

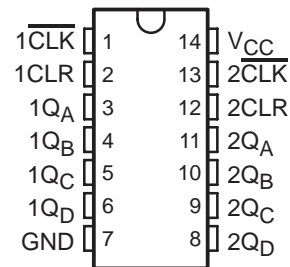
# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

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**

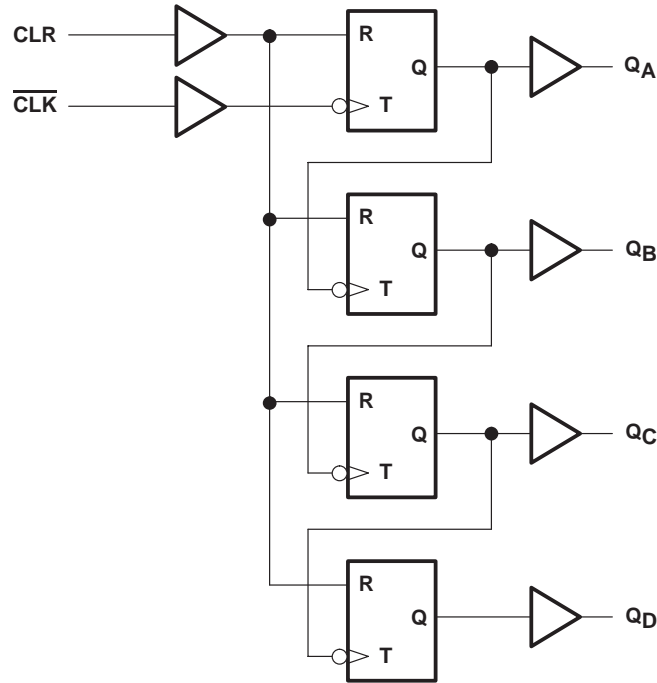
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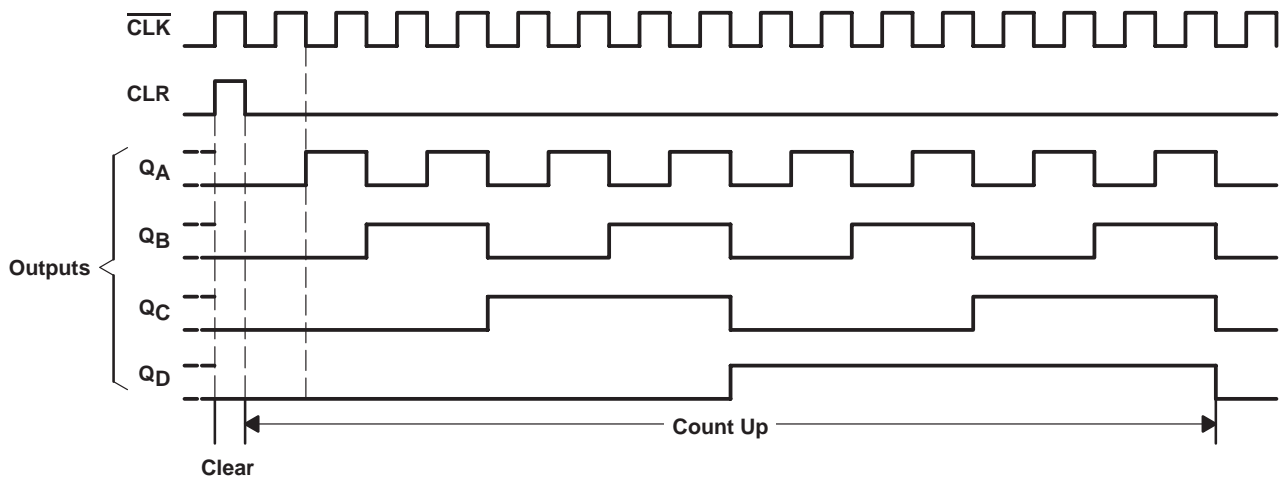
# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

