

## TC74VHC273F, TC74VHC273FW, TC74VHC273FT, TC74VHC273FK

### Octal D-Type Flip-Flop with Clear

The TC74VHC273 is an advanced high speed CMOS OCTAL D-TYPE FLIP FLOP 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.

Information signals applied to D inputs are transferred to the Q outputs on the positive going edge of the clock pulse.

When the  $\overline{\text{CLR}}$  input is held "L", the Q outputs are at a low logic level independent of the other inputs.

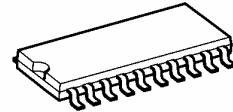
An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input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

### Features

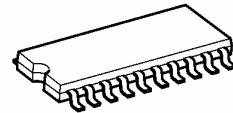
- High speed:  $f_{\text{max}} = 165 \text{ MHz (typ.)}$  at  $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation:  $I_{\text{CC}} = 4 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC (min)}}$
- Power down protection is provided on all inputs.
- Balanced propagation delays:  $t_{\text{pLH}} \approx t_{\text{pHL}}$
- Wide operating voltage range:  $V_{\text{CC (opr)}} = 2 \text{ to } 5.5 \text{ V}$
- Low noise:  $V_{\text{OLP}} = 0.9 \text{ V (max)}$
- Pin and function compatible with 74ALS273

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

TC74VHC273F

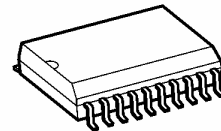


SOP20-P-300-1.27A



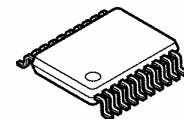
SOP20-P-300-1.27

TC74VHC273FW



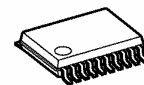
SOL20-P-300-1.27

TC74VHC273FT



TSSOP20-P-0044-0.65A

TC74VHC273FK

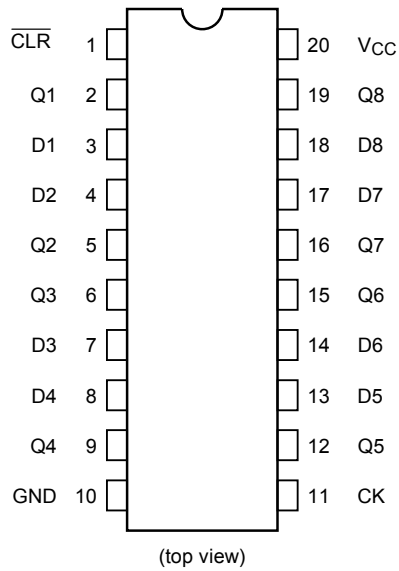


VSSOP20-P-0030-0.50

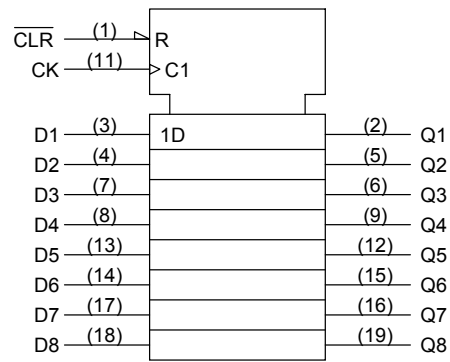
### Weight

|                      |                 |
|----------------------|-----------------|
| 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.) |
| VSSOP20-P-0030-0.50  | : 0.03 g (typ.) |

