MC14040B

12-Bit Binary Counter

The MC14040B 12-stage binary counter is constructed with MOS P-Channel and N-Channel enhancement mode devices in a single monolithic structure. This part is designed with an input wave shaping circuit and 12 stages of ripple-carry binary counter. The device advances the count on the negative-going edge of the clock pulse. Applications include time delay circuits, counter controls, and frequency-driving circuits.

Features

- Fully Static Operation
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range
- Common Reset Line
- Pin-for-Pin Replacement for CD4040B
- Pb-Free Packages are Available

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage Range	-0.5 to +18.0	V
V_{in}, V_{out}	Input or Output Voltage Range (DC or Transient)	-0.5 to V_{DD} + 0.5	V
I_{in}, I_{out}	Input or Output Current (DC or Transient) per Pin	±10	mA
P_D	Power Dissipation, per Package (Note 1)	500	mW
T_A	Ambient Temperature Range	-55 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C
T_L	Lead Temperature (8-Second Soldering)	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Temperature Derating:
   Plastic "P and D/DW" Packages: – 7.0 mW/°C From 65°C To 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.

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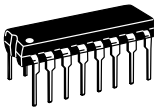
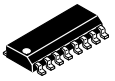
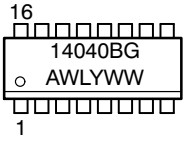
MARKING DIAGRAMS



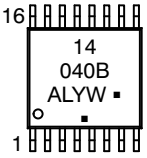
PDIP-16
P SUFFIX
CASE 648

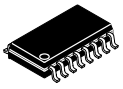


SOIC-16
D SUFFIX
CASE 751B

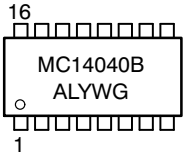


TSSOP-16
DT SUFFIX
CASE 948F





SOEIAJ-16
F SUFFIX
CASE 966



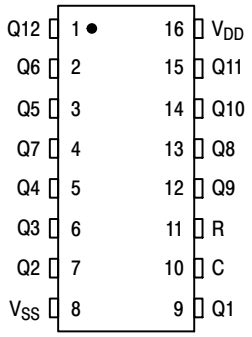
A	= Assembly Location
WL, L	= Wafer Lot
YY, Y	= Year
WW, W	= Work Week
G	= Pb-Free Indicator

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

Publication Order Number:
MC14040B/D

PIN ASSIGNMENT

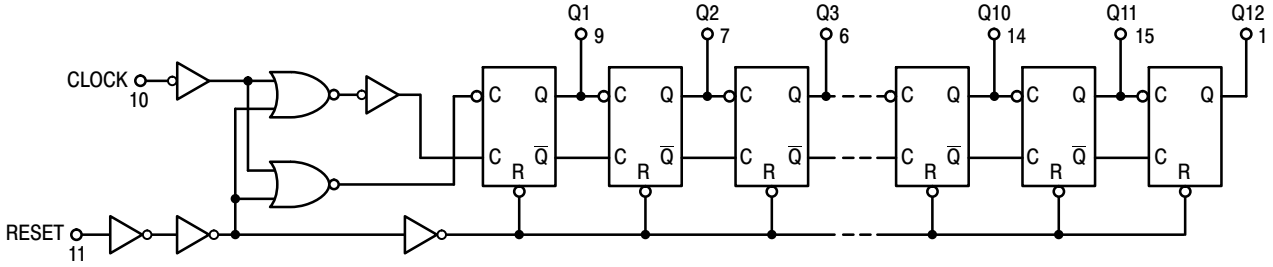


TRUTH TABLE

Clock	Reset	Output State
⎍	0	No Change
⎎	0	Advance to next state
X	1	All Outputs are low

X = Don't Care

LOGIC DIAGRAM



Q4 = PIN 5
Q5 = PIN 3
Q6 = PIN 2
Q7 = PIN 4
Q8 = PIN 13
Q9 = PIN 12
V_{DD} = PIN 16
V_{SS} = PIN 8

ORDERING INFORMATION

Device	Package	Shipping†
MC14040BCP	PDIP-16	500 Units / Rail
MC14040BCPG	PDIP-16 (Pb-Free)	500 Units / Rail
MC14040BD	SOIC-16	48 Units / Rail
MC14040BDG	SOIC-16 (Pb-Free)	48 Units / Rail
MC14040BDR2	SOIC-16	2500 Units / Tape & Reel
MC14040BDR2G	SOIC-16 (Pb-Free)	2500 Units / Tape & Reel
MC14040BDTR2	TSSOP-16*	2500 Units / Tape & Reel
MC14040BDTR2G	TSSOP-16*	2500 Units / Tape & Reel
MC14040BFEL	SOEIAJ-16	2000 Units / Tape & Reel
MC14040BFELG	SOEIAJ-16 (Pb-Free)	2000 Units / 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.
*This package is inherently Pb-Free.

