

Mini Temp Logger v1.0

A small temperature logger with a real time clock for sensing -55C to 128C with up to 65,536 logging data points, customisable logging time and powered by a coin cell. Can log voltage as well.

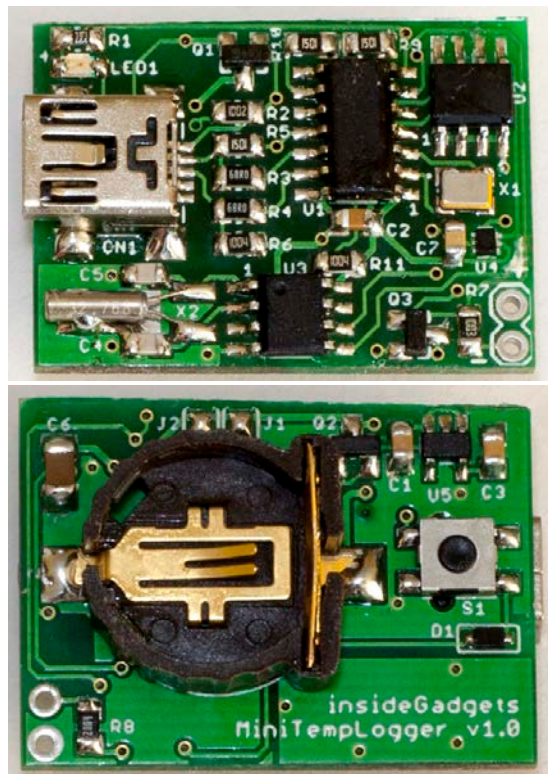
The Mini Temp Logger logger uses V-USB:

<http://www.obdev.at/vusb/>

Features

- Measure temperature using the TMP102 sensor from -55C to 128C
- Measure voltage from 0V to 22V
- Uses an I2C EEPROM to support up to 65,536 logging data recordings
- High time accuracy using the MCP7940M real time clock. Set the time via the PC application so it records the start time when logging. Features trim and auto trim from temperature settings.
- Configurable logging delay available between 1 second to 255 days via PC application
- Easily transfer the logged data to your PC via USB by running an PC application
- Operates from a 3V CR1220 coin cell

Note: You can only log temperature or voltage, not both at the same time.



Requirements

USB Mini cable & CR1220 battery

Specifications

General

Battery required: CR1220 3V coin cell
PCB Board size: 31mm (L) x 22mm (W) x 15mm
Operating voltage: 1.8V to 3.6V
Sleep current: 5uA

Operating temperature: -40C to 85C
(Most CR1220 batteries only support -40C to 70C)

Temperature sensor (TMP102)

Range: -55C to 128C
Resolution: 0.0625C
Accuracy: $\pm 0.5C$ (between -25C to 85C)

Voltage logging (ATtiny84 ADC)

Range: 0V to 22V
Resolution: 22mV
Accuracy: $\pm 66mV$

Real time clock (MCP7940M)

Accuracy: at 25C, within $\pm 12PPM$ (1 second a day)