## Pin Assignment



## IEC Logic Symbol

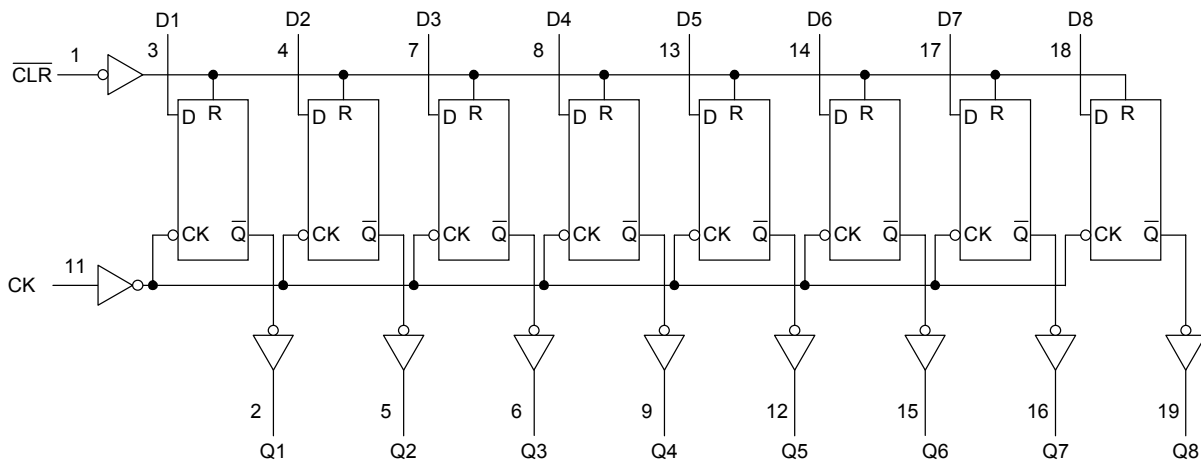


## Truth Table

| Inputs |   |              | Output | Function  |
|--------|---|--------------|--------|-----------|
| CLR    | D | CK           | Q      |           |
| L      | X | X            | L      | Clear     |
| H      | L | $\uparrow$   | L      | —         |
| H      | H | $\uparrow$   | H      | —         |
| H      | X | $\downarrow$ | $Q_n$  | No Change |

X: Don't care

## 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 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                                                                 | $^{\circ}C$ |
| 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 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 |
| 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><br>= 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             | —<br>—<br>—                   | 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><br>= 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>—                   | 0.1<br>0.1<br>0.1             | V   |
|                           |                 |                                                         | I <sub>OL</sub> = 4 mA   | 3.0                 | —                             | —                 | 0.36                          | —                             | 0.44                          |     |
|                           |                 |                                                         | I <sub>OL</sub> = 8 mA   | 4.5                 | —                             | —                 | 0.36                          | —                             | 0.44                          |     |
|                           |                 |                                                         |                          |                     |                               |                   |                               |                               |                               |     |
| 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  |

