

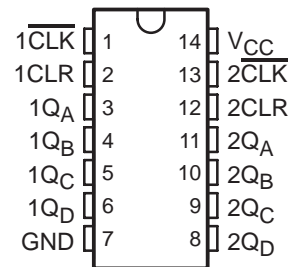
# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

SCLS566A – JANUARY 2004 – REVISED MAY 2004

- **Controlled Baseline**
  - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of –40°C to 105°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **2-V to 5.5-V V<sub>CC</sub> Operation**
- **Max t<sub>pd</sub> of 14.5 ns at 5 V**
- **Typical V<sub>OLP</sub> (Output Ground Bounce) <0.8 V at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C**
- **Typical V<sub>OHV</sub> (Output V<sub>OH</sub> Undershoot) >2.3 V at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C**
- **I<sub>off</sub> Supports Partial-Power-Down-Mode Operation**
- **Dual 4-Bit Binary Counters With Individual Clocks**
- **Direct Clear for Each 4-Bit Counter**
- **Can Significantly Improve System Densities by Reducing Counter Package Count by 50 Percent**

† 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.

PW PACKAGE  
(TOP VIEW)



## description/ordering information

The SN74LV393A contains eight flip-flops and additional gating to implement two individual 4-bit counters in a single package. This device is designed for 2-V to 5.5-V V<sub>CC</sub> operation.

This device comprises two independent 4-bit binary counters, each having a clear (CLR) and a clock ( $\overline{\text{CLK}}$ ) input. The device changes state on the negative-going transition of the  $\overline{\text{CLK}}$  pulse. N-bit binary counters can be implemented with each package, providing the capability of divide by 256. The SN74LV393A has parallel outputs from each counter stage so that any submultiple of the input count frequency is available for system timing signals.

This device is fully specified for partial-power-down applications using I<sub>off</sub>. The I<sub>off</sub> circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
	TSSOP – PW	Tape and reel		
–40°C to 105°C	TSSOP – PW	Tape and reel	SN74LV393ATPWREP	LV393EP

‡ Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE

INPUTS		FUNCTION
$\overline{\text{CLK}}$	CLR	
↑	L	No change
↓	L	Advance to next stage
X	H	All outputs L



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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.

 **TEXAS  
INSTRUMENTS**

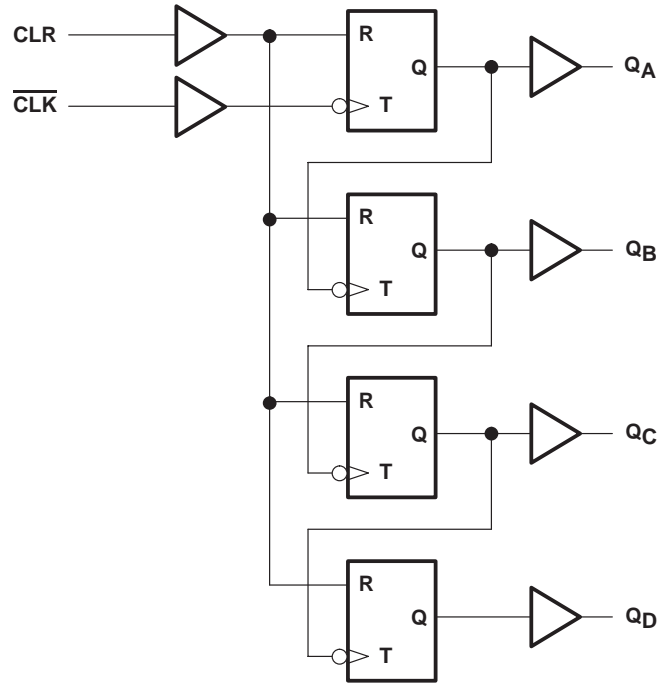
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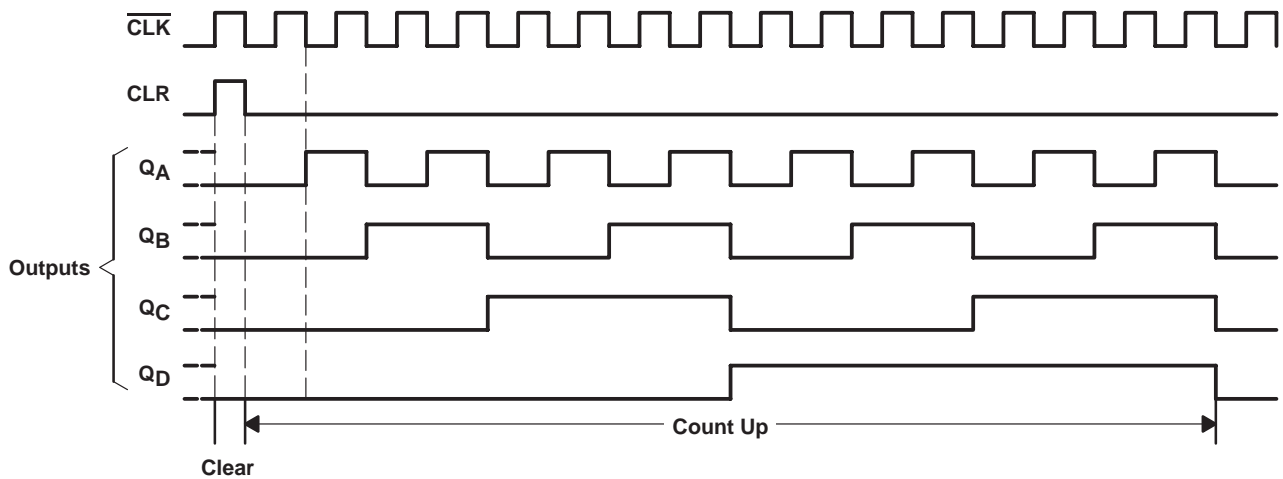
# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

