

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC4051BP, TC4051BF, TC4051BFT
TC4052BP, TC4052BF, TC4052BFT
TC4053BP, TC4053BF, TC4053BFT

TC4051B

Single 8-Channel Multiplexer/Demultiplexer

TC4052B

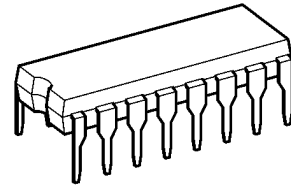
Differential 4-Channel
Multiplexer/Demultiplexer

TC4053B

Triple 2-Channel Multiplexer/Demultiplexer

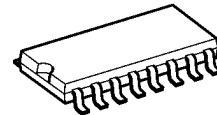
TC4051B, TC4052B and TC4053B are multiplexers with capabilities of selection and mixture of analog signal and digital signal. TC4051B has 8 channels configuration. TC4052B has 4 channel \times 2 configuration and TC4053B has 2 channel \times 3 configuration. The digital signal to the control terminal 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.

TC4051BP, TC4052BP, TC4053BP



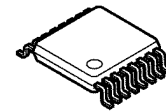
DIP16-P-300-2.54A

TC4051BF, TC4052BF, TC4053BF



SOP16-P-300-1.27A

TC4051BFT, TC4052BFT, TC4053BFT



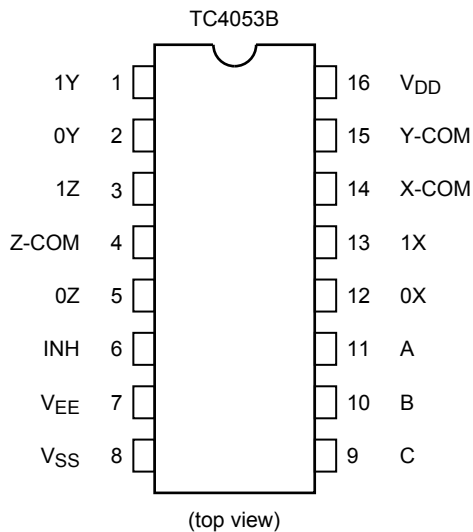
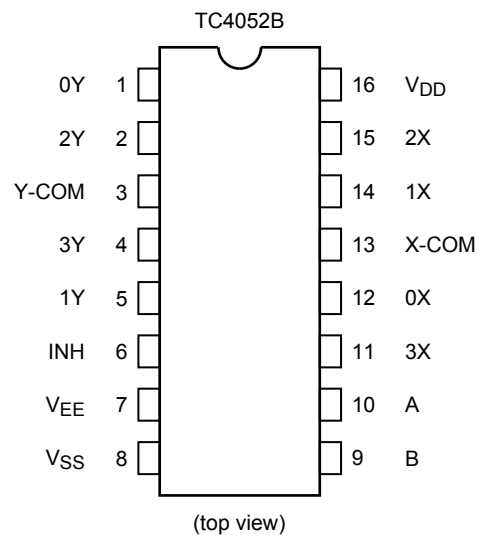
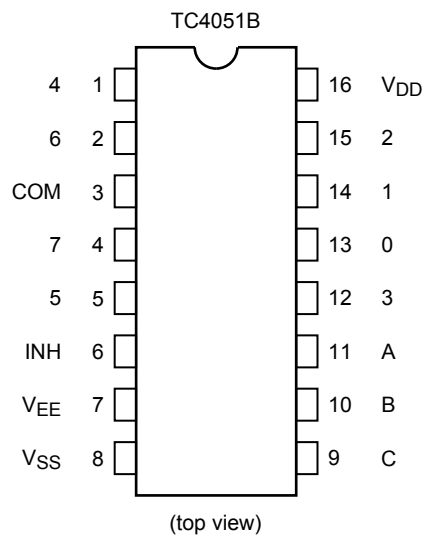
TSSOP16-P-0044-0.65A

Weight

| | |
|----------------------|-----------------|
| DIP16-P-300-2.54A | : 1.00 g (typ.) |
| SOP16-P-300-1.27A | : 0.18 g (typ.) |
| TSSOP16-P-0044-0.65A | : 0.06 g (typ.) |

