



CURTIS ELECTROMUSIC SPECIALTIES

# CEM 3328

## Four Pole Low-Pass VCF

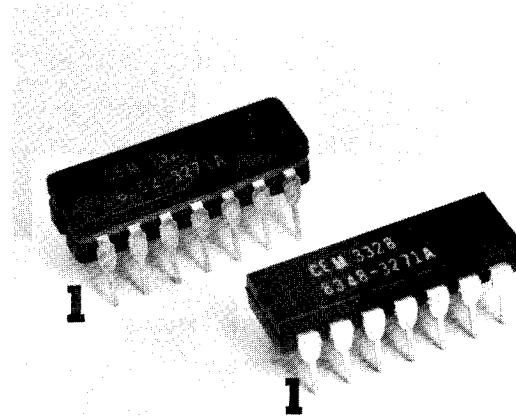
The CEM 3328 is a low cost dedicated four pole low-pass voltage controlled filter intended for electronic musical instruments. Complete with differential signal inputs, accurate exponential scale for excellent tracking, and voltage controllable resonance on-chip, the 3328 requires an absolute minimum of external components. Even the output op amp buffer required by competing devices is included within the 3328.

Special care has been taken in the design to minimize trimming: a fixed external resistor ensures the initial frequency is maintained to within  $\pm 1/3$  octave, and amount of resonances is held to within  $\pm 15\%$  from unit to unit. Finally, frequency drift is minimized using temperature

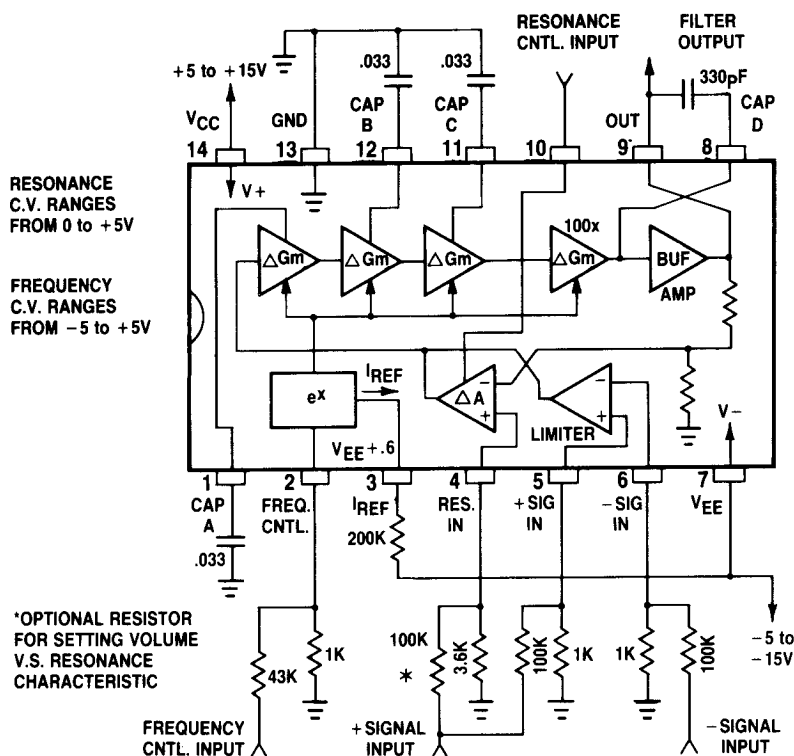
compensated transconductors.

A unique feature of this device is that a single external resistor allows the volume change with increasing resonance to be tailored anywhere from the usual (and annoying) 12dB drop to no change at all. Other features include large output swing even with  $\pm 5V$  supplies, reverse audio taper scale for the resonance control input to allow finer resolution at high resonance settings, good sonic characteristics, and smooth behavior when swept.

Offering high performance and flexibility over a wide supply range, the CEM 3328 is an ideal choice in those musical applications requiring a four pole low-pass VCF.



