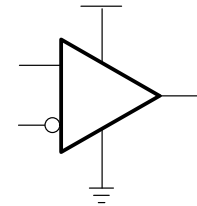


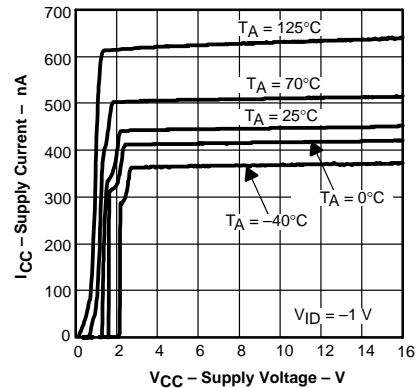
# TLV3401, TLV3402, TLV3404 FAMILY OF NANOPOWER OPEN DRAIN OUTPUT COMPARATORS

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

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



SUPPLY CURRENT  
vs  
SUPPLY VOLTAGE

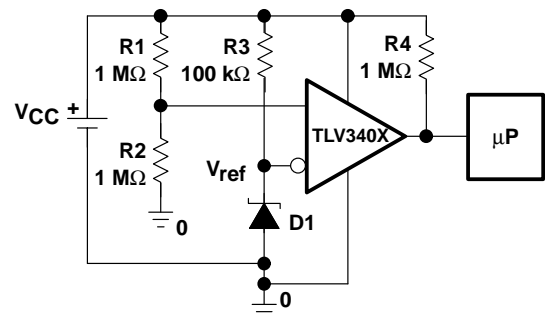


## description

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

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

## high side voltage sense circuit



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

A SELECTION OF OUTPUT COMPARATOR†

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

† All specifications are typical values measured at 5 V.



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

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

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

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

## TLV3401 AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	PACKAGED DEVICES			
		SMALL OUTLINE (D) <sup>†</sup>	SOT-23 (DBV) <sup>‡</sup>	SYMBOL	PLASTIC DIP (P)
0°C to 70°C	3600 μV	TLV3401CD	TLV3401CDBV	VBDC	—
-40°C to 125°C		TLV3401ID	TLV3401IDBV	VBDI	TLV3401IP

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

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

## TLV3402 AVAILABLE OPTIONS

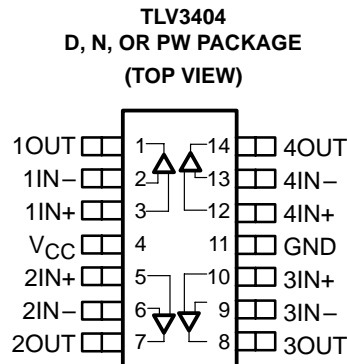
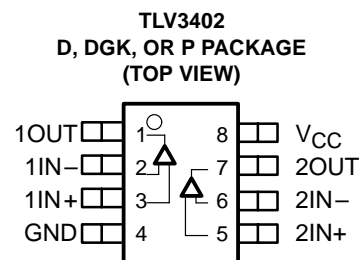
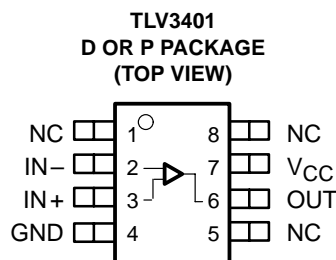
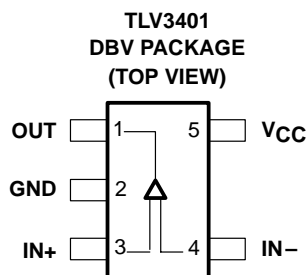
T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	PACKAGED DEVICES			
		SMALL OUTLINE (D) <sup>†</sup>	MSOP (DGK) <sup>†</sup>	SYMBOL	PLASTIC DIP (P)
0°C to 70°C	3600 μV	TLV3402CD	TLV3402CDGK	xxTIAJJ	—
-40°C to 125°C		TLV3402ID	TLV3402IDGK	xxTIAJK	TLV3402IP

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

## TLV3404 AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	PACKAGED DEVICES		
		SMALL OUTLINE (D) <sup>†</sup>	PLASTIC DIP (N)	TSSOP (PW)
0°C to 70°C	3600 μV	TLV3404CD	—	TLV3404CPW
-40°C to 125°C		TLV3404ID	TLV3404IN	TLV3404IPW

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



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

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

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

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

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

- NOTES: 1. All voltage values, except differential voltages, are with respect to GND.  
2. Input voltage range is limited to 20 V or  $V_{CC} + 5$  V, whichever is smaller.

