

MicroNoise 4093 - light sensitive para-synth

This kit is one of LJUDMILA Art & Science Laboratory and Trivia Records DIY projects further developed for THEREMIDI ORCHESTRA and related workshops by both co-producers. It is based on work by dusjagr labs.

The practice of DIY electronics is closely linked to our artistic projects since our playground is media and technology.

Briefly, here is the list of components:

Resistors:

2 x 220 Ω (can be anything from 100 Ω to 470 Ω)

Potentiometers

(variable resistors):

1 x 2 KΩ linear (can be 5KΩ / logarithmic)
2 x 2MΩ linear (can be 1MΩ / logarithmic)

Light dependent resistors (LDR):

2 x VT** (little brown beads with snakelike pattern on top)

Capacitors:

2 x 100 nF plastic (from 47 nF to 220 nF should be all right)
2 x 10 uF electrolytic (anything from 1uF to 10 uF should be ok)

optional:

2 x 4,7 uF electrolytic (up to 100 uF) - for DC decoupling of the two outputs

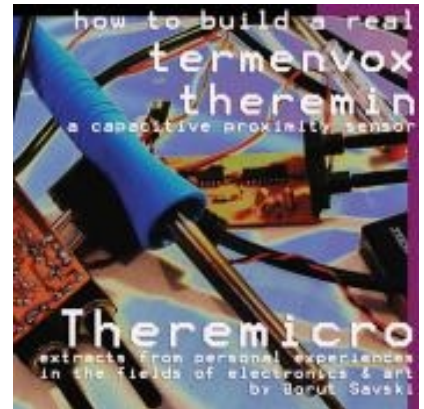
Light Emitting Diode (LED):

2 x high brightness LED (or whichever is available)

Integrated circuits:

HEF(CD)4093 - CMOS quad 2-input NAND gate with Schmitt trigger for 3V up to 18V power supply (can be 74HC4093 up to 5V power supply voltage 3V battery)

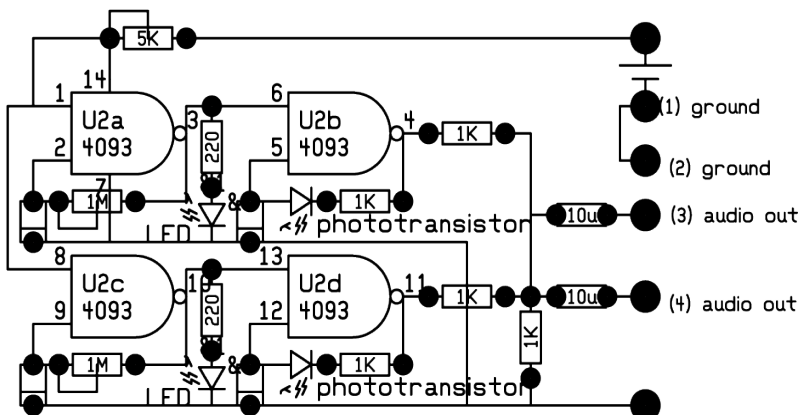
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MICRONOISE is a nickname for a simple type of double channel LFO (Low Frequency Oscillator) and light dependent audio frequency oscillator (OSC); whereby the latter is modulated by the former. That means that OSC is modulated by the LFO. It produces a two channel audio output.

The circuit was perfected/simplified and brought to our attention by Marc Dusseiller (dusjagr labs). Some were built later in the vicinity of Cirkulacija 2 collective and the positive results made it perfect for LiWoLi's workshops. The integrated circuit is now optimized and used entirely to make a two channel system with some open options for additional hacking.

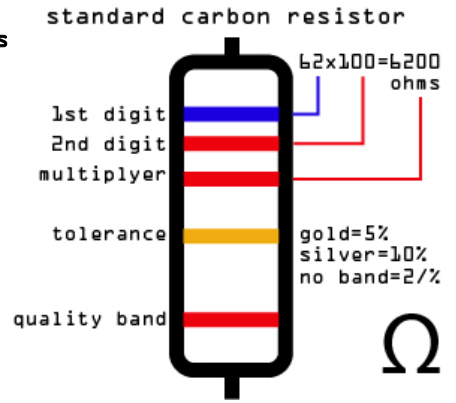
The circuit is built around quadruple 2-input logic gates of the NAND type (not AND; inverted AND). AND logic means that the 1st and the 2nd inputs have to be one to output 1 (1 = true = HIGH). The circuit has simplified oscillators sections due to use of Schmitt triggering of gates. This means that some positive feedback is applied to every gate to make the transitions from one state to another more defined (also refer to hysteresis* action). Here is a kind of electric schematics:



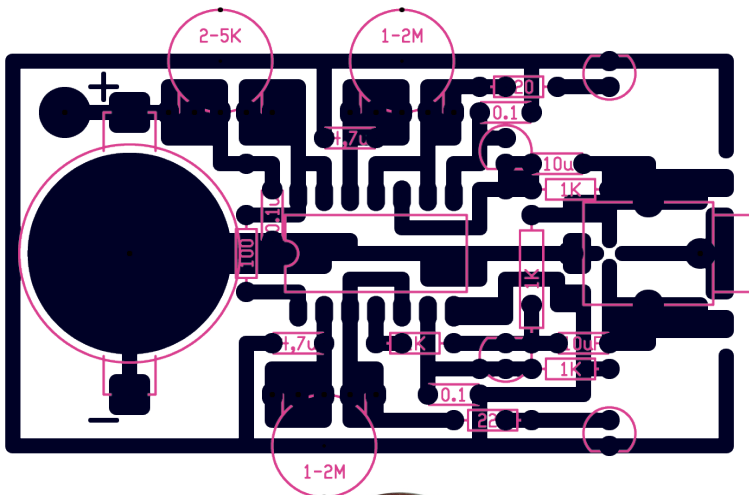
* Hysteresis is the dependence of a system not only on its current environment but also on its past environment.
** phototransistor is really LDR (light dependant resistor)
*** some elements shown here are usually omitted (resistors 1K and condensers 10 uF)

During the workshop, you will hear lots of terms that you might be or might not be familiar with. In any case it helps to clear out the terms, so we made a short glossary of terms:

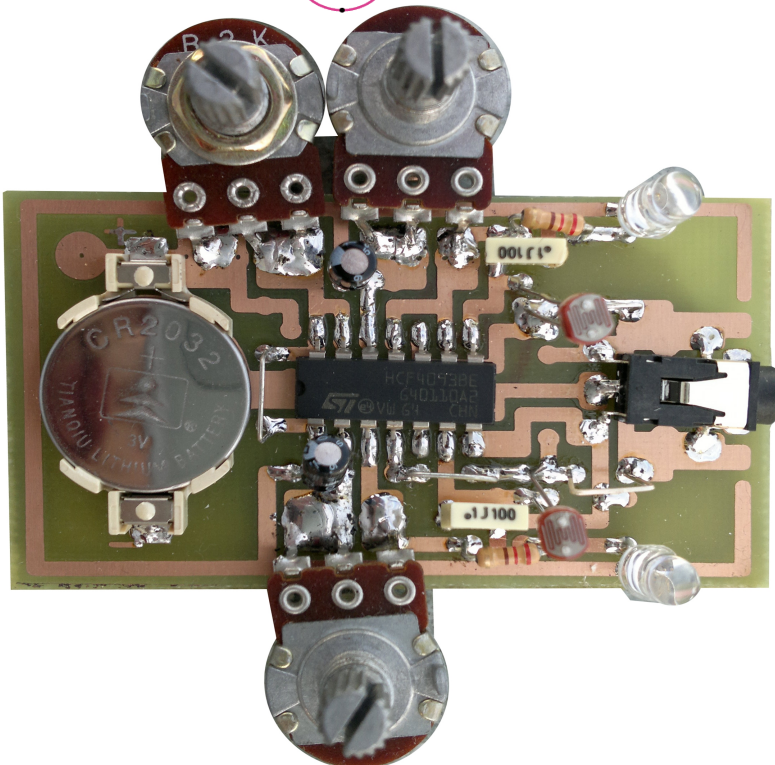
- **Resistors, condensers, inductors** are passive elements. They are used together as frequency determining circuits.
- Condenser and inductors** are reactive elements.
- Active elements are made from amplifying devices: electric tubes, transistors, integrated circuits (with integrated transistors).
- Active circuits are those that use electric power to add to the incoming signal to active some sort of amplification.
- **Oscillator** is an active circuit amplifier that can sustain / generate it's own signal.
- **Amplifier** is an active circuit that makes "bigger" from "smaller".
- **Transistors** are based on semiconductor technology.
- **Pure semiconductors** have large resistance almost like isolators.
- **Impure semiconductors** can be P-type (less electrons available) and N-type (more electrons available).
- When connected together they form PN-function which is the basis of modem amplification devices.
- **PN-function** is part o material structure where electrons from N-type move into material of P-type semiconductors.
- The current can flow from N to P not reverse.
- **Transistor** is a double diode with junctions close together.
- **MOSFET transistor** is a simpler version.



