

# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

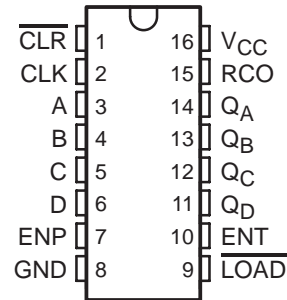
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- 2-V to 5.5-V  $V_{CC}$  Operation
- Max  $t_{pd}$  of 9.5 ns at 5 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $>2.3$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Support Mixed-Mode Voltage Operation on All Ports
- Internal Look-Ahead for Fast Counting
- Carry Output for n-Bit Cascading
- Synchronous Counting
- Synchronously Programmable
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

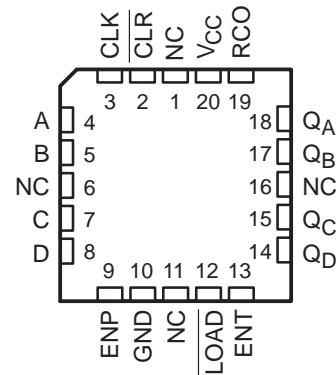
## description/ordering information

The 'LV161A devices are 4-bit synchronous binary counters designed for 2-V to 5.5-V  $V_{CC}$  operation.

SN54LV161A . . . J OR W PACKAGE  
SN74LV161A . . . D, DB, DGV, NS, OR PW PACKAGE  
(TOP VIEW)



SN54LV161A . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

| $T_A$          | PACKAGE†     |                | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|--------------|----------------|-----------------------|------------------|
| –40°C to 85°C  | SOIC – D     | Tube of 40     | SN74LV161AD           | LV161A           |
|                |              | Reel of 2500   | SN74LV161ADR          |                  |
|                | SOP – NS     | Reel of 2000   | SN74LV161ANSR         | 74LV161A         |
|                | SSOP – DB    | Reel of 2000   | SN74LV161ADBR         | LV161A           |
|                | TSSOP – PW   | Tube of 90     | SN74LV161APW          | LV161A           |
|                |              | Reel of 2000   | SN74LV161APWR         |                  |
| Reel of 250    |              | SN74LV161APWT  |                       |                  |
| TVSOP – DGV    | Reel of 2000 | SN74LV161ADGVR | LV161A                |                  |
| –55°C to 125°C | CDIP – J     | Tube of 25     | SNJ54LV161AJ          | SNJ54LV161AJ     |
|                | CFP – W      | Tube of 150    | SNJ54LV161AW          | SNJ54LV161AW     |
|                | LCCC – FK    | Tube of 55     | SNJ54LV161AFK         | SNJ54LV161AFK    |

† 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).



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 **TEXAS  
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# SN54LV161A, SN74LV161A

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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### description/ordering information (continued)

These synchronous, presettable counters feature an internal carry look-ahead for application in high-speed counting designs. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the count-enable (ENP, ENT) inputs and internal gating. This mode of operation eliminates the output counting spikes that normally are associated with synchronous (ripple-clock) counters. A buffered clock (CLK) input triggers the four flip-flops on the rising (positive-going) edge of the clock waveform.

These counters are fully programmable; that is, they can be preset to any number between 0 and 9 or 15. As presetting is synchronous, setting up a low level at the load input disables the counter and causes the outputs to agree with the setup data after the next clock pulse, regardless of the levels of the enable inputs.

The clear function for the 'LV161A devices is asynchronous. A low level at the clear ( $\overline{\text{CLR}}$ ) input sets all four of the flip-flop outputs low, regardless of the levels of the CLK, load ( $\overline{\text{LOAD}}$ ), or enable inputs.

The carry look-ahead circuitry provides for cascading counters for n-bit synchronous applications without additional gating. Instrumental in accomplishing this function are ENP, ENT, and a ripple-carry output (RCO). Both ENP and ENT must be high to count, and ENT is fed forward to enable RCO. Enabling RCO produces a high-level pulse while the count is maximum (9 or 15 with  $Q_A$  high). This high-level overflow ripple-carry pulse can be used to enable successive cascaded stages. Transitions at ENP or ENT are allowed, regardless of the level of CLK.

These counters feature a fully independent clock circuit. Changes at control inputs (ENP, ENT, or  $\overline{\text{LOAD}}$ ) that modify the operating mode have no effect on the contents of the counter until clocking occurs. The function of the counter (whether enabled, disabled, loading, or counting) is dictated solely by the conditions meeting the stable setup and hold times.

These devices are fully specified for partial-power-down applications using  $I_{\text{off}}$ . The  $I_{\text{off}}$  circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down.

