

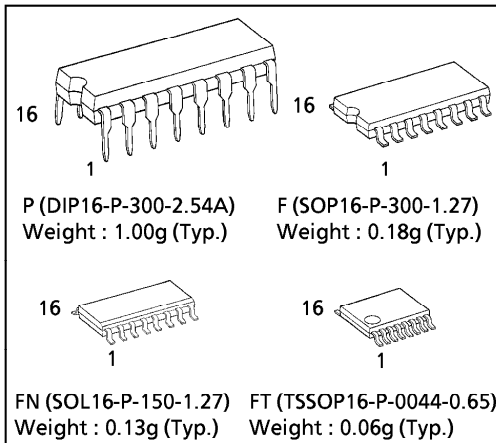
## TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC4051BP, TC4051BF, TC4051BFN, TC4051BFT**  
**TC4052BP, TC4052BF, TC4052BFN, TC4052BFT**  
**TC4053BP, TC4053BF, TC4053BFN, TC4053BFT**

**TC4051B SINGLE 8-CHANNEL MULTIPLEXER / DEMULTIPLEXER**  
**TC4052B DIFFERENTIAL 4-CHANNEL MULTIPLEXER / DEMULTIPLEXER**  
**TC4053B TRIPLE 2-CHANNEL MULTIPLEXER / DEMULTIPLEXER**

(Note) The JEDEC SOP (FN) is not available in Japan.

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×2 configuration and TC4053B has 2 channel×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  $V_{DD}=5V$   $V_{SS}=0V$  and  $V_{EE}=-5V$ , signals between  $-5V$  and  $+5V$  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.



### MAXIMUM RATINGS

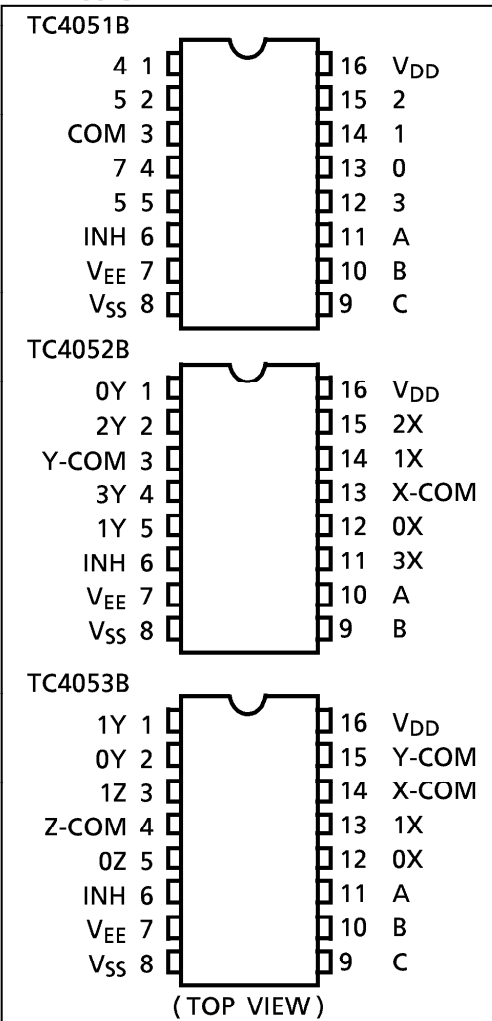
| CHARACTERISTIC                            | SYMBOL          | RATING                      | UNIT |
|-------------------------------------------|-----------------|-----------------------------|------|
| DC Supply Voltage                         | $V_{DD}-V_{SS}$ | -0.5~20                     | V    |
| DC Supply Voltage                         | $V_{DD}-V_{EE}$ | -0.5~20                     | V    |
| Control Input Voltage                     | $V_{CIN}$       | $V_{SS}-0.5\sim V_{DD}+0.5$ | V    |
| Switch I/O Voltage                        | $V_I/V_O$       | $V_{EE}-0.5\sim V_{DD}+0.5$ | V    |
| Control Input Current                     | $I_{CIN}$       | ±10                         | mA   |
| Potential difference across I/O during ON | $V_I-V_O$       | -0.5~0.5                    | V    |
| Power Dissipation                         | $P_D$           | 300 (DIP) / 180 (SOIC)      | mW   |
| Operating Temperature Range               | $T_{opr}$       | -40~85                      | °C   |
| Storage Temperature Range                 | $T_{stg}$       | -65~150                     | °C   |