How to Use

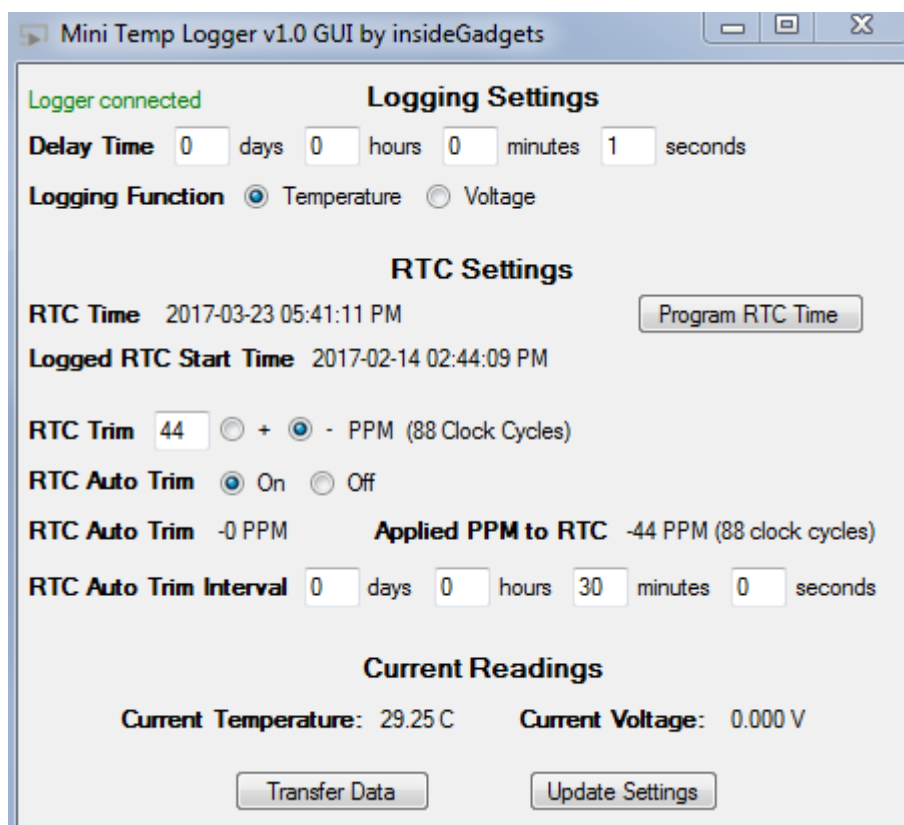
First time use

1. Insert the CR1220 battery
2. The small LED will stay lit for about 1 second
3. Connect the device to your PC via a USB cable. You may be asked to select a driver for the device, if so, the driver is in the \Driver directory.
4. Follow the "Initial Setup" guide below to configure the logging time, function and real time clock
5. Once the device is unplugged from your PC, you can press and hold the button for 2 seconds, the LED will light up and once you release the button you will see the LED turn off. The LED will blink once every time a reading is logged (one reading will happen straight away).
6. To stop the logging, press and hold the button for 2 seconds, the LED will light up and once you release the button you will see the LED turn off.
7. You can now connect the device to your PC and run the minitemplogger_transfer.exe program (or click Transfer Data in the GUI) which will create a file in the program's location as: <year>-<month>-<day>_<hour>-<minute>-<second>.txt. Once the program disappears, the transfer is complete and you can unplug the device from your PC

Initial Setup (GUI)

Interface Program

Run the minitemplogger_gui.exe application found in the MiniTempLogger_Comm folder and you will be presented with the screen below. After making any changes you wish to save, press the "Update Settings" button near the bottom.



Configure the logging time interval and function

Before we can start logging we need to program the logging interval and also the function to use – temperature logging or voltage logging

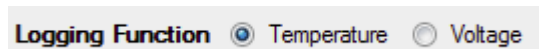
Logging time interval



The 'Logging Settings' dialog box contains a 'Delay Time' section with input fields for days (0), hours (0), minutes (0), and seconds (1).

Here you can enter in the days, hours, minutes and seconds required.

Logging function

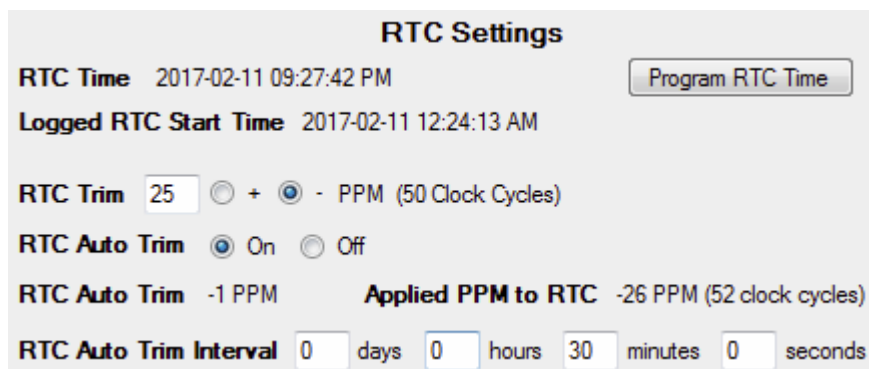


The 'Logging Function' section shows two radio buttons: 'Temperature' (selected) and 'Voltage'.

