



## 54FCT/74FCT564A Octal D Flip-Flop with TRI-STATE® Outputs

### General Description

The 'FCT564A is a high-speed, low power octal flip-flop with a buffered common Clock (CP) and a buffered common Output Enable (OE). The information presented to the D inputs is stored in the flip-flops on the LOW-to-HIGH Clock (CP) transition.

The 'FCT564A device is functionally identical to the 'FCT574A, but with inverted outputs.

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

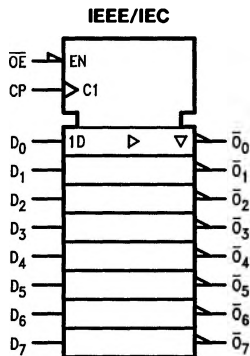
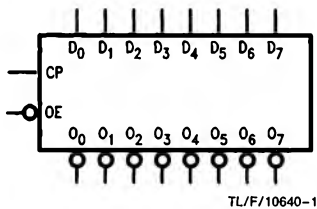
FACT FCTA features undershoot correction and split ground bus for superior performance.

### Features

- TRI-STATE outputs for bus-oriented applications
- Useful as input or output port for microprocessors
- Input clamp diodes to limit bus reflections
- TTL/CMOS input and output level compatible
- $I_{OL} = 48 \text{ mA (Com)}, 32 \text{ mA (Mil)}$
- CMOS power levels
- 4 kV minimum ESD immunity
- Military product compliant to MIL-STD-883
- Inherently radiation tolerant

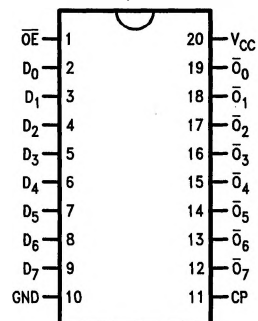
**Ordering Code:** See Section 8

### Logic Symbols

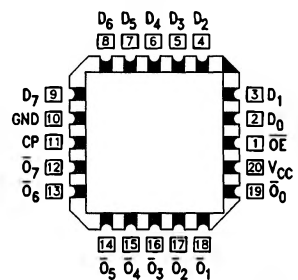


### Connection Diagrams

#### Pin Assignment for DIP, Flatpak and SOIC



#### Pin Assignment for LCC



Pin Names	Description
D <sub>0</sub> -D <sub>7</sub>	Data Inputs
CP	Clock Pulse Input
$\overline{OE}$	TRI-STATE Output Enable Input
$\overline{O_0}$ - $\overline{O_7}$	TRI-STATE Outputs

**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 ( $V_{TERM}$ )	
54FCTA	-0.5V to 7.0V
74FCTA	-0.5 to 7.0V
Temperature Under Bias ( $T_{BIAS}$ )	
74FCTA	-55°C to +125°C
54FCTA	-65°C to +135°C
Storage Temperature ( $T_{STG}$ )	
74FCTA	-55°C to +125°C
54FCTA	-65°C to +150°C
Power Dissipation ( $P_T$ )	0.5w
DC Output Current ( $I_{OUT}$ )	120 mA

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. 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. National does not recommend operation of FACT™ FCT circuits outside databook specifications.

**Recommended Operating Conditions**

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

**DC Characteristics for 'FCTA 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 +5%,  $T_A$  = 0°C to +70°; Mil:  $V_{CC}$  = 5.0V ±10%  $T_A$  = 55°C +125°C  $V_{HC}$  =  $V_{CC}$  -0.2V

