CMOS Digital Integrated Circuits Silicon Monolithic

74VHC4040FT

1. Functional Description

12-Stage Ripple Carry Binary Counter

2. General

The 74VHC4040FT is an advanced high speed CMOS 12-STAGE BINARY COUNTER/DIVIDER fabricated with silicon gate C2MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

Setting CLR to high resets the counter to low.

A negative transition on the $\overline{\text{CK}}$ input brings one increment into the counter.

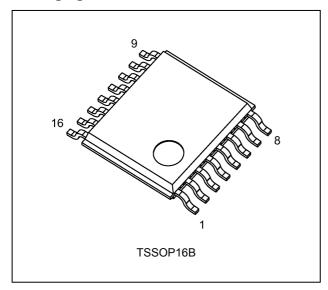
This counter provides all divided output stages, and at Q12, a 1/4096 divided frequency will be output.

An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

3. Features

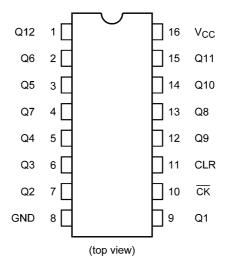
- (1) High speed: $f_{MAX} = 210 \text{ MHz}$ (typ.) at $V_{CC} = 5 \text{ V}$
- (2) Low power dissipation: $I_{CC} = 4 \mu A \text{ (max)}$ at $T_a = 25^{\circ}C$
- (3) High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- (4) Power-down protection is provided on all inputs.
- (5) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$
- (6) Wide operating voltage range: $V_{CC(opr)} = 2 \text{ V to } 5.5 \text{ V}$
- (7) Low noise: $V_{OLP} = 1.5 \text{ V (max)}$
- (8) Pin and function compatible with 74HC4040

4. Packaging

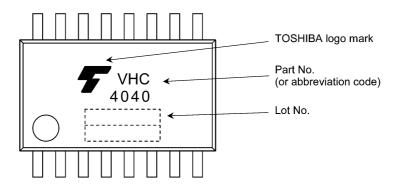




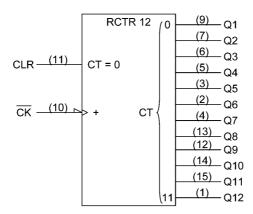
5. Pin Assignment



6. Marking



7. IEC Logic Symbol



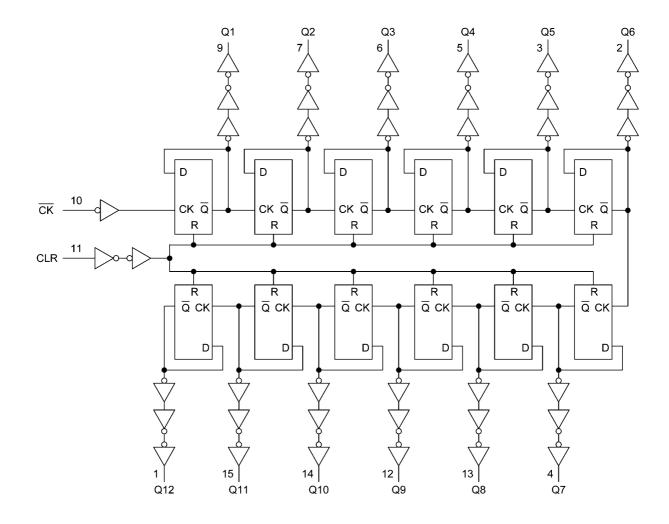


8. Truth Table

CK	CLR	Output State
Х	Н	All Outputs = "L"
	L	No Change
	L	Adovance to Next State

X: Don't care

9. System Diagram



Rev.1.0



10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V _{CC}	-0.5 to 7.0	V
Input voltage	V _{IN}	-0.5 to 7.0	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	mA
Output current	I _{OUT}	±25	mA
V _{CC} /ground current	I _{CC}	±100	mA
Power dissipation	P _D	180	mW
Storage temperature	T _{stg}	-65 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

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).

