

# 74VHC153FT

## 1. Functional Description

- Dual 4-Channel Multiplexer

## 2. General

The 74VHC153FT is an advanced high speed CMOS DUAL 4-CHANNEL MULTIPLEXERS fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

Each of these data (1C0-1C3, 2C0-2C3) is selected by the two address inputs A and B.

Separate strobe inputs ( $\overline{1G}$ ,  $\overline{2G}$ ) are provided for each of the two four-line sections.

The strobe input ( $\overline{G}$ ) can be used to inhibit the data output; the output is fixed in low level while the strobe input is held high.

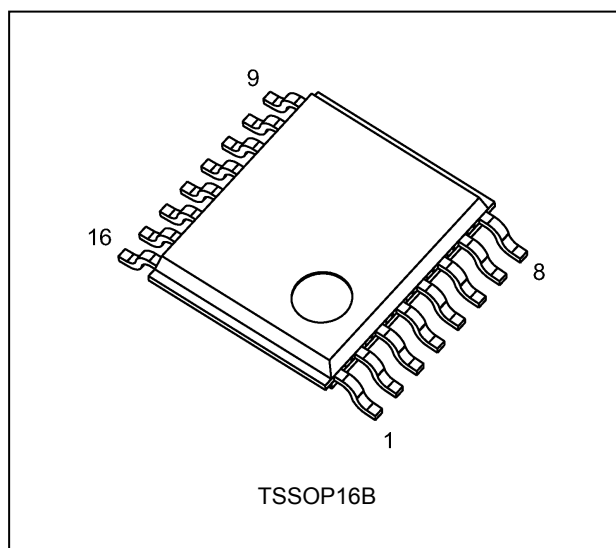
An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

## 3. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature:  $T_{opr} = -40$  to  $125$  °C
- (3) High speed:  $t_{pd} = 5.0$  ns (typ.) at  $V_{CC} = 5$  V
- (4) Low power dissipation:  $I_{CC} = 4.0$   $\mu$ A (max) at  $T_a = 25$  °C
- (5) High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- (6) Power down protection is provided on all inputs.
- (7) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (8) Wide operating voltage range:  $V_{CC(opr)} = 2.0$  V to  $5.5$  V
- (9) Pin and function compatible with 74ALS153.

