

TC7SZ125FU

1. Functional Description

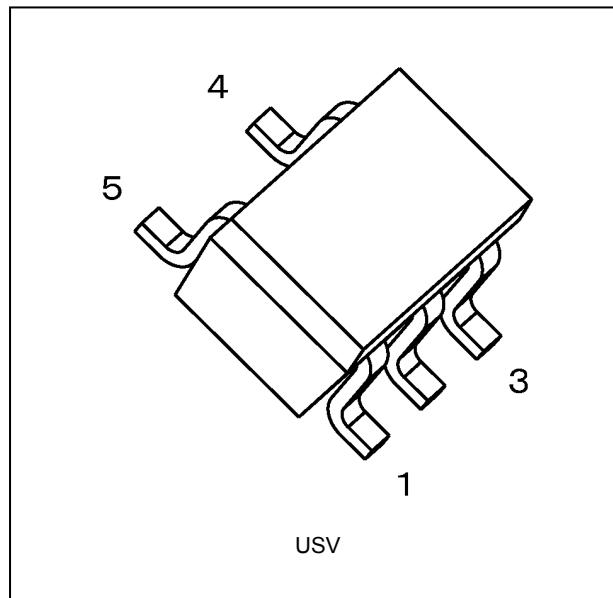
- Bus Buffer with 3-State Output

2. Features

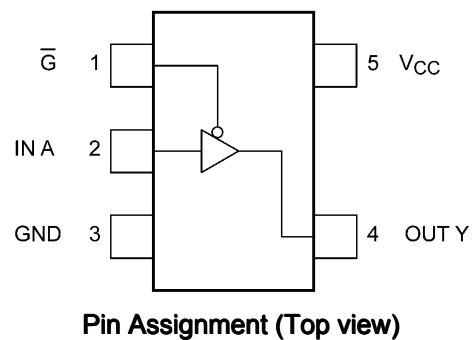
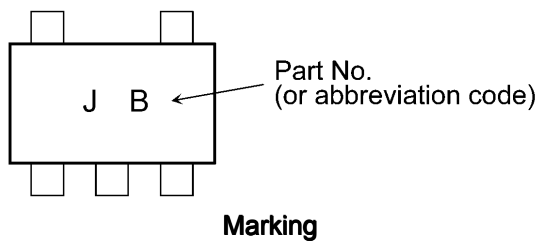
- (1) Wide operating temperature range: $T_{opr} = -40$ to 125 °C (Note 1)
- (2) High output current: ± 24 mA (min) at $V_{CC} = 3$ V
- (3) Super high speed operation: $t_{pd} = 2.6$ ns (typ.) at $V_{CC} = 5$ V, $C_L = 50$ pF
- (4) Operation voltage range: $V_{CC} = 1.8$ to 5.5 V
- (5) 5.5-V tolerant inputs
- (6) 5.5-V power down protection output
- (7) Matches the performance of TC74LCX series when operated at 3.3-V V_{CC}

Note 1: For devices with the ordering part number TC7SZ125FU,LJ(CT). $T_{opr} = -40$ to 85 °C for the other devices.

3. Packaging

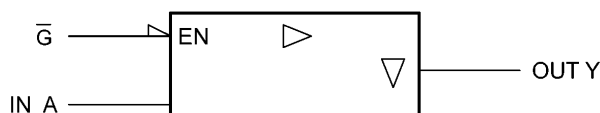


4. Marking and Pin Assignment



Start of commercial production
1998-08

5. IEC Logic Symbol



6. Truth Table

Input A	Input \bar{G}	Output Y
X	H	Z
L	L	L
H	L	H

X: Don't care
 Z: High impedance

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 6	V
Input voltage	V_{IN}		-0.5 to 6	V
DC output voltage	V_{OUT}	(Note 1)	-0.5 to 6	V
		(Note 2)	-0.5 to $V_{CC} + 0.5$	
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}	(Note 3)	-20	mA
DC output current	I_{OUT}		± 50	mA
V_{CC} /ground current	I_{CC}		± 50	mA
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: $V_{CC} = 0\text{ V}$ or high impedance condition

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

Note 3: $V_{OUT} < \text{GND}$

8. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	V_{CC}		—	1.8 to 5.5	V
		(Note 1)	—	1.5 to 5.5	
Input voltage	V_{IN}		—	0 to 5.5	V
Output voltage	V_{OUT}	(Note 2)	—	0 to 5.5	V
		(Note 3)	—	0 to V_{CC}	
Operating temperature	T_{opr}	(Note 4)	—	-40 to 125	°C
		(Note 5)	—	-40 to 85	
Input rise and fall time	dt/dv		$V_{CC} = 1.8\text{ V}, 2.5 \pm 0.2\text{ V}$	0 to 20	ns/V
			$V_{CC} = 3.3 \pm 0.3\text{ V}$	0 to 10	
			$V_{CC} = 5.0 \pm 0.5\text{ V}$	0 to 5	

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: Data retention only

Note 2: $V_{CC} = 0\text{ V}$ or high impedance condition

Note 3: High (H) or Low (L) state.

