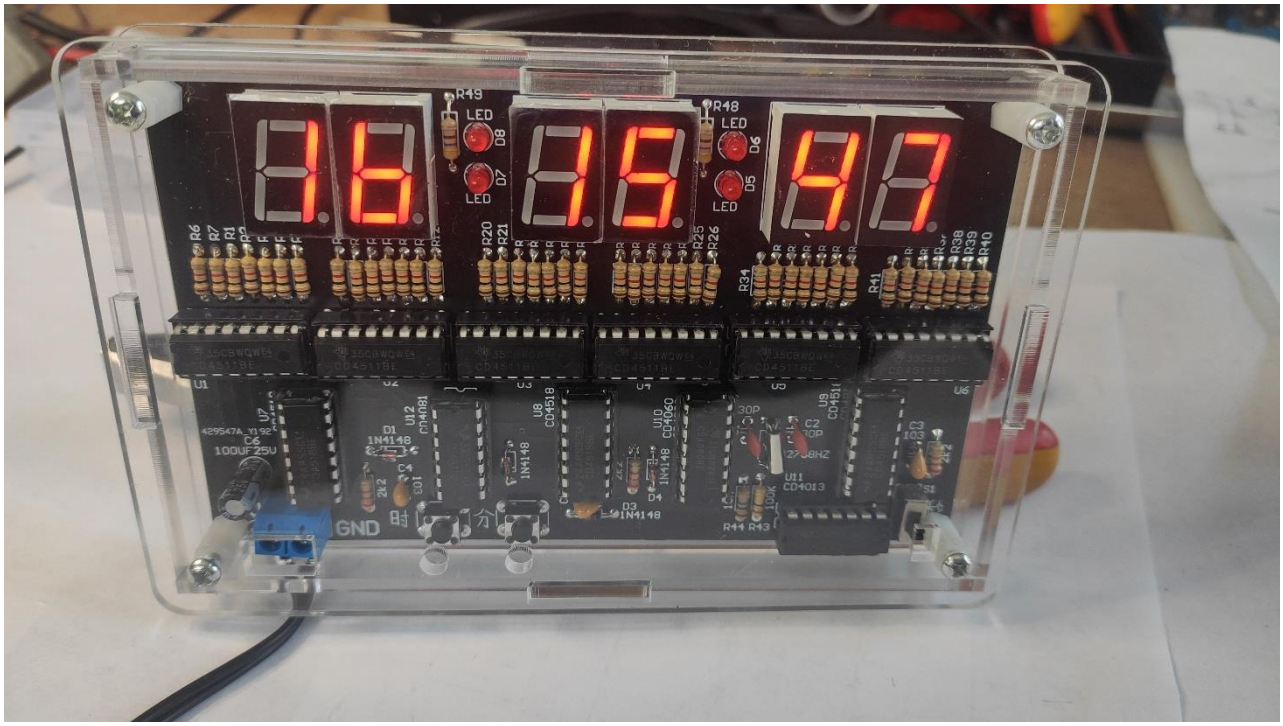
Digital Clock DIY, do it yourself!
Build and manual document. V0.1



With this Old-Skool DIY Clock, when it is finished, you can watch the correct time with seconds count!
It is a: Do It Yourself building kit, with all components inside the package!
The only thing, You need to provide is a soldering tool with solder, solder skills, a power source (5V).
Some screwdrivers, cutters etc..

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1.1 Product description

This product is a 24-hour digital circuit, clock using CD4518, CD4511, CD4081, CD4013, CD4060 and other chips, the circuit does not contain a microcontroller, so there is no program.
The hours and minutes and seconds can be calibrated, without alarm function!
This kit mainly consists of a second signal generator, counter, decoding display and time calibration circuit. The second pulse is a 1Hz square wave signal obtained by precise frequency division of a high frequency signal generator, which is more accurate in timekeeping.

The second signal generator consists of CD4060 and CD4013, which generates a square wave signal with a frequency of 1Hz. CD4060 is a 14-level binary frequency divider/oscillator. It consists of a 32768Hz oscillator with external resistors R44, R43, C1, C2 and Y1. After 14 levels of binary frequency divider, the frequency of 2Hz square wave signal is obtained at pin 3.
CD4013 contains two independent D flip-flops, take one of the flip-flops through the line configured as a binary counter, binary counting of the input 2Hz square wave signal can be obtained from the second signal.
CD4518 is a double-decimal addition counter. The CD4518 is a double-decimal addition counter.
3 CD4518s are used to time the hours, minutes and seconds, the hours are configured as 24, the minutes and seconds are configured as 60. The counting result of the CD4518 is in the form of a BCD code outputted to the BCD decoder CD4511 from the pins Q0-Q3, and the CD4511 converts the BCD code into a display segment code that lights up the corresponding digital tube, and then forms a recognizable Arabic numerals on the digital tube to display the current timing result intuitively. The minutes and seconds are in 60-bit format.

Minutes and seconds are counted in 60 decimal, the seconds signal is introduced to the EN terminal of CD4518 through switch S1, and 1 is added to the falling edge of each seconds signal (if the seconds signal is connected to the CLK terminal of CD4518, 1 is added to the rising edge of each seconds signal), and when the counter counts up to 9, Q0-Q3 outputs 1001, i.e., Q3 is 1. Since it is a decimal counter, when the next seconds signal arrives, the counter changes from 9 to 0. counter changes from 9 to 0, Q0-Q3 outputs 0000, thus forming a falling edge signal on Q3, this signal is introduced to the ten-digit counter of the second counter, after each full 10 count of the individual counter, the ten-digit counter adds 1. When the ten-digit counter value reaches 6, Q0-Q3 outputs 0110, i.e., Q1 and Q2 are both 1 at the same time, and Q1 and Q2 are connected to the counter through a summing gate and then outputs 1 to the Q1 and Q2 are connected to the reset terminal of the counter through an and gate and output 1, so that the counter counts from 6 to 0 in advance, completing the cycle of 1 hexadecimal counting. The reset signal is also used as the counting signal of the sub-counter, and the sub-counter will be increased by 1 for every full 60 seconds. The sub-counter is also 60-bit, when the sub-counter is full 60, the ten bits of the sub-counter will be reset by a gate, so that the value of the time counter will be increased by 1. When the counter is full 24, the ten bits of the counter will be 0010 and the individual bits of the counter will be 0100, and the ten bits of the counter will be connected to the counter through a gate with an algorithm and Q2. By connecting the Q1 of the tenth bit and the Q2 of the first bit with the algorithm to the reset terminals of the two counters, the hourly bit will be returned to 0 when the counter reaches the full 24, so as to realize the counting of the 24 hexadecimal.

