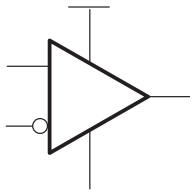
SGLS170 − JUNE 2003

NANOPOWER PUSH-PULL OUTPUT COMPARATOR

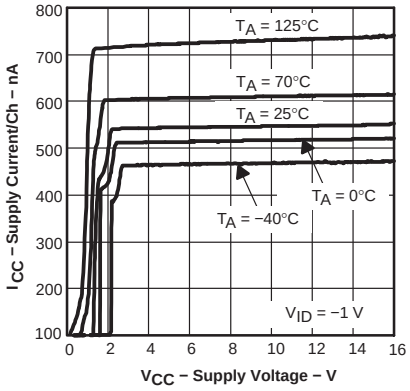
FEATURES

- **Controlled Baseline**
  - **One Assembly/Test Site, One Fabrication Site**
- **Extended Temperature Performance of −40°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **Low Supply Current . . . 560 nA**
- **Input Common-Mode Range Exceeds the Rails . . . −0.1 V to V_{CC} + 5 V**
- **Supply Voltage Range . . . 2.7 V to 16 V**
- **Reverse Battery Protection Up to 18 V**
- **Push-Pull CMOS Output Stage**
- **Ultrasmall Packaging**
  - **5-Pin SOT-23**
- **Universal Op-Amp EVM (Reference SLOU060 for more information)**

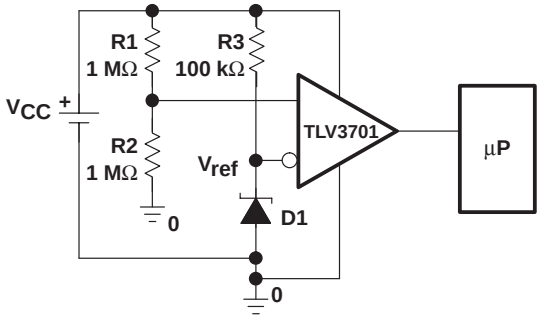
† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.



SUPPLY CURRENT vs SUPPLY VOLTAGE



high side voltage sense circuit



APPLICATIONS

- **Portable Battery Monitoring**
- **Security Detection Systems**

DESCRIPTION

The TLV3701 is part of Texas Instruments' first family of nanopower comparator with only 560 nA supply current, which make this device ideal for low power applications.

DESCRIPTION (continued)

The TLV3701 has a minimum operating supply voltage of 2.7 V over the extended temperature range T_A = −40°C to 125°C, while having an input common-mode range of −0.1 to V_{CC} + 5 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 V above the positive supply rail without damage to the device.

This device is available in the small SOT-23 package. Other package options may be made available upon request.

A SELECTION OF OUTPUT COMPARATORS†

DEVICE	V_{CC} (V)	V_{IO} (μV)	I_{CC}/Ch (μA)	I_{IB} (pA)	t_{PLH} (μs)	t_{PHL} (μs)	t_f (μs)	t_r (μs)	RAIL-TO-RAIL	OUTPUT STAGE
TLV370x	2.5 − 16	250	0.56	80	56	83	22	8	I	PP
TLV340x	2.5 − 16	250	0.47	80	55	30	5	−	I	OD
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

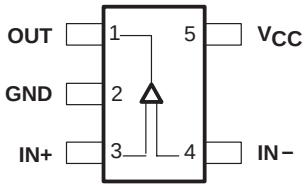
† All specifications are typical values measured at 5 V.

AVAILABLE OPTIONS†

T_A	V_{IO} max AT 25°C	PACKAGED DEVICES	
		SOT-23 (DBV)‡	SYMBOL
−40°C to 125°C	5000 μV	TLV3701QDBVREP	VBCE

† Contact the local TI sales office for availability of other package options.
‡ This package is only available taped and reeled with standard quantities of 3000 pieces per reel.

