

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

## TC74VHC540F, TC74VHC540FW, TC74VHC540FT TC74VHC541F, TC74VHC541FW, TC74VHC541FT

### OCTAL BUS BUFFER

TC74VHC540 F / FW / FT INVERTED, 3 - STATE OUTPUTS  
TC74VHC541 F / FW / FT NON - INVERTED, 3 - STATE OUTPUTS

(Note) The JEDEC SOP (FW) is not available in Japan.

The TC74VHC540/TC74VHC541 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.

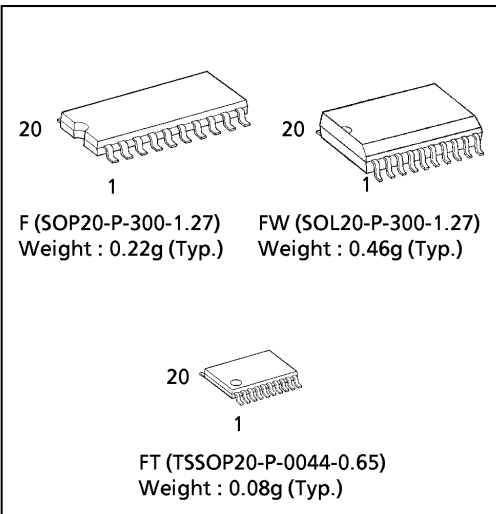
The TC74VHC540 is an inverting type, and the TC74VHC541 is a non-inverting type.

When either  $\bar{G}1$  or  $\bar{G}2$  are high, the terminal outputs are in the high-impedance state.

An input protection circuit ensures that 0 to 7V 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..... $t_{pd} = 3.7ns$ (typ.) at  $V_{CC} = 5V$
- Low Power Dissipation..... $I_{CC} = 4\mu A$ (Max.) at  $T_a = 25^\circ C$
- 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..... $V_{CC} (opr) = 2V \sim 5.5V$
- Low Noise..... $V_{OLP} = 1.2V$  (Max.)
- Pin and Function Compatible with 74ALS540/541

