

# Octal D Flip-Flop with Clock Enable

## MC74AC377, MC74ACT377

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
- These are Pb-Free Devices

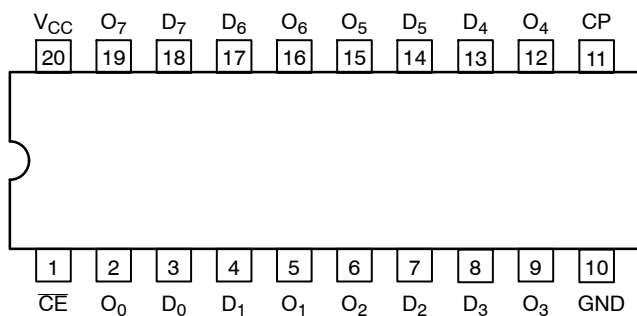
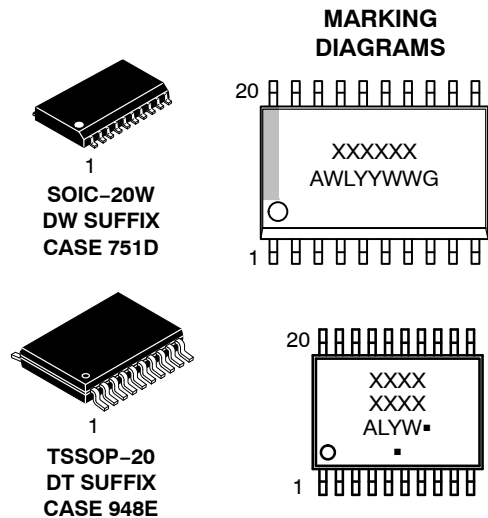


Figure 1. Pinout: 20-Lead Packages Conductors  
(Top View)

