

## TC74LCX07F, TC74LCX07FT, TC74LCX07FK

### Low-Voltage HEX Buffer with 5-V Tolerant Inputs and Outputs (open drain)

The TC74LCX07 is a high-performance CMOS buffer. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

The TC74LCX07 has high performance MOS N-channel transistor. (open-drain outputs)

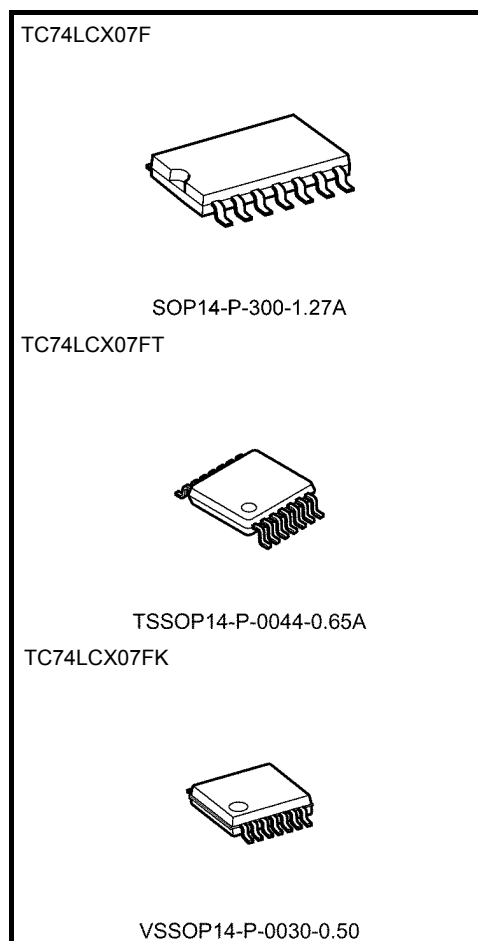
The device is designed for low-voltage (3.3 V) VCC applications, but it could be used to interface to 5-V supply\* environment for inputs.

All inputs are equipped with protection circuits against static discharge.

\*I<sub>OUT</sub> absolute maximum rating must be observed.

### Features

- Low-voltage operation: V<sub>CC</sub> = 1.65 to 5.5 V
- High-speed operation: t<sub>pZ</sub> = 3.7 ns (max) (V<sub>CC</sub> = 3.0 to 3.6 V)
- Output current: I<sub>OL</sub> = 24 mA (min) (V<sub>CC</sub> = 3.0 V)
- Latch-up performance: > -500 mA
- Available in JEITA SOP, TSSOP and VSSOP (US)
- Open-drain outputs
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 07 type

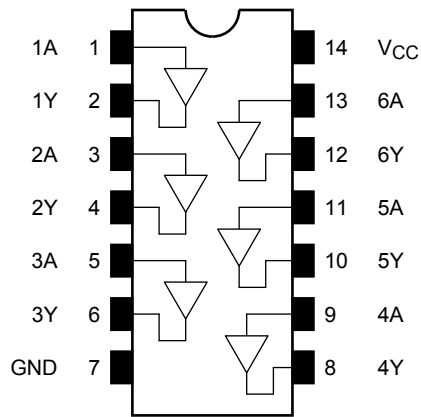


#### Weight

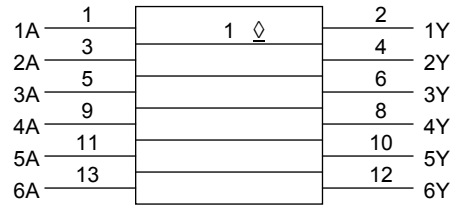
|                      |                 |
|----------------------|-----------------|
| SOP14-P-300-1.27A    | : 0.18 g (typ.) |
| TSSOP14-P-0044-0.65A | : 0.06 g (typ.) |
| VSSOP14-P-0030-0.50  | : 0.02 g (typ.) |

Note: The Voltage operation of V<sub>CC</sub>=1.65 to 5.5V is only applicable for products which manufactured from January 2009 onward.

