Octal D-type flip-flop with enable

74F377/377A

FEATURES

- High impedance inputs for reduced loading (20μA in Low and High states)
- Ideal for addressable register applications
- Enable for address and data synchronization applications
- Eight edge–triggered D–type flip–flops
- Buffered common clock
- See 'F273 for Master Reset version
- See 'F373 for transparent latch version
- See 'F374 for 3–State version
- 'F377A improved AC, DC, f_{MAX} and functionality

DESCRIPTION

The 74F377 has 8 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 Enable ($\overline{E}$) input 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 Q output.

The $\overline{E}$ input must be stable one setup time prior to the Low-to-High clock transition for predictable operation.

TYPE	TYPICAL f_{MAX}	TYPICAL SUPPLY CURRENT (TOTAL)
74F377	120MHz	65mA
74F377A	165MHz	29mA

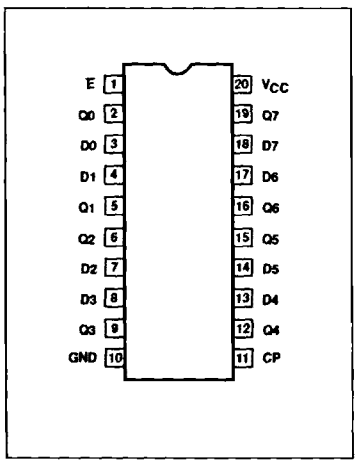
ORDERING INFORMATION

PACKAGES	COMMERCIAL RANGE V_{CC} = 5V±10%; T_{amb} = 0°C to +70°C
20–pin plastic DIP	N74F377N/N74F377AN
20–pin plastic SOL	N74F377D/N74F377AD

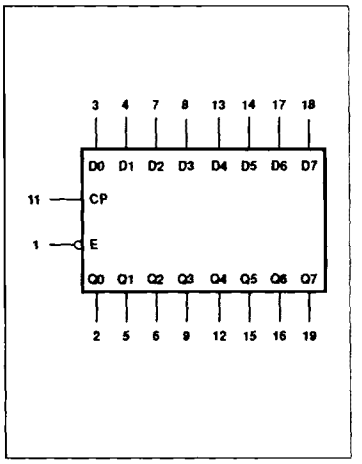
INPUT AND OUTPUT LOADING AND FAN–OUT TABLE

PINS	DESCRIPTION	74F(U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
D0 – D7	Data inputs	1.0/0.033	20μA/20μA
CP	Clock pulse input (active rising edge)	1.0/0.033	20μA/20μA
$\overline{E}$	Enable input (active–Low)	1.0/0.033	20μA/20μA
Q0 – Q7	Data outputs	50/33	1.0mA/20mA

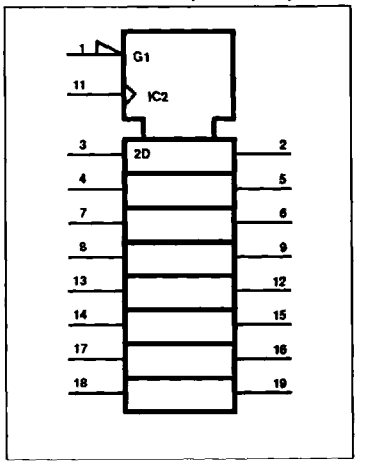
PIN CONFIGURATION



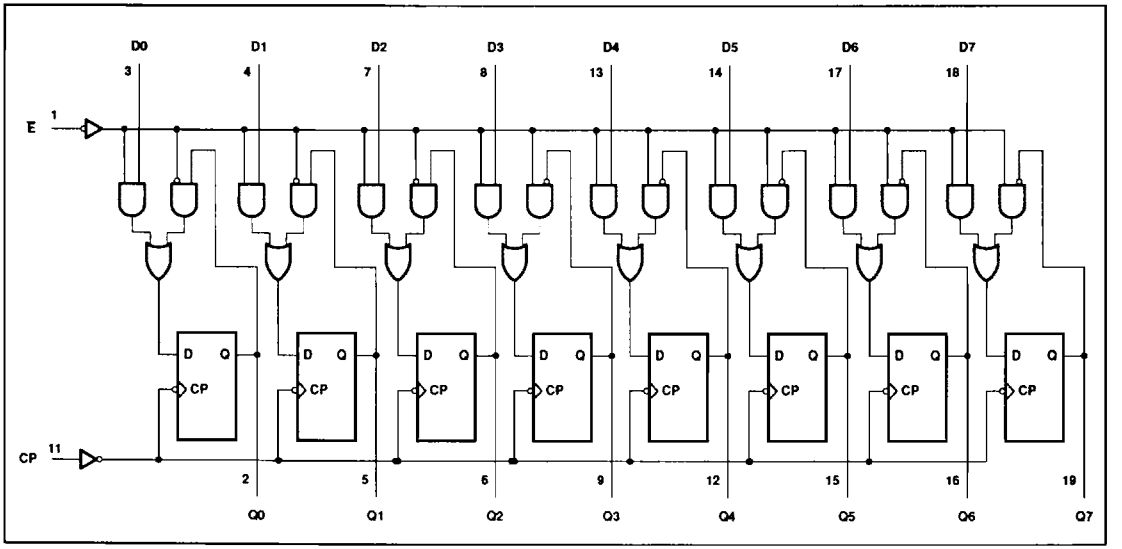
LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



