

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SP3066TU, TC7SP3067TU

TC7SP3066TU Low Voltage Dual Supply Single Bus Switch (analog)

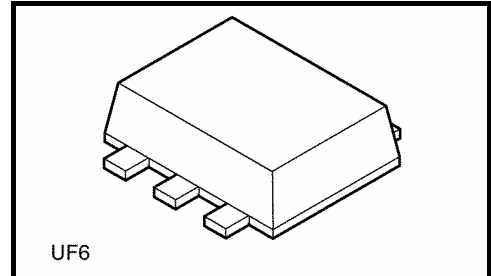
TC7SP3067TU Low Voltage Dual Supply Single Bus Switch (analog)

The TC7SP3066 and TC7SP3067 are high-speed CMOS one-bit analog bus switches with separate power supplies for control and switch portions. In the TC7SP3066, the switch is on when Output Enable (OE) is High. In the TC7SP3067, the switch is on when Output Enable ( $\overline{OE}$ ) is Low.

The TC7SP3066 and TC7SP3067 support power-down protection by incorporating 3.6-V-tolerant control inputs.

These devices are suitable for applications where the control voltage is lower than the signal line voltage.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.



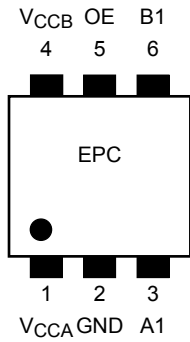
Weight: 0.007 g (typ.)

## Features

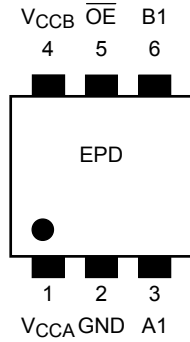
- Operating voltage range:
  - $V_{CCA} = 1.1$  to  $2.7$  V (Control portion)
  - $V_{CCB} = 1.65$  to  $3.6$  V (Switch portion)
- ON-resistance:  $R_{ON} = 8 \Omega$  (max) ( $V_{CCB} = 2.7$  V)  
 $R_{ON} = 10 \Omega$  (max) ( $V_{CCB} = 2.3$  V)
- ESD performance: Machine model  $\geq \pm 200$  V  
Human body model  $\geq \pm 2000$  V
- Ultra-small package: UF6
- 3.6-V tolerance function and power-down protection at the Output Enable input.

## Pin Assignment (top view)

TC7SP3066TU



TC7SP3067TU

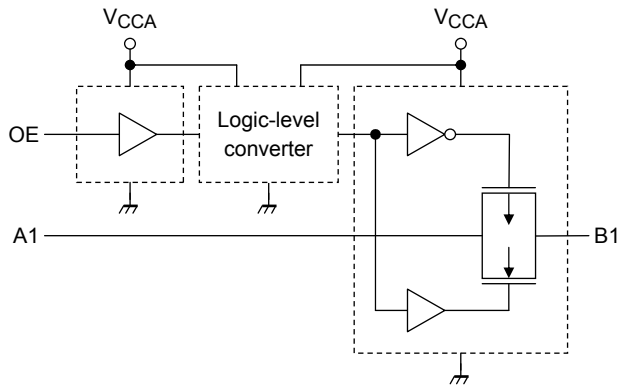


## Truth Table

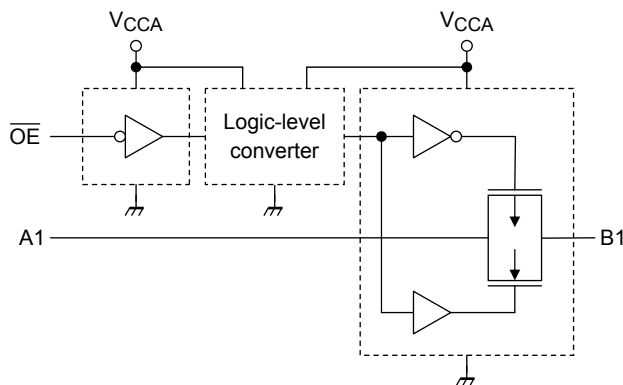
Input (3066)	Function	Input (3067)	Function
OE		$\overline{OE}$	
H	Aport = Bport	H	Disconnected
L	Disconnected	L	Aport = Bport

