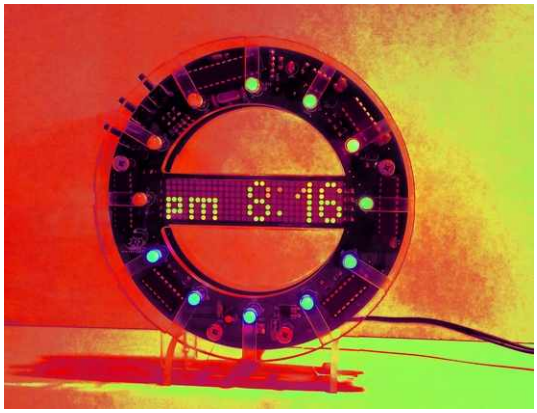
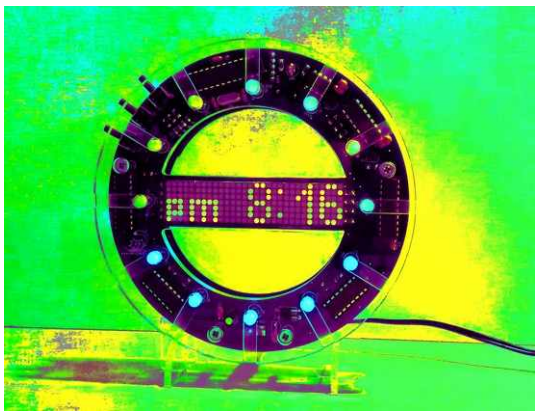
# RGB Alarm Clock

**-Color Alarm Clock-**




Design: by Christoph Kreis www.chk-creative.ch version 1.2

# Table of Contents

## Preamble:

It's the half battle when you have basic knowledge of electronic, don't be afraid if you are a novice, follow the solder instructions and you will succeed in the end. When you get stuck, don't continue! Take a break and ask a friend who has experience.

**We take no responsibility for any injury or damage as a result of assembling this kit.**

The following tools are required to assemble this kit: soldering iron, solder, diagonal cutting pliers, multimeter and a solder sucker is optional. This tools are not included in the delivery content.

When you have finished the soldering work then it's necessary to clean up the printed circuit boards with a solution of dish detergent and methylated spirit to avoid current leakage. For a more thorough cleaning you can use a toothbrush. After cleaning them, you have to dry the printed circuit boards. A hairdryer will help you to do the job. It's important that the boards are absolutely dry, that means bone-dry.

A wet board can cause a short circuit or current leakage and can damage your clock, or your clock won't work properly. Remember, we take no responsibility for this mistake on your part.

Use a suitable power supply unit. (input voltage 9-12 volt and max. 1 ampere). Inappropriate voltage or polarity can cause permanent damage.

Don't put any items into the clock. Protect your clock against water and any liquids. Avoid damp rooms when you operate this device.

**We are delighted that you have chosen this kit.**

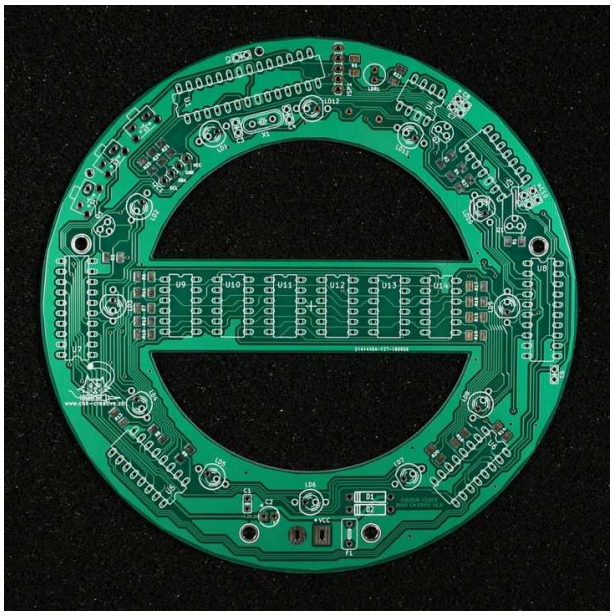
# List of parts

| Pos. | Typ | REF | Value | Quantity | I.O |
|---|---|---|---|---|---|
| 1 | SMD | R | Resistor 430 OHM | 3 | |
| 2 | SMD | R | Resistor 1K OHM | 15 | |
| 3 | SMD | R | Resistor 4.7K OHM | 2 | |
| 4 | SMD | R | Resistor 10K OHM | 21 | |
| 5 | THT | C | Capacitor 1000pF | 1 | |
| 6 | THT | C | Capacitor 22pF | 2 | |
| 7 | THT | C | Capacitor 100nF | 4 | |
| 8 | THT | C | Capacitor 10uF (Tantal) | 2 | |
| 9 | THT | C | Capacitor 22uF (ELKO) | 1 | |
| 10 | SMD | U (IC) | Regulator L4941 BDT-TR | 1 | |
| 11 | THT | U (IC) | ATMEGA328-P | 1 | |
| 12 | THT | U (IC) | Schift Registers 74HC595 | 2 | |
| 13 | THT | U (IC) | Schift Registers TPIC6B595 | 2 | |
| 14 | THT | U (IC) | DAC MCP4901 | 1 | |
| 15 | THT | U (IC) | DAC MCP4902 | 1 | |
| 16 | THT | J | IC Socket Dil 8 | 1 | |
| 17 | THT | J | IC Socket Dil 14 | 1 | |
| 18 | THT | J | IC Socket Dil 16 | 2 | |
| 19 | THT | J | IC Socket Dil 20 | 2 | |
| 20 | THT | J | IC Socket Dil 28 | 1 | |
| 22 | THT | J | Pin Head Female POL1x5 | 1 | |
| 23 | THT | F | Fuse | 1 | |
| 24 | THT | D | DIODE 1N4001 | 2 | |
| 25 | THT | Q | MOSFET 2N700 | 3 | |
| 26 | THT | X | Crystal 16MHZ | 1 | |
| 27 | THT | S | Switch (TACTILE) | 3 | |
| 28 | THT | SPK | BUZZER | 1 | |
| 29 | THT | CON | BARREL JACK | 1 | |
| 30 | THT | LDR | LDR | 1 | |
| 31 | THT | LD | RGB LED | 12 | |
| 32 | THT | LD | LED MATRIX | 6 | |
| 33 | PCB | | Clockboard | 1 | |
| 34 | Power | | Power Supply | 1 | |
| 35 | Case | | Clock Case 4 Pieces | 1 | |
| 36 | End Sleeve | | End Sleeve | 8 | |
| 37 | Bolt | | Bolts | 4 | |
| 38 | Female Screw | | Female Screws | 4 | |

Optional

| | | | | | |
|---|---|---|---|---|---|
| 1 | PCB | | RTC PCB | 1 | |
| 2 | SMD | Power | Battery holder | 1 | |
| 3 | THT | U (IC) | RTC Microcontroller | 1 | |
| 4 | THT | X | Clock Crystal | 1 | |
| 5 | THT | J | Pin Strip POL 1x4 | 1 | |
| 1 | THT | J | Pin Strip POL 1x1 | 2 | |

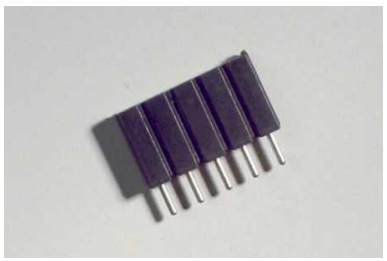
## Components



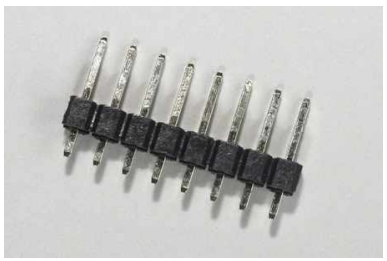
**Printed Circuit Board**

**Clock Enclosure**

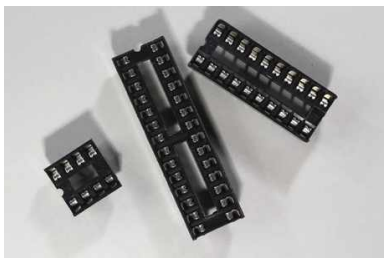
## Parts and belongings



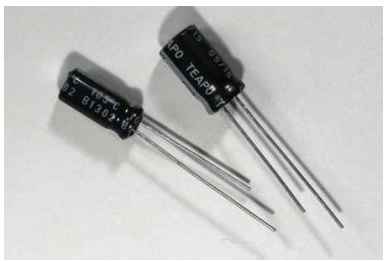
Pin Head Female



Optional: Pin Strip



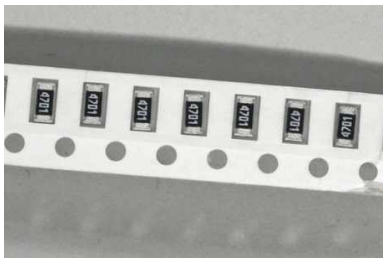
IC Socket



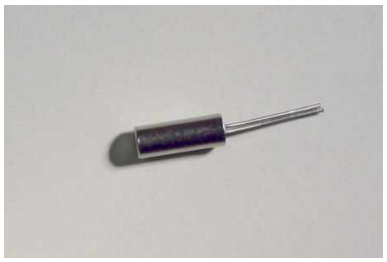
Elko Capacitor

Ceramic Capacitor

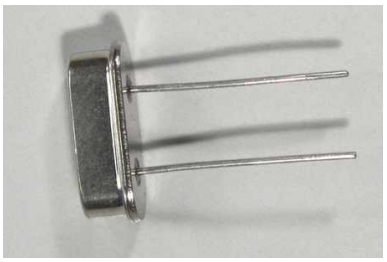
Tantal Capacitor



SMD Resistor

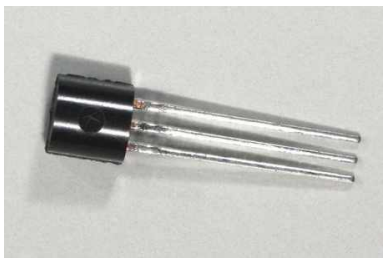


Optional: Clock Crystal

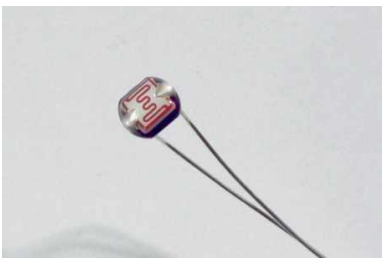


Crystal

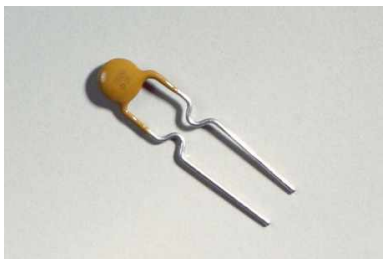
Speaker



MOSFET

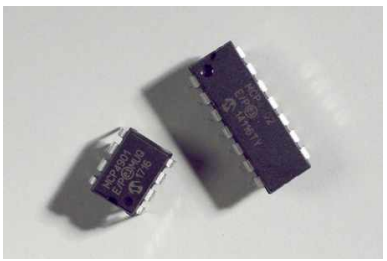


Light Detected Diode

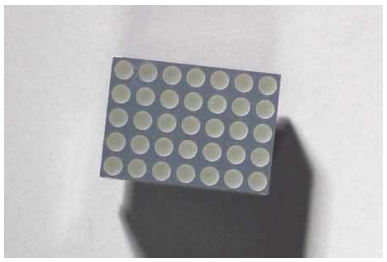


Fuse

SMD Regulator

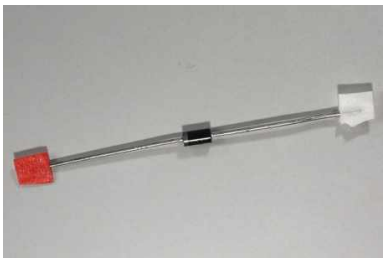


Microcontroller



LED Matrix

RGB LED

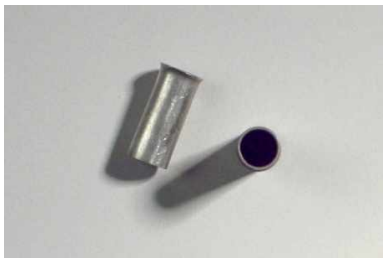


Diode

Switch

Barrel Jack

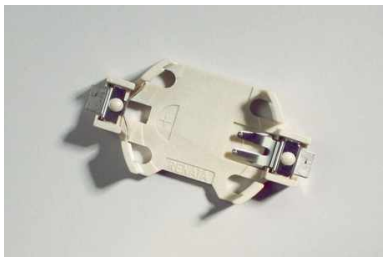
Power Supply



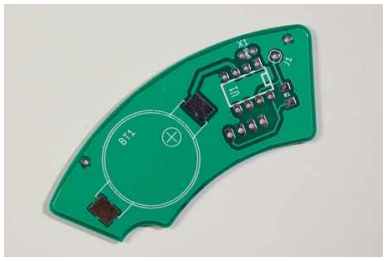
End Sleeves

Bolts

Female Screw



Optional: Battery Holder

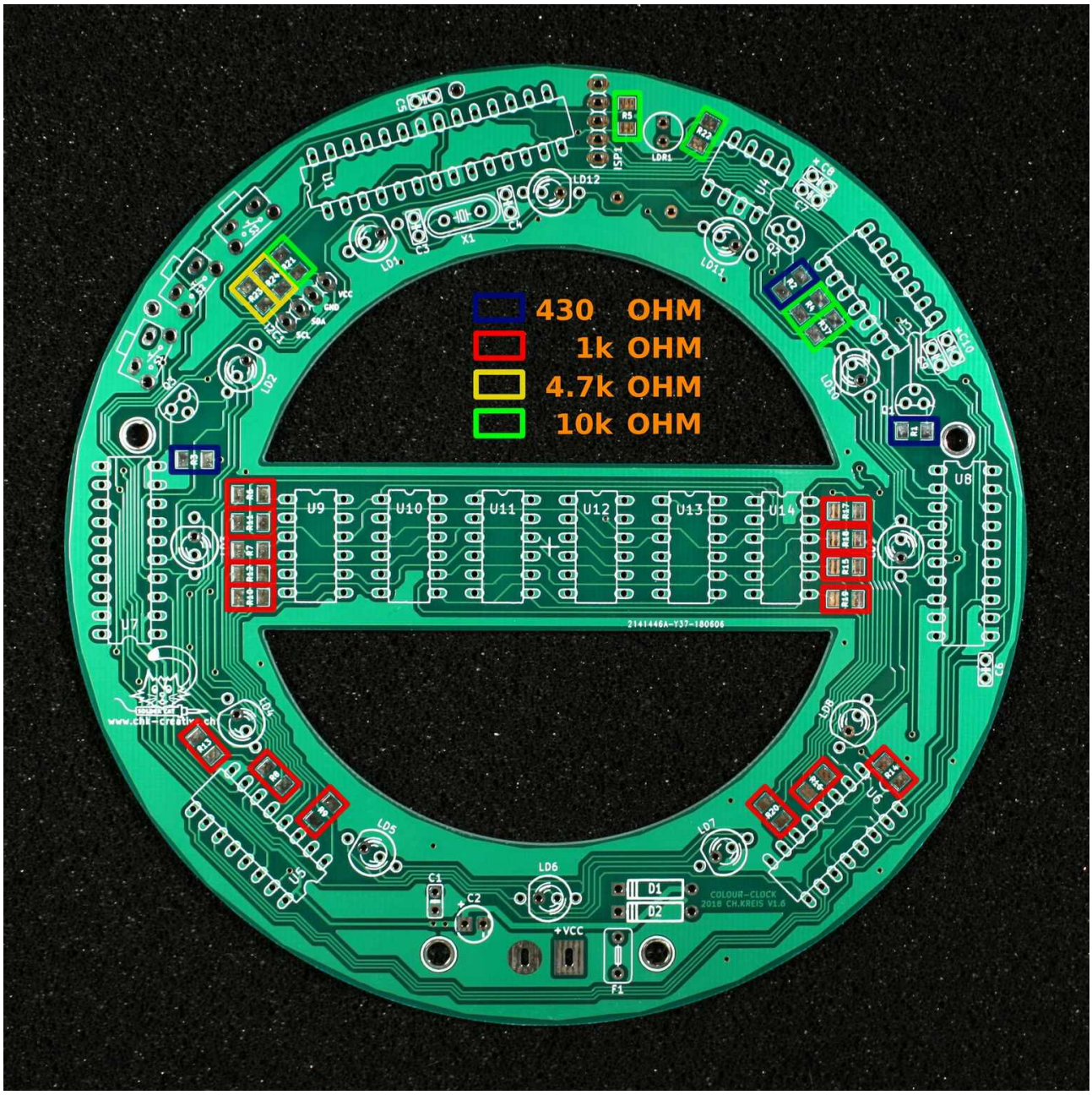


Optional: RTC Module

# Clock Board Assembly

**1.** First of all we will solder the SMD resistors onto the Printed Circuit Board. In the picture you see the color marked locations. The color must match with the value of the resistors, look on the table below. You can also use the location numbers to allocate the right place for the resistors.

