T-45-23-17

# ⓜ **MOTOROLA**

| MC14520B |
| See Page 6-288 |

| MC14521B |

## CMOS MSI

**(LOW-POWER COMPLEMENTARY MOS)**

**24-STAGE FREQUENCY DIVIDER**

### 24-STAGE FREQUENCY DIVIDER

The MC14521B consists of a chain of 24 flip-flops with an input circuit that allows three modes of operation. The input will function as a crystal oscillator, an RC oscillator, or as an input buffer for an external oscillator. Each flip-flop divides the frequency of the previous flip-flop by two, consequently this part will count up to $2^{24} = 16,777,216$. The count advances on the negative going edge of the clock. The outputs of the last seven-stages are available for added flexibility.

- All Stages are Resettable
- Reset Disables the RC Oscillator for Low Standby Power Drain
- RC and Crystal Oscillator Outputs Are Capable of Driving External Loads
- Test Mode to Reduce Test Time
- $V_{DD}'$ and $V_{SS}'$ Pins Brought Out on Crystal Oscillator Inverter to Allow the Connection of External Resistors for Low-Power Operation
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load over the Rated Temperature Range.



**L SUFFIX**
CERAMIC PACKAGE
CASE 620

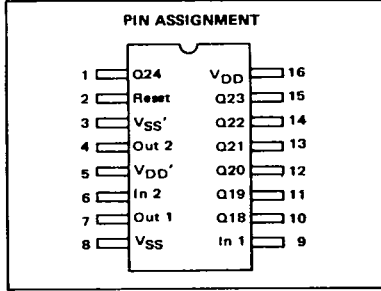**P SUFFIX**
PLASTIC PACKAGE
CASE 648

**ORDERING INFORMATION**

A Series: −55°C to +125°C
MC14XXXBAL (Ceramic Package Only)

C Series: −40°C to +85°C
MC14XXXBCP (Plastic Package)
MC14XXXBCL (Ceramic Package)

### MAXIMUM RATINGS* (Voltages Referenced to $V_{SS}$)

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DD}$ | DC Supply Voltage | −0.5 to +18.0 | V |
| $V_{in}, V_{out}$ | Input or Output Voltage (DC or Transient) | −0.5 to $V_{DD}$ +0.5 | V |
| $I_{in}, I_{out}$ | Input or Output Current (DC or Transient), per Pin | ±10 | mA |
| $P_D$ | Power Dissipation, per Package† | 500 | mW |
| $T_{stg}$ | Storage Temperature | −65 to −150 | °C |
| $T_L$ | Lead Temperature (8-Second Soldering) | 260 | °C |

*Maximum Ratings are those values beyond which damage to the device may occur.
†Temperature Derating: Plastic "P" Package: −12mW·°C from 65°C to 85°C
Ceramic "L" Package: −12mW·°C from 100°C to 125°C

### PIN ASSIGNMENT

| | | | |
|---|---|---|---|
| 1 | Q24 | V_DD | 16 |
| 2 | Reset | Q23 | 15 |
| 3 | V_SS' | Q22 | 14 |
| 4 | Out 2 | Q21 | 13 |
| 5 | V_DD' | Q20 | 12 |
| 6 | In 2 | Q19 | 11 |
| 7 | Out 1 | Q18 | 10 |
| 8 | V_SS | In 1 | 9 |

### BLOCK DIAGRAM



Reset
2

9 O In1
6 O In2
7 Out 1
5 V_DD'
3 V_SS'
4 Out 2

Stages 1 thru 17
Stages 18 thru 24
Q18 Q19 Q20 Q21 Q22 Q23 Q24

$V_{DD}$ = Pin 16
$V_{SS}$ = Pin 8

10 11 12 13 14 15 1

| OUTPUT | COUNT CAPACITY |
|---|---|
| Q18 | $2^{18} = 262,144$ |
| Q19 | $2^{19} = 524,288$ |
| Q20 | $2^{20} = 1,048,576$ |
| Q21 | $2^{21} = 2,097,152$ |
| Q22 | $2^{22} = 4,194,304$ |
| Q23 | $2^{23} = 8,388,608$ |
| Q24 | $2^{24} = 16,777,216$ |

