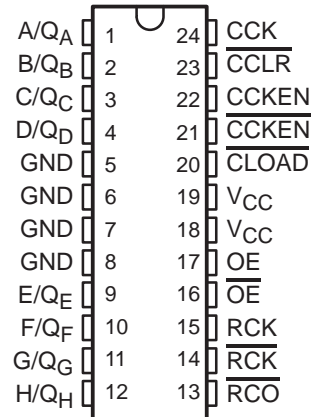


74AC11593
8-BIT BINARY COUNTER
WITH 3-STATE I/O INPUT REGISTERS
 SCAS202 – MARCH 1992 – REVISED APRIL 1993

- Parallel 3-State I/O: Register Inputs/Counter Outputs
- Counter Has Direct Overriding Load and Clear
- Flow-Through Architecture Optimizes PCB Layout
- Center-Pin V_{CC} and GND Configurations Minimize High-Speed Switching Noise
- **EPIC™** (Enhanced-Performance Implanted CMOS) 1- μ m Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic Small-Outline Packages and Standard Plastic 300-mil DIPs

DW OR NT PACKAGE
(TOP VIEW)



description

The 74AC11593 consists of a parallel input, an 8-bit storage register feeding an 8-bit counter, and a 3-state I/O which provides parallel count outputs. Both the register and the counter have individual positive-edge triggered clocks.

The function tables show the operation of the counter clock-enable (\overline{CCKEN} , \overline{CCKEN}) and output-enable (\overline{OE} , \overline{OE}) inputs. A register clock-enable (\overline{RCK}) input is also provided.

The counter (\overline{RCO}) input has direct load and clear functions. A low-going \overline{RCO} pulse will be obtained when the counter reaches the hex word FF. Expansion is easily accomplished for two stages by connecting \overline{RCO} of the first stage to \overline{CCKEN} of the second stage. Cascading for larger count chains can be accomplished by connecting \overline{RCO} of each stage to CCK of the following stage.

The 74AC11593 is characterized for operation from – 40°C to 85°C.

Function Tables

| COUNTER CLOCK ENABLE | | |
|----------------------|--------------------|---|
| INPUTS | | OUTPUTS A/Q _A THRU H/Q _H |
| \overline{CCKEN} | \overline{CCKEN} | |
| L | L | Enable |
| L | H | Disable |
| H | L | Enable |
| H | H | Enable |

| OUTPUT ENABLE | | |
|-----------------|-----------------|---|
| INPUTS | | OUTPUTS A/Q _A THRU H/Q _H |
| \overline{OE} | \overline{OE} | |
| L | L | Input mode |
| L | H | Input mode |
| H | L | Output mode |
| H | H | Input mode |

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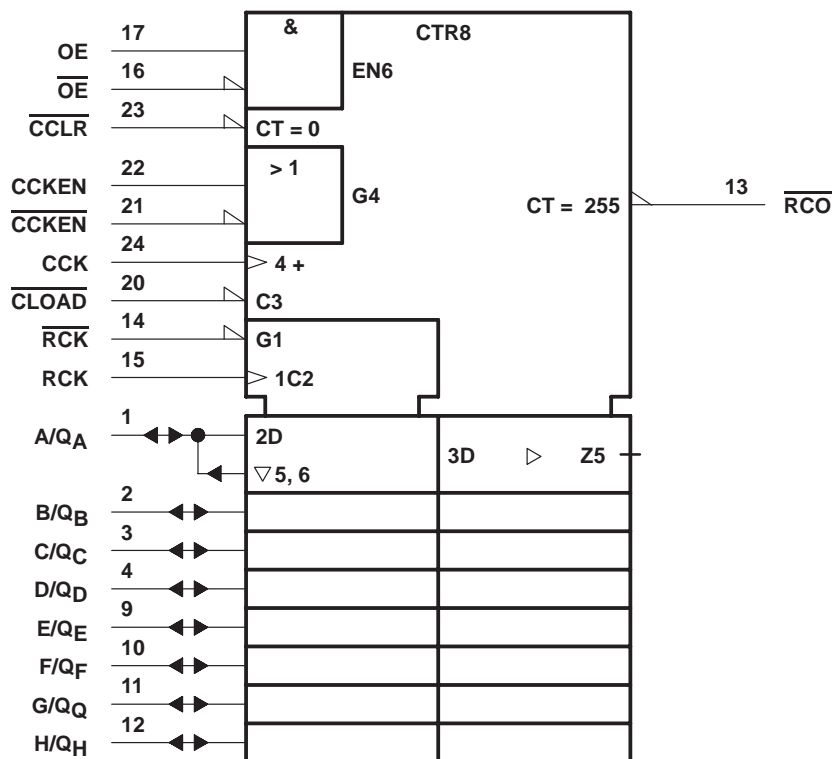
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8-BIT BINARY COUNTER

