPS on the StratoTrack far enough away from electronics on your payload that could cause interference.
- The lower antenna wire must hang freely. Never attach it to the flight line in any way (tape, zip ties, etc.). Doing so can damage both the flight line and the StratoTrack.

Operation

Power On

When the StratoTrack is first powered on (by inserting the battery), the LED will flash out the Firmware Sequence. The Firmware Sequence is a series of green and red flashes that enable you to determine the current firmware version of the StratoTrack. The number of green flashes indicates a number 1 through 9. The red flash is the decimal point. For instance, if the firmware version is 1.2, the LED would flash green once followed by a red flash, followed by two green flashes. If the firmware version is 2.3, the LED would flash green two times, followed by a red flash, followed by three green flashes.

Standby Mode

As soon as the Firmware Sequence is complete, the StratoTrack goes into Standby Mode. Standby mode lasts either 1, 5, or 15 minutes depending on the programmed TX Period (time between transmissions).

Transmission Mode

At the end of Standby Mode, the StratoTrack goes into Transmission Mode. The beginning of Transmission Mode is signaled by the LED flashing twice. The first flash indicates GPS lock. If the first flash is green, the GPS has good lock. If the first flash is red, the GPS does not have good lock and the APRS packet will not be transmitted. The second flash indicates battery voltage level. If the second flash is green, the battery voltage level is good. If the second flash is red, the battery voltage level is low.

As long as the GPS has satellite lock (first flash is green), and you have a valid callsign programmed into the StratoTrack, an APRS packet will be transmitted a few seconds after the LED flashes twice. The StratoTrack will then go back into standby mode until the end of the next TX period (1, 5, or 15 minutes).

Never launch if either of the two flashes at the beginning of Transmission Mode are red!

If the first flash is red (no GPS lock), make sure the GPS antenna has a clear view of the sky (no trees, people, buildings, etc. nearby). Also, make sure the transmitter is at least 4 m (12 ft) away from any electronics in your payload. After a few minutes the GPS should achieve satellite lock and the first flash will then be green.

If the second flash is red (low battery voltage), replace the battery before launch. The only possible exception would be if you were launching in extremely cold weather. If the Energizer Ultimate Lithium battery temperature is below freezing, its voltage may be low even if it is a fresh battery. In this case, remove the battery, warm it between your hands for a few minutes, and reinsert the battery. If the LED still indicates a low battery voltage, replace the battery. Make sure you only use Energizer Ultimate Lithium AA batteries.

Programming Callsign, SSID, and TX Period

It is currently our distributor's responsibility to program your callsign, SSID, and TX period before shipping out your StratoTrack. However, StratoGear is working on coming out with an inexpensive programming cable that will allow anyone to program their own settings.

Testing

We test each unit before shipping. As long as the LED gives you two green flashes at the beginning of each transmission and you have followed the mounting procedure carefully, paying close attention to the mounting distance between your StratoTrack and your payload, you can be confident that your tracker will connect to the APRS system once it is a few hundred meters off the ground. If you would like to do additional testing, tune any inexpensive ham radio to the APRS frequency of your region (eg. 144.600 Mhz in Europe, 144.390 MHz in North America.). Within a few seconds of the LED flashing green twice, you should clearly hear the APRS packet being transmitted. If the first flash is red (no GPS lock), no APRS packet will be transmitted.

Supported Worldwide Frequencies

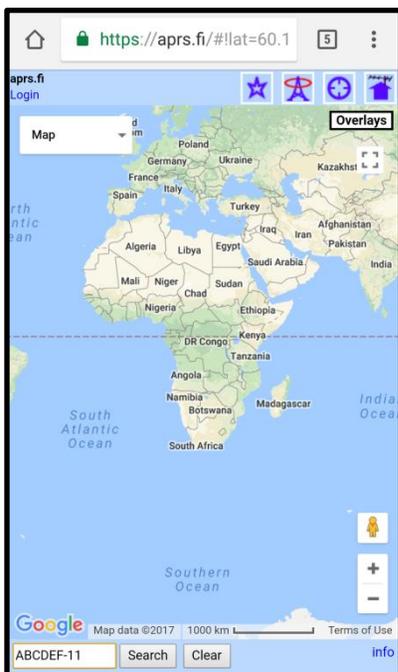
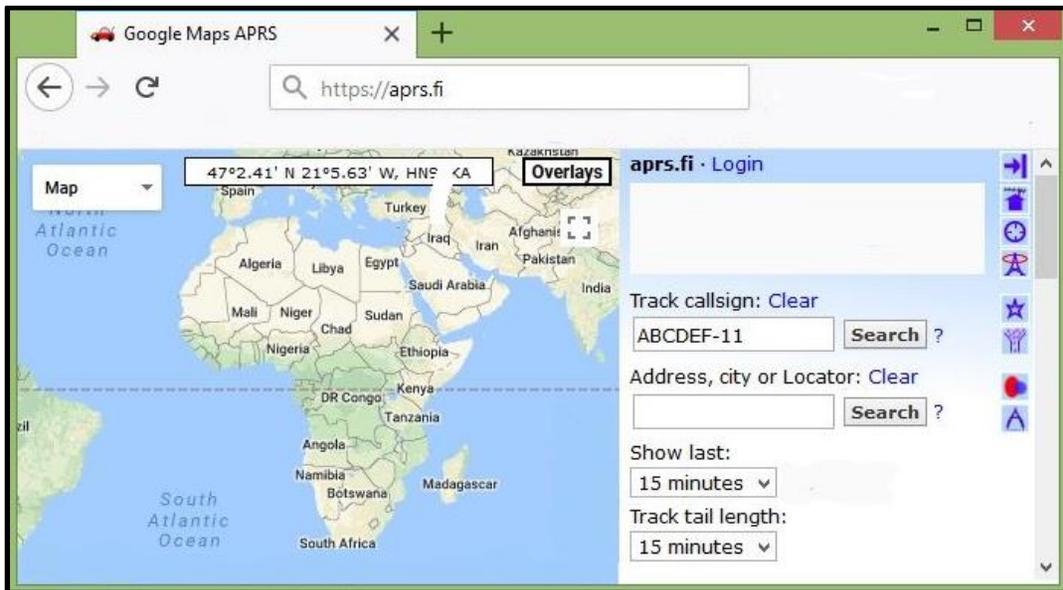
- 144.390 MHz North America, Columbia, Chile, Indonesia
- 144.575 MHz New Zealand
- 144.600 MHz Japan
- 144.800 MHz Africa, Europe, Russia, Bermuda, Azores
- 144.930 MHz Argentina
- 145.175 MHz Australia
- 145.570 MHz Brazil

