

DATA SHEET

For a complete data sheet, please also download:

- The IC06 74HC/HCT/HCU/HCMOS Logic Family Specifications
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Information
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Outlines

74HC/HCT299

8-bit universal shift register; 3-state

Product specification
File under Integrated Circuits, IC06

December 1990

8-bit universal shift register; 3-state

74HC/HCT299

FEATURES

- Multiplexed inputs/outputs provide improved bit density
- Four operating modes:
 - shift left
 - shift right
 - hold (store)
 - load data
- Operates with output enable or at high-impedance OFF-state (Z)
- 3-state outputs drive bus lines directly
- Can be cascaded for n-bits word length
- Output capability: bus driver (parallel I/Os), standard (serial outputs)
- I_{CC} category: MSI

GENERAL DESCRIPTION

The 74HC/HCT299 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT299 contain eight edge-triggered D-type flip-flops and the interstage logic necessary to perform synchronous shift-right, shift-left, parallel load and hold operations. The type of operation is determined by the mode select inputs (S₀ and S₁), as shown in the mode select table.

All flip-flop outputs have 3-state buffers to separate these outputs (I/O₀ to I/O₇) such, that they can serve as data inputs in the parallel load mode. The serial outputs (Q₀ and Q₇) are used for expansion in serial shifting of longer words.

A LOW signal on the asynchronous master reset input ($\overline{\text{MR}}$) overrides the S_n and clock (CP) inputs and resets the flip-flops. All other state changes are initiated by the rising edge of the clock pulse. Inputs can change when the clock is either state, provided that the recommended set-up and hold times, relative to the rising edge of CP, are observed.

A HIGH signal on the 3-state output enable inputs ($\overline{\text{OE}}_1$ or $\overline{\text{OE}}_2$) disables the 3-state buffers and the I/O_n outputs are set to the high-impedance OFF-state. In this condition, the shift, hold, load and reset operations can still occur. The 3-state buffers are also disabled by HIGH signals on both S₀ and S₁, when in preparation for a parallel load operation.

QUICK REFERENCE DATA

GND = 0 V; T_{amb} = 25 °C; t_r = t_f = 6 ns

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | | UNIT |
|-------------------------------------|--|---|---------|-----|------|
| | | | HC | HCT | |
| t _{PHL} / t _{PLH} | propagation delay CP to Q ₀ , Q ₇ CP to I/O _n | C _L = 15 pF; V _{CC} = 5 V | 20 | 19 | ns |
| t _{PHL} | $\overline{\text{MR}}$ to Q ₀ , Q ₇ or I/O _n | | 20 | 19 | ns |
| f _{max} | maximum clock frequency | | 20 | 23 | ns |
| C _I | input capacitance | | 50 | 46 | MHz |
| C _{I/O} | input/output capacitance | | 3.5 | 3.5 | pF |
| C _{PD} | power dissipation capacitance per package | notes 1 and 2 | 10 | 10 | pF |
| | | | 120 | 125 | pF |

