

## TC74VHC238F, TC74VHC238FT, TC74VHC238FK

### 3-to-8 Line Decoder

The TC74VHC238 is an advanced high speed CMOS 3-to-8 DECODER fabricated with silicon gate C<sup>2</sup>MOS technology.

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

When the device is enabled, 3 Binary Select inputs (A, B and C) determine which one of the outputs (Y0-Y7) will go High.

When enable input G1 is held low or either  $\overline{G2A}$  or  $\overline{G2B}$  is held high, decoding function is inhibited and all outputs go Low.

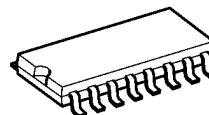
G1,  $\overline{G2A}$ , and  $\overline{G2B}$  inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

### Features

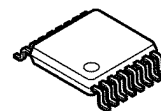
- High speed:  $t_{pd} = 5.5$  ns (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC}(\text{opr}) = 2$  to 5.5 V
- Pin and function compatible with 74ALS238

TC74VHC238F



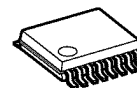
SOP16-P-300-1.27A

TC74VHC238FT



TSSOP16-P-0044-0.65A

TC74VHC238FK

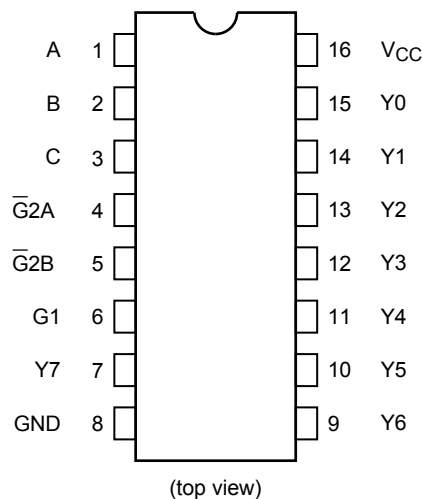


VSSOP16-P-0030-0.50

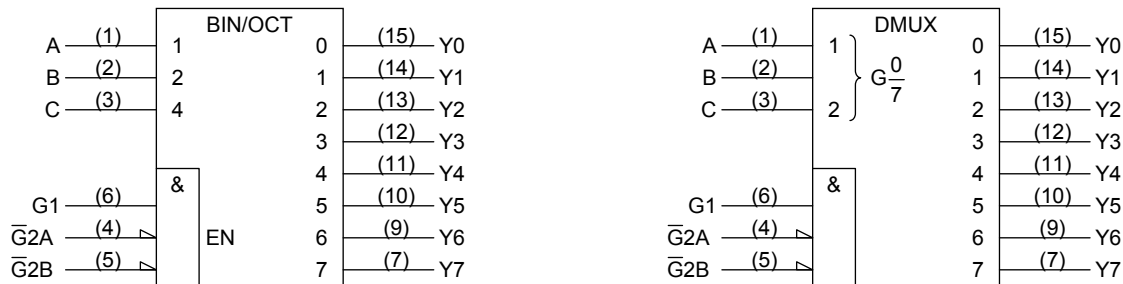
### Weight

|                      |                 |
|----------------------|-----------------|
| SOP16-P-300-1.27A    | : 0.18 g (typ.) |
| TSSOP16-P-0044-0.65A | : 0.06 g (typ.) |
| VSSOP16-P-0030-0.50  | : 0.02 g (typ.) |

