

# TicTacLights Nano Colour Construction Kit

## Contents:

- 2 PCBs (Main & Power/Data)
- 1 Microcontroller ATmega162 (QFN)
- 1 USB/UART Converter FT230X (QFN)
- 3 Shift Registers 74HC164BQ (QFN)
- 1 Step-up Converter TPS61240 (WSON)
- 1 Charge Controller MCP73831-2 (SOT23-5)
- 1 Voltage Reg. MCP170x-3302 (SOT23-3)
- 9 Dual p-Channel MOSFETs FDG6306P (SC70-6)
- 150 RGB LEDs, com. anode (size 0404, 5 spares)
- 2 Resistors 22  $\Omega$  (0603)
- 2 Resistor Arrays 4x 100  $\Omega$  (1206)
- 9 Resistor Arrays 4x 220  $\Omega$  (1206)
- 1 Resistor Array 4x 1 k $\Omega$  (1206)
- 1 Resistor Array 4x 2.2 k $\Omega$  (1206)
- 1 Resistor 4.7 k $\Omega$  (0603)

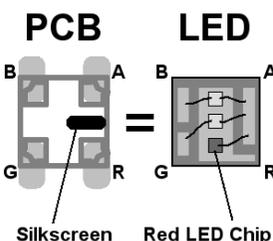
- 1 Resistor 10 k $\Omega$  (0603)
- 2 Ceramic Capacitors 12 pF/15 pF (0603)
- 2 Ceramic Capacitors 47 pF (0603)
- 4 Ceramic Capacitor 100 nF (0603)
- 5 Ceramic Capacitors 4.7  $\mu$ F (0805)
- 1 Inductor 1  $\mu$ H (0805)
- 1 Crystal, 14.7456 MHz (SMD, 3.2x2.5 mm)
- 1 Slide Switch MSS-1290BN (SMD, flat)
- 1 Micro-SD Card Slot (Molex 502774-0891)
- 1 Micro-USB-B Connector (Molex 47346-0001))
- 1 Board-to-Board Plug (Molex 55560-0168)
- 1 Board-to-Board Receptacle (Molex 54722-0164)
- 1 LiPo Battery (size 051823 = 5 x 18 x 23 mm)
- 1 USB Cable, A plug to Micro-B plug
- 1 Length of stranded wire, 0.14mm<sup>2</sup>
- 1 Length of heat-shrink sleeve,  $\varnothing$  1.2 mm

## SMD Soldering Advice

The QFN and WSON packages have a large pad underneath which requires reflow or hot air soldering. The remaining components can be soldered with a regular soldering iron using a fine, pointy tip, but **I recommend reflow soldering for the LEDs**. A set of solder paste stencils for the main PCB is available at BlinkenArea. When using hand soldering or rework, use flux (e.g. Edsyn FL 22) to facilitate soldering the fine pitch components. **I recommend soldering the components in the order listed below.**

## Main PCB

- 1. LEDs (top):** LED orientation is given by white silkscreen line on PCB, see image to the right. Same orientation for all LEDs in one row, orientation of rows changes irregularly. Keep one LED for the Power/Data PCB.
- 2. Resistor Arrays (R1~R4, top):** Not labelled on PCB. All four are 220  $\Omega$ , marked "221". Orientation doesn't matter.
- 3. ICs (IC1~IC4, bottom):** IC1~IC4. Pin 1 indicated by triangle on PCB, circle in corner on ICs. If using hot air method, tin bottom pad on PCB and IC with *thin* layer of solder. Warm up PCB with hot air until solder melts, then position IC with tweezers and continue heating until IC is placed correctly (don't rely on silkscreen). Solder pins on side of IC using very fine tip by dragging solder along the sides.



- 4. Transistors (T1~T9, bottom):** T1, T3, and T7 not labelled on PCB. Orientation doesn't matter (really!).
- 5. Crystal (Q1, bottom):** Orientation doesn't matter.
- 6. Resistor Arrays (R5~R11, bottom):** Orientation doesn't matter.

R5, R6 100  $\Omega$  marked "101"  
R7~R11 220  $\Omega$  marked "221"

- 7. Capacitors (C1~C5, bottom):** C4 not labelled on PCB, located between T1 and pad "5". Careful not to bridge C1 pad close to "C1" label to nearby crystal pad (use multimeter to check for short). Orientation doesn't matter. C1, C2 = 12 pF. C3~C5 = 100 nF.

- 8. USB Connector (X1, bottom):** Solder the two mechanical pins on the side of the connector first, then the two on the back of connector. Keep heating the pads after soldering to allow solder to flow underneath the connector. Use flux to solder the fine pitch pins (see soldering advice above).

