

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

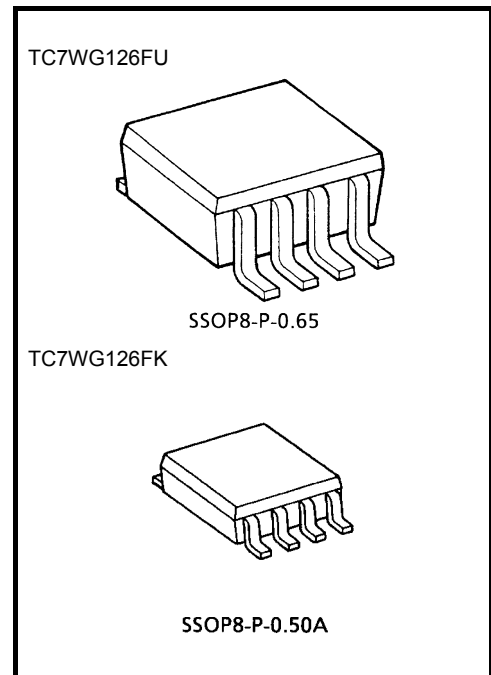
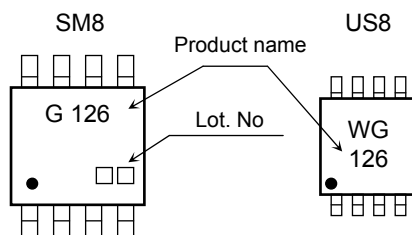
# TC7WG126FU, TC7WG126FK

Dual Bus Buffer with 3-STATE Output

## Features

- High-level output current:  $I_{OH}/I_{OL} = \pm 8 \text{ mA (min)}$   
at  $V_{CC} = 3 \text{ V}$
- High-speed operation:  $t_{pd} = 2.5 \text{ ns (typ.)}$   
at  $V_{CC} = 3.3 \text{ V}, 15 \text{ pF}$
- Operating voltage range:  $V_{CC} = 0.9 \sim 3.6 \text{ V}$
- 5.5-V tolerant inputs
- 3.6-V power down protection outputs

## Marking

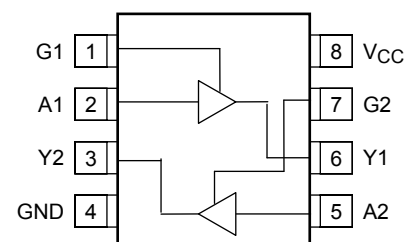


Weight  
 SSOP8-P-0.65 : 0.02 g (typ.)  
 SSOP8-P-0.50A : 0.01 g (typ.)

## Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

| Characteristics              | Symbol    | Value                             | Unit             |
|------------------------------|-----------|-----------------------------------|------------------|
| Power supply voltage         | $V_{CC}$  | $-0.5 \sim 4.6$                   | V                |
| DC input voltage             | $V_{IN}$  | $-0.5 \sim 7.0$                   | V                |
| DC output voltage            | $V_{OUT}$ | $-0.5 \sim 4.6$ (Note 1)          | V                |
|                              |           | $-0.5 \sim V_{CC} + 0.5$ (Note 2) |                  |
| Input diode current          | $I_{IK}$  | $-20$                             | mA               |
| Output diode current         | $I_{OK}$  | $-20$ (Note 3)                    | mA               |
| DC output current            | $I_{OUT}$ | $\pm 25$                          | mA               |
| DC $V_{CC}$ / ground current | $I_{CC}$  | $\pm 100$                         | mA               |
| Power dissipation            | $P_D$     | 300 (SM8)<br>200 (US8)            | mW               |
| Storage temperature          | $T_{stg}$ | $-65 \sim 150$                    | $^\circ\text{C}$ |

## Pin Assignment (top view)



Note: 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.).

Note 1:  $V_{CC} = 0 \text{ V}$

Note 2: High or Low State.  $I_{OUT}$  absolute maximum rating must be observed.

