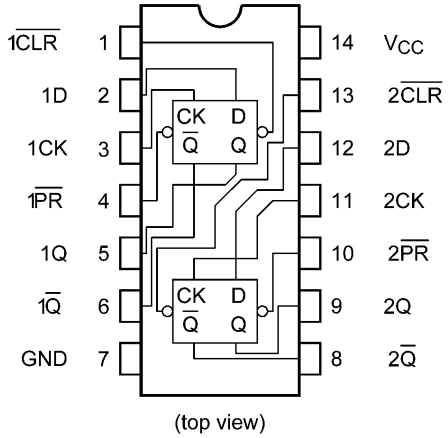
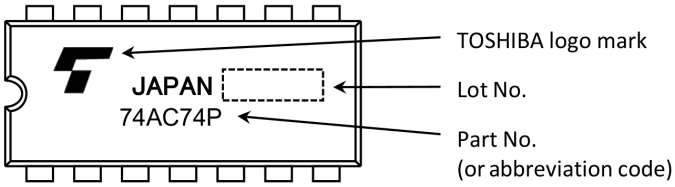
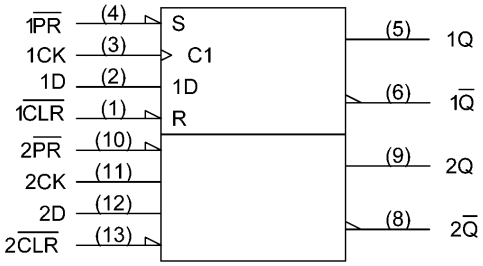
## 5. Pin Assignment




## 6. Marking




## 7. IEC Logic Symbol

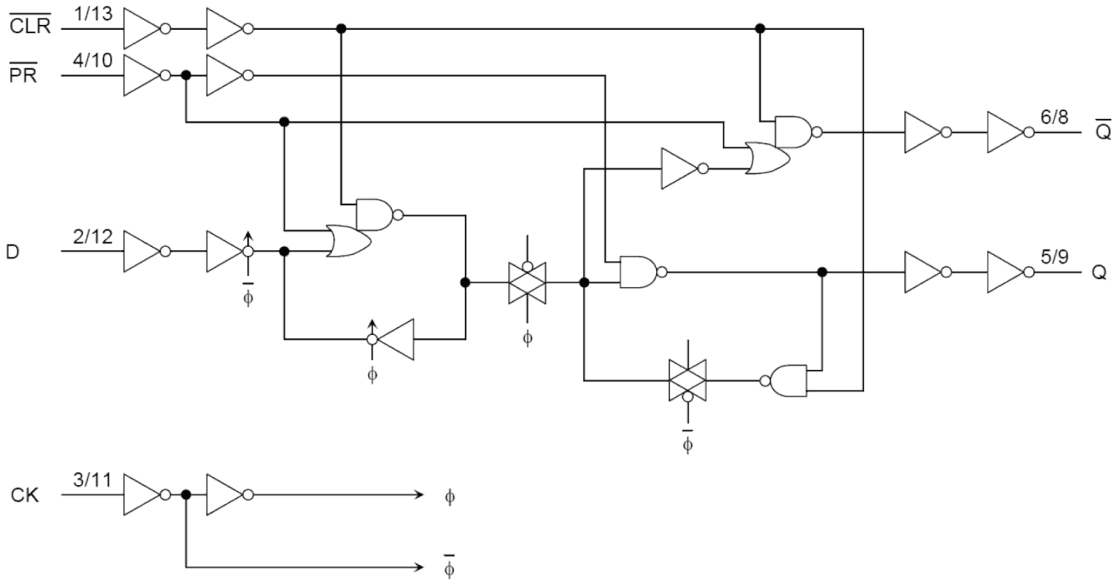



## 8. Truth Table

| Inputs | | | | Outputs | | Function |
|---|---|---|---|---|---|---|
| $\overline{CLR}$ | $\overline{PR}$ | D | CK | Q | $\overline{Q}$ | |
| L | H | X | X | L | H | Clear |
| H | L | X | X | H | L | Preset |
| L | L | X | X | H | H | — |
| H | H | L | ↑ | L | H | — |
| H | H | H | ↑ | H | L | — |
| H | H | X | ↓ | Qn | $\overline{Q}$n | No Change |

