Hello YouTubers, here is the guy with the swiss accent again

Testing batteries and rechargeable batteries is an important task. To save money and protect the environment I want to be sure that I use the batteries till the end. This means, in the first phase I use them in a flash light or in other power applications. Afterwards I still can use them in low power applications like clocks.

But how to distinguish between the two phases if you find batteries in a drawer?

The straight forward way is to measure the voltage without load and afterwards with a load of say 2 Ohms to create a typical curent of 500 mA. But this is clumsy and I want a simpler way. And I want a way which does not discharge the batteries during the measuring process.

The “normal” way is to use an Arduino Uno or Pro Mini with a small OLED. Unfortunately, these boards are way bigger than the OLED itself. Wouldn’t it be nice to use a smaller processor for the project?

The Attiny Series are exactly what I was looking for: Very small and cheap processors. Even compared with a Pro Mini they are small. And if you want to go even smaller you can go SMD…

So the concept for my automated battery tester was born: It should use an OLED display and an Attiny and should be able to measure the voltage of batteries with and without load. This measurement should be done very fast that the battery is not discharged during the measuring process.

Here is the prototype: I connect a battery to the two cables and the OLED shows two values: Without and with a load. This battery for example is capable to provide 1.6 Volts without and 1.2 Volts with load.

This other battery still provides 1.2 Volts without load but less than 1 Volt with load and therefore cannot be used for power applications However, it can still be used for low power applications because with a small load it will still provide more than 1Volt for a certain time.

The device can be used for all sizes and also for rechargeable batteries. For this project I decided to limit the voltage to max. 2.2V.

To build such a device with an Arduino Uno is not difficult. But can it be done with a small Attiny85 chip? Measure voltage and current? Switch the load on and off and show the results on an OLED attached to an I2C bus?

But let us start with the principle of the device:

A battery has to be loaded by a resistor and this load has to be switched on and off. At the same time, the voltage has to be measured.

The sketch is a simple loop. Switch the load off, measure voltage, switch the load on, measure again, and switch the load off to preserve energy during display.

Now let’s go to the data sheet of the Attiny to find out if all resources are here:

Yes, it has 4 Analog-to-digital converters with 10 bit accuracy and a precise internal 1.1V reference. So, we can measure our two voltages even if we power the device later with batteries.

And yes, it supports serial communication like I2C.

But does this tiny chip has enough pins?

VCC and Ground cannot be used for the program. And pin 1 is somehow special. It is used as reset pin. It is quite complicated to use it as an active pin in your programs because you have to program and reset a fuse to use it. And programing fuses is not part of this tutorial. So, we do not use it for this project.

Pins 5 and 7 are dedicated to serial communication and are used for our I2C interface. Pin 2 and 3 can be used to measure voltages. We use them to measure voltage and current. Pin 6 can be used to switch the load on and off.

To do this I use a small N-channel FET. These transistors have very low resistance if switched on. This is important for this application since we want to charge the battery with about 500 mA. With Ohm’s Law we need a resistance of 2 to 3 Ohms to create this load.

In the prototype I used 2 one ohm resistors in series. Together with the FET and the cables the resulting current is about 500mA.

We have enough hardware resources to do the job. But do we have enough software resources?

I2C connections are not simple to be used. This is, why we gladly use the Wire library to do the job. But this library does not work on Attinys. Fortunately, Adafruit provides a TinyWire library to use Attinys as I2C Masters.

First problem solved.

Now the second problem: Find a working OLED Library. Two problems have to be solved:

1. The library has to be small because Attiny85 only has 8k memory, which is 4 times less than the Uno. And most common OLED libraries are quite big.
2. All known libraries work with the Wire, and not with the Tinywire library

Fortunately, I found a library which is small and simple. But it is sufficient to display numbers (even big ones). And you can rotate the display if you want to mount it upside down…

Point two was just work: I adapted the library that it uses the Tinywire instead of the wire library.

Let’s now have a look to the diagram: It consists of 4 resistors, a Attiny85, an OLED and a few connections.

Here is the finished breadboard. The Attiny85 is so small you hardly see it. Everything is ready to be programmed.

Attinys are programmed differently than Arduinos or Mini Pros: You need an USBASP programmer. In the web you find also many descriptions on how to make an Arduino UNO act as such a programmer. However for me this is too complicated and I built a small programmer myself. One time the investment and now it is very comfortable…

Do not forget to Program once the “Bootloader”. This task sets the right fuses in the Attiny. It has only to be done once per chip because it will not lose it.

The necessary code is quite simple. It follows the flow chart presented at the beginning of the video. I measure also the current flowing through the load, but decided not to show it in the display. I only used it during the programming phase.

Now I program the chip and test the thing. Especially the short time the load is active has to be tested. One way to do this is with an Oscilloscope.

Here you see the voltage curve during a measuring period. The time with load is very short (less than 100ms).This is a very small load to the battery.

After I had a working prototype I put it on as small PCB. It has about the same size as the OLED! In one of the next episodes I will show you the workflow I use to mill my PCBs.

At the end I mounted it with some hot glue to a standard battery box.

After the device is built and tested you can argue that it is not worthwhile to build such a complicated device to do this simple job. And you probably are right.

But for me it helped to learn how to build small devices to be used in later projects: Small Attinys and small OLEDs. What a wonderful combination!

What kind of projects come to your mind if you see these possibilities?

I would be very glad to hear from you.

If you want to be informed about the next episodes, just subscribe the channel.

I hope, this topic was interesting for you. Bye