

# TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

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- Qualified for Automotive Applications
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- 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

#### 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.

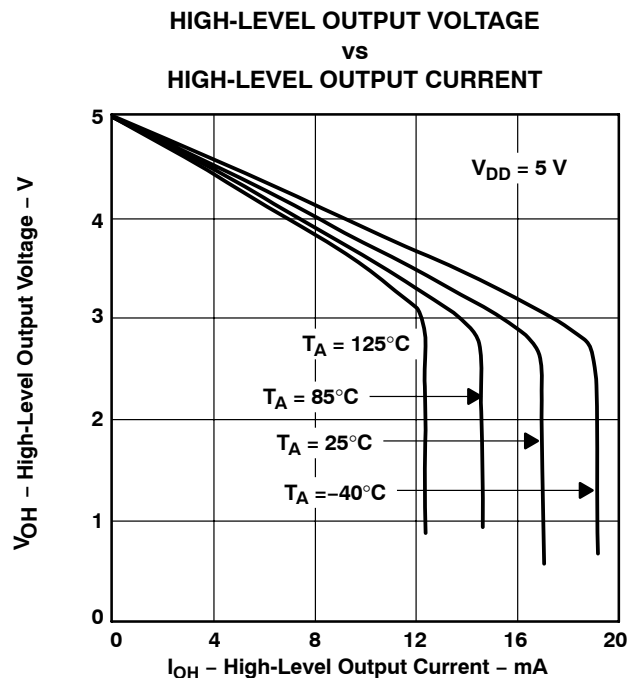


Figure 1

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.



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

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

**TEXAS  
INSTRUMENTS**

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# TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1

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## WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

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### ORDERING INFORMATION†

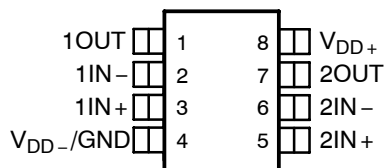
| $T_A$          | $V_{IOmax}$<br>AT 25°C | PACKAGE‡   |               | ORDERABLE<br>PART NUMBER | TOP-SIDE<br>MARKING |
|----------------|------------------------|------------|---------------|--------------------------|---------------------|
| –40°C to 125°C | 950 $\mu$ V            | SOIC (D)   | Tape and reel | TLV2432AQDRQ1            | 2432AQ              |
|                |                        | TSSOP (PW) | Tape and reel | TLV2432AQPWRQ1§          |                     |
|                | 2.5 mV                 | SOIC (D)   | Tape and reel | TLV2432QDRQ1             | 2432Q1              |
|                |                        | TSSOP (PW) | Tape and reel | TLV2432QPWRQ1§           |                     |
| –40°C to 125°C | 950 $\mu$ V            | SOIC (D)   | Tape and reel | TLV2434AQDRQ1            | 2434AQ              |
|                |                        | TSSOP (PW) | Tape and reel | TLV2434AQPWRQ1§          |                     |
|                | 2.5 mV                 | SOIC (D)   | Tape and reel | TLV2434QDRQ1§            |                     |
|                |                        | TSSOP (PW) | Tape and reel | TLV2434QPWRQ1§           |                     |

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

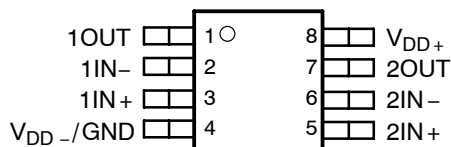
‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.

§ Product Preview.

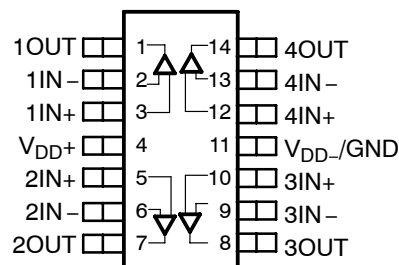
**TLV2432  
D PACKAGE  
(TOP VIEW)**



**TLV2432  
PW PACKAGE  
(TOP VIEW)**



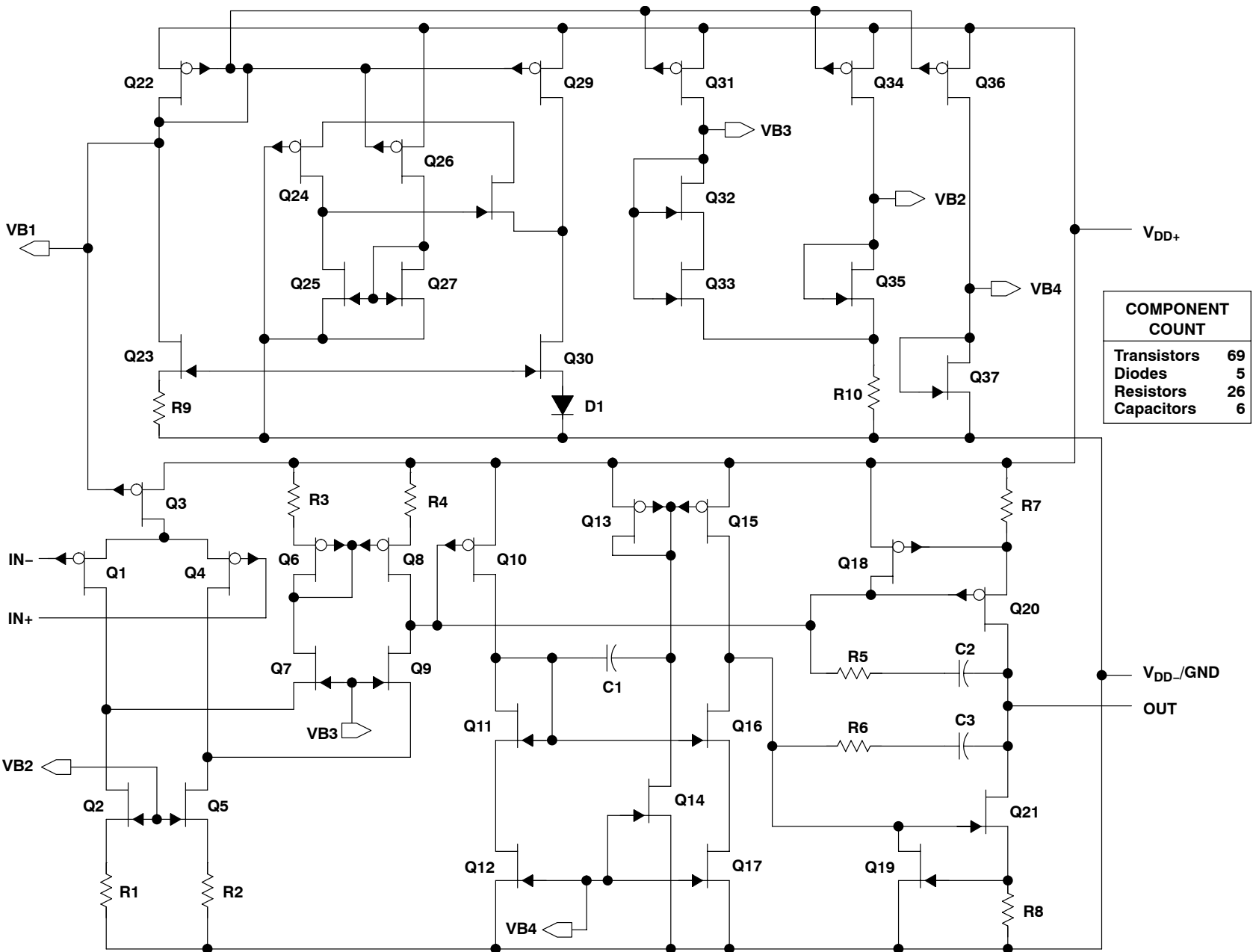
**TLV2434  
D OR PW PACKAGE  
(TOP VIEW)**



TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1  
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equivalent schematic (each amplifier)



# TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1

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## WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

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

|                                                                   |                              |
|-------------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{DD}$ (see Note 1)                             | 12 V                         |
| Differential input voltage, $V_{ID}$ (see Note 2)                 | $\pm V_{DD}$                 |
| Input 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, $T_A$ : Q suffix            | –40°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                                    |
| 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                                    |

### recommended operating conditions

|                                       | MIN       | MAX             | UNIT |
|---------------------------------------|-----------|-----------------|------|
| Supply voltage, $V_{DD}$              | 2.7       | 10              | V    |
| Input voltage range, $V_I$            | $V_{DD-}$ | $V_{DD+} - 0.8$ | V    |
| Common-mode input voltage, $V_{IC}$   | $V_{DD-}$ | $V_{DD+} - 0.8$ | V    |
| Operating free-air temperature, $T_A$ | –40       | 125             | °C   |



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

| PARAMETER                                         |                                                                      | TEST CONDITIONS                                                                                         |                        | T <sub>A</sub> <sup>†</sup> | TLV243x-Q1 |     |       | 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     | TLV243x                | 25°C                        | 300        |     | 2000  | μV   |
|                                                   |                                                                      |                                                                                                         |                        | Full range                  | 2500       |     |       |      |
|                                                   |                                                                      | TLV243xA                                                                                                | 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 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        |     | pA    |      |
|                                                   |                                                                      |                                                                                                         |                        | Full range                  | 150        |     |       |      |
| I <sub>IB</sub>                                   | Input bias current                                                   |                                                                                                         |                        | 25°C                        | 1          |     | 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, 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‡ | 25°C                        | 1.5        | 2.5 | V/mV  |      |
|                                                   |                                                                      |                                                                                                         |                        | Full range                  | 0.5        |     |       |      |
|                                                   |                                                                      |                                                                                                         | R <sub>L</sub> = 1 MΩ‡ | 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> = V <sub>ICR</sub> MIN, 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.

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

| PARAMETER              |                                             | TEST CONDITIONS                                                                                                                |                                                             | T <sub>A</sub> <sup>†</sup>        | TLV243x-Q1,<br>TLV243xA-Q1 |      |      | 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     |

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

$^\ddagger$  Referenced to 2.5 V

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

| PARAMETER                                         |                                                                      | TEST CONDITIONS                                                                                         |                        | T <sub>A</sub> <sup>†</sup> | TLV243x-Q1 |     |       | 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             | 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        |     | pA    |      |
|                                                   |                                                                      |                                                                                                         |                        | Full range                  | 150        |     |       |      |
| I <sub>IB</sub>                                   | Input bias current                                                   |                                                                                                         |                        | 25°C                        | 1          |     | 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<br>−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‡ | 25°C                        | 2.5        |     | 3.8   | V/mV |
|                                                   |                                                                      |                                                                                                         |                        | Full range                  | 0.5        |     |       |      |
|                                                   |                                                                      |                                                                                                         | R <sub>L</sub> = 1 MΩ‡ | 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> = V <sub>ICR</sub> MIN, 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.

