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Standalone Temperature/Voltage Logger v1.3 Kit

A standalone temperature/voltage logger in a small compact form factor using minimal parts including the ATtiny85 and an I2C EEPROM powered by a 3V coin cell. Logged data can be extracted to a computer with a USB cable.

The standalone temperature/voltage logger uses V-USB:

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



Features

- Low power consumption, at least 1 year battery life
- Measure temperature from -40C to 125C saving to EEPROM as 8 bit (as 1 byte) or 10 bit (as 2 bytes).
- Measure voltage from 0V to 28V saving to EEPROM as 8 bit (as 1 byte) or 10 bit (as 2 bytes).
- Uses an I2C EEPROM, supports up to 512Kbit which is 65,536 recordings (with 1 byte values) or 32,768 (with 2 byte values)
- Configurable logging delay available between 1 second to 255 days via PC application or 12 logging delay times available using the button(30secs, 1min, 5mins, 10mins, 15mins, 30mins, 1hr, 2hrs, 4hrs, 8hrs, 12hrs, 24hrs)
- Easily transfer the logged data to your PC via USB by running an application

Note: You can only log temperature or voltage, not both at the same time. No information on time is recorded when logging.

Specifications

PCB Board: 37.8mm x 28.5mm

Voltage: 2.7V to 5.5V

Current used when sleeping: 5uA

Current used when logging - Watchdog sleep routine: 0.3mA for 30ms approximately every 4 seconds

Current used when logging - Thermistor on, LED on and write to EEPROM: 3mA (max) for 50ms

Resolution of temperature (1 byte): 0.65C (rounded up or down in 0.5 - 1C increments)

Resolution of temperature (2 bytes): 0.16C (rounded up or down in 0.2C increments)

Accuracy of thermistor: within 5% -/+ (between -40C to 25C is 1.25C -/+, 25C to 50C is 1.5C -/+, 50C - 70C+ is 1.9C -/+)

Resolution of voltage (1 byte): 0.06V

Resolution of voltage (2 bytes): 0.03V

Accuracy of voltage logging: 0.2V -/+

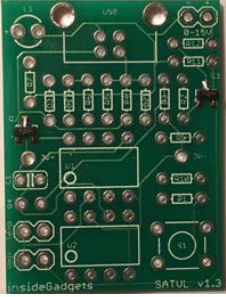

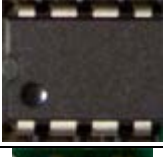


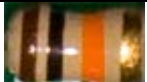








Accuracy of timer: within 10% -/+

Operating temperature: -40C to 125C (Most CR2032 batteries only support -40C to 70C)

Kit Contents

To assemble the kit you will require a soldering iron and solder.

To use the kit you will require a 3V CR2032 coin cell and a 1Kbit-512Kbit I2C EEPROM. To extract the data you will require a USB type A to B cable (commonly used for connecting printers).

Picture	Name	Description	Qty
	PCB	Standalone Temperature-Voltage Logger v1.3 PCB Pre-soldered SMD components: N Channel Mosfet SOT23 (1) - 2N7002K - [Q3] P Channel Mosfet SOT23 (1) - BSS84 - [Q2]	1
	U1	ATtiny85 20MHz DIP8 - ATTINY85-20PU (Pre-programmed)	1
	U2	EEPROM (Can be purchased when you buy this kit. Needs to be 2.7V to 5.5V)	1
	R5, R6	68R Resistor 1/8W (Blue, gray, black, gold)	2
	R8	1.5K Resistor 1/8W (Brown, green, red, gold)	1
	R1, R2, R9, R10	10K Resistor 1/8W (Brown, black, orange, gold)	4
	R3	10K Resistor 1/8W 1% (Brown, black, black, red, brown)	1
	R7	150K Resistor 1/8W 1% (Brown, green, black, orange, brown)	1
	R11	15K Resistor 1/8W 1% (Brown, green, black, red, brown)	1
	R12	390K Resistor 1/8W 1% (Orange, white, black, orange, brown)	1
	R4	10K Thermistor - NTCLE100E3103JB0	1
	D1, D2	Zener Diode 3.6V 1/2W DO-35 - 1N5227B	2
	D3	Schottky Diode 400mV[VF Max] DO-35 - BAT42 (Notice the white paper on the left lead)	1
	C1	0.1uF Capacitor	1

