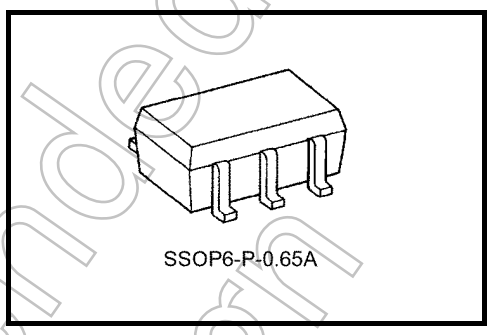
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7PA53FU

2-Channel Multiplexer/Demultiplexer

Features

- Ultra-low on resistance: R_{ON} = 21 Ω (max) at V_{CC} = 3.6 V
- Operating voltage range: $V_{CC\ (opr.)}$ = 1.8 to 3.6 V
- 3.6 V Tolerant inputs



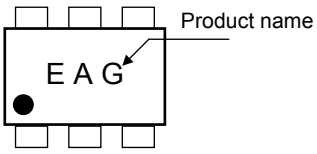
Weight: 0.0068 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

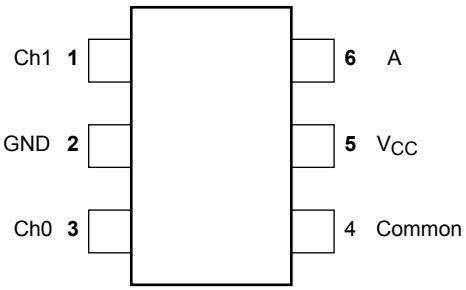
Characteristics		Symbol	Rating	Unit
Supply voltage		V_{CC}	−0.5 to 4.6	V
DC input voltage		V_{IN}	−0.5 to 4.6	V
Switch I/O voltage		V_S	−0.5 to V_{CC} + 0.5	V
Clamp diode current	Control input block	I_{IK}	−50	mA
	Switch block		±50	
Switch through current		I_T	100	mA
Power dissipation		P_D	200	mW
DC V_{CC}/ground current		I_{CC}	±100	mA
Storage temperature		T_{stg}	−65 to 150	°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).

Marking



Pin Assignment (top view)

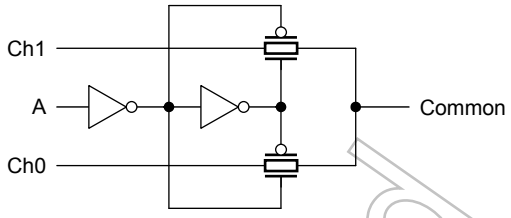


Start of commercial production
2002-01

Truth Table

Input A	On Channel
L	Ch0
H	Ch1

System Diagram



Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	1.8 to 3.6	V
Control input voltage	V_{IN}	0 to 3.6	V
Switch I/O voltage	V_S	0 to V_{CC}	V
Operating temperature	T_{opr}	−40 to 85	°C
Control input rise and fall time	dt/dv	0 to 10	ns/V

Electrical Characteristics

DC Electrical Characteristics (Ta = –40 to 85°C)

Characteristics		Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Input voltage	High level	V_{IH}	—	1.8	V_{CC} × 0.75	—	V
				2.3 to 3.6	V_{CC} × 0.75	—	
	Low level	V_{IL}	—	1.8	—	V_{CC} × 0.25	
				2.3 to 3.6	—	V_{CC} × 0.25	
On resistance $V_{I/O}$ = V_{CC} or GND		R_{ON}	V_{IN} = 0 V, I_O = 24 mA	3.6	—	19	Ω
			V_{IN} = 1.9 V, I_O = –24 mA	3.6	—	18	
			V_{IN} = 3.6 V, I_O = –24 mA	3.6	—	16	
			V_{IN} = 0 V, I_O = 24 mA	3.0	—	21	
			V_{IN} = 3 V, I_O = –24 mA	3.0	—	17	
			V_{IN} = 0 V, I_O = 18 mA	2.3	—	25	
			V_{IN} = 2.3 V, I_O = –18 mA	2.3	—	20	
			V_{IN} = 0 V, I_O = 6 mA	1.8	—	32	
			V_{IN} = 1.8 V, I_O = –6 mA	1.8	—	26	
On resistance $V_{I/O}$ = V_{CC} to GND		R_{ON}	0 < V_{IN} < 3.6 V, I_O = 24 mA	3.6	—	21	Ω
			0 < V_{IN} < 3 V, I_O = 24 mA	3.0	—	23	
			0 < V_{IN} < 2.3 V, I_O = 18 mA	2.3	—	42	
			0 < V_{IN} < 1.8 V, I_O = 6 mA	1.8	—	140	
Control input leakage current		I_{IN}	V_{IN} = 0 to 3.6 V	3.6	—	±5.0	μA
Switch I/O leakage current		I_{SZ}	V_{IN} = 0 to 3.6 V	3.6	—	10.0	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND	3.6	—	20.0	μA
Increase in I_{CC} per Input		ΔI_{CC}	V_{IH} = 3 V	3.6	—	750	

