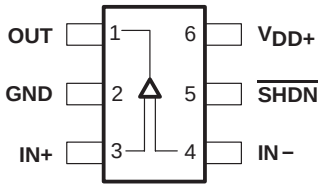
- **Rail-to-Rail Output Swing**
- **Gain Bandwidth Product . . . 6.4 MHz**
- **±80 mA Output Drive Capability**
- **Supply Current . . . 500 μA/channel**
- **Input Offset Voltage . . . 100 μV**
- **Input Noise Voltage . . . 11 nV/√Hz**
- **Slew Rate . . . 1.6 V/μs**
- **Micropower Shutdown Mode (TLV2460/3/5) . . . 0.3 μA/Channel**
- **Universal Operational Amplifier EVM**
- **Available in Q-Temp Automotive HighRel Automotive Applications Configuration Control/Print Support Qualification to Automotive Standards**

**TLV2460**
**DBV PACKAGE**
**(TOP VIEW)**




## description

The TLV246x is a family of low-power rail-to-rail input/output operational amplifiers specifically designed for portable applications. The input common-mode voltage range extends beyond the supply rails for maximum dynamic range in low-voltage systems. The amplifier output has rail-to-rail performance with high-output-drive capability, solving one of the limitations of older rail-to-rail input/output operational amplifiers. This rail-to-rail dynamic range and high output drive make the TLV246x ideal for buffering analog-to-digital converters.

The operational amplifier has 6.4 MHz of bandwidth and 1.6 V/μs of slew rate with only 500 μA of supply current, providing good ac performance with low power consumption. Three members of the family offer a shutdown terminal, which places the amplifier in an ultralow supply current mode ($I_{DD}$ = 0.3 μA/ch). While in shutdown, the operational-amplifier output is placed in a high-impedance state. DC applications are also well served with an input noise voltage of 11 nV/√Hz and input offset voltage of 100 μV.

This family is available in the low-profile SOT23, MSOP, and TSSOP packages. The TLV2460 is the first rail-to-rail input/output operational amplifier with shutdown available in the 6-pin SOT23, making it perfect for high-density circuits. The family is specified over an expanded temperature range ($T_A$ = −40°C to 125°C) for use in industrial control and automotive systems, and over the military temperature range ($T_A$ = −55°C to 125°C) for use in military systems.

**SELECTION GUIDE**

| DEVICE | $V_{DD}$ [V] | $V_{IO}$ [μV] | $I_{DD}$/ch [μA] | $I_{IB}$ [pA] | GBW [MHz] | SLEW RATE [V/μs] | $V_{n,\ 1\ kHz}$ [nV/√Hz] | $I_O$ [mA] | SHUTDOWN | RAIL-RAIL |
|---|---|---|---|---|---|---|---|---|---|---|
| TLV246x(A) | 2.7−6 | 150 | 550 | 1300 | 6.4 | 1.6 | 11 | 25 | Y | I/O |
| TLV277x(A) | 2.5−5.5 | 360 | 1000 | 2 | 5.1 | 10.5 | 17 | 6 | Y | O |
| TLV247x(A) | 2.7−6 | 250 | 600 | 2.5 | 2.8 | 1.5 | 15 | 20 | Y | I/O |
| TLV245x(A) | 2.7−6 | 20 | 23 | 500 | 0.22 | 0.11 | 52 | 10 | Y | I/O |
| TLV225x(A) | 2.7−8 | 200 | 35 | 1 | 0.2 | 0.12 | 19 | 3 | — | — |
| TLV226x(A) | 2.7−8 | 300 | 200 | 1 | 0.71 | 0.55 | 12 | 3 | — | — |

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

**TLV2460C/I/AI and TLV2461C/I/AI AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max AT 25°C | PACKAGED DEVICES | | | |
|---|---|---|---|---|---|
| | | SMALL OUTLINE (D) | SOT-23† (DBV) | SYMBOL | PLASTIC DIP (P) |
| 0°C to 70°C | 2000 μV | TLV2460CD<br>TLV2461CD | TLV2460CDBV<br>TLV2461CDBV | VAOC<br>VAPC | TLV2460CP<br>TLV2461CP |
| −40°C to 125°C | 2000 μV | TLV2460ID<br>TLV2461ID | TLV2460IDBV<br>TLV2461IDBV | VAOI<br>VAPI | TLV2460IP<br>TLV2461IP |
| | 1500 μV | TLV2460AID<br>TLV2461AID | —<br>— | —<br>— | TLV2460AIP<br>TLV2461AIP |

† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV2460CDR).
‡ Chip forms are tested at $T_A$ = 25°C only.

**TLV2460M/AM/Q/AQ and TLV2461M/AM/Q/AQ AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max AT 25°C | PACKAGED DEVICES | | | | |
|---|---|---|---|---|---|---|
| | | SMALL OUTLINE† (D) | SMALL OUTLINE† (PW) | CERAMIC DIP (JG) | CERAMIC FLATPACK (U) | CHIP CARRIER (FK) |
| −40°C to 125°C | 2000 μV | TLV2460QD<br>TLV2461QD | TLV2460QPW<br>TLV2461QPW | —<br>— | —<br>— | —<br>— |
| | 1500 μV | TLV2460AQD<br>TLV2461AQD | TLV2460AQPW<br>TLV2461AQPW | —<br>— | —<br>— | —<br>— |
| −55°C to 125°C | 2000 μV | —<br>— | —<br>— | TLV2460MJG<br>TLV2461MJG | TLV2460MU<br>TLV2461MU | TLV2460MFK<br>TLV2461MFK |
| | 1500 μV | —<br>— | —<br>— | TLV2460AMJG<br>TLV2461AMJG | TLV2460AMU<br>TLV2461AMU | TLV2460AMFK<br>TLV2461AMFK |

† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV2460QDR).

**TLV2462C/I/AI and TLV2463C/I/AI AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max AT 25°C | PACKAGED DEVICES | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | SMALL OUTLINE† (D) | MSOP (DGK) | SYMBOL | MSOP† (DGS) | SYMBOL | PLASTIC DIP (N) | PLASTIC DIP (P) |
| 0°C to 70°C | 2000 μV | TLV2462CD<br>TLV2463CD | TLV2462CDGK<br>— | xxTIAAI | —<br>TLV2463CDGS | —<br>xxTIAAK | —<br>TLV2463CN | TLV2462CP<br>— |
| −40°C to 125°C | 2000 μV | TLV2462ID<br>TLV2463ID | TLV2462IDGK<br>— | xxTIAAJ | —<br>TLV2463IDGS | —<br>xxTIAAL | —<br>TLV2463IN | TLV2462IP<br>— |
| | 1500 μV | TLV2462AID<br>TLV2463AID | —<br>— | —<br>— | —<br>— | —<br>— | —<br>TLV2463AIN | TLV2462AIP<br>— |

† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV2462CDR).
‡ Chip forms are tested at $T_A$ = 25°C only.

**TLV2462M/AM/Q/AQ and TLV2463M/AM/Q/AQ AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max AT 25°C | PACKAGED DEVICES | | | | | |
|---|---|---|---|---|---|---|---|
| | | SMALL OUTLINE† (D) | SMALL OUTLINE† (PW) | CERAMIC DIP (JG) | CERAMIC DIP (J) | CERAMIC FLATPACK (U) | CHIP CARRIER (FK) |
| −40°C to 125°C | 2000 μV | TLV2462QD<br>TLV2463QD | TLV2462QPW<br>TLV2463QPW | —<br>— | —<br>— | —<br>— | —<br>— |
| | 1500 μV | TLV2462AQD<br>TLV2463AQD | TLV2462AQPW<br>TLV2463AQPW | —<br>— | —<br>— | —<br>— | —<br>— |
| −55°C to 125°C | 2000 μV | —<br>— | —<br>— | TLV2462MJG<br>— | —<br>TLV2463MJ | TLV2462MU | TLV2462MFK<br>TLV2463MFK |
| | 1500 μV | —<br>— | —<br>— | TLV2462AMJG<br>— | —<br>TLV2463AMJ | TLV2462AMU | TLV2462AMFK<br>TLV2463AMFK |

† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV2462QDR).

**TLV2464C/I/AI and TLV2465C/I/AI AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max AT 25°C | PACKAGED DEVICES | | |
|---|---|---|---|---|
| | | SMALL OUTLINE (D) | PLASTIC DIP (N) | TSSOP (PW) |
| 0°C to 70°C | 2000 μV | TLV2464CD<br>TLV2465CD | TLV2464CN<br>TLV2465CN | TLV2464CPW<br>TLV2465CPW |
| −40°C to 125°C | 2000 μV | TLV2464ID<br>TLV2465ID | TLV2464IN<br>TLV2465IN | TLV2464IPW<br>TLV2465IPW |
| | 1500 μV | TLV2464AID<br>TLV2465AID | TLV2464AIN<br>TLV2465AIN | TLV2464AIPW<br>TLV2465AIPW |

† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number(e.g., TLV2464CDR).
‡ Chip forms are tested at $T_A$ = 25°C only.

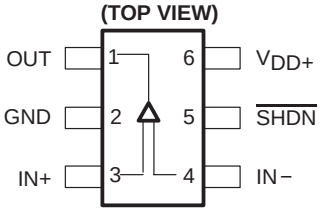
**TLV2464M/AM/Q/AQ and TLV2465M/AM/Q/AQ AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max AT 25°C | PACKAGED DEVICES | | | |
|---|---|---|---|---|---|
| | | SMALL OUTLINE† (D) | SMALL OUTLINE† (PW) | CERAMIC DIP (J) | CHIP CARRIER (FK) |
| -40°C to 125°C | 2000 μV | TLV2464QD<br>TLV2465QD | TLV2464QPW<br>TLV2465QPW | —<br>— | —<br>— |
| | 1500 μV | TLV2464AQD<br>TLV2465AQD | TLV2464AQPW<br>TLV2465AQPW | —<br>— | —<br>— |
| −55°C to 125°C | 2000 μV | —<br>— | —<br>— | TLV2464MJ<br>TLV2465MJ | TLV2464MFK<br>TLV2465MFK |
| | 1500 μV | —<br>— | —<br>— | TLV2464AMJ<br>TLV2465AMJ | TLV2464AMFK<br>TLV2465AMFK |

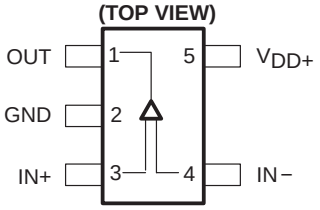
† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV2464QDR).

## TLV246x PACKAGE PINOUTS(1)

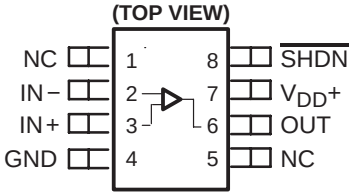
**TLV2460**
**DBV PACKAGE**
**(TOP VIEW)**



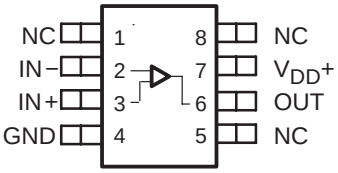

**TLV2461**
**DBV PACKAGE**
**(TOP VIEW)**



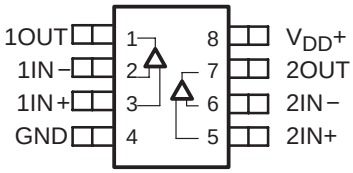

**TLV2460**
**D, P, JG, OR PW PACKAGE**
**(TOP VIEW)**



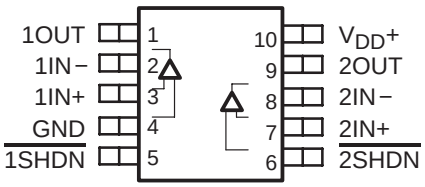

**TLV2461**
**D, P, JG, OR PW PACKAGE**
**(TOP VIEW)**



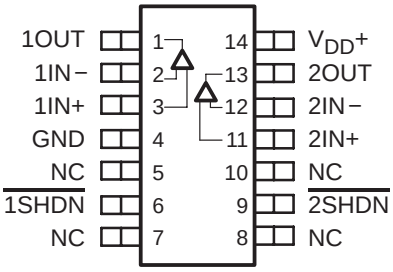

**TLV2462**
**D, DGK, P, JG, OR PW PACKAGE**
**(TOP VIEW)**



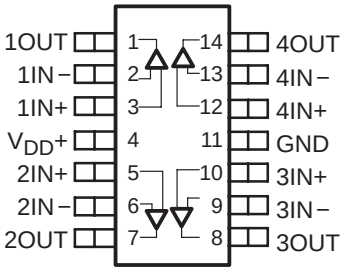

**TLV2463**
**DGS PACKAGE**
**(TOP VIEW)**



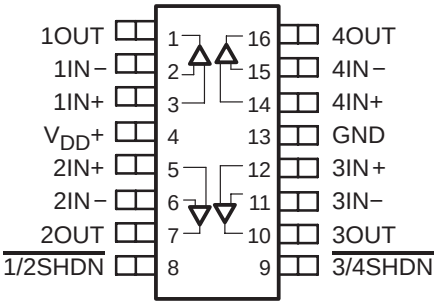

**TLV2463**
**D, N, J, OR PW PACKAGE**
**(TOP VIEW)**




**TLV2464**
**D, N, PWP, J, OR PW PACKAGE**
**(TOP VIEW)**

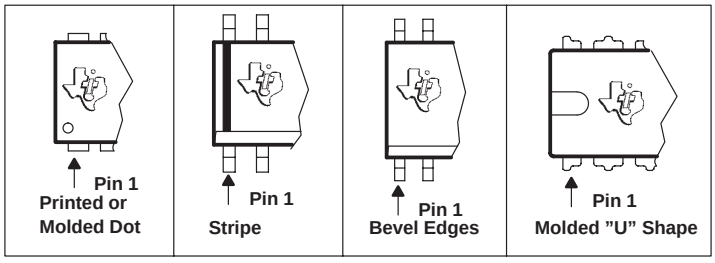



**TLV2465**
**D, N, PWP, J, OR PW PACKAGE**
**(TOP VIEW)**



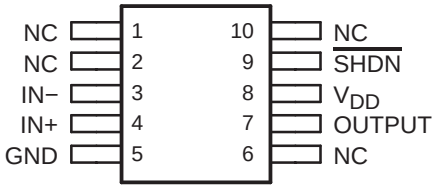

NC − No internal connection
(1) SOT−23 may or may not be indicated

## TYPICAL PIN 1 INDICATORS

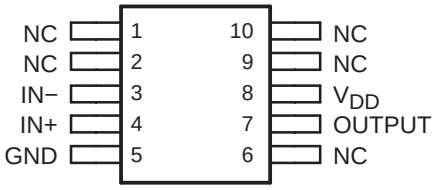


## TLV246x PACKAGE PINOUTS (continued)(1)

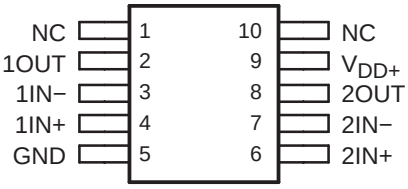
**TLV2460**
**U PACKAGE**
**(TOP VIEW)**



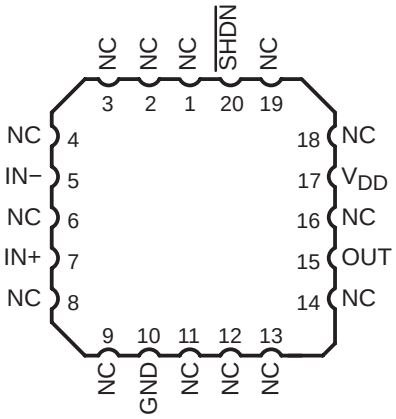

**TLV2461**
**U PACKAGE**
**(TOP VIEW)**



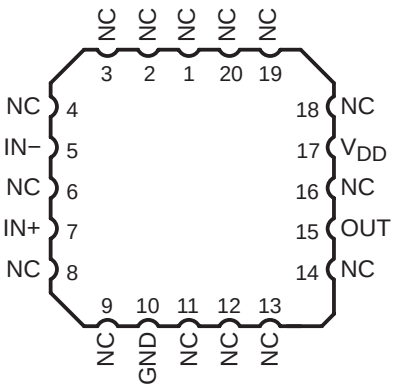

**TLV2462**
**U PACKAGE**
**(TOP VIEW)**



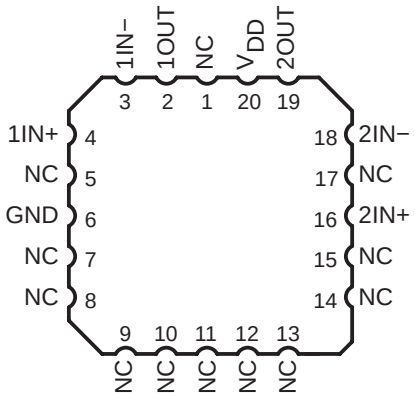

**TLV2460**
**FK PACKAGE**
**(TOP VIEW)**



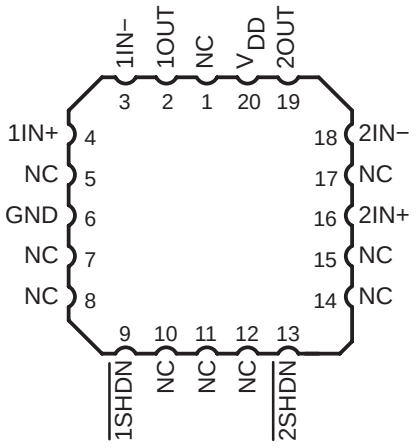

**TLV2461**
**FK PACKAGE**
**(TOP VIEW)**



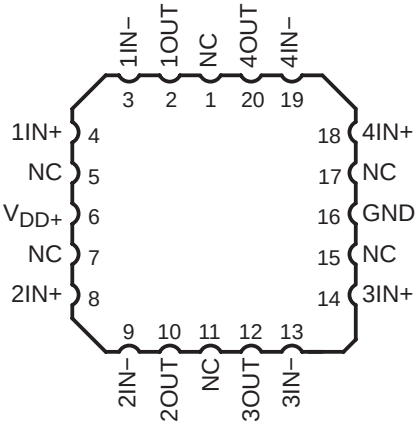

**TLV2462**
**FK PACKAGE**
**(TOP VIEW)**



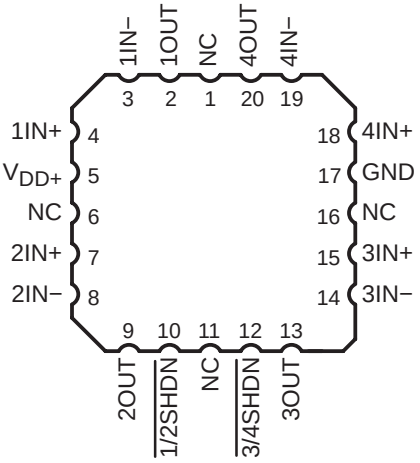

**TLV2463**
**FK PACKAGE**
**(TOP VIEW)**




**TLV2464**
**FK PACKAGE**
**(TOP VIEW)**




**TLV2465**
**FK PACKAGE**
**(TOP VIEW)**




NC − No internal connection
(1) SOT−23 may or may not be indicated

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

Supply voltage, $V_{DD}$ (see Note 1) . . . . . 6 V
Differential input voltage, $V_{ID}$ . . . . . − 0.2 V to $V_{DD}$ + 0.2 V
Input current, $I_I$ (any input) . . . . . ± 200 mA
Output current, $I_O$ . . . . . ± 175 mA
Total input current, $I_I$ (into $V_{DD+}$) . . . . . 175 mA
Total output current, $I_O$ (out of GND) . . . . . 175 mA
Continuous total power dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, $T_A$: C suffix . . . . . 0°C to 70°C
I and Q suffix . . . . . −40°C to 125°C
M suffix . . . . . −55°C to 125°C
Maximum junction temperature, $T_J$ . . . . . 150°C
Storage temperature range, $T_{stg}$ . . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°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.

NOTE 1: All voltage values, except differential voltages, are with respect to GND.

**DISSIPATION RATING TABLE FOR C and I SUFFIX**

| PACKAGE | $\theta_{JC}$ (°C/W) | $\theta_{JA}$ (°C/W) | $T_A \le 25°C$ POWER RATING | $T_A < 125°C$ POWER RATING |
|---|---|---|---|---|
| D (8) | 38.3 | 176 | 710 mW | 142 mW |
| D (14) | 26.9 | 122.6 | 1022 mW | 204.4 mW |
| D (16) | 25.7 | 114.7 | 1090 mW | 218 mW |
| DBV (5) | 55 | 324.1 | 385 mW | 77.1 mW |
| DBV (6) | 55 | 294.3 | 425 mW | 84.9 mW |
| DGK | 54.2 | 259.9 | 481 mW | 96.2 mW |
| DGS | 54.1 | 257.7 | 485 mW | 97 mW |
| N (14, 16) | 32 | 78 | 1600 mW | 320.5 mW |
| P (8) | 41 | 104 | 1200 mW | 240.4 mW |
| PW (14) | 29.3 | 173.6 | 720 mW | 144 mW |
| PW (16) | 28.7 | 161.4 | 774 mW | 154.9 mW |

NOTE: Thermal resistances are not production tested and are for informational purposes only.

