

# 74HC540D,74HC541D

## 1. Functional Description

- Octal Bus Buffer
- 74HC540D: INVERTING, 3-STATE OUTPUTS  
74HC541D: NON-INVERTING, 3-STATE OUTPUTS

## 2. General

The 74HC540D/74HC541D are high speed CMOS OCTAL BUS BUFFERS fabricated with silicon gate C<sup>2</sup>MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

The 74HC540D is an inverting type, and the 74HC541D is a non-inverting type.

When either  $\overline{G1}$  or  $\overline{G2}$  are high, the terminal outputs are in the high-impedance state.

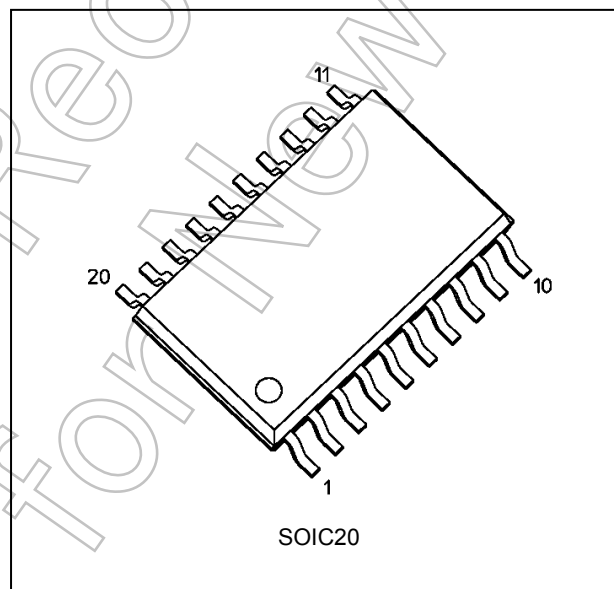
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

## 3. Features

- (1) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C (Note 1)
- (2) High speed:  $t_{pd} = 10$  ns (typ.) at  $V_{CC} = 6.0$  V
- (3) Low power dissipation:  $I_{CC} = 4.0$   $\mu$ A (max) at  $T_a = 25$  °C
- (4) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (5) Wide operating voltage range:  $V_{CC(opr)} = 2.0$  V to  $6.0$  V

Note 1: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after July 2020.

## 4. Packaging

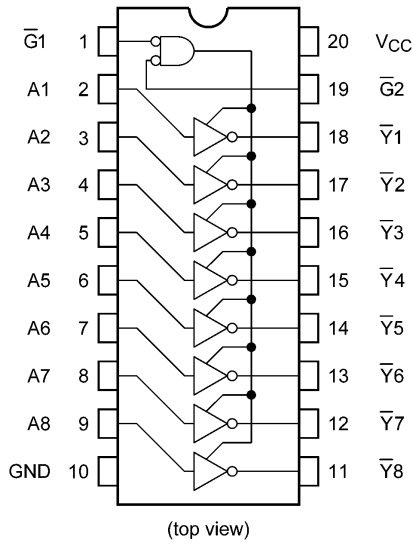


Start of commercial production

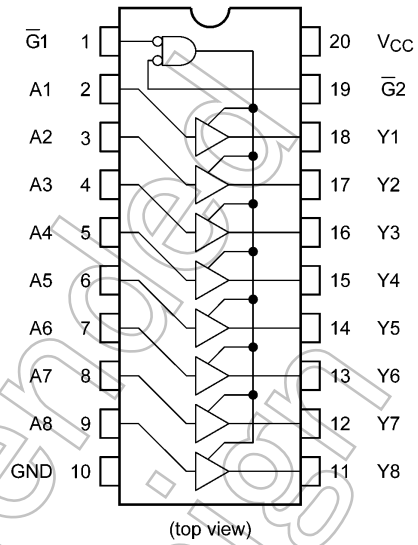
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### 5. Pin Assignment

