

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

**TC4051BFN,
TC4052BFN,
TC4053BFN****TC4051B**

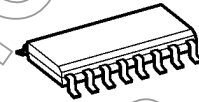
Single 8-Channel Multiplexer/Demultiplexer

TC4052BDifferential 4-Channel
Multiplexer/Demultiplexer**TC4053B**

Triple 2-Channel Multiplexer/Demultiplexer

Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4051BFN, TC4052BFN, TC4053BFN

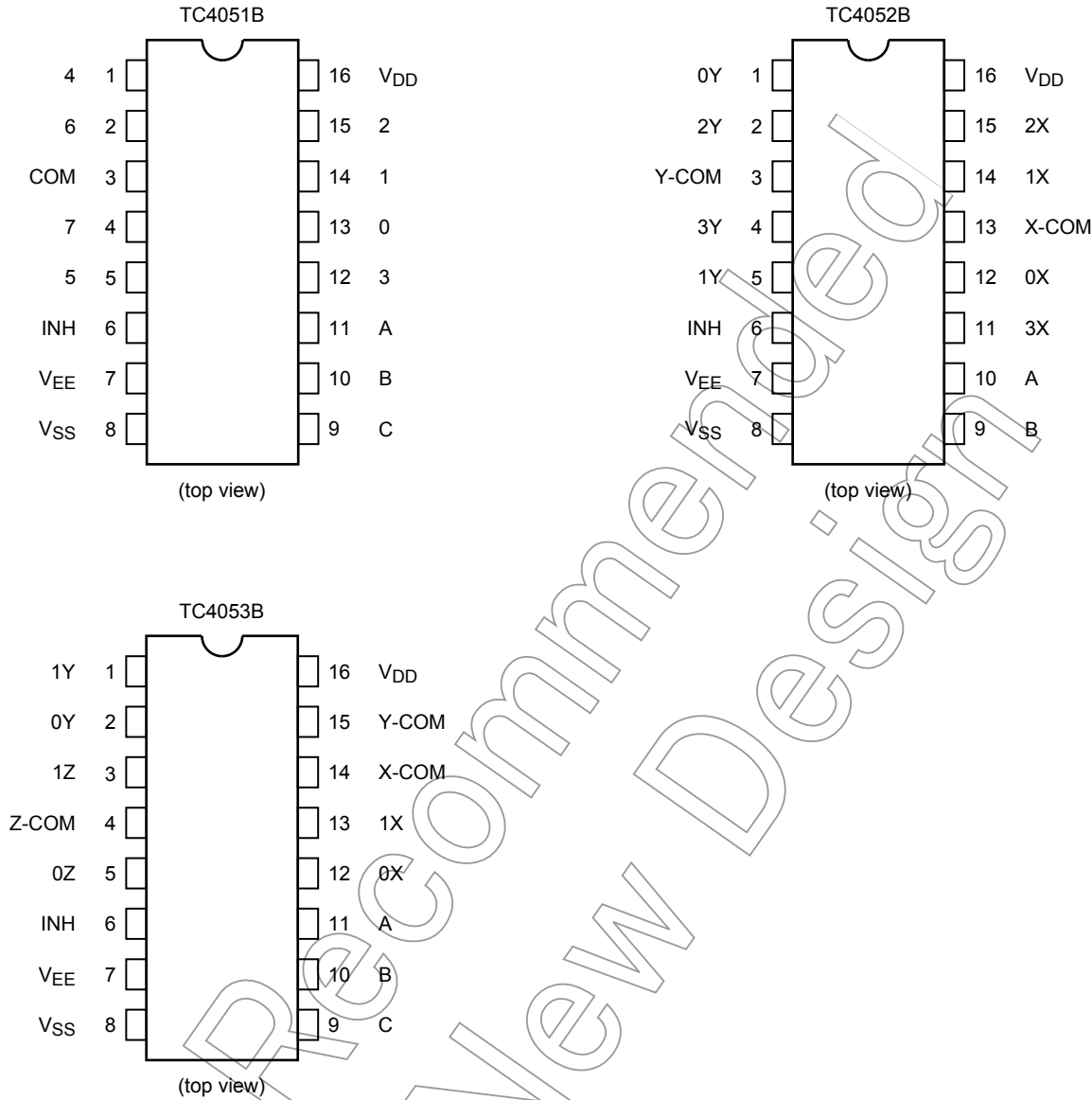


SOL16-P-150-1.27

Weight
SOL16-P-150-1.27 : 0.13 g (typ.)

