TEXAS INSTRUMENTS

CY54/74FCT377T

8-Bit Register

SCCS023 - May1994 - Revised March 2000

Features

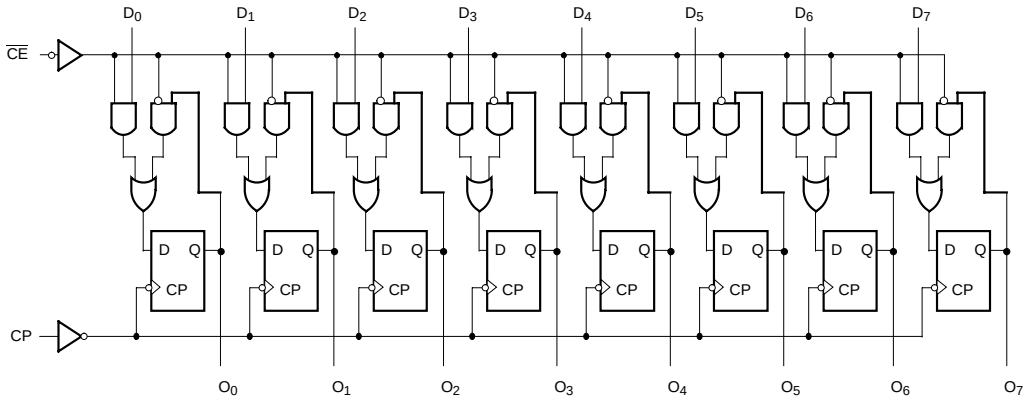
- **Function, pinout and drive compatible with FCT and F logic**
- **FCT-C speed at 5.2 ns max. (Com'l) FCT-A speed at 7.2 ns max. (Com'l)**
- **Reduced V_{OH} (typically = 3.3V) versions of equivalent FCT functions**
- **Edge-rate control circuitry for significantly improved noise characteristics**
- **Power-off disable feature**
- **Matched rise and fall times**
- **ESD > 2000V**
- **Fully compatible with TTL input and output logic levels**
- **Sink Current 64 mA (Com'l), 32 mA (Mil)**
  Source Current 32 mA (Com'l), 12 mA (Mil)
- **Clock Enable for address and data synchronization application**
- **Eight edge-triggered D flip-flops**
- **Extended commercial range of –40°C to +85°C**

Functional Description

The FCT377T has eight triggered D-type flip-flops with individual D inputs. The common buffered clock inputs ($\overline{CP}$) loads all flip-flops simultaneously when the Clock Enable ($\overline{CE}$) is LOW. The register is fully edge-triggered. 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.

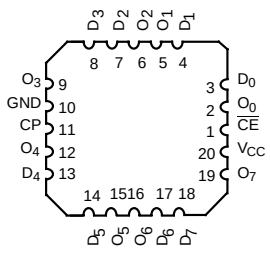
The outputs are designed with a power-off disable feature to allow for live insertion of boards.

Logic Block Diagram

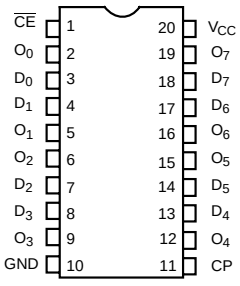


Pin Configurations

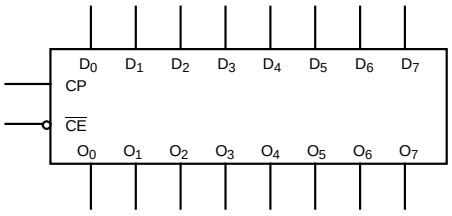
LCC
Top View



SOIC/QSOP
Top View



Logic Symbol



Function Table[1]

Operating Mode	Inputs			Outputs
	CP	CE	D	O
Load “1”	⌐	l	h	H
Load “0“	⌐	l	l	L
Hold	⌐	h	X	No Change
	X	H	X	No Change

Maximum Ratings[2, 3]

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature .....–65°C to +150°C

Ambient Temperature
with Power Applied.....–65°C to +135°C

Supply Voltage to Ground Potential..... –0.5V to +7.0V

DC Input Voltage ..... –0.5V to +7.0V

DC Output Voltage..... –0.5V to +7.0V

DC Output Current (Maximum Sink Current/Pin) .....120 mA

Power Dissipation 0.5W

Static Discharge Voltage.....>2001V
(per MIL-STD-883, Method 3015)