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

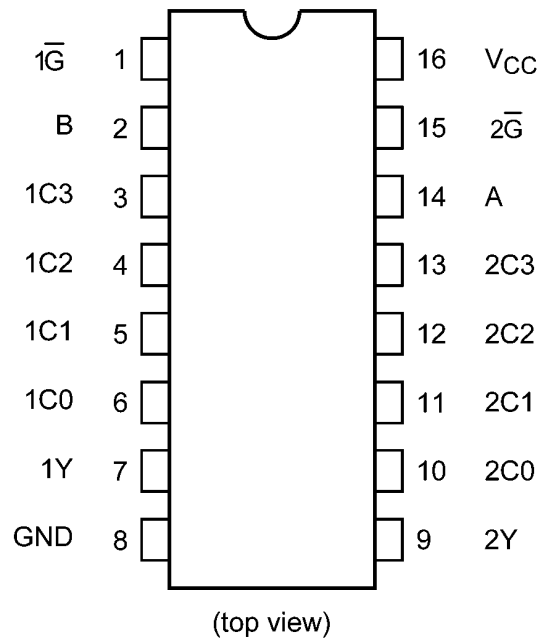
## 4. Packaging



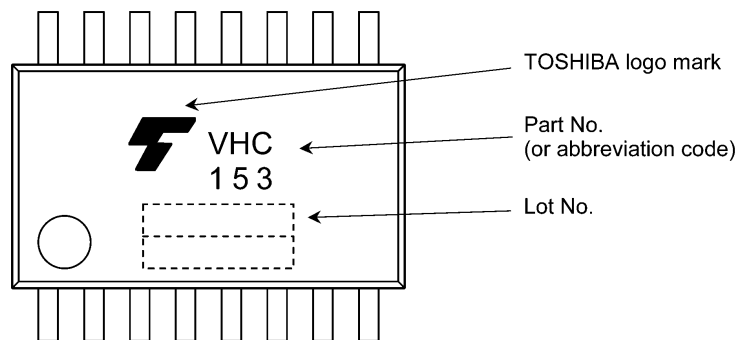
Start of commercial production

2014-11

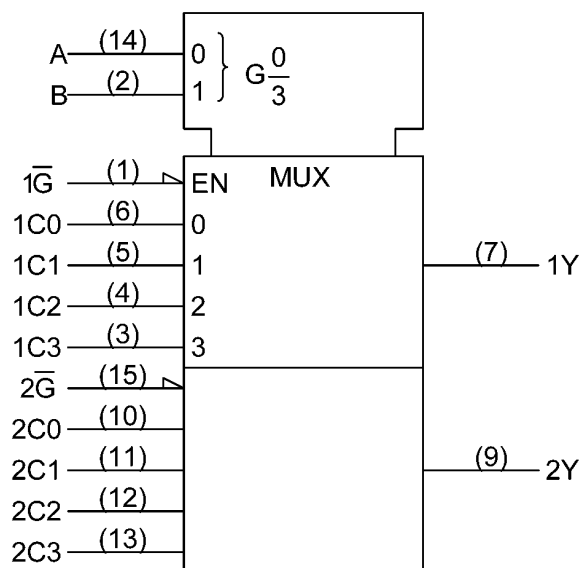
**5. Pin Assignment**



**6. Marking**



**7. IEC Logic Symbol**

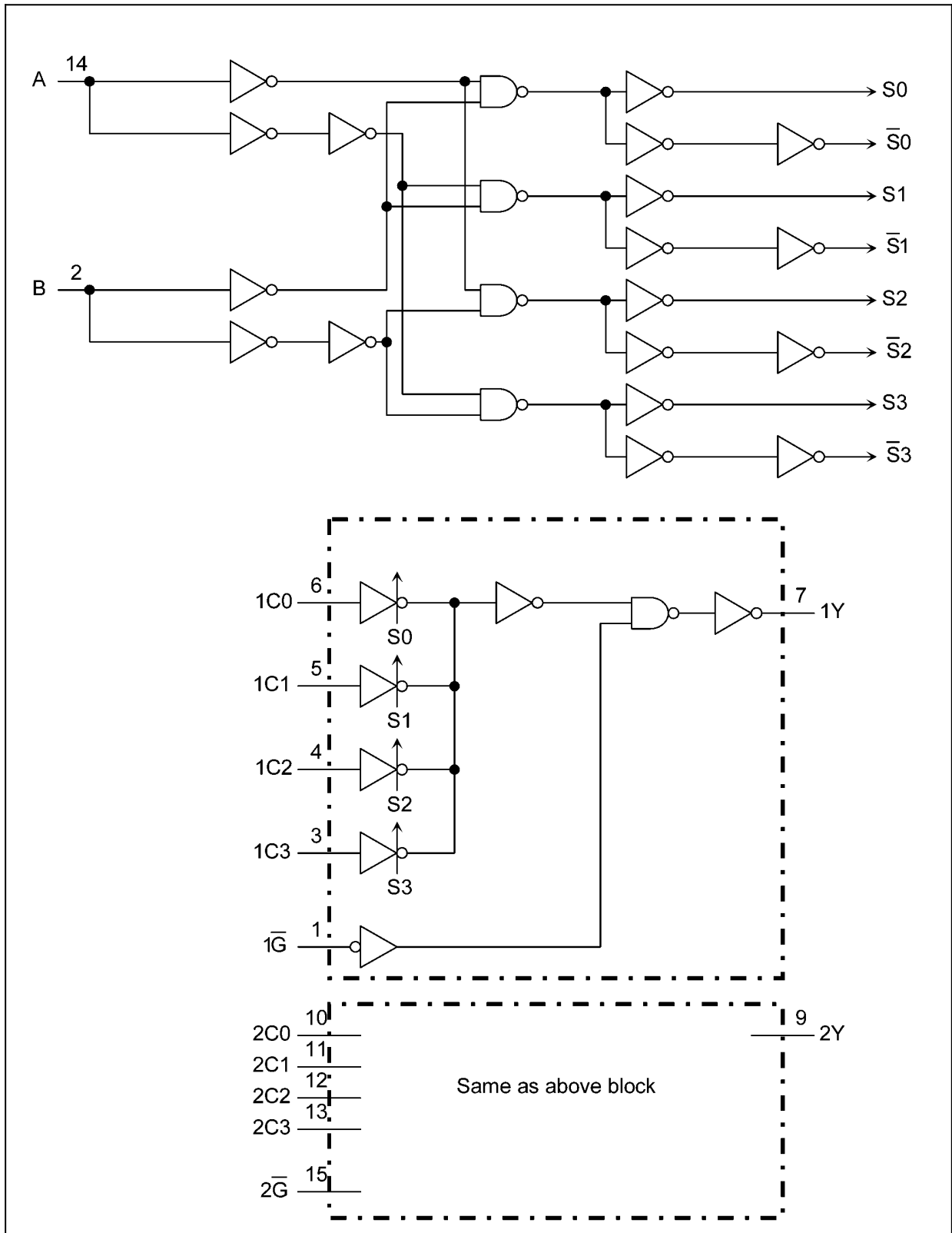


**8. Truth Table**

| Select Inputs |   | Data Inputs |    |    |    | Strobe    | Output |
|---------------|---|-------------|----|----|----|-----------|--------|
| B             | A | C0          | C1 | C2 | C3 | $\bar{G}$ | Y      |
| X             | X | X           | X  | X  | X  | H         | L      |
| L             | L | L           | X  | X  | X  | L         | L      |
| L             | L | H           | X  | X  | X  | L         | H      |
| L             | H | X           | L  | X  | X  | L         | L      |
| L             | H | X           | H  | X  | X  | L         | H      |
| H             | L | X           | X  | L  | X  | L         | L      |
| H             | L | X           | X  | H  | X  | L         | H      |
| H             | H | X           | X  | X  | L  | L         | L      |
| H             | H | X           | X  | X  | H  | L         | H      |

X: Don't care

9. System Diagram



**10. Absolute Maximum Ratings (Note)**

| Characteristics          | Symbol    | Note     | Rating                 | Unit |
|--------------------------|-----------|----------|------------------------|------|
| Supply voltage           | $V_{CC}$  |          | -0.5 to 7.0            | V    |