DBV PACKAGE
(TOP VIEW)



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

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 . . . . . −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

† 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 max or V_{CC} + 5 V, whichever is smaller.

DISSIPATION RATING TABLE

PACKAGE	θ_{JC} (°C/W)	θ_{JA} (°C/W)	$T_A \le 25°C$ POWER RATING	$T_A = 125°C$ POWER RATING
DBV	55	324.1	385 mW	77.1 mW

recommended operating conditions

		MIN	MAX	UNIT
Supply voltage, V_{CC}	Single supply	2.7	16	V
	Split supply	±1.35	±8	
Common-mode input voltage range, V_{ICR}		−0.1	V_{CC}+5	V
Operating free-air temperature, T_A		−40	125	°C

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

dc performance

PARAMETER		TEST CONDITIONS	T_A†	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = V_{CC}/2$, $R_S = 50\ \Omega$	25°C		250	5000	μV
			Full range			7000	
α_{VIO}	Offset voltage drift		25°C		3		μV/°C
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V, $R_S = 50\ \Omega$	25°C	55	72		dB
			Full range	50			
		V_{IC} = 0 to 5 V, $R_S = 50\ \Omega$	25°C	60	76		
			Full range	55			
		V_{IC} = 0 to 15 V, $R_S = 50\ \Omega$	25°C	65	88		
			Full range	60			
A_{VD}	Large-signal differential voltage amplification		25°C		1000		V/mV

† Full range is −40°C to 125°C for Q suffix.

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

input/output characteristics

PARAMETER		TEST CONDITIONS	T_A†	MIN	TYP	MAX	UNIT
I_{IO}	Input offset current	$V_{IC} = V_{CC}/2$, $R_S = 50\ \Omega$	25°C		20	100	pA
			Full range			1000	
I_{IB}	Input bias current		25°C		80	250	pA
			Full range			2000	
$r_{i(d)}$	Differential input resistance		25°C		300		MΩ
V_{OH}	High-level output voltage	$V_{IC} = V_{CC}/2$, $I_{OH} = 2\ \mu A$, $V_{ID} = 1$ V	25°C		$V_{CC}-$ 0.08		mV
		$V_{IC} = V_{CC}/2$, $I_{OH} = -50\ \mu A$, $V_{ID} = 1$ V	25°C	$V_{CC}-$ 320			
			Full range	$V_{CC}-$ 450			
V_{OL}	Low-level output voltage	$V_{IC} = V_{CC}/2$, $I_{OH} = 2\ \mu A$, $V_{ID} = -1$ V	25°C		8		mV
		$V_{IC} = V_{CC}/2$, $I_{OH} = 50\ \mu A$, $V_{ID} = -1$ V	25°C		80	200	
			Full range			300	

† Full range is −40°C to 125°C for Q suffix.

power supply

PARAMETER		TEST CONDITIONS		T_A†	MIN	TYP	MAX	UNIT
I_{CC}	Supply current	Output state high		25°C		560	800	nA
				Full range			1200	
PSRR	Power supply rejection ratio	$V_{IC} = V_{CC}/2$ V, No load	V_{CC} = 2.7 V to 5 V	25°C	75	100		dB
				Full range	70			
			V_{CC} = 5 V to 15 V	25°C	85	105		
				Full range	80			

† Full range is −40°C to 125°C for Q suffix.

switching characteristics at recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{(PLH)}$	Propagation response time, low-to-high-level output (see Note 3)	f = 1 kHz, V_{STEP} = 100 mV, C_L = 10 pF, V_{CC} = 2.7 V	Overdrive = 2 mV		240		µs
			Overdrive = 10 mV		64		
			Overdrive = 50 mV		36		
$t_{(PHL)}$	Propagation response time, high-to-low-level output (see Note 3)		Overdrive = 2 mV		167		
			Overdrive = 10 mV		67		
			Overdrive = 50 mV		37		
t_r	Rise time	C_L = 10 pF, V_{CC} = 2.7 V			7		µs
t_f	Fall time	C_L = 10 pF, V_{CC} = 2.7 V			9		µs

NOTE 3: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V. Propagation responses are longer at higher supply voltages, refer to Figures 11−16 for further details.

