

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC4049BP, TC4049BF TC4050BP, TC4050BF

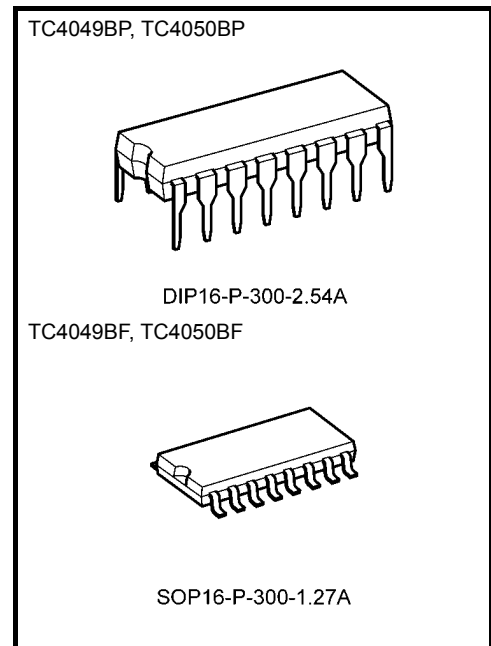
TC4049B Hex Buffer/Converter (inverting type)

TC4050B Hex Buffer/Converter (non-inverting type)

TC4049B, TC4050B contain six circuits of buffers. TC4049B is inverter type and TC4050B is non-inverter type.

Since one TTL or DTL can be directly driven having large output current, these are useful for interfacing from CMOS to TTL or DTL. As voltage up to  $V_{SS} + 18$  volts can be applied to the input regardless of  $V_{DD}$ , these can be also used as the level converter IC's which converts CMOS logical circuits of 15 volts or 10 volts system to CMOS/TTL logical circuits of 5 volts system.

Ideal switching characteristic has been obtained by the circuit diagram of three stage inverters for TC4049B and two stage inverters for TC4050B.



Weight

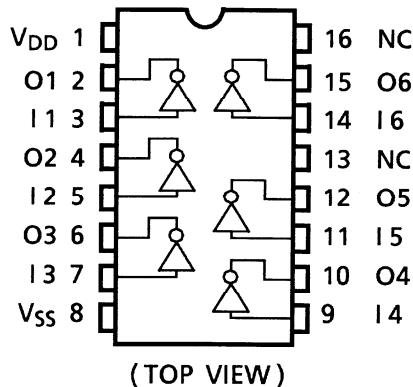
DIP16-P-300-2.54A : 1.00 g (typ.)

SOP16-P-300-1.27A : 0.18 g (typ.)

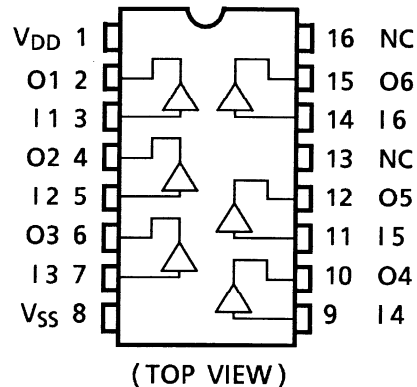
Start of commercial production  
1978-05

