

## 7UL1G07FU

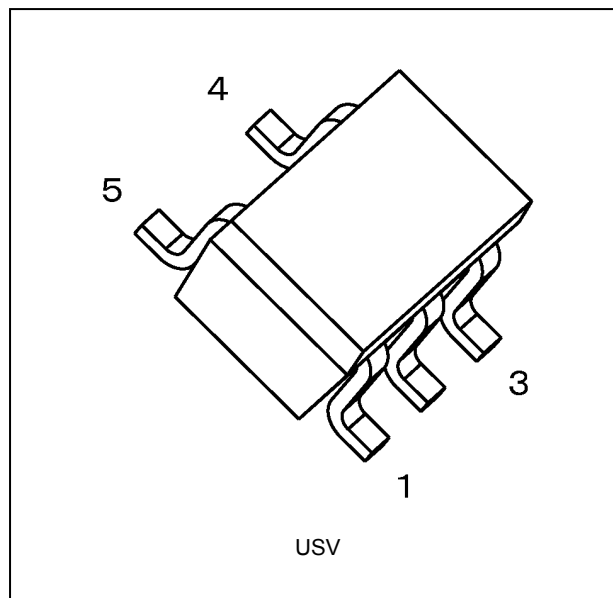
### 1. Functional Description

- Non-Inverter (Open Drain)

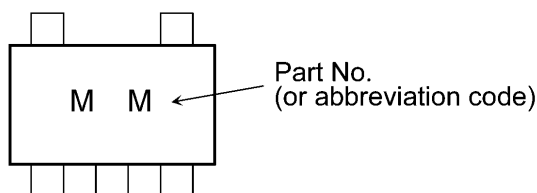
### 2. Features

- (1) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C
- (2) High output current: 8.0 mA (min) at  $V_{CC} = 3.0$  V
- (3) Super high speed operation:  $t_{pd} = 2.5$  ns (typ.) at  $V_{CC} = 3.3$  V,  $C_L = 15$  pF
- (4) Operating voltage range:  $V_{CC} = 0.9$  to  $3.6$  V
- (5) 3.6 V tolerant input
- (6) 3.6 V power down protection output

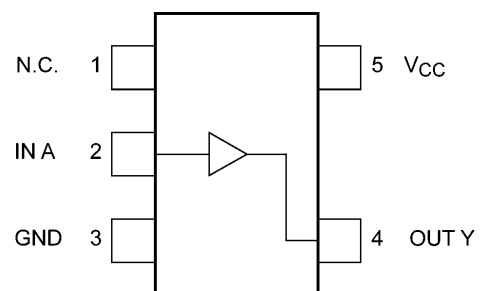
### 3. Packaging



### 4. Marking and Pin Assignment



Marking



Pin Assignment (Top view)

Start of commercial production

2020-03

## 5. IEC Logic Symbol



## 6. Truth Table

| Input A | Input Y |
|---------|---------|
| L       | L       |
| H       | Z       |

Z: High impedance

## 7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics          | Symbol    | Note     | Rating      | Unit             |
|--------------------------|-----------|----------|-------------|------------------|
| Supply voltage           | $V_{CC}$  |          | -0.5 to 4.6 | V                |
| Input voltage            | $V_{IN}$  |          | -0.5 to 4.6 | V                |
| DC output voltage        | $V_{OUT}$ | (Note 1) | -0.5 to 4.6 | V                |
| Input diode current      | $I_{IK}$  |          | -20         | mA               |
| Output diode current     | $I_{OK}$  | (Note 2) | -20         | mA               |
| DC output current        | $I_{OUT}$ |          | 25          | mA               |
| $V_{CC}$ /ground current | $I_{CC}$  |          | $\pm 50$    | mA               |
| Power dissipation        | $P_D$     |          | 200         | mW               |
| Storage temperature      | $T_{stg}$ |          | -65 to 150  | $^\circ\text{C}$ |

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).

Note 1: When  $V_{CC} = 0\text{ V}$  or when the output is in the high-impedance state

