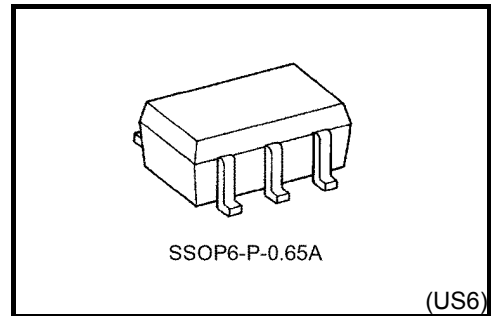


TC7PA04FU

Inverter with 3.6 V Tolerant Input and Output

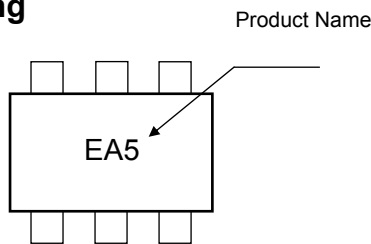
Features

- Low voltage operation : $V_{CC} = 1.8$ to 3.6 V
- High speed operation : $t_{pd} = 2.8$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
 : $t_{pd} = 3.7$ ns (max) ($V_{CC} = 2.3$ to 2.7 V)
 : $t_{pd} = 7.4$ ns (max) ($V_{CC} = 1.8$ V)
- High Output current : $I_{OH}/I_{OL} = \pm 24$ mA (min) ($V_{CC} = 3.0$ V)
 : $I_{OH}/I_{OL} = \pm 18$ mA (min) ($V_{CC} = 2.3$ V)
 : $I_{OH}/I_{OL} = \pm 6$ mA (min) ($V_{CC} = 1.8$ V)
- 3.6-V Tolerant input.
- Power down protection is provided on output.



Weight: 6.8 mg (typ.)

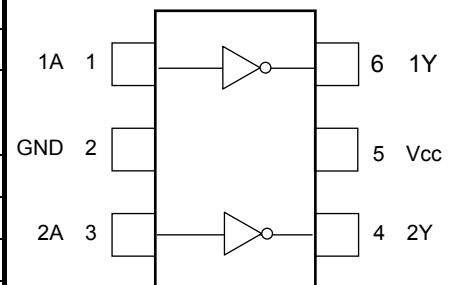
Marking



Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	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
		-0.5 to $V_{CC} + 0.5$ (Note 2)	
Input diode current	I_{IK}	-50	mA
Output diode current	I_{OK}	-50 (Note 3)	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 range	T_{stg}	-65 to 150	°C

Pin Assignment (top view)



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: $V_{CC} = 0$ V

Note 2: High or low state. I_{OUT} absolute maximum rating be observed.

Note 3: $V_{OUT} < GND$

IEC Logic Symbol



Truth Table

A	Y
L	H
H	L

Operating Ranges

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	1.8 to 3.6	V
		1.2 to 3.6 (Note 4)	
Input voltage	V_{IN}	-0.3 to 3.6	V
Output voltage	V_{OUT}	0 to 3.6 (Note 5)	V
		0 to V_{CC} (Note 6)	
Output current	I_{OH}/I_{OL}	± 24 (Note 7)	mA
		± 18 (Note 8)	
		± 6 (Note 9)	
Operating temperature range	T_{opr}	-40 to 85	$^{\circ}C$
Input rise and fall time	dt/dv	0 to 10 (Note 10)	ns/V

Note 4: Data retention only

Note 5: $V_{CC} = 0$ V

Note 6: High or low state

Note 7: $V_{CC} = 3.0$ to 3.6 V

Note 8: $V_{CC} = 2.3$ to 2.7 V

Note 9: $V_{CC} = 1.8$ V

Note 10: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C, 2.7 V < VCC ≤ 3.6 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	High level	V _{IH}	—		2.7 to 3.6	2.0	—	V
	Low level	V _{IL}	—		2.7 to 3.6	—	0.8	
Output voltage	High level	V _{OH}	V _{IN} = V _{IL}	I _{OH} = -100 μA	2.7 to 3.6	V _{CC} - 0.2	—	V
				I _{OH} = -12 mA	2.7	2.2	—	
				I _{OH} = -18 mA	3.0	2.4	—	
				I _{OH} = -24 mA	3.0	2.2	—	
	Low level	V _{OL}	V _{IN} = V _{IH}	I _{OL} = 100 μA	2.7 to 3.6	—	0.2	
				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		2.7 to 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 (Ta = -40 to 85°C, 2.3 V ≤ VCC ≤ 2.7 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	High level	V _{IH}	—		2.3 to 2.7	1.6	—	V
	Low level	V _{IL}	—		2.3 to 2.7	—	0.7	
Output voltage	High level	V _{OH}	V _{IN} = V _{IL}	I _{OH} = -100 μA	2.3 to 2.7	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	2.3	2.0	—	
				I _{OH} = -12 mA	2.3	1.8	—	
				I _{OH} = -18 mA	2.3	1.7	—	
	Low level	V _{OL}	V _{IN} = V _{IH}	I _{OL} = 100 μA	2.3 to 2.7	—	0.2	
				I _{OL} = 12 mA	2.3	—	0.4	
				I _{OL} = 18 mA	2.3	—	0.6	
Input leakage current		I _{IN}	V _{IN} = 0~3.6 V		2.3 to 2.7	—	±5.0	μA
Power off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		2.3 to 2.7	—	20.0	μA
			V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		2.3 to 2.7	—	±20.0	

