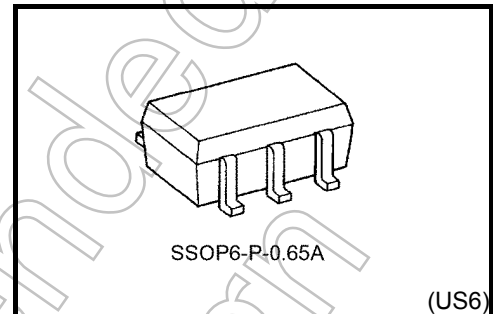


TC7PA05FU

Dual Inverter (open drain)

Features

- Operating voltage range: $V_{CC} = 1.8$ to 3.6 V
- High-speed operation: $t_{pd} = 3.5$ ns (max) at $V_{CC} = 3.0$ to 3.6 V
 $t_{pd} = 4.1$ ns (max) at $V_{CC} = 2.3$ to 2.7 V
 $t_{pd} = 8.2$ ns (max) at $V_{CC} = 1.8$ V
- High-level output current:
 $I_{OL} = 24$ mA (min) at $V_{CC} = 3.0$ V
 $I_{OL} = 18$ mA (min) at $V_{CC} = 2.3$ V
 $I_{OL} = 6$ mA (min) at $V_{CC} = 1.8$ V
- 3.6V Tolerant inputs
- 3.6V power down protection outputs



Weight: 0.0068 g (typ.)

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Characteristics	Symbol	Value	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 1)	V
Input diode current	I_{IK}	-50	mA
Output diode current	I_{OK}	-50 (Note 2)	mA
DC output current	I_{OUT}	+50	mA
Power dissipation	P_D	200	mW
DC V_{CC} /ground current	I_{CC}	± 100	mA
Storage temperature	T_{stg}	-65 to 150	$^\circ\text{C}$

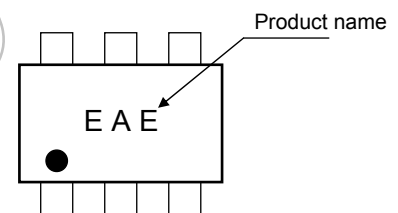
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

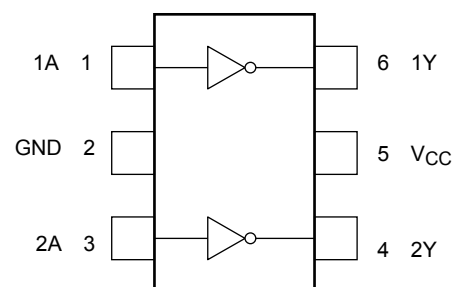
Note 1: This I_{OUT} absolute maximum rating must be adhered to.

Note 2: $V_{OUT} < \text{GND}$

Marking



Pin Assignment (top view)



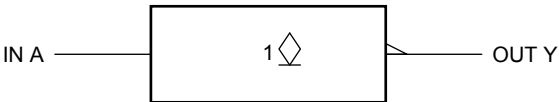
Start of commercial production
2001-10

Truth Table

A	Y
L	Z
H	L

Z: High-impedance

IEC Logic Symbol



Operating Ranges

Characteristics	Symbol	Value	Unit
Supply voltage	V _{CC}	1.8 to 3.6	V
		1.2 to 3.6 (Note 3)	
Input voltage	V _{IN}	−0.3 to 3.6	V
Output voltage	V _{OUT}	0 to V _{CC}	V
Output Current	I _{OL}	24 (Note 4)	mA
		18 (Note 5)	
		6 (Note 6)	
Operating temperature	T _{opr}	−40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 7)	ns/V

Note 3: Data retention only

Note 4: V_{CC} = 3.0 to 3.6 V

Note 5: V_{CC} = 2.3 to 2.7 V

Note 6: V_{CC} = 1.8 V

Note 7: V_{IN} = 0.8 to 2.0 V, V_{CC} = 3.0 V

DC Electrical Characteristics ($T_a = -40$ to 85°C , $2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$)

