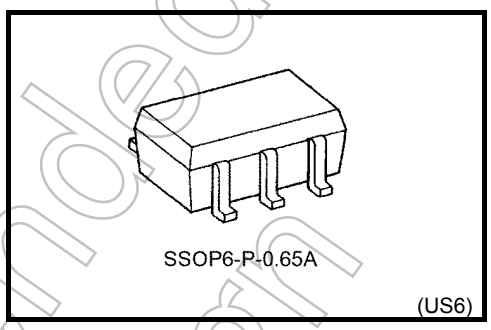
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7PA14FU

Dual Schmitt Inverter

Features

- Operating voltage range: V_{CC} = 1.8 to 3.6 V
- High-speed operation: t_{pd} = 4.0 ns (max) at V_{CC} = 3.0 to 3.6 V
  t_{pd} = 4.3 ns (max) at V_{CC} = 2.3 to 2.7 V
  t_{pd} = 8.6 ns (max) at V_{CC} = 1.8 V
- High-level output current:
  I_{OH}/I_{OL} = ±24 mA (min) at V_{CC} = 3.0 V
  I_{OH}/I_{OL} = ±18 mA (min) at V_{CC} = 2.3 V
  I_{OH}/I_{OL} = ±6 mA (min) at V_{CC} = 1.8 V
- 3.6-V tolerant inputs.
- 3.6-V power down protection outputs



Weight: 0.0068 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
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) −0.5 to V_{CC} + 0.5 (Note 2)	V
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	T_{stg}	−65 to 150	°C

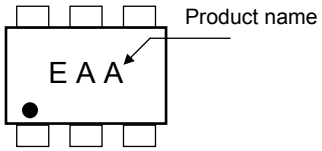
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/ current/voltage, etc.) 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: V_{CC} = 0 V

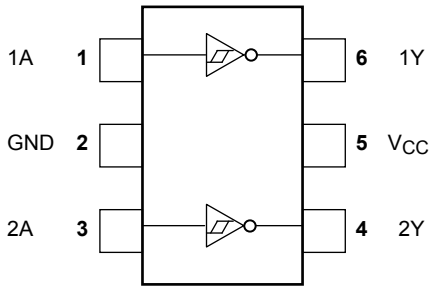
Note 2: High or Low State. I_{OUT} absolute maximum rating must be observed.

Note 3: V_{OUT} < GND

Marking

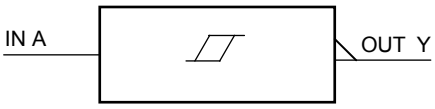


Pin Assignment (top view)



Start of commercial production
2002-12

IEC Logic Symbol



Truth Table

A	Y
L	H
H	L

Operating Ranges

Characteristics	Symbol	Rating		Unit
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	T_{opr}	−40 to 85		°C

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

Electrical Characteristics

DC Characteristics ($2.7\ V < V_{CC} \leq 3.6\ V$)

Characteristics		Symbol	Test Condition		V_{CC} (V)	Ta = 40 to 85°C Min	Ta = 40 to 85°C Max	Unit
Threshold Voltage	High level	V_P	—		3.6	—	2.2	V
					3.0	—	2.0	
	Low level	V_N	—		3.6	0.8	—	
					3.0	0.7	—	
Hysteresis Voltage		V_H	—		3.6	0.3	1.2	V
					3.0	0.3	1.2	
Output Voltage	High level	V_{OH}	$V_{IN} = V_{IL}$	$I_{OH} = -100\ \mu A$	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}	$V_{IN} = V_{IH}$	$I_{OL} = 100\ \mu A$	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
			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6$ 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 ($2.3\ V \leq V_{CC} \leq 2.7\ V$)

