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.

ON Semiconductor®

Features

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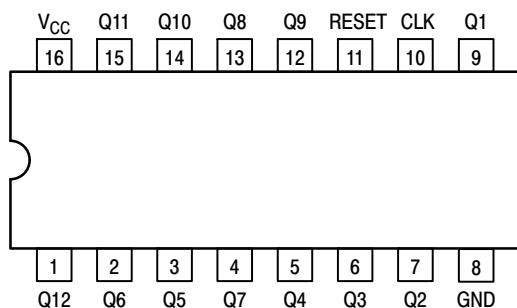- High Noise Immunity
- These are Pb–Free Devices

MARKING DIAGRAM

SOIC–16
D SUFFIX
CASE 751B

AC4040G
AWLYWW

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.
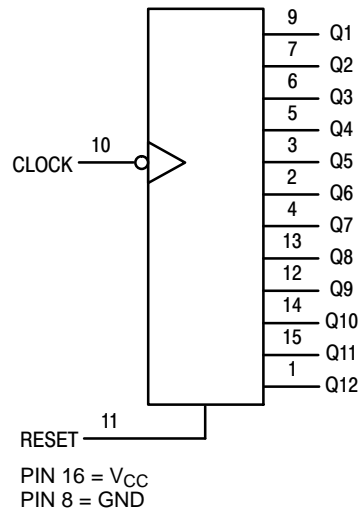

16	15	14	13	12	11	10	9
V_{CC}	Q11	Q10	Q8	Q9	RESET	CLK	Q1

1	2	3	4	5	6	7	8
Q12	Q6	Q5	Q7	Q4	Q3	Q2	GND

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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Publication Order Number:
MC74AC4040/D

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Figure 2. Logic Diagram

PIN 16 = V_{CC}
PIN 8 = GND

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MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage		−0.5 to +7.0	V
V_I	DC Input Voltage		$-0.5 \leq V_{CC} +0.5$	V
V_O	DC Output Voltage (Note 1)		$-0.5 \leq V_{CC} +0.5$	V
I_{IK}	DC Input Diode Current		±20	mA
I_{OK}	DC Output Diode Current		±50	mA
I_O	DC Output Sink/Source Current		±50	mA
I_{CC}	DC Supply Current per Output Pin		±50	mA
I_{GND}	DC Ground Current per Output Pin		±50	mA
T_{STG}	Storage Temperature Range		−65 to +150	°C
T_L	Lead temperature, 1 mm from Case for 10 Seconds		260	°C
T_J	Junction temperature under Bias		+150	°C
θ_{JA}	Thermal Resistance (Note 2)		69.1	°C/W
P_D	Power Dissipation in Still Air at 65°C (Note 3)		500	mW
MSL	Moisture Sensitivity		Level 1	
F_R	Flammability Rating	Oxygen Index: 30% – 35%	UL 94 V–0 @ 0.125 in	
V_{ESD}	ESD Withstand Voltage	Human Body Model (Note 4) Machine Model (Note 5) Charged Device Model (Note 6)	> 2000 > 200 > 1000	V
$I_{Latch-Up}$	Latch−Up Performance Above V_{CC} 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_O 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_{CC}	DC Supply Voltage (Referenced to GND)		2.0	6.0	V
V_{IN}/V_{OUT}	Input Voltage, Output Voltage (Referenced to GND)		0	V_{CC}	–
T_A	Operating Temperature, All Package Types		−40	+85	°C
t_r/t_f	Input Rise/Fall Time (Figure 1)	V_{CC} = 3.0 V V_{CC} = 4.5 V V_{CC} = 5.5 V	0 0 0	150 40 25	ns/V

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.

DC CHARACTERISTICS (unless otherwise specified)

Symbol	Parameter	Value	Unit	
I_{CC}	Maximum Quiescent Supply Voltage	80	μA	$V_{in} = V_{CC}$ or GND $V_{CC} = 5.5$ V, T_A = Worst Case
I_{CC}	Maximum Quiescent Supply Current	8.0	μA	$V_{in} = V_{CC}$ or GND $V_{CC} = 5.5$ V, $T_A = 25°C$

