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TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74LCX541F,TC74LCX541FW,TC74LCX541FT,TC74LCX541FK

## Low-Voltage Octal Bus Buffer with 5-V Tolerant Inputs and Outputs

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

The TC74LCX541F/FW/FT/FK is a high-performance CMOS octal bus buffer. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

The device is designed for low-voltage (3.3 V) $V_{CC}$ applications, but it could be used to interface to 5 V supply environment for both inputs and outputs.

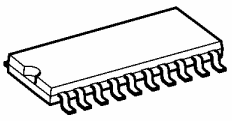
The TC74LCX541F/FW/FT is a non-inverting 3-state buffer having two active-low output enables. When either $\overline{OE}1$ or $\overline{OE}2$ are high, the terminal outputs are in the high-impedance state. This device is designed to be used with 3-state memory address drivers, etc.

All inputs are equipped with protection circuits against static discharge.

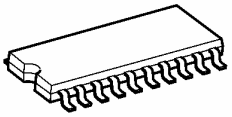
### Features

- Low-voltage operation: $V_{CC}$ = 2.0 to 3.6 V
- High-speed operation: $t_{pd}$ = 6.5 ns (max) ($V_{CC}$ = 3.0 to 3.6 V)
- Output current: $|I_{OH}|/I_{OL}$ = 24 mA (min) ($V_{CC}$ = 3.0 V)
- Latch-up performance: ±500 mA
- Available in JEDEC SOP, JEITA SOP and TSSOP
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 541 type

TC74LCX541F

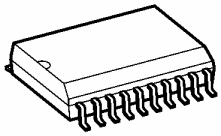


SOP20-P-300-1.27A



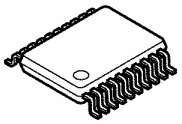
SOP20-P-300-1.27

TC74LCX541FW



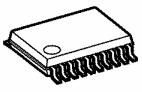
SOL20-P-300-1.27

TC74LCX541FT



TSSOP20-P-0044-0.65A

TC74LCX541FK

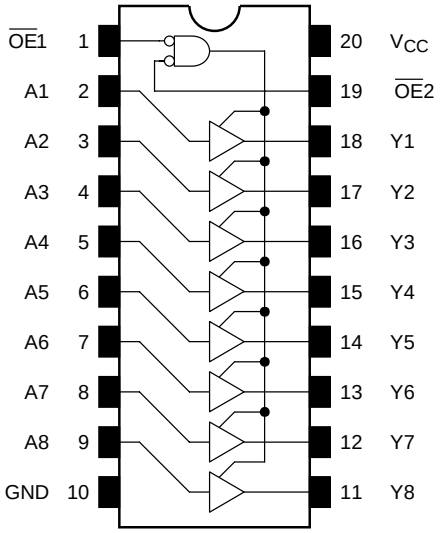


VSSOP20-P-0030-0.50

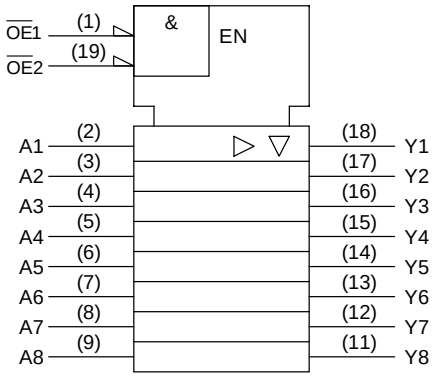
Weight

| | |
|---|---|
| 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 (top view)




## IEC Logic Symbol




## Truth Table

| Inputs | | | Outputs |
|---|---|---|---|
| $\overline{OE1}$ | $\overline{OE2}$ | An | |
| H | X | X | Z |
| X | H | X | Z |
| L | L | H | H |
| L | L | L | L |

X: Don’t care

Z: High impedance

## 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 |
| | | −0.5 to $V_{CC}$ + 0.5 (Note 3) | |
| Input diode current | $I_{IK}$ | −50 | mA |
| Output diode current | $I_{OK}$ | ±50 (Note 4) | mA |
| DC output current | $I_{OUT}$ | ±50 | mA |
| Power dissipation | $P_D$ | 180 | mW |
| DC $V_{CC}$/ground current | $I_{CC}/I_{GND}$ | ±100 | mA |
| Storage temperature | $T_{stg}$ | −65 to 150 | °C |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Note 2: Output in OFF state

Note 3: High or low state. $I_{OUT}$ absolute maximum rating must be observed.

