

TOSHIBA CMOS Digital Integrated Circuit    Silicon Monolithic

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

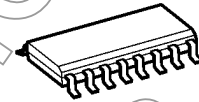
Single 8-Channel Multiplexer/Demultiplexer

**TC4052B**Differential 4-Channel  
Multiplexer/Demultiplexer**TC4053B**

Triple 2-Channel Multiplexer/Demultiplexer

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

TC4051BFN, TC4052BFN, TC4053BFN

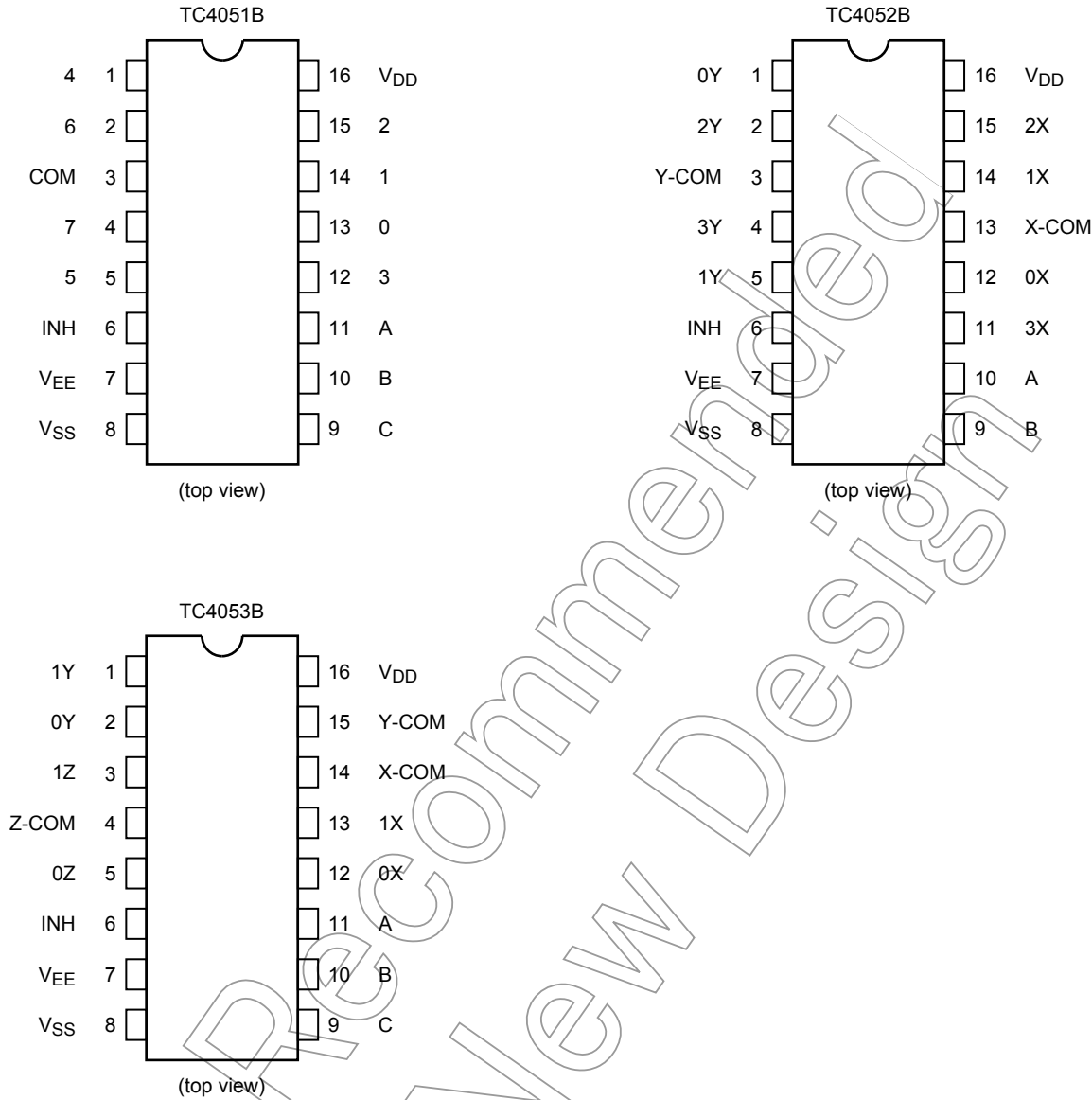


SOL16-P-150-1.27

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  $-5\text{ V}$  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