## Pin Assignment (top view)



## IEC Logic Symbol

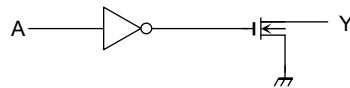


## Truth Table

| Inputs | Outputs |
|--------|---------|
| A      | Y       |
| L      | L       |
| H      | Z       |

Z: High impedance

## System Diagram (per gate)



## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol           | Rating               | Unit        |
|-----------------------------|------------------|----------------------|-------------|
| Power supply voltage        | $V_{CC}$         | -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 7.0 (Note 2) | V           |
| Input diode current         | $I_{IK}$         | -50                  | mA          |
| Output diode current        | $I_{OK}$         | -50 (Note 3)         | mA          |
| DC output current           | $I_{OUT}$        | 50                   | mA          |
| Power dissipation           | $P_D$            | 180                  | mW          |
| DC $V_{CC}$ /ground current | $I_{CC}/I_{GND}$ | $\pm 100$            | mA          |
| Storage temperature         | $T_{stg}$        | -65 to 150           | $^{\circ}C$ |

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: Output in OFF state.  $I_{OUT}$  absolute maximum rating must be observed (Output in low state)

Note 3:  $V_{OUT} < GND$

**Operating Ranges (Note 1)**

| Characteristics          | Symbol    | Rating              | Unit |
|--------------------------|-----------|---------------------|------|
| Power supply voltage     | $V_{CC}$  | 1.65 to 5.5         | V    |
|                          |           | 1.5 to 5.5 (Note 2) |      |
| Input voltage            | $V_{IN}$  | 0 to 5.5            | V    |
| Output voltage           | $V_{OUT}$ | 0 to 5.5            | V    |
| Output current           | $I_{OL}$  | 32 (Note 3)         | mA   |
|                          |           | 24 (Note 4)         |      |
|                          |           | 12 (Note 5)         |      |
| Operating temperature    | $T_{opr}$ | -40 to 85           | °C   |
| Input rise and fall time | dt/dv     | 0 to 10 (Note 6)    | ns/V |

Note 1: 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 2: Data retention only

Note 3:  $V_{CC} = 4.5$  to  $5.5$  V

Note 4:  $V_{CC} = 3.0$  to  $3.6$  V

Note 5:  $V_{CC} = 2.7$  to  $3.0$  V

Note 6:  $V_{CC} = 1.65$  to  $5.5$  V

**Electrical Characteristics**
**DC Characteristics (Ta = -40 to 85°C)**

| Characteristics                       |         | Symbol           | Test Condition                                                    |                          |                     | Min                   | Max                   | Unit |
|---------------------------------------|---------|------------------|-------------------------------------------------------------------|--------------------------|---------------------|-----------------------|-----------------------|------|
|                                       |         |                  |                                                                   |                          | V <sub>CC</sub> (V) |                       |                       |      |
| Input voltage                         | H-level | V <sub>IH</sub>  | —                                                                 |                          | 1.65 to 2.3         | V <sub>CC</sub> × 0.9 | —                     | V    |
|                                       |         |                  |                                                                   |                          | 2.3 to 2.7          | 1.7                   | —                     |      |
|                                       |         |                  |                                                                   |                          | 2.7 to 3.6          | 2.0                   | —                     |      |
|                                       |         |                  |                                                                   |                          | 4.5 to 5.5          | V <sub>CC</sub> × 0.7 | —                     |      |
|                                       | L-level | V <sub>IL</sub>  | —                                                                 |                          | 1.65 to 2.3         | —                     | V <sub>CC</sub> × 0.1 |      |
|                                       |         |                  |                                                                   |                          | 2.3 to 2.7          | —                     | 0.7                   |      |
|                                       |         |                  |                                                                   |                          | 2.7 to 3.6          | —                     | 0.8                   |      |
|                                       |         |                  |                                                                   |                          | 4.5 to 5.5          | —                     | V <sub>CC</sub> × 0.3 |      |
| Output voltage                        | L-level | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IL</sub>                                 | I <sub>OL</sub> = 100 μA | 1.65 to 5.5         | —                     | 0.2                   | V    |
|                                       |         |                  |                                                                   | I <sub>OL</sub> = 4 mA   | 1.65                | —                     | 0.45                  |      |
|                                       |         |                  |                                                                   | I <sub>OL</sub> = 8 mA   | 2.3                 | —                     | 0.7                   |      |
|                                       |         |                  |                                                                   | I <sub>OL</sub> = 12 mA  | 2.7                 | —                     | 0.4                   |      |
|                                       |         |                  |                                                                   | I <sub>OL</sub> = 16 mA  | 3.0                 | —                     | 0.4                   |      |
|                                       |         |                  |                                                                   | I <sub>OL</sub> = 24 mA  | 3.0                 | —                     | 0.55                  |      |
|                                       |         |                  |                                                                   | I <sub>OL</sub> = 32 mA  | 4.5                 | —                     | 0.55                  |      |
| Input leakage current                 |         | I <sub>IN</sub>  | V <sub>IN</sub> = 0 to 5.5 V                                      |                          | 1.65 to 5.5         | —                     | ±5.0                  | μA   |
| Output OFF state current              |         | I <sub>OZ</sub>  | V <sub>IN</sub> = V <sub>IH</sub> , V <sub>OUT</sub> = 0 to 5.5 V |                          | 1.65 to 5.5         | —                     | ±5.0                  | μA   |
| Power-off leakage current             |         | I <sub>OFF</sub> | V <sub>IN</sub> /V <sub>OUT</sub> = 5.5 V                         |                          | 0                   | —                     | 10.0                  | μA   |
| Quiescent supply current              |         | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                          |                          | 1.65 to 5.5         | —                     | 10.0                  | μA   |
| Increase in I <sub>CC</sub> per input |         | ΔI <sub>CC</sub> | V <sub>IH</sub> = V <sub>CC</sub> – 0.6 V                         |                          | 2.7 to 3.6          | —                     | 500                   |      |
|                                       |         |                  |                                                                   |                          | 4.5 to 5.5          | —                     | 1                     | mA   |