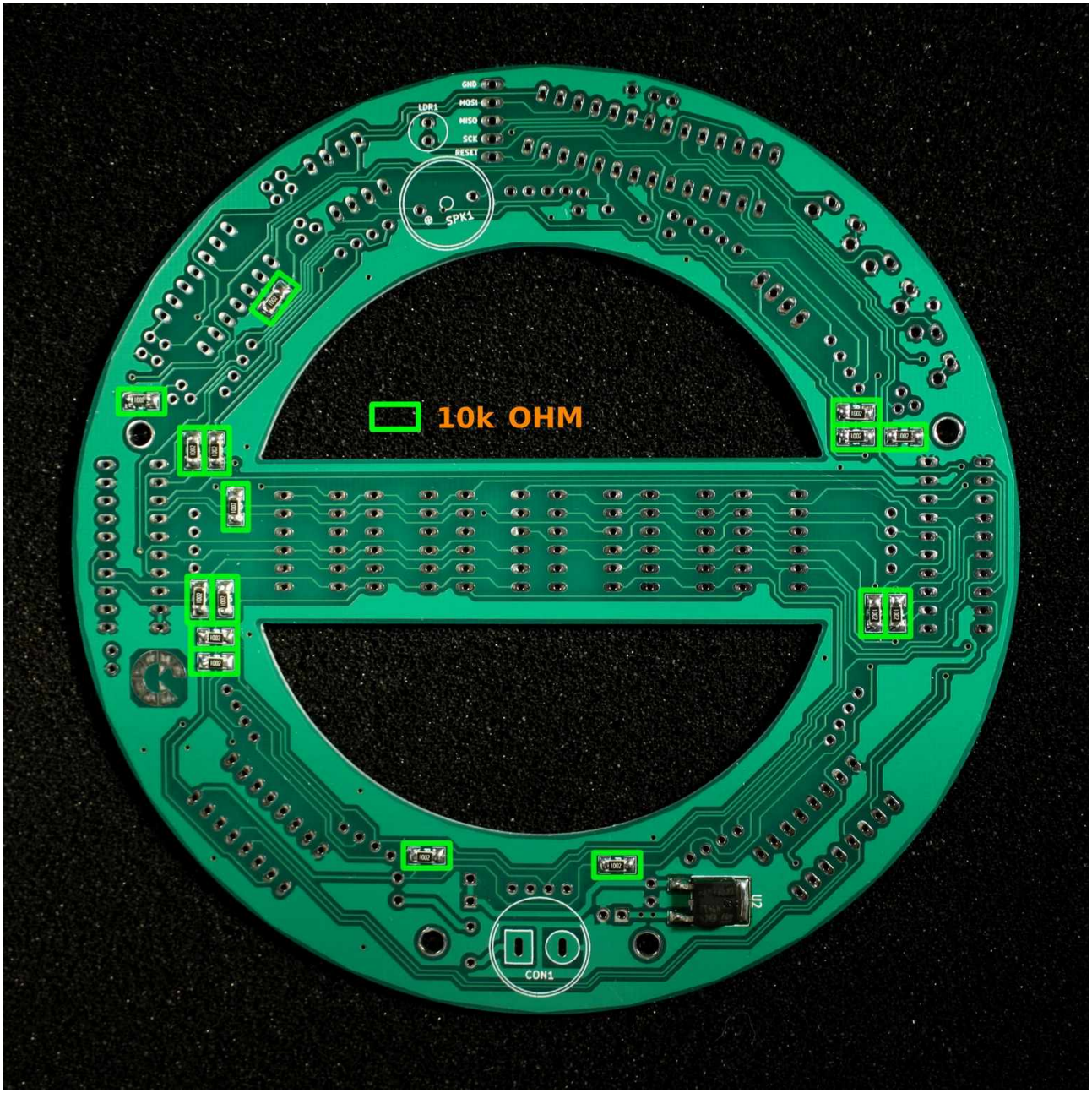
| Location Color | Inscription SMD | Value | Part Location Nr. |
|---|---|---|---|
| blue | 431 | 430 OHM | R1,R2,R3 |
| red | 102 or 1001 | 1k OHM | R6 to R20 |
| yellow | 472 | 4.7k OHM | R23,R24 |
| green | 103 or 1002 | 10k OHM | R4,R5,R21,R22,R37 |




Naturally, the inscription of the SMD resistors point upward.

**2.** Turn the PCB onto the other side and  place the resistors. We use only 10 k resistors on this side. The resistors R28 till R41 helps to avoid ghosting that caused by the RGB LED's.

| Location Color | Inscription SMD | Value | Part Location Nr. |
|---|---|---|---|
| **green** | 103 or 1002 | 10k OHM | R25 to 36, 37 to R41 |



## Identification of SMD parts:

The Three Digit System

This system is used for less accurate resistors ( tolerance > 5%). The two digits indicate the numerical resistance value of the resistor and the last digit gives a multiplier. The number of the last digit indicates the power of ten by which to multiply the given resistor value.

**Example 1: 101 = 10 × $10^1$ = 10 × 10 = 100 Ω = 100 Ω**
**Example 2: 102 = 10 × $10^2$ = 10 × 100 = 1000 Ω = 1 kΩ**
**Example 3: 103 = 10 × $10^3$ = 10 × 1000 = 10000 Ω = 10 kΩ**
**Example 4: 104 = 10 × $10^4$ = 10 × 10000 = 100000 Ω = 100 kΩ**

The letter “R” is used to indicate the position of a decimal point for resistance values lower than 10 ohms. Example for the three digit system: 1R0 would be 1Ω and 0R01 would be 0.01Ω.

The Four Digit System

This system is used for more accurate resistors ( tolerance < 5%). The three digits indicate the numerical resistance value of the resistor and the last digit gives a multiplier. The number of the last digit indicates the power of ten by which to multiply the given resistor value. Here are some examples of values under this system:

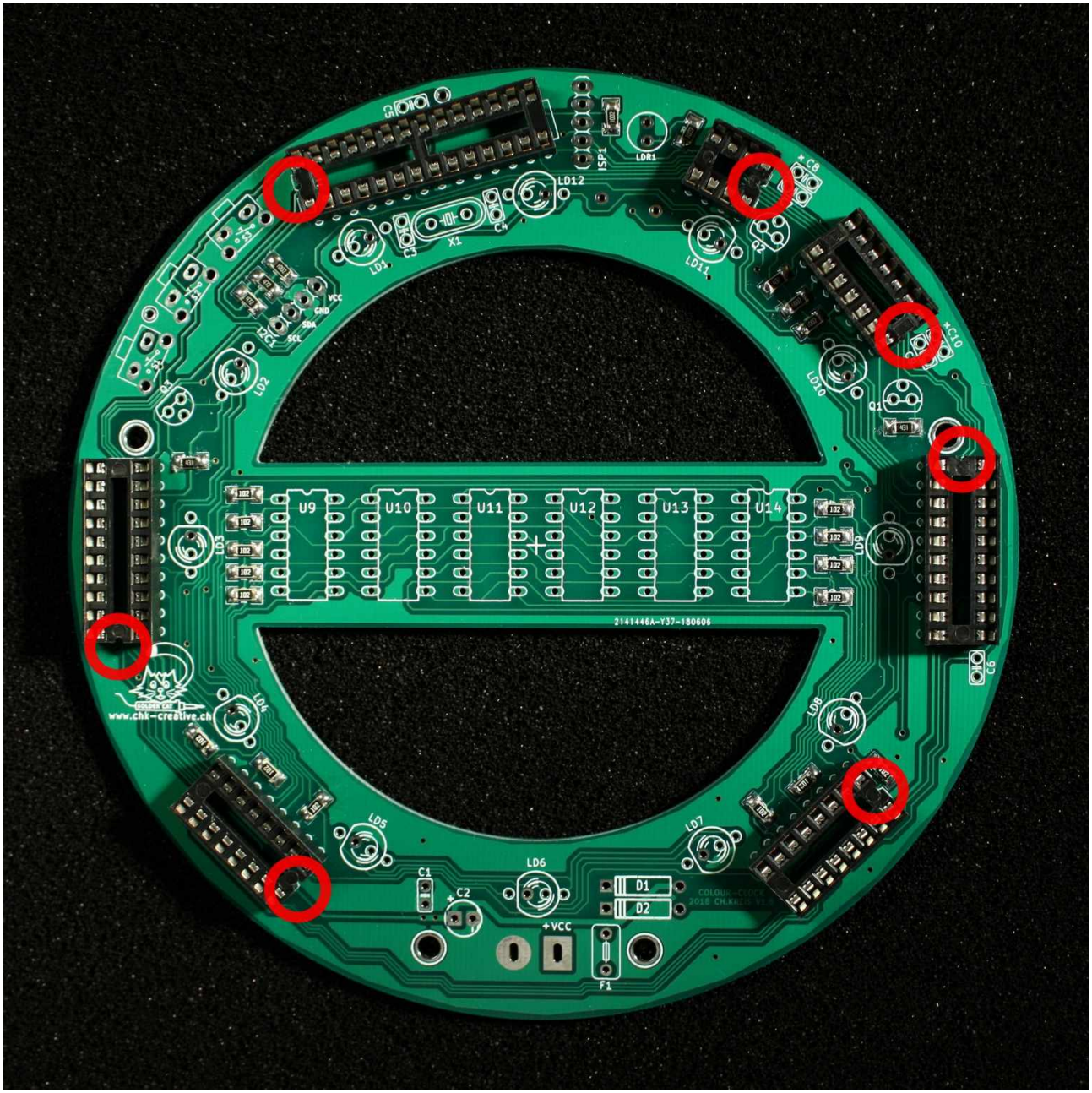
**Example 1: 1001 = 100 × $10^1$ = 100 × 10 = 1000 = 1 kΩ**
**Example 2: 1002 = 100 × $10^2$ = 100 × 100 = 10000 = 10 kΩ**
**Example 3: 1003 = 100 × $10^3$ = 100 × 1000 = 100000 = 100 kΩ**

The letter “R” is used to indicate the position of a decimal point for resistance values lower than 100 ohms. Example for the four digit system: 10R0 would be 10 Ω.

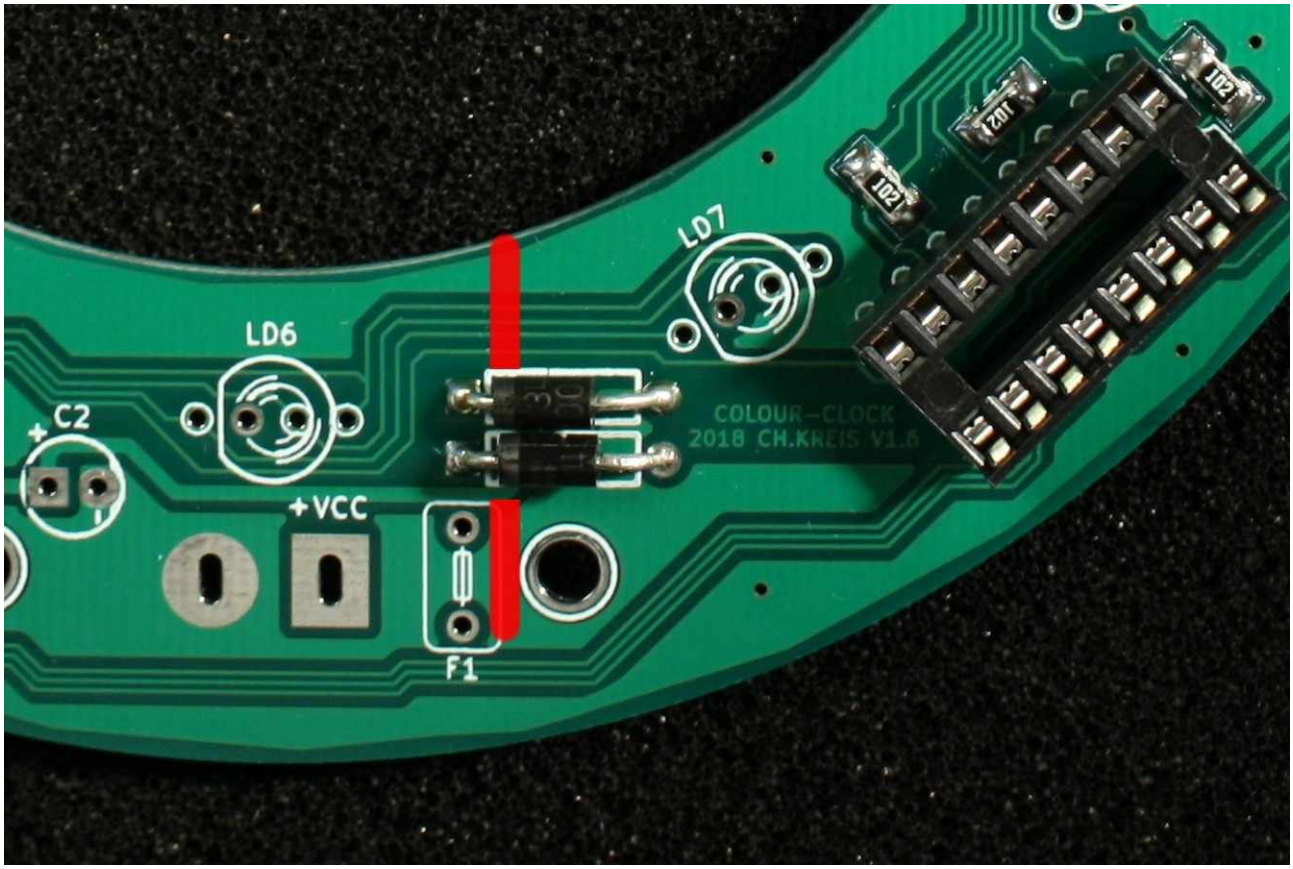
Read more http://www.resistorguide.com/resistor-smd-code/

**3.** Place and solder the IC Sockets. The notches on the sockets must match with the notch in the silkscreen. The table below helps you to place the sockets on the right location.

| Pole | Sockets For The Micro Controller | Part Location Nr. |
|---|---|---|
| 8 | MPC4901 | U4 |
| 14 | MPC4902 | U3 |
| 16 | Schiftregister 47HC595 | U5,U6 |
| 20 | Schiftregister TPIC6B595 | U7,U8 |
| 28 | Atmega 328P | U1 |

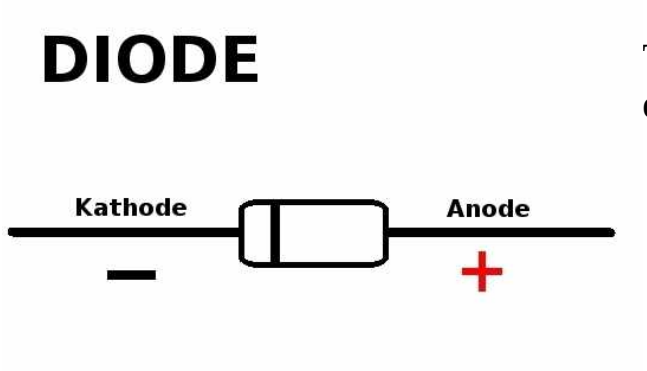


**4.** It is very important that you place the diodes in the right direction. If you have placed the diode D2 wrong, no current will flow and the clock won't work. The worse case happens when you place the Diode D1 in the wrong direction, most IC's will take damages and they could heat up, and be sure your clock will never work again.



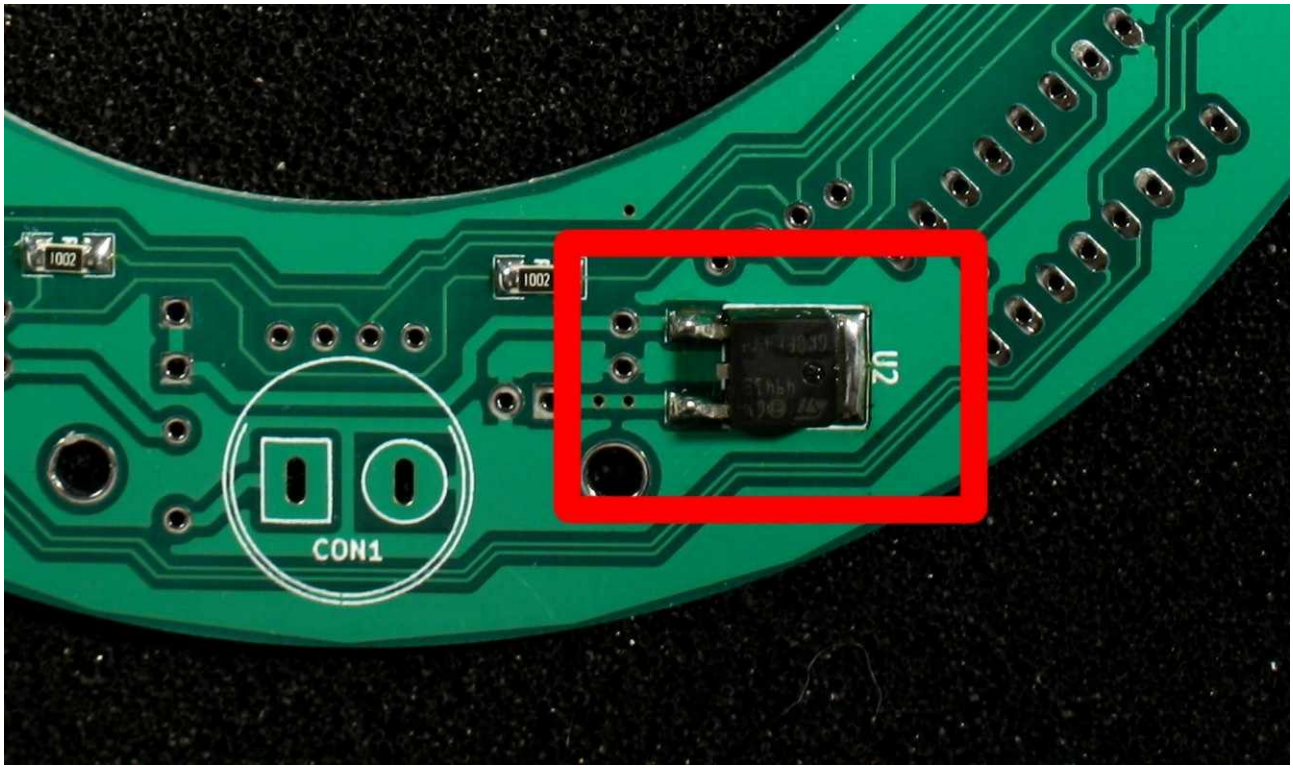

**The diodes have a silver strip at the end. Make sure this strip matches the strip in the silkscreen image.**

Look for the right location, bent the leads and now place and solder the diodes D1 and D2.

