

## TC74VHC273F, 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.

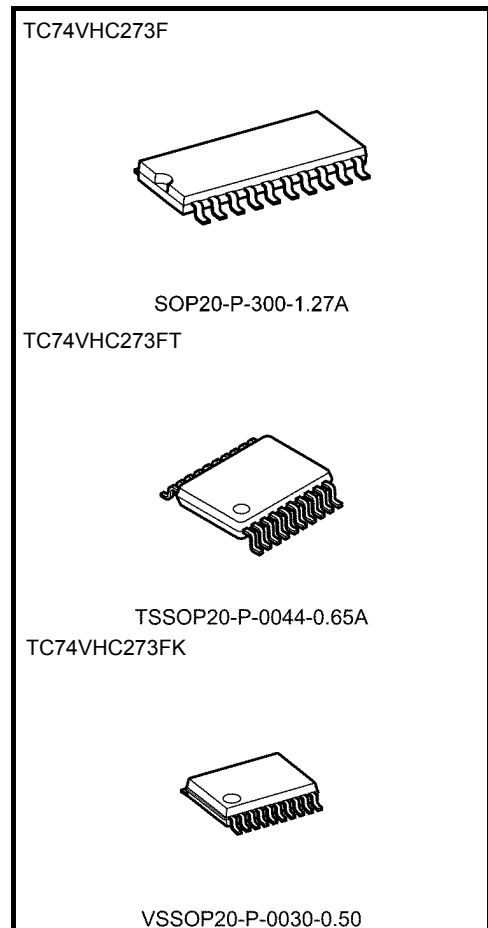
Information signals applied to D inputs are transferred to the Q outputs on the positive going edge of the clock pulse.

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

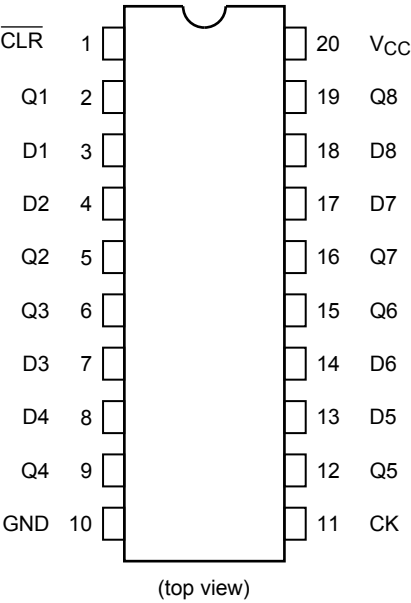
- High speed:  $f_{\text{max}} = 165 \text{ MHz}$  (typ.) at  $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation:  $I_{\text{CC}} = 4 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}$  (min)
- Power down protection is provided 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:  $V_{\text{OLP}} = 0.8 \text{ V}$  (max)
- Pin and function compatible with 74ALS273



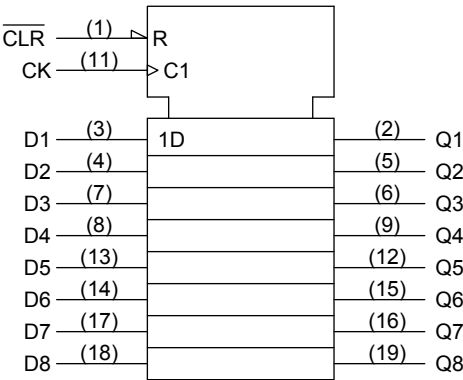
#### Weight

|                      |                 |
|----------------------|-----------------|
| SOP20-P-300-1.27A    | : 0.22 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

