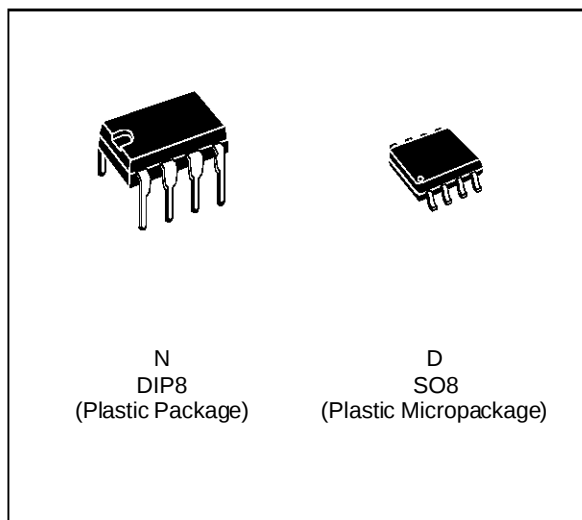


### LOW NOISE J-FET DUAL OPERATIONAL AMPLIFIERS

- WIDE COMMON-MODE (UP TO  $V_{CC}^+$ ) AND DIFFERENTIAL VOLTAGE RANGE
- LOW INPUT BIAS AND OFFSET CURRENT
- LOW NOISE  $e_n = 15\text{nV}/\sqrt{\text{Hz}}$  (typ)
- OUTPUT SHORT-CIRCUIT PROTECTION
- HIGH INPUT IMPEDANCE J-FET INPUT STAGE
- LOW HARMONIC DISTORTION : 0.01% (typ)
- INTERNAL FREQUENCY COMPENSATION
- LATCH UP FREE OPERATION
- HIGH SLEW RATE :  $16\text{V}/\mu\text{s}$  (typ)



#### DESCRIPTION

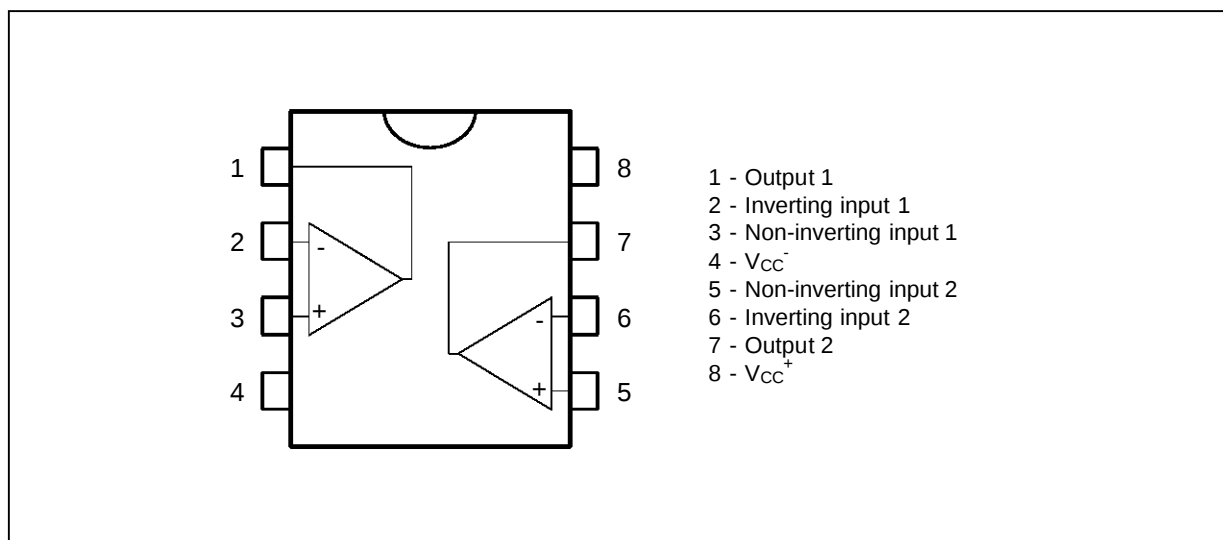
The TL072, TL072A and TL072B are high speed J-FET input dual operational amplifiers incorporating well matched, high voltage J-FET and bipolar transistors in a monolithic integrated circuit.

