

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SP57FU, TC7SP58FU

## Low Voltage Single Configurable Multiple Function Gate with 3.6-V Tolerant Inputs and Outputs

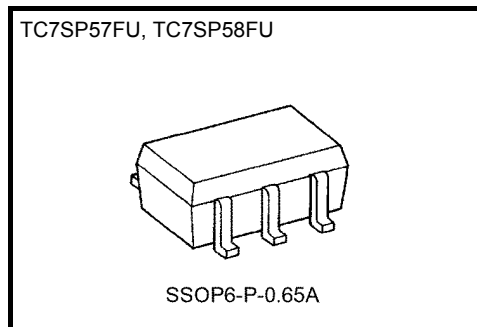
The TC7SP57,58 is a high performance CMOS multiple Function Gate which is guaranteed to operate from 1.2-V to 3.6-V. Designed for use in 1.5 V, 1.8 V, 2.5 V or 3.3 V systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

It is also designed with over voltage tolerant inputs and outputs up to 3.6 V.

The output state is determined by seven patterns of 3-inputs.

The user can choose the functions of XNOR(TC7SP57), XOR(TC7SP58), AND, OR, NAND, NOR, Schmitt Inverter, and Schmitt Buffer.

All inputs are equipped with protection circuits against static discharge.

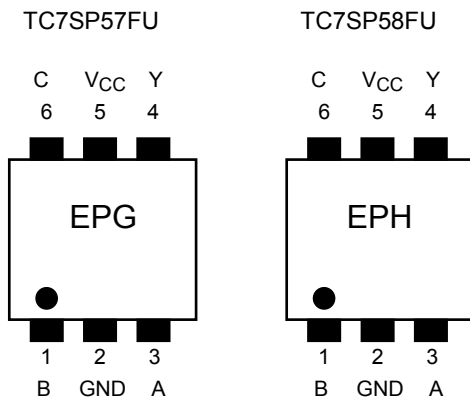


Weight: 0.0068 g (typ)

## Features

- Low-voltage operation:  $V_{CC} = 1.2$  to  $3.6$  V
- High-speed operation:  $t_{pd} = 8.5$  ns (max) ( $V_{CC} = 3.0$  to  $3.6$  V)  
 $t_{pd} = 12.0$  ns (max) ( $V_{CC} = 2.3$  to  $2.7$  V)
- Output current:  $|I_{OH}| / I_{OL} = 8$  mA (min) ( $V_{CC} = 3.0$  V)  
 $|I_{OH}| / I_{OL} = 4$  mA (min) ( $V_{CC} = 2.3$  V)  
 $|I_{OH}| / I_{OL} = 1.5$  mA (min) ( $V_{CC} = 1.65$  V)
- Latch-up performance:  $-300$  mA
- ESD performance: Machine model  $> \pm 200$  V  
Human body model  $> \pm 2000$  V
- Package: US6
- Power-down protection is provided on all inputs and outputs