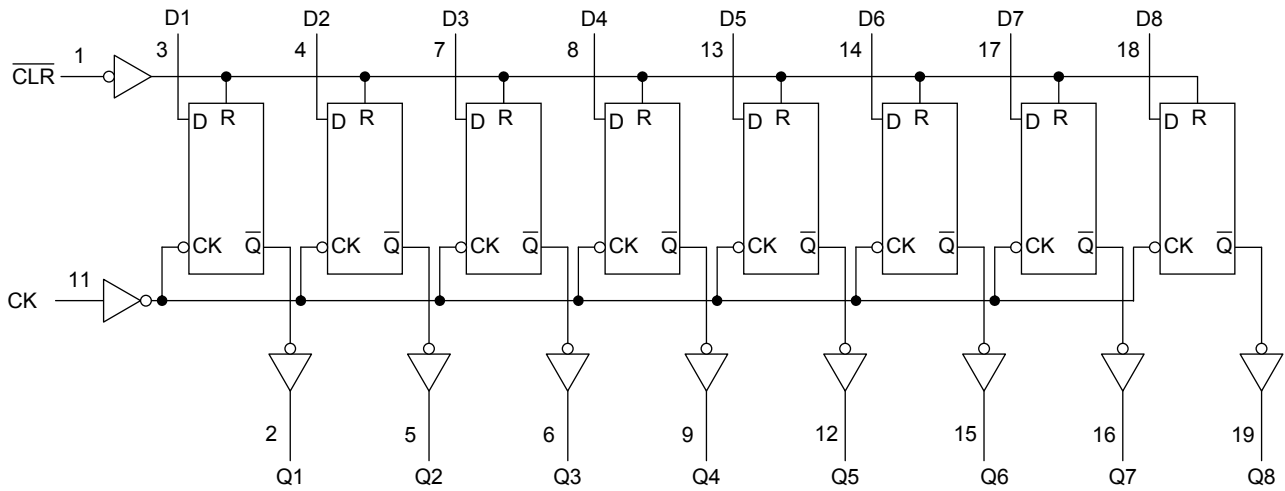


Truth Table

| Inputs |   |    | Output         | Function  |
|--------|---|----|----------------|-----------|
| CLR    | D | CK | Q              |           |
| L      | X | X  | L              | Clear     |
| H      | L |    | L              | —         |
| H      | H |    | H              | —         |
| H      | X |    | Q <sub>n</sub> | 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             | °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 Ranges (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 ranges must be maintained 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 =<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<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                 | 1.9                           | 2.0        | —                             | 1.9                           | —                             | V   |
|                           |                 |                                                         |                                                    | 3.0                 | 2.9                           | 3.0        | —                             | 2.9                           | —                             |     |
|                           |                 |                                                         | I <sub>OH</sub> = −4 mA<br>I <sub>OH</sub> = −8 mA | 4.5                 | 4.4                           | 4.5        | —                             | 4.4                           | —                             |     |
|                           |                 |                                                         |                                                    | 3.0<br>4.5          | 2.58<br>3.94                  | —<br>—     | —<br>—                        | 2.48<br>3.80                  | —<br>—                        |     |
| 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                 | —                             | 0.0        | 0.1                           | —                             | 0.1                           | V   |
|                           |                 |                                                         |                                                    | 3.0<br>4.5          | —<br>—                        | 0.0<br>0.0 | 0.1<br>0.1                    | —<br>—                        | 0.1<br>0.1                    |     |
|                           |                 |                                                         | I <sub>OL</sub> = 4 mA<br>I <sub>OL</sub> = 8 mA   | 3.0<br>4.5          | —<br>—                        | —<br>—     | 0.36<br>0.36                  | —<br>—                        | 0.44<br>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 |
|--------------------------------------------------|--------------------|----------------|-----------|------|------------------|-------|------|
|                                                  |                    |                | VCC (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: $t_r = t_f = 3 \text{ ns}$ )

| 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>(CK-Q)                        | t <sub>pLH</sub><br>t <sub>pHL</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><br>t <sub>osHL</sub> | (Note 1)       | 3.3 ± 0.3           | 50                  | —         | —    | 1.5  | —                | 1.5  | ns   |
|                                                         | 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:

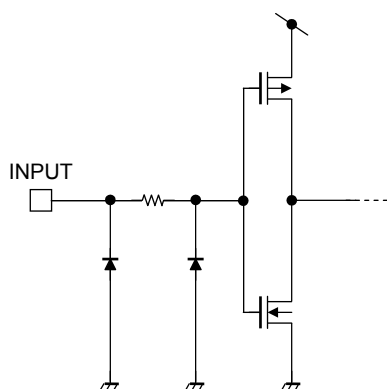
$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

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: $t_r = t_f = 3 \text{ ns}$ )

| 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  | 0.8  | V   |
| Quiet output minimum dynamic V <sub>OL</sub> | V <sub>OLV</sub> | C <sub>L</sub> = 50 pF | 5.0                 | −0.5 | −0.8 | 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   |

**Input Equivalent Circuit**


## Package Dimensions

SOP20-P-300-1.27A

Unit: mm

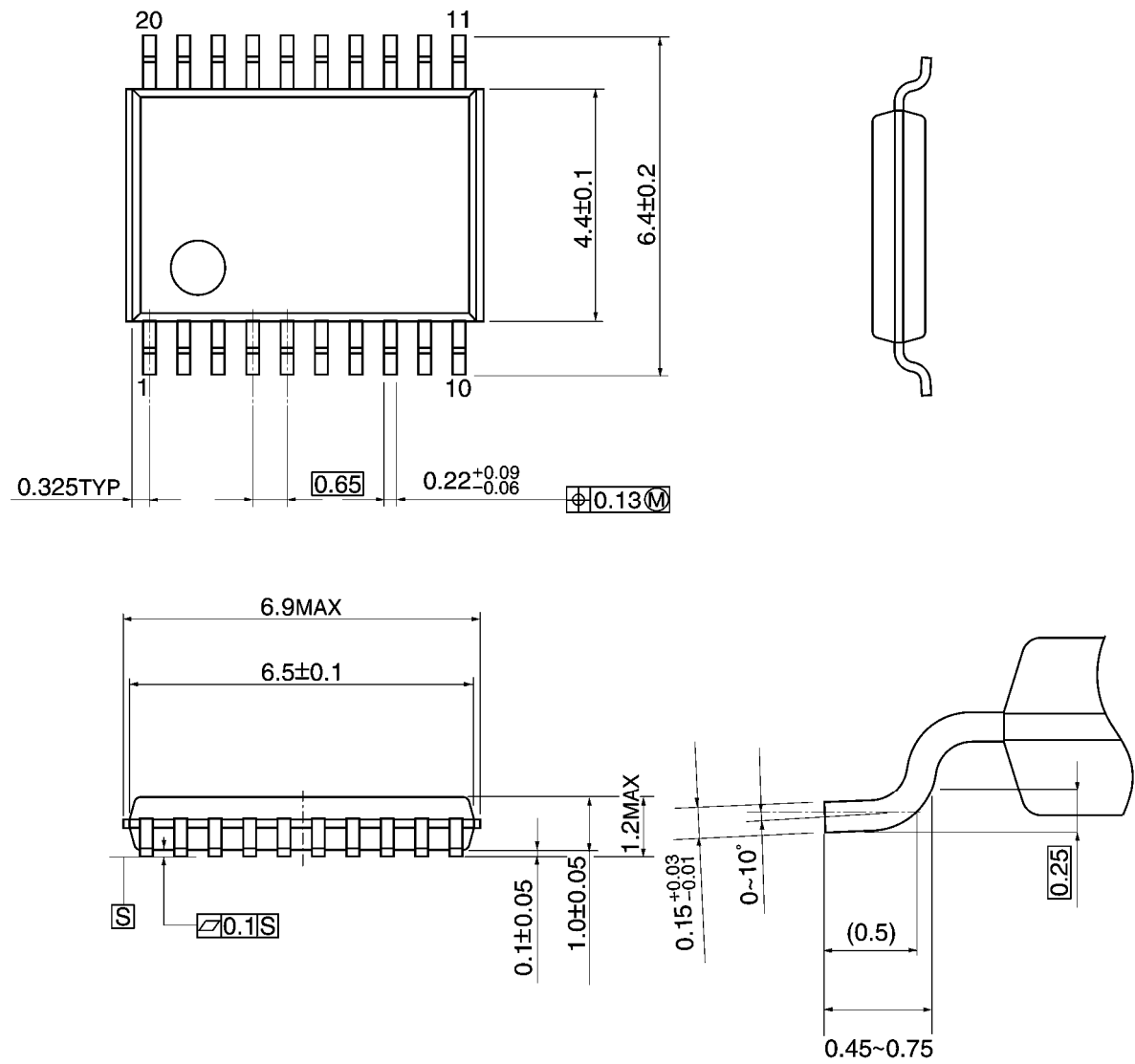


Weight: 0.22 g (typ.)

Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm

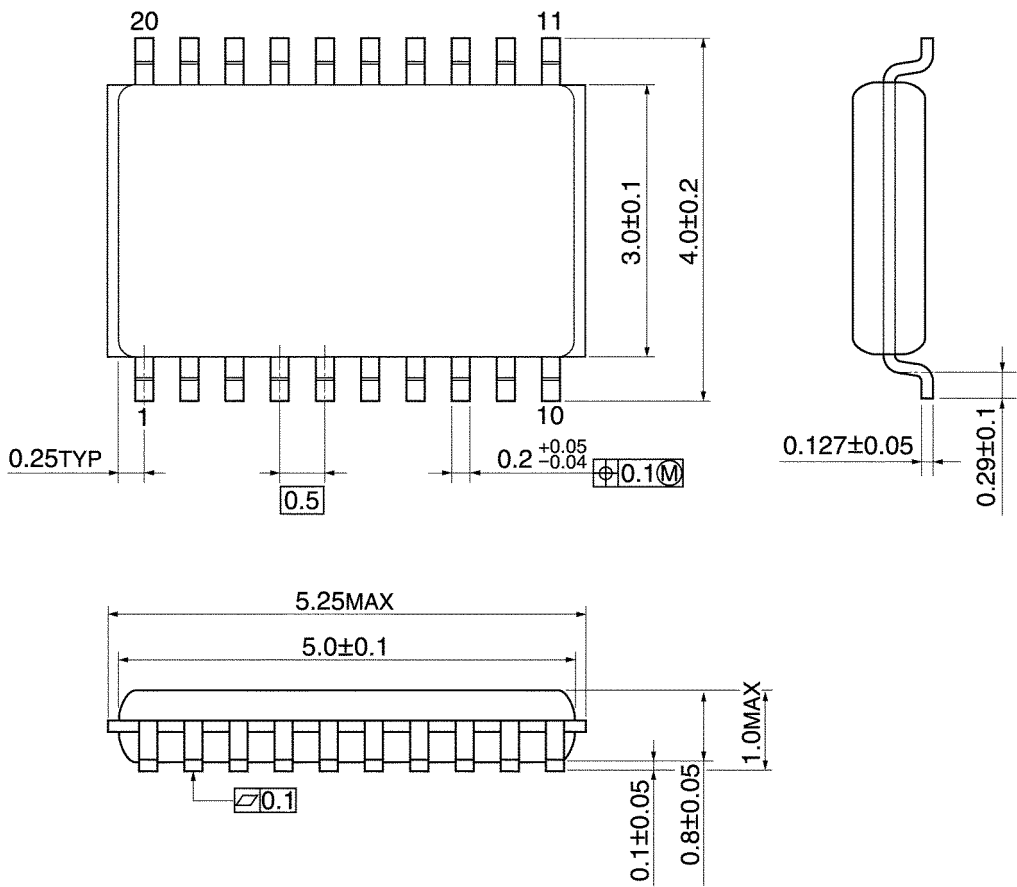


Weight: 0.08 g (typ.)

Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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