

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7W53FU, TC7W53FK

## 2-Channel Multiplexer/Demultiplexer

The TC7W53 is a high speed C<sup>2</sup>MOS Analog Multiplexer/Demultiplexer fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the C<sup>2</sup>MOS low power dissipation.

The TC7W53 has a 2 channel configuration.

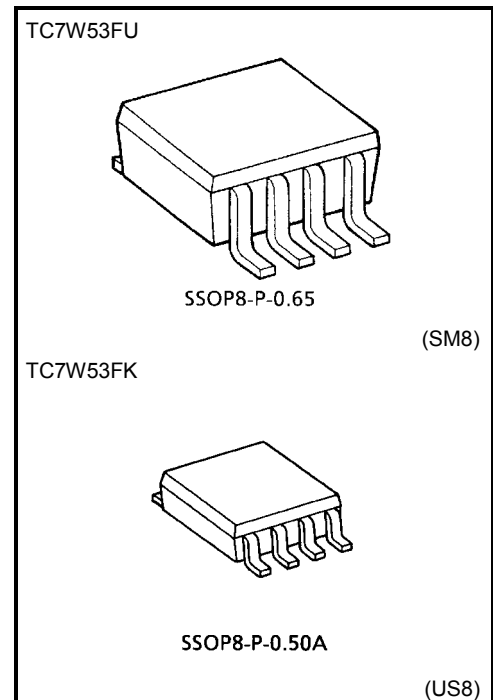
The digital signal to the control terminal turns "ON" the corresponding switch of each channel a large amplitude signal (VCC – VEE) can then be switched by the small logical amplitude (VCC – GND) control signal.

For example, in the case of VCC = 5 V, GND = 0 V, VEE = –5 V, signals between –5 V and +5 V can be switched from the logical circuit with a signal power supply of 5 V. As the ON-resistance of each switch is low, they can be connected to circuit with low input impedance.

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

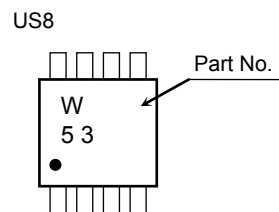
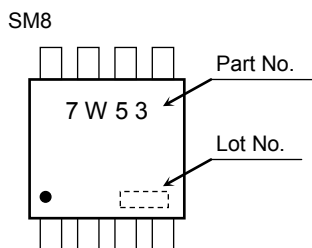
### Features

- High speed: t<sub>pd</sub> = 15 ns (typ.) at VCC = 5 V, VEE = 0 V
- Low power dissipation: I<sub>CC</sub> = 4 μA (max) at Ta = 25°C
- High noise immunity: V<sub>NIH</sub> = V<sub>NIL</sub> = 28% VCC (min)
- Low ON resistance: R<sub>ON</sub> = 50 Ω (typ.) at VCC–VEE = 9 V
- High degree of linearity: THD = 0.02% (typ.) at VCC–VEE = 9 V
- Pin and function compatible with TC4W53



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

### Marking



Start of commercial production  
 1997-12

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

Characteristics	Symbol	Rating	Unit
Supply voltage range	V <sub>CC</sub>	-0.5 to 7	V
	V <sub>CC</sub> - V <sub>EE</sub>	-0.5 to 13	
Control input voltage	V <sub>IN</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Switch I/O voltage	V <sub>I/O</sub>	V <sub>EE</sub> - 0.5 to V <sub>CC</sub> + 0.5	V
Control input diode current	I <sub>CK</sub>	±20	mA
I/O diode current	I <sub>I/O</sub>	±20	mA
Switch through current	I <sub>T</sub>	±25	mA
DC V <sub>CC</sub> /GND 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.