1.2 Build guidance.

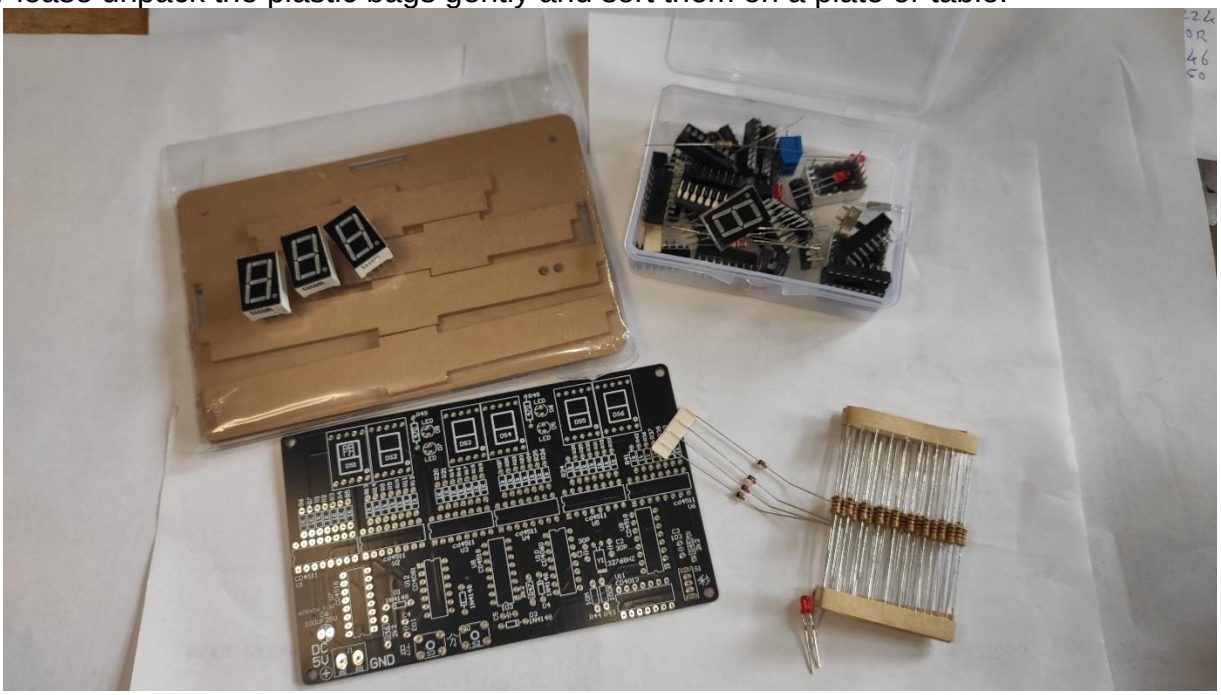
1.2.1 Item list:

1x PCB board
6x 0.56 digital 1 bit digital display
2x 470 ohm resistor
50x 1K resistor
3x 2.2K resistor
1x 100K resistor
1x 10M resistor
4x 1N4148 Diode
4x LED red 3mm
3x 103 Monolithic Capacitor
1x 32.768KHZ crystal
2x 30P Porcelain Chip Capacitor
1x 25V 100UF Capacitor
1x KF301-2P
2x 6*6*5 Keypad
1x 12D07 Toggle Switch
10x 16P IC Block
2x 14P IC Block
6x CD4511
3x CD4518
1x CD4081
1x CD4060
1x CD4013

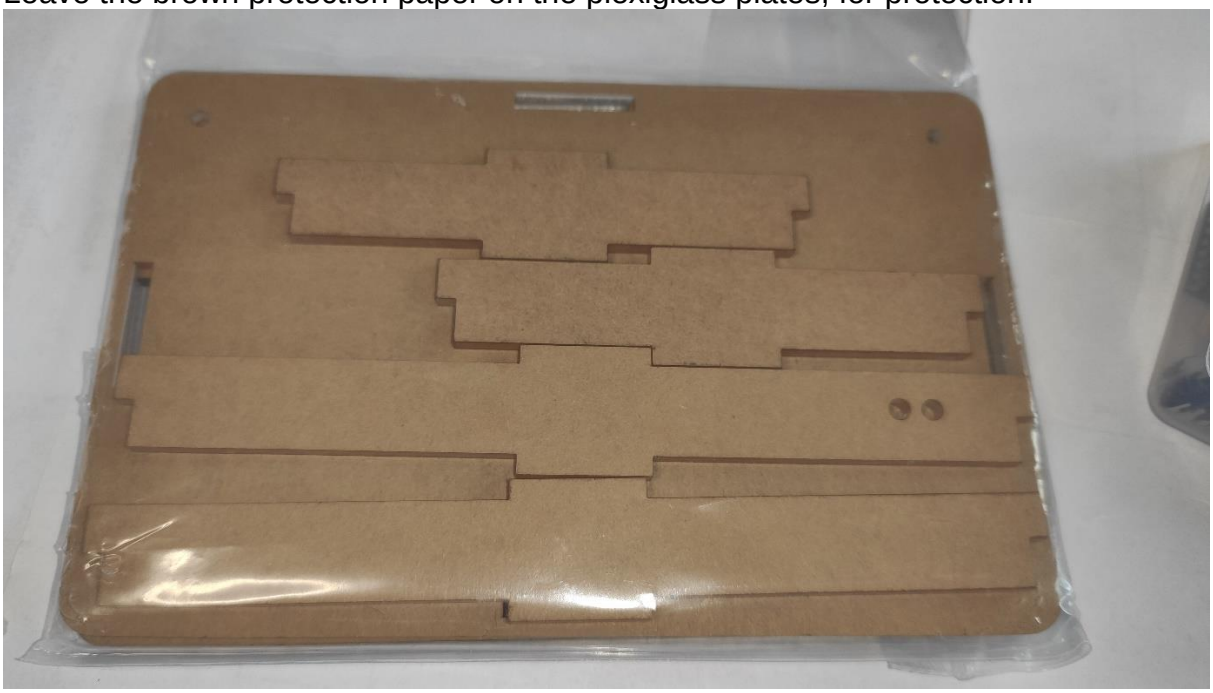
Enclosure list:
1x Acrylic shell set
5x M3*8 screws
5x M3*10 screws
5x M3 Nut
4x M3*10 double pass nylon post

