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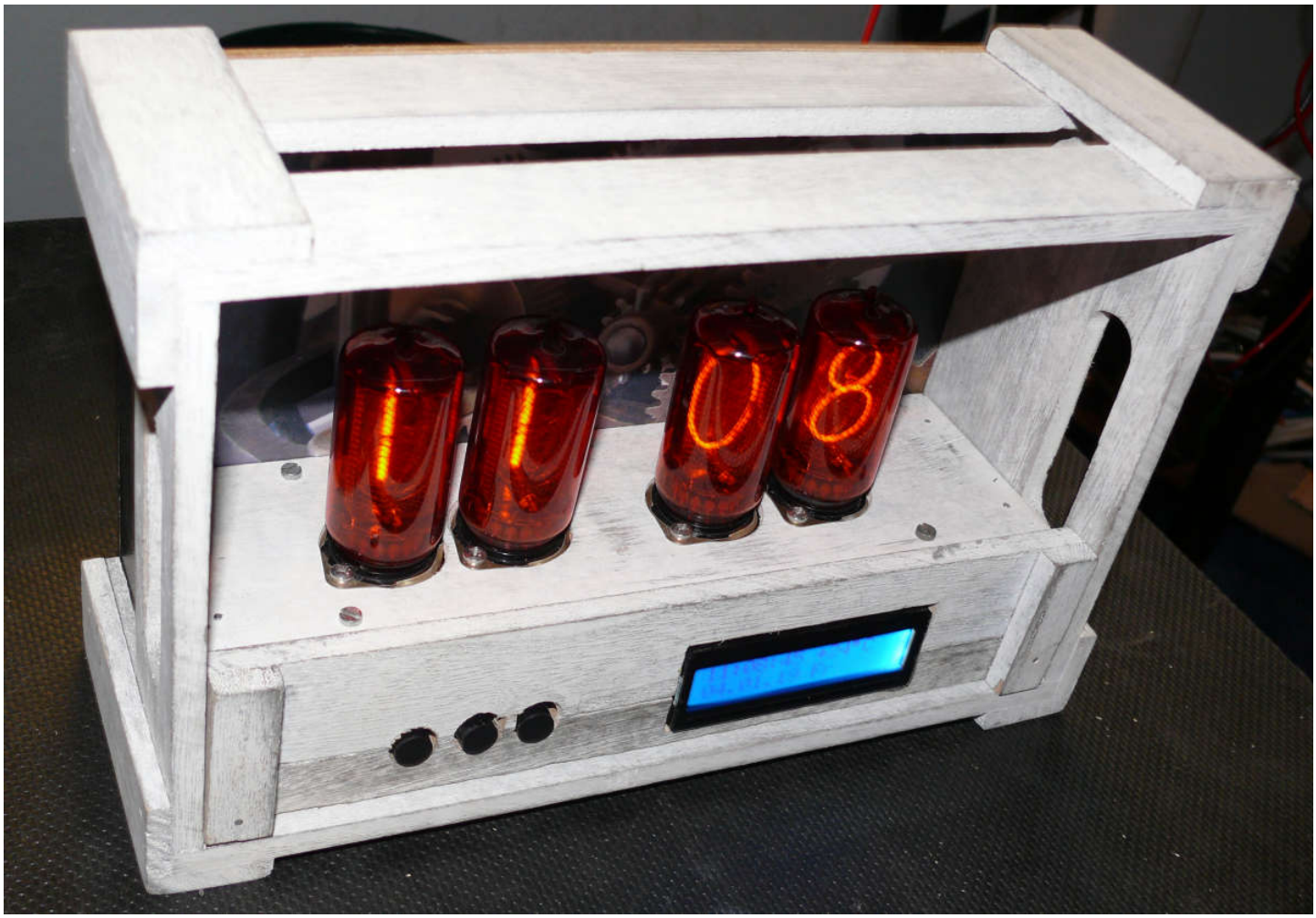
professional tube-testing-system (c) Helmut Weigl www.roehrentest.de

Nixie Clock



At last I managed to build a long planned project, a Nixie tube clock.
There are a lot of ready made clocks or complete kits available for a favorable price.

