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FAIRCHILD SEMICONDUCTOR™

October 1987
Revised January 2004

CD40193BC
Synchronous 4-Bit Up/Down Binary Counter

General Description

The CD40193BC up/down counter is monolithic complementary MOS (CMOS) integrated circuits. The CD40193BC is a binary counter.

Counting up and counting down is performed by two count inputs, one being held HIGH while the other is clocked. The outputs change on the positive-going transition of this clock.

These counters feature preset inputs that are enabled when load is a logical "0" and a clear which forces all outputs to "0" when it is at logical "1". The counters also have carry and borrow outputs so that they can be cascaded using no external circuitry.

All inputs are protected against damage due to static discharge by clamps to V_{DD} and V_{SS}.

Features

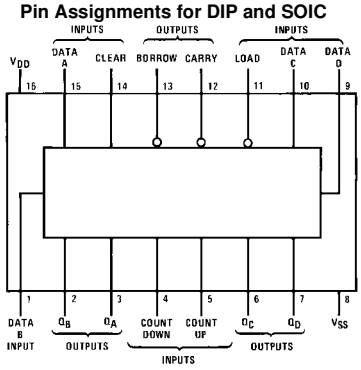
- Wide supply voltage range: 3V to 15V
- High noise immunity: 0.45 V_{DD} (typ.)
- Low power TTL compatibility: Fan out of 2 driving 74L or 1 driving 74LS
- Carry and borrow outputs for easy expansion to N-bit by cascading
- Asynchronous clear

Ordering Code:

Order Number	Package Number	Package Description
CD40193BCM	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
CD40193BCN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

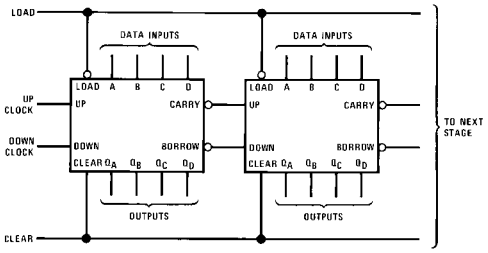
Connection Diagram

Pin Assignments for DIP and SOIC



Top View

Cascading Packages



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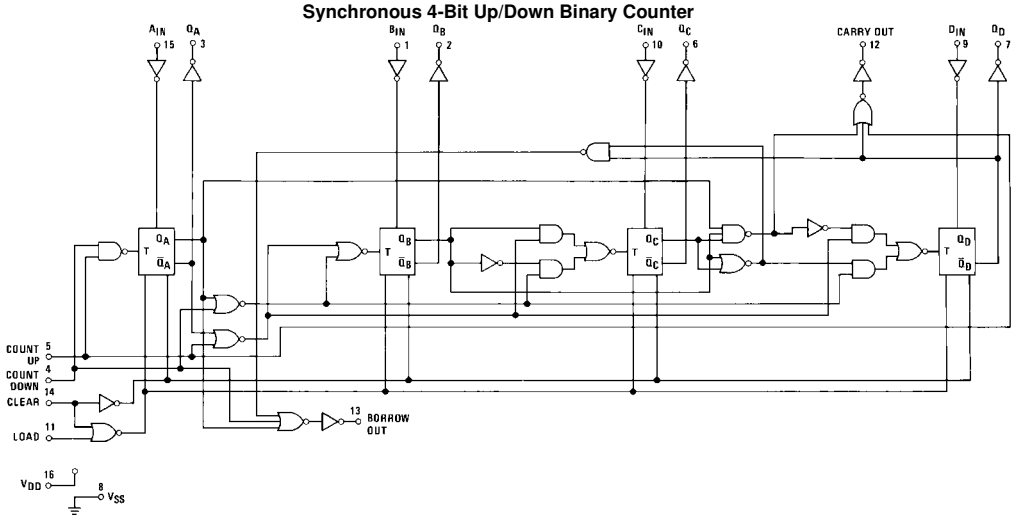
Block Diagram

Synchronous 4-Bit Up/Down Binary Counter



Absolute Maximum Ratings(Note 1)

(Note 2)

DC Supply Voltage (V_{DD})	−0.5 to +18 V_{DC}
Input Voltage (V_{IN})	−0.5 to V_{DD} +0.5 V_{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})	3 to 15 V_{DC}
Input Voltage (V_{IN})	0 to V_{DD} V_{DC}
Operating Temperature Range (T_A)	−55°C to +125°C

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 "Recommended Operating Conditions" and Electrical Characteristics tables provide conditions for actual device operation.

