

# TLC3702-EP Dual Micropower LinCMOS Voltage Comparator

## 1 Features

- Controlled baseline
  - One assembly/test site, one fabrication site
- Extended temperature performance of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Push-pull CMOS output drives capacitive loads without pullup resistor,  $I_O = \pm 8\text{mA}$
- Very low power:  $100\mu\text{W}$  typical at 5V
- Fast response time:  $t_{\text{PLH}} = 2.7\mu\text{s}$  typical with 5mV overdrive
- Single-supply operation: 4V to 16V
- On-Chip ESD protection

## 2 Description

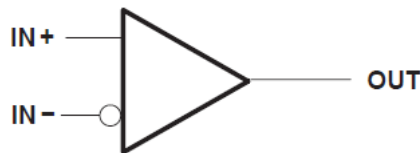
The TLC3702-EP consists of two independent micropower voltage comparators designed to operate from a single supply and be compatible with modern HCMOS logic systems. The chips are functionally similar to the LM339 but use one-twentieth of the power for similar response times. The push-pull CMOS output stage drives capacitive loads directly without a power-consuming pullup resistor to achieve the stated response time. Eliminating the pullup resistor not only reduces power dissipation, but also saves board space and component cost. The output stage is also fully compatible with TTL requirements.

Texas Instruments LinCMOS process offers high quality analog performance to standard CMOS processes. Along with the standard CMOS advantages of low power without sacrificing speed, high input impedance, and low bias currents, the LinCMOS process offers extremely stable input offset voltages with large differential input voltages. This characteristic is designed to build reliable CMOS comparators.

### Device Information

$T_A$	PACKAGE (1)	ORDERABLE PART NUMBER (2)	TOP-SIDE MARKING
$-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$	SOP- D	TLC3702MDREP	3702ME

- (1) For all available packages, see the orderable addendum at the end of the data sheet.
- (2) The package size (length  $\times$  width) is a nominal value and includes pins, where applicable.



**Symbol (Each Comparator)**



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## Pin Configuration and Functions

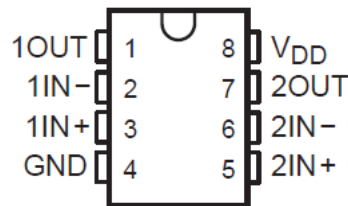


Figure 3-1. D Package (Top View)

Table 3-1. Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
OUT1	1	O	Output pin of the comparator 1
IN1-	2	I	Inverting input pin of comparator 1
IN1+	3	I	Noninverting input pin of comparator 1
V-	4	—	Negative (low) supply
IN2+	5	I	Noninverting input pin of comparator 2
IN2-	6	I	Inverting input pin of comparator 2
OUT2	7	O	Output pin of the comparator 2
V+	8	—	Positive supply

## 3 Specifications

### 3.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
V <sub>DD</sub>	Supply voltage range <sup>(2)</sup>	-0.3	18	V
V <sub>ID</sub>	Differential input voltage <sup>(3)</sup>		±V <sub>DD</sub>	V
V <sub>I</sub>	Input voltage range	-0.3	V <sub>DD</sub>	V
V <sub>O</sub>	Output voltage range	-0.3	V <sub>DD</sub>	V
I <sub>I</sub>	Input current		±5	mA
I <sub>O</sub>	Output current (each output)		±20	mA
	Total supply current into V <sub>DD</sub>		40	mA
	Total current out of GND		40	mA
T <sub>A</sub>	Operating free-air temperature range	-55	125	°C
	Storage temperature range	-65	150	°C
	Lead temperature 1.6mm (1/16 inch) from case for 10 seconds		260	°C

- (1) Stresses beyond those listed under “absolute maximum ratings” can 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 can affect device reliability.
- (2) All voltage values, except differential voltages, are with respect to network ground.
- (3) Differential voltages are at IN+ with respect to IN-.

### 3.2 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
V <sub>DD</sub>	Supply voltage	4	5	16	V
V <sub>IC</sub>	Common-mode input voltage	0		V <sub>DD</sub> - 1.5	V
T <sub>A</sub>	Operating free-air temperature	-55		125	°C

### 3.3 Electrical Characteristics

at specified operating free-air temperature,  $V_{DD} = 5V$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS <sup>(1)</sup>		$T_A$	MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage	$V_{DD} = 5V$ to $10V$ , $V_{IC} = V_{ICRmin}$ , See <sup>(2)</sup>		25°C		1.2	15 5	mV
				-55°C to 125°C			10	
$I_{IO}$	Input offset current	$V_{IC} = 2.5V$		25°C		1		pA
				125°C			15	nA
$I_{IB}$	Input bias current	$V_{IC} = 2.5V$		25°C		5		pA
				125°C			30	nA
$V_{ICR}$	Common-mode input voltage range			25°C		0 to $V_{DD} - 1$		V
				-55°C to 125°C		0 to $V_{DD} - 1.5$		
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$		25°C		84		dB
				125°C		83		
				-55°C		82		
$k_{SVR}$	Supply-voltage rejection ratio	$V_{DD} = 5V$ to $10V$		25°C		85		dB
				125°C		85		
				-55°C		82		
$V_{OH}$	High-level output voltage	$V_{ID} = 1V$ ,	$I_{OH} = -4mA$	25°C	4.5	4.7		V
				125°C	4.2			
$V_{OL}$	Low-level output voltage	$V_{ID} = -1V$ ,	$I_{OH} = -4mA$	25°C		210	300	mV
				125°C			500	
$I_{OH}$	Short-circuit current (Sourcing)			25°C	15	30		mA
$I_{OL}$	Short-circuit current (Sinking)			25°C	15	30		mA
$I_{DD}$	Supply current (both comparators)	Outputs low,	No load	25°C		18	40	$\mu A$
				-55°C to 125°C			90	

(1) All characteristics are measured with zero common-mode voltage unless otherwise noted.

