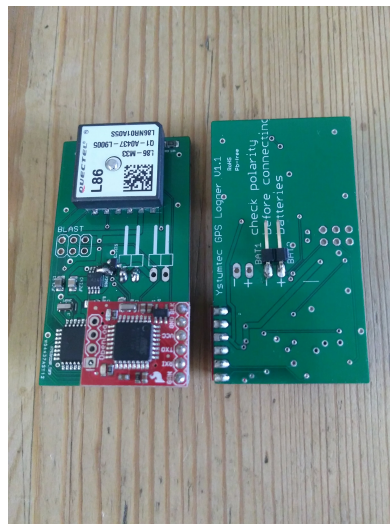# Ystumtec Ltd.

GL1: GPS Logger user guide (V1.1)

Pant y chwarel, Ystumtuen, Ceredigion, SY23 3AF, UK

April 30, 2018

1 Overview

The logger is designed to be built-in to a waterproof enclosure attached to whatever is have its movements recorded. The logger has a configurable recording rate and extremely low power consumption when standing by. The logger uses a Quectel L86 GPS module and a uSD (SDHC) card (not included) to log data to. The logging schedule is controlled by editing a text file that is saved to the uSD card and read by the logger when powered on. Three separate logging schedules to be executed periodically can be set up with time periods varying between hundreds of days to continuous

(1 second intervals). The logger is intended to provide standard accuracy GPS fixes which require a significant number of seconds for the GPS receiver to acquire and refine, so the minimum configurable time interval for a logging event is 1 minute, although continuous logging periods of up to 32,767 seconds can be scheduled. Under normal conditions with a clear view of the sky each single location logging event consumes approximately 0.15mAh from the battery. The board is intended to be powered from a single cell lithium polymer or lithium ion battery. Using a 2400 mAh battery logging one position every 15 minutes should result in a battery life of approximately 4 months. Using the same battery and logging one position per hour should result in a battery life of more than 12 months.

In order to use the logger the following steps are required:

1. Prepare a uSD card by writing the plain text files *config.txt* and *schedule.txt* as described in the sections below to the card (or insert the card provided). Any text editor such as Windows *notepad.exe* or Linux *Vim* can be used to do this.

2. Insert the uSD card into the uSD slot on the back of the small red board which is connected to the top of the logger. The contacts on the uSD card should be facing upwards when doing this. Align the card carefully and press the card in until it is locked in position. Removal of the card is achieved by pressing and releasing it, not by pulling it out.

3. Connect a single cell (1S) lithium polymer or lithium ion battery with a standard JST connector to the pins on the back of the logger. Be sure to connect the positive terminal of the battery to the positive pin.

4. Place the logger in a position where it has a clear view of the sky for 4 minutes, immediately after connecting the battery. The logger will acquire a GPS fix and then read the schedule from the uSD card and begin logging as laid out in the *schedule.txt* file.

5. That's it!

2   Physical Considerations

The enclosure (box/container) must keep the logger clean and dry and should ensure that the temperature remains between -40^oC and 80^oC. The design has been tested throughout the range -20^oC to 80^oC and functioned correctly throughout, although all components used are rated to -40^oC or lower, so it can be expected to operate below -20^oC. If the logger is intended for use at very low temperatures (less than -20^oC) then care should be taken to ensure that the enclosure, battery and uSD card used are able to operate under such conditions. The logger should also be protected from violent accelerations that are aligned with the circuit board. No calibrated testing has been carried out to quantify the effects of such accelerations, but informal tests show that the most likely failures are due to ejection/partial ejection of the uSD card. In extremely violent impacts the GPS module will tear the printed circuit pads from the PCB substrate. Significantly higher accelerations can be withstood if the acceleration is perpendicular to the surface of the PCB. The GPS antenna is the white square element at one end of the board and must not be covered or partially covered with any metallic material. Plastic enclosures that are coloured black sometimes use carbon as a colouring

agent which can also adversely affect GPS signals. Test the material/enclosure to be used prior to deployment of the logger. In general try to ensure that the GPS antenna has as unobstructed view of the sky as possible. Mounting the logger inside it's enclosure on top of the object being tracked is the best way to achieve this. Plastic enclosures such as those sold by RS and rated as IP66 are usually appropriate and sufficiently resistant to weather and mechanical shock.

