

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

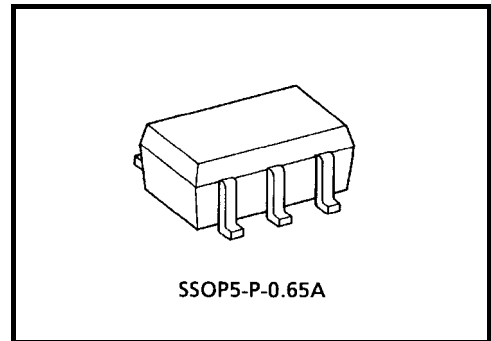
# TC7SBL66CFU, TC7SBL384CFU

## Low Voltage / Low Capacitance Single Bus Switch

The TC7SBL66C and TC7SBL384C are a Low Voltage / Low Capacitance CMOS single Bus Switch. The low On-resistance of the switch allows connections to be made with minimal propagation delay time.

The TC7SBL66C requires the output enable (OE) input to be set low to place the output into the high impedance state, whereas the TC7SBL384C requires the output enable ( $\overline{OE}$ ) input to be set high to place the output into the high impedance.

All inputs are equipped with protection circuits against static discharge.



SSOP5-P-0.65A

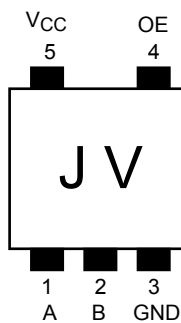
Weight: 0.006 g (typ.)

### Features

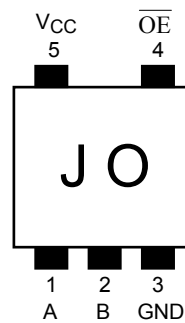
- Operating voltage :  $V_{CC} = 1.65$  to  $3.6$  V
- On-capacitance :  $C_{I/O} = 7$  pF Switch On (typ.)@ $V_{CC} = 3$  V
- On-resistance :  $R_{ON} = 5.5 \Omega$  (typ.) @  $V_{CC} = 3$  V,  $V_{I/O} = 0$  V
- ESD performance : Machine model  $\geq \pm 200$  V  
Human body model  $\geq \pm 2000$  V
- Power-down protection for inputs (OE and  $\overline{OE}$ , I/O)
- Package : USV

### Pin Assignment (top view)

TC7SBL66CFU



TC7SBL384CFU



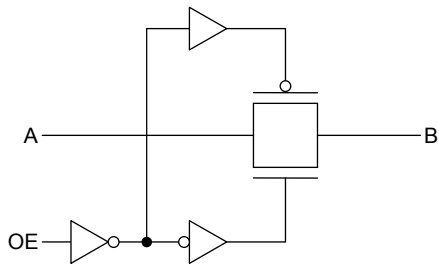
Start of commercial production  
2008-06

## Truth Table

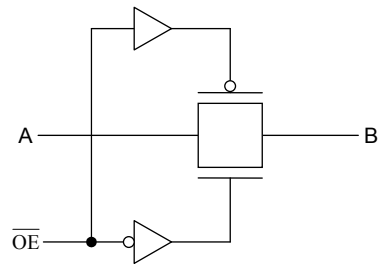
Inputs (66)	Inputs (384)	Function
OE	$\overline{\text{OE}}$	
H	L	A port = B port
L	H	Disconnect

## System Diagram

### TC7SBL66CFU



### TC7SBL384CFU



## Absolute Maximum Ratings (Note)

Characteristic	Symbol	Rating	Unit	
Power supply range	$V_{CC}$	-0.5 to 4.6	V	
Control pin input voltage ( $\overline{OE}$ , OE)	$V_{IN}$	-0.5 to 4.6	V	
Switch terminal I/O voltage	$V_{CC} = 0\text{ V}$ or Switch = Off	$V_S$	-0.5 to 4.6	V
	Switch = On	$V_S$	-0.5 to $V_{CC}+0.5$	
Clump diode current	$I_{IK}$	-50	mA	
Switch I/O current	$I_S$	50	mA	
Power dissipation	$P_D$	200	mW	
DC $V_{CC}$ /GND current	$I_{CC}/I_{GND}$	$\pm 100$	mA	
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).

