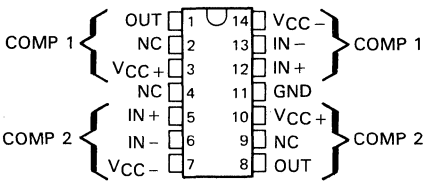
# TYPES TL820M, TIL820C
# DUAL DIFFERENTIAL COMPARATORS

D996, OCTOBER 1977—REVISED AUGUST 1983

- **Fast Response Times**
- **High Differential Voltage Amplification**
- **Low Offset Characteristics**
- **Outputs Compatible with Most TTL Circuits**

**J OR N DUAL-IN-LINE PACKAGE (TOP VIEW)**



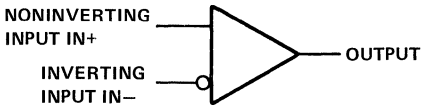

NC—No internal connection

## description

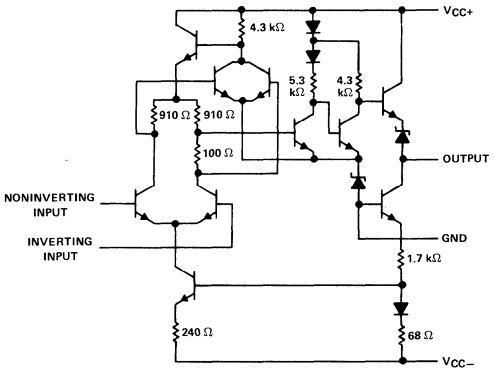
The TL820 is an improved version of the TL720 dual high-speed voltage comparator. Each comparator has differential inputs and a low-impedance output. When compared with the TL720, these circuits feature high amplification (typically 33,000) due to an extra amplification stage and increased accuracy because of lower offset characteristics. They are particularly useful in applications requiring an amplitude discriminator, memory sense amplifier, or a high-speed limit detector.

The TL820M is characterized for operation over the full military temperature range of −55°C to 125°C; the TL820C is characterized for operation from 0°C to 70°C.

## symbol (each comparator)




## schematic (each comparator)




Component values shown are nominal.

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

Supply voltage $V_{CC+}$ (see Note 1) . . . . . 14 V
Supply voltage $V_{CC-}$ (see Note 1) . . . . . −7 V
Differential input voltage (see Note 2) . . . . . ±5 V
Input voltage (any input, see Note 1) . . . . . ±7 V
Peak output current ($t_w \leq 1$ s) . . . . . 10 mA
Continuous total power dissipation at (or below) 70°C free-air temperature: each comparator . . . . . 300 mW
total package (see Note 3) . . 600 mW
Operating free-air temperature range: TL820M Circuits . . . . . −55°C to 125°C
TL820C Circuits . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J package . . . . . 300°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: N package . . . . . 260°C

NOTES: 1. All voltage values, except differential voltages, are with respect to the network ground terminal.
2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
3. For operation of the TL820M above 70°C free-air temperature, refer to Dissipation Derating Curves, Section 2. In the J package, TL820M chips are alloy-mounted, TL820C chips are glass-mounted.