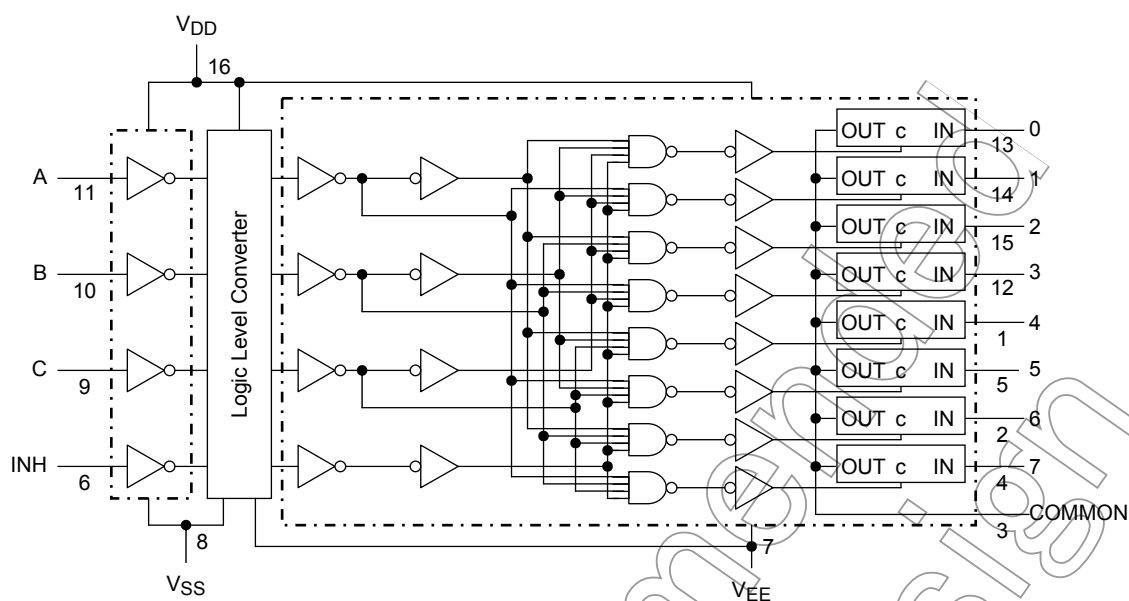
| Control Inputs |    |   |   | “ON” Channel |         |            |
|----------------|----|---|---|--------------|---------|------------|
| Inhibit        | CΔ | B | A | TC4051B      | TC4052B | TC4053B    |
| L              | L  | L | L | 0            | 0X, 0Y  | 0X, 0Y, 0Z |
| L              | L  | 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