## Operating Ranges (Note)

Characteristic	Symbol	Rating	Unit	
Power supply voltage	$V_{CC}$	1.65 to 3.6	V	
Control pin input voltage ( $\overline{OE}$ , OE)	$V_{IN}$	0 to 3.6	V	
Switch terminal I/O voltage	$V_{CC} = 0\text{ V}$ or Switch = Off	$V_S$	0 to 3.6	V
	Switch = On	$V_S$	0 to $V_{CC}$	
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}\text{C}$	
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.  
Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics (Ta = -40 to 85°C)

Parameter	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Typ. (Note1)	Max	Unit	
Input voltage (OE, $\overline{OE}$ )	"H" level	V <sub>IH</sub>	—	1.65 to 3.6	0.7 × V <sub>CC</sub>	—	—	V
	"L" level	V <sub>IL</sub>	—	1.65 to 3.6	—	—	0.3 × V <sub>CC</sub>	
Input leakage current (OE, $\overline{OE}$ )	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 3.6 V		1.65 to 3.6	—	—	±1.0	μA
Power-off leakage current	I <sub>OFF</sub>	OE, $\overline{OE}$ , A, B = 0 to 3.6 V		0	—	—	10	μA
Off-state leakage current (switch off)	I <sub>SZ</sub>	A, B = 0 to V <sub>CC</sub> , OE = GND (66), $\overline{OE}$ = V <sub>CC</sub> (384)		1.65 to 3.6	—	—	±1.0	μA
On resistance (Note2)	R <sub>ON</sub>	V <sub>IS</sub> = 0 V, I <sub>S</sub> = 30 mA (Note 1)	3.0	—	5.5	10	Ω	
		V <sub>IS</sub> = 3.0 V, I <sub>S</sub> = 30 mA (Note 1)	3.0	—	10	16		
		V <sub>IS</sub> = 2.4V, I <sub>S</sub> = 15 mA (Note 1)	3.0	—	12	18		
		V <sub>IS</sub> = 0 V, I <sub>S</sub> = 24 mA (Note 1)	2.3	—	6	10		
		V <sub>IS</sub> = 2.3 V, I <sub>S</sub> = 24 mA (Note 1)	2.3	—	13	20		
		V <sub>IS</sub> = 2.0V, I <sub>S</sub> = 15 mA (Note 1)	2.3	—	15	21		
		V <sub>IS</sub> = 0 V, I <sub>S</sub> = 4 mA (Note 1)	1.65	—	7	13		
V <sub>IS</sub> = 1.65 V, I <sub>S</sub> = 4 mA (Note 1)	1.65	—	18	27				
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND, I <sub>OUT</sub> = 0		3.6	—	—	10	μA

Note 1: All typical values are at Ta = 25°C.

Note 2: 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 to 85°C)