SCLS566A – JANUARY 2004 – REVISED MAY 2004

logic diagram, each counter (positive logic)



timing diagram



# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

SCLS566A – JANUARY 2004 – REVISED MAY 2004

## 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.



# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

SCLS566A – JANUARY 2004 – REVISED MAY 2004

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  |      |



# SN74LV393A-EP DUAL 4-BIT BINARY COUNTER

SCLS566A – JANUARY 2004 – REVISED MAY 2004

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

SCLS566A – JANUARY 2004 – REVISED MAY 2004

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

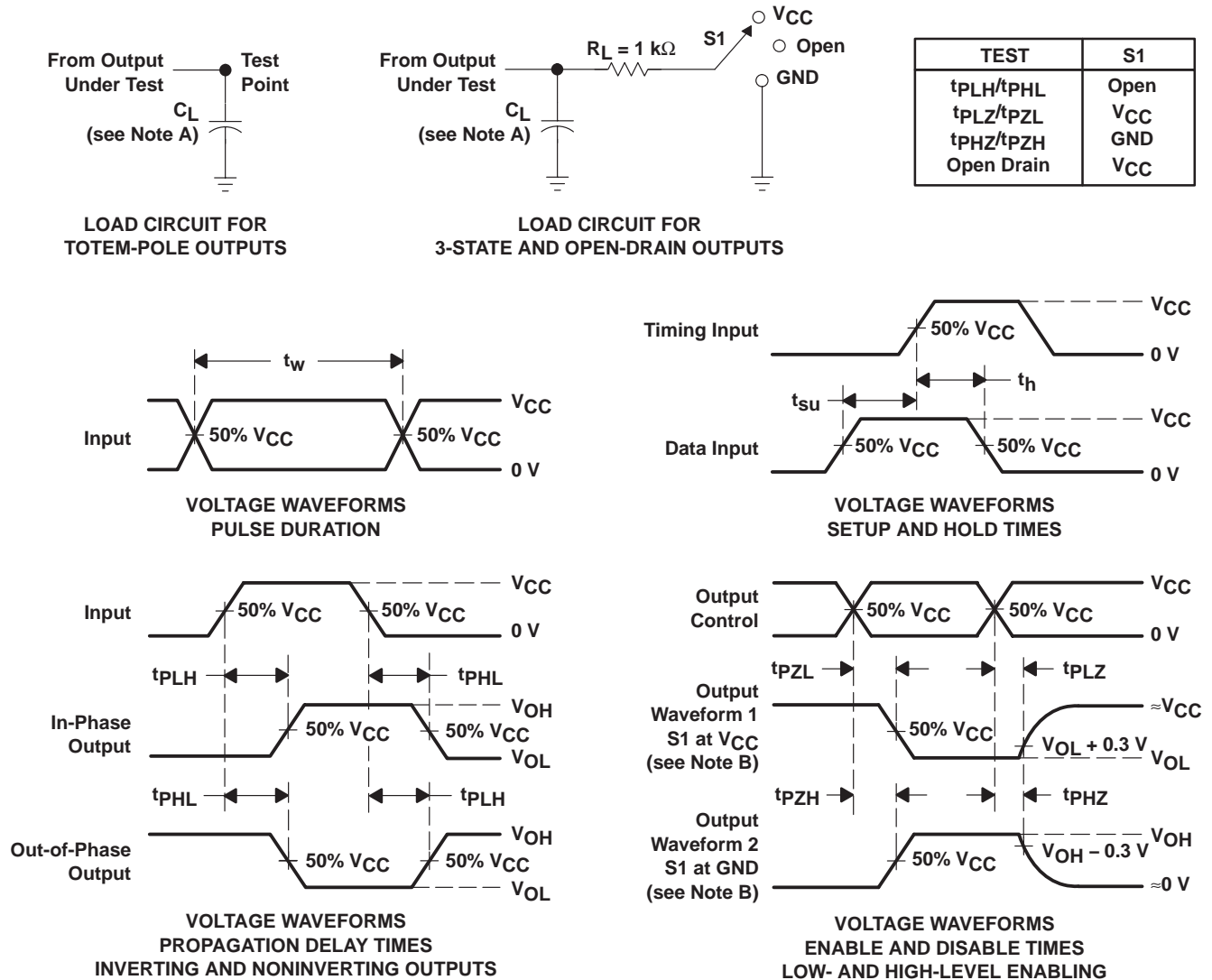
| PARAMETER  | MIN  | TYP  | MAX  | UNIT |
|--|------|------|------|------|
| $V_{OL(P)}$ Quiet output, maximum dynamic $V_{OL}$ |      | 0.3  | 0.8  | V    |
| $V_{OL(V)}$ Quiet output, minimum dynamic $V_{OL}$ |      | -0.2 | -0.8 | V    |
| $V_{OH(V)}$ Quiet output, minimum dynamic $V_{OH}$ |      | 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<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| SN74LV393ATPWREP | LIFEBUY       | TSSOP        | PW              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 105   | LV393EP                 |         |
| V62/04695-01XE   | LIFEBUY       | TSSOP        | PW              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 105   | LV393EP                 |         |

