

# TLV2442, TLV2442A, TLV2444, TLV2444A Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS169H – NOVEMBER 1996 – REVISED MARCH 2001

- Output Swing Includes Both Supply Rails
- Extended Common-Mode Input Voltage Range . . . 0 V to 4.25 V (Min) at 5-V Single Supply
- No Phase Inversion
- Low Noise . . . 16 nV/√Hz Typ at f = 1 kHz
- Low Input Offset Voltage  
950 μV Max at T<sub>A</sub> = 25°C (TLV244xA)
- Low Input Bias Current . . . 1 pA Typ
- 600-Ω Output Drive
- High-Gain Bandwidth . . . 1.8 MHz Typ
- Low Supply Current . . . 750 μA Per Channel Typ
- Macromodel Included
- Available in Q-Temp Automotive  
HighRel Automotive Applications  
Configuration Control/Print Support  
Qualification to Automotive Standards

## description

The TLV244x and TLV244xA are low-voltage operational amplifiers from Texas Instruments. The common-mode input voltage range of these devices has been extended over typical standard CMOS amplifiers, making them suitable for a wide range of applications. In addition, these devices do not phase invert when the common-mode input is driven to the supply rails. This satisfies most design requirements without paying a premium for rail-to-rail input performance. They also exhibit rail-to-rail output performance for increased dynamic range in single- or split-supply applications. This family is fully characterized at 3-V and 5-V supplies and is optimized for low-voltage operation. Both devices offer comparable ac performance while having lower noise, input offset voltage, and power dissipation than existing CMOS operational amplifiers. The TLV244x has increased output drive over previous rail-to-rail operational amplifiers and can drive 600-Ω loads for telecommunications applications.

The other members in the TLV244x family are the low-power, TLV243x, and micro-power, TLV2422, versions.

The TLV244x, exhibiting high input impedance and low noise, is excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers. Because of the micropower dissipation levels and low-voltage operation, these devices work well in hand-held monitoring and remote-sensing applications. In addition, the rail-to-rail output feature with single- or split-supplies makes this family a great choice when interfacing with analog-to-digital converters (ADCs). For precision applications, the TLV244xA is available with a maximum input offset voltage of 950 μV.

If the design requires single operational amplifiers, see the TI TLV2211/21/31. This is a family of rail-to-rail output operational amplifiers in the SOT-23 package. Their small size and low power consumption make them ideal for high density, battery-powered equipment.

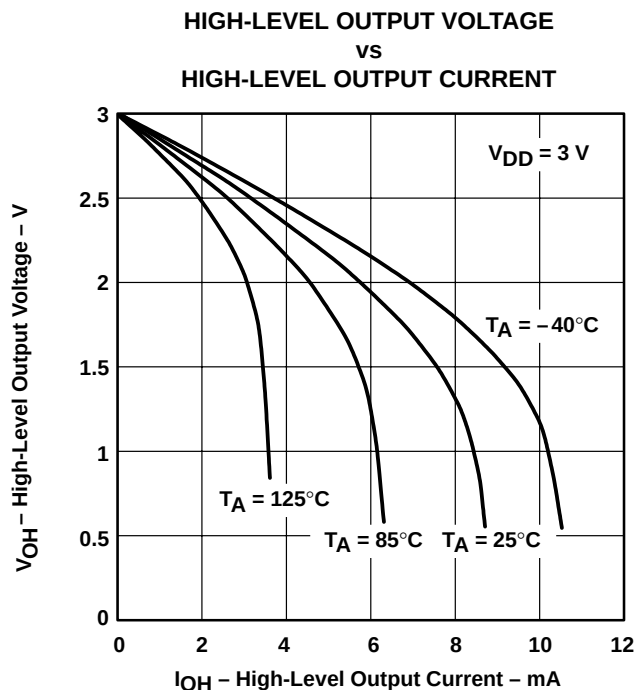


Figure 1



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.

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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.

**TEXAS  
INSTRUMENTS**

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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.

# TLV2442, TLV2442A, TLV2444, TLV2444A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

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#### TLV2442 AVAILABLE OPTIONS

| T <sub>A</sub> | V <sub>IO</sub> max<br>AT 25°C | PACKAGED DEVICES        |                           |                           |                           |                             |
|----------------|--------------------------------|-------------------------|---------------------------|---------------------------|---------------------------|-----------------------------|
|                |                                | SMALL<br>OUTLINE<br>(D) | CHIP CARRIER<br>(FK)      | CERAMIC DIP<br>(JG)       | TSSOP<br>(PW)             | CERAMIC FLAT<br>PACK<br>(U) |
| 0°C to 70°C    | 2.5 mV                         | TLV2442CD               | —                         | —                         | TLV2442CPW                | —                           |
| –40°C to 85°C  | 950 µV<br>2.5 mV               | TLV2442AID<br>TLV2442ID | —<br>—                    | —<br>—                    | TLV2442AIPW<br>—          | —<br>—                      |
| –40°C to 125°C | 950 µV<br>2.5 mV               | TLV2442AQD<br>TLV2442QD | —<br>—                    | —<br>—                    | TLV2442AQPW<br>TLV2442QPW | —<br>—                      |
| –55°C to 125°C | 950 µV<br>2.5 mV               | —<br>—                  | TLV2442AMFK<br>TLV2442MFK | TLV2442AMJG<br>TLV2442MJG | —<br>—                    | TLV2442AMU<br>TLV2442MU     |

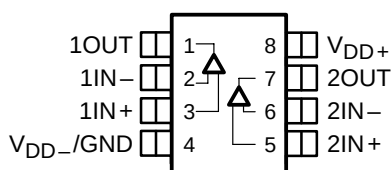
The D and PW packages are available taped and reeled. Add R suffix to device type (e.g., TLV2442CDR).

#### TLV2444 AVAILABLE OPTIONS

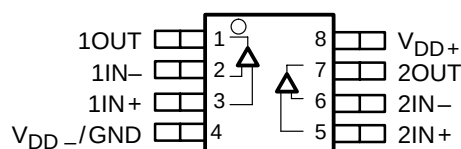
| T <sub>A</sub> | V <sub>IO</sub> max<br>AT 25°C | PACKAGED DEVICES        |                           |
|----------------|--------------------------------|-------------------------|---------------------------|
|                |                                | SMALL<br>OUTLINE<br>(D) | TSSOP<br>(PW)             |
| 0°C to 70°C    | 2.5 mV                         | TLV2444CD               | TLV2444CPW                |
| –40°C to 125°C | 950 µV<br>2.5 mV               | TLV2444AID<br>TLV2444ID | TLV2444AIPW<br>TLV2444IPW |

The D and PW packages are available taped and reeled. Add R suffix to device type (e.g., TLV2444CDR).

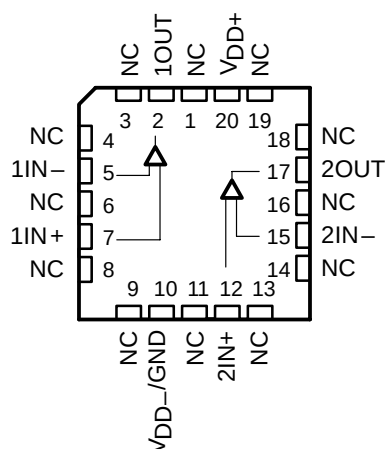
**TLV2442  
D OR JG PACKAGE  
(TOP VIEW)**



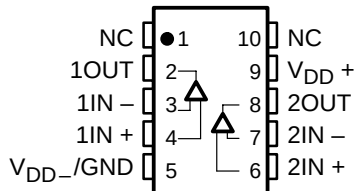
**TLV2442  
PW PACKAGE  
(TOP VIEW)**



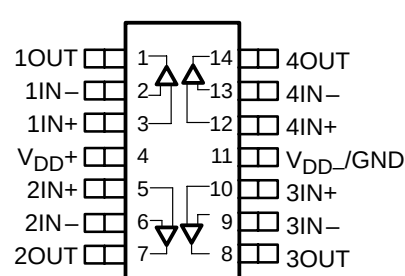
**TLV2442  
FK PACKAGE  
(TOP VIEW)**



**TLV2442  
U PACKAGE  
(TOP VIEW)**



**TLV2444  
D OR PW PACKAGE  
(TOP VIEW)**

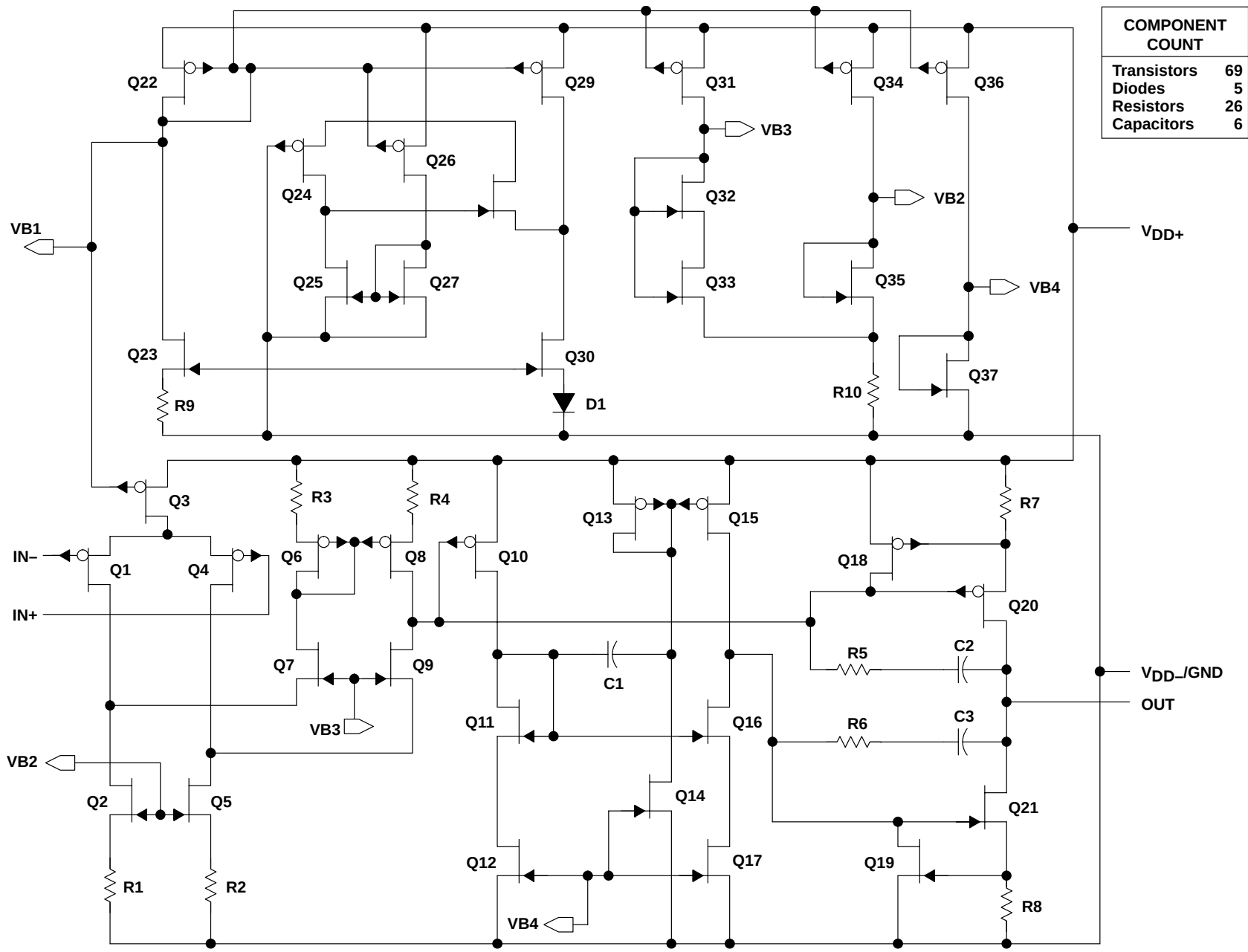


NC – No internal connection



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equivalent schematic (each amplifier)



| COMPONENT COUNT |    |
|-----------------|----|
| Transistors     | 69 |
| Diodes          | 5  |
| Resistors       | 26 |
| Capacitors      | 6  |

# TLV2442, TLV2442A, TLV2444, TLV2444A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

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

|                                                                   |                              |
|-------------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{DD}$ (see Note 1)                             | 12 V                         |
| Differential input voltage, $V_{ID}$ (see Note 2)                 | $\pm V_{DD}$                 |
| Input voltage, $V_I$ (any input, see Note 1)                      | -0.3 V to $V_{DD}$           |
| Input current, $I_I$ (any input)                                  | $\pm 5$ mA                   |
| Output current, $I_O$                                             | $\pm 50$ mA                  |
| Total current into $V_{DD+}$                                      | $\pm 50$ mA                  |
| Total current out of $V_{DD-}$                                    | $\pm 50$ mA                  |
| Duration of short-circuit current at (or below) 25°C (see Note 3) | unlimited                    |
| Continuous total dissipation                                      | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ : C suffix            | 0°C to 70°C                  |
| I suffix (dual)                                                   | -40°C to 85°C                |
| I suffix (quad)                                                   | -40°C to 125°C               |
| Q suffix                                                          | -40°C to 125°C               |
| M suffix                                                          | -55°C to 125°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                        |

<sup>†</sup> 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, except differential voltages, are with respect to the midpoint between  $V_{DD+}$  and  $V_{DD-}$ .  
2. Differential voltages are at  $IN+$  with respect to  $IN-$ . Excessive current will flow if input is brought below  $V_{DD-} - 0.3$  V.  
3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>POWER RATING | $T_A = 85^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|---------------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------------------|
| D (8)   | 725 mW                                      | 5.8 mW/°C                                         | 464 mW                                   | 377 mW                                   | 145 mW                                    |
| D (14)  | 1022 mW                                     | 7.6 mW/°C                                         | 900 mW                                   | 777 mW                                   | 450 mW                                    |
| 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                                    |
| PW (8)  | 525 mW                                      | 4.2 mW/°C                                         | 336 mW                                   | 273 mW                                   | 105 mW                                    |
| PW (14) | 720 mW                                      | 5.6 mW/°C                                         | 634 mW                                   | 547 mW                                   | 317 mW                                    |
| U       | 675 mW                                      | 5.4 mW/°C                                         | 432 mW                                   | 350 mW                                   | 135 mW                                    |

#### recommended operating conditions

|                                       | C SUFFIX  |               | I SUFFIX  |               | Q SUFFIX      |                 | M SUFFIX      |                 | UNIT |
|---------------------------------------|-----------|---------------|-----------|---------------|---------------|-----------------|---------------|-----------------|------|
|                                       | MIN       | MAX           | MIN       | MAX           | MIN           | MAX             | MIN           | MAX             |      |
| Supply voltage, $V_{DD}$              | 2.7       | 10            | 2.7       | 10            | 2.7           | 10              | 2.7           | 10              | V    |
| Input voltage range, $V_I$            | $V_{DD-}$ | $V_{DD+} - 1$ | $V_{DD-}$ | $V_{DD+} - 1$ | $V_{DD-}$     | $V_{DD+} - 1.3$ | $V_{DD-}$     | $V_{DD+} - 1.3$ | V    |
| Common-mode input voltage, $V_{IC}$   | $V_{DD-}$ | $V_{DD+} - 1$ | $V_{DD-}$ | $V_{DD+} - 1$ | $V_{DD-} + 2$ | $V_{DD+} - 1.3$ | $V_{DD-} + 2$ | $V_{DD+} - 1.3$ | V    |
| Operating free-air temperature, $T_A$ | 0         | 70            | -40       | 125           | -40           | 125             | -55           | 125             | °C   |



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

| PARAMETER        |                                                   | TEST CONDITIONS                                                              |                                                     | T <sub>A</sub> <sup>†</sup> | TLV2442     |              |       | UNIT |
|------------------|---------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------|-------------|--------------|-------|------|
|                  |                                                   |                                                                              |                                                     |                             | MIN         | TYP          | MAX   |      |
| V <sub>IO</sub>  | Input offset voltage                              | V <sub>IC</sub> = 1.5 V,<br>V <sub>O</sub> = 1.5 V,<br>R <sub>S</sub> = 50 Ω | TLV244xC<br>TLV244xI                                | 25°C                        | 300    2000 |              | μV    |      |
|                  |                                                   |                                                                              |                                                     | Full range                  | 2500        |              |       |      |
|                  |                                                   |                                                                              | TLV244xAI                                           | 25°C                        | 300    950  |              |       |      |
|                  |                                                   |                                                                              |                                                     | Full range                  | 1500        |              |       |      |
|                  |                                                   |                                                                              | TLV2442AQ<br>TLV2442AM                              | 25°C                        | 300    950  |              |       |      |
|                  |                                                   |                                                                              |                                                     | Full range                  | 1600        |              |       |      |
| αV <sub>IO</sub> | Temperature coefficient of input offset voltage   |                                                                              |                                                     | 25°C to 85°C                | 2           |              | μV/°C |      |
|                  | Input offset voltage long-term drift (see Note 4) |                                                                              |                                                     | 25°C                        | 0.002       |              | μV/mo |      |
| I <sub>IO</sub>  | Input offset current                              |                                                                              |                                                     | 25°C                        | 0.5         | 60           | pA    |      |
|                  |                                                   |                                                                              |                                                     | Full range                  | 150         |              |       |      |
| I <sub>IB</sub>  | Input bias current                                |                                                                              |                                                     | 25°C                        | 1           | 60           | pA    |      |
|                  |                                                   |                                                                              |                                                     | –40°C to 85°C               | 150         |              |       |      |
|                  |                                                   |                                                                              | 125°C                                               | 350                         |             |              |       |      |
|                  |                                                   | TLV2442Q/AQ<br>TLV2442M/AM                                                   | Full range                                          | 260                         |             |              |       |      |
|                  |                                                   |                                                                              |                                                     |                             |             |              |       |      |
| V <sub>ICR</sub> | Common-mode input voltage range                   | V <sub>IO</sub>   ≤ 5 mV,    R <sub>S</sub> = 50 Ω                           |                                                     | 25°C                        | 0 to 2.25   | –0.25 to 2.5 | V     |      |
|                  |                                                   |                                                                              |                                                     | Full range                  | 0 to 2      |              |       |      |
|                  |                                                   |                                                                              |                                                     | 25°C to –55°C               | 0 to 2.25   | –0.25 to 2.5 |       |      |
|                  |                                                   |                                                                              |                                                     | 125°C                       | 0 to 2      |              |       |      |
| V <sub>OH</sub>  | High-level output voltage                         |                                                                              | I <sub>O</sub> = –100 μA                            |                             | 25°C        | 2.98         |       | V    |
|                  |                                                   |                                                                              | I <sub>O</sub> = –3 mA                              |                             | 25°C        | 2.5          |       |      |
|                  |                                                   |                                                                              |                                                     |                             | Full range  | 2.25         |       |      |
| V <sub>OL</sub>  | Low-level output voltage                          |                                                                              | V <sub>IC</sub> = 1.5 V,    I <sub>O</sub> = 100 μA |                             | 25°C        | 0.02         |       | V    |
|                  |                                                   |                                                                              | V <sub>IC</sub> = 1.5 V,    I <sub>O</sub> = 3 mA   |                             | 25°C        | 0.63         |       |      |
|                  |                                                   |                                                                              |                                                     |                             | Full range  | 1            |       |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification   | V <sub>O</sub> = 1 V to 2 V                                                  | R <sub>L</sub> = 600 Ω                              | 25°C                        | 0.7         | 1            | V/mV  |      |
|                  |                                                   |                                                                              |                                                     | Full range                  | 0.4         |              |       |      |
|                  |                                                   |                                                                              | R <sub>L</sub> = 1 MΩ                               | 25°C                        | 750         |              |       |      |
| r <sub>id</sub>  | Differential input resistance                     |                                                                              |                                                     | 25°C                        | 1000        |              | GΩ    |      |
| r <sub>i</sub>   | Common-mode input resistance                      |                                                                              |                                                     | 25°C                        | 1000        |              | GΩ    |      |
| c <sub>i</sub>   | Common-mode input capacitance                     | f = 10 kHz                                                                   |                                                     | 25°C                        | 8           |              | pF    |      |
| z <sub>o</sub>   | Closed-loop output impedance                      | f = 1 MHz,    A <sub>V</sub> = 10                                            |                                                     | 25°C                        | 130         |              | Ω     |      |

$^\dagger$  Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is –40°C to 85°C. Full range for the quad I suffix is –40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is –55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at  $T_A = 150^\circ\text{C}$  extrapolated to  $T_A = 25^\circ\text{C}$  using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

| PARAMETER                                                                           | TEST CONDITIONS                                                                        | $T_A^\dagger$ | TLV2442 |     |      | UNIT          |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------|---------|-----|------|---------------|
|                                                                                     |                                                                                        |               | MIN     | TYP | MAX  |               |
| CMRR Common-mode rejection ratio                                                    | $V_{IC} = 0\text{ to }2.25\text{ V}$ ,<br>$V_O = 1.5\text{ V}$ ,<br>$R_S = 50\ \Omega$ | 25°C          | 65      | 75  |      | dB            |
|                                                                                     |                                                                                        | Full range    | 55      |     |      |               |
|                                                                                     |                                                                                        | Full range    | 50      |     |      |               |
| $k_{SVR}$ Supply-voltage rejection ratio<br>( $\Delta V_{DD} \pm / \Delta V_{IO}$ ) | $V_{DD} = 2.7\text{ V to }8\text{ V}$ ,<br>No load<br>$V_{IC} = V_{DD}/2$              | 25°C          | 80      | 95  |      | dB            |
|                                                                                     |                                                                                        | Full range    | 80      |     |      |               |
| $I_{DD}$ Supply current (per channel)                                               | $V_O = 1.5\text{ V}$ ,<br>No load                                                      | 25°C          |         | 725 | 1100 | $\mu\text{A}$ |
|                                                                                     |                                                                                        | Full range    |         |     | 1100 |               |

$^\dagger$  Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is –40°C to 85°C. Full range for the quad I suffix is –40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is –55°C to 125°C.

