



SCCS023 - May1994 - Revised March 2000

CY54/74FCT377T

8-Bit Register

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)

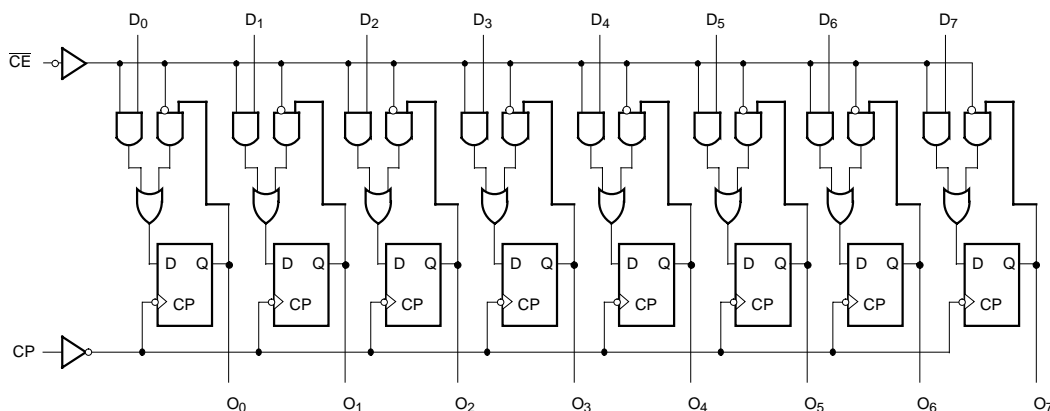
- Clock Enable for address and data synchronization application
- Eight edge-triggered D flip-flops
- Extended commercial range of -40°C to $+85^{\circ}\text{C}$

Functional Description

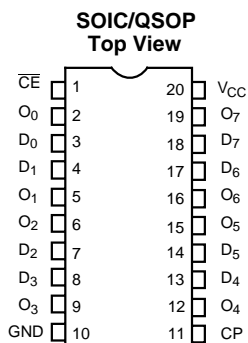
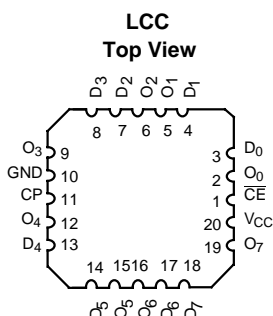
The FCT377T has eight triggered D-type flip-flops with individual D inputs. The common buffered clock inputs (CP) loads all flip-flops simultaneously when the Clock Enable (CE) is LOW. The register is fully edge-triggered. The state of each D input, one set-up time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's O output. The $\overline{\text{CE}}$ 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.

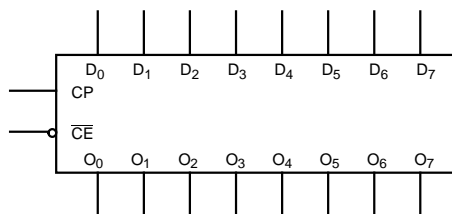
Logic Block Diagram



Pin Configurations



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:

- 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
- Unless otherwise noted, these limits are over the operating free-air temperature range.
- Unused inputs must always be connected to an appropriate logic voltage level, preferably either V_{CC} or ground.
- T_A is the "instant on" case temperature.
- Typical values are at V_{CC}=5.0V, T_A=+25°C ambient.
- This parameter is specified but not tested.
- 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} ≤0.2V, V _{IN} ≥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, CE=GND, V _{IN} ≤0.2V or V _{IN} ≥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, CE=GND, V _{IN} ≤0.2V or V _{IN} ≥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, 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, CE=GND, V _{IN} ≤0.2V or V _{IN} ≥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, 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} + ΔI_{CC}D_HN_T + I_{CCD}(f₀/2 + f₁N₁)
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)
f₀ = Clock frequency for registered devices, otherwise zero
f₁ = Input signal frequency
N₁ = Number of inputs changing at f₁
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 CE to CP	3.5		3.5		3.5		ns	4
t _W	Set-Up Time HIGH or LOW 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=1.0 ns.

