

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74HC4049AP,TC74HC4049AF,TC74HC4049AFT TC74HC4050AP,TC74HC4050AF,TC74HC4050AFT

TC74HC4049AP/AF/AFT

Hex Buffer/Converter (inverting)

TC74HC4050AP/AF/AFT

Hex  
Buffer/Converter

The TC74HC4049A and TC74HC4050A are high speed CMOS HEX 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 TC74HC4049A is an inverting buffer, while the TC74HC4050A is a non-inverting buffer. The internal circuits are composed of 3-stages (HC4049A) or 2-stages (HC4050A) of inverters, which provided high noise immunity and stable output.

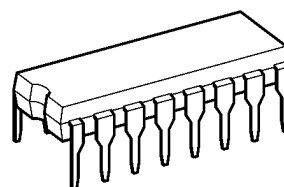
Input protection circuits are different from those of other high speed CMOS IC's. They eliminate the diodes on the VCC side thus providing of logic-level conversion from high-level volages up to 15 V to low-level volages.

They are useful for battery back up circuits, because input voltage can be applied on IC's which are not biased by VCC.

### Features

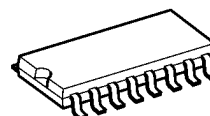
- High speed:  $t_{pd} = 9 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output Drive Capability: 15 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 6 \text{ mA}$  (min)
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC}(\text{opr}) = 2 \text{ V}$  to  $6 \text{ V}$
- Pin and function compatible with 4049B/4050B

TC74HC4049AP, TC74HC4050AP



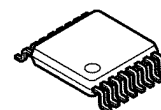
DIP16-P-300-2.54A

TC74HC4049AF, TC74HC4050AF



SOP16-P-300-1.27A

TC74HC4049AFT, TC74HC4050AFT

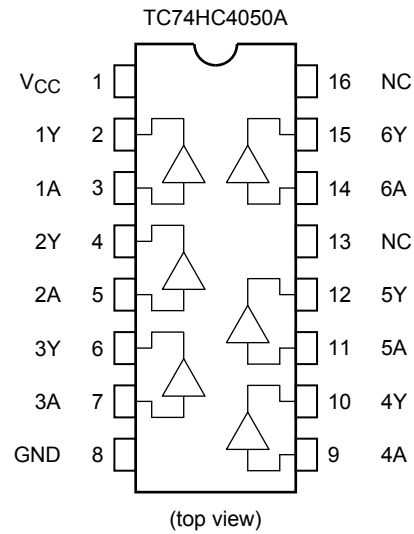
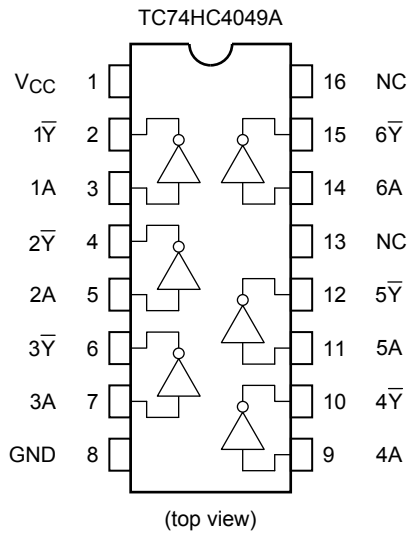


TSSOP16-P-0044-0.65A

### Weight

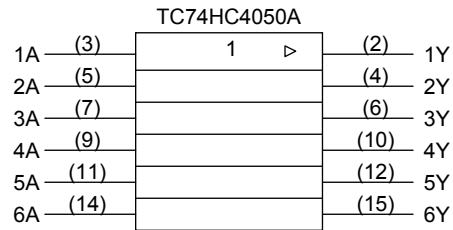
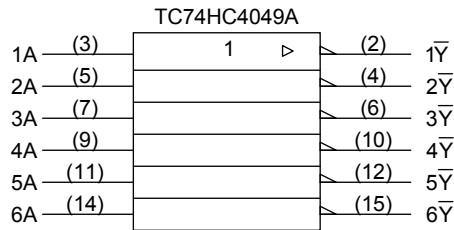
|                      |                 |
|----------------------|-----------------|
| DIP16-P-300-2.54A    | : 1.00 g (typ.) |
| SOP16-P-300-1.27A    | : 0.18 g (typ.) |
| TSSOP16-P-0044-0.65A | : 0.06 g (typ.) |