(2) The offset voltage limits given are the maximum values required to drive the output up to 4.5V or down to 0.3V.

### 3.4 Switching Characteristics

$V_{DD} = 5V$ ,  $T_A = 25^\circ C$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{PLH}$	Propagation delay time, low-to-high-level output <sup>(1)</sup>	$f = 10kHz$ , $C_L = 50pF$	Overdrive = 2mV		4.5		$\mu s$
			Overdrive = 5mV		2.7		
			Overdrive = 10mV		1.9		
			Overdrive = 20mV		1.4		
			Overdrive = 40mV		1.1		

### 3.4 Switching Characteristics (continued)

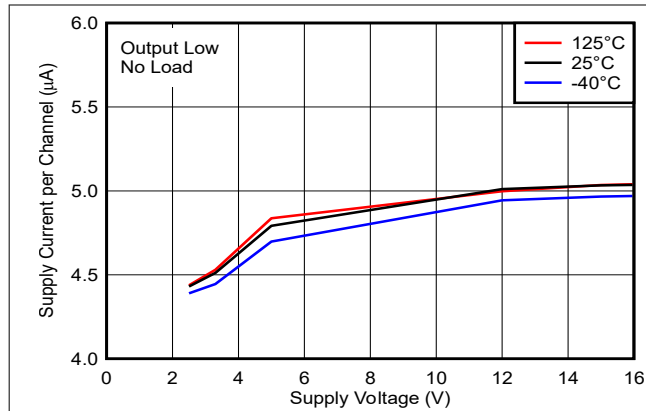
$V_{DD} = 5V$ ,  $T_A = 25^\circ C$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{PHL}$	Propagation delay time, high-to-low-level output <sup>(1)</sup>	$V_I = 1.4V$ step at IN+			1.1		$\mu s$
		$f = 10kHz$ , $C_L = 50pF$	Overdrive = 2mV		4		
			Overdrive = 5mV		2.3		
			Overdrive = 10mV		1.5		
			Overdrive = 20mV		0.95		
			Overdrive = 40mV		0.65		
		$V_I = 1.4V$ step at IN+			0.15		
$t_f$	Fall time	$f = 10kHz$ , $C_L = 50pF$	Overdrive = 50mV		50		ns
$t_r$	Rise time	$f = 10kHz$ , $C_L = 50pF$	Overdrive = 50mV		125		ns

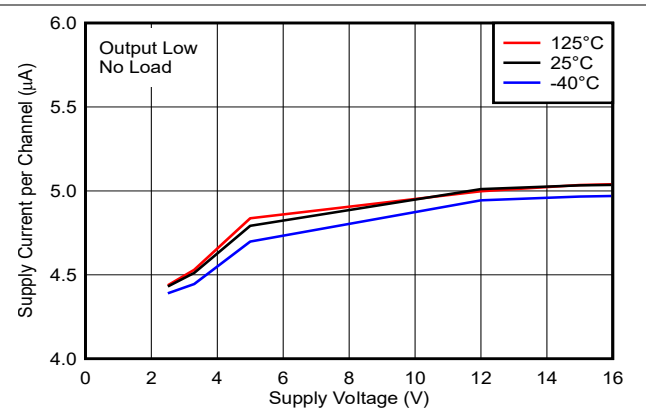
(1) Simultaneous switching of inputs causes degradation in output response.

### 3.5 Typical Characteristics

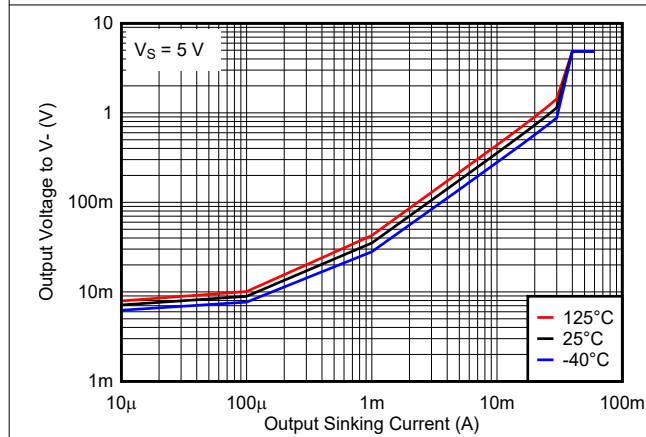
$T_A = 25^\circ\text{C}$ ,  $V_S = 12\text{V}$ ,  $R_{\text{PULLUP}} = 2.5\text{k}$ ,  $C_L = 20\text{pF}$ ,  $V_{\text{CM}} = 0\text{V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{mV}$  unless otherwise noted.