Here you can select logging function to use, either temperature or voltage.

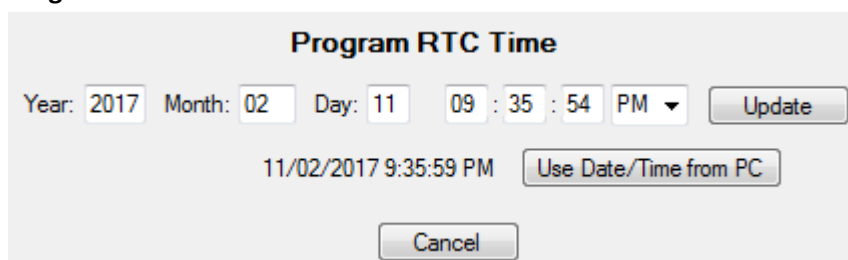
Configure the Real time clock

We need to configure the real time clock with the current time so we can record the start time and have an accurate clock source. To see what the other RTC functions do, please read the Real time clock functions section.



The 'RTC Settings' dialog box displays the current 'RTC Time' as 2017-02-11 09:27:42 PM and the 'Logged RTC Start Time' as 2017-02-11 12:24:13 AM. It includes a 'Program RTC Time' button. The 'RTC Trim' is set to 25 PPM (50 Clock Cycles) with '+' and '-' radio buttons. 'RTC Auto Trim' is set to 'On'. The 'RTC Auto Trim' value is -1 PPM, and the 'Applied PPM to RTC' is -26 PPM (52 clock cycles). The 'RTC Auto Trim Interval' is set to 0 days, 0 hours, 30 minutes, and 0 seconds.

Program RTC time



The 'Program RTC Time' dialog box shows fields for Year (2017), Month (02), Day (11), Hour (09), Minute (35), and Second (54), with a PM/AM dropdown set to PM. It includes an 'Update' button. Below these fields, it shows the current time 11/02/2017 9:35:59 PM and a 'Use Date/Time from PC' button. A 'Cancel' button is at the bottom.

Press the “Program RTC Time” button and a pop-up will appear for you to program the RTC time, we can either have it automatically set to the PC’s current time or enter in the time manually and then press the “Update” button.

The setup is now complete; you can close the program, unplug the device from your PC and read step 5 of “How to use”.

Real Time Clock Functions (GUI)

RTC Settings

RTC Time 2017-02-11 09:27:42 PM Program RTC Time

Logged RTC Start Time 2017-02-11 12:24:13 AM

RTC Trim 25 ☐ + ☒ - PPM (50 Clock Cycles)

RTC Auto Trim ☒ On ☐ Off

RTC Auto Trim -1 PPM Applied PPM to RTC -26 PPM (52 clock cycles)

RTC Auto Trim Interval 0 days 0 hours 30 minutes 0 seconds

The main RTC settings screen is shown as above.

1. Program RTC time

Program RTC Time

Year: 2017 Month: 02 Day: 11 09 : 35 : 54 PM Update

11/02/2017 9:35:59 PM Use Date/Time from PC

Cancel

Press the “Program RTC Time” button and a pop-up will appear for you to program the RTC time, we can either have it automatically set to the PC’s current time or enter in the time manually and then press the “Update” button.

2. Read current RTC time & logging start RTC time

RTC Time 2017-02-11 09:41:02 PM

Logged RTC Start Time 2017-02-11 12:24:13 AM

The RTC time shows you the current time on the device (it updates every second) and the RTC Start Time shows when logging was last started.

3. Program RTC trim

The real time clock has the functionality of digital trimming with 1 PPM resolution up to ± 127 PPM which allows us to compensate for the capacitors on the crystal and also for temperature (performed by our auto trim function).

RTC Trim 25 ☐ + ☒ - PPM (50 Clock Cycles)

Out of the box, the trim PPM has been already set for your device however you can change it if you wish. If you do change the trim setting, you should leave the logger running for a day or two (in a 25C environment) and re-evaluate if the trim needs to be increased or decreased.

