

1.8 V, NANOPOWER, PUSH/PULL OUTPUT COMPARATORS

FEATURES

- **Very Low Supply Current: 0.8 μ A (Typical)**
- **Input Common Mode Range 200 mV Beyond Supply Rails**
- **Supply Voltage: 1.8 V to 5.5 V**
- **High Speed: 6 μ s**
- **Push/Pull CMOS Output Stage**
- **Controlled Baseline**
 - **One Assembly/Test Site, One Fabrication Site**
- **Extended Temperature Performance of -55°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product Change Notification**
- **Qualification Pedigree**

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.

APPLICATIONS

- **Portable Medical Equipment**
- **Wireless Security Systems**
- **Remote Control Systems**
- **Handheld Instruments**
- **Ultra-Low Power Systems**

DESCRIPTION/ORDERING INFORMATION

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

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

TLV349x RELATED PRODUCTS

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

ORDERING INFORMATION⁽¹⁾

PRODUCT	PACKAGE-LEAD	PACKAGE DESIGNATOR ⁽²⁾	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERABLE PART NUMBER	TRANSPORT MEDIA, QUANTITY
TLV3491	SO-8	D	-55°C to 125°C	3491EP	TLV3491AMDREP ⁽³⁾	Tape and Reel, 2500
TLV3492	SO-8	D	-55°C to 125°C	3492EP	TLV3492AMDREP	Tape and Reel, 2500
TLV3494	SO-14	D	-55°C to 125°C	3494EP	TLV3494AMDREP ⁽³⁾	Tape and Reel, 2500

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

(3) Product Preview. Contact your Texas Instruments Sales Representative for availability.



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.



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.

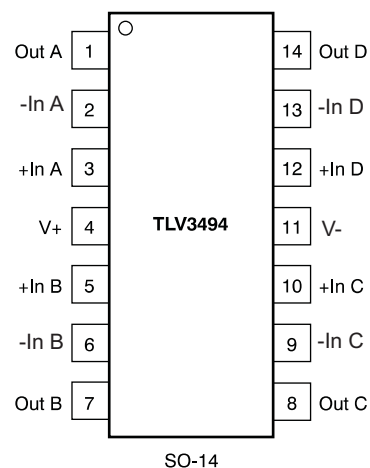
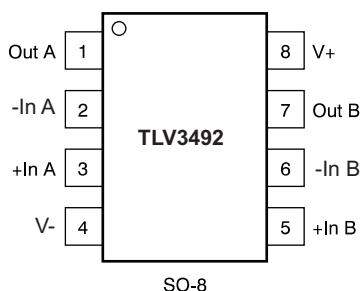
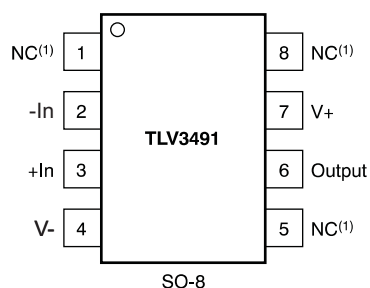
ABSOLUTE MAXIMUM RATINGS⁽¹⁾

		VALUE	UNIT
Supply Voltage		5.5	V
Signal Input Terminals	Voltage ⁽²⁾	$(V-) - 0.5$ to $(V+) + 0.5$	V
	Current ⁽²⁾	±10	mA
Output Short-Circuit ⁽³⁾		Continuous	
Operating Temperature		–55 to 125	°C
Storage Temperature		–65 to 150	°C
Junction Temperature		150	°C
Lead Temperature (soldering, 10s)		300	°C
ESD Rating (Human Body Model)		3000	V

- (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 0.5 V beyond the supply rails should be current limited to 10 mA or less.
- (3) Short-circuit to ground, one amplifier per package.

PIN CONFIGURATIONS

Top View



ELECTRICAL CHARACTERISTICS

At $T_A = 25^\circ\text{C}$, and $V_S = 1.8\text{ V}$ to 5.5 V , unless otherwise noted.

