

# SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163 SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163 SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS

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- Internal Look-Ahead Circuitry for Fast Counting
- Carry Output for n-Bit Cascading
- Synchronous Counting
- Synchronously Programmable
- Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

## description

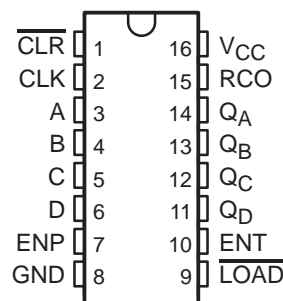
These synchronous, presettable, 4-bit decade and binary counters feature an internal carry look-ahead circuitry for application in high-speed counting designs. The SN54ALS162B is a 4-bit decade counter. The 'ALS161B, 'ALS163B, 'AS161, and 'AS163 are 4-bit binary counters. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincidentally with each other when instructed by the count-enable (ENP, ENT) inputs and internal gating. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple-clock) counters. A buffered clock (CLK) input triggers the four flip-flops on the rising (positive-going) edge of the clock input waveform.

These counters are fully programmable; they may be preset to any number between 0 and 9 or 15. Because presetting is synchronous, setting up a low level at the load ( $\overline{\text{LOAD}}$ ) 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.

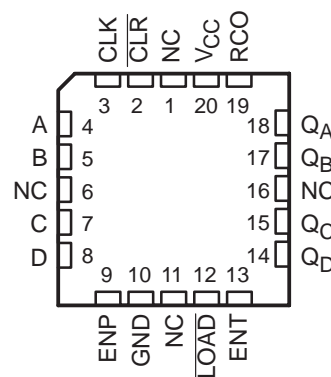
The clear function for the 'ALS161B and 'AS161 is asynchronous. A low level at the clear ( $\overline{\text{CLR}}$ ) input sets all four of the flip-flop outputs low, regardless of the levels of the CLK,  $\overline{\text{LOAD}}$ , or enable inputs. The clear function for the SN54ALS162B, 'ALS163B, and 'AS163 is synchronous, and a low level at  $\overline{\text{CLR}}$  sets all four of the flip-flop outputs low after the next clock pulse, regardless of the levels of the enable inputs. This synchronous clear allows the count length to be modified easily by decoding the Q outputs for the maximum count desired. The active-low output of the gate used for decoding is connected to  $\overline{\text{CLR}}$  to synchronously clear the counter to 0000 (LLLL).

The carry look-ahead circuitry provides for cascading counters for n-bit synchronous applications without additional gating. ENP and ENT inputs and a ripple-carry (RCO) output are instrumental in accomplishing this function. Both ENP and ENT must be high to count, and ENT is fed forward to enable RCO. RCO, thus enabled, produces a high-level pulse while the count is maximum (9 or 15 with  $Q_A$  high). The 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.

SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161,  
SN54AS163 . . . J PACKAGE  
SN74ALS161B, SN74ALS163B, SN74AS161,  
SN74AS163 . . . D OR N PACKAGE  
(TOP VIEW)



SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161,  
SN54AS163 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

**SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS**

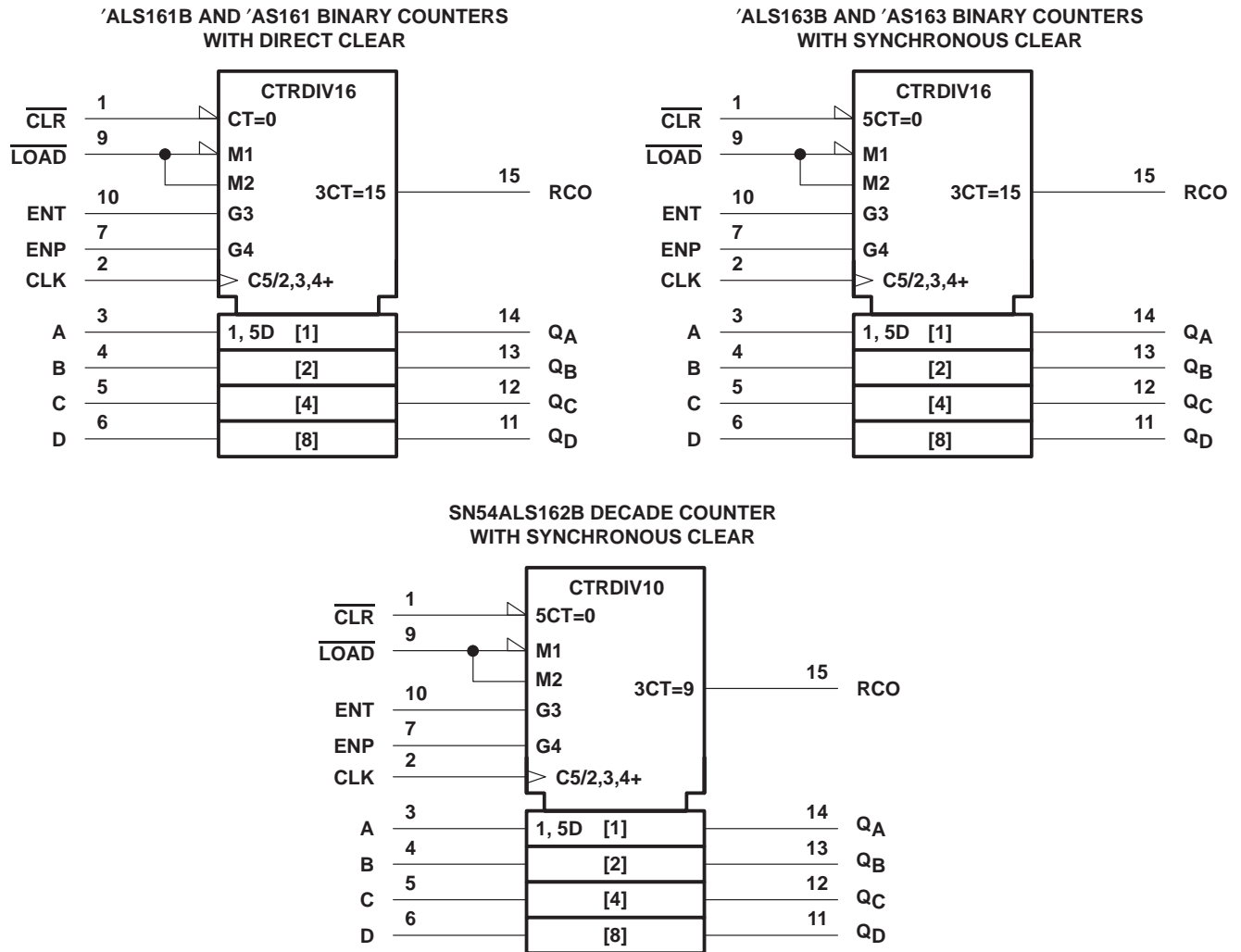
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**description (continued)**

