

# MOTOROLA SEMICONDUCTOR TECHNICAL DATA

## Advance Information

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

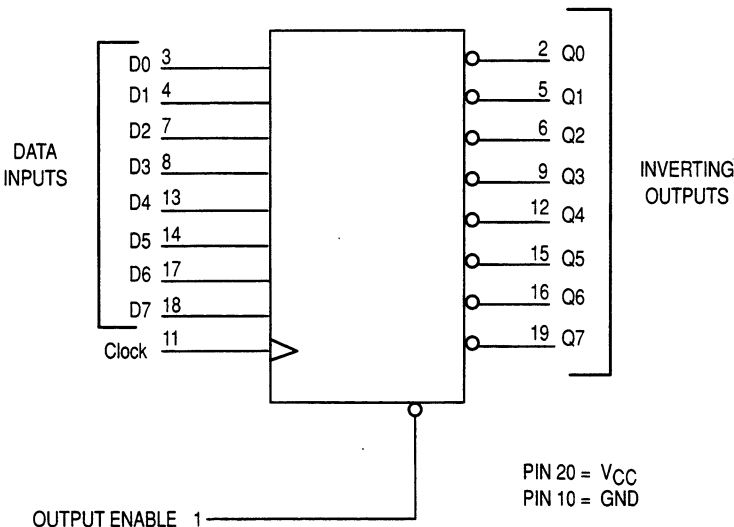
The MC54/74HCT534A is identical in pinout to the LS534. This device may be used as a level converter for interfacing TTL or NMOS outputs to High Speed CMOS inputs.

Data meeting the setup and hold time is clocked, in inverted form, 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 HCT534A is identical in function to the HCT564 which has the input pins on the opposite side of the package from the output pins. This device is similar in function to the HCT374 which has noninverting 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: 229 FETs or 57 Equivalent Gates

#### LOGIC DIAGRAM

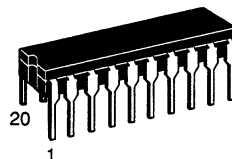


| Design Criteria                 | Value | Unit    |
|---------------------------------|-------|---------|
| Internal Gate Count *           | 57    | ea      |
| Internal Gate Propagation Delay | 1.0   | ns      |
| Internal Gate Power Dissipation | 5.0   | $\mu$ W |
| Speed Power Product             | 0.005 | pJ      |

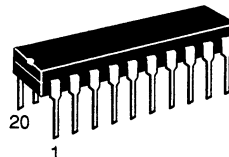
\*Equivalent to a two-input NAND gate.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

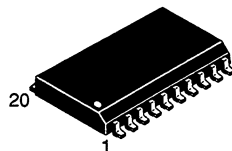
## MC54/74HCT534A



J SUFFIX  
CERAMIC  
CASE 732-03



N SUFFIX  
PLASTIC  
CASE 738-03

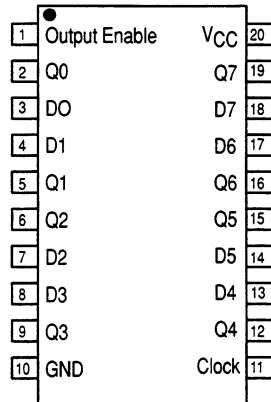


DW SUFFIX  
SOIC  
CASE 751D-03

#### ORDERING INFORMATION

|              |         |
|--------------|---------|
| MC74HCTXXAN  | Plastic |
| MC54HCTXXAJ  | Ceramic |
| MC74HCTXXADW | SOIC    |

#### PIN ASSIGNMENT



#### FUNCTION TABLE

| Inputs        |       |   | Output    |
|---------------|-------|---|-----------|
| Output Enable | Clock | D | Q         |
| L             |       | H | L         |
| L             |       | L | H         |
| L             | L, H, | X | no change |
| H             |       | X | Z         |

X = Don't Care

Z = High Impedance



**MOTOROLA**

ADI1750

| 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)                                                      | -1.5 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>(SOIC or Plastic DIP)<br>(Ceramic DIP) | 260<br>300             | °C<br>°C |

\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

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 hi-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.