WITH 3-STATE I/O INPUT REGISTERS

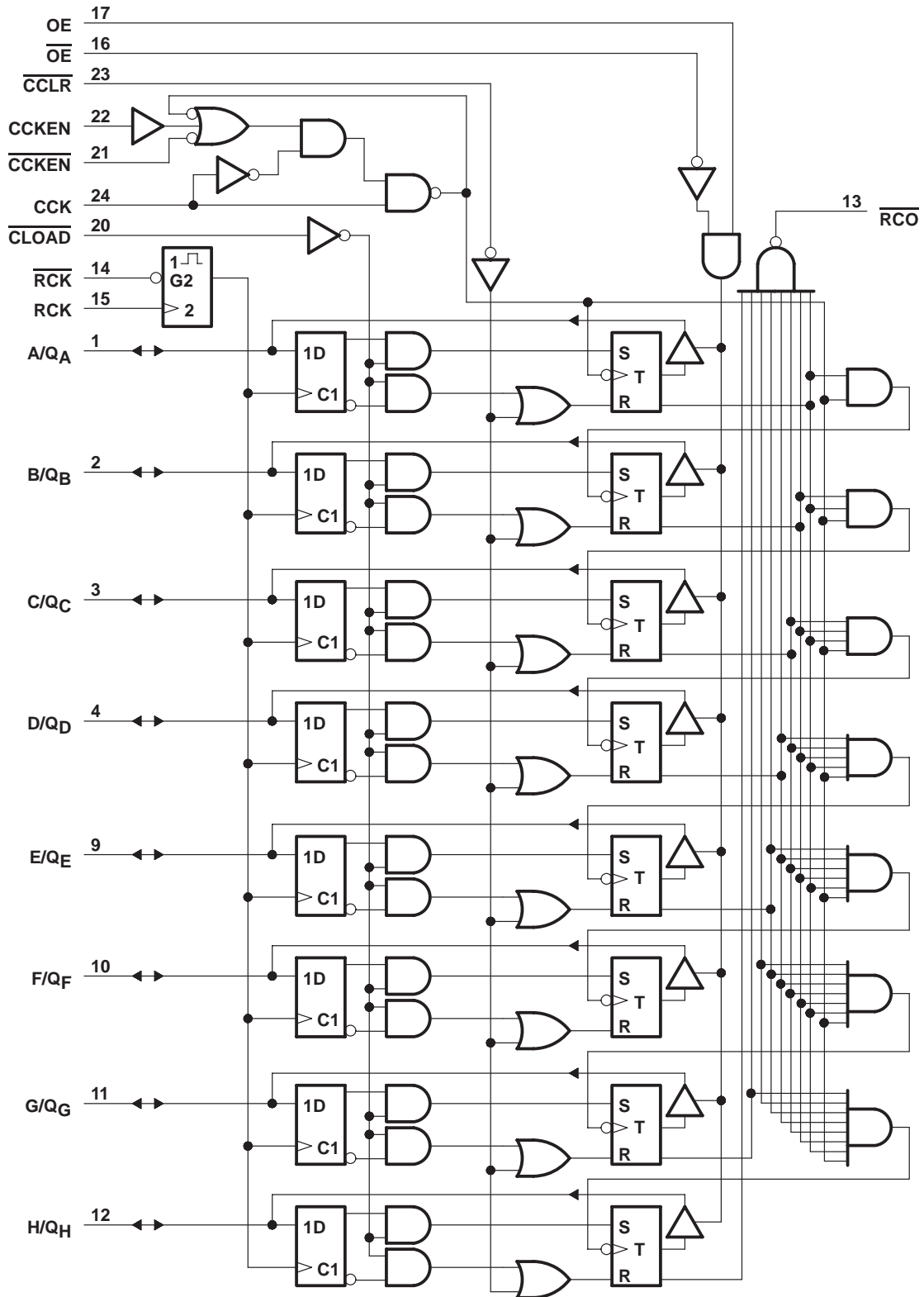
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logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



