

# BCDWristWatch

SulKith



# 1 Binary Watch

## 1.1 PCB

### 1.1.1 First PCB Version

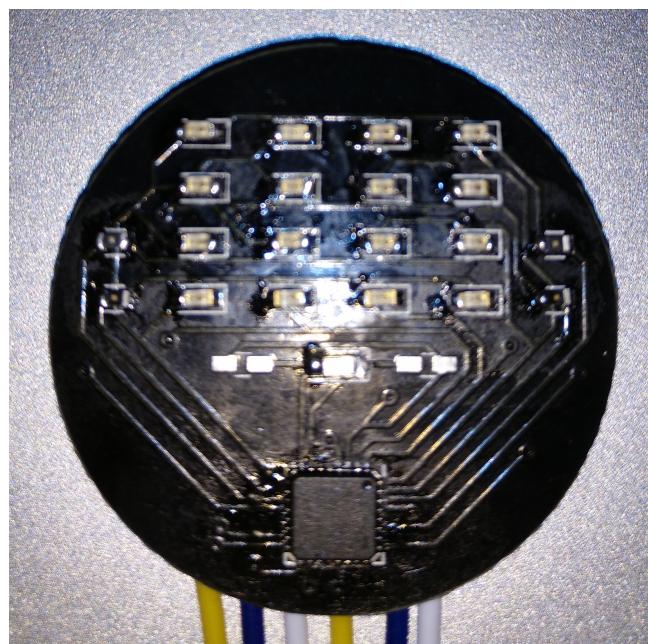
The First PCB Version was a desaster. The PCBs arrived very fast, but the QFN Package had the wrong size. ATMEL only produces QFN32 in 7x7mm. Therefore the design of the PCB hat to be changed to the smaller package, but that gave me the Chance to shrink the Design to a smaller form factor. The part which keeps the PCB from getting smaller is the Coin Cell Battery (CR2032). On the PCBs there was the order number printed on the Front side, which would be visble in the final assembly.

### 1.1.2 Second PCB Version

The second PCB Version was designed from scratch. But the Front was the side with the Battery, so hopefully the Order Number would not be printed on the visible side of the PCB. This worked out very well for the second Version of the PCBs.

### 1.1.3 PCB1

since the PCBs finally arrived. it was possible to assemble all the parts. The first PCB was assembled with some Cables soldered to the Testpins on the Backside of the Board. And the Battery case was also not assembled. Here is a Picture of the uncleanned but already soldered PCB



### 1.1.4 PCB2

The PCB2 was assembled and cleaned as a First Prototype with the Housing. Here are two Pictures of the PCB one without the LEDs turned on and one with the LEDs turned on. Brightness was set in the Program to 100/255 (see software void showLEDs, constant perc=100)



### 1.1.5 PCB3

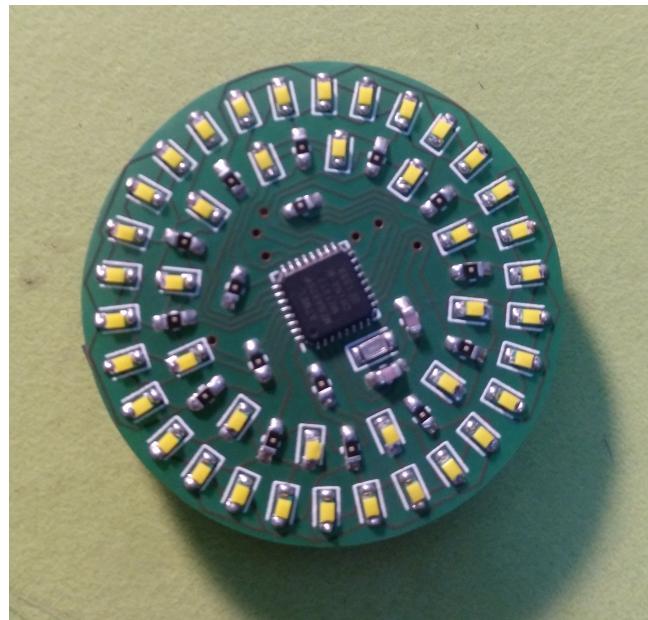
The third PCB was ordered at [aisler.net](#). It only took around one and a half week to arrive(to Germany). The PCB was not completely milled out. It was in a carrier PCB with rectangular shape, but it was easy to remove. I had to sand the edges a bit, since it was a bit rough on the parts where i removed the connections to the carrier, since i had to sand the PCB anyway to fit in the Housing that was no big problem. The overall Quality of the PCBs is very good, but you can not choose the thickness or color of the PCB.