**operating characteristics at specified free-air temperature,  $V_{DD} = 3\text{ V}$**

| PARAMETER              |                                             | TEST CONDITIONS                                                                                       |                      | T <sub>A</sub> <sup>†</sup> | TLV244x    |      |        | UNIT |
|------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------|-----------------------------|------------|------|--------|------|
|                        |                                             |                                                                                                       |                      |                             | MIN        | TYP  | MAX    |      |
| SR                     | Slew rate at unity gain                     | V <sub>O</sub> = 1 V to 2 V,<br>R <sub>L</sub> = 600 Ω,<br>C <sub>L</sub> = 100 pF                    |                      | TLV2442Q/AQ                 | Full range | 0.65 |        | V/μs |
|                        |                                             |                                                                                                       |                      | TLV2442M/AM                 |            | 1.3  |        |      |
|                        |                                             |                                                                                                       |                      | 0.4                         |            |      |        |      |
| V <sub>n</sub>         | Equivalent input noise voltage              | f = 10 Hz                                                                                             |                      | 25°C                        | 170        |      | nV/√Hz |      |
|                        |                                             | f = 1 kHz                                                                                             |                      | 25°C                        | 18         |      |        |      |
| V <sub>N(PP)</sub>     | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 1 Hz                                                                                    |                      | 25°C                        | 2.6        |      | μV     |      |
|                        |                                             | f = 0.1 Hz to 10 Hz                                                                                   |                      | 25°C                        | 5.1        |      |        |      |
| I <sub>n</sub>         | Equivalent input noise current              |                                                                                                       |                      | 25°C                        | 0.6        |      | fA/√Hz |      |
| THD + N                | Total harmonic distortion plus noise        | V <sub>O</sub> = 0.5 V to 2.5 V,<br>R <sub>L</sub> = 600 Ω,<br>f = 1 kHz                              | A <sub>V</sub> = 1   | 25°C                        | 0.08%      |      |        |      |
|                        |                                             |                                                                                                       | A <sub>V</sub> = 10  |                             | 0.3%       |      |        |      |
|                        |                                             |                                                                                                       | A <sub>V</sub> = 100 |                             | 2%         |      |        |      |
| Gain-bandwidth product |                                             | f =10 kHz, R <sub>L</sub> = 600 Ω,<br>C <sub>L</sub> = 100 pF                                         |                      | 25°C                        | 1.75       |      | MHz    |      |
| B <sub>OM</sub>        | Maximum output-swing bandwidth              | V <sub>O(PP)</sub> = 1 V, R <sub>L</sub> = 600 Ω,<br>A <sub>V</sub> = 1, C <sub>L</sub> = 100 pF      |                      | 25°C                        | 0.9        |      | MHz    |      |
| t <sub>s</sub>         | Settling time                               | A <sub>V</sub> = −1,<br>Step = −2.3 V to 2.3 V,<br>R <sub>L</sub> = 600 Ω,<br>C <sub>L</sub> = 100 pF | To 0.1%              | 25°C                        | 1.5        |      | μs     |      |
|                        |                                             |                                                                                                       | To 0.01%             |                             | 3.2        |      |        |      |
| φ <sub>m</sub>         | Phase margin at unity gain                  | R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 100 pF                                                       |                      | 25°C                        | 65°        |      |        |      |
|                        | Gain margin                                 |                                                                                                       |                      | 25°C                        | 9          |      | dB     |      |

$^\dagger$  Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is –40°C to 85°C. Full range for the quad I suffix is –40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is –55°C to 125°C.



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

| PARAMETER        |                                                   | TEST CONDITIONS                                                                                         |                                     | T <sub>A</sub> <sup>†</sup> | TLV244x  |     |       | UNIT |
|------------------|---------------------------------------------------|---------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------|----------|-----|-------|------|
|                  |                                                   |                                                                                                         |                                     |                             | MIN      | TYP | MAX   |      |
| V <sub>IO</sub>  | Input offset voltage                              | V <sub>DD</sub> ± = ±2.5 V,<br>V <sub>O</sub> = 0,<br><br>V <sub>IC</sub> = 0,<br>R <sub>S</sub> = 50 Ω | TLV244xC<br>TLV244xI                | 25°C                        | 300 2000 |     | μV    |      |
|                  |                                                   |                                                                                                         |                                     | Full range                  | 2500     |     |       |      |
|                  |                                                   |                                                                                                         | TLV244xA                            | 25°C                        | 300 950  |     |       |      |
|                  |                                                   |                                                                                                         |                                     | Full range                  | 1500     |     |       |      |
|                  |                                                   |                                                                                                         | TLV2442AQ<br>TLV2442AM              | 25°C                        | 300 950  |     |       |      |
|                  |                                                   |                                                                                                         |                                     | Full range                  | 1600     |     |       |      |
| αV <sub>IO</sub> | Temperature coefficient of input offset voltage   |                                                                                                         |                                     | 25°C to 85°C                | 2        |     | μV/°C |      |
|                  | Input offset voltage long-term drift (see Note 4) |                                                                                                         |                                     | 25°C                        | 0.002    |     | μV/mo |      |
| I <sub>IO</sub>  | Input offset current                              |                                                                                                         |                                     | 25°C                        | 0.5 60   |     | pA    |      |
|                  |                                                   |                                                                                                         |                                     | Full range                  | 150      |     |       |      |
| I <sub>IB</sub>  | Input bias current                                |                                                                                                         |                                     | 25°C                        | 1 60     |     | pA    |      |
|                  |                                                   |                                                                                                         |                                     | –40°C to 85°C               | 150      |     |       |      |
|                  |                                                   |                                                                                                         | 125°C                               | 350                         |          |     |       |      |
|                  |                                                   | TLV2442Q/AQ<br>TLV2442M/AM                                                                              | Full range                          | 260                         |          |     |       |      |
|                  |                                                   |                                                                                                         |                                     |                             |          |     |       |      |
| V <sub>ICR</sub> | Common-mode input voltage range                   | V <sub>IO</sub>   ≤ 5 mV,<br><br>R <sub>S</sub> = 50 Ω                                                  | 25°C                                | 0 to 4.25 –0.25 to 4.5      |          | V   |       |      |
|                  |                                                   |                                                                                                         | Full range                          | 0 to 4                      |          |     |       |      |
| V <sub>OH</sub>  | High-level output voltage                         | I <sub>OH</sub> = –100 μA                                                                               | 25°C                                | 4.97                        |          | V   |       |      |
|                  |                                                   | I <sub>OH</sub> = –5 mA                                                                                 | 25°C                                | 4 4.35                      |          |     |       |      |
|                  |                                                   |                                                                                                         | Full range                          | 4                           |          |     |       |      |
| V <sub>OL</sub>  | Low-level output voltage                          | V <sub>IC</sub> = 2.5 V, I <sub>OL</sub> = 100 μA                                                       | 25°C                                | 0.01                        |          | V   |       |      |
|                  |                                                   | V <sub>IC</sub> = 2.5 V, I <sub>OL</sub> = 5 mA                                                         | 25°C                                | 0.8                         |          |     |       |      |
|                  |                                                   |                                                                                                         | Full range                          | 1.25                        |          |     |       |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification   | V <sub>IC</sub> = 2.5 V,<br>V <sub>O</sub> = 1 V to 4 V                                                 | R <sub>L</sub> = 600 Ω <sup>‡</sup> | 25°C                        | 0.9 1.3  |     | V/mV  |      |
|                  |                                                   |                                                                                                         |                                     | Full range                  | 0.5      |     |       |      |
|                  |                                                   |                                                                                                         | R <sub>L</sub> = 1 MΩ <sup>‡</sup>  | 25°C                        | 950      |     |       |      |
| r <sub>id</sub>  | Differential input resistance                     |                                                                                                         | 25°C                                | 1000                        |          | GΩ  |       |      |
| r <sub>i</sub>   | Common-mode input resistance                      |                                                                                                         | 25°C                                | 1000                        |          | GΩ  |       |      |
| c <sub>i</sub>   | Common-mode input capacitance                     | f = 10 kHz                                                                                              | 25°C                                | 8                           |          | pF  |       |      |
| z <sub>0</sub>   | Closed-loop output impedance                      | f = 1 MHz, A <sub>V</sub> = 10                                                                          | 25°C                                | 140                         |          | Ω   |       |      |
| CMRR             | Common-mode rejection ratio                       | V <sub>IC</sub> = 0 to 4.25 V, V <sub>O</sub> = 2.5 V,<br>R <sub>S</sub> = 50 Ω                         | 25°C                                | 70 75                       |          | dB  |       |      |
|                  |                                                   |                                                                                                         | Full range                          | 70                          |          |     |       |      |

$^\dagger$  Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is –40°C to 85°C. Full range for the quad I suffix is –40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is –55°C to 125°C.

$^\ddagger$  Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at  $T_A = 150^\circ\text{C}$  extrapolated to  $T_A = 25^\circ\text{C}$  using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

| PARAMETER                                                                  | TEST CONDITIONS                                                          | $T_A^\dagger$ | TLV244x |     |      | UNIT          |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------|---------|-----|------|---------------|
|                                                                            |                                                                          |               | MIN     | TYP | MAX  |               |
| $k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ ) | $V_{DD} = 4.4\text{ V to }8\text{ V}$ ,<br>$V_{IC} = V_{DD}/2$ , No load | 25°C          | 80      | 95  |      | dB            |
|                                                                            |                                                                          | Full range    | 80      |     |      |               |
| $I_{DD}$ Supply current (per channel)                                      | $V_O = 2.5\text{ V}$ , No load                                           | 25°C          |         | 750 | 1100 | $\mu\text{A}$ |
|                                                                            |                                                                          | Full range    |         |     | 1100 |               |

$^\dagger$  Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is –40°C to 85°C. Full range for the quad I suffix is –40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is –55°C to 125°C.

**operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$**

| PARAMETER              |                                             | TEST CONDITIONS                                                                                                                 |                      | T <sub>A</sub> <sup>†</sup> | TLV244x    |      |     | UNIT   |
|------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------|------------|------|-----|--------|
|                        |                                             |                                                                                                                                 |                      |                             | MIN        | TYP  | MAX |        |
| SR                     | Slew rate at unity gain                     | V <sub>O</sub> = 0.5 V to 2.5 V,<br>R <sub>L</sub> = 600 Ω <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>               |                      | TLV2442Q/AQ<br>TLV2442M/AM  | 25°C       | 0.75 | 1.4 | V/μs   |
|                        |                                             |                                                                                                                                 |                      |                             | Full range | 0.75 |     |        |
|                        |                                             |                                                                                                                                 |                      |                             | Full range | 0.5  |     |        |
| V <sub>n</sub>         | Equivalent input noise voltage              | f = 10 Hz                                                                                                                       |                      | 25°C                        | 130        |      |     | nV/√Hz |
|                        |                                             | f = 1 kHz                                                                                                                       |                      | 25°C                        | 16         |      |     |        |
| V <sub>N(PP)</sub>     | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 1 Hz                                                                                                              |                      | 25°C                        | 1.8        |      |     | μV     |
|                        |                                             | f = 0.1 Hz to 10 Hz                                                                                                             |                      | 25°C                        | 3.6        |      |     |        |
| I <sub>n</sub>         | Equivalent input noise current              |                                                                                                                                 |                      | 25°C                        | 0.6        |      |     | fA/√Hz |
| THD + N                | Total harmonic distortion plus noise        | V <sub>O</sub> = 1.5 V to 3.5 V,<br>f = 1 kHz,<br>R <sub>L</sub> = 600 Ω <sup>‡</sup>                                           | A <sub>V</sub> = 1   | 25°C                        | 0.017%     |      |     |        |
|                        |                                             |                                                                                                                                 | A <sub>V</sub> = 10  |                             | 0.17%      |      |     |        |
|                        |                                             |                                                                                                                                 | A <sub>V</sub> = 100 |                             | 1.5%       |      |     |        |
| Gain-bandwidth product |                                             | f = 10 kHz, R <sub>L</sub> = 600 Ω <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                                       |                      | 25°C                        | 1.81       |      |     | MHz    |
| B <sub>OM</sub>        | Maximum output-swing bandwidth              | V <sub>O(PP)</sub> = 2 V, A <sub>V</sub> = 1,<br>R <sub>L</sub> = 600 Ω <sup>‡</sup> , C <sub>L</sub> = 100 pF <sup>‡</sup>     |                      | 25°C                        | 0.5        |      |     | MHz    |
| t <sub>s</sub>         | Settling time                               | A <sub>V</sub> = −1,<br>Step = 0.5 V to 2.5 V,<br>R <sub>L</sub> = 600 Ω <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup> | To 0.1%              | 25°C                        | 1.5        |      |     | μs     |
|                        |                                             |                                                                                                                                 | To 0.01%             |                             | 2.6        |      |     |        |
| φ <sub>m</sub>         | Phase margin at unity gain                  | R <sub>L</sub> = 600 Ω <sup>‡</sup> , C <sub>L</sub> = 100 pF <sup>‡</sup>                                                      |                      | 25°C                        | 68°        |      |     |        |
| Gain margin            |                                             |                                                                                                                                 |                      | 25°C                        | 8          |      |     | dB     |

$^\dagger$  Full range for the C suffix is 0°C to 70°C. Full range for the dual I suffix is –40°C to 85°C. Full range for the quad I suffix is –40°C to 125°C. Full range for the Q suffix is –40°C to 125°C. Full range for the M suffix is –55°C to 125°C.

$^\ddagger$  Referenced to 2.5 V





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## TYPICAL CHARACTERISTICS

Table of Graphs†

|                 |                                                                  |                                              | FIGURE       |
|-----------------|------------------------------------------------------------------|----------------------------------------------|--------------|
| $V_{IO}$        | Input offset voltage                                             | Distribution<br>vs Common-mode input voltage | 2, 3<br>4, 5 |
| $\alpha_{VIO}$  | Input offset voltage temperature coefficient                     | Distribution                                 | 6, 7         |
| $I_{IB}/I_{IO}$ | Input bias and input offset currents                             | vs Free-air temperature                      | 8            |
| $V_{OH}$        | High-level output voltage                                        | vs High-level output current                 | 9, 10        |
| $V_{OL}$        | Low-level output voltage                                         | vs Low-level output current                  | 11, 12       |
| $V_{O(PP)}$     | Maximum peak-to-peak output voltage                              | vs Frequency                                 | 13           |
| $I_{OS}$        | Short-circuit output current                                     | vs Supply voltage<br>vs Free-air temperature | 14<br>15     |
| $V_O$           | Output voltage                                                   | vs Differential Input voltage                | 16, 17       |
| $A_{VD}$        | Differential voltage amplification                               | vs Load resistance                           | 18           |
| $A_{VD}$        | Large-signal differential voltage amplification and phase margin | vs Frequency                                 | 19, 20       |
|                 | Large-signal differential voltage amplification                  | vs Free-air temperature                      | 21, 22       |
| $z_o$           | Output impedance                                                 | vs Frequency                                 | 23, 24       |
| CMRR            | Common-mode rejection ratio                                      | vs Frequency                                 | 25           |
|                 |                                                                  | vs Free-air temperature                      | 26           |
| $k_{SVR}$       | Supply-voltage rejection ratio                                   | vs Frequency                                 | 27, 28       |
|                 |                                                                  | vs Free-air temperature                      | 29           |
| $I_{DD}$        | Supply current                                                   | vs Supply voltage                            | 30           |
| SR              | Slew rate                                                        | vs Load capacitance                          | 31           |
|                 |                                                                  | vs Free-air temperature                      | 32           |
| $V_O$           | Inverting large-signal pulse response                            |                                              | 33, 34       |
|                 | Voltage-follower large-signal pulse response                     |                                              | 35, 36       |
|                 | Inverting small-signal pulse response                            |                                              | 37, 38       |
|                 | Voltage-follower small-signal pulse response                     |                                              | 39, 40       |
| $V_n$           | Equivalent input noise voltage                                   | vs Frequency                                 | 41, 42       |
|                 | Noise voltage                                                    | Over a 10-second period                      | 43           |
| $THD + N$       | Total harmonic distortion plus noise                             | vs Frequency                                 | 44, 45       |
|                 | Gain-bandwidth product                                           | vs Free-air temperature                      | 46           |
|                 |                                                                  | vs Supply voltage                            | 47           |
| $\phi_m$        | Phase margin                                                     | vs Frequency<br>vs Load capacitance          | 19, 20<br>48 |
|                 | Gain margin                                                      | vs Load capacitance                          | 49           |
| $B_1$           | Unity-gain bandwidth                                             | vs Load capacitance                          | 50           |

† For all graphs where  $V_{DD} = 5$  V, all loads are referenced to 2.5 V.



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# TLV2442, TLV2442A, TLV2444, TLV2444A

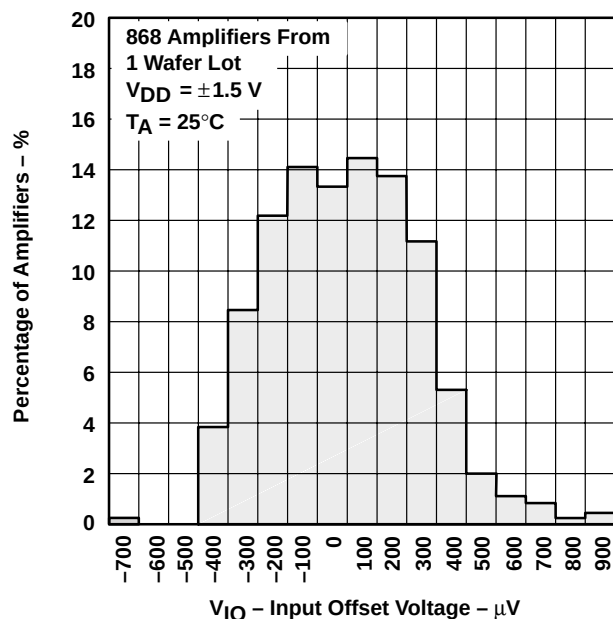
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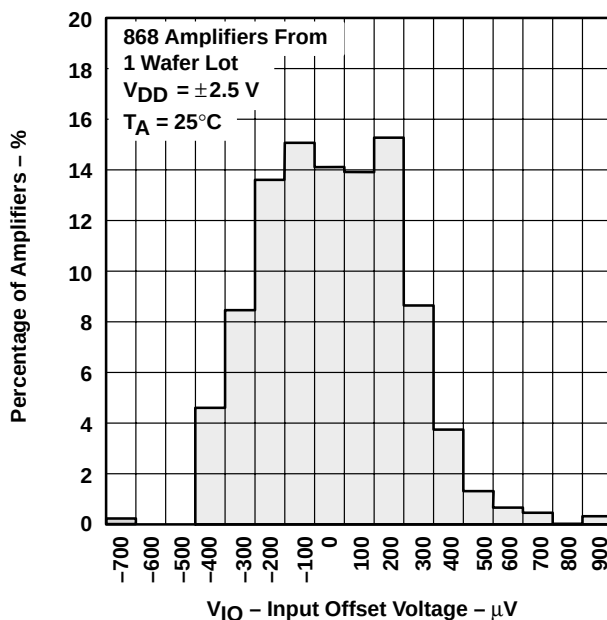
#### TYPICAL CHARACTERISTICS