### TRUTH TABLE

| CONTROL INPUTS |              |   |   | "ON" CHANNEL |         |            |
|----------------|--------------|---|---|--------------|---------|------------|
| INHIBIT        | $C\triangle$ | 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              | *            | * | * | NONE         | NONE    | NONE       |

\* : Don't Care  $\triangle$  Except TC4052B

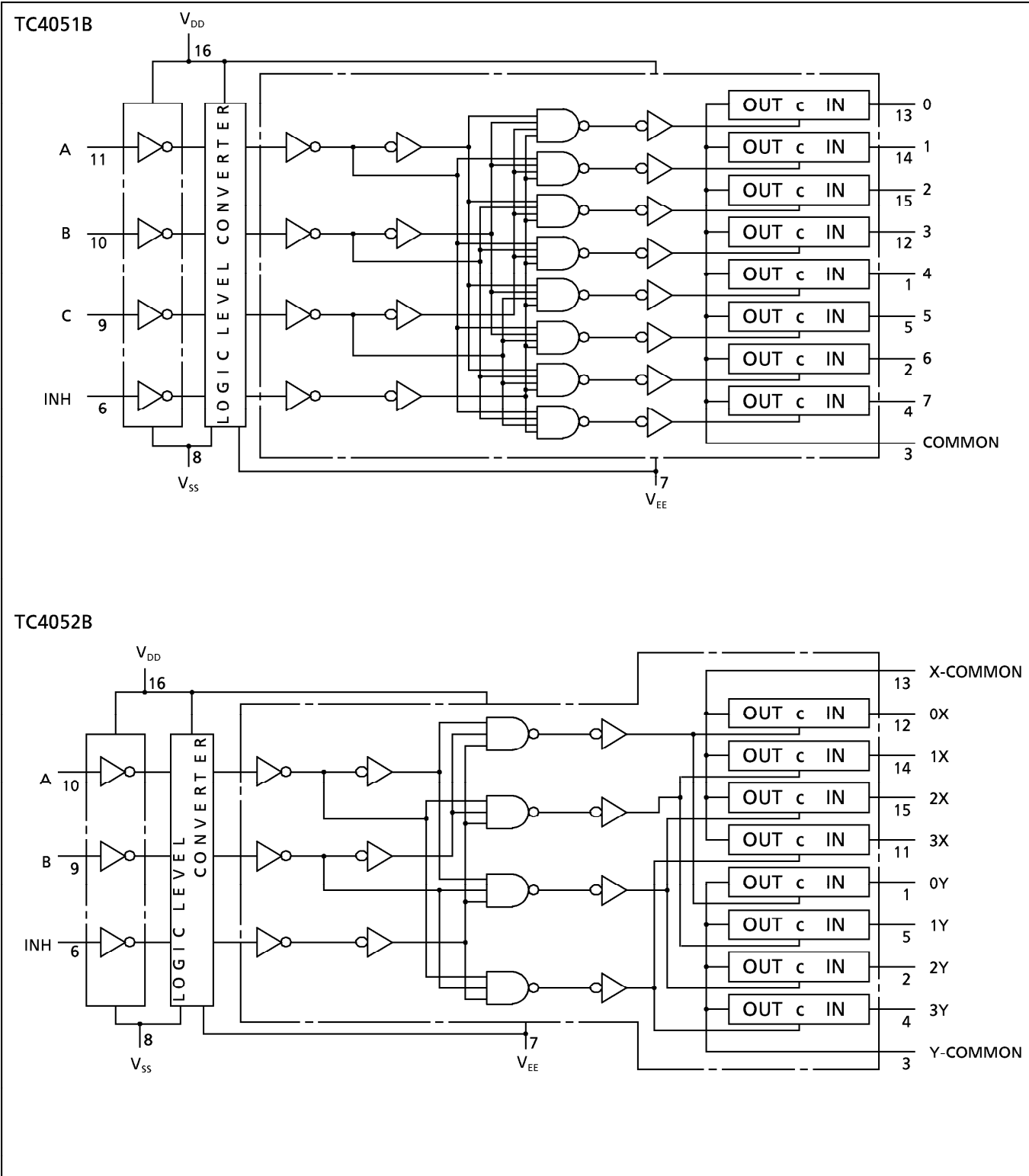
