

7UL1T126FU

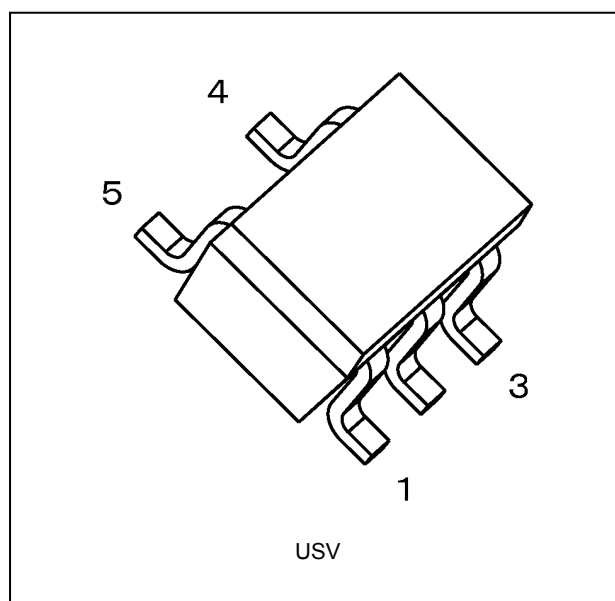
1. Functional Description

- Bus Buffer with 3-State Output

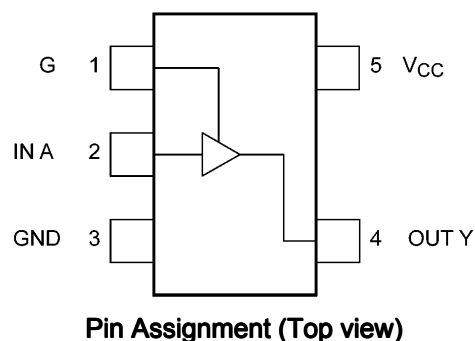
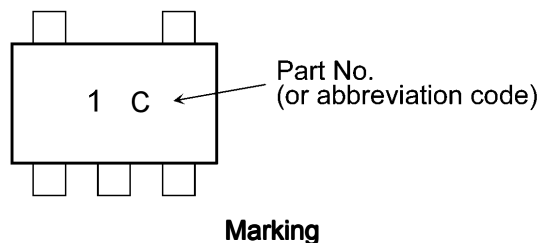
2. Features

- (1) Operating supply voltage range: $V_{CC} = 2.3 \text{ V}$ to 3.6 V
- (2) The high-level input voltage is up translation to the power supply voltage.
- (3) The high-level input voltage is down translation to the power supply voltage.
- (4) 3.6 V tolerant input
- (5) 3.6 V power-down protection is provided on output.

3. Packaging



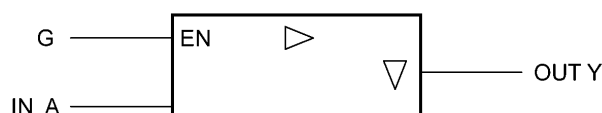
4. Marking and Pin Assignment



Start of commercial production

2019-11

5. IEC Logic Symbol



6. Truth Table

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

X: Don't care

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 |
| | | (Note 2) | -0.5 to $V_{CC} + 0.5$ | |
| Input diode current | I_{IK} | | -20 | mA |
| Output diode current | I_{OK} | (Note 3) | -20 | mA |
| DC output current | I_{OUT} | | ± 25 | mA |
| V_{CC} /ground current | I_{CC} | | ± 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: $V_{CC} = 0\text{ V}$

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

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

8. Operating Ranges (Note)

| Characteristics | Symbol | Note | Test Condition | Rating | Unit |
|--------------------------|------------------|----------|--|---------------|------|
| Supply voltage | V_{CC} | | — | 2.3 to 3.6 | V |
| Input voltage | V_{IN} | | — | 0 to 3.6 | V |
| Output voltage | V_{OUT} | (Note 1) | — | 0 to 3.6 | V |
| | | (Note 2) | — | 0 to V_{CC} | |
| 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 | |
| Operating temperature | T_{opr} | | — | -40 to 85 | °C |
| Input rise and fall time | dt/dv | | $V_{CC} = 2.3 \text{ to } 3.6 \text{ V}$ | 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.