**DISTRIBUTION OF TLV2442  
INPUT OFFSET VOLTAGE**



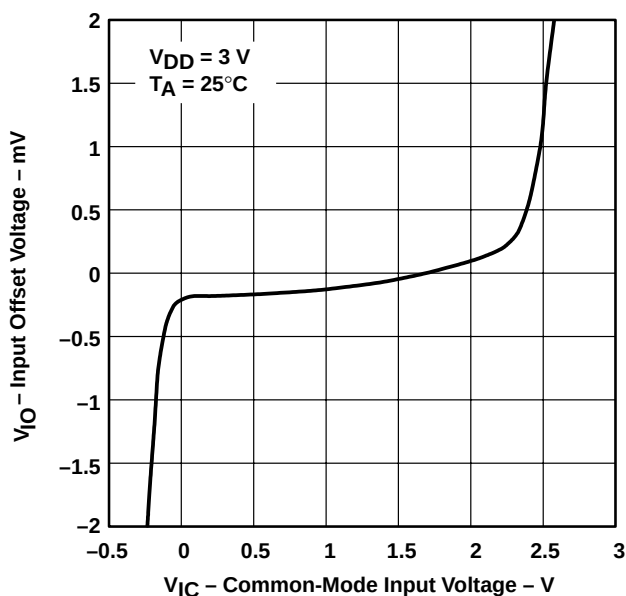
**Figure 2**

**DISTRIBUTION OF TLV2442  
INPUT OFFSET VOLTAGE**



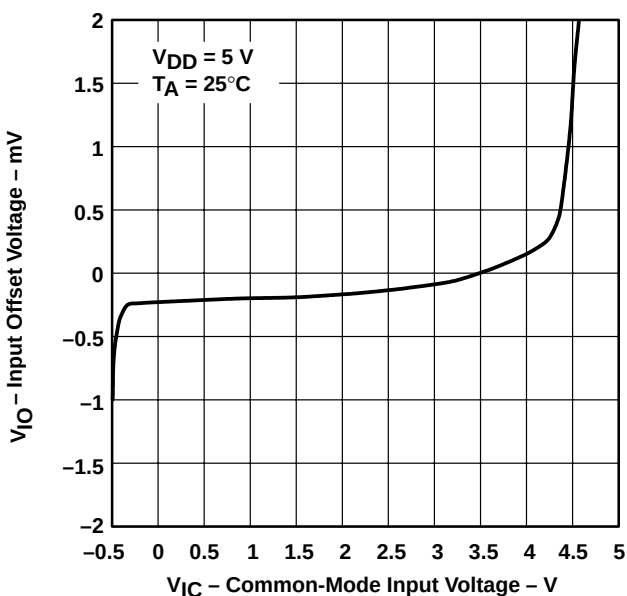
**Figure 3**

**INPUT OFFSET VOLTAGE  
vs  
COMMON-MODE INPUT VOLTAGE**



**Figure 4**

**INPUT OFFSET VOLTAGE  
vs  
COMMON-MODE INPUT VOLTAGE**



**Figure 5**

## TYPICAL CHARACTERISTICS

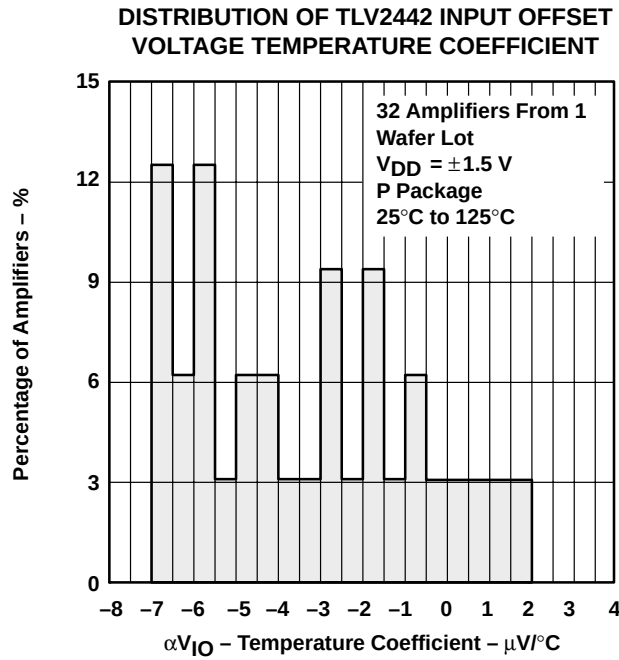


Figure 6

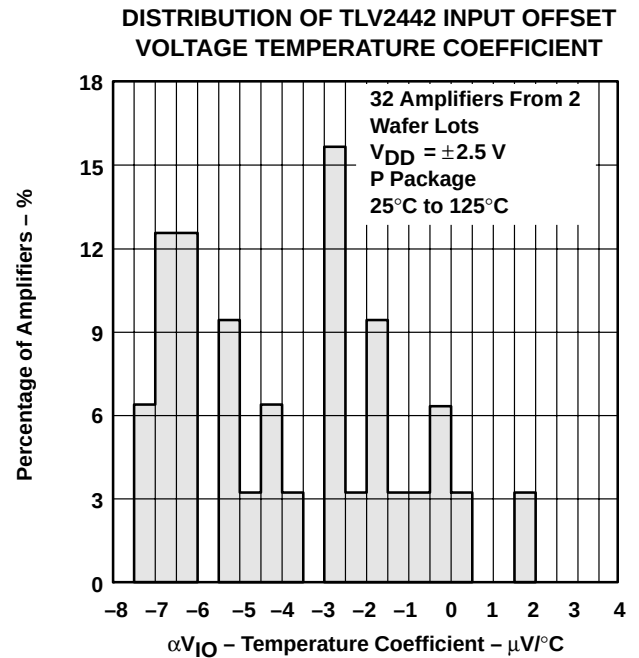


Figure 7

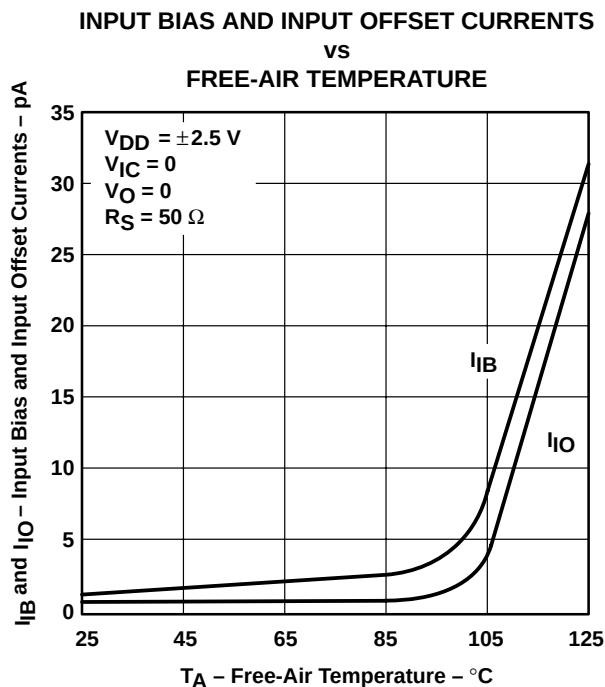


Figure 8

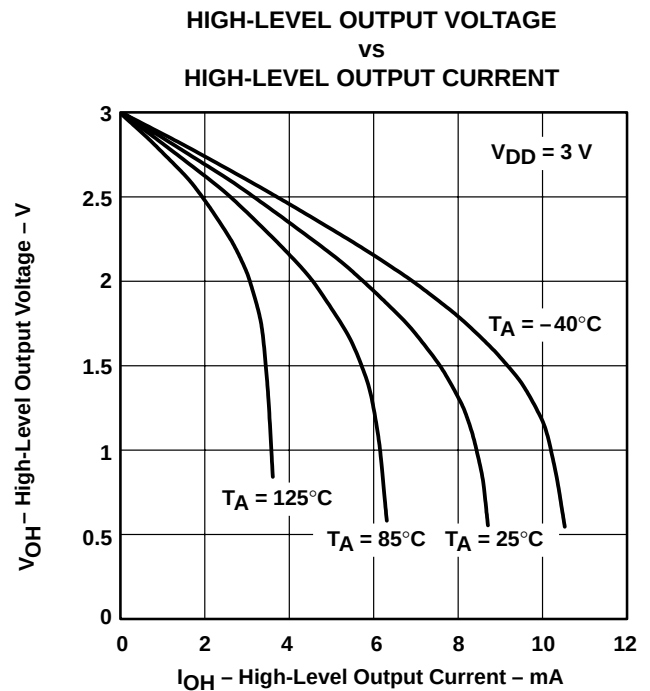


Figure 9

# TLV2442, TLV2442A, TLV2444, TLV2444A

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#### TYPICAL CHARACTERISTICS

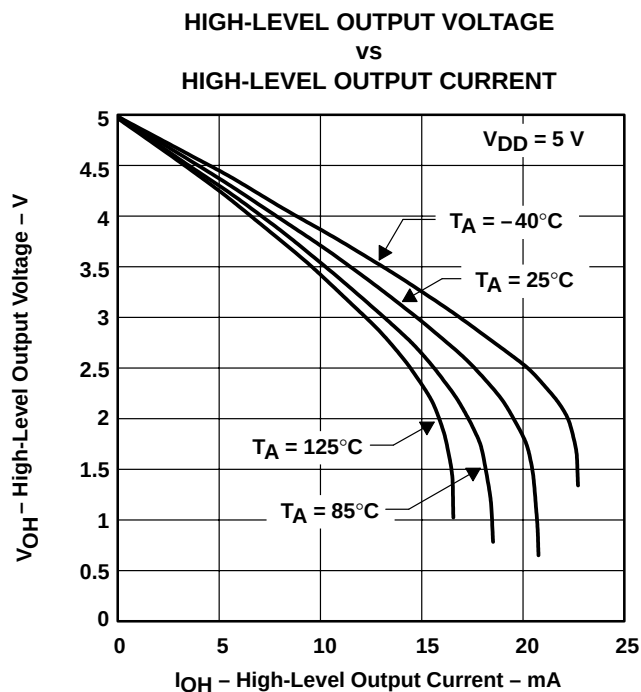


Figure 10

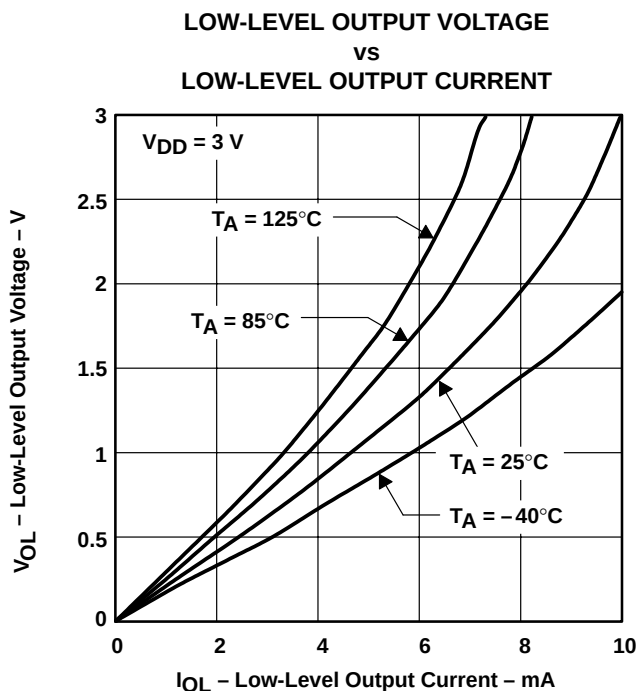


Figure 11

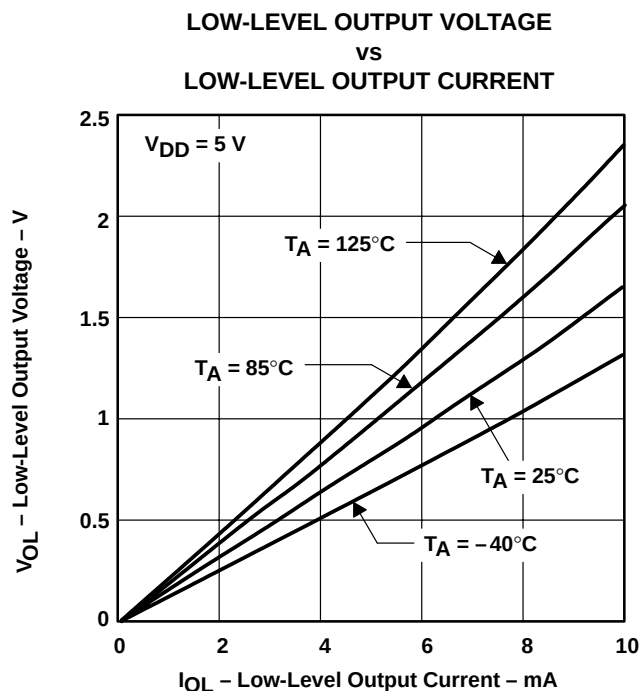


Figure 12

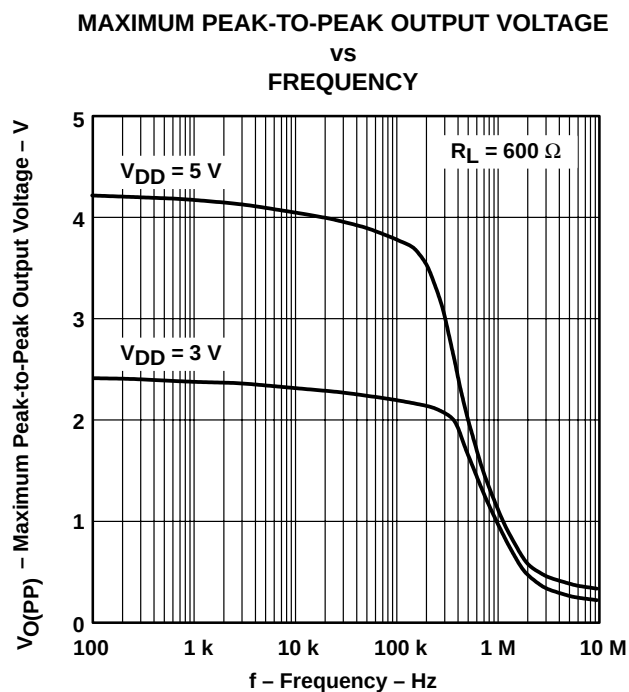
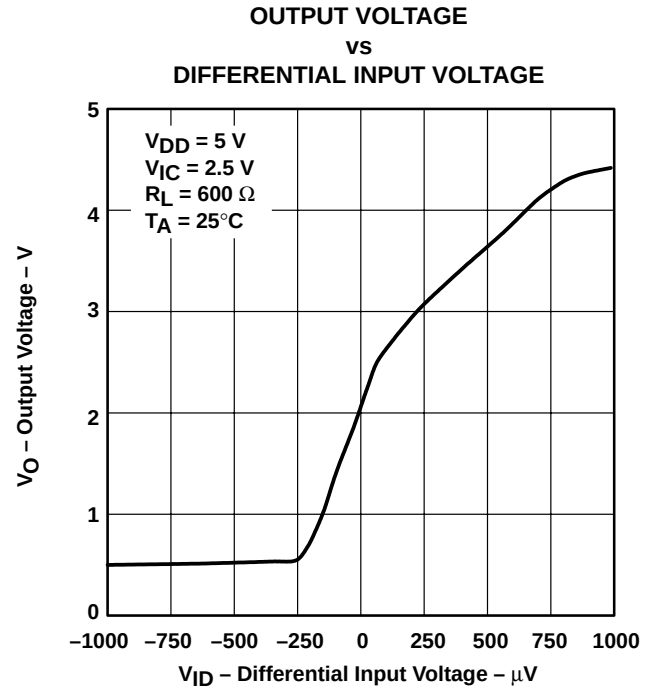
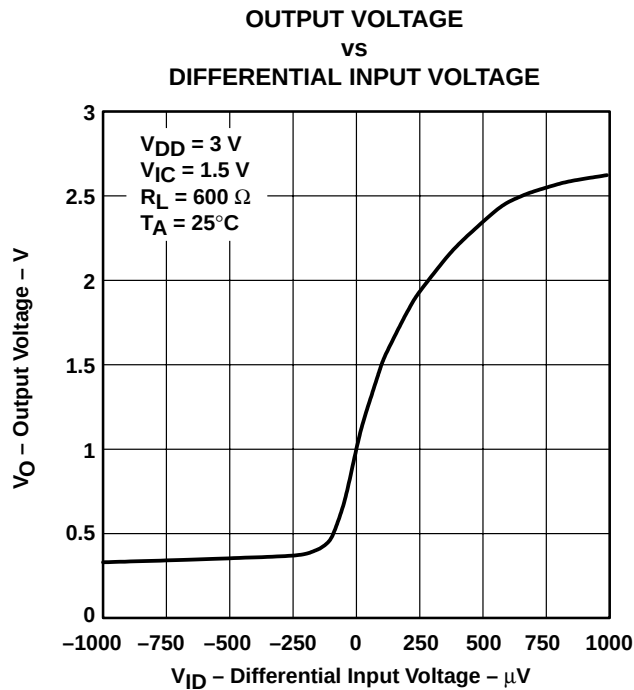
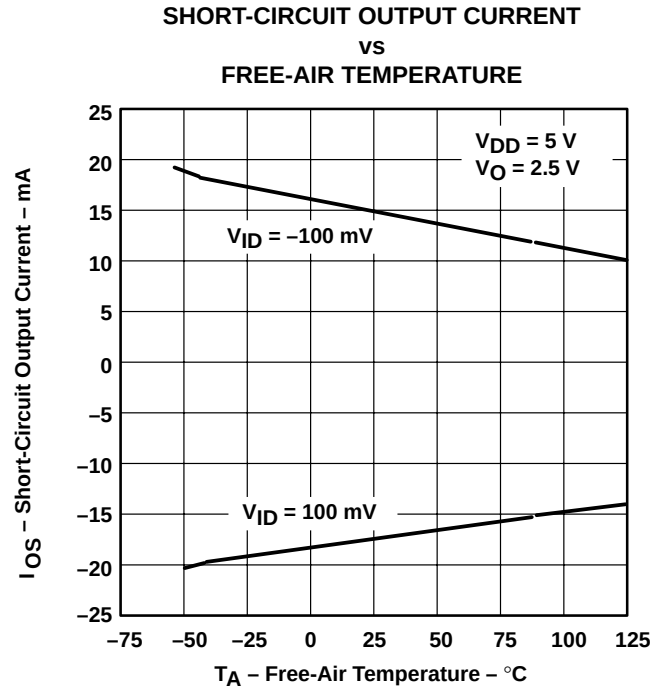
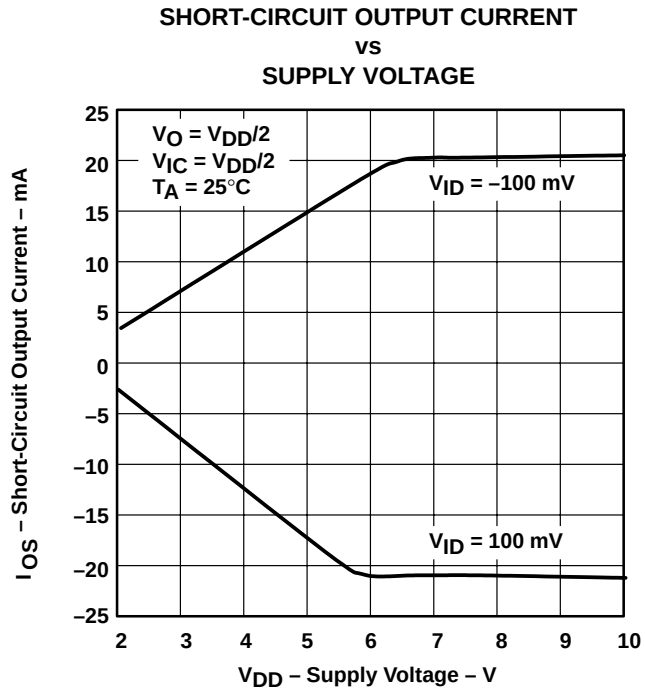


Figure 13

## TYPICAL CHARACTERISTICS

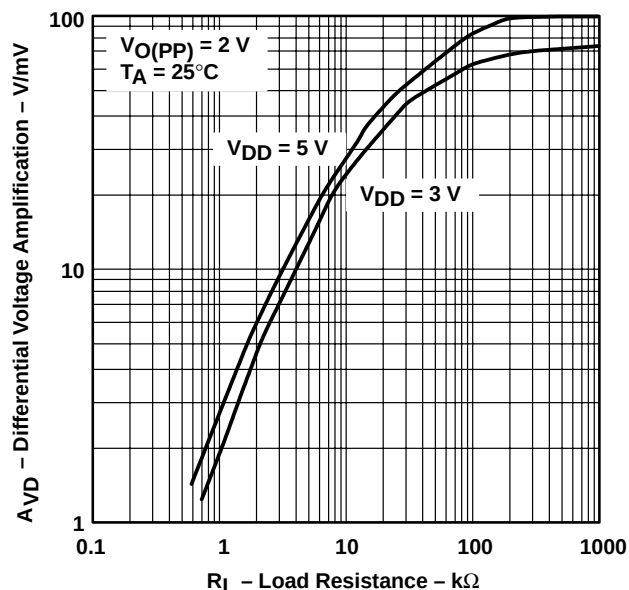


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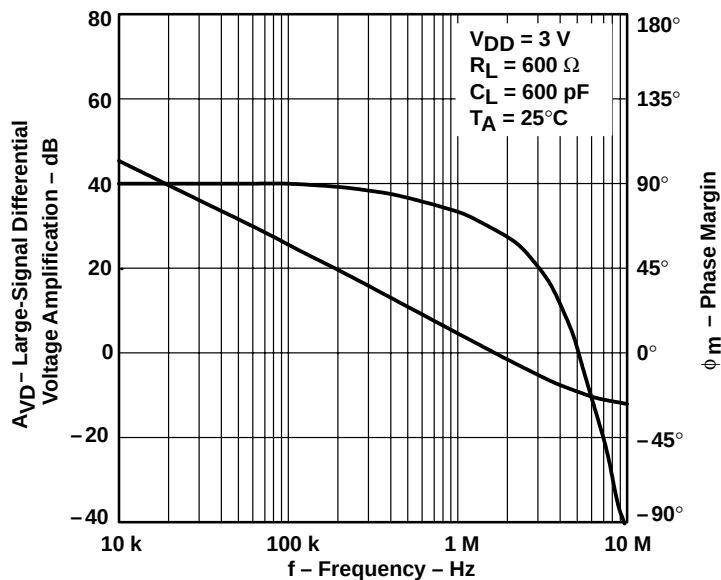
**TYPICAL CHARACTERISTICS**