AC Characteristics (Ta = –40 to 85°C, input $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500\ \Omega$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Output enable time	t_{pZL} t_{pZH}	Figure 1,2	1.8	—	9	ns
			2.5 ± 0.2	—	7	
			3.3 ± 0.3	—	5	
Output disable time	t_{pLZ} t_{pHZ}	Figure 1,2	1.8	—	9	ns
			2.5 ± 0.2	—	7	
			3.3 ± 0.3	—	5	

The propagation delay time is defined by test condition as follows: (calculating condition: see Figure 3)

Propagation delay time (reference) = - (C_{OS} + C_L) · (R_{DRIVE}+ R_{ON}) · ln (((V_{OH} – V_{OL}) – V_M) / (V_{OH} – V_{OL}))

R_{DRIVE} = Output impedance of front circuit
V_M= Arbitrary output threshold voltage

Example of calculation:

Propagation delay time (reference) = - (15 + 15) · (0 + 21) · ln (((3.6 - 0) – 3.6 · 50%) / (3.6 – 0))
= approximately 0.4 ns

Calculating condition:

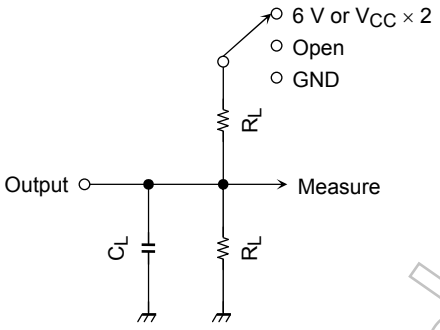
V_{CC} = 3.6V , C_L = 15pF , R_{DRIVE} = 0 Ω (ideal signal source) , V_M = 50%
Input signal to switch = Digital signal (“H” revel voltage=3.6V , ”L” revel voltage = 0V)

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Input capacitance	C_{IN}	—	1.8, 2.5, 3.3	3	pF
Common Terminal Capacitance	C_{IS}	—	1.8, 2.5, 3.3	6	pF
Switch Terminal Capacitance	C_{OS}	—	1.8, 2.5, 3.3	15	pF
Feed Through Capacitance	C_{IOS}	—	1.8, 2.5, 3.3	0.3	pF
Power dissipation capacitance	C_{PD}	f_{IN} = 10 MHz (Note 1)	1.8, 2.5, 3.3	5.5	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 is given as:
$I_{CC\ (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

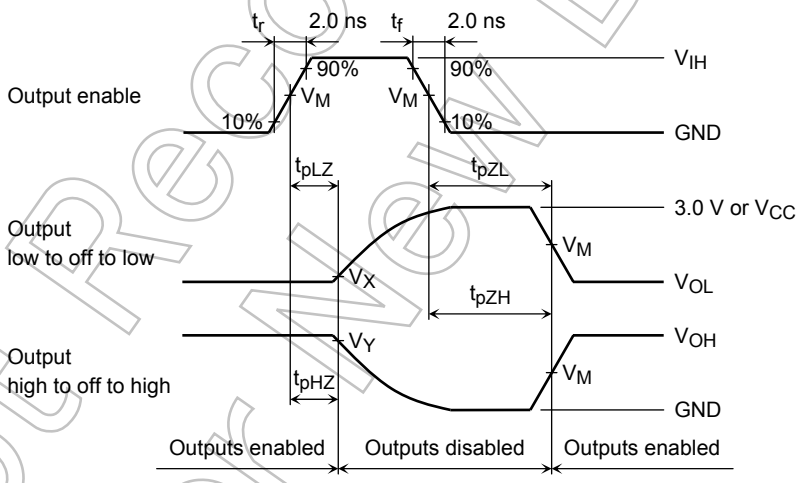
AC Test Circuit



Characteristics	Switch	
t_{pLZ}, t_{pZL}	6 V	at V_{CC} = 3.3 ± 0.3 V
	V_{CC} × 2	at V_{CC} = 2.5 ± 0.2 V at V_{CC} = 1.8 V
t_{pHZ}, t_{pZH}	GND	

