

L20 Solar-Cell Tracker

User's Manual

IMPORTANT: Your L20's SIM card has been activated for a 5-year period of service. After this period, ATS will contact the customer to determine if the data period should be renewed.

Trackers ARE NOT refurbishable. Do not return trackers for refurbishment service or disposal.



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Section 1 Introduction

The L20 Solar-Cell Tracker is a lightweight, solar rechargeable, LTE-M Cellular enabled GPS tracking device. With indefinite battery life due to rechargeability, the L20 is well-suited for use in multiple longer studies.

Tracker configuration and data download is done via web browser at ATSloggers.io. Login information will be sent by ATS sales when tracker is shipped.

IMPORTANT: Your tracker IS NOT RUNNING until the attached magnet is removed. More details in Section 4.

Data service HAS BEEN activated for all shipped L20 models.

Section 2 Theory of Operation

The L20's electronics consist of a solar panel, rechargeable battery, GPS antenna, and GPS/LTE-M modem.

The tracker has a magnetic switch that is used for entering/leaving an ultra-low-power sleep mode where all schedules are paused. Blinks from the LED confirm shutdown and wakeup.

The tracker stores all location and sensor data in flash memory within the tracker's electronics. The data is periodically uploaded via the LTE-M Cellular modem, and is stored in a cloud database. During the data upload, the tracker also checks the database for any user configuration changes that were made, such as scheduling and type of data to be collected, and it updates settings accordingly. Data access and device configuration are both done within a web browser by the user.

Section 3 Using the Web Interface

All configuration and data downloads for L20 trackers are done via a simple browser web interface at atsloggers.io. This interface changes values within a cloud that the trackers connect to on each scheduled LTE session

Logging in

From any web browser, enter 'atsloggers.io' into the web address bar. This will bring up a login page, where users will enter their username/password that is delivered via email when first purchasing any L20 model.

Selecting a Tracker

The top of the webpage has a dropdown menu that gives access to all collars that are available to the user. Clicking on one of the choices in the menu populates current settings into the interface. The user is then able to select one of the three views for the tracker:

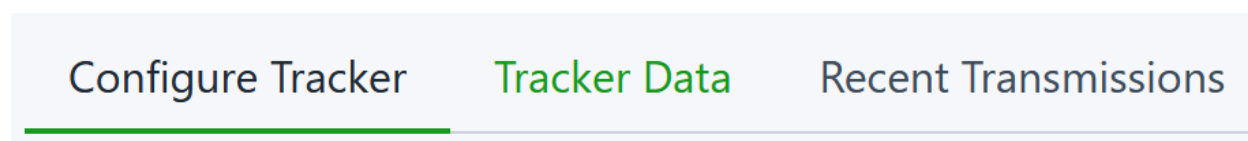


Figure 1: ATSSloggers.io page views

Configuring a Tracker

By default, after logging in, the user is brought to the tracker configuration page. This view is for changing schedule settings for the L20. The first slider changes how frequently the tracker tries to get a GPS fix. The second slider changes the interval between LTE data sessions, where the tracker sends its data and looks in the cloud for new schedule configurations.

The **Adaptive fix** switch changes the GPS fix schedule to be variable, based on battery voltage trends. The L20 will learn how quickly the battery is draining/charging over the course of several days, and adjust the fix schedule to maintain a charge of approximately 90%. The maximum and minimum fix period is 30mins/24hrs.

IMPORTANT: the user MUST click the “Save New Configuration” button for schedule changes to take effect.

Downloading Data

By clicking “Tracker data”, the user is brought to a page which gives data download options. A date range can be chosen to only retrieve data within a specific time period, or all data from the tracker can be fetched. If hhmss format is required on latitude and longitude, that can also be selected before downloading data.

Viewing Recent Transmissions

The final view that may be selected shows the recent LTE sessions and some statistics about the tracker at each event. The data shown is as follows:

- Date/time
- Number of GPS fixes sent by tracker
- Firmware version
- Battery voltage

Section 4 Interacting with the Tracker

The L20 is sealed with waterproofing material, and the only physical user interaction is with an onboard magnetic switch.

Putting the tracker in sleep mode

A magnet may be attached to the L20 over its magnet switch to put it in an ultra-low-power sleep mode. This area is marked with two dots on the tracker. Magnets that are weaker than the one shipped with the L20 may not activate the switch, so only use the provided magnet.

After attaching the magnet, the L20’s LED will blink three times to confirm that it has gone to sleep. Normally, confirmation will take a few seconds, but may take up to 3 minutes if it is attempting to find a GPS fix or connect to LTE.

Taking the tracker out of sleep mode

Taking the magnet off of the tracker will take the L20 out of sleep. Five blinks of the LED will confirm this. **On wakeup, the L20 will always attempt to connect to LTE to upload data and update settings** (provided the battery is not significantly drained). Check the table on the following page for a reference on LED blink patterns.

LED Blink Pattern Table

There are a number of events on the L20 that are indicated by LED blinks patterns, and the guide to each pattern is shown below in Table 1.

