M74LS92P

DIVIDE-BY-TWELVE COUNTER

DESCRIPTION

The M74LS92P is a semiconductor integrated circuit containing an asynchronous divide-by-twelve counter function with direct reset inputs.

FEATURES

- Direct reset input provided
- Usable independently as binary and divide-by-six counter
- High-speed counting (f_{max} = 80MHz typical)
- Wide operating temperature range (T_a = −20~+75°C)

APPLICATION

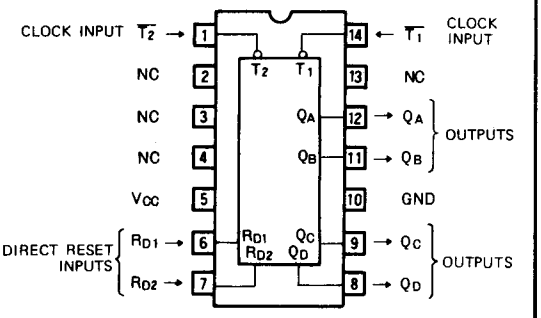
General purpose, for use in industrial and consumer equipment.

FUNCTIONAL DESCRIPTION

This device is composed of independent binary and divide-by-6 counters. Clock input $\overline{T_1}$ and output Q_A are employed for use as a binary counter while clock input $\overline{T_2}$ and Q_B, Q_C and Q_D are employed for use as a divide-by-6 counter. When employed as a divide-by-12 counter, Q_A and $\overline{T_2}$ are connected and by making $\overline{T_1}$ the input, the output appears in outputs Q_A, Q_B, Q_C and Q_D in accordance with the function table. The code appearing in the output is not pure binary code. Counting is performed when $\overline{T_1}$ and $\overline{T_2}$ are changed from high to low.

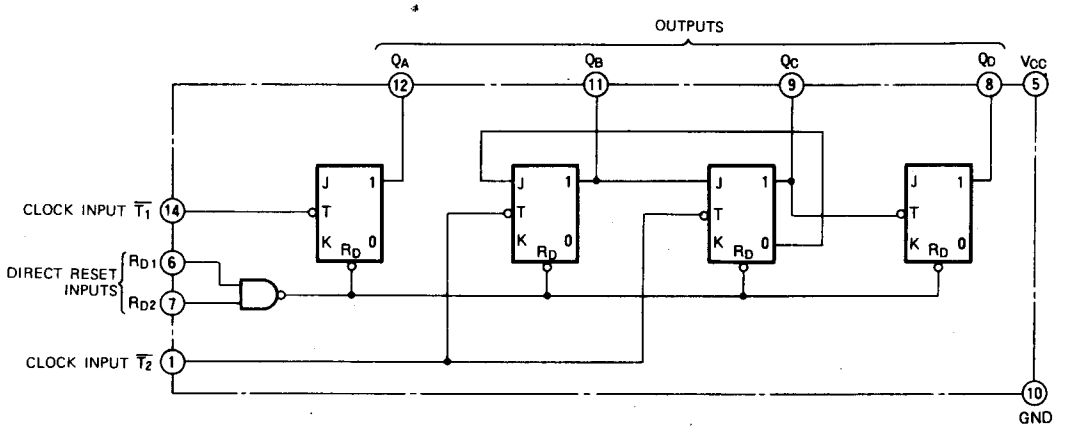
The binary and divide-by-6 counters can be reset simultaneously by setting direct reset inputs R_{D1} and R_{D2} high. For use as a counter, either R_{D1} or R_{D2} or both set low.

PIN CONFIGURATION (TOP VIEW)



Outline 14P4 NC : NO CONNECTION

BLOCK DIAGRAM



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DIVIDE-BY-TWELVE COUNTER

FUNCTION TABLE (Note 1)

$\overline{T}$	R_{D1}	R_{D2}	Q_A	Q_B	Q_C	Q_D
X	H	H	L	L	L	L
↓	L	H	Count			
↓	H	L	Count			
↓	L	L	Count			

Note 1 ↓ : Transition from high to low
X : Irrelevant

Count number	Q_A	Q_B	Q_C	Q_D
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	L	L	H
7	H	L	L	H
8	L	H	L	H
9	H	H	L	H
10	L	L	H	H
11	H	L	H	H

(1) Valid when Q_A and $\overline{T_2}$ are connected and $\overline{T_1}$ is made the input

