

# 74HC374D

## 1. Functional Description

- Octal D-Type Flip Flop with 3-State Outputs

## 2. General

The 74HC374D is a high speed CMOS OCTAL FLIP-FLOP with 3-STATE OUTPUT fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

These 8-bit D-type flip-flops are controlled by a clock input (CK) and an output enable input ( $\overline{OE}$ ).

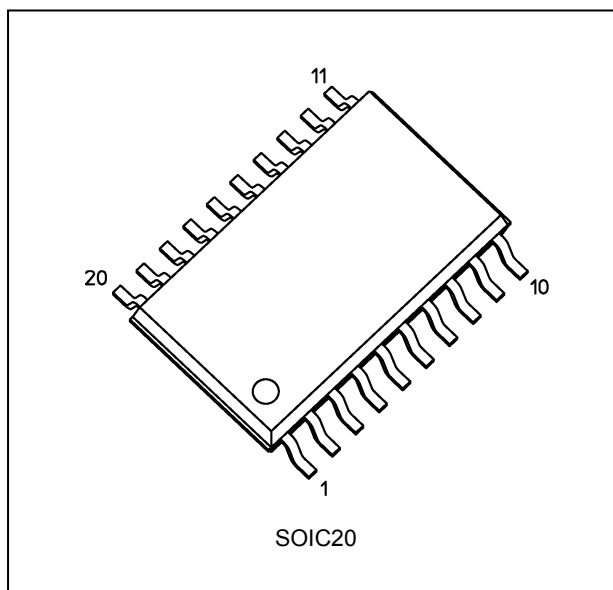
When the input is high, the eight outputs are in a high impedance state.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

## 3. Features

- (1) High speed:  $f_{\text{MAX}} = 90 \text{ MHz}$  (typ.) at  $V_{\text{CC}} = 6.0 \text{ V}$
- (2) Low power dissipation:  $I_{\text{CC}} = 4.0 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- (3) Balanced propagation delays:  $t_{\text{PLH}} \approx t_{\text{PHL}}$
- (4) Wide operating voltage range:  $V_{\text{CC(opr)}} = 2.0 \text{ V}$  to  $6.0 \text{ V}$

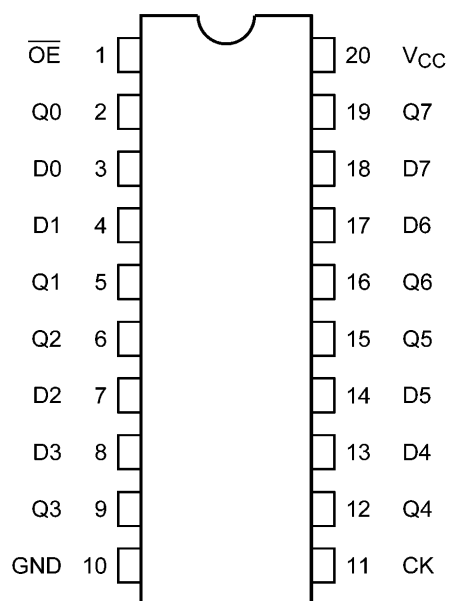
## 4. Packaging



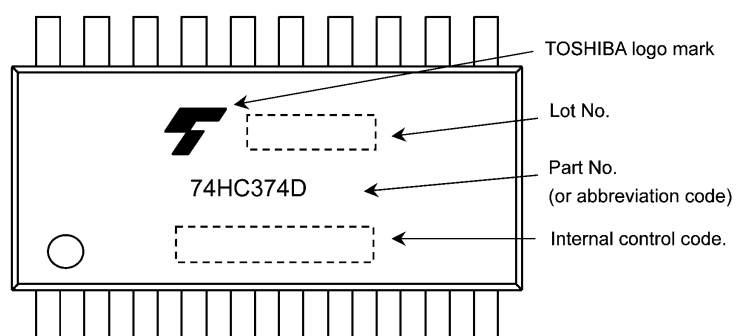
Start of commercial production

2016-03

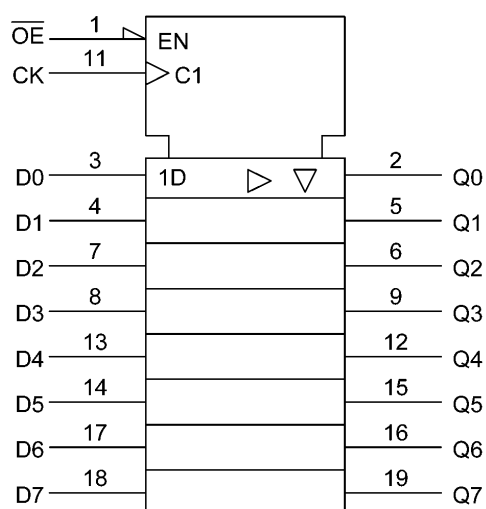
## 5. Pin Assignment






## 6. Marking



## 7. IEC Logic Symbol

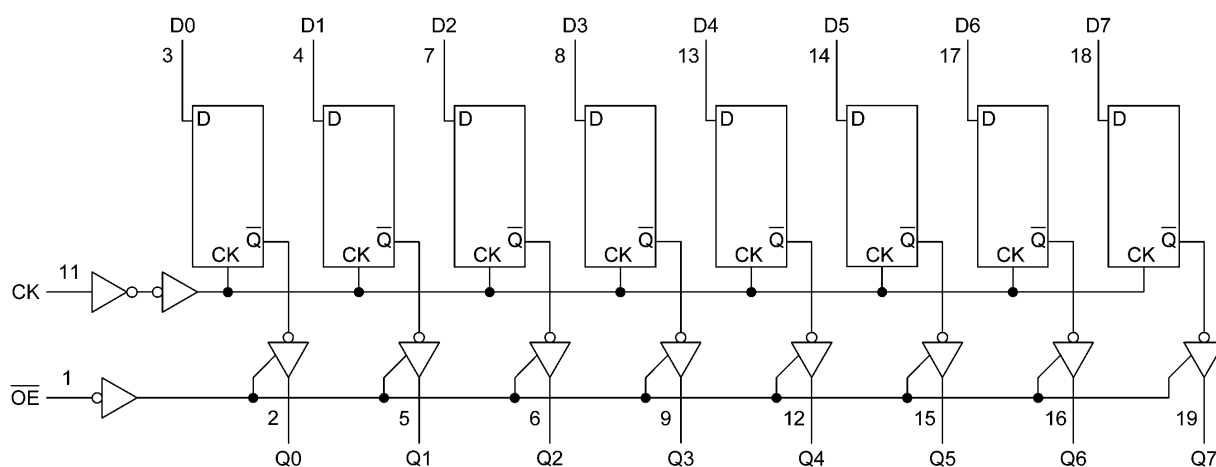


## 8. Truth Table

Inputs			Output
$\overline{OE}$	CK	D	
H	X	X	Z
L		X	Q <sub>n</sub>
L		L	L
L		H	H

X: Don't care  
 Z: High impedance  
 Q<sub>n</sub>: No change

## 9. System Diagram



## 10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Input voltage	$V_{IN}$		-0.5 to $V_{CC} + 0.5$	V
Output voltage	$V_{OUT}$		-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$		$\pm 20$	mA
Output diode current	$I_{OK}$		$\pm 20$	mA
Output current	$I_{OUT}$		$\pm 35$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 75$	mA
Power dissipation	$P_D$	(Note 1)	500	mW
Storage temperature	$T_{stg}$		-65 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1:  $P_D$  derates linearly with -8 mW/°C above 85 °C

## 11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$	—	2.0 to 6.0	V
Input voltage	$V_{IN}$	—	0 to $V_{CC}$	V
Output voltage	$V_{OUT}$	—	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	—	-40 to 125	°C
Input rise and fall times	$t_r, t_f$	—	0 to 50	µs

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{CC}$  or GND.

## 12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Typ.	Max	Unit
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	—	V
				4.5	3.15	—	—	
				6.0	4.20	—	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	—	0.50	V
				4.5	—	—	1.35	
				6.0	—	—	1.80	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	2.0	—	V
				4.5	4.4	4.5	—	
				6.0	5.9	6.0	—	
			$I_{OH} = -6\text{ mA}$	4.5	4.18	4.31	—	
			$I_{OH} = -7.8\text{ mA}$	6.0	5.68	5.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.0	0.1	V
				4.5	—	0.0	0.1	
				6.0	—	0.0	0.1	
			$I_{OL} = 6\text{ mA}$	4.5	—	0.17	0.26	
			$I_{OL} = 7.8\text{ mA}$	6.0	—	0.18	0.26	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND		6.0	—	—	$\pm 0.5$	$\mu\text{A}$
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND		6.0	—	—	$\pm 0.1$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND $I_O = 0\text{ A}$		6.0	—	—	4.0	$\mu\text{A}$

12.2. DC Characteristics (Unless otherwise specified,  $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	V
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	—	V
				4.5	4.4	—	
				6.0	5.9	—	
			$I_{OH} = -6\text{ mA}$	4.5	4.13	—	
			$I_{OH} = -7.8\text{ mA}$	6.0	5.63	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 6\text{ mA}$	4.5	—	0.33	
			$I_{OL} = 7.8\text{ mA}$	6.0	—	0.33	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND		6.0	—	$\pm 5.0$	$\mu\text{A}$
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND		6.0	—	$\pm 1.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND $I_O = 0\text{ A}$		6.0	—	40.0	$\mu\text{A}$

**12.3. DC Characteristics (Unless otherwise specified,  $T_a = -40$  to  $125\text{ }^{\circ}\text{C}$ )**

Characteristics	Symbol	Test Condition		$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		2.0	1.50	—	V
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	$V_{IL}$	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	—	V
				4.5	4.4	—	
				6.0	5.9	—	
			$I_{OH} = -6\text{ mA}$	4.5	3.7	—	
			$I_{OH} = -7.8\text{ mA}$	6.0	5.2	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 6\text{ mA}$	4.5	—	0.4	
			$I_{OL} = 7.8\text{ mA}$	6.0	—	0.4	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND		6.0	—	$\pm 10.0$	$\mu\text{A}$
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND		6.0	—	$\pm 1.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND $I_O = 0\text{ A}$		6.0	—	160.0	$\mu\text{A}$

### 12.4. Timing Requirements (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Minimum setup time (Dn)	$t_s$	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Minimum hold time (Dn)	$t_h$	—	2.0	—	0	ns
			4.5	—	0	
			6.0	—	0	
Clock frequency	f	—	2.0	—	6	MHz
			4.5	—	31	
			6.0	—	36	

### 12.5. Timing Requirements (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	—	2.0	95	ns
			4.5	19	
			6.0	16	
Minimum setup time (Dn)	$t_s$	—	2.0	95	ns
			4.5	19	
			6.0	16	
Minimum hold time (Dn)	$t_h$	—	2.0	0	ns
			4.5	0	
			6.0	0	
Clock frequency	f	—	2.0	5	MHz
			4.5	25	
			6.0	29	

### 12.6. Timing Requirements (Unless otherwise specified, $T_a = -40\text{ to }125\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	—	2.0	120	ns
			4.5	24	
			6.0	20	
Minimum setup time (Dn)	$t_s$	—	2.0	120	ns
			4.5	24	
			6.0	20	
Minimum hold time (Dn)	$t_h$	—	2.0	0	ns
			4.5	0	
			6.0	0	
Clock frequency	f	—	2.0	4	MHz
			4.5	20	
			6.0	24	

12.7. AC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^{\circ}\text{C}$ , Input:  $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$		—	50	2.0	—	20	60	ns
					4.5	—	6	12	
					6.0	—	5	10	
Propagation delay time (CK-Q)	$t_{PLH}, t_{PHL}$		—	50	2.0	—	45	140	ns
					4.5	—	15	28	
					6.0	—	13	24	
				150	2.0	—	60	190	
					4.5	—	20	38	
					6.0	—	17	32	
Output enable time	$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	50	2.0	—	39	135	ns
					4.5	—	13	27	
					6.0	—	11	23	
				150	2.0	—	54	185	
					4.5	—	18	37	
					6.0	—	15	31	
Output disable time	$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	50	2.0	—	30	135	ns
					4.5	—	13	27	
					6.0	—	12	23	
Maximum clock frequency	$f_{MAX}$		—	50	2.0	6	18	—	MHz
					4.5	31	75	—	
					6.0	36	90	—	
Input capacitance	$C_{IN}$		—			—	3	—	pF
Output capacitance	$C_{OUT}$		—			—	4	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	—			—	11	—	pF

Note 1:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8 \text{ (per latch)}$$

And the total  $C_{PD}$  when n pcs of latch operate can be gained by the following equation.

$$C_{PD} \text{ (total)} = 22 + 16 \times n$$



## 12.8. AC Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $85\text{ }^{\circ}\text{C}$ , Input:  $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	50	2.0	—	75	ns
				4.5	—	15	
				6.0	—	13	
Propagation delay time (CK-Q)	$t_{PLH}, t_{PHL}$	—	50	2.0	—	175	ns
				4.5	—	35	
				6.0	—	30	
			150	2.0	—	240	
				4.5	—	48	
				6.0	—	41	
Output enable time	$t_{PZL}, t_{PZH}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	170	ns
				4.5	—	34	
				6.0	—	29	
			150	2.0	—	230	
				4.5	—	46	
				6.0	—	39	
Output disable time	$t_{PLZ}, t_{PHZ}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	170	ns
				4.5	—	34	
				6.0	—	29	
Maximum clock frequency	$f_{MAX}$	—	50	2.0	5	—	MHz
				4.5	25	—	
				6.0	29	—	

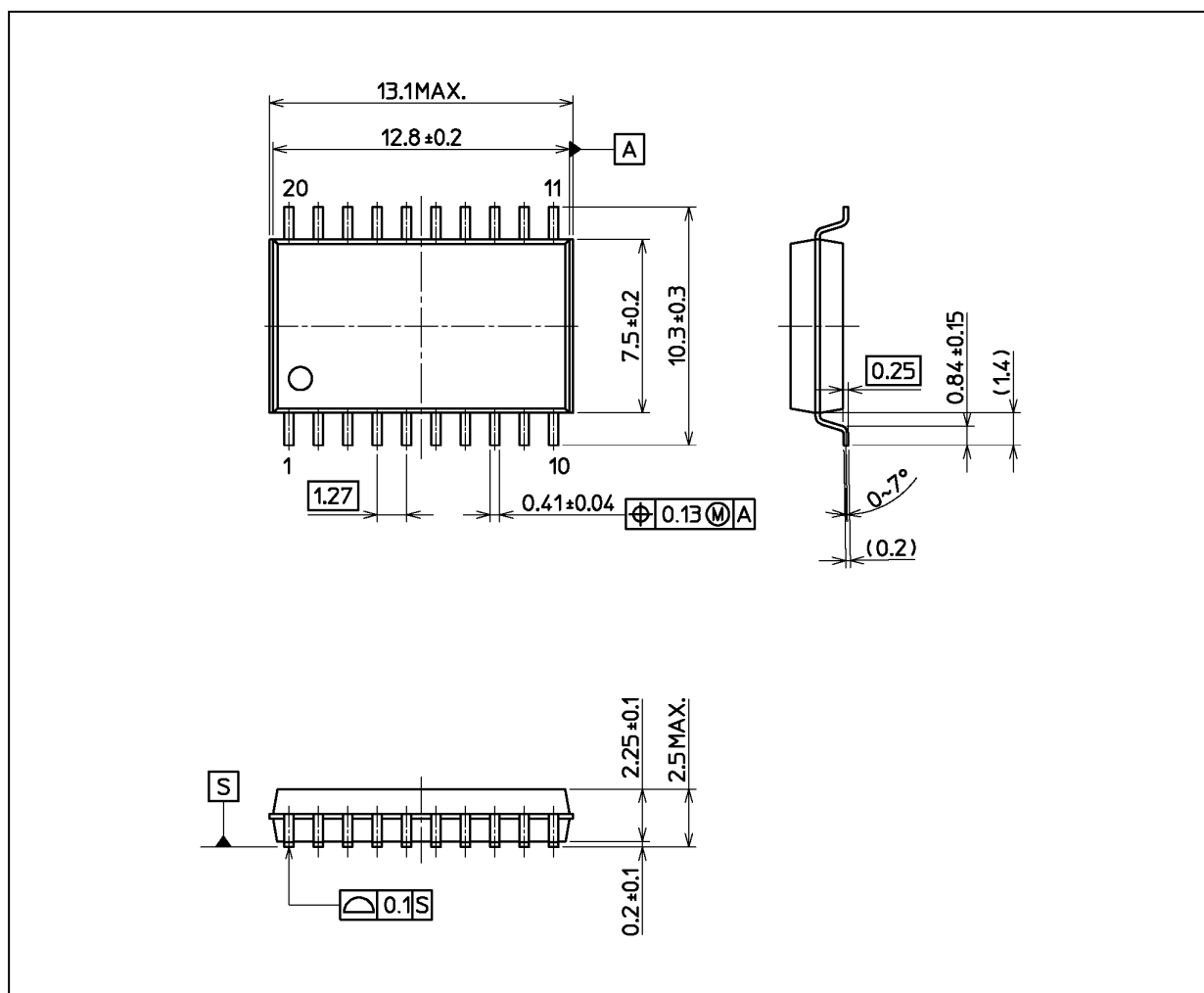
## 12.9. AC Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $125\text{ }^{\circ}\text{C}$ , Input:  $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	50	2.0	—	90	ns
				4.5	—	18	
				6.0	—	15	
Propagation delay time (CK-Q)	$t_{PLH}, t_{PHL}$	—	50	2.0	—	250	ns
				4.5	—	50	
				6.0	—	43	
			150	2.0	—	285	
				4.5	—	57	
				6.0	—	48	
Output enable time	$t_{PZL}, t_{PZH}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	205	ns
				4.5	—	41	
				6.0	—	35	
			150	2.0	—	280	
				4.5	—	56	
				6.0	—	48	
Output disable time	$t_{PLZ}, t_{PHZ}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	205	ns
				4.5	—	41	
				6.0	—	35	
Maximum clock frequency	$f_{MAX}$	—	50	2.0	4	—	MHz
				4.5	20	—	
				6.0	24	—	

## Package Dimensions

Unit: mm



Weight: 0.51 g (typ.)

Package Name(s)
Nickname: SOIC20

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