

## 54FCT374

### Octal D-Type Flip-Flop with TRI-STATE® Outputs

#### General Description

The 54FCT374 is an octal D-type flip-flop featuring separate D-type inputs for each flip-flop and TRI-STATE outputs for bus-oriented applications. A buffered Clock (CP) and Output Enable ( $\overline{OE}$ ) are common to all flip-flops.

#### Features

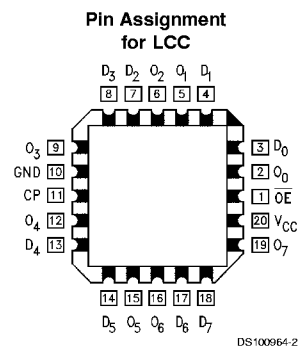
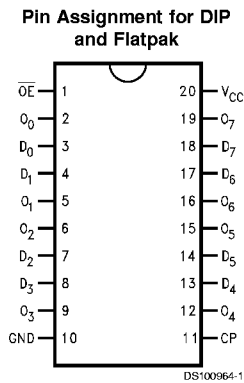
- Edge-triggered D-type inputs

- Buffered positive edge-triggered clock
- TRI-STATE outputs for bus-oriented applications
- TTL input and output level compatible
- Low CMOS power consumption
- Output sink capability of 32 mA, source capability of 12 mA
- Standard Microcircuit Drawing (SMD) 5962-9314901

#### Ordering Code

Military	Package Number	Package Description
54FCT374DMQB	J20A	20-Lead Ceramic Dual-In-Line
54FCT374FMQB	W20A	20-Lead Cerpack
54FCT374LMQB	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

#### Connection Diagrams



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## Pin Descriptions

Pin Names	Description
D <sub>0</sub> –D <sub>7</sub>	Data Inputs
CP	Clock Pulse Input (Active Rising Edge)
$\overline{OE}$	TRI-STATE Output Enable Input (Active LOW)
O <sub>0</sub> –O <sub>7</sub>	TRI-STATE Outputs

## Functional Description

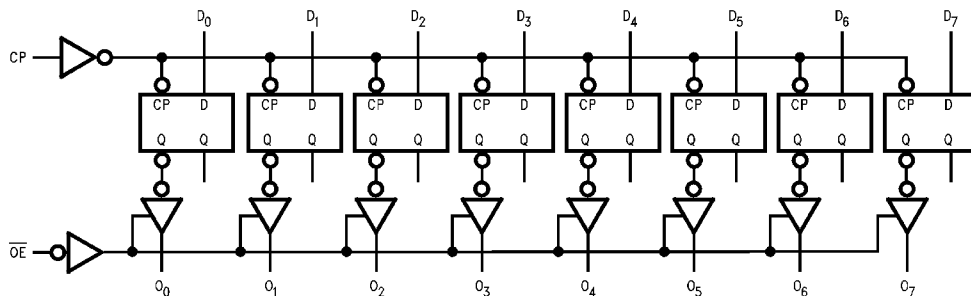
The FCT374 consists of eight edge-triggered flip-flops with individual D-type inputs and TRI-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable ( $\overline{OE}$ ) LOW, the contents of the eight flip-flops are available at the outputs. When  $\overline{OE}$  is HIGH, the outputs are in a high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

## Function Table

Inputs			Internal	Outputs	Function
$\overline{OE}$	CP	D	Q	O	
H	H	L	NC	Z	Hold
H	H	H	NC	Z	Hold
H	N	L	L	Z	Load
H	N	H	H	Z	Load
L	N	L	L	L	Data Available
L	N	H	H	H	Data Available
L	H	L	NC	NC	No Change in Data
L	H	H	NC	NC	No Change in Data

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 N = LOW-to-HIGH Transition  
 NC = No Change

## Logic Diagram



DS100964-3

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature	-65°C to +150°C
Ambient Temperature under Bias	-55°C to +125°C
Junction Temperature under Bias Ceramic	-55°C to +175°C
V <sub>CC</sub> Pin Potential to Ground Pin	-0.5V to +7.0V
Input Voltage	-0.5V to +7.0V
Input Current	-30 mA to +5.0 mA
Voltage Applied to Any Output in the Disabled or Power-Off State	-0.5V to +5.5V

in the HIGH State	-0.5V to V <sub>CC</sub>
Current Applied to Output in LOW State (Max)	twice the rated I <sub>OL</sub> (mA)
Over Voltage Latchup (I/O)	10V

