

# MC74HC377A

## Octal D Flip-Flop with Common Clock and Enable

### High-Performance Silicon-Gate CMOS

The MC74HC377A is identical in pinout to the LS273. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

This device consists of eight D flip-flops with common Clock and Enable ( $\bar{E}$ ) inputs. Each flip-flop is loaded with a low-to-high transition of the Clock input. Enable ( $\bar{E}$ ) is active low.

#### Features

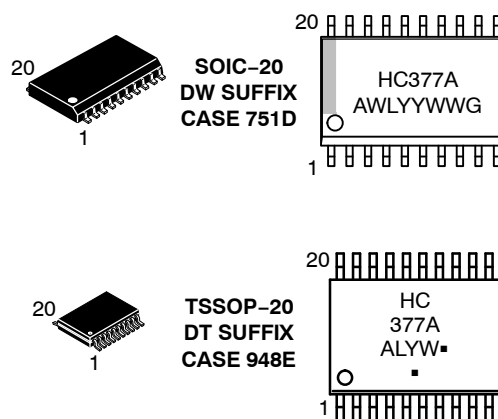
- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1.0  $\mu$ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 264 FETs or 66 Equivalent Gates
- These are Pb-Free Devices



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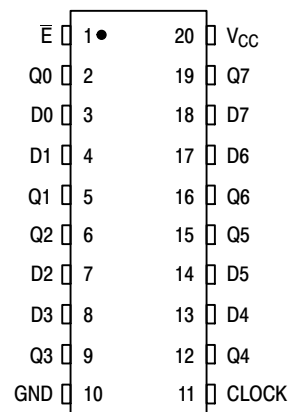
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#### MARKING DIAGRAMS



A = Assembly Location  
 WL, L = Wafer Lot  
 YY, Y = Year  
 WW, W = Work Week  
 G = Pb-Free Package  
 ■ = Pb-Free Package  
 (Note: Microdot may be in either location)

#### PIN ASSIGNMENT



#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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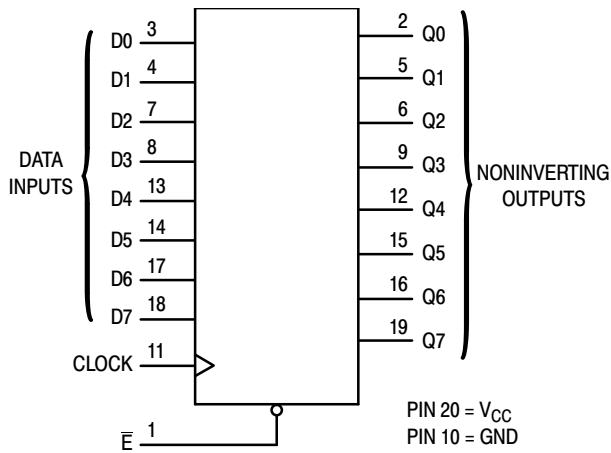


Figure 1. Logic Diagram

## FUNCTION TABLE

Operating Modes	Inputs			Outputs
	Clock	$\bar{E}$	Dn	Qn
Load "1"	↑	l	h	H
Load "0"	↑	l	l	L
Hold (Do Nothing)	↑ X	h H	X X	No Change No Change

H = HIGH voltage level

h = HIGH voltage level one setup time prior to the LOW-to-HIGH CP transition

L = LOW voltage level

l = LOW voltage level one setup time prior to the LOW-to-HIGH CP transition

↑ = LOW-to-HIGH CP transition

X = Don't Care

Design Criteria	Value	Units
Internal Gate Count*	66	ea
Internal Gate Propagation Delay	1.5	ns
Internal Gate Power Dissipation	5.0	$\mu$ W
Speed Power Product	.0075	pJ

\*Equivalent to a two-input NAND gate.

## ORDERING INFORMATION

Device	Package	Shipping†
MC74HC377ADWG	SOIC-20 WIDE (Pb-Free)	38 Units / Rail
MC74HC377ADWR2G	SOIC-20 WIDE (Pb-Free)	1000 Tape & Reel
MC74HC377ADTG	TSSOP-20*	75 Units / Rail
MC74HC377ADTR2G	TSSOP-20*	2500 Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*This package is inherently Pb-Free.

