TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SBD385AFU

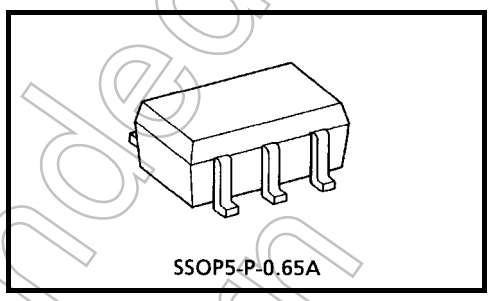
Single Bus Switch with Level Shifting

The TC7SBD385AFU provides single bit of high-speed TTL-compatible switching. The low on resistance of the switch allows connections to be made with minimal propagation delay.

The device is organized as just 1-bit low-impedance switch with output-enable (OE) input. When OE is high, the switch is on and data can flow from port A to port B, or vice versa. When OE is low, the switch is open and a high-impedance state exists between the two ports.

The device is enable to realize the shift of signal level from 5 V to 3.3 V.

All inputs are equipped with protection circuits against static discharge.

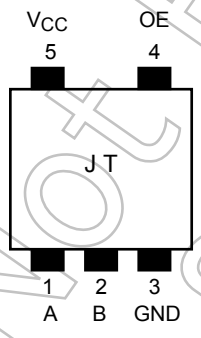



Weight: 0.006 g (typ.)

## Features

- Operating voltage: $V_{CC}$ = 4.5 to 5.5 V
- High speed operation: $t_{pd}$ = 0.32 ns (max)
- Low on resistance: $R_{ON}$ = 5 Ω (typ.)
- ESD performance: Machine model ≥ ±200 V
  Human body model ≥ ±2000 V
- TTL level input (control input)
- Low Power Dissipation: $I_{CC}$ = 10 μA (max.)
- Package: USV

## Pin Assignment (top view)



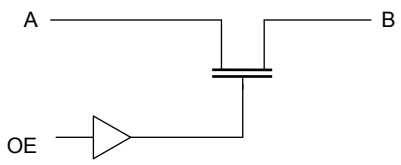



Start of commercial production
2003-02

## Truth Table

| Input OE | Function |
|---|---|
| L | Disconnect |
| H | A port = B port |

## System Diagram




## Absolute Maximum Ratings (Note)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Power supply range | $V_{CC}$ | −0.5 to 7.0 | V |
| DC input voltage | $V_{IN}$ | −0.5 to 7.0 | V |
| DC switch voltage | $V_S$ | −0.5 to 7.0 | V |
| Input diode current | $I_{IK}$ | −50 | mA |
| Continuous channel current | $I_S$ | 128 | mA |
| Power dissipation | $P_D$ | 200 | mW |
| DC $V_{CC}$/GND current | $I_{CC}/I_{GND}$ | ±100 | mA |
| Storage temperature | $T_{stg}$ | −65 to 150 | °C |

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## Operating Ranges (Note)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | 4.5 to 5.5 | V |
| Input voltage | $V_{IN}$ | 0 to 5.5 | V |
| Switch voltage | $V_S$ | 0 to 5.5 | V |
| Operating temperature | $T_{opr}$ | −40 to 85 | °C |
| Input rise and fall time | dt/dv | 0 to 10 | ns/V |

Note: The operating ranges must be maintained to ensure the normal operation of the device.

