

Octal D-type flip-flop; positive edge-triggered; 3-state

General Description

The 74HC/HCT374 is an octal positive-edge triggered D-type flip-flop with 3-state outputs. The device features a clock (CP) and output enable (\overline{OE}) inputs. The flip-flops will store the state of their individual D-inputs that meet the set-up and hold time requirements on the LOW-to-HIGH clock (CP) transition. A HIGH on \overline{OE} causes the outputs to assume a high-impedance OFF-state. Operation of the \overline{OE} input does not affect the state of the flip-flops. Inputs also include clamp diodes, this enables the use of current limiting resistors to interface inputs to voltages in excess of VCC.

The 74HCT374 features reduced input threshold levels to allow interfacing to TTL logic levels.

Features:

- Input levels:
 - For 74HC374: CMOS level
 - For 74HCT374: TTL level
- Octal bus interface
- Non-inverting 3-state outputs
- 8-bit positive, edge-triggered register
- Common 3-state output enable input
- Independent register and 3-state buffer operation
- Specified from -40°C to +85°C
- Packaging information:
DIP20/SOP20/TSSOP20

ORDERING INFORMATION

DEVICE	PACKAGE TYPE	MARKING	PACKING	PACKING QTY
74HC374N	DIP20	74HC374	TUBE	720pcs/box
74HCT374N	DIP20	74HCT374	TUBE	720pcs/box
74HC374M/TR	SOP20	74HC374	REEL	2000pcs/reel
74HCT374M/TR	SOP20	74HCT374	REEL	2000pcs/reel
74HC374MT/TR	TSSOP20	HC374	REEL	2500pcs/reel
74HCT374MT/TR	TSSOP20	HCT374	REEL	2500pcs/reel

Block Diagram

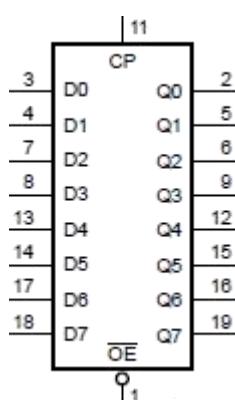


Figure 1. Logic symbol

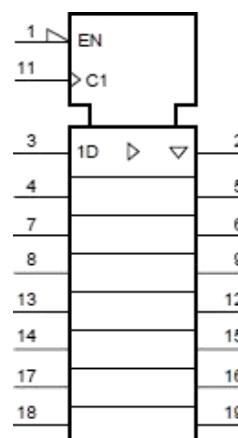


Figure 2. IEC logic symbol

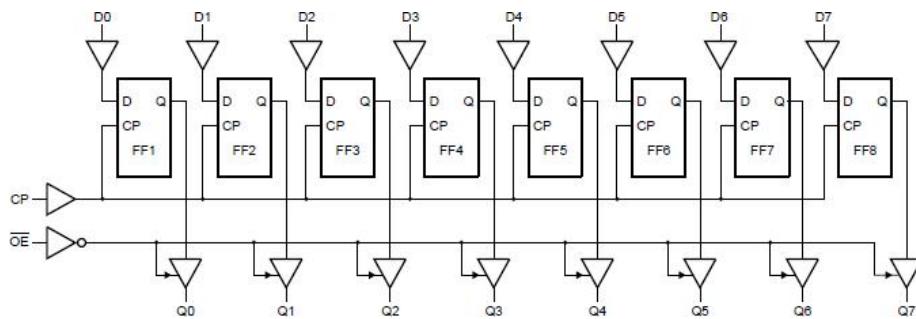


Figure 3. Logic diagram

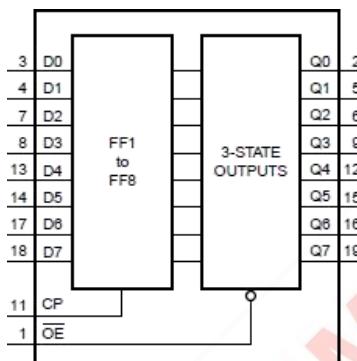
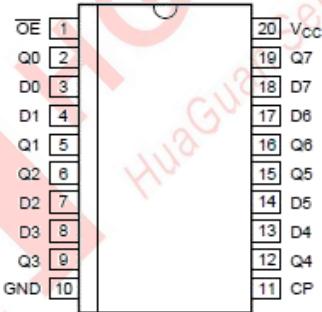