X: Don't care

## 9. System Diagram




## 10. Absolute Maximum Ratings (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | | -0.5 to 7.0 | V |
| Input voltage | $V_{IN}$ | | -0.5 to $V_{CC}$ + 0.5 | V |
| Output voltage | $V_{OUT}$ | | -0.5 to $V_{CC}$ + 0.5 | V |
| Input diode current | $I_{IK}$ | | ±20 | mA |
| Output diode current | $I_{OK}$ | | ±50 | mA |
| Output current | $I_{OUT}$ | | ±50 | mA |
| $V_{CC}$/ground current | $I_{CC}$ | | ±100 | mA |
| Power dissipation | $P_D$ | (Note 1) | 500 | mW |
| Storage temperature | $T_{stg}$ | | -65 to 150 | °C |

Note: 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 1: 500 mW in the range of $T_a$ = -40 to 65°C. From $T_a$ = 65 to 85°C a derating factor of -10 mW/°C shall be applied until 300 mW.

## 11. Operating Ranges (Note)

| Characteristics | Symbol | Test Condition | Rating | Unit |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | | 2.0 to 5.5 | 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 times | dt/dv | $V_{CC}$ = 3.3 ± 0.3 V | 0 to 100 | ns/V |
| | | $V_{CC}$ = 5.0 ± 0.5 V | 0 to 20 | |

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.

## 12. Electrical Characteristics

### 12.1. DC Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | | $V_{CC}$ (V) | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| High-level input voltage | $V_{IH}$ | — | | 2.0 | 1.50 | — | — | V |
| | | | | 3.0 | 2.10 | — | — | |
| | | | | 5.5 | 3.85 | — | — | |
| Low-level input voltage | $V_{IL}$ | — | | 2.0 | — | — | 0.50 | V |
| | | | | 3.0 | — | — | 0.90 | |
| | | | | 5.5 | — | — | 1.65 | |
| High-level output voltage | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = -50 μA | 2.0 | 1.9 | 2.0 | — | V |
| | | | | 3.0 | 2.9 | 3.0 | — | |
| | | | | 4.5 | 4.4 | 4.5 | — | |
| | | | $I_{OH}$ = -4 mA | 3.0 | 2.58 | — | — | |
| | | | $I_{OH}$ = -24 mA | 4.5 | 3.94 | — | — | |
| Low-level output voltage | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 50 μA | 2.0 | — | 0.0 | 0.1 | V |
| | | | | 3.0 | — | 0.0 | 0.1 | |
| | | | | 4.5 | — | 0.0 | 0.1 | |
| | | | $I_{OL}$ = 12 mA | 3.0 | — | — | 0.36 | |
| | | | $I_{OL}$ = 24 mA | 4.5 | — | — | 0.36 | |
| Input leakage current | $I_{IN}$ | $V_{IN}$ = $V_{CC}$ or GND | | 5.5 | — | — | ±0.1 | μA |
| Quiescent supply current | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | | 5.5 | — | — | 4.0 | μA |

### 12.2. DC Characteristics (Unless otherwise specified, $T_a$ = -40 to 85 °C)

| Characteristics | Symbol | Test Condition | | Note | $V_{CC}$ (V) | Min | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| High-level input voltage | $V_{IH}$ | — | | | 2.0 | 1.50 | — | V |
| | | | | | 3.0 | 2.10 | — | |
| | | | | | 5.5 | 3.85 | — | |
| Low-level input voltage | $V_{IL}$ | — | | | 2.0 | — | 0.50 | V |
| | | | | | 3.0 | — | 0.90 | |
| | | | | | 5.5 | — | 1.65 | |
| High-level output voltage | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = -50 μA | | 2.0 | 1.9 | — | V |
| | | | | | 3.0 | 2.9 | — | |
| | | | | | 4.5 | 4.4 | — | |
| | | | $I_{OH}$ = -4 mA | | 3.0 | 2.48 | — | |
| | | | $I_{OH}$ = -24 mA | | 4.5 | 3.80 | — | |
| | | | $I_{OH}$ = -75 mA | (Note 1) | 5.5 | 3.85 | — | |
| Low-level output voltage | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 50 μA | | 2.0 | — | 0.1 | V |
| | | | | | 3.0 | — | 0.1 | |
| | | | | | 4.5 | — | 0.1 | |
| | | | $I_{OL}$ = 12 mA | | 3.0 | — | 0.44 | |
| | | | $I_{OL}$ = 24 mA | | 4.5 | — | 0.44 | |
| | | | $I_{OL}$ = 75 mA | (Note 1) | 5.5 | — | 1.65 | |
| Input leakage current | $I_{IN}$ | $V_{IN}$ = $V_{CC}$ or GND | | | 5.5 | — | ±1.0 | μA |
| Quiescent supply current | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | | | 5.5 | — | 40.0 | μA |

Note 1: This spec indicates the capability of driving 50 Ω transmission lines.
One output should be tested within a 10 ms maximum duration.

