National Semiconductor

February 1988

CD40174BM/CD40174BC Hex D Flip-Flop
CD40175BM/CD40175BC Quad D Flip-Flop

General Description

The CD40174B consists of six positive-edge triggered D-type flip-flops; the true outputs from each flip-flop are externally available. The CD40175B consists of four positive-edge triggered D-type flip-flops; both the true and complement outputs from each flip-flop are externally available.

All flip-flops are controlled by a common clock and a common clear. Information at the D inputs meeting the set-up time requirements is transferred to the Q outputs on the positive-going edge of the clock pulse. The clearing operation, enabled by a negative pulse at Clear input, clears all Q outputs to logical "0" and $\overline{Q}$s (CD40175B only) to logical "1".

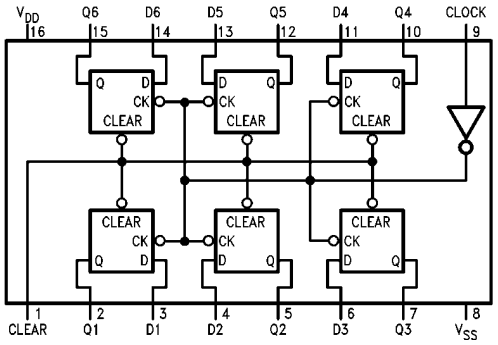
All inputs are protected from static discharge by diode clamps to V_{DD} and V_{SS}.

Features

- Wide supply voltage range — 3V to 15V
- High noise immunity — 0.45 V_{DD} (typ.)
- Low power TTL compatibility — fan out of 2 driving 74L or 1 driving 74 LS
- Equivalent to MC14174B, MC14175B
- Equivalent to MM74C174, MM74C175

Connection Diagrams

CD40174B
Dual-In-Line Package



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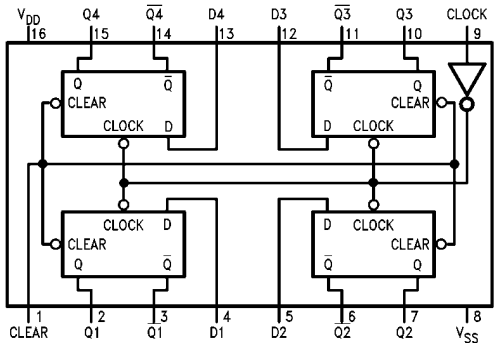
Top View

CD40175B
Dual-In-Line Package



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Top View

Order Number CD40174B or CD40175B

Truth Table

Inputs			Outputs	
Clear	Clock	D	Q	$\overline{Q}$*
L	X	X	L	H
H	↑	H	H	L
H	↑	L	L	H
H	H	X	NC	NC
H	L	X	NC	NC

H = High level
L = Low level
X = Irrelevant
↑ = Transition from low to high level
NC = No change
* = $\overline{Q}$ for CD40175B only

Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

DC Supply Voltage (V_{DD})	−0.5V to +18V
Input Voltage (V_{IN})	−0.5V to V_{DD} +0.5V_{DC}
Storage Temperature Range (T_S)	−65°C to +150°C
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature (T_L) (Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	3V to 15 V_{DC}
Input Voltage (V_{IN})	0V to V_{DD} V_{DC}
Operating Temperature Range (T_A)	
CD40XXXBM	−55°C to +125°C
CD40XXXBC	−40°C to +85°C

DC Electrical Characteristics CD40174BM/CD40175BM (Note 2)

Symbol	Parameter	Conditions	−55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		1.0			1.0		30	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		2.0			2.0		60	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		4.0			4.0		120	μA
V_{OL}	Low Level Output Voltage	$\|I_O\| < 1$ μA								
		V_{DD} = 5V		0.05			0.05		0.05	V
		V_{DD} = 10V		0.05			0.05		0.05	V
		V_{DD} = 15V		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	$\|I_O\| < 1$ μA								
		V_{DD} = 5V	4.95		4.95	5		4.95		V
		V_{DD} = 10V	9.95		9.95	10		9.95		V
		V_{DD} = 15V	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 1V or 9V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1V or 9V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current (Note 3)	V_{DD} = 5V, V_O = 0.4V	0.64		0.51	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.6		1.3	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	4.2		3.4	8.8		2.4		mA
I_{OH}	High Level Output Current (Note 3)	V_{DD} = 5V, V_O = 4.6V	−0.64		−0.51	−0.8.8		−0.36		mA
		V_{DD} = 10V, V_O = 9.5V	−1.6		−1.3	−2.25		−0.9		mA
		V_{DD} = 15V, V_O = 13.5V	−4.2		−3.4	−8.8		−2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.1		-10^{-5}	−0.1		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.1		10^{-5}	0.1		1.0	μA

DC Electrical Characteristics CD40174BC/CD40175BC (Note 2)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		4			4		30	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		8			8		60	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		16			16		120	μA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

Note 2: V_{SS} = 0V unless otherwise specified.

