

# TL022C, TL022M DUAL LOW-POWER OPERATIONAL AMPLIFIERS

SLOS076 – SEPTEMBER 1973 – REVISED SEPTEMBER 1990

- Very Low Power Consumption
- Power Dissipation With  $\pm 2$ -V Supplies  
170  $\mu$ W Typ
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Input Offset Voltage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- Popular Dual Operational Amplifier Pinout

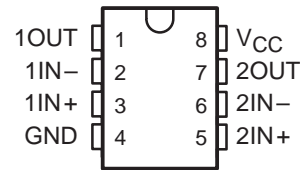
**TL022M IS NOT RECOMMENDED FOR  
NEW DESIGNS**

## description

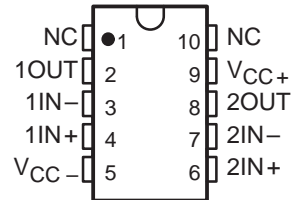
The TL022 is a dual low-power operational amplifier designed to replace higher power devices in many applications without sacrificing system performance. High input impedance, low supply currents, and low equivalent input noise voltage over a wide range of operating supply voltages result in an extremely versatile operational amplifier for use in a variety of analog applications including battery-operated circuits. Internal frequency compensation, absence of latch-up, high slew rate, and output short-circuit protection assure ease of use.

The TL022C is characterized for operation from 0°C to 70°C. The TL022M is characterized for operation over the full military temperature range of -55°C to 125°C.

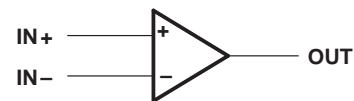
TL022M . . . JG PACKAGE  
TL022C . . . D OR P PACKAGE  
(TOP VIEW)



TL022M . . . U PACKAGE  
(TOP VIEW)



## symbol (each amplifier)



## AVAILABLE OPTIONS

| T <sub>A</sub> | V <sub>IO</sub> max<br>AT 25°C | PACKAGE              |                     |                    |                          |
|----------------|--------------------------------|----------------------|---------------------|--------------------|--------------------------|
|                |                                | SMALL OUTLINE<br>(D) | CERAMIC DIP<br>(JG) | PLASTIC DIP<br>(P) | CERAMIC FLAT PACK<br>(U) |
| 0°C to 70°C    | 5 mV                           | TL022CD              | —                   | TL022CP            | —                        |
| -55°C to 125°C | 5 mV                           | —                    | TL022MJG            | —                  | TL022MU                  |

The D package is available taped and reeled. Add the suffix R to the device type (i.e. TL022CDR).

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## schematic



## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|  | TL022C                       | TL022M     | UNIT               |
|--|------------------------------|------------|--------------------|
| Supply voltage, $V_{CC+}$ (see Note 1)                       | 18                           | 22         | V                  |
| Supply voltage, $V_{CC-}$ (see Note 1)                       | -18                          | -22        | V                  |
| Differential input voltage (see Note 2)                      | $\pm 30$                     | $\pm 30$   | V                  |
| Input voltage (any input, see Notes 1 and 3)                 | $\pm 15$                     | $\pm 15$   | V                  |
| Duration of output short circuit (see Note 4)                | unlimited                    | unlimited  |                    |
| Continuous total dissipation                                 | See Dissipation Rating Table |            |                    |
| Operating free-air temperature range                         | 0 to 70                      | -55 to 125 | $^{\circ}\text{C}$ |
| Storage temperature range                                    | -65 to 150                   | -65 to 150 | $^{\circ}\text{C}$ |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds | JG or U package              | 300        | $^{\circ}\text{C}$ |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | D or P package               | 260        | $^{\circ}\text{C}$ |

