

# TLV3401, TLV3402, TLV3404 FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

- Low Supply Current . . . 470 nA/Per Channel
- Input Common-Mode Range Exceeds the Rails . . .  $-0.1\text{ V}$  to  $V_{CC} + 5\text{ V}$
- Supply Voltage Range . . .  $2.5\text{ V}$  to  $16\text{ V}$
- Reverse Battery Protection Up to  $18\text{ V}$
- Open Drain CMOS Output Stage
- Specified Temperature Range
  - $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  – Commercial Grade
  - $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  – Industrial Grade
- Ultrasmall Packaging
  - 5-Pin SOT-23 (TLV3401)
  - 8-Pin MSOP (TLV3402)
- Universal Op-Amp EVM (Reference SLOU060 for more information)

## description

The TLV340x is Texas Instruments' first family of nanopower comparators with only 470 nA per channel supply current, which make this device ideal for battery power and wireless handset applications.

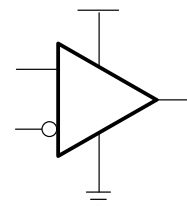
The TLV340x has a minimum operating supply voltage of  $2.7\text{ V}$  over the extended industrial temperature range ( $T_A = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ), while having an input common-mode range of  $-0.1$  to  $V_{CC} + 5\text{ V}$ . The low supply current makes it an ideal choice for battery powered portable applications where quiescent current is the primary concern. Reverse battery protection guards the amplifier from an over-current condition due to improper battery installation. For harsh environments, the inputs can be taken  $5\text{ V}$  above the positive supply rail without damage to the device.

All members are available in PDIP and SOIC with the singles in the small SOT-23 package, duals in the MSOP, and quads in the TSSOP package.

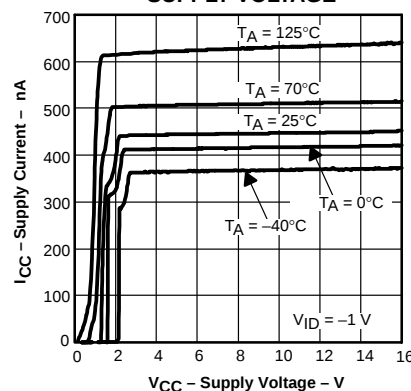
A SELECTION OF OUTPUT COMPARATORS†

| DEVICE     | $V_{CC}$<br>(V) | $V_{IO}$<br>( $\mu\text{V}$ ) | $I_{CC}/\text{Ch}$<br>( $\mu\text{A}$ ) | $I_{IB}$<br>(pA) | $t_{PLH}$<br>( $\mu\text{s}$ ) | $t_{PHL}$<br>( $\mu\text{s}$ ) | $t_f$<br>( $\mu\text{s}$ ) | $t_r$<br>( $\mu\text{s}$ ) | RAIL-TO-RAIL | OUTPUT STAGE |
|------------|-----------------|-------------------------------|-----------------------------------------|------------------|--------------------------------|--------------------------------|----------------------------|----------------------------|--------------|--------------|
| TLV340x    | 2.5 – 16        | 250                           | 0.47                                    | 80               | 55                             | 30                             | 5                          | –                          | I            | OD           |
| TLV370x    | 2.5 – 16        | 250                           | 0.47                                    | 80               | 25                             | 30                             | 5                          | 3.5                        | I            | PP           |
| TLC3702/4  | 3 – 16          | 1200                          | 9                                       | 5                | 1.1                            | 0.65                           | 0.5                        | 0.125                      | –            | PP           |
| TLC393/339 | 3 – 16          | 1400                          | 11                                      | 5                | 1.1                            | 0.55                           | 0.22                       | –                          | –            | OD           |
| TLC372/4   | 3 – 16          | 1000                          | 75                                      | 5                | 0.65                           | 0.65                           | –                          | –                          | –            | OD           |

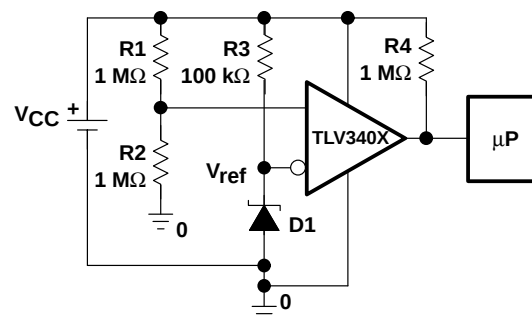
† All specifications are typical values measured at  $5\text{ V}$ .