Note 2:  $V_{OUT} < \text{GND}$

## 8. Operating Ranges (Note)

| Characteristics          | Symbol           | Test Condition   | Rating     | Unit             |
|--------------------------|------------------|--|------------|------------------|
| Supply voltage           | $V_{CC}$         | —  | 0.9 to 3.6 | V                |
| Input voltage            | $V_{IN}$         | —  | 0 to 3.6   | V                |
| Output voltage           | $V_{OUT}$        | —  | 0 to 3.6   | V                |
| Output current           | $I_{OH}, I_{OL}$ | $V_{CC} = 3.0\text{ to }3.6\text{ V}$                        | 8.0        | mA               |
|                          |                  | $V_{CC} = 2.3\text{ to }2.7\text{ V}$                        | 4.0        |                  |
|                          |                  | $V_{CC} = 1.65\text{ to }1.95\text{ V}$                      | 3.0        |                  |
|                          |                  | $V_{CC} = 1.4\text{ to }1.6\text{ V}$                        | 1.7        |                  |
|                          |                  | $V_{CC} = 1.1\text{ to }1.3\text{ V}$                        | 0.3        |                  |
|                          |                  | $V_{CC} = 0.9\text{ V}$                                      | 0.02       |                  |
| Operating temperature    | $T_{opr}$        | —  | -40 to 125 | $^\circ\text{C}$ |
| Input rise and fall time | $dt/dv$          | $V_{IN} = 0.8\text{ to }2.0\text{ V}, V_{CC} = 3.0\text{ V}$ | 0 to 10    | 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.

## 9. Electrical Characteristics

### 9.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                          | Symbol    | Test Condition  | $V_{CC}$ (V)              | Min                  | Typ. | Max                  | Unit                 |   |
|--|-----------|---|---------------------------|----------------------|------|----------------------|----------------------|---|
| High-level input voltage                 | $V_{IH}$  | —   | 0.9                       | $V_{CC}$             | —    | —                    | V                    |   |
|  |           |   | 1.1 to 1.3                | $V_{CC} \times 0.70$ | —    | —                    |                      |   |
|  |           |   | 1.4 to 1.6                | $V_{CC} \times 0.65$ | —    | —                    |                      |   |
|  |           |   | 1.65 to 1.95              | $V_{CC} \times 0.65$ | —    | —                    |                      |   |
|  |           |   | 2.3 to 2.7                | 1.7                  | —    | —                    |                      |   |
|  |           |   | 3.0 to 3.6                | 2.0                  | —    | —                    |                      |   |
| Low-level input voltage                  | $V_{IL}$  | —   | 0.9                       | —                    | —    | GND                  | V                    |   |
|  |           |   | 1.1 to 1.3                | —                    | —    | $V_{CC} \times 0.30$ |                      |   |
|  |           |   | 1.4 to 1.6                | —                    | —    | $V_{CC} \times 0.35$ |                      |   |
|  |           |   | 1.65 to 1.95              | —                    | —    | $V_{CC} \times 0.35$ |                      |   |
|  |           |   | 2.3 to 2.7                | —                    | —    | 0.7                  |                      |   |
|  |           |   | 3.0 to 3.6                | —                    | —    | 0.8                  |                      |   |
| Low-level output voltage                 | $V_{OL}$  | $V_{IN} = V_{IL}$   | $I_{OL} = 0.02\text{ mA}$ | 0.9                  | —    | —                    | 0.1                  | V |
|  |           |   | $I_{OL} = 0.3\text{ mA}$  | 1.1 to 1.3           | —    | —                    | $V_{CC} \times 0.25$ |   |
|  |           |   | $I_{OL} = 1.7\text{ mA}$  | 1.4 to 1.6           | —    | —                    | $V_{CC} \times 0.25$ |   |
|  |           |   | $I_{OL} = 3.0\text{ mA}$  | 1.65 to 1.95         | —    | —                    | 0.45                 |   |
|  |           |   | $I_{OL} = 4.0\text{ mA}$  | 2.3 to 2.7           | —    | —                    | 0.4                  |   |
|  |           |   | $I_{OL} = 8.0\text{ mA}$  | 3.0 to 3.6           | —    | —                    | 0.4                  |   |
| Input leakage current                    | $I_{IN}$  | $V_{IN} = 0\text{ to }3.6\text{ V}$   | 0 to 3.6                  | —                    | —    | $\pm 0.1$            | $\mu\text{A}$        |   |
| 3-state output OFF-state leakage current | $I_{OZ}$  | $V_{IN} = V_{IH}$ ,<br>$V_{OUT} = 0\text{ to }3.6\text{ V}$                   | 0.9 to 3.6                | —                    | —    | $\pm 1.0$            | $\mu\text{A}$        |   |
| Power-OFF leakage current                | $I_{OFF}$ | $V_{IN} = 0\text{ to }3.6\text{ V}$ ,<br>$V_{OUT} = 0\text{ to }3.6\text{ V}$ | 0                         | —                    | —    | 1.0                  | $\mu\text{A}$        |   |
| Quiescent supply current                 | $I_{CC}$  | $V_{IN} = V_{CC}\text{ or GND}$   | 3.6                       | —                    | —    | 1.0                  | $\mu\text{A}$        |   |

