

# **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 input sets all four outputs low regardless of the state of the clock.

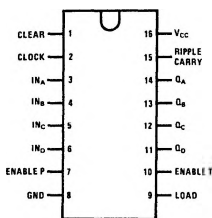
Counting is enabled when both count enable inputs are high. Input T is fed forward to also enable the carry out. The carry output is a positive pulse with a duration approximately equal to the positive portion of  $Q_A$  and can

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.

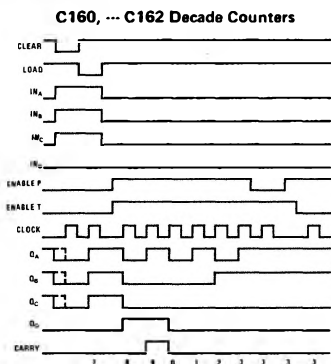
## Features

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

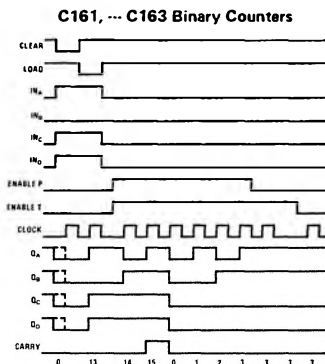
## Connection Diagram



## Logic Waveforms



TOP VIEW



**Absolute Maximum Ratings** (Note 1)

Voltage at Any Pin	-0.3V to $V_{CC}+0.3V$
Operating Temperature Range	-55°C to +125°C
MM54C160/1/2/3	-40°C to +85°C
MM74C160/1/2/3	-65°C to +150°C
Storage Temperature Range	-65°C to +150°C
Maximum $V_{CC}$ Voltage	18V
Package Dissipation	500mW
Operating $V_{CC}$ Range	3V to 15V
Lead Temperature (Soldering, 10 sec.)	300°C

**DC Electrical Characteristics** Max./min. limits apply across temperature range, unless otherwise noted.

Parameter	Conditions	Min.	Typ.	Max.	Units
<b>CMOS to CMOS</b>					
$V_{IN(1)}$ Logical "1" Input Voltage	$V_{CC} = 5.0V$ $V_{CC} = 10V$	3.5 8.0			V V
$V_{IN(0)}$ Logical "0" Input Voltage	$V_{CC} = 5.0V$ $V_{CC} = 10V$			1.5 2.0	V V
$V_{OUT(1)}$ Logical "1" Output Voltage	$V_{CC} = 5.0V, I_O = -10\mu A$ $V_{CC} = 10V, I_O = -10\mu A$	4.5 9.0			V V
$V_{OUT(0)}$ Logical "0" Output Voltage	$V_{CC} = 5.0V, I_O = +10\mu A$ $V_{CC} = 10V, I_O = +10\mu A$			0.5 1.0	V 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	54C $V_{CC} = 4.5V$ 74C $V_{CC} = 4.75V$	$V_{CC} - 1.5$ $V_{CC} - 1.5$			V V
$V_{IN(0)}$ Logical "0" Input Voltage	54C $V_{CC} = 4.5V$ 74C $V_{CC} = 4.75V$			0.8 0.8	V V
$V_{OUT(1)}$ Logical "1" Output Voltage	54C $V_{CC} = 4.5V, I_O = -360\mu A$ 74C $V_{CC} = 4.75V, I_O = -360\mu A$	2.4 2.4			V V
$V_{OUT(0)}$ Logical "0" Output Voltage	54C $V_{CC} = 4.5V, I_O = +360\mu A$ 74C $V_{CC} = 4.75V, I_O = +360\mu A$			0.4 0.4	V V
<b>Output Drive (See 54C/74C Family Characteristics Data Sheet) (Short Circuit Current)</b>					
$I_{SOURCE}$ Output Source Current	$V_{CC} = 5.0V, V_{IN(0)} = 0V$ $T_A = 25^\circ C, V_{OUT} = 0V$	1.75			mA
$I_{SOURCE}$ Output Source Current	$V_{CC} = 10V, V_{IN(0)} = 0V$ $T_A = 25^\circ C, V_{OUT} = 0V$	8.0			mA
$I_{SINK}$ Output Sink Current	$V_{CC} = 5.0V, V_{IN(1)} = 5.0V$ $T_A = 25^\circ C, V_{OUT} = V_{CC}$	1.75			mA
$I_{SINK}$ Output Sink Current	$V_{CC} = 10V, V_{IN(1)} = 10V$ $T_A = 25^\circ C, V_{OUT} = V_{CC}$	8.0			mA

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

Parameter	Conditions	Min.	Typ.	Max.	Units
$t_{pd}$ Propagation Delay Time from Clock to Q	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		250 100	400 160	ns ns
$t_{pd}$ Propagation Delay Time from Clock to Carry Out	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		290 120	450 190	ns ns
$t_{pd}$ Propagation Delay Time from T Enable to Carry Out	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		180 70	290 120	ns ns
$t_{pd}$ Propagation Time from Clear to Q (C160 and C161 only)	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		190 80	300 150	ns ns
$t_S$ Time prior to Clock that Data or Load must be Present	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		120 30		ns ns
$t_S$ Time prior to Clock that Enable P or T must be Present	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		170 70	280 120	ns ns
$t_S$ Time prior to Clock that Clear must be Present (162, 163 only)	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		120 50	190 80	ns ns
$t_W$ Minimum Clock Pulses Width	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$		90 35	170 70	ns ns
$t_r, t_f$ Maximum Clock Rise or Fall Time	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$			15 5.0	$\mu\text{s}$ $\mu\text{s}$
$f_{MAX}$ Maximum Clock Frequency	$V_{CC} = 5.0\text{ V}$ $V_{CC} = 10\text{ V}$	2.0 5.5	3.0 8.5		MHz MHz
$C_{PD}$ Power Dissipation Capacitance	Note 3		95		pF
Input Capacitance	Note 2		5.0		pF

