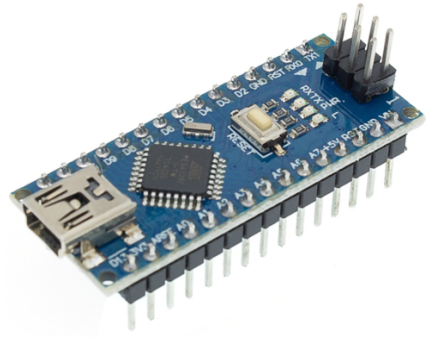
ASCII Components List

A list of basic, easy-to-find components used in most ASCII modules

ASCII modules are designed using the fewest possible types of components. This should make them quick and (fairly!) easy to build, and allow cost savings to DIYers who want to buy their own components, because they can be bought in bulk. For instance, if all 20 resistors on a module have different values, a DIYer has to buy 20 individual resistors. But if there are only 2 different values, they can buy 2 sets of 10 resistors, which is usually cheaper.

All components are through-hole where possible. Through-hole components are beginner-friendly and tend to be faster to solder than SMD for DIYers of any level of experience, unless solder paste and a hotplate are used to solder multiple SMD components at once.

Arduino Nano
ATmega328P, 16MHz, 5V



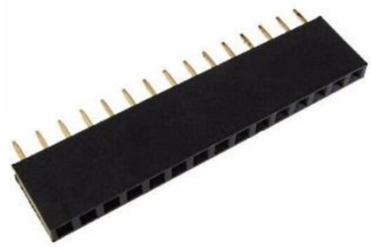
https://store.arduino.cc/collections/core-family/products/arduino-nano

https://uk.farnell.com/arduino/a000005/arduino-nano-evaluation-board/dp/1848691

Compatible clones using the CH340 USB chip will also work. They can be found on sites like AliExpress. Just make sure to buy the 328 chip, NOT the 168.

12 years old, the Nano is still a versatile choice for synth building. Unlike most modern uCs, it runs at 5V, so its ADC can read synth control voltages within a useful range without many additional components. Its 8-bit fast PWM is accurate enough to output 1V/Oct over a 127-note range, as long as you don't need digitally-controlled slides between notes.

1x15 Pin Header Socket / Female Pin Header
2.54mm pitch



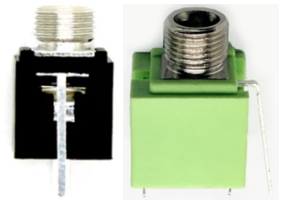
Mouser #: 992-15FX1-254MM

Plug the Nano into a pair of these. Always soldered to the rear of the PCB.

It would be possible to solder the Nano straight to the module, but it's a good idea to use sockets so you can fault-find the module, or just re-use the Nano.

Also, some modules connect to the TX and RX pins of the Nano, so the Nano cannot be programmed whilst connected to the module.

3.5mm Jack
Mono and Stereo



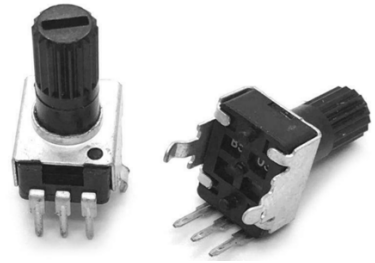
https://www.thonk.co.uk/shop/thonkiconn/

Thonkiconn 3.5mm jacks are the inputs and outputs from every module. Mono are black; these are used on all analogue inputs and outputs. Stereo are green; these are only used for TRS MIDI in/outputs.

Similar 3.5mm jacks are available from other shops, but the quality is usually lower, and the ground connections are not so easy to solder to a PCB. I would recommend only buying real Thonkiconn jacks.

Make sure to buy enough nuts for all the jacks. I recommend knurled nuts, available on the same Thonk page.

RV09 9mm Vertical Linear Potentiometer



Shaft length: at least **12mm**
Almost all modules use **100k linear**

Unavailable on Mouser, easy to find on eBay and AliExpress. To save panel space, it's best not to use an additional knob/cap with these potentiometers. To indicate direction, draw a line on the shaft with a white paint marker.