**DIFFERENTIAL VOLTAGE AMPLIFICATION**  
**VS**  
**LOAD RESISTANCE**



**Figure 18**

**LARGE-SIGNAL DIFFERENTIAL VOLTAGE**  
**AMPLIFICATION AND PHASE MARGIN**  
**VS**  
**FREQUENCY**



**Figure 19**



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## TYPICAL CHARACTERISTICS

### LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN

VS  
FREQUENCY

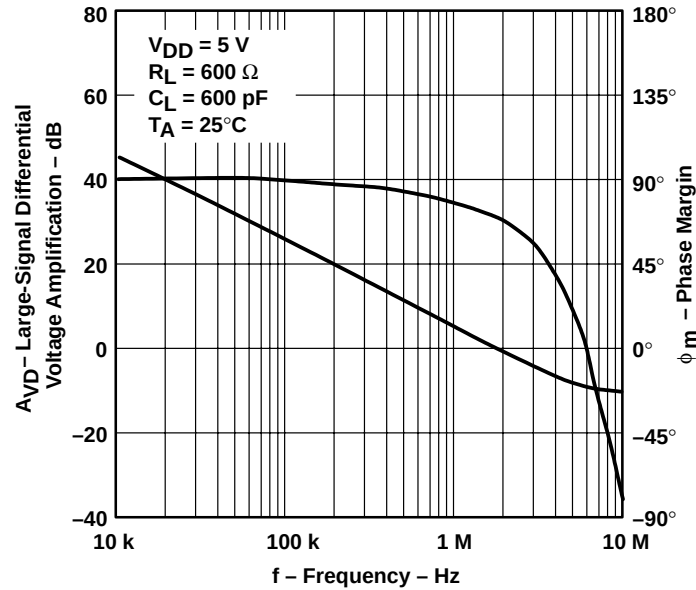


Figure 20

### LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION

VS

FREE-AIR TEMPERATURE

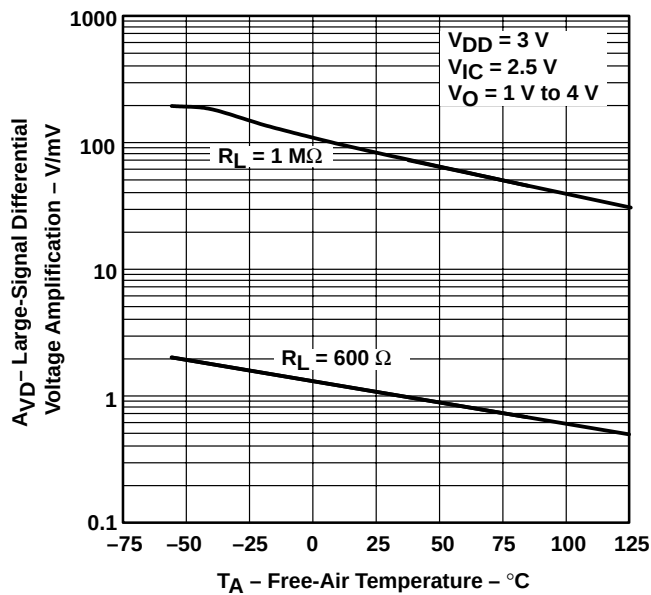


Figure 21

### LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION

VS

FREE-AIR TEMPERATURE

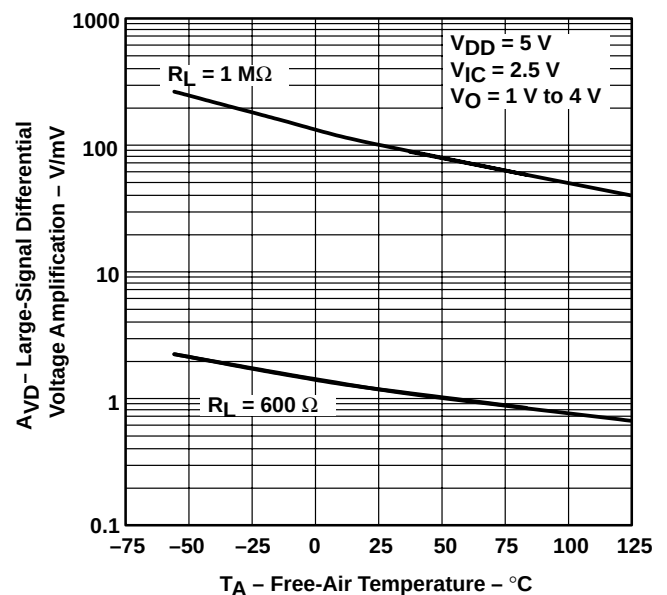


Figure 22

# TLV2442, TLV2442A, TLV2444, TLV2444A

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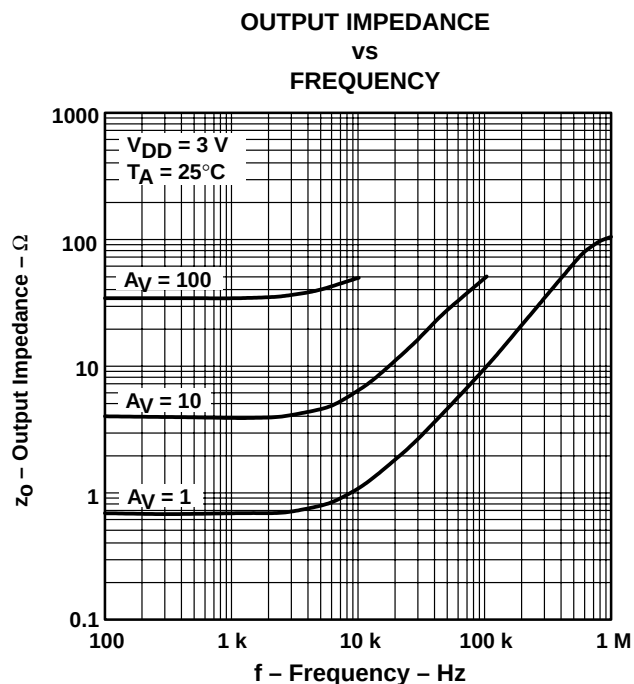


Figure 23

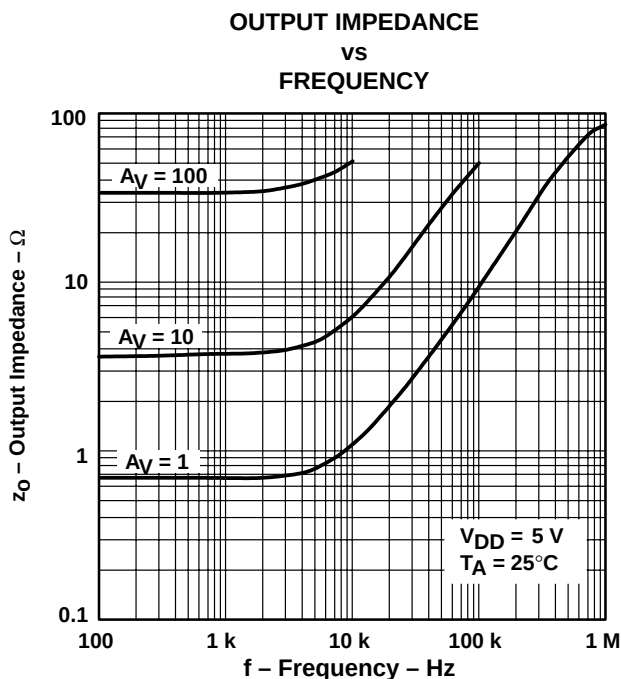


Figure 24

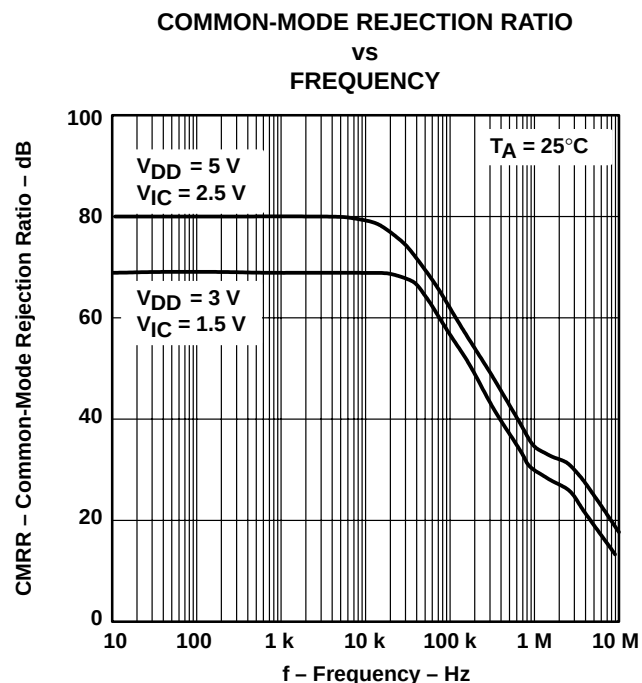


Figure 25

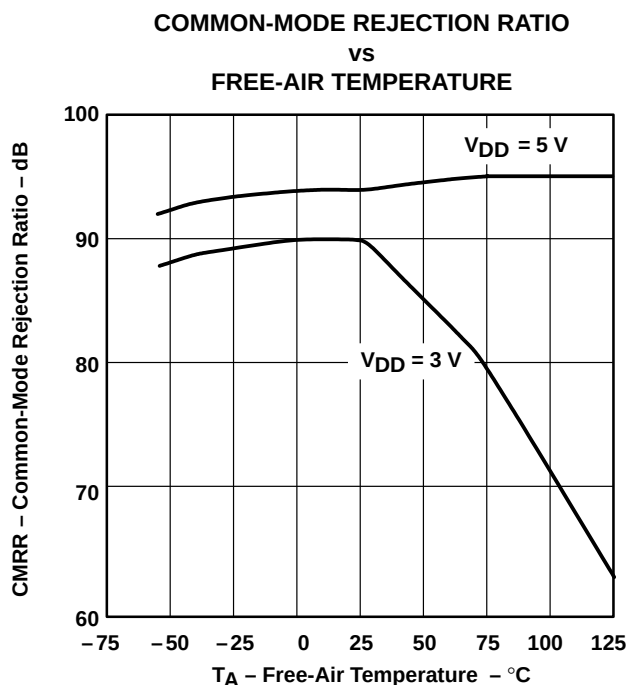


Figure 26



## TYPICAL CHARACTERISTICS

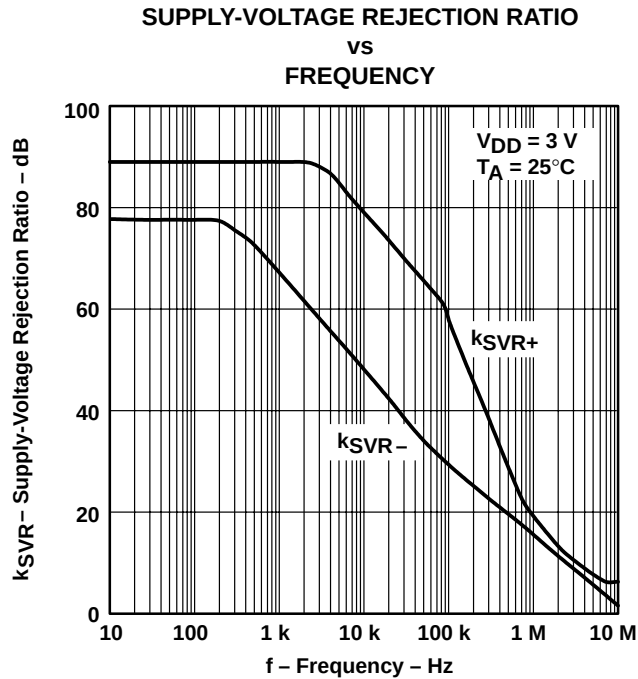


Figure 27

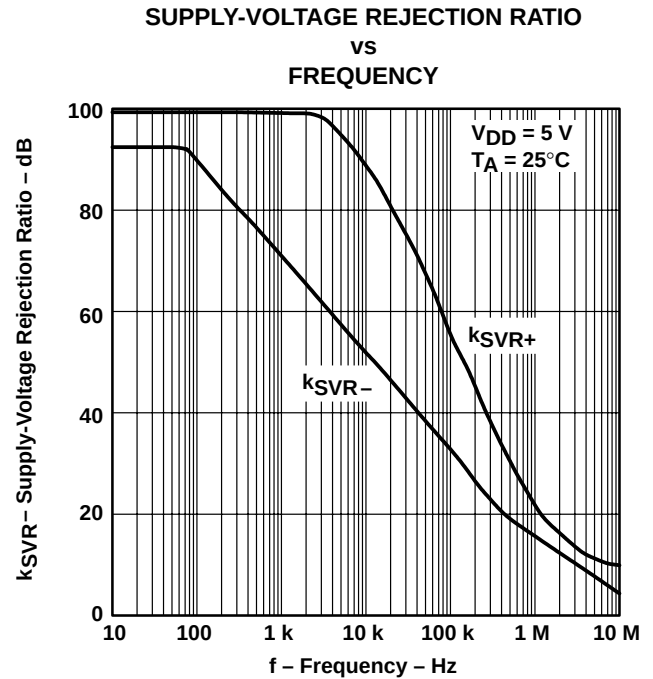


Figure 28

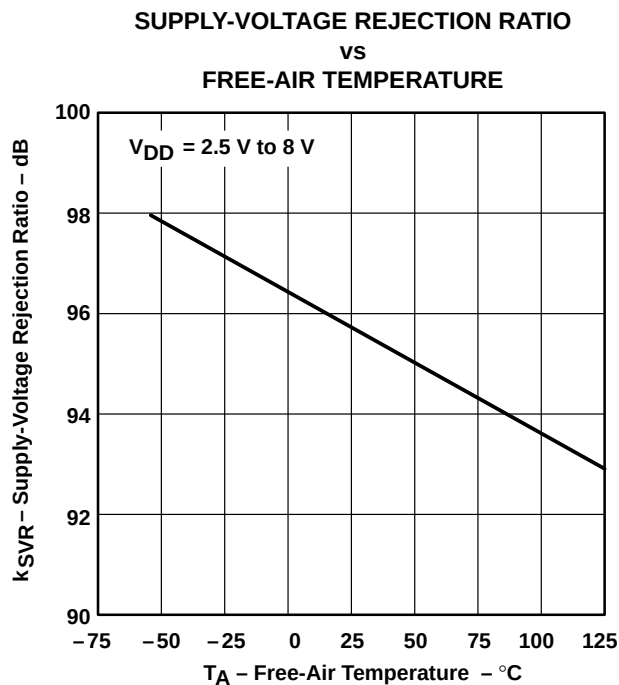


Figure 29

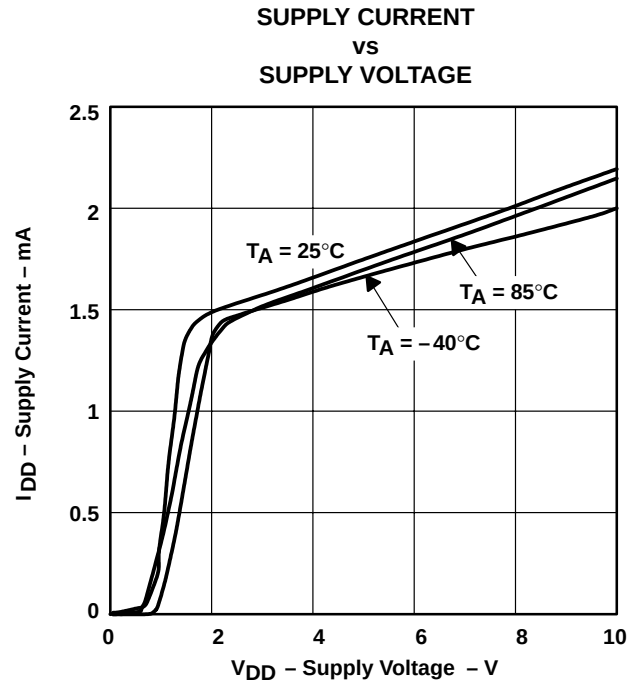
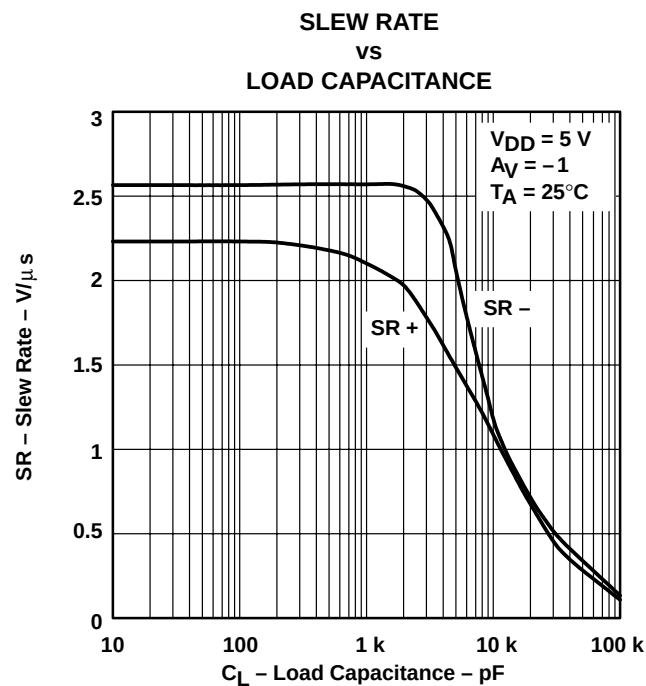


Figure 30

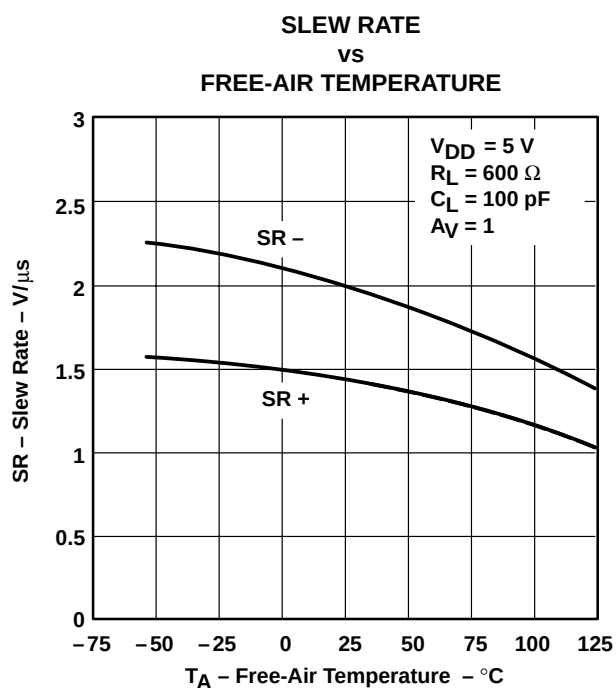
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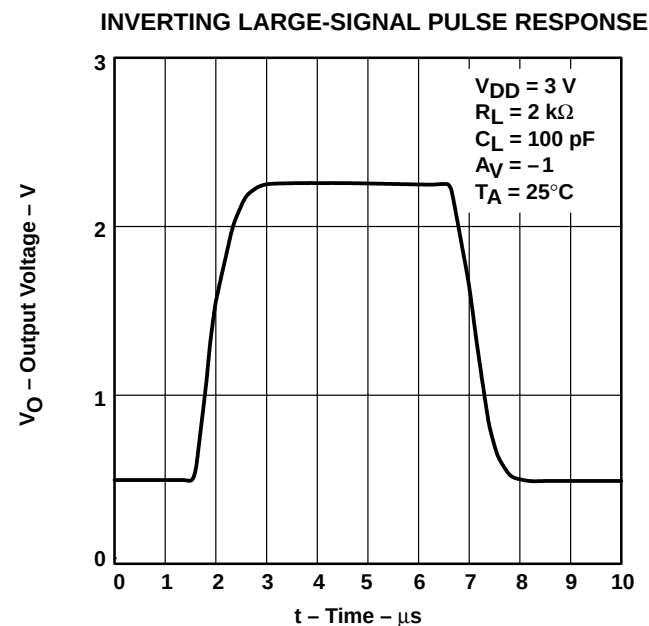
**TYPICAL CHARACTERISTICS**