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logic diagram, each counter (positive logic)



timing diagram



# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

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

Supply voltage range, $V_{CC}$ .....	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) .....	–0.5 V to 7 V
Output voltage range applied in high or low state, $V_O$ (see Notes 1 and 2) .....	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range applied in power-off state, $V_O$ (see Note 1) .....	–0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	–20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	–50 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	±25 mA
Continuous current through $V_{CC}$ or GND .....	±50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3) .....	113°C/W
Storage temperature range, $T_{stg}$ .....	–65°C to 150°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. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. This value is limited to 7 V maximum.  
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions (see Note 4)

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage	2	5.5	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ V	1.5	V
		$V_{CC} = 2.3$ V to 2.7 V	$V_{CC} \times 0.7$	
		$V_{CC} = 3$ V to 3.6 V	$V_{CC} \times 0.7$	
		$V_{CC} = 4.5$ V to 5.5 V	$V_{CC} \times 0.7$	
$V_{IL}$	Low-level input voltage	$V_{CC} = 2$ V	0.5	V
		$V_{CC} = 2.3$ V to 2.7 V	$V_{CC} \times 0.3$	
		$V_{CC} = 3$ V to 3.6 V	$V_{CC} \times 0.3$	
		$V_{CC} = 4.5$ V to 5.5 V	$V_{CC} \times 0.3$	
$V_I$	Input voltage	0	5.5	V
$V_O$	Output voltage	0	$V_{CC}$	V
$I_{OH}$	High-level output current	$V_{CC} = 2$ V	–50	$\mu$ A
		$V_{CC} = 2.3$ V to 2.7 V	–2	mA
		$V_{CC} = 3$ V to 3.6 V	–6	
		$V_{CC} = 4.5$ V to 5.5 V	–12	
$I_{OL}$	Low-level output current	$V_{CC} = 2$ V	50	$\mu$ A
		$V_{CC} = 2.3$ V to 2.7 V	2	mA
		$V_{CC} = 3$ V to 3.6 V	6	
		$V_{CC} = 4.5$ V to 5.5 V	12	
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 2.3$ V to 2.7 V	200	ns/V
		$V_{CC} = 3$ V to 3.6 V	100	
		$V_{CC} = 4.5$ V to 5.5 V	20	
$T_A$	Operating free-air temperature	–40	105	°C

NOTE 4: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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## DUAL 4-BIT BINARY COUNTER