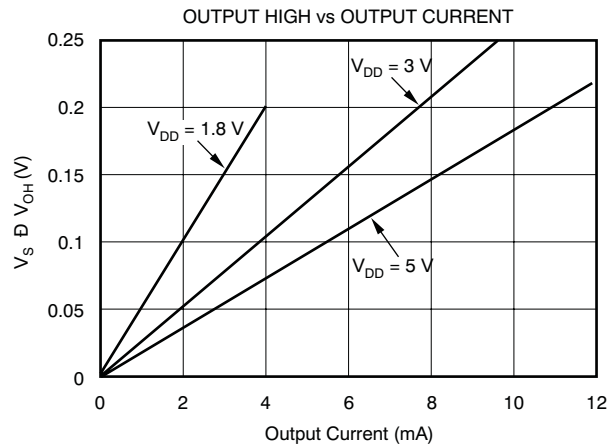
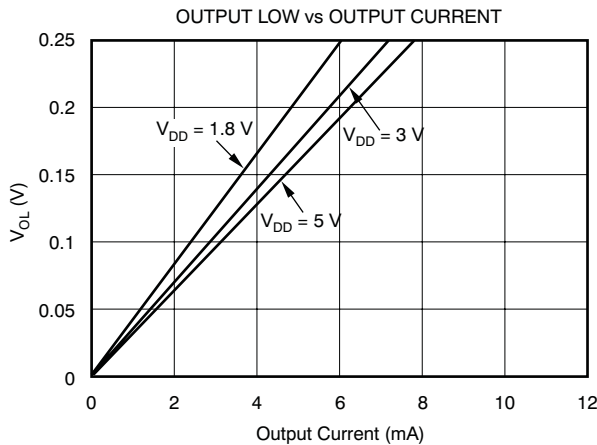
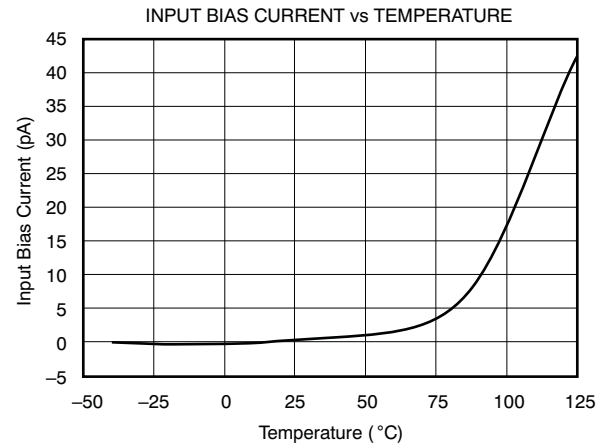
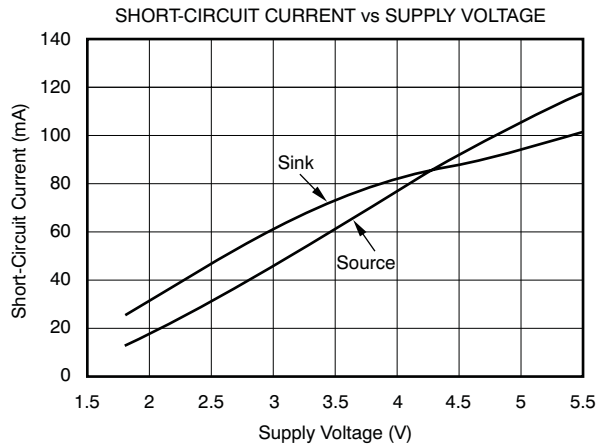
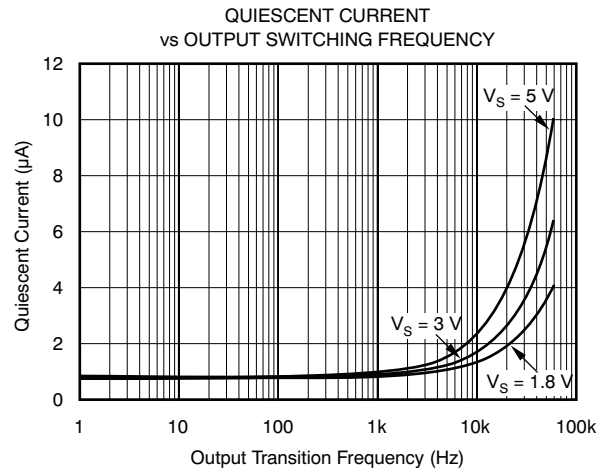
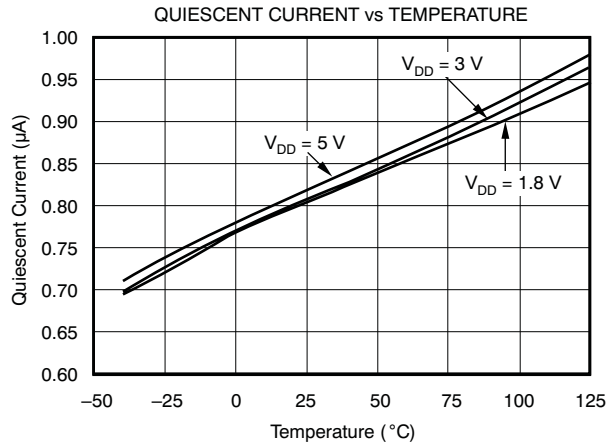
PARAMETER		TEST CONDITIONS		T _A ⁽¹⁾	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE								
Input Offset Voltage	V _{OS}	V _{CM} = 0V, I _O = 0mA	25°C		±3		±15	mV
			Full Range			±25		
vs Temperature	dV _{OS} /dT	T _A = −55°C to 125°C			±12			μV/°C
vs Power Supply	PSRR	V _S = 1.8 V to 5.5 V	25°C		350		1000	μV/V
			Full Range			1600		
INPUT BIAS CURRENT								
Input Bias Current	I _B	V _{CM} = V _{CC} /2	25°C		±1		±50	pA
			Full Range			±1600		
Input Offset Current	I _{OS}	V _{CM} = V _{CC} /2	25°C		±1		±50	pA
			Full Range			±200		
INPUT VOLTAGE RANGE								
Common-Mode Voltage Range	V _{CM}				(V−) − 0.2		(V+) + 0.2	V
Common-Mode Rejection Ratio	CMRR	V _{CM} = −0.2 V to (V+) − 1.5 V	25°C		60		74	dB
			Full Range		55			
		V _{CM} = −0.2 V to (V+) + 0.2 V	25°C		54		62	
			Full Range		50			
