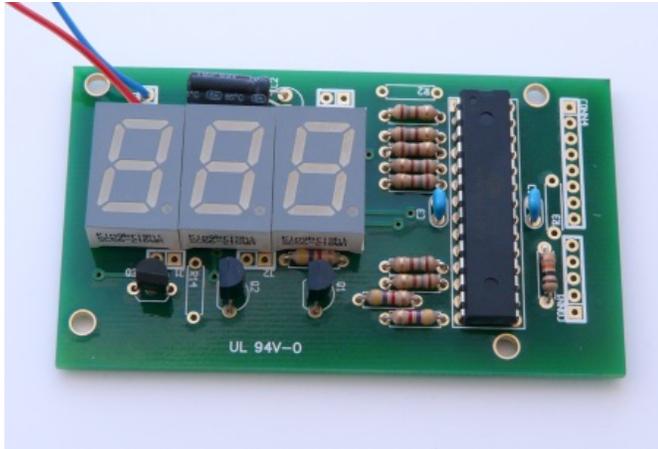




Using the "Mini 3 digit display"



Abstract:

The [Mini 3 digit display](#) aka "DVM-module" (digital voltmeter module) can easily be tuned and modified because you have control over the firmware. The key advantages of this module are:

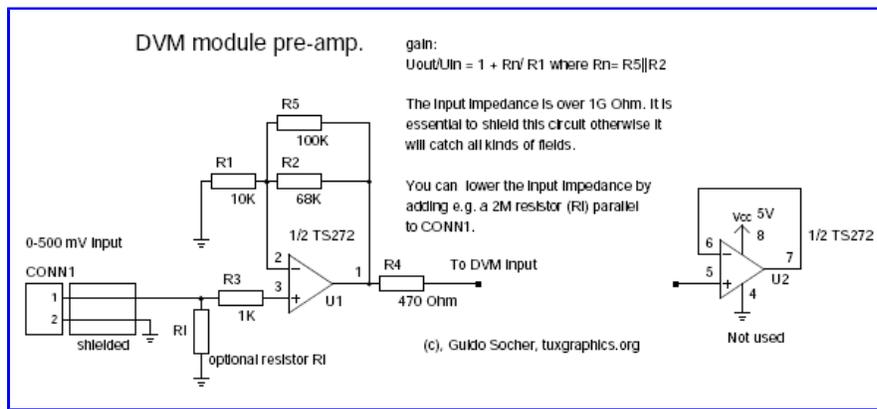
- can be freely programmed and calibrated
- one can power the module from the same power source as the power of the circuit were you want to take the measurement.
- it's not only a voltmeter

Let's experiment a bit with this module.

Not only 2.56V and higher

The internal reference voltage in the atmega8 microcontroller is 2.56V. Just by adding 2 resistors one can measure any voltage higher than 2.56V. How can I measure smaller voltages?

It's simple: just add an amplifier. The problem is only the power of supply for the amplifier circuit. A lot operational amplifiers need positive and negative voltages of e.g +/- 15V. That is not really convenient for our application. We need something that works with about 5V (same as the atmega8). The [TS272](#) or [TLC272](#) is a very good option. It has a very high input impedance of typically 1GOhm. You can use this therefore for true voltage measurements e.g on electrochemical cells.

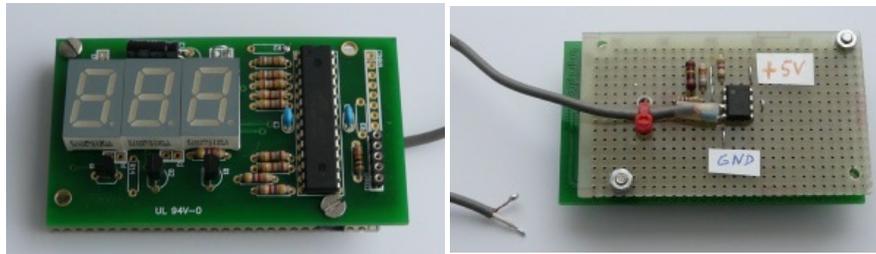


DC pre-amplifier for measuring 0-500mV. The resistor R3 protects the op-amp.

The combination of resistors in the above example gives you a measurement range from 0-500mV with 1mV resolution. VDIV has to be adjusted in the file analog.c to calibrate the amplification factor into the software:

```
#define VDIV 1.955
```

It is easy to add this amplifier by adding a dot matrix board on the back of the 3 digit display module:



You can build a compact "sandwich" by adding the amplifier on the back.

