

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

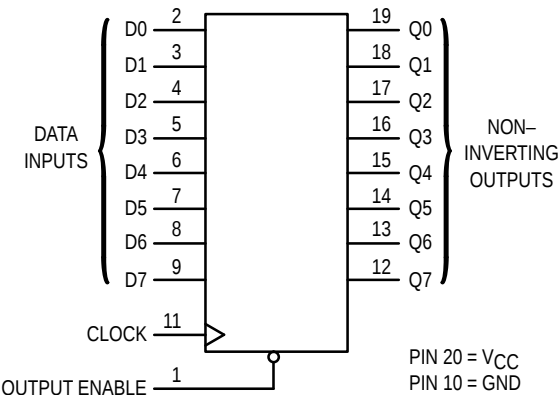
The MC54/74HCT574A is identical in pinout to the LS574. This device may be used as a level converter for interfacing TTL or NMOS outputs to High Speed CMOS inputs.

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

The HCT574A is identical in function to the HCT374A but has the flip-flop inputs on the opposite side of the package from the outputs to facilitate PC board layout.

- 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: 286 FETs or 71.5 Equivalent Gates

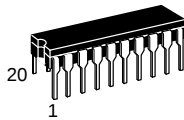
LOGIC DIAGRAM



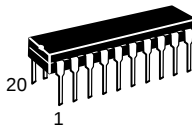
| Design Criteria                 | Value  | Units   |
|---------------------------------|--------|---------|
| Internal Gate Count*            | 71.5   | ea      |
| Internal Gate Propagation Delay | 1.5    | ns      |
| Internal Gate Power Dissipation | 5.0    | $\mu$ W |
| Speed Power Product             | 0.0075 | pJ      |

\* Equivalent to a two-input NAND gate.

## MC54/74HCT574A



J SUFFIX  
CERAMIC PACKAGE  
CASE 732-03



N SUFFIX  
PLASTIC PACKAGE  
CASE 738-03



DW SUFFIX  
SOIC PACKAGE  
CASE 751D-04

### ORDERING INFORMATION

|               |         |
|---------------|---------|
| MC54HCTXXXAJ  | Ceramic |
| MC74HCTXXXAN  | Plastic |
| MC74HCTXXXADW | SOIC    |

### PIN ASSIGNMENT

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

### FUNCTION TABLE

| Inputs |       |   | Output    |
|--------|-------|---|-----------|
| OE     | 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



## 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                                                                        | $\pm 35$                | mA   |
| $I_{CC}$  | DC Supply Current, $V_{CC}$ and GND Pins                                                          | $\pm 75$                | mA   |
| $P_D$     | Power Dissipation in Still Air, Plastic or Ceramic DIP†<br>SOIC Package†                          | 750<br>500              | mW   |
| $T_{stg}$ | Storage Temperature                                                                               | – 65 to + 150           | °C   |
| $T_L$     | Lead Temperature, 1 mm from Case for 10 Seconds<br>(Plastic DIP or SOIC Package)<br>(Ceramic DIP) | 260<br>300              | °C   |

\* 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

Ceramic DIP: – 10 mW/°C from 100° to 125°C

SOIC Package: – 7 mW/°C from 65° to 125°C

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

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.

## RECOMMENDED OPERATING CONDITIONS

| Symbol            | Parameter                                            | Min  | Max      | Unit |
|-------------------|------------------------------------------------------|------|----------|------|
| $V_{CC}$          | DC Supply Voltage (Referenced to GND)                | 4.5  | 5.5      | 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 1)                  | 0    | 500      | ns   |

## DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

| Symbol   | Parameter                                      | Test Conditions                                                                         | $V_{CC}$<br>V | Guaranteed Limit |                         |                          | Unit          |
|----------|------------------------------------------------|-----------------------------------------------------------------------------------------|---------------|------------------|-------------------------|--------------------------|---------------|
|          |                                                |                                                                                         |               | – 55 to<br>25°C  | $\leq 85^\circ\text{C}$ | $\leq 125^\circ\text{C}$ |               |
| $V_{IH}$ | Minimum High-Level Input Voltage               | $V_{out} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$<br>$ I_{out}  \leq 20 \mu\text{A}$ | 4.5<br>5.5    | 2.0<br>2.0       | 2.0<br>2.0              | 2.0<br>2.0               | V             |
| $V_{IL}$ | Maximum Low-Level Input Voltage                | $V_{out} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$<br>$ I_{out}  \leq 20 \mu\text{A}$ | 4.5<br>5.5    | 0.8<br>0.8       | 0.8<br>0.8              | 0.8<br>0.8               | V             |
| $V_{OH}$ | Minimum High-Level Output Voltage              | $V_{in} = V_{IH} \text{ or } V_{IL}$<br>$ I_{out}  \leq 20 \mu\text{A}$                 | 4.5<br>5.5    | 4.4<br>5.4       | 4.4<br>5.4              | 4.4<br>5.4               | V             |
|          |                                                | $V_{in} = V_{IH} \text{ or } V_{IL}$<br>$ I_{out}  \leq 6.0 \text{ mA}$                 | 4.5           | 3.98             | 3.84                    | 3.7                      |               |
| $V_{OL}$ | Maximum Low-Level Output Voltage               | $V_{in} = V_{IH} \text{ or } V_{IL}$<br>$ I_{out}  \leq 20 \mu\text{A}$                 | 4.5<br>5.5    | 0.1<br>0.1       | 0.1<br>0.1              | 0.1<br>0.1               | V             |
|          |                                                | $V_{in} = V_{IH} \text{ or } V_{IL}$<br>$ I_{out}  \leq 6.0 \text{ mA}$                 | 4.5           | 0.26             | 0.33                    | 0.4                      |               |
| $I_{in}$ | Maximum Input Leakage Current                  | $V_{in} = V_{CC} \text{ or GND}$                                                        | 5.5           | $\pm 0.1$        | $\pm 1.0$               | $\pm 1.0$                | $\mu\text{A}$ |
| $I_{CC}$ | Maximum Quiescent Supply Current (per Package) | $V_{in} = V_{CC} \text{ or GND}$<br>$I_{out} = 0 \mu\text{A}$                           | 5.5           | 4.0              | 40                      | 160                      | $\mu\text{A}$ |

1. Output in high-impedance state.

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

**DC ELECTRICAL CHARACTERISTICS** (Voltages Referenced to GND)

| Symbol           | Parameter                           | Test Conditions                                                                                                             | V <sub>CC</sub><br>V | Guaranteed Limit |               |         | Unit |
|------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------|------------------|---------------|---------|------|
|                  |                                     |                                                                                                                             |                      | – 55 to 25°C     | ≤ 85°C        | ≤ 125°C |      |
| I <sub>OZ</sub>  | Maximum Three-State Leakage Current | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> (Note 1)<br>V <sub>out</sub> = V <sub>CC</sub> or GND                  | 5.5                  | – 0.5            | – 5.0         | – 10    | μA   |
| ΔI <sub>CC</sub> | Additional Quiescent Supply Current | V <sub>in</sub> = 2.4 V, Any One Input<br>V <sub>in</sub> = V <sub>CC</sub> or GND, Other Inputs<br>I <sub>out</sub> = 0 μA | 5.5                  | ≥ – 55°C         | 25°C to 125°C |         | mA   |
|                  |                                     |                                                                                                                             |                      | 2.9              | 2.4           |         |      |

1. Output in high-impedance state.

**AC ELECTRICAL CHARACTERISTICS** (V<sub>CC</sub> = 5.0 V ± 10%, C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6.0 ns)

| Symbol                                 | Parameter                                                               | Guaranteed Limit |        |         | Unit |
|----------------------------------------|-------------------------------------------------------------------------|------------------|--------|---------|------|
|                                        |                                                                         | – 55 to 25°C     | ≤ 85°C | ≤ 125°C |      |
| f <sub>MAX</sub>                       | Maximum Clock Frequency (50% Duty Cycle) (Figures 1 and 4)              | 30               | 24     | 20      | MHz  |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Clock to Q<br>(Figures 1 and 4)              | 30               | 38     | 45      | ns   |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Maximum Propagation Delay, Output Enable to Q<br>(Figures 2 and 5)      | 28               | 35     | 42      | ns   |
| t <sub>PZH</sub> ,<br>t <sub>PZL</sub> | Maximum Propagation Delay Time, Output Enable to Q<br>(Figures 2 and 5) | 28               | 35     | 42      | ns   |
| t <sub>TLH</sub> ,<br>t <sub>THL</sub> | Maximum Output Transition Time, Any Output<br>(Figures 1, 2 and 4)      | 12               | 15     | 18      | ns   |
| C <sub>in</sub>                        | Maximum Input Capacitance                                               | 10               | 10     | 10      | pF   |