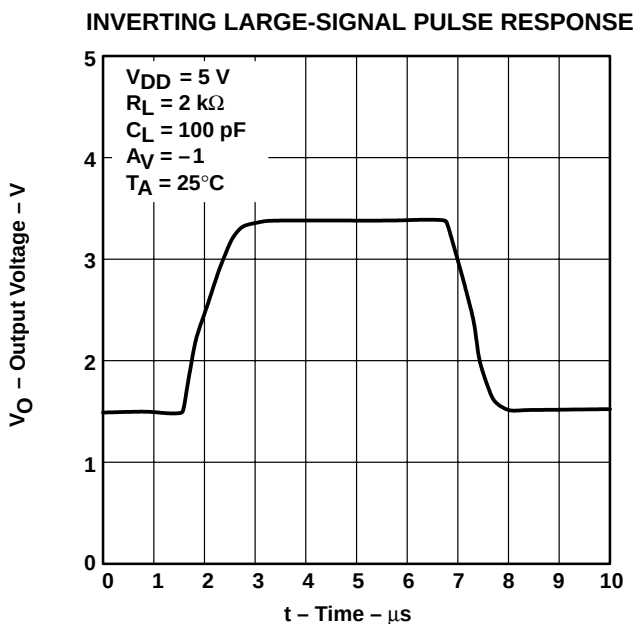
**Figure 31**



**Figure 32**



**Figure 33**



**Figure 34**

## TYPICAL CHARACTERISTICS

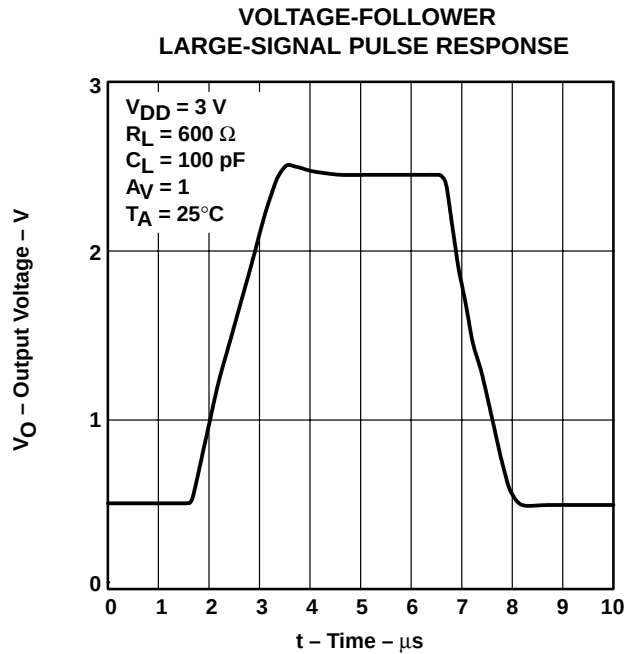


Figure 35

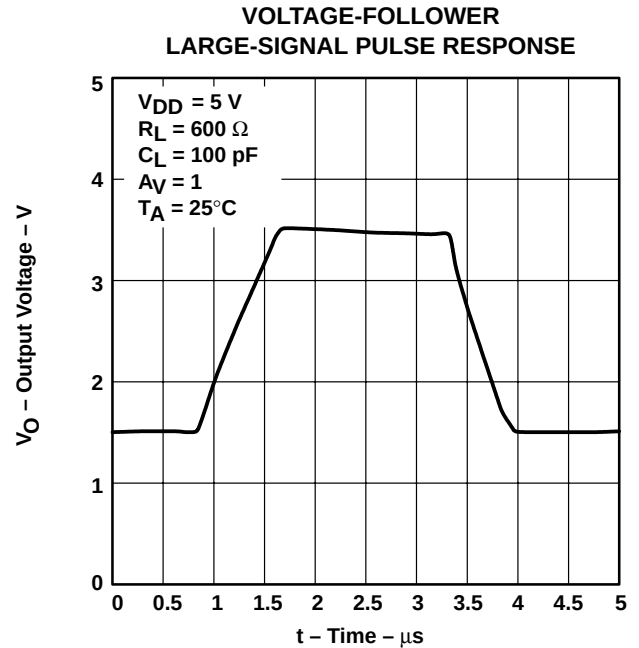


Figure 36

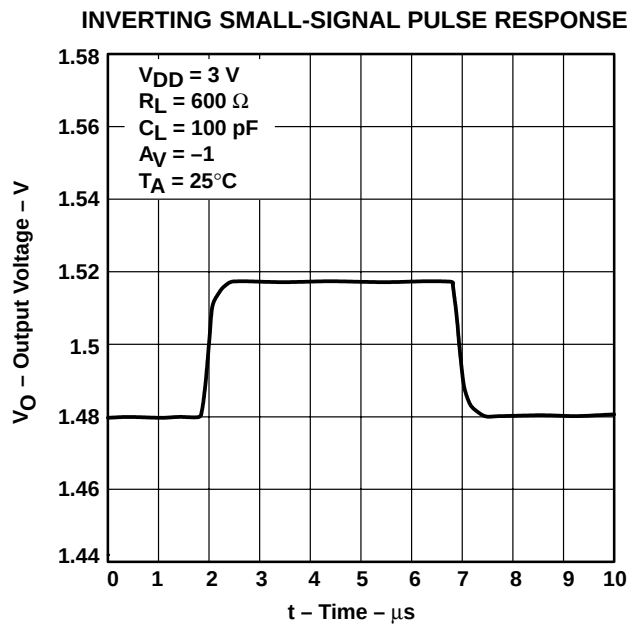


Figure 37

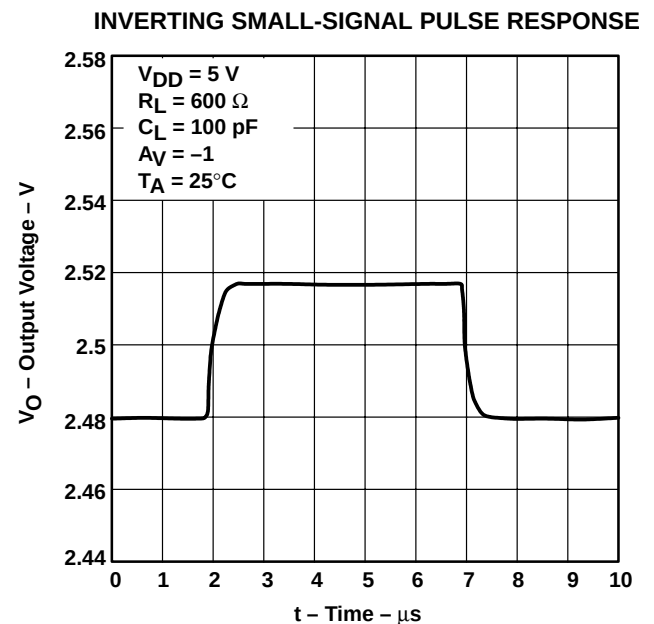
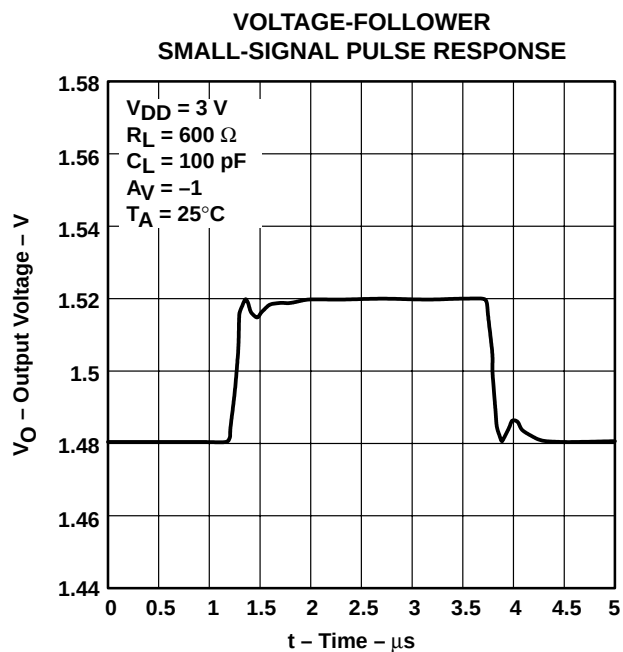


Figure 38

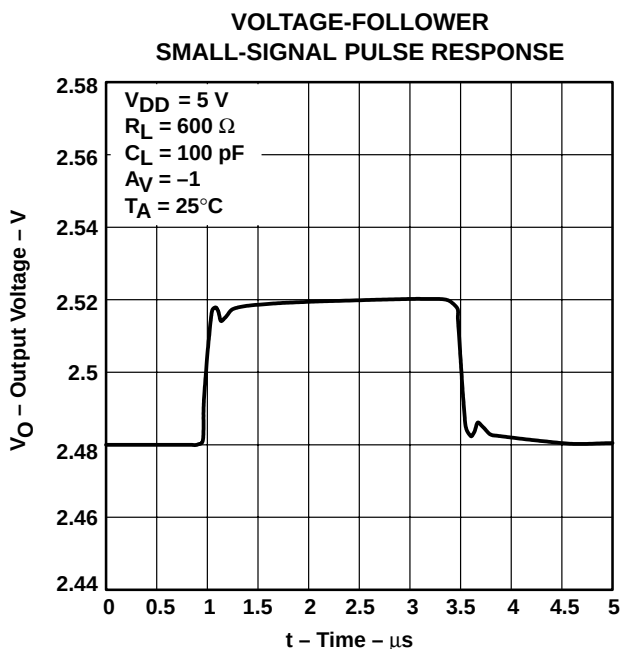
**TLV2442, TLV2442A, TLV2444, TLV2444A**  
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**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

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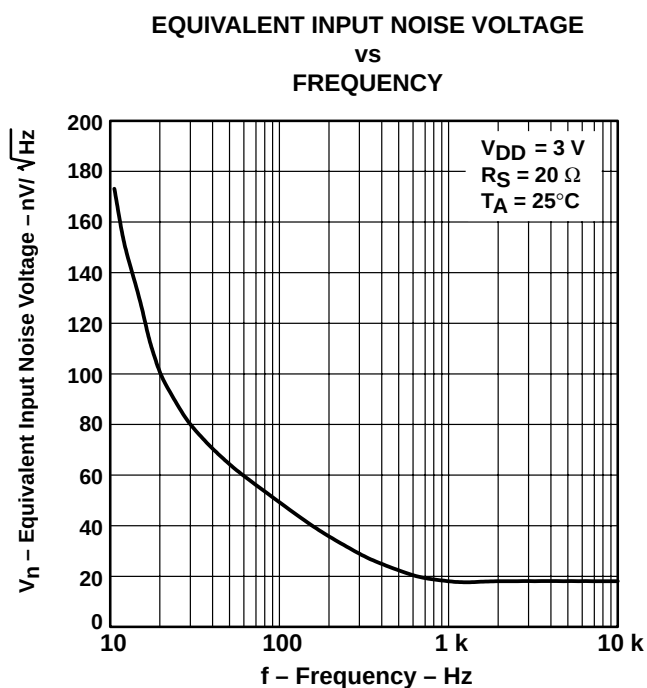
**TYPICAL CHARACTERISTICS**



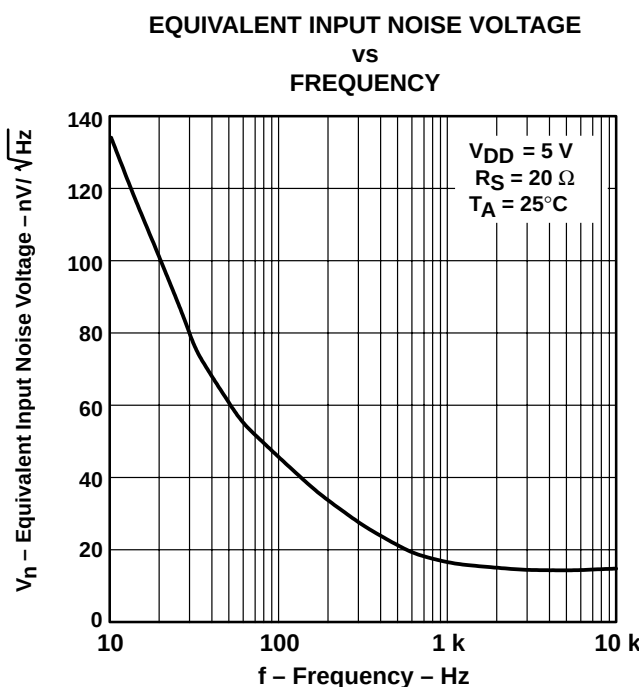
**Figure 39**



**Figure 40**



**Figure 41**



**Figure 42**

## TYPICAL CHARACTERISTICS

NOISE VOLTAGE  
OVER A 10-SECOND PERIOD

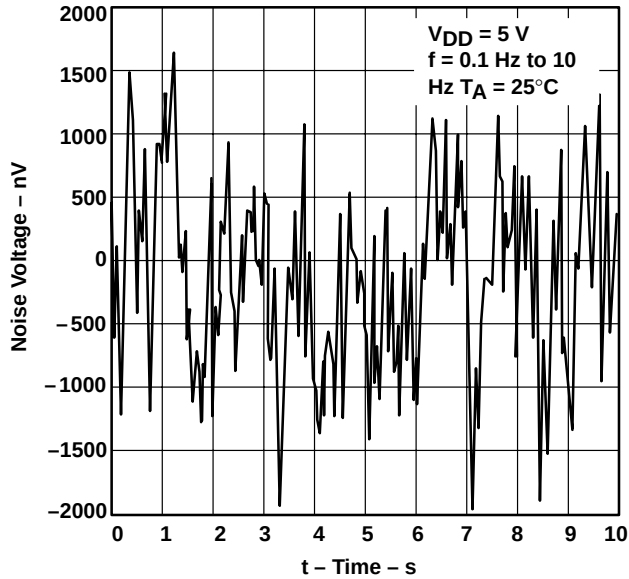


Figure 43

TOTAL HARMONIC DISTORTION PLUS NOISE  
VS  
FREQUENCY

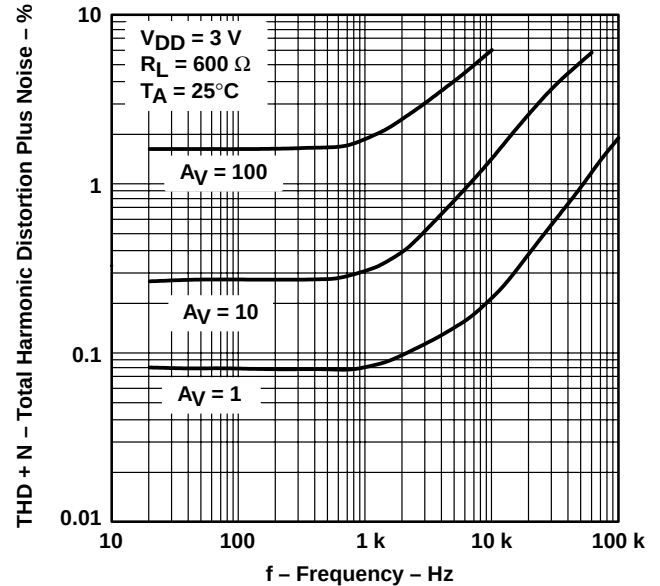


Figure 44

TOTAL HARMONIC DISTORTION PLUS NOISE  
VS  
FREQUENCY

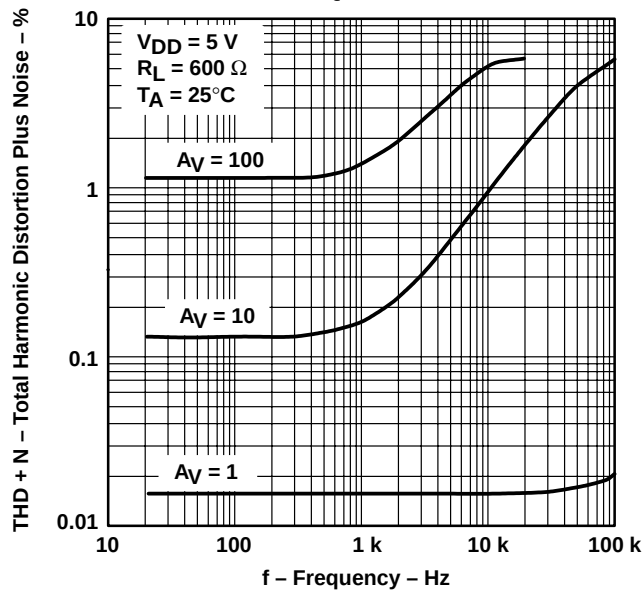


Figure 45

GAIN-BANDWIDTH PRODUCT  
VS  
FREE-AIR TEMPERATURE

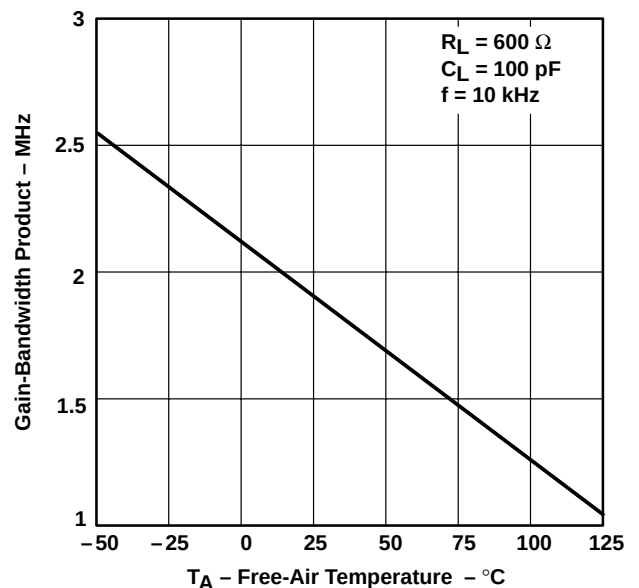
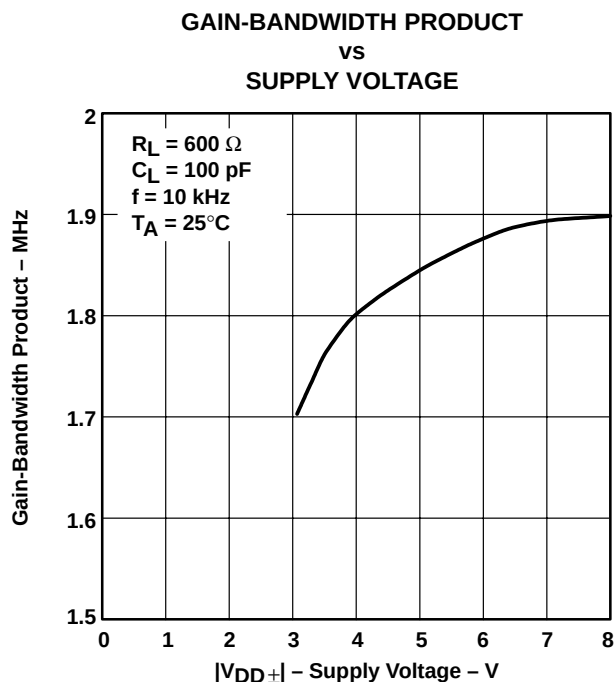


Figure 46

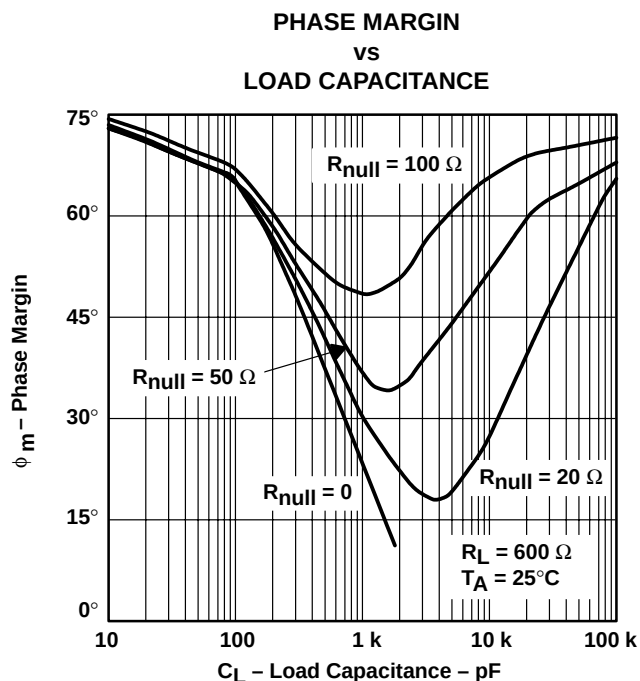
**TLV2442, TLV2442A, TLV2444, TLV2444A**  
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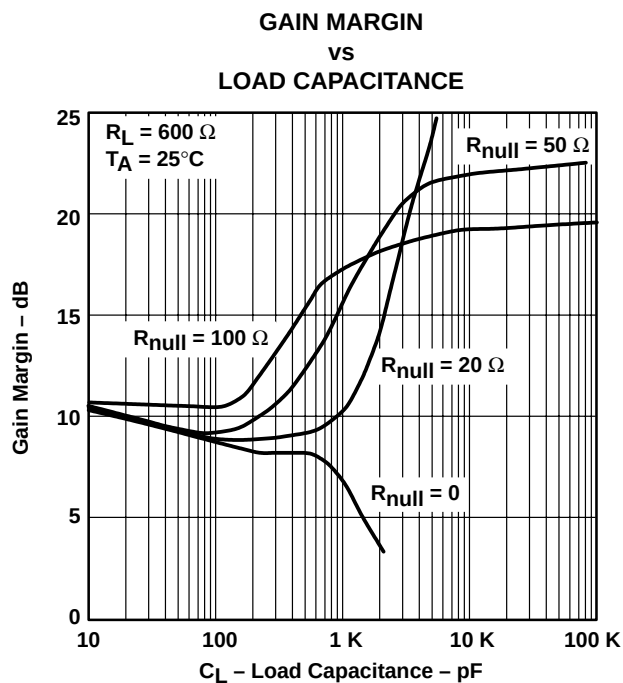
**TYPICAL CHARACTERISTICS**



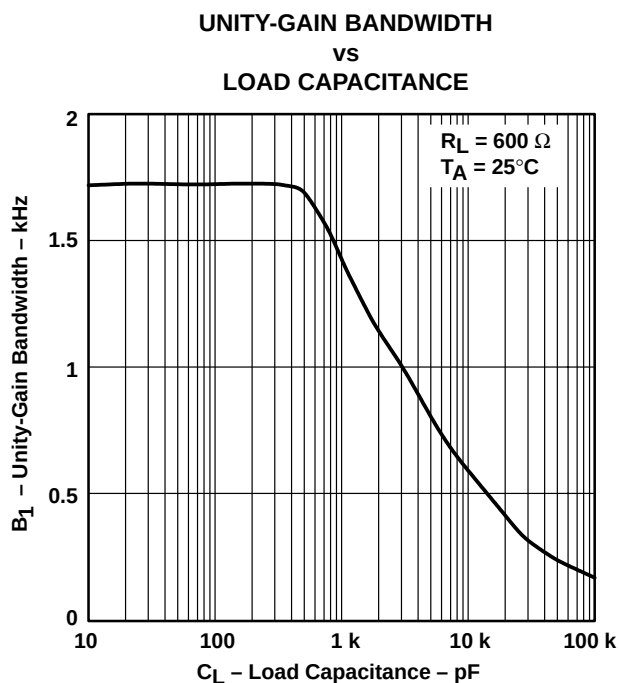
**Figure 47**



**Figure 48**



**Figure 49**



**Figure 50**

# TLV2442, TLV2442A, TLV2444, TLV2444A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

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## APPLICATION INFORMATION

### macromodel information

Macromodel information provided was derived using *PSpice™ Parts™* model generation software. The Boyle macromodel (see Note 5) and subcircuit in Figure 51 were generated using the TLV244x typical electrical and operating characteristics at  $T_A = 25^\circ\text{C}$ . 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 5: G. R. Boyle, B. M. Cohn, D. O. Pederson, and J. E. Solomon, "Macromodeling of Integrated Circuit Operational Amplifiers," *IEEE Journal of Solid-State Circuits*, SC-9, 353 (1974).