Characteristics	Symbol	Test Condition		Min	Max	Unit	
		V _{CC} (V)					
High-Level Input Voltage	V _{IH}	—		2.7 to 3.6	2.0	—	V
Low-Level Input Voltage	V _{IL}	—		2.7 to 3.6	—	0.8	
Low-Level Output Voltage	V _{OL}	V _{IN} = V _{IH}	I _{OL} = 100 μA	2.7 to 3.6	—	0.2	V
			I _{OL} = 12 mA	2.7	—	0.4	
			I _{OL} = 18 mA	3.0	—	0.4	
			I _{OL} = 24 mA	3.0	—	0.55	
Input Leakage Current	I _{IN}	V _{IN} = 0 to 3.6 V		2.7 to 3.6	—	±5.0	μA
Power-off Leakage Current	I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent Supply Current	I _{CC}	V _{IN} = V _{CC} or GND		2.7to 3.6	—	20.0	μA
		V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		2.7 to 3.6	—	±20.0	
Increase in I _{CC} per Input	ΔI _{CC}	V _{IH} = V _{CC} – 0.6 V		2.7 to 3.6	—	750	

DC Characteristics ($T_a = -40$ to 85°C , $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$)

Characteristics	Symbol	Test Condition		Min	Max	Unit
		V_{CC} (V)				
High-Level Input Voltage	V_{IH}	—		2.3 to 2.7	1.6	V
Low-Level Input Voltage	V_{IL}	—		2.3 to 2.7	—	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$	$I_{OL} = 100\text{ }\mu\text{A}$	2.3 to 2.7	—	V
			$I_{OL} = 12\text{ mA}$	2.3	—	
			$I_{OL} = 18\text{ mA}$	2.3	—	
Input Leakage Current	I_{IN}	$V_{IN} = 0$ to 3.6 V		2.3 to 2.7	—	± 5.0
Power-off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0$ to 3.6 V		0	—	10.0
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND		2.3 to 2.7	—	μA
		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$		2.3 to 2.7	—	

DC Characteristics ($T_a = -40$ to 85°C , $1.8\text{ V} \leq V_{CC} < 2.3\text{ V}$)

Characteristics	Symbol	Test Condition		Min	Max	Unit
High-Level Input Voltage	V_{IH}	—	V_{CC} (V) 1.8 to 2.3	$V_{CC} \times 0.7$	—	V
Low-Level Input Voltage	V_{IL}	—	1.8 to 2.3	—	$V_{CC} \times 0.2$	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$	$I_{OL} = 100\text{ }\mu\text{A}$	1.8	—	V
			$I_{OL} = 6\text{ mA}$	1.8	—	
Input Leakage Current	I_{IN}	$V_{IN} = 0$ to 3.6 V	1.8	—	± 5.0	μA
Power-off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0$ to 3.6 V	0	—	10.0	μA
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND	1.8	—	20.0	μA
		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	1.8	—	± 20.0	

AC Electrical Characteristics

(Ta = -40 to 85°C, input $t_r = t_f = 2.0\text{ ns}$, $C_L = 30\text{ pF}$, $R_L = 500\text{ }\Omega$)

Characteristics	Symbol	Test Condition		Min	Max	Unit
Propagation delay time	t_{pZL}	(Figure 1 and 2)	V_{CC} (V) 1.8	1.0	8.2	ns
			2.5 ± 0.2	0.8	4.1	
			3.3 ± 0.3	0.6	3.5	
	t_{pLZ}	(Figure 1 and 2)	1.8	1.0	6.8	ns
			2.5 ± 0.2	0.8	3.8	
			3.3 ± 0.3	0.6	3.5	

For $C_L = 50\text{ pF}$, add approximately 300 ps to the AC maximum specification.

Dynamic Switching Characteristics (Ta = 25°C, input tr = tf = 2.0 ns, CL = 30 pF)

Characteristics	Symbol	Test Condition		Typ.	Unit
			VCC (V)		
Quiet Output Maximum Dynamic VOL	VOLP	VIN = 1.8 V, VIL = 0 V (Note 8)	1.8	0.25	ns
		VIN = 2.5 V, VIL = 0 V (Note 8)	2.5	0.6	
		VIN = 3.3 V, VIL = 0 V (Note 8)	3.3	0.8	
Quiet Output Minimum Dynamic VOL	VOLV	VIN = 1.8 V, VIL = 0 V (Note 8)	1.8	-0.25	ns
		VIN = 2.5 V, VIL = 0 V (Note 8)	2.5	-0.6	
		VIN = 3.3 V, VIL = 0 V (Note 8)	3.3	-0.8	
Quiet Output Minimum Dynamic VOH	VOHV	VIN = 1.8 V, VIL = 0 V (Note 8)	1.8	1.5	ns
		VIN = 2.5 V, VIL = 0 V (Note 8)	2.5	1.9	
		VIN = 3.3 V, VIL = 0 V (Note 8)	3.3	2.2	