### 9.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85$ °C)

| Characteristics                          | Symbol    | Test Condition                                       | $V_{CC}$ (V)       | Min                  | Max                  | Unit                 |   |
|--|-----------|--|--------------------|----------------------|----------------------|----------------------|---|
| High-level input voltage                 | $V_{IH}$  | —  | 0.9                | $V_{CC}$             | —                    | V                    |   |
|  |           |  | 1.1 to 1.3         | $V_{CC} \times 0.70$ | —                    |                      |   |
|  |           |  | 1.4 to 1.6         | $V_{CC} \times 0.65$ | —                    |                      |   |
|  |           |  | 1.65 to 1.95       | $V_{CC} \times 0.65$ | —                    |                      |   |
|  |           |  | 2.3 to 2.7         | 1.7                  | —                    |                      |   |
|  |           |  | 3.0 to 3.6         | 2.0                  | —                    |                      |   |
| Low-level input voltage                  | $V_{IL}$  | —  | 0.9                | —                    | GND                  | V                    |   |
|  |           |  | 1.1 to 1.3         | —                    | $V_{CC} \times 0.30$ |                      |   |
|  |           |  | 1.4 to 1.6         | —                    | $V_{CC} \times 0.35$ |                      |   |
|  |           |  | 1.65 to 1.95       | —                    | $V_{CC} \times 0.35$ |                      |   |
|  |           |  | 2.3 to 2.7         | —                    | 0.7                  |                      |   |
|  |           |  | 3.0 to 3.6         | —                    | 0.8                  |                      |   |
| Low-level output voltage                 | $V_{OL}$  | $V_{IN} = V_{IL}$                                    | $I_{OL} = 0.02$ mA | 0.9                  | —                    | 0.1                  | V |
|  |           |  | $I_{OL} = 0.3$ mA  | 1.1 to 1.3           | —                    | $V_{CC} \times 0.25$ |   |
|  |           |  | $I_{OL} = 1.7$ mA  | 1.4 to 1.6           | —                    | $V_{CC} \times 0.25$ |   |
|  |           |  | $I_{OL} = 3.0$ mA  | 1.65 to 1.95         | —                    | 0.45                 |   |
|  |           |  | $I_{OL} = 4.0$ mA  | 2.3 to 2.7           | —                    | 0.4                  |   |
|  |           |  | $I_{OL} = 8.0$ mA  | 3.0 to 3.6           | —                    | 0.4                  |   |
| Input leakage current                    | $I_{IN}$  | $V_{IN} = 0$ to $3.6$ V                              | 0 to 3.6           | —                    | $\pm 0.5$            | $\mu$ A              |   |
| 3-state output OFF-state leakage current | $I_{OZ}$  | $V_{IN} = V_{IH}$ ,<br>$V_{OUT} = 0$ to $3.6$ V      | 0.9 to 3.6         | —                    | $\pm 10.0$           | $\mu$ A              |   |
| Power-OFF leakage current                | $I_{OFF}$ | $V_{IN} = 0$ to $3.6$ V,<br>$V_{OUT} = 0$ to $3.6$ V | 0                  | —                    | 10.0                 | $\mu$ A              |   |
| Quiescent supply current                 | $I_{CC}$  | $V_{IN} = V_{CC}$ or GND                             | 3.6                | —                    | 10.0                 | $\mu$ A              |   |