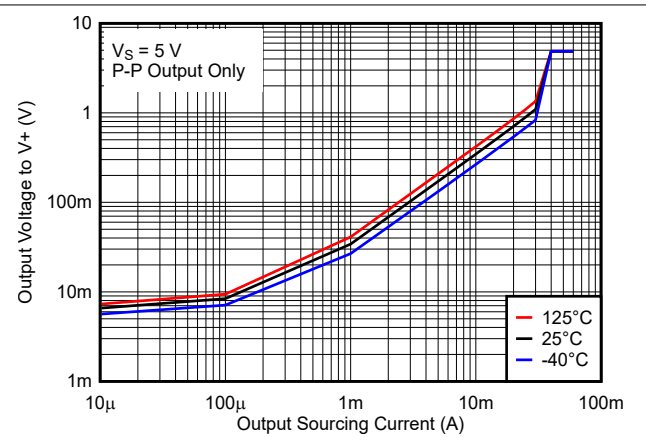
**Figure 3-1. Supply Current per Channel vs. Supply Voltage, Output Low**



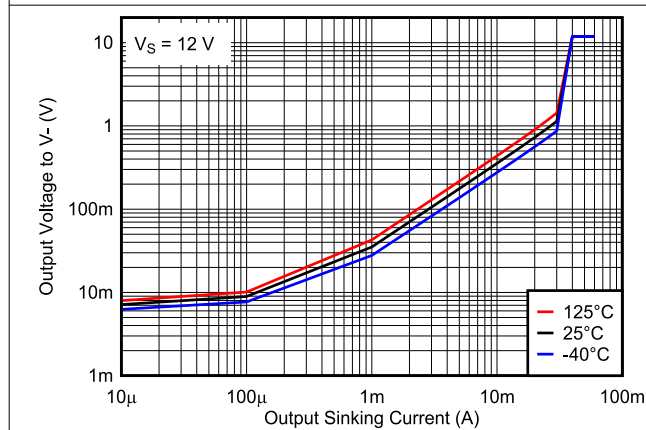
**Figure 3-2. Supply Current per Channel vs. Supply Voltage, Output High**



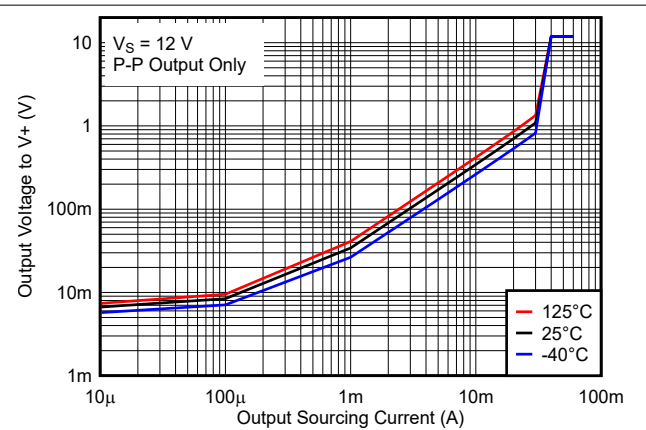
**Figure 3-3. Output Voltage vs. Output Sinking Current, 5V**



**Figure 3-4. Output Voltage vs. Output Sourcing Current, 5V**



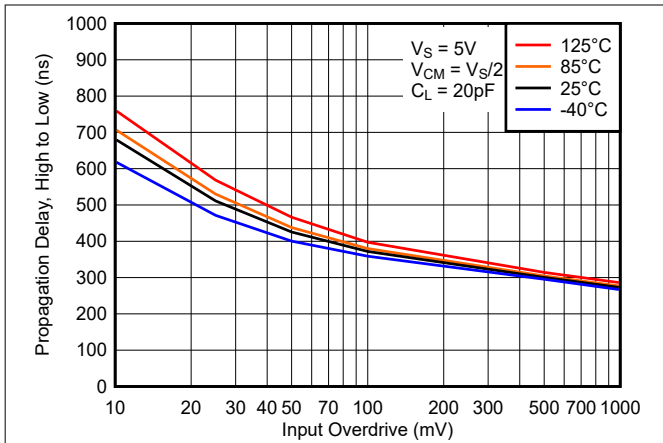
**Figure 3-5. Output Voltage vs. Output Sinking Current, 12V**



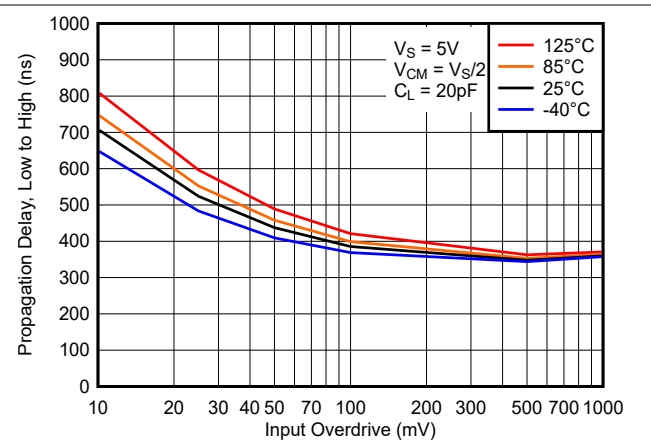
**Figure 3-6. Output Voltage vs. Output Sourcing Current, 12V**

### 3.5 Typical Characteristics (continued)

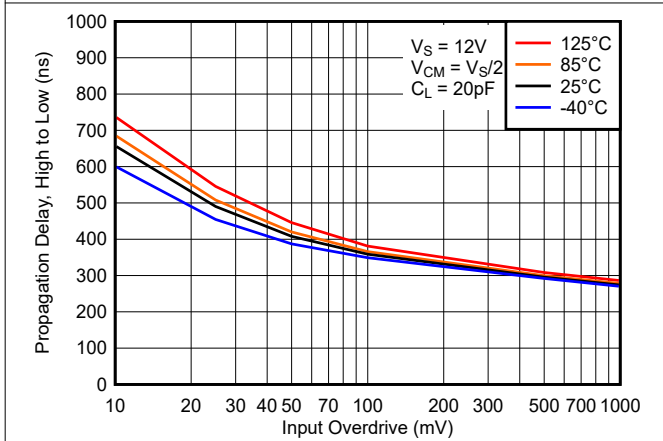
$T_A = 25^\circ\text{C}$ ,  $V_S = 12\text{V}$ ,  $R_{\text{PULLUP}} = 2.5\text{k}$ ,  $C_L = 20\text{pF}$ ,  $V_{\text{CM}} = 0\text{V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{mV}$  unless otherwise noted.



