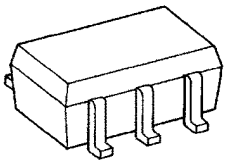
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7PAU04FU

Dual Inverter (unbuffer) with 3.6 V Tolerant Input

Features

- Low voltage operation: V_{CC} = 1.8~3.6 V
- Quiescent supply current: I_{CC} < 20 μA (max)
  V_{CC} = 3.6 V, Ta = −40~85°C)
- High-speed operation: t_{pd} = 3.5 ns (max) (V_{CC} = 3.0~3.6 V)
  t_{pd} = 4.2 ns (max) (V_{CC} = 2.3~2.7 V)
  t_{pd} = 8.4 ns (max) (V_{CC} = 1.8 V)
- High-output current: I_{OH}/I_{OL} = ±24 mA (min) (V_{CC} = 3.0 V)
  I_{OH}/I_{OL} = ±18 mA (min) (V_{CC} = 2.3 V)
  I_{OH}/I_{OL} = ±6 mA (min) (V_{CC} = 1.8 V)
- Latch-up performance: ±300 mA
- ESD Performance: ±200 V (JEITA)
  ±2000 V (MIL)
- 3.6 V tolerant function for input and power down protection are provided.



SSOP6-P-0.65A

Weight: 0.0068 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

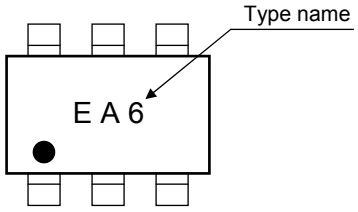
Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	−0.5~4.6	V
DC input voltage	V_{IN}	−0.5~4.6	V
DC output voltage	V_{OUT}	−0.5~V_{CC} + 0.5(Note 1)	V
Input diode current	I_{IK}	−50	mA
Output diode current	I_{OK}	±50 (Note 2)	mA
DC output current	I_{OUT}	±50	mA
DC V_{CC}/ground current	I_{CC}	±100	mA
Power dissipation	P_D	200	mW
Storage temperature	T_{stg}	−65~150	°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).

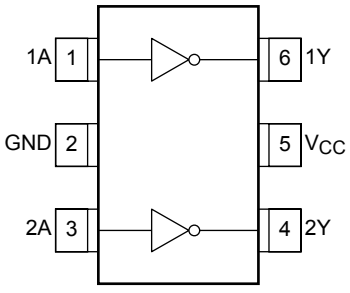
Note 1: Date retention only

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

Marking



Pin Assignment (top view)



Logic Diagram

Truth Table

A	Y
L	H
H	L

Operating Ranges

Characteristics	Symbol	Rating		Unit
Supply voltage	V_{CC}	1.8~3.6		V
		1.2~3.6	(Note 3)	
Input voltage	V_{IN}	−0.3~3.6		V
Output voltage	V_{OUT}	0~V_{CC}	(Note 4)	V
Output Current	I_{OH}/I_{OL}	±24	(Note 5)	mA
		±18	(Note 6)	
		±6	(Note 7)	
Operating temperature	T_{opr}	−40~85		°C
Input rise and fall time	dt/dv	0~10	(Note 8)	ns/V

Note 3: Date Retention Only

Note 4: High or low state

Note 5: V_{CC} = 3.0~3.6 V

Note 6: V_{CC} = 2.3~2.7 V

Note 7: V_{CC} = 1.8 V

Note 8: V_{CC} = 3.0 V

Electrical Characteristics

DC Characteristics (Ta = −40~85°C)

