

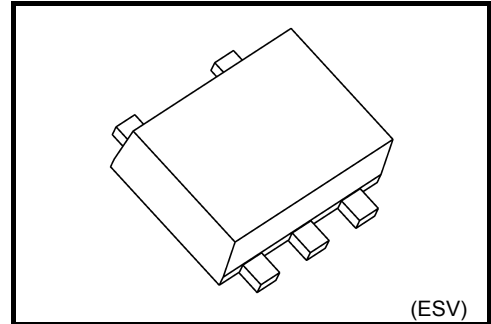
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SX04BFE

Digital Clock-Buffer with High-pass-filter, linear-amplifier and Digital-output-buffer

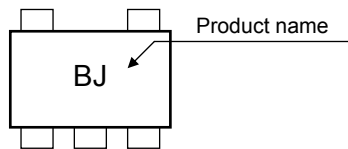
Features

- High speed operation : f_{IN} = 0.032 to 80 MHz
at square-wave,
input rise and fall time = 0 to 10 ns/V
: Slew rate = 0.53 V/ns (min)
at V_{CC} = 1.65 to 1.95 V, C_L = 25 pF
- Operating voltage range : V_{CC} = 1.65 to 3.6 V
- Output drive capability : Fan-out (Load capacitance) = 25 pF
- 3.6-V tolerant inputs.

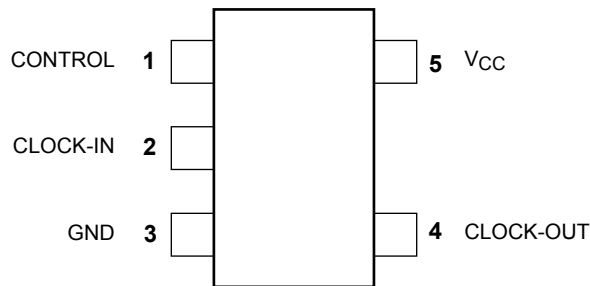


Weight: 0.003 g (Typ.)

Marking



Pin Assignment (top view)



Absolute Maximum Ratings (Ta = 25°C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{CC}	-0.5 to 4.6	V
Input voltage	V_{IN}	-0.5 to 4.6	V
Output voltage	V_{OUT}	-0.5 to $V_{CC} + 0.5$	V
Input diode current	I_{IK}	-20	mA
Output diode current	I_{OK}	±20 (Note 1)	mA
Output current	I_{OUT}	±50	mA
V_{CC} /GND current	I_{CC}	±50	mA
Power dissipation	P_D	150	mW
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: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

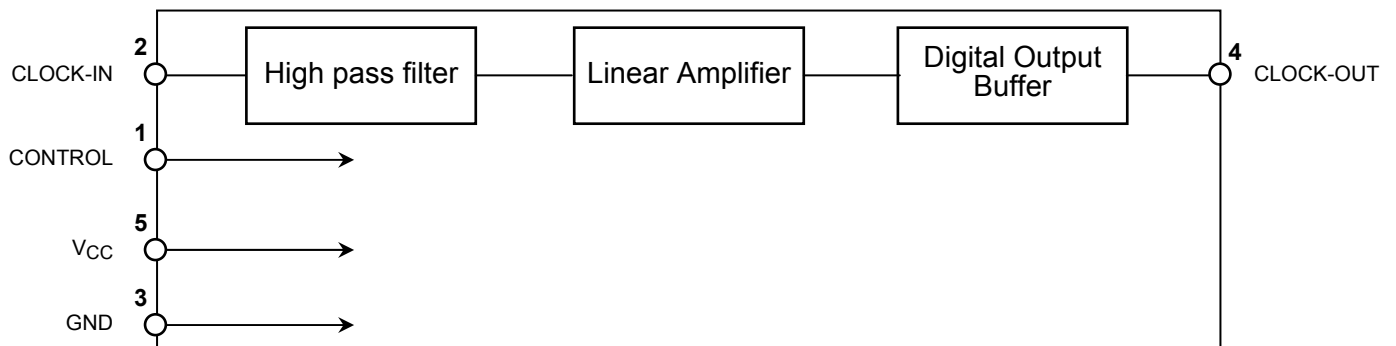
Start of commercial production
2011-05

Truth Table

INPUT		OUTPUT	Function
CONTROL	CLOCK-IN	CLOCK-OUT	
L	X	L	Disable
H		H	Enable
H		L	Enable

