# *ArcadeNano Construction Kit*

Contents:

- 1 PCB "ArcadeNano Rev. 1.0"
- 1 Microcontroller ATmega162 (TQFP44)
- 1 USB/UART converter CH340G (SOIC16)
- 3 Shift Registers 74HC164PW (SSOP14)
- 1 LiPo Charger MCP73831-2ACI (SOT23)
- 1 Voltage Reg. MCP170x-3302 (SOT23)
- 20 n-Ch. MOSFETs DMG1012T (SOT523)
- 530 LEDs APT1608SECK, 0603 (10 spares)
- 7 Resistor Arrays 4x 220 Ω (1206)
- 2 Resistors 4.7 kΩ (0805)

- 1 Resistor 10 kΩ (0805)
- 4 Ceramic Capacitors 12 pF/15 pF (0805)
- 6 Ceramic Capacitors 100 nF (0805)
- 3 Ceramic Capacitors, 4.7 µF (0805)
- 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)
- 1 Lithium-Polymer-Battery, 4x30x35 mm
- 1 USB cable, A plug to Mini-B plug

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.**
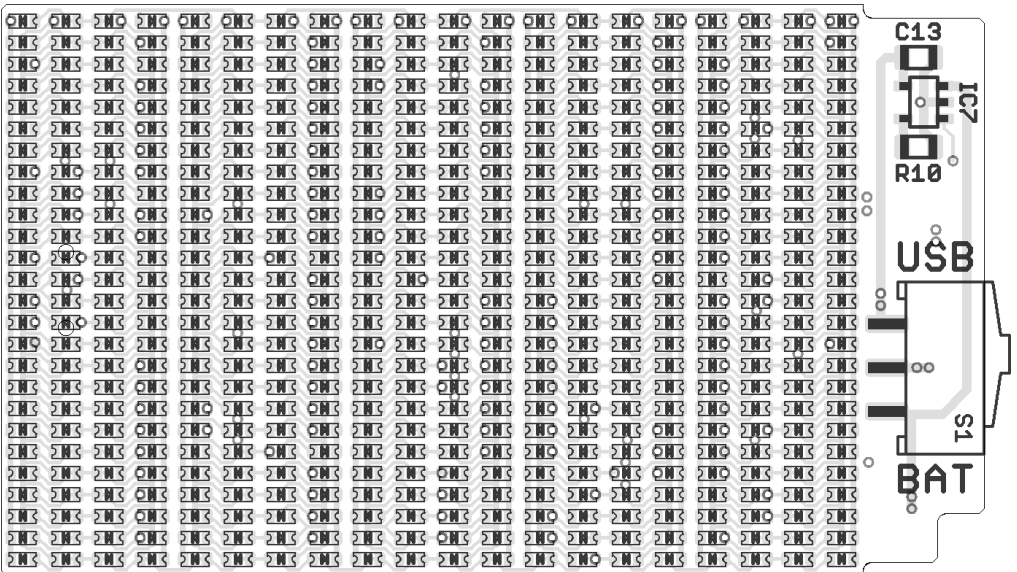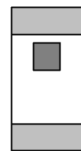

PCB top component placement

1. LEDs: The orientation is important for the LEDs, it can be determined by the triangle on the back of the LED or the position of the chip inside the LED (see image to the right). Please note that the orientation changes after every two rows. Please refer to the image above for the correct orientation, as the low-resolution print on the PCB can sometimes be ambiguous.
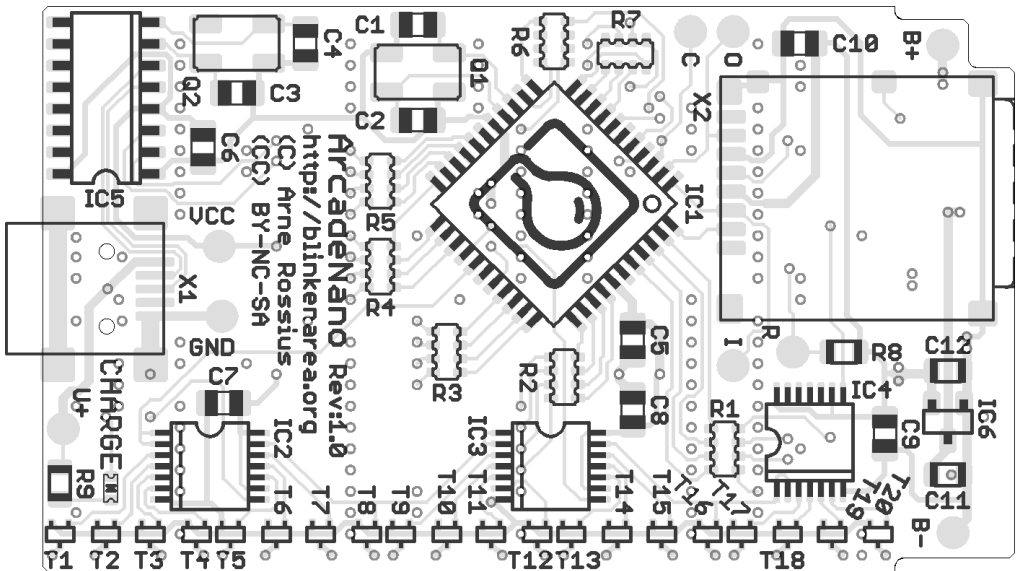

Bottom   Top   PCB

There are 520 LEDs on the top side of the PCB and the charge LED on the bottom side.

