

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74HC373AP, TC74HC373AF

### Octal D-Type Latch with 3-State Output

The TC74HC373A is a high speed CMOS OCTAL LATCH with 3-STATE OUTPUT fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

These 8-bit D-type latches are controlled by a latch enable input (LE) and an output enable input ( $\overline{OE}$ ).

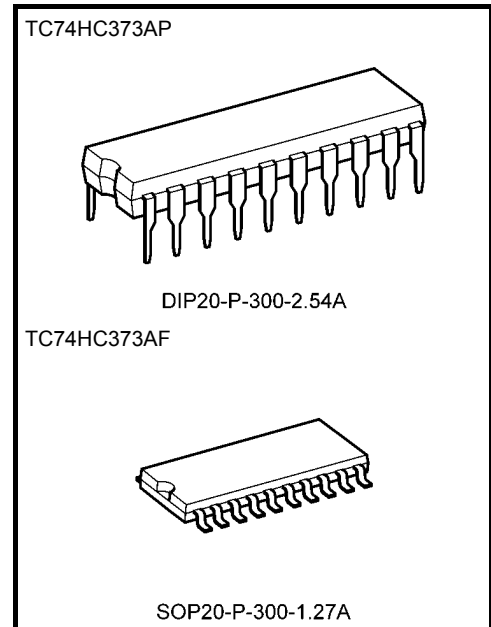
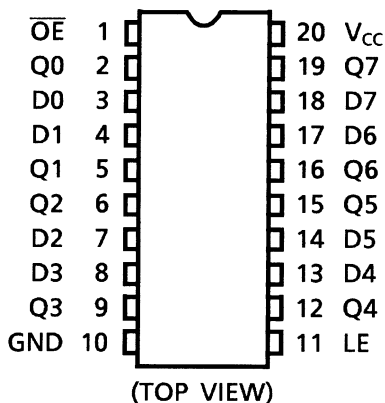
When the  $\overline{OE}$  input is high, the eight outputs are in a high impedance state.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### Features

- High speed:  $t_{pd} = 11 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability: 15 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 6 \text{ mA}$  (min)
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} (\text{opr}) = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS373

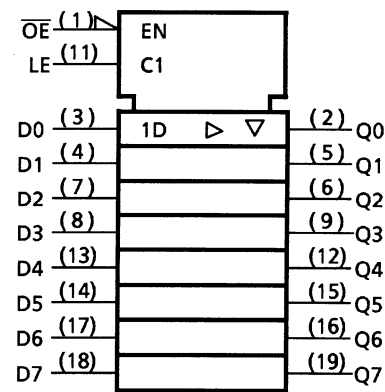
### Pin Assignment



|                   |                 |
|-------------------|-----------------|
| Weight            |                 |
| DIP20-P-300-2.54A | : 1.30 g (typ.) |
| SOP20-P-300-1.27A | : 0.22 g (typ.) |

Start of commercial production  
1986-05

IEC Logic Symbol



Truth Table

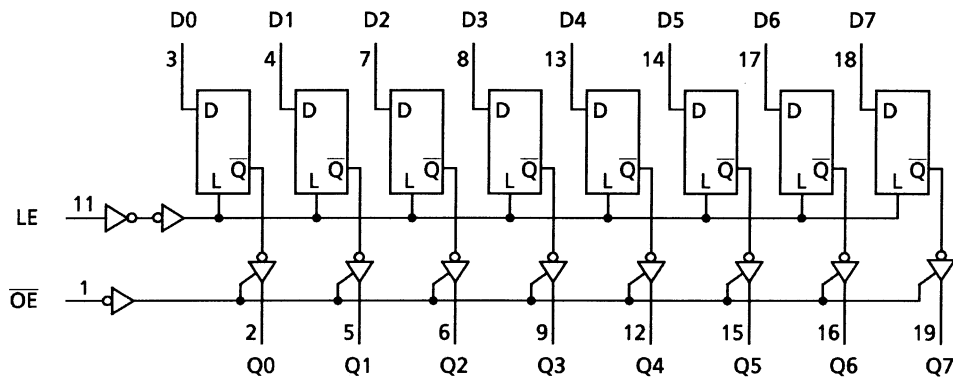
| Inputs          |      |   | Output |
|-----------------|------|---|--------|
| $\overline{OE}$ | $LE$ | D | Q      |
| H               | X    | X | Z      |
| L               | L    | X | $Q_n$  |
| L               | H    | L | L      |
| L               | H    | H | H      |

X: Don't care

Z: High impedance

$Q_n$ : Q outputs are latched at the time when the  $LE$  input is taken to a low logic level.

