

# MC74AC377, MC74ACT377

## Octal D Flip-Flop with Clock Enable

The MC74AC377/74ACT377 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

- Ideal for Addressable Register Applications
- Clock Enable for Address and Data Synchronization Applications
- Eight Edge-Triggered D Flip-Flops
- Buffered Common Clock
- Outputs Source/Sink 24 mA
- See MC74AC273 for Master Reset Version
- See MC74AC373 for Transparent Latch Version
- See MC74AC374 for 3-State Version
- ACT377 Has TTL Compatible Inputs
- MSL = 1 for all Surface Mount
- Chip Complexity: 292 FETs or 73 Gates
- Pb-Free Packages are Available

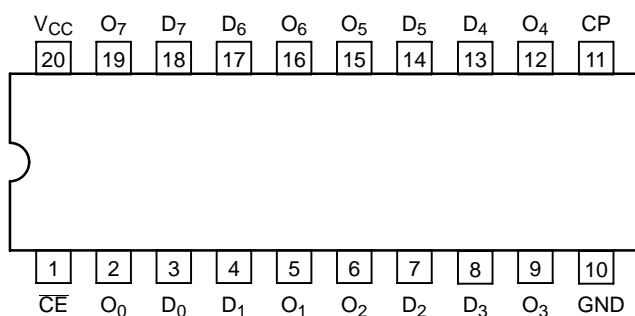


Figure 1. Pinout: 20-Lead Packages Conductors (Top View)

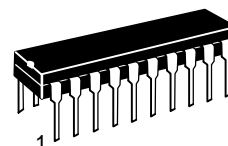
### PIN NAMES

PIN	FUNCTION
D <sub>0</sub> -D <sub>7</sub>	Data Inputs
$\overline{CE}$	Clock Enable (Active LOW)
Q <sub>0</sub> -Q <sub>7</sub>	Data Outputs
CP	Clock Pulse Input

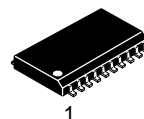


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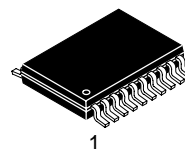
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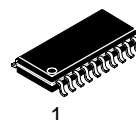
PDIP-20  
N SUFFIX  
CASE 738



SOIC-20W  
DW SUFFIX  
CASE 751D



TSSOP-20  
DT SUFFIX  
CASE 948E



SOEIAJ-20  
M SUFFIX  
CASE 967

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 7 of this data sheet.

