

# TLV2432, TLV2432A, TLV2434, TLV2434A Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

- Output Swing Includes Both Supply Rails
- Extended Common-Mode Input Voltage Range . . . 0 V to 4.5 V (Min) with 5-V Single Supply
- No Phase Inversion
- Low Noise . . . 18 nV/√Hz Typ at f = 1 kHz
- Low Input Offset Voltage  
950 μV Max at T<sub>A</sub> = 25°C (TLV243xA)
- Low Input Bias Current . . . 1 pA Typ
- Very Low Supply Current . . . 125 μA Per Channel Max
- 600-Ω Output Drive
- Macromodel Included
- Available in Q-Temp Automotive  
HighRel Automotive Applications  
Configuration Control / Print Support  
Qualification to Automotive Standards

## description

The TLV243x and TLV243xA are low-voltage operational amplifier from Texas Instruments. The common-mode input voltage range for each device is extended over the typical 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. The TLV243x only requires 100 μA (typ) of supply current per channel, making it ideal for battery-powered applications. The TLV243x also has increased output drive over previous rail-to-rail operational amplifiers and can drive 600-Ω loads for telecom applications.

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

The TLV243x, 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 TLV243xA is available and has 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.

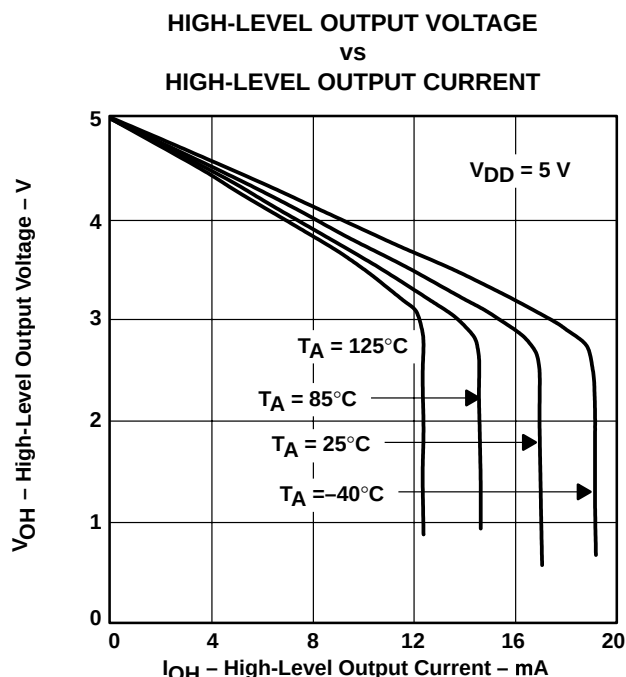


Figure 1



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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**TEXAS  
INSTRUMENTS**

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# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

#### TLV2432 and TLV2432A 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                         | TLV2432CD               | —                         | —                         | TLV2432CPW       | —                           |
| –40°C to 85°C  | 950 µV<br>2.5 mV               | TLV2432AID<br>TLV2432ID | —<br>—                    | —<br>—                    | TLV2432AIPW<br>— | —<br>—                      |
| –40°C to 125°C | 950 µV<br>2.5 mV               | TLV2432AQD<br>TLV2432QD | —<br>—                    | —<br>—                    | —<br>—           | —<br>—                      |
| –55°C to 125°C | 950 µV<br>2.5 mV               | —                       | TLV2432AMFK<br>TLV2432MFK | TLV2432AMJG<br>TLV2432MJG | —<br>—           | TLV2432AMU<br>TLV2432MU     |

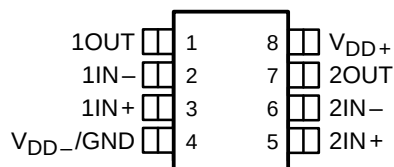
The D packages are available taped and reeled. Add R suffix to device type (e.g., TLV2432CDR). The PW package is available only left-end taped and reeled.

#### TLV2434 AVAILABLE OPTIONS

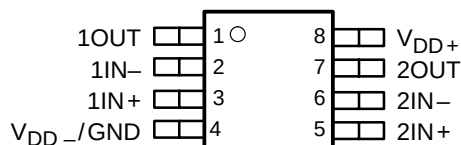
| T <sub>A</sub> | V <sub>IO</sub> max AT 25°C | PACKAGED DEVICES        |                           |
|----------------|-----------------------------|-------------------------|---------------------------|
|                |                             | SMALL<br>OUTLINE<br>(D) | TSSOP<br>(PW)             |
| 0°C to 70°C    | 2.5 mV                      | TLV2434CD               | TLV2434CPW                |
| –40°C to 125°C | 950 µV<br>2.5 mV            | TLV2434AID<br>TLV2434ID | TLV2434AIPW<br>TLV2434IPW |

The D packages are available taped and reeled. Add R suffix to device type (e.g., TLV2434CDR). The PW package is available only left-end taped and reeled.

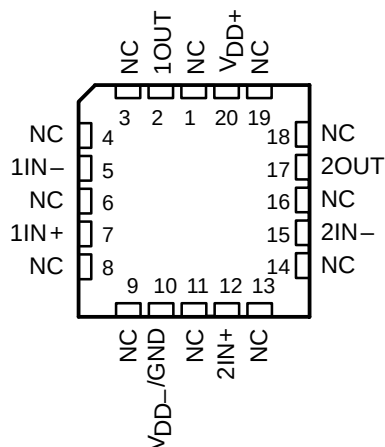
**TLV2432  
D OR JG PACKAGE  
(TOP VIEW)**



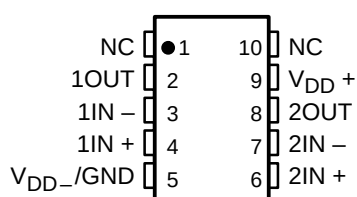
**TLV2432  
PW PACKAGE  
(TOP VIEW)**



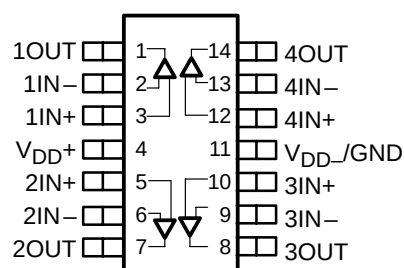
**TLV2432  
FK PACKAGE  
(TOP VIEW)**



**TLV2432  
U PACKAGE  
(TOP VIEW)**



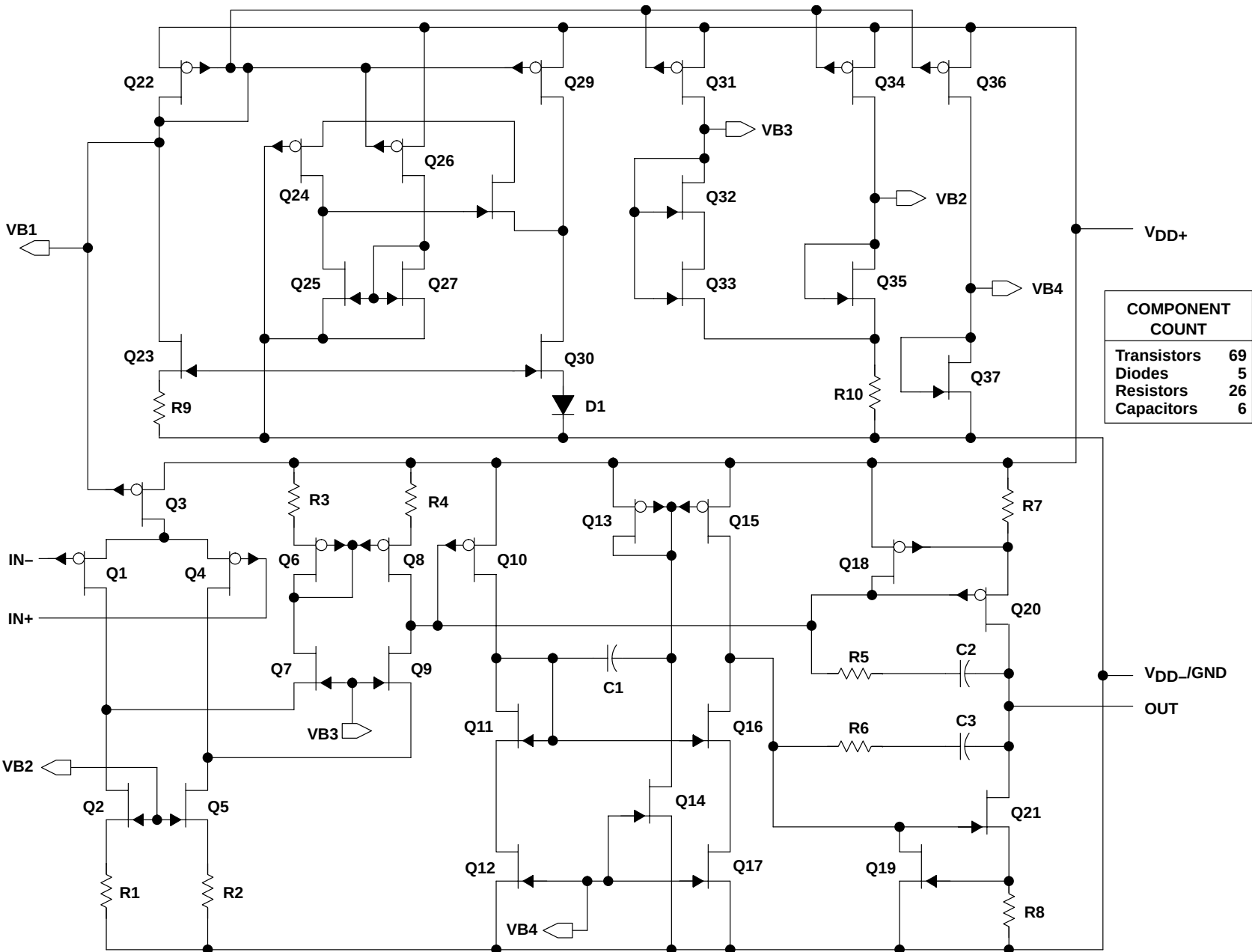
**TLV2434  
D OR PW PACKAGE  
(TOP VIEW)**



NC – No internal connection

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WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS  
SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

equivalent schematic (each amplifier)



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

# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

#### 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): C and I suffix      | -0.3 V to $V_{DD}$           |
| Input current, $I_I$ (each 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 flows 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, $V_I$            | $V_{DD-}$ | $V_{DD+} - 0.8$ | $V_{DD-}$ | $V_{DD+} - 0.8$ | $V_{DD-}$ | $V_{DD+} - 0.8$ | $V_{DD-}$ | $V_{DD+} - 0.8$ | V    |
| Common-mode input voltage, $V_{IC}$   | $V_{DD-}$ | $V_{DD+} - 1.3$ | $V_{DD-}$ | $V_{DD+} - 1.3$ | $V_{DD-}$ | $V_{DD+} - 1.3$ | $V_{DD-}$ | $V_{DD+} - 1.3$ | V    |
| Operating free-air temperature, $T_A$ | 0         | 70              | -40       | 125             | -40       | 125             | -55       | 125             | °C   |



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**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER                                            |                                                                      | TEST CONDITIONS                                                                                         |                                    | T <sub>A</sub> <sup>†</sup> | TLV243x |                     |       | UNIT |
|------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------------|---------|---------------------|-------|------|
|                                                      |                                                                      |                                                                                                         |                                    |                             | MIN     | TYP                 | MAX   |      |
| V <sub>IO</sub>                                      | Input offset voltage                                                 | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br>V <sub>DD</sub> ± = ±1.5 V,<br>R <sub>S</sub> = 50 Ω     | TLV243xC,<br>TLV243xI              | 25°C                        | 300     |                     | 2000  | μV   |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 2500    |                     |       |      |
|                                                      |                                                                      |                                                                                                         | TLV243xAI                          | 25°C                        | 300     |                     | 950   |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 1500    |                     |       |      |
| α <sub>VIO</sub>                                     | Temperature coefficient of input offset voltage                      | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br><br>V <sub>DD</sub> ± = ±1.5 V,<br>R <sub>S</sub> = 50 Ω |                                    | 25°C<br>to 70°C             | 2       |                     | μV/°C |      |
| Input offset voltage long-term drift<br>(see Note 4) |                                                                      |                                                                                                         |                                    | 25°C                        | 0.003   |                     | 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   |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 150     |                     |       |      |
| 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<br>to<br>2.5              |         | −0.25<br>to<br>2.75 | V     |      |
|                                                      |                                                                      |                                                                                                         | Full range                         | 0<br>to<br>2.2              |         |                     |       |      |
| V <sub>OH</sub>                                      | High-level output voltage                                            | I <sub>OH</sub> = −100 μA                                                                               |                                    | 25°C                        | 2.98    |                     | V     |      |
|                                                      |                                                                      | I <sub>OH</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>OL</sub> = 100 μA                                                       |                                    | 25°C                        | 0.02    |                     | V     |      |
|                                                      |                                                                      | V <sub>IC</sub> = 1.5 V, I <sub>OL</sub> = 3 mA                                                         |                                    | 25°C                        | 0.83    |                     |       |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 1       |                     |       |      |
| A <sub>VD</sub>                                      | Large-signal differential voltage amplification                      | V <sub>IC</sub> = 2.5 V,<br>V <sub>O</sub> = 1 V to 2 V                                                 | R <sub>L</sub> = 2 kΩ <sup>‡</sup> | 25°C                        | 1.5     | 2.5                 | V/mV  |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 1       |                     |       |      |
|                                                      |                                                                      |                                                                                                         | R <sub>L</sub> = 1 MΩ <sup>‡</sup> | 25°C                        | 750     |                     |       |      |
| r <sub>i(d)</sub>                                    | Differential input resistance                                        |                                                                                                         |                                    | 25°C                        | 1000    |                     | GΩ    |      |
| r <sub>i(c)</sub>                                    | Common-mode input resistance                                         |                                                                                                         |                                    | 25°C                        | 1000    |                     | GΩ    |      |
| c <sub>i(c)</sub>                                    | Common-mode input capacitance                                        | f = 10 kHz                                                                                              |                                    | 25°C                        | 8       |                     | pF    |      |
| z <sub>o</sub>                                       | Closed-loop output impedance                                         | f = 100 kHz, A <sub>V</sub> = 10                                                                        |                                    | 25°C                        | 130     |                     | Ω     |      |
| CMRR                                                 | Common-mode rejection ratio                                          | V <sub>IC</sub> = 0 to 2.5 V, V <sub>O</sub> = 1.5 V,<br>R <sub>S</sub> = 50 Ω                          |                                    | 25°C                        | 70      | 83                  | dB    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 70      |                     |       |      |
| k <sub>SVR</sub>                                     | Supply-voltage rejection ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> ) | V <sub>DD</sub> = 2.7 V to 8 V,<br>V <sub>IC</sub> = V <sub>DD</sub> /2, No load                        |                                    | 25°C                        | 80      | 95                  | dB    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 80      |                     |       |      |
| I <sub>DD</sub>                                      | Supply current (per channel)                                         | V <sub>O</sub> = 1.5 V, No load                                                                         |                                    | 25°C                        | 98      | 125                 | μA    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 125     |                     |       |      |

$^\dagger$  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.

$^\ddagger$  Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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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SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER              |                                             | TEST CONDITIONS                                                                                                                |                                                             | T <sub>A</sub> <sup>†</sup>        | TLV243x    |      |      | UNIT   |
|------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------|------------|------|------|--------|
|                        |                                             |                                                                                                                                |                                                             |                                    | MIN        | TYP  | MAX  |        |
| SR                     | Slew rate at unity gain                     | V <sub>O</sub> = 1 V to 2 V,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                                                           |                                                             | R <sub>L</sub> = 2 kΩ <sup>‡</sup> | 25°C       | 0.15 | 0.25 | V/μs   |
|                        |                                             |                                                                                                                                |                                                             |                                    | Full range | 0.1  |      |        |
| V <sub>n</sub>         | Equivalent input noise voltage              | f = 10 Hz                                                                                                                      |                                                             | 25°C                               | 120        |      |      | nV/√Hz |
|                        |                                             | f = 1 kHz                                                                                                                      |                                                             | 25°C                               | 22         |      |      |        |
| V <sub>N(PP)</sub>     | Peak-to-peak equivalent input noise voltage | f = 0.1 Hz to 1 Hz                                                                                                             |                                                             | 25°C                               | 2.7        |      |      | μV     |
|                        |                                             | f = 0.1 Hz to 10 Hz                                                                                                            |                                                             | 25°C                               | 4          |      |      |        |
| 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>f = 1 kHz,<br>R <sub>L</sub> = 2 kΩ <sup>‡</sup>                                           | A <sub>V</sub> = 1                                          | 25°C                               | 0.065%     |      |      |        |
|                        |                                             |                                                                                                                                | A <sub>V</sub> = 10                                         |                                    | 0.5%       |      |      |        |
| Gain-bandwidth product |                                             | f = 10 kHz,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                                                                            | R <sub>L</sub> = 2 kΩ <sup>‡</sup>                          | 25°C                               | 0.5        |      |      | MHz    |
| B <sub>OM</sub>        | Maximum output-swing bandwidth              | V <sub>O(PP)</sub> = 1 V,<br>R <sub>L</sub> = 2 kΩ <sup>‡</sup>                                                                | A <sub>V</sub> = 1,<br>C <sub>L</sub> = 100 pF <sup>‡</sup> | 25°C                               | 220        |      |      | kHz    |
| 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> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup> | To 0.1%                                                     | 25°C                               | 6.4        |      |      | μs     |
|                        |                                             |                                                                                                                                | To 0.01%                                                    |                                    | 14.1       |      |      |        |
| φ <sub>m</sub>         | Phase margin at unity gain                  | R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                                                   |                                                             | 25°C                               | 62°        |      |      |        |
|                        | Gain margin                                 |                                                                                                                                |                                                             | 25°C                               | 11         |      |      | dB     |

† 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.