black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
violet	7
gray	8
white	9



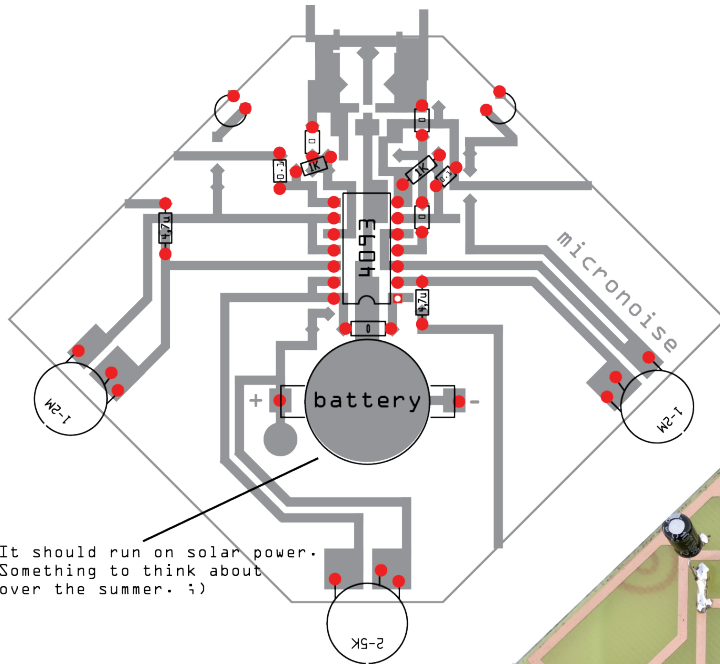
This is how you connect the elements on the copper side of PCB (printed circuit board):



After a steady hand and an hour of soldering (give or take a minute), it should look something like this:

And some more terms:

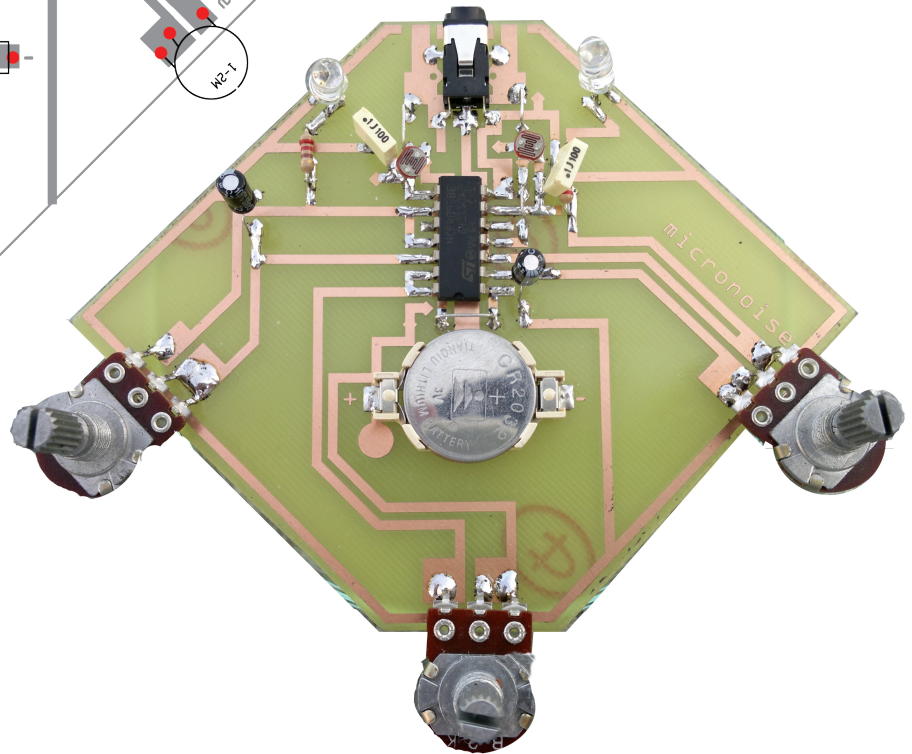
- Resistance \neq conductance.
- **Resistor** is a passive electric element that "burns" electric energy. It is used for setting the voltage drops; it limits / defines the electric current.
- **Capacitor / condenser** is used to keep an amount of energy (as electrons) for alternate current. It shows frequency dependent resistance: the higher the frequency the less resistance ($X_c=1/wC$).
- **Inductor** also saves electric energy as electromagnetic energy ($X_L=wL$). Resistance grows with higher frequency.
- **Inverter** is an amplifier that inverts the signal - a 180° turn of phase.
- **Signal** is a periodic change of (electric) value (voltage, current).
- **Logic circuits** are used to process (amplify; change) digital signals.
- Processing that keeps the incoming and outgoing signals in some (mathematically) proportional (analogous) relations is called **analog**.
- **Digital circuits** deal only with two distinctive levels: 0 and 1 (no / yes logic); high and low.



