

# TC74LVX374F, TC74LVX374FW, TC74LVX374FT

## Octal D-Type Flip-Flop with 3-State Output

The TC74LVX374F/FW/FT is a high-speed CMOS octal D-flip flop fabricated with silicon gate CMOS technology. Designed for use in 3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

This device is suitable for low-voltage and battery operated systems.

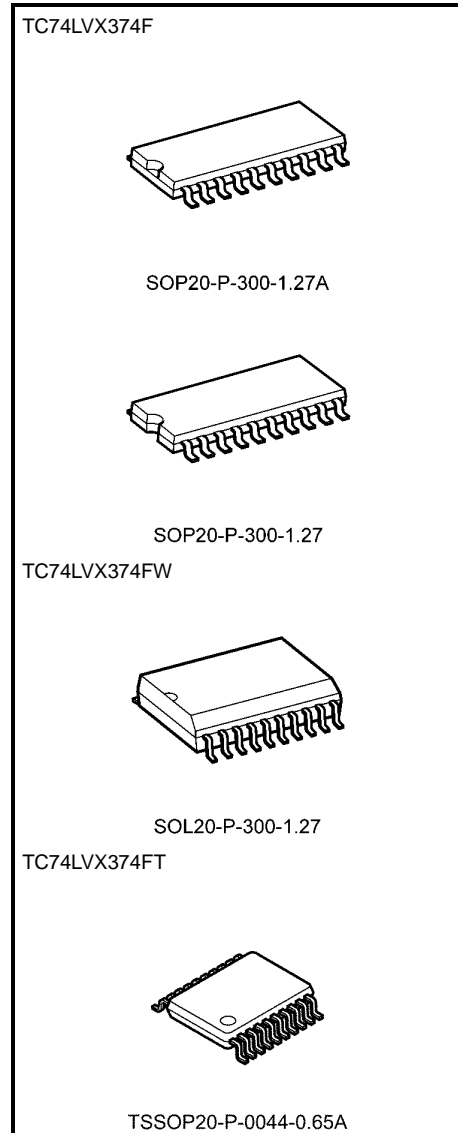
This 8-bit D-type flip-flop is controlled by a clock input (CK) and an output enable input ( $\overline{OE}$ ). When the  $\overline{OE}$  input is high, the eight outputs are in a high-impedance state.

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

### Features

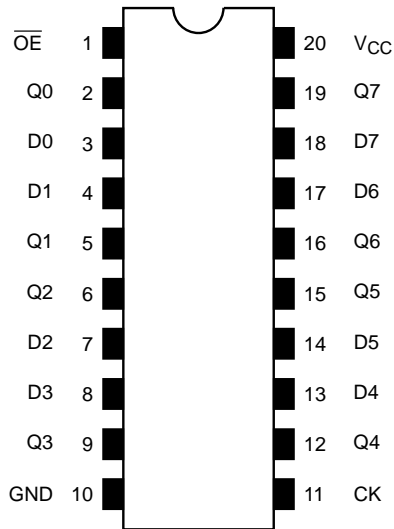
- High-speed:  $f_{max} = 160$  MHz (typ.) ( $V_{CC} = 3.3$  V)
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) ( $T_a = 25^\circ$ C)
- Input voltage level:  $V_{IL} = 0.8$  V (max) ( $V_{CC} = 3$  V)  
 $V_{IH} = 2.0$  V (min) ( $V_{CC} = 3$  V)
- Power-down protection is provided on all inputs
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Low noise:  $V_{OLP} = 0.8$  V (max)
- Pin and function compatible with 74HC374

Note: xxxFW (JEDEC SOP) is not available in Japan.

