

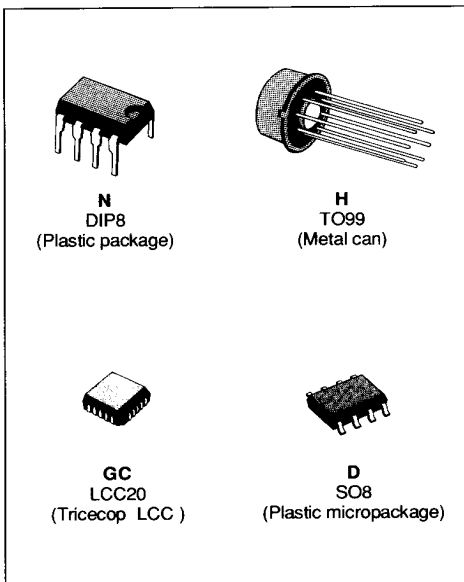
## J-FET INPUT SINGLE OP-AMPs

- LOW POWER CONSUMPTION
- WIDE COMMON-MODE AND DIFFERENTIAL VOLTAGE RANGE
- LOW INPUT BIAS AND OFFSET CURRENT
- OUTPUT SHORT-CIRCUIT PROTECTION
- HIGH INPUT IMPEDANCE J-FET INPUT STAGE
- INTERNAL FREQUENCY COMPENSATION
- LATCH UP FREE OPERATION
- HIGH SLEW RATE : 13 V/μs (typ)

### DESCRIPTION

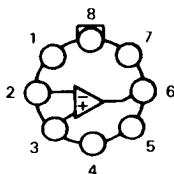
These circuits are high speed J-FET input single operational amplifiers incorporating well matched, high voltage J-FET and bipolar transistors in a monolithic integrated circuit.

The devices feature high slew rates, low input bias and offset current, and low offset voltage temperature coefficient.



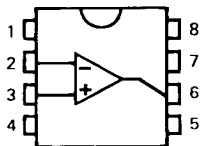
### PIN CONNECTIONS (Top views)

**TO99**

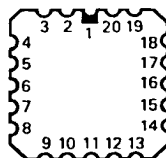


- 1 - Balance
- 2 - Inverting input
- 3 - Non-inverting input
- 4 -  $V_{CC}$
- 5 - Balance
- 6 - Output
- 7 -  $V_{CC}$
- 8 - NC

**DIP  
SO8**



**LCC20**



- |                         |               |
|-------------------------|---------------|
| 1 - NC                  | 11 - NC       |
| 2 - Balance             | 12 - Balance  |
| 3 - NC                  | 13 - NC       |
| 4 - NC                  | 14 - NC       |
| 5 - Inverting input     | 15 - Output   |
| 6 - NC                  | 16 - NC       |
| 7 - Non-inverting input | 17 - $V_{CC}$ |
| 8 - NC                  | 18 - NC       |
| 9 - NC                  | 19 - NC       |
| 10 - $V_{CC}$           | 20 - NC       |

