

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7S66F, TC7S66FU

## Bilateral Switch

The TC7S66 is a high Speed C<sup>2</sup>MOS Bilateral Switch fabricated with silicon gate C<sup>2</sup>MOS technology.

It consists of a high speed switch capable of controlling either digital or analog signals while maintaining the C<sup>2</sup>MOS low power dissipation.

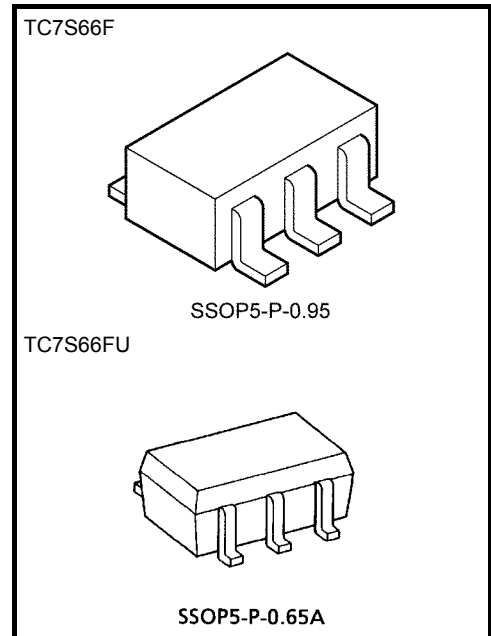
Control input (C) is provided to control the switch.

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

Input is equipped with protection circuits against static discharge or transient excess voltage.

## Features

- High speed:  $t_{pd} = 7 \text{ ns (typ.) @} V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A (max) @} T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Low ON resistance:  $R_{ON} = 100 \Omega \text{ (typ.) @} V_{CC} = 9 \text{ V}$
- Low T.H.D:  $\text{THD} = 0.05\% \text{ (typ.) @} V_{CC} = 5 \text{ V}$
- Pin and function compatible with TC4S66F



Weight  
 SSOP5-P-0.95 : 0.016 g (typ.)  
 SSOP5-P-0.65A : 0.006 g (typ.)

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

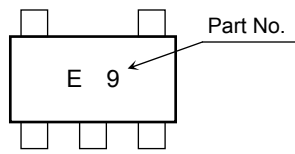
Characteristics	Symbol	Rating	Unit
DC Supply voltage	$V_{CC}$	-0.5 to 13	V
Control input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
Switch I/O voltage	$V_{I/O}$	-0.5 to $V_{CC} + 0.5$	V
Control diode current	$I_{CK}$	$\pm 20$	mA
I/O diode current	$I_{I/OK}$	$\pm 20$	mA
Through I/O current	$I_T$	$\pm 12.5$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 25$	mA
Power dissipation	$P_D$	200	mW
Storage temperature range	$T_{stg}$	-65 to 150	°C
Lead temperature (10 s)	$T_L$	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.

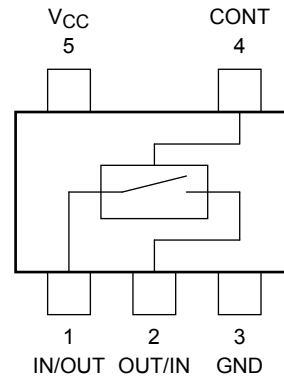
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Start of commercial production  
 1991-06