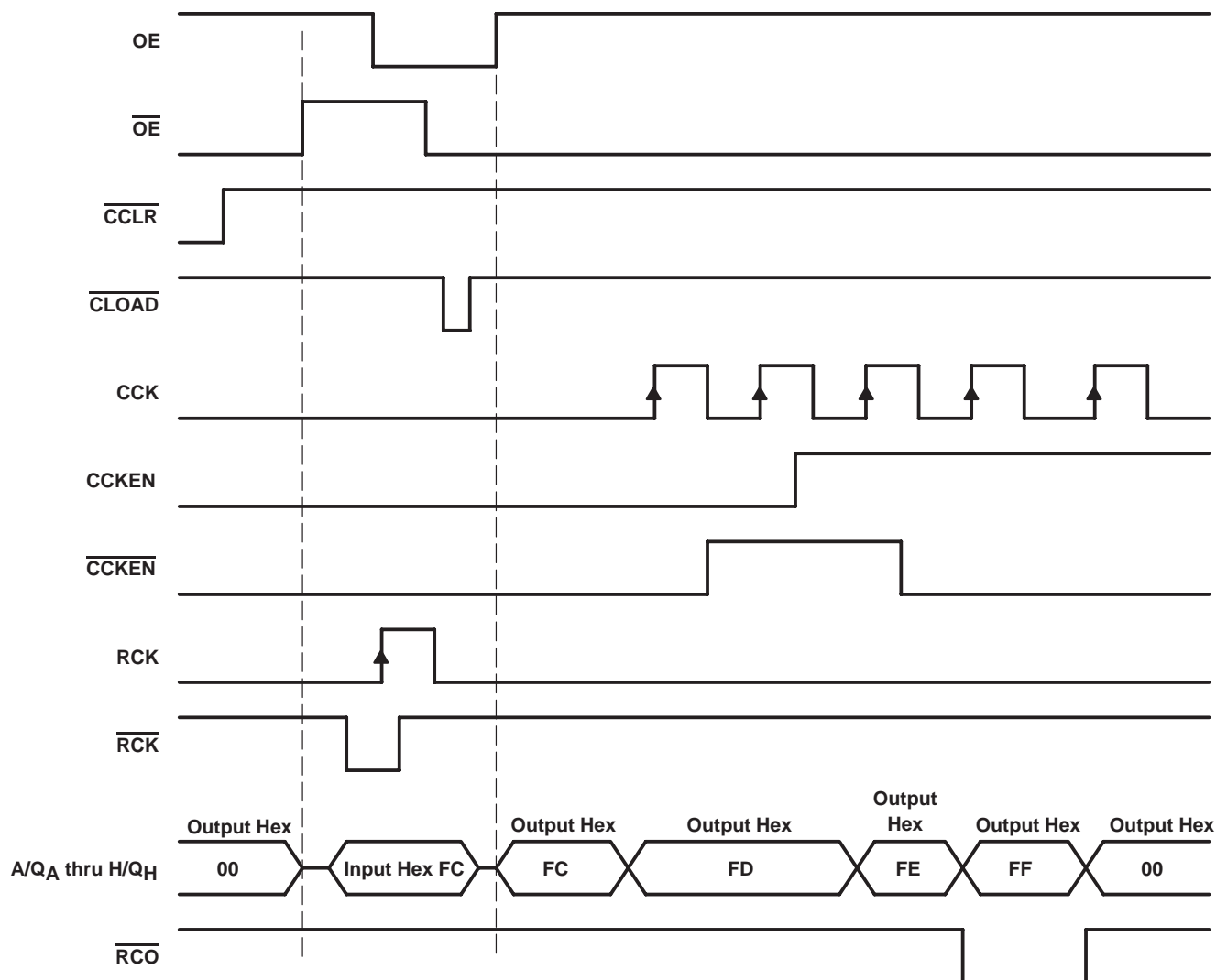
74AC11593

8-BIT BINARY COUNTER

WITH 3-STATE I/O INPUT REGISTERS

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typical operating sequence



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 $V_{CC} + 0.5$ V |
| Output voltage range, V_O (see Note 1) | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) | ± 20 mA |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) | ± 50 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ± 50 mA |
| Continuous current through V_{CC} or GND | ± 225 mA |
| 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.

