

# TC7SET04FU

## 1. Functional Description

- Inverter

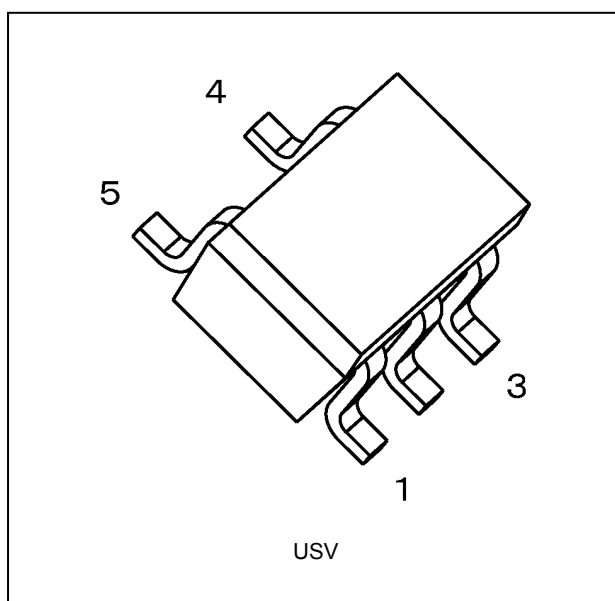
## 2. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature range:  $T_{opr} = -40$  to  $125\text{ }^{\circ}\text{C}$  (Note 2)
- (3) High speed operation:  $t_{pd} = 5.0\text{ ns}$  (typ.) ( $V_{CC} = 5.0\text{ V}$ ,  $C_L = 15\text{ pF}$ )
- (4) Low power dissipation:  $I_{CC} = 2.0\text{ }\mu\text{A}$  (max) ( $T_a = 25\text{ }^{\circ}\text{C}$ )
- (5) Compatible with TTL outputs:  $V_{IL} = 0.8\text{ V}$  (max)  
 $V_{IH} = 2.0\text{ V}$  (min)
- (6) 5.5 V tolerant inputs
- (7) Balanced Propagation Delay:  $t_{PLH} \approx t_{PHL}$

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  $85\text{ }^{\circ}\text{C}$  for the other devices.

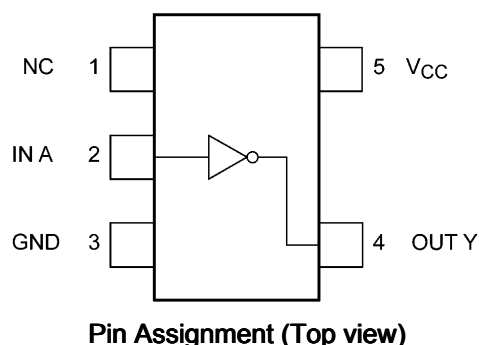
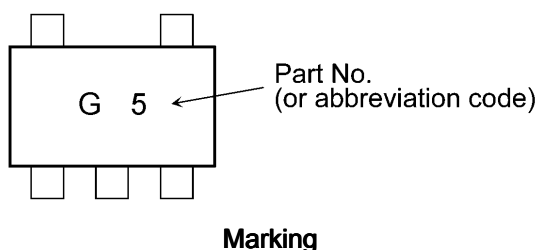
## 3. Packaging



Start of commercial production

1996-09

## 4. Marking and Pin Assignment



## 5. IEC Logic Symbol



## 6. Truth Table

A	Y
L	H
H	L

## 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	Rating	Unit
Supply voltage	$V_{CC}$		4.5 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		0 to 20	ns/V

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, $T_a = 25\text{ °C}$ )

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Typ.	Max	Unit
High-level input voltage	$V_{IH}$	—		4.5 to 5.5	2.0	—	—	V
Low-level input voltage	$V_{IL}$	—		4.5 to 5.5	—	—	0.8	V
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	4.5	4.4	4.5	—	V
			$I_{OH} = -8\text{ mA}$	4.5	3.94	—	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 50\text{ }\mu\text{A}$	4.5	—	0.0	0.1	V
			$I_{OL} = 8\text{ mA}$	4.5	—	—	0.36	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V or GND}$		0 to 5.5	—	—	$\pm 0.1$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	—	2.0	$\mu\text{A}$
	$I_{CCT}$	$V_{IN} = 3.4\text{ V}$		5.5	—	—	1.35	mA

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

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		4.5 to 5.5	2.0	—	V
Low-level input voltage	$V_{IL}$	—		4.5 to 5.5	—	0.8	V
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	4.5	4.4	—	V
			$I_{OH} = -8\text{ mA}$	4.5	3.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 50\text{ }\mu\text{A}$	4.5	—	0.1	V
			$I_{OL} = 8\text{ mA}$	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	$\mu\text{A}$
	$I_{CCT}$	$V_{IN} = 3.4\text{ V}$		5.5	—	1.50	mA

**9.3. DC Characteristics (Note) (Unless otherwise specified,  $T_a = -40$  to  $125\text{ }^\circ\text{C}$ )**

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		4.5 to 5.5	2.0	—	V
Low-level input voltage	$V_{IL}$	—		4.5 to 5.5	—	0.8	V
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	4.5	4.4	—	V
			$I_{OH} = -8\text{ mA}$	4.5	3.70	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 50\text{ }\mu\text{A}$	4.5	—	0.1	V
			$I_{OL} = 8\text{ mA}$	4.5	—	0.55	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V}$ or GND		0 to 5.5	—	$\pm 2.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	40.0	$\mu\text{A}$
	$I_{CCT}$	$V_{IN} = 3.4\text{ V}$		5.5	—	1.50	mA

