October 1999

National Semiconductor

54FCT377
Octal D-Type Flip-Flop with Clock Enable

General Description

The 'FCT377 has eight edge-triggered, D-type flip-flops with individual D inputs and Q 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-triggered. The state of each D input, one setup time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's Q output. The $\overline{CE}$ input must be stable only one setup time prior to the LOW-to-HIGH clock transition for predictable operation.

Features

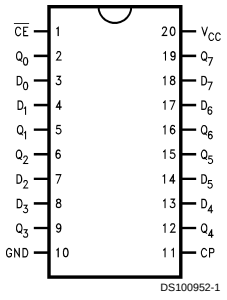
- Clock enable for address and data synchronization applications
- Eight edge-triggered D flip-flops
- Buffered common clock
- See 'FCT273 for master reset version
- See 'FCT373 for transparent latch version
- See 'FCT374 for TRI-STATE® version
- TTL input and output level compatible
- CMOS power consumption
- Output sink capability of 32 mA, source capability of 12 mA
- Standard Microcircuit Drawing (SMD) 5962-8762701

Ordering Code

Military	Package Number	Package Description
54FCT377DMQB	J20A	20-Lead Ceramic Dual-In-Line
54FCT377FMQB	W20A	20-Lead Cerpack
54FCT377LMQB	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

Connection Diagram

Pin Assignment for DIP and Cerpack



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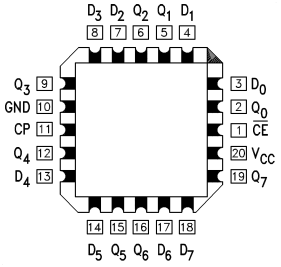
Pin Assignment for LCC



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Pin Names	Description
D_0–D_7	Data Inputs
$\overline{CE}$	Clock Enable (Active LOW)
CP	Clock Pulse Input
Q_0–Q_7	Data Outputs

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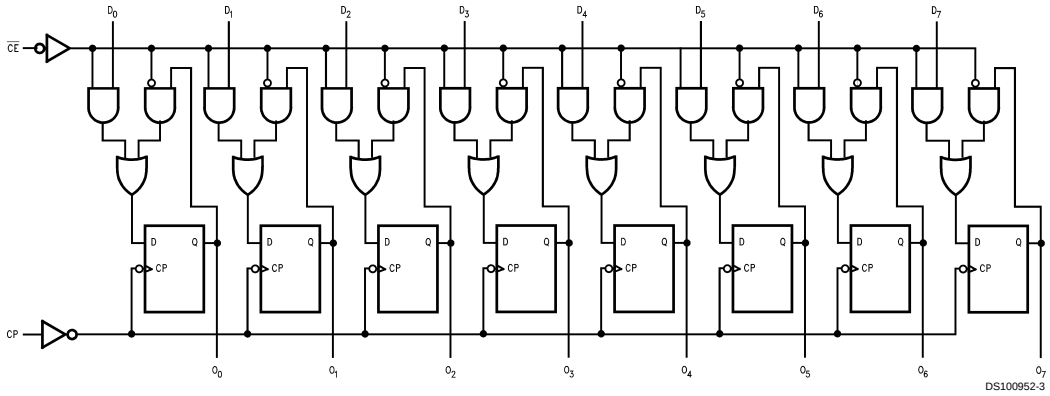
Truth Table

Mode Select-Function Table

Operating Mode	Inputs			Output
	CP	$\overline{CE}$	D_n	Q_n
Load “1”		l	h	H
Load “0”		l	l	L
Hold		h	X	No Change
(Do Nothing)	X	H	X	No Change

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

Logic Diagram



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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 Ratings (Note 1)

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

Storage Temperature	−65˚C to +150˚C
Ambient Temperature under Bias	−55˚C to +125˚C
Junction Temperature under Bias	
Ceramic	−55˚C to +175˚C
V_{CC} Pin Potential to	
Ground Pin	−0.5V to +7.0V
Input Voltage (Note 2)	−0.5V to +7.0V
Input Current (Note 2)	−30 mA to +5.0 mA
Voltage Applied to Any Output	
in the Disabled or	
Power-Off State	−0.5V to +4.75V
in the HIGH State	−0.5V to V_{CC}
Current Applied to Output	
in LOW State (Max)	Twice the rated I_{OL} (mA)
DC Latchup Source Current	−500 mA
(Across Comm Operating Range)	

Recommended Operating Conditions

Free Air Ambient Temperature	
Military	−55˚C to +125˚C
Supply Voltage	
Military	+4.5V to +5.5V
Minimum Input Edge Rate	(ΔV/Δt)
Data Input	50 mV/ns
Enable Input	20 mV/ns