11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	V _{CC}		2.0 to 5.5	V
Input voltage	V _{IN}		0 to 5.5	V
Output voltage	V _{OUT}		0 to V _{CC}	V
Operating temperature	T _{opr}		-40 to 85	°C
Input rise and fall times	dt/dv	V_{CC} = 3.3 ± 0.3 V	0 to 100	ns/V
		V _{CC} = 5 ± 0.5 V	0 to 20	

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either V_{CC} or GND.



12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified, $T_a = 25$ °C)

Characteristics	Symbol	Test Condition		V _{CC} (V)	Min	Тур.	Max	Unit
High-level input voltage	V _{IH}	_		2.0	1.50	_	_	V
				3.0 to 5.5	$V_{CC} \times 0.7$	_	_	
Low-level input voltage	V _{IL}	_		2.0	_	_	0.50	V
				3.0 to 5.5	_		$V_{CC} \times 0.3$	
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50 μA	2.0	1.9	2.0	_	V
				3.0	2.9	3.0	_	
				4.5	4.4	4.5	_	
			I_{OH} = -4 mA	3.0	2.58	-	_	
			I_{OH} = -8 mA	4.5	3.94		_	
Low-level output voltage	V _{OL}	$V_{IN} = V_{IH}$ or V_{IL}	I_{OL} = 50 μ A	2.0	_	0.0	0.1	V
				3.0	_	0.0	0.1	
				4.5	_	0.0	0.1	
			I _{OL} = 4 mA	3.0	_	_	0.36	
			I _{OL} = 8 mA	4.5	_		0.36	
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND		0 to 5.5	_		±0.1	μΑ
Quiescent supply current	I _{CC}	$V_{IN} = V_{CC}$ or GND		5.5	_	_	4.0	μΑ

12.2. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
High-level input voltage	V _{IH}	_		2.0	1.50	_	V
				3.0 to 5.5	$V_{CC} \times 0.7$	_	
Low-level input voltage	V _{IL}	_		2.0	_	0.50	٧
				3.0 to 5.5	_	$V_{CC} \times 0.3$	
High-level output voltage	V _{OH}	$V_{IN} = V_{IH}$ or V_{IL}	I _{OH} = -50 μA	2.0	1.9	_	V
				3.0	2.9	_	
				4.5	4.4	_	
			I _{OH} = -4 mA	3.0	2.48	_	
			I _{OH} = -8 mA	4.5	3.80	_	
Low-level output voltage	V _{OL}	$V_{IN} = V_{IH}$ or V_{IL}	I _{OL} = 50 μA	2.0	_	0.1	V
				3.0	_	0.1	
				4.5	_	0.1	
			I _{OL} = 4 mA	3.0	_	0.44	
			I _{OL} = 8 mA	4.5	_	0.44	
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND		0 to 5.5		±1.0	μΑ
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		5.5	_	40.0	μА



12.3. Timing Requirements (Unless otherwise specified, $T_a = 25$ °C, Input: $t_f = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Limit	Unit
Minimum pulse width	$t_{w(L)}, t_{w(H)}$	_	3.3 ± 0.3	5.0	ns
(CK)			5.0 ± 0.5	5.0	
Minimum pulse width	t _{w(H)}	_	3.3 ± 0.3	5.0	ns
(CLR)			5.0 ± 0.5	5.0	
Minimum removal time	t _{rem}	_	3.3 ± 0.3	5.0	ns
			5.0 ± 0.5	5.0	

12.4. Timing Requirements (Unless otherwise specified, $T_a = -40$ to 85°C, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	_	3.3 ± 0.3	5.0	ns
(CK)			5.0 ± 0.5	5.0	
Minimum pulse width	t _{w(H)}	_	3.3 ± 0.3	5.0	ns
(CLR)			5.0 ± 0.5	5.0	
Minimum removal time	t _{rem}	_	3.3 ± 0.3	5.0	ns
			5.0 ± 0.5	5.0	