74HC540D

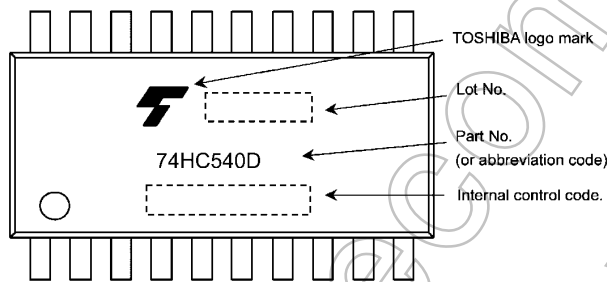


74HC541D

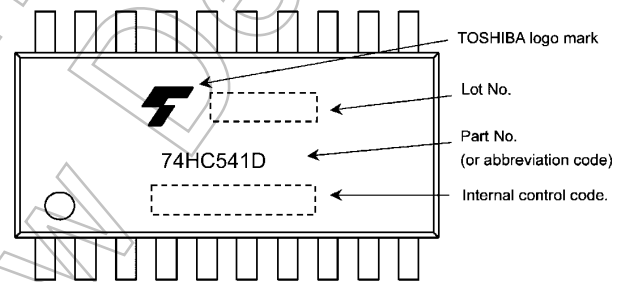


### 6. Marking

74HC540D

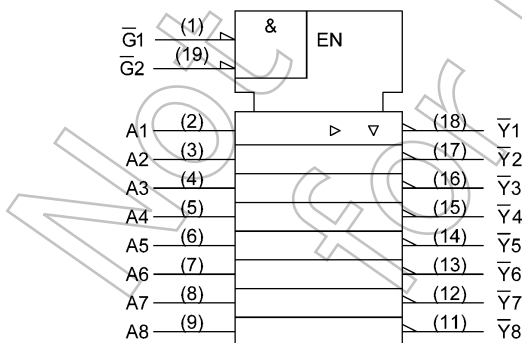


74HC541D

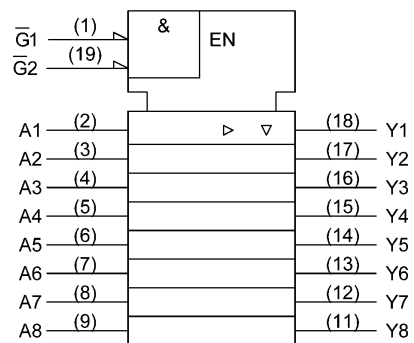


### 7. IEC Logic Symbol

74HC540D



74HC541D



### 8. Truth Table

| Input $\bar{G}1$ | Input $\bar{G}2$ | Input $A_n$ | Output $Y_n$ | Output $\bar{Y}_n$ |
|------------------|------------------|-------------|--------------|--------------------|
| H                | X                | X           | Z            | Z                  |
| X                | H                | X           | Z            | Z                  |
| L                | L                | H           | H            | L                  |
| L                | L                | L           | L            | H                  |

X: Don't care

Z: High impedance

$Y_n$ : 74HC541D

$\bar{Y}_n$ : 74HC540D

### 9. 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      | $I_{IK}$  |          | $\pm 20$               | mA   |
| Output diode current     | $I_{OK}$  |          | $\pm 20$               | mA   |
| Output current           | $I_{OUT}$ |          | $\pm 35$               | mA   |
| $V_{CC}$ /ground current | $I_{CC}$  |          | $\pm 75$               | 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:  $P_D$  derates linearly with -8 mW/°C above 85 °C

### 10. Operating Ranges (Note)

| Characteristics           | Symbol     | Test Condition          | Note     | 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     | $T_{opr}$  |                         | (Note 1) | -40 to 125    | °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.

Note 1: Operating Range spec of  $T_{opr} = -40\text{ °C}$  to  $125\text{ °C}$  is applicable only for the products which manufactured after July 2020.

