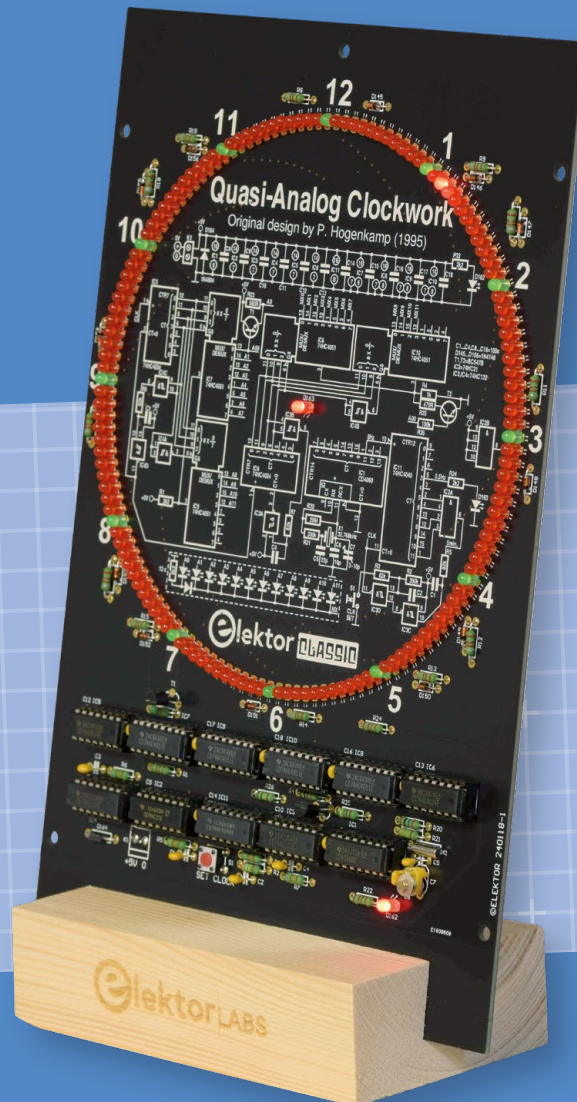


Elektor Quasi Analog Clockwork Kit Construction Manual



SKU 20944

Elektor Quasi Analog Clockwork Kit

Construction Manual

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You can find this essential document at the following address:
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Notice

This document is complementary to the information contained in the engineering background and discussions posted on the *Elektor Labs* website.

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1 – Kit Contents

The kit supplied by Elektor contains the PCB and all parts stated in the Bill of Materials found in section 5.

The next photo shows the components in the kit.

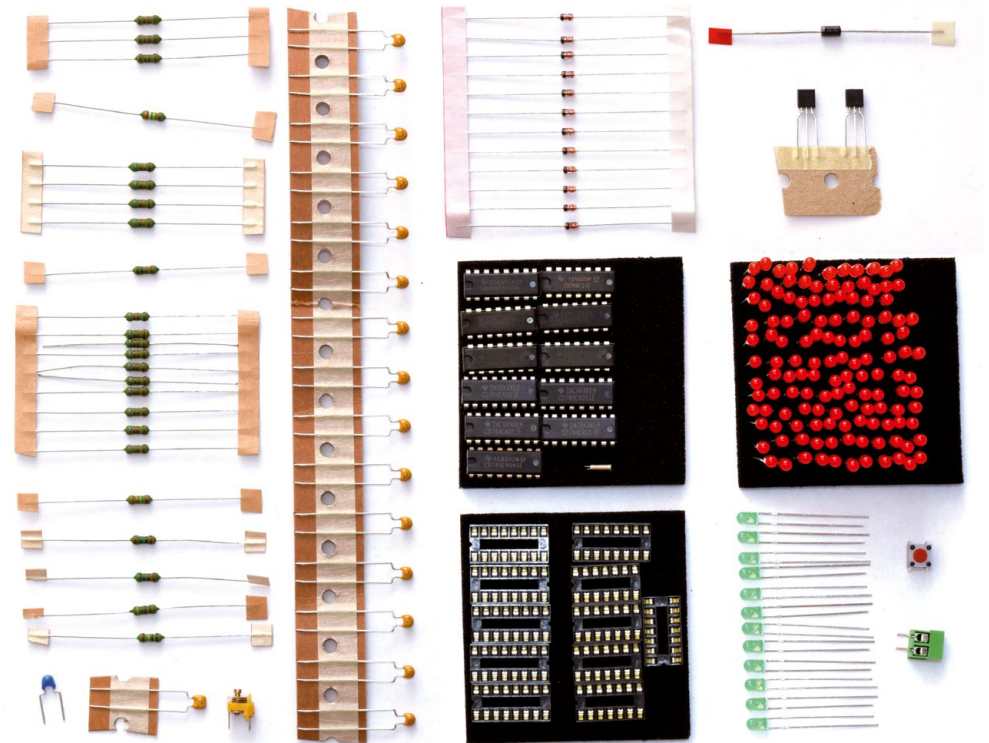


Figure 1: Components contained in the Elektor Quasi-Analog Clockwork kit.

The following images show the top and bottom side of the PCB contained in the kit.