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

| PARAMETER   |                                             | TEST CONDITIONS                                                                                               |                                              | $T_A^\dagger$ | TLV243x-Q1,<br>TLV243xA-Q1 |        |     | UNIT                   |
|-------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------|----------------------------|--------|-----|------------------------|
|             |                                             |                                                                                                               |                                              |               | MIN                        | TYP    | MAX |                        |
| SR          | Slew rate at unity gain                     | $V_O = 1.5\text{ V to }3.5\text{ V},$<br>$C_L = 100\text{ pF}^\ddagger$                                       | $R_L = 2\text{ k}\Omega^\ddagger,$           | 25°C          | 0.15                       | 0.25   |     | V/ $\mu\text{s}$       |
|             |                                             |                                                                                                               |                                              | Full range    | 0.1                        |        |     |                        |
| $V_n$       | Equivalent input noise voltage              | $f = 10\text{ Hz}$                                                                                            |                                              | 25°C          |                            | 100    |     | nV/ $\sqrt{\text{Hz}}$ |
|             |                                             | $f = 1\text{ kHz}$                                                                                            |                                              | 25°C          |                            | 18     |     |                        |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage | $f = 0.1\text{ Hz to }1\text{ Hz}$                                                                            |                                              | 25°C          |                            | 1.9    |     | $\mu\text{V}$          |
|             |                                             | $f = 0.1\text{ Hz to }10\text{ Hz}$                                                                           |                                              | 25°C          |                            | 2.8    |     |                        |
| $I_n$       | Equivalent input noise current              |                                                                                                               |                                              | 25°C          |                            | 0.6    |     | fA/ $\sqrt{\text{Hz}}$ |
| THD + N     | Total harmonic distortion plus noise        | $V_O = 1.5\text{ V to }3.5\text{ V},$<br>$f = 1\text{ kHz},$<br>$R_L = 2\text{ k}\Omega^\ddagger$             | $A_V = 1$                                    | 25°C          |                            | 0.045% |     |                        |
|             |                                             |                                                                                                               | $A_V = 10$                                   |               |                            | 0.4%   |     |                        |
|             | Gain-bandwidth product                      | $f = 10\text{ kHz},$<br>$C_L = 100\text{ pF}^\ddagger$                                                        | $R_L = 2\text{ k}\Omega^\ddagger,$           | 25°C          |                            | 0.55   |     | MHz                    |
| $B_{OM}$    | Maximum output-swing bandwidth              | $V_{O(PP)} = 2\text{ V},$<br>$R_L = 2\text{ k}\Omega^\ddagger,$                                               | $A_V = 1,$<br>$C_L = 100\text{ pF}^\ddagger$ | 25°C          |                            | 100    |     | kHz                    |
| $t_s$       | Settling time                               | $A_V = -1,$<br>Step = 1.5 V to 3.5 V,<br>$R_L = 2\text{ k}\Omega^\ddagger,$<br>$C_L = 100\text{ pF}^\ddagger$ | $T_o = 0.1\%$                                | 25°C          |                            | 6.4    |     | $\mu\text{s}$          |
|             |                                             |                                                                                                               | $T_o = 0.01\%$                               |               |                            | 13.1   |     |                        |
| $\phi_m$    | Phase margin at unity gain                  |                                                                                                               |                                              | 25°C          |                            | 66°    |     |                        |
|             | Gain margin                                 | $R_L = 2\text{ k}\Omega^\ddagger,$                                                                            | $C_L = 100\text{ pF}^\ddagger$               | 25°C          |                            | 11     |     | dB                     |

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

$^\ddagger$  Referenced to 2.5 V

**TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1**  
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**TYPICAL CHARACTERISTICS**

**Table of Graphs**

|                 |                                                 |                                                | <b>FIGURE</b> |
|-----------------|-------------------------------------------------|------------------------------------------------|---------------|
| $V_{IO}$        | 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-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1

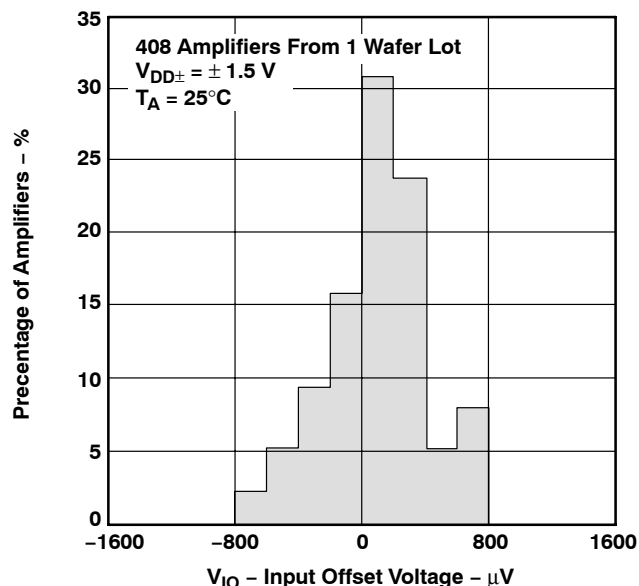
## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

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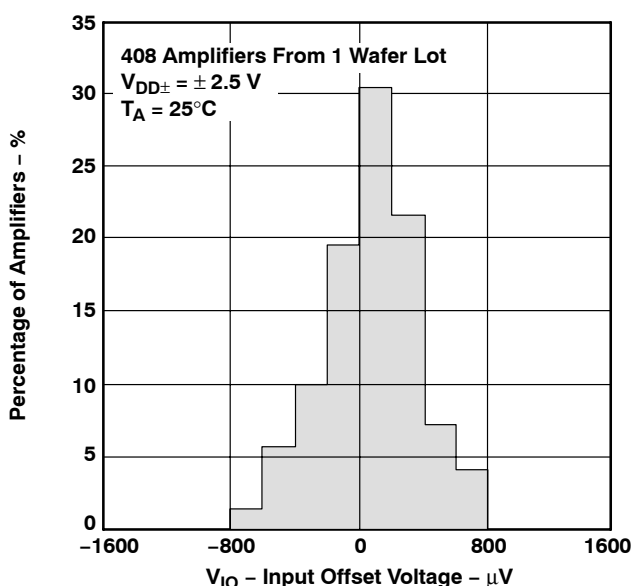
#### TYPICAL CHARACTERISTICS

**DISTRIBUTION OF TLV2432  
INPUT OFFSET VOLTAGE**



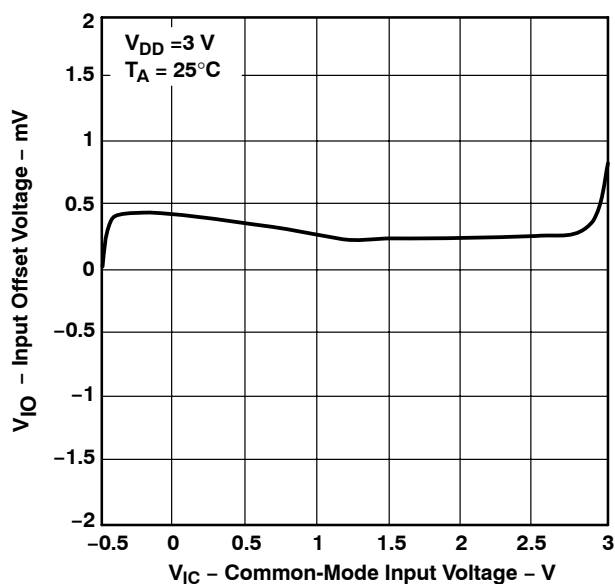
**Figure 2**

**DISTRIBUTION OF TLV2432  
INPUT OFFSET VOLTAGE**



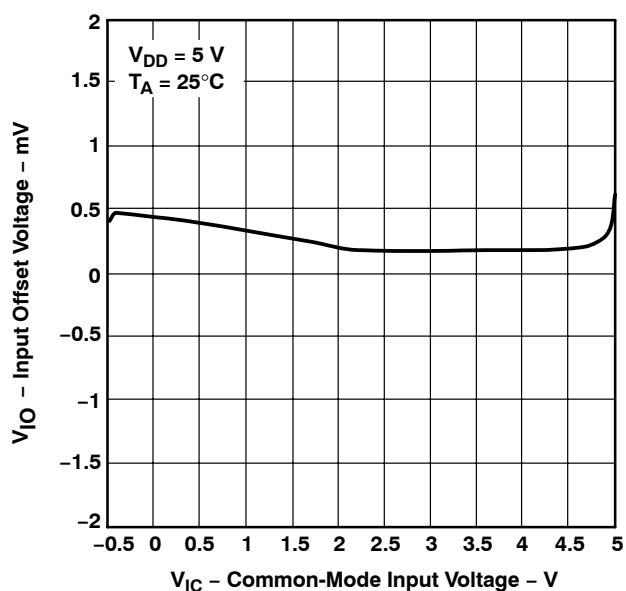
**Figure 3**

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



**Figure 4**

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



**Figure 5**

TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1  
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TYPICAL CHARACTERISTICS