Figure 4. Functional diagram

Pin Configurations



Pin Description

Pin No.	Pin Name	Description	Pin No.	Pin Name	Description
1	OE	output enable input (active LOW)	11	CP	clock input (LOW-to-HIGH, edge-triggered)
2	Q0	data output	12	Q4	data output
3	D0	data input	13	D4	data input
4	D1	data input	14	D5	data input
5	Q1	data output	15	Q5	data output
6	Q2	data output	16	Q6	data output
7	D2	data input	17	D6	data input
8	D3	data input	18	D7	data input
9	Q3	data output	19	Q7	data output
10	GND	ground (0V)	20	VCC	supply voltage

Function Table

Operating modes	Input			Internal flip-flops	Output Qn
	OE	CP	Dn		
Load and read register	L	↑	I	L	L
	L	↑	h	H	H
Load register and disable outputs	H	↑	I	L	Z
	H	↑	h	H	Z

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care; Z=high-impedance OFF-state;

h=HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition;

I=LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition;

↑=LOW-to-HIGH clock transition.

Absolute Maximum Ratings

(Voltages are referenced to GND(ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Max.	Unit
supply voltage	V _{CC}	-		-0.5	+7.0	V
input clamping current	I _{IK}	V _I < -0.5V or V _I > V _{CC} +0.5V		-	±20	mA
output clamping current	I _{OK}	V _O < -0.5V or V _O > V _{CC} +0.5V		-	±20	mA
output current	I _O	-0.5V < V _O < V _{CC} +0.5V		-	±35	mA
supply current	I _{CC}	-		-	70	mA
ground current	I _{GND}	-		-70	-	mA
storage temperature	T _{STG}	-		-65	+150	°C
total powerdissipation	P _{TOT}	-		-	500	mW
Soldering temperature	T _L	10s	DIP	245		°C
			SOP	250		

Note:

For DIP20 packages: above 70°C the value of P_{TOT} derates linearly with 12mW/K.

For SOP20 packages: above 70°C the value of P_{TOT} derates linearly with 8mW/K.

For TSSOP20 packages: above 60°C the value of P_{TOT} derates linearly with 5.5mW/K.

Recommended Operationg Conditions

74HC374

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
supply voltage	V _{CC}	-		2.0	5.0	6.0	V
input voltage	V _I	-		0	-	V _{CC}	V
output voltage	V _O	-		0	-	V _{CC}	V
Input transitionrise and fall rate	$\Delta t/\Delta V$	V _{CC} =2.0V		-	-	625	ns/V
		V _{CC} =4.5V		-	1.67	139	ns/V
		V _{CC} =6.0V		-	-	83	ns/V
ambient emperature	T _{AMB}	-		-40	-	+85	°C

74HCT374

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
supply voltage	V _{CC}	-	4.5	5.0	5.5	V
input voltage	V _I	-	0	-	V _{CC}	V
output voltage	V _O	-	0	-	V _{CC}	V
input transitionrise and fall rate	$\Delta t/\Delta V$	V _{CC} =2.0V	-	-	-	ns/V
		V _{CC} =4.5V	-	1.67	139	ns/V
		V _{CC} =6.0V	-	-	-	ns/V
ambient temperature	T _{tamb}	-	-40	-	+85	°C