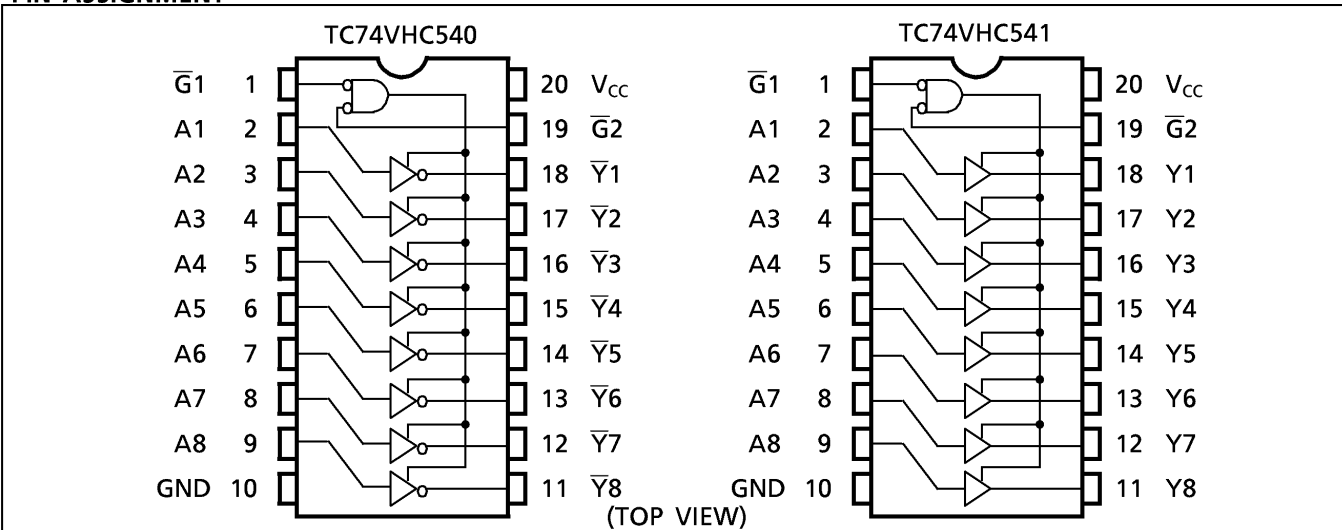


### TRUTH TABLE

| INPUTS     |            |    | OUTPUTS |            |
|------------|------------|----|---------|------------|
| $\bar{G}1$ | $\bar{G}2$ | An | Yn      | $\bar{Y}n$ |
| H          | X          | X  | Z       | Z          |
| X          | H          | X  | Z       | Z          |
| L          | L          | H  | H       | L          |
| L          | L          | L  | L       | H          |

X : Don't Care  
Z : High Impedance  
 $Y_n$  : TC74VHC541  
 $\bar{Y}_n$  : TC74VHC540

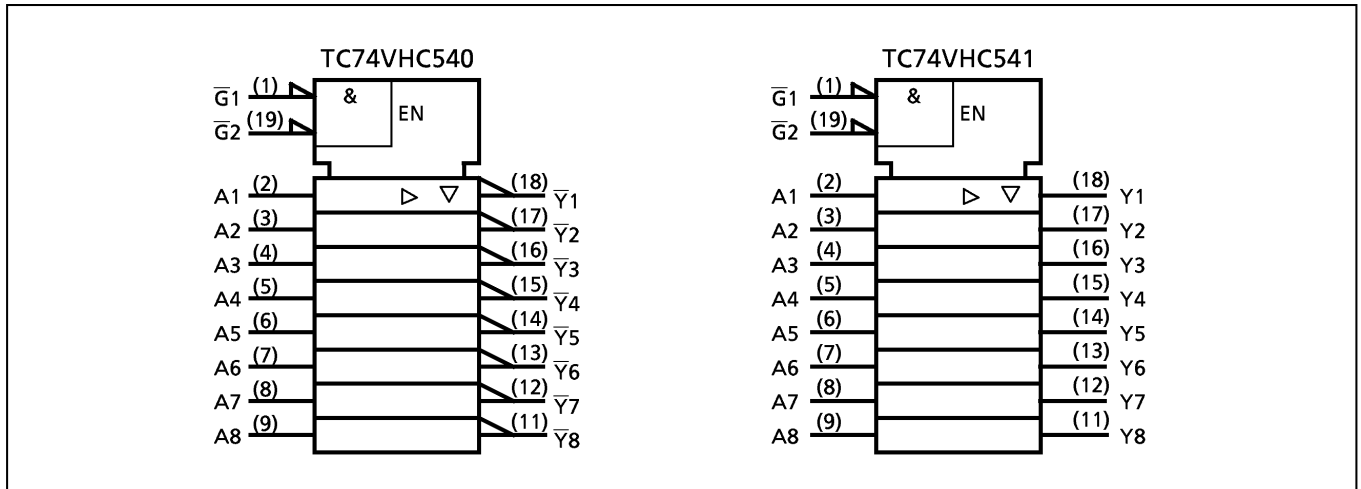
### PIN ASSIGNMENT



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**IEC LOGIC SYMBOL**



**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                   | SYMBOL    | VALUE                | UNIT |
|-----------------------------|-----------|----------------------|------|
| Supply Voltage Range        | $V_{CC}$  | -0.5~7.0             | V    |
| DC Input Voltage            | $V_{IN}$  | -0.5~7.0             | V    |
| DC Output Voltage           | $V_{OUT}$ | -0.5~ $V_{CC} + 0.5$ | V    |
| Input Diode Current         | $I_{IK}$  | -20                  | mA   |
| Output Diode Current        | $I_{OK}$  | ±20                  | mA   |
| DC Output Current           | $I_{OUT}$ | ±25                  | mA   |
| DC $V_{CC}$ /Ground Current | $I_{CC}$  | ±75                  | mA   |
| Power Dissipation           | $P_D$     | 180                  | mW   |
| Storage Temperature         | $T_{stg}$ | -65~150              | °C   |