Pin Assignment



IEC Logic Symbol

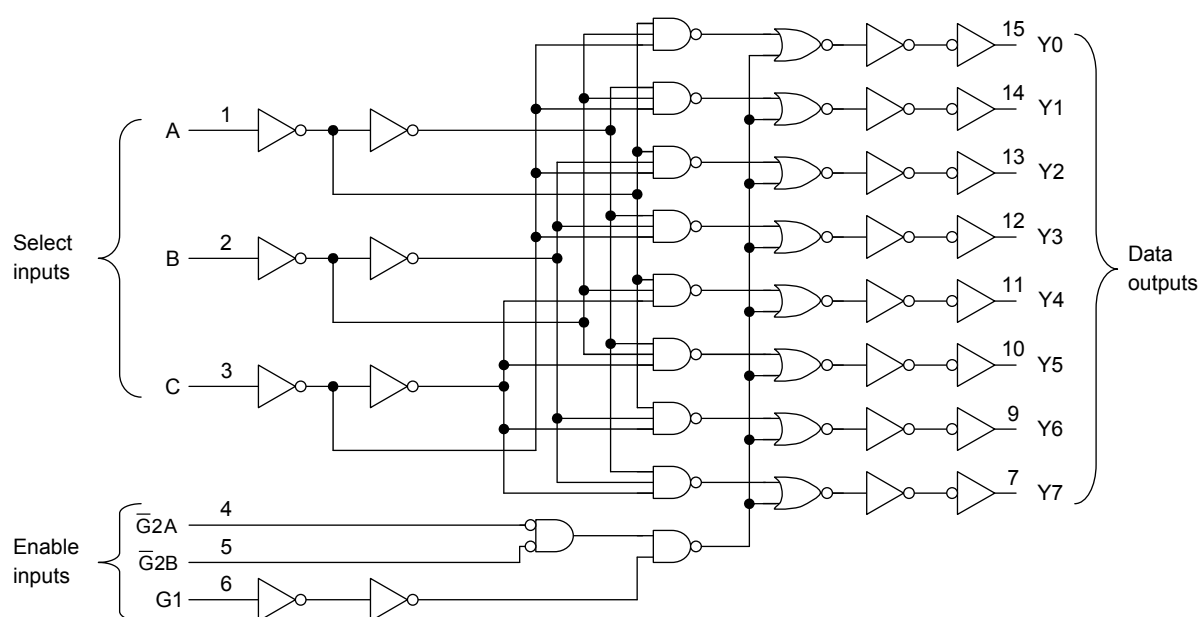


Truth Table

| Inputs |     |     |        |   |   | Outputs |    |    |    |    |    |    |    | Selected Output |
|--------|-----|-----|--------|---|---|---------|----|----|----|----|----|----|----|-----------------|
| Enable |     |     | Select |   |   | Y0      | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |                 |
| G1     | G2A | G2B | C      | B | A |         |    |    |    |    |    |    |    |                 |
| L      | X   | X   | X      | X | X | L       | L  | L  | L  | L  | L  | L  | L  | None            |
| X      | H   | X   | X      | X | X | L       | L  | L  | L  | L  | L  | L  | L  | None            |
| X      | X   | H   | X      | X | X | L       | L  | L  | L  | L  | L  | L  | L  | None            |
| H      | L   | L   | L      | L | L | H       | L  | L  | L  | L  | L  | L  | L  | Y0              |
| H      | L   | L   | L      | L | H | L       | H  | L  | L  | L  | L  | L  | L  | Y1              |
| H      | L   | L   | L      | H | L | L       | L  | H  | L  | L  | L  | L  | L  | Y2              |
| H      | L   | L   | L      | H | H | L       | L  | L  | H  | L  | L  | L  | L  | Y3              |
| H      | L   | L   | H      | L | L | L       | L  | L  | L  | H  | L  | L  | L  | Y4              |
| H      | L   | L   | H      | L | H | L       | L  | L  | L  | L  | H  | L  | L  | Y5              |
| H      | L   | L   | H      | H | L | L       | L  | L  | L  | L  | L  | H  | L  | Y6              |
| H      | L   | L   | H      | H | H | L       | L  | L  | L  | L  | L  | L  | H  | Y7              |

X: Don't care

## Logic Diagram



## Absolute Maximum Ratings (Note)

| Characteristics             | Symbol    | Rating                 | Unit |
|-----------------------------|-----------|------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7.0            | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to 7.0            | 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           | $I_{OUT}$ | $\pm 25$               | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 75$               | mA   |
| Power dissipation           | $P_D$     | 180                    | 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.).