### 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                | $V_{OH}$ | $V_{IN} = V_{IH}$ or $V_{IL}$                              | $I_{OH} = -20\text{ }\mu\text{A}$ | 2.0  | 1.9  | 2.0       | —             | V |
|  |          |  |                                   | 4.5  | 4.4  | 4.5       | —             |   |
|  |          |  | 6.0                               | 5.9  | 6.0  | —         |               |   |
|  |          |  | $I_{OH} = -6\text{ mA}$           | 4.5  | 4.18 | 4.31      | —             |   |
|  |          |  | $I_{OH} = -7.8\text{ mA}$         | 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           |   |
|  |          |  | $I_{OL} = 6\text{ mA}$            | 4.5  | —    | 0.17      | 0.26          |   |
|  |          |  | $I_{OL} = 7.8\text{ mA}$          | 6.0  | —    | 0.18      | 0.26          |   |
| 3-state output OFF-state leakage current | $I_{OZ}$ | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$V_{OUT} = V_{CC}$ or GND | 6.0                               | —    | —    | $\pm 0.5$ | $\mu\text{A}$ |   |
| Input leakage current                    | $I_{IN}$ | $V_{IN} = V_{CC}$ or GND                                   | 6.0                               | —    | —    | $\pm 0.1$ | $\mu\text{A}$ |   |
| Quiescent supply current                 | $I_{CC}$ | $V_{IN} = V_{CC}$ or GND                                   | 6.0                               | —    | —    | 4.0       | $\mu\text{A}$ |   |

#### 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                | $V_{OH}$ | $V_{IN} = V_{IH}$ or $V_{IL}$                              | $I_{OH} = -20\text{ }\mu\text{A}$ | 2.0  | 1.9       | —             | V |
|  |          |  |                                   | 4.5  | 4.4       | —             |   |
|  |          |  | 6.0                               | 5.9  | —         |               |   |
|  |          |  | $I_{OH} = -6\text{ mA}$           | 4.5  | 4.13      | —             |   |
|  |          |  | $I_{OH} = -7.8\text{ mA}$         | 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           |   |
|  |          |  | $I_{OL} = 6\text{ mA}$            | 4.5  | —         | 0.33          |   |
|  |          |  | $I_{OL} = 7.8\text{ mA}$          | 6.0  | —         | 0.33          |   |
| 3-state output OFF-state leakage current | $I_{OZ}$ | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$V_{OUT} = V_{CC}$ or GND | 6.0                               | —    | $\pm 5.0$ | $\mu\text{A}$ |   |
| Input leakage current                    | $I_{IN}$ | $V_{IN} = V_{CC}$ or GND                                   | 6.0                               | —    | $\pm 1.0$ | $\mu\text{A}$ |   |
| Quiescent supply current                 | $I_{CC}$ | $V_{IN} = V_{CC}$ or GND                                   | 6.0                               | —    | 40.0      | $\mu\text{A}$ |   |

### 11.3. DC Characteristics (Note) (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 $V_{IL}$                              | $I_{OH} = -20 \mu A$     | 2.0  | 1.9       | —       | V |
|  |          |  |                          | 4.5  | 4.4       | —       |   |
|  |          |  |                          | 6.0  | 5.9       | —       |   |
|  |          |  | $I_{OH} = -6 \text{ mA}$ | 4.5  | 3.7       | —       |   |
|  |          |  |                          | 6.0  | 5.2       | —       |   |
| Low-level output voltage                 | $V_{OL}$ | $V_{IN} = V_{IH}$ or $V_{IL}$                              | $I_{OL} = 20 \mu A$      | 2.0  | —         | 0.1     | V |
|  |          |  |                          | 4.5  | —         | 0.1     |   |
|  |          |  |                          | 6.0  | —         | 0.1     |   |
|  |          |  | $I_{OL} = 6 \text{ mA}$  | 4.5  | —         | 0.4     |   |
|  |          |  |                          | 6.0  | —         | 0.4     |   |
| 3-state output OFF-state leakage current | $I_{OZ}$ | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$V_{OUT} = V_{CC}$ or GND | 6.0                      | —    | $\pm 5.0$ | $\mu A$ |   |
| Input leakage current                    | $I_{IN}$ | $V_{IN} = V_{CC}$ or GND                                   | 6.0                      | —    | $\pm 1.0$ | $\mu A$ |   |
| Quiescent supply current                 | $I_{CC}$ | $V_{IN} = V_{CC}$ or GND                                   | 6.0                      | —    | 80.0      | $\mu A$ |   |