Electrical Characteristics

DC Characteristics 1

(T_{tamb}=25°C, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
74HC374							
HIGH-level input voltage	V _{IH}	V _{CC} =2.0V	1.5	1.2	-	V	
		V _{CC} =4.5V	3.15	2.4	-	V	
		V _{CC} =6.0V	4.2	3.2	-	V	
LOW-level input voltage	V _{IL}	V _{CC} =2.0V	-	0.8	0.5	V	
		V _{CC} =4.5V	-	2.1	1.35	V	
		V _{CC} =6.0V	-	2.8	1.8	V	
HIGH-level output voltage	V _{OH}	V _I = V _{IH} or V _{IL}	I _O =-20uA; V _{CC} =2.0V	1.9	2.0	-	V
			I _O =-20uA; V _{CC} =4.5V	4.4	4.5	-	V
			I _O =-20uA; V _{CC} =6.0V	5.9	6.0	-	V
			I _O =-6.0mA; V _{CC} =4.5V	3.98	4.32	-	V
			I _O =-7.8mA; V _{CC} =6.0V	5.48	5.81	-	V
LOW-level output voltage	V _{OL}	V _I = V _{IH} or V _{IL}	I _O =20uA; V _{CC} =2.0V	-	0	0.1	V
			I _O =20uA; V _{CC} =4.5V	-	0	0.1	V
			I _O =20uA; V _{CC} =6.0V	-	0	0.1	V
			I _O =6.0mA; V _{CC} =4.5V	-	0.15	0.26	V
			I _O =7.8mA; V _{CC} =6.0V	-	0.16	0.26	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =6.0V	-	-	±0.1	uA	
OFF-state output current	I _{OZ}	V _I =V _{IH} or V _{IL} ; V _{CC} =6.0V; V _O =V _{CC} or GND	-	-	±0.5	uA	
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V	-	-	8.0	uA	
input capacitance	C _I	-	-	3.5	-	pF	
74HCT374							
HIGH-level input voltage	V _{IH}	V _{CC} =4.5V to 5.5V	2.0	1.6	-	V	
LOW-level input voltage	V _{IL}	V _{CC} =4.5V to 5.5V	-	1.2	0.8	V	
HIGH-level output voltage	V _{OH}	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =-20uA	4.4	4.5	-	V
			I _O =-6.0mA	3.98	4.32	-	V
LOW-level	V _{OL}	V _I = V _{IH} or V _{IL} ;	I _O =20uA	-	0	0.1	V

output voltage		V _{CC} =4.5V	I _O =6.0mA	-	0.16	0.26	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =5.5V	-	-	±0.1	uA	
OFF-state output current	I _{OZ}	V _I =V _{IH} or V _{IL} ; V _{CC} =5.5V; V _O =V _{CC} or GND	-	-	±0.5	uA	
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =5.5V	-	-	8.0	uA	
additional supply current	ΔI _{CC}	per input pin; V _I =V _{CC} -2.1V; other inputs at V _{CC} or GND; I _O =0A; V _{CC} =4.5V to 5.5V	OE input	-	125	450	uA
			CP input	-	90	324	uA
			Dn input	-	35	126	uA
input capacitance	C _I	-	-	3.5	-	pF	

DC Characteristics 2

(T_{amb}=-40°C to +85°C, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
74HC374							
HIGH-level input voltage	V _{IH}	V _{CC} =2.0V	-	1.5	-	-	V
		V _{CC} =4.5V	-	3.15	-	-	V
		V _{CC} =6.0V	-	4.2	-	-	V
LOW-level input voltage	V _{IL}	V _{CC} =2.0V	-	-	0.5	-	V
		V _{CC} =4.5V	-	-	1.35	-	V
		V _{CC} =6.0V	-	-	1.8	-	V
HIGH-level output voltage	V _{OH}	V _I = V _{IH} or V _{IL}	I _O =-20uA; V _{CC} =2.0V	1.9	-	-	V
			I _O =-20uA; V _{CC} =4.5V	4.4	-	-	V
			I _O =-20uA; V _{CC} =6.0V	5.9	-	-	V
			I _O =-6.0mA; V _{CC} =4.5V	3.84	-	-	V
			I _O =-7.8mA; V _{CC} =6.0V	5.34	-	-	V
LOW-level output voltage	V _{OL}	V _I = V _{IH} or V _{IL}	I _O =20uA; V _{CC} =2.0V	-	-	0.1	V
			I _O =20uA; V _{CC} =4.5V	-	-	0.1	V
			I _O =20uA; V _{CC} =6.0V	-	-	0.1	V
			I _O =6.0mA; V _{CC} =4.5V	-	-	0.33	V
			I _O =7.8mA; V _{CC} =6.0V	-	-	0.33	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =6.0V		-	-	±1.0	uA
OFF-state output current	I _{OZ}	V _I =V _{IH} or V _{IL} ; V _{CC} =6.0V; V _O =V _{CC} or GND		-	-	±5.0	uA
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V		-	-	80	uA
input capacitance	C _I	-		-	-	-	pF
74HCT374							
HIGH-level input voltage	V _{IH}	V _{CC} =4.5V to 5.5V		2.0	-	-	V
LOW-level input voltage	V _{IL}	V _{CC} =4.5V to 5.5V		-	-	0.8	V
input voltage							
HIGH-level output voltage	V _{OH}	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =-20uA	4.4	-	-	V
			I _O =-6.0mA	3.84	-	-	V