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

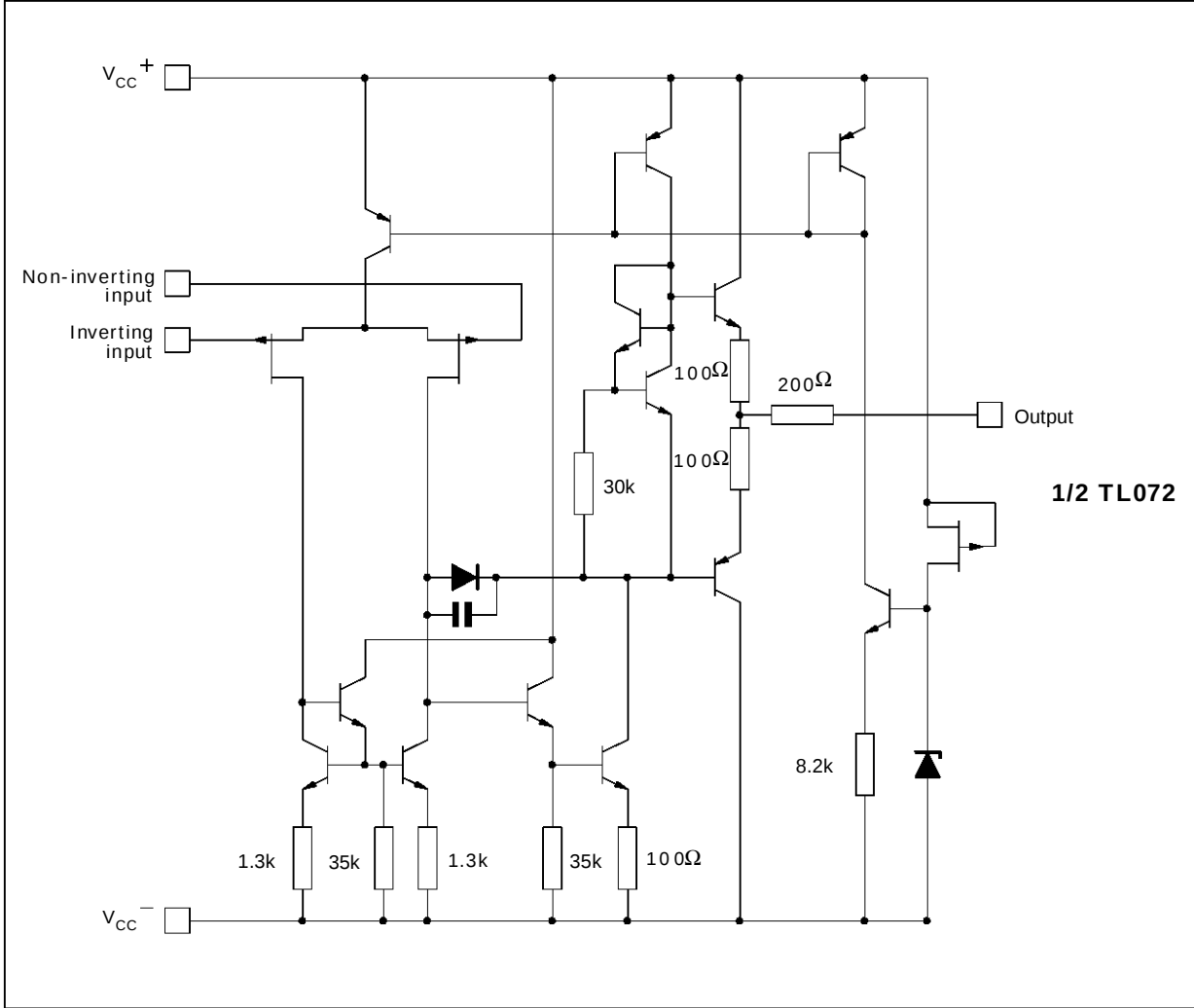
#### ORDER CODES

| Part Number       | Temperature Range | Package |   |
|-------------------|-------------------|---------|---|
|                   |                   | N       | D |
| TL072M/AM/BM      | -55°C, +125°C     | •       | • |
| TL072I/AI/BI      | -40°C, +105°C     | •       | • |
| TL072C/AC/BC      | 0°C, +70°C        | •       | • |
| Example : TL072CN |                   |         |   |

#### PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Symbol     | Parameter                                | Value                                                                               | Unit               |
|------------|------------------------------------------|-------------------------------------------------------------------------------------|--------------------|
| $V_{CC}$   | Supply Voltage - (note 1)                | $\pm 18$                                                                            | V                  |
| $V_i$      | Input Voltage - (note 3)                 | $\pm 15$                                                                            | V                  |
| $V_{id}$   | Differential Input Voltage - (note 2)    | $\pm 30$                                                                            | V                  |
| $P_{tot}$  | Power Dissipation                        | 680                                                                                 | mW                 |
|            | Output Short-circuit Duration - (note 4) | Infinite                                                                            |                    |
| $T_{oper}$ | Operating Free Air Temperature Range     | TL072C,AC,BC<br>TL072I,AI,BI<br>TL072M,AM,BM<br>0 to 70<br>-40 to 105<br>-55 to 125 | $^{\circ}\text{C}$ |
| $T_{stg}$  | Storage Temperature Range                | -65 to 150                                                                          | $^{\circ}\text{C}$ |

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  $V_{CC}^{+}$  and  $V_{CC}^{-}$ .
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.

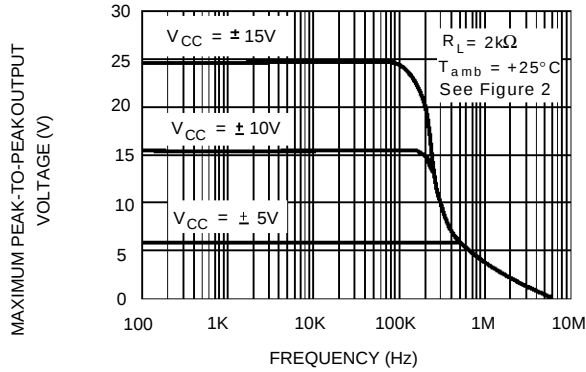
# ELECTRICAL CHARACTERISTICS

$V_{CC} = \pm 15V$ ,  $T_{amb} = 25^{\circ}C$  (unless otherwise specified)