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

Note 2: High (H) or Low (L) state.

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} | — | | 2.3 to 2.7 | 1.1 | — | — | V |
| | | | | 3.0 to 3.6 | 1.2 | — | — | |
| Low-level input voltage | V_{IL} | — | | 2.3 to 2.7 | — | — | 0.35 | V |
| | | | | 3.0 to 3.6 | — | — | 0.5 | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ | $I_{OH} = -0.02\text{ mA}$ | 2.3 to 3.6 | $V_{CC} - 0.1$ | — | — | V |
| | | | $I_{OH} = -4.0\text{ mA}$ | 2.3 to 2.7 | 2.0 | — | — | |
| | | | $I_{OH} = -8.0\text{ mA}$ | 3.0 to 3.6 | 2.48 | — | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IL}$ | $I_{OL} = 0.02\text{ mA}$ | 2.3 to 3.6 | — | — | 0.1 | V |
| | | | $I_{OL} = 4.0\text{ mA}$ | 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 | — | — | ± 0.1 | μA |
| 3-state output OFF-state leakage current | I_{OZ} | $V_{IN} = V_{IL}\text{ or }V_{IH}$ $V_{OUT} = 0\text{ to }3.6\text{ V}$ | | 2.3 to 3.6 | — | — | ± 1.0 | μA |
| Power-OFF leakage current | I_{OFF} | $V_{IN} = 0\text{ to }3.6\text{ V}$, $V_{OUT} = 0\text{ to }3.6\text{ V}$ | | 0 | — | — | 1.0 | μA |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}\text{ or GND}$ | | 3.6 | — | — | 1.0 | μA |
| Quiescent supply current | I_{CCT} | $V_{IN} = 1.5\text{ V}$ | | 3.6 | — | — | 35 | μA |

9.2. DC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^{\circ}\text{C}$)

| Characteristics | Symbol | Test Condition | | V_{CC} (V) | Min | Max | Unit |
|--|-----------|---|----------------------------|--------------|----------------|------------|---------------|
| High-level input voltage | V_{IH} | — | | 2.3 to 2.7 | 1.1 | — | V |
| | | | | 3.0 to 3.6 | 1.2 | — | |
| Low-level input voltage | V_{IL} | — | | 2.3 to 2.7 | — | 0.35 | V |
| | | | | 3.0 to 3.6 | — | 0.5 | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ | $I_{OH} = -0.02\text{ mA}$ | 2.3 to 3.6 | $V_{CC} - 0.1$ | — | V |
| | | | $I_{OH} = -4.0\text{ mA}$ | 2.3 to 2.7 | 2.0 | — | |
| | | | $I_{OH} = -8.0\text{ mA}$ | 3.0 to 3.6 | 2.48 | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IL}$ | $I_{OL} = 0.02\text{ mA}$ | 2.3 to 3.6 | — | 0.1 | V |
| | | | $I_{OL} = 4.0\text{ mA}$ | 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 | — | ± 0.5 | μA |
| 3-state output OFF-state leakage current | I_{OZ} | $V_{IN} = V_{IL}\text{ or }V_{IH}$ $V_{OUT} = 0\text{ to }3.6\text{ V}$ | | 2.3 to 3.6 | — | ± 10.0 | μA |
| Power-OFF leakage current | I_{OFF} | $V_{IN} = 0\text{ to }3.6\text{ V}$, $V_{OUT} = 0\text{ to }3.6\text{ V}$ | | 0 | — | 10.0 | μA |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}\text{ or GND}$ | | 3.6 | — | 10.0 | μA |
| Quiescent supply current | I_{CCT} | $V_{IN} = 1.5\text{ V}$ | | 3.6 | — | 40 | μA |