Note 4: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

## Recommended Operating Conditions (Note 1)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Power supply voltage | $V_{CC}$ | 2.0 to 3.6 | V |
| | | 1.5 to 3.6 (Note 2) | |
| Input voltage | $V_{IN}$ | 0 to 5.5 | V |
| Output voltage | $V_{OUT}$ | 0 to 5.5 (Note 3) | V |
| | | 0 to $V_{CC}$ (Note 4) | |
| Output current | $I_{OH}/I_{OL}$ | ±24 (Note 5) | mA |
| | | ±12 (Note 6) | |
| Operating temperature | $T_{opr}$ | −40 to 85 | °C |
| Input rise and fall time | dt/dv | 0 to 10 (Note 7) | ns/V |

Note 1: The recommended operating conditions are required to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

Note 2: Data retention only

Note 3: Output in OFF state

Note 4: High or low state

Note 5: $V_{CC}$ = 3.0 to 3.6 V

Note 6: $V_{CC}$ = 2.7 to 3.0 V

Note 7: $V_{IN}$ = 0.8 to 2.0 V, $V_{CC}$ = 3.0 V

## Electrical Characteristics

### DC Characteristics (Ta = –40 to 85°C)

| Characteristics | | Symbol | Test Condition | | $V_{CC}$ (V) | Min | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Input voltage | H-level | $V_{IH}$ | — | | 2.7 to 3.6 | 2.0 | — | V |
| | L-level | $V_{IL}$ | — | | 2.7 to 3.6 | — | 0.8 | |
| Output voltage | H-level | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –100 μA | 2.7 to 3.6 | $V_{CC}$ – 0.2 | — | V |
| | | | | $I_{OH}$ = –12 mA | 2.7 | 2.2 | — | |
| | | | | $I_{OH}$ = –18 mA | 3.0 | 2.4 | — | |
| | | | | $I_{OH}$ = –24 mA | 3.0 | 2.2 | — | |
| | L-level | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 100 μA | 2.7 to 3.6 | — | 0.2 | |
| | | | | $I_{OL}$ = 12 mA | 2.7 | — | 0.4 | |
| | | | | $I_{OL}$ = 16 mA | 3.0 | — | 0.4 | |
| | | | | $I_{OL}$ = 24 mA | 3.0 | — | 0.55 | |
| Input leakage current | | $I_{IN}$ | $V_{IN}$ = 0 to 5.5 V | | 2.7 to 3.6 | — | ±5.0 | μA |
| 3-state output off-state current | | $I_{OZ}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$<br>$V_{OUT}$ = 0 to 5.5 V | | 2.7 to 3.6 | — | ±5.0 | μA |
| Power off leakage current | | $I_{OFF}$ | $V_{IN}$/$V_{OUT}$ = 5.5 V | | 0 | — | 10.0 | μA |
| Quiescent supply current | | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | | 2.7 to 3.6 | — | 10.0 | μA |
| | | | $V_{IN}$/$V_{OUT}$ = 3.6 to 5.5 V | | 2.7 to 3.6 | — | ±10.0 | |
| Increase in $I_{CC}$ per input | | $\Delta I_{CC}$ | $V_{IH}$ = $V_{CC}$ – 0.6 V | | 2.7 to 3.6 | — | 500 | |