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

DC Electrical Characteristics (Note 3)

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}		5			5		150	µA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		10			10		300	
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		20			20		600	
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_{DD} = 15V		0.05			0.05		0.05	
V_{OH}	HIGH Level Output Voltage	V_{DD} = 5V	4.95		4.95			4.95		V
		V_{DD} = 10V	9.95		9.95			9.95		
		V_{DD} = 15V	14.95		14.95			14.95		
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_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	
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_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		
I_{OL}	LOW Level Output Current (Note 4)	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		
		V_{DD} = 15V, V_O = 1.5V	4.2		3.4	8.8		2.4		
I_{OH}	HIGH Level Output Current (Note 4)	V_{DD} = 5V, V_O = 4.6V	−0.64		−0.51	−0.88		−0.36		mA
		V_{DD} = 10V, V_O = 9.5V	−1.6		−1.3	−2.25		−0.9		
		V_{DD} = 15V, V_O = 13.5V	−4.2		−3.4	−8.8		−2.4		
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	

Note 3: AC Parameters are guaranteed by DC correlated testing.

Note 4: I_{OH} and I_{OL} are tested one output at a time.

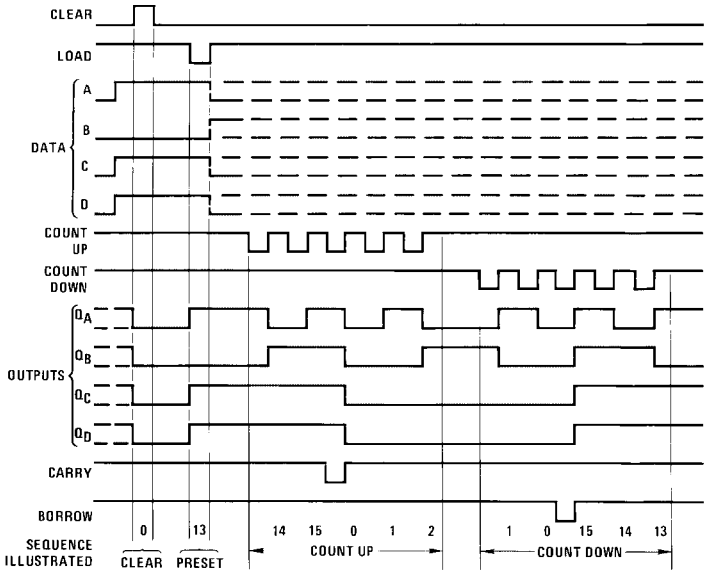
AC Electrical Characteristics (Note 3)

$T_A = 25°C$, $C_L = 50$ pF, $R_L = 200$ kΩ, input $t_r = t_f = 20$ ns, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL} or t_{PLH}	Propagation Delay Time	$V_{DD} = 5V$		250	400	
	from Count Up or	$V_{DD} = 10V$		100	160	ns
	Count Down to Q	$V_{DD} = 15V$		80	130	
t_{PHL} or t_{PLH}	Propagation Delay Time	$V_{DD} = 5V$		120	200	
	from Count Up to Carry	$V_{DD} = 10V$		50	80	ns
		$V_{DD} = 15V$		40	65	
t_{PHL} or t_{PLH}	Propagation Delay Time	$V_{DD} = 5V$		120	200	
	from Count Down	$V_{DD} = 10V$		50	80	ns
	to Borrow	$V_{DD} = 15V$		40	65	
t_{SU}	Time Prior to Load	$V_{DD} = 5V$		100	160	
	That Data Must	$V_{DD} = 10V$		30	50	ns
	Be Present	$V_{DD} = 15V$		25	40	
t_{PHL}	Propagation Delay Time	$V_{DD} = 5V$		130	220	
	from Clear to Q	$V_{DD} = 10V$		60	100	ns
		$V_{DD} = 15V$		50	80	
t_{PLH} or t_{PHL}	Propagation Delay Time	$V_{DD} = 5V$		300	480	
	from Load to Q	$V_{DD} = 10V$		120	190	ns
		$V_{DD} = 15V$		95	150	
t_{TLH} or t_{THL}	Output Transition Time	$V_{DD} = 5V$		100	200	
		$V_{DD} = 10V$		50	100	ns
		$V_{DD} = 15V$		40	80	
f_{CL}	Maximum Count Frequency	$V_{DD} = 5V$	2.5	4		
		$V_{DD} = 10V$	6	10		MHz
		$V_{DD} = 15V$	7.5	12.5		
t_{rCL} or t_{fCL}	Maximum Count Rise	$V_{DD} = 5V$	15			
	or Fall Time	$V_{DD} = 10V$	5			μs
		$V_{DD} = 15V$	1			
t_{WH}, t_{WL}	Minimum Count Pulse	$V_{DD} = 5V$		120	200	
	Width	$V_{DD} = 10V$		35	80	ns
		$V_{DD} = 15V$		28	65	
t_{WH}	Minimum Clear	$V_{DD} = 5V$		300	480	
	Pulse Width	$V_{DD} = 10V$		120	190	ns
		$V_{DD} = 15V$		95	150	
t_{WL}	Minimum Load	$V_{DD} = 5V$		100	160	
	Pulse Width	$V_{DD} = 10V$		40	65	ns
		$V_{DD} = 15V$		32	55	
C_{IN}	Average Input Capacitance	Load and Data		5	7.5	
		Inputs (A,B,C,D)				pF
		Count Up, Count		10	15	
		Down and Clear				
C_{PD}	Power Dissipation Capacity	(Note 5)		100		pF

Note 5: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation, see Family Characteristics application note, AN-90.