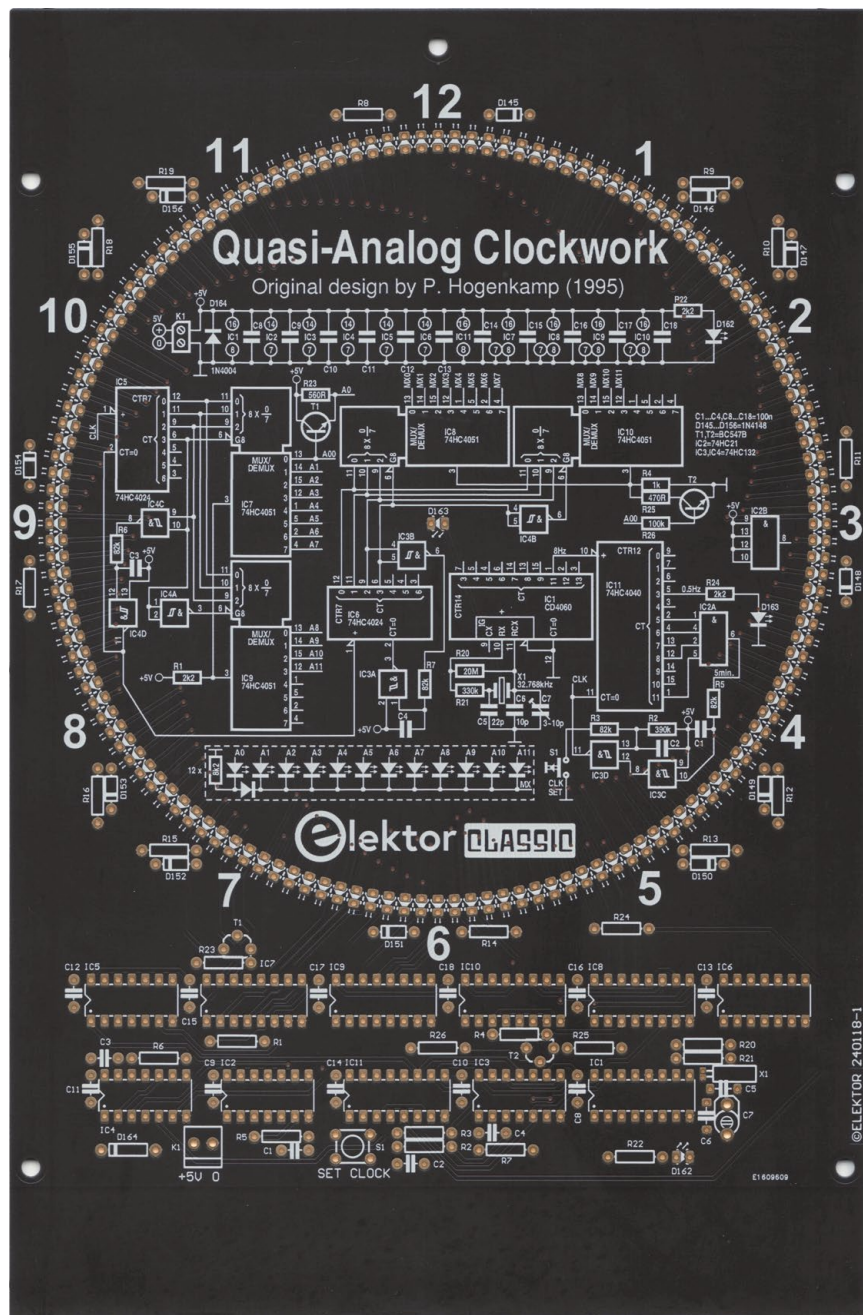


Figure 2: Top view of supplied PCB 240118-1 v1.1.



Figure 3: Bottom view of supplied PCB 240118-1 v1.1.

2 – Tools Needed

- Soldering equipment for through-hole components. Soldering iron with a relatively small tip.
- Cutting pliers
- Flat-jaw pliers
- Flat and clean surface to place the PCB on when soldering the components

3 – Assembling the PCB

Start by placing the lowest components first and solder them. The quartz crystal, X1, is the smallest and most fragile component and best fitted when the rest of the components are placed and soldered. In case of the diodes, pay attention to the cathode marking. First solder one lead and check polarity again — it's easier to remove a diode with just one lead soldered. When turning over the PCB to solder the leads, make sure the surface is perfectly flat. After soldering the first leads — also applicable to the resistors — check if the body of every component is level and flush on the PCB surface. Then solder the second lead of each component.

Place the following components and solder them in this order:

1. Diodes D145 – D156
2. Resistors R1 – R26
3. Diode D164
4. Tactile switch S1
5. All IC sockets: first solder 2 pins in opposite corners of each IC socket and check they are all fitted correctly; then solder the rest
6. Capacitors C5 (22 pF) and C6 (10 pF)
7. Capacitors C1 – C4, C8 – C18
8. LEDs D1 – D144, D162, D163

The short leads (i.e. cathodes) of the LEDs in the circle are on the outside. When soldering, pay close attention to this! Place one LED at a time and solder one lead of each LED only and check if it's placed perpendicular with the PCB surface and if the last LED soldered lines up perfectly with the previously soldered ones. Check if this is the case, with every LED, every time! Also place the green LEDs in the correct position. Between two green LEDs go 11 red LEDs. If everything looks good it's safe to solder the second lead of each LED. Before soldering, make 12 stacks of 12 LEDs, 11 red and 1 green. This is to remind you that after 11 red LEDs one green LED must be soldered. Placing all 144 LEDs in the circle first and soldering them all at once will not work since the transparent plastic of the LEDs is subject to tolerances too much, and the holes in the pads are larger than the LED wire diameter.

