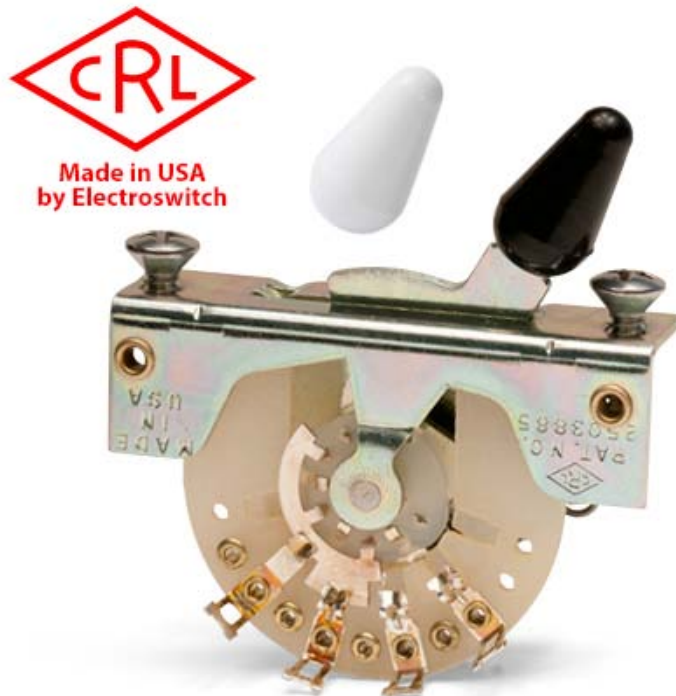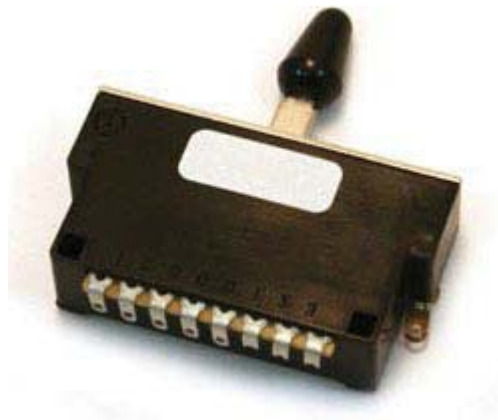## Pickup Selector - Documentation

The aforementioned patch is designed to simulate the sound of an electric guitar pickup selector switch, like those found on the Fender Stratocaster and it's numerous imported variations.
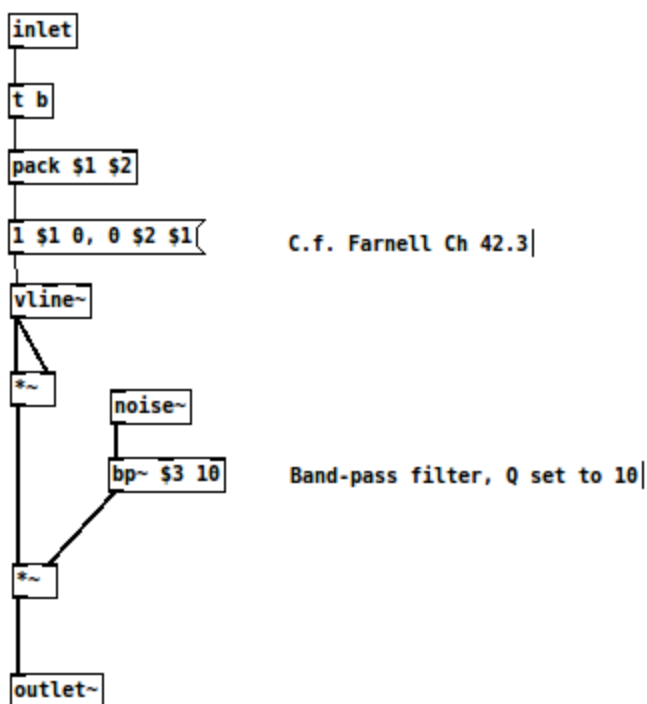
The particular brand/model is the CRL 5-way switch, which utilizes an "open" design, a non-PCB-based architecture which is preferred by top luthiers and 'tone purists.' Other switches may include "closed" models, that use a PCB surrounded by a plastic casing.
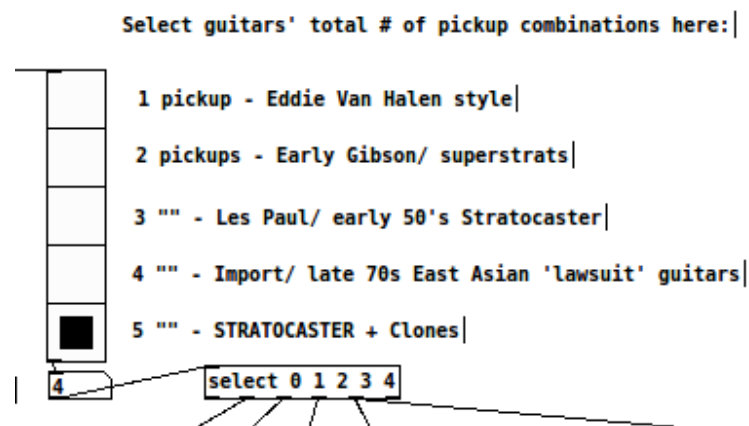
One argument in favor of the closed switch design is that a sealed enclosure protects the contacts from dust and corrosion; however the matter is that the electronics are housed in a cavity entirely covered by a pickguard, ultimately preventing this.