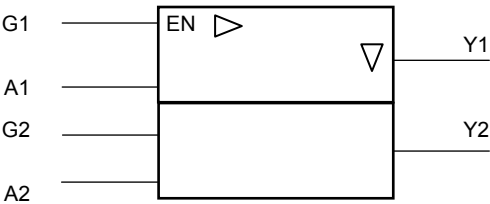
Note 3:  $V_{OUT} < \text{GND}$

Truth Table

| Inputs |   | Outputs |
|--------|---|---------|
| G      | A | Y       |
| L      | X | Z       |
| H      | L | L       |
| H      | H | H       |

X: Don't Care  
Z: High impedance

IEC Logic Symbol



Operating Ranges

| Characteristics          | Symbol          | Value                | Unit |
|--------------------------|-----------------|----------------------|------|
| Power supply voltage     | $V_{CC}$        | 0.9~3.6              | V    |
| Input voltage            | $V_{IN}$        | 0~5.5                | V    |
| Output voltage           | $V_{OUT}$       | 0~3.6 (Note 4)       | V    |
|                          |                 | 0~ $V_{CC}$ (Note 5) |      |
| Output Current           | $I_{OH}/I_{OL}$ | ±8.0 (Note 6)        | mA   |
|                          |                 | ±4.0 (Note 7)        |      |
|                          |                 | ±3.0 (Note 8)        |      |
|                          |                 | ±1.7 (Note 9)        |      |
|                          |                 | ±0.3 (Note 10)       |      |
|                          |                 | ±0.02 (Note 11)      |      |
| Operating temperature    | $T_{opr}$       | -40~85               | °C   |
| Input rise and fall time | dt/dV           | 0~10 (Note 12)       | ns/V |

- Note 4:  $V_{CC} = 0V$   
Note 5: High or Low state  
Note 6:  $V_{CC} = 3.0\sim3.6\text{ V}$   
Note 7:  $V_{CC} = 2.3\sim2.7\text{ V}$   
Note 8:  $V_{CC} = 1.65\sim1.95\text{ V}$   
Note 9:  $V_{CC} = 1.4\sim1.6\text{ V}$   
Note 10:  $V_{CC} = 1.1\sim1.3\text{ V}$   
Note 11:  $V_{CC} = 0.9\text{ V}$   
Note 12:  $V_{IN} = 0.8\sim2.0\text{ V}$ ,  $V_{CC} = 3.0\text{ V}$

