



**MM54C160/MM74C160**  
**Decade Counter with Asynchronous Clear**  
**MM54C161/MM74C161**  
**Binary Counter with Asynchronous Clear**  
**MM54C162/MM74C162**  
**Decade Counter with Synchronous Clear**  
**MM54C163/MM74C163**  
**Binary Counter with Synchronous Clear**

### General Description

These (synchronous presettable up) counters are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. They feature an internal carry lookahead for fast counting schemes and for cascading packages without additional gating.

A low level at the load input disables counting and causes the outputs to agree with the data input after the next positive clock edge. The clear function for the C162 and C163 is synchronous and a low level at the clear input sets all four outputs low after the next positive clock edge. The clear function for the C160 and C161 is asynchronous and a low level at the clear inputs sets all four outputs low regardless of the state of the clock.

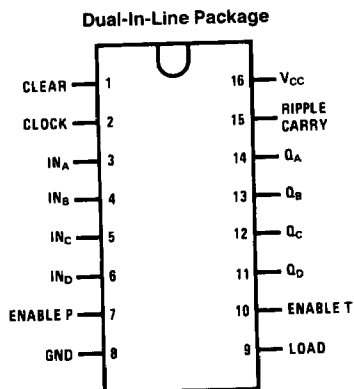
Counting is enabled when both count enable inputs are high. Input T is fed forward to also enable the carry out. The

carry output is a positive pulse with a duration approximately equal to the positive portion of  $Q_A$  and can be used to enable successive cascaded stages. Logic transitions at the enable P or T inputs can occur when the clock is high or low.

### Features

- High noise margin 1V guaranteed
- High noise immunity 0.45  $V_{CC}$  (typ.)
- Tenth power TTL compatible Drives 2 LPTTL loads
- Wide supply voltage range 3V to 15V
- Internal look-ahead for fast counting schemes
- Carry output for N-bit cascading
- Load control line
- Synchronously programmable

### Connection Diagram



**Order Number MM54C160\*, MM74C160\*,  
MM54C161\*, MM74C161\*, MM54C162\*,  
MM74C162\*, MM54C163\* or MM74C163\***

\*Please look into Section 8, Appendix D  
for availability of various package types.

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### Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                             |                          |
|-----------------------------|--------------------------|
| Voltage at Any Pin          | -0.3V to $V_{CC} + 0.3V$ |
| Operating Temperature Range |                          |
| MM54C160/1/2/3              | -55°C to +125°C          |
| MM74C160/1/2/3              | -40°C to +85°C           |

|  |                 |
|--|-----------------|
| Storage Temperature Range                | -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 (Soldering, 10 seconds) | 260°C           |

### 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        | $\mu A$ |

### CMOS TO LPTTL INTERFACE

|              |                            |   |                                  |  |            |        |
|--------------|----------------------------|---|----------------------------------|--|------------|--------|
| $V_{IN(1)}$  | Logical "1" Input Voltage  | 54C $V_{CC} = 4.5V$<br>74C $V_{CC} = 4.75V$                                     | $V_{CC} - 1.5$<br>$V_{CC} - 1.5$ |  |            | V<br>V |
| $V_{IN(0)}$  | Logical "0" Input Voltage  | 54C $V_{CC} = 4.5V$<br>74C $V_{CC} = 4.75V$                                     |                                  |  | 0.8<br>0.8 | V<br>V |
| $V_{OUT(1)}$ | Logical "1" Output Voltage | 54C $V_{CC} = 4.5V, I_O = -360 \mu A$<br>74C $V_{CC} = 4.75V, I_O = -360 \mu A$ | 2.4<br>2.4                       |  |            | V<br>V |
| $V_{OUT(0)}$ | Logical "0" Output Voltage | 54C $V_{CC} = 4.5V, I_O = 360 \mu A$<br>74C $V_{CC} = 4.75V, I_O = 360 \mu A$   |                                  |  | 0.4<br>0.4 | V<br>V |

### OUTPUT DRIVE (See 54C/74C Family Characteristics Data Sheet) (Short Circuit Current)

|              |                       |   |      |  |  |    |
|--------------|-----------------------|---|------|--|--|----|
| $I_{SOURCE}$ | 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>$T_A = 25^\circ C, V_{OUT} = 0V$      | 8.0  |  |  | 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>$T_A = 25^\circ C, V_{OUT} = V_{CC}$ | 8.0  |  |  | mA |

