

## MM74HC393 Dual 4-Bit Binary Counter

### General Description

The MM74HC393 counter circuits contain independent ripple carry counters and utilize advanced silicon-gate CMOS technology. The MM74HC393 contains two 4-bit ripple carry binary counters, which can be cascaded to create a single divide-by-256 counter.

Each of the two 4-bit counters is incremented on the HIGH-to-LOW transition (negative edge) of the clock input, and each has an independent clear input. When clear is set HIGH all four bits of each counter are set to a low level. This enables count truncation and allows the implementation of divide-by-N counter configurations.

Each of the counters outputs can drive 10 low power Schottky TTL equivalent loads. This counter is functionally

as well as pin equivalent to the 74LS393. All inputs are protected from damage due to static discharge by diodes to  $V_{CC}$  and ground.

### Features

- Typical operating frequency: 50 MHz
- Typical propagation delay: 13 ns (Ck to  $Q_A$ )
- Wide operating supply voltage range: 2–6V
- Low input current:  $<1 \mu\text{A}$
- Low quiescent supply current: 80  $\mu\text{A}$  maximum (74HC Series)
- Fanout of 10 LS-TTL loads

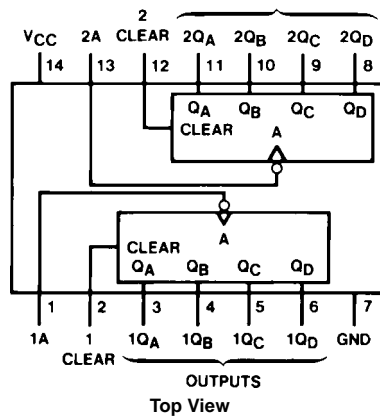
### Ordering Code:

| Order Number | Package Number | Package Description  |
|--------------|----------------|--|
| MM74HC393M   | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow |
| MM74HC393SJ  | M14D           | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |
| MM74HC393MTC | MTC14          | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |
| MM74HC393N   | N14A           | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

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

### Connection Diagram

Pin Assignments for DIP, SOIC, SOP and TSSOP  
OUTPUTS



**Absolute Maximum Ratings**

(Note 2)

(Note 1)

|  |                       |
|--|-----------------------|
| Supply Voltage ( $V_{CC}$ )                      | -0.5 to +7.0V         |
| DC Input Voltage ( $V_{IN}$ )                    | -1.5 to $V_{CC}+1.5V$ |
| DC Output Voltage ( $V_{OUT}$ )                  | -0.5 to $V_{CC}+0.5V$ |
| Clamp Diode Current ( $I_{IK}, I_{OK}$ )         | $\pm 20$ mA           |
| DC Output Current, per pin ( $I_{OUT}$ )         | $\pm 25$ mA           |
| DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ ) | $\pm 50$ mA           |
| Storage Temperature Range ( $T_{STG}$ )          | -65°C to +150°C       |
| Power Dissipation ( $P_D$ )                      |                       |
| (Note 3)   | 600 mW                |
| S.O. Package only                                | 500 mW                |
| Lead Temperature ( $T_L$ )                       |                       |
| (Soldering 10 seconds)                           | 260°C                 |

**Recommended Operating Conditions**

|  | Min | Max      | Units |
|--|-----|----------|-------|
| Supply Voltage ( $V_{CC}$ )                                | 2   | 6        | V     |
| DC Input or Output Voltage<br>( $V_{IN}, V_{OUT}$ )        | 0   | $V_{CC}$ | V     |
| Operating Temperature Range ( $T_A$ )                      | -40 | +85      | °C    |
| Input Rise or Fall Times<br>( $t_r, t_f$ ) $V_{CC} = 2.0V$ |     | 1000     | ns    |
| $V_{CC} = 4.5V$  |     | 500      | ns    |
| $V_{CC} = 6.0V$  |     | 400      | ns    |

**Note 1:** Absolute Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation temperature derating — plastic "N" package: -12 mW/°C from 65°C to 85°C.

