

T-46-07-11

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## 54FCT/74FCT373

### Octal Transparent Latch with TRI-STATE® Outputs

#### General Description

The 'FCT373 consists of eight latches with TRI-STATE outputs for bus organized system applications. The flip-flops appear transparent to the data when Latch Enable (LE) is HIGH. When LE is LOW, the data that meets the setup time is latched. Data appears on the bus when the Output Enable (OE) is LOW. When OE is HIGH, the bus output is in the high impedance state.

FACT FCT utilizes NSC quiet series technology to provide improved quiet output switching and dynamic threshold performance.

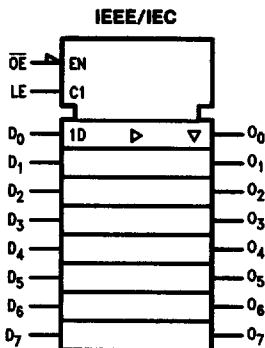
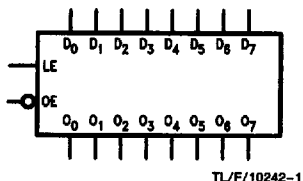
FACT FCT features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

#### Features

- $I_{CC}$  and  $I_{OZ}$  reduced to 40.0  $\mu A$  and  $\pm 2.5 \mu A$  respectively
- NSC 54FCT/74FCT373 is pin and functionally equivalent to IDT 54FCT/74FCT373
- Controlled output edge rates and undershoot for improved noise immunity. Internal split ground for improved noise immunity
- Input clamp diodes to limit bus reflections
- TTL/CMOS input and output level compatible
- $I_{OL} = 48 \text{ mA}$  (commercial) and 32 mA (military)
- CMOS power levels
- ESD immunity  $\geq 4 \text{ kV typ}$
- Military product compliant to MIL-STD 883 and standard military drawing #5962-87644

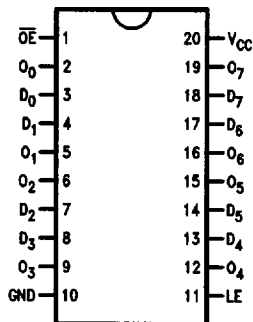
**Ordering Code:** See Section 8

#### Logic Symbols



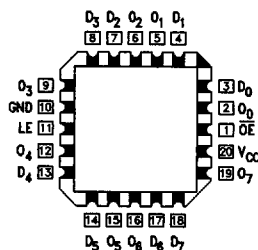
#### Connection Diagrams

Pin Assignment for DIP, Flatpak and SOIC



Pin Names	Description
D <sub>0</sub> -D <sub>7</sub>	Data Inputs
LE	Latch Enable Input
OE	Output Enable Input
O <sub>0</sub> -O <sub>7</sub>	TRI-STATE Latch Outputs

Pin Assignment for LCC



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### Functional Description

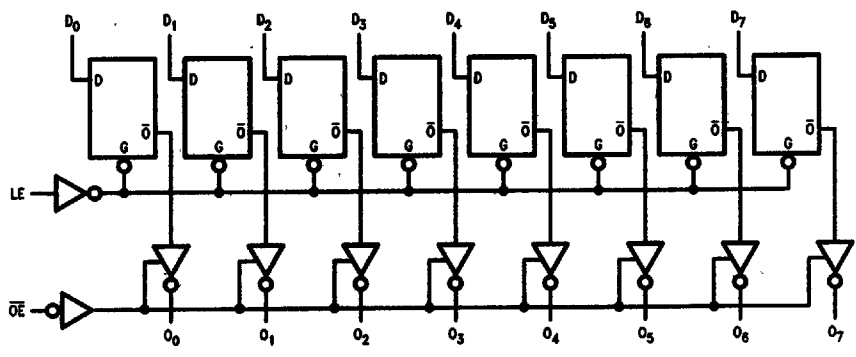
The 'FCT373 contains eight D-type latches with TRI-STATE standard outputs. When the Latch Enable (LE) input is HIGH, data on the  $D_n$  inputs enters the latches. In this condition the latches are transparent, i.e., a latch output will change state each time its D input changes. When LE is LOW, the latches store the information that was present on the D inputs a setup time preceding the HIGH-to-LOW transition of LE. The TRI-STATE standard outputs are controlled by the Output Enable ( $\overline{OE}$ ) input. When  $\overline{OE}$  is LOW, the standard outputs are in the 2-state mode. When  $\overline{OE}$  is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the latches.

