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## General Description

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

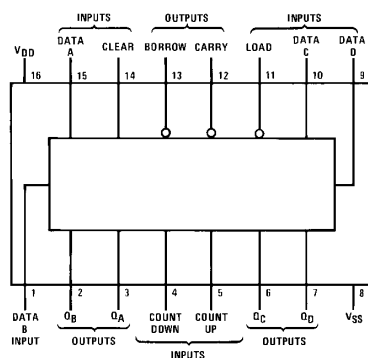
## Features

- 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 74LS or 1 driving 74LS
- Carry and borrow outputs for easy expansion to N-bit by cascading
- Asynchronous clear
- Equivalent to MM54C192/MM74C192

MM54C192/MM74C192  
and MM54C193/MM74C193

### Connection Diagram

### Dual-In-Line Package

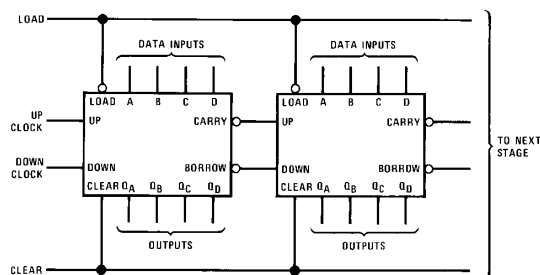


**Order Number CD40192B or CD40193**

TL/F/5988-1

### Top View

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

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

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

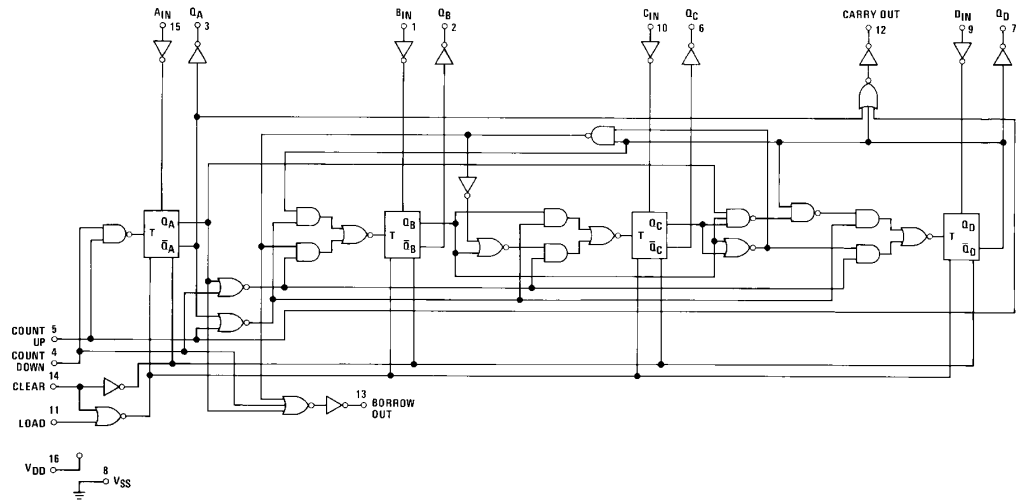
**Note 2:**  $V_{SS} = 0V$  unless otherwise specified.