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	$t_{PLH}, t_{PHL}$		—	$5.0 \pm 0.5$	15	—	5.0	7.0	ns
					50	—	8.0	10.5	
Input capacitance	$C_{IN}$		—			—	4	10	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	—			—	17	—	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:  $t_r = t_f = 3\text{ ns}$ )**

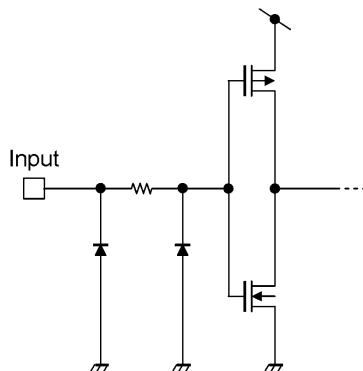
Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time	$t_{PLH}, t_{PHL}$	—	$5.0 \pm 0.5$	15	1.0	8.0	ns
				50	1.0	12.0	
Input capacitance	$C_{IN}$	—			—	10	pF

**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	$t_{PLH}, t_{PHL}$	—	$5.0 \pm 0.5$	15	1.0	9.0	ns
				50	1.0	13.5	
Input capacitance	$C_{IN}$	—			—	10	pF

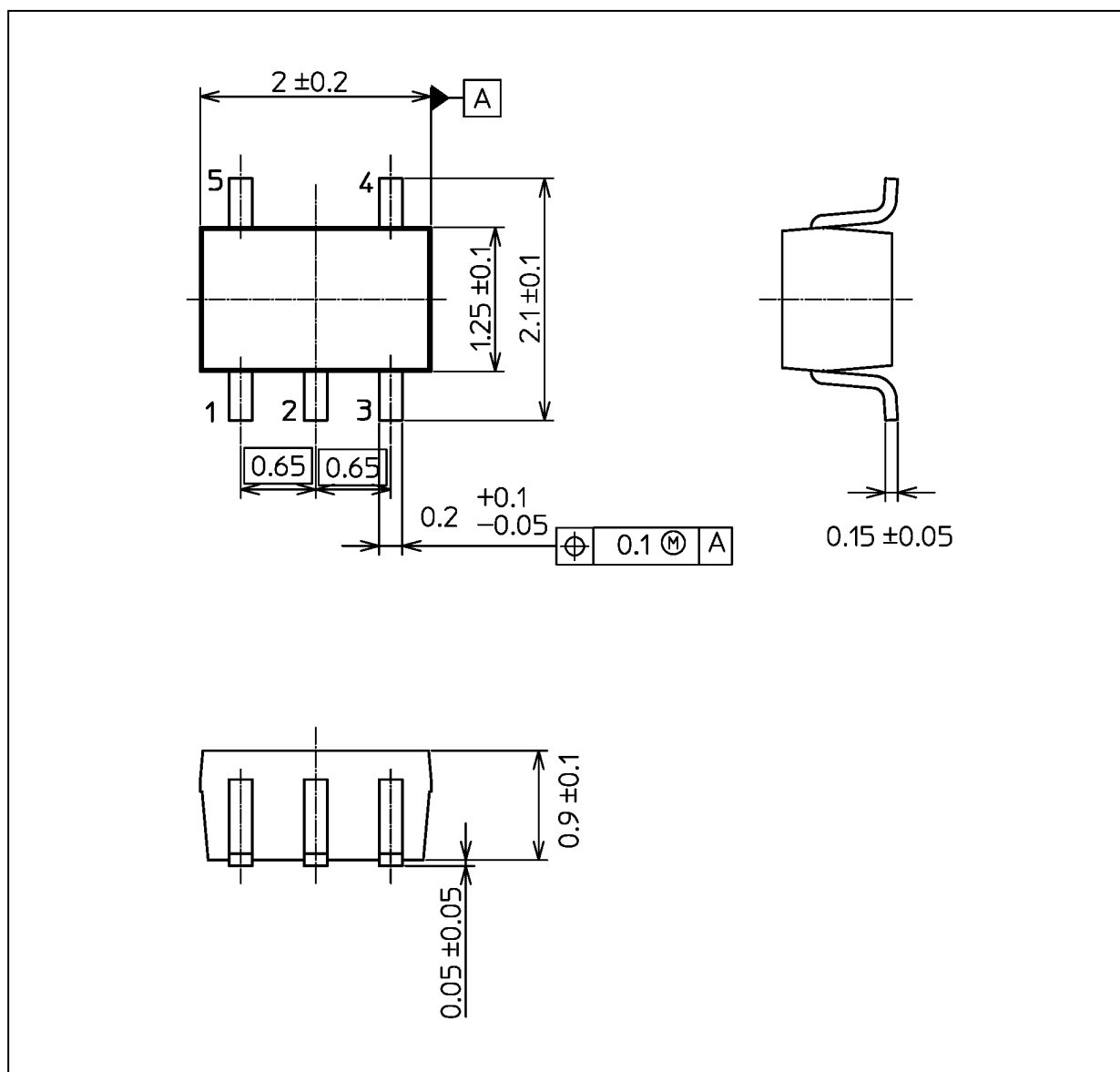
Note: For devices with the ordering part number ending in J(CT).

**9.7. Internal Equivalent Circuit**



## Package Dimensions

Unit: mm



Weight: 0.006 g (typ.)

Package Name(s)
JEDEC: SOT-353
Nickname: USV

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