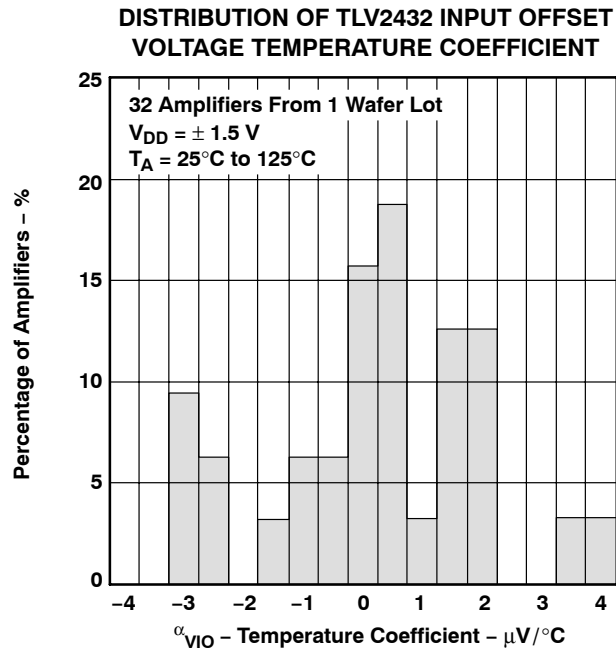


Figure 6

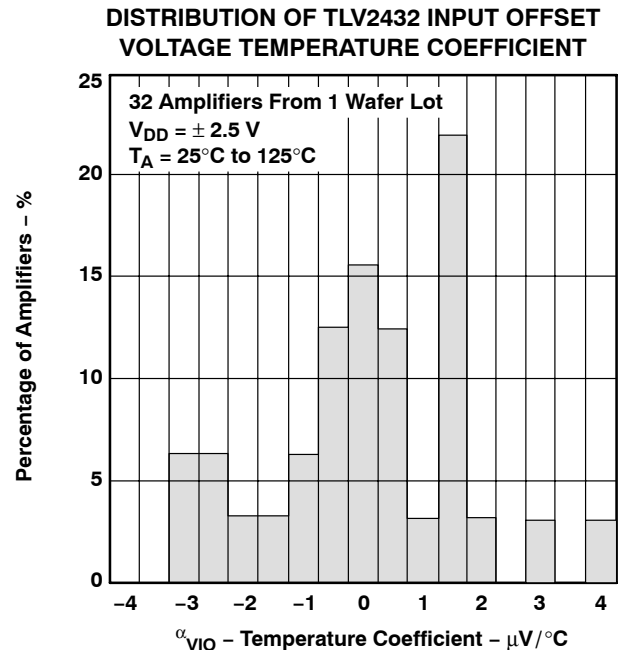


Figure 7

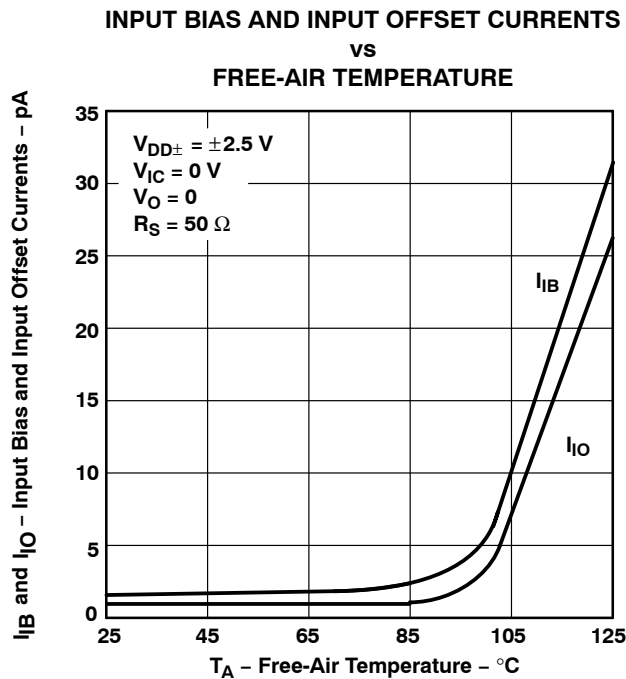


Figure 8

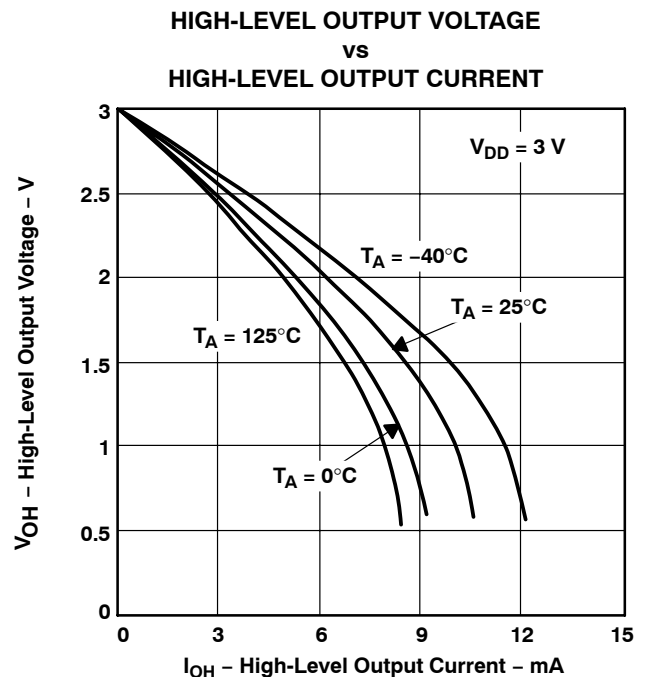


Figure 9

## TYPICAL CHARACTERISTICS

LOW-LEVEL OUTPUT VOLTAGE  
vs  
LOW-LEVEL OUTPUT CURRENT

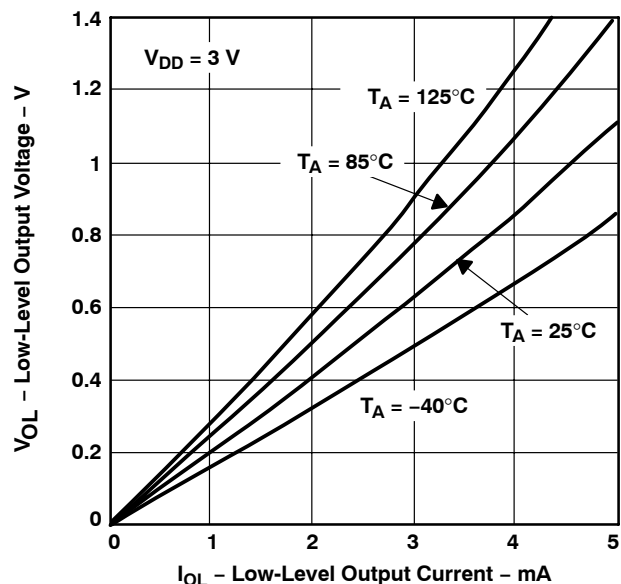


Figure 10

HIGH-LEVEL OUTPUT VOLTAGE  
vs  
HIGH-LEVEL OUTPUT CURRENT

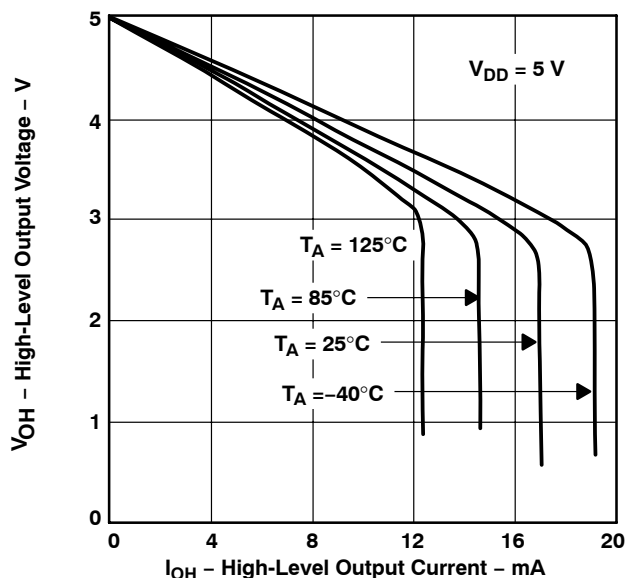


Figure 11

LOW-LEVEL OUTPUT VOLTAGE  
vs  
LOW-LEVEL OUTPUT CURRENT

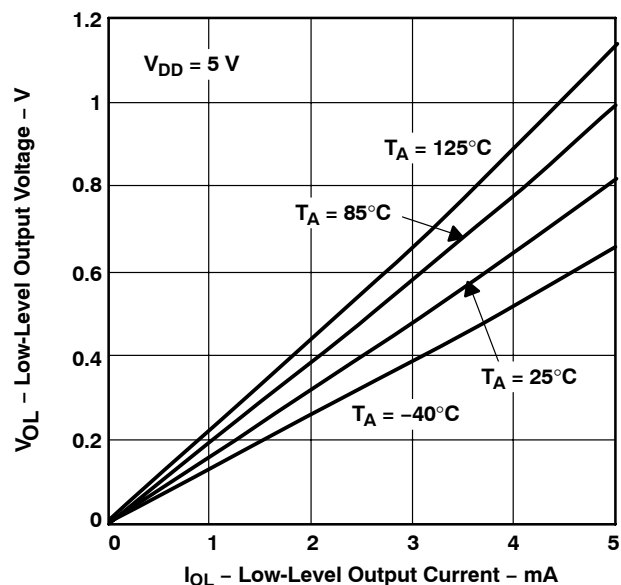


Figure 12

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE  
vs  
FREQUENCY

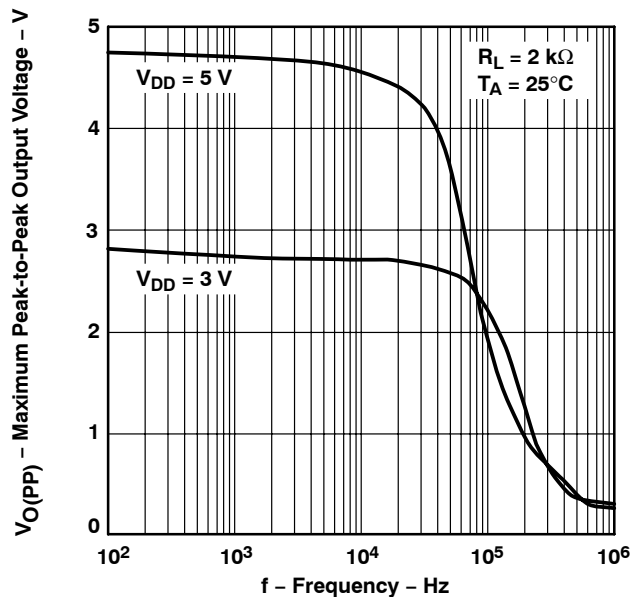


Figure 13

TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1  
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TYPICAL CHARACTERISTICS

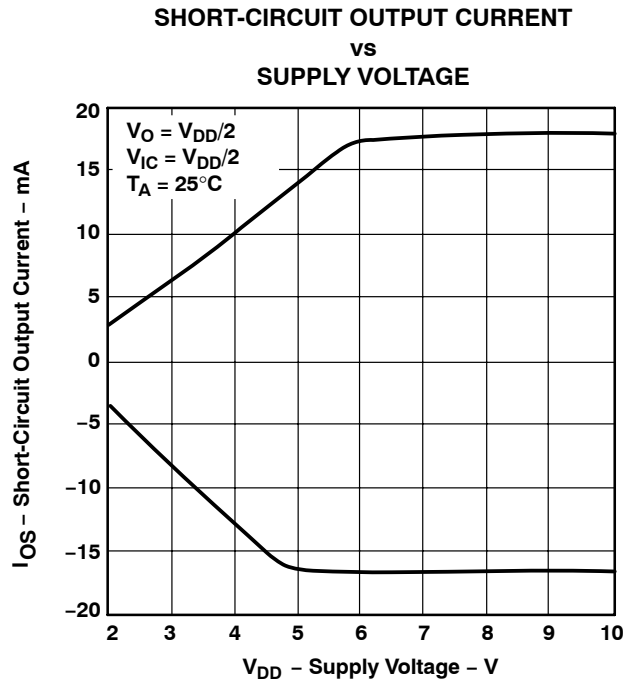


Figure 14

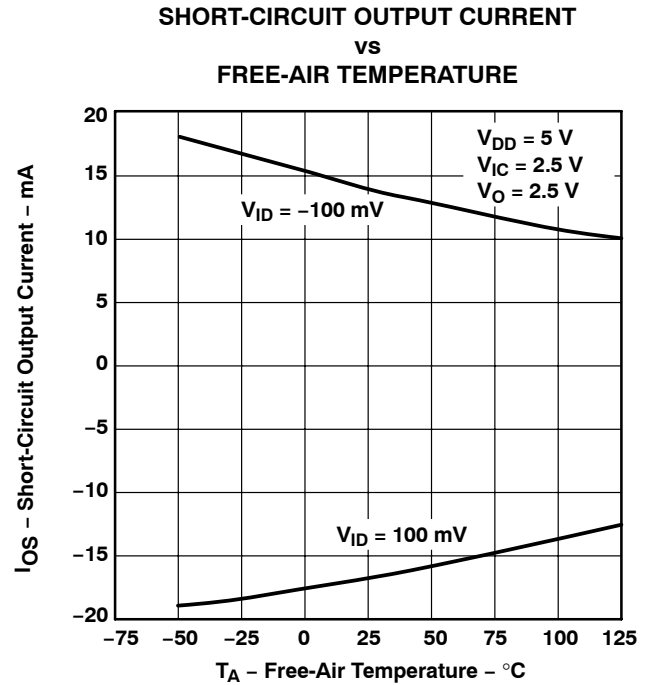


Figure 15

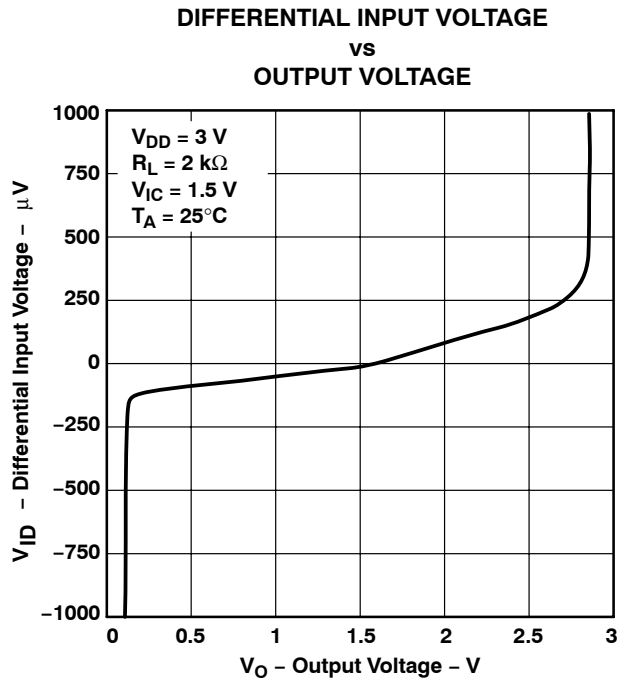


Figure 16

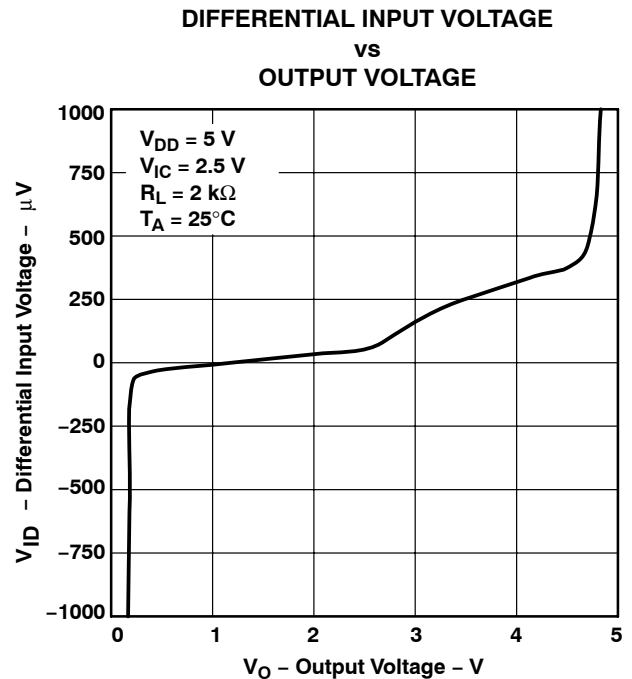
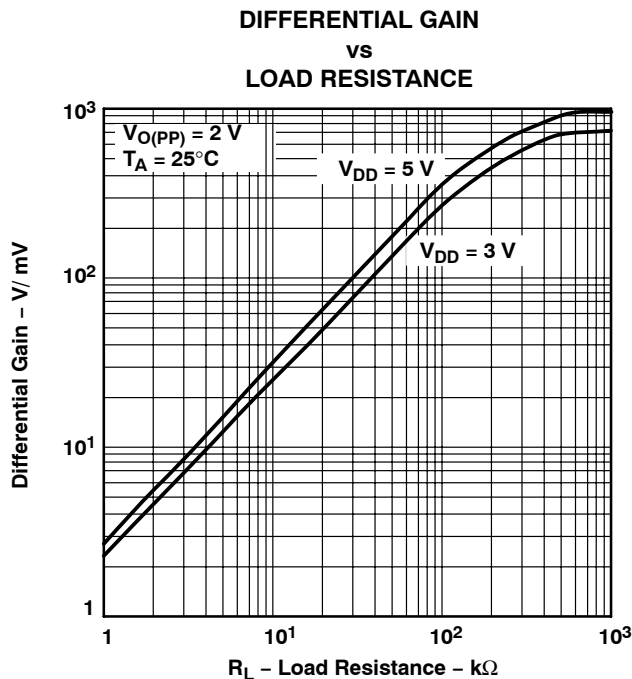


Figure 17

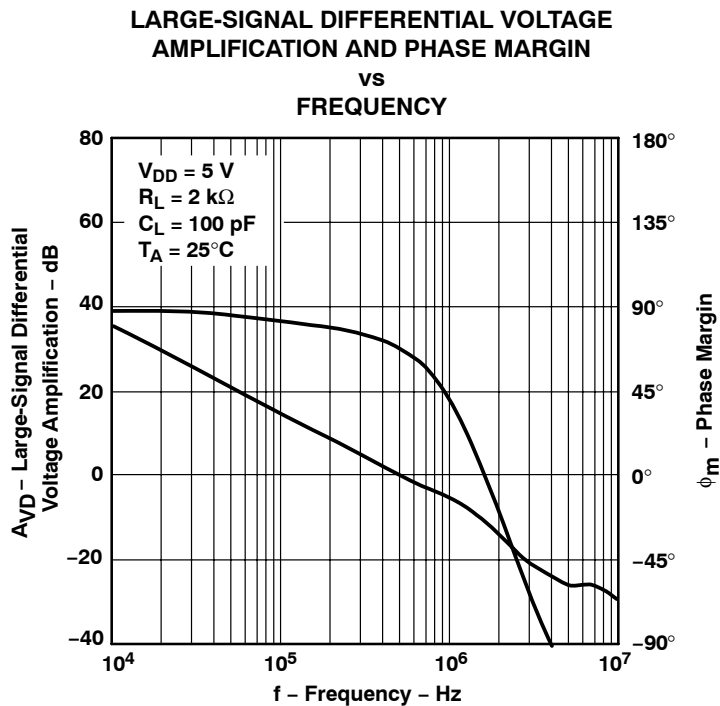
**TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1**  
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**TYPICAL CHARACTERISTICS**



**Figure 18**



**Figure 19**

TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1  
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TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE  
AMPLIFICATION AND PHASE MARGIN

