

VOLTAGE CONTROLLED FILTER CIRCUIT

DESCRIPTION

The SSM 2040* is a four section filter whose cutoff frequency can be exponentially voltage controlled over a 10,000 to 1 range. This flexible building block can be used in virtually any active filter design including lowpass, highpass, bandpass and notch. Roll-off characteristics can be selected to be Butterworth, Bessel, Chebyshev, Cauer or any other filter type.

Applications include tracking filters, organs, music synthesizers, music phase shifters and sound effects generation.

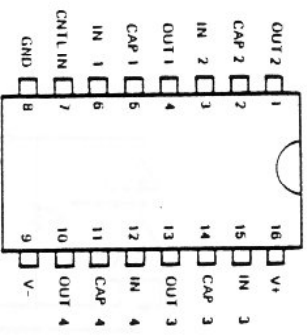
FEATURES

- +/- 15V Supplies
- Exponential Frequency Control Response
- 4 Filter Sections in One Package
- Low Noise
- Low Distortion
- Guaranteed Control Rejection Characteristics
- 10,000:1 Sweep Range

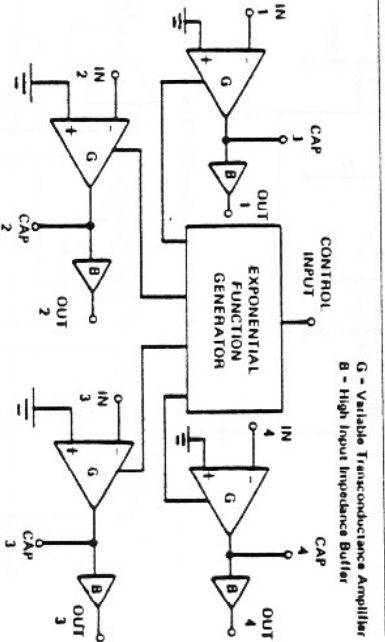
*Covered by U.S. Patent Number 3,969,882.

APPLICATIONS

- Voltage Controlled Filters:
 - Lowpass
 - Bandpass
 - Highpass
 - Allpass
 - Notch
- Parametric Equalizers
- Music Synthesizers
- Music Phase Shifters
- Tracking Filters
- Low Distortion Sine VCO's



Pin Diagram



Block Diagram

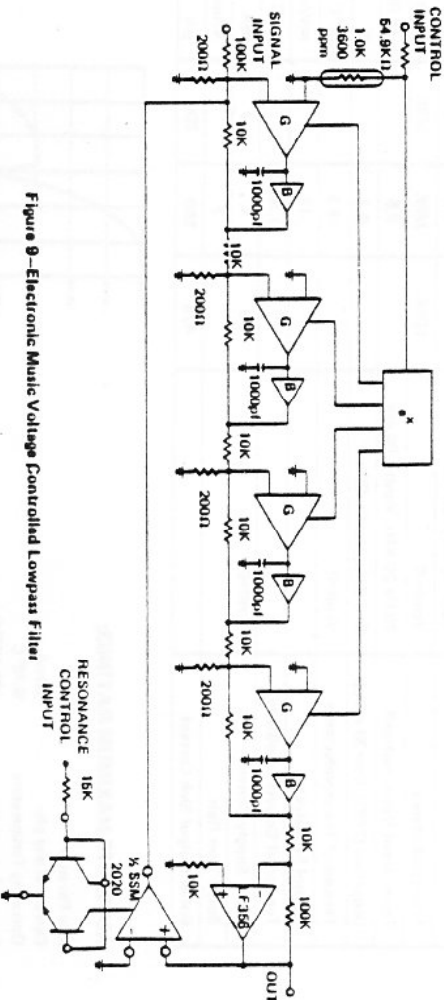
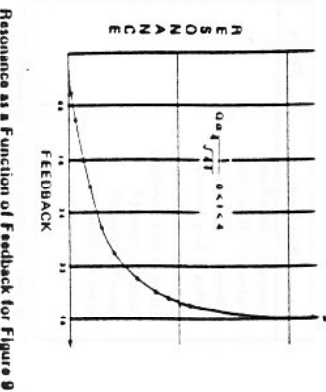
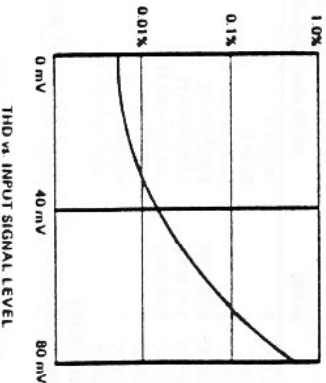