## Pin Assignment

### TC4049B

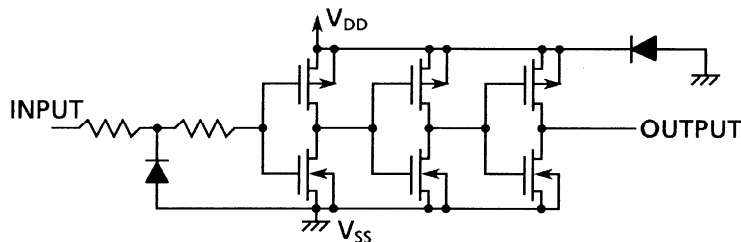


### TC4050B

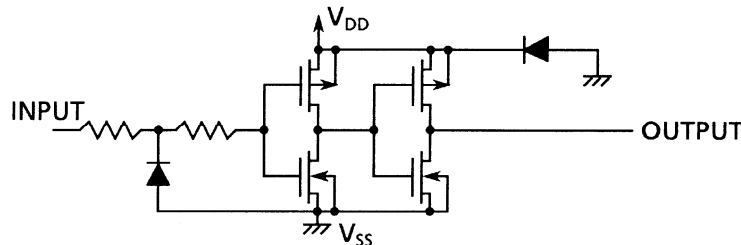


## Circuit Diagram

### 1/6 TC4049B



### 1/6 TC4050B



## Absolute Maximum Ratings (Note)

| Characteristics             | Symbol    | Rating                           | Unit |
|-----------------------------|-----------|----------------------------------|------|
| DC supply voltage           | $V_{DD}$  | $V_{SS} - 0.5$ to $V_{SS} + 20$  | V    |
| Input voltage               | $V_{IN}$  | $V_{SS} - 0.5$ to $V_{SS} + 20$  | V    |
| Output voltage              | $V_{OUT}$ | $V_{SS} - 0.5$ to $V_{DD} + 0.5$ | V    |
| DC input current            | $I_{IN}$  | -10                              | mA   |
| Power dissipation           | $P_D$     | 300 (DIP)/180 (SOP)              | 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 ( $V_{SS} = 0\text{ V}$ ) (Note)

| Characteristics   | Symbol   | Test Condition | Min | Typ. | Max | Unit |
|-------------------|----------|----------------|-----|------|-----|------|
| DC supply voltage | $V_{DD}$ | —              | 3   | —    | 18  | V    |
| Input voltage     | $V_{IN}$ | —              | 0   | —    | 18  | V    |

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{DD}$  or  $V_{SS}$ .

## Static Electrical Characteristics ( $V_{SS} = 0\text{ V}$ )

| Characteristics              | Sym-<br>bol | Test Condition  | $V_{DD}$<br>(V)        | -40°C |      | 25°C  |       |            | 85°C  |      | Unit          |               |
|------------------------------|-------------|---|------------------------|-------|------|-------|-------|------------|-------|------|---------------|---------------|
|                              |             |   |                        | Min   | Max  | Min   | Typ.  | Max        | Min   | Max  |               |               |
| High-level output<br>voltage | $V_{OH}$    | $ I_{OUT}  < 1\ \mu\text{A}$<br>$V_{IN} = V_{SS}, V_{DD}$   | 5                      | 4.95  | —    | 4.95  | 5.00  | —          | 4.95  | —    | V             |               |
|                              |             |   | 10                     | 9.95  | —    | 9.95  | 10.00 | —          | 9.95  | —    |               |               |
|                              |             |   | 15                     | 14.95 | —    | 14.95 | 15.00 | —          | 14.95 | —    |               |               |
| Low-level output<br>voltage  | $V_{OL}$    | $ I_{OUT}  < 1\ \mu\text{A}$<br>$V_{IN} = V_{SS}, V_{DD}$   | 5                      | —     | 0.05 | —     | 0.00  | 0.05       | —     | 0.05 | V             |               |
|                              |             |   | 10                     | —     | 0.05 | —     | 0.00  | 0.05       | —     | 0.05 |               |               |
|                              |             |   | 15                     | —     | 0.05 | —     | 0.00  | 0.05       | —     | 0.05 |               |               |
| Output high current          | $I_{OH}$    | $V_{OH} = 4.6\text{ V}$<br>$V_{OH} = 2.5\text{ V}$<br>$V_{OH} = 9.5\text{ V}$<br>$V_{OH} = 13.5\text{ V}$<br>$V_{IN} = V_{SS}, V_{DD}$                      | 5                      | -0.73 | —    | -0.65 | -1.2  | —          | -0.58 | —    | mA            |               |
|                              |             |   | 5                      | -2.40 | —    | -2.10 | -3.9  | —          | -1.90 | —    |               |               |
|                              |             |   | 10                     | -1.80 | —    | -1.65 | -2.5  | —          | -1.35 | —    |               |               |
|                              |             |   | 15                     | -4.80 | —    | -4.30 | -8.0  | —          | -3.50 | —    |               |               |
|                              |             |   |                        |       |      |       |       |            |       |      |               |               |
| Output low current           | $I_{OL}$    | $V_{OL} = 0.4\text{ V}$<br>$V_{OL} = 0.5\text{ V}$<br>$V_{OL} = 1.5\text{ V}$<br>$V_{IN} = V_{SS}, V_{DD}$  | 5                      | 3.8   | —    | 3.2   | 6.4   | —          | 2.9   | —    | mA            |               |
|                              |             |   | 10                     | 9.6   | —    | 8.0   | 16.0  | —          | 6.6   | —    |               |               |
|                              |             |   | 15                     | 28.0  | —    | 24.0  | 48.0  | —          | 20.0  | —    |               |               |
|                              |             |   |                        |       |      |       |       |            |       |      |               |               |
| Input high voltage           | $V_{IH}$    | $V_{OUT} = 0.5\text{ V}, 4.5\text{ V}$<br>$V_{OUT} = 1.0\text{ V}, 9.0\text{ V}$<br>$V_{OUT} = 1.5\text{ V}, 13.5\text{ V}$<br>$ I_{OUT}  < 1\ \mu\text{A}$ | 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  | —    |               |               |
|                              |             |   |                        |       |      |       |       |            |       |      |               |               |
| Input low voltage            | $V_{IL}$    | $V_{OUT} = 0.5\text{ V}, 4.5\text{ V}$<br>$V_{OUT} = 1.0\text{ V}, 9.0\text{ V}$<br>$V_{OUT} = 1.5\text{ V}, 13.5\text{ V}$<br>$ I_{OUT}  < 1\ \mu\text{A}$ | 5                      | —     | 1.5  | —     | 2.25  | 1.5        | —     | 1.5  | V             |               |
|                              |             |   | 10                     | —     | 3.0  | —     | 4.50  | 3.0        | —     | 3.0  |               |               |
|                              |             |   | 15                     | —     | 4.0  | —     | 6.75  | 4.0        | —     | 4.0  |               |               |
|                              |             |   |                        |       |      |       |       |            |       |      |               |               |
| Input<br>current             | "H" level   | $I_{IH}$  | $V_{IH} = 18\text{ V}$ | 18    | —    | 0.1   | —     | $10^{-5}$  | 0.1   | —    | 1.0           | $\mu\text{A}$ |
|                              | "L" level   | $I_{IL}$  | $V_{IL} = 0\text{ V}$  | 18    | —    | -0.1  | —     | $-10^{-5}$ | -0.1  | —    | -1.0          |               |
| Quiescent supply<br>current  | $I_{DD}$    | $V_{IN} = V_{SS}, V_{DD}$<br>(Note)   | 5                      | —     | 1    | —     | 0.002 | 1          | —     | 30   | $\mu\text{A}$ |               |
|                              |             |   | 10                     | —     | 2    | —     | 0.004 | 2          | —     | 60   |               |               |
|                              |             |   | 15                     | —     | 4    | —     | 0.008 | 4          | —     | 120  |               |               |

