

# LinCMOS™ QUADRUPLE LOW-VOLTAGE DIFFERENTIAL COMPARATORS

TLV2354, TLV2354Y

SLCS012C – MAY 1992 – REVISED AUGUST 2000

- Wide Range of Supply Voltages  
2 V to 8 V
- Fully Characterized at 3 V and 5 V
- Very-Low Supply-Current Drain  
240  $\mu$ A Typ at 3 V
- Common-Mode Input Voltage Range  
Includes Ground
- High Input Impedance . . .  $10^{12} \Omega$  Typ
- Fast Response Time . . . 200 ns Typ for  
TTL-Level Input Step
- Extremely Low Input Bias Current  
5 pA Typ
- Output Compatible With TTL, MOS, and  
CMOS
- Built-In ESD Protection

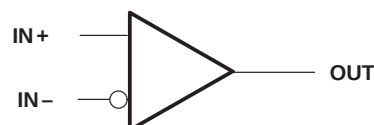
## description

The TLV2354 consists of four independent, low-power comparators specifically designed for single power-supply applications and operateS with power-supply rails as low as 2 V. When powered from a 3-V supply, the typical supply current is only 240  $\mu$ A.

The TLV2354 is designed using the Texas Instruments LinCMOS™ technology and, therefore, features an extremely high input impedance (typically greater than  $10^{12} \Omega$ ), which allows direct interfacing with high-impedance sources. The outputs are N-channel open-drain configurations that require an external pullup resistor to provide a positive output voltage swing, and they can be connected to achieve positive-logic wired-AND relationships. The TLV2354I is fully characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ . The TLV2354M is fully characterized for operation from  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

The TLV2354 has internal electrostatic-discharge (ESD)-protection circuits and has been classified with a 1000-V ESD rating using human body model testing. However, care should be exercised in handling this device as exposure to ESD may result in degradation of the device parametric performance.

## symbol (each comparator)



## AVAILABLE OPTIONS

| T <sub>A</sub>                                    | V <sub>IOmax</sub><br>at 25°C | PACKAGED DEVICES                     |                         |                       |                       |                            |                            | CHIP<br>FORM<br>(Y) |
|---------------------------------------------------|-------------------------------|--------------------------------------|-------------------------|-----------------------|-----------------------|----------------------------|----------------------------|---------------------|
|                                                   |                               | SMALL<br>OUTLINE<br>(D) <sup>†</sup> | CHIP<br>CARRIER<br>(FK) | CERAMIC<br>DIP<br>(J) | PLASTIC<br>DIP<br>(N) | TSSOP<br>(PW) <sup>‡</sup> | CERAMIC<br>FLATPACK<br>(W) |                     |
| $-40^{\circ}\text{C}$ to<br>$85^{\circ}\text{C}$  | 5 mV                          | TLV2354ID                            | —                       | —                     | TLV2354IN             | TLV2354IPW                 | —                          | TLV2354Y            |
| $-55^{\circ}\text{C}$ to<br>$125^{\circ}\text{C}$ | 5 mV                          | —                                    | TLV2354MFK              | TLV2354MJ             | —                     | —                          | TLV2354MW                  |                     |

<sup>†</sup> The D package is available taped and reeled. Add the suffix R to the device type (e.g., TLV2352IDR).

<sup>‡</sup> The PW packages are only available left-ended taped and reeled (e.g., TLV2354IPW).



These devices have limited built-in protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.



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

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

 **TEXAS  
INSTRUMENTS**

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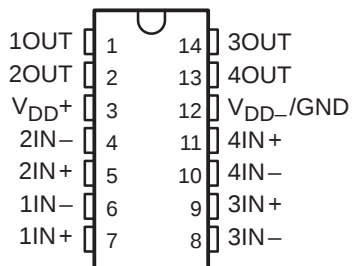
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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

# TLV2354, TLV2354Y

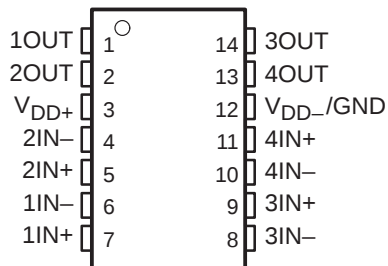
## LinCMOS™ QUADRUPLE LOW-VOLTAGE DIFFERENTIAL COMPARATORS

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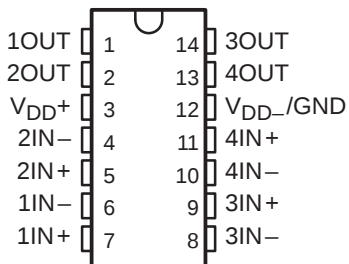
**TLV2354I**  
**D OR N PACKAGE**  
**(TOP VIEW)**



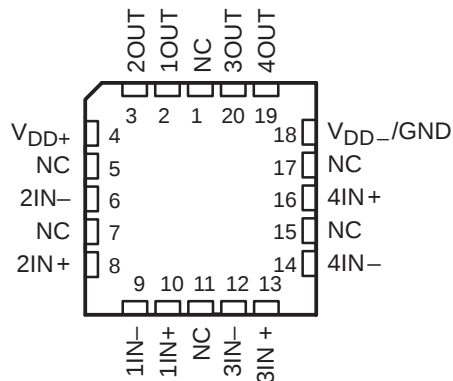
**TLV2354I**  
**PW PACKAGE**  
**(TOP VIEW)**