### 9.3. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $125$ °C)

| Characteristics                          | Symbol    | Test Condition                                      | $V_{CC}$ (V)       | Min                  | Max                  | Unit                 |   |
|--|-----------|---|--------------------|----------------------|----------------------|----------------------|---|
| High-level input voltage                 | $V_{IH}$  | —   | 0.9                | $V_{CC}$             | —                    | V                    |   |
|  |           |   | 1.1 to 1.3         | $V_{CC} \times 0.70$ | —                    |                      |   |
|  |           |   | 1.4 to 1.6         | $V_{CC} \times 0.65$ | —                    |                      |   |
|  |           |   | 1.65 to 1.95       | $V_{CC} \times 0.65$ | —                    |                      |   |
|  |           |   | 2.3 to 2.7         | 1.7                  | —                    |                      |   |
|  |           |   | 3.0 to 3.6         | 2.0                  | —                    |                      |   |
| Low-level input voltage                  | $V_{IL}$  | —   | 0.9                | —                    | GND                  | V                    |   |
|  |           |   | 1.1 to 1.3         | —                    | $V_{CC} \times 0.30$ |                      |   |
|  |           |   | 1.4 to 1.6         | —                    | $V_{CC} \times 0.35$ |                      |   |
|  |           |   | 1.65 to 1.95       | —                    | $V_{CC} \times 0.35$ |                      |   |
|  |           |   | 2.3 to 2.7         | —                    | 0.7                  |                      |   |
|  |           |   | 3.0 to 3.6         | —                    | 0.8                  |                      |   |
| Low-level output voltage                 | $V_{OL}$  | $V_{IN} = V_{IL}$                                   | $I_{OL} = 0.02$ mA | 0.9                  | —                    | 0.1                  | V |
|  |           |   | $I_{OL} = 0.3$ mA  | 1.1 to 1.3           | —                    | $V_{CC} \times 0.27$ |   |
|  |           |   | $I_{OL} = 1.7$ mA  | 1.4 to 1.6           | —                    | $V_{CC} \times 0.27$ |   |
|  |           |   | $I_{OL} = 3.0$ mA  | 1.65 to 1.95         | —                    | 0.5                  |   |
|  |           |   | $I_{OL} = 4.0$ mA  | 2.3 to 2.7           | —                    | 0.45                 |   |
|  |           |   | $I_{OL} = 8.0$ mA  | 3.0 to 3.6           | —                    | 0.45                 |   |
| Input leakage current                    | $I_{IN}$  | $V_{IN} = 0$ to $3.6$ V                             | 0 to 3.6           | —                    | $\pm 2.0$            | $\mu$ A              |   |
| 3-state output OFF-state leakage current | $I_{OZ}$  | $V_{IN} = V_{IH}$<br>$V_{OUT} = 0$ to $3.6$ V       | 0.9 to 3.6         | —                    | $\pm 80.0$           | $\mu$ A              |   |
| Power-OFF leakage current                | $I_{OFF}$ | $V_{IN} = 0$ to $3.6$ V<br>$V_{OUT} = 0$ to $3.6$ V | 0                  | —                    | 80.0                 | $\mu$ A              |   |
| Quiescent supply current                 | $I_{CC}$  | $V_{IN} = V_{CC}$ or GND                            | 3.6                | —                    | 80.0                 | $\mu$ A              |   |

### 9.4. AC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 3\text{ ns}$ )

| Characteristics               | Symbol    | Note     | Test Condition             | $V_{CC}$ (V) | $C_L$ (pF) | Min | Typ.  | Max  | Unit |
|-------------------------------|-----------|----------|----------------------------|--------------|------------|-----|-------|------|------|
| Output enable time            | $t_{PZL}$ |          | $R_L = 100\text{ k}\Omega$ | 0.9          | 10         | —   | 23.0  | —    | ns   |
|                               |           |          | $R_L = 5\text{ k}\Omega$   | 1.1 to 1.3   |            | —   | 10.8  | 18.7 |      |
|                               |           |          |                            | 1.4 to 1.6   |            | —   | 6.2   | 9.5  |      |
|                               |           |          |                            | 1.65 to 1.95 |            | —   | 4.5   | 7.0  |      |
|                               |           |          |                            | 2.3 to 2.7   |            | —   | 3.1   | 4.6  |      |
|                               |           |          |                            | 3.0 to 3.6   |            | —   | 2.5   | 3.6  |      |