Figure 9—Electronic Music Voltage Controlled Lowpass Filter

Figure 9 is a voltage controlled lowpass filter with voltage controlled resonance for electronic music applications. The frequency control input sensitivity is 1 volt/octave, temperature compensated. At high resonance settings the filter will oscillate with a pure sine wave. The output signal level is 10V p/p max.



DESIGN HINTS:

1. The output pins (OUT 1-OUT 4) are only capable of swinging +/- 1V, and sinking 500 μ A DC. Hence a 10K feedback resistor & load will give good performance.
2. Control input sensitivity tempo is best cancelled by a +3300 ppm resistor (Tel Labs 081 or equiv) as shown in Figure 9.
3. C values should be kept above 1000 pF to insure stability at all control settings.
4. The 200 ohm attenuating resistor is chosen for optimal control rejection. Other values can be used with some degradation of this parameter.
5. The outputs are not short circuit protected. Care should be taken to avoid shorting any OUT, CAP or IN pin to either supply.

SPECIFICATIONS:
 $V_S = \pm 15V, T_A = 25^\circ C$

SPECIFICATION	CONDITIONS	MIN	TYP	MAX	UNIT
Functional Range		10,000:1			
Input Offset, each cell			2	5	mV
Δ Input Offset, 4 cells in series			0.6	3	mV
			0.6	3	mV
Transconductance			1/10K	1/5K	mhos
Equip. Input Noise, each cell			20 Hz 20 KHz, $V_{ent} = -90$ mV		μV RMS
Distortion (THD), $E_{in} = 30$ mVpp			F = 1 KHz, $V_{ent} = -90$ mV		%
Tempco of Transconductance			$V_{ent} = 0$		%/°C
Control Sensitivity					mV/oct
Tempco of Control Sensitivity					%/°C
Power Supply Current			2	4	mA
Buffer Slew Rate				2	V/ μ sec
Buffer Output Sink Current			425	560	μA

ABSOLUTE MAXIMUM RATINGS:

Any Pin to V- 30V
 Current at any pin 20mA
 Operating Temperature 0-70° C
 Storage Temperature -55-125° C
 Power Dissipation 625 mW

APPLICATIONS FIGURES:

Filter Type	Figure	Gain (K)	ω_0	d-1/Q	XFER char. ($S = j\omega/\omega_0$)
Lowpass - Real Pole	1	$-R_2/R_1$	$2000G/R_2C$	2	$-K/(S+1)$
Highpass - Real Pole	2	1	$2000G/RC$	2	$S/(S+1)$
Allpass	3	1	$2000G/RC$	2	$(S-1)/(S+1)$
Sallen & Key Lowpass	4	R_2/R_1	$2000G/R_2C$	2 (R4/R3)	$K/(S^2+dS+1)$
Sallen & Key Highpass	5	R_2/R_1	$2000G/R_1C$	2 (R3/R2)	$S^2/(S^2+dS+1)$
State Variable LP	6	$-R_2/R_1$	$2000G/R_2C$	2 (R2/R3)	$-KS/(S^2+dS+1)$
State Variable BP	7	$-R_2/R_1$	$2000G/R_3C$.	$-K/(S^2+dS+1)$
State Variable HP	7	$-R_2/R_1$	$2000G/R_3C$.	$KS/(S^2+dS+1)$
Cauer (Elliptical)	8	R_2/R_1	$\omega_0 = 2000G/C/R_2$ $\omega_0 = 2000G/C/R_2$		$K(SB^2+1)/(S^2+1)^2 (SB+1)^2$