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

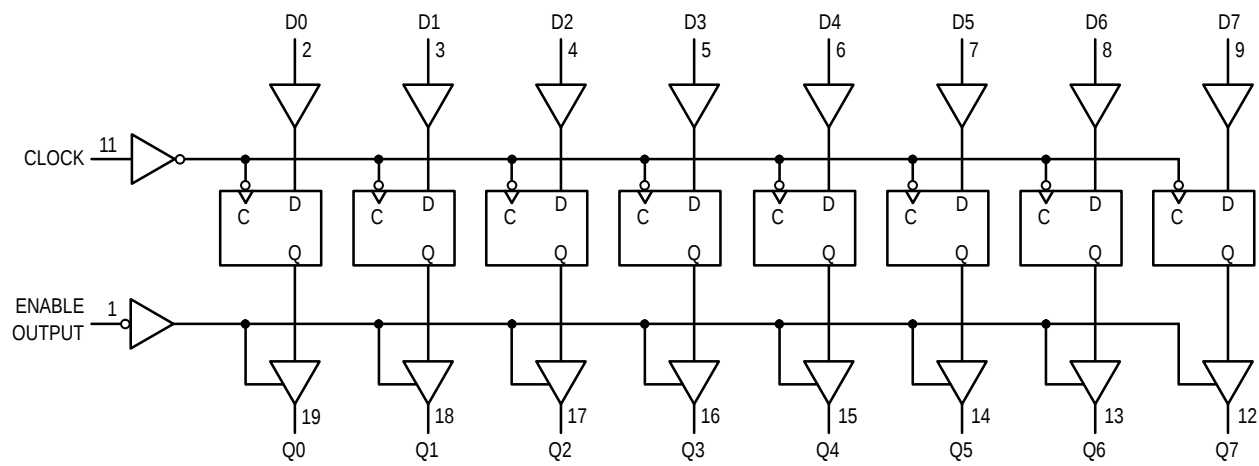
| C <sub>PD</sub> | Power Dissipation Capacitance (Per Flip-Flop)* | Typical @ 25°C, V <sub>CC</sub> = 5.0 V | pF |
|-----------------|------------------------------------------------|-----------------------------------------|----|
|                 |                                                | 58                                      |    |

\* Used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>. For load considerations, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

**TIMING REQUIREMENTS** (V<sub>CC</sub> = 5.0 V ± 10%, C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6.0 ns)

| Symbol                          | Parameter                         | Fig. | Guaranteed Limit |     |        |     |         |     | Unit |
|---------------------------------|-----------------------------------|------|------------------|-----|--------|-----|---------|-----|------|
|                                 |                                   |      | – 55 to 25°C     |     | ≤ 85°C |     | ≤ 125°C |     |      |
|                                 |                                   |      | Min              | Max | Min    | Max | Min     | Max |      |
| t <sub>su</sub>                 | Minimum Setup Time, Data to Clock | 3    | 10               |     | 13     |     | 15      |     | ns   |
| t <sub>h</sub>                  | Minimum Hold Time, Clock to Data  | 3    | 5.0              |     | 5.0    |     | 5.0     |     | ns   |
| t <sub>w</sub>                  | Minimum Pulse Width, Clock        | 1    | 15               |     | 19     |     | 22      |     | ns   |
| t <sub>r</sub> , t <sub>f</sub> | Maximum Input Rise and Fall Times | 1    |                  | 500 |        | 500 |         | 500 | ns   |

EXPANDED LOGIC DIAGRAM



SWITCHING WAVEFORMS

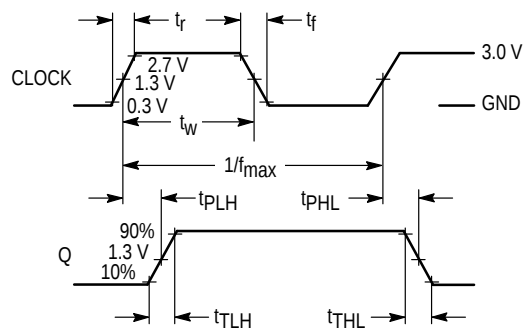


Figure 1.

