

74HC21D

1. Functional Description

- Dual 4-Input AND Gate

2. General

The 74HC21D is a high speed CMOS 4-INPUT AND GATE fabricated with silicon gate C²MOS technology.

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

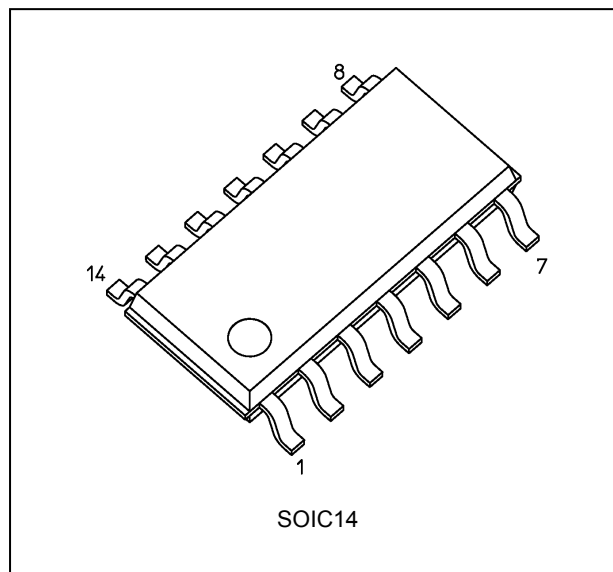
The internal circuit is composed of 4 stages including buffer an output, which provide high noise immunity and stable output.

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

3. Features

- (1) High speed: $t_{pd} = 10 \text{ ns}$ (typ.) at $V_{CC} = 5 \text{ V}$
- (2) Low power dissipation: $I_{CC} = 1.0 \mu\text{A}$ (max) $T_a = 25 \text{ }^\circ\text{C}$
- (3) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$
- (4) Wide operating voltage range: $V_{CC(opr)} = 2.0 \text{ to } 6.0 \text{ V}$

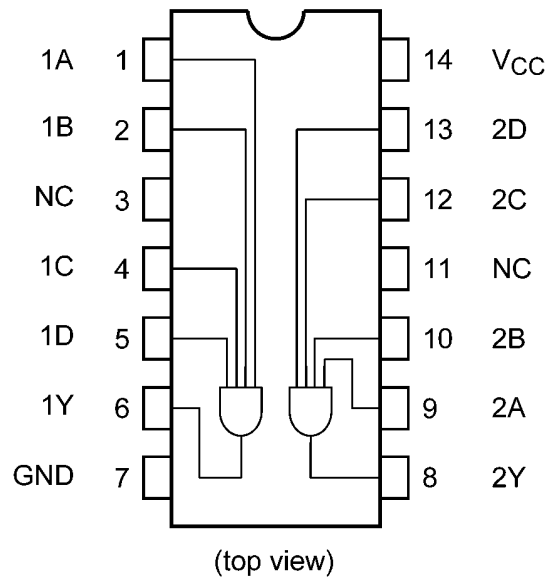
4. Packaging



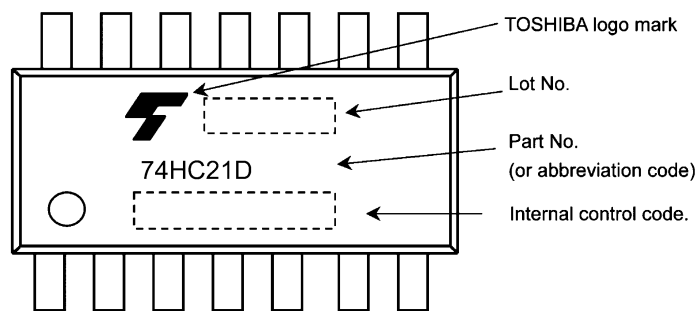
Start of commercial production

2016-04

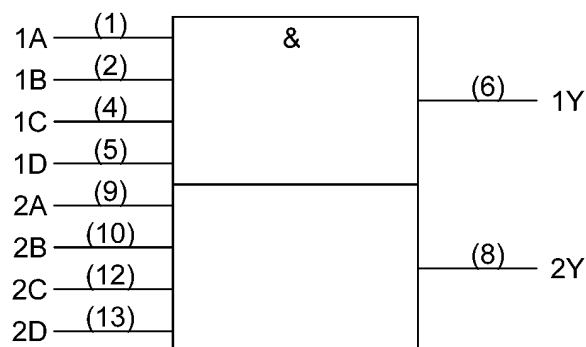
5. Pin Assignment



6. Marking



7. IEC Logic Symbol



8. Truth Table

| A | B | C | D | Y |
|---|---|---|---|---|
| L | X | X | X | L |
| X | L | X | X | L |
| X | X | L | X | L |
| X | X | X | L | L |
| H | H | H | H | H |

X: Don't care

9. Absolute Maximum Ratings (Note)

| Characteristics | Symbol | 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} | ± 20 | mA |
| Output current | I_{OUT} | ± 25 | mA |
| V_{CC} /ground current | I_{CC} | ± 50 | mA |
| Power dissipation | P_D | 500 | mW |
| Storage temperature | T_{stg} | -65 to 150 | $^{\circ}C$ |

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).