**DISSIPATION RATING TABLE FOR Q and M SUFFIX**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$‡ | $T_A = 70°C$ POWER RATING | $T_A = 85°C$ POWER RATING | $T_A = 125°C$ POWER RATING |
|---|---|---|---|---|---|
| FK | 1375 mW | 11.0 mW/°C | 880 mW | 715 mW | 275 mW |
| JG | 1050 mW | 8.4 mW/°C | 672 mW | 546 mW | 210 mW |
| U | 675 mW | 5.4 mW/°C | 432 mW | 350 mW | 135 mW |

‡ This is the inverse of the traditional junction-to-ambient thermal resistance ($R\Theta_{JA}$). Thermal resistances are not production tested and are for informational purposes only.

## recommended operating conditions

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| Supply voltage, $V_{DD}$ | Single supply | 2.7 | 6 | V |
| | Split supply | ±1.35 | ±3 | |
| Common-mode input voltage range, $V_{ICR}$ | | 0 | $V_{DD}$ | V |
| Operating free-air temperature, $T_A$ | C-suffix | 0 | 70 | °C |
| | I-suffix and Q-suffix | −40 | 125 | |
| | M-suffix | −55 | 125 | |
| Shutdown on/off voltage level‡ | $V_{IH}$ | 2 | | V |
| | $V_{IL}$ | | 0.7 | |

‡ Relative to voltage on the GND terminal of the device.

## electrical characteristics at specified free-air temperature, $V_{DD}$ = 3 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | $T_A$† | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | $V_{DD}$ = 3 V, $V_{IC}$ = 1.5 V, $V_O$ = 1.5 V, $R_S$ = 50 Ω | | 25°C | | 500 | 2000 | μV |
| | | | | Full range | | | 2200 | |
| | | | TLV246xA | 25°C | | 500 | 1500 | |
| | | | TLV246xA | Full range | | | 1700 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | | | 2 | | μV/°C |
| $I_{IO}$ | Input offset current | $V_{DD}$ = 3 V, $V_{IC}$ = 1.5 V, $V_O$ = 1.5 V, $R_S$ = 50 Ω | | 25°C | | 2.8 | 7 | nA |
| | | | TLV246xC | Full range | | | 20 | |
| | | | TLV246xI/Q/M | Full range | | | 75 | |
| $I_{IB}$ | Input bias current | | | 25°C | | 4.4 | 14 | nA |
| | | | TLV246xC | Full range | | | 25 | |
| | | | TLV246xI/Q/M | Full range | | | 75 | |
| $V_{OH}$ | High-level output voltage | $I_{OH}$ = −2.5 mA | | 25°C | | 2.9 | | V |
| | | | | Full range | 2.8 | | | |
| | | $I_{OH}$ = −10 mA | | 25°C | | 2.7 | | |
| | | | | Full range | 2.5 | | | |
| $V_{OL}$ | Low-level output voltage | $V_{IC}$ = 1.5 V, | $I_{OL}$ = 2.5 mA | 25°C | | 0.1 | | V |
| | | | | Full range | | | 0.2 | |
| | | $V_{IC}$ = 1.5 V, | $I_{OL}$ = 10 mA | 25°C | | 0.3 | | |
| | | | | Full range | | | 0.5 | |
| $I_{OS}$ | Short-circuit output current | Sourcing | | 25°C | | 50 | | mA |
| | | | | Full range | 20 | | | |
| | | Sinking | | 25°C | | 40 | | |
| | | | | Full range | 20 | | | |
| $I_O$ | Output current | Measured 1 V from rail | | 25°C | | ±40 | | mA |
| $A_{VD}$ | Large-signal differential voltage amplification | $R_L$ = 10 kΩ, | $V_{O(PP)}$ = 1 V | 25°C | 90 | 105 | | dB |
| | | | | Full range | 89 | | | |
| $r_{i(d)}$ | Differential input resistance | | | 25°C | | $10^9$ | | Ω |

† Full range is 0°C to 70°C for the C suffix, −40°C to 125°C for the I and Q suffixes, and −55°C to 125°C for the M suffix.

## electrical characteristics at specified free-air temperature, $V_{DD}$ = 3 V (unless otherwise noted) (continued)

| PARAMETER | | TEST CONDITIONS | | $T_A$† | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $c_{i(c)}$ | Common-mode input capacitance | f = 10 kHz | | 25°C | | 7 | | pF |
| $z_o$ | Closed-loop output impedance | f = 100 kHz, | $A_V$ = 10 | 25°C | | 33 | | Ω |
| CMRR | Common-mode rejection ratio | $V_{ICR}$ = 0 to 3 V, $R_S$ = 50 Ω | | 25°C | 66 | 80 | | dB |
| | | | TLV246xC | Full range | 64 | | | |
| | | | TLV246xI/Q/M | Full range | 60 | | | |
| $k_{SVR}$ | Supply voltage rejection ratio ($\Delta V_{DD}$ /$\Delta V_{IO}$) | $V_{DD}$ = 2.7 V to 6 V, No load | $V_{IC}$ = $V_{DD}$/2, | 25°C | 80 | 85 | | dB |
| | | | | Full range | 75 | | | |
| | | $V_{DD}$ = 3 V to 5 V, No load | $V_{IC}$ = $V_{DD}$/2, | 25°C | 85 | 95 | | |
| | | | | Full range | 80 | | | |
| $I_{DD}$ | Supply current (per channels) | $V_O$ = 1.5 V, | No load | 25°C | | 0.5 | 0.575 | mA |
| | | | | Full range | | | 0.9 | |
| $I_{DD(SHDN)}$ | Supply current in shutdown (TLV2460, TLV2463, TLV2465) | $\overline{SHDN}$ < 0.7 V, Per channel in shutdown | | 25°C | | 0.3 | | µA |
| | | | | Full range | | | 2.5 | |

† Full range is 0°C to 70°C for the C suffix, −40°C to 125°C for the I and Q suffixes, and −55°C to 125°C for the M suffix.

## operating characteristics at specified free-air temperature, $V_{DD}$ = 3 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | $T_A$† | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| SR | Slew rate at unity gain | $V_{O(PP)}$ = 0.8 V, $R_L$ = 10 kΩ | $C_L$ = 160 pF, | 25°C | 0.9 | 1.6 | | V/µs |
| | | | | Full range | 0.8 | | | |
| $V_n$ | Equivalent input noise voltage | f = 100 Hz | | 25°C | | 16 | | nV/√Hz |
| | | f = 1 kHz | | 25°C | | 11 | | |
| $I_n$ | Equivalent input noise current | f = 1 kHz | | 25°C | | 0.13 | | pA/√Hz |
| THD + N | Total harmonic distortion plus noise | $V_{O(PP)}$ = 2 V, $R_L$ = 10 kΩ, f = 1 kHz | $A_V$ = 1 | 25°C | | 0.006% | | |
| | | | $A_V$ = 10 | | | 0.02% | | |
| | | | $A_V$ = 100 | | | 0.08% | | |
| $t_{(on)}$ | Amplifier turnon time | $A_V$ = 1, $R_L$ = 10 kΩ | Both channels | 25°C | | 7.6 | | µs |
| | | | Channel 1 only, Channel 2 on | | | 7.65 | | |
| $t_{(off)}$ | Amplifier turnoff time | $A_V$ = 1, $R_L$ = 10 kΩ | Both channels | 25°C | | 333 | | ns |
| | | | Channel 1 only, Channel 2 on | | | 328 | | |
| | | | Channel 2 only, Channel 1 on | | | 329 | | |
| | Gain-bandwidth product | f = 10 kHz, $C_L$ = 160 pF | $R_L$ = 10 kΩ, | 25°C | | 5.2 | | MHz |
| $t_s$ | Settling time | $V_{(STEP)PP}$ = 2 V, $A_V$ = −1, $C_L$ = 10 pF, $R_L$ = 10 kΩ | 0.1% | 25°C | | 1.47 | | µs |
| | | | 0.01% | | | 1.78 | | |
| | | $V_{(STEP)PP}$ = 2 V, $A_V$ = −1, $C_L$ = 56 pF, $R_L$ = 10 kΩ | 0.1% | | | 1.77 | | |
| | | | 0.01% | | | 1.98 | | |
| $\phi_m$ | Phase margin at unity gain | $R_L$ = 10 kΩ, | $C_L$ = 160 pF | 25°C | | 44° | | |
| | Gain margin | | | 25°C | | 7 | | dB |

† Full range is 0°C to 70°C for the C suffix, −40°C to 125°C for the I and Q suffixes, and −55°C to 125°C for the M suffix.

## electrical characteristics at specified free-air temperature, $V_{DD}$ = 5 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | $T_A$† | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | $V_{DD}$ = 5 V, $V_{IC}$ = 2.5, $V_O$ = 2.5 V, $R_S$ = 50 Ω | | 25°C | | 500 | 2000 | μV |
| | | | | Full range | | | 2200 | |
| | | | TLV246xA | 25°C | | 500 | 1500 | |
| | | | TLV246xA | Full range | | | 1700 | |
| $\alpha_{VIO}$ | Temperature coefficient of input offset voltage | | | 25°C | | 2 | | μV/°C |
| $I_{IO}$ | Input offset current | $V_{DD}$ = 5 V, $V_{IC}$ = 2.5 V, $V_O$ = 2.5 V, $R_S$ = 50 Ω | | 25°C | | 0.3 | 7 | nA |
| | | | TLV246xC | Full range | | | 15 | |
| | | | TLV246xI/Q/M | Full range | | | 60 | |
| $I_{IB}$ | Input bias current | | | 25°C | | 1.3 | 14 | nA |
| | | | TLV246xC | Full range | | | 30 | |
| | | | TLV246xI/Q/M | Full range | | | 60 | |
| $V_{OH}$ | High-level output voltage | $I_{OH}$ = −2.5 mA | | 25°C | | 4.9 | | V |
| | | | | Full range | 4.8 | | | |
| | | $I_{OH}$ = −10 mA | | 25°C | | 4.8 | | |
| | | | | Full range | 4.7 | | | |
| $V_{OL}$ | Low-level output voltage | $V_{IC}$ = 2.5 V, | $I_{OL}$ = 2.5 mA | 25°C | | 0.1 | | V |
| | | | | Full range | | | 0.2 | |
| | | $V_{IC}$ = 2.5 V, | $I_{OL}$ = 10 mA | 25°C | | 0.2 | | |
| | | | | Full range | | | 0.3 | |
| $I_{OS}$ | Short-circuit output current | Sourcing | | 25°C | | 145 | | mA |
| | | | | Full range | 60 | | | |
| | | Sinking | | 25°C | | 100 | | |
| | | | | Full range | 60 | | | |
| $I_O$ | Output current | Measured at 1 V from rail | | 25°C | | ±80 | | mA |
| $A_{VD}$ | Large-signal differential voltage amplification | $V_{IC}$ = 2.5 V, $V_O$ = 1 V to 4 V | $R_L$ = 10 kΩ, | 25°C | 92 | 109 | | dB |
| | | | | Full range | 90 | | | |
| $r_{i(d)}$ | Differential input resistance | | | 25°C | | $10^9$ | | Ω |
| $c_{i(c)}$ | Common-mode input capacitance | f = 10 kHz | | 25°C | | 7 | | pF |
| $z_o$ | Closed-loop output impedance | f = 100 kHz, | $A_V$ = 10 | 25°C | | 29 | | Ω |
| CMRR | Common-mode rejection ratio | $V_{ICR}$ = 0 V to 5 V, $R_S$ = 50 Ω | | 25°C | 71 | 85 | | dB |
| | | | TLV246xC | Full range | 69 | | | |
| | | | TLV246xI/Q/M | Full range | 60 | | | |
| $k_{SVR}$ | Supply voltage rejection ratio ($\Delta V_{DD}$ /$\Delta V_{IO}$) | $V_{DD}$ = 2.7 V to 6 V, No load | $V_{IC}$ = $V_{DD}$/2, | 25°C | 80 | 85 | | dB |
| | | | | Full range | 75 | | | |
| | | $V_{DD}$ = 3 V to 5 V, No load | $V_{IC}$ = $V_{DD}$/2, | 25°C | 85 | 95 | | dB |
| | | | | Full range | 80 | | | |
| $I_{DD}$ | Supply current (per channel) | $V_O$ = 2.5 V, | No load, | 25°C | | 0.55 | 0.65 | mA |
| | | | | Full range | | | 1 | |
| $I_{DD(SHDN)}$ | Supply current in shutdown (TLV2460, TLV2463, TLV2465) | $\overline{SHDN}$ < 0.7 V, Per channels in shutdown | | 25°C | | 1 | | μA |
| | | | | Full range | | | 3 | |

† Full range is 0°C to 70°C for the C suffix, −40°C to 125°C for the I and Q suffixes, and −55°C to 125°C for the M suffix.

## operating characteristics at specified free-air temperature, $V_{DD}$ = 5 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | $T_A$† | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| SR | Slew rate at unity gain | $V_{O(PP)}$ = 2 V, $C_L$ = 160 pF, $R_L$ = 10 kΩ | | 25°C | 0.9 | 1.6 | | V/μs |
| | | | | Full range | 0.8 | | | |
| $V_n$ | Equivalent input noise voltage | f = 100 Hz | | 25°C | | 14 | | nV/√Hz |
| | | f = 1 kHz | | 25°C | | 11 | | |
| $I_n$ | Equivalent input noise current | f = 100 Hz | | 25°C | | 0.13 | | pA/√Hz |
| THD + N | Total harmonic distortion plus noise | $V_{O(PP)}$ = 4 V, $R_L$ = 10 kΩ, f = 10 kHz | $A_V$ = 1 | 25°C | | 0.004% | | |
| | | | $A_V$ = 10 | | | 0.01% | | |
| | | | $A_V$ = 100 | | | 0.04% | | |
| $t_{(on)}$ | Amplifier turnon time | $A_V$ = 1, $R_L$ = 10 kΩ | Both channels | 25°C | | 7.6 | | μs |
| | | | Channel 1 only, Channel 2 on | | | 7.65 | | |
| | | | Channel 2 only, Channel 1 on | | | 7.25 | | |
| $t_{(off)}$ | Amplifier turnoff time | $A_V$ = 1, $R_L$ = 10 kΩ | Both channels | 25°C | | 333 | | ns |
| | | | Channel 1 only, Channel 2 on | | | 328 | | |
| | | | Channel 2 only, Channel 1 on | | | 329 | | |
| | Gain-bandwidth product | f = 10 kHz, $C_L$ = 160 pF | $R_L$ = 10 kΩ, | 25°C | | 6.4 | | MHz |
| $t_s$ | Settling time | $V_{(STEP)PP}$ = 2 V, $A_V$ = −1, $C_L$ = 10 pF, $R_L$ = 10 kΩ | 0.1% | 25°C | | 1.53 | | μs |
| | | | 0.01% | | | 1.83 | | |
| | | $V_{(STEP)PP}$ = 2 V, $A_V$ = −1, $C_L$ = 56 pF, $R_L$ = 10 kΩ | 0.1% | | | 3.13 | | |
| | | | 0.01% | | | 3.33 | | |
| $\phi_m$ | Phase margin at unity gain | $R_L$ = 10 kΩ, | $C_L$ = 160 pF | 25°C | | 45° | | |
| | Gain margin | | | 25°C | | 7 | | dB |

† Full range is 0°C to 70°C for the C suffix, −40°C to 125°C for the I and Q suffixes, and −55°C to 125°C for the M suffix.

## TYPICAL CHARACTERISTICS

### Table of Graphs

| | | | FIGURE |
|---|---|---|---|
| $V_{IO}$ | Input offset voltage | vs Common-mode input voltage | 1, 2 |
| $I_{IB}$ | Input bias current | vs Free-air temperature | 3, 4 |
| $I_{IO}$ | Input offset current | vs Free-air temperature | 3, 4 |
| $V_{OH}$ | High-level output voltage | vs High-level output current | 5, 6 |
| $V_{OL}$ | Low-level output voltage | vs Low-level output current | 7, 8 |
| $V_{O(PP)}$ | Peak-to-peak output voltage | vs Frequency | 9, 10 |
| | Open-loop gain | vs Frequency | 11, 12 |
| | Phase | vs Frequency | 11, 12 |
| $A_{VD}$ | Differential voltage amplification | vs Load resistance | 13 |
| | Capacitive load | vs Load resistance | 14 |
| $Z_o$ | Output impedance | vs Frequency | 15, 16 |
| CMRR | Common-mode rejection ratio | vs Frequency | 17 |
| $k_{SVR}$ | Supply-voltage rejection ratio | vs Frequency | 18, 19 |
| $I_{DD}$ | Supply current | vs Supply voltage | 20 |
| | | vs Free-air temperature | 21 |
| | Amplifier turnon characteristics | | 22 |
| | Amplifier turnoff characteristics | | 23 |
| | Supply current turnon | | 24 |
| | Supply current turnoff | | 25 |
| | Shutdown supply current | vs Free-air temperature | 26 |
| SR | Slew rate | vs Supply voltage | 27 |
| $V_n$ | Equivalent input noise voltage | vs Frequency | 28, 29 |
| | | vs Common-mode input voltage | 30, 31 |
| THD | Total harmonic distortion | vs Frequency | 32, 33 |
| THD+N | Total harmonic distortion plus noise | vs Peak-to-peak signal amplitude | 34, 35 |
| $\phi_m$ | Phase margin | vs Frequency | 11, 12 |
| | | vs Load capacitance | 36 |
| | | vs Free-air temperature | 37 |
| | Gain bandwidth product | vs Supply voltage | 38 |
| | | vs Free-air temperature | 39 |
| | Large signal follower | | 40, 41 |
| | Small signal follower | | 42, 43 |
| | Inverting large signal | | 44, 45 |
| | Inverting small signal | | 46, 47 |

