

## CD40192BC • CD40193BC

### Synchronous 4-Bit Up/Down Decade Counter • Synchronous 4-Bit Up/Down Binary Counter

#### General Description

The CD40192BC and CD40193BC up/down counters are monolithic complementary MOS (CMOS) integrated circuits. The CD40192BC is a BCD counter, while 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

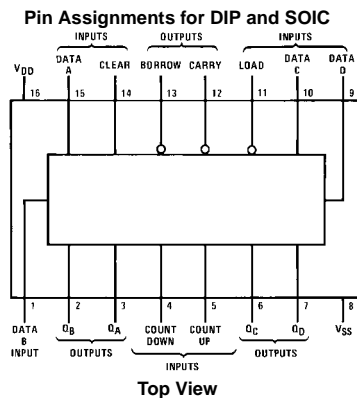
- Wide supply voltage range: 3V to 15V
- High noise immunity:  $0.45 V_{DD}$  (typ.)
- Low power TTL compatibility: Fan out of 2 driving 74L or 1 driving 74LS
- Carry and borrow outputs for easy expansion to N-bit by cascading
- Asynchronous clear
- Equivalent to: MM74C192 and MM74C193

#### Ordering Code:

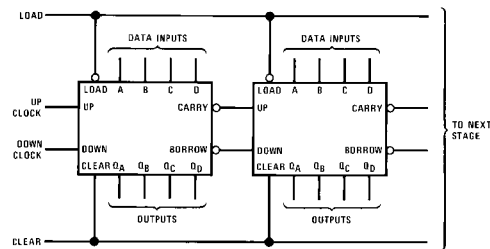
Order Number	Package Number	Package Description
CD40192BCN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
CD40193BCN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
CD40193BCM	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body