	L1	3mm Red LED - MCL514SRD	1
	S1	4.3mm Tactile switch	1
	ICSOCKET	8 pin IC socket	2
	MALEHEADER	2 pin male header	2
	FEMALEHEADER	2 pin female header	1
	SHORTBLOCK	Shorting block	1
	BATHOLD	Coin cell battery holder	1
	USB	USB Type B Receptacle	1

Step by Step Instructions

1. Install the 9 resistors –10K (R1, R2, R9, R10), 10K 1% (R3), 68R (R5, R6), 150K (R7), 1.5K (R8), 15K (R12) and 390K (R13) and two 3.6V Zener diodes (D1, D2) - note the orientation.



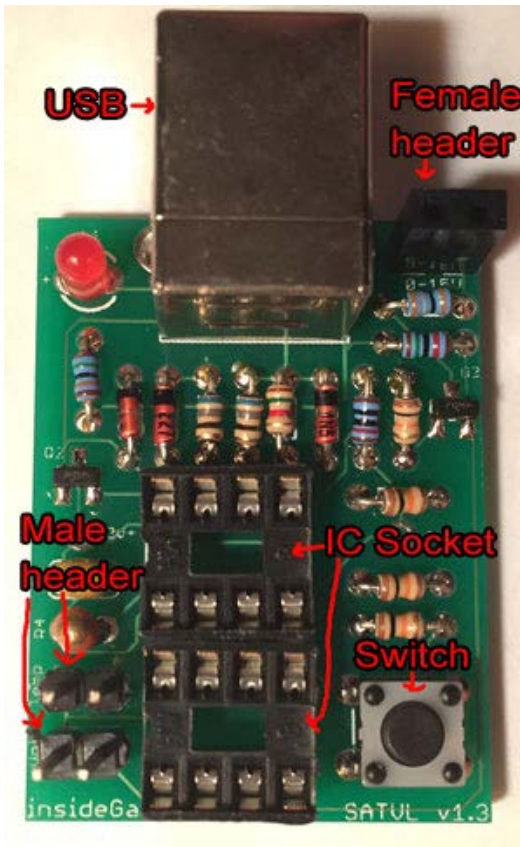
2. Install the Schottky diode (D3) - it has a white paper on one of the leads, note the orientation. Install the LED (L1), capacitor (C1) and thermistor (R4). The longer lead of the LED should go on the + pad.



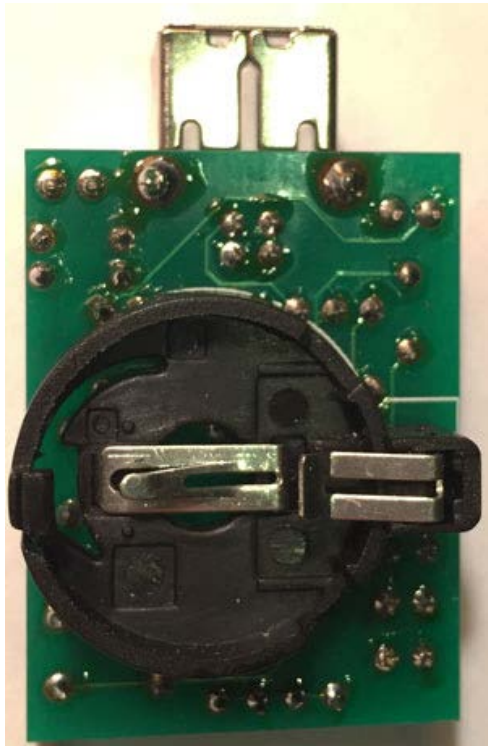


You can also choose to solder the thermistor with the leads intact so you can place the PCB in a small container and the thermistor's top would be located outside the container. You can also solder wires to position the thermistor elsewhere.

3. Install the IC sockets (on U1 and U2), switch (S1), male headers, female header (on the 0-15V pads) and USB receptacle (USB).