Characteristics		Symbol	Test Condition		V_{CC} (V)	Ta = 40 to 85°C Min	Ta = 40 to 85°C Max	Unit
Threshold Voltage	High level	V_P	—		2.3	—	1.8	V
	Low level	V_N	—		2.3	0.5	—	
Hysteresis Voltage		V_H	—		2.3	0.3	1.0	V
Output Voltage	High level	V_{OH}	$V_{IN} = V_{IL}$	$I_{OH} = -100\ \mu A$	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}	$V_{IN} = V_{IH}$	$I_{OL} = 100\ \mu A$	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}	$V_{IN} = 0$ to 3.6 V		2.3 to 2.7	—	±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		2.3 to 2.7	—	20.0	μA
			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6$ V		2.3 to 2.7	—	±20.0	

DC Characteristics (1.8 V ≤ V_{CC} < 2.3 V)

Characteristics		Symbol	Test Condition		Ta = 40 to 85°C			Unit
					V_{CC} (V)	Min	Max	
Threshold Voltage	High level	V_P	—		1.8	—	1.4	V
	Low level	V_N	—		1.8	0.25	—	
Hysteresis Voltage		V_H	—		1.8	0.2	0.95	V
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 (Input t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

Characteristics	Symbol	Test Condition	Ta = 40 to 85°C			Unit
			V_{CC} (V)	Min	Max	
Propagation delay time	t_{pLH} t_{pHL}	(Figure 1 and 2)	1.8	1.0	8.6	ns
			2.5 ± 0.2	0.8	4.3	
			3.3 ± 0.3	0.6	4.0	

For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

Dynamic Switching Characteristics (Input $t_r = t_f = 2.0$ ns, $C_L = 30$ pF)

Characteristics	Symbol	Test Condition		Ta = 25°C	Unit
			V_{CC} (V)	Typ	
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	V_{IN} = 1.8 V, V_{IL} = 0 V (Note 10)	1.8	0.25	ns
		V_{IN} = 2.5 V, V_{IL} = 0 V (Note 10)	2.5	0.6	
		V_{IN} = 3.3 V, V_{IL} = 0 V (Note 10)	3.3	0.8	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	V_{IN} = 1.8 V, V_{IL} = 0 V (Note 10)	1.8	−0.25	ns
		V_{IN} = 2.5 V, V_{IL} = 0 V (Note 10)	2.5	−0.6	
		V_{IN} = 3.3 V, V_{IL} = 0 V (Note 10)	3.3	−0.8	
Quiet Output Minimum Dynamic V_{OH}	V_{OLP}	V_{IN} = 1.8 V, V_{IL} = 0 V (Note 10)	1.8	1.5	ns
		V_{IN} = 2.5 V, V_{IL} = 0 V (Note 10)	2.5	1.9	
		V_{IN} = 3.3 V, V_{IL} = 0 V (Note 10)	3.3	2.2	

Note 10: Characteristics guaranteed by design.

Capacitive Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C	Unit
			V_{CC} (V)	Typ	
Input Capacitance	C_{IN}	—	1.8, 2.5, 3.3	4	pF
Power Dissipation Capacitance	C_{PD}	f_{IN} = 10 MHz (Note 11)	1.8, 2.5, 3.3	27	pF

Note 11: 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:
$I_{CC\ (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$

AC Test Circuit

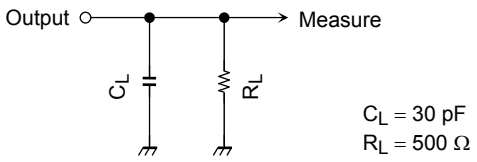
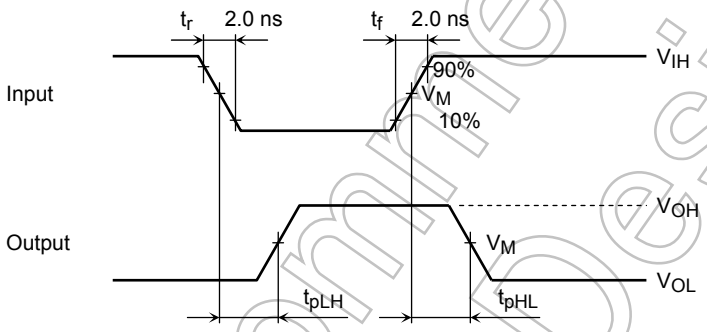