FUNCTION TABLE

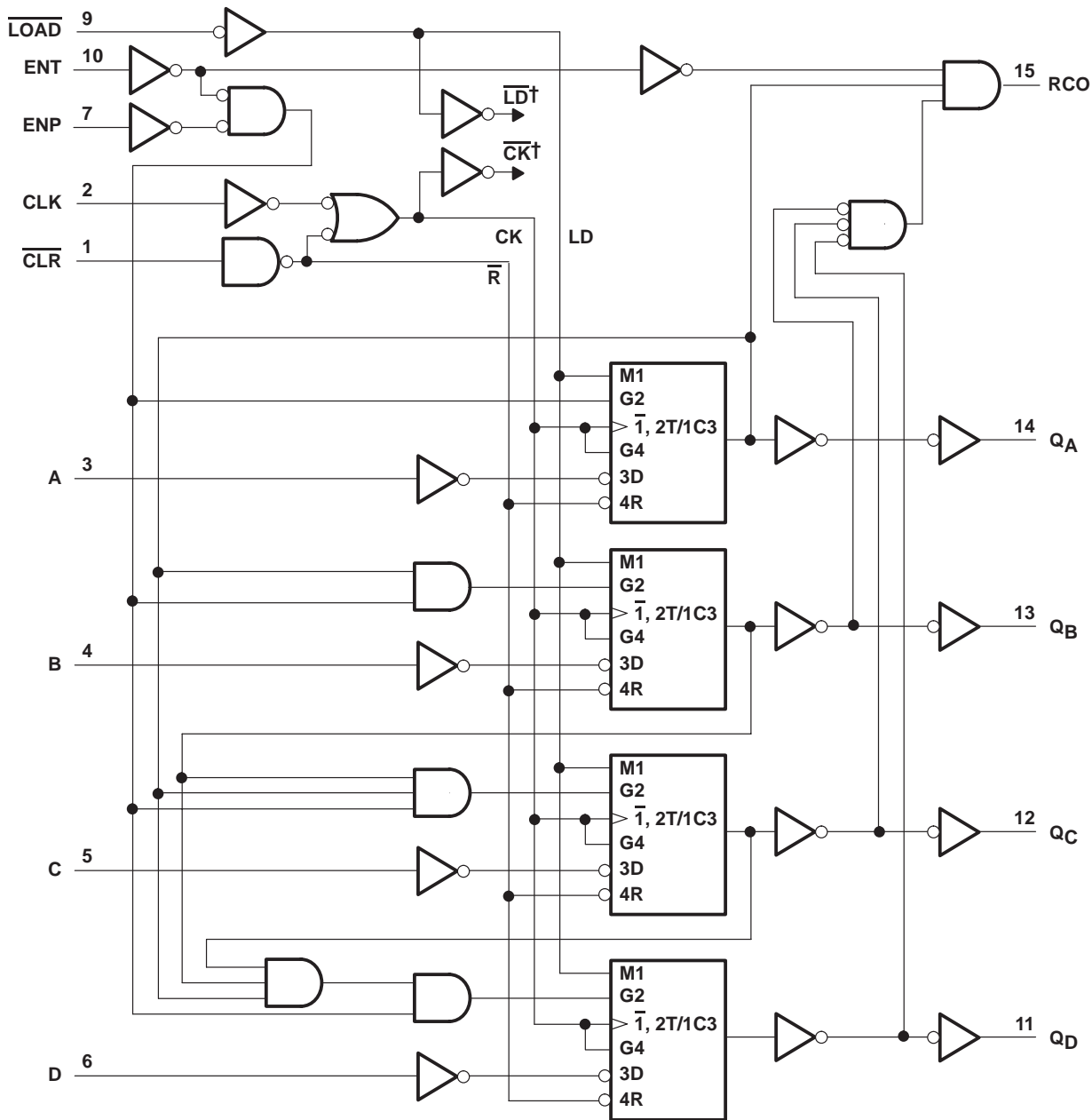
| INPUTS                  |                          |     |     |     | OUTPUTS   |    |    |    | FUNCTION     |
|-------------------------|--------------------------|-----|-----|-----|-----------|----|----|----|--------------|
| $\overline{\text{CLR}}$ | $\overline{\text{LOAD}}$ | ENP | ENT | CLK | QA        | QB | QC | QD |              |
| L                       | X                        | X   | X   | X   | L         | L  | L  | L  | Reset to "0" |
| H                       | L                        | X   | X   | ↑   | A         | B  | C  | D  | Preset Data  |
| H                       | H                        | X   | L   | ↑   | No Change |    |    |    | No Count     |
| H                       | H                        | L   | X   | ↑   | No Change |    |    |    | No Count     |
| H                       | H                        | H   | H   | ↑   | Count up  |    |    |    | Count        |
| H                       | X                        | X   | X   | ↑   | No Change |    |    |    | No Count     |



# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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## logic diagram (positive logic)



† For simplicity, routing of complementary signals  $\overline{LD}$  and  $\overline{CK}$  is not shown on this overall logic diagram. The uses of these signals are shown on the logic diagram of the D/T flip-flops.

Pin numbers shown are for the D, DB, DGV, J, NS, PW, and W packages.