Regardless, the solid tactile feel of the "open" switch and the satisfying sound it makes when flipped is overwhelmingly preferred by players of all styles. Thus it will be the reference standard for this sound synthesis.

```
inlet

t b

pack $1 $2

1 $1 0, 0 $2 $1(        C.f. Farnell Ch 42.3

vline~

*~
      noise~

      bp~ $3 10         Band-pass filter, Q set to 10

*~

outlet~
```

switchclick.pd

The switch noises in the patch are made by using a filtered noise source that is shaped with a short, abrupt envelope. The abstraction switchclick.pd uses a bandpass filter with a "Q" of 10 to make the clicks. This differs from the example in Farnell fig 42.3, which uses a "Q" of 12, which provides a slightly narrower filter range. Thus the lower "Q" makes the band-pass filter a little less specific.

```
         Select guitars' total # of pickup combinations here:

            1 pickup - Eddie Van Halen style

            2 pickups - Early Gibson/ superstrats

            3 "" - Les Paul/ early 50's Stratocaster

            4 "" - Import/ late 70s East Asian 'lawsuit' guitars

            5 "" - STRATOCASTER + Clones

   4              select 0 1 2 3 4
```
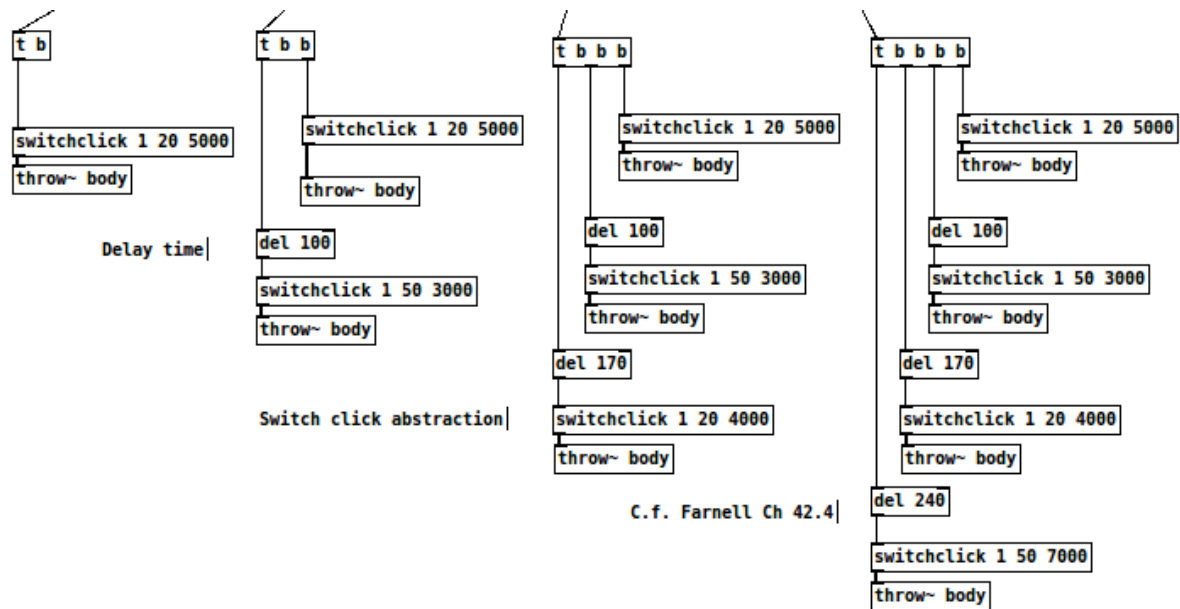
The only user-adjustable parameter is the vertical radio at the top of pickup_selector.pd, which selects the total number of possible pickup combinations the guitar has. It is very important that this be the total number of possible permutations, NOT the number of pickups on the guitar.
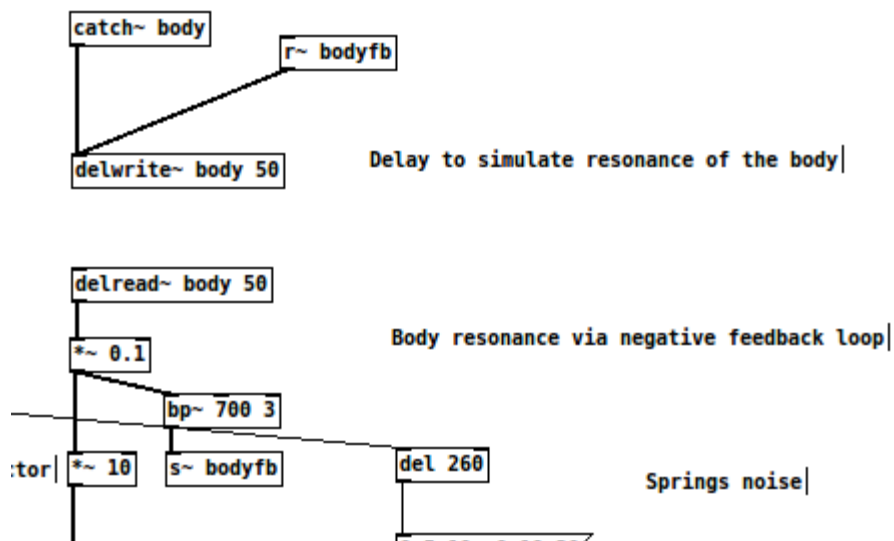
The number of clicks produced by each type of switch is (*n-1*), where *n* is the total number of pickup combinations. Thus a standard Strat with a 5-way switch will have FOUR clicks, and a Les Paul with a 3-way switch will have TWO clicks.