### 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



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

### ORDERING INFORMATION

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

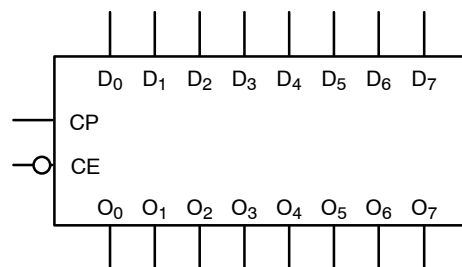


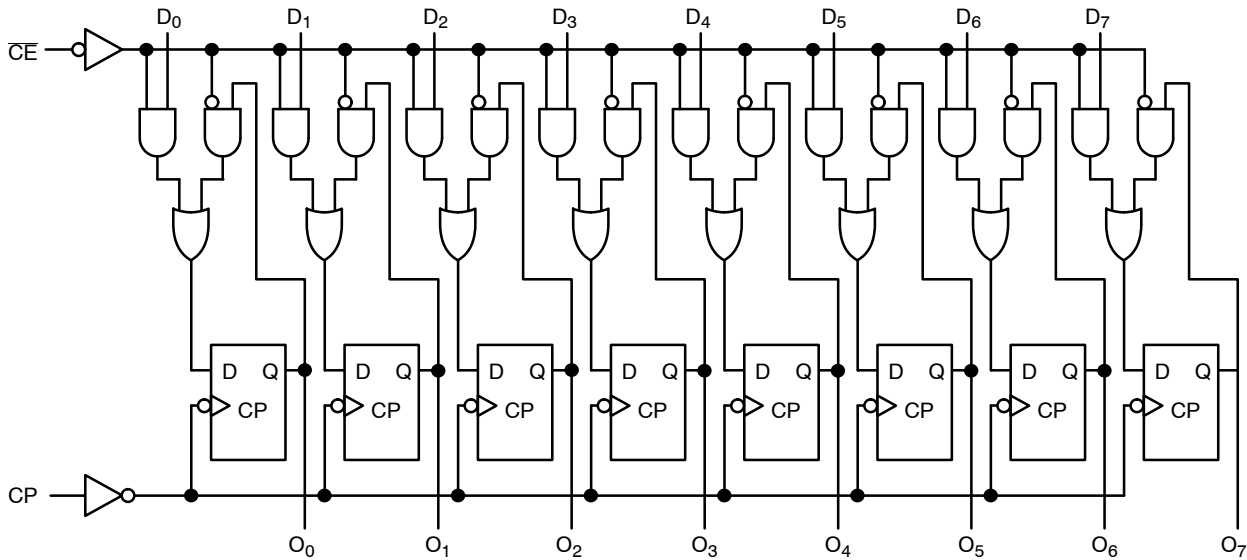
Figure 2. Logic Symbol

# MC74AC377, MC74ACT377

**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**

# MC74AC377, MC74ACT377

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	-0.5 to +6.5	V
V <sub>IN</sub>	DC Input Voltage (Referenced to GND)	-0.5 to V <sub>CC</sub> +0.5	V
V <sub>OUT</sub>	DC Output Voltage (Referenced to GND) (Note 1)	-0.5 to V <sub>CC</sub> +0.5	V
I <sub>IK</sub>	DC Input Diode Current	±20	mA
I <sub>OK</sub>	DC Output Diode Current	±50	mA
I <sub>OUT</sub>	DC Output Sink/Source Current	±50	mA
I <sub>CC</sub>	DC Supply Current, per Output Pin	±50	mA
I <sub>GND</sub>	DC Ground Current, per Output Pin	±100	mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead temperature, 1 mm from Case for 10 Seconds	260	°C
T <sub>J</sub>	Junction Temperature Under Bias	140	°C
θ <sub>JA</sub>	Thermal Resistance (Note 2)	SOIC TSSOP 96 150	°C/W
MSL	Moisture Sensitivity	Level 1	
F <sub>R</sub>	Flammability Rating	Oxygen Index: 30% – 35% UL 94 V-0 @ 0.125 in	
V <sub>ESD</sub>	ESD Withstand Voltage	Human Body Model (Note 3) Charged Device Model (Note 4) > 2000 > 1000	V
I <sub>Latchup</sub>	Latchup Performance	Above V <sub>CC</sub> and Below GND at 85°C (Note 5)	±100 mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. I<sub>OUT</sub> absolute maximum rating must be observed.
2. The package thermal impedance is calculated in accordance with JESD 51-7.
3. Tested to EIA/JESD22-A114-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit	
V <sub>CC</sub>	Supply Voltage	'AC	2.0	5.0	6.0	V
		'ACT	4.5	5.0	5.5	
V <sub>in</sub> , V <sub>out</sub>	DC Input Voltage, Output Voltage (Ref. to GND)	0	-	V <sub>CC</sub>	V	
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time (Note 6) 'AC Devices except Schmitt Inputs	V <sub>CC</sub> @ 3.0 V	-	150	-	ns/V
		V <sub>CC</sub> @ 4.5 V	-	40	-	
		V <sub>CC</sub> @ 5.5 V	-	25	-	
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time (Note 7) 'ACT Devices except Schmitt Inputs	V <sub>CC</sub> @ 4.5 V	-	10	-	ns/V
		V <sub>CC</sub> @ 5.5 V	-	8.0	-	
T <sub>A</sub>	Operating Ambient Temperature Range	-40	25	85	°C	
I <sub>OH</sub>	Output Current – High	-	-	-24	mA	
I <sub>OL</sub>	Output Current – Low	-	-	24	mA	

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

6. V<sub>in</sub> from 30% to 70% V<sub>CC</sub>; see individual Data Sheets for devices that differ from the typical input rise and fall times.
7. V<sub>in</sub> from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

# MC74AC377, MC74ACT377

## 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.

# MC74AC377, MC74ACT377

## 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		
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

# MC74AC377, MC74ACT377

## SWITCHING WAVEFORMS

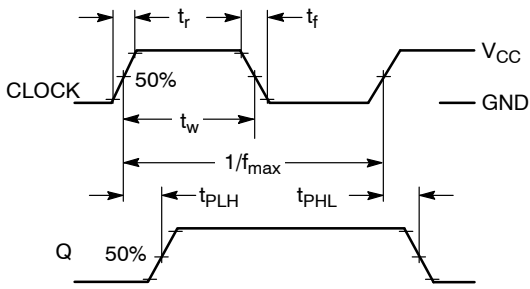


Figure 4.

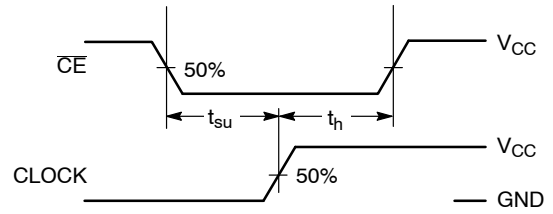


Figure 5.