Devices also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

#### Connection Diagram

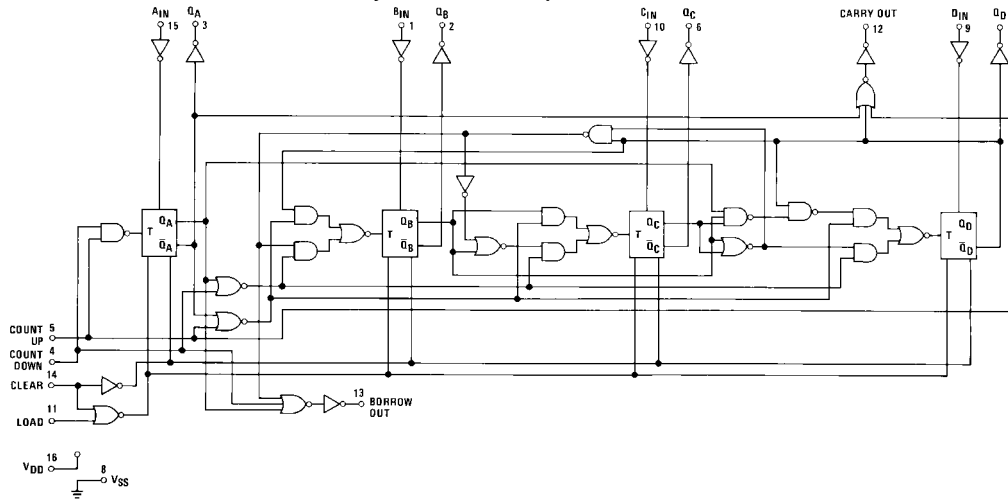


#### Cascading Packages

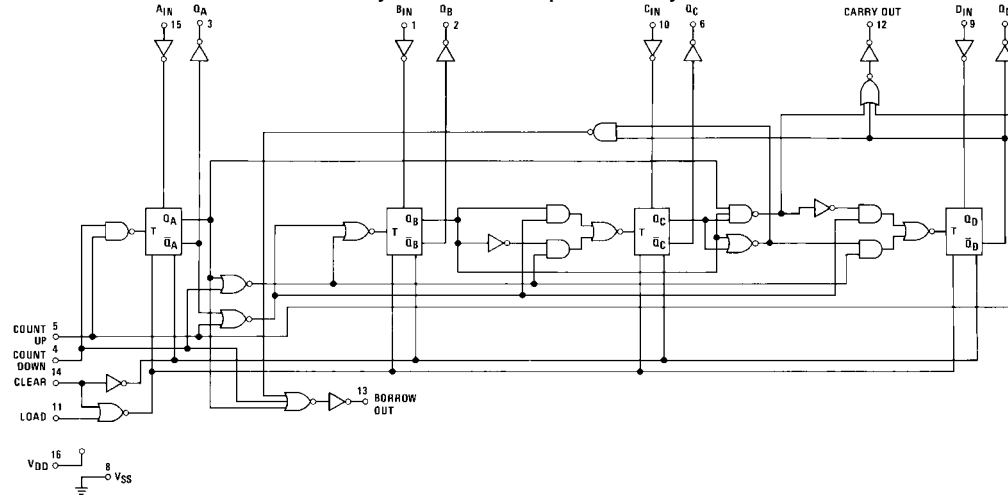


Block Diagrams

CD40192BC Synchronous 4-Bit Up/Down Decade Counter



CD40193BC Synchronous 4-Bit Up/Down Binary Counter



<b>Absolute Maximum Ratings</b> (Note 1)		<b>Recommended Operating Conditions</b> (Note 2)	
(Note 2)			
DC Supply Voltage ( $V_{DD}$ )	-0.5 to +18 $V_{DC}$	DC Supply Voltage ( $V_{DD}$ )	3 to 15 $V_{DC}$
Input Voltage ( $V_{IN}$ )	-0.5 to $V_{DD}$ +0.5 $V_{DC}$	Input Voltage ( $V_{IN}$ )	0 to $V_{DD}$ $V_{DC}$
Storage Temperature Range ( $T_S$ )	-65°C to +150°C	Operating Temperature Range ( $T_A$ )	-40°C to +85°C
Power Dissipation ( $P_D$ )		CD40192BC, CD40193BC	
Dual-In-Line	700 mW	<b>Note 1:</b> "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.	
Small Outline	500 mW	<b>Note 2:</b> $V_{SS} = 0V$ unless otherwise specified.	
Lead Temperature ( $T_L$ )			
(Soldering, 10 seconds)	260°C		

**DC Electrical Characteristics** (Note 3)

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 $V_{SS}$		20			20		150	$\mu A$
		$V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$		40			40		300	$\mu A$
		$V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$		80			80		600	$\mu A$
$V_{OL}$	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			4.95		V
		$V_{DD} = 10V$	9.95		9.95			9.95		V
		$V_{DD} = 15V$	14.95		14.95			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 4)	$V_{DD} = 5V, V_O = 0.4V$	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 4)	$V_{DD} = 5V, V_O = 4.6V$	-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	$V_{DD} = 15V, V_{IN} = 0V$		-0.3		$-10^{-5}$	-0.3		-1.0	$\mu A$
		$V_{DD} = 15V, V_{IN} = 15V$		0.3		$10^{-5}$	0.3		1.0	$\mu A$

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

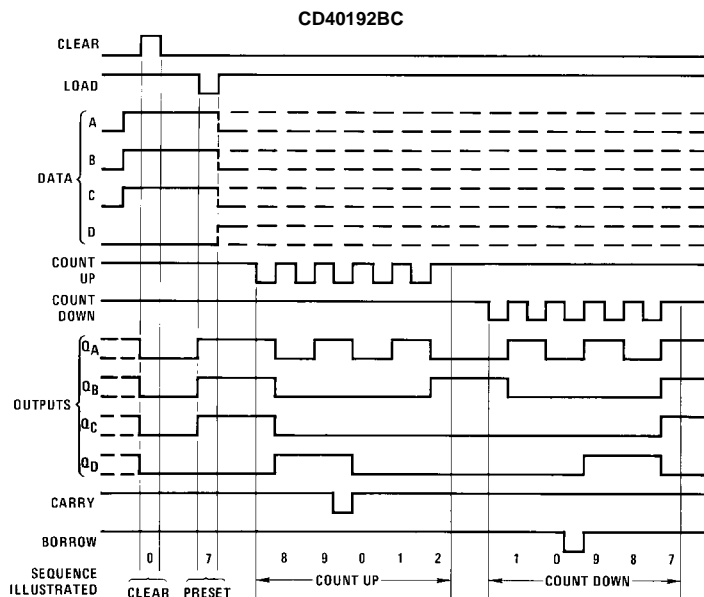
**Note 4:**  $I_{OH}$  and  $I_{OL}$  are tested one output at a time.

**AC Electrical Characteristics** (Note 3)T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200 kΩ, input t<sub>r</sub> = t<sub>f</sub> = 20 ns, unless otherwise specified.