Proceed with soldering:

9. Trimmer C7
10. Transistors T1 and T2
11. Terminal block K1 (place it on the bottom side, see Fig. 5)
12. Crystal X1

4 – Adjusting Trimmer Capacitor C7

Adjusting C7 requires a frequency counter with at least a 7 digits. Many modern multimeters with an graphical display also are able to measure frequency but not that accurately. The latter can be used to get an indication whether or not the 8 Hz deviates too much. Measure at pin 1 of IC1. If an accurate frequency measurement isn't possible, adjust the trimmer halfway. A quote from the datasheet published for the trimmer used (BFC280823109): "Life of trimmer is specified as 10 cycles maximum, rotation in 180° only (is the effective angle of rotation). The electrical and mechanical performance is not guaranteed if rotated beyond 10 cycles." Also solder the trimmer as close as possible to the board!

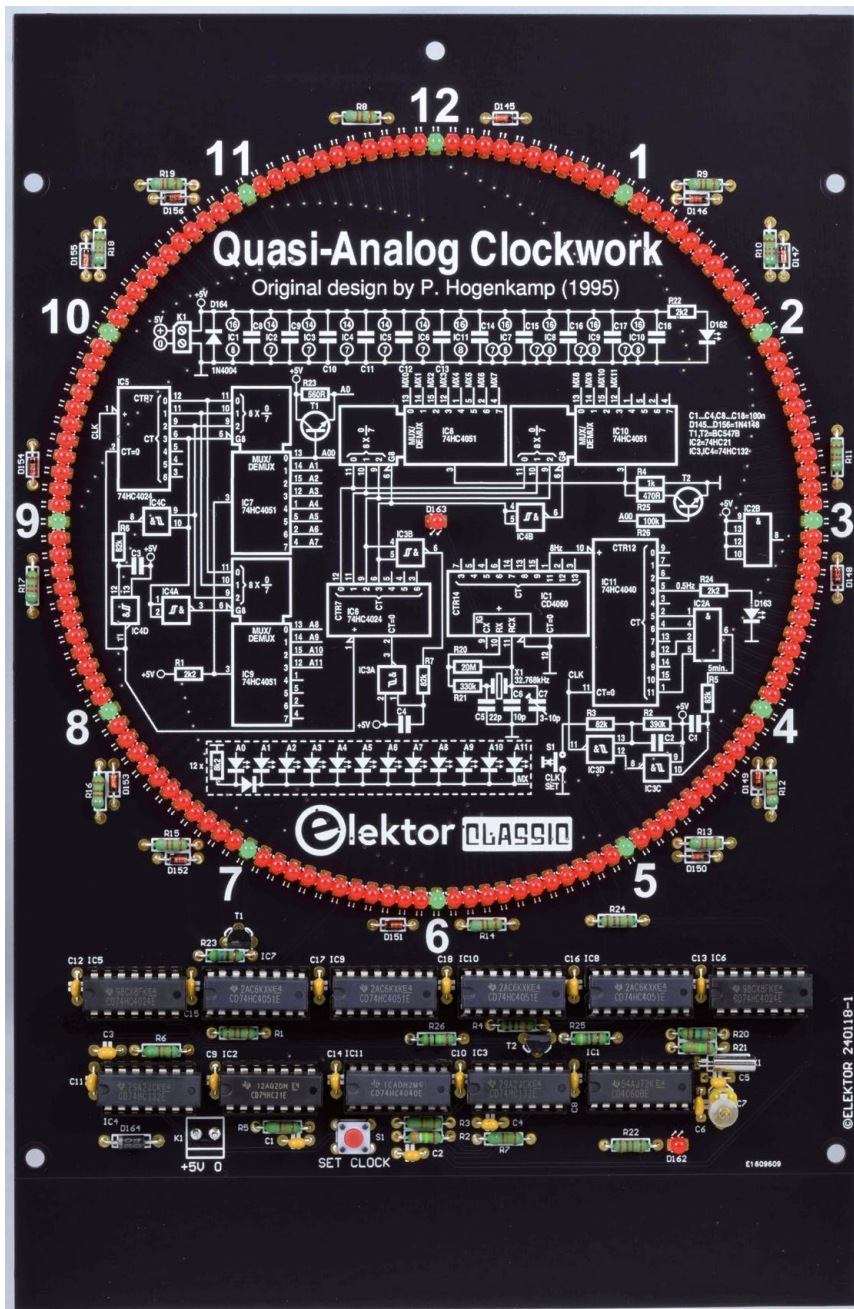


Figure 4: Front view on PCB 240118-1 v1.1. All parts are fitted and soldered.



Figure 5: View of back of PCB 240118-1 v1.1. All parts are fitted and soldered.

