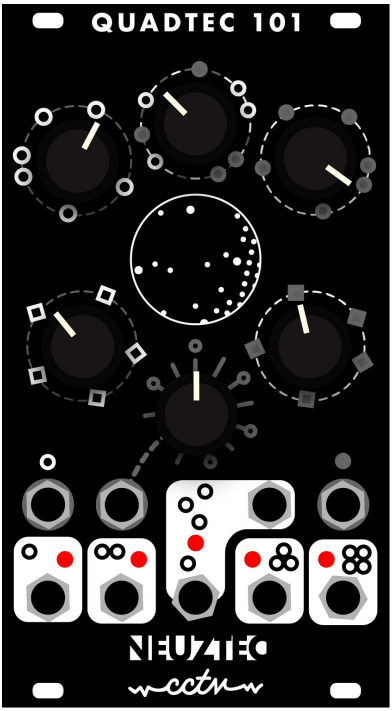


QUADTEC - 101
BUILD GUIDE

Written by Filip Pietruszewski
v1.1

Introduction

QUADTEC-101 is a dual-core quadrophonic oscillator in a desktop or Eurorack format. QUADTEC-101 is offered as a DIY kit, which requires soldering. The goal of this Build Guide is to make the assembly process as easy as possible and accessible to tinkerers of all skill and age levels.

Tools Required

- Soldering iron: Any will do, however a higher power (30W+) iron with a fine chisel or bevel tip will be easiest to use
- Side Cutters (also known as flush or diagonal cutters) to clip off excess leads
- Two Wrenches: One 8mm, and one 7/16” to tighten pot and jack nuts

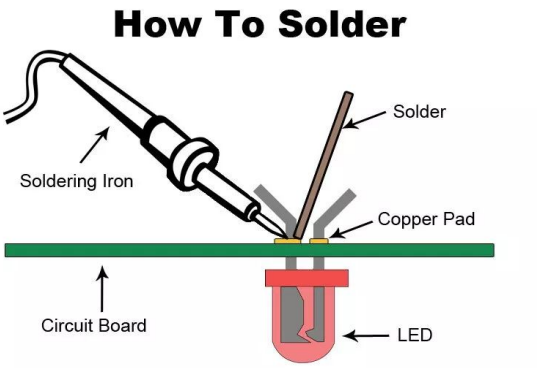
Consumables Required

- Rosin Core Solder, preferable 63/37 Lead/Tin composition
- Solder wick in case of mistakes

What is Soldering and How Do I Get Really Good?

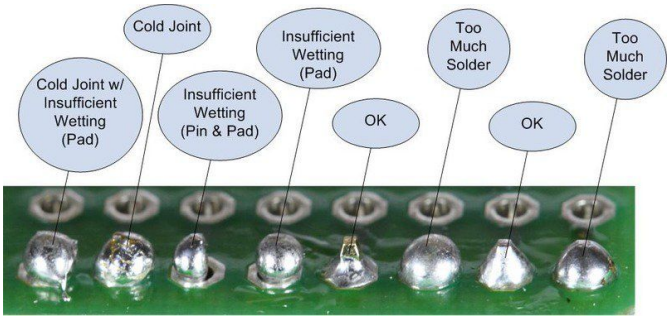
Soldering is the act of joining two metals using an intermediate metal to bridge the connection. We are soldering copper component legs to copper pads on a printed circuit board (PCB) using lead-based solder.

The most important tip to good solder joints is to first concentrate on heating up both pieces of metal first and then introduce the solder. You are not “painting” the molten solder onto the part, you are heating up the parts and then filling in the gaps with solder.



A good idea is to apply heat from the soldering iron first, count to 3 in your head, and then introduce a little bit of solder. Count to 3 again in your head and finally remove the soldering iron.

Once you complete your first solder joint, compare your results with this image and see where you stand.



If you are struggling, please ask for assistance! It's what we're here for.

Bill of Materials

A Bill of Materials (or BOM for short) is a table that matches each part number with its value or part type. BOMs are used in DIY builds, as

well as mass assembly as a means of describing what parts are placed on a PCB, and where to find them.

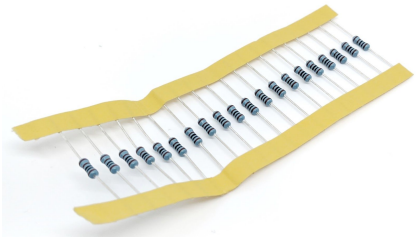
To save on space, part numbers are printed on the PCB rather than their values. For instance, a resistor will be labelled as ‘R12’ instead of ‘200 Ohms’. The BOM will tell you what value ‘R12’ is and what type of part it is. Resistors are conventionally referred to as ‘R*’, capacitors as ‘C*’, and integrated circuits as ‘IC*’ or ‘U*’

The Bill of Materials is your best friend and is found on PAGE 18.

A good idea is to mark off the components you’ve already soldered on the BOM with a high-lighter or pencil. This keeps you on track in the event you take a break or get distracted.