## Electrical Characteristics

## DC Characteristics

| Characteristics                  |            | Symbol           | Test Condition                                                                    |                            | Ta = 25°C              |                        |                        |                        | Ta = -40~85°C          |                        | Unit |
|----------------------------------|------------|------------------|-----------------------------------------------------------------------------------|----------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------|
|                                  |            |                  |                                                                                   |                            | V <sub>CC</sub> (V)    | Min                    | Typ.                   | Max                    | Min                    | Max                    |      |
| Input voltage                    | High level | V <sub>IH</sub>  | —                                                                                 | 0.9                        | V <sub>CC</sub>        | —                      | —                      | V <sub>CC</sub>        | —                      | V                      |      |
|                                  |            |                  |                                                                                   | 1.1~1.3                    | V <sub>CC</sub> × 0.7  | —                      | —                      | V <sub>CC</sub> × 0.7  | —                      |                        |      |
|                                  |            |                  |                                                                                   | 1.4~1.6                    | V <sub>CC</sub> × 0.65 | —                      | —                      | V <sub>CC</sub> × 0.65 | —                      |                        |      |
|                                  |            |                  |                                                                                   | 1.65~1.95                  | V <sub>CC</sub> × 0.65 | —                      | —                      | V <sub>CC</sub> × 0.65 | —                      |                        |      |
|                                  |            |                  |                                                                                   | 2.3~2.7                    | 1.7                    | —                      | —                      | 1.7                    | —                      |                        |      |
|                                  |            |                  |                                                                                   | 3.0~3.6                    | 2.0                    | —                      | —                      | 2.0                    | —                      |                        |      |
|                                  | Low level  | V <sub>IL</sub>  | —                                                                                 | 0.9                        | —                      | —                      | GND                    | —                      | GND                    |                        |      |
|                                  |            |                  |                                                                                   | 1.1~1.3                    | —                      | —                      | V <sub>CC</sub> × 0.3  | —                      | V <sub>CC</sub> × 0.3  |                        |      |
|                                  |            |                  |                                                                                   | 1.4~1.6                    | —                      | —                      | V <sub>CC</sub> × 0.35 | —                      | V <sub>CC</sub> × 0.35 |                        |      |
|                                  |            |                  |                                                                                   | 1.65~1.95                  | —                      | —                      | V <sub>CC</sub> × 0.35 | —                      | V <sub>CC</sub> × 0.35 |                        |      |
|                                  |            |                  |                                                                                   | 2.3~2.7                    | —                      | —                      | 0.7                    | —                      | 0.7                    |                        |      |
|                                  |            |                  |                                                                                   | 3.0~3.6                    | —                      | —                      | 0.8                    | —                      | 0.8                    |                        |      |
| Output voltage                   | High level | V <sub>OH</sub>  | V <sub>IN</sub> =V <sub>IH</sub>                                                  | I <sub>OH</sub> = -0.02 mA | 0.9                    | 0.75                   | —                      | —                      | 0.75                   | —                      | V    |
|                                  |            |                  |                                                                                   | I <sub>OH</sub> = -0.3 mA  | 1.1~1.3                | V <sub>CC</sub> × 0.75 | —                      | —                      | V <sub>CC</sub> × 0.75 | —                      |      |
|                                  |            |                  |                                                                                   | I <sub>OH</sub> = -1.7 mA  | 1.4~1.6                | V <sub>CC</sub> × 0.75 | —                      | —                      | V <sub>CC</sub> × 0.75 | —                      |      |
|                                  |            |                  |                                                                                   | I <sub>OH</sub> = -3.0 mA  | 1.65~1.95              | V <sub>CC</sub> -0.45  | —                      | —                      | V <sub>CC</sub> -0.45  | —                      |      |
|                                  |            |                  |                                                                                   | I <sub>OH</sub> = -4.0 mA  | 2.3~2.7                | 2.0                    | —                      | —                      | 2.0                    | —                      |      |
|                                  |            |                  |                                                                                   | I <sub>OH</sub> = -8.0 mA  | 3.0~3.6                | 2.48                   | —                      | —                      | 2.48                   | —                      |      |
|                                  | Low level  | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>                              | I <sub>OL</sub> = 0.02 mA  | 0.9                    | —                      | —                      | 0.1                    | —                      | 0.1                    |      |
|                                  |            |                  |                                                                                   | I <sub>OL</sub> = 0.3 mA   | 1.1~1.3                | —                      | —                      | V <sub>CC</sub> × 0.25 | —                      | V <sub>CC</sub> × 0.25 |      |
|                                  |            |                  |                                                                                   | I <sub>OL</sub> = 1.7 mA   | 1.4~1.6                | —                      | —                      | V <sub>CC</sub> × 0.25 | —                      | V <sub>CC</sub> × 0.25 |      |
|                                  |            |                  |                                                                                   | I <sub>OL</sub> = 3.0 mA   | 1.65~1.95              | —                      | —                      | 0.45                   | —                      | 0.45                   |      |
|                                  |            |                  |                                                                                   | I <sub>OL</sub> = 4.0 mA   | 2.3~2.7                | —                      | —                      | 0.4                    | —                      | 0.4                    |      |
|                                  |            |                  |                                                                                   | I <sub>OL</sub> = 8.0 mA   | 3.0~3.6                | —                      | —                      | 0.4                    | —                      | 0.4                    |      |
| Input leakage current            |            | I <sub>IN</sub>  | V <sub>IN</sub> = 0~5.5V                                                          | 0~3.6                      | —                      | —                      | ±0.1                   | —                      | ±1.0                   | μA                     |      |
| 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> = 0~3.6V | 0.9~3.6                    | —                      | —                      | 1.0                    | —                      | 10.0                   | μA                     |      |
| Power off leakage current        |            | I <sub>OFF</sub> | V <sub>IN</sub> = 5.5V<br>or V <sub>OUT</sub> = 3.6V                              | 0.0                        | —                      | —                      | 1.0                    | —                      | 10.0                   | μA                     |      |
| Quiescent supply current         |            | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                                          | 3.6                        | —                      | —                      | 1.0                    | —                      | 10.0                   | μA                     |      |