ABSOLUTE MAXIMUM RATINGS
($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		$-0.5 \sim +7$	V
V_I	Input voltage	Inputs $\overline{T_1}$, $\overline{T_2}$	$-0.5 \sim +5.5$	V
		Inputs R_{D1}, R_{D2}	$-0.5 \sim +15$	V
V_O	Output voltage	High-level state	$-0.5 \sim V_{CC}$	V
Topr	Operating free-air ambient temperature range		$-20 \sim +75$	°C
Tstg	Storage temperature range		$-65 \sim +150$	°C

RECOMMENDED OPERATING CONDTIONS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.75	5	5.25	V
I_{OH}	High-level output current	$V_{OH} \geqq 2.7V$	0		-400	μA
I_{OL}	Low-level output current	$V_{OL} \leqq 0.4V$	0		4	mA
		$V_{OL} \leqq 0.5V$	0		8	mA

ELECTRICAL CHARACTERISTICS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter		Test conditions		Limits			Unit
					Min	Typ *	Max	
V_{IH}	High-level input voltage				2			V
V_{IL}	Low-level input voltage						0.8	V
V_{IC}	Input clamp voltage		$V_{CC}=4.75V$, $I_{IC}=-18mA$				-1.5	V
V_{OH}	High-level output voltage		$V_{CC}=4.75V$, $V_I=0.8V$					
			$V_I=2V$, $I_{OH}=-400\mu A$		2.7	3.4		V
V_{OL}	Low-level output voltage		$V_{CC}=4.75V$	$I_{OL}=4mA$ (Note 2)		0.25	0.4	V
			$V_I=0.8V$, $V_I=2V$	$I_{OL}=8mA$ (Note 2)		0.35	0.5	V
I_{IH}	High-level input current	R_{D1}, R_{D2}	$V_{CC}=5.25V$, $V_I=2.7V$				20	μA
		$\overline{T_1}$					40	
		$\overline{T_2}$					80	
		$\overline{T_1}$	$V_{CC}=5.25V$, $V_I=5.5V$				0.2	mA
		$\overline{T_2}$					0.4	
		R_{D1}, R_{D2}	$V_{CC}=5.25V$, $V_I=10V$				0.1	mA
I_{IL}	Low-level input current	R_{D1}, R_{D2}	$V_{CC}=5.25V$, $V_I=0.4V$				-0.4	mA
		$\overline{T_1}$					-2.4	
		$\overline{T_2}$					-3.2	
I_{OS}	Short-circuit output current (Note 3)		$V_{CC}=5.25V$, $V_O=0V$		-20		-100	mA
I_{CC}	Supply current		$V_{CC}=5.25V$ (Note 4)			9	15	mA

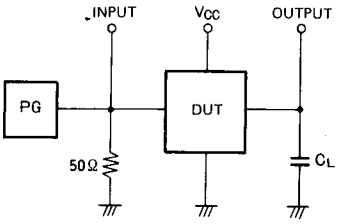
* : All typical values are at $V_{CC}=5V$, $Ta=25°C$.

Note 2: Testing of output Q_A should be conducted with input $\overline{T_2}$ connected to output Q_A.
Note 3: All measurements should be done quickly and not more than one output should be shorted at a time.
Note 4: I_{CC} is measured with $\overline{T_1}$ and $\overline{T_2}$ at 0V after R_{D1} and R_{D2} have been set to 0V from 4.5V.

SWITCHING CHARACTERISTICS (V_{CC}=5V, T_a=25°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
f_{max}	Maximum clock frequency, from input $\overline{T_1}$ to output Q_A	C_L=15pF (Note 4)	32	80		MHz
f_{max}	Maximum clock frequency, from input $\overline{T_2}$ to output Q_B		16	30		MHz
t_{PLH}	Low-to-high-level, high-to-low-level output propagation fime, from input $\overline{T_1}$ to output Q_A			7	16	ns
t_{PHL}				8	18	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input $\overline{T_1}$ to output Q_D			25	48	ns
t_{PHL}				25	50	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input $\overline{T_2}$ to output Q_B			7	16	ns
t_{PHL}				8	21	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation fime, from input $\overline{T_2}$ to output Q_C			8	16	ns
t_{PHL}				10	21	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input $\overline{T_2}$ to output Q_D			15	32	ns
t_{PHL}				15	35	ns
t_{PHL}	High-to-low-level output propagation time, from inputs R_{D1}, R_{D2} to outputs Q_A, Q_B, Q_C, Q_D			17	40	ns

Note 4: Measurement circuit



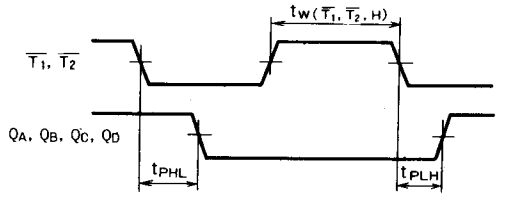
(1) The pulse generator (PG) has the following characteristics: PRR = 1MNz, t_r = 6ns, t_f = 6ns, t_w = 500ns, V_P = $3V_{P-P}$, Z_O = 50Ω.

