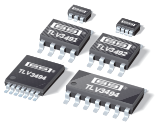


TLV3491
TLV3492
TLV3494

SBOS262B – DECEMBER 2002 – JANUARY 2004

1.8V, Nanopower, PUSH-PULL OUTPUT COMPARATOR

FEATURES

- **VERY LOW SUPPLY CURRENT: 0.8μA (typ)**
- **INPUT COMMON-MODE RANGE 200mV BEYOND SUPPLY RAILS**
- **SUPPLY VOLTAGE: +1.8V to +5.5V**
- **HIGH SPEED: 6μs**
- **PUSH-PULL CMOS OUTPUT STAGE**
- **SMALL PACKAGES:**
  SOT23-5 (Single)
  SOT23-8 (Dual)

APPLICATIONS

- **PORTABLE MEDICAL EQUIPMENT**
- **WIRELESS SECURITY SYSTEMS**
- **REMOTE CONTROL SYSTEMS**
- **HANDHELD INSTRUMENTS**
- **ULTRA-LOW POWER SYSTEMS**

DESCRIPTION

The TLV349x family of push-pull output comparators features a fast 6μs response time, and < 1.2μA (max) nanopower capability, allowing operation from 1.8V – 5.5V. Input common-mode range beyond supply rails make the TLV349x an ideal choice for low-voltage applications.

Micro-sized packages provide options for portable and space-restricted applications. The single (TLV3491) is available in SOT23-5 and SO-8. The dual (TLV3492) comes in SOT23-8 and SO-8. The quad (TLV3494) is available in TSSOP-14 and SO-14.

The TLV349x is excellent for power-sensitive, low-voltage (2-cell) applications.

TLV349x RELATED PRODUCTS

PRODUCT	FEATURES
TLV370x	560nA, 2.5V to 16V, Push-Pull CMOS Output Stage Comparator
TLV340x	550nA, 2.5V to 16V, Open Drain Output Stage Comparator

ABSOLUTE MAXIMUM RATINGS(1)

Supply Voltage	+5.5V
Signal Input Terminals, Voltage(2)	(V–) – 0.5V to (V+) + 0.5V
Current(2)	±10mA
Output Short-Circuit(3)	Continuous
Operating Temperature	–40°C to +125°C
Storage Temperature	–65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (soldering, 10s)	+300°C

NOTE: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied. (2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current limited to 10mA or less. (3) Short-circuit to ground, one amplifier per package.

ELECTROSTATIC DISCHARGE SENSITIVITY

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.

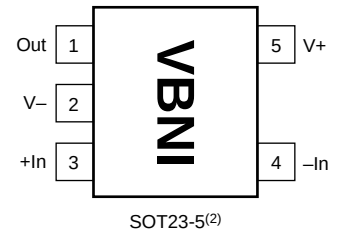
PACKAGE/ORDERING INFORMATION(1)

PRODUCT	PACKAGE-LEAD	PACKAGE DESIGNATOR	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
TLV3491	SOT23-5	DBV	–40°C to +125°C	VBNI	TLV3491AIDBVT	Tube, 250
"	"	"	"	"	TLV3491AIDBVR	Tape and Reel, 3000
TLV3491	SO-8	D	–40°C to +125°C	TLV3491	TLV3491AID	Tube, 100
"	"	"	"	"	TLV3491AIDR	Tube, 2500
TLV3492	SOT23-8	DCN	–40°C to +125°C	VBO1	TLV3492AIDCNT	Tube, 250
"	"	"	"	"	TLV3492AIDCNR	Tape and Reel, 3000
TLV3492	SO-8	D	–40°C to +125°C	TLV3492	TLV3492AID	Tube, 100
"	"	"	"	"	TLV3492AIDR	Tape and Reel, 2500
TLV3494	TSSOP-14	PW	–40°C to +125°C	TLV3494	TLV3494AIPWT	Tape and Reel, 94
"	"	"	"	"	TLV3494AIPWR	Tape and Reel, 2500
TLV3494	SO-14	D	–40°C to +125°C	TLV3494	TLV3494AID	Tape and Reel, 58
"	"	"	"	"	TLV3494AIDR	Tape and Reel, 2500

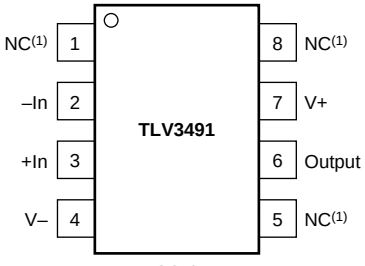
NOTE: (1) For the most current package and ordering information, see the Package Option Addendum located at the end of this data sheet.

PIN CONFIGURATIONS

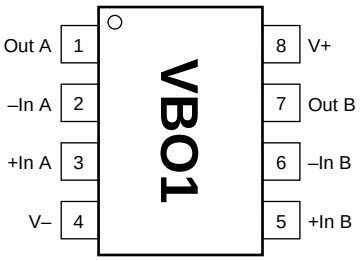
Top View



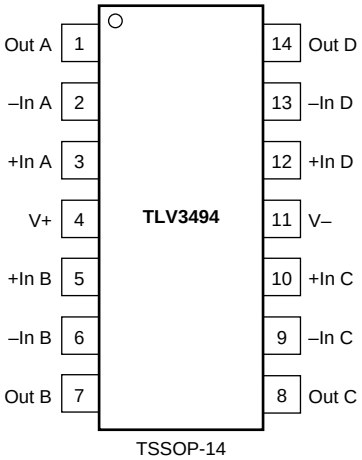
SOT23-5(2)



SO-8



SOT23-8
SO-8



TSSOP-14
SO-14

NOTES: (1) NC means no internal connection.
(2) Orient pins according to package marking.