Note 8: Characteristics guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition		Typ.	Unit
			VCC (V)		
Input Capacitance	CIN	—	1.8, 2.5, 3.3	4	pF
Output Capacitance	COU	—		3	pF
Power Dissipation Capacitance	CPD	fIN = 10 MHz (Note 9)	1.8, 2.5, 3.3	4	pF

Note 9: CPD 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:

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

Test Circuit

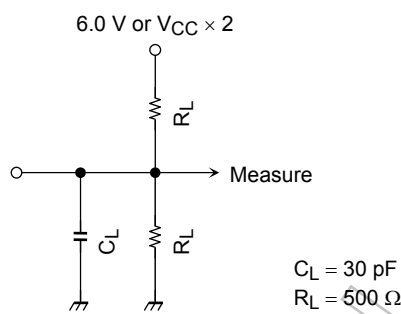
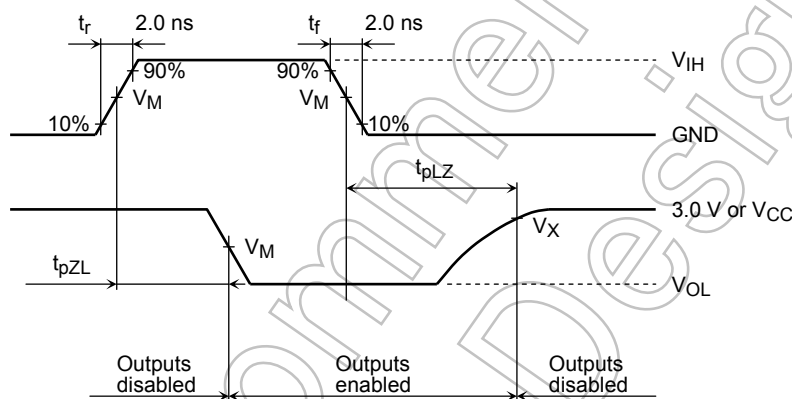


Figure 1

AC Waveforms



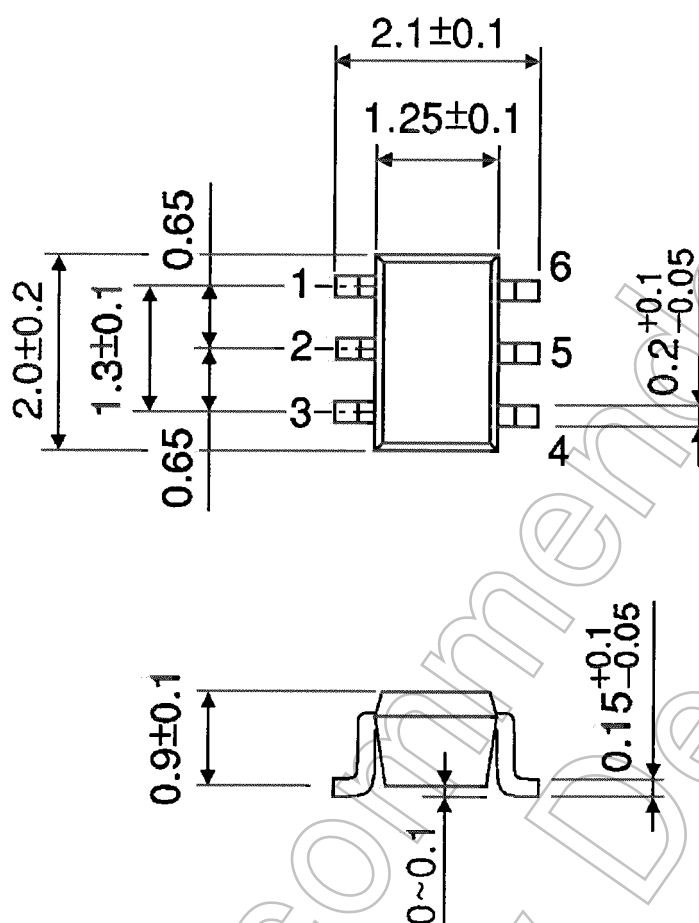
Symbol	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$

Figure 2 t_{pLH} , t_{pHL}

Package Dimensions

SSOP6-P-0.65A

Unit: mm



Weight: 0.0068 g (typ.)

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