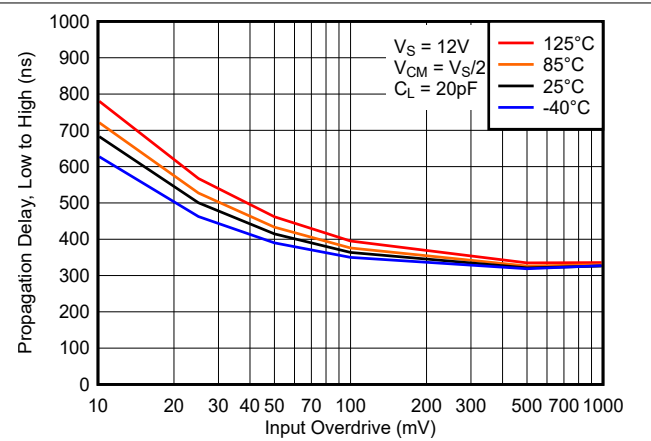
**Figure 3-7. Propagation Delay, High to Low, 5V**



**Figure 3-8. Propagation Delay, Low to High, 5V**



**Figure 3-9. Propagation Delay, High to Low, 12V**



**Figure 3-10. Propagation Delay, Low to High, 12V**

## 4 Detailed Description

### 4.1 Overview

The TLC3702-EP device is a micro-power comparator with push-pull output. Operating down to 4V while only consuming only 5 $\mu$ A per channel, the TLC3702-EP is excellent for power conscious applications.

### 4.2 Functional Block Diagrams

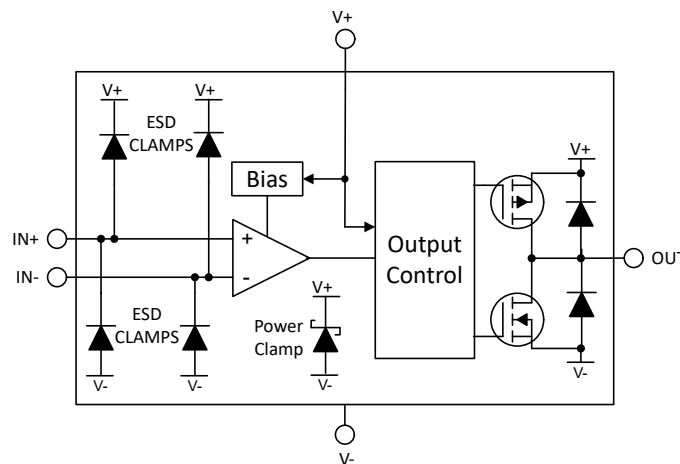


Figure 4-1. Block Diagram

### 4.3 Feature Description

The TLC3702-EP comparator consists of a CMOS differential pair input, allowing the device to operate with very high gain and fast response with minimal input bias current. The output consists of a push-pull output stage capable of sinking current with a negative differential input voltage and sourcing current with a positive differential input.

### 4.4 Device Functional Modes

#### 4.4.1 Input

The TLC3702-EP input voltage range extends from  $V_-$  to 1.5V below  $V_+$  over the full temperature range. The differential input voltage ( $V_{ID}$ ) can be any voltage within these limits. No phase-inversion of the comparator output occurs when the input voltages stay within the specified range.

#### 4.4.2 ESD Protection

The TLC3702-EP input and output ESD protection contains a conventional diode-type "upper" ESD clamp between the I/O pins and  $V_+$ , and a "lower" ESD clamp between the I/O pins and  $V_-$ . The inputs or output must not exceed the supply rails by more than 300mV. TI does not recommend applying signals to the inputs with no supply voltage.

When the inputs are connected to a low impedance source, such as a power supply or buffered reference line, add a current-limiting resistor in series with the input to limit any currents when the clamps conduct. The current must be limited 10mA or less, though TI recommends limiting the current to 1mA or less. This series resistance can be part of any resistive input dividers or networks.

#### 4.4.3 Unused Inputs

If a channel is not to be used, DO NOT tie the inputs together. Due to the high equivalent bandwidth and low offset voltage, tying the inputs directly together can cause high frequency chatter as the device triggers on its own internal wideband noise. Instead, the inputs must be tied to any available voltage that resides within the specified input voltage range and provides a minimum of 50mV differential voltage. For example, one input can be grounded and the other input connected to a reference voltage.



#### 4.4.4 Push-Pull Output

The TLC3702-EP features a push-pull output stage capable of both sinking and sourcing current. This allows driving loads such as LED's and MOSFET gates, as well as eliminating the need for a power-wasting external pull-up resistor. The push-pull output must never be connected to another output.

Directly shorting the output to the opposite supply rail (V+ when output "low" or V- when output "High") can result in thermal runaway and eventual device destruction at high (>12V) supply voltages. If output shorts are possible, a series current limiting resistor is recommended to limit the power dissipation.

Unused push-pull outputs must be left floating, and never tied to a supply, ground, or another output.