NOTE 1: The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

recommended operating conditions (see Note 2)

| | | MIN | NOM | MAX | UNIT |
|---------------------|------------------------------------|-------------------------|------|----------|------|
| V_{CC} | Supply voltage | 3 | 5 | 5.5 | V |
| V_{IH} | High-level input voltage | $V_{CC} = 3\text{ V}$ | 2.1 | | V |
| | | $V_{CC} = 4.5\text{ V}$ | 3.15 | | |
| | | $V_{CC} = 5.5\text{ V}$ | 3.85 | | |
| V_{IL} | Low-level input voltage | $V_{CC} = 3\text{ V}$ | | 0.9 | V |
| | | $V_{CC} = 4.5\text{ V}$ | | 1.35 | |
| | | $V_{CC} = 5.5\text{ V}$ | | 1.65 | |
| V_I | Input voltage | 0 | | V_{CC} | V |
| V_O | Output voltage | 0 | | V_{CC} | V |
| I_{OH} | High-level output current | $V_{CC} = 3\text{ V}$ | | – 4 | mA |
| | | $V_{CC} = 4.5\text{ V}$ | | – 24 | |
| | | $V_{CC} = 5.5\text{ V}$ | | – 24 | |
| I_{OL} | Low-level output current | $V_{CC} = 3\text{ V}$ | | 12 | mA |
| | | $V_{CC} = 4.5\text{ V}$ | | 24 | |
| | | $V_{CC} = 5.5\text{ V}$ | | 24 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | 0 | | 10 | ns/V |
| T_A | Operating free-air temperature | – 40 | | 85 | °C |

NOTE 2: Unused or floating inputs must be held high or low.

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

| PARAMETER | TEST CONDITIONS | V_{CC} | $T_A = 25^\circ\text{C}$ | | | MIN | MAX | UNIT |
|-----------|-----------------------------------|----------|--------------------------|-----|-----------|------|---------|---------------|
| | | | MIN | TYP | MAX | | | |
| V_{OH} | $I_{OH} = -50\text{ }\mu\text{A}$ | 3 V | 2.9 | | | 2.9 | | V |
| | | 4.5 V | 4.4 | | | 4.4 | | |
| | | 5.5 V | 5.4 | | | 5.4 | | |
| | $I_{OH} = -4\text{ mA}$ | 3 V | 2.58 | | | 2.48 | | |
| | | 4.5 V | 3.94 | | | 3.8 | | |
| | | 5.5 V | 4.94 | | | 4.8 | | |
| | $I_{OH} = -75\text{ mA}^\dagger$ | 5.5 V | | | | 3.85 | | |
| V_{OL} | $I_{OL} = 50\text{ }\mu\text{A}$ | 3 V | | | 0.1 | | 0.1 | V |
| | | 4.5 V | | | 0.1 | | 0.1 | |
| | | 5.5 V | | | 0.1 | | 0.1 | |
| | $I_{OL} = 12\text{ mA}$ | 3 V | | | 0.36 | | 0.44 | |
| | | 4.5 V | | | 0.36 | | 0.44 | |
| | | 5.5 V | | | 0.36 | | 0.44 | |
| | $I_{OL} = 75\text{ mA}^\dagger$ | 5.5 V | | | | | 1.65 | |
| I_I | $V_I = V_{CC}$ or GND | 5.5 V | | | ± 0.1 | | ± 1 | μA |
| I_{OZ} | $V_O = V_{CC}$ or GND | 5.5 V | | | ± 0.5 | | ± 5 | μA |
| I_{CC} | $V_I = V_{CC}$ or GND, $I_O = 0$ | 5.5 V | | | 8 | | 80 | μA |
| C_i | $V_I = V_{CC}$ or GND | 5 V | | 4.5 | | | | pF |