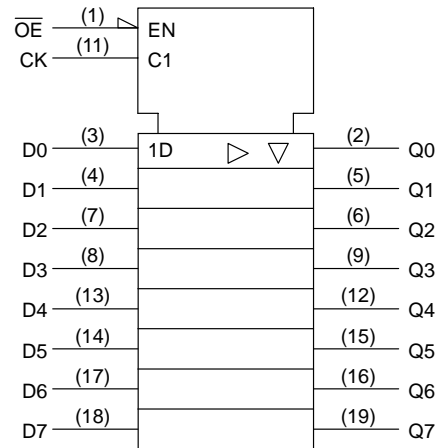


|                      |                 |
|----------------------|-----------------|
| Weight               |                 |
| SOP20-P-300-1.27A    | : 0.22 g (typ.) |
| SOP20-P-300-1.27     | : 0.22 g (typ.) |
| SOL20-P-300-1.27     | : 0.46 g (typ.) |
| TSSOP20-P-0044-0.65A | : 0.08 g (typ.) |

## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

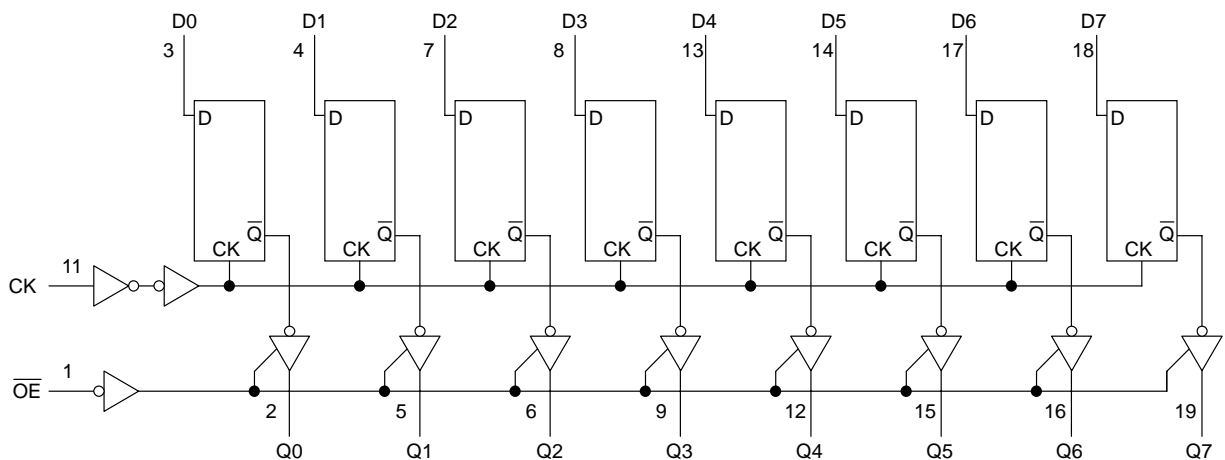
| Inputs          |    |   | Outputs |
|-----------------|----|---|---------|
| $\overline{OE}$ | CK | D |         |
| H               | X  | X | Z       |
| L               |    | X | Qn      |
| L               |    | L | L       |
| L               |    | H | H       |

X: Don't care

Z: High impedance

Qn: No change

## System 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             | $^{\circ}C$ |

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

**Recommended Operating Conditions (Note)**

| Characteristics          | Symbol    | Rating        | Unit        |
|--------------------------|-----------|---------------|-------------|
| Supply voltage           | $V_{CC}$  | 2.0 to 3.6    | 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     | $^{\circ}C$ |
| Input rise and fall time | dt/dv     | 0 to 100      | ns/V        |