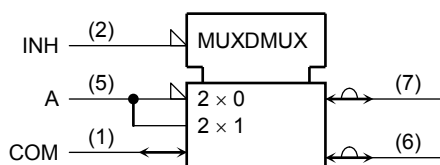
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## Truth Table

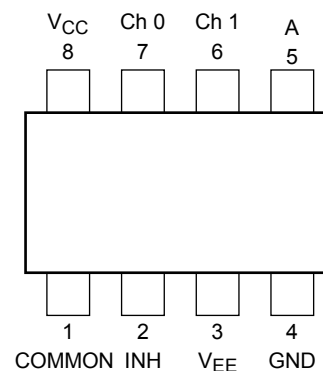
Control Input		On Channel
INH	A	
L	L	Ch 0
L	H	Ch 1
H	X	None

X: Don't care

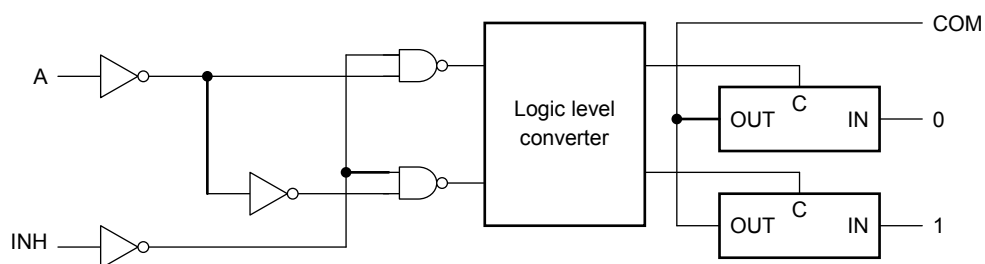
## Logic Symbol



## Pin Assignment (top view)



## Logic Diagram



## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2 to 6	V
	$V_{EE}$	-6 to 0	
	$V_{CC} - V_{EE}$	2 to 12	
Control input voltage	$V_{IN}$	0 to $V_{CC}$	V
Switch I/O voltage	$V_{I/O}$	$V_{EE}$ 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)	

## Electrical Characteristics

### DC Electrical Characteristics

Characteristics		Symbol	Test Condition	Ta = 25°C					Ta = -40 to 85°C		Unit
				V <sub>EE</sub> (V)	V <sub>CC</sub> (V)	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	—	
				—	6.0	4.2	—	—	4.2	—	
	Low level	V <sub>ILC</sub>	—	—	2.0	—	—	0.5	—	0.5	
				—	4.5	—	—	1.35	—	1.35	
				—	6.0	—	—	1.8	—	1.8	
ON resistance	R <sub>ON</sub>	V <sub>IN</sub> = V <sub>ILC</sub> or V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub> I <sub>I/O</sub> ≤ 2 mA	GND	4.5	—	85	180	—	225	Ω	
			-4.5	4.5	—	55	120	—	150		
			-6.0	6.0	—	50	100	—	125		
			GND	2.0	—	150	—	—	—		
			GND	4.5	—	70	150	—	190		
			-4.5	4.5	—	50	100	—	125		
Difference of ON resistance between switches	ΔR <sub>ON</sub>	V <sub>IN</sub> = V <sub>ILC</sub> or V <sub>IHC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub> I <sub>I/O</sub> ≤ 2 mA	GND	4.5	—	10	30	—	35	Ω	
			-4.5	4.5	—	5	12	—	15		
			-6.0	6.0	—	5	10	—	12		
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 to V <sub>CC</sub> V <sub>IN</sub> = V <sub>ILC</sub> or V <sub>IHC</sub>	GND	6.0	—	—	±60	—	±600	nA	
			-6.0	6.0	—	—	±100	—	±1000		
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>ILC</sub> or V <sub>IHC</sub>	GND	6.0	—	—	±60	—	±600	nA	
			-6.0	6.0	—	—	±100	—	±1000		
Control input current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	GND	6.0	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	GND	6.0	—	—	4	—	40	μA	
			-6.0	6.0	—	—	8	—	80		