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz

f_o = output frequency in MHz

∑ (C_L × V_{CC}² × f_o) = sum of outputs

C_L = output load capacitance in pF

V_{CC} = supply voltage in V

2. For HC the condition is V_I = GND to V_{CC}
For HCT the condition is V_I = GND to V_{CC} – 1.5 V

ORDERING INFORMATION

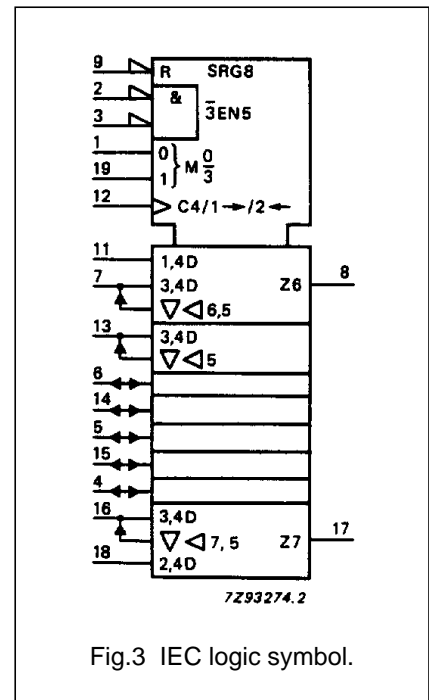
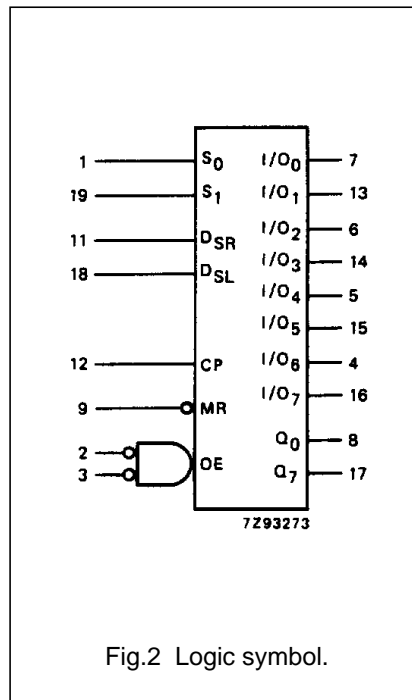
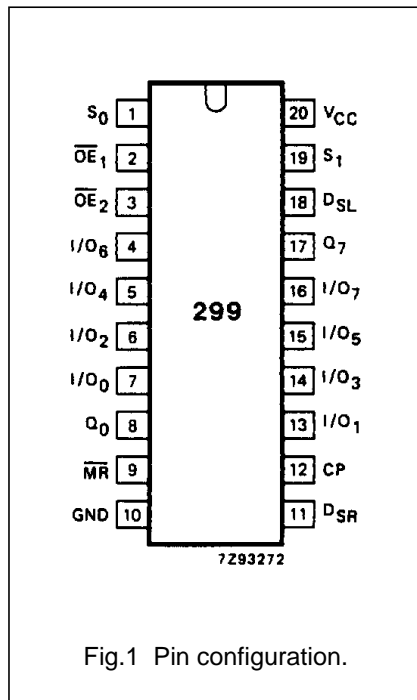
See "74HC/HCT/HCU/HCMOS Logic Package Information".

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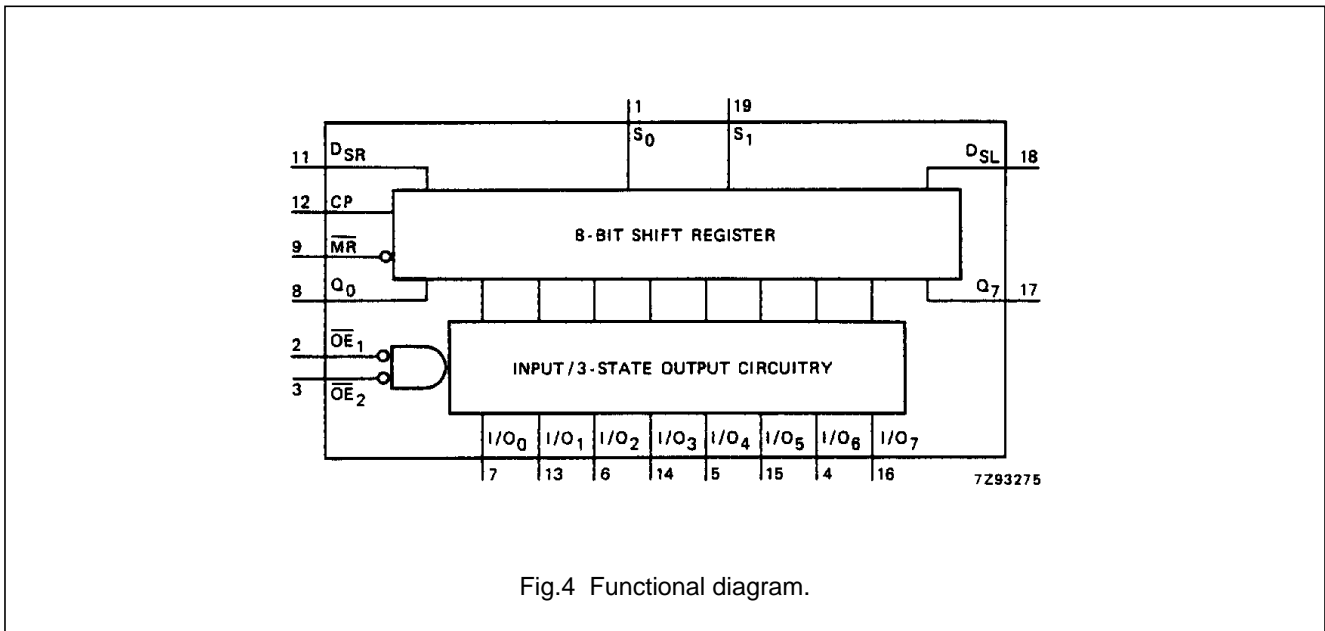
PIN DESCRIPTION