Note: The recommended operating conditions are required to ensure the normal operation of the device. Unused inputs must be tied to either VCC 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  |   |
| Input voltage                       | H-level | V <sub>IH</sub> | —   |     | 2.0                      | 1.5 | —     | —                | 1.5  | —    | V    |   |
|                                     |         |                 |   |     | 3.0                      | 2.0 | —     | —                | 2.0  | —    |      |   |
|                                     |         |                 |   |     | 3.6                      | 2.4 | —     | —                | 2.4  | —    |      |   |
|                                     | L-level | V <sub>IL</sub> |   |     | 2.0                      | —   | —     | 0.5              | —    | 0.5  |      |   |
|                                     |         |                 |   |     | 3.0                      | —   | —     | 0.8              | —    | 0.8  |      |   |
|                                     |         |                 |   |     | 3.6                      | —   | —     | 0.8              | —    | 0.8  |      |   |
| Output voltage                      | H-level | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub>   |     | I <sub>OH</sub> = -50 μA | 2.0 | 1.9   | 2.0              | —    | 1.9  | —    | V |
|                                     |         |                 |   |     | I <sub>OH</sub> = -50 μA | 3.0 | 2.9   | 3.0              | —    | 2.9  | —    |   |
|                                     |         |                 |   |     | I <sub>OH</sub> = -4 mA  | 3.0 | 2.58  | —                | —    | 2.48 | —    |   |
|                                     | L-level | V <sub>OL</sub> |   |     | I <sub>OL</sub> = 50 μA  | 2.0 | —     | 0                | 0.1  | —    | 0.1  |   |
|                                     |         |                 |   |     | I <sub>OL</sub> = 50 μA  | 3.0 | —     | 0                | 0.1  | —    | 0.1  |   |
|                                     |         |                 |   |     | I <sub>OL</sub> = 4 mA   | 3.0 | —     | —                | 0.36 | —    | 0.44 |   |
| 3-state output<br>Off-state current |         | I <sub>OZ</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND | 3.6 | —                        | —   | ±0.25 | —                | ±2.5 | μA   |      |   |
| Input leakage current               |         | I <sub>IN</sub> | V <sub>IN</sub> = 5.5 V or GND  | 3.6 | —                        | —   | ±0.1  | —                | ±1.0 | μA   |      |   |
| Quiescent supply current            |         | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND  | 3.6 | —                        | —   | 4.0   | —                | 40.0 | μA   |      |   |

**Timing Requirements (input: t<sub>r</sub> = t<sub>f</sub> = 3 ns)**

| Characteristics             | Symbol             | Test Condition |  | Ta = 25°C           |       | Ta = -40 to 85°C |    | Unit |
|-----------------------------|--------------------|----------------|--|---------------------|-------|------------------|----|------|
|                             |                    |                |  | V <sub>CC</sub> (V) | Limit | Limit            |    |      |
| Minimum pulse width<br>(CK) | t <sub>w</sub> (H) | —              |  | 2.7                 | 7.5   | 8.0              | ns |      |
|                             | t <sub>w</sub> (L) |                |  | 3.3 ± 0.3           | 5.0   | 5.5              |    |      |
| Minimum set-up time         | t <sub>s</sub>     | —              |  | 2.7                 | 6.5   | 6.5              | ns |      |
|                             |                    |                |  | 3.3 ± 0.3           | 4.5   | 4.5              |    |      |
| Minimum hold time           | t <sub>h</sub>     | —              |  | 2.7                 | 2.0   | 2.0              | ns |      |
|                             |                    |                |  | 3.3 ± 0.3           | 2.0   | 2.0              |    |      |