System Diagram



## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit |
|-----------------------------|-----------|------------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7                    | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$       | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$       | V    |
| Input diode current         | $I_{IK}$  | $\pm 20$                     | mA   |
| Output diode current        | $I_{OK}$  | $\pm 20$                     | mA   |
| DC output current           | $I_{OUT}$ | $\pm 35$                     | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 75$                     | mA   |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW   |
| Storage temperature         | $T_{stg}$ | -65 to 150                   | °C   |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^\circ\text{C}$ . From  $T_a = 65$  to  $85^\circ\text{C}$  a derating factor of  $-10\text{ mW}/^\circ\text{C}$  shall be applied until 300 mW.

## Operating Ranges (Note)

| Characteristics          | Symbol     | Rating                                                                                                                | Unit |
|--------------------------|------------|-----------------------------------------------------------------------------------------------------------------------|------|
| Supply voltage           | $V_{CC}$   | 2 to 6                                                                                                                | V    |
| Input voltage            | $V_{IN}$   | 0 to $V_{CC}$                                                                                                         | V    |
| Output voltage           | $V_{OUT}$  | 0 to $V_{CC}$                                                                                                         | V    |
| Operating temperature    | $T_{opr}$  | -40 to 85                                                                                                             | °C   |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0\text{ V}$ )<br>0 to 500 ( $V_{CC} = 4.5\text{ V}$ )<br>0 to 400 ( $V_{CC} = 6.0\text{ V}$ ) | ns   |

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

## DC Characteristics

| Characteristics                     | Symbol          | Test Condition                                                                                    |                          | Ta = 25°C           |                      |             | Ta =<br>−40 to 85°C  |                      | Unit |     |
|-------------------------------------|-----------------|---------------------------------------------------------------------------------------------------|--------------------------|---------------------|----------------------|-------------|----------------------|----------------------|------|-----|
|                                     |                 |                                                                                                   |                          | V <sub>CC</sub> (V) | Min                  | Typ.        | Max                  | Min                  |      | Max |
| High-level input voltage            | V <sub>IH</sub> | —                                                                                                 |                          | 2.0<br>4.5<br>6.0   | 1.50<br>3.15<br>4.20 | —<br>—<br>— | —<br>—<br>—          | 1.50<br>3.15<br>4.20 | V    |     |
| Low-level input voltage             | V <sub>IL</sub> | —                                                                                                 |                          | 2.0<br>4.5<br>6.0   | —<br>—<br>—          | —<br>—<br>— | 0.50<br>1.35<br>1.80 | —<br>—<br>—          | V    |     |
| High-level output voltage           | V <sub>OH</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or V <sub>IL</sub>                                           | I <sub>OH</sub> = −20 μA | 2.0                 | 1.9                  | 2.0         | —                    | 1.9                  | —    | V   |
|                                     |                 |                                                                                                   |                          | 4.5                 | 4.4                  | 4.5         | —                    | 4.4                  | —    |     |
|                                     |                 |                                                                                                   |                          | 6.0                 | 5.9                  | 6.0         | —                    | 5.9                  | —    |     |
|                                     |                 |                                                                                                   | I <sub>OH</sub> = −6 mA  | 4.5                 | 4.18                 | 4.31        | —                    | 4.13                 | —    |     |
| I <sub>OH</sub> = −7.8 mA           | 6.0             | 5.68                                                                                              |                          | 5.80                | —                    | 5.63        | —                    |                      |      |     |
| Low-level output voltage            | V <sub>OL</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or V <sub>IL</sub>                                           | I <sub>OL</sub> = 20 μA  | 2.0                 | —                    | 0.0         | 0.1                  | —                    | 0.1  | V   |
|                                     |                 |                                                                                                   |                          | 4.5                 | —                    | 0.0         | 0.1                  | —                    | 0.1  |     |
|                                     |                 |                                                                                                   |                          | 6.0                 | —                    | 0.0         | 0.1                  | —                    | 0.1  |     |
|                                     |                 |                                                                                                   | I <sub>OL</sub> = 6 mA   | 4.5                 | —                    | 0.17        | 0.26                 | —                    | 0.33 |     |
| I <sub>OL</sub> = 7.8 mA            | 6.0             | —                                                                                                 |                          | 0.18                | 0.26                 | —           | 0.33                 |                      |      |     |
| 3-state output<br>off-state current | I <sub>OZ</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND |                          | 6.0                 | —                    | —           | ±0.5                 | —                    | ±5.0 | μA  |
| Input leakage<br>current            | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                          |                          | 6.0                 | —                    | —           | ±0.1                 | —                    | ±1.0 | μA  |
| Quiescent supply<br>current         | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                          |                          | 6.0                 | —                    | —           | 4.0                  | —                    | 40.0 | μA  |