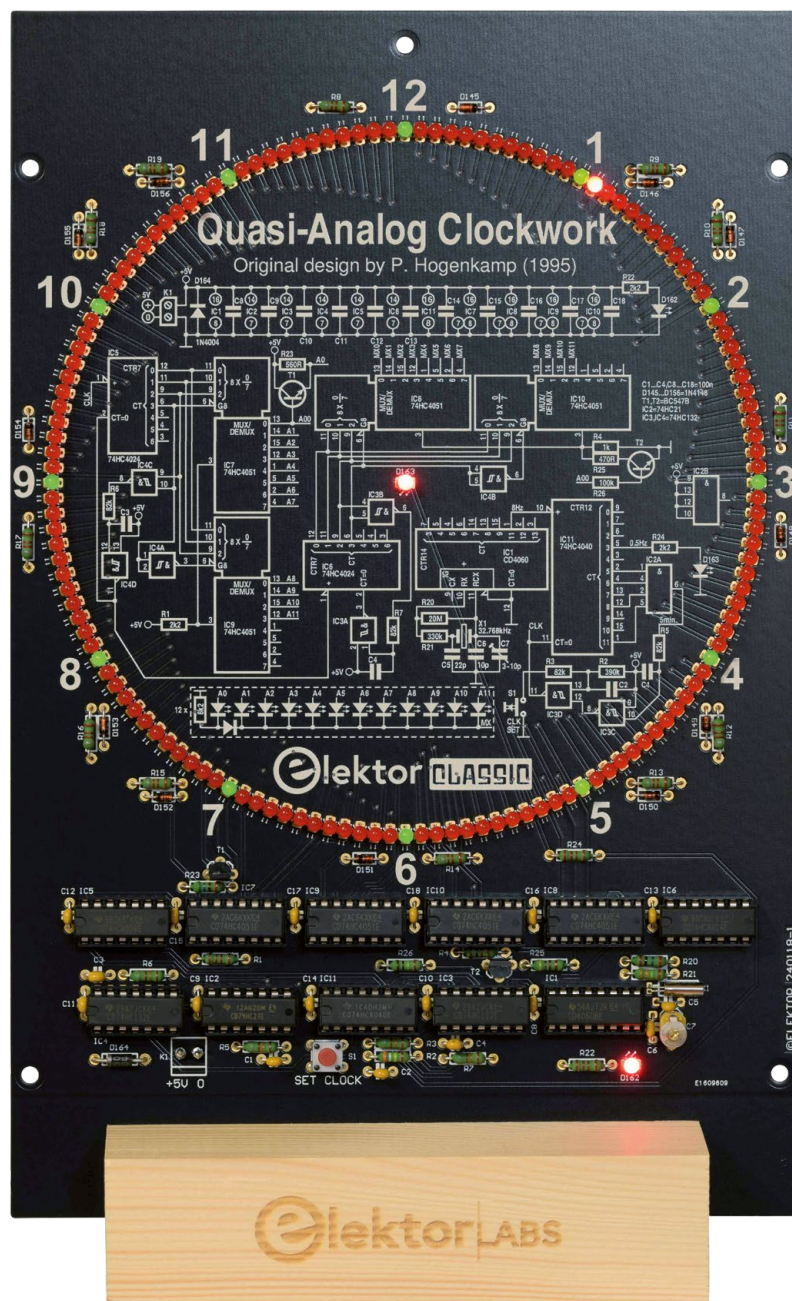


Figure 6: PCB powered and secured in wooden stand.
Time indicated is between 5 and 10 minutes past 1.



Figure 7: Another view of the clock in the wooden stand.
Time indicated is between 10 and 15 minutes past 1.

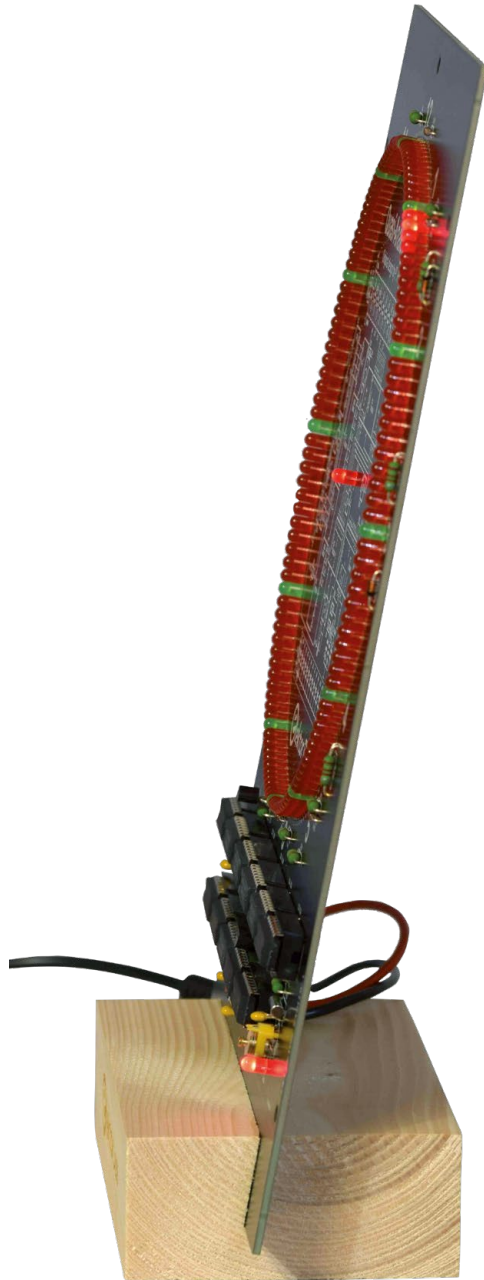


Figure 8. Side view on the clock in the wooden stand.
Time indicated is between 10 and 15 minutes past 1.