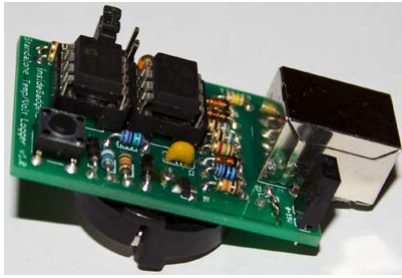
4. Install the coin cell battery holder (BATHOLD) on the back.



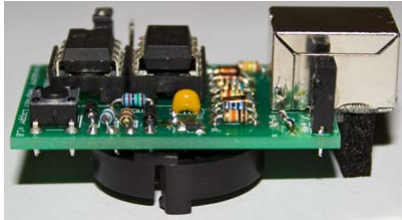
5. Install the ATtiny85 (on U1) and the EEPROM (on U2). Notice the small circles on each device and how they are mounted. Install the shorting block on the temperature male header (default).



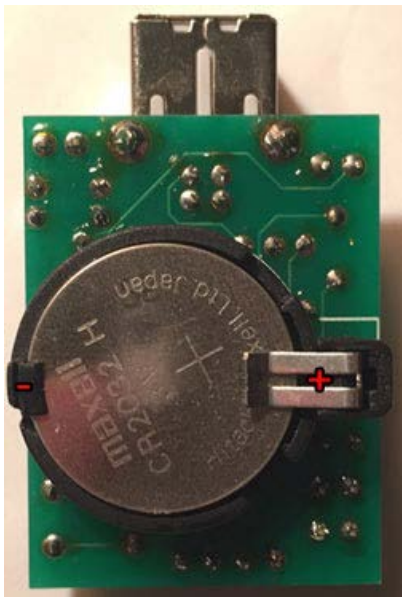
6. Optional Step - You will notice that the Standalone Temperature/Voltage Logger leans to one side once placed in a flat surface.



You can adjust this by cutting a small piece of the foam that came with the ATtiny85 and gluing it underneath the USB receptacle.



7. Install the battery with positive side facing outwards. The kit has now been assembled, please read the “How to use - First time use” section.



How to Use

Inserting or removing the ATtiny85/EEPROM

You should only insert or remove the ATtiny85/EEPROM when the battery has been removed and the USB cable isn't connected.

First time use

1. Insert the ATtiny85 and EEPROM.
2. Insert the battery.
3. The LED will either blink to indicate there is an EEPROM present or it will stay on for 2 seconds to indicate that no EEPROM was found.

The number of blinks corresponds to the EEPROM size that was found as shown below.

Blinks	EEPROM size	Max recordings (1 byte)	Max recordings (2 bytes)
1	1 Kbit	128	64
2	2 Kbit	256	128
3	4 Kbit	512	256
4	8 Kbit	1,024	512
5	16 Kbit	2,048	1,024
6	32 Kbit	4,096	2,048
7	64 Kbit	8,192	4,096
8	128 Kbit	16,384	8,192
9	256 Kbit	32,768	16,384
10	512 Kbit	65,536	32,768

Configure the logging time interval and function via PC

1. Plug the USB cable into the Standalone Temperature/Voltage Logger and press the button once, the LED should light up.
2. Run the SATVL_v1.3_Program application found in the SATVL_v1.3_Interface folder to program the delay time and function to use.
3. Once the delay time and function have been programmed the LED will switch off and you can then remove the USB cable.

Configure the logging time interval via the button

1. Hold the button down for 3 seconds until you see the LED light up and then let go.
2. Configure the logging time interval by pressing the button the amount of times shown below. Please wait for the LED to light up to confirm each button press.

Button presses	Logging time interval
1	30 seconds
2	1 minute
3	5 minutes

4	10 minutes
5	15 minutes
6	30 minutes
7	1 hour
8	2 hours
9	4 hours
10	8 hours
11	12 hours
12	24 hours

(The time interval accuracy is within 10% +/-)

3. Wait for 4 seconds, the LED will blink three times to confirm your logging time interval. (If the LED stays on for 2 seconds too many button presses were made, please repeat step 2)

Configure the function to use via the button

1. On the PCB there are 2 connectors, one called "Temp" for temperature and another called "Volt" for voltage. Use the shorting block (jumper) on the connector depending on which function you wish to use and leave it in place when you start logging temperature or voltage.

