# MC54/74HC640A

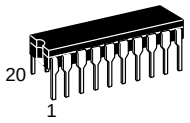
# Octal 3-State Inverting Bus Transceiver

## High–Performance Silicon–Gate CMOS

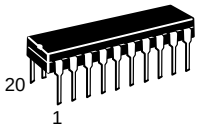
The MC54/74HC640A is identical in pinout to the LS640. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

The HC640A is a 3–state transceiver that is used for 2–way asynchronous communication between data buses. The device has an active–low Output Enable pin, which is used to place the I/O ports into high–impedance states. The Direction control determines whether data flows from A to B or from B to A.

- Output Drive Capability: 15 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2 to 6 V
- Low Input Current: 1 μA
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 276 FETs or 69 Equivalent Gates




**J SUFFIX**
CERAMIC PACKAGE
CASE 732–03



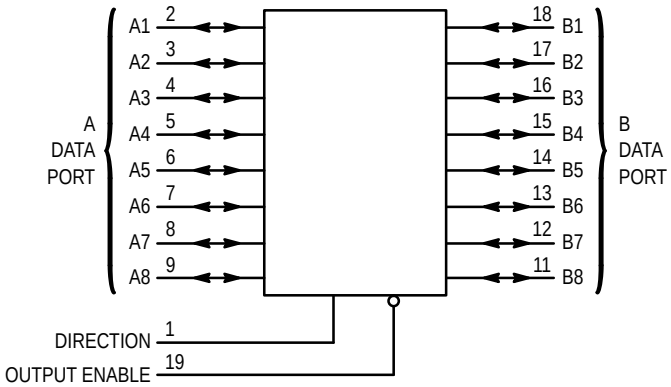

**N SUFFIX**
PLASTIC PACKAGE
CASE 738–03


**DW SUFFIX**
SOIC PACKAGE
CASE 751D–04

**ORDERING INFORMATION**

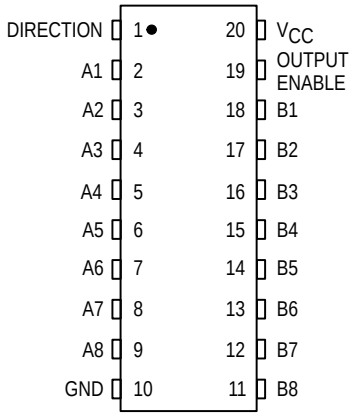
| | |
|---|---|
| MC54HCXXXAJ | Ceramic |
| MC74HCXXXAN | Plastic |
| MC74HCXXXADW | SOIC |

**LOGIC DIAGRAM**




PIN 10 = GND
PIN 20 = $V_{CC}$

**PIN ASSIGNMENT**




**FUNCTION TABLE**

| Control Inputs | | |
|---|---|---|
| **Output Enable** | **Direction** | **Operation** |
| L | L | Data Transmitted from Bus B to Bus A (Inverted) |
| L | H | Data Transmitted from Bus A to Bus B (Inverted) |
| H | X | Buses Isolated (High–Impedance State) |

X = don't care

**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), Pin 1 or 19 | – 0.5 to $V_{CC}$ + 0.5 | V |
| $V_{I/O}$ | DC I/O Voltage (Referenced to GND) | – 0.5 to $V_{CC}$ + 0.5 | V |
| $I_{in}$ | DC Input Current, per Pin | ± 20 | mA |
| $I_{I/O}$ | DC I/O Current, per Pin | ± 35 | mA |
| $I_{CC}$ | DC Supply Current, $V_{CC}$ and GND Pins | ± 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) | <br>260<br>300 | °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, $V_{in}$ and $V_{out}$ should be constrained to the range GND ≤ ($V_{in}$ or $V_{out}$) ≤ $V_{CC}$.

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. I/O pins must be connected to a properly terminated line or bus.

* 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).