| PIN NO. | SYMBOL | NAME AND FUNCTION |
|----------------------------|--------------------------------------|---|
| 1, 19 | S_0, S_1 | mode select inputs |
| 2, 3 | $\overline{OE}_1, \overline{OE}_2$ | 3-state output enable inputs (active LOW) |
| 7, 13, 6, 14, 5, 15, 4, 16 | I/O ₀ to I/O ₇ | parallel data inputs or 3-state parallel outputs (bus driver) |
| 8, 17 | Q ₀ , Q ₇ | serial outputs (standard output) |
| 9 | \overline{MR} | asynchronous master reset input (active LOW) |
| 10 | GND | ground (0 V) |
| 11 | D _{SR} | serial data shift-right input |
| 12 | CP | clock input (LOW-to-HIGH, edge-triggered) |
| 18 | D _{SL} | serial data shift-left input |
| 20 | V _{CC} | positive supply voltage |



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MODE SELECT TABLE

| INPUTS | | | | RESPONSE |
|--------|----------------|----------------|----|--|
| MR | S ₁ | S ₀ | CP | |
| L | X | X | X | asynchronous reset; Q ₀ -Q ₇ = LOW |
| H | H | H | ↑ | parallel load; I/O _n → Q _n |
| H | L | H | ↑ | shift right; D _{SR} → Q ₀ , Q ₀ → Q ₁ etc. |
| H | H | L | ↑ | shift left; D _{SL} → Q ₇ , Q ₇ → Q ₆ etc. |
| H | L | L | X | hold |

Notes

- H = HIGH voltage level
 L = LOW voltage level
 X = don't care
 ↑ = LOW-to-HIGH CP transition

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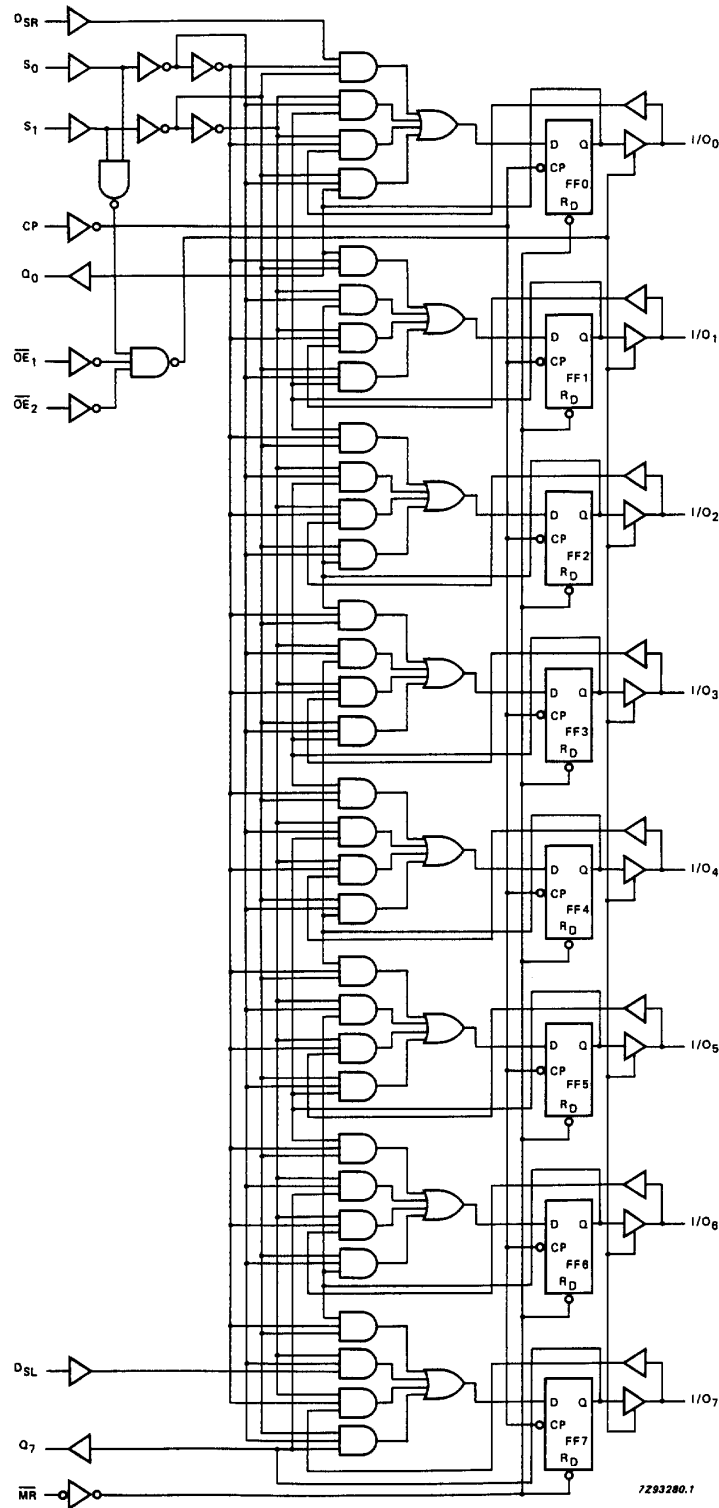