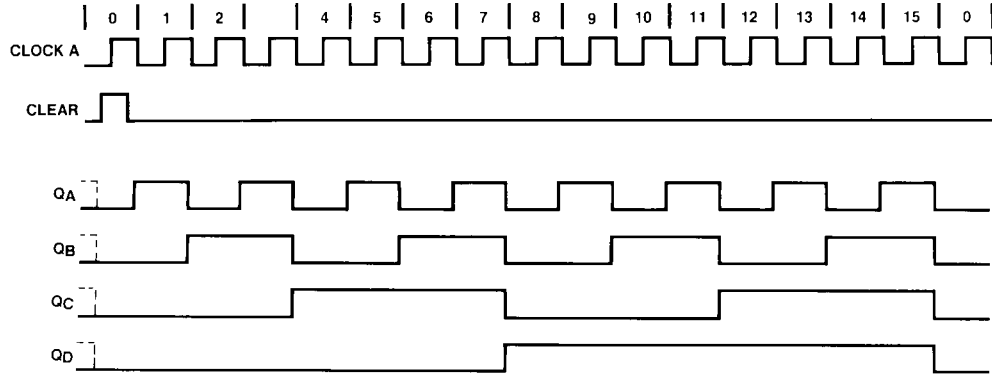
**DC Electrical Characteristics** (Note 4)

| Symbol   | Parameter                         | Conditions  | $V_{CC}$ | $T_A = 25^\circ C$ |                   |           | $T_A = -40$ to $85^\circ C$ | $T_A = -55$ to $125^\circ C$ | Units |
|----------|-----------------------------------|---|----------|--------------------|-------------------|-----------|-----------------------------|------------------------------|-------|
|          |                                   |   |          | Typ                | Guaranteed Limits |           |                             |                              |       |
| $V_{IH}$ | Minimum HIGH Level Input Voltage  |   | 2.0V     |                    | 1.5               | 1.5       | 1.5                         | V                            |       |
|          |                                   |   | 4.5V     |                    | 3.15              | 3.15      | 3.15                        | V                            |       |
|          |                                   |   | 6.0V     |                    | 4.2               | 4.2       | 4.2                         | V                            |       |
| $V_{IL}$ | Maximum LOW Level Input Voltage   |   | 2.0V     |                    | 0.5               | 0.5       | 0.5                         | V                            |       |
|          |                                   |   | 4.5V     |                    | 1.35              | 1.35      | 1.35                        | V                            |       |
|          |                                   |   | 6.0V     |                    | 1.8               | 1.8       | 1.8                         | V                            |       |
| $V_{OH}$ | Minimum HIGH Level Output Voltage | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 20 \mu A$                          | 2.0V     | 2.0                | 1.9               | 1.9       | 1.9                         | V                            |       |
|          |                                   |   | 4.5V     | 4.5                | 4.4               | 4.4       | 4.4                         | V                            |       |
|          |                                   |   | 6.0V     | 6.0                | 5.9               | 5.9       | 5.9                         | V                            |       |
|          |                                   | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 4.0$ mA<br>$ I_{OUT}  \leq 5.2$ mA | 4.5V     | 4.2                | 3.98              | 3.84      | 3.7                         | V                            |       |
|          |                                   |   | 6.0V     | 5.7                | 5.48              | 5.34      | 5.2                         | V                            |       |
|          |                                   |   |          |                    |                   |           |                             |                              |       |
| $V_{OL}$ | Maximum LOW Level Output Voltage  | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 20 \mu A$                          | 2.0V     | 0                  | 0.1               | 0.1       | 0.1                         | V                            |       |
|          |                                   |   | 4.5V     | 0                  | 0.1               | 0.1       | 0.1                         | V                            |       |
|          |                                   |   | 6.0V     | 0                  | 0.1               | 0.1       | 0.1                         | V                            |       |
|          |                                   | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 4.0$ mA<br>$ I_{OUT}  \leq 5.2$ mA | 4.5V     | 0.2                | 0.26              | 0.33      | 0.4                         | V                            |       |
|          |                                   |   | 6.0V     | 0.2                | 0.26              | 0.33      | 0.4                         | V                            |       |
|          |                                   |   |          |                    |                   |           |                             |                              |       |
| $I_{IN}$ | Maximum Input Current             | $V_{IN} = V_{CC}$ or GND  | 6.0V     |                    | $\pm 0.1$         | $\pm 1.0$ | $\pm 1.0$                   | $\mu A$                      |       |
| $I_{CC}$ | Maximum Quiescent Supply Current  | $V_{IN} = V_{CC}$ or GND<br>$I_{OUT} = 0 \mu A$                                     | 6.0V     |                    | 8.0               | 80        | 160                         | $\mu A$                      |       |