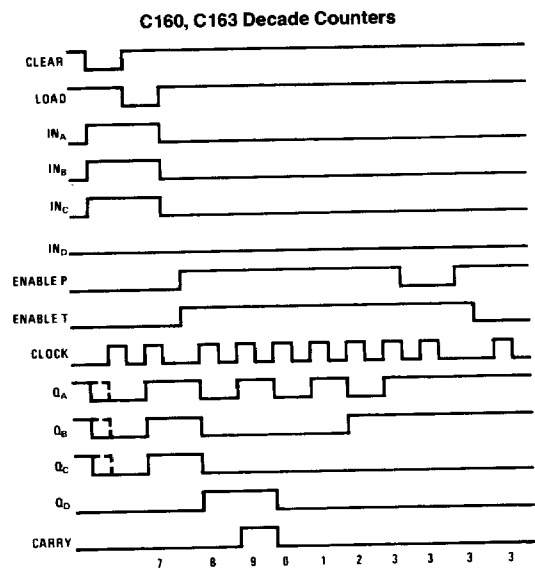
**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for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

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

| Symbol     | Parameter   | Conditions                                    | Min        | Typ        | Max        | Units                          |
|------------|---|---|------------|------------|------------|--------------------------------|
| $t_{pd}$   | Propagation Delay Time from Clock to Q                            | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            | 250<br>100 | 400<br>160 | ns<br>ns                       |
| $t_{pd}$   | Propagation Delay Time from Clock to Carry Out                    | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            | 290<br>120 | 450<br>190 | ns<br>ns                       |
| $t_{pd}$   | Propagation Delay Time from T Enable to Carry Out                 | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            | 180<br>70  | 290<br>120 | ns<br>ns                       |
| $t_{pd}$   | Propagation Time from Clear to Q<br>(C160 and C161 only)          | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            | 190<br>80  | 300<br>150 | ns<br>ns                       |
| $t_S$      | Time prior to Clock that Data or Load must be Present             | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            |            | 120<br>30  | ns<br>ns                       |
| $t_S$      | Time prior to Clock that Enable P or T must be Present            | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            | 170<br>70  | 280<br>120 | ns<br>ns                       |
| $t_S$      | Time prior to Clock that Clear must be Present<br>(162, 163 only) | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            | 120<br>50  | 190<br>80  | ns<br>ns                       |
| $t_W$      | Minimum Clock Pulses Width  | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            | 90<br>35   | 170<br>70  | ns<br>ns                       |
| $t_r, t_f$ | Maximum Clock Rise or Fall Time                                   | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ |            |            | 15<br>5    | $\mu\text{s}$<br>$\mu\text{s}$ |
| $f_{MAX}$  | Maximum Clock Frequency   | $V_{CC} = 5\text{V}$<br>$V_{CC} = 10\text{V}$ | 2.0<br>5.5 | 3<br>8.5   |            | MHz<br>MHz                     |
| CPD        | Power Dissipation Capacitance                                     | (Note 3)                                      |            | 95         |            | pF                             |
| CIN        | Input Capacitance   | (Note 2)                                      |            | 5          |            | pF                             |

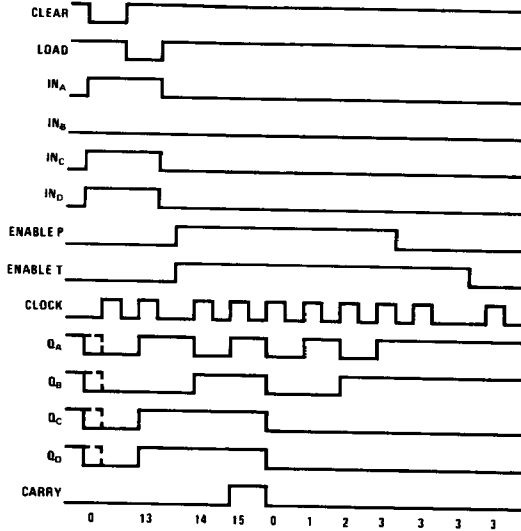
\*AC Parameters are guaranteed by DC correlated testing.  
**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.  
**Note 2:** Capacitance is guaranteed by periodic testing.  
**Note 3:**  $C_{PD}$  determines the no load AC power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics Application Note AN-90.