Note 3: I_{OH} and I_{OL} are tested one output at a time.

DC Electrical Characteristics CD40174BC/CD40175BC (Note 2) (Continued)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
V_{OL}	Low Level Output Voltage	V_{DD} = 5V		0.05			0.05		0.05	V
		V_{DD} = 10V		0.05			0.05		0.05	V
		V_{DD} = 15V		0.05			0.05		0.05	V
V_{OH}	High Level Output Voltage	V_{DD} = 5V	4.95		4.95	5		4.95		V
		V_{DD} = 10V	9.95		9.95	10		9.95		V
		V_{DD} = 15V	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 1V or 9V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1V or 9V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current (Note 3)	V_{DD} = 5V, V_O = 0.4V	0.52		0.44	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.3		1.1	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	3.6		3.0	8.8		2.4		mA
I_{OH}	High Level Output Current (Note 3)	V_{DD} = 5V, V_O = 4.6V	−0.52		−0.44	−0.88		−0.36		mA
		V_{DD} = 10V, V_O = 9.5V	−1.3		−1.1	−2.25		−0.9		mA
		V_{DD} = 15V, V_O = 13.5V	−3.6		−3.0	−8.8		−2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.30		-10^{-5}	−0.30		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.30		10^{-5}	0.30		1.0	μA

AC Electrical Characteristics*

T_A = 25°C, C_L = 50 pF, R_L = 200k and $t_r = t_f$ = 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL}, t_{PLH}	Propagation Delay Time to a Logical "0" or Logical "1" from Clock to Q or $\overline{Q}$ (CD40175 Only)	V_{DD} = 5V		190	300	ns
		V_{DD} = 10V		75	110	ns
		V_{DD} = 15V		60	90	ns
t_{PHL}	Propagation Delay Time to a Logical "0" from Clear to Q	V_{DD} = 5V		180	300	ns
		V_{DD} = 10V		70	110	ns
		V_{DD} = 15V		60	90	ns
t_{PLH}	Propagation Delay Time to a Logical "1" from Clear to $\overline{Q}$ (CD40175 Only)	V_{DD} = 5V		230	400	ns
		V_{DD} = 10V		90	150	ns
		V_{DD} = 15V		75	120	ns
t_{SU}	Time Prior to Clock Pulse that Data must be Present	V_{DD} = 5V		45	100	ns
		V_{DD} = 10V		15	40	ns
		V_{DD} = 15V		13	35	ns
t_H	Time after Clock Pulse that Data Must be Held	V_{DD} = 5V		−11	0	ns
		V_{DD} = 10V		−4	0	ns
		V_{DD} = 15V		−3	0	ns
t_{THL}, t_{TLH}	Transition Time	V_{DD} = 5V		100	200	ns
		V_{DD} = 10V		50	100	ns
		V_{DD} = 15V		40	80	ns
t_{WH}, t_{WL}	Minimum Clock Pulse Width	V_{DD} = 5V		130	250	ns
		V_{DD} = 10V		45	100	ns
		V_{DD} = 15V		40	80	ns

AC Electrical Characteristics*

$T_A = 25°C$, $C_L = 50$ pF, $R_L = 200k$ and $t_r = t_f = 20$ ns, unless otherwise specified (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{WL}	Minimum Clear Pulse Width	$V_{DD} = 5V$		120	250	ns
		$V_{DD} = 10V$		45	100	ns
		$V_{DD} = 15V$		40	80	ns
t_{RCL}	Maximum Clock Rise Time	$V_{DD} = 5V$	15			μs
		$V_{DD} = 10V$	5.0			μs
		$V_{DD} = 15V$	5.0			μs
t_{fCL}	Maximum Clock Fall Time	$V_{DD} = 5V$	15	50		μs
		$V_{DD} = 10V$	5.0	50		μs
		$V_{DD} = 15V$	5.0	50		μs
f_{CL}	Maximum Clock Frequency	$V_{DD} = 5V$	2.0	3.5		MHz
		$V_{DD} = 10V$	5.0	10		MHz
		$V_{DD} = 15V$	6.0	12		MHz
C_{IN}	Input Capacitance	Clear Input		10	15	pF
		Other Input		5.0	7.5	pF
C_{PD}	Power Dissipation	Per Package (Note 4)		130		pF

*AC Parameters are guaranteed by DC correlated testing.