Note 4: For devices with the ordering part number TC7SZ125FU,LJ(CT).

Note 5: For devices except those with the ordering part number TC7SZ125FU,LJ(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}	—		1.8	$V_{CC} \times 0.88$	—	—	V
				2.3 to 5.5	$V_{CC} \times 0.75$	—	—	
Low-level input voltage	V_{IL}	—		1.8	—	—	$V_{CC} \times 0.12$	V
				2.3 to 5.5	—	—	$V_{CC} \times 0.25$	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\text{ }\mu\text{A}$	1.8	1.7	1.8	—	V
				2.3	2.2	2.3	—	
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			$I_{OH} = -8\text{ mA}$	2.3	1.9	2.15	—	
			$I_{OH} = -16\text{ mA}$	3.0	2.4	2.8	—	
			$I_{OH} = -24\text{ mA}$	3.0	2.3	2.68	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IL}$	$I_{OL} = 100\text{ }\mu\text{A}$	1.8	—	0.0	0.1	V
				2.3	—	0.0	0.1	
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 8\text{ mA}$	2.3	—	0.1	0.3	
			$I_{OL} = 16\text{ mA}$	3.0	—	0.15	0.4	
			$I_{OL} = 24\text{ mA}$	3.0	—	0.22	0.55	
Input leakage current	I_{IN}	$V_{IN} = 5.5\text{ V}$ or GND		0 to 5.5	—	—	± 1.0	μA
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 5.5 V		1.8 to 5.5	—	—	± 1.0	μA
Power-OFF leakage current	I_{OFF}	V_{IN} or $V_{OUT} = 5.5\text{ V}$		0.0	—	—	1	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	—	2	μA

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}	—		1.8	$V_{CC} \times 0.88$	—	V	
				2.3 to 5.5	$V_{CC} \times 0.75$	—		
Low-level input voltage	V_{IL}	—		1.8	—	$V_{CC} \times 0.12$	V	
				2.3 to 5.5	—	$V_{CC} \times 0.25$		
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100 \mu A$	1.8	1.7	—	V	
				2.3	2.2	—		
				3.0	2.9	—		
				4.5	4.4	—		
			$I_{OH} = -8$ mA	2.3	1.9	—		
				$I_{OH} = -16$ mA	3.0	2.4		—
				$I_{OH} = -24$ mA	3.0	2.3		—
				$I_{OH} = -32$ mA	4.5	3.8		—
Low-level output voltage	V_{OL}	$V_{IN} = V_{IL}$	$I_{OL} = 100 \mu A$	1.8	—	0.1	V	
				2.3	—	0.1		
				3.0	—	0.1		
				4.5	—	0.1		
			$I_{OL} = 8$ mA	2.3	—	0.3		
				$I_{OL} = 16$ mA	3.0	—		0.4
				$I_{OL} = 24$ mA	3.0	—		0.55
				$I_{OL} = 32$ mA	4.5	—		0.55
Input leakage current	I_{IN}	$V_{IN} = 5.5$ V or GND		0 to 5.5	—	± 10.0	μA	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 5.5 V		1.8 to 5.5	—	± 10.0	μA	
Power-OFF leakage current	I_{OFF}	V_{IN} or $V_{OUT} = 5.5$ V		0.0	—	10	μA	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	20	μA	