TC4051B, TC4052B and TC4053B are multiplexers with capabilities of selection and mixture of analog signal and digital signal. TC4051B has 8 channels configuration. TC4052B has 4 channel \times 2 configuration and TC4053B has 2 channel \times 3 configuration. The digital signal to the control terminal turns "ON" the corresponding switch of each channel, with large amplitude ($V_{DD} - V_{EE}$) can be switched by the control signal with small logical amplitude ($V_{DD} - V_{SS}$). For example, in the case of $V_{DD} = 5\text{ V}$, $V_{SS} = 0\text{ V}$ and $V_{EE} = -5\text{ V}$, signals between -5 V and $+5\text{ V}$ can be switched from the logical circuit with single power supply of 5 volts. As the ON-resistance of each switch is low, these can be connected to the circuits with low input impedance.

Pin Assignment



Truth Table

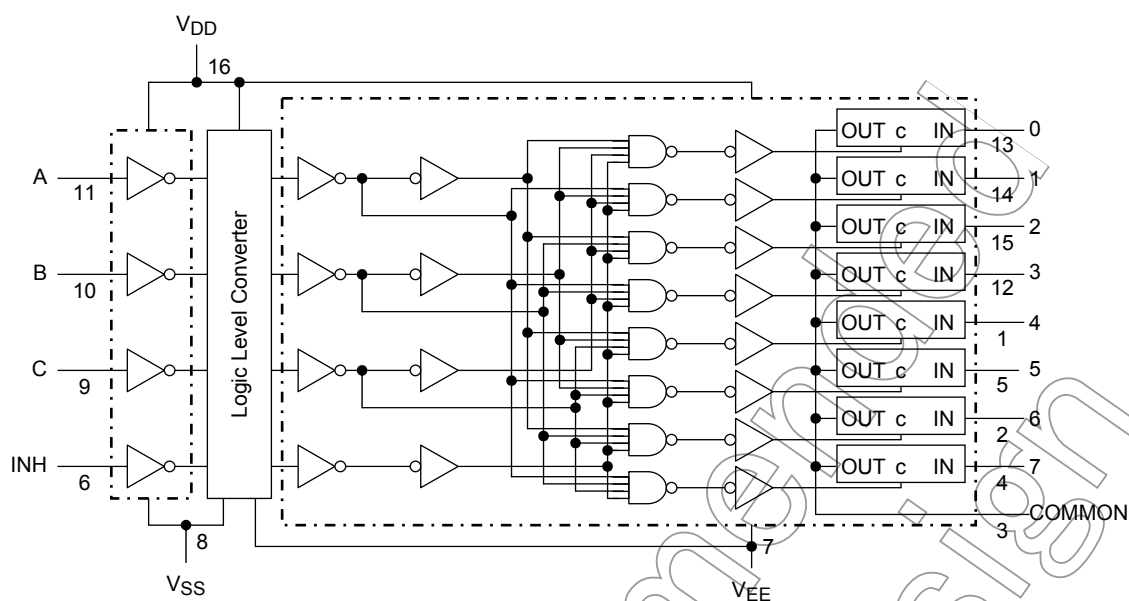
Control Inputs				“ON” Channel		
Inhibit	CΔ	B	A	TC4051B	TC4052B	TC4053B
L	L	L	L	0	0X, 0Y	0X, 0Y, 0Z
L	L	L	H	1	1X, 1Y	1X, 0Y, 0Z
L	L	H	L	2	2X, 2Y	0X, 1Y, 0Z
L	L	H	H	3	3X, 3Y	1X, 1Y, 0Z
L	H	L	L	4	—	0X, 0Y, 1Z
L	H	L	H	5	—	1X, 0Y, 1Z
L	H	H	L	6	—	0X, 1Y, 1Z
L	H	H	H	7	—	1X, 1Y, 1Z
H	X	X	X	None	None	None