**TLV2354M**  
**J OR W PACKAGE**  
**(TOP VIEW)**



**TLV2354AM, TLV2354M**  
**FK PACKAGE**  
**(TOP VIEW)**

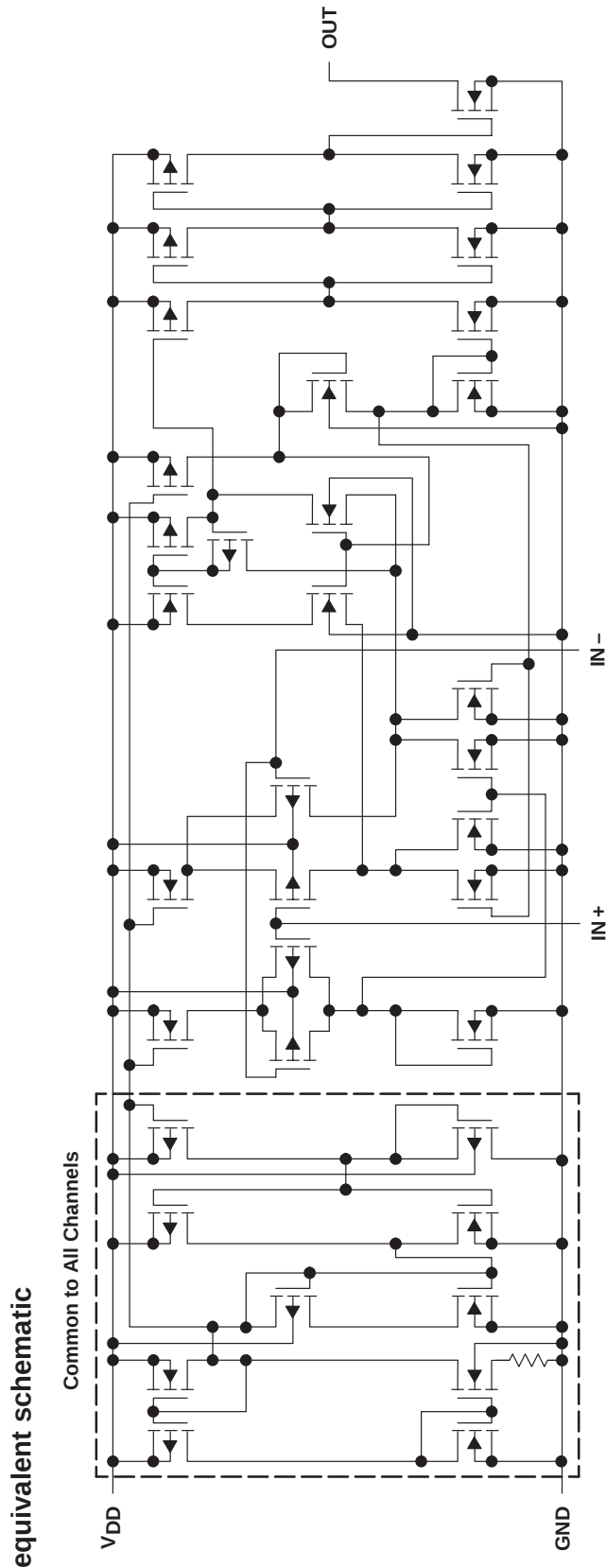


NC – No internal connection

# TLV2254, TLV2254Y

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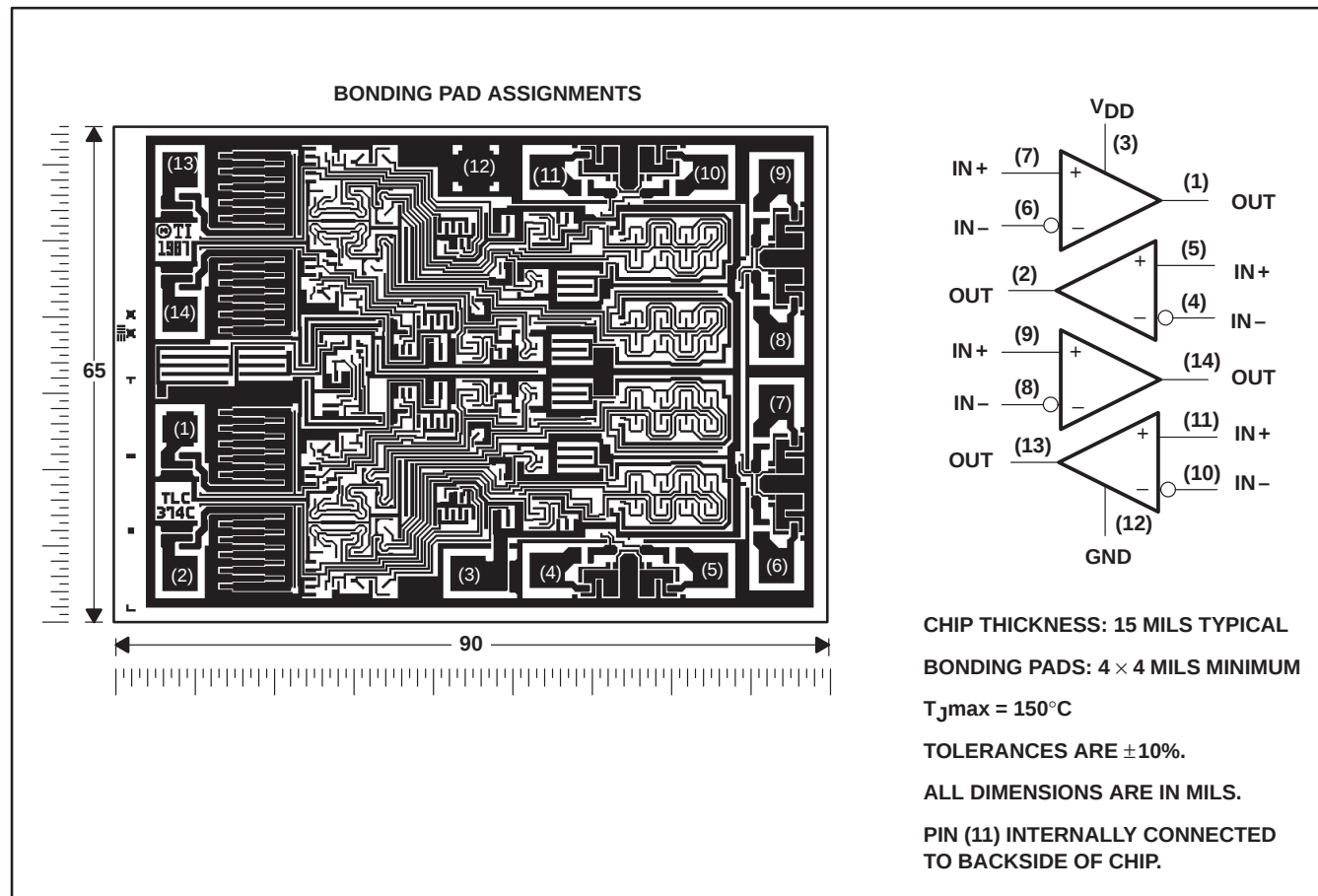


# TLV2354, TLV2354Y LinCMOS™ QUADRUPLER LOW-VOLTAGE DIFFERENTIAL COMPARATORS

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## TLV2354Y chip information

This chip, when properly assembled, displays characteristics similar to the TLV2354. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. This chip may be mounted with conductive epoxy or a gold-silicon preform.