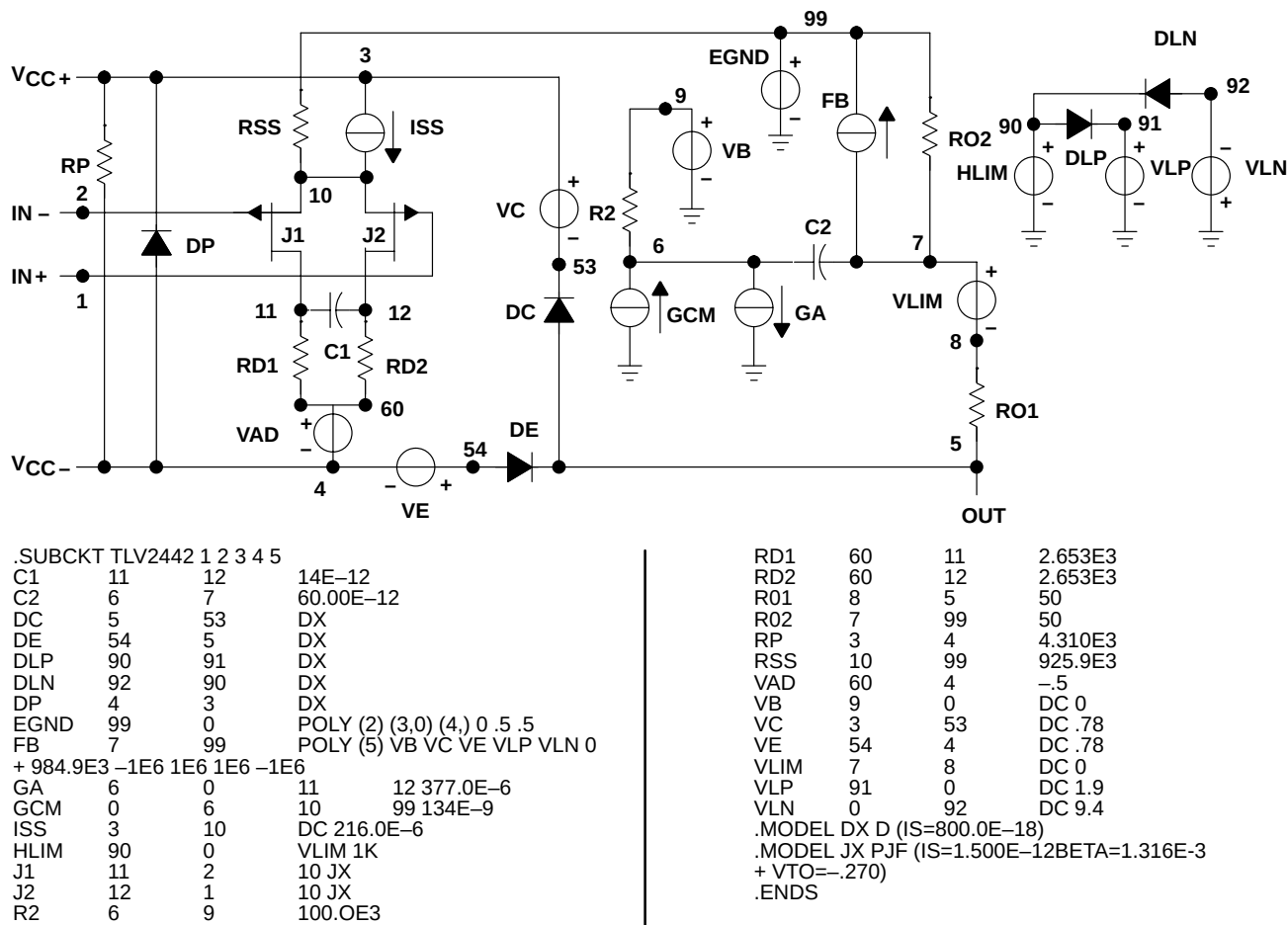


Figure 51. Boyle Macromodel and Subcircuit

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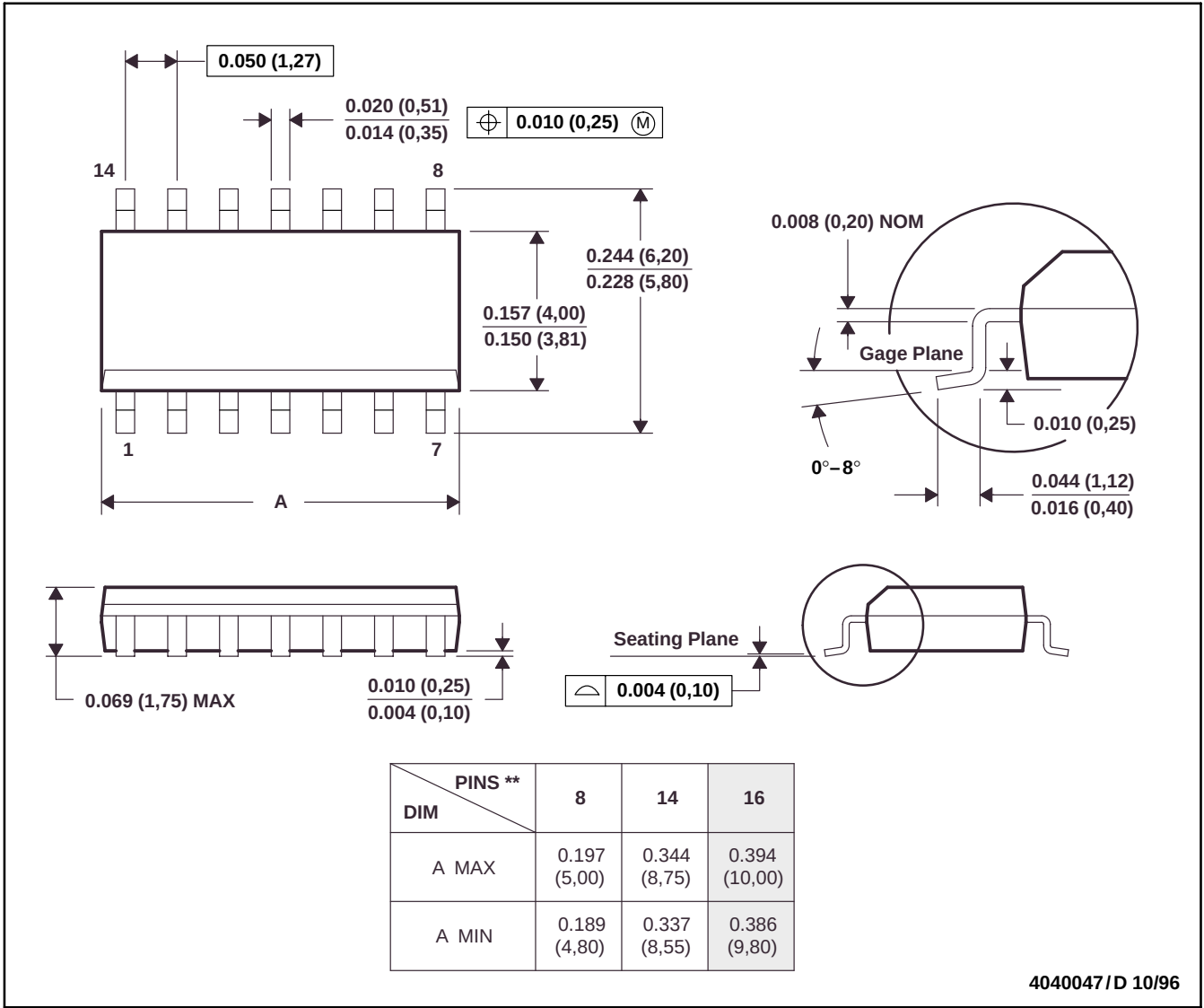
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MECHANICAL DATA

D (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PIN SHOWN



- 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



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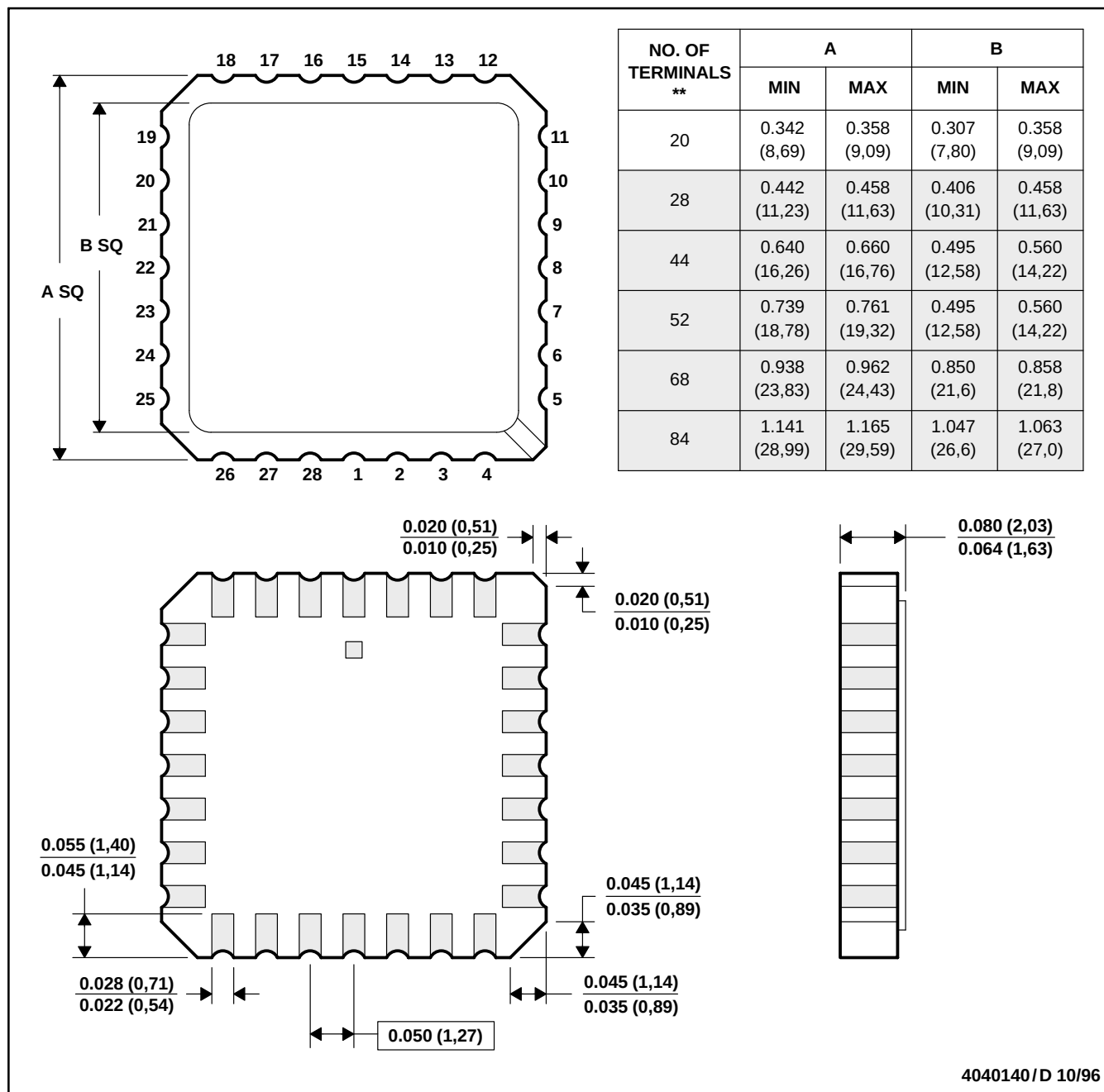
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**MECHANICAL DATA**

**FK (S-CQCC-N\*\*)**

**LEADLESS CERAMIC CHIP CARRIER**

**28 TERMINAL SHOWN**



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



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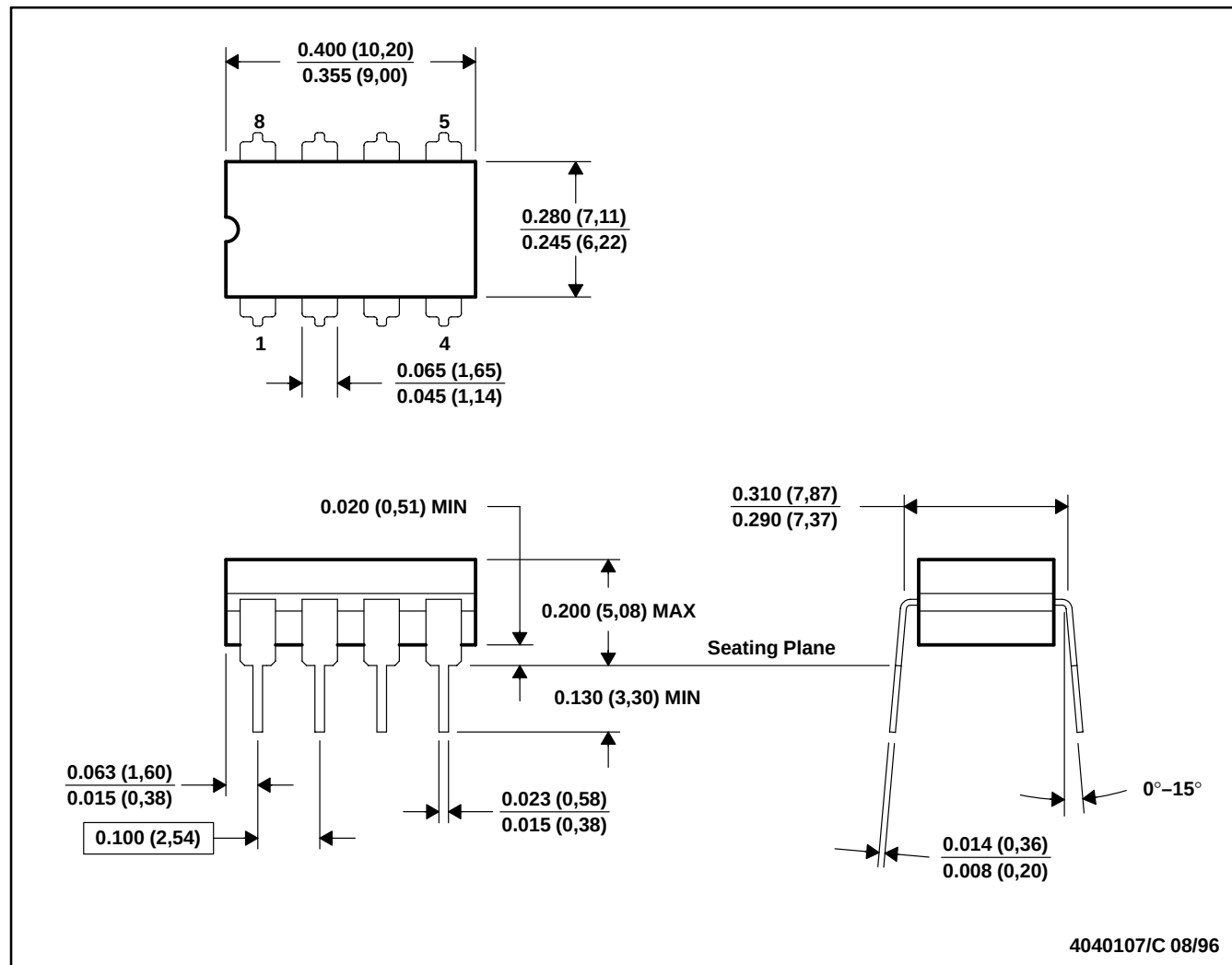
**TLV2442, TLV2442A, TLV2444, TLV2444A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
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**MECHANICAL DATA**

**JG (R-GDIP-T8)**

**CERAMIC DUAL-IN-LINE PACKAGE**



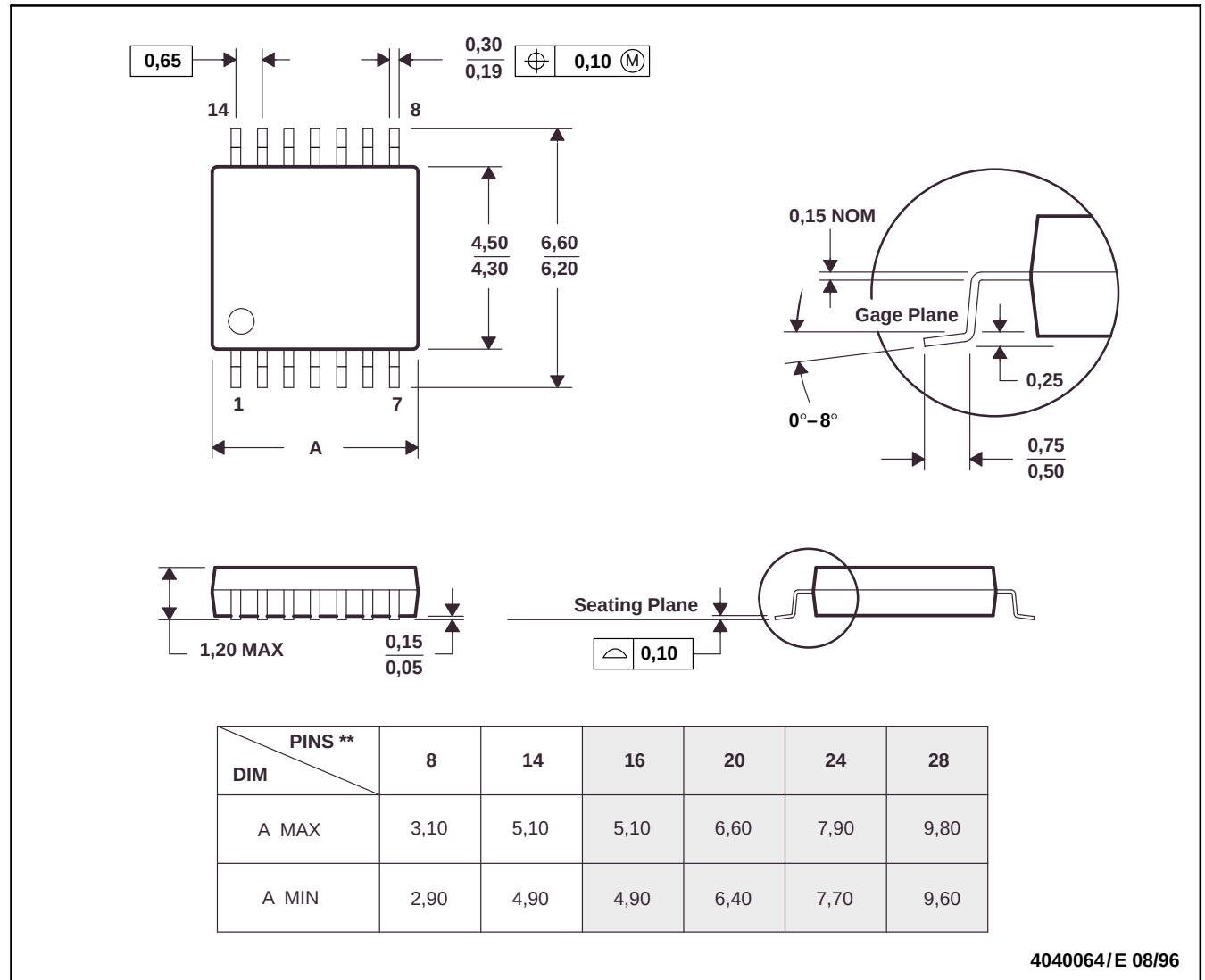
- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification on press ceramic glass frit seal only.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

## MECHANICAL DATA

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PIN SHOWN



- 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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**U (S-GDFP-F10)**

Technical drawing of a 10-pin connector. The drawing shows a top view of the connector with dimensions in millimeters (mm) and inches (in) in parentheses. The dimensions are as follows:

- Overall width: 1.000 (25,40) mm / 0.750 (19,05) mm
- Pin pitch (center-to-center): 0.250 (6,35) mm
- Pin diameter: 0.080 (2,03) mm / 0.050 (1,27) mm
- Pin length: 0.006 (0,15) mm / 0.004 (0,10) mm
- Pin spacing (edge-to-edge): 0.045 (1,14) mm / 0.026 (0,66) mm
- Pin 1 location: 0.350 (8,89) mm / 0.250 (6,35) mm from the left edge
- Pin 10 location: 0.350 (8,89) mm / 0.250 (6,35) mm from the right edge
- Pin 5 location: 0.300 (7,62) mm from the left edge
- Pin 6 location: 0.300 (7,62) mm from the right edge
- Pin 1 diameter: 0.019 (0,48) mm / 0.015 (0,38) mm
- Pin 10 diameter: 0.019 (0,48) mm / 0.015 (0,38) mm
- Pin 5 diameter: 0.050 (1,27) mm
- Pin 6 diameter: 0.025 (0,64) mm / 0.005 (0,13) mm

- 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

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| 5962-9751101QPA  | ACTIVE        | CDIP         | JG                 | 8    | 1              | TBD             | Call TI                              | Call TI              | -55 to 125   | 9751101QPA<br>TLV2442M  | <a href="#">Samples</a> |
| 5962-9751102QPA  | ACTIVE        | CDIP         | JG                 | 8    | 1              | TBD             | Call TI                              | Call TI              | -55 to 125   | 9751102QPA<br>TLV2442AM | <a href="#">Samples</a> |
| TLV2442AID       | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 2442AI                  | <a href="#">Samples</a> |
| TLV2442AIDR      | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 2442AI                  | <a href="#">Samples</a> |
| TLV2442AIPW      | ACTIVE        | TSSOP        | PW                 | 8    | 150            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | TV2442                  | <a href="#">Samples</a> |
| TLV2442AIPWR     | ACTIVE        | TSSOP        | PW                 | 8    | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 2442AI                  | <a href="#">Samples</a> |
| TLV2442AMJGB     | ACTIVE        | CDIP         | JG                 | 8    | 1              | TBD             | Call TI                              | Call TI              | -55 to 125   | 9751102QPA<br>TLV2442AM | <a href="#">Samples</a> |
| TLV2442AQD       | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | V2442A                  | <a href="#">Samples</a> |
| TLV2442AQDG4     | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   |              | V2442A                  | <a href="#">Samples</a> |
| TLV2442AQPW      | ACTIVE        | TSSOP        | PW                 | 8    | 150            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2442AQ                  | <a href="#">Samples</a> |
| TLV2442AQPWR     | ACTIVE        | TSSOP        | PW                 | 8    | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2442AQ                  | <a href="#">Samples</a> |
| TLV2442CD        | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2442C                   | <a href="#">Samples</a> |
| TLV2442CDG4      | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2442C                   | <a href="#">Samples</a> |
| TLV2442CDR       | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2442C                   | <a href="#">Samples</a> |
| TLV2442CPW       | ACTIVE        | TSSOP        | PW                 | 8    | 150            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | TV2442                  | <a href="#">Samples</a> |
| TLV2442CPWR      | ACTIVE        | TSSOP        | PW                 | 8    | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | TV2442                  | <a href="#">Samples</a> |
| TLV2442ID        | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 2442I                   | <a href="#">Samples</a> |
| TLV2442IDG4      | ACTIVE        | SOIC         | D                  | 8    | 75             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 2442I                   | <a href="#">Samples</a> |
| TLV2442IDR       | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | 2442I                   | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLV2442MJGB      | ACTIVE        | CDIP         | JG                 | 8    | 1              | TBD             | Call TI                              | Call TI              | -55 to 125   | 9751101QPA<br>TLV2442M  | <a href="#">Samples</a> |
| TLV2442QPW       | ACTIVE        | TSSOP        | PW                 | 8    | 150            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2442Q                   | <a href="#">Samples</a> |
| TLV2442QPWR      | ACTIVE        | TSSOP        | PW                 | 8    | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2442Q                   | <a href="#">Samples</a> |
| TLV2442QPWRG4    | ACTIVE        | TSSOP        | PW                 | 8    | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   |              | 2442Q                   | <a href="#">Samples</a> |
| TLV2444AID       | ACTIVE        | SOIC         | D                  | 14   | 50             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444AI                  | <a href="#">Samples</a> |
| TLV2444AIPW      | ACTIVE        | TSSOP        | PW                 | 14   | 90             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444AI                  | <a href="#">Samples</a> |
| TLV2444AIPWG4    | ACTIVE        | TSSOP        | PW                 | 14   | 90             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444AI                  | <a href="#">Samples</a> |
| TLV2444AIPWR     | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444AI                  | <a href="#">Samples</a> |
| TLV2444AIPWRG4   | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444AI                  | <a href="#">Samples</a> |
| TLV2444CD        | ACTIVE        | SOIC         | D                  | 14   | 50             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2444C                   | <a href="#">Samples</a> |
| TLV2444CDR       | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2444C                   | <a href="#">Samples</a> |
| TLV2444CDRG4     | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2444C                   | <a href="#">Samples</a> |
| TLV2444CPW       | ACTIVE        | TSSOP        | PW                 | 14   | 90             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2444C                   | <a href="#">Samples</a> |
| TLV2444CPWG4     | ACTIVE        | TSSOP        | PW                 | 14   | 90             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2444C                   | <a href="#">Samples</a> |
| TLV2444CPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 2444C                   | <a href="#">Samples</a> |
| TLV2444ID        | ACTIVE        | SOIC         | D                  | 14   | 50             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444I                   | <a href="#">Samples</a> |
| TLV2444IDR       | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444I                   | <a href="#">Samples</a> |
| TLV2444IPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 2444I                   | <a href="#">Samples</a> |

(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.