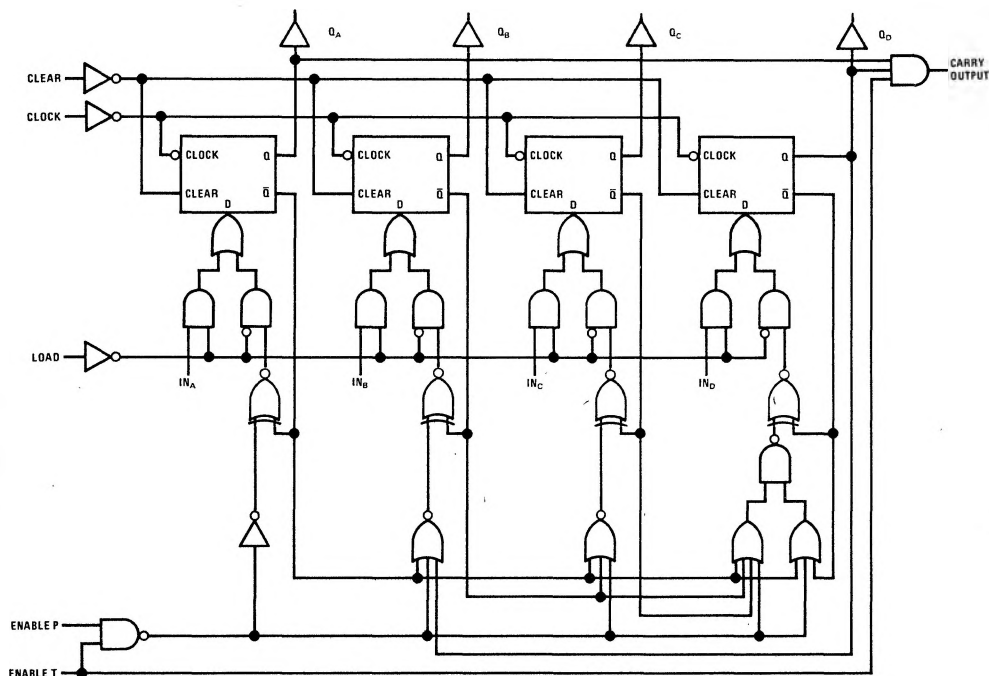
**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for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

**Note 2:** Capacitance is guaranteed by periodic testing.

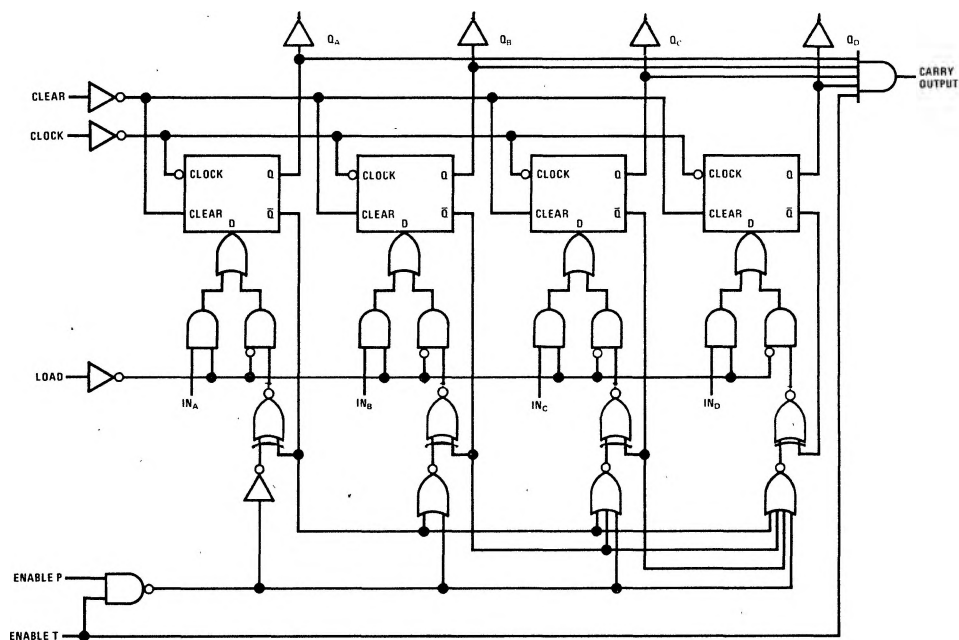
**Note 3:**  $C_{PD}$  determines the no load AC power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics application note AN-90.

# Logic Diagrams

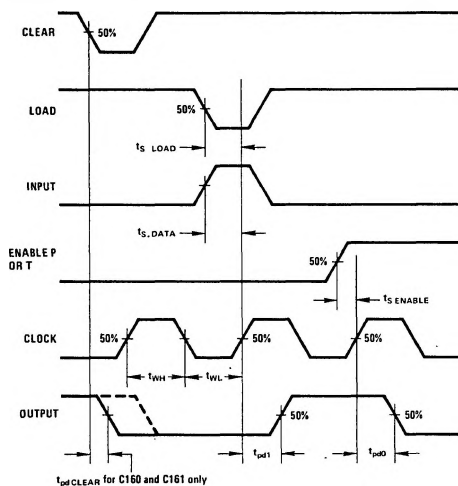
MM74C160, MM74C162; Clear is Synchronous for the MM74C162



MM74C161, MM74C163; Clear is Synchronous for the MM74C163



## Switching Time Waveforms



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

Note 2: All times are measured from 50% to 50%.

## Cascading Packages