DC Electrical Characteristics

Symbol	Parameter		FCT377 Min	FCT377 Typ	FCT377 Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage		2.0			V		Recognized HIGH Signal
V_{IL}	Input LOW Voltage				0.8	V		Recognized LOW Signal
V_{CD}	Input Clamp Diode Voltage				−1.2	V	Min	I_{IN} = −18 mA
V_{OH}	Output HIGH Voltage	54FCT	4.3			V	Min	I_{OH} = −300 uA
		54FCT	2.4					I_{OH} = −12 mA
V_{OL}	Output LOW Voltage	54FCT			0.2	V	Min	I_{OL} = 300 uA
		54FCT			0.5			I_{OL} = 32mA
I_{IH}	Input HIGH Current				5	µA	Max	V_{IN} = V_{CC}
I_{IL}	Input LOW Current				−5	µA	Max	V_{IN} = 0.5V
I_{OS}	Output Short-Circuit Current		−60			mA	Max	V_{OUT} = 0.0V
I_{CCQ}	Quiescent Power Supply Current				1.5	mA	Max	V_I = 0.2V or V_I = 5.3V, V_{CC} = 5.5V
ΔI_{CC}	Maximum I_{CC}/Input							V_I = V_{CC} − 2.1V
					2.0	mA	Max	Data Input V_I = V_{CC} − 2.1V
								All Others at V_{CC} or GND
I_{CCD}	Dynamic I_{CC}				0.4	mA/ MHz	Max	Outputs Open
								One bit Toggling, 50% Duty Cycle
I_{CC}	Total Power Supply Current				6.0	mA	Max	V_{CC} = 5.5V, Outputs Open, f_{CP} = 10MHz, 50% Duty Cycle, One bit Toggling at f_i = 5 MHz, 50% Duty Cycle

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

AC Electrical Characteristics

Symbol	Parameter	54FCT $T_A = -55^\circ C$ to $+125^\circ C$, $V_{CC} = 4.5V$ to $5.5V$, $C_L = 50$ pF		Units	Fig. No.
		Min	Max		
t_{PLH}	Propagation Delay	2.0	15.0	ns	*Figure 4*
t_{PHL}	CP to O_n	2.0	8.3		

AC Operating Requirements

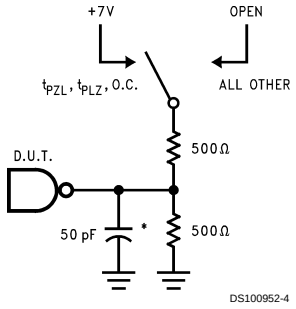
Symbol	Parameter	54FCT $T_A = -55^\circ C$ to $+125^\circ C$, $V_{CC} = 4.5V$ to $5.5V$, $C_L = 50$ pF		Units	Fig. No.
		Min	Max		
$t_s(H)$	Setup Time, HIGH	4.0		ns	*Figure 6*
$t_s(L)$	or LOW D_n to CP	4.0			
$t_h(H)$	Hold Time, HIGH	2.5		ns	*Figure 6*
$t_h(L)$	or LOW D_n to CP	2.5			
$t_s(H)$	Setup Time, HIGH	4.5		ns	*Figure 6*
$t_s(L)$	or LOW $\overline{CE}$ to CP	4.5			
$t_h(H)$	Hold Time, HIGH	2.0		ns	*Figure 6*
$t_h(L)$	or LOW $\overline{CE}$ to CP	2.0			
$t_w(H)$	Pulse Width, CP,	7.0		ns	*Figure 5*
$t_w(L)$	HIGH or LOW	7.0			

Capacitance

Symbol	Parameter	Max	Units	Conditions
C_{IN}	Input Capacitance	10	pF	$V_{CC} = 0V$, $T_A = 25^\circ C$
C_{OUT} (Note 3)	Output Capacitance	12	pF	$V_{CC} = 5.0V$

Note 3: C_{OUT} is measured at frequency f = 1 MHz, per MIL-STD-883B, Method 3012.