SUPPLY CURRENT  
vs  
SUPPLY VOLTAGE



## high side voltage sense circuit



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**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2000, Texas Instruments Incorporated

# TLV3401, TLV3402, TLV3404

## FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

### TLV3401 AVAILABLE OPTIONS

| $T_A$          | $V_{IOmax}$<br>AT 25°C | PACKAGED DEVICES                  |                              |        |                    |
|----------------|------------------------|-----------------------------------|------------------------------|--------|--------------------|
|                |                        | SMALL OUTLINE<br>(D) <sup>†</sup> | SOT-23<br>(DBV) <sup>‡</sup> | SYMBOL | PLASTIC DIP<br>(P) |
| 0°C to 70°C    | 3600 $\mu$ V           | TLV3401CD                         | TLV3401CDBV                  | VBDC   | —                  |
| -40°C to 125°C |                        | TLV3401ID                         | TLV3401IDBV                  | VBDI   | TLV3401IP          |

<sup>†</sup> This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV3401CDR).

<sup>‡</sup> This package is only available taped and reeled. For standard quantities (3000 pieces per reel), add an R suffix (i.e., TLV3401CDBVR). For small quantities (250 pieces per mini-reel), add a T suffix to the part number (e.g., TLV3401CDBVT).

### TLV3402 AVAILABLE OPTIONS

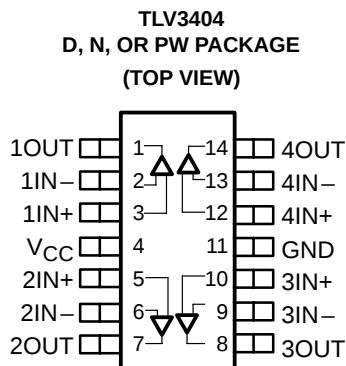
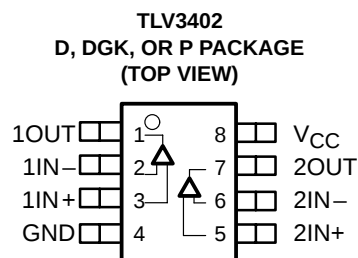
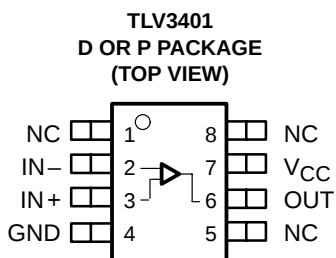
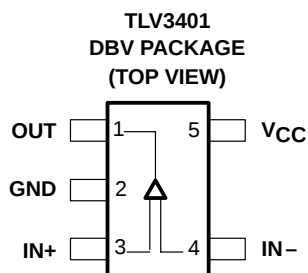
| $T_A$          | $V_{IOmax}$<br>AT 25°C | PACKAGED DEVICES                  |                            |         |                    |
|----------------|------------------------|-----------------------------------|----------------------------|---------|--------------------|
|                |                        | SMALL OUTLINE<br>(D) <sup>†</sup> | MSOP<br>(DGK) <sup>†</sup> | SYMBOL  | PLASTIC DIP<br>(P) |
| 0°C to 70°C    | 3600 $\mu$ V           | TLV3402CD                         | TLV3402CDGK                | xxTIAJJ | —                  |
| -40°C to 125°C |                        | TLV3402ID                         | TLV3402IDGK                | xxTIAJK | TLV3402IP          |

<sup>†</sup> This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV3402CDR).

### TLV3404 AVAILABLE OPTIONS

| $T_A$          | $V_{IOmax}$<br>AT 25°C | PACKAGED DEVICES                  |                    |               |
|----------------|------------------------|-----------------------------------|--------------------|---------------|
|                |                        | SMALL OUTLINE<br>(D) <sup>†</sup> | PLASTIC DIP<br>(N) | TSSOP<br>(PW) |
| 0°C to 70°C    | 3600 $\mu$ V           | TLV3404CD                         | —                  | TLV3404CPW    |
| -40°C to 125°C |                        | TLV3404ID                         | TLV3404IN          | TLV3404IPW    |

<sup>†</sup> This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV3404CDR).



# TLV3401, TLV3402, TLV3404

## FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

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

|                                                              |                              |
|--------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{CC}$ (see Note 1)                        | 17 V                         |
| Differential input voltage, $V_{ID}$                         | ±20 V                        |
| Input voltage range, $V_I$ (see Notes 1 and 2)               | 0 to $V_{CC} + 5$ V          |
| Input current range, $I_I$                                   | ±10 mA                       |
| Output current range, $I_O$                                  | ±10 mA                       |
| Continuous total power dissipation                           | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ : C suffix       | 0°C to 70°C                  |
| I suffix                                                     | –40°C to 125°C               |
| Maximum junction temperature, $T_J$                          | 150°C                        |
| Storage temperature range, $T_{stg}$                         | –65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C                        |

<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 GND.  
 2. Input voltage range is limited to 20 V or  $V_{CC} + 5$  V, whichever is smaller.