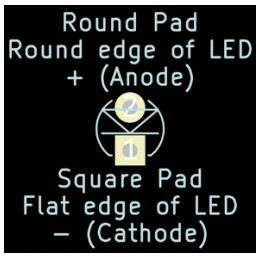
Alpha 9mm Vertical T18-shaft Potentiometer

https://www.thonk.co.uk/shop/alpha-9mm-pots-vertical-t18/
https://www.thonk.co.uk/shop/micro-knobs/

Almost all modules use **100k linear**

This potentiometer has a nut, which can help hold the module to the panel. It needs a T18 knob. I use micro-T18 knobs to save panel space.

3mm Red LED



RS #: 228-5916
https://uk.rs-online.com/web/p/leds/2285916

Any LED rated between 1.7V-2V, 20mA will work well. The lens can either be clear or red. There are good deals on eBay and AliExpress.

3mm Bicolour LED
Red-Green or Red-Blue 2-lead / 3-lead common-cathode

RS #: 2-lead: 228-5641 / 3-lead: 228-5685
Mouser #: 2-lead: 941-C4SMARGYCS4V1BB1 / 3-lead: 859-LTL1BEKVJNN
Any LED rated between 1.7V-2V, 20-30mA will work well.
Useful for representing bipolar signals, or several different digital states, within a small space.

3-lead version needs to be common-cathode.

SPDT Toggle Switch
2 position / 3 position
ON-ON / ON-OFF-ON

Mouser #:
2-pos: 506-A101SYAB04 / 3-pos: 506-A103SYCB04

2-position switches will be marked 'ON ON' on the metal side.
3-position switches will be marked 'ON OFF ON'.
Body Size: 13 x 8 x 10mm (L*W*H)

6mm Momentary Switch
9.5mm stem/plunger height, 13mm overall height

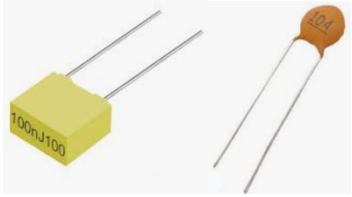
Mouser #: 706-95C06D4RAT (image on Mouser is misleading)

Resistors
0.25W axial, 1% tolerance

Body size: 6.5 x 2.5mm

5% tolerance resistors will work fine in some situations, but 1% are cheap enough when bought in bulk, that it is simpler to specify 1% tolerance.
The colour band representing tolerance is slightly separated from the others. For 1% resistors, this is brown.

Capacitors (unpolarised)
5mm pitch poly or ceramic



Mouser #: 75-MKT1817410015W (for 100n)

In ASCII modules, 'disc' type unpolarised capacitors are used for power filtering on ICs, and to filter analogue signals.

Poly capacitors tend to be more durable and are encapsulated in plastic. Ceramic capacitors work fine, but check the orange stuff for cracks before soldering them in.

Capacitors (polarised)
5mm pitch radial electrolytic

Mouser #: 667-ECA-2AM100I (for 10uF)

Ideally should be rated for 35V or more.

Always soldered to the rear of the PCB. They're too tall to be soldered to the top of the PCB.

Electrolytic capacitors tend to have higher values than ceramic or poly ones. In ASCII modules, they are mostly used to filter the main power supply entering the module from the Eurorack case.

1N5817 Schottky diode
DO-41 package

Mouser #: 511-1N5817

Diodes only let current pass in one direction. Schottky diodes have a very low voltage drop of around 0.45V. In ASCII modules 1N5817 diodes protect the module from being reverse-connected to the Eurorack power supply. Diodes have some resistance, so when followed by a large electrolytic capacitor, they also help to filter the power supply.