9.3. 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) | V_{IN} (V) | Min | Typ. | Max | Unit |
|-------------------------------|-----------|----------|--|--------------|--------------|-----|------|-----|------|
| Propagation delay time | t_{PLH} | | $C_L = 15\text{ pF}$ $R_L = 1\text{ M}\Omega$ | 2.3 to 2.7 | 1.65 to 1.95 | — | 3.6 | 5.1 | ns |
| | | | | | 2.3 to 2.7 | — | 2.9 | 4.3 | |
| | | | | | 3.0 to 3.6 | — | 2.5 | 3.8 | |
| | | | | 3.0 to 3.6 | 1.65 to 1.95 | — | 3.6 | 4.7 | |
| | | | | | 2.3 to 2.7 | — | 2.7 | 3.8 | |
| | | | | | 3.0 to 3.6 | — | 2.2 | 3.3 | |
| Propagation delay time | t_{PHL} | | $C_L = 15\text{ pF}$ $R_L = 1\text{ M}\Omega$ | 2.3 to 2.7 | 1.65 to 1.95 | — | 3.5 | 5.1 | ns |
| | | | | | 2.3 to 2.7 | — | 3.9 | 5.5 | |
| | | | | | 3.0 to 3.6 | — | 4.2 | 5.9 | |
| | | | | 3.0 to 3.6 | 1.65 to 1.95 | — | 2.9 | 3.8 | |
| | | | | | 2.3 to 2.7 | — | 3.0 | 4.1 | |
| | | | | | 3.0 to 3.6 | — | 3.2 | 4.4 | |
| 3-state output enable time | t_{PZH} | | $C_L = 15\text{ pF}$ $R_L = 5\text{ k}\Omega$ | 2.3 to 2.7 | 1.65 to 1.95 | — | 4.0 | 5.6 | ns |
| | | | | | 2.3 to 2.7 | — | 3.2 | 4.6 | |
| | | | | | 3.0 to 3.6 | — | 2.8 | 4.0 | |
| | | | | 3.0 to 3.6 | 1.65 to 1.95 | — | 4.0 | 5.4 | |
| | | | | | 2.3 to 2.7 | — | 3.0 | 4.2 | |
| | | | | | 3.0 to 3.6 | — | 2.5 | 3.5 | |
| 3-state output enable time | t_{PZL} | | $C_L = 15\text{ pF}$ $R_L = 5\text{ k}\Omega$ | 2.3 to 2.7 | 1.65 to 1.95 | — | 4.0 | 5.6 | ns |
| | | | | | 2.3 to 2.7 | — | 3.2 | 4.6 | |
| | | | | | 3.0 to 3.6 | — | 2.8 | 4.0 | |
| | | | | 3.0 to 3.6 | 1.65 to 1.95 | — | 4.0 | 5.4 | |
| | | | | | 2.3 to 2.7 | — | 3.0 | 4.2 | |
| | | | | | 3.0 to 3.6 | — | 2.5 | 3.5 | |
| 3-state output disable time | t_{PLZ} | | $C_L = 15\text{ pF}$ $R_L = 1\text{ M}\Omega$ | 2.3 to 2.7 | 1.65 to 1.95 | — | 5.0 | 6.7 | ns |
| | | | | | 2.3 to 2.7 | — | 5.4 | 7.6 | |
| | | | | | 3.0 to 3.6 | — | 5.6 | 8.2 | |
| | | | | 3.0 to 3.6 | 1.65 to 1.95 | — | 6.3 | 7.7 | |
| | | | | | 2.3 to 2.7 | — | 6.4 | 8.4 | |
| | | | | | 3.0 to 3.6 | — | 6.5 | 8.4 | |
| | t_{PHZ} | | $C_L = 15\text{ pF}$ $R_L = 1\text{ M}\Omega$ | 2.3 to 2.7 | 1.65 to 1.95 | — | 5.0 | 6.7 | ns |
| | | | | | 2.3 to 2.7 | — | 5.4 | 7.6 | |
| | | | | | 3.0 to 3.6 | — | 5.6 | 8.2 | |
| | | | | 3.0 to 3.6 | 1.65 to 1.95 | — | 6.3 | 7.7 | |
| | | | | | 2.3 to 2.7 | — | 6.4 | 8.4 | |
| | | | | | 3.0 to 3.6 | — | 6.5 | 8.4 | |
| Input capacitance | C_{IN} | | — | 3.6 | — | — | 3 | — | pF |
| Power dissipation capacitance | C_{PD} | (Note 1) | — | 2.3 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.