1. Resistors

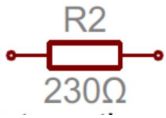
Always start with resistors. They come in a strip and they look like this:



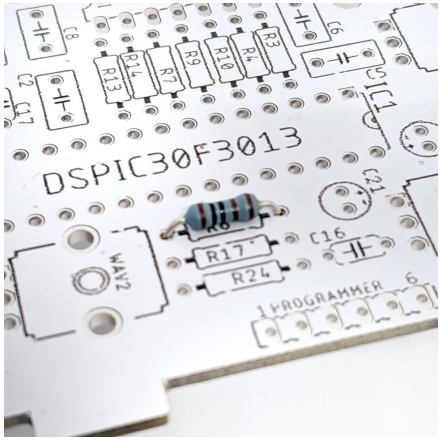
Resistors impede the flow of current and have a variety of uses in electrical circuits. In the QUADTEC-101 they are used to set the cut-off frequency of the output filters, to set the output gain of the output amplifiers, and to limit current coming from the CV inputs.

Resistor leads need to be bent and inserted into the PCB. Resistors do not have a polarity, and can be installed either way around.

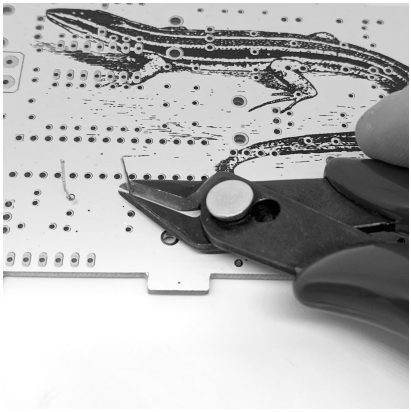
Note the shape and labelling of the markings that indicate where resistors are installed on the PCB board. They look like this:



Below is an image of a correctly installed resistor.



Once you have bent the leads on the resistor and inserted it into the PCB board, you will need to flip the PCB over and solder the leads in the way described in the earlier sections. Once you have both leads properly soldered, you can go ahead and trim the leads using the side cutters.

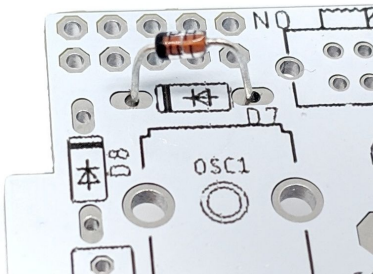


Congratulations! You've soldered one perfect resistor. Great job! Finish up the rest of the resistors using the BOM, before moving forward.

2. Diodes

Diodes are similarly shaped to resistors, however they have a much different purpose. Diodes are semiconductors, and they only conduct in one direction. In the Quadtec-101 they are used to prevent power from being applied backwards and potentially destroying your beautiful instrument.

Diodes DO HAVE A POLARITY and you need to double or triple-check that you are installing them the right way around.



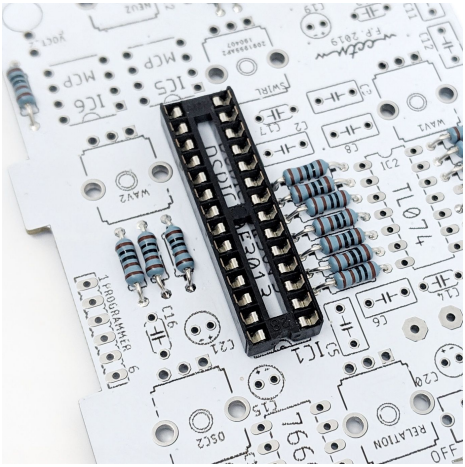
The diagram on the PCB shows one black end that needs to line up with the black end of the diode. Insert them flush and solder the same way you solder resistors.

3. Sockets and ICs

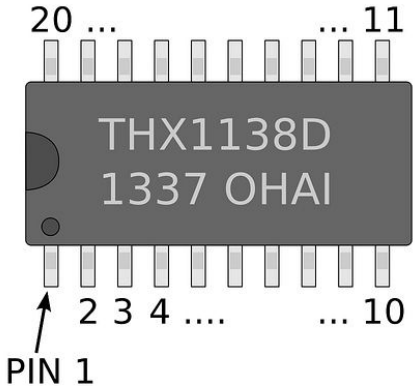
The order for soldering PCBs is always flattest to tallest - this is so it's easier to flip the board over and have the desk supporting the