5 – Bill of Materials

Resistors

(body 2.5 x 6.8mm, 250mW)

R1, R22, R24 = 2.2k Ω

R2 = 390k Ω

R3, R5, R6, R7 = 82k Ω

R4 = 1k Ω

R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19 = 8.2k Ω

R20 = 20M Ω

R21 = 330k Ω

R23 = 560 Ω

R25 = 470 Ω

R26 = 100k Ω

Capacitors

C1, C2, C3, C4, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18 = 100nF, 50V, ceramic X7R, lead spacing 5mm

C5 = 22pF, 50V, 5 %, ceramic C0G/NP0, lead spacing 5mm

C6 = 10pF, 50V, 5 %, ceramic C0G/NP0, lead spacing 5mm

C7 = 3~10 pF, trimmer capacitor, 150V, through hole (BFC280823109 Vishay BCcomponents)

Semiconductors

D1, D13, D25, D37, D49, D61, D73, D85, D97, D109, D121, D133 = LED green, 3mm (T1), flat side, no ledge

D2-D12, D14-D24, D26-D36, D50-D60, D62-D72, D74-D84, D86-D96, D98-D108, D110-D120, D122-D132, D134-D144, D162, D163 = LED red, 3 mm (T1), flat side, no ledge

D145, D146, D147, D148, D149, D150, D151, D152, D153, D154, D155,

D156 = 1N4148, DO-35

D164 = 1N4004, DO-41

T1, T2 = BC547B, TO-92

IC1 = CD4060, DIP-16

IC2 = 74HC21, DIP-14

IC3, IC4 = 74HC132, DIP-14

IC5, IC6 = 74HC4024, DIP-14
 IC7, IC8, IC9, IC10 = 74HC4051, DIP-16
 IC11 = 74HC4040, DIP-16

Miscellaneous:

K1 = 2-way wire-to-board terminal block, 3.5mm pitch
 S1 = 6mm tactile push button
 X1 = 32.768kHz crystal, 20ppm, C_{load} 12.5pF, 8x3mm cylinder package
 IC2, IC3, IC4, IC5, IC6 = IC socket, DIP, 14 contacts
 IC1, IC7, IC8, IC9, IC10, IC11 = IC socket, DIP, 16 contacts
 PCB no. 240118-1 v1.1

6 – Specifications

Supply voltage	5 V
Supply current	11 mA max.
Power supply indicator	1 LED
Time display	12 hours in a circle
Display	144 LEDs
LED circle	132 red LEDs, 12 green LEDs
Resolution (display)	5 minutes
Seconds indication	1 LED in center of circle, blinking at 0.5 Hz
Technology	10 pcs HC-logic series ICs, 1 pc. 4000-logic series IC
Reference signal	32 kHz quartz oscillator, adjustable
Set clock	1 pushbutton, 5 minutes step
Programming needed	no

7 – Web Link

Project as published on Elektor Labs:
<https://www.elektormagazine.com/labs/quasi-analog-clockwork-an-elektor-classic-a-remake>

8 – Schematic and PCB Layout

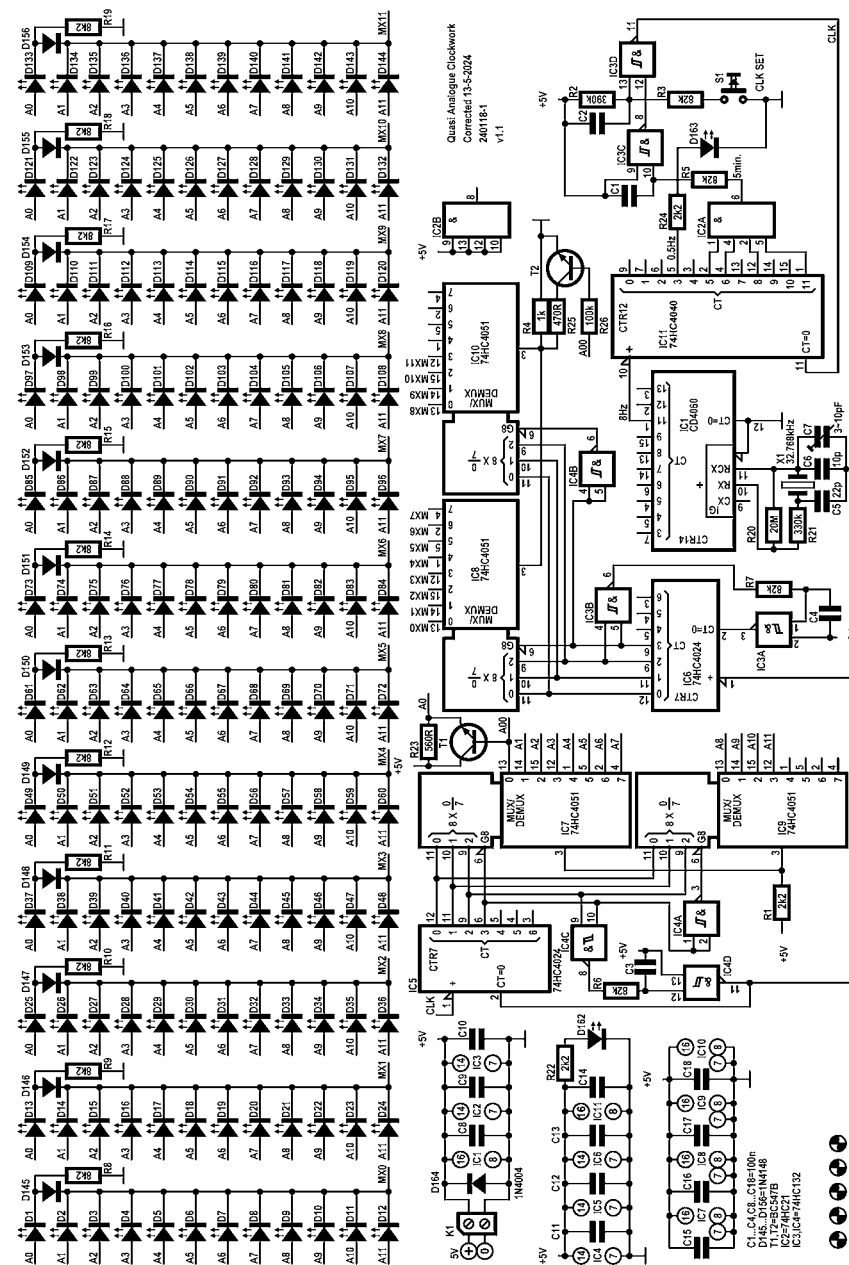


Fig. 9. Schematic of the Quasi-Analog Clockwork (240118-1 v1.1).