### 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) | Typ. | Limit            |      | Limit |
| Minimum pulse width (CK)                         | t <sub>w</sub> (L) | —              |  | 3.3 ± 0.3           | —    | 5.5              | 6.5  | ns    |
|                                                  | t <sub>w</sub> (H) | —              |  | 5.0 ± 0.5           | —    | 5.0              | 5.0  |       |
| Minimum pulse width ( $\overline{\text{CLR}}$ )  | t <sub>w</sub> (L) | —              |  | 3.3 ± 0.3           | —    | 5.0              | 6.0  | ns    |
|                                                  |                    | —              |  | 5.0 ± 0.5           | —    | 5.0              | 5.0  |       |
| Minimum set-up time                              | t <sub>s</sub>     | —              |  | 3.3 ± 0.3           | —    | 5.5              | 6.5  | ns    |
|                                                  |                    | —              |  | 5.0 ± 0.5           | —    | 4.5              | 4.5  |       |
| Minimum hold time                                | t <sub>h</sub>     | —              |  | 3.3 ± 0.3           | —    | 1.0              | 1.0  | ns    |
|                                                  |                    | —              |  | 5.0 ± 0.5           | —    | 1.0              | 1.0  |       |
| Minimum removal time ( $\overline{\text{CLR}}$ ) | t <sub>rem</sub>   | —              |  | 3.3 ± 0.3           | —    | 2.5              | 2.5  | ns    |
|                                                  |                    | —              |  | 5.0 ± 0.5           | —    | 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 |      |     |
|---------------------------------------------------------|-------------------|----------------|---------------------|---------------------|-----|------------------|------|------|------|-----|
|                                                         |                   |                | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min | Typ.             | Max  |      | Min  | Max |
| Propagation delay time<br>(CK-Q)                        | t <sub>pLH</sub>  | —              | 3.3 ± 0.3           | 15                  | —   | 8.7              | 13.6 | 1.0  | 16.0 | ns  |
|                                                         |                   |                |                     | 50                  | —   | 11.2             | 17.1 | 1.0  | 19.5 |     |
|                                                         | 5.0 ± 0.5         |                | 15                  | —                   | 5.8 | 9.0              | 1.0  | 10.5 |      |     |
|                                                         |                   |                | 50                  | —                   | 7.3 | 11.0             | 1.0  | 12.5 |      |     |
| Propagation delay time<br>( $\overline{\text{CLR}}$ -Q) | t <sub>pHL</sub>  | —              | 3.3 ± 0.3           | 15                  | —   | 8.9              | 13.6 | 1.0  | 16.0 | ns  |
|                                                         |                   |                |                     | 50                  | —   | 11.4             | 17.1 | 1.0  | 19.5 |     |
|                                                         |                   |                | 5.0 ± 0.5           | 15                  | —   | 5.2              | 8.5  | 1.0  | 10.0 |     |
|                                                         |                   |                |                     | 50                  | —   | 6.7              | 10.5 | 1.0  | 12.0 |     |
| Maximum clock frequency                                 | f <sub>max</sub>  | —              | 3.3 ± 0.3           | 15                  | 75  | 120              | —    | 65   | —    | MHz |
|                                                         |                   |                |                     | 50                  | 50  | 75               | —    | 45   | —    |     |
|                                                         |                   |                | 5.0 ± 0.5           | 15                  | 120 | 165              | —    | 100  | —    |     |
|                                                         |                   |                |                     | 50                  | 80  | 110              | —    | 70   | —    |     |
| Output to output skew                                   | t <sub>osLH</sub> | (Note 1)       | 3.3 ± 0.3           | 50                  | —   | —                | 1.5  | —    | 1.5  | ns  |
|                                                         | t <sub>osHL</sub> |                | 5.0 ± 0.5           | 50                  | —   | —                | 1.0  | —    | 1.0  |     |
| Input capacitance                                       | C <sub>IN</sub>   | —              | —                   | —                   | 4   | 10               | —    | 10   | pF   |     |
| Power dissipation capacitance                           | C <sub>PD</sub>   | (Note 2)       | —                   | —                   | 31  | —                | —    | —    | pF   |     |

Note 1: Parameter guaranteed by design.

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

Note 2: 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:

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

And the total C<sub>PD</sub> when n pcs. of flip flop operate can be gained by the following equation:

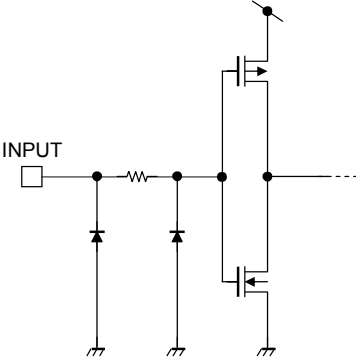
$$C_{PD} \text{ (total)} = 22 + 9 \cdot n$$

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

| Characteristics                              | Symbol           | Test Condition         | Ta = 25°C           |                |                | Unit |
|----------------------------------------------|------------------|------------------------|---------------------|----------------|----------------|------|
|                                              |                  |                        | V <sub>CC</sub> (V) | Typ.           | Max            |      |
| Quiet output maximum dynamic V <sub>OL</sub> | V <sub>OLP</sub> | C <sub>L</sub> = 50 pF | 5.0                 | 0.5<br>(0.6)   | 0.8<br>(0.9)   | V    |
| Quiet output minimum dynamic V <sub>OL</sub> | V <sub>OLV</sub> | C <sub>L</sub> = 50 pF | 5.0                 | -0.5<br>(-0.6) | -0.8<br>(-0.9) | V    |
| Minimum high level dynamic input voltage     | V <sub>IHD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —              | 3.5            | V    |
| Maximum low level dynamic input voltage      | V <sub>ILD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —              | 1.5            | V    |

Note: The value in ( ) only applies to JEDEC SOP (FW) devices.