4. Program RTC auto trim

The RTC auto trim is a function which automatically sets the trim PPM based on the temperature, for the RTC crystal we are using (MH32768L), the PPM is always negative if temperature rises or decreases from 25C. The function reads the static trim PPM and then applies the temperature compensation to that trim PPM. This function runs when logging and also when not logging.

RTC Auto Trim ☒ On ☐ Off

You can switch on or off the auto trim function here (default is on).

5. Read RTC auto trim PPM and applied PPM

RTC Auto Trim -1 PPM Applied PPM to RTC -26 PPM (52 clock cycles)

You can read the auto trim value which depends on the temperature, if the device is at 20C or lower, at 30C or higher, you will see the PPM value. For example, if the temperature was 30C, the auto trim value would be -1PPM. There is an applied PPM reading which shows how it would apply to the static RTC trim value, in the example case, it would rise to -26 PPM.

6. Program RTC auto trim interval

RTC Auto Trim Interval days hours minutes seconds

The auto trim function runs at the interval time you specify, the default is 30 minutes. If the device's temperature will fluctuate rapidly, we recommend changing this interval to suit.

Other functions (GUI)

Current Readings

Current Temperature: 30.19 C Current Voltage: 0.000 V

While the device is plugged into your PC, the current temperature and voltage (if you have a voltage sources connected to the +/- pins) will be updated automatically every second.

Initial Setup (Console Interface)

Interface Program

Run the minitemplogger_interface application found in the MiniTempLogger_Comm folder and you will be presented with the screen below.

```
Please select an option:
1. Program delay time
2. Read delay time
3. Program logging function
4. Read logging function
5. RTC functions
6. Read TMP102 temperature
7. Read voltage
0. Exit
```

Configure the logging time interval and function

Before we can start logging we need to program the interval between the logging data point and the function to use – temperature logging or voltage logging

Logging time interval

```
1
--- Programming delay time ---
Please enter in the days: 0
Please enter in the hours: 0
Please enter in the minutes: 0
Please enter in the seconds: 1
Programming delay time as 0 days, 0 hours, 0 minutes, 1 seconds... Completed
```

Press 1 to enter the logging time interval, and then enter in the days, hours, minutes and seconds required.

```
2
--- Read delay time ---
Days = 0
Hours = 0
Minutes = 0
Seconds = 1
```

You can read back the logging time by pressing 2.

Logging function

```
3
--- Program logging function ---
Please select 1 to log temperature and 2 to log voltage: 1
Programming function is use as temperature logging... Completed
```

Press 3 to enter the logging function to use.

```
4
--- Read logging function ---
Function in use is temperature logging
```

And read it back by pressing 4.

Configure the Real time clock

We need to configure the real time clock with the current time so we can record the start time and have an accurate clock source. To see what the other RTC functions do, please read the Real time clock functions section.

```
5
--- RTC Functions ---
Please select an RTC function option:
1. Program RTC time
2. Read current RTC time
3. Read logging start RTC time
4. Program RTC trim
5. Read RTC trim
6. Program RTC auto trim
7. Read RTC auto trim setting
8. Read RTC auto trim and calculated value
9. Program RTC auto trim seconds interval
10. Read RTC auto trim seconds interval
0. Go back
```

Press 5 to access the real time clock functions.

Program RTC time

```
1
--- Programming RTC time ---
1. Read time from PC
2. Program time manually
1
Programming RTC time as 2017 year, 1 month, 11 date, 8 hour, 28 minutes, 29 seconds PM... Completed
```

Press 1 to program the RTC time, we can either have it automatically set to the PC's current time or enter in the time manually; the quickest way is to press 1 again.

```
2
--- Read current RTC time ---
Year = 2017
Month = 1
Date = 11
Hour = 8
Minutes = 30
Seconds = 33
Am/Pm = PM
```

And read it back by pressing 2, as the real time clock is started, you should see the time count up and it should match your PC's clock (it can be 1 second out due to the time it takes to program the clock).

The setup is now complete; you can close the program, unplug the device from your PC and read step 5 of "How to use".

Real Time Clock Functions (Console Interface)

1. Program RTC time

```
1
--- Programming RTC time ---
1. Read time from PC
2. Program time manually
1
Programming RTC time as 2017 year, 1 month, 11 date, 8 hour, 28 minutes, 29 seconds PM... Completed
```

To program the RTC time, we can either have it automatically set to the PC's current time or enter in the time manually; the quickest way is to press 1 again.