LOGIC DIAGRAM



FUNCTION TABLE

INPUTS			OUTPUTS	OPERATING MODE
$\overline{E}$	CP	Dn	Qn	
l	↑	h	H	Load "1"
l	↑	l	L	Load "0"
h H	↑ X	X X	no change no change	Hold (do nothing)

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
↑ = Low-to-High clock transition

ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limit set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage	–0.5 to +7.0	V
V_{IN}	Input voltage	–0.5 to +7.0	V
I_{IN}	Input current	–30 to +5	mA
V_{OUT}	Voltage applied to output in High output state	–0.5 to V_{CC}	V
I_{OUT}	Current applied to output in Low output state	40	mA
T_{amb}	Operating free air temperature range	0 to +70	°C
T_{stg}	Storage temperature range	–65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_{IH}	High–level input voltage	2.0			V
V_{IL}	Low–level input voltage			0.8	V
I_{Ik}	Input clamp current			–18	mA
I_{OH}	High–level output current			–1	mA
I_{OL}	Low–level output current			20	mA
T_{amb}	Operating free air temperature range	0		+70	°C

DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER		TEST CONDITIONS[1]		LIMITS			UNIT
					MIN	TYP[2]	MAX	
V_{OH}	High-level output voltage	$\overline{E}$ & CP inputs	V_{CC} = MIN, V_{IL} = 0.0V[3],	±10%V_{CC}	2.5			V
			V_{IH} = 4.5V[3], I_{OH} = MAX	±5%V_{CC}	2.7	3.4		V
		Other inputs	V_{CC} = MIN, V_{IL} = MAX,	±10%V_{CC}	2.5			V
			V_{IH} = MIN, I_{OH} = MAX	±5%V_{CC}	2.7			V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IL} = MAX,	±10%V_{CC}		0.35	0.50	V
			V_{IH} = MIN, I_{OL} = MAX	±5%V_{CC}		0.35	0.50	V
V_{IK}	Input clamp voltage		V_{CC} = MIN, I_I = I_{IK}			–0.73	-1.2	V
I_I	Input current at maximum input voltage		V_{CC} = 0.0V, V_I = 7.0V				100	µA
I_{IH}	High–level input current		V_{CC} = MAX, V_I = 2.7V				20	µA
I_{IL}	Low–level input current		V_{CC} = MAX, V_I = 0.5V				–20	µA
I_{OS}	Short circuit output current[4]		V_{CC} = MAX		–60		–150	mA
I_{CC}	Supply current (total)	'F377 I_{CCH}	V_{CC} = MAX			55	72	mA
		'F377 I_{CCL}	V_{CC} = MAX			70	90	mA
		'F377A I_{CCH}	V_{CC} = MAX			27	40	mA
		'F377A I_{CCL}	V_{CC} = MAX			29	43	mA

Notes to DC electrical characteristics

1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V_{CC} = 5V, T_{amb} = 25°C.
3. To reduce the effect of external noise during test. Special test conditions are not necessary for the '377A.
4. Not more than one output should be shorted at a time. For testing I_{OS}, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal 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.

AC CHARACTERISTICS FOR 'F377

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			T_{amb} = +25°C, V_{CC} = +5.0V, C_L = 50pF, R_L = 500Ω			T_{amb} = -40 to +85°C, V_{CC} = +5.0V ±10%, C_L = 50pF, R_L = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
f_{MAX}	Maximum clock frequency	1	110	120		100		MHz
t_{PLH} t_{PHL}	Propagation delay CP to Qn	1	4.0 4.0	7.0 7.0	9.0 9.0	4.0 4.0	10.0 10.5	ns

AC CHARACTERISTICS FOR 'F377A

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			T_{amb} = +25°C V_{CC} = +5.0V C_L = 50pF R_L = 500Ω			T_{amb} = -40 to +85°C V_{CC} = +5.0V ±10% C_L = 50pF R_L = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
f_{MAX}	Maximum clock frequency	1	150	165		120		MHz
t_{PLH} t_{PHL}	Propagation delay CP to Qn	1	3.0 4.5	5.0 6.5	8.0 9.0	2.5 4.0	9.0 10.5	ns