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
	Input bias/offset current	vs Free-air temperature	1
V_{OL}	Low-level output voltage	vs Low-level output current	2, 4, 6
V_{OH}	High-level output voltage	vs High-level output current	3, 5, 7
I_{CC}	Supply current	vs Supply voltage	8
		vs Free-air temperature	9
	Output fall time/rise time	vs Supply voltage	10
	Low-to-high level output response for various input overdrives		11, 13, 15
	High-to-low level output response for various input overdrives		12, 14, 16

INPUT BIAS/OFFSET CURRENT vs FREE-AIR TEMPERATURE

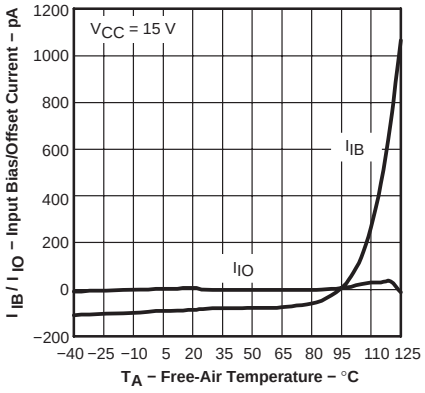


Figure 1

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

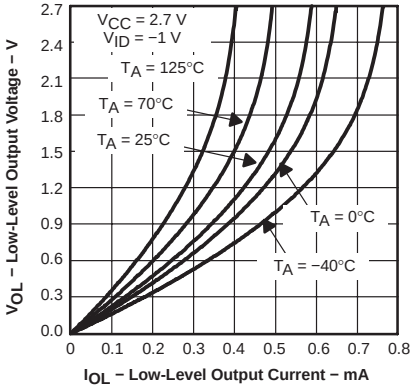


Figure 2

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

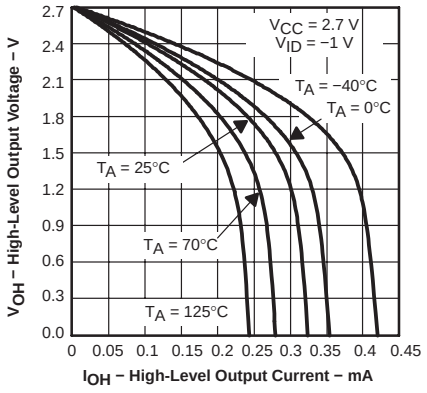


Figure 3

