CMOS Digital Integrated Circuits Silicon Monolithic

# 74HC237D

## 1. Functional Description

- 3-to-8 Line Decoder/Latch

## 2. General

The 74HC237D is a high speed CMOS 3-to-8 DECODER ADDRESS LATCH fabricated with silicon gate $C^2MOS$ technology.

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

It is composed of a 3-bit input latches with a common $\overline{GL}$ enable input and 3-to-8 line decoder with enable inputs G1 and $\overline{G}2$. The 3-bit binary data is stored into the input latch on the high level of $\overline{GL}$. The value of this data determines which one of the outputs will go low.

When the enable input G1 is held low or $\overline{G}2$ is held high, decoding function is inhibited and all the 8 outputs go high. The two enable inputs are provided to ease cascade connection and permits the application address decoder for memory system.

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

## 3. Features

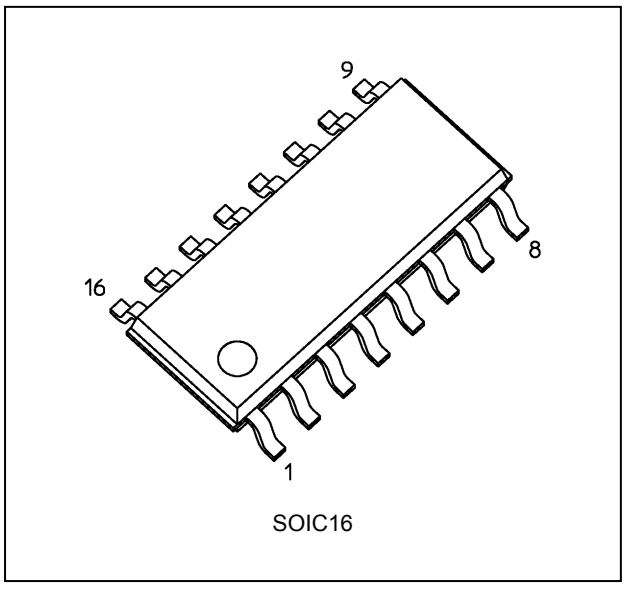
(1) High speed: $t_{pd}$ = 12 ns (typ.) at $V_{CC}$ = 5 V

(2) Low power dissipation: $I_{CC}$ = 4.0 μA (max) at $T_a$ = 25 °C

(3) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$

(4) Wide operating voltage range: $V_{CC(opr)}$ = 2.0 V to 6.0 V

## 4. Packaging

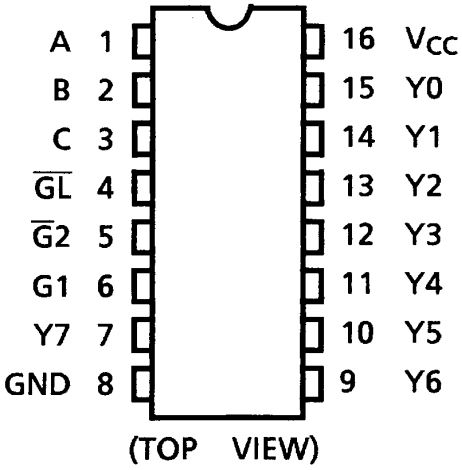



SOIC16

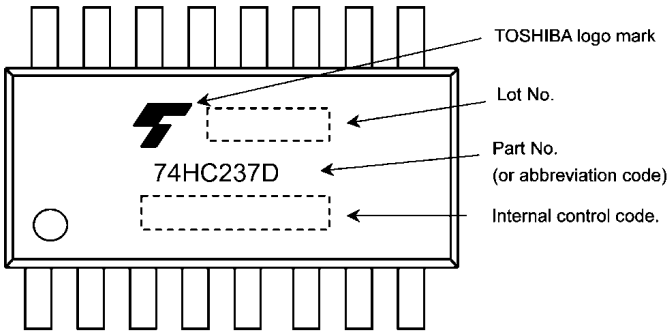
Start of commercial production
2016-05

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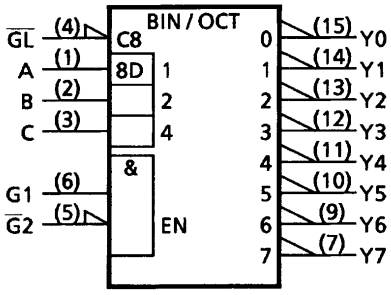
## 5. Pin Assignment

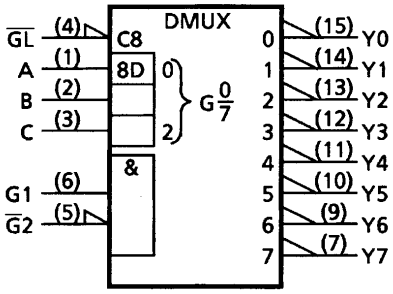



## 6. Marking




## 7. IEC Logic Symbol



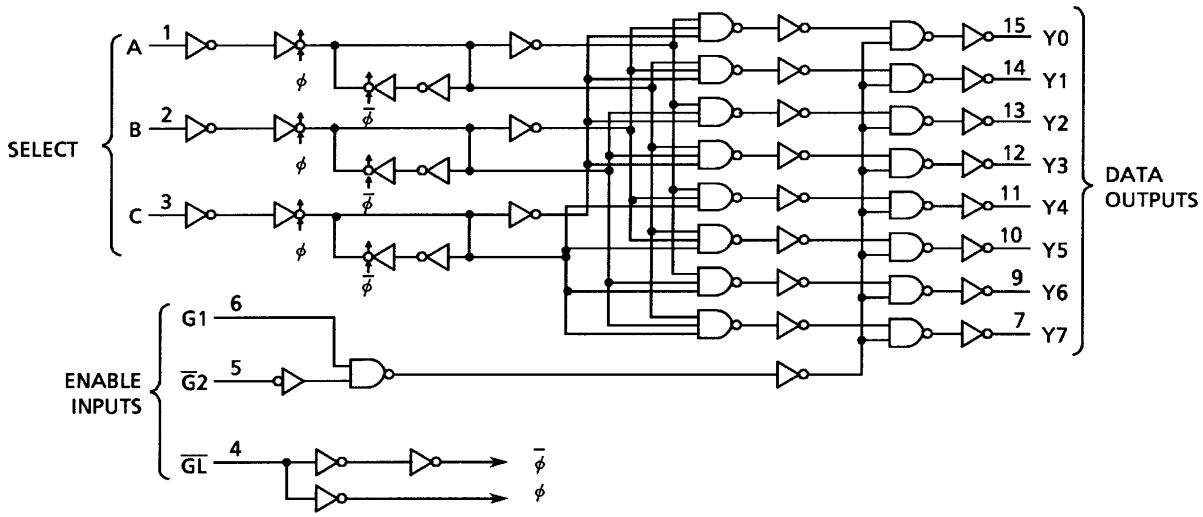



## 8. Truth Table

| Inputs | | | | | | Outputs | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Enable | | | Address | | | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| $\overline{GL}$ | $\overline{G2}$ | G1 | C | B | A | | | | | | | | |
| X | X | L | X | X | X | L | L | L | L | L | L | L | L |
| X | H | X | X | X | X | L | L | L | L | L | L | L | L |
| L | L | H | L | L | L | H | L | L | L | L | L | L | L |
| L | L | H | L | L | H | L | H | L | L | L | L | L | L |
| L | L | H | L | H | L | L | L | H | L | L | L | L | L |
| L | L | H | L | H | H | L | L | L | H | L | L | L | L |
| L | L | H | H | L | L | L | L | L | L | H | L | L | L |
| L | L | H | H | L | H | L | L | L | L | L | H | L | L |
| L | L | H | H | H | L | L | L | L | L | L | L | H | L |
| L | L | H | H | H | H | L | L | L | L | L | L | L | H |
| H | L | H | X | X | X | Depends upon the address previously applied while $\overline{GL}$ was at a low level | | | | | | | |

X: Don't care

## 9. Logic 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 | |
| Output voltage | $V_{OUT}$ | | -0.5 to $V_{CC}$ + 0.5 | |
| Input diode current | $I_{IK}$ | | ±20 | mA |
| Output diode current | $I_{OK}$ | | ±20 | |
| Output current | $I_{OUT}$ | | ±25 | |
| $V_{CC}$/ground current | $I_{CC}$ | | ±50 | |
| 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: $P_D$ derates linearly with -8 mW/°C above 85 °C

## 11. 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 125 | °C |
| Input rise and fall times | $t_r$,$t_f$ | — | 0 to 50 | μs |