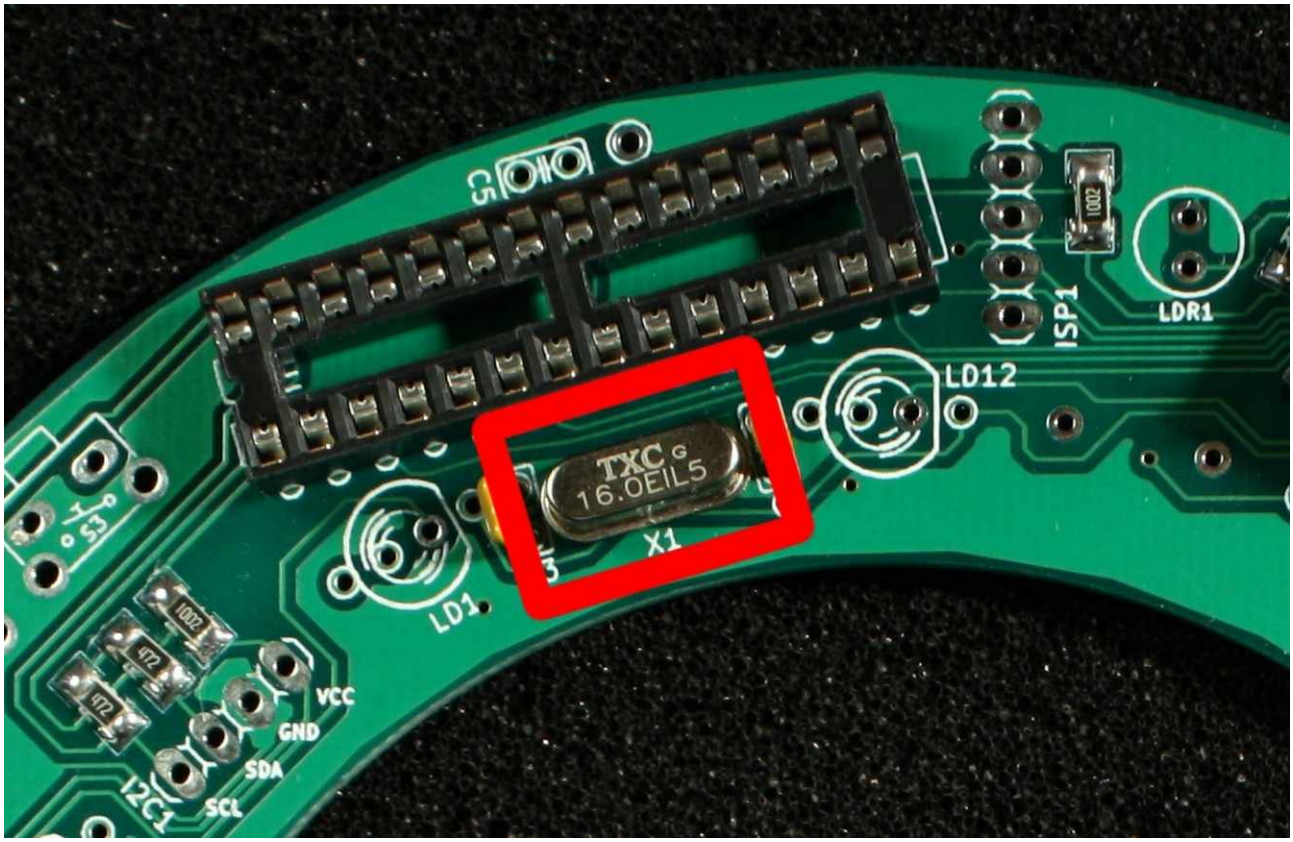



The ring on the diode marks the current direction.

**5**. Lay the SMD regulator U2 on the marked place **on the backside** of the printed circuit board. Align the component and solder them. Make sure that no solder joins the pins. The regulator reduce the power form 9 Volt to 5 Volt.



**6.** Tack and solder the crystal X1.
The crystal has a frequency at 16 000 000 Hertz pro second and beats the clock.

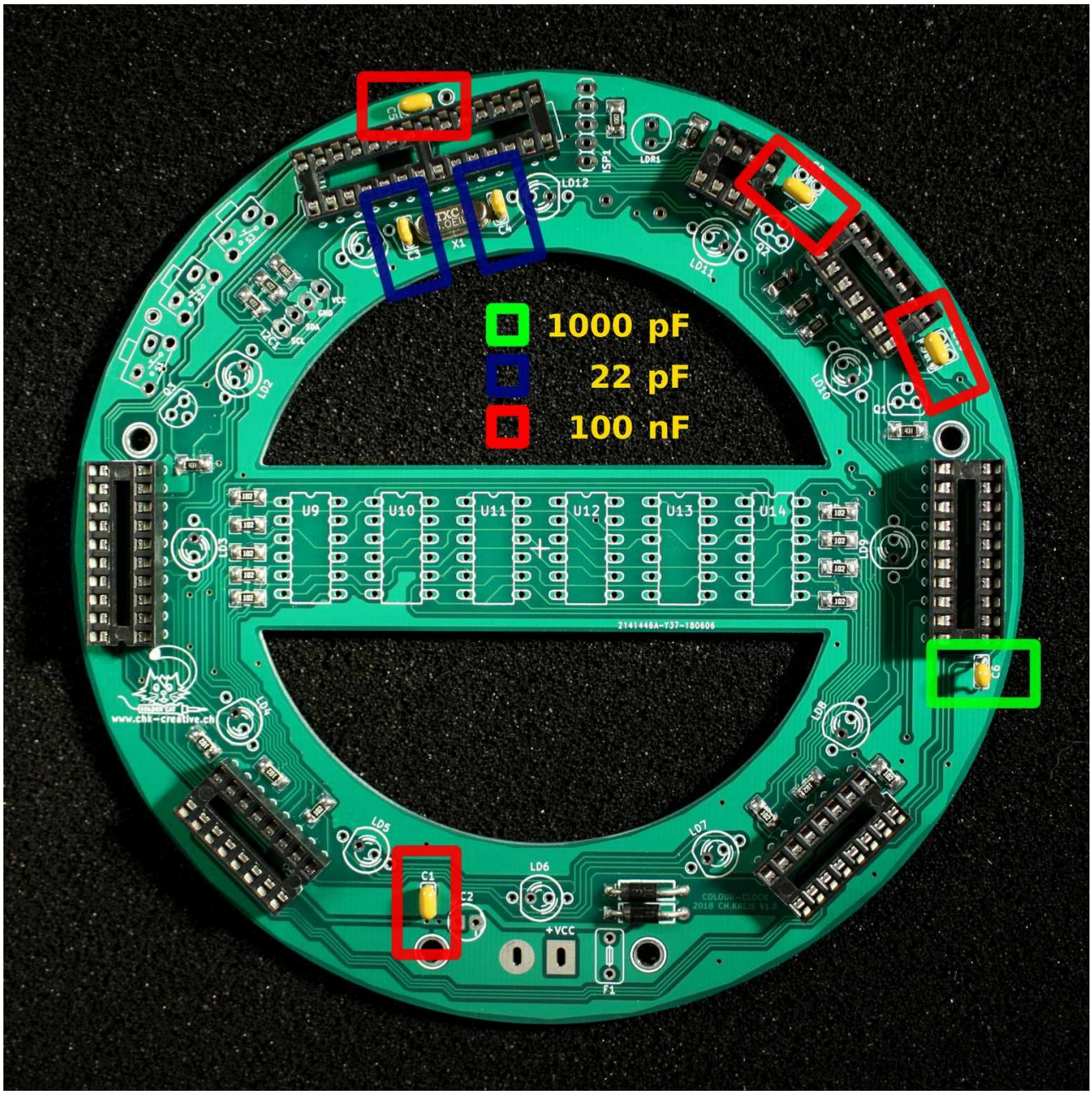


**7.** A capacitor is a passive two terminal electrical component that stores electrical energy in an electric field. In this circuit we use the capacitors to smooth the power supply output and reduce electric noise.

.

Now it is time to solder the ceramic capacitors. A look on the picture will help you to place the capacitors onto the right spot.

| Location Color | Inscription | Value | Part Location Nr. |
|---|---|---|---|
| **green** | 102 | 1000 pF | C6 |
| **blue** | 220 | 22 nF | C3,C4 |
| **red** | 104 | 100 nF | C1,C5,C7,C9 |

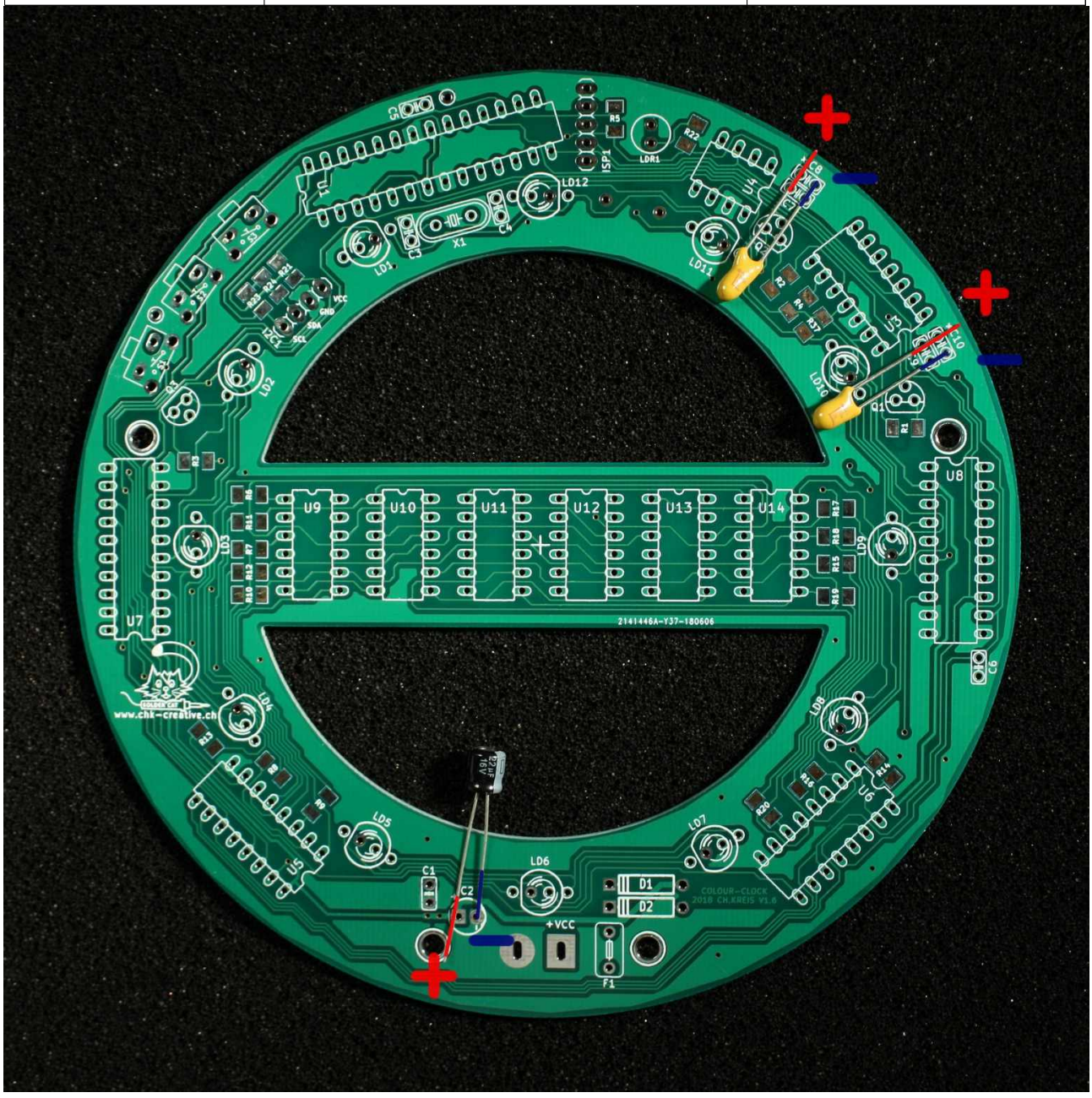


Electrolytic and tantal capacitors are two poles components. Look at the longer wire, that is the positive pole. It is very important to double check that the positive pole match with the “+” on the silkscreen. You may have noticed a broad strip on the electrolytic capacitor which is marked. This side is the negative pole.

Be aware of a **wrongly connected capacitor won't work at all. In the worst case the capacitor could explode !**

Now place the electrolytic capacitor onto the location C1.
The location C8 and C10 are reserved for the tantal capacitor.

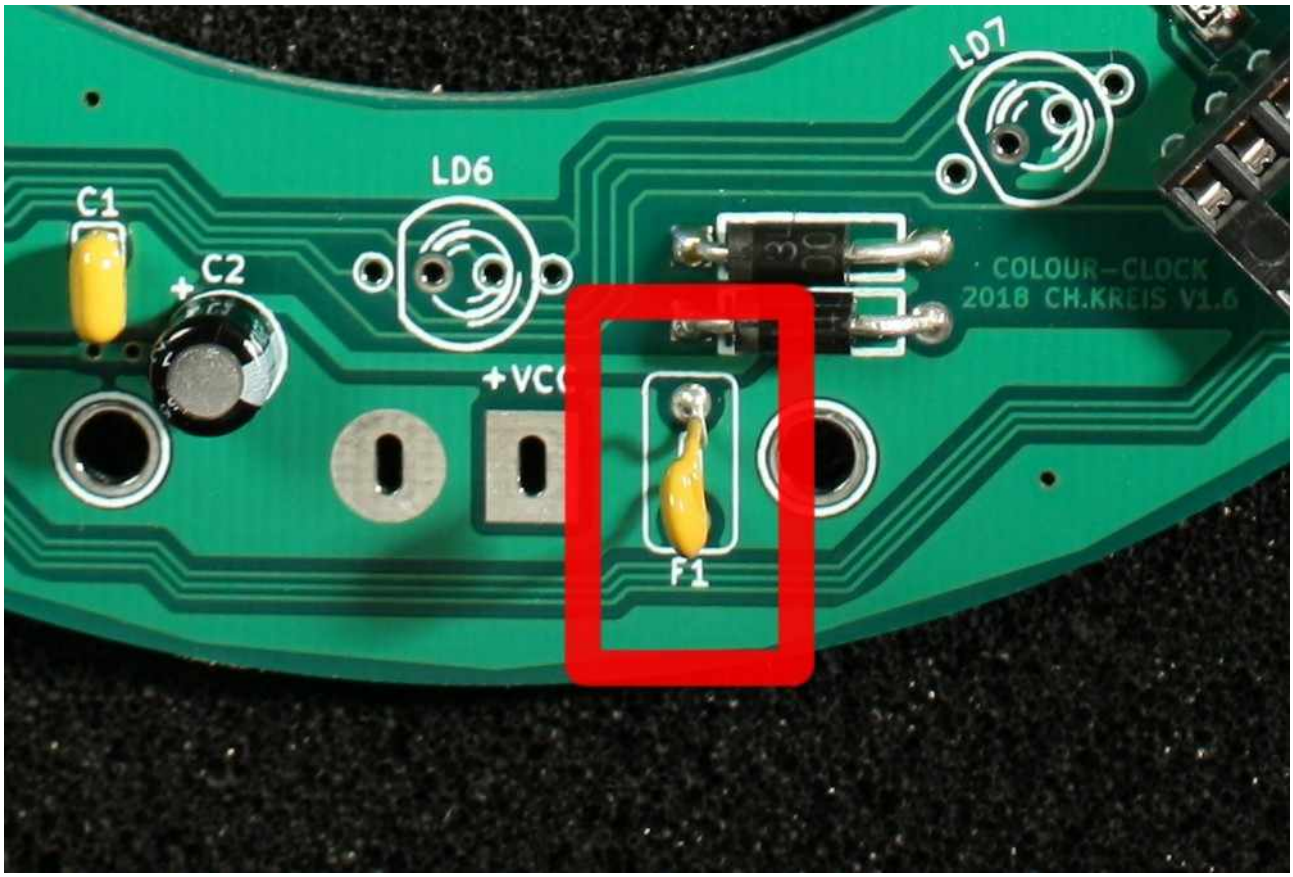
| Typ | Inscription | Part Location Nr. |
|---|---|---|
| Elko | 22 uF | C2 |
| Tantal | 10 uF | C8,C10 |



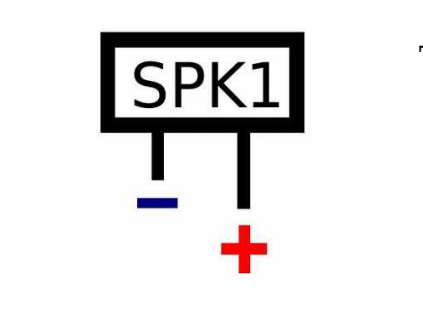
**8.** Solder the fuse.
The fuse protect the electric circuit against excessive current. The fuse will heat up and cut off the power supply. After a while the fuse cools down, it resets and the current flows again.