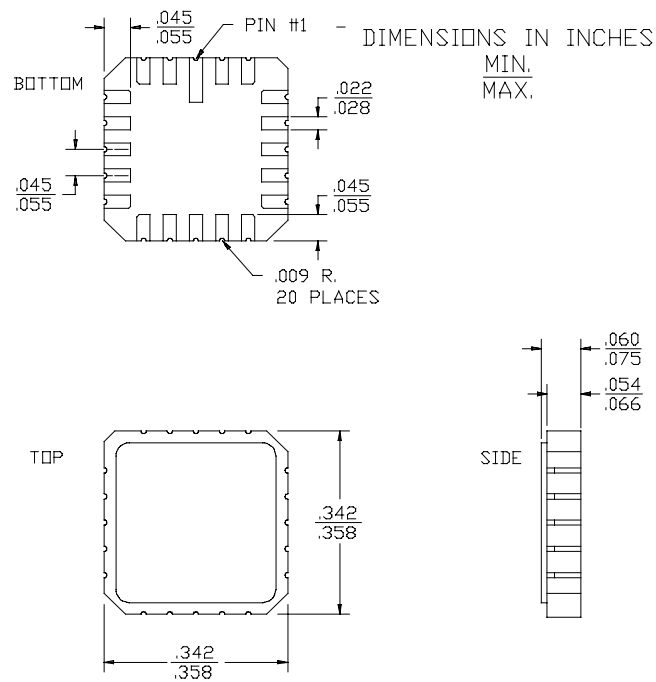
Ordering Information—FCT377T

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

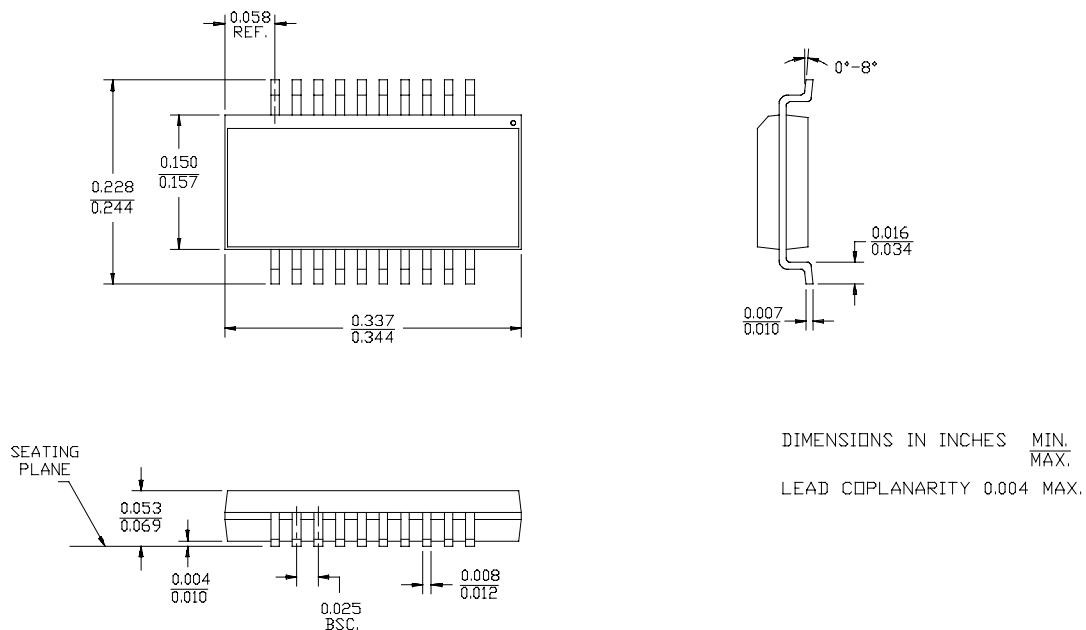
Document #: 38-00279-B

Package Diagrams

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

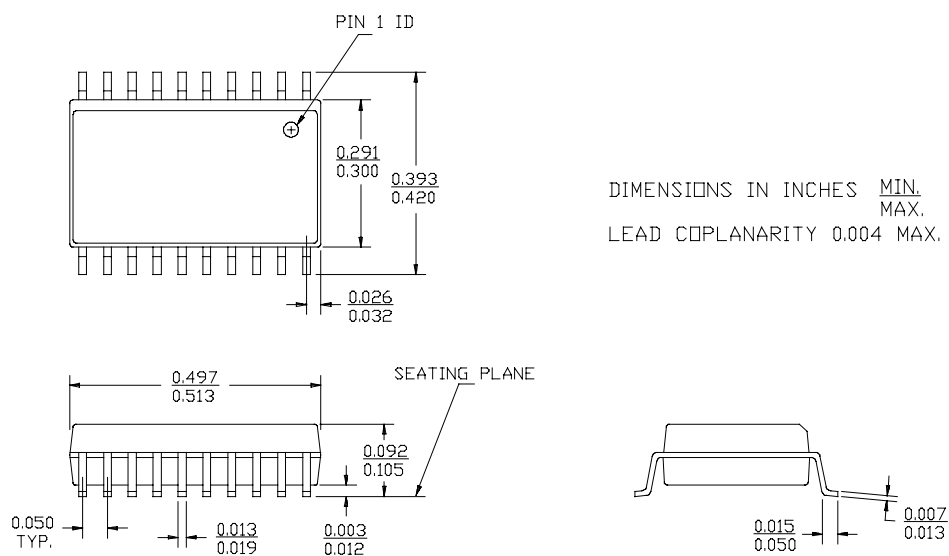


20-Lead Quarter Size Outline Q5



Package Diagrams (continued)

20-Lead (300-Mil) Molded SOIC S5



IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.