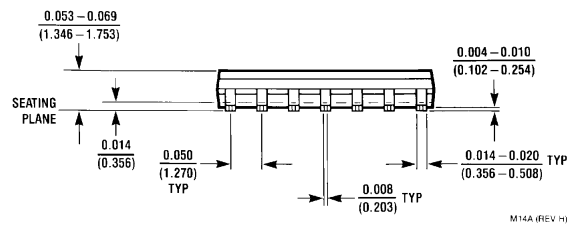
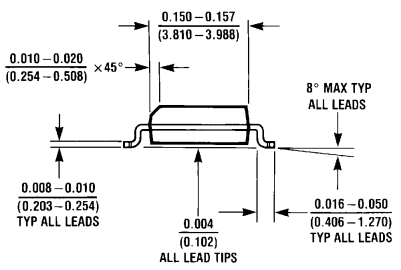
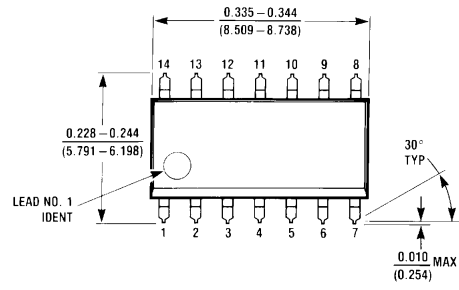
**Note 4:** For a power supply of 5V  $\pm 10\%$  the worst case output voltages ( $V_{OH}$  and  $V_{OL}$ ) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  value at 5.5V is 3.85V.) The worst case leakage current ( $I_{IN}$ ,  $I_{CC}$ , and  $I_{OZ}$ ) occur for CMOS at the higher voltage and so the 6.0V values should be used.

| AC Electrical Characteristics   |   |               |          |                    |                             |                              |       |    |
|---|---|---------------|----------|--------------------|-----------------------------|------------------------------|-------|----|
| $V_{CC} = 5V$ , $T_A = 25^\circ C$ , $C_L = 15$ pF, $t_r = t_f = 6$ ns  |   |               |          |                    |                             |                              |       |    |
| Symbol  | Parameter                                   | Conditions    | Typ      | Guaranteed Limit   | Units                       |                              |       |    |
| $f_{MAX}$   | Maximum Operating Frequency                 |               | 50       | 30                 | MHz                         |                              |       |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay, Clock A to $Q_A$ |               | 13       | 20                 | ns                          |                              |       |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay, Clock A to $Q_B$ |               | 19       | 35                 | ns                          |                              |       |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay, Clock A to $Q_C$ |               | 23       | 42                 | ns                          |                              |       |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay, Clock A to $Q_D$ |               | 27       | 50                 | ns                          |                              |       |    |
| $t_{PHL}$   | Maximum Propagation Delay, Clear to any Q   |               | 15       | 28                 | ns                          |                              |       |    |
| $t_{REM}$   | Minimum Removal Time                        |               | -2       | 5                  | ns                          |                              |       |    |
| $t_W$   | Minimum Pulse Width Clear or Clock          |               | 10       | 16                 | ns                          |                              |       |    |
| AC Electrical Characteristics   |   |               |          |                    |                             |                              |       |    |
| $C_L = 50$ pF, $t_r = t_f = 6$ ns (unless otherwise specified)  |   |               |          |                    |                             |                              |       |    |
| Symbol  | Parameter                                   | Conditions    | $V_{CC}$ | $T_A = 25^\circ C$ | $T_A = -40$ to $85^\circ C$ | $T_A = -55$ to $125^\circ C$ | Units |    |
|   |   |               |          | Typ                | Guaranteed Limits           |                              |       |    |
| $f_{MAX}$   | Maximum Operating Frequency                 |               | 2.0V     | 5                  | 4                           | 3                            | MHz   |    |
|   |   |               | 4.5V     | 27                 | 21                          | 18                           |       |    |
|   |   |               | 6.0V     | 31                 | 24                          | 20                           |       |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay Clock A to $Q_A$  |               | 2.0V     | 45                 | 120                         | 150                          | 180   | ns |
|   |   |               | 4.5V     | 15                 | 24                          | 30                           | 35    |    |
|   |   |               | 6.0V     | 13                 | 21                          | 26                           | 31    |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay Clock A to $Q_B$  |               | 2.0V     | 68                 | 190                         | 240                          | 285   | ns |
|   |   |               | 4.5V     | 23                 | 38                          | 47                           | 57    |    |
|   |   |               | 6.0V     | 20                 | 32                          | 40                           | 48    |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay Clock A to $Q_C$  |               | 2.0V     | 90                 | 240                         | 300                          | 360   | ns |
|   |   |               | 4.5V     | 30                 | 48                          | 60                           | 72    |    |
|   |   |               | 6.0V     | 26                 | 41                          | 51                           | 61    |    |
| $t_{PHL}$ , $t_{PLH}$   | Maximum Propagation Delay Clock to $Q_D$    |               | 2.0V     | 100                | 290                         | 360                          | 430   | ns |
|   |   |               | 4.5V     | 35                 | 58                          | 72                           | 87    |    |
|   |   |               | 6.0V     | 30                 | 50                          | 62                           | 75    |    |
| $t_{PHL}$   | Maximum Propagation Delay Clear to any Q    |               | 2.0V     | 54                 | 165                         | 210                          | 250   | ns |
|   |   |               | 4.5V     | 18                 | 33                          | 41                           | 49    |    |
|   |   |               | 6.0V     | 15                 | 28                          | 35                           | 42    |    |
| $t_{REM}$   | Minimum Clear Removal Time                  |               | 2.0V     | 25                 | 25                          | 25                           | ns    |    |
|   |   |               | 4.5V     | 5                  | 5                           | 5                            |       |    |
|   |   |               | 6.0V     | 5                  | 5                           | 5                            |       |    |
| $t_W$   | Minimum Pulse Width Clear or Clock          |               | 2.0V     | 30                 | 80                          | 100                          | 120   | ns |
|   |   |               | 4.5V     | 10                 | 16                          | 20                           | 24    |    |
|   |   |               | 6.0V     | 9                  | 14                          | 18                           | 20    |    |
| $t_{THL}$ , $t_{TLH}$   | Maximum Output Rise and Fall Time           |               | 2.0V     | 30                 | 75                          | 95                           | 110   | ns |
|   |   |               | 4.5V     | 8                  | 15                          | 19                           | 22    |    |
|   |   |               | 6.0V     | 7                  | 13                          | 16                           | 19    |    |
| $t_r$ , $t_f$   | Maximum Input Rise and Fall Time            |               |          | 1000               | 1000                        | 1000                         | ns    |    |
|   |   |               |          | 500                | 500                         | 500                          |       |    |
|   |   |               |          | 400                | 400                         | 400                          |       |    |
| $C_{PD}$  | Power Dissipation Capacitance (Note 5)      | (per counter) |          | 42                 |                             |                              | pF    |    |
| $C_{IN}$  | Maximum Input Capacitance                   |               |          | 5                  | 10                          | 10                           | 10    | pF |
| <b>Note 5:</b> $C_{PD}$ determines the no load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ , and the no load dynamic current consumption, $I_S = C_{PD} V_{CC} f + I_{CC}$ . |   |               |          |                    |                             |                              |       |    |