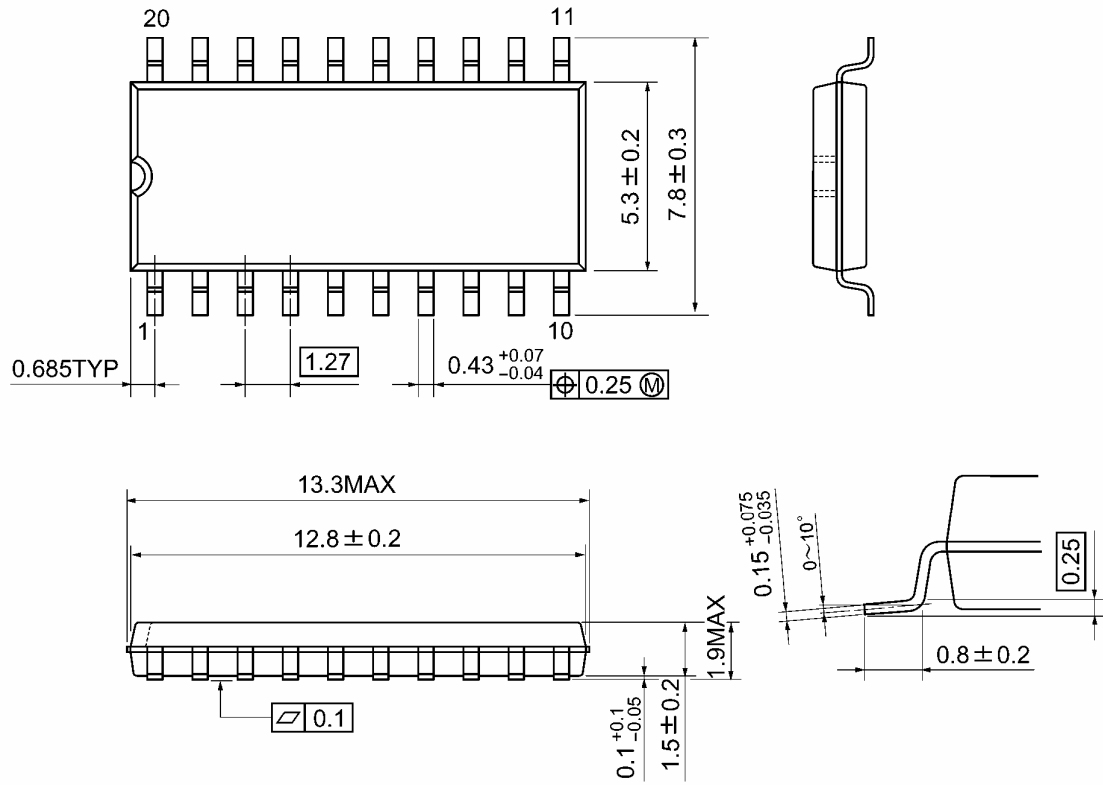
**Input Equivalent Circuit**



## Package Dimensions

SOP20-P-300-1.27A

Unit: mm

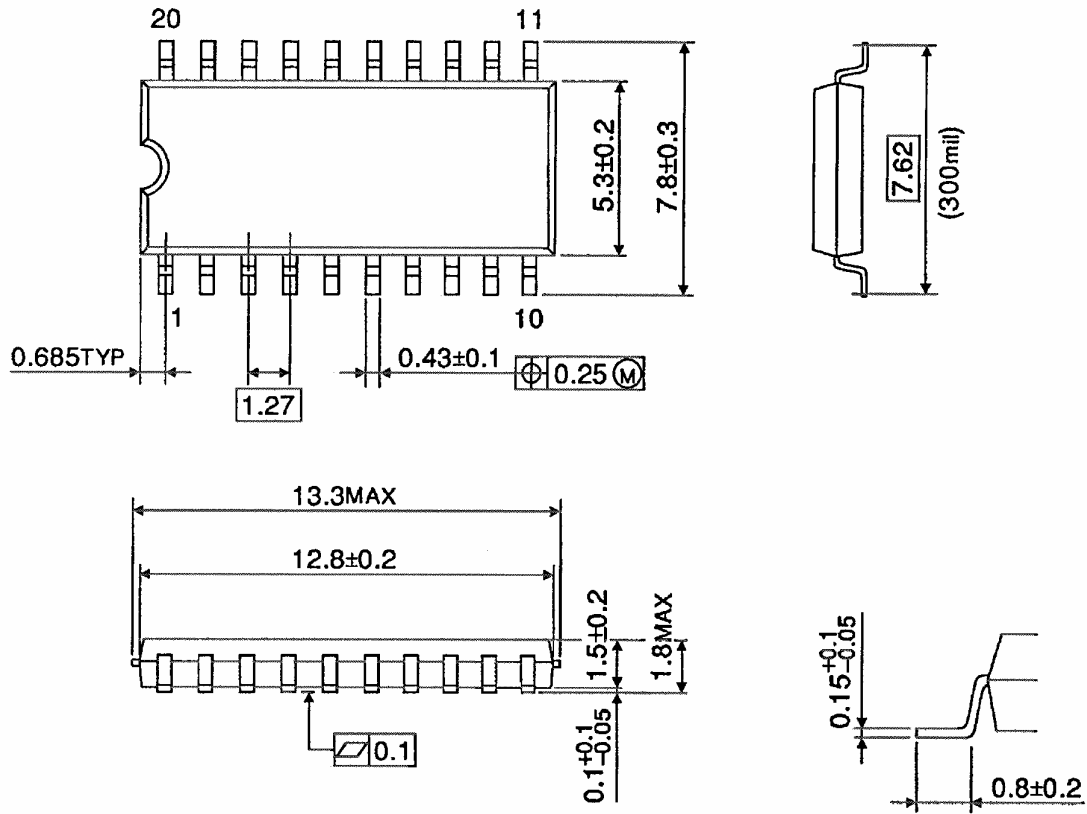