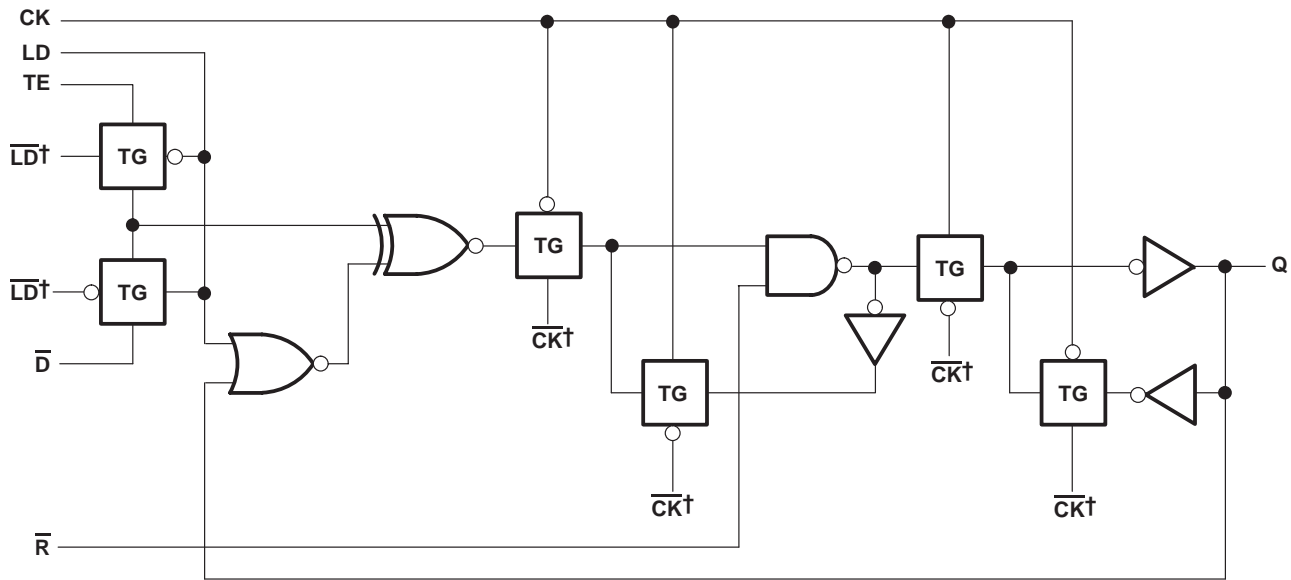
# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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## logic symbol, each D/T flip-flop