**RECOMMENDED OPERATING CONDITIONS**

| Symbol | Parameter | | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | DC Supply Voltage (Referenced to GND) | | 2.0 | 6.0 | 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<br>(Figure 1) | $V_{CC}$ = 2.0 V<br>$V_{CC}$ = 4.5 V<br>$V_{CC}$ = 6.0 V | 0<br>0<br>0 | 1000<br>500<br>400 | ns |

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

| Symbol | Parameter | Test Conditions | $V_{CC}$ V | Guaranteed Limit | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | – 55 to 25°C | ≤ 85°C | ≤ 125°C | |
| $V_{IH}$ | Minimum High–Level Input Voltage | $V_{out}$ = $V_{CC}$ – 0.1 V<br>$\|I_{out}\|$ ≤ 20 μA | 2.0<br>3.0<br>4.5<br>6.0 | 1.5<br>2.1<br>3.15<br>4.2 | 1.5<br>2.1<br>3.15<br>4.2 | 1.5<br>2.1<br>3.15<br>4.2 | V |
| $V_{IL}$ | Maximum Low–Level Input Voltage | $V_{out}$ = 0.1 V<br>$\|I_{out}\|$ ≤ 20 μA | 2.0<br>3.0<br>4.5<br>6.0 | 0.5<br>0.9<br>1.35<br>1.8 | 0.5<br>0.9<br>1.35<br>1.8 | 0.5<br>0.9<br>1.35<br>1.8 | V |
| $V_{OH}$ | Minimum High–Level Output Voltage | $V_{in}$ = $V_{IH}$<br>$\|I_{out}\|$ ≤ 20 μA | 2.0<br>4.5<br>6.0 | 1.9<br>4.4<br>5.9 | 1.9<br>4.4<br>5.9 | 1.9<br>4.4<br>5.9 | V |
| | | $V_{in}$ = $V_{IH}$ $\|I_{out}\|$ ≤ 2.4 mA<br>$\|I_{out}\|$ ≤ 6.0 mA<br>$\|I_{out}\|$ ≤ 7.8 mA | 3.0<br>4.5<br>6.0 | 2.48<br>3.98<br>5.48 | 2.34<br>3.84<br>5.34 | 2.2<br>3.7<br>5.2 | |
| $V_{OL}$ | Maximum Low–Level Output Voltage | $V_{in}$ = $V_{IL}$<br>$\|I_{out}\|$ ≤ 20 μA | 2.0<br>4.5<br>6.0 | 0.1<br>0.1<br>0.1 | 0.1<br>0.1<br>0.1 | 0.1<br>0.1<br>0.1 | V |
| | | $V_{in}$ = $V_{IL}$ $\|I_{out}\|$ ≤ 2.4 mA<br>$\|I_{out}\|$ ≤ 6.0 mA<br>$\|I_{out}\|$ ≤ 7.8 mA | 3.0<br>4.5<br>6.0 | 0.26<br>0.26<br>0.26 | 0.33<br>0.33<br>0.33 | 0.4<br>0.4<br>0.4 | |

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

| Symbol | Parameter | Test Conditions | $V_{CC}$ V | Guaranteed Limit | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | – 55 to 25°C | ≤ 85°C | ≤ 125°C | |
| $I_{in}$ | Maximum Input Leakage Current | $V_{in} = V_{CC}$ or GND | 6.0 | ± 0.1 | ± 1.0 | ± 1.0 | μA |
| $I_{OZ}$ | Maximum Three–State Leakage Current | Output in High–Impedance State<br>$V_{in} = V_{IL}$ or $V_{IH}$<br>$V_{out} = V_{CC}$ or GND | 6.0 | ± 0.5 | ± 5.0 | ± 10 | μA |
| $I_{CC}$ | Maximum Quiescent Supply Current (per Package) | $V_{in} = V_{CC}$ or GND<br>$I_{out}$ = 0 μA | 6.0 | 4.0 | 40 | 160 | μA |