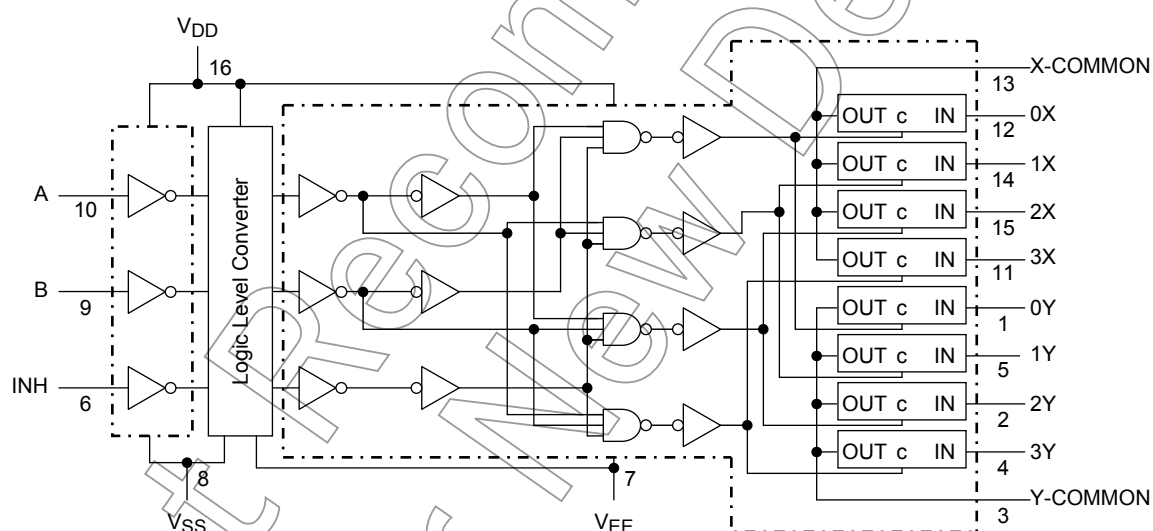
Δ: Except TC4052B

## Logic Diagram

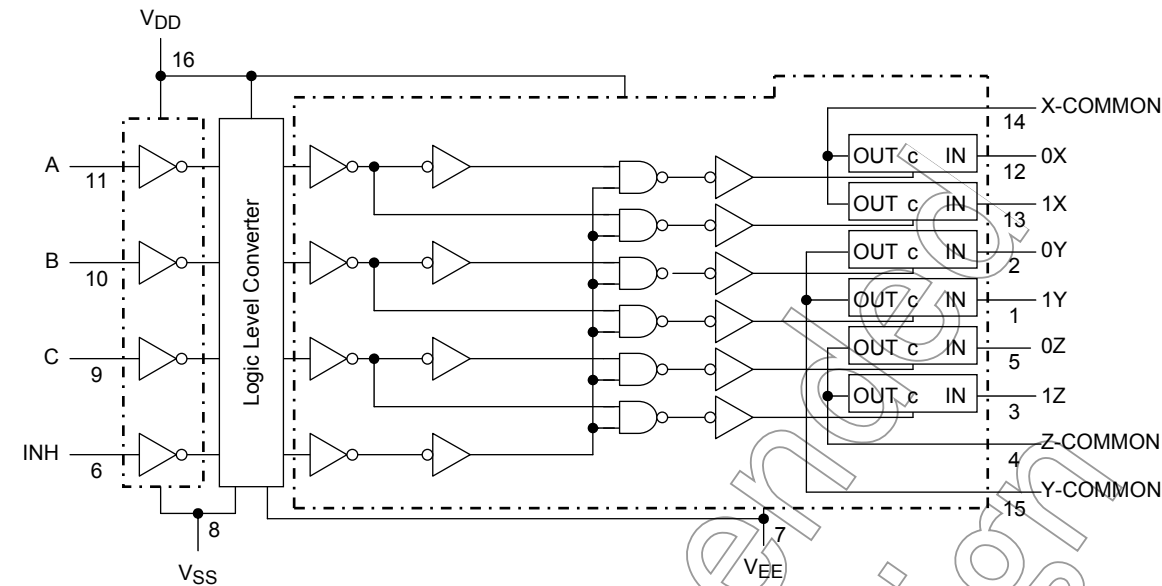
### TC4051B



### TC4052B



TC4053B



Truth Table

| Control<br>C | Impedance between<br>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                     | $I_{CIN}$       | $\pm 10$                                | 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 <sub>SS</sub><br>(V)                                                                           | V <sub>EE</sub><br>(V)                                                           | V <sub>DD</sub><br>(V) | Min            | Max         | Min         | Typ.        | Max               | Min         | Max         |             |    |
| Control input high voltage                  | V <sub>IH</sub>                       | V <sub>IS</sub> = V <sub>DD</sub><br>thru 1 kΩ                                                   | V <sub>EE</sub> = V <sub>SS</sub><br>R <sub>L</sub> = 1 kΩ<br>to V <sub>SS</sub> |                        | 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 <sub>IL</sub>                       |                                                                                                  | I <sub>IS</sub> < 2 μA<br>on all OFF<br>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 <sub>ON</sub>                       | 0 ≤ V <sub>IS</sub> ≤ V <sub>DD</sub><br>R <sub>L</sub> = 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 <sub>ONΔ</sub>                      | —                                                                                                | 0                                                                                | 0                      | 5              | —           | —           | —           | 10                | —           | —           | —           | Ω  |
|                                             |                                       |                                                                                                  | 0                                                                                | 0                      | 10             | —           | —           | —           | 6                 | —           | —           | —           |    |
|                                             |                                       |                                                                                                  | 0                                                                                | 0                      | 15             | —           | —           | —           | 4                 | —           | —           | —           |    |
| Input/output leakage current                | I <sub>OFF</sub>                      | V <sub>IN</sub> = 18 V, V <sub>OUT</sub> = 0 V<br>V <sub>IN</sub> = 0 V, V <sub>OUT</sub> = 18 V |                                                                                  |                        | 18             | —           | ±100        | —           | ±0.01             | ±100        | —           | ±1000       | nA |
|                                             |                                       |                                                                                                  |                                                                                  |                        | 18             | —           | ±100        | —           | ±0.01             | ±100        | —           | ±1000       |    |
| Quiescent supply current                    | I <sub>DD</sub>                       | V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>                                              | (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 <sub>IN</sub>                       | V <sub>IH</sub> = 18 V<br>V <sub>IL</sub> = 0 V                                                  |                                                                                  |                        | 18             | —           | 0.1         | —           | 10 <sup>-5</sup>  | 0.1         | —           | 1.0         | μA |
|                                             |                                       |                                                                                                  |                                                                                  |                        | 18             | —           | -0.1        | —           | -10 <sup>-5</sup> | -0.1        | —           | -1.0        |    |
| Input capacitance                           | C <sub>IN</sub>                       |                                                                                                  |                                                                                  |                        | —              | —           | —           | —           | 5                 | 7.5         | —           | —           | pF |
| Switch input capacitance                    | C <sub>IN</sub>                       |                                                                                                  |                                                                                  |                        | —              | —           | —           | —           | 10                | —           | —           | —           | pF |
| Output capacitance                          | C <sub>OUT</sub>                      | TC4051B<br>TC4052B<br>TC4053B                                                                    |                                                                                  |                        | 10<br>10<br>10 | —<br>—<br>— | —<br>—<br>— | —<br>—<br>— | 58<br>30<br>17    | —<br>—<br>— | —<br>—<br>— | —<br>—<br>— | pF |
| Feedthrough capacitance                     | C <sub>IN</sub> -<br>C <sub>OUT</sub> | TC4051B<br>TC4052B<br>TC4053B                                                                    |                                                                                  |                        | 10<br>10<br>10 | —<br>—<br>— | —<br>—<br>— | —<br>—<br>— | 0.2<br>0.2<br>0.2 | —<br>—<br>— | —<br>—<br>— | —<br>—<br>— | 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 | $\phi_{I-O}$     | —                                               | 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                |                  | $R_L = 10\text{ k}\Omega$<br>$f = 1\text{ kHz}$ | (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  $\pm \left( \frac{V_{DD} - V_{EE}}{4} \right) p-p$ .

