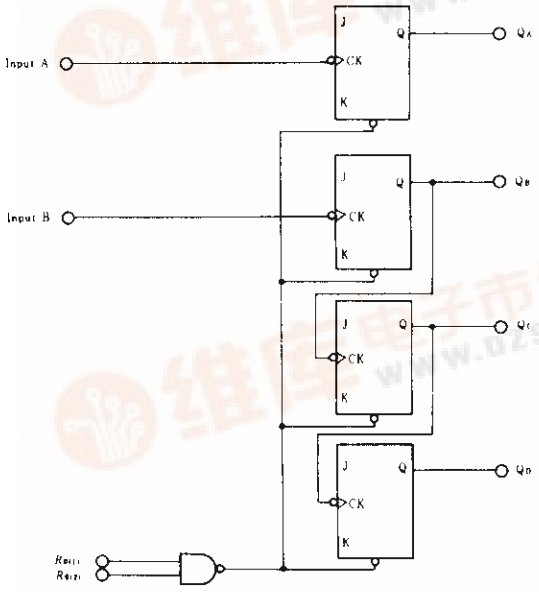
HD74LS93 ●4-bit Binary Counters

The HD74LS93 contains four master-slave flip-flops and additional gating to provide a divide-by-two counter and three-state binary counter for divide-by-eight. To use this maximum count length of this counter, the B input is connected to the Q_A output. The input count pulses are applied to input A and the outputs are described in the appropriate function table.

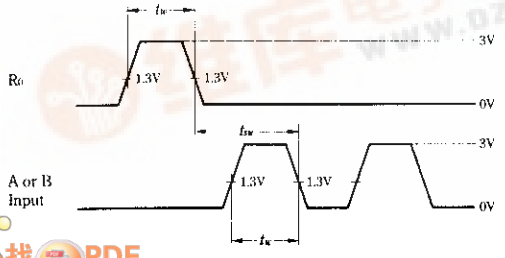
■BLOCK DIAGRAM



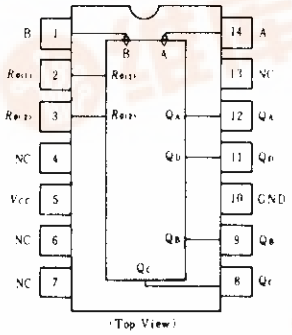
■RECOMMENDED OPERATING CONDITIONS

Item		Symbol	min	typ	max	Unit
Count frequency	A input	f_{count}	0	—	32	MHz
	B input		0	—	16	
Pulse width	A input	t_W	15	—	—	ns
	B input		30	—	—	
	Reset inputs		15	—	—	
Setup time		t_{su}	25	—	—	ns

■TIMING DEFINITION



■PIN ARRANGEMENT



■ABSOLUTE MAXIMUM RATINGS

Item		Symbol	Ratings	Unit
Supply voltage		V_{CC}	7.0	V
Input voltage	R Inputs	V_{IN}	7.0	V
	A, B Inputs		5.5	V
Operating temperature range		T_{opr}	−20 ~ +75	°C
Storage temperature range		T_{stg}	−65 ~ +150	°C

■FUNCTION TABLE

●Reset/Count Function Table

Reset Inputs		Outputs			
$R0_{(1)}$	$R0_{(2)}$	Q_D	Q_C	Q_B	Q_A
H	H	L	L	L	L
L	×	Count			
×	L	Count			

●BCD Count Sequence (Notes 1)

Count	Outputs			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

Notes) 1. Output Q_A is connected to input B for BCD count.
2. H; high level, L; low level, X; irrelevant

■ELECTRICAL CHARACTERISTICS ($Ta=-20\sim+75°C$)