ELECTRICAL CHARACTERISTICS: V_S = +1.8V to +5.5V

Boldface limits apply over the specified temperature range, **T_A = –40°C to +125°C.**

At T_A = +25°C, and V_S = +1.8V to +5.5V, unless otherwise noted.

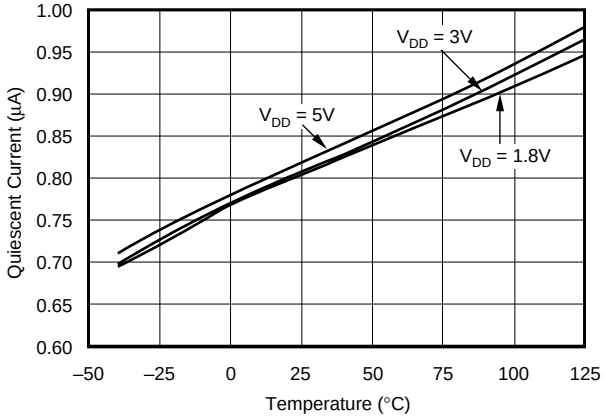
PARAMETER		CONDITION	TLV3491, TLV3492, TLV3494 MIN	TYP	MAX	UNITS
OFFSET VOLTAGE	V_{OS}					
Input Offset Voltage		V_{CM} = 0V, I_O = 0V		±3	±15	mV
vs Temperature	**dV_{OS}/dT**	**T_A = –40°C to +125°C**		**±12**		**µV/°C**
vs Power Supply	PSRR	V_S = 1.8V to 5.5V		350	1000	µV/V
INPUT BIAS CURRENT						
Input Bias Current	I_B	V_{CM} = V_{CC}/2		±1	±10	pA
Input Offset Current	I_{OS}	V_{CM} = V_{CC}/2		±1	±10	pA
INPUT VOLTAGE RANGE						
Common-Mode Voltage Range	V_{CM}		(V–) – 0.2V		(V+) + 0.2V	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = –0.2V to (V+) – 1.5V	60	74		dB
		V_{CM} = –0.2V to (V+) + 0.2V	54	62		dB
INPUT CAPACITANCE						
Common-Mode				2		pF
Differential				4		pF
SWITCHING CHARACTERISTICS		f = 10kHz, V_{STEP} = 1V				
Propagation Delay Time, Low-to-High	$t_{(PLH)}$	Input Overdrive = 10mV		12		µs
		Input Overdrive = 100mV		6		µs
Propagation Delay Time, High-to-Low	$t_{(PHL)}$	Input Overdrive = 10mV		13.5		µs
		Input Overdrive = 100mV		6.5		µs
Rise Time	t_R	C_L = 10pF		100		ns
Fall Time	t_F	C_L = 10pF		100		ns
OUTPUT		V_S = 5V				
Voltage Output High from Rail	V_{OH}	I_{OUT} = 5mA		90	200	mV
Voltage Output Low from Rail	V_{OL}	I_{OUT} = 5mA		160	200	mV
Short-Circuit Current	I_{SC}		See Typical Characteristics			
POWER SUPPLY						
Specified Voltage	V_S		1.8		5.5	V
Operating Voltage Range			1.8		5.5	V
Quiescent Current(1)	I_Q	V_O = 5V, V_O = High		0.85	1.2	µA
TEMPERATURE RANGE						
Specified Range			–40		+125	°C
Operating Range			–40		+125	°C
Storage Range			–65		+150	°C
Thermal Resistance, θ_{JA}						
SOT23-5, SOT23-8				200		°C/W
SO-8				150		°C/W
SO-14, TSSOP-14				100		°C/W

NOTE: (1) I_Q per channel.

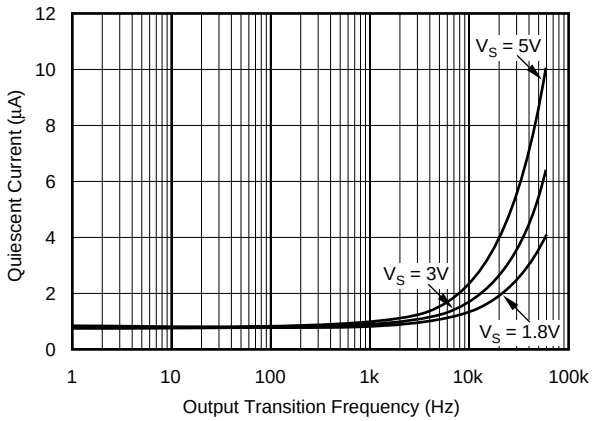
TYPICAL CHARACTERISTICS

At T_A = +25°C, V_S = +1.8V to +5.5V, and V_{OD} = 100mV, unless otherwise noted.