## electrical characteristics at specified free-air temperature, $V_{CC+}$ = 12 V, $V_{CC-}$ = −6 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS† | | TL820M | | | TL820C | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_{IO}$ | Input offset voltage | $R_S \leq 200\ \Omega$, See Note 4 | 25°C | | 0.6 | 2 | | 1.6 | 3.5 | mV |
| | | | Full range | | | 3 | | | 4.5 | |
| $\alpha_{VIO}$ | Average temperature coefficient of input offset voltage | $R_S$ = 50 Ω, See Note 4 | MIN to 25°C | | 3 | 10 | | 3 | 20 | μV/°C |
| | | | 25°C to MAX | | 3 | 10 | | 3 | 20 | |
| $I_{IO}$ | Input offset current | See Note 4 | 25°C | | 0.75 | 3 | | 1.8 | 5 | μA |
| | | | MIN | | 1.8 | 7 | | | 7.5 | |
| | | | MAX | | 0.25 | 3 | | | 7.5 | |
| $\alpha_{IIO}$ | Average temperature coefficient of input offset current | See Note 4 | MIN to 25°C | | 15 | 75 | | 24 | 100 | nA/°C |
| | | | 25°C to MAX | | 5 | 25 | | 15 | 50 | |
| $I_{IB}$ | Input bias current | See Note 4 | 25°C | | 7 | 15 | | 7 | 20 | μA |
| | | | MIN | | 12 | 25 | | 9 | 30 | |
| $V_{ICR}$ | Common-mode input voltage range | $V_{CC-}$ = −7 V | Full range | ±5 | | | ±5 | | | V |
| $V_{ID}$ | Differential input voltage range | | Full range | ±5 | | | ±5 | | | V |
| $A_{VD}$ | Large-signal differential voltage amplification | No load, $V_O$ = 0 to 2.5 V | 25°C | 12.5 | 33 | | 10 | 33 | | V/mV |
| | | | Full range | 10 | | | 8 | | | |
| $V_{OH}$ | High-level output voltage | $V_{ID}$ = 5 mV, $I_{OH}$ = 0 | Full range | | 4§ | 5 | | 4§ | 5 | V |
| | | $V_{ID}$ = 5 mV, $I_{OH}$ = −5 mA | Full range | 2.5 | 3.6§ | | 2.5 | 3.6§ | | |
| $V_{OL}$ | Low-level output voltage | $V_{ID}$ = −5 mV, $I_{OL}$ = 0 | Full range | −1 | −0.5§ | 0‡ | −1 | −0.5§ | 0‡ | V |
| $I_{OL}$ | Low-level output current | $V_{ID}$ = −5 mV, $V_O$ = 0 | 25°C | 2 | 2.4 | | 1.6 | 2.4 | | mA |
| | | | MIN | 1 | 2.3 | | 0.5 | 2.4 | | |
| | | | MAX | 0.5 | 2.3 | | 0.5 | 2.4 | | |
| $r_o$ | Output resistance | $V_O$ = 1.4 V | 25°C | | 200 | | | 200 | | Ω |
| CMRR | Common-mode rejection ratio | $R_S \leq 200\ \Omega$ | Full range | 80 | 100§ | | 70 | 100§ | | dB |
| $I_{CC+}$ | Supply current from $V_{CC+}$ (each comparator) | $V_{ID}$ = −5 mV, No load | Full range | | 5.5§ | 9 | | 5.5§ | 9 | mA |
| $I_{CC-}$ | Supply current from $V_{CC-}$ (each comparator) | | Full range | | −3.5§ | −7 | | −3.5§ | −7 | mA |
| $P_D$ | Total power dissipation (each comparator) | | Full range | | 90§ | 150 | | 90§ | 150 | mW |

†Full range (MIN to MAX) for TL820M is −55°C to 125°C and for the TL820C is 0°C to 70°C.

‡The algebraic convention where the most-positive (least-negative) limit is designated as maximum is used in this data sheet for logic levels only, e.g., when 0 V is the maximum, the minimum limit is a more-negative voltage.

§These typical values are at $T_A$ = 25°C.

NOTE 4: These characteristics are verified by measurements at the following temperatures and output voltage levels: for TL820M, $V_O$ = 1.8 V at $T_A$ = −55°C, $V_O$ = 1.4 V at $T_A$ = 25°C, and $V_O$ = 1 V at $T_A$ = 125°C; for TL820C, $V_O$ = 1.5 V at $T_A$ = 0°C, $V_O$ = 1.4 V at 25°C, and $V_O$ = 1.2 V at $T_A$ = 70°C. These output voltage levels were selected to approximate the logic threshold voltages of the types of digital logic circuits these comparators are intended to drive.

## switching characteristics, $V_{CC+}$ = 12 V, $V_{CC-}$ = −6 V, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| Response time | $R_L = \infty$, $C_L$ = 5 pF, See Note 5 | | 30 | 80 | ns |

NOTE 5: The response time specified is for a 100-mV input step with 5-mV overdrive and is the interval between the input step function and the instant when the output crosses 1.4 V.