## Circuit Schematic

TC7SP3066TU



TC7SP3067TU



## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage (Note 2)	$V_{CCA}$	-0.5 to 4.6	V
	$V_{CCB}$	-0.5 to 4.6	
Control input voltage (OE (3066)/ OE (3067))	$V_{IN}$	-0.5 to 4.6	V
Switch input/output voltage	$V_S$	-0.5 to $V_{CCB} + 0.5$	V
Diode current in the control portion	$I_{IK}$	-25	mA
Diode current in the switch portion	$I_{IK}$	±50 (Note 3)	mA
Switch input/output current	$I_S$	128	mA
DC $V_{CC}$ /ground current	$I_{CCA}$	±50	mA
	$I_{CCB}$	±100	
Power dissipation	$P_D$	200	mW
Storage temperature	$T_{stg}$	-65 to 150	°C

Note 1: 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 2: Do not supply a voltage to the  $V_{CCB}$  pin when  $V_{CCA}$  is in the OFF state.

Note 3:  $V_S < GND$ ,  $V_S > V_{CCB}$

## Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Power supply voltage	$V_{CCA}$	1.1 to 2.7	V
	$V_{CCB}$	1.65 to 3.6	
Control input voltage	$V_{IN}$	0 to 3.6	V
Switch input/output voltage	$V_S$	0 to $V_{CCB}$	V
Operating temperature	$T_{opr}$	-40 to 85	°C
Control input rise and fall times	dt/dv	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  $V_{CCA}$  or GND.

## Electrical Characteristics

### DC Characteristics (1.1 V ≤ V<sub>CCA</sub> ≤ 2.7 V, 1.65 V ≤ V<sub>CCB</sub> ≤ 3.6 V)

Characteristics	Symbol	Test Condition		V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	Ta = -40 to 85°C		Unit
						Min	Max	
High-level input voltage	V <sub>IH</sub>	OE (3066), $\overline{OE}$ (3067)		1.1 ≤ V <sub>CCA</sub> < 1.4	1.65 to 3.6	0.70 × V <sub>CCA</sub>	—	V
				1.4 ≤ V <sub>CCA</sub> < 1.65	1.65 to 3.6	0.70 × V <sub>CCA</sub>	—	V
				1.65 ≤ V <sub>CCA</sub> < 2.3	2.3 to 3.6	0.70 × V <sub>CCA</sub>	—	V
				2.3 ≤ V <sub>CCA</sub> ≤ 2.7	2.7 to 3.6	1.6	—	V
Low-level input voltage	V <sub>IL</sub>	OE (3066), $\overline{OE}$ (3067)		1.1 ≤ V <sub>CCA</sub> < 1.4	1.65 to 3.6	—	0.30 × V <sub>CCA</sub>	V
				1.4 ≤ V <sub>CCA</sub> < 1.65	1.65 to 3.6	—	0.30 × V <sub>CCA</sub>	V
				1.65 ≤ V <sub>CCA</sub> < 2.3	2.3 to 3.6	—	0.30 × V <sub>CCA</sub>	V
				2.3 ≤ V <sub>CCA</sub> ≤ 2.7	2.7 to 3.6	—	0.7	V
ON-resistance (Note)	R <sub>ON</sub>	V <sub>IS</sub> = 0 V	I <sub>S</sub> = 30 mA	1.1 to 2.7	2.7	—	8	Ω
		V <sub>IS</sub> = 2.7 V	I <sub>S</sub> = 30 mA	1.1 to 2.7	2.7	—	12	
		V <sub>IS</sub> = 2.1 V	I <sub>S</sub> = 15 mA	1.1 to 2.7	2.7	—	20	
		V <sub>IS</sub> = 0 V	I <sub>S</sub> = 24 mA	1.1 to 2.3	2.3	—	10	
		V <sub>IS</sub> = 2.3 V	I <sub>S</sub> = 24 mA	1.1 to 2.3	2.3	—	15	
		V <sub>IS</sub> = 2.0 V	I <sub>S</sub> = 15 mA	1.1 to 2.3	2.3	—	25	
Switch-off leakage current	I <sub>SZ</sub>	A1, B1 = 0 to V <sub>CCB</sub> $\overline{OE}$ = V <sub>CCA</sub> , OE = GND		1.1 to 2.7	1.65 to 3.6	—	±2.0	μA
Control input current	I <sub>IN</sub>	$\overline{OE}$ or OE = 0 to 3.6 V		1.1 to 2.7	1.65 to 3.6	—	±1.0	μA
Quiescent supply current	I <sub>CCA</sub>	V <sub>IN</sub> = V <sub>CCA</sub> or GND, I <sub>S</sub> = 0 A		1.1 to 2.7	1.65 to 3.6	—	4.0	μA
	I <sub>CCB</sub>	V <sub>IN</sub> = V <sub>CCA</sub> or GND, I <sub>S</sub> = 0 A		1.1 to 2.7	1.65 to 3.6	—	4.0	
	I <sub>CCA</sub>	V <sub>CCA</sub> ≤ V <sub>IN</sub> ≤ 3.6 V, I <sub>S</sub> = 0 A		1.1 to 2.7	1.65 to 3.6	—	4.0	
	I <sub>CCB</sub>	V <sub>CCA</sub> ≤ V <sub>IN</sub> ≤ 3.6 V, I <sub>S</sub> = 0 A		1.1 to 2.7	1.65 to 3.6	—	4.0	