## Recommended Operating Conditions

Free Air Ambient Temperature Military	-55°C to +125°C
Supply Voltage Military	+4.5V to +5.5V

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

## DC Electrical Characteristics

Symbol	Parameter	FCT374		Units	V <sub>CC</sub>	Conditions
		Min	Max			
V <sub>IH</sub>	Input HIGH Voltage	2.0		V		Recognized HIGH Signal
V <sub>IL</sub>	Input LOW Voltage		0.8	V		Recognized LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage		-1.2	V	Min	I <sub>IN</sub> = -18 mA
V <sub>OH</sub>	Output HIGH Voltage	54FCT	4.3	V	Min	I <sub>OH</sub> = -300 μA
		54FCT	2.4	V	Min	I <sub>OH</sub> = -12 mA
V <sub>OL</sub>	Output LOW Voltage	54FCT	0.2	V	Min	I <sub>OL</sub> = 300 μA
		54FCT	0.5	V	Min	I <sub>OL</sub> = 32mA
I <sub>IH</sub>	Input HIGH Current		5	μA	Max	V <sub>IN</sub> = 2.7V (Note 3)
			5	μA	Max	V <sub>IN</sub> = V <sub>CC</sub>
I <sub>IL</sub>	Input LOW Current		-5	μA	Max	V <sub>IN</sub> = 0.5V (Note 3)
			-5	μA	Max	V <sub>IN</sub> = 0.0V
I <sub>OZH</sub>	Output Leakage Current		10	μA	0 - 5.5V	V <sub>OUT</sub> = 2.7V; $\overline{OE}$ = 2.0V
I <sub>OZL</sub>	Output Leakage Current		-10	μA	0 - 5.5V	V <sub>OUT</sub> = 0.5V; $\overline{OE}$ = 2.0V
I <sub>OS</sub>	Output Short-Circuit Current		-60	mA	Max	V <sub>OUT</sub> = 0.0V
I <sub>CCQ</sub>	Power Supply Current		1.5	mA	Max	V <sub>IN</sub> = 0.2V or V <sub>IN</sub> = 5.3V, f <sub>i</sub> = 0MHz
ΔI <sub>CC</sub>	Power Supply Current		2.0	mA	Max	V <sub>IN</sub> = 3.4V
I <sub>CCCT</sub>	Additional I <sub>CC</sub> /Input		6.0	mA	Max	V <sub>I</sub> = V <sub>CC</sub> - 2.1V or V <sub>IN</sub> = GND, f <sub>CP</sub> = 10MHz, Outputs open, $\overline{OE}$ = GND, one bit toggling at f <sub>i</sub> = 5MHz, 50% duty cycle
			5.5	mA	Max	V <sub>I</sub> = 5.3V or V <sub>CC</sub> = 0.2V, f <sub>CP</sub> = 10MHz, Outputs open, $\overline{OE}$ = GND, one bit toggling at f <sub>i</sub> = 5MHz, 50% duty cycle
I <sub>CCD</sub>	Dynamic I <sub>CC</sub> No Load		0.4	mA/ MHz	Max	Outputs Open, $\overline{OE}$ = GND, One bit toggling, 50% duty cycle, V <sub>IN</sub> = 5.3V or V <sub>IN</sub> = 0.2V

Note 2: For 8-bit toggling, I<sub>CCD</sub> < 0.8 mA/MHz.

Note 3: Guaranteed, but not tested.

### AC Electrical Characteristics

Symbol	Parameter	54FCT		Units
		$T_A = -55^{\circ}\text{C to }+125^{\circ}\text{C}$ $V_{CC} = 4.5\text{V to }5.5\text{V}$ $C_L = 50\text{ pF}$		
		Min	Max	
$t_{PLH}$	Propagation Delay	2.0	11.0	ns
$t_{PHL}$	CP to $O_n$	2.0	11.0	
$t_{PZH}$	Output Enable Time	1.5	14.0	ns
$t_{PZL}$		1.5	14.0	
$t_{PHZ}$	Output Disable Time	1.5	8.0	ns
$t_{PLZ}$		1.5	8.0	