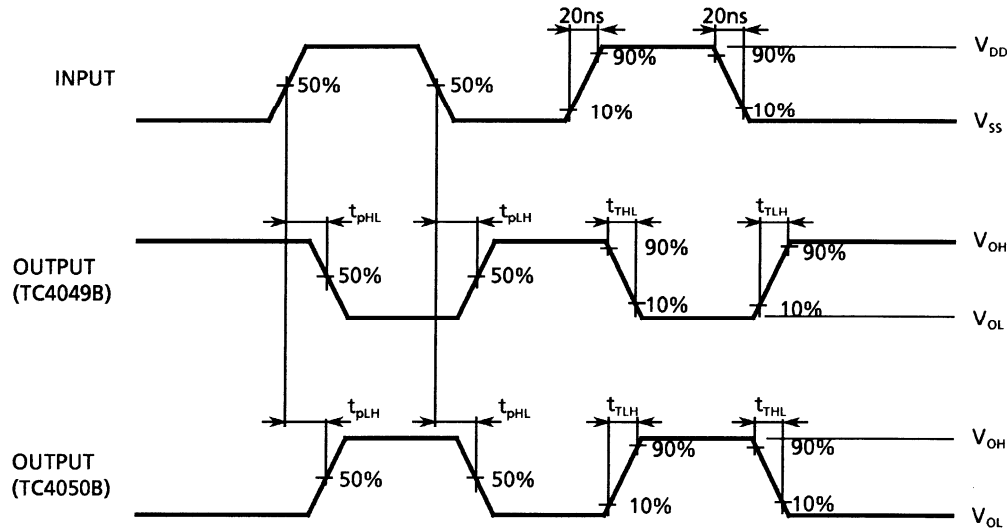
Note: All valid input combinations.