<sup>(2)</sup> **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm threshold requirement.

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

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

<sup>(5)</sup> Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF TLV2442, TLV2442A, TLV2442AM, TLV2442M :**

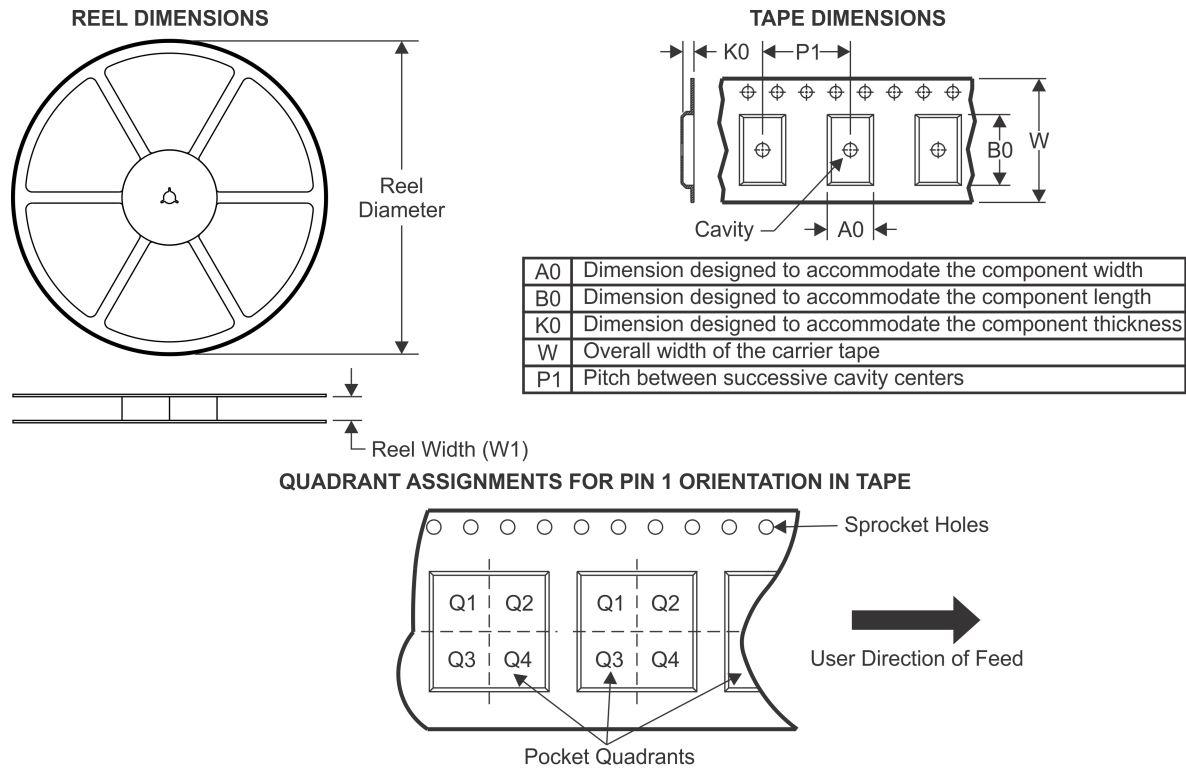
- Catalog : [TLV2442A](#), [TLV2442](#)
- Automotive : [TLV2442-Q1](#), [TLV2442A-Q1](#), [TLV2442A-Q1](#), [TLV2442-Q1](#)
- Military : [TLV2442M](#), [TLV2442AM](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

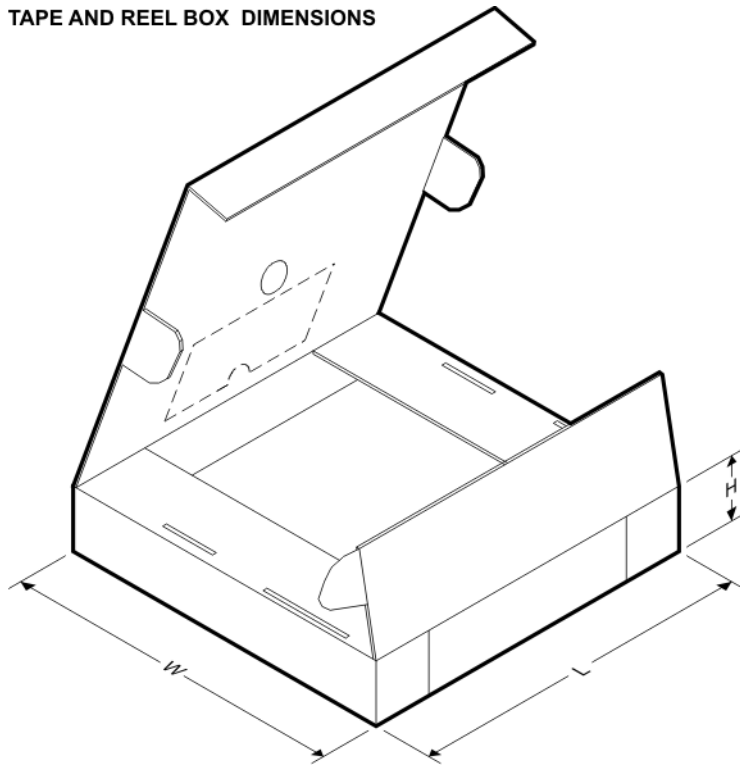


**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

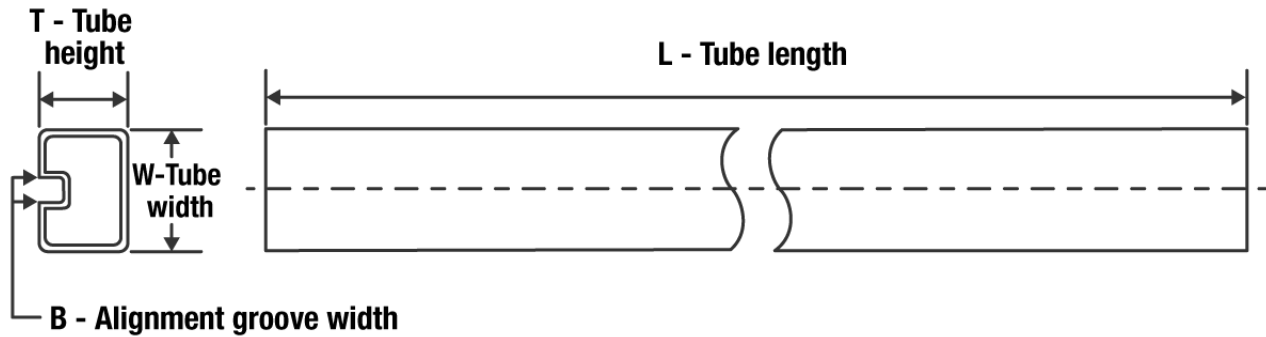
| Device        | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV2442AIDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV2442AIPWR  | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2442AQPWR  | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2442CDR    | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV2442CPWR   | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2442IDR    | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV2442QPWR   | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2442QPWRG4 | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2444AIPWR  | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2444CDR    | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV2444CPWR   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2444IDR    | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV2444IPWR   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV2442AIDR   | SOIC         | D               | 8    | 2500 | 340.5       | 336.1      | 25.0        |
| TLV2442AIPWR  | TSSOP        | PW              | 8    | 2000 | 853.0       | 449.0      | 35.0        |
| TLV2442AQPWR  | TSSOP        | PW              | 8    | 2000 | 853.0       | 449.0      | 35.0        |
| TLV2442CDR    | SOIC         | D               | 8    | 2500 | 340.5       | 336.1      | 25.0        |
| TLV2442CPWR   | TSSOP        | PW              | 8    | 2000 | 367.0       | 367.0      | 35.0        |
| TLV2442IDR    | SOIC         | D               | 8    | 2500 | 340.5       | 336.1      | 25.0        |
| TLV2442QPWR   | TSSOP        | PW              | 8    | 2000 | 853.0       | 449.0      | 35.0        |
| TLV2442QPWRG4 | TSSOP        | PW              | 8    | 2000 | 853.0       | 449.0      | 35.0        |
| TLV2444AIPWR  | TSSOP        | PW              | 14   | 2000 | 853.0       | 449.0      | 35.0        |
| TLV2444CDR    | SOIC         | D               | 14   | 2500 | 350.0       | 350.0      | 43.0        |
| TLV2444CPWR   | TSSOP        | PW              | 14   | 2000 | 853.0       | 449.0      | 35.0        |
| TLV2444IDR    | SOIC         | D               | 14   | 2500 | 350.0       | 350.0      | 43.0        |
| TLV2444IPWR   | TSSOP        | PW              | 14   | 2000 | 853.0       | 449.0      | 35.0        |

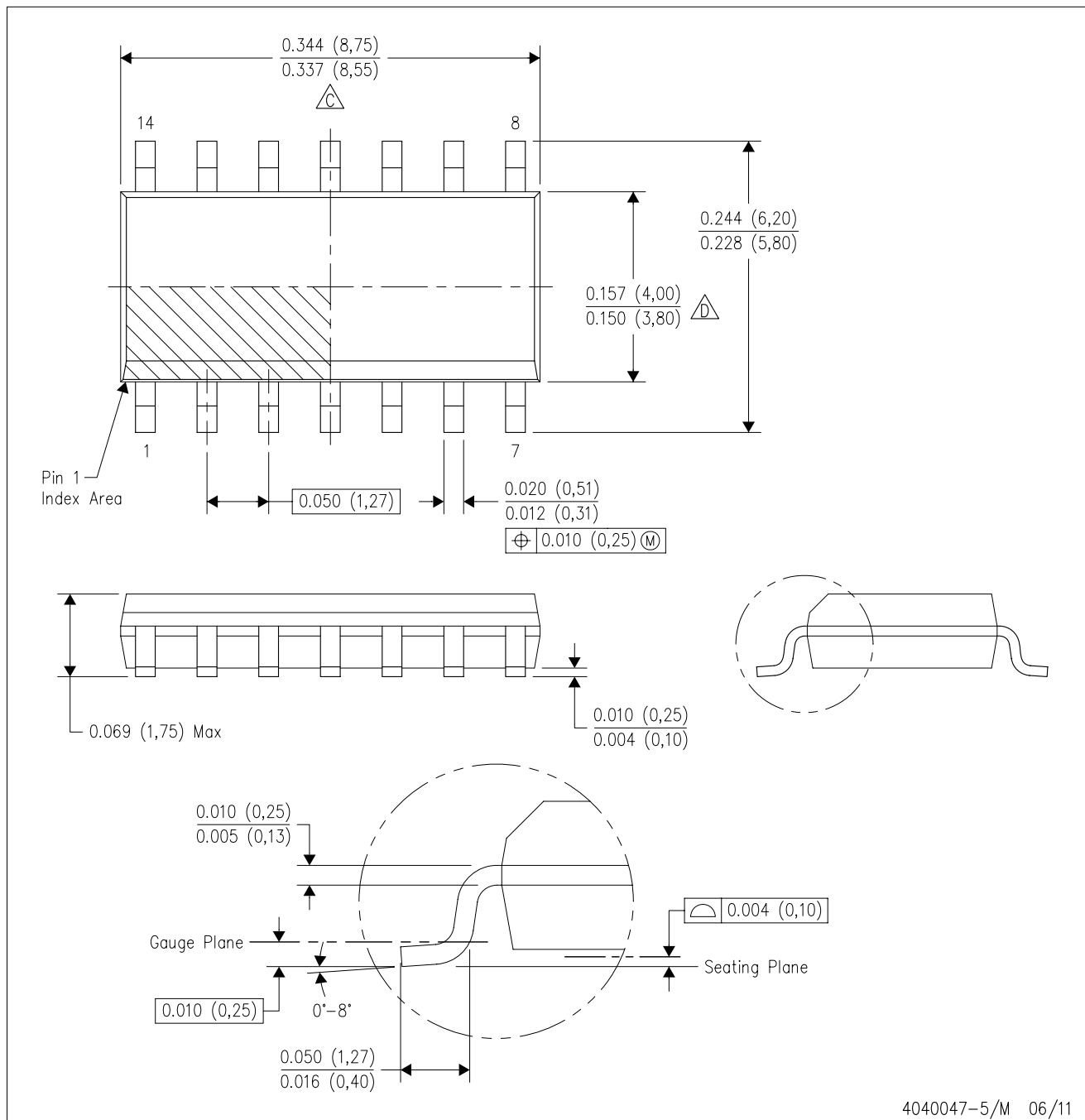
**TUBE**


\*All dimensions are nominal

| Device        | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|---------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| TLV2442AID    | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TLV2442AID    | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| TLV2442AIPW   | PW           | TSSOP        | 8    | 150 | 530    | 10.2   | 3600   | 3.5    |
| TLV2442AQD    | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TLV2442AQDG4  | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TLV2442AQPW   | PW           | TSSOP        | 8    | 150 | 530    | 10.2   | 3600   | 3.5    |
| TLV2442CD     | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| TLV2442CD     | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TLV2442CDG4   | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| TLV2442CDG4   | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TLV2442CPW    | PW           | TSSOP        | 8    | 150 | 530    | 10.2   | 3600   | 3.5    |
| TLV2442ID     | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TLV2442ID     | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| TLV2442IDG4   | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| TLV2442IDG4   | D            | SOIC         | 8    | 75  | 507    | 8      | 3940   | 4.32   |
| TLV2442QPW    | PW           | TSSOP        | 8    | 150 | 530    | 10.2   | 3600   | 3.5    |
| TLV2444AID    | D            | SOIC         | 14   | 50  | 505.46 | 6.76   | 3810   | 4      |
| TLV2444AIPW   | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| TLV2444AIPWG4 | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| TLV2444CD     | D            | SOIC         | 14   | 50  | 505.46 | 6.76   | 3810   | 4      |
| TLV2444CPW    | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| TLV2444CPWG4  | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| TLV2444ID     | D            | SOIC         | 14   | 50  | 505.46 | 6.76   | 3810   | 4      |

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE

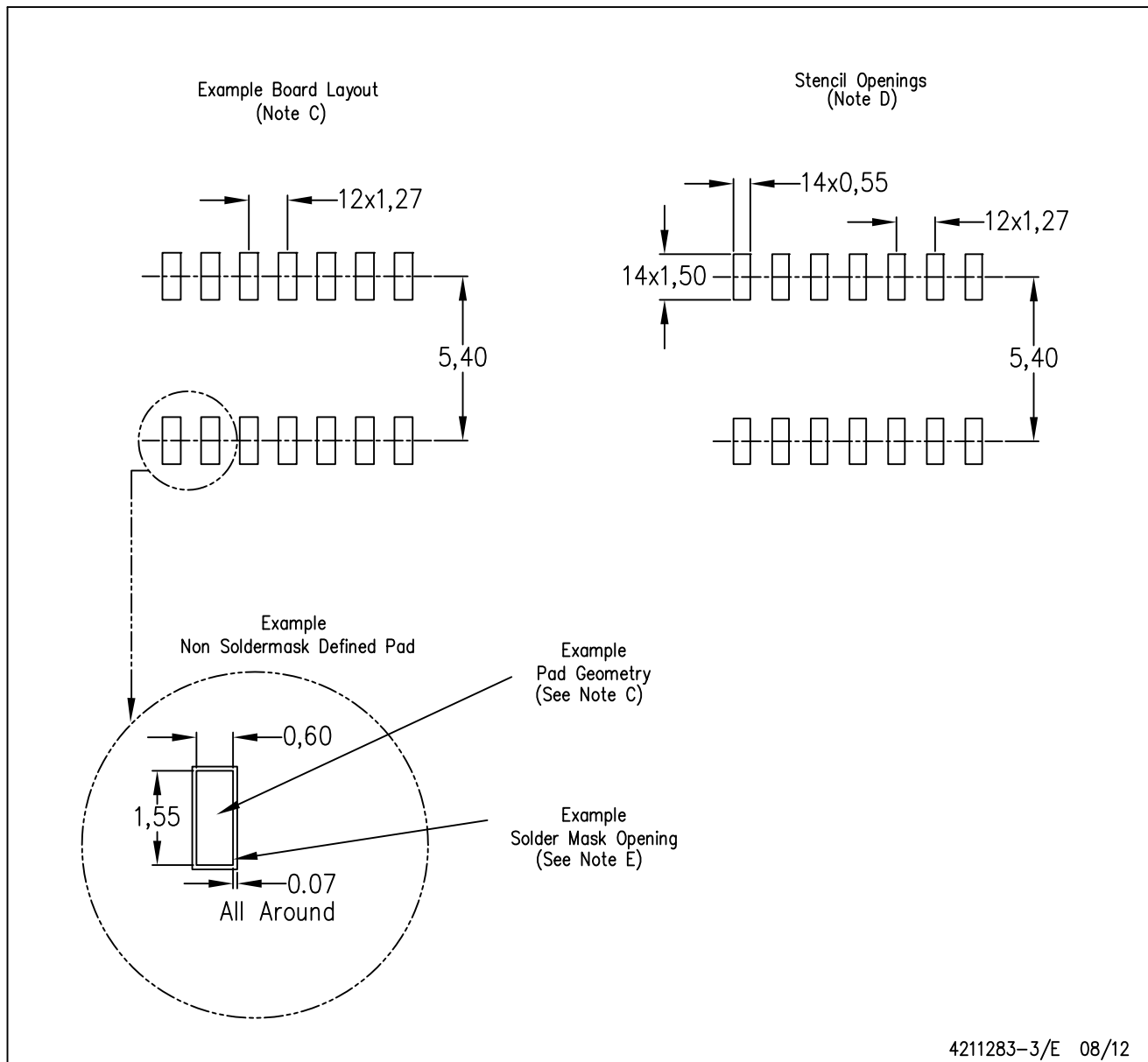


NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

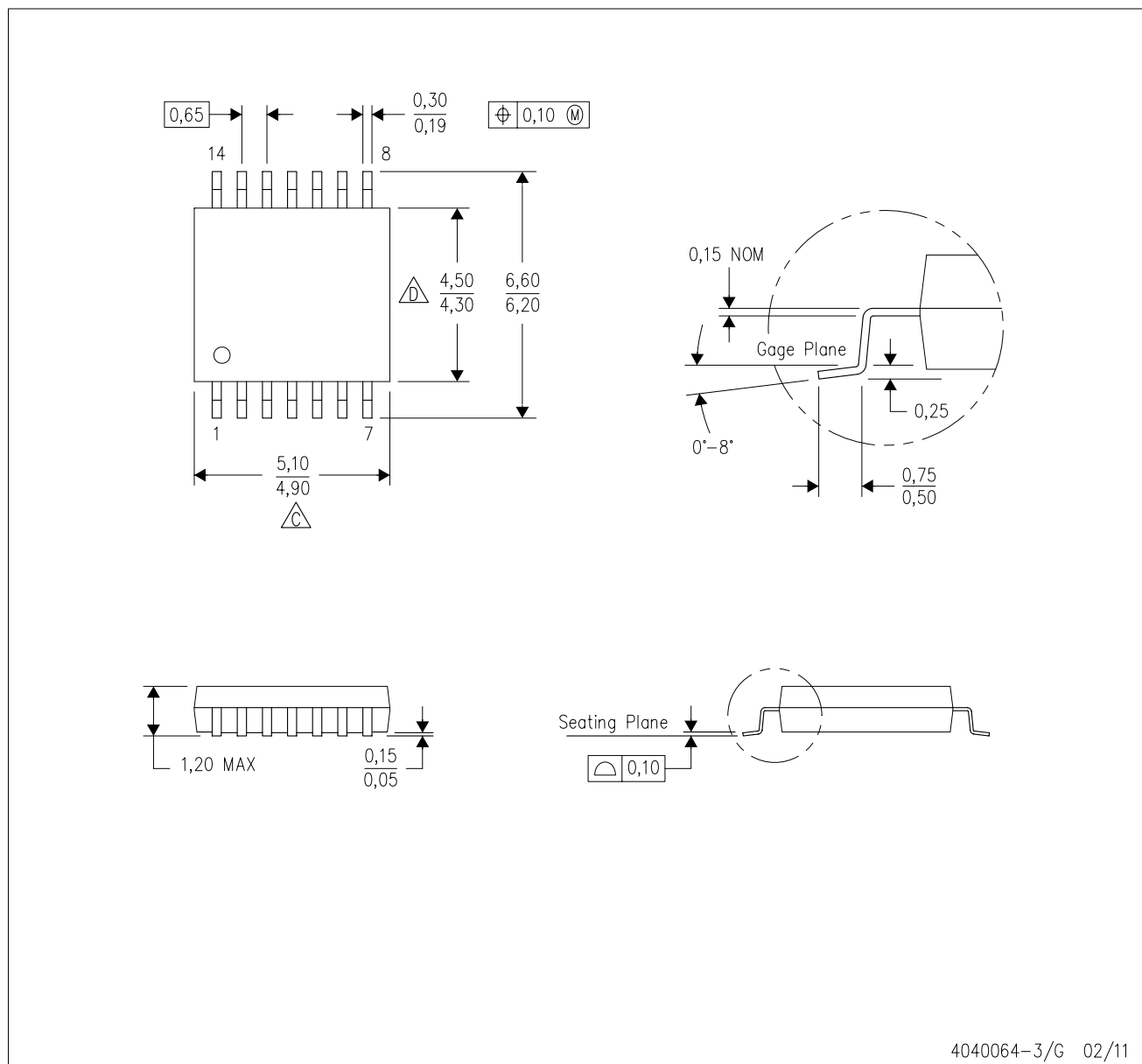
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