### AC Characteristics (Ta = –40 to 85°C)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Min | Max | Unit |
|---|---|---|---|---|---|---|
| Propagation delay time | $t_{pLH}$<br>$t_{pHL}$ | Figure 1, Figure 2 | 2.7 | — | 7.5 | ns |
| | | | 3.3 ± 0.3 | 1.5 | 6.5 | |
| Output enable time | $t_{pZL}$<br>$t_{pZH}$ | Figure 1, Figure 3 | 2.7 | — | 9.5 | ns |
| | | | 3.3 ± 0.3 | 1.5 | 8.5 | |
| Output disable time | $t_{pLZ}$<br>$t_{pHZ}$ | Figure 1, Figure 3 | 2.7 | — | 8.5 | ns |
| | | | 3.3 ± 0.3 | 1.5 | 7.5 | |
| Output to output skew | $t_{osLH}$<br>$t_{osHL}$ | (Note) | 2.7 | — | — | ns |
| | | | 3.3 ± 0.3 | — | 1.0 | |

Note: Parameter guaranteed by design.
($t_{osLH}$ = $|t_{pLHm} - t_{pLHn}|$, $t_{osHL}$ = $|t_{pHLm} - t_{pHLn}|$)

### Dynamic Switching Characteristics (Ta = 25°C, input: $t_r$ = $t_f$ = 2.5 ns, $C_L$ = 50 pF, $R_L$ = 500 Ω)

| Characteristics | | Symbol | Test Condition | $V_{CC}$ (V) | Typ. | Unit |
|---|---|---|---|---|---|---|
| Quiet output maximum dynamic | $V_{OL}$ | $V_{OLP}$ | $V_{IH}$ = 3.3 V, $V_{IL}$ = 0 V | 3.3 | 0.8 | V |
| Quiet output minimum dynamic | $V_{OL}$ | $\|V_{OLV}\|$ | $V_{IH}$ = 3.3 V, $V_{IL}$ = 0 V | 3.3 | 0.8 | V |

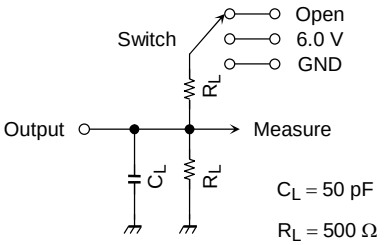
**Capacitive Characteristics (Ta = 25°C)**

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Typ. | Unit |
|---|---|---|---|---|---|
| Input capacitance | $C_{IN}$ | — | 3.3 | 7 | pF |
| Output capacitance | $C_{OUT}$ | — | 3.3 | 8 | pF |
| Power dissipation capacitance | $C_{PD}$ | $f_{IN}$ = 10 MHz (Note) | 3.3 | 40 | pF |

Note: $C_{PD}$ 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:

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

## AC Test Circuit




| Parameter | Switch |
|---|---|
| $t_{pLH}$, $t_{pHL}$ | Open |
| $t_{pLZ}$, $t_{pZL}$ | 6.0 V |
| $t_{pHZ}$, $t_{pZH}$ | GND |