## AC Characteristics (input: $t_r = t_f = 3$ ns)

| Characteristics               | Symbol        | Test Condition       |               |         | Ta = 25°C |      |      | Ta = -40 to 85°C |      | Unit |
|-------------------------------|---------------|----------------------|---------------|---------|-----------|------|------|------------------|------|------|
|                               |               |                      | VCC (V)       | CL (pF) | Min       | Typ. | Max  | Min              | Max  |      |
| Propagation delay time (CK-Q) | $t_{pLH}$     | —                    | 2.7           | 15      | —         | 8.5  | 16.3 | 1.0              | 19.5 | ns   |
|                               |               |                      |               | 50      | —         | 11.0 | 19.8 | 1.0              | 23.0 |      |
|                               | $3.3 \pm 0.3$ |                      | 15            | —       | 6.7       | 10.6 | 1.0  | 12.5             |      |      |
|                               |               |                      | 50            | —       | 9.2       | 14.1 | 1.0  | 16.0             |      |      |
| Output enable time            | $t_{pZL}$     | $R_L = 1$ k $\Omega$ | 2.7           | 15      | —         | 7.6  | 14.5 | 1.0              | 17.5 | ns   |
|                               |               |                      |               | 50      | —         | 10.1 | 18.0 | 1.0              | 21.0 |      |
|                               | $3.3 \pm 0.3$ |                      | 15            | —       | 5.9       | 9.3  | 1.0  | 11.0             |      |      |
|                               |               |                      | 50            | —       | 8.4       | 12.8 | 1.0  | 14.5             |      |      |
| Output disable time           | $t_{pLZ}$     | $R_L = 1$ k $\Omega$ | 2.7           | 50      | —         | 11.5 | 18.5 | 1.0              | 22.0 | ns   |
|                               | $t_{pHZ}$     |                      | $3.3 \pm 0.3$ | 50      | —         | 9.6  | 13.2 | 1.0              | 15.0 |      |
| Maximum clock frequency       | $f_{max}$     | —                    | 2.7           | 15      | 60        | 115  | —    | 50               | —    | MHz  |
|                               |               |                      |               | 50      | 45        | 60   | —    | 40               | —    |      |
|                               |               |                      | $3.3 \pm 0.3$ | 15      | 100       | 160  | —    | 85               | —    |      |
|                               |               |                      |               | 50      | 60        | 95   | —    | 55               | —    |      |
| Output to output skew         | $t_{osLH}$    | (Note 1)             | 2.7           | 50      | —         | —    | 1.5  | —                | 1.5  | ns   |
|                               | $t_{osHL}$    |                      | $3.3 \pm 0.3$ | 50      | —         | —    | 1.5  | —                | 1.5  |      |
| Input capacitance             | $C_{IN}$      | (Note 2)             |               | —       | 4         | 10   | —    | 10               | pF   |      |
| Output capacitance            | $C_{OUT}$     | —                    |               | —       | 6         | —    | —    | —                | pF   |      |
| Power dissipation capacitance | $C_{PD}$      | (Note 3)             |               | —       | 32        | —    | —    | —                | pF   |      |

Note 1: Parameter guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

Note 2: Parameter guaranteed by design.

Note 3:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

Average operating current can be obtained by the equation:

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

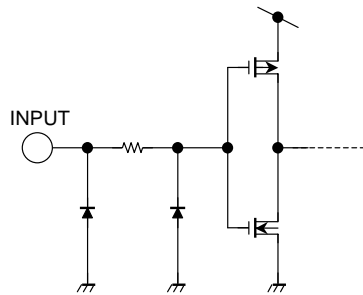
And the total  $C_{PD}$  when n pcs. of Flip Flop operate can be gained by the following equation:

$$C_{PD} \text{ (total)} = 20 + 12 \cdot n$$

**Noise Characteristics (Ta = 25°C, input:  $t_r = t_f = 3$  ns,  $C_L = 50$  pF)**

| Characteristics  | Symbol           | Test Condition | V <sub>CC</sub> (V) | Typ. | Limit | Unit |
|--|------------------|----------------|---------------------|------|-------|------|
|  |                  |                |                     |      |       |      |
| Quiet output maximum dynamic V <sub>OL</sub>             | V <sub>OLP</sub> | —              | 3.3                 | 0.5  | 0.8   | V    |
| Quiet output minimum dynamic V <sub>OL</sub>             | V <sub>OLV</sub> | —              | 3.3                 | -0.5 | -0.8  | V    |
| Minimum high level dynamic input voltage V <sub>IH</sub> | V <sub>IHD</sub> | —              | 3.3                 | —    | 2.0   | V    |
| Maximum low level dynamic input voltage V <sub>IL</sub>  | V <sub>ILD</sub> | —              | 3.3                 | —    | 0.8   | V    |