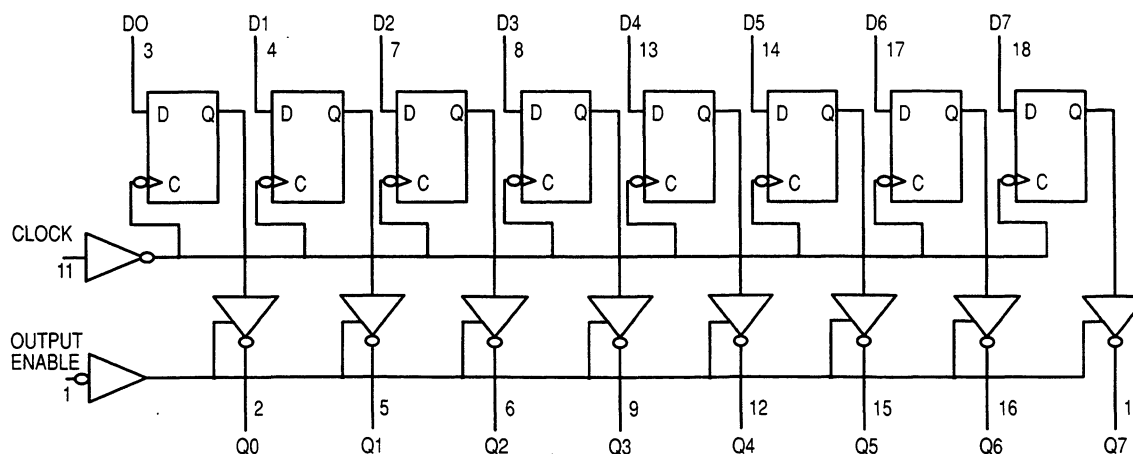
| RECOMMENDED OPERATING CONDITIONS |                                                      |     |          |      |
|----------------------------------|------------------------------------------------------|-----|----------|------|
| Symbol                           | Parameter                                            | 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 <sub>CC</sub><br>V | Guaranteed Limit |               |            | Unit |
|                                                            |                                                |                                                                                                                                     |                      | 25°C to -55°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<br> I <sub>out</sub>   ≤ 20 μA                                                  | 4.5<br>5.5           | 2.0<br>2.0       | 2.0<br>2.0    | 2.0<br>2.0 | V    |
| V <sub>IL</sub>                                            | Maximum Low-Level Input Voltage                | V <sub>out</sub> = 0.1 V or V <sub>CC</sub> – 0.1 V<br> I <sub>out</sub>   ≤ 20 μA                                                  | 4.5<br>5.5           | 0.8<br>0.8       | 0.8<br>0.8    | 0.8<br>0.8 | V    |
| V <sub>OH</sub>                                            | Minimum High-Level Output Voltage              | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA                                                 | 4.5<br>5.5           | 4.4<br>5.4       | 4.4<br>5.4    | 4.4<br>5.4 | V    |
|                                                            |                                                | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 6.0 mA                                                | 4.5                  | 3.98             | 3.84          | 3.7        |      |
| V <sub>OL</sub>                                            | Maximum Low-Level Output Voltage               | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA                                                 | 4.5<br>5.5           | 0.1<br>0.1       | 0.1<br>0.1    | 0.1<br>0.1 | V    |
|                                                            |                                                | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 6.0 mA                                                | 4.5                  | 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>CC</sub>                                            | Maximum Quiescent Supply Current (per Package) | V <sub>in</sub> = V <sub>CC</sub> or GND<br>I <sub>out</sub> = 0 μA                                                                 | 5.5                  | 4.0              | 40            | 160        | μA   |
| I <sub>OZ</sub>                                            | Maximum Three-State Leakage Current            | Output in High-Impedance State<br>V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub><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           |            |      |

| 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 |
|                                                                                                                                       |                                                                                                                                                                                                         | 25°C to –55°C                           | ≤85°C | ≤125°C |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub>                                                                                                | Maximum Propagation Delay, Clock to Q<br>(Figure 1)                                                                                                                                                     | 35                                      | 44    | 53     | ns   |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub>                                                                                                | Maximum Propagation Delay Time, Output Enable to Q<br>(Figure 2)                                                                                                                                        | 32                                      | 40    | 48     | ns   |
| t <sub>TZH</sub> ,<br>t <sub>TZL</sub>                                                                                                | Maximum Propagation Delay Time, Output Enable to Q<br>(Figure 2)                                                                                                                                        | 28                                      | 35    | 42     | ns   |
| t <sub>TLH</sub> ,<br>t <sub>THL</sub>                                                                                                | Maximum Output Transition Time, any Output<br>(Figure 1)                                                                                                                                                | 12                                      | 15    | 18     | ns   |
| C <sub>in</sub>                                                                                                                       | Maximum Input Capacitance                                                                                                                                                                               | 10                                      | 10    | 10     | pF   |
| C <sub>out</sub>                                                                                                                      | Maximum Tri-State Output Capacitance, Output in Hi-Impedance State                                                                                                                                      | 15                                      | 15    | 15     | pF   |
| CPD                                                                                                                                   | Power Dissipation Capacitance (Per Enabled Output)<br>Used to determine the no-load dynamic power consumption:<br>P <sub>D</sub> = CPD V <sub>CC</sub> <sup>2</sup> f + I <sub>CC</sub> V <sub>CC</sub> | Typical @ 25°C, V <sub>CC</sub> = 5.0 V |       |        | pF   |
|                                                                                                                                       |                                                                                                                                                                                                         | 138.2                                   |       |        |      |