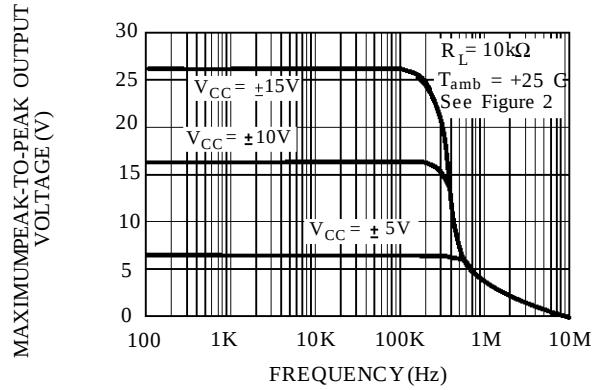
| Symbol          | Parameter                                                                                                                                                                  | TL072I,M,AC,AI,<br>AM,BC,BI,BM |            |                  | TL072C               |            |            | Unit                   |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------|------------------|----------------------|------------|------------|------------------------|
|                 |                                                                                                                                                                            | Min.                           | Typ.       | Max.             | Min.                 | Typ.       | Max.       |                        |
| $V_{io}$        | Input Offset Voltage ( $R_S = 50\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$<br>TL072BC,BI,BM<br>TL072BC,BI,BM                            |                                | 3<br>1     | 6<br>3<br>7<br>5 |                      | 3          | 10<br>13   | mV                     |
| $DV_{io}$       | Input Offset Voltage Drift                                                                                                                                                 |                                | 10         |                  |                      | 10         |            | $\mu V/^{\circ}C$      |
| $I_{io}$        | Input Offset Current *<br>$T_{amb} = 25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                                 |                                | 5          | 100<br>4         |                      | 5          | 100<br>10  | pA<br>nA               |
| $I_{ib}$        | Input Bias Current *<br>$T_{amb} = 25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                                   |                                | 20         | 200<br>20        |                      | 20         | 200<br>20  | pA<br>nA               |
| $A_{vd}$        | Large Signal Voltage Gain ( $R_L = 2k\Omega$ , $V_O = \pm 10V$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                       | 50<br>25                       | 200        |                  | 25<br>15             | 200        |            | V/mV                   |
| SVR             | Supply Voltage Rejection Ratio ( $R_S = 50\Omega$ )<br>$T_{amb} = 25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                    | 80<br>80                       | 86         |                  | 70<br>70             | 86         |            | dB                     |
| $I_{CC}$        | Supply Current, per Amp, no Load<br>$T_{amb} = 25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                       |                                | 1.4        | 2.5<br>2.5       |                      | 1.4        | 2.5<br>2.5 | mA                     |
| $V_{icm}$       | Input Common Mode Voltage Range                                                                                                                                            | $\pm 11$                       | +15<br>-12 |                  | $\pm 11$             | +15<br>-12 |            | V                      |
| CMR             | Common Mode Rejection Ratio ( $R_S = 50\Omega$ )<br>$T_{amb} = 25^{\circ}C$<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>$T_{amb} = 25^{\circ}C$<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>$T_{amb} = 25^{\circ}C$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$<br>$R_L = 2k\Omega$<br>$R_L = 10k\Omega$<br>$R_L = 2k\Omega$<br>$R_L = 10k\Omega$ | 10<br>12<br>10<br>12           | 12<br>13.5 |                  | 10<br>12<br>10<br>12 | 12<br>13.5 |            | V                      |
| SR              | Slew Rate ( $V_{in} = 10V$ , $R_L = 2k\Omega$ , $C_L = 100pF$ ,<br>$T_{amb} = 25^{\circ}C$ , unity gain)                                                                   | 8                              | 16         |                  | 8                    | 16         |            | V/ $\mu s$             |
| $t_r$           | Rise Time ( $V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ ,<br>$T_{amb} = 25^{\circ}C$ , unity gain)                                                                  |                                | 0.1        |                  |                      | 0.1        |            | $\mu s$                |
| $K_{OV}$        | Overshoot ( $V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ ,<br>$T_{amb} = 25^{\circ}C$ , unity gain)                                                                  |                                | 10         |                  |                      | 10         |            | %                      |
| GBP             | Gain Bandwidth Product ( $f = 100kHz$ ,<br>$T_{amb} = 25^{\circ}C$ , $V_{in} = 10mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ )                                                  | 2.5                            | 4          |                  | 2.5                  | 4          |            | MHz                    |
| $R_i$           | Input Resistance                                                                                                                                                           |                                | $10^{12}$  |                  |                      | $10^{12}$  |            | $\Omega$               |
| THD             | Total Harmonic Distortion ( $f = 1kHz$ , $A_V = 20dB$ ,<br>$R_L = 2k\Omega$ , $C_L = 100pF$ , $T_{amb} = 25^{\circ}C$ , $V_O = 2V_{PP}$ )                                  |                                | 0.01       |                  |                      | 0.01       |            | %                      |
| $e_n$           | Equivalent Input Noise Voltage<br>( $f = 1kHz$ , $R_S = 100\Omega$ )                                                                                                       |                                | 15         |                  |                      | 15         |            | $\frac{nV}{\sqrt{Hz}}$ |
| $\phi_m$        | Phase Margin                                                                                                                                                               |                                | 45         |                  |                      | 45         |            | Degrees                |
| $V_{O1}/V_{O2}$ | Channel Separation ( $A_V = 100$ )                                                                                                                                         |                                | 120        |                  |                      | 120        |            | dB                     |