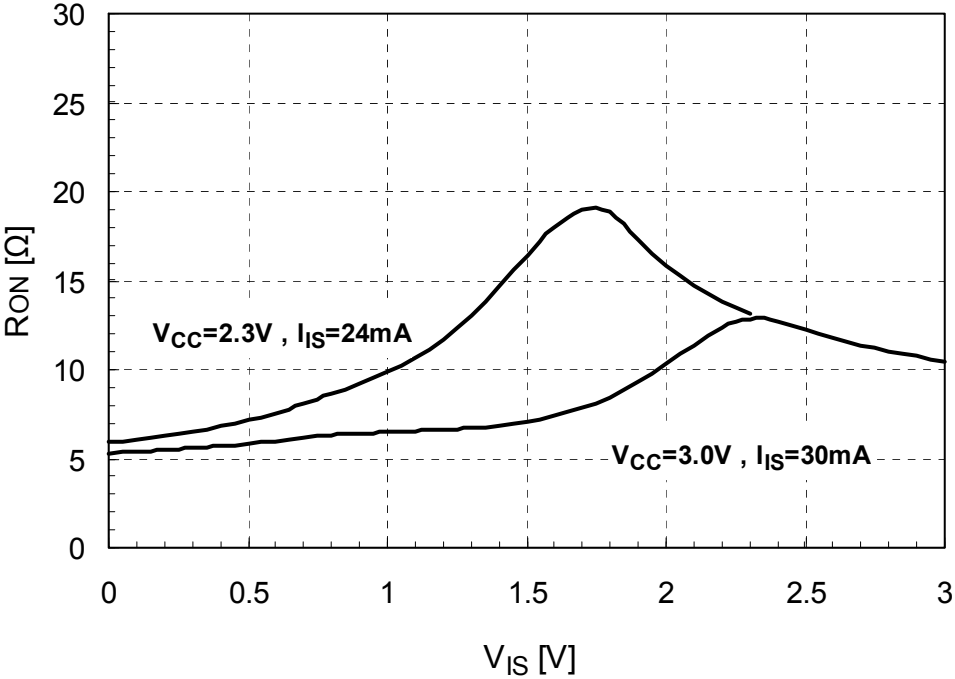
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	

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

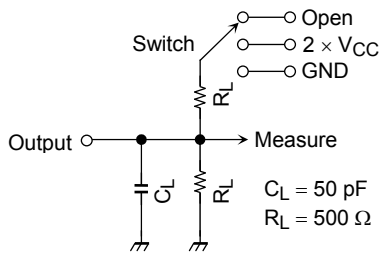
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Control pin input capacitance	C <sub>IN</sub>	V <sub>IN</sub> = 0 V (Note)	3.0	4	pF
Switch terminal capacitance (Switch Off)	C <sub>I/O</sub>	OE = GND (66), $\overline{OE}$ = V <sub>CC</sub> (384), V <sub>IS</sub> = 0 V (Note)	3.0	3.5	pF
Switch terminal capacitance (Switch On)	C <sub>I/O</sub>	OE = V <sub>CC</sub> (66), $\overline{OE}$ = GND (384), V <sub>IS</sub> = 0 V (Note)	3.0	7	pF

Note: This parameter is guaranteed by design.