## TYPICAL CHARACTERISTICS

INPUT OFFSET VOLTAGE
vs
COMMON-MODE INPUT VOLTAGE

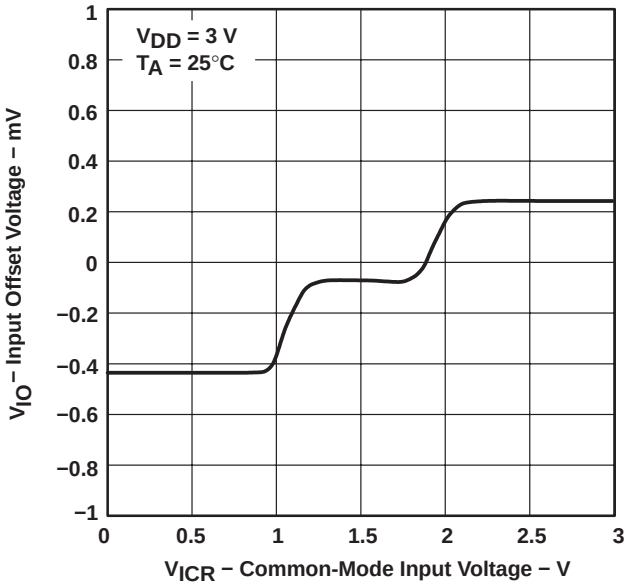



Figure 1

INPUT OFFSET VOLTAGE
vs
COMMON-MODE INPUT VOLTAGE

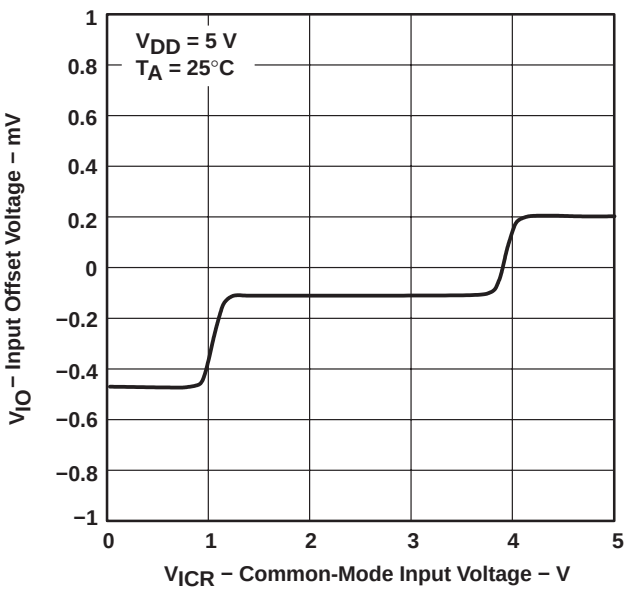



Figure 2

INPUT BIAS AND INPUT OFFSET CURRENT
vs
FREE-AIR TEMPERATURE

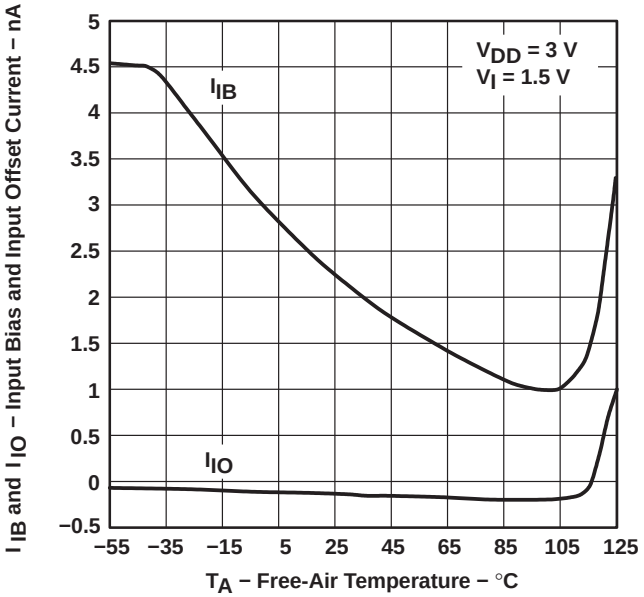



Figure 3

INPUT BIAS AND INPUT OFFSET CURRENT
vs
FREE-AIR TEMPERATURE

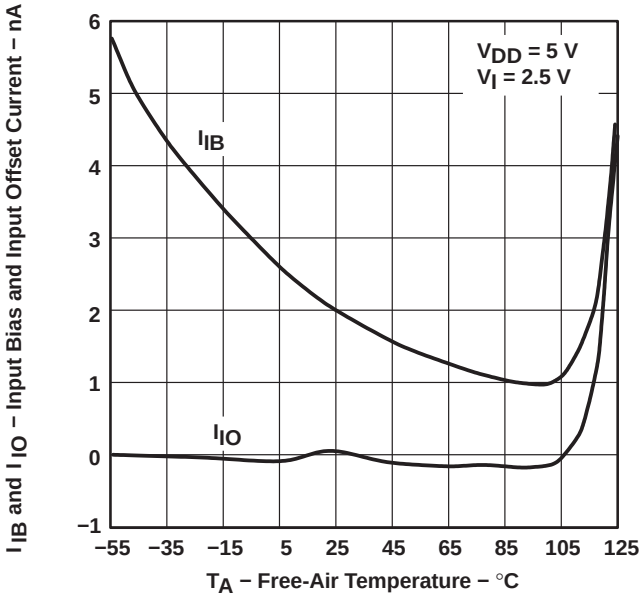



Figure 4

## TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

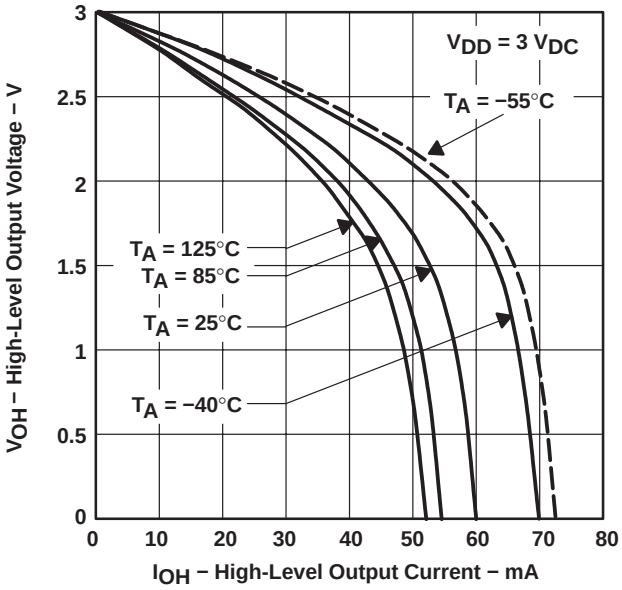



Figure 5

HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

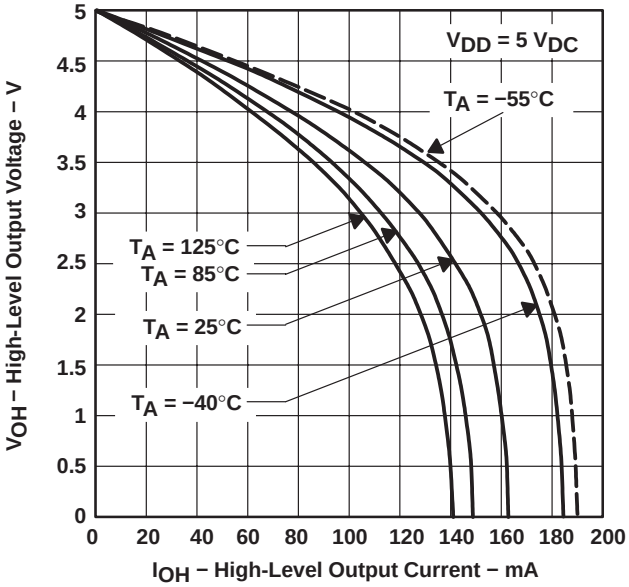



Figure 6

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

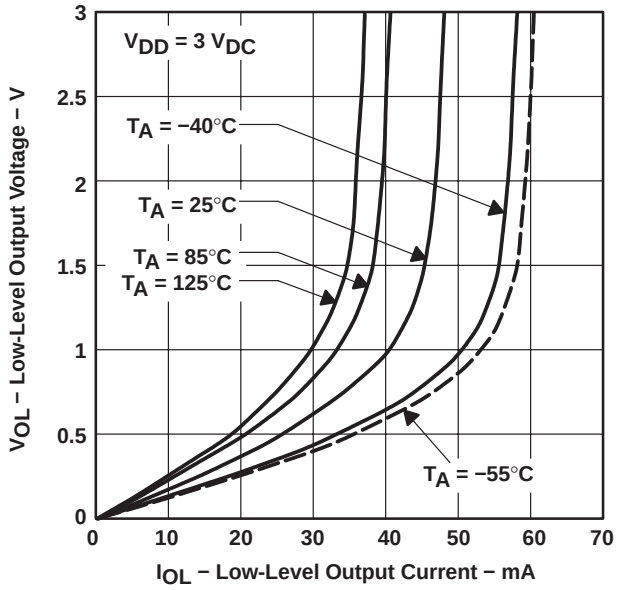



Figure 7

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

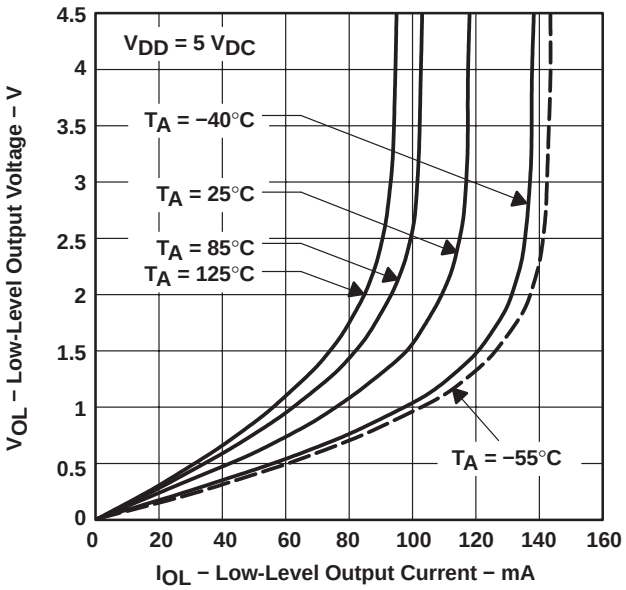



Figure 8

## TYPICAL CHARACTERISTICS

PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY

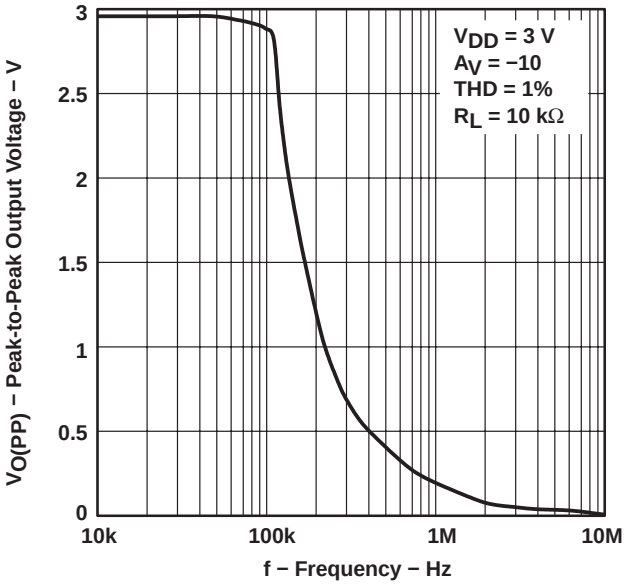



Figure 9

PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY

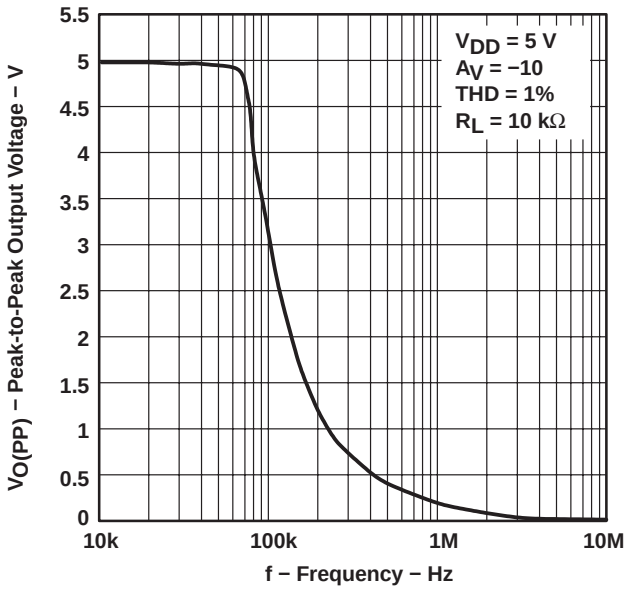



Figure 10

OPEN-LOOP GAIN AND PHASE
vs
FREQUENCY

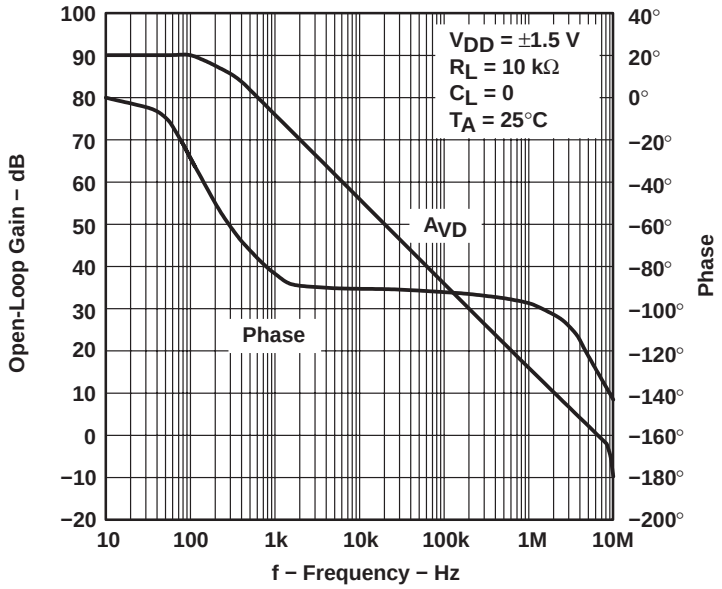



Figure 11

## TYPICAL CHARACTERISTICS

**OPEN-LOOP GAIN AND PHASE vs FREQUENCY**

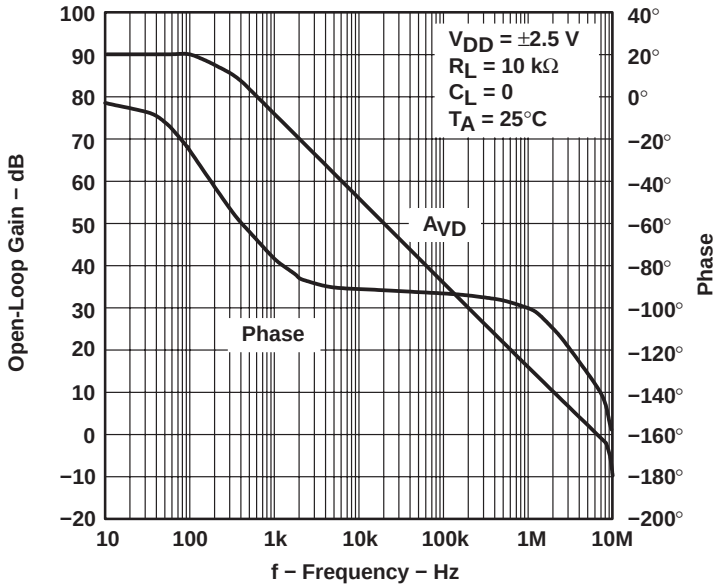



**Figure 12**

**DIFFERENTIAL VOLTAGE AMPLIFICATION vs LOAD RESISTANCE**

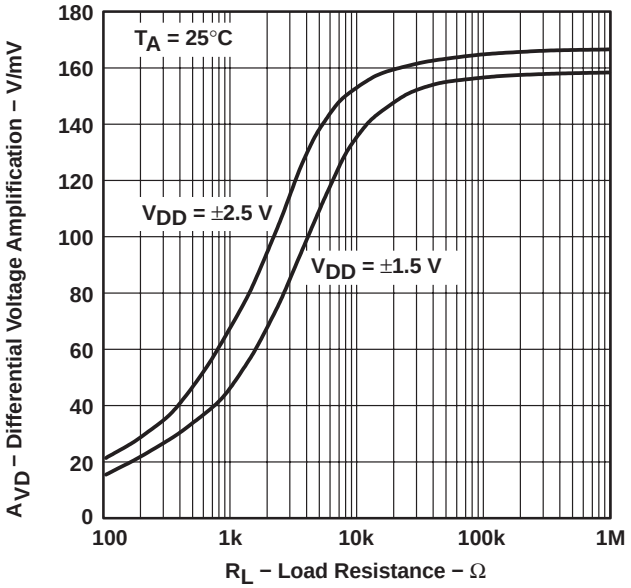



**Figure 13**

**CAPACITIVE LOAD vs LOAD RESISTANCE**

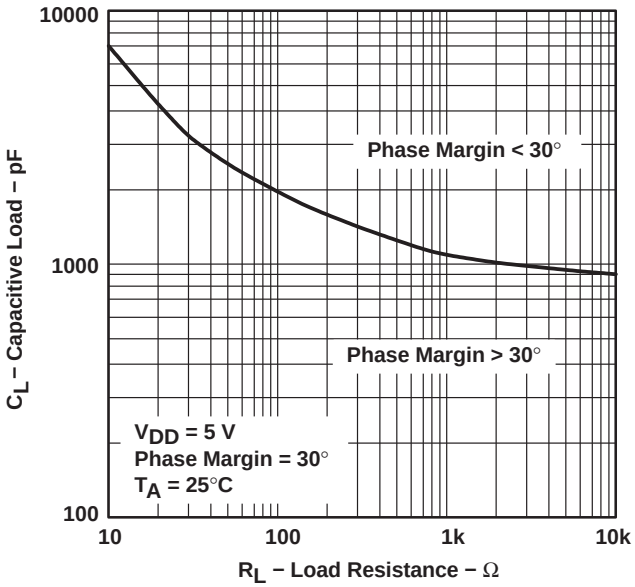



**Figure 14**

## TYPICAL CHARACTERISTICS

**OUTPUT IMPEDANCE vs FREQUENCY**

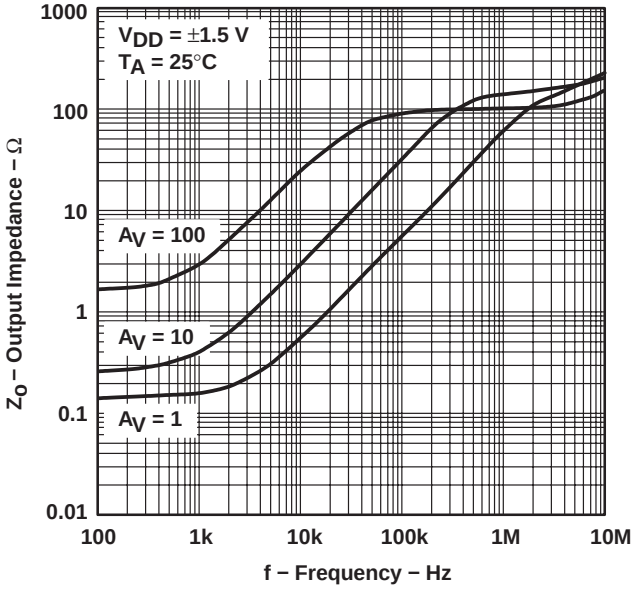



Figure 15

**OUTPUT IMPEDANCE vs FREQUENCY**

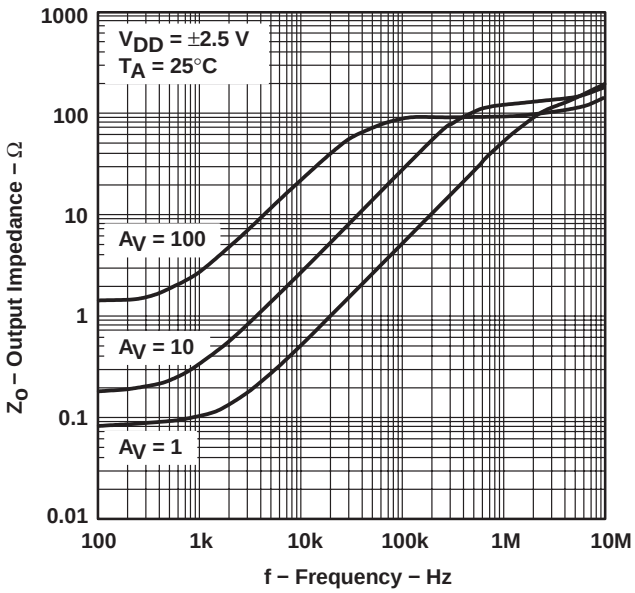



Figure 16

**COMMON-MODE REJECTION RATIO vs FREQUENCY**

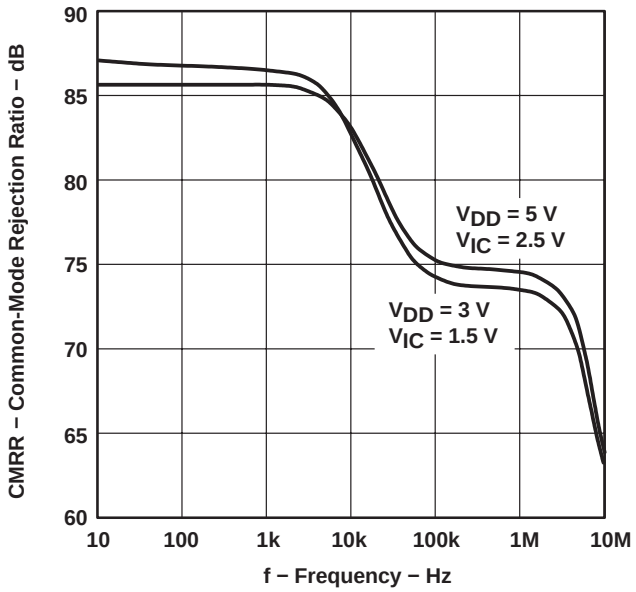



Figure 17

## TYPICAL CHARACTERISTICS

**SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY**

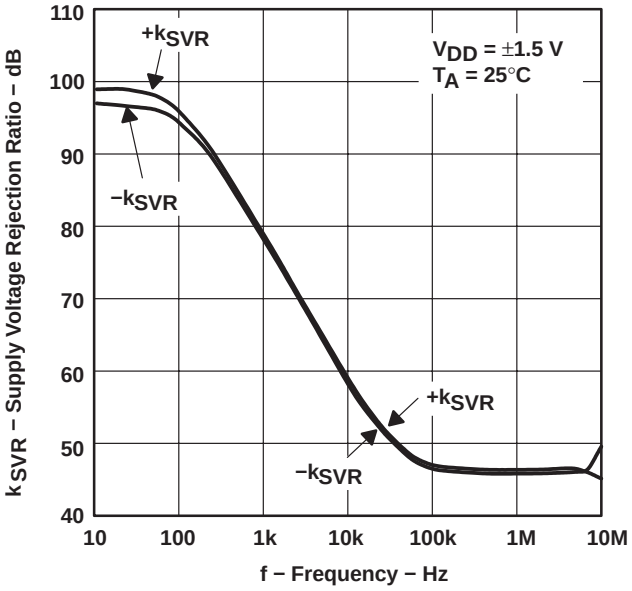



Figure 18

**SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY**

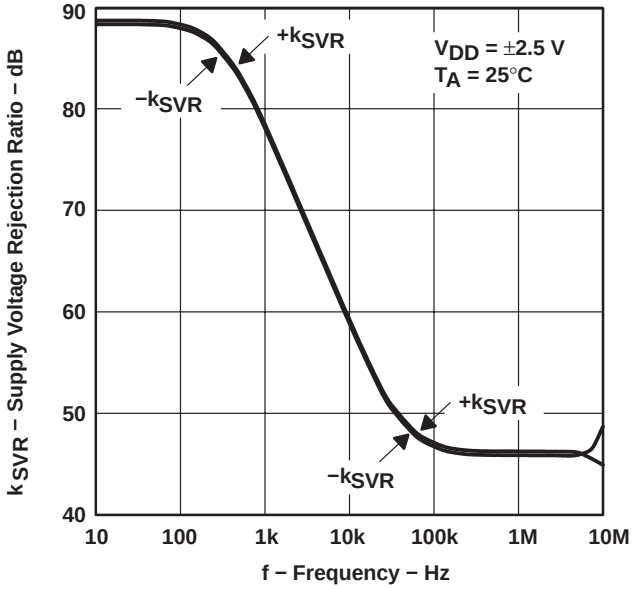



Figure 19

**SUPPLY CURRENT vs SUPPLY VOLTAGE**

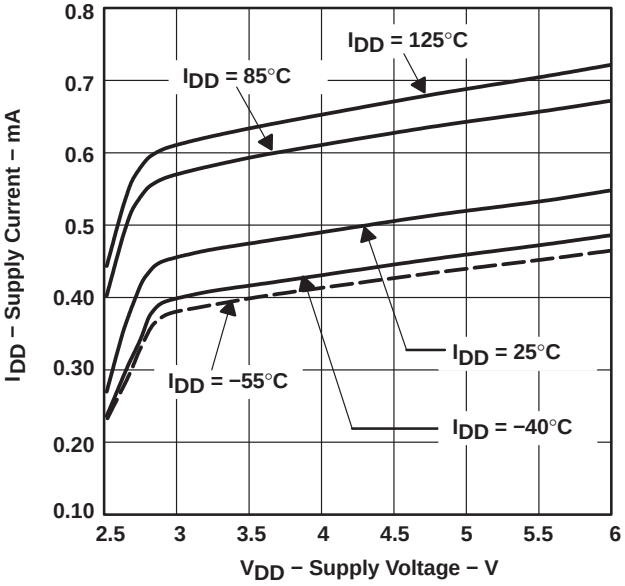



Figure 20

**SUPPLY CURRENT vs FREE-AIR TEMPERATURE**

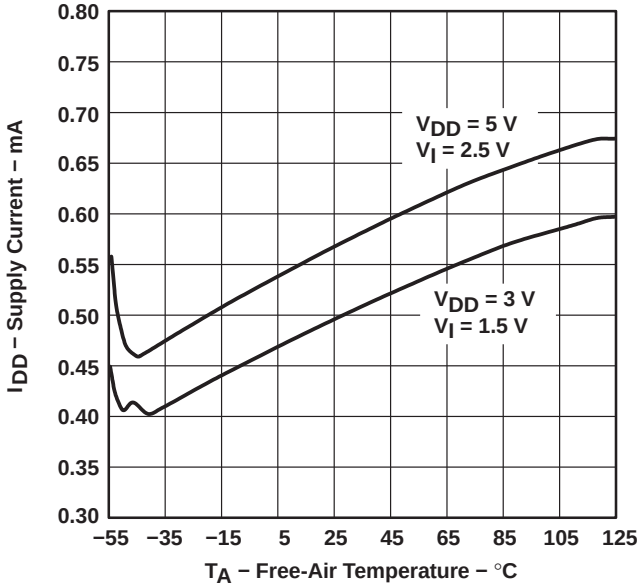



Figure 21

## TYPICAL CHARACTERISTICS

**AMPLIFIER WITH A SHUTDOWN PULSE TURNON CHARACTERISTICS**

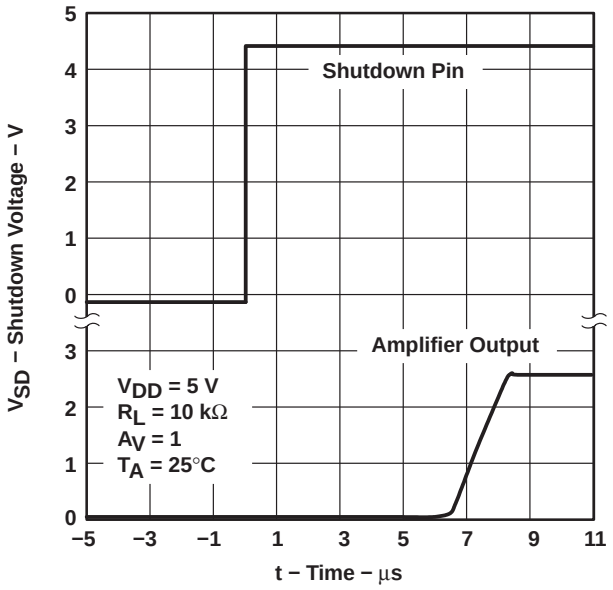



Figure 22

**AMPLIFIER WITH A SHUTDOWN PULSE TURNOFF CHARACTERISTICS**

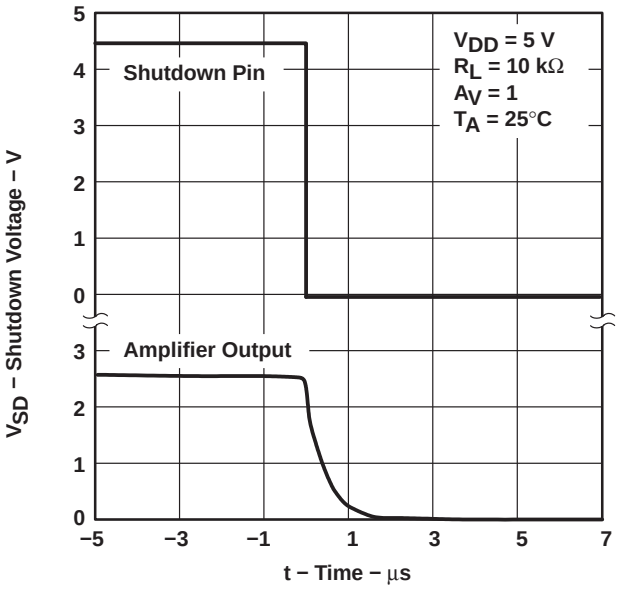



Figure 23

