

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC7MP97FT, TC7MP97FK TC7MP98FT, TC7MP98FK

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

The TC7MP97,98 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.

It independently consists of three circuits for Multiple Function Gate.

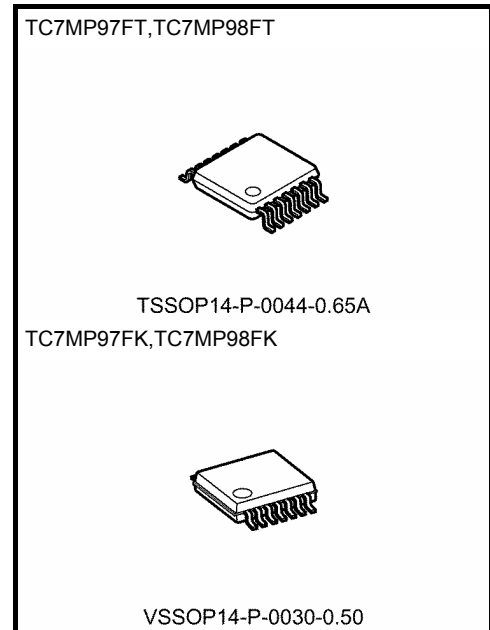
The output state is determined by seven patterns of 3-inputs.

The user can choose the functions of Multiplexer, AND, OR, NAND, Schmitt Inverter, and Schmitt Buffer.

All inputs are equipped with protection circuits against static discharge.

### 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 :  $|I_{OH}|/I_{OL} = \pm 8$  mA (min) ( $V_{CC} = 3.0$  V)  
:  $|I_{OH}|/I_{OL} = \pm 4$  mA (min) ( $V_{CC} = 2.3$  V)  
:  $|I_{OH}|/I_{OL} = \pm 1.5$  mA (min) ( $V_{CC} = 1.65$  V)
- Latch-up performance :  $-300$  mA
- ESD performance : Machine model  $\geq \pm 200$  V  
Human body model  $\geq \pm 2000$  V
- Package : VSSOP14 (US14), TSSOP14
- Power-down protection is provided on all inputs and outputs

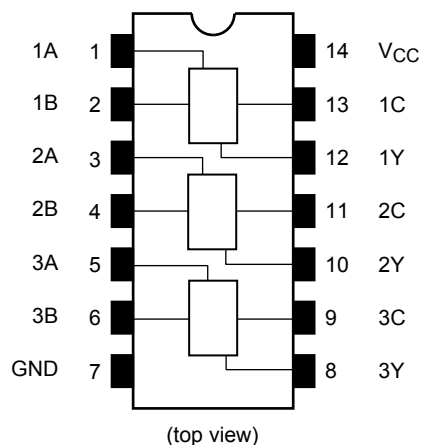


Weight:

TSSOP14-P-0044-0.65A : 0.06 g(typ)

VSSOP14-P-0030-0.50 : 0.02 g(typ)