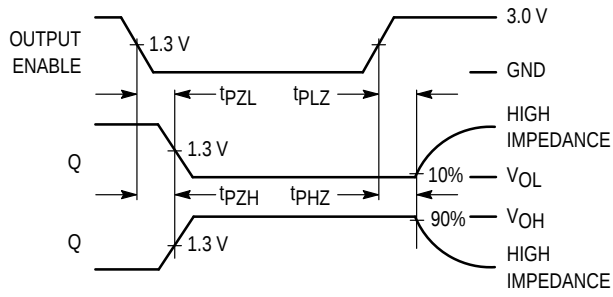


Figure 2.

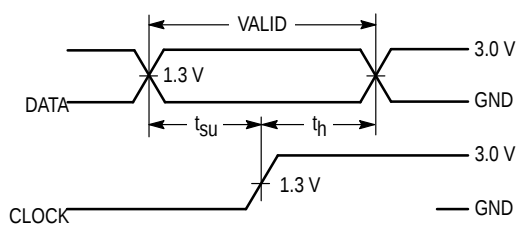
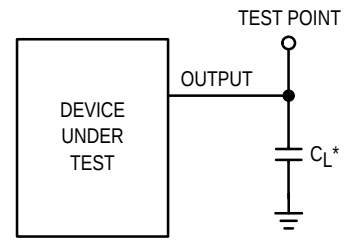
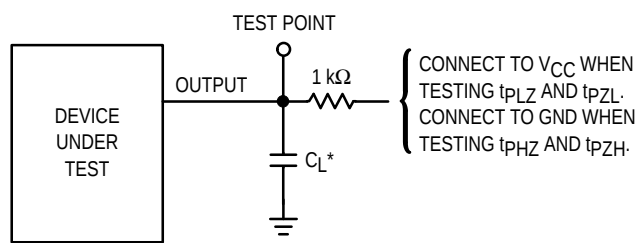


Figure 3.



