TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7W53FU, TC7W53FK

1. Functional Description

2-Channel Multiplexer/Demultiplexer

2. General

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

It achieves the high speed operation similar to equivalent LSTTL while maintaining the C^2MOS low power dissipation.

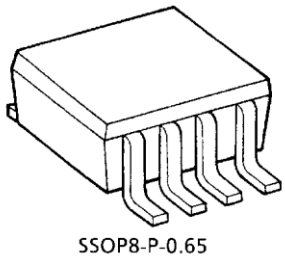
The TC7W53 has a 2 channel configuration.

The digital signal to the control terminal turns “ON” the corresponding switch of each channel a large amplitude signal (V_{CC} – V_{EE}) can then be switched by the small logical amplitude (V_{CC} – GND) control signal.

For example, in the case of V_{CC} = 5 V, GND = 0 V, V_{EE} = –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.

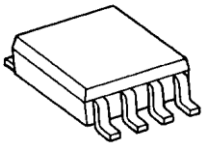
TC7W53FU



SSOP8-P-0.65

(SM8)

TC7W53FK



SSOP8-P-0.50A

(US8)

Weight

SSOP8-P-0.65: 0.02 g (typ.)

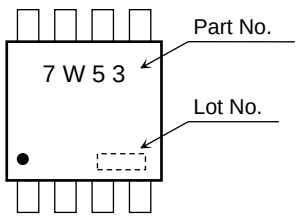
SSOP8-P-0.50A: 0.01 g (typ.)

3. Features

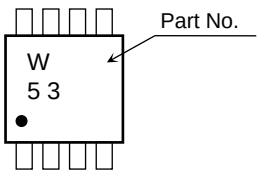
- High speed: t_{pd} = 15 ns (typ.) at V_{CC} = 5 V, V_{EE} = 0 V
- Low power dissipation: I_{CC} = 4 μA (max) at Ta = 25°C
- High noise immunity: V_{NIH} = V_{NIL} = 28 % V_{CC} (min)
- Low ON resistance: R_{ON} = 50 Ω (typ.) at V_{CC}–V_{EE} = 9 V
- High degree of linearity: THD = 0.02 % (typ.) at V_{CC}–V_{EE} = 9 V
- Pin and function compatible with TC4W53

4. Marking

SM8



US8



Start of commercial production

1997-12

5. Absolute Maximum Ratings (Ta = 25°C) (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	−0.5 to 7	V
	$V_{CC} - V_{EE}$	−0.5 to 13	
Control input voltage	V_{IN}	−0.5 to V_{CC} + 0.5	V
Switch I/O voltage	$V_{I/O}$	V_{EE} −0.5 to V_{CC} + 0.5	V
Control input diode current	I_{CK}	±20	mA
I/O diode current	I_{IOK}	±20	mA
Switch through current	I_T	±25	mA
DC V_{CC}/GND current	I_{CC}	±25	mA
Power dissipation	P_D	300 (SM8)	mW
		200 (US8)	
Storage temperature range	T_{stg}	−65 to 150	°C
Lead temperature (10 s)	T_L	260	°C

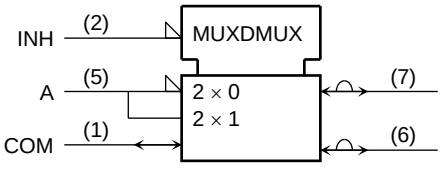
Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease 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).

6. Truth Table

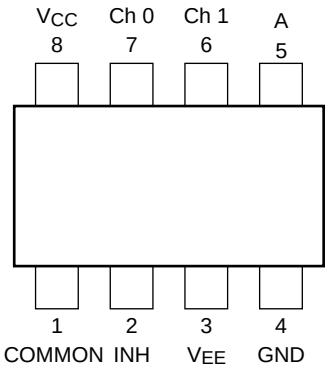
Control Input		On Channel
INH	A	
L	L	Ch 0
L	H	Ch 1
H	X	None