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.

The SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, and SN54AS163 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS161B, SN74ALS163B, SN74AS161, and SN74AS163 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

**logic symbols†**

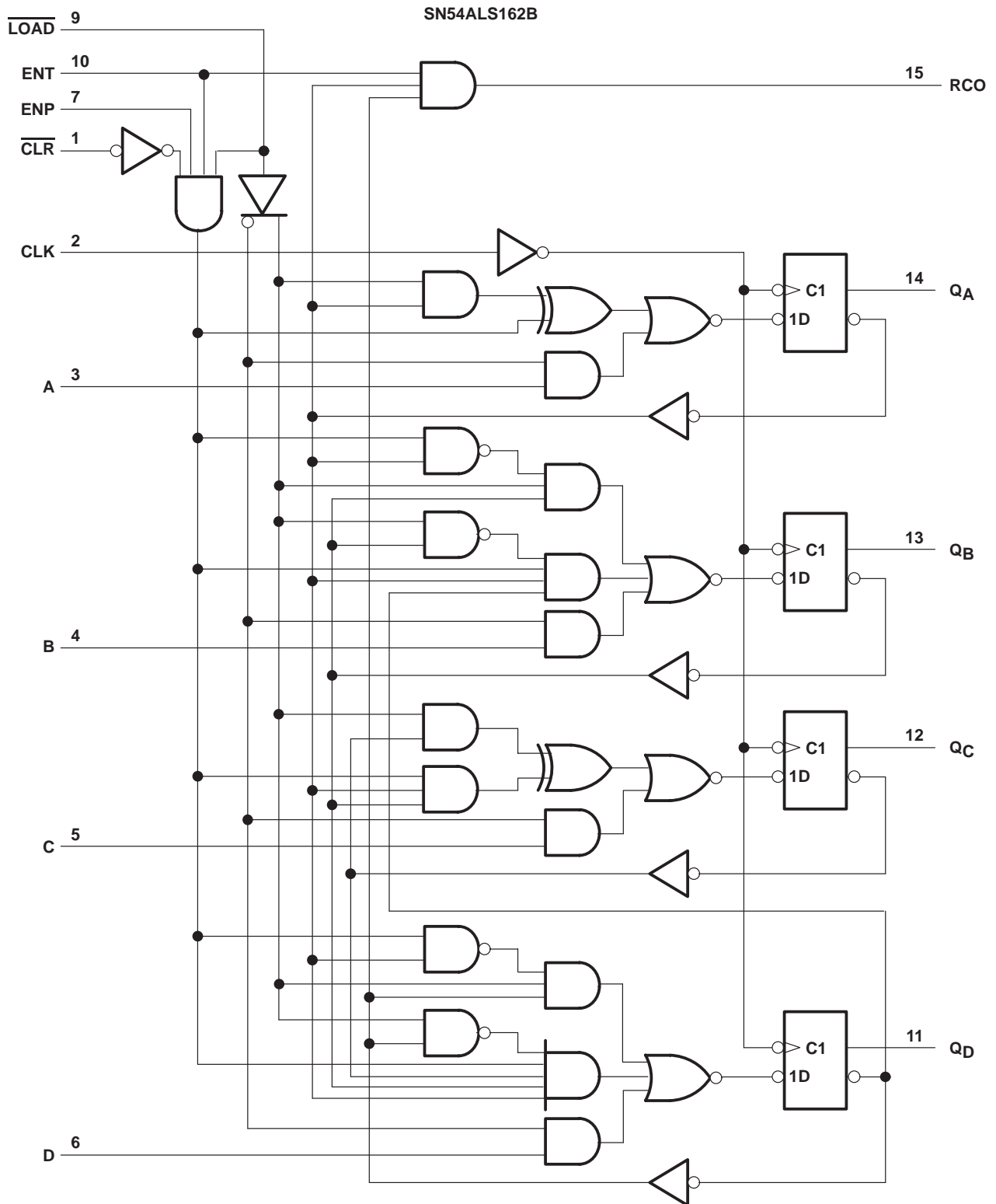


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the D, J, and N packages.

SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
 SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
 SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS

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logic diagram (positive logic)

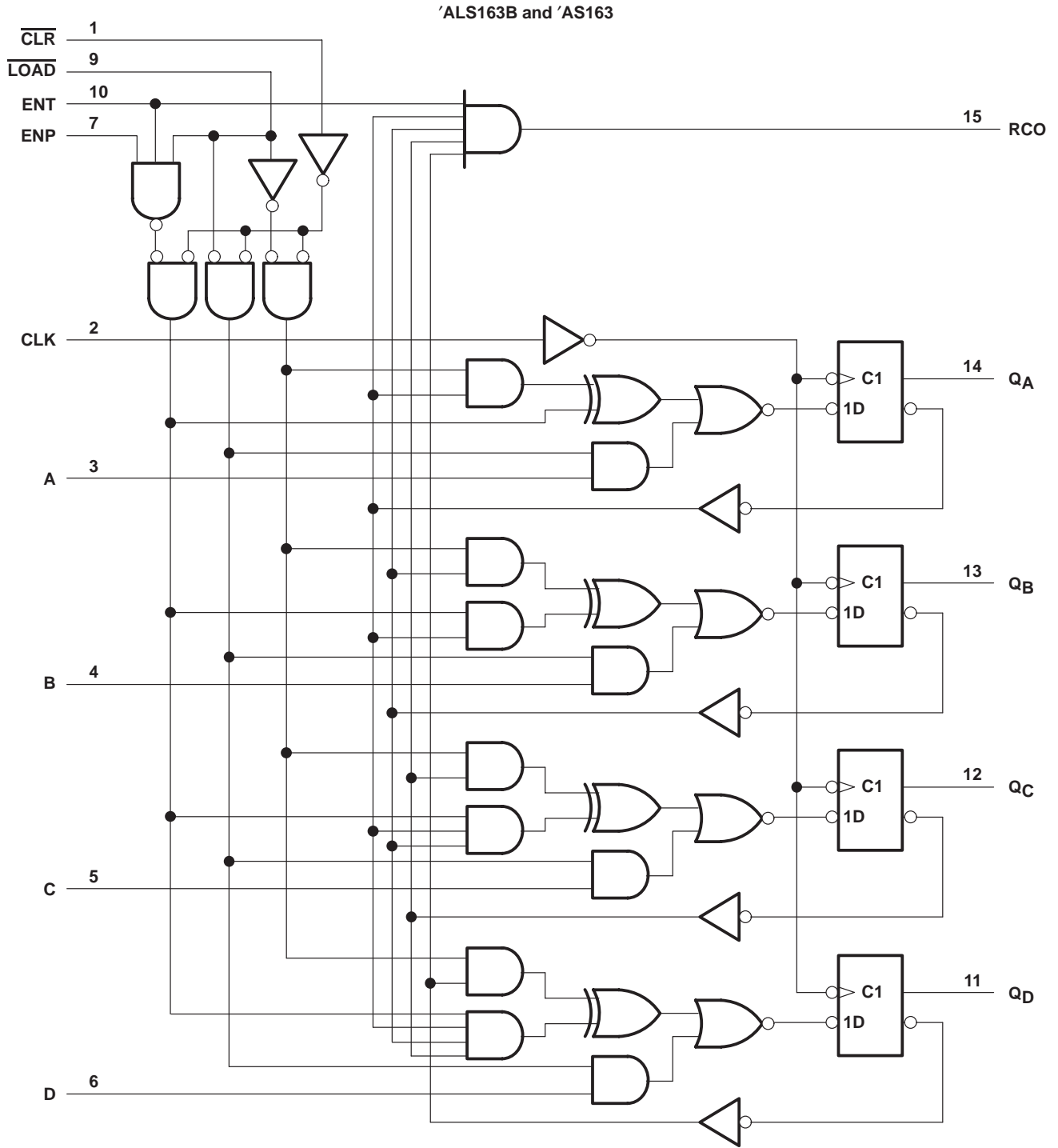


Pin numbers shown are for the J package.

SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
 SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
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logic diagram (positive logic)



Pin numbers shown are for the D, J, and N packages.