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP	MAX	UNIT
V <sub>OH</sub>	I <sub>OH</sub> = -50 μA	2 V to 5.5 V	V <sub>CC</sub> -0.1			V
	I <sub>OH</sub> = -2 mA	2.3 V	2			
	I <sub>OH</sub> = -6 mA	3 V	2.48			
	I <sub>OH</sub> = -12 mA	4.5 V	3.8			
V <sub>OL</sub>	I <sub>OL</sub> = 50 μA	2 V to 5.5 V	0.1			V
	I <sub>OL</sub> = 2 mA	2.3 V	0.4			
	I <sub>OL</sub> = 6 mA	3 V	0.44			
	I <sub>OL</sub> = 12 mA	4.5 V	0.55			
I <sub>I</sub>	V <sub>I</sub> = 5.5 V or GND	0 to 5.5 V	±1			μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V	20			μA
I <sub>off</sub>	V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V	0	5			μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V	1.8			pF

timing requirements over recommended operating free-air temperature range, V<sub>CC</sub> = 2.5 V ± 0.2 V (unless otherwise noted) (see Figure 1)

		T <sub>A</sub> = 25°C		MIN	MAX	UNIT
		MIN	MAX			
t <sub>w</sub>	Pulse duration	CLK high or low	5	5	ns	
		CLR high	5	5		
t <sub>su</sub>	Setup time	CLR inactive before CLK↓	6	6	ns	

timing requirements over recommended operating free-air temperature range, V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

		T <sub>A</sub> = 25°C		MIN	MAX	UNIT
		MIN	MAX			
t <sub>w</sub>	Pulse duration	CLK high or low	5	5	ns	
		CLR high	5	5		
t <sub>su</sub>	Setup time	CLR inactive before CLK↓	5	5	ns	

timing requirements over recommended operating free-air temperature range, V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

		T <sub>A</sub> = 25°C		MIN	MAX	UNIT
		MIN	MAX			
t <sub>w</sub>	Pulse duration	CLK high or low	5	5	ns	
		CLR high	5	5		
t <sub>su</sub>	Setup time	CLR inactive before CLK↓	4	4	ns	



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switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$f_{\max}$			$C_L = 50\text{ pF}$	30	70		25		MHz
$t_{pd}$	$\overline{\text{CLK}}$	$Q_A$	$C_L = 50\text{ pF}$	9.3	21.3		1	24.5	ns
		$Q_B$		10.9	23.9		1	27.5	
		$Q_C$		12.3	26.1		1	30	
		$Q_D$		13.4	27.8		1	32	
$t_{PHL}$	CLR	$Q_n$	$C_L = 50\text{ pF}$	9.1	17.4		1	20	ns

switching characteristics over recommended operation free-air temperature range,  
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$f_{\max}$			$C_L = 50\text{ pF}$	45	105		35		MHz
$t_{pd}$	$\overline{\text{CLK}}$	$Q_A$	$C_L = 50\text{ pF}$	6.7	16.7		1	19	ns
		$Q_B$		7.8	19.3		1	22	
		$Q_C$		8.7	21.5		1	24.5	
		$Q_D$		9.5	23.2		1	26.5	
$t_{PHL}$	CLR	$Q_n$	$C_L = 50\text{ pF}$	6.8	15.8		1	18	ns

switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$f_{\max}$			$C_L = 50\text{ pF}$	85	150		75		MHz
$t_{pd}$	$\overline{\text{CLK}}$	$Q_A$	$C_L = 50\text{ pF}$	4.9	10.5		1	12	ns
		$Q_B$		5.6	11.8		1	13.5	
		$Q_C$		6.2	13.2		1	15	
		$Q_D$		6.6	14.5		1	16.5	
$t_{PHL}$	CLR	$Q_n$	$C_L = 50\text{ pF}$	5.2	10.1		1	11.5	ns



# SN74LV393A-EP

## DUAL 4-BIT BINARY COUNTER

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### noise characteristics, $V_{CC} = 3.3\text{ V}$ , $C_L = 50\text{ pF}$ , $T_A = 25^\circ\text{C}$ (see Note 5)