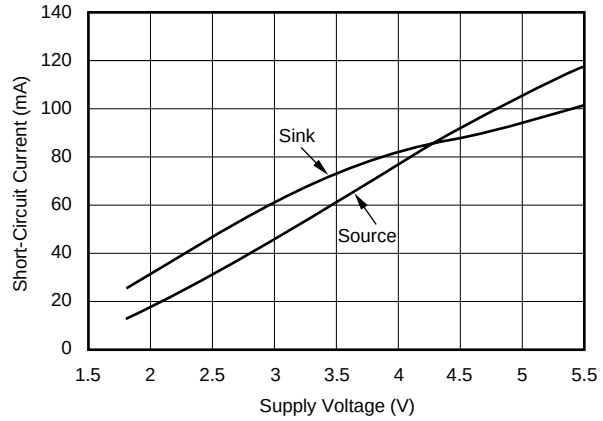
QUIESCENT CURRENT vs TEMPERATURE



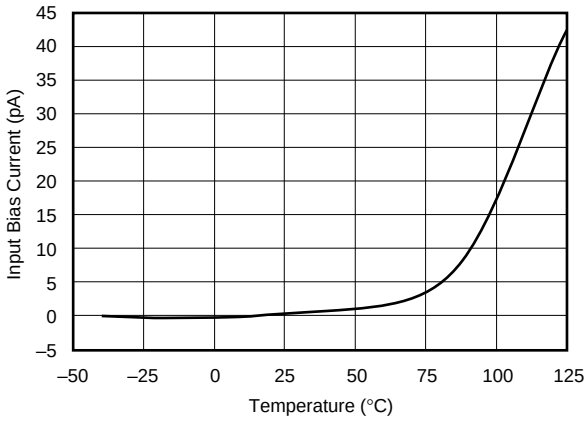
QUIESCENT CURRENT
vs OUTPUT SWITCHING FREQUENCY



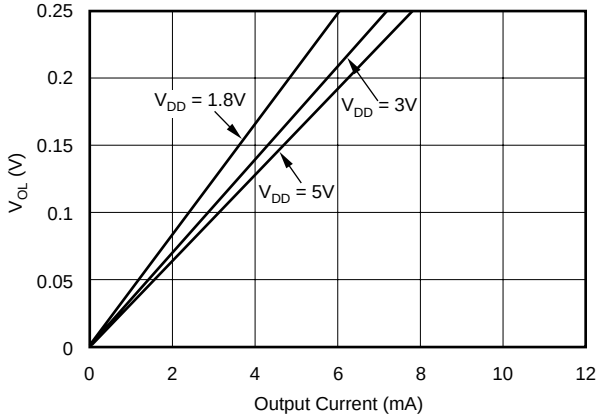
SHORT-CIRCUIT CURRENT vs SUPPLY VOLTAGE



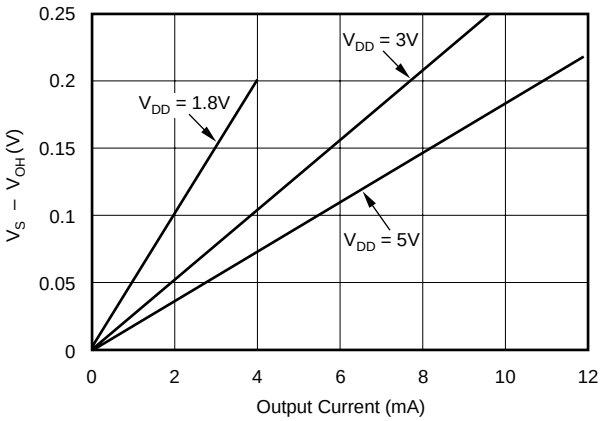
INPUT BIAS CURRENT vs TEMPERATURE



OUTPUT LOW vs OUTPUT CURRENT



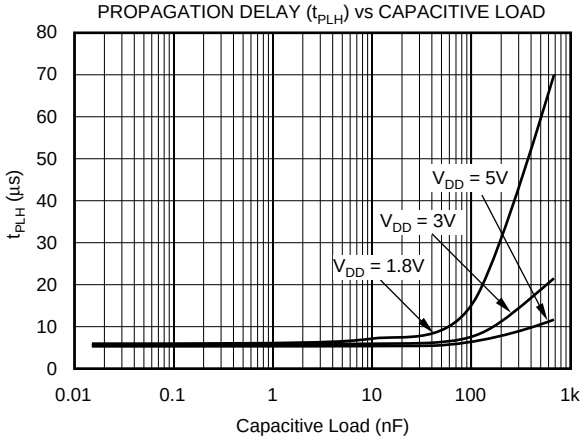
OUTPUT HIGH vs OUTPUT CURRENT



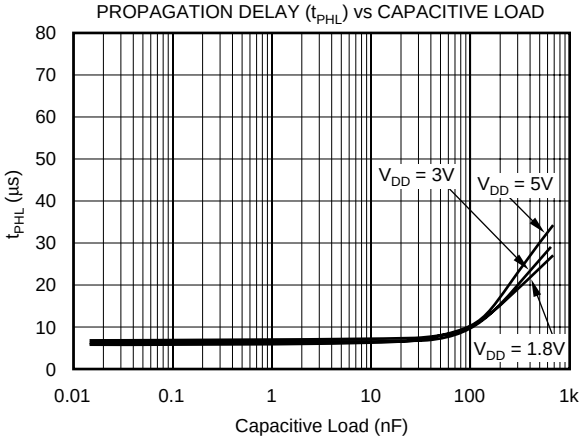
TYPICAL CHARACTERISTICS (Cont.)

At T_A = +25°C, V_S = +1.8V to +5.5V, and V_{OD} = 100mV, unless otherwise noted.