### AC Operating Requirements

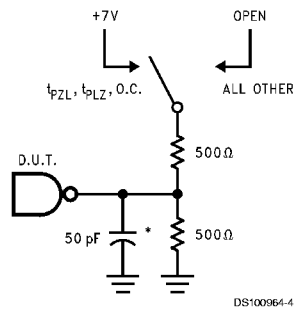
Symbol	Parameter	54FCT		Units
		$T_A = -55^{\circ}\text{C to }+125^{\circ}\text{C}$ $V_{CC} = 4.5\text{V to }5.5\text{V}$ $C_L = 50\text{ pF}$		
		Min	Max	
$t_s(H)$	Setup Time, HIGH	2.5		ns
$t_s(L)$	or LOW $D_n$ to CP	2.5		
$t_h(H)$	Hold Time, HIGH	2.5		ns
$t_h(L)$	or LOW $D_n$ to CP	2.5		
$t_w(H)$	Pulse Width, CP	7.0		ns
$t_w(L)$	HIGH or LOW	7.0		

### Capacitance

Symbol	Parameter	Typ	Units	Conditions ( $T_A = 25^{\circ}\text{C}$ )
$C_{IN}$	Input Capacitance	5.0	pF	$V_{CC} = 0\text{V}$
$C_{OUT}$ (Note 4)	Output Capacitance	9.0	pF	$V_{CC} = 5.0\text{V}$