## logic diagram, each D/T flip-flop (positive logic)

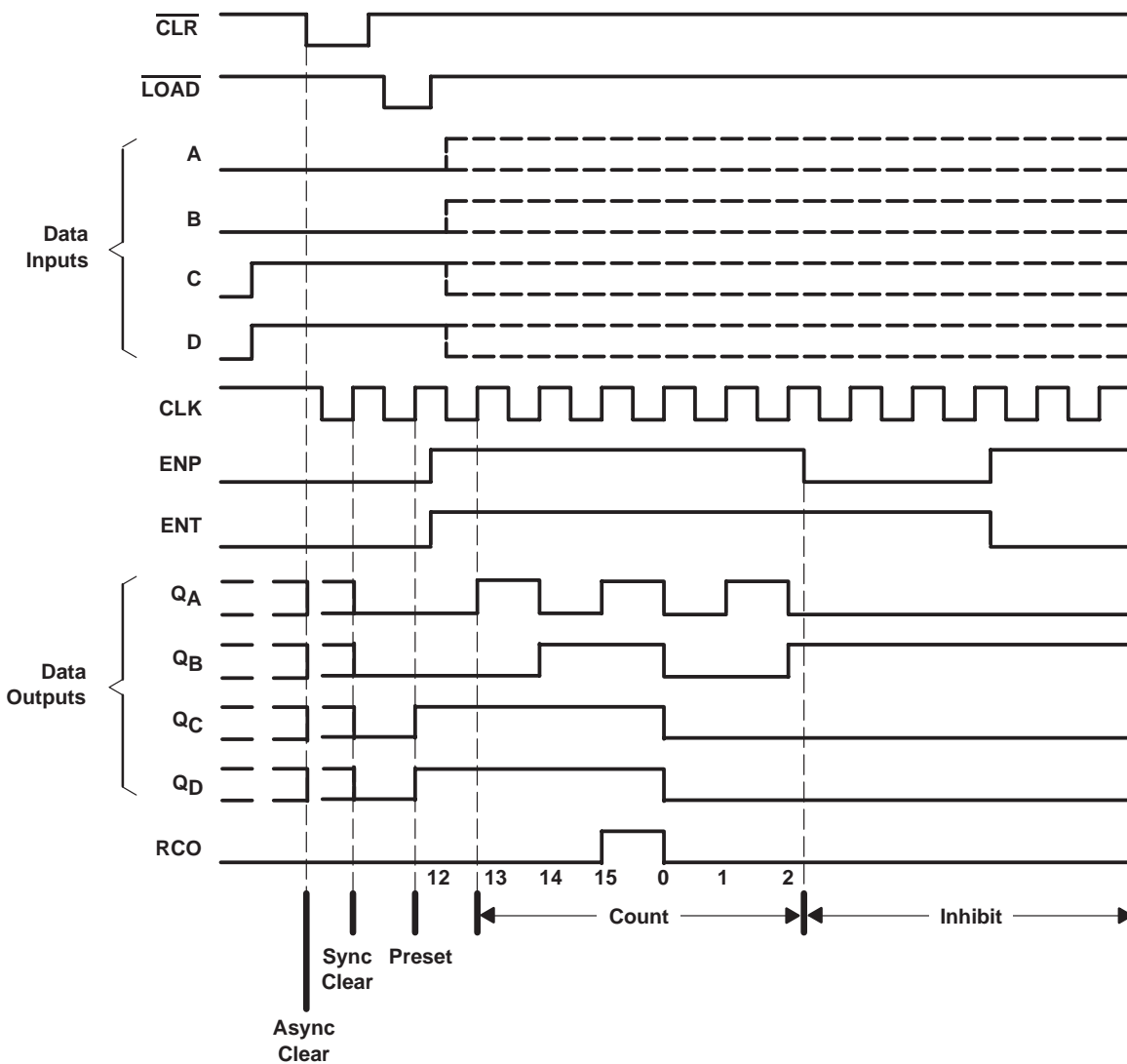


† The origins of  $\overline{LD}$  and  $\overline{CK}$  are shown in the overall logic diagram of the device.

typical clear, preset, count, and inhibit sequence

The following sequence is illustrated below:

1. Clear outputs to zero (asynchronous)
2. Preset to binary 12
3. Count to 13, 14, 15, 0, 1, and 2
4. Inhibit



# SN54LV161A, SN74LV161A

## 4-BIT SYNCHRONOUS BINARY COUNTERS

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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 |
| Voltage range applied to any output in the 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 $V_{CC}$ ) .....                     | $\pm 25$ mA                |
| Continuous current through $V_{CC}$ or GND .....                                     | $\pm 50$ mA                |
| Package thermal impedance, $\theta_{JA}$ (see Note 3): D package .....               | 73°C/W                     |
| DB package .....   | 82°C/W                     |
| DGV package .....  | 120°C/W                    |
| NS package .....   | 64°C/W                     |
| PW package .....   | 108°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 5.5 V maximum.
  3. The package thermal impedance is calculated in accordance with JESD 51-7.



# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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## recommended operating conditions (see Note 4)

|                 |                                    | SN54LV161A                       |                       | SN74LV161A            |                 | UNIT |      |
|-----------------|------------------------------------|----------------------------------|-----------------------|-----------------------|-----------------|------|------|
|                 |                                    | MIN                              | MAX                   | MIN                   | MAX             |      |      |
| V <sub>CC</sub> | Supply voltage                     | 2                                | 5.5                   | 2                     | 5.5             | V    |      |
| V <sub>IH</sub> | High-level input voltage           | V <sub>CC</sub> = 2 V            | 1.5                   | 1.5                   |                 | V    |      |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V | V <sub>CC</sub> × 0.7 | V <sub>CC</sub> × 0.7 |                 |      |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | V <sub>CC</sub> × 0.7 | V <sub>CC</sub> × 0.7 |                 |      |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | V <sub>CC</sub> × 0.7 | V <sub>CC</sub> × 0.7 |                 |      |      |
| V <sub>IL</sub> | Low-level input voltage            | V <sub>CC</sub> = 2 V            | 0.5                   | 0.5                   |                 | V    |      |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V | V <sub>CC</sub> × 0.3 | V <sub>CC</sub> × 0.3 |                 |      |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | V <sub>CC</sub> × 0.3 | V <sub>CC</sub> × 0.3 |                 |      |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | V <sub>CC</sub> × 0.3 | V <sub>CC</sub> × 0.3 |                 |      |      |
| V <sub>I</sub>  | Input voltage                      | 0                                | 5.5                   | 0                     | 5.5             | V    |      |
| V <sub>O</sub>  | Output voltage                     | 0                                | V <sub>CC</sub>       | 0                     | V <sub>CC</sub> | V    |      |
| I <sub>OH</sub> | High-level output current          | V <sub>CC</sub> = 2 V            |                       | -50                   | -50             | μA   |      |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V |                       | -2                    | -2              | mA   |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   |                       | -6                    | -6              |      |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V |                       | -12                   | -12             |      |      |
| I <sub>OL</sub> | Low-level output current           | V <sub>CC</sub> = 2 V            |                       | 50                    | 50              | μA   |      |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V |                       | 2                     | 2               | mA   |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   |                       | 6                     | 6               |      |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V |                       | 12                    | 12              |      |      |
| Δt/Δv           | Input transition rise or fall rate | V <sub>CC</sub> = 2.3 V to 2.7 V | 0                     | 200                   | 0               | 200  | ns/V |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | 0                     | 100                   | 0               | 100  |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | 0                     | 20                    | 0               | 20   |      |
| T <sub>A</sub>  | Operating free-air temperature     | -55                              | 125                   | -40                   | 85              | °C   |      |