Item		Symbol	Test Conditions		min	typ*	max	Unit
Input voltage		V_{IH}			2.0	–	–	V
		V_{IL}			–	–	0.8	V
Output voltage		V_{OH}	$V_{CC}=4.75V$, $V_{IH}=2V$, $V_{IL}=0.8V$, $I_{OH}=-400\mu A$		2.7	–	–	V
		V_{OL}	$V_{CC}=4.75V$, $V_{IH}=2V$, $V_{IL}=0.8V$	$I_{OL}=4mA$**	–	–	0.4	V
				$I_{OL}=8mA$**	–	–	0.5	
Input current	Any Reset	I_{IL}	$V_{CC}=5.25V$, $V_I=0.4V$		–	–	−0.4	mA
	A input				–	–	−2.4	
	B input				–	–	−1.6	
	Any Reset	I_{IH}	$V_{CC}=5.25V$, $V_I=2.7V$		–	–	20	μA
	A input				–	–	40	
	B input				–	–	40	
	Any Reset	I_I	$V_{CC}=5.25V$	$V_I=7V$	–	–	0.1	mA
	A input			$V_I=5.5V$	–	–	0.2	
	B input			$V_I=5.5V$	–	–	0.2	
Short-circuit output current		I_{OS}	$V_{CC}=5.25V$		−20	–	−100	mA
Supply current		I_{CC}***	$V_{CC}=5.25V$		–	9	15	mA
Input clamp voltage		V_{IK}	$V_{CC}=4.75V$, $I_{IN}=-18mA$		–	–	−1.5	V

* $V_{CC}=5V$, $Ta=25°C$

** Q_A output is tested at specified I_{OL} plus the limit value of I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

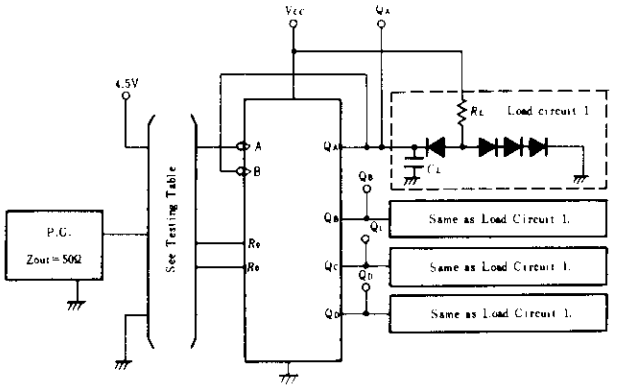
*** I_{CC} is measured with all outputs open, both R_0 inputs grounded following momentary connection to 4.5V, and all other inputs grounded.

■SWITCHING CHARACTERISTICS ($V_{CC}=5V$, $Ta=25°C$)

Item	Symbol	Inputs	Outputs	Test Conditions	min	typ	max	Unit
Maximum count frequency	f_{max}	A	Q_A	$C_L=15pF$, $R_L=2k\Omega$	32	42	–	MHz
		B	Q_B		16	–	–	
Propagation delay time	t_{PLH}	A	Q_A		–	10	16	ns
	t_{PHL}				–	12	18	
	t_{PLH}	A	Q_D		–	46	70	ns
	t_{PHL}				–	46	70	
	t_{PLH}	B	Q_B		–	10	16	ns
	t_{PHL}				–	14	21	
	t_{PLH}	B	Q_C		–	21	32	ns
	t_{PHL}				–	23	35	
	t_{PLH}	B	Q_D		–	34	51	ns
	t_{PHL}				–	34	51	
	t_{PHL}	Set-to-0	$Q_A\sim Q_D$		–	26	40	ns

■TESTING METHOD

1) Test Circuit



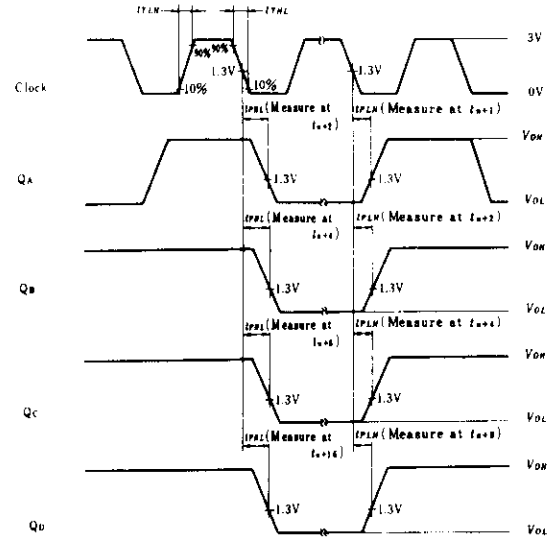
Notes) 1. C_L includes probe and jig capacitance.
2. All diodes are 1S2074 Ⓗ.