Pin Assignment



NC: No connection

IEC Logic Symbol

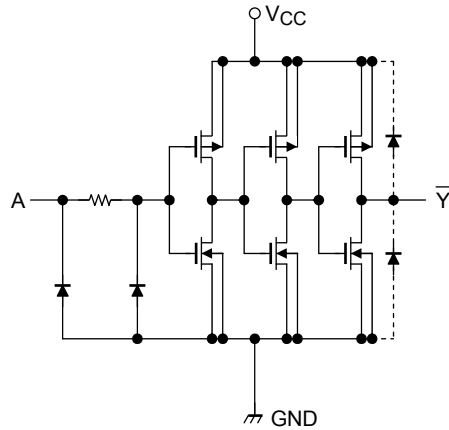


Truth Table

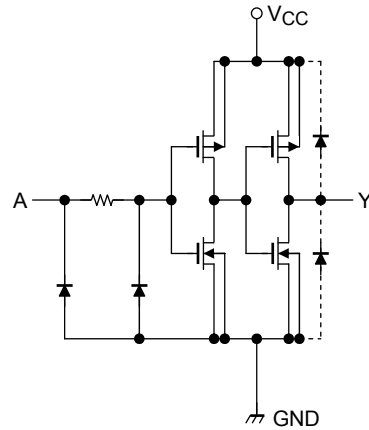
| A | $\bar{Y}$ (4049A) | Y (4050A) |
|---|-------------------|-----------|
| L | H                 | L         |
| H | L                 | H         |

Input and Output Equivalent Circuit

TC74HC4049A



TC74HC4050A



## 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 18 (Note 2)                | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$             | V    |
| Input diode current         | $I_{IK}$  | -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 3)/180 (SOP/TSSOP) | 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: DC input voltage ( $V_{IN}$ ) specified is measured to GND and is not related to  $V_{CC}$ .

Recommended operating range is 0 V to 15 V and it is possible to convert logic-levels from 15 V to 5 V or 5 V to 2 V.

Note 3: 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 15                                                                                                               | 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                 | 1.50 | —    | —                   | 1.50 | —    | V   |
|                           |                 |                                                         |                                                      | 4.5                 | 3.15 | —    | —                   | 3.15 | —    |     |
|                           |                 |                                                         |                                                      | 6.0                 | 4.20 | —    | —                   | 4.20 | —    |     |
| Low-level input voltage   | V <sub>IL</sub> | —                                                       |                                                      | 2.0                 | —    | —    | 0.50                | —    | 0.50 | V   |
|                           |                 |                                                         |                                                      | 4.5                 | —    | —    | 1.35                | —    | 1.35 |     |
|                           |                 |                                                         |                                                      | 6.0                 | —    | —    | 1.80                | —    | 1.80 |     |
| 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<br>I <sub>OH</sub> = -7.8 mA | 4.5                 | 4.18 | 4.31 | —                   | 4.13 | —    |     |
|                           |                 |                                                         |                                                      | 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<br>I <sub>OL</sub> = 7.8 mA   | 4.5                 | —    | 0.17 | 0.26                | —    | 0.33 |     |
|                           |                 |                                                         |                                                      | 6.0                 | —    | 0.18 | 0.26                | —    | 0.33 |     |
|                           |                 |                                                         |                                                      |                     |      |      |                     |      |      |     |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                |                                                      | 6.0                 | —    | —    | ±0.1                | —    | ±1.0 | μA  |
|                           |                 | V <sub>IN</sub> = 15 V                                  |                                                      | 6.0                 | —    | —    | ±0.5                | —    | ±5.0 |     |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                |                                                      | 6.0                 | —    | —    | 1.0                 | —    | 10.0 | μA  |