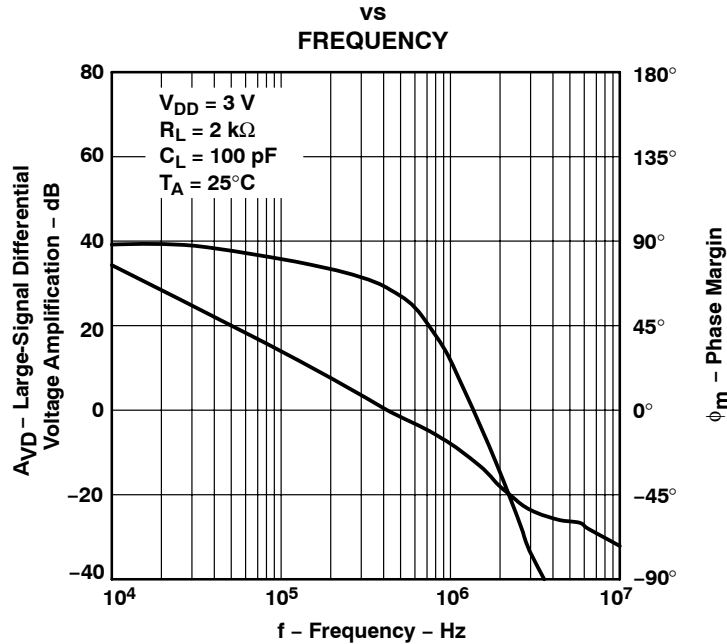


Figure 20

DIFFERENTIAL VOLTAGE AMPLIFICATION  
vs  
FREE-AIR TEMPERATURE

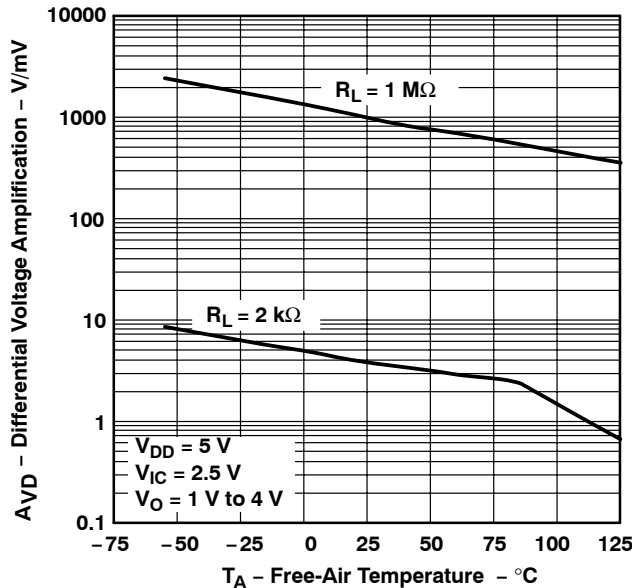


Figure 21

DIFFERENTIAL VOLTAGE AMPLIFICATION  
vs  
FREE-AIR TEMPERATURE

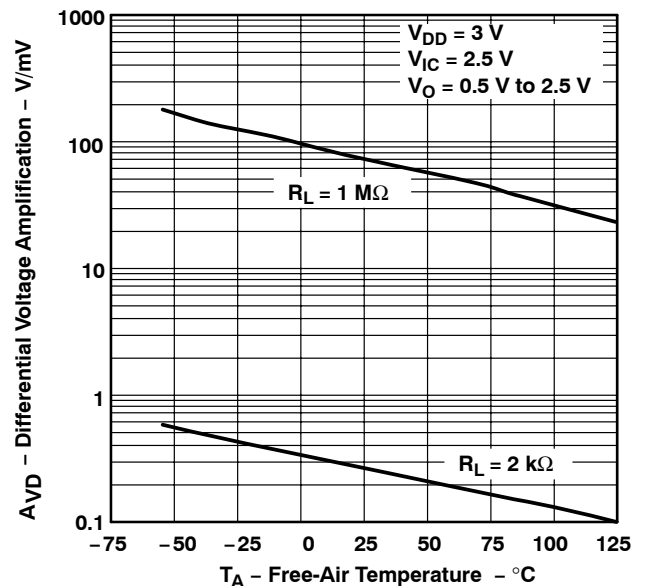


Figure 22

## TYPICAL CHARACTERISTICS

OUTPUT IMPEDANCE  
vs  
FREQUENCY

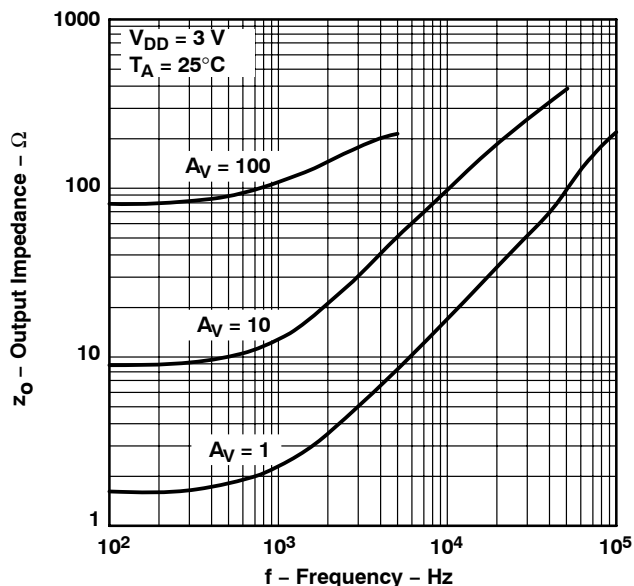


Figure 23

OUTPUT IMPEDANCE  
vs  
FREQUENCY

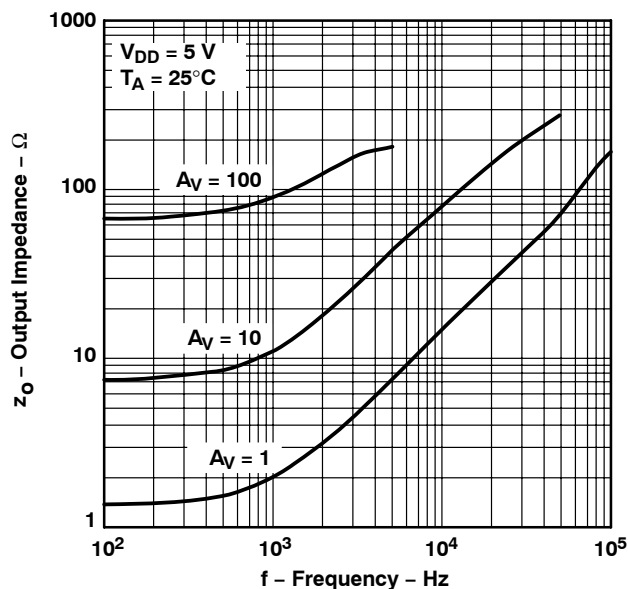


Figure 24

COMMON-MODE REJECTION RATIO  
vs  
FREQUENCY

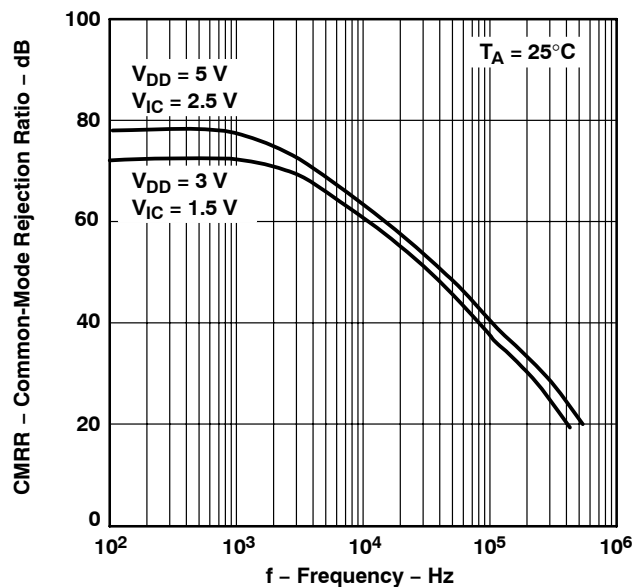


Figure 25

COMMON-MODE REJECTION RATIO  
vs  
FREE-AIR TEMPERATURE

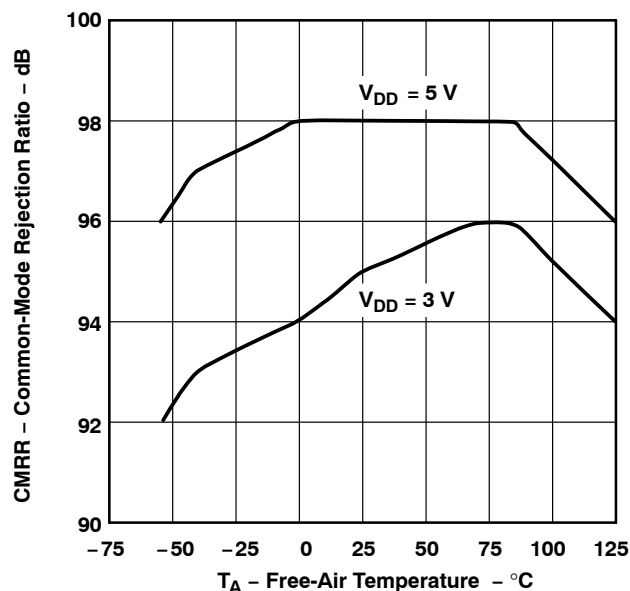


Figure 26

TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1  
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TYPICAL CHARACTERISTICS

