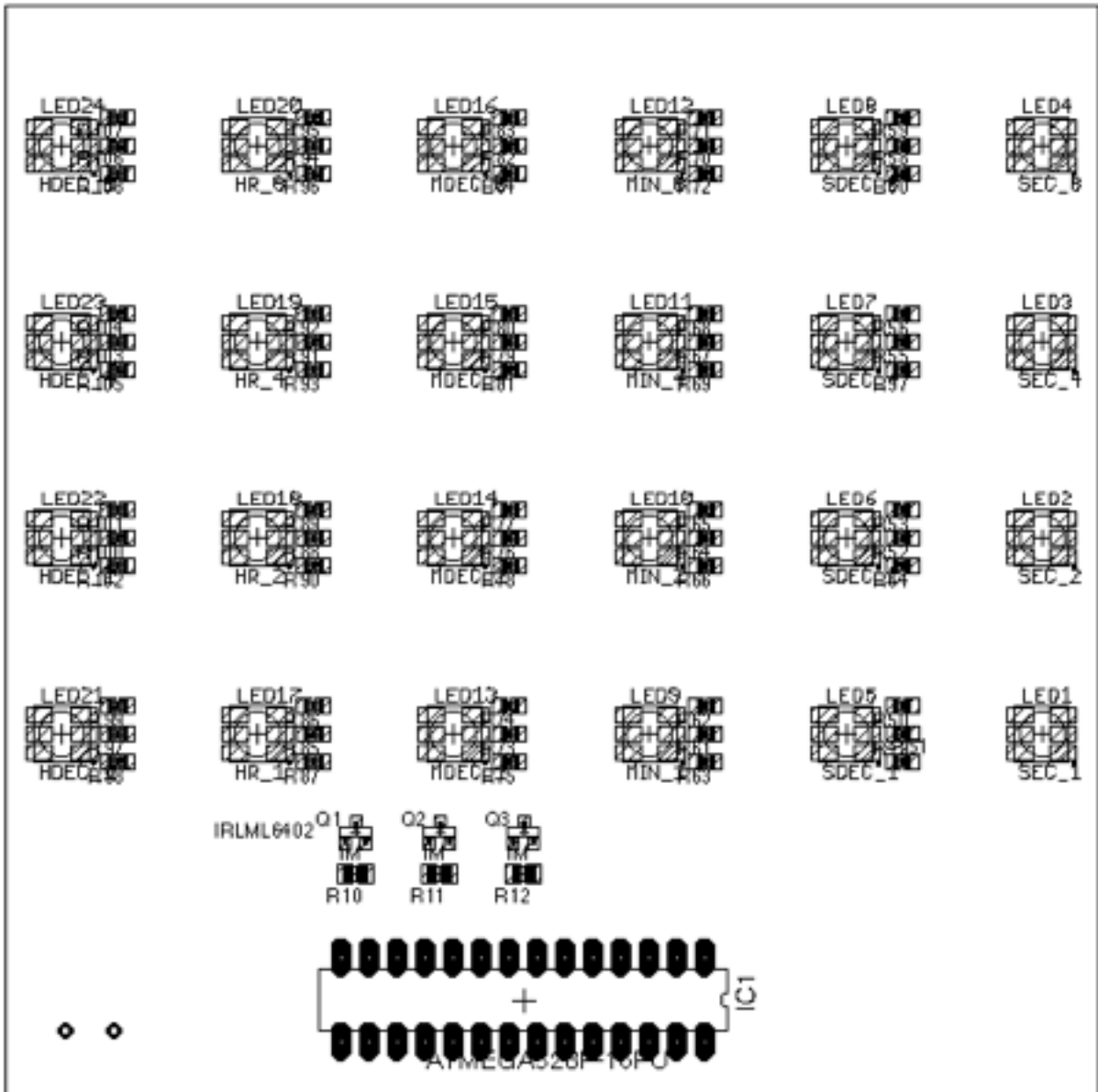


NERDCLOCK.

An Open Source Arduino® RGB Binary Clock



Assembly Instructions

For PCB Version 1.0, Document Version 1.0.1 - English

Welcome to your new NerdClock Open Source Arduino® RGB Binary Clock.

Thank you for being a part of the project, thank you for being awesome :D

This is the assembly instruction of NerdClock. It shows you how to solder components from the kit to the PCB, to make the NerdClock work!