| Input voltage            | $V_{IN}$  |          | -0.5 to 7.0            | V    |
| Output voltage           | $V_{OUT}$ |          | -0.5 to $V_{CC} + 0.5$ | V    |
| Input diode current      | $I_{IK}$  |          | -20                    | mA   |
| Output diode current     | $I_{OK}$  |          | $\pm 20$               | mA   |
| Output current           | $I_{OUT}$ |          | $\pm 25$               | mA   |
| $V_{CC}$ /ground current | $I_{CC}$  |          | $\pm 50$               | mA   |
| Power dissipation        | $P_D$     | (Note 1) | 180                    | mW   |
| Storage temperature      | $T_{stg}$ |          | -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).

Note 1: 180 mW in the range of  $T_a = -40$  to  $85$  °C. From  $T_a = 85$  to  $125$  °C a derating factor of  $-3.25$  mW/°C shall be applied until 50 mW.

**11. Operating Ranges (Note)**

| Characteristics           | Symbol    | Test Condition           | Rating        | Unit |
|---------------------------|-----------|--------------------------|---------------|------|
| Supply voltage            | $V_{CC}$  |                          | 2.0 to 5.5    | V    |
| Input voltage             | $V_{IN}$  |                          | 0 to 5.5      | V    |
| Output voltage            | $V_{OUT}$ |                          | 0 to $V_{CC}$ | V    |
| Operating temperature     | $T_{opr}$ |                          | -40 to 125    | °C   |
| Input rise and fall times | $dt/dv$   | $V_{CC} = 3.3 \pm 0.3$ V | 0 to 100      | ns/V |
|                           |           | $V_{CC} = 5 \pm 0.5$ V   | 0 to 20       |      |