LOW-level output voltage	V _{OL}	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =20uA I _O =6.0mA	-	-	0.1	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =5.5V	-	-	±1.0	uA	
OFF-state output current	I _{OZ}	V _I =V _{IH} or V _{IL} ; V _{CC} =5.5V; V _O =V _{CC} or GND	-	-	±5.0	uA	
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =5.5V	-	-	80	uA	
additional supply current	ΔI _{CC}	per input pin; V _I =V _{CC} -2.1V; other inputs at V _{CC} or GND; I _O =0A; V _{CC} =4.5V to 5.5V;	OE input	-	-	563	uA
			CP input	-	-	405	uA
			Dn input	-	-	158	uA
input capacitance	C _I	-	-	-	-	pF	

AC Characteristics 1

(T_{amb}=25°C, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
74HC374							
CP to Qn propagationdelay	t _{pd}	see Figure 6	V _{CC} =2.0V	-	50	165	ns
			V _{CC} =4.5V	-	18	33	ns
			V _{CC} =5.0V; C _L =15pF	-	15	-	ns
			V _{CC} =6.0V	-	14	18	ns
OE to Qn enable time	t _{en}	see Figure 7	V _{CC} =2.0V	-	41	150	ns
			V _{CC} =4.5V	-	15	30	ns
			V _{CC} =6.0V	-	12	26	ns
OE to Qn disable time	t _{dis}	see Figure 7	V _{CC} =2.0V	-	50	150	ns
			V _{CC} =4.5V	-	18	30	ns
			V _{CC} =6.0V	-	14	26	ns
transition time	t _t	Qn output; see Figure 6	V _{CC} =2.0V	-	14	60	ns
			V _{CC} =4.5V	-	5	12	ns
			V _{CC} =6.0V	-	4	10	ns
pulse width	t _w	CP; HIGH orLOW; see Figure 6	V _{CC} =2.0V	80	19	-	ns
			V _{CC} =4.5V	16	7	-	ns
			V _{CC} =6.0V	14	6	-	ns
Dn to CP set-up time	t _{su}	see Figure 6	V _{CC} =2.0V	60	14	-	ns
			V _{CC} =4.5V	12	5	-	ns
			V _{CC} =6.0V	10	4	-	ns
Dn to CPhold time	t _h	see Figure 6	V _{CC} =2.0V	5	-6	-	ns
			V _{CC} =4.5V	5	-2	-	ns
			V _{CC} =6.0V	5	-2	-	ns
maximum frequency	f _{max}	CP input; see Figure 6	V _{CC} =2.0V	6.0	23	-	MHz
			V _{CC} =4.5V	30	70	-	MHz
			V _{CC} =5.0V; C _L =15pF	-	77	-	MHz
			V _{CC} =6.0V	35	83	-	MHz
power dissipation capacitance	C _{PD}	per flip-flop; V _I =GND to V _{CC}	-	17	-	pF	
74HCT374							
CP to Qn propagationdelay	t _{pd}	see Figure 6	V _{CC} =4.5V	-	16	32	ns
			V _{CC} =5.0V; C _L =15pF	-	13	-	ns
OE to Qn enable time	t _{en}	V _{CC} =4.5V; see Figure 7	-	16	30	ns	
OE to Qn disable time	t _{dis}	V _{CC} =4.5V; see Figure 7	-	18	28	ns	

transition time	t_t	Qn; $V_{CC}=4.5V$; see Figure 6		-	5	12	ns
pulse width	t_w	CP; HIGH or LOW; $V_{CC}=4.5V$; see Figure 6		19	11	-	ns
Dn to CP set-up time	t_{su}	$V_{CC}=4.5V$; see Figure 6		12	7	-	ns
Dn to CPhold time	t_h	$V_{CC}=4.5V$; see Figure 6		5	-3	-	ns
maximum frequency	f_{max}	CP input; see Figure 6	$V_{CC}=4.5V$	26	44	-	MHz
		$V_{CC}=5.0V$; $C_L=15pF$		-	48	-	MHz
power dissipation capacitance	CPD	per flip-flop; $V_I=GND$ to $V_{CC}-1.5V$		-	17	-	pF