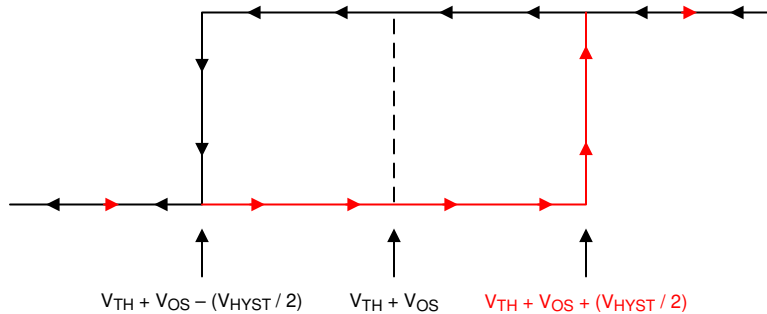
#### 4.4.5 Hysteresis

The basic comparator configuration can oscillate or produce a noisy "chatter" output if the applied differential input voltage is near the comparator's offset voltage. This usually occurs when the input signal is moving very slowly across the switching threshold of the comparator.

This problem can be prevented by the addition of hysteresis or positive feedback.

The hysteresis transfer curve is shown in [Figure 4-2](#). This curve is a function of three components:  $V_{TH}$ ,  $V_{OS}$ , and  $V_{HYST}$ :

- $V_{TH}$  is the actual set voltage or threshold trip voltage.
- $V_{OS}$  is the internal offset voltage between  $V_{IN+}$  and  $V_{IN-}$ . This voltage is added to  $V_{TH}$  to form the actual trip point at which the comparator must respond to change output states.
- $V_{HYST}$  is the hysteresis (or trip window) that is designed to reduce comparator sensitivity to noise.

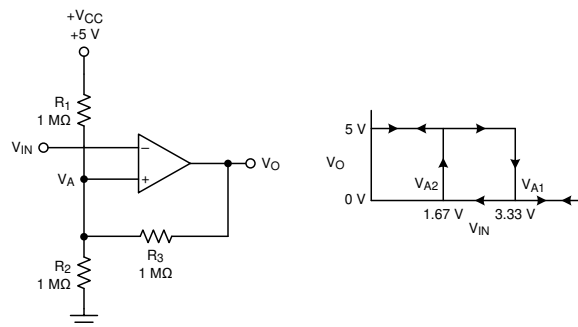


**Figure 4-2. Hysteresis Transfer Curve**

For more information, please see Application Note SBOA219 "[Comparator with and without hysteresis circuit](#)".

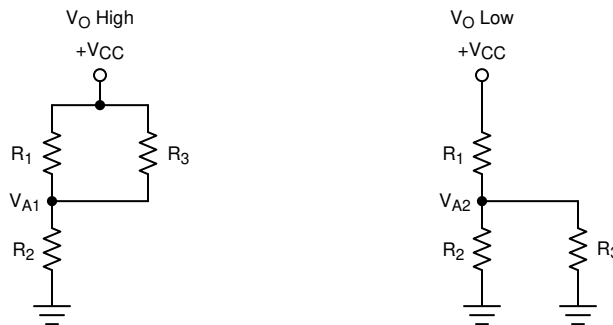
#### 4.4.5.1 Inverting Comparator With Hysteresis

The inverting comparator with hysteresis requires a three-resistor network that is referenced to the comparator supply voltage ( $V_{CC}$ ), as shown below.



**Figure 4-3. Inverting Configuration With Hysteresis**

The equivalent resistor networks when the output is high and low are shown below.



**Figure 4-4. Inverting Configuration Resistor Equivalent Networks**

When  $V_{IN}$  is less than  $V_A$ , the output voltage is high (for simplicity, assume  $V_O$  switches as high as  $V_{CC}$ ). The three network resistors can be represented as  $R1 \parallel R3$  in series with  $R2$ , as shown above on the left.

The equation below defines the high-to-low trip voltage ( $V_{A1}$ ).

$$V_{A1} = V_{CC} \times \frac{R2}{(R1 \parallel R3) + R2} \tag{1}$$

When  $V_{IN}$  is greater than  $V_A$ , the output voltage is low. In this case, the three network resistors can be presented as  $R2 \parallel R3$  in series with  $R1$ , as shown above on the right.

Use the equation below to define the low to high trip voltage ( $V_{A2}$ ).

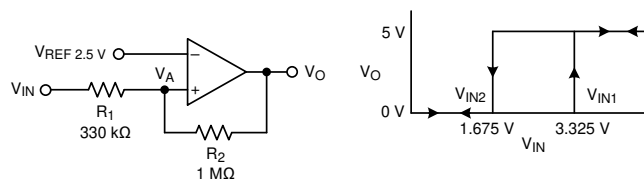
$$V_{A2} = V_{CC} \times \frac{R2 \parallel R3}{R1 + (R2 \parallel R3)} \tag{2}$$

The equation below defines the total hysteresis provided by the network.

$$\Delta V_A = V_{A1} - V_{A2} \tag{3}$$

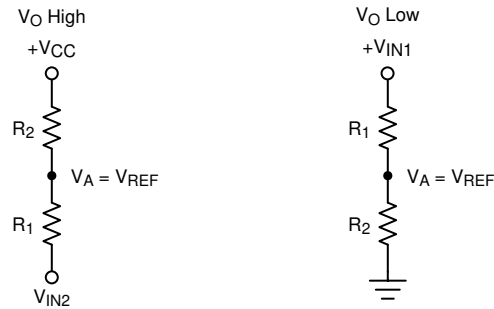
#### 4.4.5.2 Non-Inverting Comparator With Hysteresis

A non-inverting comparator with hysteresis requires a two-resistor network and a voltage reference ( $V_{REF}$ ) at the inverting input, as shown in [Figure 4-5](#).



**Figure 4-5. Non-Inverting Configuration With Hysteresis**

The equivalent resistor networks when the output is high and low are shown in [Figure 4-6](#).