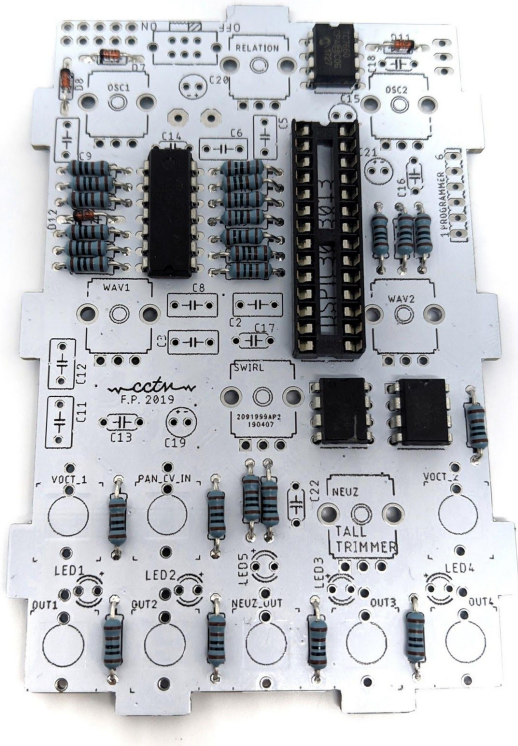
components. If you do taller ones first, then the shorter components will drop down when you flip the PCB over.

Let's solder the socket first. The socket is for the DSPIC chip. We use a socket for a few reasons, primarily because the DSPIC is the most sensitive component on this board, and we don't want to introduce too much heat to it. The other reason is that the DSPIC is the most costly component to replace in case of accidentally soldering it in backwards.



Next up are the ICs. There are 4 - TL074, TC7660, and 2 x MCP4802. Make sure you do not confuse the TC7660 with the MCP4802, even though they look very similar. Double check under a light source to tell them apart by the markings on top. The diagrams on the PCB show which direction the notch of the chips needs to go. If there is no notch, there are several ways to find which end is pin 1.



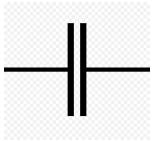


At this point, your board should look like this. Hooray!

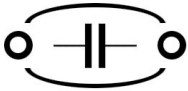
4. Capacitors

Quadtec-101 Uses 3 different types of capacitors, but luckily they all have different shapes and colours, so it's easy to tell them apart.

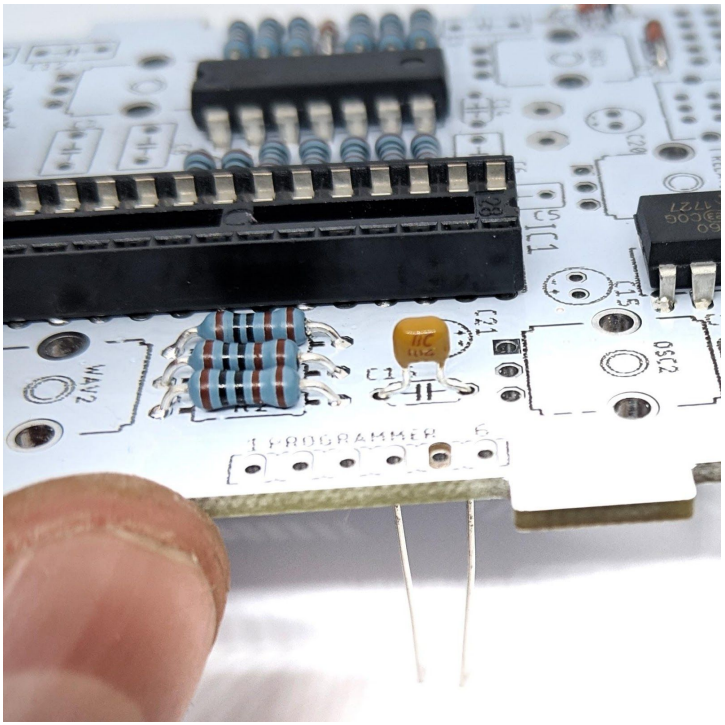
The standard symbol for a capacitor (as seen on the Quadtec-101's pcb board) look like this:



The small yellow capacitors are called Ceramic Capacitors, and we should solder them first. Note that the yellow capacitors go on the spots that look like this:

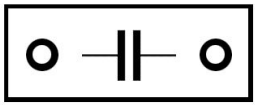


These caps DO NOT HAVE POLARITY, so you can solder them either way. These caps, like the others, match their footprint so it's easy to find where to install them. Here is an image of a correctly installed ceramic capacitor:

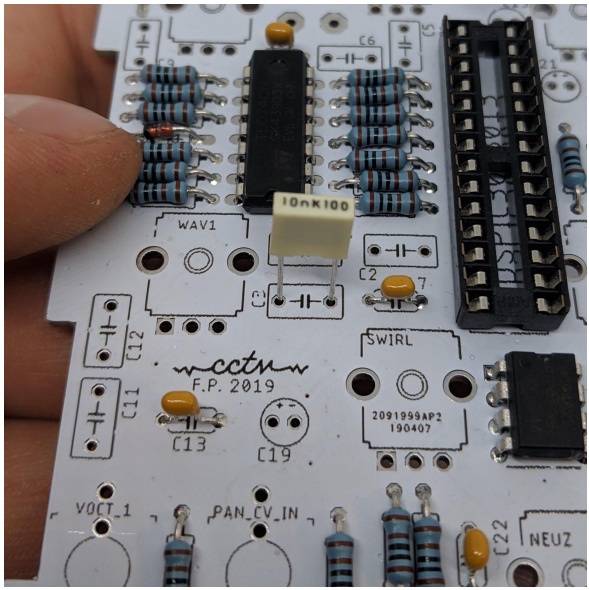


Ceramic Capacitors are cheap, but behave non-linearly in audio paths. In QUADTEC-101 we are using ceramic capacitors to smooth out the DC voltage rails, and to provide localized storage of high-current energy for each of the ICs.