Now look for the right location “F1”, place and solder the fuse onto your board.

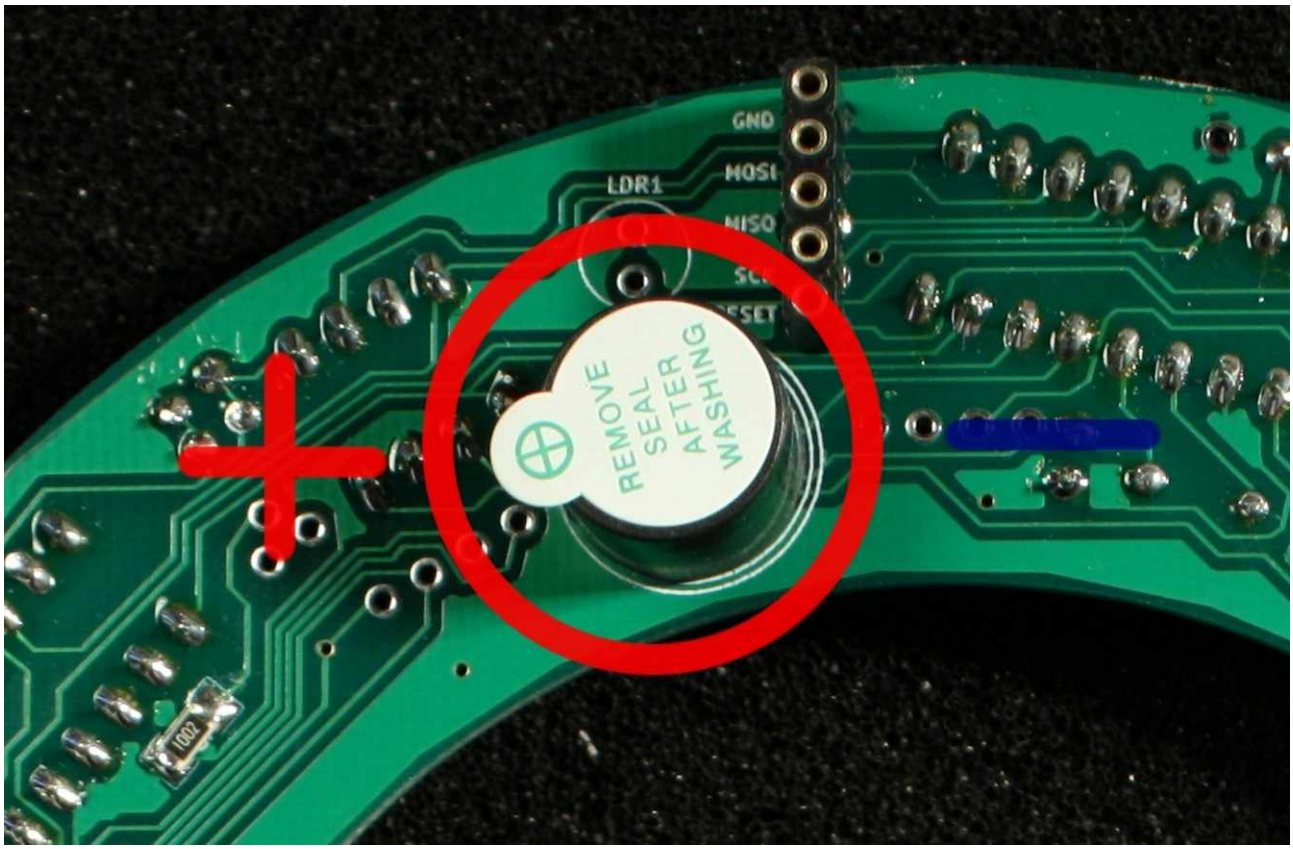
**Ensure that the fuse not touch the enclosure after you have solder them. Draw the fuse tight to the printed circuit board.**



**9.** Your alarm clock needs a speaker to wake you up in the morning!
Make sure the positive pole matches the silkscreen. Have you placed the speaker the wrong sides then no sound will come out. Now solder the speaker.



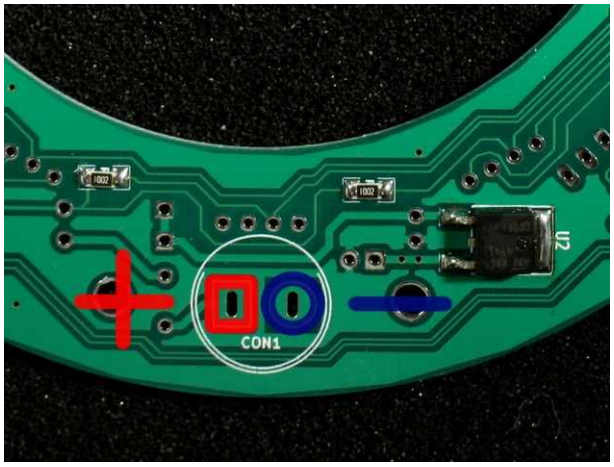

The longer wire is the positive pole.



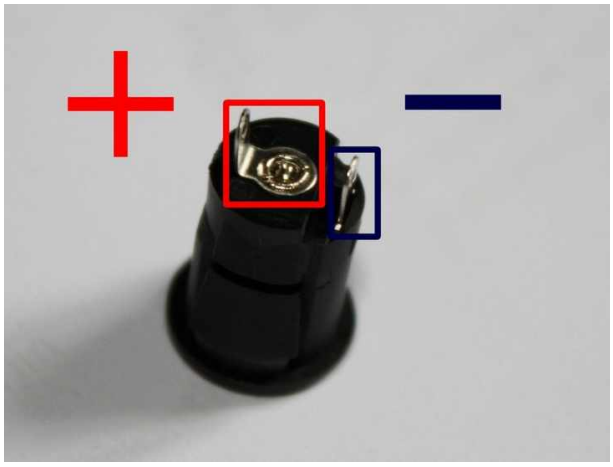
**10.** Tack the power jack CON1 on the backside of your Clock Board. It is very important that you place the power jack with the right polarity onto your board. Double check and solder the component onto the topside. It takes some time to heat up the metal and make sure there is plenty of solder on the pads.

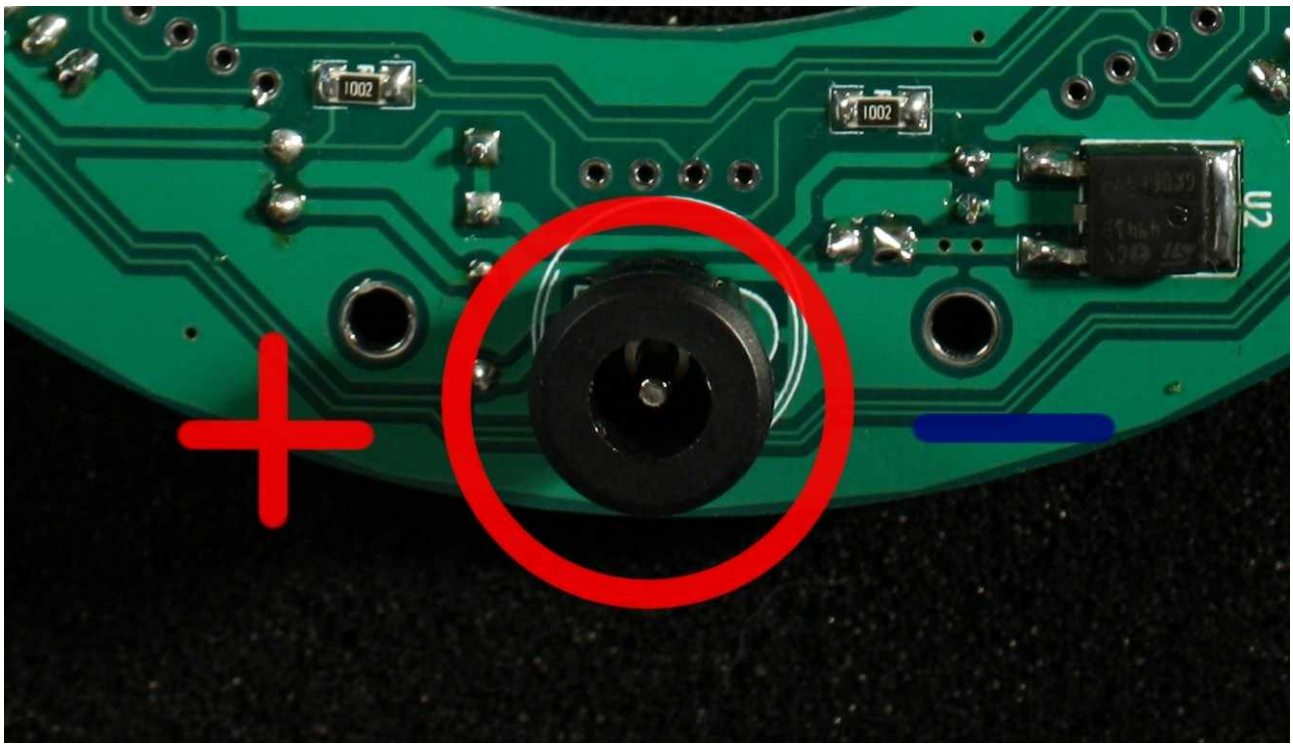
**Attention: tack the power jack onto the backside of your pcb and solder the leads on the frontside.**

## Double check polarity and ensure yourself.



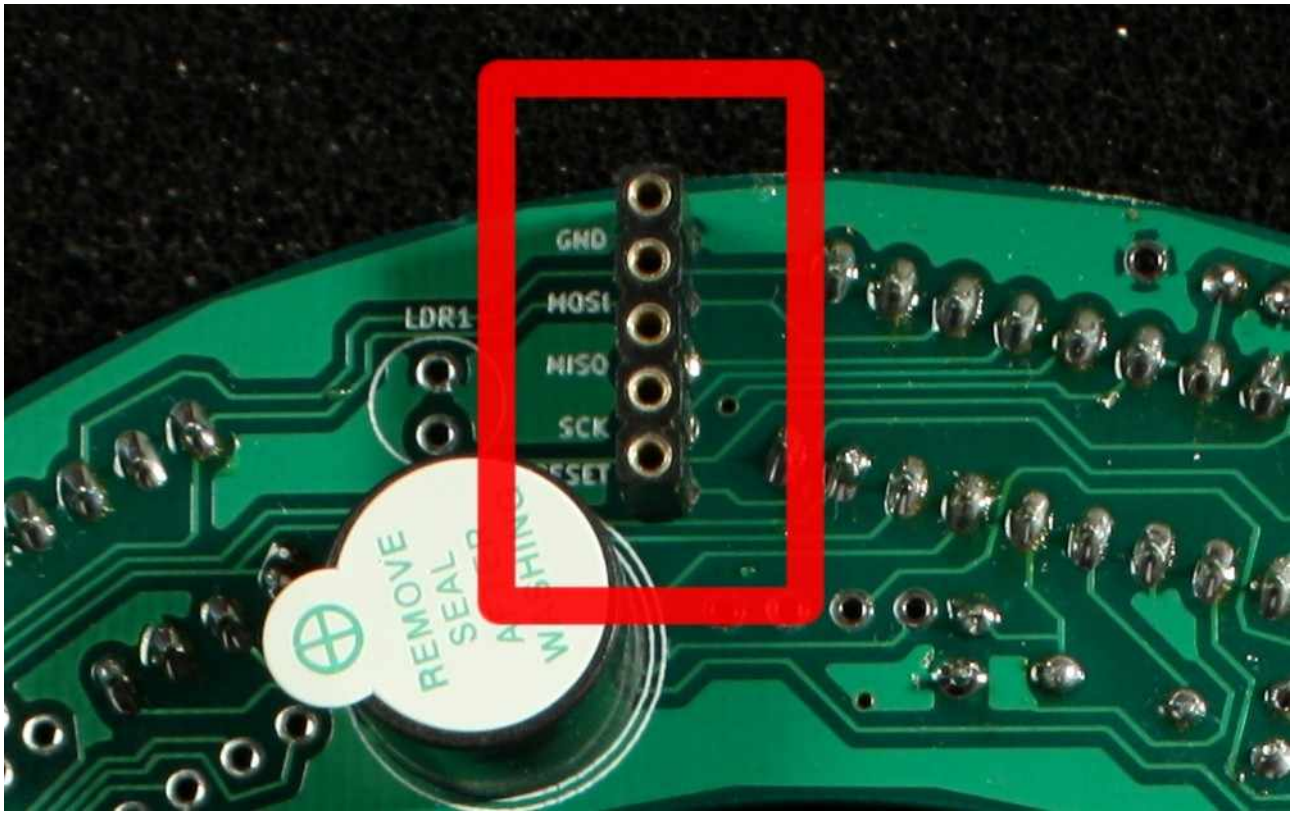
backside


power jack



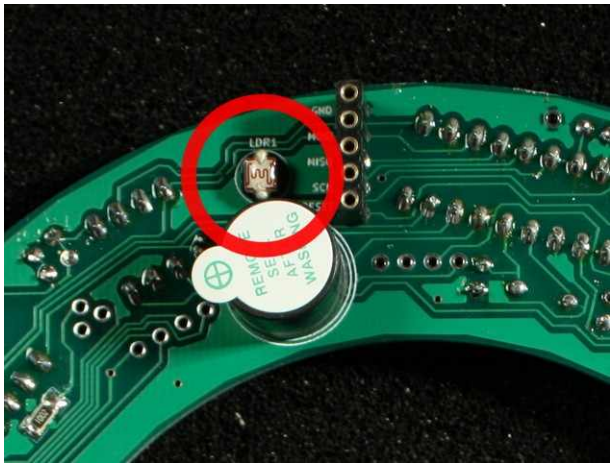
correct mounted power jack

**11.** Place and solder the 5 pol female pin head  ISP1 onto the backside of the circuit board. Via the interface ISP1 you can reprogram the clock firmware.




**12**. Solder the **L**ight **D**etecting **R**esistor (LDR) onto the PCB.
You can mount the LDR on the front- or backside. It is recommended to mount the LDR on the frontside of the board, the sensor reacts faster by light chance.


Frontside mounted



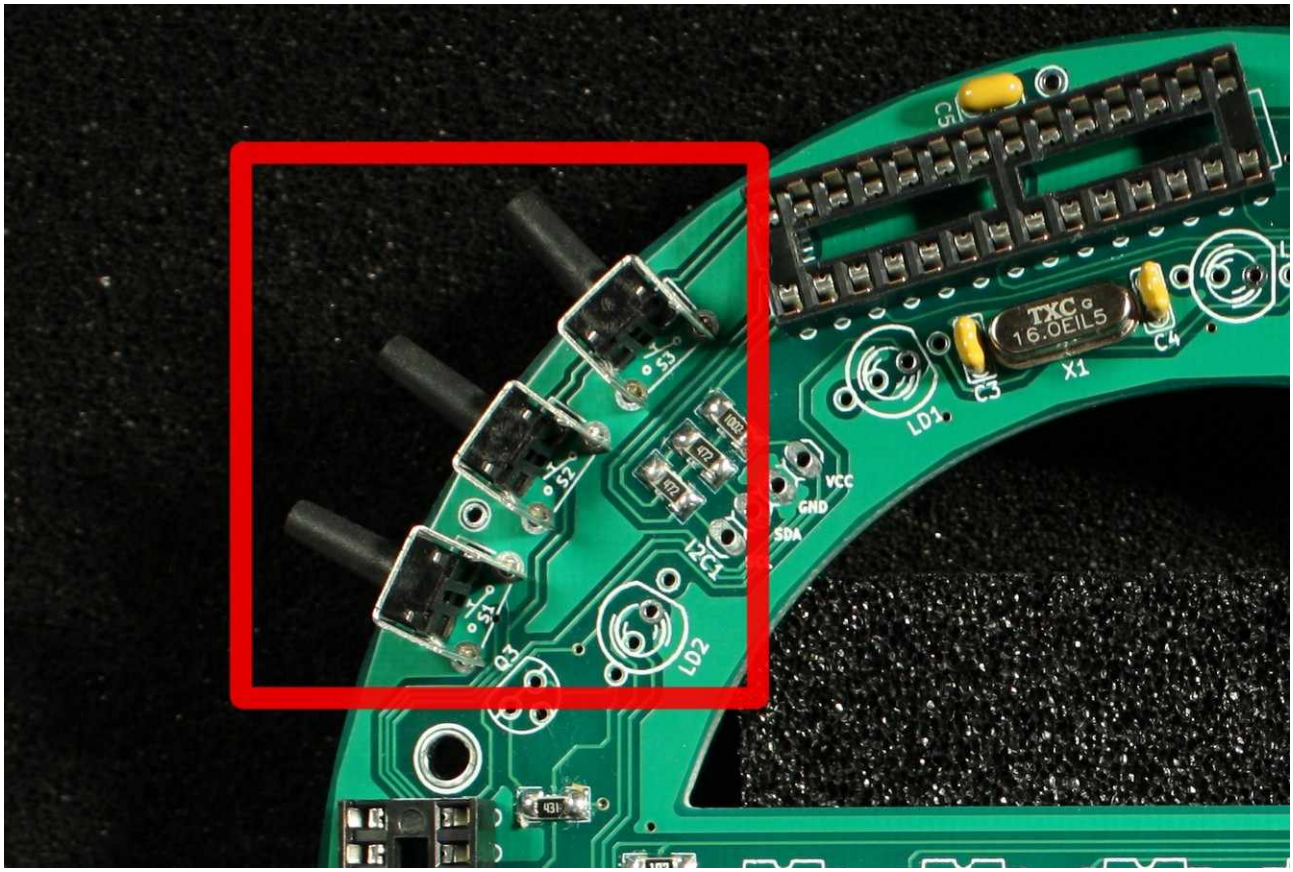

Backside mounted

**13.** Before you solder the buttons you should clean the board thoroughly with a solution of dish detergent and methylated spirit.