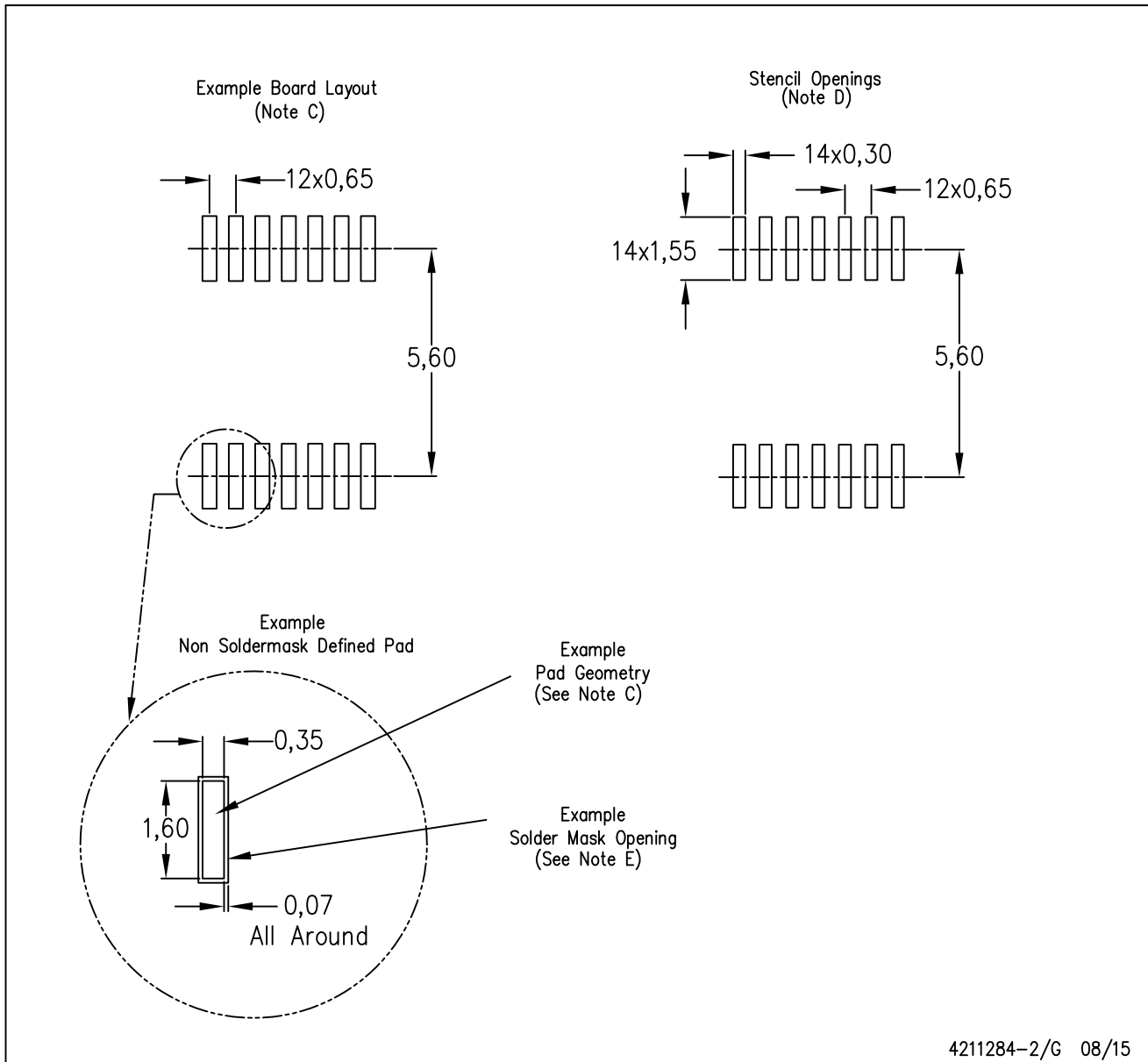
PLASTIC SMALL OUTLINE



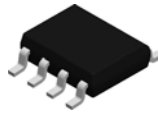
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

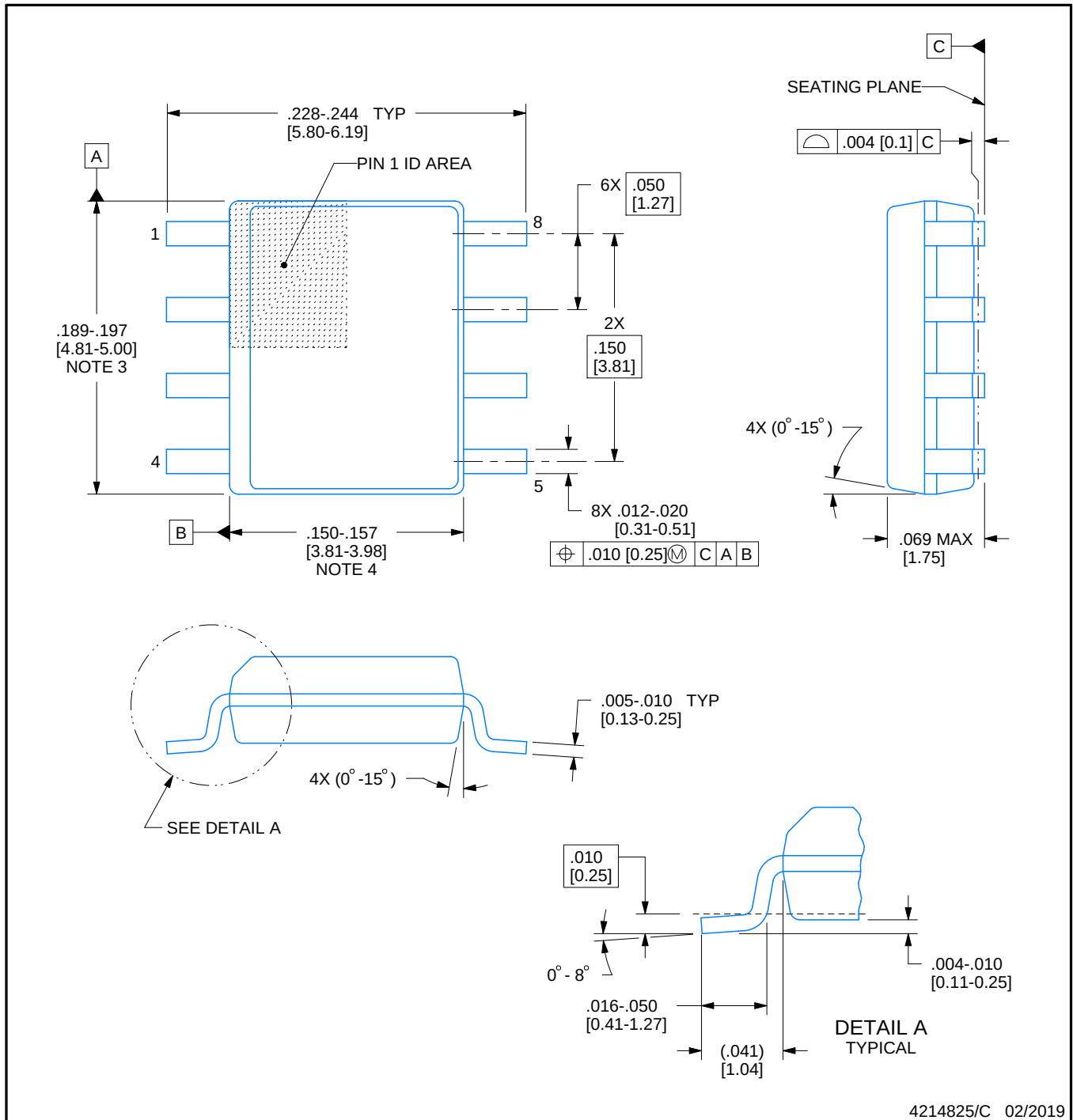


**D0008A**

# PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

## NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

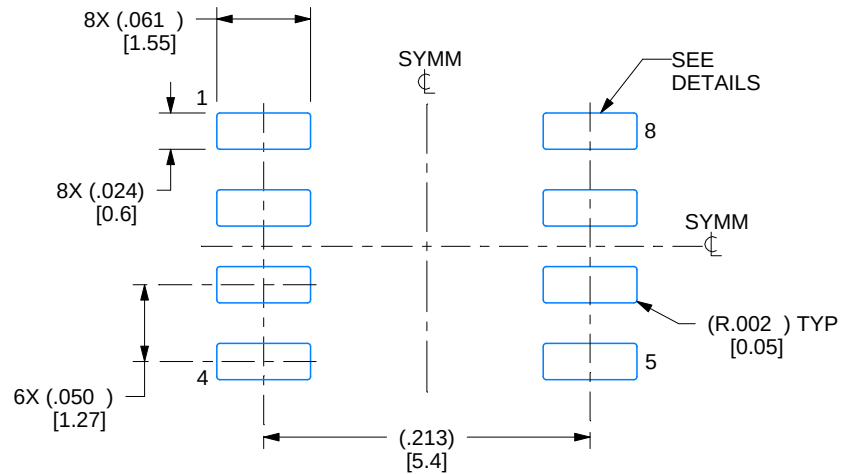


# EXAMPLE BOARD LAYOUT

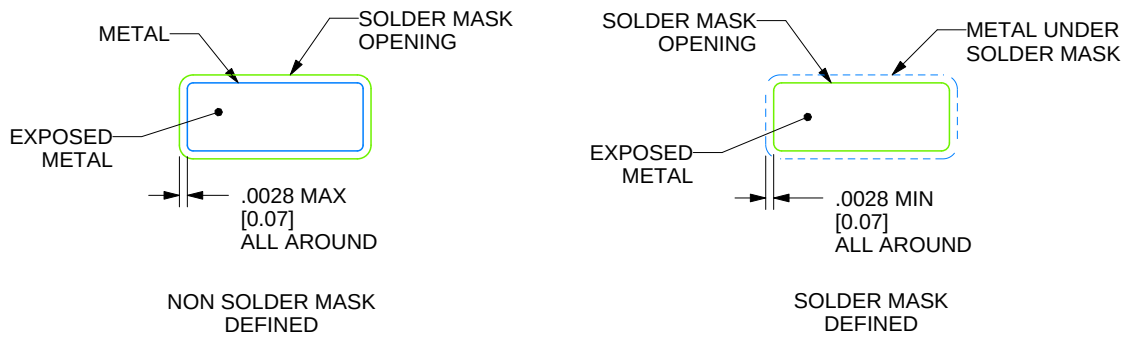
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

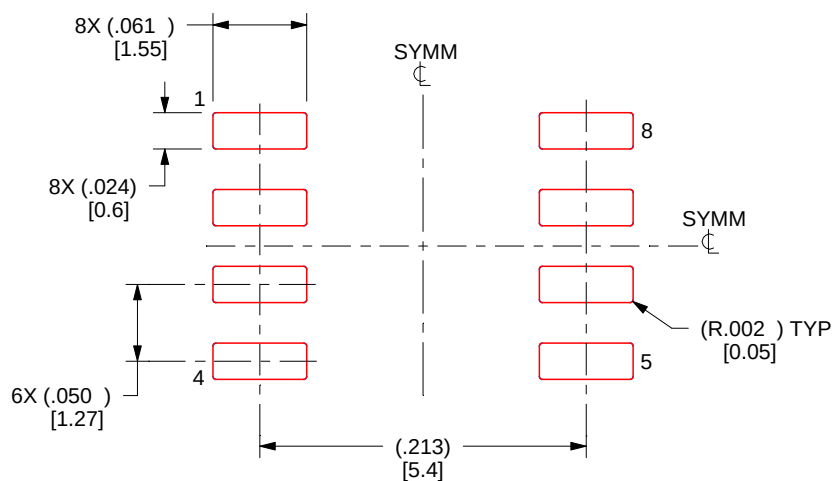
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

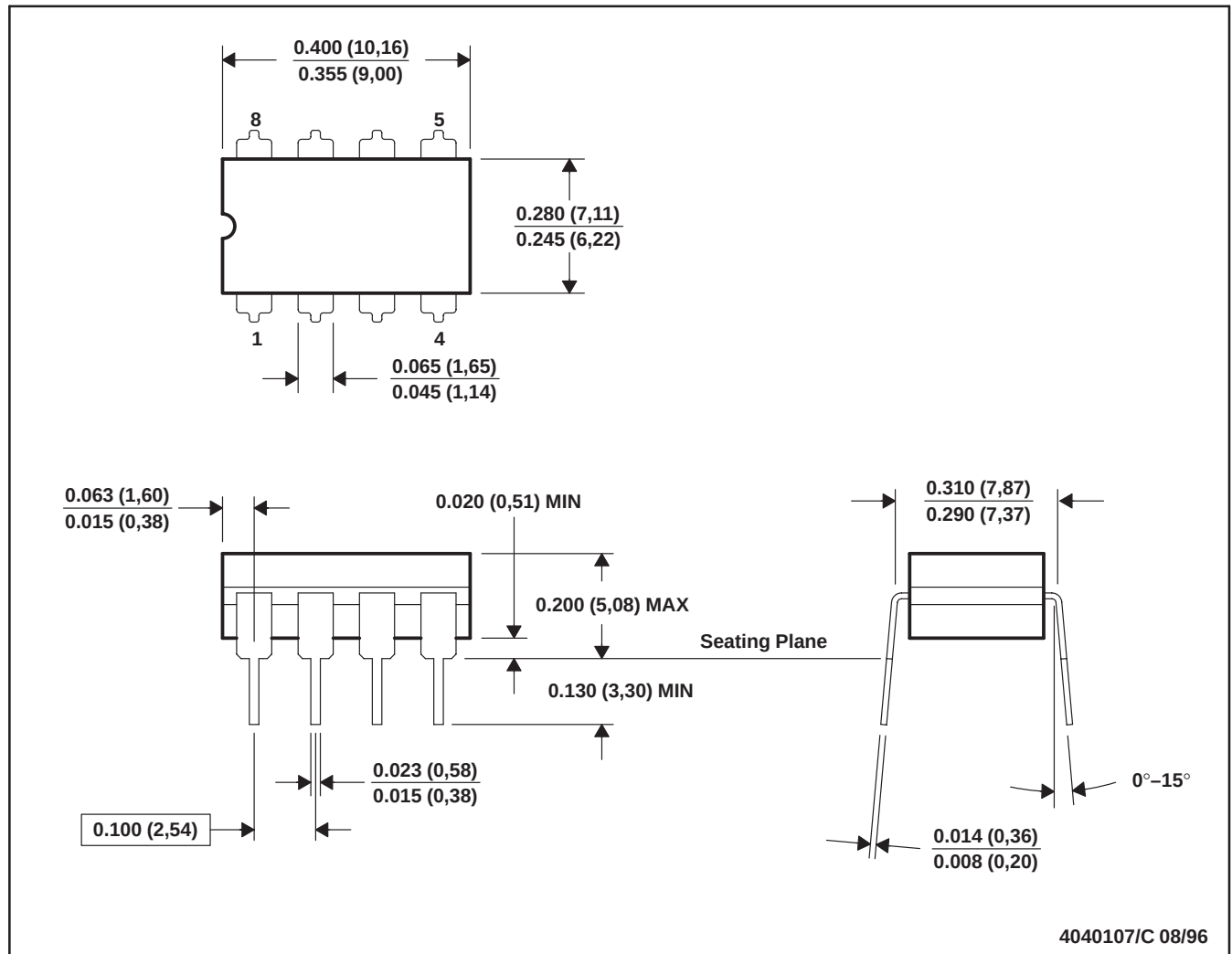
4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

## JG (R-GDIP-T8)

## CERAMIC DUAL-IN-LINE



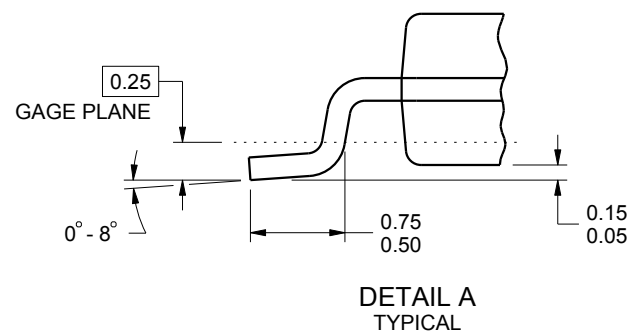
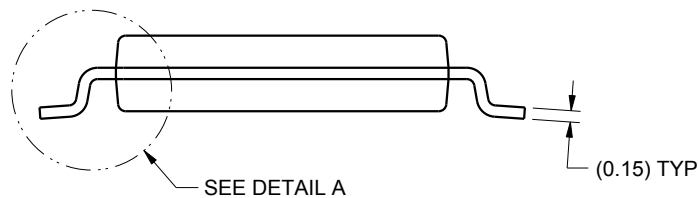
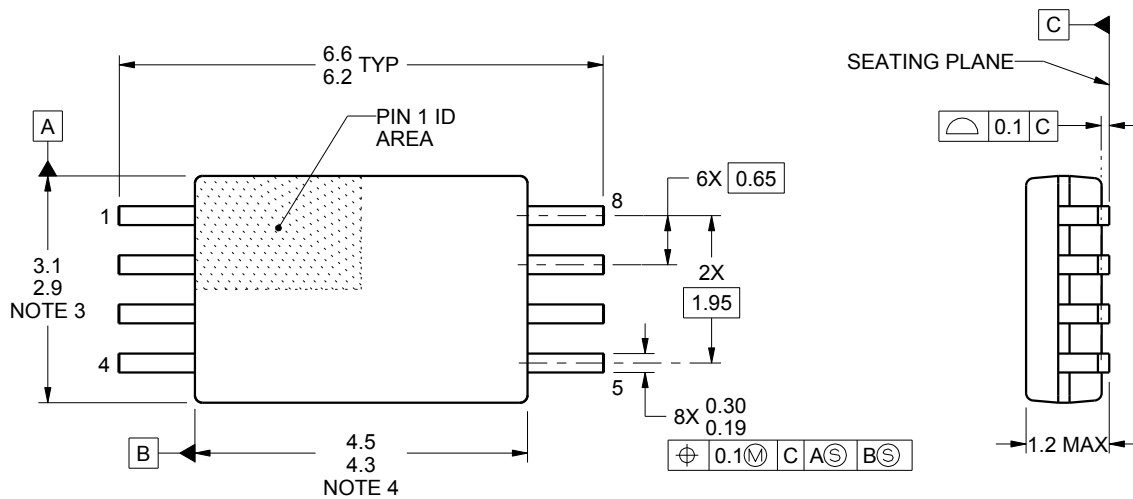
- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification.
  - Falls within MIL STD 1835 GDIP1-T8

**PW0008A**

## PACKAGE OUTLINE

## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4221848/A 02/2015

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153, variation AA.

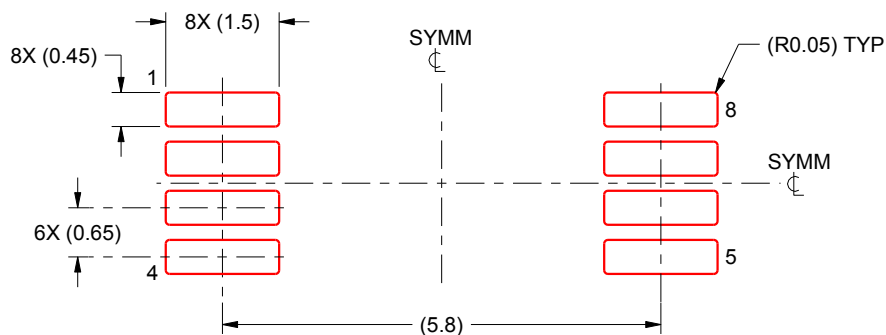


# EXAMPLE STENCIL DESIGN

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:10X

4221848/A 02/2015

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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