\* Includes all probe and jig capacitance

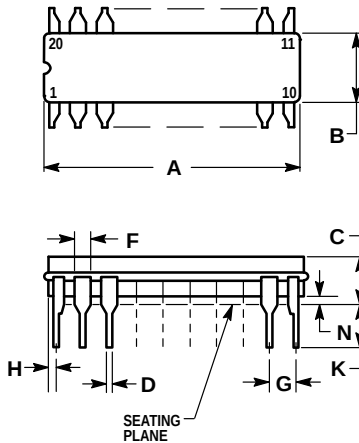
Figure 4. Test Circuit



\* Includes all probe and jig capacitance

Figure 5. Test Circuit

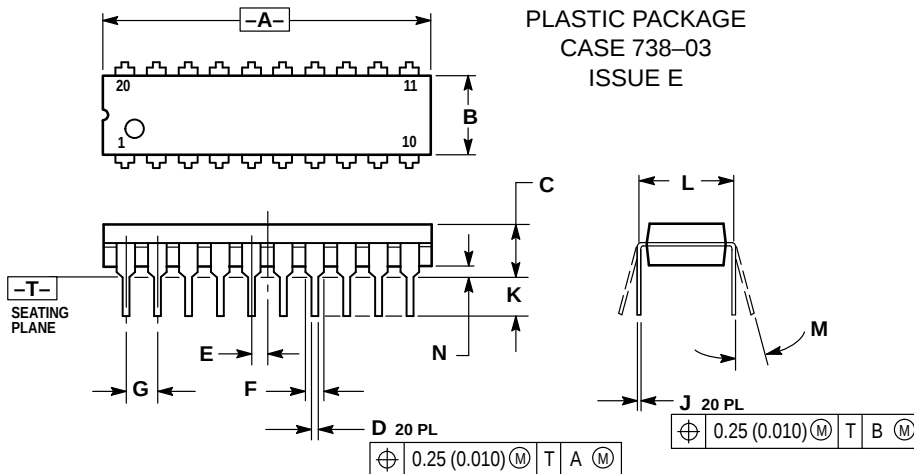
## OUTLINE DIMENSIONS

**J SUFFIX**  
 CERAMIC PACKAGE  
 CASE 732-03  
 ISSUE E


## NOTES:

- LEADS WITHIN 0.25 (0.010) DIAMETER, TRUE POSITION AT SEATING PLANE, AT MAXIMUM MATERIAL CONDITION.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSIONS A AND B INCLUDE MENISCUS.

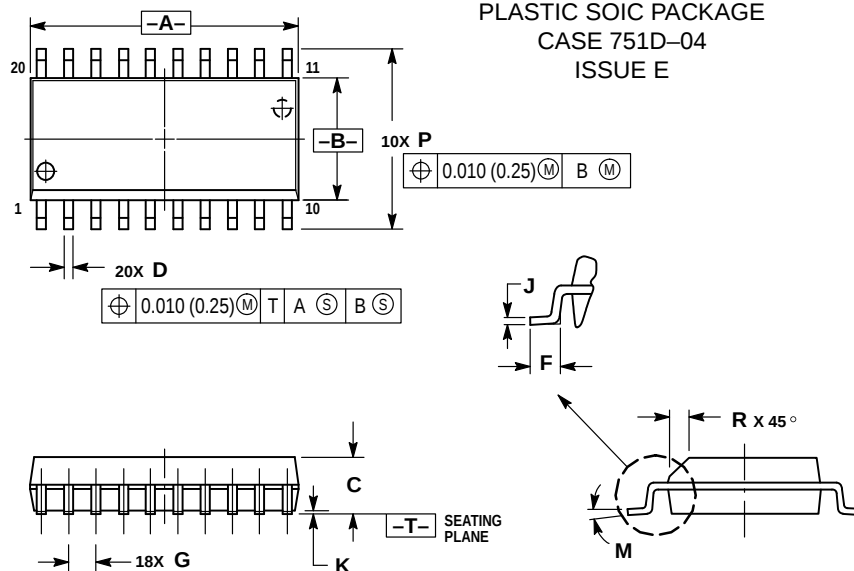
| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 23.88       | 25.15 | 0.940     | 0.990 |
| B   | 6.60        | 7.49  | 0.260     | 0.295 |
| C   | 3.81        | 5.08  | 0.150     | 0.200 |
| D   | 0.38        | 0.56  | 0.015     | 0.022 |
| F   | 1.40        | 1.65  | 0.055     | 0.065 |
| G   | 2.54 BSC    |       | 0.100 BSC |       |
| H   | 0.51        | 1.27  | 0.020     | 0.050 |
| J   | 0.20        | 0.30  | 0.008     | 0.012 |
| K   | 3.18        | 4.06  | 0.125     | 0.160 |
| L   | 7.62 BSC    |       | 0.300 BSC |       |
| M   | 0°          | 15°   | 0°        | 15°   |
| N   | 0.25        | 1.02  | 0.010     | 0.040 |

**N SUFFIX**  
 PLASTIC PACKAGE  
 CASE 738-03  
 ISSUE E


## NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
- 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  |

**DW SUFFIX**  
 PLASTIC SOIC PACKAGE  
 CASE 751D-04  
 ISSUE E


## NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.150 (0.006) PER SIDE.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 12.65       | 12.95 | 0.499     | 0.510 |
| B   | 7.40        | 7.60  | 0.292     | 0.299 |
| C   | 2.35        | 2.65  | 0.093     | 0.104 |
| D   | 0.35        | 0.49  | 0.014     | 0.019 |
| F   | 0.50        | 0.90  | 0.020     | 0.035 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.25        | 0.32  | 0.010     | 0.012 |
| K   | 0.10        | 0.25  | 0.004     | 0.009 |
| M   | 0°          | 7°    | 0°        | 7°    |
| P   | 10.05       | 10.55 | 0.395     | 0.415 |
| R   | 0.25        | 0.75  | 0.010     | 0.029 |

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