

CMOS Digital Integrated Circuits Silicon Monolithic

# TC7SH08FU

## 1. Functional Description

- 2-Input AND Gate

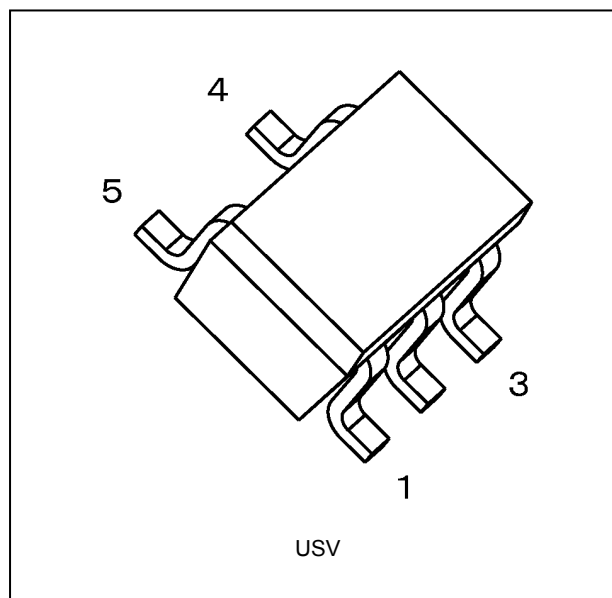
## 2. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C (Note 2)
- (3) High speed operation:  $t_{pd} = 4.3$  ns (typ.) ( $V_{CC} = 5.0$  V,  $C_L = 15$  pF)
- (4) Low power dissipation:  $I_{CC} = 2.0$   $\mu$ A (max) ( $T_a = 25$  °C)
- (5) High noise immunity:  $V_{NIH} = V_{NIL} = 28$  %  $V_{CC}$  (min)
- (6) 5.5 V tolerant inputs
- (7) Wide operating voltage range:  $V_{CC} = 2.0$  to  $5.5$  V

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

Note 2: For devices with the ordering part number ending in J(CT).  $T_{opr} = -40$  to  $85$  °C for the other devices.

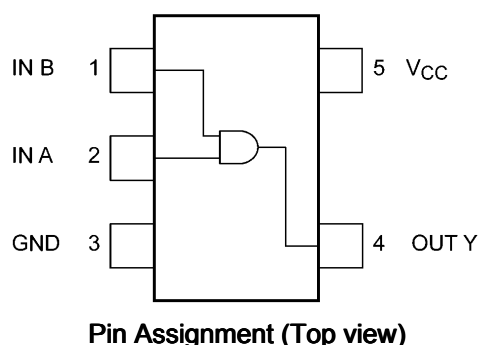
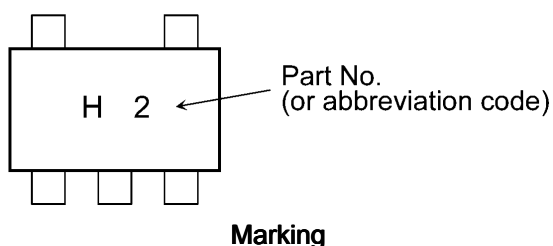
## 3. Packaging



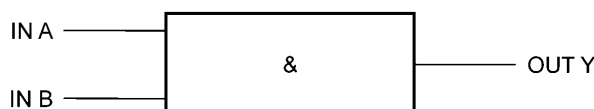
Start of commercial production

1993-09

### 4. Marking and Pin Assignment



### 5. IEC Logic Symbol



### 6. Truth Table

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

### 7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Input voltage	$V_{IN}$		-0.5 to 7.0	
DC output voltage	$V_{OUT}$		-0.5 to $V_{CC} + 0.5$	
Input diode current	$I_{IK}$		-20	mA
Output diode current	$I_{OK}$	(Note 1)	$\pm 20$	
DC output current	$I_{OUT}$		$\pm 25$	
$V_{CC}$ /ground current	$I_{CC}$		$\pm 50$	
Power dissipation	$P_D$		200	mW
Storage temperature	$T_{stg}$		-65 to 150	$^\circ\text{C}$