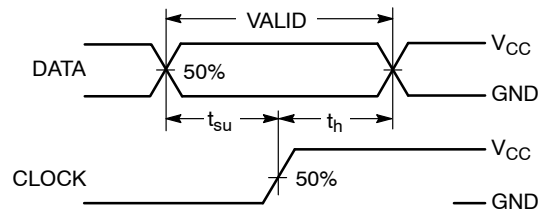
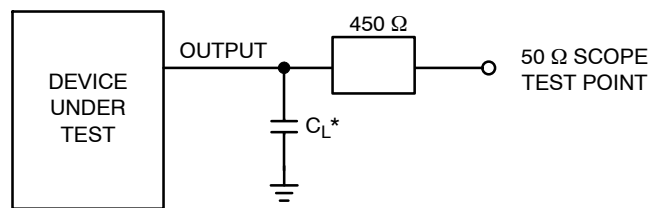


Figure 6.



\*Includes all probe and jig capacitance

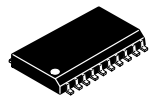
Figure 7. Test Circuit

## MC74AC377, MC74ACT377

### ORDERING INFORMATION

Device	Marking	Package	Shipping <sup>†</sup>
MC74AC377DWR2G	AC377	SOIC-20	1000 / Tape & Reel
MC74ACT377DWR2G	ACT377	SOIC-20	1000 / Tape & Reel
MC74AC377DTG	AC 377	TSSOP-20	75 Units / Rail
MC74AC377DTR2G	AC 377	TSSOP-20	2500 / Tape & Reel

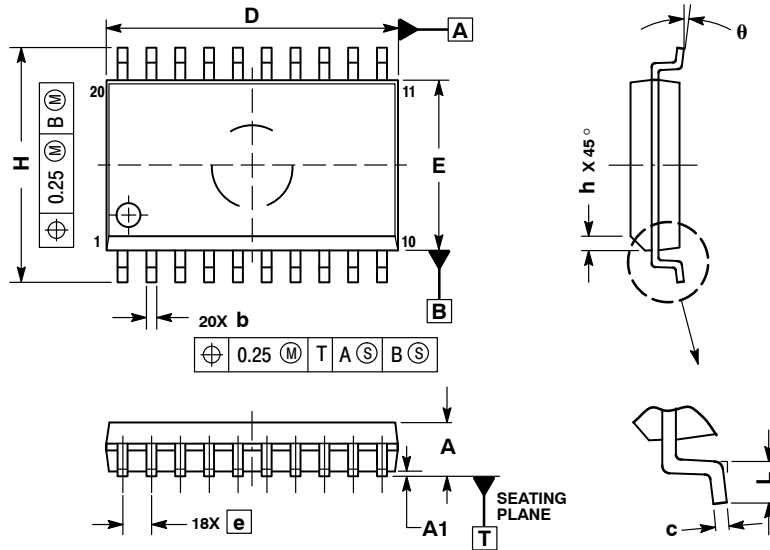
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



SCALE 1:1

SOIC-20 WB  
CASE 751D-05  
ISSUE H

DATE 22 APR 2015

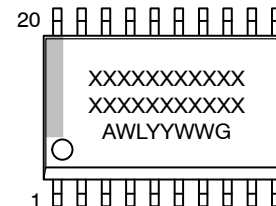


NOTES:

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.

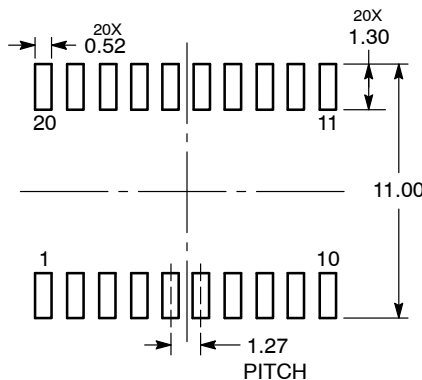
DIM	MILLIMETERS	
	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
b	0.35	0.49
c	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°

GENERIC MARKING DIAGRAM\*



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

RECOMMENDED SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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