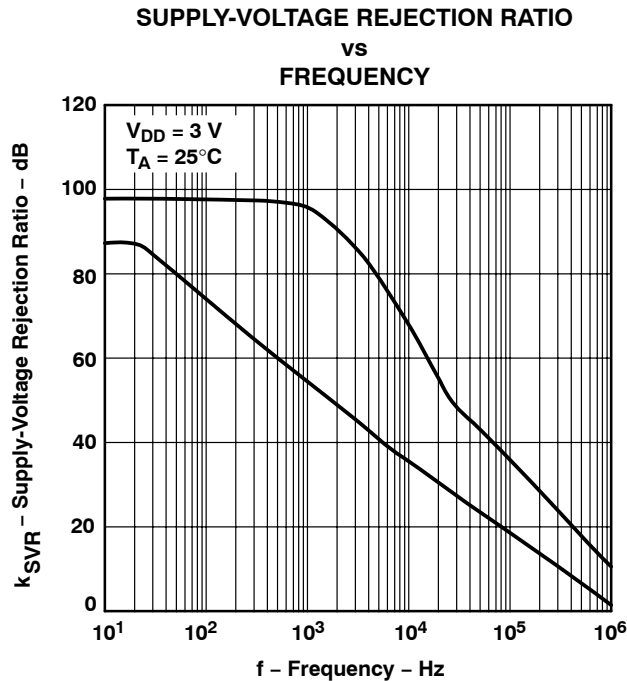


Figure 27

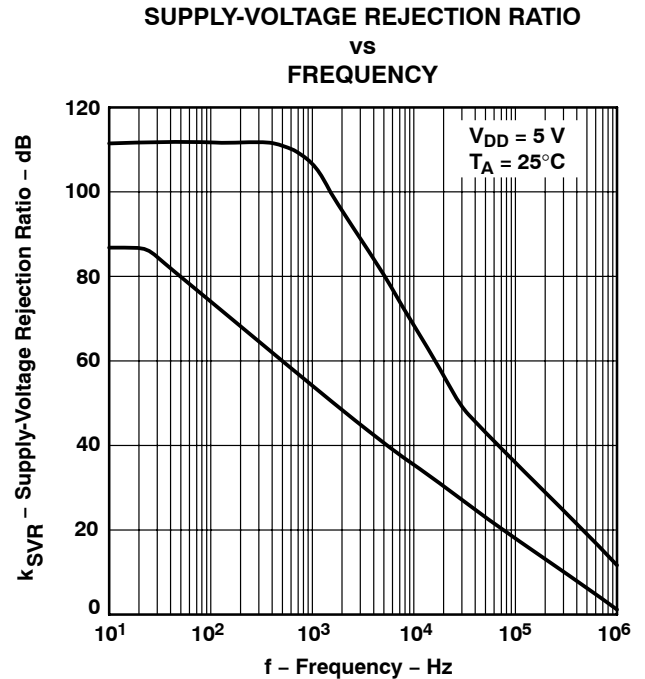


Figure 28

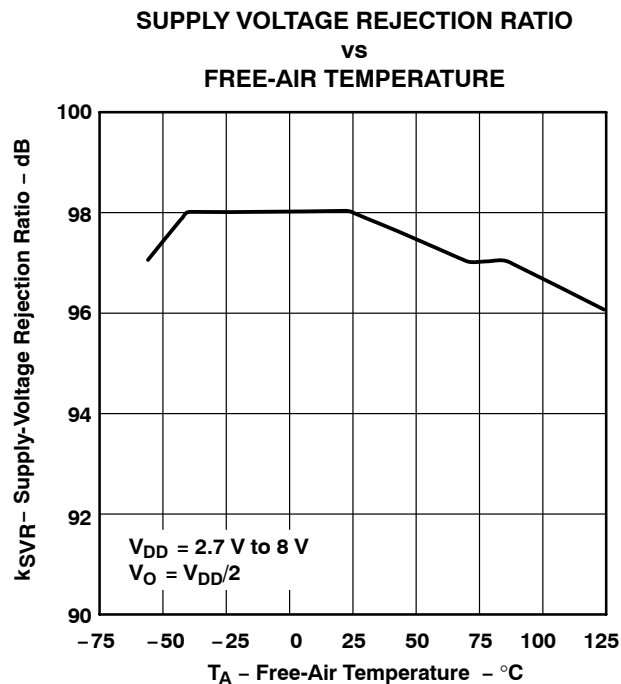


Figure 29

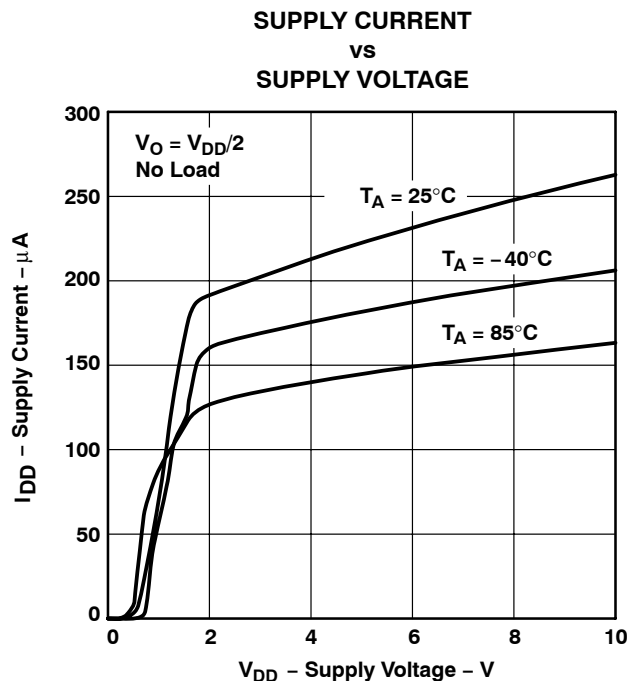


Figure 30

## TYPICAL CHARACTERISTICS

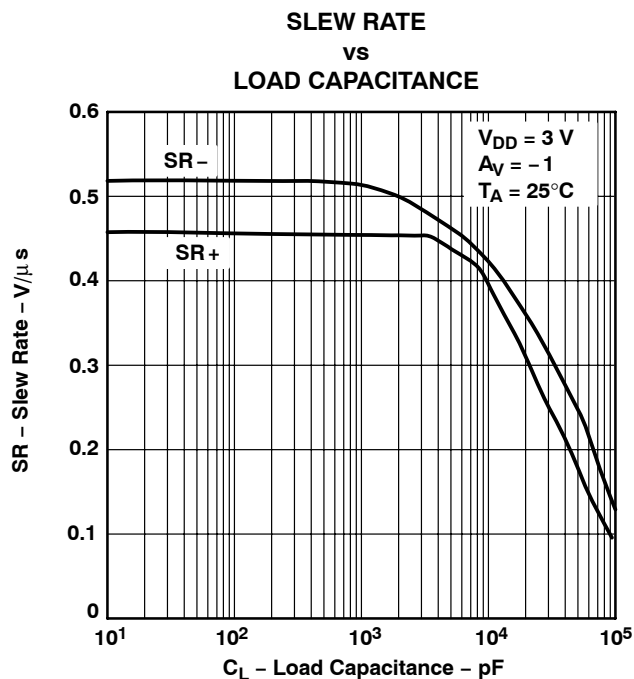


Figure 31

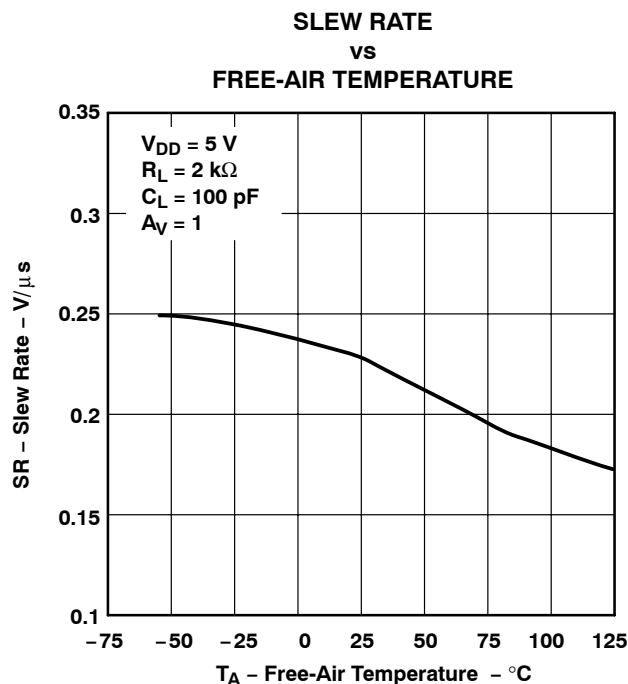


Figure 32

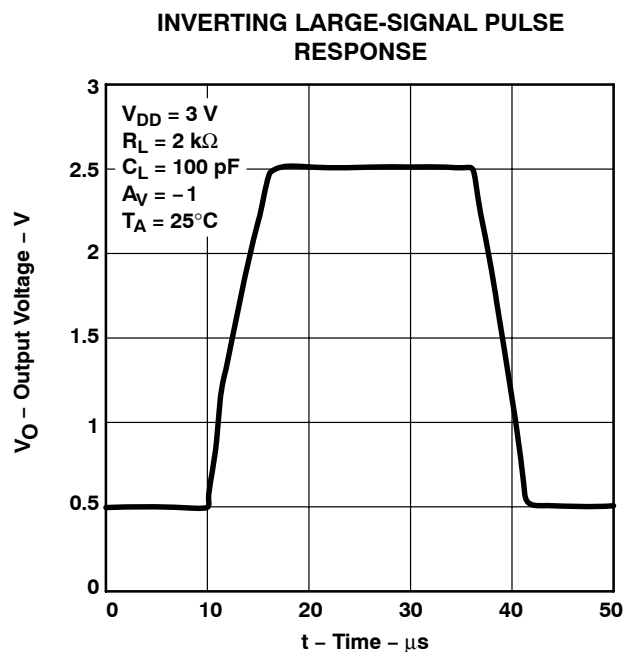


Figure 33

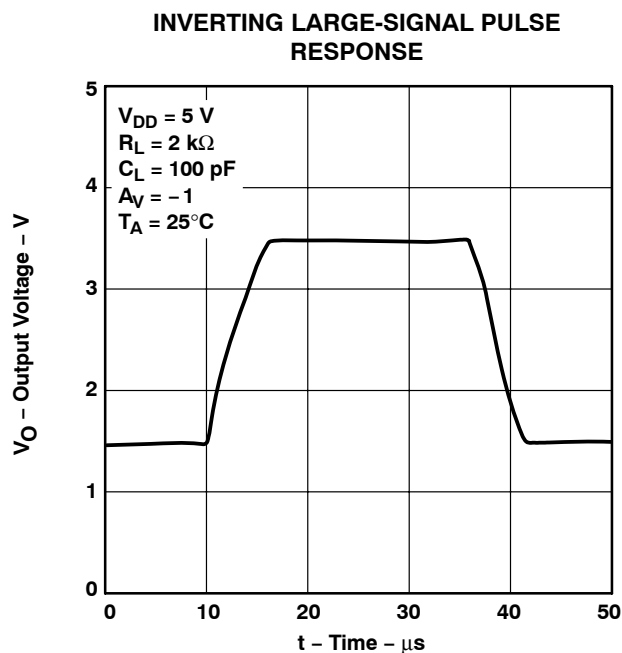


Figure 34

TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1  
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TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER LARGE-SIGNAL  
PULSE RESPONSE