It should run on solar power. Something to think about over the summer. ;)

And another adorable version:

And when it's all done, it should look like this:



MicroNoise (and all similar basic circuits) is non-original. It belongs to open-source principle from before the open-source era. It is not a concept - it is an application. However, the principles of modulated LFO / OSC combination is the basis of any information transfer. It is at the heart of any synthesizer concept.

Definitions:


- LOGIC GATES are blocks with two or more input options to produce basic logic operations: OR and AND
- OR: one or the other must be "true" to make the result to be "true"
- AND: one and the other must be "true" to make the result "true"
- NOR, NAND: for the sake of simplicity of technology used the negated/ inverted values are most commonly used.

LOGIC GATES are the basis of building up "memory" cells. The simplest cells are called flipflops (T-flipflop, D-flipflop, RS-flipflop, JK-flipflop). We do not use it yet.

LJUDMILA says:

MicroNoise is very nice addition to the Theremini and TouchTone line, because it reuses the "ethereal" playing - now with light sensitive approach. We will use it on workshops at our laboratory and use it as yet another sound source of the Theremidi orchestra.

We furthered our use of combined technologies we have everything necessary to prepare the masks, design and etch the circuit boards, so we can make more anytime we please!



<http://www.ljudmila.org>
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TouchTone 4049 - finger-synth

Briefly, here is the list of components:

Resistors:

2x 10K to 100KΩ
1x 1MΩ

Integrated circuit:

HEF(CD)4049 - six invertors' CMOS chip (3 to 18 V) or
74HC4049 - the same chip as high speed CMOS version (3 to 5V)

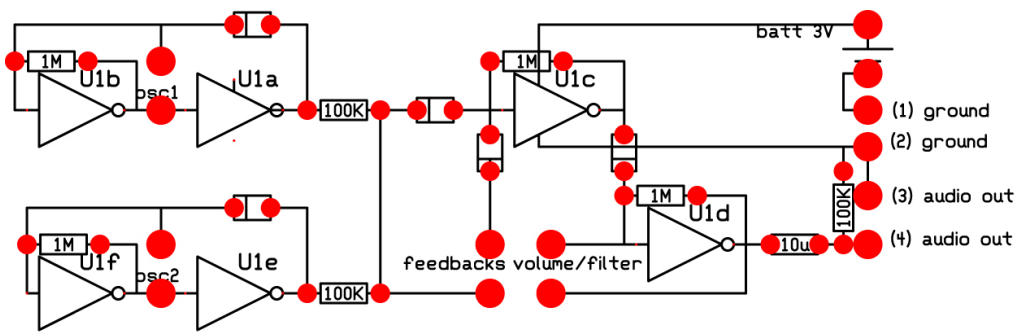
Capacitors:

5 x 100 nF
1 x 10 uF electrolytic

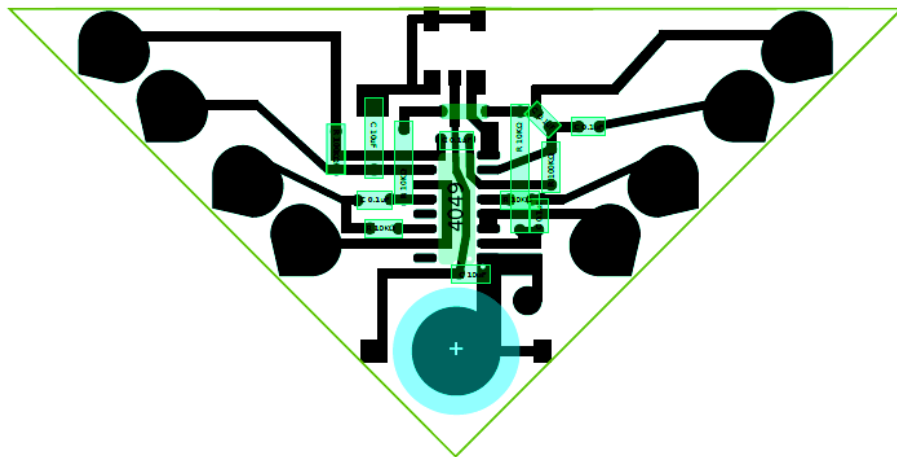
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TouchTone is a feedback amplifier system using all six invertors (inverting amplifiers) of CMOS chip 4049. We use the invertors in combined digital/ analog mode. Two pairs are used as variable frequency oscillators (lower and high frequencies) and third pair is used in mixed amplifying/ filtering/ oscillating (feedback) mode to play around with the existing pads all over the system.