## Pin Assignment (top view)

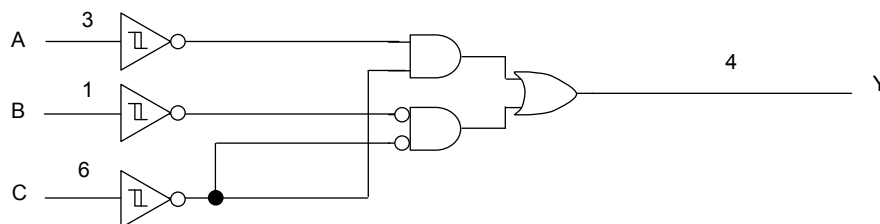


## Truth Table

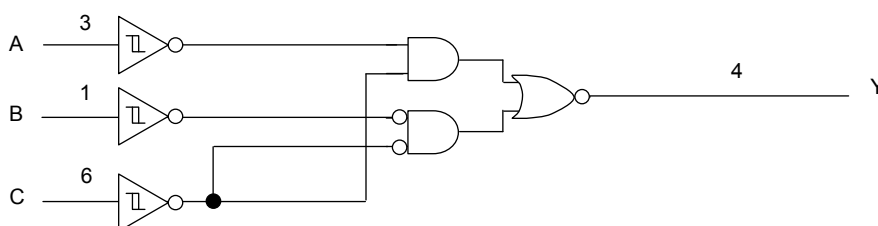
| INPUTS |   |   | OUTPUT  |         |
|--------|---|---|---------|---------|
|        |   |   | TC7SP57 | TC7SP58 |
| A      | B | C | Y       | Y       |
| L      | L | L | H       | L       |
| L      | L | H | L       | H       |
| L      | H | L | H       | L       |
| L      | H | H | H       | L       |
| H      | L | L | L       | H       |
| H      | L | H | L       | H       |
| H      | H | L | L       | H       |
| H      | H | H | H       | L       |

## System Diagram

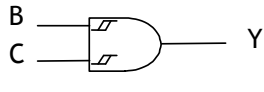
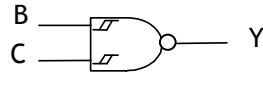
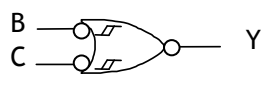
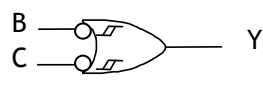
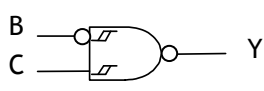
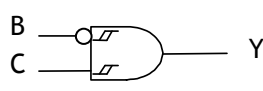
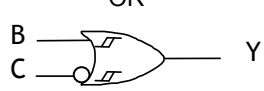
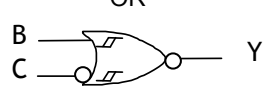
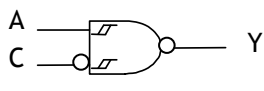
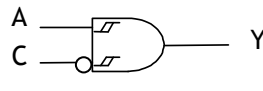
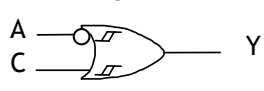
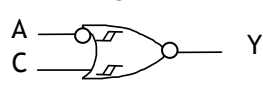
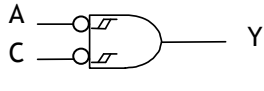
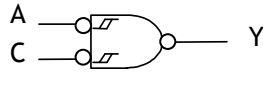
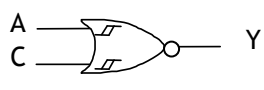
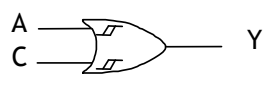
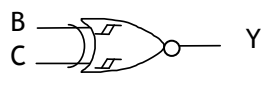
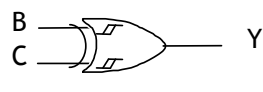