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

**12. Electrical Characteristics**

**12.1. DC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

| Characteristics           | Symbol                   | Test Condition                | $V_{CC}$ (V)                      | Min                              | Typ. | Max                 | Unit          |               |
|---------------------------|--------------------------|-------------------------------|-----------------------------------|----------------------------------|------|---------------------|---------------|---------------|
| High-level input voltage  | $V_{IH}$                 | —                             | 2.0                               | 1.50                             | —    | —                   | V             |               |
|                           |                          |                               | 3.0 to 5.5                        | $V_{CC} \times 0.7$              | —    | —                   |               |               |
| Low-level input voltage   | $V_{IL}$                 | —                             | 2.0                               | —                                | —    | 0.50                | V             |               |
|                           |                          |                               | 3.0 to 5.5                        | —                                | —    | $V_{CC} \times 0.3$ |               |               |
| High-level output voltage | $V_{OH}$                 | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OH} = -50\text{ }\mu\text{A}$ | 2.0                              | 1.9  | 2.0                 | —             | V             |
|                           |                          |                               |                                   | 3.0                              | 2.9  | 3.0                 | —             |               |
|                           |                          |                               |                                   | 4.5                              | 4.4  | 4.5                 | —             |               |
|                           |                          |                               | $I_{OH} = -4\text{ mA}$           | 3.0                              | 2.58 | —                   | —             |               |
| $I_{OH} = -8\text{ mA}$   | 4.5                      | 3.94                          |                                   | —                                | —    |                     |               |               |
|                           | Low-level output voltage | $V_{OL}$                      | $V_{IN} = V_{IH}$ or $V_{IL}$     | $I_{OL} = 50\text{ }\mu\text{A}$ | 2.0  | —                   | 0.0           | 0.1           |
| 3.0                       |                          |                               |                                   |                                  | —    | 0.0                 | 0.1           |               |
| 4.5                       |                          |                               |                                   |                                  | —    | 0.0                 | 0.1           |               |
| $I_{OL} = 4\text{ mA}$    |                          |                               |                                   | 3.0                              | —    | —                   | 0.36          |               |
|                           | $I_{OL} = 8\text{ mA}$   | 4.5                           | —                                 | —                                | 0.36 |                     |               |               |
| Input leakage current     |                          | $I_{IN}$                      | $V_{IN} = 5.5\text{ V}$ or GND    | 0 to 5.5                         | —    | —                   | $\pm 0.1$     | $\mu\text{A}$ |
| Quiescent supply current  | $I_{CC}$                 | $V_{IN} = V_{CC}$ or GND      | 5.5                               | —                                | —    | 4.0                 | $\mu\text{A}$ |               |

**12.2. DC Characteristics (Unless otherwise specified,  $T_a = -40$  to  $85\text{ }^\circ\text{C}$ )**

| Characteristics           | Symbol                   | Test Condition                | $V_{CC}$ (V)                      | Min                              | Max                 | Unit          |               |
|---------------------------|--------------------------|-------------------------------|-----------------------------------|----------------------------------|---------------------|---------------|---------------|
| High-level input voltage  | $V_{IH}$                 | —                             | 2.0                               | 1.50                             | —                   | V             |               |
|                           |                          |                               | 3.0 to 5.5                        | $V_{CC} \times 0.7$              | —                   |               |               |
| Low-level input voltage   | $V_{IL}$                 | —                             | 2.0                               | —                                | 0.50                | V             |               |
|                           |                          |                               | 3.0 to 5.5                        | —                                | $V_{CC} \times 0.3$ |               |               |
| High-level output voltage | $V_{OH}$                 | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OH} = -50\text{ }\mu\text{A}$ | 2.0                              | 1.9                 | —             | V             |
|                           |                          |                               |                                   | 3.0                              | 2.9                 | —             |               |
|                           |                          |                               |                                   | 4.5                              | 4.4                 | —             |               |
|                           |                          |                               | $I_{OH} = -4\text{ mA}$           | 3.0                              | 2.48                | —             |               |
| $I_{OH} = -8\text{ mA}$   | 4.5                      | 3.80                          |                                   | —                                |                     |               |               |
|                           | Low-level output voltage | $V_{OL}$                      | $V_{IN} = V_{IH}$ or $V_{IL}$     | $I_{OL} = 50\text{ }\mu\text{A}$ | 2.0                 | —             | 0.1           |
| 3.0                       |                          |                               |                                   |                                  | —                   | 0.1           |               |
| 4.5                       |                          |                               |                                   |                                  | —                   | 0.1           |               |
| $I_{OL} = 4\text{ mA}$    |                          |                               |                                   | 3.0                              | —                   | 0.44          |               |
|                           | $I_{OL} = 8\text{ mA}$   | 4.5                           | —                                 | 0.44                             |                     |               |               |
| Input leakage current     |                          | $I_{IN}$                      | $V_{IN} = 5.5\text{ V}$ or GND    | 0 to 5.5                         | —                   | $\pm 1.0$     | $\mu\text{A}$ |
| Quiescent supply current  | $I_{CC}$                 | $V_{IN} = V_{CC}$ or GND      | 5.5                               | —                                | 40.0                | $\mu\text{A}$ |               |