### AC Characteristics (input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Characteristics               | Symbol                               | Test Condition |                     |                     | Ta = 25°C |      |     | Ta =<br>–40 to 85°C |     | Unit |
|-------------------------------|--------------------------------------|----------------|---------------------|---------------------|-----------|------|-----|---------------------|-----|------|
|                               |                                      |                | C <sub>L</sub> (pF) | V <sub>CC</sub> (V) | Min       | Typ. | Max | Min                 | Max |      |
| Output transition time        | t <sub>TLH</sub>                     | —              | 50                  | 2.0                 | —         | 25   | 60  | —                   | 75  | ns   |
|                               | t <sub>THL</sub>                     |                |                     | 4.5                 | —         | 6    | 12  | —                   | 15  |      |
|                               |                                      |                |                     | 6.0                 | —         | 5    | 10  | —                   | 13  |      |
| Propagation delay time        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 50                  | 2.0                 | —         | 30   | 75  | —                   | 95  | ns   |
|                               |                                      |                |                     | 4.5                 | —         | 9    | 15  | —                   | 19  |      |
|                               |                                      |                |                     | 6.0                 | —         | 8    | 13  | —                   | 16  |      |
|                               |                                      |                | 150                 | 2.0                 | —         | 45   | 100 | —                   | 145 |      |
|                               |                                      |                |                     | 4.5                 | —         | 14   | 20  | —                   | 29  |      |
|                               |                                      |                |                     | 6.0                 | —         | 12   | 17  | —                   | 25  |      |
| Input capacitance             | C <sub>IN</sub>                      | —              |                     |                     | —         | 5    | 10  | —                   | 10  | pF   |
| Power dissipation capacitance | C <sub>PD</sub>                      | (Note)         |                     |                     | —         | 26   | —   | —                   | —   | pF   |

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

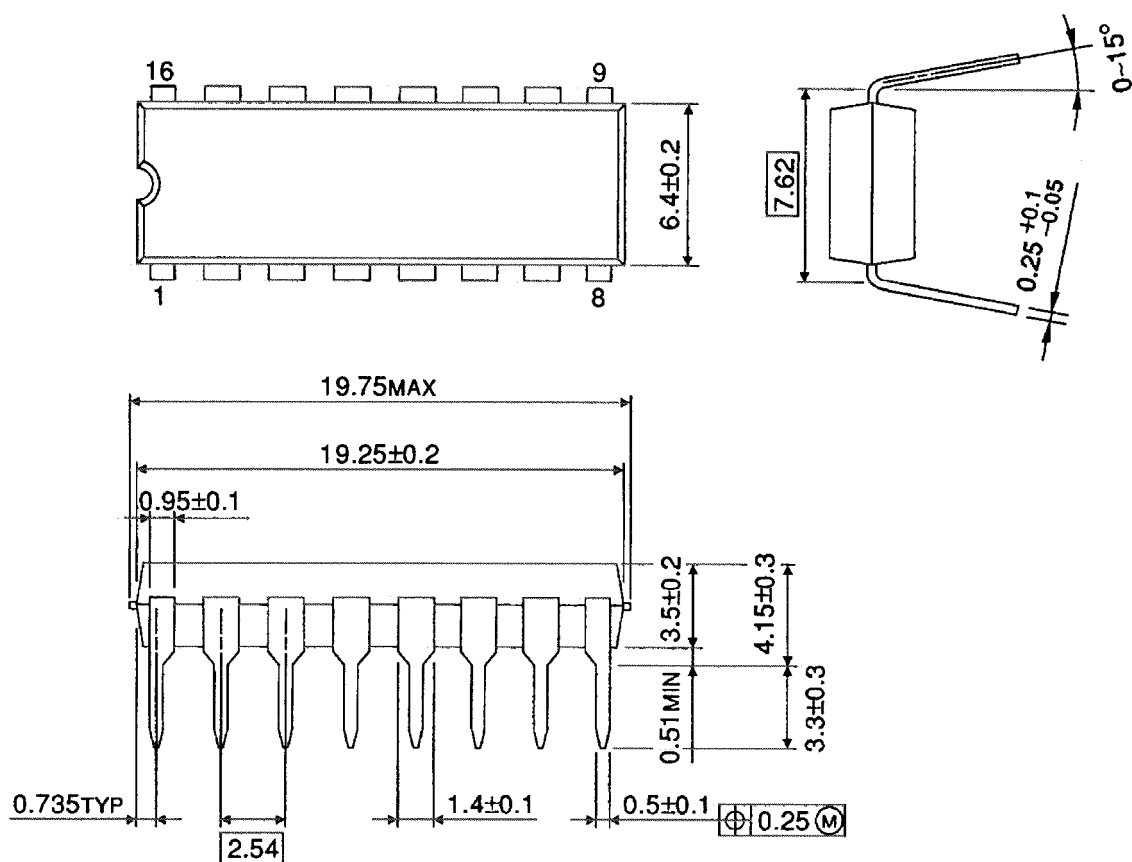
Average operating current can be obtained by the equation:

$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per gate)}$$

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

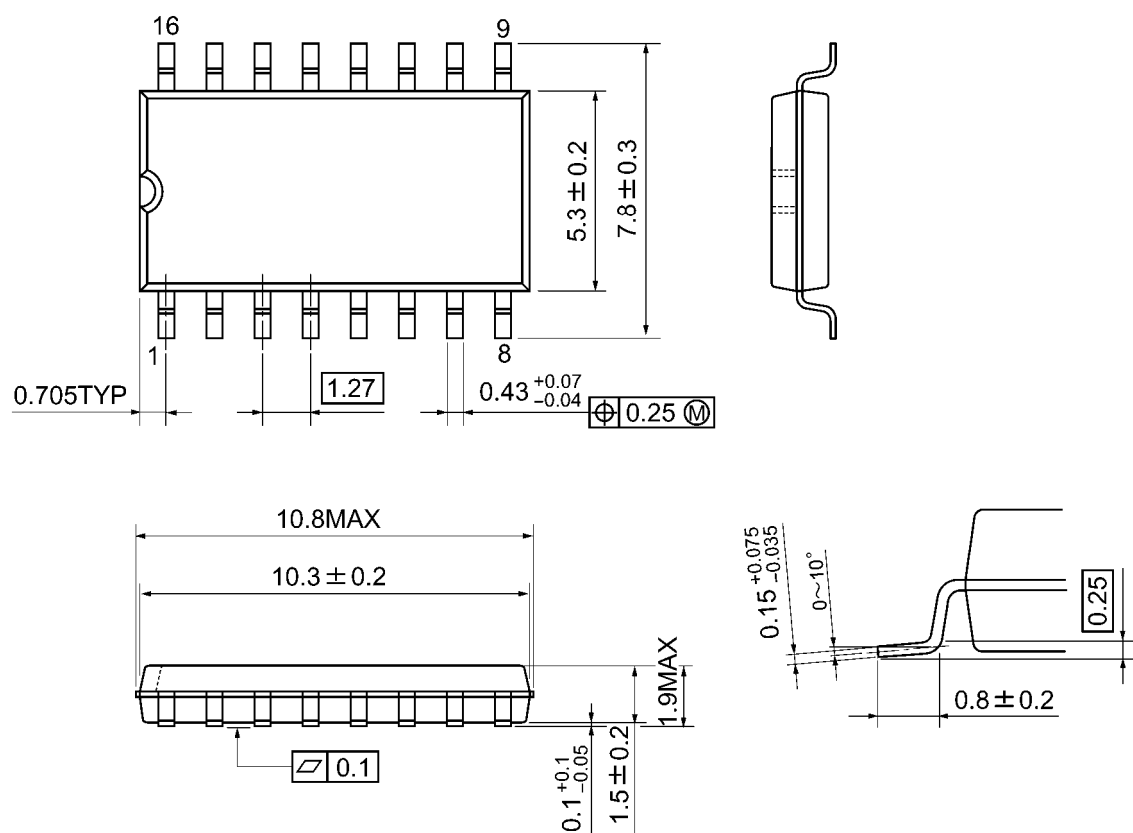