## Pin Assignment (top view)

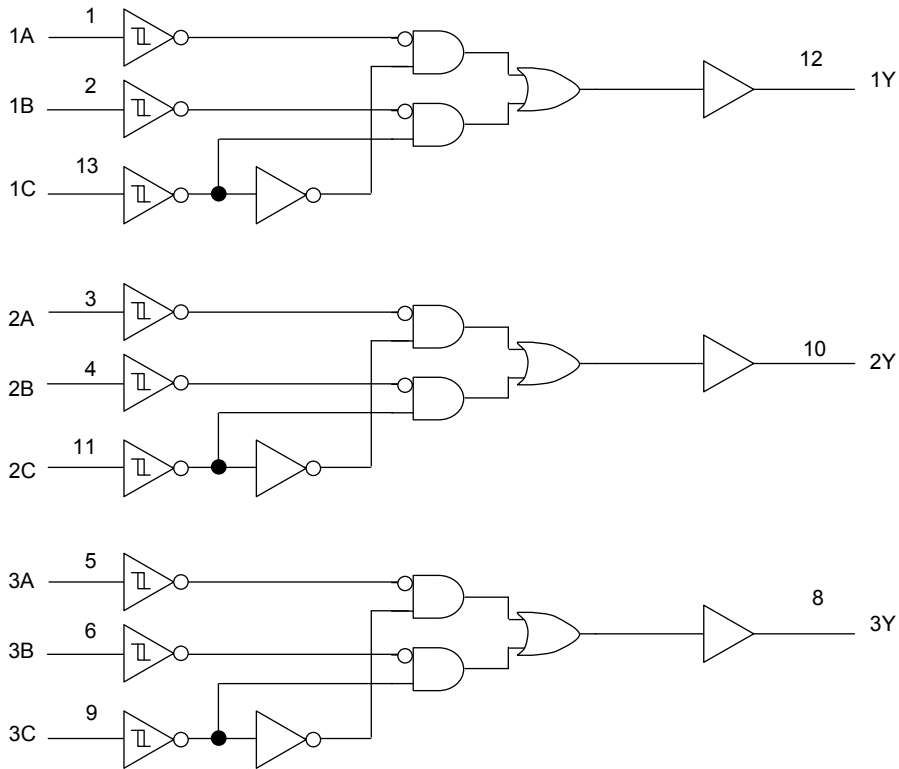


## Truth Table

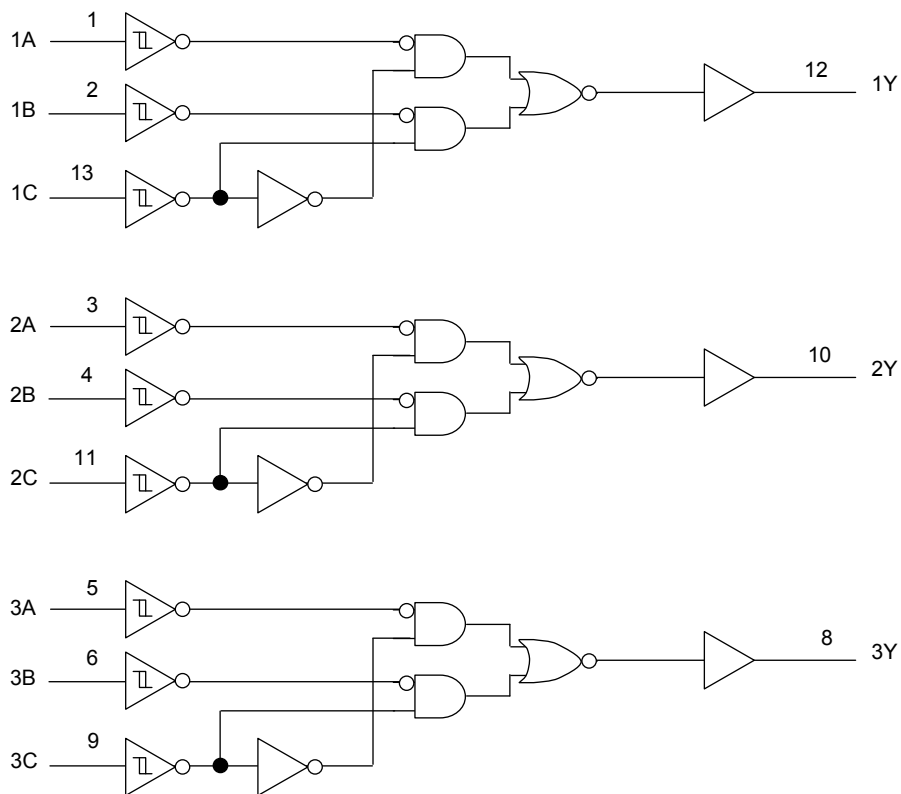
| INPUTS |   |   | OUTPUT  |         |
|--------|---|---|---------|---------|
|        |   |   | TC7MP97 | TC7MP98 |
| A      | B | C | Y       | Y       |
| L      | L | L | L       | H       |
| L      | L | H | L       | H       |
| L      | H | L | H       | L       |
| L      | H | H | L       | H       |
| H      | L | L | L       | H       |
| H      | L | H | H       | L       |
| H      | H | L | H       | L       |
| H      | H | H | H       | L       |