1.3 Unpacking the package.

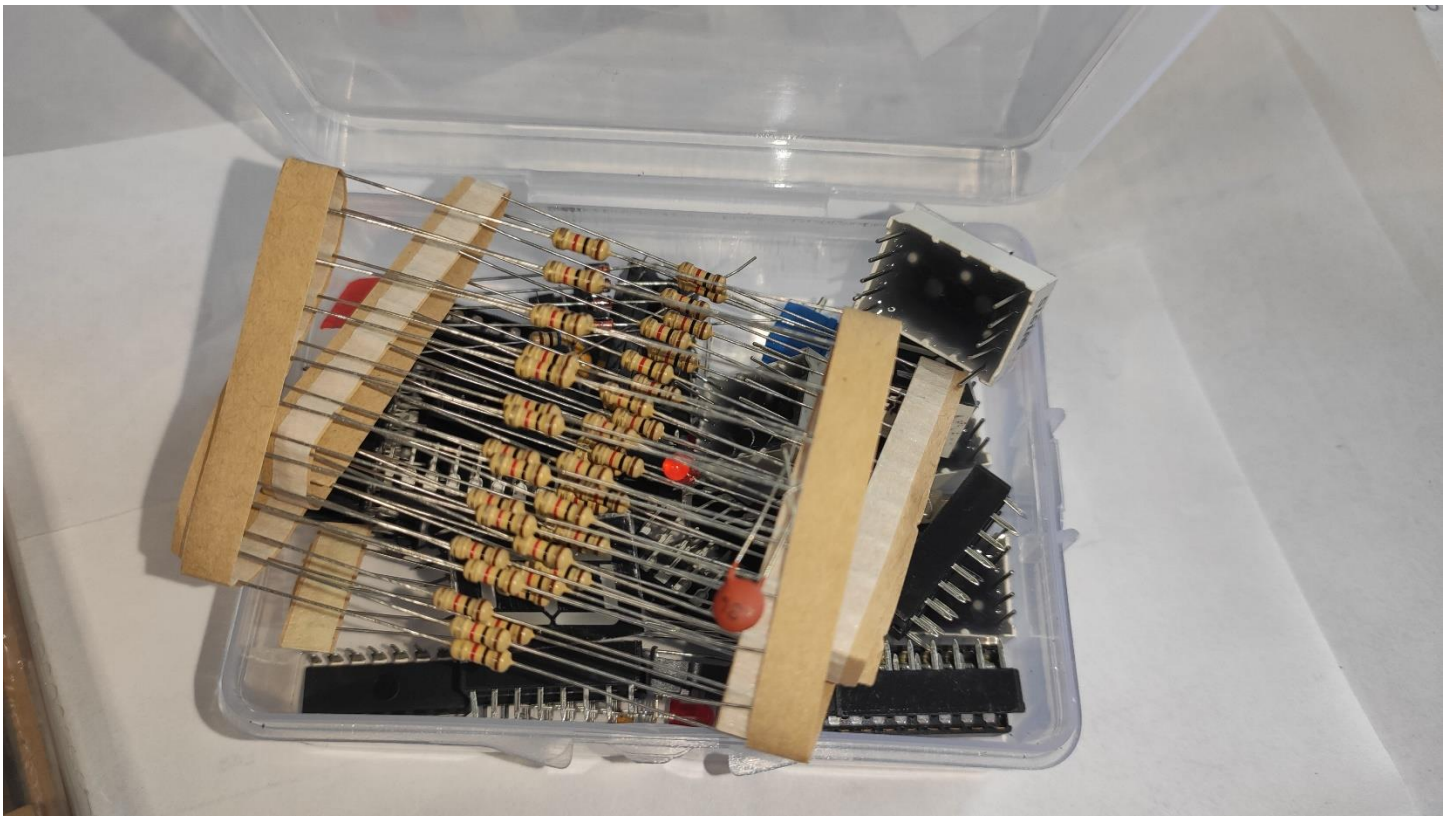
Please unpack the plastic bags gently and sort them on a plate or table.



Leave the brown protection paper on the plexiglass plates, for protection.



Be sure that all components are present:



Check the item list carefully.

1.4 Step by Step, of the building process:

Here are some pictures from the step by step process:

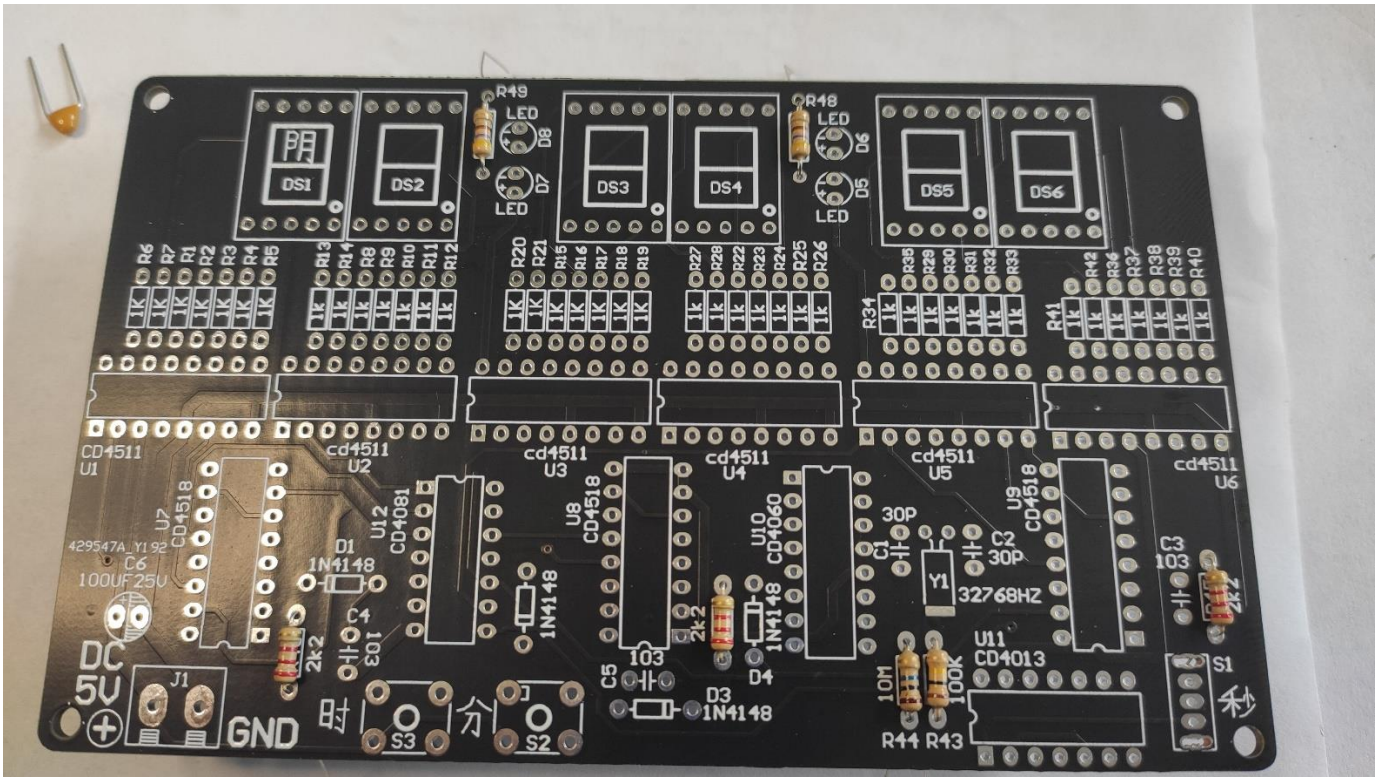
1.4.1 The Build:

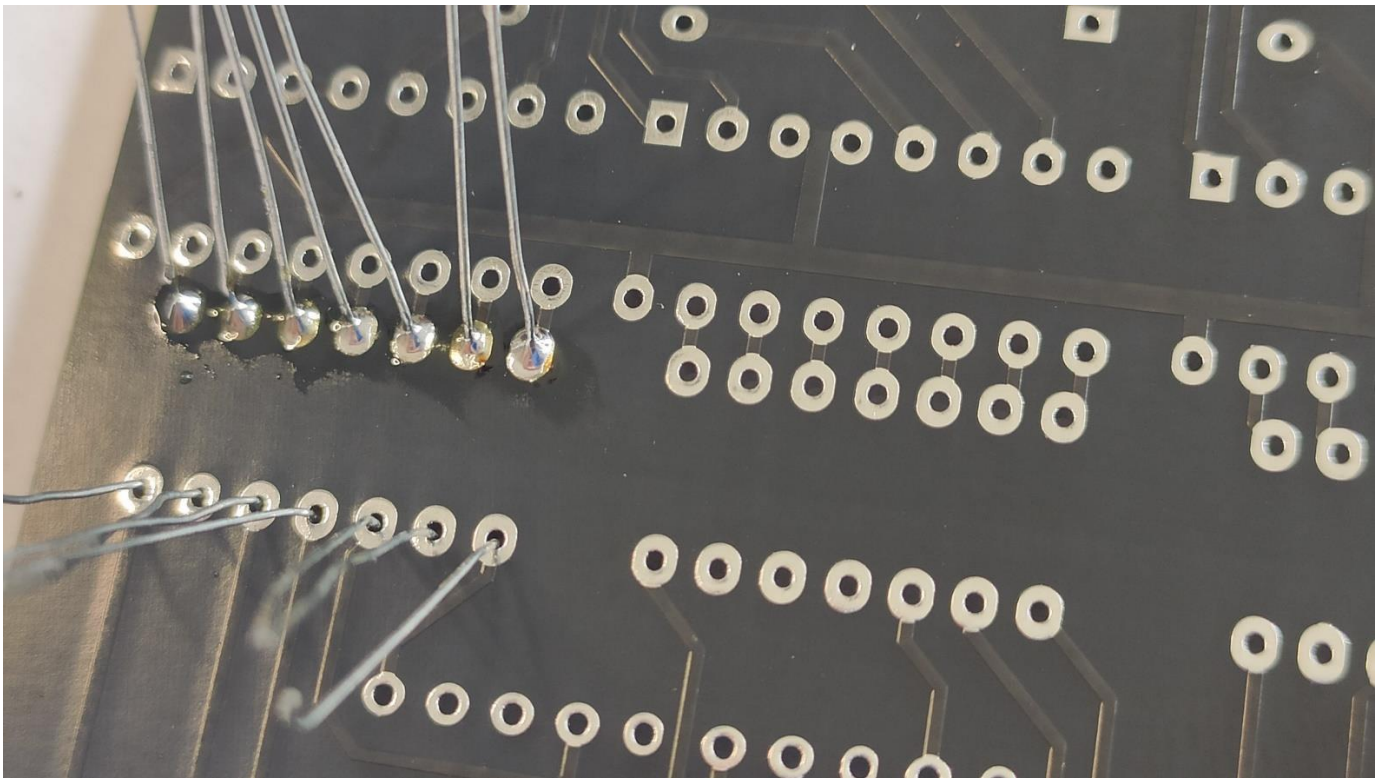
Note:
The Clock kit has no very small SMD components. So it will be easy to build.

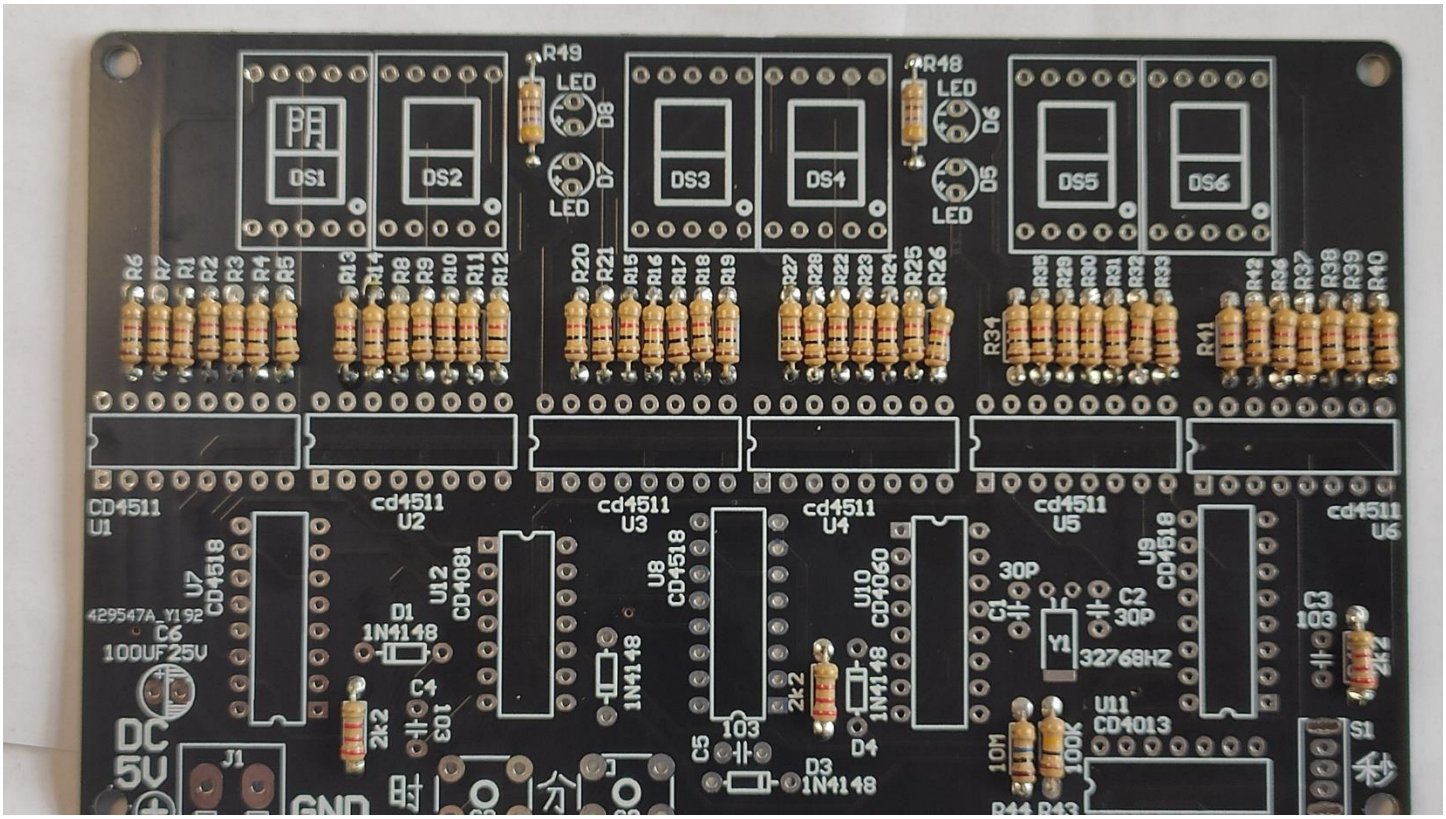
We start with the placement of the resistors and there are a lot of them..
Here's a help:

Kleur	Mantisse/waarde	Vermenigvuldingsfactor	Tolerantie	Temperatuurcoëfficient	Ezelsbruggetje
zilver		10^{-2}	10%		
goud		10^{-1}	5%		
zwart	0	10^{0}		250 ppm/K	Zij
bruin	1	10^{1}	1%	100 ppm/K	BRengt
rood	2	10^{2}	2%	50 ppm/K	ROzen
oranje	3	10^{3}		15 ppm/K	Op
geel	4	10^{4}		25 ppm/K	GErrits
groen	5	10^{5}	0,5%	20 ppm/K	GRaf
blauw	6	10^{6}	0,25%	10 ppm/K	Bij
violet	7	10^{7}	0,1%	5 ppm/K	Vles
grijs	8	10^{8}	0,05%	1 ppm/K	GRIJS
wit	9	10^{9}			Weer

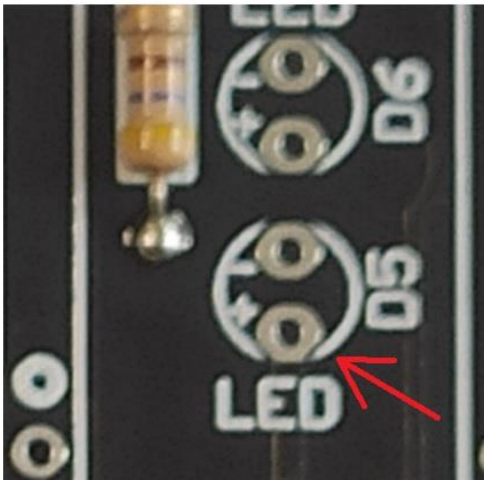
Place them all so, that they all face the same direction.