|                               |           |          | $R_L = 100\text{ k}\Omega$ | 0.9          | 15         | —   | 25.2  | —    | ns   |
|                               |           |          | $R_L = 5\text{ k}\Omega$   | 1.1 to 1.3   |            | —   | 11.8  | 20.7 |      |
|                               |           |          |                            | 1.4 to 1.6   |            | —   | 6.9   | 10.0 |      |
|                               |           |          |                            | 1.65 to 1.95 |            | —   | 5.1   | 7.3  |      |
|                               |           |          |                            | 2.3 to 2.7   |            | —   | 3.4   | 4.8  |      |
|                               |           |          |                            | 3.0 to 3.6   |            | —   | 2.8   | 3.7  |      |
|                               |           |          | $R_L = 100\text{ k}\Omega$ | 0.9          | 30         | —   | 31.0  | —    | ns   |
|                               |           |          | $R_L = 5\text{ k}\Omega$   | 1.1 to 1.3   |            | —   | 15.7  | 30.7 |      |
|                               |           |          |                            | 1.4 to 1.6   |            | —   | 8.6   | 13.1 |      |
|                               |           |          |                            | 1.65 to 1.95 |            | —   | 6.6   | 9.2  |      |
|                               |           |          |                            | 2.3 to 2.7   |            | —   | 4.5   | 5.8  |      |
|                               |           |          |                            | 3.0 to 3.6   |            | —   | 3.7   | 4.5  |      |
| Output disable time           | $t_{PLZ}$ |          | $R_L = 100\text{ k}\Omega$ | 0.9          | 10         | —   | 120.7 | —    | ns   |
|                               |           |          | $R_L = 5\text{ k}\Omega$   | 1.1 to 1.3   |            | —   | 10.6  | 16.0 |      |
|                               |           |          |                            | 1.4 to 1.6   |            | —   | 6.3   | 9.1  |      |
|                               |           |          |                            | 1.65 to 1.95 |            | —   | 7.3   | 8.6  |      |
|                               |           |          |                            | 2.3 to 2.7   |            | —   | 5.1   | 6.4  |      |
|                               |           |          |                            | 3.0 to 3.6   |            | —   | 5.8   | 7.9  |      |
|                               |           |          | $R_L = 100\text{ k}\Omega$ | 0.9          | 15         | —   | 152.4 | —    | ns   |
|                               |           |          | $R_L = 5\text{ k}\Omega$   | 1.1 to 1.3   |            | —   | 12.2  | 16.9 |      |
|                               |           |          |                            | 1.4 to 1.6   |            | —   | 7.5   | 9.8  |      |
|                               |           |          |                            | 1.65 to 1.95 |            | —   | 8.3   | 9.6  |      |
|                               |           |          |                            | 2.3 to 2.7   |            | —   | 6.0   | 9.4  |      |
|                               |           |          |                            | 3.0 to 3.6   |            | —   | 7.1   | 9.5  |      |
|                               |           |          | $R_L = 100\text{ k}\Omega$ | 0.9          | 30         | —   | 246.9 | —    | ns   |
|                               |           |          | $R_L = 5\text{ k}\Omega$   | 1.1 to 1.3   |            | —   | 16.9  | 20.8 |      |
|                               |           |          |                            | 1.4 to 1.6   |            | —   | 10.1  | 13.2 |      |
|                               |           |          |                            | 1.65 to 1.95 |            | —   | 12.7  | 14.6 |      |
|                               |           |          |                            | 2.3 to 2.7   |            | —   | 8.6   | 10.8 |      |
|                               |           |          |                            | 3.0 to 3.6   |            | —   | 12.2  | 14.4 |      |
| Input capacitance             | $C_{IN}$  |          | —                          | 3.6          | —          | —   | 3     | —    | pF   |
| Power dissipation capacitance | $C_{PD}$  | (Note 1) | —                          | 0.9 to 3.6   | —          | —   | 9     | —    | pF   |