**DISSIPATION RATING TABLE**

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

## recommended operating conditions

			MIN	MAX	UNIT
Supply voltage, $V_{CC}$	Single supply	C-suffix	2.5	16	V
		I-suffix	2.7	16	
	Split supply	C-suffix	$\pm 1.25$	$\pm 8$	
		I-suffix	$\pm 1.35$	$\pm 8$	
Common-mode input voltage range, $V_{ICR}$			-0.1	$V_{CC}+5$	V
Operating free-air temperature, $T_A$	C-suffix		0	70	°C
	I-suffix		-40	125	

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

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

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

## dc performance

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

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

## input/output characteristics

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

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

## power supply

PARAMETER	TEST CONDITIONS	$T_A$ †	MIN	TYP	MAX	UNIT
$I_{CC}$ Supply current (per channel)	$R_P = \text{No pullup}$	Output state low	25°C	470	550	nA
			Full range			
		Output state high	25°C	560	640	
			Full range			
PSRR Power supply rejection ratio	$V_{IC} = V_{CC}/2\text{ V}, \text{No load}$	$V_{CC} = 2.7\text{ V to }5\text{ V}$	25°C	75	100	dB
			Full range	70		
		$V_{CC} = 5\text{ V to }15\text{ V}$	25°C	85	105	
			Full range	80		

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

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

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

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

PARAMETER		TEST CONDITIONS		$T_A$	MIN	TYP	MAX	UNIT
$t_{(PLH)}$	Propagation delay time, low-to-high-level output	f = 10 kHz, VSTEP = 1 V, R <sub>P</sub> = 1 M $\Omega$ , C <sub>L</sub> = 10 pF	Overdrive = 2 mV	25°C		175		$\mu\text{s}$
			Overdrive = 10 mV			80		
			Overdrive = 50 mV			55		
$t_{(PHL)}$	Propagation delay time, high-to-low-level output		Overdrive = 2 mV	25°C		300		
			Overdrive = 10 mV			60		
			Overdrive = 50 mV			30		
$t_f$	Fall time	R <sub>P</sub> = 1 M $\Omega$ , C <sub>L</sub> = 10 pF		25°C		5	$\mu\text{s}$	