**12.3. DC Characteristics (Unless otherwise specified, T<sub>a</sub> = -40 to 125 °C)**

| Characteristics           | Symbol          | Test Condition                                       |                          | V <sub>CC</sub> (V) | Min                   | Max                   | Unit |
|---------------------------|-----------------|--|--------------------------|---------------------|-----------------------|-----------------------|------|
| High-level input voltage  | V <sub>IH</sub> | —  |                          | 2.0                 | 1.50                  | —                     | V    |
|                           |                 |  |                          | 3.0 to 5.5          | V <sub>CC</sub> × 0.7 | —                     |      |
| Low-level input voltage   | V <sub>IL</sub> | —  |                          | 2.0                 | —                     | 0.50                  | V    |
|                           |                 |  |                          | 3.0 to 5.5          | —                     | V <sub>CC</sub> × 0.3 |      |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -50 μA | 2.0                 | 1.9                   | —                     | V    |
|                           |                 |  |                          | 3.0                 | 2.9                   | —                     |      |
|                           |                 |  |                          | 4.5                 | 4.4                   | —                     |      |
|                           |                 |  | I <sub>OH</sub> = -4 mA  | 3.0                 | 2.40                  | —                     |      |
|                           |                 |  | I <sub>OH</sub> = -8 mA  | 4.5                 | 3.70                  | —                     |      |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OL</sub> = 50 μA  | 2.0                 | —                     | 0.1                   | V    |
|                           |                 |  |                          | 3.0                 | —                     | 0.1                   |      |
|                           |                 |  |                          | 4.5                 | —                     | 0.1                   |      |
|                           |                 |  | I <sub>OL</sub> = 4 mA   | 3.0                 | —                     | 0.55                  |      |
|                           |                 |  | I <sub>OL</sub> = 8 mA   | 4.5                 | —                     | 0.55                  |      |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = 5.5 V or GND                       |                          | 0 to 5.5            | —                     | ±2.0                  | μA   |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             |                          | 5.5                 | —                     | 80.0                  | μA   |

**12.4. AC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )**

| Characteristics                      | Symbol             | Note     | $V_{CC}$ (V)  | $C_L$ (pF) | Min | Typ. | Max  | Unit |
|--------------------------------------|--------------------|----------|---------------|------------|-----|------|------|------|
| Propagation delay time<br>(Cn - Y)   | $t_{PLH}, t_{PHL}$ |          | $3.3 \pm 0.3$ | 15         | —   | 7.7  | 11.9 | ns   |
|                                      |                    |          |               | 50         | —   | 10.2 | 15.4 |      |
|                                      |                    |          | $5.0 \pm 0.5$ | 15         | —   | 5.0  | 7.7  |      |
|                                      |                    |          |               | 50         | —   | 6.5  | 9.7  |      |
| Propagation delay time<br>(A, B - Y) | $t_{PLH}, t_{PHL}$ |          | $3.3 \pm 0.3$ | 15         | —   | 10.8 | 16.7 | ns   |
|                                      |                    |          |               | 50         | —   | 13.3 | 20.2 |      |
|                                      |                    |          | $5.0 \pm 0.5$ | 15         | —   | 6.8  | 9.9  |      |
|                                      |                    |          |               | 50         | —   | 8.3  | 11.9 |      |
| Propagation delay time<br>(G - Y)    | $t_{PLH}, t_{PHL}$ |          | $3.3 \pm 0.3$ | 15         | —   | 6.3  | 10.1 | ns   |
|                                      |                    |          |               | 50         | —   | 8.8  | 13.6 |      |
|                                      |                    |          | $5.0 \pm 0.5$ | 15         | —   | 4.4  | 6.4  | ns   |
|                                      |                    |          |               | 50         | —   | 5.9  | 8.4  |      |
| Input capacitance                    | $C_{IN}$           |          |               |            | —   | 4    | 10   | pF   |
| Power dissipation capacitance        | $C_{PD}$           | (Note 1) |               |            | —   | 20   | —    | pF   |