## System Diagram

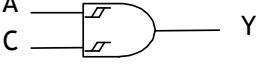
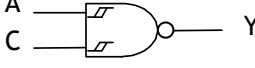
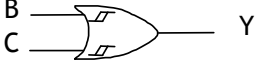
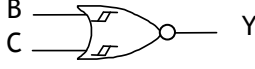
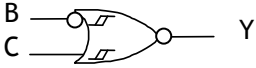
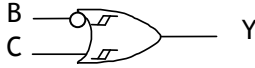
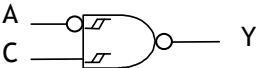
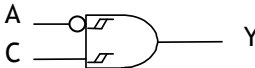
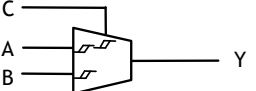
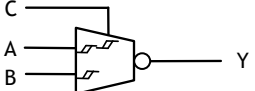
TC7MP97



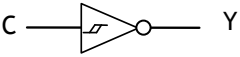
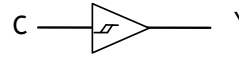

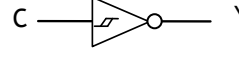
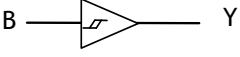
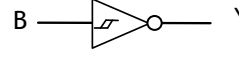

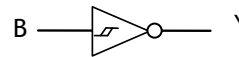
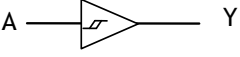
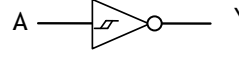
TC7MP98



## Logic configurations(1/2)

| Function   | Input Condition                             | TC7MP97 Logic symbol  | TC7MP98 Logic symbol   | FUNCTION TABLE  |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--|---|---|--|---|---|---|---|---|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MP97<br>AND  | 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>97</th> <th>98</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</td> <td>L</td> <td>H</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>H</td> <td>L</td> </tr> </tbody> </table>   | A | B | C | Y |   | 97 | 98 | L | L | L | L | H | L | L | H | L | H | H | L | L | L | H | H | L | H | H | L |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| A  |   |   |  | B   |   |   |   | C | Y |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 97  | 98  |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | L   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | H   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | L   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | H   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP98<br>NAND   |   |   |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP97<br>OR   | 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>97</th> <th>98</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>H</td> <td>L</td> </tr> <tr> <td>H</td> <td>H</td> <td>L</td> <td>H</td> <td>L</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 |   | 97 | 98 | H | L | L | L | H | H | L | H | H | L | H | H | L | H | L | H | H | H | H | L |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| A  |   |   |  | B   |   |   |   | C | Y |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 97  | 98  |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | L   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | H   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | L   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | H   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP98<br>NOR  |   |   |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP97<br>Schmitt<br>INV+NOR<br>or<br>Schmitt<br>INV+AND | 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>97</th> <th>98</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</td> <td>L</td> <td>H</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>L</td> <td>H</td> </tr> </tbody> </table>   | A | B | C | Y |   | 97 | 98 | L | L | L | L | H | L | L | H | L | H | L | H | L | H | L | L | H | H | L | H |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| A  |   |   |  |   |   |   |   | B | C | Y  |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 97  | 98  |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | L   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | H   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | L   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | H   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP98<br>Schmitt<br>INV+OR<br>or<br>Schmitt<br>INV+NAND |   |   |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP97<br>Schmitt<br>INV+NAND<br>or<br>Schmitt<br>INV+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>97</th> <th>98</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>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</td> <td>L</td> <td>H</td> <td>L</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 |   | 97 | 98 | L | H | L | H | L | L | H | H | L | H | H | H | L | H | L | H | H | H | H | L |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| A  |   |   |  |   |   |   |   | B | C | Y  |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 97  | 98  |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | L   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | H   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | L   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | H   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP98<br>Schmitt<br>INV+AND<br>or<br>Schmitt<br>INV+NOR |   |   |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP97<br>2 to 1 Selector                                | A=INPUT<br>B=INPUT<br>C=Select<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>97</th> <th>98</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</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>H</td> <td>L</td> <td>L</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>H</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>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>H</td> <td>L</td> <td>H</td> <td>H</td> <td>L</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 |   | 97 | 98 | L | L | L | L | H | L | H | L | H | L | H | L | L | L | H | H | H | L | H | L | L | L | H | L | H | L | H | H | L | H | H | L | H | H | L | H | H | H | H | L |
| A  |   |   |  |   |   |   |   | B | C | Y  |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 97  | 98  |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | L   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | L   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | L   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | L   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | L   | H   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| L  | H   | H   | L  | H   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | L   | H   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| H  | H   | H   | H  | L   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MP98<br>2 to 1<br>Selector+INV                         |   |   |  |   |   |   |   |   |   |    |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