INPUT CAPACITANCE								
Common-Mode						2		pF
Differential						4		pF
SWITCHING CHARACTERISTICS								
Propagation Delay Time, Low-to-High	t _(PLH)	f = 10 kHz, V _{STEP} = 1 V	Input Overdrive = 10 mV		12			μs
			Input Overdrive = 100 mV		6		μs	
Propagation Delay Time, High-to-Low	t _(PHL)	f = 10 kHz, V _{STEP} = 1 V	Input Overdrive = 10 mV		13.5			μs
			Input Overdrive = 100 mV		6.5		μs	
Rise Time	t _R	C _L = 10 pF			100			ns
Fall Time	t _F	C _L = 10 pF			100			ns
OUTPUT								
Voltage Output High from Rail	V _{OH}	V _S = 5 V, I _{OUT} = -5 mA		Full Range	90		300	mV
Voltage Output Low from Rail	V _{OL}	V _S = 5 V, I _{OUT} = 5 mA		Full Range	160		300	mV
Short-Circuit Current	I _{SC}				See Typical Characteristics			
POWER SUPPLY								
Specified Voltage Range	V _S				1.8		5.5	V
Quiescent Current ⁽²⁾	I _Q	V _s = 5.5 V, V _O = High	25°C		0.85		1.2	μA
			Full Range		2.1			
TEMPERATURE RANGE								
Specified Range	T _A				−55		125	°C
Storage Range					−65		150	°C
Thermal Resistance, θ _{JA}								
SO-8					165			°C/W
SO-14					133			°C/W