**SUPPLY CURRENT WITH A SHUTDOWN PULSE TURNON CHARACTERISTICS**

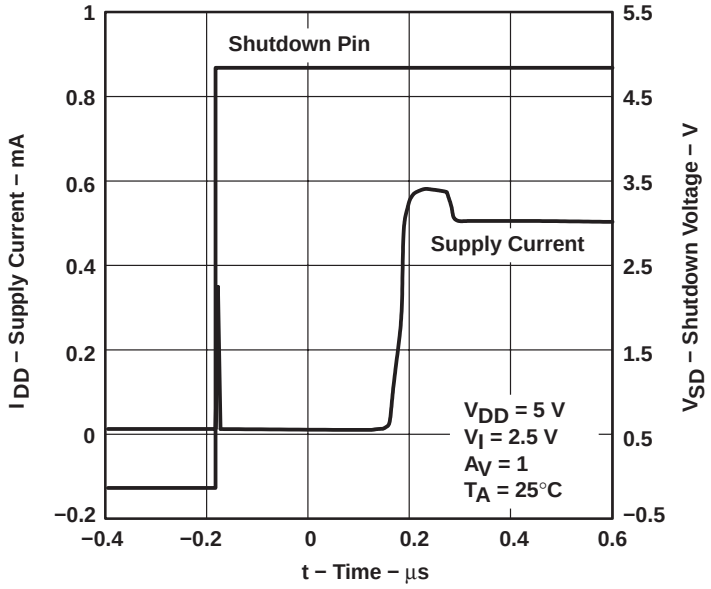



Figure 24

## TYPICAL CHARACTERISTICS

**TURNOFF SUPPLY CURRENT
WITH A SHUTDOWN PULSE**

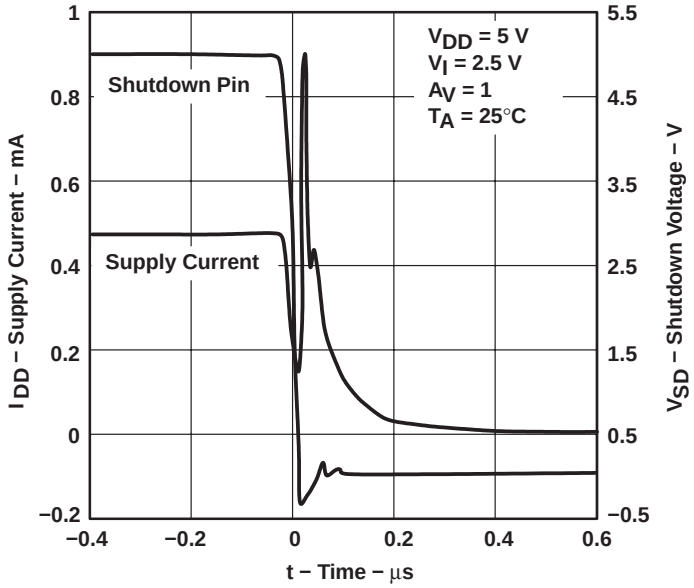



**Figure 25**

**SHUTDOWN SUPPLY CURRENT
vs
FREE-AIR TEMPERATURE**

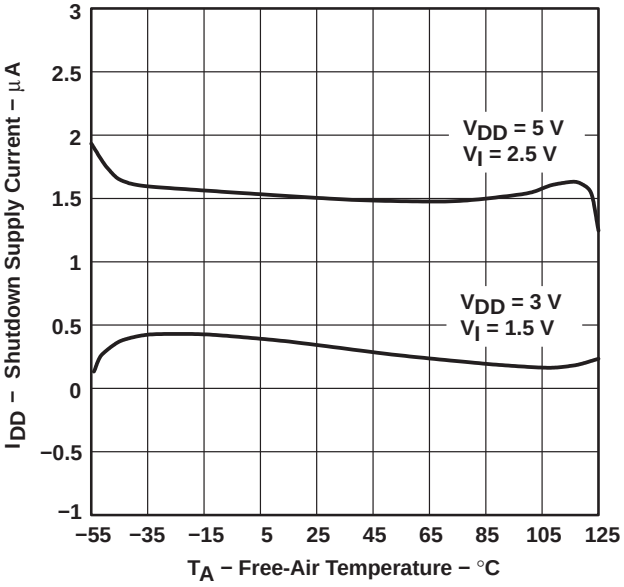



**Figure 26**

**SLEW RATE
vs
SUPPLY VOLTAGE**

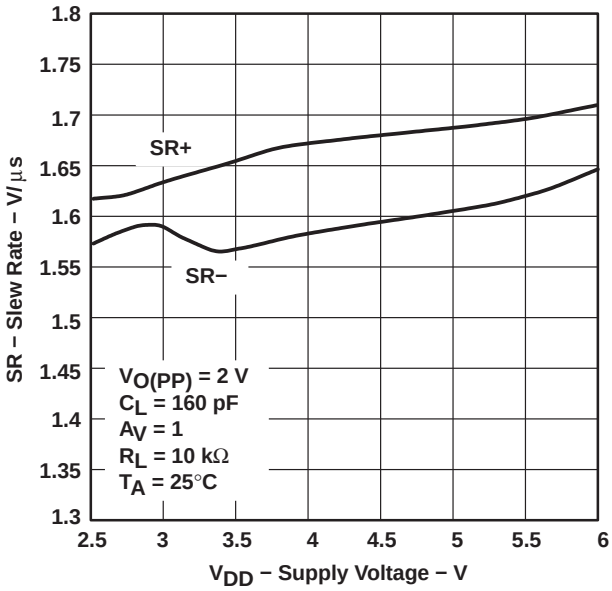



**Figure 27**

## TYPICAL CHARACTERISTICS

**EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY**

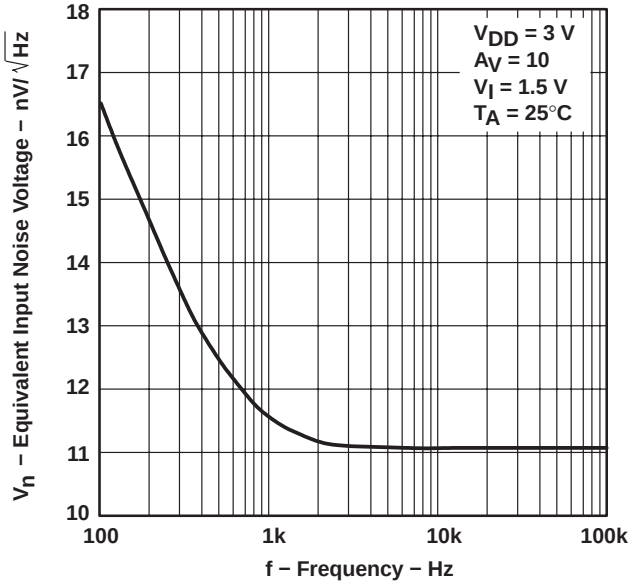



Figure 28

**EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY**

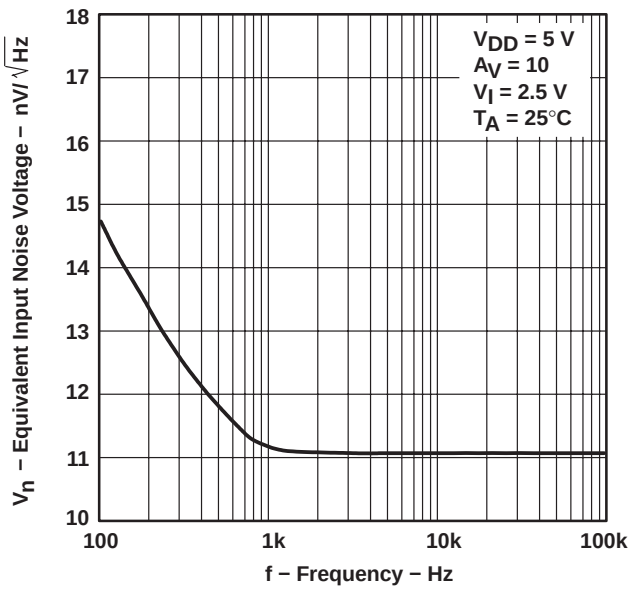



Figure 29

**EQUIVALENT INPUT NOISE VOLTAGE vs COMMON-MODE INPUT VOLTAGE**

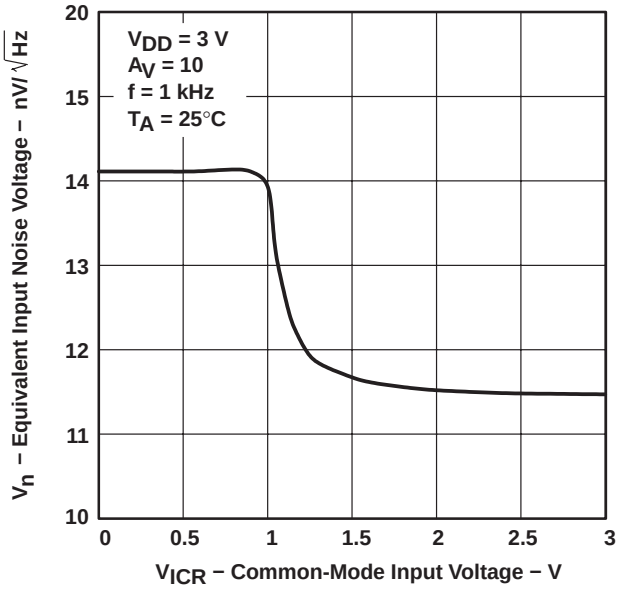



Figure 30

**EQUIVALENT INPUT NOISE VOLTAGE vs COMMON-MODE INPUT VOLTAGE**

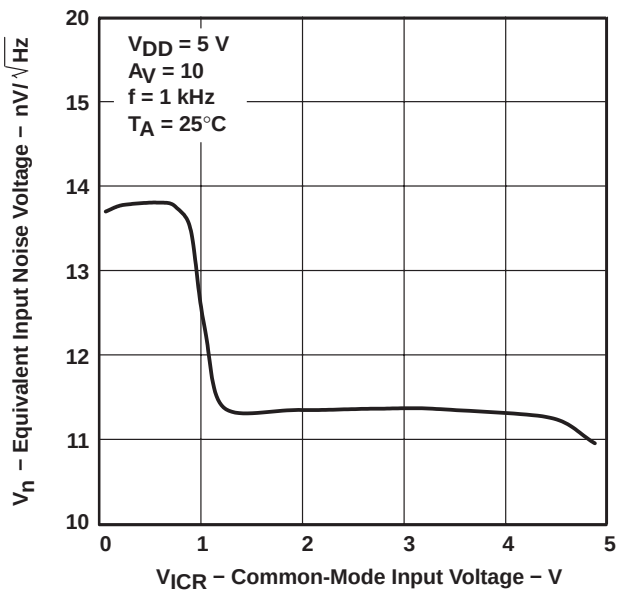



Figure 31

## TYPICAL CHARACTERISTICS

**TOTAL HARMONIC DISTORTION vs FREQUENCY**

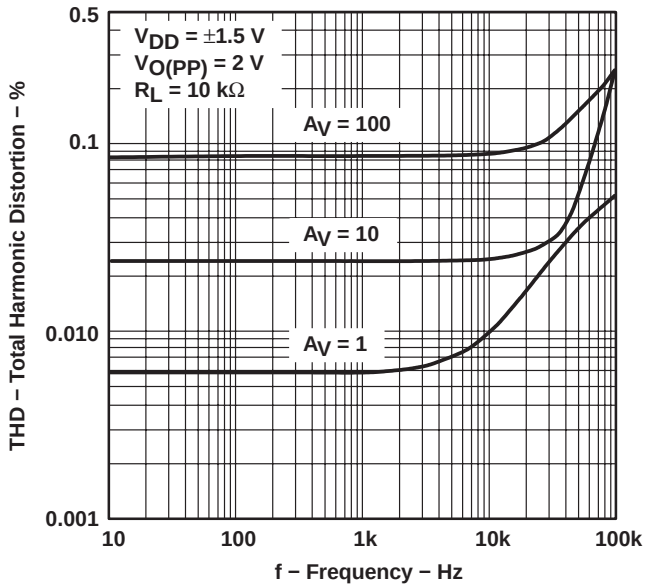



Figure 32

**TOTAL HARMONIC DISTORTION vs FREQUENCY**

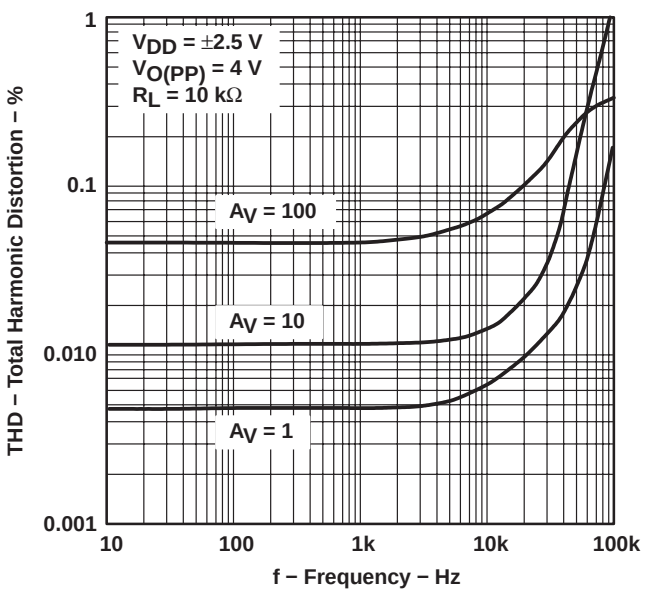



Figure 33

**TOTAL HARMONIC DISTORTION PLUS NOISE vs PEAK-TO-PEAK SIGNAL AMPLITUDE**

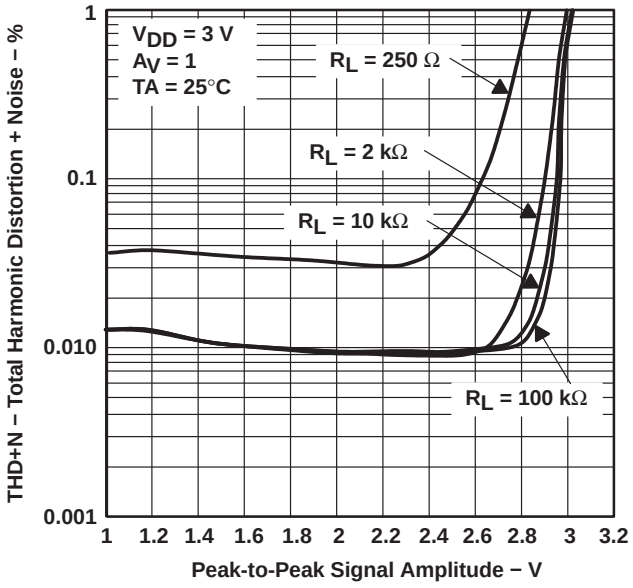



Figure 34

**TOTAL HARMONIC DISTORTION PLUS NOISE vs PEAK-TO-PEAK SIGNAL AMPLITUDE**

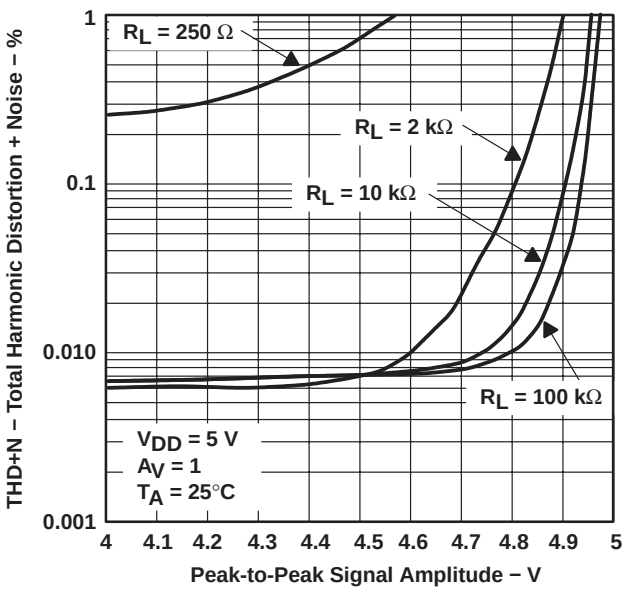



Figure 35

## TYPICAL CHARACTERISTICS

**PHASE MARGIN vs LOAD CAPACITANCE**

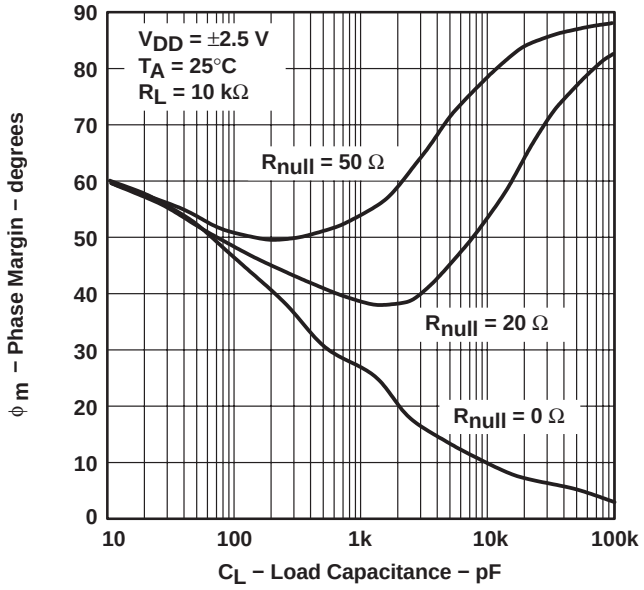



Figure 36

**PHASE MARGIN vs FREE-AIR TEMPERATURE**

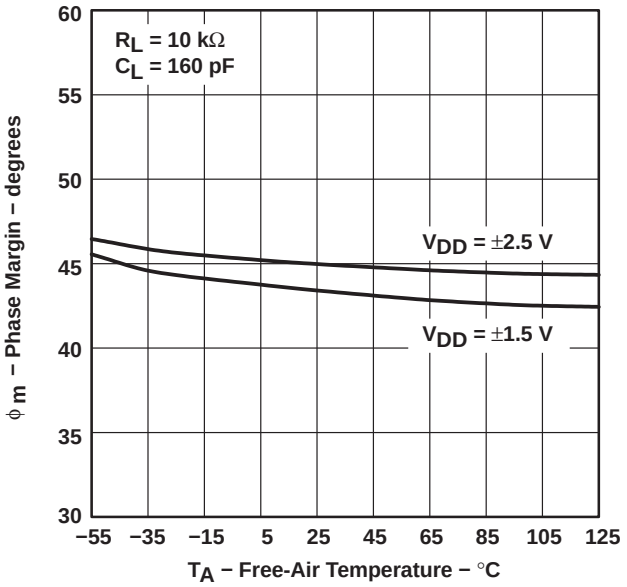



Figure 37

**GAIN BANDWIDTH PRODUCT vs SUPPLY VOLTAGE**

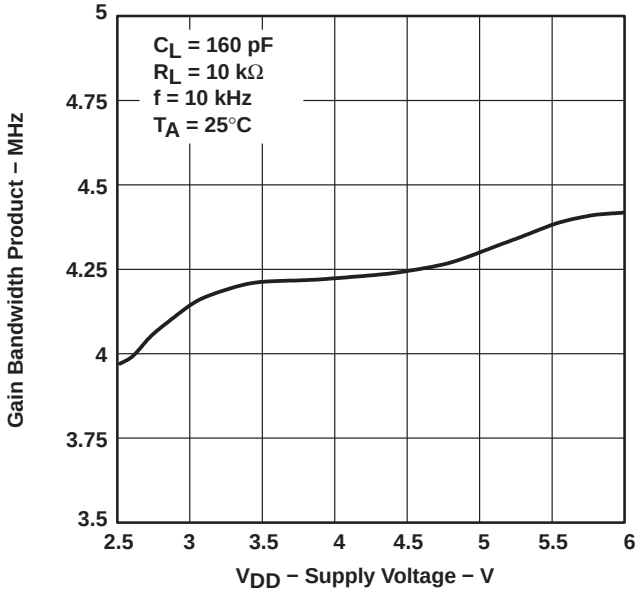



Figure 38

**GAIN BANDWIDTH PRODUCT vs FREE-AIR TEMPERATURE**

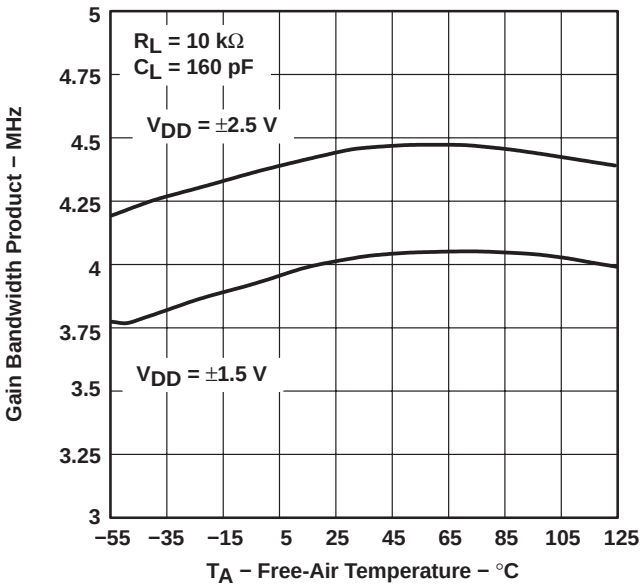



Figure 39

## TYPICAL CHARACTERISTICS

LARGE SIGNAL FOLLOWER

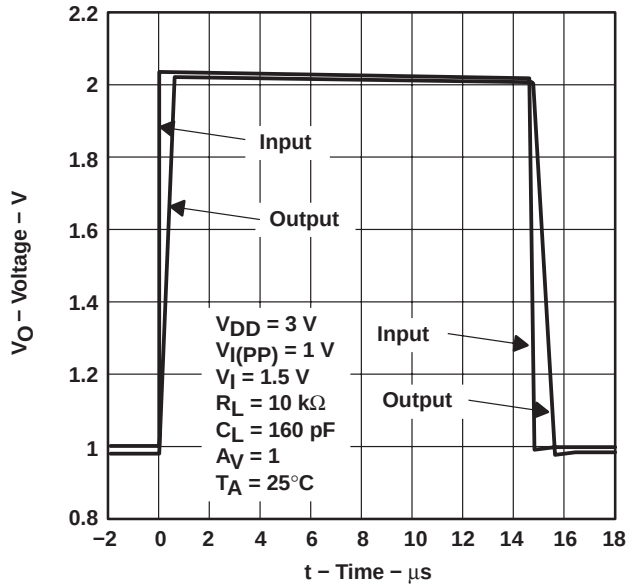



Figure 40

LARGE SIGNAL FOLLOWER

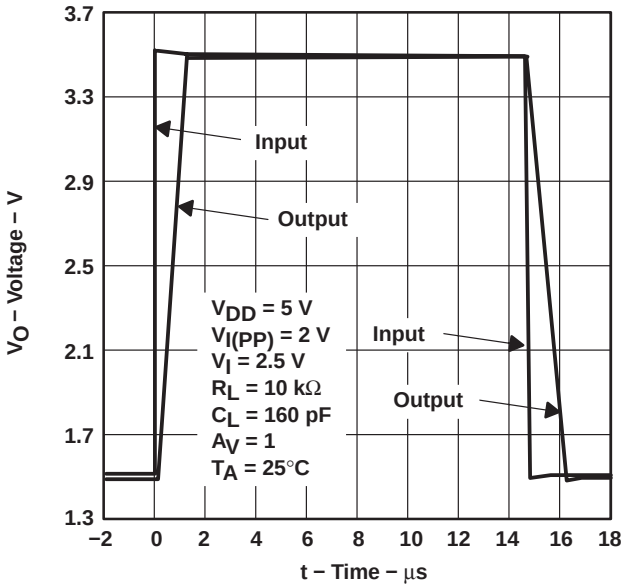



Figure 41

SMALL SIGNAL FOLLOWER

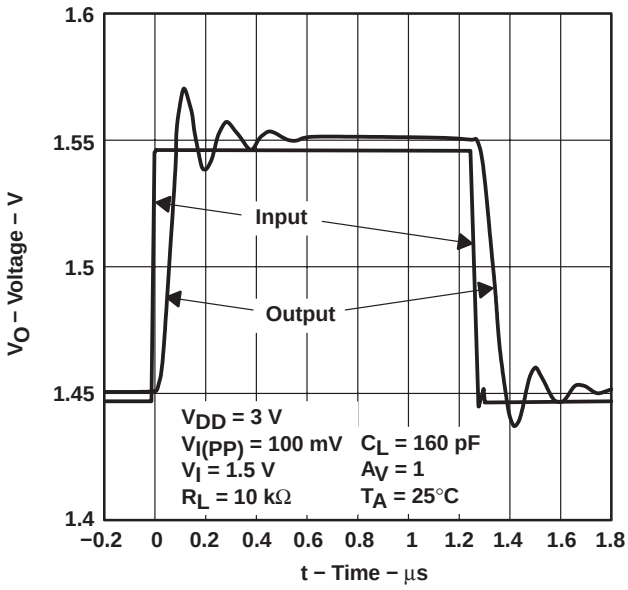



Figure 42

SMALL SIGNAL FOLLOWER

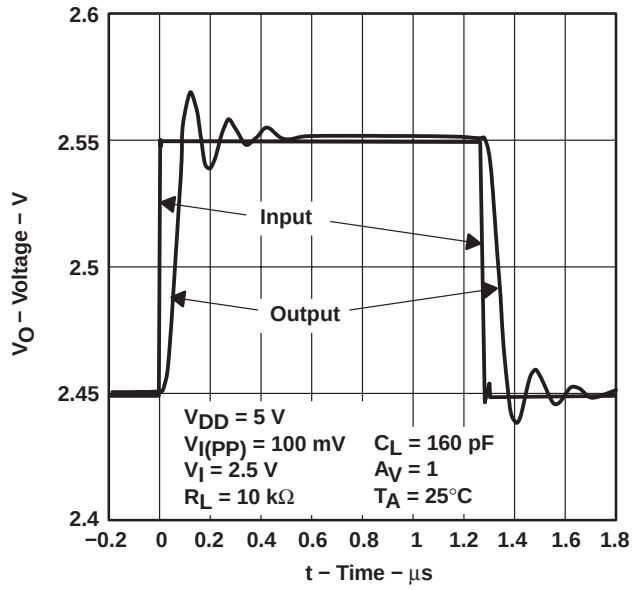



Figure 43

## TYPICAL CHARACTERISTICS

INVERTING LARGE SIGNAL

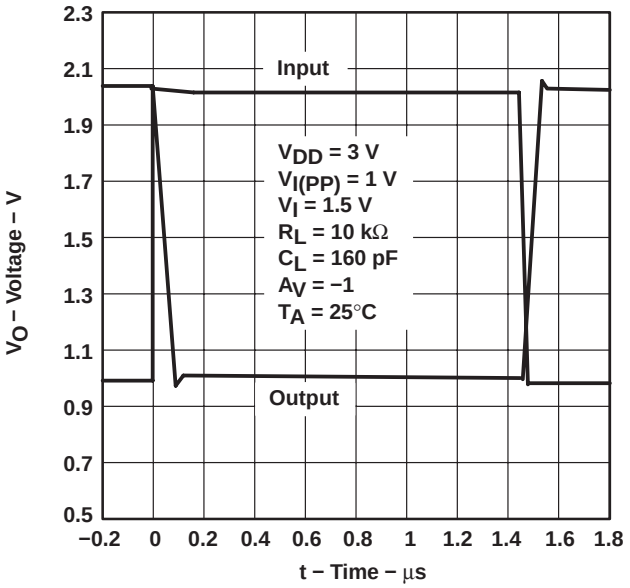



Figure 44

INVERTING LARGE SIGNAL

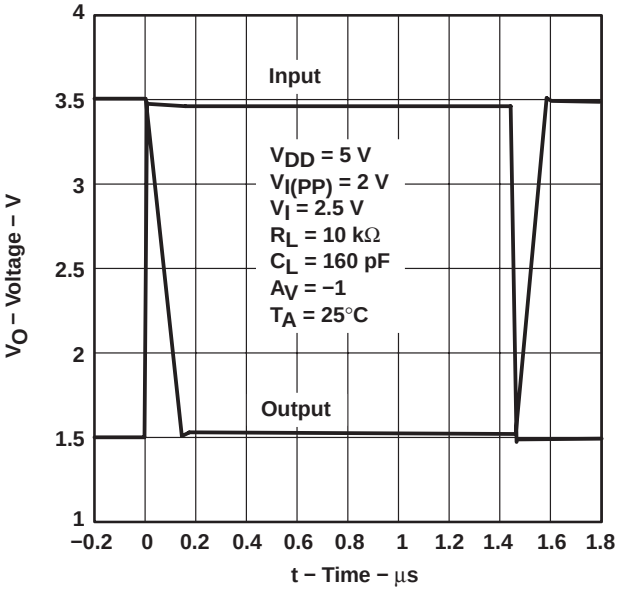



Figure 45

INVERTING SMALL SIGNAL

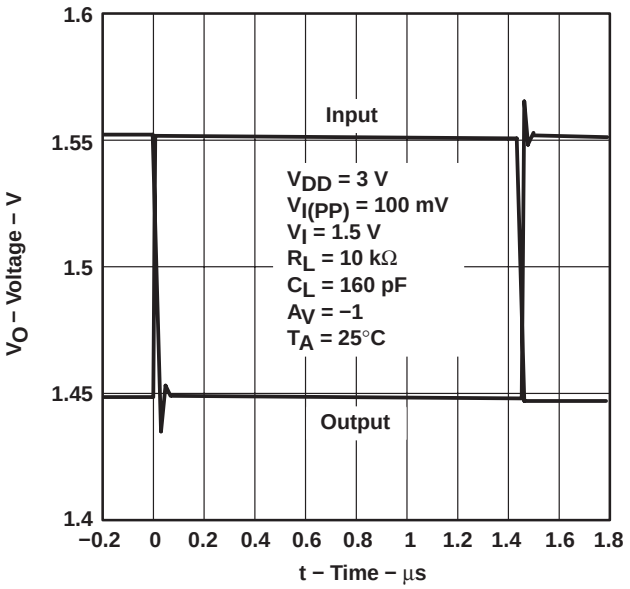



Figure 46

INVERTING SMALL SIGNAL

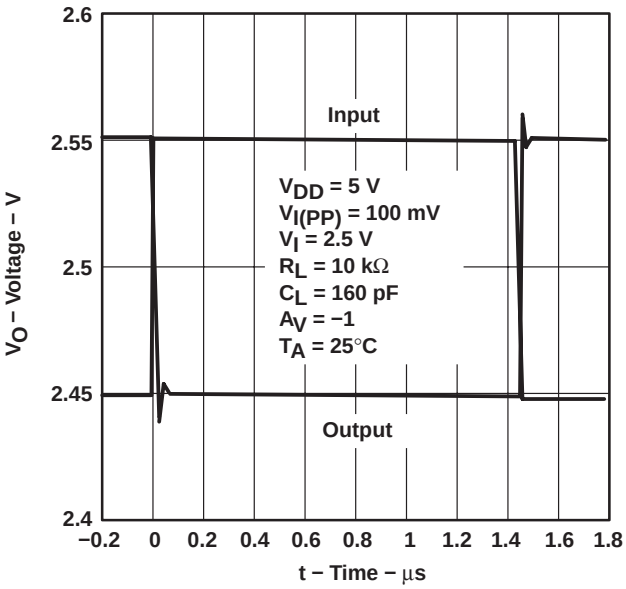



Figure 47

## PARAMETER MEASUREMENT INFORMATION

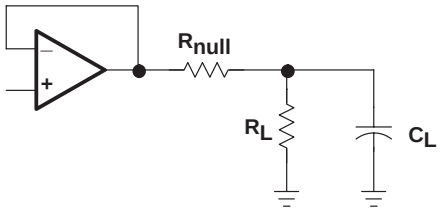