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

## TYPICAL CHARACTERISTICS

### Table of Graphs

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

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

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

## TYPICAL CHARACTERISTICS

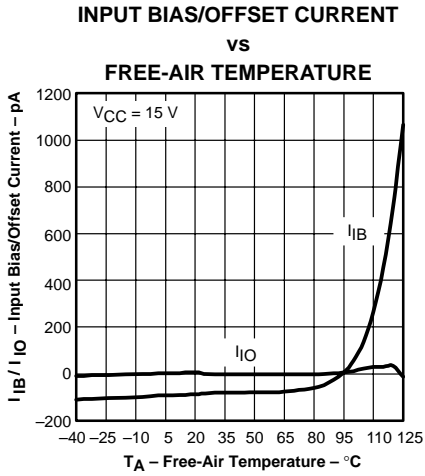


Figure 1

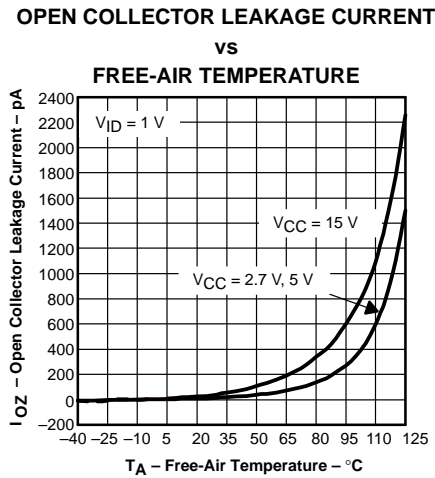


Figure 2

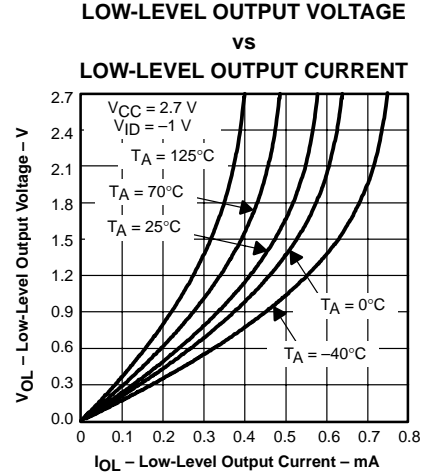


Figure 3

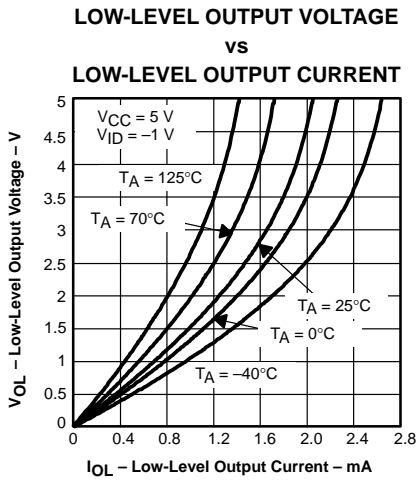


Figure 4

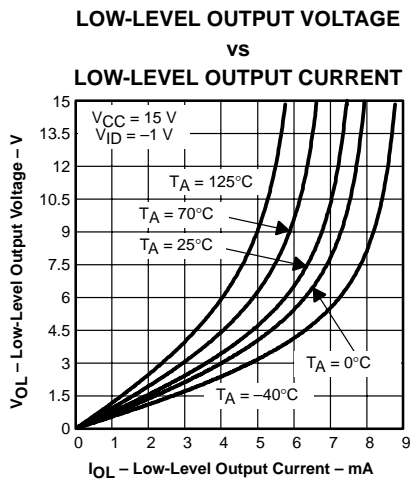


Figure 5

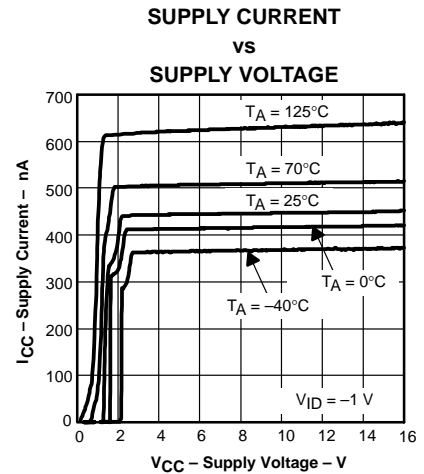


Figure 6

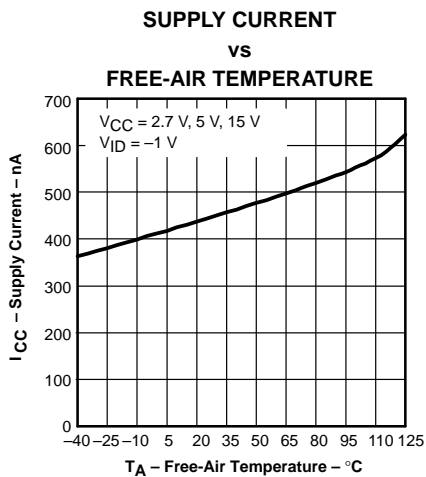


Figure 7

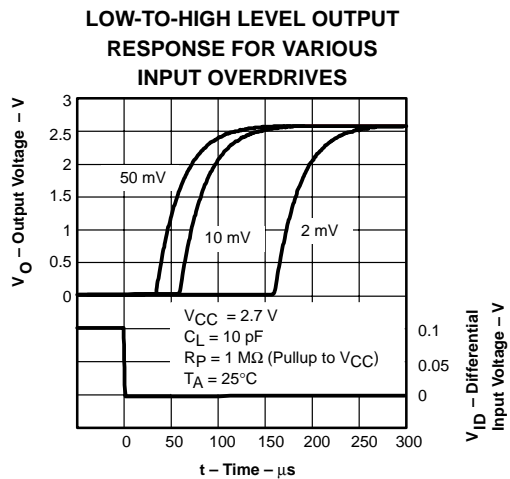


Figure 8



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

SLCS135A – AUGUST 2000 – REVISED NOVEMBER 2000

## TYPICAL CHARACTERISTICS

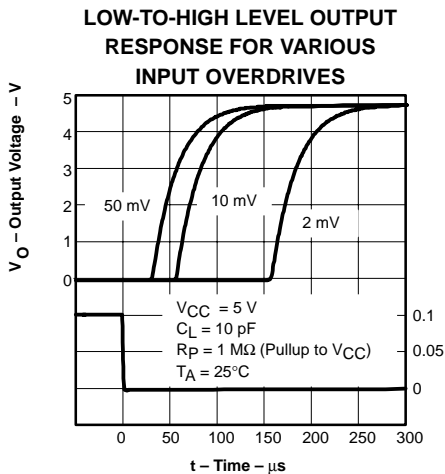


Figure 9

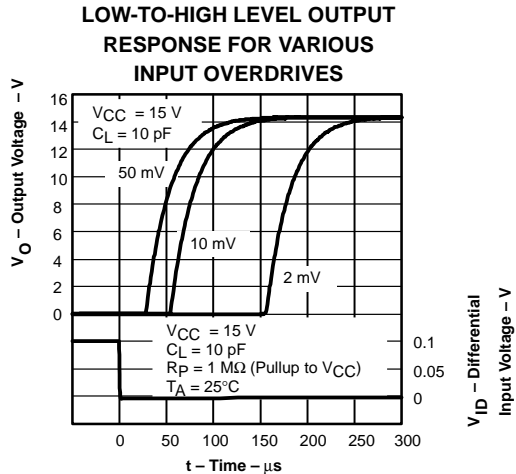


Figure 10

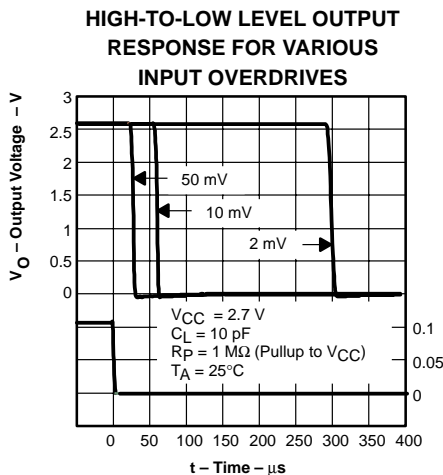


Figure 11

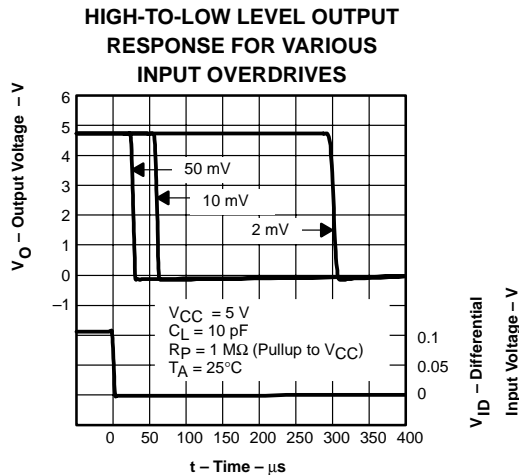


Figure 12