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# MC14521B

### ELECTRICAL CHARACTERISTICS (Voltages Referenced to V$_{SS}$)

| Characteristic | Symbol | V$_{DD}$ Vdc | T$_{low}$* Min | T$_{low}$* Max | 25°C Min | 25°C Typ # | 25°C Max | T$_{high}$* Min | T$_{high}$* Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| Output Voltage "0" Level V$_{in}$ = V$_{DD}$ or O | V$_{OL}$ | 5.0 | — | 0.05 | — | 0 | 0.05 | — | 0.05 | Vdc |
| | | 10 | — | 0.05 | — | 0 | 0.05 | — | 0.05 | |
| | | 15 | — | 0.5 | — | 0 | 0.05 | — | 0.05 | |
| "1" Level V$_{in}$ = O or V$_{DD}$ | V$_{OH}$ | 5.0 | 4.95 | — | 4.95 | 5.0 | — | 4.95 | — | Vdc |
| | | 10 | 9.95 | — | 9.95 | 10 | — | 9.95 | — | |
| | | 15 | 14.95 | — | 14.95 | 15 | — | 14.95 | — | |
| Input Voltage "0" Level (V$_O$ = 4.5 or 0.5 Vdc) | V$_{IL}$ | 5.0 | — | 1.5 | — | 2.25 | 1.5 | — | 1.5 | Vdc |
| (V$_O$ = 9.0 or 1.0 Vdc) | | 10 | — | 3.0 | — | 4.50 | 3.0 | — | 3.0 | |
| (V$_O$ = 13.5 or 1.5 Vdc) | | 15 | — | 4.0 | — | 6.75 | 4.0 | — | 4.0 | |
| "1" Level (V$_O$ = 0.5 or 4.5 Vdc) | V$_{IH}$ | 5.0 | 3.5 | — | 3.5 | 2.75 | — | 3.5 | — | Vdc |
| (V$_O$ = 1.0 or 9.0 Vdc) | | 10 | 7.0 | — | 7.0 | 5.50 | — | 7.0 | — | |
| (V$_O$ = 1.5 or 13.5 Vdc) | | 15 | 11.0 | — | 11.0 | 8.25 | — | 11.0 | — | |
| Output Drive Current (AL Device) (V$_{OH}$ = 2.5 Vdc)        Source | I$_{OH}$ | 5.0 | −1.2 | — | −1.0 | −1.7 | — | −0.7 | — | mAdc |
| (V$_{OH}$ = 4.6 Vdc)    Pins 4 & 7 | | 5.0 | −0.25 | — | −0.2 | −0.36 | — | −0.14 | — | |
| (V$_{OH}$ = 9.5 Vdc) | | 10 | −0.62 | — | −0.5 | −0.9 | — | −0.35 | — | |
| (V$_{OH}$ = 13.5 Vdc) | | 15 | −1.8 | — | −1.5 | −3.5 | — | −1.1 | — | |
| (V$_{OH}$ = 2.5 Vdc)        Source | | 5.0 | −3.0 | — | −2.4 | −4.2 | — | −1.7 | — | mAdc |
| (V$_{OH}$ = 4.6 Vdc)    Pins 1, 10, | | 5.0 | −0.64 | — | −0.51 | −0.88 | — | −0.36 | — | |
| (V$_{OH}$ = 9.5 Vdc) 11, 12, 13, 14 | | 10 | −1.6 | — | −1.3 | −2.25 | — | −0.9 | — | |
| (V$_{OH}$ = 13.5 Vdc)        and 15 | | 15 | −4.2 | — | −3.4 | −8.8 | — | −2.4 | — | |
| (V$_{OL}$ = 0.4 Vdc)        Sink | I$_{OL}$ | 5.0 | 0.64 | — | 0.51 | 0.88 | — | 0.36 | — | mAdc |
| (V$_{OL}$ = 0.5 Vdc) | | 10 | 1.6 | — | 1.3 | 2.25 | — | 0.9 | — | |
| (V$_{OL}$ = 1.5 Vdc) | | 15 | 4.2 | — | 3.4 | 8.8 | — | 2.4 | — | |
| Output Drive Current (CL/CP Device) (V$_{OH}$ = 2.5 Vdc)        Source | I$_{OH}$ | 5.0 | −1.0 | — | −0.8 | −1.7 | — | −0.6 | — | mAdc |
| (V$_{OH}$ = 4.6 Vdc)    Pins 4 & 7 | | 5.0 | −0.2 | — | −0.16 | −0.36 | — | −0.12 | — | |
| (V$_{OH}$ = 9.5 Vdc) | | 10 | −0.5 | — | −0.4 | −0.9 | — | −0.3 | — | |
| (V$_{OH}$ = 13.5 Vdc) | | 15 | −1.4 | — | −1.2 | −3.5 | — | −1.0 | — | |
| (V$_{OH}$ = 2.5 Vdc)        Source | | 5.0 | −2.5 | — | −2.1 | −4.2 | — | −1.7 | — | mAdc |
| (V$_{OH}$ = 4.6 Vdc)    Pins 1, 10, | | 5.0 | −0.52 | — | −0.44 | −0.88* | — | −0.36 | — | |
| (V$_{OH}$ = 9.5 Vdc) 11, 12, 13, 14 | | 10 | −1.3 | — | −1.1 | −2.25 | — | −0.9 | — | |
| (V$_{OH}$ = 13.5 Vdc)        and 15 | | 15 | −3.6 | — | −3.0 | −8.8 | — | −2.4 | — | |
| (V$_{OL}$ = 0.4 Vdc)        Sink | I$_{OL}$ | 5.0 | 0.52 | — | 0.44 | 0.88 | — | 0.36 | — | mAdc |
| (V$_{OL}$ = 0.5 Vdc) | | 10 | 1.3 | — | 1.1 | 2.25 | — | 0.9 | — | |
| (V$_{OL}$ = 1.5 Vdc) | | 15 | 3.6 | — | 3.0 | 8.8 | — | 2.4 | — | |
| Input Current (AL Device) | I$_{in}$ | 15 | — | ±0.1 | — | ±0.00001 | ±0.1 | — | ±1.0 | µAdc |
| Input Current (CL/CP Device) | I$_{in}$ | 15 | — | ±0.3 | — | ±0.00001 | ±0.3 | — | ±1.0 | µAdc |
| Input Capacitance (V$_{in}$ = O) | C$_{in}$ | — | — | — | — | 5.0 | 7.5 | — | — | pF |
| Quiescent Current (AL Device) (Per Package) | I$_{DD}$ | 5.0 | — | 5.0 | — | 0.005 | 5.0 | — | 150 | µAdc |
| | | 10 | — | 10 | — | 0.010 | 10 | — | 300 | |
| | | 15 | — | 20 | — | 0.015 | 20 | — | 600 | |
| Quiescent Current (CL/CP Device) (Per Package) | I$_{DD}$ | 5.0 | — | 20 | — | 0.005 | 20 | — | 150 | µAdc |
| | | 10 | — | 40 | — | 0.010 | 40 | — | 300 | |
| | | 15 | — | 80 | — | 0.015 | 80 | — | 600 | |
| Total Supply Current**† (Dynamic plus Quiescent, Per Package) (C$_L$ = 50 pF on all outputs, all buffers switching) | I$_T$ | 5.0 10 15 | | | I$_T$ = (0.42 µA/kHz) f + I$_{DD}$ / I$_T$ = (0.85 µA/kHz) f + I$_{DD}$ / I$_T$ = (1.4 µA/kHz) f + I$_{DD}$ | | | | | µAdc |

