# ANALOG DEVICES

# Precision Voltage Comparators

# PM-111/PM-211

## FEATURES

- **High Output Drive** ..... **50mA**
- **Low Input Bias Current** ..... **50nA Max**
- **Low Offset Voltage** ..... **3mV Max**
- **Differential Input Voltage Range** ..... **±30V**
- **Logic Outputs Compatible with Bipolar and CMOS**
- **Fully-Specified at All Temperatures**
- **Available in Die Form**

## ORDERING INFORMATION †

| $V_{OS}$ MAX (mV) | PACKAGE TO-99 | CERDIP | PLASTIC 8-PIN | SO 8-PIN | LCC 20-CONTACT | OPERATING TEMPERATURE RANGE |
|---|---|---|---|---|---|---|
| 3.0 | PM111J* | PM111Y* | – | – | PM111RC/883 | MIL |
| 3.0 | – | PM111Z* | – | – | – | MIL |
| 3.0 | PM211J | PM211Y | – | – | – | IND |
| 3.0 | – | PM211Z | – | – | – | IND |
| 3.0 | – | – | PM211P | PM211S | – | XIND |

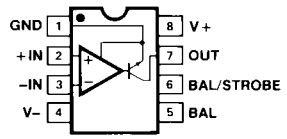
* For devices processed in total compliance to MIL-STD-883, add /883 after part number. Consult factory for 883 data sheet.

† Burn-in is available on commercial and industrial temperature range parts in CerDIP, plastic DIP, and TO-can packages.

## GENERAL DESCRIPTION

The PM-111/PM-211 are voltage comparators featuring low input bias and offset currents, high-differential voltage ranges, and wide-supply voltage ranges. The inputs and outputs can be isolated from system ground, and the output can drive loads referred to ground or either supply voltage. Strobing and offset balancing are available and the outputs can be wire OR'ed.

