

## MM74C192 • MM74C193

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

#### General Description

The MM74C192 and MM74C193 up/down counters are monolithic complementary MOS (CMOS) integrated circuits. The MM74C192 is a BCD counter, while the MM74C193 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 set when load is a logical "0" and a clear which forces all outputs to "0" when it is at a logical "1". The counters also have carry and borrow outputs so that they can be cascaded using no external circuitry.

#### Features

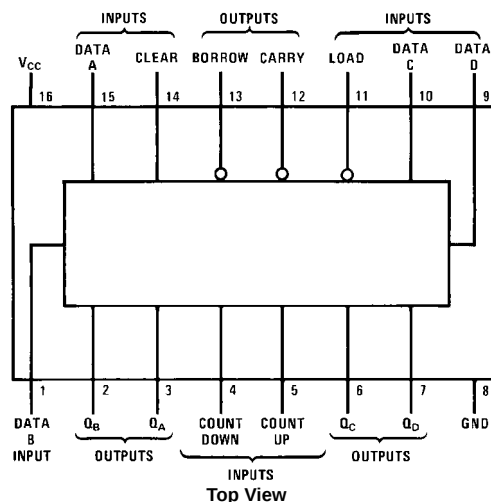
- High noise margin: 1V guaranteed
- Tenth power TTL compatible: Drive 2 LPTTL loads
- Wide supply range: 3V to 15V
- Carry and borrow outputs for N-bit cascading
- Asynchronous clear
- High noise immunity: 0.45  $V_{CC}$  (typ.)

#### Ordering Code:

| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| MM74C192N    | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |
| MM74C193M    | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| MM74C193N    | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

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

#### Connection Diagram



**Absolute Maximum Ratings**(Note 1)

|                                       |                          |
|---------------------------------------|--------------------------|
| Voltage at Any Pin                    | -0.3V to $V_{CC} + 0.3V$ |
| Operating Temperature Range ( $T_A$ ) | -40°C to +85°C           |
| Storage Temperature Range ( $T_S$ )   | -65°C to +150°C          |
| Maximum $V_{CC}$ Voltage              | 18V                      |
| Power Dissipation ( $P_D$ )           |                          |
| Dual-In-Line                          | 700 mW                   |
| Small Outline                         | 500 mW                   |
| Operating $V_{CC}$ Range              | 3V to 15V                |
| Lead Temperature ( $T_A$ )            |                          |
| (Soldering, 10 seconds)               | 260°C                    |

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The Electrical Characteristics table provides conditions for actual device operation.