### PIN ASSIGNMENT



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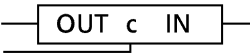
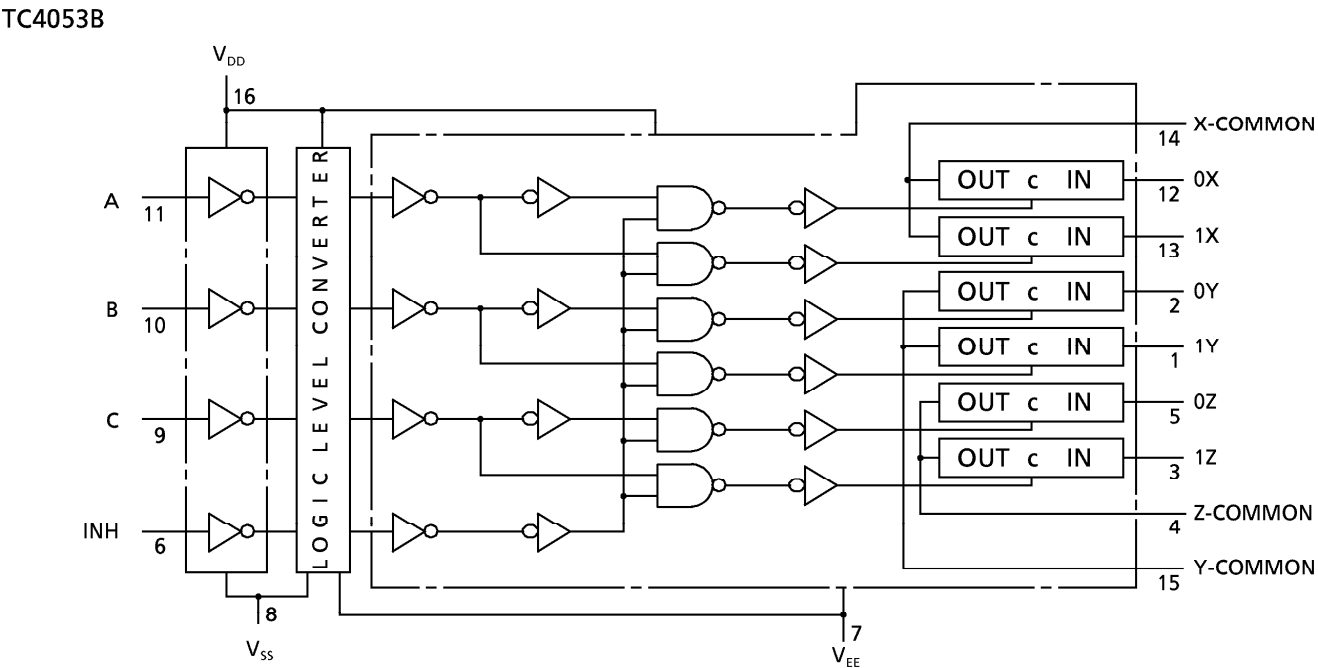
**LOGIC DIAGRAM**



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LOGIC DIAGRAM



TRUTH TABLE

| CONTROL<br>C | Impedance Between<br>IN-OUT*    |
|--------------|---------------------------------|
| H            | $0.5 \sim 5 \times 10^2 \Omega$ |
| L            | $> 10^9 \Omega$                 |