**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.

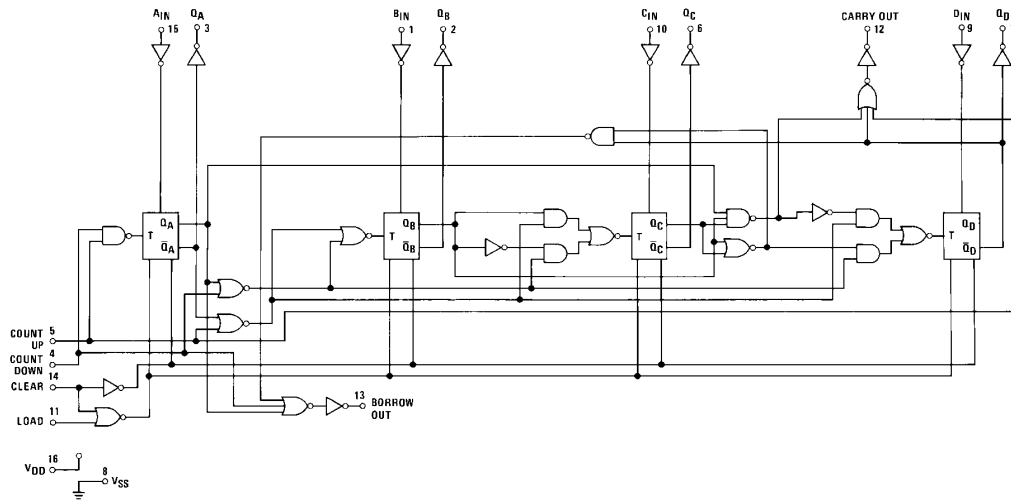
## Schematic Diagrams

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



TL/F/5988-3

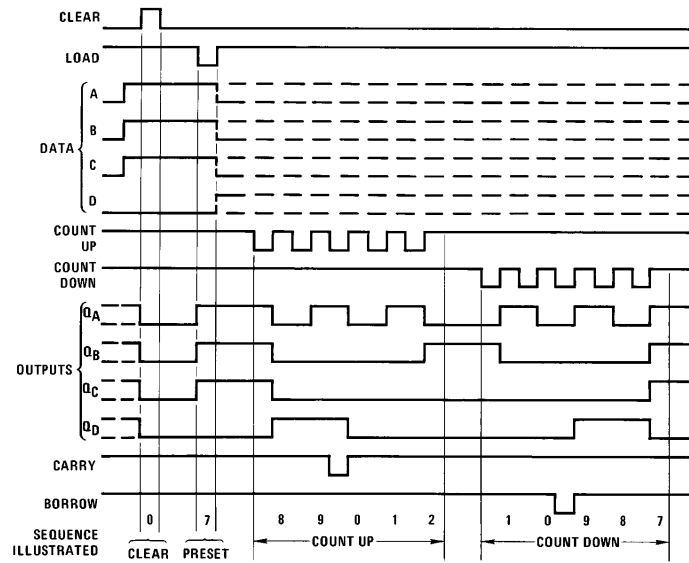
CD40193BM/CD40193BC Synchronous 4-Bit Up/Down Binary Counter



TL/F/5988-4

## Timing Diagrams

CD40192BM/CD40192BC

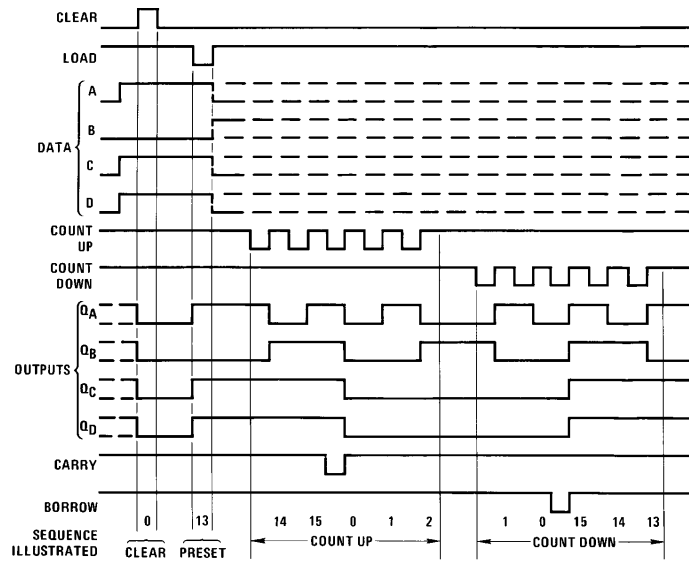


TL/F/5988-5

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

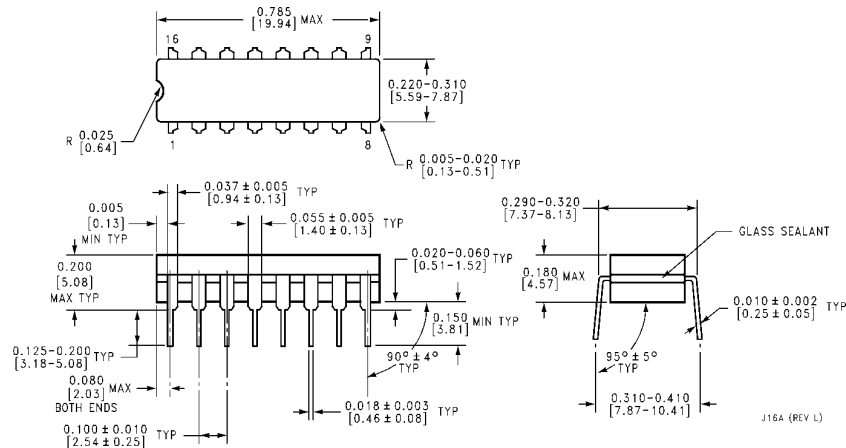


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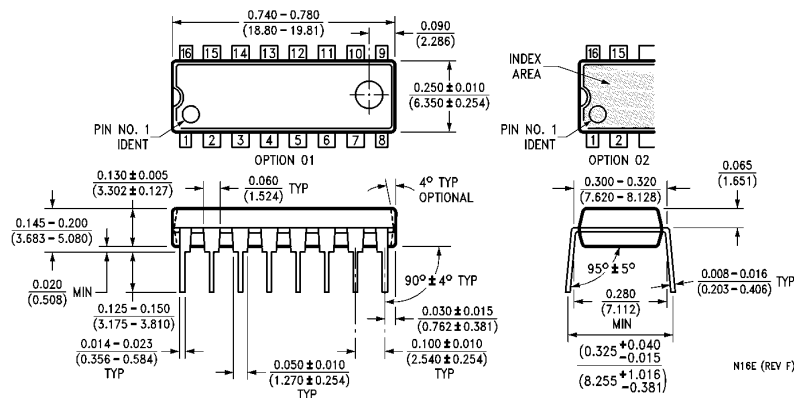
Sequence:

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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**National Semiconductor Corporation**  
1111 West Bardin Road  
Arlington, TX 76017  
Tel: 1(800) 272-9959  
Fax: 1(800) 737-7018

**National Semiconductor Europe**  
Fax: (+49) 0-180-530 85 86  
Email: cnjwge@tevm2.nsc.com  
Deutsch Tel: (+49) 0-180-530 85 85  
English Tel: (+49) 0-180-532 78 32  
Français Tel: (+49) 0-180-532 93 58  
Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
13th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
Tel: 81-043-299-2309  
Fax: 81-043-299-2408