ORDER CODES

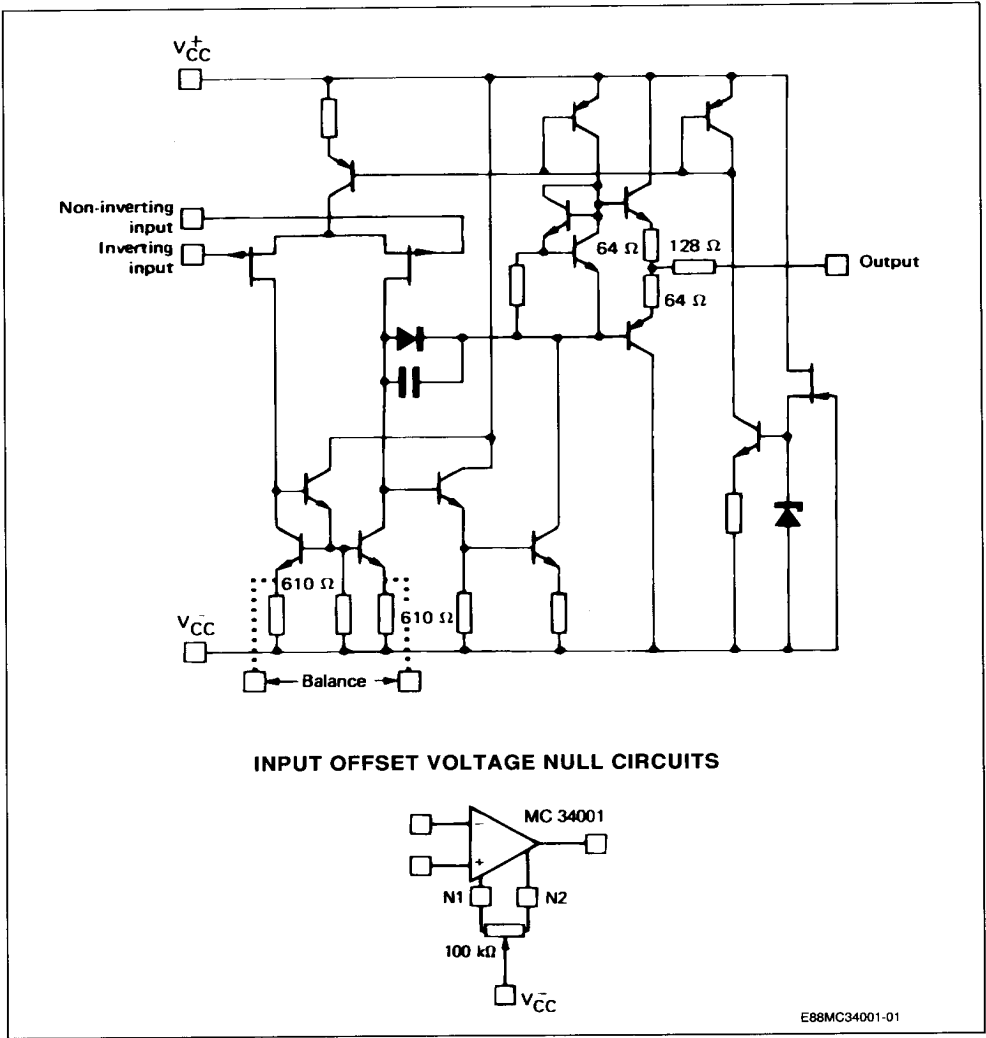
| Part Number | Temperature         | Package   |
|-------------|---------------------|-----------|
| MC35001GC   | – 55 °C to + 125 °C | LCC       |
| MC35001AGC  | – 55 °C to + 125 °C | LCC       |
| MC35001BGC  | – 55 °C to + 125 °C | LCC       |
| MC35001H    | – 55 °C to + 125 °C | METAL CAN |
| MC35001AH   | – 55 °C to + 125 °C | METAL CAN |
| MC35001BH   | – 55 °C to + 125 °C | METAL CAN |
| MC33001N    | – 40 °C to + 105 °C | DIP8      |
| MC33001AN   | – 40 °C to + 105 °C | DIP8      |
| MC33001BN   | – 40 °C to + 105 °C | DIP8      |
| MC33001D    | – 40 °C to + 105 °C | SO8       |
| MC33001AD   | – 40 °C to + 105 °C | SO8       |
| MC33001BD   | – 40 °C to + 105 °C | SO8       |
| MC34001N    | 0 °C to + 70 °C     | DIP8      |
| MC34001AN   | 0 °C to + 70 °C     | DIP8      |
| MC34001BN   | 0 °C to + 70 °C     | DIP8      |
| MC34001D    | 0 °C to + 70 °C     | SO8       |
| MC34001AD   | 0 °C to + 70 °C     | SO8       |
| MC34001BD   | 0 °C to + 70 °C     | SO8       |

ABSOLUTE MAXIMUM RATINGS

| Symbol            | Parameter                                                                               | Value                                 | Unit |
|-------------------|-----------------------------------------------------------------------------------------|---------------------------------------|------|
| V <sub>CC</sub>   | Supply Voltage (note 1)                                                                 | ± 18                                  | V    |
| V <sub>i</sub>    | Input Voltage (note 3)                                                                  | ± 15                                  | V    |
| V <sub>CC</sub>   | Diff. Input Voltage (note 2)                                                            | ± 30                                  | V    |
| P <sub>tot</sub>  | Power Dissipation                                                                       | 680                                   | mW   |
|                   | Output Short-circuit Duration (note 4)                                                  | Infinite                              |      |
| T <sub>oper</sub> | Operating Free Air Temperature Range<br>MC34001, A, B<br>MC33001, A, B<br>MC35001, A, B | 0 to 70<br>– 40 to 105<br>– 55 to 125 | °C   |
| T <sub>stg</sub>  | Storage Temperature Range                                                               | – 65 to 150                           | °C   |