**RECOMMENDED OPERATING CONDITIONS**

| PARAMETER                | SYMBOL    | VALUE   | UNIT   |
|--------------------------|-----------|---|--------|
| Supply Voltage           | $V_{CC}$  | 2.0~5.5   | V      |
| Input Voltage            | $V_{IN}$  | 0~5.5   | V      |
| Output Voltage           | $V_{OUT}$ | 0~ $V_{CC}$   | V      |
| Operating Temperature    | $T_{opr}$ | -40~85  | °C     |
| Input Rise and Fall Time | dt / dv   | 0~100 ( $V_{CC} = 3.3 \pm 0.3V$ )<br>0~20 ( $V_{CC} = 5 \pm 0.5V$ ) | ns / V |

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## DC ELECTRICAL CHARACTERISTICS

| PARAMETER                            | SYMBOL          | TEST CONDITION  | V <sub>CC</sub><br>(V)                           | Ta = 25°C                     |        |                               | Ta = -40~85°C                 |                               | UNIT |   |
|--------------------------------------|-----------------|---|--|-------------------------------|--------|-------------------------------|-------------------------------|-------------------------------|------|---|
|                                      |                 |   |  | MIN.                          | TYP.   | MAX.                          | MIN.                          | MAX.                          |      |   |
| High - Level Input Voltage           | V <sub>IH</sub> |   | 2.0<br>3.0~<br>5.5                               | 1.50<br>V <sub>CC</sub> × 0.7 | —<br>— | —<br>—                        | 1.50<br>V <sub>CC</sub> × 0.7 | —                             | V    |   |
| Low - Level Input Voltage            | V <sub>IL</sub> |   | 2.0<br>3.0~<br>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> = -50μA                          | 2.0                           | 1.9    | 2.0                           | —                             | 1.9                           | —    | V |
|                                      |                 |   |  | 3.0                           | 2.9    | 3.0                           | —                             | 2.9                           | —    |   |
|                                      |                 |   | I <sub>OH</sub> = -4mA<br>I <sub>OH</sub> = -8mA | 4.5                           | 4.4    | 4.5                           | —                             | 4.4                           | —    |   |
|                                      |                 |   |  | 3.0                           | 2.58   | —                             | —                             | 2.48                          | —    |   |
|                                      |                 |   | I <sub>OH</sub> = -8mA                           | 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> = 50μA                           | 2.0                           | —      | 0.0                           | 0.1                           | —                             | 0.1  | V |
|                                      |                 |   |  | 3.0                           | —      | 0.0                           | 0.1                           | —                             | 0.1  |   |
|                                      |                 |   | I <sub>OL</sub> = 4mA<br>I <sub>OL</sub> = 8mA   | 4.5                           | —      | 0.0                           | 0.1                           | —                             | 0.1  |   |
|                                      |                 |   |  | 3.0                           | —      | —                             | 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> = 5.5V or GND   | 0~5.5  | —                             | —      | ±0.1                          | —                             | ±1.0                          |      |   |
| Quiescent Supply Current             | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND  | 5.5  | —                             | —      | 4.0                           | —                             | 40.0                          |      |   |

AC ELECTRICAL CHARACTERISTICS (Input  $t_r = t_f = 3\text{ns}$ )

