National Semiconductor

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CD40192BM/CD40192BC Synchronous 4-Bit Up/Down Decade Counter CD40193BM/CD40193BC Synchronous 4-Bit Up/Down Binary Counter

General Description

These up/down counters are monolithic complementary MOS (CMOS) integrated circuits. The CD40192BM and CD40192BC are BCD counters, while the CD40193BM and CD40193BC are binary counters.

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.

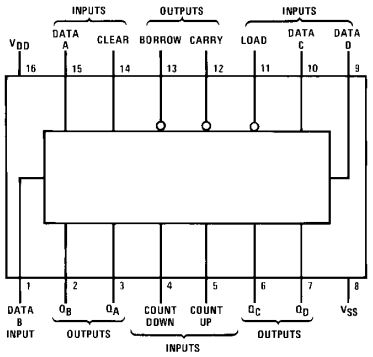
All inputs are protected against damage due to static discharge by clamps to V_{DD} and V_{SS}.

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 — MM54C192/MM74C192 and MM54C193/MM74C193

Connection Diagram

Dual-In-Line Package



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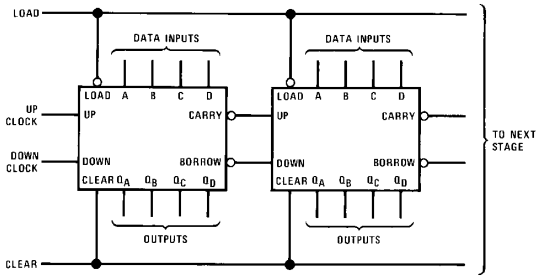
Top View

Order Number CD40192B or CD40193

Cascading Packages



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  RRD-B30M105/Printed in U. S. A.

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})	-0.5 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)	
CD40192BM, CD40193BM	$-55°C$ to $+125°C$
CD40192BC, CD40193BC	$-40°C$ to $+85°C$

DC Electrical Characteristics CD40192BM/CD40193BM (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}		5			5		150	μA
		$V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS}		10			10		300	μA
		$V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS}		20			20		600	μA
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 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	-0.88		-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 CD40192BC/CD40193BC (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}		20			20		150	μA
		$V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS}		40			40		300	μA
		$V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS}		80			80		600	μA
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 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

DC Electrical Characteristics CD40192BC/CD40193BC (Note 2) (Continued)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
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		−0.3		-10^{-5}	−0.3		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.3		10^{-5}	0.3		1.0	μA

AC Electrical Characteristics*

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 from Count Up or Count Down to Q	V_{DD} = 5V		250	400	ns
		V_{DD} = 10V		100	160	ns
		V_{DD} = 15V		80	130	ns
t_{PHL} or t_{PLH}	Propagation Delay Time from Count Up to Carry	V_{DD} = 5V		120	200	ns
		V_{DD} = 10V		50	80	ns
		V_{DD} = 15V		40	65	ns
t_{PHL} or t_{PLH}	Propagation Delay Time from Count Down to Borrow	V_{DD} = 5V		120	200	ns
		V_{DD} = 10V		50	80	ns
		V_{DD} = 15V		40	65	ns
t_{SU}	Time Prior to Load That Data Must Be Present	V_{DD} = 5V		100	160	ns
		V_{DD} = 10V		30	50	ns
		V_{DD} = 15V		25	40	ns
t_{PHL}	Propagation Delay Time from Clear to Q	V_{DD} = 5V		130	220	ns
		V_{DD} = 10V		60	100	ns
		V_{DD} = 15V		50	80	ns
t_{PLH} or t_{PHL}	Propagation Delay Time from Load to Q	V_{DD} = 5V		300	480	ns
		V_{DD} = 10V		120	190	ns
		V_{DD} = 15V		95	150	ns
t_{TLH} or t_{THL}	Output Transition Time	V_{DD} = 5V		100	200	ns
		V_{DD} = 10V		50	100	ns
		V_{DD} = 15V		40	80	ns
f_{CL}	Maximum Count Frequency	V_{DD} = 5V	2.5	4		MHz
		V_{DD} = 10V	6	10		MHz
		V_{DD} = 15V	7.5	12.5		MHz
t_{rCL} or t_{fCL}	Maximum Count Rise or Fall Time	V_{DD} = 5V	15			μs
		V_{DD} = 10V	5			μs
		V_{DD} = 15V	1			μs
t_{WH}, t_{WL}	Minimum Count Pulse Width	V_{DD} = 5V		120	200	ns
		V_{DD} = 10V		35	80	ns
		V_{DD} = 15V		28	65	ns
t_{WH}	Minimum Clear Pulse Width	V_{DD} = 5V		300	480	ns
		V_{DD} = 10V		120	190	ns
		V_{DD} = 15V		95	150	ns
t_{WL}	Minimum Load Pulse Width	V_{DD} = 5V		100	160	ns
		V_{DD} = 10V		40	65	ns
		V_{DD} = 15V		32	55	ns
C_{IN}	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_{PD}	Power Dissipation Capacity	(Note 4)		100		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 table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