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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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**

**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 |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| 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**

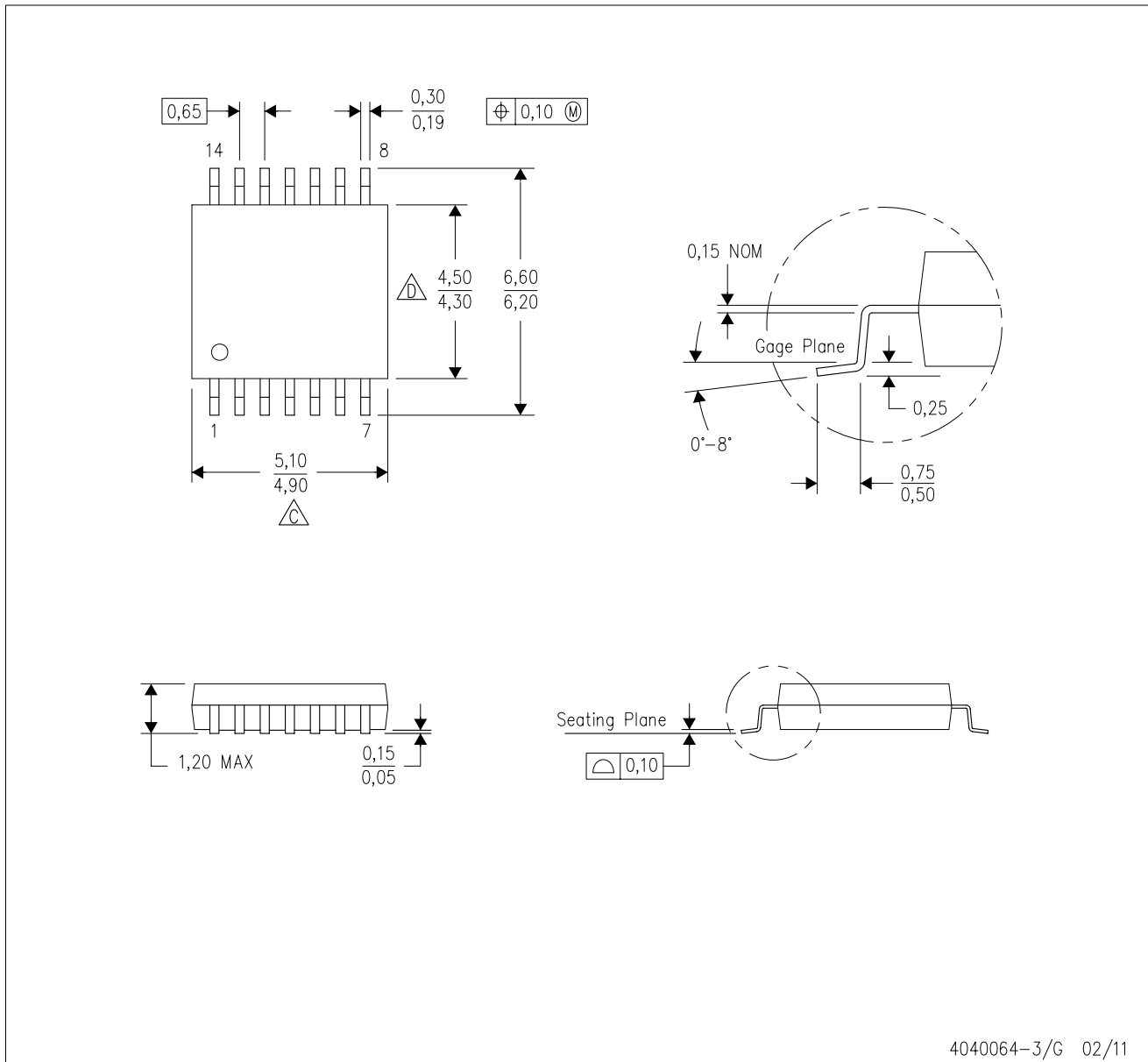

\*All dimensions are nominal

| Device           | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV393ATPWREP | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |

# MECHANICAL DATA

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- 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

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