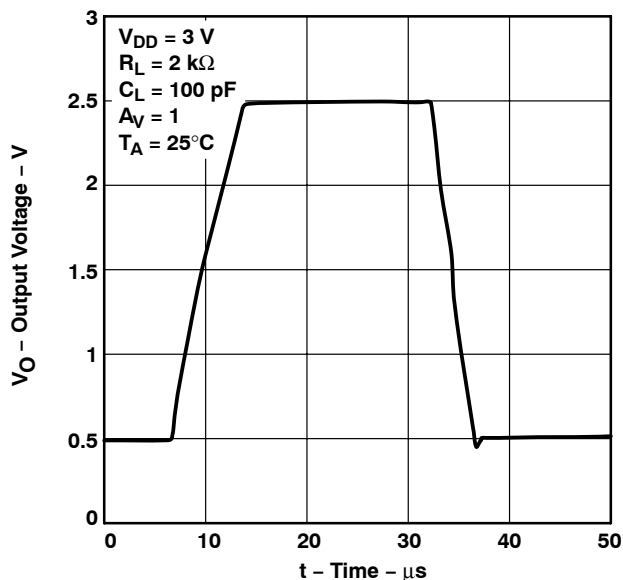


Figure 35

VOLTAGE-FOLLOWER LARGE-SIGNAL  
PULSE RESPONSE

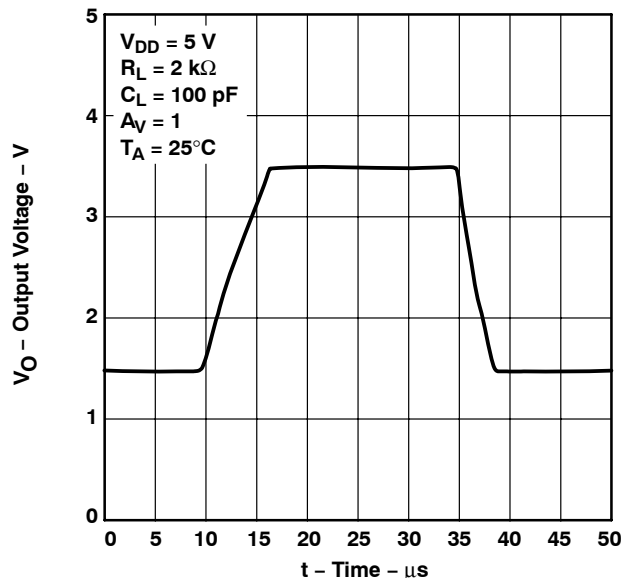


Figure 36

INVERTING SMALL-SIGNAL PULSE  
RESPONSE

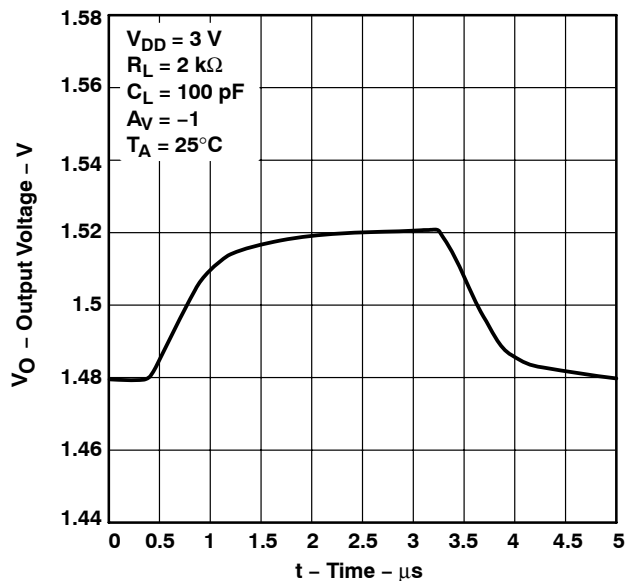


Figure 37

INVERTING SMALL-SIGNAL PULSE  
RESPONSE

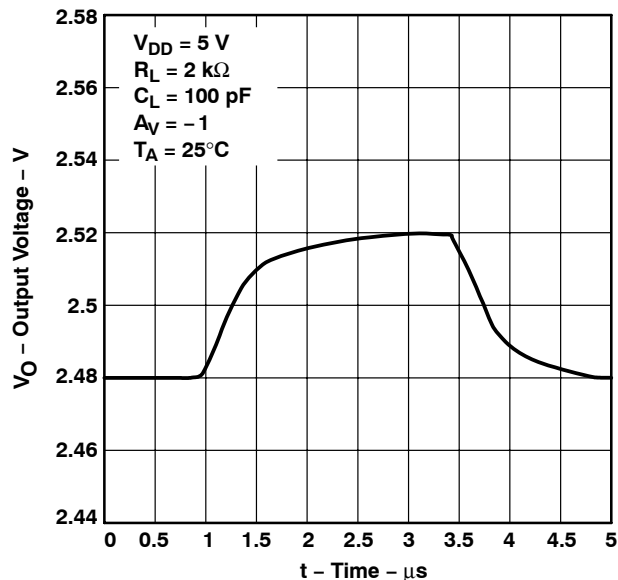


Figure 38

## TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER SMALL-SIGNAL  
PULSE RESPONSE

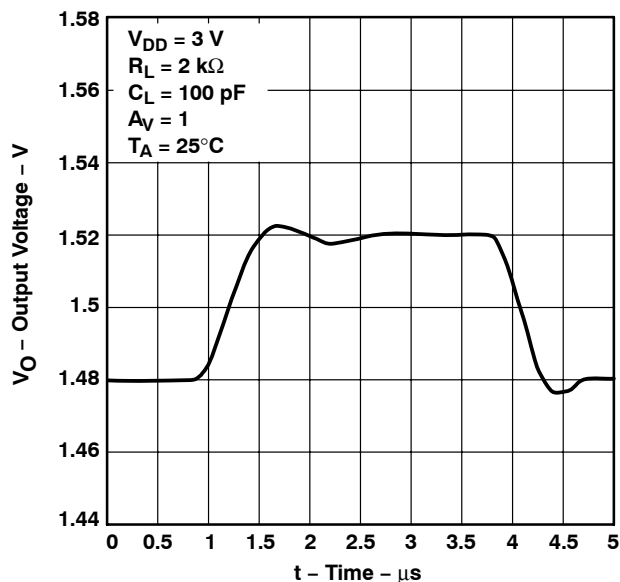


Figure 39

VOLTAGE-FOLLOWER SMALL-SIGNAL  
PULSE RESPONSE

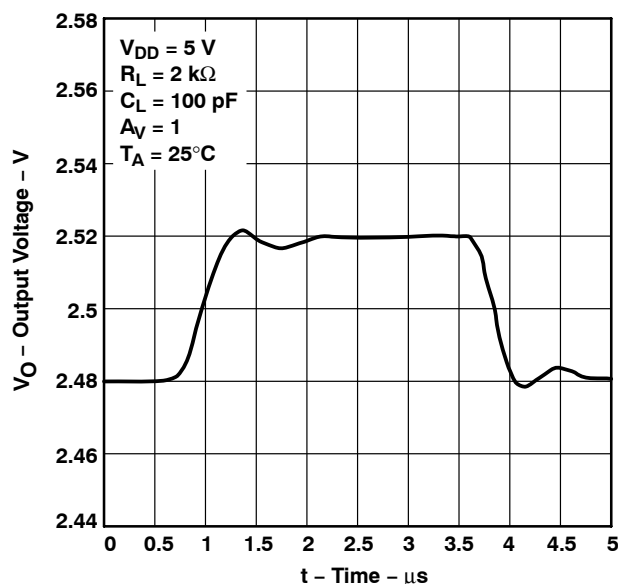


Figure 40

EQUIVALENT INPUT NOISE VOLTAGE  
vs  
FREQUENCY

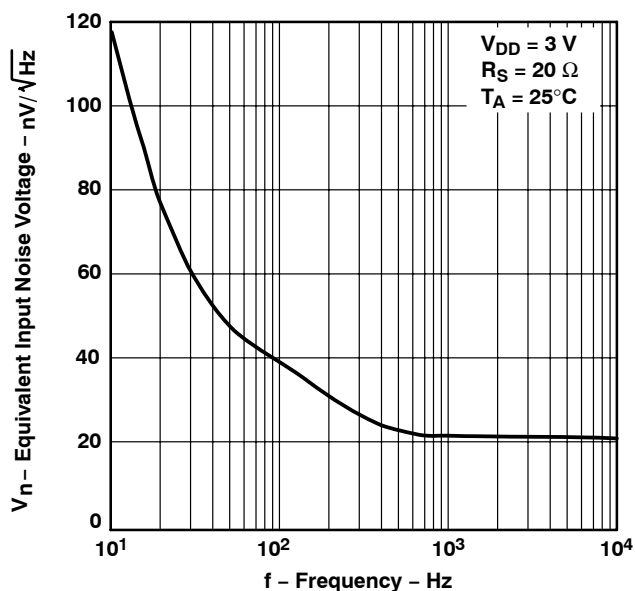


Figure 41

EQUIVALENT INPUT NOISE VOLTAGE  
vs  
FREQUENCY

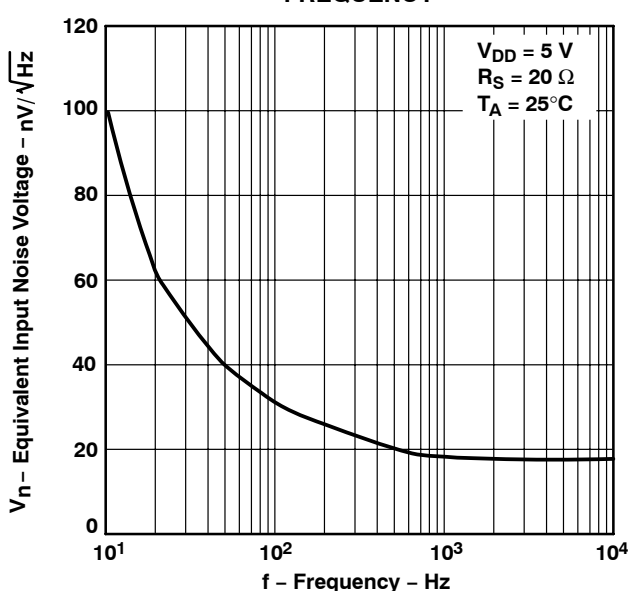


Figure 42

## TYPICAL CHARACTERISTICS

NOISE VOLTAGE OVER A 10-SECOND PERIOD

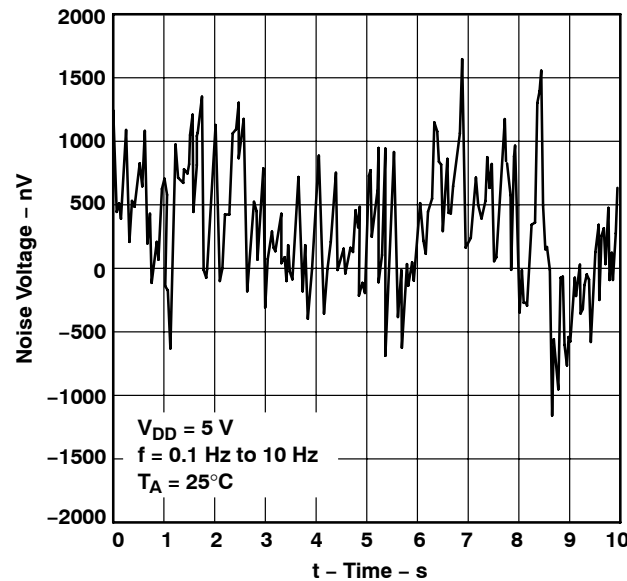


Figure 43

TOTAL HARMONIC DISTORTION PLUS NOISE  
 vs  
 FREQUENCY

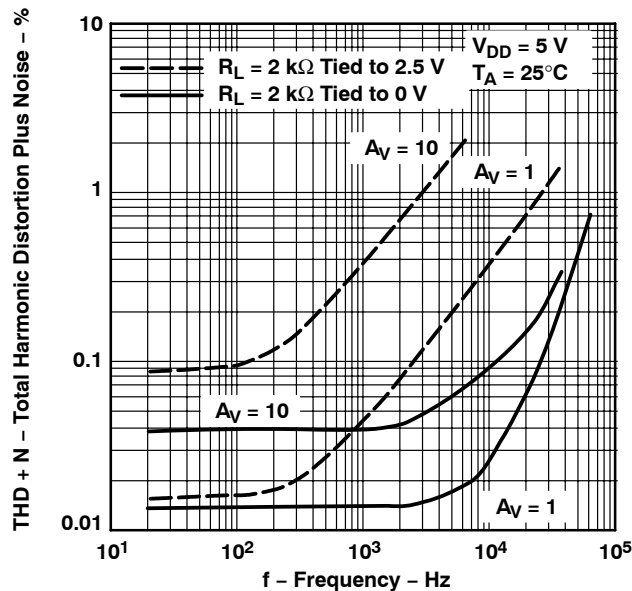


Figure 44

TOTAL HARMONIC DISTORTION PLUS NOISE  
 vs  
 FREQUENCY

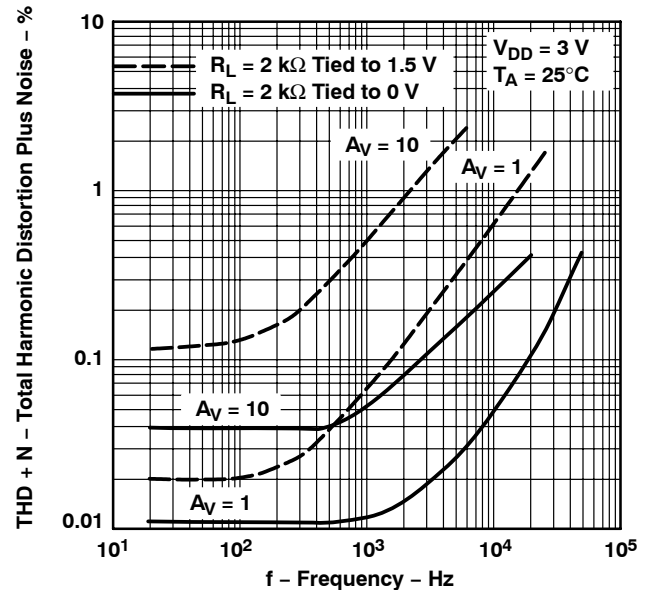


Figure 45

## TYPICAL CHARACTERISTICS

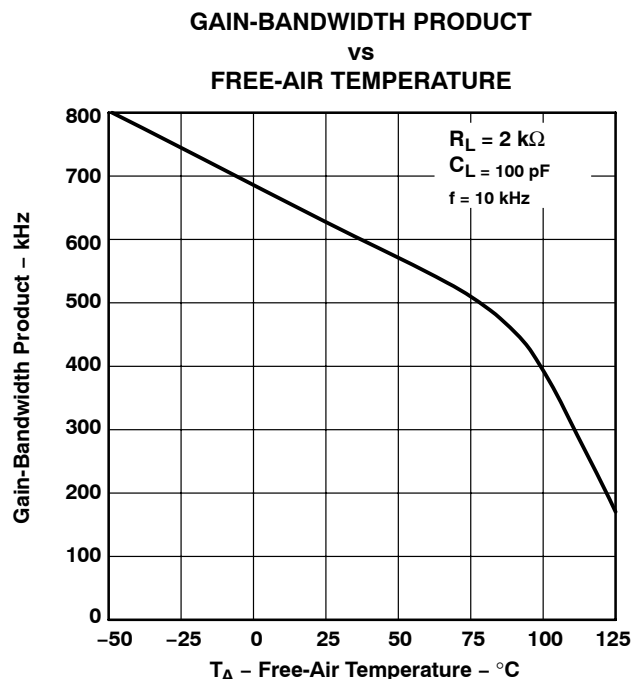


Figure 46

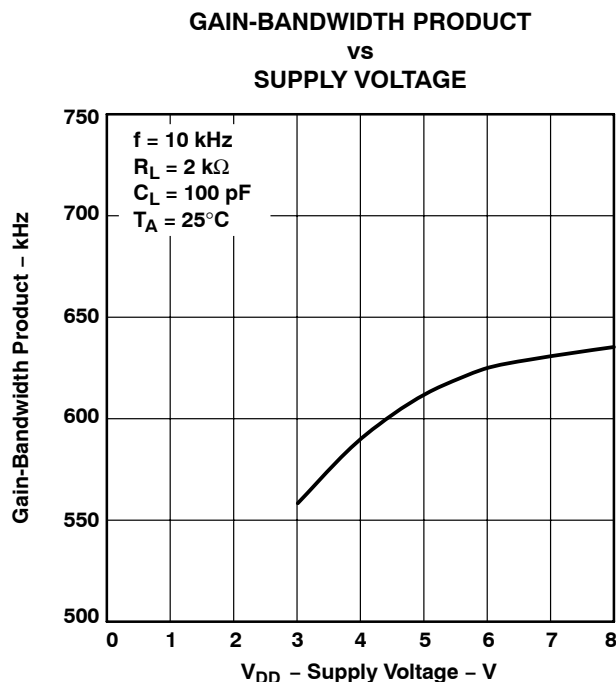


Figure 47

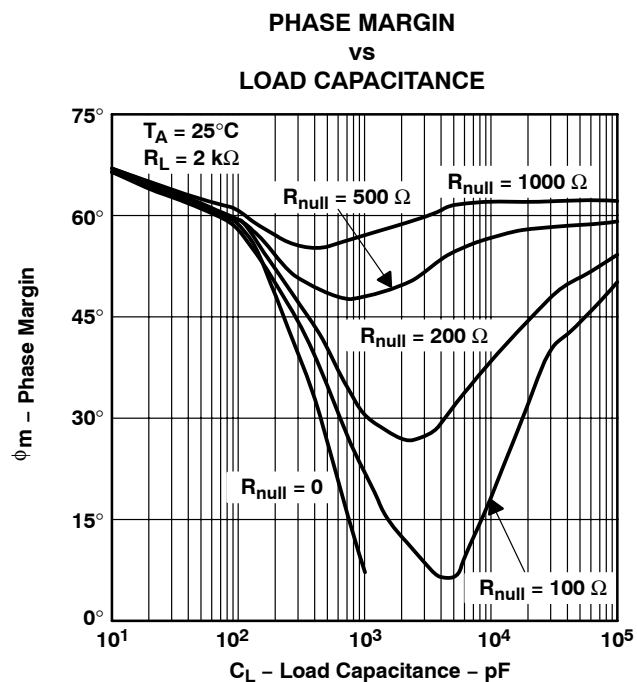


Figure 48

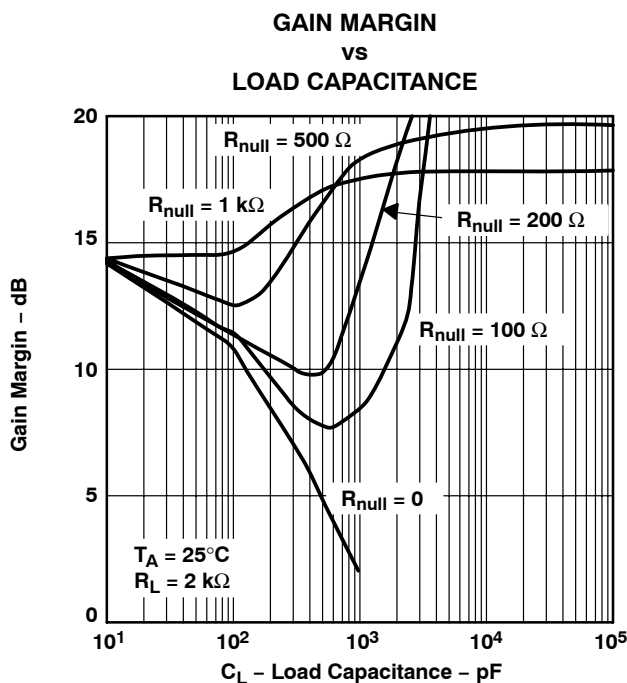


Figure 49

TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1  
Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT  
WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SGLS182B – SEPTEMBER 2003 – REVISED NOVEMBER 2010

TYPICAL CHARACTERISTICS

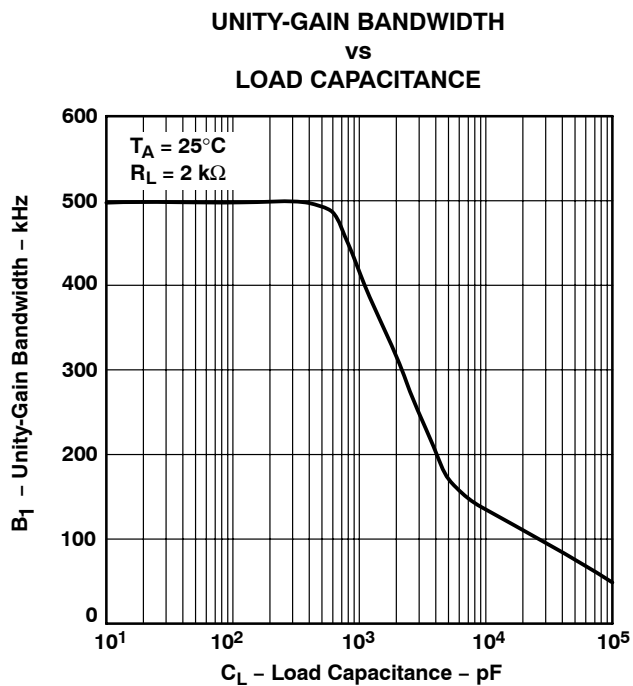


Figure 50

# TLV2432-Q1, TLV2432A-Q1, TLV2434-Q1, TLV2434A-Q1

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT

### WIDE-INPUT-VOLTAGE OPERATIONAL AMPLIFIERS

SGLS182B – SEPTEMBER 2003 – REVISED NOVEMBER 2010

## 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).

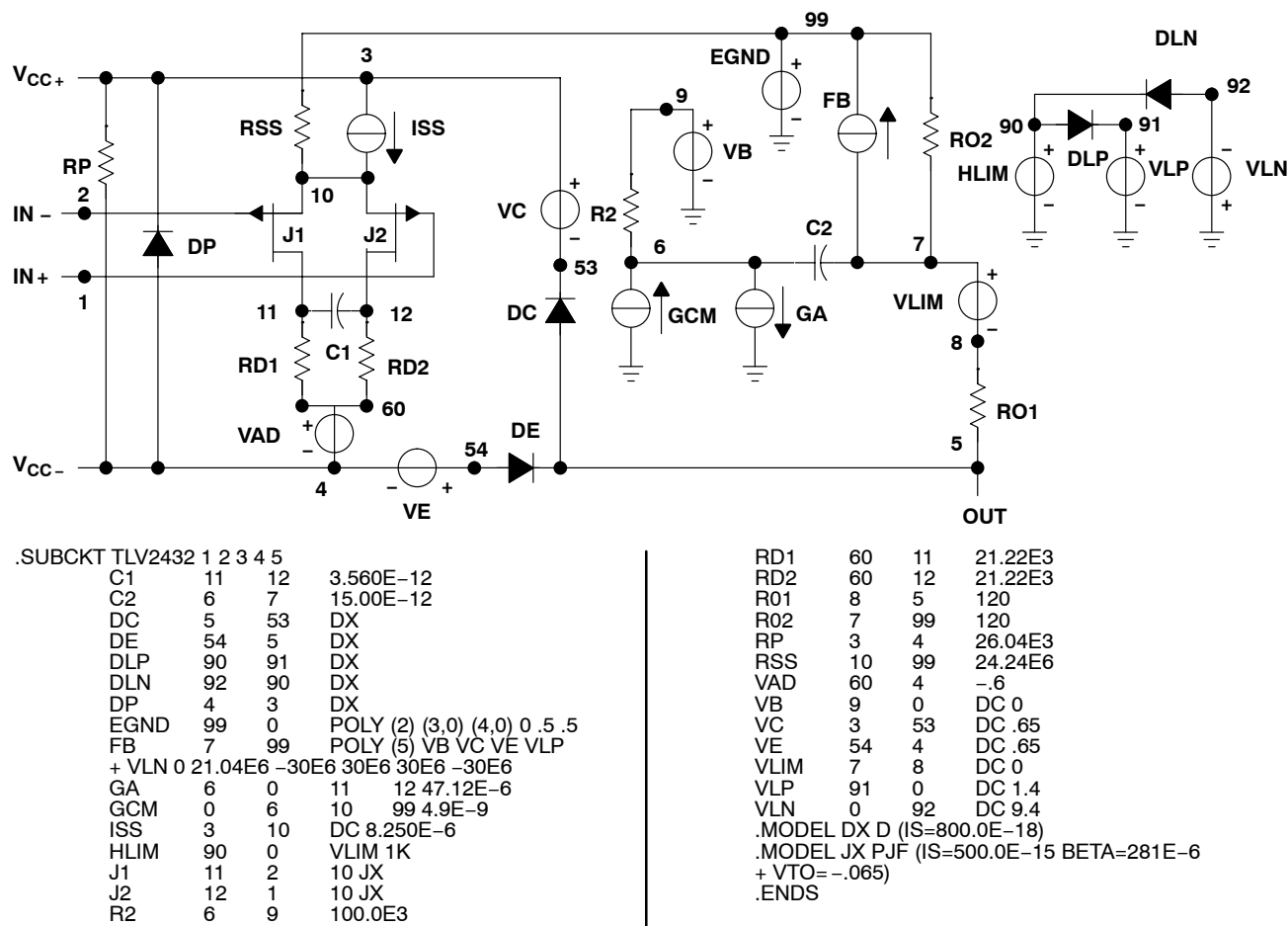


Figure 51. Boyle Macromodel and Subcircuit

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



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## PACKAGING INFORMATION

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TLV2432AQDRQ1</a>  | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 2432AQ              |
| TLV2432AQDRQ1.A                | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 2432AQ              |
| <a href="#">TLV2432QDRG4Q1</a> | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 2432Q1              |
| TLV2432QDRG4Q1.A               | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 2432Q1              |