This was out of question for me. I want to do handicrafts and fulfill exactly my own demands.

My Nixie clock has the following properties:

- On my clock I want to show time, date and room temperature. This would require a lot of Nixie tubes or the data must be shown alternating or the data must change at the push of a button. All that is not an option for me. My solution is: hours and minutes are displayed with Nixie tubes (therefore also good readable from the distance), all other data are displayed on an LCD display. So all information is simultaneously available.

- The clock is in my hobby room. There I switch off all mains sockets with a central switch when I am absent. This saves lifetime of the Nixie tubes and also reduces power consumption. The whole circuit is then without power. When switching on the clock

it must be functioning immediately. Therefore a solution with a radio-controlled clock that first has to synchronize itself is not an option. My solution: a precise real time clock (RTC). The RTC continues to operate from battery power. The rest of the circuitry (PIC micro-controller) can be powered off.

- No multiplexing. All 4 Nixie tubes are driven separately.
- No specific driving ICs → single transistors (cheap and always available)
- Signal distribution to the Nixie tubes: via I²C-Bus PCF8574
- High voltage with well-proven generator circuit using MC34063
- Supply from a wall AC adapter 12V/0,5A (no built in power supply)
- One circuit board for all components. Only the Nixie tubes are connected with wires.

Thus the circuit board is not limited to a specific Nixie tube type.

- No unnecessary software burden (no alarm, no relay, no daylight savings time switching).
- Individual housing. I used a wooden case, slightly shortened in depth from a DIY store.

From the remaining wood I built the inner case.

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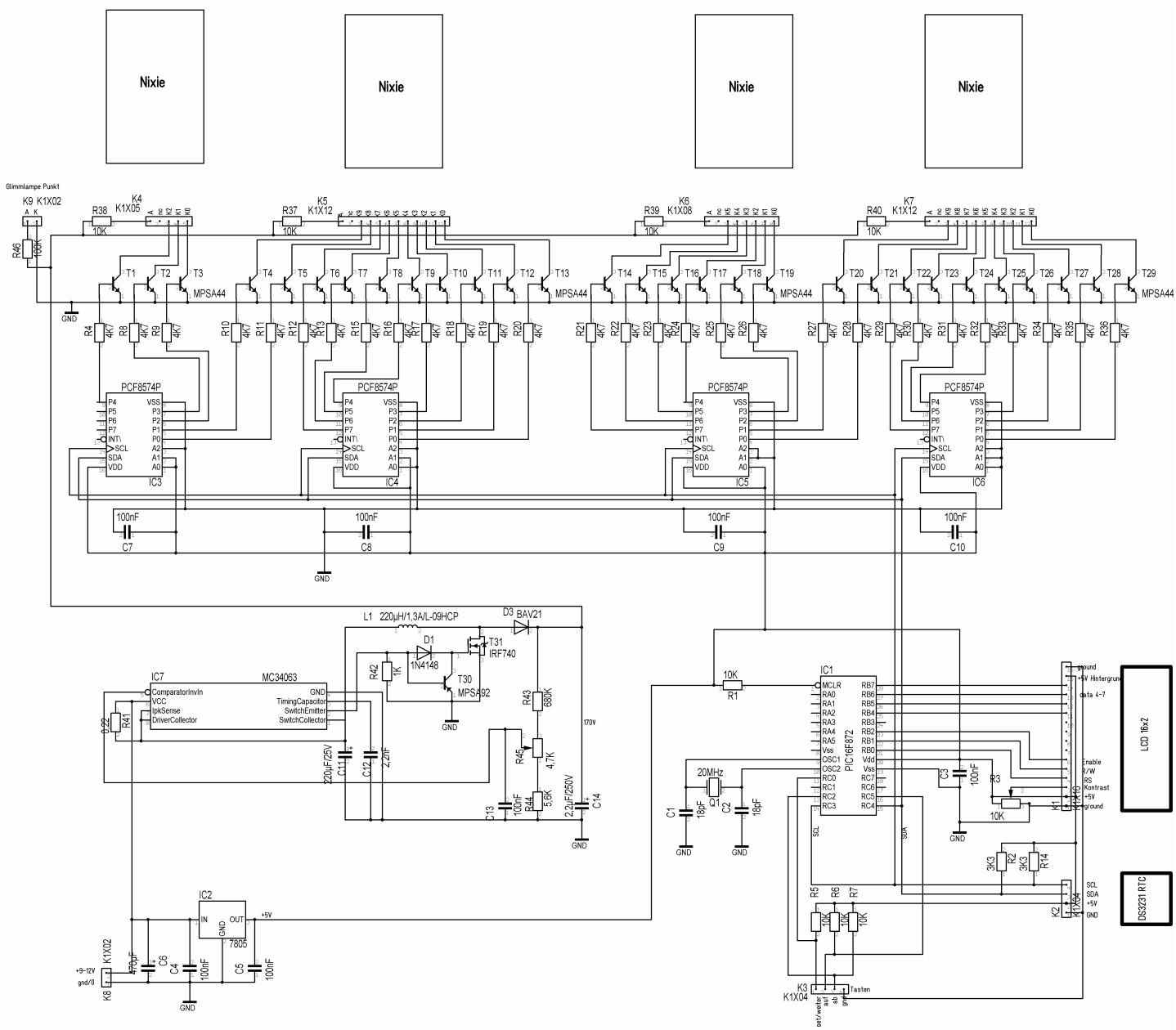
Circuitry:

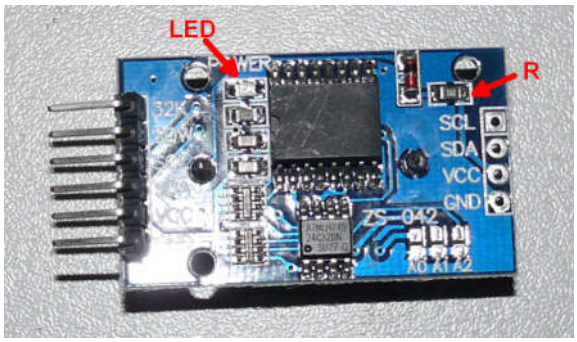


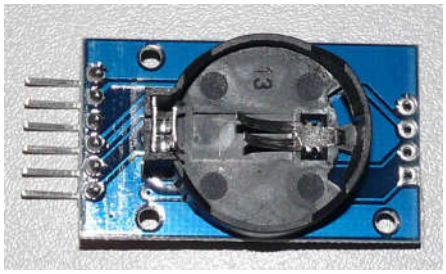
At the top: discrete Nixie tube drivers with transistors. Below are the PCF8574 for signal distribution to the driver transistors. Down on the left side: high voltage generation. Depending on the Nixie tube type and the series resistors a voltage of 170-200V is required. The series resistors, 10 Kohm in the circuitry above, and the high voltage (trimmer R45) must be adapted for the used Nixie tubes. I used Z566M Nixie tubes and adjusted the minimum current to 3 mA. With that current the Nixie tubes are bright enough and it increases the lifetime of the tubes. On the circuit board there is also a connector for a glow lamp as a decimal point. There is a separate resistor on the circuit board that must be adapted for the used glow lamp (if a glow lamp is used at all). Further down on the left side: the 5V voltage regulator. Down on the right side: PIC micro-controller (PIC16F872), connector for the LCD-display, connector for 3 push buttons for time and date setting (set, +, -), connector for the DS3231 RTC clock module.

The DS3231 is a high precision real time clock (RTC). A complete module (from ebay) is cheaper than building the RTC from discrete components and no SMD parts have to be soldered. So I used a module for the RTC.