Operating Range

Range	Range	Ambient Temperature	V_{CC}
Commercial	All	–40°C to +85°C	5V ± 5%
Military[4]	All	–55°C to +125°C	5V ± 10%

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions		Min.	Typ.[5]	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC}=Min., I_{OH}=–32 mA	Com’l	2.0			V
		V_{CC}=Min., I_{OH}=–15 mA	Com’l	2.4	3.3		V
		V_{CC}=Min., I_{OH}=–12 mA	Mil	2.4	3.3		V
V_{OL}	Output LOW Voltage	V_{CC}=Min., I_{OL}=64 mA	Com’l		0.3	0.55	V
		V_{CC}=Min., I_{OL}=32 mA	Mil		0.3	0.55	V
V_{IH}	Input HIGH Voltage			2.0			V
V_{IL}	Input LOW Voltage					0.8	V
V_H	Hysteresis[6]	All inputs			0.2		V
V_{IK}	Input Clamp Diode Voltage	V_{CC}=Min., I_{IN}=–18 mA			–0.7	–1.2	V
I_I	Input HIGH Current	V_{CC}=Max., V_{IN}=V_{CC}				5	µA
I_{IH}	Input HIGH Current	V_{CC}=Max., V_{IN}=2.7V				±1	µA
I_{IL}	Input LOW Current	V_{CC}=Max., V_{IN}=0.5V				±1	µA
I_{OS}	Output Short Circuit Current[7]	V_{CC}=Max., V_{OUT}=0.0V		–60	–120	–225	mA
I_{OFF}	Power-Off Disable	V_{CC}=0V., V_{OUT}=4.5V				±1	µA

Notes:

1. H = HIGH Voltage Level
   h = HIGH Voltage Level one set-up time prior to the LOW-to-HIGH Clock Transition
   L = LOW Voltage Level
   l = LOW Voltage Level one set-up time prior to the LOW-to-HIGH Clock Transition
   X = Don’t Care
   Z = HIGH Impedance
   ⌐ = LOW-to-HIGH clock transition
2. Unless otherwise noted, these limits are over the operating free-air temperature range.
3. Unused inputs must always be connected to an appropriate logic voltage level, preferably either V_{CC} or ground.
4. T_A is the “instant on” case temperature.
5. Typical values are at V_{CC}=5.0V, T_A=+25˚C ambient.
6. This parameter is specified but not tested.
7. 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 parametric tests. In any sequence of parameter tests, I_{OS} tests should be performed last.

Capacitance[2]

Parameter	Description	Typ.[5]	Max.	Unit
C_{IN}	Input Capacitance	5	10	pF
C_{OUT}	Output Capacitance	9	12	pF

Power Supply Characteristics

Parameter	Description	Test Conditions	Typ.[5]	Max.	Unit
I_{CC}	Quiescent Power Supply Current	V_{CC}=Max., $V_{IN} \le 0.2V$, $V_{IN} \ge V_{CC}-0.2V$	0.1	0.2	mA
ΔI_{CC}	Quiescent Power Supply Current (TTL inputs HIGH)	V_{CC}=Max., V_{IN}=3.4V, f_1=0, Outputs Open[8]	0.5	2.0	mA
I_{CCD}	Dynamic Power Supply Current[9]	V_{CC}=Max., One Bit Toggling, 50% Duty Cycle, Outputs Open, $\overline{CE}$=GND, $V_{IN} \le 0.2V$ or $V_{IN} \ge V_{CC}-0.2V$	0.06	0.12	mA/MHz
I_C	Total Power Supply Current[10]	V_{CC}=Max., f_0=10 MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling at f_1=5 MHz, $\overline{CE}$=GND, $V_{IN} \le 0.2V$ or $V_{IN} \ge V_{CC}-0.2V$	0.7	1.4	mA
		V_{CC}=Max., f_0=10 MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling at f_1=5 MHz, $\overline{CE}$=GND, V_{IN}=3.4V or V_{IN}=GND	1.2	3.4	mA
		V_{CC}=Max., f_0=10 MHz, 50% Duty Cycle, Outputs Open, Eight Bits Toggling at f_1=2.5 MHz, $\overline{CE}$=GND, $V_{IN} \le 0.2V$ or $V_{IN} \ge V_{CC}-0.2V$	1.6	3.2[11]	mA
		V_{CC}=Max., f_0=10 MHz, 50% Duty Cycle, Outputs Open, Eight Bits Toggling at f_1=2.5 MHz, $\overline{CE}$=GND, V_{IN}=3.4V or V_{IN}=GND	3.9	12.2[11]	mA

Notes:

8. Per TTL driven input (V_{IN}=3.4V); all other inputs at V_{CC} or GND.
9. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
10. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
    $I_C = I_{CC}+\Delta I_{CC} D_H N_T + I_{CCD}(f_0/2 + f_1 N_1)$
    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 registered devices, otherwise zero
    f_1 = Input signal frequency
    N_1 = Number of inputs changing at f_1
    All currents are in milliamps and all frequencies are in megahertz.
11. Values for these conditions are examples of the I_{CC} formula. These limits are specified but not tested.

