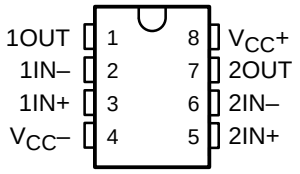
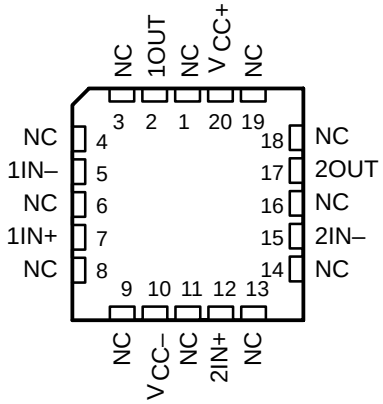
SLOS069B – FEBRUARY 1971 – REVISED SEPTEMBER 2002

- **Short-Circuit Protection**
- **Wide Common-Mode and Differential Voltage Ranges**
- **No Frequency Compensation Required**
- **Low Power Consumption**
- **No Latch-Up**
- **Designed to Be Interchangeable With Motorola MC1558/MC1458 and Signetics S5558/N5558**

**MC1458 . . . D, P, OR PS PACKAGE**
**MC1558 . . . JG PACKAGE**
**(TOP VIEW)**




**MC1558 . . . FK PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## description/ordering information

The MC1458 and MC1558 are dual general-purpose operational amplifiers, with each half electrically similar to the μA741, except that offset null capability is not provided.

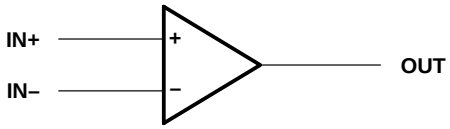
The high-common-mode input voltage range and the absence of latch-up make these amplifiers ideal for voltage-follower applications. The devices are short-circuit protected and the internal frequency compensation ensures stability without external components.

**ORDERING INFORMATION**

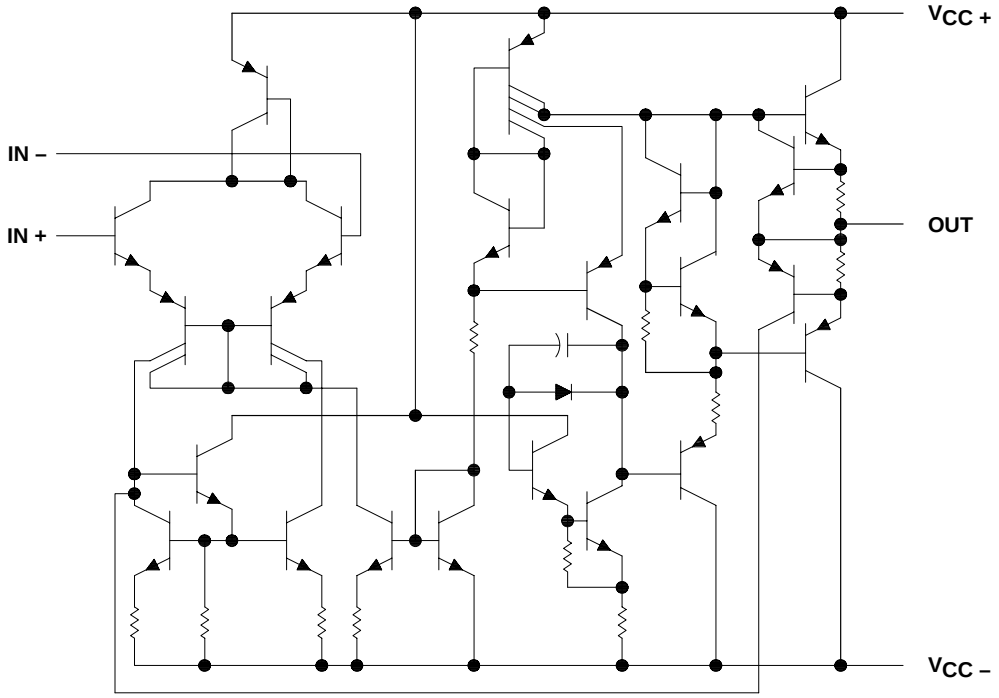
| $T_A$ | $V_{IO}$max AT 25°C | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|---|
| 0°C to 70°C | 6 mV | PDIP (P) | Tube | MC1458P | MC1458P |
| | | SOIC (D) | Tube | MC1458D | MC1458 |
| | | | Tape and reel | MC1458DR | |
| | | SOP (PS) | Tape and reel | MC1458PSR | M1458 |
| –55°C to 125°C | 5 mV | CDIP (JG) | Tube | MC1558JG | MC1558JG |
| | | CDIP (JGB) | Tube | MC1558JGB | MC1558JGB |
| | | LCCC (FK) | Tube | MC1558FK | MC1558FK |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

