P54/74FCT377T/AT/CT
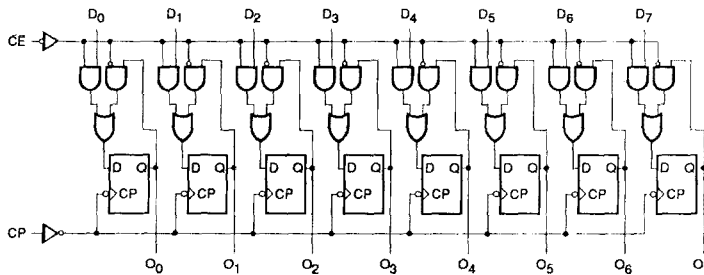# OCTAL D FLIP-FLOP WITH CLOCK ENABLE

FEATURES

- Function, Pinout and Drive Compatible with the FCT and F Logic

- FCT-C speed at 5.2ns max. (Com'l)
  FCT-A speed at 7.2ns max. (Com'l)

- Reduced V_{OH} (typically = 3.3V) versions of Equivalent FCT functions

- Edge-rate Control Circuitry for Significantly Improved Noise Characteristics

- ESD protection exceeds 2000V

- Power-off disable feature

- Matched Rise and Fall times

- Fully Compatible with TTL Input and Output Logic Levels

- 64 mA Sink Current (Com'l), 32 mA (Mil)
  15 mA Source Current (Com'l), 12 mA (Mil)

- Clock Enable for Address and Data Synchronization Application

- Eight Edge-Triggered D Flip-Flops

- Manufactured in 0.7 micron PACE Technology™

DESCRIPTION

The 'FCT377T have eight edge-triggered, D-type flip-flops with individual D inputs and O outputs. The common buffered clock (CP) input loads all flip-flops simultaneously when the Clock Enable ($\overline{CE}$) is LOW. The register is fully edge-tr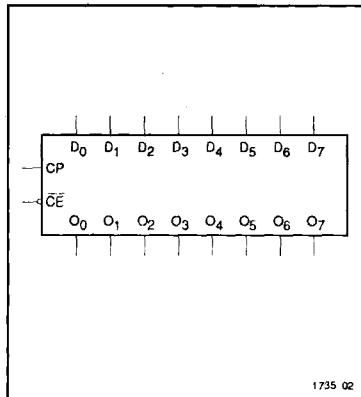iggered. The state of each D input one set-up time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's O output. The $\overline{CE}$ input must be stable only one set-up time prior to the LOW-to-HIGH clock transition for predictable operation.
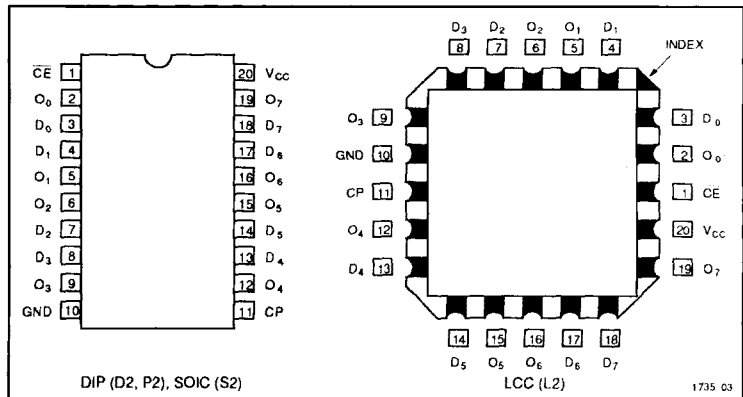
FUNCTIONAL BLOCK DIAGRAM

1735 01

LOGIC SYMBOL

1735 02

PIN CONFIGURATIONS

DIP (D2, P2), SOIC (S2)

LCC (L2)

1735 03

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PERFORMANCE
SEMICONDUCTOR CORPORATION

Means Quality, Service and Speed

ABSOLUTE MAXIMUM RATINGS[1,2]

Symbol	Parameter	Value	Unit
T_{STG}	Storage Temperature	−65 to +150	°C
T_A	Ambient Temperature Under Bias	−65 to +135	°C
V_{CC}	V_{CC} Potential to Ground	−0.5 to +7.0	V
P_T	Power Dissipation	0.5	W

1735 Tbl 01

Symbol	Parameter	Value	Unit
I_{OUTPUT}	Current Applied to Output	120	mA
V_{IN}	Input Voltage	−0.5 to +7.0	V
V_{OUT}	Voltage Applied to Output	−0.5 to +7.0	V

1735 Tbl 02

Notes:
1. Operation beyond the limits set forth in the above table may impair the useful life of the device. Unless otherwise noted, these limits are over the operating free-air temperature range.

