Variable speed discrete reversing LED chaser

I was inspired to design this circuit by the "LED Headband" project which appeared in *Electronics Australia*, January 1983. This was a simple four-stage LED chaser driving 12 LEDs in three groups. The LEDs were arranged around a headband to produce the effect of lights rotating around the wearer's head.

I thought the effect could be taken a few steps further, by varying the speed at which the LEDs chase – starting from stationary and speeding up to peak speed then slowing back to a stop. I also wanted to make the LEDs reverse after stopping, and chase back the other way. The circuit shown here is the result of my endeavours.

The circuitry around CD4069 hex inverter IC1 is adapted from the Technilab 301 Function Generator described in the March 1988 issue of SILICON CHIP. IC1b and IC1c are arranged as a Schmitt trigger with the output feeding IC1a, configured to operate in linear mode as an inverting integrator.

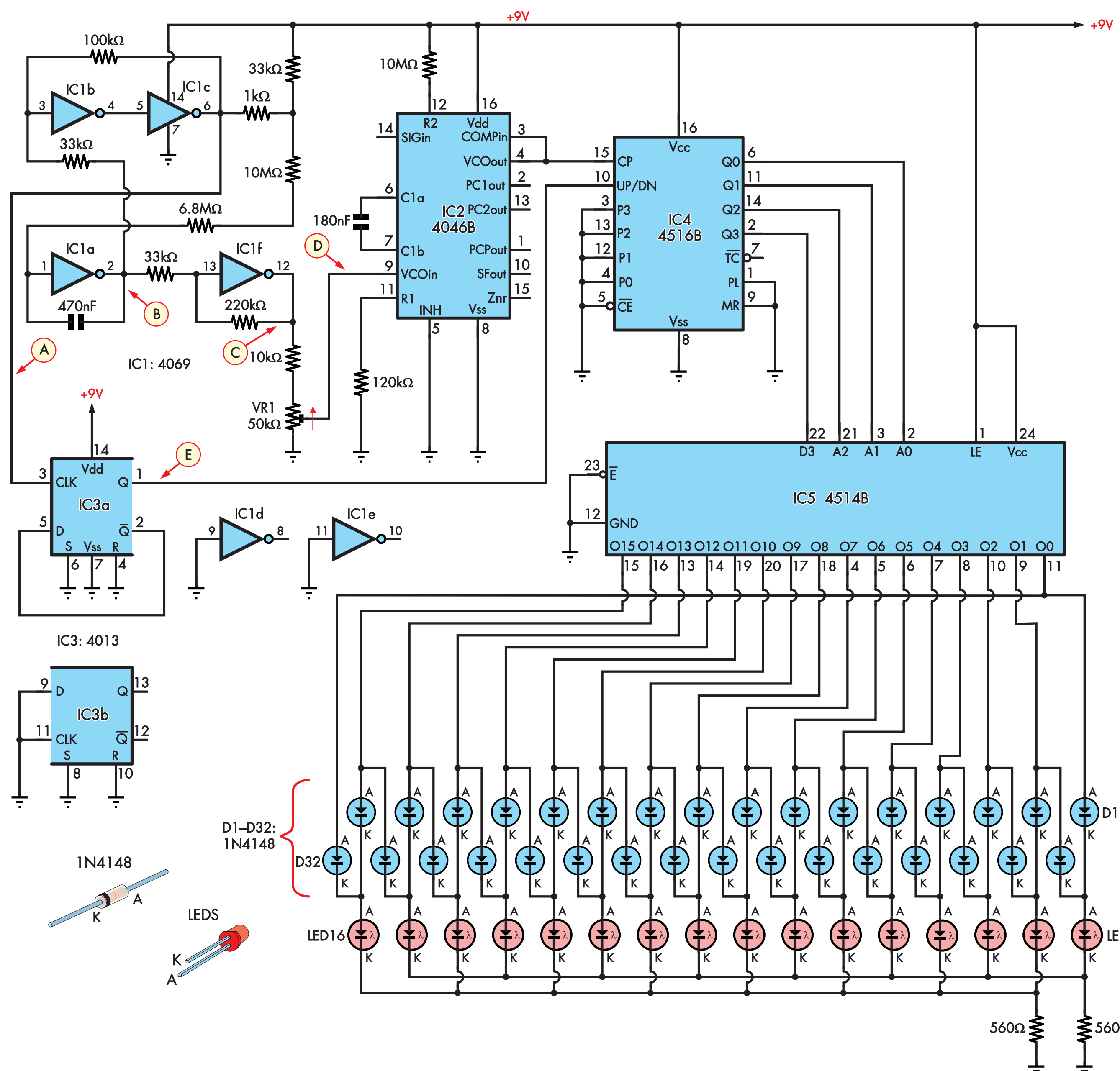
The integrator output ramps up if the Schmitt trigger output is low, and ramps down if it is high. The ramp output is fed back to the input of the Schmitt trigger, to toggle it when its switching threshold is reached.