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In order to assemble the NerdClock kit, **advanced experience with SMD components is required** as the PCB uses single-pad-components as small as 0603 (1.6 x 0.8 mm), SOT-23 transistors and SOP-16 integrated circuits. For those new to SMD soldering, this assembly manual also provides step for step soldering tips for these small components. Basic knowledge of electronics designations and packages are required to identify and map components. Being able to read circuit diagrams helps a lot in troubleshooting.

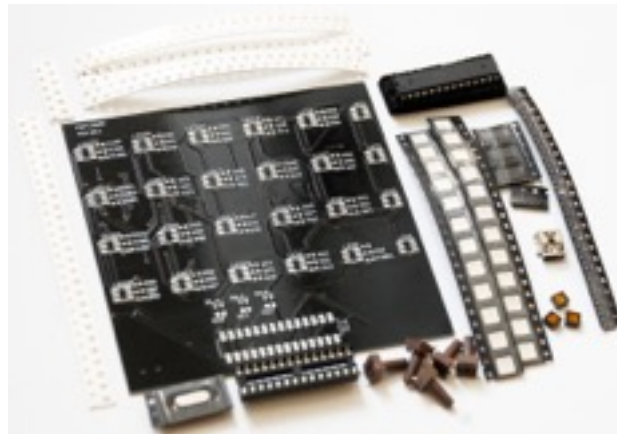
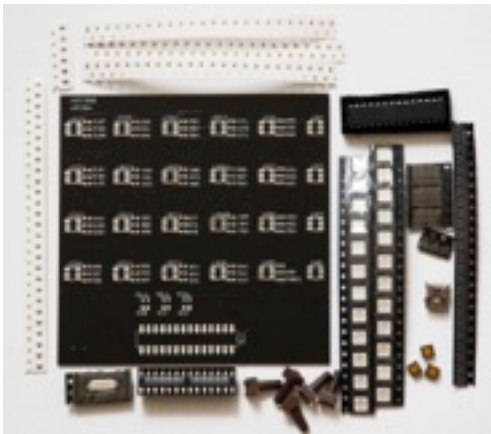
Assembling the clock kit precisely including testing, troubleshooting and cleaning up will take no longer than one day. Make sure your working area is properly light up, safe and clean. Don't work thoroughly as it is very bad for your eyes and health. Frequently take breaks and relax your eyes.

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Required Tools:

- *Soldering iron (fine tip)*
- *Soldering tin (thinner than 0.5 mm diameter)*
- *Solder sucker*
- *Solder wick (recommended)*
- *Multimeter with resistance measurement, continuity testing and diode testing*
- *Tweezer*

1. Make sure that these components are included in the kit:



Qty.	Part Name	Circuit Board Assignment/Mapping
1x	ATMEL® Atmega328P-PU DIP-28	IC1
3x	74HC595D SOP-16	IC2, IC3, IC4
1x	28-pin DIP Socket 7.62 mm	(IC1)
24x	5050 RGB LED	LED1, LED2, ..., LED24
3x	IRLML6402 P-Channel MOSFET	Q1, Q2, Q3
24x	2N7002 N-Channel MOSFET	Q4, Q5, ..., Q27
1x	16 MHz HC49-SMD	X1
6x	Tactile Switch DTSM-66N-V-B	RESET, SECONDS, MINUTES, HOURS, M_COLOR, ADJ_HALT
3x	10K SMD Trimm Potentiometer	R5, R6, R7
6x	10K 0805 Resistor	R1, R2, R3, R4, R8, R9
27x	1M 0805 Resistor	R13, R14, ..., R36
24x	180R 0603 Resistor	R37, R40, R43, R46, R49, R52, R55, R58, R61, R64, R67, R70, R73, R76, R79, R82, R85, R88, R91, R94, R97, R100, R103, R106
24x	200R 0603 Resistor* (See errata)	R38, R41, R44, R47, R50, R53, R56, R59, R62, R65, R68, R71, R74, R77, R80, R83, R86, R89, R92, R95, R98, R101, R104, R107
24x	220R 0603 Resistor* (See errata)	R39, R42, R45, R48, R51, R54, R57, R60, R63, R66, R69, R72, R75, R78, R81, R84, R87, R90, R93, R96, R99, R102, R105, R108
2x	22pF 0805 Capacitor	C1, C2
1x	10µF - 47µF 1206 Capacitor	C3
1x	USB Mini-B Female Connector	CN1

2. Before You Begin: Precautions and Safety Notice

I do not assume any liability for any damage caused to components, PCB, testing devices, or people by the assembler due to lack of knowledge or other reasons. I guarantee that all parts, if assembled 100% correctly will work correctly as NerdClock and that all parts are in new, working condition themselves, but I do not guarantee if the clock assembled by the assembler (customer) does not work properly or not at all. Assemble NerdClock at your own risk.