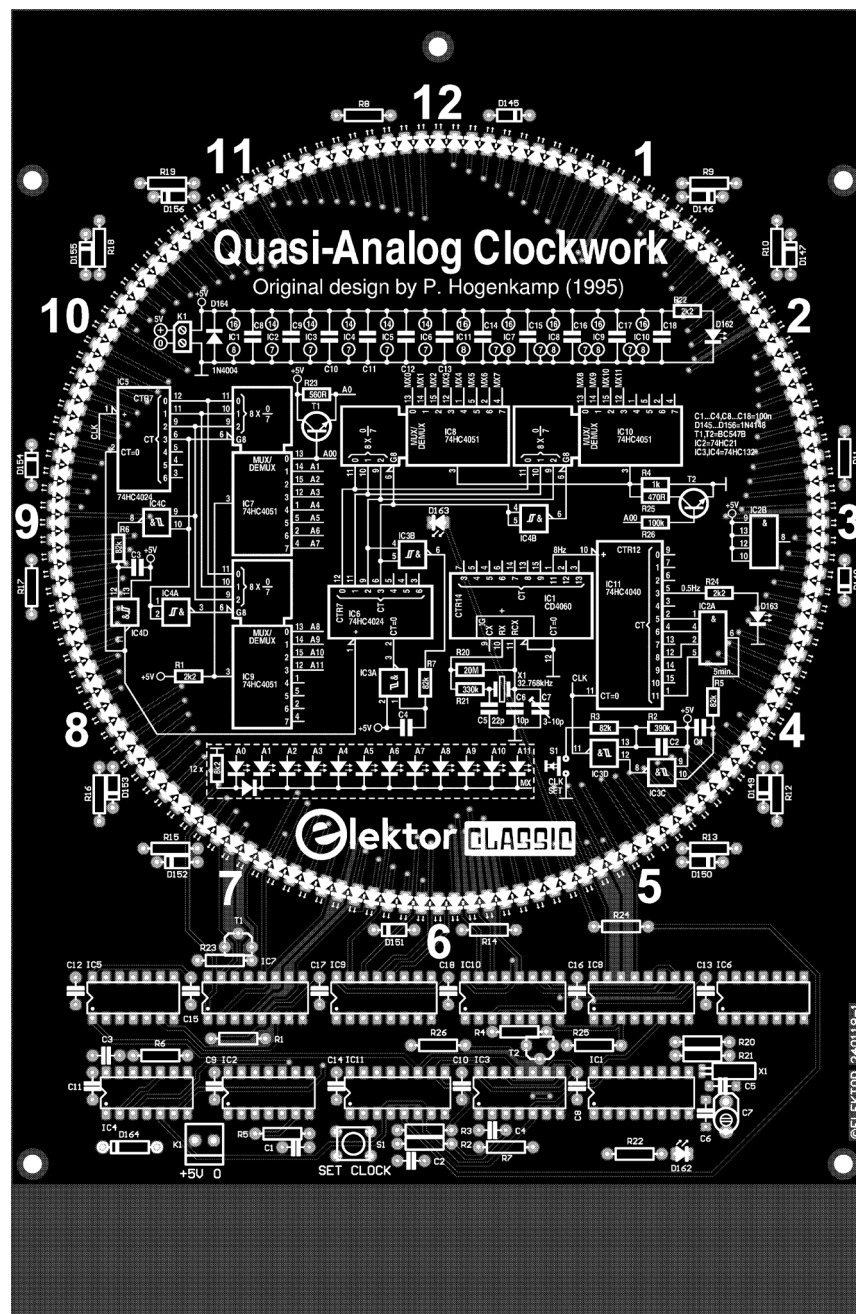


Fig. 10. Top overlay of PCB 240118-1 v1.1 of the Quasi-Analog Clockwork.