Note: ON-resistance is measured by measuring the voltage drop across the switch at the indicated current. V<sub>IS</sub> is defined as the lower voltage at the A and B pins.

## AC Characteristics (Ta = -40 to 85°C, Input: tr = tf = 2.0 ns)

**VCCA = 2.5 ± 0.2 V, VCCB = 3.3 ± 0.3 V**

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	t <sub>pLH</sub> t <sub>pHL</sub>	Figures 1 and 2 (Note)	—	0.25	ns
3-state output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figures 1 and 3	—	7	
3-state output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figures 1 and 3	—	7	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

**VCCA = 1.8 ± 0.15 V, VCCB = 3.3 ± 0.3 V**

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	t <sub>pLH</sub> t <sub>pHL</sub>	Figures 1 and 2 (Note)	—	0.25	ns
3-state output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figures 1 and 3	—	9	
3-state output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figures 1 and 3	—	9	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

**VCCA = 1.5 ± 0.1 V, VCCB = 3.3 ± 0.3 V**

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	t <sub>pLH</sub> t <sub>pHL</sub>	Figures 1 and 2 (Note)	—	0.25	ns
3-state output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figures 1 and 3	—	12	
3-state output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figures 1 and 3	—	12	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

**VCCA = 1.2 ± 0.1 V, VCCB = 3.3 ± 0.3 V**

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	t <sub>pLH</sub> t <sub>pHL</sub>	Figures 1 and 2 (Note)	—	0.25	ns
3-state output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figures 1 and 3	—	20	
3-state output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figures 1 and 3	—	20	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

$$V_{CCA} = 1.8 \pm 0.15 \text{ V}, V_{CCB} = 2.5 \pm 0.2 \text{ V}$$

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	$t_{pLH}$ $t_{pHL}$	Figures 1 and 2 (Note)	—	0.61	ns
3-state output enable time	$t_{pZL}$ $t_{pZH}$	Figures 1 and 3	—	11	
3-state output disable time	$t_{pLZ}$ $t_{pHZ}$	Figures 1 and 3	—	11	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