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

### 8. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$		—	2.0 to 5.5	V
Input voltage	$V_{IN}$		—	0 to 5.5	
Output voltage	$V_{OUT}$		—	0 to $V_{CC}$	
Operating temperature	$T_{opr}$	(Note 1)	—	-40 to 125	°C
		(Note 2)	—	-40 to 85	
Input rise and fall time	dt/dv		$V_{CC} = 3.3 \pm 0.3 \text{ V}$	0 to 100	ns/V
			$V_{CC} = 5.0 \pm 0.5 \text{ V}$	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.

Note 1: For devices with the ordering part number ending in J(CT).

Note 2: For devices except those with the ordering part number ending in J(CT).

### 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	$V_{OH}$	$V_{IN} = V_{IH}$	$I_{OH} = -50 \text{ } \mu\text{A}$	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	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 50 \text{ } \mu\text{A}$	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	—	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 8 \text{ mA}$	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	$I_{CC}$	$V_{IN} = V_{CC} \text{ or GND}$		5.5	—	—	2.0	$\mu\text{A}$

### 9.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85$ °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	$V_{OH}$	$V_{IN} = V_{IH}$	$I_{OH} = -50 \mu A$	2.0	1.9	—	V	
				3.0	2.9	—		
				4.5	4.4	—		
				$I_{OH} = -4$ mA	3.0	2.48		—
			$I_{OH} = -8$ mA	4.5	3.80	—		
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$	2.0	—	0.1	V	
				3.0	—	0.1		
				4.5	—	0.1		
				$I_{OL} = 4$ mA	3.0	—		0.44
				$I_{OL} = 8$ mA	4.5	—		0.44
Input leakage current	$I_{IN}$	$V_{IN} = 5.5$ V or GND		0 to 5.5	—	$\pm 1.0$	$\mu A$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	20.0	$\mu A$	

### 9.3. DC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to $125$ °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	$V_{OH}$	$V_{IN} = V_{IH}$	$I_{OH} = -50 \mu A$	2.0	1.9	—	V	
				3.0	2.9	—		
				4.5	4.4	—		
				$I_{OH} = -4$ mA	3.0	2.40		—
			$I_{OH} = -8$ mA	4.5	3.70	—		
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$	2.0	—	0.1	V	
				3.0	—	0.1		
				4.5	—	0.1		
				$I_{OL} = 4$ mA	3.0	—		0.55
				$I_{OL} = 8$ mA	4.5	—		0.55
Input leakage current	$I_{IN}$	$V_{IN} = 5.5$ V or GND		0 to 5.5	—	$\pm 2.0$	$\mu A$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	40.0	$\mu A$	

Note: For devices with the ordering part number ending in J(CT).

### 9.4. 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	—	6.2	8.8	ns
					50	—	8.7	12.3	
				$5.0 \pm 0.5$	15	—	4.3	5.9	
					50	—	5.8	7.9	
Input capacitance	$C_{IN}$		—		—	4	10	pF	
Power dissipation capacitance	$C_{PD}$	(Note 1)	—		—	14	—	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.

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

### 9.5. 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	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	10.5	ns
				50	1.0	14.0	
			$5.0 \pm 0.5$	15	1.0	7.0	
				50	1.0	9.0	
Input capacitance	$C_{IN}$	—		—	10	pF	