- Notes :
1. All voltage values, except differential voltage, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between V<sub>CC</sub> and V<sub>CC</sub>.
  2. Differential voltages are at the non-inverting input terminal with respect to the inverting input terminal.
  3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
  4. The output may be shorted to ground or to either supply. Temperature and /or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

SCHEMATIC DIAGRAM



| Case                | Balance | Inverting Input | Non-inverting Input | Output | V <sub>CC</sub> | V <sub>CC</sub> | N.C. |
|---------------------|---------|-----------------|---------------------|--------|-----------------|-----------------|------|
| DIP8<br>SO8<br>TO99 | 1, 5    | 2               | 3                   | 6      | 7               | 4               | 8    |
| LCC20               | 2, 12   | 5               | 7                   | 15     | 17              | 10              | *    |

\* LCC20 : Other pins are not connected.

**ELECTRICAL CHARACTERISTICS**
 $V_{CC} = \pm 15 \text{ V}$  (unless otherwise specified)

MC35001, MC35001A, MC35001B  $-55 \leq T_{amb} \leq +125 \text{ }^{\circ}\text{C}$ 

MC33001, MC33001A, MC33001B  $-40 \leq T_{amb} \leq +105 \text{ }^{\circ}\text{C}$ 

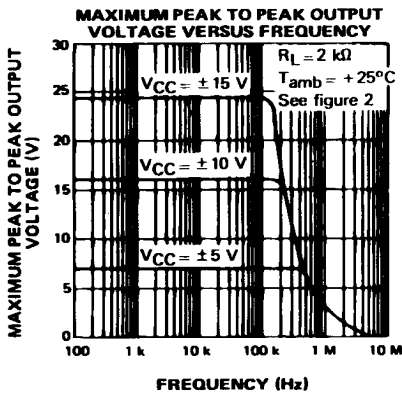
MC34001, MC34001A, MC34001B  $0 \leq T_{amb} \leq +70 \text{ }^{\circ}\text{C}$ 

| Symbol        | Parameter                                                                                                                                                                                                                                                             | MC35001A, B<br>MC33001A, B<br>MC34001A, B                                                                                                              |            |            | MC35001<br>MC33001<br>MC34001 |            |            | Unit                           |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|-------------------------------|------------|------------|--------------------------------|
|               |                                                                                                                                                                                                                                                                       | Min.                                                                                                                                                   | Typ.       | Max.       | Min.                          | Typ.       | Max.       |                                |
| $V_{IO}$      | Input Offset Voltage<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$ ( $R_S < 10 \text{ k}\Omega$ )<br>MC35001B, MC34001B, MC33001B<br>MC35001A, MC34001A, MC33001A<br>$T_{min} \leq T_{amb} \leq T_{max}$<br>MC35001B, MC34001B, MC33001B<br>MC35001A, MC34001A, MC33001A |                                                                                                                                                        | 3<br>0.2   | 5<br>1     |                               | 3<br>13    | 8          | mV                             |
| $DV_{IO}$     | Input Offset Voltage Drift                                                                                                                                                                                                                                            |                                                                                                                                                        | 10         |            |                               | 10         |            | $\mu\text{V}/^{\circ}\text{C}$ |
| $I_{IO}$      | Input Offset Current *<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                                                              |                                                                                                                                                        | 5          | 50<br>4    |                               | 5<br>4     | 50<br>4    | pA<br>nA                       |
| $I_{IB}$      | Input Bias Current *<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                                                                |                                                                                                                                                        | 20         | 200<br>20  |                               | 20<br>20   | 200<br>20  | pA<br>nA                       |
| $A_{VD}$      | Large Signal Voltage Gain<br>( $R_L > 2 \text{ k}\Omega$ , $V_o = \pm 10 \text{ V}$ )<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                               | 50<br>25                                                                                                                                               | 200        |            | 50<br>25                      | 200        |            | V/mV                           |
| SVR           | Supply Voltage Rejection Ratio<br>( $R_S < 10 \text{ k}\Omega$ )<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                    | 80<br>80                                                                                                                                               | 86         |            | 80<br>80                      | 86         |            | dB                             |
| $I_{CC}$      | Supply Current, No Load<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                                                             |                                                                                                                                                        | 1.4        | 2.5<br>2.5 |                               | 1.4        | 2.5<br>2.5 | mA                             |
| $V_I$         | Input Voltage Range<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                                                                 | - 11                                                                                                                                                   |            | + 11       | - 11                          |            | + 11       | V                              |
| CMR           | Common Mode Rejection Ratio<br>( $R_S < 10 \text{ k}\Omega$ )<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                       | 80<br>80                                                                                                                                               | 86         |            | 70<br>70                      | 86         |            | dB                             |
| $I_{OS}$      | Output Short-circuit Current<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                                                        | 10<br>10                                                                                                                                               | 40         | 60<br>60   | 10<br>10                      | 40         | 60<br>60   | mA                             |
| $\pm V_{OPP}$ | Output Voltage Swing<br>$T_{amb} = 25 \text{ }^{\circ}\text{C}$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                                                                                | $R_L \geq 2 \text{ k}\Omega$<br>11<br>$R_L \geq 10 \text{ k}\Omega$<br>12<br>$R_L \geq 2 \text{ k}\Omega$<br>11<br>$R_L \geq 10 \text{ k}\Omega$<br>12 | 12<br>13.5 |            | 11<br>12<br>11<br>12          | 12<br>13.5 |            | V                              |
| $S_{VO}$      | Slew-rate ( $V_I = 10 \text{ V}$ , $R_L = 2 \text{ k}\Omega$ )<br>$C_L \leq 100 \text{ pF}$ , $T_{amb} = 25 \text{ }^{\circ}\text{C}$ , unity gain                                                                                                                    | 12                                                                                                                                                     | 16         |            | 12                            | 16         |            | V/ $\mu\text{s}$               |