| PARAMETER                                 | SYMBOL            | TEST CONDITION      |           | Ta = 25°C |      |      | Ta = -40~85°C |      | UNIT |
|---|-------------------|---------------------|-----------|-----------|------|------|---------------|------|------|
|   |                   | V <sub>CC</sub> (V) | CL (pF)   | MIN.      | TYP. | MAX. | MIN.          | MAX. |      |
| Propagation Delay Time<br>(TC74VHC540)    | t <sub>pLH</sub>  | 3.3 ± 0.3           | 15        | —         | 4.8  | 7.0  | 1.0           | 8.5  | ns   |
|   |                   |                     | 50        | —         | 7.3  | 10.5 | 1.0           | 12.0 |      |
|   | t <sub>pHL</sub>  | 5.0 ± 0.5           | 15        | —         | 3.7  | 5.0  | 1.0           | 6.0  |      |
|   |                   |                     | 50        | —         | 5.2  | 7.0  | 1.0           | 8.0  |      |
| Propagation Delay Time<br>(TC74VHC541)    | t <sub>pLH</sub>  | 3.3 ± 0.3           | 15        | —         | 5.0  | 7.0  | 1.0           | 8.5  |      |
|   |                   |                     | 50        | —         | 7.5  | 10.5 | 1.0           | 12.0 |      |
|   | t <sub>pHL</sub>  | 5.0 ± 0.5           | 15        | —         | 3.5  | 5.0  | 1.0           | 6.0  |      |
|   |                   |                     | 50        | —         | 5.0  | 7.0  | 1.0           | 8.0  |      |
| 3-State<br>Output Enable Time             | t <sub>pZL</sub>  | RL = 1kΩ            | 3.3 ± 0.3 | 15        | —    | 6.8  | 10.5          | 1.0  | 12.5 |
|   |                   |                     |           | 50        | —    | 9.3  | 14.0          | 1.0  | 16.0 |
|   | t <sub>pZH</sub>  |                     | 5.0 ± 0.5 | 15        | —    | 4.7  | 7.2           | 1.0  | 8.5  |
|   |                   |                     |           | 50        | —    | 6.2  | 9.2           | 1.0  | 10.5 |
| 3-State<br>Output Disable Time            | t <sub>pLZ</sub>  | RL = 1kΩ            | 3.3 ± 0.3 | 50        | —    | 11.2 | 15.4          | 1.0  | 17.5 |
|   |                   |                     |           | 50        | —    | 6.0  | 8.8           | 1.0  | 10.0 |
| t <sub>pHZ</sub>                          | 5.0 ± 0.5         |                     | 50        | —         | 6.0  | 8.8  | 1.0           | 10.0 |      |
|   |                   |                     | 50        | —         | 6.0  | 8.8  | 1.0           | 10.0 |      |
| Output to Output Skew                     | t <sub>osHL</sub> | (Note 1)            | 3.3 ± 0.3 | 50        | —    | —    | 1.5           | —    | 1.5  |
|   |                   |                     |           | 50        | —    | —    | 1.0           | —    | 1.0  |
| t <sub>osLH</sub>                         | 5.0 ± 0.5         |                     | 50        | —         | —    | 1.0  | —             | 1.0  |      |
|   |                   |                     | 50        | —         | —    | 1.0  | —             | 1.0  |      |
| Input Capacitance                         | C <sub>IN</sub>   |                     |           | —         | 4    | 10   | —             | 10   | pF   |
| Output Capacitance                        | C <sub>OUT</sub>  |                     |           | —         | 6    | —    | —             | —    |      |
| Power Dissipation Capacitance<br>(Note 2) | C <sub>PD</sub>   | TC74VHC540          |           | —         | 17   | —    | —             | —    |      |
|   |                   | TC74VHC541          |           | —         | 18   | —    | —             | —    |      |

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:

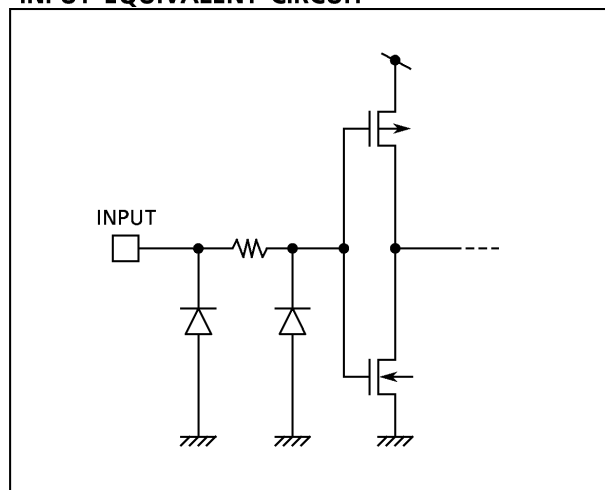
$$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 8 \text{ (per bit)}$$