Once you have the yellow ceramic capacitors installed, it is time for the rectangular shaped Film Capacitors. The Film Capacitors go on the spots that look like this:



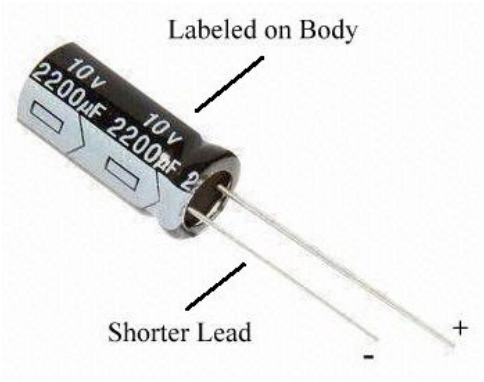
The image below shows a correctly installed Film Capacitor.

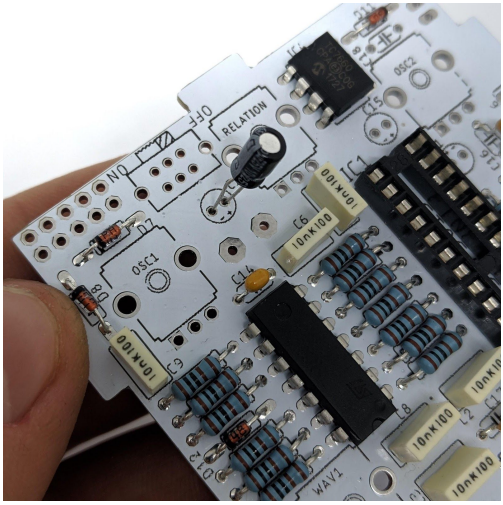


Film capacitors are best for audio and high-voltage applications; we are using them in the output filter stages here.

Film capacitors are non-polarized, so you can install them either way.

Finally, we have a few electrolytic capacitors to install. Electrolytics are very cheap for high capacities, and are excellent at storing large amounts of energy. These are used to smooth out ripple noise in the power supplies.
Electrolytics **DO HAVE POLARITY** AND YOU MUST MAKE SURE TO INSTALL THEM CORRECTLY.



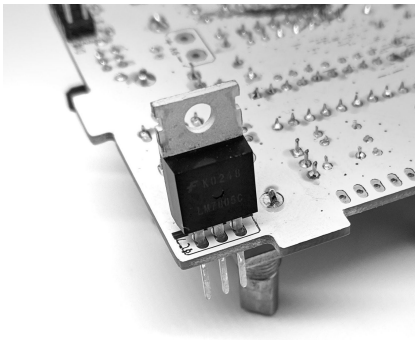


The PCB has a marking showing ‘+’ and ‘-’, and these correspond to the longer and shorter lead, respectively.

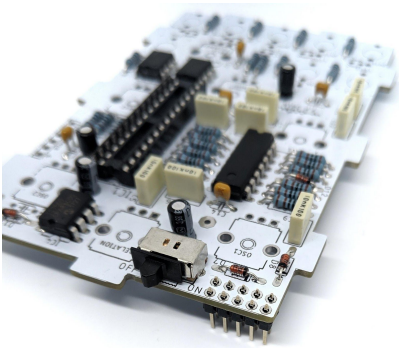
5. Odds and Ends

Next we’ll solder the 10-pin power connector, the battery on-off switch, and the voltage regulator. Extra attention needs to be paid to the voltage regulator, since it has to go in the right way, but it also needs to be soldered on the bottom of the PCB (not the top!). The power header also needs to be soldered on the bottom of the PCB.

Below: Voltage regulator as seen from the bottom of the pcb:

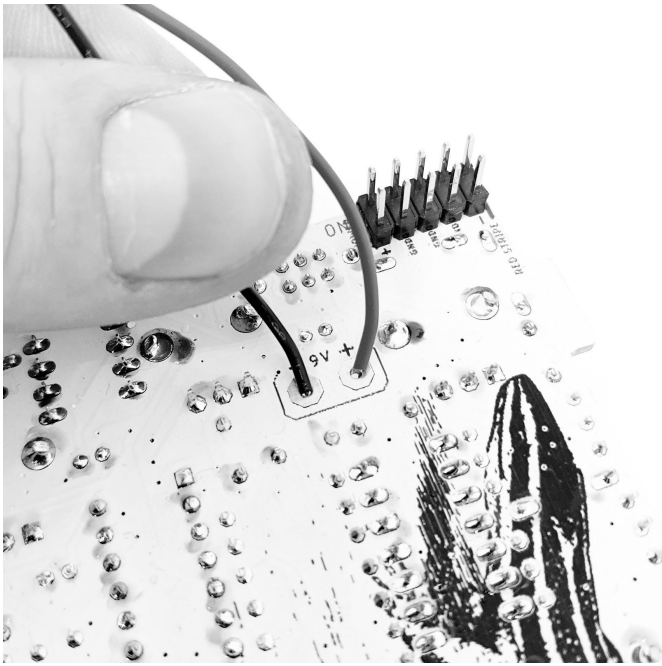


Below: Power header (bottom right on PCB)



Note: There is a similar footprint labelled ‘programmer’. No component is installed here. If you wish to hack your Quadtec-101 by writing your own firmware, or updating in the future, this is a port for the common ‘PicKit 3’ programmer.

Before moving on, be sure to solder the 9V battery clip. The Red Lead goes to the ‘+’ sign, the black lead goes to ‘-’.

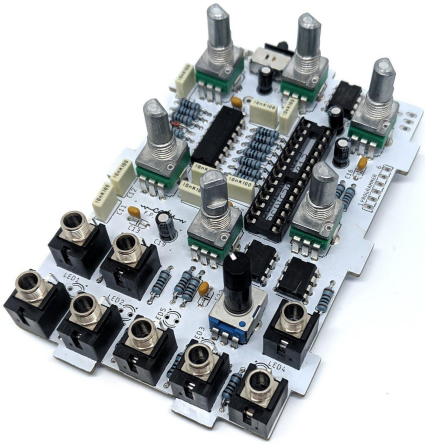


6. Jacks and Potentiometers and LEDs

All that's left is the easy part.

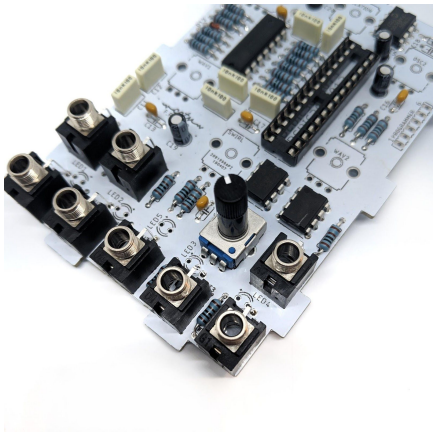
Important: These components should be assembled by doing a 'dry fit' with the panel - meaning you insert the components through their footprints, then attach the panel with one or two nuts, and then solder. This makes sure the components are lined up properly with the panel, and ensures the LEDs are at the right height, and all equal.

It should look like this image (below):

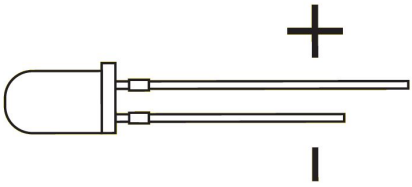


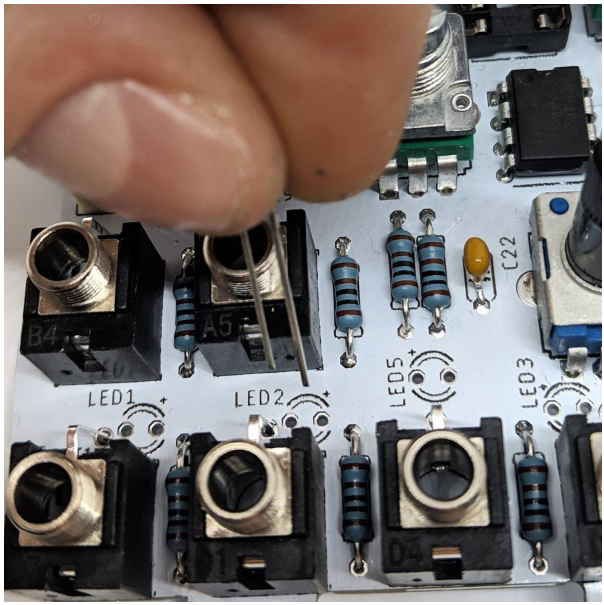
A potentiometer (or pot for short) is a type of variable resistor that is used to control various parameters in synthesizer. This is the electrical component that is dressed up with the knob.

Quadtec-101 has one pot that is different than the others, and you should make sure it goes in the right place!



The LEDs (light emitting diodes) are diodes after all, and as such they also HAVE A POLARITY. Make sure you install them the right way around!





The PCB has a ‘+’ sign marking the positive leg of the LED. The positive leg of the LED is the longer of the two.

Once you have “dry-fitted” the panel on top of the PCB pots and jacks, you may proceed to solder.