X: Don’t care

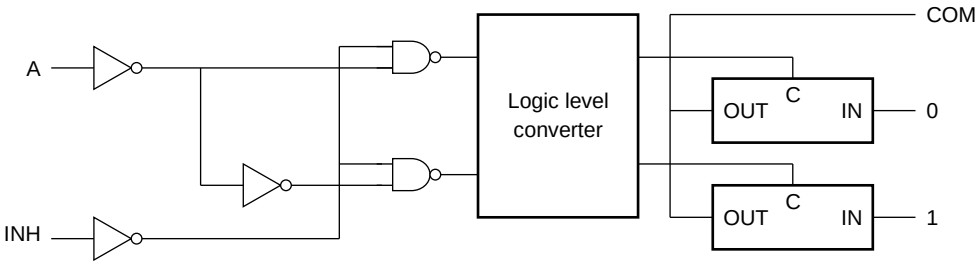
7. Logic Symbol



8. Pin Assignment (top view)



9. Logic Diagram



10. 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)	

11. Electrical Characteristics

DC Electrical Characteristics

Characteristics		Symbol	Test Condition	V_{EE} (V)	V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = –40 to 85°C Min	Ta = –40 to 85°C Max	Unit
Control input voltage	High level	V_{IHC}	—	—	2.0	1.5	—	—	1.5	—	V
				—	4.5	3.15	—	—	3.15	—	
				—	6.0	4.2	—	—	4.2	—	
	Low level	V_{ILC}	—	—	2.0	—	—	0.5	—	0.5	
				—	4.5	—	—	1.35	—	1.35	
				—	6.0	—	—	1.8	—	1.8	
ON resistance		R_{ON}	V_{IN} = V_{ILC} or V_{IHC} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O}$ ≤ 2 mA	GND	4.5	—	85	180	—	225	Ω
				–4.5	4.5	—	55	120	—	150	
				–6.0	6.0	—	50	100	—	125	
			V_{IN} = V_{ILC} or V_{IHC} $V_{I/O}$ = V_{CC} or V_{EE} $I_{I/O}$ ≤ 2 mA	GND	2.0	—	150	—	—	—	
				GND	4.5	—	70	150	—	190	
				–4.5	4.5	—	50	100	—	125	
				–6.0	6.0	—	45	80	—	100	
Difference of ON resistance between switches		ΔR_{ON}	V_{IN} = V_{ILC} or V_{IHC} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O}$ ≤ 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_{OFF}	V_{OS} = V_{CC} or GND V_{IS} = GND to V_{CC} V_{IN} = V_{ILC} or V_{IHC}	GND	6.0	—	—	±60	—	±600	nA
				–6.0	6.0	—	—	±100	—	±1000	
Switch input leakage current (switch on output open)		I_{IZ}	V_{OS} = V_{CC} or GND V_{IN} = V_{ILC} or V_{IHC}	GND	6.0	—	—	±60	—	±600	nA
				–6.0	6.0	—	—	±100	—	±1000	
Control input current		I_{IN}	V_{IN} = V_{CC} or GND	GND	6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND	GND	6.0	—	—	4	—	40	μA
				–6.0	6.0	—	—	8	—	80	

AC Electrical Characteristics (C_L = 50 pF, input $t_r = t_f$ = 6 ns, GND = 0 V)

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = −40 to 85°C		Unit
			V_{EE} (V)	V_{CC} (V)	Min	Typ.	Max	Min	Max	
Phase difference between input and output	ϕI/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 kΩ	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 kΩ	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 1)	GND	5.0	—	67	—	—	—	pF

Note 1: 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: $I_{CC\ (opr)} = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/2$

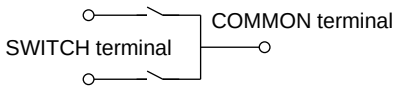
Analog Switch Characteristics (Note) (GND = 0 V, Ta = 25°C)