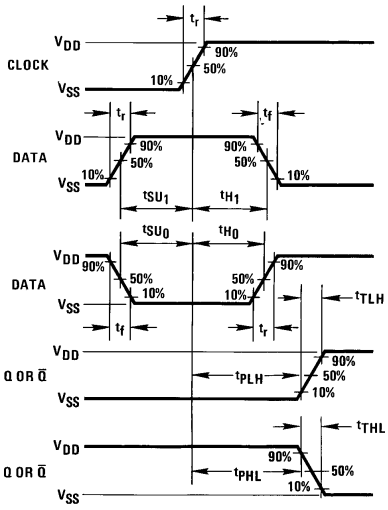
Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

Note 2: $V_{SS} = 0V$ unless otherwise specified.

Note 3: I_{OH} and I_{OL} are tested one output at a time.

Note 4: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation, see 54C/74C Family Characteristics application note, AN-90.

Switching Time Waveforms



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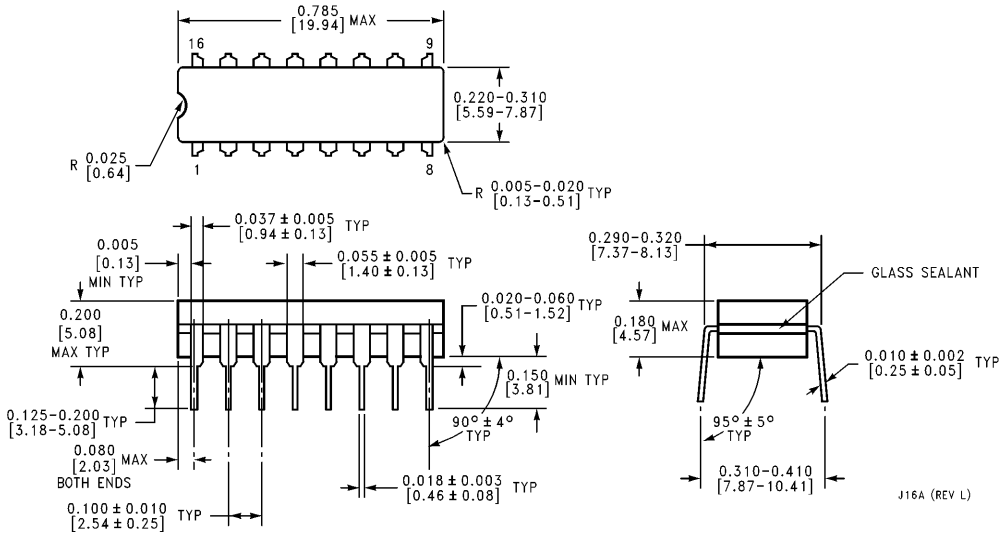
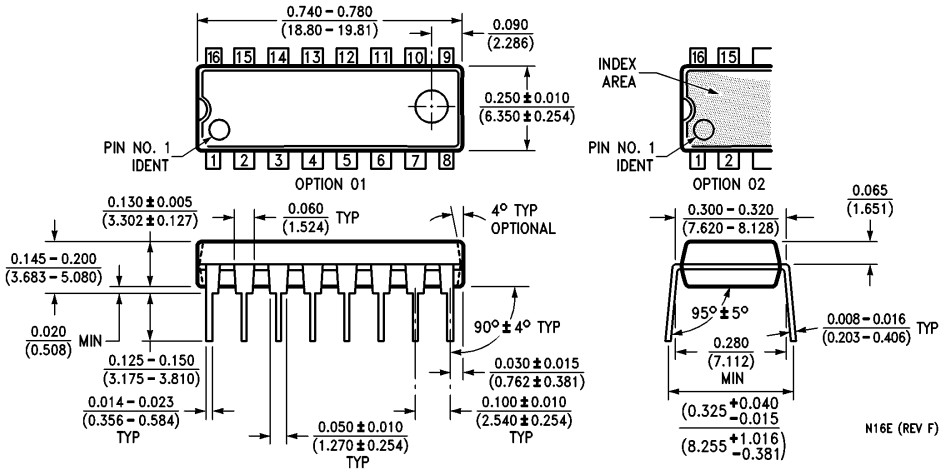
$t_r = t_f = 20$ ns

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD40174BMJ, CD40174BCJ, CD40175BMJ or CD40175BCJ
NS Package Number J16A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD40174BMN, CD40174BCN, CD40174BMN or CD40175BCN
NS Package Number N16E

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