

# MC74HCT374A

## Octal 3-State Noninverting D Flip-Flop with LSTTL-Compatible Inputs High-Performance Silicon-Gate CMOS

The MC74HCT374A may be used as a level converter for interfacing TTL or NMOS outputs to High-Speed CMOS inputs.

The HCT374A is identical in pinout to the LS374.

Data meeting the setup and hold time is clocked to the outputs with the rising edge of Clock. The Output Enable does not affect the state of the flip-flops, but when Output Enable is high, the outputs are forced to the high-impedance state. Thus, data may be stored even when the outputs are not enabled.

The HCT374A is identical in function to the HCT574A, which has the input pins on the opposite side of the package from the output pins. This device is similar in function to the HCT534A, which has inverting outputs.

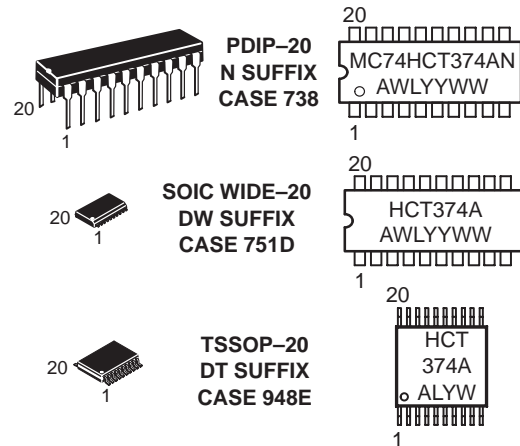
- Output Drive Capability: 15 LSTTL Loads
- TTL/NMOS-Compatible Input Levels
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 4.5 to 5.5 V
- Low Input Current: 1.0  $\mu$ A
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 276 FETs or 69 Equivalent Gates
- Improvements over HCT374
  - Improved Propagation Delays
  - 50% Lower Quiescent Power
  - Improved Input Noise and Latchup Immunity



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### MARKING DIAGRAMS

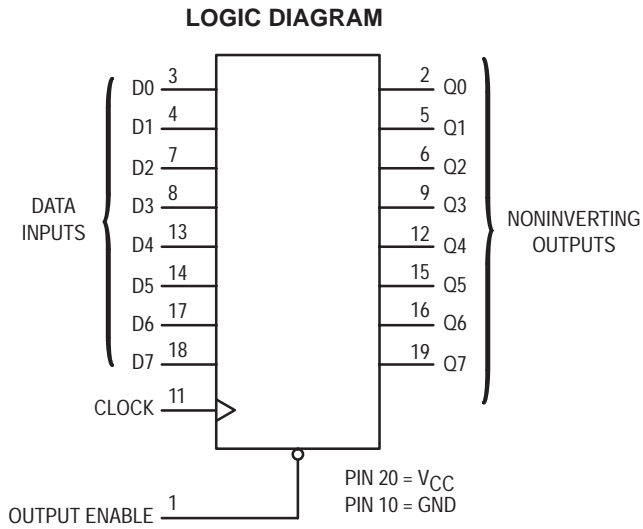


A = Assembly Location  
 WL = Wafer Lot  
 YY = Year  
 WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping
MC74HCT374AN	PDIP-20	1440 / Box
MC74HCT374ADW	SOIC-WIDE	38 / Rail
MC74HCT374ADWR2	SOIC-WIDE	1000 / Reel
MC74HCT374ADT	TSSOP-20	75 / Rail
MC74HCT374ADTR2	TSSOP-20	2500 / Reel

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**PIN ASSIGNMENT**

OUTPUT ENABLE	1	20	V <sub>CC</sub>
Q0	2	19	Q7
D0	3	18	D7
D1	4	17	D6
Q1	5	16	Q6
Q2	6	15	Q5
D2	7	14	D5
D3	8	13	D4
Q3	9	12	Q4
GND	10	11	CLOCK

**FUNCTION TABLE**

Output Enable	Inputs		Output
	Clock	D	Q
L		H	H
L		L	L
L	L, H,	X	No Change
H	X	X	Z

X = don't care  
Z = high impedance

Design Criteria	Value	Units
Internal Gate Count*	69	ea.
Internal Gate Propagation Delay	1.5	ns
Internal Gate Power Dissipation	5.0	μW
Speed Power Product	.0075	pJ

\*Equivalent to a two-input NAND gate.