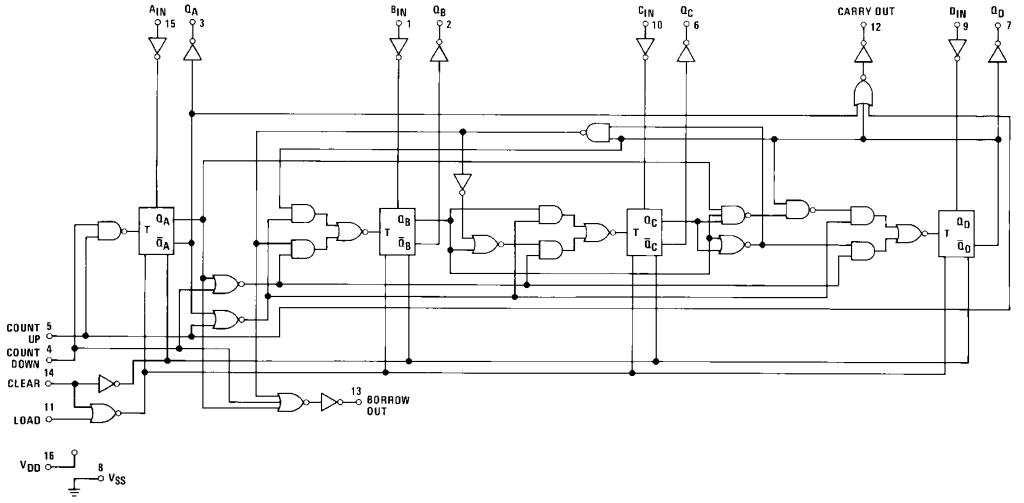
Note 2: V_{SS} = 0V unless otherwise specified.

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.

Schematic Diagrams

CD40192BM/CD40192BC Synchronous 4-Bit Up/Down Decade Counter



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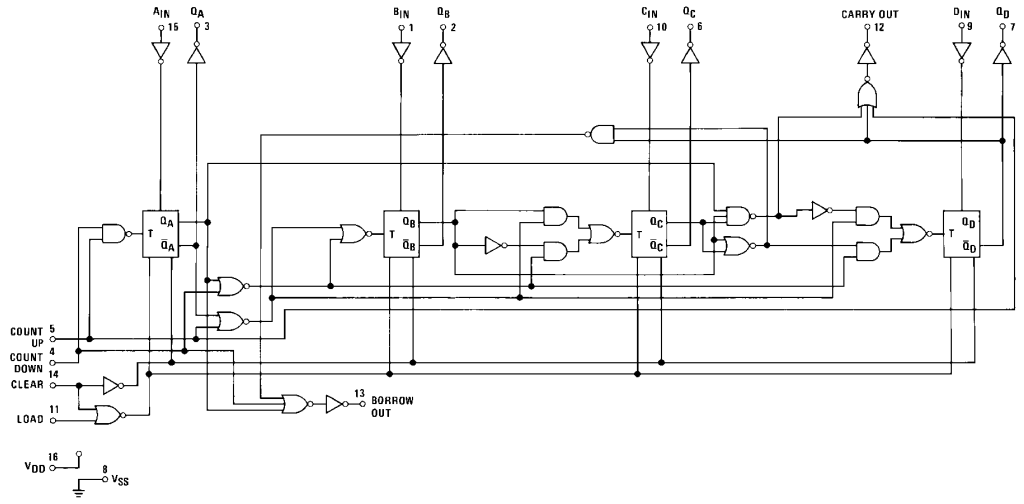
CD40193BM/CD40193BC Synchronous 4-Bit Up/Down Binary Counter



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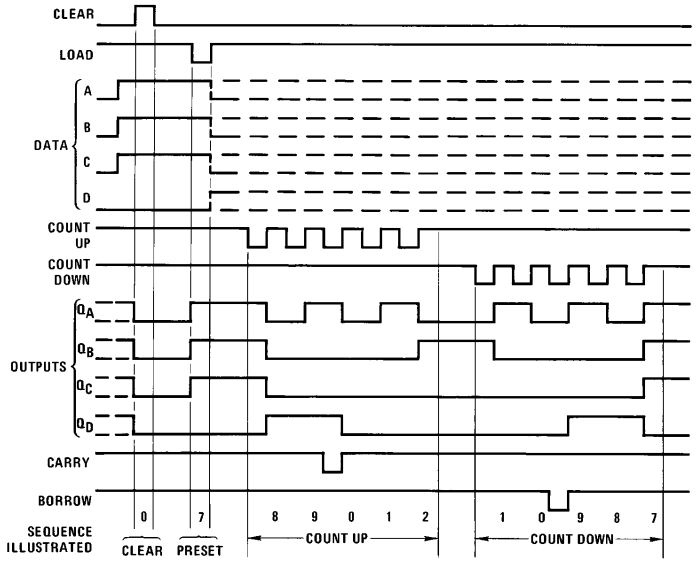
Timing Diagrams