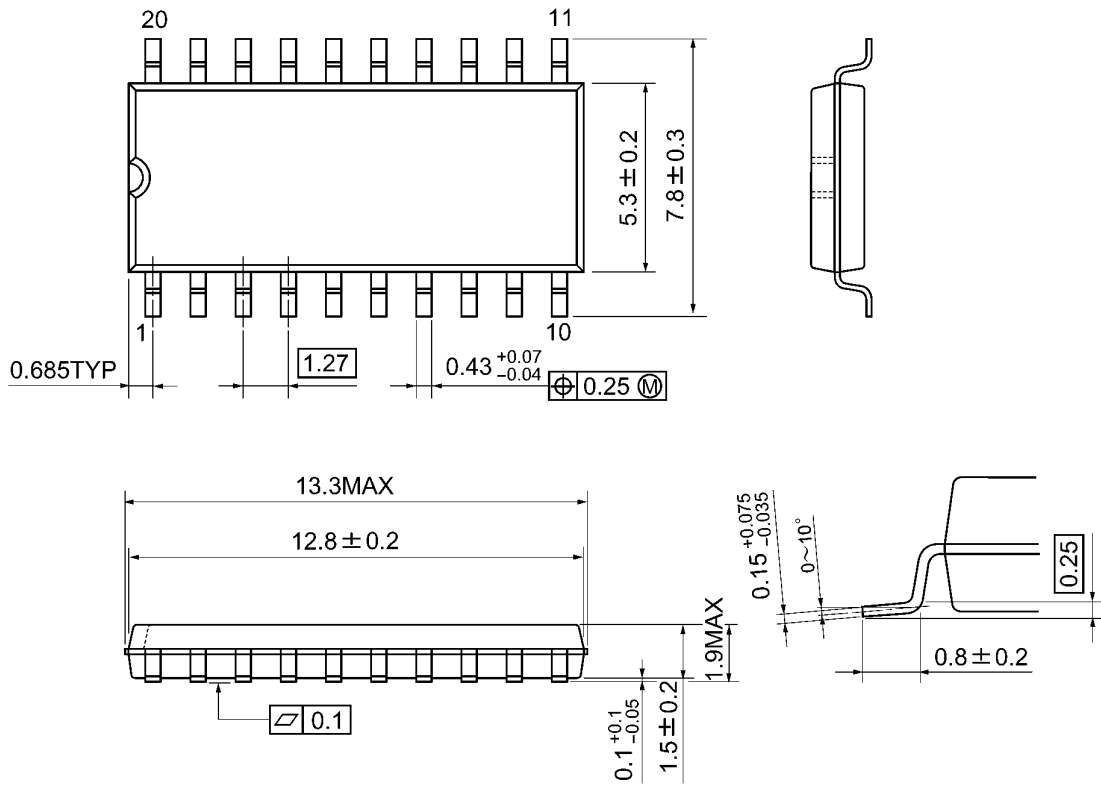
**Input Equivalent Circuit**



## Package Dimensions

SOP20-P-300-1.27A

Unit: mm

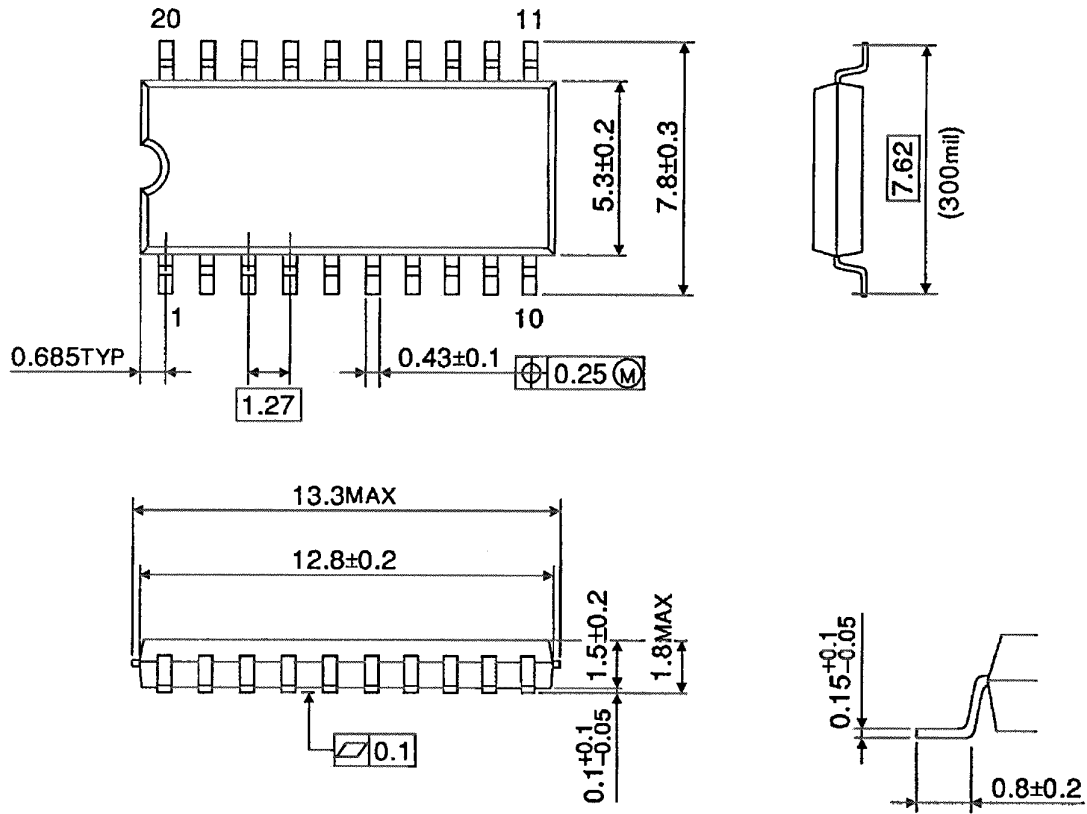