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

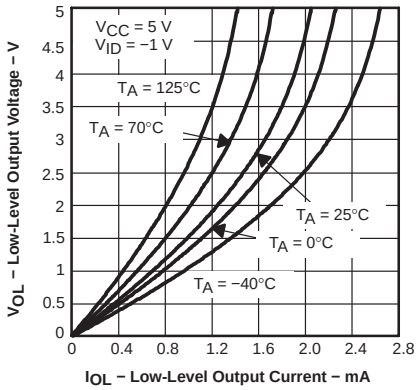


Figure 4

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

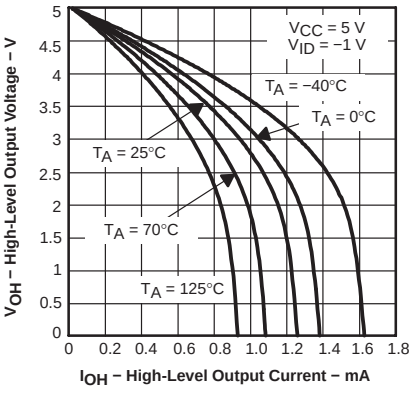


Figure 5

TYPICAL CHARACTERISTICS

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

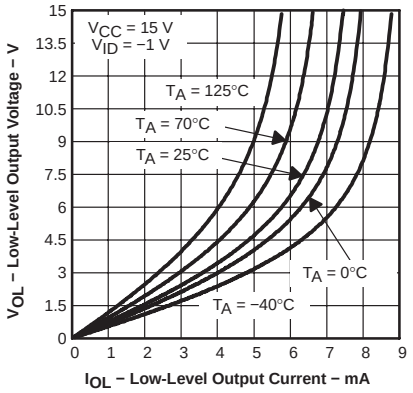


Figure 6

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

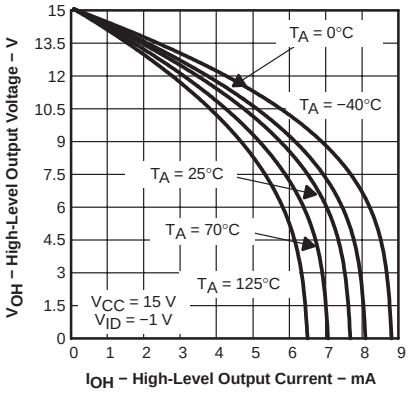


Figure 7

SUPPLY CURRENT vs SUPPLY VOLTAGE

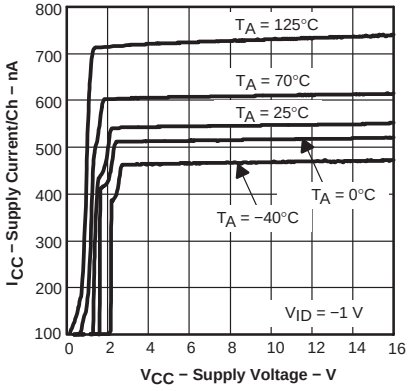


Figure 8

SUPPLY CURRENT vs FREE-AIR TEMPERATURE

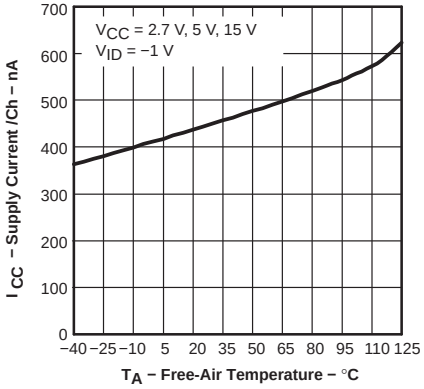


Figure 9

OUTPUT RISE/FALL TIME vs SUPPLY VOLTAGE

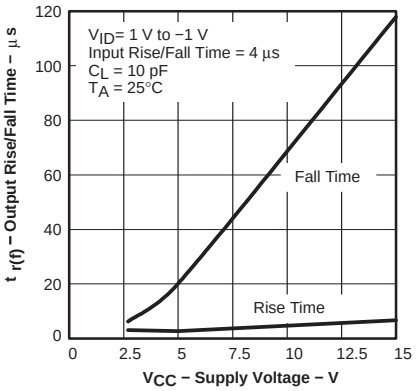


Figure 10

LOW-TO-HIGH OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

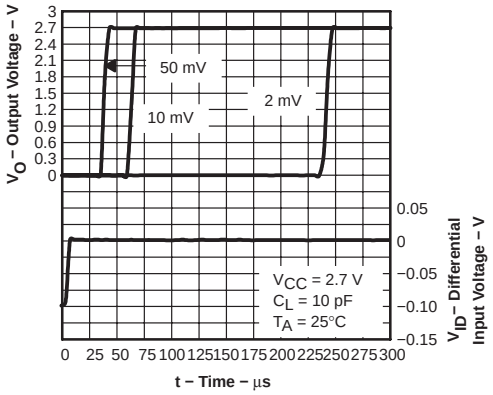