Symbol	Parameter	54FCTA/74FCTA			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) $V_I = \text{GND}$
$I_{OZ}$	Maximum TRI-STATE Current			10.0 10.0 -10.0 -10.0	$\mu A$	$V_{CC} = \text{Max}$	$V_O = V_{CC}$ $V_O = 2.7V$ (Note 2) $V_O = 0.5V$ (Note 2) $V_O = \text{GND}$
$V_{IK}$	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); $V_O = \text{GND}$	
$V_{OH}$	Minimum High Level Output Voltage	2.8 $V_{HC}$ 2.4 2.4	3.0 $V_{CC}$ 4.3 4.3		V	$V_{CC} = 3V; V_{IN} = 0.2V$ or $V_{HC}; I_{OH} = -32 \mu A$	$I_{OH} = -300 \mu A$ $I_{OH} = -12 \text{ mA}$ (Mil) $I_{OH} = -15 \text{ mA}$ (Com)
$V_{OL}$	Maximum Low Level Output Voltage		GND GND 0.3 0.3	0.2 0.2 0.50 0.50	V	$V_{CC} = 3V; V_{IN} = 0.2V$ or $V_{HC}; I_{OL} = 300 \mu A$	$I_{OH} = 300 \mu A$ $I_{OL} = 32 \text{ mA}$ (Mil) $I_{OL} = 48 \text{ mA}$ (Com)

## DC Characteristics for 'FCTA Family Devices (Continued)

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  $+125^{\circ}C$ ;  $V_{HC} = V_{CC} - 0.2V$

Symbol	Parameter	54FCTA/74FCTA			Units	Conditions	
		Min	Typ	Max			
$I_{CC}$	Maximum Quiescent Supply Current		0.001	1.5	mA	$V_{CC} = \text{Max}$ $V_{IN} \geq V_{HC}$ , $V_{IN} \leq 0.2V$ $f_I = 0$	
$\Delta I_{CC}$	Quiescent Supply Current; TTL Inputs HIGH		0.5	2.0	mA	$V_{CC} = \text{Max}$ $V_{IN} = 3.4V$ (Note 3)	
$I_{CCD}$	Dynamic Power Supply Current (Note 4)		0.25	0.40	mA/MHz	$V_{CC} = \text{Max}$ Outputs Open $\overline{OE} = \text{GND}$ 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	4.0	mA	$V_{CC} = \text{Max}$ Outputs Open $\overline{OE} = \text{GND}$ $f_{CP} = 10 \text{ MHz}$ $f_I = 5 \text{ MHz}$ 50% Duty Cycle One Bit Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
			1.8	6.0		$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	
			3.0	7.8		(Note 5) $V_{CC} = \text{Max}$ Outputs Open $\overline{OE} = \text{GND}$ $f_{CP} = 10 \text{ MHz}$ 50% Duty Cycle $f_I = 2.5 \text{ MHz}$ Eight Bits Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
			5.0	16.8		$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	
$V_H$	Input Hysteresis on Clock 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.

## AC Electrical Characteristics: See Section 2 for Waveforms

Symbol	Parameter	54FCTA/74FCTA	74FCTA		54FCTA		Units	Fig. No.
		$T_A = +25^\circ\text{C}$ $V_{CC} = 5.0\text{V}$	$T_A, V_{CC} = \text{Com}$ $R_L = 500\Omega$ $C_L = 50\text{pF}$		$T_A, V_{CC} = \text{Mil}$ $R_L = 500\Omega$ $C_L = 50\text{pF}$			
		Typ	Min (Note) Max		Min	Max		
$t_{PLH}$ $t_{PHL}$	Propagation Delay CP to $\bar{O}_n$	4.5	2.0	6.5			ns	2-8
$t_{PZH}$ $t_{PZL}$	Output Enable Time	5.5	1.5	6.5			ns	2-11
$t_{PHZ}$ $t_{PLZ}$	Output Disable Timed	4.0	1.5	5.5			ns	2-11
$t_S$	Set-Up Time High or Low $D_n$ to CP	1.0	2.0				ns	2-10
$t_H$	HOLD Time High or Low $D_n$ to CP	1.0	1.5				ns	2-10
$t_W$	CP Pulse Width High or Low	4.0	5.0				ns	2-9

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

### Capacitance ( $T_A = +25^\circ\text{C}$ , $f = 1.0\text{MHz}$ )

Symbol	Parameter	Typ	Max	Units	Conditions
$C_{IN}$	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.