**AC Characteristics (Ta = -40 to 85°C)**

| Characteristics       | Symbol            | Test Condition     | V <sub>CC</sub> (V) | Min | Max  | Unit |
|-----------------------|-------------------|--------------------|---------------------|-----|------|------|
|                       |                   |                    |                     |     |      |      |
| Output enable time    | t <sub>pZL</sub>  | Figure 1, Figure 2 | 1.8 ± 0.15          | 1.5 | 22.0 | ns   |
|                       |                   |                    | 2.5 ± 0.2           | 1.2 | 11.0 |      |
|                       |                   |                    | 2.7                 | 1.0 | 4.4  |      |
|                       |                   |                    | 3.3 ± 0.3           | 0.8 | 3.7  |      |
|                       |                   |                    | 5.0 ± 0.5           | 0.5 | 3.0  |      |
| Output disable time   | t <sub>pLZ</sub>  | Figure 1, Figure 2 | 1.8 ± 0.15          | 1.5 | 22.0 | ns   |
|                       |                   |                    | 2.5 ± 0.2           | 1.2 | 11.0 |      |
|                       |                   |                    | 2.7                 | 1.0 | 4.4  |      |
|                       |                   |                    | 3.3 ± 0.3           | 0.8 | 3.7  |      |
|                       |                   |                    | 5.0 ± 0.5           | 0.5 | 3.0  |      |
| Output to output skew | t <sub>osZL</sub> | (Note)             | 2.7                 | —   | —    | ns   |
|                       |                   |                    | 3.3 ± 0.3           | —   | 1.0  |      |

Note: Parameter guaranteed by design.  
 (t<sub>osZL</sub> = |t<sub>pZLm</sub> - t<sub>pZLn</sub>|)

**Dynamic Switching Characteristics (Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 2.5 ns, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω)**

| Characteristics                              | Symbol           | Test Condition                                 | V <sub>CC</sub> (V) | Typ. | Unit |
|----------------------------------------------|------------------|------------------------------------------------|---------------------|------|------|
|                                              |                  |                                                |                     |      |      |
| Quiet output maximum dynamic V <sub>OL</sub> | V <sub>OLP</sub> | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V | 3.3                 | 0.8  | V    |
| Quiet output minimum dynamic V <sub>OL</sub> | V <sub>OLV</sub> | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V | 3.3                 | 0.8  | V    |

**Capacitive Characteristics (Ta = 25°C)**

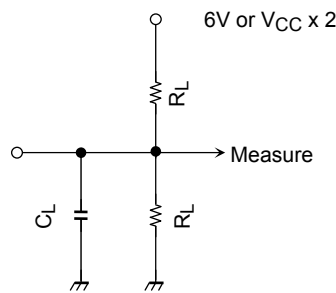
| Characteristics               | Symbol           | Test Condition                  | V <sub>CC</sub> (V) | Typ. | Unit |
|-------------------------------|------------------|---------------------------------|---------------------|------|------|
|                               |                  |                                 |                     |      |      |
| Input capacitance             | C <sub>IN</sub>  | —                               | 3.3                 | 7    | pF   |
| Output capacitance            | C <sub>OUT</sub> |                                 | 3.3                 | 8    | pF   |
| Power dissipation capacitance | C <sub>PD</sub>  | f <sub>IN</sub> = 10 MHz (Note) | 3.3                 | 5    | 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:

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

AC Test Circuit



| Parameter          | Switch                                                                                                                    |
|--------------------|---------------------------------------------------------------------------------------------------------------------------|
| $t_{pLZ}, t_{pZL}$ | 6.0 V @ $V_{CC}=3.3 \pm 0.3 \text{ V}$<br>@ $V_{CC}=2.7\text{V}$                                                          |
|                    | $V_{CC} \times 2$ @ $V_{CC}=5.0 \pm 0.5 \text{ V}$<br>@ $V_{CC}=2.5 \pm 0.2\text{V}$<br>@ $V_{CC}=1.8 \pm 0.15 \text{ V}$ |
|                    |                                                                                                                           |
|                    |                                                                                                                           |

Figure 1

AC Waveform

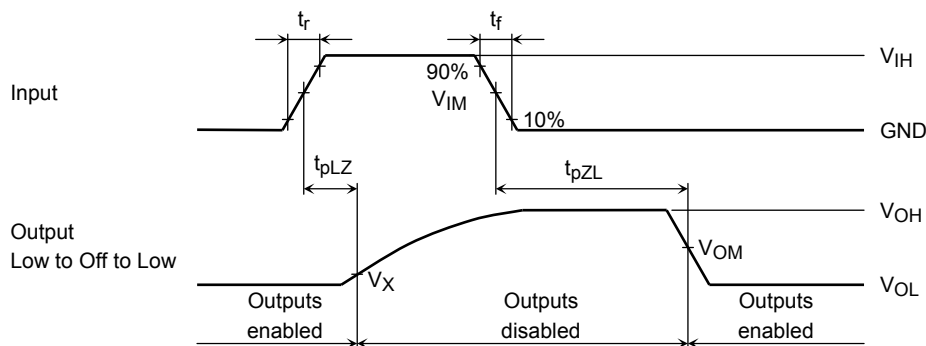


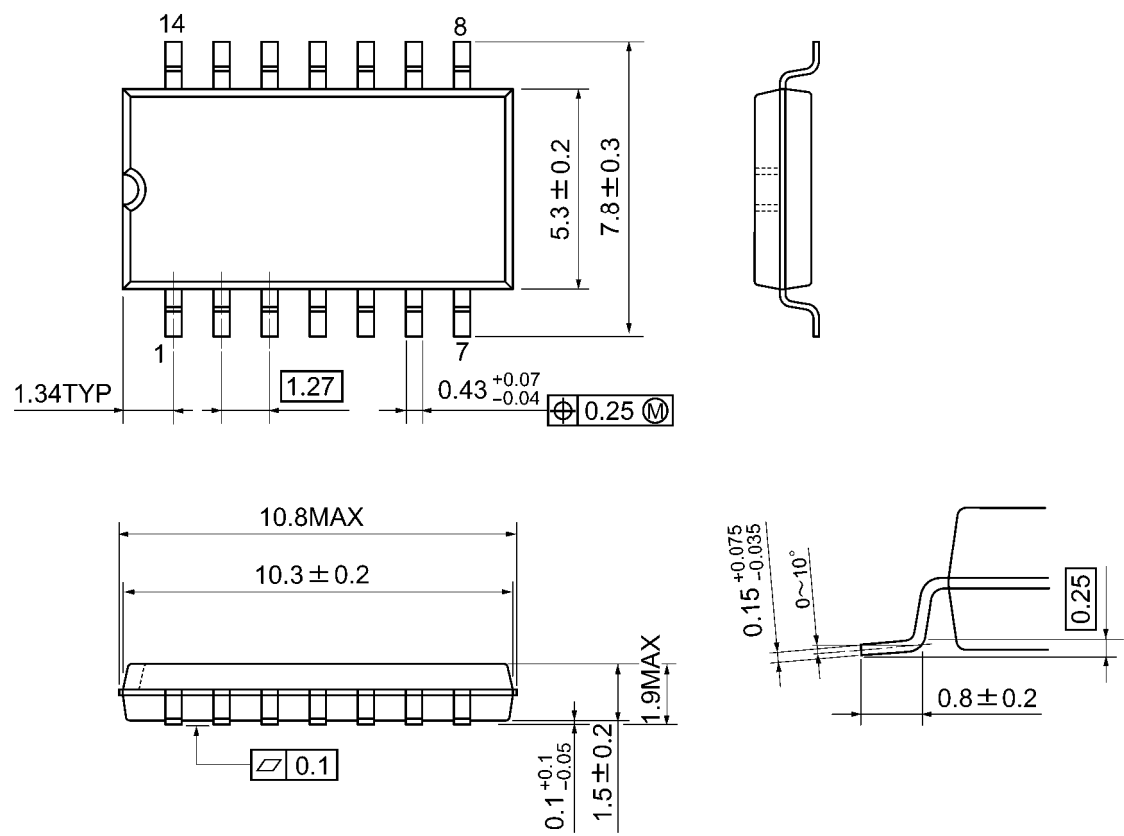
Figure 2  $t_{pLZ}, t_{pZL}$

|        | Symbol     | $V_{CC}$                |                                 |                         |                          |
|--------|------------|-------------------------|---------------------------------|-------------------------|--------------------------|
|        |            | $5.0 \pm 0.5 \text{ V}$ | $3.3 \pm 0.3 \text{ V}$<br>2.7V | $2.5 \pm 0.2 \text{ V}$ | $1.8 \pm 0.15 \text{ V}$ |
| Input  | $V_{IH}$   | $V_{CC}$                | 2.7V                            | $V_{CC}$                | $V_{CC}$                 |
|        | $V_{IM}$   | $V_{CC}/2$              | 1.5V                            | $V_{CC}/2$              | $V_{CC}/2$               |
|        | $t_r, t_f$ | 2.5ns                   | 2.5ns                           | 2.0ns                   | 2.0ns                    |
| Output | $V_{OM}$   | $V_{CC}/2$              | 1.5V                            | $V_{OH}/2$              | $V_{OH}/2$               |
|        | $V_X$      | $V_{OL} + 0.3\text{V}$  | $V_{OL} + 0.3\text{V}$          | $V_{OL} + 0.15\text{V}$ | $V_{OL} + 0.15\text{V}$  |
| Load   | $C_L$      | 50pF                    | 50pF                            | 30pF                    | 30pF                     |
|        | $R_L$      | 500 $\Omega$            | 500 $\Omega$                    | 500 $\Omega$            | 1k $\Omega$              |