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

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## 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 |
| | | | | 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 | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = -20 μA | 2.0 | 1.9 | 2.0 | — | V |
| | | | | 4.5 | 4.4 | 4.5 | — | |
| | | | | 6.0 | 5.9 | 6.0 | — | |
| | | | $I_{OH}$ = -4 mA | 4.5 | 4.18 | 4.31 | — | |
| | | | $I_{OH}$ = -5.2 mA | 6.0 | 5.68 | 5.80 | — | |
| Low-level output voltage | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 20 μA | 2.0 | — | 0.0 | 0.1 | V |
| | | | | 4.5 | — | 0.0 | 0.1 | |
| | | | | 6.0 | — | 0.0 | 0.1 | |
| | | | $I_{OL}$ = 4 mA | 4.5 | — | 0.17 | 0.26 | |
| | | | $I_{OL}$ = 5.2 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 | — | — | 4.0 | μA |

### 12.2. DC Characteristics (Unless otherwise specified, $T_a$ = -40 to 85 °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 | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = -20 μA | 2.0 | 1.9 | — | V |
| | | | | 4.5 | 4.4 | — | |
| | | | | 6.0 | 5.9 | — | |
| | | | $I_{OH}$ = -4 mA | 4.5 | 4.13 | — | |
| | | | $I_{OH}$ = -5.2 mA | 6.0 | 5.63 | — | |
| Low-level output voltage | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 20 μA | 2.0 | — | 0.1 | V |
| | | | | 4.5 | — | 0.1 | |
| | | | | 6.0 | — | 0.1 | |
| | | | $I_{OL}$ = 4 mA | 4.5 | — | 0.33 | |
| | | | $I_{OL}$ = 5.2 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 | — | 40.0 | μA |

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### 12.3. DC Characteristics (Unless otherwise specified, $T_a$ = -40 to 125 °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 | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = -20 μA | 2.0 | 1.9 | — | V |
| | | | | 4.5 | 4.4 | — | |
| | | | | 6.0 | 5.9 | — | |
| | | | $I_{OH}$ = -4 mA | 4.5 | 3.7 | — | |
| | | | $I_{OH}$ = -5.2 mA | 6.0 | 5.2 | — | |
| Low-level output voltage | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 20 μA | 2.0 | — | 0.1 | V |
| | | | | 4.5 | — | 0.1 | |
| | | | | 6.0 | — | 0.1 | |
| | | | $I_{OL}$ = 4 mA | 4.5 | — | 0.4 | |
| | | | $I_{OL}$ = 5.2 mA | 6.0 | — | 0.4 | |
| 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 | — | 160.0 | μA |

### 13. Timing Requirements (Unless otherwise specified, $T_a$ = 25 °C, Input: $t_r$ = $t_f$ = 6 ns)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Typ. | Limit | Unit |
|---|---|---|---|---|---|---|
| Minimum pulse width ($\overline{GL}$) | $t_{w(L)}$ | — | 2.0 | — | 75 | ns |
| | | | 4.5 | — | 15 | |
| | | | 6.0 | — | 13 | |
| Minimum setup time (A, B, C - $\overline{GL}$) | $t_s$ | — | 2.0 | — | 50 | ns |
| | | | 4.5 | — | 10 | |
| | | | 6.0 | — | 9 | |
| Minimum hold time (A, B, C - $\overline{GL}$) | $t_h$ | — | 2.0 | — | 25 | ns |
| | | | 4.5 | — | 5 | |
| | | | 6.0 | — | 5 | |

### 14. Timing Requirements (Unless otherwise specified, $T_a$ = -40 to 85 °C, Input: $t_r$ = $t_f$ = 6 ns)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Limit | Unit |
|---|---|---|---|---|---|
| Minimum pulse width ($\overline{GL}$) | $t_{w(L)}$ | — | 2.0 | 95 | ns |
| | | | 4.5 | 19 | |
| | | | 6.0 | 16 | |
| Minimum setup time (A, B, C - $\overline{GL}$) | $t_s$ | — | 2.0 | 65 | ns |
| | | | 4.5 | 13 | |
| | | | 6.0 | 11 | |
| Minimum hold time (A, B, C - $\overline{GL}$) | $t_h$ | — | 2.0 | 30 | ns |
| | | | 4.5 | 6 | |
| | | | 6.0 | 5 | |