Don't feel discouraged though: I'm extremely clumsy. Even I managed to get several copies of my NerdClock to run 100% perfectly.



NerdClock contains highly electrostatic sensitive MOSFETs and integrated circuits. Before touching the assembled clock, please make sure that you are statically discharged.

The NerdClock is designed for indoor use only.

***Errata: Please mind during assembly! (PCB Version 1.0)**

- **Schematics: All green resistors on the schematics are actually blue resistors and all blue resistors on the schematics are actually green resistors. You will note this when diode testing the 5050 RGB LEDs. This is caused by an error in the library of the schematics software.**
- **R98 and R99 are reversed**
- **R49 and R51 printings are overlapping**

Document revisions:

V 1.0.1 11/05/2015: Corrected the values of resistor R74 (200R) and added the missing resistor R75 (220R) on the „included components“ list

3. Assembly Instructions - Guide

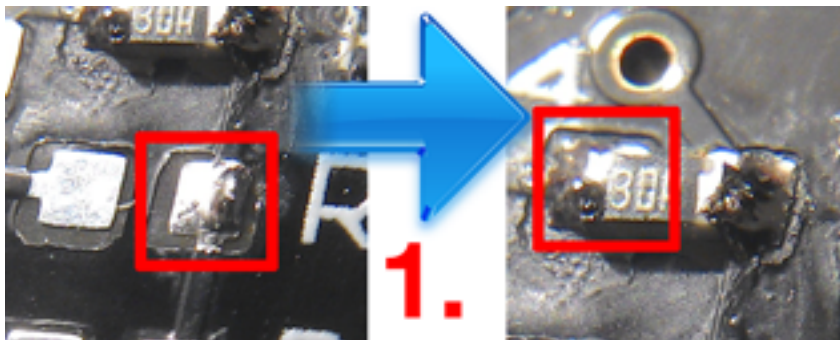
Do not begin soldering yet. Read first. For the easiest possible assembly I have divided the types of how you solder the components into groups with a description of how to solder components of each group. Each group is represented with a color. The table above shows you components assigned to the groups. They have the following color groups:

Group White	Through hole components. No explanation needed.
Group Yellow	Components with two leads.
Group Orange	Components with three or more leads.
Group Green/ Blue/Red	The LEDs, SOP ICs and the USB mini connector. Needs extra explanation.

Group White - This is how you solder them:

These are just simple through hole components. Solder **two diagonal pins** with the **SOLDERING IRON** and **SOLDERING TIN**. With the component fixed on both ends, solder all other remaining pads. **Persist on the pad** with the **SOLDERING IRON** in order to let the **TIN flow evenly** on the pad of both the top and bottom layer pad of the plated-through PCB.

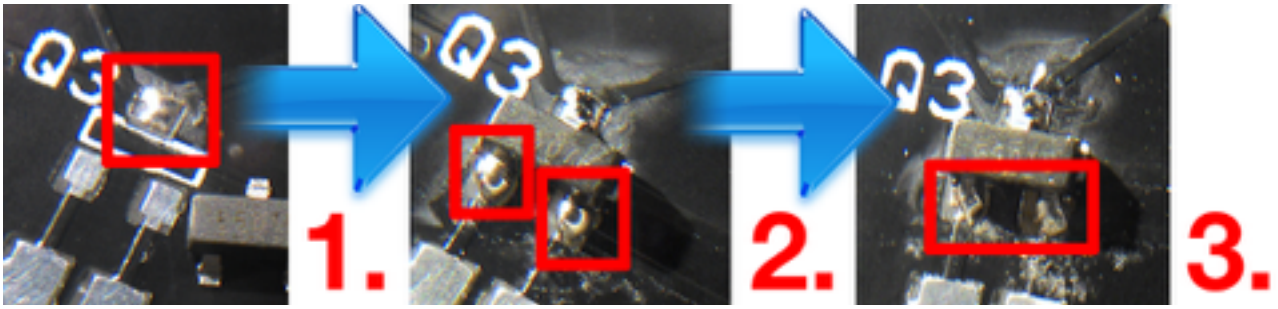
Group Yellow - This is how you solder them:



This type of SMD component is the easiest to solder: Apply a **very small amount** of **SOLDERING TIN** to **one** pad (1). If

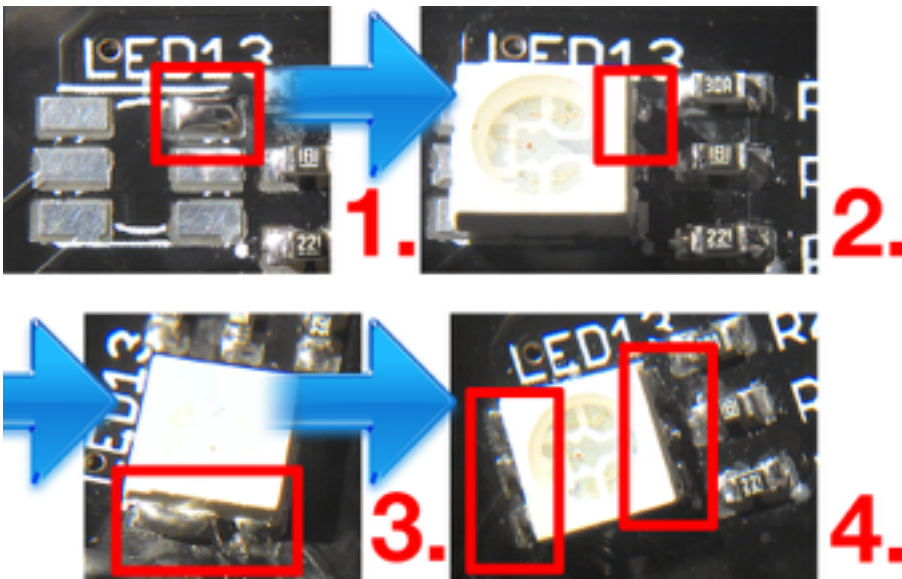
there is too much, use the **SOLDER SUCKER** to remove excessive **TIN**. Now take the component, use a fine **TWEEZER**, heat up the solder joint (pad) again and carefully place the component on the PCB. Apply again a **very small amount** of **SOLDERING TIN** on the remaining pad (2). Measure resistance or capacitance with a **MULTIMETER** to check the connection.

Group Orange - This is how you solder them:



Just like the two leaded components, apply **SOLDERING TIN** to one pad (1) and place the component with a **TWEEZER** while heating up the pad again. Now **generously** apply **SOLDERING TIN** to the remaining two or more opposite pads (2), optionally also to the first pad and remove excessive **TIN** one by one (3). **Check the connections using the continuity testing function** of your **MULTIMETER**. Check between leads and from connected leads. Remove unwanted connections with a **SOLDER SUCKER**.

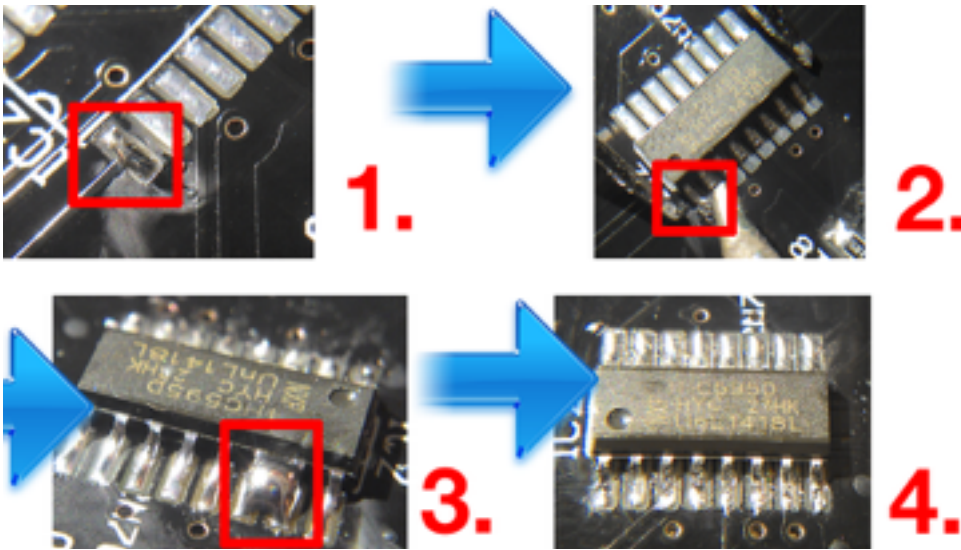
Group Green - This is how you solder them:



Begin by applying **SOLDERING TIN** to one pad (1) and placing the LED using a **TWEEZER** while heating up the pre-tinned pad (2). **Make sure the notch points in the opposite direction of the dot printed on the PCB.**

Generously apply **SOLDERING TIN** to the opposite leads (3). Correct excessive **TIN** (4) and repeat (3) to the remaining two leads with a **SOLDER SUCKER**. Correct excessive **TIN** again (4). Now **use the diode testing function** of your **MULTIMETER**. Each color of the LED should slightly light up **individually** if everything is correct.

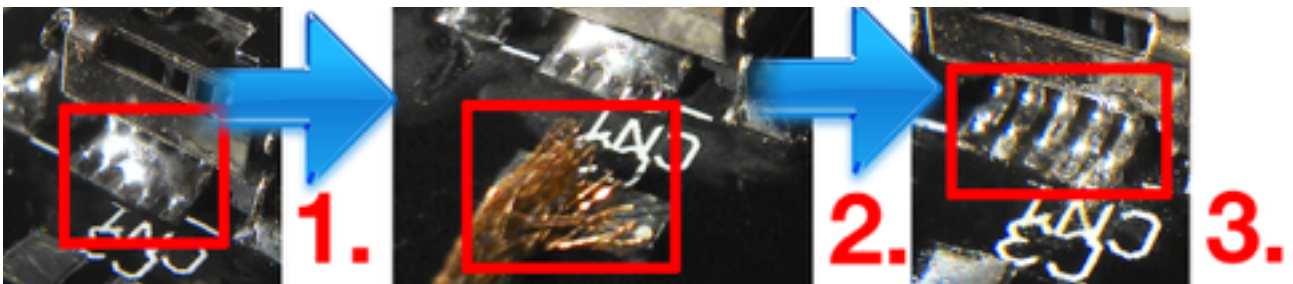
Group Blue - This is how you solder them:



The SOP IC. Begin by applying **SOLDERING TIN** to one pad (1) and placing the SOP IC using a **TWEEZER** while heating up the pre-tinned pad (2). Apply **SOLDERING TIN**

generously to all opposite pins (3). Use a **SOLDER SUCKER** to correct excessive TIN. Apply **SOLDER TIN** generously to the other side again and correct the excessive. The solder joints should look perfect after cleanup (4). Use the continuity tester of your **MULTIMETER** to check that there are no solder bridges between leads that are next to each other.

Group Red - This is how you solder them:



Fix the pads of the USB connector with **SOLDERING TIN** and generously apply **TIN** to the leads of the connector. Use **SOLDER WICK** like in (2) to free excessive **TIN** if your **SOLDER SUCKER** is not able to access the leads. Use the continuity tester of your **MULTIMETER** to check that there are no solder bridges between leads that are next to each other.