Note 1:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$$

**12.5. AC Characteristics (Unless otherwise specified,  $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )**

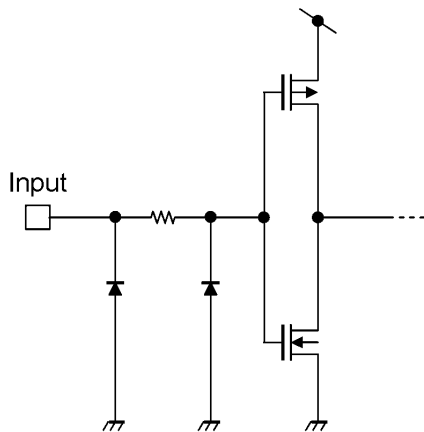
| Characteristics                      | Symbol             | $V_{CC}$ (V)  | $C_L$ (pF) | Min | Max  | Unit |
|--------------------------------------|--------------------|---------------|------------|-----|------|------|
| Propagation delay time<br>(Cn - Y)   | $t_{PLH}, t_{PHL}$ | $3.3 \pm 0.3$ | 15         | 1.0 | 14.0 | ns   |
|                                      |                    |               | 50         | 1.0 | 17.5 |      |
|                                      |                    | $5.0 \pm 0.5$ | 15         | 1.0 | 9.0  |      |
|                                      |                    |               | 50         | 1.0 | 11.0 |      |
| Propagation delay time<br>(A, B - Y) | $t_{PLH}, t_{PHL}$ | $3.3 \pm 0.3$ | 15         | 1.0 | 19.5 | ns   |
|                                      |                    |               | 50         | 1.0 | 23.0 |      |
|                                      |                    | $5.0 \pm 0.5$ | 15         | 1.0 | 11.5 |      |
|                                      |                    |               | 50         | 1.0 | 13.5 |      |
| Propagation delay time<br>(G - Y)    | $t_{PLH}, t_{PHL}$ | $3.3 \pm 0.3$ | 15         | 1.0 | 12.0 | ns   |
|                                      |                    |               | 50         | 1.0 | 15.5 |      |
|                                      |                    | $5.0 \pm 0.5$ | 15         | 1.0 | 7.5  |      |
|                                      |                    |               | 50         | 1.0 | 9.5  |      |
| Input capacitance                    | $C_{IN}$           |               |            | —   | 10   | pF   |



**12.6. AC Characteristics**  
 (Unless otherwise specified,  $T_a = -40$  to  $125\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