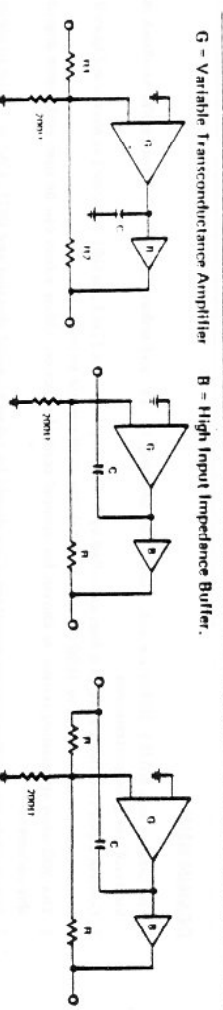
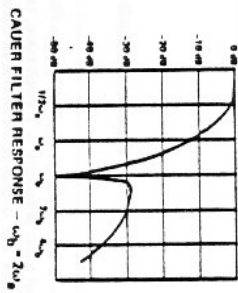


Figure 1 - Lowpass Real Pole

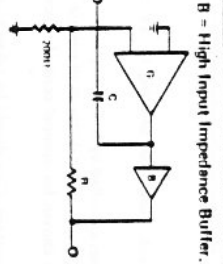


Figure 2 - Highpass Real Pole

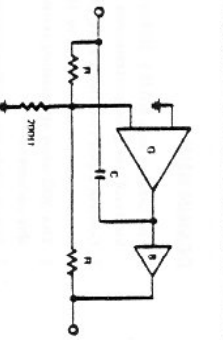


Figure 3 - Allpass (Phase shift)

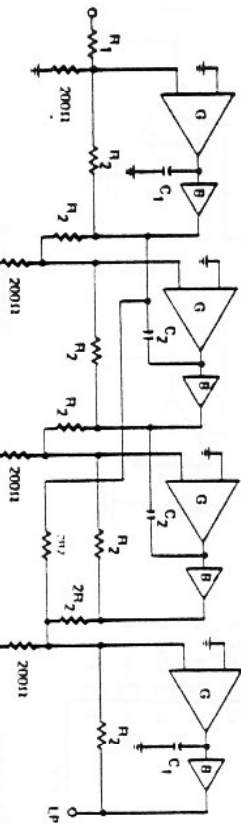


Figure 7 - State Variable Filter

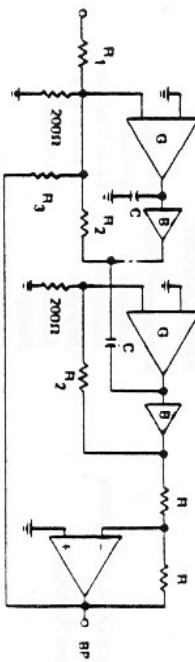


Figure 8 - Sallen & Key Bandpass

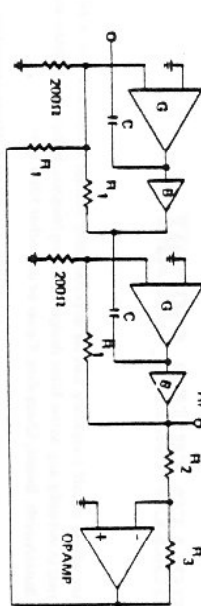


Figure 5 - Sallen & Key Highpass

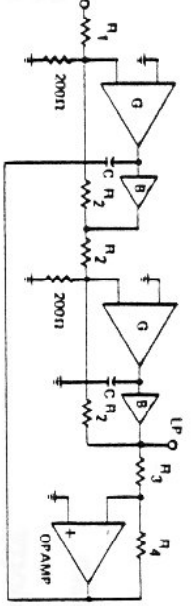


Figure 4 - Sallen & Key Lowpass