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}	—	1.8	$V_{CC} \times 0.88$	—	V		
			2.3 to 5.5	$V_{CC} \times 0.75$	—			
Low-level input voltage	V_{IL}	—	1.8	—	$V_{CC} \times 0.12$	V		
			2.3 to 5.5	—	$V_{CC} \times 0.25$			
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100 \mu A$	1.8	1.7	—	V	
				2.3	2.2	—		
				3.0	2.9	—		
				4.5	4.4	—		
			$I_{OH} = -8$ mA	2.3	1.7	—		
				$I_{OH} = -16$ mA	3.0	2.2		—
				$I_{OH} = -24$ mA	3.0	2.0		—
				$I_{OH} = -32$ mA	4.5	3.4		—
Low-level output voltage	V_{OL}	$V_{IN} = V_{IL}$	$I_{OL} = 100 \mu A$	1.8	—	0.1	V	
				2.3	—	0.1		
				3.0	—	0.1		
				4.5	—	0.1		
			$I_{OL} = 8$ mA	2.3	—	0.45		
				$I_{OL} = 16$ mA	3.0	—		0.6
				$I_{OL} = 24$ mA	3.0	—		0.8
				$I_{OL} = 32$ mA	4.5	—		0.8
Input leakage current	I_{IN}	$V_{IN} = 5.5$ V or GND	0 to 5.5	—	± 20.0	μA		
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 5.5 V	1.8 to 5.5	—	± 20.0	μA		
Power-OFF leakage current	I_{OFF}	V_{IN} or $V_{OUT} = 5.5$ V	0.0	—	100	μA		
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	5.5	—	200	μA		

Note: For devices with the ordering part number TC7SZ125FU,LJ(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}		$R_L = 1\text{ M}\Omega$ See 9.7 AC Test Circuit, Table 9.7.1	1.8	15	2.0	5.3	11.0	ns					
				2.5 ± 0.2		0.8	3.4	7.5						
				3.3 ± 0.3		0.5	2.5	5.2						
				5.0 ± 0.5		0.5	2.1	4.5						
			$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	3.3 ± 0.3	50	1.5	3.2	5.7	ns					
				5.0 ± 0.5		0.8	2.6	5.0						
				Output enable time		t_{PZL}, t_{PZH}	$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	1.8		50	2.0	7.0	12.5	ns
								2.5 ± 0.2			1.5	4.6	8.5	
$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	3.3 ± 0.3	50	1.5	3.5	6.2	ns								
			5.0 ± 0.5	0.8	2.8		5.5							
			Output disable time	t_{PLZ}, t_{PHZ}	$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1		1.8	50	2.0	5.4	11.0	ns		
							2.5 ± 0.2		1.5	3.5	8.0			
3.3 ± 0.3	1.0	2.8				5.7								
5.0 ± 0.5	0.5	2.1				4.7								
Input capacitance	C_{IN}		—	0 to 5.5	—	—	4	—	pF					
Power dissipation capacitance	C_{PD}	(Note 1)	—	3.3	—	—	17	—	pF					
				5.5			—			24	—			

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	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit					
Propagation delay time	t_{PLH}, t_{PHL}		$R_L = 1\text{ M}\Omega$ See 9.7 AC Test Circuit, Table 9.7.1	1.8	15	2.0	11.5	ns					
				2.5 ± 0.2		0.8	8.0						
				3.3 ± 0.3		0.5	5.5						
				5.0 ± 0.5		0.5	4.8						
			$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	3.3 ± 0.3	50	1.5	6.0	ns					
				5.0 ± 0.5		0.8	5.3						
				Output enable time		t_{PZL}, t_{PZH}	$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1		1.8	50	2.0	13.0	ns
									2.5 ± 0.2		1.5	9.0	
3.3 ± 0.3	1.5	6.5											
5.0 ± 0.5	0.8	5.8											
Output disable time	t_{PLZ}, t_{PHZ}	$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	1.8	50	2.0	12.0	ns						
			2.5 ± 0.2		1.5	8.5							
			3.3 ± 0.3		1.0	6.0							
			5.0 ± 0.5		0.5	5.0							

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

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH}, t_{PHL}		$R_L = 1\text{ M}\Omega$ See 9.7 AC Test Circuit, Table 9.7.1	1.8	15	2.0	13.0	ns
				2.5 ± 0.2		0.8	9.0	
				3.3 ± 0.3		0.5	6.5	
				5.0 ± 0.5		0.5	5.5	
			$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	3.3 ± 0.3	50	1.5	7.0	ns
				5.0 ± 0.5		0.8	6.0	
Output enable time	t_{PZL}, t_{PZH}		$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	1.8	50	2.0	14.5	ns
				2.5 ± 0.2		1.5	10.0	
				3.3 ± 0.3		1.5	7.5	
				5.0 ± 0.5		0.8	6.5	
Output disable time	t_{PLZ}, t_{PHZ}		$R_L = 500\ \Omega$ See 9.7 AC Test Circuit, Table 9.7.1	1.8	50	2.0	13.5	ns
				2.5 ± 0.2		1.5	9.5	
				3.3 ± 0.3		1.0	7.0	
				5.0 ± 0.5		0.5	5.5	

Note: For devices with the ordering part number TC7SZ125FU,LJ(CT).