## AC Electrical Characteristics ( $C_L = 50 \text{ pF}$ , input $t_r = t_f = 6 \text{ ns}$ , $GND = 0 \text{ V}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V <sub>EE</sub> (V)	V <sub>CC</sub> (V)	Min	Typ.	Max		Min	Max
Phase difference between input and output	$\phi/I/O$	—	GND	2.0	—	25	60	—	75	ns
			GND	4.5	—	6	12	—	15	
			GND	6.0	—	5	10	—	13	
			-4.5	4.5	—	4	—	—	—	
Output enable time	$t_{pZL}$ $t_{pZH}$	$R_L = 1 \text{ k}\Omega$	GND	2.0	—	50	225	—	280	ns
			GND	4.5	—	14	45	—	56	
			GND	6.0	—	12	38	—	48	
			-4.5	4.5	—	14	—	—	—	
Output disable time	$t_{pLZ}$ $t_{pHZ}$	$R_L = 1 \text{ k}\Omega$	GND	2.0	—	95	225	—	280	ns
			GND	4.5	—	30	45	—	56	
			GND	6.0	—	26	38	—	48	
			-4.5	4.5	—	26	—	—	—	
Control input capacitance	$C_{IN}$	—	—	—	—	5	10	—	10	pF
Common terminal capacitance	$C_{IS}$	—	-5.0	5.0	—	11	20	—	20	pF
Switch terminal capacitance	$C_{OS}$	—	-5.0	5.0	—	7	15	—	15	pF
Feed through capacitance	$C_{IOS}$	—	-5.0	5.0	—	0.75	2	—	2	pF
Power dissipation capacitance	$C_{PD}$	(Note)	GND	5.0	—	67	—	—	—	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:  $I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$

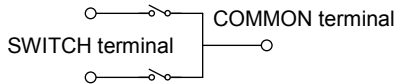
**Analog Switch Characteristics (GND = 0 V, Ta = 25°C)**

Characteristics	Symbol	Test Condition	V <sub>EE</sub> (V)		V <sub>CC</sub> (V)		Typ.	Unit
Sine wave distortion (T.H.D)	—	R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 kHz	V <sub>IN</sub> = 4.0 Vp-p	-2.25	-2.25	0.025	%	
			V <sub>IN</sub> = 8.0 Vp-p	-4.5	4.5	0.02		
			V <sub>IN</sub> = 11 Vp-p	-6.0	6.0	0.018		
Frequency response (switch ON)	t <sub>MAX</sub>	Adjust V <sub>IN</sub> voltage to obtain 0dBm at V <sub>OS</sub> Increase F <sub>IN</sub> 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	(Note1)	-2.25	-2.5	120	MHz	
			(Note2)			95		
			(Note1)	-4.5	4.5	190		
			(Note2)			150		
			(Note1)	-6.0	6.0	200		
			(Note2)			190		
Feed Through attenuation (switch OFF)	—	V <sub>IN</sub> is centered at (V <sub>CC</sub> -V <sub>EE</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	-2.25	2.25	-50	dB		
			-4.5	-4.5	-50			
			-6.0	6.0	-50			
Crosstalk (control input to signal output)	—	R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 MHz, square wave (t <sub>r</sub> = t <sub>f</sub> = 6 ns)	-2.25	2.25	60	mV		
			-4.5	-4.5	140			
			-6.0	6.0	200			
Crosstalk (between any switches)	—	Adjust V <sub>IN</sub> to obtain 0dBm at input R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 MHz, sine wave	2.25	2.25	-50	dB		
			-4.5	-4.5	-50			
			6.0	6.0	-50			

Note: These characteristics are determined by design of device.