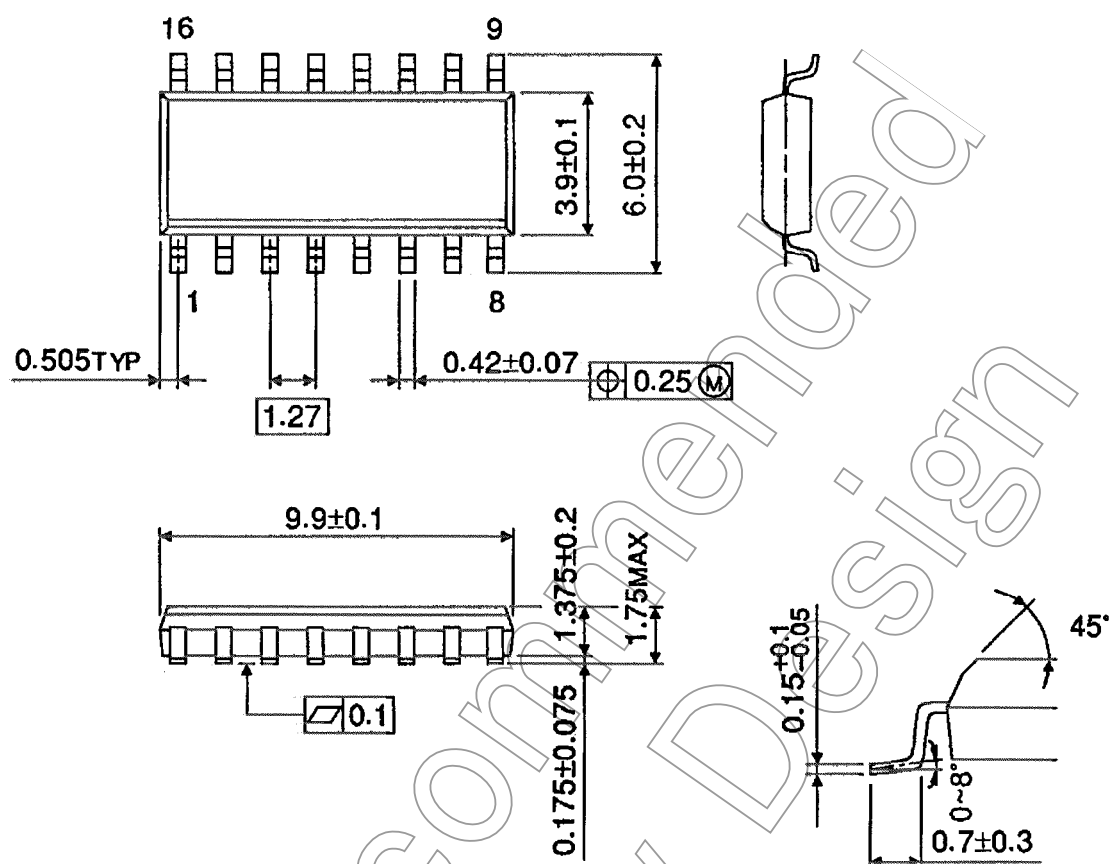
Note 3: Sine wave of  $\pm 2.5\text{ V}_{p-p}$  shall be used for  $V_{is}$  and the frequency of  $20 \log 10 \frac{V_{OS}}{V_{is}} = -50\text{dB}$  shall be feed-through.

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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