$$V_{CCA} = 1.5 \pm 0.1 \text{ V}, V_{CCB} = 2.5 \pm 0.2 \text{ V}$$

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	$t_{pLH}$ $t_{pHL}$	Figures 1 and 2 (Note)	—	0.61	ns
3-state output enable time	$t_{pZL}$ $t_{pZH}$	Figures 1 and 3	—	12	
3-state output disable time	$t_{pLZ}$ $t_{pHZ}$	Figures 1 and 3	—	12	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

$$V_{CCA} = 1.2 \pm 0.1 \text{ V}, V_{CCB} = 2.5 \pm 0.2 \text{ V}$$

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	$t_{pLH}$ $t_{pHL}$	Figures 1 and 2 (Note)	—	0.61	ns
3-state output enable time	$t_{pZL}$ $t_{pZH}$	Figures 1 and 3	—	17	
3-state output disable time	$t_{pLZ}$ $t_{pHZ}$	Figures 1 and 3	—	17	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

$$V_{CCA} = 1.2 \pm 0.1 \text{ V}, V_{CCB} = 1.8 \pm 0.15 \text{ V}$$

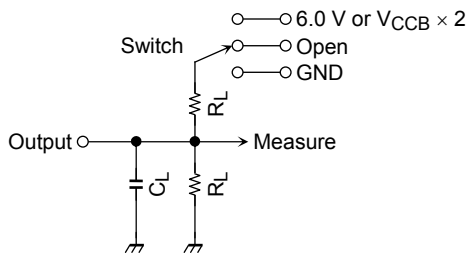
Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time (bus to bus)	$t_{pLH}$ $t_{pHL}$	Figures 1 and 2 (Note)	—	1.15	ns
3-state output enable time	$t_{pZL}$ $t_{pZH}$	Figures 1 and 3	—	25	
3-state output disable time	$t_{pLZ}$ $t_{pHZ}$	Figures 1 and 3	—	25	

Note: Calculated from the RC time constant of the ON-resistance of the output and the capacitive load.

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

Characteristics	Symbol	Test Condition	VCCB (V)		Typ.	Unit
			VCCA (V)	VCCB (V)		
Control input capacitance	C <sub>IN</sub>		2.5	3.3	7	pF
Switch input/output capacitance	C <sub>I/O</sub>	$\overline{OE} = V_{CCA}, OE = GND$	2.5	3.3	10	pF

**AC Test Circuit**

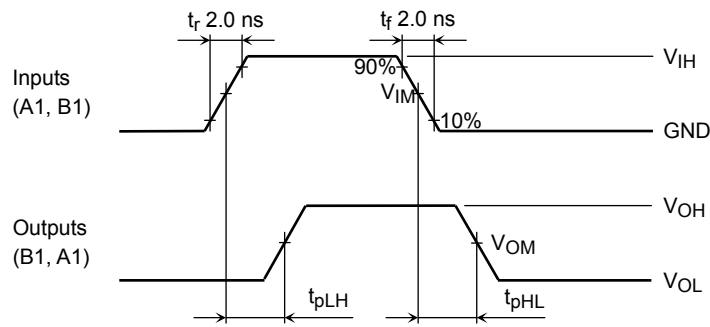


Parameter	Switch
t <sub>pLH</sub> , t <sub>pHL</sub>	Open
t <sub>pLZ</sub> , t <sub>pZL</sub>	6.0 V @ VCCB = 3.3 ± 0.3 V
	VCCB × 2 @ VCCB = 2.5 ± 0.2 V
	@ VCCB = 1.8 ± 0.15 V
t <sub>pHZ</sub> , t <sub>pZH</sub>	GND