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

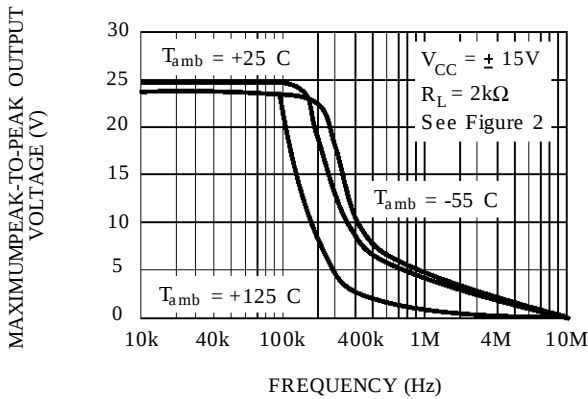
MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE VERSUS FREQUENCY



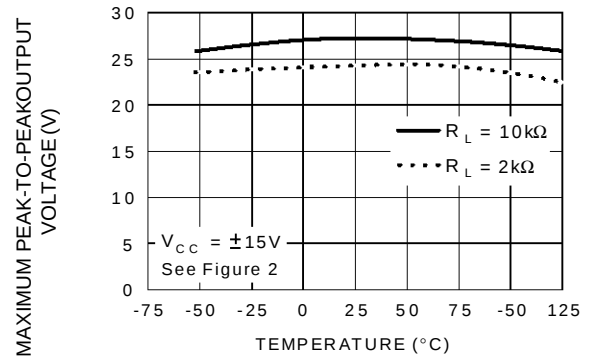
MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE VERSUS FREQUENCY



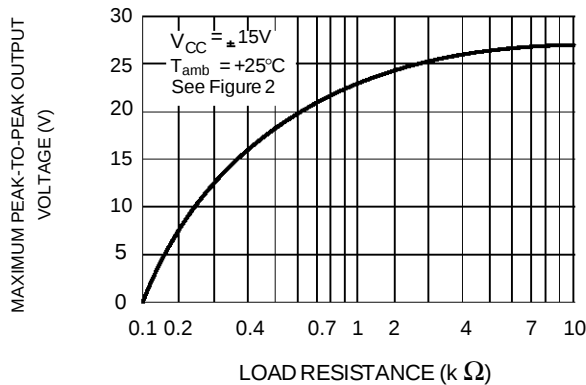
MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE VERSUS FREQUENCY



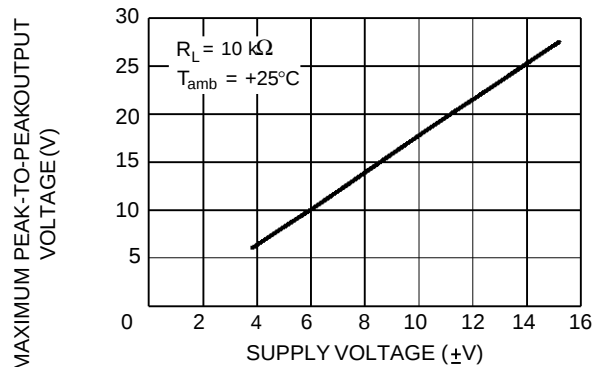
MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE VERSUS FREE AIR TEMP.



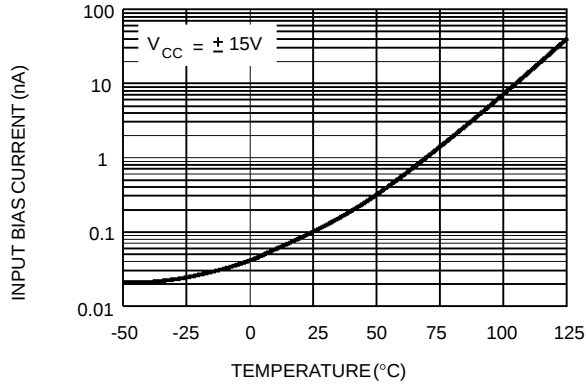
MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE VERSUS LOAD RESISTANCE



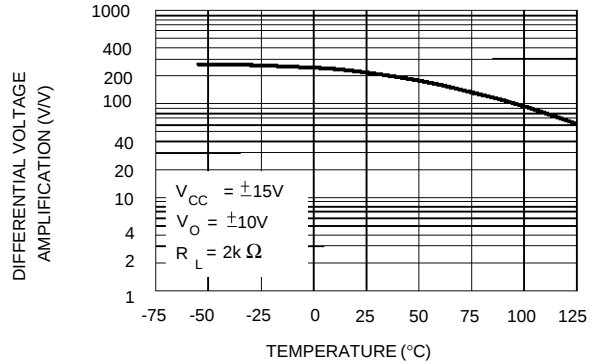
MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE VERSUS SUPPLY VOLTAGE