Fig.5 Logic diagram.

8-bit universal shift register; 3-state

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DC CHARACTERISTICS FOR 74HC

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*.

Output capability: bus driver (parallel I/Os)
standard (serial outputs)

I_{CC} category: MSI

AC CHARACTERISTICS FOR 74HC

GND = 0 V; t_r = t_f = 6 ns; C_L = 50 pF

| SYMBOL | PARAMETER | T _{amb} (°C) | | | | | | UNIT | TEST CONDITIONS | | |
|-------------------------------------|--|-----------------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------------|-------------------|-------|
| | | 74HC | | | | | | | V _{CC} (V) | WAVEFORMS | |
| | | +25 | | | -40 to +85 | | -40 to +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | | | | max. |
| t _{PHL} / t _{PLH} | propagation delay CP to Q ₀ , Q ₇ | | 66 24 19 | 200 40 34 | | 250 50 43 | | 300 60 51 | ns | 2.0 4.5 6.0 | Fig.6 |
| t _{PHL} / t _{PLH} | propagation delay CP to I/O _n | | 66 24 19 | 200 40 34 | | 250 50 43 | | 300 60 51 | ns | 2.0 4.5 6.0 | Fig.6 |
| t _{PHL} | propagation delay MR to Q ₀ , Q ₇ or I/O _n | | 66 24 19 | 200 40 34 | | 250 50 43 | | 300 60 51 | ns | 2.0 4.5 6.0 | Fig.7 |
| t _{PZH} | 3-state output enable time \overline{OE}_n to I/O _n | | 50 18 14 | 155 31 26 | | 195 39 33 | | 235 47 40 | ns | 2.0 4.5 6.0 | Fig.9 |
| t _{PZL} | 3-state output enable time \overline{OE}_n to I/O _n | | 41 15 12 | 130 26 22 | | 165 33 28 | | 195 39 33 | ns | 2.0 4.5 6.0 | Fig.9 |
| t _{PHZ} | 3-state output disable time \overline{OE}_n to I/O _n | | 66 24 19 | 185 37 31 | | 230 46 39 | | 280 56 48 | ns | 2.0 4.5 6.0 | Fig.9 |
| t _{PLZ} | 3-state output disable time \overline{OE}_n to I/O _n | | 55 20 16 | 155 31 26 | | 195 39 33 | | 235 47 40 | ns | 2.0 4.5 6.0 | Fig.9 |
| t _{THL} / t _{TLH} | output transition time bus driver (I/O _n) | | 14 5 4 | 60 12 10 | | 75 15 13 | | 90 18 15 | ns | 2.0 4.5 6.0 | Fig.6 |
| t _{THL} / t _{TLH} | output transition time standard (Q ₀ , Q ₇) | | 19 7 6 | 75 15 13 | | 95 19 16 | | 110 22 19 | ns | 2.0 4.5 6.0 | Fig.6 |
| t _w | clock pulse width HIGH or LOW | 80 16 14 | 17 6 5 | | 100 20 17 | | 120 24 20 | | ns | 2.0 4.5 6.0 | Fig.6 |
| t _w | master reset pulse width LOW | 80 16 14 | 19 7 6 | | 100 20 17 | | 120 24 20 | | ns | 2.0 4.5 6.0 | Fig.7 |

