

GeoChron Blue Datasheet

2009.1.15

Overview

The new GeoChron Blue adds Bluetooth functionality to an already popular GPS logging platform. Now you can access logged files, delete old files or reformat your SD card, plus run diagnostics and change settings all over the Bluetooth link. Additionally, we've broken out some of the free lines on the LPC2138 processor, and our open source code is now compiled with the free WinARM compiler. All of this in an effort to make the GeoChron Blue a very attractive GPS logger and development platform.

- 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, 1100mAH capacity
- Current Draw: 135mA free-running, 2mA in sleep (~10mA with Bluetooth active)
- Run Time: 7.4 Hours continuous, up to 500 hours in sleep (Bluetooth off, both cases)
- Charge Voltage: 6V to 14V
- GPS Sensitivity: -159dBm

The basic layout of the GeoChron Blue can be seen in Figure 1.

1. 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
2. Power switch. Turns unit on and off.
3. Stop/Standby switch. Works differently 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.
4. Status LED. Works differently in different modes. In mode 0 the status LED will usually be dark, blinking either blue or green very quickly while the unit is writing to the SD card. In modes 1 or 2, the unit will show 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.

5. SD card slot

Figure 1



Quick Setup

Note: Unit should be charged overnight before setup.

The power up sequence incorporates a self test to make sure the unit is fully functional before running. When the power is turned on, the GeoChron will first blink red-blue-green very quickly 5 times. Immediately thereafter the unit will test the real time clock (RTC), during which the red LED will remain on. Then it will test the GPS connection, during which the green LED will remain on. Lastly, it will test the Bluetooth, during which the blue LED will remain on. When all testing is completed, the unit will again blink red-blue-green very quickly 5 times and then begin running normal operations. If the unit should stop on any of the LEDs during the test, it indicates a failure of that portion of the GeoChron.

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 switch is in the off position – opposite to that of the power switch. The unit will first run through the test sequence, then will periodically blink blue or green indicating that it is logging to the card (if it blinks red

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- 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.
- 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 its contents.

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
Bluetooth Active = 1
```

Here's a description of what this all means:

Mode

The unit runs in three modes: 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 5 parameters in the configuration file.

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 just like it shows in the above example. 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. Lastly, this setting is only active in Mode 1 and Mode 2.

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 1.5mA. However it should be noted that the delay time does not include time to lock into the GPS, but rather 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 log according to what's set in "Log What".

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.

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. To summarize, in order to achieve optimal results with the GeoChron Blue, users outside of the United States should set this setting to 0.

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Bluetooth Active

The addition of Bluetooth to the GeoChron allows for some interesting applications where access to the device may be restricted (shipping containers, rental vehicles, etc). Setting this field to 0 disables the Bluetooth, a good idea for low-power applications. Otherwise, setting it to 1 (default) enables the Bluetooth module.

Using the Bluetooth

The user may access all of the GeoChron's operations over the Bluetooth link. To do so, first turn the GeoChron on and perform a Bluetooth discovery. The device will show up as "GeoChron" with some MAC address. Connect to it as a serial port and open a terminal emulator to the port number to which your local Bluetooth device is connected, preferably at 115200 baud to prevent any buffer overruns. Once connected, the menu will likely come up immediately. If it doesn't, press the spacebar once or twice. If it still doesn't, your GeoChron is likely in the middle of logging operations. When these complete the GeoChron will display the menu.

The File Manager

When the menu comes up, it will look like this:

GeoChron File Manager and Diagnostics

- ```
=====
1) Read directory
2) Read file
3) Delete file
4) Format SD card
5) Listen to GPS (press ^s to stop)
6) Create a test log file
7) Change settings in the config file
9) Exit menu and reset GeoChron
```

### Read Directory

Pressing "1" will display the contents of the root directory on the SD card.

### Read File

After pressing "2", you will be prompted to enter the name of the file you wish to read. Enter the complete file name followed by "enter" and the contents of the file will be downloaded onto your terminal emulator. A useful way of doing a file read is to first do a directory

read, then a copy and paste when prompted for the file name. Also, most terminal emulators allow logging data (Teraterm, for example, allows this). Setting up a log file this way allows for easy saving of the data.

### Delete file

After pressing "3", you will be prompted to enter the name of the file you wish to delete. Enter the complete file name followed by "enter" and the file will be deleted from the SD card.

### Format SD card

Pressing "4" will reformat your SD card, erasing all contents. This also includes the configuration file. To recreate the configuration file, either select "9" to reset the GeoChron or select "7" to change settings. Selecting "9" will cause the GeoChron to disconnect the Bluetooth link and restart, which will place a new configuration file with default settings on the SD card. Selecting "7" will allow you to change settings that are stored in memory, and at the end of this procedure a new configuration file with your new settings will be placed on the SD card.

### Listen to GPS

Pressing "5" will allow you to listen directly to the EM-408 GPS module over the Bluetooth link. This can be handy for diagnosing a potentially faulty unit. Pressing "^s" (<control>s) stops the GPS reporting and returns the user to the main menu.

### Create a test log file

Pressing "6" will cause the GeoChron to create a GPS log file called "Testlog.txt" on the SD card. The unit will start logging directly from the EM-408 GPS module and continue until the user presses the space bar, after which the main menu comes up again. This also can be handy for diagnosing a potentially faulty unit.

### Change settings in the config file

Pressing "7" will first delete the existing configuration file, then take you to the settings menu.

Pressing any of the corresponding numbers for the configuration settings will allow the user to toggle or otherwise change the settings (you will be prompted for Log What, Time Between Logs and Holdoff).

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Pressing "9" will save the settings in a new configuration file and return the user to the main menu. The settings menu looks like this:

### GeoChron Settings Menu

- 
- 1) Change mode, currently 0
  - 2) Change Log What, currently RMC;GGA;GSA
  - 3) Change Time Between Logs, currently 00:10:00
  - 4) Change Holdoff, currently 5
  - 5) Change WAAS, currently 0
  - 6) Change Bluetooth Active, currently 1
  - 9) Return to main menu

### Exit menu and reset GeoChron

Pressing "9" from the main menu will terminate the Bluetooth link and reset the GeoChron. A new log file will be created and any new settings will take effect.

### Examples, Tips, Tricks...

Let's say you're...

#### Hiking

As stated earlier, the GeoChron can run more than 7 hours when allowed to free-run in mode 0 with Bluetooth off, 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:

$$\text{Run Time} = 1100\text{mAh} / (((\text{on time}) / (\text{on time} + \text{off time})) * 158\text{mA}) + 2\text{mA}$$

Where 1100mAh 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

$$(\text{on time}) * (158\text{mA})$$

$$----- - \text{on time} = \text{off time}$$

$$(1100\text{mAh/run time}) - 2\text{mA}$$

Substituting values gives an off time of 52.09, or 52, 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 = 00:00:52 (52 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.

#### 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

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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 comes 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)

### 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 was 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.

### 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](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 (lat, lon, time, date, ground speed). But if the user is 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.

### 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>

### Notes on Charging

The GeoChron uses a 1100mAh 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.

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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.