**Figure 1**

## AC Waveform

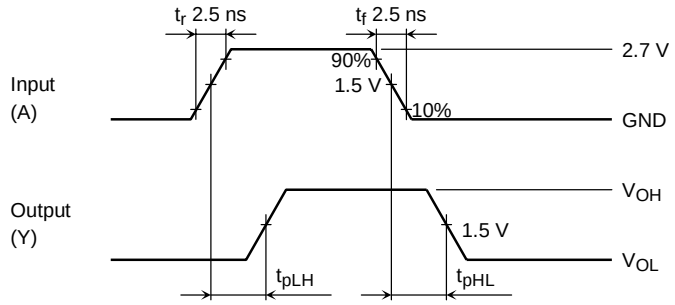



**Figure 2 $t_{pLH}$, $t_{pHL}$**

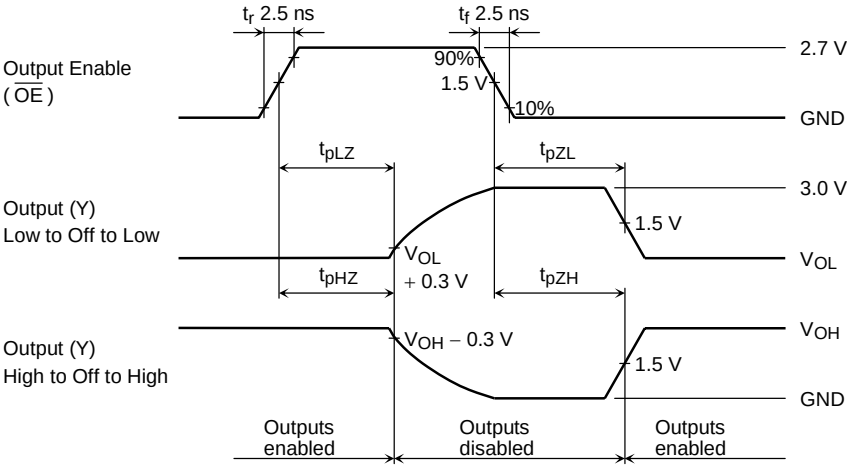
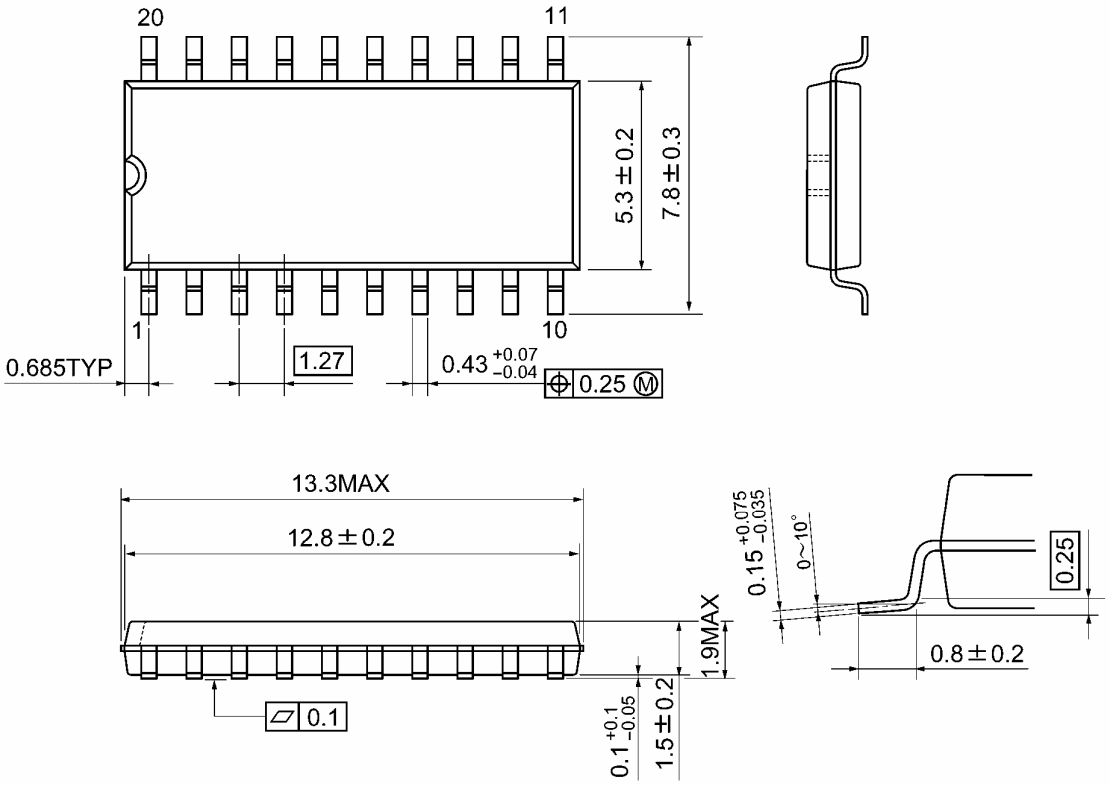