**NOISE CHARACTERISTICS (Input  $t_r = t_f = 3ns$ )**

| PARAMETER                                | SYMBOL | TEST CONDITION | Ta = 25°C           |                |                | UNIT |
|--|--------|----------------|---------------------|----------------|----------------|------|
|  |        |                | V <sub>CC</sub> (V) | TYP.           | LIMIT          |      |
| Quiet Output Maximum Dynamic VOL         | VOLP   | CL = 50pF      | 5.0                 | 0.7<br>(0.9)   | 1.0<br>(1.2)   | V    |
| Quiet Output Minimum Dynamic VOL         | VOLV   | CL = 50pF      | 5.0                 | -0.7<br>(-0.9) | -1.0<br>(-1.2) | V    |
| Minimum High Level Dynamic Input Voltage | VIHD   | CL = 50pF      | 5.0                 | —              | 3.5            | V    |
| Maximum Low Level Dynamic Input Voltage  | VILD   | CL = 50pF      | 5.0                 | —              | 1.5            | V    |

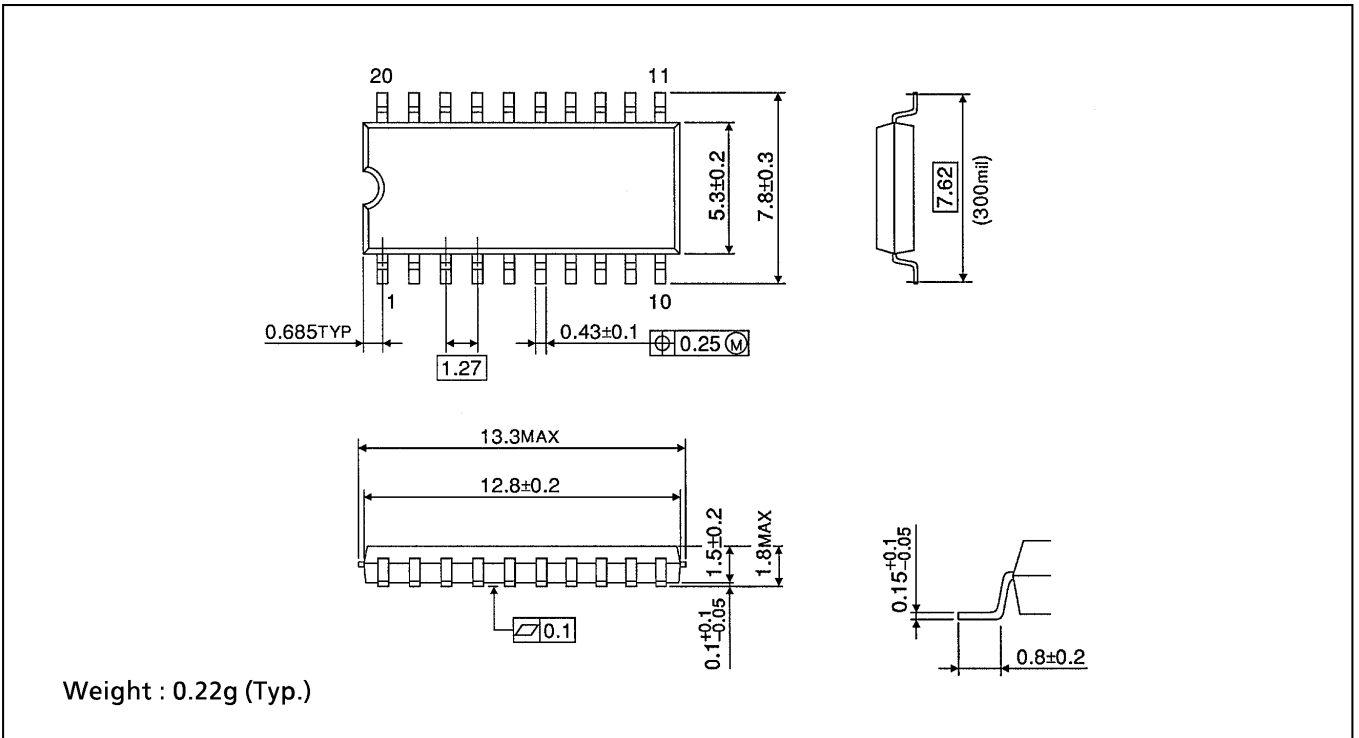
(Note) The value in ( ) only applies to JEDEC SOP (FW) devices.