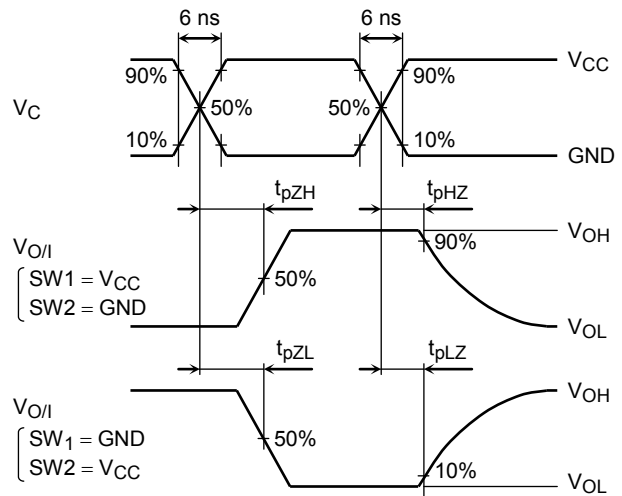
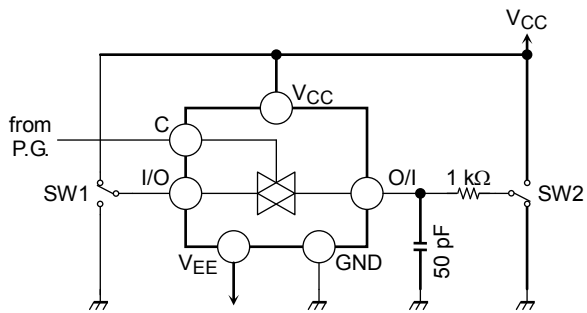
Note 1: Input COMMON terminal, and measure at SWITCH terminal.

Note 2: Input SWITCH terminal, and measure at COMMON terminal.



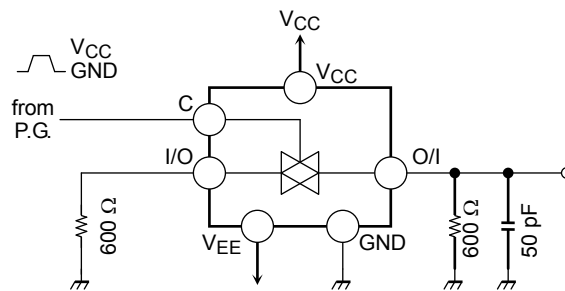
## Switching Characteristics Test Circuits

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

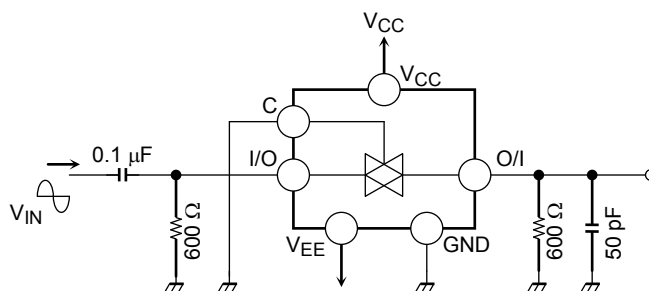


### 2. Cross Talk (control input-switch output)

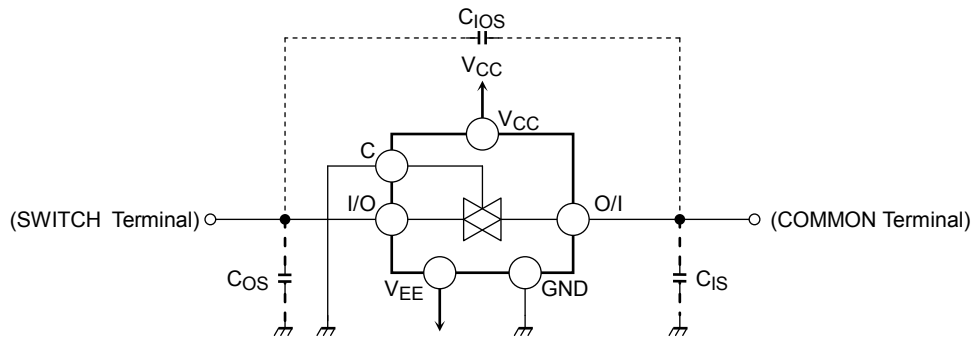
$f_{IN} = 1 \text{ MHz}$ , duty = 50% and  $t_r = t_f = 6 \text{ ns}$



