Component Profile: SSM 2033 and SSM 2044

By: Tom Heifrich

Introduction
While several manufacturers make IC's suitable for electronic music, there are only two companies specializing in the field, Solid State Music and Curtis Electromusic Specialties. This article will examine two relatively new chips from SSM, the SSM2044 dedicated low pass filter and SSM2O33 temperature compensated VCO.

The SSM2033.
The SSM2O33 is a sawtooth-based oscillator with hard and soft sync capabilities, triangle converter, pulse width comparator, and full linear/exponential converter. Requiring only passive components, all inputs accept industry standard voltages and present standard impedance levels. Outputs are short circuit protected.

All active components for the linear/exponential controls are located on chip. Discrete components may offer improved accuracy, but the 0.05% typical, 0.2% maximum exponential error is more than adequate for reliable polyphonic performance. A solid-state heater/sensor combination for temperature compensation keeps drift to a maximum of **+** 100 ppm/ºC.

Referring to fig. 1, resistor ratios (R2 **+** T1)/R3 and R22/(R23 **+** R24) establish one Volt per octave tuning. The ratio of R23/R24 sets high frequency tracking, where R23 **+** R24 must equal 1k. Thus, a 1k trimpot, T3, may substitute for R23 **+** R24. If frequencies above 5 kHz are not needed (which is often the case), you may replace R24 with a jumper and make R23 equal to 1k. The remaining trimpot, T2, trims out frequency offsets of multiple oscillators when using several SSM2033's in polyphonic applications.

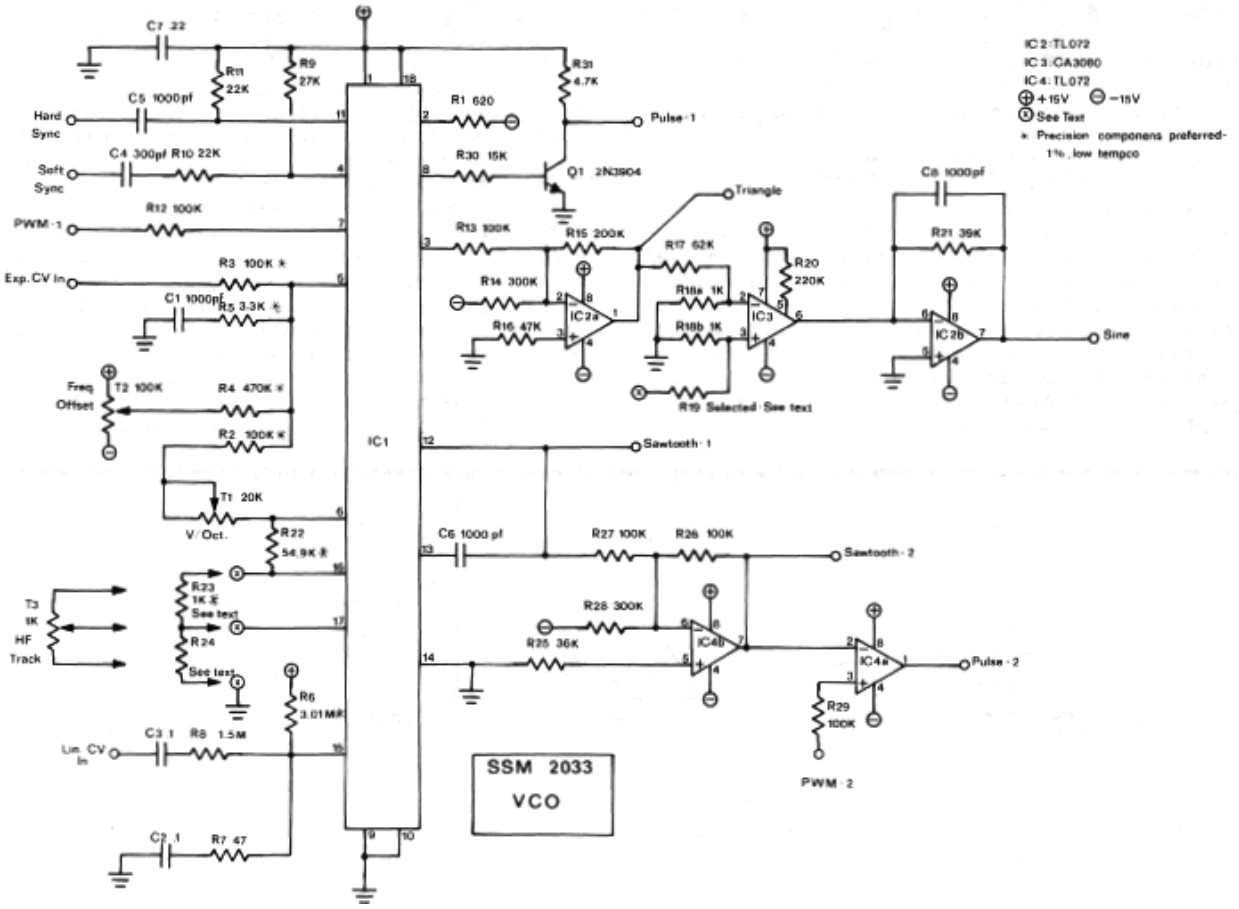
Since the SSM2033 derives its negative voltage from an on chip Zener regulating diode, its outputs are clamped to about zero Volts on negative transitions. External circuitry has been provided to level shift and amplify these signals to + 5V standards. Thus, IC2a outputs a + 5V triangle.