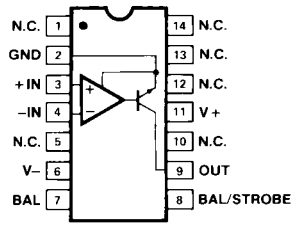
## PIN CONNECTIONS



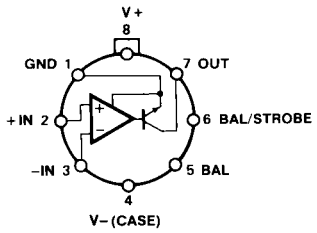

**HERMETIC MINI-DIP**
**(Z-Suffix)**

**8-PIN PLASTIC**
**(P-Suffix)**

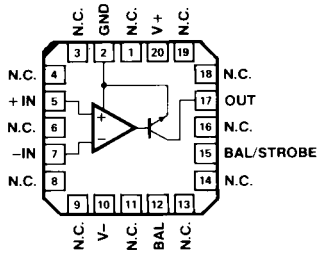
**8-PIN SO**
**(S-Suffix)**




**14-PIN HERMETIC DIP**
**(Y-Suffix)**

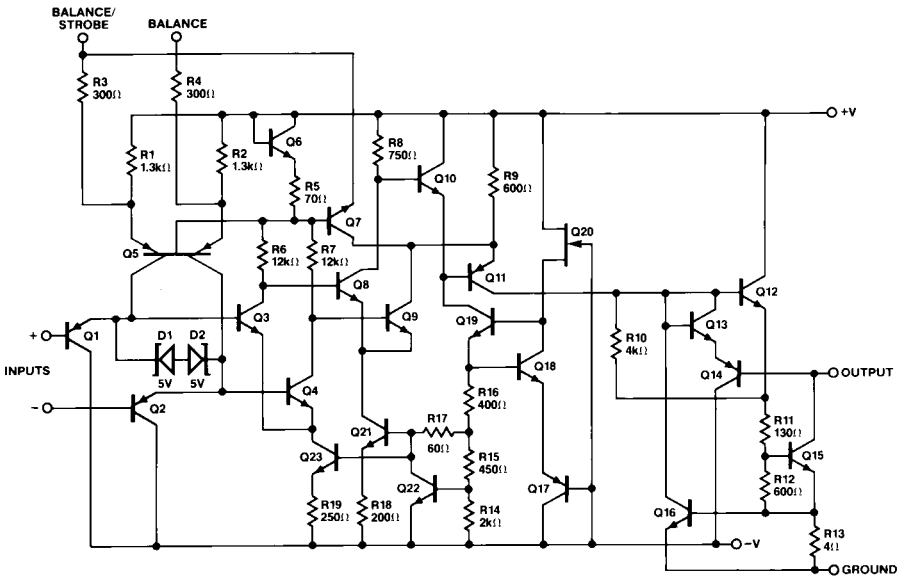



**TO-99**
**(J-Suffix)**




**PM-111RC/883**
**LCC**
**(RC-Suffix)**

## SIMPLIFIED SCHEMATIC



## ABSOLUTE MAXIMUM RATINGS (Note 1)

Total Supply Voltage, V+ to V– ..... 36V
Output to Negative Supply Voltage ..... 50V
Ground to Negative Supply Voltage ..... 30V
Strobe Pin Voltage ..... $V^+$–5V
Differential Input Voltage ..... ±30V
Input Voltage (Note 2) ..... ±15V
Output Short-Circuit Duration ..... 10s
Operating Temperature Range
PM-111 ..... –55°C to +125°C
PM-211 (J, Y, Z) ..... –25°C to +85°C
PM-211S/PM-211P ..... –40°C to +85°C
Junction Temperature ($T_j$) ..... –65°C to +150°C
Storage Temperature Range ..... –65°C to +150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

| PACKAGE TYPE | $\Theta_{jA}$ (Note 3) | $\Theta_{jC}$ | UNITS |
|---|---|---|---|
| TO-99 (J) | 150 | 18 | °C/W |
| 14-Pin Hermetic DIP (Y) | 108 | 16 | °C/W |
| 8-Pin Hermetic DIP (Z) | 148 | 16 | °C/W |
| 8-Pin Plastic DIP (P) | 103 | 43 | °C/W |
| 20-Contact LCC (RC) | 98 | 38 | °C/W |
| 8-Pin SO (S) | 158 | 43 | °C/W |

**NOTES:**
1. Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.
2. Rating applies to $V_S$ = ±15V. The positive input-voltage limit is 30V above the negative supply. The negative input-voltage limit is equal to the negative supply or 30V below the positive supply, whichever is less.
3. $\Theta_{jA}$ is specified for worst case mounting conditions, i.e., $\Theta_{jA}$ is specified for device in socket for TO, CerDIP, P-DIP, and LCC packages; $\Theta_{jA}$ is specified for device soldered to printed circuit board for SO package.

## ELECTRICAL CHARACTERISTICS at $V_S$ = ±15V, ground pin at ground and $T_A$ = 25°C, unless otherwise noted.

| | | | PM-111/PM-211 | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
| Input Offset Voltage | $V_{OS}$ | (Note 1) | — | 0.75 | 3.0 | mV |
| Input Offset Current | $I_{OS}$ | (Note 1) | — | 0.3 | 5.0 | nA |
| Input Bias Current | $I_B$ | (Note 1) | — | 25 | 50 | nA |
| Voltage Gain (Emitter) | $A_{VE}$ | (Note 2) | — | 75 | — | V/mV |
| Voltage Gain (Collector) | $A_{VC}$ | | — | 200 | — | V/mV |
| Response Time | $t_r$ | $R_L$ = 500Ω (tied to V+)<br>$V_{OD}$ = 5mV (Note 3) | — | 180 | — | ns |
| Saturation Voltage | $V_{OL}$ | $V_{IN} \leq -5mV$<br>$I_{OUT}$ = 50mA | — | 0.68 | 1.0 | V |
| Output Leakage Current | $I_{CEX}$ | $V_{IN} \geq +5mV$<br>$V_{OUT}$ = 50V | — | 5 | 15 | nA |
| Positive Supply Current | $I_{SY^+}$ | | — | 3.3 | 5 | mA |
| Negative Supply Current | $I_{SY^-}$ | | — | 2.4 | 4 | mA |
| Input Voltage Range | IVR | | −14.5<br>+13 | −14.8<br>+14 | — | V |

**NOTES:**
1. The offset voltage, offset current, and bias current given are the maximum values required to drive the collector output to within 1V of the supplies with a 7.5kΩ load. These parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
2. Average of $A_{V^+}$ and $A_{V^-}$ over a ±10V output range measured at the emitter.
3. The response time specified is for a 100mV input step with a 5mV overdrive and is the time required for the slowest edge. The slowest response occurs at the highest temperature of operation.