Note that a voltmeter with more than 1GOhm input impedance is very sensitive to electric fields and grabs any voltage just out of the air. I recommend to use a shielded cable or to lower the input impedance by adding a resistor in parallel to the input (Ri in the above schematic).

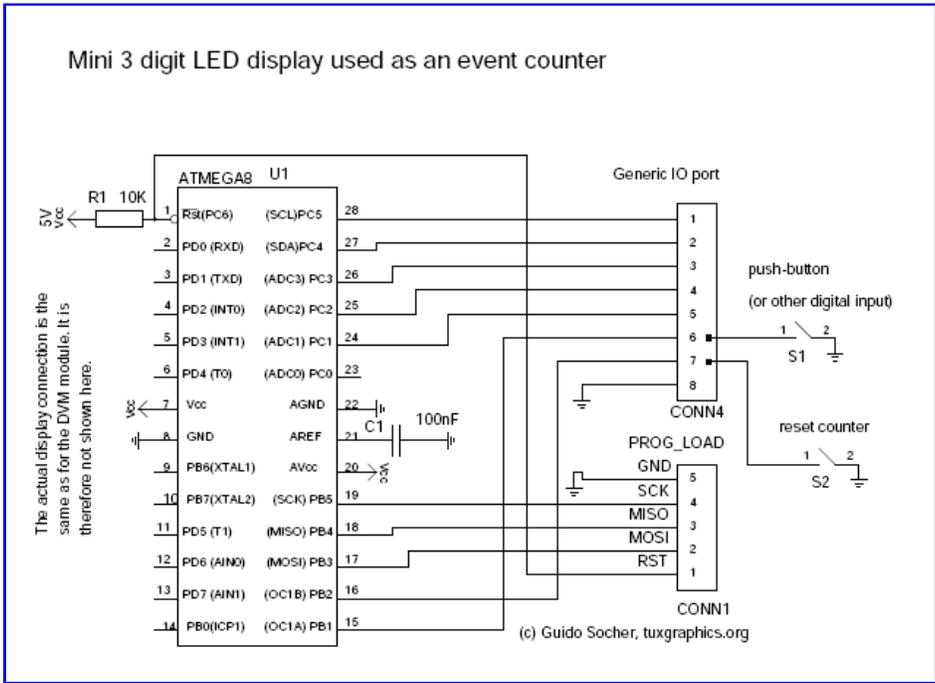
Measuring current

To measure a current you just need to measure the voltage over a low ohm resistor (e.g 1 Ohm, 5W). A current of 2A would then result in a voltage drop of 2V. By changing the VDIV calibration in the file analog.c you can calibrate the circuit as needed. If a voltage drop of 2V is not acceptable then just use a low ohm resistor (e.g 0.1 Ohm or even an inch of some copper wire). You can then adjust it to your needs by using the above amplifier circuit with a different amplification factor (resistors R1, R5 and R2).

The calibration can be done by using a reference ampere meter and modification of the VDIV value in analog.c

Counting events

So far we have use mostly the analog to digital conversion capability of the atmega8 microcontroller. This microcontroller has however also digital input lines. Here is a little counter:



A digital counter

The counter software is included in the source code software package from version mini-voltmeter-0.4 and up.