## Electrical Characteristics

### DC Characteristics (Ta = −40~85°C)

| Characteristics | | Symbol | Test Condition | | $V_{CC}$ (V) | Min | Typ. (Note 1) | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Input voltage | "H" level | $V_{IH}$ | — | | 4.5 to 5.5 | 2.0 | — | — | V |
| | "L" level | $V_{IL}$ | — | | 4.5 to 5.5 | — | — | 0.8 | |
| High-level output voltage (Note 2) | | $V_{OH}$ | IOH=-1μA<br>$V_{IS}$ = $V_{CC}$ | | 4.75 | 2.3 | 2.8 | 3.2 | V |
| | | | | | 5.0 | 2.5 | 3.0 | 3.4 | |
| | | | | | 5.25 | 2.7 | 3.2 | 3.6 | |
| Input leakage current | | $I_{IN}$ | $V_{IN}$ = 0 to 5.5 V | | 4.5 to 5.5 | — | — | ±1.0 | μA |
| Power off leakage current | | $I_{OFF}$ | A, B, OE= 0 to 5.5 V | | 0 | — | — | ±1.0 | μA |
| Off-STATE leakage current (switch off) | | $I_{SZ}$ | A, B = 0 to 5.5 V, OE = GND | | 4.5 to 5.5 | — | — | ±1.0 | μA |
| ON resistance (Note 3) | | $R_{ON}$ | $V_{IS}$ = 0 V | $I_{IS}$ = 64 mA | 4.5 | — | 5 | 9 | Ω |
| | | | | | 4.75 | — | 5 | 8 | |
| | | | | $I_{IS}$ = 30 mA | 4.5 | — | 5 | 9 | |
| | | | | | 4.75 | — | 5 | 8 | |
| | | | $V_{IS}$ = 2.3 V, $I_{IS}$ = 15 mA | | 4.5 | — | 35 | 65 | |
| | | | | | 4.75 | — | 35 | 50 | |
| Quiescent supply current | | $I_{CC}$ | VIN = VCC or GND, $I_{OUT}$ = 0 | | 5.5 | — | — | 10 | μA |
| Increase in $I_{CC}$ per input | | $\Delta I_{CC}$ | $V_{IN}$ = 3.4 V (one input) | | 5.5 | — | — | 2.5 | mA |

Note 1: Typical values are at $V_{CC}$ = 5 V, Ta = 25°C.

Note 2: It recommends that this device uses Pull-up resistance when adding and using resistance for an output terminal. Since it couses to drop a VOH voltage level when using Pull-down resistance for an output terminal.

Note 3: Measured by the voltage drop between A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltages on the two (A or B) pins.

### AC Characteristics (Ta = −40~85°C)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Min | Max | Unit |
|---|---|---|---|---|---|---|
| Propagation delay time (bus to bus) | $t_{pLH}$<br>$t_{pHL}$ | Figure 1, Figure 2 (Note) | 4.5 | — | 0.32 | ns |
| Output enable time | $t_{pZL}$<br>$t_{pZH}$ | Figure 1, Figure 3 | 4.5 | — | 4.5 | ns |
| Output disable time | $t_{pLZ}$<br>$t_{pHZ}$ | Figure 1, Figure 3 | 4.5 | — | 5.0 | ns |

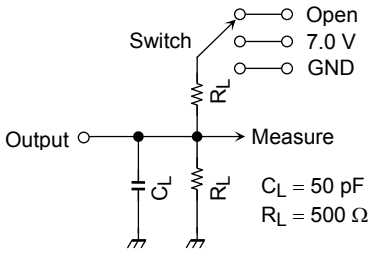
Note: The propagation delay time is calculated by the RC (on-resistance and load capacitance) time constant.

### Capacitive Characteristics (Ta = 25°C)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Typ. | Unit |
|---|---|---|---|---|---|
| Control pin input capacitance | $C_{IN}$ | (Note) | 5.0 | 3 | pF |
| Switch terminal capacitance | $C_{I/O}$ | OE = GND (Note) | 5.0 | 10 | pF |

Note: This parameter is guaranteed by design.

## AC Test Circuit




| Parameter | Switch |
|---|---|
| $t_{pLH}$, $t_{pHL}$ | Open |
| $t_{pLZ}$, $t_{pZL}$ | 7.0 V |
| $t_{pHZ}$, $t_{pZH}$ | GND |