**DC Electrical Characteristics**

Min/Max limits apply across temperature range unless otherwise noted

| Symbol                                                                              | Parameter                  | Conditions                                                              | Min            | Typ    | Max        | Units   |
|-------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------|----------------|--------|------------|---------|
| <b>CMOS TO CMOS</b>                                                                 |                            |                                                                         |                |        |            |         |
| $V_{IN(1)}$                                                                         | Logical "1" Input Voltage  | $V_{CC} = 5V$<br>$V_{CC} = 10V$                                         | 3.5<br>8.0     |        |            | V<br>V  |
| $V_{IN(0)}$                                                                         | Logical "0" Input Voltage  | $V_{CC} = 5V$<br>$V_{CC} = 10V$                                         |                |        | 1.5<br>2.0 | V<br>V  |
| $V_{OUT(1)}$                                                                        | Logical "1" Output Voltage | $V_{CC} = 5V, I_O = -10 \mu A$<br>$V_{CC} = 10V, I_O = -10 \mu A$       | 4.5<br>9.0     |        |            | V<br>V  |
| $V_{OUT(0)}$                                                                        | Logical "0" Output Voltage | $V_{CC} = 5V, I_O = 10 \mu A$<br>$V_{CC} = 10V, I_O = 10 \mu A$         |                |        | 0.5<br>1.0 | V<br>V  |
| $I_{IN(1)}$                                                                         | Logical "1" Input Current  | $V_{CC} = 15V, V_{IN} = 15V$                                            |                | 0.005  | 1.0        | $\mu A$ |
| $I_{IN(0)}$                                                                         | Logical "0" Input Current  | $V_{CC} = 15V, V_{IN} = 0V$                                             | -1.0           | -0.005 |            | $\mu A$ |
| $I_{CC}$                                                                            | Supply Current             | $V_{CC} = 15V$                                                          |                | 0.05   | 300        | $\mu A$ |
| <b>CMOS TO LPTTL INTERFACE</b>                                                      |                            |                                                                         |                |        |            |         |
| $V_{IN(1)}$                                                                         | Logical "1" Input Voltage  | $V_{CC} = 4.75V$                                                        | $V_{CC} - 1.5$ |        |            | V       |
| $V_{IN(0)}$                                                                         | Logical "0" Input Voltage  | $V_{CC} = 4.75V$                                                        |                |        | 0.8        | V       |
| $V_{OUT(1)}$                                                                        | Logical "1" Output Voltage | $V_{CC} = 4.75V, I_O = -100 \mu A$                                      | 2.4            |        |            | V       |
| $V_{OUT(0)}$                                                                        | Logical "0" Output Voltage | $V_{CC} = 4.75V, I_O = 360 \mu A$                                       |                |        | 0.4        | V       |
| <b>OUTPUT DRIVE (See Family Characteristics Data Sheet) (Short Circuit Current)</b> |                            |                                                                         |                |        |            |         |
| $I_{SOURCE}$                                                                        | Output Source Current      | $V_{CC} = 5V, V_{IN(0)} = 0V$<br>$T_A = 25^\circ C, V_{OUT} = 0V$       | -1.75          |        |            | mA      |
| $I_{SOURCE}$                                                                        | Output Source Current      | $V_{CC} = 10V, V_{IN(0)} = 0V$<br>$T_A = 25^\circ C, V_{OUT} = 0V$      | -8             |        |            | mA      |
| $I_{SINK}$                                                                          | Output Sink Current        | $V_{CC} = 5V, V_{IN(1)} = 5V$<br>$T_A = 25^\circ C, V_{OUT} = V_{CC}$   | 1.75           |        |            | mA      |
| $I_{SINK}$                                                                          | Output Sink Current        | $V_{CC} = 10V, V_{IN(1)} = 10V$<br>$T_A = 25^\circ C, V_{OUT} = V_{CC}$ | 8              |        |            | mA      |

## AC Electrical Characteristics (Note 2)

$T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ , unless otherwise noted

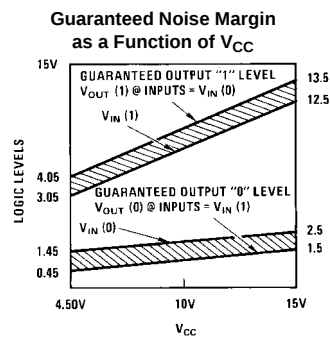
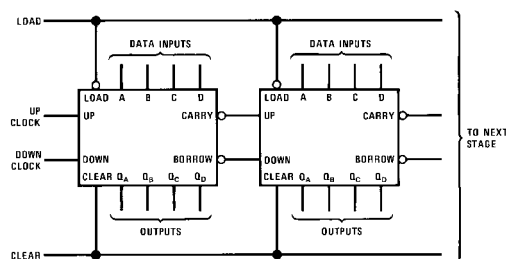
| Symbol    | Parameter                                    | Conditions            | Min | Typ | Max | Units         |
|-----------|----------------------------------------------|-----------------------|-----|-----|-----|---------------|
| $t_{pd}$  | Propagation Delay                            | $V_{CC} = 5\text{V}$  |     | 250 | 400 | ns            |
|           | Time to Q from Count Up or Down              | $V_{CC} = 10\text{V}$ |     | 100 | 160 | ns            |
| $t_{pd}$  | Propagation Delay                            | $V_{CC} = 5\text{V}$  |     | 120 | 200 | ns            |
|           | Time to Q Borrow from Count Down             | $V_{CC} = 10\text{V}$ |     | 50  | 80  | ns            |
| $t_{pd}$  | Propagation Delay                            | $V_{CC} = 5\text{V}$  |     | 120 | 200 | ns            |
|           | Time to Carry from Count Up                  | $V_{CC} = 10\text{V}$ |     | 50  | 80  | ns            |
| $t_S$     | Time Prior to Load that Data Must be Present | $V_{CC} = 5\text{V}$  |     | 100 | 160 | ns            |
|           |                                              | $V_{CC} = 10\text{V}$ |     | 30  | 50  | ns            |
| $t_W$     | Minimum Clear Pulse Width                    | $V_{CC} = 5\text{V}$  |     | 300 | 480 | ns            |
|           |                                              | $V_{CC} = 10\text{V}$ |     | 120 | 190 | ns            |
| $t_W$     | Minimum Load Pulse Width                     | $V_{CC} = 5\text{V}$  |     | 100 | 160 | ns            |
|           |                                              | $V_{CC} = 10\text{V}$ |     | 40  | 65  | ns            |
| $t_{pd0}$ | Propagation Delay                            | $V_{CC} = 5\text{V}$  |     | 300 | 480 | ns            |
| $t_{pd1}$ | Time to Q from Load                          | $V_{CC} = 10\text{V}$ |     | 120 | 190 | ns            |
| $t_W$     | Minimum Count Pulse Width                    | $V_{CC} = 5\text{V}$  |     | 120 | 200 | ns            |
|           |                                              | $V_{CC} = 10\text{V}$ |     | 35  | 80  | ns            |
| $f_{MAX}$ | Maximum Count Frequency                      | $V_{CC} = 5\text{V}$  | 2.5 | 4   |     | MHz           |
|           |                                              | $V_{CC} = 10\text{V}$ | 6   | 10  |     | MHz           |
| $t_r$     | Count Rise and Fall Time                     | $V_{CC} = 5\text{V}$  |     |     | 15  | $\mu\text{s}$ |
| $t_f$     |                                              | $V_{CC} = 10\text{V}$ |     |     | 5   | $\mu\text{s}$ |
| $C_{IN}$  | Input Capacitance                            | (Note 3)              |     | 5   |     | pF            |
| $C_{PD}$  | Power Dissipation Capacitance                | (Note 4)              |     | 100 |     | pF            |