‡ Referenced to 2.5 V

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SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER                                            |                                                                      | TEST CONDITIONS                                                                                         |                                    | T <sub>A</sub> <sup>†</sup> | TLV243xQ,<br>TLV243xM |      |       | UNIT |
|------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------------|-----------------------|------|-------|------|
|                                                      |                                                                      |                                                                                                         |                                    |                             | MIN                   | TYP  | MAX   |      |
| V <sub>IO</sub>                                      | Input offset voltage                                                 | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br>V <sub>DD</sub> ± = ±1.5 V,<br>R <sub>S</sub> = 50 Ω     | TLV243xQ,<br>TLV243xM              | 25°C                        | 300                   | 2000 | μV    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 2500                  |      |       |      |
|                                                      |                                                                      |                                                                                                         | TLV243xAQ,<br>TLV243xAM            | 25°C                        | 300                   | 950  |       |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 2000                  |      |       |      |
| α <sub>VIO</sub>                                     | Temperature coefficient of input offset voltage                      | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br><br>V <sub>DD</sub> ± = ±1.5 V,<br>R <sub>S</sub> = 50 Ω |                                    | 25°C<br>to 70°C             | 2                     |      | μV/°C |      |
| Input offset voltage long-term drift<br>(see Note 4) |                                                                      |                                                                                                         |                                    | 25°C                        | 0.003                 |      | 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    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 300                   |      |       |      |
| 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 2.5<br>−0.25 to 2.75   |                       | V    |       |      |
|                                                      |                                                                      |                                                                                                         | Full range                         | 0 to 2.2                    |                       |      |       |      |
| V <sub>OH</sub>                                      | High-level output voltage                                            | I <sub>OH</sub> = −100 μA                                                                               |                                    | 25°C                        | 2.98                  |      | V     |      |
|                                                      |                                                                      | I <sub>OH</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,<br><br>V <sub>IC</sub> = 1.5 V,                                                | I <sub>OL</sub> = 100 μA           | 25°C                        | 0.02                  |      | V     |      |
|                                                      |                                                                      | I <sub>OL</sub> = 3 mA                                                                                  |                                    | 25°C                        | 0.83                  |      |       |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 1                     |      |       |      |
| A <sub>VD</sub>                                      | Large-signal differential voltage amplification                      | V <sub>IC</sub> = 2.5 V,<br>V <sub>O</sub> = 1 V to 2 V                                                 | R <sub>L</sub> = 2 kΩ <sup>‡</sup> | 25°C                        | 1.5                   | 2.5  | V/mV  |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 0.5                   |      |       |      |
|                                                      |                                                                      |                                                                                                         | R <sub>L</sub> = 1 MΩ <sup>‡</sup> | 25°C                        | 750                   |      |       |      |
| r <sub>i(d)</sub>                                    | Differential input resistance                                        |                                                                                                         |                                    | 25°C                        | 1000                  |      | GΩ    |      |
| r <sub>i(c)</sub>                                    | Common-mode input resistance                                         |                                                                                                         |                                    | 25°C                        | 1000                  |      | GΩ    |      |
| c <sub>i(c)</sub>                                    | Common-mode input capacitance                                        | f = 10 kHz                                                                                              |                                    | 25°C                        | 8                     |      | pF    |      |
| z <sub>o</sub>                                       | Closed-loop output impedance                                         | f = 100 kHz,      A <sub>V</sub> = 10                                                                   |                                    | 25°C                        | 130                   |      | Ω     |      |
| CMRR                                                 | Common-mode rejection ratio                                          | V <sub>IC</sub> = 0 to 2.5 V,   V <sub>O</sub> = 1.5 V,<br>R <sub>S</sub> = 50 Ω                        |                                    | 25°C                        | 70                    | 83   | dB    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 70                    |      |       |      |
| k <sub>SVR</sub>                                     | Supply-voltage rejection ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> ) | V <sub>DD</sub> = 2.7 V to 8 V,<br>V <sub>IC</sub> = V <sub>DD</sub> /2,      No load                   |                                    | 25°C                        | 80                    | 95   | dB    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 80                    |      |       |      |
| I <sub>DD</sub>                                      | Supply current                                                       | V <sub>O</sub> = 1.5 V,      No load                                                                    |                                    | 25°C                        | 195                   | 250  | μA    |      |
|                                                      |                                                                      |                                                                                                         |                                    | Full range                  | 260                   |      |       |      |

$^\dagger$  Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part,  $-55^\circ\text{C}$  to  $125^\circ\text{C}$  for M level part.

$^\ddagger$  Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER                                               | TEST CONDITIONS                                                                                                                                                 | $T_A$ †            | TLV243xQ,<br>TLV243xM,<br>TLV243xAQ,<br>TLV243xAM |                |     | UNIT                   |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------------|----------------|-----|------------------------|
|                                                         |                                                                                                                                                                 |                    | MIN                                               | TYP            | MAX |                        |
| SR Slew rate at unity gain                              | $V_O = 1\text{ V to }2\text{ V},$<br>$C_L = 100\text{ pF}^\ddagger$<br>$R_L = 2\text{ k}\Omega^\ddagger$                                                        | 25°C<br>Full range | 0.15<br>0.1                                       | 0.25           |     | V/ $\mu\text{s}$       |
| $V_n$ Equivalent input noise voltage                    | $f = 10\text{ Hz}$<br>$f = 1\text{ kHz}$                                                                                                                        | 25°C<br>25°C       |                                                   | 120<br>22      |     | nV/ $\sqrt{\text{Hz}}$ |
| $V_{N(PP)}$ Peak-to-peak equivalent input noise voltage | $f = 0.1\text{ Hz to }1\text{ Hz}$<br>$f = 0.1\text{ Hz to }10\text{ Hz}$                                                                                       | 25°C<br>25°C       |                                                   | 2.7<br>4       |     | $\mu\text{V}$          |
| $I_n$ Equivalent input noise current                    |                                                                                                                                                                 | 25°C               |                                                   | 0.6            |     | fA/ $\sqrt{\text{Hz}}$ |
| THD + N Total harmonic distortion plus noise            | $V_O = 0.5\text{ V to }2.5\text{ V},$<br>$f = 1\text{ kHz},$<br>$R_L = 2\text{ k}\Omega^\ddagger$<br>$A_V = 1$<br>$A_V = 10$                                    | 25°C               |                                                   | 0.065%<br>0.5% |     |                        |
| Gain-bandwidth product                                  | $f = 10\text{ kHz},$<br>$C_L = 100\text{ pF}^\ddagger$<br>$R_L = 2\text{ k}\Omega^\ddagger$                                                                     | 25°C               |                                                   | 0.5            |     | MHz                    |
| BOM Maximum output-swing bandwidth                      | $V_{O(PP)} = 1\text{ V},$<br>$R_L = 2\text{ k}\Omega^\ddagger$<br>$A_V = 1,$<br>$C_L = 100\text{ pF}^\ddagger$                                                  | 25°C               |                                                   | 220            |     | kHz                    |
| $t_s$ Settling time                                     | $A_V = -1,$<br>Step = $0.5\text{ V to }2.5\text{ V},$<br>$R_L = 2\text{ k}\Omega^\ddagger$<br>$C_L = 100\text{ pF}^\ddagger$<br>$T_o = 0.1\%$<br>$T_o = 0.01\%$ | 25°C               |                                                   | 6.4<br>14.1    |     | $\mu\text{s}$          |
| $\phi_m$ Phase margin at unity gain                     | $R_L = 2\text{ k}\Omega^\ddagger$<br>$C_L = 100\text{ pF}^\ddagger$                                                                                             | 25°C               |                                                   | 62°            |     |                        |
| Gain margin                                             |                                                                                                                                                                 | 25°C               |                                                   | 11             |     | dB                     |

† Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part,  $-55^\circ\text{C}$  to  $125^\circ\text{C}$  for M level part.

‡ Referenced to  $2.5\text{ V}$



**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER                                         |                                                                      | TEST CONDITIONS                                                                                         |                                    | T <sub>A</sub> <sup>†</sup> | TLV243x |               |       | UNIT |
|---------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------------|---------|---------------|-------|------|
|                                                   |                                                                      |                                                                                                         |                                    |                             | MIN     | TYP           | MAX   |      |
| V <sub>IO</sub>                                   | Input offset voltage                                                 | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br>V <sub>DD</sub> ± = ±2.5 V,<br>R <sub>S</sub> = 50 Ω     | TLV243x                            | 25°C                        | 300     |               | 2000  | μV   |
|                                                   |                                                                      |                                                                                                         |                                    | Full range                  | 2500    |               |       |      |
|                                                   |                                                                      |                                                                                                         | TLV243xA                           | 25°C                        | 300     |               | 950   |      |
|                                                   |                                                                      |                                                                                                         |                                    | Full range                  | 1500    |               |       |      |
| α <sub>VIO</sub>                                  | Temperature coefficient of input offset voltage                      | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br><br>V <sub>DD</sub> ± = ±2.5 V,<br>R <sub>S</sub> = 50 Ω |                                    | 25°C to 70°C                | 2       |               | μV/°C |      |
| Input offset voltage long-term drift (see Note 4) |                                                                      |                                                                                                         |                                    | 25°C                        | 0.003   |               | 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   |
|                                                   |                                                                      |                                                                                                         |                                    | Full range                  | 150     |               |       |      |
| 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 4.5                    |         | −0.25 to 4.75 | V     |      |
|                                                   |                                                                      |                                                                                                         | Full range                         | 0 to 4.2                    |         |               |       |      |
| 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> = 2 kΩ <sup>‡</sup> | 25°C                        | 2.5     | 3.8           | V/mV  |      |
|                                                   |                                                                      |                                                                                                         |                                    | Full range                  | 1.5     |               |       |      |
|                                                   |                                                                      |                                                                                                         | R <sub>L</sub> = 1 MΩ <sup>‡</sup> | 25°C                        | 950     |               |       |      |
| r <sub>i(d)</sub>                                 | Differential input resistance                                        |                                                                                                         |                                    | 25°C                        | 1000    |               | GΩ    |      |
| r <sub>i(c)</sub>                                 | Common-mode input resistance                                         |                                                                                                         |                                    | 25°C                        | 1000    |               | GΩ    |      |
| c <sub>i(c)</sub>                                 | Common-mode input capacitance                                        | f = 10 kHz                                                                                              |                                    | 25°C                        | 8       |               | pF    |      |
| z <sub>o</sub>                                    | Closed-loop output impedance                                         | f = 100 kHz, A <sub>V</sub> = 10                                                                        |                                    | 25°C                        | 130     |               | Ω     |      |
| CMRR                                              | Common-mode rejection ratio                                          | V <sub>IC</sub> = 0 to 4.5 V, V <sub>O</sub> = 2.5 V,<br>R <sub>S</sub> = 50 Ω                          |                                    | 25°C                        | 70      | 90            | dB    |      |
|                                                   |                                                                      |                                                                                                         |                                    | Full range                  | 70      |               |       |      |
| k <sub>SVR</sub>                                  | Supply-voltage rejection ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> ) | V <sub>DD</sub> = 4.4 V to 8 V,<br>V <sub>IC</sub> = V <sub>DD</sub> /2, No load                        |                                    | 25°C                        | 80      | 95            | dB    |      |
|                                                   |                                                                      |                                                                                                         |                                    | Full range                  | 80      |               |       |      |
| I <sub>DD</sub>                                   | Supply current (per channel)                                         | V <sub>O</sub> = 2.5 V, No load                                                                         |                                    | 25°C                        | 100     | 125           | μA    |      |
|                                                   |                                                                      |                                                                                                         |                                    | Full range                  | 125     |               |       |      |

$^\dagger$  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.

$^\ddagger$  Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER              |                                             | TEST CONDITIONS                                                                                                                |                     | T <sub>A</sub> <sup>†</sup> | TLV243x |      |        | UNIT |
|------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------|---------|------|--------|------|
|                        |                                             |                                                                                                                                |                     |                             | MIN     | TYP  | MAX    |      |
| SR                     | Slew rate at unity gain                     | V <sub>O</sub> = 1.5 V to 3.5 V, R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                  |                     | 25°C                        | 0.15    | 0.25 | V/μs   |      |
|                        |                                             |                                                                                                                                |                     | Full range                  | 0.1     |      |        |      |
| V <sub>n</sub>         | Equivalent input noise voltage              | f = 10 Hz                                                                                                                      |                     | 25°C                        | 100     |      | 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                        | 1.9     |      | μV     |      |
|                        |                                             | f = 0.1 Hz to 10 Hz                                                                                                            |                     | 25°C                        | 2.8     |      |        |      |
| 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> = 2 kΩ <sup>‡</sup>                                           | A <sub>V</sub> = 1  | 25°C                        | 0.045%  |      |        |      |
|                        |                                             |                                                                                                                                | A <sub>V</sub> = 10 |                             | 0.4%    |      |        |      |
| Gain-bandwidth product |                                             | f = 10 kHz,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                                                                            |                     | 25°C                        | 0.55    |      | MHz    |      |
| B <sub>OM</sub>        | Maximum output-swing bandwidth              | V <sub>O(PP)</sub> = 2 V,<br>R <sub>L</sub> = 2 kΩ <sup>‡</sup>                                                                |                     | 25°C                        | 100     |      | kHz    |      |
| t <sub>s</sub>         | Settling time                               | A <sub>V</sub> = −1,<br>Step = 1.5 V to 3.5 V,<br>R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup> | To 0.1%             | 25°C                        | 6.4     |      | μs     |      |
|                        |                                             |                                                                                                                                | To 0.01%            |                             | 13.1    |      |        |      |
| φ <sub>m</sub>         | Phase margin at unity gain                  | R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                                                   |                     | 25°C                        | 66°     |      |        |      |
| Gain margin            |                                             |                                                                                                                                |                     | 25°C                        | 11      |      | dB     |      |

† 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.

‡ Referenced to 2.5 V

**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER         |                                                                      | TEST CONDITIONS                                                                                         |                                                        | T <sub>A</sub> <sup>†</sup> | TLV243xQ,<br>TLV243xM |               |       | UNIT |
|-------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------|-----------------------|---------------|-------|------|
|                   |                                                                      |                                                                                                         |                                                        |                             | MIN                   | TYP           | MAX   |      |
| V <sub>IO</sub>   | Input offset voltage                                                 | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br>V <sub>DD</sub> ± = ±2.5 V,<br>R <sub>S</sub> = 50 Ω     | TLV2453x                                               | 25°C                        | 300                   | 2000          | μV    |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 2500                  |               |       |      |
|                   |                                                                      |                                                                                                         | TLV2453xA                                              | 25°C                        | 300                   | 950           |       |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 2000                  |               |       |      |
| α <sub>VIO</sub>  | Temperature coefficient of input offset voltage                      | V <sub>IC</sub> = 0,<br>V <sub>O</sub> = 0,<br><br>V <sub>DD</sub> ± = ±2.5 V,<br>R <sub>S</sub> = 50 Ω |                                                        | 25°C to 70°C                | 2                     |               | μV/°C |      |
|                   | Input offset voltage long-term drift (see Note 4)                    |                                                                                                         |                                                        | 25°C                        | 0.003                 |               | 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    |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 300                   |               |       |      |
| 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 4.5              | −0.25 to 4.75 | V     |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 0 to 4.2              |               |       |      |
| V <sub>OH</sub>   | High-level output voltage                                            | I <sub>OH</sub> = −100 μA<br><br>I <sub>OH</sub> = −5 mA                                                |                                                        | 25°C                        | 4.97                  |               | V     |      |
|                   |                                                                      |                                                                                                         |                                                        | 25°C                        | 4                     | 4.35          |       |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 4                     |               |       |      |
| V <sub>OL</sub>   | Low-level output voltage                                             | V <sub>IC</sub> = 2.5 V,<br><br>V <sub>IC</sub> = 2.5 V,                                                | I <sub>OL</sub> = 100 μA<br><br>I <sub>OL</sub> = 5 mA | 25°C                        | 0.01                  |               | V     |      |
|                   |                                                                      |                                                                                                         |                                                        | 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> = 2 kΩ <sup>‡</sup>                     | 25°C                        | 2.5                   | 3.8           | V/mV  |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 0.5                   |               |       |      |
|                   |                                                                      |                                                                                                         | R <sub>L</sub> = 1 MΩ <sup>‡</sup>                     | 25°C                        | 950                   |               |       |      |
| r <sub>i(d)</sub> | Differential input resistance                                        |                                                                                                         |                                                        | 25°C                        | 1000                  |               | GΩ    |      |
| r <sub>i(c)</sub> | Common-mode input resistance                                         |                                                                                                         |                                                        | 25°C                        | 1000                  |               | GΩ    |      |
| c <sub>i(c)</sub> | Common-mode input capacitance                                        | f = 10 kHz                                                                                              |                                                        | 25°C                        | 8                     |               | pF    |      |
| z <sub>o</sub>    | Closed-loop output impedance                                         | f = 100 kHz,      A <sub>V</sub> = 10                                                                   |                                                        | 25°C                        | 130                   |               | Ω     |      |
| CMRR              | Common-mode rejection ratio                                          | V <sub>IC</sub> = 0 to 4.5 V,   V <sub>O</sub> = 2.5 V,<br>R <sub>S</sub> = 50 Ω                        |                                                        | 25°C                        | 70                    | 90            | dB    |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 70                    |               |       |      |
| k <sub>SVR</sub>  | Supply-voltage rejection ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> ) | V <sub>DD</sub> = 4.4 V to 8 V,<br>V <sub>IC</sub> = V <sub>DD</sub> /2,      No load                   |                                                        | 25°C                        | 80                    | 95            | dB    |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 80                    |               |       |      |
| I <sub>DD</sub>   | Supply current                                                       | V <sub>O</sub> = 2.5 V,      No load                                                                    |                                                        | 25°C                        | 200                   | 250           | μA    |      |
|                   |                                                                      |                                                                                                         |                                                        | Full range                  | 270                   |               |       |      |

$^\dagger$  Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part,  $-55^\circ\text{C}$  to  $125^\circ\text{C}$  for M level part.

$^\ddagger$  Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

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

| PARAMETER              |                                             | TEST CONDITIONS                                                                                                                |                                                             | T <sub>A</sub> <sup>†</sup> | TLV243xQ,<br>TLV243xM,<br>TLV243xAQ,<br>TLV243xAM |      |        | UNIT |
|------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------|---------------------------------------------------|------|--------|------|
|                        |                                             |                                                                                                                                |                                                             |                             | MIN                                               | TYP  | MAX    |      |
| SR                     | Slew rate at unity gain                     | V <sub>O</sub> = 1.5 V to 3.5 V,    R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>               |                                                             | 25°C                        | 0.15                                              | 0.25 | V/μs   |      |
|                        |                                             |                                                                                                                                |                                                             | Full range                  | 0.1                                               |      |        |      |
| V <sub>n</sub>         | Equivalent input noise voltage              | f = 10 Hz                                                                                                                      |                                                             | 25°C                        | 100                                               |      | 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                        | 1.9                                               |      | μV     |      |
|                        |                                             | f = 0.1 Hz to 10 Hz                                                                                                            |                                                             | 25°C                        | 2.8                                               |      |        |      |
| 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> = 2 kΩ <sup>‡</sup>                                           | A <sub>V</sub> = 1                                          | 25°C                        | 0.045%                                            |      |        |      |
|                        |                                             |                                                                                                                                | A <sub>V</sub> = 10                                         |                             | 0.4%                                              |      |        |      |
| Gain-bandwidth product |                                             | f = 10 kHz,    R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup>                                    |                                                             | 25°C                        | 0.55                                              |      | MHz    |      |
| B <sub>OM</sub>        | Maximum output-swing bandwidth              | V <sub>O(PP)</sub> = 2 V,<br>R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,                                                              | A <sub>V</sub> = 1,<br>C <sub>L</sub> = 100 pF <sup>‡</sup> | 25°C                        | 100                                               |      | kHz    |      |
| t <sub>s</sub>         | Settling time                               | A <sub>V</sub> = −1,<br>Step = 1.5 V to 3.5 V,<br>R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,<br>C <sub>L</sub> = 100 pF <sup>‡</sup> | To 0.1%                                                     | 25°C                        | 6.4                                               |      | μs     |      |
|                        |                                             |                                                                                                                                | To 0.01%                                                    |                             | 13.1                                              |      |        |      |
| φ <sub>m</sub>         | Phase margin at unity gain                  | R <sub>L</sub> = 2 kΩ <sup>‡</sup> ,    C <sub>L</sub> = 100 pF <sup>‡</sup>                                                   |                                                             | 25°C                        | 66°                                               |      |        |      |
| Gain margin            |                                             |                                                                                                                                |                                                             | 25°C                        | 11                                                |      | dB     |      |

$^\dagger$  Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part,  $-55^\circ\text{C}$  to  $125^\circ\text{C}$  for M level part.

