

SPXXHC90
SPXXHC160
SPXXHC162
SPXXHC176
SPXXHC192

54/74 Series
BCD/Decade Counters

Features

- Utilizes SPI's Selective Oxidation, Silicon-Gate CMOS Process.
- Speed, function and pin-out compatible to 74LS series Logic.
- High Noise Immunity.
- Low quiescent power consumption.
- Wide power supply range.
- Operates over V_{CC} range of 2.0 to 6.0 Volts.
- Symmetric current drive.
- All Inputs are fully buffered.
- All devices have Input Protection diodes to V_{CC} and ground.
- All devices have Logic Input voltage levels consistent with CMOS.

All devices contain diodes to protect inputs against damage due to high static voltages or electric fields; however, it is advised that precautions be taken not to exceed the maximum recommended input voltages. All unused inputs must be connected to an appropriate logic voltage level (either V_{CC} or GND).

Ordering Information

Plastic DIP, Industrial Temp Range	Ceramic DIP, Industrial Temp Range	Ceramic DIP, Military Temp Range
SP74HCXXXN	SP74HCXXXJ	SP54HCXXXJ

Absolute Maximum Ratings

Parameter	Min	Max	Units
V_{CC} DC Supply Voltage	-0.5	+7.0	V
V_I, V_O Input or Output Voltage	-0.5	$V_{CC} + 0.5$	V
I_L DC Current Per Pin Any Input or Output	—	25	mA
I_{CC} DC Current Drain, V_{CC} or GND	—	50	mA
T_S Storage Temperature	-65	+150	°C
P_D Power Dissipation (Note 1)	—	500	mW
T_L Lead Temperature (1/16" from mounting surface for 10 sec)	—	+300	°C

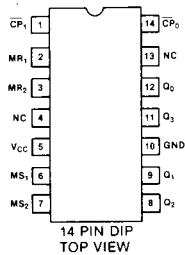
Note 1: Derate at 12mW/°C over +45 to +85°C for Plastic "N" Package.

Recommended Operating Conditions

Parameter	SP74HCXXX		SP54HCXXX		Units
	Min	Max	Min	Max	
V_{CC} DC Supply Voltage Range	2.0	6.0	2.0	6.0	V
V_I, V_O Input Voltage, Output Voltage	0	V_{CC}	0	V_{CC}	V
T_A Operating Temperature Range	-40	+85	-55	+125	°C