X: Don't care

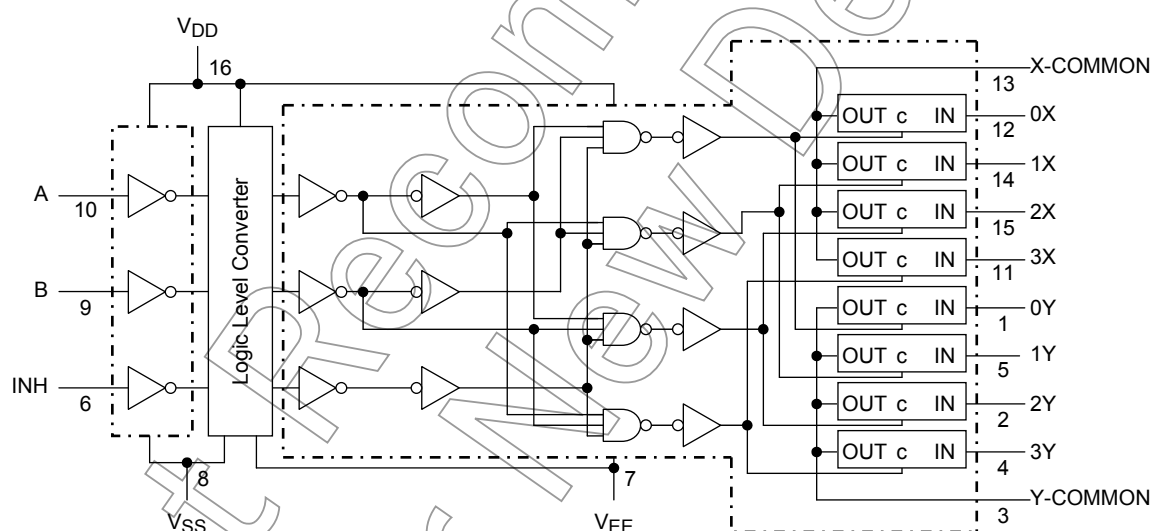
Δ: Except TC4052B

Logic Diagram

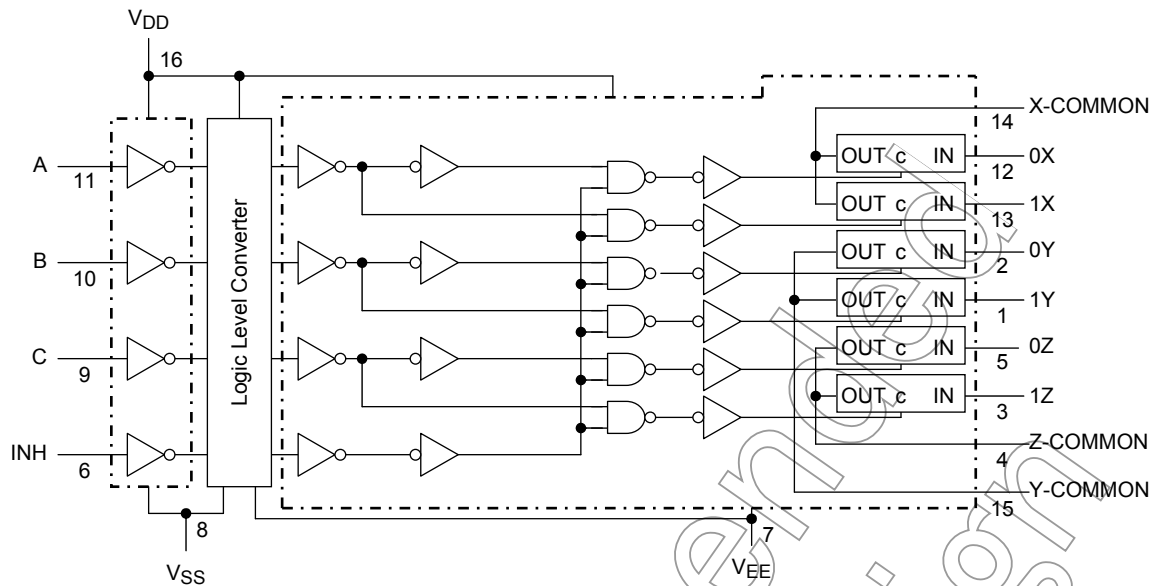
TC4051B



TC4052B



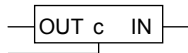
TC4053B



Truth Table

Control C	Impedance between IN-OUT (Note)
H	$0.5 \text{ to } 5 \times 10^2 \Omega$
L	$>10^9 \Omega$

Note: See electrical characteristics



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	$V_{DD}-V_{SS}$	-0.5 to 20	V
DC supply voltage	$V_{DD}-V_{EE}$	-0.5 to 20	V
Control input voltage	V_{CIN}	$V_{SS} - 0.5 \text{ to } V_{DD} + 0.5$	V
Switch I/O voltage	V_I/V_O	$V_{EE} - 0.5 \text{ to } V_{DD} + 0.5$	V
Control input current	I_{CIN}	± 10	mA
Potential difference across I/O during ON	V_I-V_O	-0.5 to 0.5	V
Power dissipation	P_D	180	mW
Operating temperature range	T_{opr}	-40 to 85	°C
Storage temperature range	T_{stg}	-65 to 150	°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).

Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	$V_{DD}-V_{SS}$	—	3	—	18	V
	$V_{DD}-V_{EE}$	—	3	—	18	
Control input voltage	V_{IN}	—	V_{SS}	—	V_{DD}	V
Input/output voltage	V_{IN}/V_{OUT}	—	V_{EE}	—	V_{DD}	V

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused Control inputs must be tied to either V_{DD} or V_{SS} .

Static Electrical Characteristics

Characteristics	Symbol	Test Condition			-40°C		25°C			85°C		Unit	
		V _{SS} (V)	V _{EE} (V)	V _{DD} (V)	Min	Max	Min	Typ.	Max	Min	Max		