Figure 1

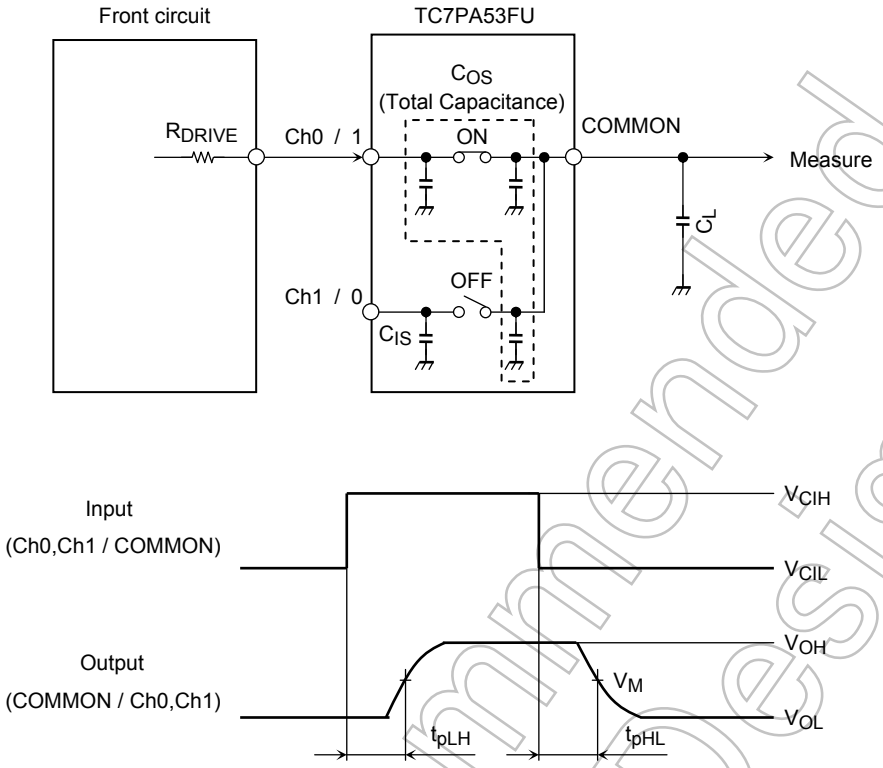
AC Waveforms



Symbol	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC/2}$	$V_{CC/2}$
V_X	V_{OL} + 0.3 V	V_{OL} + 0.15 V	V_{OL} + 0.15 V
V_Y	V_{OH} − 0.3 V	V_{OH} − 0.15 V	V_{OH} − 0.15 V

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

Calculating condition for propagation delay time



R_{DRIVE} = Output impedance of front circuit
V_M = Arbitrary output threshold voltage
V_{CIH} = “H” revel input voltage to switch
V_{CIL} = ”L” revel input voltage to switch

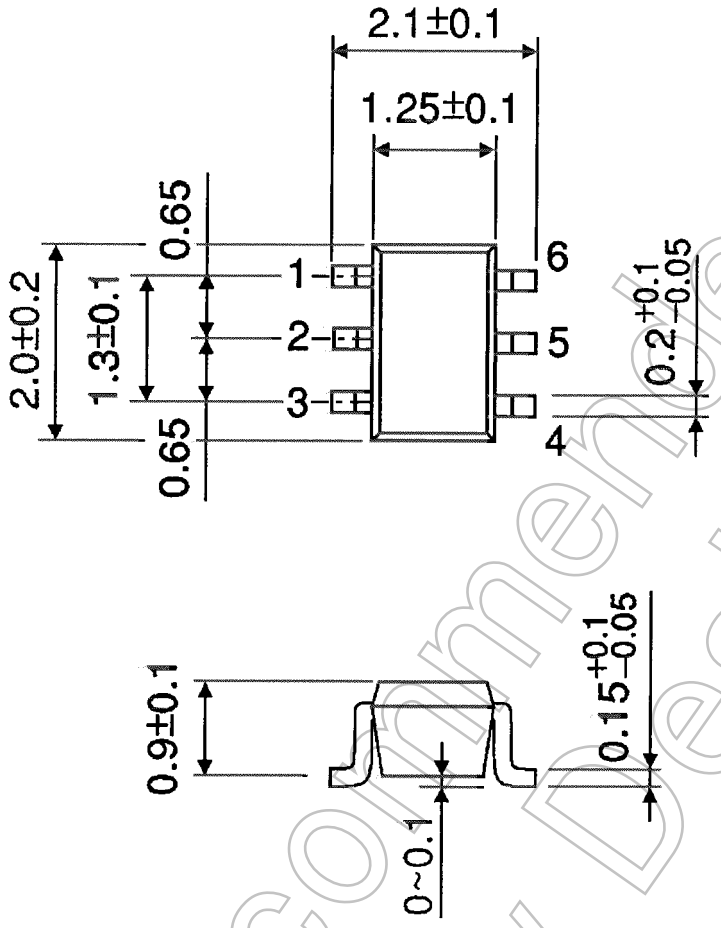
Symbol	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_M	arbitrary	arbitrary	arbitrary

Figure 3 t_{pLH}, t_{pHL}

Package Dimensions

SSOP6-P-0.65A

Unit: mm



Weight: 0.0068 g (typ.)

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