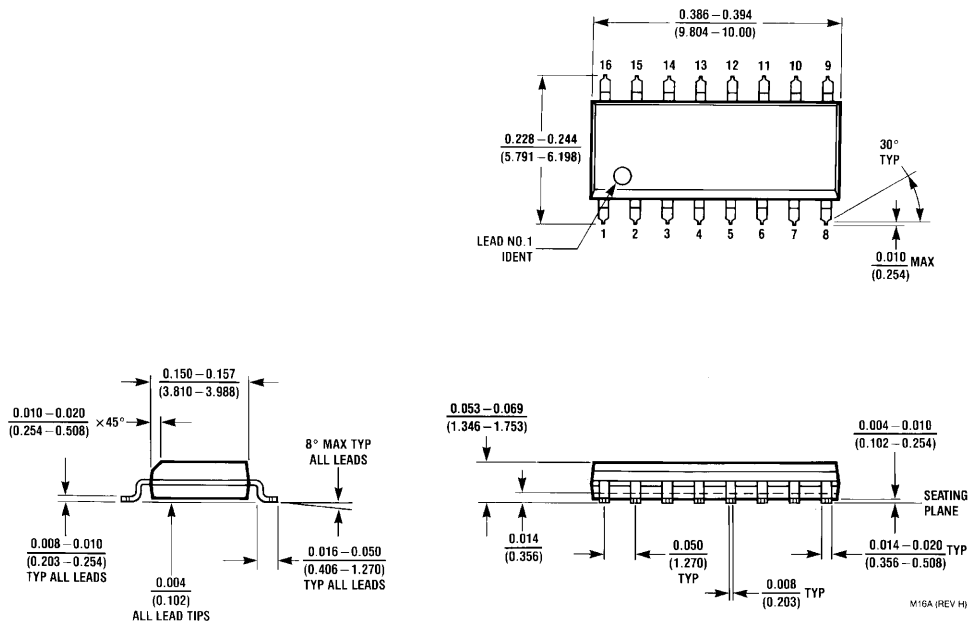
Timing Diagrams



Sequence:

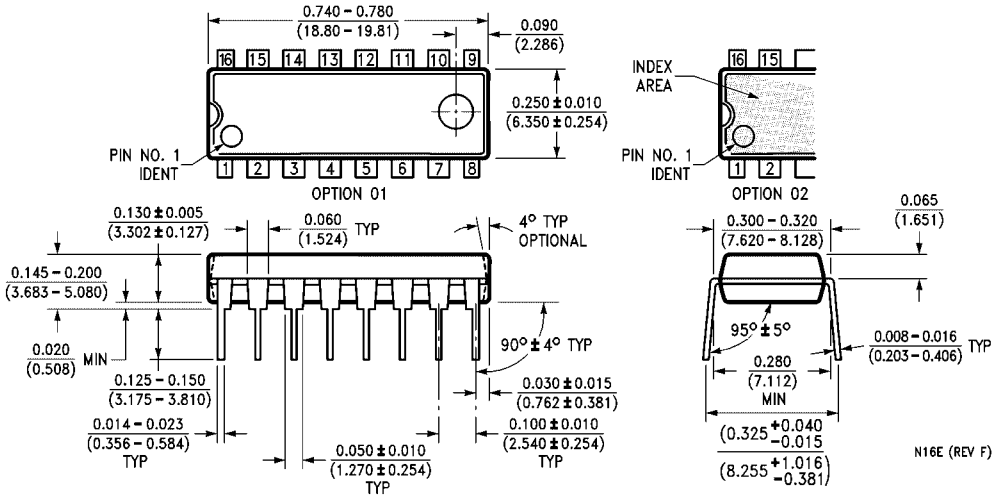
1. Clear outputs to zero.
2. Load (preset) to binary thirteen.
3. Count up to fourteen, fifteen, carry, zero, one and two.
4. Count down to one, zero, borrow, fifteen, fourteen and thirteen.

Physical Dimensions inches (millimeters) unless otherwise noted



16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
Package Number M16A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N16E

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