**Note 4:**  $C_{OUT}$  is measured at frequency  $f = 1\text{ MHz}$ , per MIL-STD-883B, Method 3012.

## AC Loading



\*Includes jig and probe capacitance

FIGURE 1. Standard AC Test Load

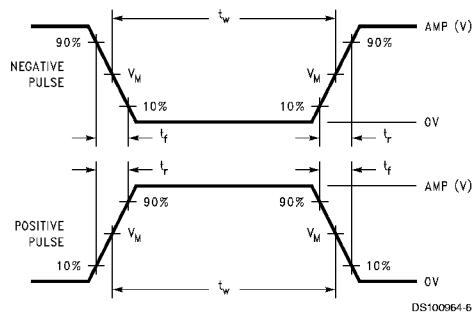


FIGURE 2.  $V_M = 1.5V$

## Input Pulse Requirements

Amplitude	Rep. Rate	$t_w$	$t_r$	$t_f$
3.0V	1 MHz	500 ns	2.5 ns	2.5 ns

FIGURE 3. Test Input Signal Requirements

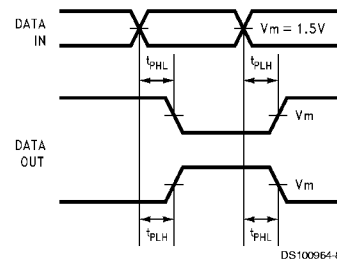


FIGURE 4. Propagation Delay Waveforms for Inverting and Non-Inverting Functions

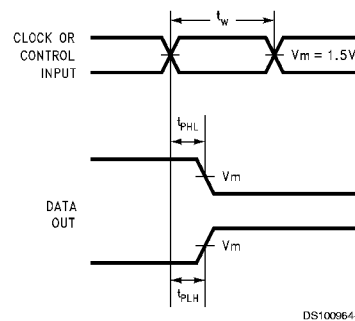


FIGURE 5. Propagation Delay, Pulse Width Waveforms

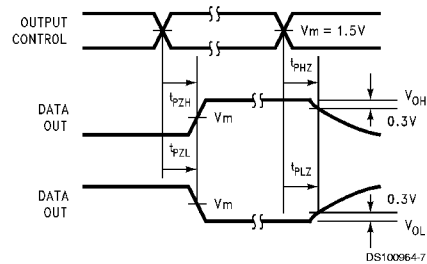


FIGURE 6. TRI-STATE Output HIGH and LOW Enable and Disable Times

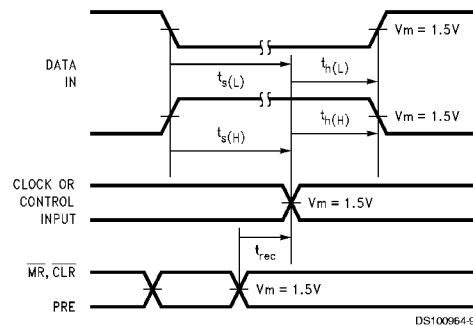
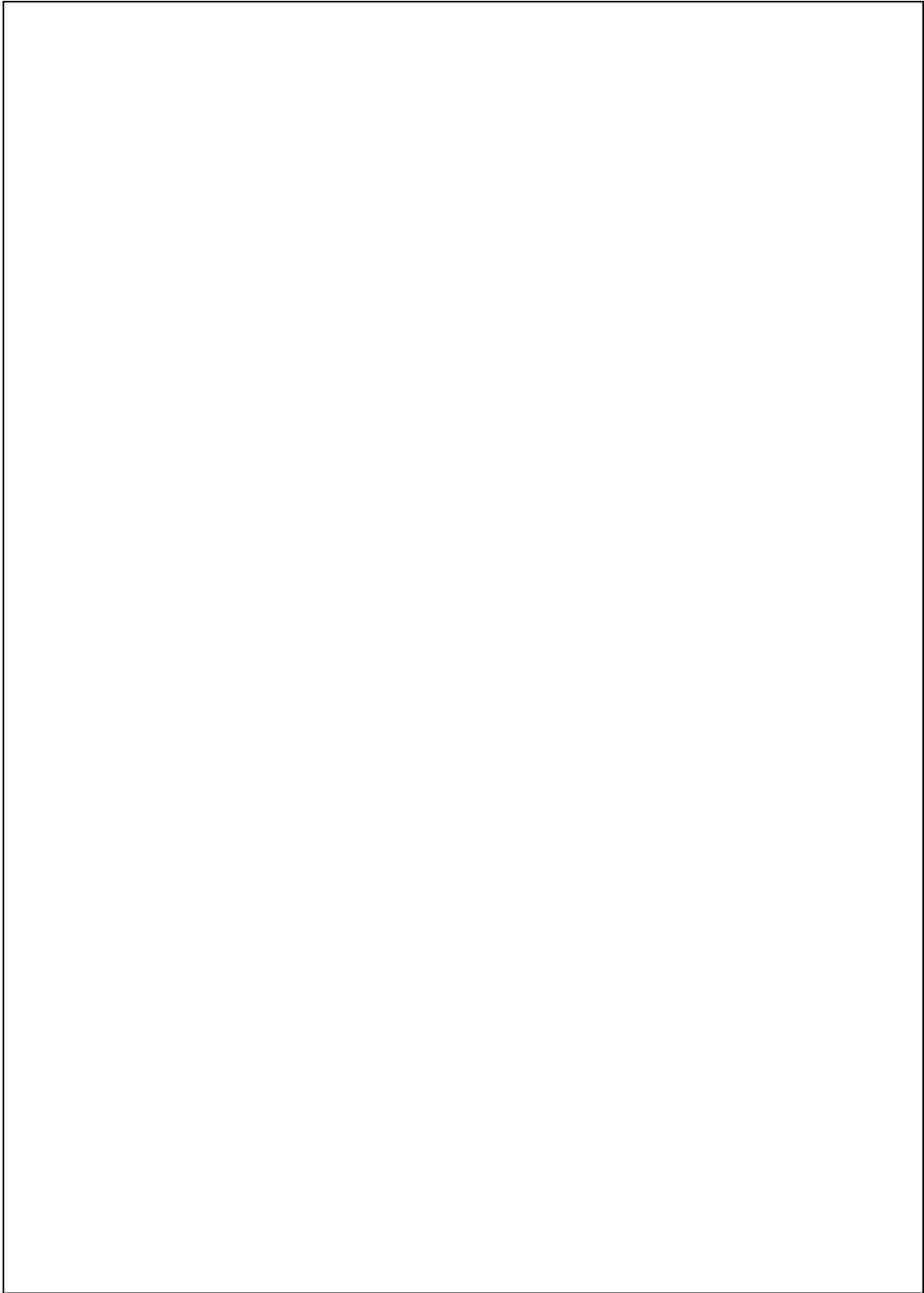
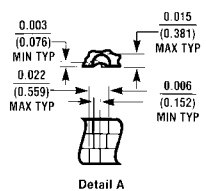
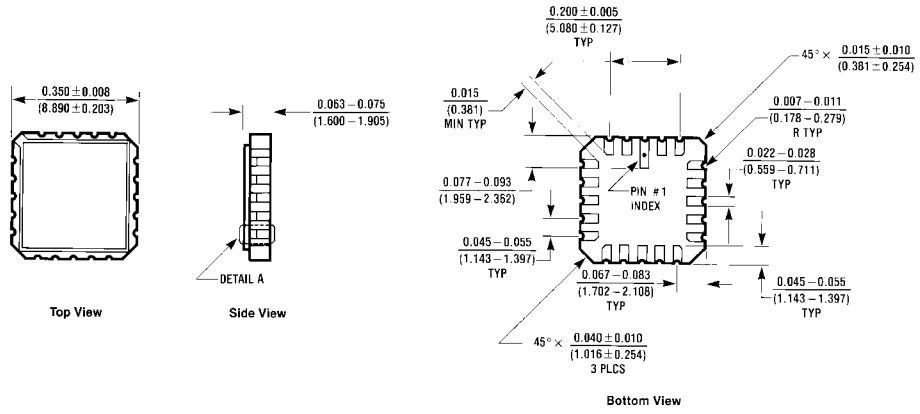