**Figure 48**

## APPLICATION INFORMATION

### driving a capacitive load

When the amplifier is configured in this manner, capacitive loading directly on the output will decrease the device's phase margin leading to high frequency ringing or oscillations. Therefore, for capacitive loads of greater than 10 pF, it is recommended that a resistor be placed in series ($R_{NULL}$) with the output of the amplifier, as shown in Figure 49. A minimum value of 20 Ω should work well for most applications.

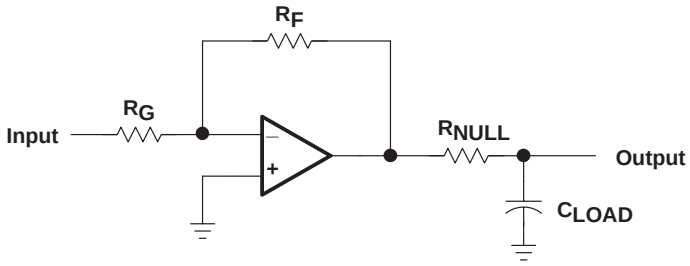
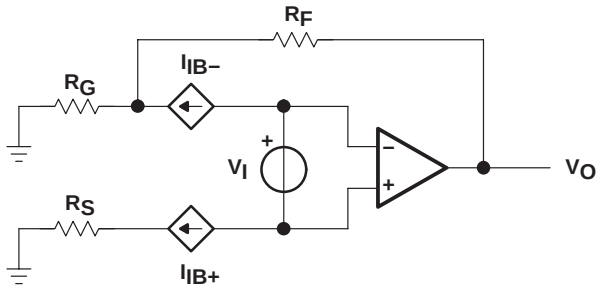



**Figure 49. Driving a Capacitive Load**

### offset voltage

The output offset voltage, ($V_{OO}$) is the sum of the input offset voltage ($V_{IO}$) and both input bias currents ($I_{IB}$) times the corresponding gains. The following schematic and formula can be used to calculate the output offset voltage:




$$V_{OO} = V_{IO}\left(1 + \left(\frac{R_F}{R_G}\right)\right) \pm I_{IB+}\, R_S\left(1 + \left(\frac{R_F}{R_G}\right)\right) \pm I_{IB-}\, R_F$$

**Figure 50. Output Offset Voltage Model**

## APPLICATION INFORMATION

### general configurations

When receiving low-level signals, limiting the bandwidth of the incoming signals into the system is often required. The simplest way to accomplish this is to place an RC filter at the noninverting terminal of the amplifier (see Figure 51).

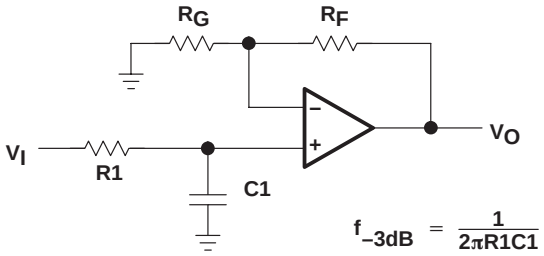



**Figure 51. Single-Pole Low-Pass Filter**

If even more attenuation is needed, a multiple pole filter is required. The Sallen-Key filter can be used for this task. For best results, the amplifier should have a bandwidth that is 8 to 10 times the filter frequency bandwidth. Failure to do this can result in phase shift of the amplifier.

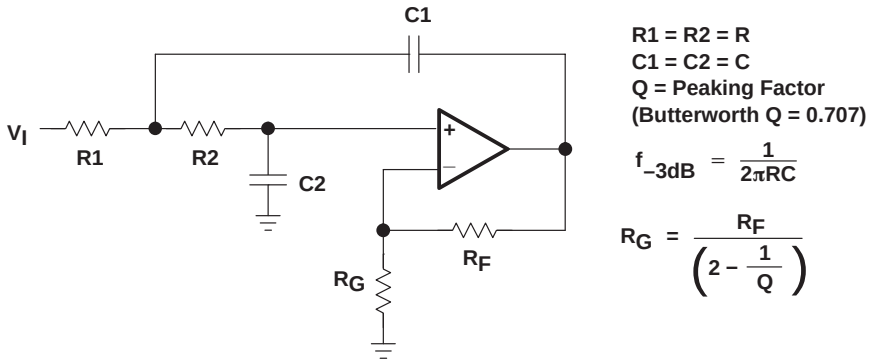



**Figure 52. 2-Pole Low-Pass Sallen-Key Filter**

## APPLICATION INFORMATION

### shutdown function

Three members of the TLV246x family (TLV2460/3/5) have a shutdown terminal for conserving battery life in portable applications. When the shutdown terminal is tied low, the supply current is reduced to 0.3 μA/channel, the amplifier is disabled, and the outputs are placed in a high impedance mode. To enable the amplifier, the shutdown terminal can either be left floating or pulled high. When the shutdown terminal is left floating, care should be taken to ensure that parasitic leakage current at the shutdown terminal does not inadvertently place the operational amplifier into shutdown. The shutdown terminal threshold is always referenced to $V_{DD}/2$. Therefore, when operating the device with split supply voltages (e.g. ±2.5 V), the shutdown terminal needs to be pulled to $V_{DD}-$ (not GND) to disable the operational amplifier.

