



Notes on assembling and using the Mini Pearl Logger

Assembly

The three primary boards of the logger kit have some male headers (pins) soldered on. Loose headers are included for the Arduino Pro Mini, but these are optional. To connect the boards, wires can be soldered to the header pins or directly to the holes in the Pro Mini. Some holes in the Pro Mini (VCC and GND) must have more than one wire soldered to them. Wires can be twisted together and passed through a single hole for soldering, but three wires are easier to connect if a header pin is present. So soldering pins to VCC and GND can be helpful. Don't solder the battery case wires directly to the Pro Mini – extend them with included pieces of stranded wire (the solid battery wires are brittle).

If you are not familiar with troubleshooting electronics, a safe approach to assembly is to connect one component at a time and test it:

1. Before soldering anything, connect the Arduino Pro Mini to your computer with an FTDI converter (not included in the kit, see below for more). Start the serial monitor (e.g., from the Arduino IDE) and something like the following should be displayed:

```
Cannot find SD card
Cannot save to SD
RTC time: :85
RTC UTC time: 1467330385
Alarm triggered at 2165/165/165,165:165:85
RTC temp: 0.00 C
RTC temp: 0.00 F
Cannot save to SD card

Alarm set, will sleep for: 1 minute
```

This will repeat every few seconds, and the time, date, and temperature information will be wrong. But this indicates that the Arduino Pro Mini is operating normally and running the sketch installed on it.

2. Disconnect the Pro Mini from your computer. Now connect the real-time clock (with battery installed) according to the wiring diagram. Again connect your computer using an FTDI converter and start the serial monitor. Similar information will display, but this time it will repeat once per minute (the real-time clock is controlling the timing). The temperature data will be correct (check this by holding your thumb against the larger black chip on the real-time clock board to warm it up). The time and date will not be correct, but you can follow the instructions below to set the clock and repeat this step.
3. Disconnect the Pro Mini from your computer. Now connect the microSD card board according to the wiring diagram. Insert a microSD card, connect the Pro Mini to your computer with an FTDI converter, and start the serial monitor. This time the three errors about the SD card will be missing or different (see below). Disconnect the logger from your computer and insert the microSD card in a card reader on your computer. A file on the microSD card (datalog.txt) will have time, data, and temperature data (see below).

Default sketch

A sketch has been loaded onto the Arduino Pro Mini. When the logger is assembled and powered it should begin to log temperature data from the sensor in the real-time clock module to the microSD card and can also display information on the serial monitor if the logger is connected via USB to a computer.

If you want to:

1. Set the real-time clock,
2. Change the sampling interval from once per minute to something else,
3. Use the Mini Pearl Logger with external sensors,
4. Make any other changes,

then the sketch must be edited and loaded again onto the Arduino Pro Mini. The sketch on the Pro Mini is "mini_rtctemp03.ino" and the most recent version is available here: <http://kaptery.com/guides/> (the sketch cannot be copied off the Pro Mini).

There is error checking in the sketch to detect if the SD card is available. If it is not, an error will display on the serial monitor. There is not much other error checking in the sketch.

Powering the logger

The Mini Pearl Logger runs at 3.3 volts. It can be powered by USB from a computer via an FTDI converter (see below). It can also be powered by batteries which deliver anywhere from 4 to 12 volts (a regulator on the Pro Mini reduces the voltage when the batteries are connected to the "RAW" pin). The VCC pin on the Pro Mini will output 3.3 volts, and all components powered by that pin (microSD board, real-time clock, sensors) must operate at 3.3 volts.

Using an FTDI converter (TTL Level Serial Converter Cable)

This functions as a portable USB port to power the Mini Pearl Logger and to allow data exchange between the logger and your computer. Set the FTDI converter to 3.3v. It connects with six pins to the Arduino Pro Mini (see below). To confirm that it is hooked up properly, make sure the TX pin is connected to RX_ and the RX pin is connected to TX_. The Arduino IDE will let you know if it can upload a sketch to the Pro Mini (try it several times before you decide something is wrong). When a sketch is running on the Pro Mini, start the serial monitor from the Arduino IDE to see if data are being transferred.