$^\ddagger$  Referenced to 2.5 V

**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

## TYPICAL CHARACTERISTICS

**Table of Graphs**

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

# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

#### TYPICAL CHARACTERISTICS

DISTRIBUTION OF TLV2432  
INPUT OFFSET VOLTAGE

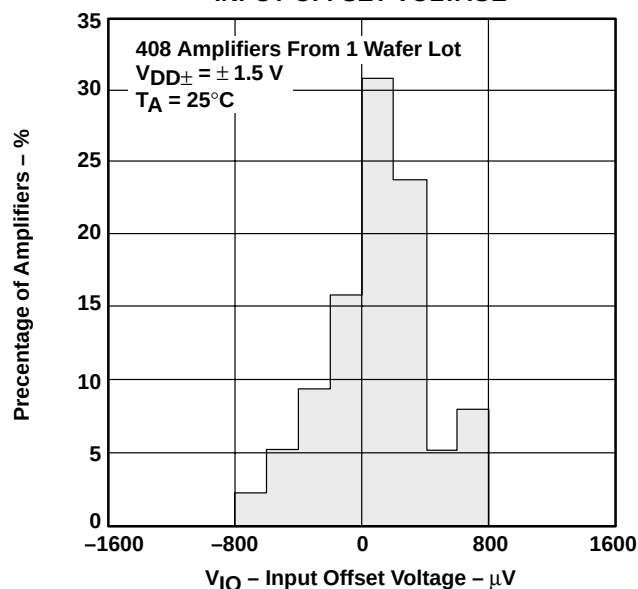


Figure 2

DISTRIBUTION OF TLV2432  
INPUT OFFSET VOLTAGE

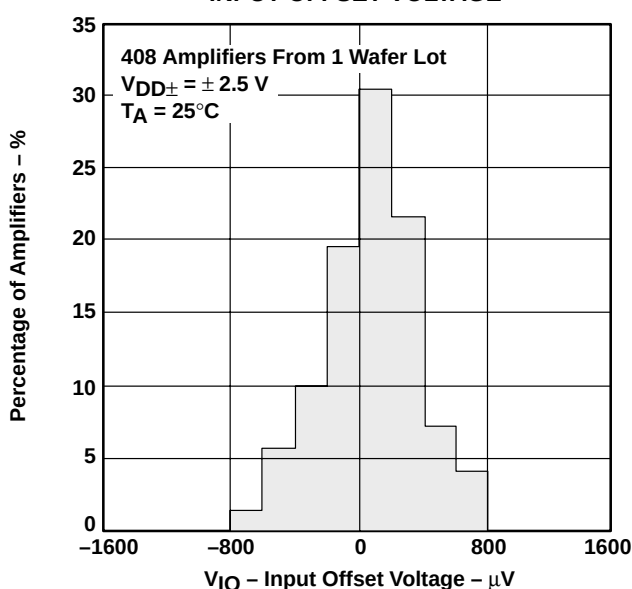


Figure 3

INPUT OFFSET VOLTAGE  
VS  
COMMON-MODE INPUT VOLTAGE

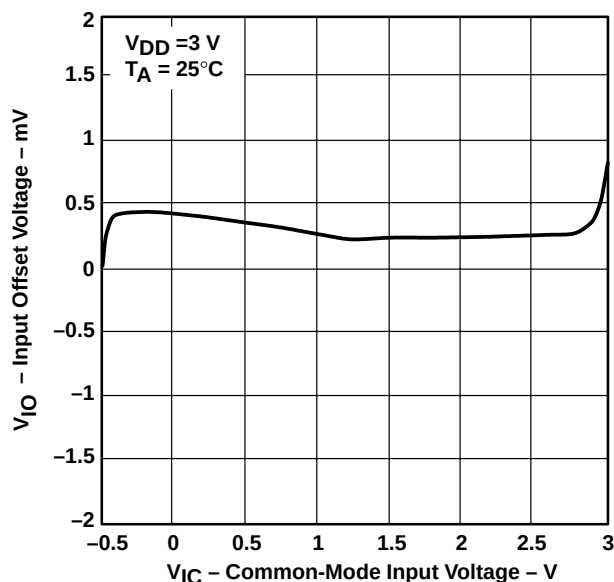


Figure 4

INPUT OFFSET VOLTAGE  
VS  
COMMON-MODE INPUT VOLTAGE

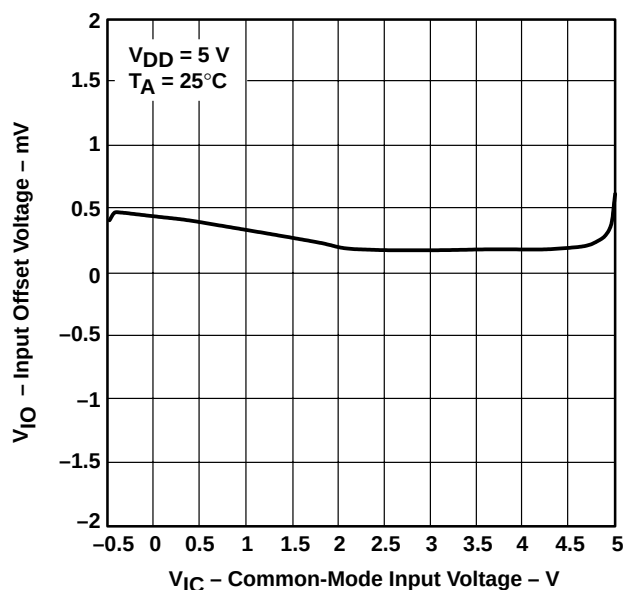


Figure 5

## TYPICAL CHARACTERISTICS

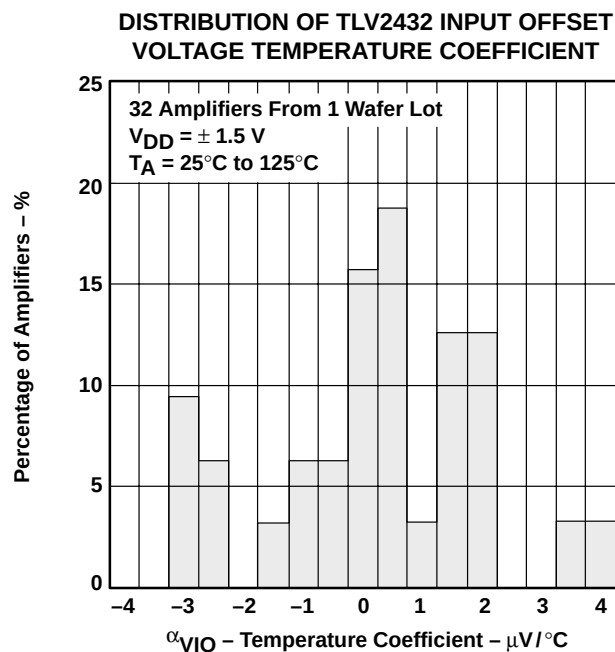


Figure 6

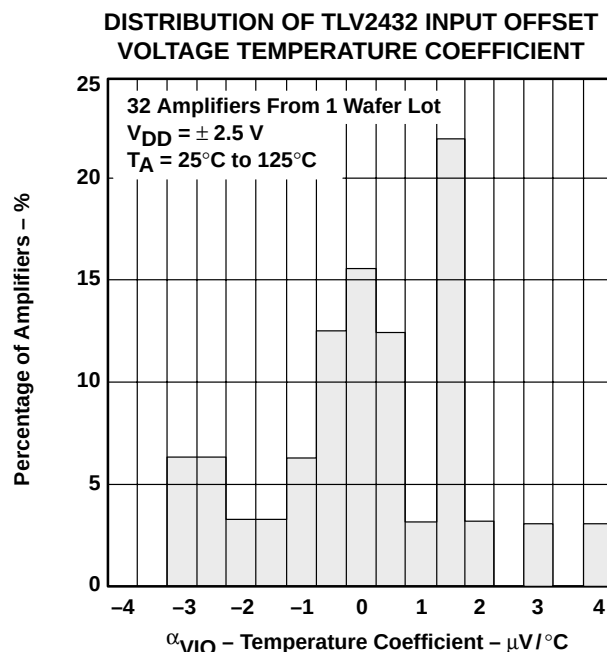


Figure 7

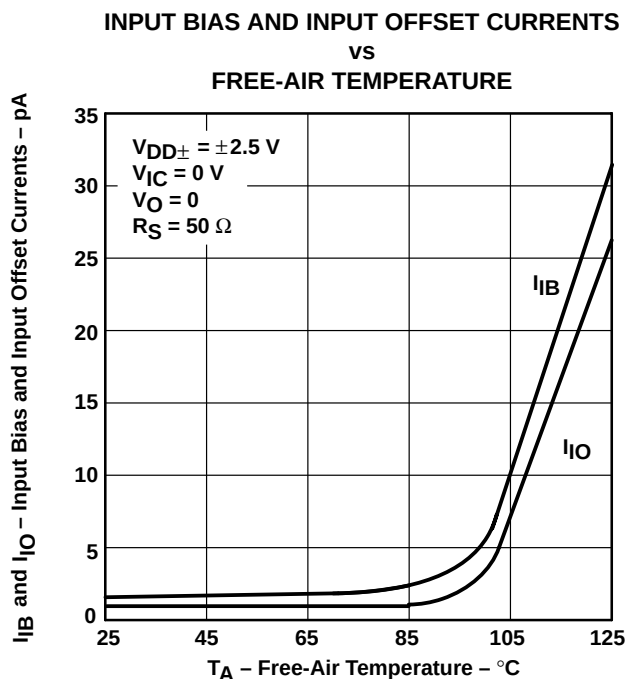


Figure 8

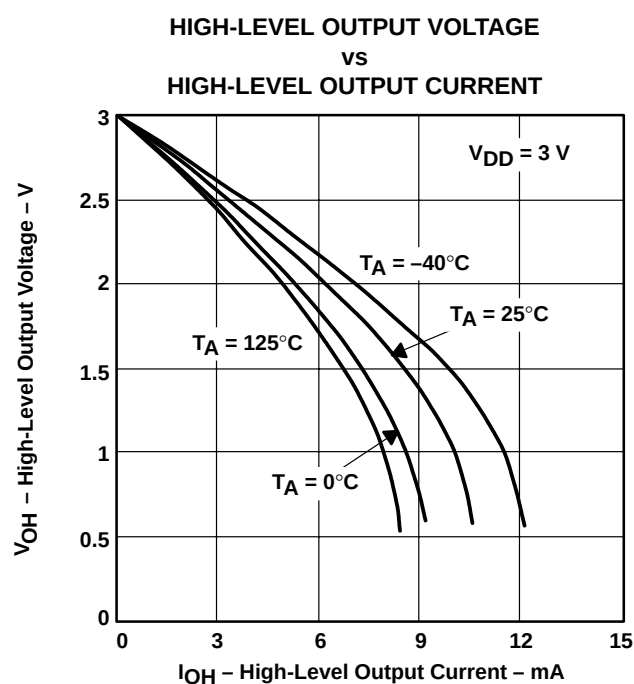
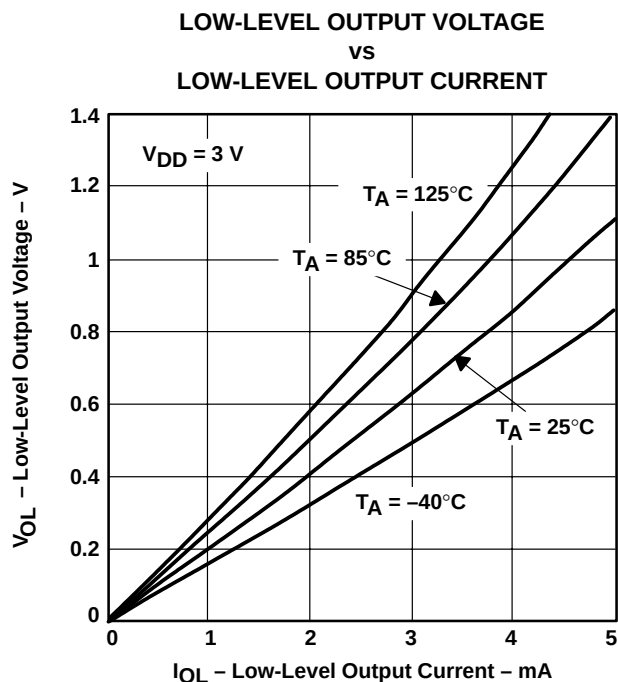


Figure 9

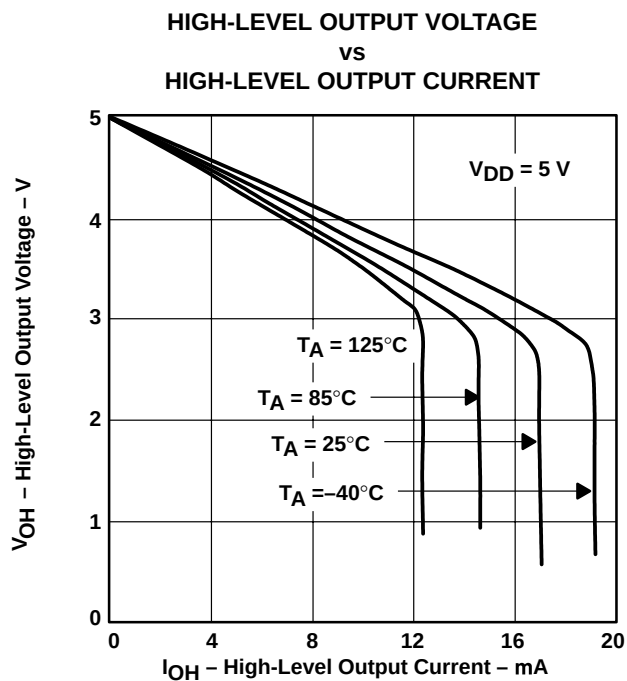
**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

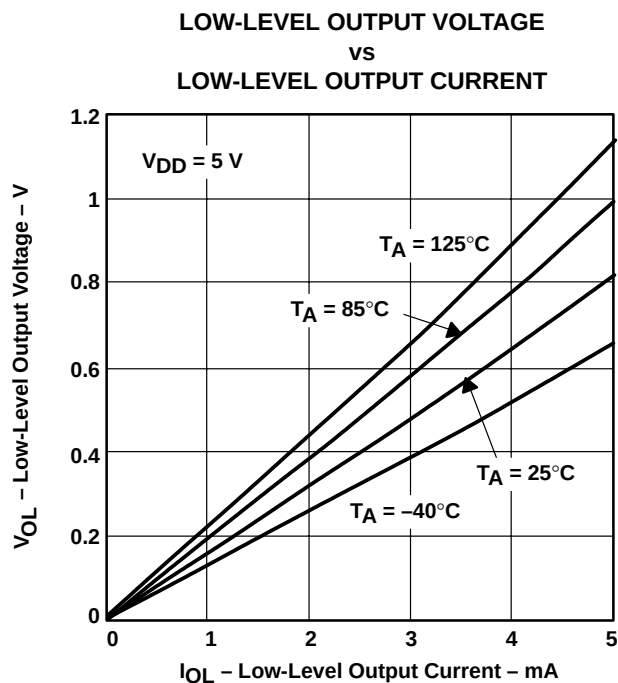
**TYPICAL CHARACTERISTICS**



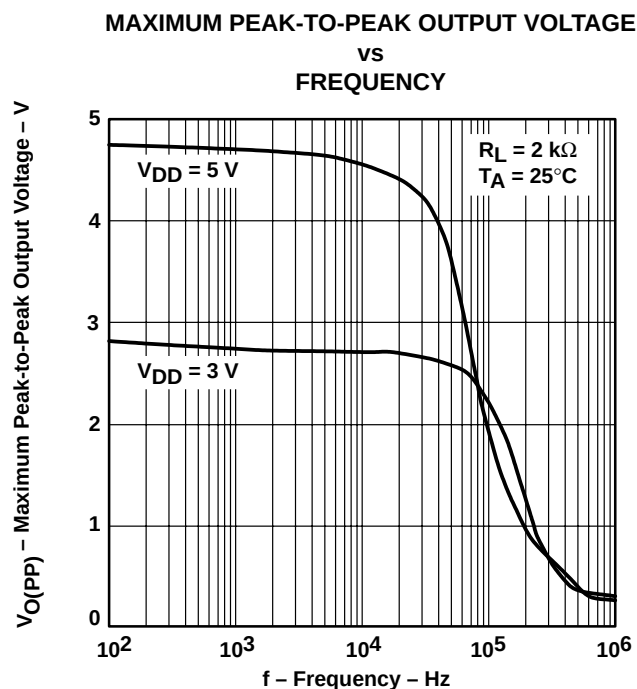
**Figure 10**



**Figure 11**



**Figure 12**



**Figure 13**



TLV2432, TLV2432A, TLV2434, TLV2434A  
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WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

