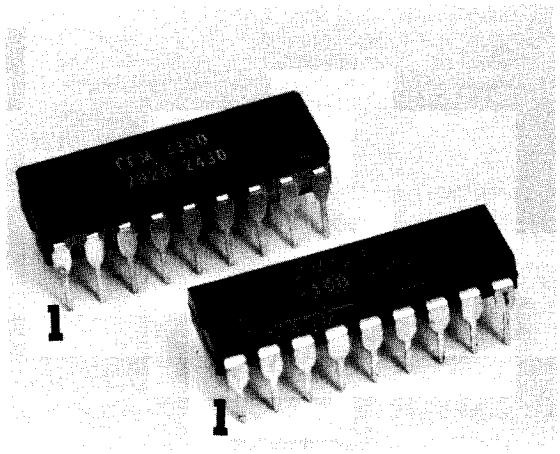
CURTIS ELECTROMUSIC SPECIALTIES

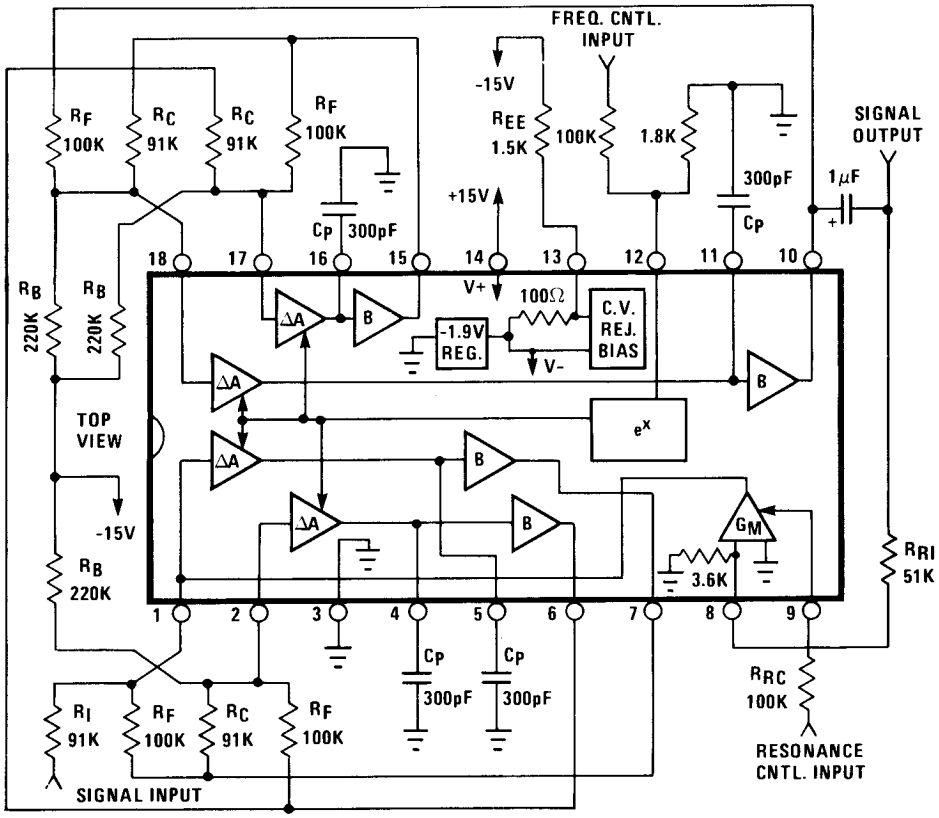
# CEM 3320

## Voltage Controlled Filter

The CEM 3320 is a high performance voltage controlled four-pole filter complete with on-chip voltage controllable resonance. The four independent sections may be interconnected to provide a wide variety of filter responses, such as low pass, high pass, band pass and all pass. A single input exponentially controls the frequency over greater than a ten octave range with little control voltage feedthrough. Another input controls the resonance in a modified linear manner from zero to low distortion oscillation. For those demanding applications, provision has been made to allow trimming for improved control voltage rejection. Each filter section features a novel variable gain cell which, unlike the traditional cell, is fully temperature compensated, exhibits a better signal-to-noise ratio and generates its low distortion predominantly in the second harmonic. The device further includes a minus two volt regulator to ensure low power dissipation and consequent low warm-up drift even with ±15 volt supplies.



## Circuit Block and Connection Diagram




### Features

- Low Cost
- Voltage Controllable Frequency: 12 octave range minimum
- Voltage Controllable Resonance: From zero to oscillation
- Accurate Exponential Frequency Scale
- Accurate Linear Resonance Scale
- Low Control Voltage Feedthrough: -45dB typical
- Filter Configurable into Low Pass, High Pass, All Pass, etc.
- Large Output: 12V.P.P. typical
- Low Noise: -86dB typical
- Low Distortion in Passband: 0.1% typical
- Low Warm Up Drift
- Configurable into Low Distortion Voltage Controlled Sine Wave Oscillator
- ±15 Volt Supplies