**Figure 3 $t_{pLZ}$, $t_{pHZ}$, $t_{pZL}$, $t_{pZH}$**

## Package Dimensions

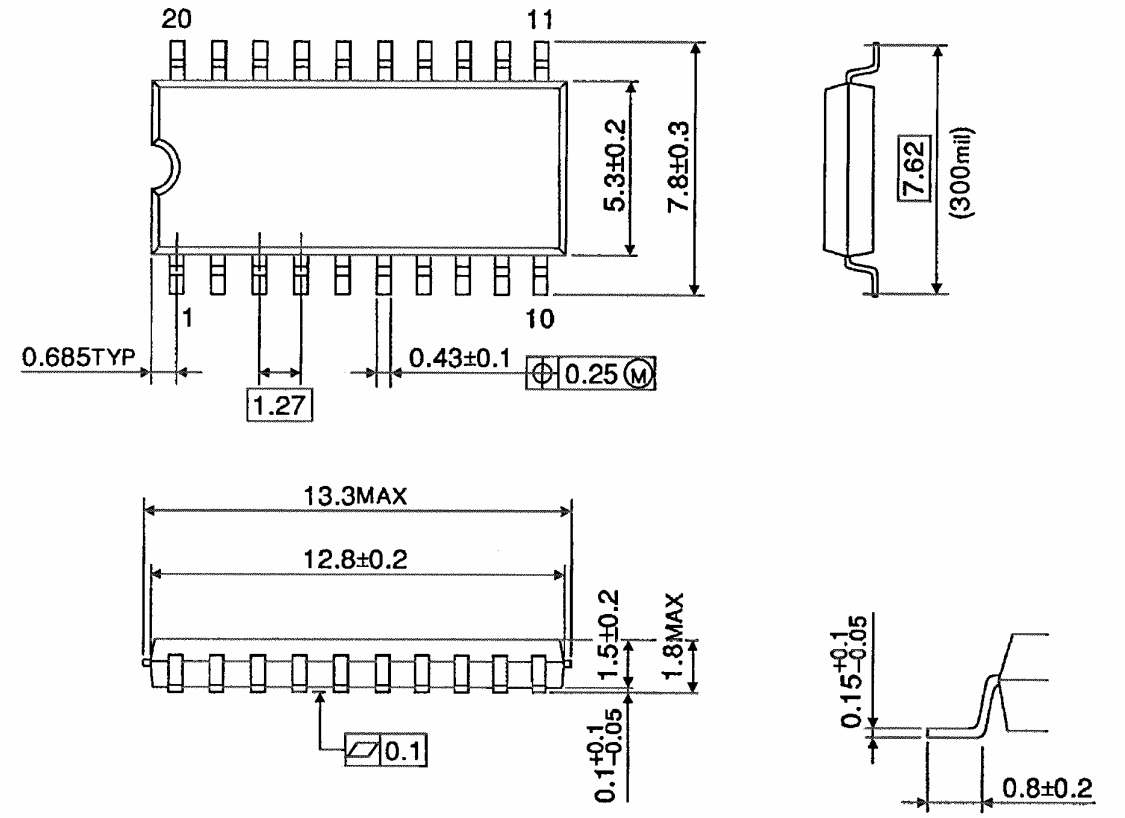
SOP20-P-300-1.27A Unit: mm




Weight: 0.22 g (typ.)