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

| Characteristics        | Symbol                 | Test Condition                                         | Ta = 25°C           |     |      | Ta = -40~85°C |     | Unit |
|------------------------|------------------------|--------------------------------------------------------|---------------------|-----|------|---------------|-----|------|
|                        |                        |                                                        | V <sub>CC</sub> (V) | Min | Typ. | Max           | Min | Max  |
| Propagation delay time | $t_{pLH}$<br>$t_{pHL}$ | $C_L = 10 \text{ pF}$ ,<br>$R_L = 1 \text{ M}\Omega$   | 0.9                 | —   | 18.3 | —             | —   | —    |
|                        |                        |                                                        | 1.1~1.3             | —   | 9.4  | 18.4          | 1.0 | 34.9 |
|                        |                        |                                                        | 1.4~1.6             | —   | 5.5  | 8.5           | 1.0 | 10.7 |
|                        |                        |                                                        | 1.65~ 1.95          | —   | 4.2  | 6.2           | 1.0 | 6.7  |
|                        |                        |                                                        | 2.3~2.7             | —   | 2.8  | 3.9           | 1.0 | 4.4  |
|                        |                        |                                                        | 3.0~3.6             | —   | 2.3  | 3.1           | 1.0 | 3.7  |
|                        |                        | $C_L = 15 \text{ pF}$ ,<br>$R_L = 1 \text{ M}\Omega$   | 0.9                 | —   | 21.2 | —             | —   | —    |
|                        |                        |                                                        | 1.1~1.3             | —   | 10.7 | 21.5          | 1.0 | 38.0 |
|                        |                        |                                                        | 1.4~1.6             | —   | 6.1  | 9.3           | 1.0 | 11.9 |
|                        |                        |                                                        | 1.65~ 1.95          | —   | 4.7  | 6.9           | 1.0 | 7.1  |
|                        |                        |                                                        | 2.3~2.7             | —   | 3.1  | 4.4           | 1.0 | 5.0  |
|                        |                        |                                                        | 3.0~3.6             | —   | 2.5  | 3.4           | 1.0 | 3.9  |
|                        |                        | $C_L = 30 \text{ pF}$ ,<br>$R_L = 1 \text{ M}\Omega$   | 0.9                 | —   | 30.5 | —             | —   | —    |
|                        |                        |                                                        | 1.1~1.3             | —   | 14.9 | 30.0          | 1.0 | 58.1 |
|                        |                        |                                                        | 1.4~1.6             | —   | 8.2  | 13.2          | 1.0 | 16.6 |
|                        |                        |                                                        | 1.65~ 1.95          | —   | 6.1  | 9.2           | 1.0 | 9.9  |
|                        |                        |                                                        | 2.3~2.7             | —   | 4.1  | 5.7           | 1.0 | 6.1  |
|                        |                        |                                                        | 3.0~3.6             | —   | 3.4  | 4.4           | 1.0 | 4.8  |
| Output enable time     | $t_{pZL}$<br>$t_{pZH}$ | $C_L = 10 \text{ pF}$ ,<br>$R_L = 100 \text{ k}\Omega$ | 0.9                 | —   | 24.0 | —             | —   | —    |
|                        |                        | $C_L = 10 \text{ pF}$ ,<br>$R_L = 5 \text{ k}\Omega$   | 1.1~1.3             | —   | 11.8 | 22.5          | 1.0 | 35.8 |
|                        |                        |                                                        | 1.4~1.6             | —   | 6.8  | 10.4          | 1.0 | 12.0 |
|                        |                        |                                                        | 1.65~ 1.95          | —   | 5.1  | 7.3           | 1.0 | 8.1  |
|                        |                        |                                                        | 2.3~2.7             | —   | 3.4  | 4.6           | 1.0 | 5.3  |
|                        |                        |                                                        | 3.0~3.6             | —   | 2.5  | 3.4           | 1.0 | 3.9  |
|                        |                        | $C_L = 15 \text{ pF}$ ,<br>$R_L = 100 \text{ k}\Omega$ | 0.9                 | —   | 26.6 | —             | —   | —    |
|                        |                        | $C_L = 15 \text{ pF}$ ,<br>$R_L = 5 \text{ k}\Omega$   | 1.1~1.3             | —   | 13.0 | 25.0          | 1.0 | 41.9 |
|                        |                        |                                                        | 1.4~1.6             | —   | 7.4  | 11.4          | 1.0 | 13.4 |
|                        |                        |                                                        | 1.65~ 1.95          | —   | 5.5  | 7.9           | 1.0 | 8.5  |
|                        |                        |                                                        | 2.3~2.7             | —   | 3.7  | 4.9           | 1.0 | 5.5  |
|                        |                        |                                                        | 3.0~3.6             | —   | 3.0  | 4.1           | 1.0 | 4.6  |
|                        |                        | $C_L = 30 \text{ pF}$ ,<br>$R_L = 100 \text{ k}\Omega$ | 0.9                 | —   | 36.4 | —             | —   | —    |
|                        |                        | $C_L = 30 \text{ pF}$ ,<br>$R_L = 5 \text{ k}\Omega$   | 1.1~1.3             | —   | 17.9 | 35.8          | 1.0 | 59.1 |
|                        |                        |                                                        | 1.4~1.6             | —   | 9.8  | 15.3          | 1.0 | 17.8 |
|                        |                        |                                                        | 1.65~ 1.95          | —   | 7.2  | 10.5          | 1.0 | 11.2 |
|                        |                        |                                                        | 2.3~2.7             | —   | 4.5  | 5.9           | 1.0 | 6.6  |
|                        |                        |                                                        | 3.0~3.6             | —   | 3.6  | 4.6           | 1.0 | 5.3  |

