Tone Generator with Envelope

A great many circuit designs include a piezo buzzer as a way of attracting attention, typically the warning siren on cars to indicate you have left the lights on, or exit delays on burglar alarms. On a recent project I required an intermittent tone, the circuit generally used for such applications is a tone generator which is switched by an ANDing function to gate the tone on and off. Using digital gates this gives a waveform as shown in fig(1). This gives a harsh and undesirable output. "How much nicer it would be," I thought, "if the tone actually had an envelope.", (as in fig(2)). The reason that the former is used is generally because it makes life easier for the digital boys in the profession. The design I came-up with for my alternative solution is not over complicated and has a low component count.

The design relies on a long-tailed pair differential amplifier to produce the envelope. A feature of the differential pair is that the gain can be varied by changing the size of the current drawn by current source I_{TAIL}. I_{TAIL} is generally provided by the circuit of fig(4), which provides a constant collector current for a wide swing in the collector-emitter potential difference. By driving V_{diffin} with the required tone therefore and V_{BIAS} with a voltage $V_{envelope}$ (see fig(5)), the output produced is suitably similar to that of fig(2). So where do these inputs come from? The completed circuit is shown in fig(6), using a transistor astable and an easy RC network to produce the additional inputs. Initially it may appear that the component count has become a little excessive, with 5 transistors and R's and C's everywhere, but you will be happy to hear that the transistors are all provided in a neat plastic DIL package and hence don't take up too much room and will fit in nicely with that *Black all over* board design you have always strived for.

Explaining one or two of the components:

R_{BUF1} and R_{BUF2} buffer the oscillator capacitors from the load presented by the input transistors of the differential pair. This load impedance actually changes with the gain of the differential pair and hence, if the resistors are not present, the output frequency goes up as the volume increases, (not a bad effect actually). R_{ATTACK} controls the increase rate of the volume, R_{DECAY} the rate at which it dies away. Removing C_{ENV} will revert the output to the waveform in fig(1), an option I lovingly call *Japanese Mode*. AS you can see by providing variable R's, C's or link-outs for the components mentioned in this paragraph the envelope can be programmed.

For experimenting with the above circuit I used the familiar astable of fig(7) to drive the TONE input.

Richard B Sagar

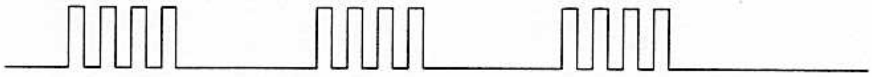

Figure (1) - Waveform generally used for driving piezo

Figure (2) - More desirable waveshape

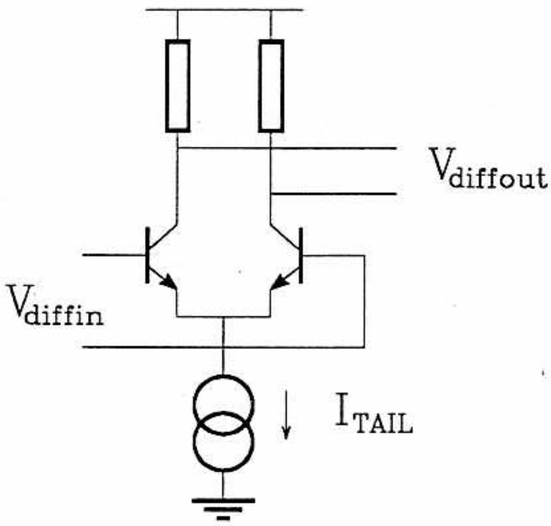

Figure (3) - Basic long-tailed differential amplifier

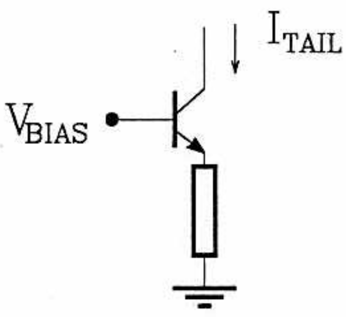

Figure (4) - Current sink circuit for generating I_{TAIL}

Figure (5) - Voltage to generate volume envelope

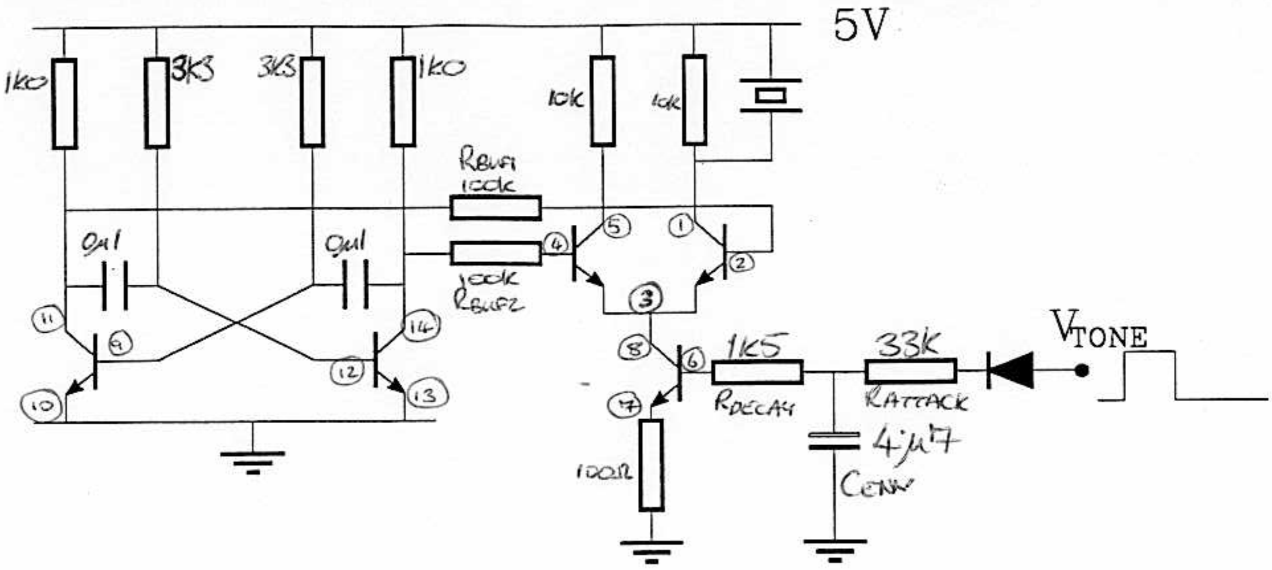

Figure (6) - Complete circuit diagram of tone generator

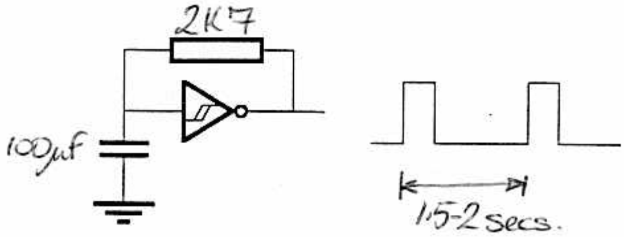

Figure (7) - Simple Astable using Schmitt gate