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

**AC ELECTRICAL CHARACTERISTICS** ($C_L$ = 50 pF, Input $t_r = t_f$ = 6 ns)

| Symbol | Parameter | $V_{CC}$ V | Guaranteed Limit | | | Unit |
|---|---|---|---|---|---|---|
| | | | – 55 to 25°C | ≤ 85°C | ≤ 125°C | |
| $t_{PLH}$, $t_{PHL}$ | Maximum Propagation Delay, A to B, B to A (Figures 1 and 3) | 2.0<br>3.0<br>4.5<br>6.0 | 75<br>55<br>15<br>13 | 95<br>70<br>19<br>16 | 110<br>80<br>22<br>19 | ns |
| $t_{PLZ}$, $t_{PHZ}$ | Maximum Propagation Delay, Direction or Output Enable to A or B (Figures 2 and 4) | 2.0<br>3.0<br>4.5<br>6.0 | 110<br>90<br>22<br>19 | 140<br>110<br>28<br>24 | 165<br>130<br>33<br>28 | ns |
| $t_{PZL}$, $t_{PZH}$ | Maximum Propagation Delay, Output Enable to A or B (Figures 2 and 4) | 2.0<br>3.0<br>4.5<br>6.0 | 110<br>90<br>22<br>19 | 140<br>110<br>28<br>24 | 165<br>130<br>33<br>25 | ns |
| $t_{TLH}$, $t_{THL}$ | Maximum Output Transition Time, Any Output (Figures 1 and 3) | 2.0<br>3.0<br>4.5<br>6.0 | 60<br>23<br>12<br>10 | 75<br>27<br>15<br>13 | 90<br>32<br>18<br>15 | ns |
| $C_{in}$ | Maximum Input Capacitance, Pin 1 or 19 | — | 10 | 10 | 10 | pF |
| $C_{out}$ | Maximum Three–State I/O 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 Motorola High–Speed CMOS Data Book (DL129/D).

| | | Typical @ 25°C, $V_{CC}$ = 5.0 V | |
|---|---|---|---|
| $C_{PD}$ | Power Dissipation Capacitance (Per Transceiver Channel)* | 40 | pF |

* 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 Motorola High–Speed CMOS Data Book (DL129/D).

## SWITCHING WAVEFORMS

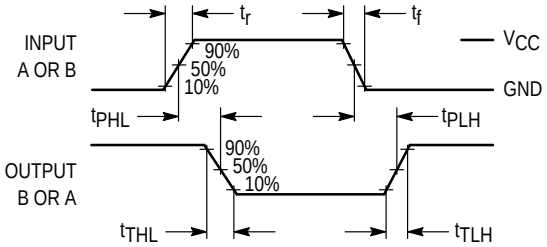



**Figure 1.**

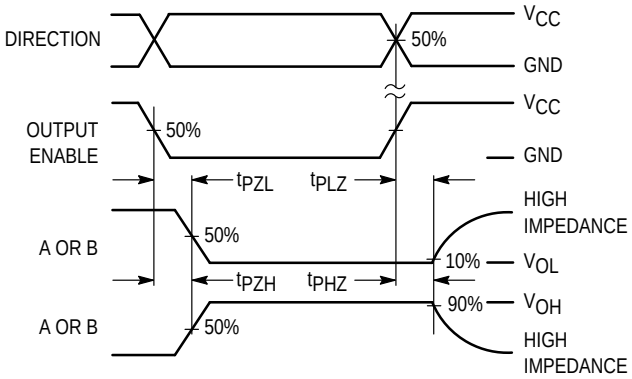
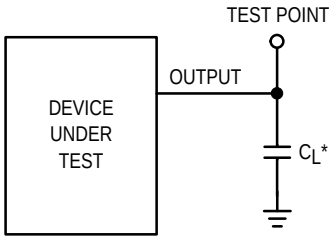