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| SYMBOL | PARAMETER | T _{amb} (°C) | | | | | | UNIT | TEST CONDITIONS | | |
|------------------|---|-----------------------|------|------|------------|------|-------------|------|------------------------|-----------|-------|
| | | 74HC | | | | | | | V _{CC} (V) | WAVEFORMS | |
| | | +25 | | | -40 to +85 | | -40 to +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | | | | max. |
| t _{rem} | removal time MR to CP | 5 | -14 | | 5 | | 5 | | ns | 2.0 | Fig.7 |
| | | 5 | -5 | | 5 | | 5 | | | 4.5 | |
| | | 5 | -4 | | 5 | | 5 | | | 6.0 | |
| t _{su} | set-up time D _{SR} , D _{SL} to CP | 100 | 33 | | 125 | | 150 | | ns | 2.0 | Fig.6 |
| | | 20 | 12 | | 25 | | 30 | | | 4.5 | |
| | | 17 | 10 | | 21 | | 26 | | | 6.0 | |
| t _{su} | set-up time S ₀ , S ₁ to CP | 100 | 33 | | 125 | | 150 | | ns | 2.0 | Fig.8 |
| | | 20 | 12 | | 25 | | 30 | | | 4.5 | |
| | | 17 | 10 | | 21 | | 26 | | | 6.0 | |
| t _{su} | set-up time I/O _n to CP | 125 | 39 | | 155 | | 190 | | ns | 2.0 | Fig.6 |
| | | 25 | 14 | | 31 | | 38 | | | 4.5 | |
| | | 21 | 11 | | 26 | | 32 | | | 6.0 | |
| t _h | hold time I/O _n , D _{SR} , D _{SL} to CP | 0 | -14 | | 0 | | 0 | | ns | 2.0 | Fig.6 |
| | | 0 | -5 | | 0 | | 0 | | | 4.5 | |
| | | 0 | -4 | | 0 | | 0 | | | 6.0 | |
| t _h | hold time S ₀ , S ₁ to CP | 0 | -28 | | 0 | | 0 | | ns | 2.0 | Fig.8 |
| | | 0 | -10 | | 0 | | 0 | | | 4.5 | |
| | | 0 | -8 | | 0 | | 0 | | | 6.0 | |
| f _{max} | maximum clock pulse frequency | 5.0 | 15 | | 4.0 | | 3.4 | | MHz | 2.0 | Fig.6 |
| | | 25 | 45 | | 20 | | 17 | | | 4.5 | |
| | | 29 | 54 | | 24 | | 20 | | | 6.0 | |

8-bit universal shift register; 3-state**74HC/HCT299**

DC CHARACTERISTICS FOR 74HCT

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*.

Output capability: bus driver (parallel I/Os)
standard (serial outputs)

I_{CC} category: MSI

Note to HCT types

The value of additional quiescent supply current (ΔI_{CC}) for unit load of 1 is given in the family specifications. To determine ΔI_{CC} per input, multiply this value by the unit load coefficient shown in the table below.

| INPUT | UNIT LOAD COEFFICIENT |
|-----------------------------------|-----------------------|
| I/O _n | 0.25 |
| D _{SR} , D _{SL} | 0.25 |
| CP, S ₀ | 0.60 |
| \overline{MR} , S ₁ | 0.25 |
| \overline{OE}_n | 0.30 |

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AC CHARACTERISTICS FOR 74HCT