Counting objects with a photoelectric light barrier

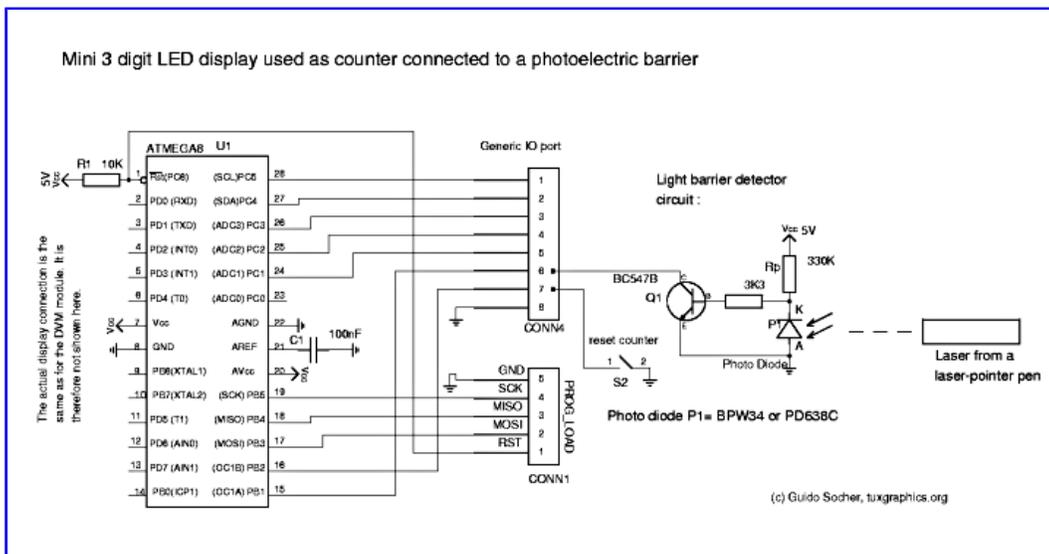
The counter does not have to be connected to a mechanical switch. It can also be connected to a "light beam" and count objects interrupting that beam. For this we add a photodiode and a transistor which acts as amplifier. A small laser pointer pen makes a very good light beam and works even over long distances. You do not have to power the laser-pointer from a battery. Just open it take out the battery and connect it to a DC power supply. You can power it from the same 5V that the counter circuit is powered from. In this case you need to add a resistor in series with the laser pointer. A laser pointer that used 2x1.5V batteries will probably need a 220 Ohm resistor in series when connected to 5V.

The photo diode needs to be placed in a small dark plastic tube to shield it from day light. You can take a ball-pen apart to get a small plastic tube.



Photodiodes:
left: Everlight PD638C, right: BPW34

The longer wire or the top layer of the chip is Anode (marked with "A" in the circuit diagram).



Counting objects with a photoelectric light barrier

Photodiodes are most sensitive to infrared light. A laser pointer is the best light source for long distances (1m to 200m). For shorter distances you can also use an Infrared-LED (invisible to humans).

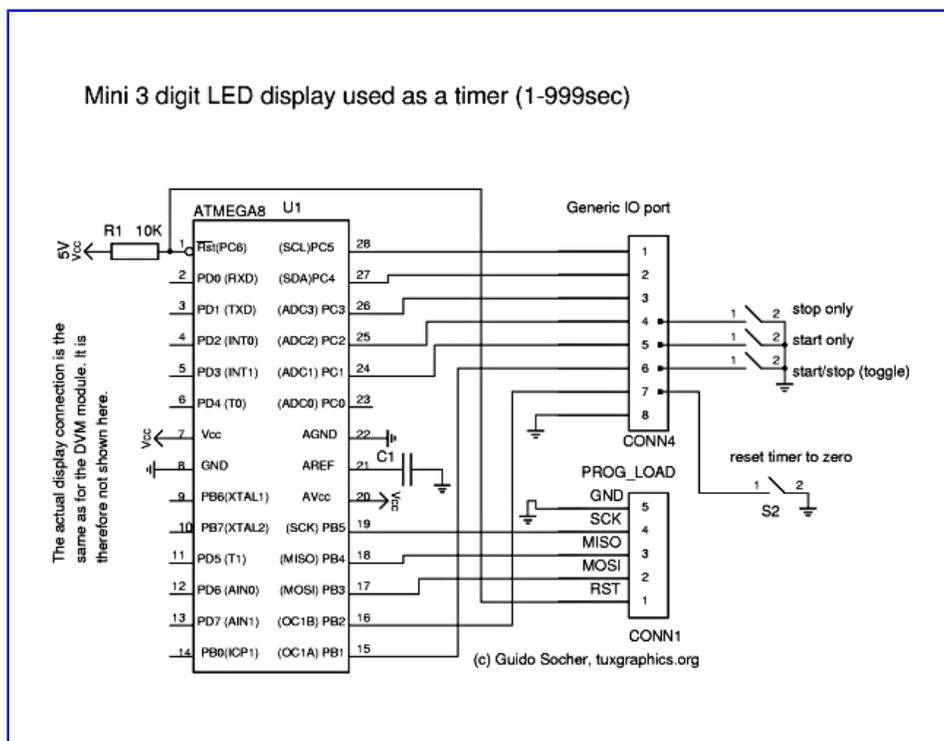
Timer (1-999 sec)

This application is quite similar to the counter except that we generate the pulses via the atmega8 internal clock. The circuit has no crystal but uses the internal clock. This internal clock is not calibrated but you can calibrate the timer by adjusting the line

```
#define CLOCKDIV 223
```

in file timer.c. The internal clock is stable enough for a short term timer.