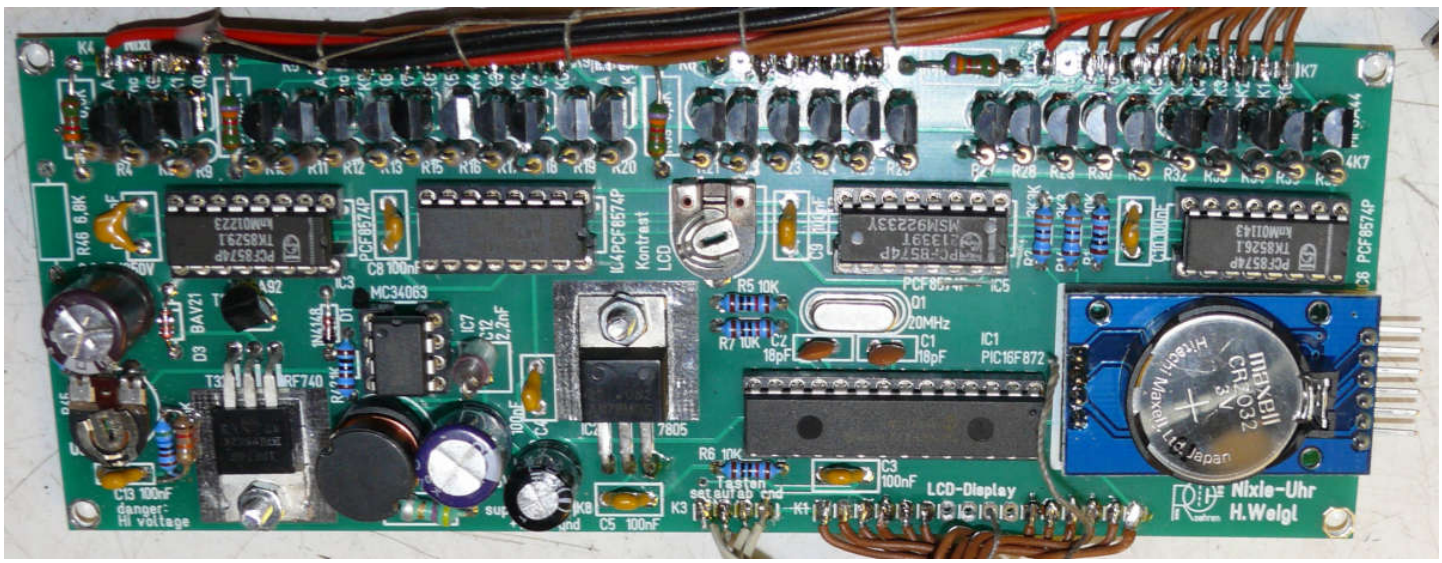
The DS3231 also implements a temperature sensor that is used for compensation of the components temperature drift. The temperature can be read out from the chip and is used for display of the room temperature. It is important to implement a good case ventilation so that the inner temperature of the clock is the same as the room temperature.

The module is intended for use with an accumulator. Due to the module's very small current consumption the self discharge of an accumulator seems to be higher than the module's power consumption. A better choice is therefore to use a battery (CR2032). For this option the accumulator loading resistor R on the module must be removed. I also removed the module's operation display LED (the red glow is annoying).





The whole circuit is mounted on a 16 cm x 6 cm circuit board:



On top are the connections for the Nixie tubes. Only the required driving transistors were implemented (the ten's of the hour display only needs the digits 0-2, the ten's of the minute display only the figures 0-5).

At the bottom are the connections for the LCD-display (16x2 characters) and the 3 push buttons.