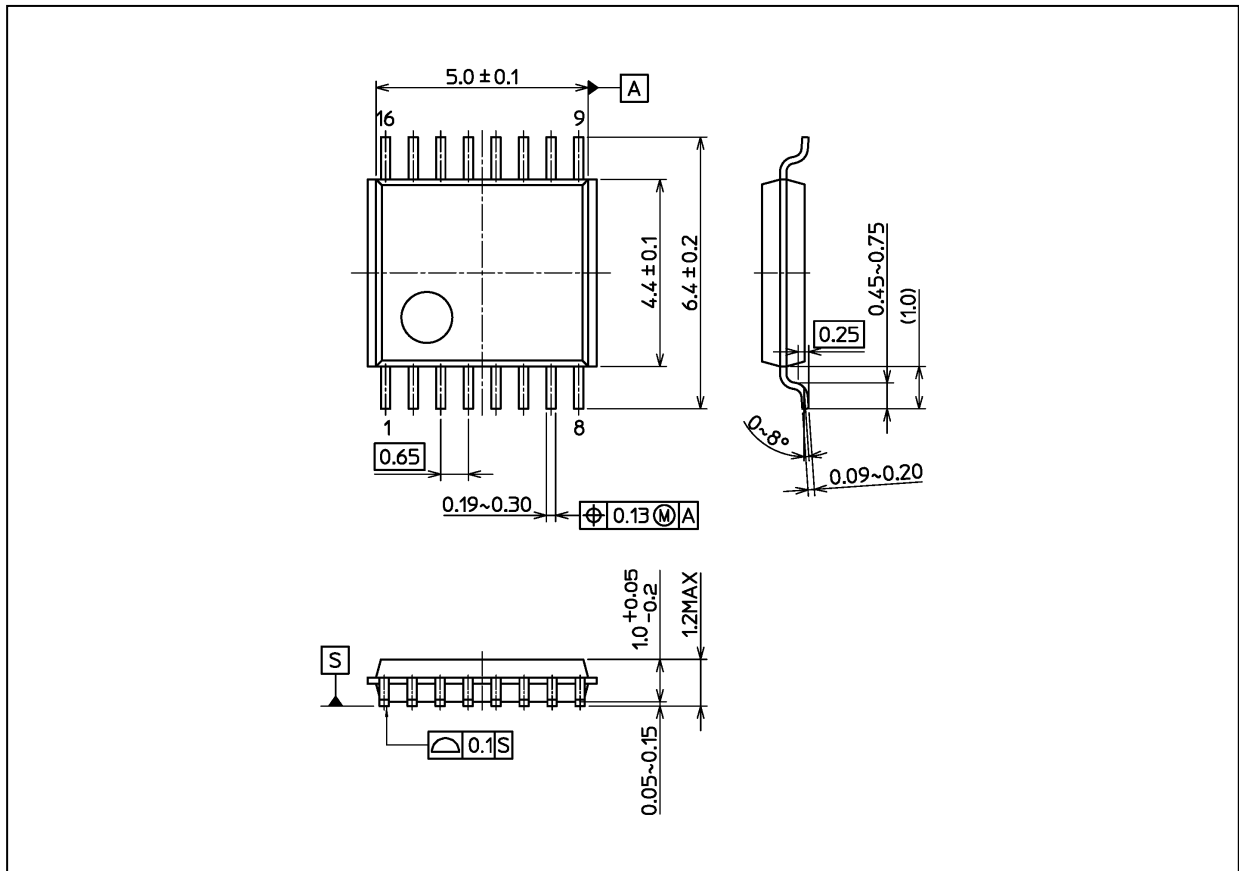
| Characteristics                      | Symbol             | $V_{CC}$ (V)  | $C_L$ (pF) | Min | Max  | Unit |
|--------------------------------------|--------------------|---------------|------------|-----|------|------|
| Propagation delay time<br>(Cn - Y)   | $t_{PLH}, t_{PHL}$ | $3.3 \pm 0.3$ | 15         | 1.0 | 16.0 | ns   |
|                                      |                    |               | 50         | 1.0 | 19.5 |      |
|                                      |                    | $5.0 \pm 0.5$ | 15         | 1.0 | 10.5 |      |
|                                      |                    |               | 50         | 1.0 | 12.5 |      |
| Propagation delay time<br>(A, B - Y) | $t_{PLH}, t_{PHL}$ | $3.3 \pm 0.3$ | 15         | 1.0 | 22.0 | ns   |
|                                      |                    |               | 50         | 1.0 | 25.5 |      |
|                                      |                    | $5.0 \pm 0.5$ | 15         | 1.0 | 13.0 |      |
|                                      |                    |               | 50         | 1.0 | 15.0 |      |
| Propagation delay time<br>(G - Y)    | $t_{PLH}, t_{PHL}$ | $3.3 \pm 0.3$ | 15         | 1.0 | 13.5 | ns   |
|                                      |                    |               | 50         | 1.0 | 17.0 |      |
|                                      |                    | $5.0 \pm 0.5$ | 15         | 1.0 | 8.5  |      |
|                                      |                    |               | 50         | 1.0 | 10.5 |      |
| Input capacitance                    | $C_{IN}$           |               |            | —   | 10   | pF   |

**12.7. Input Equivalent Circuit**



Package Dimensions

Unit: mm



Weight: 0.055 g (typ.)

|                    |
|--------------------|
| Package Name(s)    |
| Nickname: TSSOP16B |

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