## 1.2 PCB for an analog Version

After the PCBs for the BCD Version were working, i also created an analog Version, so i dont have to explain the Clock everytime ;-)

The Analog Watch features the same Schematics for the basic clock functionality, but the display is done via Charlieplexing the LEDs. There are 4 Clusters with 4 Pins which drive all the 42 LEDs. 12 LEDs on the inner ring are displaying the hours. On the outer ring 30 LEDs display the Minutes. Since it was not possible to fit 60 LEDs on the outer ring, uneven numbers are shown while lighting up the two neighbouring LEDs.



### **1.2.1 first Watch which i gave away**

The first Watch i gave away was one of the analog PCB ones i built for my dads birthday. for this Watch i replaced all the resistors for the LEDs with Zero  $\Omega$  resistors, so the LEDs got more bright and are clearly readable also in the sunlight.



## **1.3 Housing**

The Housing was designed in OpenSCAD. a very helpfull reference for the OpenSCAD syntax was [https://en.wikibooks.org/wiki/OpenSCAD\\_User\\_Manual/Transformations](https://en.wikibooks.org/wiki/OpenSCAD_User_Manual/Transformations)

### **1.3.1 Housing 1**

The Housing was printed by the TOOM Printing Service as SLS in PLA. Sadly all the surfaces are not really smooth, therefore the Buttons are working very bad. I tried to glue in the glass with superglue, but the glue dried out white, this looks really bad :-(

### **1.3.2 Plans for Housing 2**

The next housing should be produced via SLA with transparent Resin, so no glass for Protection is needed, since the resin could be used.

**Problems while printing with SLA** It turns out, that there is no completely transparent Resin available. All of them get a yellow color sooner or later. So it is not really beautiful as a glass.

### 1.3.3 Housing 2

A friend told me that most of the time the resin will not reflect light equally in every spot, therefore i decided to order a PCB without glass and do the mounting of the glass with very tight tolerances and a rim on the top edge. this worked out extremely well. Another goal was to make the second Housing slim, because the first one was very bulky. With a bit of optimization it was possible to integrate the bottom plate completely in the housing. The overall thickness was reduced from about 15mm to 9.4mm with the 1mm PCB or 10mm with the new 1.6mm PCB. For the PCB to tightly fit in either the Housing has to get some additional holes or at least the Battery clip has to be modified.



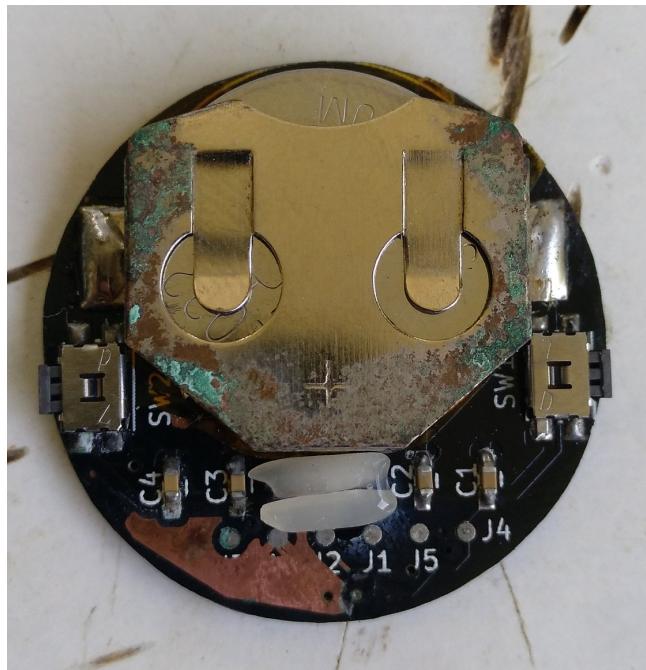
## 1.4 Problems

### 1.4.1 Sweat is entering the Housing

The first watch broke down after nearly 1 year. After opening the Housing the Problem was very obvious. Sweat was entering the Housing and corroded the PCB and the mounted parts.