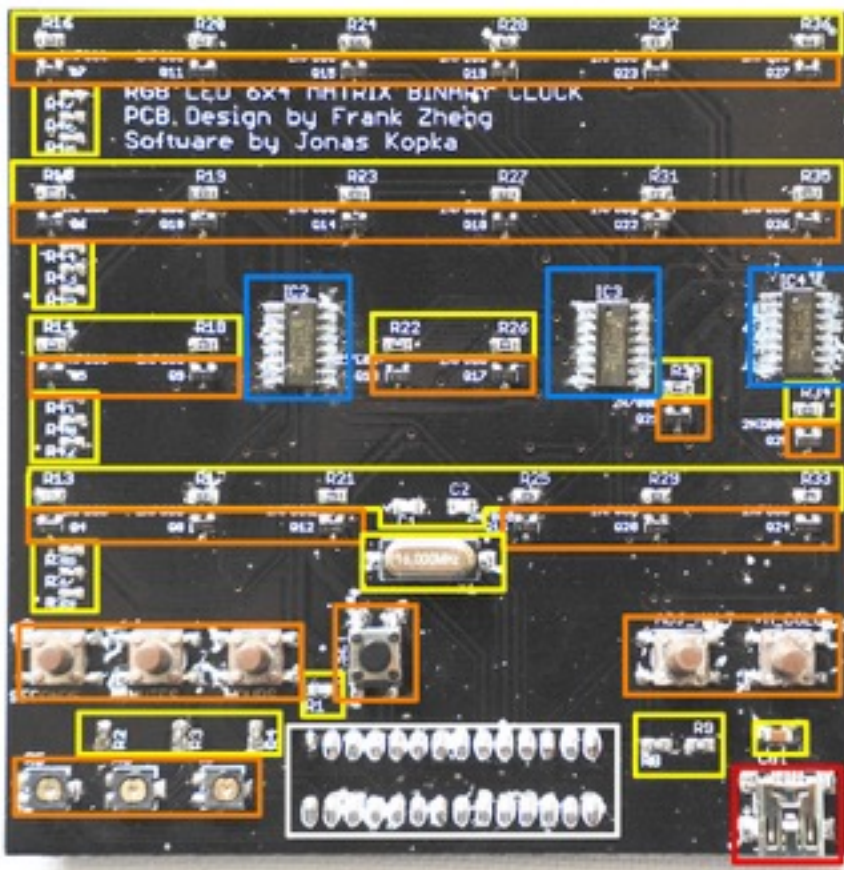
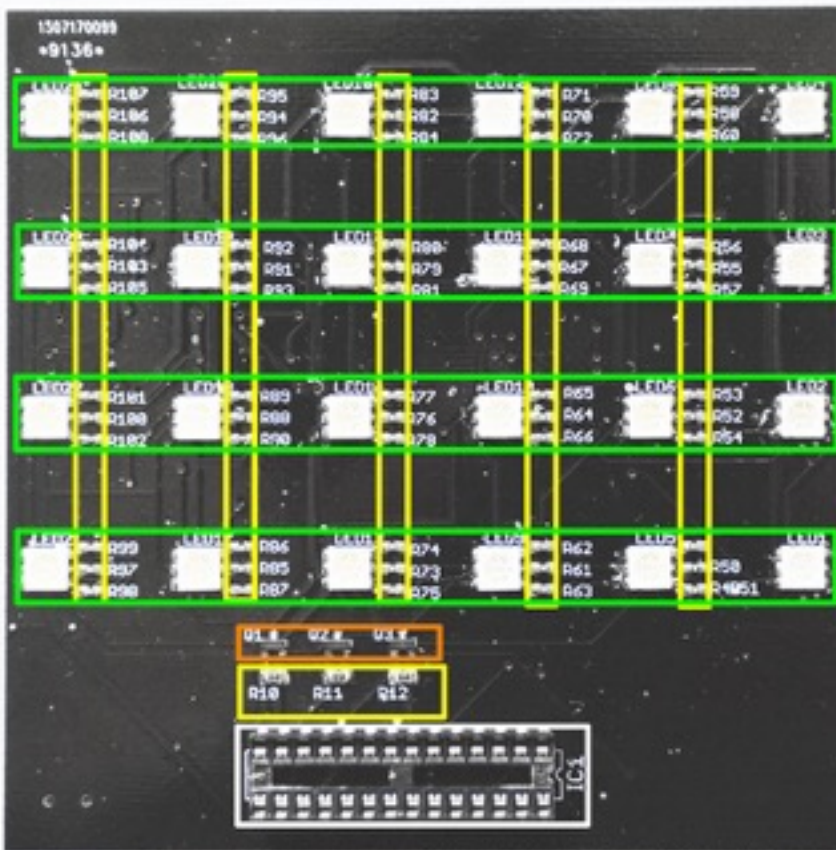
4. Assembly Instructions - PCB Reference and Instructions

Here you can see the assembled PCB of NerdClock. The colors highlight the group the components belong to.