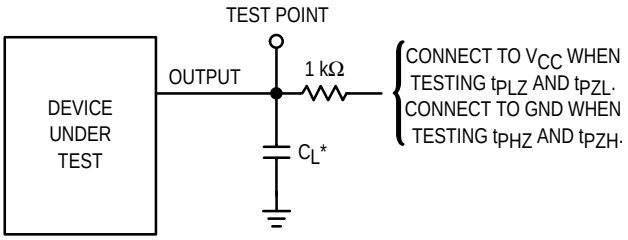

**Figure 2.**

## tTEST CIRCUITS




* Includes all probe and jig capacitance

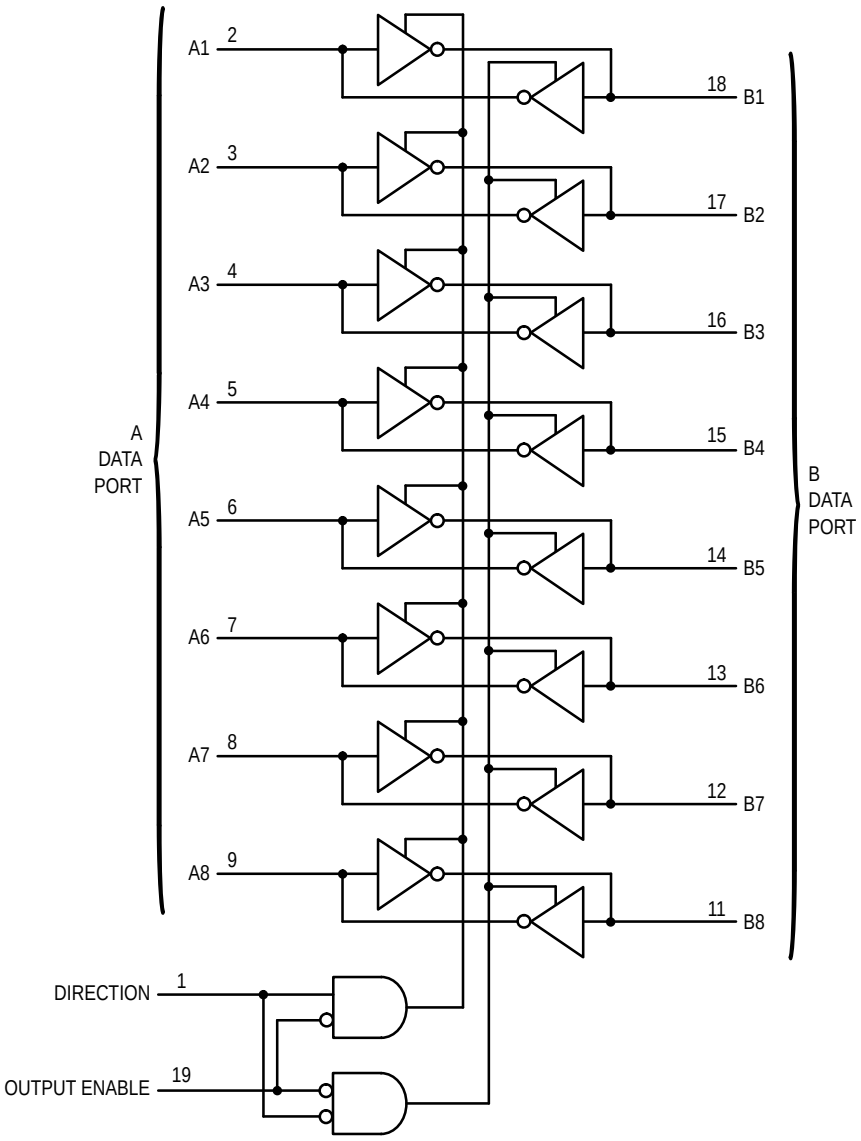
**Figure 3.**




* Includes all probe and jig capacitance

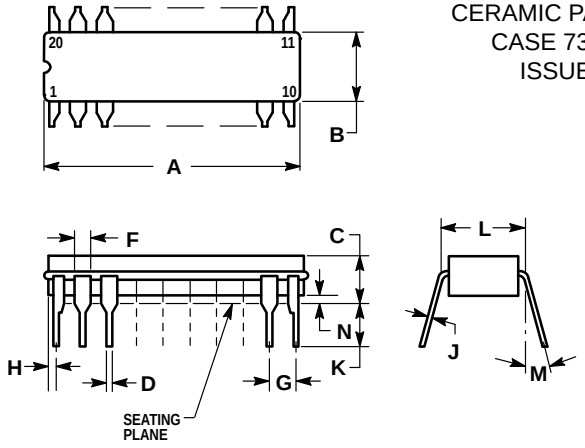
**Figure 4.**

**EXPANDED LOGIC DIAGRAM**



## OUTLINE DIMENSIONS

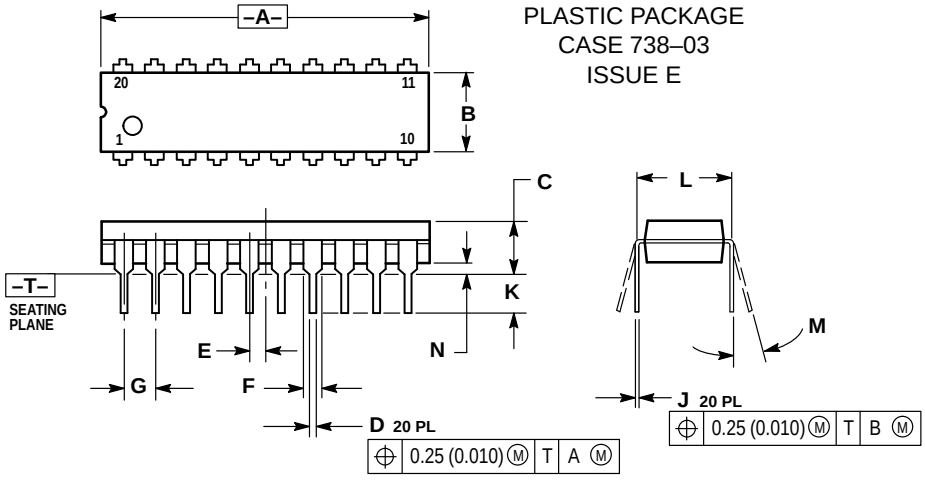
### J SUFFIX
CERAMIC PACKAGE
CASE 732–03
ISSUE E




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