FIGURE 7. Setup Time, Hold Time and Recovery Time Waveforms

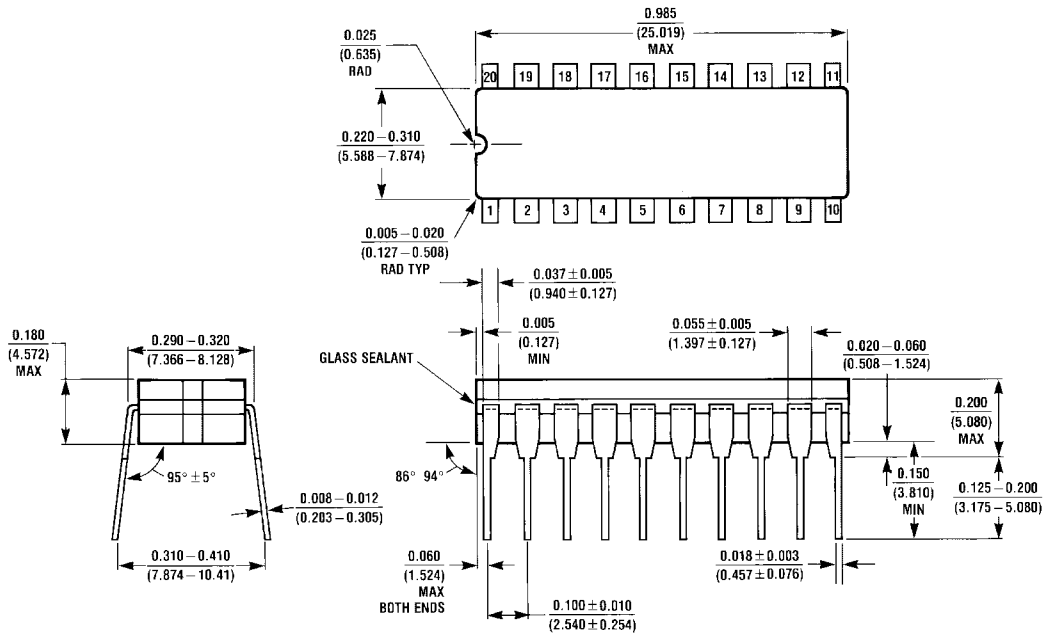


**Physical Dimensions** inches (millimeters) unless otherwise noted



L20A (REV D)

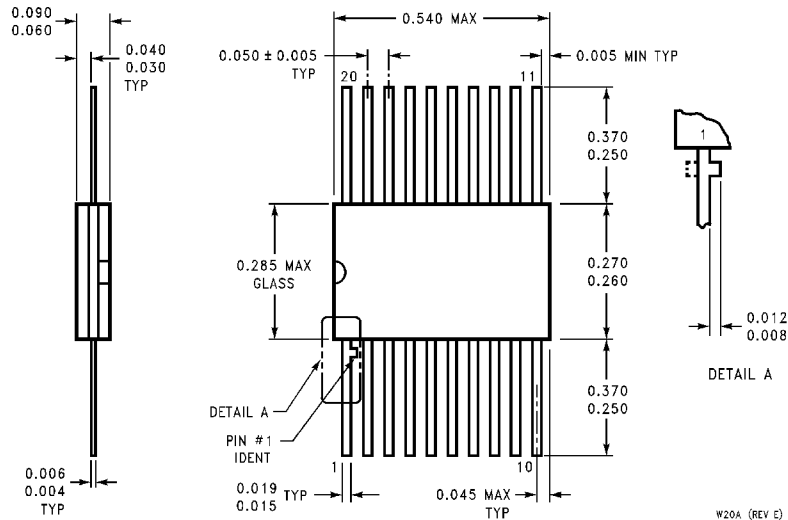
**20-Terminal Ceramic Chip Carrier (L)  
 NS Package Number E20A**



J20A (REV M)

**20-Lead Ceramic Dual-In-Line (D)  
 NS Package Number J20A**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



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