Weight: 0.22 g (typ.)

**Package Dimensions**

SOP20-P-300-1.27

Unit : mm



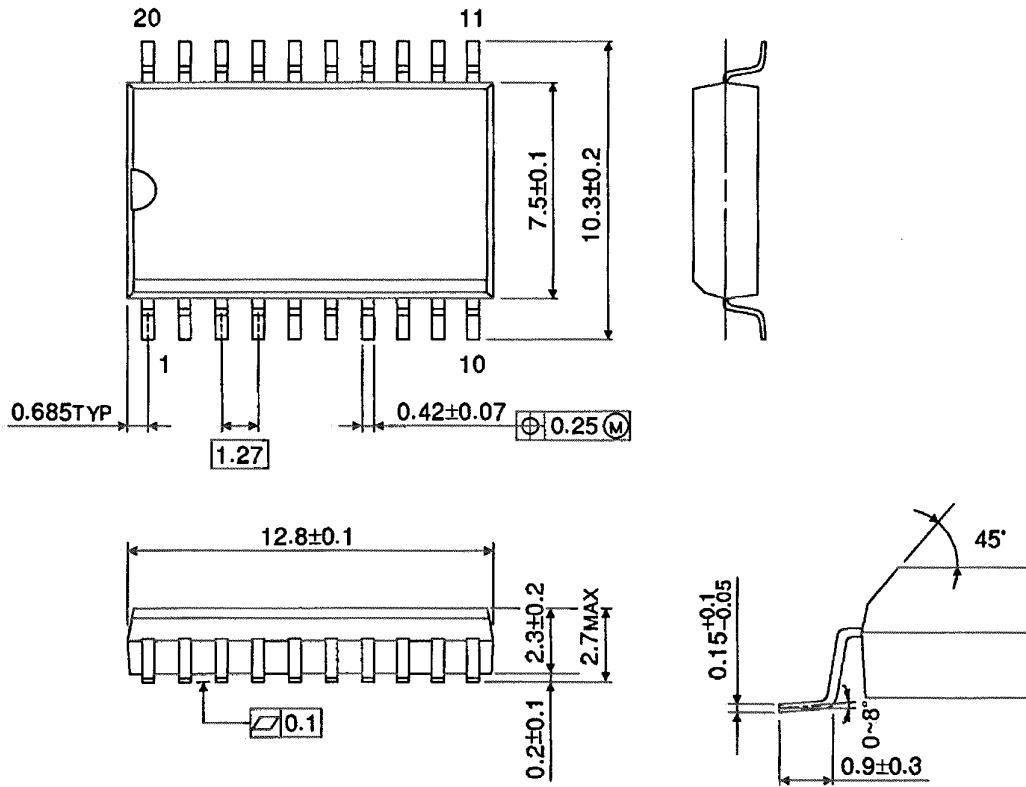
Weight: 0.22 g (typ.)



