

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74VHC240F, TC74VHC240FT, TC74VHC240FK TC74VHC244F, TC74VHC244FT, TC74VHC244FK

Octal Bus Buffer

TC74VHC240F/FT/FK

Inverted, 3-State Outputs

TC74VHC244F/FT/FK

Non-Inverted, 3-State Outputs

The TC74VHC240 and 244 are advanced high speed CMOS OCTAL BUS BUFFERS fabricated with silicon gate C<sup>2</sup>MOS technology.

They achieve the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The 74VHC240 is an inverting 3-state buffer having two active-low output enables. The TC74VHC244 is a non-inverting 3-state buffer, and has two active-low output enables.

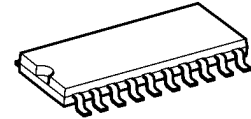
These devices are designed to be used with 3-state memory address drivers, etc.

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

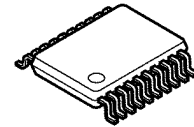
- High speed:  $t_{pd} = 3.9 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC}(\text{opr}) = 2 \text{ to } 5.5 \text{ V}$
- Low noise:  $V_{OLP} = 0.8 \text{ V}$  (max)
- Pin and function compatible with 74ALS240/244

TC74VHC240F, TC74VHC244F



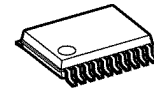
SOP20-P-300-1.27A

TC74VHC240FT, TC74VHC244FT



TSSOP20-P-0044-0.65A

TC74VHC240FK, TC74VHC244FK

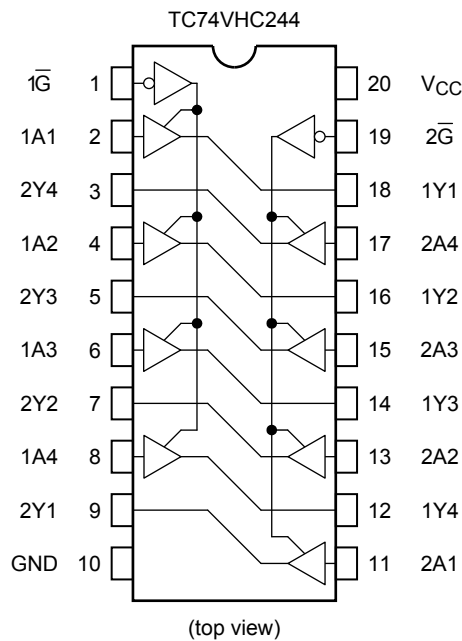
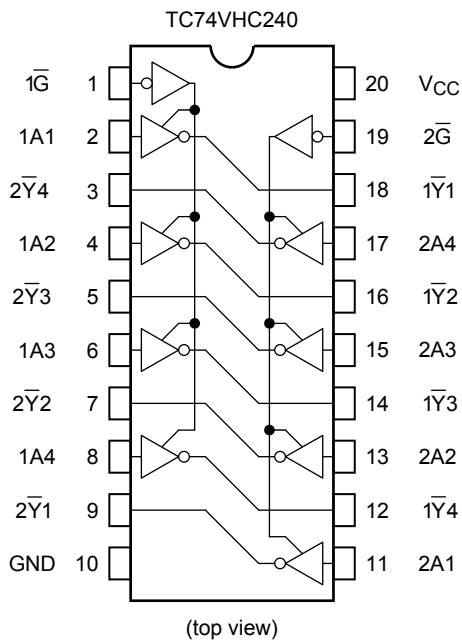