\* See Electrical Characteristics

## RECOMMENDED OPERATING CONDITIONS

| CHARACTERISTIC         | 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    |

## STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC                                      | SYM-BOL          | TEST CONDI-TION                                              | $V_{SS}$ (V) $V_{EE}$ (V) $V_{DD}$ (V) |          |          | - 40°C |           | 25°C |            |           | 85°C |            | UNIT     |
|-----------------------------------------------------|------------------|--------------------------------------------------------------|----------------------------------------|----------|----------|--------|-----------|------|------------|-----------|------|------------|----------|
|                                                     |                  |                                                              | $V_{SS}$                               | $V_{EE}$ | $V_{DD}$ | MIN.   | MAX.      | MIN. | TYP.       | MAX.      | MIN. | MAX.       |          |
| Control Input High Voltage                          | $V_{IH}$         | $V_{IS} = V_{DD}$<br>thru 1k $\Omega$                        | $V_{EE} = V_{SS}$                      |          | 5        | 3.5    | —         | 3.5  | 2.75       | —         | 3.5  | —          | V        |
|                                                     |                  |                                                              | $R_L = 1k\Omega$                       |          | 10       | 7.0    | —         | 7.0  | 5.50       | —         | 7.0  | —          |          |
|                                                     |                  |                                                              | to $V_{SS}$                            |          | 15       | 11.0   | —         | 11.0 | 8.25       | —         | 11.0 | —          |          |
| Control Input Low Voltage                           | $V_{IL}$         |                                                              | $I_{IS} < 2\mu A$                      |          | 5        | —      | 1.5       | —    | 2.25       | 1.5       | —    | 1.5        |          |
|                                                     |                  |                                                              | on all OFF                             |          | 10       | —      | 3.0       | —    | 4.5        | 3.0       | —    | 3.0        |          |
|                                                     |                  |                                                              | channels                               |          | 15       | —      | 4.0       | —    | 6.75       | 4.0       | —    | 4.0        |          |
| On-State Resistance                                 | $R_{ON}$         | $0 \leq V_{IS} \leq V_{DD}$                                  | 0                                      | 0        | 5        | —      | 850       | —    | 240        | 950       | —    | 1200       | $\Omega$ |
|                                                     |                  | $R_L = 10k\Omega$                                            | 0                                      | 0        | 10       | —      | 210       | —    | 110        | 250       | —    | 300        |          |
|                                                     |                  |                                                              | 0                                      | 0        | 15       | —      | 140       | —    | 80         | 160       | —    | 200        |          |
| $\Delta$ On-State Resistance Between Any 2 Switches | $R_{ON} \Delta$  |                                                              | 0                                      | 0        | 5        | —      | —         | —    | 10         | —         | —    | —          |          |
|                                                     |                  |                                                              | 0                                      | 0        | 10       | —      | —         | —    | 6          | —         | —    | —          |          |
|                                                     |                  |                                                              | 0                                      | 0        | 15       | —      | —         | —    | 4          | —         | —    | —          |          |
| Input / Output Leakage Current                      | $I_{OFF}$        | $V_{IN} = 18V, V_{OUT} = 0V$<br>$V_{IN} = 0V, V_{OUT} = 18V$ |                                        |          | 18       | —      | $\pm 100$ | —    | $\pm 0.01$ | $\pm 100$ | —    | $\pm 1000$ | nA       |
|                                                     |                  |                                                              |                                        |          | 18       | —      | $\pm 100$ | —    | $\pm 0.01$ | $\pm 100$ | —    | $\pm 1000$ |          |
| Quiescent Supply Current                            | $I_{DD}$         | $V_{IN} = V_{SS}, V_{DD}^*$                                  |                                        |          | 5        | —      | 5.0       | —    | 0.005      | 5.0       | —    | 150        | $\mu A$  |
|                                                     |                  |                                                              |                                        |          | 10       | —      | 10        | —    | 0.010      | 10        | —    | 300        |          |
|                                                     |                  |                                                              |                                        |          | 15       | —      | 20        | —    | 0.015      | 20        | —    | 600        |          |
| Input Current                                       | $I_{IN}$         | $V_{IH} = 18V$<br>$V_{IL} = 0V$                              |                                        |          | 18       | —      | 0.1       | —    | $10^{-5}$  | 0.1       | —    | 1.0        |          |
|                                                     |                  |                                                              |                                        |          | 18       | —      | -0.1      | —    | $-10^{-5}$ | -0.1      | —    | -1.0       |          |
| Input Capacitance                                   | $C_{IN}$         |                                                              |                                        |          |          | —      | —         | —    | 5          | 7.5       | —    | —          | pF       |
| Switch Input Capacitance                            | $C_{IN}$         |                                                              |                                        |          |          | —      | —         | —    | 10         | —         | —    | —          |          |
| Output Capacitance                                  | $C_{OUT}$        | TC4051B<br>TC4052B<br>TC4053B                                |                                        |          | 10       | —      | —         | —    | 58         | —         | —    | —          |          |
|                                                     |                  |                                                              |                                        |          | 10       | —      | —         | —    | 30         | —         | —    | —          |          |
|                                                     |                  |                                                              |                                        |          | 10       | —      | —         | —    | 17         | —         | —    | —          |          |
| Feedthrough Capacitance                             | $C_{IN}-C_{OUT}$ | TC4051B<br>TC4052B<br>TC4053B                                |                                        |          | 10       | —      | —         | —    | 0.2        | —         | —    | —          |          |
|                                                     |                  |                                                              |                                        |          | 10       | —      | —         | —    | 0.2        | —         | —    | —          |          |
|                                                     |                  |                                                              |                                        |          | 10       | —      | —         | —    | 0.2        | —         | —    | —          |          |