*T$_{low}$ = −55°C for AL Device, −40°C for CL/CP Device.
T$_{high}$ = +125°C for AL Device, +85°C for CL/CP Device.

#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

**The formulas given are for the typical characteristics only at 25°C.

†To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) \text{ Vfk}$$

where: I$_T$ is in µA (per package), C$_L$ in pF, V = (V$_{DD}$ − V$_{SS}$) in volts, f in kHz is input frequency, and k = 0.003.

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6367252 MOTOROLA SC (LOGIC)                98D 79723    D

# MC14521B

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**SWITCHING CHARACTERISTICS** ($C_L$ = 50 pF, $T_A$ = 25°C)

| Characteristic | Symbol | $V_{DD}$ Vdc | Min | Typ # | Max | Unit |
|---|---|---|---|---|---|---|
| Output Rise and Fall Time (Counter Outputs) $t_{TLH}$, $t_{THL}$ = (1.5 ns/pF) $C_L$ + 25 ns $t_{TLH}$, $t_{THL}$ = (0.75 ns/pF) $C_L$ + 12.5 ns $t_{TLH}$, $t_{THL}$ = (0.55 ns/pF) $C_L$ + 12.5 ns | $t_{TLH}$, $t_{THL}$ | 5.0 10 15 | — — — | 100 50 40 | 200 100 80 | ns |
| Propagation Delay Time Clock to Q18 $t_{PHL}$, $t_{PLH}$ = (1.7 ns/pF) $C_L$ + 4415 ns $t_{PHL}$, $t_{PLH}$ = (0.66 ns/pF) $C_L$ + 1667 ns $t_{PHL}$, $t_{PLH}$ = (0.5 ns/pF) $C_L$ + 1275 ns | $t_{PHL}$, $t_{PLH}$ | 5.0 10 15 | — — — | 4.5 1.7 1.3 | 9.0 3.5 2.7 | µs |
| Clock to Q24 $t_{PHL}$, $t_{PLH}$ = (1.7 ns/pF) $C_L$ + 5915 ns $t_{PHL}$, $t_{PLH}$ = (0.66 ns/pF) $C_L$ + 2167 ns $t_{PHL}$, $t_{PLH}$ = (0.5 ns/pF) $C_L$ + 1675 ns | | 5.0 10 15 | — — — | 6.0 2.2 1.7 | 12 4.5 3.5 | |
| Propagation Delay Time Reset to $Q_n$ $t_{PHL}$ = (1.7 ns/pF) $C_L$ + 1215 ns $t_{PHL}$ = (0.66 ns/pF) $C_L$ + 467 ns $t_{PHL}$ = (0.5 ns/pF) $C_L$ + 350 ns | $t_{PHL}$ | 5.0 10 15 | — — — | 1300 500 375 | 2600 1000 750 | ns |
| Clock Pulse Width | $t_{WH(cl)}$ | 5.0 10 15 | 385 150 120 | 140 55 40 | — — — | ns |
| Clock Pulse Frequency | $f_{cl}$ | 5.0 10 15 | — — — | 3.5 9.0 12 | 2.0 5.0 6.5 | MHz |
| Clock Rise and Fall Time | $t_{TLH}$, $t_{THL}$ | 5.0 10 15 | — — — | — — — | 15 5.0 4.0 | µs |
| Reset Pulse Width | $t_{WH(R)}$ | 5.0 10 15 | 1400 600 450 | 700 300 225 | — — — | ns |
| Reset Removal Time | $t_{rem}$ | 5.0 10 15 | 30 0 −40 | −200 −160 −110 | — — — | ns |