Note:

1. t_{pd} is the same as t_{PLH} and t_{PHL} .
 2. t_{en} is the same as t_{PZL} and t_{PZH} .
 3. t_{dis} is the same as t_{PLZ} and t_{PHZ} .
 4. t_t is the same as t_{THL} and t_{TLH} .
5. CPD is used to determine the dynamic power dissipation (P_D in uW).

$$P_D = C_{PD} \times V \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$$
 where:

f_i =input frequency in MHz;

V_{CC} =supply voltage in V;

f_o =output frequency in MHz;

N =number of inputs switching;

C_L =output load capacitance in pF;

$\sum(C_L \times V_{CC}^2 \times f_o)$ =sum of outputs.

AC Characteristics 2

(Tamb=-40°C to +85°C, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
74HC374						
CP to Qn propagation delay	t_{pd}	see Figure 6	$V_{CC}=2.0V$	-	-	205 ns
			$V_{CC}=4.5V$	-	-	41 ns
			$V_{CC}=5.0V$; $C_L=15pF$	-	-	- ns
			$V_{CC}=6.0V$	-	-	35 ns
\overline{OE} to Qn enable time	t_{en}	see Figure 7	$V_{CC}=2.0V$	-	-	190 ns
			$V_{CC}=4.5V$	-	-	38 ns
			$V_{CC}=6.0V$	-	-	33 ns
\overline{OE} to Qn disable time	t_{dis}	see Figure 7	$V_{CC}=2.0V$	-	-	190 ns
			$V_{CC}=4.5V$	-	-	38 ns
			$V_{CC}=6.0V$	-	-	33 ns
transition time	t_t	Qn output; see Figure 6	$V_{CC}=2.0V$	-	-	75 ns
			$V_{CC}=4.5V$	-	-	15 ns
			$V_{CC}=6.0V$	-	-	13 ns
pulse width	t_w	CP; HIGH orLOW; see Figure 6	$V_{CC}=2.0V$	100	-	- ns
			$V_{CC}=4.5V$	20	-	- ns
			$V_{CC}=6.0V$	17	-	- ns
Dn to CP set-up time	t_{su}	see Figure 6	$V_{CC}=2.0V$	75	-	- ns
			$V_{CC}=4.5V$	15	-	- ns
			$V_{CC}=6.0V$	13	-	- ns
Dn to CPhold time	t_h	see Figure 6	$V_{CC}=2.0V$	5	-	- ns
			$V_{CC}=4.5V$	5	-	- ns
			$V_{CC}=6.0V$	5	-	- ns
maximumfrequency	f_{max}	CP input; see Figure 6	$V_{CC}=2.0V$	4.8	-	- MHz
			$V_{CC}=4.5V$	24	-	- MHz
			$V_{CC}=5.0V$; $C_L=15pF$	-	-	- MHz
			$V_{CC}=6.0V$	28	-	- MHz
power dissipation capacitance	CPD	per flip-flop; $V_I=GND$ to V_{CC}		-	-	- pF

74HCT374							
CP to Qn propagation delay	tpd	see Figure 6	V _{CC} =4.5V	-	-	40	ns
			V _{CC} =5.0V; C _L =15pF	-	-	-	ns
OE to Qn enable time	t _{en}	V _{CC} =4.5V; see Figure 7			-	-	38 ns
OE to Qn disable time	t _{dis}	V _{CC} =4.5V; see Figure 7			-	-	35 ns
transition time	t _t	Qn; V _{CC} =4.5V; see Figure 6			-	-	15 ns
pulse width	t _w	CP; HIGH or LOW; V _{CC} =4.5V; see Figure 6			24	-	- ns
Dn to CP set-up time	t _{su}	V _{CC} =4.5V; see Figure 6			15	-	- ns
Dn to CP hold time	t _h	V _{CC} =4.5V; see Figure 6			5	-	- ns
maximum frequency	f _{max}	CP input; see Figure 6	V _{CC} =4.5V	21	-	-	MHz
power dissipation capacitance	C _{PD}	per flip-flop; V _I =GND to V _{CC} -1.5V			-	-	pF