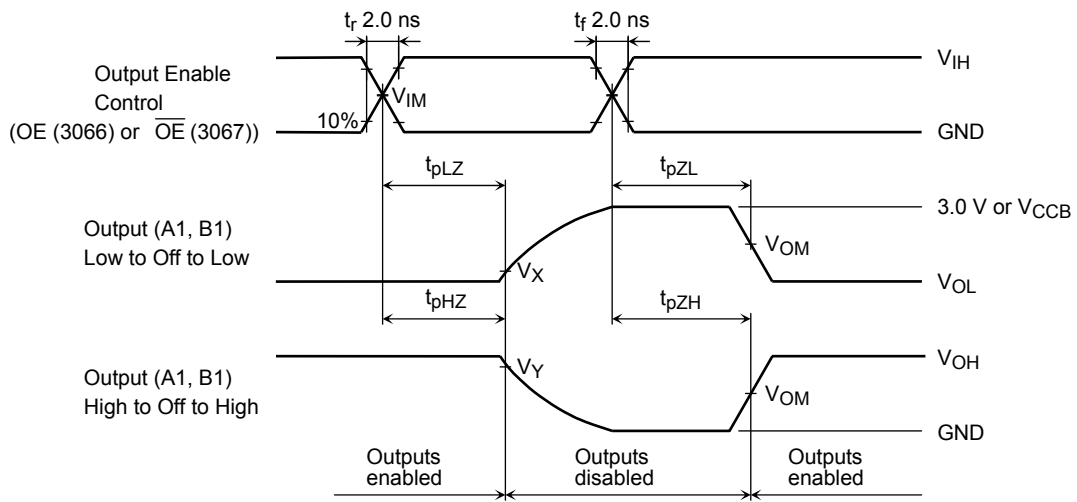
Symbol	VCCB (output)	
	3.3 ± 0.3 V 2.5 ± 0.2 V	1.8 ± 0.15 V
R <sub>L</sub>	500 Ω	1 kΩ
C <sub>L</sub>	30 pF	30 pF

**Figure 1**

**AC Test Waveform**



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



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

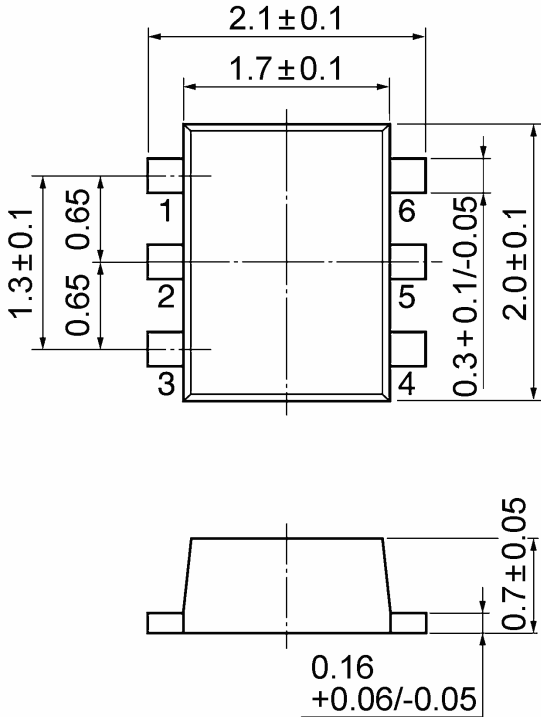
	Symbol	$V_{CCA}$ or $V_{CCB}$		
		$3.3 \pm 0.3$ V	$2.5 \pm 0.2$ V $1.8 \pm 0.15$ V	$1.5 \pm 0.1$ V $1.2 \pm 0.1$ V
Input	$V_{IH}$	—	$V_{CCA}$	$V_{CCA}$
	$V_{IM}$	—	$V_{CCA}/2$	$V_{CCA}/2$
Output	$V_{OM}$	$V_{OH}/2$	$V_{OH}/2$	—
	$V_X$	$V_{OL} + 0.3$ V	$V_{OL} + 0.15$ V	—
	$V_Y$	$V_{OH} - 0.3$ V	$V_{OH} - 0.15$ V	—



**Package Dimensions**

UF6

Unit: mm



Weight: 0.007 g (typ.)

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20070701-EN GENERAL

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