Control input high voltage	V _{IH}	V _{IS} = V _{DD} thru 1 kΩ	V _{EE} = V _{SS} R _L = 1 kΩ to V _{SS}		5	3.5	—	3.5	2.75	—	3.5	—	V
					10	7.0	—	7.0	5.50	—	7.0	—	
					15	11.0	—	11.0	8.25	—	11.0	—	
Control input low voltage	V _{IL}		I _{IS} < 2 μA on all OFF channels		5	—	1.5	—	2.25	1.5	—	1.5	V
					10	—	3.0	—	4.5	3.0	—	3.0	
					15	—	4.0	—	6.75	4.0	—	4.0	
On-state resistance	R _{ON}	0 ≤ V _{IS} ≤ V _{DD} R _L = 10 kΩ	0	0	5	—	850	—	240	950	—	1200	Ω
			0	0	10	—	210	—	110	250	—	300	
			0	0	15	—	140	—	80	160	—	200	
ΔOn-state resistance between any 2 switches	R _{ONΔ}	—	0	0	5	—	—	—	10	—	—	—	Ω
			0	0	10	—	—	—	6	—	—	—	
			0	0	15	—	—	—	4	—	—	—	
Input/output leakage current	I _{OFF}	V _{IN} = 18 V, V _{OUT} = 0 V V _{IN} = 0 V, V _{OUT} = 18 V			18	—	±100	—	±0.01	±100	—	±1000	nA
					18	—	±100	—	±0.01	±100	—	±1000	
Quiescent supply current	I _{DD}	V _{IN} = V _{SS} , V _{DD}	(Note)		5	—	5.0	—	0.005	5.0	—	150	μA
					10	—	10	—	0.010	10	—	300	
					15	—	20	—	0.015	20	—	600	
Input current	I _{IN}	V _{IH} = 18 V V _{IL} = 0 V			18	—	0.1	—	10 ⁻⁵	0.1	—	1.0	μA
					18	—	-0.1	—	-10 ⁻⁵	-0.1	—	-1.0	
Input capacitance	C _{IN}				—	—	—	—	5	7.5	—	—	pF
Switch input capacitance	C _{IN}				—	—	—	—	10	—	—	—	pF
Output capacitance	C _{OUT}	TC4051B TC4052B TC4053B			10 10 10	— — —	— — —	— — —	58 30 17	— — —	— — —	— — —	pF
Feedthrough capacitance	C _{IN} - C _{OUT}	TC4051B TC4052B TC4053B			10 10 10	— — —	— — —	— — —	0.2 0.2 0.2	— — —	— — —	— — —	pF

Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, CL = 50 pF)

Characteristics	Symbol	Test Condition	Test Condition			Min	Typ.	Max	Unit
			VSS (V)	VEE (V)	VDD (V)				
Phase difference between input to output	ϕ_{I-O}	—	0	0	5	—	15	45	ns
			0	0	10	—	8	20	
			0	0	15	—	6	15	
Propagation delay time (A, B, C, -OUT)	t_{pZL}	$R_L = 1\text{ k}\Omega$	0	0	5	—	170	550	ns
	t_{pZH}		0	0	10	—	90	240	
	t_{pLZ}		0	0	15	—	70	160	
	t_{pHZ}		0	-5	5	—	100	240	
	t_{pHZ}		0	-7.5	7.5	—	80	160	
Propagation delay time (INH-OUT)	t_{pZL}	$R_L = 1\text{ k}\Omega$	0	0	5	—	120	380	ns
	t_{pZH}		0	0	10	—	60	200	
	t_{pZH}		0	0	15	—	50	160	
	t_{pZH}		0	-5	5	—	80	200	
	t_{pZH}		0	-7.5	7.5	—	60	160	
Propagation delay time (INH-OUT)	t_{pLZ}	$R_L = 1\text{ k}\Omega$	0	0	5	—	170	450	ns
	t_{pLZ}		0	0	10	—	90	210	
	t_{pLZ}		0	0	15	—	70	160	
	t_{pHZ}		0	-5	5	—	100	210	
	t_{pHZ}		0	-7.5	7.5	—	80	160	
-3dB cutoff frequency	f_{\max} (I-O)	$R_L = 1\text{ k}\Omega$	(Note 1)	-5	-5	5	—	20	MHz
TC4051B				-5	-5	5	—	30	
TC4052B				-5	-5	5	—	40	
TC4053B									
Total harmonic distortion		$R_L = 10\text{ k}\Omega$ $f = 1\text{ kHz}$	(Note 2)	-2.5	-2.5	2.5	—	0.15	%
				-5	-5	5	—	0.03	
				-7.5	-7.5	7.5	—	0.02	
-50dB feedthrough (switch off)	—	$R_L = 1\text{ k}\Omega$	(Note 3)	-5	-5	5	—	500	kHz
Crosstalk	—	$R_L = 1\text{ k}\Omega$	(Note 4)	-5	-5	5	—	1.5	MHz
Crosstalk (control-OUT)	—	$R_{IN} = 1\text{ k}\Omega$		0	0	5	—	200	mV
		$R_{OUT} = 10\text{ k}\Omega$		0	0	10	—	400	
		$C_L = 15\text{ pF}$		0	0	15	—	600	

Note 1: Sine wave of $\pm 2.5\text{ V}_{p-p}$ shall be used for V_{is} and the frequency of $20 \log 10 \frac{V_{OS}}{V_{is}} = -3\text{dB}$ shall be f_{\max} .