Timing Requirements (input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Characteristics          | Symbol             | Test Condition |  | Ta = 25°C           |      | Ta = -40 to 85°C | Unit |
|--------------------------|--------------------|----------------|--|---------------------|------|------------------|------|
|                          |                    |                |  | V <sub>CC</sub> (V) | Typ. | Limit            |      |
| Minimum pulse width (LE) | t <sub>W</sub> (H) | —              |  | 2.0                 | —    | 75               | 95   |
|                          |                    |                |  | 4.5                 | —    | 15               | 19   |
|                          |                    |                |  | 6.0                 | —    | 13               | 16   |
| Minimum set-up time (Dn) | t <sub>s</sub>     | —              |  | 2.0                 | —    | 50               | 65   |
|                          |                    |                |  | 4.5                 | —    | 10               | 13   |
|                          |                    |                |  | 6.0                 | —    | 9                | 11   |
| Minimum hold time (Dn)   | t <sub>h</sub>     | —              |  | 2.0                 | —    | 5                | 5    |
|                          |                    |                |  | 4.5                 | —    | 5                | 5    |
|                          |                    |                |  | 6.0                 | —    | 5                | 5    |

## AC Characteristics (input: $t_r = t_f = 6 \text{ ns}$ )

| Characteristics                  | Symbol                 | Test Condition            |         |                     | Ta = 25°C |      |     | Ta = -40 to 85°C |     | Unit |
|----------------------------------|------------------------|---------------------------|---------|---------------------|-----------|------|-----|------------------|-----|------|
|                                  |                        |                           | CL (pF) | V <sub>CC</sub> (V) | Min       | Typ. | Max | Min              | Max |      |
| Output transition time           | $t_{TLH}$<br>$t_{THL}$ | —                         | 50      | 2.0                 | —         | 20   | 60  | —                | 75  | ns   |
|                                  |                        |                           |         | 4.5                 | —         | 6    | 12  | —                | 15  |      |
|                                  |                        |                           |         | 6.0                 | —         | 5    | 10  | —                | 13  |      |
| Propagation delay time<br>(LE-Q) | $t_{pLH}$<br>$t_{pHL}$ | —                         | 50      | 2.0                 | —         | 42   | 125 | —                | 155 | ns   |
|                                  |                        |                           |         | 4.5                 | —         | 14   | 25  | —                | 31  |      |
|                                  |                        |                           |         | 6.0                 | —         | 12   | 21  | —                | 26  |      |
|                                  |                        |                           | 150     | 2.0                 | —         | 57   | 175 | —                | 220 |      |
|                                  |                        |                           |         | 4.5                 | —         | 19   | 35  | —                | 44  |      |
|                                  |                        |                           |         | 6.0                 | —         | 16   | 30  | —                | 37  |      |
| Propagation delay time<br>(D-Q)  | $t_{pLH}$<br>$t_{pHL}$ | —                         | 50      | 2.0                 | —         | 42   | 125 | —                | 155 | ns   |
|                                  |                        |                           |         | 4.5                 | —         | 14   | 25  | —                | 31  |      |
|                                  |                        |                           |         | 6.0                 | —         | 12   | 21  | —                | 26  |      |
|                                  |                        |                           | 150     | 2.0                 | —         | 57   | 175 | —                | 220 |      |
|                                  |                        |                           |         | 4.5                 | —         | 19   | 35  | —                | 44  |      |
|                                  |                        |                           |         | 6.0                 | —         | 16   | 30  | —                | 37  |      |
| Output enable time               | $t_{pZL}$<br>$t_{pZH}$ | $R_L = 1 \text{ k}\Omega$ | 50      | 2.0                 | —         | 39   | 125 | —                | 155 | ns   |
|                                  |                        |                           |         | 4.5                 | —         | 13   | 25  | —                | 31  |      |
|                                  |                        |                           |         | 6.0                 | —         | 11   | 21  | —                | 26  |      |
|                                  |                        |                           | 150     | 2.0                 | —         | 54   | 175 | —                | 220 |      |
|                                  |                        |                           |         | 4.5                 | —         | 18   | 35  | —                | 44  |      |
|                                  |                        |                           |         | 6.0                 | —         | 15   | 30  | —                | 37  |      |
| Output disable time              | $t_{pLZ}$<br>$t_{pHZ}$ | $R_L = 1 \text{ k}\Omega$ | 50      | 2.0                 | —         | 30   | 125 | —                | 155 | ns   |
|                                  |                        |                           |         | 4.5                 | —         | 14   | 25  | —                | 31  |      |
|                                  |                        |                           |         | 6.0                 | —         | 13   | 21  | —                | 26  |      |
| Input capacitance                | $C_{IN}$               | —                         | —       | —                   | —         | 5    | 10  | —                | 10  | pF   |
| Output capacitance               | $C_{OUT}$              | —                         | —       | —                   | —         | 10   | —   | —                | —   | pF   |
| Power dissipation capacitance    | $C_{PD}$<br>(Note)     | —                         | —       | —                   | —         | 38   | —   | —                | —   | pF   |

Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per latch)}$$

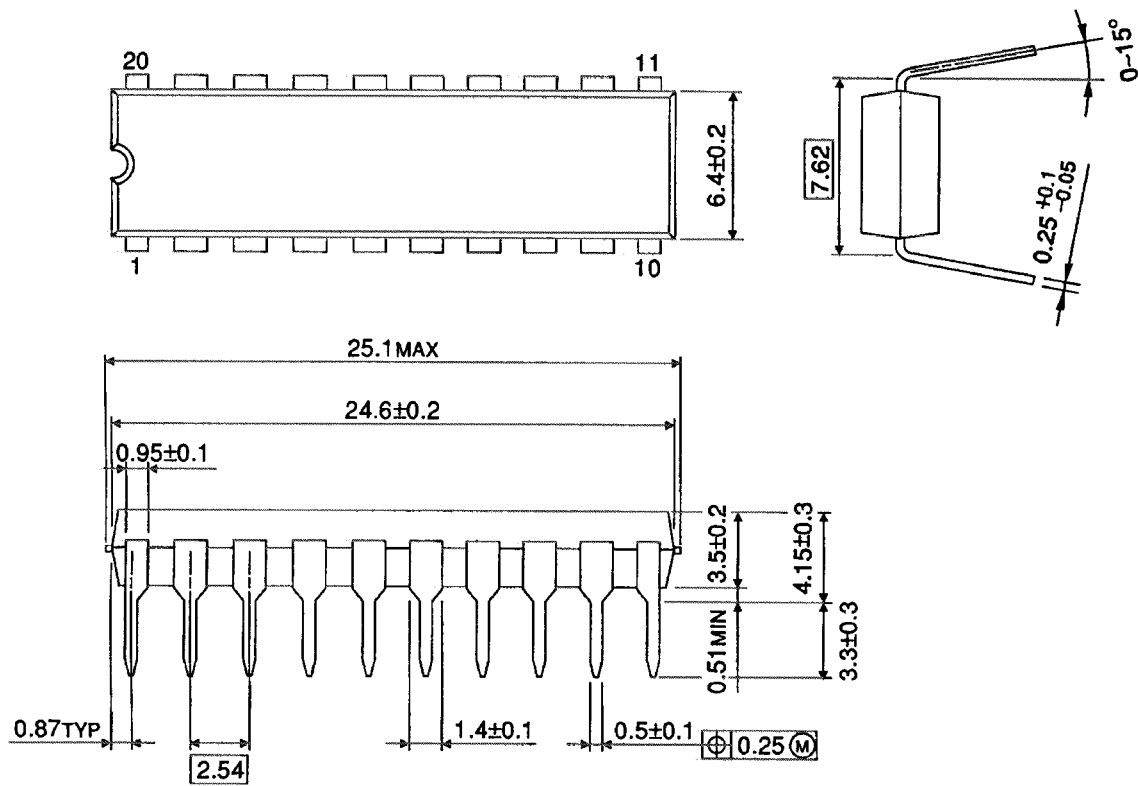
And the total  $C_{PD}$  when n pcs. of latch operate can be gained by the following equation:

$$C_{PD}(\text{total}) = 22 + 16 \cdot n$$

## Package Dimensions

DIP20-P-300-2.54A

Unit : mm

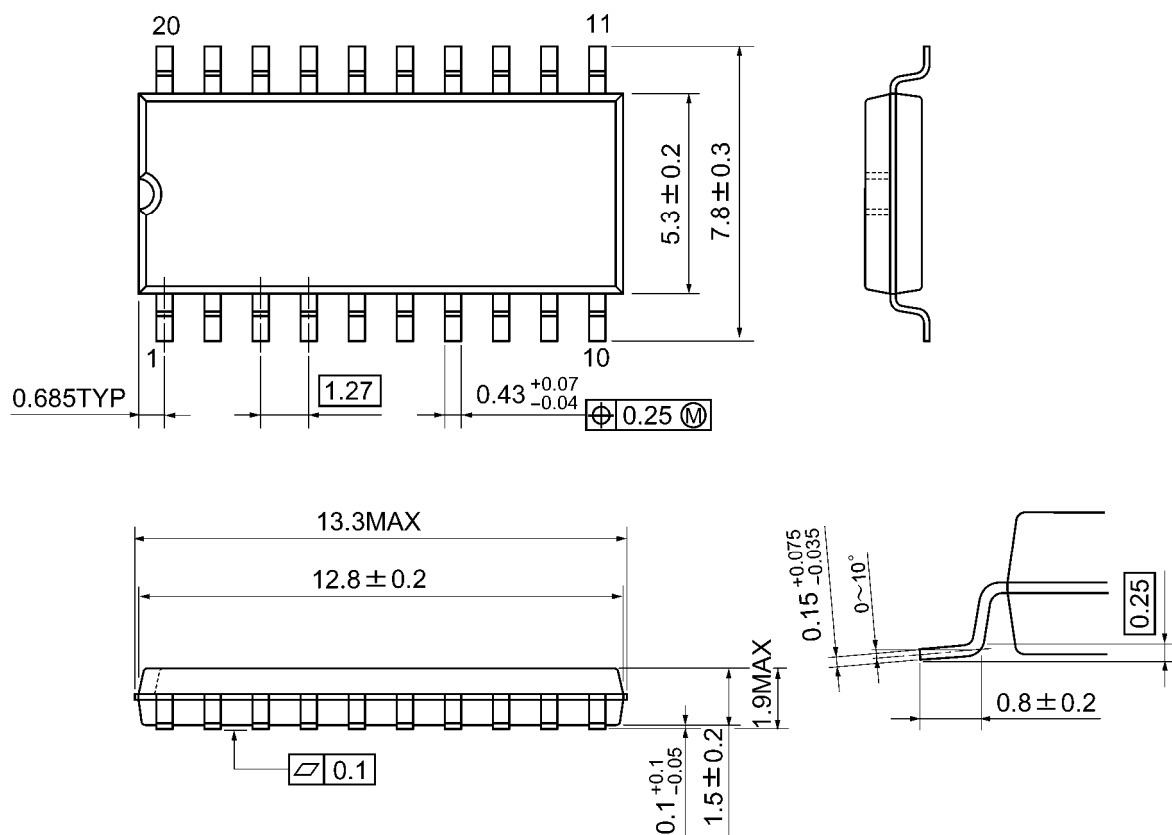


Weight: 1.30 g (typ.)

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)

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