*The formulas given are for the typical characteristics only at 25°C.

# Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

**FIGURE 1 – POWER DISSIPATION TEST CIRCUIT AND WAVEFORM**

6367252 MOTOROLA SC (LOGIC)               98D 79724    D

## MC14521B

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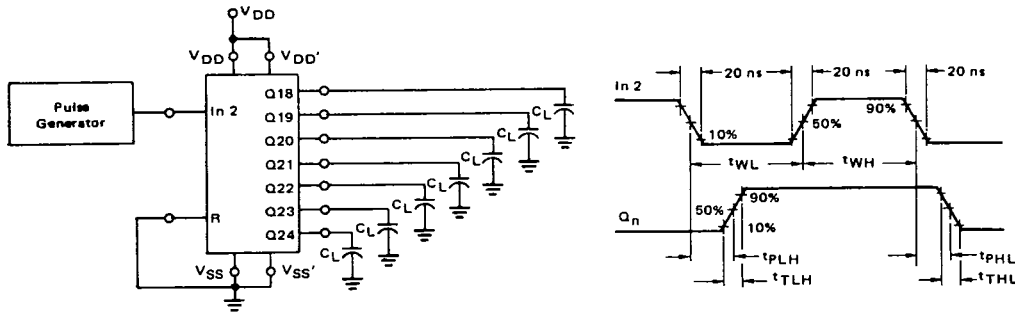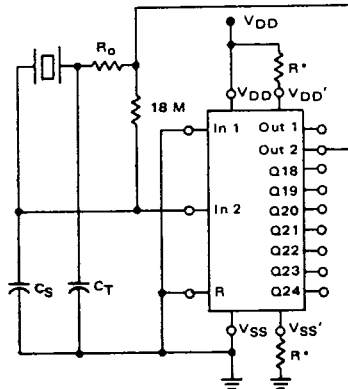FIGURE 2 — SWITCHING TIME TEST CIRCUIT AND WAVEFORMS



FIGURE 3 — CRYSTAL OSCILLATOR CIRCUIT



*Optional for low power operation.
10 kΩ < R < 70 kΩ

### FIGURE 4 — TYPICAL DATA FOR CRYSTAL OSCILLATOR CIRCUIT

| CHARACTERISTIC | 500 kHz CIRCUIT | 50 kHz CIRCUIT | UNIT |
|---|---|---|---|
| **Crystal Characteristics** | | | |
| Resonant Frequency | 500 | 50 | kHz |
| Equivalent Resistance, $R_S$ | 1.0 | 6.2 | kΩ |
| **External Resistor/Capacitor Values** | | | |
| $R_0$ | 47 | 750 | kΩ |
| $C_T$ | 82 | 82 | pF |
| $C_S$ | 20 | 20 | pF |
| **Frequency Stability** | | | |
| Frequency Change as a Function of $V_{DD}$ ($T_A = 25°C$) | | | |
| $V_{DD}$ Change from 5.0 V to 10 V | +6.0 | +2.0 | ppm |
| $V_{DD}$ Change from 10 V to 15 V | +2.0 | +2.0 | ppm |
| Frequency Change as a Function of Temperature ($V_{DD} = 10$ V) | | | |
| $T_A$ Change from -55°C to +25°C | | | |
| MC14521 only | -4.0 | -2.0 | ppm |
| Complete Oscillator* | +100 | +120 | ppm |
| $T_A$ Change from +25°C to +125°C | | | |
| MC14521 only | -2.0 | -2.0 | ppm |
| Complete Oscillator* | -160 | -560 | ppm |

*Complete oscillator includes crystal, capacitors, and resistors.