9.7. AC Test Circuit

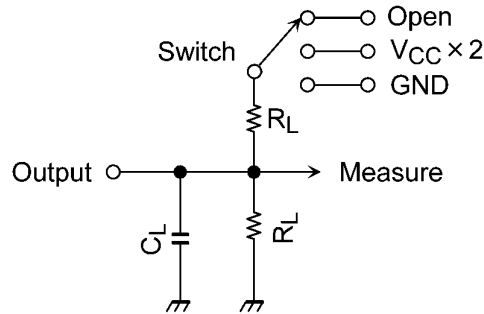
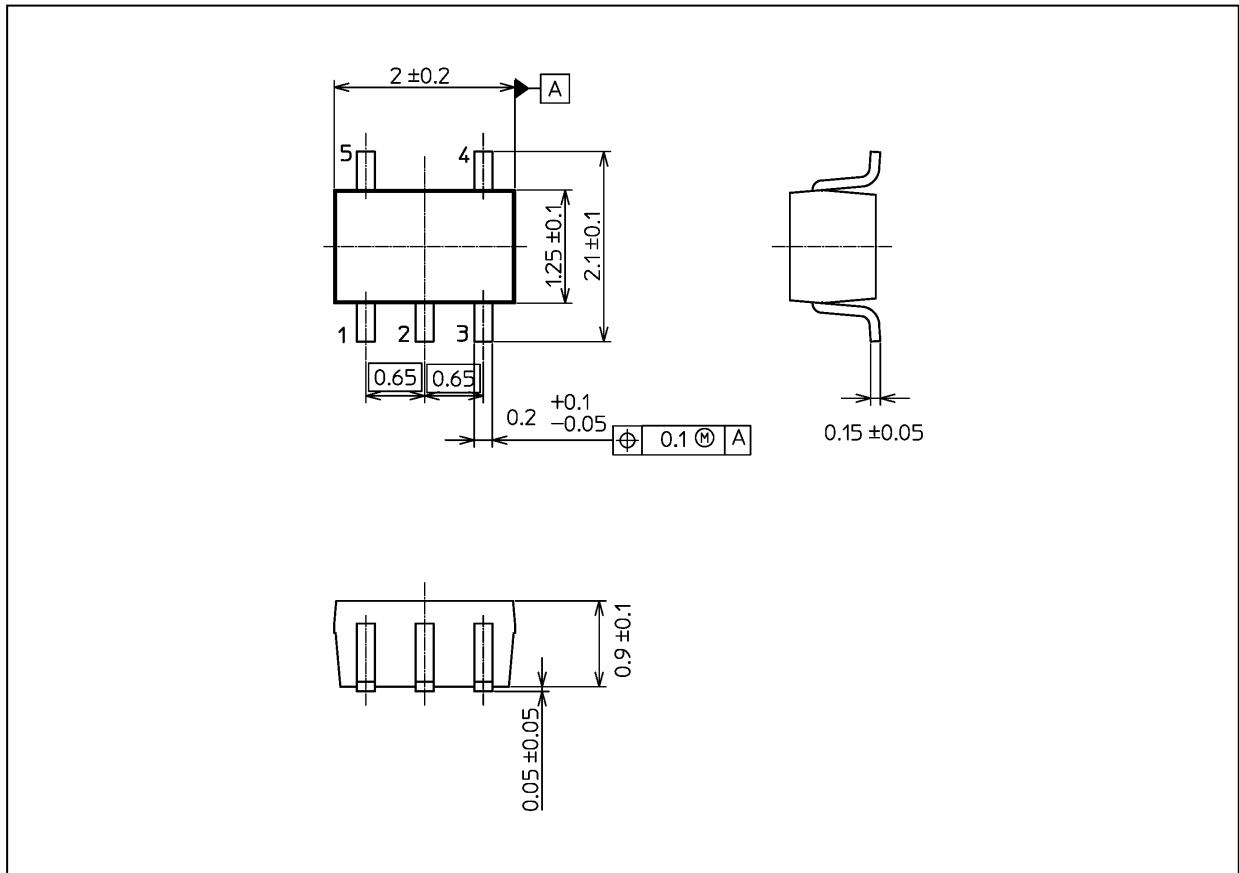


Table 9.7.1 Parameter for AC Test Circuit

Characteristics	Switch
t_{PLH}, t_{PHL}	Open
t_{PLZ}, t_{PZL}	$V_{CC} \times 2$
t_{PHZ}, t_{PZH}	GND

Package Dimensions

Unit: mm



Weight: 0.006 g (typ.)

Package Name(s)
TOSHIBA: SSOP5-P-0.65S
Nickname: USV

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