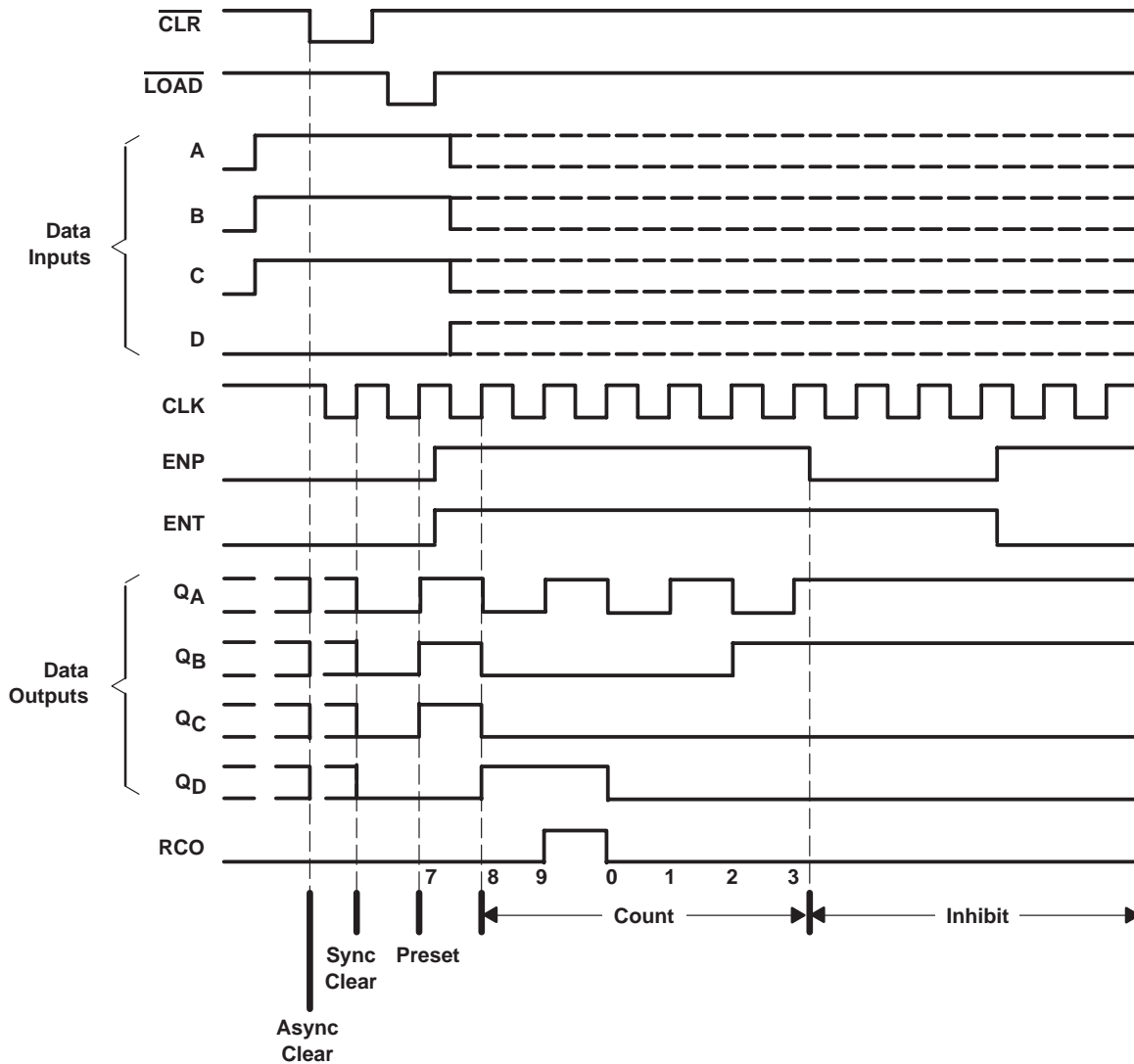
'ALS161B and 'AS161 synchronous binary counters are similar; however,  $\overline{\text{CLR}}$  is asynchronous.

typical clear, preset, count, and inhibit sequences

SN54ALS162B

The following sequence is illustrated below:

1. Clear outputs to zero (SN54ALS162B is synchronous)
2. Preset to BCD 7
3. Count to 8, 9, 0, 1, 2, and 3
4. Inhibit



**SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
 SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
 SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS**

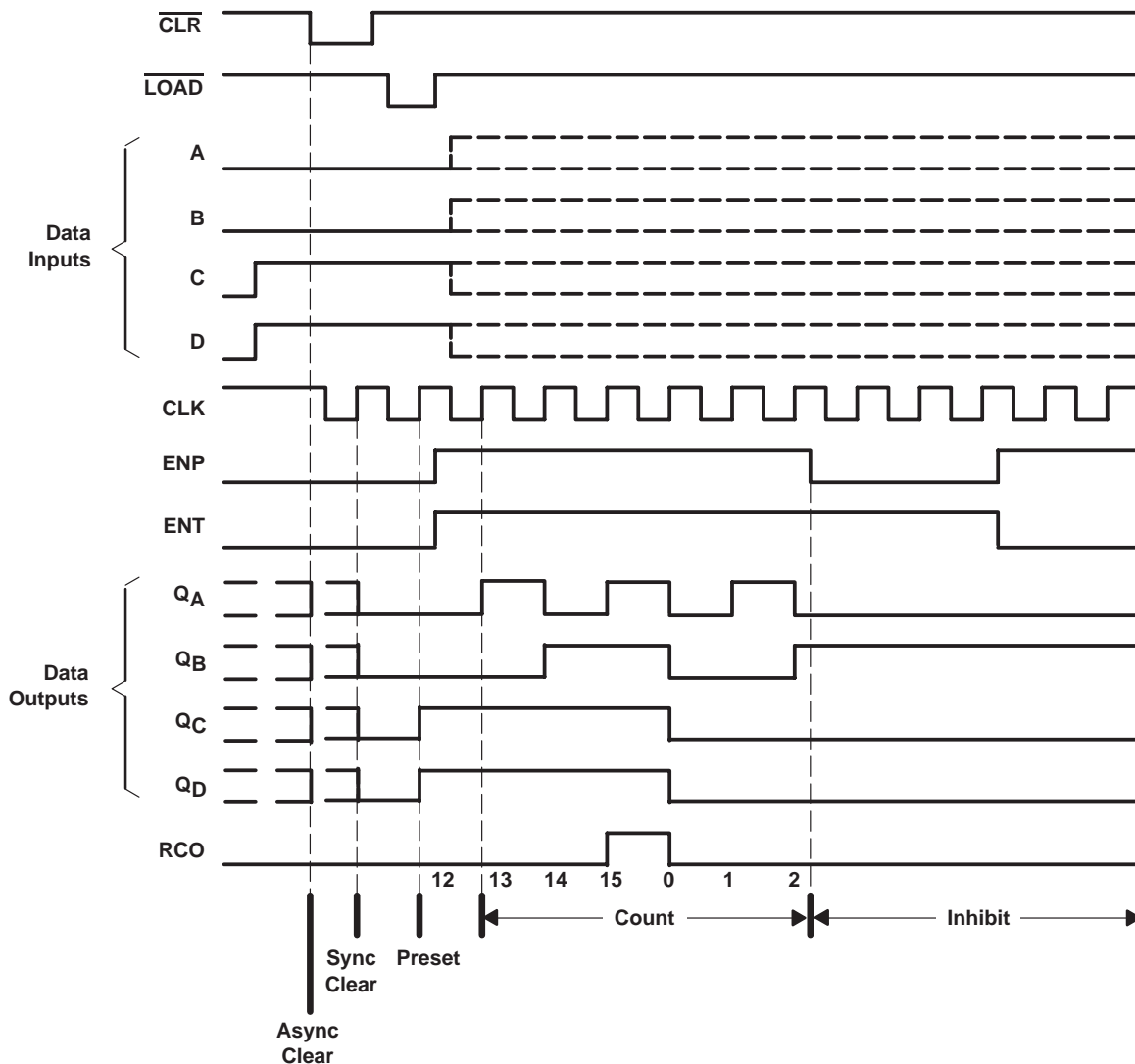
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**typical clear, preset, count, and inhibit sequences**