X: Don't care

System Diagram



Operating Ranges

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{CC}	1.65 to 3.6	V
CONTROL Input voltage	V_{IN}	0 to 3.6	V
CLOCK-IN Input voltage (peak to peak)	V_{ICpp}	0.7 to 3.6 (Note 2)	V
		0 to 3.6 (Note 3)	
Output voltage	V_{OUT}	0 to V_{CC}	V
Operating temperature	T_{opr}	-40 to 85	°C
Clock input frequency (Square-wave)	f_{IN}	0.032 to 80 (Note 4)	MHz
Clock input frequency (Sine-wave)	f_{IN}	12 to 80	MHz

Note 2: CONTROL = H level state

Note 3: CONTROL = L level state

Note 4: Input rise and fall time = 0 to 10 ns/V

Electrical Characteristics

DC Characteristics

Characteristic		Symbol	Test Condition	Ta = 25°C						Ta = -40 to 85°C		Unit
				V _{CC} (V)	Min	Typ.	Max	Min	Max			
CONTROL Input voltage	High Level	V _{IH}	—	1.65 to 1.95	V _{CC} × 0.75	—	—	V _{CC} × 0.75	—	V		
				2.3 to 3.6	V _{CC} × 0.7	—	—	V _{CC} × 0.7	—			
	Low Level	V _{IL}	—	1.65 to 1.95	—	—	V _{CC} × 0.25	—	V _{CC} × 0.25			
				2.3 to 3.6	—	—	V _{CC} × 0.3	—	V _{CC} × 0.3			
Output voltage	High Level	V _{OH}	—	I _{OH} = -100 μA	1.65	1.55	1.65	—	1.55	—	V	
					2.3	2.2	2.3	—	2.2	—		
					3.0	2.9	3.0	—	2.9	—		
				I _{OH} = -4 mA	1.65	1.29	1.52	—	1.29	—		
					2.3	1.9	2.15	—	1.9	—		
					3.0	2.3	2.68	—	2.3	—		
	Low Level	V _{OL}	—	I _{OL} = 100 μA	1.65	—	0	0.1	—	0.1		
					2.3	—	0	0.1	—	0.1		
					3.0	—	0	0.1	—	0.1		
				I _{OL} = 4 mA	1.65	—	0.08	0.24	—	0.24		
					2.3	—	0.1	0.3	—	0.3		
					3.0	—	0.22	0.55	—	0.55		
Input leakage current		I _{IN}	V _{IN} (CONTROL) = 0 to 3.6V	0 to 3.6	—	—	±1	—	±10	μA		
Quiescent supply current		I _{CC}	V _{IN} (CONTROL) = V _{IL} V _{IC} (CLOCK-IN) = OPEN	3.6	—	—	±1	—	±10	μA		

AC Characteristics (unless otherwise specified, Input: square-wave, $t_r = t_f = 3ns$)