3   Electrical Considerations

The sensor requires a single cell (1S) lithium ion/lithium polymer battery to be connected to the pins on the back of the board using a JST connecter. The battery should be placed within the enclosure beneath the circuit board or at least in a position which does not obscure the view of the sky from the GPS antenna. Ensure that the battery is connected with the correct polarity: the positive (usually red) wire connects to the positive symbol marked on the back of the PCB. The logger is proteced against reverse polarity connections, but it will not function if the battery is connected the wrong way around. The logger should be placed well away from sources of electrical interference such as electric motors and motor controllers. When in doubt carry out some testing to ensure that the logger is functioning as expected.

4   Schedule file format and examples

The schedule file is called *schedule.txt* and is placed in the root folder of the uSD card. The schedule file has a fixed format which contains the *base date* and the *schedules*. The base date comes first in the file and is marked with a lower-case *b* on a line on its own followed by the date considered to be the start date of the schedules on the following line:

```
b
18 04 2018
```

All of the schedules are then counted beginning from this date which may be the date of the day that the logger is powered on or a date prior to this. **Setting a base date in the future will have unpredictable results**.

Schedules are constructed to set particular days and times for position recordings to be made. Each schedule can set:

Day repeat pattern. The day repeat pattern is set by the first two numbers of each schedule. The first number sets the day, as an offset from the base date, on which to begin the schedule and the second as the day on which to end the schedule. For example setting the first value to *10* will cause the schedule to begin on the tenth day after the base date. Setting the second value to *12* will cause the schedule to run for three days (from the 10th to the 12th day inclusive). Setting the first and second values both to *1* will cause the schedule to run every day. This will repeat every ten days

Hour repeat pattern. The hour repeat pattern is set by the third and fourth numbers of each schedule. The first sets the starting hour for the schedule and the second the ending hour. Thus

using *11* and *19* will cause the schedule to run during the hours from 11am until 7pm. Setting the two values both to *15* will cause the schedule to begin running at 3pm and finish running at 3:59pm

Minute recording pattern. The minute recording pattern is set by the fifth and sixth numbers of each schedule. The first sets the times during the hour at which recordings will be made and the second the duration in minutes for which recordings should be made (at ∼1Hz). For example if the first number is set to *10* and the second to *0* then a single reading will be made every ten minutes. Setting the first number ro *15* and the second to *5* will cause 5 minutes of ∼1Hz recordings to be made every 15 minutes.

This schedule line will set the logger to record a single position every 10 minutes during every hour of the day on every day:

```
1 1 0 23 10 0
```

This schedule line will set the logger to record one minutes worth of positions (∼60) every 10 minutes during every hour of the day on every day:

```
1 1 0 23 10 1
```

This schedule will set the logger to record one minutes worth of positions (∼60) every 10 minutes during every hour of the day on every other day:

```
2 2 0 23 10 1
```

This schedule will set the logger to record sixty minutes worth of positions (at ∼1Hz) beginning at 3am on every ninth and tenth day:

```
9 10 3 3 1 60
```

The schedules are listed on three lines following a lower-case *y* on a line on its own:

```
y
7 7 9 15 1 60
1 1 22 23 10 1
1 1 0 23 15 0
```

There must be exactly three schedule lines in the file following the base date identifier. A complete file looks like this:

```
b
18 4 2018
y
7 7 9 15 1 60
1 1 22 23 10 1
1 1 0 23 15 0
```

The order of the schedules is important: if two schedules set an event to happen at the same time then the schedule nearest the top of the file will take priority. In many circumstances this means that the "background" recording rate should be placed in the last schedule line, and more infrequent scheduled events with longer recording periods should be placed in the first two schedule positions. For example in the file example above the second and third schedules both indicate recordings to be made at 22:30 each day. The second schedule will take priority and will cause one minute of readings to be recorded. If the two schedules were switched then only a single reading would be made at 22:30.

5   Config file

The file *config.txt* determines the behaviour of the uSD card logger module and should not be editted and must contain the following on the first line:

```
19200,26,3,1,0,0,1
```

Any content after the first line is ignored.