Switching Characteristics Over the Operating Range[12, 13]

Parameter	Description	FCT377T		FCT377AT				Unit	Fig. No.[14]
		Commercial		Military		Commercial			
		Min.	Max.	Min.	Max.	Min.	Max.		
t_{PLH} t_{PHL}	Propagation Delay Clock to Output	2.0	13.0	2.0	8.3	2.0	7.2	ns	1, 5
t_S	Set-Up Time HIGH or LOW Data to CP	2.0		2.0		2.0		ns	4
t_H	Hold Time HIGH or LOW Data to CP	1.5		1.5		1.5		ns	4
t_W	Set-Up Time HIGH or LOW $\overline{CE}$ to CP	3.5		3.5		3.5		ns	4
t_W	Set-Up Time HIGH or LOW $\overline{CE}$ to CP	1.5		1.5		1.5		ns	4
t_W	Clock Pulse Width[15] HIGH or LOW	6.0		7.0		6.0		ns	6

Parameter	Description	FCT377CT				Unit	Fig. No.[14]
		Military		Commercial			
		Min.	Max.	Min.	Max.		
t_{PLH} t_{PHL}	Propagation Delay Clock to Output	2.0	5.5	2.0	5.2	ns	1, 5
t_S	Set-Up Time, HIGH or LOW, Data to CP	2.0		2.0		ns	4
t_H	Hold Time, HIGH or LOW, Data to CP	1.5		1.5		ns	4
t_W	Set-Up Time, HIGH or LOW, $\overline{CE}$ to CP	3.5		3.5		ns	4
t_W	Set-Up Time HIGH or LOW, $\overline{CE}$ to CP	1.5		1.5		ns	4
t_W	Clock Pulse Width[15] HIGH or LOW	7.0		6.0		ns	6

Notes:
12. AC Characteristics specified with C_L=50 pF as shown in Figure 1 of the “Parameter Measurement Information” in the General Information section.
13. Minimum limits are specified but not tested on Propagation Delays.
14. See “Parameter Measurement Information” in the General Information section.
15. With one data channel toggling, $t_W(L)=t_W(H)=4.0$ ns and $t_r=t_f=1.0$ ns.

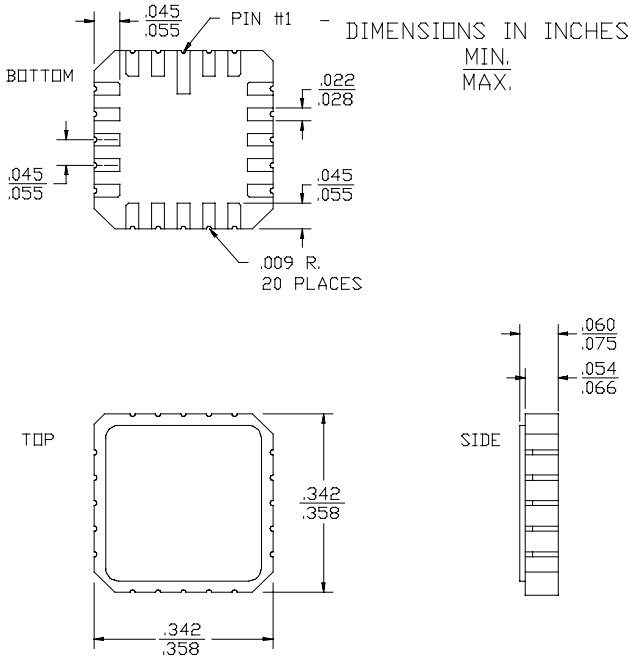
Ordering Information—FCT377T

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
5.2	CY74FCT377CTQCT	Q5	20-Lead (150-Mil) QSOP	Commercial
	CY74FCT377CTSOC/SOCT	S5	20-Lead (300-Mil) Molded SOIC	
5.5	CY54FCT377CTLMB	L61	20-Pin Square Leadless Chip Carrier	Military
7.2	CY74FCT377ATQCT	Q5	20-Lead (150-Mil) QSOP	Commercial
	CY74FCT377ATSOC/SOCT	S5	20-Lead (300-Mil) Molded SOIC	
8.3	CY54FCT377TLMB	L61	20-Pin Square Leadless Chip Carrier	Military
13.0	CY74FCT377TQCT	Q5	20-Lead (150-Mil) QSOP	Commercial