NOTE 4: All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

| PARAMETER        | TEST CONDITIONS   | V <sub>CC</sub> | SN54LV161A           |     |      | SN74LV161A           |      |     | UNIT |
|------------------|---|-----------------|----------------------|-----|------|----------------------|------|-----|------|
|                  |   |                 | MIN                  | TYP | MAX  | MIN                  | TYP  | MAX |      |
| V <sub>OH</sub>  | I <sub>OH</sub> = -50 μA                                    | 2 V to 5.5 V    | V <sub>CC</sub> -0.1 |     |      | V <sub>CC</sub> -0.1 |      | V   |      |
|                  | I <sub>OH</sub> = -2 mA                                     | 2.3 V           | 2                    |     | 2    |                      |      |     |      |
|                  | I <sub>OH</sub> = -6 mA                                     | 3 V             | 2.48                 |     | 2.48 |                      |      |     |      |
|                  | I <sub>OH</sub> = -12 mA                                    | 4.5 V           | 3.8                  |     | 3.8  |                      |      |     |      |
| V <sub>OL</sub>  | I <sub>OL</sub> = 50 μA                                     | 2 V to 5.5 V    |                      |     |      | 0.1                  | 0.1  | V   |      |
|                  | I <sub>OL</sub> = 2 mA                                      | 2.3 V           |                      |     |      | 0.4                  | 0.4  |     |      |
|                  | I <sub>OL</sub> = 6 mA                                      | 3 V             |                      |     |      | 0.44                 | 0.44 |     |      |
|                  | I <sub>OL</sub> = 12 mA                                     | 4.5 V           |                      |     |      | 0.55                 | 0.55 |     |      |
| I <sub>I</sub>   | V <sub>I</sub> = 5.5 V or GND                               | 0 to 5.5 V      |                      |     | ±1   |                      | ±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   |                      | 20   | μA  |      |
| I <sub>off</sub> | V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V               | 0               |                      |     | 5    |                      | 5    | μA  |      |
| C <sub>i</sub>   | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 3.3 V           |                      | 1.8 |      | 1.8                  |      | pF  |      |

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# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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

|          |  | $T_A = 25^\circ\text{C}$     |     | SN54LV161A |      | SN74LV161A |     | UNIT |
|----------|--|------------------------------|-----|------------|------|------------|-----|------|
|          |  | MIN                          | MAX | MIN        | MAX  | MIN        | MAX |      |
| $t_w$    | Pulse duration   | CLK high or low              | 7   | 7          | 7    | 7          | ns  |      |
|          |  | $\overline{\text{CLR}}$ low  | 7   | 7          | 7    | 7          |     |      |
| $t_{su}$ | Setup time before CLK $\uparrow$                       | $\overline{\text{CLR}}$      | 4.5 | 4.5        | 4.5  | ns         |     |      |
|          |  | Data (A, B, C, and D)        | 7.5 | 8.5        | 8.5  |            |     |      |
|          |  | ENP, ENT                     | 9.5 | 11         | 11   |            |     |      |
|          |  | $\overline{\text{LOAD}}$ low | 10  | 11.5       | 11.5 |            |     |      |
| $t_h$    | Hold time, all synchronous inputs after CLK $\uparrow$ | 1.5                          | 1.5 | 1.5        | 1.5  | ns         |     |      |

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

|          |  | $T_A = 25^\circ\text{C}$     |     | SN54LV161A |     | SN74LV161A |     | UNIT |
|----------|--|------------------------------|-----|------------|-----|------------|-----|------|
|          |  | MIN                          | MAX | MIN        | MAX | MIN        | MAX |      |
| $t_w$    | Pulse duration   | CLK high or low              | 5   | 5          | 5   | ns         |     |      |
|          |  | $\overline{\text{CLR}}$ low  | 5   | 5          | 5   |            |     |      |
| $t_{su}$ | Setup time before CLK $\uparrow$                       | $\overline{\text{CLR}}$      | 2.5 | 2.5        | 2.5 | ns         |     |      |
|          |  | Data (A, B, C, and D)        | 5.5 | 6.5        | 6.5 |            |     |      |
|          |  | ENP, ENT                     | 7.5 | 9          | 9   |            |     |      |
|          |  | $\overline{\text{LOAD}}$ low | 8   | 9.5        | 9.5 |            |     |      |
| $t_h$    | Hold time, all synchronous inputs after CLK $\uparrow$ | 1                            | 1   | 1          | 1   | ns         |     |      |

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

|          |  | $T_A = 25^\circ\text{C}$     |     | SN54LV161A |     | SN74LV161A |     | UNIT |
|----------|--|------------------------------|-----|------------|-----|------------|-----|------|
|          |  | MIN                          | MAX | MIN        | MAX | MIN        | MAX |      |
| $t_w$    | Pulse duration   | CLK high or low              | 5   | 5          | 5   | ns         |     |      |
|          |  | $\overline{\text{CLR}}$ low  | 5   | 5          | 5   |            |     |      |
| $t_{su}$ | Setup time before CLK $\uparrow$                       | $\overline{\text{CLR}}$      | 1.5 | 1.5        | 1.5 | ns         |     |      |
|          |  | Data (A, B, C, and D)        | 4.5 | 4.5        | 4.5 |            |     |      |
|          |  | ENP, ENT                     | 5   | 6          | 6   |            |     |      |
|          |  | $\overline{\text{LOAD}}$ low | 5   | 6          | 6   |            |     |      |
| $t_h$    | Hold time, all synchronous inputs after CLK $\uparrow$ | 1                            | 1   | 1          | 1   | ns         |     |      |