6367252 MOTOROLA SC (LOGIC)                    98D 79725    D

## MC14521B

*T-45-23-17*

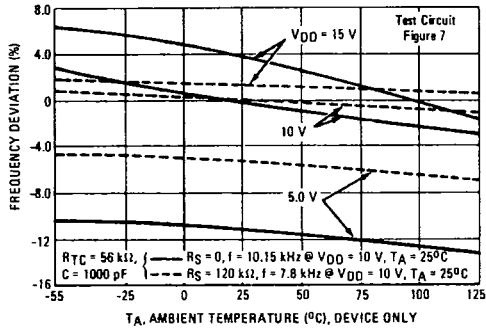### FIGURE 5 – RC OSCILLATOR STABILITY



### FIGURE 6 – RC OSCILLATOR FREQUENCY AS A FUNCTION OF R<sub>TC</sub> AND C
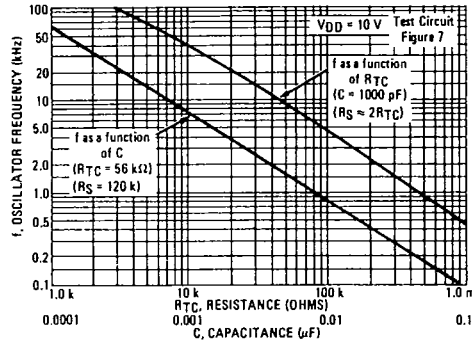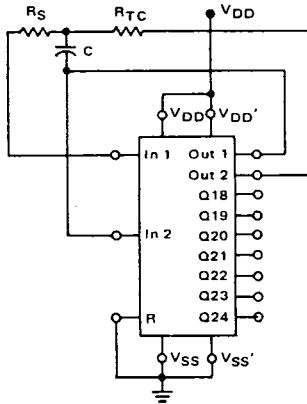


### FIGURE 7 – RC OSCILLATOR CIRCUIT



### FIGURE 8 – FUNCTIONAL TEST CIRCUIT



### FUNCTIONAL TEST SEQUENCE

A test function (see Figure 8) has been included for the reduction of test time required to exercise all 24 counter stages. This test function divides the counter into three 8-stage sections, and 255 counts are loaded in each of the 8-stage sections in parallel. All flip-flops are now at a logic "1". The counter is now returned to the normal 24-stages in series configuration. One more pulse is entered into Input 2 (In 2) which will cause the counter to ripple from an all "1" state to an all "0" state.

| INPUTS | | OUTPUTS | | | | COMMENTS |
|---|---|---|---|---|---|---|
| Reset | In 2 | Out 2 | V<sub>SS</sub>' | V<sub>DD</sub>' | Q18 thru Q24 | |
| 1 | 0 | 0 | V<sub>DD</sub> | Gnd | 0 | Counter is in three 8-stage sections in parallel mode. Counter is reset. In 2 and Out 2 are connected together |
| 0 | 1 | 1 | | | | First "0" to "1" transition on In 2, Out 2 node. |
| | 0 | 0 | | | | 255 "0" to "1" transitions are clocked into this In 2, Out 2 node. |
| | 1 | 1 | | | | |
| | – | – | | | | |
| | – | – | | | | |
| | 1 | 1 | | | 1 | The 255th "0" to "1" transition. |
| | 0 | 0 | | | 1 | |
| | 0 | 0 | Gnd | | 1 | |
| | 1 | 0 | | V<sub>DD</sub> | 1 | Counter converted back to 24-stages in series mode. |
| | 1 | 0 | | | 1 | Out 2 converts back to an output. |
| | 0 | 1 | | | 0 | Counter ripples from an all "1" state to an all "0" stage. |

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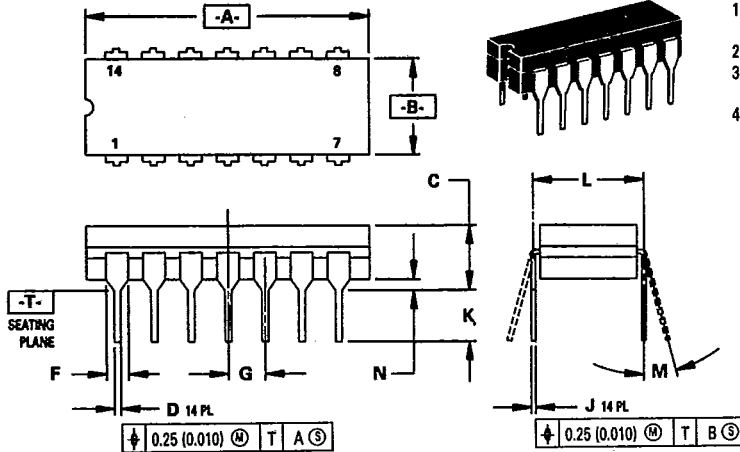## MC14521B