Weight: 0.22 g (typ.)

## Package Dimensions

SOP20-P-300-1.27

Unit : mm



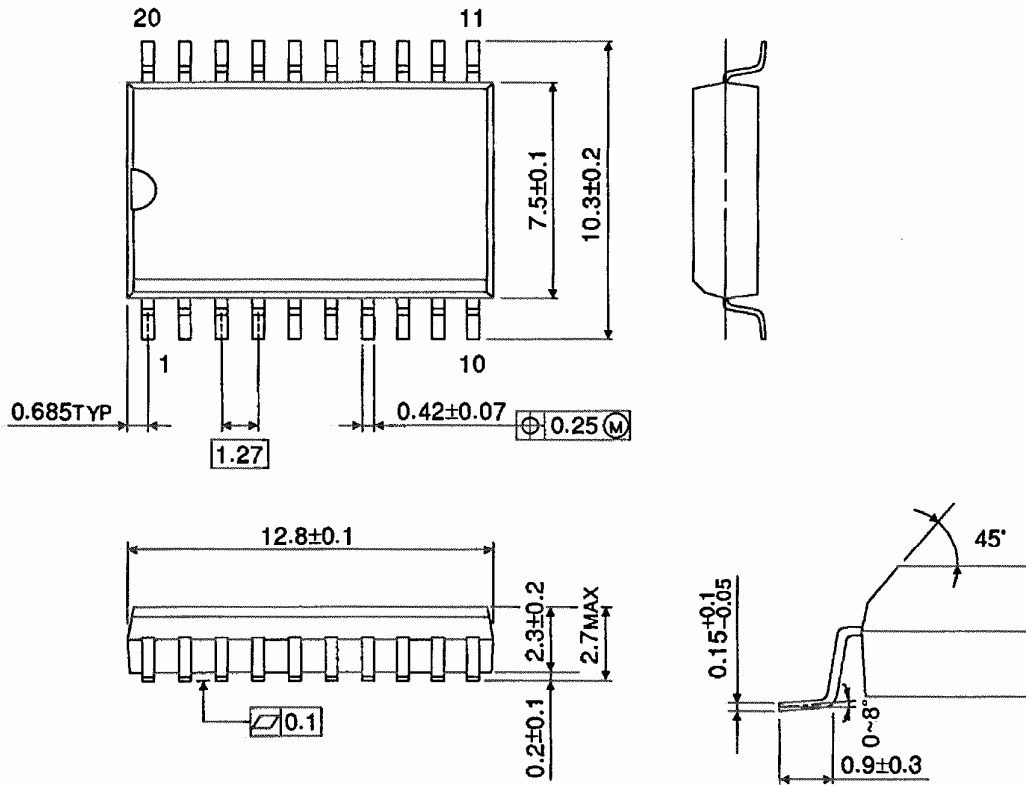
Weight: 0.22 g (typ.)