2) Testing Table

Item	From input to output	Inputs A	Inputs B	Inputs R_0	Outputs Q_A	Outputs Q_B	Outputs Q_C	Outputs Q_D
f_{max}	A →Q	IN	to Q_A	GND	Out	Out	Out	Out
	B →Q	4.5V	IN	GND	–	Out	Out	Out
t_{PLH} t_{PHL}	A →Q_A	IN	to Q_A	GND	Out	–	–	–
	A →Q_D	IN	to Q_A	GND	–	–	–	Out
	B →Q_B	4.5V	IN	GND	–	Out	–	–
	B →Q_C	4.5V	IN	GND	–	–	Out	–
	B →Q_D	4.5V	IN	GND	–	–	–	Out
	R0*→Q	IN*	to Q_A	IN	Out	Out	Out	Out

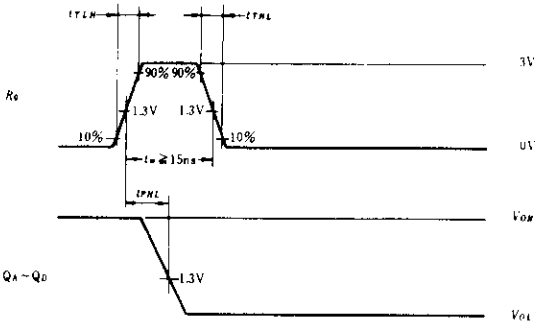
* For initialized.
** Measured with each input and unused inputs at 4.5V.

Waveform-1 f_{max}, t_{PLH}, t_{PHL}, (Clock→Q)



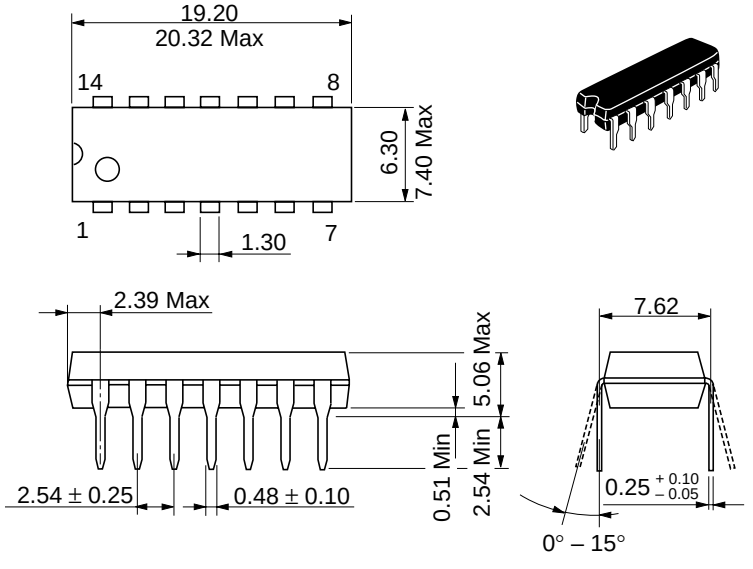
Notes) 1. Input pulse; $t_{TLH} \leqq 15$ns, $t_{THL} \leqq 5$ns, PRR=1MHz, duty cycle=50% and: for f_{max}, $t_{TLH} = t_{THL} \leqq 2.5$ns.
2. t_n is reference bit time when all outputs are low.