VSSOP20-P-0030-0.50

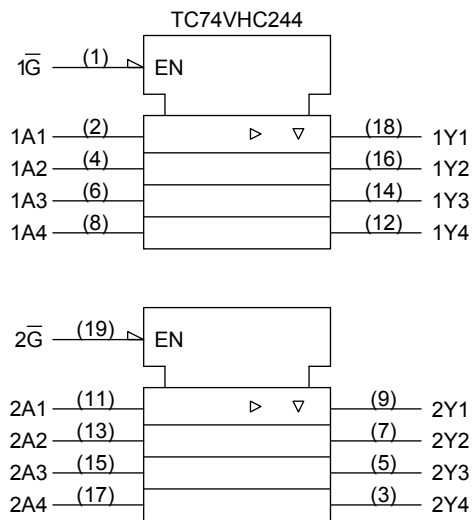
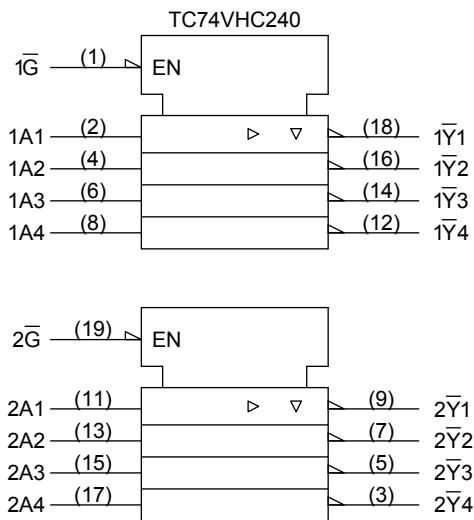
Weight

|                      |                 |
|----------------------|-----------------|
| 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         |       | Outputs |                  |
|----------------|-------|---------|------------------|
| $\overline{G}$ | $A_n$ | $Y_n$   | $\overline{Y}_n$ |
| L              | L     | L       | H                |
| L              | H     | H       | L                |
| H              | X     | Z       | Z                |

X: Don't care

Z: High impedance

$Y_n$ : TC74VHC244

$\overline{Y}_n$ : TC74VHC240

## 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  $V_{CC}$  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                           | —                             |     |
|                                  |                 |   |                          | 4.5                 | 4.4                           | 4.5    | —                             | 4.4                           | —                             |     |
|                                  |                 |   | 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                 | —                             | 0.0    | 0.1                           | —                             | 0.1                           | V   |
|                                  |                 |   |                          | 3.0                 | —                             | 0.0    | 0.1                           | —                             | 0.1                           |     |
|                                  |                 |   |                          | 4.5                 | —                             | 0.0    | 0.1                           | —                             | 0.1                           |     |
|                                  |                 |   | I <sub>OL</sub> = 4 mA   | 3.0                 | —                             | —      | 0.36                          | —                             | 0.44                          |     |
| I <sub>OL</sub> = 8 mA           | 4.5             | —   |                          | —                   | 0.36                          | —      | 0.44                          |                               |                               |     |
| 3-state output 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 |                          | 5.5                 | —                             | —      | ±0.25                         | —                             | ±2.50                         | μA  |
| 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  |

## AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

| Characteristics                        | Symbol                   | Test Condition        |                     |                     | Ta = 25°C |      |      | Ta =<br>−40 to 85°C |      | Unit |
|--|--------------------------|-----------------------|---------------------|---------------------|-----------|------|------|---------------------|------|------|
|  |                          |                       | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min       | Typ. | Max  | Min                 | Max  |      |
| Propagation delay time<br>(TC74VHC240) | $t_{pLH}$<br>$t_{pHL}$   | —                     | $3.3 \pm 0.3$       | 15                  | —         | 5.3  | 7.5  | 1.0                 | 9.0  | ns   |
|  |                          |                       |                     | 50                  | —         | 7.8  | 11.0 | 1.0                 | 12.5 |      |
|  |                          |                       | $5.0 \pm 0.5$       | 15                  | —         | 3.6  | 5.5  | 1.0                 | 6.5  |      |
|  |                          |                       |                     | 50                  | —         | 5.1  | 7.5  | 1.0                 | 8.5  |      |
| Propagation delay time<br>(TC74VHC244) | $t_{pLH}$<br>$t_{pHL}$   | —                     | $3.3 \pm 0.3$       | 15                  | —         | 5.8  | 8.4  | 1.0                 | 10.0 | ns   |
|  |                          |                       |                     | 50                  | —         | 8.3  | 11.9 | 1.0                 | 13.5 |      |
|  |                          |                       | $5.0 \pm 0.5$       | 15                  | —         | 3.9  | 5.5  | 1.0                 | 6.5  |      |
|  |                          |                       |                     | 50                  | —         | 5.4  | 7.5  | 1.0                 | 8.5  |      |
| 3-state output enable time             | $t_{pZL}$<br>$t_{pZH}$   | R <sub>L</sub> = 1 kΩ | $3.3 \pm 0.3$       | 15                  | —         | 6.6  | 10.6 | 1.0                 | 12.5 | ns   |
|  |                          |                       |                     | 50                  | —         | 9.1  | 14.1 | 1.0                 | 16.0 |      |
|  |                          |                       | $5.0 \pm 0.5$       | 15                  | —         | 4.7  | 7.3  | 1.0                 | 8.5  |      |
|  |                          |                       |                     | 50                  | —         | 6.2  | 9.3  | 1.0                 | 10.5 |      |
| 3-state output disable time            | $t_{pLZ}$<br>$t_{pHZ}$   | R <sub>L</sub> = 1 kΩ | $3.3 \pm 0.3$       | 50                  | —         | 10.3 | 14.0 | 1.0                 | 16.0 | ns   |
|  |                          |                       | $5.0 \pm 0.5$       | 50                  | —         | 6.7  | 9.2  | 1.0                 | 10.5 |      |
| Output to output skew                  | $t_{oSLH}$<br>$t_{oSHL}$ | (Note 1)              | $3.3 \pm 0.3$       | 50                  | —         | —    | 1.5  | —                   | 1.5  | ns   |
|  | $5.0 \pm 0.5$            |                       | 50                  | —                   | —         | 1.0  | —    | 1.0                 |      |      |
| Input capacitance                      | C <sub>IN</sub>          | —                     |                     |                     | —         | 4    | 10   | —                   | 10   | pF   |
| Output capacitance                     | C <sub>OUT</sub>         | —                     |                     |                     | —         | 6    | —    | —                   | —    | pF   |
| Power dissipation capacitance (Note 2) | C <sub>PD</sub>          | TC74VHC240            |                     |                     | —         | 17   | —    | —                   | —    | pF   |
|  |                          | TC74VHC244            |                     |                     | —         | 19   | —    | —                   | —    |      |