Characteristics	Symbol	Test Condition		V_{EE} (V)	V_{CC} (V)	Typ.	Unit
Sine wave distortion (T.H.D)	—	R_L = 10 kΩ, C_L = 50 pF f_{IN} = 1 kHz	V_{IN} = 4.0 Vp-p	−2.25	2.25	0.025	%
			V_{IN} = 8.0 Vp-p	−4.5	4.5	0.02	
			V_{IN} = 11 Vp-p	−6.0	6.0	0.018	
Frequency response (switch ON)	t_{MAX}	Adjust V_{IN} voltage to obtain 0 dBm at V_{OS} Increase F_{IN} until dB Meter reads −3 dB R_L = 50 Ω, C_L = 10 pF f_{IN} = 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_{IN} is centered at (V_{CC}−V_{EE})/2. Adjust input for 0 dBm R_L = 600 Ω, C_L = 50 pF f_{IN} = 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_L = 600 Ω, C_L = 50 pF f_{IN} = 1 MHz, square wave (t_r = t_f = 6 ns)		−2.25	2.25	60	mV
				−4.5	4.5	140	
				−6.0	6.0	200	
Crosstalk (between any switches)	—	Adjust V_{IN} to obtain 0 dBm at input R_L = 600 Ω, C_L = 50 pF f_{IN} = 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.

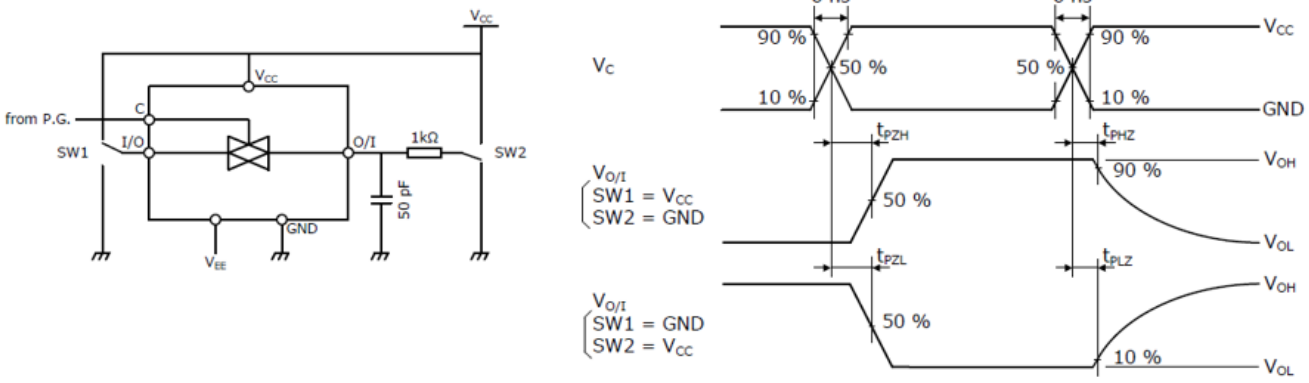
Note 1: Input COMMON terminal, and measure at SWITCH terminal.

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



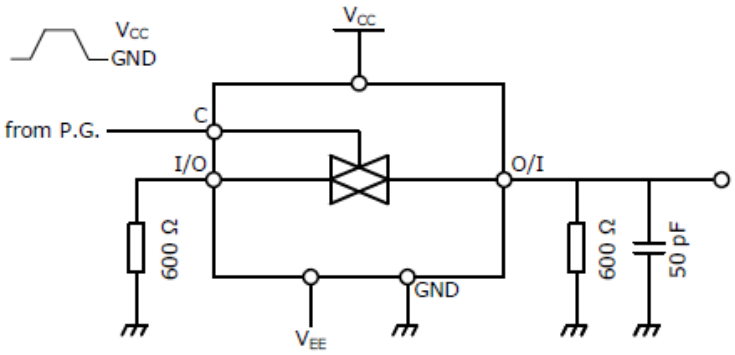
12. Switching Characteristics Test Circuits

