

# TC7WH02FU

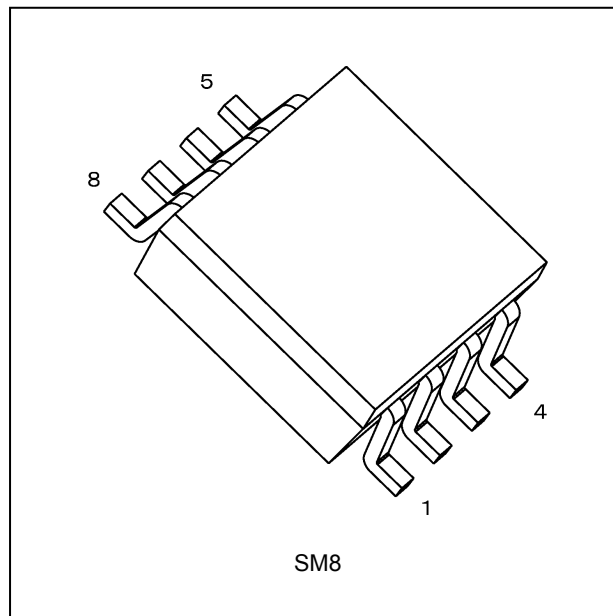
## 1. Functional Description

- Dual 2-Input NOR Gate

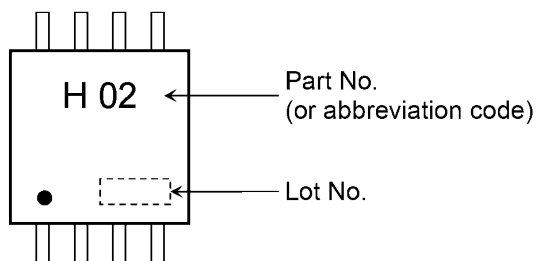
## 2. Features

- (1) Wide operating temperature range:  $T_{opr} = -40$  to  $85\text{ }^{\circ}\text{C}$
- (2) High speed operation:  $t_{pd} = 3.6\text{ ns (typ.)}$  ( $V_{CC} = 5.0\text{ V}$ ,  $C_L = 15\text{ pF}$ )
- (3) Low power dissipation:  $I_{CC} = 2.0\text{ }\mu\text{A (max)}$  ( $T_a = 25\text{ }^{\circ}\text{C}$ )
- (4) High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- (5) 5.5 V tolerant inputs
- (6) Balanced Propagation delay:  $t_{PLH} \approx t_{PHL}$
- (7) Wide operating voltage range:  $V_{CC} = 2.0$  to  $5.5\text{ V}$
- (8) Identical pin assignment and function with TC7W02

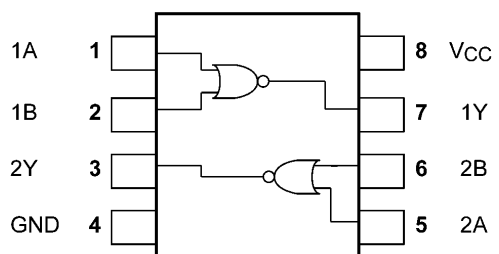
## 3. Packaging



## 4. Marking and Pin Assignment



Marking

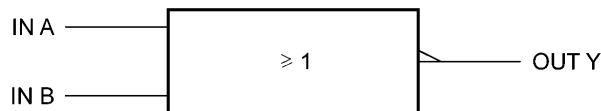


Pin Assignment (Top view)

Start of commercial production

1997-10

**5. IEC Logic Symbol**



**6. Truth Table**

A	B	Y
L	L	H
L	H	L
H	L	L
H	H	L

**7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T<sub>a</sub> = 25 °C)**

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V <sub>CC</sub>		-0.5 to 7.0	V
Input voltage	V <sub>IN</sub>		-0.5 to 7.0	
DC output voltage	V <sub>OUT</sub>		-0.5 to V <sub>CC</sub> + 0.5	
Input diode current	I <sub>IK</sub>		-20	mA
Output diode current	I <sub>OK</sub>	(Note 1)	±20	
DC output current	I <sub>OUT</sub>		±25	
V <sub>CC</sub> /ground current	I <sub>CC</sub>		±50	
Power dissipation	P <sub>D</sub>		300	mW
Storage temperature	T <sub>stg</sub>		-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: V<sub>OUT</sub> < GND, V<sub>OUT</sub> > V<sub>CC</sub>

**8. Operating Ranges (Note)**

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	V <sub>CC</sub>	—	2.0 to 5.5	V
Input voltage	V <sub>IN</sub>	—	0 to 5.5	
Output voltage	V <sub>OUT</sub>	—	0 to V <sub>CC</sub>	
Operating temperature	T <sub>opr</sub>	—	-40 to 85	°C
Input rise and fall time	dt/dv	V <sub>CC</sub> = 3.3 ± 0.3 V	0 to 100	ns/V
		V <sub>CC</sub> = 5.0 ± 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<sub>CC</sub> or GND.