**Logic Waveforms**



**Logic Waveforms** (Continued)

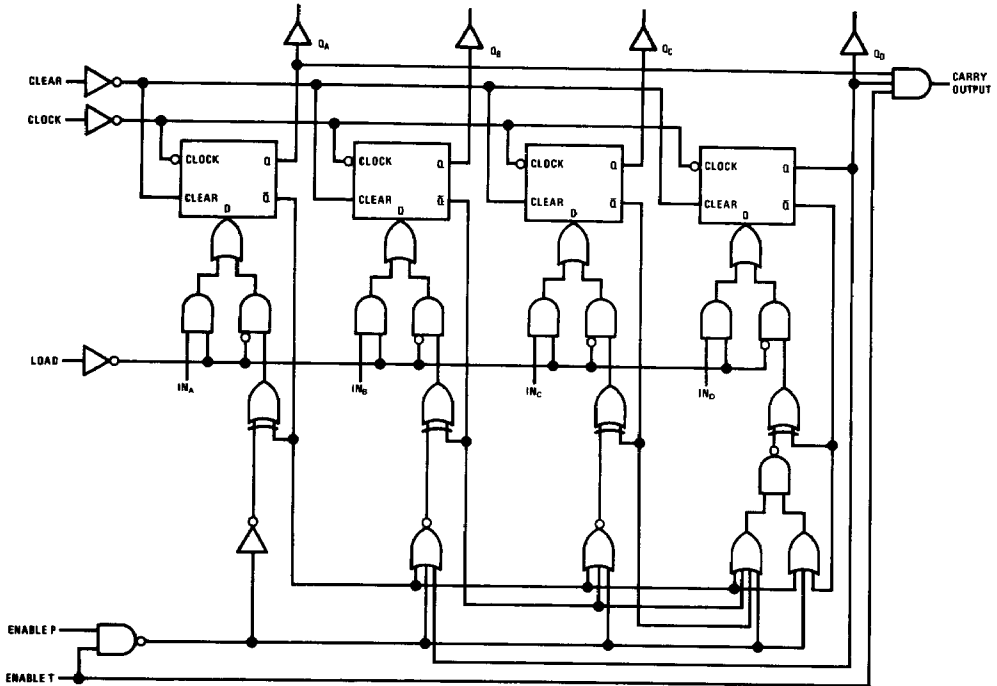
**C161, ... C163 Binary Counters**



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**Logic Diagrams**

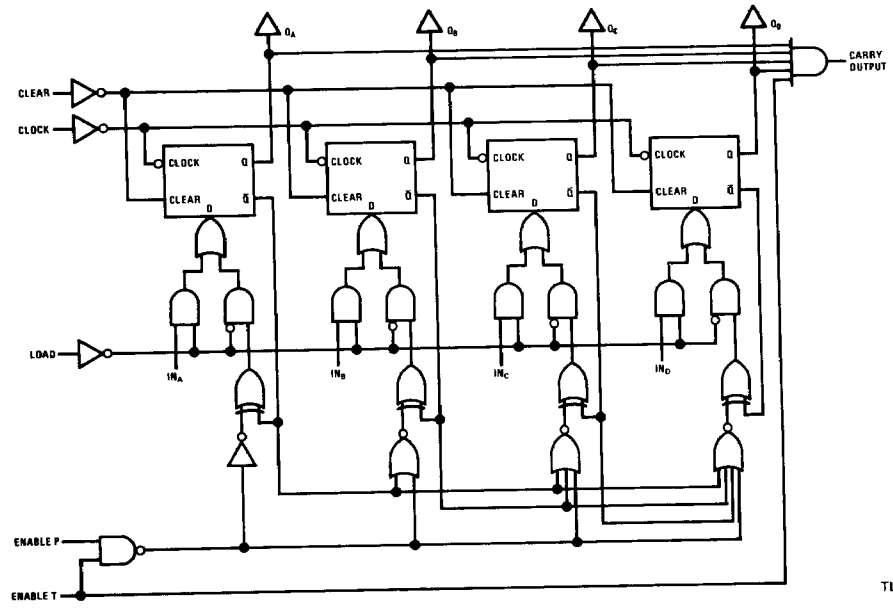
**MM74C160, MM74C162; Clear is Synchronous for the MM74C162**



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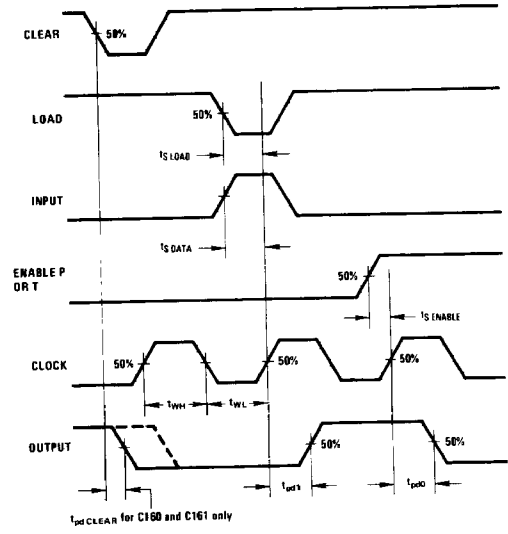
### Logic Diagrams (Continued)

MM74C161, MM74C163; Clear is Synchronous for the MM74C163



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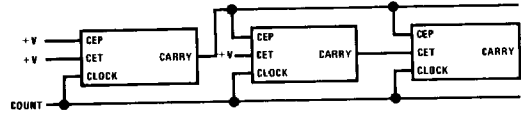
### Switching Time Waveforms



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**Note 1:** All input pulses are from generators having the following characteristics;  $t_r = t_f = 20$  ns, PRR  $\leq 1$  MHz, duty cycle  $\leq 50\%$ ,  $Z_{OUT} \approx 50\Omega$ .  
**Note 2:** All times are measured from 50% to 50%.

### Cascading Packages



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