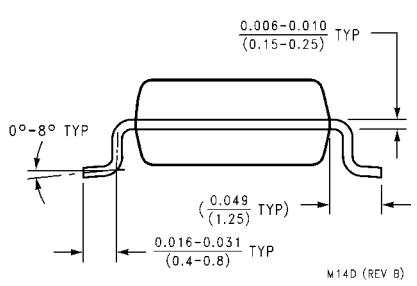
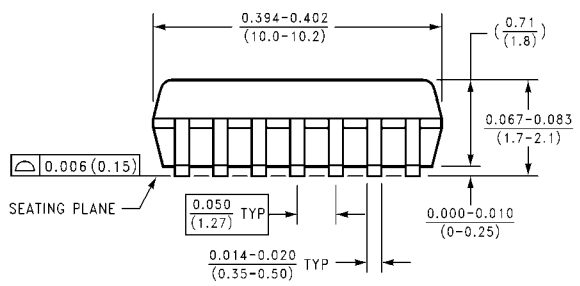
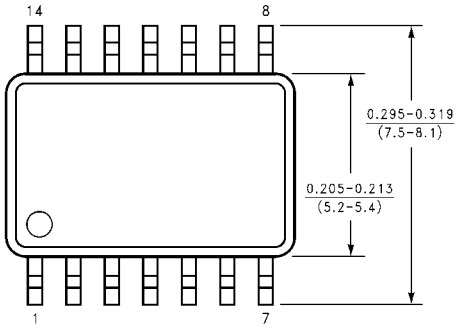
### Logic Timing Waveforms