12.5. AC Characteristics (Unless otherwise specified, T_a = 25 °C, Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Note	Test Condition	V _{CC} (V)	C _L (pF)	Min	Тур.	Max	Unit
Propagation delay time	t _{PLH} ,t _{PHL}		_	3.3 ± 0.3	15	_	7.5	11.9	ns
(CK-Q1)					50	_	10.0	15.4	
				5.0 ± 0.5	15	_	4.8	7.3	
					50	_	6.3	9.3	
Propagation delay time	Δt_{PD}		_	3.3 ± 0.3	50	_	2.4	4.4	ns
(Q_n-Q_{n+1})				5.0 ± 0.5	50	_	1.6	3.1	
Propagation delay time	t _{PHL}		_	3.3 ± 0.3	15	_	8.3	12.8	ns
(CLR-Q)					50	_	10.8	16.3	
				5.0 ± 0.5	15		5.6	8.6	
					50	_	7.1	10.6	
Maximum clock frequency	f _{MAX}		_	3.3 ± 0.3	15	75	140	_	MHz
					50	55	80		
				5.0 ± 0.5	15	150	210		
					50	95	125	_	
Input capacitance	C _{IN}		_		·	_	4	10	pF
Power dissipation capacitance	C _{PD}	(Note 1)	_			_	21	_	pF

Note 1: 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.



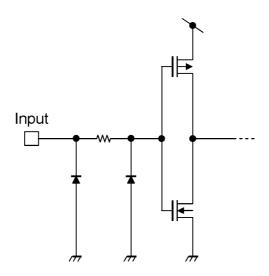
12.6. AC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C, Input: t_f = t_f = 3 ns)

Characteristics	Symbol	Test Condition	V _{CC} (V)	C _L (pF)	Min	Max	Unit
Propagation delay time	t _{PLH} ,t _{PHL}	_	3.3 ± 0.3	15	1.0	14.0	ns
(CK-Q1)				50	1.0	17.5	
			5.0 ± 0.5	15	1.0	8.5	
				50	1.0	10.5	
Propagation delay time	Δt_{PD}	_	3.3 ± 0.3	50	_	5.0	ns
(Q_n-Q_{n+1})			5.0 ± 0.5	50	_	3.5	
Propagation delay time	t _{PHL}	_	3.3 ± 0.3	15	1.0	15.0	ns
(CLR-Q)				50	1.0	18.5	
			5.0 ± 0.5	15	1.0	10.0	
				50	1.0	12.0	
Maximum clock frequency	f _{MAX}	_	3.3 ± 0.3	15	75	_	MHz
				50	50	_	
			5.0 ± 0.5	15	125	_	
				50	80	_	
Input capacitance	C _{IN}					10	pF

12.7. Noise Characteristics (Unless otherwise specified, T_a = 25°C, Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Тур.	Limit	Unit
Quiet output maximum dynamic V _{OL}	V _{OLP}	C _L = 50 pF	5.0	1.2	1.5	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	C _L = 50 pF	5.0	-1.2	-1.5	V
Minimum high-level dynamic input voltage	V_{IHD}	C _L = 50 pF	5.0	_	3.5	V
Maximum low-level dynamic input voltage	V_{ILD}	C _L = 50 pF	5.0	_	1.5	V

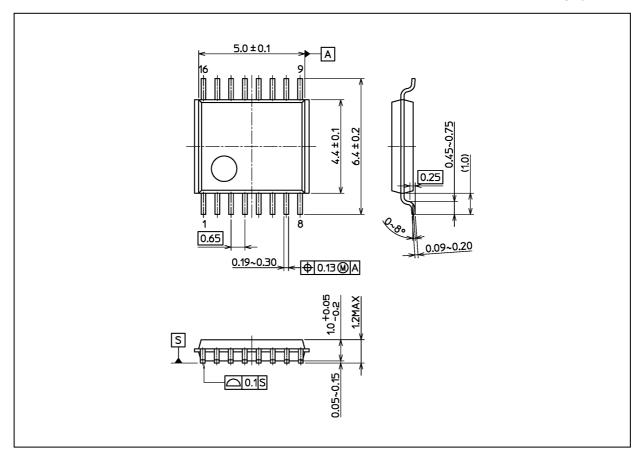
13. Input Equivalent Circuit





Package Dimensions

Unit: mm



Weight: 0.055 g (typ.)

	Package Name(s)
Nickname: TSSOP16B	



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