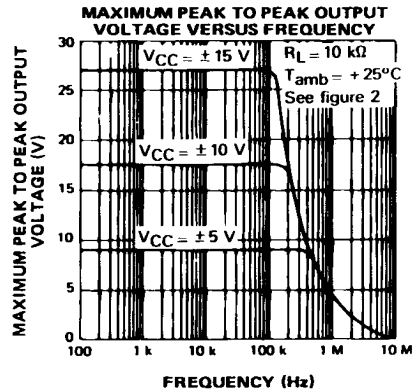
\* The input bias currents are junction leakage currents which approximately double for every  $10 \text{ }^{\circ}\text{C}$  increase in the junction temperature.

## ELECTRICAL CHARACTERISTICS (continued)

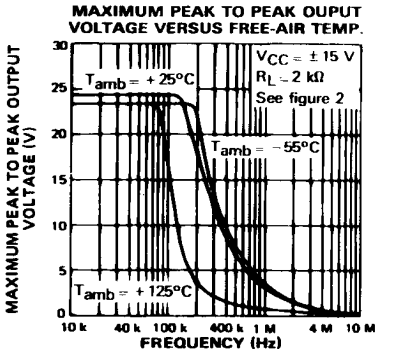
| Symbol   | Parameter                                                                                                                                              | MC34001A, B<br>MC33001A, B<br>MC35001A, B |           |      | MC34001<br>MC33001<br>MC35001 |           |      | Unit            |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-----------|------|-------------------------------|-----------|------|-----------------|
|          |                                                                                                                                                        | Min.                                      | Typ.      | Max. | Min.                          | Typ.      | Max. |                 |
| $t_r$    | Rise Time<br>( $V_i = 20$ mV, $R_L = 2$ k $\Omega$ )<br>$C_L = 100$ pF, $T_{amb} = 25$ °C, unity gain)                                                 |                                           | 0.1       |      |                               | 0.1       |      | $\mu$ s         |
| $K_{OV}$ | Overshoot ( $V_i = 20$ mV, $R_L = 2$ k $\Omega$ )<br>$C_L \leq 100$ pF, $T_{amb} = 25$ °C, unity gain)                                                 |                                           | 10        |      |                               | 10        |      | %               |
| GBP      | Gain Bandwidth Product<br>( $f = 100$ kHz, $T_{amb} = 25$ °C<br>$V_{IN} = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 100$ pF)                               | 3.3                                       | 4.0       | 5.0  | 3.3                           | 4.0       | 5.0  | MHz             |
| $R_i$    | Input Resistance ( $T_{amb} = 25$ °C)                                                                                                                  |                                           | $10^{12}$ |      |                               | $10^{12}$ |      | $\Omega$        |
| THD      | Total Harmonic Distortion<br>( $f = 1$ kHz, $A_V = 20$ dB, $R_L = 2$ k $\Omega$ )<br>$C_L \leq 100$ pF, $T_{amb} = 25$ °C, $V_O = 2$ V <sub>PP</sub> ) |                                           | 0.01      |      |                               | 0.01      |      | %               |
| $V_n$    | Equivalent Input Noise Voltage<br>( $f = 1$ kHz, $R_g = 100$ $\Omega$ )                                                                                |                                           | 15        |      |                               | 15        |      | nV/ $\sqrt{Hz}$ |
| $\phi_m$ | Phase Margin                                                                                                                                           |                                           | 45        |      |                               | 45        |      | Degrees         |