Characteristics		Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
Input voltage	"H" level	V_{IH}	—		1.8	0.85 × V_{CC}	—	V
					2.3~3.6	0.8 × V_{CC}	—	
	"L" level	V_{IL}	—		1.8	—	0.15 × V_{CC}	
					2.3~3.6	—	0.2 × V_{CC}	
Output voltage	"H" level	V_{OH}	V_{IN} = V_{IL}	I_{OH} = −100 μA	1.8~3.6	V_{CC} − 0.2	—	V
				I_{OH} = −6 mA	1.8	1.4	—	
				I_{OH} = −12 mA	2.3	1.8	—	
				I_{OH} = −18 mA	2.3	1.7	—	
				I_{OH} = −12 mA	2.7	2.2	—	
				I_{OH} = −18 mA	3.0	2.4	—	
				I_{OH} = −24 mA	3.0	2.2	—	
	"L" level	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 100 μA	1.8~3.6	—	0.2	
				I_{OH} = 6 mA	1.8	—	0.3	
				I_{OL} = 12 mA	2.3	—	0.4	
				I_{OL} = 18 mA	2.3	—	0.6	
				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} = 0~3.6 V		2.7~3.6	—	±5.0	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND		2.7~3.6	—	20.0	μA
			V_{CC} ≦ (V_{IN}, V_{OUT}) ≦ 3.6 V		2.7~3.6	—	±20.0	

AC Characteristics (Ta = –40~85°C, input $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500\ \Omega$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Propagation delay time	t_{pLH} t_{pHL}	(Fig.1, 2)	1.8	1.0	8.4	ns
			2.5 ± 0.2	0.8	4.2	
			3.3 ± 0.3	0.6	3.5	

For C_L = pF,add approximately 300 ps to the Ac maximum specification.

Dynamic Switching Characteristics (Ta = 25°C, input $t_r = t_f = 2.0$ ns, $C_L = 30$ pF)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	V_{IN} = 1.8 V, V_{IL} = 0 V (Note 9)	1.8	0.25	ns
		V_{IN} = 2.5 V, V_{IL} = 0 V (Note 9)	2.5	0.6	
		V_{IN} = 3.3 V, V_{IL} = 0 V (Note 9)	3.3	0.8	
Quiet output maximum dynamic VOL	V_{OLV}	V_{IN} = 1.8 V, V_{IL} = 0 V (Note 9)	1.8	–0.25	ns
		V_{IN} = 2.5 V, V_{IL} = 0 V (Note 9)	2.5	–0.6	
		V_{IN} = 3.3 V, V_{IL} = 0 V (Note 9)	3.3	–0.8	
Quiet output maximum dynamic VOH	V_{OHP}	V_{IN} = 1.8 V, V_{IL} = 0 V (Note 9)	1.8	1.5	ns
		V_{IN} = 2.5 V, V_{IL} = 0 V (Note 9)	2.5	1.9	
		V_{IN} = 3.3 V, V_{IL} = 0 V (Note 9)	3.3	2.2	

Note 9: Parameter guaranteed by design.

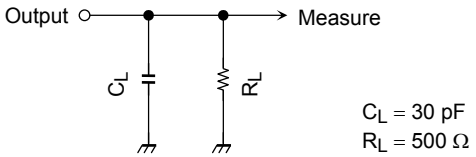
Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Input capacitance	C_{IN}	—	1.8, 2.5, 3.3	4	pF
Power dissipation capacitance	C_{PD}	f_{IN} = 10 MHz (Note 10)	1.8, 2.5, 3.3	7	pF

Note 10: 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:
$I_{CC\ (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$

