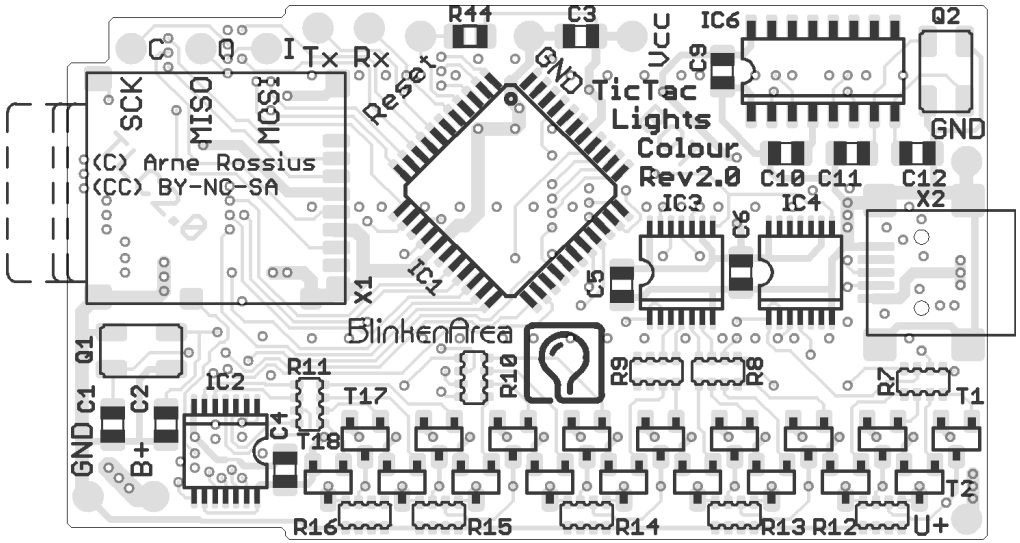
# TicTacLights Colour Construction Kit

**Contents:**

| | |
|---|---|
| 1 | PCB “TicTacLights Colour Rev. 2.0” |
| 1 | Microcontroller ATmega162 (TQFP44) |
| 1 | USB/UART converter CH340G (SOIC16) |
| 3 | Shift Registers 74HC164PW (SSOP14) |
| 1 | Voltage Reg. MCP170x-3302 (SOT23) |
| 18 | p-Ch. MOSFETs IRLML6402 (SOT23) |
| 150 | LEDs RGB, SMD size 0805 (6 spares) |
| 5 | Resistor Arrays 4x 22 Ω (1206) |
| 11 | Resistor Arrays 4x 220 Ω (1206) |
| 1 | Resistor Array 4x 1 kΩ (1206) |
| 1 | Resistor Array 4x 2.2 kΩ (1206) |
| 1 | Resistor 4.7 kΩ (0805) |
| 4 | Ceramic Capacitors 12 pF/15 pF (0805) |
| 6 | Ceramic Capacitors 100 nF (0805) |
| 1 | Tantalum Capacitor, 1 µF (size code A) |
| 1 | Tantalum Capacitor, 100 µF (size code C) |
| 1 | Crystal, 12 MHz (SMD, 5x3.2 mm) |
| 1 | Crystal, 14.7456 MHz (SMD, 5x3.2 mm) |
| 1 | Slide Switch ESP4020 (SMD, flat) |
| 1 | Micro-SD Card Slot (Molex 502774-0891) |
| 1 | Mini-USB-B connector (SMD, female) |

**SMD Soldering Advice**

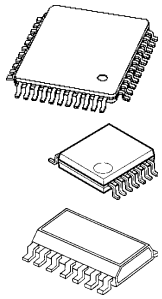
To solder the SMD components, tin only one of the pads, then grab the component with tweezers, re-heat the tinned pad and slide the component in sideways. When the component is aligned properly, remove the soldering iron, let the solder joint cool down and solder the rest of the pins. **I recommend soldering the components in the order listed below.**




*PCB bottom component placement*

**1. Integrated Circuits (bottom):** Start with the integrated circuits (ICs) on the bottom side. The orientation is important, see the description in the table.

| | | |
|---|---|---|
| **IC1** | Microcontroller ATmega162 | Circular dent in one corner must match small circle on the PCB silkscreen. |
| **IC2~4** | Shift Register 74HC164 | Circular dent in one corner must face toward the notch in the silkscreen outline. |
| **IC6** | USB/UART Converter CH340G | |