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

|                                                                                   |                              |
|-----------------------------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{DD}$ (see Note 1)                                             | 8 V                          |
| Differential input voltage, $V_{ID}$ (see Note 2)                                 | $\pm 8$ V                    |
| Input voltage range, $V_I$                                                        | –0.3 to 8 V                  |
| Output voltage, $V_O$                                                             | 8 V                          |
| Input current, $I_I$                                                              | $\pm 5$ mA                   |
| Output current, $I_O$                                                             | 20 mA                        |
| Duration of output short-circuit current to GND (see Note 3)                      | unlimited                    |
| Continuous total power dissipation                                                | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ : TLV2354I                            | –40°C to 85°C                |
| TLV2354M                                                                          | –55°C to 125°C               |
| Storage temperature range                                                         | –65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, N, or PW package | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: FK, J, or W package | 300°C                        |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. All voltage values, except differential voltages, are with respect to network ground.
  2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
  3. Short circuits from outputs to  $V_{DD}$  can cause excessive heating and eventual device destruction.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING<br>FACTOR | $T_A = 85^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|--------------------|------------------------------------------|-------------------------------------------|
| D       | 950 mW                                      | 7.6 mW/°C          | 494 mW                                   | —                                         |
| FK      | 1375 mW                                     | 11.0 mW/°C         | 715 mW                                   | 275 mW                                    |
| J       | 1375 mW                                     | 11.0 mW/°C         | 715 mW                                   | 275 mW                                    |
| N       | 1150 mW                                     | 9.2 mW/°C          | 598 mW                                   | —                                         |
| PW      | 700 mW                                      | 5.6 mW/°C          | 364 mW                                   | —                                         |
| W       | 700 mW                                      | 5.5 mW/°C          | 370 mW                                   | 150 mW                                    |

**recommended operating conditions**

|                                       |                | MIN | MAX  | UNIT |
|---------------------------------------|----------------|-----|------|------|
| Supply voltage, $V_{DD}$              |                | 2   | 8    | V    |
| Common-mode input voltage, $V_{IC}$   | $V_{DD} = 3$ V | 0   | 1.75 | V    |
|                                       | $V_{DD} = 5$ V | 0   | 3.75 |      |
| Operating free-air temperature, $T_A$ | TLV2354I       | –40 | 85   | °C   |
|                                       | TLV2354M       | –55 | 125  |      |

# TLV2354, TLV2354Y

## LinCMOS™ QUADRUPLE LOW-VOLTAGE DIFFERENTIAL COMPARATORS

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### electrical characteristics at specified free-air temperature†

| PARAMETER        |                                 | TEST CONDITIONS                                       | T <sub>A</sub> <sup>‡</sup> | TLV2354I              |     |     |                       |     |     | UNIT |
|------------------|---------------------------------|-------------------------------------------------------|-----------------------------|-----------------------|-----|-----|-----------------------|-----|-----|------|
|                  |                                 |                                                       |                             | V <sub>DD</sub> = 3 V |     |     | V <sub>DD</sub> = 5 V |     |     |      |
|                  |                                 |                                                       |                             | MIN                   | TYP | MAX | MIN                   | TYP | MAX |      |
| V <sub>IO</sub>  | Input offset voltage            | V <sub>IC</sub> = V <sub>ICRmin</sub> ,<br>See Note 4 | 25°C                        | 1                     | 5   |     | 1                     | 5   | mV  |      |
|                  |                                 |                                                       | Full range                  |                       | 7   |     | 7                     |     |     |      |
| I <sub>IO</sub>  | Input offset current            |                                                       | 25°C                        | 1                     |     |     | 1                     |     | pA  |      |
|                  |                                 |                                                       | 85°C                        |                       | 1   |     | 1                     | nA  |     |      |
| I <sub>IB</sub>  | Input bias current              |                                                       | 25°C                        | 5                     |     |     | 5                     |     | pA  |      |
|                  |                                 |                                                       | 85°C                        |                       | 2   |     | 2                     | nA  |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range |                                                       | 25°C                        | 0 to 2                |     |     | 0 to 4                |     | V   |      |
|                  |                                 |                                                       | Full range                  | 0 to 1.75             |     |     | 0 to 3.75             |     |     |      |
| I <sub>OH</sub>  | High-level output current       | V <sub>ID</sub> = 1 V                                 | 25°C                        | 0.1                   |     |     | 0.1                   |     | nA  |      |
|                  |                                 |                                                       | Full range                  | 1                     |     |     | 1                     |     | μA  |      |
| V <sub>OL</sub>  | Low-level output voltage        | V <sub>ID</sub> = −1 V,<br>I <sub>OL</sub> = 2 mA     | 25°C                        | 115                   | 300 |     | 150                   | 400 | mA  |      |
|                  |                                 |                                                       | Full range                  | 600                   |     |     | 700                   |     |     |      |
| I <sub>OL</sub>  | Low-level output current        | V <sub>ID</sub> = −1 V,<br>V <sub>OL</sub> = 1.5 V    | 25°C                        | 6                     | 16  |     | 6                     | 16  | mA  |      |
| I <sub>DD</sub>  | Supply current                  | V <sub>ID</sub> = 1 V,<br>No load                     | 25°C                        | 240                   | 500 |     | 290                   | 600 | μA  |      |
|                  |                                 |                                                       | Full range                  | 700                   |     |     | 800                   |     |     |      |

† All characteristics are measured with zero common-mode input voltage unless otherwise noted.

‡ Full range is -40°C to 85°C. IMPORTANT: See Parameter Measurement Information.

NOTE 4: The offset voltage limits given are the maximum values required to drive the output above 4 V with V<sub>DD</sub> = 5 V, 2 V with V<sub>DD</sub> = 3 V, or below 400 mV with a 10-kΩ resistor between the output and V<sub>DD</sub>. They can be verified by applying the limit value to the input and checking for the appropriate output state.

### switching characteristics, V<sub>DD</sub> = 3 V, T<sub>A</sub> = 25°C

| PARAMETER     | TEST CONDITIONS                                              | TLV2354I                              |     |     | UNIT |
|---------------|--------------------------------------------------------------|---------------------------------------|-----|-----|------|
|               |                                                              | MIN                                   | TYP | MAX |      |
| Response time | R <sub>L</sub> = 5.1 kΩ, C <sub>L</sub> = 15 pF§, See Note 5 | 100-mV input step with 5-mV overdrive |     |     | ns   |

§ C<sub>L</sub> includes probe and jig capacitance.

NOTE 5: The response time specified is the interval between the input step function and the instant when the output crosses V<sub>O</sub> = 1 V with V<sub>DD</sub> = 3 V or when the output crosses V<sub>O</sub> = 1.4 with V<sub>DD</sub> = 5 V.

### switching characteristics, V<sub>DD</sub> = 5 V, T<sub>A</sub> = 25°C

| PARAMETER     | TEST CONDITIONS                        |                          |                                       | TLV2354I |     |     | UNIT |
|---------------|----------------------------------------|--------------------------|---------------------------------------|----------|-----|-----|------|
|               |                                        |                          |                                       | MIN      | TYP | MAX |      |
| Response time | R <sub>L</sub> = 5.1 kΩ,<br>See Note 5 | C <sub>L</sub> = 15 pF§, | 100-mV input step with 5-mV overdrive | 650      |     |     | ns   |
|               |                                        |                          | TTL-level input step                  | 200      |     |     |      |

§ C<sub>L</sub> includes probe and jig capacitance.

NOTE 5: The response time specified is the interval between the input step function and the instant when the output crosses V<sub>O</sub> = 1 V with V<sub>DD</sub> = 3 V or when the output crosses V<sub>O</sub> = 1.4 with V<sub>DD</sub> = 5 V.