The circuit has several inputs to start and stop the timer as well as a button to reset it. You can use a button connected to pin PB1. Clicking once starts the timer and clicking a second time stops it. You can use the individual start stop input lines or buttons.



A digital timer

The timer software is included in the source code software package from version mini-voltmeter-0.5 and up.

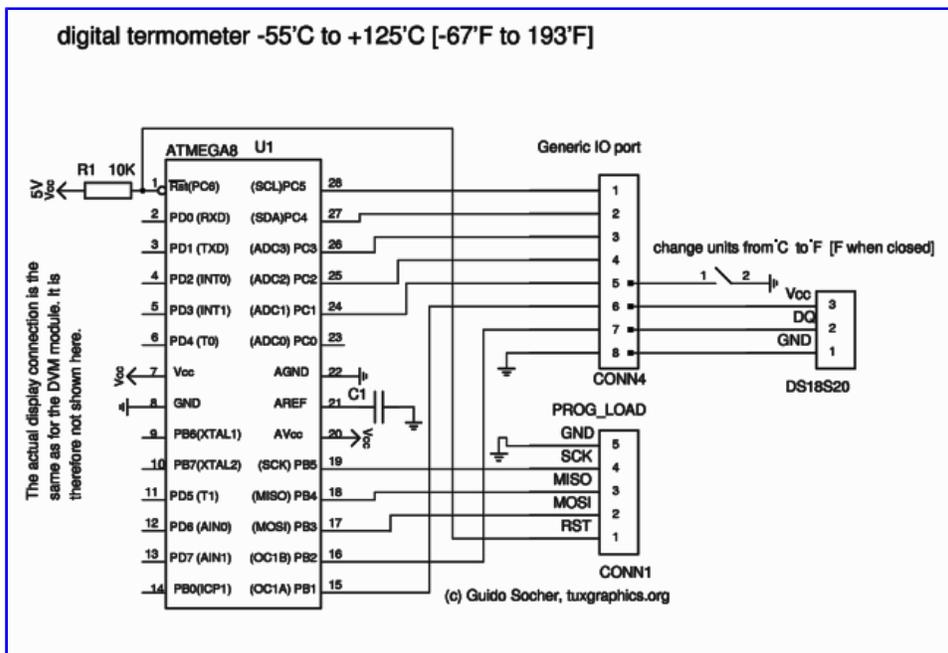
A calibrated digital thermometer

The ds18s20 from maxim dallas semiconductors is a calibrated digital temperature sensor. It looks like a small transistor. The pinout description is shown on the right.

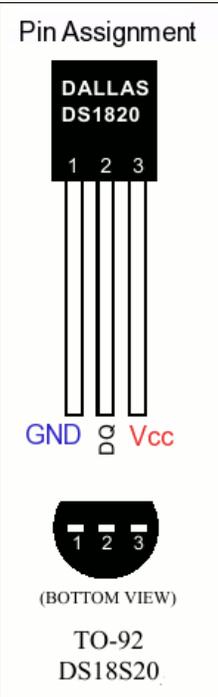
We connect it to this "Mini 3 digit display" and we have a very reliable and accurate digital thermometer. This thermometer source code is included in mini-voltmeter-0.9 and higher and you find it in the subdirectory therm. There is also a pre-compiled hex file (main_therm_pre.hex) suitable for loading into the atmega8 chip.

The sensor can be connected without any additional components and you can have a couple of meters cable between sensor and circuit board.

The microcontroller pin PC1 can be used to change the display units. If PC1 is left open then it displays 'C'. If connected to GND then it displays 'F'. If you connect a little switch then you can change the units at run time. The display shows full degrees (no decimal point).



A calibrated digital thermometer



Your own formula and your own application

This display can be used to convert any voltages into some kind of number and display it. To make your life easier we provided from version mini-voltmeter-0.7 on-wards a custom_formula_example.c file. It shows how to read out a hall sensor and display a value based on a custom formula. It uses floating point math and you can use any type of formula. Open custom_formula_example.c and look at the code. It has towards the end of the file a long explanation.

In version mini-voltmeter-0.8 a second custom formula example was added. It will display -58°F at 0.73V input and 347°F at 2.32V input. It is an application developed for a customer who wanted to display the values of a sensor in his car.

From this revision 0.8 onward it is possible to display negative and positive numbers as long as they are in the range from -99 to 999.

References/Download

- Software download area: [Download page](#)
- The avr ethernet board is available in our online shop: shop.tuxgraphics.org