**Package Dimensions**

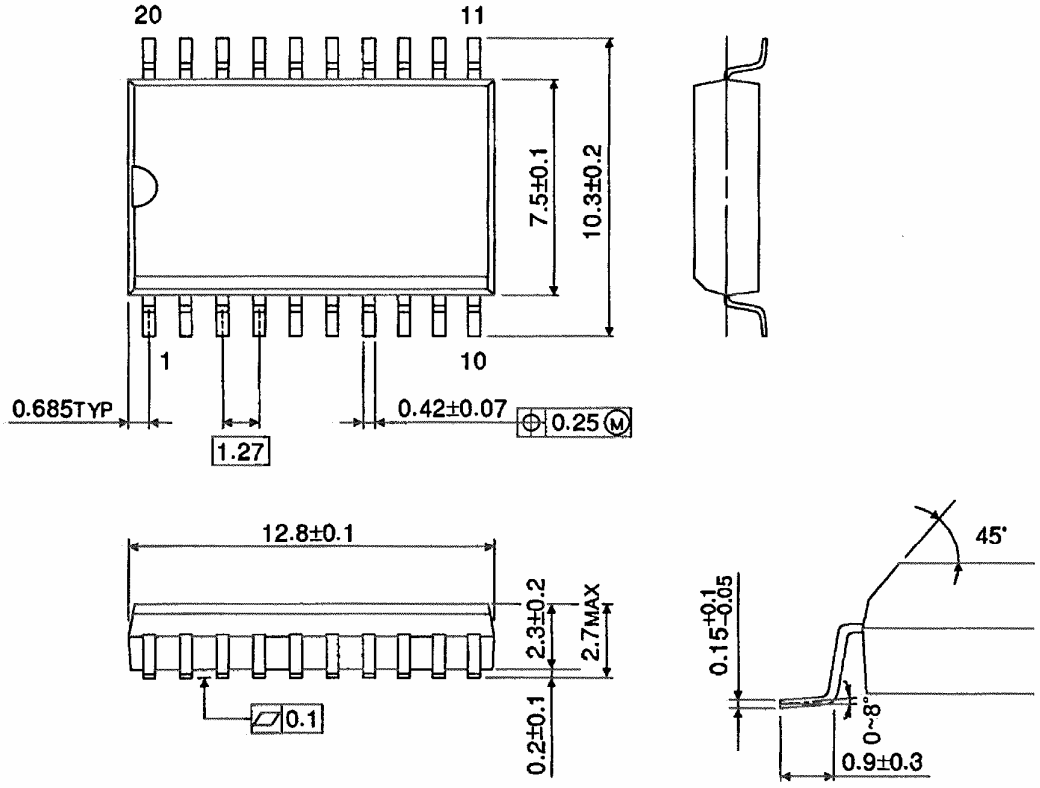
SOP20-P-300-1.27 Unit : mm




Weight: 0.22 g (typ.)