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## 15. Timing Requirements (Unless otherwise specified, $T_a$ = -40 to 125 °C, Input: $t_r = t_f$ = 6 ns)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Limit | Unit |
|---|---|---|---|---|---|
| Minimum pulse width ($\overline{GL}$) | $t_{w(L)}$ | — | 2.0 | 115 | ns |
| | | | 4.5 | 23 | |
| | | | 6.0 | 20 | |
| Minimum setup time (A, B, C - $\overline{GL}$) | $t_S$ | — | 2.0 | 75 | ns |
| | | | 4.5 | 15 | |
| | | | 6.0 | 13 | |
| Minimum hold time (A, B, C - $\overline{GL}$) | $t_h$ | — | 2.0 | 40 | ns |
| | | | 4.5 | 8 | |
| | | | 6.0 | 7 | |

### 15.1. AC Characteristics (Unless otherwise specified, $C_L$ = 15 pF, $V_{CC}$ = 5 V, $T_a$ = 25 °C, Input: $t_r = t_f$ = 6 ns)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Output transition time | $t_{TLH}$,$t_{THL}$ | — | — | 4 | 8 | ns |
| Propagation delay time (G1 - Y) | $t_{PLH}$,$t_{PHL}$ | — | — | 12 | 24 | ns |
| Propagation delay time ($\overline{G2}$ - Y) | $t_{PLH}$,$t_{PHL}$ | — | — | 12 | 24 | ns |
| Propagation delay time ($\overline{GL}$ - Y) | $t_{PLH}$,$t_{PHL}$ | — | — | 17 | 33 | ns |
| Propagation delay time (A, B, C - Y) | $t_{PLH}$,$t_{PHL}$ | — | — | 15 | 31 | ns |

### 15.2. AC Characteristics (Unless otherwise specified, $C_L$ = 50pF, $T_a$ = 25 °C, Input: $t_r = t_f$ = 6 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 (G1 - Y) | $t_{PLH}$,$t_{PHL}$ | | 2.0 | — | 45 | 140 | ns |
| | | | 4.5 | — | 15 | 28 | |
| | | | 6.0 | — | 13 | 24 | |
| Propagation delay time ($\overline{G2}$ - Y) | $t_{PLH}$,$t_{PHL}$ | | 2.0 | — | 45 | 140 | ns |
| | | | 4.5 | — | 15 | 28 | |
| | | | 6.0 | — | 13 | 24 | |
| Propagation delay time ($\overline{GL}$ - Y) | $t_{PLH}$,$t_{PHL}$ | | 2.0 | — | 65 | 190 | ns |
| | | | 4.5 | — | 21 | 38 | |
| | | | 6.0 | — | 18 | 32 | |
| Propagation delay time (A, B, C - Y) | $t_{PLH}$,$t_{PHL}$ | | 2.0 | — | 60 | 180 | ns |
| | | | 4.5 | — | 19 | 36 | |
| | | | 6.0 | — | 16 | 31 | |
| Input capacitance | $C_{IN}$ | | — | — | 3 | — | pF |
| Power dissipation capacitance | $C_{PD}$ | (Note 1) | — | — | 17 | — | 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.

$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

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### 15.3. AC Characteristics
**(Unless otherwise specified, $C_L$ = 50 pF, $T_a$ = -40 to 85 °C, Input: $t_r = t_f$ = 6 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 (G1 - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 175 | ns |
| | | 4.5 | — | 35 | |
| | | 6.0 | — | 30 | |
| Propagation delay time ($\overline{G2}$ - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 175 | ns |
| | | 4.5 | — | 35 | |
| | | 6.0 | — | 30 | |
| Propagation delay time ($\overline{GL}$ - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 240 | ns |
| | | 4.5 | — | 48 | |
| | | 6.0 | — | 41 | |
| Propagation delay time (A, B, C - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 225 | ns |
| | | 4.5 | — | 45 | |
| | | 6.0 | — | 38 | |