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## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
$V_{in}$	DC Input Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
$V_{out}$	DC Output Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
$I_{in}$	DC Input Current, per Pin	$\pm 20$	mA
$I_{out}$	DC Output Current, per Pin	$\pm 25$	mA
$I_{CC}$	DC Supply Current, $V_{CC}$ and GND Pins	$\pm 50$	mA
$P_D$	Power Dissipation in Still Air SOIC Package <sup>†</sup> TSSOP Package <sup>†</sup>	500 450	mW
$T_{stg}$	Storage Temperature	-65 to +150	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$ . Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

<sup>†</sup>Derating - SOIC Package: - 7 mW/°C from 65° to 125°C  
TSSOP Package: - 6.1 mW/°C from 65° to 125°C

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
$V_{in}, V_{out}$	DC Input Voltage, Output Voltage (Referenced to GND)	0	$V_{CC}$	V
$T_A$	Operating Temperature, All Package Types	-55	+125	°C
$t_r, t_f$	Input Rise and Fall Time (Figure 2)			ns
	$V_{CC} = 2.0 \text{ V}$	0	1000	
	$V_{CC} = 4.5 \text{ V}$	0	500	
	$V_{CC} = 6.0 \text{ V}$	0	400	

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## DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				-55 to 25°C	≤ 85°C	≤ 125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>out</sub> = V <sub>CC</sub> - 0.1 V  I <sub>out</sub>   ≤ 20 μA	2.0	1.5	1.5	1.5	V
			3.0	2.1	2.1	2.1	
			4.5	3.15	3.15	3.15	
			6.0	4.2	4.2	4.2	
V <sub>IL</sub>	Maximum Low-Level Input Voltage	V <sub>out</sub> = 0.1 V  I <sub>out</sub>   ≤ 20 μA	2.0	0.5	0.5	0.5	V
			3.0	0.9	0.9	0.9	
			4.5	1.35	1.35	1.35	
			6.0	1.8	1.8	1.8	
V <sub>OH</sub>	Minimum High-Level Output Voltage	V <sub>in</sub> = V <sub>IH</sub>  I <sub>out</sub>   ≤ 20 μA	2.0	1.9	1.9	1.9	V
			4.5	4.4	4.4	4.4	
		V <sub>in</sub> = V <sub>IH</sub>  I <sub>out</sub>   ≤ 4.0 mA  I <sub>out</sub>   ≤ 5.2 mA	4.5	3.98	3.84	3.7	
			6.0	5.48	5.34	5.2	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>in</sub> = V <sub>IL</sub>  I <sub>out</sub>   ≤ 20 μA	2.0	0.1	0.1	0.1	V
			4.5	0.1	0.1	0.1	
		V <sub>in</sub> = V <sub>IL</sub>  I <sub>out</sub>   ≤ 4.0 mA  I <sub>out</sub>   ≤ 5.2 mA	4.5	0.26	0.33	0.4	
			6.0	0.26	0.33	0.4	
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = V <sub>CC</sub> or GND	6.0	±0.1	±1.0	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>in</sub> = V <sub>CC</sub> or GND I <sub>out</sub> = 0 μA	6.0	4.0	40	160	μA

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## AC Electrical Characteristics ( $C_L = 50$ pF, Input $t_r, t_f = 6.0$ ns)

Symbol	Parameter	Test Conditions	$V_{CC}$ (V)	Guaranteed Limits			Unit
				-55°C to 25°	≤ 85°C	≤ 125°C	
$t_{PHL}, t_{PLH}$	Maximum Propagation Delay Clock to Qn	Figures 2, 4	2.0	160	200	240	ns
			4.5	32	40	48	
			6.0	27	34	41	
$t_{THL}, t_{TLH}$	Maximum Output Transition Time	Figures 2, 4	2.0	75	95	110	ns
			4.5	15	19	22	
			6.0	13	16	19	
$t_W$	Minimum Clock Pulse Width High or Low	Figure 2	2.0	80	100	120	ns
			4.5	16	20	24	
			6.0	4	17	20	
$t_{su}$	Minimum Set-up Time $D_n$ to Clock	Figure 3	2.0	60	75	90	ns
			4.5	12	15	18	
			6.0	10	13	15	
$t_{su}$	Minimum Set-up Time Enable to Clock	Figure 3	2.0	60	75	90	ns
			4.5	12	15	18	
			6.0	10	13	15	
$t_h$	Minimum Hold Time $D_n$ to Clock	Figure 3	2.0	3	3	3	ns
			4.5	3	3	3	
			6.0	3	3	3	
$t_h$	Minimum Hold Time Enable to Clock	Figure 3	2.0	4	4	4	ns
			4.5	4	4	4	
			6.0	4	4	4	
$f_{max}$	Maximum Clock Pulse Frequency (50% duty cycle)	Figures 2, 4	2.0	6	5	4	ns
			4.5	30	24	20	
			6.0	35	28	24	
$C_{in}$	Maximum Input Capacitance		-	10	10	10	pF

$C_{PD}$ (Note 1)		<b>Typical @ 25°C, <math>V_{CC} = 5.0</math> V</b>	pF
	Power Dissipation Capacitance	35	

1.  $C_{PD}$  is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from:  
 $I_{CC(operating)} \approx C_{PD} \times V_{CC} \times f_{IN} \times N_{SW}$  where  $N_{SW}$  = total number of outputs switching and  $f_{IN}$  = switching frequency.