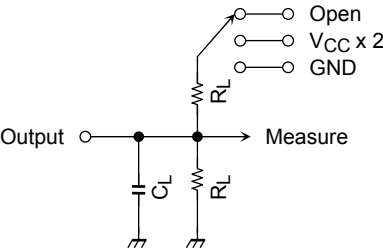
| Characteristics               | Symbol                               | Test Condition                                     | Ta = 25°C  |     |       | Ta = -40~85°C |     | Unit |
|-------------------------------|--------------------------------------|----------------------------------------------------|------------|-----|-------|---------------|-----|------|
|                               |                                      |                                                    | VCC (V)    | Min | Typ.  | Max           | Min | Max  |
| Output disable time           | t <sub>pLZ</sub><br>t <sub>pHZ</sub> | C <sub>L</sub> = 10 pF,<br>R <sub>L</sub> = 100 kΩ | 0.9        | —   | 168.6 | —             | —   | —    |
|                               |                                      | C <sub>L</sub> = 10 pF,<br>R <sub>L</sub> = 5 kΩ   | 1.1~1.3    | —   | 9.5   | 18.4          | 1.0 | 25.2 |
|                               |                                      |                                                    | 1.4~1.6    | —   | 7.5   | 9.5           | 1.0 | 10.6 |
|                               |                                      |                                                    | 1.65~ 1.95 | —   | 7.1   | 8.7           | 1.0 | 9.6  |
|                               |                                      |                                                    | 2.3~2.7    | —   | 6.8   | 7.9           | 1.0 | 8.8  |
|                               |                                      |                                                    | 3.0~3.6    | —   | 6.5   | 7.5           | 1.0 | 8.4  |
|                               |                                      | C <sub>L</sub> = 15 pF,<br>R <sub>L</sub> = 100 kΩ | 0.9        | —   | 201.8 | —             | —   | —    |
|                               |                                      | C <sub>L</sub> = 15 pF,<br>R <sub>L</sub> = 5 kΩ   | 1.1~1.3    | —   | 10.5  | 19.8          | 1.0 | 27.6 |
|                               |                                      |                                                    | 1.4~1.6    | —   | 9.0   | 10.4          | 1.0 | 12.3 |
|                               |                                      |                                                    | 1.65~ 1.95 | —   | 8.5   | 9.7           | 1.0 | 10.6 |
|                               |                                      |                                                    | 2.3~2.7    | —   | 7.9   | 8.8           | 1.0 | 10.3 |
|                               |                                      |                                                    | 3.0~3.6    | —   | 7.6   | 8.3           | 1.0 | 9.5  |
|                               |                                      | C <sub>L</sub> = 30 pF,<br>R <sub>L</sub> = 100 kΩ | 0.9        | —   | 251.5 | —             | —   | —    |
|                               |                                      | C <sub>L</sub> = 30 pF,<br>R <sub>L</sub> = 5 kΩ   | 1.1~1.3    | —   | 14.1  | 23.8          | 1.0 | 31.9 |
|                               |                                      |                                                    | 1.4~1.6    | —   | 13.5  | 14.5          | 1.0 | 16.0 |
|                               |                                      |                                                    | 1.65~ 1.95 | —   | 12.7  | 14.3          | 1.0 | 15.0 |
|                               |                                      |                                                    | 2.3~2.7    | —   | 12.2  | 14.1          | 1.0 | 14.7 |
|                               |                                      |                                                    | 3.0~3.6    | —   | 11.9  | 13.8          | 1.0 | 14.4 |
| Input capacitance             | C <sub>IN</sub>                      | —                                                  | 3.6        | —   | 3     | —             | —   | pF   |
| Power dissipation capacitance | C <sub>PD</sub>                      | (Note 13)                                          | 0.9 ~ 3.6  | —   | 10    | —             | —   | pF   |