**Note 2:** AC Parameters are guaranteed by DC correlated testing.

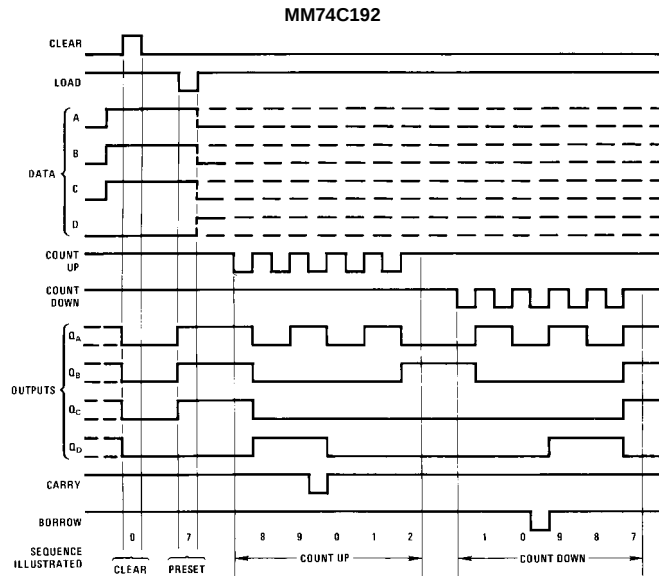
**Note 3:** Capacitance is guaranteed by periodic testing.

**Note 4:**  $C_{PD}$  determines the no load AC power consumption of any CMOS device. For complete explanation, see Application Note AN-90.

## Cascading Packages



## Timing Diagrams

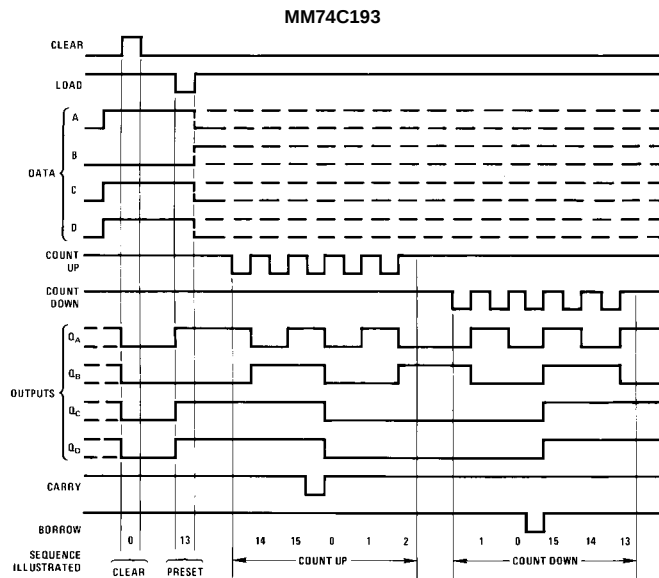


Note A: Clear outputs to zero.