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## MAXIMUM RATINGS\*

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	- 0.5 to + 7.0	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)	- 0.5 to V <sub>CC</sub> + 0.5	V
I <sub>in</sub>	DC Input Current, per Pin	± 20	mA
I <sub>out</sub>	DC Output Current, per Pin	± 35	mA
I <sub>CC</sub>	DC Supply Current, V <sub>CC</sub> and GND Pins	± 75	mA
PD	Power Dissipation in Still Air, Plastic DIP† SOIC Package† TSSOP Package†	750 500 450	mW
T <sub>stg</sub>	Storage Temperature	- 65 to + 150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds (Plastic DIP, SOIC, SSOP or TSSOP Package)	260	°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<sub>in</sub> and V<sub>out</sub> should be constrained to the range GND ≤ (V<sub>in</sub> or V<sub>out</sub>) ≤ V<sub>CC</sub>. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

\*Maximum Ratings are those values beyond which damage to the device may occur.

Functional operation should be restricted to the Recommended Operating Conditions.

†Derating — Plastic DIP: - 10 mW/°C from 65° to 125°C  
SOIC Package: - 7 mW/°C from 65° to 125°C  
TSSOP Package: - 6.1 mW/°C from 65° to 125°C

For high frequency or heavy load considerations, see Chapter 2 of the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	4.5	5.5	V
V <sub>in</sub> , V <sub>out</sub>	DC Input Voltage, Output Voltage (Referenced to GND)	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature, All Package Types	- 55	+ 125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time (Figure 1)	0	500	ns

## 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> = 0.1 V or V <sub>CC</sub> - 0.1 V  I <sub>out</sub>   ≤ 20 μA	4.5	2.0	2.0	2.0	V
			5.5	2.0	2.0	2.0	
V <sub>IL</sub>	Maximum Low-Level Input Voltage	V <sub>out</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V  I <sub>out</sub>   ≤ 20 μA	4.5	0.8	0.8	0.8	V
			5.5	0.8	0.8	0.8	
V <sub>OH</sub>	Minimum High-Level Output Voltage	V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 20 μA	4.5	4.4	4.4	4.4	V
			5.5	5.4	5.4	5.4	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 6.0 mA	4.5	3.98	3.84	3.7	V
			5.5	0.1	0.1	0.1	
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = V <sub>CC</sub> or GND	4.5	0.1	0.1	0.1	μA
			5.5	0.26	0.33	0.4	
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = V <sub>CC</sub> or GND	5.5	± 0.1	± 1.0	± 1.0	μA
I <sub>OZ</sub>	Maximum Three-State Leakage Current	Output in High-Impedance State V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>out</sub> = V <sub>CC</sub> or GND	5.5	± 0.5	± 5.0	± 10	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	5.5	4.0	40	160	μA

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$\Delta I_{CC}$	Additional Quiescent Supply Current	$V_{in} = 2.4\text{ V}$ , Any One Input $V_{in} = V_{CC}$ or GND, Other Inputs $I_{out} = 0\ \mu\text{A}$	5.5	$\geq -55^\circ\text{C}$	$25^\circ\text{C to }125^\circ\text{C}$	mA
				2.9	2.4	

NOTE: 1. Total Supply Current =  $I_{CC} + \Sigma\Delta I_{CC}$ .