**ELECTRICAL CHARACTERISTICS** at $V_S$ = ±15V, ground pin at ground and $-25°C \leq T_A \leq +85°C$ for PM-211J, Z and Y, $-40°C \leq T_A \leq +85°C$ for PM-211P and S, unless otherwise noted.

| | | | PM-211 | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **CONDITIONS** | **MIN** | **TYP** | **MAX** | **UNITS** |
| Input Offset Voltage | $V_{OS}$ | (Note 1) | — | 0.8 | 3.0 | mV |
| Input Offset Current | $I_{OS}$ | (Note 1) | — | 0.3 | 7 | nA |
| Input Bias Current | $I_B$ | (Note 1) | — | 25 | 100 | nA |
| Voltage Gain (Emitter) | $A_{VE}$ | (Note 2) | — | 35 | — | V/mV |
| Response Time | $t_r$ | $R_L = 500\Omega$ (tied to V+)<br>$V_{OD} = 5mV$ (Note 3) | — | 240 | — | ns |
| Saturation Voltage | $V_{OL}$ | $V_{IN} \leq -5mV$<br>$I_{OUT} = 50mA$ | — | 0.8 | 1.5 | V |
| Output Leakage Current | $I_{CEX}$ | $V_{IN} \geq +5mV$<br>$V_{OUT} = 50V$ | — | 10 | 100 | nA |
| Positive Supply Current | $I_{SY^+}$ | | — | 4 | 6 | mA |
| Negative Supply Current | $I_{SY^-}$ | | — | 2.8 | 5 | mA |
| Input Voltage Range | IVR | | −14.5<br>13 | −14.8<br>14 | — | V |

**ELECTRICAL CHARACTERISTICS** at $V_S = \pm 15V$, ground pin at ground and $-55°C \leq T_A \leq +125°C$, unless otherwise noted.

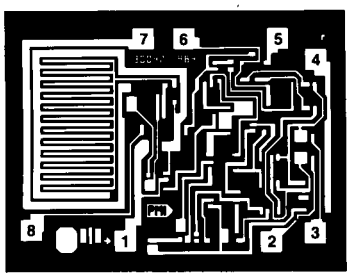
| | | | PM-111 | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **CONDITIONS** | **MIN** | **TYP** | **MAX** | **UNITS** |
| Input Offset Voltage | $V_{OS}$ | (Note 1) | — | 0.8 | 3.0 | mV |
| Input Offset Current | $I_{OS}$ | (Note 1) | — | 0.3 | 10 | nA |
| Input Bias Current | $I_B$ | (Note 1) | — | 25 | 100 | nA |
| Voltage Gain (Emitter) | $A_{VE}$ | (Note 2) | — | 20 | — | V/mV |
| Response Time | $t_r$ | $R_L = 500\Omega$ (tied to V+)<br>$V_{OD} = 5mV$ (Note 3) | — | 420 | — | ns |
| Saturation Voltage | $V_{OL}$ | $V_{IN} \leq -5mV$<br>$I_{OUT} = 50mA$ | — | 0.62 | 1.5 | V |
| Output Leakage Current | $I_{CEX}$ | $V_{IN} \geq +5mV$<br>$V_{OUT} = 50V$ | — | 145 | 500 | nA |
| Positive Supply Current | $I_{SY^+}$ | | — | 4.2 | 6 | mA |
| Negative Supply Current | $I_{SY^-}$ | | — | 3 | 5 | mA |
| Input Voltage Range | IVR | | −14.5<br>+13 | −14.8<br>+14 | — | V |

**NOTES:**

1. The offset voltage, offset current, and bias current given are the maximum values required to drive the collector output to within 1V of the supplies with a 7.5kΩ load. These parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
2. Average of $A_V+$ and $A_V-$ over a ±10V output range measured at the emitter.
3. The response time specified is for a 100mV input step with a 5mV overdrive and is the time required for the slowest edge. The slowest response occurs at the highest temperature of operation.