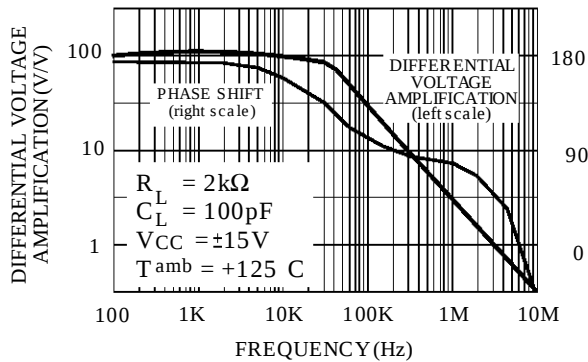
**INPUT BIAS CURRENT VERSUS  
FREE AIR TEMPERATURE**



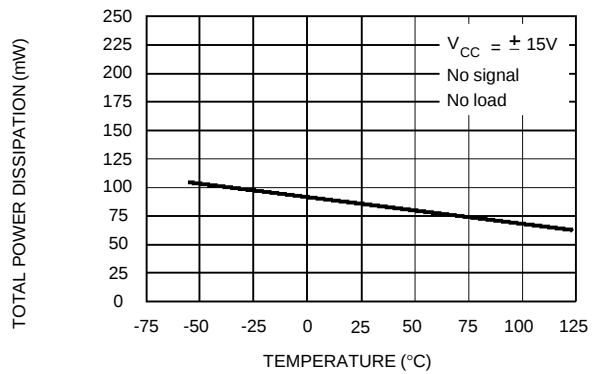
**LARGE SIGNAL DIFFERENTIAL  
VOLTAGE AMPLIFICATION VERSUS  
FREE AIR TEMPERATURE**



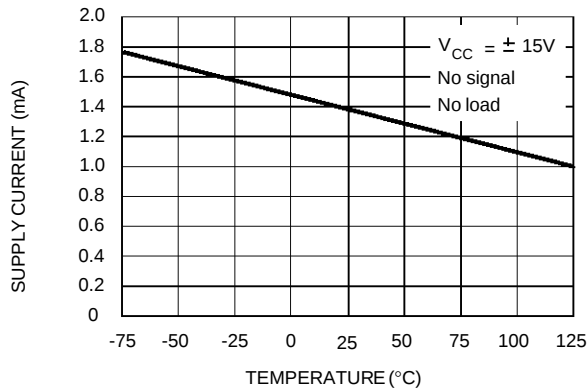
**LARGE SIGNAL DIFFERENTIAL  
VOLTAGE AMPLIFICATION AND PHASE  
SHIFT VERSUS FREQUENCY**