**LOGIC DIAGRAM**



$V_{DD}$ = Pin 16
$V_{SS}$ = Pin 8

# PACKAGE DIMENSIONS

The standard package availability for each device is indicated on the front page of the individual data sheets. Dimensions for the packages are given in this chapter. Surface mount packages may be special ordered by specifying the following suffixes: "D" (narrow SOIC), "DW" (wide SOIC), or "FN" (PLCC). For example, to order a quad NOR gate, use MC14001BD.
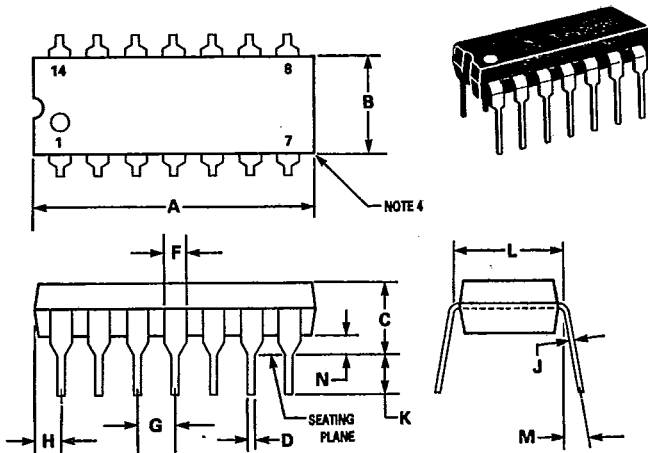
## 14-PIN PACKAGE

### CERAMIC PACKAGE
### CASE 632-08



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. DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|-----|-----|-----|-----|-----|
| A | 19.05 | 19.94 | 0.750 | 0.785 |
| B | 6.23 | 7.11 | 0.245 | 0.280 |
| C | 3.94 | 5.08 | 0.155 | 0.200 |
| D | 0.39 | 0.50 | 0.015 | 0.020 |
| F | 1.40 | 1.65 | 0.055 | 0.065 |
| G | 2.54 BSC | | 0.100 BSC | |
| J | 0.21 | 0.38 | 0.008 | 0.015 |
| K | 3.18 | 4.31 | 0.125 | 0.170 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.51 | 1.01 | 0.020 | 0.040 |

### PLASTIC PACKAGE
### CASE 646-06



NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
4. ROUNDED CORNERS OPTIONAL.

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|-----|-----|-----|-----|-----|
| A | 18.16 | 19.56 | 0.715 | 0.770 |
| B | 6.10 | 6.60 | 0.240 | 0.260 |
| C | 3.69 | 4.69 | 0.145 | 0.185 |
| D | 0.38 | 0.53 | 0.015 | 0.021 |
| F | 1.02 | 1.78 | 0.040 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 1.32 | 2.41 | 0.052 | 0.095 |
| J | 0.20 | 0.38 | 0.008 | 0.015 |
| K | 2.92 | 3.43 | 0.115 | 0.135 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 10° | 0° | 10° |
| N | 0.39 | 1.01 | 0.015 | 0.039 |

9
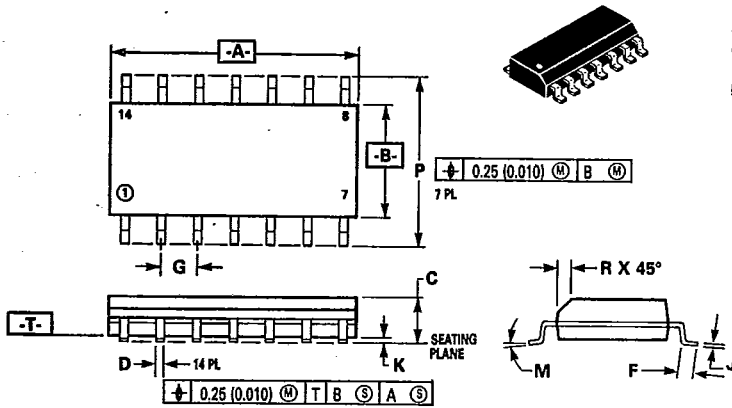
## PACKAGE DIMENSIONS (Continued)

### ■ 14-PIN PACKAGE ■

**SOIC PACKAGE**
**CASE 751A-02**
**D SUFFIX**

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

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 8.55 | 8.75 | 0.337 | 0.344 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