[†] Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

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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°C | | MIN | MAX | UNIT |
|--------------------|-----------------------------|---------------------------|------|------|-----|------|
| | | MIN | MAX | | | |
| f _{clock} | Clock frequency, CCK or RCK | 40 | | 40 | | MHz |
| t _w | Pulse duration | CCK high or low | 6 | 6 | | ns |
| | | RCK high or low | 6 | 6 | | |
| | | RCK high or low | 4.5 | 4.5 | | |
| | | CCLR low | 7.5 | 7.5 | | |
| | | CLOAD low | 6.1 | 6.1 | | |
| t _{su} | Setup time | CCKEN low before CCK↑ | 5.2 | 5.2 | | ns |
| | | CCKEN high before CCK↑ | 6.4 | 6.4 | | |
| | | CCLR high before CCK↑ | 1.7 | 1.7 | | |
| | | CLOAD high before CCK↑ | 8.2 | 8.2 | | |
| | | RCK↑ before CLOAD↑† | 11.1 | 11.1 | | |
| | | Data A thru H before RCK↑ | 2.3 | 2.3 | | |
| t _h | Hold time | Data A thru H after RCK↑ | 0.5 | 0.5 | | ns |
| | | All others | 0.2 | 0.2 | | |

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°C | | MIN | MAX | UNIT |
|--------------------|-----------------------------|---------------------------|-----|-----|-----|------|
| | | MIN | MAX | | | |
| f _{clock} | Clock frequency, CCK or RCK | 70 | | 70 | | MHz |
| t _w | Pulse duration | CCK high or low | 5 | 5 | | ns |
| | | RCK high or low | 5 | 5 | | |
| | | RCK high or low | 4.5 | 4.5 | | |
| | | CCLR low | 5 | 5 | | |
| | | CLOAD low | 4.7 | 4.7 | | |
| t _{su} | Setup time | CCKEN low before CCK↑ | 3.1 | 3.1 | | ns |
| | | CCKEN high before CCK↑ | 4.3 | 4.3 | | |
| | | CCLR high before CCK↑ | 1.1 | 1.1 | | |
| | | CLOAD high before CCK↑ | 5.4 | 5.4 | | |
| | | RCK↑ before CLOAD↑† | 7.8 | 7.8 | | |
| | | Data A thru H before RCK↑ | 2 | 2 | | |
| t _h | Hold time | Data A thru H after RCK↑ | 1.1 | 1.1 | | ns |
| | | All others | 0.8 | 0.8 | | |

[†] This time insures the data saved by $\text{RCK}\uparrow$ will also be loaded into the counter.



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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) | $T_A = 25^\circ\text{C}$ | | | MIN | MAX | UNIT |
|------------------|---------------------------|-------------------------|--------------------------|------|------|------|------|------|
| | | | MIN | TYP | MAX | | | |
| f_{max} | | | 40 | | | 40 | | MHz |
| t_{PLH} | CCK | Q | 6.8 | 14.4 | 19.3 | 6.8 | 22.4 | ns |
| t_{PHL} | | | 6.4 | 14.1 | 18.8 | 6.4 | 21.1 | |
| t_{PLH} | $\overline{\text{CLOAD}}$ | Q | 6.7 | 17.3 | 23.6 | 6.7 | 27.1 | ns |
| t_{PHL} | | | 3.9 | 18.9 | 29.1 | 3.9 | 32.3 | |
| t_{PHL} | $\overline{\text{CCLR}}$ | Q | 5.4 | 13 | 17.6 | 5.4 | 19.8 | ns |
| t_{PZH} | OE | Q | 7.3 | 15.7 | 20.8 | 7.3 | 24.1 | ns |
| t_{PZL} | | | 8 | 17.7 | 23.2 | 8 | 26.7 | |
| t_{PZH} | $\overline{\text{OE}}$ | Q | 6.9 | 15.2 | 20.2 | 6.9 | 23.3 | ns |
| t_{PZL} | | | 7.8 | 17.3 | 22.7 | 7.8 | 26.1 | |
| t_{PHZ} | OE | Q | 6.4 | 10.3 | 13.8 | 6.4 | 15.2 | ns |
| t_{PLZ} | | | 6.6 | 10.8 | 14.1 | 6.6 | 16.1 | |
| t_{PHZ} | $\overline{\text{OE}}$ | Q | 5.7 | 9.6 | 12.8 | 5.7 | 14.1 | ns |
| t_{PLZ} | | | 5.9 | 10.2 | 13.4 | 5.9 | 15.2 | |
| t_{PLH} | CCK | $\overline{\text{RCO}}$ | 5.3 | 12 | 16 | 5.3 | 18.6 | ns |
| t_{PHL} | | | 7.1 | 15.4 | 20.3 | 7.1 | 23.1 | |
| t_{PLH} | $\overline{\text{CLOAD}}$ | $\overline{\text{RCO}}$ | 5.9 | 12.4 | 16.5 | 5.9 | 18.8 | ns |
| t_{PHL} | | | 10.1 | 19.6 | 25.5 | 10.1 | 29.4 | |
| t_{PLH} | $\overline{\text{CCLR}}$ | $\overline{\text{RCO}}$ | 5.6 | 12.3 | 16.6 | 5.6 | 19.2 | ns |
| t_{PLH} | RCK | $\overline{\text{RCO}}$ | 8.6 | 17.3 | 22.2 | 8.6 | 25.8 | ns |
| t_{PHL} | | | 10.3 | 20.3 | 26.2 | 10.3 | 30.3 | |