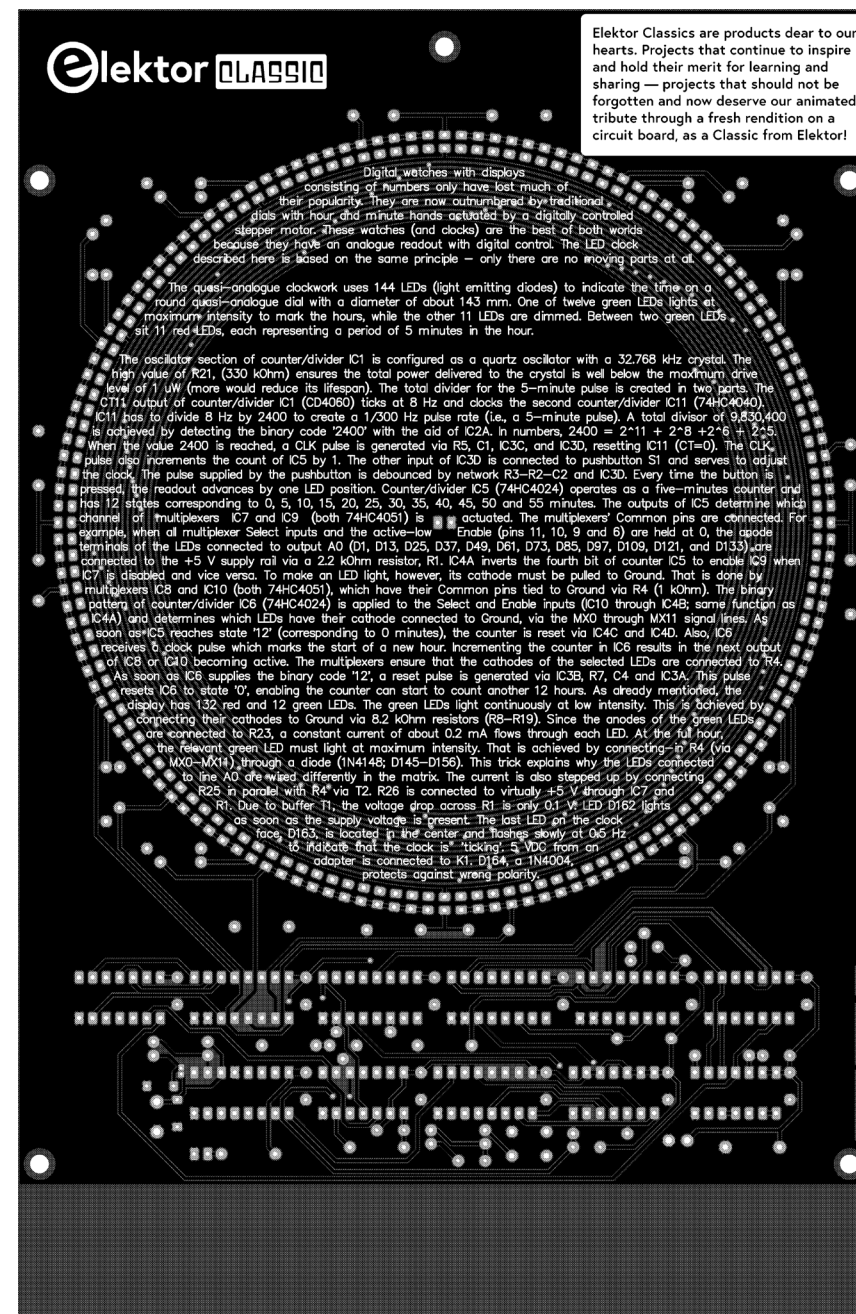


Fig. 11. Bottom overlay of PCB 240118-1 v1.1 of the Quasi-Analog Clockwork.