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

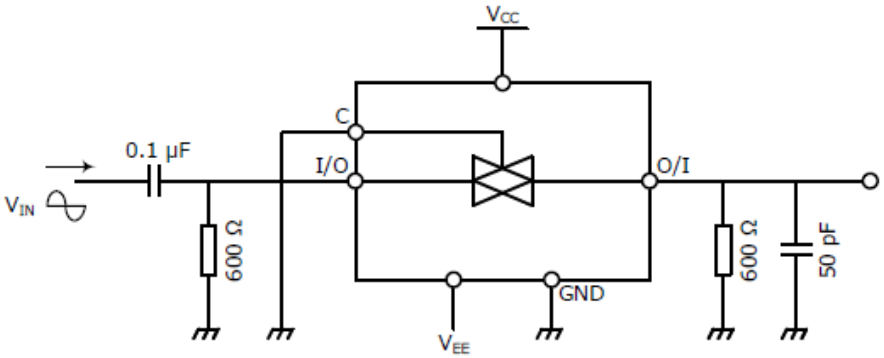


2. Cross Talk (control input-switch output)

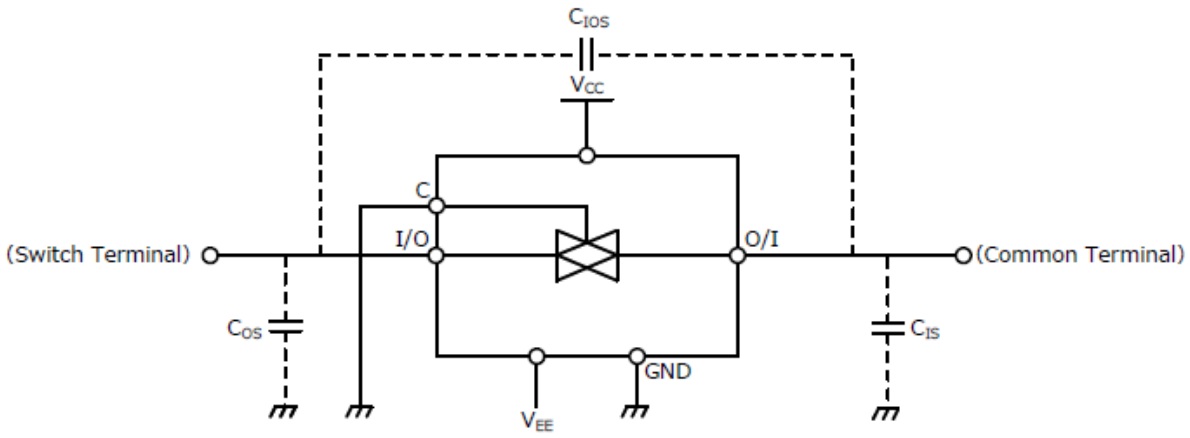
f_{IN} = 1 MHz, duty = 50% and $t_r = t_f$ = 6 ns