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## SWITCHING WAVEFORMS

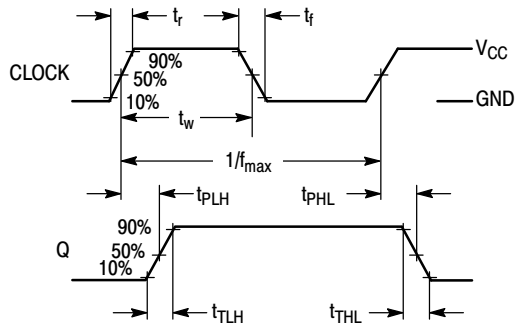


Figure 2.

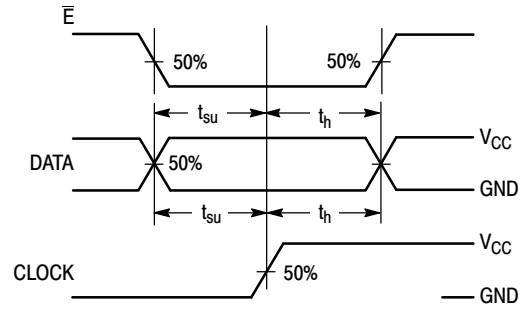
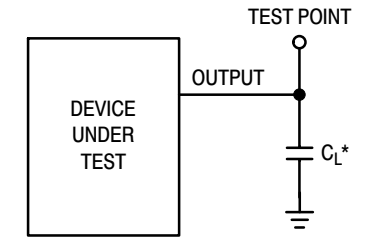


Figure 3.



\*Includes all probe and jig capacitance

Figure 4. Test Circuit

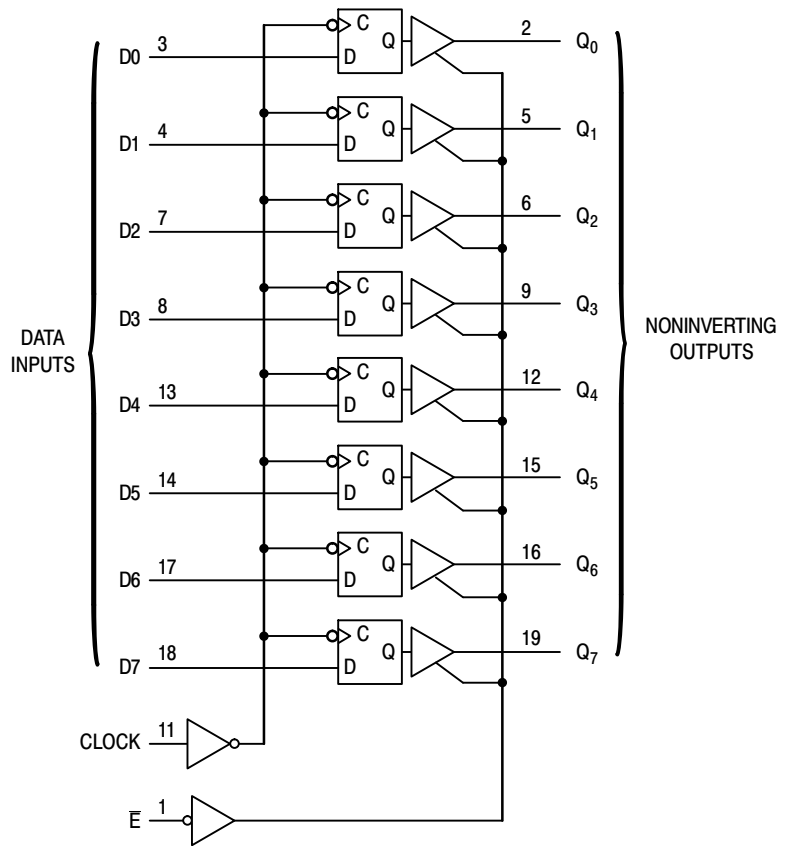
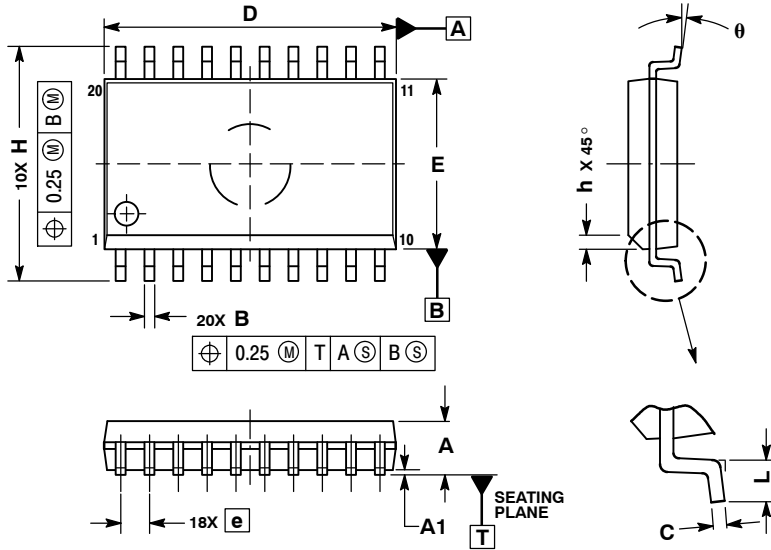