# PM-111/PM-211

## DICE CHARACTERISTICS




**DIE SIZE 0.066 × 0.050 inch, 3300 sq. mils**
**(1.68 × 1.27mm, 2.13 sq. mm)**

1. **GROUND**
2. **+IN**
3. **−IN**
4. **V−**
5. **BALANCE**
6. **BALANCE/STROBE**
7. **OUTPUT**
8. **V+**

**WAFER TEST LIMITS** at $V_S = \pm 15V$, $T_A = 25°C$ and ground pin at ground for PM-111GBC, $T_A = 125°C$ for PM-111GTBC, unless otherwise noted.

| PARAMETER | SYMBOL | CONDITIONS | PM-111GTBC LIMIT | PM-111GBC LIMIT | UNITS |
|---|---|---|---|---|---|
| Input Offset Voltage | $V_{OS}$ | (Note 1) | 3 | 3 | mV MAX |
| Input Offset Current | $I_{OS}$ | (Note 1) | 10 | 5 | nA MAX |
| Input Bias Current | $I_B$ | (Note 1) | 100 | 50 | nA MAX |
| Saturation Voltage | $V_{OL}$ | | 1.5 | 1.0 | V MAX |
| Output Leakage Current | $I_{CEX}$ | $V_{IN} \geq +5mV$<br>$V_{OUT} = 50V$ | 500 | 15 | nA MAX |
| Input Voltage Range | IVR | | ±13 | — | V MIN |
| Positive Supply Current | $I_{SY}+$ | | 6 | 5 | mA MAX |
| Negative Supply Current | $I_{SY}-$ | | 5 | 4 | mA MAX |

**NOTE:**
Electrical tests are performed at wafer probe to the limits shown. Due to variations in assembly methods and normal yield loss, yield after packaging is not guaranteed for standard product dice. Consult factory to negotiate specifications based on dice lot qualification through sample lot assembly and testing.

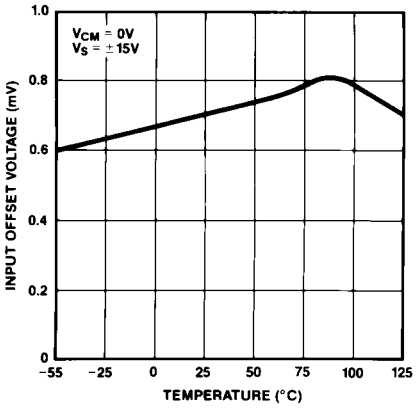
**TYPICAL ELECTRICAL CHARACTERISTICS** at $V_S = \pm 15V$, $T_A = 25°C$ and ground pin at ground for PM-111GBC, $T_A = 125°C$ for PM-111GTBC, unless otherwise noted.

| PARAMETER | SYMBOL | CONDITIONS | PM-111GTBC TYPICAL | PM-111GBC TYPICAL | UNITS |
|---|---|---|---|---|---|
| Voltage Gain (Emitter) | $A_{VE}$ | (Note 2) | 20 | 75 | V/mV |
| Response Time | $t_r$ | (Note 3) | 420 | 180 | ns |

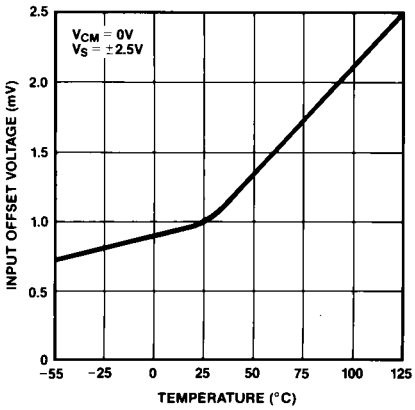
**NOTES:**
1. The offset voltage, offset current, and bias current given are the maximum values required to drive the collector output to within 1V of the supplies with a 7.5kΩ load. These parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
2. Average of $A_V+$ and $A_V-$ over a ±10V output range measured at the emitter.
3. The response time specified is for a 100mV input step with a 5mV overdrive and is the time required for the slowest edge. The slowest response occurs at the highest temperature of operation.