**2. Resistors (bottom):** Most of the resistors are arrays of 4 resistors in one package. Only R44 is a single resistor. The arrays are a bit fiddly to solder, make sure there are no shorts between adjacent pins. Also be careful not to put too much mechanical stress on the pins as they can tear off quite easily. Orientation doesn't matter. The marking shows the resistance as two (or three) digits mantissa and one digit exponent, e.g. “221” = **22**·10¹ Ω = 220 Ω or “4701” = **470**·10¹ = 4700 Ω = 4.7 kΩ.

| **Name** | R7~R11 | R12~R16 | R44 |
|---|---|---|---|
| **Value** | 4x 22 Ω | 4x 220 Ω | 4.7 kΩ |
| **Marking** | 220 | 221 | 472 or 4701 |

**3. Quartz Crystals (Q1, Q2, bottom):** You need a fine tip and thin solder wire to solder the quartz crystals. After soldering the first pad as described above, try to heat a pad and then squeeze some solder wire between the board and the crystal. Don't use too much solder wire, or you'll end up soldering a bridge between the pad and the crystal's metal lid. Use a continuity tester to check for shorts between the two non-grounded pads and the lid. Make sure you don't mix up the two frequencies, they are clearly marked on the crystal. Orientation doesn't matter.

| Q1 = 14.7456 MHz | Q2 = 12 MHz |
|---|---|

**4. Capacitors (bottom):** All capacitors on the bottom side are non-polarized ceramic capacitors, i.e. the orientation doesn't matter. The capacitors have no markings, you can only identify them by their quantity (the strip with 4 capacitors in it contains the 12 pF ones).

| **Name** | C1, C2, C11, C12 | C3~C6, C9, C10 |
|---|---|---|
| **Value** | 12 pF | 100 nF |

**5. Transistors (T1~T18, bottom):** The transistors only fit in one orientation. They are marked “E.....” (only the first letter is important) for IRLML6402.

**6. Resistors (top):** All resistors on the top side are arrays. See step 2.

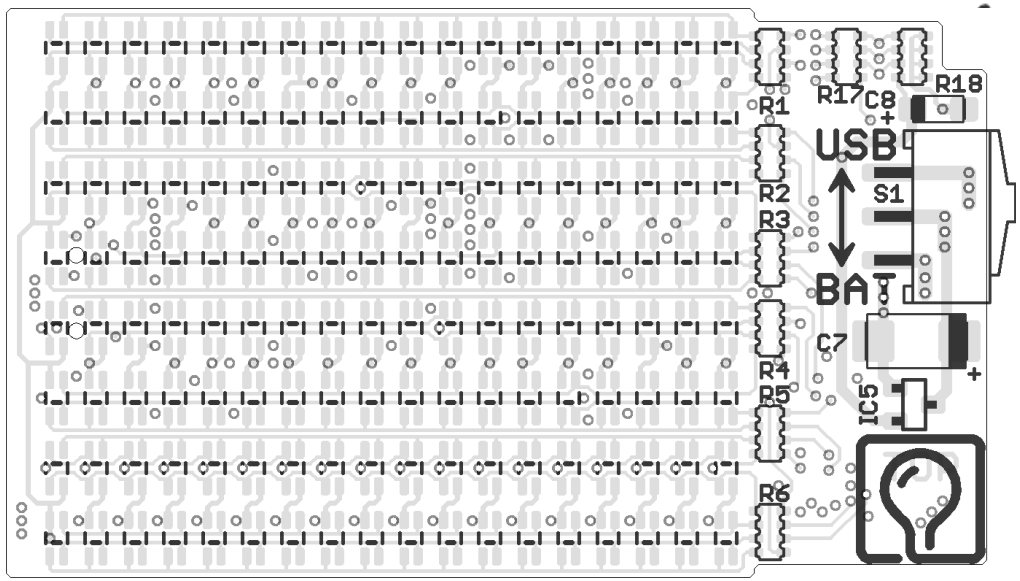
| **Name** | R1~R6 | R17 | R18 |
|---|---|---|---|
| **Value** | 220 Ω | 1 kΩ | 2.2 kΩ |
| **Marking** | 221 | 102 | 222 |

**7. Voltage Regulator (IC5, top):** This IC, which looks like a transistor, is a low-dropout regulator with an output voltage of 3.3 V. It only fits in one orientation.

**8. Capacitors (top):** The capacitors on the top side are tantalum electrolytic capacitors. This type of capacitor is polarized, which means the orientation is important. The printed bar on top of the capacitor identifies the positive side, which must face toward the small “+” sign on the PCB.

| **Name** | C7 | C8 |
|---|---|---|
| **Value** | 100 µF | 1 µF |
| **Marking** | 107 | 105 *or* A6E |

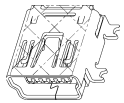
**9. Switch (S1, top):** Align the switch so the black (or blue) part is flush with the side of the board before soldering. Make sure to get a good mechanical solder connection between the switch and the board.