Not all FTDI converters are the same, but the pin connections below are typical:

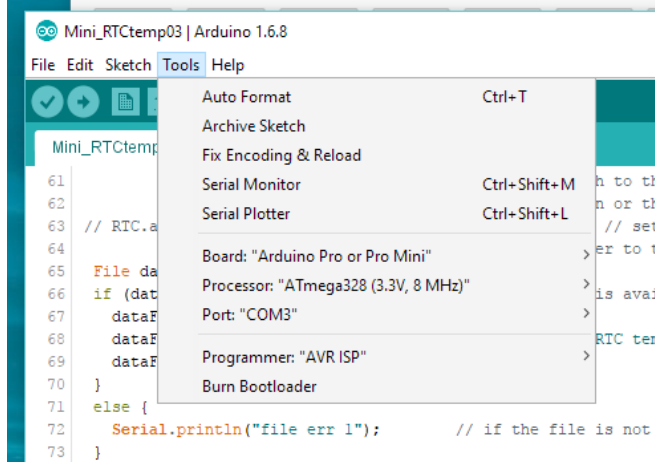
Pins on the Arduino Pro Mini: **DTR TXO RXI VCC GND GND**

|| || || || || ||

Pins on the FTDI converter: **DTR RX TX VCC CTS GND**

Connecting the Arduino IDE

To establish communication between the Arduino IDE on your computer and the Arduino Pro Mini, select the correct board, processor, and COM port.



Your COM port might differ.

Setting the real-time clock

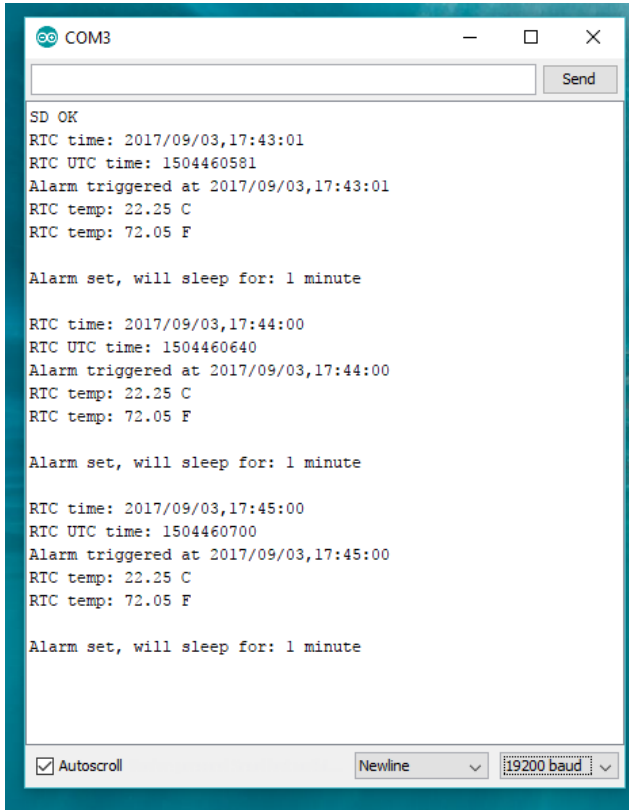
The real-time clock has not been set (the battery is not in it) so it does not know what time it is. The battery goes into the battery holder with the plus side up (so you can read all the text). There are instructions to set the clock in the sketch or follow these more detailed steps:

1. Install the Arduino IDE on your computer or use the web based version.
2. Open a copy of the sketch in the IDE.
3. Edit the sketch as described in the sketch by uncommenting one line (delete the "//").
4. The line to change is: `// RTC.adjust(DateTime((__DATE__), (__TIME__)));`
5. Load the edited sketch onto the Pro Mini.
6. The sketch will start to run on the Pro Mini.
7. Start the serial monitor to watch the output on your computer monitor.
8. The time and date should be correct.
9. Edit the sketch so that line is once again commented out (preceded by "//").
10. Load the sketch again onto the Pro Mini.
11. If the Pro Mini is restarted before step 9 and 10 are completed, the time will be wrong and the procedure must be repeated.

There are other ways to set the clock. Let me know if you find a better one.

Default output

When the sketch is running and a connection has been established between the logger and the serial monitor, information should be displayed on your computer monitor:



```
COM3
Send

SD OK
RTC time: 2017/09/03,17:43:01
RTC UTC time: 1504460581
Alarm triggered at 2017/09/03,17:43:01
RTC temp: 22.25 C
RTC temp: 72.05 F

Alarm set, will sleep for: 1 minute

RTC time: 2017/09/03,17:44:00
RTC UTC time: 1504460640
Alarm triggered at 2017/09/03,17:44:00
RTC temp: 22.25 C
RTC temp: 72.05 F

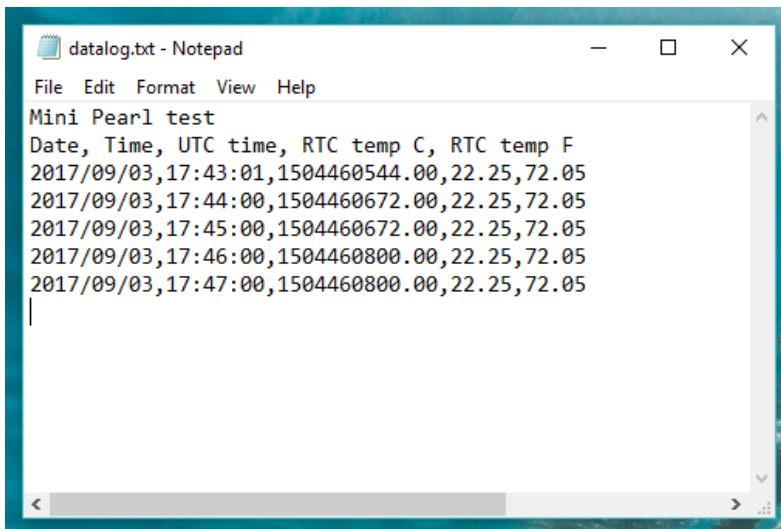
Alarm set, will sleep for: 1 minute

RTC time: 2017/09/03,17:45:00
RTC UTC time: 1504460700
Alarm triggered at 2017/09/03,17:45:00
RTC temp: 22.25 C
RTC temp: 72.05 F

Alarm set, will sleep for: 1 minute

 Autoscroll
Newline
19200 baud
```