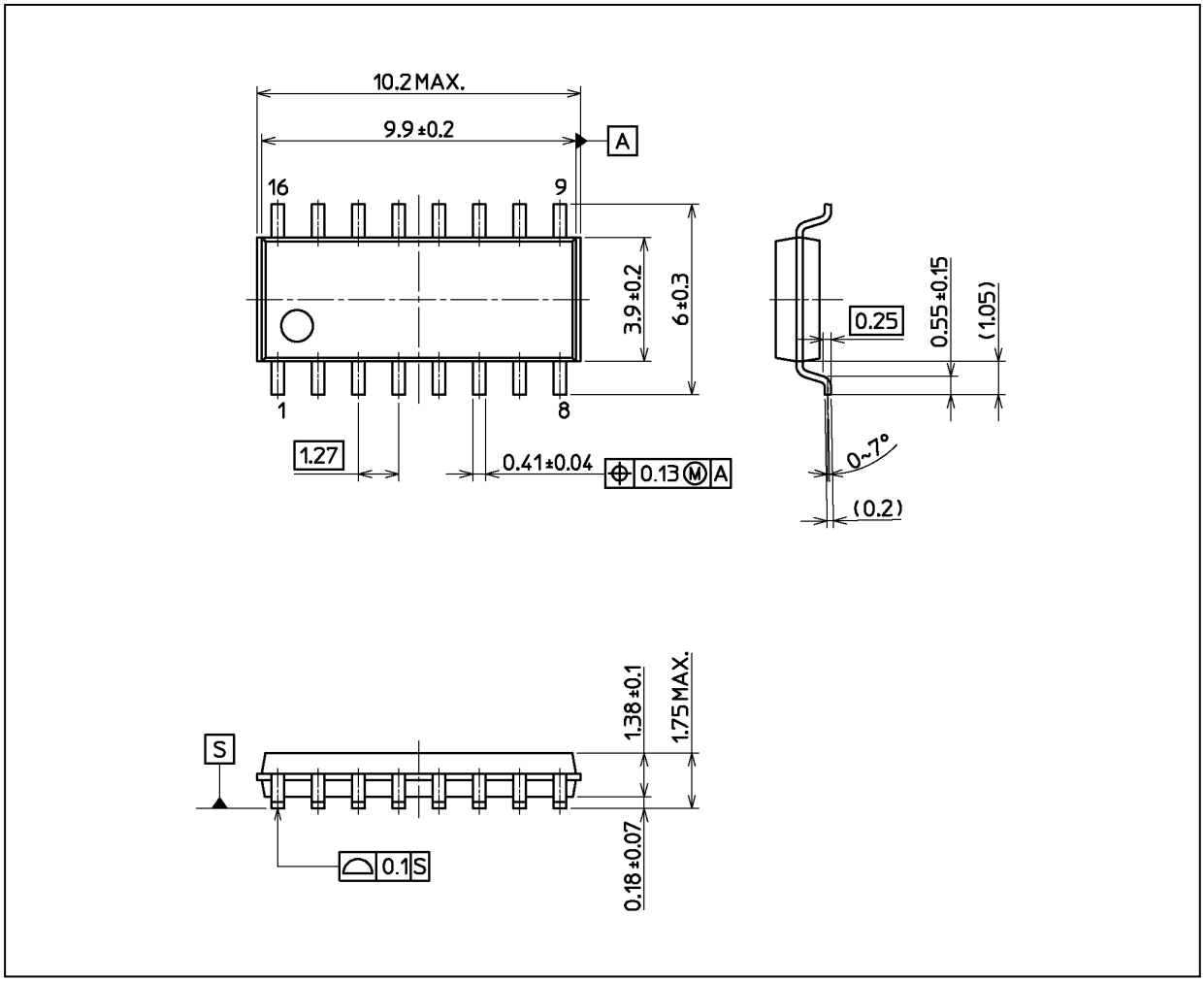
### 15.4. AC Characteristics
**(Unless otherwise specified, $C_L$ = 50 pF, $T_a$ = -40 to 125 °C, Input: $t_r = t_f$ = 6 ns)**

| Characteristics | Symbol | $V_{CC}$ (V) | Min | Max | Unit |
|---|---|---|---|---|---|
| Output transition time | $t_{TLH}$,$t_{THL}$ | 2.0 | — | 110 | ns |
| | | 4.5 | — | 22 | |
| | | 6.0 | — | 19 | |
| Propagation delay time (G1 - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 210 | ns |
| | | 4.5 | — | 42 | |
| | | 6.0 | — | 36 | |
| Propagation delay time ($\overline{G2}$ - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 210 | ns |
| | | 4.5 | — | 42 | |
| | | 6.0 | — | 36 | |
| Propagation delay time ($\overline{GL}$ - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 285 | ns |
| | | 4.5 | — | 57 | |
| | | 6.0 | — | 48 | |
| Propagation delay time (A, B, C - Y) | $t_{PLH}$,$t_{PHL}$ | 2.0 | — | 270 | ns |
| | | 4.5 | — | 54 | |
| | | 6.0 | — | 46 | |

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## Package Dimensions

Unit: mm




Weight: 0.15 g (typ.)

| Package Name(s) |
| --- |
| Nickname: SOIC16 |

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