**INPUT EQUIVALENT CIRCUIT**



**SOP 20PIN (200mil BODY) OUTLINE DRAWING (SOP20-P-300-1.27)**

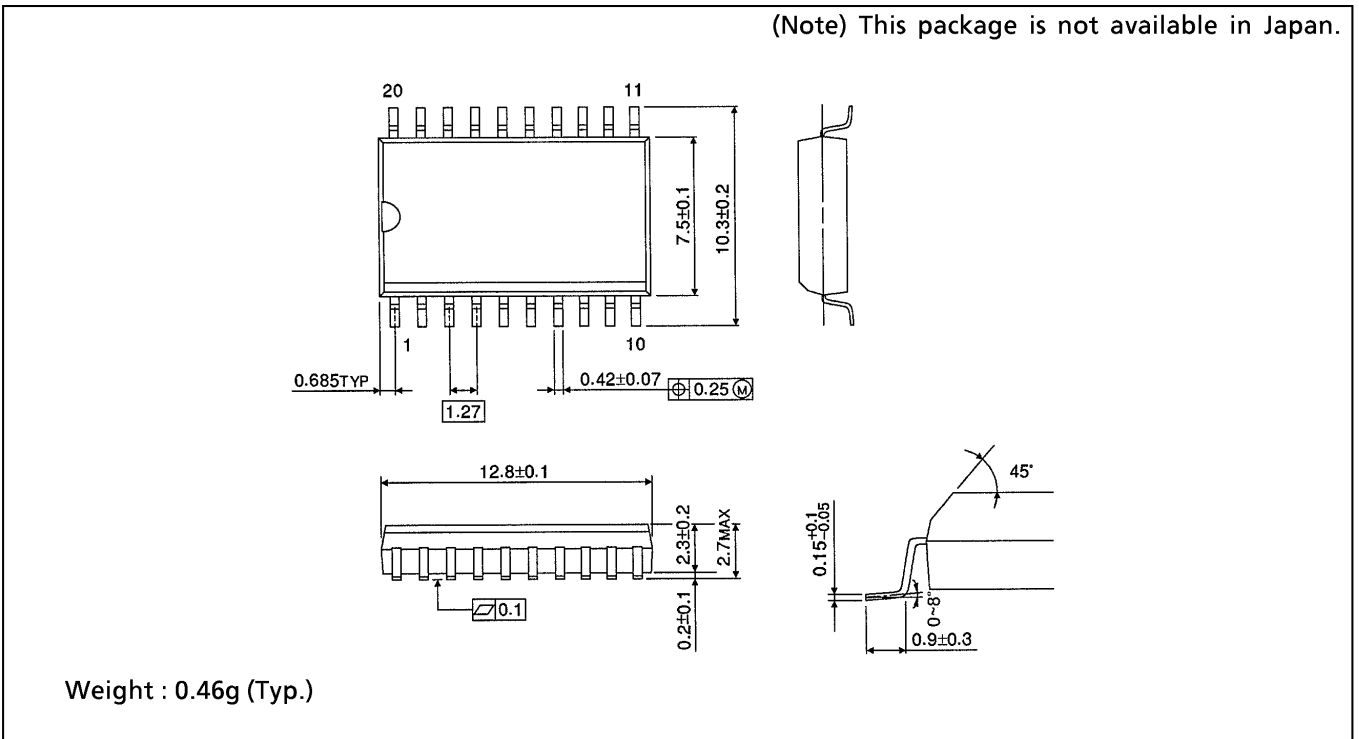
Unit in mm



**SOP 20PIN (300mil BODY) OUTLINE DRAWING (SOP20-P-300-1.27)**

Unit in mm

(Note) This package is not available in Japan.



**TSSOP 20PIN OUTLINE DRAWING (TSSOP20-P-0044-0.65)**

Unit in mm

