

# TC74VHC4040F, TC74VHC4040FN, TC74VHC4040FT

## 12 - STAGE RIPPLE - CARRY BINARY COUNTER

The TC74VHC4040 is an advanced high speed CMOS 12 - STAGE BINARY COUNTER / DIVIDER fabricated with silicon gate C<sup>2</sup>MOS 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  $\overline{CK}$  input brings one increment into the counter.

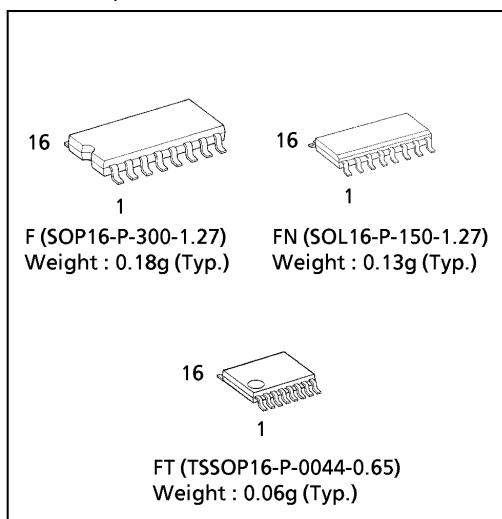
This counter provides all divided output stages, and at Q12, a 1/4096 divided frequency will be output.

An input protection circuit ensures that 0 to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

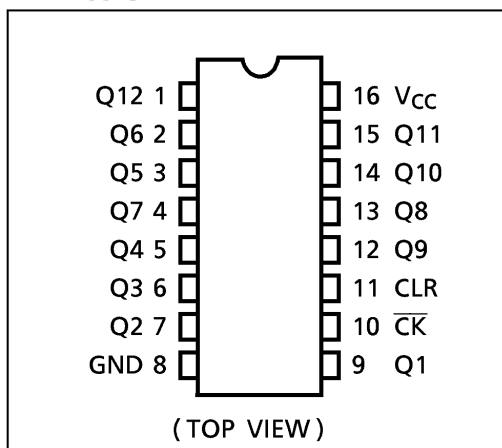
### FEATURES :

- High Speed.....  $f_{MAX} = 210\text{MHz}$  (typ.)  
at  $V_{CC} = 5\text{V}$
- Low Power Dissipation.....  $I_{CC} = 4\mu\text{A}$  (Max.) at  $T_a = 25^\circ\text{C}$
- High Noise Immunity.....  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min.)
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays...  $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range...  $V_{CC} \text{ (opr)} = 2\text{V} \sim 5.5\text{V}$
- Low Noise .....  $V_{OLP} = 1.5\text{V}$  (Max.)
- Pin and Function Compatible with 74HC4040

(Note) The JEDEC SOP (FN) is not available in Japan.