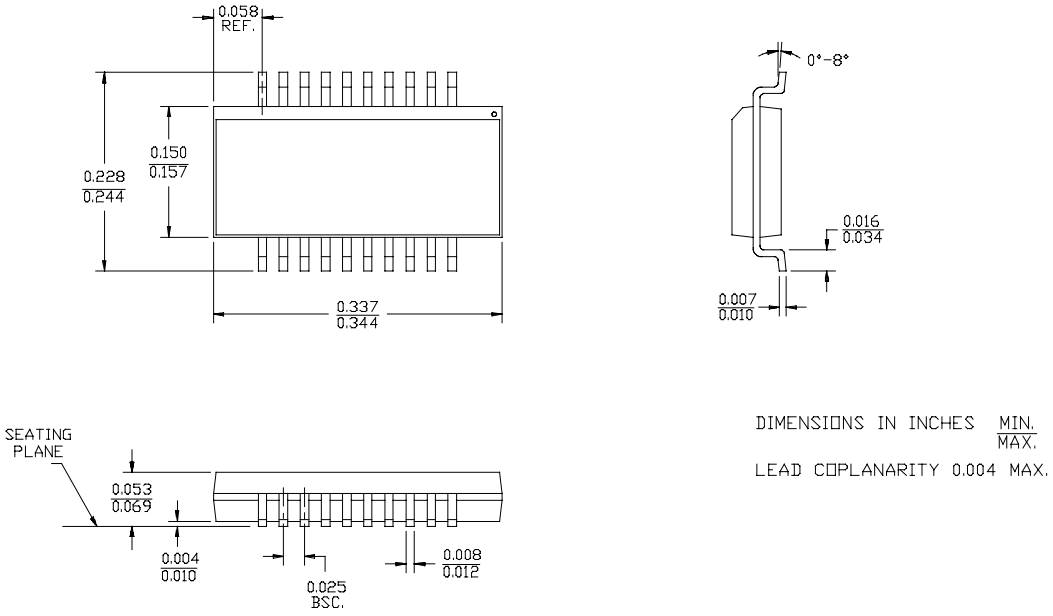
Document #: 38-00279-B

Package Diagrams

20-Pin Square Leadless Chip Carrier L61
MIL–STD–1835 C–2A

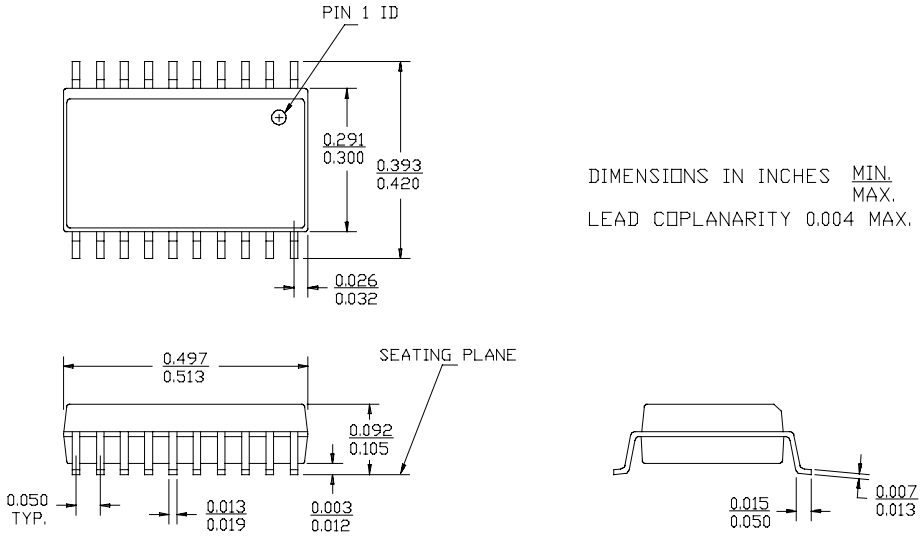


20-Lead Quarter Size Outline Q5



Package Diagrams (continued)

20-Lead (300-Mil) Molded SOIC S5



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