## Operating Range (Note)

| Characteristics          | Symbol    | Rating                                                                    | Unit |
|--------------------------|-----------|---------------------------------------------------------------------------|------|
| Supply voltage           | $V_{CC}$  | 2.0 to 5.5                                                                | V    |
| Input voltage            | $V_{IN}$  | 0 to 5.5                                                                  | V    |
| Output voltage           | $V_{OUT}$ | 0 to $V_{CC}$                                                             | V    |
| Operating temperature    | $T_{opr}$ | -40 to 85                                                                 | °C   |
| Input rise and fall time | $dt/dv$   | 0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V)<br>0 to 20 ( $V_{CC} = 5 \pm 0.5$ V) | ns/V |

Note: The operating range 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 = -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<br>3.0 to 5.5        | 1.50<br>V <sub>CC</sub> × 0.7 | —<br>—            | —<br>—                        | 1.50<br>V <sub>CC</sub> × 0.7 | —<br>—                        | V    |
| Low-level input voltage   | V <sub>IL</sub> | —                                                    | 2.0<br>3.0 to 5.5        | —<br>—                        | —<br>—            | 0.50<br>V <sub>CC</sub> × 0.3 | —<br>—                        | 0.50<br>V <sub>CC</sub> × 0.3 | V    |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -50 µA | 2.0<br>3.0<br>4.5             | 1.9<br>2.9<br>4.4 | 2.0<br>3.0<br>4.5             | —<br>—<br>—                   | 1.9<br>2.9<br>4.4             | V    |
|                           |                 |                                                      | I <sub>OH</sub> = -4 mA  | 3.0                           | 2.58              | —                             | —                             | 2.48                          |      |
|                           |                 |                                                      | I <sub>OH</sub> = -8 mA  | 4.5                           | 3.94              | —                             | —                             | 3.80                          |      |
|                           |                 |                                                      |                          |                               |                   |                               |                               |                               |      |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OL</sub> = 50 µA  | 2.0<br>3.0<br>4.5             | —<br>—<br>—       | 0.0<br>0.0<br>0.0             | 0.1<br>0.1<br>0.1             | —<br>—<br>—                   | V    |
|                           |                 |                                                      | I <sub>OL</sub> = 4 mA   | 3.0                           | —                 | —                             | 0.36                          | —                             |      |
|                           |                 |                                                      | I <sub>OL</sub> = 8 mA   | 4.5                           | —                 | —                             | 0.36                          | —                             |      |
|                           |                 |                                                      |                          |                               |                   |                               |                               |                               |      |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = 5.5 V or GND                       | 0 to 5.5                 | —                             | —                 | ±0.1                          | —                             | ±1.0                          | µA   |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             | 5.5                      | —                             | —                 | 4.0                           | —                             | 40.0                          | µA   |

## AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

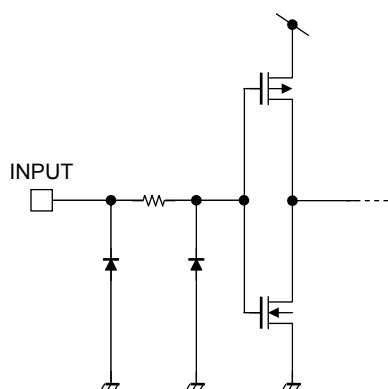
| Characteristics                                 | Symbol                               | Test Condition |                     |                     | Ta = 25°C |      |      | Ta = -40 to 85°C |      | Unit |
|-------------------------------------------------|--------------------------------------|----------------|---------------------|---------------------|-----------|------|------|------------------|------|------|
|                                                 |                                      |                | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min       | Typ. | Max  | Min              | Max  |      |
| Propagation delay time<br>(A, B, C-Y)           | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 3.3 ± 0.3           | 15                  | —         | 8.0  | 12.3 | 1.0              | 14.5 | ns   |
|                                                 |                                      |                |                     | 50                  | —         | 10.5 | 15.8 | 1.0              | 18.0 |      |
|                                                 |                                      |                | 5.0 ± 0.5           | 15                  | —         | 5.5  | 8.1  | 1.0              | 9.5  |      |
|                                                 |                                      |                |                     | 50                  | —         | 7.0  | 10.1 | 1.0              | 11.5 |      |
| Propagation delay time<br>(G1-Y)                | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 3.3 ± 0.3           | 15                  | —         | 8.1  | 12.8 | 1.0              | 15.0 | ns   |
|                                                 |                                      |                |                     | 50                  | —         | 10.6 | 16.3 | 1.0              | 18.5 |      |
|                                                 |                                      |                | 5.0 ± 0.5           | 15                  | —         | 5.4  | 8.1  | 1.0              | 9.5  |      |
|                                                 |                                      |                |                     | 50                  | —         | 6.9  | 10.1 | 1.0              | 11.5 |      |
| Propagation delay time<br>( $\overline{G}2$ -Y) | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 3.3 ± 0.3           | 15                  | —         | 8.1  | 12.3 | 1.0              | 14.5 | ns   |
|                                                 |                                      |                |                     | 50                  | —         | 10.6 | 15.8 | 1.0              | 18.0 |      |
|                                                 |                                      |                | 5.0 ± 0.5           | 15                  | —         | 5.7  | 8.1  | 1.0              | 9.5  |      |
|                                                 |                                      |                |                     | 50                  | —         | 7.2  | 10.1 | 1.0              | 11.5 |      |
| Input capacitance                               | C <sub>IN</sub>                      | —              |                     |                     | —         | 4    | —    | —                | 10   | pF   |
| Power dissipation capacitance                   | C <sub>PD</sub>                      | (Note)         |                     |                     | —         | 37   | —    | —                | —    | 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:

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

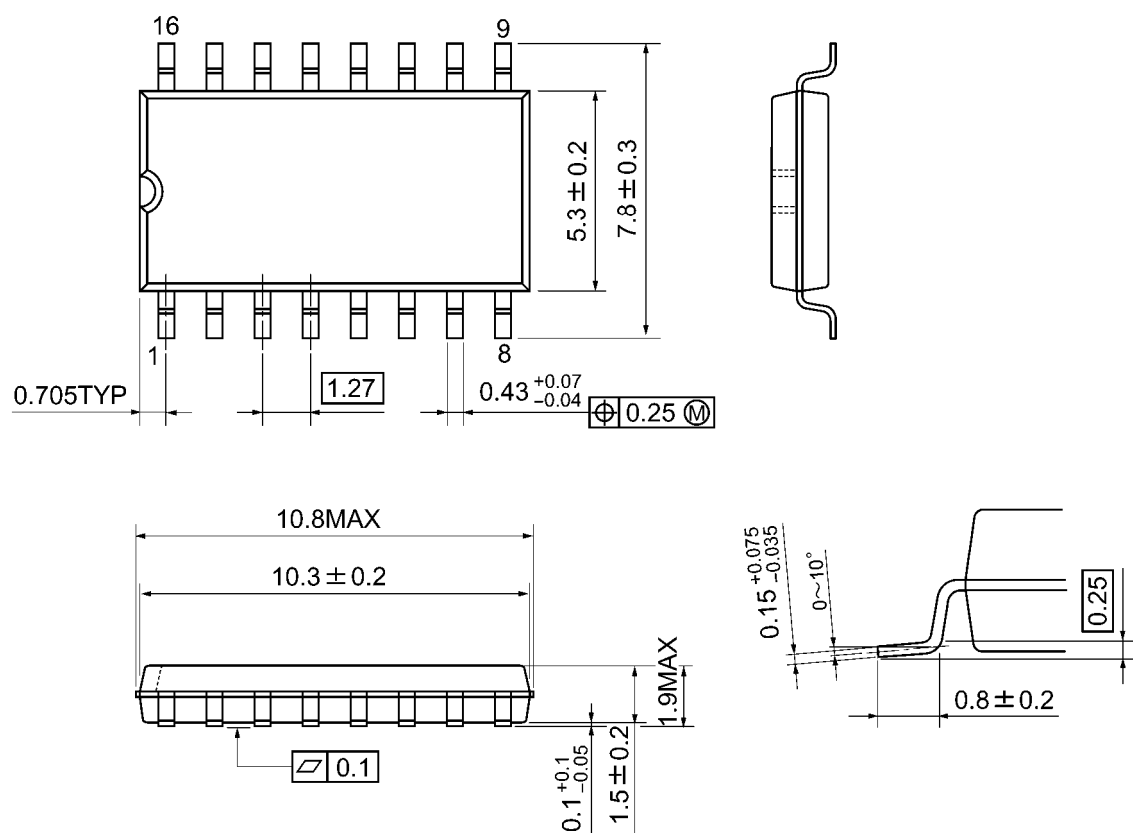
## Input Equivalent Circuit



## Package Dimensions

SOP16-P-300-1.27A

Unit: mm

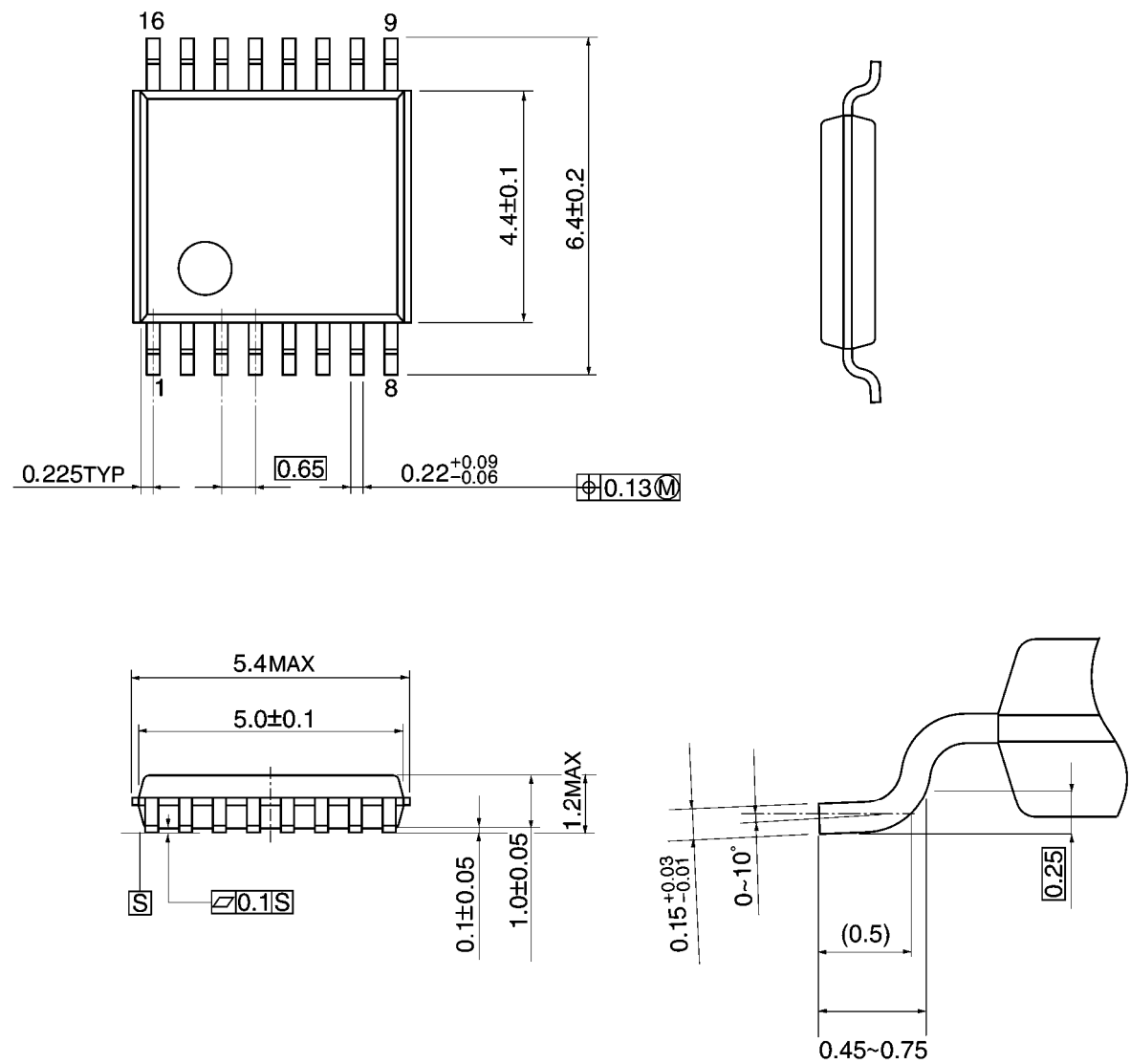