### PIN ASSIGNMENT



### TRUTH TABLE

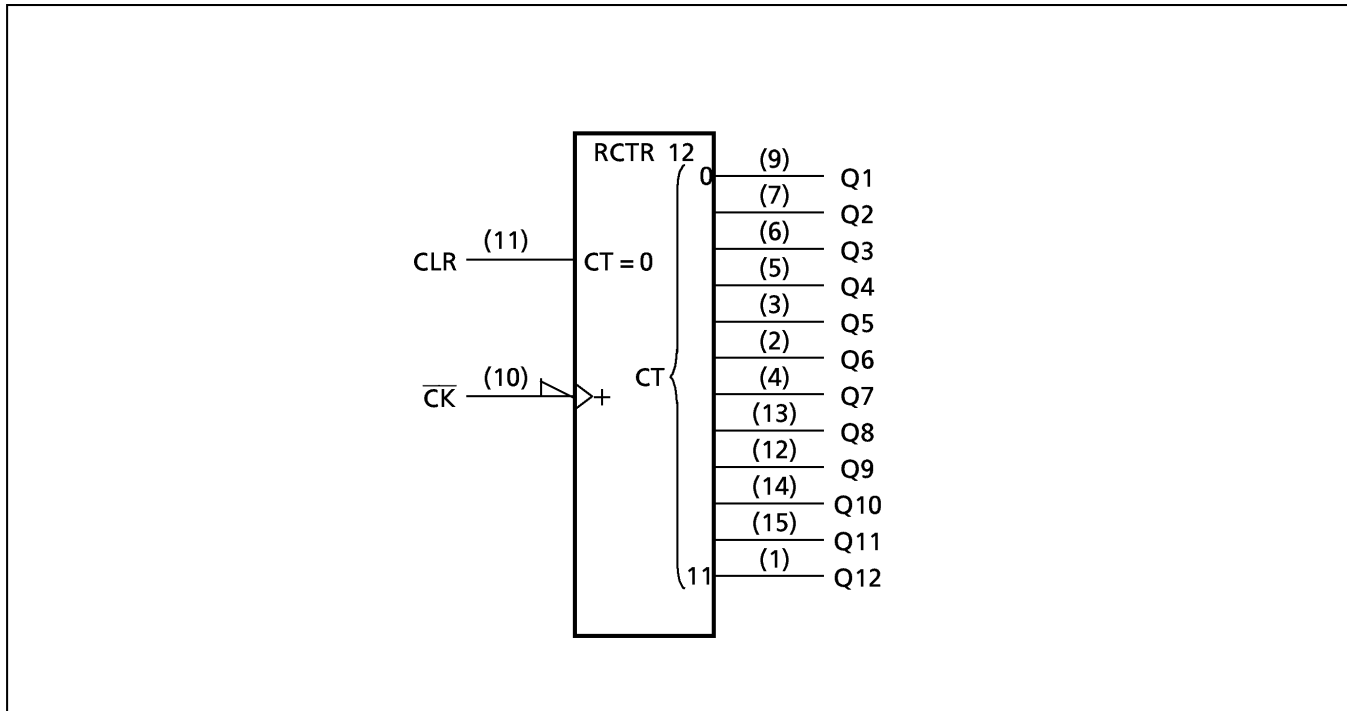
$\overline{CK}$	CLR	OUTPUT STATE
X	H	ALL OUTPUTS = "L"
	L	NO CHANGE
	L	ADVANCE TO NEXT STATE