⊕ 0.25 (0.010) Ⓜ B Ⓜ
7 PL

⊕ 0.25 (0.010) Ⓜ T B Ⓢ A Ⓢ
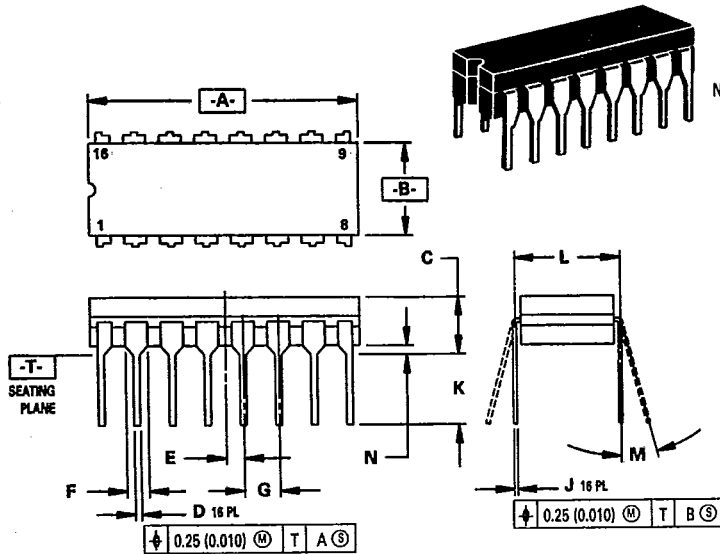
R X 45°

SEATING PLANE

9

## PACKAGE DIMENSIONS (Continued)

# 16-PIN PACKAGE
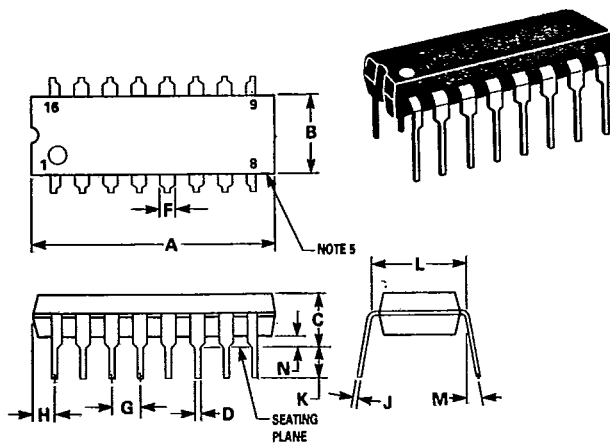
**CERAMIC PACKAGE**
**CASE 620-09**



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. DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

| DIM | MILLIMETERS | | INCHES | |
|-----|-----|-----|-----|-----|
| | MIN | MAX | MIN | MAX |
| A | 19.05 | 19.55 | 0.750 | 0.770 |
| B | 6.10 | 7.36 | 0.240 | 0.290 |
| C | — | 4.19 | — | 0.165 |
| D | 0.39 | 0.53 | 0.015 | 0.021 |
| E | 1.27 BSC | | 0.050 BSC | |
| F | 1.40 | 1.77 | 0.055 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| J | 0.23 | 0.27 | 0.009 | 0.011 |
| K | — | 5.08 | — | 0.200 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.39 | 0.88 | 0.015 | 0.035 |

**PLASTIC PACKAGE**
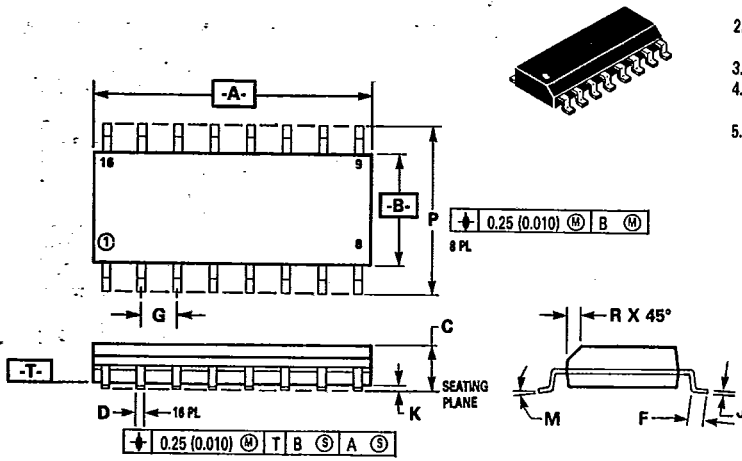**CASE 648-06**



NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
4. "F" DIMENSION IS FOR FULL LEADS.
5. ROUNDED CORNERS OPTIONAL.

| DIM | MILLIMETERS | | INCHES | |
|-----|-----|-----|-----|-----|
| | MIN | MAX | MIN | MAX |
| A | 18.80 | 21.34 | 0.740 | 0.840 |
| B | 6.10 | 6.60 | 0.240 | 0.260 |
| C | 3.69 | 4.69 | 0.145 | 0.185 |
| D | 0.38 | 0.53 | 0.015 | 0.021 |
| F | 1.02 | 1.78 | 0.040 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 0.38 | 2.41 | 0.015 | 0.095 |
| J | 0.20 | 0.38 | 0.008 | 0.015 |
| K | 2.92 | 3.43 | 0.115 | 0.135 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 10° | 0° | 10° |
| N | 0.39 | 1.01 | 0.015 | 0.040 |

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# PACKAGE DIMENSIONS (Continued)