10. Operating Ranges (Note)

| Characteristics | Symbol | Test Condition | Rating | Unit |
|---------------------------|------------|-------------------------|---------------|-------------|
| Supply voltage | V_{CC} | | 2.0 to 6.0 | 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 | $^{\circ}C$ |
| Input rise and fall times | t_r, t_f | $V_{CC} = 2.0\text{ V}$ | 0 to 1000 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 0 to 500 | |
| | | $V_{CC} = 6.0\text{ V}$ | 0 to 400 | |

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.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$)

| Characteristics | Symbol | Test Condition | | V_{CC} (V) | Min | Typ. | Max | Unit |
|---------------------------|----------|-------------------------------|-----------------------------------|--------------|------|------|-----------|---------------|
| High-level input voltage | V_{IH} | — | | 2.0 | 1.50 | — | — | V |
| | | | | 4.5 | 3.15 | — | — | |
| | | | | 6.0 | 4.20 | — | — | |
| Low-level input voltage | V_{IL} | — | | 2.0 | — | — | 0.50 | V |
| | | | | 4.5 | — | — | 1.35 | |
| | | | | 6.0 | — | — | 1.80 | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ | $I_{OH} = -20\text{ }\mu\text{A}$ | 2.0 | 1.9 | 2.0 | — | V |
| | | | | 4.5 | 4.4 | 4.5 | — | |
| | | | 6.0 | 5.9 | 6.0 | — | | |
| | | | $I_{OH} = -4\text{ mA}$ | 4.5 | 4.18 | 4.31 | — | |
| | | | $I_{OH} = -5.2\text{ mA}$ | 6.0 | 5.68 | 5.80 | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OL} = 20\text{ }\mu\text{A}$ | 2.0 | — | 0.0 | 0.1 | V |
| | | | | 4.5 | — | 0.0 | 0.1 | |
| | | | | 6.0 | — | 0.0 | 0.1 | |
| | | | $I_{OL} = 4\text{ mA}$ | 4.5 | — | 0.17 | 0.26 | |
| | | | $I_{OL} = 5.2\text{ mA}$ | 6.0 | — | 0.18 | 0.26 | |
| Input leakage current | I_{IN} | $V_{IN} = V_{CC}$ or GND | | 6.0 | — | — | ± 0.1 | μA |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | | 6.0 | — | — | 1.0 | μA |

11.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85\text{ }^\circ\text{C}$)

| Characteristics | Symbol | Test Condition | | V_{CC} (V) | Min | Max | Unit |
|---------------------------|----------|-------------------------------|-----------------------------------|--------------|------|-----------|---------------|
| High-level input voltage | V_{IH} | — | | 2.0 | 1.50 | — | V |
| | | | | 4.5 | 3.15 | — | |
| | | | | 6.0 | 4.20 | — | |
| Low-level input voltage | V_{IL} | — | | 2.0 | — | 0.50 | V |
| | | | | 4.5 | — | 1.35 | |
| | | | | 6.0 | — | 1.80 | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ | $I_{OH} = -20\text{ }\mu\text{A}$ | 2.0 | 1.9 | — | V |
| | | | | 4.5 | 4.4 | — | |
| | | | 6.0 | 5.9 | — | | |
| | | | $I_{OH} = -4\text{ mA}$ | 4.5 | 4.13 | — | |
| | | | $I_{OH} = -5.2\text{ mA}$ | 6.0 | 5.63 | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OL} = 20\text{ }\mu\text{A}$ | 2.0 | — | 0.1 | V |
| | | | | 4.5 | — | 0.1 | |
| | | | | 6.0 | — | 0.1 | |
| | | | $I_{OL} = 4\text{ mA}$ | 4.5 | — | 0.33 | |
| | | | $I_{OL} = 5.2\text{ mA}$ | 6.0 | — | 0.33 | |
| Input leakage current | I_{IN} | $V_{IN} = V_{CC}$ or GND | | 6.0 | — | ± 1.0 | μA |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | | 6.0 | — | 10.0 | μA |

11.3. AC Characteristics

(Unless otherwise specified, $C_L = 15 \text{ pF}$, $V_{CC} = 5 \text{ V}$, $T_a = 25 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|------------------------|--------------------|----------------|-----|------|-----|------|
| Output transition time | t_{TLH}, t_{THL} | — | — | 4 | 8 | ns |
| Propagation delay time | t_{PLH}, t_{PHL} | — | — | 10 | 17 | ns |