## 12.3. Timing Requirements (Unless otherwise specified, $T_a$ = 25°C, Input: $t_r = t_f$ = 3 ns)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Limit | Unit |
|---|---|---|---|---|---|
| Minimum pulse width (CK) | $t_{w(L)}$,$t_{w(H)}$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 7.0 | ns |
| | | | 5.0 ± 0.5 | 5.0 | |
| Minimum pulse width ($\overline{CLR}$, $\overline{PR}$) | $t_{w(L)}$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 7.0 | ns |
| | | | 5.0 ± 0.5 | 5.0 | |
| Minimum setup time | $t_s$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 6.0 | ns |
| | | | 5.0 ± 0.5 | 3.5 | |
| Minimum hold time | $t_h$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 1.0 | ns |
| | | | 5.0 ± 0.5 | 1.0 | |
| Minimum removal time ($\overline{CLR}$, $\overline{PR}$) | $t_{rem}$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 4.0 | ns |
| | | | 5.0 ± 0.5 | 2.0 | |

## 12.4. Timing Requirements (Unless otherwise specified, $T_a$ = -40 to 85°C, Input: $t_r = t_f$ = 3 ns)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Limit | Unit |
|---|---|---|---|---|---|
| Minimum pulse width (CK) | $t_{w(L)}$,$t_{w(H)}$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 7.0 | ns |
| | | | 5.0 ± 0.5 | 5.0 | |
| Minimum pulse width ($\overline{CLR}$, $\overline{PR}$) | $t_{w(L)}$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 7.0 | ns |
| | | | 5.0 ± 0.5 | 5.0 | |
| Minimum setup time | $t_s$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 6.0 | ns |
| | | | 5.0 ± 0.5 | 3.5 | |
| Minimum hold time | $t_h$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 1.0 | ns |
| | | | 5.0 ± 0.5 | 1.0 | |
| Minimum removal time ($\overline{CLR}$, $\overline{PR}$) | $t_{rem}$ | $C_L$ = 50 pF<br>$R_L$ = 500 Ω | 3.3 ± 0.3 | 4.0 | ns |
| | | | 5.0 ± 0.5 | 2.0 | |

## 12.5. AC Characteristics (Unless otherwise specified, $T_a$ = 25 °C, Input: $t_r = t_f$ = 3 ns)

| Characteristics | Symbol | Note | Test Condition | $V_{CC}$ (V) | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Propagation delay time (CK-Q, $\overline{Q}$) | $t_{PLH}$,$t_{PHL}$ | | $C_L$ = 50 pF $R_L$ = 500 Ω | 3.3 ± 0.3 | — | 8.2 | 13.9 | ns |
| | | | | 5.0 ± 0.5 | — | 6.1 | 8.7 | |
| Propagation delay time ($\overline{CLR}$, $\overline{PR}$-Q, $\overline{Q}$) | $t_{PLH}$,$t_{PHL}$ | | $C_L$ = 50 pF $R_L$ = 500 Ω | 3.3 ± 0.3 | — | 8.0 | 13.1 | ns |
| | | | | 5.0 ± 0.5 | — | 5.7 | 8.2 | |
| Maximum clock frequency | $f_{MAX}$ | | $C_L$ = 50 pF $R_L$ = 500 Ω | 3.3 ± 0.3 | 60 | 120 | — | MHz |
| | | | | 5.0 ± 0.5 | 100 | 160 | — | |
| Input capacitance | $C_{IN}$ | | — | | — | 5 | 10 | pF |
| Power dissipation capacitance | $C_{PD}$ | (Note 1) | — | | — | 77 | — | pF |