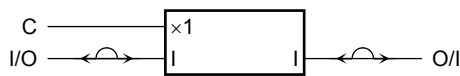
**Marking**



**Pin Configuration (top view)**



**Logic Diagram**



**Truth Table**

Control	Switch Function
H	ON
L	OFF

**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	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to 85°C		Unit
					Min	Typ.	Max	Min	Max	
Control input voltage	High level	V <sub>IHC</sub>	—	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 <sub>ILC</sub>	—	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 <sub>ON</sub>	V <sub>IN</sub> = V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to GND I <sub>I/O</sub> ≤ 1 mA	4.5	—	192	340	—	400	Ω	
			9.0	—	110	170	—	200		
			12.0	—	90	160	—	180		
			V <sub>IN</sub> = V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> or GND I <sub>I/O</sub> ≤ 1 mA	2.0	—	320	—	—		—
				4.5	—	140	200	—		260
				9.0	—	100	150	—		190
		12.0	—	90	140	—	180			
		Input/output leakage current (switch off)	I <sub>OFF</sub>	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IS</sub> = GND or V <sub>CC</sub> V <sub>IN</sub> = V <sub>ILC</sub>	12.0	—	—	±100		—
Switch input leakage current (switch on, output open)	I <sub>IZ</sub>	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IN</sub> = V <sub>IHC</sub>	12.0	—	—	±100	—	±1000	nA	
Control input current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	12.0	—	—	±100	—	±1000	nA	
Quiescent device current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	6.0	—	—	1.0	—	10.0	μA	
			9.0	—	—	4.0	—	40.0		
			12.0	—	—	8.0	—	80.0		

## AC Electrical Characteristics (C<sub>L</sub> = 50 pF, input t<sub>r</sub> = t<sub>f</sub> = 6 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	φ <sub>I-O</sub>	—	2.0	—	20	75	—	100	ns
			4.5	—	7	15	—	20	
			9.0	—	4	12	—	15	
			12.0	—	4	11	—	14	
Output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	R <sub>L</sub> = 1 kΩ	2.0	—	20	150	—	190	ns
			4.5	—	13	30	—	38	
			9.0	—	9	18	—	33	
			12.0	—	8	18	—	27	
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	R <sub>L</sub> = 1 kΩ	2.0	—	40	170	—	220	ns
			4.5	—	11	35	—	44	
			9.0	—	10	30	—	38	
			12.0	—	9	27	—	33	
Maximum control input frequency	—	R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 15 pF V <sub>OUT</sub> = 1/2 V <sub>CC</sub>	2.0	—	30	—	—	—	MHz
			4.5	—	30	—	—	—	
			9.0	—	30	—	—	—	
			12.0	—	30	—	—	—	
Control input capacitance	C <sub>IN</sub>	—	—	5	10	—	10	pF	
Switch terminal capacitance	C <sub>I/O</sub>	—	—	6	—	—	—	pF	
Feedthrough capacitance	C <sub>IOS</sub>	—	—	0.5	—	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note)	—	15	—	—	—	pF	

Note: C<sub>PD</sub> 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:

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

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

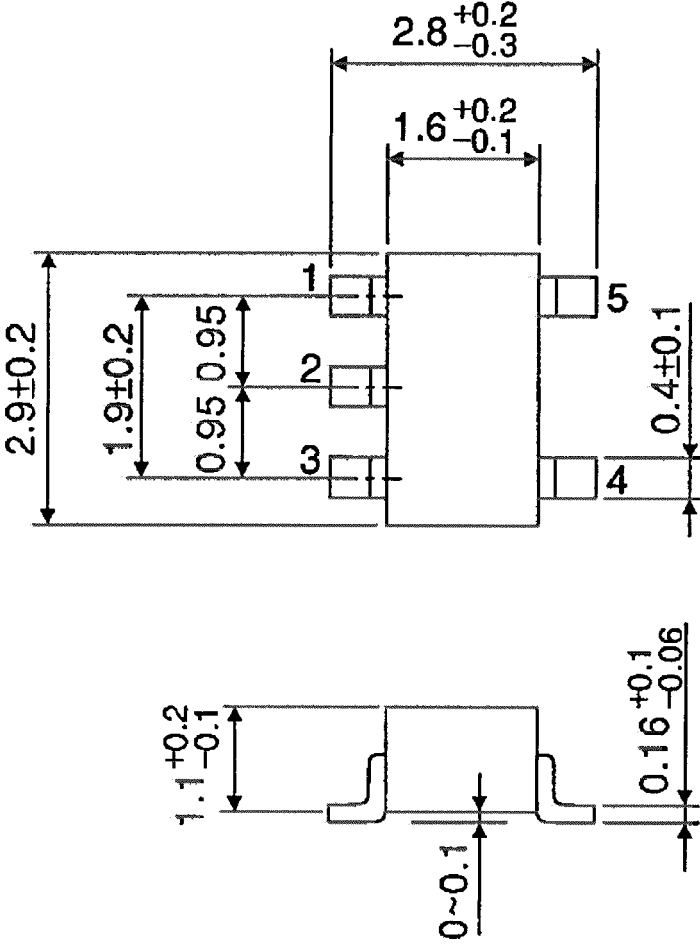
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Total harmonic distortion (T.H.D)	—	f <sub>IN</sub> = 1 kHz, V <sub>IN</sub> = 4 V <sub>p-p</sub> (V <sub>CC</sub> = 4.5 V) R <sub>L</sub> = 10 kΩ, V <sub>IN</sub> = 8 V <sub>p-p</sub> (V <sub>CC</sub> = 9.0 V) C <sub>L</sub> = 50 pF	4.5	0.05	%
			9.0	0.04	
Maximum propagation frequency (switch on)	f <sub>MAX</sub>	Adjust f <sub>IN</sub> voltage to obtain 0dBm at V <sub>OS</sub> increase f <sub>IN</sub> frequency until dB meter reads -3dB. R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF f <sub>IN</sub> = 1 MHz, Sine wave	4.5	200	MHz
			9.0	200	
Feedthrough (switch on)	—	V <sub>IN</sub> is centered at V <sub>CC</sub> /2 adjust input for 0dBm R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 MHz, Sine wave	4.5	-60	dB
			9.0	-60	
Crosstalk (control switch)	—	R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 MHz, Pulse (t <sub>r</sub> = t <sub>f</sub> = 6 ns)	4.5	60	mV
			9.0	100	

Note: These characteristics are determined by design of devices.

**Package Dimensions**

SSOP5-P-0.95

Unit : mm

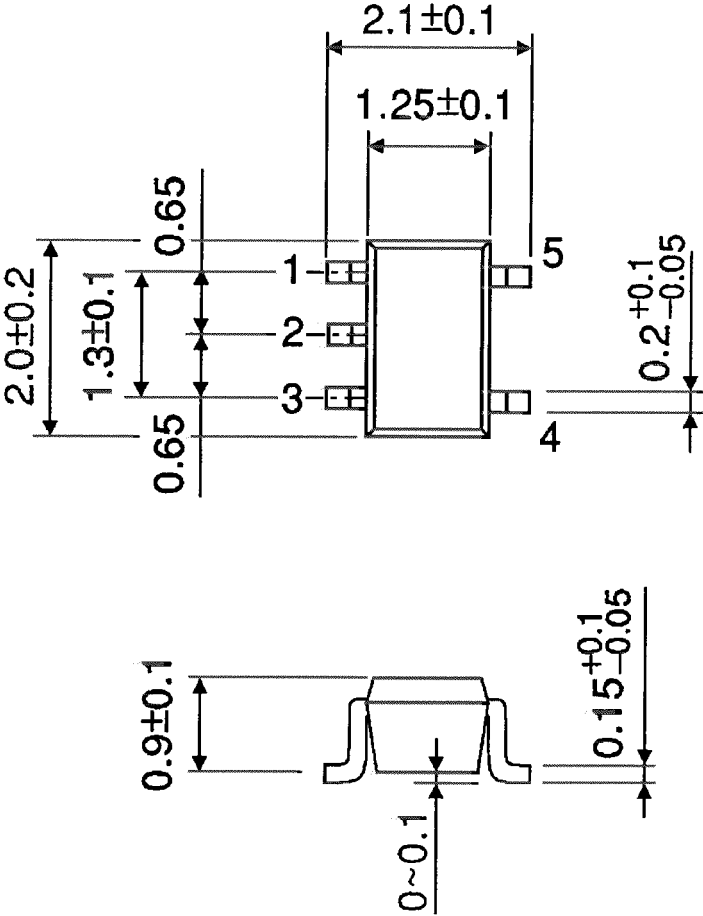


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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