Important: do not solder the LED’s on to the pcb until the top panel has been “dry-fit” placed over the pots and jacks! The LED’s need to be placed at the correct height above the PCB to allow the LED to just protrude above the exterior panel. Place each LED at the correct height before you solder it.

Once the pots, jacks, and leds are installed, power up the synth to see if all is well. If everything looks good (IE no smoke!), you can insert the DSPIC and install the panel by tightening down the pot and jack nuts.

At this point, it's time to do a test. Check if your LEDs are all working, and listen to each output to make sure you have signal. If something's not right, you'll need to troubleshoot. Ask for assistance in troubleshooting if you need it.

7. Enclosure

Quadtec-101 includes a simple enclosure to allow use in desktop mode. This enclosure consists of 3 laser cut pieces and one 3d-printed battery holder. The pieces friction fit together using the tabs cut into the PCB. If you find that a large amount of force is needed to get the pieces to snap together, flip the front piece and/or swap the left and right pieces around to find a combination that fits.

8. Usage

The digital oscillators are coded to provide synthesis at 40,000 samples per second. Using the waveshape knob, different waveshapes are blended together to create new, complex, and often unusual sounds. Some waveshapes are stored as wavetables, gathered from a variety of sources, and others are synthesized in real time. As you turn the knob from fully counter-clockwise to fully clockwise, you will experience a blending of the following 9 waveshapes:

Triangle
Evenangle
Eventooth
Cello
Saw
Square
"Videogame" Pulse
Pluck
FM

Each oscillator has controls dedicated for each on the left and right half of the module. Each of the two oscillators has pitch control with the knob in the top left/right and CV inputs that tracks 1 V/OCT, as well as the waveshape blend knob.

The top middle knob is a blend control that blends Oscillators 1 and 2 together. At fully counter-clockwise, you will only hear Oscillator 1, and at fully clockwise you will only hear Oscillator 2. At noon o'clock you will output an equal proportion of Oscillators 1 and 2.

ON THE SUBJECT OF QUAD SOUND

The goal of this module is to provide an easy way to distribute an oscillator around a quad sound environment. The four outputs (1,2,3,4) accomplish this task by routing the input (the blend of oscillators 1 and 2 along with their waveshapes and pitch) through to the four outputs in a smooth rotation. You can think of these as four VCAs with 90° quadrature shift of their control inputs. The Quad panning (as we call this movement) is controlled by a triangle wave modulating each output's amplitude, providing a smooth transition from one output to the other. In a quad setup, this has the impression of the sound swirling around you, with no sudden jumps between each speaker.

The Quad Pan knob adjusts the rate and direction that this panning occurs. At fully clockwise, the pan will occur from left to right at approximately 1Hz. At fully counter-clockwise, the pan will occur from right to left at the same 1Hz frequency.

With the knob at 12 o'clock, the signal not only stands still, but is also output on all four outputs simultaneously. When the pan knob is at 12 o'clock, we have also entered 'VCA Mode' where the pan input will be considered as a control input to a digital VCA. This allows the operator to utilize this module as a mono synth voice, requiring only an external envelope or gate.

ON THE SUBJECT OF RANDOMNESS

The center output at the bottom of the module provides a pseudo-random noise source, hereby referred to as NEUZ. This NEUZ output is a source of digital noise, swinging from 0V to 5V. The small knob to the top right of the NEUZ output controls the speed at which a pseudorandom sample is taken and the output consequently updated. This output can be fed back into the CV inputs of QUADTEC-101 to offer self-patching options.