Ex. (Strat): Neck **-->** Neck/Mid **-->** Mid **-->** Mid/Bridge **-->** Bridge; four transitions.
Ex. (LP):　　Neck **-->** Neck/Bridge **-->** Bridge; two transitions.

```
t b                    t b b                  t b b b                 t b b b b

                       switchclick 1 20 5000  switchclick 1 20 5000   switchclick 1 20 5000
switchclick 1 20 5000                         throw~ body             throw~ body
throw~ body            throw~ body
                                              del 100                 del 100
          Delay time   del 100
                                              switchclick 1 50 3000   switchclick 1 50 3000
                       switchclick 1 50 3000  throw~ body             throw~ body
                       throw~ body
                                              del 170                 del 170

          Switch click abstraction           switchclick 1 20 4000   switchclick 1 20 4000
                                              throw~ body             throw~ body

                                              C.f. Farnell Ch 42.4    del 240

                                                                      switchclick 1 50 7000
                                                                      throw~ body
```
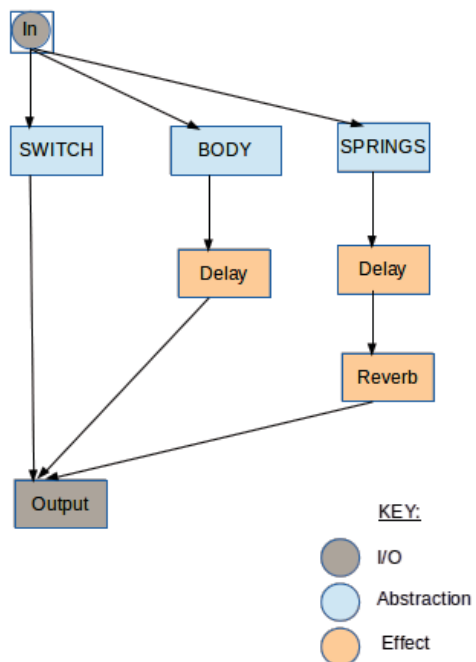
The delay between each of the individual clicks was set through trial-and-error. Although the switch may be flipped rapidly, the clicks are easily distinguishable from each other. Thus a delay of 100ms, then a delay for 70ms for each transition thereafter provides a decent approximation of the acceleration of the flip speed.
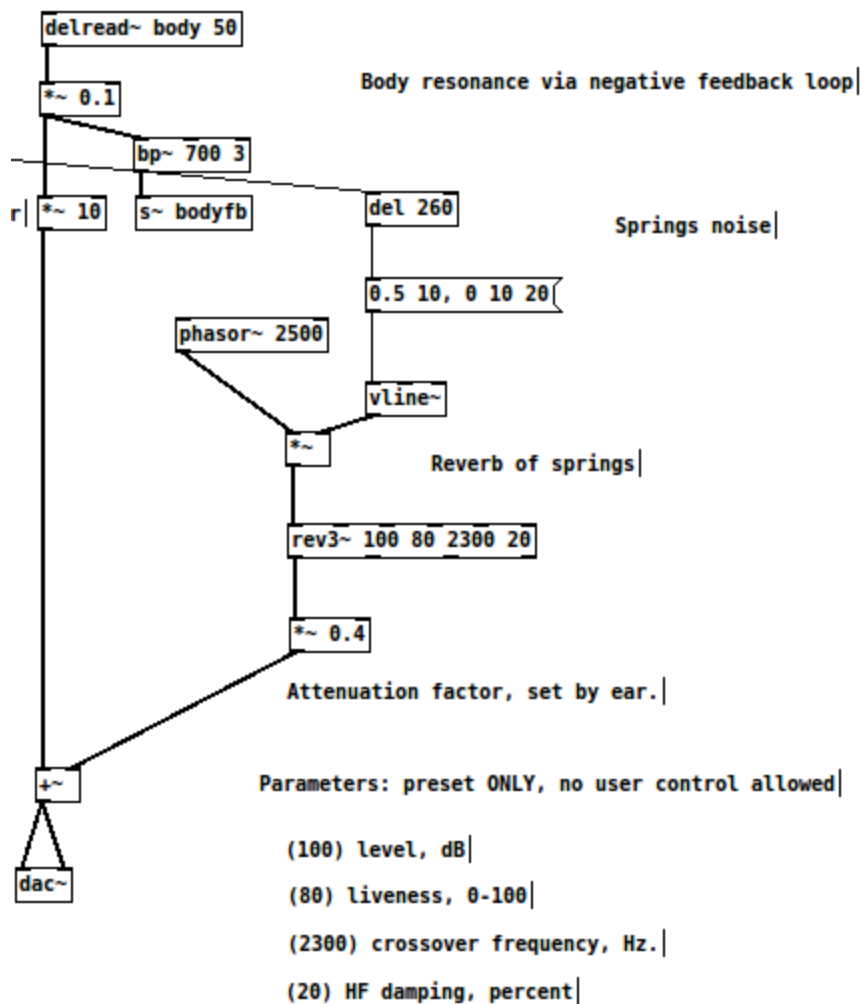
```
catch~ body
           r~ bodyfb



delwrite~ body 50        Delay to simulate resonance of the body|


delread~ body 50

  *~ 0.1                 Body resonance via negative feedback loop|

        bp~ 700 3
:tor| *~ 10  s~ bodyfb      del 260
                                       Springs noise|
```