Note: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after July 2020.

Not Recommended for New Design

### 11.4. AC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

| Characteristics               | Part Number | Symbol             | Note     | Test Condition           | $C_L$ (pF) | $V_{CC}$ (V) | Min | Typ. | Max | Unit |
|-------------------------------|-------------|--------------------|----------|--------------------------|------------|--------------|-----|------|-----|------|
| Output transition time        |             | $t_{TLH}, t_{THL}$ |          |                          | 50         | 2.0          | —   | 25   | 60  | ns   |
|                               |             |                    |          |                          |            | 4.5          | —   | 7    | 12  |      |
|                               |             |                    |          |                          |            | 6.0          | —   | 6    | 10  |      |
| Propagation delay time        |             | $t_{PLH}, t_{PHL}$ |          |                          | 50         | 2.0          | —   | 36   | 90  | ns   |
|                               |             |                    |          |                          |            | 4.5          | —   | 12   | 18  |      |
|                               |             |                    |          |                          |            | 6.0          | —   | 10   | 15  |      |
|                               |             |                    |          |                          | 150        | 2.0          | —   | 51   | 130 |      |
|                               |             |                    |          |                          |            | 4.5          | —   | 17   | 26  |      |
|                               |             |                    |          |                          |            | 6.0          | —   | 14   | 22  |      |
| Output enable time            |             | $t_{PZL}, t_{PZH}$ |          | $R_L = 1\text{ k}\Omega$ | 50         | 2.0          | —   | 45   | 125 | ns   |
|                               |             |                    |          |                          |            | 4.5          | —   | 14   | 25  |      |
|                               |             |                    |          |                          |            | 6.0          | —   | 12   | 21  |      |
|                               |             |                    |          |                          | 150        | 2.0          | —   | 60   | 165 |      |
|                               |             |                    |          |                          |            | 4.5          | —   | 19   | 33  |      |
|                               |             |                    |          |                          |            | 6.0          | —   | 16   | 28  |      |
| Output disable time           |             | $t_{PLZ}, t_{PHZ}$ |          | $R_L = 1\text{ k}\Omega$ | 50         | 2.0          | —   | 40   | 125 | ns   |
|                               |             |                    |          |                          |            | 4.5          | —   | 16   | 25  |      |
|                               |             |                    |          |                          |            | 6.0          | —   | 14   | 21  |      |
| Input capacitance             |             | $C_{IN}$           |          | —                        |            |              | —   | 5    | 10  | pF   |
| Output capacitance            |             | $C_{OUT}$          |          | —                        |            |              | —   | 10   | —   | pF   |
| Power dissipation capacitance | 74HC540D    | $C_{PD}$           | (Note 1) | —                        |            |              | —   | 32   | —   | pF   |
|                               | 74HC541D    |                    |          |                          |            |              |     | —    | 35  |      |

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.