## Package Dimensions (Note)

SOL20-P-300-1.27

Unit : mm



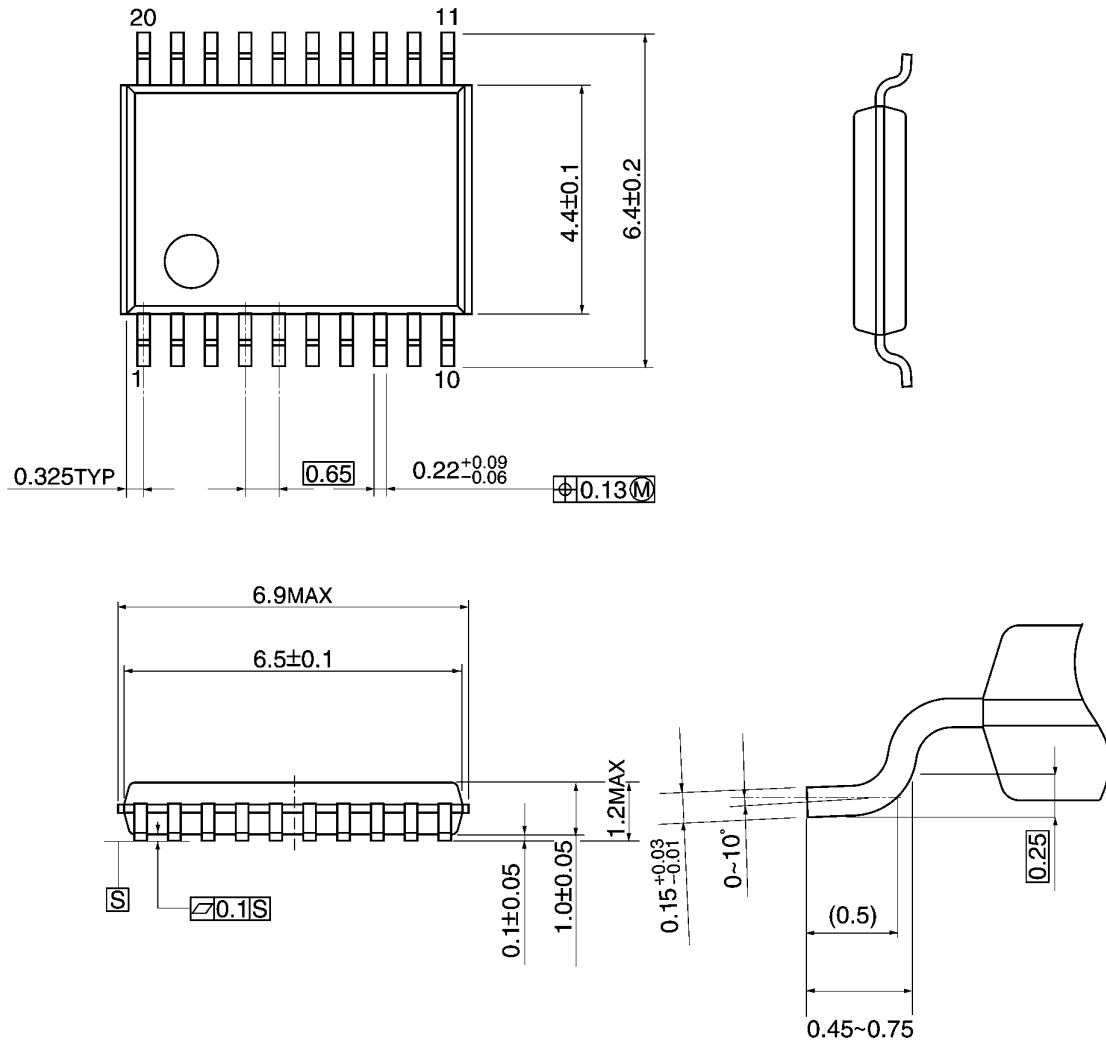
Note: This package is not available in Japan.

Weight: 0.46 g (typ.)

**Package Dimensions**

TSSOP20-P-0044-0.65A

Unit: mm



Weight: 0.08 g (typ.)

**Note: Lead (Pb)-Free Packages****SOP20-P-300-1.27A TSSOP20-P-0044-0.65A****RESTRICTIONS ON PRODUCT USE**

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