2. Read current RTC time

```
2
--- Read current RTC time ---
Year = 2017
Month = 1
Date = 11
Hour = 8
Minutes = 30
Seconds = 33
Am/Pm = PM
```

Read the current time on the RTC, as the real time clock is started, you should see the time count up and it should match your PC's clock (it can be 1 second out due to the time it takes to program the clock).

3. Read logging start RTC time

```
--- Read RTC time when logging started ---
Year = 2017
Month = 1
Date = 11
Hour = 8
Minutes = 30
Seconds = 33
Am/Pm = PM
```

If you wish to see when you started logging, you can read back the time.

4. Program RTC trim

The real time clock has the functionality of digital trimming with 1 PPM resolution up to ± 127 PPM which allows us to compensate for the capacitors on the crystal and also for temperature (performed by our auto trim function).

```
--- Program RTC trim ---
Please enter the Trim sign bit (0 reduce clocks, 1 add clocks): 0
Please enter the Trim (0 to 127): 50
Programming Trim as -50 (100 clock cycles)... Completed
```

Out of the box, the trim PPM has been already set for your device however you can change it if you wish. If you do change the trim setting, you should leave the logger running for a day or two (in a 25C environment) and re-evaluate if the trim needs to be increased or decreased.

5. Read RTC trim

```
--- Read RTC trim ---
RTC Trim: -50 (100 clock cycles)
```

You can read back the RTC trim setting.

6. Program RTC auto trim

The RTC auto trim is a function which automatically sets the trim PPM based on the temperature, for the RTC crystal we are using (MH32768L), the PPM is always negative if temperature rises or decreases from 25C. The function reads the static trim PPM and then applies the temperature compensation to that trim PPM. This function runs when logging and also when not logging.

```
--- Program RTC auto trim ---
Enter 0 to disable auto trim or 1 to enable auto trim (default): 1
Programming RTC auto trim as on... Completed
```

You can switch on or off the auto trim function here (default is on).

7. Read RTC auto trim setting

```
--- Read RTC auto trim setting ---  
RTC Auto Trim is on
```

You can read back the auto trim setting.

8. Read RTC auto trim PPM and applied PPM

```
--- Read RTC auto trim PPM and applied PPM ---  
RTC auto trim value: -0 PPM  
When applied to static trim: -50 <100 clock cycles>
```

You can read the auto trim value which depends on the temperature, if the device is at 20C or lower, at 30C or higher, you will see the PPM value. For example, if the temperature was 30C, the auto trim value would be -1PPM. There is an applied PPM reading which shows how it would apply to the static RTC trim value, in the example case, it would rise to -51 PPM.

9. Program RTC auto trim interval

```
--- Program RTC auto trim interval ---  
Please enter in the days: 0  
Please enter in the hours: 0  
Please enter in the minutes: 30  
Please enter in the seconds: 0  
  
Programming auto trim interval time as 0 days, 0 hours, 30 minutes, 0 seconds...  
Completed
```

The auto trim function runs at the interval time you specify, the default is 30 minutes. If the device's temperature will fluctuate rapidly, we recommend changing this interval to suit.

10. Read RTC auto trim interval

```
--- Read RTC auto trim interval---  
Days = 0  
Hours = 0  
Minutes = 30  
Seconds = 0
```

You can read back the auto trim interval setting.

Other functions (Console Interface)

```
--- Read TMP102 temperature ---  
Current temperature: 29.44
```

```
--- Read voltage ---  
Current voltage: 3.061
```

While the device is plugged into your PC, you can read the current temperature or voltage if you have a voltage sources connected to the +/- pins.

Transfer data logged to your PC (Console Interface)

1. Plug the USB cable into the device
2. Run the minitemplogger_transfer.exe program (or click Transfer Data in the GUI) which will create a file in the program's location as: <year>-<month>-<day>_<hour>-<minute>-<second>.txt.
3. Once the program disappears, the transfer is complete and you can unplug the device from your PC

Revision History

v1.0 Rev. 1 – 23/03/2017

- Initial Revision

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