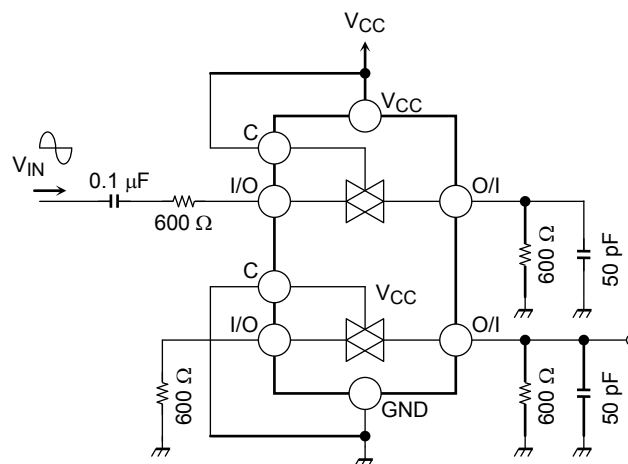
### 3. Feed Through Attenuation



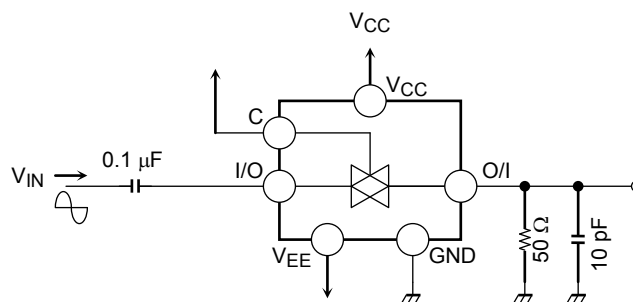
**4.  $C_{Ios}$ ,  $C_{Is}$ ,  $C_{Os}$**



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



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

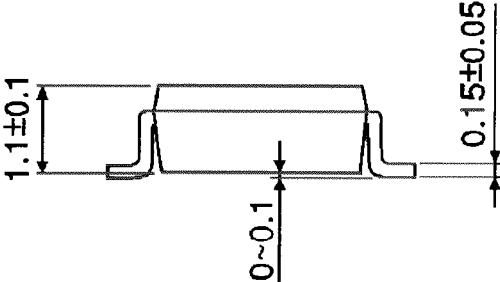
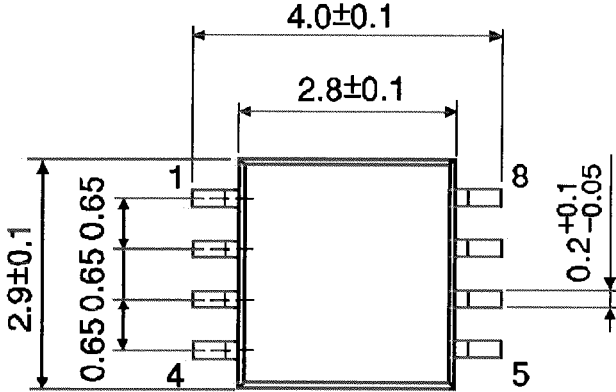




**Package Dimensions**

SSOP8-P-0.65

Unit : mm

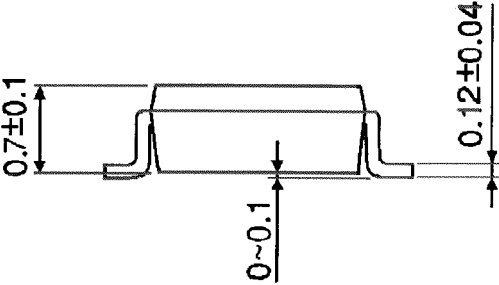
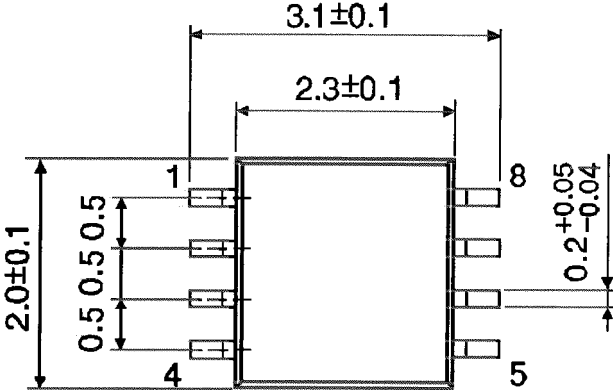


Weight: 0.02 g (typ.)

**Package Dimensions**

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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