'ALS161B, 'AS161, 'ALS163B, and 'AS163

The following sequence is illustrated below:

1. Clear outputs to zero ('ALS161B and 'AS161 are asynchronous; 'ALS163B and 'AS163 are synchronous.)
2. Preset to binary 12
3. Count to 13, 14, 15, 0, 1, and 2
4. Inhibit



**SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS**

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

|  |                |
|--|----------------|
| Supply voltage, $V_{CC}$ .....   | 7 V            |
| Input voltage, $V_I$ .....   | 7 V            |
| Operating free-air temperature range, $T_A$ : SN54ALS161B, SN54ALS162B,<br>SN54ALS163B ..... | –55°C to 125°C |
| SN74ALS161B, SN74ALS163B .....   | 0°C to 70°C    |
| Storage temperature range .....  | –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.

**recommended operating conditions**

|                       |  | SN54ALS161B<br>SN54ALS162B<br>SN54ALS163B |                           |      | SN74ALS161B<br>SN74ALS163B |      |      | UNIT |
|-----------------------|--|---|---------------------------|------|----------------------------|------|------|------|
|                       |  | MIN                                       | NOM                       | MAX  | MIN                        | NOM  | MAX  |      |
| $V_{CC}$              | Supply voltage                               | 4.5                                       | 5                         | 5.5  | 4.5                        | 5    | 5.5  | V    |
| $V_{IH}$              | High-level input voltage                     | 2   |                           |      | 2                          |      |      | V    |
| $V_{IL}$              | Low-level input voltage                      |   |                           | 0.7  |                            |      | 0.8  | V    |
| $I_{OH}$              | High-level output current                    |   |                           | –0.4 |                            |      | –0.4 | mA   |
| $I_{OL}$              | Low-level output current                     |   |                           | 4    |                            |      | 8    | mA   |
| $f_{clock}$           | Clock frequency                              | 0   |                           | 22   | 0                          |      | 40   | MHz  |
| $t_w$                 | Pulse duration                               | $\overline{CLR}$ high or low              |                           | 20   |                            | 12.5 |      | ns   |
|                       |  | 'ALS161B                                  | $\overline{CLR}$ low      | 20   |                            | 15   |      |      |
| $t_{su}$              | Setup time before CLK↑                       | A, B, C, D                                |                           | 50   |                            | 15   |      | ns   |
|                       |  | $\overline{LOAD}$                         |                           | 20   |                            | 15   |      |      |
|                       |  | 'ALS161B                                  | ENP, ENT                  | 25   |                            | 15   |      |      |
|                       |  | SN54ALS162B, 'ALS163B                     |                           | 20   |                            | 15   |      |      |
|                       |  | 'ALS161B                                  | $\overline{CLR}$ inactive | 10   |                            | 10   |      |      |
|                       |  | SN54ALS162B, 'ALS163B                     | $\overline{CLR}$ low      | 20   |                            | 15   |      |      |
| $\overline{CLR}$ high | 20   |   |                           | 10   |                            |      |      |      |
| $t_h$                 | Hold time, all synchronous inputs after CLK↑ | 0   |                           |      | 0                          |      |      | ns   |
| $T_A$                 | Operating free-air temperature               | –55                                       |                           | 125  | 0                          |      | 70   | °C   |



**SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS**

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

| PARAMETER       | TEST CONDITIONS   | SN54ALS161B<br>SN54ALS162B<br>SN54ALS163B |      |      | SN74ALS161B<br>SN74ALS163B |                        |      | UNIT          |    |
|-----------------|---|---|------|------|----------------------------|------------------------|------|---------------|----|
|                 |   | MIN                                       | TYP† | MAX  | MIN                        | TYP†                   | MAX  |               |    |
| $V_{IK}$        | $V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$                     |   |      | -1.5 |                            |                        | -1.5 | V             |    |
| $V_{OH}$        | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ , $I_{OH} = -0.4\text{ mA}$ | $V_{CC} - 2$                              |      |      | $V_{CC} - 2$               |                        |      | V             |    |
| $V_{OL}$        | $V_{CC} = 4.5\text{ V}$   | $I_{OL} = 4\text{ mA}$                    |      | 0.25 | 0.4                        | $I_{OL} = 4\text{ mA}$ |      | V             |    |
|                 |   | $I_{OL} = 8\text{ mA}$                    |      |      |                            | $I_{OL} = 8\text{ mA}$ |      |               |    |
| $I_I$           | $V_{CC} = 5.5\text{ V}$ , $V_I = 7\text{ V}$                        |   |      | 0.1  |                            |                        | 0.1  | mA            |    |
| $I_{IH}$        | $V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$                      |   |      | 20   |                            |                        | 20   | $\mu\text{A}$ |    |
| $I_{IL}$        | $V_{CC} = 5.5\text{ V}$ , $V_I = 0.4\text{ V}$                      |   |      | -0.2 |                            |                        | -0.2 | mA            |    |
| $I_{O\ddagger}$ | $V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$                     | -20                                       |      | -112 |                            |                        | -30  | -112          | mA |
| $I_{CC}$        | $V_{CC} = 5.5\text{ V}$   |   | 12   | 21   |                            | 12                     | 21   | mA            |    |

† All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

**switching characteristics (see Figure 3)**

| PARAMETER | FROM<br>(INPUT)         | TO<br>(OUTPUT) | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ,<br>$C_L = 50\text{ pF}$ ,<br>$R_L = 500\ \Omega$ ,<br>$T_A = \text{MIN to MAX}\S$ |     |             |     | UNIT |
|-----------|-------------------------|----------------|---|-----|-------------|-----|------|
|           |                         |                | SN54ALS161B   |     | SN74ALS161B |     |      |
|           |                         |                | MIN   | MAX | MIN         | MAX |      |
| $f_{max}$ |                         |                | 22  |     | 40          | MHz |      |
| $t_{PLH}$ | CLK                     | RCO            | 5   | 34  | 5           | 20  | ns   |
| $t_{PHL}$ |                         |                | 5   | 27  | 5           | 20  |      |
| $t_{PLH}$ | CLK                     | Any Q          | 4   | 19  | 4           | 15  | ns   |
| $t_{PHL}$ |                         |                | 6   | 25  | 6           | 20  |      |
| $t_{PLH}$ | ENT                     | RCO            | 3   | 18  | 3           | 13  | ns   |
| $t_{PHL}$ |                         |                | 3   | 17  | 3           | 13  |      |
| $t_{PHL}$ | $\overline{\text{CLR}}$ | Any Q          | 8   | 27  | 8           | 24  | ns   |
|           |                         | RCO            | 11  | 32  | 11          | 23  |      |

§ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



**SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS**

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**switching characteristics (see Figure 3)**

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX† |     |             |     | UNIT |
|------------------|-----------------|----------------|---|-----|-------------|-----|------|
|                  |                 |                | SN54ALS162B<br>SN54ALS163B  |     | SN74ALS163B |     |      |
|                  |                 |                | MIN   | MAX | MIN         | MAX |      |
| f <sub>max</sub> |                 |                | 35  |     | 40          |     | MHz  |
| t <sub>PLH</sub> | CLK             | RCO            | 5   | 25  | 5           | 20  | ns   |
| t <sub>PHL</sub> |                 |                | 5   | 25  | 5           | 20  |      |
| t <sub>PLH</sub> | CLK             | Any Q          | 4   | 18  | 4           | 15  | ns   |
| t <sub>PHL</sub> |                 |                | 6   | 25  | 6           | 20  |      |
| t <sub>PLH</sub> | ENT             | RCO            | 3   | 16  | 3           | 13  | ns   |
| t <sub>PHL</sub> |                 |                | 3   | 16  | 3           | 13  |      |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡**

|   |                |
|---|----------------|
| Supply voltage, V <sub>CC</sub>   | 7 V            |
| Input voltage, V <sub>I</sub>   | 7 V            |
| Operating free-air temperature range, T <sub>A</sub> : SN54AS161, SN54AS163 | –55°C to 125°C |
| SN74AS161, SN74AS163  | 0°C to 70°C    |
| Storage temperature range   | –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.