NOTE: Information on typical parametric values can be found in Chapter 2 of the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

## AC ELECTRICAL CHARACTERISTICS ( $V_{CC} = 5.0\text{ V} \pm 10\%$ , $C_L = 50\text{ pF}$ , Input $t_r = t_f = 6.0\text{ ns}$ )

Symbol	Parameter	Guaranteed Limit			Unit
		$-55\text{ to }25^\circ\text{C}$	$\leq 85^\circ\text{C}$	$\leq 125^\circ\text{C}$	
$f_{max}$	Maximum Clock Frequency (50% Duty Cycle) (Figures 1 and 4)	30	24	20	MHz
$t_{PLH}$ , $t_{PHL}$	Maximum Propagation Delay, Clock to Q (Figures 1 and 4)	31	39	47	ns
$t_{PLZ}$ , $t_{PHZ}$	Maximum Propagation Delay, Output Enable to Q (Figures 2 and 5)	30	38	45	ns
$t_{PZL}$ , $t_{PZH}$	Maximum Propagation Delay, Output Enable to Q (Figures 2 and 5)	30	38	45	ns
$t_{TLH}$ , $t_{THL}$	Maximum Output Transition Time, Any Output (Figures 1 and 4)	12	15	18	ns
$C_{in}$	Maximum Input Capacitance	10	10	10	pF
$C_{out}$	Maximum Three-State Output Capacitance (Output in High-Impedance State)	15	15	15	pF

NOTE: For propagation delays with loads other than 50 pF, and information on typical parametric values, see Chapter 2 of the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

$C_{PD}$	Power Dissipation Capacitance (Per Flip-Flop)*	Typical @ $25^\circ\text{C}$ , $V_{CC} = 5.0\text{ V}$		pF
		65		

\* Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ . For load considerations, see Chapter 2 of the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

## TIMING REQUIREMENTS ( $V_{CC} = 5.0\text{ V} \pm 10\%$ , Input $t_r = t_f = 6.0\text{ ns}$ )

Symbol	Parameter	Guaranteed Limit			Unit
		$-55\text{ to }25^\circ\text{C}$	$\leq 85^\circ\text{C}$	$\leq 125^\circ\text{C}$	
$t_{su}$	Minimum Setup Time, Data to Clock (Figure 3)	12	15	18	ns
$t_h$	Minimum Hold Time, Clock to Data (Figure 3)	5.0	5.0	5.0	ns
$t_w$	Minimum Pulse Width, Clock (Figure 1)	12	15	18	ns
$t_r$ , $t_f$	Maximum Input Rise and Fall Times (Figure 1)	500	500	500	ns

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## SWITCHING WAVEFORMS

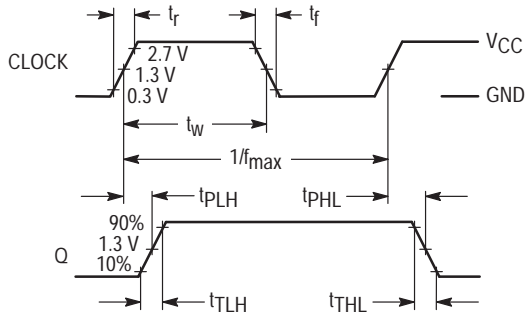


Figure 1.

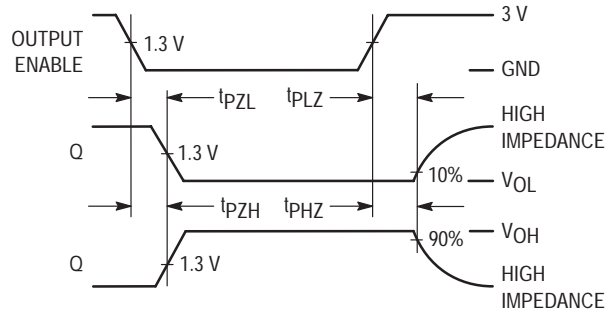


Figure 2.