## symbol (each amplifier)




## schematic (each amplifier)



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

Supply voltage, $V_{CC+}$ (see Note 1): MC1458 . . . 18 V
MC1558 . . . 22 V
Supply voltage, $V_{CC-}$ (see Note 1): MC1458 . . . –18 V
MC1558 . . . –22 V
Differential input voltage, $V_{ID}$ (see Note 2) . . . ±30 V
Input voltage, $V_I$ (either input, see Notes 1 and 3) . . . ±15 V
Duration of output short circuit (see Note 4) . . . Unlimited
Operating virtual junction temperature, $T_J$ . . . 150°C
Package thermal impedance, $\theta_{JA}$ (see Notes 5 and 6): D package . . . 97°C/W
P package . . . 85°C/W
PS package . . . 95°C/W
Package thermal impedance, $\theta_{JC}$ (see Notes 7 and 8): FK package . . . 5.61°C/W
JG package . . . 14.5°C/W
Case temperature for 60 seconds: FK package . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: JG package . . . 300°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: D, P, or PS package . . . 260°C
Storage temperature range, $T_{stg}$ . . . –65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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 IN+ with respect to 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 can be shorted to ground or either power supply. For the MC1558 only, the unlimited duration of the short circuit applies at (or below) 125°C case temperature or 70°C free-air temperature.
5. Maximum power dissipation is a function of $T_J(max)$, $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of 150°C can affect reliability.
6. The package thermal impedance is calculated in accordance with JESD 51-7.
7. Maximum power dissipation is a function of $T_J(max)$, $\theta_{JC}$, and $T_C$. The maximum allowable power dissipation at any allowable case temperature is $P_D = (T_J(max) – T_C)/\theta_{JC}$. Operating at the absolute maximum $T_J$ of 150°C can affect reliability.
8. The package thermal impedance is calculated in accordance with MIL-STD-883.

## recommended operating conditions

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{CC\pm}$ | Supply voltage | | ±5 | ±15 | V |
| $T_A$ | Operating free-air temperature range | MC1458 | 0 | 70 | °C |
| | | MC1558 | –55 | 125 | |

## electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V

| PARAMETER | | TEST CONDITIONS† | | MC1458 | | | MC1558 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_{IO}$ | Input offset voltage | $V_O$ = 0 | 25°C | | 1 | 6 | | 1 | 5 | mV |
| | | | Full range | | | 7.5 | | | 6 | |
| $I_{IO}$ | Input offset current | $V_O$ = 0 | 25°C | | 20 | 200 | | 20 | 200 | nA |
| | | | Full range | | | 300 | | | 500 | |
| $I_{IB}$ | Input bias current | $V_O$ = 0 | 25°C | | 80 | 500 | | 80 | 500 | nA |
| | | | Full range | | | 800 | | | 1500 | |
| $V_{ICR}$ | Common-mode input voltage range | | 25°C | ±12 | ±13 | | ±12 | ±13 | | V |
| | | | Full range | ±12 | | | ±12 | | | |
| $V_{OM}$ | Maximum peak output voltage swing | $R_L$ = 10 kΩ | 25°C | ±12 | ±14 | | ±12 | ±14 | | V |
| | | $R_L$ ≥ 10 kΩ | Full range | ±12 | | | ±12 | | | |
| | | $R_L$ = 2 kΩ | 25°C | ±10 | ±13 | | ±10 | ±13 | | |
| | | $R_L$ ≥ 2 kΩ | Full range | ±10 | | | ±10 | | | |
| $A_{VD}$ | Large-signal differential voltage amplification | $R_L$ ≥ 2 kΩ, $V_O$ = ±10 V | 25°C | 20 | 200 | | 50 | 200 | | V/mV |
| | | | Full range | 15 | | | 25 | | | |
| $B_{OM}$ | Maximum-output-swing bandwidth (closed loop) | $R_L$ = 2 kΩ, $V_O$ ≥ ±10 V, $A_{VD}$ = 1, THD ≥ 5% | 25°C | | 14 | | | 14 | | kHz |
| $B_1$ | Unity-gain bandwidth | | 25°C | | 1 | | | 1 | | MHz |
| ϕm | Phase margin | $A_{VD}$ = 1 | 25°C | | 65 | | | 65 | | deg |
| | Gain margin | | 25°C | | 11 | | | 11 | | dB |
| $r_i$ | Input resistance | | 25°C | 0.3 | 2 | | 0.3* | 2 | | MΩ |
| $r_o$ | Output resistance | $V_O$ = 0, See Note 9 | 25°C | | 75 | | | 75 | | Ω |
| $C_i$ | Input capacitance | | 25°C | | 1.4 | | | 1.4 | | pF |
| $z_{ic}$ | Common-mode input impedance | f = 20 Hz | 25°C | | 200 | | | 200 | | MΩ |
| CMRR | Common-mode rejection ratio | $V_{IC}$ = $V_{ICR}$ min, $V_O$ = 0 | 25°C | 70 | 90 | | 70 | 90 | | dB |
| | | | Full range | 70 | | | 70 | | | |
| $k_{SVS}$ | Supply-voltage sensitivity ($\Delta V_{IO}/\Delta V_{CC}$) | $V_{CC}$ = ±9 V to ±15 V, $V_O$ = 0 | 25°C | | 30 | 150 | | 30 | 150 | μV/V |
| | | | Full range | | | 150 | | | 150 | |
| $V_n$ | Equivalent input noise voltage (closed loop) | $A_{VD}$ = 100, $R_S$ = 0, f = 1 kHz, BW = 1 Hz | 25°C | | 45 | | | 45 | | nV/√Hz |
| $I_{OS}$ | Short-circuit output current | | 25°C | | ±25 | ±40 | | ±25 | ±40 | mA |
| $I_{CC}$ | Supply current (both amplifiers) | $V_O$ = 0, No load | 25°C | | 3.4 | 5.6 | | 3.4 | 5 | mA |
| | | | Full range | | | 6.6 | | | 6.6 | |
| $P_D$ | Total power dissipation (both amplifiers) | $V_O$ = 0, No load | 25°C | | 100 | 170 | | 100 | 150 | mW |
| | | | Full range | | | 200 | | | 200 | |
| $V_{O1}/V_{O2}$ | Crosstalk attenuation | | 25°C | | 120 | | | 120 | | dB |

*On products compliant to MIL-PRF-38535, this parameter is not production tested.

† All characteristics are specified under open-loop operating conditions with zero common-mode input voltage, unless otherwise specified. Full range for MC1458 is 0°C to 70°C and for MC1558 is –55°C to 125°C.

NOTE 9: This typical value applies only at frequencies above a few hundred hertz because of the effect of drift and thermal feedback.

## operating characteristics, $V_{CC\pm}$ = ±15 V, $C_L$ = 100 pF, $T_A$ = 25°C (see Figure 1)

| PARAMETER | | TEST CONDITIONS | | MC1458 | | | MC1558 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $t_r$ | Rise time | $V_I$ = 20 mV, | $R_L$ = 2 kΩ, | | 0.3 | | | 0.3 | | µs |
| | Overshoot factor | $V_I$ = 20 mV, | $R_L$ = 2 kΩ | | 5 | | | 5 | | % |
| SR | Slew rate at unity gain | $V_I$ = 10 V, | $R_L$ = 2 kΩ | | 0.5 | | | 0.5 | | V/µs |