X : Don't Care

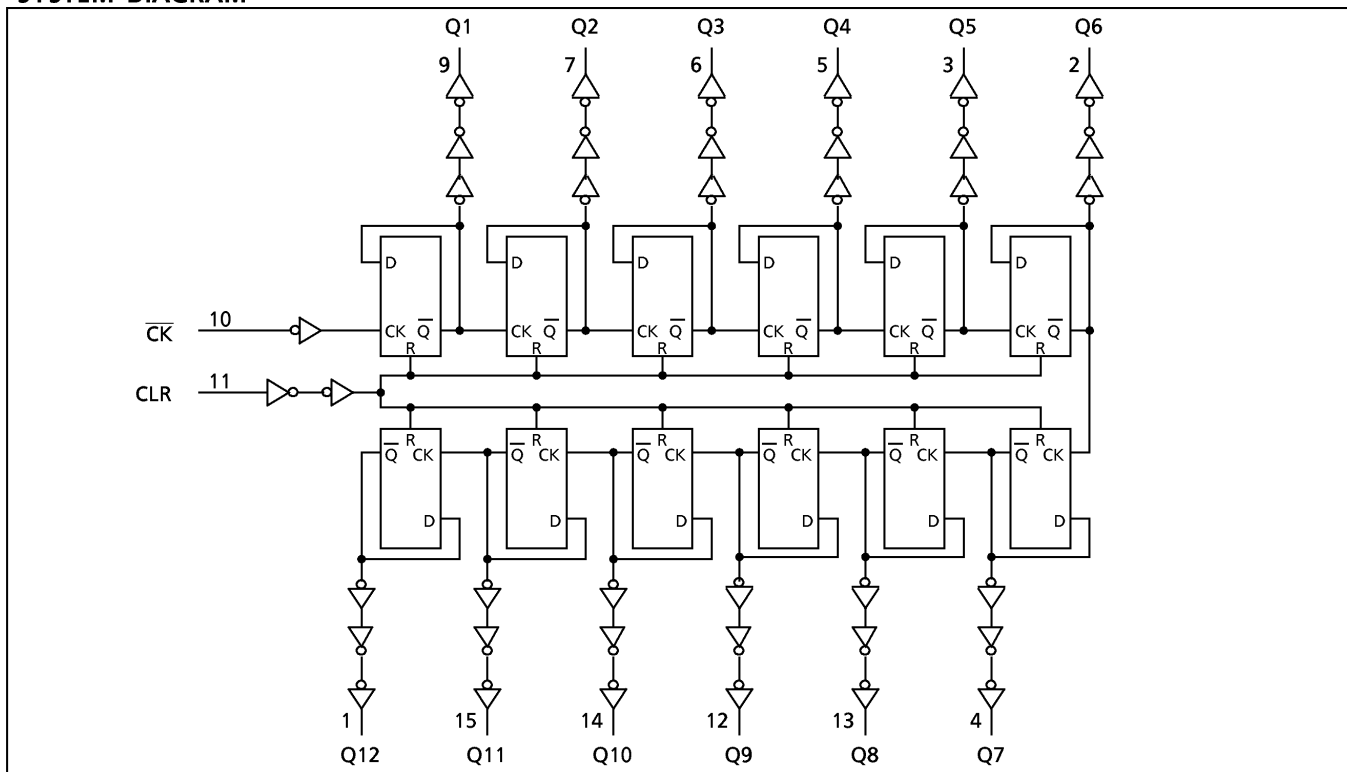
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IEC LOGIC SYMBOL



SYSTEM DIAGRAM



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## ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	$V_{CC}$	-0.5~7.0	V
DC Input Voltage	$V_{IN}$	-0.5~7.0	V
DC Output Voltage	$V_{OUT}$	-0.5~ $V_{CC} + 0.5$	V
Input Diode Current	$I_{IK}$	-20	mA
Output Diode Current	$I_{OK}$	$\pm 20$	mA
DC Output Current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /Ground Current	$I_{CC}$	$\pm 100$	mA
Power Dissipation	$P_D$	180	mW
Storage Temperature	$T_{stg}$	-65~150	$^{\circ}C$

## RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	$V_{CC}$	2.0~5.5	V
Input Voltage	$V_{IN}$	0~5.5	V
Output Voltage	$V_{OUT}$	0~ $V_{CC}$	V
Operating Temperature	$T_{opr}$	-40~85	$^{\circ}C$
Input Rise and Fall Time	dt/dv	0~100 ( $V_{CC} = 3.3 \pm 0.3V$ ) 0~20 ( $V_{CC} = 5 \pm 0.5V$ )	ns/V

## DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION		$V_{CC}$ (V)	$T_a = 25^{\circ}C$			$T_a = -40 \sim 85^{\circ}C$		UNIT
					MIN.	TYP.	MAX.	MIN.	MAX.	
High - Level Input Voltage	$V_{IH}$			2.0	1.50	—	—	1.50	—	V
				3.0~ 5.5	$V_{CC} \times 0.7$	—	—	$V_{CC} \times 0.7$	—	
Low - Level Input Voltage	$V_{IL}$			2.0	—	—	0.50	—	0.50	V
				3.0~ 5.5	—	—	$V_{CC} \times 0.3$	—	$V_{CC} \times 0.3$	
High - Level Output Voltage	$V_{OH}$	$V_{IN} =$ $V_{IH}$ or $V_{IL}$	$I_{OH} = -50\mu A$	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
			4.5	4.4	4.5	—	4.4	—		
			3.0	2.58	—	—	2.48	—	3.80	
4.5	3.94	—								—
Low - Level Output Voltage	$V_{OL}$	$V_{IN} =$ $V_{IH}$ or $V_{IL}$	$I_{OL} = 50\mu A$	2.0	—	0.0	0.1	—	0.1	V
				3.0	—	0.0	0.1	—	0.1	
			4.5	—	0.0	0.1	—	0.1		
			3.0	—	—	0.36	—	0.44	—	
4.5	—	—								0.36
Input Leakage Current	$I_{IN}$	$V_{IN} = 5.5V$ or GND		0~5.5	—	—	$\pm 0.1$	—	$\mu A$	
Quiescent Supply Current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	—	4.0	—	40.0	