### Truth Table

Inputs			Outputs
LE	$\overline{OE}$	$D_n$	$O_n$
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	$O_n$

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 Z = High Impedance  
 X = Immaterial  
 $O_n$  = Previous  $O_n$  before HIGH to Low transition of Latch Enable

### Logic Diagram



TL/F/10242-5

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 Rating (Note 1)

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

Terminal Voltage with Respect to GND ( $V_{TERM}$ )	
54FCT	-0.5V to +7.0V
74FCT	-0.5V to +7.0V
Temperature under Bias ( $T_{BIAS}$ )	
74FCT	-55°C to +125°C
54FCT	-65°C to +135°C
Storage Temperature ( $T_{STG}$ )	
74FCT	-55°C to +125°C
54FCT	-65°C to +150°C
DC Output Current ( $I_{OUT}$ )	
	120 mA

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. Exposure to absolute maximum rating conditions for extended periods may affect reliability. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables.

### Recommended Operating Conditions

Supply Voltage ( $V_{CC}$ )	
54FCT	4.5V to 5.5V
74FCT	4.75V to 5.25V
Input Voltage	
	0V to $V_{CC}$
Output Voltage	
	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	
54FCT	-55°C to +125°C
74FCT	-0°C to +70°C
Junction Temperature ( $T_J$ )	
CDIP	175°C
PDIP	140°C

Note: All commercial packaging is not recommended for applications requiring greater than 2000 temperature cycles from -40°C to +125°C.

### DC Characteristics for 'FCT Family Devices

Typical values are at  $V_{CC} = 5.0V$ , 25°C ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type: Com:  $V_{CC} = 5.0V \pm 5\%$ ,  $T_A = 0^\circ C$  to +70°C; Mil:  $V_{CC} = 5.0V \pm 10\%$ ,  $T_A = -55^\circ C$  to +125°C,  $V_{HC} = V_{CC} - 0.2V$

Symbol	Parameter	54FCT/74FCT			Units	Conditions	
		Min	Typ	Max			
$V_{IH}$	Minimum High Level Input Voltage	2.0			V		
$V_{IL}$	Maximum Low Level Input Voltage			0.8	V		
$I_{IH}$	Input High Current		5.0	5.0	$\mu A$	$V_{CC} = \text{Max}$	$V_I = V_{CC}$ $V_I = 2.7V$ (Note 2)
$I_{IL}$	Input Low Current		-5.0	-5.0	$\mu A$	$V_{CC} = \text{Max}$	$V_I = 0.5V$ (Note 2) $V_I = GND$
$I_{OZ}$	Maximum TRI-STATE Current		2.5	2.5	$\mu A$	$V_{CC} = \text{Max}$	$V_O = V_{CC}$ $V_O = 2.7V$ (Note 2) $V_O = 0.5V$ (Note 2) $V_O = GND$
$V_{IK}$	Clamp Diode Voltage		-0.7	-1.2	V	$V_{CC} = \text{Min}$ ; $I_N = -18 \text{ mA}$	
$I_{OS}$	Short Circuit Current	-60	-120		mA	$V_{CC} = \text{Max}$ (Note 1); $V_O = GND$	
$V_{OH}$	Minimum High Level Output Voltage	2.8	3.0		V	$V_{CC} = 3V$ ; $V_{IN} = 0.2V$ or $V_{HC}$ ; $I_{OH} = -32 \mu A$	
		$V_{HC}$	$V_{CC}$			$V_{CC} = \text{Min}$	$I_{OH} = -300 \mu A$
		2.4	4.3			$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -12 \text{ mA}$ (Mil) $I_{OH} = -15 \text{ mA}$ (Com)
$V_{OL}$	Maximum Low Level Output Voltage	GND	0.2		V	$V_{CC} = 3V$ ; $V_{IN} = 0.2V$ or $V_{HC}$ ; $I_{OL} = 300 \mu A$	
		GND	0.2			$V_{CC} = \text{Min}$	$I_{OL} = 300 \mu A$
		0.3	0.50			$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 32 \text{ mA}$ (Mil) $I_{OL} = 48 \text{ mA}$ (Com)
$I_{CC}$	Maximum Quiescent Supply Current		1.0	40.0	$\mu A$	$V_{CC} = \text{Max}$ $V_{IN} \geq V_{HC}$ , $V_{IN} \leq 0.2V$ $I_I = 0$	
$\Delta I_{CC}$	Quiescent Supply Current; TTL Inputs HIGH		0.5	2.0	mA	$V_{CC} = \text{Max}$ $V_{IN} = 3.4V$ (Note 3)	

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### DC Characteristics for 'FCT Family Devices