## Logic configurations(2/2)

| Function               | Input Condition                               | TC7MP97<br>Logic symbol   | TC7MP98<br>Logic symbol  | FUNCTION<br>TABLE   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
|------------------------|---|---|--|---|---|---|---|---|--|----|----|---|---|---|---|---|---|---|---|---|---|
| MP97<br>Schmitt INV    | A=L-Level<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>97</th> <th>98</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>L</td> <td>H</td> </tr> </tbody> </table> | A | B | C | Y |  | 97 | 98 | L | H | L | H | L | L | H | H | L | H |
| A                      | B   | C   | Y  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |   |   | 97   | 98  |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | H   | L   | H  | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | H   | H   | L  | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP98<br>Schmitt Buffer |   |   |  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP97<br>Schmitt Buffer | A=H-Level<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>97</th> <th>98</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>H</td> <td>L</td> </tr> </tbody> </table> | A | B | C | Y |  | 97 | 98 | H | L | L | L | H | H | L | H | H | L |
| A                      | B   | C   | Y  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |   |   | 97   | 98  |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | L   | L   | L  | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | L   | H   | H  | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP98<br>Schmitt INV    |   |   |  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP97<br>Schmitt Buffer | A=L-Level<br>B=INPUT<br>C=L-Level<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>97</th> <th>98</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>L</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> </tbody> </table> | A | B | C | Y |  | 97 | 98 | L | L | L | L | H | L | H | L | H | L |
| A                      | B   | C   | Y  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |   |   | 97   | 98  |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | L   | L   | L  | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | H   | L   | H  | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP98<br>Schmitt INV    |   |   |  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP97<br>Schmitt Buffer | A=H-Level<br>B=INPUT<br>C=L-Level<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>97</th> <th>98</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>H</td> <td>L</td> <td>H</td> <td>L</td> </tr> </tbody> </table> | A | B | C | Y |  | 97 | 98 | H | L | L | L | H | H | H | L | H | L |
| A                      | B   | C   | Y  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |   |   | 97   | 98  |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | L   | L   | L  | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | H   | L   | H  | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP98<br>Schmitt INV    |   |   |  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP97<br>Schmitt Buffer | A=INPUT<br>B=L-Level<br>C=H-Level<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>97</th> <th>98</th> </tr> </thead> <tbody> <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>H</td> <td>H</td> <td>L</td> </tr> </tbody> </table> | A | B | C | Y |  | 97 | 98 | L | L | H | L | H | H | L | H | H | L |
| A                      | B   | C   | Y  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
|                        |   |   | 97   | 98  |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| L                      | L   | H   | L  | H   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| H                      | L   | H   | H  | L   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |
| MP98<br>Schmitt INV    |   |   |  |   |   |   |   |   |  |    |    |   |   |   |   |   |   |   |   |   |   |

## Absolute Maximum Ratings (Note 1)

| 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 (Note 2)            | V                  |
|                             |                  | -0.5 to $V_{CC} + 0.5$ (Note 3) |                    |
| Input diode current         | $I_{IK}$         | -20                             | mA                 |
| Output diode current        | $I_{OK}$         | $\pm 20$ (Note 4)               | 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         | $T_{stg}$        | -65~150                         | $^{\circ}\text{C}$ |

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:  $V_{CC} = 0\text{ V}$

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

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

## Operating Ranges (Note 1)

| Characteristics       | Symbol          | Rating               | Unit               |
|-----------------------|-----------------|----------------------|--------------------|
| Supply voltage        | $V_{CC}$        | 1.2~3.6              | V                  |
| Input voltage         | $V_{IN}$        | -0.3~3.6             | V                  |
| Output voltage        | $V_{OUT}$       | 0~3.6 (Note 2)       | V                  |
|                       |                 | 0~ $V_{CC}$ (Note 3) |                    |
| Output current        | $I_{OH}/I_{OL}$ | $\pm 8.0$ (Note 4)   | mA                 |
|                       |                 | $\pm 4.0$ (Note 5)   |                    |
|                       |                 | $\pm 1.5$ (Note 6)   |                    |
| Operating temperature | $T_{opr}$       | -40~85               | $^{\circ}\text{C}$ |

Note 1: 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.