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm

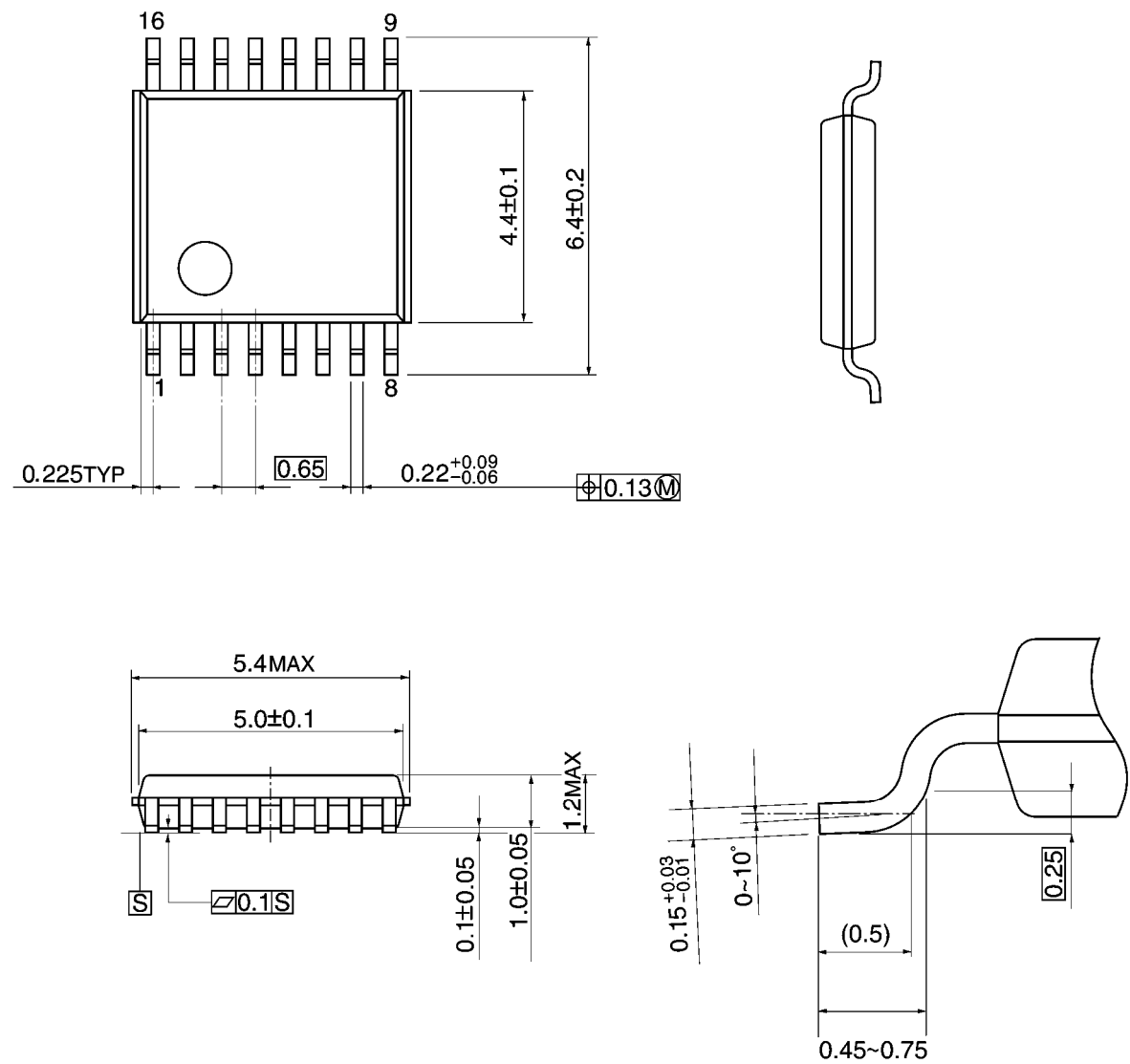


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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