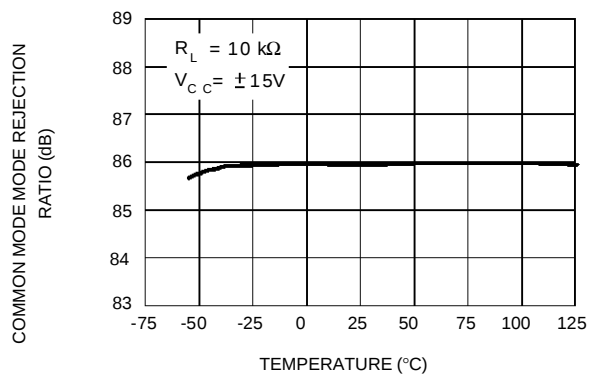
**TOTAL POWER DISSIPATION VERSUS  
FREE AIR TEMPERATURE**



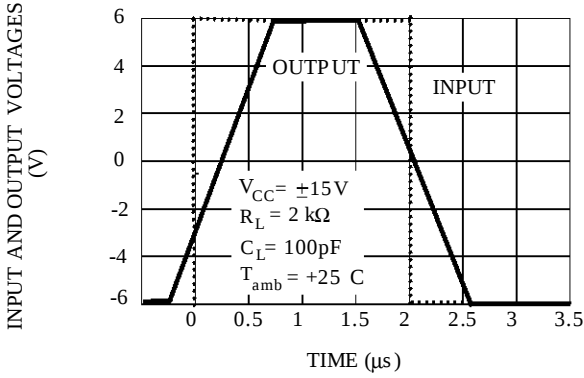
**SUPPLY CURRENT PER AMPLIFIER  
VERSUS FREE AIR TEMPERATURE**



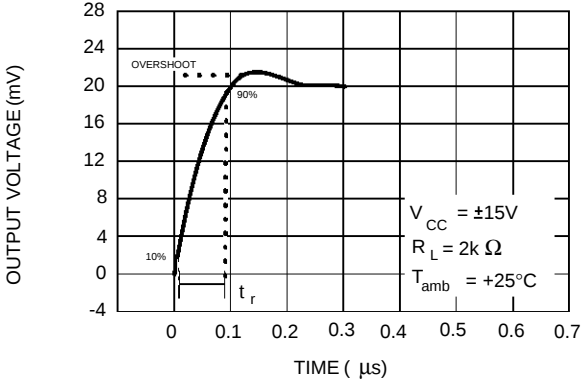
**COMMON MODE REJECTION RATIO  
VERSUS FREE AIR TEMPERATURE**



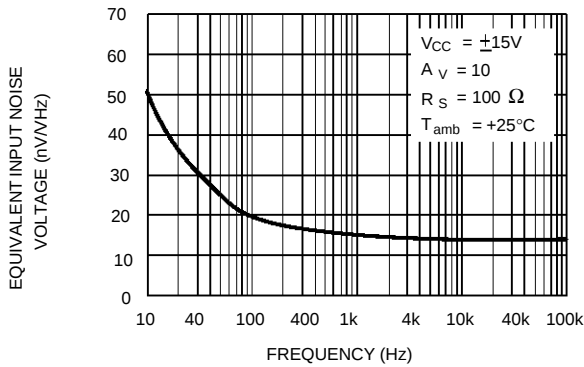
VOLTAGE FOLLOWER LARGE SIGNAL  