## Dynamic Electrical Characteristics (Ta = 25°C, VSS = 0 V, CL = 50 pF)

| Characteristics                         |   | Symbol           | Test Condition |         | Min | Typ. | Max | Unit |
|---|---|------------------|----------------|---------|-----|------|-----|------|
|   |   |                  |                | VDD (V) |     |      |     |      |
| Output transition time<br>(low to high) | t <sub>TLH</sub>                        | —                | 5              | —       | 60  | 160  | ns  |      |
|   |   |                  | 10             | —       | 30  | 80   |     |      |
|   |   |                  | 15             | —       | 25  | 60   |     |      |
| Output transition time<br>(high to low) | t <sub>THL</sub>                        | —                | 5              | —       | 120 | 60   | ns  |      |
|   |   |                  | 10             | —       | 10  | 40   |     |      |
|   |   |                  | 15             | —       | 8   | 30   |     |      |
| TC4049B                                 | Propagation delay time<br>(low to high) | t <sub>pLH</sub> | 5              | —       | 60  | 120  | ns  |      |
|   |   |                  | 10             | —       | 35  | 65   |     |      |
|   |   |                  | 15             | —       | 30  | 50   |     |      |
|   | Propagation delay time<br>(high to low) | t <sub>pHL</sub> | 5              | —       | 40  | 60   | ns  |      |
|   |   |                  | 10             | —       | 20  | 30   |     |      |
|   |   |                  | 15             | —       | 15  | 20   |     |      |
| TC4050B                                 | Propagation delay time<br>(low to high) | t <sub>pLH</sub> | 5              | —       | 50  | 130  | ns  |      |
|   |   |                  | 10             | —       | 30  | 70   |     |      |
|   |   |                  | 15             | —       | 25  | 55   |     |      |
|   | Propagation delay time<br>(high to low) | t <sub>pHL</sub> | 5              | —       | 30  | 70   | ns  |      |
|   |   |                  | 10             | —       | 17  | 35   |     |      |
|   |   |                  | 15             | —       | 14  | 25   |     |      |
| Input capacitance                       |   | C <sub>IN</sub>  | —              |         | —   | 5    | 7.5 | pF   |