The amplifier's output with a shutdown pulse is shown in Figures 22, 23, 24, and 25. The amplifier is powered with a single 5-V supply and configured as a noninverting configuration with a gain of 5. The amplifier turnon and turnoff times are measured from the 50% point of the shutdown pulse to the 50% point of the output waveform. The times for the single, dual, and quad are listed in the data tables.

### circuit layout considerations

To achieve the levels of high performance of the TLV246x, follow proper printed-circuit board design techniques. A general set of guidelines is given in the following.

- Ground planes − It is highly recommended that a ground plane be used on the board to provide all components with a low inductive ground connection. However, in the areas of the amplifier inputs and output, the ground plane can be removed to minimize the stray capacitance.
- Proper power supply decoupling − Use a 6.8-μF tantalum capacitor in parallel with a 0.1-μF ceramic capacitor on each supply terminal. It may be possible to share the tantalum among several amplifiers depending on the application, but a 0.1-μF ceramic capacitor should always be used on the supply terminal of every amplifier. In addition, the 0.1-μF capacitor should be placed as close as possible to the supply terminal. As this distance increases, the inductance in the connecting trace makes the capacitor less effective. The designer should strive for distances of less than 0.1 inches between the device power terminals and the ceramic capacitors.
- Sockets − Sockets can be used but are not recommended. The additional lead inductance in the socket pins will often lead to stability problems. Surface-mount packages soldered directly to the printed-circuit board is the best implementation.
- Short trace runs/compact part placements − Optimum high performance is achieved when stray series inductance has been minimized. To realize this, the circuit layout should be made as compact as possible, thereby minimizing the length of all trace runs. Particular attention should be paid to the inverting input of the amplifier. Its length should be kept as short as possible. This will help to minimize stray capacitance at the input of the amplifier.
- Surface-mount passive components − Using surface-mount passive components is recommended for high performance amplifier circuits for several reasons. First, because of the extremely low lead inductance of surface-mount components, the problem with stray series inductance is greatly reduced. Second, the small size of surface-mount components naturally leads to a more compact layout thereby minimizing both stray inductance and capacitance. If leaded components are used, it is recommended that the lead lengths be kept as short as possible.

## APPLICATION INFORMATION

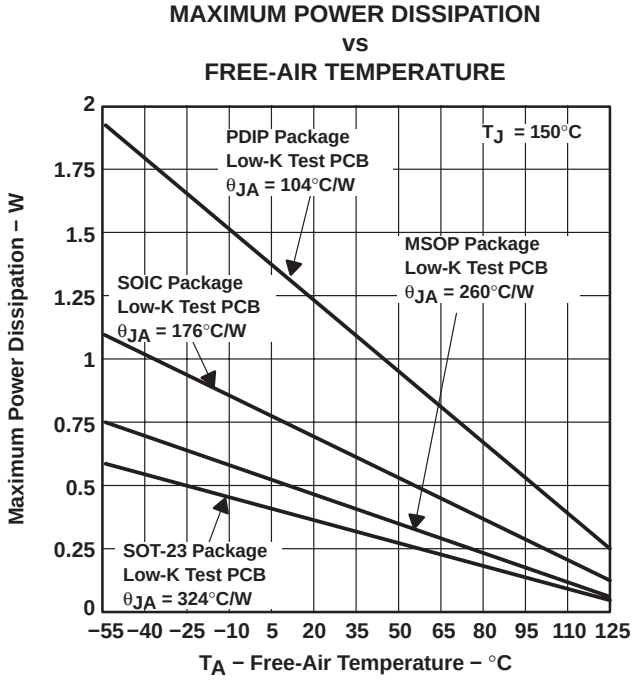
### general power dissipation considerations

For a given $\theta_{JA}$, the maximum power dissipation is shown in Figure 53 and is calculated by the following formula:

$$P_D = \left( \frac{T_{MAX} - T_A}{\theta_{JA}} \right)$$

Where:

$P_D$ = Maximum power dissipation of THS246x IC (watts)
$T_{MAX}$ = Absolute maximum junction temperature (150°C)
$T_A$ = Free-ambient air temperature (°C)
$\theta_{JA} = \theta_{JC} + \theta_{CA}$
$\theta_{JC}$ = Thermal coefficient from junction to case
$\theta_{CA}$ = Thermal coefficient from case to ambient air (°C/W)




NOTE A: Results are with no air flow and using JEDEC Standard Low-K test PCB.

**Figure 53. Maximum Power Dissipation vs Free-Air Temperature**

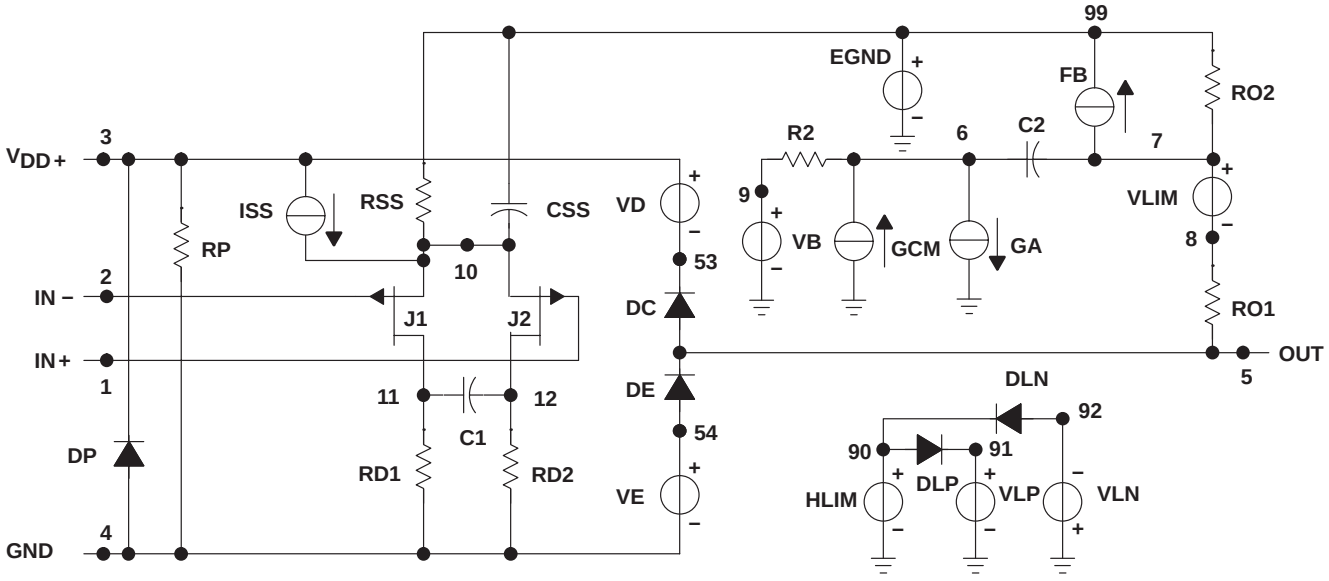
## APPLICATION INFORMATION

### macromodel information

Macromodel information provided was derived using Microsim *Parts*™ Release 8, the model generation software used with Microsim *PSpice*™. The Boyle macromodel (see Note 2) and subcircuit in Figure 54 are generated using the TLV246x typical electrical and operating characteristics at $T_A$ = 25°C. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

- Maximum positive output voltage swing
- Maximum negative output voltage swing
- Slew rate
- Quiescent power dissipation
- Input bias current
- Open-loop voltage amplification
- Unity-gain frequency
- Common-mode rejection ratio
- Phase margin
- DC output resistance
- AC output resistance
- Short-circuit output current limit

NOTE 2: G. R. Boyle, B. M. Cohn, D. O. Pederson, and J. E. Solomon, “Macromodeling of Intergrated Circuit Operational Amplifiers”, *IEEE Journal of Solid-State Circuits,* SC-9, 353 (1974).




```
.SUBCKT TLV246X   1 2 3 4 5
C1          11      12      2.46034E−12
C2          6       7       10.0000E−12
CSS         10      99      443.21E−15
DC          5       53      DY
DE          54      5       DY
DLP         90      91      DX
DLN         92      90      DX
DP          4       3       DX
EGND        99      0       POLY (2) (3,0) (4,0) 0 .5 .5
FB          7       99      POLY (5) VB VC VE VLP
+ VLN 0 21.600E6 −1E3 1E3 22E6 −22E6
GA          6       0       11      12 345.26E−6
GCM         0       6       10      99 15.4226E−9
ISS         10      4       DC 18.850E−6
HLIM        90      0       VLIM 1K
J1          11      2       10 JX1
J2          12      1       10 JX2
R2          6       9       100.00E3
RD1         3       11      2.8964E3
RD2         3       12      2.8964E3
R01         8       5       5.6000
R02         7       99      6.2000
RP          3       4       8.9127
RSS         10      99      10.610E6
VB          9       0       DC 0
VC          3       53      DC .7836
VE          54      4       DC .7436
VLIM        7       8       DC 0
VLP         91      0       DC 117
VLN         0       92      DC 117
.MODEL DX D (IS=800.00E−18)
.MODEL DY D (IS=800.00E−18 Rs = 1m Cjo=10p)
.MODEL JX1 NJF (IS=1.0000E−12 BETA=6.3239E−3
+ VTO=−1)
.MODEL JX2 NJF (IS=1.0000E−12 BETA=6.3239E−3
+ VTO=−1)
.ENDS
```

**Figure 54. Boyle Macromodels and Subcircuit**

*PSpice* and *Parts* are trademarks of MicroSim Corporation.

## macromodel information (continued)

```
.subckt TLV_246Y 1 2 3 4 5 6
c1      11      12      2.4603E−12
c2      72      7       10.000E−12
css     10      99      443.21E−15
dc      70      53      dy
de      54      70      dy
dlp     90      91      dx
dln     92      90      dx
dp      4       3       dx
egnd    99      0       poly(2) (3,0) (4,0) 0 .5 .5
fb      7       99      poly(5) vb vc ve vlp vln 0
21.600E6 −1E3 1E3 22E6 −22E6
ga      72      0       11 12 345.26E−6
gcm     0       72      10 99 15.422E−9
iss     74      4       dc 18.850E−6
hlim    90      0       vlim 1K
j1      11      2       10 jx1
j2      12      1       10 jx2
r2      72      9       100.00E3
rd1     3       11      2.8964E3
rd2     3       12      2.8964E3
ro1     8       70      5.6000
ro2     7       99      6.2000
rp      3       71      8.9127
rss     10      99      10.610E6
rs1     6       4       1G
rs2     6       4       1G
rs3     6       4       1G
rs4     6       4       1G
s1      71      4       6  4  s1x
s2      70      5       6  4  s1x
s3      10      74      6  4  s1x
s4      74      4       6  4  s2x
vb      9       0       dc 0
vc      3       53      dc .7836
ve      54      4       dc .7436
vlim    7       8       dc 0
vlp     91      0       dc 117
vln     0       92      dc 117
.model dx D(Is=800.00E−18)
.model dy D(Is=800.00E−18 Rs=1m Cjo=10p)
.model jx1 NJF(Is=1.0000E−12 Beta=6.3239E−3 Vto=−1)
.model jx2 NJF(Is=1.0000E−12 Beta=6.3239E−3 Vto=−1)
.model s1x VSWITCH(Roff=1E8 Ron=1.0 Voff=2.5 Von=0.0)
.model s2x  VSWITCH(Roff=1E8 Ron=1.0 Voff=0 Von=2.5)
.ends
```

**Figure 54. Boyle Macromodels and Subcircuit (Continued)**

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| 5962-0051201Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051201QHA | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051201QPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051202Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051202QHA | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051202QPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051203Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051203QHA | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051203QPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051204Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051204QHA | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051204QPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051205Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051205QHA | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051205QPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051206Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051206QHA | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051206QPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051207Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051207QCA | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-0051208Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-0051208QCA | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2460AIDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460AIP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2460AIPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2460AMFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2460AMJG | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2460AMJGB | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2460AMUB | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2460AQD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2460AQDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2460AQPW | ACTIVE | TSSOP | PW | 8 | 150 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2460AQPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2460CD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460CDBVR | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460CDBVRG4 | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TLV2460CDBVT | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460CDBVTG4 | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460CDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460CDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460CP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2460CPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2460ID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460IDBVR | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460IDBVRG4 | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460IDBVT | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460IDBVTG4 | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460IDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460IDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2460IP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2460IPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2460MFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2460MJG | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2460MJGB | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2460MUB | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2460QD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2460QDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2460QPW | ACTIVE | TSSOP | PW | 8 | 150 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2460QPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2461AID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461AIDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461AIDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461AIP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2461AIPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TLV2461AMFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2461AMJGB | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2461AMUB | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2461AQD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2461AQDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2461AQPW | ACTIVE | TSSOP | PW | 8 | 150 | TBD | Call TI | Call TI |
| TLV2461AQPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2461CD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461CDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461CDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461CDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461CDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461CDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461CDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461CP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2461CPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2461ID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IDBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IDBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IDBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IDBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IDG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2461IP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2461IPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2461MFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2461MJGB | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2461MUB | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TLV2461QD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2461QDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2461QPW | ACTIVE | TSSOP | PW | 8 | 150 | TBD | Call TI | Call TI |
| TLV2461QPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2462AID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462AIDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462AIDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462AIP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2462AIPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2462AMFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2462AMJG | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2462AMJGB | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2462AMUB | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2462AQD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2462AQDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2462AQPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2462CD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462CDG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462CDGK | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462CDGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462CDGKRG4 | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462CDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462CDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462CP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2462CPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2462ID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462IDG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462IDGK | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462IDGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | no Sb/Br) | | |
| TLV2462IDGKRG4 | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462IDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462IDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2462IP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2462IPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2462MFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2462MJG | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2462MJGB | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2462MUB | ACTIVE | CFP | U | 10 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2462QD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2462QDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-UNLIM/ Level-1-235C-UNLIM |
| TLV2462QPW | ACTIVE | TSSOP | PW | 8 | 150 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2462QPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2463AID | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463AIDG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463AIDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463AIDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463AIN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2463AINE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2463AMFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2463AMJ | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2463AMJB | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2463AQD | ACTIVE | SOIC | D | 14 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR/ Level-1-235C-UNLIM |
| TLV2463AQDR | ACTIVE | SOIC | D | 14 | 75 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2463AQPWR | ACTIVE | TSSOP | PW | 14 | 2000 | TBD | CU NIPD | Level-1-250C-UNLIM |
| TLV2463CD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463CDGS | ACTIVE | MSOP | DGS | 10 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463CDGSG4 | ACTIVE | MSOP | DGS | 10 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| TLV2463CDGSR | ACTIVE | MSOP | DGS | 10 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463CDGSRG4 | ACTIVE | MSOP | DGS | 10 | 2500 | Green (RoHS & | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | no Sb/Br) | | |
| TLV2463CDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463CDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463CN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2463CNE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2463ID | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463IDGS | ACTIVE | MSOP | DGS | 10 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463IDGSR | ACTIVE | MSOP | DGS | 10 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463IDGSRG4 | ACTIVE | MSOP | DGS | 10 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2463IN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2463INE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2463MFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| TLV2463MJ | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2463MJB | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| TLV2463QD | ACTIVE | SOIC | D | 14 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR/ Level-1-235C-UNLIM |
| TLV2463QDR | ACTIVE | SOIC | D | 14 | 75 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| TLV2463QPWR | ACTIVE | TSSOP | PW | 14 | 2000 | TBD | CU NIPD | Level-1-250C-UNLIM |
| TLV2464AID | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464AIDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464AIDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464AIN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPD | N / A for Pkg Type |
| TLV2464AINE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPD | N / A for Pkg Type |
| TLV2464AIPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464AIPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464AIPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464CD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464CDG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464CDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TLV2464CDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464CN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPD | N / A for Pkg Type |
| TLV2464CNE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPD | N / A for Pkg Type |
| TLV2464CPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464CPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464CPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464CPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464ID | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464IDG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464IDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464IDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464IN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPD | N / A for Pkg Type |
| TLV2464INE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPD | N / A for Pkg Type |
| TLV2464IPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464IPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464IPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2464IPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465AID | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465AIDG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465AIPWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465AIPWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465CD | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465CDR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465CDRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465CN | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2465CNE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TLV2465CPW | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465CPWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465CPWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465ID | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465IDG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465IDR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465IDRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465IN | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2465INE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| TLV2465IPW | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465IPWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TLV2465IPWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

(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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**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.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

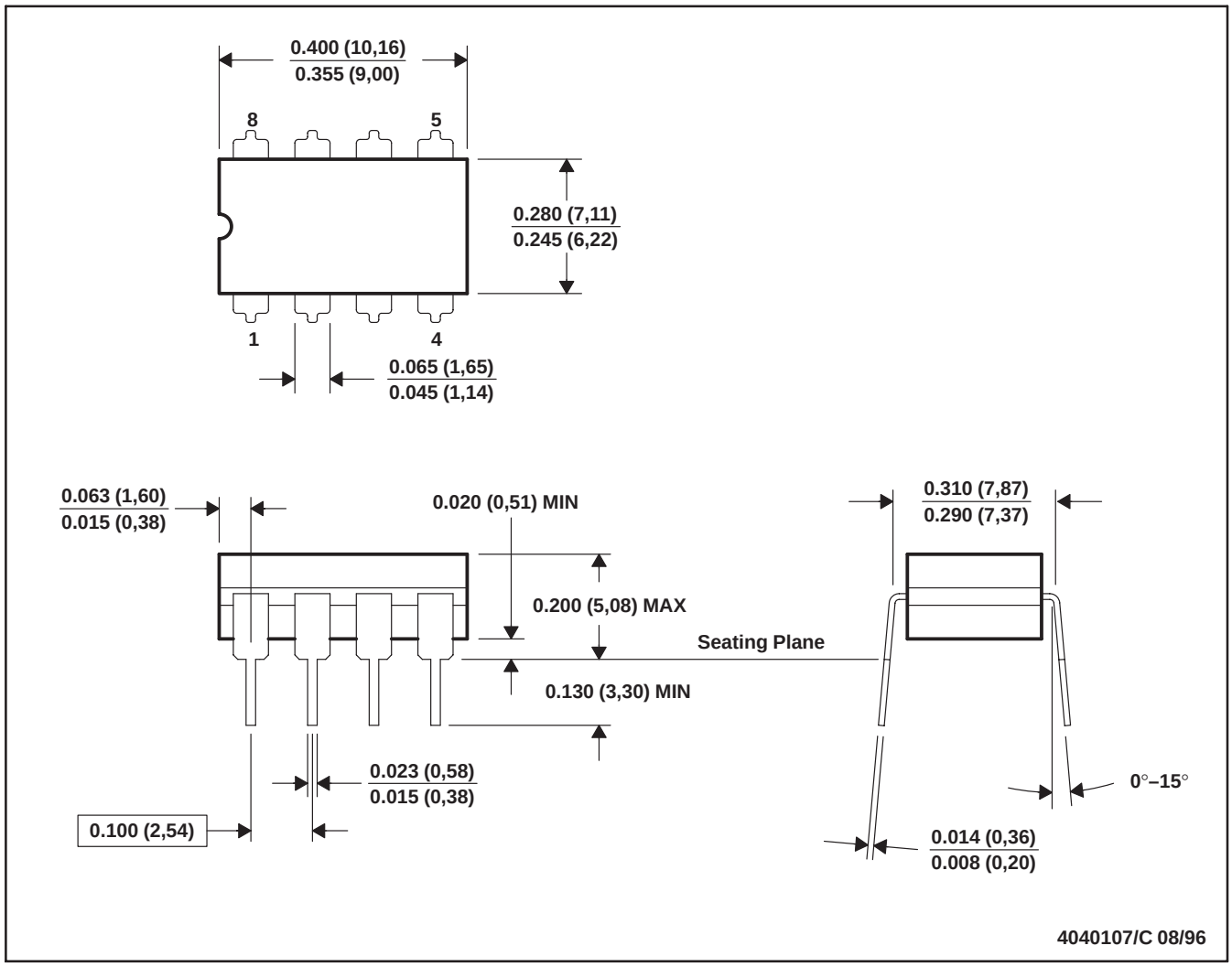
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to Customer on an annual basis.