PULSE RESPONSE



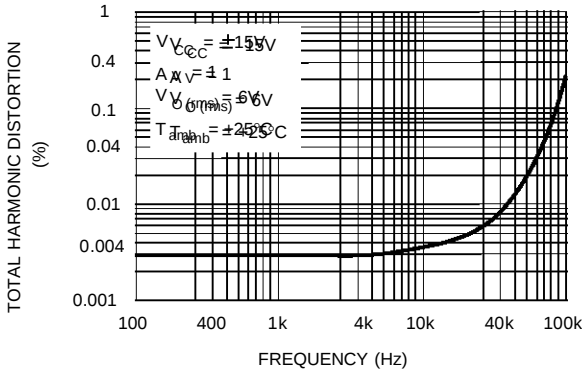
OUTPUT VOLTAGE VERSUS  
ELAPSED TIME



EQUIVALENT INPUT NOISE VOLTAGE  
VERSUS FREQUENCY



TOTAL HARMONIC DISTORTION VERSUS  
FREQUENCY



## PARAMETER MEASUREMENT INFORMATION

Figure 1 : Voltage Follower

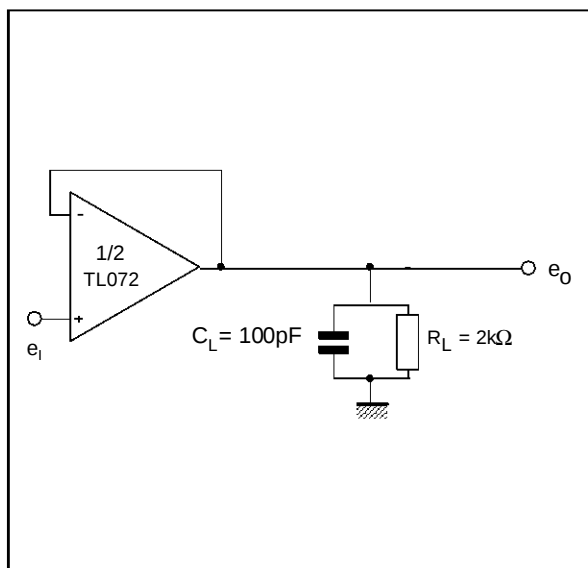
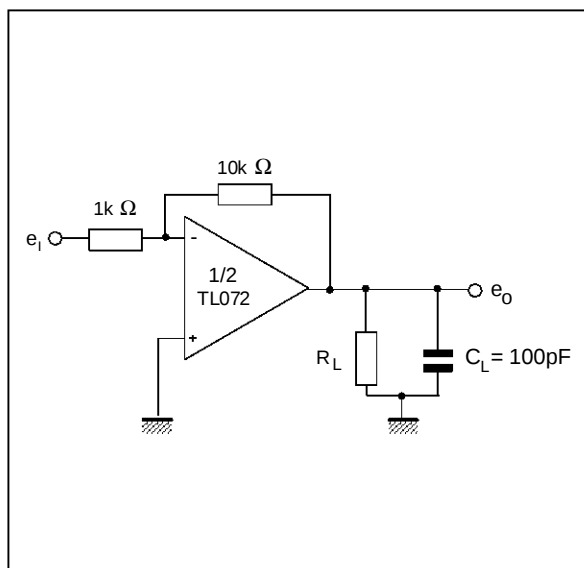
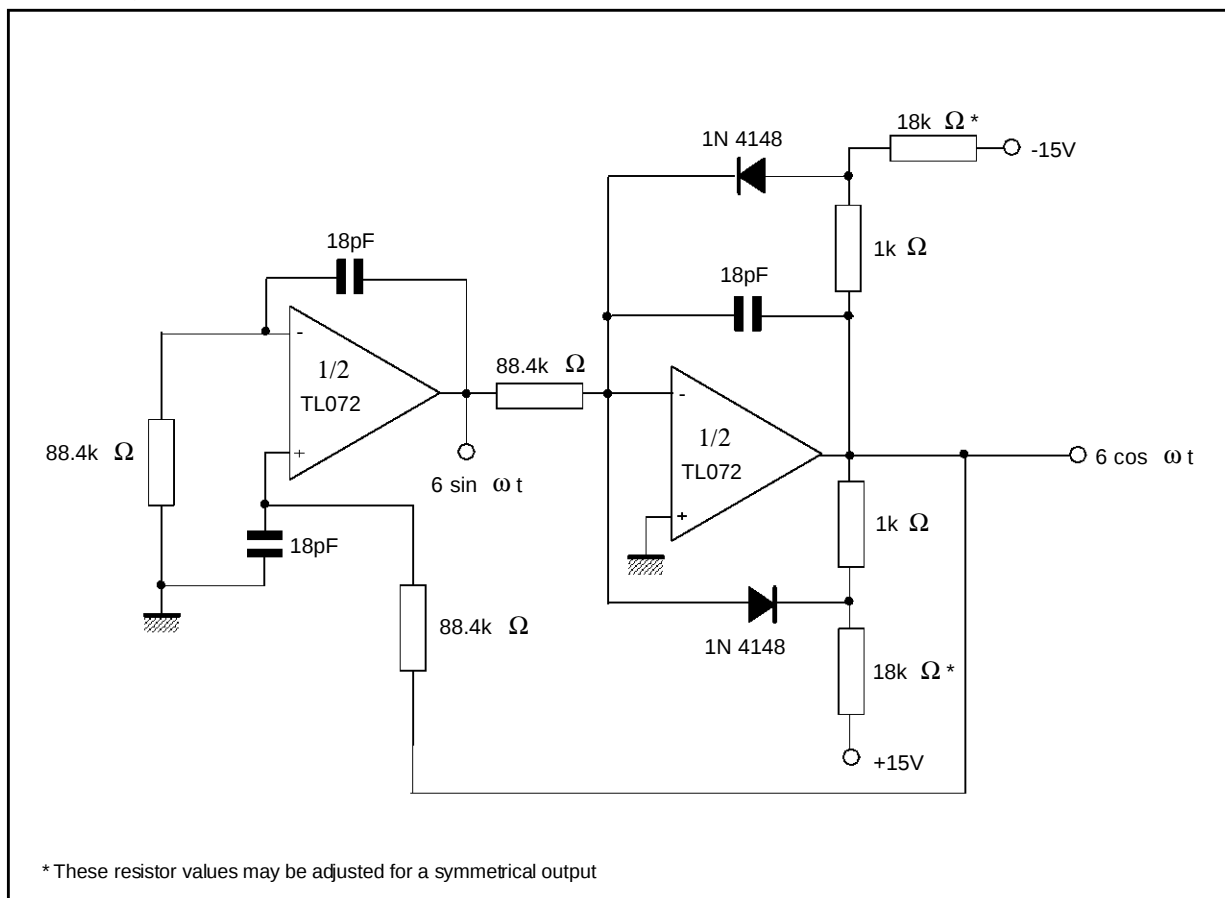