TYPICAL CHARACTERISTICS

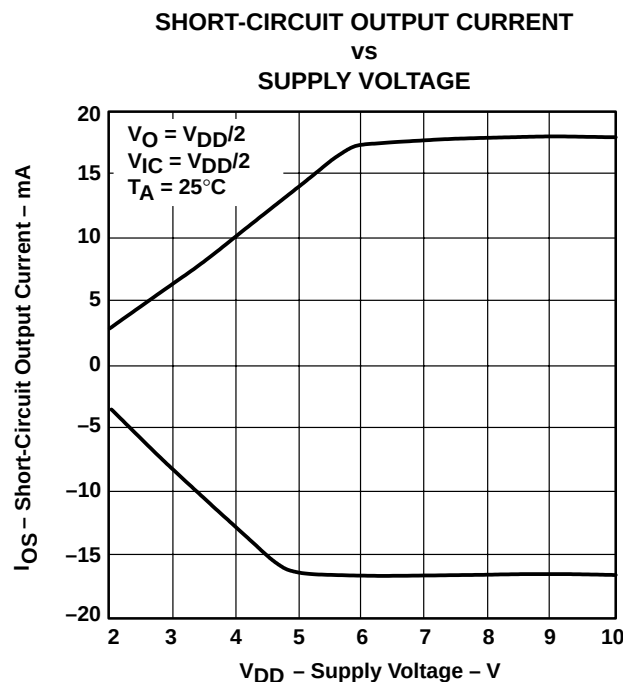


Figure 14

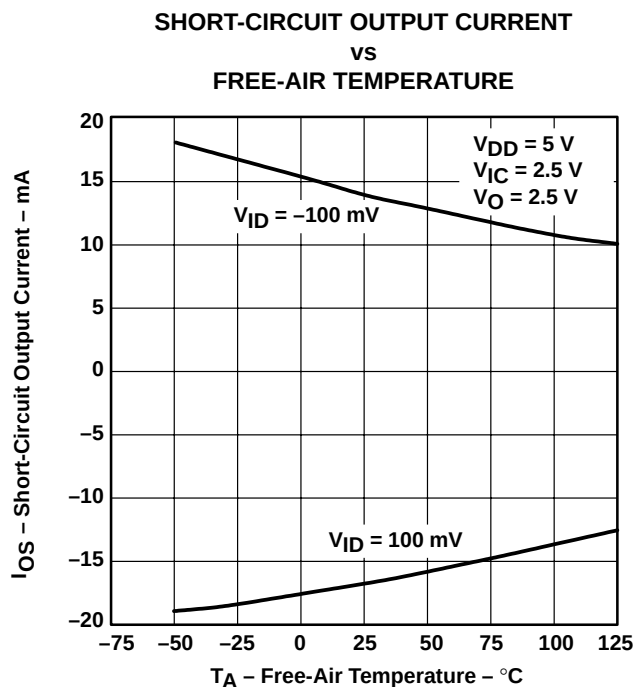


Figure 15

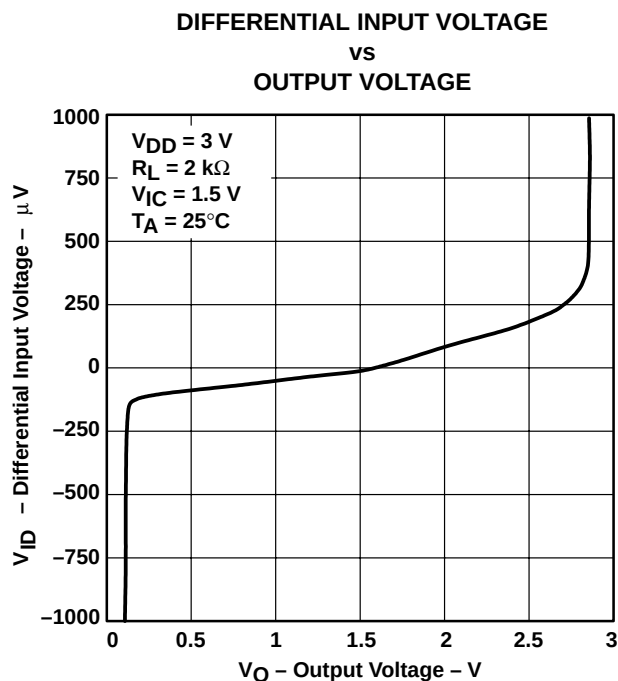


Figure 16

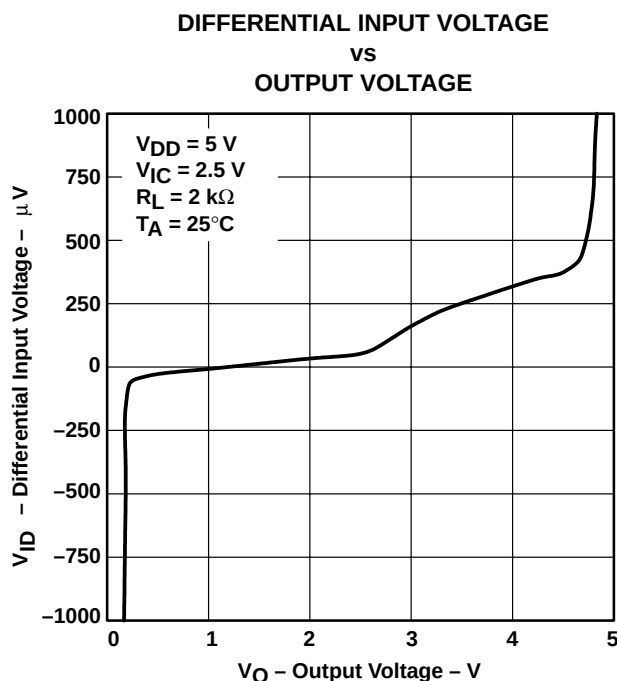
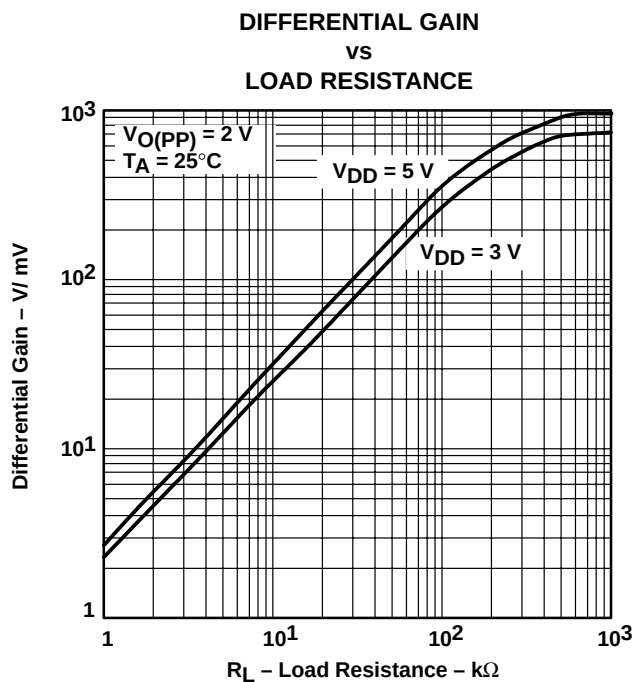


Figure 17

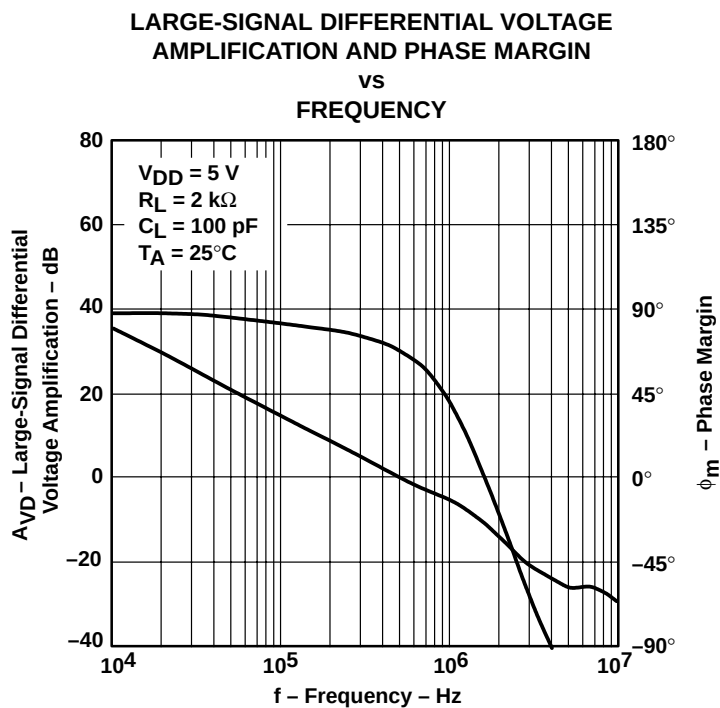
**TLV2432, TLV2432A, TLV2434, TLV2434A**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS**