Then the click sound is set to the "body", which is a 50ms delay combined with a feedback loop that simulates the wooden resonance of the body cavities in response to the energy radiated by the switch.

Then this combined with a short, high-pitched "pinging" noise, that simulates the sounds of the tremolo springs.

Refer to the block diagram from FP2 to visualize the general data-flow throughout the patch:

```
delread~ body 50

*~ 0.1

bp~ 700 3

r| *~ 10   s~ bodyfb   del 260

0.5 10, 0 10 20

phasor~ 2500

vline~

*~

rev3~ 100 80 2300 20

*~ 0.4

+~

dac~
```

Body resonance via negative feedback loop

Springs noise

Reverb of springs

Attenuation factor, set by ear.

Parameters: preset ONLY, no user control allowed

(100) level, dB

(80) liveness, 0-100

(2300) crossover frequency, Hz.

(20) HF damping, percent

The spring 'pinging' will ONLY occur on the 5 pickup setting. This was changed from the original design, which proposed the spring noise to occur on every setting. However, after more careful consideration, this design was chosen for realism purposes because very few guitars without a 5-way switch are equipped with a traditional tremolo system. Les Pauls certainly aren't known for having springs, neither are most non-strat imports, which often use hardtails to reduce cost.

The tremolo springs, which are almost analogous to springs in a reverb tank, will ring out after the switch has completed its range of movement.

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21M.380 Music and Technology: Sound Design
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