



## MM54C192/MM74C192 Synchronous 4-Bit Up/Down Decade Counter

## MM54C193/MM74C193 Synchronous 4-Bit Up/Down Binary Counter

### General Description

These up/down counters are monolithic complementary MOS (CMOS) integrated circuits. The MM54C192 and MM74C192 are BCD counters, while the MM54C193 and MM74C193 are binary counters.

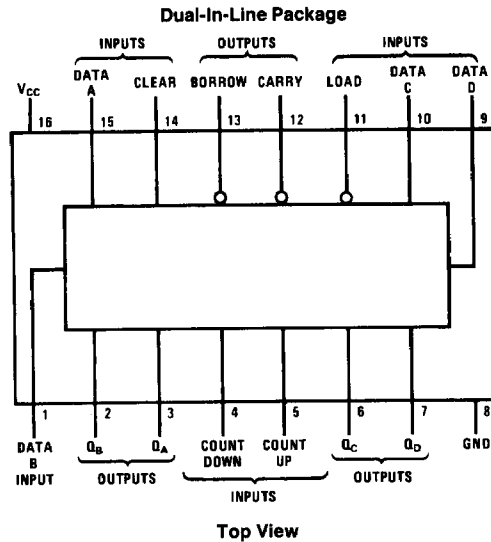
Counting up and counting down is performed by two count inputs, one being held high while the other is clocked. The outputs change on the positive-going transition of this clock.

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
  - Tenth power TTL compatible
  - Wide supply range
  - Carry and borrow outputs for N-bit cascading
  - Asynchronous clear
  - High noise immunity
- 1V guaranteed  
Drive 2 LPTTL loads  
3V to 15V  
0.45 V<sub>CC</sub> (typ.)

### Connection Diagram



TL/F/5901-1

Order Number MM54C192\*, MM74C192\*,  
MM54C193\* or MM74C193\*

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

### 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 ( $T_A$ )	
MM54C154	-55°C to +125°C
MM74C154	-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 sec.)	260°C

### DC Electrical Characteristics Min/Max limits apply across temperature range unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
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#### CMOS TO CMOS

$V_{IN(1)}$	Logical "1" Input Voltage	$V_{CC} = 5V$	3.5			V
		$V_{CC} = 10V$	8.0			V
$V_{IN(0)}$	Logical "0" Input Voltage	$V_{CC} = 5V$			1.5	V
		$V_{CC} = 10V$			2.0	V
$V_{OUT(1)}$	Logical "1" Output Voltage	$V_{CC} = 5V, I_O = -10 \mu A$	4.5			V
		$V_{CC} = 10V, I_O = -10 \mu A$	9.0			V
$V_{OUT(0)}$	Logical "0" Output Voltage	$V_{CC} = 5V, I_O = 10 \mu A$			0.5	V
		$V_{CC} = 10V, I_O = 10 \mu A$			1.0	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 $V_{CC} = 4.5V$	$V_{CC} - 1.5$			V
		74C $V_{CC} = 4.75V$	$V_{CC} - 1.5$			V
$V_{IN(0)}$	Logical "0" Input Voltage	54C $V_{CC} = 4.5V$			0.8	V
		74C $V_{CC} = 4.75V$			0.8	V
$V_{OUT(1)}$	Logical "1" Output Voltage	54C $V_{CC} = 4.5V, I_O = -100 \mu A$	2.4			V
		74C $V_{CC} = 4.75V, I_O = -100 \mu A$	2.4			V
$V_{OUT(0)}$	Logical "0" Output Voltage	54C $V_{CC} = 4.5V, I_O = 360 \mu A$			0.4	V
		74C $V_{CC} = 4.75V, I_O = 360 \mu A$			0.4	V