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

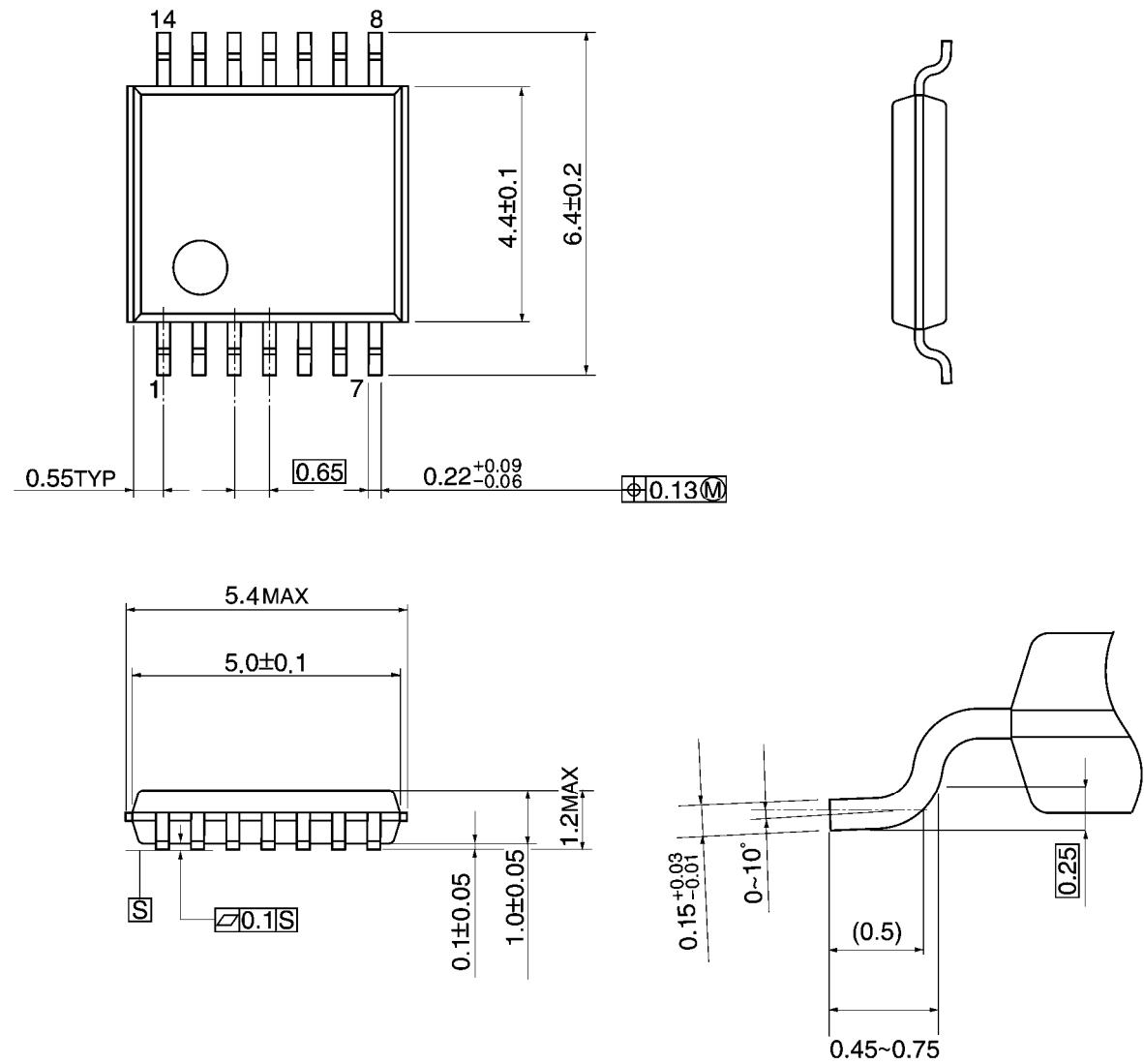


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm



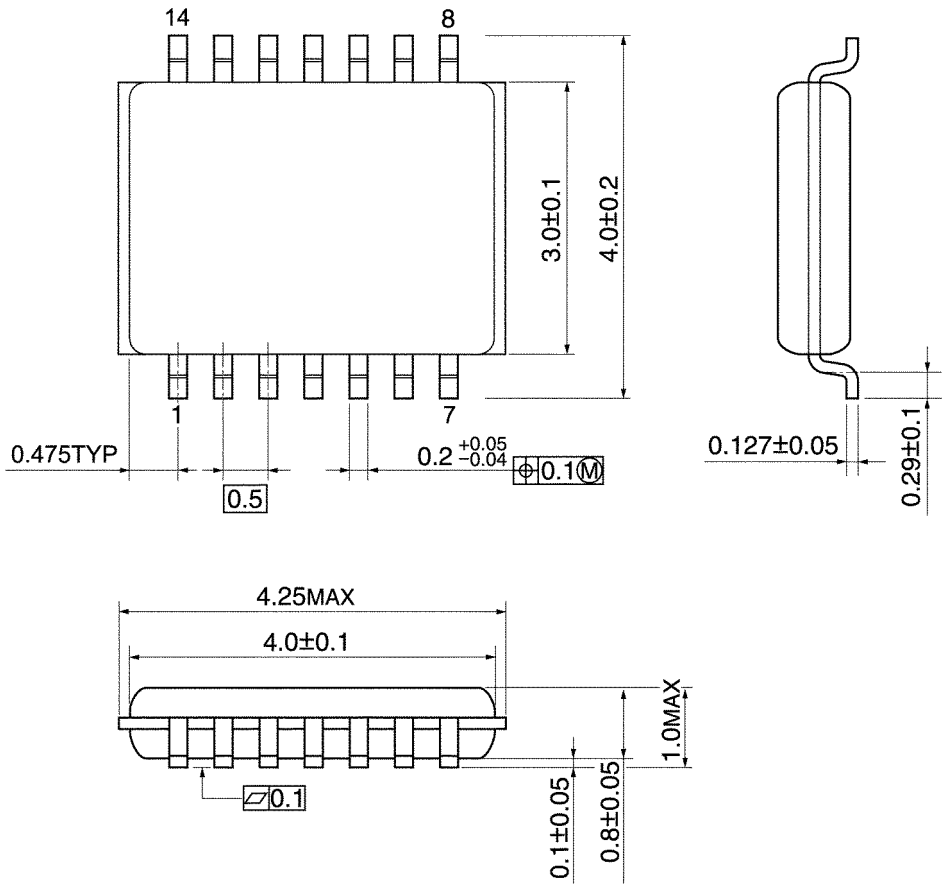
Weight: 0.06 g (typ.)



Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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