ON THE SUBJECT OF POWER

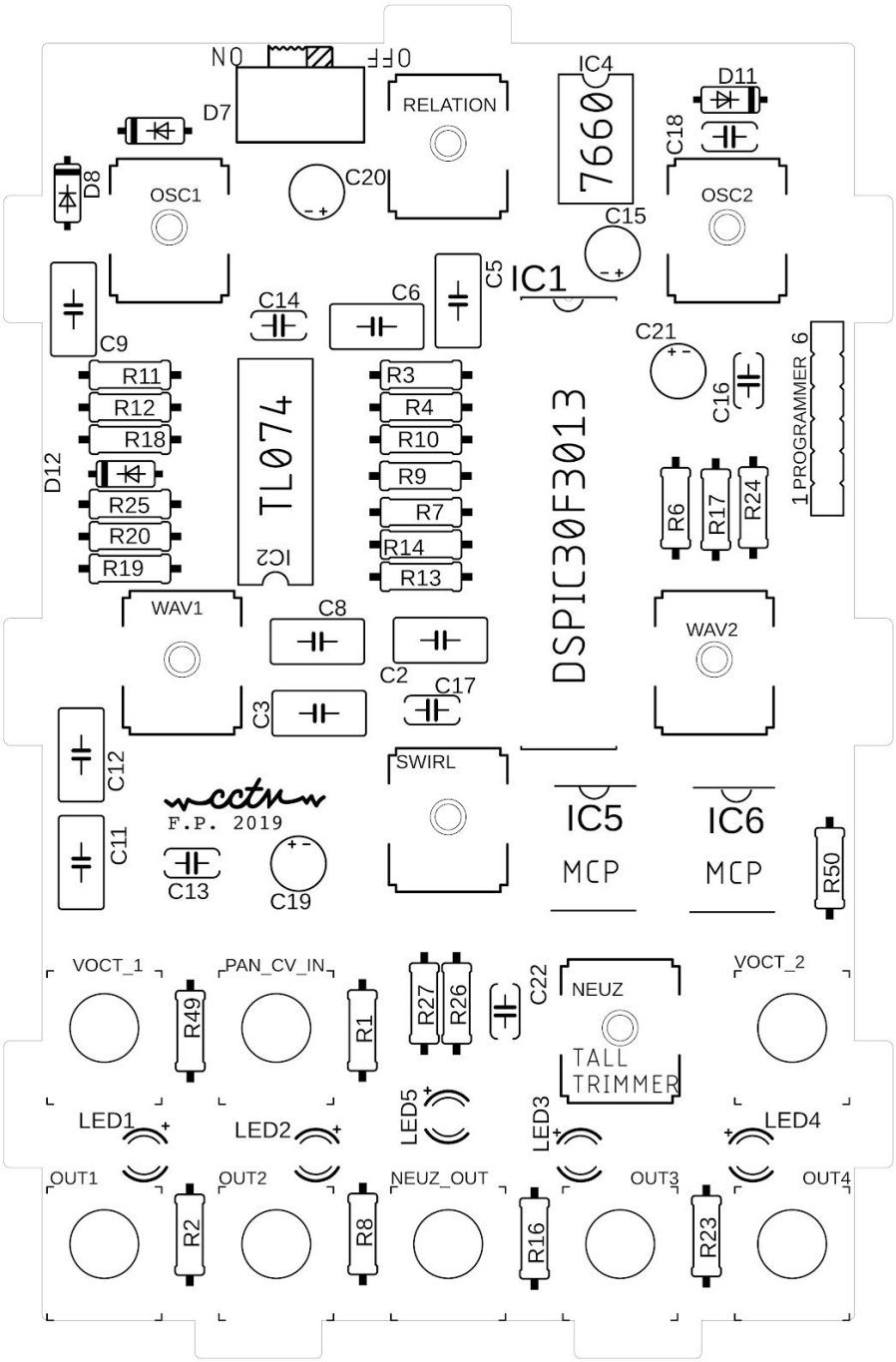
Quadtec-101 is designed to be powered from a eurorack system, or standalone on a table or lap. When using the device in standalone mode, a 9V battery is required. This battery will last about 4-5 hours of usage. There is a small switch on the top to turn off the battery supply in order to save battery life. When in eurorack mode, this switch has no effect. If you wish to power from eurorack power while a battery is installed, make sure to put the switch is in 'off' position to preserve battery life. The enclosure can be ommited and the battery clip can be left unsoldered if you wish to only use Quadtec-101 in a eurorack system.

ON THE SUBJECT OF TECHNICAL SPECIFICATIONS

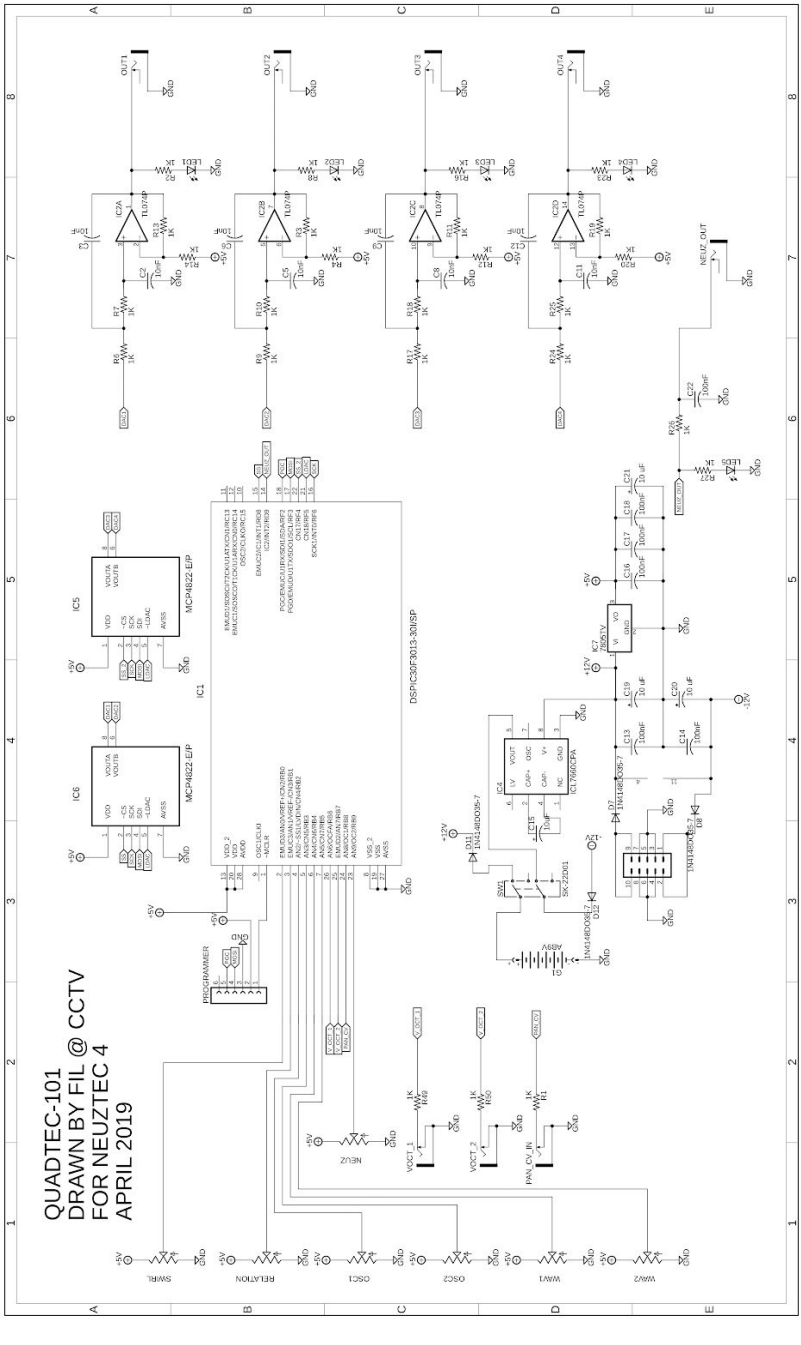
Horizontal Dimension - 14HP / 70.8mm
Vertical Dimension - 128.5mm (3U / Eurorack)
Depth with case - 40mm
Depth without case - 14mm