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## TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

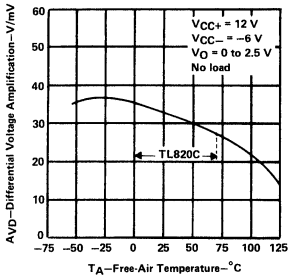


FIGURE 1

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs SUPPLY VOLTAGE

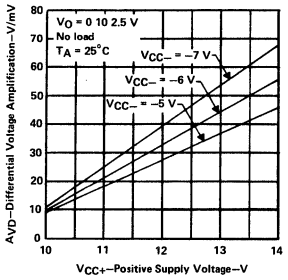


FIGURE 2

OUTPUT VOLTAGE LEVELS vs FREE-AIR TEMPERATURE

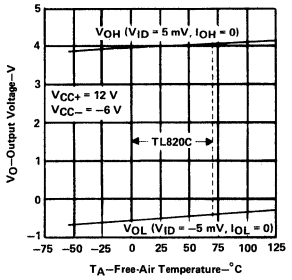


FIGURE 3

LOW-LEVEL OUTPUT CURRENT vs FREE-AIR TEMPERATURE

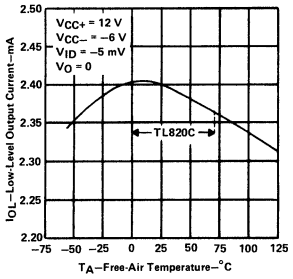


FIGURE 4

**TL820M**
VOLTAGE TRANSFER CHARACTERISTICS

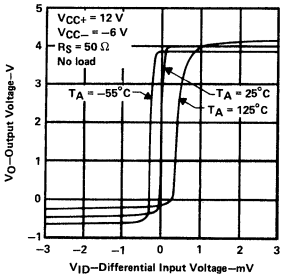


FIGURE 5

**TL820C**
VOLTAGE TRANSFER CHARACTERISTICS

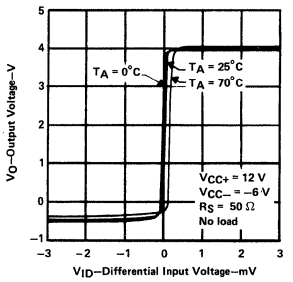


FIGURE 6

## TYPICAL CHARACTERISTICS

INPUT BIAS CURRENT
vs
FREE-AIR TEMPERATURE

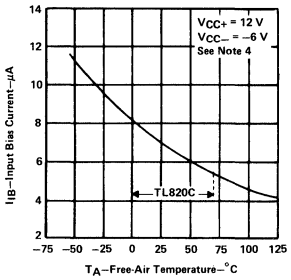


FIGURE 7

COMMON-MODE REJECTION RATIO
vs
FREE-AIR TEMPERATURE

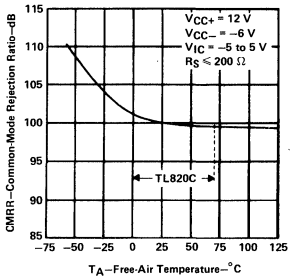


FIGURE 8

COMMON-MODE PULSE RESPONSE

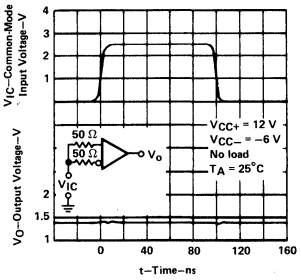


FIGURE 9

OUTPUT RESPONSE FOR
VARIOUS INPUT OVERDRIVES

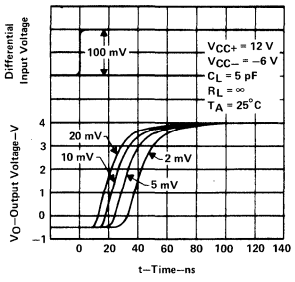


FIGURE 10

TOTAL POWER DISSIPATION
vs
FREE-AIR TEMPERATURE

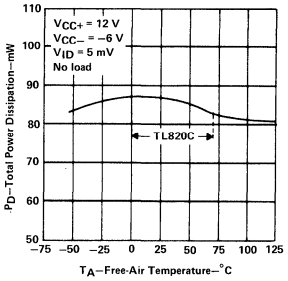


FIGURE 11

NOTE 4: These characteristics are verified by measurements at the following temperatures and output voltage levels: for TL820M, $V_O$ = 1.8 V at $T_A$ = – 55°C, $V_O$ = 1.4 V at $T_A$ = 25°C, and $V_O$ = 1 V at $T_A$ = 125°C; for TL820C, $V_O$ = 1.5 V at $T_A$ = 0°C, $V_O$ = 1.4 V at 25°C, and $V_O$ = 1.2 V at $T_A$ = 70°C. These output voltage levels were selected to approximate the logic threshold voltages of the types of digital logic circuits these comparators are intended to drive.





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