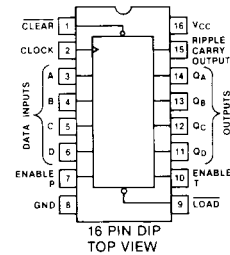
SPXXHC90

Decade Counters, Divide-by-2/
Synchronous Divide-by-5



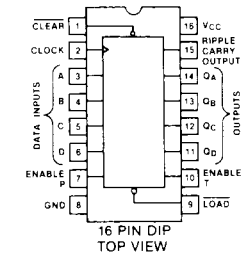
SPXXHC160

BCD Decade Counter
Asynchronous Reset



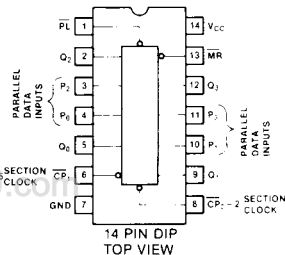
SPXXHC162

BCD Decade Counter
Synchronous Reset



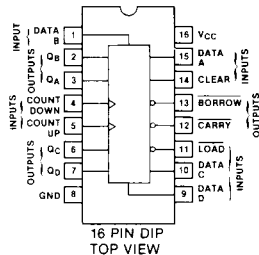
SPXXHC176

Presetable Decade Counter



SPXXHC192

BCD Decade Up/Down Counter



DC Electrical Characteristics

Symbol	Parameter	Conditions	V _{CC}	Typ T = 25 °C	Guaranteed Limits		Units		
					SP74HC -40 to +85 °C	SP54HC -55 to +125 °C			
V _{IH}	Minimum High Level Input Voltage	V _O = 0.1V or V _{CC} - 0.1V I _O ≤ 20 μA	2.0V		1.5	1.5	V		
			4.5V		3.15	3.15			
			6.0V		4.2	4.2			
V _{IL}	Maximum Low Level Input Voltage	V _O = 0.1V or V _{CC} - 0.1V I _O ≤ 20 μA	2.0V		0.3	0.3	V		
			4.5V		0.9	0.9			
			6.0V		1.2	1.2			
V _{OH}	Minimum High Level Output Voltage	I _{OH} = 20 μA V _I = V _{CC} or GND	2.0V	2.0	1.9	1.9	V		
			4.5V	4.5	4.4	4.4			
			6.0V	6.0	5.9	5.9			
									V
				I _{OH} = *			3.7	3.7	
				V _I = V _{CC} or GND			5.2	5.2	
V _{OL}	Maximum Low Level Output Voltage	I _{OL} = 20 μA V _I = V _{CC} or GND	2.0V	0	0.1	0.1	V		
			4.5V	0	0.1	0.1			
			6.0V	0	0.1	0.1			
									V
				I _{OL} = *			0.3	0.4	
				V _I = V _{CC} or GND			0.3	0.4	
I _{IN}	Input Leakage Current	V _I = V _{CC} or GND V _{CC} = 2.0 to 6.0V			±1.0	±1.0	μA		
I _{CC}	Maximum Quiescent Supply Current	V _I = V _{CC} or GND I _O = 0 μA					μA		
				T _A = 25 °C	5.0V	0.1		2.0	2.0
				T _A = 85 °C	5.0V			20.0	20.0
				T _A = 125 °C	5.0V				40.0

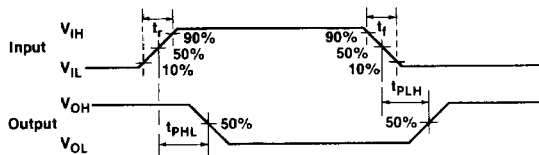
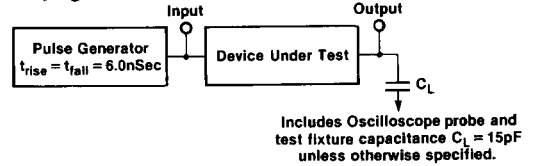
* 4ma STD outputs 6ma Bus-Drivers

AC Electrical Characteristics (V_{CC} = 5.0V, t_r = t_f = 6ns, T_A = 25 °C, unless otherwise specified)

Device Type	Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
90	t _{PHL} , t _{PLH}	C _{P0} to Q ₀	C _L = 15pF	24		ns
			C _L = 50pF	26		
	t _{PHL} , t _{PLH}	C _{P0} to Q ₃	C _L = 15pF	46		ns
			C _L = 50pF	50		
	t _{PHL} , t _{PLH}	C _{P1} to Q ₁	C _L = 15pF	26		ns
			C _L = 50pF	28		
	t _{PHL} , t _{PLH}	C _{P1} to Q ₃	C _L = 15pF	26		ns
			C _L = 50pF	28		
	t _{PHL} , t _{PLH}	M _S to Q ₀	C _L = 15pF	25		ns
C _L = 50pF			27			
t _{PHL} , t _{PLH}	M _S to Q ₃	C _L = 15pF	26		ns	
		C _L = 50pF	28			
t _{PHL} , t _{PLH}	M _R to All Q's	C _L = 15pF	32		ns	
		C _L = 50pF	35			
	f _{max}		30		MHz	
	t _w		10		ns	
	C _{IN}		2		pF	
160 162	t _{PHL} , t _{PLH}	Clock to Q	C _L = 15pF	20		ns
			C _L = 50pF	22		
	t _{PHL} , t _{PLH}	Clear to Q	C _L = 15pF	20		ns
			C _L = 50pF	22		
t _{PHL} , t _{PLH}	Clock to Carry	C _L = 15pF	20		ns	
		C _L = 50pF	22			
	f _{max}		40		MHz	
	C _{IN}		2		pF	