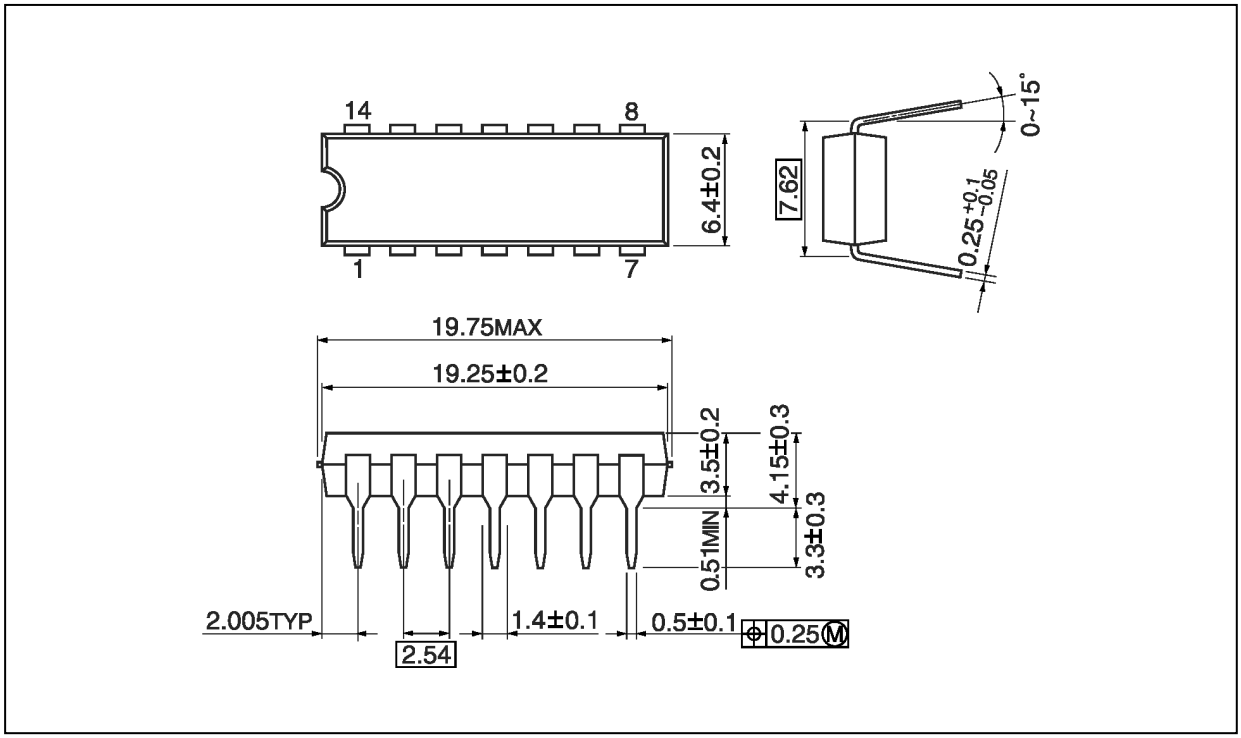
Note 1: $C_{PD}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation.
$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$ (per F/F)

## 12.6. AC Characteristics (Unless otherwise specified, $T_a$ = -40 to 85 °C, Input: $t_r = t_f$ = 3 ns)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Min | Max | Unit |
|---|---|---|---|---|---|---|
| Propagation delay time (CK-Q, $\overline{Q}$) | $t_{PLH}$,$t_{PHL}$ | $C_L$ = 50 pF $R_L$ = 500 Ω | 3.3 ± 0.3 | 1.0 | 16.0 | ns |
| | | | 5.0 ± 0.5 | 1.0 | 10.0 | |
| Propagation delay time ($\overline{CLR}$, $\overline{PR}$-Q, $\overline{Q}$) | $t_{PLH}$,$t_{PHL}$ | $C_L$ = 50 pF $R_L$ = 500 Ω | 3.3 ± 0.3 | 1.0 | 15.0 | ns |
| | | | 5.0 ± 0.5 | 1.0 | 9.4 | |
| Maximum clock frequency | $f_{MAX}$ | $C_L$ = 50 pF $R_L$ = 500 Ω | 3.3 ± 0.3 | 60 | — | MHz |
| | | | 5.0 ± 0.5 | 100 | — | |
| Input capacitance | $C_{IN}$ | — | | — | 10 | pF |

## Package Dimensions

Unit: mm




Weight: 0.96 g (typ.)

| Package Name(s) |
| --- |
| Nickname: DIP14 |

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