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

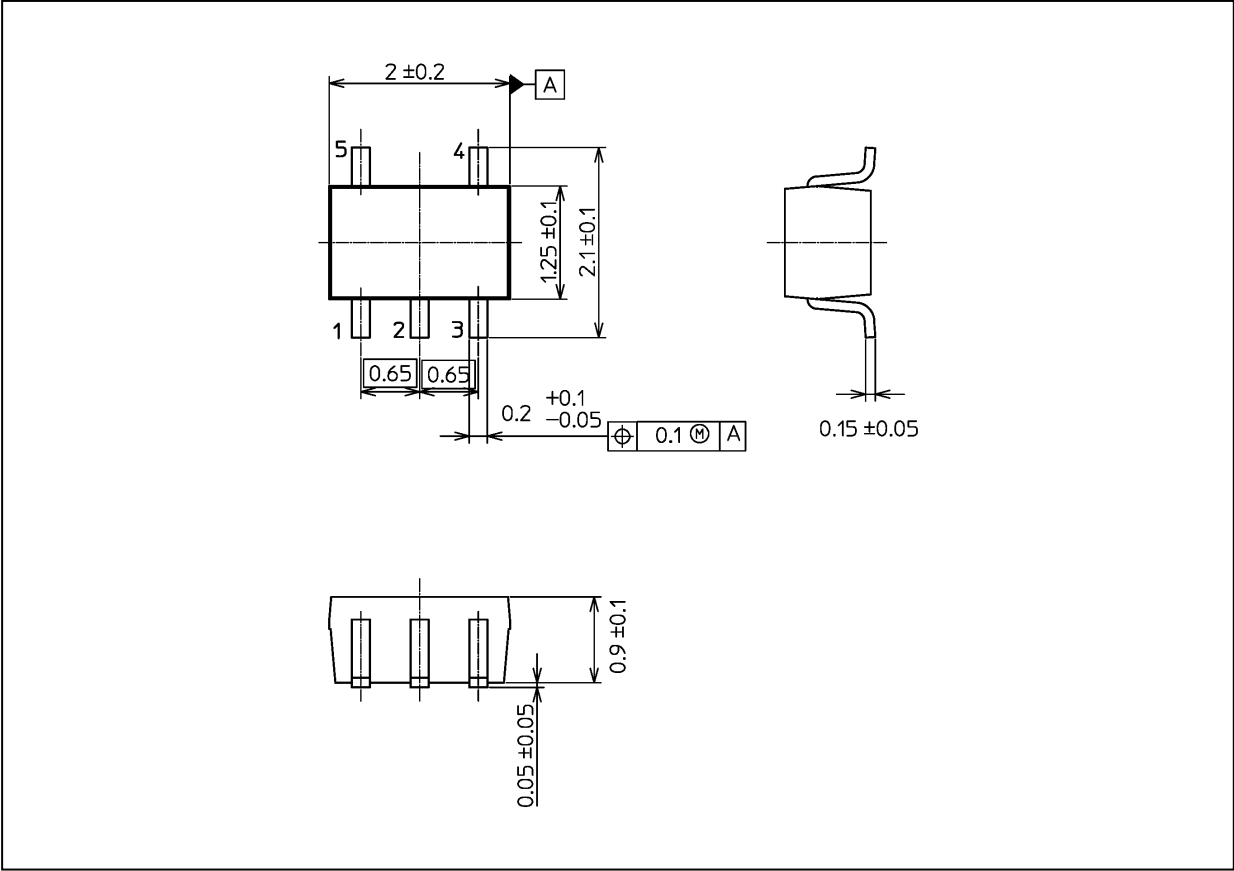
9.4. AC Characteristics

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

| Characteristics | Symbol | Test Condition | V _{CC} (V) | V _{IN} (V) | Min | Max | Unit |
|-----------------------------|------------------|---|---------------------|---------------------|-----|------|------|
| Propagation delay time | t _{PLH} | C _L = 15 pF R _L = 1 MΩ | 2.3 to 2.7 | 1.65 to 1.95 | 1.0 | 5.9 | ns |
| | | | | 2.3 to 2.7 | 1.0 | 5.1 | |
| | | | | 3.0 to 3.6 | 1.0 | 4.6 | |
| | | | 3.0 to 3.6 | 1.65 to 1.95 | 1.0 | 5.6 | |
| | | | | 2.3 to 2.7 | 1.0 | 4.7 | |
| | | | | 3.0 to 3.6 | 1.0 | 4.1 | |
| Propagation delay time | t _{PHL} | C _L = 15 pF R _L = 1 MΩ | 2.3 to 2.7 | 1.65 to 1.95 | 1.0 | 6.0 | ns |
| | | | | 2.3 to 2.7 | 1.0 | 6.4 | |
| | | | | 3.0 to 3.6 | 1.0 | 6.9 | |
| | | | 3.0 to 3.6 | 1.65 to 1.95 | 1.0 | 4.8 | |
| | | | | 2.3 to 2.7 | 1.0 | 5.0 | |
| | | | | 3.0 to 3.6 | 1.0 | 5.3 | |
| 3-state output enable time | t _{PZH} | C _L = 15 pF R _L = 5 kΩ | 2.3 to 2.7 | 1.65 to 1.95 | 1.0 | 6.6 | ns |
| | | | | 2.3 to 2.7 | 1.0 | 5.4 | |