**DISSIPATION RATING TABLE**

| PACKAGE | $\theta_{JC}$<br>(°C/W) | $\theta_{JA}$<br>(°C/W) | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>POWER RATING |
|---------|-------------------------|-------------------------|---------------------------------------------|-------------------------------------------|
| D (8)   | 38.3                    | 176                     | 710 mW                                      | 142 mW                                    |
| D (14)  | 26.9                    | 122.6                   | 1022 mW                                     | 204.4 mW                                  |
| DBV (5) | 55                      | 324.1                   | 385 mW                                      | 77.1 mW                                   |
| DGK (8) | 54.2                    | 259.9                   | 481 mW                                      | 96.2 mW                                   |
| N (14)  | 32                      | 78                      | 1600 mW                                     | 320.5 mW                                  |
| P (8)   | 41                      | 104                     | 1200 mW                                     | 240.4 mW                                  |
| PW (14) | 29.3                    | 173.6                   | 720 mW                                      | 144 mW                                    |

### recommended operating conditions

|                                                   |               |          | MIN   | MAX                | UNIT |
|---------------------------------------------------|---------------|----------|-------|--------------------|------|
| Supply voltage, V <sub>CC</sub>                   | Single supply | C-suffix | 2.5   | 16                 | V    |
|                                                   |               | I-suffix | 2.7   | 16                 |      |
|                                                   | Split supply  | C-suffix | ±1.25 | ±8                 |      |
|                                                   |               | I-suffix | ±1.35 | ±8                 |      |
| Common-mode input voltage range, V <sub>ICR</sub> |               |          | −0.1  | V <sub>CC</sub> +5 | V    |
| Operating free-air temperature, T <sub>A</sub>    | C-suffix      |          | 0     | 70                 | °C   |
|                                                   | I-suffix      |          | −40   | 125                |      |



# TLV3401, TLV3402, TLV3404

## FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

electrical characteristics at specified operating free-air temperature,  $V_{CC} = 2.7\text{ V}, 5\text{ V}, 15\text{ V}$  (unless otherwise noted)

### dc performance

| PARAMETER                                                | TEST CONDITIONS                                               | $T_A^\dagger$ | MIN | TYP  | MAX  | UNIT                         |
|----------------------------------------------------------|---------------------------------------------------------------|---------------|-----|------|------|------------------------------|
| $V_{IO}$ Input offset voltage                            | $V_{IC} = V_{CC}/2, R_S = 50\ \Omega, R_P = 1\text{ M}\Omega$ | 25°C          |     | 250  | 3600 | $\mu\text{V}$                |
|                                                          |                                                               | Full range    |     |      | 4400 |                              |
| $\alpha_{VIO}$ Offset voltage drift                      |                                                               | 25°C          |     | 3    |      | $\mu\text{V}/^\circ\text{C}$ |
| CMRR Common-mode rejection ratio                         | $V_{IC} = 0\text{ to }2.7\text{ V}, R_S = 50\ \Omega$         | 25°C          |     | 55   | 72   | dB                           |
|                                                          |                                                               | Full range    |     | 50   |      |                              |
|                                                          | $V_{IC} = 0\text{ to }5\text{ V}, R_S = 50\ \Omega$           | 25°C          |     | 60   | 76   |                              |
|                                                          |                                                               | Full range    |     | 55   |      |                              |
|                                                          | $V_{IC} = 0\text{ to }15\text{ V}, R_S = 50\ \Omega$          | 25°C          |     | 65   | 88   |                              |
|                                                          |                                                               | Full range    |     | 60   |      |                              |
| $A_{VD}$ Large-signal differential voltage amplification | $R_P = 1\text{ M}\Omega$                                      | 25°C          |     | 1000 |      | V/mV                         |

$^\dagger$  Full range is 0°C to 70°C for C suffix and –40°C to 125°C for I suffix. If not specified, full range is –40°C to 125°C.