Note 1: Parameter guaranteed by design.

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

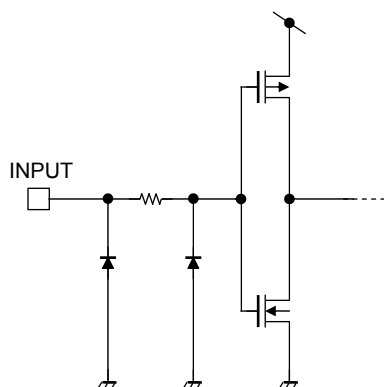
Note 2: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

## Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

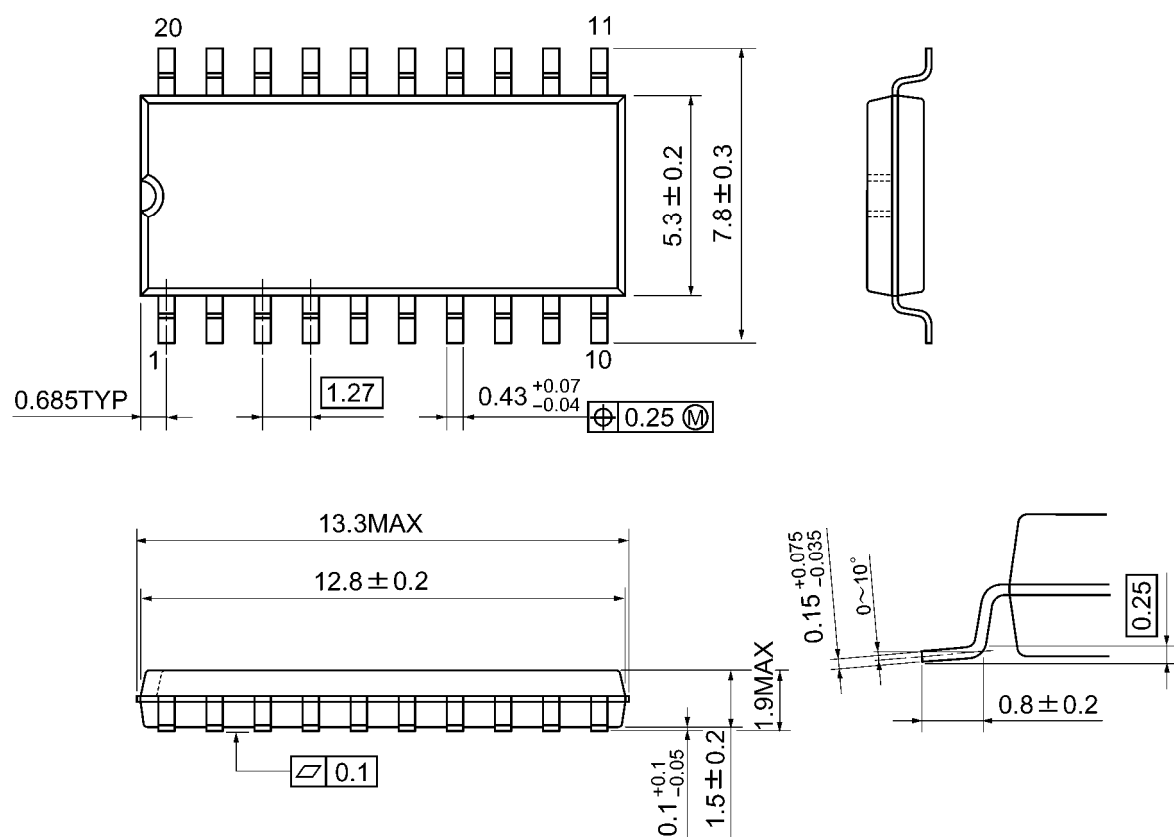
| Characteristics                              | Symbol           | Test Condition         | Ta = 25°C           |            | Unit |   |
|--|------------------|------------------------|---------------------|------------|------|---|
|  |                  |                        | V <sub>CC</sub> (V) | Typ. Limit |      |   |
| 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