The result is that IC1a, IC1b and IC1c together form an oscillator with a frequency set by the values of resistance and capacitance around the integrator, with a square wave output at the pin 6 output of IC1c (waveform "A") and a triangle wave output at output pin 2 of IC1a (waveform "B").

With the R and C values shown (10MΩ, 6.8MΩ and 470nF), its oscillation frequency is approximately 0.5Hz.

The triangle wave is then processed by IC1f, operating in linear mode as a soft limiter, to produce an approximate sinewave at its pin 12 output (waveform "C").

IC2 is a CD4046 phase-locked loop (PLL) IC, but here only the voltage-controlled oscillator (VCO) part is used. The frequency of the VCO is set by the 120kΩ resistor from pin 11 to ground,



the 180nF capacitor between pins 6 and 7 and by the control voltage fed to it at pin 9, ie, the ~0.5Hz sinewave.

VR1 sets the level of the sinewave applied to the VCO (waveform "D") and hence the peak frequency of the VCO. So, the VCO frequency will vary from 0Hz up to a maximum at the upper peak of the sinewave, then die back to zero over about two seconds.

IC3a is a CD4013 D-type flip-flop which simply divides the square wave output frequency from the oscillator by two (waveform "E"), to control the direction of counting in IC4 (a CD4516 binary up/down counter). Its preset count function is not used in this application.

It counts the varying frequency pulse train output of VCOout, and delivers the count at its four binary outputs Q0-Q3. Whether it counts up or down is determined by the control applied to its pin 10, which comes from IC3a. If the control applied to pin 10 is high, it counts up; if low, it counts down.

IC4 therefore counts up for one IC1 oscillator period, then down for the next, repeating forever.

IC5 (CD4514) is a 4-to-16 decoder with active low outputs. It decodes the Q0-Q3 binary outputs from IC4, taking the appropriate output high, thus turning on the corresponding LED(s). The overall effect then is that the LEDs at the IC5 outputs are turned on sequentially in one direction at increasing then decreasing speed, then repeating in the opposite direction.

Diodes D1 to D32 enhance the effect of "rolling" rather than "stepping" chase motion by OR-ing adjacent IC5 outputs so that not only is the primary selected LED on, but also is its immediate predecessor.

Bob Martindale,
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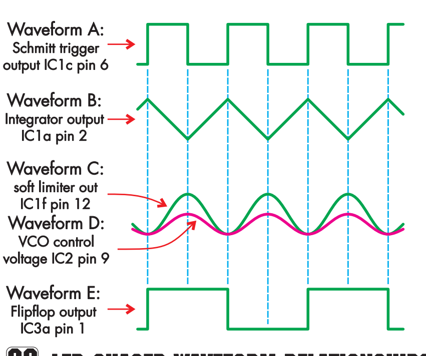

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