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

**TYPICAL CHARACTERISTICS**



**Figure 18**



**Figure 19**

## TYPICAL CHARACTERISTICS

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

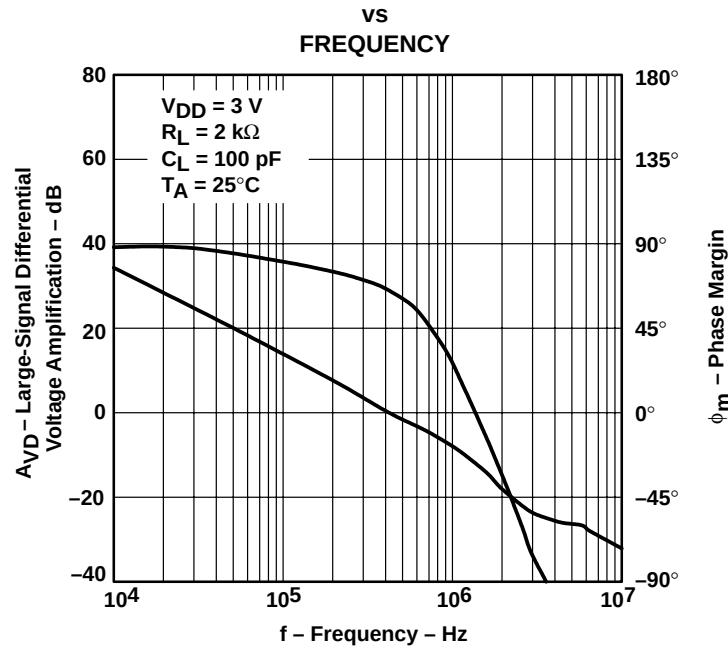


Figure 20

### DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

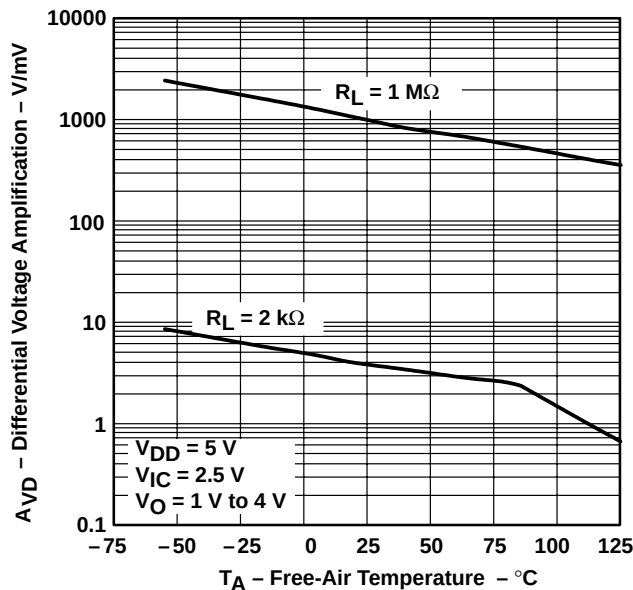


Figure 21

### DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

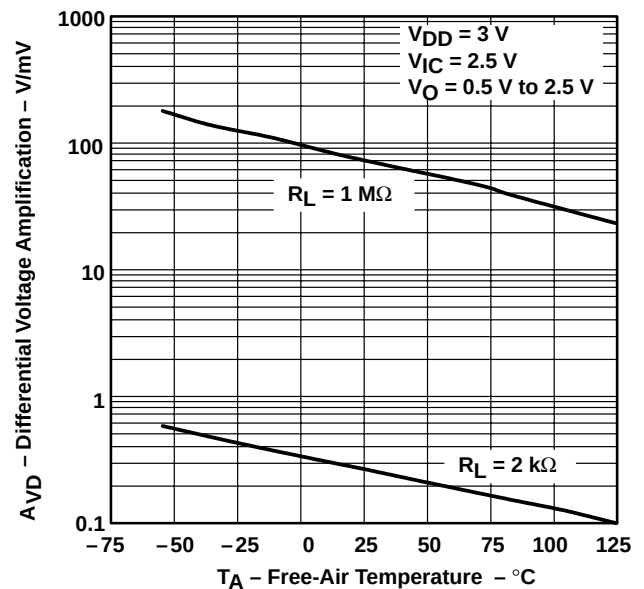


Figure 22

# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

#### TYPICAL CHARACTERISTICS

OUTPUT IMPEDANCE  
VS  
FREQUENCY

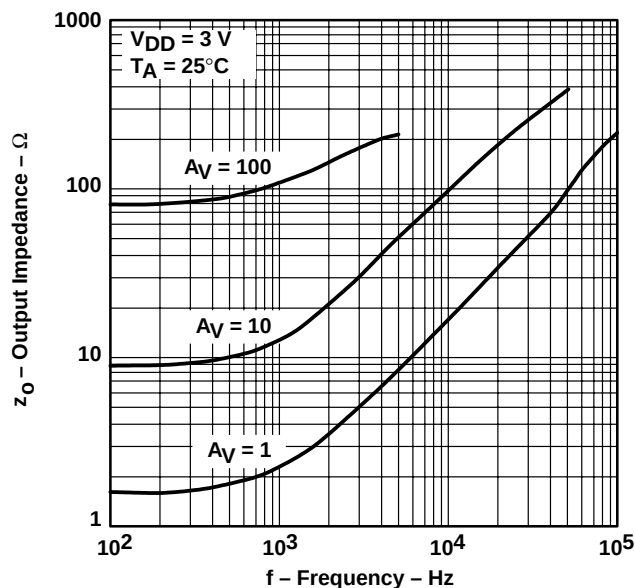


Figure 23

OUTPUT IMPEDANCE  
VS  
FREQUENCY

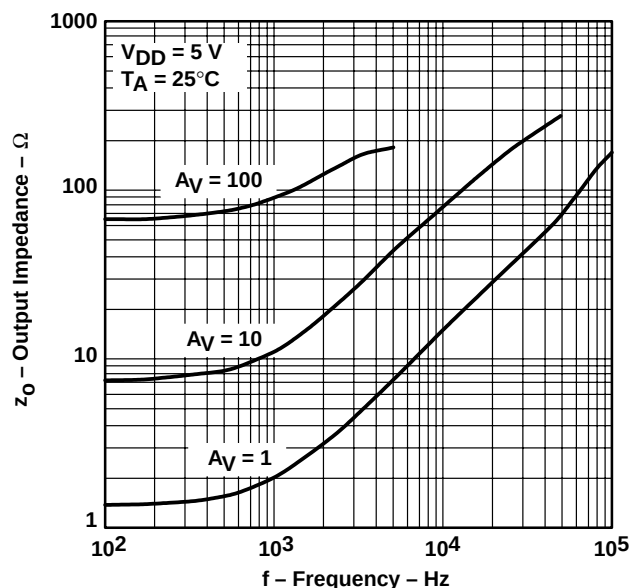


Figure 24

COMMON-MODE REJECTION RATIO  
VS  
FREQUENCY

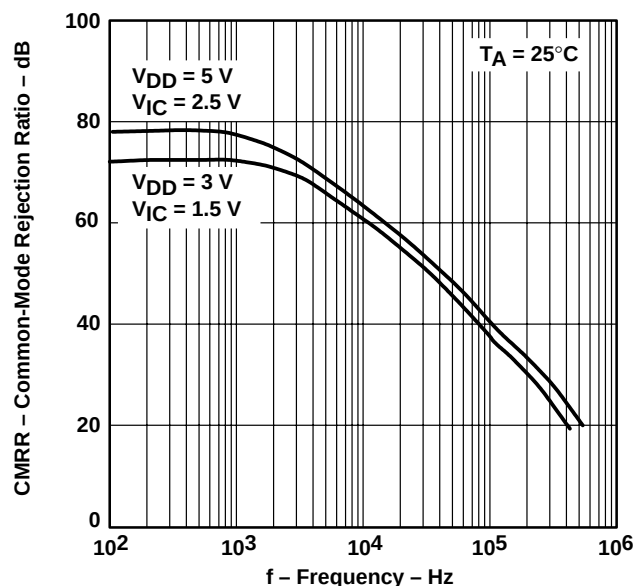


Figure 25

COMMON-MODE REJECTION RATIO  
VS  
FREE-AIR TEMPERATURE

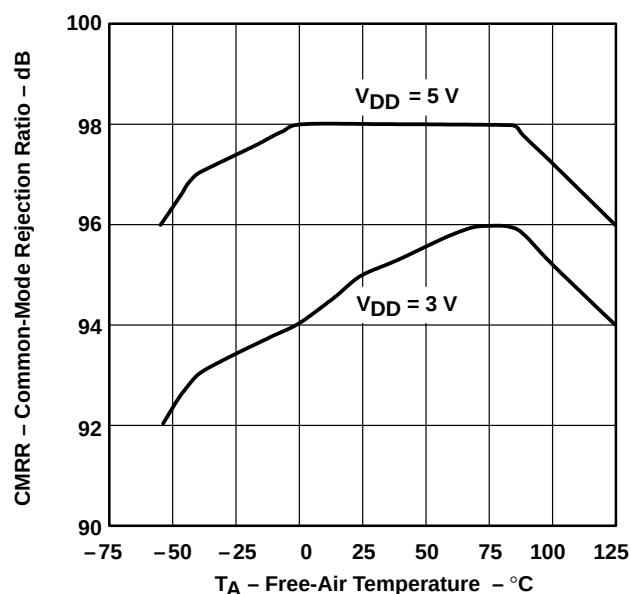


Figure 26

## TYPICAL CHARACTERISTICS

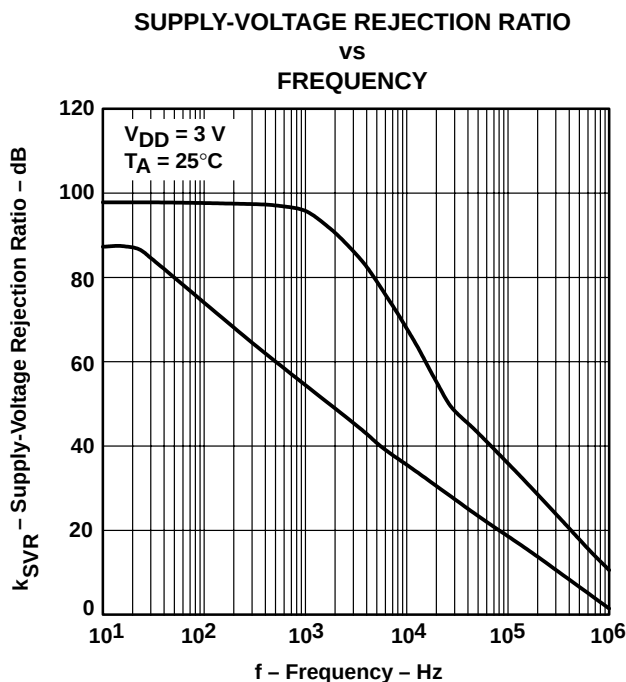


Figure 27

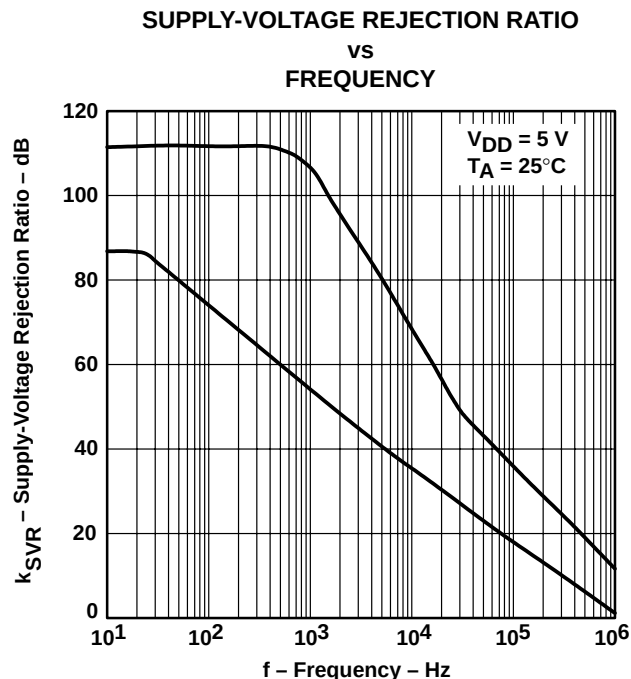


Figure 28

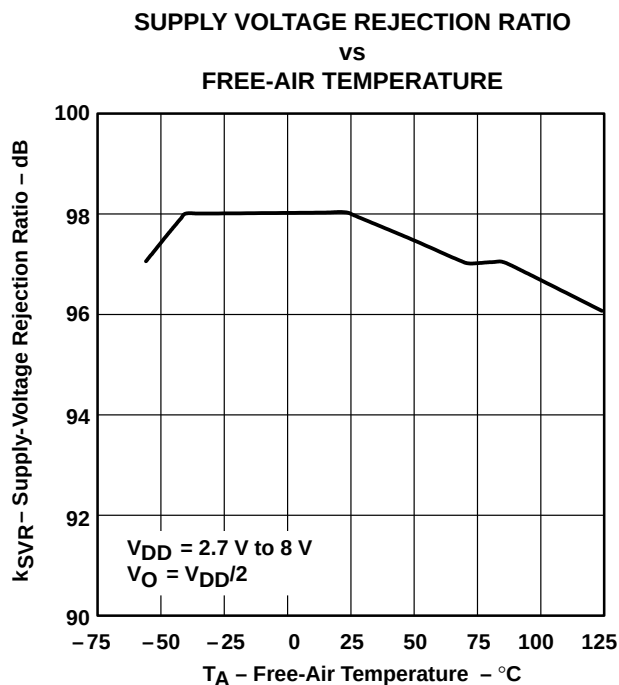


Figure 29

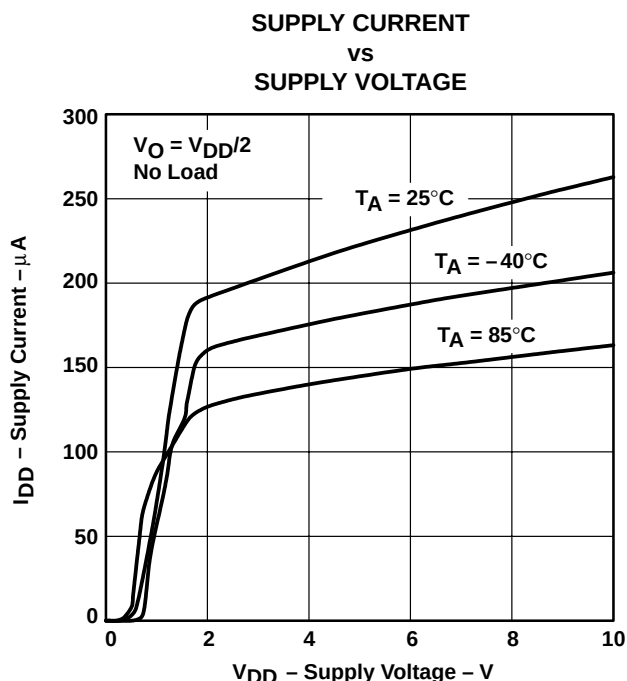


Figure 30

# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

#### TYPICAL CHARACTERISTICS

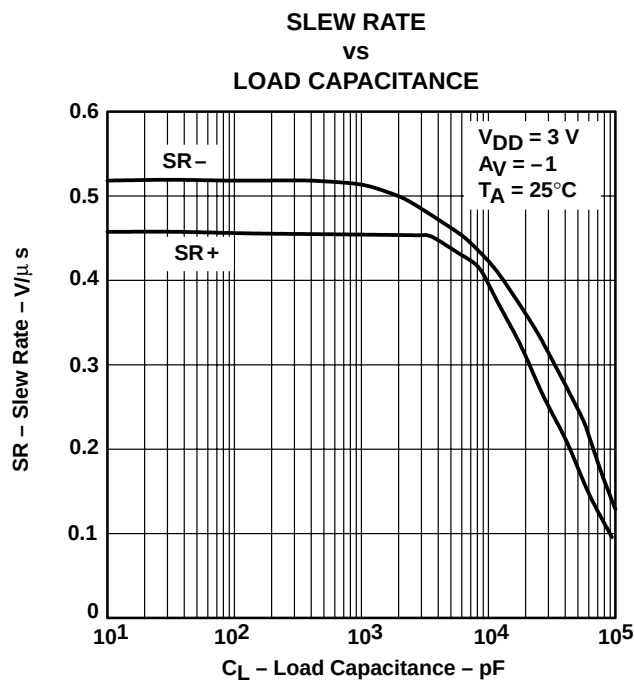


Figure 31

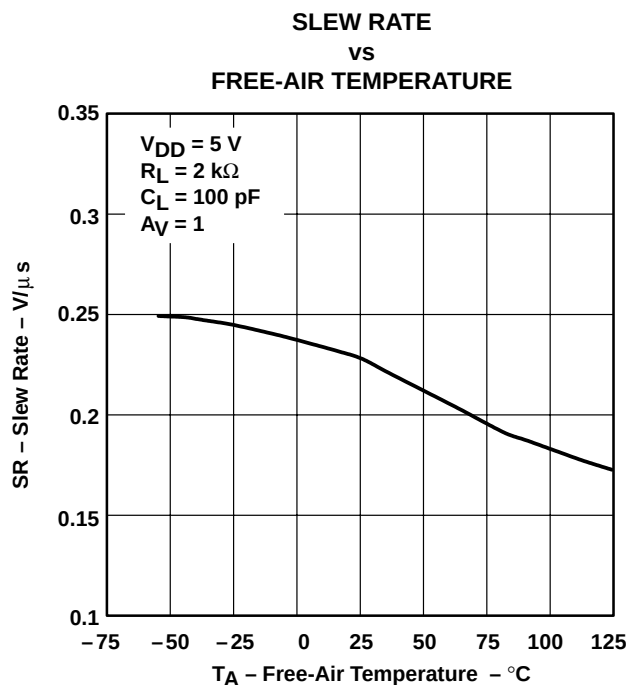


Figure 32

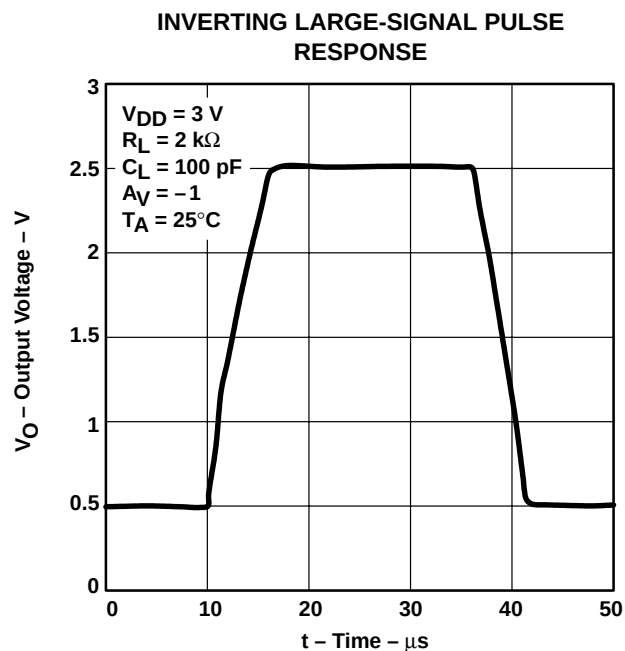


Figure 33

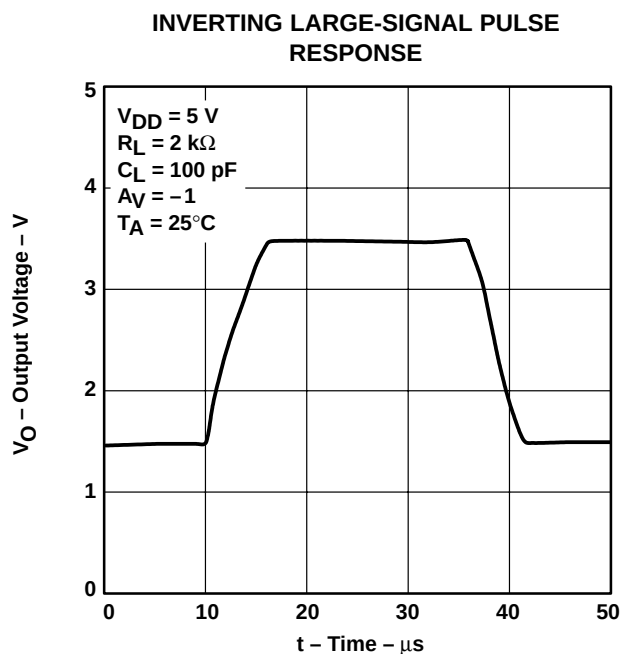


Figure 34

## TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER LARGE-SIGNAL  
PULSE RESPONSE

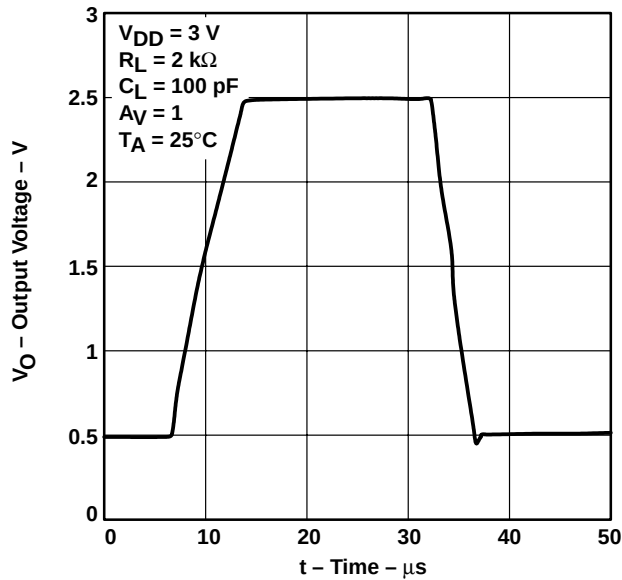


Figure 35

VOLTAGE-FOLLOWER LARGE-SIGNAL  
PULSE RESPONSE

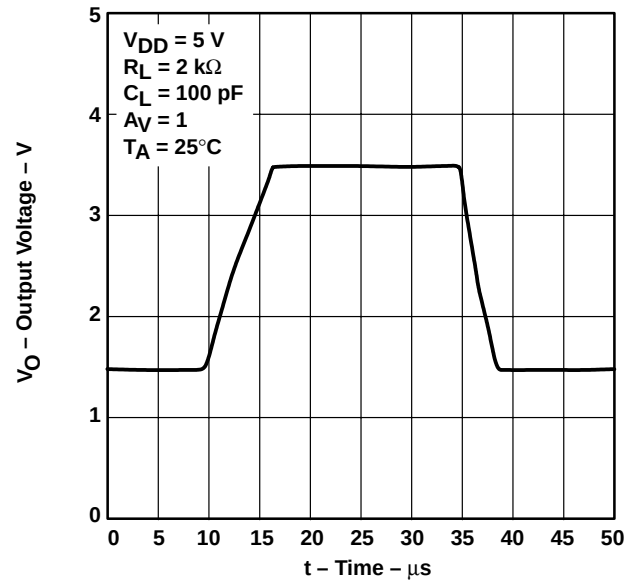


Figure 36

INVERTING SMALL-SIGNAL PULSE  
RESPONSE

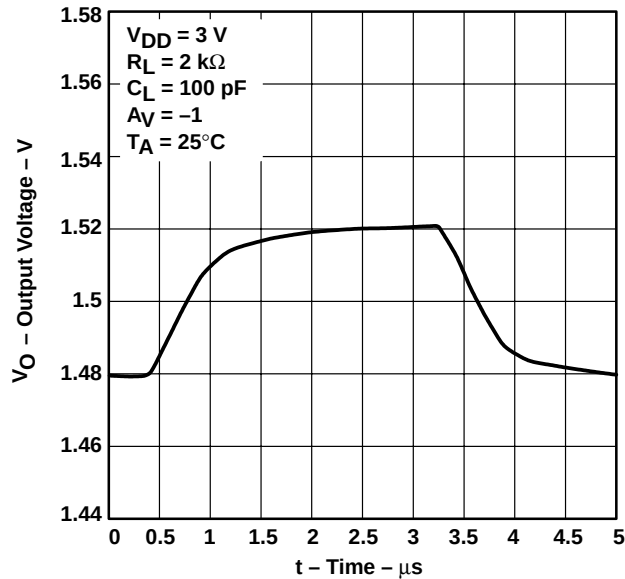


Figure 37

INVERTING SMALL-SIGNAL PULSE  
RESPONSE

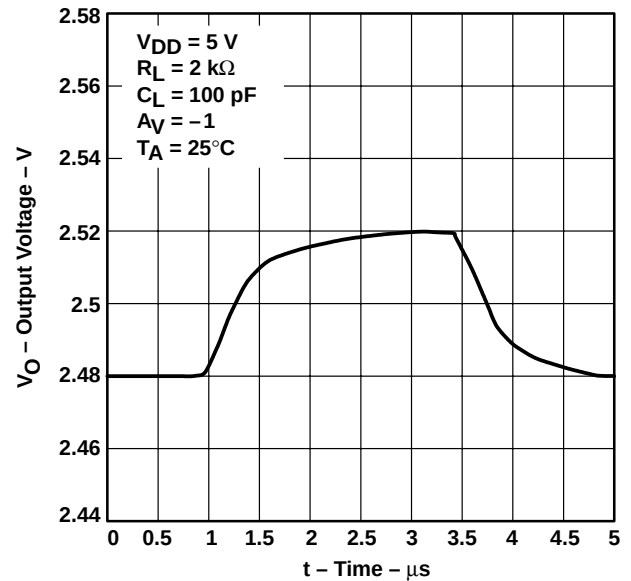


Figure 38

# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

#### TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER SMALL-SIGNAL  
PULSE RESPONSE

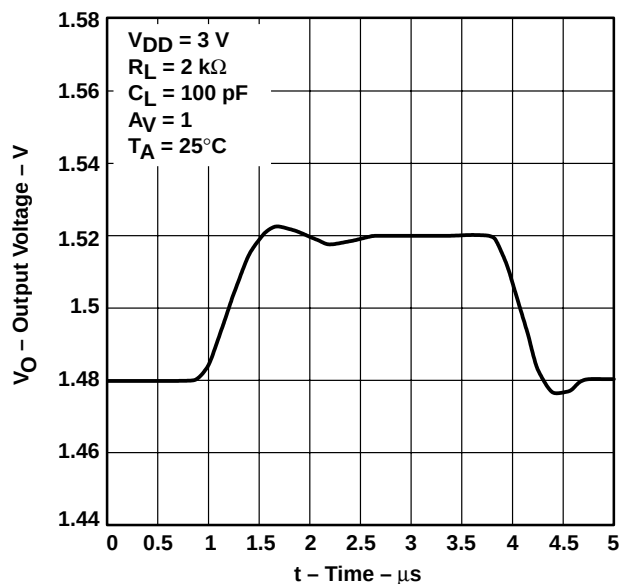


Figure 39

VOLTAGE-FOLLOWER SMALL-SIGNAL  
PULSE RESPONSE

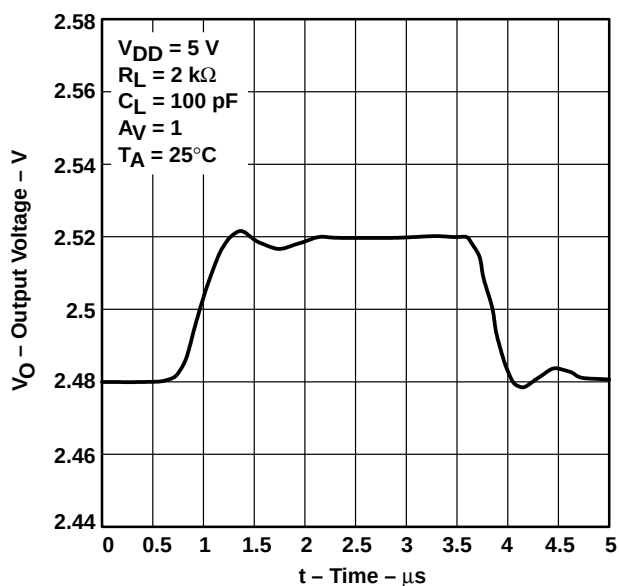


Figure 40

EQUIVALENT INPUT NOISE VOLTAGE  
VS  
FREQUENCY

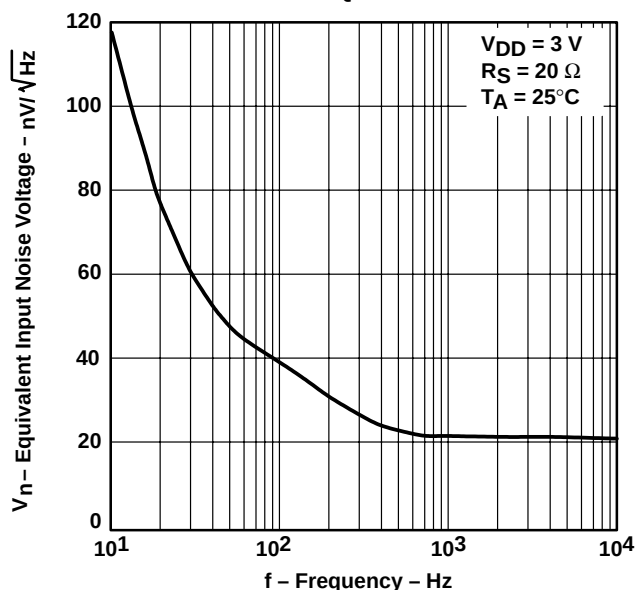


Figure 41

EQUIVALENT INPUT NOISE VOLTAGE  
VS  
FREQUENCY

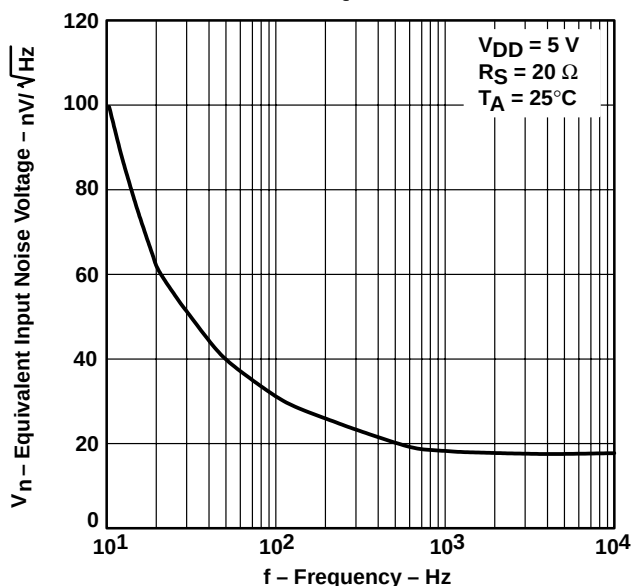


Figure 42



## TYPICAL CHARACTERISTICS

NOISE VOLTAGE OVER A 10-SECOND PERIOD

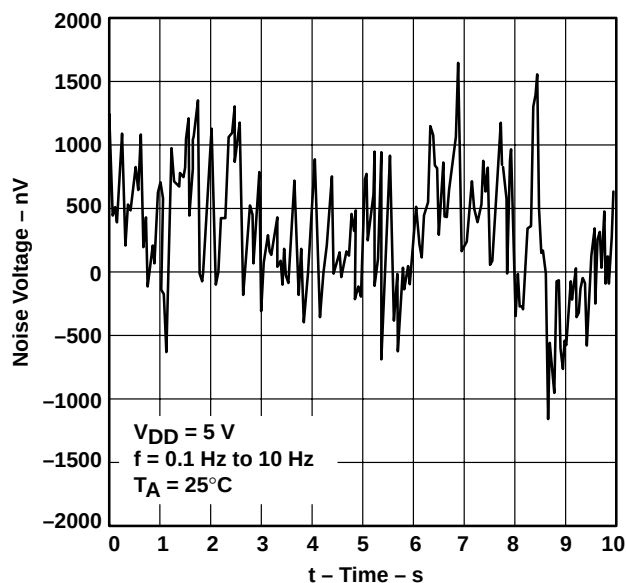


Figure 43

TOTAL HARMONIC DISTORTION PLUS NOISE  
VS  
FREQUENCY

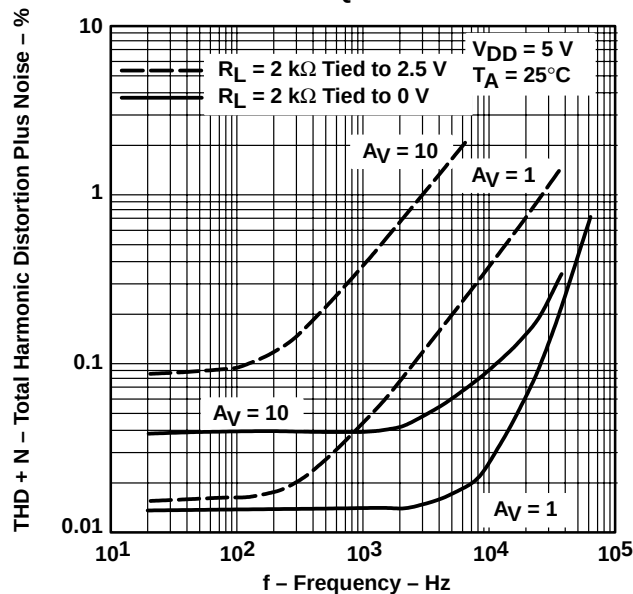


Figure 44

TOTAL HARMONIC DISTORTION PLUS NOISE  
VS  
FREQUENCY

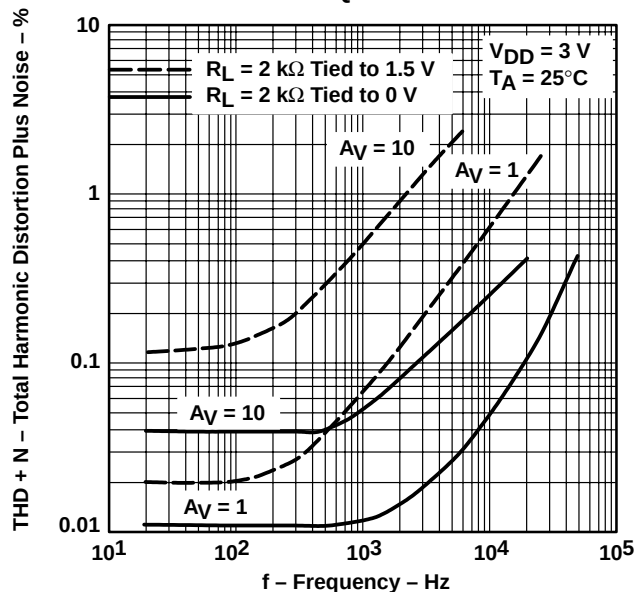


Figure 45

# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

#### TYPICAL CHARACTERISTICS

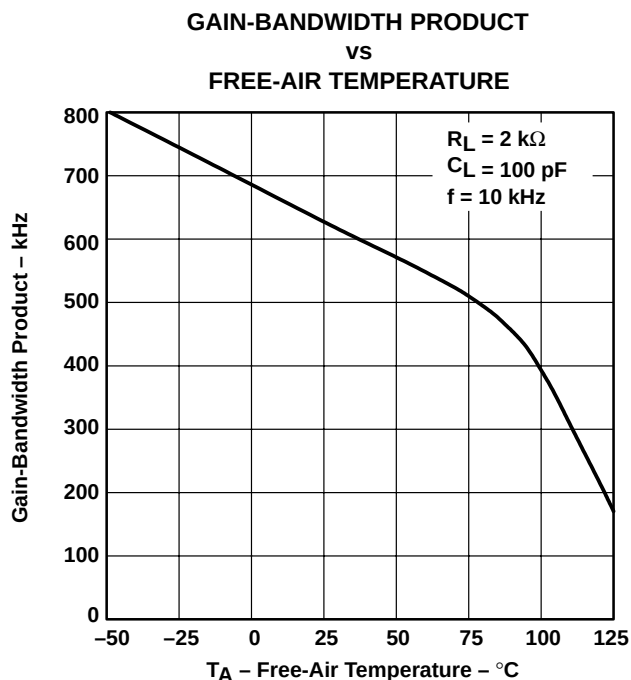


Figure 46

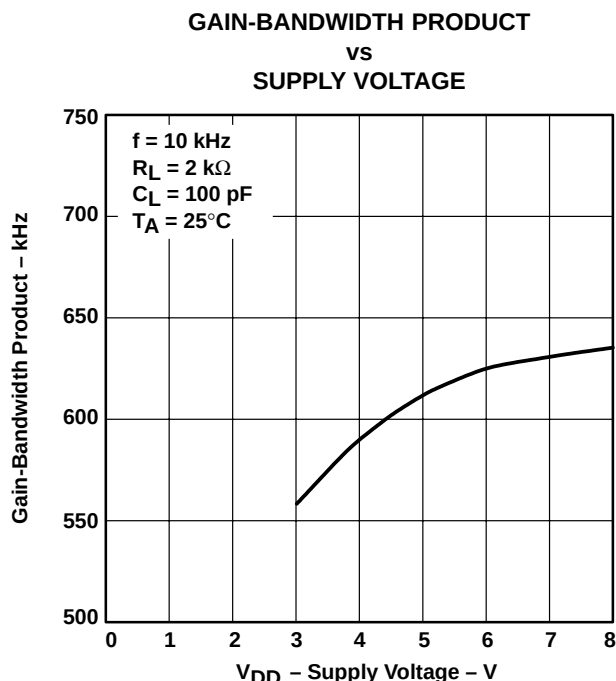


Figure 47

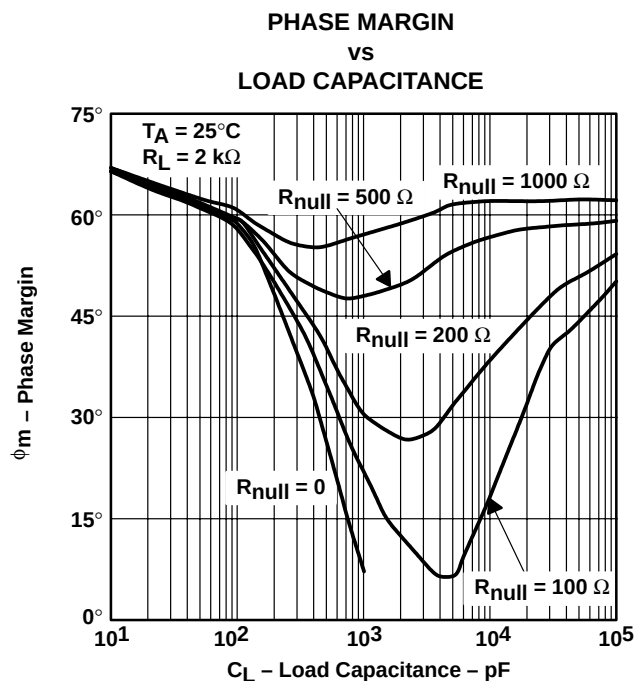


Figure 48

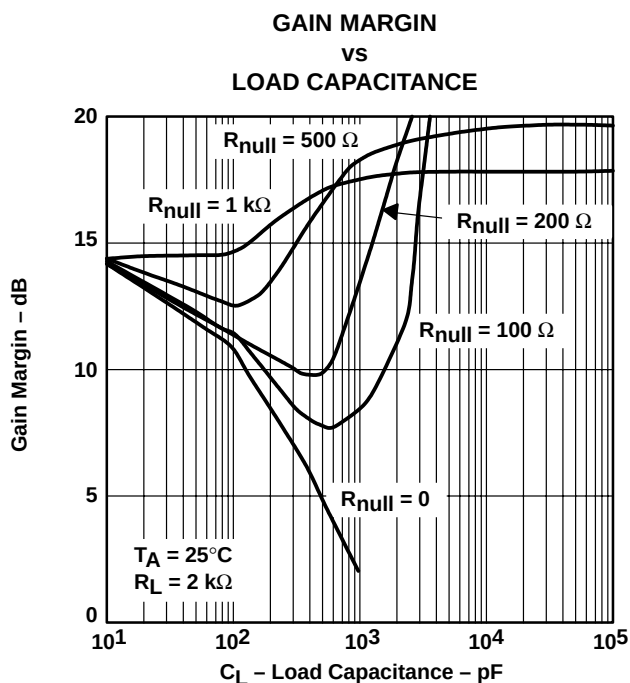


Figure 49

## TYPICAL CHARACTERISTICS

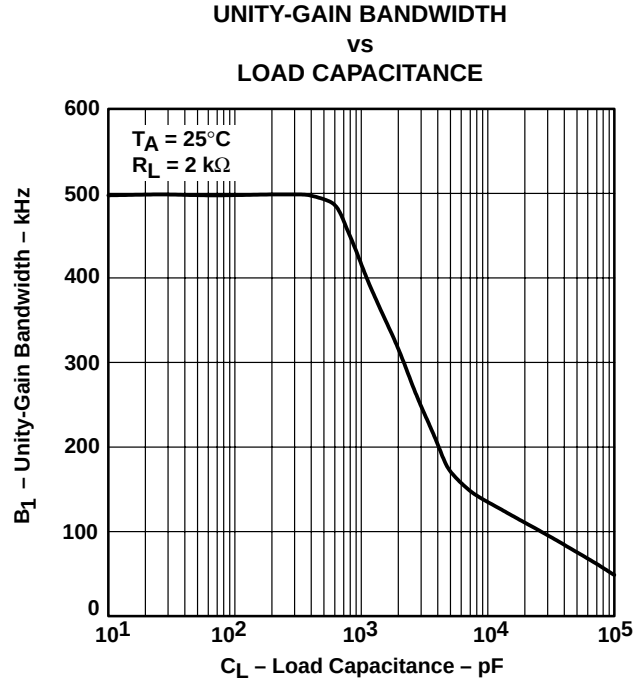


Figure 50

# TLV2432, TLV2432A, TLV2434, TLV2434A

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SLOS168F – NOVEMBER 1996 – REVISED MARCH 2001

## APPLICATION INFORMATION

### macromodel information

Macromodel information provided was derived using Microsim *Parts*™, the model generation software used with Microsim *PSpice*™. The Boyle macromodel (see Note 5) and subcircuit in Figure 51 are generated using the TLV243x 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 4: 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).

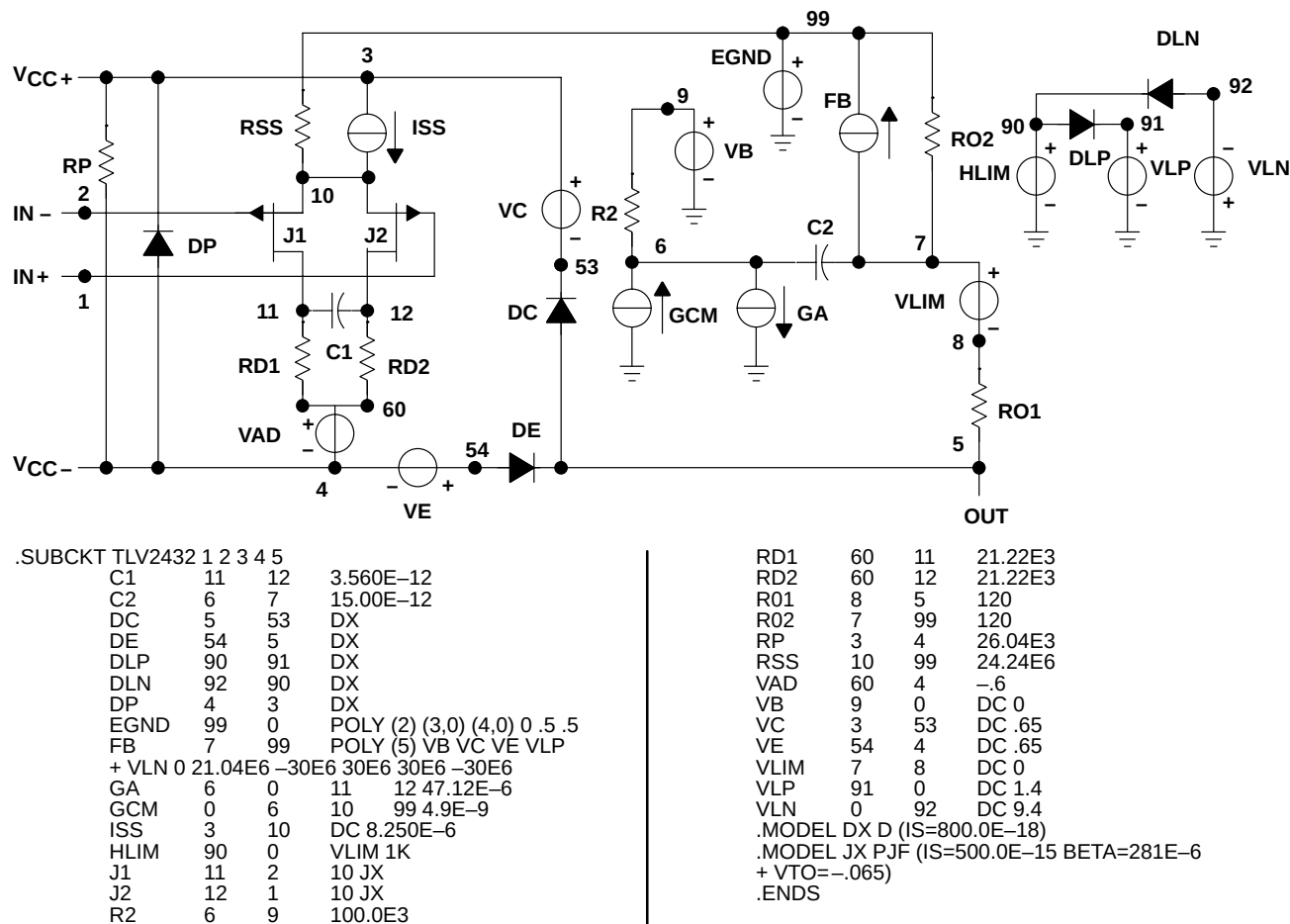


Figure 51. Boyle Macromodel and Subcircuit

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POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Samples<br>(Requires Login) |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|-----------------------------|
| 5962-9751001Q2A  | ACTIVE        | LCCC         | FK                 | 20   | 1           | TBD                        | Call TI          | Call TI              |                             |
| 5962-9751001QHA  | ACTIVE        | CFP          | U                  | 10   | 1           | TBD                        | Call TI          | Call TI              |                             |
| 5962-9751001QPA  | ACTIVE        | CDIP         | JG                 | 8    | 1           | TBD                        | Call TI          | Call TI              |                             |
| 5962-9751002Q2A  | ACTIVE        | LCCC         | FK                 | 20   | 1           | TBD                        | Call TI          | Call TI              |                             |
| 5962-9751002QHA  | ACTIVE        | CFP          | U                  | 10   | 1           | TBD                        | Call TI          | Call TI              |                             |
| 5962-9751002QPA  | ACTIVE        | CDIP         | JG                 | 8    | 1           | TBD                        | Call TI          | Call TI              |                             |
| TLV2432AID       | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AIDG4     | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AIDR      | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AIDRG4    | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AIPW      | ACTIVE        | TSSOP        | PW                 | 8    | 150         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AIPWG4    | ACTIVE        | TSSOP        | PW                 | 8    | 150         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AIPWLE    | OBSOLETE      | TSSOP        | PW                 | 8    |             | TBD                        | Call TI          | Call TI              |                             |