Note 13: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<sub>CC</sub> (opr.) = C<sub>PD</sub>·V<sub>CC</sub>·f<sub>IN</sub> + I<sub>CC</sub>/2

AC Characteristics Measurement Circuit



| Characteristics                     | Switch              |
|-------------------------------------|---------------------|
| t <sub>pLH</sub> , t <sub>pHL</sub> | Open                |
| t <sub>pLZ</sub> , t <sub>pZL</sub> | V <sub>CC</sub> x 2 |
| t <sub>pHZ</sub> , t <sub>pZH</sub> | GND                 |

Figure1 t<sub>pLH</sub>, t<sub>pHL</sub>

AC Waveforms

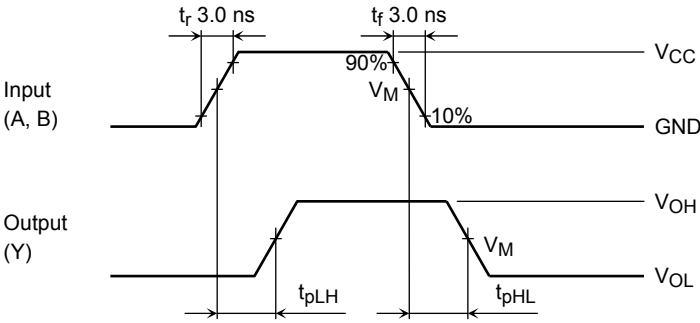


Figure2  $t_{PLH}$ ,  $t_{PHL}$

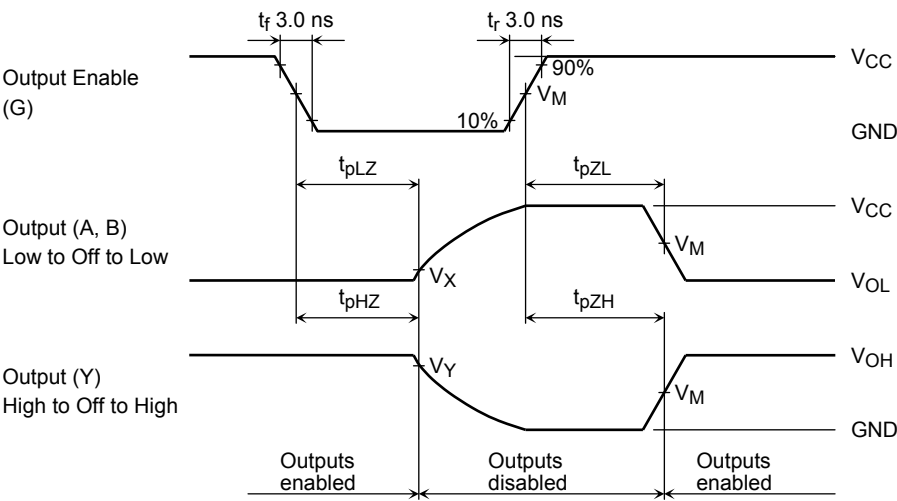


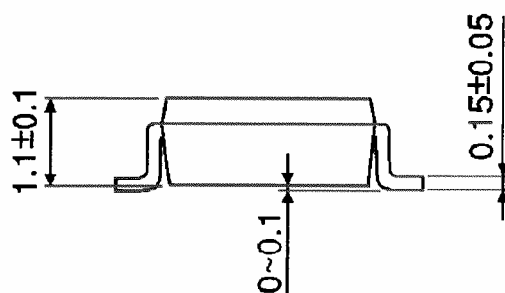
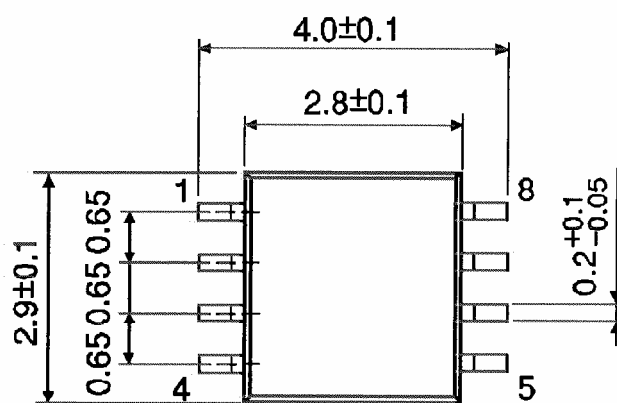
Figure3  $t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$

| unit  | $V_{CC}$                 |                           |                           |                          |                          |                          |