CD40192BM/CD40192BC



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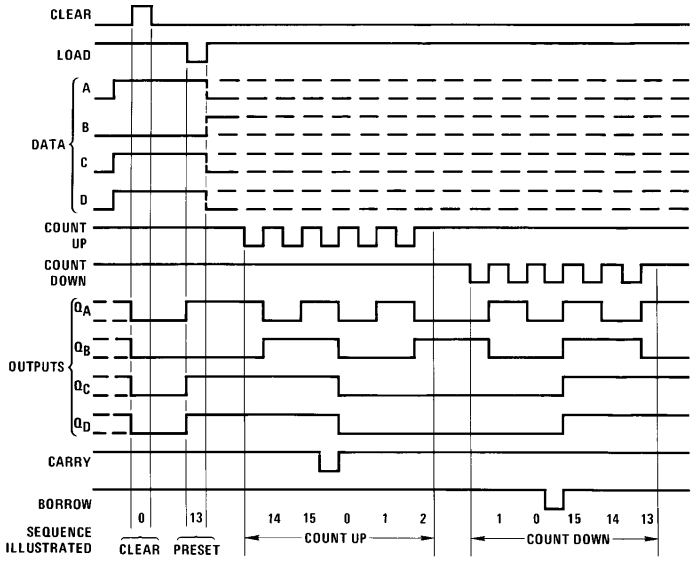
Sequence:

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.

CD40193BM/CD40193BC



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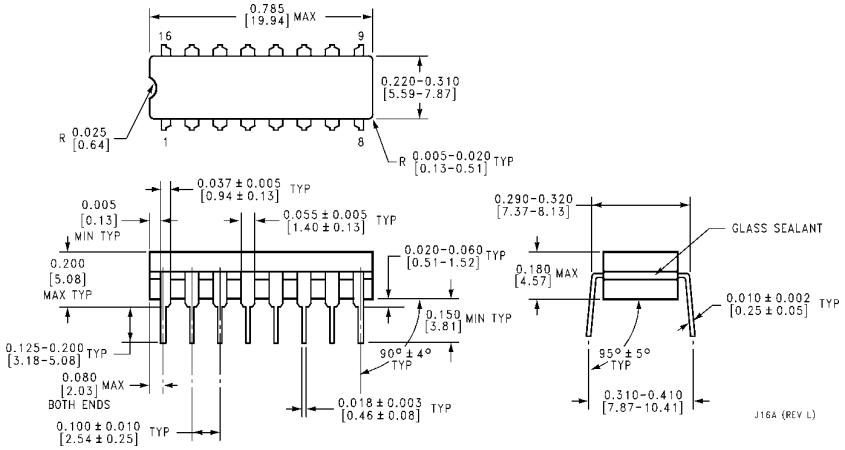
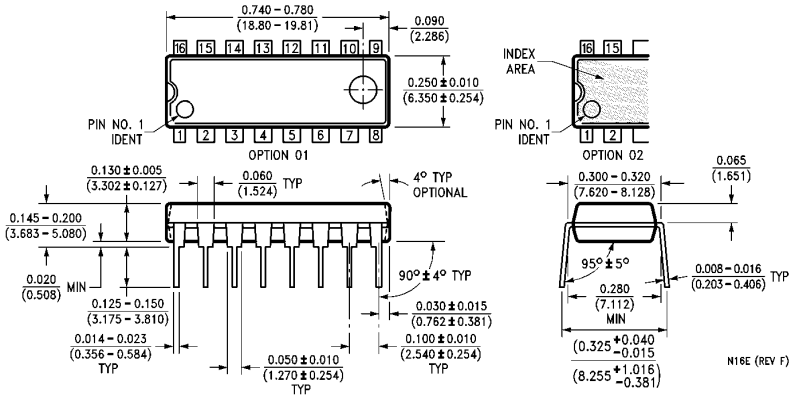
Sequence:

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)



Ceramic Dual-In-Line Package (J)
Order Number CD40192BMJ, CD40192BCJ, CD40193BMJ or CD40193BCJ
NS Package Number J16A



Molded Dual-In-Line Package (N)
Order Number CD40192BMN, CD40192BCN, CD40193BMN or CD40193BCN
NS Package Number N16E

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