MCER001A – JANUARY 1995 – REVISED JANUARY 1997

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

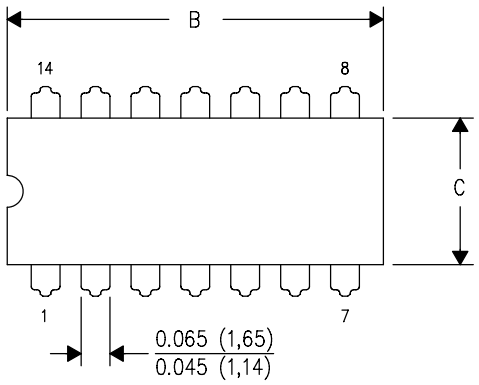



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP1-T8

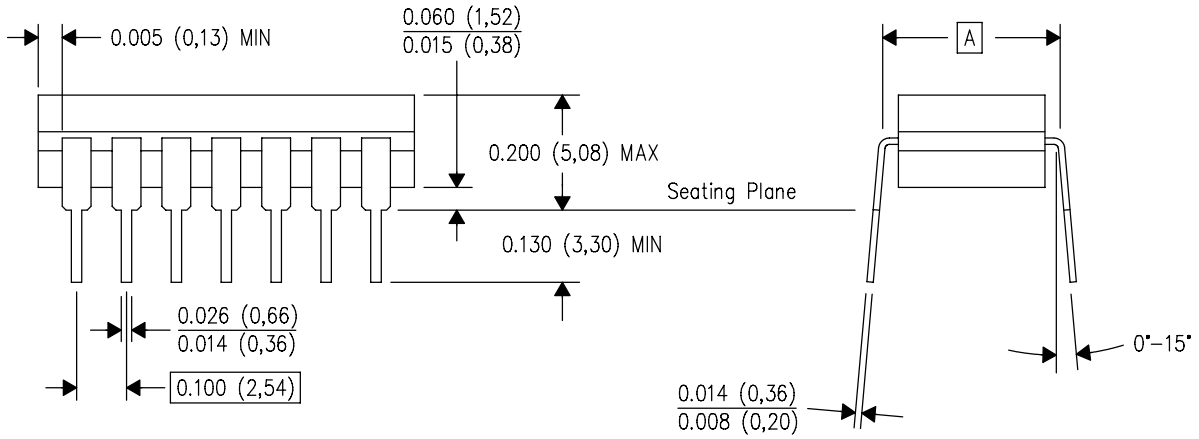
J (R–GDIP–T**)

14 LEADS SHOWN

# CERAMIC DUAL IN–LINE PACKAGE



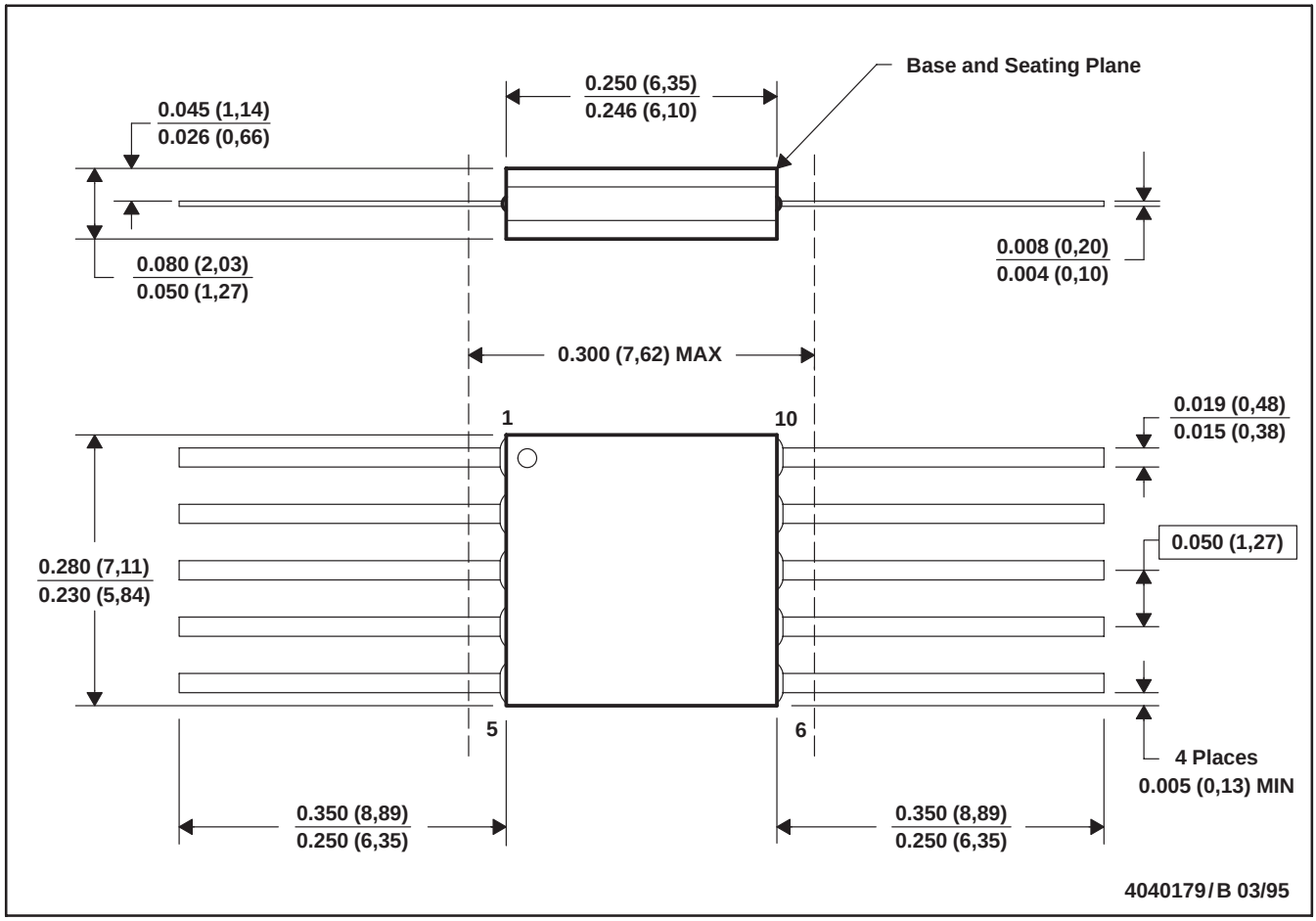

| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |




4040083/F 03/03

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL STD 1835 GDIP1–T14, GDIP1–T16, GDIP1–T18 and GDIP1–T20.

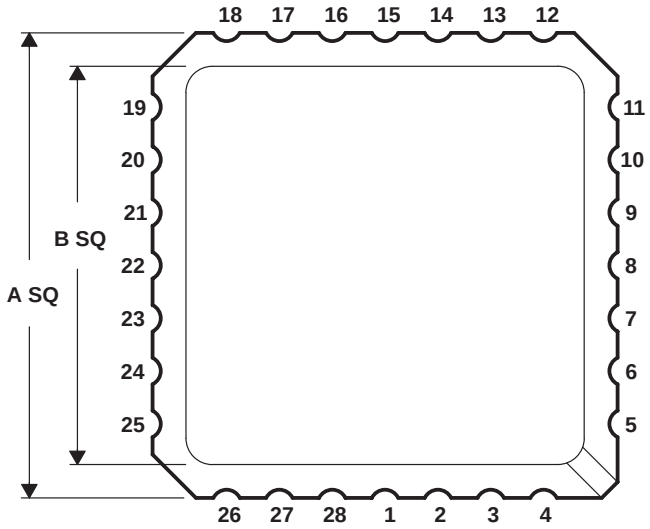
**U (S-GDFP-F10)** **CERAMIC DUAL FLATPACK**



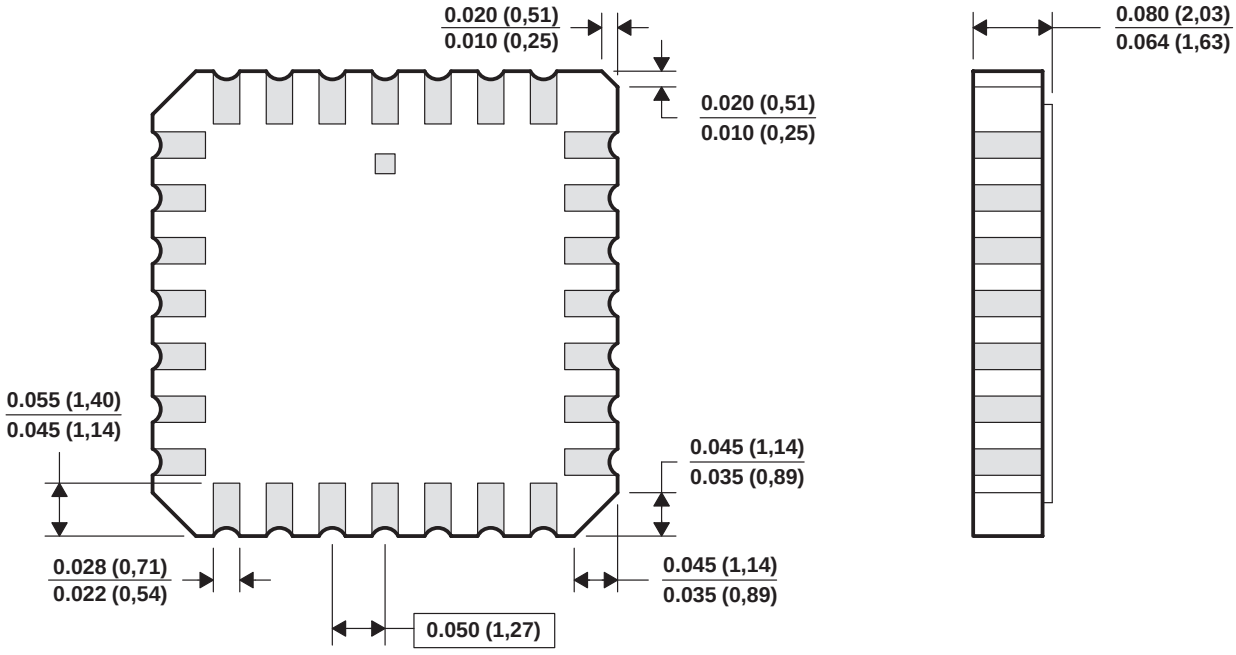

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only.
E. Falls within MIL STD 1835 GDFP1-F10 and JEDEC MO-092AA

**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) |

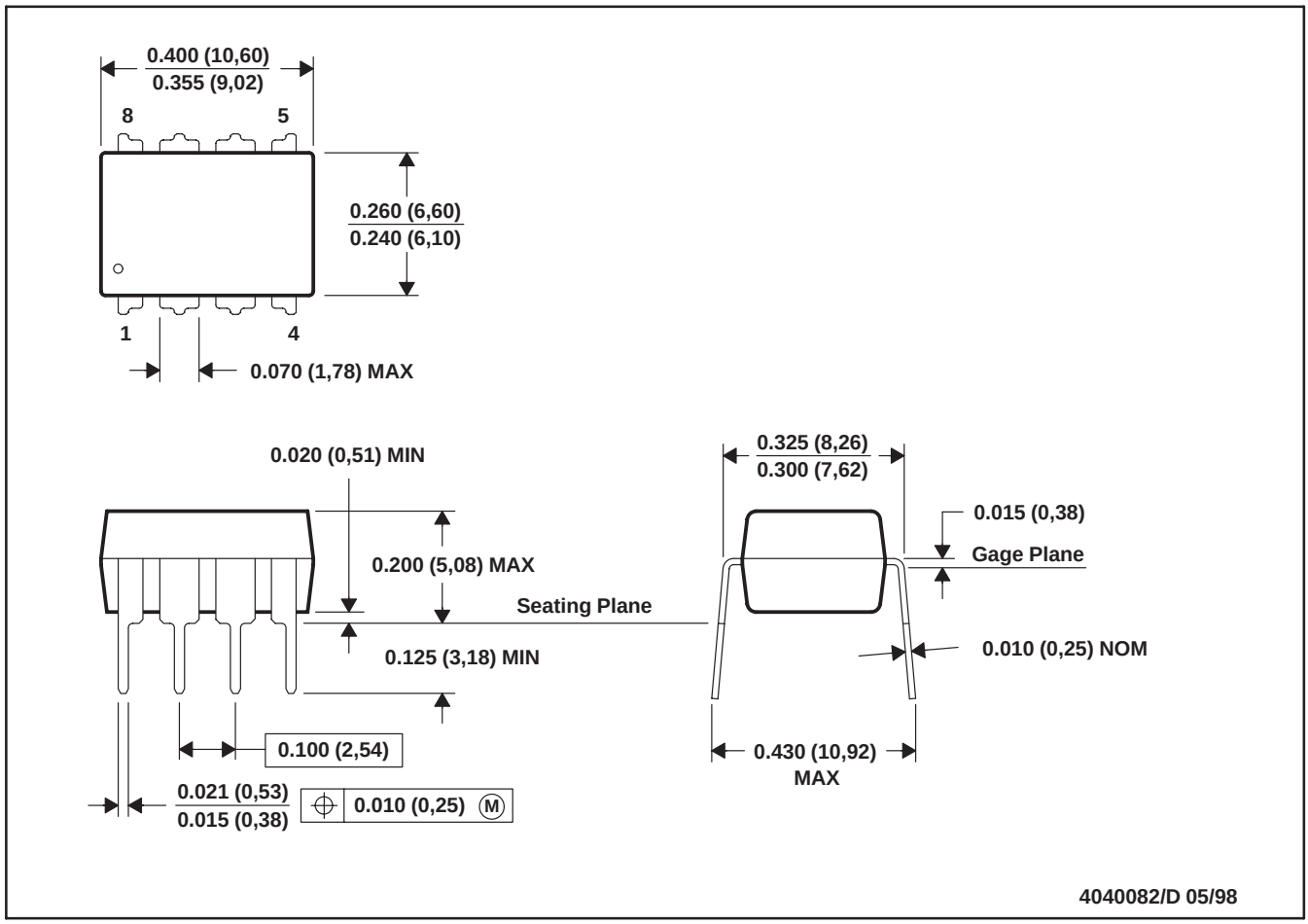



**4040140/D 10/96**

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**



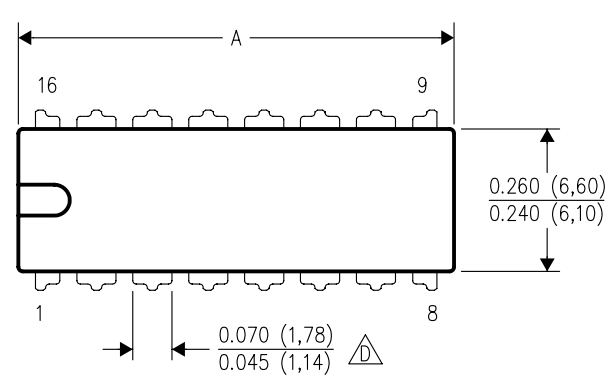

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001

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

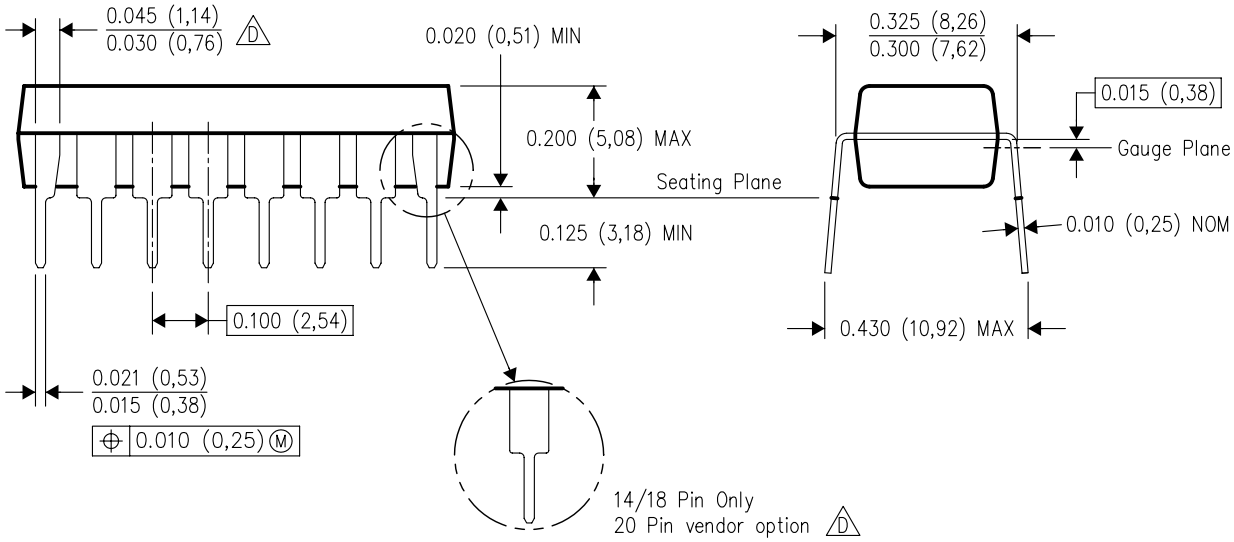
## N (R–PDIP–T**)

## PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



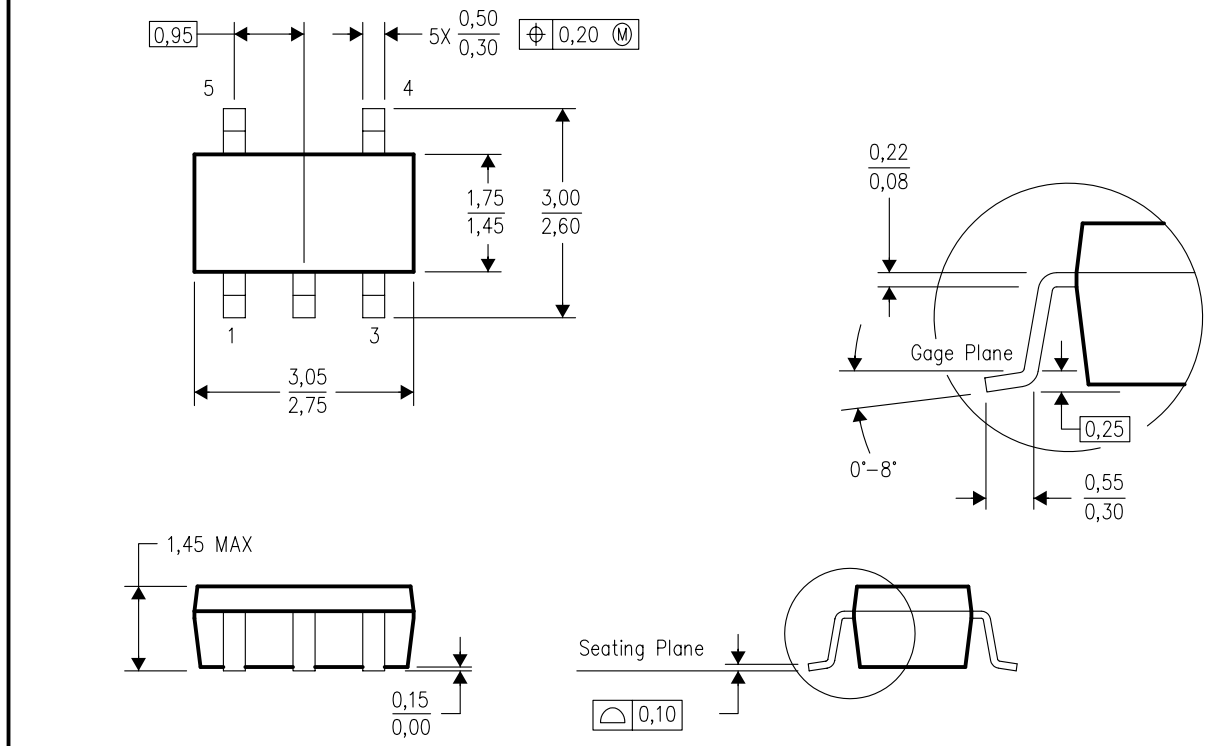

| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION (C) | AA | BB | AC | AD |




4040049/E 12/2002

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

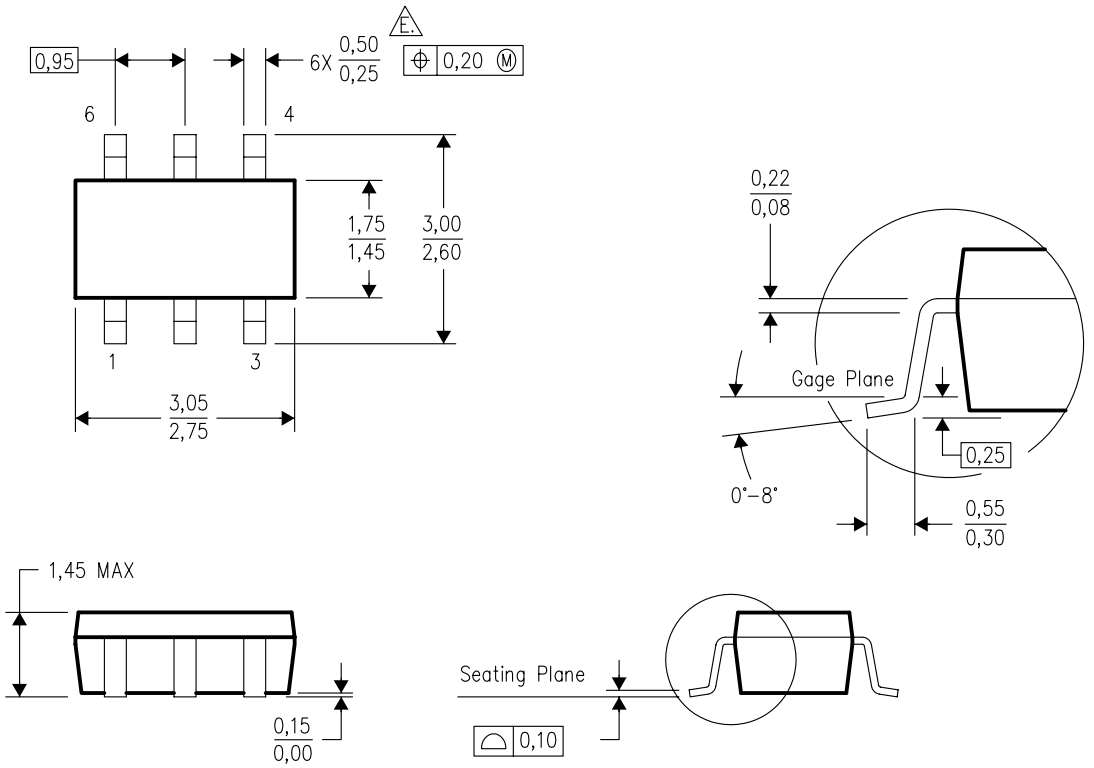
## DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE




4073253–4/J 10/2005

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. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

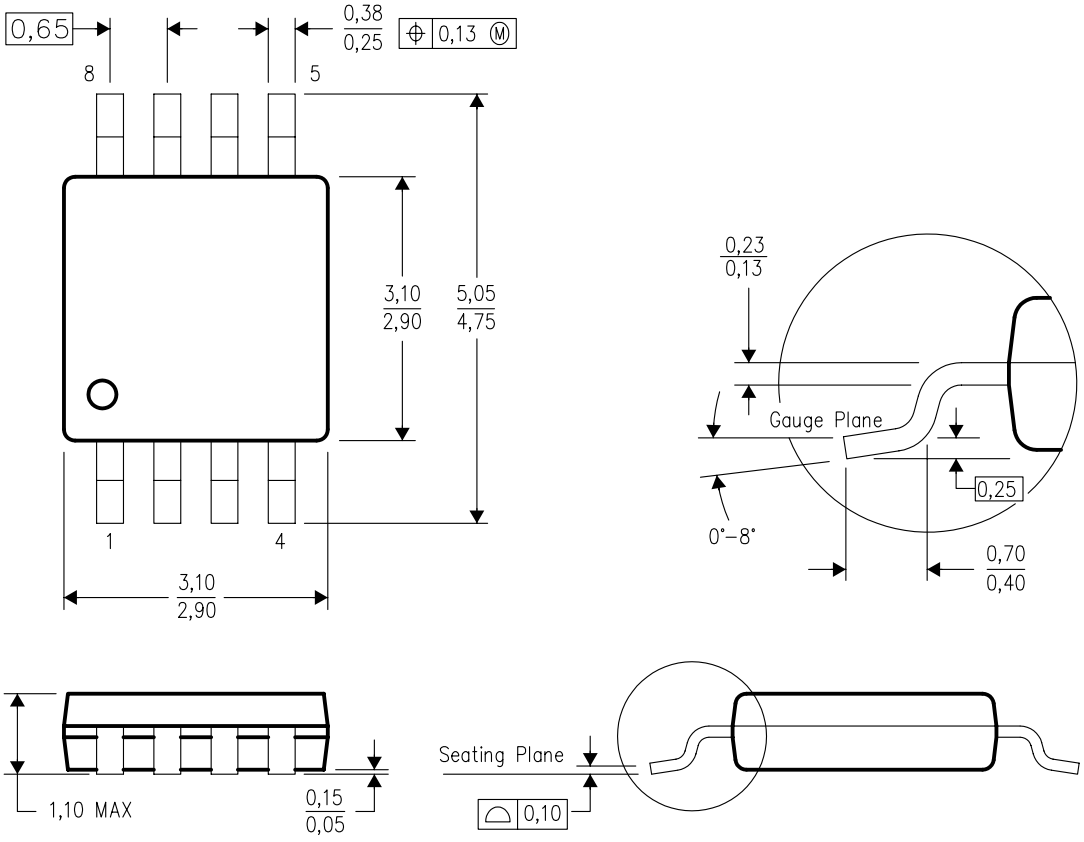
## DBV (R–PDSO–G6) PLASTIC SMALL–OUTLINE PACKAGE




4073253–5/J 10/2005

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. Mold flash and protrusion shall not exceed 0.15 per side.
D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
E. Falls within JEDEC MO–178 Variation AB, except minimum lead width.

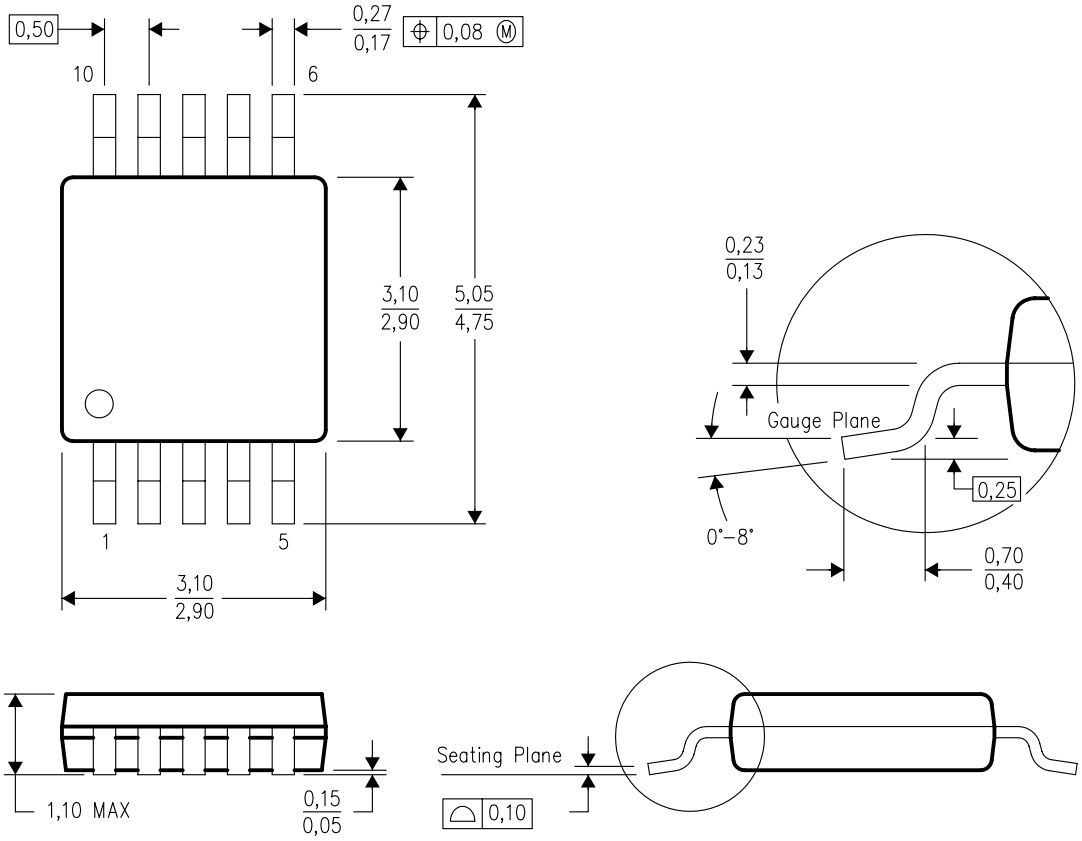
## DGK (S–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE




4073329/D 12/03

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.
D. Falls within JEDEC MO–187 variation AA.

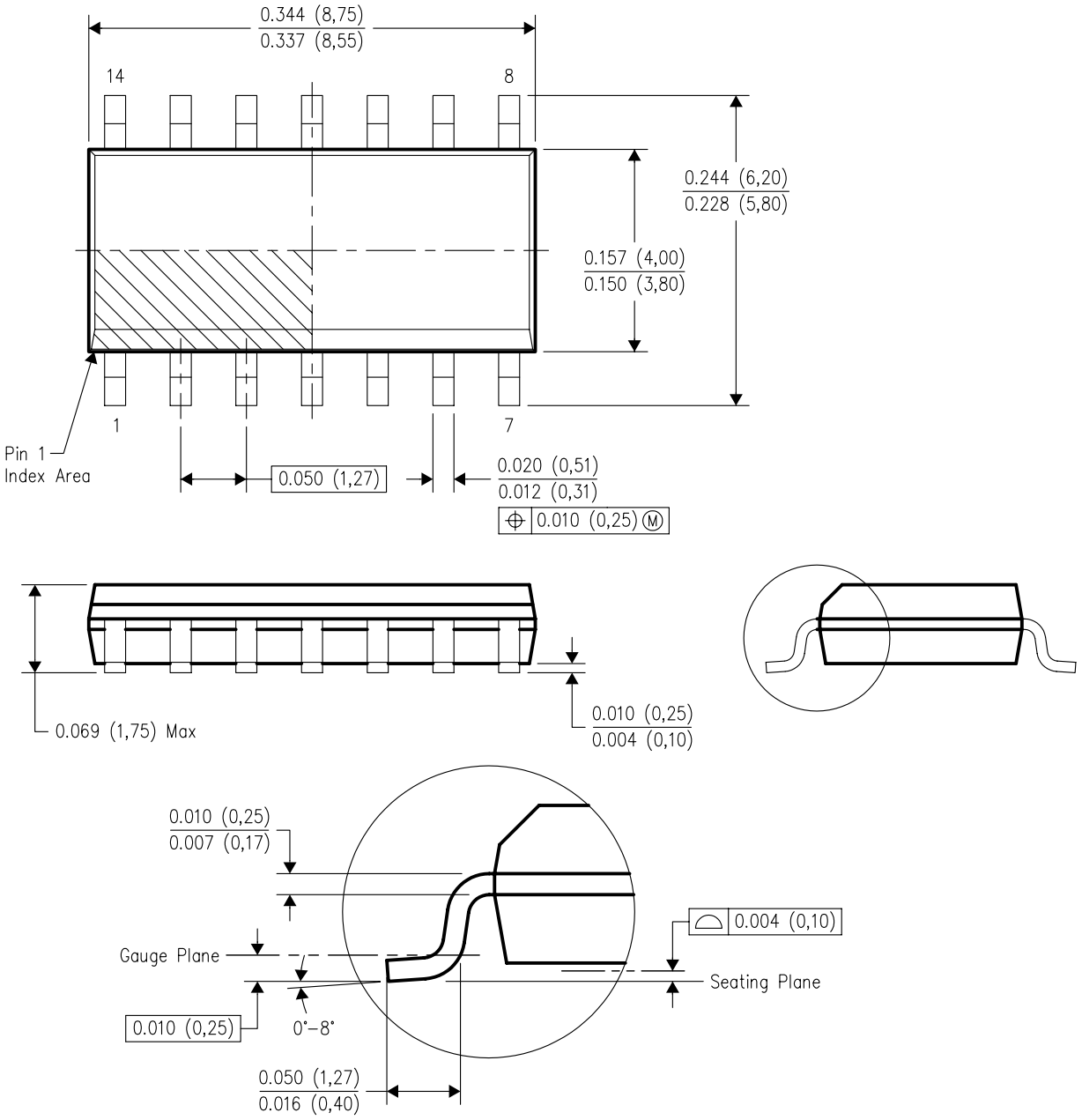
DGS (S–PDSO–G10) PLASTIC SMALL–OUTLINE PACKAGE




4073272/C 02/04

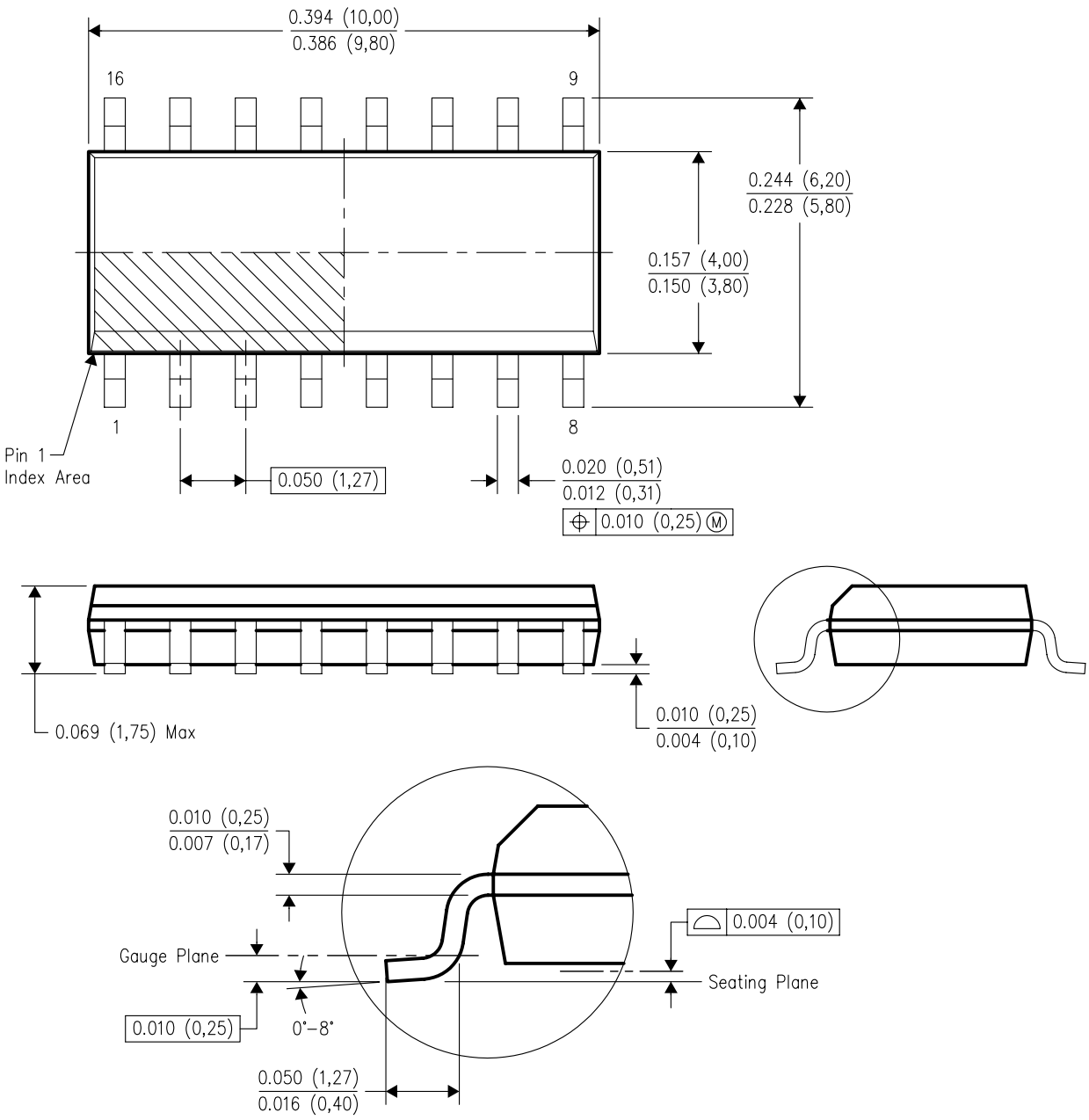
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–187 variation BA.

D (R–PDSO–G14) PLASTIC SMALL–OUTLINE PACKAGE



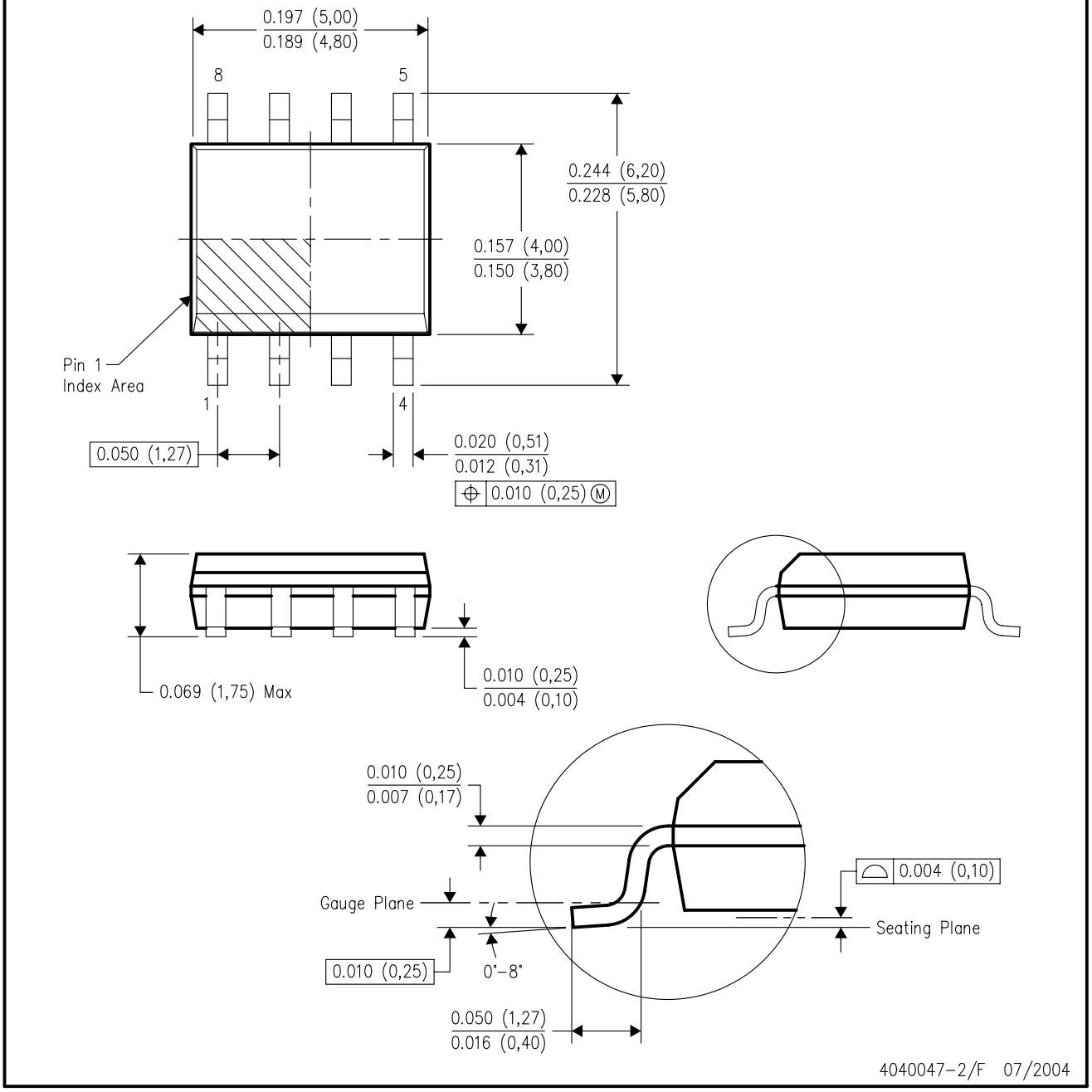

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–012 variation AB.

## D (R–PDSO–G16) 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 AC.

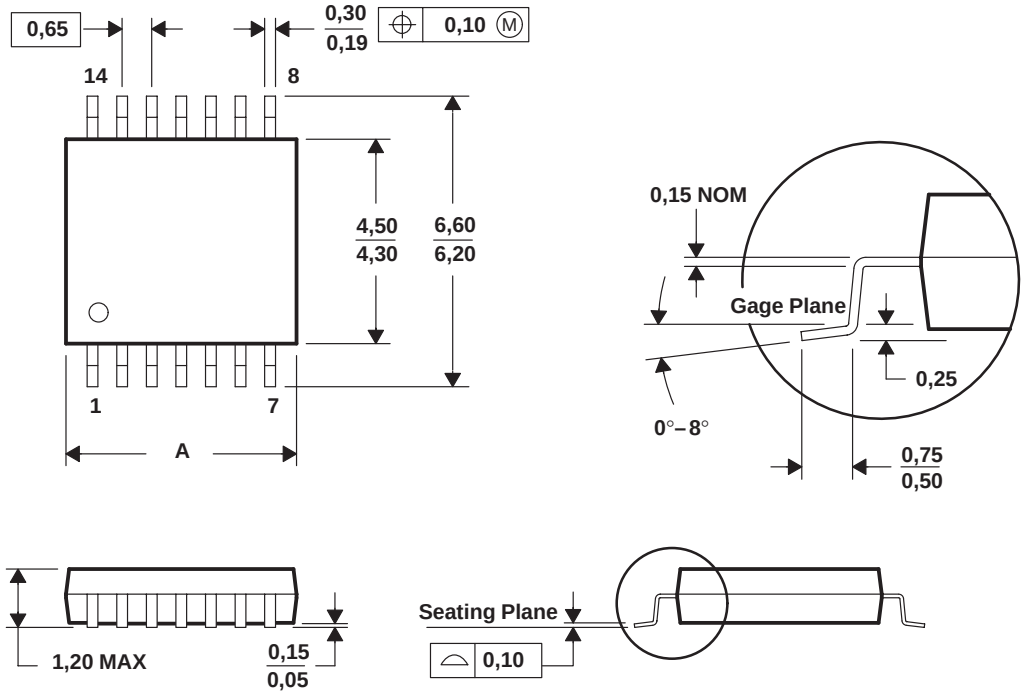
## D (R–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE




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.

**PW (R-PDSO-G**)** **PLASTIC SMALL-OUTLINE PACKAGE**

**14 PINS SHOWN**




| DIM \ PINS ** | 8 | 14 | 16 | 20 | 24 | 28 |
|---|---|---|---|---|---|---|
| A MAX | 3,10 | 5,10 | 5,10 | 6,60 | 7,90 | 9,80 |
| A MIN | 2,90 | 4,90 | 4,90 | 6,40 | 7,70 | 9,60 |

**4040064/F 01/97**

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.
D. Falls within JEDEC MO-153

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