(1) Full Range is -55°C to 125°C .

(2) I_Q per channel.

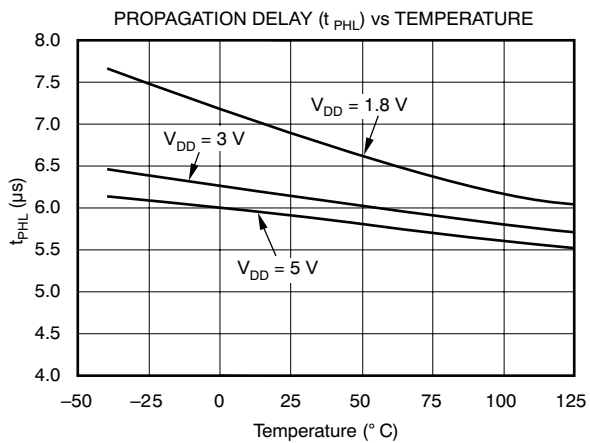
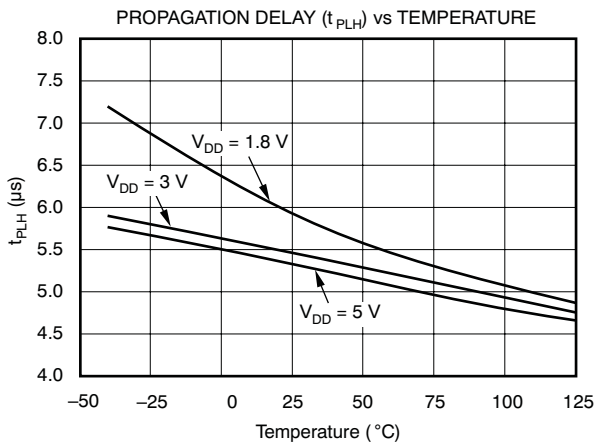
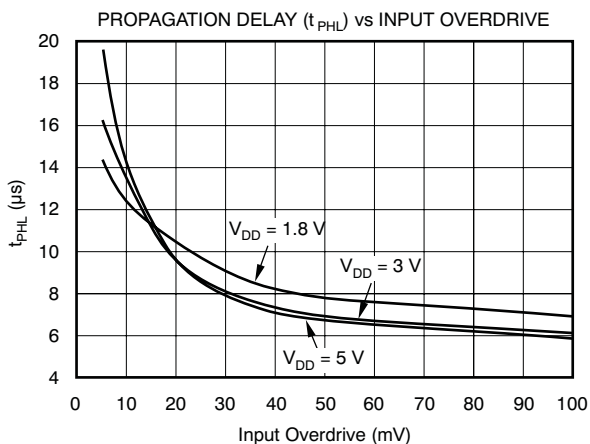
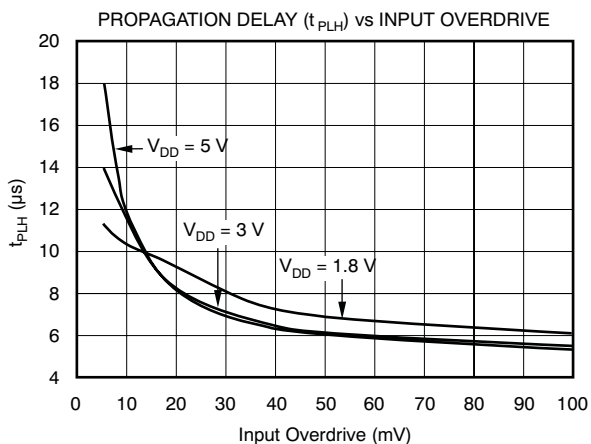
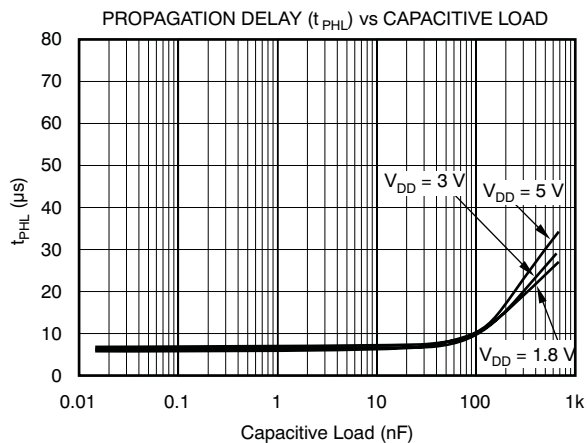
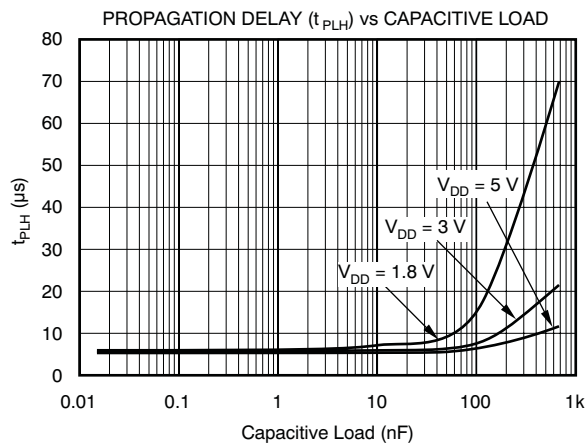
TYPICAL CHARACTERISTICS

At $T_A = 25^\circ\text{C}$, $V_S = 1.8\text{ V}$ to 5.5 V , and Input Overdrive = 100 mV , unless otherwise noted.