Start of commercial production
1978-04

Pin Assignment



Truth Table

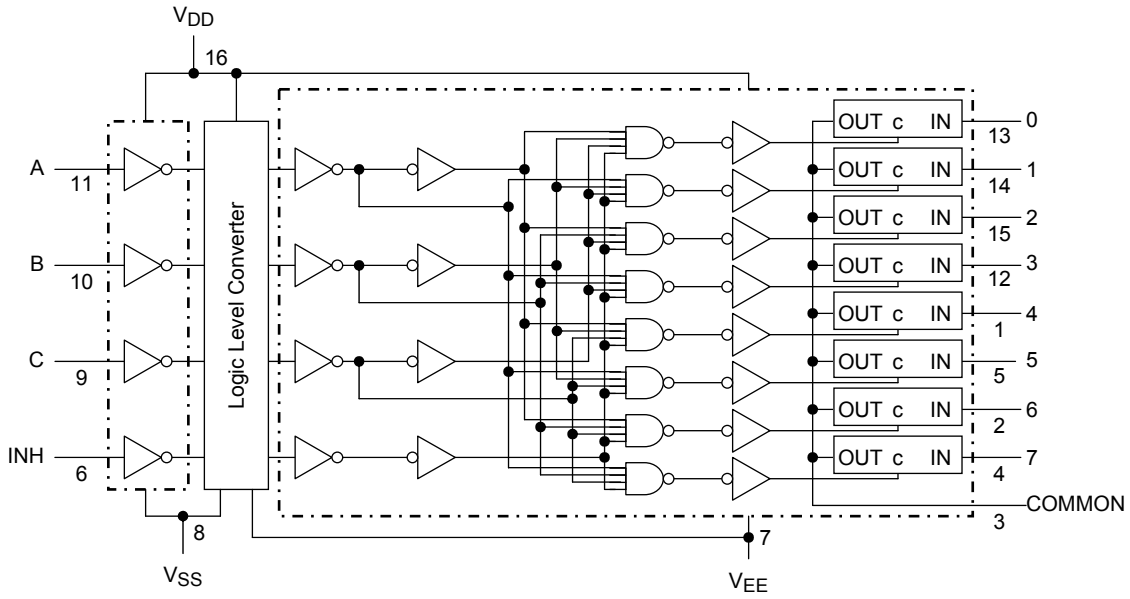
| Control Inputs | | | | "ON" Channel | | |
|----------------|------------|---|---|--------------|---------|------------|
| Inhibit | C Δ | B | A | TC4051B | TC4052B | TC4053B |
| L | L | L | L | 0 | 0X, 0Y | 0X, 0Y, 0Z |
| L | L | L | H | 1 | 1X, 1Y | 1X, 0Y, 0Z |
| L | L | H | L | 2 | 2X, 2Y | 0X, 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