The buttons don't like moisture also the speaker !

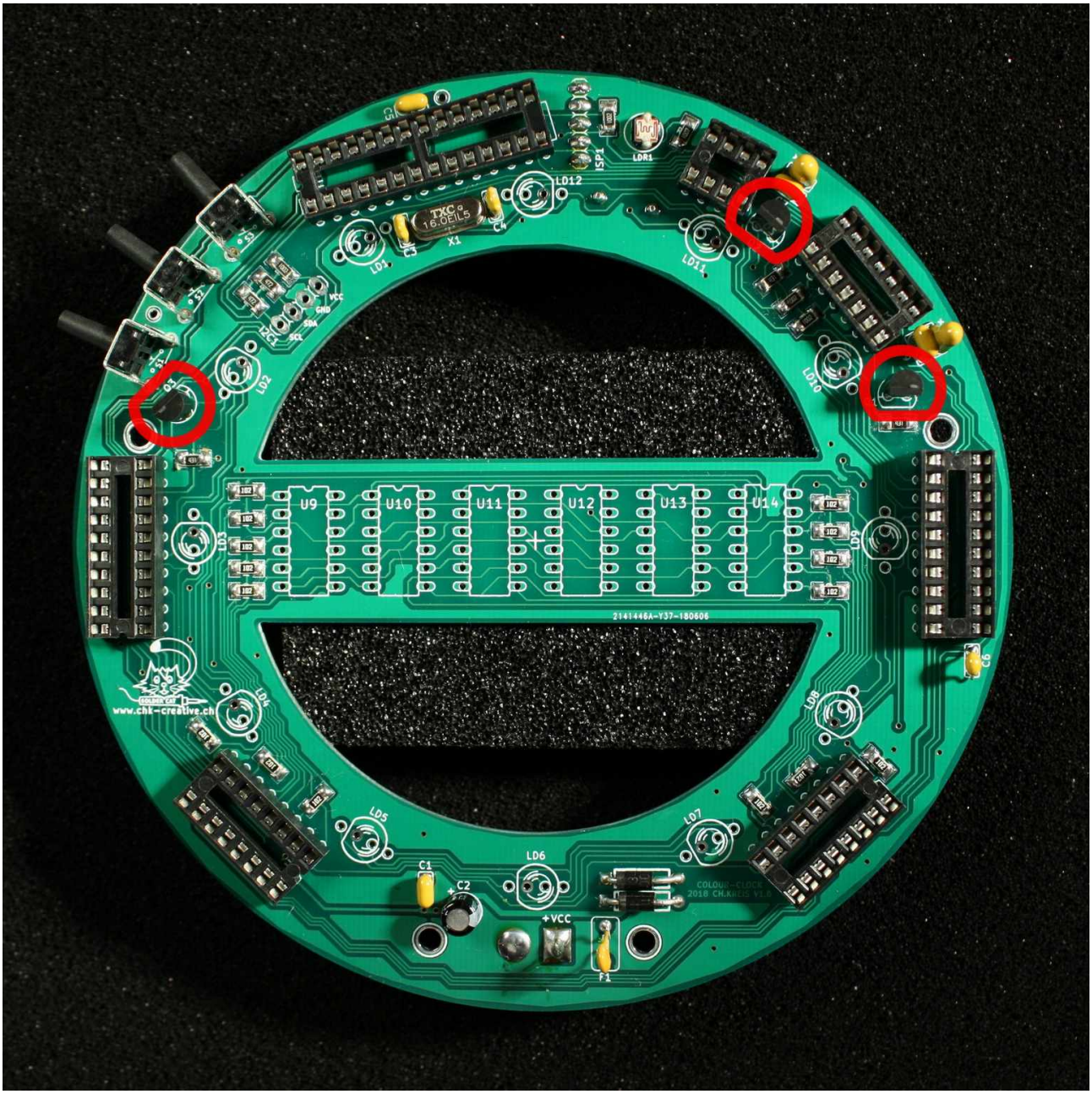
## Important: Make sure that the board is absolutely bone dry after cleaning.

Now place and solder the button S1,S2,S3



**14.** MOSFET are easily damaged by static discharge. Use an anti-static surface to handle the component. Ensure that you are free of electrostatic charge. Before you handle the component ground yourself, the best way is to touch a radiator or a water pipe to discharged yourself.

The half round transistor case must match the half round silkscreen, check twice. Now solder the MOSFET's 2N7000 onto the location Q1 ,Q2 and  Q3.

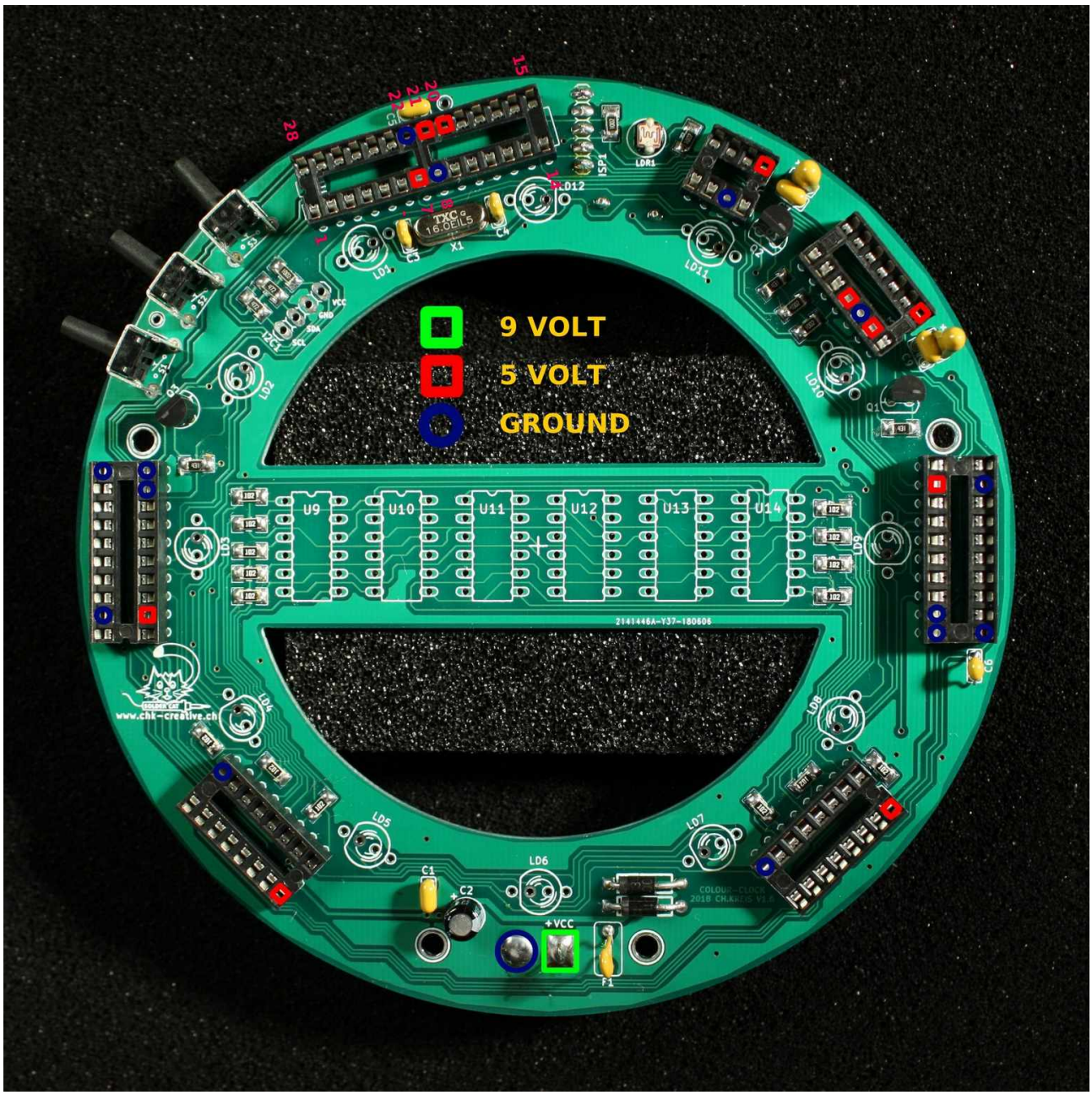


## The power supply check

**15.** The power supply check.

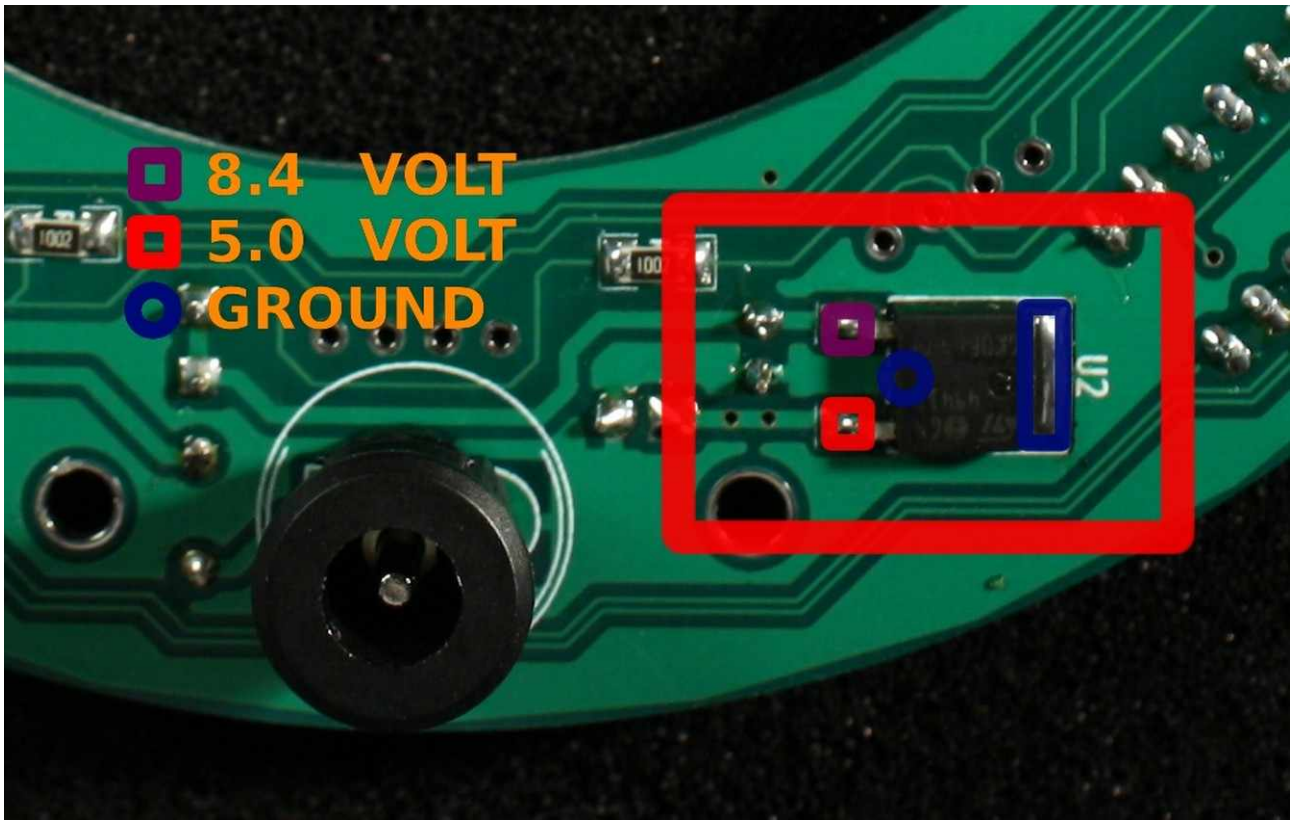
Look for metal bits they could cause a short circuit before you energize your board.

Compare the values with the measure points on the picture. Take time for your measurements and check twice. The voltage can differ at a minimal range, depending on your multimeter tolerance value.



Turn the PCB on the other side and measure the violet marked point of the SMD Regulator. The multimeter should you show approximate 8.4 Volt. Shows your multimeter 0 Volt, than you have mounted the Diode D2 in the wrong direction.

Maybe you asking your self “why 8.4Volt and not 9Volt”. The voltage drop is caused between the violet (backside) and the green measure point (frontside) by the protector diode D2 .



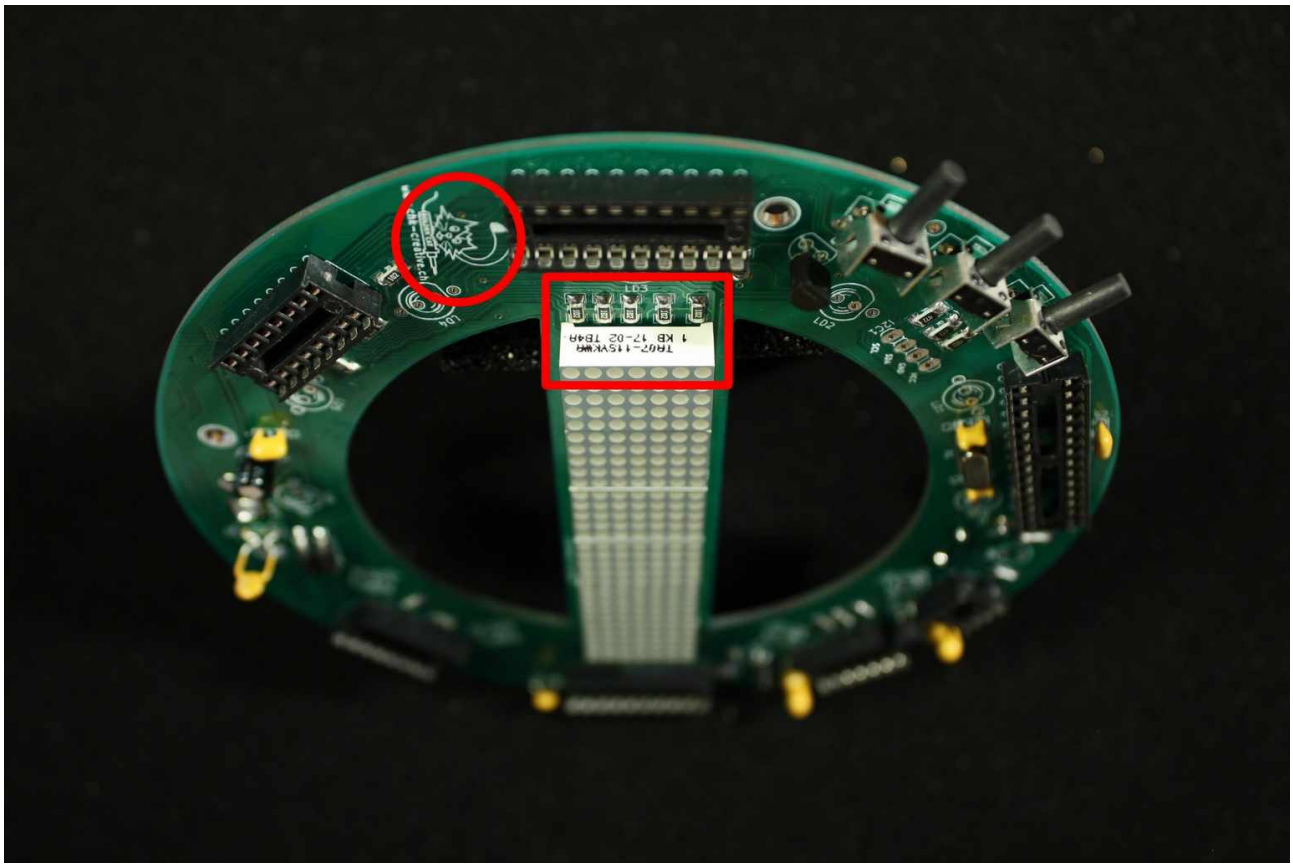

**Important: If the power supply check failed, check step by step every instruction point to find the bug.**
**Don't continue until you have find the malfunction and remember we don't take responsibility for any injury or damage as a result of assembling this kit. The wrong voltage and polarity could destroy and overheat the ICs.**

Disconnect the power supply from the clock board.