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# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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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     | $T_A = 25^\circ\text{C}$ |       |     | SN54LV161A |       | SN74LV161A |      | UNIT |
|------------------|-------------------------|-------------------|----------------------|--------------------------|-------|-----|------------|-------|------------|------|------|
|                  |                         |                   |                      | MIN                      | TYP   | MAX | MIN        | MAX   | MIN        | MAX  |      |
| $f_{\text{max}}$ |                         |                   | $C_L = 15\text{ pF}$ | 50*                      | 125*  |     | 40*        |       | 40         |      | MHz  |
|                  |                         |                   | $C_L = 50\text{ pF}$ | 30                       | 95    |     | 25         |       | 25         |      |      |
| $t_{\text{pd}}$  | CLK                     | Q                 | $C_L = 15\text{ pF}$ | 7.9*                     | 16.2* |     | 1*         | 19.5* | 1          | 19.5 | ns   |
|                  |                         | RCO (count mode)  |                      | 8.9*                     | 17*   |     | 1*         | 20.5* | 1          | 20.5 |      |
|                  |                         | RCO (preset mode) |                      | 11.9*                    | 20.6* |     | 1*         | 24.5* | 1          | 24.5 |      |
|                  | ENT                     | 8.3*              |                      | 15.7*                    |       | 1*  | 19*        | 1     | 19         |      |      |
| $t_{\text{PHL}}$ | $\overline{\text{CLR}}$ | Q                 |                      | 8.8*                     | 17*   |     | 1*         | 20.5* | 1          | 20.5 |      |
|                  |                         | RCO               |                      | 9.8*                     | 16.6* |     | 1*         | 20*   | 1          | 20   |      |
| $t_{\text{pd}}$  | CLK                     | Q                 | $C_L = 50\text{ pF}$ | 10.5                     | 19.2  |     | 1          | 22.5  | 1          | 22.5 | ns   |
|                  |                         | RCO (count mode)  |                      | 11.7                     | 20    |     | 1          | 23.5  | 1          | 23.5 |      |
|                  |                         | RCO (preset mode) |                      | 14.5                     | 23.6  |     | 1          | 27.5  | 1          | 27.5 |      |
|                  | ENT                     | 11                |                      | 18.7                     |       | 1   | 22         | 1     | 22         |      |      |
| $t_{\text{PHL}}$ | $\overline{\text{CLR}}$ | Q                 |                      | 11.4                     | 20    |     | 1          | 23.5  | 1          | 23.5 |      |
|                  |                         | RCO               |                      | 12.6                     | 19.6  |     | 1          | 23    | 1          | 23   |      |

\* On products compliant to MIL-PRF-38535, this parameter is not production tested.

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# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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switching characteristics over recommended operating 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       | $T_A = 25^\circ\text{C}$ |      |     | SN54LV161A |       | SN74LV161A |      | UNIT |
|-------------|-------------------------|-------------------|------------------------|--------------------------|------|-----|------------|-------|------------|------|------|
|             |                         |                   |                        | MIN                      | TYP  | MAX | MIN        | MAX   | MIN        | MAX  |      |
| $f_{\max}$  |                         |                   | $C_L = 15\text{ pF}^*$ | 80*                      | 165* |     | 70*        |       | 70         |      | MHz  |
|             |                         |                   | $C_L = 50\text{ pF}$   | 55                       | 125  |     | 50         |       | 50         |      |      |
| $t_{pd}^*$  | CLK                     | Q                 | $C_L = 15\text{ pF}$   | 6                        | 12.8 |     | 1*         | 15*   | 1          | 15   | ns   |
|             |                         | RCO (count mode)  |                        | 6.7                      | 13.6 |     | 1*         | 16*   | 1          | 16   |      |
|             |                         | RCO (preset mode) |                        | 8.6                      | 17.2 |     | 1*         | 20*   | 1          | 20   |      |
|             | ENT                     | RCO               |                        | 6.2                      | 12.3 |     | 1*         | 14.5* | 1          | 14.5 |      |
| $t_{PHL}^*$ | $\overline{\text{CLR}}$ | Q                 |                        | 6.5                      | 13.6 |     | 1*         | 16*   | 1          | 16   |      |
|             |                         | RCO               |                        | 7.2                      | 13.2 |     | 1*         | 15.5* | 1          | 15.5 |      |
| $t_{pd}$    | CLK                     | Q                 | $C_L = 50\text{ pF}$   | 7.8                      | 16.3 |     | 1          | 18.5  | 1          | 18.5 | ns   |
|             |                         | RCO (count mode)  |                        | 8.7                      | 17.1 |     | 1          | 19.5  | 1          | 19.5 |      |
|             |                         | RCO (preset mode) |                        | 10.6                     | 20.7 |     | 1          | 23.5  | 1          | 23.5 |      |
|             | ENT                     | RCO               |                        | 8.3                      | 15.8 |     | 1          | 18    | 1          | 18   |      |
| $t_{PHL}$   | $\overline{\text{CLR}}$ | Q                 |                        | 8.4                      | 17.1 |     | 1          | 19.5  | 1          | 19.5 |      |
|             |                         | RCO               |                        | 9.2                      | 16.7 |     | 1          | 19    | 1          | 19   |      |

\* On products compliant to MIL-PRF-38535, this parameter is not production tested.

# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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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     | $T_A = 25^\circ\text{C}$ |       |      | SN54LV161A |      | SN74LV161A |     | UNIT |
|------------|-------------------------|-------------------|----------------------|--------------------------|-------|------|------------|------|------------|-----|------|
|            |                         |                   |                      | MIN                      | TYP   | MAX  | MIN        | MAX  | MIN        | MAX |      |
| $f_{\max}$ |                         |                   | $C_L = 15\text{ pF}$ | 135*                     | 220   |      | 115*       |      | 115        |     | MHz  |
|            |                         |                   | $C_L = 50\text{ pF}$ | 95                       | 165   |      | 85         |      | 85         |     |      |
| $t_{pd}$   | CLK                     | Q                 | $C_L = 15\text{ pF}$ | 4.5*                     | 8.1*  | 1*   | 9.5*       | 1    | 9.5        | ns  |      |
|            |                         | RCO (count mode)  |                      | 5.1*                     | 8.1*  | 1*   | 9.5*       | 1    | 9.5        |     |      |
|            |                         | RCO (preset mode) |                      | 6.3*                     | 10.3* | 1*   | 12*        | 1    | 12         |     |      |
|            | ENT                     | 4.8*              |                      | 8.1*                     | 1*    | 9.5* | 1          | 9.5  |            |     |      |
| $t_{PHL}$  | $\overline{\text{CLR}}$ | Q                 |                      | 4.9*                     | 9*    | 1*   | 10.5*      | 1    | 10.5       |     |      |
|            |                         | RCO               |                      | 5.5*                     | 8.6*  | 1*   | 10*        | 1    | 10         |     |      |
| $t_{pd}$   | CLK                     | Q                 | $C_L = 50\text{ pF}$ | 5.9                      | 10.1  | 1    | 11.5       | 1    | 11.5       | ns  |      |
|            |                         | RCO (count mode)  |                      | 6.6                      | 10.1  | 1    | 11.5       | 1    | 11.5       |     |      |
|            |                         | RCO (preset mode) |                      | 7.8                      | 12.3  | 1    | 14         | 1    | 14         |     |      |
|            | ENT                     | 6.1               |                      | 10.1                     | 1     | 11.5 | 1          | 11.5 |            |     |      |
| $t_{PHL}$  | $\overline{\text{CLR}}$ | Q                 |                      | 6.3                      | 11    | 1    | 12.5       | 1    | 12.5       |     |      |
|            |                         | RCO               |                      | 6.9                      | 10.6  | 1    | 12         | 1    | 12         |     |      |

\* On products compliant to MIL-PRF-38535, this parameter is not production tested.

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

| PARAMETER   |  | SN74LV161A |      |      | UNIT |
|-------------|--|------------|------|------|------|
|             |  | MIN        | TYP  | MAX  |      |
| $V_{OL(P)}$ | 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 $V_{OH}$ |            | 3    |      | 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    | 23.6 | pF   |
|           |                               |  | 5 V      | 25.8 |      |

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.

