

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7W66FU, TC7W66FK

## Dual Bilateral Switch

The TC7W66 is a high speed CMOS Dual Bilateral Switch fabricated with silicon gate CMOS technology.

It consists of four independent high speed switches capable of controlling either digital or analog signals while maintaining the CMOS low power dissipation.

Control input (C) is provided to control the switch.

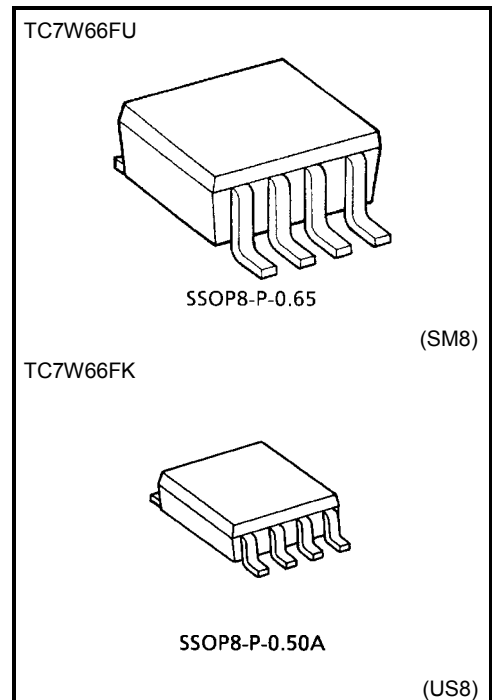
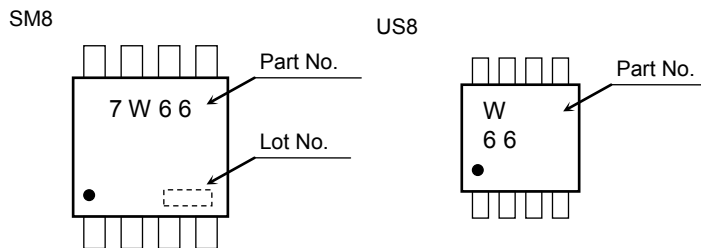
The switch turns ON while the C input is high, and the switch turns OFF while low.

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

### Features

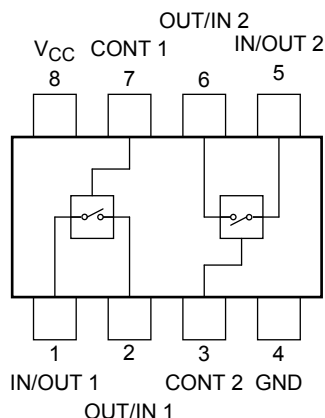
- High speed:  $t_{pd} = 7 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Low ON resistance:  $R_{ON} = 50 \Omega$  (typ.) at  $V_{CC} = 9 \text{ V}$
- High degree of linearity:  $\text{THD} = 0.05\%$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Pin and function compatible with TC4W66

### Marking



Weight  
 SSOP8-P-0.65: 0.02 g (typ.)  
 SSOP8-P-0.50A: 0.01 g (typ.)

### Pin Configuration (top view)



Start of commercial production  
 1996-02

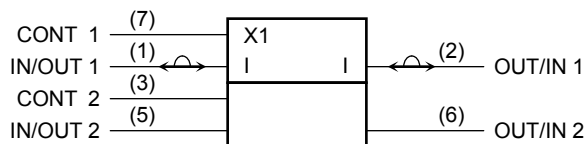
## Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V <sub>CC</sub>	-0.5 to 13	V
DC input voltage	V <sub>IN</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
DC output voltage	V <sub>OUT</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Input diode current	I <sub>IK</sub>	±20	mA
Output diode current	I <sub>OK</sub>	±20	mA
DC output current	I <sub>OUT</sub>	±25	mA
DC V <sub>CC</sub> /ground current	I <sub>CC</sub>	±25	mA
Power dissipation	P <sub>D</sub>	300 (SM8)	mW
		200 (US8)	
Storage temperature range	T <sub>stg</sub>	-65 to 150	°C
Lead temperature (10 s)	T <sub>L</sub>	260	°C

Note: 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).