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V_{DD} Vdc	- 55°C Min	- 55°C Max	25°C Min	25°C Typ (Note 2)	25°C Max	125°C Min	125°C Max	Unit
Output Voltage "0" Level	V_{OL}	5.0	-	0.05	-	0	0.05	-	0.05	Vdc
V_{in} = V_{DD} or 0		10	-	0.05	-	0	0.05	-	0.05	
		15	-	0.05	-	0	0.05	-	0.05	
"1" Level	V_{OH}	5.0	4.95	—	4.95	5.0	-	4.95	-	Vdc
V_{in} = 0 or V_{DD}		10	9.95	—	9.95	10	-	9.95	-	
		15	14.95	—	14.95	15	-	14.95	-	
Input Voltage "0" Level	V_{IL}									Vdc
(V_O = 4.5 or 0.5 Vdc)		5.0	-	1.5	-	2.25	1.5	-	1.5	
(V_O = 9.0 or 1.0 Vdc)		10	-	3.0	-	4.50	3.0	-	3.0	
(V_O = 13.5 or 1.5 Vdc)		15	-	4.0	-	6.75	4.0	-	4.0	
"1" Level	V_{IH}									Vdc
(V_O = 0.5 or 4.5 Vdc)		5.0	3.5	-	3.5	2.75	-	3.5	-	
(V_O = 1.0 or 9.0 Vdc)		10	7.0	-	7.0	5.50	-	7.0	-	
(V_O = 1.5 or 13.5 Vdc)		15	11	-	11	8.25	-	11	-	
Output Drive Current	I_{OH}									mAdc
(V_{OH} = 2.5 Vdc) Source		5.0	− 3.0	-	− 2.4	− 4.2	-	− 1.7	-	
(V_{OH} = 4.6 Vdc)		5.0	− 0.64	-	− 0.51	− 0.88	-	− 0.36	-	
(V_{OH} = 9.5 Vdc)		10	− 1.6	-	− 1.3	− 2.25	-	− 0.9	-	
(V_{OH} = 13.5 Vdc)		15	− 4.2	-	− 3.4	− 8.8	-	− 2.4	-	
(V_{OL} = 0.4 Vdc) Sink	I_{OL}	5.0	0.64	-	0.51	0.88	-	0.36	-	mAdc
(V_{OL} = 0.5 Vdc)		10	1.6	-	1.3	2.25	-	0.9	-	
(V_{OL} = 1.5 Vdc)		15	4.2	-	3.4	8.8	-	2.4	-	
Input Current	I_{in}	15	-	± 0.1	-	±0.00001	± 0.1	-	± 1.0	μAdc
Input Capacitance (V_{in} = 0)	C_{in}	-	-	-	-	5.0	7.5	-	-	pF
Quiescent Current (Per Package)	I_{DD}	5.0	-	5.0	-	0.005	5.0	-	150	μAdc
		10	-	10	-	0.010	10	-	300	
		15	-	20	-	0.015	20	-	600	
Total Supply Current (Notes 3 & 4) (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)	I_T	5.0	I_T = (0.42 μA/kHz) f + I_{DD}							μAdc
		10	I_T = (0.85 μA/kHz) f + I_{DD}							
		15	I_T = (1.43 μA/kHz) f + I_{DD}							

2. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.
3. The formulas given are for the typical characteristics only at 25°C.
4. To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50\ pF) + (C_L - 50)\ Vfk$$

where: I_T is in μA (per package), C_L in pF, V = (V_{DD} − V_{SS}) in volts, f in kHz is input frequency, and k = 0.001.

SWITCHING CHARACTERISTICS (Note 5) (C_L = 50 pF, T_A = 25°C)