Figure 2 : Gain-of-10 Inverting Amplifier



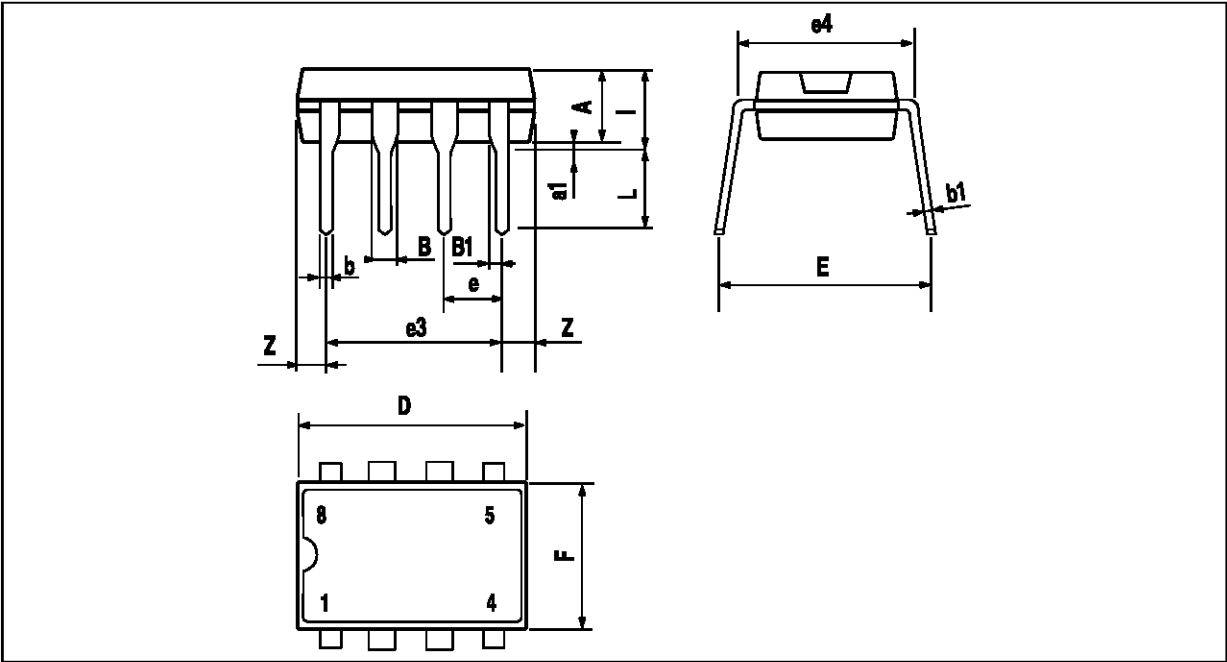
## TYPICAL APPLICATION

### 100KHz QUADRUPLE OSCILLATOR

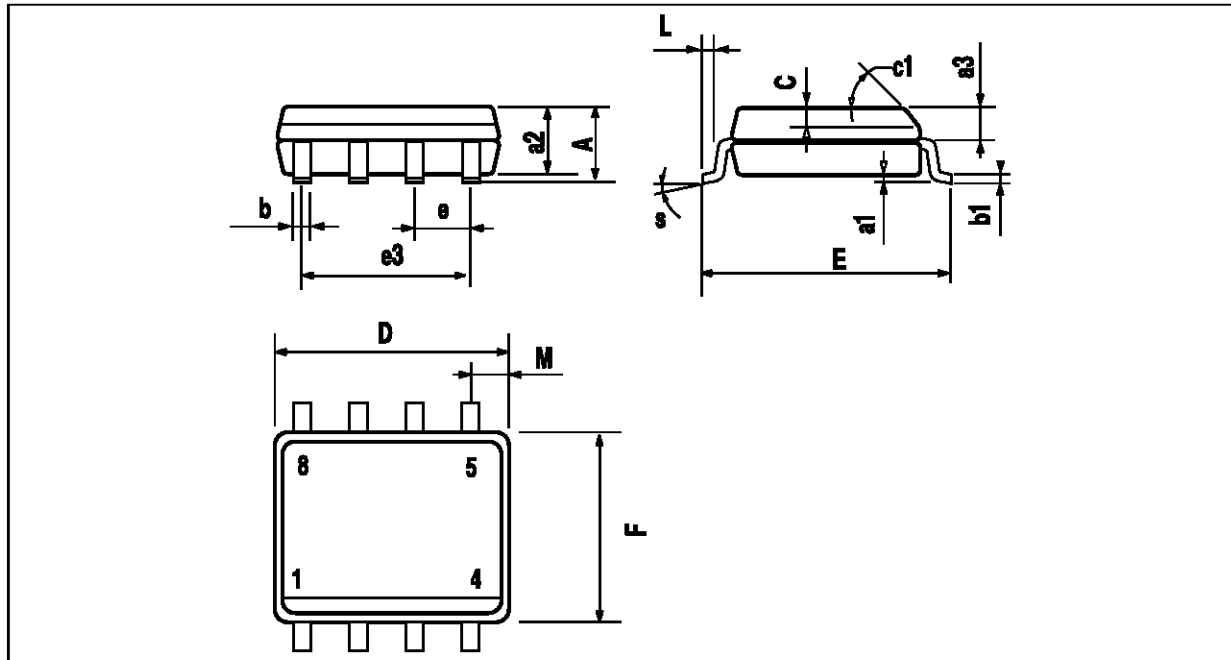


TL072 - TL072A - TL072B

PACKAGE MECHANICAL DATA  
8 PINS - PLASTIC DIP



| Dimensions | Millimeters |      |       | Inches |       |       |
|------------|-------------|------|-------|--------|-------|-------|
|            | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A          |             | 3.32 |       |        | 0.131 |       |
| a1         | 0.51        |      |       | 0.020  |       |       |
| B          | 1.15        |      | 1.65  | 0.045  |       | 0.065 |
| b          | 0.356       |      | 0.55  | 0.014  |       | 0.022 |
| b1         | 0.204       |      | 0.304 | 0.008  |       | 0.012 |
| D          |             |      | 10.92 |        |       | 0.430 |
| E          | 7.95        |      | 9.75  | 0.313  |       | 0.384 |
| e          |             | 2.54 |       |        | 0.100 |       |
| e3         |             | 7.62 |       |        | 0.300 |       |
| e4         |             | 7.62 |       |        | 0.300 |       |
| F          |             |      | 6.6   |        |       | 0.260 |
| i          |             |      | 5.08  |        |       | 0.200 |
| L          | 3.18        |      | 3.81  | 0.125  |       | 0.150 |
| Z          |             |      | 1.52  |        |       | 0.060 |

**PACKAGE MECHANICAL DATA****8 PINS - PLASTIC MICROPACKAGE (SO)**

PM-SO8 EPS

| Dimensions | Millimeters |      |      | Inches |       |       |
|------------|-------------|------|------|--------|-------|-------|
|            | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A          |             |      | 1.75 |        |       | 0.069 |
| a1         | 0.1         |      | 0.25 | 0.004  |       | 0.010 |
| a2         |             |      | 1.65 |        |       | 0.065 |
| a3         | 0.65        |      | 0.85 | 0.026  |       | 0.033 |
| b          | 0.35        |      | 0.48 | 0.014  |       | 0.019 |
| b1         | 0.19        |      | 0.25 | 0.007  |       | 0.010 |
| C          | 0.25        |      | 0.5  | 0.010  |       | 0.020 |
| c1         | 45° (typ.)  |      |      |        |       |       |
| D          | 4.8         |      | 5.0  | 0.189  |       | 0.197 |
| E          | 5.8         |      | 6.2  | 0.228  |       | 0.244 |
| e          |             | 1.27 |      |        | 0.050 |       |
| e3         |             | 3.81 |      |        | 0.150 |       |
| F          | 3.8         |      | 4.0  | 0.150  |       | 0.157 |
| L          | 0.4         |      | 1.27 | 0.016  |       | 0.050 |
| M          |             |      | 0.6  |        |       | 0.024 |
| S          | 8° (max.)   |      |      |        |       |       |

SO8.TBL

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