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

Note 3: High or low state

Note 4:  $V_{CC} = 3.0\sim 3.6\text{ V}$

Note 5:  $V_{CC} = 2.3\sim 2.7\text{ V}$

Note 6:  $V_{CC} = 1.65\sim 1.8\text{ V}$

## 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 | 1.2~1.3   | V <sub>CC</sub> - 0.1 | —    | V |
|                                       |         |                  |  | I <sub>OH</sub> = -500 μA | 1.4~1.6   | V <sub>CC</sub> - 0.2 | —    |   |
|                                       |         |                  |  | I <sub>OH</sub> = -1.5 mA | 1.65~1.95 | V <sub>CC</sub> - 0.3 | —    |   |
|                                       |         |                  |  | I <sub>OH</sub> = -4.0 mA | 2.3~2.7   | V <sub>CC</sub> - 0.4 | —    |   |
|                                       |         |                  |  | I <sub>OH</sub> = -8.0 mA | 3.0~3.6   | 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  | 1.2~1.3   | —                     | 0.10 |   |
|                                       |         |                  |  | I <sub>OL</sub> = 500 μA  | 1.4~1.6   | —                     | 0.20 |   |
|                                       |         |                  |  | I <sub>OL</sub> = 3.0 mA  | 1.65~1.95 | —                     | 0.25 |   |
|                                       |         |                  |  | I <sub>OL</sub> = 4.0 mA  | 2.3~2.7   | —                     | 0.40 |   |
|                                       |         |                  |  | I <sub>OL</sub> = 8.0 mA  | 3.0~3.6   | —                     | 0.40 |   |
| Input leakage current                 |         | I <sub>IN</sub>  | V <sub>IN</sub> = 0~3.6 V                            | 1.2~3.6                   | —         | ±5.0                  | μA   |   |
| Power-off leakage current             |         | I <sub>OFF</sub> | V <sub>IN</sub> , V <sub>OUT</sub> = 0~3.6 V         | 0                         | —         | 10.0                  | μA   |   |
| Quiescent supply current              |         | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND             | 1.2~3.6                   | —         | 20.0                  | μA   |   |
|                                       |         |                  | V <sub>CC</sub> ≤ V <sub>IN</sub> ≤ 3.6 V            | 1.2~3.6                   | —         | ±20.0                 |      |   |
| Increase in I <sub>CC</sub> per input |         | ΔI <sub>CC</sub> | V <sub>IH</sub> = V <sub>CC</sub> - 0.6 V            | 2.7~3.6                   | —         | 750                   |      |   |

## AC Characteristics (Ta = -40 to 85°C, input: tr = tf = 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 = 1M Ω | 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 = 1M Ω | 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 = 1M Ω | 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  |      |

## Dynamic Switching Characteristics (Ta = 25°C, input: tr = tf = 3.0 ns, CL = 30 pF)

| Characteristics                  | Symbol | Test Condition  | VCC (V) | Typ.  | Unit |
|----------------------------------|--------|---|---------|-------|------|
|                                  |        |   |         |       |      |
| Quiet output maximum dynamic VOL | VOLP   | V <sub>IH</sub> = 1.8 V, V <sub>IL</sub> = 0 V (Note) | 1.8     | 0.25  | V    |
|                                  |        | V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V (Note) | 2.5     | 0.6   |      |
|                                  |        | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V (Note) | 3.3     | 0.8   |      |
| Quiet output minimum dynamic VOL | VOLV   | V <sub>IH</sub> = 1.8 V, V <sub>IL</sub> = 0 V (Note) | 1.8     | -0.25 | V    |
|                                  |        | V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V (Note) | 2.5     | -0.6  |      |
|                                  |        | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V (Note) | 3.3     | -0.8  |      |
| Quiet output minimum dynamic VOH | VOHV   | V <sub>IH</sub> = 1.8 V, V <sub>IL</sub> = 0 V (Note) | 1.8     | 1.5   | V    |
|                                  |        | V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V (Note) | 2.5     | 1.9   |      |
|                                  |        | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V (Note) | 3.3     | 2.2   |      |

Note: Parameter guaranteed by design.