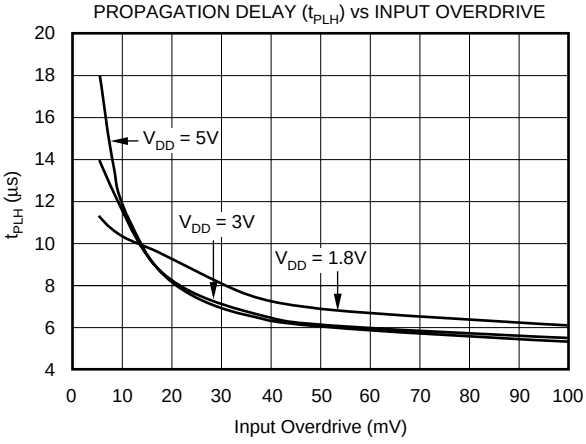
PROPAGATION DELAY (t_{PLH}) vs CAPACITIVE LOAD



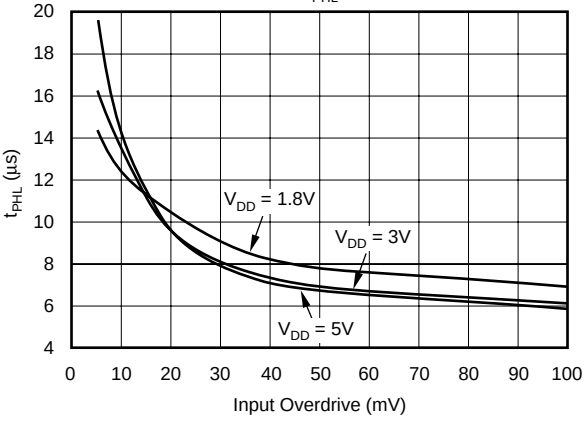
PROPAGATION DELAY (t_{PHL}) vs CAPACITIVE LOAD



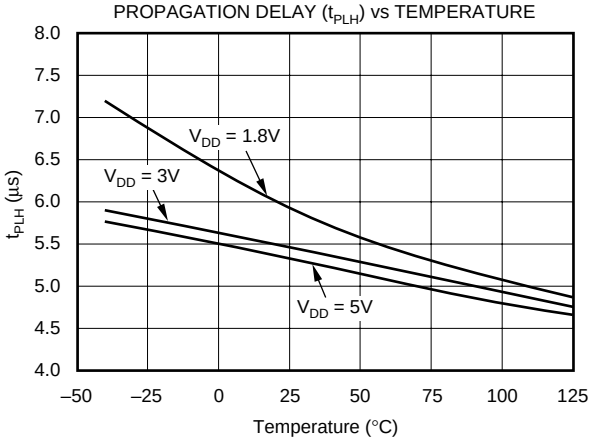
PROPAGATION DELAY (t_{PLH}) vs INPUT OVERDRIVE



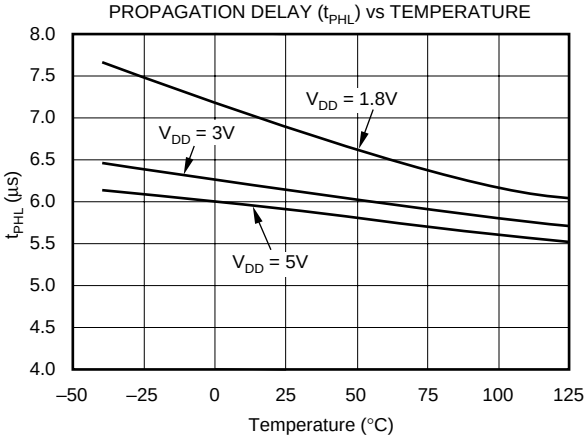
PROPAGATION DELAY (t_{PHL}) vs INPUT OVERDRIVE



PROPAGATION DELAY (t_{PLH}) vs TEMPERATURE



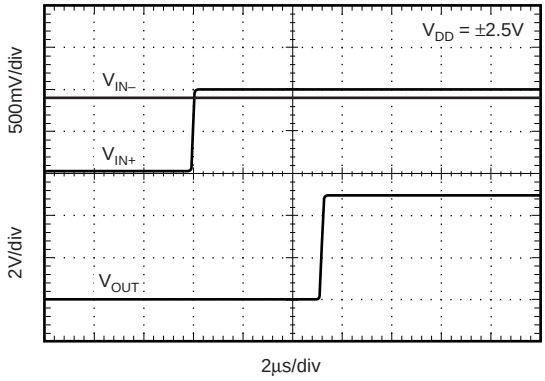
PROPAGATION DELAY (t_{PHL}) vs TEMPERATURE



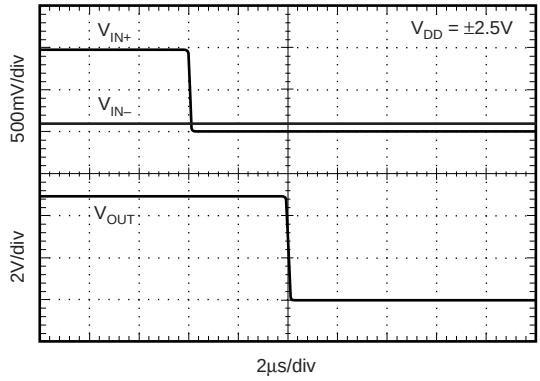
TYPICAL CHARACTERISTICS (Cont.)

At T_A = +25°C, V_S = +1.8V to +5.5V, and V_{OD} = 100mV, unless otherwise noted.