| TIMING REQUIREMENTS ( $V_{CC} = 5.0\text{ V} \pm 10\%$ , $C_L = 50\text{ pF}$ , Input $t_r = t_f = 6.0\text{ ns}$ ) |                                         |      |                  |     |        |     |         |     |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|------------------|-----|--------|-----|---------|-----|
| Symbol                                                                                                              | Parameter                               | Fig. | Guaranteed Limit |     |        |     |         |     |
|                                                                                                                     |                                         |      | 25°C to -55°C    |     | ≤ 85°C |     | ≤ 125°C |     |
|                                                                                                                     |                                         |      | Min              | Max | Min    | Max | Min     | Max |
| $t_{su}$                                                                                                            | Minimum Setup Time, Data to Clock       | 3    |                  | 10  |        | 13  |         | 15  |
| $t_h$                                                                                                               | Minimum Hold Time, Clock to Data        | 3    |                  | 5.0 |        | 6.0 |         | 8.0 |
| $t_w$                                                                                                               | Minimum Pulse Width, Latch Enable Clock | 1    |                  | 12  |        | 15  |         | 18  |
| $t_r, t_f$                                                                                                          | Maximum Input Rise and Fall Times       | 1    |                  | 500 |        | 500 |         | 500 |

#### EXPANDED LOGIC DIAGRAM



## SWITCHING WAVEFORMS

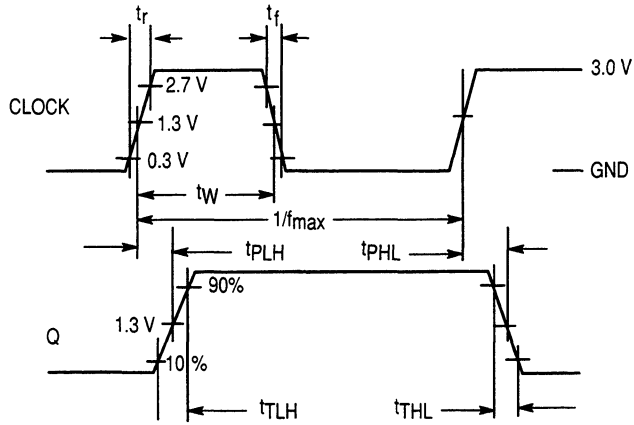


Figure 1.

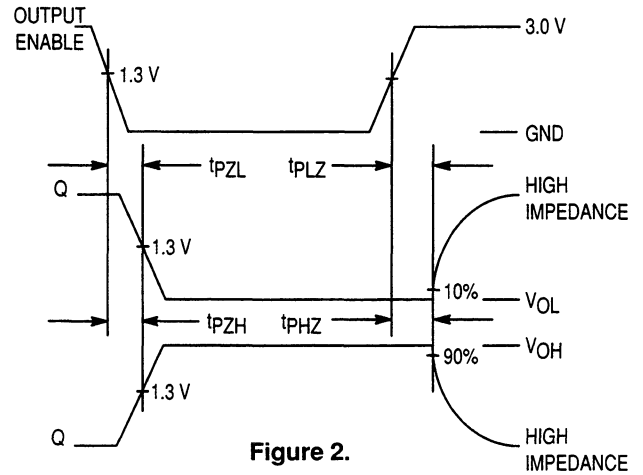


Figure 2.

