

**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.

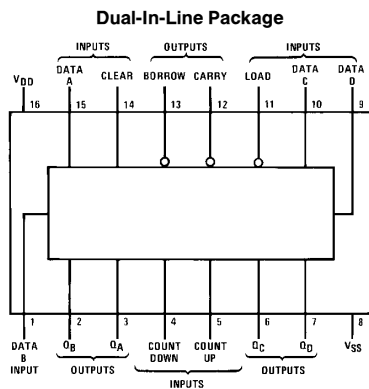
These counters feature preset inputs that are enabled when load is a logical “0” and a clear which forces all outputs to “0” when it is at logical “1”. The counters also have carry and borrow outputs so that they can be cascaded using no external circuitry.

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<sub>DD</sub> (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

## Connection Diagram

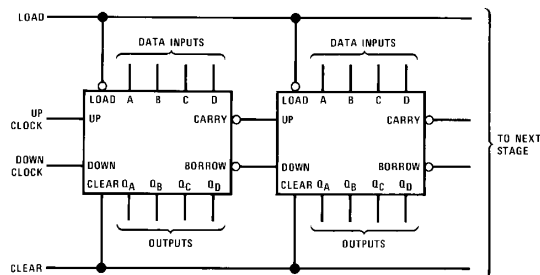


### Top View

**Order Number CD40192B or CD40193**

TL/F/5988-1

## Cascading Packages



TL/F/5988-2

**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 $V_{SS}$ $V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$ $V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$		5 10 20			5 10 20		150 300 600	$\mu A$ $\mu A$ $\mu A$
$V_{OL}$	Low Level Output Voltage	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
$V_{OH}$	High Level Output Voltage	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	4.95 9.95 14.95		4.95 9.95 14.95			4.95 9.95 14.95		V V V
$V_{IL}$	Low Level Input Voltage	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V $V_{DD} = 10V, V_O = 1V$ or 9V $V_{DD} = 15V, V_O = 1.5V$ or 13.5V		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V
$V_{IH}$	High Level Input Voltage	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V $V_{DD} = 10V, V_O = 1V$ or 9V $V_{DD} = 15V, V_O = 1.5V$ or 13.5V	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
$I_{OL}$	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 0.4V$ $V_{DD} = 10V, V_O = 0.5V$ $V_{DD} = 15V, V_O = 1.5V$	0.64 1.6 4.2		0.51 1.3 3.4	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
$I_{OH}$	High Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 4.6V$ $V_{DD} = 10V, V_O = 9.5V$ $V_{DD} = 15V, V_O = 13.5V$	−0.64 −1.6 −4.2		−0.51 −1.3 −3.4	−0.88 −2.25 −8.8		−0.36 −0.9 −2.4		mA mA mA
$I_{IN}$	Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		−0.1 0.1		−10 <sup>−5</sup> 10 <sup>−5</sup>	−0.1 0.1		−1.0 1.0	$\mu A$ $\mu A$

**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 $V_{SS}$ $V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$ $V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$		20 40 80			20 40 80		150 300 600	$\mu A$ $\mu A$ $\mu A$
$V_{OL}$	Low Level Output Voltage	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
$V_{OH}$	High Level Output Voltage	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	4.95 9.95 14.95		4.95 9.95 14.95			4.95 9.95 14.95		V V V
$V_{IL}$	Low Level Input Voltage	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V $V_{DD} = 10V, V_O = 1V$ or 9V $V_{DD} = 15V, V_O = 1.5V$ or 13.5V		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V
$V_{IH}$	High Level Input Voltage	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V $V_{DD} = 10V, V_O = 1V$ or 9V $V_{DD} = 15V, V_O = 1.5V$ or 13.5V	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
$I_{OL}$	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 0.4V$ $V_{DD} = 10V, V_O = 0.5V$ $V_{DD} = 15V, V_O = 1.5V$	0.52 1.3 3.6		0.44 1.1 3.0	0.88 2.25 8.8		0.36 0.9 2.4		mA mA 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)	$V_{DD} = 5V, V_O = 4.6V$ $V_{DD} = 10V, V_O = 9.5V$ $V_{DD} = 15V, V_O = 13.5V$	−0.52 −1.3 −3.6		−0.44 −1.1 −3.0	−0.88 −2.25 −8.8		−0.36 −0.9 −2.4		mA mA mA
$I_{IN}$	Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		−0.3 0.3		$-10^{-5}$ $10^{-5}$	−0.3 0.3		−1.0 1.0	$\mu A$ $\mu A$