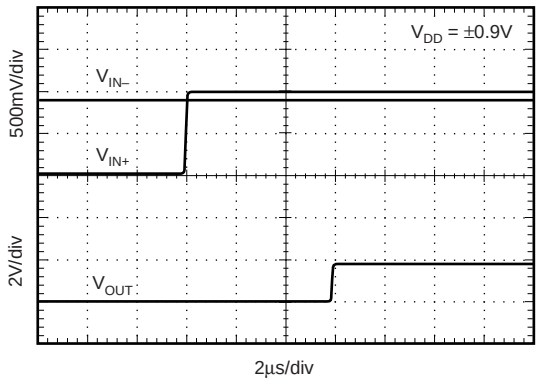
PROPAGATION DELAY (t_{PLH})



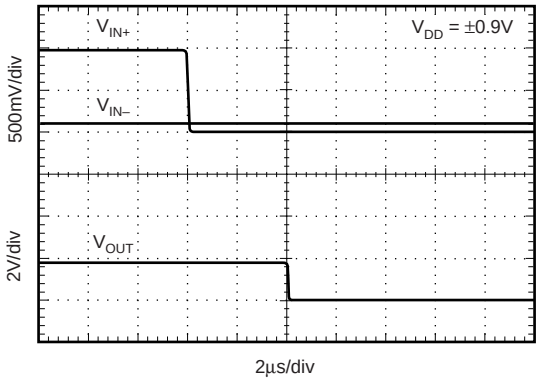
PROPAGATION DELAY (t_{PHL})



PROPAGATION DELAY (t_{PLH})



PROPAGATION DELAY (t_{PHL})



APPLICATIONS INFORMATION

The TLV349x family of comparators feature rail-to-rail input and output on supply voltages as low as 1.8V. The push-pull output stage is optimal for reduced power budget applications and features no shoot-through current. Low supply voltages, common-mode input range beyond supply rails, and a typical supply current of 0.8µA make the TLV349x family an excellent candidate for battery-powered applications with single-cell operation.

BOARD LAYOUT

Figure 1 shows the typical connections for the TLV349x. To minimize supply noise, power supplies should be capacitively decoupled by a 0.01µF ceramic capacitor in parallel with a 10µF electrolytic capacitor. Comparators are very sensitive to input noise. Proper grounding (use of ground plane) and guarding of high-impedance nodes will help maintain specified performance of the TLV349x family.

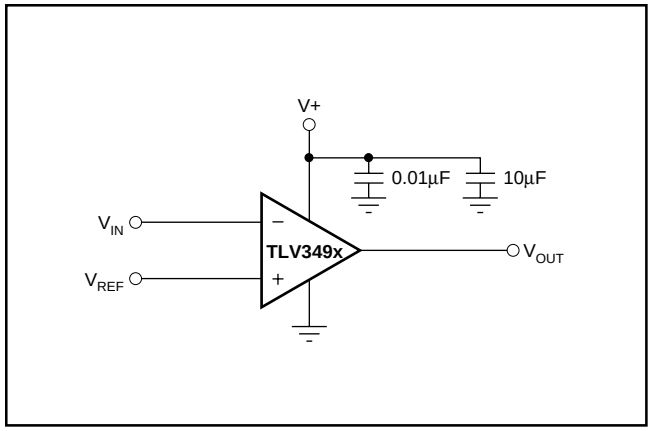


FIGURE 1. Basic Connections of the TLV349x.

SETTING REFERENCE VOLTAGE

It is important to use a stable reference when setting the transition point for the TLV349. The REF1004 provides a 1.25V reference voltage with low drift and only 8µA of quiescent current.

EXTERNAL HYSTERESIS

Comparator inputs have no noise immunity within the range of specified offset voltage (±15mV). For noisy input signals, the comparator output may display multiple switching as input signals move through the switching threshold. The typical comparator threshold of the TLV349x is ±15mV. To prevent multiple switching within the comparator threshold of the TLV349x, external hysteresis may be added by connecting a small amount of feedback to the positive input. Figure 2 shows a typical topology used to introduce hysteresis, described by the equation:

$$V_{HYST} = (V^{+} - V_{REF})\frac{R_1}{R_1 + R_2}$$

V_{HYST} will set the value of the transition voltage required to switch the comparator output by increasing the threshold region, thereby reducing sensitivity to noise.

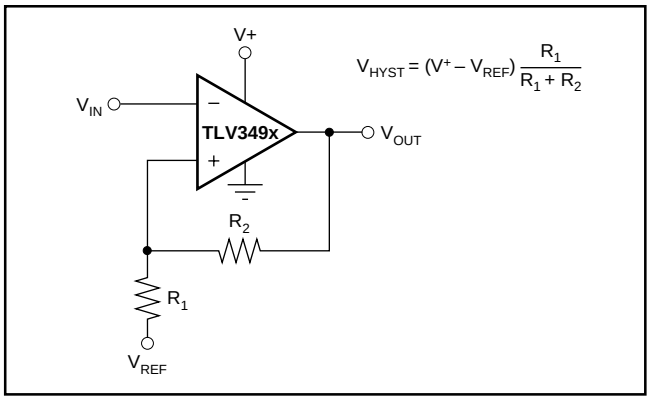


FIGURE 2. Adding Hysteresis to the TLV349x.

APPLICATIONS

RELAXATION OSCILLATOR

The TLV349x can be configured as a relaxation oscillator to provide a simple and inexpensive clock output. The capacitor is charged and discharged at a period of T = 0.69RC, and is powered by a single supply.