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

### 11.5. AC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

| Characteristics        | Symbol             | Test Condition           | $C_L$ (pF) | $V_{CC}$ (V) | Min | Max | Unit |
|------------------------|--------------------|--------------------------|------------|--------------|-----|-----|------|
| Output transition time | $t_{TLH}, t_{THL}$ | —                        | 50         | 2.0          | —   | 75  | ns   |
|                        |                    |                          |            | 4.5          | —   | 15  |      |
|                        |                    |                          |            | 6.0          | —   | 13  |      |
| Propagation delay time | $t_{PLH}, t_{PHL}$ | —                        | 50         | 2.0          | —   | 115 | ns   |
|                        |                    |                          |            | 4.5          | —   | 23  |      |
|                        |                    |                          |            | 6.0          | —   | 20  |      |
|                        |                    |                          | 150        | 2.0          | —   | 165 |      |
|                        |                    |                          |            | 4.5          | —   | 33  |      |
|                        |                    |                          |            | 6.0          | —   | 28  |      |
| Output enable time     | $t_{PZL}, t_{PZH}$ | $R_L = 1\text{ k}\Omega$ | 50         | 2.0          | —   | 155 | ns   |
|                        |                    |                          |            | 4.5          | —   | 31  |      |
|                        |                    |                          |            | 6.0          | —   | 26  |      |
|                        |                    |                          | 150        | 2.0          | —   | 205 |      |
|                        |                    |                          |            | 4.5          | —   | 41  |      |
|                        |                    |                          |            | 6.0          | —   | 35  |      |
| Output disable time    | $t_{PLZ}, t_{PHZ}$ | $R_L = 1\text{ k}\Omega$ | 50         | 2.0          | —   | 155 | ns   |
|                        |                    |                          |            | 4.5          | —   | 31  |      |
|                        |                    |                          |            | 6.0          | —   | 26  |      |
| Input capacitance      | $C_{IN}$           | —                        |            |              | —   | 10  | pF   |