- 9. Board-to-Board Connector (X2):** Orientation doesn't matter. Use flux to avoid bridges between pins and run soldering iron along the ends of the pins (not on top of the pins). Be very gentle and don't use any pressure to avoid bending pins or damaging pads. Avoid getting any flux or solder inside the connector.

## Power/Data PCB

- 1. ICs (IC5~IC8, bottom):** For IC5 and IC6, see Main PCB ICs. Orientation is obvious for IC7 and IC8.
- 2. LED (no label, bottom):** For orientation, see Main PCB LEDs. Default colour is red when charging, install LED rotated 90° counter-clockwise for green or 180° for blue.

- 3. MicroSD Card Slot (X4, bottom):** Solder mechanical pads in the corners first. Don't forget the two pads on the bottom edge of the slot (near R16 and R17).

- 4. Inductor (L1, bottom):** Orientation doesn't matter.

- 5. Resistors (R12~R15, top; R16, R17, bot.):** R12, R13 R14 R15 R16 R17  
Orientation doesn't matter. 22  $\Omega$  1 k $\Omega$  2.2 k $\Omega$  4.7 k $\Omega$  10 k $\Omega$   
R14, R15 are arrays. Marked: "220"/"22R0" "102" "222" "472"/"4701" "103"/"1002"

- 6. Capacitors (C7, C8, top; C6, C9~C13, bottom):** C6 C7, C8 C9~C13  
Orientation doesn't matter. 100 nF 47 pF 4.7  $\mu$ F

- 7. Switch (S1):** Plastic Pins on bottom of switch lock into holes in PCB. Don't solder the 4 pads on sides.

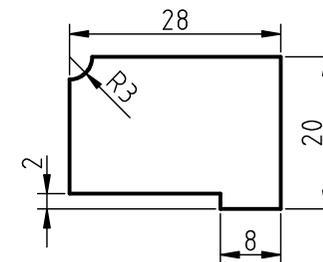
- 8. Board-to-Board Connector (X3):** See X2 on Main PCB.

- 9. Battery: Test the TicTacLights Nano (using USB for power) before installing battery.**

Strip one end of red piece of wire and solder to battery. Use heatshrink to insulate the join. Orient battery so wires come out near "X4" designator on PCB. Solder black wire to "-" pad on PCB (wire must be long enough so battery doesn't overlap with cut-out in PCB). Cut red wire to needed length, strip and solder to "+" pad. **Battery wires must never touch each other!**

## Assembly and Operation

Connect the two PCBs by plugging the board-to-board connectors into each other. Cut a piece of cardboard in the shape shown to the right (1:1) and insert between the power/data PCB and the battery (to protect the battery from anything pointy). Cut holes for switch and USB connector into a mini TicTac box using a sharp, pointy knife and carefully insert the stack into the box.



## Power Supply

- USB power: switch must be in bottom position (toward "+" pad). Also charges battery.
- Battery power: switch must be in top position (toward "-" pad). Since the current drawn by the TicTacLights Nano Colour can be larger than the battery charge current, the battery might still be drained even if USB is connected with the switch in this position.

## Using the TicTacLights Nano Colour

After turning it on, the TicTacLights Nano Colour 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 format for streaming is described at <http://wiki.blinkenarea.org/index.php/MicroControllerUnitFrameEnglish>. MMC, SD and SDHC cards are supported with a FAT16 or FAT32 filesystem. The first primary partition with a FAT16 or FAT32 partition ID (0x04, 0x06, 0x0B, 0x0C) will be used. Files on the SD card must be stored in a directory with the name `BL18X8.RGB` and will be played in the order listed in the FAT. If there is no `BL18X8.RGB` directory, an error message will scroll across the LEDs. All files must be 18x8 pixels, 3 channels (red, green, blue). The supported file formats are BIN, BLM, BML and BBM, described at <http://wiki.blinkenarea.org/index.php/FileFormats>

**Programming the Controller:** The controller is pre-programmed. To update, connect an AVR programmer to the solder pads on main PCB. Target voltage is 5 V.

Pad (Main PCB)	I	O	C	R	GND	5
Programmer	MOSI	MISO	SCK	RESET	GND	V <sub>CC</sub> (V <sub>Target</sub> )

**Questions? Problems? Comments? Ideas?** Please contact me:  
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Hardware project page: <http://wiki.blinkenarea.org/index.php/TicTacLightsNanoEnglish>  
Firmware project page: <http://wiki.blinkenarea.org/index.php/BlinkenPlusEnglish>