**Package Dimensions (Note)**

SOL20-P-300-1.27 Unit : mm

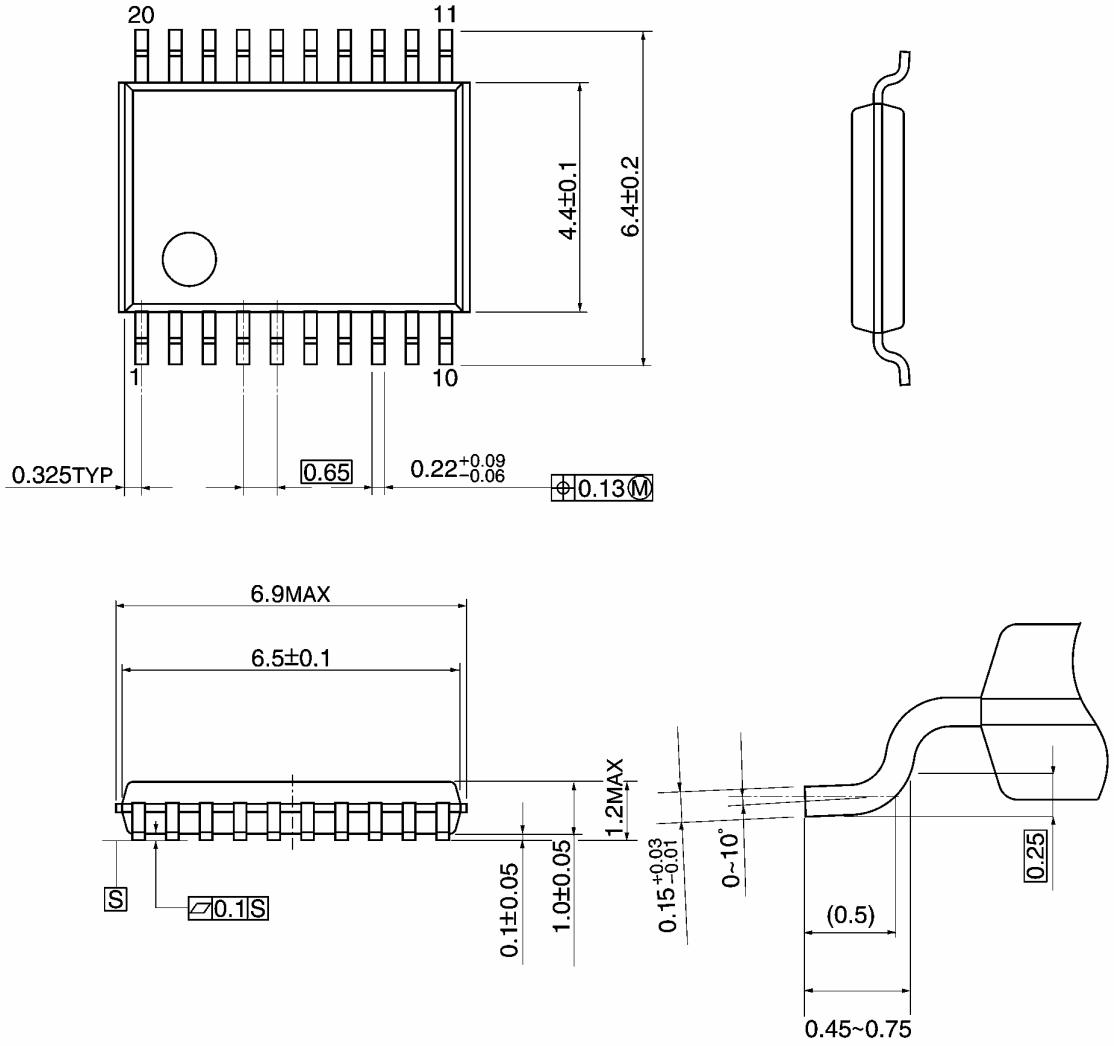



Note: This package is not available in japan.

Weight: 0.46 g (typ.)

## Package Dimensions

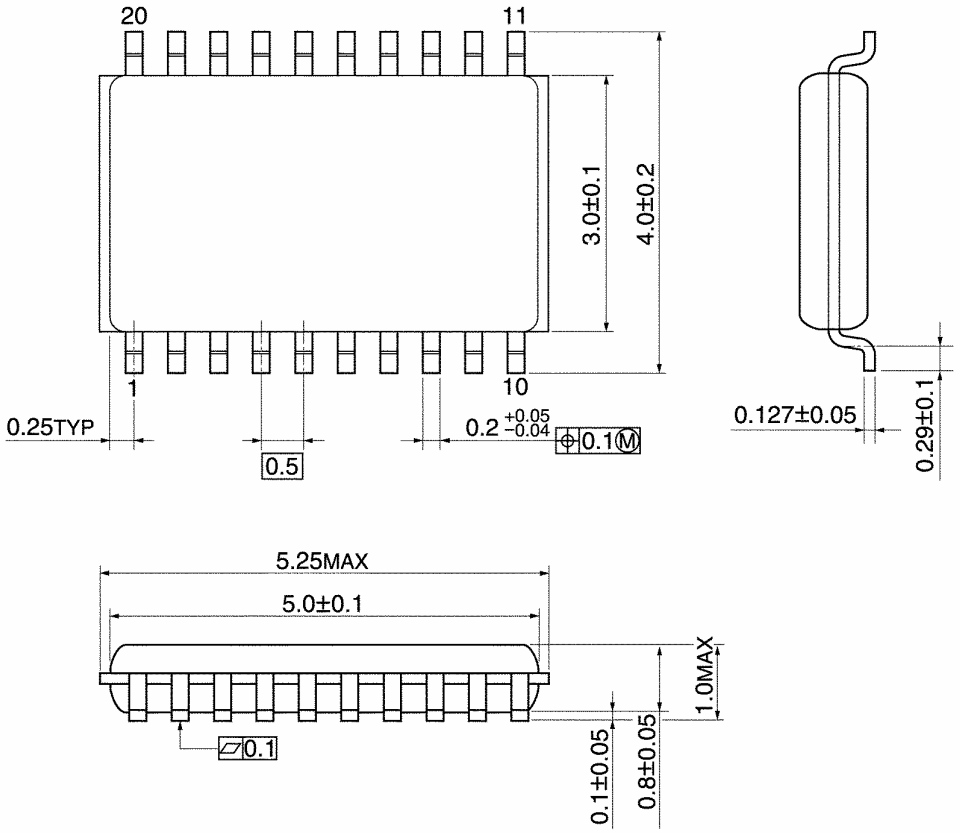
TSSOP20-P-0044-0.65A Unit: mm




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**

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