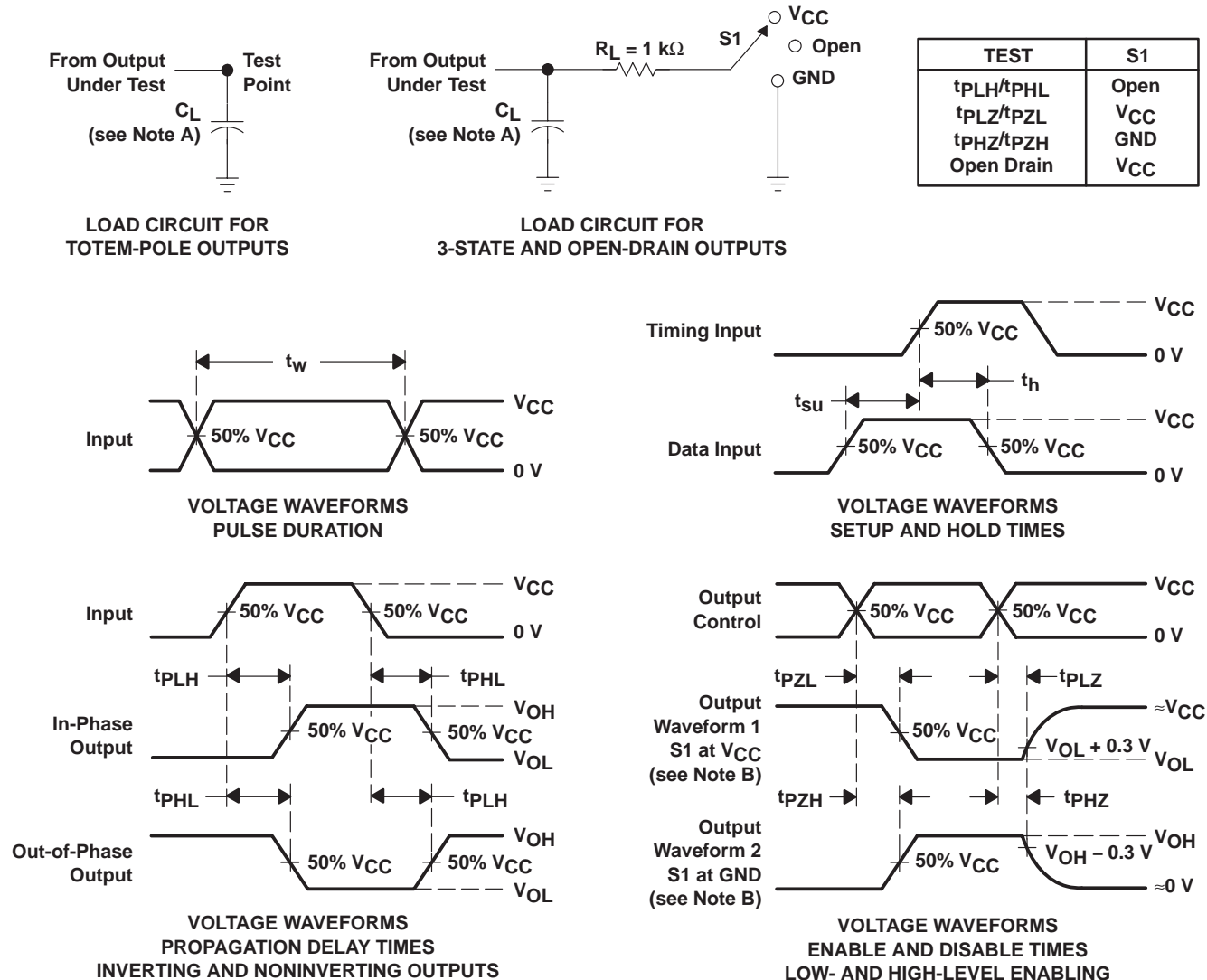


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# SN54LV161A, SN74LV161A 4-BIT SYNCHRONOUS BINARY COUNTERS

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## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $C_L$  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  $\leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 3\text{ ns}$ ,  $t_f \leq 3\text{ ns}$ .
  - D. The outputs are measured one at a time, with one input transition per measurement.
  - E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - G.  $t_{PHL}$  and  $t_{PLH}$  are the same as  $t_{pd}$ .
  - 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<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| SN74LV161AD      | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADBR    | ACTIVE        | SSOP         | DB                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADBRE4  | ACTIVE        | SSOP         | DB                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADBRG4  | ACTIVE        | SSOP         | DB                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADE4    | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADG4    | ACTIVE        | SOIC         | D                  | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADGVR   | ACTIVE        | TVSOP        | DGV                | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADGVRE4 | ACTIVE        | TVSOP        | DGV                | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADGVRG4 | ACTIVE        | TVSOP        | DGV                | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADR     | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADRE4   | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ADRG4   | ACTIVE        | SOIC         | D                  | 16   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161ANSR    | ACTIVE        | SO           | NS                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | 74LV161A                 | <a href="#">Samples</a> |
| SN74LV161ANSRE4  | ACTIVE        | SO           | NS                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | 74LV161A                 | <a href="#">Samples</a> |
| SN74LV161ANSRG4  | ACTIVE        | SO           | NS                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | 74LV161A                 | <a href="#">Samples</a> |
| SN74LV161APW     | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161APWE4   | ACTIVE        | TSSOP        | PW                 | 16   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| SN74LV161APWG4   | ACTIVE        | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161APWR    | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161APWRE4  | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161APWRG4  | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161APWT    | ACTIVE        | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161APWTE4  | ACTIVE        | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |
| SN74LV161APWTG4  | ACTIVE        | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | LV161A                   | <a href="#">Samples</a> |

(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) 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)

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

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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**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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LV161ADBR  | SSOP         | DB              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 6.6     | 2.5     | 12.0    | 16.0   | Q1            |
| SN74LV161ADGVR | TVSOP        | DGV             | 16   | 2000 | 330.0              | 12.4               | 6.8     | 4.0     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74LV161ADR   | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74LV161ANSR  | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| SN74LV161APWR  | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74LV161APWT  | TSSOP        | PW              | 16   | 250  | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV161ADBR  | SSOP         | DB              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| SN74LV161ADGVR | TVSOP        | DGV             | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| SN74LV161ADR   | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| SN74LV161ANSR  | SO           | NS              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| SN74LV161APWR  | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| SN74LV161APWT  | TSSOP        | PW              | 16   | 250  | 367.0       | 367.0      | 35.0        |

DGV (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- 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 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - 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 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

PW (R-PDSO-G16)

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

PW (R-PDSO-G16)

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.

DB (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- 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-150

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- 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.

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| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity        | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

|                               |  |
|-------------------------------|--|
| Automotive and Transportation | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>                         |
| Communications and Telecom    | <a href="http://www.ti.com/communications">www.ti.com/communications</a>                 |
| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
| Security                      | <a href="http://www.ti.com/security">www.ti.com/security</a>                             |
| Space, Avionics and Defense   | <a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a> |
| Video and Imaging             | <a href="http://www.ti.com/video">www.ti.com/video</a>                                   |

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