# CEM 3320

## Electrical Characteristics

| $V_{CC}$ = +15V | $R_F$ = 100K | $T_A$ = 25°C | | |
|---|---|---|---|---|
| Parameter | Min. | Typ. | Max. | Units |
| Pole Frequency Control Range | 3500:1 | 10,000:1 | – | |
| Sensitivity of Pole Frequency Control Scale, Midrange | 57.5 | 60 | 62.5 | mV/decade |
| Tempco of Pole Frequency Control Scale | 3000 | 3300 | 3600 | ppm |
| Exponential Error of Pole Frequency Control Scale[1] | – | 4 | 12 | % |
| Gain of Variable Gain Cell at $V_C$=0 | 0.7 | 0.9 | 1.3 | |
| Max Gain of Variable Gain Cell | 2.4 | 3.0 | 3.6 | |
| Tempco of Variable Gain Cell[2] | – | 500 | 1500 | ppm |
| Output Impedance of Gain Cell[2] | 0.5 | 1.0 | 2.0 | MΩ |
| Pole Frequency Control Feedthrough | – | 60 | 200 | mV |
| Pole Frequency Warm-up Drift | – | .5 | 1.5 | % |
| Gm of Resonance Control Element at $I_{CR}$=100uA | .8 | 1.0 | 1.2 | mmhos |
| Amount of Resonance Obtainable Before Oscillation | 20 | 30 | – | dB |
| Resonance Control Feedthrough[3] | – | 0.2 | 1.5 | V |
| Output Swing At Clipping | 10 | 12 | 14 | V.P.P. |
| Output Noise re Max Output[4] | -76 | -86 | – | dB |
| Rejection in Bandreject | 73 | 83 | – | dB |
| Distortion in Passband[5,7] | – | 0.1 | 0.3 | % |
| Distortion in Bandreject[6,7] | – | 0.3 | 1 | % |
| Distortion of Sine Wave Oscillation[8] | – | 0.5 | 1.5 | % |
| Internal Reference Current, $I_{REF}$ | 45 | 63 | 85 | μA |
| Input Bias Current of Frequency Control Input | 0.2 | 0.5 | 1.5 | μA |
| Input Impedance to Resonance Signal Input | 2.7 | 3.6 | 4.5 | KΩ |
| Buffer Slew Rate | 1.5 | 3.0 | – | V/uS |
| Buffer Input Bias Current ($I_{EE}$=8mA) | ±8 | ±30 | ±100 | nA |
| Buffer Sink Capability | .4 | .5 | .63 | mA |
| Buffer Output Impedance[2] | 75 | 100 | 200 | Ω |
| Positive Supply Range | +9 | – | +18 | V |
| Negative Supply Range[9] | -4 | – | -18 | V |
| Positive Supply Current | 3.8 | 5 | 6.5 | mA |

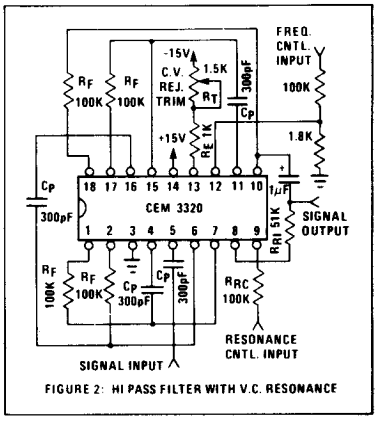


FIGURE 2: HI PASS FILTER WITH V.C. RESONANCE

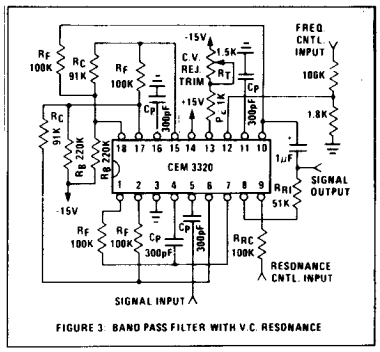


FIGURE 3: BAND PASS FILTER WITH V.C. RESONANCE

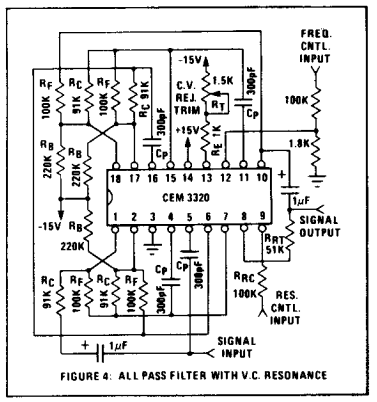


FIGURE 4: ALL PASS FILTER WITH V.C. RESONANCE

**Note 1:** -25mV < $V_C$ < +155mV. Most of this error occurs in upper two octaves.
**Note 2:** $V_C$ = 0
**Note 3:** Untrimmed. 0 < $I_{CR}$ < 100μA
**Note 4:** Filter is connected as low pass and set for 20 KHz cut-off frequency.
**Note 5:** Output signal is 3dB below clipping point.
**Note 6:** Output signal is 3dB below passband level, which is 3dB below clipping point. In general, this is worst case condition.
**Note 7:** Distortion is predominantly second harmonic.
**Note 8:** Sinewave is not clipped by first stage.
**Note 9:** Current limiting resistor always required.

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