## 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   |

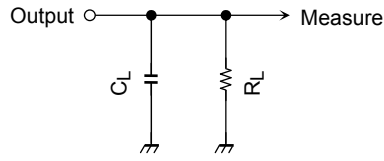
Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

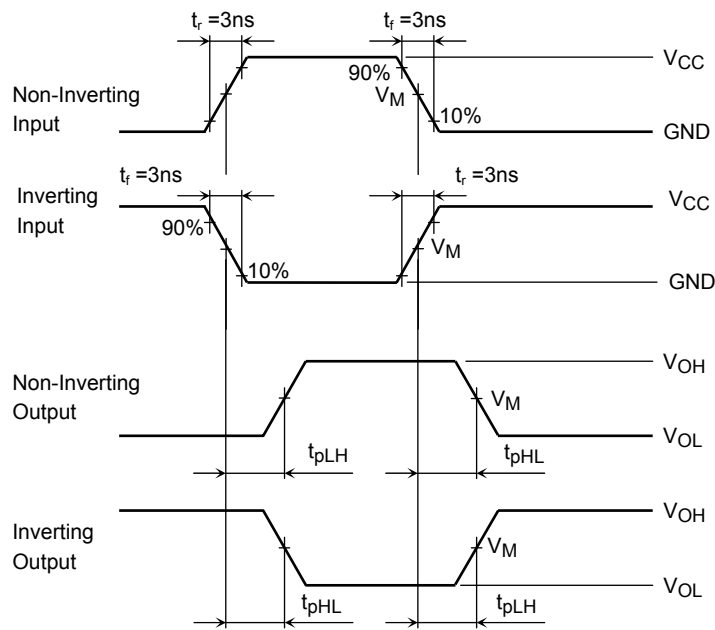


**AC Test Circuit**



**Figure 1**

**AC Waveform**



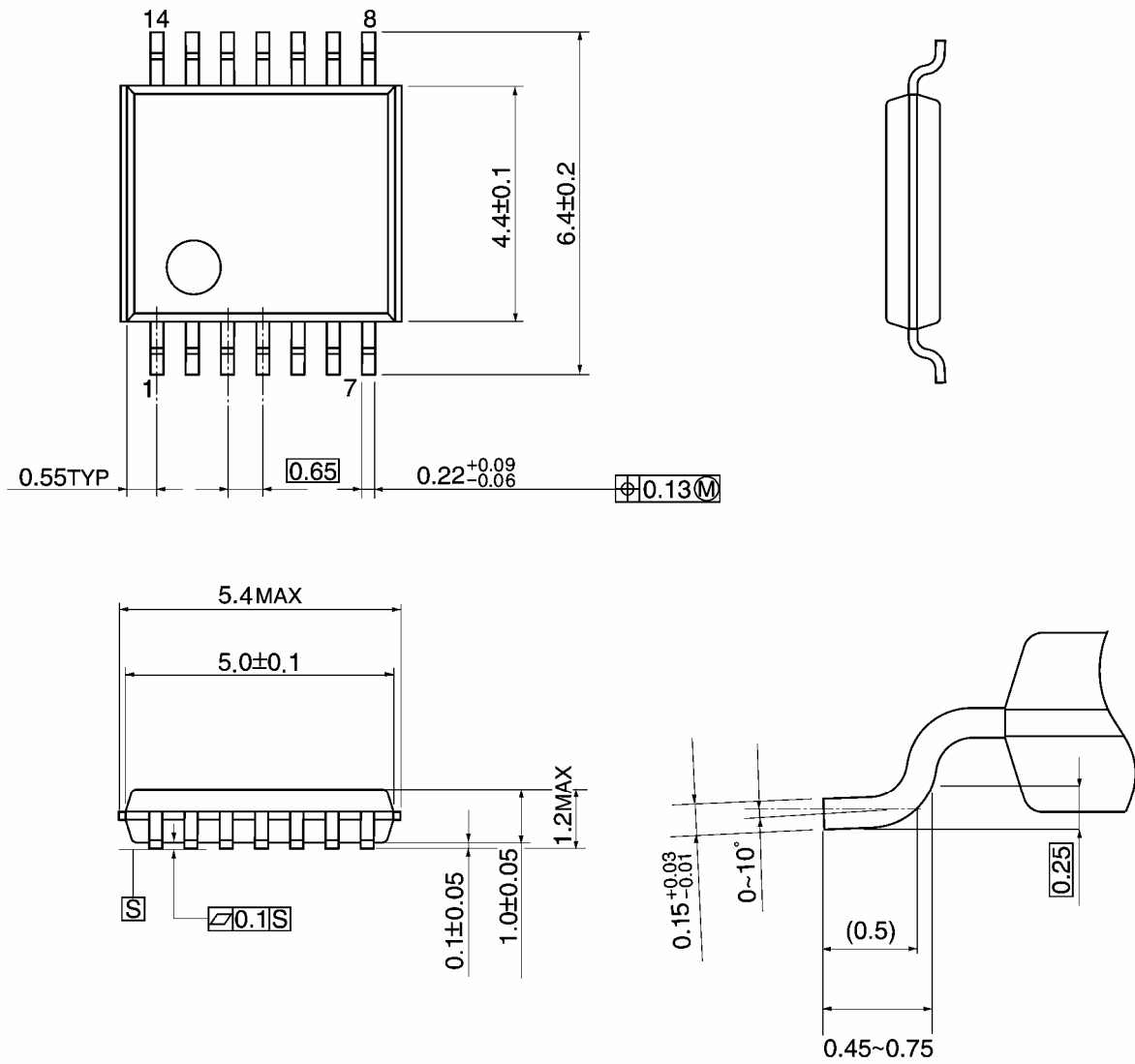
| Symbol   | $V_{CC}$                |                         |                                    |
|----------|-------------------------|-------------------------|------------------------------------|
|          | $3.3 \pm 0.3 \text{ V}$ | $2.5 \pm 0.2 \text{ V}$ | $1.8 \text{ V} \pm 0.15 \text{ V}$ |
| $V_{IN}$ | $V_{CC}$                | $V_{CC}$                | $V_{CC}$                           |
| $V_M$    | $1.5 \text{ V}$         | $V_{CC}/2$              | $V_{CC}/2$                         |