Note 1:  $C_{PD}$  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.

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

## 9.5. AC Characteristics (Unless otherwise specified, $T_a = -40$ to $85$ °C, Input: $t_r = t_f = 3$ ns)

| Characteristics            | Symbol                   | Test Condition             | $V_{CC}$ (V)             | $C_L$ (pF)                 | Min                      | Max | Unit       |      |    |      |
|----------------------------|--------------------------|----------------------------|--------------------------|----------------------------|--------------------------|-----|------------|------|----|------|
| Output enable time         | $t_{PZL}$                | $R_L = 100\text{ k}\Omega$ | 0.9                      | 10                         | —                        | —   | ns         |      |    |      |
|                            |                          |                            | $R_L = 5\text{ k}\Omega$ |                            | 1.1 to 1.3               | 1.0 |            | 29.8 |    |      |
|                            |                          |                            |                          |                            | 1.4 to 1.6               | 1.0 |            | 11.3 |    |      |
|                            |                          |                            |                          |                            | 1.65 to 1.95             | 1.0 |            | 7.5  |    |      |
|                            |                          |                            |                          |                            | 2.3 to 2.7               | 1.0 |            | 5.2  |    |      |
|                            |                          |                            |                          |                            | 3.0 to 3.6               | 1.0 |            | 4.2  |    |      |
|                            |                          | $R_L = 100\text{ k}\Omega$ | 0.9                      | 15                         | —                        | —   | ns         |      |    |      |
|                            |                          |                            | $R_L = 5\text{ k}\Omega$ |                            | 1.1 to 1.3               | 1.0 |            | 34.7 |    |      |
|                            |                          |                            |                          |                            | 1.4 to 1.6               | 1.0 |            | 11.1 |    |      |
|                            |                          |                            |                          |                            | 1.65 to 1.95             | 1.0 |            | 8.5  |    |      |
|                            |                          |                            |                          |                            | 2.3 to 2.7               | 1.0 |            | 5.7  |    |      |
|                            |                          |                            |                          |                            | 3.0 to 3.6               | 1.0 |            | 4.9  |    |      |
|                            |                          | $R_L = 100\text{ k}\Omega$ | 0.9                      | 30                         | —                        | —   | ns         |      |    |      |
|                            |                          |                            | $R_L = 5\text{ k}\Omega$ |                            | 1.1 to 1.3               | 1.0 |            | 50.5 |    |      |
|                            |                          |                            |                          |                            | 1.4 to 1.6               | 1.0 |            | 15.1 |    |      |
|                            |                          |                            |                          |                            | 1.65 to 1.95             | 1.0 |            | 11.9 |    |      |
|                            |                          |                            |                          |                            | 2.3 to 2.7               | 1.0 |            | 7.6  |    |      |
|                            |                          |                            |                          |                            | 3.0 to 3.6               | 1.0 |            | 6.1  |    |      |
|                            |                          | Output disable time        | $t_{PLZ}$                | $R_L = 100\text{ k}\Omega$ | 0.9                      | 10  | —          | —    | ns |      |
|                            |                          |                            |                          |                            | $R_L = 5\text{ k}\Omega$ |     | 1.1 to 1.3 | 1.0  |    | 22.4 |
|                            |                          |                            |                          |                            |                          |     | 1.4 to 1.6 | 1.0  |    | 10.4 |
| 1.65 to 1.95               | 1.0                      |                            |                          |                            |                          |     | 9.8        |      |    |      |
| 2.3 to 2.7                 | 1.0                      |                            |                          |                            |                          |     | 7.2        |      |    |      |
| 3.0 to 3.6                 | 1.0                      |                            |                          |                            |                          |     | 9.3        |      |    |      |
| $R_L = 100\text{ k}\Omega$ | 0.9                      |                            |                          | 15                         | —                        | —   | ns         |      |    |      |
|                            | $R_L = 5\text{ k}\Omega$ |                            |                          |                            | 1.1 to 1.3               | 1.0 |            | 25.1 |    |      |
|                            |                          |                            |                          |                            | 1.4 to 1.6               | 1.0 |            | 11.3 |    |      |
|                            |                          |                            |                          |                            | 1.65 to 1.95             | 1.0 |            | 11.1 |    |      |
|                            |                          |                            |                          |                            | 2.3 to 2.7               | 1.0 |            | 12.4 |    |      |
|                            |                          |                            |                          |                            | 3.0 to 3.6               | 1.0 |            | 13.2 |    |      |
| $R_L = 100\text{ k}\Omega$ | 0.9                      |                            |                          | 30                         | —                        | —   | ns         |      |    |      |
|                            | $R_L = 5\text{ k}\Omega$ |                            |                          |                            | 1.1 to 1.3               | 1.0 |            | 31.9 |    |      |
|                            |                          |                            |                          |                            | 1.4 to 1.6               | 1.0 |            | 14.9 |    |      |
|                            |                          |                            |                          |                            | 1.65 to 1.95             | 1.0 |            | 16.6 |    |      |
|                            |                          |                            |                          |                            | 2.3 to 2.7               | 1.0 |            | 12.2 |    |      |
|                            |                          |                            |                          |                            | 3.0 to 3.6               | 1.0 |            | 16.4 |    |      |