**9. Electrical Characteristics**

**9.1. 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	1.5	—	—	V	
			3.0 to 5.5	$V_{CC} \times 0.7$	—	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.5	V	
			3.0 to 5.5	—	—	$V_{CC} \times 0.3$		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	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	V
				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	—	—	
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	—	—	2.0	$\mu\text{A}$	

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Max	Unit		
High-level input voltage	$V_{IH}$	—	2.0	1.5	—	V		
			3.0 to 5.5	$V_{CC} \times 0.7$	—			
Low-level input voltage	$V_{IL}$	—	2.0	—	0.5	V		
			3.0 to 5.5	—	$V_{CC} \times 0.3$			
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	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	—	V
				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	—	20.0	$\mu\text{A}$		

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

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Typ.	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$		—	$3.3 \pm 0.3$	15	—	5.6	7.9	ns
					50	—	8.1	11.4	
				$5.0 \pm 0.5$	15	—	3.6	5.5	
					50	—	5.1	7.5	
Input capacitance	$C_{IN}$		—			—	4	10	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	—			—	15	—	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.

$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per 1 gate)}$$

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

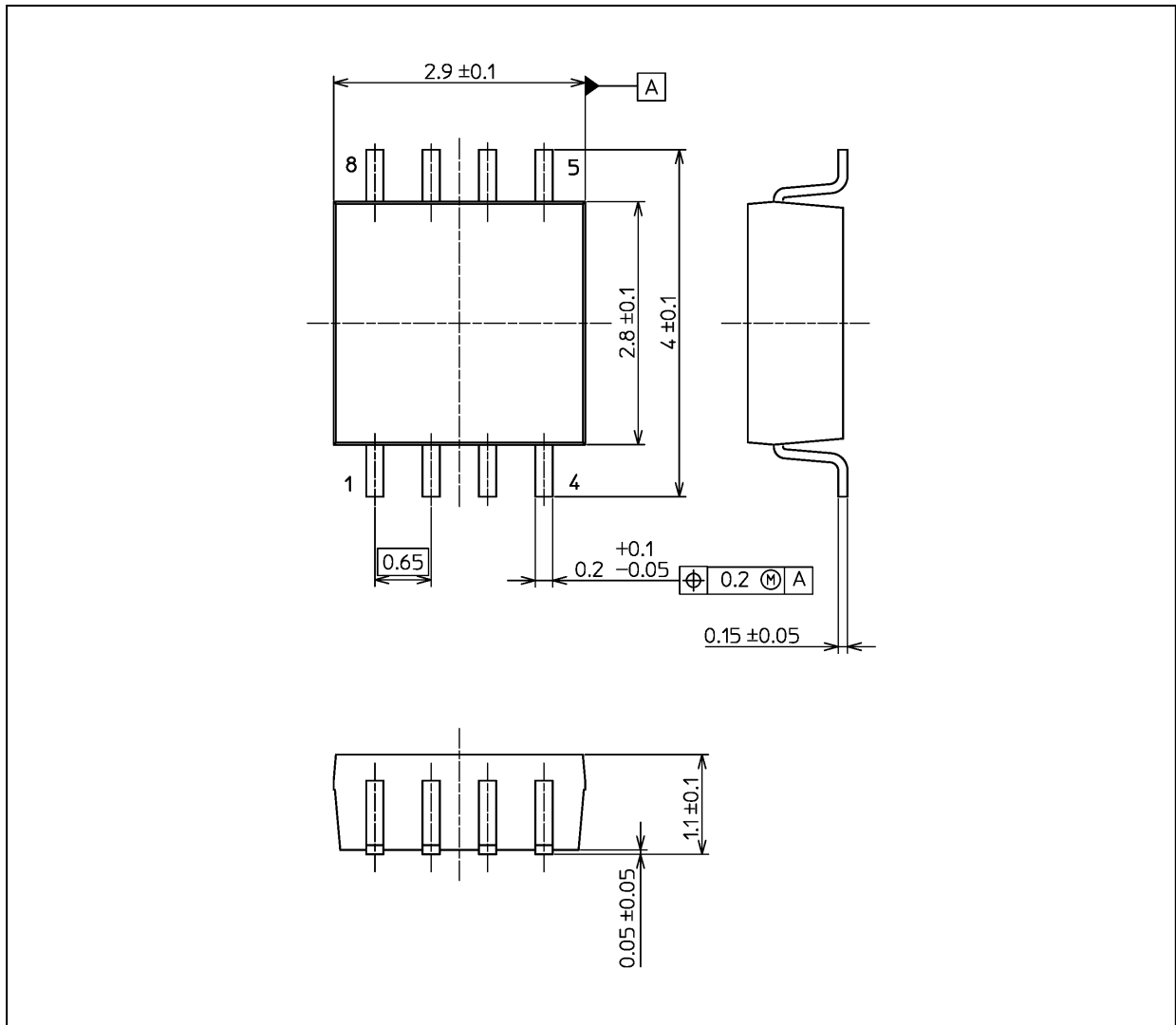
Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$	—	$3.3 \pm 0.3$	15	1.0	9.5	ns
				50	1.0	13.0	
			$5.0 \pm 0.5$	15	1.0	6.5	
				50	1.0	8.5	
Input capacitance	$C_{IN}$	—			—	10	pF

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Limit	Unit
Quiet output maximum dynamic $V_{OL}$	$V_{OLP}$	$C_L = 50\text{ pF}$	5.0	0.3	0.8	V
Quiet output minimum dynamic $V_{OL}$	$V_{OLV}$	$C_L = 50\text{ pF}$	5.0	-0.3	-0.8	V
Minimum high-level dynamic input voltage	$V_{IHD}$	$C_L = 50\text{ pF}$	5.0	—	3.5	V
Maximum low-level dynamic input voltage	$V_{ILD}$	$C_L = 50\text{ pF}$	5.0	—	1.5	V

Package Dimensions

Unit: mm



Weight: 21 mg (typ.)

Package Name(s)
JEDEC: SOT-505
Nickname: SM8

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