**Figure 2  $t_{pLH}$ ,  $t_{pHL}$**

**Package Dimensions**

TSSOP14-P-0044-0.65A

Unit: mm

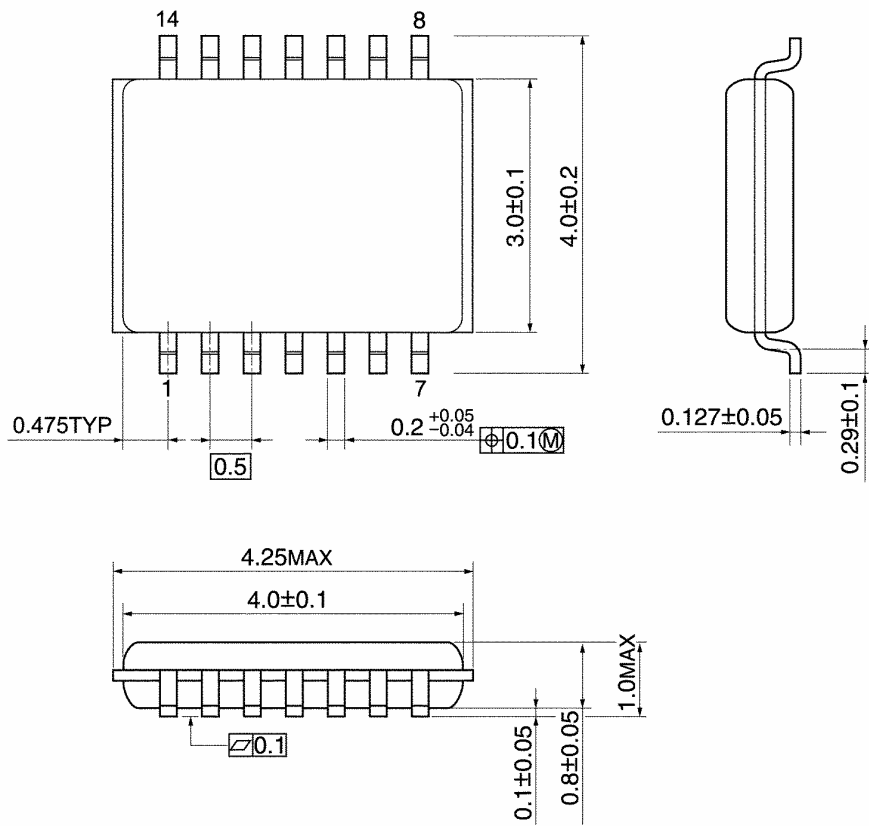


Weight: 0.06 g (typ.)

## Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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20070701-EN GENERAL

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