| TLV2432AIPWR     | ACTIVE        | TSSOP        | PW                 | 8    | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AIPWRG4   | ACTIVE        | TSSOP        | PW                 | 8    | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AMFKB     | ACTIVE        | LCCC         | FK                 | 20   | 1           | TBD                        | POST-PLATE       | N / A for Pkg Type   |                             |
| TLV2432AMJGB     | ACTIVE        | CDIP         | JG                 | 8    | 1           | TBD                        | A42              | N / A for Pkg Type   |                             |
| TLV2432AMUB      | ACTIVE        | CFP          | U                  | 10   | 1           | TBD                        | A42              | N / A for Pkg Type   |                             |
| TLV2432AQD       | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AQDG4     | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432AQDR      | OBSOLETE      | SOIC         | D                  | 8    |             | TBD                        | Call TI          | Call TI              |                             |
| TLV2432AQDRG4    | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Samples<br>(Requires Login) |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|-----------------------------|
| TLV2432CD        | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432CDG4      | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432CDR       | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432CDRG4     | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432ID        | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432IDG4      | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432IDR       | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432IDRG4     | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432MFKB      | ACTIVE        | LCCC         | FK                 | 20   | 1           | TBD                        | POST-PLATE       | N / A for Pkg Type   |                             |
| TLV2432MJGB      | ACTIVE        | CDIP         | JG                 | 8    | 1           | TBD                        | A42              | N / A for Pkg Type   |                             |
| TLV2432MUB       | ACTIVE        | CFP          | U                  | 10   | 1           | TBD                        | A42              | N / A for Pkg Type   |                             |
| TLV2432QD        | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432QDG4      | ACTIVE        | SOIC         | D                  | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2432QDR       | OBSOLETE      | SOIC         | D                  | 8    |             | TBD                        | Call TI          | Call TI              |                             |
| TLV2432QDRG4     | ACTIVE        | SOIC         | D                  | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434AID       | ACTIVE        | SOIC         | D                  | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434AIDG4     | ACTIVE        | SOIC         | D                  | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434AIDR      | ACTIVE        | SOIC         | D                  | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434AIDRG4    | ACTIVE        | SOIC         | D                  | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Samples<br>(Requires Login) |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|-----------------------------|
| TLV2434AIPWR     | ACTIVE        | TSSOP        | PW                 | 14   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434AIPWRG4   | ACTIVE        | TSSOP        | PW                 | 14   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CD        | ACTIVE        | SOIC         | D                  | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CDG4      | ACTIVE        | SOIC         | D                  | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CDR       | ACTIVE        | SOIC         | D                  | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CDRG4     | ACTIVE        | SOIC         | D                  | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CPW       | ACTIVE        | TSSOP        | PW                 | 14   | 90          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CPWG4     | ACTIVE        | TSSOP        | PW                 | 14   | 90          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434CPWRG4    | ACTIVE        | TSSOP        | PW                 | 14   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434ID        | ACTIVE        | SOIC         | D                  | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434IDG4      | ACTIVE        | SOIC         | D                  | 14   | 50          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434IDR       | ACTIVE        | SOIC         | D                  | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434IDRG4     | ACTIVE        | SOIC         | D                  | 14   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434IPW       | ACTIVE        | TSSOP        | PW                 | 14   | 90          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434IPWG4     | ACTIVE        | TSSOP        | PW                 | 14   | 90          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434IPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |
| TLV2434IPWRG4    | ACTIVE        | TSSOP        | PW                 | 14   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   |                             |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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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 TLV2432, TLV2432A, TLV2432AM, TLV2432M, TLV2434A :**