\* All valid input combinations.

## DYNAMIC ELECTRICAL CHARACTERISTICS (Ta = 25°C, CL = 50pF)

| CHARACTERISTIC                                          | SYMBOL               | TEST<br>CONDITION                                            | V <sub>SS</sub> (V) V <sub>EE</sub> (V) V <sub>DD</sub> (V) |                    |                 | MIN.        | TYP.                 | MAX.           | UNIT |
|---------------------------------------------------------|----------------------|--------------------------------------------------------------|-------------------------------------------------------------|--------------------|-----------------|-------------|----------------------|----------------|------|
|                                                         |                      |                                                              |                                                             |                    |                 |             |                      |                |      |
| Phase Difference<br>Between Input to<br>Output          | $\phi_I - O$         |                                                              | 0<br>0<br>0                                                 | 0<br>0<br>0        | 5<br>10<br>15   | —<br>—<br>— | 15<br>8<br>6         | 45<br>20<br>15 | ns   |
| Propagation Delay Time<br>(A, B, C, - OUT)              | $t_{pZL}$            | $R_L = 1k\Omega$                                             | 0                                                           | 0                  | 5               | —           | 170                  | 550            |      |
|                                                         | $t_{pZH}$            |                                                              | 0                                                           | 0                  | 10              | —           | 90                   | 240            |      |
|                                                         | $t_{pLZ}$            |                                                              | 0                                                           | 0                  | 15              | —           | 70                   | 160            |      |
|                                                         | $t_{pLZ}$            |                                                              | 0                                                           | -5                 | 5               | —           | 100                  | 240            |      |
|                                                         | $t_{pHZ}$            |                                                              | 0                                                           | -7.5               | 7.5             | —           | 80                   | 160            |      |
| Propagation Delay Time<br>(INH - OUT)                   | $t_{pZL}$            | $R_L = 1k\Omega$                                             | 0                                                           | 0                  | 5               | —           | 120                  | 380            |      |
|                                                         | $t_{pZH}$            |                                                              | 0                                                           | 0                  | 10              | —           | 60                   | 200            |      |
|                                                         | $t_{pLZ}$            |                                                              | 0                                                           | 0                  | 15              | —           | 50                   | 160            |      |