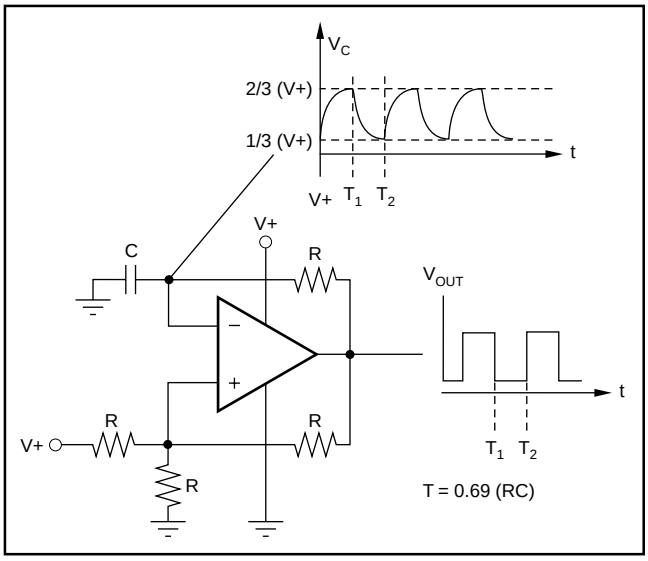


FIGURE 3. TLV349x Configured as a Relaxation Oscillator.

DRIVING THE MSP430

The reset circuit shown in Figure 4 provides a reset to the MSP430 microcontroller. Operation of the circuit is based on a stabilization time constant of the supply voltage, rather than on a predetermined voltage value. The negative input is a reference voltage created by a simple resistor divider. These resistor values should be relatively high to reduce the current consumption of the circuit. The positive input is an RC circuit that provides a power-up delay. When power is applied, the output of the comparator is low, holding the processor in the reset condition. Only after the supply voltage has stabilized does the positive input of the comparator become higher than the negative input, resulting in a high output state, and releasing the processor for operation. The stabilization time required for the supply voltage is adjustable by the selection of the RC component values. Use of a lower-valued resistor in this portion of the circuit will not increase current consumption because no current flows through the RC circuit after the supply has stabilized. By selecting R_1, C_1, R_2, and R_3, the user can ensure a reliable reset signal to the microcontroller for a given dv/dt for V_{CC}.

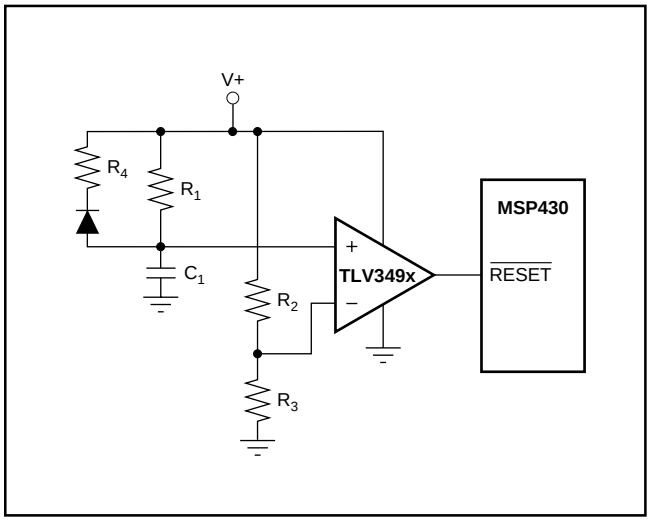


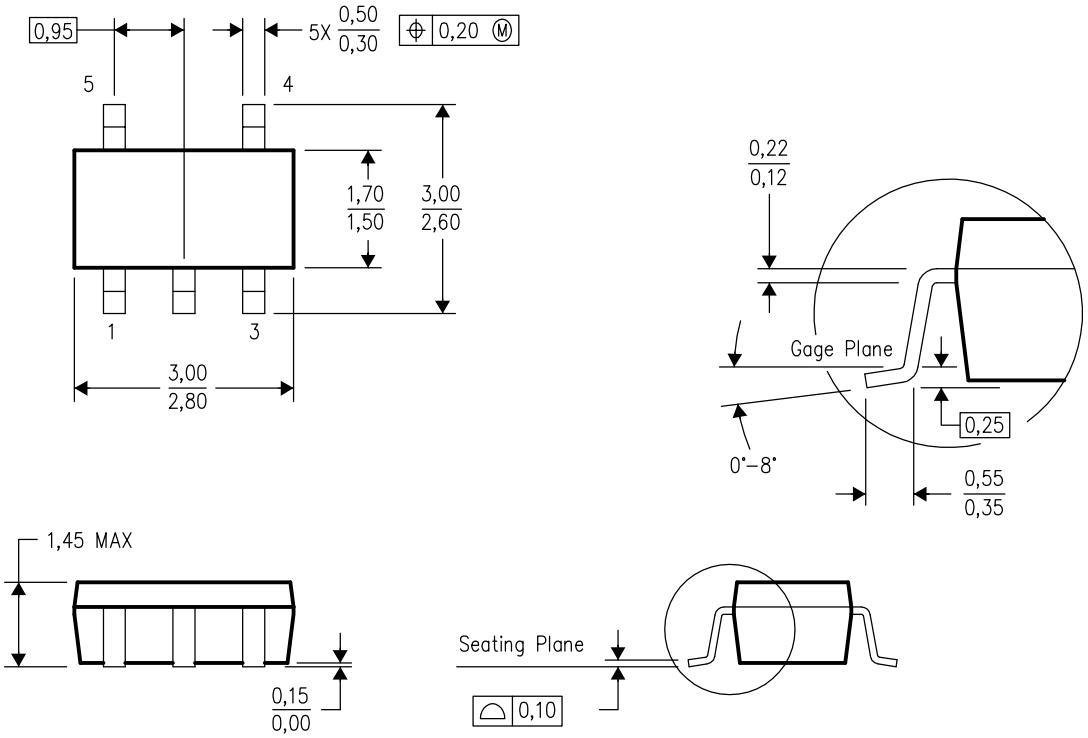
FIGURE 4. The TLV349x Configured as a Reset Circuit for the MSP430.