## Circuit Block and Connections Diagram



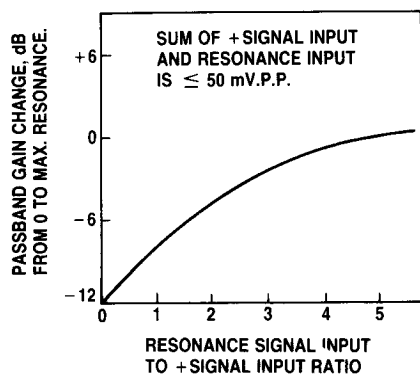
### Features

- Low Cost
- Low External Parts Count
- Open Loop Design for Enhanced Sound Richness
- Tight Parameter Spreads for Minimal Trimming
- Wide Sweep Range, Low Control Feedthrough, and Low Noise
- Temperature Compensated Transconductors
- Custom Tailoring of Volume vs. Resonance
- Differential Inputs
- Internal Buffer
- Wide Supply Range
- Large Output Swings Even at  $\pm 5V$  supply

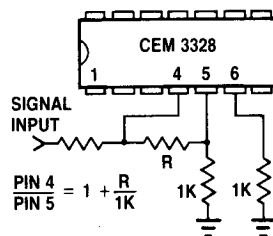
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## Electrical Characteristics

V <sub>CC</sub> = +12V V <sub>EE</sub> = 12V R <sub>REF</sub> = 100K T <sub>A</sub> = 20°C				
Parameter	Minimum	Typical	Maximum	Units
Frequency Control Range	14	—	—	octaves
Frequency Control Voltage for 14 Octave Range	—	-150 to +130	—	mV
Frequency Control Scale Factor	+18.5	+20.0	+21.5	mV/octave
Exponential Scale Error, Midrange	—	0.3	1.0	%
TC of Frequency Control Scale	+3000	+3300	+3600	ppm
Frequency Control Input Bias Current	-0.4	-1.2	-3.5	μA
Initial Frequency at V <sub>FREQ</sub> = 0 (C <sub>A</sub> = C <sub>B</sub> = C <sub>C</sub> = 0.03μF; C <sub>D</sub> = 300pF)	260	350	470	Hz
Frequency Temperature Coefficient (V <sub>FREQ</sub> = 0)	-500	0	+500 ppm	
Resonance Control Range	0dB		oscillation	
Resonance Control Voltage Required for Oscillation	+2.7	+3.2	+3.7	V
Resonance Control Input Bias Current	-0.1	-0.4	-1.2	μA/V
Input Signal for 1% THD	—	50	—	mV.P.P.
Signal Gain to Output from				
+ Input	+110	+130	+150	
- Input	-110	-130	-150	
Resonance Input	0 to	0 to	0 to	
Signal Input Bias Current,				
± Input	-0.1	-0.3	-1.0	μA
Resonance Input	-0.2	-0.8	-2.4	μA
Maximum Output Swing with ±5V Supplies	—	—	8.5	V.P.P.
Nominal Output Swing for 1% THD (No Resonance)	—	6.5	—	V.P.P.
Nominal Output Swing with Resonance	—	3.2	—	V.P.P.
Oscillation Output Swing	1.0	2.3	3.5	V.P.P.
DC Output Shift Over 10 Octave Range (-90mV < V <sub>FREQ</sub> < +110mV)	—	60	250	mV.P.P.
Output Noise, Filter Wide Open	—	—	200	μV.R.M.S.
Buffer/Amp Input Bias Current	—	±0.7	±5	nA
Output Sink Current	-1.0	-1.5	-2.3	mA
Output Source Drive Current	—	—	+3.0	mA
Voltage at I <sub>REF</sub> Pin(3) Relative to V <sub>EE</sub>				
V <sub>EE</sub> = -12V	+0.75	+0.85	+0.95	V
V <sub>EE</sub> = -5V	+0.50	+0.58	+0.66	V
Positive Supply Range	+4.5	—	+16.0	V
Negative Supply Range	-4.5	—	-16.0	V
Supply Current	4.8	6.8	9.5	mA



VOLUME CHANGE V.S. RESONANCE SIGNAL INPUT



ALTERNATE METHOD  
FOR TAILORING VOLUME  
V.S. RESONANCE  
CHARACTERISTIC



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