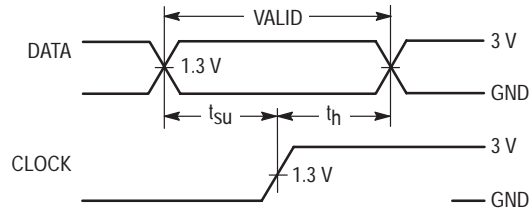
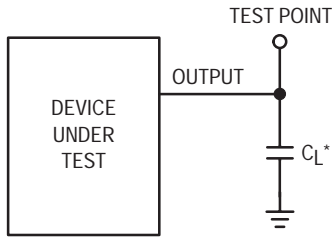


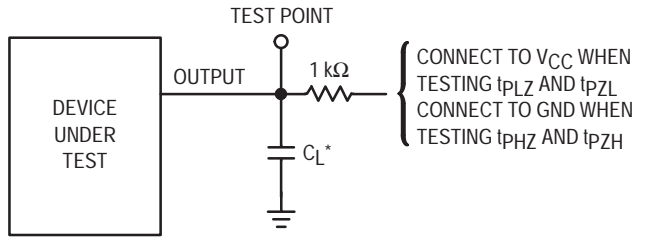
Figure 3.

## TEST CIRCUITS



\*Includes all probe and jig capacitance

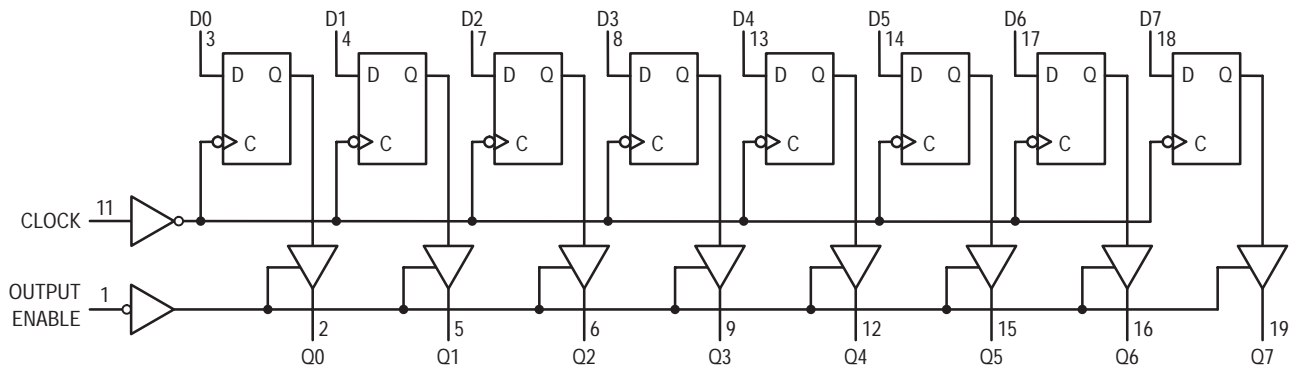
Figure 4.



\*Includes all probe and jig capacitance

Figure 5.