Waveform-2 $t_{PHL}(R_0 \rightarrow Q)$

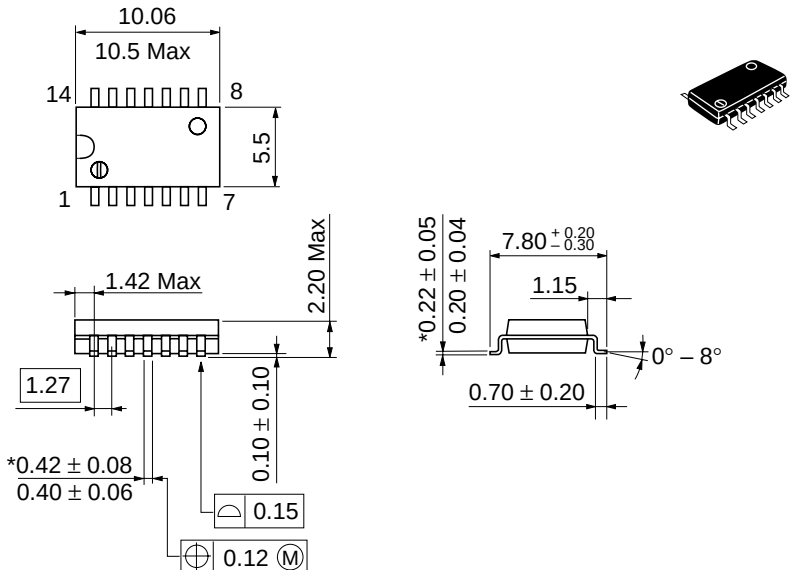


Notes) 1. $t_{TLH} \leqq 15$ns, $t_{THL} \leqq 5$ns.

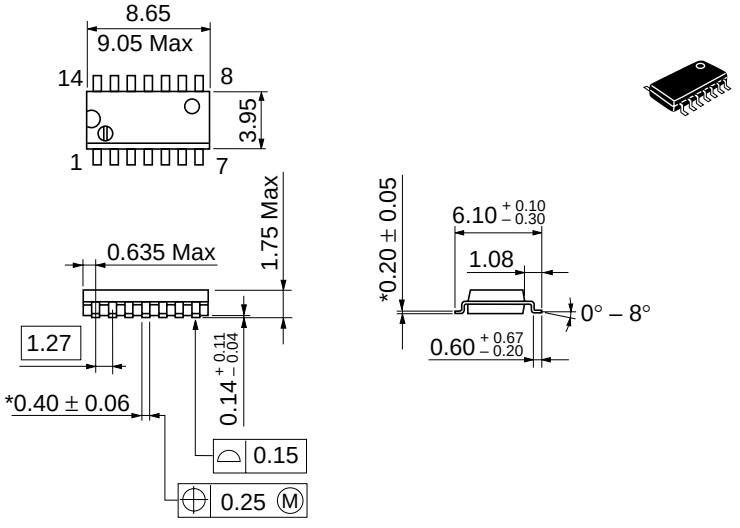
Unit: mm


19.20
20.32 Max
14
8
6.30
7.40 Max
1
1.30
7
2.39 Max
5.06 Max
0.51 Min
2.54 Min
2.54 ± 0.25
0.48 ± 0.10
7.62
0.25 +0.10 −0.05
0° – 15°

Unit: mm


10.06
10.5 Max
14
8
1
7
5.5
1.42 Max
2.20 Max
1.27
0.10 ± 0.10
*0.42 ± 0.08
0.40 ± 0.06
0.15
0.12 M
*0.22 ± 0.05
0.20 ± 0.04
7.80 +0.20 −0.30
1.15
0° – 8°
0.70 ± 0.20

Unit: mm


8.65
9.05 Max
14
8
3.95
1
7
1.75 Max
0.635 Max
1.27
*0.40 ± 0.06
0.14 +0.11 −0.04
0.15
0.25 M
*0.20 ± 0.05
6.10 +0.10 −0.30
1.08
0° – 8°
0.60 +0.67 −0.20

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