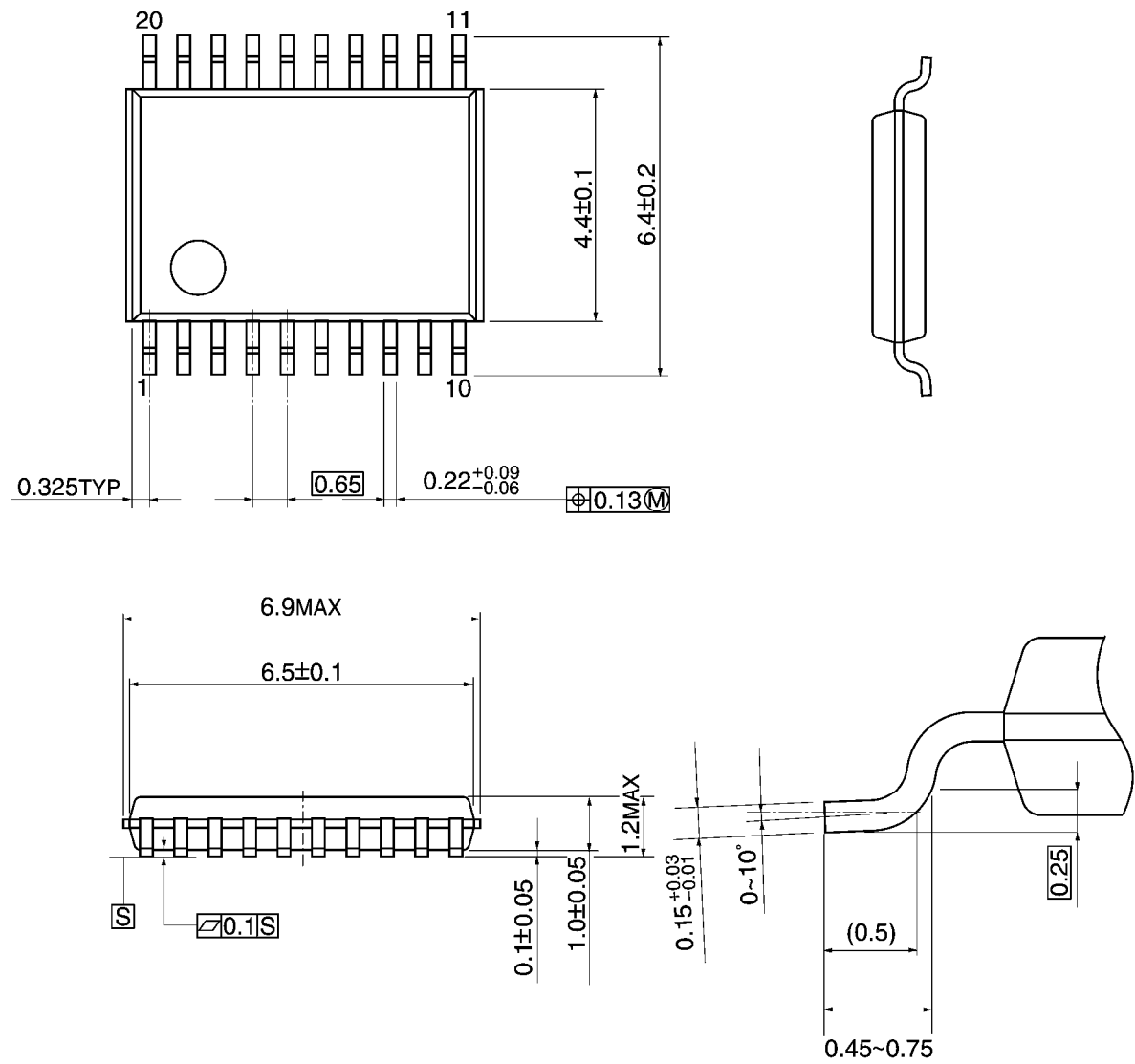


Weight: 0.22 g (typ.)

Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm



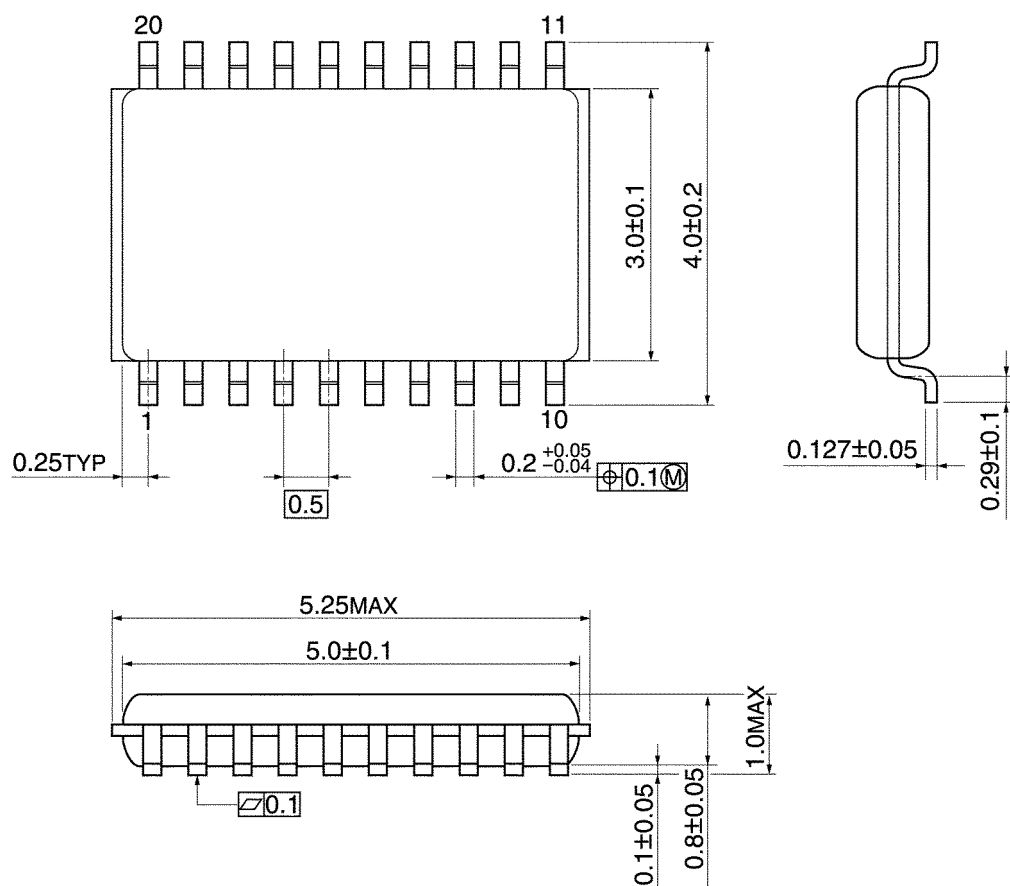
Weight: 0.08 g (typ.)



## Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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