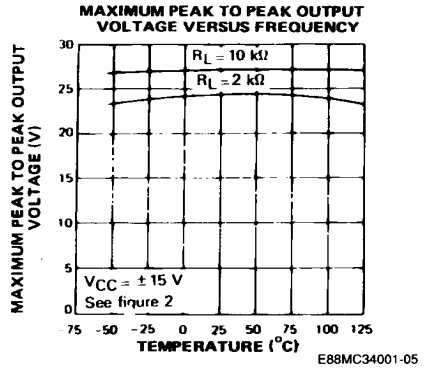
E88MC34001-02



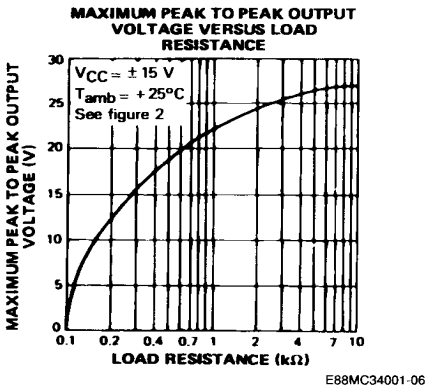
E88MC34001-03



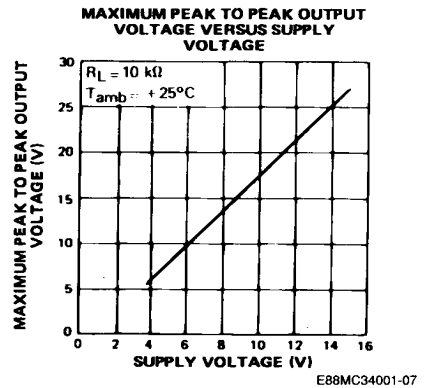
E88MC34001-04



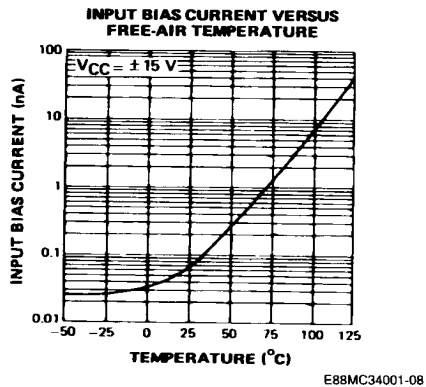
E88MC34001-05



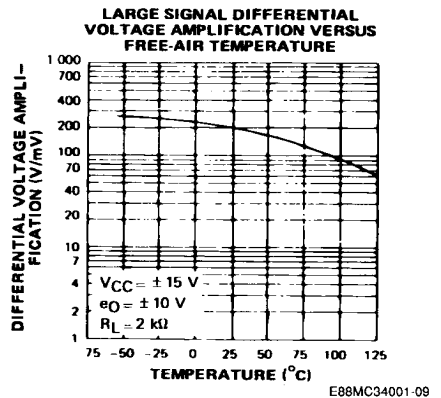
E88MC34001-06



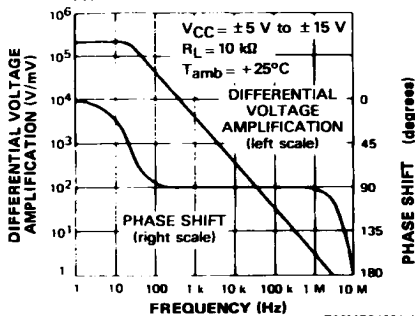
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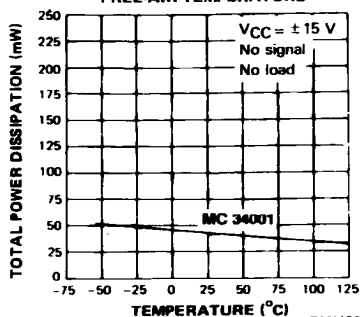
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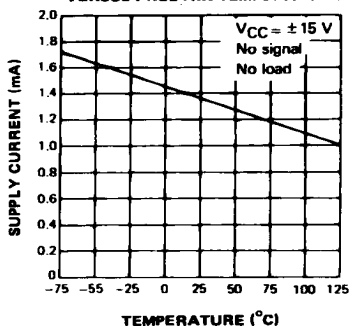
E88MC34001-09

**LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT VERSUS FREQUENCY**


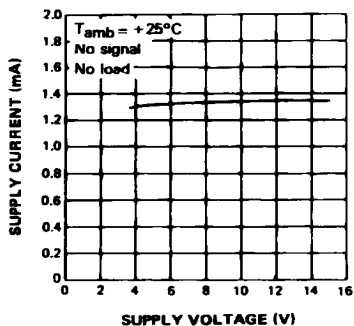
E88MC34001-10

**TOTAL POWER DISSIPATION VERSUS FREE-AIR TEMPERATURE**


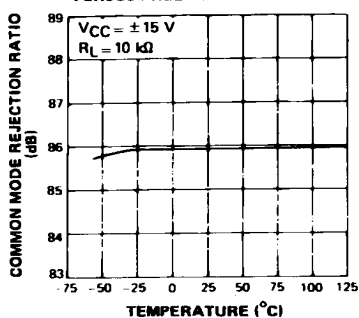
E88MC34001-11

**SUPPLY CURRENT PER AMPLIFIER VERSUS FREE-AIR TEMPERATURE**


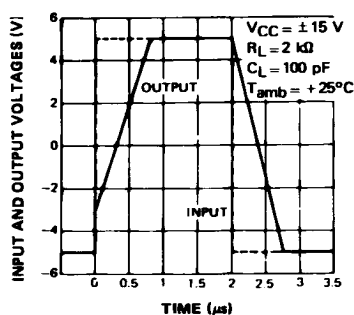
E88MC34001-12

**SUPPLY CURRENT PER AMPLIFIER VERSUS SUPPLY VOLTAGE**


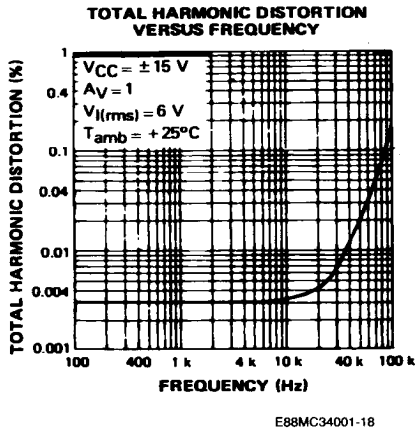
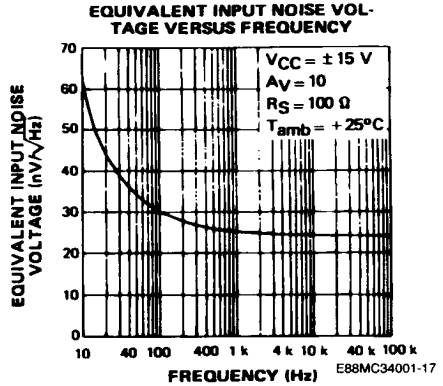
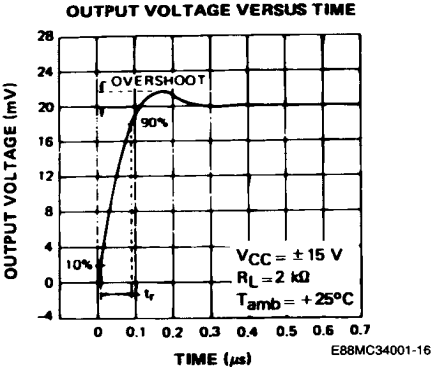
E88MC34001-13

**COMMON MODE REJECTION RATIO VERSUS FREE-AIR TEMPERATURE**


E88MC34001-14

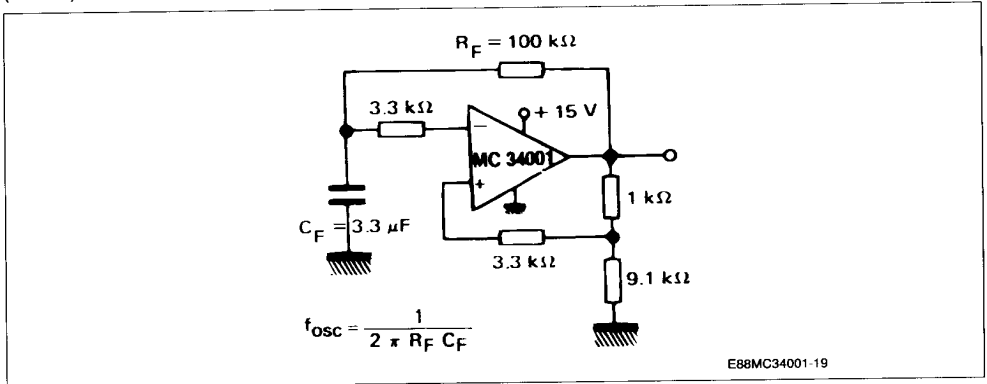
**VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE**