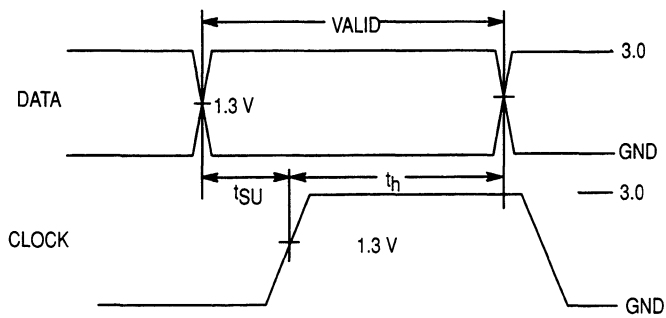
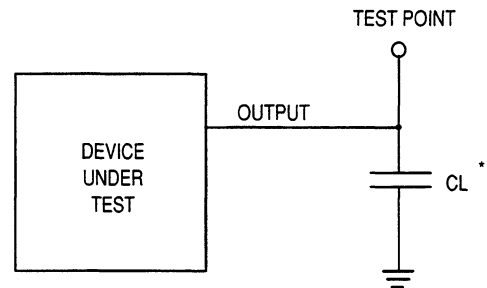
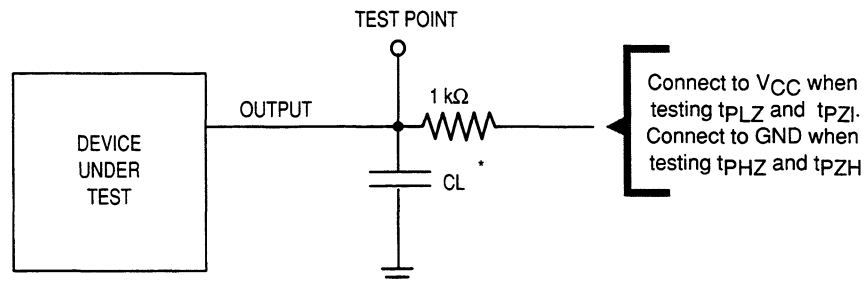


Figure 3.



\* Includes all probe and jig capacitance

Figure 4. Test Circuit

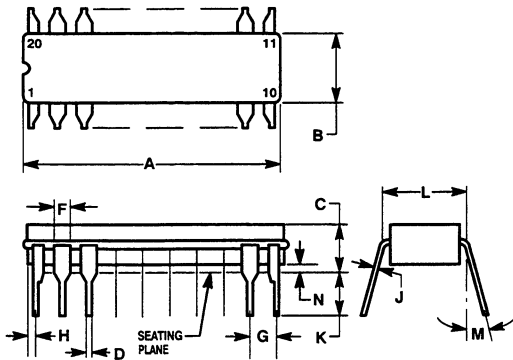


\* Includes all probe and jig capacitance

Figure 5. Test Circuit

## OUTLINE DIMENSIONS

### J SUFFIX CERAMIC CASE 732-03

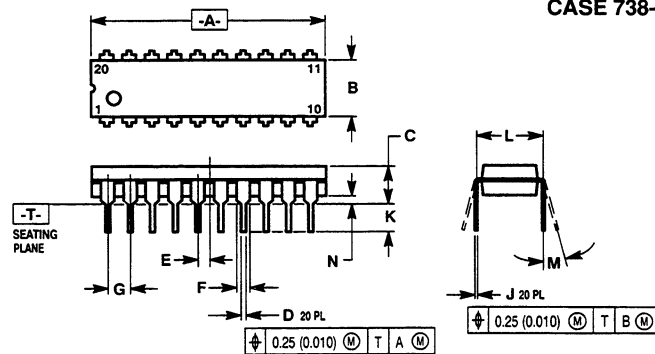


#### NOTES:

- LEADS WITHIN 0.25 mm (0.010) DIA., TRUE POSITION AT SEATING PLANE, AT MAXIMUM MATERIAL CONDITION.
- DIM L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIM A AND B INCLUDES 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 CASE 738-03

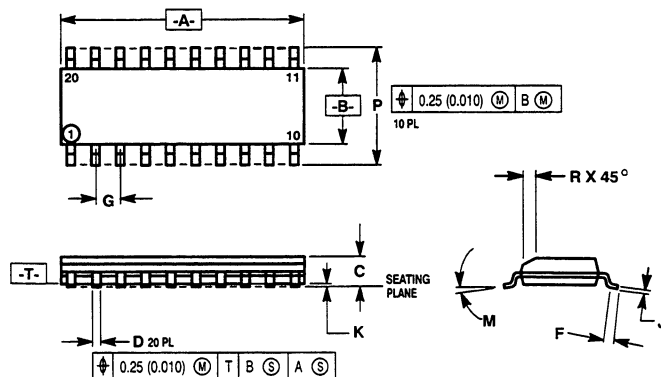


#### NOTES:

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

### DW SUFFIX SOIC CASE 751D-03



#### NOTES:

- DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.

| 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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