PACKAGING INFORMATION

ORDERABLE DEVICE	STATUS(1)	PACKAGE TYPE	PACKAGE DRAWING	PINS	PACKAGE QTY
TLV3491AID	ACTIVE	SOIC	D	8	100
TLV3491AIDBVR	ACTIVE	SOP	DBV	5	3000
TLV3491AIDBVT	ACTIVE	SOP	DBV	5	250
TLV3491AIDR	ACTIVE	SOIC	D	8	2500
TLV3492AID	ACTIVE	SOIC	D	8	100
TLV3492AIDCNR	ACTIVE	SSOP	DCN	8	3000
TLV3492AIDCNT	ACTIVE	SSOP	DCN	8	250
TLV3492AIDR	ACTIVE	SOIC	D	8	2500
TLV3494AID	ACTIVE	SOIC	D	14	58
TLV3494AIDR	ACTIVE	SOIC	D	14	2500
TLV3494AIPWR	ACTIVE	TSSOP	PW	14	2500
TLV3494AIPWT	ACTIVE	TSSOP	PW	14	250

(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.

DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE

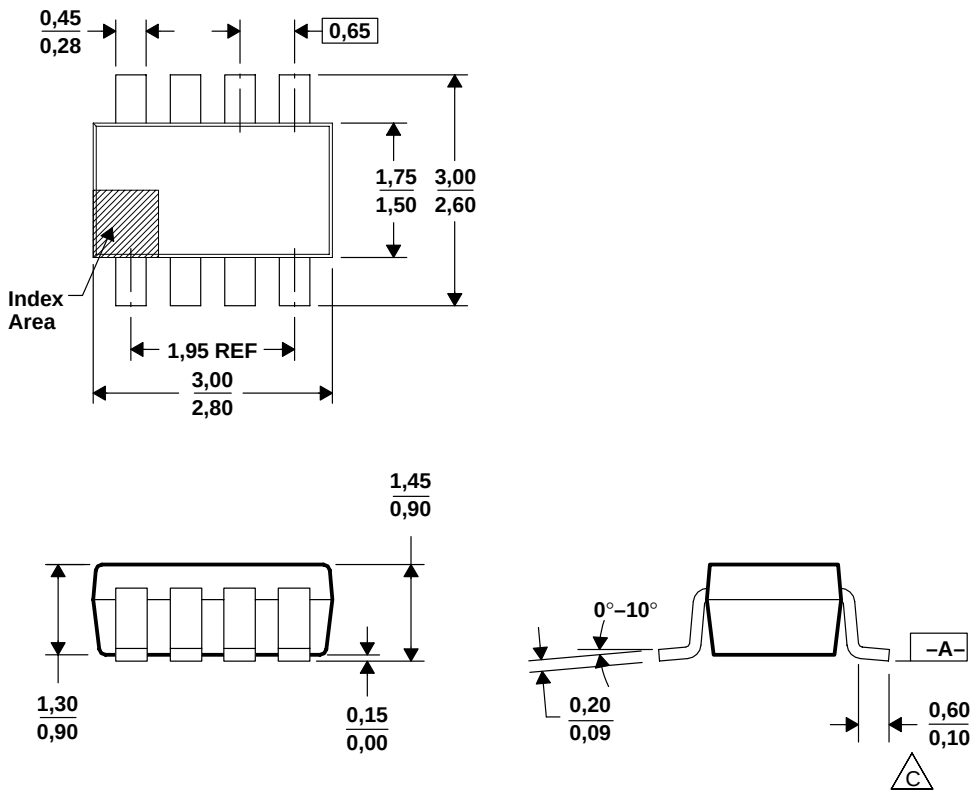


4073253–4/H 10/2003

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–178 Variation AA.