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

$I_{SOURCE}$	Output Source Current	$V_{CC} = 5V, V_{IN(0)} = 0V$ $T_A = 25^\circ C, V_{OUT} = 0V$	-1.75			mA
$I_{SOURCE}$	Output Source Current	$V_{CC} = 10V, V_{IN(0)} = 0V$ $T_A = 25^\circ C, V_{OUT} = 0V$	-8			mA
$I_{SINK}$	Output Sink Current	$V_{CC} = 5V, V_{IN(1)} = 5V$ $T_A = 25^\circ C, V_{OUT} = V_{CC}$	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			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 to Q from Count Up or Down	$V_{CC} = 5\text{V}$		250	400	ns
		$V_{CC} = 10\text{V}$		100	160	ns
$t_{pd}$	Propagation Delay Time to Q Borrow from Count Down	$V_{CC} = 5\text{V}$		120	200	ns
		$V_{CC} = 10\text{V}$		50	80	ns
$t_{pd}$	Propagation Delay Time to Carry from Count Up	$V_{CC} = 5\text{V}$		120	200	ns
		$V_{CC} = 10\text{V}$		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
$t_{pd0}$ , $t_{pd1}$	Propagation Delay Time to Q from Load	$V_{CC} = 5\text{V}$		300	480	ns
		$V_{CC} = 10\text{V}$		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
$t_r$ , $t_f$	Count Rise and Fall Time	$V_{CC} = 5\text{V}$			15	$\mu\text{s}$
		$V_{CC} = 10\text{V}$			5	$\mu\text{s}$
$C_{IN}$	Input Capacitance	(Note 2)		5		pF
$C_{PD}$	Power Dissipation Capacitance	(Note 3)		100		pF

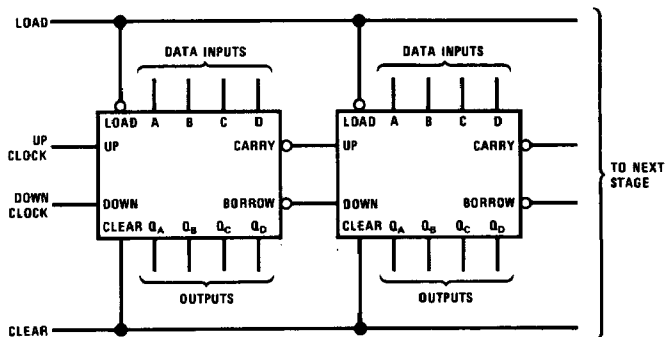
\*AC Parameters are guaranteed by DC correlated testing.

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. 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.

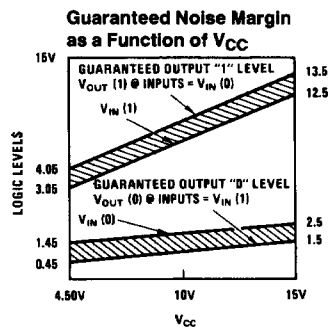
**Note 2:** Capacitance is guaranteed by periodic testing.

**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.

## Cascading Packages



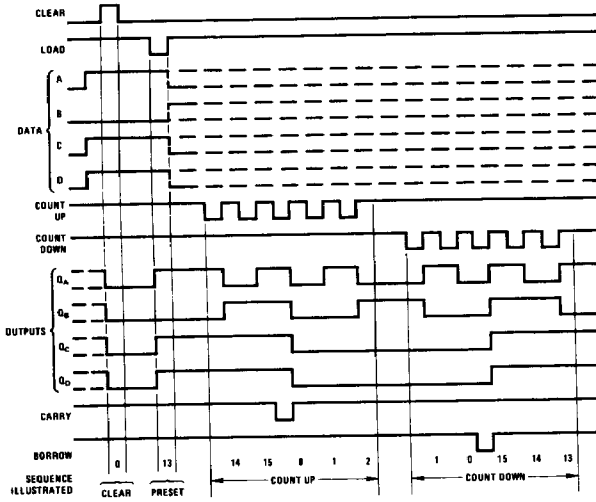
TL/F/5901-2



TL/F/5901-3

# Timing Diagrams

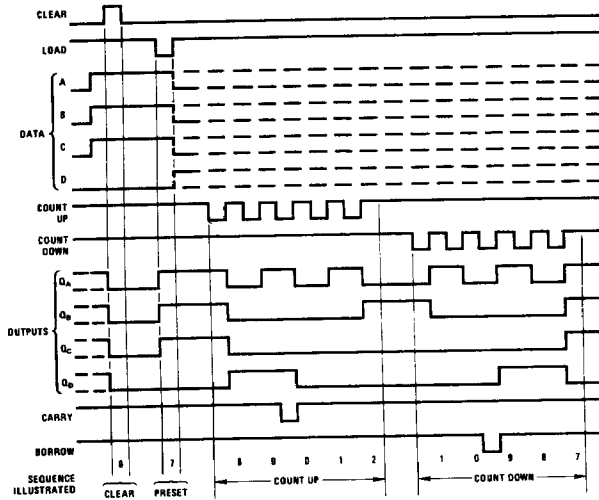
MM54C192/MM74C192



TL/F/5901-4

- Note 1:** Clear outputs to zero.
- Note 2:** Load (preset) to binary thirteen.
- Note 3:** Count up to fourteen, fifteen, carry, zero, one and two.
- Note 4:** Count down to one, zero, borrow, fifteen, fourteen, and thirteen.