- NOTES: 1. All voltage values, unless otherwise noted, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .  
 2. Differential voltages are at  $\text{IN}+$  with respect to  $\text{IN}-$ .  
 3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.  
 4. The output may be shorted to ground or either power supply. For the TL022M only, the unlimited duration of the short circuit applies at (or below) 125 $^{\circ}\text{C}$  case temperature or 75 $^{\circ}\text{C}$  free-air temperature.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^{\circ}\text{C}$<br>POWER RATING | DERATING<br>FACTOR         | DERATE<br>ABOVE $T_A$ | $T_A = 70^{\circ}\text{C}$<br>POWER RATING | $T_A = 125^{\circ}\text{C}$<br>POWER RATING |
|---------|---|----------------------------|-----------------------|--|---|
| D       | 680 mW  | 5.8 mW/ $^{\circ}\text{C}$ | 33 $^{\circ}\text{C}$ | 464 mW                                     | —   |
| JG      | 680 mW  | 8.4 mW/ $^{\circ}\text{C}$ | 69 $^{\circ}\text{C}$ | 672 mW                                     | 210 mW                                      |
| P       | 680 mW  | 8.0 mW/ $^{\circ}\text{C}$ | 65 $^{\circ}\text{C}$ | 640 mW                                     | —   |
| U       | 675 mW  | 5.4 mW/ $^{\circ}\text{C}$ | 25 $^{\circ}\text{C}$ | 432 mW                                     | 135 mW                                      |



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## recommended operating conditions

|                           | MIN | MAX | UNIT |
|---------------------------|-----|-----|------|
| Supply voltage, $V_{CC+}$ | 5   | 15  | V    |
| Supply voltage, $V_{CC-}$ | -5  | -15 | V    |

## electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

| PARAMETER  | TEST CONDITIONS†                                       | TL022C     |     |     | TL022M |     |                 | UNIT          |
|--|--|------------|-----|-----|--------|-----|-----------------|---------------|
|  |  | MIN        | TYP | MAX | MIN    | TYP | MAX             |               |
| $V_{IO}$ Input offset voltage  | $V_O = 0$ ,<br>$R_S = 50 \Omega$                       | 25°C       | 1   | 5   | 1      | 5   | mV              |               |
|  |  | Full range |     | 7.5 |        | 6   |                 |               |
| $I_{IO}$ Input offset current  | $V_O = 0$  | 25°C       | 15  | 80  | 5      | 40  | nA              |               |
|  |  | Full range |     | 200 |        | 100 |                 |               |
| $I_{IB}$ Input bias current  | $V_O = 0$  | 25°C       | 100 | 250 | 50     | 100 | nA              |               |
|  |  | Full range |     | 400 |        | 250 |                 |               |
| $V_{ICR}$ Common-mode input voltage range                              |  | 25°C       | ±12 | ±13 | ±12    | ±13 | V               |               |
|  |  | Full range | ±12 |     | ±12    |     |                 |               |
| $V_{O(PP)}$ Maximum peak-to-peak output voltage swing                  | $R_L = 10 \text{ k}\Omega$                             | 25°C       | 20  | 26  | 20     | 26  | V               |               |
|  | $R_L \geq 10 \text{ k}\Omega$                          | Full range | 20  |     | 20     |     |                 |               |
| $A_{VD}$ Large-signal differential voltage amplification               | $R_L \geq 10 \text{ k}\Omega$ ,<br>$V_O = \pm 10$ V    | 25°C       | 60  | 80  | 72     | 86  | dB              |               |
|  |  | Full range | 60  |     | 66     |     |                 |               |
| $B_1$ Unity-gain bandwidth   |  | 25°C       |     | 0.5 |        | 0.5 | MHz             |               |
| CMRR Common-mode rejection ratio                                       | $V_{IC} = V_{ICRmin}$ ,<br>$R_S = 50 \Omega$           | 25°C       | 60  | 72  | 60     | 72  | dB              |               |
|  |  | Full range | 60  |     | 60     |     |                 |               |
| $k_{SVS}$ Supply voltage sensitivity ( $\Delta V_{IO}/\Delta V_{CC}$ ) | $V_{CC} = \pm 9$ V to $\pm 15$ V,<br>$R_S = 50 \Omega$ | 25°C       | 30  | 200 | 30     | 150 | $\mu\text{V/V}$ |               |
|  |  | Full range |     | 200 |        | 150 |                 |               |
| $V_n$ Equivalent input noise voltage                                   | $A_{VD} = 20$ dB,<br>$B = 1$ Hz,                       | 25°C       |     | 50  |        | 50  | nV/Hz           |               |
| $I_{OS}$ Short-circuit output current                                  |  | 25°C       |     | ±6  |        | ±6  | mA              |               |
| $I_{CC}$ Supply current (both amplifiers)                              | $V_O = 0$ , No load                                    | 25°C       |     | 130 | 250    | 130 | 250             | $\mu\text{A}$ |
|  |  | Full range |     |     | 250    |     | 250             |               |
| $P_D$ Total dissipation (both amplifiers)                              | $V_O = 0$ , No load                                    | 25°C       |     | 3.9 | 7.5    | 3.9 | 6               | mW            |
|  |  | Full range |     |     | 7.5    |     | 6               |               |