IC3 smoothes this triangle into a sine wave, buffered by IC2b. To optimise sine wave characteristics, observe the sine symmetry at IC2b's output while testing the assembled module. If the positive peak is more rounded, connect R19 to -15V; if the negative peak is more rounded, connect R19 to +15V. Use a potentiometer to determine the optimum value for R19. After establishing correct symmetry, adjust for lowest distortion by selecting R1 in the range of 50k to 100k.

Sawtooth-1 is a 0 to 10V output; IC4b converts this to a + 5V standard. IC4a's output is a +12.5V pulse whose width may be varied from 0% to 100% by voltages applied to R29 (PWM-2).

The SSM2033's main pulse output has been purposely inverted by Q1 for the following reasons. Note that the hard and soft sync inputs trigger on falling edges. The falling pulse edge observed at pin 8 is fixed to the discharge of the sawtooth, while the leading pulse edge varies with the PWM-1 control. If the pulse is inverted and applied to the sync input of another VCO, then the oscillators will be frequency locked at a phase angle determined by the PWM-1 control voltage. Thus, PWM-1 may be considered to be a voltage controlled phase shifter in a multi-oscillator voice. This might also be useful in an LFO system employed in location modulators.

Figure 1



The SSM2044

Unlike the SSM2040 and CEM3320 (filter IC's which allow a variety of complex responses), the 2044 is a dedicated 24-dB/octave low pass filter. Its accuracy, low parts count, and ease of application should attract many musicians interested in developing their own performance systems. Filter input signals are accepted and processed differentially, canceling some offset and linearity errors. The on-chip resonance circuitry also uses differential techniques. Output signals are quiet, "pop free", and stable within the audio spectrum. Applications include electronic music low pass filters, tracking filters for analog delay lines, stable sine wave generation, and the like.

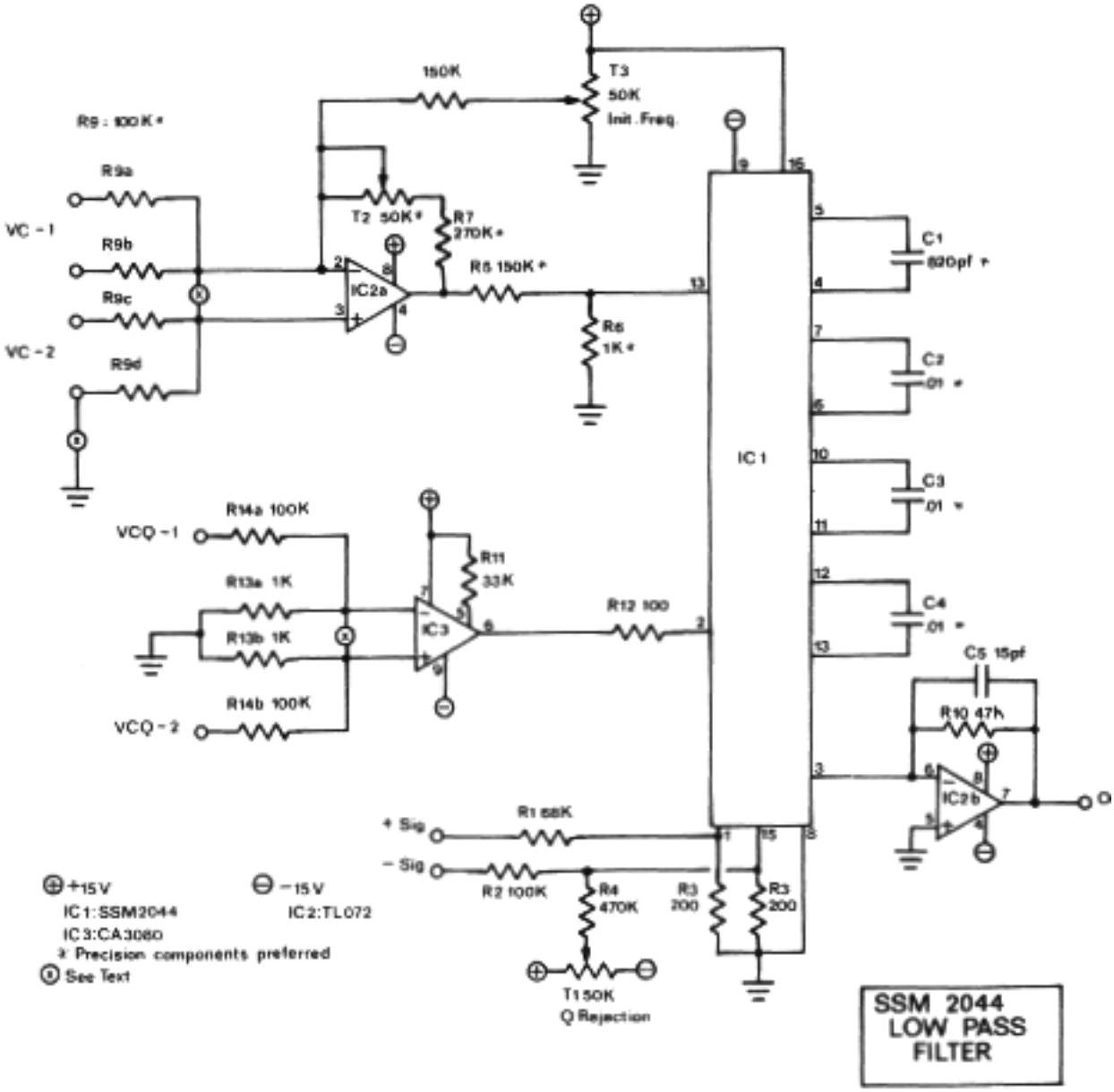
Referring to fig. 2, scaling resistors R1/R3a and R2/R3b allow the differential signal inputs to accept input levels up to the power supply limits. If using two oscillators in a voice, the output of one voice should go to one input, and the output of the second voice should go to the opposite input with a 3 dB level difference (values shown assume this type of application). Filter tuning capacitors C1 - C4 should be 1% tolerance, low temperature coefficient parts for best results and precise response. IC2b along with R10 and C5 convert the output current to a voltage.