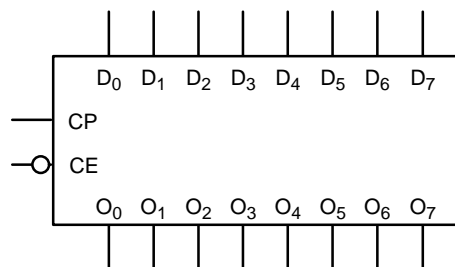


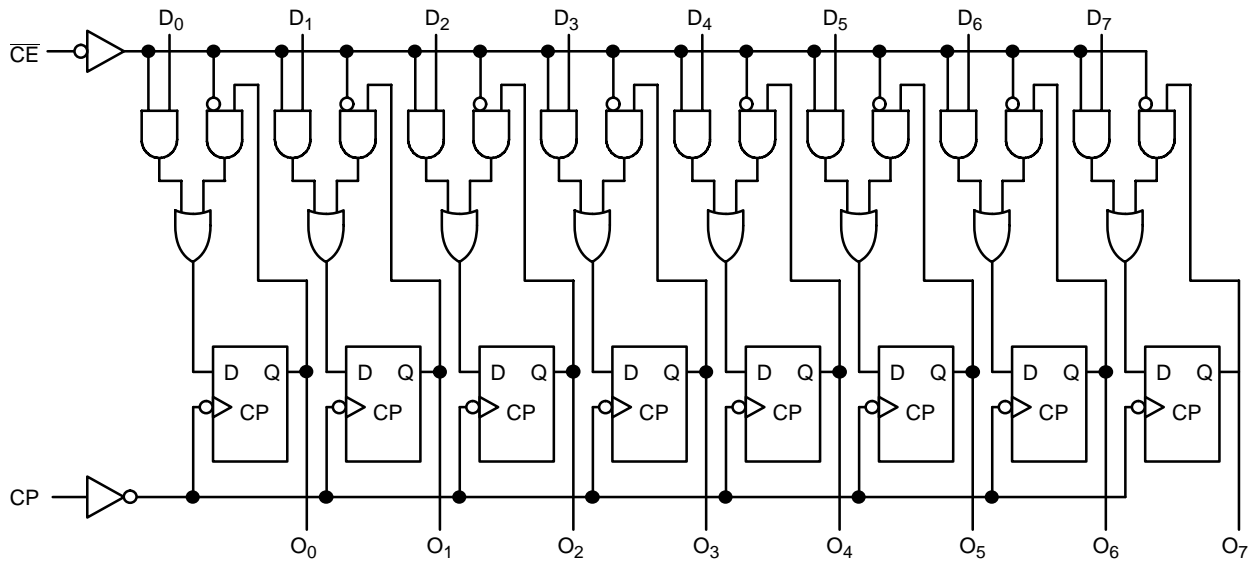
Figure 2. Logic Symbol

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## MODE SELECT-FUNCTION TABLE

Operating Mode	Inputs			Outputs
	CP	CE	D <sub>n</sub>	Q <sub>n</sub>
Load '1'	┐	L	H	H
Load '0'	┐	L	L	L
Hold (Do Nothing)	┐	H	X	No Change
	X	H	X	No Change

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 ┐ = LOW-to-HIGH Clock Transition



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Figure 3. Logic Diagram

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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 Sink/Source Current, per Pin	$\pm 50$	mA
$I_{CC}$	DC $V_{CC}$ or GND Current per Output Pin	$\pm 50$	mA
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}\text{C}$
$\theta_{JA}$	Thermal Resistance, (Junction-to-Ambient)	SOIC TSSOP PDIP 97 129 69	$^{\circ}\text{C}/\text{W}$
$V_{ESD}$	ESD Withstand Voltage	Human Body Model (Note 1) Machine Model (Note 2) Charged Device Model (Note 3) > 2000 > 200 > 1000	V
$I_{Latchup}$	Latchup Performance	$V_{CC} = 5.5\text{ V}$ ; $T_A = 125^{\circ}\text{C}$ (Note 4)	> 100 mA

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.

1. Tested to EIA/JESD22-A114-A
2. Tested to EIA/JESD22-A115-A
3. Tested to JESD22-C101-A
4. Tested to EIA/JESD78

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit	
$V_{CC}$	Supply Voltage	'AC	2.0	5.0	6.0	V
		'ACT	4.5	5.0	5.5	
$V_{in}, V_{out}$	DC Input Voltage, Output Voltage (Ref. to GND)	0	-	$V_{CC}$	V	
$t_r, t_f$	Input Rise and Fall Time (Note 5) 'AC Devices except Schmitt Inputs	$V_{CC}$ @ 3.0 V	-	150	-	ns/V
		$V_{CC}$ @ 4.5 V	-	40	-	
		$V_{CC}$ @ 5.5 V	-	25	-	
$t_r, t_f$	Input Rise and Fall Time (Note 6) 'ACT Devices except Schmitt Inputs	$V_{CC}$ @ 4.5 V	-	10	-	ns/V
		$V_{CC}$ @ 5.5 V	-	8.0	-	
$T_J$	Junction Temperature (PDIP)	-	-	140	$^{\circ}\text{C}$	
$T_A$	Operating Ambient Temperature Range	-40	25	85	$^{\circ}\text{C}$	
$I_{OH}$	Output Current - High	-	-	-24	mA	
$I_{OL}$	Output Current - Low	-	-	24	mA	

5.  $V_{in}$  from 30% to 70%  $V_{CC}$ ; see individual Data Sheets for devices that differ from the typical input rise and fall times.
6.  $V_{in}$  from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