DC CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	74AC $T_A = +25°C$ Typ	74AC $T_A = -40°C$ to $+85°C$ Guaranteed Limits	Unit	Conditions
V_{IH}	Minimum High Level Input Voltage	3.0 4.5 5.5	– – –	2.1 3.15 3.85	2.1 3.15 3.85	V	$V_{OUT} = 0.1$ V or $V_{CC} - 0.1$ V
V_{IL}	Maximum Low Level Input Voltage	3.0 4.5 5.5	– – –	0.9 1.35 1.65	0.9 1.35 1.65	V	$V_{OUT} = 0.1$ V or $V_{CC} - 0.1$ V
V_{OH}	Minimum High Level Output Voltage	3.0 4.5 5.5	2.99 4.49 5.49	2.9 4.4 5.4	2.9 4.4 5.4	V	$I_{OUT} = -50$ μA
		3.0 4.5 5.5	– – –	2.56 3.86 4.86	2.46 3.76 4.76	V	*$V_{IN} = V_{IL}$ or V_{IH} –12 mA I_{OH} –24 mA –24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0 4.5 5.5	0.002 0.001 0.001	0.1 0.1 0.1	0.1 0.1 0.1	V	$I_{OUT} = 50$ μA
		3.0 4.5 5.5	– – –	0.36 0.36 0.36	0.44 0.44 0.44	V	*$V_{IN} = V_{IL}$ or V_{IH} 12 mA I_{OL} 24 mA 24 mA
I_{IN}	Maximum Input Leakage Current	5.5	–	±0.1	±1.0	μA	$V_I = V_{CC}$, GND
I_{OLD}	Minimum Dynamic Output Current†	5.5	–	–	75	mA	$V_{OLD} = 1.65$ V Max
I_{OHD}		5.5	–	–	–75	mA	$V_{OHD} = 3.85$ V 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$_{CC}$* (V)	74AC T$_A$ = +25°C C$_L$ = 50 pF			74AC T$_A$ = −40°C to +85°C C$_L$ = 50 pF		Unit	Fig. No.
			Min	Typ	Max	Min	Max		
f$_{max}$	Maximum Clock Frequency	3.3 5.0	110 130	120 140	– –	100 120	– –	MHz	–
n$_{CP}$ to Q1	Propagation Delay n$_{CP}$ to Q1	3.3 5.0	2.0 2.0	– –	11 8.0	2.0 2.0	14 10	ns	–
Q$_n$ to Q$_n$ +1	Propagation Delay Q$_n$ to Q$_n$ +1	3.3 5.0	0 0	– –	5.5 3.5	0 0	6.5 4.5	ns	–
MR to Q t$_{HL}$	Propagation Delay MR to Q	3.3 5.0	3.0 3.0	– –	12 10	3.0 3.0	15 12	ns	–
t$_{rec}$ n$_{CP}$ to MR	Recovery Time	3.3 5.0	0 0	−2.5 −1.5	– –	0 0	– –	ns	–
t$_w$ n$_{CP}$	Minimum Pulse Width Clock Pin	3.3 5.0	4.0 3.0	3.5 2.5	– –	4.5 3.5	– –	ns	–
t$_w$ 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$_{IN}$	Input Capacitance	4.5	pF	V$_{CC}$ = 5.0 V
C$_{PD}$	Power Dissipation Capacitance	50	pF	V$_{CC}$ = 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.
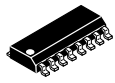
SOIC−16
CASE 751B−05
ISSUE K

DATE 29 DEC 2006

SCALE 1:1

−A−

16   9

−B−   P 8 PL

⊕ | 0.25 (0.010) Ⓜ | B Ⓢ

①   8

G

K

C

−T− SEATING PLANE

D 16 PL

R X 45°

F

M   J

⊕ | 0.25 (0.010) Ⓜ | T | B Ⓢ | A Ⓢ
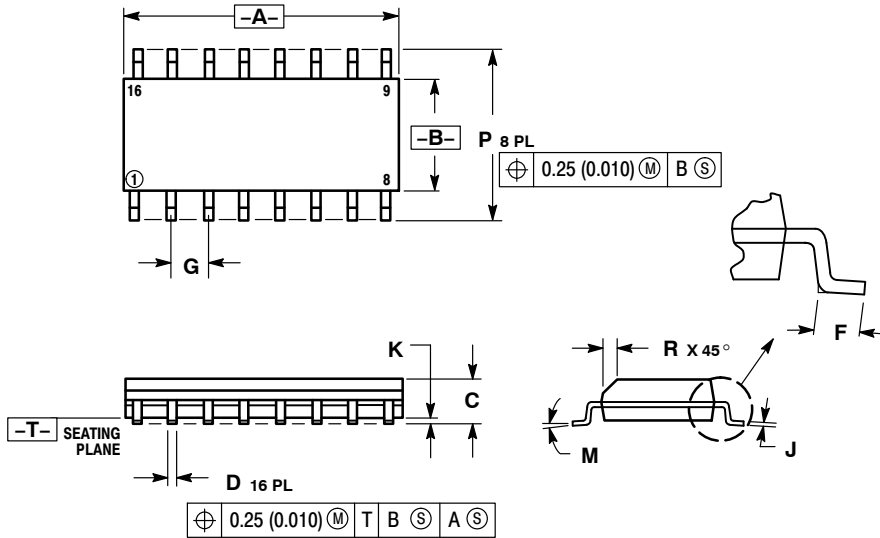
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES 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