**Figure 1**

## AC Waveform

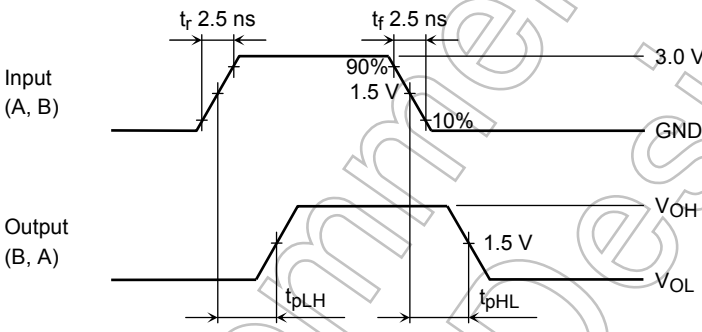



**Figure 2 $t_{pLH}$, $t_{pHL}$**

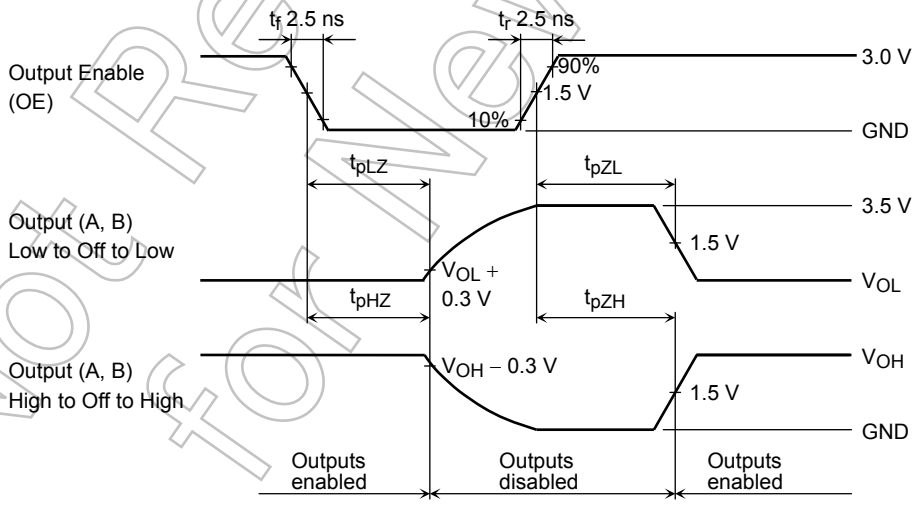
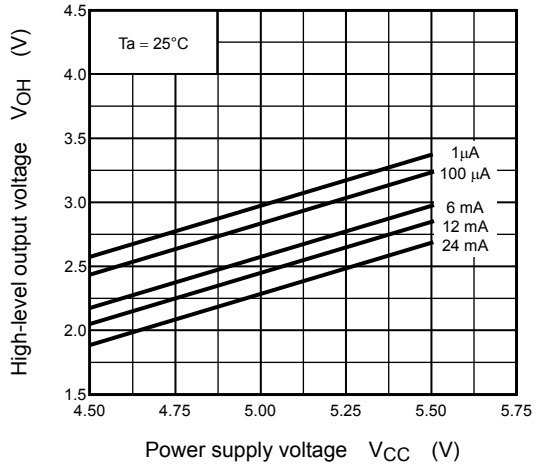
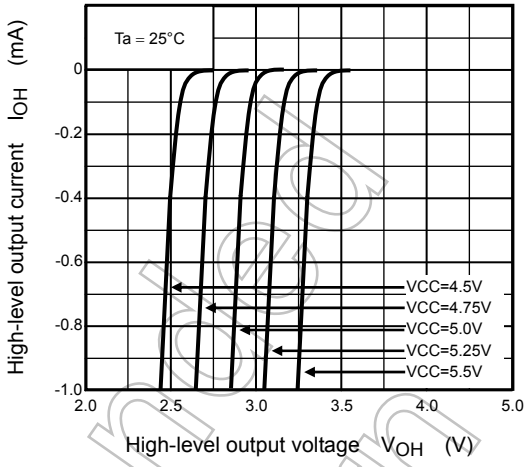
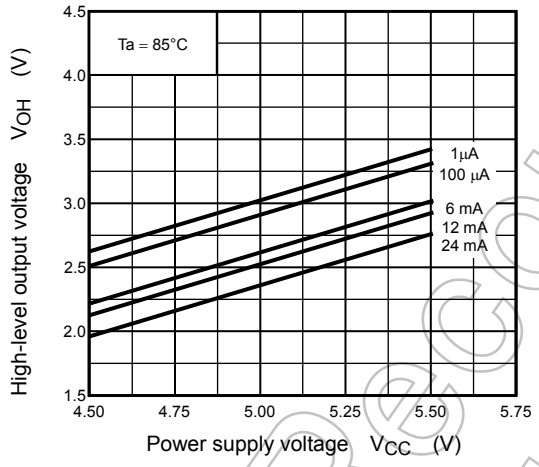