E88MC34001-15

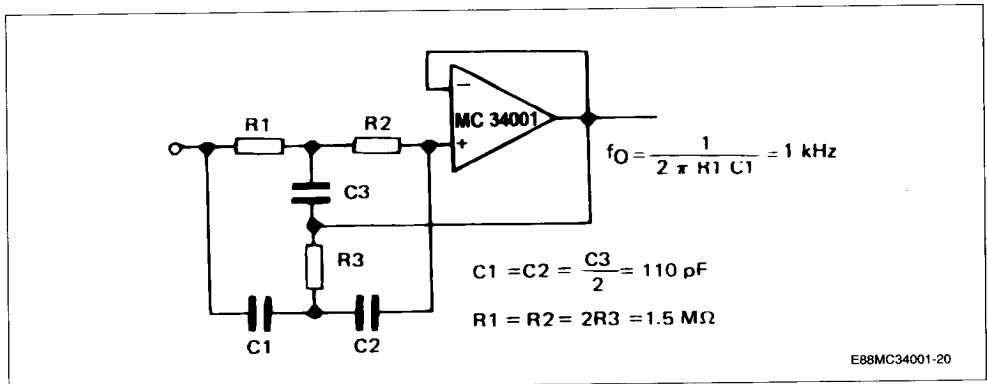


## TYPICAL APPLICATIONS

## (0.5 Hz) SQUARE WAVE OSCILLATOR



## HIGH Q NOTCH FILTER



## PARAMETER MEASUREMENT INFORMATION

Figure 1 : Voltage Follower.

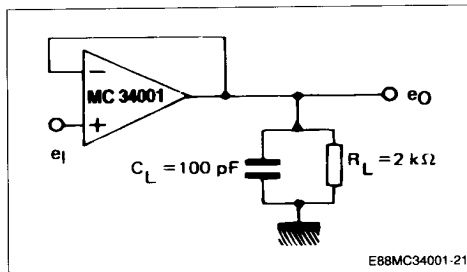
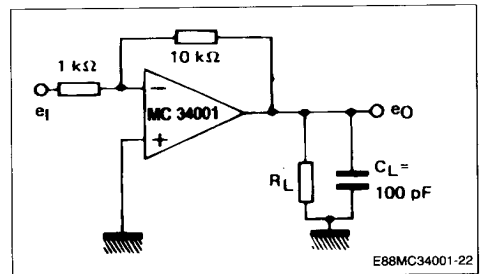
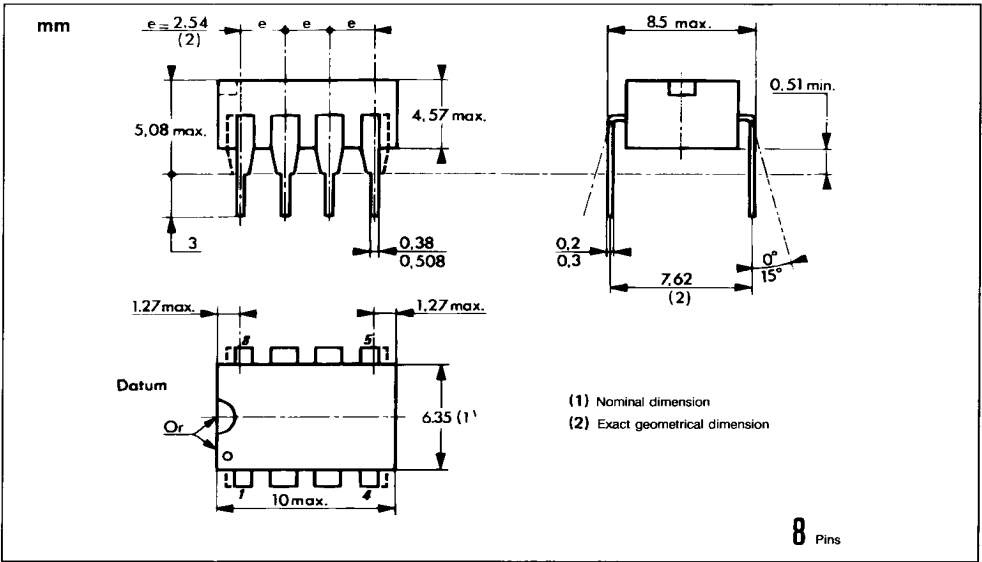


Figure 2 : Gain-of-10 Inverting Amplifier.