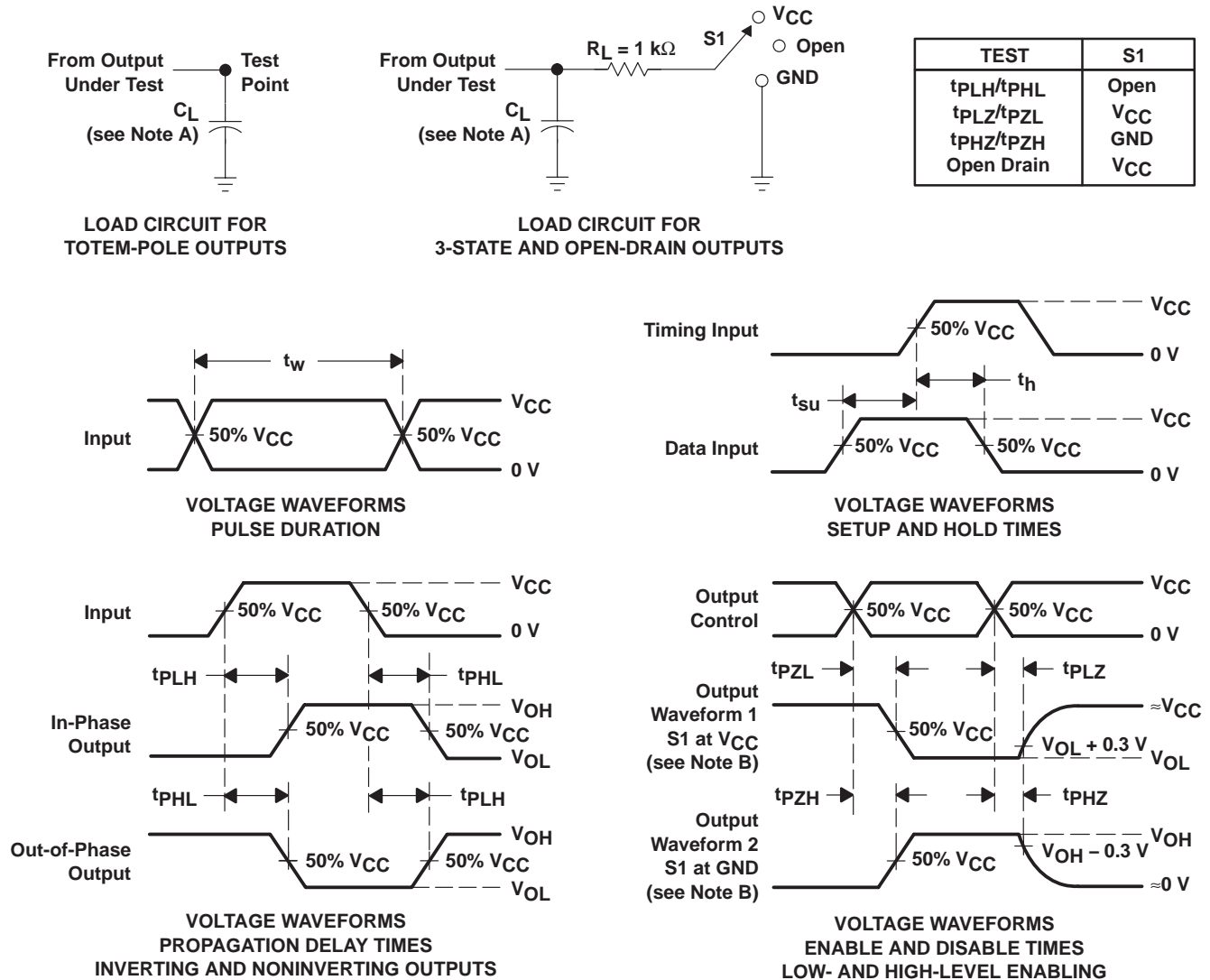
PARAMETER	MIN	TYP	MAX	UNIT
$V_{OL(P)}$ Quiet output, maximum dynamic $V_{OL}$		0.3	0.8	V
$V_{OL(V)}$ Quiet output, minimum dynamic $V_{OL}$		-0.2	-0.8	V
$V_{OH(V)}$ Quiet output, minimum dynamic $V_{OH}$		2.8		V
$V_{IH(D)}$ High-level dynamic input voltage	2.31			V
$V_{IL(D)}$ Low-level dynamic input voltage			0.99	V

NOTE 5: Characteristics are for surface-mount packages only.

### operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	$V_{CC}$	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	$C_L = 50\text{ pF}$ , $f = 10\text{ MHz}$	3.3 V	15.2	pF
		5 V	17.3	

PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A. C<sub>L</sub> includes probe and jig capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
  - C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z<sub>O</sub> = 50 Ω, t<sub>r</sub> ≤ 3 ns, t<sub>f</sub> ≤ 3 ns.
  - D. The outputs are measured one at a time, with one input transition per measurement.
  - E. t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.
  - F. t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.
  - G. t<sub>PHL</sub> and t<sub>PLH</sub> are the same as t<sub>pd</sub>.
  - H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**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>
SN74LV393ATPWREP	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/04695-01XE	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.

**OBsolete:** 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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**OTHER QUALIFIED VERSIONS OF SN74LV393A-EP :**

- Catalog: [SN74LV393A](#)
- Automotive: [SN74LV393A-Q1](#)

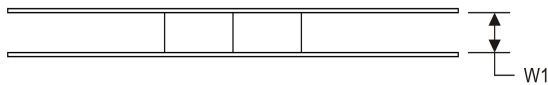
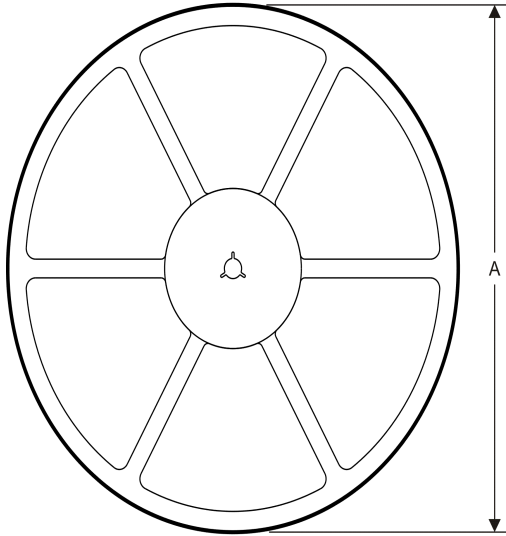
NOTE: Qualified Version Definitions:

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

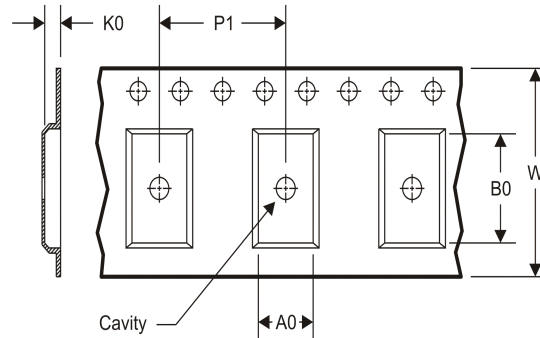


**TAPE AND REEL INFORMATION**

**REEL DIMENSIONS**



**TAPE DIMENSIONS**



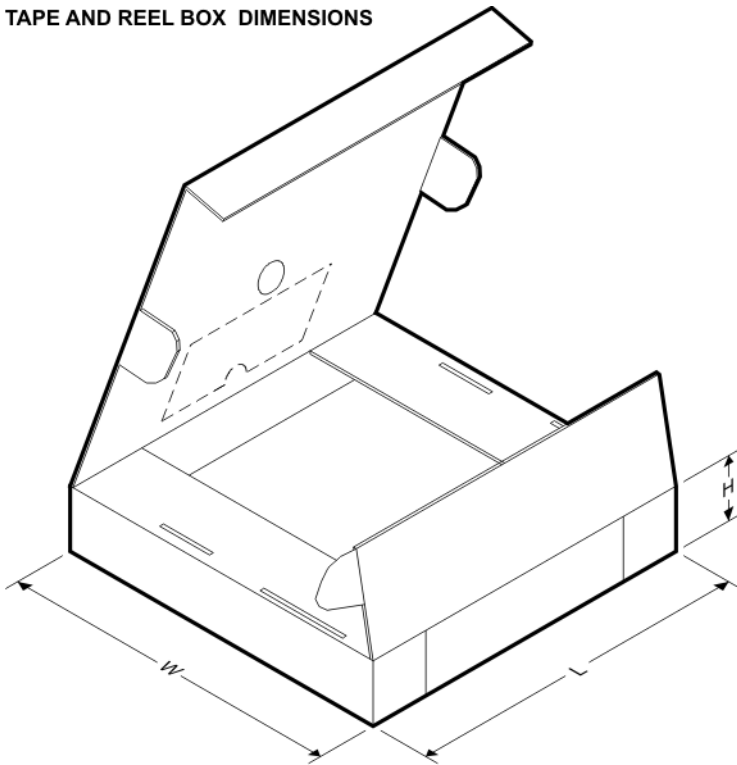
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**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
SN74LV393ATPWREP	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)
SN74LV393ATPWREP	TSSOP	PW	14	2000	367.0	367.0	35.0