## PARAMETER MEASUREMENT INFORMATION

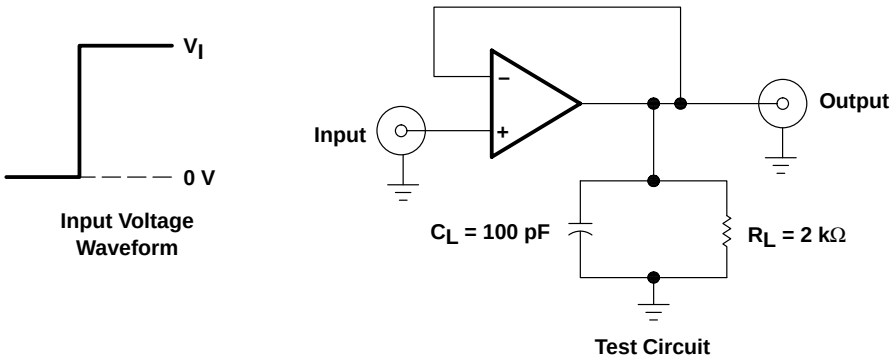



**Figure 1. Rise-Time, Overshoot, and Slew-Rate Waveform and Test Circuit**

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| 5962-9760301Q2A | ACTIVE | LCCC | FK | 20 | 1 | None | POST-PLATE | Level-NC-NC-NC |
| 5962-9760301QPA | ACTIVE | CDIP | JG | 8 | 1 | None | A42 SNPB | Level-NC-NC-NC |
| MC1458D | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| MC1458DR | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| MC1458P | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| MC1458PSR | ACTIVE | SO | PS | 8 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| MC1558FKB | ACTIVE | LCCC | FK | 20 | 1 | None | POST-PLATE | Level-NC-NC-NC |
| MC1558JG | ACTIVE | CDIP | JG | 8 | 1 | None | A42 SNPB | Level-NC-NC-NC |
| MC1558JGB | ACTIVE | CDIP | JG | 8 | 1 | None | A42 SNPB | Level-NC-NC-NC |
| MC1558P | OBSOLETE | PDIP | P | 8 | | None | Call TI | Level-NC-NC-NC |
| SN98212P | OBSOLETE | PDIP | P | 8 | | None | Call TI | Call TI |

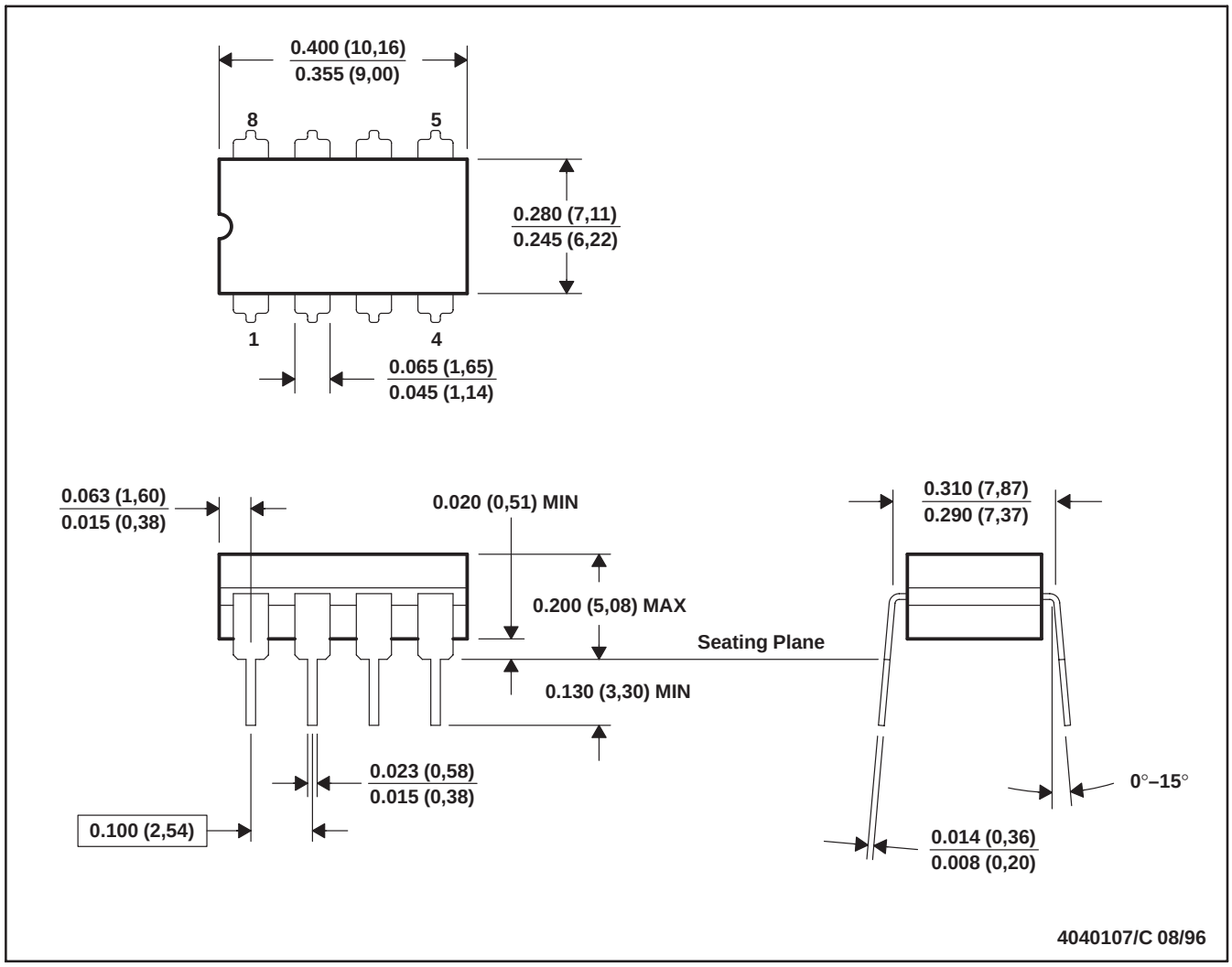
(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - May not be currently available - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**None:** Not yet available Lead (Pb-Free).
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDECindustry standard classifications, and peak solder temperature.