Note:

6. t_{pd} is the same as t_{PLH} and t_{PHL}.
7. t_{en} is the same as t_{PZL} and t_{PZH}.
8. t_{dis} is the same as t_{PLZ} and t_{PHZ}.
9. t_t is the same as t_{THL} and t_{TLH}.
10. C_{PD} is used to determine the dynamic power dissipation (P_D in uW).

$$P_D = C_{PD} \times V_{CC} 2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$$

f_i=input frequency in MHz;

f_o=output frequency in MHz;

C_L=output load capacitance in pF;

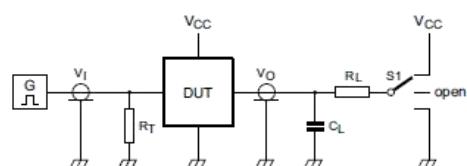
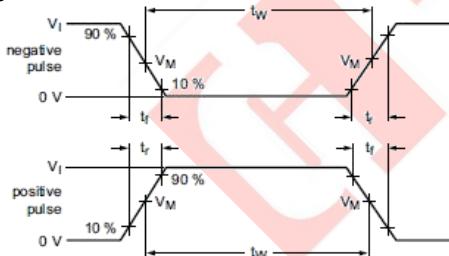
V_{CC}=supply voltage in V;

N=number of inputs switching;

$\sum (C_L \times V_{CC}^2 \times f_o)$ =sum of outputs.

Testing Circuit

AC Testing Circuit



Definitions for test circuit:

R_L=Load resistance.

C_L=Load capacitance including jig and probe capacitance.

R_T=Termination resistance should be equal to the output impedance Z_o of the pulse generator.S1=Test selection switch.

Figure 5. Test circuit for measuring switching times

AC Testing Waveforms

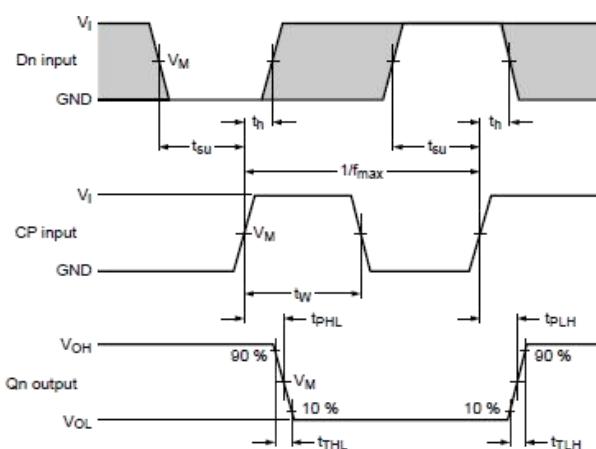


Figure 6. Clock input (CP) to output (Qn) propagation delay, clock pulse width, data (Dn) to clock (CP) set-up and hold times, output transition times (Qn) and maximum clock frequency