TC7SP57



TC7SP58



## Logic configurations(1/2)

| Function   | Input Condition   | TC7SP57<br>Logic symbol  | TC7SP58<br>Logic symbol  | Function Table  |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--|---|--|--|---|----|---|---|---|--|----|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SP57<br>Schmitt AND<br>or<br>Schmitt INV<br>+ NOR          | A=H-Level<br>B=INPUT<br>C=INPUT<br>Y=OUTPUT   |     |    | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>H</td> <td>L</td> <td>L</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>L</td> <td>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</td> <td>L</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</td> <td>H</td> <td>H</td> <td>L</td> </tr> </tbody> </table> | A  | B | C | Y |  | 57 | 58 | H | L | L | L | H | H | L | H | L | H | H | H | L | L | H | H | H | H | H | L |
| A  |   | B  | C  |   |    |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 57  |  |  |   | 58 |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | L  | L  |   | H  |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | H  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | L  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | H  | H  | L   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt NAND<br>or<br>Schmitt INV<br>+ OR          |    |    |  |   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP57<br>Schmitt INV<br>+NAND<br>or<br>Schmitt INV<br>+OR   | A=L-Level<br>B=INPUT<br>C=INPUT<br>Y=OUTPUT   |     |    | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>L</td> <td>L</td> <td>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>L</td> <td>H</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>L</td> <td>H</td> <td>H</td> <td>H</td> <td>L</td> </tr> </tbody> </table> | A  | B | C | Y |  | 57 | 58 | L | L | L | H | L | L | L | H | L | H | L | H | L | H | L | L | H | H | H | L |
| A  |   | B  | C  |   |    |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 57  |  |  |   | 58 |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | L  | H  |   | L  |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | H  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | L  | H  | L   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | H  | H  | L   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt INV<br>+AND<br>or<br>Schmitt INV<br>+ NOR  |    |    |  |   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP57<br>Schmitt INV<br>+NAND<br>or<br>Schmitt INV<br>+ OR  | A= INPUT<br>B= H-Level<br>C=INPUT<br>Y=OUTPUT                                       |   |  | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>H</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>L</td> <td>H</td> <td>H</td> <td>H</td> <td>L</td> </tr> <tr> <td>H</td> <td>H</td> <td>L</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</td> <td>H</td> <td>H</td> <td>L</td> </tr> </tbody> </table> | A  | B | C | Y |  | 57 | 58 | L | H | L | H | L | L | H | H | H | L | H | H | L | L | H | H | H | H | H | L |
| A  |   | B  | C  |   |    |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 57  |  |  |   | 58 |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | L  | H  |   | L  |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | H  | H  | L   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | L  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | H  | H  | L   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt INV<br>+AND<br>or<br>Schmitt INV<br>+ NOR  |  |  |  |   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP57<br>Schmitt INV<br>+AND<br>or<br>Schmitt INV<br>+NOR   | A=INPUT<br>B=L-Level<br>C=INPUT<br>Y=OUTPUT   |   |  | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>L</td> <td>L</td> <td>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>L</td> <td>L</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>L</td> <td>H</td> <td>L</td> <td>H</td> </tr> </tbody> </table> | A  | B | C | Y |  | 57 | 58 | L | L | L | H | L | L | L | H | L | H | H | L | L | L | H | H | L | H | L | H |
| A  |   | B  | C  |   |    |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 57  |  |  |   | 58 |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | L  | H  |   | L  |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | H  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | L  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | H  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt INV<br>+ NAND<br>or<br>Schmitt INV<br>+ OR |  |  |  |   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP57<br>Schmitt XNOR                                       | A=B<br>B=INPUT<br>C=INPUT<br>Y=OUTPUT   |   |  | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>L</td> <td>L</td> <td>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</td> <td>L</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</td> <td>H</td> <td>H</td> <td>L</td> </tr> </tbody> </table> | A  | B | C | Y |  | 57 | 58 | L | L | L | H | L | L | L | H | L | H | H | H | L | L | H | H | H | H | H | L |
| A  |   | B  | C  |   |    |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 57  |  |  |   | 58 |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | L  | H  |   | L  |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | H  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | L  | L  | H   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | H  | H  | L   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt XOR  |  |  |  |   |    |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