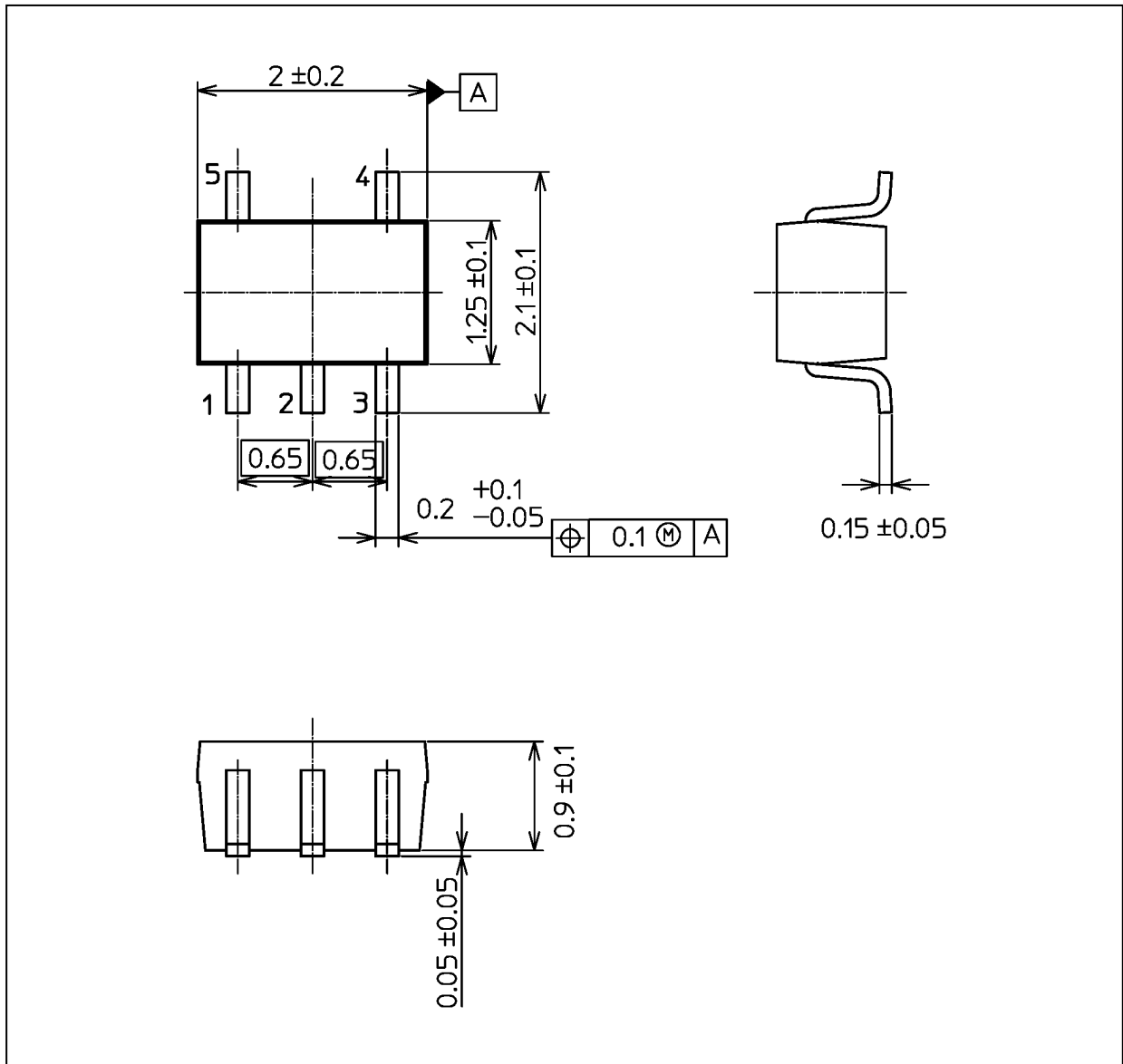
### 9.6. AC Characteristics (Note) (Unless otherwise specified, $T_a = -40\text{ to }125\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 3\text{ ns}$ )

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	12.0	ns
				50	1.0	15.5	
			$5.0 \pm 0.5$	15	1.0	8.0	
				50	1.0	10.0	
Input capacitance	$C_{IN}$	—		—	10	pF	

Note: For devices with the ordering part number ending in J(CT).

## Package Dimensions

Unit: mm



Weight: 0.006 g (typ.)

Package Name(s)
Nickname: USV

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