## AC Electrical Characteristics\*

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

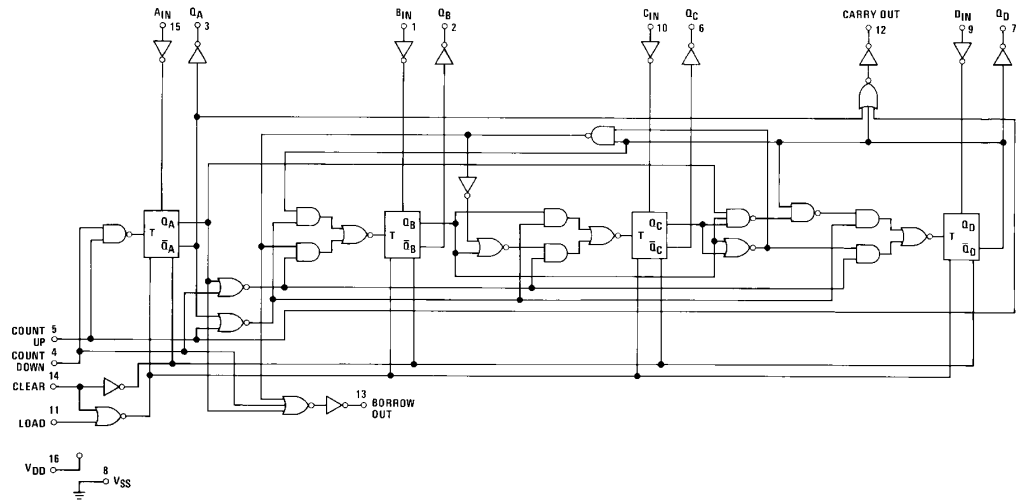
**Note 2:**  $V_{SS} = 0V$  unless otherwise specified.

**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.

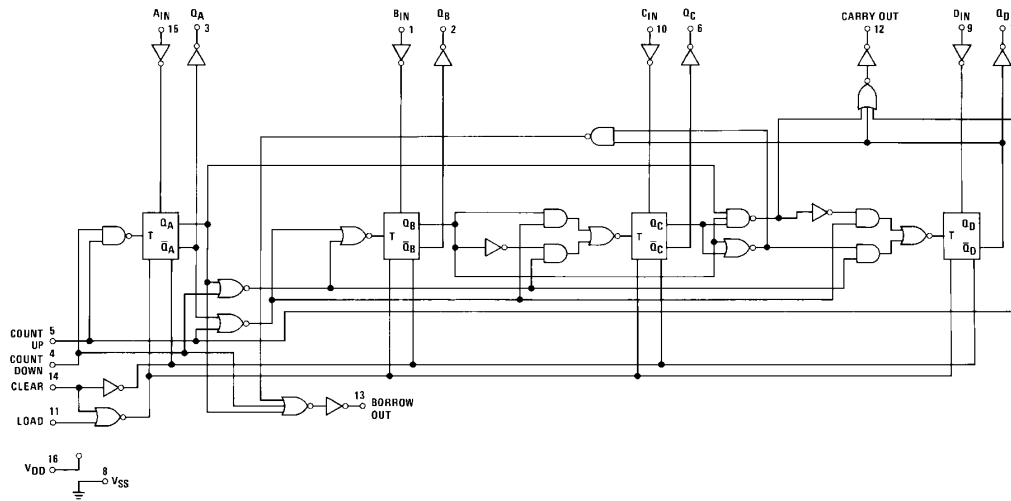
## Schematic Diagrams

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



TL/F/5988-3

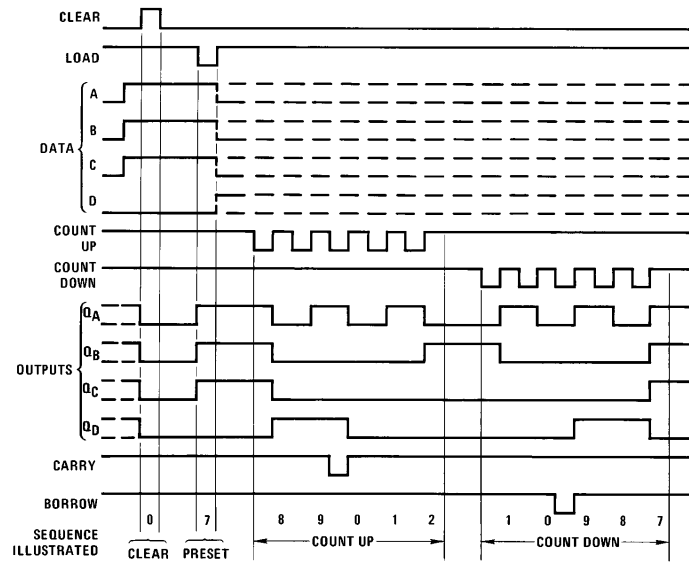
CD40193BM/CD40193BC Synchronous 4-Bit Up/Down Binary Counter