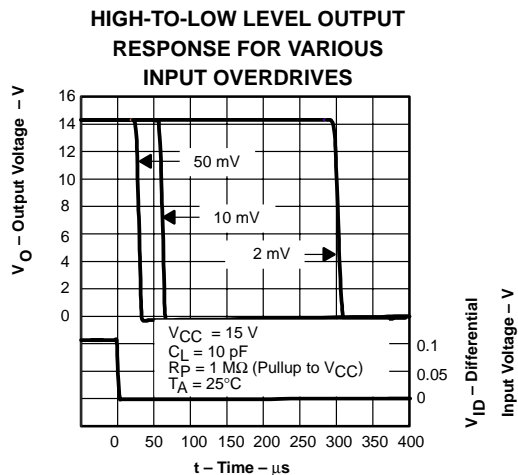


Figure 13

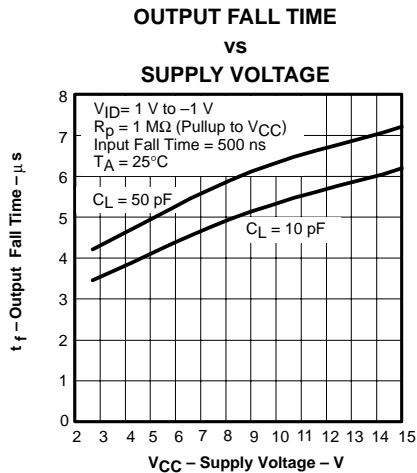


Figure 14

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TLV3401CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401CDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401CDBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401CDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401CDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IDBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IDBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IDBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IDBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3401IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV3401IPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV3402CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402CDGK	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402CDGKG4	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402CDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402CDGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM



Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TLV3402IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402IDGK	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402IDGKG4	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402IDGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402IDGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3402IP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV3402IPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV3404CD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404CDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404CDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404CDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404CPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404CPWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404CPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404CPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404ID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404IDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404IDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404IDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404IN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV3404INE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLV3404IPW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404IPWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV3404IPWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TLV3404IPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

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

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

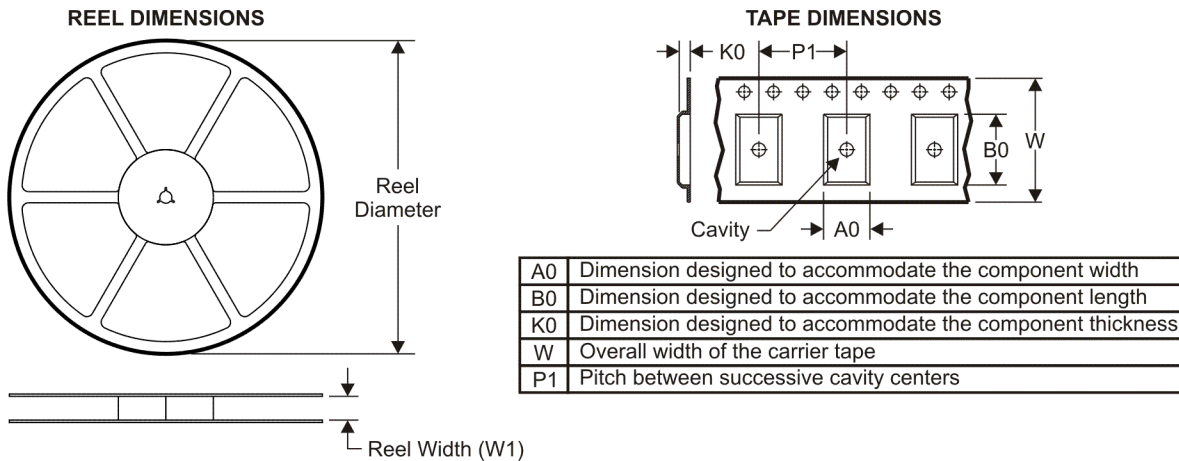
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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**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
TLV3401CDBVR	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TLV3401CDBVT	SOT-23	DBV	5	250	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TLV3401IDBVR	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TLV3401IDBVT	SOT-23	DBV	5	250	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TLV3401IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV3402CDGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TLV3402CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV3402IDGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TLV3402IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLV3404CDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLV3404CPWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TLV3404IDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLV3404IPWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV3401CDBVR	SOT-23	DBV	5	3000	182.0	182.0	20.0
TLV3401CDBVT	SOT-23	DBV	5	250	182.0	182.0	20.0
TLV3401IDBVR	SOT-23	DBV	5	3000	182.0	182.0	20.0
TLV3401IDBVT	SOT-23	DBV	5	250	182.0	182.0	20.0
TLV3401IDR	SOIC	D	8	2500	340.5	338.1	20.6
TLV3402CDGKR	MSOP	DGK	8	2500	358.0	335.0	35.0
TLV3402CDR	SOIC	D	8	2500	340.5	338.1	20.6
TLV3402IDGKR	MSOP	DGK	8	2500	358.0	335.0	35.0
TLV3402IDR	SOIC	D	8	2500	533.4	186.0	36.0
TLV3404CDR	SOIC	D	14	2500	333.2	345.9	28.6
TLV3404CPWR	TSSOP	PW	14	2000	346.0	346.0	29.0
TLV3404IDR	SOIC	D	14	2500	333.2	345.9	28.6
TLV3404IPWR	TSSOP	PW	14	2000	346.0	346.0	29.0

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