



1 GeoChron Specifications

Dimensions: 4.165" x 2.8" x 1.1" (106mm x 72mm x 28mm)

Weight: 5.2 ounces (148g)

Battery Voltage: 3.7V, one lithium polymer cell, 1000mAH capacity

Current Draw: 135mA free-running, 2mA in sleep

Run Time: 7.4 Hours continuous, 500 hours in sleep

Charge Voltage: 6V to 14V

GPS Sensitivity: -159dBm

2 Layout



A Charge jack and charge indicator. Input voltage of 6 to 14V. The red charge indicator LED will be lit when unit is charging, and it will go out when fully charged.

B Power switch. Turns unit on and off.

C Stop/Standby switch. Behavior varies in different modes. In mode 0, actuating this switch will close the current log file and shut down the GPS module (power must be cycled to start a new log file). In modes 1 and 2, actuating this switch will cause the GeoChron to stop logging, but it will not close the current log file and it will not shut off the GPS module. Check the examples section for more on this operation.

D Status LED. Behavior varies in different modes. In mode 0 the status LED will be dark by default, blinking either blue or green very quickly while the unit is writing to the SD card. In modes 1 or 2, the unit will light the blue LED while it is getting a lock and/or waiting through the Holdoff sequence, then it will flash green very quickly while it is writing to the SD card. If the unit is asleep in mode 1 or 2, the status LED will be dark. The status LED will flash red if the stop/standby switch has been actuated, or if there is a problem reading the SD card.

E SD card socket. Insert SD card here with face up.

3 Quick Setup

Note: Unit should be charged overnight before setup.

- 1) With a fully charged battery, insert a blank SD card (formatted in FAT16) into the SD slot and turn the unit on. Make sure that the Stop/Standby switch is in the off position – opposite to that of the power switch. The unit will blink red-blue-green very quickly 5 times, and then will periodically blink blue or green indicating that it is logging to the card. (If it blinks red repeatedly, shut the unit off and reformat your SD card.) Shut the unit off, pull out the SD card and put it in your card reader. (Note: Most SD cards are sold preformatted with FAT16.)
- 2) Examine the contents of your SD card. You will find that the unit has placed two files there: GLOGCON.TXT (the Configuration File) and LOG0.TXT (the first log file). Open the configuration file and read through the following description of it's contents.

4 The Configuration File

When you open this file, you will see:

```
Mode = 0
Log What = RMC;GGA;GSA
Time Between Logs = 00:10:00
Holdoff = 5
WAAS = 0
```

4.1 Mode

There are 3 modes that the unit can run in: 0, 1 and 2. Mode 0 will log everything that comes out of the GPS module to the SD card. Mode 1 will log selectively based on the next 3 parameters in the config file. Mode 2 will log just like Mode 1, but is active only when there is an input on the charging jack. Mode 0 doesn't pay any attention to the other 4 parameters in the configuration file.

4.2 Log What

The EM-408 GPS module from US Globalsat outputs 4 different NMEA sentences by default: RMC, GGA, GSA and GSV. Additionally, these GPS modules can be configured to output GLL and VTG NMEA sentences, but the logger unit cannot perform the reconfiguration to do this. However, the logger unit is capable of logging any and all of these sentences. The user only has to put the desired sentence identifiers in the "Log What" line as shown in the example above. The identifiers can be in any sequence, but they do need to be separated by ";" and they need to be all capitals. If there is only



one identifier, for example “RMC”, there is no need for a semicolon nor should you use one as it will confuse the parser that reads the settings from the config file. No spaces should be used between sentences. Lastly, this setting is only active in Mode 1 and Mode 2.

4.3 Time Between Logs

This sets the time between logs for intermittent logging, and the format is hours:minutes:seconds. The maximum delay is 24 hours (one log per day). If the delay is set to more than that, it will default to a 24 hour delay. The unit will shutdown during times between logs and have a current draw of about 2mA. The delay time does not include time to lock for the GPS, it is only the time that the unit spends in its power-down state.

Setting the delay time to 0 will cause the unit to log continuously and not shut down, and it will continue to log according to what's set in “Log What”.

4.4 Holdoff

When a GPS unit powers up, the first lock is rarely the best. It usually takes a few before it becomes what one might call “reasonably” accurate. The Holdoff setting allows the user to specify how many instances of the RMC sentence to disregard after the initial lock before taking data and logging it. RMC does not need to be set in “Log What” for this to be active, and other sentences logged will also obey this setting. The RMC sentence just happens to be the one that the parser watches for this setting, and it will do so regardless of the other settings (except if the unit is in mode 0, in which case everything is logged).

The default setting for Holdoff is 5. We find this to be a reasonable compromise between accuracy and power consumption, but it can be set as high as 99 or as low as 1. If any number greater than 99 or less than 1 is used, the value will revert to 5.

4.5 WAAS

For increased accuracy, you can enable the WAAS feature of the EM-408 by setting WAAS = 1 in the config file. However, the user should note that lock times are generally longer for a WAAS enabled unit. The user should also note that the WAAS service is only available in the U.S., and that a WAAS enabled device will give more inaccurate GPS positions outside of the U.S. than if WAAS were not enabled. In short, if you're outside the U.S., this setting should be 0 for best results.

5 Examples, Tips, Tricks...

The following information includes tips and tricks for using the GeoChron while hiking or driving.

5.1 Hiking

As stated earlier, the GeoChron can run more than 7 hours when allowed to free-run in mode 0, logging everything that the GPS engine has to say. But what if you're going to be out a few days with no way to recharge? And when you're out wandering in the woods you're not moving all that fast, so you probably don't need to have an update every second.