Characteristic	Symbol	V_{DD} Vdc	Min	Typ (Note 6)	Max	Unit
Output Rise and Fall Time	t_{TLH},					ns
T_{TLH}, T_{THL} = (1.5 ns/pF) C_L + 25 ns	t_{THL}	5.0	-	100	200	
T_{TLH}, T_{THL} = (0.75 ns/pF) C_L + 12.5 ns		10	-	50	100	
T_{TLH}, T_{THL} = (0.55 ns/pF) C_L + 9.5 ns		15	-	40	80	
Propagation Delay Time	t_{PLH},					
Clock to Q1	t_{PHL}					ns
t_{PHL}, t_{PLH} = (1.7 ns/pF) C_L + 315 ns		5.0	-	260	520	
t_{PHL}, t_{PLH} = (0.66 ns/pF) C_L + 137 ns		10	-	115	230	
t_{PHL}, t_{PLH} = (0.5 ns/pF) C_L + 95 ns		15	-	80	160	
Clock to Q12						ns
t_{PHL}, t_{PLH} = (1.7 ns/pF) C_L + 2415 ns		5.0	-	1625	3250	
t_{PHL}, t_{PLH} = (0.66 ns/pF) C_L + 867 ns		10	-	720	1440	
t_{PHL}, t_{PLH} = (0.5 ns/pF) C_L + 475 ns		15	-	500	1000	
Propagation Delay Time	t_{PHL}					ns
Reset to Q_n						
t_{PHL} = (1.7 ns/pF) C_L + 485 ns		5.0	-	370	740	
t_{PHL} = (0.86 ns/pF) C_L + 182 ns		10	-	155	310	
t_{PHL} = (0.5 ns/pF) C_L + 145 ns		15	-	115	230	
Clock Pulse Width	t_{WH}	5.0	385	140	-	ns
		10	150	55	-	
		15	115	38	-	
Clock Pulse Frequency	f_{cl}	5.0	-	2.1	1.5	MHz
		10	-	7.0	3.5	
		15	-	10.0	4.5	
Clock Rise and Fall Time	t_{TLH}, t_{THL}	5.0	No Limit			ns
		10				
		15				
Reset Pulse Width	t_{WH}	5.0	960	320	-	ns
		10	360	120	-	
		15	270	80	-	
Reset Removal Time	t_{rem}	5.0	130	65	-	ns
		10	50	25	-	
		15	30	15	-	

5. The formulas given are for the typical characteristics only at 25°C.
6. Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.

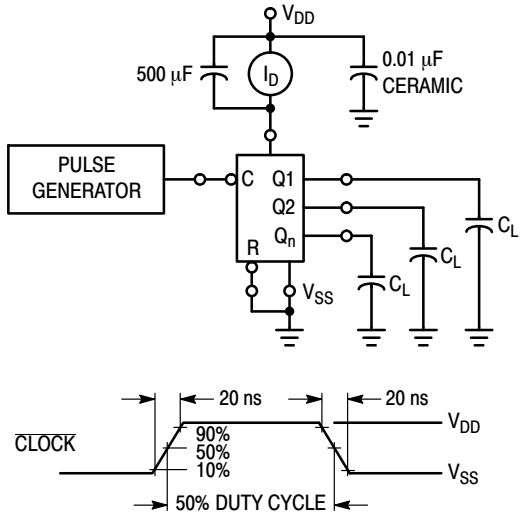


Figure 1. Power Dissipation Test Circuit and Waveform

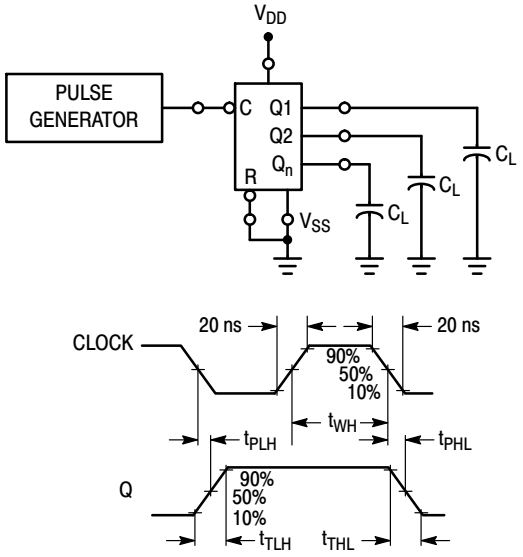
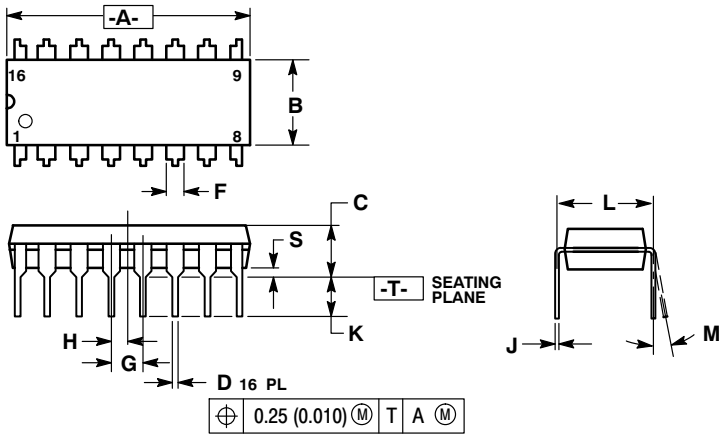


Figure 2. Switching Time Test Circuit and Waveforms

PACKAGE DIMENSIONS

PDIP-16
P SUFFIX
PLASTIC DIP PACKAGE
CASE 648-08
ISSUE T



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0 °	10 °	0 °	10 °
S	0.020	0.040	0.51	1.01