**electrical characteristics at specified free-air temperature†**

| PARAMETER        |                                 | TEST CONDITIONS                                       |            | T <sub>A</sub> <sup>‡</sup> | TLV2354M              |     |     |                       |     |     | UNIT |
|------------------|---------------------------------|-------------------------------------------------------|------------|-----------------------------|-----------------------|-----|-----|-----------------------|-----|-----|------|
|                  |                                 |                                                       |            |                             | V <sub>DD</sub> = 3 V |     |     | V <sub>DD</sub> = 5 V |     |     |      |
|                  |                                 |                                                       |            |                             | MIN                   | TYP | MAX | MIN                   | TYP | MAX |      |
| V <sub>IO</sub>  | Input offset voltage            | V <sub>IC</sub> = V <sub>ICRmin</sub> ,<br>See Note 4 | 25°C       |                             | 1                     | 5   |     | 1                     | 5   | mV  |      |
|                  |                                 |                                                       | Full range |                             |                       | 10  |     |                       | 10  |     |      |
| I <sub>IO</sub>  | Input offset current            |                                                       | 25°C       |                             | 1                     |     |     | 1                     |     | pA  |      |
|                  |                                 |                                                       | 125°C      |                             |                       | 10  |     |                       | 10  | nA  |      |
| I <sub>IB</sub>  | Input bias current              |                                                       | 25°C       |                             | 5                     |     |     | 5                     |     | pA  |      |
|                  |                                 |                                                       | 125°C      |                             |                       | 20  |     |                       | 20  | nA  |      |
| V <sub>ICR</sub> | Common-mode input voltage range |                                                       | 25°C       |                             | 0 to 2                |     |     | 0 to 4                |     | V   |      |
|                  |                                 |                                                       | Full range |                             | 0 to 1.75             |     |     | 0 to 3.75             |     |     |      |
| I <sub>OH</sub>  | High-level output current       | V <sub>ID</sub> = 1 V                                 | 25°C       |                             | 0.1                   |     |     | 0.1                   |     | nA  |      |
|                  |                                 |                                                       | Full range |                             | 1                     |     |     | 1                     |     | μA  |      |
| V <sub>OL</sub>  | Low-level output voltage        | V <sub>ID</sub> = −1 V,<br>I <sub>OL</sub> = 2 mA     | 25°C       |                             | 115                   | 300 |     | 150                   | 400 | mA  |      |
|                  |                                 |                                                       | Full range |                             | 600                   |     |     | 700                   |     |     |      |
| I <sub>OL</sub>  | Low-level output current        | V <sub>ID</sub> = −1 V,<br>V <sub>OL</sub> = 1.5 V    | 25°C       |                             | 6                     | 16  |     | 6                     | 16  | mA  |      |
| I <sub>DD</sub>  | Supply current                  | V <sub>ID</sub> = 1 V,<br>No load                     | 25°C       |                             | 240                   | 500 |     | 290                   | 600 | μA  |      |
|                  |                                 |                                                       | Full range |                             | 700                   |     |     | 800                   |     |     |      |

† All characteristics are measured with zero common-mode input voltage unless otherwise noted.

‡ Full range is –55°C to 125°C. IMPORTANT: See Parameter Measurement Information.

NOTE 4: The offset voltage limits given are the maximum values required to drive the output above 4 V with V<sub>DD</sub> = 5 V, 2 V with V<sub>DD</sub> = 3 V, or below 400 mV with a 10-kΩ resistor between the output and V<sub>DD</sub>. They can be verified by applying the limit value to the input and checking for the appropriate output state.

**switching characteristics, V<sub>DD</sub> = 3 V, T<sub>A</sub> = 25°C**

| PARAMETER     | TEST CONDITIONS                                               |                                       | TLV2354M |     |      | UNIT |
|---------------|---------------------------------------------------------------|---------------------------------------|----------|-----|------|------|
|               |                                                               |                                       | MIN      | TYP | MAX  |      |
| Response time | R <sub>L</sub> = 5.1 kΩ, C <sub>L</sub> = 100 pF§, See Note 5 | 100-mV input step with 5-mV overdrive |          |     | 1400 | ns   |

§ C<sub>L</sub> includes probe and jig capacitance.

NOTE 5: The response time specified is the interval between the input step function and the instant when the output crosses V<sub>O</sub> = 1 V with V<sub>DD</sub> = 3 V or when the output crosses V<sub>O</sub> = 1.4 with V<sub>DD</sub> = 5 V.

**switching characteristics, V<sub>DD</sub> = 5 V, T<sub>A</sub> = 25°C**

| PARAMETER     | TEST CONDITIONS                                               |                                       | TLV2354M |     |      | UNIT |
|---------------|---------------------------------------------------------------|---------------------------------------|----------|-----|------|------|
|               |                                                               |                                       | MIN      | TYP | MAX  |      |
| Response time | R <sub>L</sub> = 5.1 kΩ, C <sub>L</sub> = 100 pF§, See Note 5 | 100-mV input step with 5-mV overdrive |          |     | 1300 | ns   |
|               |                                                               | TTL-level input step                  |          |     | 900  |      |

§ C<sub>L</sub> includes probe and jig capacitance.

NOTE 5: The response time specified is the interval between the input step function and the instant when the output crosses V<sub>O</sub> = 1 V with V<sub>DD</sub> = 3 V or when the output crosses V<sub>O</sub> = 1.4 with V<sub>DD</sub> = 5 V.

# TLV2354, TLV2354Y

## LinCMOS™ QUADRUPLE LOW-VOLTAGE DIFFERENTIAL COMPARATORS

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electrical characteristics at specified free-air temperature,  $T_A = 25^\circ\text{C}^\dagger$

| PARAMETER        |                                 | TEST CONDITIONS                                    | TLV2354Y              |     |     |                       |     |     | UNIT |
|------------------|---------------------------------|----------------------------------------------------|-----------------------|-----|-----|-----------------------|-----|-----|------|
|                  |                                 |                                                    | V <sub>DD</sub> = 3 V |     |     | V <sub>DD</sub> = 5 V |     |     |      |
|                  |                                 |                                                    | MIN                   | TYP | MAX | MIN                   | TYP | MAX |      |
| V <sub>IO</sub>  | Input offset voltage            | V <sub>IC</sub> = V <sub>ICRmin</sub> , See Note 4 | 1                     |     | 5   | 1                     |     | 5   | mV   |
| I <sub>IO</sub>  | Input offset current            |                                                    | 1                     |     |     | 1                     |     |     | pA   |
| I <sub>IB</sub>  | Input bias current              |                                                    | 5                     |     |     | 5                     |     |     | pA   |
| V <sub>ICR</sub> | Common-mode input voltage range |                                                    | 0 to 2                |     |     | 0 to 4                |     |     | V    |
| I <sub>OH</sub>  | High-level output current       | V <sub>ID</sub> = 1 V                              | 0.1                   |     |     | 0.1                   |     |     | nA   |
| V <sub>OL</sub>  | Low-level output voltage        | V <sub>ID</sub> = −1 V, I <sub>OL</sub> = 2 mA     | 115                   | 300 |     | 150                   | 400 |     | mV   |
| I <sub>OL</sub>  | Low-level output current        | V <sub>ID</sub> = −1 V, V <sub>OL</sub> = 1.5 V    | 6                     | 16  |     | 6                     | 16  |     | mA   |
| I <sub>DD</sub>  | Supply current                  | V <sub>ID</sub> = 1 V, No load                     | 240                   | 500 |     | 290                   | 600 |     | μA   |

<sup>†</sup> All characteristics are measured with zero common-mode input voltage unless otherwise noted.

NOTE 4: The offset voltage limits given are the maximum values required to drive the output above 4 V with  $V_{DD} = 5\text{ V}$ , 2 V with  $V_{DD} = 3\text{ V}$ , or below 400 mV with a 10-k $\Omega$  resistor between the output and  $V_{DD}$ . They can be verified by applying the limit value to the input and checking for the appropriate output state.

## TYPICAL CHARACTERISTICS

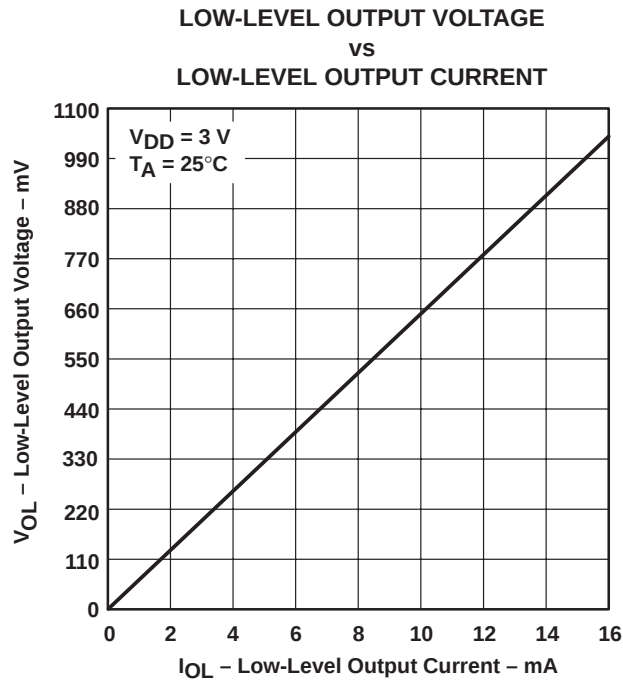


Figure 1

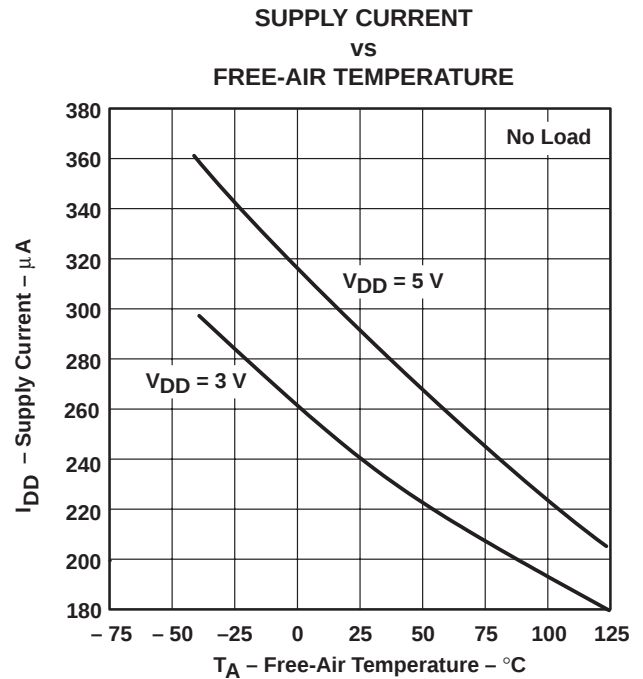


Figure 2

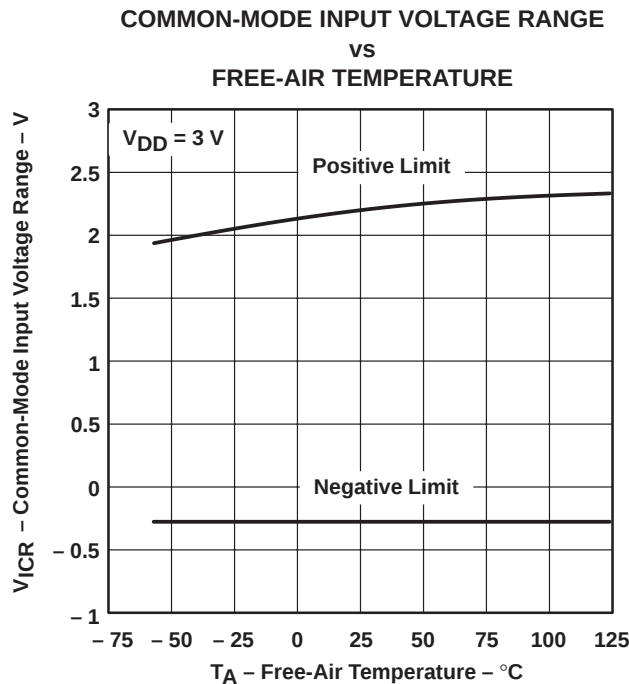


Figure 3

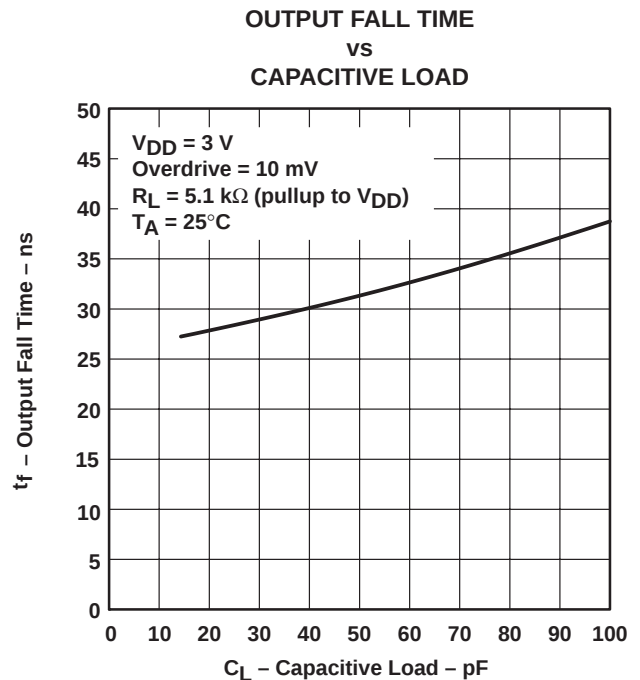


Figure 4

# TLV2354, TLV2354Y

## LinCMOS™ QUADRUPLE LOW-VOLTAGE DIFFERENTIAL COMPARATORS

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### TYPICAL CHARACTERISTICS

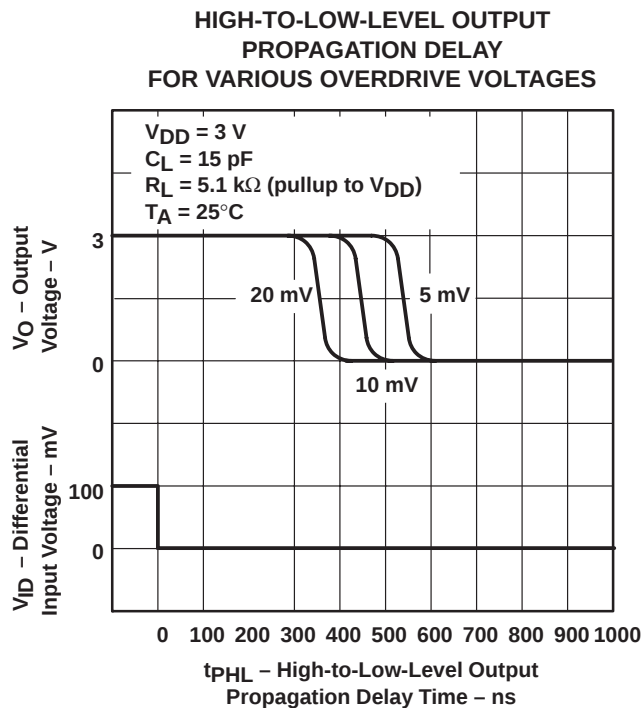


Figure 5

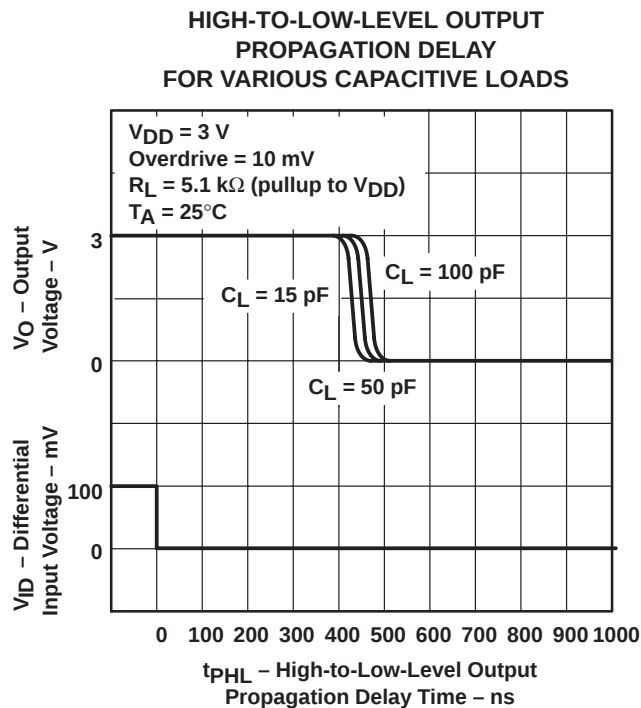


Figure 6

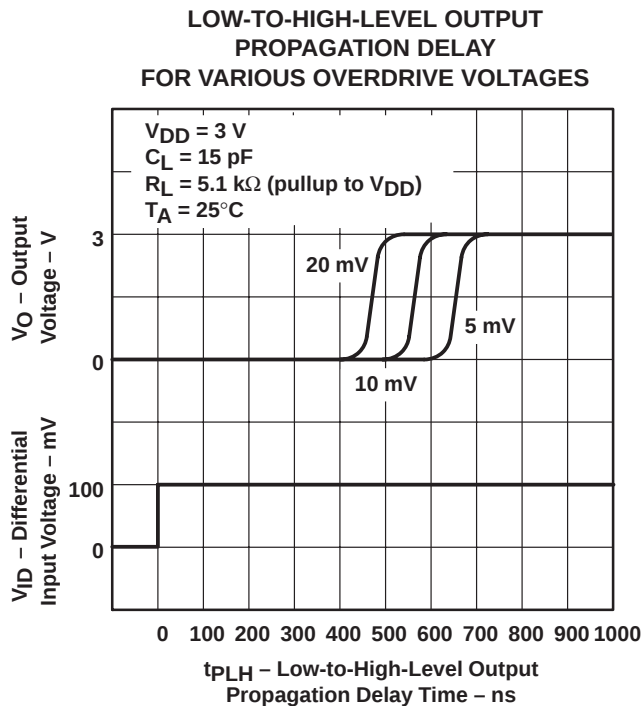


Figure 7

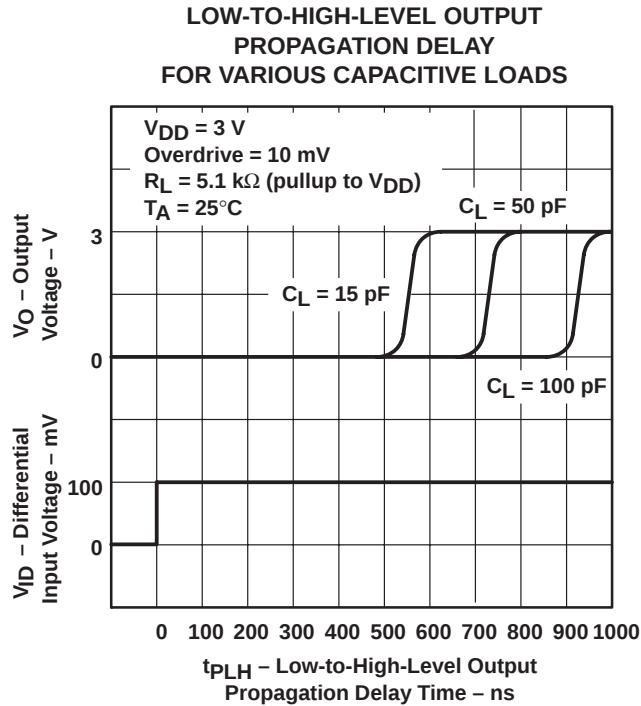


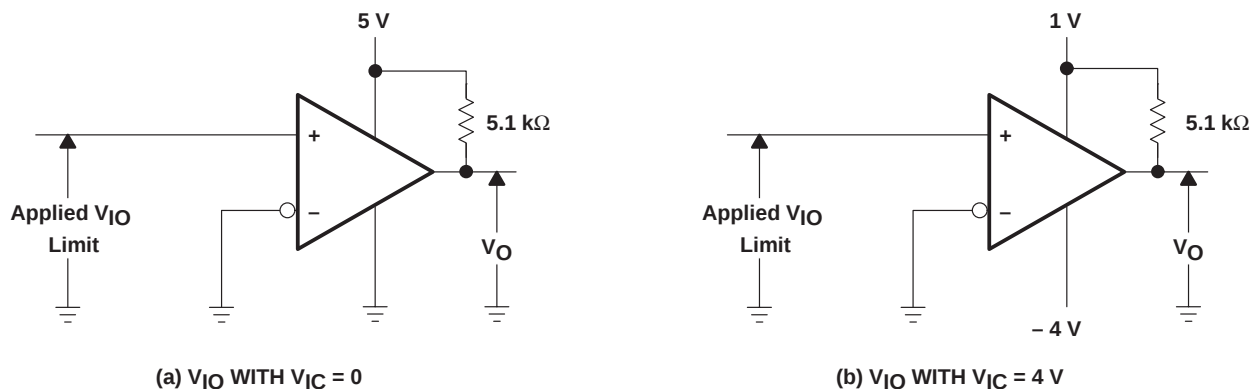
Figure 8

## PARAMETER MEASUREMENT INFORMATION

The digital output stage of the TLV2354 can be damaged if it is held in the linear region of the transfer curve. Conventional operational amplifier/comparator testing incorporates the use of a servo loop that is designed to force the device output to a level within this linear region. Since the servo-loop method of testing cannot be used, the following alternatives for measuring parameters such as input offset voltage, common-mode rejection, etc., are offered.