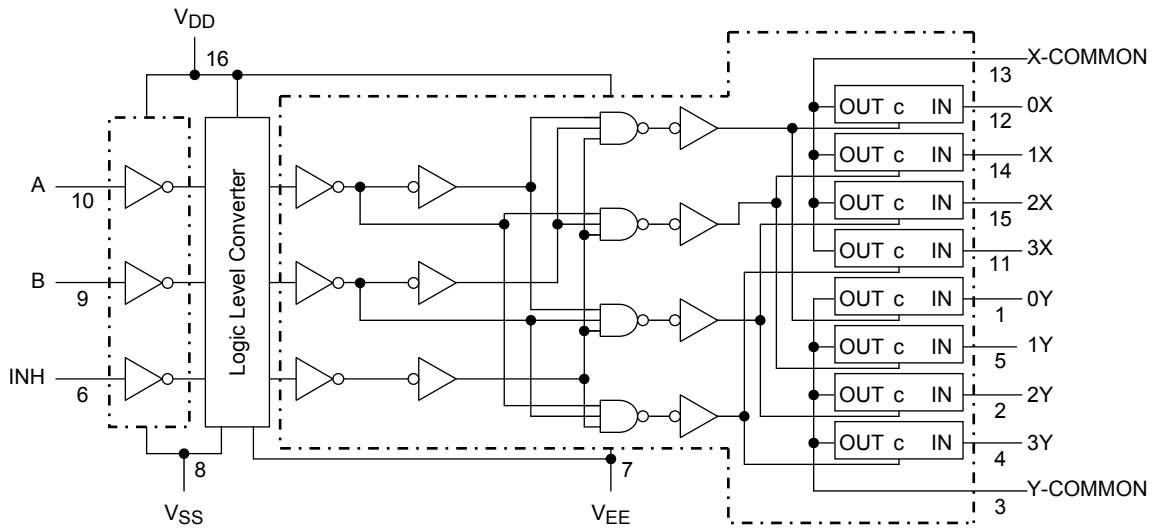
Δ : Except TC4052B

Logic Diagram

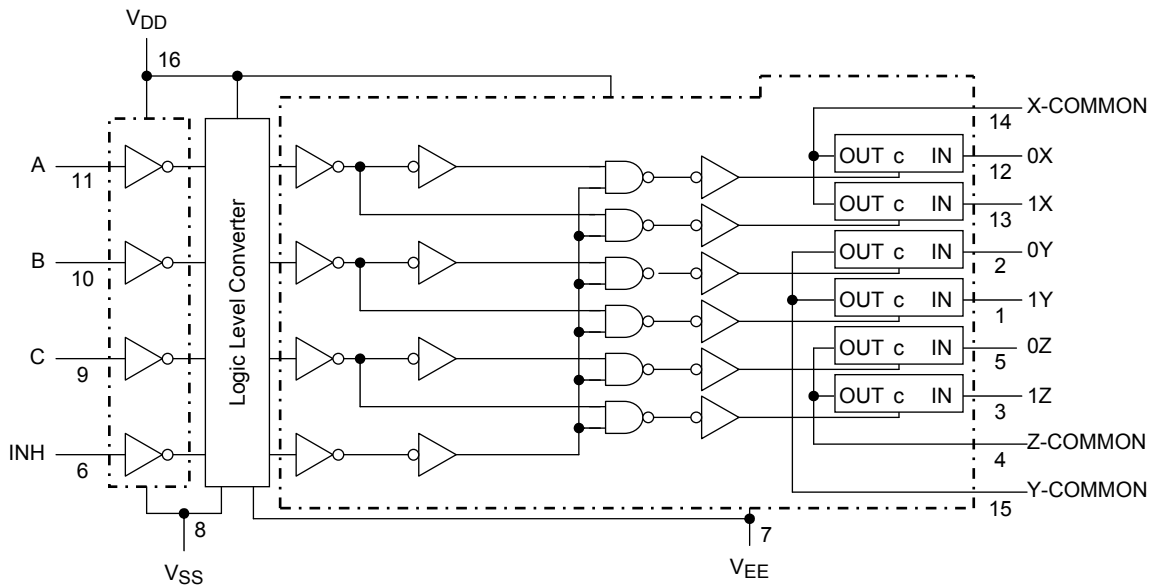
TC4051B



TC4052B



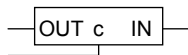
TC4053B



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 | 300 (DIP)/180 (SOIC) | mW |
| Operating temperature range | T_{opr} | -40 to 85 | $^{\circ}\text{C}$ |
| Storage temperature range | T_{stg} | -65 to 150 | $^{\circ}\text{C}$ |

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 k Ω | $V_{EE} = V_{SS}$ $R_L = 1$ k Ω 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} | | | $V_{IS} = V_{DD}$ thru 1 k Ω | $V_{EE} = V_{SS}$ $R_L = 1$ k Ω to V_{SS} | 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} | $0 \leq V_{IS} \leq V_{DD}$ $R_L = 10$ k Ω | 0 | | | 0 | 5 | — | 850 | — | 240 | 950 | — | 1200 | Ω |
| | | | 0 | | | 0 | 10 | — | 210 | — | 110 | 250 | — | 300 | |
| | | | 0 | | | 0 | 15 | — | 140 | — | 80 | 160 | — | 200 | |
| Δ On-state resistance between any 2 switches | $R_{ON\Delta}$ | — | 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 | 18 | — | ± 100 | — | ± 0.01 | ± 100 | — | ± 1000 | — | ± 1000 | nA | | |
| | | $V_{IN} = 0$ V, $V_{OUT} = 18$ V | 18 | — | ± 100 | — | ± 0.01 | ± 100 | — | ± 1000 | — | ± 1000 | | | |
| Quiescent supply current | I_{DD} | $V_{IN} = V_{SS}, V_{DD}$ | (Note) | 5 | — | 5.0 | — | 0.005 | 5.0 | — | 150 | μ A | | | |
| | | | 10 | — | 10 | — | 0.010 | 10 | — | 300 | | | | | |
| | | | 15 | — | 20 | — | 0.015 | 20 | — | 600 | | | | | |
| Input current | I_{IN} | $V_{IH} = 18$ V | 18 | — | 0.1 | — | 10^{-5} | 0.1 | — | 1.0 | μ A | | | | |
| | | $V_{IL} = 0$ V | 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 | 10 | — | — | — | 58 | — | — | — | — | pF | | | |
| | | TC4052B | 10 | — | — | — | 30 | — | — | — | — | | | | |
| | | TC4053B | 10 | — | — | — | 17 | — | — | — | — | | | | |
| Feedthrough capacitance | $C_{IN-C-OUT}$ | TC4051B | 10 | — | — | — | 0.2 | — | — | — | — | pF | | | |
| | | TC4052B | 10 | — | — | — | 0.2 | — | — | — | — | | | | |
| | | TC4053B | 10 | — | — | — | 0.2 | — | — | — | — | | | | |

Note: All valid input combinations.