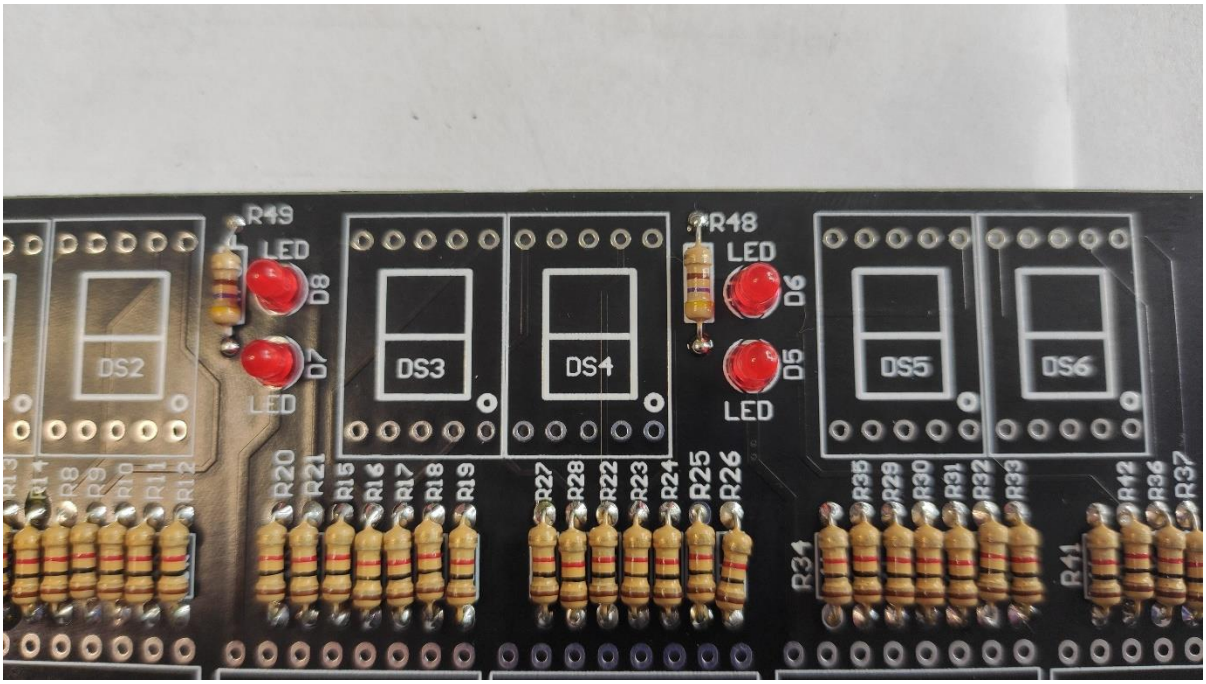






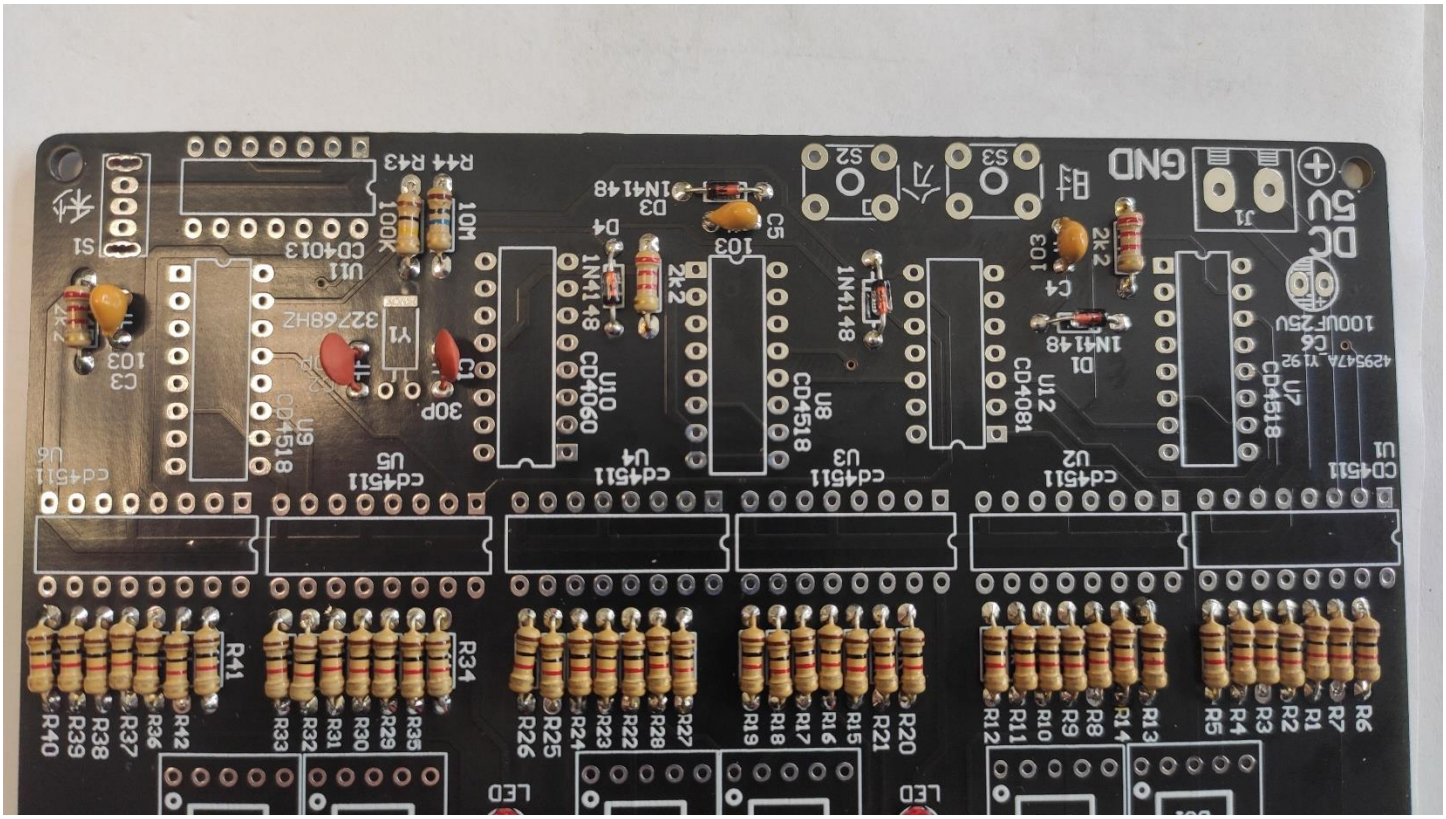
Next:
Solder all LED's on the PCB. Be sure that you place them in the right polarity position





Next:
the ceramic capacitors can be soldered, ceramic capacitors do not have polarity!