Figure 1

AC Waveforms



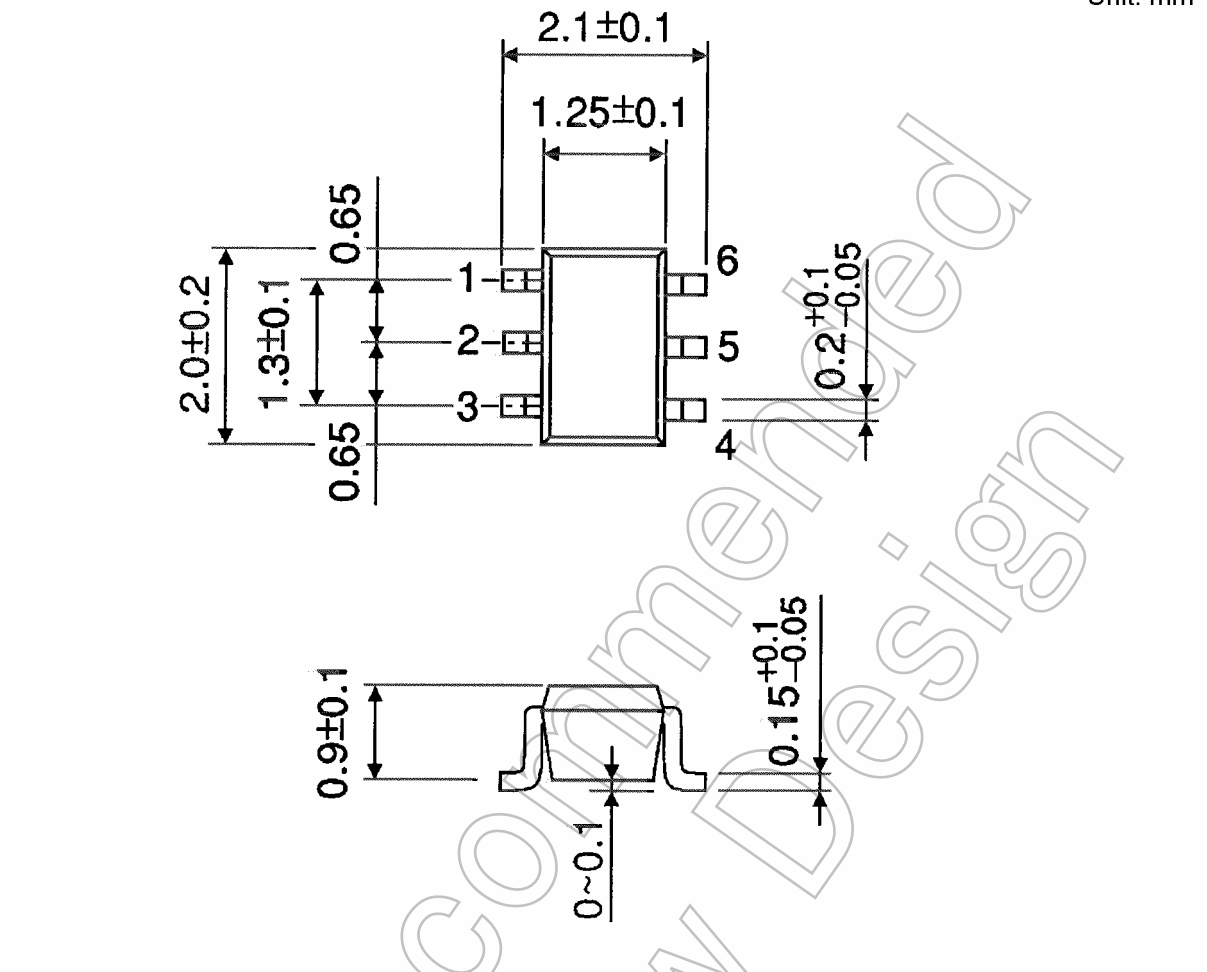
Symbol	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

Figure 2 t_{pLH}, t_{pHL}

Package Dimensions

SSOP6-P-0.65A

Unit: mm



Weight: 0.0068 g (typ.)

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