## Logic configurations(2/2)

| Function               | Input Condition       | TC7SP57<br>Logic symbol | TC7SP58<br>Logic symbol | Function<br>Table   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
|------------------------|-----------------------|-------------------------|-------------------------|---|---|---|---|---|--|----|----|---|---|---|---|---|---|---|---|---|---|
| SP57<br>Schmitt INV    | A= INPUT<br>B=L-Level |                         |                         | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>H</td> <td>L</td> <td>L</td> <td>L</td> <td>H</td> </tr> </tbody> </table> | A | B | C | Y |  | 57 | 58 | L | L | L | H | L | H | L | L | L | H |
| A                      | B                     |                         |                         | C   |   |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |                       | 57                      | 58                      |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | L                     | L                       | H                       | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | L                     | L                       | L                       | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt Buffer | C=L-Level<br>Y=OUTPUT |                         |                         |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| SP57<br>Schmitt INV    | A= INPUT<br>B=H-Level |                         |                         | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>H</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>H</td> <td>H</td> <td>L</td> <td>L</td> <td>H</td> </tr> </tbody> </table> | A | B | C | Y |  | 57 | 58 | L | H | L | H | L | H | H | L | L | H |
| A                      | B                     |                         |                         | C   |   |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |                       | 57                      | 58                      |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | H                     | L                       | H                       | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | H                     | L                       | L                       | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt Buffer | C=L-Level<br>Y=OUTPUT |                         |                         |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| SP57<br>Schmitt Buffer | A=L-Level<br>B= INPUT |                         |                         | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>L</td> <td>H</td> <td>H</td> <td>H</td> <td>L</td> </tr> </tbody> </table> | A | B | C | Y |  | 57 | 58 | L | L | H | L | H | L | H | H | H | L |
| A                      | B                     |                         |                         | C   |   |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |                       | 57                      | 58                      |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | L                     | H                       | L                       | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | H                     | H                       | H                       | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt INV    | C=H-Level<br>Y=OUTPUT |                         |                         |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| SP57<br>Schmitt Buffer | A=H-Level<br>B=INPUT  |                         |                         | <table border="1"> <thead> <tr> <th rowspan="2">A</th> <th rowspan="2">B</th> <th rowspan="2">C</th> <th colspan="2">Y</th> </tr> <tr> <th>57</th> <th>58</th> </tr> </thead> <tbody> <tr> <td>H</td> <td>L</td> <td>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</td> <td>H</td> <td>H</td> <td>H</td> </tr> </tbody> </table> | A | B | C | Y |  | 57 | 58 | H | L | H | L | H | H | H | H | H | H |
| A                      | B                     |                         |                         | C   |   |   |   | Y |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |                       | 57                      | 58                      |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | L                     | H                       | L                       | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | H                     | H                       | H                       | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| SP58<br>Schmitt INV    | C=H-Level<br>Y=OUTPUT |                         |                         |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |

## Absolute Maximum Rating (Note1)

| Characteristics             | Symbol           | Rating                         | Unit        |
|-----------------------------|------------------|--------------------------------|-------------|
| Power supply voltage        | $V_{CC}$         | -0.5 to 4.6                    | V           |
| DC input voltage            | $V_{IN}$         | -0.5 to 4.6                    | V           |
| DC output voltage           | $V_{OUT}$        | -0.5 to 4.6 (Note2)            | V           |
|                             |                  | -0.5 to $V_{CC} + 0.5$ (Note3) |             |
| Input diode current         | $I_{IK}$         | -20                            | mA          |
| Output diode current        | $I_{OK}$         | $\pm 20$ (Note4)               | mA          |
| DC output current           | $I_{OUT}$        | $\pm 25$                       | mA          |
| Power dissipation           | $P_D$            | 180                            | mW          |
| DC $V_{CC}$ /ground current | $I_{CC}/I_{GND}$ | $\pm 25$                       | mA          |
| Storage temperature         | $T_{stg}$        | -65 to 150                     | $^{\circ}C$ |

Note 1: 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 2:  $V_{CC} = 0$  V

Note 3: High or Low state.  $I_{OUT}$  absolute rating must be observed.

Note 4:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## Operating Ranges (Note1)

| Characteristics       | Symbol          | Rating                | Unit        |
|-----------------------|-----------------|-----------------------|-------------|
| Supply voltage        | $V_{CC}$        | 1.2 to 3.6            | V           |
| Input voltage         | $V_{IN}$        | -0.3 to 3.6           | V           |
| Output voltage        | $V_{OUT}$       | 0 to 3.6 (Note2)      | V           |
|                       |                 | 0 to $V_{CC}$ (Note3) |             |
| Output current        | $I_{OH}/I_{OL}$ | $\pm 8.0$ (Note4)     | mA          |
|                       |                 | $\pm 4.0$ (Note5)     |             |
|                       |                 | $\pm 1.5$ (Note6)     |             |
| Operating temperature | $T_{opr}$       | -40 to 85             | $^{\circ}C$ |

Note 1: The operating range is required to ensure the normal operation of the device.  
Unused inputs must be tied to either  $V_{CC}$  or GND.