AC Loading



*Includes jig and probe capacitance

FIGURE 1. Standard AC Test Load

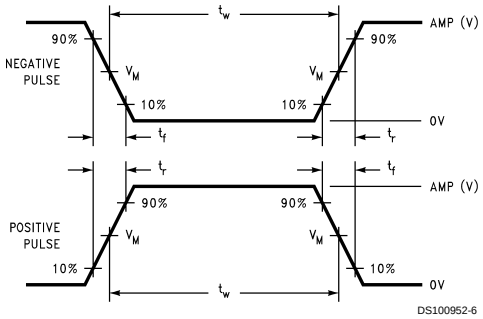


FIGURE 2. V_M = 1.5V

Input Pulse Requirements

Amplitude	Rep. Rate	t_w	t_r	t_f
3.0V	1 MHz	500 ns	2.5 ns	2.5 ns

FIGURE 3. Test Input Signal Requirements

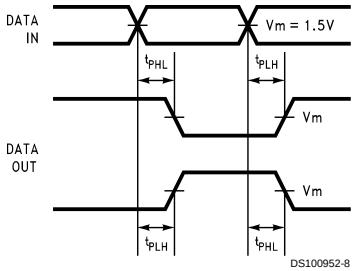


FIGURE 4. Propagation Delay Waveforms for Inverting and Non-Inverting Functions

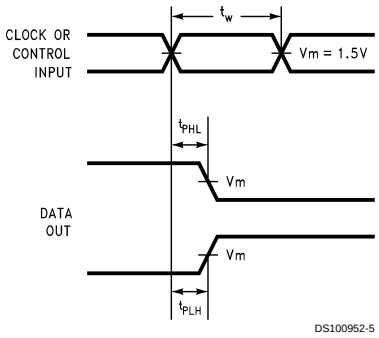


FIGURE 5. Propagation Delay, Pulse Width Waveforms

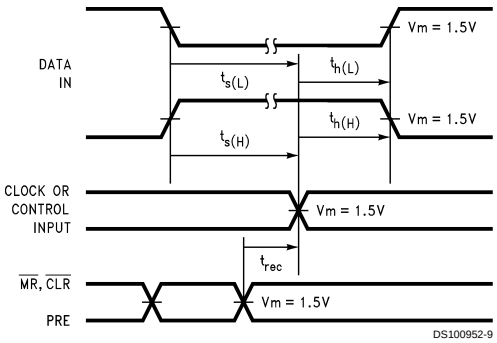
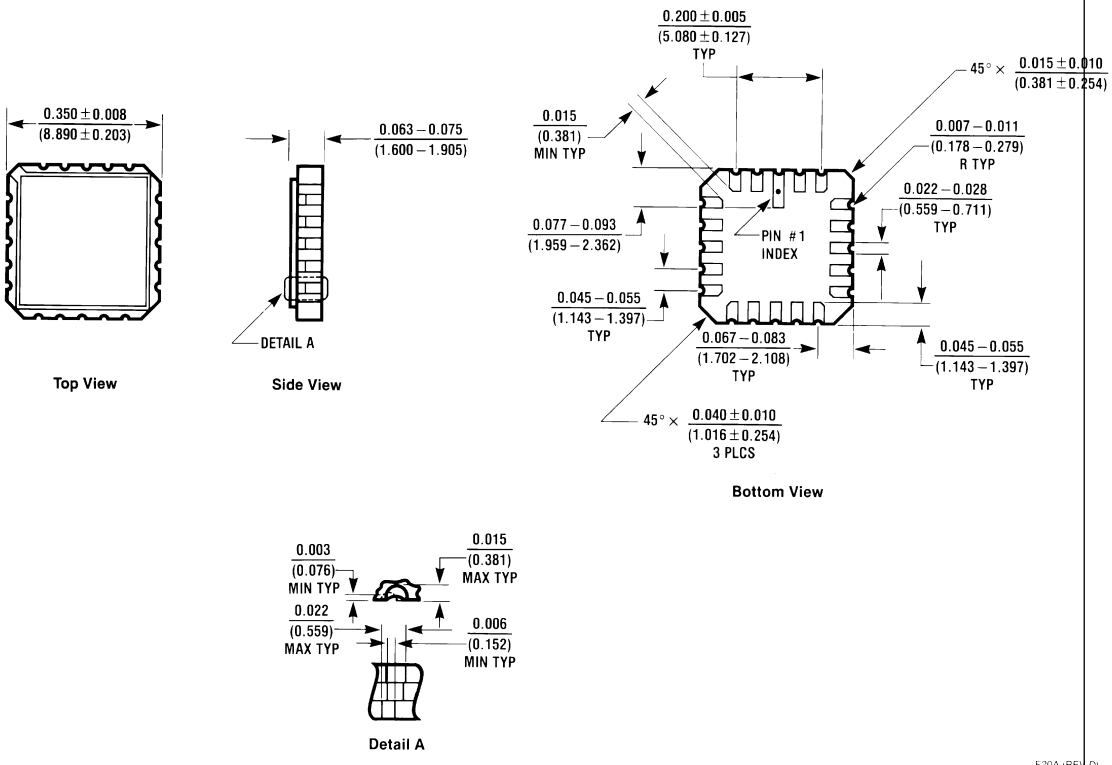