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | 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 |

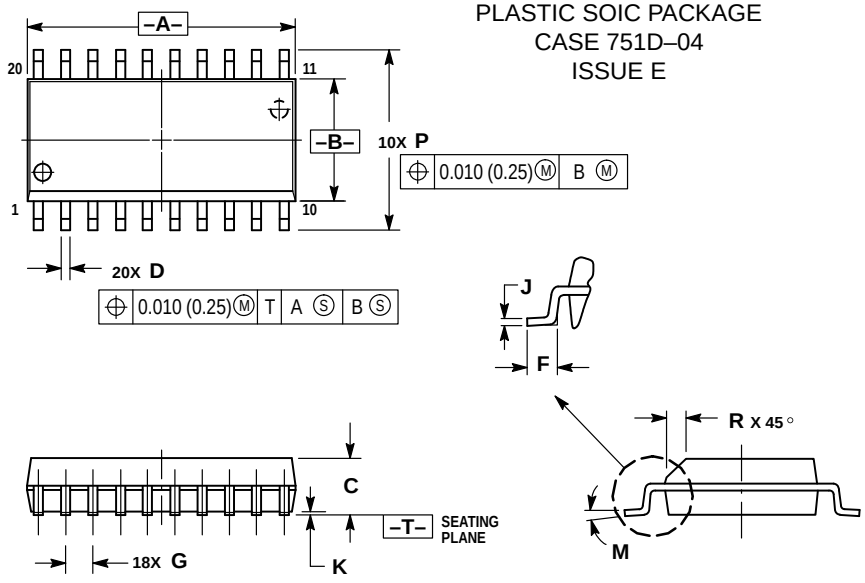
### N SUFFIX
PLASTIC PACKAGE
CASE 738–03
ISSUE E




NOTES:
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.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.150 (0.006) PER SIDE.
5. 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.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | 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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