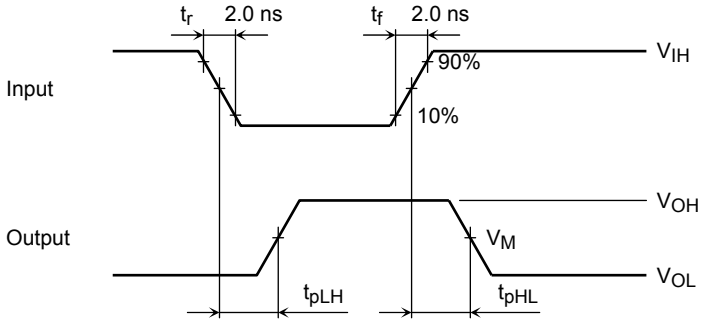
Test Circuit

Figure 1



AC Waveform

Figure 2 t_{pLH}, t_{pHL}

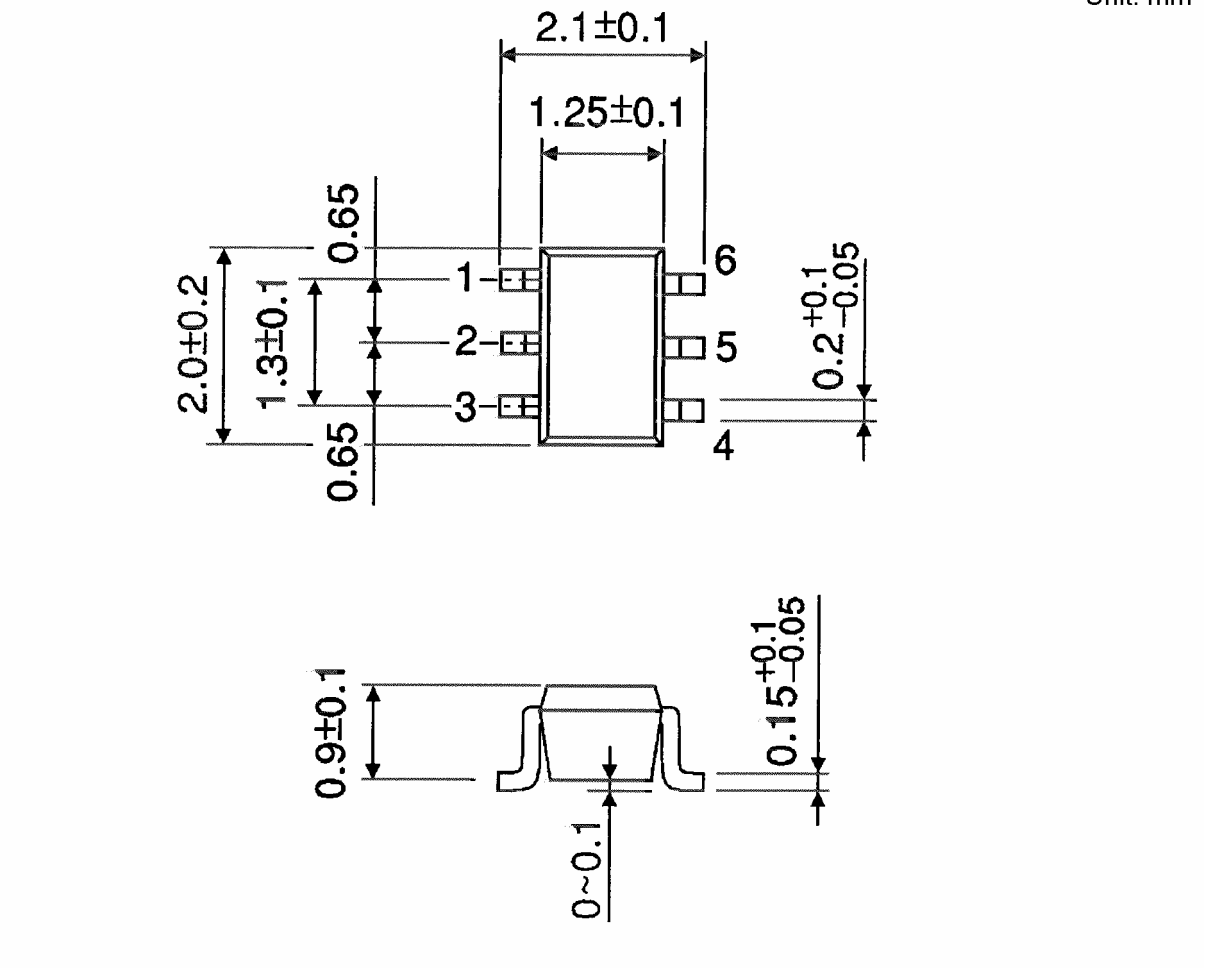


Symbol	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

Package Dimensions

SSOP6-P-0.65A

Unit: mm



Weight: 0.0068 g (typ.)

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20070701-EN GENERAL

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