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm

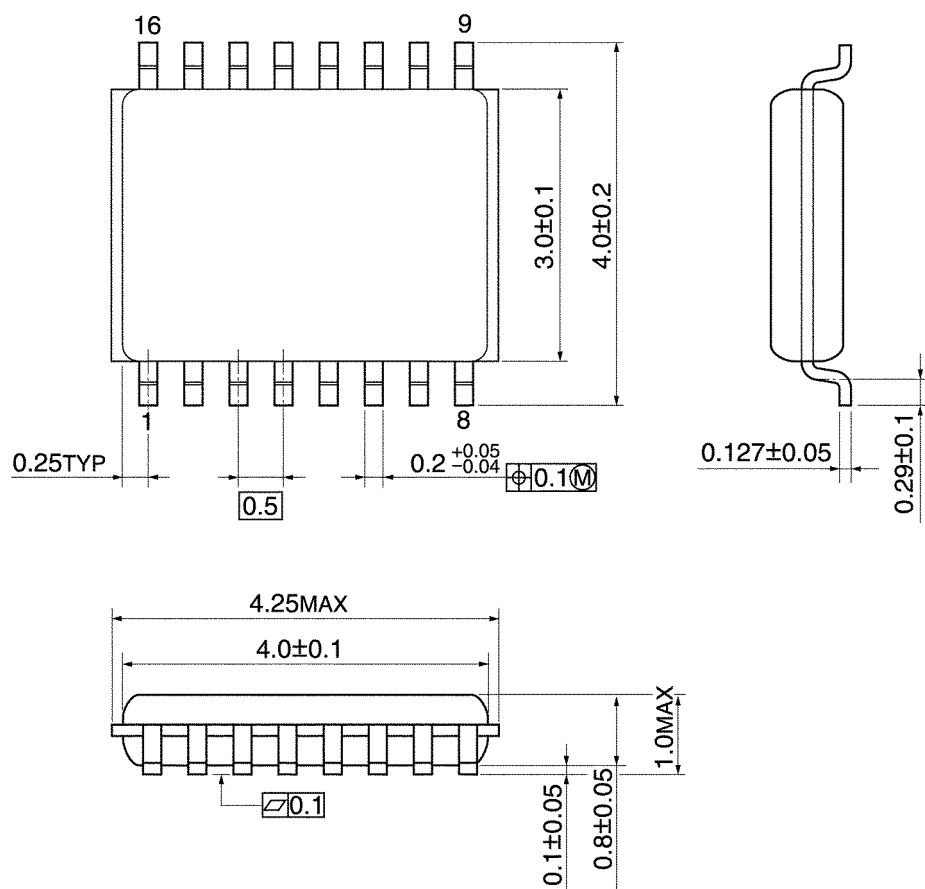


Weight: 0.06 g (typ.)

## Package Dimensions

VSSOP16-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)



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