Note B: Load (preset) to binary thirteen.

Note C: Count up to fourteen, fifteen, carry, zero, one and two.

Note D: Count down to one, zero, borrow, fifteen, fourteen, and thirteen.



Note A: Clear outputs to zero.

Note B: Load (preset) to BCD seven.

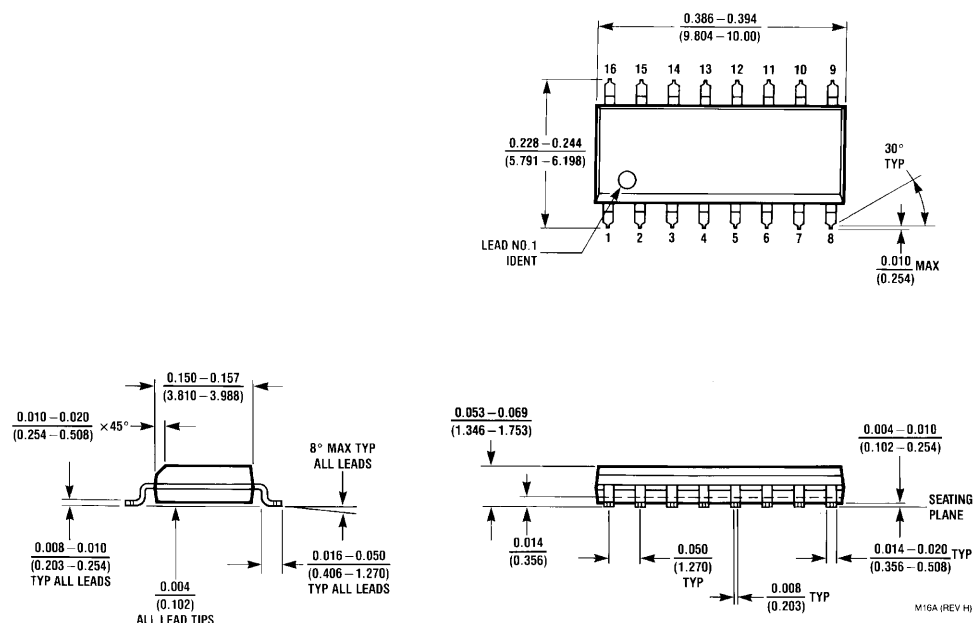
Note C: Count up to eight, nine, carry, zero, one, and two.

Note D: Count down to one, zero, borrow, nine, eight, and seven.

Note E: Clear overrides load, data, and count inputs.

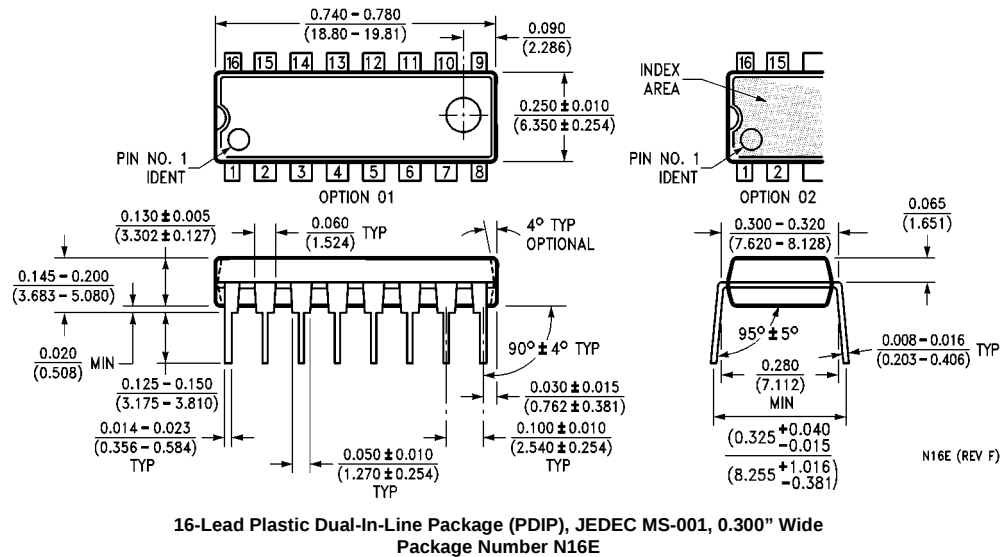
Note F: When counting up, count down input must be HIGH; when counting down, count-up input must be HIGH.

**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)



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