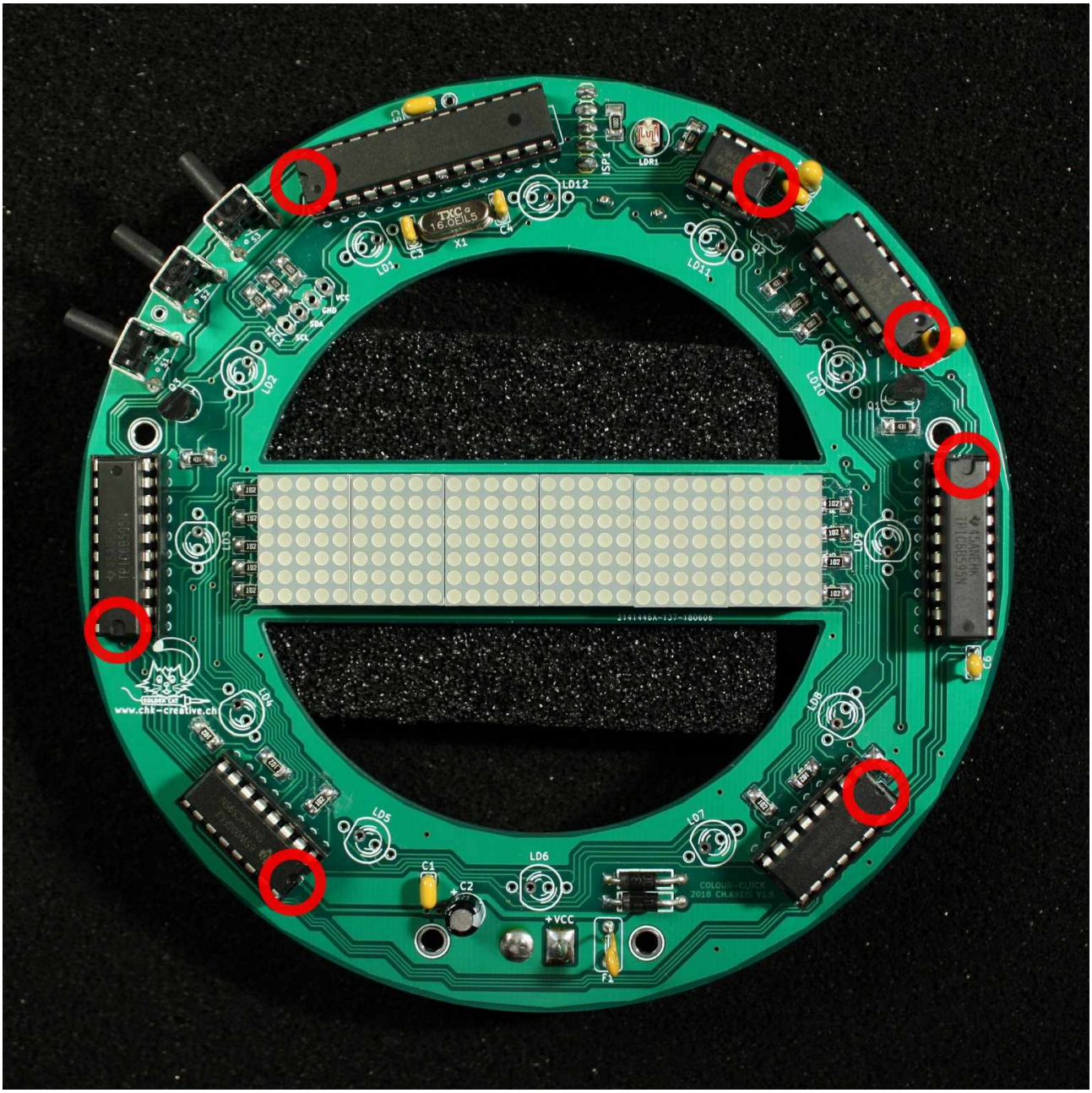
**Was the test successful then you can continue with the next step.**

**16.** Solder the Matrix LED's
The lettering on the LED matrix blog must point at the cat symbol on the silkscreen. Look twice, a incorrectly mounted LED block can not work properly.

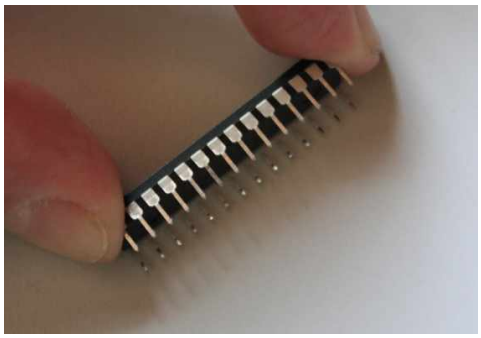
**Advice:** solder at first only the corners leads with a few tin solder onto the PCB. Stick on the microchips (see next step) and energize your clock board. Single shining dots should lite up on your Matrix Display.



**17.** Plug on the IC's
Take attention to the U-shaped notches they must compare with the silkscreen.



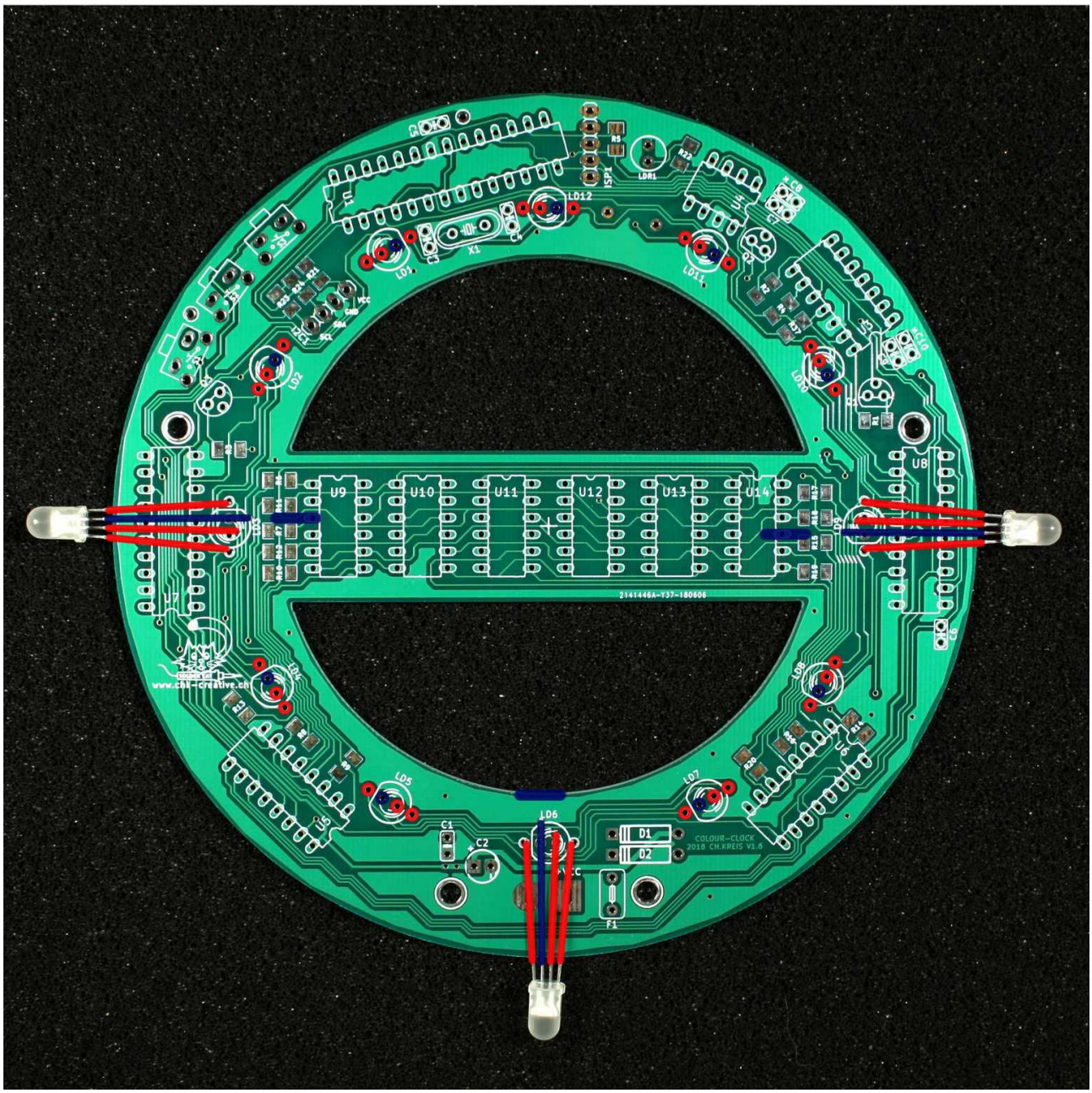

**Attention: Incorrectly installed micro controllers could heat up, or they will be immediately destroyed.**

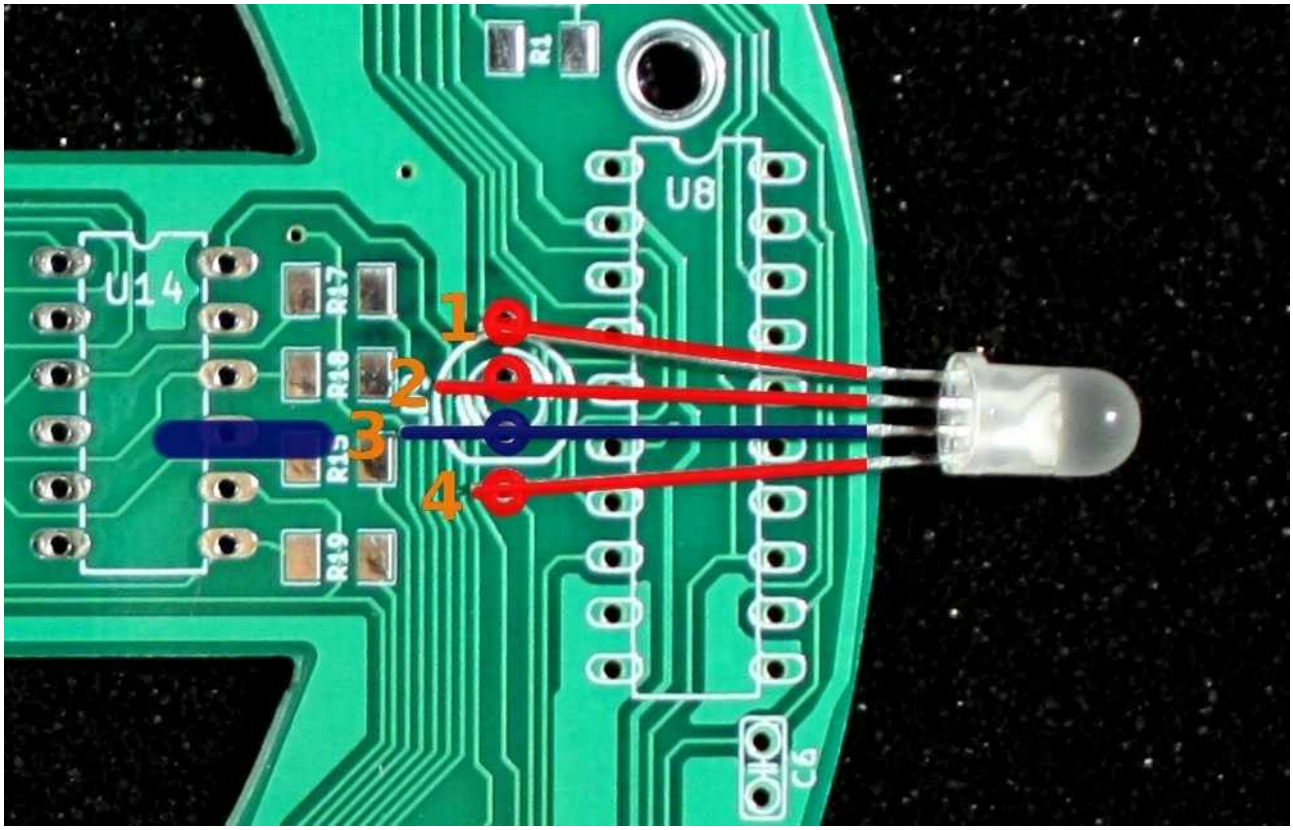


Occasionally it is necessary to bend the pins of the chip, they slide and fit better in the socket. Take a look at the picture, lay the pins parallel onto a flat surface and push them carefully in the right position (pins 90° to the case).

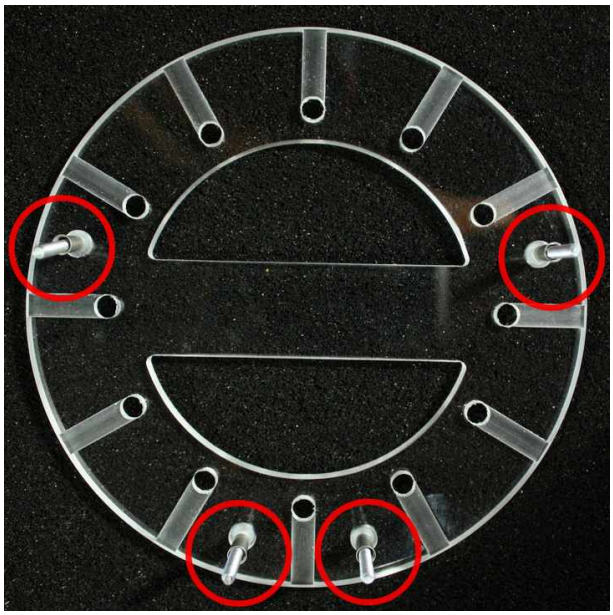
**18.** Assembly the RGB LED's
Look at the RGB LED leads, the third blue one marked is the longest, take a look on the close up view picture to ensure yourself. The color marked leads must compare with colored spots on the PCB.

# Check twice !

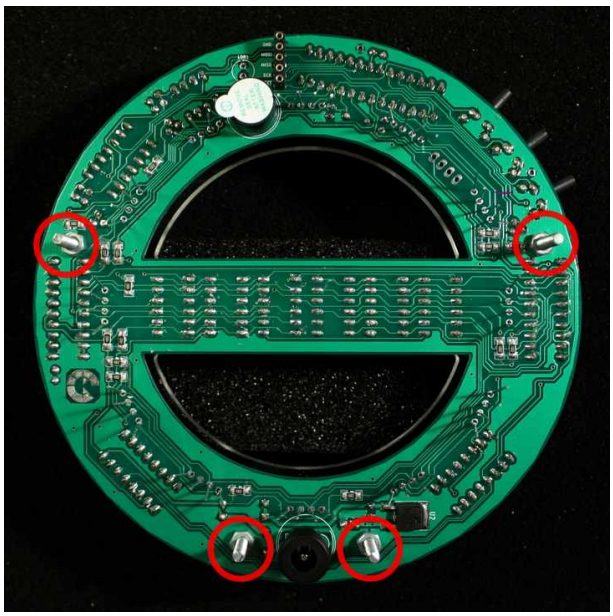





Close up view: RGB LED



Put the bolts through the watch face and pull the end sleeves over them.

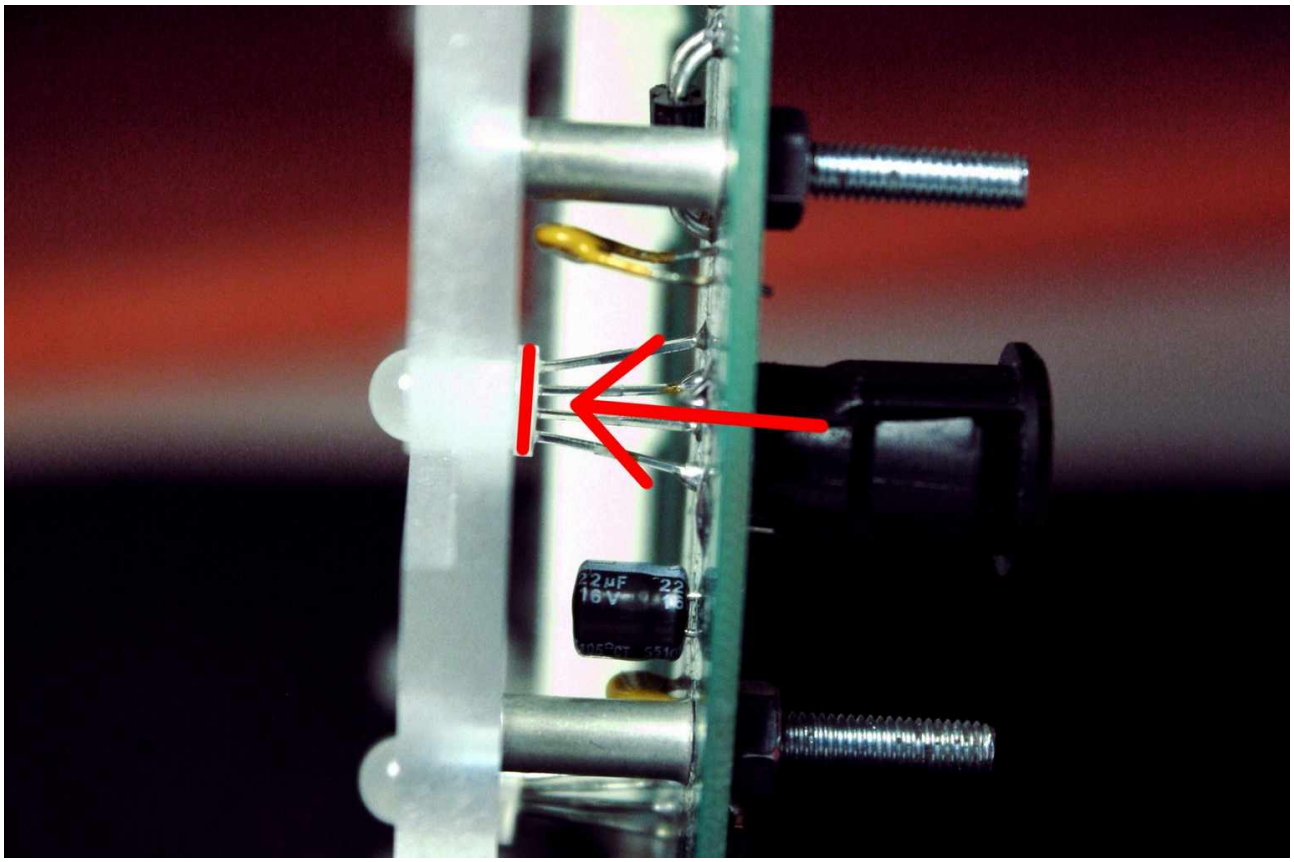


Mount the PCB with the RGB LED's on the watch face and screw they tight.