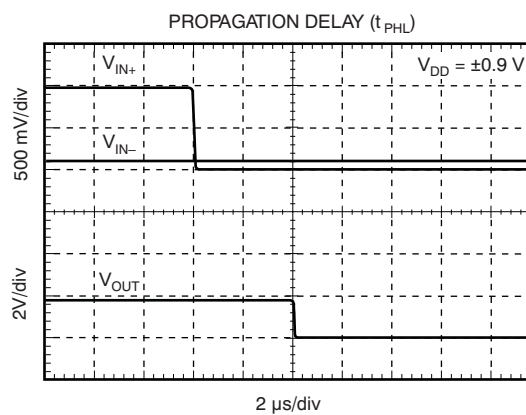
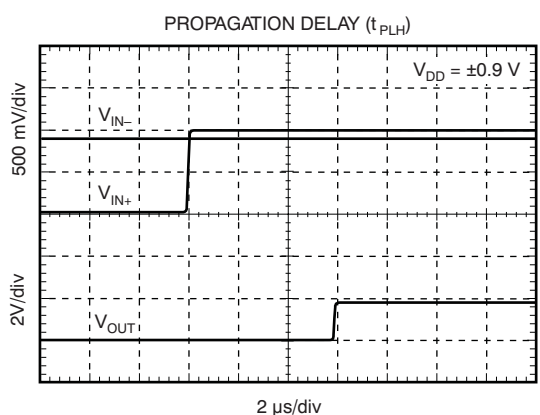
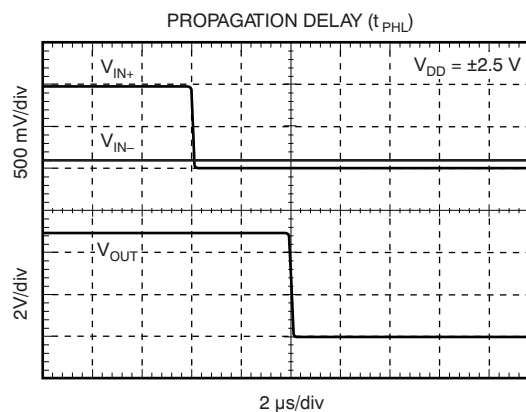
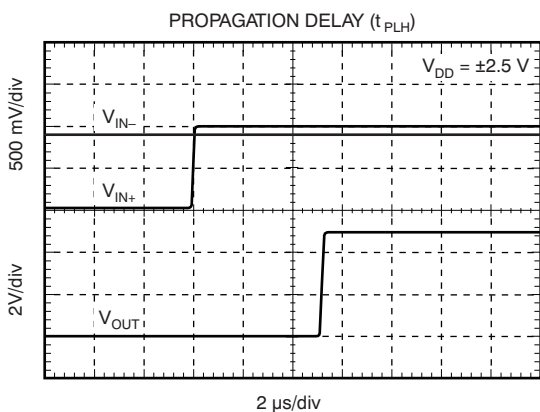
TYPICAL CHARACTERISTICS (continued)

At $T_A = 25^\circ\text{C}$, $V_S = 1.8\text{ V}$ to 5.5 V , and Input Overdrive = 100 mV , unless otherwise noted.



TYPICAL CHARACTERISTICS (continued)

At $T_A = 25^\circ\text{C}$, $V_S = 1.8\text{ V}$ to 5.5 V , and Input Overdrive = 100 mV , unless otherwise noted.



APPLICATION INFORMATION

The TLV349x family of comparators features rail-to-rail input and output on supply voltages as low as 1.8 V. 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 0.8 μ A 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 0.01 μ F ceramic capacitor in parallel with a 10 μ F electrolytic capacitor. Comparators are very sensitive to input noise. Proper grounding (use of ground plane) will help maintain specified performance of the TLV349x family.