## TYPICAL PERFORMANCE CHARACTERISTICS

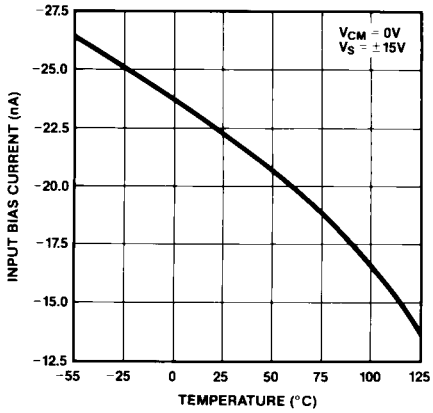
### INPUT OFFSET VOLTAGE vs TEMPERATURE



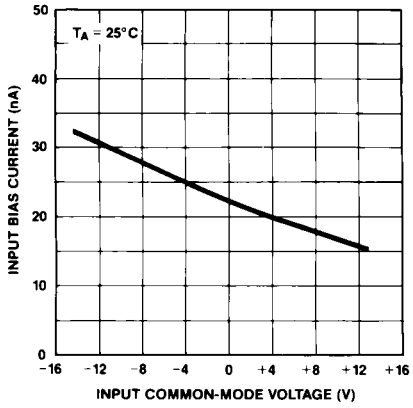

### INPUT OFFSET VOLTAGE vs TEMPERATURE



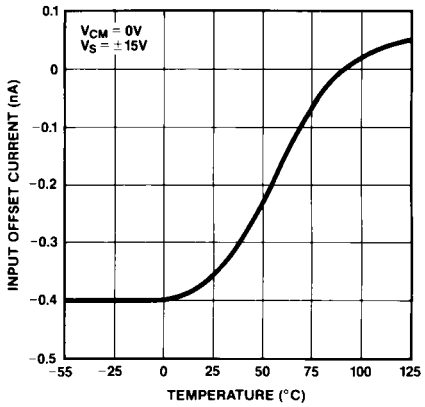

### INPUT BIAS CURRENT vs TEMPERATURE



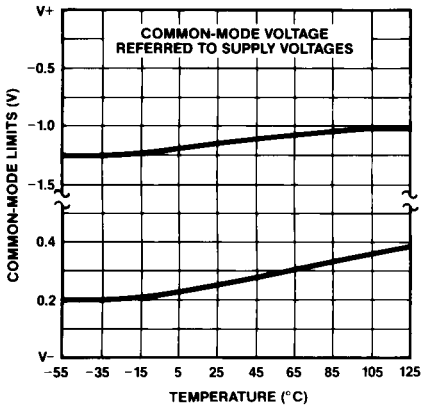

### INPUT BIAS CURRENT vs COMMON-MODE VOLTAGE



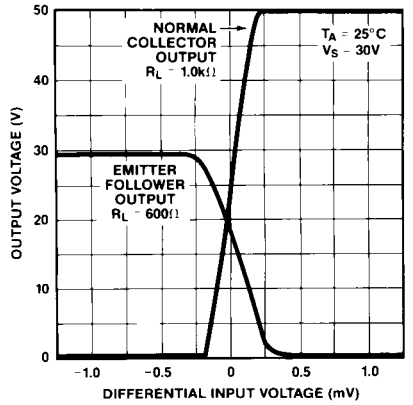

### INPUT OFFSET CURRENT vs TEMPERATURE



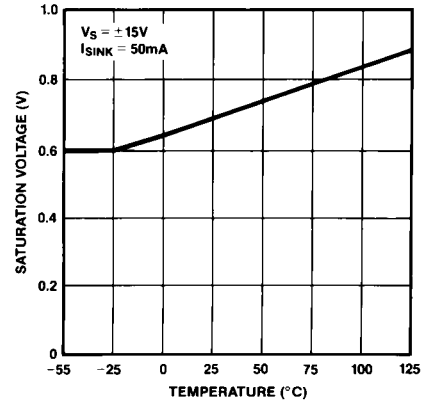

### COMMON-MODE LIMITS vs TEMPERATURE



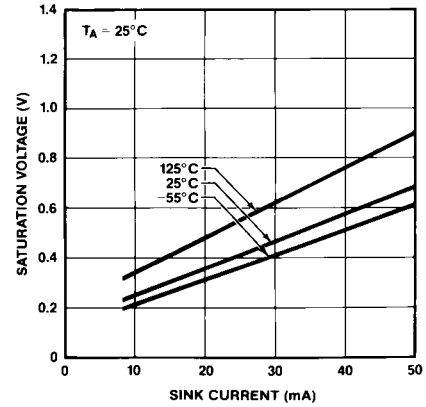

### TRANSFER FUNCTION




### SATURATION VOLTAGE vs TEMPERATURE

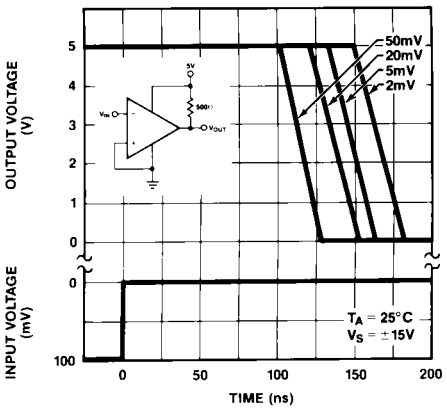



### SATURATION VOLTAGE vs SINK CURRENT

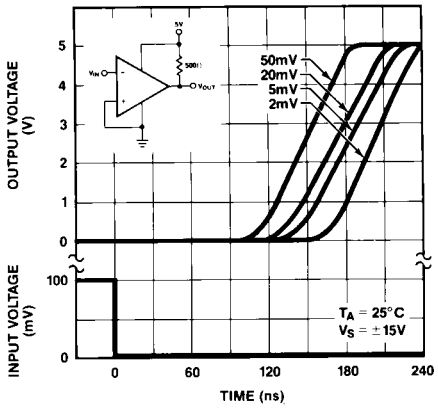


## TYPICAL PERFORMANCE CHARACTERISTICS

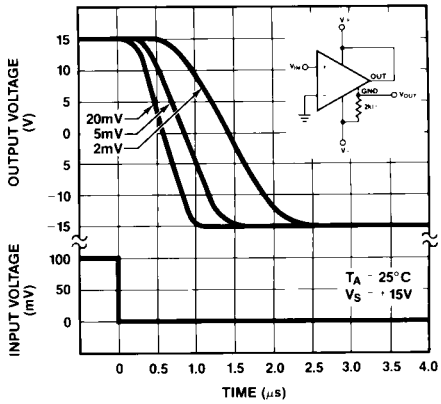
### RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



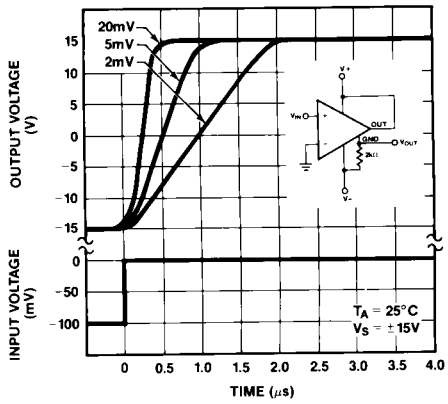

### RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



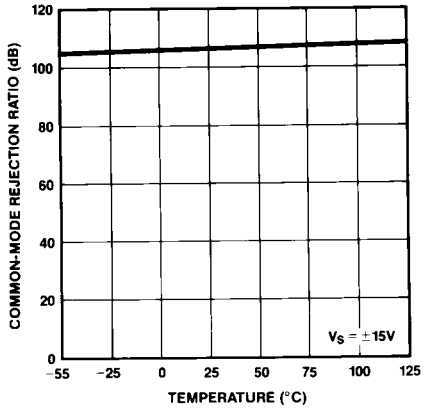

### RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



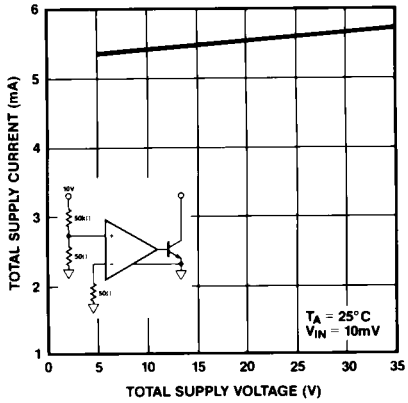

### RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



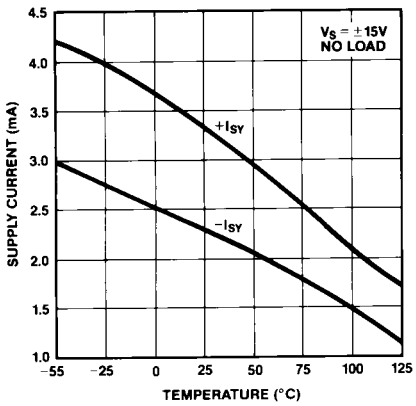

### COMMON-MODE REJECTION RATIO vs TEMPERATURE




### TOTAL SUPPLY CURRENT vs TOTAL SUPPLY VOLTAGE




### SUPPLY CURRENT vs TEMPERATURE




### BURN-IN CIRCUIT