TIMING REQUIREMENTS ( Input  $t_r = t_f = 3ns$  )

PARAMETER	SYMBOL	TEST CONDITION	Ta = 25°C			Ta = -40~85°C		UNIT
			V <sub>CC</sub> (V)	TYP .	LIMIT	LIMIT		
Minimum Pulse Width ( $\overline{CK}$ )	$t_{W(L)}$		3.3 ± 0.3	—	5.0	5.0		ns
	$t_{W(H)}$		5.0 ± 0.5	—	5.0	5.0		
Minimum Pulse Width (CLR)	$t_{W(H)}$		3.3 ± 0.3	—	5.0	5.0		
			5.0 ± 0.5	—	5.0	5.0		
Minimum Removal Time	$t_{rem}$		3.3 ± 0.3	—	5.0	5.0		
			5.0 ± 0.5	—	5.0	5.0		

AC ELECTRICAL CHARACTERISTICS ( Input  $t_r = t_f = 3ns$  )

PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C			Ta = -40~85°C		UNIT
		V <sub>CC</sub> (V)	CL (pF)	MIN.	TYP.	MAX.	MIN.	MAX.	
Propagation Delay Time ( $\overline{CK}$ -Q)	$t_{pLH}$ $t_{pHL}$	3.3 ± 0.3	15	—	7.5	11.9	1.0	14.0	ns
			50	—	10.0	15.4	1.0	17.5	
		5.0 ± 0.5	15	—	4.8	7.3	1.0	8.5	
			50	—	6.3	9.3	1.0	10.5	
Propagation Delay Time (Qn-Qn + 1)	$\Delta t_{pd}$	3.3 ± 0.3	50	—	2.4	4.4	1.0	5.0	
			50	—	1.6	3.1	1.0	3.5	
Propagation Delay Time (CLR-Q)	$t_{pHL}$	3.3 ± 0.3	15	—	8.3	12.8	1.0	15.0	
			50	—	10.8	16.3	1.0	18.5	
		5.0 ± 0.5	15	—	5.6	8.6	1.0	10.0	
			50	—	7.1	10.6	1.0	12.0	
Maximum Clock Frequency	$f_{MAX}$	3.3 ± 0.3	15	75	140	—	75	—	MHZ
			50	55	80	—	50	—	
		5.0 ± 0.5	15	150	210	—	125	—	
			50	95	125	—	80	—	
Input Capacitance	$C_{IN}$			—	4	10	—	10	pF
Power Dissipation Capacitance	$C_{PD}$	(Note 1)		—	21	—	—	—	

Note(1)  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

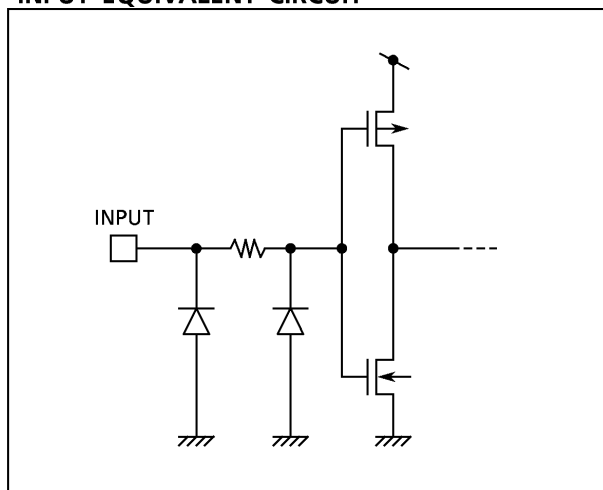
Average operating current can be obtained by the equation :