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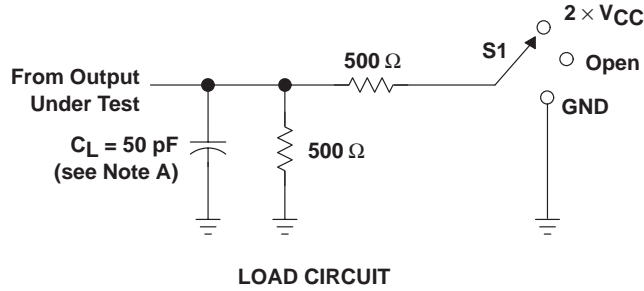
**switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)**

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $T_A = 25^\circ\text{C}$ | | | MIN | MAX | UNIT |
|------------------|---------------------------|-------------------------|--------------------------|------|------|-----|------|------|
| | | | MIN | TYP | MAX | | | |
| f_{max} | | | 70 | | | 70 | | MHz |
| t_{PLH} | CCK | Q | 4.1 | 8.7 | 12.4 | 4.1 | 14.3 | ns |
| t_{PHL} | | | 4.2 | 8.9 | 12.6 | 4.2 | 14.2 | |
| t_{PLH} | $\overline{\text{CLOAD}}$ | Q | 3.7 | 10 | 15.3 | 3.7 | 17.4 | ns |
| t_{PHL} | | | 3.4 | 11.4 | 18.3 | 3.4 | 20.6 | |
| t_{PHL} | $\overline{\text{CCLR}}$ | Q | 3.3 | 7.9 | 11.8 | 3.3 | 13.4 | ns |
| t_{PZH} | OE | Q | 4.1 | 9.1 | 13.2 | 4.1 | 15.3 | ns |
| t_{PZL} | | | 4.1 | 9.4 | 13.8 | 4.1 | 16 | |
| t_{PZH} | $\overline{\text{OE}}$ | Q | 3.8 | 8.7 | 13 | 3.8 | 15 | ns |
| t_{PZL} | | | 3.9 | 9.1 | 13.4 | 3.9 | 15.4 | |
| t_{PHZ} | OE | Q | 4.2 | 7.6 | 10.6 | 4.2 | 11.6 | ns |
| t_{PLZ} | | | 5.3 | 8.8 | 11.8 | 5.3 | 13.1 | |
| t_{PHZ} | $\overline{\text{OE}}$ | Q | 4.4 | 7.3 | 10.1 | 4.4 | 11 | ns |
| t_{PLZ} | | | 5.2 | 8.5 | 11.6 | 5.2 | 13 | |
| t_{PLH} | CCK | $\overline{\text{RCO}}$ | 3.5 | 7.6 | 11.2 | 3.5 | 12.8 | ns |
| t_{PHL} | | | 4.1 | 9.2 | 13.4 | 4.1 | 15.4 | |
| t_{PLH} | $\overline{\text{CLOAD}}$ | $\overline{\text{RCO}}$ | 3.5 | 7.8 | 11.2 | 3.5 | 12.8 | ns |
| t_{PHL} | | | 5.6 | 11.7 | 16.6 | 5.6 | 19 | |
| t_{PLH} | $\overline{\text{CCLR}}$ | $\overline{\text{RCO}}$ | 3.6 | 8 | 11.6 | 3.6 | 13.4 | ns |
| t_{PLH} | RCK | $\overline{\text{RCO}}$ | 5 | 10.3 | 14.4 | 5 | 16.7 | ns |
| t_{PHL} | | | 5.5 | 11.7 | 16.6 | 5.5 | 19.2 | |