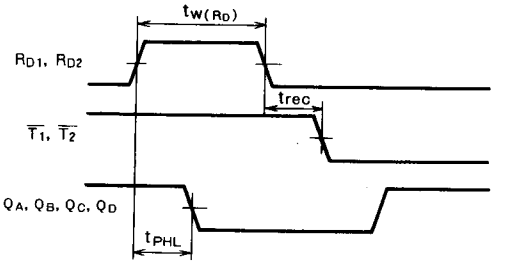
(2) C_L includes probe and jig capacitance

TIMING REQUIREMENTS (V_{CC}=5V, T_a=25°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$t_{W(\overline{T_1}H)}$	Clock input $\overline{T_1}$ high pulse width		15	6		ns
$t_{W(\overline{T_2}H)}$	Clock input $\overline{T_2}$ high pulse width		30	17		ns
$t_{W(R_D)}$	Direct reset R_{D1}, R_{D2} pulse width		15	5		ns
t_r	Clock pulse rise time			500	100	ns
t_f	Clock pulse fall time			200	100	ns
$t_{rec(R_D)}$	Recovery time R_{D1}, R_{D2} to $\overline{T_1}$, $\overline{T_2}$		25	8		ns

TIMING DIAGRAM (Reference level = 1.3V)





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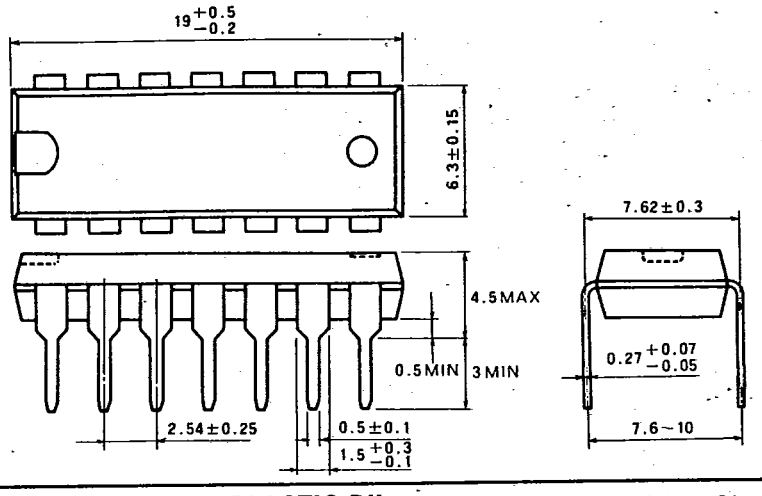
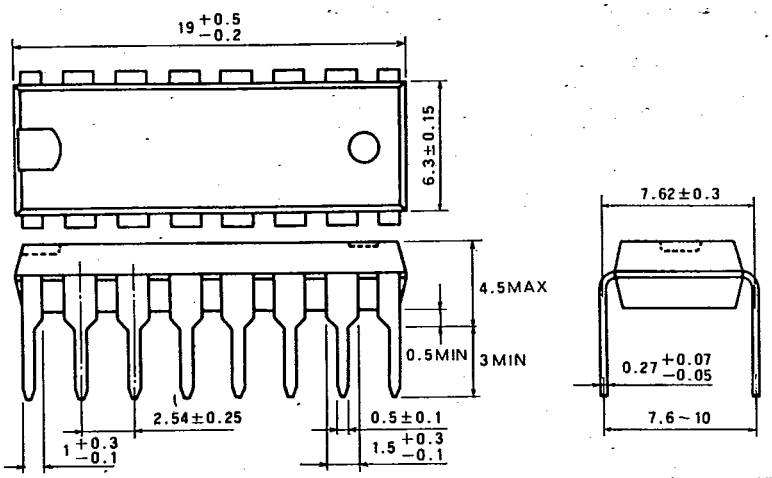
TYPE 14P4 14-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 16P4 16-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 20P4 20-PIN MOLDED PLASTIC DIL

Dimension in mm