**recommended operating conditions**

|                      |  | SN54AS161<br>SN54AS163 |                     |     | SN74AS161<br>SN74AS163 |     |     | UNIT |
|----------------------|--|------------------------|---------------------|-----|------------------------|-----|-----|------|
|                      |  | MIN                    | NOM                 | MAX | MIN                    | NOM | MAX |      |
| V <sub>CC</sub>      | Supply voltage                               | 4.5                    | 5                   | 5.5 | 4.5                    | 5   | 5.5 | V    |
| V <sub>IH</sub>      | High-level input voltage                     | 2                      |                     |     | 2                      |     |     | V    |
| V <sub>IL</sub>      | Low-level input voltage                      |                        |                     | 0.8 |                        |     | 0.8 | V    |
| I <sub>OH</sub>      | High-level output current                    |                        |                     | –2  |                        |     | –2  | mA   |
| I <sub>OL</sub>      | Low-level output current                     |                        |                     | 20  |                        |     | 20  | mA   |
| f <sub>clock</sub> * | Clock frequency                              | 0                      |                     | 65  | 0                      |     | 75  | MHz  |
| t <sub>w</sub> *     | Pulse duration                               | CLR high or low        |                     | 7.7 | 6.7                    |     | ns  |      |
|                      |  | 'AS161                 | CLR low             | 10  | 8                      |     |     |      |
| t <sub>su</sub> *    | Setup time before CLK↑                       | A, B, C, D             |                     | 10  | 8                      |     | ns  |      |
|                      |  | LOAD                   |                     | 10  | 8                      |     |     |      |
|                      |  | ENP, ENT               |                     | 10  | 8                      |     |     |      |
|                      |  | 'AS161                 | CLR inactive        | 10  | 8                      |     |     |      |
|                      |  | 'AS163                 | CLR low             | 14  | 12                     |     |     |      |
|                      |  |                        | CLR high (inactive) | 10  | 9                      |     |     |      |
| t <sub>h</sub> *     | Hold time, all synchronous inputs after CLK↑ | 2                      |                     |     | 0                      |     |     | ns   |
| T <sub>A</sub>       | Operating free-air temperature               | –55                    |                     | 125 | 0                      |     | 70  | °C   |

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.



**SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS**

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

| PARAMETER       | TEST CONDITIONS  | SN54AS161<br>SN54AS163 |      | SN74AS161<br>SN74AS163 |     | UNIT |               |      |    |
|-----------------|--|------------------------|------|------------------------|-----|------|---------------|------|----|
|                 |  | MIN                    | TYP† | MAX                    | MIN |      | TYP†          | MAX  |    |
| $V_{IK}$        | $V_{CC} = 4.5\text{ V}$ ,<br>$I_I = -18\text{ mA}$                   |                        |      | -1.2                   |     | -1.2 | V             |      |    |
| $V_{OH}$        | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ,<br>$I_{OH} = -2\text{ mA}$ | $V_{CC} - 2$           |      | $V_{CC} - 2$           |     |      | V             |      |    |
| $V_{OL}$        | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OL} = 20\text{ mA}$                 | 0.25                   | 0.5  | 0.25                   | 0.5 |      | V             |      |    |
| $I_I$           | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 7\text{ V}$                      | LOAD                   |      | 0.3                    |     | 0.3  | mA            |      |    |
|                 |  | ENT                    |      | 0.2                    |     | 0.2  |               |      |    |
|                 |  | All others             |      | 0.1                    |     | 0.1  |               |      |    |
| $I_{IH}$        | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 2.7\text{ V}$                    | LOAD                   |      | 60                     |     | 60   | $\mu\text{A}$ |      |    |
|                 |  | ENT                    |      | 40                     |     | 40   |               |      |    |
|                 |  | All others             |      | 20                     |     | 20   |               |      |    |
| $I_{IL}$        | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 0.4\text{ V}$                    | LOAD                   |      | -1.5                   |     | -1.5 | mA            |      |    |
|                 |  | ENT                    |      | -1                     |     | -1   |               |      |    |
|                 |  | All others             |      | -0.5                   |     | -0.5 |               |      |    |
| $I_{O\ddagger}$ | $V_{CC} = 5.5\text{ V}$ ,<br>$V_O = 2.25\text{ V}$                   | -30                    |      | -112                   |     | -30  |               | -112 | mA |
| $I_{CC}$        | $V_{CC} = 5.5\text{ V}$  |                        | 35   | 53                     |     | 35   | 53            | mA   |    |

† All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

**switching characteristics (see Figure 3)**

| PARAMETER   | FROM<br>(INPUT)         | TO<br>(OUTPUT)                           | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ,<br>$C_L = 50\text{ pF}$ ,<br>$R_L = 500\ \Omega$ ,<br>$T_A = \text{MIN to MAX}\S$ |      |           |      | UNIT |
|-------------|-------------------------|--|---|------|-----------|------|------|
|             |                         |  | SN54AS161   |      | SN74AS161 |      |      |
|             |                         |  | MIN   | MAX  | MIN       | MAX  |      |
| $f_{max}^*$ |                         |  | 65  |      | 75        | MHz  |      |
| $t_{PLH}$   | CLK                     | RCO (with $\overline{\text{LOAD}}$ high) | 1   | 8.5  | 1         | 8    | ns   |
|             |                         | RCO (with $\overline{\text{LOAD}}$ low)  | 3   | 17.5 | 3         | 16.5 |      |
| $t_{PHL}$   |                         | RCO                                      | 2   | 14   | 2         | 12.5 |      |
| $t_{PLH}$   | CLK                     | Any Q                                    | 1   | 7.5  | 1         | 7    | ns   |
|             |                         |  | 2   | 14   | 2         | 13   |      |
| $t_{PHL}$   | ENT                     | RCO                                      | 1.5   | 10   | 1.5       | 9    | ns   |
|             |                         |  | 1   | 9.5  | 1         | 8.5  |      |
| $t_{PHL}$   | $\overline{\text{CLR}}$ | Any Q                                    | 2   | 14   | 2         | 13   | ns   |
|             |                         | RCO                                      | 2   | 14   | 2         | 12.5 |      |

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.

§ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



**SN54ALS161B, SN54ALS162B, SN54ALS163B, SN54AS161, SN54AS163  
SN74ALS161B, SN74ALS163B, SN74AS161, SN74AS163  
SYNCHRONOUS 4-BIT DECADE AND BINARY COUNTERS**

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**switching characteristics (see Figure 3)**

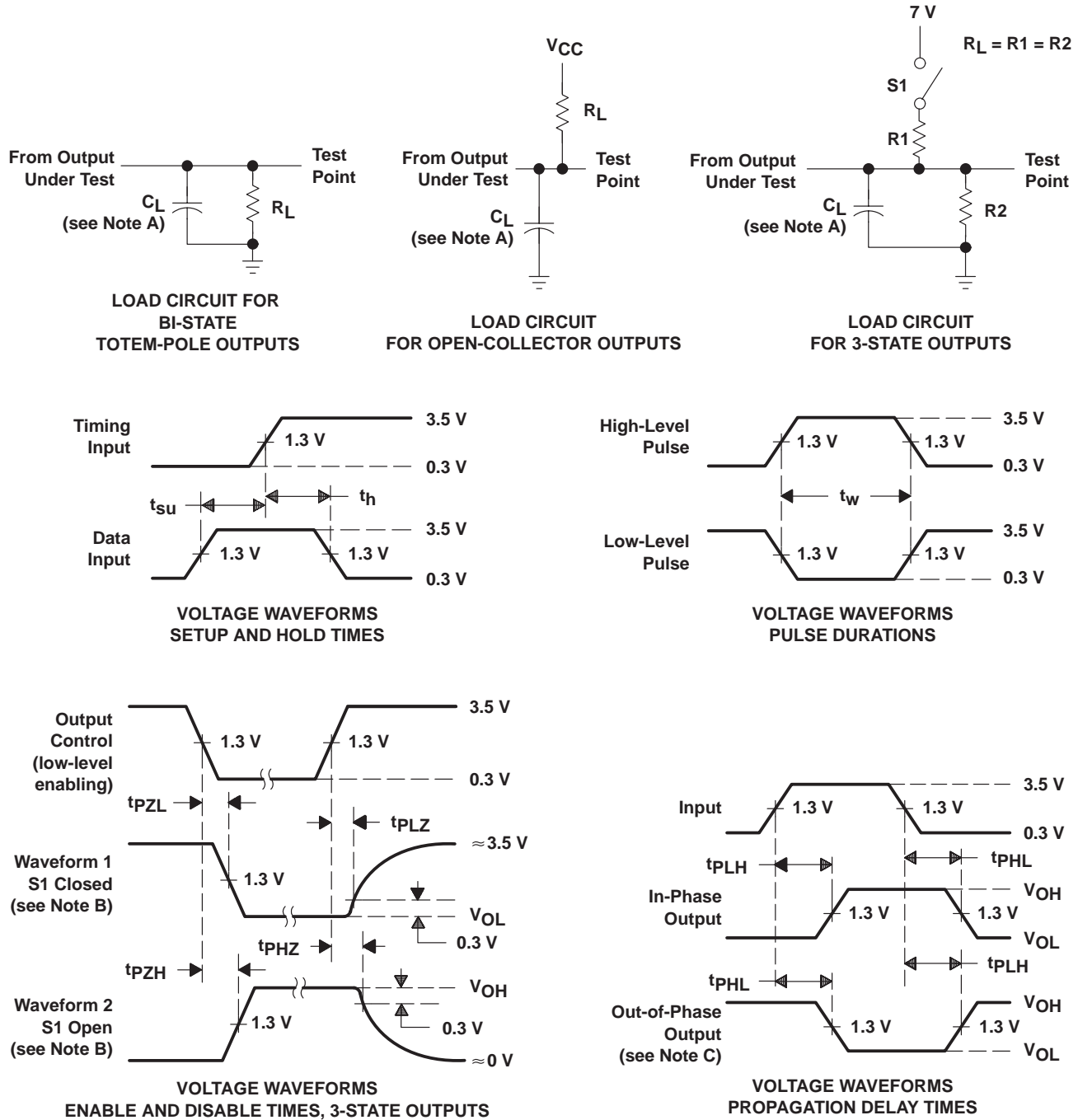
| PARAMETER          | FROM<br>(INPUT) | TO<br>(OUTPUT)                           | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX† |      |           |      | UNIT |
|--------------------|-----------------|--|---|------|-----------|------|------|
|                    |                 |  | SN54AS163   |      | SN74AS163 |      |      |
|                    |                 |  | MIN   | MAX  | MIN       | MAX  |      |
| f <sub>max</sub> * |                 |  | 65  |      | 75        |      | MHz  |
| t <sub>PLH</sub>   | CLK             | RCO (with $\overline{\text{LOAD}}$ high) | 1   | 8.5  | 1         | 8    | ns   |
|                    |                 | RCO (with $\overline{\text{LOAD}}$ low)  | 3   | 17.5 | 3         | 16.5 |      |
| t <sub>PHL</sub>   |                 | RCO                                      | 2   | 14   | 2         | 12.5 |      |
| t <sub>PLH</sub>   | CLK             | Any Q                                    | 1   | 7.5  | 1         | 7    | ns   |
| t <sub>PHL</sub>   |                 |  | 2   | 14   | 2         | 13   |      |
| t <sub>PLH</sub>   | ENT             | RCO                                      | 1.5   | 10   | 1.5       | 9    | ns   |
| t <sub>PHL</sub>   |                 |  | 1   | 9.5  | 1         | 8.5  |      |

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



PARAMETER MEASUREMENT INFORMATION  
 SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
 D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
 E. The outputs are measured one at a time with one transition per measurement.

Figure 3. Load Circuits and Voltage Waveforms

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