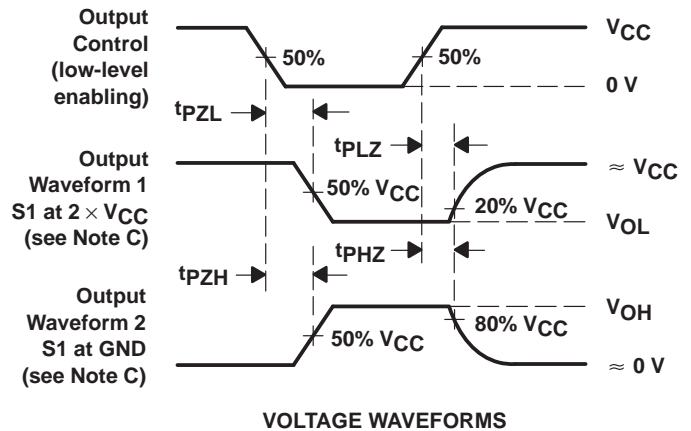
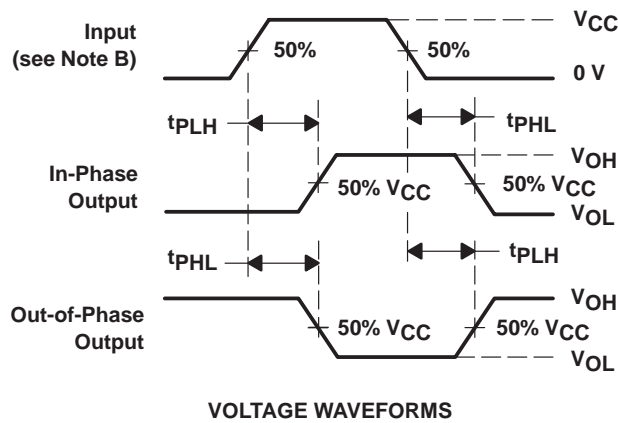
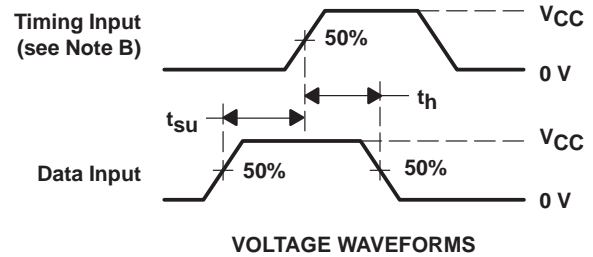
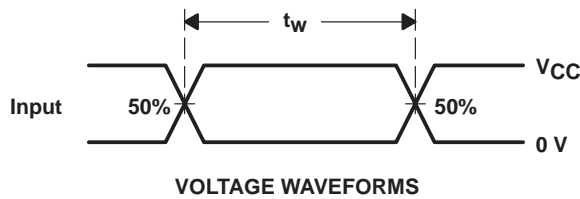
operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | | | TEST CONDITIONS | TYP | UNIT |
|-----------------|-------------------------------|------------------|---|-----|------|
| C_{pd} | Power dissipation capacitance | Outputs enabled | $C_L = 50\text{ pF}$, $f = 1\text{ MHz}$ | 66 | pF |
| | | Outputs disabled | | 15 | |

PARAMETER MEASUREMENT INFORMATION



| TEST | S1 |
|-------------------|-------------------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | 2 $\times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



- NOTES: A. C_L includes probe and jig capacitance.
 B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 3 \text{ ns}$, $t_f = 3 \text{ ns}$.
 C. 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.
 D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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