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## 74AC – DC CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C	Unit	Conditions
			Typ	Guaranteed Limits			
V <sub>IH</sub>	Minimum High Level Input Voltage	3.0	1.50	2.10	2.10	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V
		4.5	2.25	3.15	3.15	V	
		5.5	2.75	3.85	3.85	V	
V <sub>IL</sub>	Maximum Low Level Input Voltage	3.0	1.50	0.90	0.90	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V
		4.5	2.25	1.35	1.35	V	
		5.5	2.75	1.65	1.65	V	
V <sub>OH</sub>	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	V	I <sub>OUT</sub> = -50 μA
		4.5	4.49	4.4	4.4	V	
		5.5	5.49	5.4	5.4	V	
		3.0	-	2.56	2.46	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> -12 mA I <sub>OH</sub> -24 mA -24 mA
		4.5		3.86	3.76	V	
		5.5		4.86	4.76	V	
V <sub>OL</sub>	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	V	I <sub>OUT</sub> = 50 μA
		4.5	0.001	0.1	0.1	V	
		5.5	0.001	0.1	0.1	V	
		3.0	-	0.36	0.44	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> -12 mA I <sub>OH</sub> -24 mA -24 mA
		4.5		0.36	0.44	V	
		5.5		0.36	0.44	V	
I <sub>IN</sub>	Maximum Input Leakage Current	5.5	-	±0.1	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND
I <sub>OLD</sub> I <sub>OHD</sub>	Maximum Input Leakage Current	5.5	-	-	75	mA	V <sub>OLD</sub> = 1.65 V Max V <sub>OHD</sub> = 3.85 V Min
		5.5			-75	mA	
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5	-	8.0	80	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

NOTE: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V<sub>CC</sub>.

## 74AC – AC CHARACTERISTICS For Figures and Waveforms, See Figures 4, 5, and 6.

Symbol	Parameter	V <sub>CC</sub> * (V)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
f <sub>max</sub>	Maximum Clock Frequency	3.3 5.0	90 140	-	-	75 125	-	MHz
t <sub>PLH</sub>	Propagation Delay CP to Q <sub>n</sub>	3.3 5.0	3.0 2.0	-	13.0 9.0	1.5 1.5	14.0 10.0	ns
t <sub>PHL</sub>	Propagation Delay CP to Q <sub>n</sub>	3.3 5.0	3.5 2.5	-	13.0 10.0	2.0 1.5	14.5 11.0	ns

\* Voltage Range 3.3 V is 3.3 V ±0.3 V; Voltage Range 5.0 V is 5.0 V ±0.5 V.

## 74AC – AC OPERATING REQUIREMENTS

Symbol	Parameter	V <sub>CC</sub> * (V)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C	Unit
			Typ	Guaranteed Minimum		
t <sub>s</sub>	Setup Time, HIGH or LOW D <sub>n</sub> to CP	3.3 5.0	-	5.5 4.07	6.0 4.5	ns
t <sub>h</sub>	Hold Time, HIGH or LOW D <sub>n</sub> to CP	3.3 5.0	-	0 1.0	0 1.0	ns
t <sub>s</sub>	Setup Time, HIGH or LOW $\overline{CE}$ to CP	3.3 5.0	-	6.0 4.0	7.5 4.5	ns
t <sub>h</sub>	Hold Time, HIGH or LOW $\overline{CE}$ to CP	3.3 5.0	-	0 1.0	0 1.0	ns
t <sub>w</sub>	CP Pulse Width HIGH or LOW	3.3 5.0	-	5.5 4.0	6.0 4.5	ns

\* Voltage Range 3.3 V is 3.3 V ±0.3 V; Voltage Range 5.0 V is 5.0 V ±0.5 V.

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## 74ACT – DC CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C	Unit	Conditions
			Typ	Guaranteed Limits			
V <sub>IH</sub>	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V
V <sub>IL</sub>	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V
V <sub>OH</sub>	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	V	I <sub>OUT</sub> = -50 μA
		4.5 5.5	-	3.86 4.86	3.76 4.76	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> -24 mA I <sub>OH</sub> -24 mA
V <sub>OL</sub>	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	V	I <sub>OUT</sub> = 50 μA
		4.5 5.5	-	0.36 0.36	0.44 0.44	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> -24 mA I <sub>OH</sub> -24 mA
I <sub>IN</sub>	Maximum Input Leakage Current	5.5	-	±0.1	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND
ΔI <sub>CCT</sub>	Additional Max I <sub>CC</sub> /Input	5.5	0.6	-	1.5	mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1 V
I <sub>OLD</sub> I <sub>OHD</sub>	†Minimum Dynamic Output Current	5.5	-	-	75 -75	mA	V <sub>OLD</sub> = 1.65 V Max V <sub>OHD</sub> = 3.85 V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5	-	8.0	80	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