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

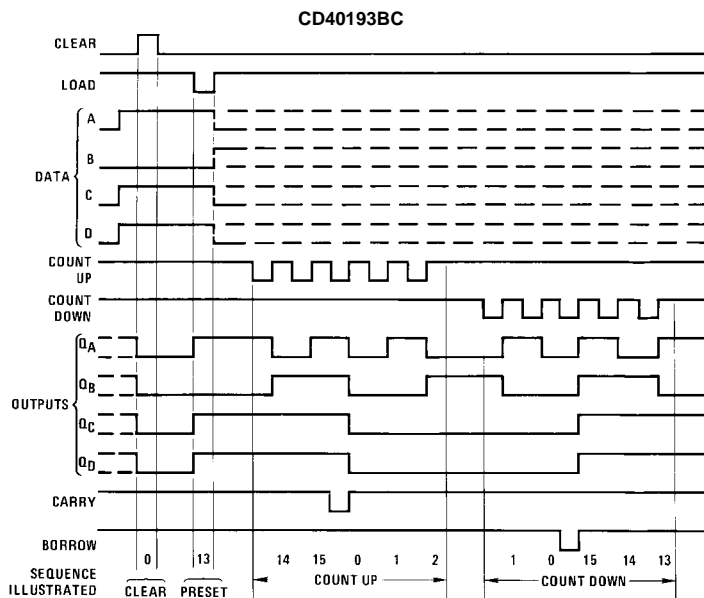
**Note 5:** C<sub>PD</sub> determines the no load AC power consumption of any CMOS device. For complete explanation, see Family Characteristics application note, AN-90.

## Timing Diagrams



Sequence:

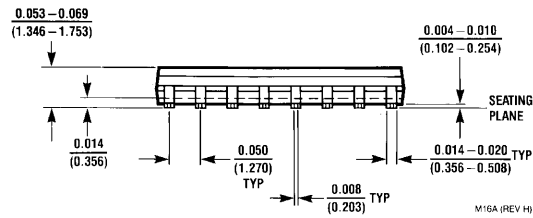
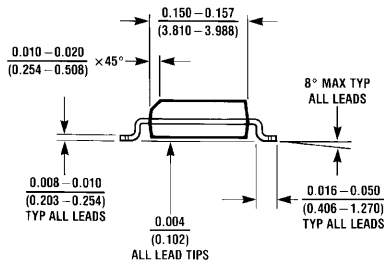
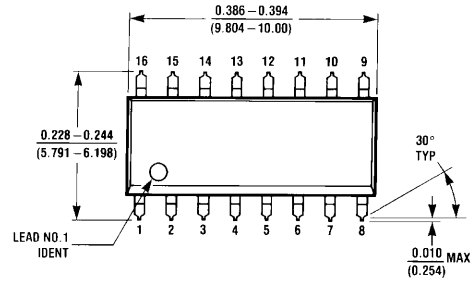
1. Clear outputs to zero.
2. Load (preset) to BCD seven.
3. Count up to eight, nine, carry, zero, one and two.
4. Count down to one, zero, borrow, nine, eight and seven.



Sequence:

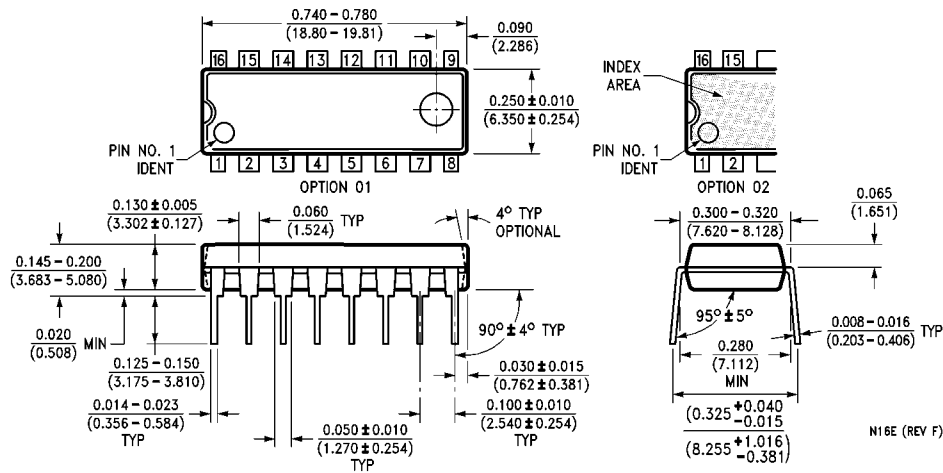
1. Clear outputs to zero.
2. Load (preset) to binary thirteen.
3. Count up to fourteen, fifteen, carry, zero, one and two.
4. Count down to one, zero, borrow, fifteen, fourteen and thirteen.

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



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body  
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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