STYLE 1:
PIN 1. COLLECTOR
2. BASE
3. EMITTER
4. NO CONNECTION
5. EMITTER
6. BASE
7. COLLECTOR
8. COLLECTOR
9. BASE
10. EMITTER
11. NO CONNECTION
12. EMITTER
13. BASE
14. COLLECTOR
15. EMITTER
16. COLLECTOR

STYLE 2:
PIN 1. CATHODE
2. ANODE
3. NO CONNECTION
4. CATHODE
5. CATHODE
6. NO CONNECTION
7. ANODE
8. CATHODE
9. CATHODE
10. ANODE
11. NO CONNECTION
12. CATHODE
13. CATHODE
14. NO CONNECTION
15. ANODE
16. CATHODE

STYLE 3:
PIN 1. COLLECTOR, DYE #1
2. BASE, #1
3. EMITTER, #1
4. COLLECTOR, #1
5. COLLECTOR, #2
6. BASE, #2
7. EMITTER, #2
8. COLLECTOR, #2
9. COLLECTOR, #3
10. BASE, #3
11. EMITTER, #3
12. COLLECTOR, #3
13. COLLECTOR, #4
14. BASE, #4
15. EMITTER, #4
16. COLLECTOR, #4

STYLE 4:
PIN 1. COLLECTOR, DYE #1
2. COLLECTOR, #1
3. COLLECTOR, #2
4. COLLECTOR, #2
5. COLLECTOR, #3
6. COLLECTOR, #3
7. COLLECTOR, #4
8. COLLECTOR, #4
9. BASE, #4
10. EMITTER, #4
11. BASE, #3
12. EMITTER, #3
13. BASE, #2
14. EMITTER, #2
15. BASE, #1
16. EMITTER, #1

STYLE 5:
PIN 1. DRAIN, DYE #1
2. DRAIN, #1
3. DRAIN, #2
4. DRAIN, #2
5. DRAIN, #3
6. DRAIN, #3
7. DRAIN, #4
8. DRAIN, #4
9. GATE, #4
10. SOURCE, #4
11. GATE, #3
12. SOURCE, #3
13. GATE, #2
14. SOURCE, #2
15. GATE, #1
16. SOURCE, #1

STYLE 6:
PIN 1. CATHODE
2. CATHODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE
7. CATHODE
8. CATHODE
9. ANODE
10. ANODE
11. ANODE
12. ANODE
13. ANODE
14. ANODE
15. ANODE
16. ANODE

STYLE 7:
PIN 1. SOURCE N-CH
2. COMMON DRAIN (OUTPUT)
3. COMMON DRAIN (OUTPUT)
4. GATE P-CH
5. COMMON DRAIN (OUTPUT)
6. COMMON DRAIN (OUTPUT)
7. COMMON DRAIN (OUTPUT)
8. SOURCE P-CH
9. SOURCE P-CH
10. COMMON DRAIN (OUTPUT)
11. COMMON DRAIN (OUTPUT)
12. COMMON DRAIN (OUTPUT)
13. GATE N-CH
14. COMMON DRAIN (OUTPUT)
15. COMMON DRAIN (OUTPUT)
16. SOURCE N-CH

SOLDERING FOOTPRINT

8X
6.40

16X 1.12

1   16

16X
0.58

1.27
PITCH

8   9
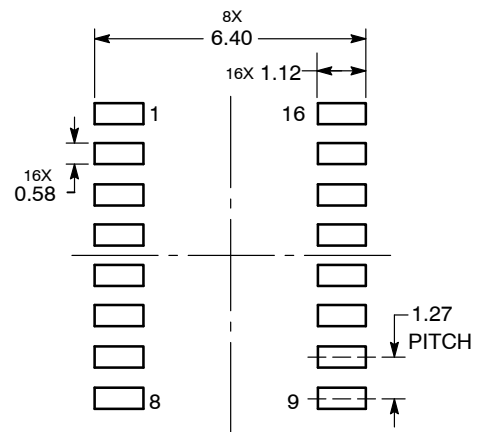
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ADDITIONAL INFORMATION

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