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



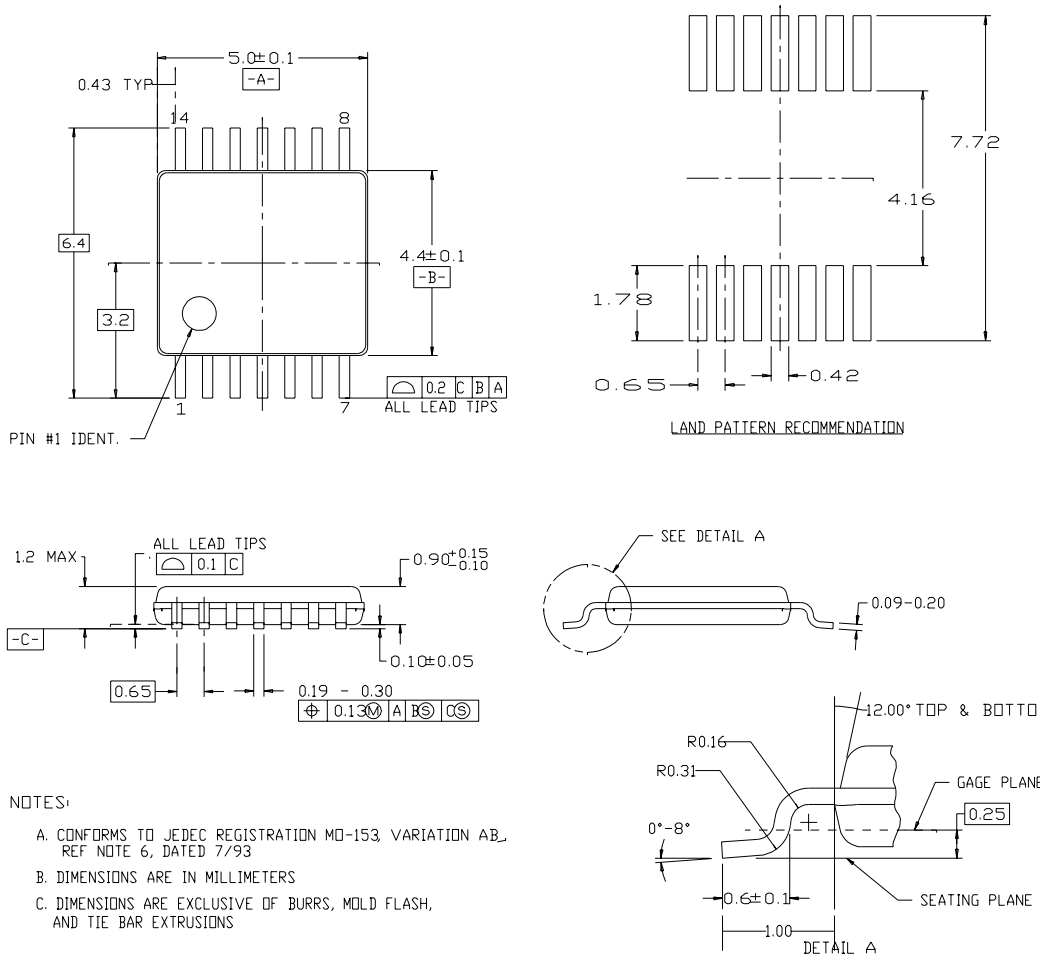
**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow  
Package Number M14A**



**14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M14D**

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

14LD, TSSOP, JEDEC MO-153, 4.4MM WIDE

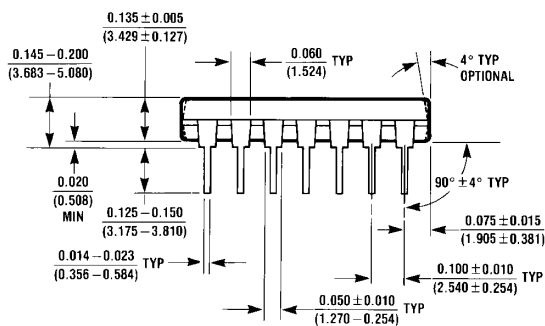
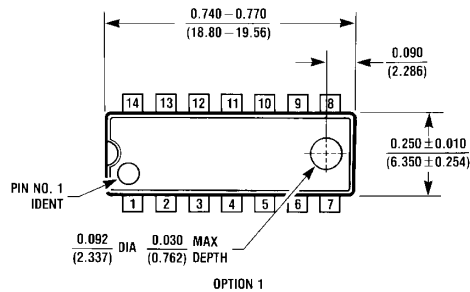


NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6, DATED 7/93
- B. DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS

**14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC14**

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



**14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide  
Package Number N14A**

N14A (REV F)

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