## Package Dimensions (Note)

SOL20-P-300-1.27

Unit : mm



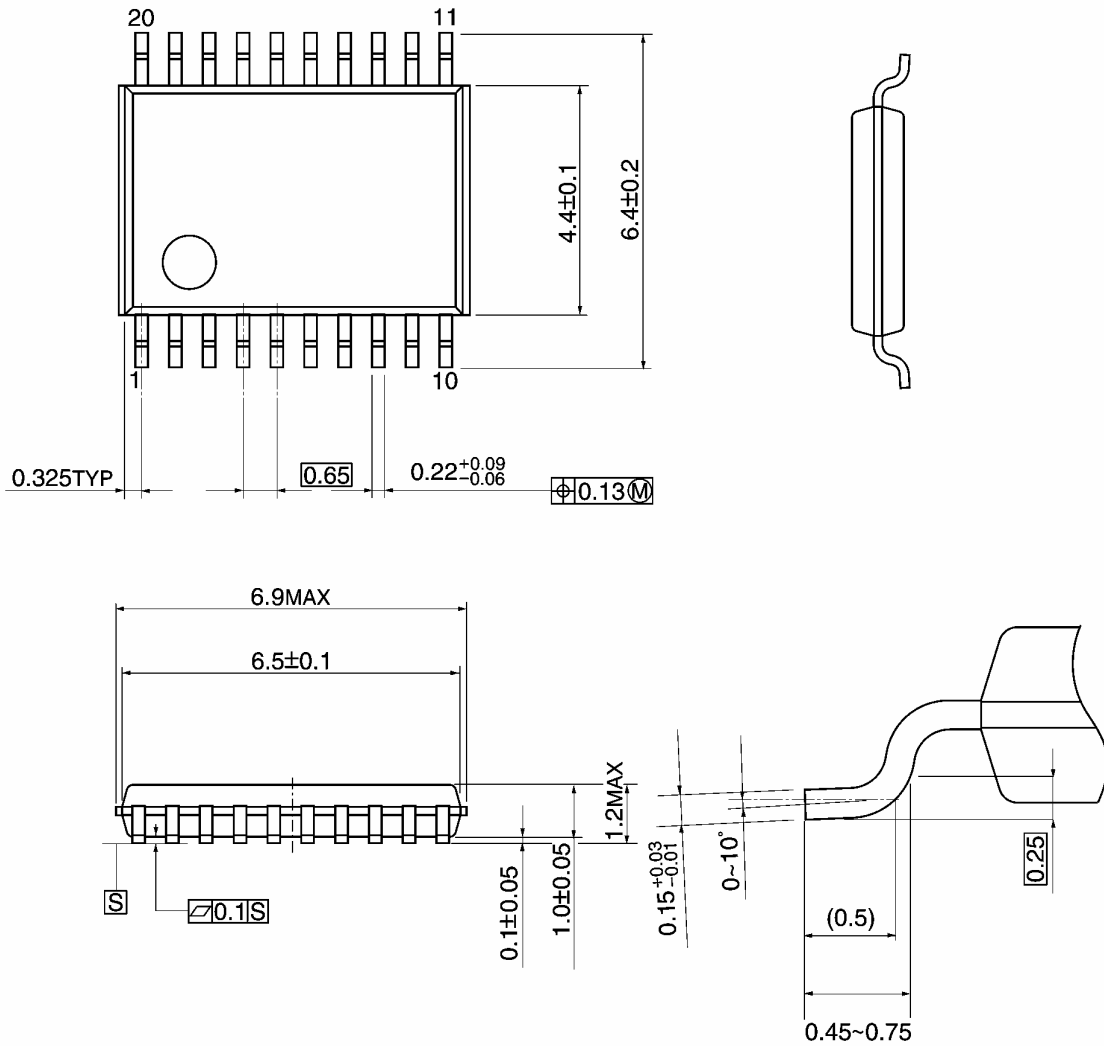
Note: This package is not available in Japan.