On the PCB you find the printed values for the capacitors, 103 is printed on the PCB

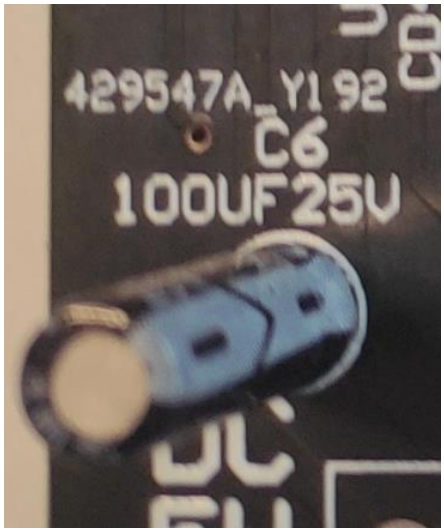


And also the diodes, place them the correct way; the black ring on them must be in the small square where it says 1N1418

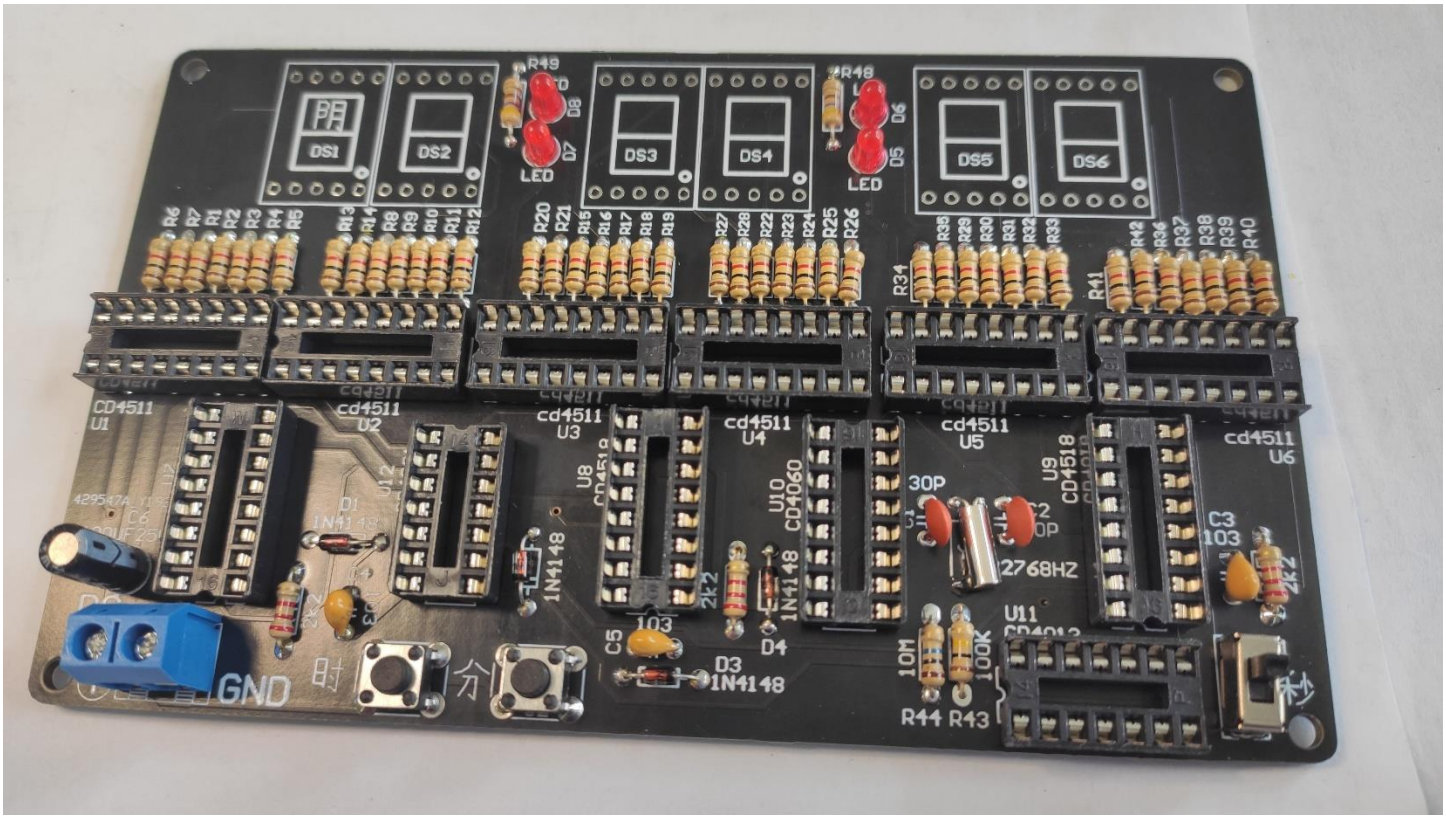
Like this: 

Next:

The Aluminum electrolytic capacitors **do have polarity**, the positive have the longer lead than the negative. Aluminum electrolytic capacitor, a band with white color is pointing the negative lead.