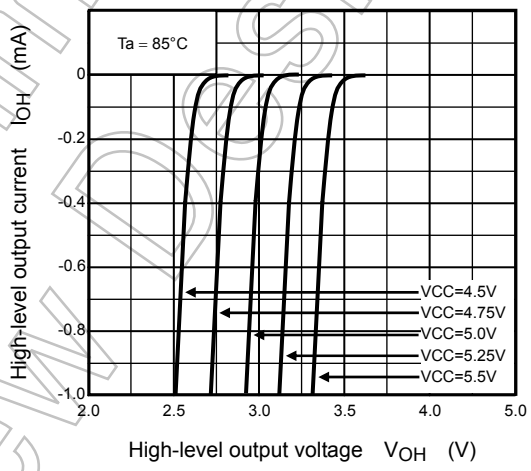

**Figure 3 $t_{pLZ}$, $t_{pHZ}$, $t_{pZL}$, $t_{pZH}$**

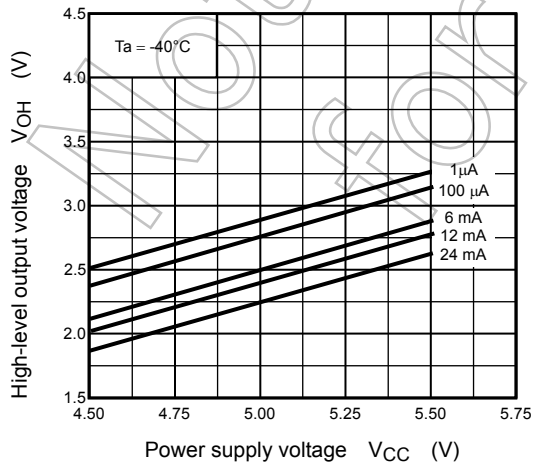
## $V_{OH}$ – $V_{CC}$ Characteristics (typ.)



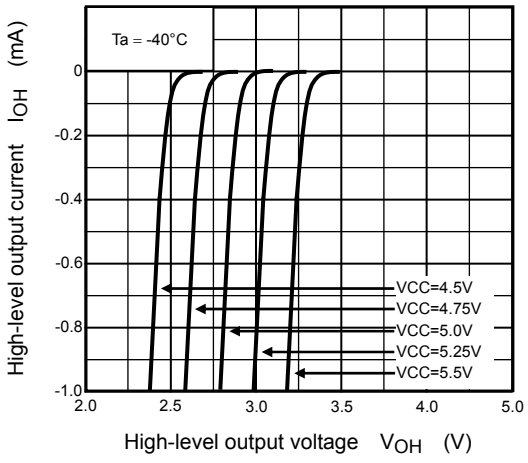
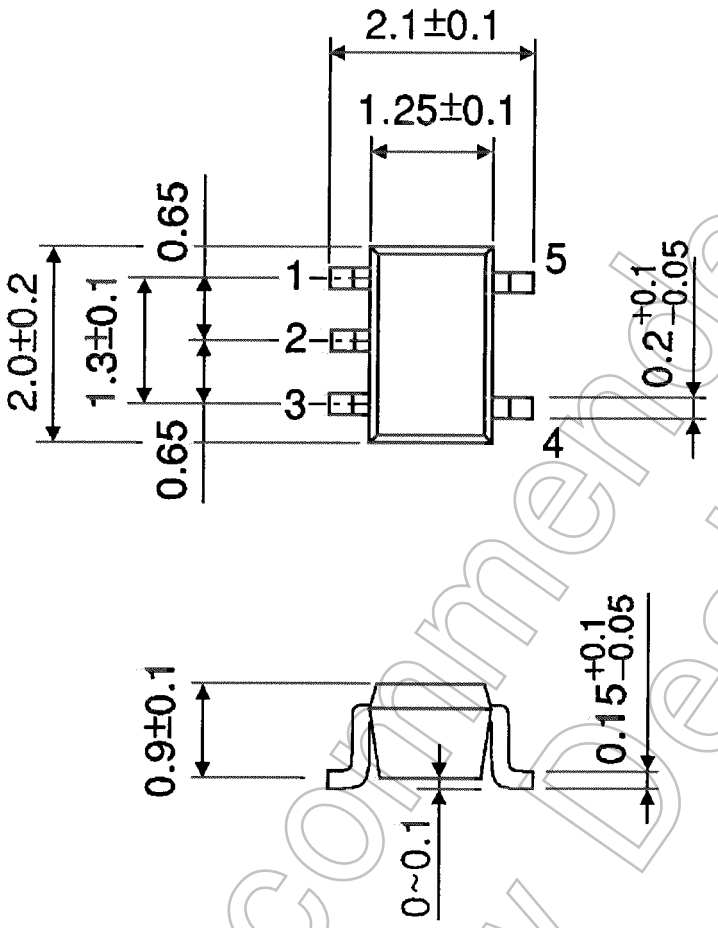




**Figure 4**

**Package Dimensions**

SSOP5-P-0.65A Unit : mm




Weight: 0.006 g (typ.)

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