Characteristic	Symbol	Test Condition	V_{CC} (V)	$T_a = 25^\circ C$			$T_a = -40 \text{ to } 85^\circ C$		Unit
				Min	Typ.	Max	Min	Max	
Propagation delay time	t_{pLH}	$C_L = 5 \text{ pF}, R_L = 1 \text{ M}\Omega$	1.65 to 1.95	—	5.2	—	—	7.4	ns
			2.3 to 2.7	—	3.0	—	—	4.8	
			3.0 to 3.6	—	2.3	—	—	4.1	
	t_{pHL}	$C_L = 25 \text{ pF}, R_L = 1 \text{ M}\Omega$	1.65 to 1.95	—	5.4	—	—	8.7	
			2.3 to 2.7	—	3.3	—	—	5.3	
			3.0 to 3.6	—	2.6	—	—	4.6	
Slew rate	SR	$C_L = 5 \text{ pF}, R_L = 1 \text{ M}\Omega$	1.65 to 1.95	—	—	—	1.02	—	V/ns
			2.3 to 2.7	—	—	—	1.42	—	
			3.0 to 3.6	—	—	—	1.85	—	
		$C_L = 25 \text{ pF}, R_L = 1 \text{ M}\Omega$	1.65 to 1.95	—	—	—	0.53	—	
			2.3 to 2.7	—	—	—	0.74	—	
			3.0 to 3.6	—	—	—	0.96	—	
Input capacitance (CONTROL)	C_{IN-CNT}	—	3.3	—	2.1	—	—	pF	
Input capacitance (CLOCK-IN)	C_{IN-CKI}	—	3.3	—	3.3	—	—	pF	
Power dissipation capacitance	C_{PD}	(Note 5)	1.8	—	24	—	—	—	pF
			3.3	—	29	—	—	—	

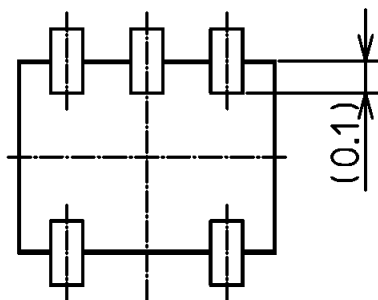
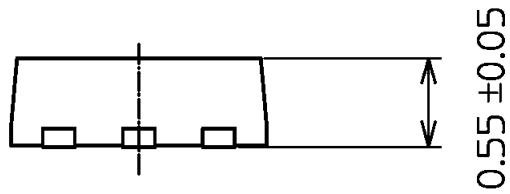
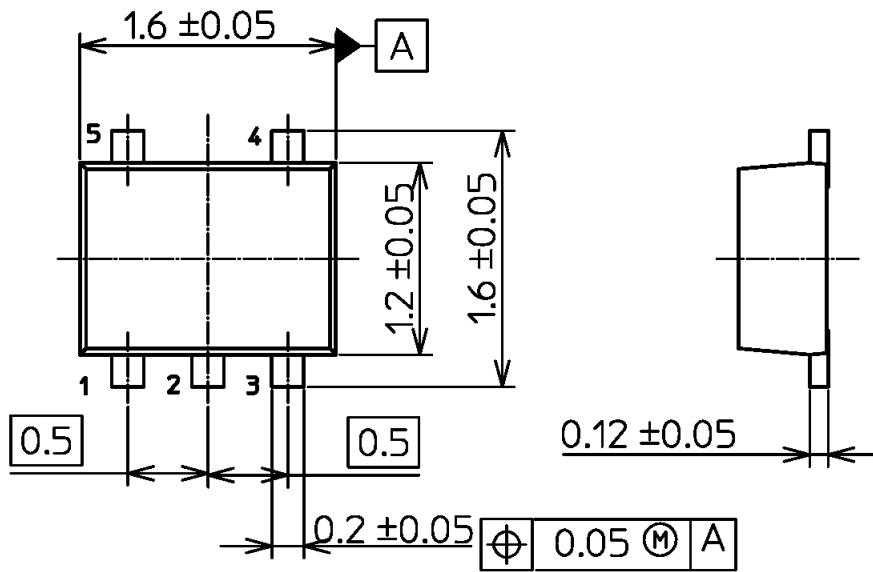
Note 5: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

Package Dimensions

Unit: mm



BOTTOM VIEW

Weight: 0.003 g (Typ.)

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