**R<sub>ON</sub> - V<sub>IS</sub> Characteristic (typ.) Ta=25°C**



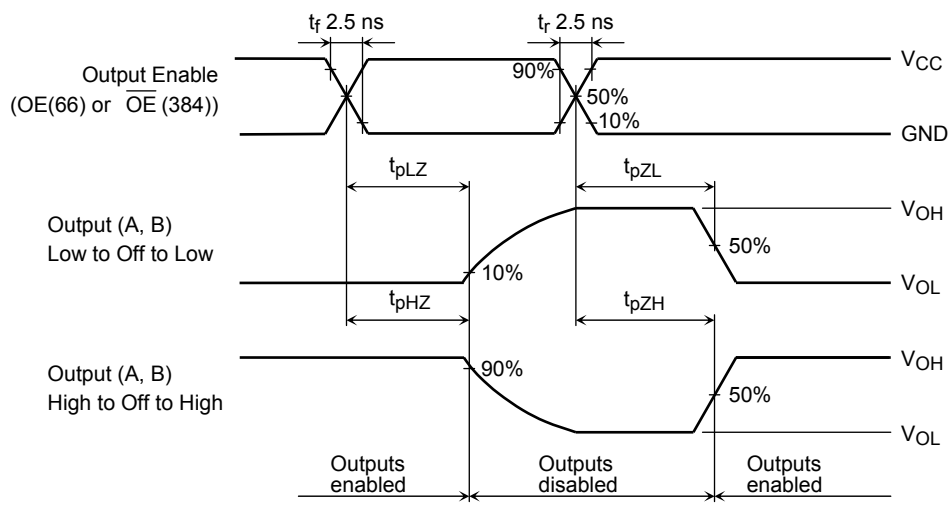
**AC Test Circuit**



Parameter	Switch
$t_{pLZ}, t_{pZL}$	$2 \times V_{CC}$
$t_{pHZ}, t_{pZH}$	GND

**Figure 1**

**AC Waveform**



**Figure 2  $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$**

**Rise and Fall Times (tr / tf) of the TC7SBL66C, 384C I/O Signals**

The tr(out) and tf(out) values of the output signals are affected by the CR time constant of the input, which consists of the switch terminal capacitance (C<sub>I/O</sub>) and the on-resistance (R<sub>ON</sub>) of the input.

In practice, the tr(out) and tf(out) values are also affected by the circuit's capacitance and resistance components other than those of the TC7SBL66CFU, 384CFU.

The tr(out) / tf(out) values can be approximated as follows. (Figure 3 shows the test circuit.)

$$tr(out) / tf(out) \text{ (approx)} = -(C_{I/O} + C_L) \cdot (R_{DRIVE} + R_{ON}) \cdot \ln \left( \frac{(V_{OH} - V_{OL}) - V_M}{V_{OH} - V_{OL}} \right)$$

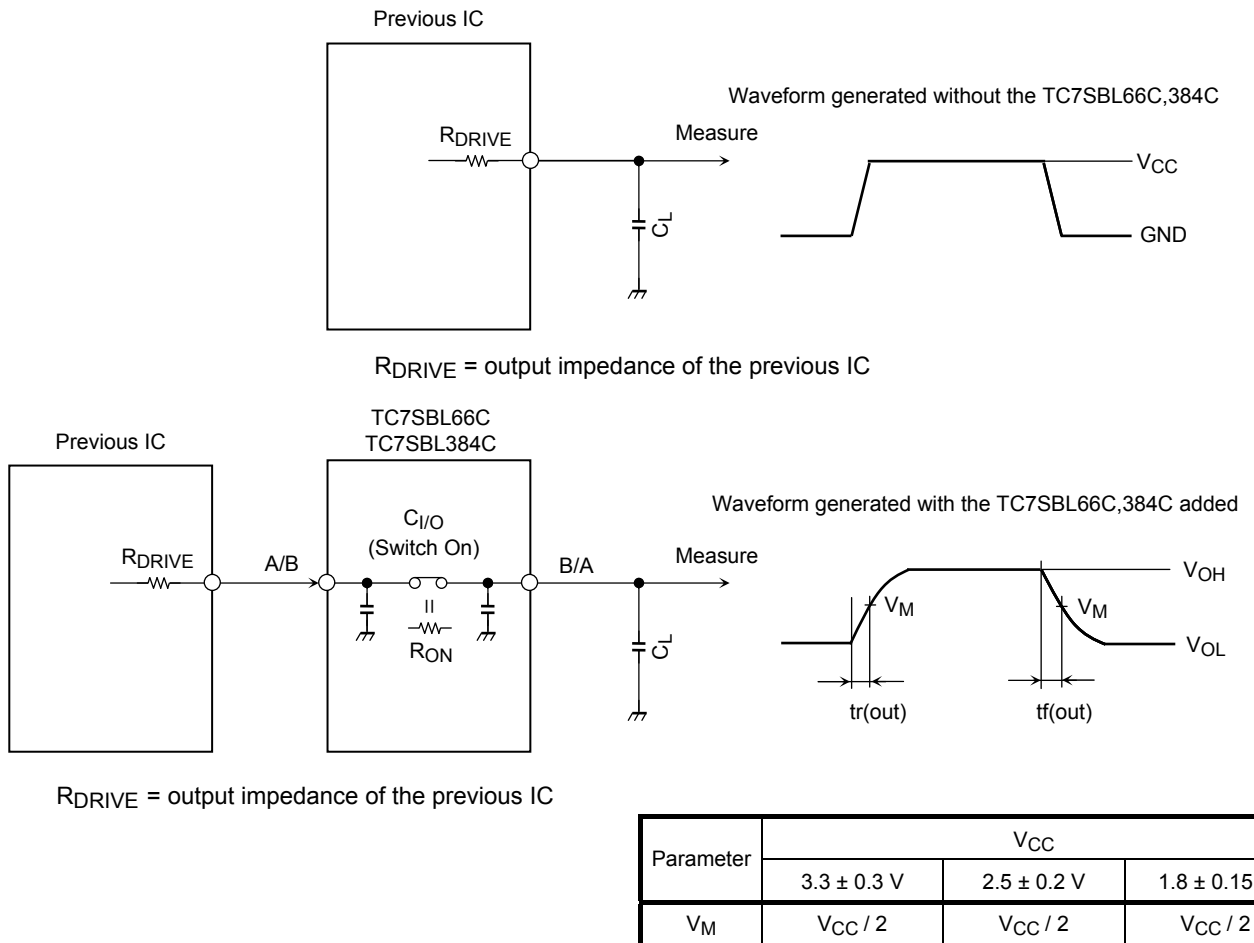
where, R<sub>DRIVE</sub> is the output impedance of the previous-stage circuit.