DC Characteristics (Ta = -40 to 85°C, 1.8 V ≤ VCC < 2.3 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	High level	V _{IH}	—		1.8 to 2.3	V _{CC} × 0.7	—	V
	Low level	V _{IL}	—		1.8 to 2.3	—	V _{CC} × 0.2	
Output voltage	High level	V _{OH}	V _{IN} = V _{IL}	I _{OH} = -100 μA	1.8	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	1.8	1.4	—	
	Low level	V _{OL}	V _{IN} = V _{IH}	I _{OL} = 100 μA	1.8	—	0.2	
				I _{OL} = 6 mA	1.8	—	0.3	
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} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		1.8	—	±20.0	

AC Characteristics (Ta = -40~85°C, input: t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Propagation delay time	t _{pLH} t _{pHL}	Figure 1, Figure 2			1.8	1.0	7.4	ns
					2.5 ± 0.2	0.8	3.7	
					3.3 ± 0.3	0.6	2.8	

For C_L = 50 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)

項目	記号	測定条件		VCC (V)	標準	単位	
Quiet output maximum dynamic	VOL	VOLP	VIH = 1.8V, VIL = 0V	(Note 11)	1.8	0.25	V
			VIH = 2.5V, VIL = 0V	(Note 11)	2.5	0.6	
			VIH = 3.3V, VIL = 0V	(Note 11)	3.3	0.8	
Quiet output minimum dynamic	VOL	VOLV	VIH = 1.8V, VIL = 0V	(Note 11)	1.8	-0.25	V
			VIH = 2.5V, VIL = 0V	(Note 11)	2.5	-0.6	
			VIH = 3.3V, VIL = 0V	(Note 11)	3.3	-0.8	
Quiet output minimum dynamic	VOHV	VOH	VIH = 1.8V, VIL = 0V	(Note 11)	1.8	1.5	V
			VIH = 2.5V, VIL = 0V	(Note 11)	2.5	1.9	
			VIH = 3.3V, VIL = 0V	(Note 11)	3.3	2.2	

Note 11: Parameter guaranteed by design

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition		VCC (V)	Typ.	Unit
Input capacitance	CIN	—		1.8, 2.5, 3.3	5	pF
Power dissipation capacitance	CPD	fIN = 10 MHz	(Note 12)	1.8, 2.5, 3.3	18	pF

Note 12: 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.

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

AC Test Circuit

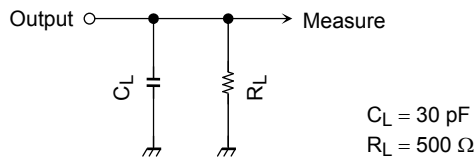
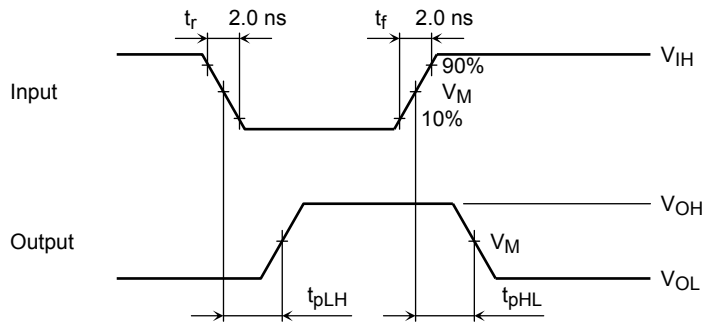


Figure 1

AC Waveform



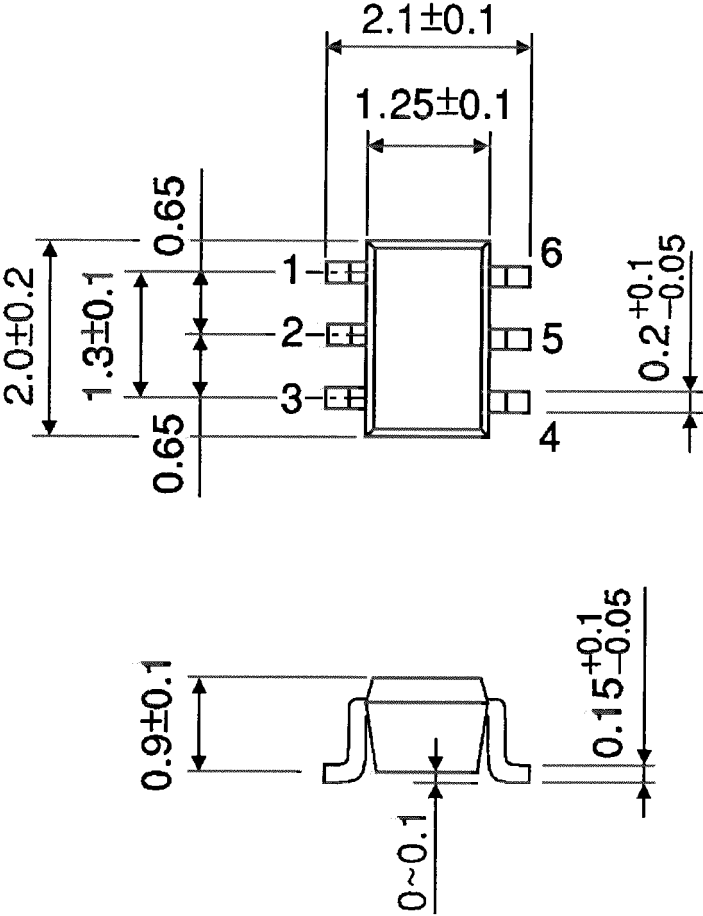
Symbol	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

Figure 2 t_{pLH} , t_{pHL}

Package Dimensions

SSOP6-P-0.65A

Unit: mm



Weight: 6.8 mg (typ.)

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