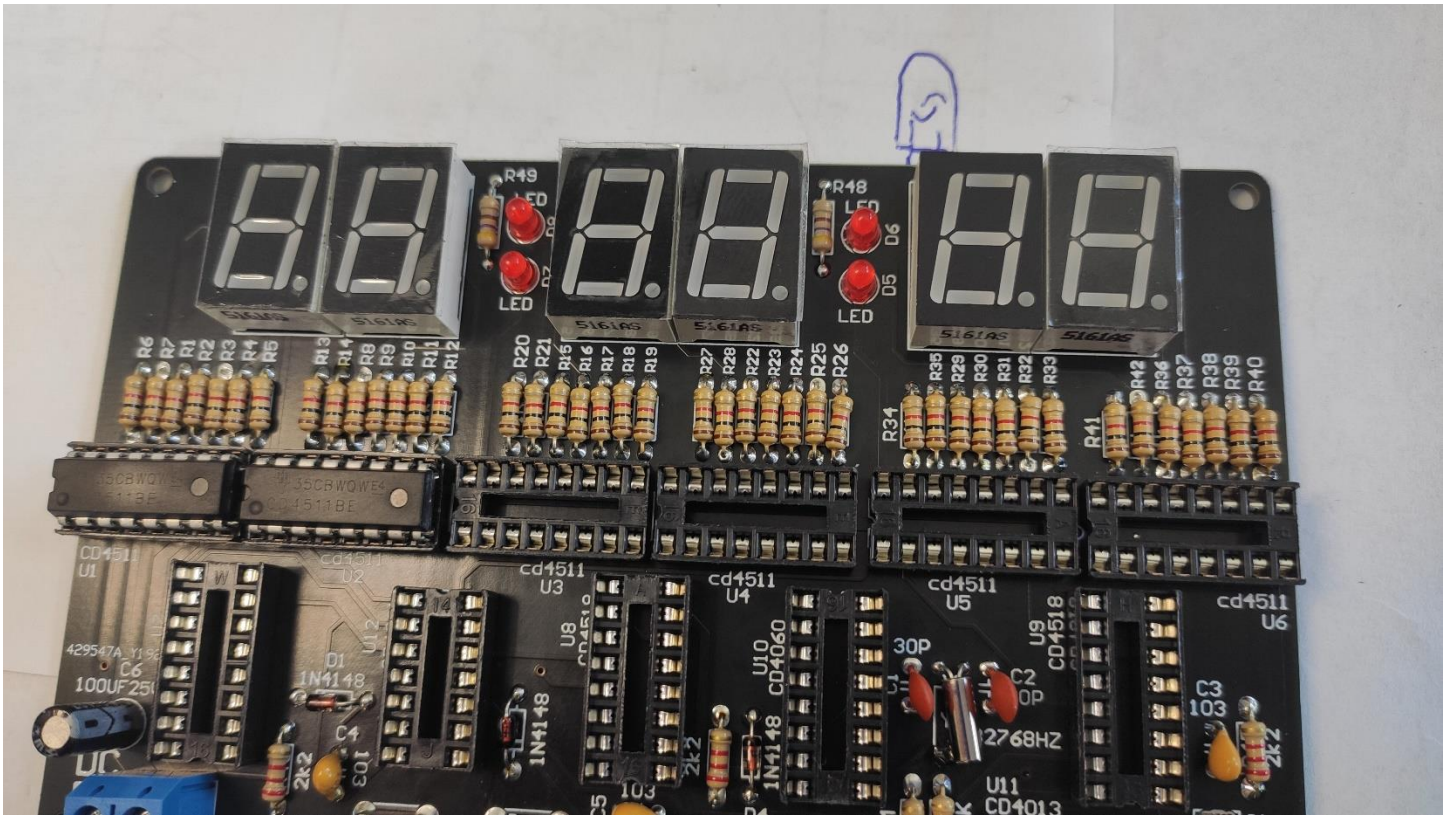


Next is solder all IC-Sockets on the board.

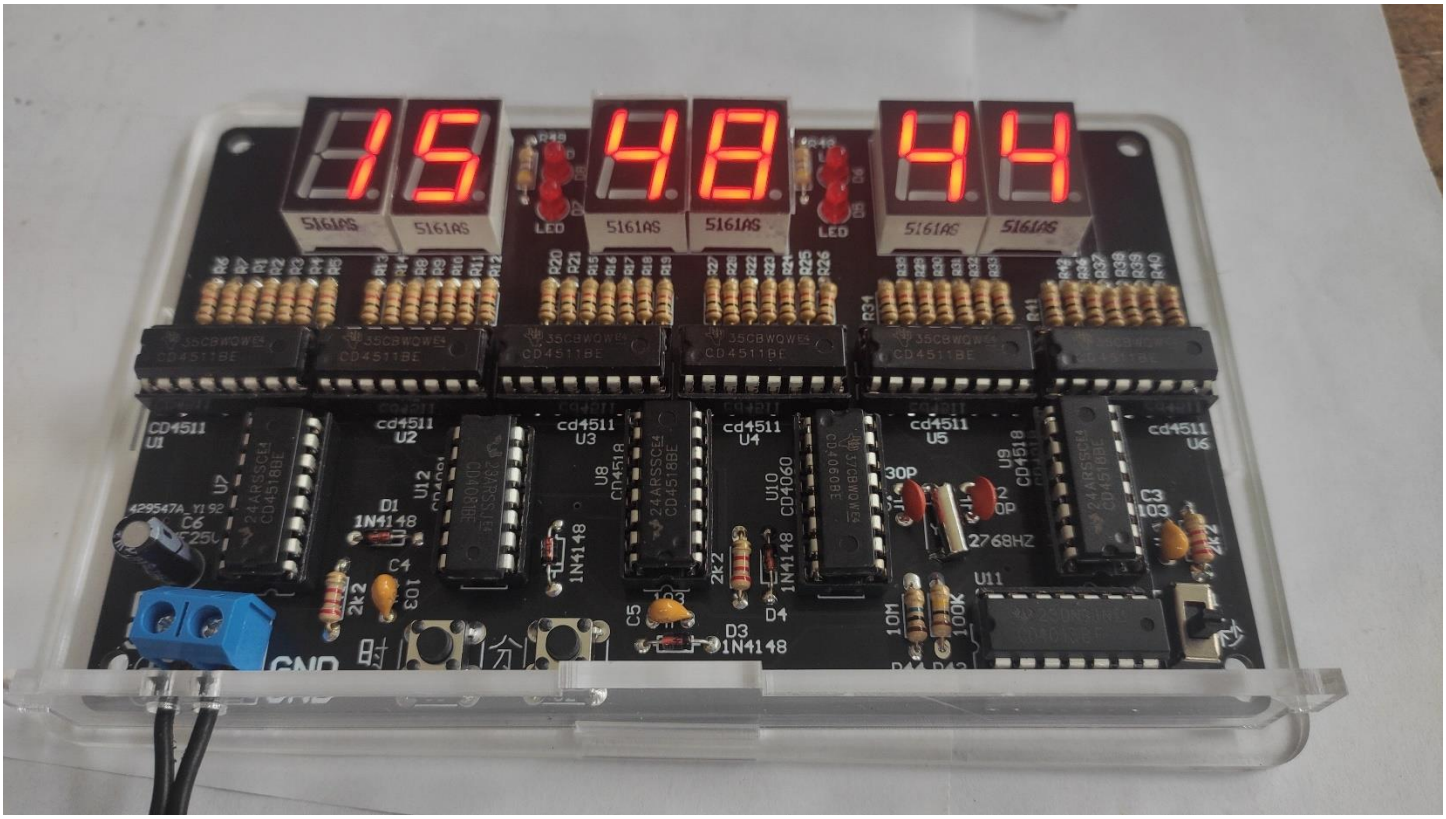


Also both press switches and power supply socket.
The switch for starting the clock.
The crystal (no polarity) and the two ceramic disks.