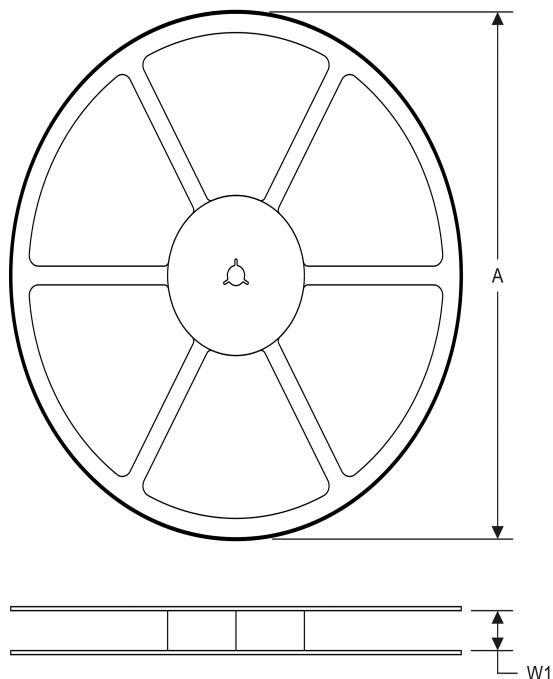
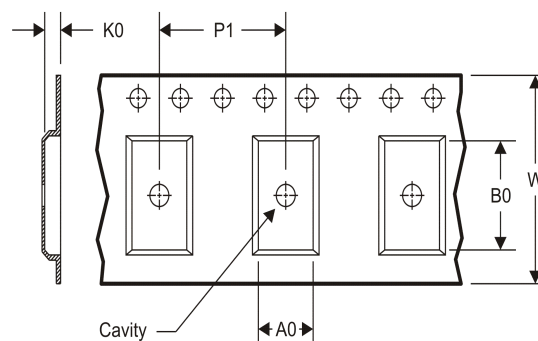
- Catalog: [TLV2432A](#), [TLV2432](#)
- Automotive: [TLV2432-Q1](#), [TLV2432A-Q1](#), [TLV2432A-Q1](#), [TLV2432-Q1](#), [TLV2434A-Q1](#)
- Military: [TLV2432M](#), [TLV2432AM](#)

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**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


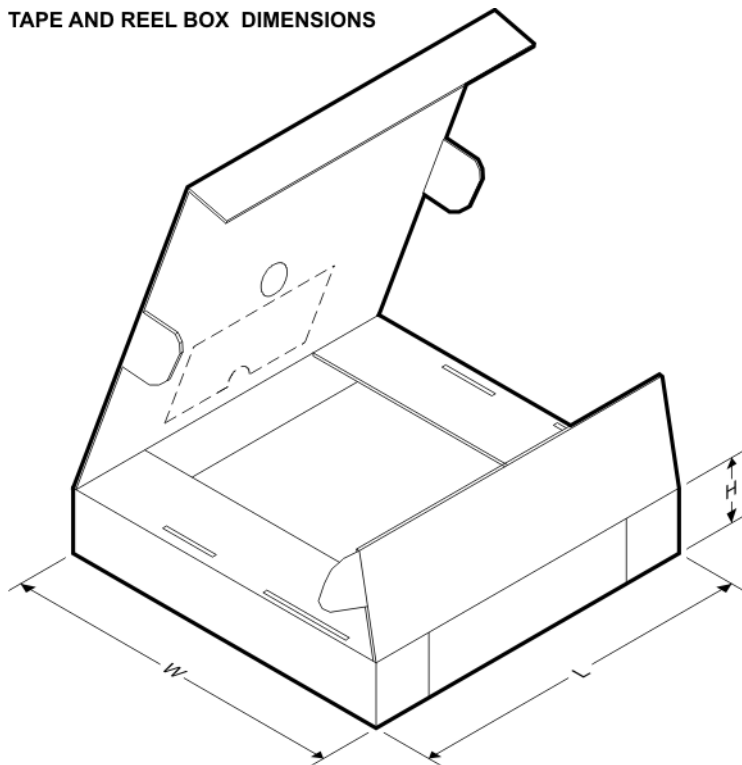
|    |                                                           |
|----|-----------------------------------------------------------|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

**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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV2432AIDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV2432AIPWR | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2432CDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV2432IDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV2434AIDR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV2434AIPWR | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2434CDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV2434CPWR  | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2434IDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV2434IPWR  | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

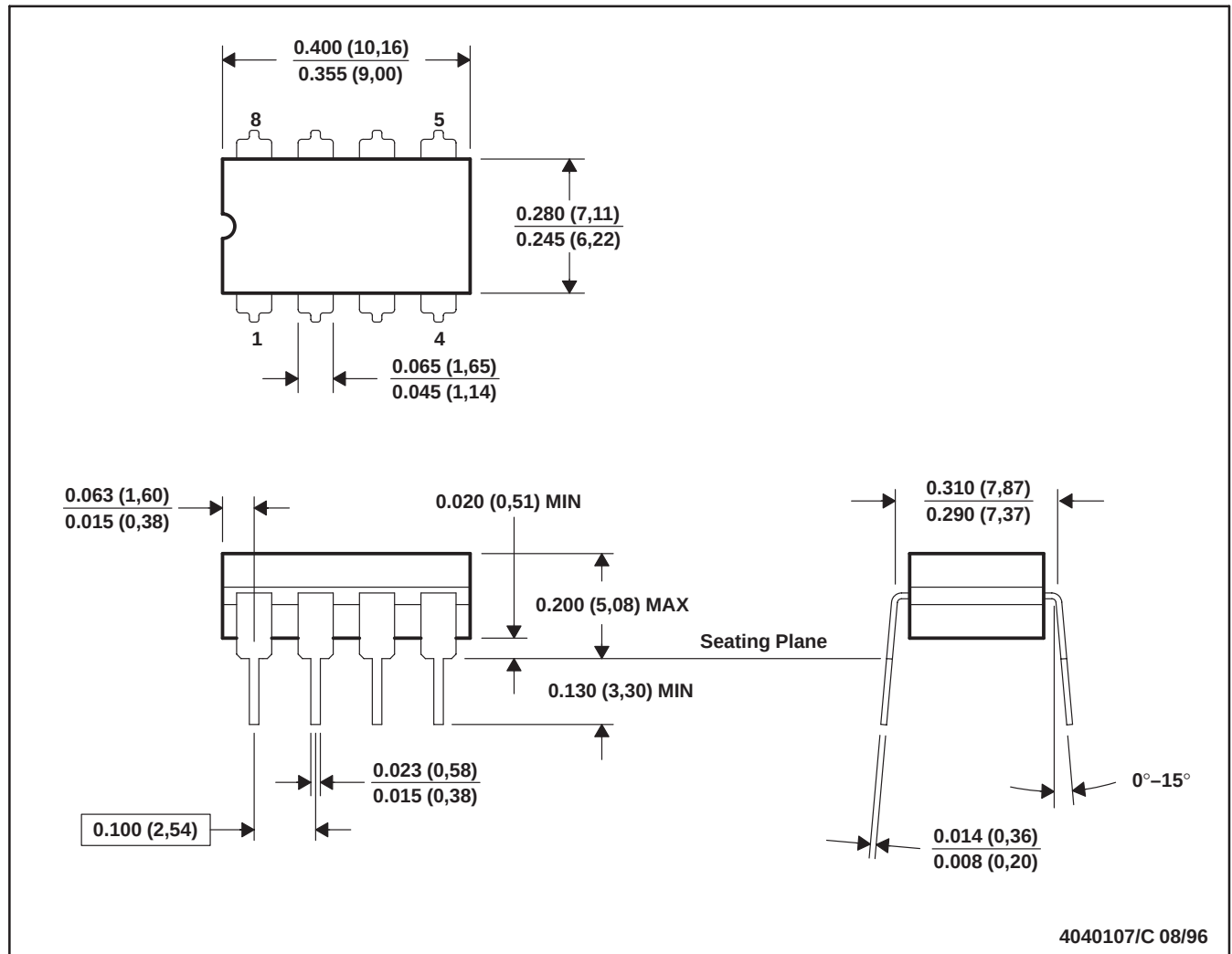


\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV2432AIDR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TLV2432AIPWR | TSSOP        | PW              | 8    | 2000 | 367.0       | 367.0      | 35.0        |
| TLV2432CDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TLV2432IDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TLV2434AIDR  | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| TLV2434AIPWR | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| TLV2434CDR   | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| TLV2434CPWR  | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| TLV2434IDR   | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| TLV2434IPWR  | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |

## JG (R-GDIP-T8)

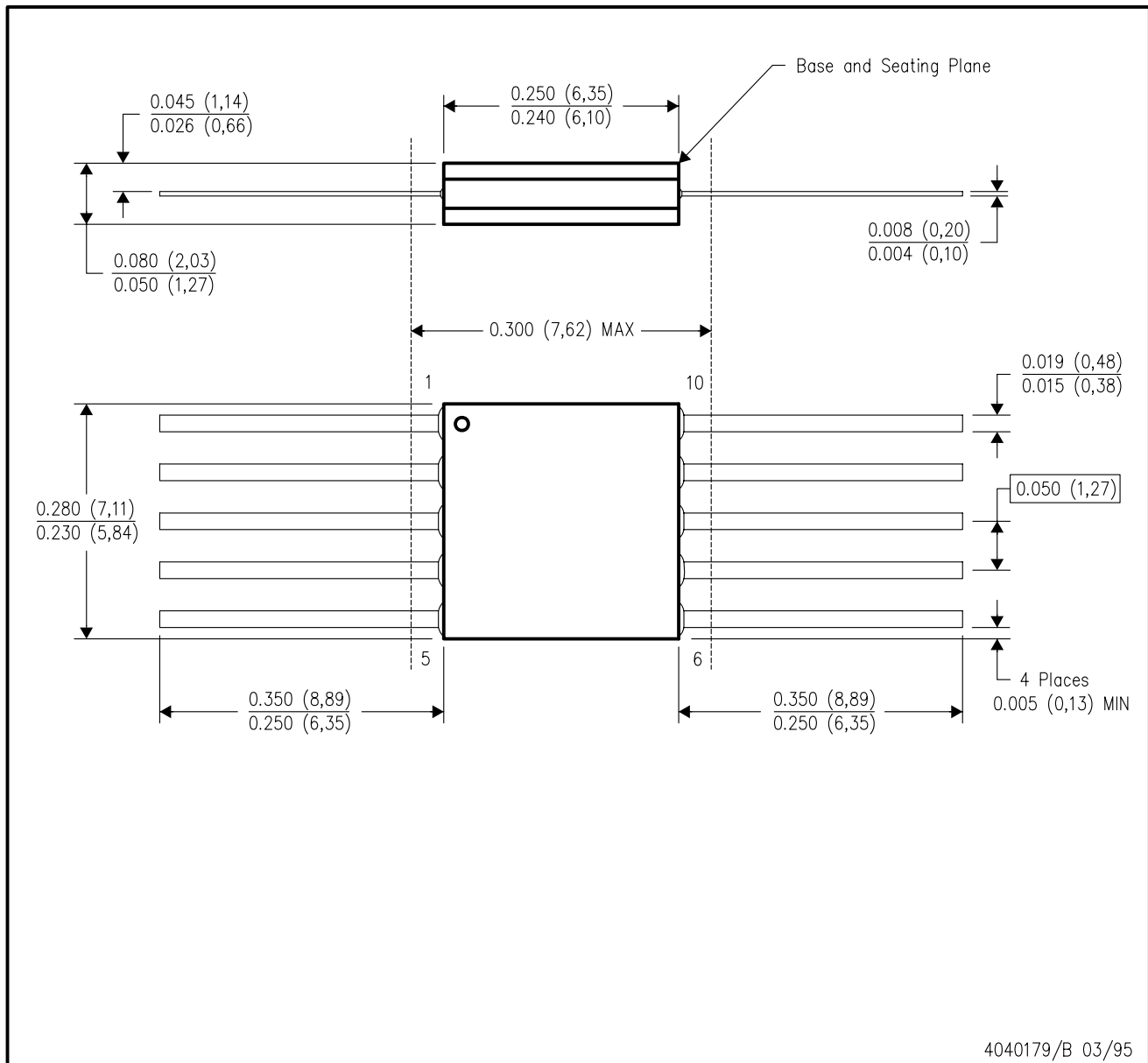
## CERAMIC DUAL-IN-LINE



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

U (S-GDFP-F10)

CERAMIC DUAL FLATPACK

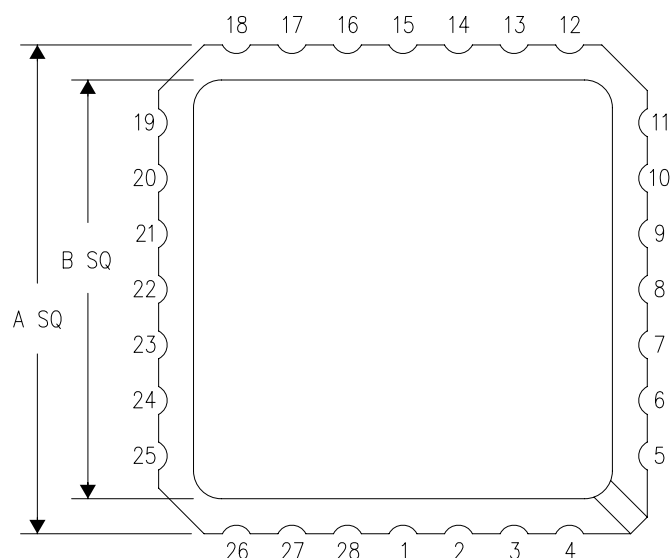


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only.
  - Falls within MIL STD 1835 GDFP1-F10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

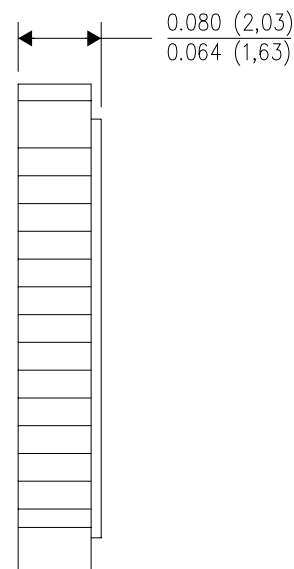
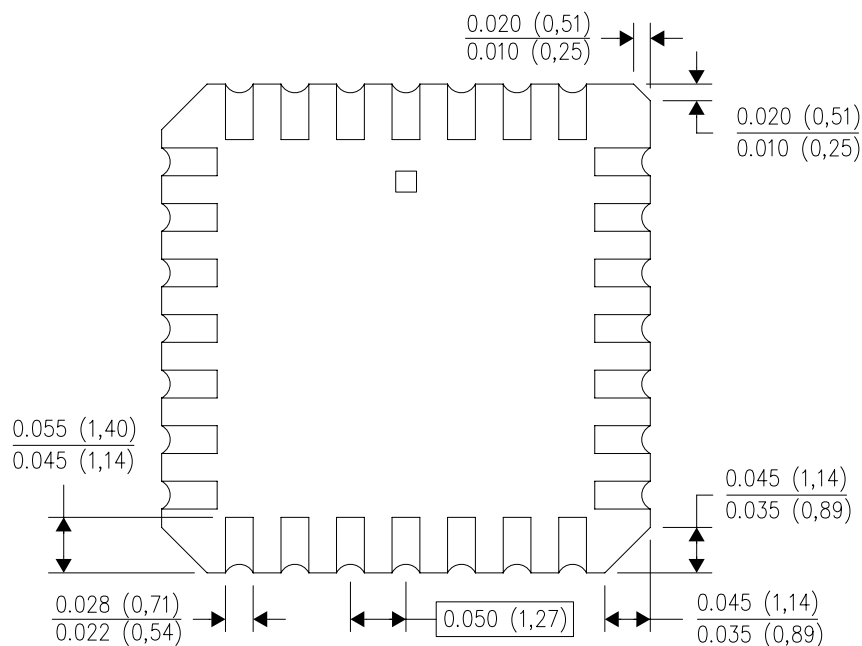
FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF<br>TERMINALS<br>** | A                |                  | B                |                  |
|---------------------------|------------------|------------------|------------------|------------------|
|                           | MIN              | MAX              | MIN              | MAX              |
| 20                        | 0.342<br>(8,69)  | 0.358<br>(9,09)  | 0.307<br>(7,80)  | 0.358<br>(9,09)  |
| 28                        | 0.442<br>(11,23) | 0.458<br>(11,63) | 0.406<br>(10,31) | 0.458<br>(11,63) |
| 44                        | 0.640<br>(16,26) | 0.660<br>(16,76) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 52                        | 0.740<br>(18,78) | 0.761<br>(19,32) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 68                        | 0.938<br>(23,83) | 0.962<br>(24,43) | 0.850<br>(21,6)  | 0.858<br>(21,8)  |
| 84                        | 1.141<br>(28,99) | 1.165<br>(29,59) | 1.047<br>(26,6)  | 1.063<br>(27,0)  |

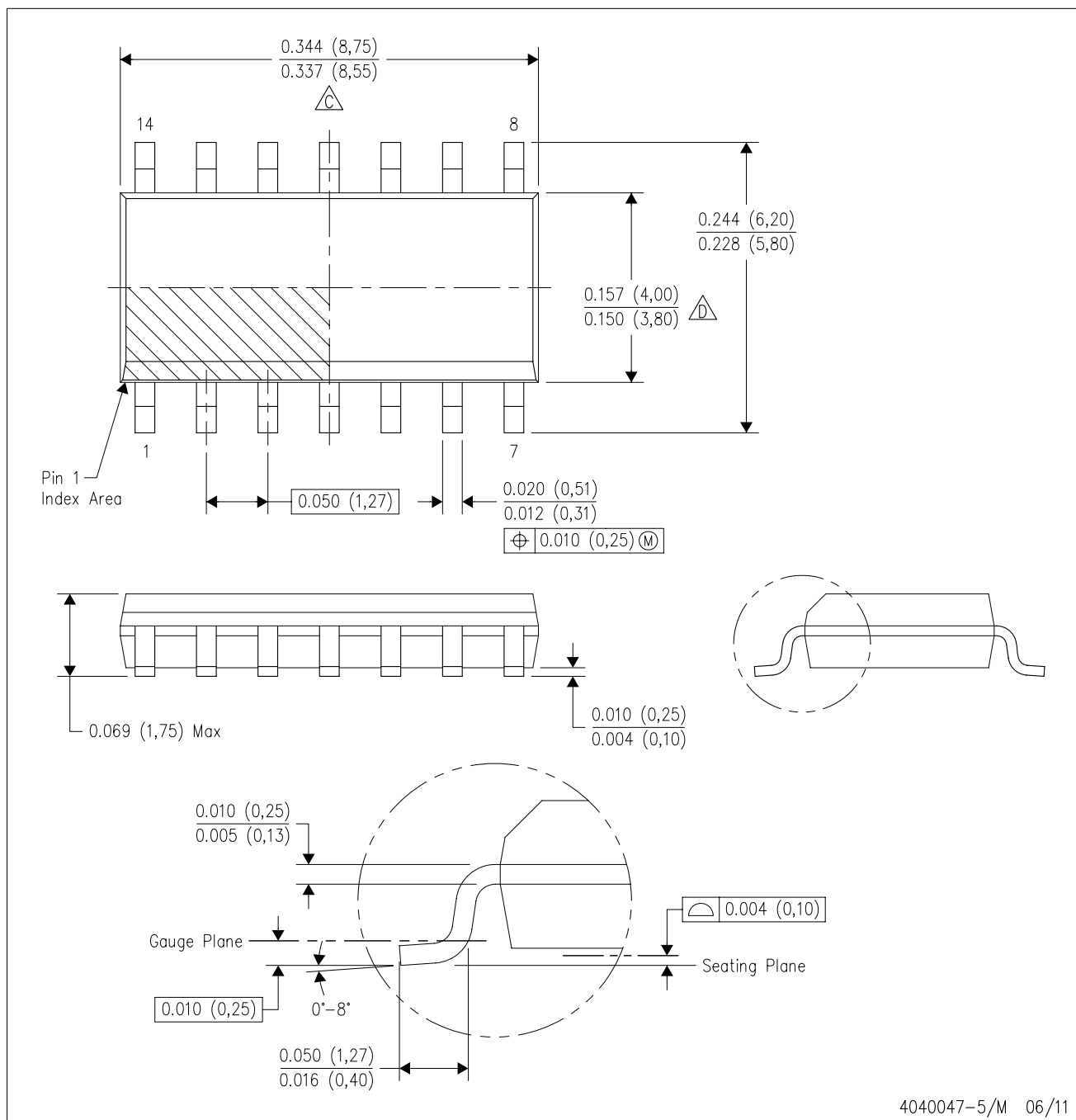


4040140/D 01/11

- 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.
  - Falls within JEDEC MS-004