|-------|--------------------------|---------------------------|---------------------------|--------------------------|--------------------------|--------------------------|
|       | 3.3±0.3 V                | 2.5±0.2 V                 | 1.8±0.15 V                | 1.5±0.1 V                | 1.2±0.1 V                | 0.9 V                    |
| $V_M$ | $V_{CC} / 2$             | $V_{CC} / 2$              | $V_{CC} / 2$              | $V_{CC} / 2$             | $V_{CC} / 2$             | $V_{CC} / 2$             |
| $V_X$ | $V_{OL} + 0.3 \text{ V}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OL} + 0.1 \text{ V}$ | $V_{OL} + 0.1 \text{ V}$ | $V_{OL} + 0.1 \text{ V}$ |
| $V_Y$ | $V_{OH} - 0.3 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ | $V_{OH} - 0.1 \text{ V}$ | $V_{OH} - 0.1 \text{ V}$ | $V_{OH} - 0.1 \text{ V}$ |

## Package Dimensions

SSOP8-P-0.65

Unit : mm

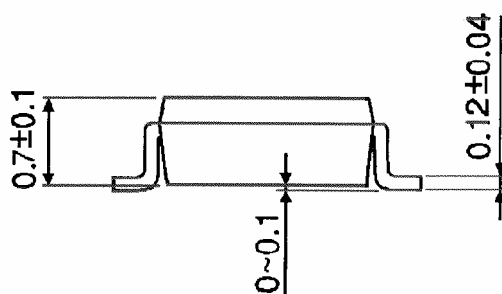
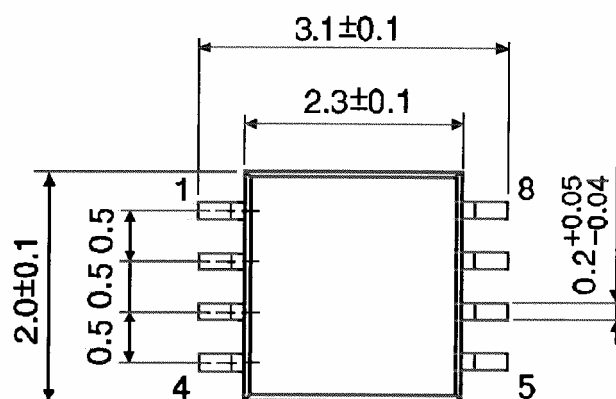


Weight: 0.02 g (typ.)

## Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)



**RESTRICTIONS ON PRODUCT USE**

20070701-EN GENERAL

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