Figure 11

HIGH-TO-LOW LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

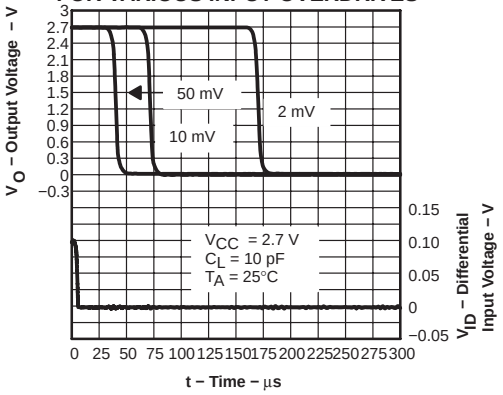


Figure 12

TYPICAL CHARACTERISTICS

LOW-TO-HIGH LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

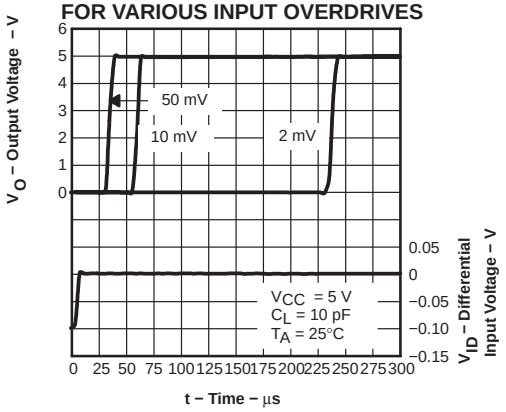


Figure 13

HIGH-TO-LOW LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

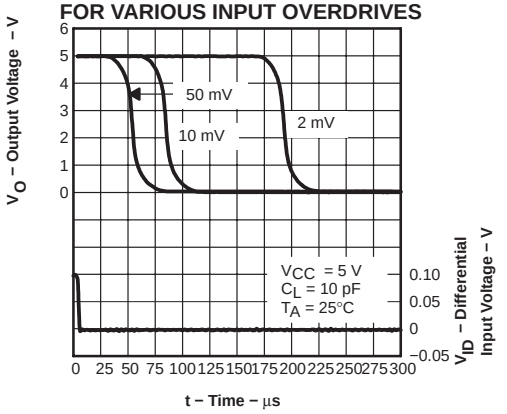


Figure 14

LOW-TO-HIGH LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

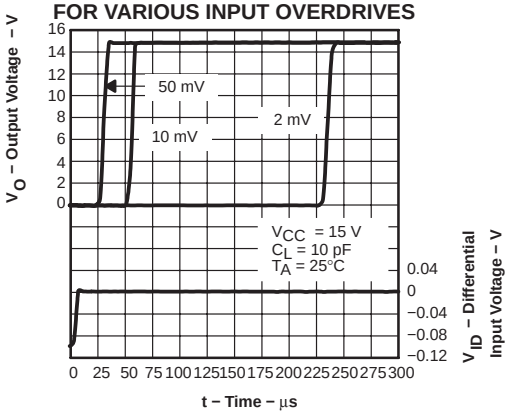


Figure 15

HIGH-TO-LOW LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

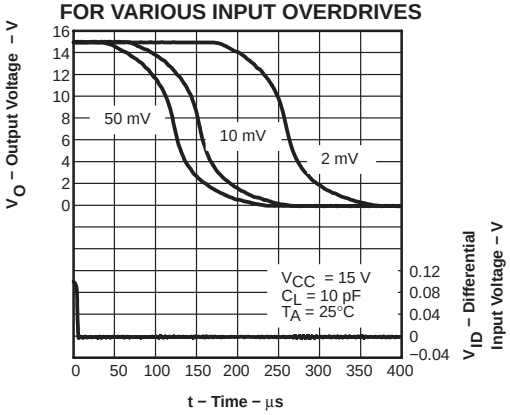


Figure 16

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TLV3701QDBVREP	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/04726-01XE	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