Weight: 0.46 g (typ.)

## Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm

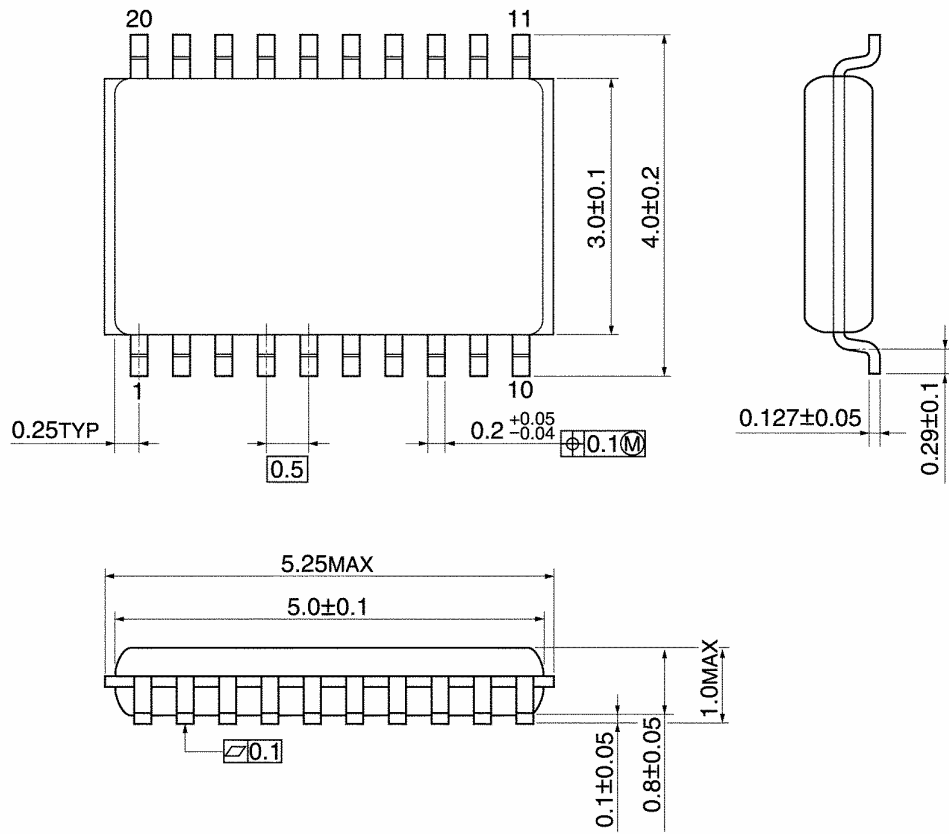


Weight: 0.08 g (typ.)

**Package Dimensions**

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

**Note: Lead (Pb)-Free Packages****SOP20-P-300-1.27A TSSOP20-P-0044-0.65A VSSOP20-P-0030-0.50****RESTRICTIONS ON PRODUCT USE**

060116EBA

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