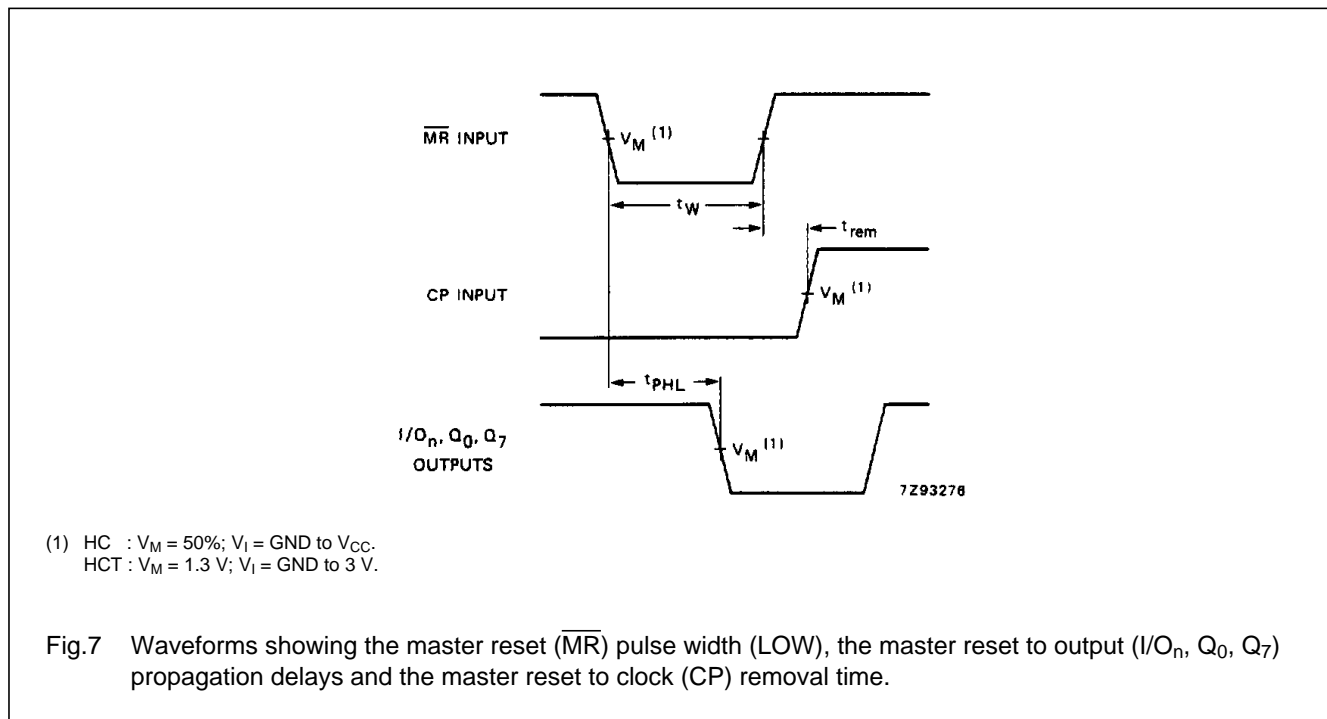
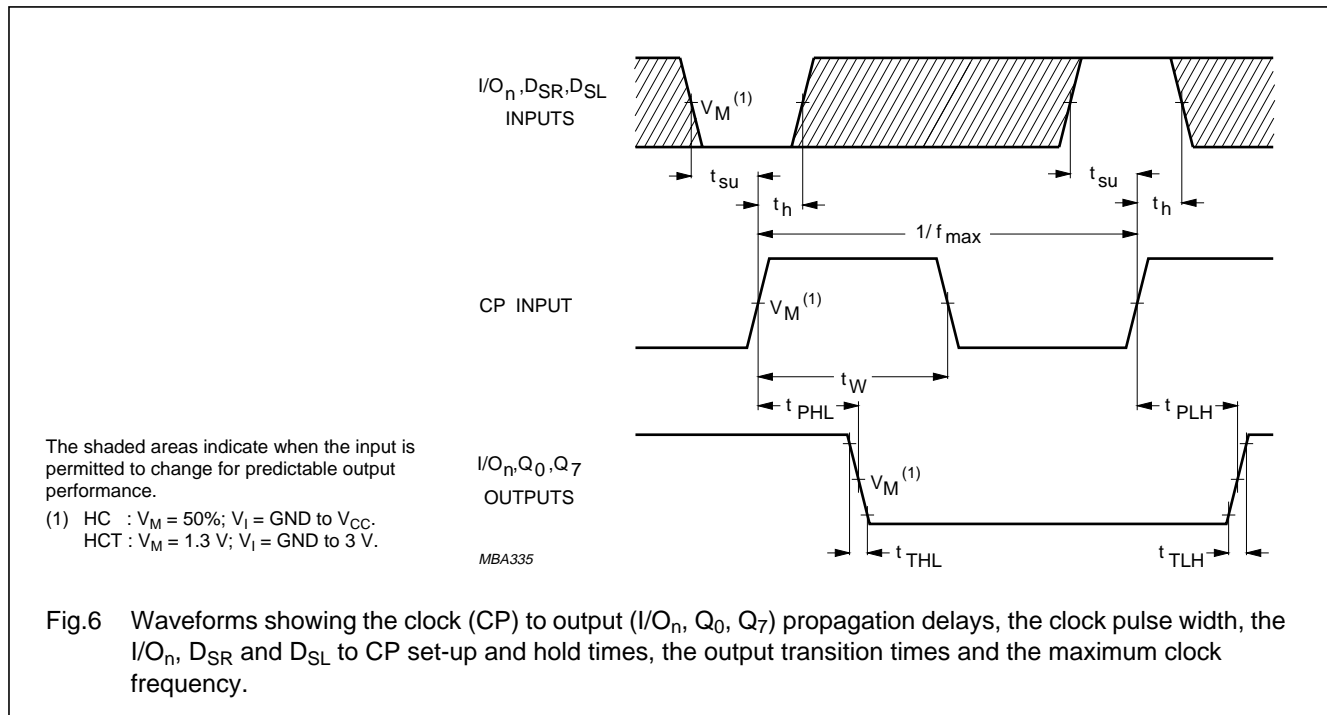
GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