Power Draw
12V - 120mA
-12V - 10mA
Battery - 130mA

Layout


ON
OFF
RELATION
IC4
7660
D11
D7
D8
OSC1
C20
C18
OSC2
C15
C5
IC1
C14
C6
C21
C9
C16
1 PROGRAMMER 6
R11
R12
R18
R25
R20
R19
TL074
IC2
R3
R4
R10
R9
R7
R14
R13
DSPIC30F3013
D12
R6
R17
R24
WAV1
C8
WAV2
C2
C17
C3
C12
SWIRL
F.P. 2019
IC5
MCP
IC6
MCP
R50
C11
C13
C19
VOCT_1
PAN_CV_IN
R27
R26
C22
NEUZ
VOCT_2
R49
R1
TALL
TRIMMER
LED1
LED2
LED5
LED3
LED4
OUT1
OUT2
NEUZ_OUT
OUT3
OUT4
R2
R8
R16
R23

Schematic



Qty	Value	Device	Package	Reference	Description
6	B10K	9MM Pot		OSC1, OSC2, RELATION, SWIRL, WAV1, WAV2	9mm vertical snap-in pot, Alpha / Panasonic style
1	B10K	9MM Trim Pot		NEUZ	9mm vertical snap-in trimmer pot, Song-Huei Style
25	1K	R-US_0207/10	0207/10	R1, R2, R3, R4, R6, R7, R8, R9, R10, R11, R12, R13, R14, R16, R17, R18, R19, R20, R23, R24, R25, R26, R27, R49, R50	Resistor, Through-hole
4	10 uF	CPOL-USE2-4	E2-4	C15 C19, C20, C21	Polarized Electrolytic Capacitor
6	100nF	C-US050-024X044	C050-024X044	C13, C14, C16, C17, C18, C22	Ceramic Capacitor
8	10nF	C-US050-035X075	C050-035X075	C2, C3, C5, C6, C8, C9, C11, C12	Film Capacitor
5		LED3MM	T3	LED1, LED2, LED3, LED4, LED5	3mm Red LED
4		1N4148	DO35-7	D7, D8, D11, D12	Small Signal Diode
1		7805TV	TO220V	IC7	Positive 5V Voltage Regulator
1		AB9V		G1	9-V Battery Clip
1		DSPIC30F3013	DIP28	IC1	16-bit Digital Signal Processor ***USE 28-PIN SOCKET***
1		Pin Header		SV2	Power Header
1		ICL7660	DIP8	IC4	Negative Voltage Converter
2		MCP4802	DIP8	IC5, IC6	Digital to Analog Converter
1		SK-22D01		SW1	DPDT Slide Switch
8		PJ301M		NEUZ_OUT, OUT1, OUT2, OUT3, OUT4, PAN_CV_IN, VOCT_1, VOCT_2	3.5mm jack for Eurorack modular synths
1		TL074P	DIL14	IC2	OP AMP

Design Files:

github.com/cctvfm/quadtec101

Usage Information:
cctv.fm/product-page/quadtec-101

Manual written in April 2019
V1.1 Updated in May 2019 with the help of Doug Blackley