| | | | | 3.0 to 3.6 | 1.0 | 4.7 | |
| | | | 3.0 to 3.6 | 1.65 to 1.95 | 1.0 | 6.6 | |
| | | | | 2.3 to 2.7 | 1.0 | 5.2 | |
| | | | | 3.0 to 3.6 | 1.0 | 4.1 | |
| | t _{PZL} | C _L = 15 pF R _L = 5 kΩ | 2.3 to 2.7 | 1.65 to 1.95 | 1.0 | 6.6 | ns |
| | | | | 2.3 to 2.7 | 1.0 | 5.4 | |
| | | | | 3.0 to 3.6 | 1.0 | 4.7 | |
| | | | 3.0 to 3.6 | 1.65 to 1.95 | 1.0 | 6.6 | |
| 3-state output disable time | t _{PLZ} | C _L = 15 pF R _L = 1 MΩ | 2.3 to 2.7 | 1.65 to 1.95 | 1.0 | 7.3 | ns |
| | | | | 2.3 to 2.7 | 1.0 | 8.3 | |
| | | | | 3.0 to 3.6 | 1.0 | 11.7 | |
| | | | 3.0 to 3.6 | 1.65 to 1.95 | 1.0 | 10.2 | |
| | | | | 2.3 to 2.7 | 1.0 | 11.8 | |
| | | | | 3.0 to 3.6 | 1.0 | 12.6 | |
| | t _{PHZ} | C _L = 15 pF R _L = 1 MΩ | 2.3 to 2.7 | 1.65 to 1.95 | 1.0 | 7.3 | ns |
| | | | | 2.3 to 2.7 | 1.0 | 8.3 | |
| | | | | 3.0 to 3.6 | 1.0 | 11.7 | |
| | | | 3.0 to 3.6 | 1.65 to 1.95 | 1.0 | 10.2 | |
| | | | | 2.3 to 2.7 | 1.0 | 11.8 | |
| | | | | 3.0 to 3.6 | 1.0 | 12.6 | |

Package Dimensions

Unit: mm



Weight: 6.2 mg (typ.)

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

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