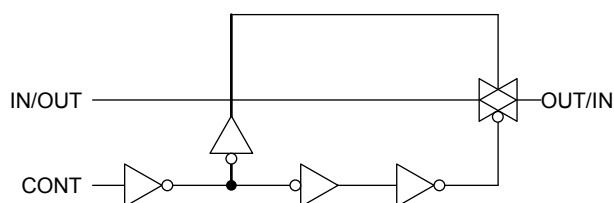
## Logic Diagram



## Truth Table

Control	Switch Function
H	ON
L	OFF

## Logic Diagram (1/2 TC7W66)



## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2 to 12	V
Control input voltage	$V_{IN}$	0 to $V_{CC}$	V
Switch I/O voltage	$V_{I/O}$	0 to $V_{CC}$	V
Operating temperature range	$T_{opr}$	-40 to 85	°C
Input rise and fall time	$t_r, t_f$	0 to 1000 ( $V_{CC} = 2.0$ V)	ns
		0 to 500 ( $V_{CC} = 4.5$ V)	
		0 to 400 ( $V_{CC} = 6.0$ V)	
		0 to 250 ( $V_{CC} = 10.0$ V)	

## Electrical Characteristics

### DC Electrical Characteristics

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40$ to $85^\circ\text{C}$		Unit		
			$V_{CC}$ (V)	Min	Typ.	Max	Min		Max	
Control input voltage	High level	$V_{IHC}$	—	2.0	1.5	—	—	1.5	V	
				4.5	3.15	—	—	3.15		
				9.0	6.3	—	—	6.3		
				12.0	8.4	—	—	8.4		
	Low level	$V_{ILC}$	—	2.0	—	—	0.5	—		0.5
				4.5	—	—	1.35	—		1.35
				9.0	—	—	2.7	—		2.7
				12.0	—	—	3.6	—		3.6
ON resistance	$R_{ON}$	$V_{IN} = V_{IHC}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1$ mA	4.5	—	96	170	—	200	$\Omega$	
			9.0	—	55	85	—	100		
			12.0	—	45	80	—	90		
		$V_{IN} = V_{IHC}$ $V_{I/O} = V_{CC}$ or GND $I_{I/O} \leq 1$ mA	2.0	—	160	—	—	—		
			4.5	—	70	100	—	130		
			9.0	—	50	75	—	95		
	Difference of ON resistance between switches	$\Delta R_{ON}$	$V_{IN} = V_{IHC}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1$ mA	4.5	—	10	—	—		—
				9.0	—	5	—	—		—
12.0				—	5	—	—	—		
Input/output leakage current (switch off)	$I_{OFF}$	$V_{OS} = V_{CC}$ or GND $V_{IS} = \text{GND}$ or $V_{CC}$ $V_{IN} = V_{ILC}$	12.0	—	—	$\pm 100$	—	$\pm 1000$	nA	
Switch input leakage current (switch on output open)	$I_{IZ}$	$V_{OS} = V_{CC}$ or GND $V_{IN} = V_{IHC}$	12.0	—	—	$\pm 100$	—	$\pm 1000$	nA	
Control input current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	12.0	—	—	$\pm 100$	—	$\pm 1000$	nA	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	1.0	—	10.0	$\mu\text{A}$	
			9.0	—	—	4.0	—	40.0		
			12.0	—	—	8.0	—	80.0		

## AC Electrical Characteristics ( $C_L = 50 \text{ pF}$ , input $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Phase difference between input and output	$\phi_{I/O}$	—	2.0	—	10	50	—	65	ns
			4.5	—	4	10	—	13	
			9.0	—	3	8	—	10	
			12.0	—	3	7	—	9	
Output enable time	$t_{pZL}$ $t_{pZH}$	$R_L = 1 \text{ k}\Omega$	2.0	—	18	100	—	125	ns
			4.5	—	8	20	—	25	
			9.0	—	6	12	—	22	
			12.0	—	6	12	—	18	
Output disable time	$t_{pLZ}$ $t_{pHZ}$	$R_L = 1 \text{ k}\Omega$	2.0	—	20	115	—	145	ns
			4.5	—	10	23	—	29	
			9.0	—	8	20	—	25	
			12.0	—	8	18	—	22	
Maximum control input frequency	—	$R_L = 1 \text{ k}\Omega$ $C_L = 15 \text{ pF}$ $V_{OUT} = 1/2 V_{CC}$	2.0	—	30	—	—	—	MHz
			4.5	—	30	—	—	—	
			9.0	—	30	—	—	—	
			12.0	—	30	—	—	—	
Control input capacitance	$C_{IN}$	—	—	5	10	—	10	pF	
Switch terminal capacitance	$C_{I/O}$	—	—	6	—	—	—	pF	
Feed through capacitance	$C_{IOS}$	—	—	0.5	—	—	—	pF	
Power dissipation capacitance	$C_{PD}$	(Note)	—	15	—	—	—	pF	

Note:  $C_{PD}$  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:

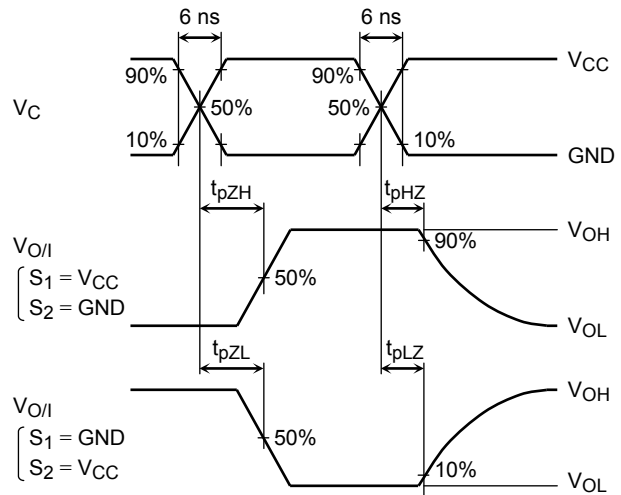
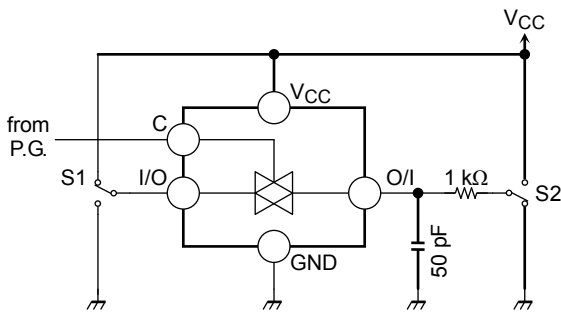
$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$$

## Analog Switch Characteristics (GND = 0 V, Ta = 25°C)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Sine wave distortion (T.H.D)	—	$f_{IN} = 1 \text{ kHz}$ , $V_{IN} = 4.0 \text{ V}_{p-p}$ @ $V_{CC} = 4.5 \text{ V}$ $R_L = 10 \text{ k}\Omega$ , $V_{IN} = 8.0 \text{ V}_{p-p}$ @ $V_{CC} = 9.0 \text{ V}$ $C_L = 50 \text{ pF}$	4.5	0.05	%
			9.0	0.04	
Frequency response (switch ON)	$f_{MAX}$	Adjust $V_{IN}$ voltage to obtain 0dBm at $V_{OS}$ Increase $f_{IN}$ frequency until dB Meter reads -3dB $R_L = 50 \Omega$ , $C_L = 10 \text{ pF}$ $f_{IN} = 1 \text{ MHz}$ , sine wave	4.5	200	MHz
			9.0	200	
Feed Through attenuation (switch OFF)	—	$V_{IN}$ is centered at $V_{CC}/2$ Adjust input for 0dBm $R_L = 600 \Omega$ , $C_L = 50 \text{ pF}$ $f_{IN} = 1 \text{ MHz}$ , sine wave	4.5	-60	dB
			9.0	-60	
Crosstalk (control input to signal output)	—	$R_L = 600 \Omega$ , $C_L = 50 \text{ pF}$ $f_{IN} = 1 \text{ MHz}$ , square wave ( $t_r = t_f = 6 \text{ ns}$ )	4.5	60	mV
			9.0	100	
Crosstalk (between any switches)	—	Adjust $V_{IN}$ to obtain 0dBm at input $R_L = 600 \Omega$ , $C_L = 50 \text{ pF}$ $f_{IN} = 1 \text{ MHz}$ , sine wave	4.5	-60	dB
			9.0	-60	

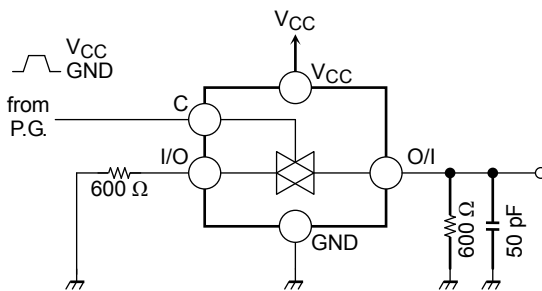
## Switching Characteristics Test Circuits

### 1. $t_{pLZ}$ , $t_{pHZ}$ , $t_{pZL}$ , $t_{pZH}$

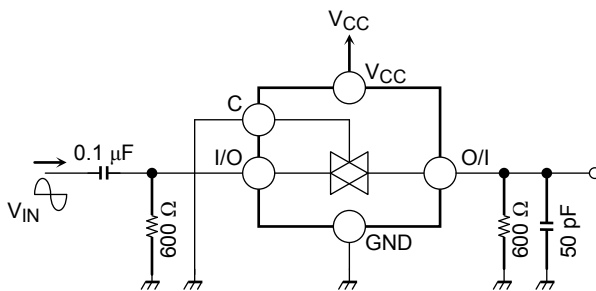


### 2. Cross Talk (control input-switch output)

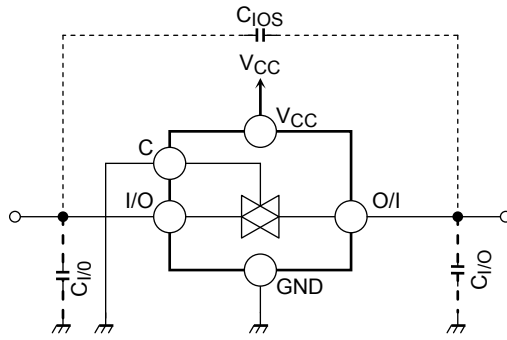
$f_{IN} = 1 \text{ MHz}$ , duty = 50%,  $t_r = t_f = 6 \text{ ns}$