|                                                         | $t_{pLZ}$            |                                                              | 0                                                           | -5                 | 5               | —           | 80                   | 200            |      |
|                                                         | $t_{pHZ}$            |                                                              | 0                                                           | -7.5               | 7.5             | —           | 60                   | 160            |      |
| Propagation Delay Time<br>(INH - OUT)                   | $t_{pLZ}$            | $R_L = 1k\Omega$                                             | 0                                                           | 0                  | 5               | —           | 170                  | 450            |      |
|                                                         | $t_{pZH}$            |                                                              | 0                                                           | 0                  | 10              | —           | 90                   | 210            |      |
|                                                         | $t_{pLZ}$            |                                                              | 0                                                           | 0                  | 15              | —           | 70                   | 160            |      |
|                                                         | $t_{pLZ}$            |                                                              | 0                                                           | -5                 | 5               | —           | 100                  | 210            |      |
|                                                         | $t_{pHZ}$            |                                                              | 0                                                           | -7.5               | 7.5             | —           | 80                   | 160            |      |
| - 3dB Cutoff Frequency<br>TC4051B<br>TC4052B<br>TC4053B | $f_{MAX}$<br>(I - O) | $R_L = 1k\Omega$ (*1)                                        | -5<br>-5<br>-5                                              | -5<br>-5<br>-5     | 5<br>5<br>5     | —<br>—<br>— | 20<br>30<br>40       | —<br>—<br>—    | MHz  |
| Total Harmonic<br>Distortion                            | —                    | $R_L = 10k\Omega$<br>$f = 1kHz$ (*2)                         | -2.5<br>-5<br>-7.5                                          | -2.5<br>-5<br>-7.5 | 2.5<br>5<br>7.5 | —<br>—<br>— | 0.15<br>0.03<br>0.02 | —<br>—<br>—    | %    |
| - 50dB Feedthrough<br>(SWITCH OFF)                      | —                    | $R_L = 1k\Omega$ (*3)                                        | -5                                                          | -5                 | 5               | —           | 500                  | —              | kHz  |
| Crosstalk                                               | —                    | $R_L = 1k\Omega$ (*4)                                        | -5                                                          | -5                 | 5               | —           | 1.5                  | —              | MHz  |
| Crosstalk<br>(CONTROL - OUT)                            | —                    | $R_{IN} = 1k\Omega$<br>$R_{OUT} = 10k\Omega$<br>$C_L = 15pF$ | 0<br>0<br>0                                                 | 0<br>0<br>0        | 5<br>10<br>15   | —<br>—<br>— | 200<br>400<br>600    | —<br>—<br>—    | mV   |

\*1 Sine wave of  $\pm 2.5V_{p-p}$  shall be used for  $V_{is}$  and the frequency of  $20 \log 10 \frac{V_{OS}}{V_{is}} = -3dB$  shall be  $f_{MAX}$ .

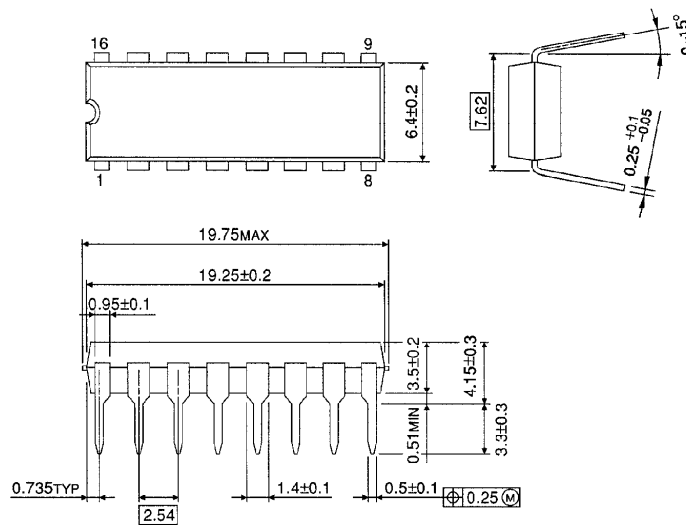
\*2  $V_{is}$  shall be sine wave of  $\pm \left( \frac{V_{DD} - V_{EE}}{4} \right) p-p$ .