2. Hold the button down until the LED is lit and once it turns off, let go of the button

3. Configure the function to use by pressing the button the amount of times shown below. Please wait for the LED to light up to confirm each button press.

Button presses	Function
1	Temperature logging (using 1 byte)
2	Temperature logging (using 2 bytes) - default
3	Voltage logging (using 1 byte)
4	Voltage logging (using 2 bytes)

4. Wait for 4 seconds, the LED will blink three times to confirm your logging time interval. (If the LED stays on for 2 seconds too many button presses were made, please repeat step 3)

Start temperature/voltage logging

1. Press the button 3 times within 2 seconds to activate the temperature/voltage logging. The LED will blink three times to confirm and the LED will blink very quickly every time it logs a reading.

2. If the LED stays on for 2 seconds this means that no external EEPROM was found. You will need an external EEPROM to be able to log data.

Exit temperature/voltage logging

Press the button once and the LED will blink once.

Transfer data logged to your PC

1. Plug the USB cable into the Standalone Temperature/Voltage Logger and press the button once, the LED should light up.
2. Run the SATVL_v1.3_Transfer application found in the SATVL_v1.3_Interface folder to transfer the data to a file. The filename that will be create is: <year>-<month>-<day>_<hour>-<minute>-<second>.txt
3. The LED will stay on or blink until the data transfer is complete. Once the LED is off, unplug the USB cable.

If you remove the USB cable mid-way through the data transfer and find the LED is still lit, please remove and re-insert the battery.

Test the USB communication

1. Remove the EEPROM and battery
2. Follow the "Transfer data logged to your PC" steps
3. The number "124.5", "0" or "14.98" will be printed until the USB cable is disconnected.

Programming the ATtiny85 (optional)

This step is only necessary if you wish to update the firmware on the ATtiny85 or if you have replaced the ATtiny85. You will require a programmer such as the USBtinyISP and your programmer will need to be supported by the software called AVRDUDE.

To program the ATtiny85 and fuse bits we use the AVRDUDE software:

<http://savannah.nongnu.org/projects/avrdude/>

1. Change the fuse bits so the ATtiny85 uses 16MHz PLL and divide clock by 8 by running the following command:

```
avrdude -p ATtiny85 -c usbtiny -U lfuse:w:0x61:m -U hfuse:w:0xdf:m -U effuse:w:0xff:m
```

Note: You can select to add a Brown-out Detection of 2.7V however it is optional (replace "-U hfuse:w:0xdf:m" in the above line with "-U hfuse:w:0xdd:m") and is only recommended for CR2032 batteries that are new or near new condition. When batteries drop to 2.95V or thereabouts there may be issues when powering up the ATtiny85.

2. Upload the main.hex file to the ATtiny85 by running the following command:

```
avrdude -p ATtiny85 -c usbtiny -U flash:w:main.hex
```

Revision History

v1.3 Rev. 1 – 3/05/2015

- Updated PCB with new voltage switcher circuit and removed 2 protection diodes on input voltage
- Updated code with various small improvements
- Now allows for programming delay times/function in use via PC

v1.2 Rev. 9 – 28/03/2015

- Updated documentation formatting

v1.2 Rev. 8 – 11/10/2014

- Updated documentation to merge temperature and voltage assembly together, removed any v1.0 or v1.1 references including errata and moved programming the ATtiny to the bottom

v1.2 Rev. 7 – 11/10/2012

- Updated SATVL picture on page 1

v1.2 Rev. 6 – 1/10/2012

- Updated R12 (15K) to be R11 and R13 (390K) to be R12

v1.1 Rev. 5 – 12/08/2012

- Split up “Transfer data logged to your PC” section into 2 parts – firmware 1.1.x and firmware 1.0.x
- Updated “Errata” section to apply only to v1.0 PCB

v1.0 Rev. 4 – 4/08/2012

- Small changes to some sentences

v1.0 Rev. 3 – 7/07/2012

- Added time interval accuracy to logging time interval table
- Updated “How To Use” section 5a

v1.0 Rev. 2 – 11/06/2012

- Updated “Feature” notes
- Updated “How To Use” guide

v1.0 Rev. 1 – 13/04/2012

- Initial Revision

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