### input/output characteristics

| PARAMETER                                      | TEST CONDITIONS                                                     | $T_A^\dagger$ | MIN | TYP | MAX  | UNIT             |
|------------------------------------------------|---------------------------------------------------------------------|---------------|-----|-----|------|------------------|
| $I_{IO}$ Input offset current                  | $V_{IC} = V_{CC}/2, R_P = 1\text{ M}\Omega, R_S = 50\ \Omega$       | 25°C          |     | 20  | 100  | $\text{pA}$      |
|                                                |                                                                     | Full range    |     |     | 1000 |                  |
| $I_{IB}$ Input bias current                    |                                                                     | 25°C          |     | 80  | 250  | $\text{pA}$      |
|                                                |                                                                     | Full range    |     |     | 1500 |                  |
| $r_{i(d)}$ Differential input resistance       |                                                                     | 25°C          |     | 300 |      | $\text{M}\Omega$ |
| $I_{OZ}$ High-impedance output leakage current | $V_{IC} = V_{CC}/2, V_O = V_{CC}, V_{ID} = 1\text{ V}$              | 25°C          |     | 50  |      | $\text{pA}$      |
| $V_{OL}$ Low-level output voltage              | $V_{IC} = V_{CC}/2, I_{OL} = 2\ \mu\text{A}, V_{ID} = -1\text{ V}$  | 25°C          |     | 8   |      | mV               |
|                                                | $V_{IC} = V_{CC}/2, I_{OL} = 50\ \mu\text{A}, V_{ID} = -1\text{ V}$ | 25°C          |     | 80  | 200  |                  |
|                                                |                                                                     | Full range    |     |     | 300  |                  |

$^\dagger$  Full range is 0°C to 70°C for C suffix and –40°C to 125°C for I suffix. If not specified, full range is –40°C to 125°C.

### power supply

| PARAMETER       |                              | TEST CONDITIONS                                    |                                | T <sub>A</sub> <sup>†</sup> | MIN | TYP | MAX | UNIT |
|-----------------|------------------------------|----------------------------------------------------|--------------------------------|-----------------------------|-----|-----|-----|------|
| I <sub>CC</sub> | Supply current (per channel) | R <sub>P</sub> = No pullup                         | Output state low               | 25°C                        |     | 470 | 550 | nA   |
|                 |                              |                                                    |                                | Full range                  |     | 750 |     |      |
|                 |                              |                                                    | Output state high              | 25°C                        |     | 560 | 640 |      |
|                 |                              |                                                    |                                | Full range                  |     | 950 |     |      |
| PSRR            | Power supply rejection ratio | V <sub>IC</sub> = V <sub>CC</sub> /2 V,<br>No load | V <sub>CC</sub> = 2.7 V to 5 V | 25°C                        | 75  | 100 |     | dB   |
|                 |                              |                                                    |                                | Full range                  | 70  |     |     |      |
|                 |                              |                                                    | V <sub>CC</sub> = 5 V to 15 V  | 25°C                        | 85  | 105 |     |      |
|                 |                              |                                                    |                                | Full range                  | 80  |     |     |      |

$^\dagger$  Full range is 0°C to 70°C for C suffix and –40°C to 125°C for I suffix. If not specified, full range is –40°C to 125°C.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

# TLV3401, TLV3402, TLV3404

## FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

**switching characteristics at recommended operating conditions,  $V_{CC} = 2.7\text{ V}$ ,  $5\text{ V}$ ,  $15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

| PARAMETER          |                                                  | TEST CONDITIONS                                                                             |                   | T <sub>A</sub> | MIN | TYP | MAX | UNIT |
|--------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------|----------------|-----|-----|-----|------|
| t <sub>(PLH)</sub> | Propagation delay time, low-to-high-level output | f = 10 kHz,<br>V <sub>STEP</sub> = 1 V,<br>R <sub>P</sub> = 1 MΩ,<br>C <sub>L</sub> = 10 pF | Overdrive = 2 mV  | 25°C           | 175 |     |     | μs   |
|                    |                                                  |                                                                                             | Overdrive = 10 mV |                | 80  |     |     |      |
|                    |                                                  |                                                                                             | Overdrive = 50 mV |                | 55  |     |     |      |
| t <sub>(PHL)</sub> | Propagation delay time, high-to-low-level output |                                                                                             | Overdrive = 2 mV  | 25°C           | 300 |     |     |      |
|                    |                                                  |                                                                                             | Overdrive = 10 mV |                | 60  |     |     |      |
|                    |                                                  |                                                                                             | Overdrive = 50 mV |                | 30  |     |     |      |
| t <sub>f</sub>     | Fall time                                        | R <sub>P</sub> = 1 MΩ,<br>C <sub>L</sub> = 10 pF                                            | 25°C              | 5              |     |     | μs  |      |

NOTE: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

## TYPICAL CHARACTERISTICS

### Table of Graphs

|                                                                |                          |                             | FIGURE     |
|----------------------------------------------------------------|--------------------------|-----------------------------|------------|
| Input bias/offset current                                      | vs Free-air temperature  |                             | 1          |
| Open collector leakage current                                 | vs Free-air temperature  |                             | 2          |
| $V_{OL}$                                                       | Low-level output voltage | vs Low-level output current | 3, 4, 5    |
| $I_{DD}$                                                       | Supply current           | vs Supply voltage           | 6          |
| $I_{DD}$                                                       | Supply current           | vs Free-air temperature     | 7          |
| Low-to-high level output response for various input overdrives |                          |                             | 8, 9, 10   |
| High-to-low level output response for various input overdrives |                          |                             | 11, 12, 13 |
| Output fall time                                               |                          | vs Supply voltage           | 14         |