Let's say you're going to be out for 3 days camping and hiking, and you expect to be hiking 8 hours every day. You need the unit to run 8 hours a day for 3 days, or 24 hours total. How do you set up the config file to give that amount of run time? Here's an equation to help you figure it out:

$$\frac{1000\text{mAh}}{((\text{on time}) / (\text{on time} + \text{off time})) * 158\text{mA}) + 2\text{mA}} = \text{Run Time}$$

where 1000mAh is the battery capacity, 158mA is normal current draw, 2mA is sleep current draw, “off time” is the time that the unit sleeps between logs, and “on time” is the time it takes the unit to lock plus the number of seconds in the Holdoff parameter in the configuration file. That may sound complicated, but we'll walk you through it.

We've already determined the necessary run time to be 24 hours, which assumes that you will turn the unit off at the end of each day of hiking (you will end up with 3 different files at the end of your trip, one for each day). Now we figure out what the on time will be. For being out in the woods far away from buildings and electronic noise, a good estimate for the time it will take the unit to get a GPS lock would be 10 seconds. Add to that a Holdoff time of 10 seconds as a way to insure that the lock is a good one, and you've got an on time of 20 seconds. The only thing to figure out now is the off time, or the time between logs. Rearranging the equation gives us

$$\frac{(\text{on time}) * (158\text{mA})}{(1000\text{mAh}/\text{run time}) - 2\text{mA}} - \text{on time} = \text{off time}$$

Substituting values gives an off time of 59.67, or 60, seconds. Now that we have all of our values, we can set up the config file:

Mode = 1 (we're running in intermittent logging mode)

Log What = RMC;GGA;GSA (depending on what info you want)

Time Between Logs = 00:01:00 (1 minute, or 60 seconds)

Holdoff = 10

WAAS = 0 (or 1)

Save those parameters in the configuration file on the SD card and put the card back into the GeoChron, and you're good to go.

5.2 Driving

Let's suppose you're logging a road trip. The GeoChron has some neat features that lend themselves well to this application.

The first thing to know is that the GeoChron can charge right from your cigarette lighter plug, so you don't need to worry about calculating run time.

The second thing to know is that the GeoChron can be set up to log only when there is a voltage input at the charging jack. So when you turn your car off, the lighter plug also goes off and the GeoChron goes to sleep until the car starts up again. Then it continues logging in the same log file, picking up right where it left off.

The third thing to know is that you can still set it up to log intermittently while allowing the GPS to maintain a lock between logs. This is helpful to keep file sizes more manageable.



The last thing to know is that you can use the standby switch to stop logging for a while if you're not interested in the current geography, yet still leaving the GPS active and locked.

Let's say that you're going off-roading, or on a long road trip with lots of long, straight highways (Nebraska come to mind). And you've determined that you only need every 15th log. Set up your configuration file like this:

Mode = 2 (we're running in intermittent logging mode, only active with input at the charge jack)

Log What = RMC;GGA;GSA (depending on what info you want)

Time Between Logs = 00:00:00 (no sleep time)

Holdoff = 15 (unit will only log every 15th GPS report, or every 15 seconds)

WAAS = 0 (or 1)

6 Stopping the Log, Closing the File

Accidentally turning the GeoChron off while it is in the middle of writing to the SD card can result in a corrupted log file, so a little bit of care should be taken to avoid this.

If logging in mode 0, just flip the stop/standby switch to stop. The GeoChron will close the log file and flash the red LED indicating that it is stopped. You can now remove the SD card to retrieve the log file.

If logging in mode 1 or 2, you can just shut the unit off anytime it is asleep (status LED is dark) and pull out the SD card. You can also use the Stop/Standby switch in the same way as for mode 0, but the standby function won't be active until the unit wakes up from sleep so it's not really necessary.

Optionally, you can pull out the SD card from the GeoChron any time the unit is asleep to retrieve your current log file. As long as the card is back in place before the unit wakes up, it will continue to log like nothing has happened. Your time may be short in mode 1 depending on the sleep time you've set, but it's handy to do this when logging in mode 2 because the unit will be asleep as long as the vehicle is off.

7 Which NMEA sentences should I record?

A full description for the various NMEA sentences can be found here:

http://www.usglobalsat.com/downloads/NMEA_commands.pdf

In general, setting the Log What parameter to RMC alone will give most of the information that one might need (latitude, longitude, time, date, ground speed). But if you are interested in altitude, set Log What = GGA, though the GGA sentence does not contain date information. These are, however, very rough guidelines. To determine exactly what information you need and where to get it, please see the linked document.

8 How do I see the track in Google Earth?

There are various free online sources that will translate the raw NMEA data to KML/XML format (which Google Earth uses). We like GPS Visualizer:

<http://www.gpsvisualizer.com/map?form=googleearth>

Just follow the link, upload your file with your selected options (make sure you set the altitude mode correctly if you're doing a 3-D flight path), and click the "Create KML File" button. In a matter of seconds you will get a link to your file. Now just open the file with Google Earth. If you don't have Google Earth installed, here's a link for that, too:

<http://www.earth-2008.com/>

9 Notes on Charging

The GeoChron uses a 1000mAh lithium polymer battery. When plugged into a voltage source (6V to 14V), the battery will charge at a maximum of 280mA. While the unit is charging the red charge indicator LED will be on, and will go off when charge is completed.

The charging characteristic curve of a lipo battery is such that it slowly tapers off over time, and so the charge time can be longer than one might expect as the battery slowly tops-up. But for the most part, the battery is essentially charged after about 4 hours, whether the indicator LED goes off or not.

