

# MC74AC4040

## 12-Stage Binary Ripple Counter

The MC74AC4040 consists of 12 master-slave flip-flops. The output of each flip-flop feeds the next and the frequency at each output is half that of the preceding one. The state of the counter advances on the negative-going edge of the Clock input. Reset is asynchronous and active-high.

State changes of the Q outputs do not occur simultaneously because of internal ripple delays. Therefore, decoded output signals are subject to decoding spikes and may have to be gated with the Clock of the MC74AC4040 for some designs.

### Features

- 140 MHz Typ. Clock
- Outputs Source/Sink 24 mA
- Operating Voltage Range: 2.0 to 6.0 V
- High Noise Immunity
- These are Pb-Free Devices

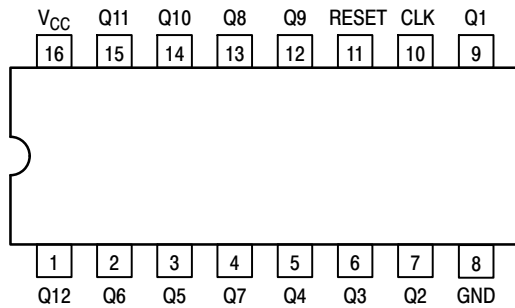


Figure 1. Pinout: 16-Lead Packages Conductors (Top View)

### FUNCTION TABLE

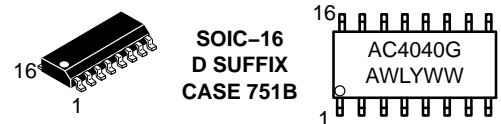
Clock	Reset	Output State
	L	No Change
	L	Advance to next state
X	H	All Outputs are low



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### MARKING DIAGRAM



A = Assembly Location  
 WL = Wafer Lot  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

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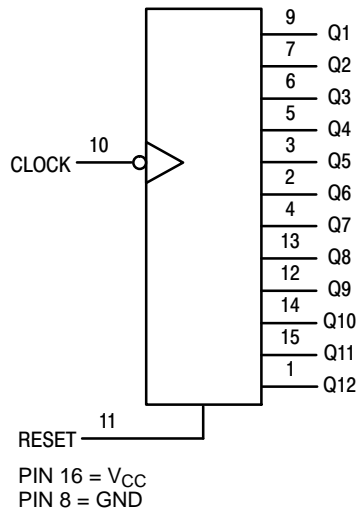


Figure 2. Logic Diagram

# MC74AC4040

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit	
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +7.0	V	
V <sub>I</sub>	DC Input Voltage	-0.5 ≤ V <sub>CC</sub> +0.5	V	
V <sub>O</sub>	DC Output Voltage (Note 1)	-0.5 ≤ V <sub>CC</sub> +0.5	V	
I <sub>IK</sub>	DC Input Diode Current	±20	mA	
I <sub>OK</sub>	DC Output Diode Current	±50	mA	
I <sub>O</sub>	DC Output Sink/Source Current	±50	mA	
I <sub>CC</sub>	DC Supply Current per Output Pin	±50	mA	
I <sub>GND</sub>	DC Ground Current per Output Pin	±50	mA	
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C	
T <sub>L</sub>	Lead temperature, 1 mm from Case for 10 Seconds	260	°C	
T <sub>J</sub>	Junction temperature under Bias	+150	°C	
θ <sub>JA</sub>	Thermal Resistance (Note 2)	69.1	°C/W	
P <sub>D</sub>	Power Dissipation in Still Air at 65°C (Note 3)	500	mW	
MSL	Moisture Sensitivity	Level 1		
F <sub>R</sub>	Flammability Rating	Oxygen Index: 30% – 35% UL 94 V-0 @ 0.125 in		
V <sub>ESD</sub>	ESD Withstand Voltage	Human Body Model (Note 4) Machine Model (Note 5) Charged Device Model (Note 6)	> 2000 > 200 > 1000	V
I <sub>Latch-Up</sub>	Latch-Up Performance	Above V <sub>CC</sub> and Below GND at 85°C (Note 7)	±100	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. I<sub>O</sub> absolute maximum rating must be observed.
2. The package thermal impedance is calculated in accordance with JESD51-7.
3. 500 mW at 65°C; derate to 300 mW by 10 mW/ from 65°C to 85°C.
4. Tested to EIA/JESD22-A114-A.
5. Tested to EIA/JESD22-A115-A.
6. Tested to JESD22-C101-A.
7. Tested to EIA/JESD78.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
V <sub>IN</sub> /V <sub>OUT</sub>	Input Voltage, Output Voltage (Referenced to GND)	0	V <sub>CC</sub>	-
T <sub>A</sub>	Operating Temperature, All Package Types	-40	+85	°C
t <sub>r</sub> /t <sub>f</sub>	Input Rise/Fall Time (Figure 1)			
	V <sub>CC</sub> = 3.0 V	0	150	ns/V
	V <sub>CC</sub> = 4.5 V	0	40	
	V <sub>CC</sub> = 5.5 V	0	25	