## Waveform for Measurement of Dynamic Characteristics

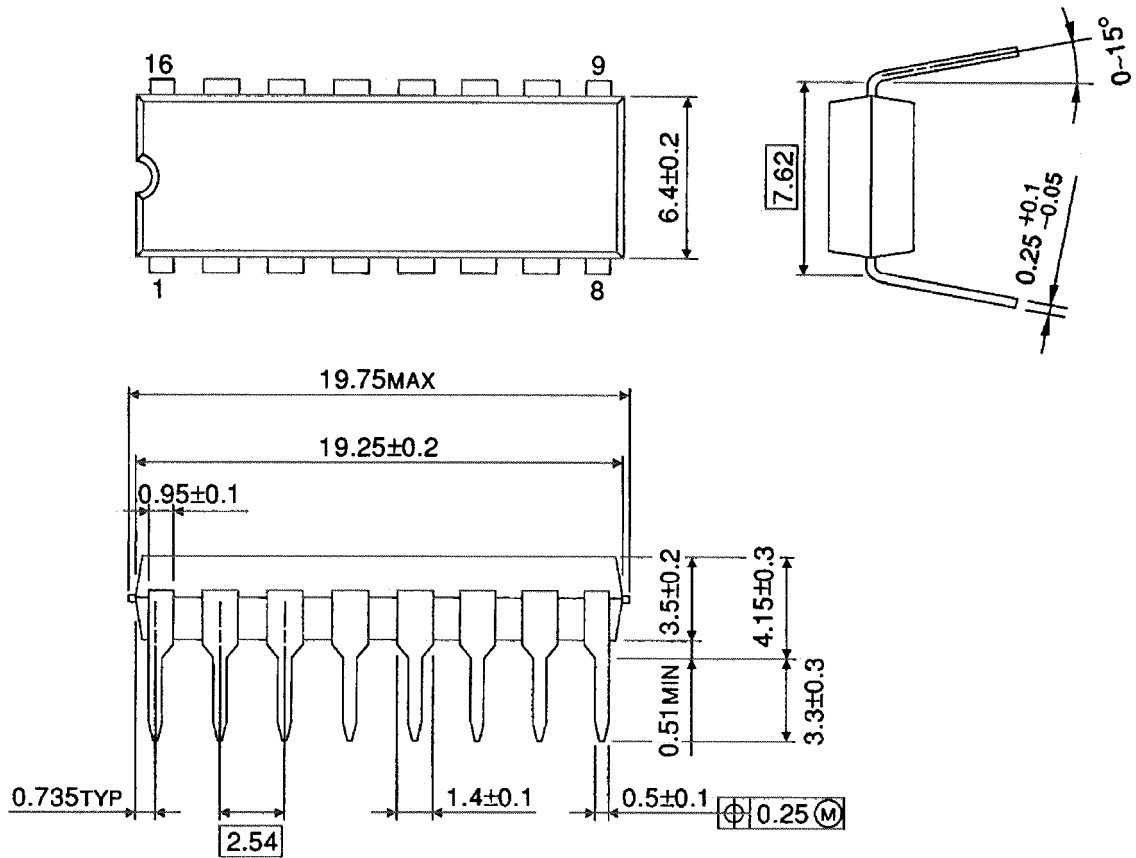
### Waveform



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

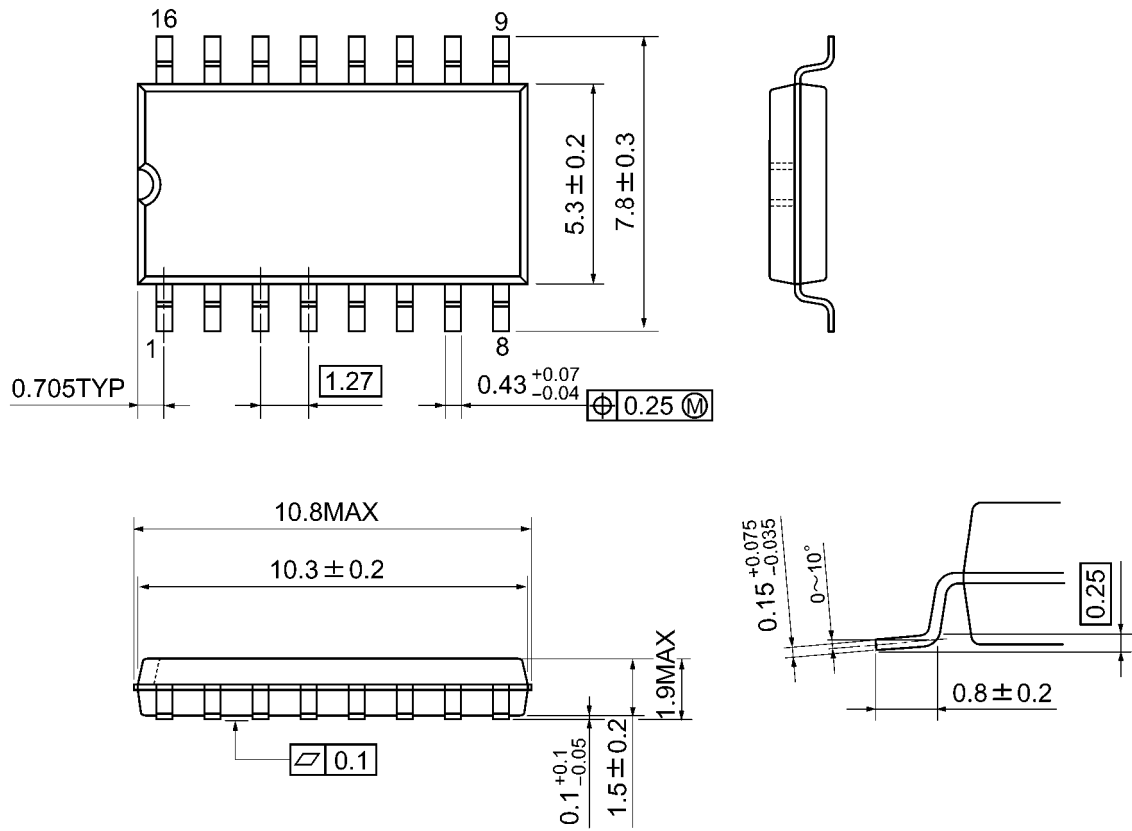


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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