2. Unused inputs must always be connected to an appropriate logic voltage level, preferably either V_{CC} or ground.

RECOMMENDED OPERATING CONDITIONS

Free Air Ambient Temperature	Min	Max
Military	−55°C	+125°C
Commercial	0°C	+70°C

1735 Tbl 03

Supply Voltage (V_{CC})	Min	Max
Military	+4.5V	+5.5V
Commercial	+4.75V	+5.25V

1735 Tbl 04

DC ELECTRICAL CHARACTERISTICS (Over recommended operating conditions)

Symbol	Parameter		Min	Typ[1]	Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage		2.0			V		
V_{IL}	Input LOW Voltage				0.8	V		
V_H	Hysteresis			0.2		V		All inputs
V_{IK}	Input Clamp Diode Voltage			−0.7	−1.2	V	MIN	$I_{IN} = -18$mA
V_{OH}	Output HIGH Voltage	Military	2.4	3.3		V	MIN	$I_{OH} = -12$mA
		Commercial	2.4	3.3		V	MIN	$I_{OH} = -15$mA
V_{OL}	Output LOW Voltage	Military		0.3	0.5	V	MIN	$I_{OL} = 32$mA
		Commercial		0.3	0.5	V	MIN	$I_{OL} = 48$mA
		Commercial		0.3	0.5	V	MIN	$I_{OL} = 64$mA
I_I	Input HIGH Current				20	µA	MAX	$V_{IN} = V_{CC}$
I_{IH}	Input HIGH Current				5	µA	MAX	$V_{IN} = 2.7$V
I_{IL}	Input LOW Current				−5	µA	MAX	$V_{IN} = 0.5$V
I_{OZH}	Off State I_{OUT} HIGH-Level Output Current				10	µA	MAX	$V_{OUT} = 2.7$V
I_{OZL}	Off State I_{OUT} LOW-Level Output Current				−10	µA	MAX	$V_{OUT} = 0.5$V
I_{OS}	Output Short Circuit Current[2]		−60	−120	−225	mA	MAX	$V_{OUT} = 0.0$V
C_{IN}	Input Capacitance[3]			5	10	pF	MAX	All inputs
C_{OUT}	Output Capacitance[3]			9	12	pF	MAX	All outputs
I_{CC}	Quiescent Power Supply Current			0.2	1.5	mA	MAX	$V_{IN} \le 0.2$V, $V_{IN} \ge V_{CC}-0.2$V

1735 Tbl 05

Notes:
1. Typical limits are at $V_{CC} = 5.0$V, $T_A = +25$°C ambient.
2. Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high speed test apparatus and/or sample and hold techniques are preferable in order to minimize internal chip heating and more accurately reflect operational values. Otherwise prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I_{os} tests should be performed last.
3. This parameter is guaranteed but not tested.

DC CHARACTERISTICS (Over recommended operating conditions unless otherwise specified.)

Symbol	Parameter	Typ[1]	Max	Units	Conditions
ΔI_{CC}	Quiescent Power Supply Current (TTL inputs)	0.5	2.0	mA	V_{CC} = MAX, V_{IN} = 3.4V[2], f_i = 0, Outputs Open
I_{CCD}	Dynamic Power Supply Current[3]	0.15	0.25	mA/ mHz	V_{CC} = MAX, One Bit Toggling, 50% Duty Cycle, Outputs Open, $\overline{CE}$ = GND, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$
I_C	Total Power Supply Current[5]	1.7	4.0	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling at f_i = 5MHz, $\overline{CE}$ = GND, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$
		2.2	6.0	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling at f_i = 5MHz, $\overline{CE}$ = GND, V_{IN} = 3.4V or V_{IN} = GND
		4.0	7.8[4]	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, Eight Bits Toggling at f_i = 2.5MHz, $\overline{CE}$ = GND, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$
		6.2	16.8[4]	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, Eight Bits Toggling at f_i = 2.5MHz, $\overline{CE}$ = GND, V_{IN} = 3.4V or V_{IN} = GND

1735 Tbl 06

Notes:
1. Typical values are at V_{CC} = 5.0V, +25°C ambient.
2. Per TTL driven input (V_{IN} = 3.4V); all other inputs at V_{CC} or GND.
3. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
4. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
5. I_C = $I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   I_C = $I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD}(f_0/2 + f_i N_i)$
   I_{CC} = Quiescent Current with CMOS input levels

ΔI_{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 TTL Inputs at D_H
I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)
f_0 = 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 milliamps and all frequencies are in megahertz.