The crimp of the end sleeve looks upward.

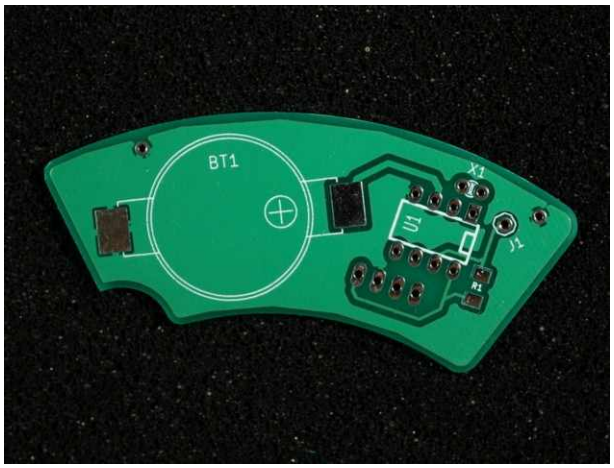
Have you aligned all RGB LED correct ? Lets make a test.
Energize your board and look close at them. You see the the red second hand (LED) moves clockwise around.

Align the RGB LED's, push them forward until up to the stop of the dial clock.
Now solder the wires tight on.

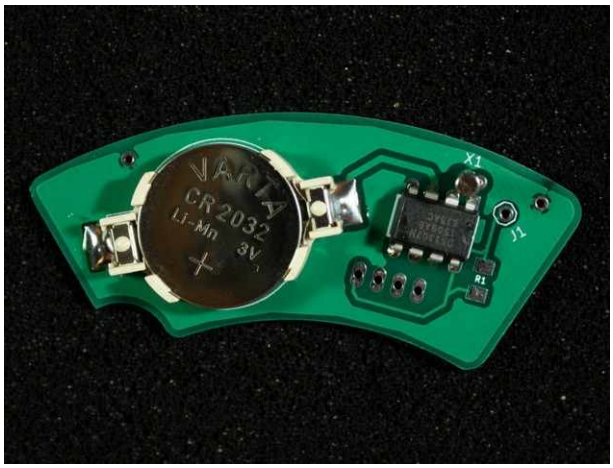


## RTC Module

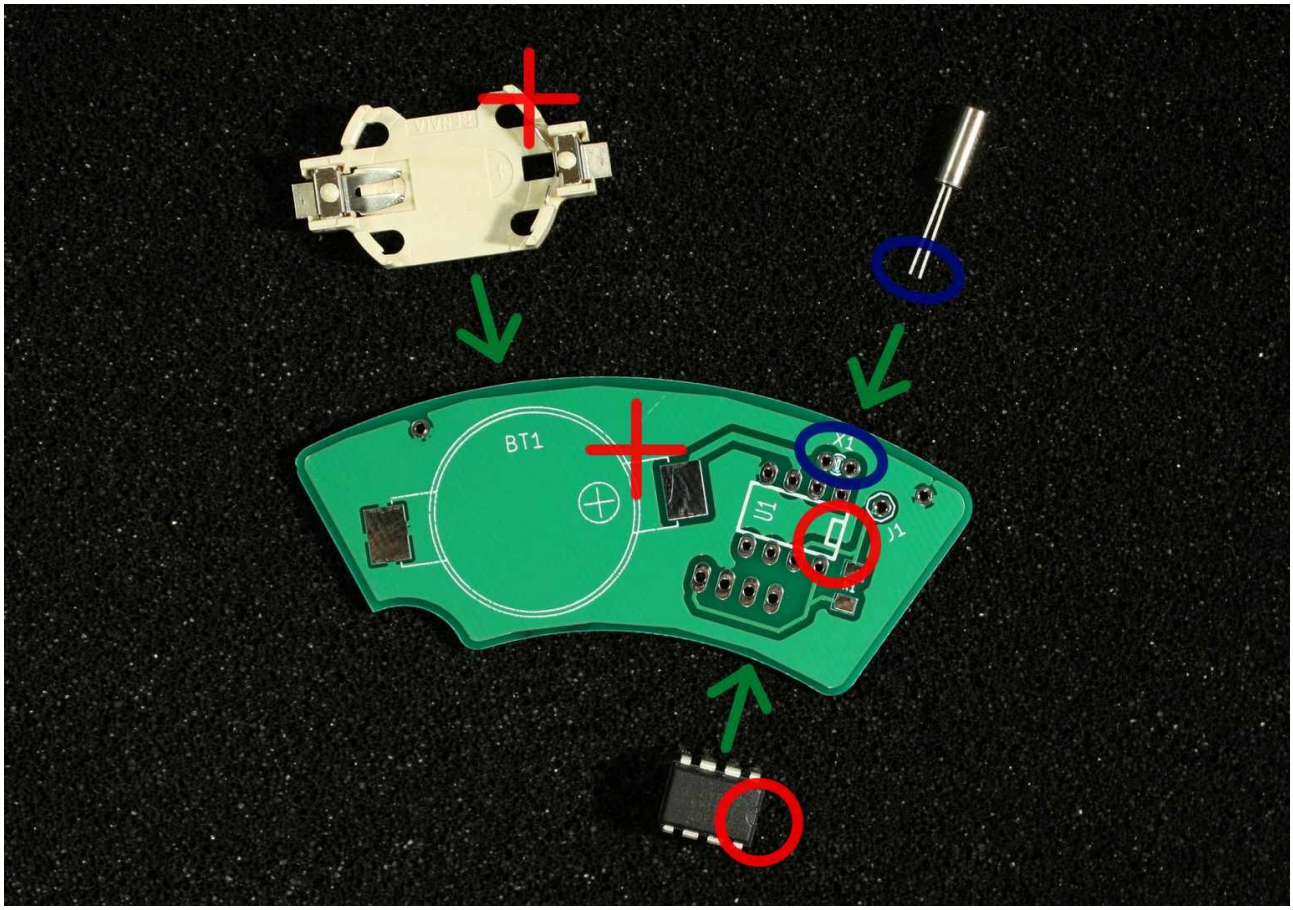
**19.** RTC Module Assembly (Optional)
Optional you could put on the RTC Module onto the interface IC21



RTC Module



RTC Module Mounted

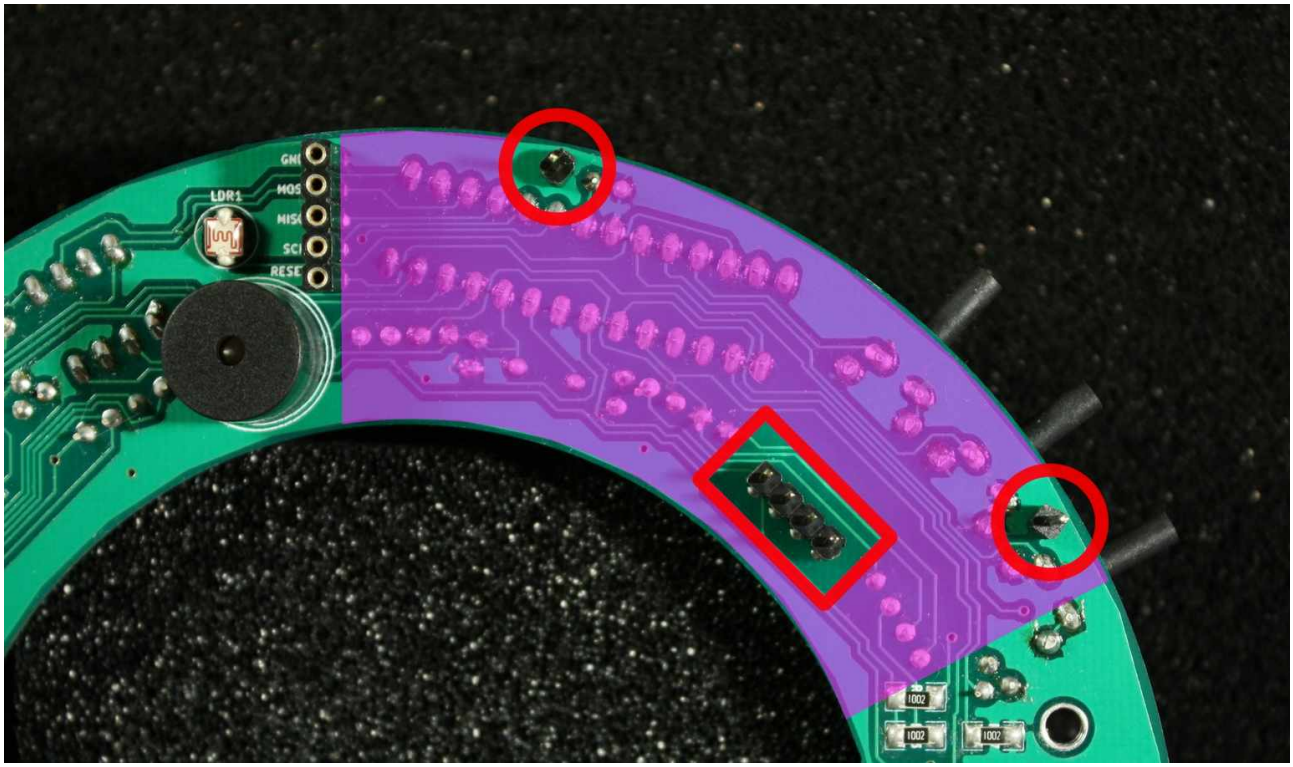



Place the battery holder, the positive pole must match with the silkscreen.
As usual the notch of the IC must match. At the end, tack on the crystal.

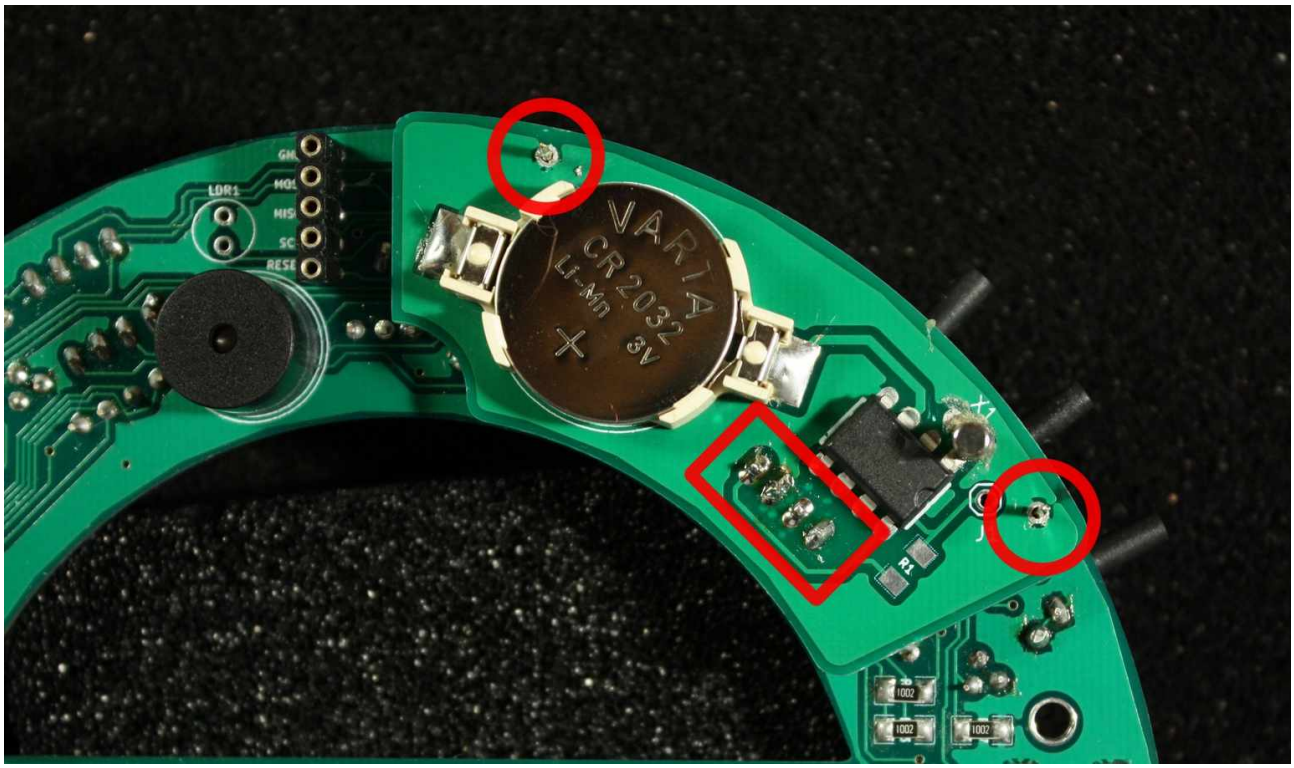
After you have soldered the components **you must cut the leads short as possible to avoid short circuit.**

Tack the 4 pol pin strip onto the location I2C1 on the back of the PCB.
Don't forget to mount the two single pin strips. Now solder them.

The same principle is valid also here, **cut the leads between the marked area as short as possible to avoid short circuit on the clock board.**

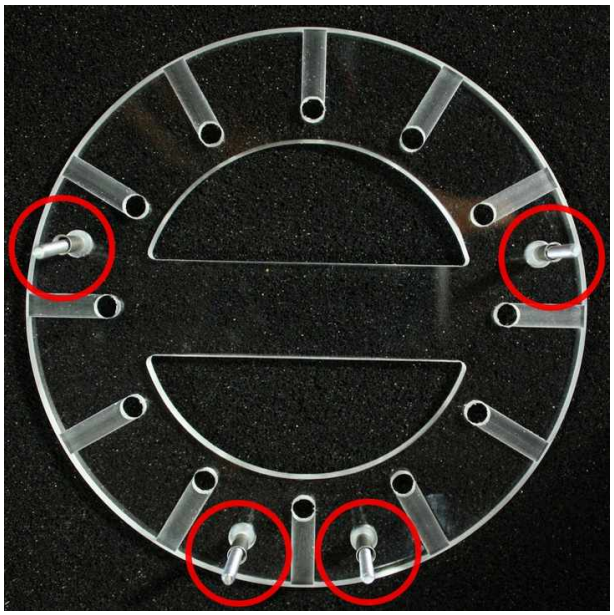



Pull the RTC Module over the pin strips and solder them tight.

