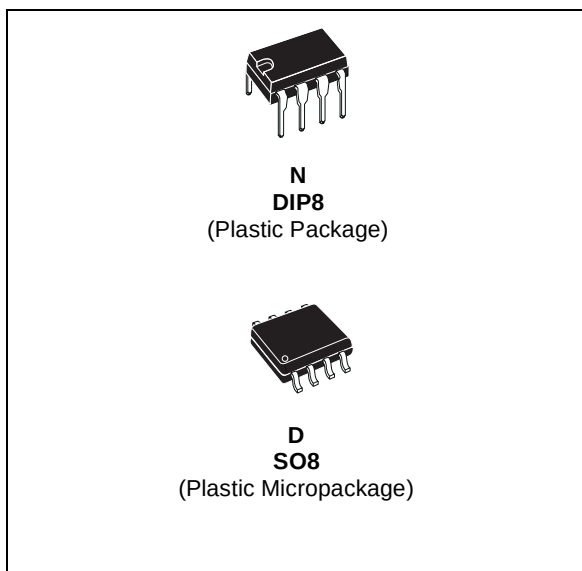




# TL081 TL081A - TL081B

## GENERAL PURPOSE J-FET SINGLE OPERATIONAL AMPLIFIERS

- WIDE COMMON-MODE (UP TO  $V_{CC}^+$ ) 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 : 16V/ $\mu$ s (typ)

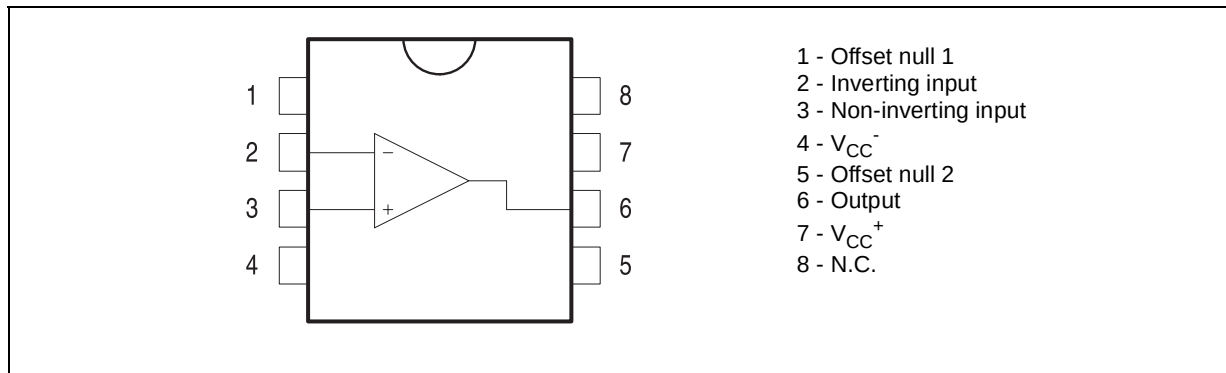


### DESCRIPTION

The TL081, TL081A and TL081B 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 currents, and low offset voltage temperature coefficient.

### PIN CONNECTIONS (top view)



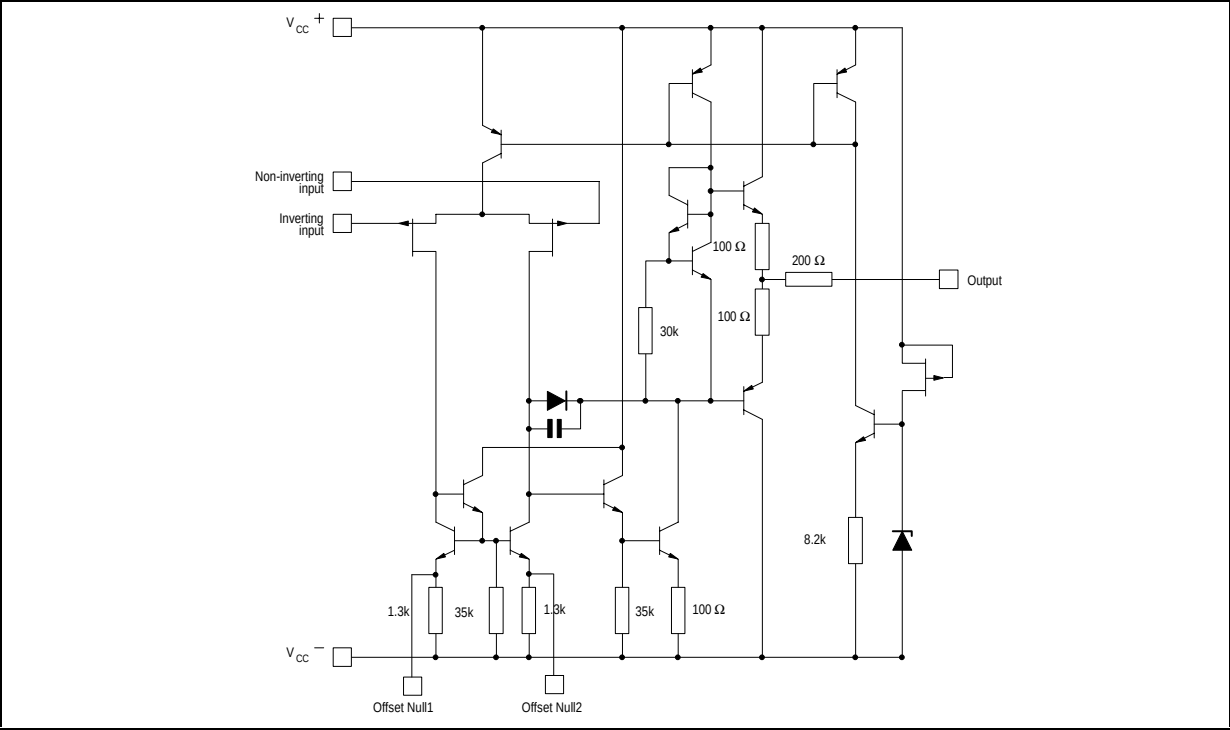
### ORDER CODE

| Part Number  | Temperature Range | Package |   |
|--------------|-------------------|---------|---|
|              |                   | N       | D |
| TL081M/AM/BM | -55°C, +125°C     | •       | • |
| TL081I/AI/BI | -40°C, +105°C     | •       | • |
| TL081C/AC/BC | 0°C, +70°C        | •       | • |

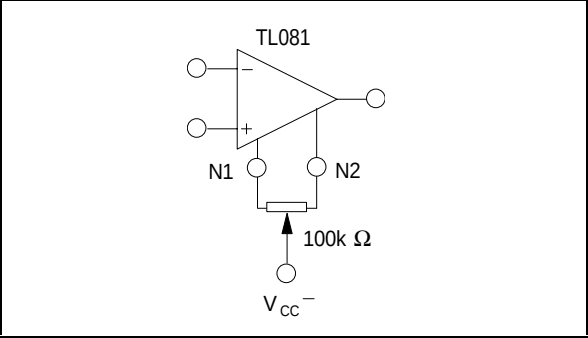
**Example :** TL081CD, TL081IN

**N** = Dual in Line Package (DIP)  
**D** = Small Outline Package (SO) - also available in Tape & Reel (DT)

SCHEMATIC DIAGRAM



INPUT OFFSET VOLTAGE NULL CIRCUIT



ABSOLUTE MAXIMUM RATINGS

| Symbol     | Parameter                                          | TL081M, AM, BM | TL081I, AI, BI | TL081C, AC, BC | Unit |
|------------|----------------------------------------------------|----------------|----------------|----------------|------|
| $V_{CC}$   | Supply voltage - note <sup>1)</sup>                | $\pm 18$       |                |                | V    |
| $V_i$      | Input Voltage - note <sup>2)</sup>                 | $\pm 15$       |                |                | V    |
| $V_{id}$   | Differential Input Voltage - note <sup>3)</sup>    | $\pm 30$       |                |                | V    |
| $P_{tot}$  | Power Dissipation                                  | 680            |                |                | mW   |
|            | Output Short-circuit Duration - note <sup>4)</sup> | Infinite       |                |                |      |
| $T_{oper}$ | Operating Free-air Temperature Range               | -55 to +125    | -40 to +105    | 0 to +70       | °C   |
| $T_{stg}$  | Storage Temperature Range                          | -65 to +150    |                |                | °C   |

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. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
3. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
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

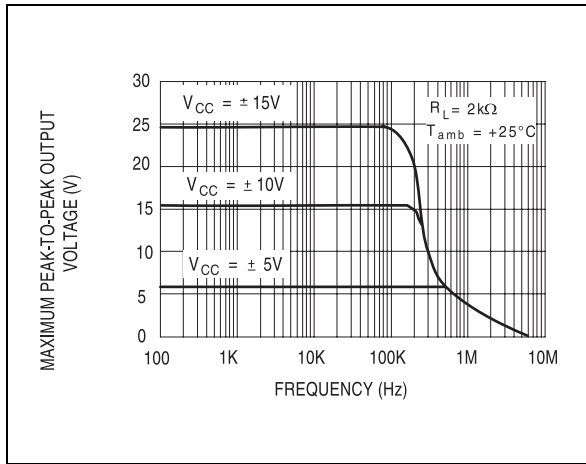
$V_{CC} = \pm 15V$ ,  $T_{amb} = +25^{\circ}C$  (unless otherwise specified)

| Symbol        | Parameter                                                                                                                                                                 | TL081I,M,AC,AI,AM,BC,BI,BM |             |                              | TL081C               |            |              | 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>TL081<br>TL081A<br>TL081B<br>TL081<br>TL081A<br>TL081B    |                            | 3<br>3<br>1 | 10<br>6<br>3<br>13<br>7<br>5 |                      | 3          | 10<br><br>13 | mV                |
| $DV_{io}$     | Input Offset Voltage Drift                                                                                                                                                |                            | 10          |                              |                      | 10         |              | $\mu V/^{\circ}C$ |
| $I_{io}$      | Input Offset Current - note 1)<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 -note 1<br>$T_{amb} = +25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                             |                            | 20          | 200<br>20                    |                      | 20         | 400<br>20    | 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, 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 ( $T_{amb} = +25^{\circ}C$ )<br>$V_{in} = 10V$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain                                                                  | 8                          | 16          |                              | 8                    | 16         |              | V/ $\mu s$        |
| $t_r$         | Rise Time ( $T_{amb} = +25^{\circ}C$ )<br>$V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain                                                                 |                            | 0.1         |                              |                      | 0.1        |              | $\mu s$           |
| $K_{ov}$      | Overshoot ( $T_{amb} = +25^{\circ}C$ )<br>$V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain                                                                 |                            | 10          |                              |                      | 10         |              | %                 |
| GBP           | Gain Bandwidth Product ( $T_{amb} = +25^{\circ}C$ )<br>$V_{in} = 10mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , $f = 100kHz$                                                  | 2.5                        | 4           |                              | 2.5                  | 4          |              | MHz               |
| $R_i$         | Input Resistance                                                                                                                                                          |                            | $10^{12}$   |                              |                      | $10^{12}$  |              | $\Omega$          |

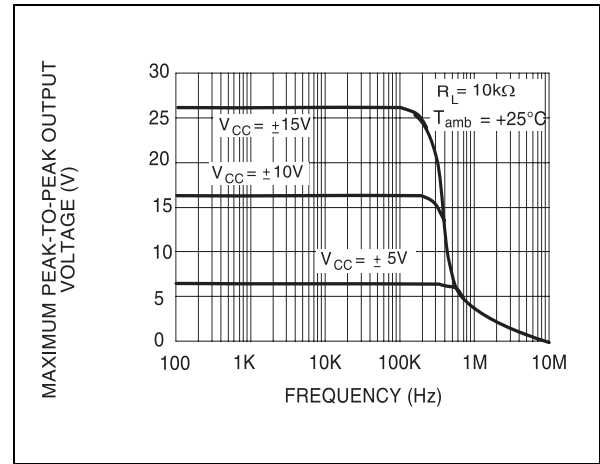
| Symbol   | Parameter                                                                                                                                                                       | TL081I,M,AC,AI,AM,<br>BC,BI,BM |      |      | TL081C |      |      | Unit                                 |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------|------|--------|------|------|--------------------------------------|
|          |                                                                                                                                                                                 | Min.                           | Typ. | Max. | Min.   | Typ. | Max. |                                      |
| THD      | Total Harmonic Distortion ( $T_{amb} = +25^{\circ}\text{C}$ ),<br>$f = 1\text{kHz}$ , $R_L = 2\text{k}\Omega$ , $C_L = 100\text{pF}$ , $A_v = 20\text{dB}$ ,<br>$V_o = 2V_{pp}$ |                                | 0.01 |      |        | 0.01 |      | %                                    |
| $e_n$    | Equivalent Input Noise Voltage<br>$R_S = 100\Omega$ , $f = 1\text{KHz}$                                                                                                         |                                | 15   |      |        | 15   |      | $\frac{\text{nV}}{\sqrt{\text{Hz}}}$ |
| $\phi_m$ | Phase Margin                                                                                                                                                                    |                                | 45   |      |        | 45   |      | degrees                              |

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

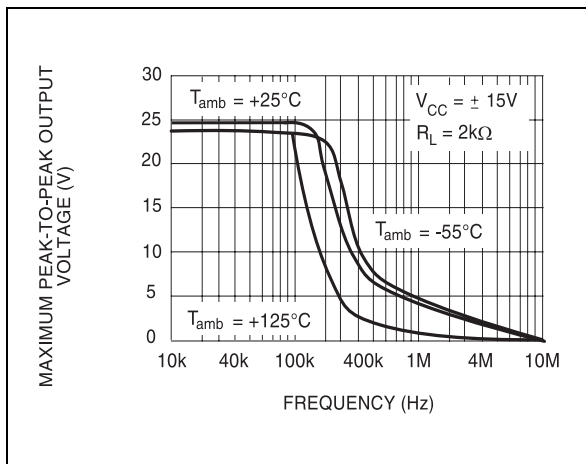
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREQUENCY**



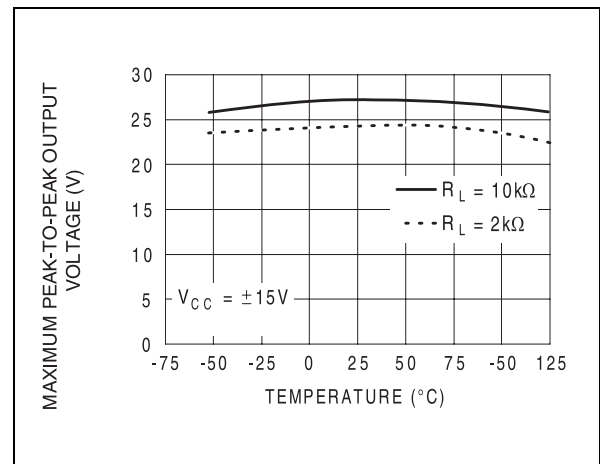
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREQUENCY**



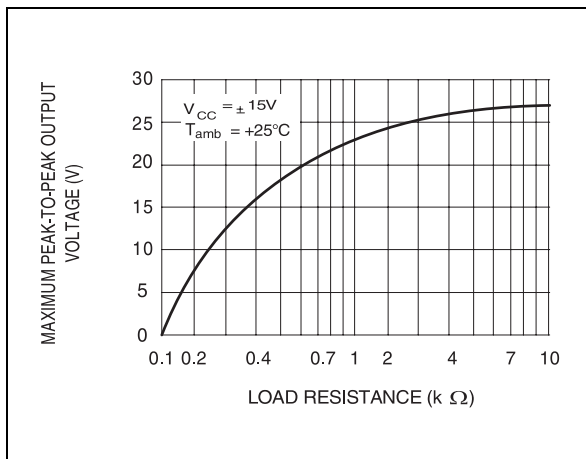
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREQUENCY**



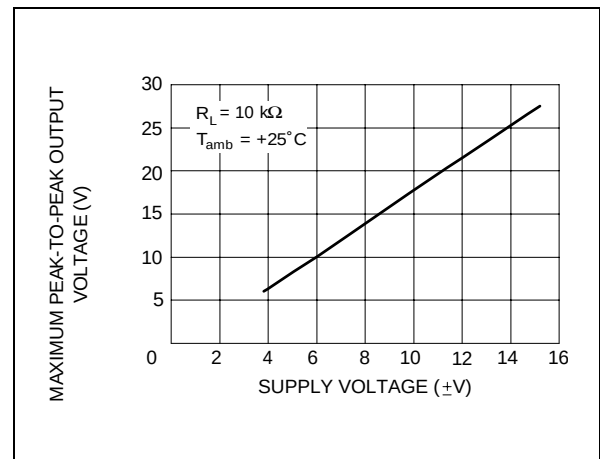
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus FREE AIR TEMP.**



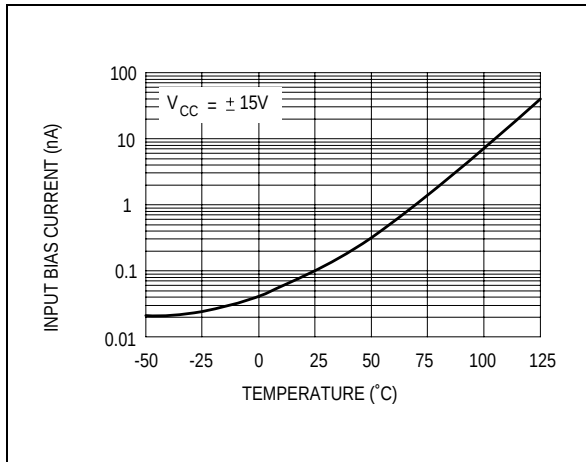
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus LOAD RESISTANCE**



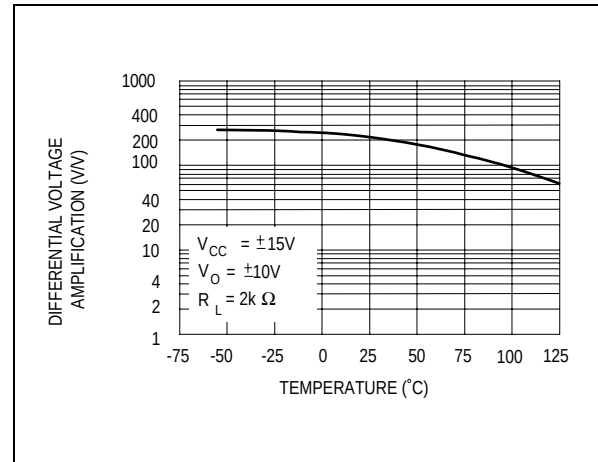
**MAXIMUM PEAK-TO-PEAK OUTPUT  
VOLTAGE versus SUPPLY VOLTAGE**



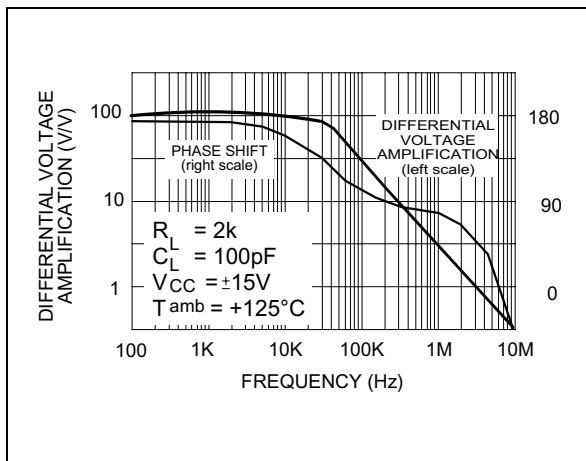
**INPUT BIAS CURRENT versus FREE AIR TEMPERATURE**



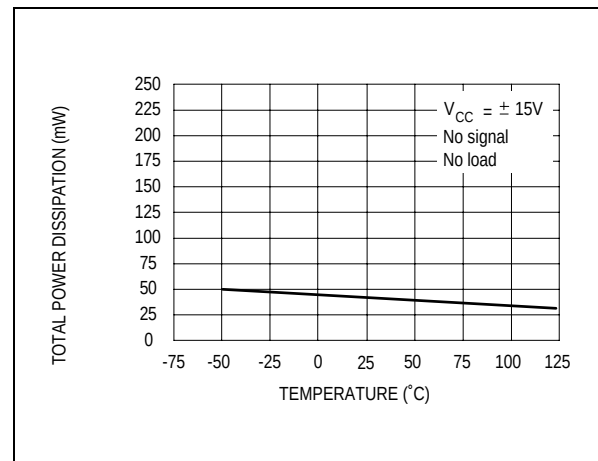
**LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION versus FREE AIR TEMP.**



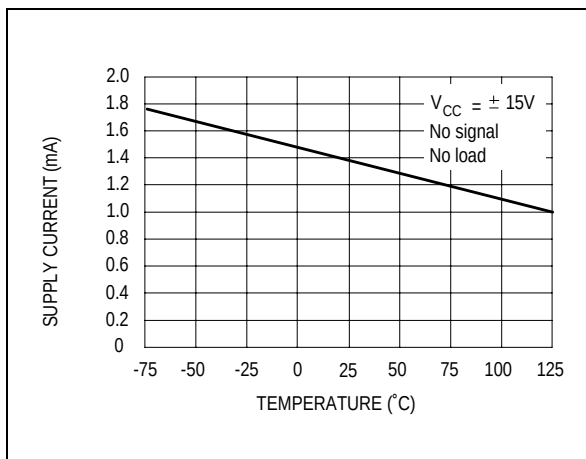
**LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT versus FREQUENCY**



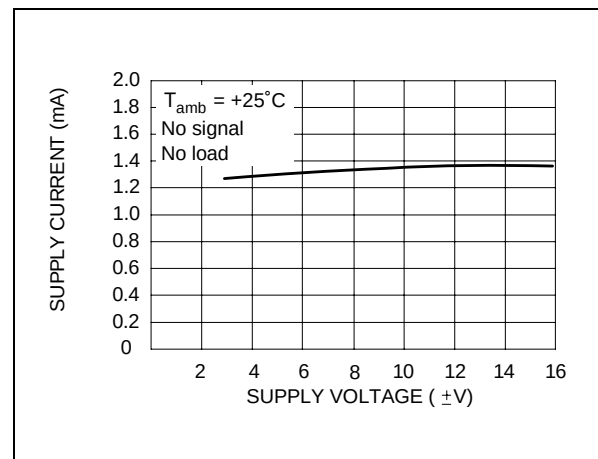
**TOTAL POWER DISSIPATION versus FREE AIR TEMPERATURE**



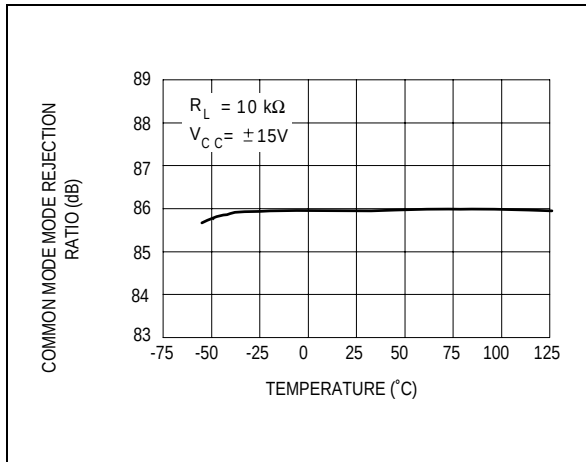
**SUPPLY CURRENT PER AMPLIFIER versus FREE AIR TEMPERATURE**



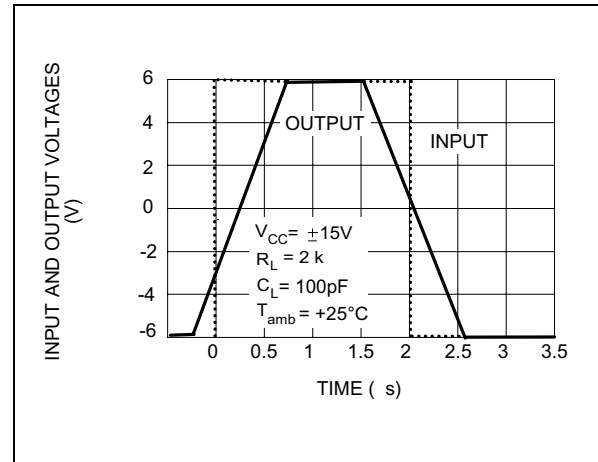
**SUPPLY CURRENT PER AMPLIFIER versus SUPPLY VOLTAGE**



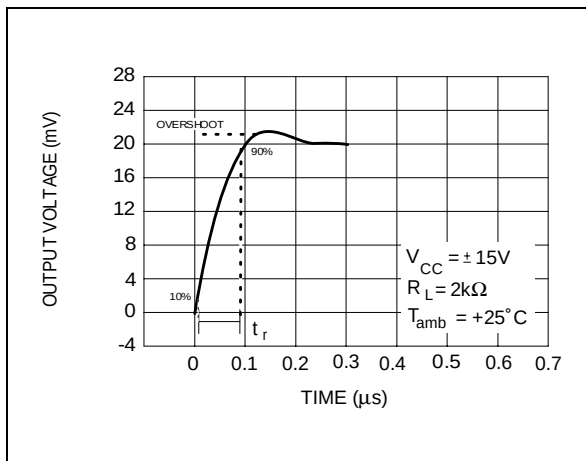
**COMMON MODE REJECTION RATIO versus FREE AIR TEMPERATURE**



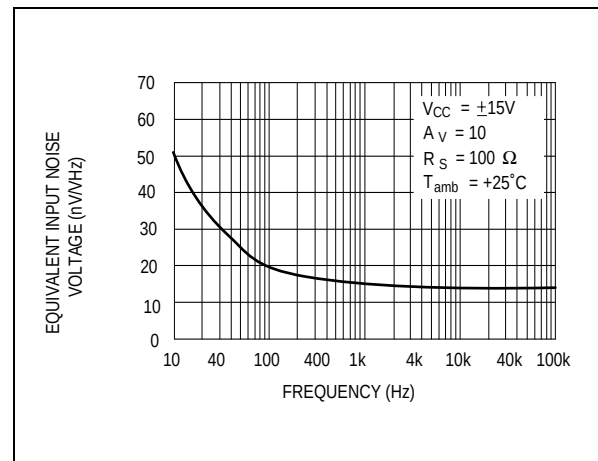
**VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE**



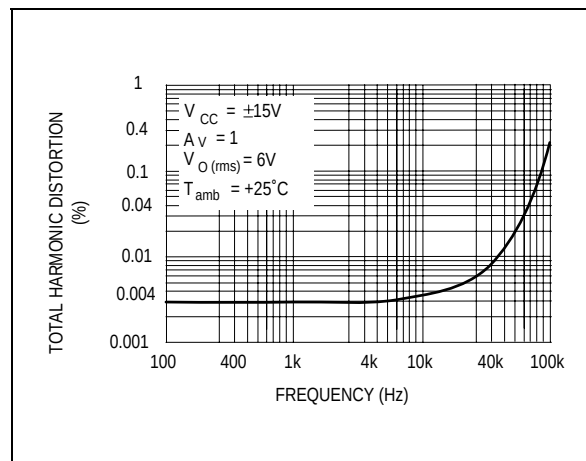
**OUTPUT VOLTAGE versus ELAPSED TIME**



**EQUIVALENT INPUT NOISE VOLTAGE versus FREQUENCY**

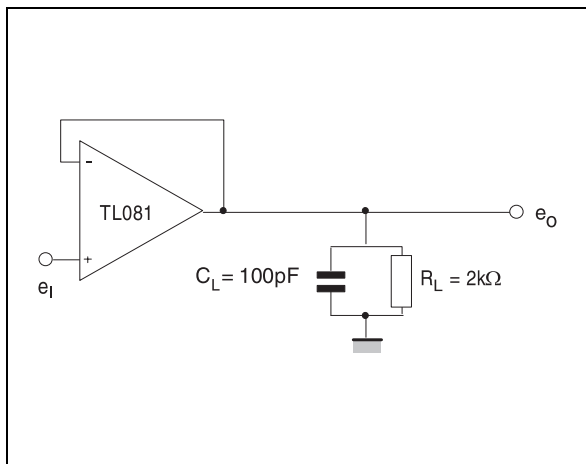


**TOTAL HARMONIC DISTORTION versus FREQUENCY**

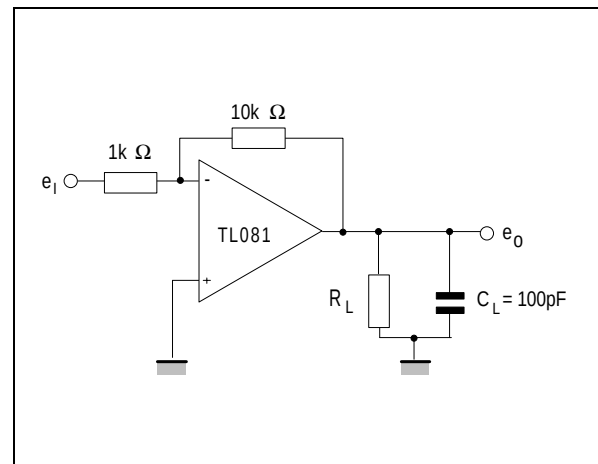


## PARAMETER MEASUREMENT INFORMATION

**Figure 1 : Voltage Follower**

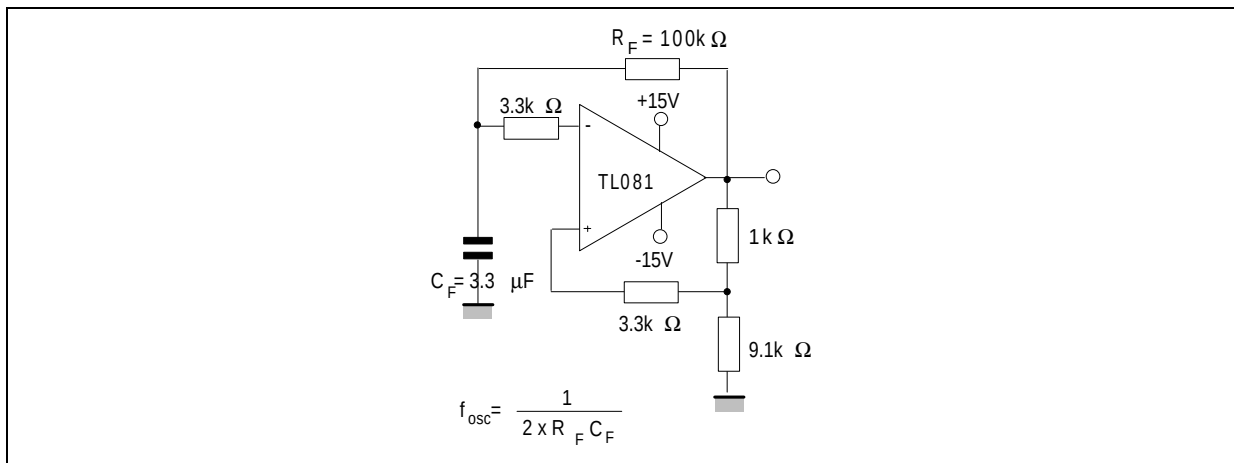


**Figure 2 : Gain-of-10 Inverting Amplifier**

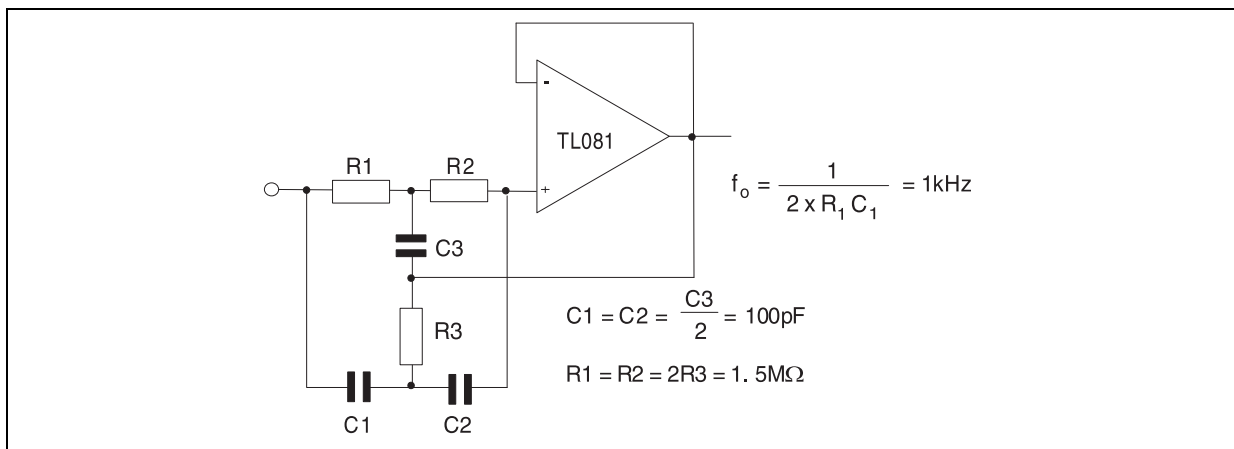


## TYPICAL APPLICATIONS

### (0.5Hz) SQUARE WAVE OSCILLATOR



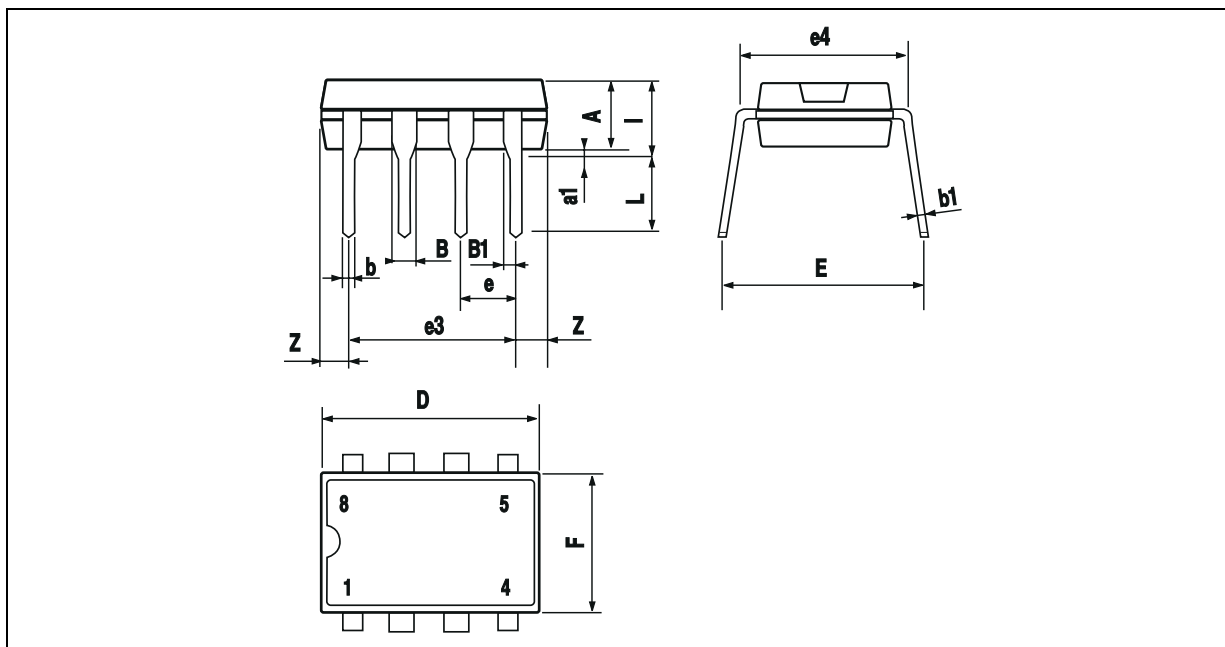
### HIGH Q NOTCH FILTER





**PACKAGE MECHANICAL DATA**

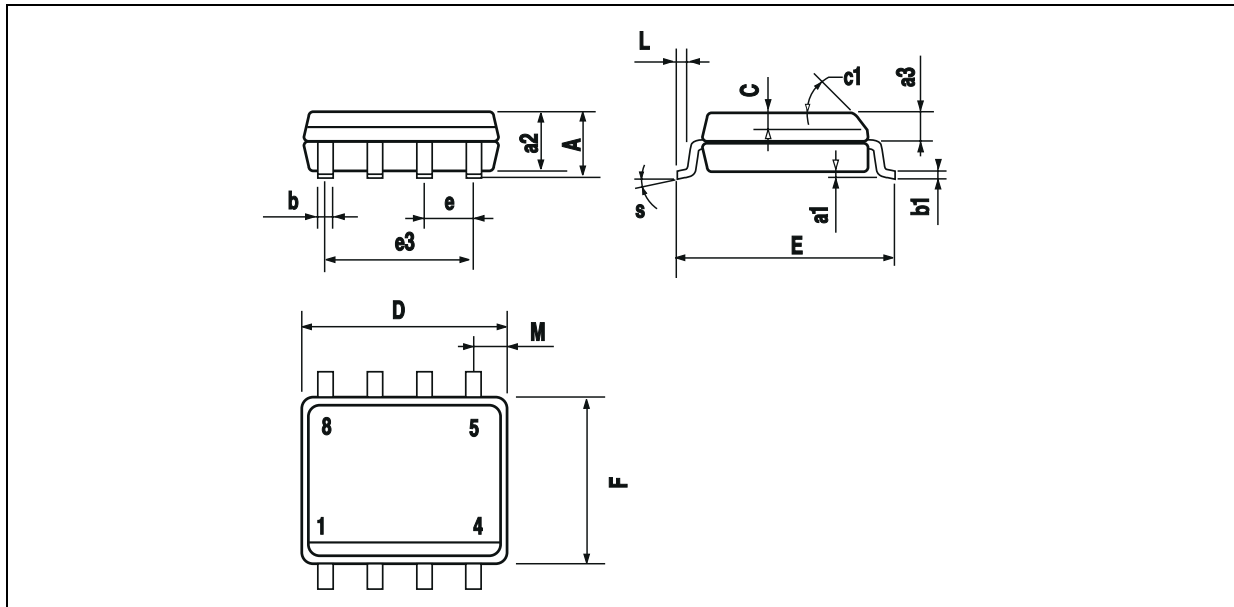
8 PINS - PLASTIC DIP



| Dim. | 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)**



| Dim. | 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.)   |      |      |        |       |       |

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