On the evaluation boards manufactured by Global, op amp IC2a provides for differential summing. There are provisions for up to eight CV input resistors, which terminate in one PC board trace that bridges pins 2 and 3 of IC2. This trace may be broken anywhere along its length to split the eight resistors between the inverting and non-inverting inputs of IC2a. The circled x between IC2a pins 2 and 3 represents where you would break the trace.

To configure this stage so that a positive voltage increases the resonant frequency of the filter, feed the control voltage into VC-1 and ground R9c or R9d. Since pin 2 of IC2a is a summing junction, adding more 100k resistors to this point allows multiple control voltage mixing. For a response where negative control voltages decrease the resonant frequency of the filter, feed the control voltage into VC-2. This stage can also accommodate both positive and negative going control voltages by feeding them into VC-1 and VC-2 respectively.

Scaling resistors R9/(R7 + T2) and R5/R6 give a 1V/octave response, where R6 may be selected for a +3600 ppm/OC response if extreme temperature stability is required. Since the on-chip resonance control has a reverse audio response, a CA3080 was selected to sum the resonance control voltages and approximate the proper taper for electronic music applications. Maximum attainable resonance is set by R11 and breakpoint for the non-linear function is set by R14/R13. Note also that IC3 is set up in a manner similar to IC2a, and can accept both positive and negative going control voltages; again, the input resistors connect to one trace which may be broken to assign different resistors to IC3's two inputs. Optional "Q rejection" and initial frequency trims are available as Ti and T3 respectively.

Figure 2


150K
T3
50K
Init. Freq.
R9 : 100K *
R9a
R9b
R9c
R9d
VC - 1
VC - 2
T2 50K *
R7
270K *
R5 150K *
IC2a
R6
1K *
IC 1
C1
820pf *
C2
.01 *
C3
.01 *
C4
.01 *
C5 15pf
R14a 100K
VCO - 1
R13a 1K
R13b 1K
R14b 100K
VCO - 2
R11
33K
IC3
R12 100
R10 47h
IC2b
+ Sig
- Sig
R1 68K
R2 100K
R4
470K
R3
200
R3
200
T1 50K
Q Rejection
+15V
-15V
IC1: SSM2044
IC2: TL072
IC3: CA3080
* Precision components preferred
See Text
SSM 2044
LOW PASS
FILTER

Parts List SSM2033 Oscillator

R1	620 Ohms
R2, R3	100k*
R4	470k*
R5	3.3k*
R6	3.01M*
R7	47 Ohms
R8	1.5M
R9	27k
R10, R11	22k
R12, R13, R26, R27, R29	100k
R14, R28	300k
R15	200k
R16	47k
R17	62k
R18a, b	1k
R19	see text
R20	220k
R21	39k
R22	54.9k*
R23	1k; see text
R24	see text
R25	36k
R30	15k
R31	4.7k
C1, C5, C6	1000 pF
C2, C3	0.1 uF
C4	300 pF
C7	0.22 uF
T1	20k trimpot
T2	100k trimpot
T3	1k trimpot
IC1	SSM2033
IC2, IC4	TL072
IC3	CA3080
Q1	2N3904

Parts List SSM2044 Low Pass Filter

R1	68k
R2, R14	100k
R3a, b	200 Ohms
R4	470k
R5	150k*
R6	1k*
R7	270k*
R8	150k*
R9	100k*
R10	47k
R11	56k
R12	22k
R13	1k
C1	820 pF*
C2 - C4	0.01 uF*
C5	15pF
T1	50k trimpot
T2	50k trimpot*
T3	50k trimpot
IC1	SSM2044
IC2	TL072
IC3	CA3080

*1%, low tempco for best stability