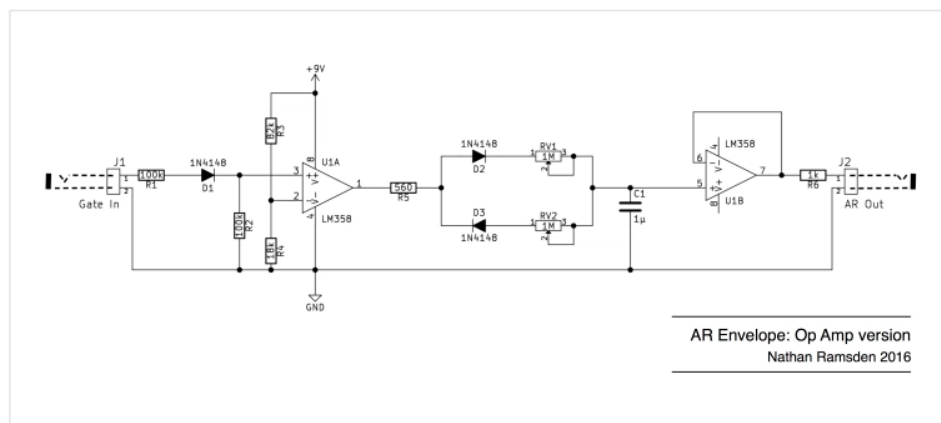


# ...Envelope Circuits: a simple AR design using op amps

A very simple Attack-Release envelope generator can be built with a dual op amp and just a handful of extra components. The input stage is basically the same as my op amp gate buffer (<https://synthnerd.wordpress.com/2016/03/17/synth-diy-gate-buffer/>), with only its output resistor changed; the rest is a simple low-pass resistor/capacitor setup with an output buffer. Here's how it works:

The input acts as a comparator (<http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/opampvar8.html>). When the gate input goes high, the comparator output goes high, and the capacitor is charged up via D2 and the Attack pot RV1; when the gate goes low, the comparator goes low, and the capacitor discharges through the Release pot RV2 and D3. The diodes directionalise this process, so the attack time is governed only by the Attack control, etc. The output is a very simple unity-gain follower.



(<https://synthnerd.files.wordpress.com/2016/04/op-amp-ar.jpg>)  
Operational Amplifier Attack-Release Envelope Schematic

With the values shown, attack and release times range from just a couple of milliseconds to around 5 seconds. Larger values for the pots and/or cap will extend the times proportionally, smaller ones reduce them. The 560 Ohm resistor sets the minimum time against a given capacitance.

With an op amp such as the LM358, the output will swing between 0V and approximately 1.5V below the positive rail. If a lower output level is desired, add a potential divider of resistors in the low-mid single Ks after the output buffer amplifier, taking the overall output from their junction.

Supply voltage is not critical, but as mentioned above, the LM358 op amp will swing to around 1.5V below supply at maximum. It does, however, swing to ground too, which when operated on a single supply is necessary in obtaining a correct 'gate low' output. If you cannot find a 358, use another op amp which will swing rail to rail, or ground to near-positive.

A circuit like this makes a nice addition to synths with only one envelope, such as the Moog Werkstatt (<http://www.moogmusic.com/products/semi-modular/werkstatt-01-moogfest-2014-kit>) and Mother 32 (<http://www.moogmusic.com/products/semi-modular/mother-32>), or Arturia Microbrute (<https://www.arturia.com/products/hardware-synths/microbrute/overview>). It will run from a 9V battery and is small enough to build into the Werkstatt itself, or indeed any small external box of your choice. You could easily build one for a Eurorack modular system too, and it will run happily on +12V or +15V.

For details of how to modify the Werkstatt, take a look at my Werkstatt page (<https://synthnerd.wordpress.com/moog-werkstatt-01/>).

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## Op Amp AR, parts list:

U1: LM358 or similar

D1-3: 1N4148 or equivalent

C1: 1 $\mu$  poly non-polarized

R1,2: 100k 1/4W resistor (I use 1% Metal Film types, but 5% Carbon are also fine)

R3: 82k —"—

R4: 18k —"—

R5: 560 $\Omega$  —"—

R6: 1k —"—

RV1,2: 1M linear pot

Input and output connectors as desired.