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

NOISE CHARACTERISTICS (Input  $t_r = t_f = 3\text{ns}$ )

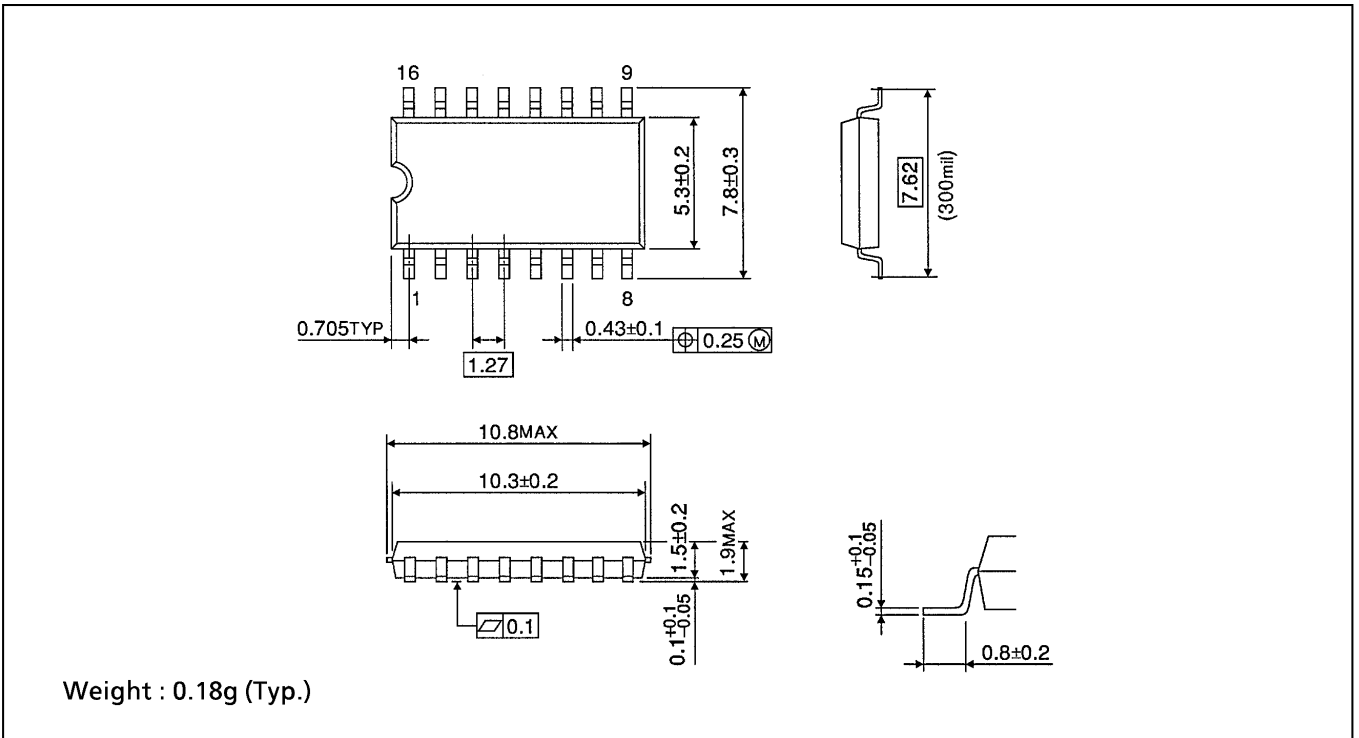
PARAMETER	SYMBOL	TEST CONDITION	Ta = 25°C		UNIT
			V <sub>CC</sub> (V)	TYP. / LIMIT	
Quiet Output Maximum Dynamic VOL	VOLP	CL = 50pF	5.0	1.2 / 1.5	V
Quiet Output Minimum Dynamic VOL	VOLV	CL = 50pF	5.0	-1.2 / -1.5	V
Minimum High Level Dynamic Input Voltage	VIHD	CL = 50pF	5.0	- / 3.5	V
Maximum Low Level Dynamic Input Voltage	VILD	CL = 50pF	5.0	- / 1.5	V

## INPUT EQUIVALENT CIRCUIT



SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27)

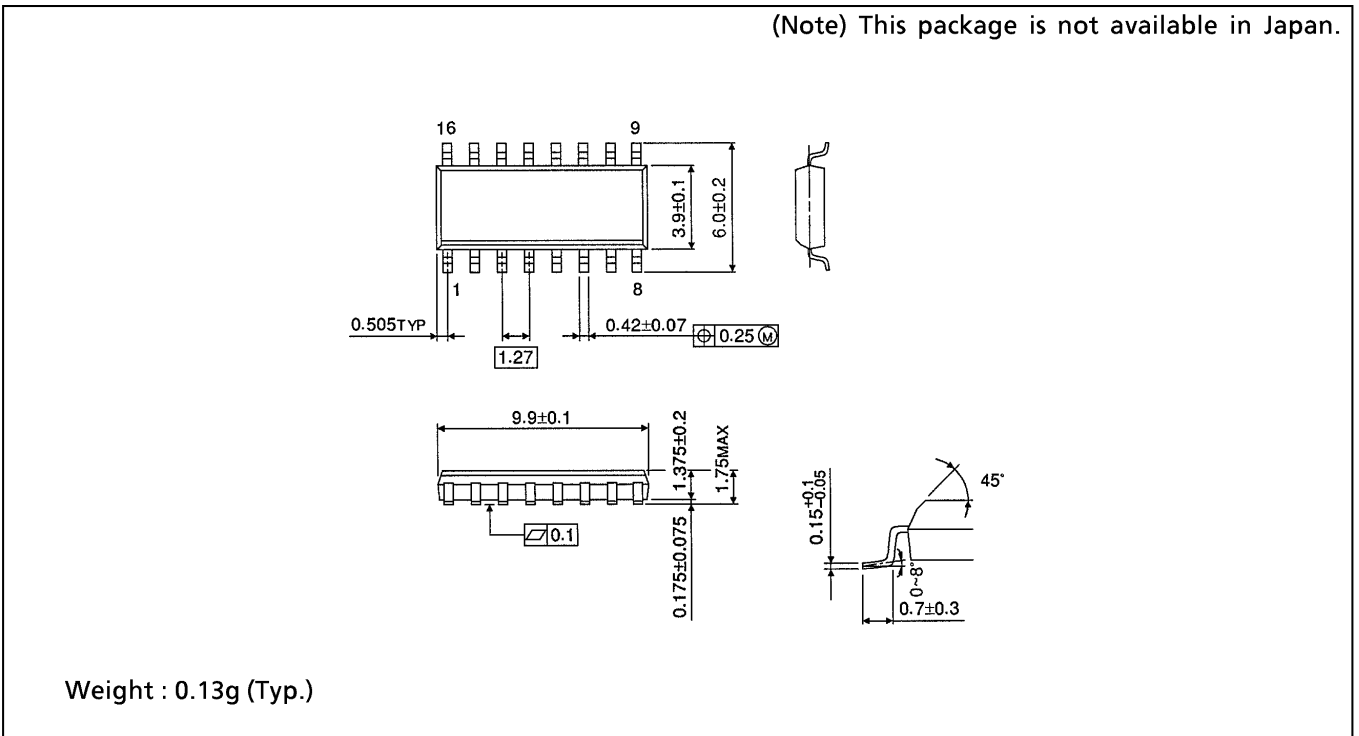
Unit in mm



SOP 16PIN (150mil BODY) OUTLINE DRAWING (SOP16-P-150-1.27)

Unit in mm

(Note) This package is not available in Japan.



**TSSOP 16PIN OUTLINE DRAWING (TSSOP16-P-0044-0.65)**

Unit in mm