| SYMBOL | PARAMETER | T _{amb} (°C) | | | | | | UNIT | TEST CONDITIONS | | |
|-------------------------------------|---|-----------------------|------|------|------------|------|-------------|------|------------------------|-----------|-------|
| | | 74HCT | | | | | | | V _{CC} (V) | WAVEFORMS | |
| | | +25 | | | -40 to +85 | | -40 to +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | | | | max. |
| t _{PHL} / t _{PLH} | propagation delay CP to Q ₀ , Q ₇ | | 22 | 37 | | 46 | | 56 | ns | 4.5 | Fig.6 |
| t _{PHL} / t _{PLH} | propagation delay CP to I/O _n | | 22 | 37 | | 46 | | 56 | ns | 4.5 | Fig.6 |
| t _{PHL} | propagation delay \overline{MR} to Q ₀ , Q ₇ or I/O _n | | 27 | 46 | | 58 | | 69 | ns | 4.5 | Fig.7 |
| t _{PZH} / t _{PZL} | 3-state output enable time \overline{OE}_n to I/O _n | | 19 | 30 | | 38 | | 45 | ns | 4.5 | Fig.9 |
| t _{PHZ} | 3-state output disable time \overline{OE}_n to I/O _n | | 24 | 37 | | 46 | | 56 | ns | 4.5 | Fig.9 |
| t _{PLZ} | 3-state output disable time \overline{OE}_n to I/O _n | | 20 | 32 | | 40 | | 48 | ns | 4.5 | Fig.9 |
| t _{THL} / t _{TLH} | output transition time bus driver (I/O _n) | | 5 | 12 | | 15 | | 18 | ns | 4.5 | Fig.6 |
| t _{THL} / t _{TLH} | output transition time standard (Q ₀ , Q ₇) | | 7 | 15 | | 19 | | 22 | ns | 4.5 | Fig.6 |
| t _W | clock pulse width HIGH or LOW | 20 | 10 | | 25 | | 30 | | ns | 4.5 | Fig.6 |
| t _W | master reset pulse width LOW | 20 | 11 | | 25 | | 30 | | ns | 4.5 | Fig.7 |
| t _{rem} | removal time MR to CP | 10 | 2 | | 9 | | 11 | | ns | 4.5 | Fig.7 |
| t _{su} | set-up time I/O _n , D _{SR} , D _{SL} to CP | 25 | 14 | | 31 | | 38 | | ns | 4.5 | Fig.6 |
| t _{su} | set-up time S ₀ , S ₁ to CP | 32 | 18 | | 40 | | 48 | | ns | 4.5 | Fig.8 |
| t _h | hold time I/O _n , D _{SR} , D _{SL} to CP | 0 | -11 | | 0 | | 0 | | ns | 4.5 | Fig.6 |
| t _h | hold time S ₀ , S ₁ to CP | 0 | -17 | | 0 | | 0 | | ns | 4.5 | Fig.8 |
| f _{max} | maximum clock pulse frequency | 25 | 42 | | 20 | | 17 | | MHz | 4.5 | Fig.6 |