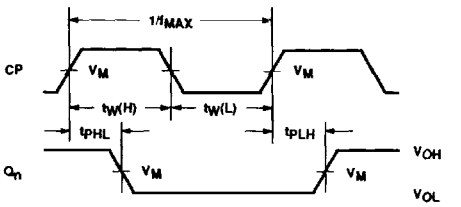
AC SETUP REQUIREMENTS FOR 'F377

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			T_{amb} = +25°C V_{CC} = +5.0V C_L = 50pF R_L = 500Ω			T_{amb} = -40 to +85°C V_{CC} = +5.0V ±10% C_L = 50pF R_L = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
t_s(H) t_s(L)	Setup time, High or Low Dn to CP	2	2.0 2.0			2.5 2.0		ns
t_h(H) t_h(L)	Hold time, High or Low Dn to CP	2	0.0 1.0			1.0 1.0		ns
t_s(H) t_s(L)	Setup time, High or Low $\overline{E}$ to CP	2	3.0 4.0			3.0 4.0		ns
t_h(H) t_h(L)	Hold time, High or Low $\overline{E}$ to CP	2	0.0 0.0			0.0 0.0		ns
t_w(H) t_w(L)	Clock Pulse width High or Low	1	4.0 4.5			5.0 5.0		ns

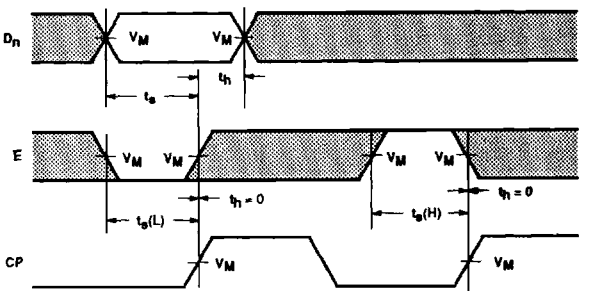
AC SETUP REQUIREMENTS FOR 'F377A

SYMBOL	PARAMETER	WAVEFORM	LIMITS					UNIT
			T_{amb} = +25°C V_{CC} = +5.0V C_L = 50pF R_L = 500Ω			T_{amb} = -40 to +85°C V_{CC} = +5.0V ±10% C_L = 50pF R_L = 500Ω		
			MIN	TYP	MAX	MIN	MAX	
t_s(H) t_s(L)	Setup time, High or Low Dn to CP	2	2.5 2.5			2.5 2.5		ns
t_h(H) t_h(L)	Hold time, High or Low Dn to CP	2	1.0 0.0			1.0 0.0		ns
t_s(H) t_s(L)	Setup time, High or Low $\overline{E}$ to CP	2	3.0 4.0			3.0 4.5		ns
t_h(H) t_h(L)	Hold time, High or Low $\overline{E}$ to CP	2	0.0 0.0			0.0 0.0		ns
t_w(H) t_w(L)	Clock Pulse width High or Low	1	4.0 4.0			5.0 4.0		ns

AC WAVEFORMS



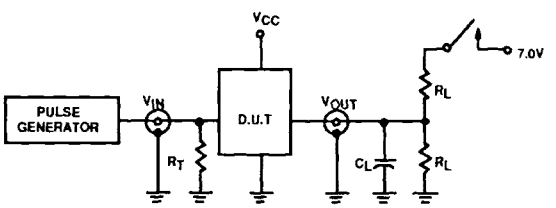
Waveform 1. Propagation Delay, Clock Input to Output, Clock Pulse Width and Maximum Clock Frequency



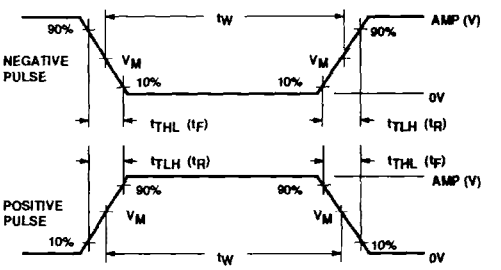
Waveform 2. Data and Enable Setup and Hold Times

NOTE: For all waveforms, V_M = 1.5V.
The shaded areas indicate when the input is permitted to change for predictable output performance.

TEST CIRCUIT AND WAVEFORM



Test Circuit for 3–State Outputs



V_M = 1.5V
Input Pulse Definition

SWITCH POSITION

TEST	SWITCH
t_{PLZ}	closed
t_{PZL}	closed
All other	open

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.

C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	t_W	t_R	t_F
74F	3.0V	1MHz	500ns	2.5ns	2.5ns