11.4. AC Characteristics

(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = 25 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

| Characteristics | Symbol | Note | V_{CC} (V) | Min | Typ. | Max | Unit |
|-------------------------------|--------------------|----------|--------------|-----|------|-----|------|
| Output transition time | t_{TLH}, t_{THL} | | 2.0 | — | 30 | 75 | ns |
| | | | 4.5 | — | 8 | 15 | |
| | | | 6.0 | — | 7 | 13 | |
| Propagation delay time | t_{PLH}, t_{PHL} | | 2.0 | — | 40 | 100 | ns |
| | | | 4.5 | — | 13 | 20 | |
| | | | 6.0 | — | 11 | 17 | |
| Input capacitance | C_{IN} | | — | — | 5 | — | pF |
| Power dissipation capacitance | C_{PD} | (Note 1) | — | — | 25 | — | 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.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2 \text{ (per gate)}$$

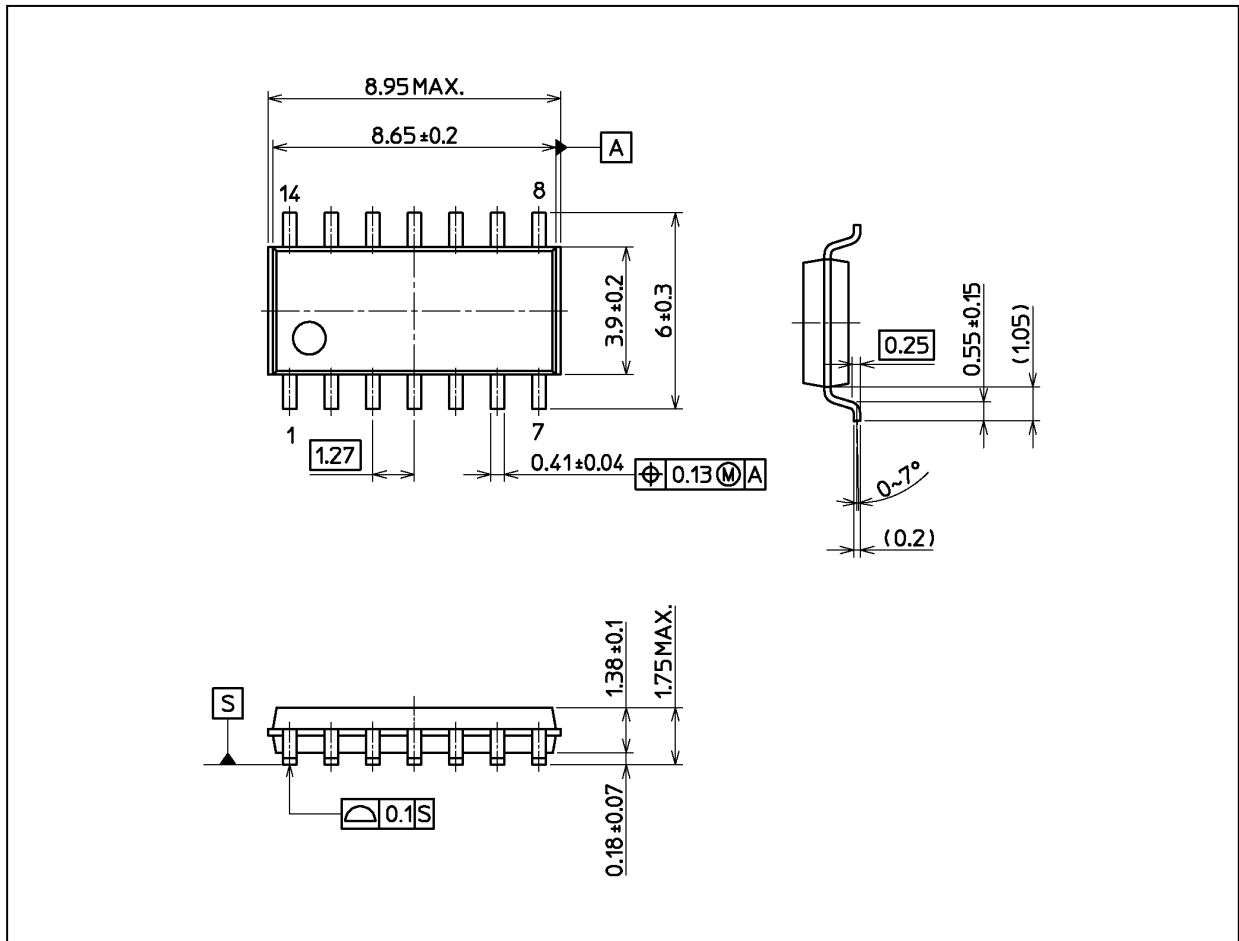
11.5. AC Characteristics

(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

| Characteristics | Symbol | V_{CC} (V) | Min | Max | Unit |
|------------------------|--------------------|--------------|-----|-----|------|
| Output transition time | t_{TLH}, t_{THL} | 2.0 | — | 95 | ns |
| | | 4.5 | — | 19 | |
| | | 6.0 | — | 16 | |
| Propagation delay time | t_{PLH}, t_{PHL} | 2.0 | — | 125 | ns |
| | | 4.5 | — | 25 | |
| | | 6.0 | — | 21 | |

Package Dimensions

Unit: mm



Weight: 0.13 g (typ.)

| |
|------------------|
| Package Name(s) |
| Nickname: SOIC14 |

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