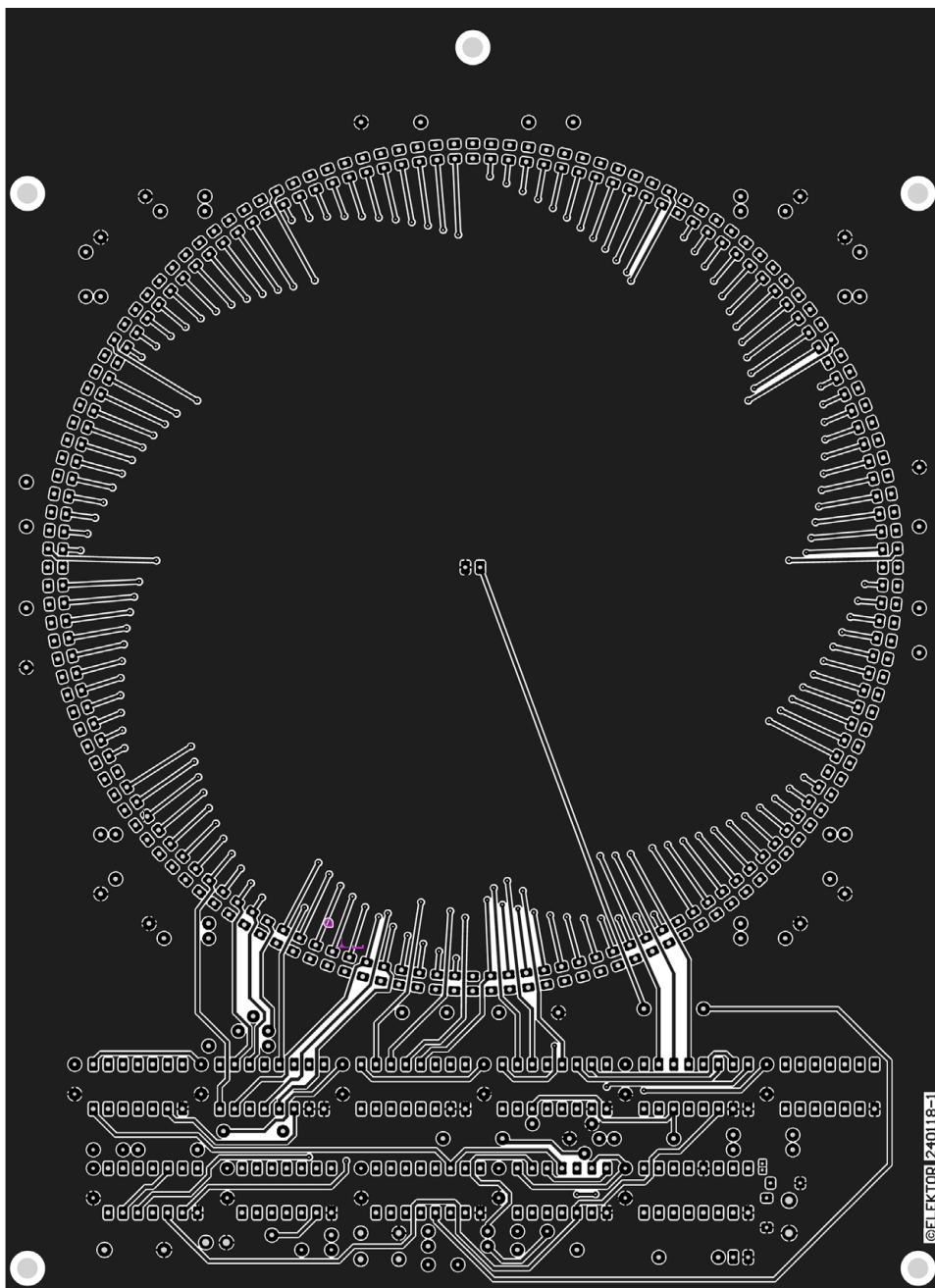


Fig. 12. Copper top of PCB 240118-1 v1.1 of the Quasi-Analog Clockwork.

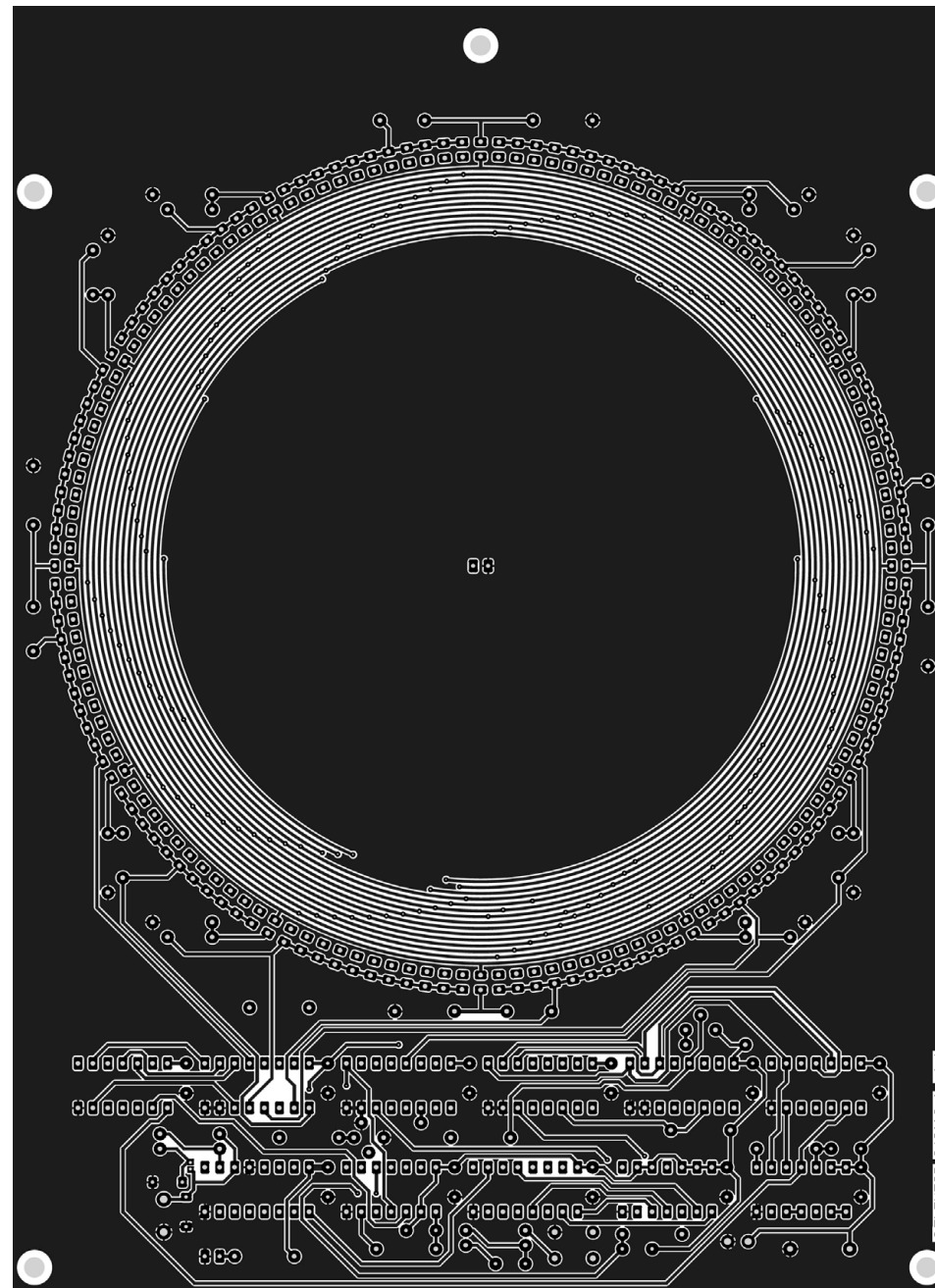


Fig. 13. Copper bottom of PCB 240118-1 v1.1 of the Quasi-Analog Clockwork.