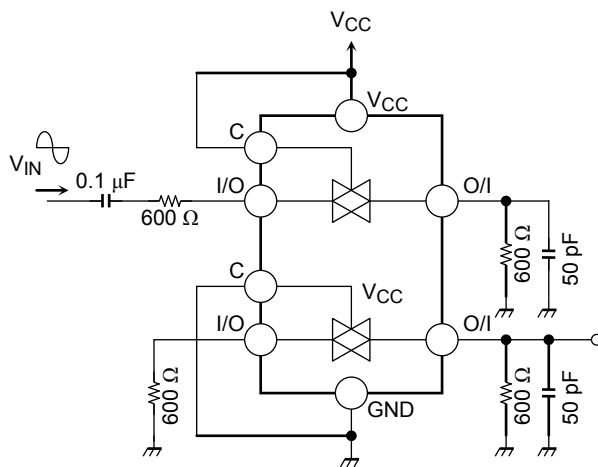
### 3. Feed Through Attenuation



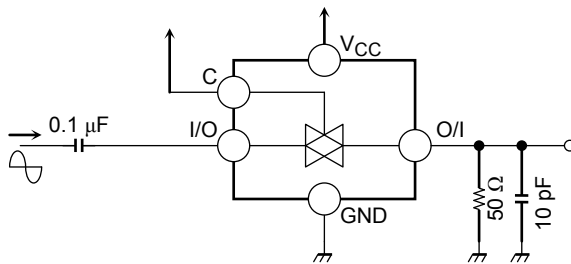
**4. C<sub>I/O</sub>, C<sub>I/O</sub>**



**5. Cross Talk (between any two switches)**



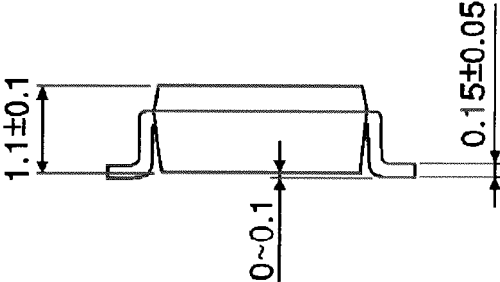
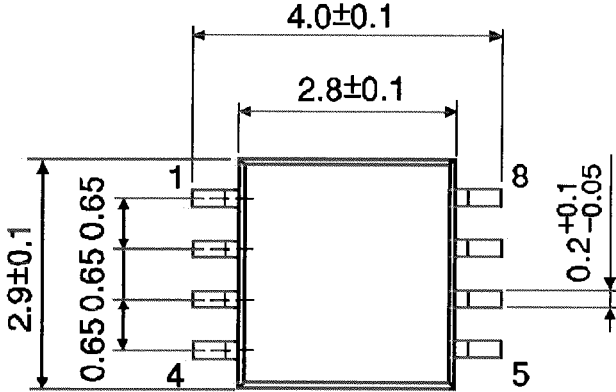
**6. Frequency Response (switch ON)**



**Package Dimensions**

SSOP8-P-0.65

Unit : mm

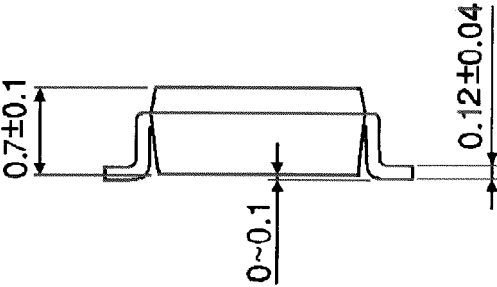
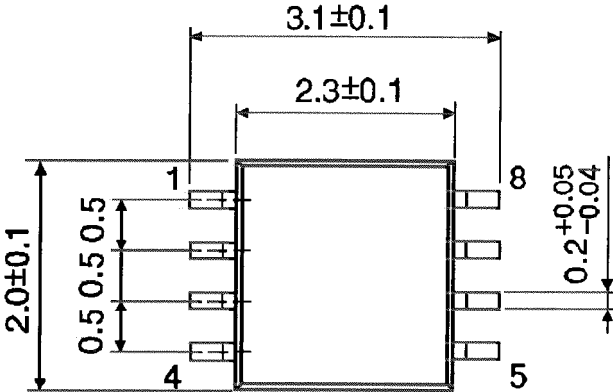


Weight: 0.02 g (typ.)

**Package Dimensions**

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)



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