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

| Characteristics | Symbol | Test Condition | | | Min | Typ. | Max | Unit | |
|--|--|-------------------------------------|----------|---------|------|------|-----|------|-----|
| | | VSS (V) | VEE (V) | VDD (V) | | | | | |
| Phase difference between input to output | φI-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} t _{pZH} t _{pLZ} t _{pHZ} | R _L = 1 kΩ | 0 | 0 | 5 | — | 170 | 550 | ns |
| | | | 0 | 0 | 10 | — | 90 | 240 | |
| | | | 0 | 0 | 15 | — | 70 | 160 | |
| | | | 0 | -5 | 5 | — | 100 | 240 | |
| | | | 0 | -7.5 | 7.5 | — | 80 | 160 | |
| Propagation delay time (INH-OUT) | t _{pZL} t _{pZH} | R _L = 1 kΩ | 0 | 0 | 5 | — | 120 | 380 | ns |
| | | | 0 | 0 | 10 | — | 60 | 200 | |
| | | | 0 | 0 | 15 | — | 50 | 160 | |
| | | | 0 | -5 | 5 | — | 80 | 200 | |
| | | | 0 | -7.5 | 7.5 | — | 60 | 160 | |
| Propagation delay time (INH-OUT) | t _{pLZ} t _{pHZ} | R _L = 1 kΩ | 0 | 0 | 5 | — | 170 | 450 | ns |
| | | | 0 | 0 | 10 | — | 90 | 210 | |
| | | | 0 | 0 | 15 | — | 70 | 160 | |
| | | | 0 | -5 | 5 | — | 100 | 210 | |
| | | | 0 | -7.5 | 7.5 | — | 80 | 160 | |
| -3dB cutoff frequency | f _{max} (I-O) | R _L = 1 kΩ | (Note 1) | -5 | -5 | 5 | — | 20 | MHz |
| TC4051B | | | | -5 | -5 | 5 | — | 30 | |
| TC4052B TC4053B | | | | -5 | -5 | 5 | — | 40 | |
| Total harmonic distortion | — | R _L = 10 kΩ f = 1 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 kΩ | (Note 3) | -5 | -5 | 5 | — | 500 | kHz |
| Crosstalk | — | R _L = 1 kΩ | (Note 4) | -5 | -5 | 5 | — | 1.5 | MHz |
| Crosstalk (control-OUT) | — | R _{IN} = 1 kΩ | | 0 | 0 | 5 | — | 200 | mV |
| | | R _{OUT} = 10 kΩ | | 0 | 0 | 10 | — | 400 | |
| | | C _L = 15 pF | | 0 | 0 | 15 | — | 600 | |

Note 1: Sine wave of ±2.5 V_{p-p} shall be used for V_{is} and the frequency of 20 log 10 $\frac{V_{OS}}{V_{is}}$ = -3dB 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 ±2.5 V_{p-p} shall be used for V_{is} and the frequency of 20 log 10 $\frac{V_{OS}}{V_{is}}$ = -50dB shall be feed-through.

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

Package Dimensions

DIP16-P-300-2.54A

Unit : mm



Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm

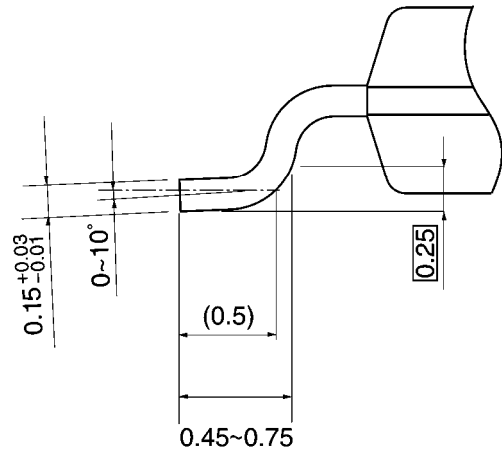
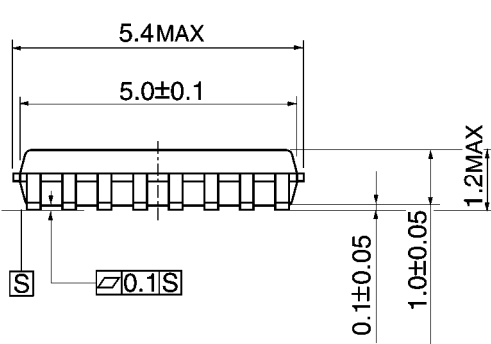


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.