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

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

**DIP 16PIN OUTLINE DRAWING (DIP16-P-300-2.54A)**

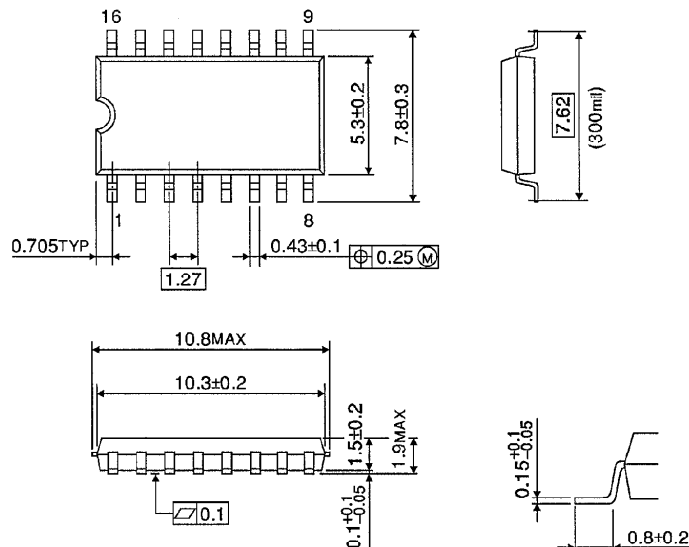
Unit in mm



Weight : 1.00g (Typ.)

**SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27)**

Unit in mm



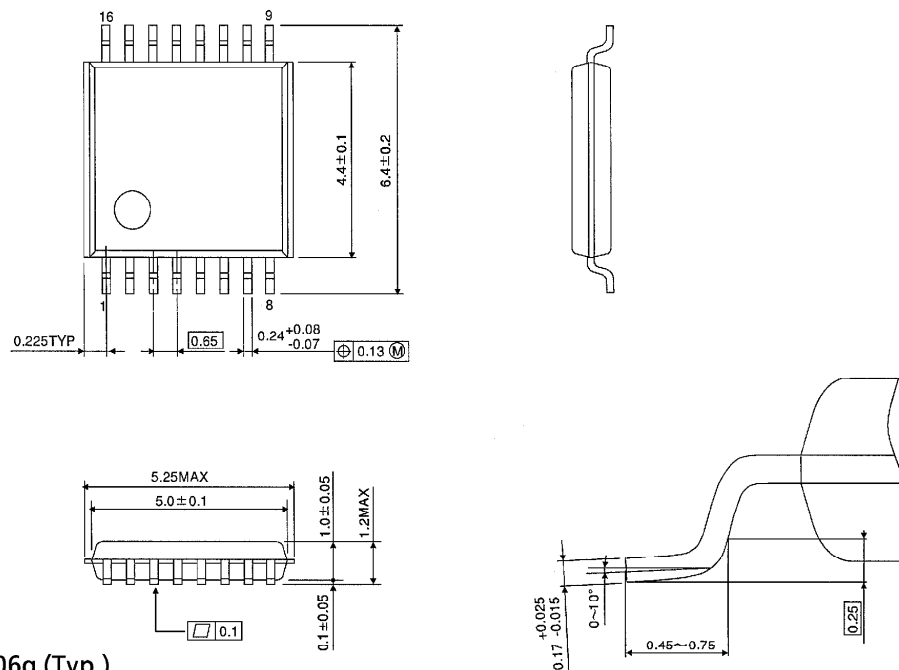
Weight : 0.18g (Typ.)

## Unit in mm

[illegible]

Weight : 0.13g (Typ.)

## Unit in mm



Weight : 0.06g (Typ.)