To verify that the input offset voltage falls within the limits specified, the limit value is applied to the input as shown in Figure 9(a). With the noninverting input positive with respect to the inverting input, the output should be high. With the input polarity reversed, the output should be low.

A similar test can be made to verify the input offset voltage at the common-mode extremes. The supply voltages can be slewed as shown in Figure 9(b) for the  $V_{ICR}$  test rather than changing the input voltages to provide greater accuracy.



**Figure 9. Method for Verifying That Input Offset Voltage Is Within Specified Limits**

A close approximation of the input offset voltage can be obtained by using a binary search method to vary the differential input voltage while monitoring the output state. When the applied input voltage differential is equal but opposite in polarity to the input offset voltage, the output changes states.

# TLV2354, TLV2354Y

## LinCMOS™ QUADRUPLE LOW-VOLTAGE DIFFERENTIAL COMPARATORS

SLCS012C – MAY 1992 – REVISED AUGUST 2000

### PARAMETER MEASUREMENT INFORMATION

Figure 10 illustrates a practical circuit for direct dc measurement of input offset voltage that does not bias the comparator in the linear region. The circuit consists of a switching-mode servo loop in which U1a generates a triangular waveform of approximately 20-mV amplitude. U1b acts as a buffer, with C2 and R4 removing any residual dc offset. The signal is then applied to the inverting input of the comparator under test while the noninverting input is driven by the output of the integrator formed by U1c through the voltage divider formed by R9 and R10. The loop reaches a stable operating point when the output of the comparator under test has a duty cycle of exactly 50%, which can only occur when the incoming triangle wave is sliced symmetrically or when the voltage at the noninverting input exactly equals the input offset voltage.

Voltage dividers R9 and R10 provide a step up of the input offset voltage by a factor of 100 to make measurement easier. The values of R5, R8, R9, and R10 can significantly influence the accuracy of the reading; therefore, it is suggested that their tolerance level be 1% or lower.

Measuring the extremely low values of input current requires isolation from all other sources of leakage current and compensation for the leakage of the test socket and board. With a good picoammeter, the socket and board leakage can be measured with no device in the socket. Subsequently, this open-socket leakage value can be subtracted from the measurement obtained with a device in the socket to obtain the actual input current of the device.

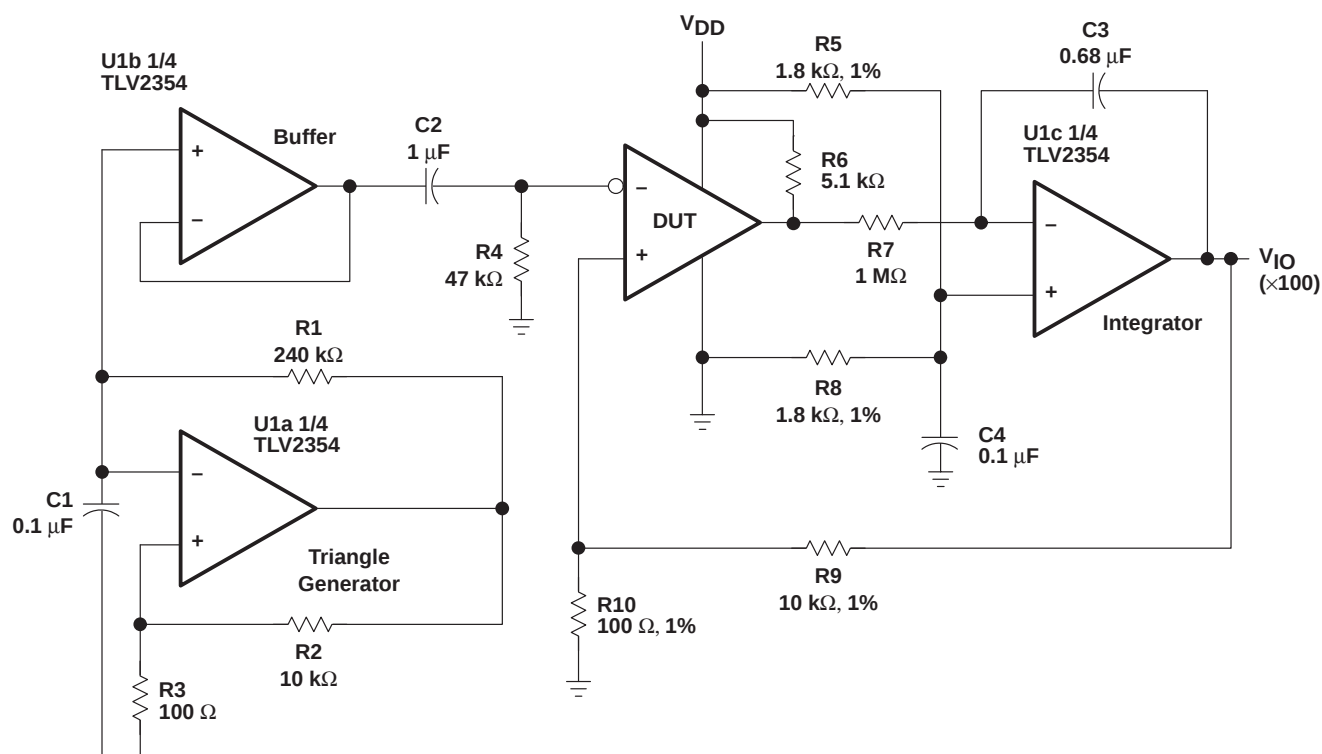
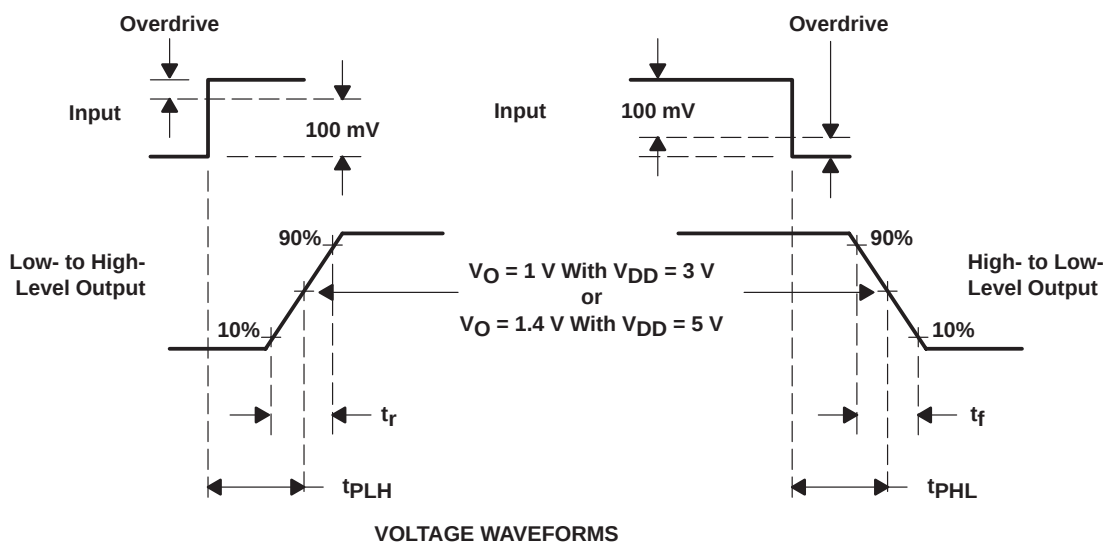
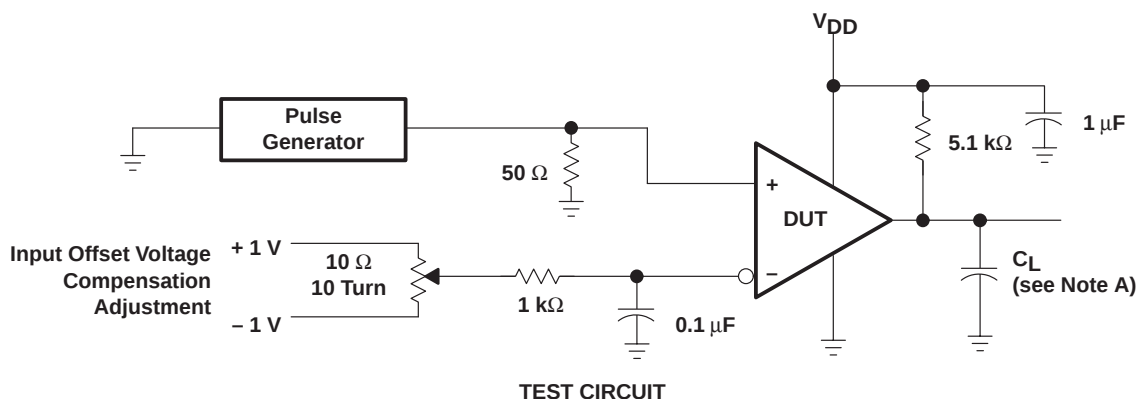


Figure 10. Circuit for Input Offset Voltage Measurement

## PARAMETER MEASUREMENT INFORMATION

Propagation delay time is defined as the interval between the application of an input step function and the instant when the output crosses  $V_O = 1\text{ V}$  with  $V_{DD} = 3\text{ V}$  or when the output crosses  $V_O = 1.4\text{ V}$  with  $V_{DD} = 5\text{ V}$ . Propagation delay time, low-to-high-level output, is measured from the leading edge of the input pulse, while propagation delay time, high-to-low-level output, is measured from the trailing edge of the input pulse. Propagation-delay-time measurement at low input signal levels can be greatly affected by the input offset voltage. The offset voltage should be balanced by the adjustment at the inverting input (as shown in Figure 11) so that the circuit is just at the transition point. Then a low signal, for example a 105-mV or 5-mV overdrive, causes the output to change state.



NOTE A:  $C_L$  includes probe and jig capacitance.

**Figure 11. Propagation Delay, Rise, and Fall Times Test Circuit and Voltage Waveforms**

**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="#">5962-9688201Q2A</a> | Active        | Production           | LCCC (FK)   20  | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9688201Q2A<br>TLV2354<br>MFKB |
| <a href="#">5962-9688201QCA</a> | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9688201QC<br>A<br>TLV2354MJB      |
| <a href="#">5962-9688201QDA</a> | Active        | Production           | CFP (W)   14    | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9688201QD<br>A<br>TLV2354MWB      |
| <a href="#">TLV2354IDR</a>      | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TLV2354I                               |
| TLV2354IDR.A                    | Active        | Production           | SOIC (D)   14   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TLV2354I                               |
| <a href="#">TLV2354IPW</a>      | Active        | Production           | TSSOP (PW)   14 | 90   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TY2354                                 |
| TLV2354IPW.A                    | Active        | Production           | TSSOP (PW)   14 | 90   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TY2354                                 |
| <a href="#">TLV2354IPWR</a>     | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TY2354                                 |
| TLV2354IPWR.A                   | Active        | Production           | TSSOP (PW)   14 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | TY2354                                 |
| <a href="#">TLV2354MFKB</a>     | Active        | Production           | LCCC (FK)   20  | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9688201Q2A<br>TLV2354<br>MFKB |
| TLV2354MFKB.A                   | Active        | Production           | LCCC (FK)   20  | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9688201Q2A<br>TLV2354<br>MFKB |
| <a href="#">TLV2354MJB</a>      | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9688201QC<br>A<br>TLV2354MJB      |
| TLV2354MJB.A                    | Active        | Production           | CDIP (J)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9688201QC<br>A<br>TLV2354MJB      |
| <a href="#">TLV2354MWB</a>      | Active        | Production           | CFP (W)   14    | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9688201QD<br>A<br>TLV2354MWB      |

| 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)               |
|-----------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------------------|
| TLV2354MWB.A          | Active        | Production           | CFP (W)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9688201QD<br>A<br>TLV2354MWB |

<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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## OTHER QUALIFIED VERSIONS OF TLV2354, TLV2354M :

- Catalog : [TLV2354](#)

- Military : [TLV2354M](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## TAPE AND REEL INFORMATION



\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV2354IDR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TLV2354IPWR | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV2354IDR  | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| TLV2354IPWR | TSSOP        | PW              | 14   | 2000 | 353.0       | 353.0      | 32.0        |

## TUBE



\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-9688201Q2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| 5962-9688201QDA | W            | CFP          | 14   | 25  | 506.98 | 26.16  | 6220   | NA     |
| TLV2354IPW      | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| TLV2354IPW.A    | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |
| TLV2354MFKB     | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLV2354MFKB.A   | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLV2354MWB      | W            | CFP          | 14   | 25  | 506.98 | 26.16  | 6220   | NA     |
| TLV2354MWB.A    | W            | CFP          | 14   | 25  | 506.98 | 26.16  | 6220   | NA     |

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Last updated 10/2025