### 11.6. AC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to $125$ °C, Input: $t_r = t_f = 6$ ns)

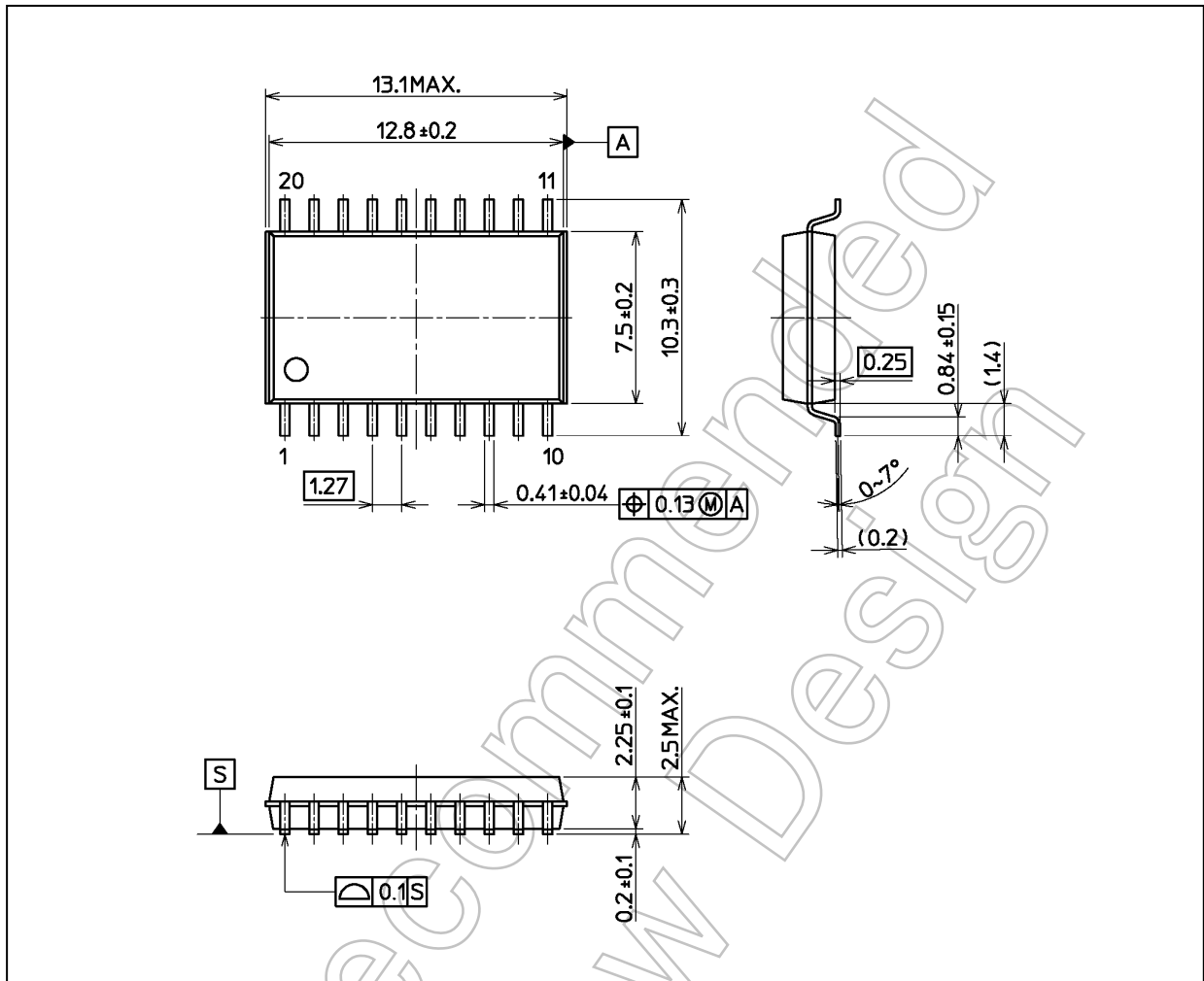
| Characteristics        | Symbol             | Test Condition       | $C_L$ (pF) | $V_{CC}$ (V) | Min | Max | Unit |
|------------------------|--------------------|----------------------|------------|--------------|-----|-----|------|
| Output transition time | $t_{TLH}, t_{THL}$ | —                    | 50         | 2.0          | —   | 85  | ns   |
|                        |                    |                      |            | 4.5          | —   | 17  |      |
|                        |                    |                      |            | 6.0          | —   | 15  |      |
| Propagation delay time | $t_{PLH}, t_{PHL}$ | —                    | 50         | 2.0          | —   | 135 | ns   |
|                        |                    |                      |            | 4.5          | —   | 27  |      |
|                        |                    |                      |            | 6.0          | —   | 24  |      |
|                        |                    |                      | 150        | 2.0          | —   | 190 |      |
|                        |                    |                      |            | 4.5          | —   | 38  |      |
|                        |                    |                      |            | 6.0          | —   | 32  |      |
| Output enable time     | $t_{PZL}, t_{PZH}$ | $R_L = 1$ k $\Omega$ | 50         | 2.0          | —   | 175 | ns   |
|                        |                    |                      |            | 4.5          | —   | 35  |      |
|                        |                    |                      |            | 6.0          | —   | 30  |      |
|                        |                    |                      | 150        | 2.0          | —   | 235 |      |
|                        |                    |                      |            | 4.5          | —   | 47  |      |
|                        |                    |                      |            | 6.0          | —   | 40  |      |
| Output disable time    | $t_{PLZ}, t_{PHZ}$ | $R_L = 1$ k $\Omega$ | 50         | 2.0          | —   | 175 | ns   |
|                        |                    |                      |            | 4.5          | —   | 35  |      |
|                        |                    |                      |            | 6.0          | —   | 30  |      |
| Input capacitance      | $C_{IN}$           | —                    | —          | —            | —   | 10  | pF   |

Note: Operating Range spec of  $T_{opr} = -40$  °C to  $125$  °C is applicable only for the products which manufactured after July 2020.

Not Recommended for New Design

## Package Dimensions

Unit: mm



Weight: 0.51 g (typ.)

|                  |
|------------------|
| Package Name(s)  |
| Nickname: SOIC20 |



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