**Figure 4-6. Non-Inverting Configuration Resistor Networks**

When  $V_{IN}$  is less than  $V_{REF}$ , the output is low. For the output to switch from low to high,  $V_{IN}$  must rise above the  $V_{IN1}$  threshold. Use [Equation 4](#) to calculate  $V_{IN1}$ .

$$V_{IN1} = R1 \times \frac{V_{REF}}{R2} + V_{REF} \quad (4)$$

When  $V_{IN}$  is greater than  $V_{REF}$ , the output is high. For the comparator to switch back to a low state,  $V_{IN}$  must drop below  $V_{IN2}$ . Use [Equation 5](#) to calculate  $V_{IN2}$ .

$$V_{IN2} = \frac{V_{REF} (R1 + R2) - V_{CC} \times R1}{R2} \quad (5)$$

The hysteresis of this circuit is the difference between  $V_{IN1}$  and  $V_{IN2}$ , as shown in [Equation 6](#).

$$\Delta V_{IN} = V_{CC} \times \frac{R1}{R2} \quad (6)$$

For more information, please see Application Notes SNOA997 "[Inverting comparator with hysteresis circuit](#)" and SBOA313 "[Non-Inverting Comparator With Hysteresis Circuit](#)".

## 5 Application and Implementation

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 5.1 Application Information

#### 5.1.1 Basic Comparator Definitions

##### 5.1.1.1 Operation

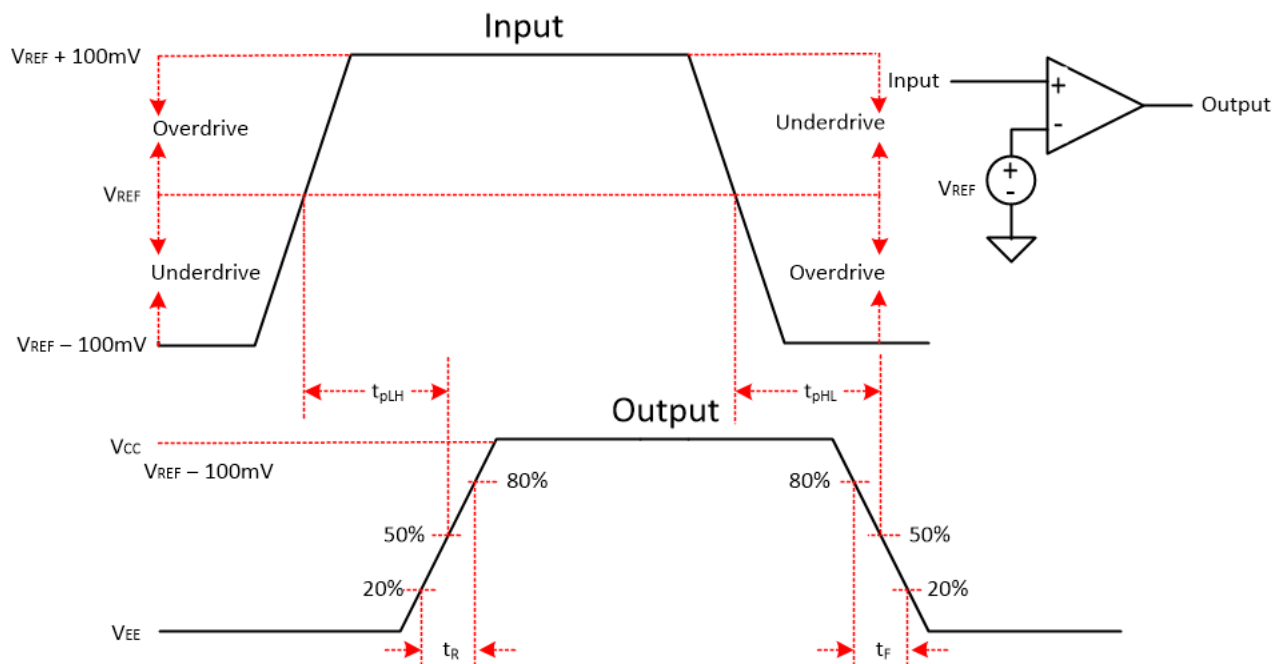
The basic comparator compares the input voltage ( $V_{IN}$ ) on one input to a reference voltage ( $V_{REF}$ ) on the other input. In the [Figure 5-1](#) example below, if  $V_{IN}$  is less than  $V_{REF}$ , the output voltage ( $V_O$ ) is logic low ( $V_{OL}$ ). If  $V_{IN}$  is greater than  $V_{REF}$ , the output voltage ( $V_O$ ) is at logic high ( $V_{OH}$ ). [Table 5-1](#) summarizes the output conditions. The output logic can be inverted by simply swapping the input pins.

**Table 5-1. Output Conditions**

Inputs Condition	Output
$IN+ > IN-$	HIGH ( $V_{OH}$ )
$IN+ = IN-$	Indeterminate (chatters - see <a href="#">Hysteresis</a> )
$IN+ < IN-$	LOW ( $V_{OL}$ )

##### 5.1.1.2 Propagation Delay

There is a delay between from when the input crosses the reference voltage and the output responds. This is called the Propagation Delay. Propagation delay can be different between high-to low and low-to-high input transitions. This is shown as  $t_{pLH}$  and  $t_{pHL}$  in [Figure 5-1](#) and is measured from the mid-point of the input to the midpoint of the output. Likewise, propagation varies with what is called overdrive ( $V_{OD}$ ) and underdrive ( $V_{UD}$ ) voltage levels (see section below).