MM54C193/MM74C193

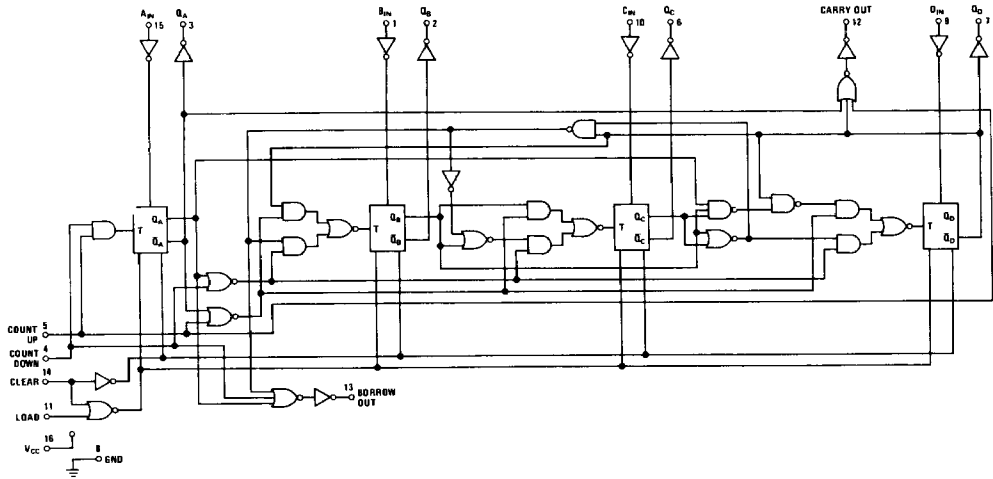


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- Note 1:** Clear outputs to zero.
- Note 2:** Load (preset) to BCD seven.
- Note 3:** Count up to eight, nine, carry, zero, one, and two.
- Note 4:** Count down to one, zero, borrow, nine, eight, and seven.
- Note A:** Clear overrides load, data, and count inputs.
- Note B:** When counting up, count down input must be high; when counting down, count-up input must be high.

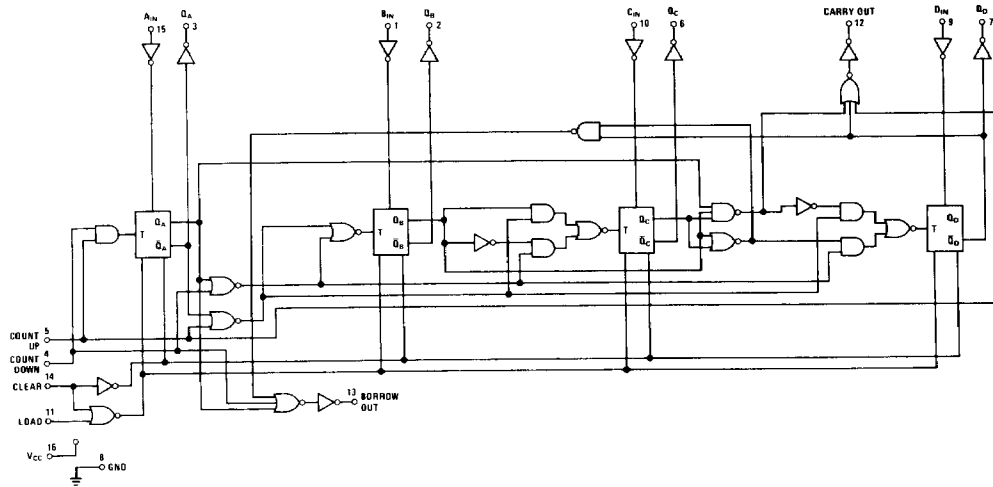
# Schematic Diagrams

## MM54C192 Synchronous 4-Bit Up/Down Decade Counter



TL/F/5901-6

## MM54C193 Synchronous 4-Bit Up/Down Binary Counter



TL/F/5901-7