# TLV3401, TLV3402, TLV3404

## FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

### TYPICAL CHARACTERISTICS

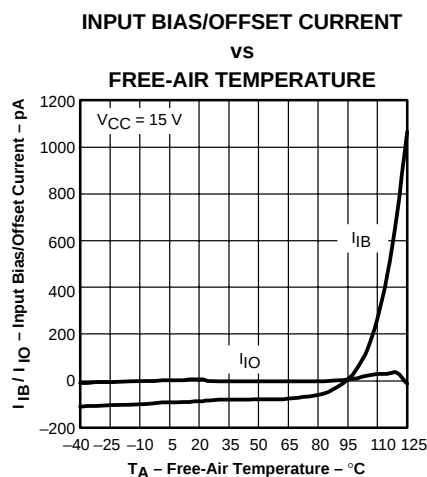


Figure 1

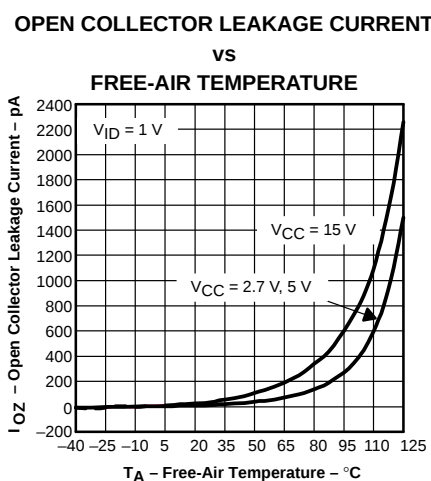


Figure 2

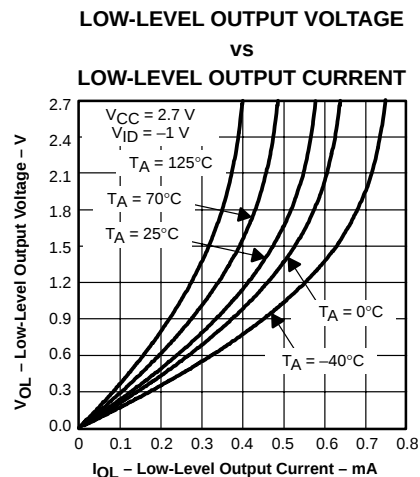


Figure 3

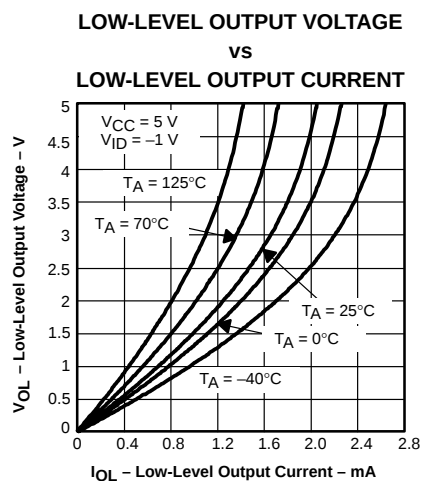


Figure 4

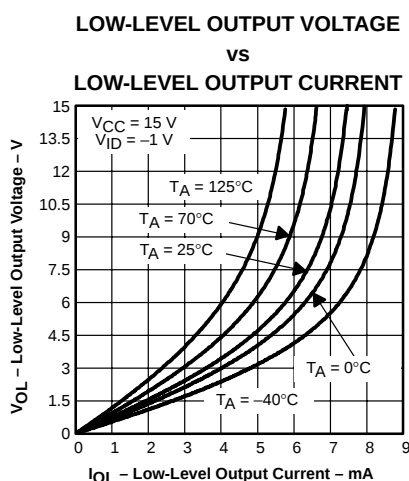


Figure 5

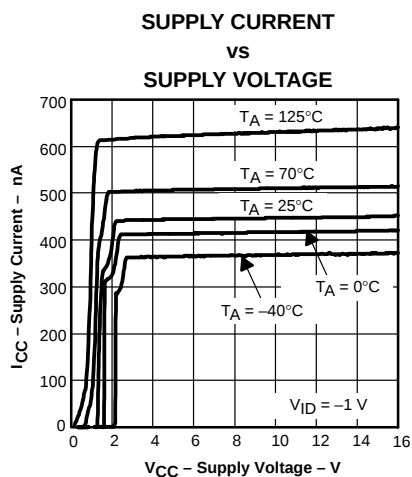


Figure 6

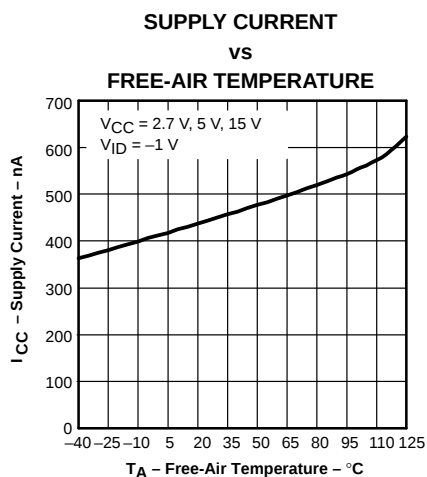


Figure 7

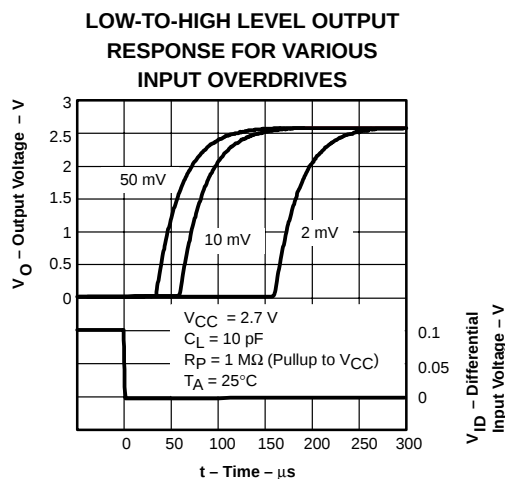


Figure 8

# TLV3401, TLV3402, TLV3404 FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

## TYPICAL CHARACTERISTICS

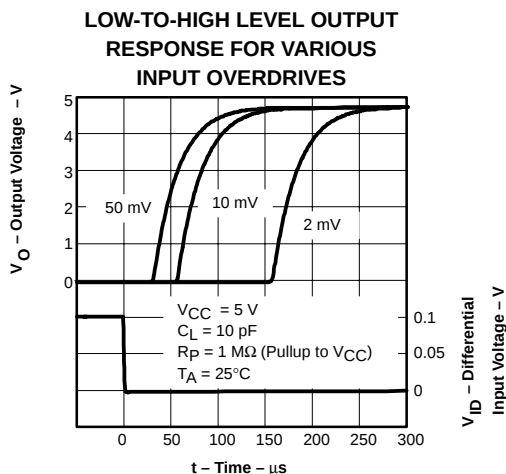


Figure 9

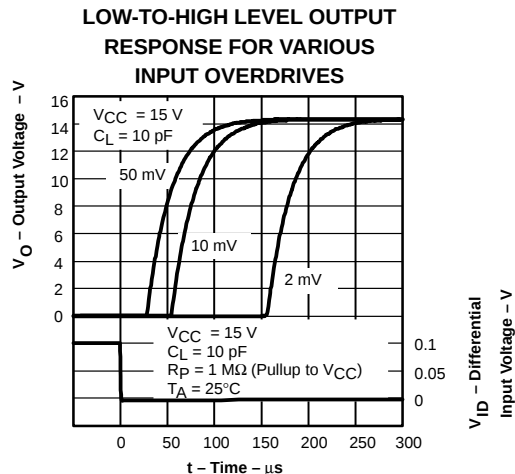


Figure 10

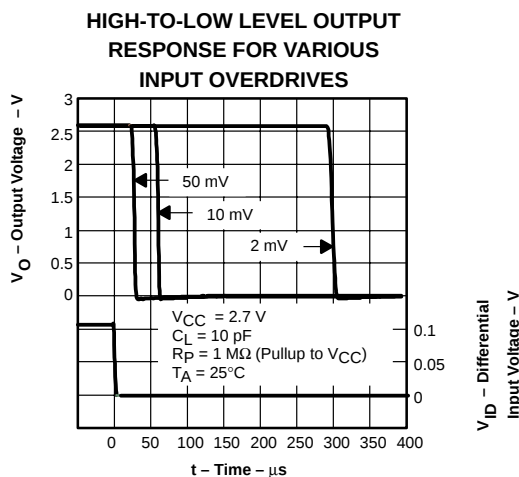


Figure 11

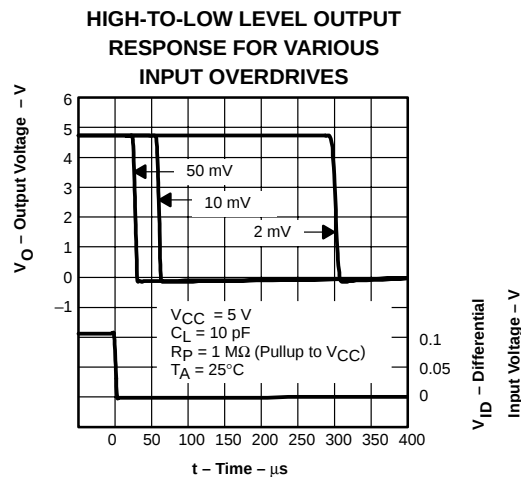


Figure 12

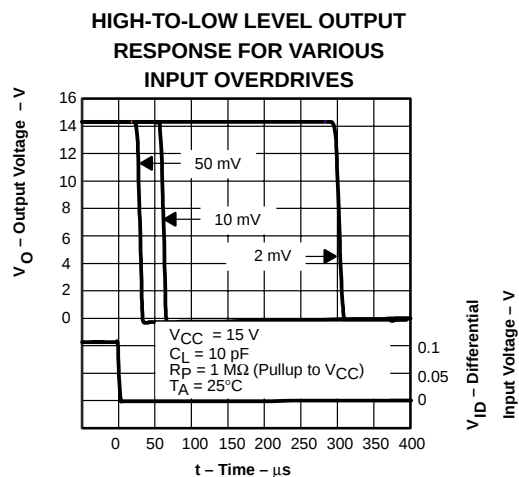


Figure 13

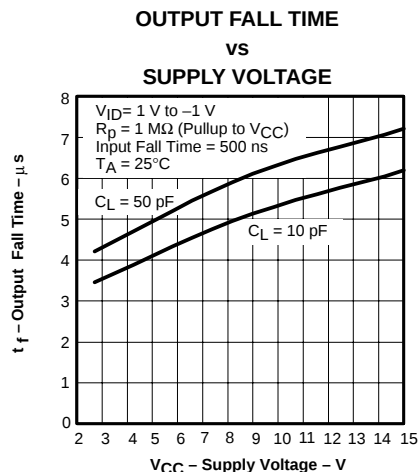


Figure 14

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| TLV3401CD        | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3401C                    | <a href="#">Samples</a> |
| TLV3401CDBVR     | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | VBDC                     | <a href="#">Samples</a> |
| TLV3401CDBVRG4   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | VBDC                     | <a href="#">Samples</a> |
| TLV3401CDBVT     | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | VBDC                     | <a href="#">Samples</a> |
| TLV3401CDBVTG4   | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | VBDC                     | <a href="#">Samples</a> |
| TLV3401CDG4      | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3401C                    | <a href="#">Samples</a> |
| TLV3401ID        | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3401I                    | <a href="#">Samples</a> |
| TLV3401IDBVR     | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | VBDI                     | <a href="#">Samples</a> |
| TLV3401IDBVRG4   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | VBDI                     | <a href="#">Samples</a> |
| TLV3401IDBVT     | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | VBDI                     | <a href="#">Samples</a> |
| TLV3401IDBVTG4   | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | VBDI                     | <a href="#">Samples</a> |
| TLV3401IDG4      | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3401I                    | <a href="#">Samples</a> |
| TLV3401IDR       | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3401I                    | <a href="#">Samples</a> |