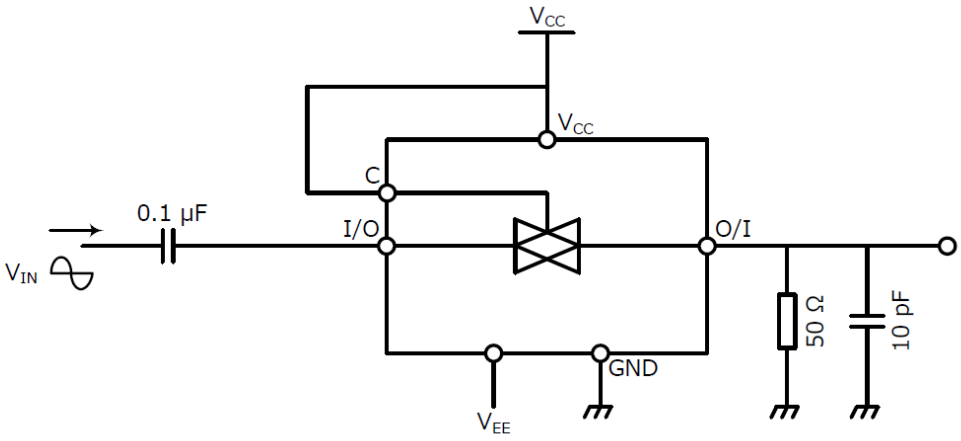
3. Feed Through Attenuation



4. C_{IOS}, C_{IS}, C_{OS}

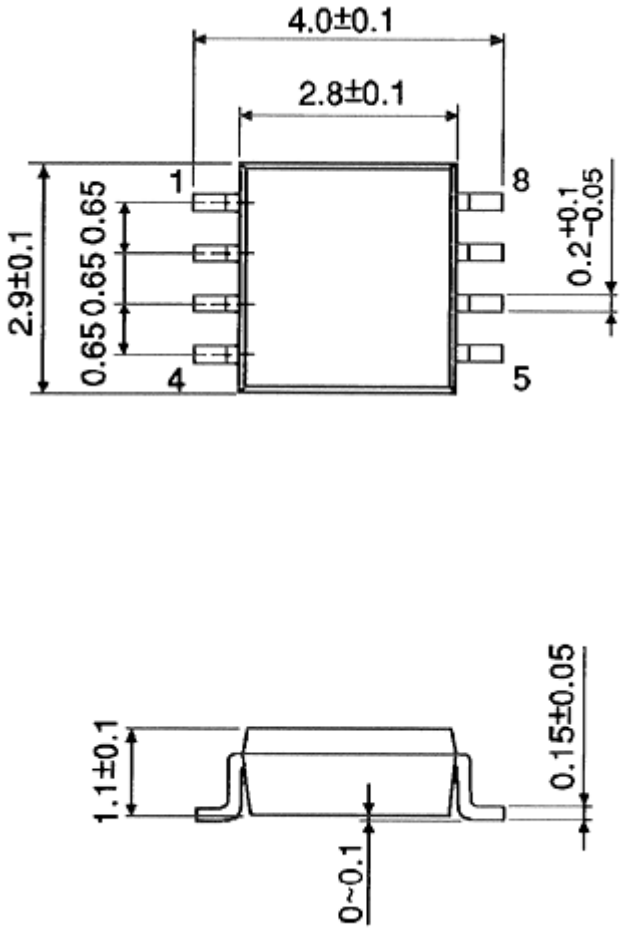


5. Frequency Response (switch ON)



Package Dimensions

SSOP8-P-0.65 Unit : mm

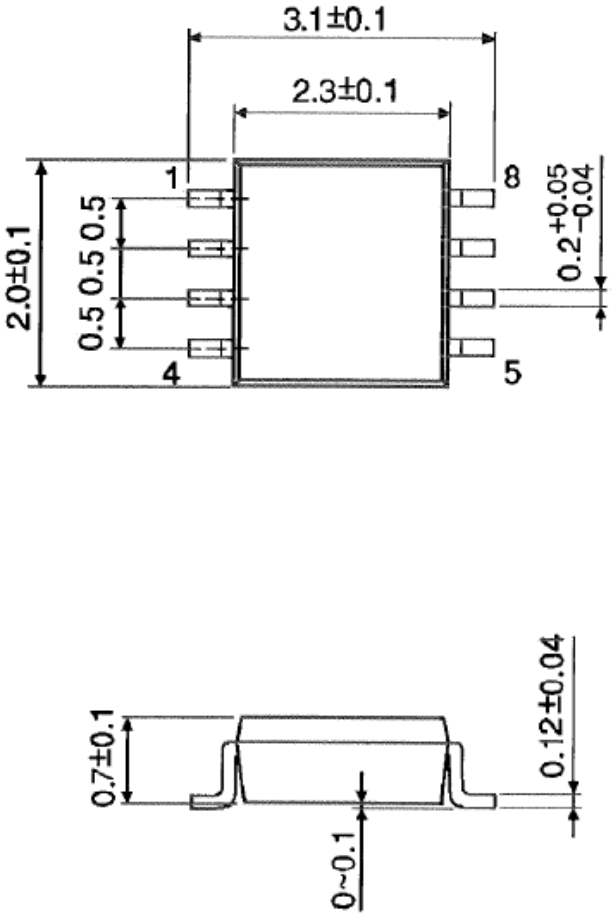


Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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