TL/F/5988-4

## Timing Diagrams

CD40192BM/CD40192BC

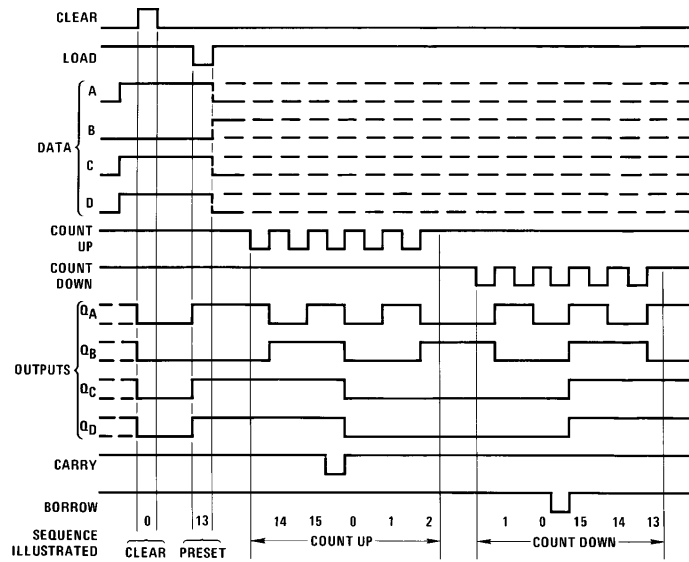


TL/F/5988-5

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

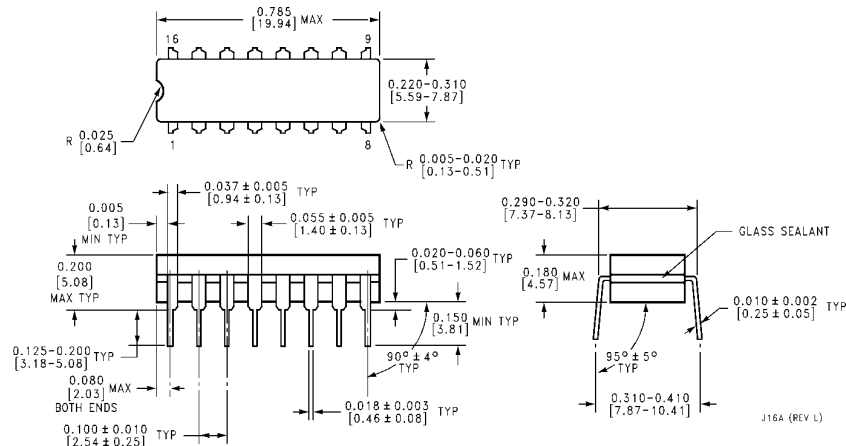


TL/F/5988-6

Sequence:

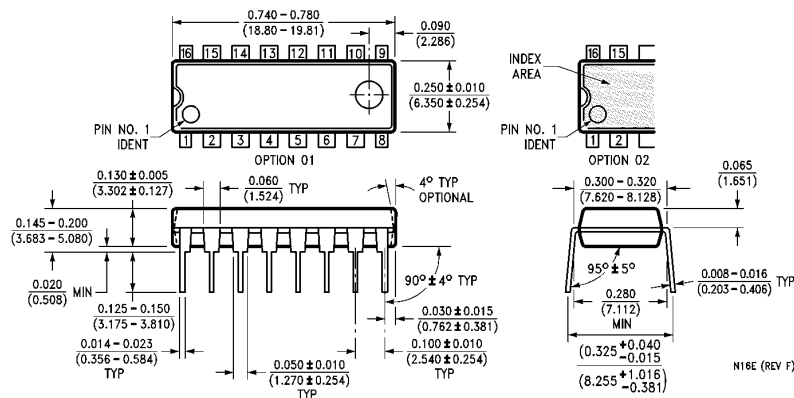
1. Clear outputs to zero.
2. Load (preset) to binary thirteen.
3. Count up to fourteen, fifteen, carry, zero, one and two.
4. Count down to one, zero, borrow, fifteen, fourteen and thirteen.

## 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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