MCER001A – JANUARY 1995 – REVISED JANUARY 1997

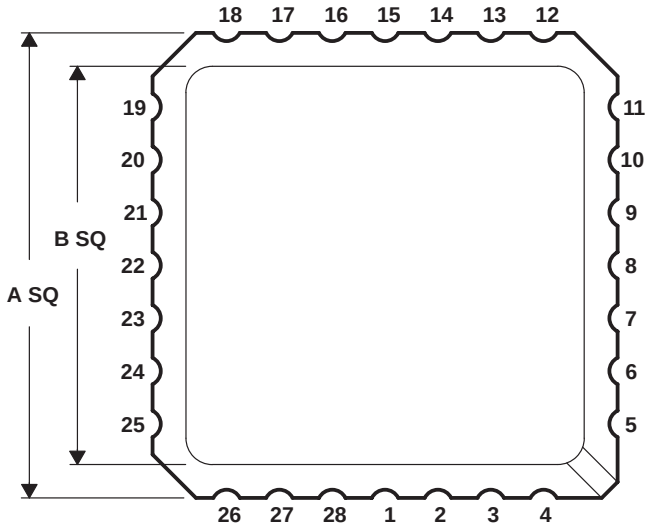
**JG (R-GDIP-T8)** **CERAMIC DUAL-IN-LINE**