PCB bottom component placement

2. Integrated Circuits: Orientation is important, see description in the table.

IC1	ATmega162	bottom	Circular dent in one corner must match small circle on PCB silkscreen.
IC2~4	74HC164PW	bottom	Circular dent in one corner must face toward the notch in silkscreen outline.
IC5	CH340G	bottom	
IC6	MCP1700-3302	bottom	Orientation is obvious.
IC7	MCP73831-2ACI	top	
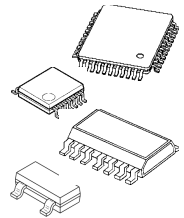
3. Transistors (T1~T20, bottom): The transistors only fit in one orientation.

4. Quartz Crystals (Q1, Q2, bottom): Use a fine tip and thin solder wire for the 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 marked on the crystal. Orientation doesn't matter.

Q1 = 14.7456 MHz	Q2 = 12 MHz

5. Resistors: Some of the resistors come as arrays of 4 resistors in one package. They 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" = $22 \cdot 10^1$ Ω = 220 Ω or "4701" = $470 \cdot 10^1$ = 4700 Ω = 4.7 kΩ.

| Name	R1~R7 (bottom)	R8, R9 (bottom)	R10 (top)
Value	4x 220 Ω	4.7 kΩ	10 kΩ
Marking	221	471 *or* 4700	103 *or* 1002

6. Capacitors: All capacitors 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 (e.g. the strip with 4 capacitors in it contains the 12 pF/15 pF ones).

Name	C1~C4 (bottom)	C5~C10 (bottom)	C11, C12 (bottom)	C13 (top)
Value	12 pF *or* 15 pF	100 nF	4.7 µF	

7. USB Connector (X1, 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. Use flux to prevent solder bridges between the pins.
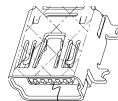
8. Micro-SD Card Slot (X2, bottom): The Micro-SD card slot is another component that will need a very fine tip to solder. The pads on the corners are connected to the frame and require little care when soldering, but the pad near the "B+" pad is very easy to short to the frame. Use very little solder here and check for shorts with a continuity tester. If there is a short, the SD card detection won't work.

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

10. Lithium Polymer Battery: The battery should only be installed after the ArcadeNano has been tested using USB for power. Solder the red wire to the "B+" pad and the black wire to the "B–" pad. To protect the battery from being pierced by pointy components on the PCB, cut a piece of thick cardboard to fit between the PCB and the battery inside the TicTac box

Power Supply
The ArcadeNano can be supplied with power in two different ways: USB power or battery supply. The maximum current consumption is approx. 150 mA, not including battery charging and the Micro-SD card. USB can be used for data streaming in both cases.

Battery Charging
To charge the battery, set the switch to "USB" and connect the ArcadeNano to a USB port or USB charger. The "CHARGE" LED on the bottom side will turn on while the battery is charging and turn off when it is full. Please note that if the switch is in "BAT" position, the ArcadeNano will be supplied from the battery. Depending on the number of LEDs turned on, the current drawn from the battery might exceed the charging current, in which case the battery would actually be discharged instead of charged. Always make sure the switch is in the "USB" position for charging.

Using the ArcadeNano

After switching it on, the ArcadeNano 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. 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 ArcadeNano, an error message will scroll across the LEDs.

Files on the SD card must be stored in a directory with the name ARCADE. 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 ARCADE directory, an error message will scroll across the LEDs. All files must be 26x20 pixels, 1 channel. The supported file formats are:

Filename extension	Format
BIN	Modified BlinkströmAdvanced file (binary, 8 grayscales)
BLM	BlinkenLights Movie (simple ASCII format, no grayscale support)
BML	Blinkenlights Markup Language (XML-based, 2 to 256 grayscales, but only 8 grayscales displayed)
BBM	Blinken Binary Movie (binary format with up to 256 grayscales, but only 8 grayscales displayed)

More information about the file formats: 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 IC5. You can now connect 3.3 V logic-level ("TTL") signals to pads 2 ("Rx") and 3 ("Tx") of the IC5 footprint. 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 frames (scrolling 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 connect an AVR ISP programmer to the solder pads on the PCB. Please note that the programmer must support 3.3 V targets. Remove the SD card before connecting a programmer, and disconnect the programmer before inserting an SD card.

Pad Name	C	O	I	R	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/ArcadeNanoEnglish
Software project page: http://wiki.blinkenarea.org/index.php/BlinkenPlusEnglish