Tracking

After your payload has climbed a few hundred meters and has line-of-sight to surrounding digipeaters and/or IGates, go to the following website:

aprs.fi

In the **Track callsign:** box, enter your callsign followed by the “-” symbol and SSID. For example, if your callsign is ABCDEF and your SSID is 11, enter “ABCDEF-11” and click **Search**. Your payload’s position will be displayed on the Google maps.



If you are using a smartphone, type your callsign into the box in the lower left corner of your display and tap **Search**.

Reading Your Flight Data

The screenshot below is an example of an APRS packet transmitted during flight. Each of the pink dots along the flight path of the high altitude balloon represents an APRS packet. By clicking on any of the pink dots you can read the APRS data from that packet.



- Line 1 - **2017-11-24 14:45:32** displays the date and time the packet was received by the APRS system.
- Line 2 - **48 km/h 142° alt 6169 m** displays the ground speed, direction of travel, and altitude of the StratoTrack.
- Line 3 - **,StrTrk,19C,1.48V,9,1270** displays the alias of the StratoTrack “StrTrk”, the temperature of the StratoTrack “19C”, the battery voltage “1.48V”, the quality of GPS lock “9”, and how many minutes since the StratoTrack was first powered on “1270”.

The GPS lock quality is a value that ranges from zero to nine. Zero represents a failure for the GPS to achieve lock. This will occur if the GPS does not have a clear view of the sky, if the GPS is receiving too much interference from your payload’s electronics, or if the GPS receiver experiences a sudden change in temperature (which can occur right after the balloon bursts and the payload descends rapidly through the upper atmosphere). If the value is 1, the GPS receiver has lock at least 10% of the time, if the value is 2, the GPS receiver has lock at least 20% of the time... if the value is 9, the GPS receiver has lock at least 90% of the time.

APRS Path

Because the line-of-sight footprint for a weather balloon payload flying at high altitudes is so large (typically 1,000's of square kilometers), any APRS transmitter on a weather balloon payload should either use no path (digipeaters will not repeat the packet) or at the most WIDE2-1 (digipeaters will repeat the packet one time only). If hundreds of digipeaters within your payload's line-of-sight are all trying to repeat the same packet multiple times, the APRS network within a few hundred kilometers of your payload can become overwhelmed. However, when your payload is close to the ground, either immediately following launch or just before landing, its line-of-sight footprint is much smaller. At these lower altitudes, it is advantageous to use fill-in digipeaters. To get the best of both worlds, the StratoTrack changes the path based on altitude:

Altitude	Path	Description
< 2500 m	Wide1-1, WIDE2-2	Packet repeated up to three times
2500 to 4000 m	Wide2-2	Packet repeated up to two times
> 4000 m	Wide2-1	Packet repeated up to one time.

Performance

	Min.	Typ.	Max.
RF			
RF Power Output*	19.5 dBm	20.0 dBm	20.5 dBm
Spurious Emissions	-	-40 dBm	-
Frequency Accuracy	-500 Hz	0 Hz	+ 500 Hz
FM deviation	±2.0 kHz	±2.5 kHz	±3.0 kHz
Battery Life**			
1 minute TX Period	-	24 hr	-
5 minute TX Period	-	96 hr	-
15 minute TX Period	-	168 hr	-

*Measured into a 50Ω resistive load.

** Measured using Energizer Ultimate Lithium battery and GPS with clear view of sky and no nearby electronics emitting electromagnetic interference.