Typical values are at  $V_{CC} = 5.0V$ ,  $25^{\circ}C$  ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type: Com:  $V_{CC} = 5.0V \pm 5\%$ ,  $T_A = 0^{\circ}C$  to  $+70^{\circ}C$ ; Mil:  $V_{CC} = 5.0V \pm 10\%$ ,  $T_A = -55^{\circ}C$  to  $+125^{\circ}C$ ,  $V_{HC} = V_{CC} - 0.2V$  (Continued)

Symbol	Parameter	74FCT			Units	Conditions	
		Min	Typ	Max			
$I_{CCD}$	Dynamic Power Supply Current (Note 4)		0.15	0.45	mA/MHz	$V_{CC} = \text{Max}$ Outputs Open $\overline{OE} = \text{GND}$ $LE = V_{CC}$ One Input Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
$I_C$	Total Power Supply Current (Note 6)		1.5	4.5		mA	$V_{CC} = \text{Max}$ Outputs Open $\overline{OE} = \text{GND}$ $LE = V_{CC}$ $f_I = 10 \text{ MHz}$ One Bit Toggling 50% Duty Cycle
			1.8	5.0	$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$		
			3.0	8.0	(Note 5) $V_{CC} = \text{Max}$ $\overline{OE} = \text{GND}$ $LE = V_{CC}$		$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
			5.0	14.5	Outputs Open $f_I = 2.5 \text{ MHz}$ Eight Bits Toggling 50% Duty Cycle		$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$
$V_H$	Input Hysteresis on LE Only		200		mV		

- Note 1: Maximum test duration not to exceed one second, not more than one output shorted at one time.
- Note 2: This parameter guaranteed but not tested.
- Note 3: Per TTL driven input ( $V_{IN} = 3.4V$ ); all other inputs at  $V_{CC}$  or GND.
- Note 4: This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
- Note 5: Values for these conditions are examples of the  $I_{CC}$  formula. These limits are guaranteed but not tested.
- Note 6:  $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$   
 $I_{CC}$  = Quiescent Current  
 $\Delta I_{CC}$  = Power Supply Current for a TTL High Input ( $V_{IN} = 3.4V$ )  
 $D_H$  = Duty Cycle for TTL Inputs High  
 $N_T$  = Number of Inputs at  $D_H$   
 $I_{CCD}$  = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)  
 $f_{CP}$  = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 $f_I$  = Input Frequency  
 $N_I$  = Number of Inputs at  $f_I$   
 All currents are in milliamperes and all frequencies are in megahertz.
- Note 7: For 54FCT,  $I_{CCD} = 0.40 \text{ mA/MHz}$ .  
 Refer to applicable standard military drawing or NSC Table I for test conditions and  $I_C/I_{CC}$  limits.

**AC Electrical Characteristics:** See Section 2 for Waveforms

Symbol	Parameter	54FCT/74FCT	74FCT		54FCT		Units	Fig. No.
		$T_A = +25^\circ\text{C}$ $V_{CC} = 5.0\text{V}$	$T_A, V_{CC} = \text{Com}$ $R_L = 500\Omega$ $C_L = 50\text{pF}$		$T_A, V_{CC} = \text{MH}$ $R_L = 500\Omega$ $C_L = 50\text{pF}$			
		Typ	Min (Note 1)	Max	Min	Max		
$t_{PLH}$ $t_{PHL}$	Propagation Delay $D_n$ to $O_n$	5.0	1.5	8.0	1.5	8.5	ns	2-8
$t_{PZH}$ $t_{PZL}$	Output Enable Time	7.0	1.5	12.0	1.5	13.5	ns	2-11
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time	6.0	1.5	7.5	1.5	10.0	ns	2-11
$t_{PLH}$ $t_{PHL}$	Propagation Delay LE to $O_n$	9.0	2.0	13.0	2.0	15.0	ns	2-8
$t_{SU}$	Set Up Time High or Low $D_n$ to LE	1.0	2.0		2.0		ns	2-10
$t_H$	Hold Time High or Low $D_n$ to LE	1.0	1.5		3.0		ns	2-10
$t_W$	LE Pulse Width High or Low	5.0	6.0		6.0		ns	2-9

Note 1: Minimum limits are guaranteed but not tested on propagation delays.

**Capacitance**  $T_A = +25^\circ\text{C}, f = 10\text{MHz}$

Symbol	Parameter (Note)	Typ	Max	Units	Condition
$C_{IN}$	Input Capacitance	6	10	pF	$V_{IN} = 0\text{V}$
$C_{OUT}$	Output Capacitance	8	12	pF	$V_{OUT} = 0\text{V}$

Note: This parameter is measured at characterization but not tested.

$C_{OUT}$  for 74FCT only.