TRUTH TABLE

Operating Mode	Inputs			Outputs
	CP	$\overline{CE}$	D	O
Load "1"	⌐⌐	l	h	H
Load "0"	⌐⌐	l	l	L
Hold (Do Nothing)	⌐⌐	h	X	No Change
	X	H	X	No Change

1735 Tbl 07

H = HIGH Voltage Level
h = HIGH Voltage Level one setup time prior to the LOW-to-HIGH Clock Transition
L = LOW Voltage Level
l = LOW Voltage Level one setup time prior to the LOW-to-HIGH Clock Transition
X = Immaterial
⌐⌐ = LOW-to-HIGH Clock Transition

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AC CHARACTERISTICS

Symbol	Parameter	'FCT377T				'FCT377AT				'FCT377CT				Units	Fig. No.
		MIL		COM'L		MIL		COM'L		MIL		COM'L			
		Min.[1]	Max.	Min.[1]	Max.	Min.[1]	Max.	Min.[1]	Max.	Min.[1]	Max	Min.[1]	Max.		
t_{PLH} t_{PHL}	Propagation Delay Clock to Output	2.0	15.0	2.0	13.0	2.0	8.3	2.0	7.2	2.0	5.5	2.0	5.2	ns	1, 5

1735 Tbl 08

Note: AC Characteristics guaranteed with C_L = 50pF as shown in Figure 1.
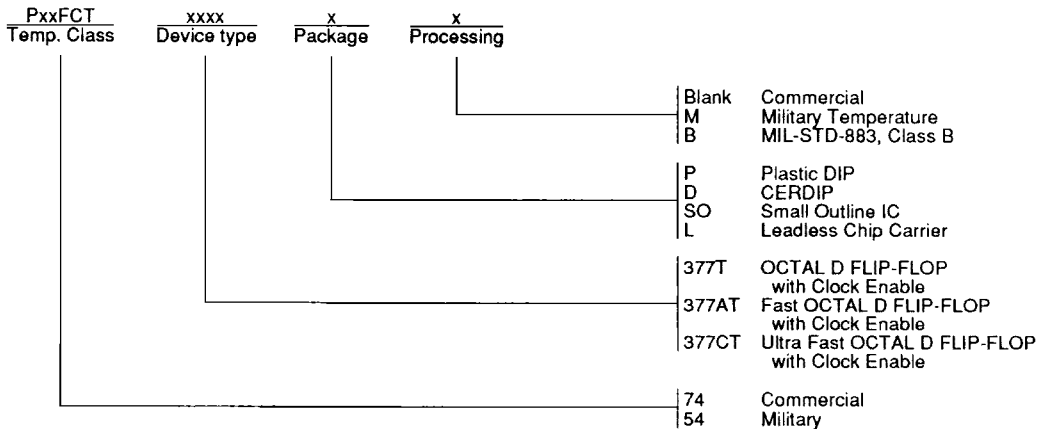
AC OPERATING REQUIREMENTS

Symbol	Parameter	'FCT377T				'FCT377AT				'FCT377CT				Units	Fig. No.
		MIL		COM'L		MIL		COM'L		MIL		COM'L			
		Min.[1]	Max.	Min.[1]	Max.	Min.[1]	Max.	Min.[1]	Max.	Min.[1]	Max	Min.[1]	Max.		
$t_s(H)$	Setup Time, HIGH or LOW Data to CP	3.0	—	2.5	—	2.0	—	2.0	—	2.0	—	2.0	—	ns	4
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW Data to CP	2.5	—	2.0	—	1.5	—	1.5	—	1.5	—	1.5	—	ns	4
$t_w(H)$ $t_w(L)$	Setup Time, HIGH or LOW $\overline{CE}$ to CP	4.0	—	4.0	—	3.5	—	3.5	—	3.5	—	3.5	—	ns	5
$t_w(H)$ $t_w(L)$	Hold Time, HIGH or LOW $\overline{CE}$ to CP	1.5	—	1.5	—	1.5	—	1.5	—	1.5	—	1.5	—	ns	6
$t_w(L)$	Clock Pulse Width LOW[2]	7.0	—	7.0	—	7.0	—	6.0	—	7.0	—	6.0	—	ns	6

1735 Tbl 09

Notes:
1. Minimum limits are guaranteed but not tested on Propagation Delays.
2. With one data channel toggling, $t_w(L) = t_w(H)$ = 4.0ns and $t_r = t_f$ = 1.0ns.

ORDERING INFORMATION

PxxFCT — Temp. Class
xxxx — Device type
x — Package
x — Processing

Blank — Commercial
M — Military Temperature
B — MIL-STD-883, Class B

P — Plastic DIP
D — CERDIP
SO — Small Outline IC
L — Leadless Chip Carrier

377T — OCTAL D FLIP-FLOP with Clock Enable
377AT — Fast OCTAL D FLIP-FLOP with Clock Enable
377CT — Ultra Fast OCTAL D FLIP-FLOP with Clock Enable

74 — Commercial
54 — Military

1735 04