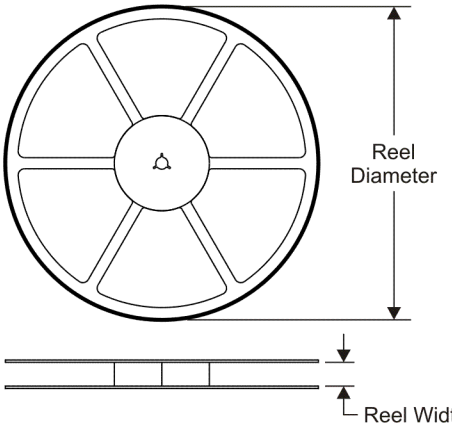
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

OTHER QUALIFIED VERSIONS OF TLV3701-EP :
- Catalog: TLV3701
- Automotive: TLV3701-Q1

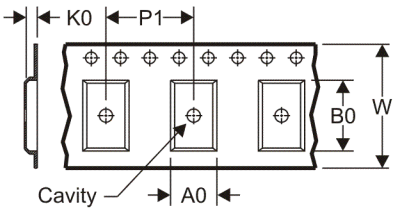
NOTE: Qualified Version Definitions:
- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

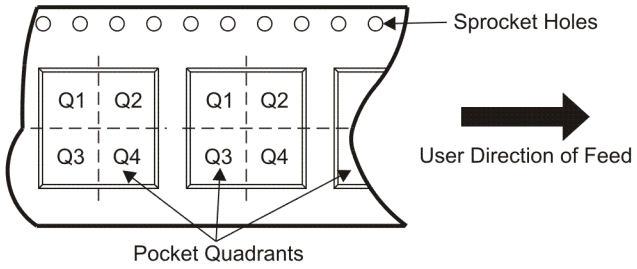


TAPE DIMENSIONS



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

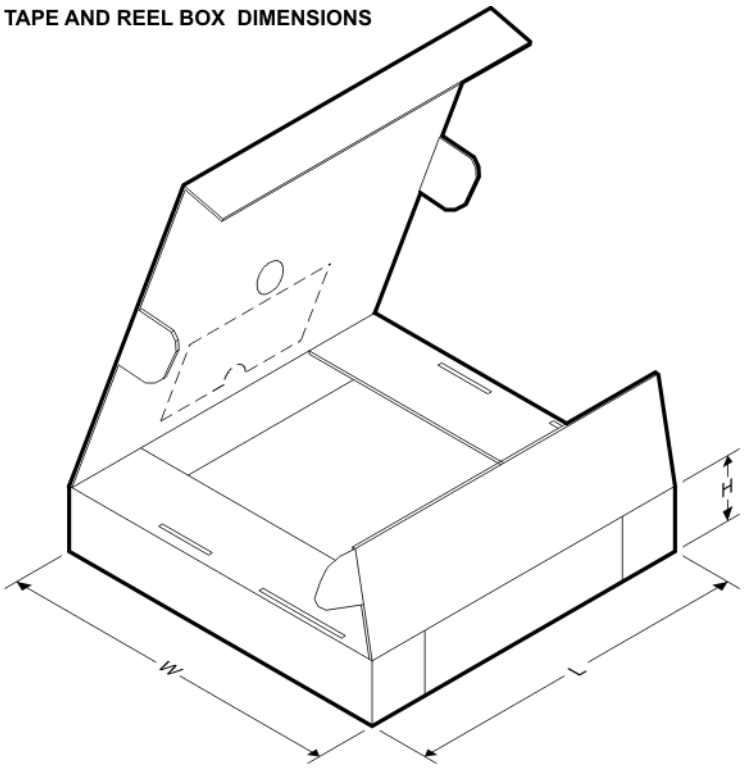
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLV3701QDBVREP	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV3701QDBVREP	SOT-23	DBV	5	3000	182.0	182.0	20.0

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