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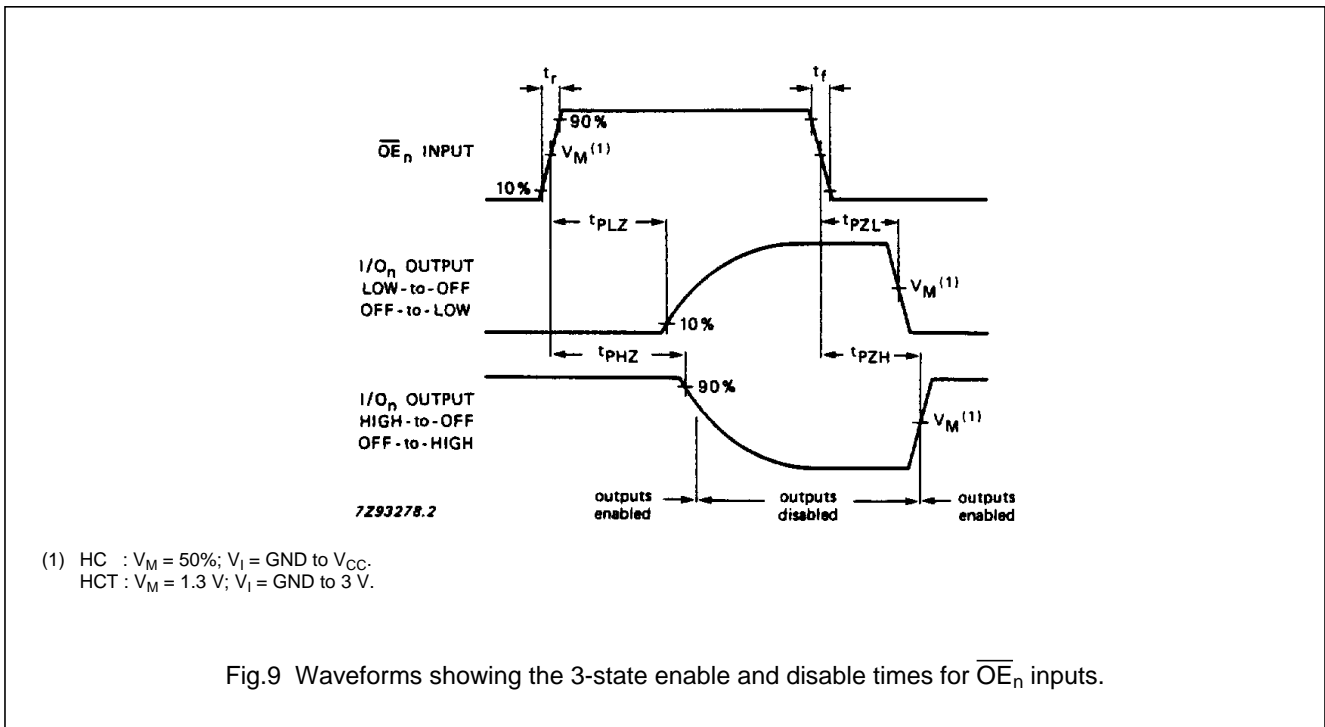
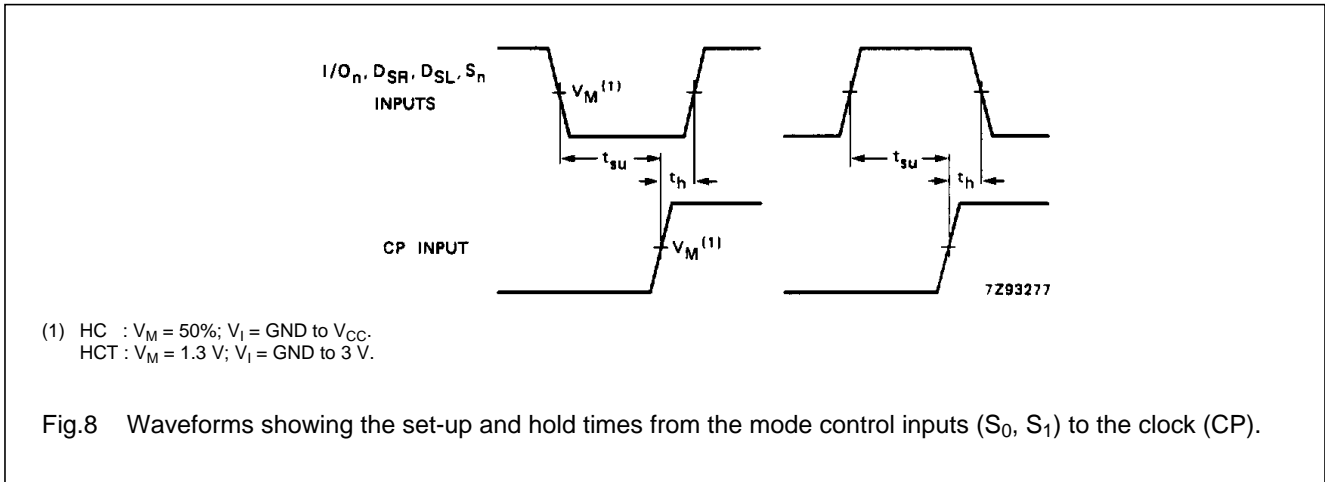
74HC/HCT299

AC WAVEFORMS



8-bit universal shift register; 3-state

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PACKAGE OUTLINES

See "74HC/HCT/HCU/HCMOS Logic Package Outlines".