## 74ACT – AC CHARACTERISTICS For Figures and Waveforms — See Figures 4, 5, and 6.

Symbol	Parameter	V <sub>CC</sub> * (V)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
f <sub>max</sub>	Maximum Clock Frequency	5.0	140	-	-	125	-	MHz
t <sub>PLH</sub>	Propagation Delay CP to Q <sub>n</sub>	5.0	3.0	-	9.0	2.5	10	ns
t <sub>PHL</sub>	Propagation Delay CP to Q <sub>n</sub>	5.0	3.5	-	10	2.5	11	ns

\*Voltage Range 5.0 V is 5.0 V ±0.5 V.

## 74ACT – AC OPERATING REQUIREMENTS

Symbol	Parameter	V <sub>CC</sub> * (V)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Typ	Guaranteed Minimum	Min	Max	
t <sub>s</sub>	Setup Time, HIGH or LOW D <sub>n</sub> to CP	5.0	-	4.5	5.5	ns	
t <sub>h</sub>	Hold Time, HIGH or LOW D <sub>n</sub> to CP	5.0	-	1.0	1.0	ns	
t <sub>s</sub>	Setup Time, HIGH or LOW $\overline{CE}$ to CP	5.0	-	4.5	5.5	ns	
t <sub>h</sub>	Hold Time, HIGH or LOW $\overline{CE}$ to CP	5.0	-	1.0	1.0	ns	
t <sub>w</sub>	CP Pulse Width HIGH or LOW	5.0	-	4.0	4.5	ns	

\*Voltage Range 5.0 V is 5.0 V ±0.5 V.

## CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = 5.0 V
C <sub>PD</sub>	Power Dissipation Capacitance	90	pF	V <sub>CC</sub> = 5.0 V

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## SWITCHING WAVEFORMS

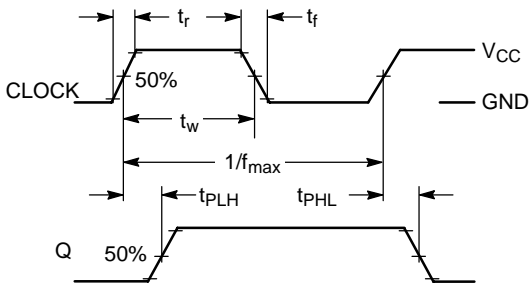


Figure 4.

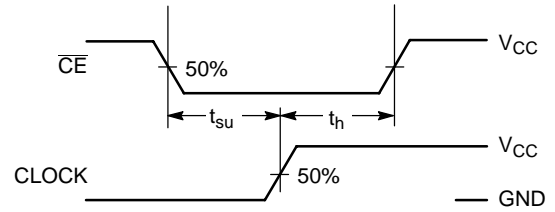


Figure 5.

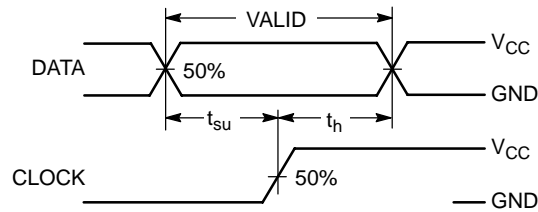
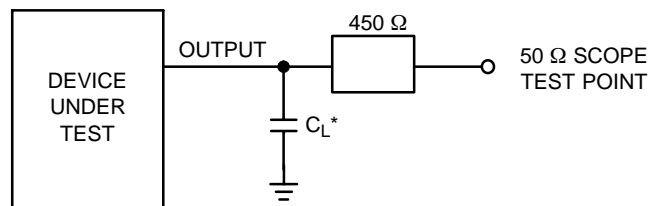


Figure 6.