Calculation example:

$$tr(out) \text{ (approx)} = -(7 + 15) \times 10^{-12} \cdot (120 + 5.5) \cdot \ln \left( \frac{(3.0 - 0) - 1.5}{(3.0 - 0)} \right) \approx 1.9 \text{ ns}$$

Calculation conditions:

V<sub>CC</sub> = 3.0 V, C<sub>L</sub> = 15 pF, R<sub>DRIVE</sub> = 120 Ω (output impedance of the previous IC), V<sub>M</sub> = 1.5 V (V<sub>CC</sub> / 2)  
 Output voltage of the previous IC = digital (i.e., high-level voltage = V<sub>CC</sub>; low-level voltage = GND)

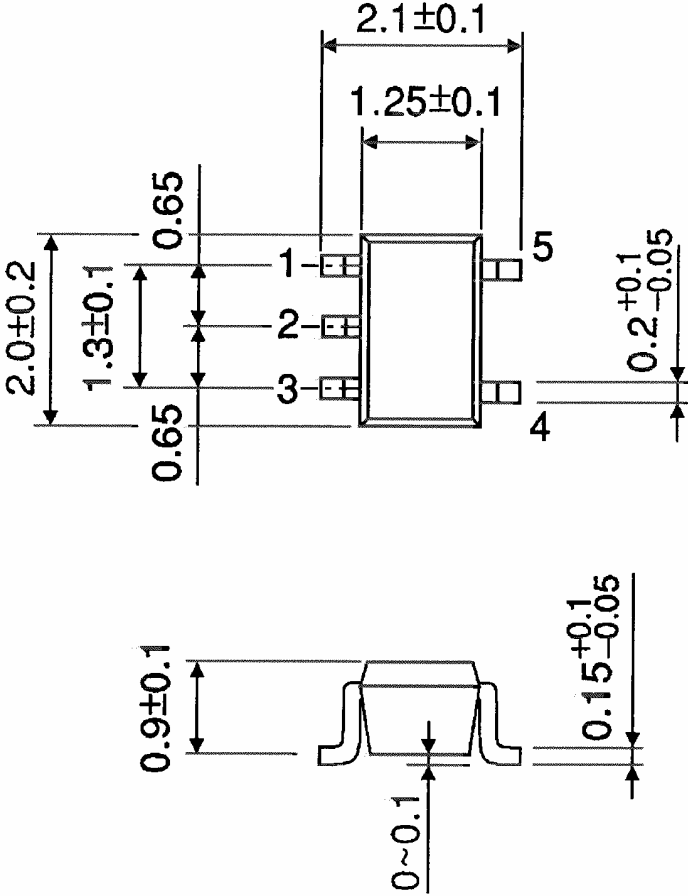


**Figure 3 Test Circuit**

**Package Dimensions**

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)



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