Note 2: V_{is} shall be sine wave of $\pm \left(\frac{V_{DD} - V_{EE}}{4} \right) p-p$.

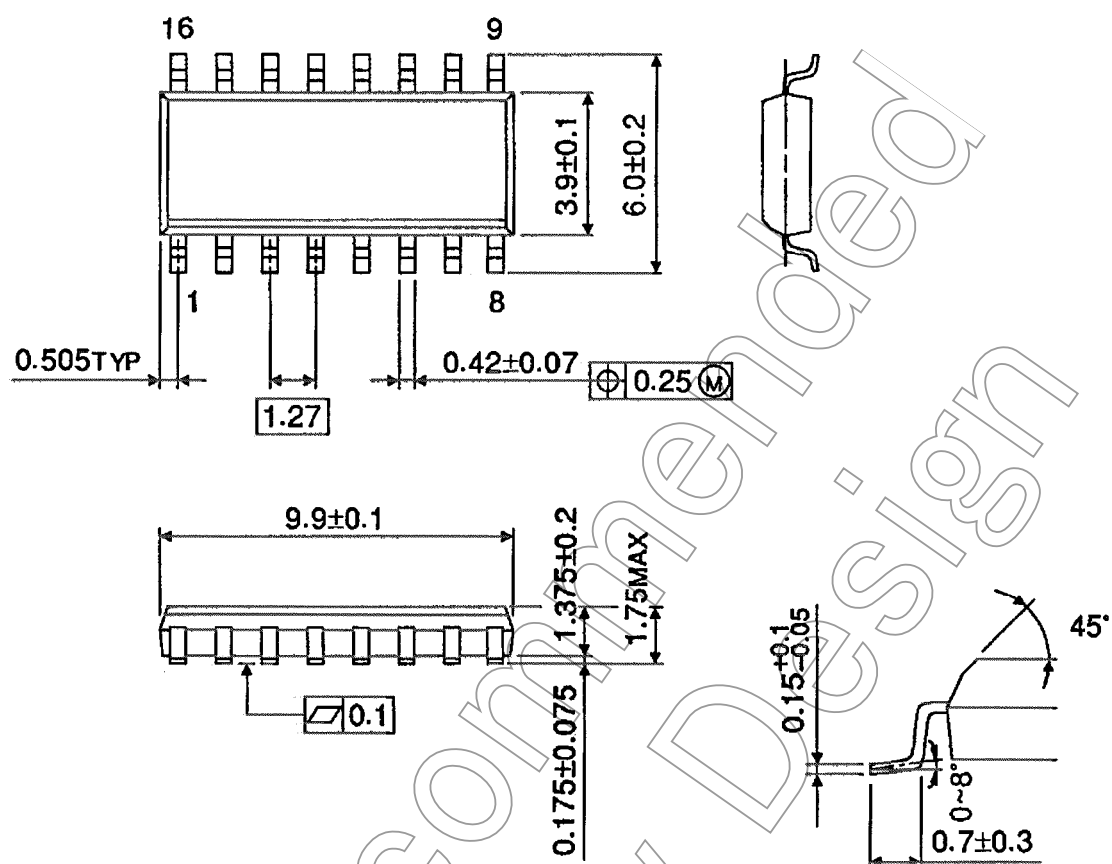
Note 3: Sine wave of $\pm 2.5\text{ V}_{p-p}$ shall be used for V_{is} and the frequency of $20 \log 10 \frac{V_{OS}}{V_{is}} = -50\text{dB}$ shall be feed-through.

Note 4: Sine wave of $\pm 2.5\text{ V}_{p-p}$ shall be used for V_{is} and the frequency of $20 \log 10 \frac{V_{OS}}{V_{is}} = -50\text{dB}$ shall be crosstalk.

Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

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