**Cleaning the PCB and adding something to absorb the moisture** As a solution i tried to clean the PCB with Isopropanol and glued some rice to the PCB to absorb the moisture, that helped only for about a week and the Watch stopped working again. So that is not the best solution, but is is an extraordinary try ;-)



**adding isolation Tape between the lid and the housing** The second solution was to add Tape, which is originally designed to be used to seal threads, between the housing and the lid. That worked out a little bit better, but the Watch also stopped working after a few weeks.

**Analyzing the Watch again** After analyzing it again the PCB seemd to be ok. The PCB was only a little damaged from the first sweat attack. The Problem was that the time stopped to run, but another point was that the LEDs wont go off anymore. But it was possible to set the time. So the conclusion is that the clock which is run by the crystal stopped running.

**Adding clear Nailpolish to guard the Crystal** The next attempted solution was to add clear Nailpolish to the PCB, so the crystal is completely covered. This is an attempt to stop moisture from crawling below the crystal and stopping the clock.

Adding Nailpolish was also not the real solution. The Clock also stopped to work after a few weeks.

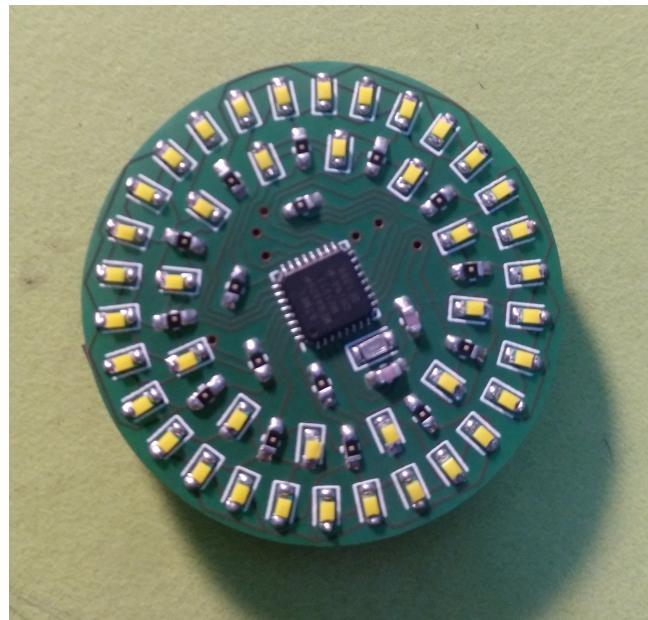
**commercial products to insulate PCBs** The next attempt will be to use a commercial Product to insulate the PCB. For this i will try Plastik 70 Super from Kontakchemie.

## 2 Analog Watch

### 2.1 PCB

After the PCBs for the BCD Version were working, i also created an analog Version, so i dont have to explain the Clock everytime ;-)

The Analog Watch features the same Schematics for the basic clock functionality, but the display is done via Charlieplexing the LEDs. There are 4 Clusters with 4 Pins which drive all the 42 LEDs. 12 LEDs on the inner ring are displaying the hours. On the outer ring 30 LEDs display the Minutes. Since it was not possible to fit 60 LEDs on the outer ring, uneven numbers are shown while lighting up the two neighbouring LEDs.



## 2.2 Housing

The PCB for the analog Version is designed with the same mechanical Interface as the Binary Version therefore the Housing from the Binary Version can be used.

## 2.3 first Watch which i gave away

The first Watch i gave away was one of the analog PCB ones i built for my dads birthday. for this Watch i replaced all the resistors for the LEDs with Zero  $\Omega$  resistors, so the LEDs got more bright and are clearly readable also in the sunlight.