Next is the 6 led-display’s

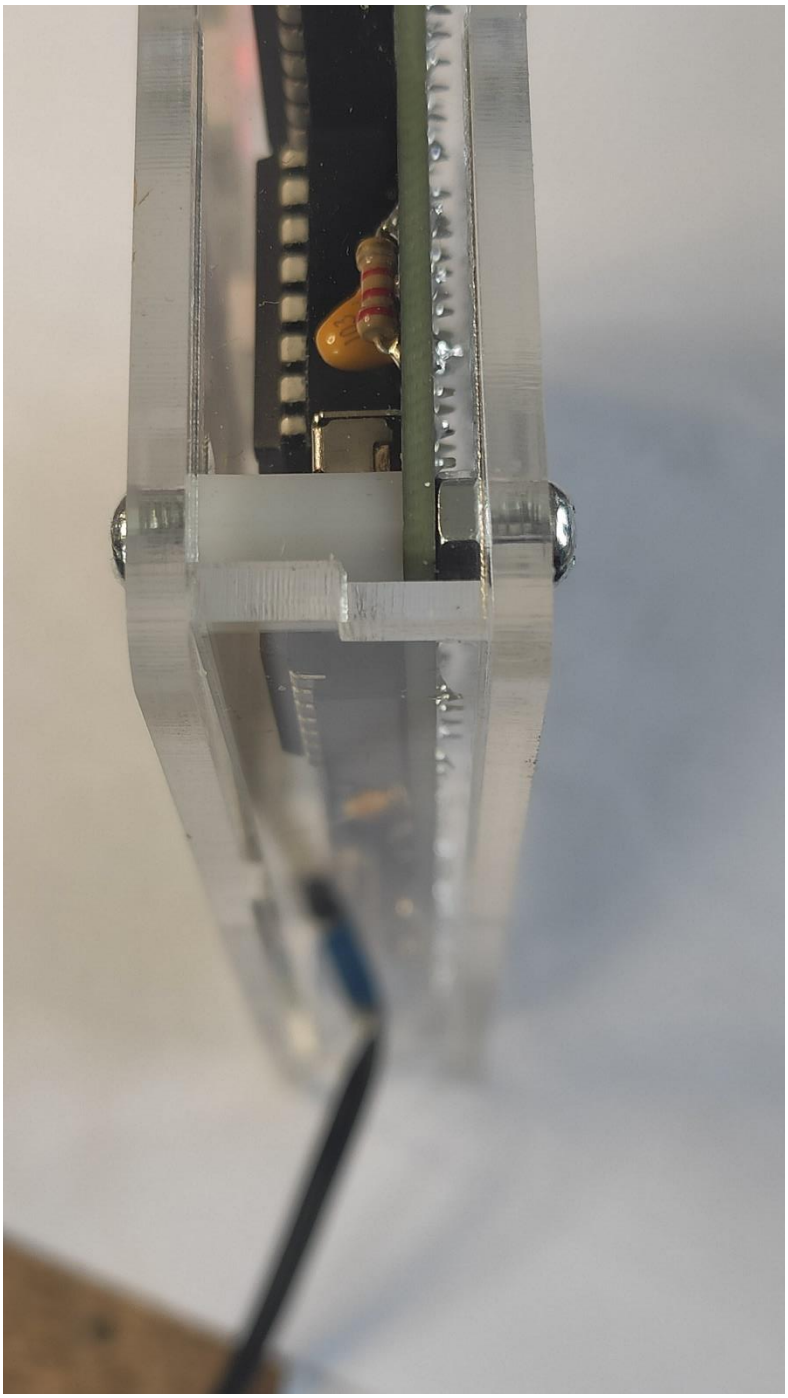


Here is the finished board.



As for the IC's: gently bend the pins straight, before forcing it into the sockets.
It must fit precisely, before pressing it inside the pin-sockets.
This takes a certain force to do, but try it gently!

1.5 Building the housing-case.



Use the long screw at the backside of the housing. Then assemble the nut, then the pcb then the nylon distance-nut then the short screw.
Like here at the left.

To build the housing, first remove the bruin foil. This foil is for protecting the acryl surface.

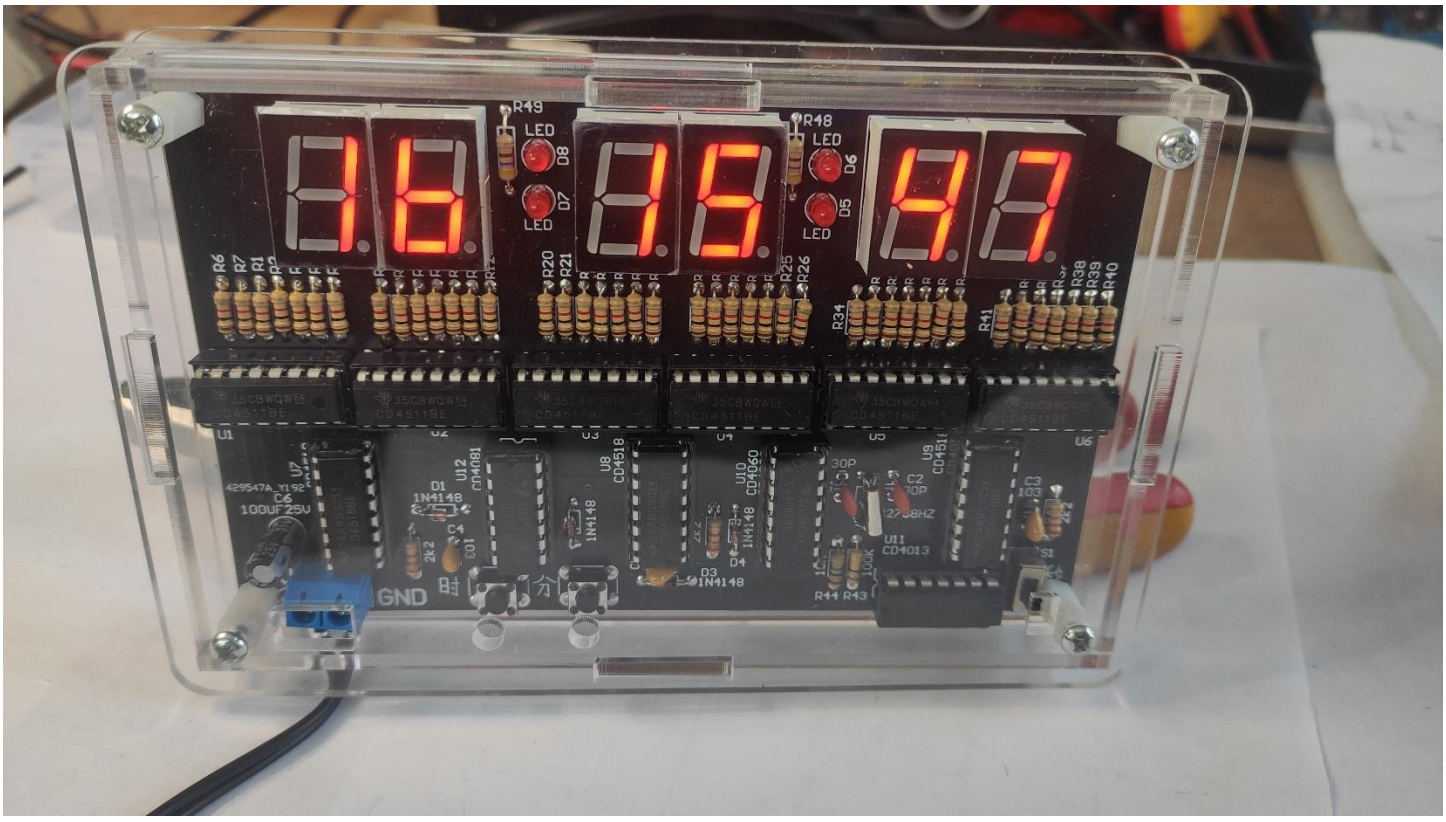
1.6 The Clock operating instructions:

Input voltage: DC 4,5 – 5,5V (Recommended power supply is 5Vdc, or a USB charger)

Connect the negative wire at the power supply terminal and then the positive wire.

Description:
1. This is a 24uurs digital clock kit old-skool, with help from IC's CD4518, CD4511, CD4081, CD4013, CD4060 and other chips,
2. The product is made out of quality components and materials,
3. It can be used for teaching children from 10-18 Year, for adjucation purposes, very suitable for DIY enthousiasts,
4. stabel productscore and a sustainable lifespan,
5. The use of red led display units, make it incredable clear to view the corect time

1.6.1 Switch the clock on



With the left push button you can adjust HOURS and with the right one, you can adjust the minutes.

The switch on the right is in the lower position for starting the clock, in the upper position; the clock stopped and can be adjusted.
Once adjusted, it will give you a very accurate time, but loss of power will reset the clock to 00:00:00..

There is no battery backup, but with a little effort, you will be able to add a rechargeable-battery source. 1,2 +1,2+1,2+1,2=4,8Vdc.