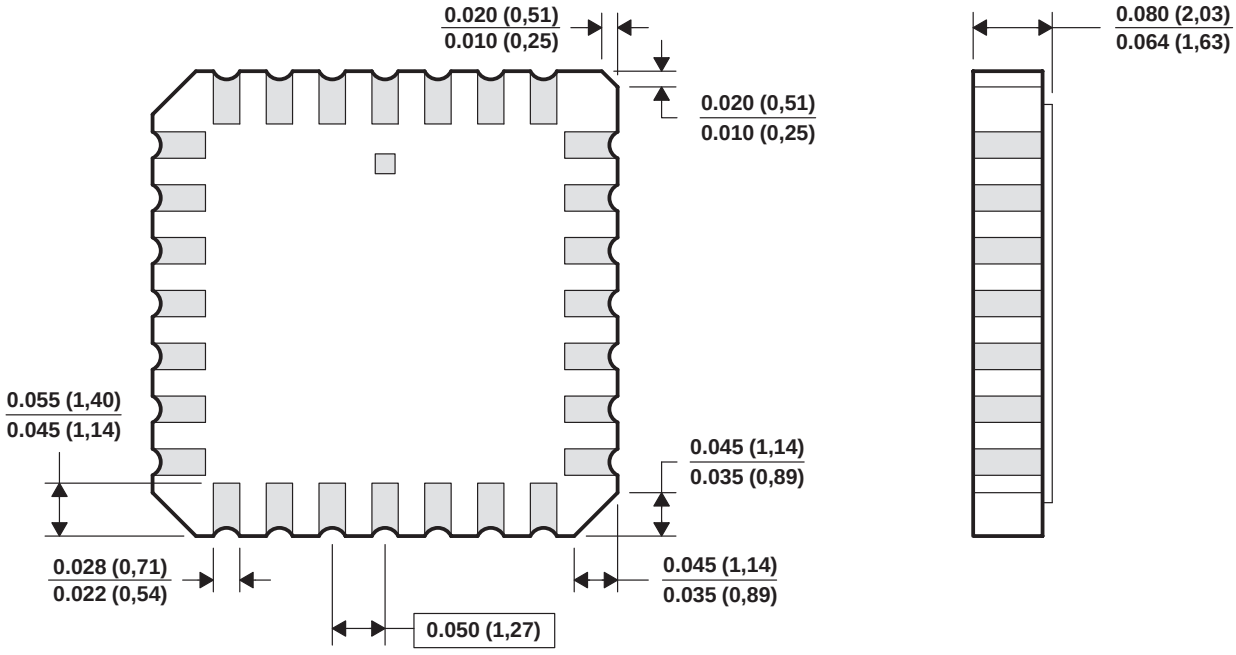

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP1-T8

**FK (S-CQCC-N**)** **LEADLESS CERAMIC CHIP CARRIER**

**28 TERMINAL SHOWN**




| NO. OF TERMINALS ** | A | | B | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| 20 | 0.342 (8,69) | 0.358 (9,09) | 0.307 (7,80) | 0.358 (9,09) |
| 28 | 0.442 (11,23) | 0.458 (11,63) | 0.406 (10,31) | 0.458 (11,63) |
| 44 | 0.640 (16,26) | 0.660 (16,76) | 0.495 (12,58) | 0.560 (14,22) |
| 52 | 0.739 (18,78) | 0.761 (19,32) | 0.495 (12,58) | 0.560 (14,22) |
| 68 | 0.938 (23,83) | 0.962 (24,43) | 0.850 (21,6) | 0.858 (21,8) |
| 84 | 1.141 (28,99) | 1.165 (29,59) | 1.047 (26,6) | 1.063 (27,0) |

