Electric Druid ADSR Envelope Generator

Introduction

This voltage-controlled ADSR envelope generator chip is a completely modern, microprocessor-based design that emulates the analogue ADSR chips of the late 70's and 80's.

The two key chips that were used as a model are the CEM3312 Voltage Controlled Envelope Generator and the SSM2056 Voltage Controlled Envelope Generator. The first of these was used in the Sequential Pro-One (and probably many other Sequential synths) and the SSM was used in the Korg Polysix, amongst others. In many ways these are extremely similar ICs. Both chips include control voltages for A, D, S and R.

The CEM3312 includes a CV pin for the final envelope output level. This is intended to provide a voltage-controlled envelope depth to a VCF in programmable systems. As such, this is a very useful feature, and saves a VCA doing the job, as they point out in the datasheet.

The SSM2056 includes a pin for the keyboard CV. An increasing voltage on this pin reduces the attack, decay, and release times overall. This allows you to set up shorter envelopes at the high end of the keyboard than the low end, mimicking the effect of many natural percussion instruments.

This VCADSR chip includes both these inputs, with the added bonus that the TIME_CV input is bipolar, allowing the overall envelope time to be either lengthened or shortened. It also includes a digital input to select between the 'traditional' exponential envelope shape and a linear envelope, typical of early-era digital synths.

The output from the chip is a PWM pulse train which only requires simple lowpass filtering to produce a genuine ADSR envelope shape.

The chip currently has no separate TRIGGER input, which means that the GATE must drop low momentarily in order to retrigger the envelope. In practice, this is not as much of a limitation as it sounds, since the GATE only need remain low for a few microseconds, a completely imperceptible amount of time. It is possible that at some point in the future I might replace the GATE OUTPUT with a TRIGGER input.

Features

Shortest attack time of around 1 mSec.

The Minimoog, Sequential Pro-One and SH101 all have a famously quick attack time. I've never measured it, but it's supposed to be around 1 mSec. This envelope generator can also produce times that short.

Longest attack time of around 10 Sec.

Most analogue synths can do a slow attack of a handful of seconds, but 10 seconds gives a neat range of 1:10000 to be covered by the control voltages, and allows really slowly evolving sounds to be generated.

8-bit resolution on the control voltages

The Sequential Prophet 5 used a 7-bit control resolution, so this is going slightly better. Whether a standard potentiometer actually has the accuracy to directly produce an 8 bit resolution is another question.

10 bit envelope output resolution

The internal envelope mapping and calculation is 8-bit, but the final LEVEL_CV multiplication provides a 16-bit output, of which 10 bits are fed to the PWM module.

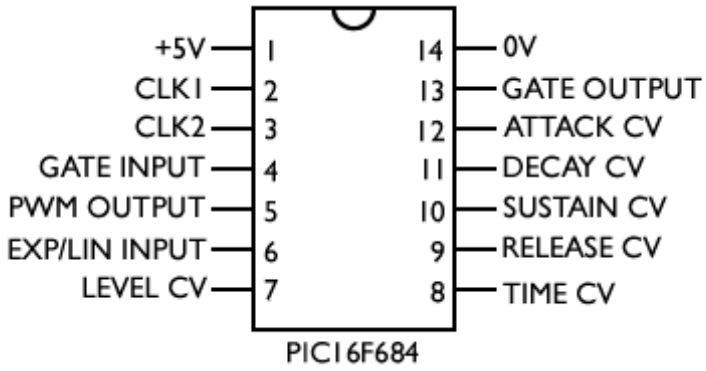
19.5KHz sample output rate

The PWM frequency is around 19.5KHz. This allows the PWM output to be heavily filtered for a smooth analogue output whilst maintaining the snappy response.

Logarithmic time control response over 1:10,000 range

The A, D and R control voltage inputs give the full range from 1 mSec to 10 Secs in four even decades, eg 1-10mSecs, 10-100mSecs, 100-1000mSecs, and 1-10Secs.

Pinout Diagram



Pin	Function	Details	Notes
1	+5V	Power supply	
2	CLK1	Connect to Xtal	20Mhz Clock
3	CLK2	Connect to Xtal	20Mhz Clock
4	GATE INPUT	0-5V digital input	Envelope triggers on rising edge of 0-5V pulse.
5	PWM OUTPUT	0-5V digital output	PWM output at 19.5KHz
6	EXP/LIN INPUT	0-5V digital input	0V - Exponential envelope 5V - Linear envelope
7	LEVEL CV	0-5V analogue input	8 bit, values from 0 to 255
8	TIME CV	0-5V analogue input	Bipolar input. This input regards the 2.5V level as zero. 8-bit, values from -127 to 128
9	RELEASE CV	0-5V analogue input	8 bit, values from 0 to 255
10	SUSTAIN CV	0-5V analogue input	8 bit, values from 0 to 255
11	DECAY CV	0-5V analogue input	8 bit, values from 0 to 255
12	ATTACK CV	0-5V analogue input	8 bit, values from 0 to 255
13	GATE OUTPUT	0-5V digital output	
14	0V	Power supply	

Example Application