MPDS099 – MARCH 2001

DCN (R-PDSO-G8) **PLASTIC SMALL-OUTLINE**



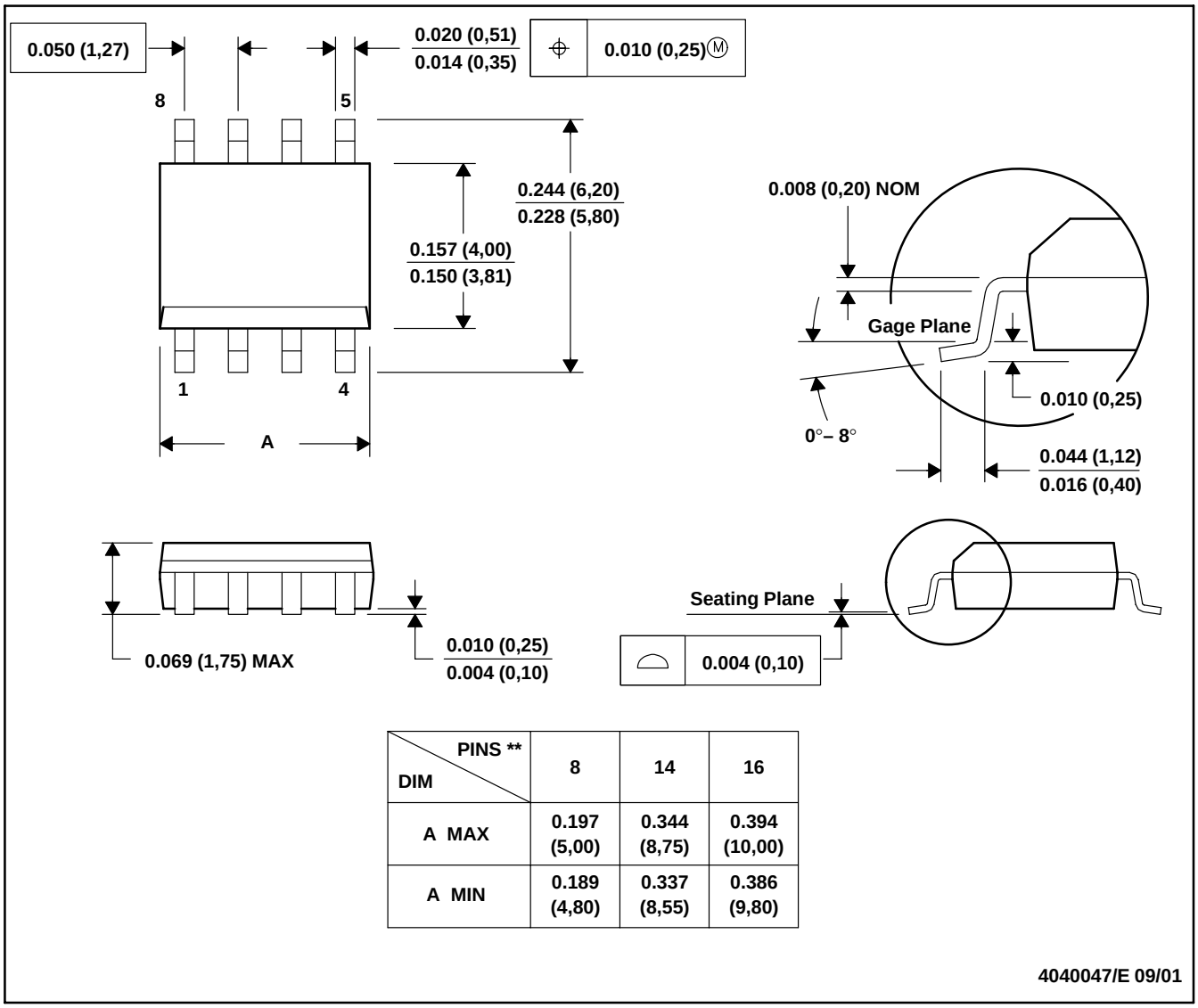
NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Foot length measured reference to flat foot surface parallel to Datum A.
D. Package outline exclusive of mold flash, metal burr and dambar protrusion/intrusion.
E. Package outline inclusive of solder plating.
F. A visual index feature must be located within the cross-hatched area.

MSOI002B – JANUARY 1995 – REVISED SEPTEMBER 2001

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN



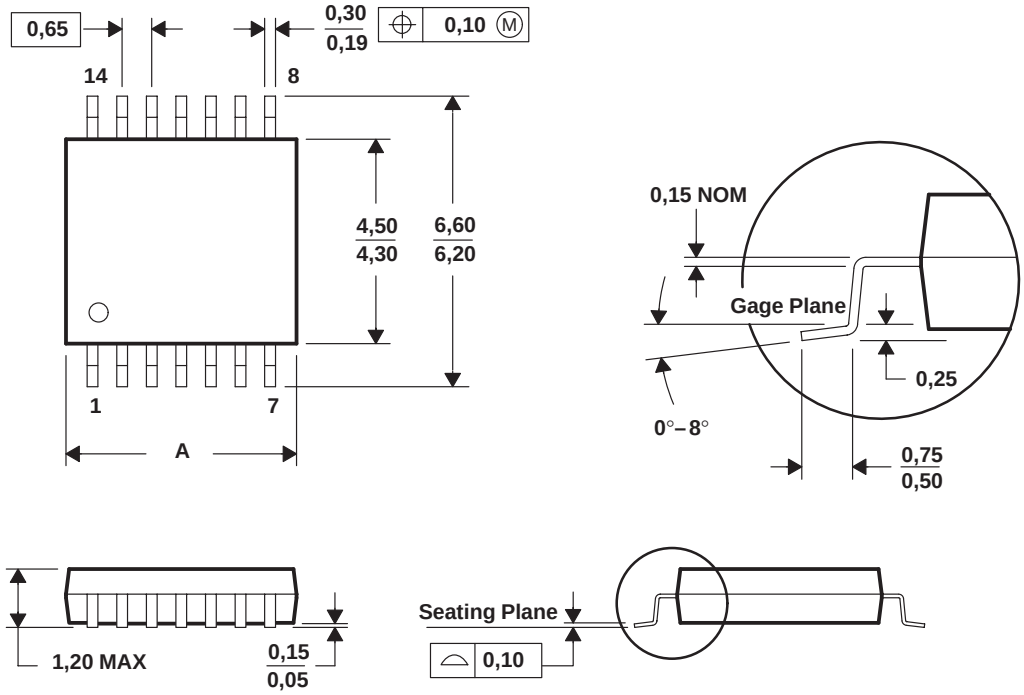
DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

4040047/E 09/01

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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