\*Includes all probe and jig capacitance

Figure 7. Test Circuit

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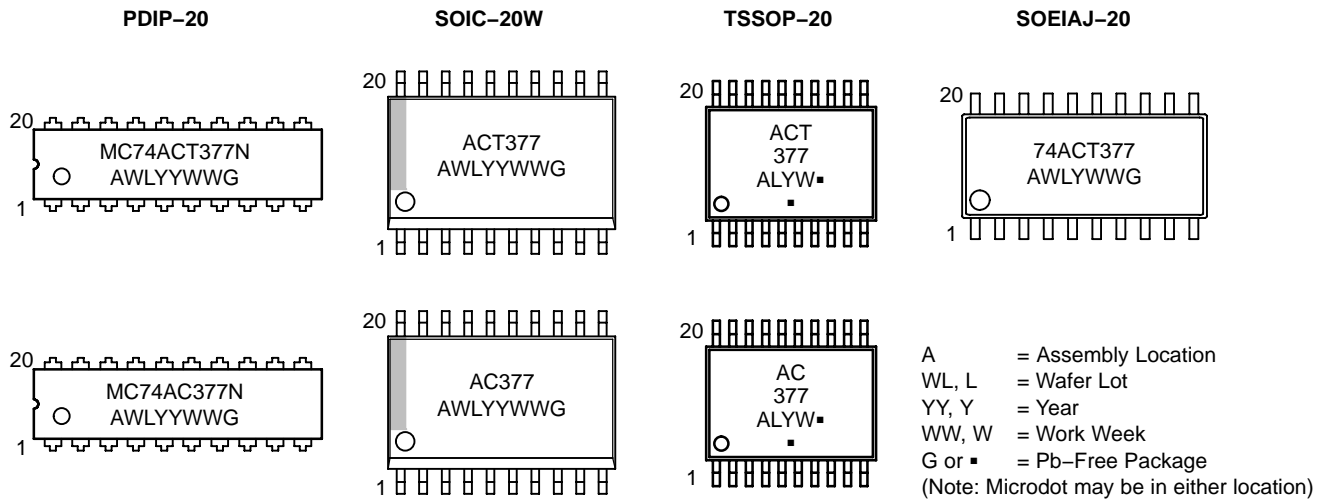
## ORDERING INFORMATION

Device	Package	Shipping†
MC74AC377N	PDIP-20	18 Units / Rail
MC74AC377NG	PDIP-20 (Pb-Free)	
MC74ACT377N	PDIP-20	
MC74ACT377NG	PDIP-20 (Pb-Free)	
MC74AC377DW	SOIC-20	38 Units / Rail
MC74AC377DWG	SOIC-20 (Pb-Free)	
MC74AC377DWR2	SOIC-20	1000 / Tape & Reel
MC74AC377DWR2G	SOIC-20 (Pb-Free)	
MC74ACT377DW	SOIC-20	38 Units / Rail
MC74ACT377DWG	SOIC-20 (Pb-Free)	
MC74ACT377DWR2	SOIC-20	1000 / Tape & Reel
MC74ACT377DWR2G	SOIC-20 (Pb-Free)	
MC74AC377DT	TSSOP-20*	75 Units / Rail
MC74AC377DTG	TSSOP-20*	
MC74AC377DTR2	TSSOP-20*	2500 / Tape & Reel
MC74AC377DTR2G	TSSOP-20*	
MC74ACT377MEL	SOEIAJ-20	2000 / Tape & Reel
MC74ACT377MELG	SOEIAJ-20 (Pb-Free)	

†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.

\*These packages are inherently Pb-Free.

## MARKING DIAGRAMS



# MC74AC377, MC74ACT377

## PACKAGE DIMENSIONS

**PDIP-20**  
**N SUFFIX**  
 PLASTIC DIP PACKAGE  
 CASE 738-03  
 ISSUE E



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
  4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.010	1.070	25.66	27.17
B	0.240	0.260	6.10	6.60
C	0.150	0.180	3.81	4.57
D	0.015	0.022	0.39	0.55
E	0.050 BSC		1.27 BSC	
F	0.050	0.070	1.27	1.77
G	0.100 BSC		2.54 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.140	2.80	3.55
L	0.300 BSC		7.62 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.01

**SOIC-20W**  
**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
θ	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°

### SOLDERING FOOTPRINT\*



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

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## PACKAGE DIMENSIONS

SOEIAJ-20  
M SUFFIX  
CASE 967-01  
ISSUE A



DETAIL P



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A <sub>1</sub>	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.15	0.25	0.006	0.010
D	12.35	12.80	0.486	0.504
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
HE	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
LE	1.10	1.50	0.043	0.059
M	0° - 10°		0° - 10°	
Q <sub>1</sub>	0.70	0.90	0.028	0.035
Z	---	0.81	---	0.032

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Телефон: 8 (812) 309-75-97 (многоканальный)

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Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А