AC Electrical Characteristics ($V_{CC} = 5.0V$, $t_r = t_f = 6ns$, $T_A = 25^\circ C$, unless otherwise specified) CONTINUED

Device Type	Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
176	t_{PHL}, t_{PLH}	C_{P1} to Q_A	$C_L = 15pF$ $C_L = 50pF$	21 23		ns
	t_{PHL}, t_{PLH}	C_{P2} to Q_B	$C_L = 15pF$ $C_L = 50pF$	29 31		ns
	t_{PHL}, t_{PLH}	C_{P2} to Q_D	$C_L = 15pF$ $C_L = 50pF$	27 29		ns
	t_{PHL}, t_{PLH}	D_A to Q_A	$C_L = 15pF$ $C_L = 50pF$	21 23		ns
	t_{PHL}, t_{PLH}	D_D to Q_D	$C_L = 15pF$ $C_L = 50pF$	23 25		ns
	t_{PHL}, t_{PLH}	C_{LR} to Q_A	$C_L = 15pF$ $C_L = 50pF$	27 29		ns
	t_{PHL}, t_{PLH}	C_{LR} to Q_D	$C_L = 15pF$ $C_L = 50pF$	27 29		ns
	t_w	CP_1 Pulse Width Minimum		10		ns
	f_{max}	Maximum Clock Frequency		50		MHz
	C_{IN}	Input Capacitance		2		pF
192	t_{PHL}, t_{PLH}	C_{PU} or C_{PD} to Q_n	$C_L = 15pF$ $C_L = 50pF$	28 31		ns
	t_{PHL}, t_{PLH}	C_{PU} to \overline{TC}_U	$C_L = 15pF$ $C_L = 50pF$	23 26		ns
	t_{PHL}, t_{PLH}	C_{PD} to \overline{TC}_D	$C_L = 15pF$ $C_L = 50pF$	24 27		ns
	t_{PHL}, t_{PLH}	P_n to Q_n	$C_L = 15pF$ $C_L = 50pF$	25 28		ns
	t_{PHL}, t_{PLH}	\overline{PL} to Q_n	$C_L = 15pF$ $C_L = 50pF$	33 36		ns
	t_{PHL}	MR to Q_n	$C_L = 50pF$	33		ns
	C_{IN}	Input Capacitance		2		pF

AC Waveforms

Propagation Time Test Circuit


Mode Select and Function Tables

HC90

Reset/Set Inputs				Outputs			
MR ₁	MR ₂	MS ₁	MS ₂	Q ₀	Q ₁	Q ₂	Q ₃
H	H	L	X	L	L	L	L
H	H	X	L	L	L	L	L
X	X	H	H	H	L	L	H
L	X	L	X			Count	
X	L	X	L			Count	
L	X	X	L			Count	
X	L	L	X			Count	

HC160, HC162

*SR	PE	CET	CEP	Action on the Rising Clock Edge ()
L	X	X	X	RESET (Clear)
H	L	X	X	LOAD (P _n → Q _n)
H	H	H	H	COUNT (Increment)
H	H	L	X	NO CHANGE (Hold)
H	H	X	L	NO CHANGE (Hold)

* For the '162'.

HC176

Inputs				Response
MR	PL	CP		
L	X	X		Q _n forced LOW
H	L	X		P _n → Q _n
H	H			Count Up

HC192

MR	PL	CP _U	CP _D	Mode
H	X	X	X	Reset (Asyn.)
L	L	X	X	Preset (Asyn.)
L	H	H	H	No Change
L	H		H	Count Up
L	H	H		Count Down

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial