74HC374; 74HCT374

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

Draft datasheet, Rev. 1.0 Aug 08, 2024

1.General Description

The 74HC374; 74HCT374 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 V_{CC}.

2.Features and Benefits

- Wide operating voltage 2.0 V to 6.0 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 250 mA
- 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
- Complies with JEDEC standards
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- ESD protection:

- HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3500 V
- CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 2000 V

3.Ordering Information

Table 1. Ordering information

Type number	Package		
	Name	Description	Quantity
74HC374D	SOP-20L	plastic small outline package; 20 leads; body width 7.5 mm	2000
74HCT374D			
74HC374PW	TSSOP-20L	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	2500
74HCT374PW			

4.Function Diagram

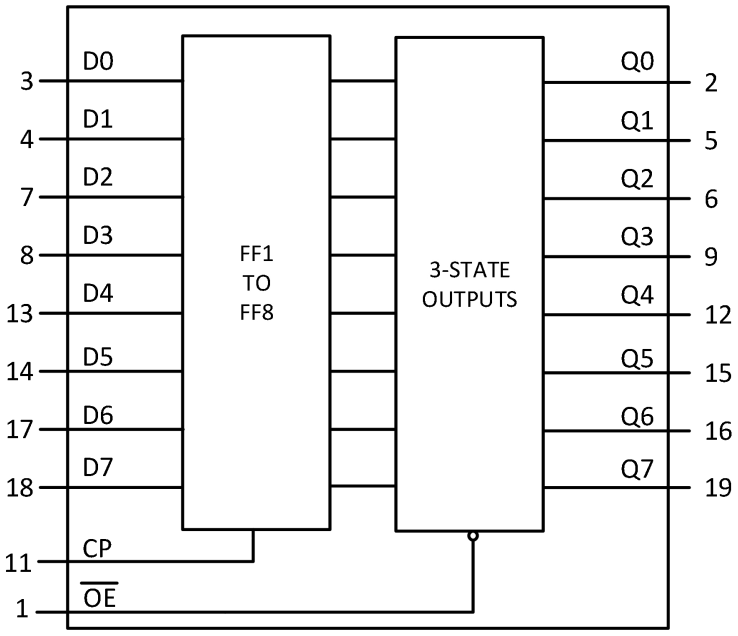


Fig 1. Functional diagram

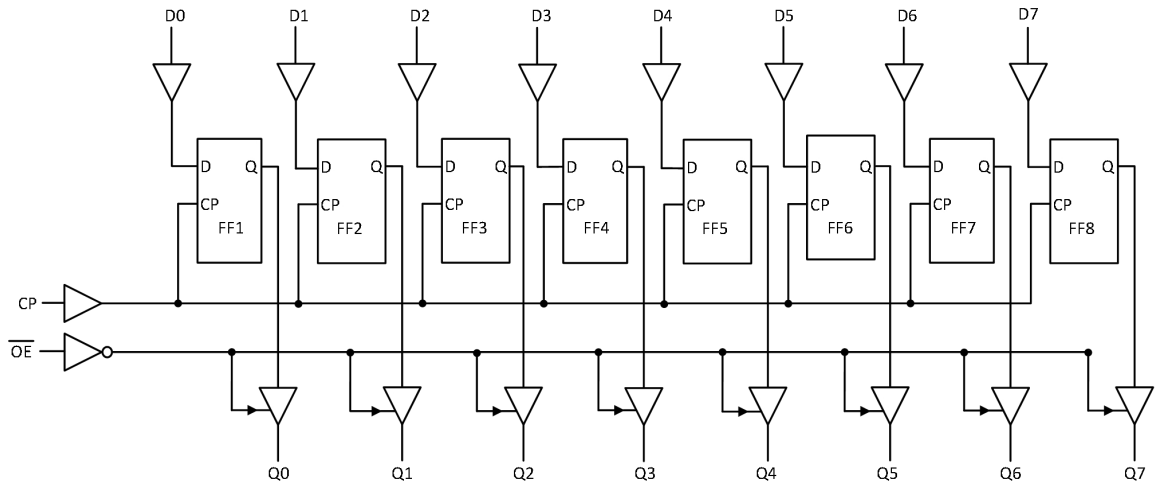


Fig 2. Logic diagram

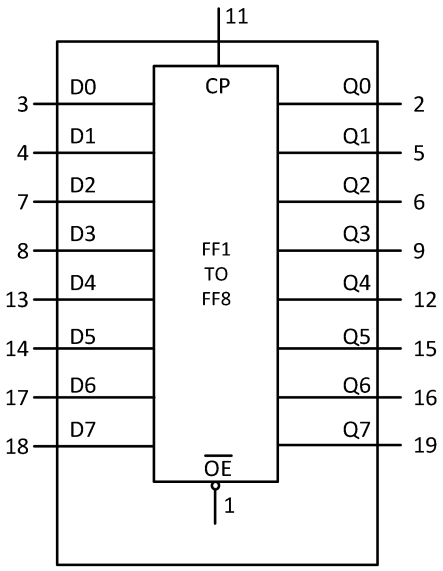


Fig 3. Logic symbol

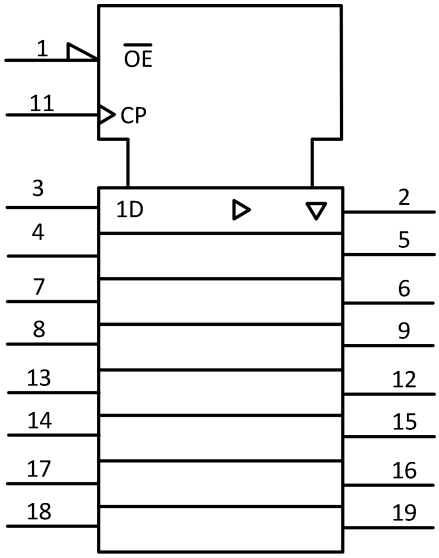


Fig 4. IEC logic symbol

5.Pinning Information

5.1. Pin map

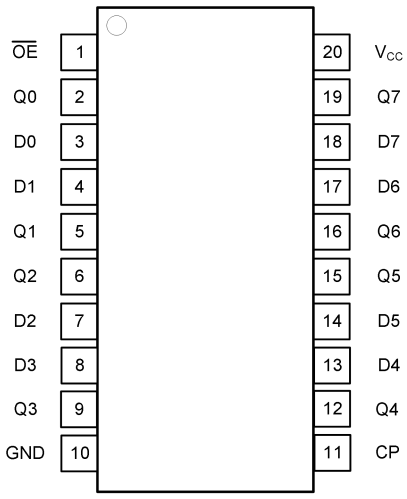


Fig 5. Top view pin configuration SOP-20L and TSSOP-20L

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{OE}$	1	output enable input (active LOW)
Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7	2, 5, 6, 9, 12, 15, 16, 19	data outputs
D0, D1, D2, D3, D4, D5, D6, D7	3, 4, 7, 8, 13, 14, 17, 18	data inputs
GND	10	ground (0V)
CP	11	clock pulse input (active rising edge)
V_{CC}	20	supply voltage

6.Functional Description

Table 3. Function table

H = HIGH voltage level; h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition; L = LOW voltage level; l = LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition; Z = high-impedance OFF-state; ↑ = LOW-to-HIGH clock transition.

Operating mode	Input			Internal flip-flops	Output
	$\overline{OE}$	CP	Dn		Qn
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Load register and disable outputs	H	↑	l	L	Z
	H	↑	h	H	Z

7.Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Table 4. Absolute Maximum Ratings

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	7	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V [1]		±20	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V [1]		±20	mA
I_O	output current	-0.5 V $< V_O < V_{CC} + 0.5$ V		±35	mA
I_{CC}	supply current			70	mA
I_{GND}	ground current		-70		mA
T_{stg}	storage temperature		-65	150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to + 125 °C		500	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

8.Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. EnergyMath does not recommend exceeding them or designing to Absolute Maximum Ratings.

Table 5. Recommended Operating Conditions

Symbol	Parameter	Conditions	74HC374			74HCT374			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V_I	input voltage		0		V_{CC}	0		V_{CC}	V
V_O	output voltage		0		V_{CC}	0		V_{CC}	V
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 2.0 V			625				ns/V
		V_{CC} = 4.5 V		1.67	139		1.67	139	ns/V
		V_{CC} = 6.0 V			83				ns/V
T_{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C

9.Static Characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
74HC374								
V_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.5	1.2		1.5		V
		V_{CC} = 4.5 V	3.15	2.4		3.15		V
		V_{CC} = 6.0 V	4.2	3.2		4.2		V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V		0.8	0.5		0.5	V
		V_{CC} = 4.5 V		2.1	1.35		1.35	V
		V_{CC} = 6.0 V		2.8	1.8		1.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}						
		I_O = -20µA; V_{CC} = 2.0 V	1.9	2.0		1.9		V
		I_O = -20µA; V_{CC} = 4.5 V	4.4	4.5		4.4		V
		I_O = -20µA; V_{CC} = 6.0 V	5.9	6.0		5.9		V
		I_O = -6.0 mA; V_{CC} = 4.5 V	3.98	4.32		3.7		V
		I_O = -7.8 mA; V_{CC} = 6.0 V	5.48	5.81		5.2		V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}						
		I_O = 20µA; V_{CC} = 2.0 V		0	0.1		0.1	V
		I_O = 20µA; V_{CC} = 4.5 V		0	0.1		0.1	V
		I_O = 20µA; V_{CC} = 6.0 V		0	0.1		0.1	V
		I_O = 6.0 mA; V_{CC} = 4.5 V		0.15	0.33		0.4	V
		I_O = 7.8 mA; V_{CC} = 6.0 V		0.16	0.33		0.4	V
I_I	input leakage current	V_I = V_{CC} or GND ; V_{CC} = 6.0 V			±1		±1	µA
I_{OZ}	OFF-state output current	V_I = V_{IH} or V_{IL}; V_{CC} = 6.0 V; V_O = V_{CC} or GND			±5		±10	µA
I_{CC}	supply current	V_I = V_{CC} or GND ; I_O = 0A ; V_{CC} = 6.0 V			80		160	µA
C_I	input capacitance			3.5				pF

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
74HCT273								
V_{IH}	HIGH-level input voltage	V_{CC} = 4.5 V to 5.5 V	2.0	1.6		2.0		V
V_{IL}	LOW-level input voltage	V_{CC} = 4.5 V to 5.5 V		1.2	0.8		0.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}; V_{CC} = 4.5 V						
		I_O = -20 µA	4.4	4.5		4.4		V
		I_O = -6 mA	3.84	4.32		3.7		
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}; V_{CC} = 4.5 V						
		I_O = 20 µA		0	0.1		0.1	V
		I_O = 6.0 mA		0.16	0.33		0.4	V
I_I	input leakage current	V_I = V_{CC} or GND ; V_{CC} = 5.5 V			±1		±1	µA
I_{OZ}	OFF-state output current	V_I = V_{IH} or V_{IL}; V_{CC} = 5.5 V; V_O = V_{CC} or GND			±5		±10	µA
I_{CC}	supply current	V_I = V_{CC} or GND ; I_O = 0A ; V_{CC} = 5.5 V			80		160	µA
ΔI_{CC}	additional supply current	per pin ; V_I = V_{CC} - 2.1 V; I_O = 0 A; other inputs at V_{CC} or GND;V_{CC} = 4.5 V to 5.5 V						
		$\overline{OE}$ input		125	563		613	µA
		CP input		90	405		441	µA
		Dn input		35	158		172	µA
C_I	input capacitance			3.5				pF

[1]All typical values are measured at T_{amb} = 25℃.

10. Dynamic Characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 8.

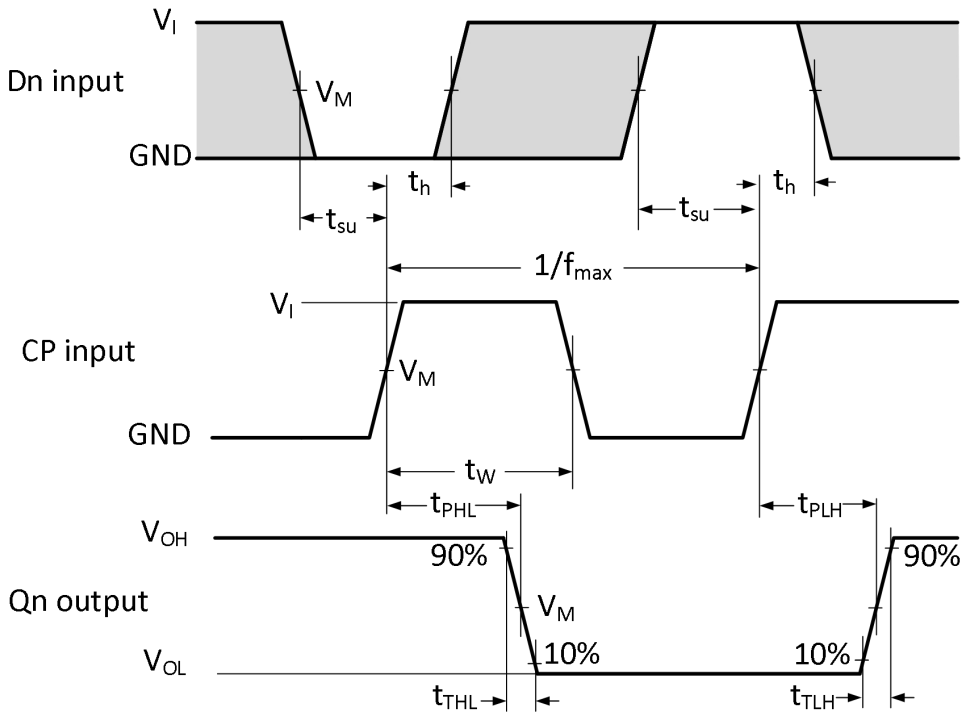
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
74HC374								
t_{pd}	propagation delay	CP to Qn; see Fig. 6 [2]						
		V_{CC} = 2.0 V		50	205		250	ns
		V_{CC} = 4.5 V		18	41		50	ns
		V_{CC} = 5.0 V; C_L = 15 pF		15				
		V_{CC} = 6.0 V		14	35		43	ns
t_{en}	enable time	$\overline{OE}$ to Qn; see Fig. 7 [3]						
		V_{CC} = 2.0 V		41	190		225	ns
		V_{CC} = 4.5 V		15	38		45	ns
		V_{CC} = 6.0 V		12	33		38	ns
t_{dis}	disable time	$\overline{OE}$ to Qn; see Fig. 7 [4]						
		V_{CC} = 2.0 V		50	190		225	ns
		V_{CC} = 4.5 V		18	38		45	ns
		V_{CC} = 6.0 V		14	33		38	ns
t_t	transition time	Qn; see Fig. 6 [5]						
		V_{CC} = 2.0 V		14	75		90	ns
		V_{CC} = 4.5 V		5	15		18	ns
		V_{CC} = 6.0 V		4	13		15	ns
t_W	pulse width	CP: HIGH or LOW; see Fig. 6						
		V_{CC} = 2.0 V	80	19		120		ns
		V_{CC} = 4.5 V	16	7		24		ns
		V_{CC} = 6.0 V	14	6		20		ns
t_{SU}	set up time	Dn to CP; see Fig.6						
		V_{CC} = 2.0 V	60	14		90		ns

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
		V_{CC} = 4.5 V	12	5		18		ns
		V_{CC} = 6.0 V	10	4		15		ns
t_h	hold time	Dn to CP; see Fig.6						
		V_{CC} = 2.0 V	5	-6		5		ns
		V_{CC} = 4.5 V	5	-2		5		ns
		V_{CC} = 6.0 V	5	-2		5		ns
f_{max}	maximum frequency	CP; see Fig.6						
		V_{CC} = 2.0 V	4.8	23		4		MHz
		V_{CC} = 4.5 V	24	70		20		MHz
		V_{CC} = 5 V; C_L= 15 pF		77				
		V_{CC} = 6.0 V	35	83		24		MHz
C_{PD}	power dissipation capacitance	per flip-flop; f_i = 1 MHz; V_I = GND to V_{CC} [6]		17				pF
74HCT374								
t_{pd}	propagation delay	CP to Qn; see Fig. 6 [2]						
		V_{CC} = 4.5 V		16	40		48	ns
		V_{CC} = 5.0 V; C_L = 15 pF		13				ns
t_{en}	enable time	$\overline{OE}$ to Qn; V_{CC} = 4.5 V; [3]		16	38		45	ns
t_{dis}	disable time	$\overline{OE}$ to Qn; V_{CC} = 4.5 V; [4]		18	35		42	ns
t_t	transition time	Qn; V_{CC} = 4.5 V; see Fig. 6 [5]		5	15		18	ns
t_W	pulse width	CP HIGH or LOW; V_{CC} = 4.5 V; see Fig. 6	19	11		29		ns
t_{su}	set up time	Dn to CP; V_{CC}=4.5 V;see Fig. 6	12	7		18		ns
t_h	hold time	Dn to CP; V_{CC}=4.5 V; see Fig. 6	5	-3		5		ns
f_{max}	maximum frequency	CP; V_{CC} = 4.5 V; see Fig.6	21	44		17		MHz
		CP; V_{CC} = 5 V; C_L = 15 pF		48				MHz
C_{PD}	power dissipation capacitance	Per package; f_i = 1 MHz; V_I = GND to V_{CC} - 1.5 V ; [6]		17				pF

[1] Typical values are measured at nominal supply voltage and 25℃.

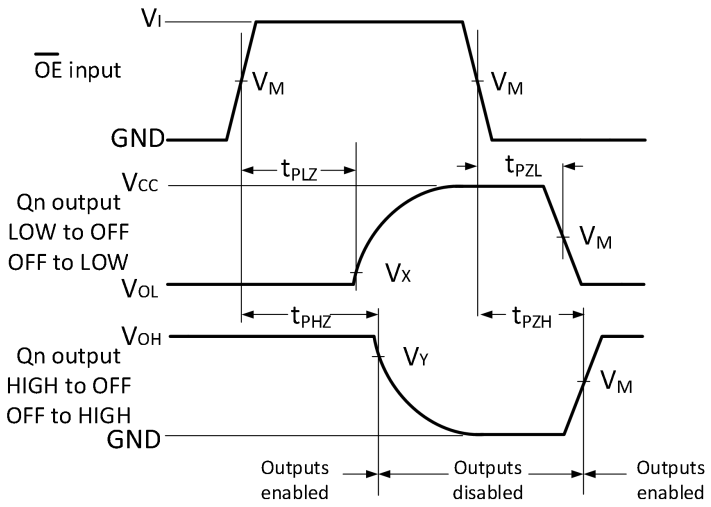
[2] t_{pd} is the same as t_{PHL} and t_{PLH}.
[3] t_{en} is the same as t_{PZL} and t_{PZH}.
[4] t_{dis} is the same as t_{PLZ} and t_{PHZ}.
[5] t_t is the same as t_{THL} and t_{TLH}.
[6] C_{PD} is used to determine the dynamic power dissipation (P_D in µW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
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;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

10.1. Waveforms and test circuit



Measurement points are given in Table 8.
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.
The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig 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



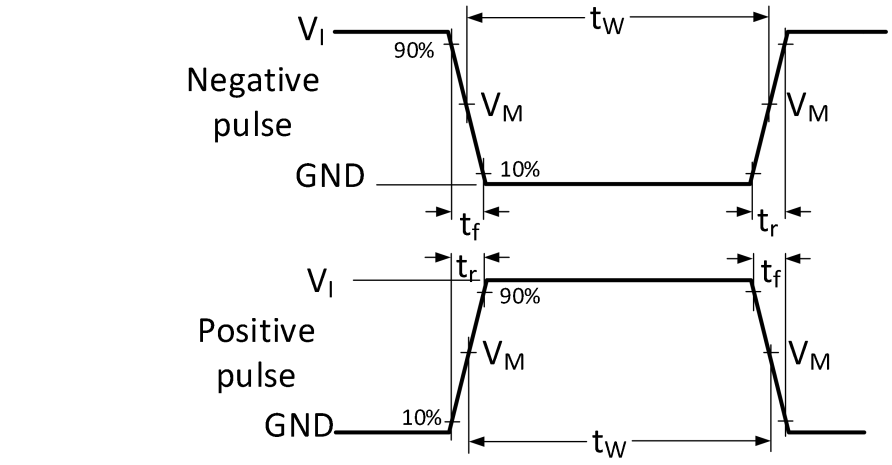
Measurement points are given in Table 8.

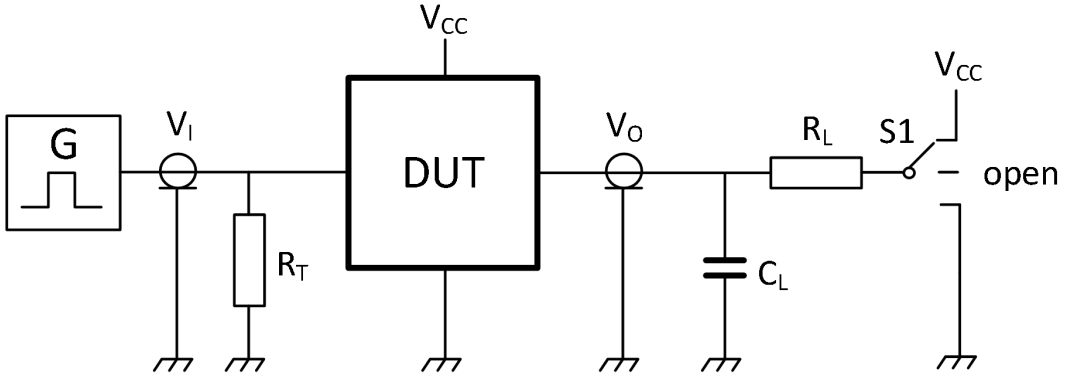
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 7. 3-state enable and disable times

Table 8. Measurement points

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





Test data is given in Table 9.
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.

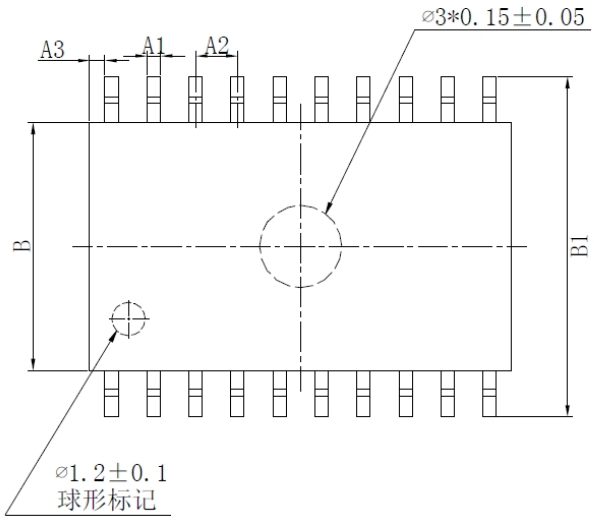
Fig 8. Test circuit for measuring switching times

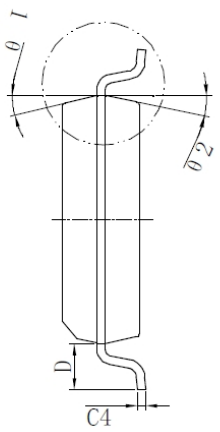
Table 9. Test data

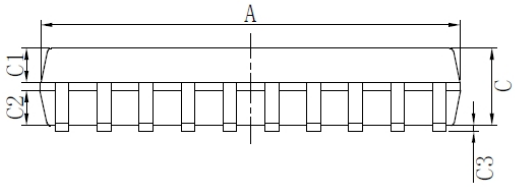
Type	Input		Load		S1 position		
	V_I	$t_r = t_f$	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74HC374	GND to V_{CC}	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V_{CC}
74HCT374	GND to 3.0V	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V_{CC}

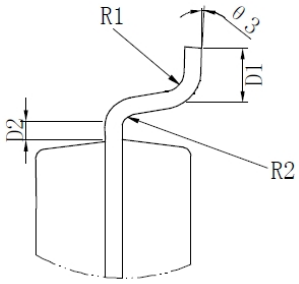
11. Package Outline

SOP-20L



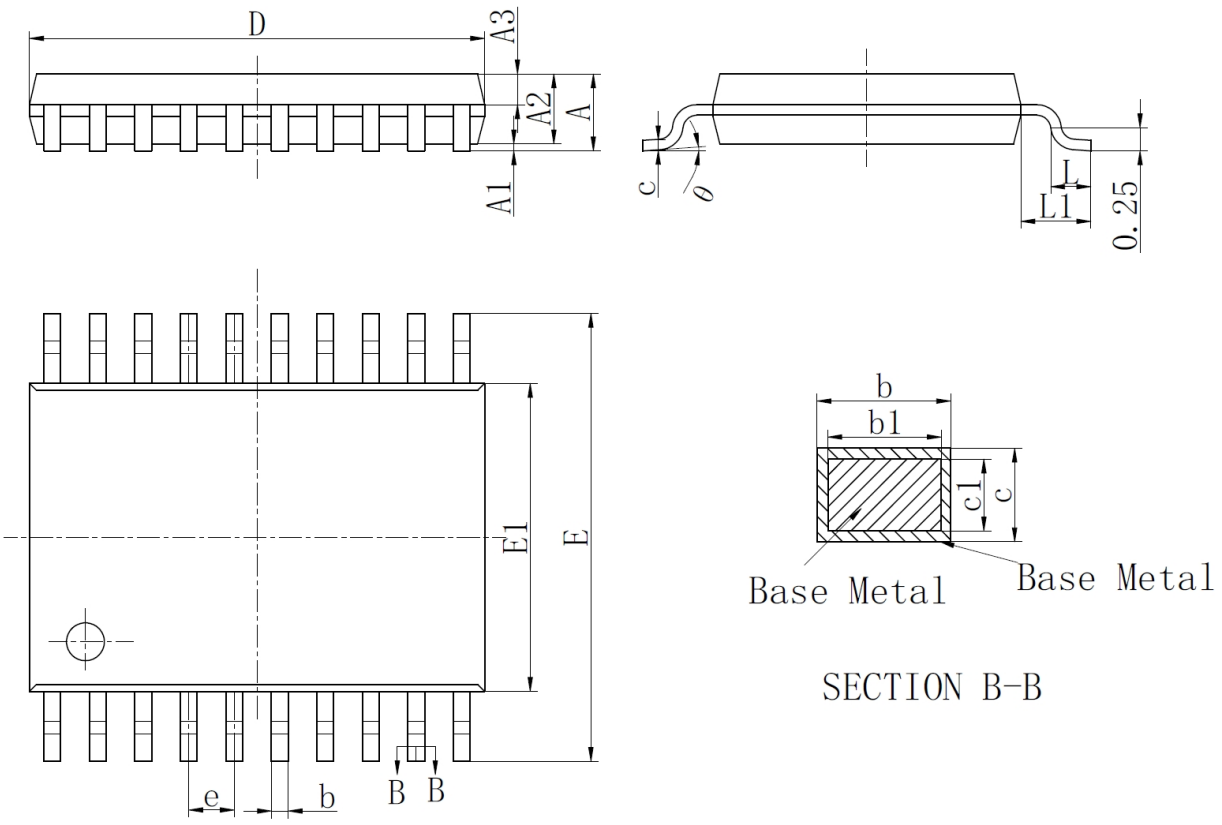






Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min.	Max.		Min.	Max.
A	12.600	12.900	C4	0.246	0.262
A1	0.381	0.431	D	1.353	1.453
A2	1.240	1.300	D1	0.764	0.964
A3	0.450	0.460	D2	0.18TYP	
B	7.400	7.600	R1	0.30TYP	
B1	10.206	10.406	R2	0.20TYP	
C	2.150	2.300	θ1	12° TYP	
C1	0.938	1.038	θ2	12° TYP	
C2	0.938	1.2038	θ3	0° ~ 8°	
C3	0.145	0.205			

TSSOP-20L



Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min.	Max.		Min.	Max.
A	-	1.20	E	6.20	6.60
A1	0.05	0.15	e	0.65BSC	
A2	0.80	1.05	L	0.45	0.75
A3	0.39	0.49	L1	1.00REF	
b	0.20	0.28	θ	0°	8°
b1	0.19	0.25			
c	0.13	0.17			
c1	0.12	0.14			
D	6.40	6.60			
E1	4.30	4.50			

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
CDM	Charge Device Model
TTL	Transistor-Transistor Logic

13. Revision History

Table 11. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
74HC_HCT374 Rev. 1.0	Aug 08, 2024	Draft datasheet		