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for TL022C is 0°C to 70°C and for TL022M is -55°C to 125°C.

## operating characteristics, $V_{CC\pm} = \pm 15$ V, $T_A = 25^\circ\text{C}$

| PARAMETER                  | TEST CONDITIONS  | MIN | TYP | MAX | UNIT             |
|----------------------------|--|-----|-----|-----|------------------|
| $t_r$ Rise time            | $V_I = 20$ mV, $R_L = 10 \text{ k}\Omega$ , $C_L = 100$ pF, See Figure 1 |     | 0.3 |     | $\mu\text{s}$    |
| Overshoot factor           |  |     | 5%  |     |                  |
| SR Slew rate at unity gain | $V_I = 10$ V, $R_L = 10 \text{ k}\Omega$ , $C_L = 100$ pF, See Figure 1  |     | 0.5 |     | V/ $\mu\text{s}$ |



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## PARAMETER MEASUREMENT INFORMATION

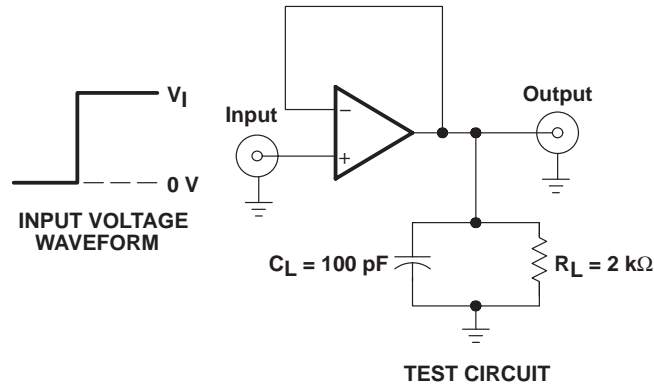


Figure 1. Rise Time, Overshoot Factor, and Slew Rate

## TYPICAL CHARACTERISTICS

TOTAL POWER DISSIPATION  
vs  
SUPPLY RATE

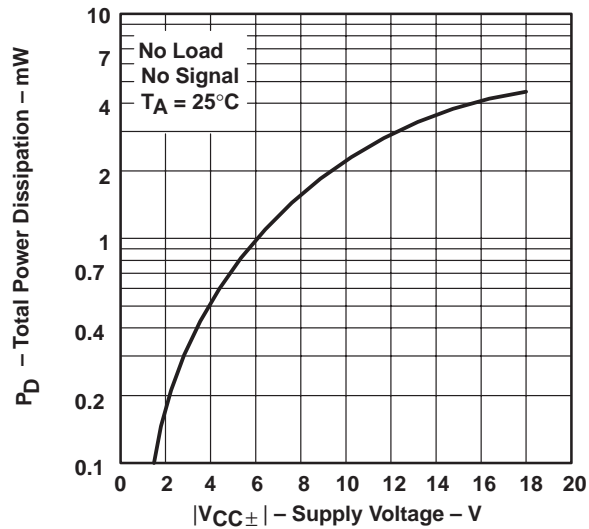


Figure 2

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