Note 2:  $V_{CC} = 0$  V

Note 3: High or low state

Note 4:  $V_{CC} = 3.0$  to 3.6 V

Note 5:  $V_{CC} = 2.3$  to 2.7 V

Note 6:  $V_{CC} = 1.65$  to 1.8 V

## Electrical Characteristics

### DC Characteristics (Ta = -40 to 85°C)

| Characteristics                       |         | Symbol           | Test Condition                                       | V <sub>CC</sub> (V)       | Min          | Max                   | Unit |
|---------------------------------------|---------|------------------|--|---------------------------|--------------|-----------------------|------|
|                                       |         |                  |  |                           |              |                       |      |
| Input voltage                         | H-level | V <sub>P</sub>   | —  | 1.2                       | —            | 1.10                  | V    |
|                                       |         |                  |  | 1.4                       | —            | 1.20                  |      |
|                                       |         |                  |  | 1.65                      | —            | 1.35                  |      |
|                                       |         |                  |  | 2.3                       | —            | 1.70                  |      |
|                                       |         |                  |  | 3.0                       | —            | 2.00                  |      |
|                                       |         |                  |  | 3.6                       | —            | 2.20                  |      |
|                                       | L-level | V <sub>N</sub>   | —  | 1.2                       | 0.10         | —                     | V    |
|                                       |         |                  |  | 1.4                       | 0.20         | —                     |      |
|                                       |         |                  |  | 1.65                      | 0.30         | —                     |      |
|                                       |         |                  |  | 2.3                       | 0.50         | —                     |      |
|                                       |         |                  |  | 3.0                       | 0.70         | —                     |      |
|                                       |         |                  |  | 3.6                       | 0.80         | —                     |      |
| Hysteresis voltage                    |         | V <sub>H</sub>   | —  | 1.2                       | 0.2          | 0.9                   | V    |
|                                       |         |                  |  | 1.4                       | 0.2          | 0.9                   |      |
|                                       |         |                  |  | 1.65                      | 0.2          | 0.95                  |      |
|                                       |         |                  |  | 2.3                       | 0.3          | 1.0                   |      |
|                                       |         |                  |  | 3.0                       | 0.3          | 1.2                   |      |
|                                       |         |                  |  | 3.6                       | 0.3          | 1.2                   |      |
| Output voltage                        | H-level | V <sub>OH</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -100 μA | 1.2 to 1.3   | V <sub>CC</sub> - 0.1 | V    |
|                                       |         |                  |  | I <sub>OH</sub> = -500 μA | 1.4 to 1.6   | V <sub>CC</sub> - 0.2 |      |
|                                       |         |                  |  | I <sub>OH</sub> = -1.5 mA | 1.65 to 1.95 | V <sub>CC</sub> - 0.3 |      |
|                                       |         |                  |  | I <sub>OH</sub> = -4.0 mA | 2.3 to 2.7   | V <sub>CC</sub> - 0.4 |      |
|                                       |         |                  |  | I <sub>OH</sub> = -8.0 mA | 3.0 to 3.6   | 2.40                  |      |
|                                       | L-level | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OL</sub> = 100 μA  | 1.2 to 1.3   | —                     | V    |
|                                       |         |                  |  | I <sub>OL</sub> = 500 μA  | 1.4 to 1.6   | —                     |      |
|                                       |         |                  |  | I <sub>OL</sub> = 3.0 mA  | 1.65 to 1.95 | —                     |      |
|                                       |         |                  |  | I <sub>OL</sub> = 4.0 mA  | 2.3 to 2.7   | —                     |      |
|                                       |         |                  |  | I <sub>OL</sub> = 8.0 mA  | 3.0 to 3.6   | —                     |      |
| Input leakage current                 |         | I <sub>IN</sub>  | V <sub>IN</sub> = 0 to 3.6 V                         | 1.2 to 3.6                | —            | ±1.5                  | μA   |
| Power-off leakage current             |         | I <sub>OFF</sub> | V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V      | 0                         | —            | 1.5                   | μA   |
| Quiescent supply current              |         | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND             | 1.2 to 3.6                | —            | 3.0                   | μA   |
|                                       |         |                  | V <sub>CC</sub> ≤ V <sub>IN</sub> ≤ 3.6 V            | 1.2 to 3.6                | —            | ±3.0                  |      |
| Increase in I <sub>CC</sub> per input |         | ΔI <sub>CC</sub> | V <sub>IH</sub> = V <sub>CC</sub> - 0.6 V            | 2.7 to 3.6                | —            | 100                   |      |