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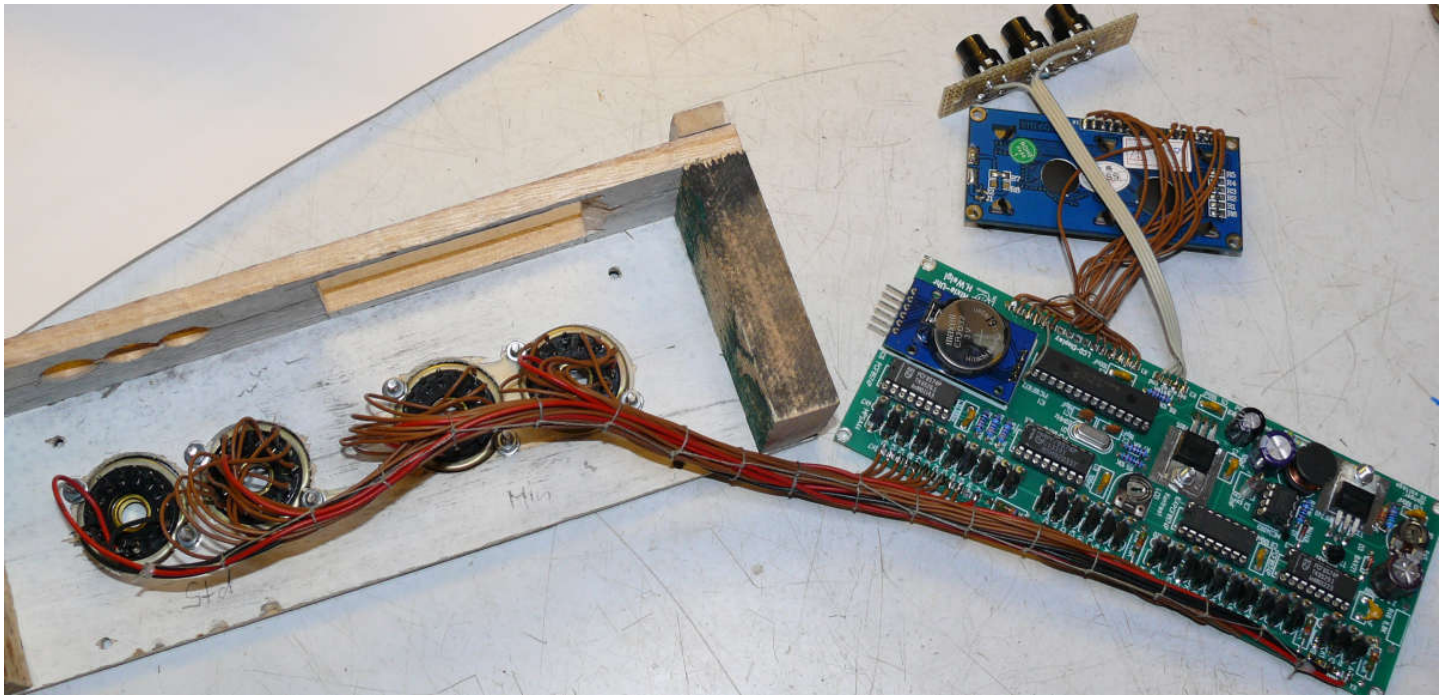
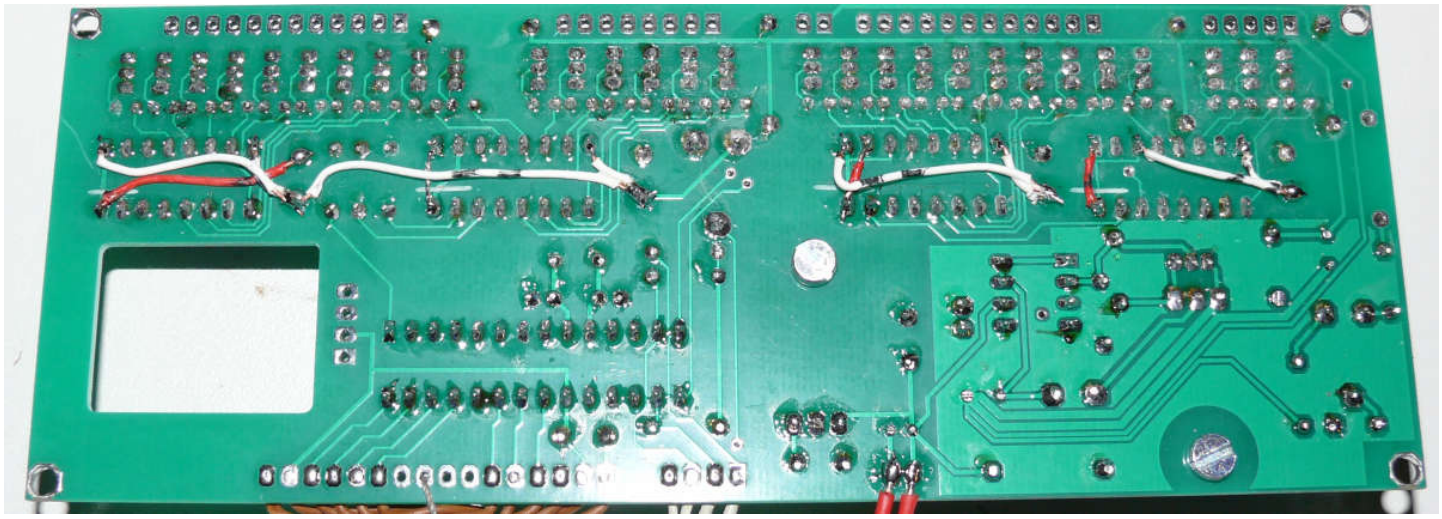
The Nixie tubes, the push buttons and the LCD-display are connected to the circuit board with wiring harnesses:



Unfortunately ('as usual') an error occurred on the circuit board's prototype. The VDD and VSS pins of the PCF8574 are transposed. Therefore some tracks had to be cut and wire bridges had to be inserted:



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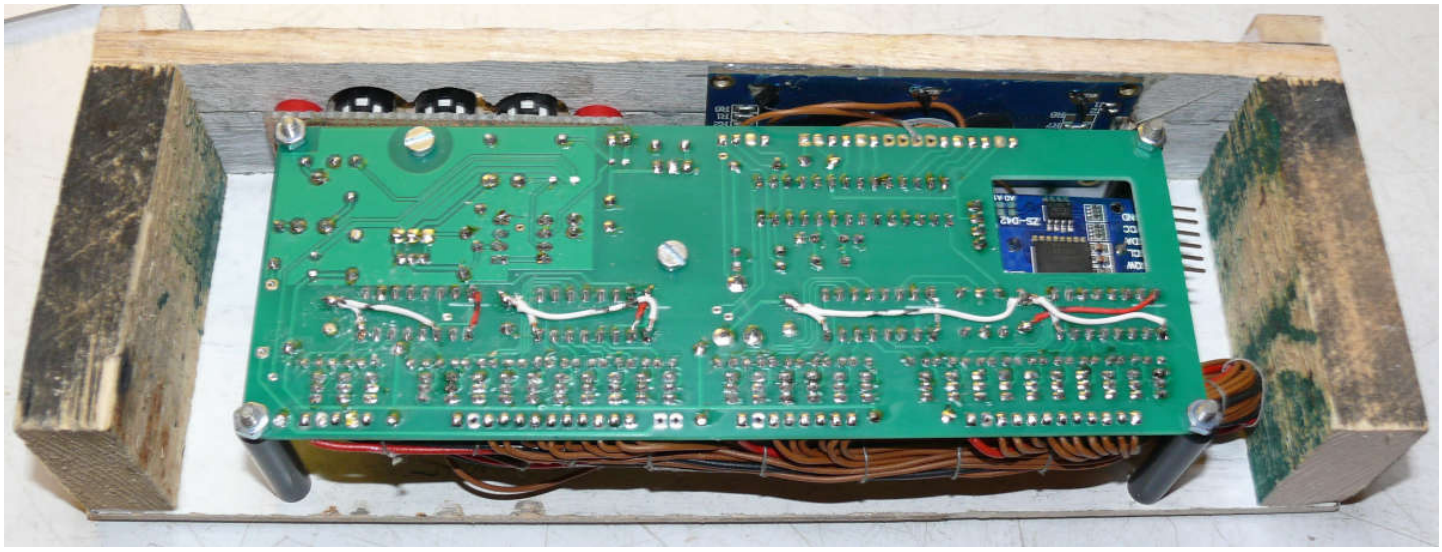
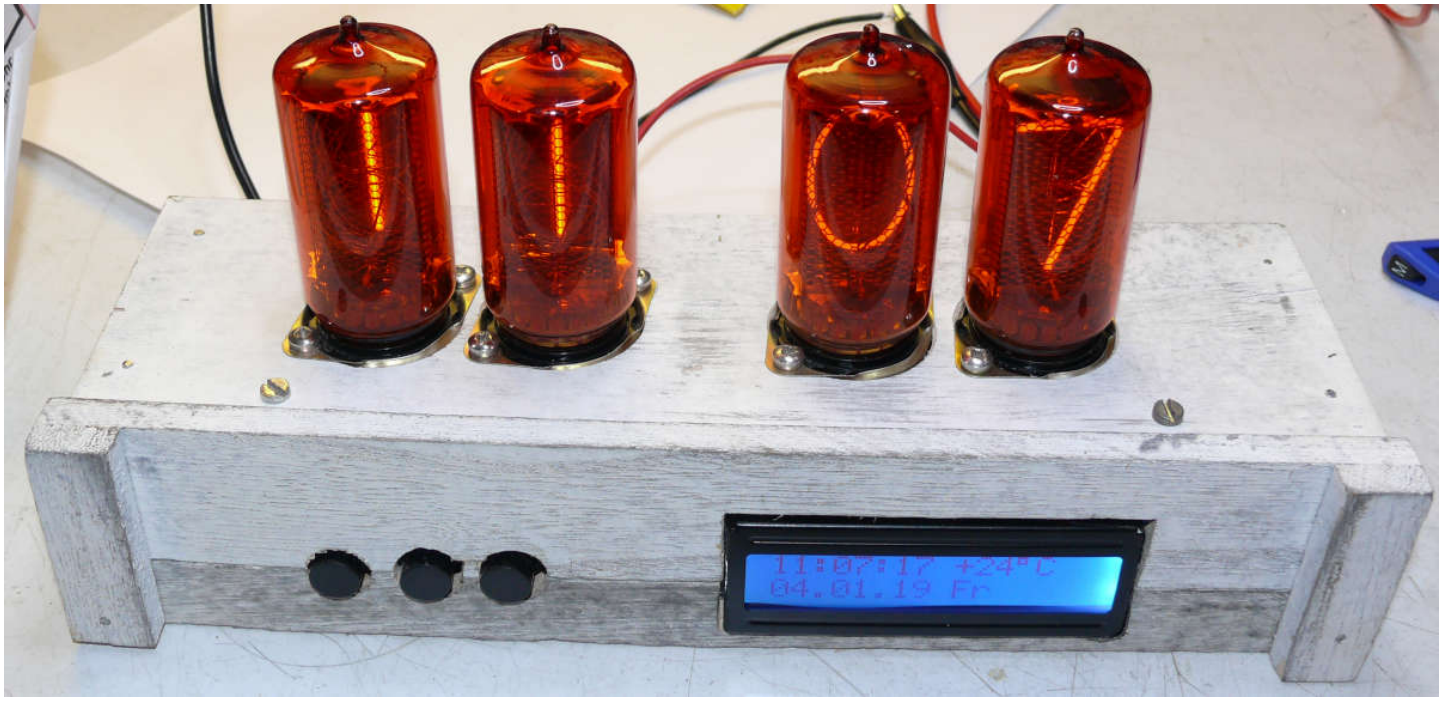
The electronic circuits mounted into the small case:





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… the small box with the electronics inserted into the outer case:

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… the wooden parts of the outer case (with a picture of gearwheels in the background):

With some creativity for case construction the clock pleases more than a ready made bought one.