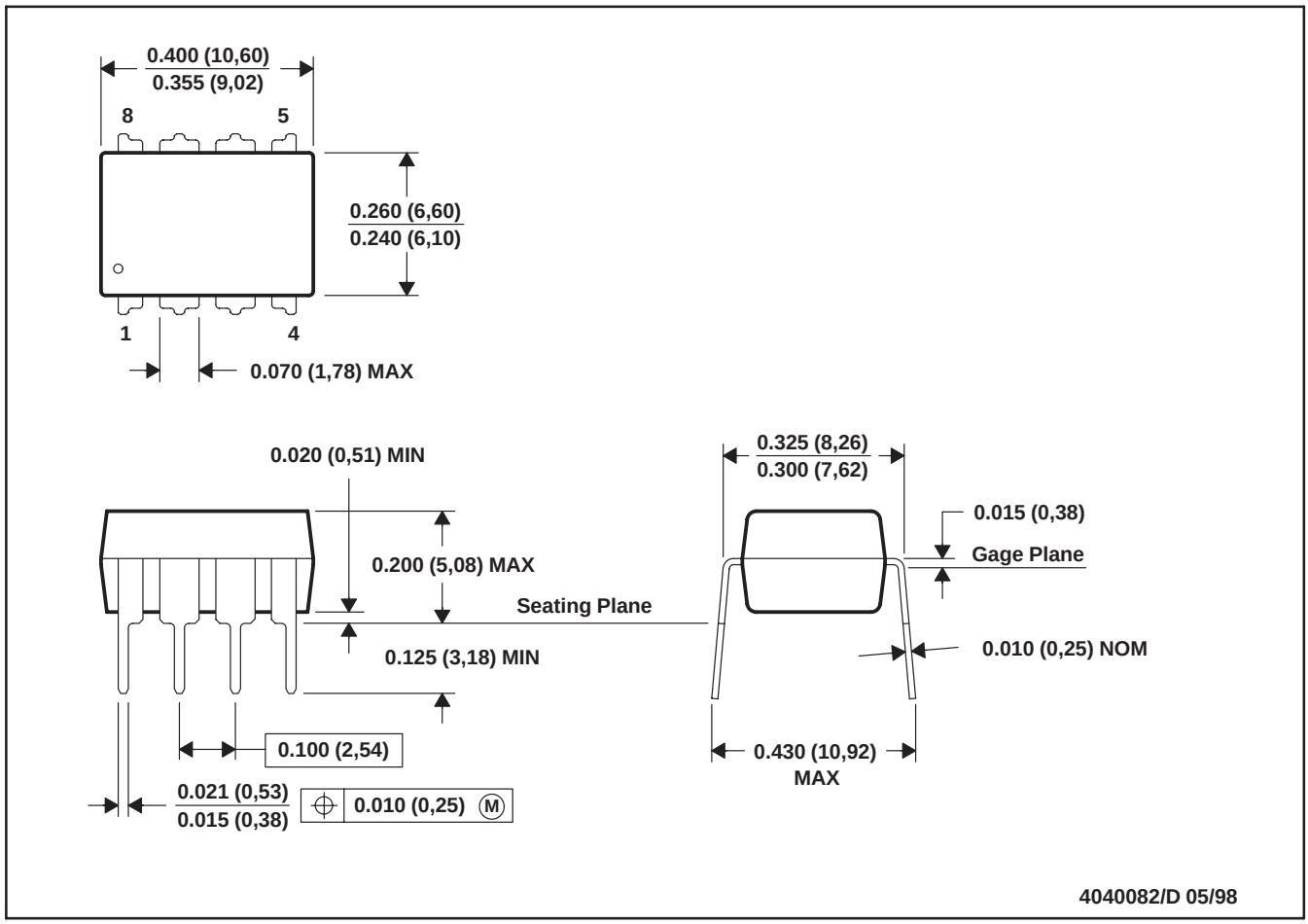



**4040140/D 10/96**

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

MPDI001A – JANUARY 1995 – REVISED JUNE 1999

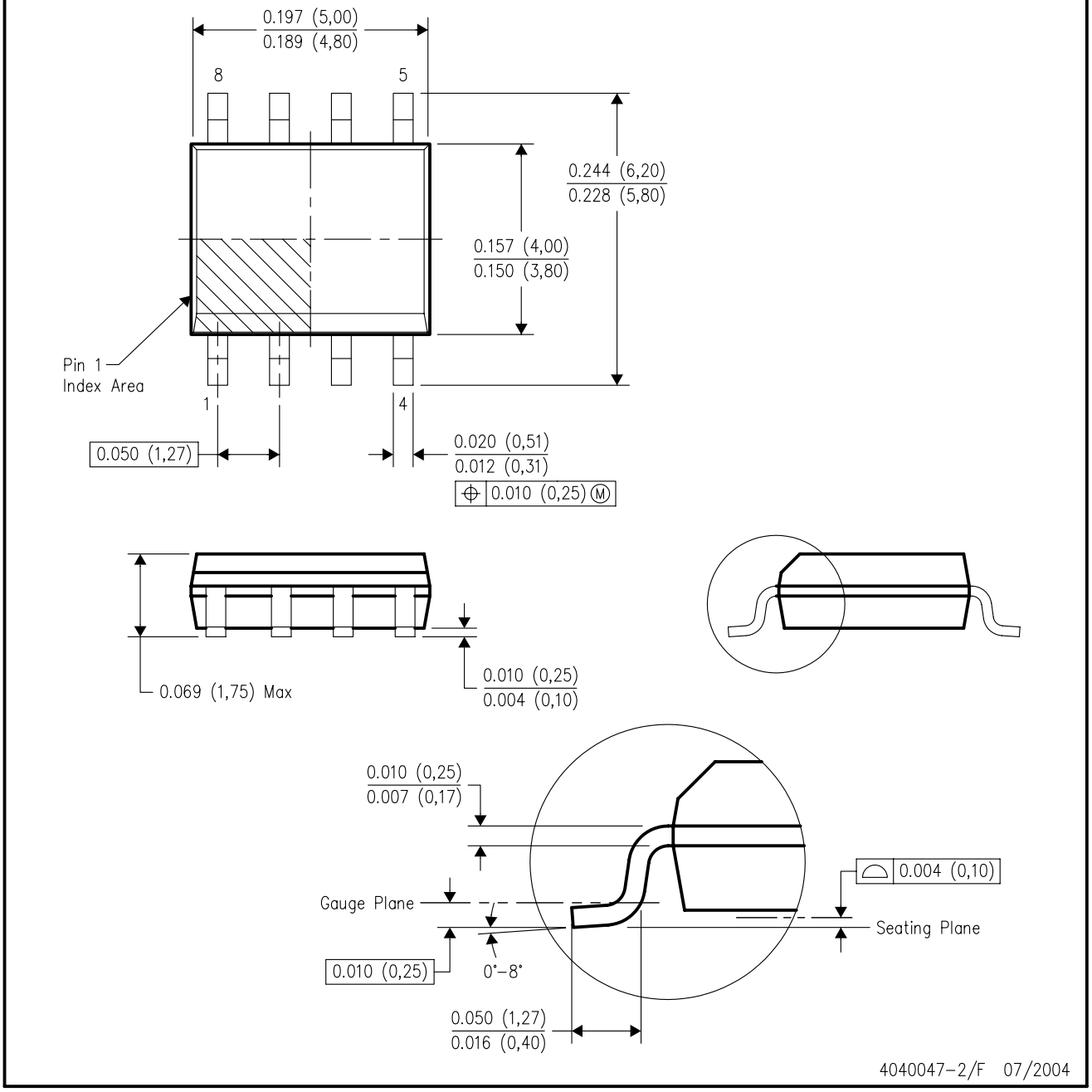
**P (R-PDIP-T8)** **PLASTIC DUAL-IN-LINE**




NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

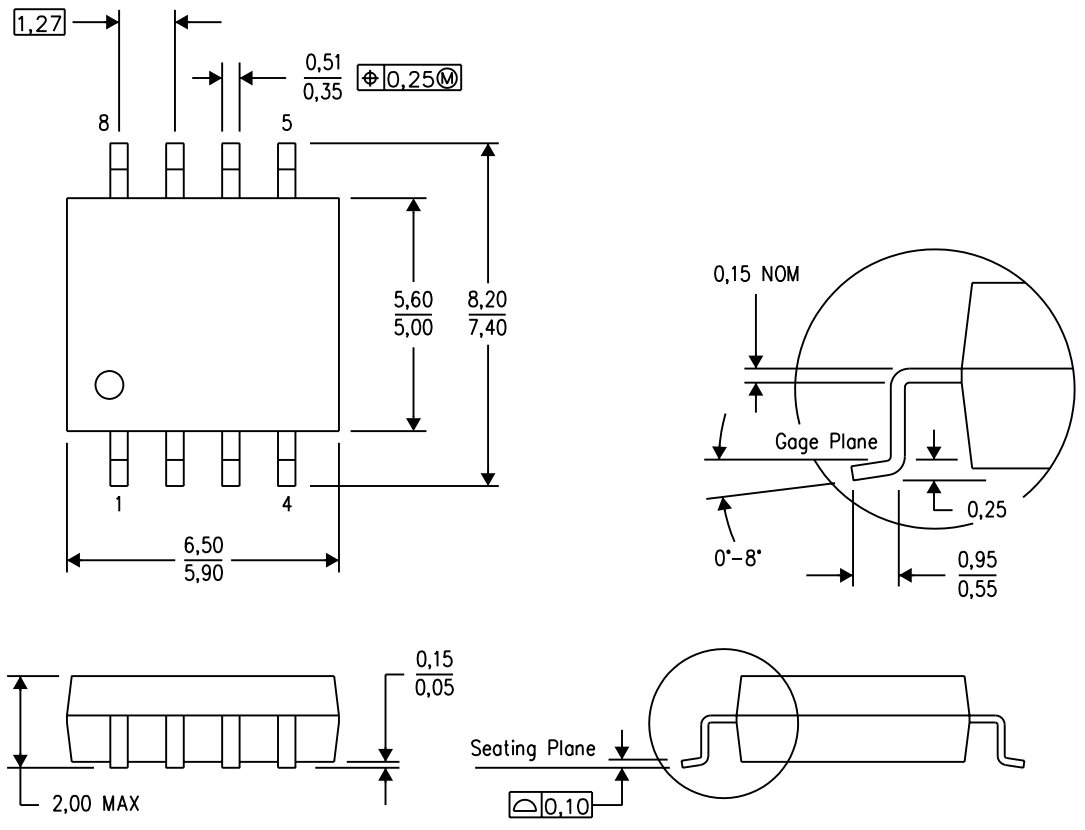
## D (R–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE




NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–012 variation AA.

## MECHANICAL DATA

**PS (R-PDSO-G8)** **PLASTIC SMALL-OUTLINE PACKAGE**




4040063/C 03/03

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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