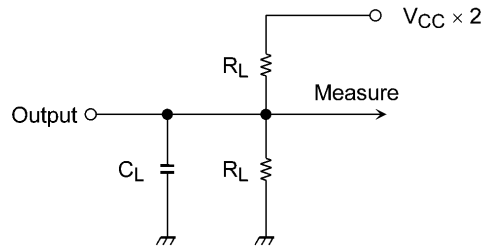
## 9.6. AC Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $125$  °C, Input:  $t_r = t_f = 3$  ns)

| Characteristics        | Symbol               | Test Condition         | $V_{CC}$ (V)         | $C_L$ (pF)             | Min                  | Max | Unit       |      |    |      |
|------------------------|----------------------|------------------------|----------------------|------------------------|----------------------|-----|------------|------|----|------|
| Output enable time     | $t_{PZL}$            | $R_L = 100$ k $\Omega$ | 0.9                  | 10                     | —                    | —   | ns         |      |    |      |
|                        |                      |                        | $R_L = 5$ k $\Omega$ |                        | 1.1 to 1.3           | 1.0 |            | 37.2 |    |      |
|                        |                      |                        |                      |                        | 1.4 to 1.6           | 1.0 |            | 12.5 |    |      |
|                        |                      |                        |                      |                        | 1.65 to 1.95         | 1.0 |            | 8.2  |    |      |
|                        |                      |                        |                      |                        | 2.3 to 2.7           | 1.0 |            | 5.8  |    |      |
|                        |                      |                        |                      |                        | 3.0 to 3.6           | 1.0 |            | 4.8  |    |      |
|                        |                      | $R_L = 100$ k $\Omega$ | 0.9                  | 15                     | —                    | —   | ns         |      |    |      |
|                        |                      |                        | $R_L = 5$ k $\Omega$ |                        | 1.1 to 1.3           | 1.0 |            | 44.1 |    |      |
|                        |                      |                        |                      |                        | 1.4 to 1.6           | 1.0 |            | 11.9 |    |      |
|                        |                      |                        |                      |                        | 1.65 to 1.95         | 1.0 |            | 9.3  |    |      |
|                        |                      |                        |                      |                        | 2.3 to 2.7           | 1.0 |            | 6.3  |    |      |
|                        |                      |                        |                      |                        | 3.0 to 3.6           | 1.0 |            | 5.7  |    |      |
|                        |                      | $R_L = 100$ k $\Omega$ | 0.9                  | 30                     | —                    | —   | ns         |      |    |      |
|                        |                      |                        | $R_L = 5$ k $\Omega$ |                        | 1.1 to 1.3           | 1.0 |            | 63.7 |    |      |
|                        |                      |                        |                      |                        | 1.4 to 1.6           | 1.0 |            | 16.5 |    |      |
|                        |                      |                        |                      |                        | 1.65 to 1.95         | 1.0 |            | 13.7 |    |      |
|                        |                      |                        |                      |                        | 2.3 to 2.7           | 1.0 |            | 8.8  |    |      |
|                        |                      |                        |                      |                        | 3.0 to 3.6           | 1.0 |            | 7.2  |    |      |
|                        |                      | Output disable time    | $t_{PLZ}$            | $R_L = 100$ k $\Omega$ | 0.9                  | 10  | —          | —    | ns |      |
|                        |                      |                        |                      |                        | $R_L = 5$ k $\Omega$ |     | 1.1 to 1.3 | 1.0  |    | 26.7 |
|                        |                      |                        |                      |                        |                      |     | 1.4 to 1.6 | 1.0  |    | 11.7 |
| 1.65 to 1.95           | 1.0                  |                        |                      |                        |                      |     | 10.8       |      |    |      |
| 2.3 to 2.7             | 1.0                  |                        |                      |                        |                      |     | 9.5        |      |    |      |
| 3.0 to 3.6             | 1.0                  |                        |                      |                        |                      |     | 11.3       |      |    |      |
| $R_L = 100$ k $\Omega$ | 0.9                  |                        |                      | 15                     | —                    | —   | ns         |      |    |      |
|                        | $R_L = 5$ k $\Omega$ |                        |                      |                        | 1.1 to 1.3           | 1.0 |            | 30.6 |    |      |
|                        |                      |                        |                      |                        | 1.4 to 1.6           | 1.0 |            | 12.3 |    |      |
|                        |                      |                        |                      |                        | 1.65 to 1.95         | 1.0 |            | 12.1 |    |      |
|                        |                      |                        |                      |                        | 2.3 to 2.7           | 1.0 |            | 14.4 |    |      |
|                        |                      |                        |                      |                        | 3.0 to 3.6           | 1.0 |            | 15.7 |    |      |
| $R_L = 100$ k $\Omega$ | 0.9                  |                        |                      | 30                     | —                    | —   | ns         |      |    |      |
|                        | $R_L = 5$ k $\Omega$ |                        |                      |                        | 1.1 to 1.3           | 1.0 |            | 39.3 |    |      |
|                        |                      |                        |                      |                        | 1.4 to 1.6           | 1.0 |            | 16.1 |    |      |
|                        |                      |                        |                      |                        | 1.65 to 1.95         | 1.0 |            | 18.0 |    |      |
|                        |                      |                        |                      |                        | 2.3 to 2.7           | 1.0 |            | 13.2 |    |      |
|                        |                      |                        |                      |                        | 3.0 to 3.6           | 1.0 |            | 17.8 |    |      |