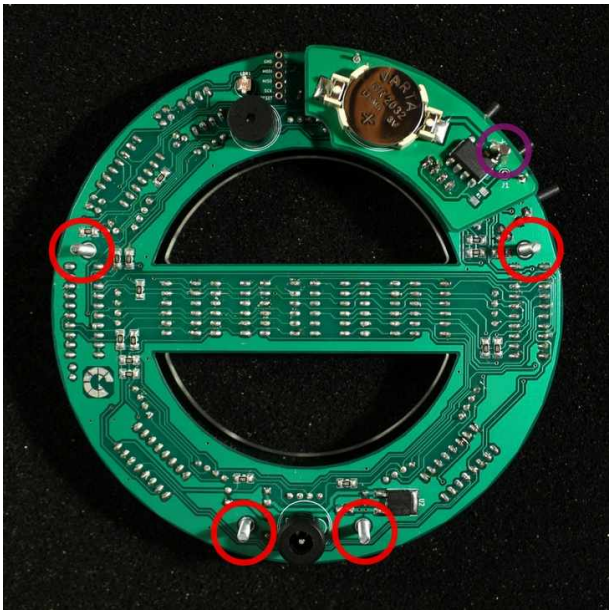


## The final assembly

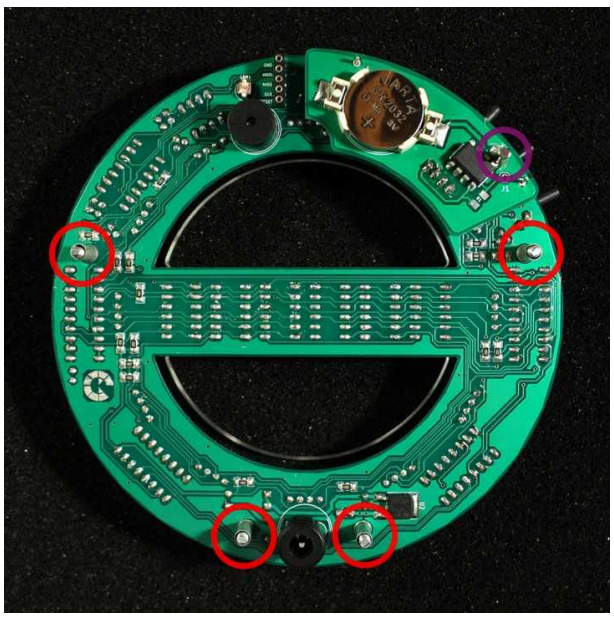
**20.** Final assembly



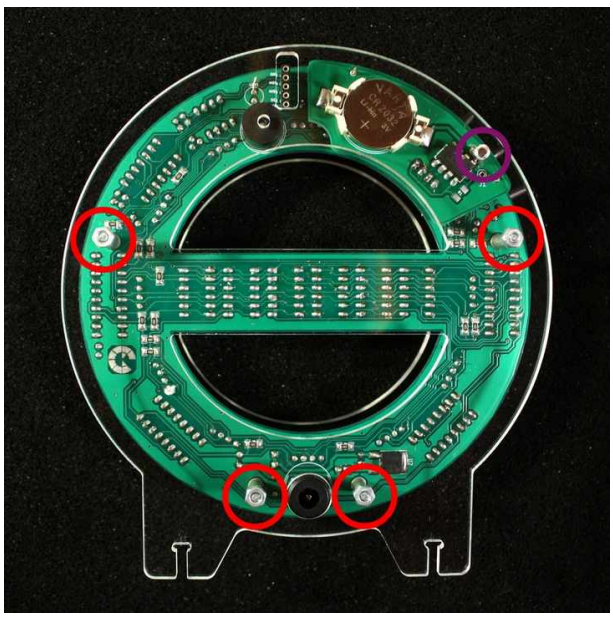
Put the bolts through the dial clock. Mount the four end sleeves, the crimp should look upward. Don’t forget do remove the masking film!



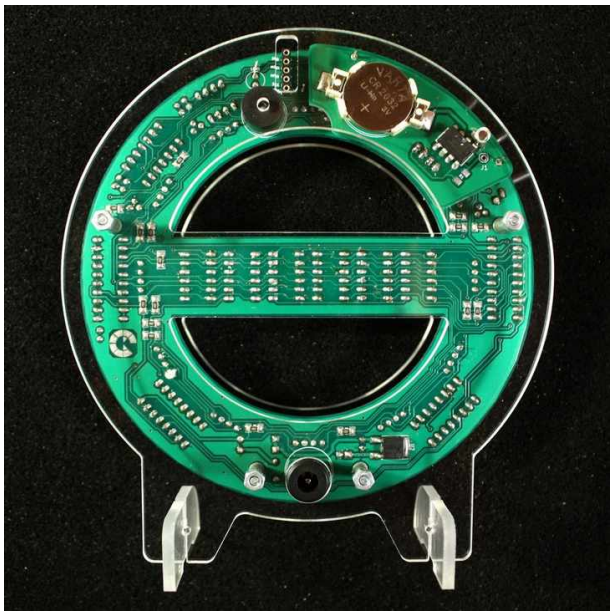
Assemble the PCB onto the dial without you damage the crystal (violet marked).



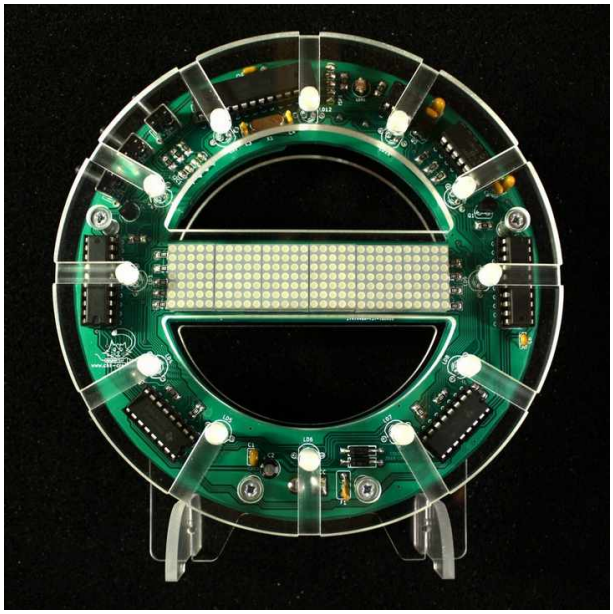
Again place the last four end sleeves onto the bolts. The crimps pointing down.



Place and screw tight the back cover. The crystal must fit in the enclosure hole.



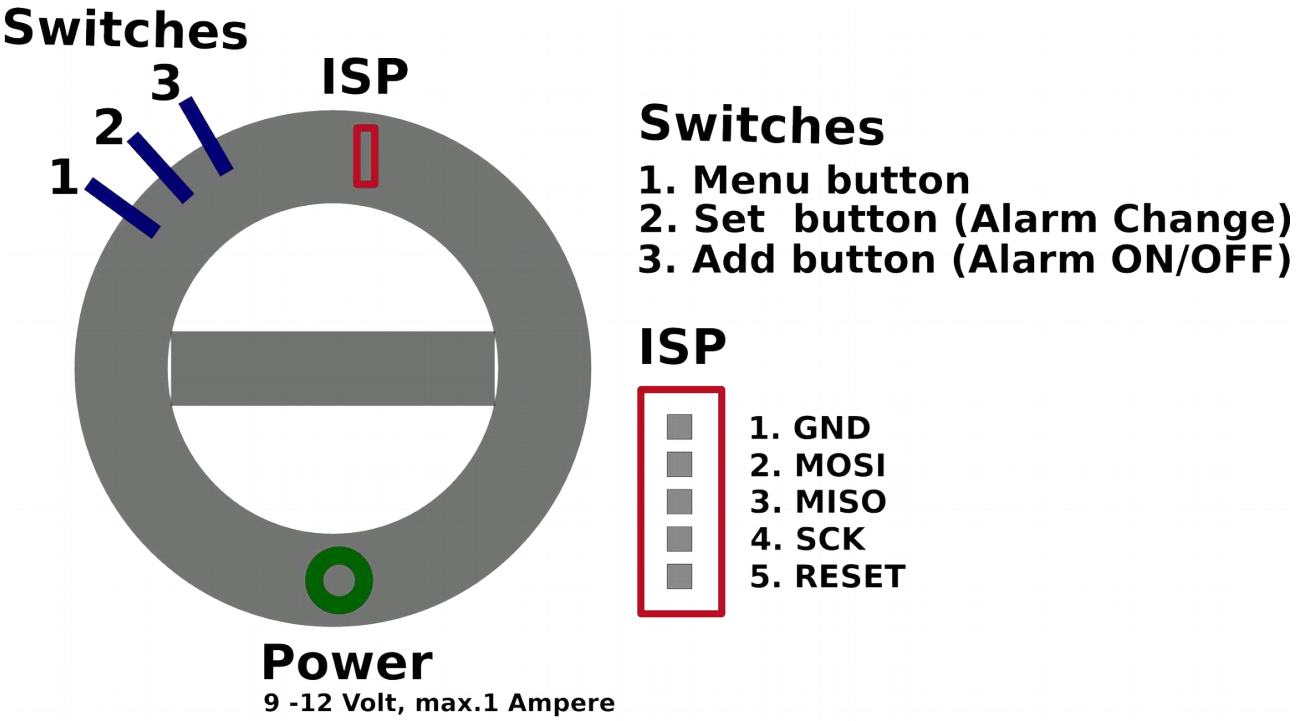
At last we put on the supporting foot.



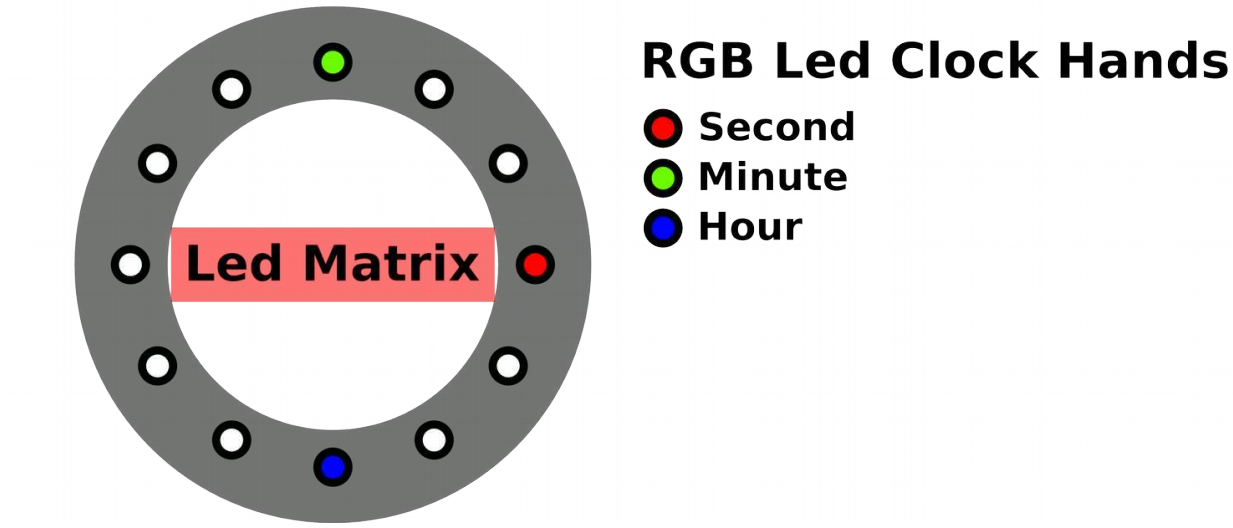
Completed clock, the round shaped supporting foot points forward.

**Every item has a masking film on it to protect the enclosure from minor scratches. Therefore don’t forget to remove the masking film!**

# Alarm Clock Description




## Clock Display



# Clock Menu

| MENU | SETTING POINT 1 | SETTING POINT 2 | SETTING POINT 3 |
|---|---|---|---|
| ALARM | A1 00:00 | | |
| TIME | 00:00 00 | | |
| | 12:00 00 | | |
| DATE | YEAR 99 | JAN. 01 | |
| SCREEN | >TIME | MOD. 12 | SEC ON |
| | >DATE | MOD. 24 | SEC OFF |
| | >ALARM | | |
| RING | >SINGLE | | |
| | >MULTI | | |
| | >MIXED | | |
| BRIGHT | RGBM 9 | | |
| GLOW | >ON | | |
| | >OFF | | |
| SENSOR | >OFF | >>OFF | |
| | >DIM | >>WAKE | |
| BEEP | >ON | | |
| | >OFF | | |
| INFO | DRIVER | by CHK- | |
| | VER. 1.0 | CrEaTIVE | |

## Menu settings

Step 1: Press the **MENU** button to select the menu setting, press again and you will advance to the next menu item.

Step 2: Press the **SET** button to enter the setting mode. You can now change the settings with the **ADD** button.

Step 3: Press the **SET** button again, you advance to the next settings item. Change the settings with the **ADD** button.

Step 4: When you have reached the last settings item, press the **SET** button to leave the settings menu and the clock goes into normal operation mode.

## Menu description

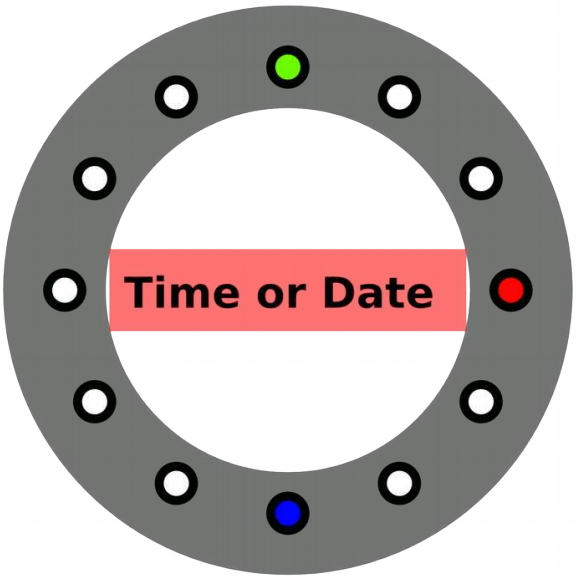
- Alarm: You can choose nine different alarms.
- Time: Time setting.
- Date: Date setting.
- Screen: Choose your favorite screen mod for displaying on the LED Matrix.
- Ring: The output of the time on the LED Ring can be set to different formats.
- Bright: Adjust the brightness level of the LED Matrix and RGB Ring display.
- Glow: Is this function enabled, the display bright will be set instantly on the maximum level at one hour prior of the time the alarm trigger off and every five minutes a red light dot will be set. When the alarm starts the LED Ring will be instantly and furious blink.
- Sensor: Enable the dim function for the automatic display light adjustment. The display bright adapts to the ambient light. Enable the wake function and you can turn on the light to stop the alarm sound (easy wake). When you turn off the light within 10 seconds after the alarm starts the clock will fell in the snooze mod. The snooze mod is only available when you turn on the wake function.
- Beep: Enable the beep function and the clock will beep on every button press.
- Info: Information about the driver version and designer.

## Alarm Settings and Display

Press the **Add** button to enable or disable the Alarm.
To switch the alarm time press the **Set** button.

### SCREEN MOD: Option Time or Date

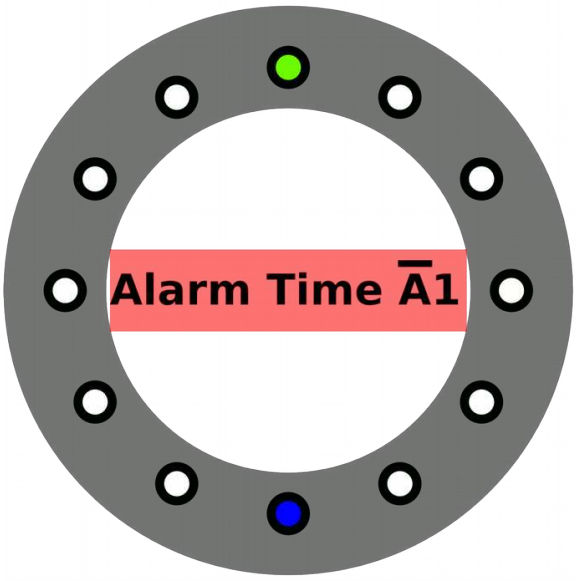
### Alarm off:




**RGB LED Clock Hands**

**Clock time**

### Alarm on:



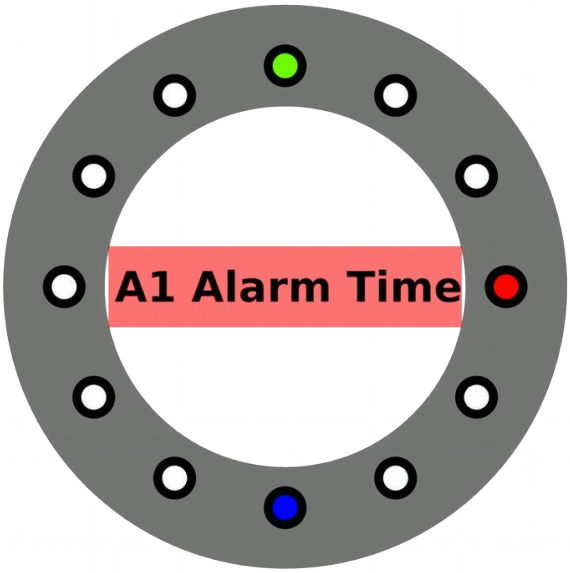

**RGB LED Clock Hands**

**Alarm time**

**Second**
**Minute**
**Hour**

## SCREEN MOD: Option Alarm

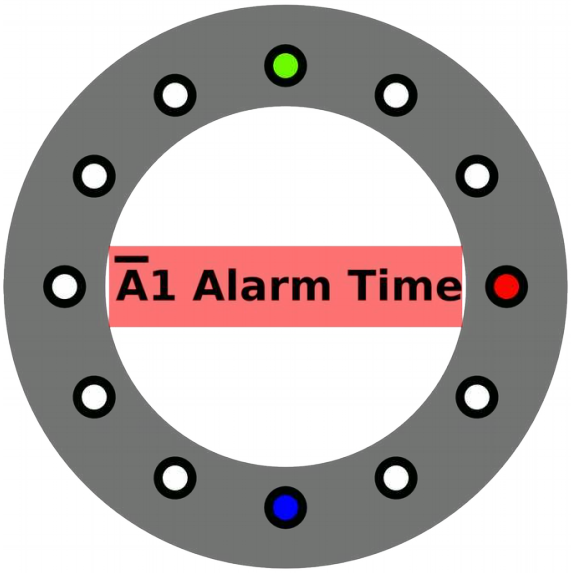
### Alarm off:




**RGB Led Clock Hands**

**Clock Time**

### Alarm on:




**RGB Led Clock Hands**

**Clock Time**

**Second**
**Minute**
**Hour**