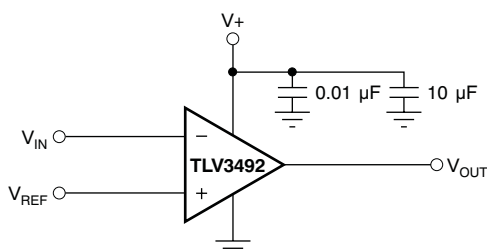


Figure 1. Basic Connections of the TLV3492

SETTING REFERENCE VOLTAGE

It is important to use a stable reference when setting the transition point for the TLV349x. The REF1004 provides a 1.25-V reference voltage with low drift and only 8 μ A of quiescent current.

EXTERNAL HYSTERESIS

Comparator inputs have no noise immunity within the range of specified offset voltage (± 15 mV). 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 ± 15 mV. 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:

$$V_{\text{HYST}} = \frac{V^+ \times R_1}{R_1 + R_2}$$

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.

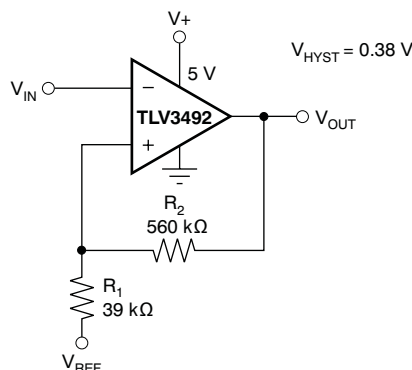


Figure 2. Adding Hysteresis to the TLV3492

RELAXATION OSCILLATOR

The TLV3492 can be configured as a relaxation oscillator to provide a simple and inexpensive clock output (see Figure 3). The capacitor is charged at a rate of $0.69 RC$. It also discharges at a rate of $0.69 RC$. Therefore, the period is $1.38 RC$. R_1 may be a different value than R_2 .

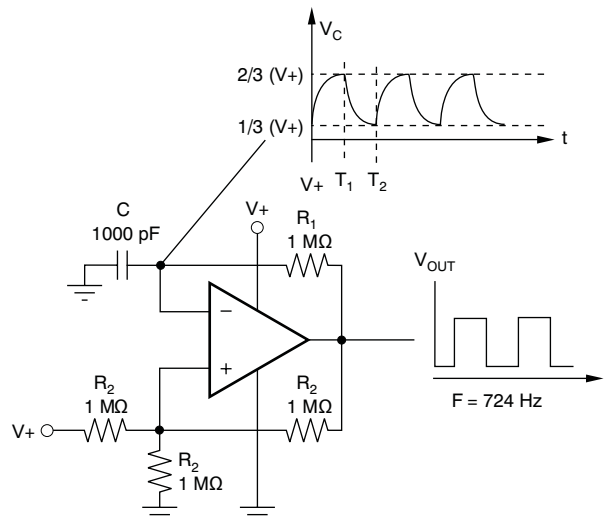


Figure 3. TLV3492 Configured as a Relaxation Oscillator

POWER-ON RESET

The reset circuit shown in Figure 4 provides a time delayed release of 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 allowing time for the supply voltage to stabilize 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. The reset delay time needed depends on the power-up characteristics of the system power supply. R_1 and C_1 are selected to allow enough time for the power supply to stabilize. D1 provides rapid reset if power is lost. In this example, the $R_1 \cdot C_1$ time constant is 10 ms.

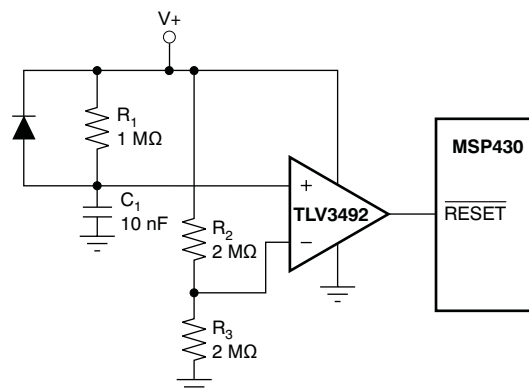


Figure 4. The TLV349x Configured as a Reset Circuit for the MSP430.

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)
TLV3492AMDREP	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	3492EP
V62/07635-02XE	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	3492EP

⁽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.

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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLV3492AMDREP	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)
TLV3492AMDREP	SOIC	D	8	2500	353.0	353.0	32.0



D0008A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

1. 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.
2. This drawing is subject to change without notice.
3. 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.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

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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