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE

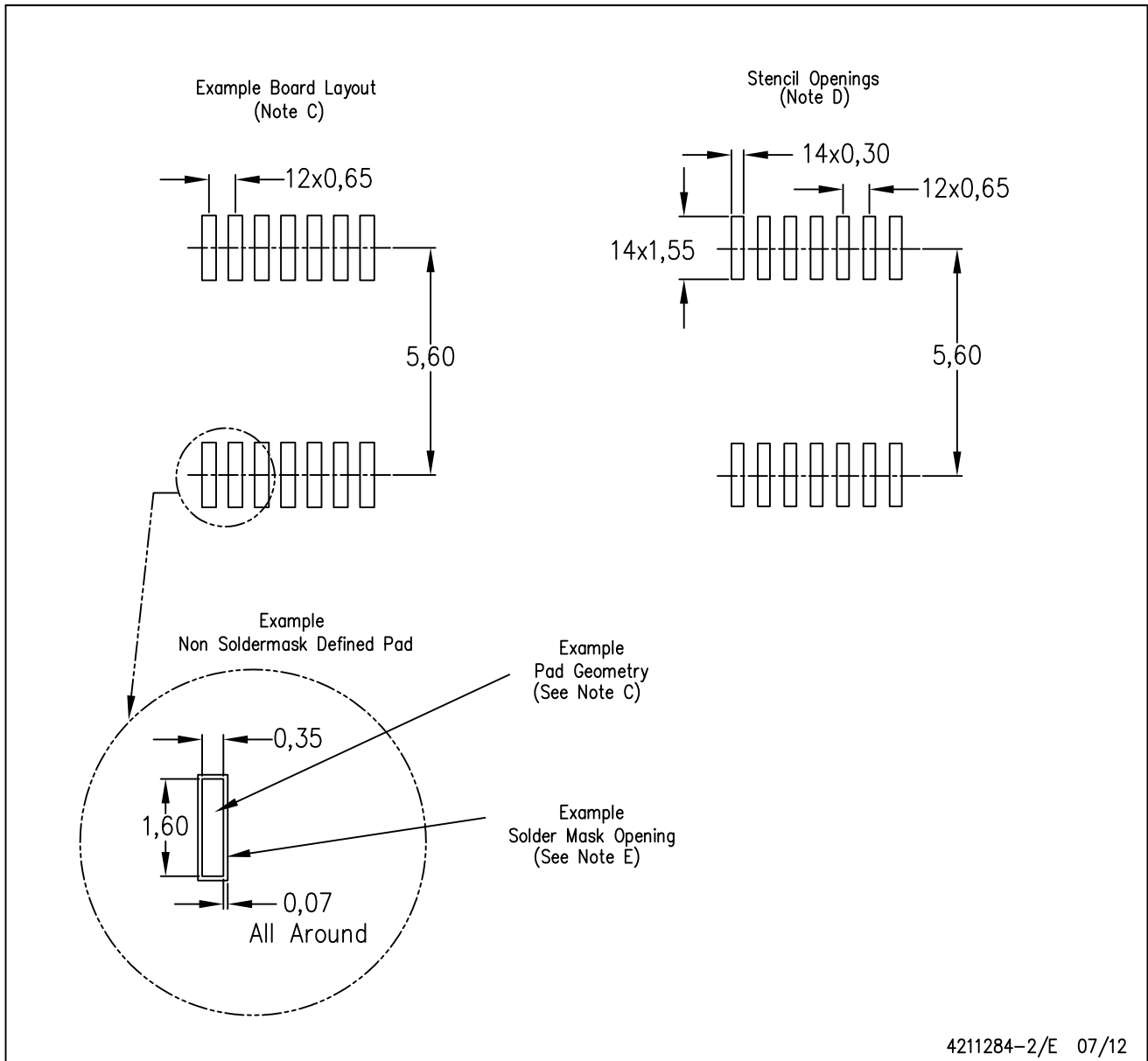


4040064-3/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

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