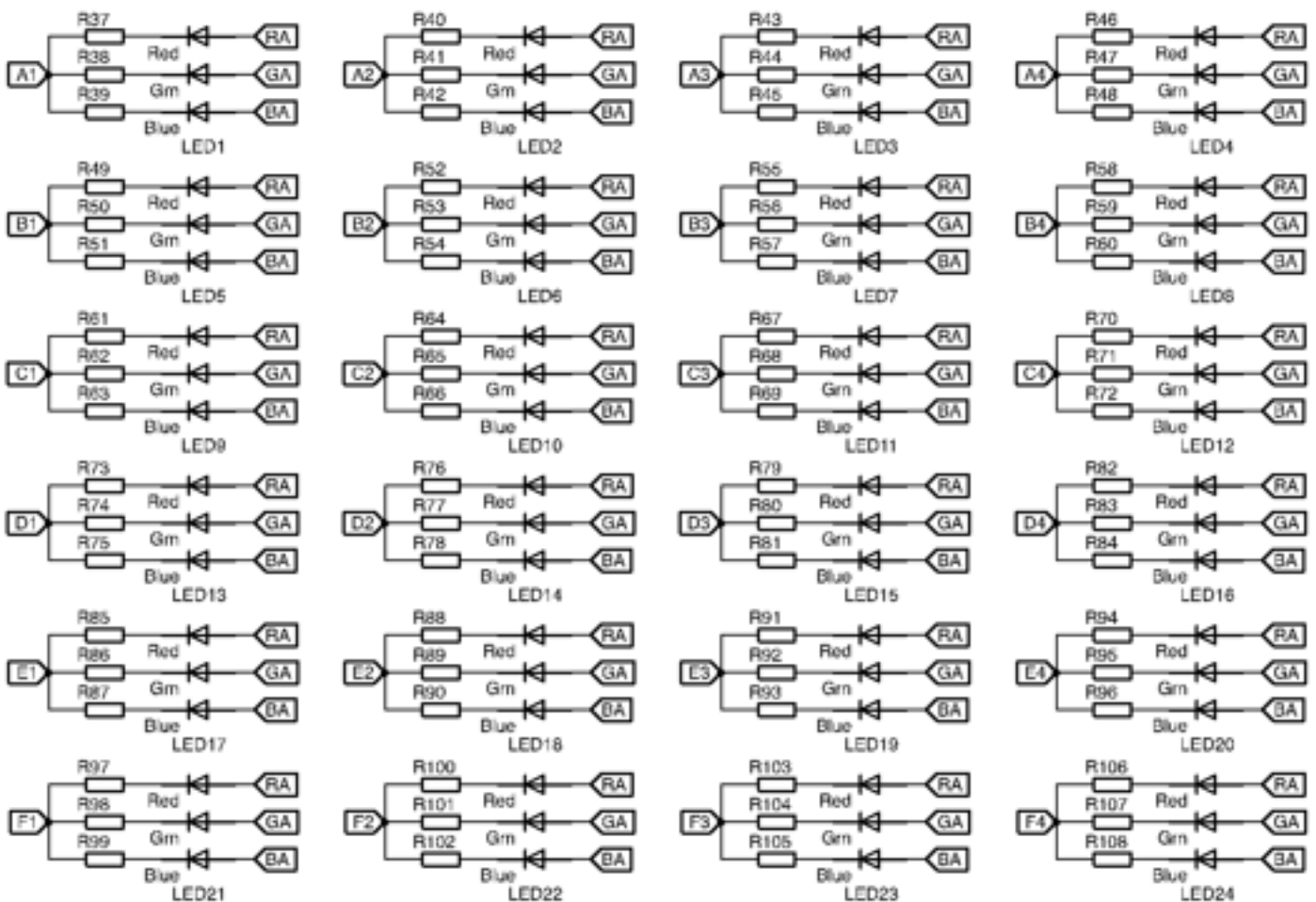
The picture above shows the front PCB layer; the one below how the bottom PCB layer looks like after assembly.

Now these are the steps how I recommend you to begin assembling the components to the NerdClock PCB:

- Begin with the shortest (0603) components (the yellow group) of the top PCB
- Solder the three orange group SOT-23 P-MOSFETs (Q1, Q2, Q3) to the top PCB



- Turn around, begin by adding the leftmost 0603 resistors (R37-R48)
- Add the 1M, 10K 0805 resistors, the two 22 pF 0805 capacitors, the SOT-23 N-MOSFETs, C3 and the shift registers to the PCB
- Turn around again, solder all 5050 RGB LEDs to the top side of the PCB
- Switch to the bottom side again; add the potentiometers, the 16 MHz crystal and the USB connectors. Then solder the six buttons.
- Insert the IC socket from the top side of the PCB. Please note the notch marked on the PCB silk screen. The notch of your IC socket should point in the same direction. Solder the connectors to the bottom PCB side
- Check every connection with the continuity testing function of your multimeter and ensure that every connection is clean and not shorted out to each other
- If you have purchased or programmed a NerdClock assembly checker, insert it into the IC socket. Begin testing the connectivity of the LEDs to the whole circuit
- If each and every connection is correct, insert the NerdClock firmware to the socket



5. Reference - Circuit Diagram (Cathode, Control and LED Circuit)