**Figure 5-1. Comparator Timing Diagram**

### 5.1.1.3 Overdrive and Underdrive Voltage

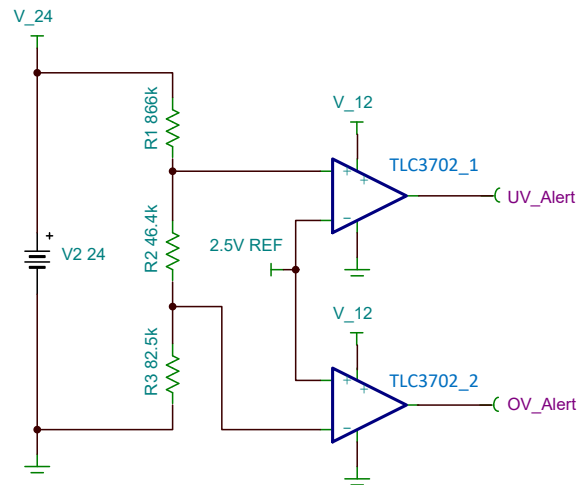
The overdrive voltage,  $V_{OD}$ , is the amount of input voltage beyond the reference voltage (and not the total input peak-to-peak voltage). The overdrive voltage is 100mV as shown in the [Figure 5-1](#) example. Similarly, underdrive voltage,  $V_{UD}$ , is how far below REF the input starts. The overdrive and underdrive voltages influence the propagation delay ( $t_p$ ). See curves in the Typical Characteristics section for more details. The smaller the overdrive voltage, the longer the propagation delay, particularly when <100mV. If the fastest speeds are desired, apply the highest amount of overdrive possible. Contrary to overdrive voltage, larger underdrive voltage causes propagation delay to increase. This is particularly important in applications where rail-to-rail input swings are present at the comparator inputs. The result can be skewed propagation delay (difference between  $t_{pLH}$  and  $t_{pHL}$ ). As a low power comparator, do not use this comparator family if variation in propagation delay is critical.

The risetime ( $t_r$ ) and falltime ( $t_f$ ) is the time from the 20% and 80% points of the output waveform.

## 5.2 Typical Applications

### 5.2.1 Window Comparator

Window comparators are commonly used to detect undervoltage and overvoltage conditions. The figure below shows a simple window comparator circuit monitoring a 24V PLC power supply.



**Figure 5-2. Window Comparator**

#### 5.2.1.1 Design Requirements

For this design, follow these design requirements:

- UV\_Alert (logic low output) when the 24V supply is less than 19.2V
- OV\_Alert (logic low output) when the 24V supply is greater than 30V
- Current dissipated in the resistor string is 30uA
- Comparator operates from the 5V supply
- 2.5V external reference is utilized

#### 5.2.1.2 Detailed Design Procedure

Configure the circuit as shown in the circuit above where the 2.5V REF from the TLC3702-EP is used as the reference voltage and the resistor string of R1, R2, and R3 define the upper and lower threshold voltages for the 24V PLC power supply. When the comparator detects that the 24V supply has exceeded the maximum voltage of 30V or has drooped below the minimum voltage of 19.2V, OV\_Alert and UV\_Alert nets are pulled to a logic LOW state.

The first step is to determine the sum total resistance of the resistor string (R1, R2, R3) using the dissipation limit of 30uA. With a maximum operating voltage of 30V, the resistor string draws 30uA if the total resistance of  $R1+R2+R3$  is 1Mohm.

The second step is to set the value of R3 such that the lower comparator changes output state from HIGH to LOW when the 24V supply reaches 30V. This is achieved when the voltage at the junction of R2 and R3 is equal to the reference voltage of 2.5V. Since 30 $\mu$ A is passing through the resistor string at 30V, R3 can be calculated from  $2.5V / 30\mu A$  which is approximately 83.3k $\Omega$ s.

The third step is to set the value of R2 such that the upper comparator changes output state from HIGH to LOW when the 24V supply reaches 19.2V. This is achieved when the voltage at the junction of R1 and R2 is equal to the reference voltage of 2.5V. Since 19.2 $\mu$ A passes through the resistor string at 19.2V, R2 can be calculated from  $(2.5V / 19.2\mu A) - R3$  which is approximately 46.9k $\Omega$ s.

Lastly, the value of R1 is calculated from 1M $\Omega$  - (R2 + R3) which is approximately 870k $\Omega$ s. Please note that standard 1% resistor values were selected for the circuit

The respective comparator outputs (OV\_Alert and UV\_Alert) are LOW when the 24V PLC power supply is less than 19.2V or greater than 30V. Likewise, the respective comparator outputs are HIGH when the 24V supply is within the range of 19.2V to 30V (within the "window"), as shown below.