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



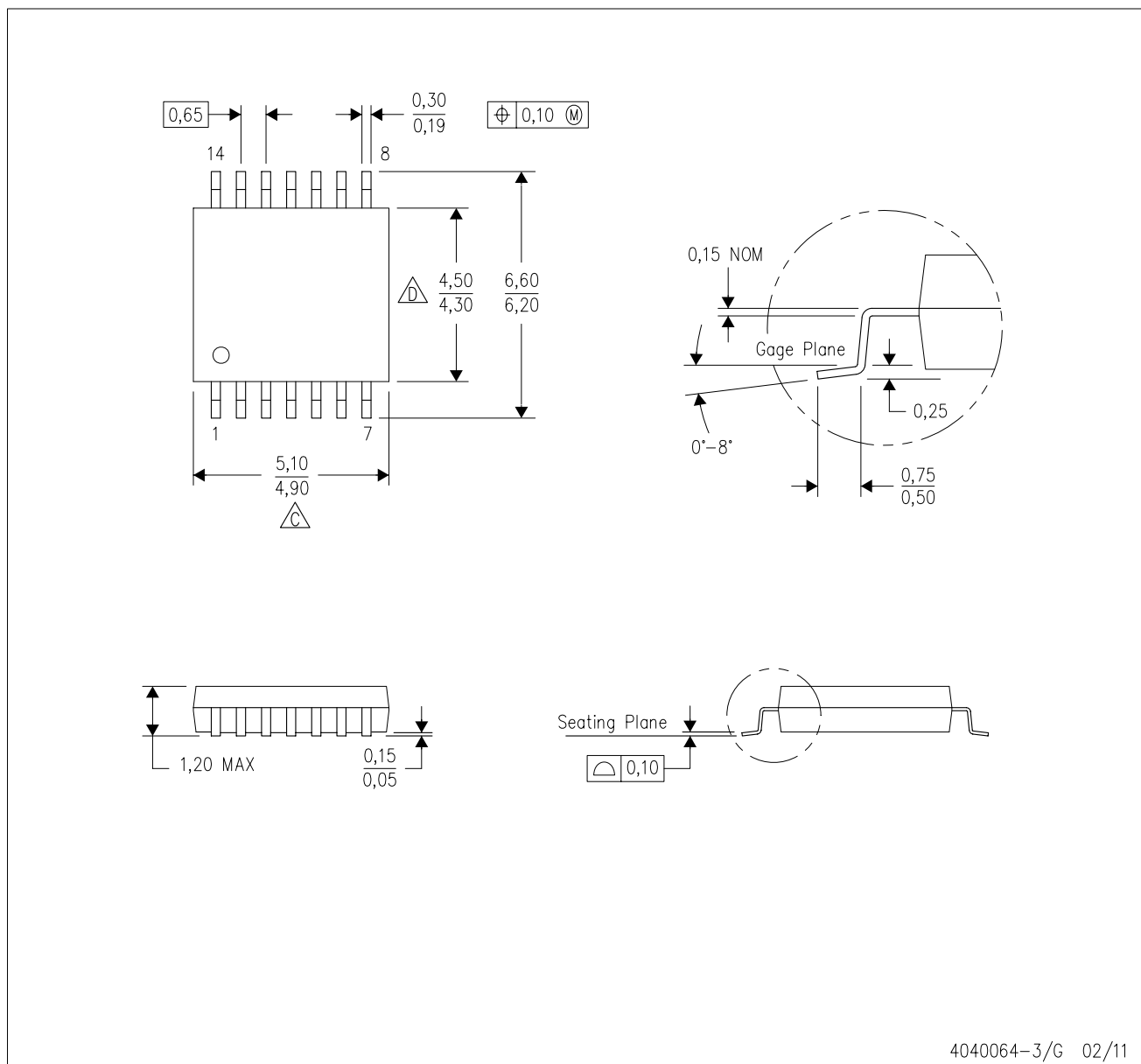
4040047-5/M 06/11

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.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



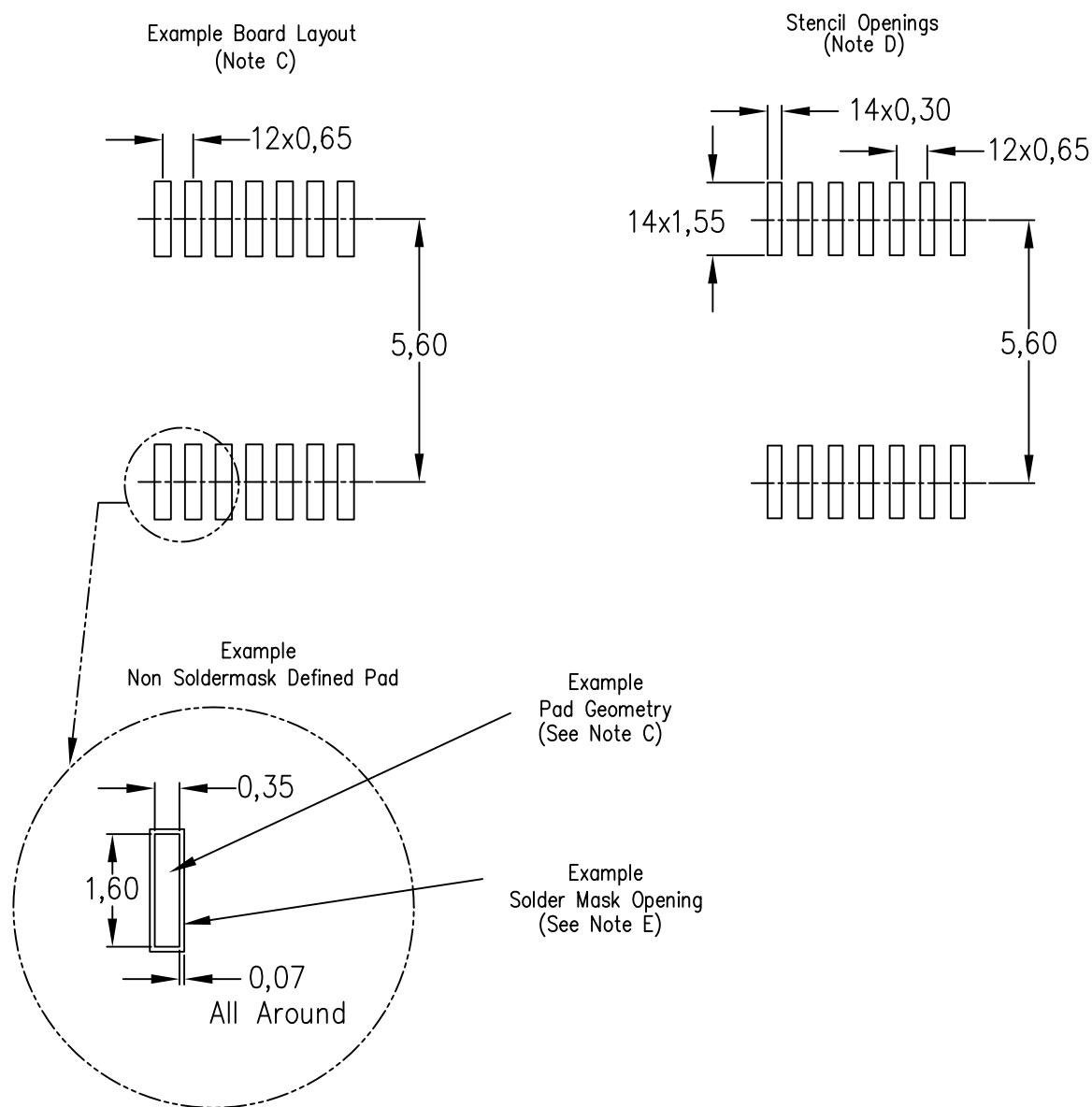
4040064-3/G 02/11

- 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

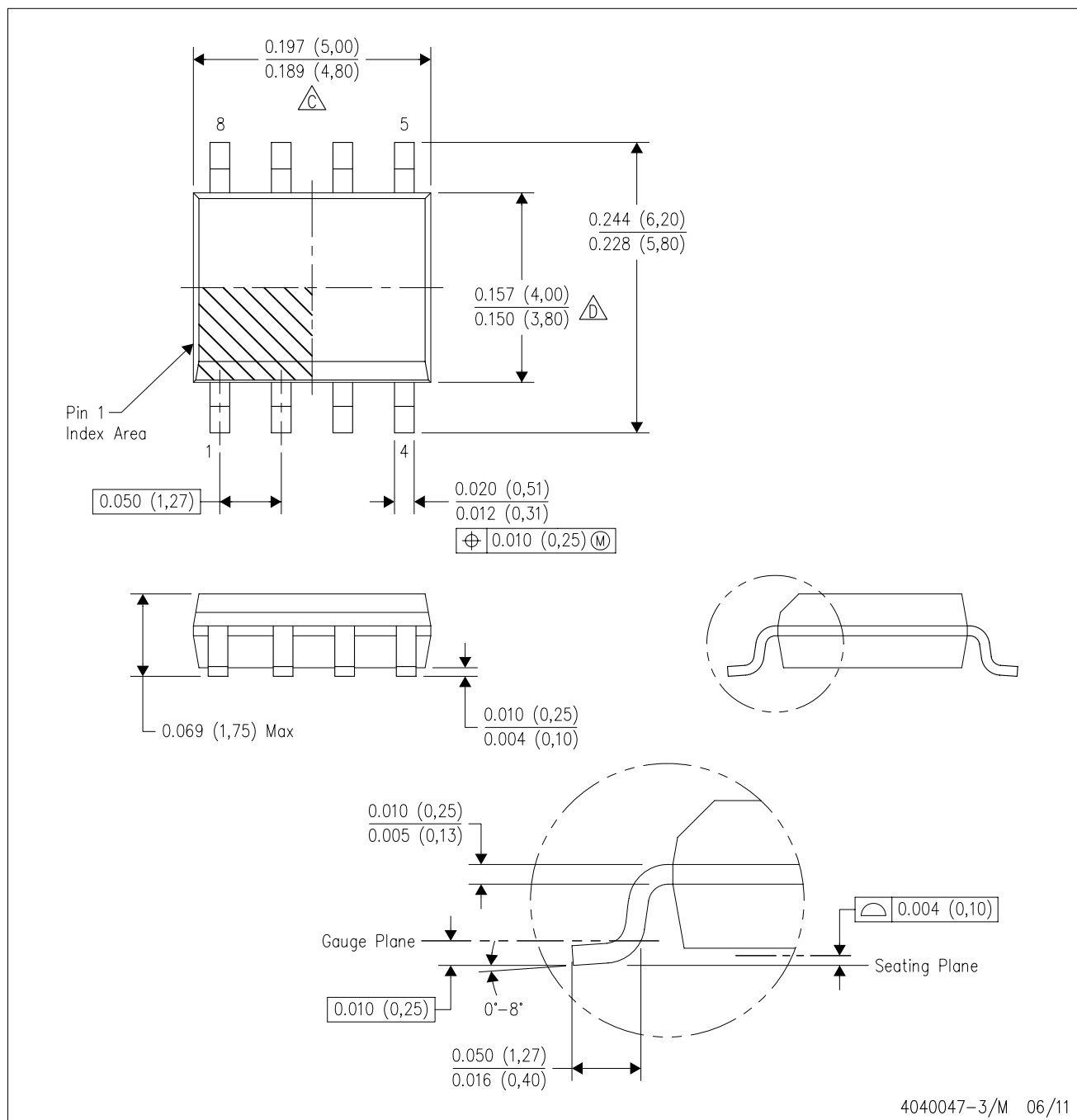


4211284-2/F 12/12

- 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.

D (R-PDSO-G8)

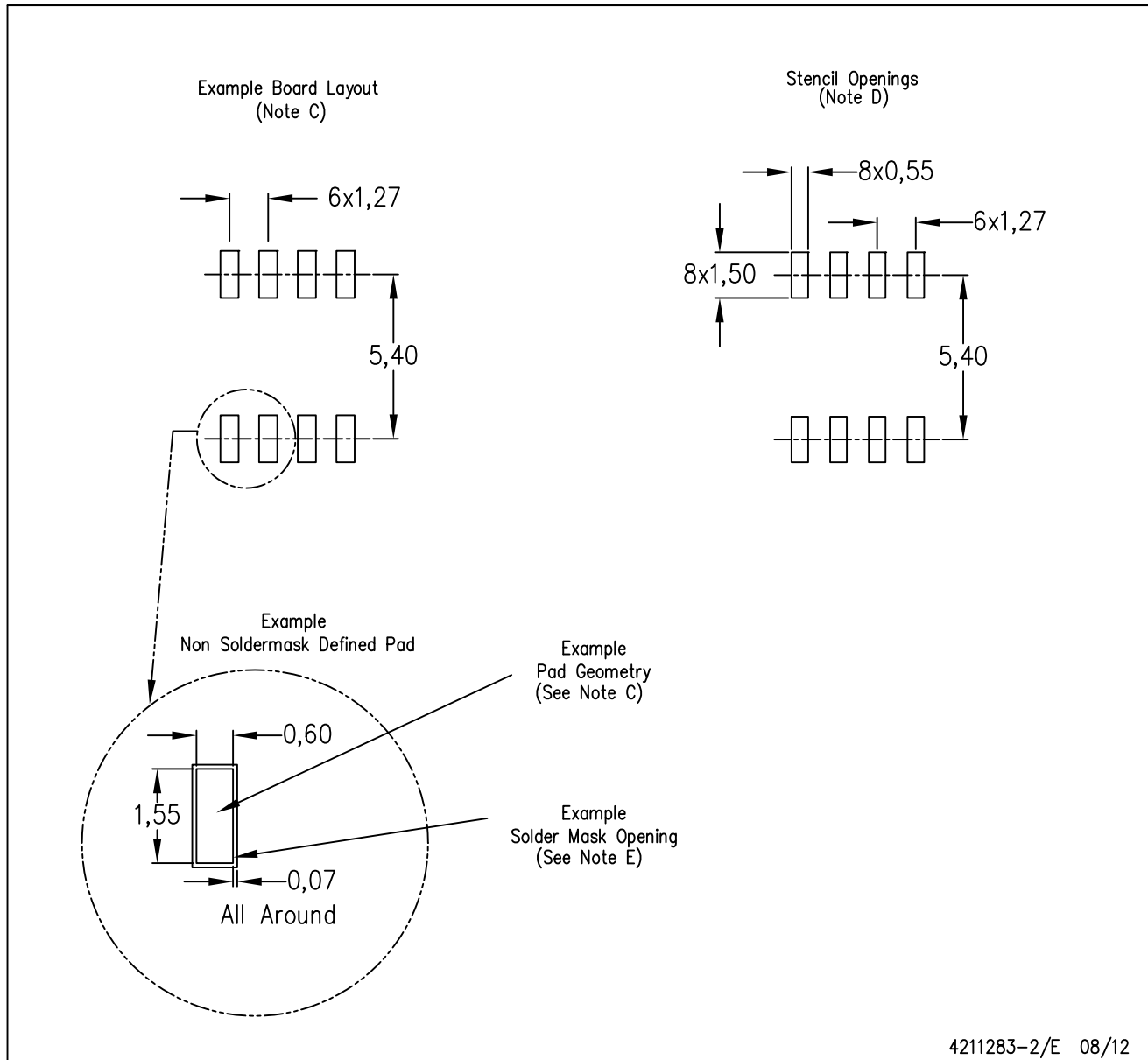
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  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.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE

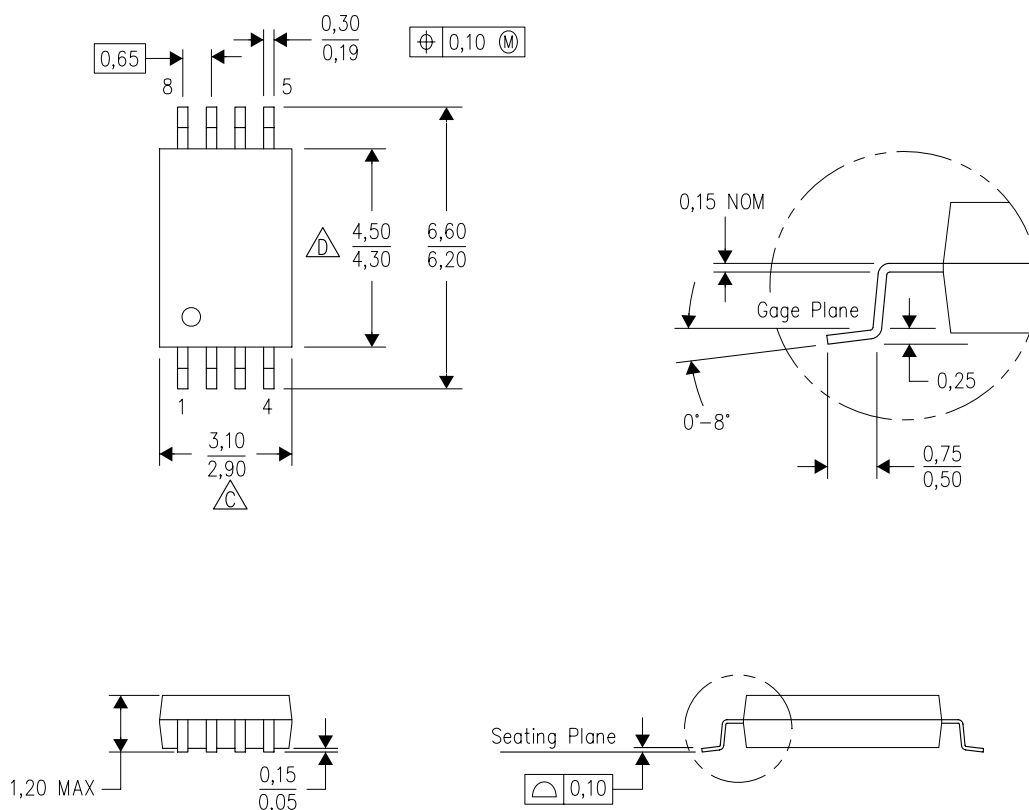


4211283-2/E 08/12

- 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-G8)

PLASTIC SMALL OUTLINE



4040064-2/G 02/11

- 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

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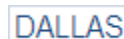
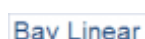
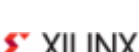
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