“SD OK” means that the sketch detected the microSD card. Each block of data was displayed a minute apart. Check the baud rate (lower right) – sometimes 19200 works, sometimes 9600 works.



```
datalog.txt - Notepad
File Edit Format View Help
Mini Pearl test
Date, Time, UTC time, RTC temp C, RTC temp F
2017/09/03,17:43:01,1504460544.00,22.25,72.05
2017/09/03,17:44:00,1504460672.00,22.25,72.05
2017/09/03,17:45:00,1504460672.00,22.25,72.05
2017/09/03,17:46:00,1504460800.00,22.25,72.05
2017/09/03,17:47:00,1504460800.00,22.25,72.05
|
```

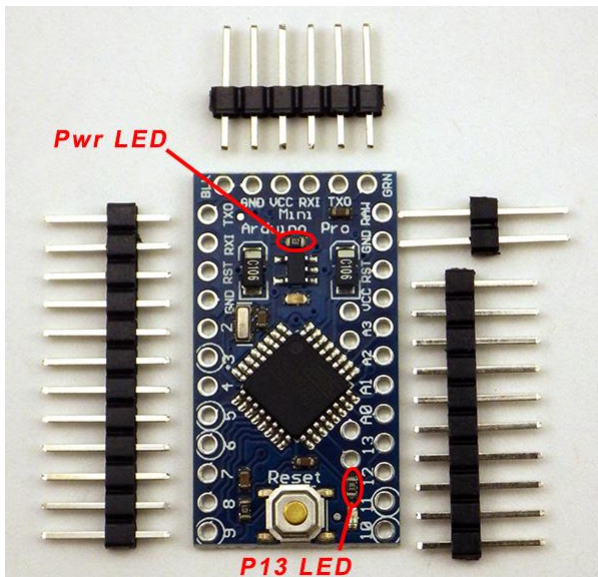
The data file on the microSD card will look something like this after about five minutes of logger operation.

RGB LED

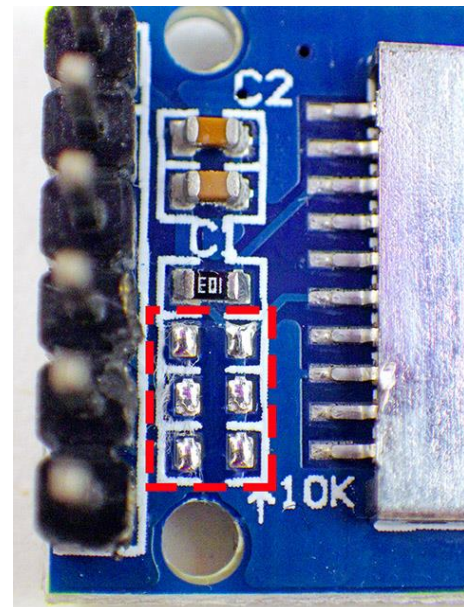
The RGB LED is optional. The default sketch includes code to change the color of the LED when the logger is sleeping (red), when it wakes up (green), and when it is writing to the SD card (blue). If the LED is not connected, the sketch will run normally. The LED is handy for troubleshooting and to confirm that everything is operating normally when deploying the logger in the field when a serial monitor cannot be used. It is especially handy when the LEDs on the Pro Mini and real-time clock have been disabled (to save power).

Modifying the boards

To lower the power used by the logger and increase the time the logger can run on batteries, the LEDs on the Pro Mini and real-time clock boards can be disabled by removing specific resistors. Removing other resistors on the real-time clock and microSD board can further reduce power consumption. It is quite easy to flick these tiny resistors off the boards with a soldering iron.



Remove these two resistors from the Pro Mini board.



Remove these three resistors from the microSD card board (already removed in this photo).



Remove these two resistors from the real-time clock board. (These photos are from Ed Mallon.)