| <a href="#">TLV2434AQDRQ1</a>  | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 2434AQ              |
| TLV2434AQDRQ1.A                | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 2434AQ              |
| <a href="#">TLV2434AQPWRQ1</a> | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 125   | 2434AQ              |
| TLV2434AQPWRQ1.A               | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 125   | 2434AQ              |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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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-Q1, TLV2432A-Q1, TLV2434A-Q1 :**

- Catalog : [TLV2432](#), [TLV2432A](#), [TLV2434A](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

## 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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV2434AQPWRQ1 | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV2434AQPWRQ1 | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV2434AQPWRQ1 | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| TLV2434AQPWRQ1 | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |



## PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



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

# EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES: (continued)

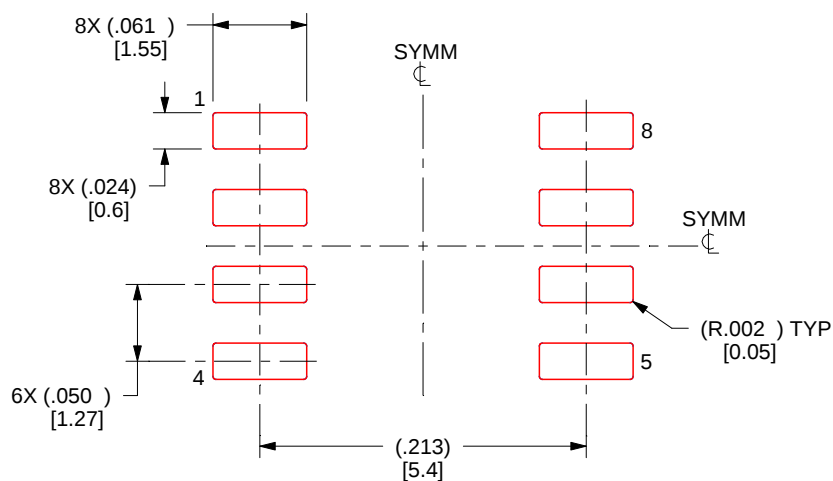
6. Publication IPC-7351 may have alternate designs.

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

**D0008A**

### SOIC - 1.75 mm max height

## SMALL OUTLINE INTEGRATED CIRCUIT



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

4214825/C 02/2019

NOTES: (continued)

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



# EXAMPLE BOARD LAYOUT

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220202/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

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

# EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220202/B 12/2023

NOTES: (continued)

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

**D0014A****PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

**NOTES:**

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

# EXAMPLE BOARD LAYOUT

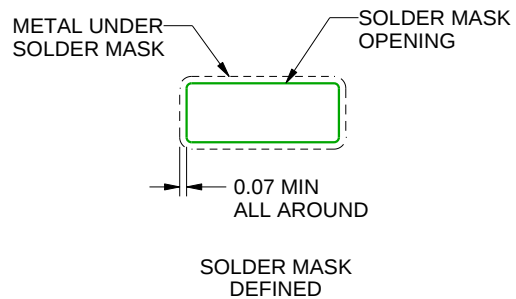
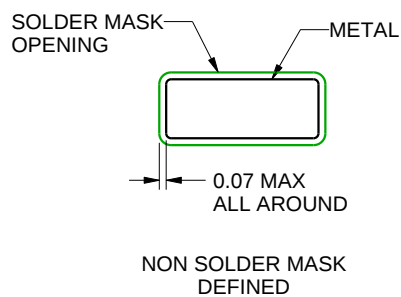
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

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

## EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

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

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