### 5.2.1.3 Application Curve

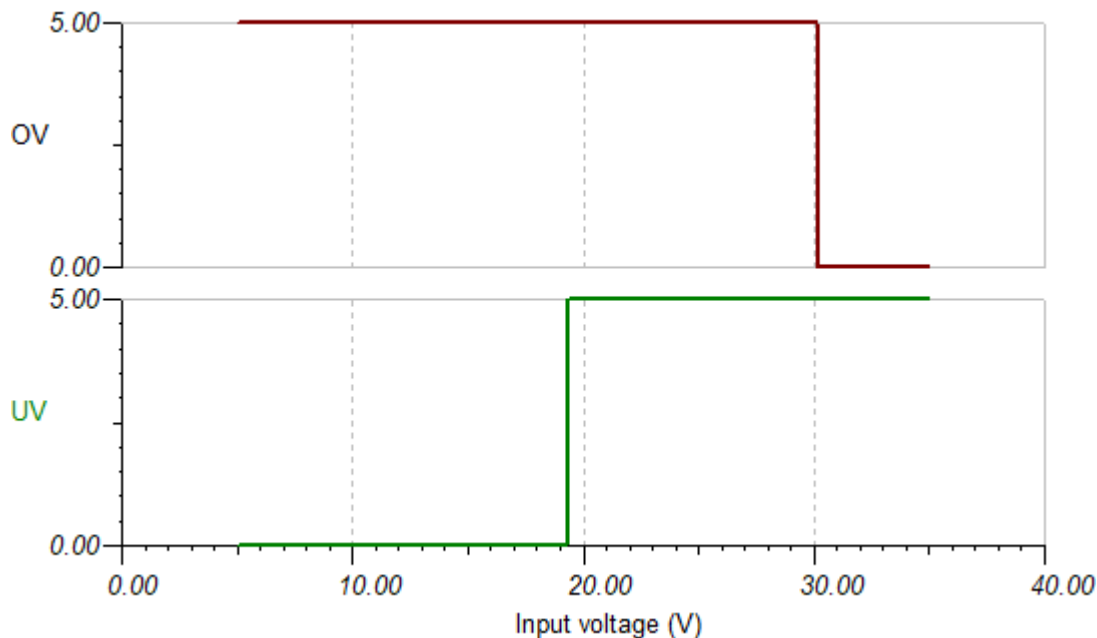


Figure 5-3. Window Comparator Results

## 5.3 Power Supply Recommendations

Due to the fast output edge rates, bypass capacitors are critical on the supply pin to prevent supply ringing and false triggers and oscillations. Bypass the supply directly at *each* device with a low ESR 0.1 $\mu$ F ceramic bypass capacitor directly between V+ pin and ground pins. Narrow, peak currents are drawn during the output transition time, particularly for the push-pull output device. These narrow pulses can cause un-bypassed supply lines and poor grounds to ring, possibly causing variation that can eat into the input voltage range and create an inaccurate comparison or even oscillations.

The device can be powered from both "split" supplies (V+ and V-), or "single" supplies (V+ and GND), with GND applied to the V- pin. Input signals must stay within the specified input range (between V+ and V-) for either type. Note that with a "split" supply the output swings "low" ( $V_{OL}$ ) to V- potential and not GND.

## 5.4 Layout

### 5.4.1 Layout Guidelines

For accurate comparator applications, a clean, stable power supply is important to minimize output glitches. Output rise and fall times are in the tens of nanoseconds, and must be treated as high speed logic devices. The bypass capacitor must be as close to the supply pin as possible and connected to a solid ground plane, and preferably directly between the V+ and GND pins.

Minimize coupling between outputs and inputs to prevent output oscillations. Do not run output and input traces in parallel unless there is a V+ or GND trace between output to reduce coupling. When series resistance is added to inputs, place resistor close to the device. A low value ( $\leq 100$  ohms) resistor can also be added in series with the output to dampen any ringing or reflections on long, non-impedance controlled traces. For best edge shapes, controlled impedance traces with back-terminations must be used when routing long distances.

### 5.4.2 Layout Example

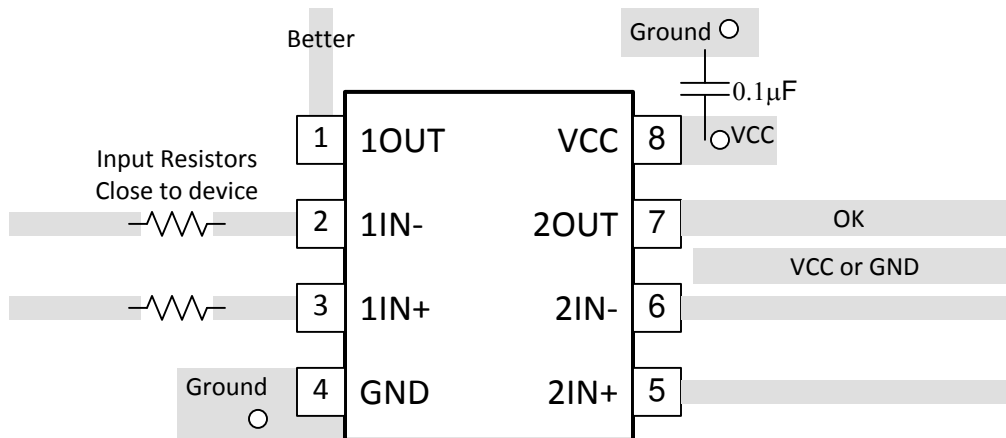


Figure 5-4. Dual Layout Example

## 6 Device and Documentation Support

### 6.1 Documentation Support

#### 6.1.1 Related Documentation

### 6.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 6.3 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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### 6.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 6.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 6.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

### Changes from Revision A (March 2025) to Revision B (June 2025) Page

- Updated features..... 1

### Changes from Revision \* (July 2002) to Revision A (March 2025) Page

- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1
- Updated entire data sheet to reflect new die - no change to min max specifications..... 1

## 8 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.



## PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">TLC3702MDREP</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	3702ME
TLC3702MDREP.A	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	3702ME
<a href="#">V62/03643-01XE</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	3702ME

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

(2) **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.

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

(4) **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.

(5) **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.

(6) **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.

**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.

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### OTHER QUALIFIED VERSIONS OF TLC3702-EP :

- Catalog : [TLC3702](#)

- Automotive : [TLC3702-Q1](#)

- Military : [TLC3702M](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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
TLC3702MDREP	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	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)
TLC3702MDREP	SOIC	D	8	2500	350.0	350.0	43.0



D0008A

# PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

### NOTES:

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

# EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
 EXPOSED METAL SHOWN  
 SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



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

4214825/C 02/2019

NOTES: (continued)

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

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