## 9.7. AC Test Circuit



## 9.8. AC Waveform

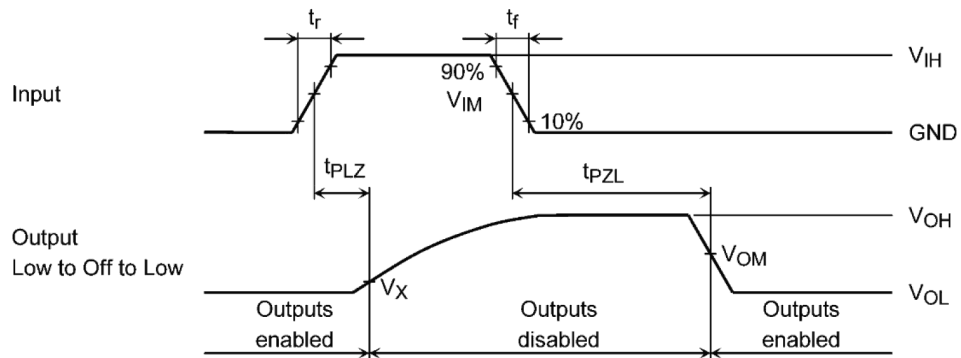


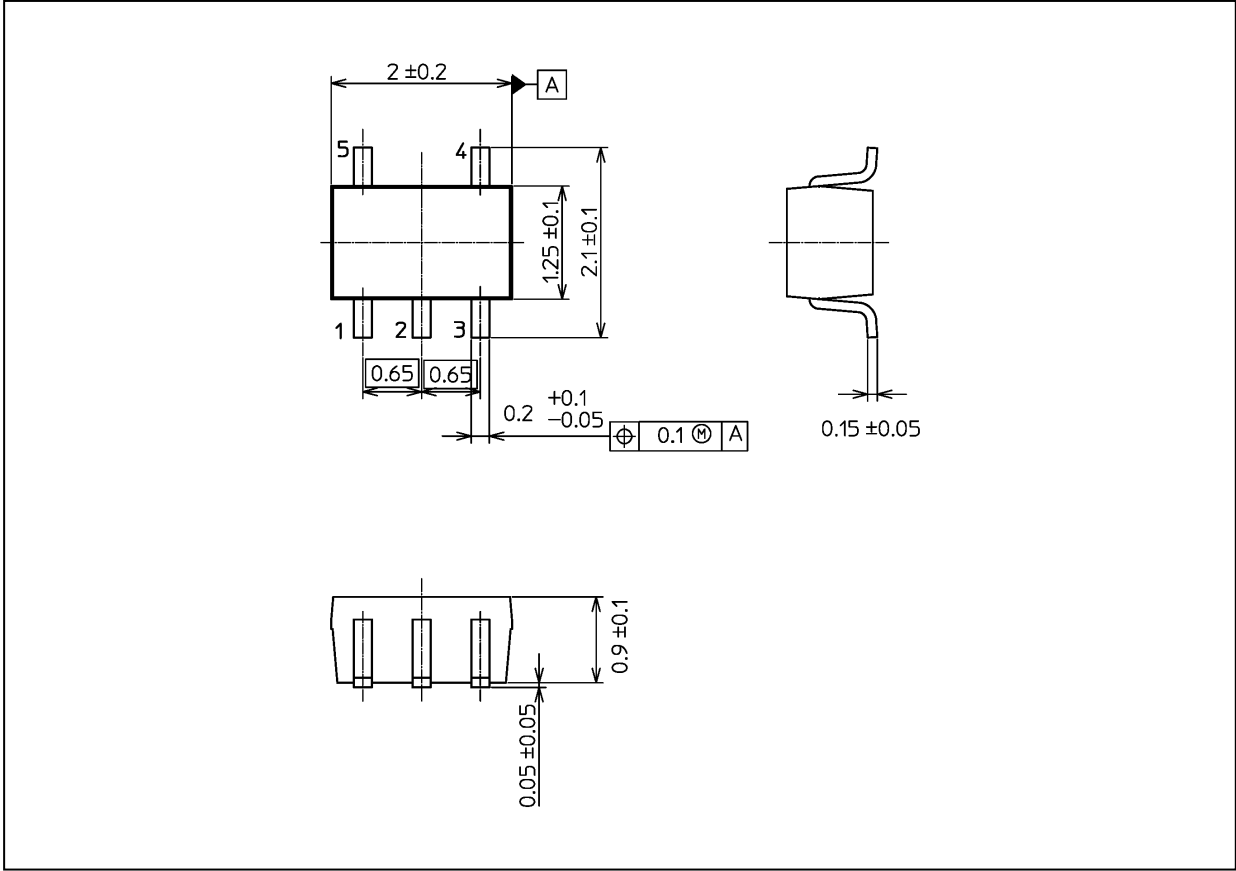
Fig. 9.8.1  $t_{PLH}$ ,  $t_{PHL}$

Table 9.8.1 AC Waveform Symbols

| Symbol           | $V_{CC} = 3.3 \pm 0.3 \text{ V}$ | $V_{CC} = 2.5 \pm 0.2 \text{ V}$ | $V_{CC} = 1.8 \pm 0.15 \text{ V}$ | $V_{CC} = 1.5 \pm 0.1 \text{ V}$ | $V_{CC} = 1.2 \pm 0.1 \text{ V}$ | $V_{CC} = 0.9 \text{ V}$ |
|------------------|----------------------------------|----------------------------------|-----------------------------------|----------------------------------|----------------------------------|--------------------------|
| $V_{IM}, V_{OM}$ | $V_{CC}/2$                       | $V_{CC}/2$                       | $V_{CC}/2$                        | $V_{CC}/2$                       | $V_{CC}/2$                       | $V_{CC}/2$               |
| $V_X$            | $V_{OL} + 0.3 \text{ V}$         | $V_{OL} + 0.15 \text{ V}$        | $V_{OL} + 0.15 \text{ V}$         | $V_{OL} + 0.1 \text{ V}$         | $V_{OL} + 0.1 \text{ V}$         | $V_{OL} + 0.1 \text{ V}$ |

Package Dimensions

Unit: mm



Weight: 6.2 mg (typ.)

|                 |
|-----------------|
| Package Name(s) |
| Nickname: USV   |

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