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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## DC CHARACTERISTICS (unless otherwise specified)

Symbol	Parameter	Value	Unit	
$I_{CC}$	Maximum Quiescent Supply Voltage	80	$\mu A$	$V_{in} = V_{CC}$ or GND $V_{CC} = 5.5 V, T_A = \text{Worst Case}$
$I_{CC}$	Maximum Quiescent Supply Current	8.0	$\mu A$	$V_{in} = V_{CC}$ or GND $V_{CC} = 5.5 V, T_A = 25^\circ C$

## DC CHARACTERISTICS

Symbol	Parameter	$V_{CC}$ (V)	74AC		74AC		Unit	Conditions
			$T_A = +25^\circ C$		$T_A = -40^\circ C$ to $+85^\circ C$			
			Typ	Guaranteed Limits				
$V_{IH}$	Minimum High Level Input Voltage	3.0	–	2.1	2.1		V	$V_{OUT} = 0.1 V$ or $V_{CC} - 0.1 V$
		4.5	–	3.15	3.15			
		5.5	–	3.85	3.85			
$V_{IL}$	Maximum Low Level Input Voltage	3.0	–	0.9	0.9		V	$V_{OUT} = 0.1 V$ or $V_{CC} - 0.1 V$
		4.5	–	1.35	1.35			
		5.5	–	1.65	1.65			
$V_{OH}$	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9		V	$I_{OUT} = -50 \mu A$
		4.5	4.49	4.4	4.4			
		5.5	5.49	5.4	5.4			
		3.0	–	2.56	2.46		V	* $V_{IN} = V_{IL}$ or $V_{IH}$ –12 mA $I_{OH}$ –24 mA –24 mA
		4.5	–	3.86	3.76			
		5.5	–	4.86	4.76			
$V_{OL}$	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1		V	$I_{OUT} = 50 \mu A$
		4.5	0.001	0.1	0.1			
		5.5	0.001	0.1	0.1			
		3.0	–	0.36	0.44		V	* $V_{IN} = V_{IL}$ or $V_{IH}$ 12 mA $I_{OL}$ 24 mA 24 mA
		4.5	–	0.36	0.44			
		5.5	–	0.36	0.44			
$I_{IN}$	Maximum Input Leakage Current	5.5	–	$\pm 0.1$	$\pm 1.0$		$\mu A$	$V_I = V_{CC}, GND$
$I_{OLD}$	Minimum Dynamic Output Current†	5.5	–	–	75		mA	$V_{OLD} = 1.65 V \text{ Max}$
$I_{OHD}$		5.5	–	–	–75		mA	$V_{OHD} = 3.85 V \text{ Min}$

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

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**AC CHARACTERISTICS** (For Figures and Waveforms – See Section 3 of the ON Semiconductor FACT Data Book, DL138/D)

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC			74AC		Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF			
			Min	Typ	Max	Min	Max		
f <sub>max</sub>	Maximum Clock Frequency	3.3 5.0	110 130	120 140	– –	100 120	– –	MHz	–
n <sub>CP</sub> to Q1	Propagation Delay n <sub>CP</sub> to Q1	3.3 5.0	2.0 2.0	– –	11 8.0	2.0 2.0	14 10	ns	–
Q <sub>n</sub> to Q <sub>n+1</sub>	Propagation Delay Q <sub>n</sub> to Q <sub>n+1</sub>	3.3 5.0	0 0	– –	5.5 3.5	0 0	6.5 4.5	ns	–
MR to Q t <sub>HL</sub>	Propagation Delay MR to Q	3.3 5.0	3.0 3.0	– –	12 10	3.0 3.0	15 12	ns	–
t <sub>rec</sub> n <sub>CP</sub> to MR	Recovery Time	3.3 5.0	0 0	–2.5 –1.5	– –	0 0	– –	ns	–
t <sub>w</sub> n <sub>CP</sub>	Minimum Pulse Width Clock Pin	3.3 5.0	4.0 3.0	3.5 2.5	– –	4.5 3.5	– –	ns	–
t <sub>w</sub> MR	Minimum Pulse Width Master Reset	3.3 3.0	4.0 3.0	3.5 2.5	– –	4.5 3.5	– –	ns	–

\*Voltage Range 3.3 V is 3.3 V ±0.3 V.

\*Voltage Range 5.0 V is 5.0 V ±0.5 V.

## CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = 5.0 V
C <sub>PD</sub>	Power Dissipation Capacitance	50	pF	V <sub>CC</sub> = 5.0 V

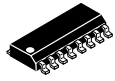
## ORDERING INFORMATION

Part Number	Package	Shipping†
MC74AC4040DG	SOIC-16 (Pb-Free)	48 Units / Rail
MC74AC4040DR2G	SOIC-16 (Pb-Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1

## SOIC-16 CASE 751B-05 ISSUE K

DATE 29 DEC 2006



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

- |  |  |  |  |
|--|--|--|--|
| <p>STYLE 1:</p> <p>PIN 1. COLLECTOR</p> <p>2. BASE</p> <p>3. EMITTER</p> <p>4. NO CONNECTION</p> <p>5. EMITTER</p> <p>6. BASE</p> <p>7. COLLECTOR</p> <p>8. COLLECTOR</p> <p>9. BASE</p> <p>10. EMITTER</p> <p>11. NO CONNECTION</p> <p>12. EMITTER</p> <p>13. BASE</p> <p>14. COLLECTOR</p> <p>15. EMITTER</p> <p>16. COLLECTOR</p>                           | <p>STYLE 2:</p> <p>PIN 1. CATHODE</p> <p>2. ANODE</p> <p>3. NO CONNECTION</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. NO CONNECTION</p> <p>7. ANODE</p> <p>8. CATHODE</p> <p>9. CATHODE</p> <p>10. ANODE</p> <p>11. NO CONNECTION</p> <p>12. CATHODE</p> <p>13. CATHODE</p> <p>14. NO CONNECTION</p> <p>15. ANODE</p> <p>16. CATHODE</p> | <p>STYLE 3:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. BASE, #1</p> <p>3. EMITTER, #1</p> <p>4. COLLECTOR, #1</p> <p>5. COLLECTOR, #2</p> <p>6. BASE, #2</p> <p>7. EMITTER, #2</p> <p>8. COLLECTOR, #2</p> <p>9. COLLECTOR, #3</p> <p>10. BASE, #3</p> <p>11. EMITTER, #3</p> <p>12. COLLECTOR, #3</p> <p>13. COLLECTOR, #4</p> <p>14. BASE, #4</p> <p>15. EMITTER, #4</p> <p>16. COLLECTOR, #4</p>   | <p>STYLE 4:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. COLLECTOR, #1</p> <p>3. COLLECTOR, #2</p> <p>4. COLLECTOR, #2</p> <p>5. COLLECTOR, #3</p> <p>6. COLLECTOR, #3</p> <p>7. COLLECTOR, #4</p> <p>8. COLLECTOR, #4</p> <p>9. BASE, #4</p> <p>10. EMITTER, #4</p> <p>11. BASE, #3</p> <p>12. EMITTER, #3</p> <p>13. BASE, #2</p> <p>14. EMITTER, #2</p> <p>15. BASE, #1</p> <p>16. EMITTER, #1</p> |
| <p>STYLE 5:</p> <p>PIN 1. DRAIN, DYE #1</p> <p>2. DRAIN, #1</p> <p>3. DRAIN, #2</p> <p>4. DRAIN, #2</p> <p>5. DRAIN, #3</p> <p>6. DRAIN, #3</p> <p>7. DRAIN, #4</p> <p>8. DRAIN, #4</p> <p>9. GATE, #4</p> <p>10. SOURCE, #4</p> <p>11. GATE, #3</p> <p>12. SOURCE, #3</p> <p>13. GATE, #2</p> <p>14. SOURCE, #2</p> <p>15. GATE, #1</p> <p>16. SOURCE, #1</p> | <p>STYLE 6:</p> <p>PIN 1. CATHODE</p> <p>2. CATHODE</p> <p>3. CATHODE</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. CATHODE</p> <p>7. CATHODE</p> <p>8. CATHODE</p> <p>9. ANODE</p> <p>10. ANODE</p> <p>11. ANODE</p> <p>12. ANODE</p> <p>13. ANODE</p> <p>14. ANODE</p> <p>15. ANODE</p> <p>16. ANODE</p>                                 | <p>STYLE 7:</p> <p>PIN 1. SOURCE N-CH</p> <p>2. COMMON DRAIN (OUTPUT)</p> <p>3. COMMON DRAIN (OUTPUT)</p> <p>4. GATE P-CH</p> <p>5. COMMON DRAIN (OUTPUT)</p> <p>6. COMMON DRAIN (OUTPUT)</p> <p>7. COMMON DRAIN (OUTPUT)</p> <p>8. SOURCE P-CH</p> <p>9. SOURCE P-CH</p> <p>10. COMMON DRAIN (OUTPUT)</p> <p>11. COMMON DRAIN (OUTPUT)</p> <p>12. COMMON DRAIN (OUTPUT)</p> <p>13. GATE N-CH</p> <p>14. COMMON DRAIN (OUTPUT)</p> <p>15. COMMON DRAIN (OUTPUT)</p> <p>16. SOURCE N-CH</p> |  |

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