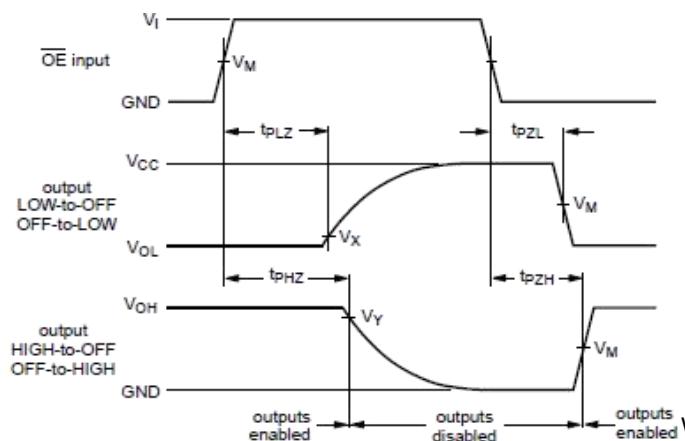


Figure 7.3-state enable and disable times

Measurement Points

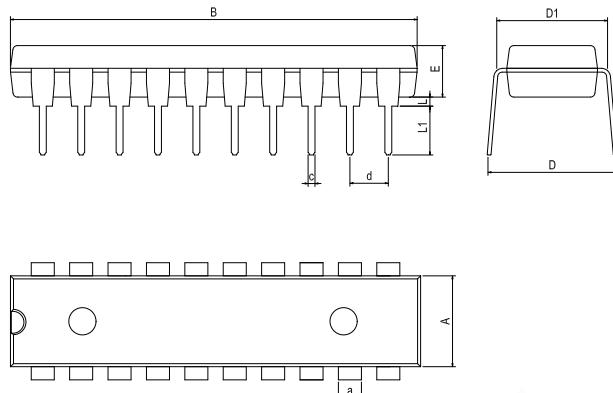
Type	Input		Output		
	V_I	V_M	V_M	V_X	V_Y
74HC374	GND to V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$
74HCT374	GND to 3V	1.3V	1.3V	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$

Test Data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74HC374	GND to V_{CC}	6ns	15pF, 50pF	1kΩ	open	GND	V_{CC}
74HCT374	GND to 3V	6ns	15pF, 50pF	1kΩ	open	GND	V_{CC}

Physical Dimensions

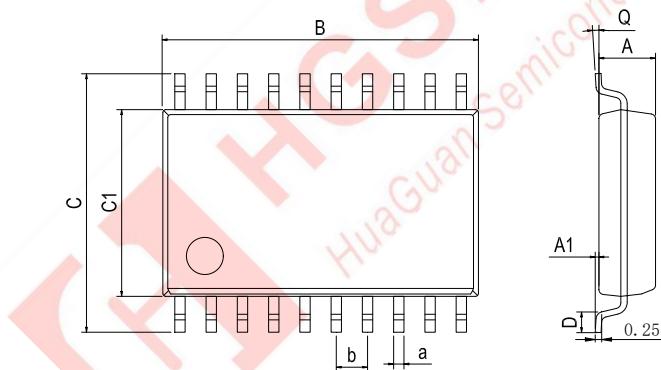
DIP20



Dimensions In Millimeters(DIP20)

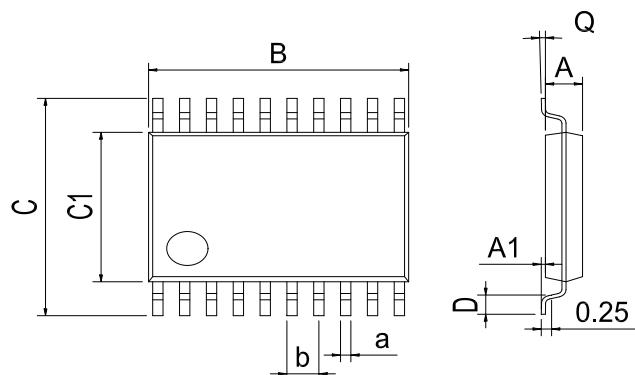
Symbol:	A	B	D	D1	E	L	L1	a	c	d
Min:	6.10	24.95	8.40	7.42	3.10	0.50	3.00	1.50	0.40	2.54 BSC
Max:	6.68	26.55	9.00	7.82	3.55	0.70	3.60	1.55	0.50	

SOP20



Dimensions In Millimeters(SOP20)

Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	2.10	0.05	12.50	10.21	7.40	0.45	0°	0.35	1.27 BSC
Max:	2.50	0.25	13.00	10.61	7.60	1.25	8°	0.45	

TSSOP20

Dimensions In Millimeters(TSSOP20)

Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.85	0.05	6.40	6.20	4.30	0.40	0°	0.20	0.65 BSC
Max:	1.05	0.20	6.60	6.60	4.50	0.80	8°	0.25	

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