1N5711 Schottky diode
DO-35 package

Mouser #: 511-1N5711

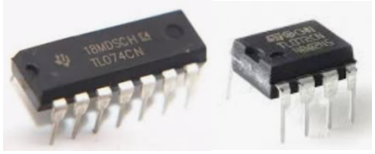
Red or blue packages are common.
In a smaller package than the 1N5817, 1N5711 diodes are used in ASCII modules to 'clamp' control voltage inputs to a range that is safe for the Arduino.

1N4148 / 1N914 diode
DO-35 package

Mouser #: 512-1N4148

General purpose small-signal diode with a voltage drop of 0.7V. Used for multiplexing switches, or other applications where voltage drop doesn't matter.

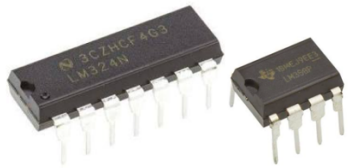
TL074 / TL072
DIP-14 and DIP-8 packages



Mouser #: 595-TL074CN / 511-TL072CN

An inexpensive dual supply op-amp with good all-round performance. TL074 has 4 channels; TL072 has 2. Used to amplify or attenuate signals, and buffer filter outputs.

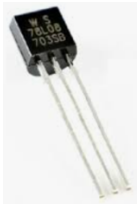
LM324 / LM358
DIP-14 and DIP-8 packages



Mouser #: 595-LM324N / 595-LM358P

A pair of inexpensive single-supply op-amps. LM324 has 4 channels; LM358 has 2. Can be paired with a 78L-series voltage regulator, to output gates, with minimal additional components.

78L08
8V 100mA voltage regulator



Mouser #: 595-UA78L08ACLPE3

Used to set the gate output voltage, when paired with LM324 or LM358 op-amps. In any module with a 78L08, a different gate voltage can be set by choosing another regulator in the 78L series, between 5V and 10V.

DIP-14 and DIP-8 IC sockets

Mouser #: 14-pin: 649-DILB14P-223TLF /
8-pin: 575-11041308410010

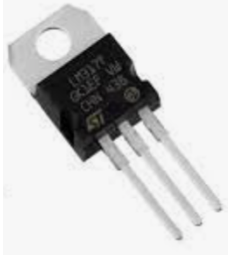
Solder IC sockets to the PCB. It makes fault finding much easier.

2x5 Pin Header
2.54mm pitch

Mouser #: 649-68602-110HLF

Used as the Eurorack power connector. Less bulky than a shrouded connector. +12V and -12V orientation is always printed on the PCB, with diodes as an additional protection against reverse power connection.

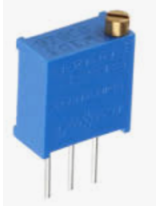
LM317 Adjustable Voltage Regulator
TO-220-3 package



Mouser #: 511-LM317BT

This regulator can be precisely adjusted to set the maximum range of a 1V/Oct output.

3296W Trimmer Potentiometer

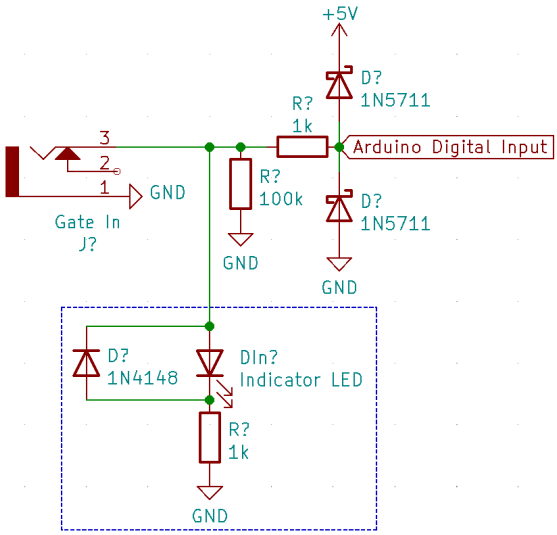


Can be adjusted with a small flat-head screwdriver, to precisely calibrate modules.

Electronic Building Blocks

Some useful sub-circuits for Arduino Eurorack modules

Digital (Gate / Trigger) Input



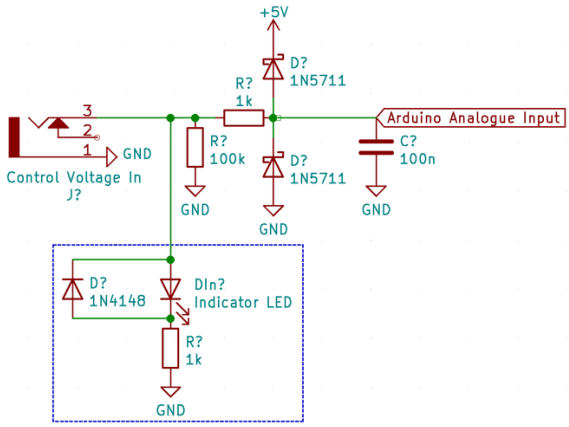
This sub-circuit will protect the Arduino from input voltages outside the safe range of about 0-5V, And 'normal' the digital input to ground so that it doesn't 'float' (alternate randomly between High and Low states) if nothing is plugged in to the jack.

The 1k resistor and the 1N5711 diodes perform the voltage 'clamping'.

The 100k resistor 'normals' the input to ground. It is placed before the 1k resistor; if it was placed afterwards this would create a voltage divider (the pin would read a lower voltage).

An indicator LED can be added as shown.

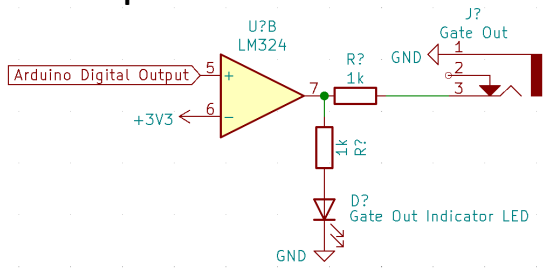
Analogue Input



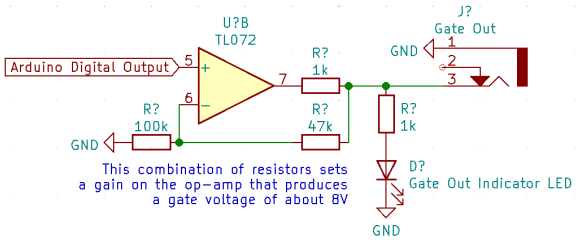
This sub-circuit is identical to the digital input circuit, except for the 100n capacitor connected directly to the Arduino pin.

Combined with the 1k resistor, the capacitor forms a low-pass filter on the pin. This helps to remove noise ('jitter') from the analogue reading. Some software filtering is usually needed, but a stable reading of at least 7 bit resolution (0-127) is easily achievable.

Gate Output

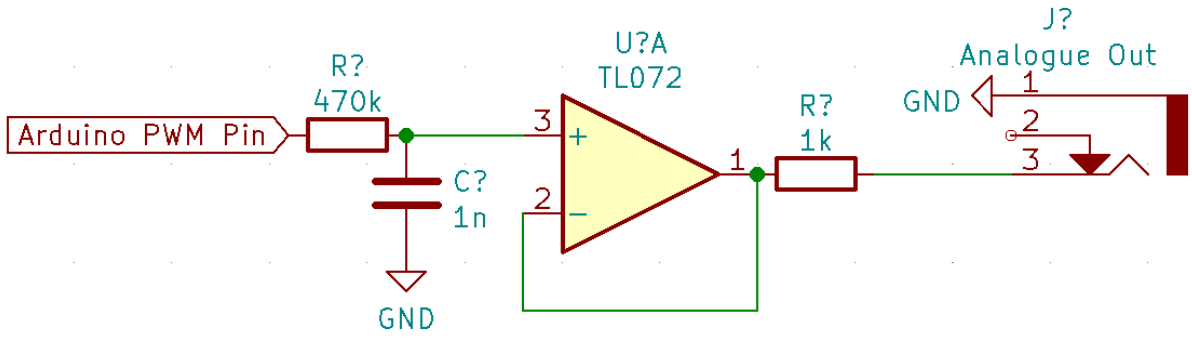


This sub-circuit uses the fewest components, if the module needs 2 or more buffered gate outputs. Use LM324 (4 gates) or LM358 (2 gates). The LM324 should be powered by a voltage regulator, which determines the gate voltage. +3V3 is supplied from the Arduino +3V3 pin.



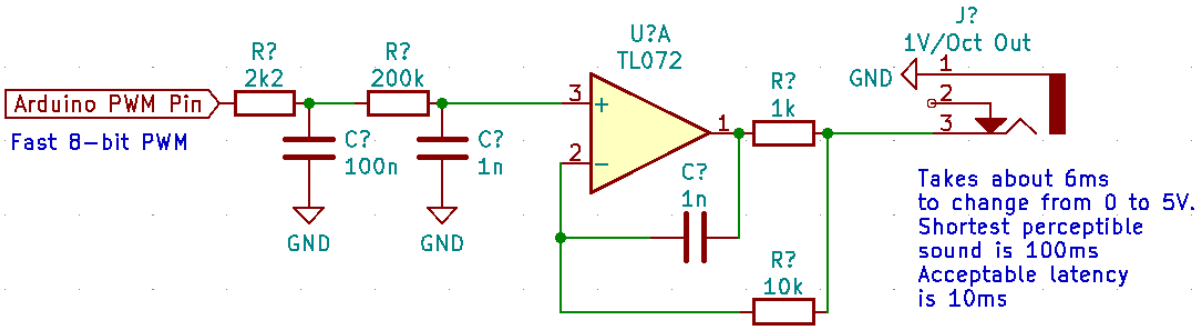
In a module with unused sections of TL072/TL074 chips, it can be more economical to use these as buffered gate outputs. Each gate needs 2 more resistors than in the LM324/LM358 circuit, to set a gain on the Arduino 5V output voltage.

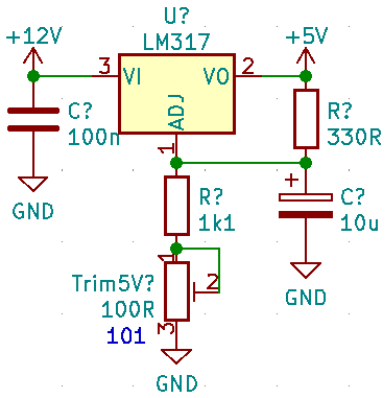
Basic Analogue Output



The simplest analogue output circuit consists of an Arduino PWM output pin connected to a single-pole low-pass filter (470k resistor and 1n capacitor), buffered by an op-amp. The response to changing voltages / PWM % (slew rate) will be slow and may have some ripple. For CVs running at below audio rate, this may be acceptable.

1V/Octave Analogue Output



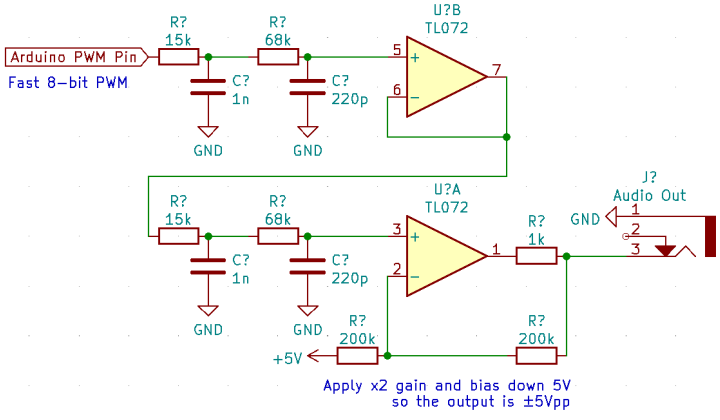


With additional filtering, Arduino PWM can output accurate 1V/Octave control voltage. The scale can be trimmed to 1V/Octave with an adjustable voltage regulator. The output of the regulator is connected to the Arduino 5V input pin. This needs to be trimmed to around 5.33V. The Arduino can tolerate roughly 6V without damage.

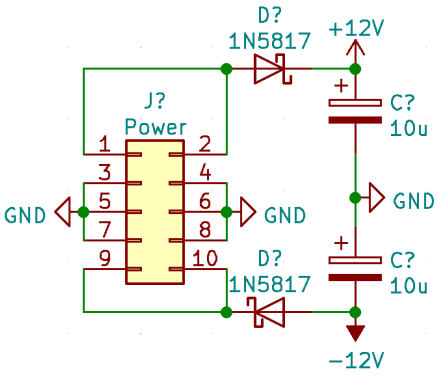
The circuit shown here can output 64 notes, up to 5.33V. Using a more complex filter, the Arduino can output 127 notes, as 0-10.66V or ±5.33V.

Audio Output

With a 4-pole low-pass filter and 2 TL07x op-amps for a faster response time, the Arduino can output a good quality 8-bit audio signal. Adding bias and gain resistors to the final op-amp stage converts the unipolar 0-5V signal into a bipolar ±5V signal.



Eurorack Power Connector



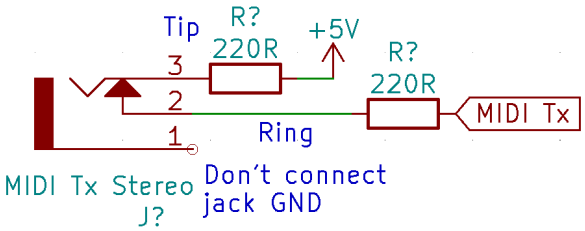
A 2x5 pin header connects to the Eurorack standard IDC-style 10 pin power plug.

The 1N5817 Schottky diodes protect the module from reverse power connection. Standard diodes would also work, but would cause a 0.7V voltage drop, reducing the voltage reaching the module to about ±11.3V. Schottky diodes have a lower voltage drop of about 0.4V.

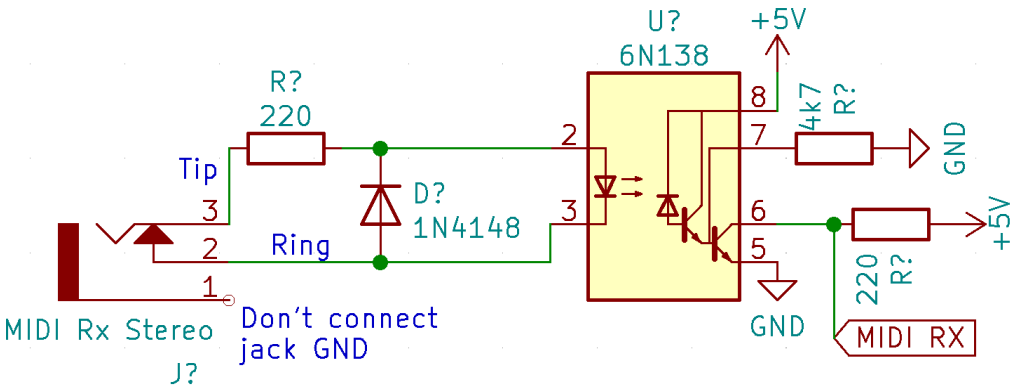
The diodes have a small resistance, so when combined with a large value capacitor (10uF) they form a simple low-pass filter which partially isolates the module from the Eurorack case power supply.

MIDI Output

A Thonkiconn 3.5mm stereo jack socket can be used as a TRS MIDI connector. A 3.5mm socket is easier to connect to a PCB than a DIN connector, and takes up less space on the module panel. A MIDI DIN to TRS cable can be used to connect the module to devices with DIN connectors, but between modules using 3.5mm sockets, standard stereo jack cables will work.



MIDI Input



This subcircuit isolates the Arduino from the MIDI signal using an optocoupler.