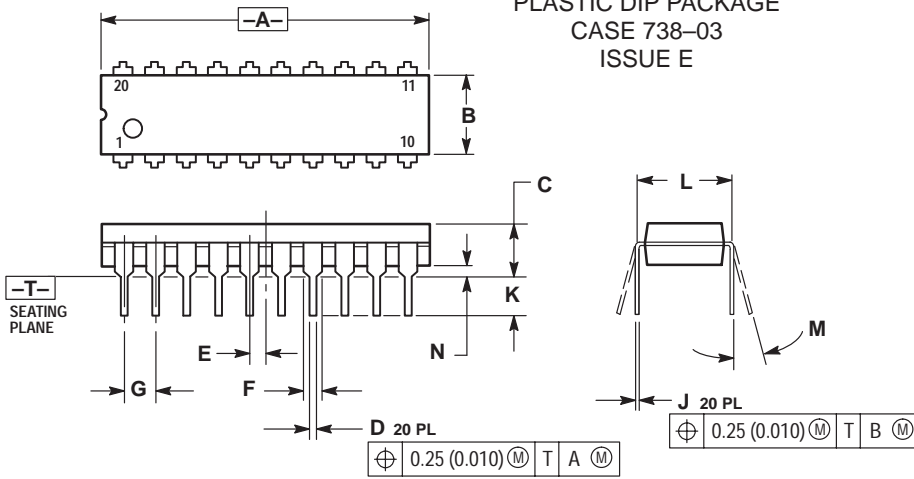
## EXPANDED LOGIC DIAGRAM



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## PACKAGE DIMENSIONS

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

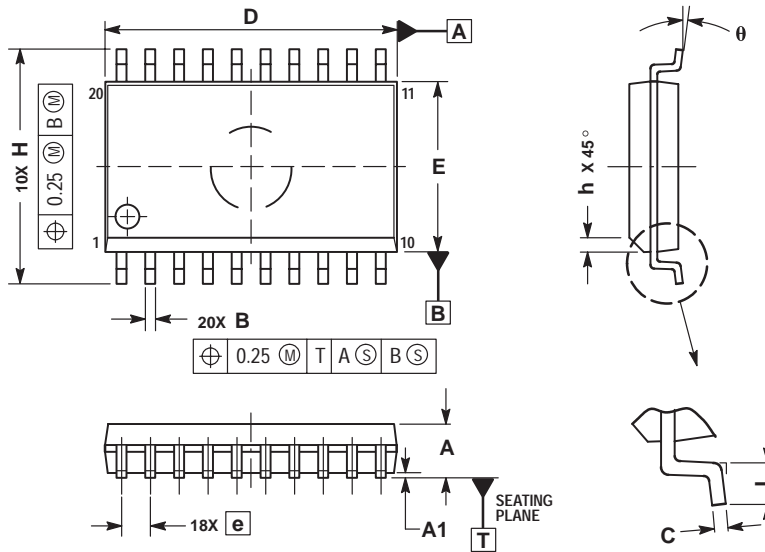


**NOTES:**

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

**SO-20**  
**DW SUFFIX**  
CASE 751D-05  
ISSUE F



**NOTES:**

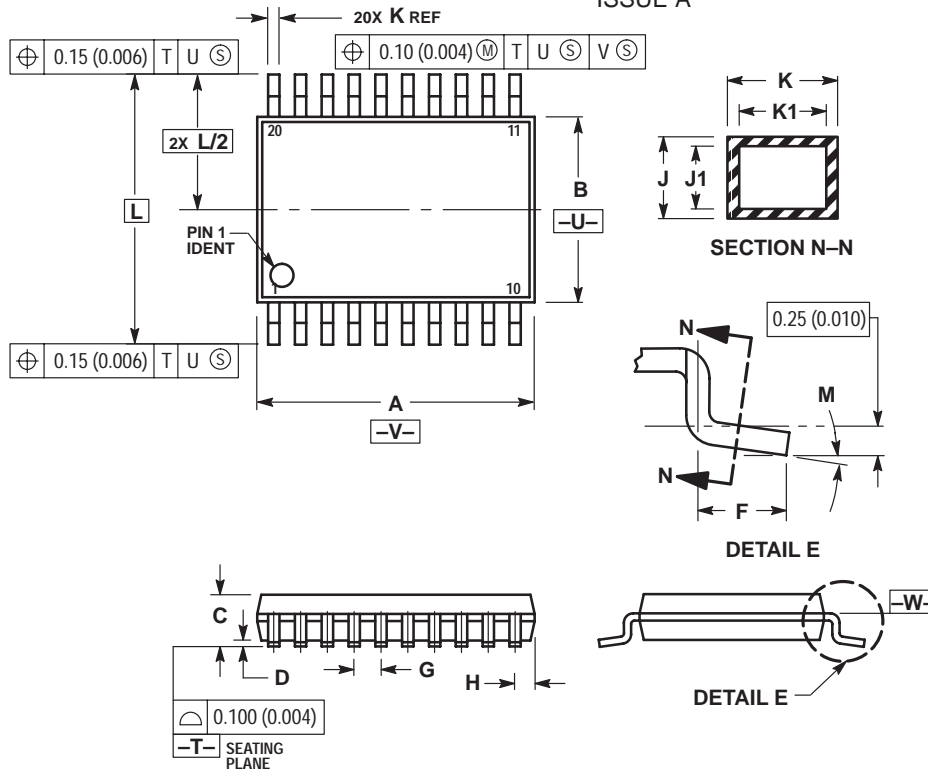
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION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



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°

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