Creating a Single-Tone Chime Effect

Hopefully this should coherently describe the means for making a simple chime using a microprocessor. This was adapted from a 25-year-old Wurlitzer organ schematic (apparently circa pre-spell-check, the diagram consistently misspells “capacitor”). I tried to find the model that used this method to create a multi-timbral chime tone, but I guess those old books are long gone.

The waveform in from a tone signal source (such as an oscillator, or the oscillator output of a microprocessor) is a square wave that swings from zero to 5-8 volts. (The source does not need to be a square wave, but as you will see, by the time it is sent through the circuit it will be clipped anyway before the signal is re-shaped.) With the square wave above ground level, the signal is fed into the cathode end of a small-signal diode. When the diode is reverse biased (i.e., the anode is kept at ground or negative level), the square wave can not pass through the diode. But if the anode is brought above the level of the square wave, the diode is forward biased, allowing the square wave to come through riding on the DC keying voltage.

The shaping capacitor takes the harmonic edge off the square wave and creates a pleasing audio tone. The value of the capacitor depends upon the frequency of the square wave, but a single value can adequately filter a fairly wide range of frequencies.

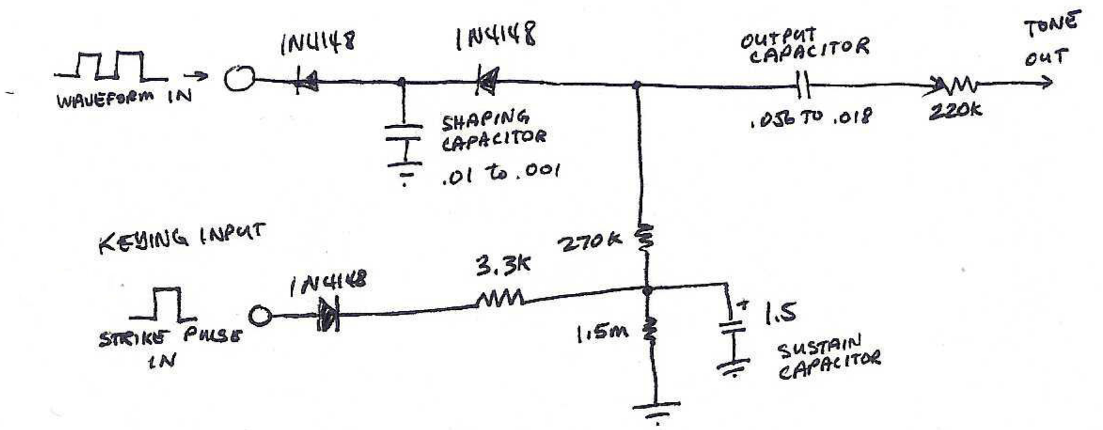
A positive-going pulse is introduced on the keying input. The amplitude of the keying pulse should be at or above the peak level of the square wave source. If the waveform source is 5 volts, a 5-volt keying pulse should work just fine. The keying pulse should be wide enough to adequately charge the sustain capacitor, but not so long that it will hold the tone on too long such that it will not sound natural.

With a positive voltage on the anodes of the diodes, the diodes are forward-biased and the tone is passed through riding on the DC level of the keying voltage. When the pulse is removed, the capacitor is discharged through the 1.5m resistor, and partially through the forward biased diodes. The diminishing voltage from the capacitor creates a decaying effect with the tone.

The output capacitor blocks the DC component of the keying voltage and passes the shaped signal through as audio. The 3.3k resistor and the 270k resistor, along with the sustain capacitor, create a ramping-up time constant in the keying signal that reduces the likelihood of an audible DC pop being carried through to the output when the strike pulse is introduced. By the time the signal passes through this circuit it will have been weakened somewhat, so it may need an op amp on the output.

I have used a variation of this circuit to turn on and off music or speech audio signals from an audio source without having to use an FET pair or an analog switch. It’s pretty effective, and very inexpensive. With complex audio, though, you can’t properly vary the amplitude in the same manner as the decay is done with the tone; the result would be a distorted audio signal. When the signal is decayed, it is clipped at the level of the DC voltage from the discharging capacitor. The only reason this is effective with the tone is that the source is a square wave anyway, so clipping is not noticed. With complex audio, the clipping would not be avoidable.

And now, with appropriately enthusiastic fanfare, we present a sketch of the circuit. Please note the artistic calligraphy.



A couple of afterthoughts: If some of the waveform bleeds through during a non-keyed period, it may help to slightly raise the baseline of the oscillator signal above ground level. This can be done either by running it through an op amp ahead of the keying diodes with a slight offset voltage on the + input, or by creating a resistor network with a voltage divider and ballast resistor ahead of the keying diodes, pulling up the baseline.

Also, you might try experimenting with the circuit without the second keying diode. That one may not be necessary. I have seen other circuits with only one keying diode.

This method of using small-signal diodes to key oscillator frequencies was used extensively in electronic organs throughout the 70's and 80's… maybe even longer. Some of the larger church organs of that period, such as the Rodgers and the Allen organs, contain literally tens of thousands of diodes just for that purpose. With that much to work with, it's a heckuva job to track down the one diode that is leaking and causing a tone to bleed through.

I hope this makes sense. I am sure there are plenty who see this who can improve on it. I'll be happy to try to answer any questions.