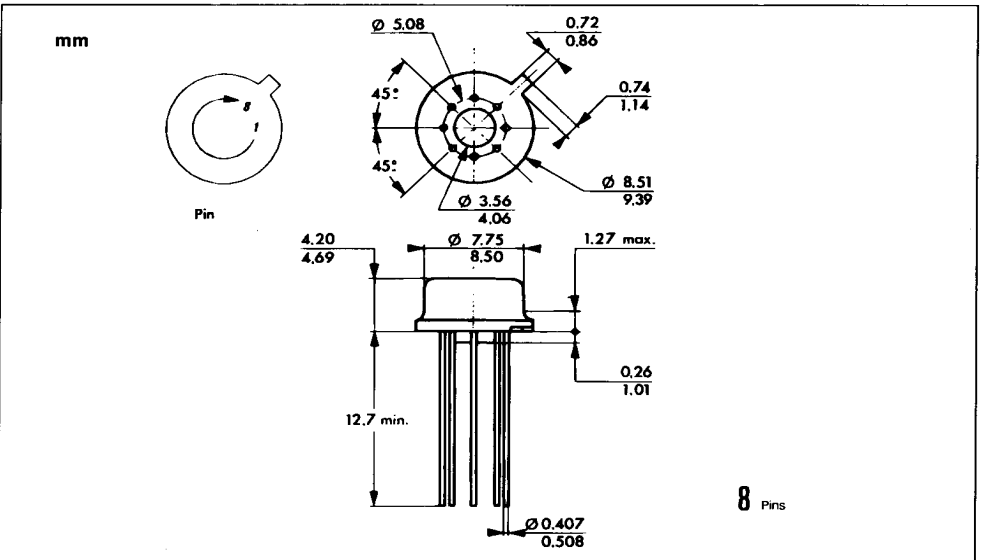


PACKAGE MECHANICAL DATA

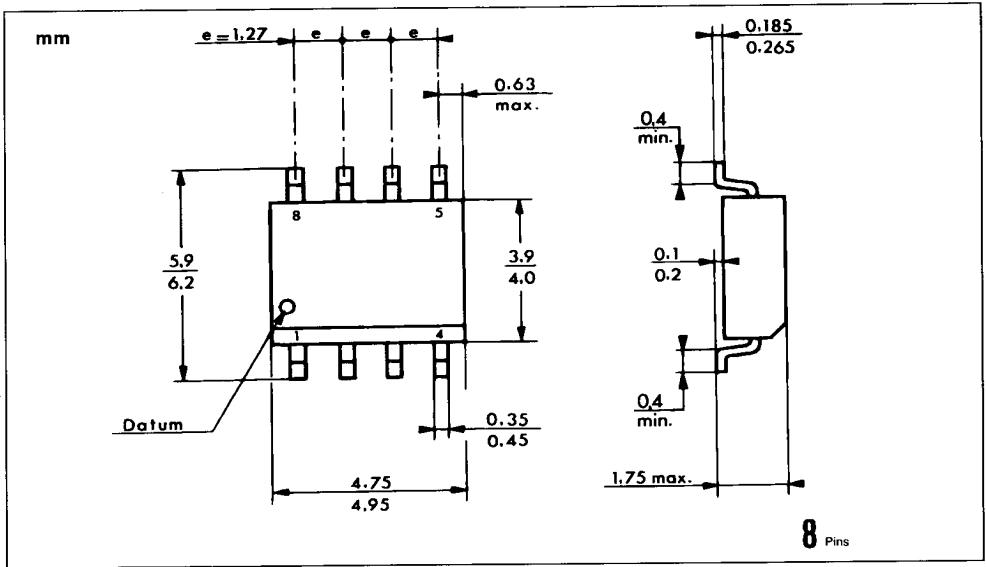
8 PINS – PLASTIC DIP



TO99 – METAL CAN



## 8 PINS – PLASTIC MICROPACKAGE (SO)



## 20 PINS – TRICECOP (LCC)