Interaction	LED pattern	Meaning
Place magnet on Tracker	3 x blink	Tracker is now in Sleep Mode
Remove magnet from Tracker	5 x blink	Tracker has left Sleep Mode
-	5x double blinks	Tracker started looking for LTE network
-	3x double blinks	Tracker successfully connected, sent LTE message
-	1 Hz short blinks	Tracker is searching for GPS
-	1 sec. blink	Battery too low to operate GPS or LTE

Table 1: LED Blink Patterns

Section 5 Tracker Functionality

GPS Operation

A GPS attempt may last as long 180 seconds but may also be shorter depending on the collar's view of the sky. In the case where a fix was not successfully found, no data will be recorded, and the tracker will continue on the schedule.

The GPS receiver specifications are shown in table 2:

Symbol	Description	Value	Unit
Sensitivity, cold	Acquisition sensitivity, cold start	-142	dBm
Sensitivity, hot	Acquisition sensitivity, hot start	-145	dBm
Sensitivity, tracking	Tracking sensitivity	-151	dBm
TTFF, cold	Acquisition time (time to first fix (TTFF)), cold start, open sky, typical	36	s
TTFF, hot	Acquisition time (TTFF), hot start, open sky, typical	1.3	s
Accuracy, periodic	Positioning accuracy (CEP50), periodic tracking	5	m
Accuracy, continuous	Positioning accuracy (CEP50), continuous tracking	3	m

Table 2: GPS receiver specifications

LTE-M Transmission Operation

The L20 has an embedded Global IoT SIM card which allows it to communicate with LTE networks in most parts of the world. To check coverage in your country, visit <https://www.hologram.io/pricing/coverage#coverage-table>. If there is a dot that indicates 4G LTE coverage in the country of choice, most cell carriers will be able to connect to the L20 there.

During an LTE transmission, the data stored in flash is sent over cell networks, and once the data is confirmed as received, it is deleted from the tracker's internal memory.

On connection to the LTE network, the tracker also reads the current configuration from the cloud that is populated by the [atsloggers.io](https://www.atsloggers.io) website. Internal timers are updated in the case of a schedule change since the last connection.

Solar charging Operation

The L20 has an onboard solar charging circuit that is able to charge the battery in both high and low-light scenarios. There are separate battery thresholds for different events within the L20, as when battery drops too low, activity is kept at a minimum in order to charge.

Cloudy conditions and dense may impact the number of LTE transmissions or GPS data points. Very sunny conditions can yield upwards of 48 fixes a day, where consistently low light conditions may only allow for 1 fix per day. The Adaptive Fix option on [atsloggers.io](https://www.atsloggers.io) is recommended to keep the tracker operational under changing light levels.

In the case of very long periods of time with little light, like hibernation, the battery will be completely cut off from the microprocessor. All sensor data is held in flash, and will be retained over the power-out period. When the tracker is in sufficient sunlight and the battery reaches a set level, the circuit will power on again and resume its schedule.

Rechargeable battery management is difficult in cold climates, where lithium-ion batteries can have issues when under load. Below freezing temperatures, the tracker is set to not attempt an LTE connection unless it is near a full charge. This is done in order to improve reliability and keep the battery from being damaged in cold temperatures.

Section 6 Attaching the Tracker

The method of attaching the L20 to an animal varies on the exact model that was ordered.

Glue-on Attachment

The Glue-on configuration is up to the customer, when it comes to choosing adhesives and location on the animal. To ensure proper operation, do not cover the solar panel, even with a clear material. Also, do not have the L20 near metal objects on the mounting, as this can detune the onboard LTE antenna.

For trackers with a whip antenna, it is possible to bend the antenna (say around the perimeter of a turtle shell), but expect some slight reduction in cell service.

Backpack Attachment

The backpack configuration has through-holes for feeding wire through, creating loops to go around an animal's limbs.

Collar Attachment

Your Collar(s) has been optimized according to the collar dimensions specified during ordering. The size of the collar is determined by the collar adjustment bracket and the main collar holes. To adjust the collar and/or attach the collar to an animal, the procedure is as follows (some differences may exist between models):

1. First remove the collar adjustment bracket nuts and plate from the collar adjustment bracket and remove the collar adjustment bracket from the main collar.
2. Wrap the collar around the animal's neck so that the extra length (if any) of the main collar is tucked inside the main collar end with the solar panels. The extra length can also be cut if desired.
3. Observe where the set of holes on the solar panel end of the main collar line up with the holes on the other end of the main collar such as to maintain a desired tension level on the animal's neck.
4. Place the collar attachment bracket through both sets of holes and through the brass bracket and tighten the collar adjustment bracket nuts using the provided nut driver. Do not over-tighten as this may damage the collar adjustment bracket.
5. Finally ensure that the case nuts have been tightened before releasing the animal.

Section 7 Warranty and Service

The model Collar(s) series collars are warranted for one year from the time of shipment.

NOTE: Collars ARE NOT refurbishable. Do not return collars for refurbishment or disposal.

Should you encounter any difficulty during configuration or operation of your trackers, please contact ATS Sales and Service at 763.444.9267 during normal business hours. This and other ATS User Manuals, as well as software, are available for download from the ATS website, at www.atstrack.com.