Figure 5. Expanded Logic Diagram

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## PACKAGE DIMENSIONS

SOIC-20  
DW SUFFIX  
CASE 751D-05  
ISSUE G



NOTES:

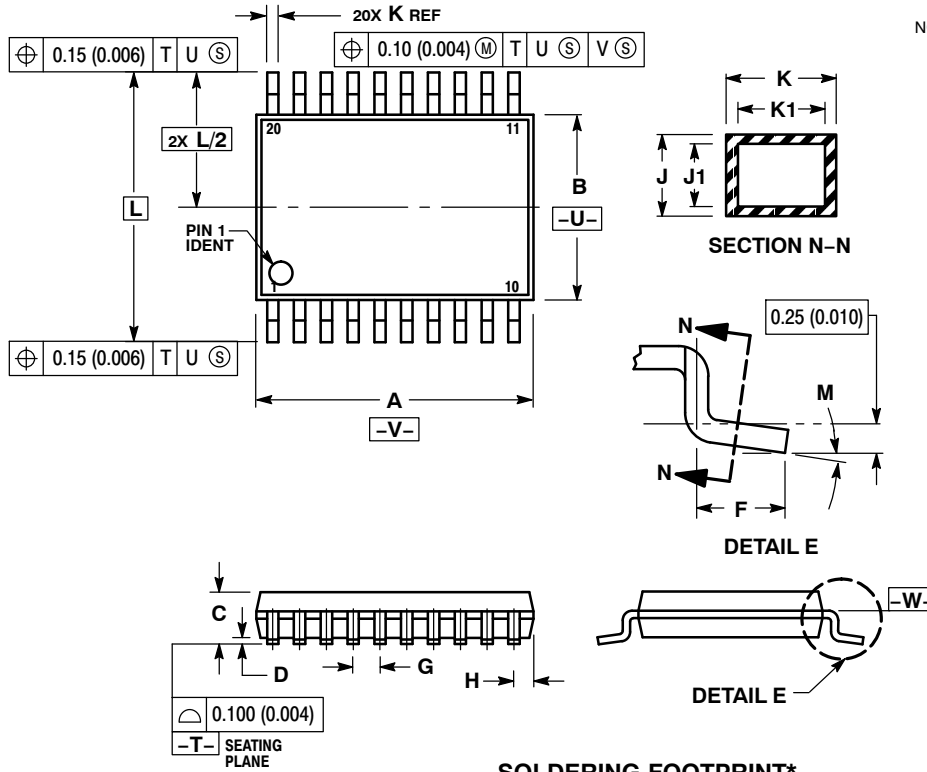
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS	
	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
theta	0°	7°

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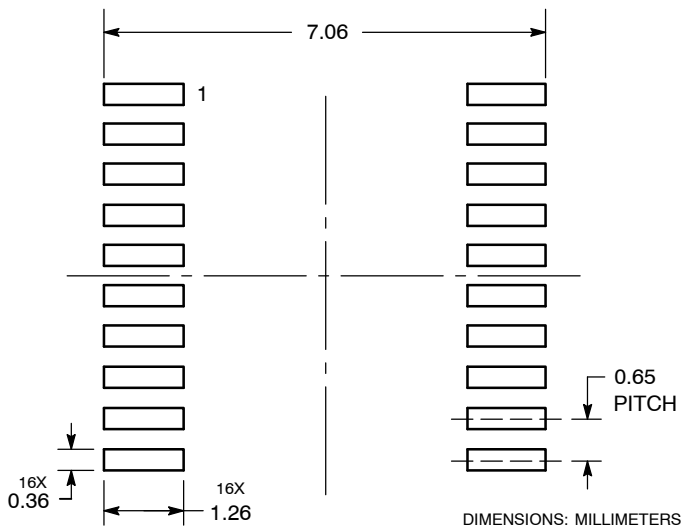
## PACKAGE DIMENSIONS

TSSOP-20  
DT SUFFIX  
CASE 948E-02  
ISSUE C



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
  5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



# MC74HC377A

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