*PCB top component placement*

**10. Micro-SD Card Slot (X1, bottom):** The Micro-SD card slot is another component that will need a very fine tip to solder. The pads on the corners are connected to the case and require little care when soldering, but the pad to the right of Q1 is very easy to short to the metal case. Use very little solder here and check for shorts with a continuity tester. If there is a short, the SD card detection will not work.

**11. USB Connector (X2, bottom):** The USB connector locks in place with the two plastic pins on the bottom side. Solder the four large pads first to secure the connector in place, then continue with the five smaller pins.



**12. LEDs (top):** The orientation is important for the LEDs, they have a green dot between the pads on one side. This green dot must face *away* from the thick bar printed on the PCB. If you find it hard to see the green dot, you can use the position of the dark red LED chip inside the LED package (see photo to the right) instead. Please note that the orientation changes after every row. Power up the TicTacLights Colour to test the LEDs after every row, as this will make it a lot easier to find out where a short is.




**Power Supply**
The TicTacLights Colour can be supplied with power in two different ways: USB power or battery supply. The battery supply must be 5 V (±10%) connected to the “B+” and “GND” solder pads on the bottom side of the PCB. The maximum current consumption is 250 mA. USB can be used for data streaming in both cases.



**Using the TicTacLights Colour**
After switching it on, the TicTacLights Color should display the BlinkenPlus (B+) logo followed by a “Chaosknoten”. You can now send an MCUF stream through the USB virtual serial port (115200 Baud) or insert a Micro-SD card. The MCUF streaming format is described at http://wiki.blinkenarea.org/index.php/MicroControllerUnitFrameEnglish

MMC, SD and SDHC cards are supported with a FAT16 or FAT32 filesystem. Very small MMC and SD cards (up to 32 MB) use FAT12 and must be reformatted to FAT16 before they can be used with this kit. If there are several partitions on the card, the first primary partition with a FAT16 or FAT32 partition ID (0x04, 0x06, 0x0B, 0x0C) will be used. Some SD cards come with no partition at all, in which case a partition must be created and formatted. If your SD card isn't compatible with the TicTacLights Colour, an error message will scroll across the LEDs.
Files on the SD card must be stored in a directory with the name `BP18X8.RGB`. The files in that directory will be played in the order listed in the FAT (usually the order in which they were copied onto the SD card, or use 'fatsort' from http://fatsort.sourceforge.net/). If there is no `BP18X8.RGB` directory, an error message will be scroll across the LEDs. All files must be 18x8 pixels, 3 channels. The supported file formats are:

| Filename extension | Format |
|---|---|
| BIN | Modified BlinkströmAdvanced file (binary, 8 grayscales per colour = 512 colours) |
| BLM | BlinkenLights Movie (simple ASCII format, no grayscale support: each colour can be either on or off, resulting in a total of 8 possible colours) |
| BML | Blinkenlights Markup Language (XML-based, 2 to 256 grayscales per colour, but only 8 grayscales per colour displayed, i.e. 512 colours) |
| BBM | Blinken Binary Movie (binary format with up to 256 grayscales per colour, but only 8 grayscales per colour displayed, i.e. 512 colours) |

More information: http://wiki.blinkenarea.org/index.php/FileFormats

**Using the UART serial port**
If you want to use the UART to send data rather than the USB connection, you can do that by removing IC3. You can now use the “Tx” and “Rx” solder pads with 5 V logic-level (“TTL”) signals. The input (“Rx”) can be fed with an MCUF stream which is then displayed (unless an SD card is inserted). On the output (“Tx”), an MCUF stream of all displayed images (error messages included) is available. The baud rate is 115200 Baud.

**Programming the Microcontroller**
The kit comes with a pre-programmed controller. If you want to update the firmware or use your own, you can use these solder pads to connect an AVR ISP programmer:

| **Pad Name** | C | O | I | RST | Vcc | GND |
|---|---|---|---|---|---|---|
| **ISP Function** | SCK | MISO | MOSI | Reset | +5V | Ground |

**Questions? Problems? Comments? Ideas?** Please contact me:
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**Project Webpage**
Hardware project page: http://wiki.blinkenarea.org/index.php/TicTacLightsColourEnglish
Software project page: http://wiki.blinkenarea.org/index.php/BlinkenPlusEnglish