## AC Characteristics (Ta = -40 to 85°C, Input: tr = tr = 3.0 ns)

| Characteristics                      | Symbol                               | Test Condition                             | VCC (V)    | Min | Max  | Unit |
|--------------------------------------|--------------------------------------|--|------------|-----|------|------|
|                                      |                                      |  |            |     |      |      |
| Propagation delay time<br>(A, B,C-Y) | t <sub>pLH</sub><br>t <sub>pHL</sub> | Figure 1, Figure 2<br>CL = 10pF, RL = 1 MΩ | 1.8 ± 0.15 | 1.0 | 21.0 | ns   |
|                                      |                                      |  | 2.5 ± 0.2  | 0.8 | 10.0 |      |
|                                      |                                      |  | 3.3 ± 0.3  | 0.6 | 7.0  |      |
|                                      | t <sub>pLH</sub><br>t <sub>pHL</sub> | Figure 1, Figure 2<br>CL = 15pF, RL = 1 MΩ | 1.8 ± 0.15 | 1.0 | 23.0 | ns   |
|                                      |                                      |  | 2.5 ± 0.2  | 0.8 | 11.0 |      |
|                                      |                                      |  | 3.3 ± 0.3  | 0.6 | 7.7  |      |
|                                      | t <sub>pLH</sub><br>t <sub>pHL</sub> | Figure 1, Figure 2<br>CL = 30pF, RL = 1 MΩ | 1.8 ± 0.15 | 1.0 | 27.0 | ns   |
|                                      |                                      |  | 2.5 ± 0.2  | 0.8 | 12.0 |      |
|                                      |                                      |  | 3.3 ± 0.3  | 0.6 | 8.5  |      |

## Capacitive Characteristics (Ta = 25°C)

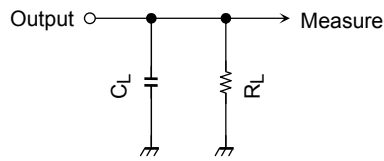
| Characteristics               | Symbol          | Test Condition                  | VCC (V)       | Typ. | Unit |
|-------------------------------|-----------------|---------------------------------|---------------|------|------|
|                               |                 |                                 |               |      |      |
| Input capacitance             | C <sub>IN</sub> | —                               | 1.8, 2.5, 3.3 | 6    | pF   |
| Power dissipation capacitance | C <sub>PD</sub> | f <sub>IN</sub> = 10 MHz (Note) | 1.8, 2.5, 3.3 | 30   | pF   |

Note : C<sub>PD</sub> 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:

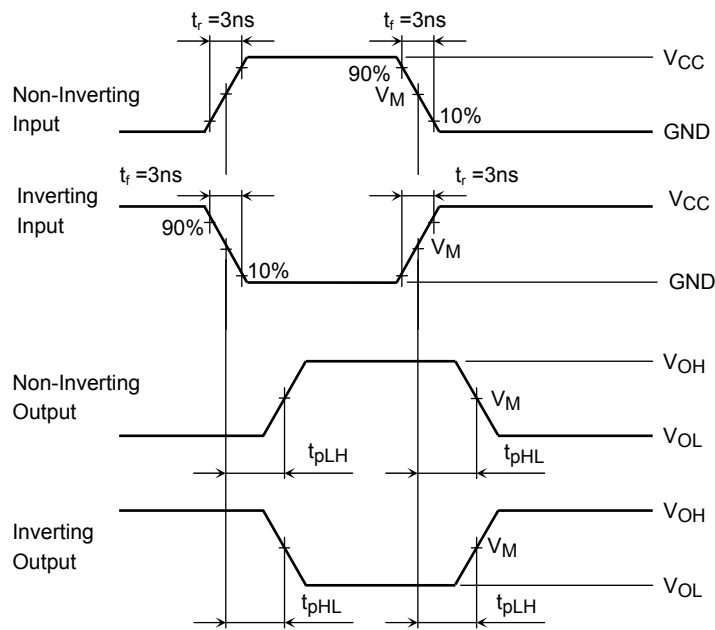
$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

**AC Test Circuit**



**Figure 1**

**AC Waveform**



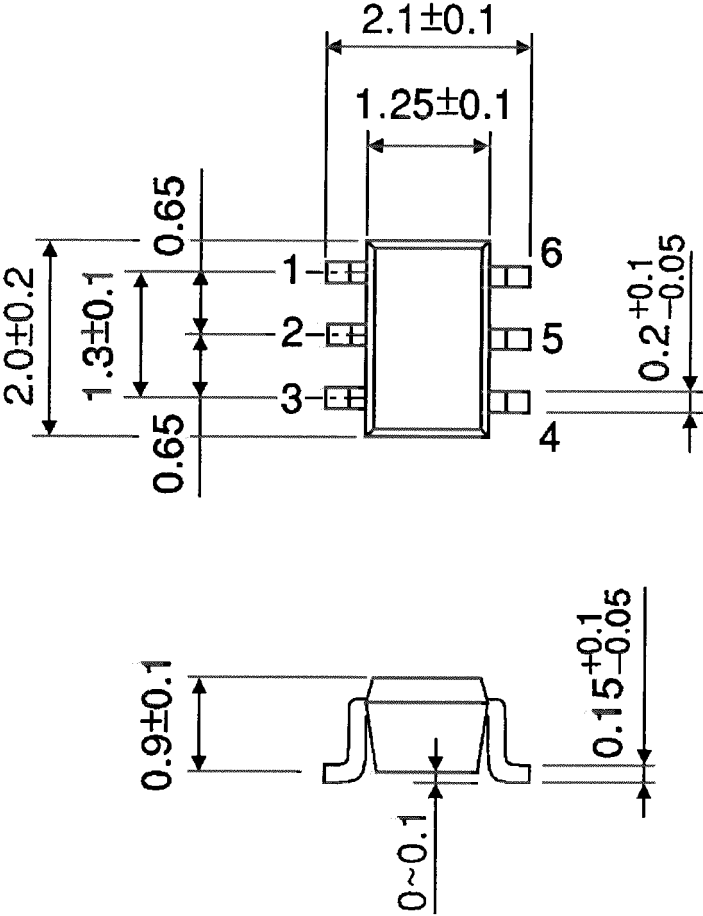
| Symbol          | V <sub>CC</sub> |                    |                    |
|-----------------|-----------------|--------------------|--------------------|
|                 | 3.3 ± 0.3 V     | 2.5 ± 0.2 V        | 1.8 V ± 0.15 V     |
| V <sub>IN</sub> | V <sub>CC</sub> | V <sub>CC</sub>    | V <sub>CC</sub>    |
| V <sub>M</sub>  | 1.5 V           | V <sub>CC</sub> /2 | V <sub>CC</sub> /2 |

**Figure 2 t<sub>pLH</sub>, t<sub>pHL</sub>**

**Package Dimensions**

SSOP6-P-0.65A

Unit: mm



Weight: 0.0068 g (typ)

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