| TLV3401IDRG4     | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3401I                    | <a href="#">Samples</a> |
| TLV3401IP        | ACTIVE        | PDIP         | P                  | 8    | 50             | Pb-Free<br>(RoHS)          | CU NIPDAU        | N / A for Pkg Type   | -40 to 125   | TLV3401I                 | <a href="#">Samples</a> |
| TLV3401IPE4      | ACTIVE        | PDIP         | P                  | 8    | 50             | Pb-Free<br>(RoHS)          | CU NIPDAU        | N / A for Pkg Type   | -40 to 125   | TLV3401I                 | <a href="#">Samples</a> |
| TLV3402CD        | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3402C                    | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| TLV3402CDG4      | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3402C                    | <a href="#">Samples</a> |
| TLV3402CDGK      | ACTIVE        | VSSOP        | DGK                | 8    | 80             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | (AJJ ~ AJK)              | <a href="#">Samples</a> |
| TLV3402CDGKG4    | ACTIVE        | VSSOP        | DGK                | 8    | 80             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | (AJJ ~ AJK)              | <a href="#">Samples</a> |
| TLV3402CDGKR     | ACTIVE        | VSSOP        | DGK                | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | (AJJ ~ AJK)              | <a href="#">Samples</a> |
| TLV3402CDGKRG4   | ACTIVE        | VSSOP        | DGK                | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | (AJJ ~ AJK)              | <a href="#">Samples</a> |
| TLV3402CDR       | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3402C                    | <a href="#">Samples</a> |
| TLV3402CDRG4     | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3402C                    | <a href="#">Samples</a> |
| TLV3402ID        | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3402I                    | <a href="#">Samples</a> |
| TLV3402IDG4      | ACTIVE        | SOIC         | D                  | 8    | 75             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3402I                    | <a href="#">Samples</a> |
| TLV3402IDGK      | ACTIVE        | VSSOP        | DGK                | 8    | 80             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | AJK                      | <a href="#">Samples</a> |
| TLV3402IDGKG4    | ACTIVE        | VSSOP        | DGK                | 8    | 80             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | AJK                      | <a href="#">Samples</a> |