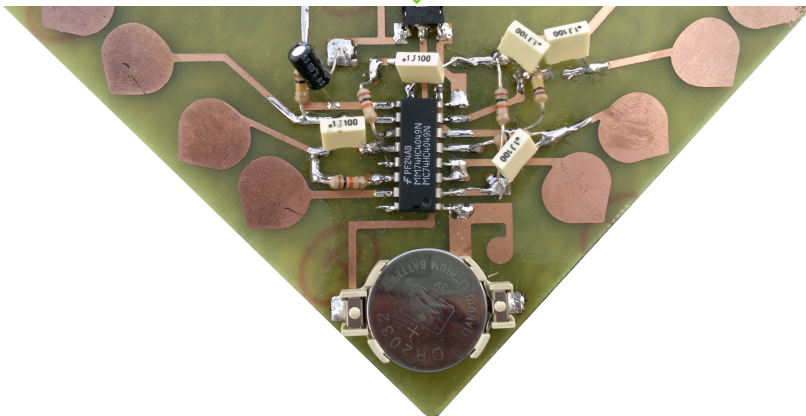
Combining touchable pads in various manners can bring out interesting - very complex results. The "touchables" also give name to this synthesizer - "Touchable Anton" (TouchTone)*



For those of you who are legible in electronics - a schematic map:



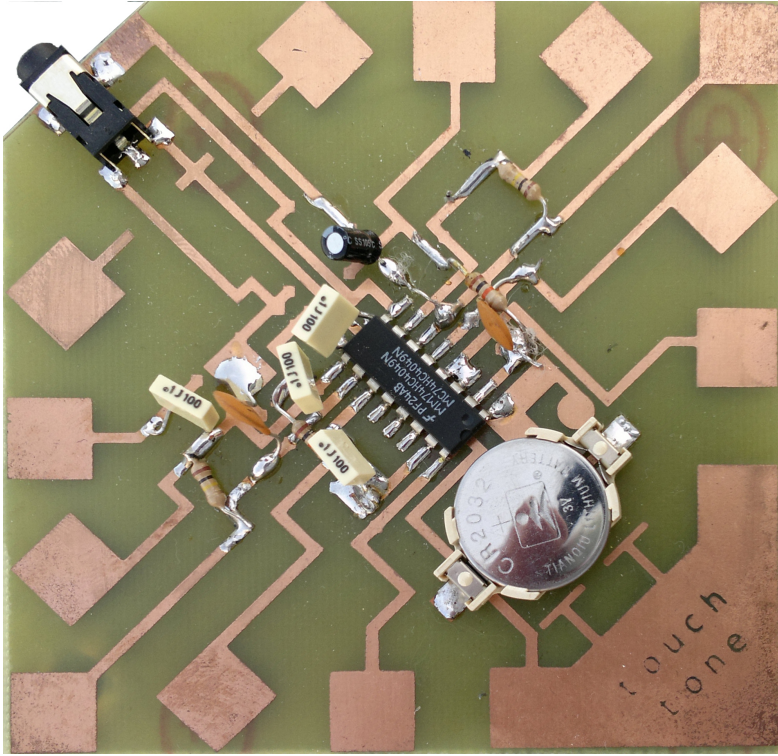
And for those less fortunate a circuit board map:



This how it will turn out. Pretty nice. Isn't it?

* Some elements are omitted for the sake of simplicity.

And again, an even more adorable look. It should look like this. The design was made by Saša who wants everything to look very beautiful in symmetry and harmony.



LJUDMILA says:

We are very pleased that our "tovariš" Borut thought us how to make Tereminis on workshops at our laboratory and excited that the participants started playing together as the Theremidi Orchestra.

We also have all the scary chemicals (NaOH, HCl & peroxide) necessary to etch the circuit boards, so we can make lots more anytime we want! There is ten of us so the manufacturing process is smooth and fun.



LJUDMILA