FIGURE 6. Setup Time, Hold Time and Recovery Time Waveforms

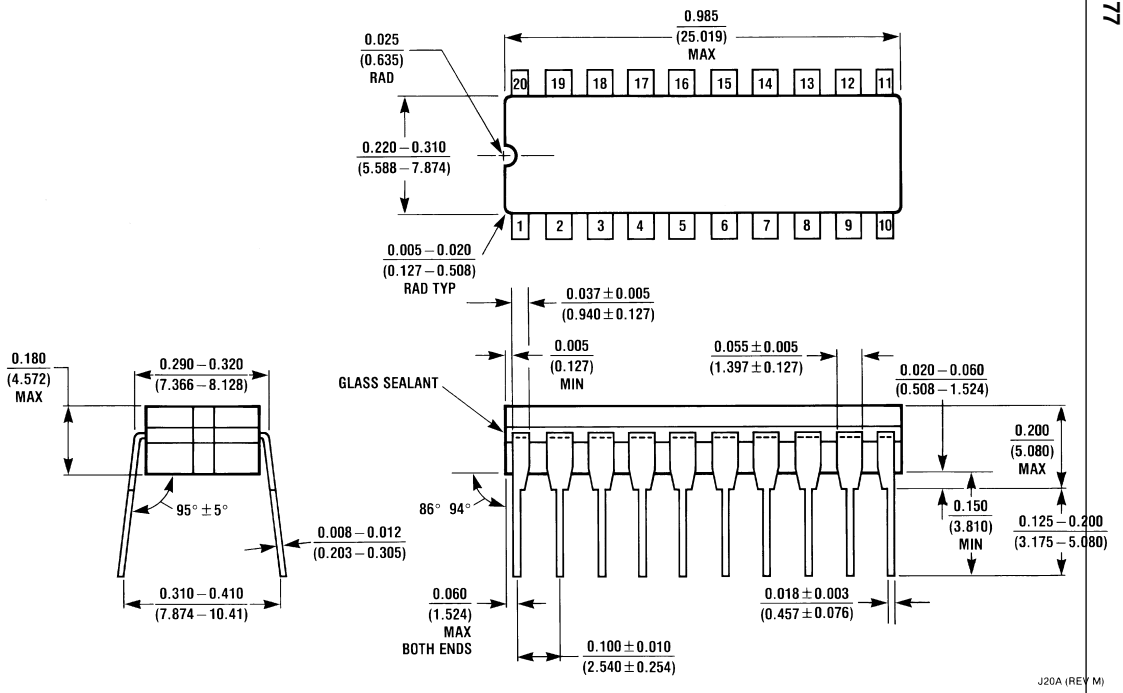
Physical Dimensions inches (millimeters) unless otherwise noted



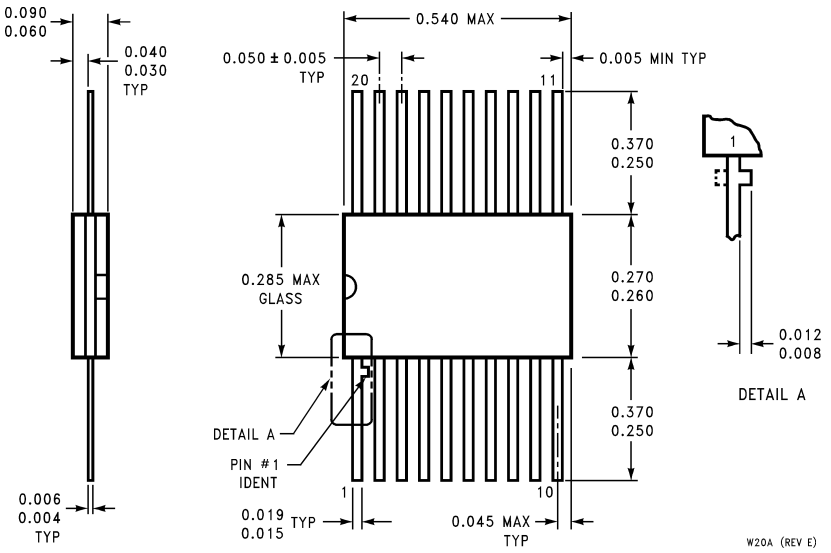
E20A (REV D)

20-Lead Ceramic Chip Carrier
NS Package Number E20A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



20-Lead Ceramic Dual-In-Line Package
NS Package Number J20A



20-Lead Ceramic Flatpack
NS Package Number W20A

Notes

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