| TLV3402IDGKR     | ACTIVE        | VSSOP        | DGK                | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | AJK                      | <a href="#">Samples</a> |
| TLV3402IDGKRG4   | ACTIVE        | VSSOP        | DGK                | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | AJK                      | <a href="#">Samples</a> |
| TLV3402IDR       | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3402I                    | <a href="#">Samples</a> |
| TLV3402IDRG4     | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3402I                    | <a href="#">Samples</a> |
| TLV3402IP        | ACTIVE        | PDIP         | P                  | 8    | 50             | Pb-Free<br>(RoHS)          | CU NIPDAU        | N / A for Pkg Type   | -40 to 125   | TLV3402I                 | <a href="#">Samples</a> |
| TLV3402IPE4      | ACTIVE        | PDIP         | P                  | 8    | 50             | Pb-Free<br>(RoHS)          | CU NIPDAU        | N / A for Pkg Type   | -40 to 125   | TLV3402I                 | <a href="#">Samples</a> |
| TLV3404CD        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| TLV3404CDG4      | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |
| TLV3404CDR       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |
| TLV3404CDRG4     | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |
| TLV3404CPW       | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |
| TLV3404CPWG4     | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |
| TLV3404CPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |
| TLV3404CPWRG4    | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | 0 to 70      | 3404C                    | <a href="#">Samples</a> |
| TLV3404ID        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |
| TLV3404IDG4      | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |
| TLV3404IDR       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |
| TLV3404IDRG4     | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |
| TLV3404IN        | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU        | N / A for Pkg Type   | -40 to 125   | TLV3404I                 | <a href="#">Samples</a> |
| TLV3404INE4      | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU        | N / A for Pkg Type   | -40 to 125   | TLV3404I                 | <a href="#">Samples</a> |
| TLV3404IPW       | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |
| TLV3404IPWG4     | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |
| TLV3404IPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |
| TLV3404IPWRG4    | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 125   | 3404I                    | <a href="#">Samples</a> |

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

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

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

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

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

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

<sup>(2)</sup> 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)

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

<sup>(4)</sup> Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.

**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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV3401CDBVR | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV3401CDBVT | SOT-23       | DBV             | 5    | 250  | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV3401IDBVR | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV3401IDBVT | SOT-23       | DBV             | 5    | 250  | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TLV3401IDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV3402CDGKR | VSSOP        | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| TLV3402CDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV3402IDGKR | VSSOP        | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| TLV3402IDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLV3404CDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV3404CPWR  | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLV3404IDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV3404IPWR  | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV3401CDBVR | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TLV3401CDBVT | SOT-23       | DBV             | 5    | 250  | 182.0       | 182.0      | 20.0        |
| TLV3401IDBVR | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TLV3401IDBVT | SOT-23       | DBV             | 5    | 250  | 182.0       | 182.0      | 20.0        |
| TLV3401IDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TLV3402CDGKR | VSSOP        | DGK             | 8    | 2500 | 364.0       | 364.0      | 27.0        |
| TLV3402CDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TLV3402IDGKR | VSSOP        | DGK             | 8    | 2500 | 364.0       | 364.0      | 27.0        |
| TLV3402IDR   | SOIC         | D               | 8    | 2500 | 533.4       | 186.0      | 36.0        |
| TLV3404CDR   | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| TLV3404CPWR  | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| TLV3404IDR   | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| TLV3404IPWR  | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

|                              |                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------|
| Audio                        | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                               |
| Amplifiers                   | <a href="http://amplifier.ti.com">amplifier.ti.com</a>                               |
| Data Converters              | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products                | <a href="http://www.dlp.com">www.dlp.com</a>                                         |
| DSP                          | <a href="http://dsp.ti.com">dsp.ti.com</a>                                           |
| Clocks and Timers            | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>                             |
| Interface                    | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                        | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt                   | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers             | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                         | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity        | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

|                               |                                                                                          |
|-------------------------------|------------------------------------------------------------------------------------------|
| Automotive and Transportation | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>                         |
| Communications and Telecom    | <a href="http://www.ti.com/communications">www.ti.com/communications</a>                 |
| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
| Security                      | <a href="http://www.ti.com/security">www.ti.com/security</a>                             |
| Space, Avionics and Defense   | <a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a> |
| Video and Imaging             | <a href="http://www.ti.com/video">www.ti.com/video</a>                                   |

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)