## ■ 16-PIN PACKAGE ■
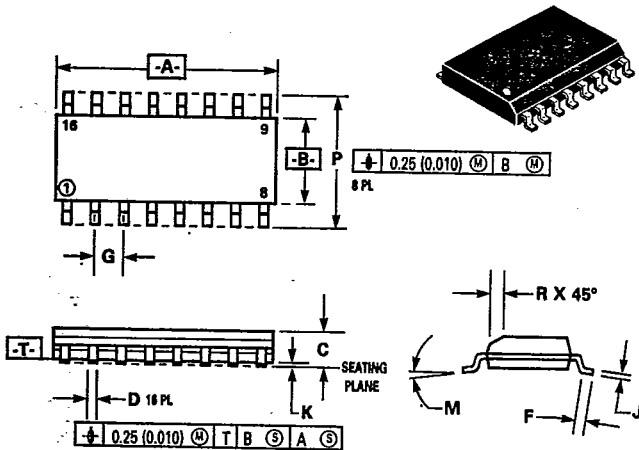
### SOIC PACKAGE
### CASE 751B-03
### D SUFFIX

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

| DIM | MILLIMETERS | | INCHES | |
|-----|-----|-----|-----|-----|
| | MIN | MAX | MIN | MAX |
| A | 9.80 | 10.00 | 0.386 | 0.393 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

### SOIC PACKAGE
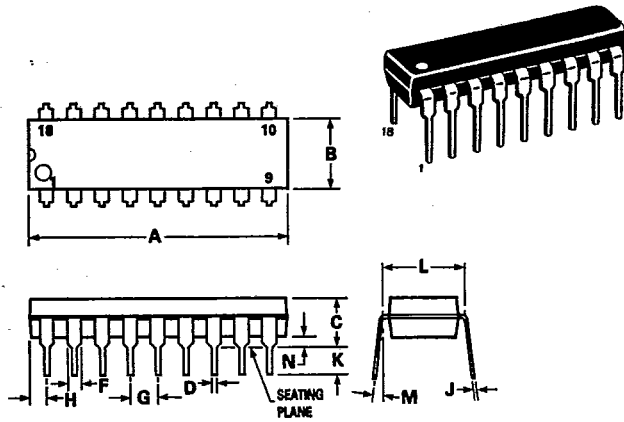### CASE 751G-01
### DW SUFFIX

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

| DIM | MILLIMETERS | | INCHES | |
|-----|-----|-----|-----|-----|
| | MIN | MAX | MIN | MAX |
| A | 10.15 | 10.45 | 0.400 | 0.411 |
| 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 | 0.26 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 10.05 | 10.55 | 0.395 | 0.415 |
| | 0.25 | 0.75 | 0.010 | 0.029 |

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## PACKAGE DIMENSIONS (Continued)

### ═══ 18-PIN PACKAGE ═══
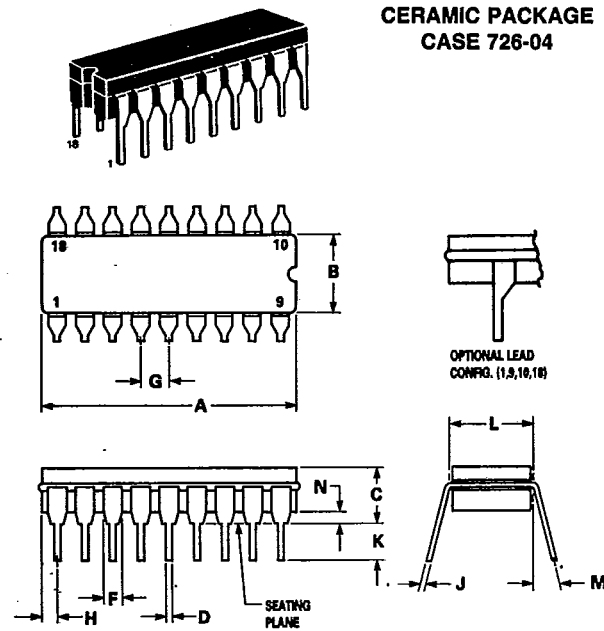
**PLASTIC PACKAGE
CASE 707-02**



**NOTES:**
1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25mm(0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|---|---|---|---|---|
| A | 22.22 | 23.24 | 0.875 | 0.915 |
| B | 6.10 | 6.60 | 0.240 | 0.260 |
| C | 3.56 | 4.57 | 0.140 | 0.180 |
| D | 0.36 | 0.56 | 0.014 | 0.022 |
| F | 1.27 | 1.78 | 0.050 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 1.02 | 1.52 | 0.040 | 0.060 |
| J | 0.20 | 0.30 | 0.008 | 0.012 |
| K | 2.92 | 3.43 | 0.115 | 0.135 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.51 | 1.02 | 0.020 | 0.040 |

**CERAMIC PACKAGE
CASE 726-04**



OPTIONAL LEAD CONFIG. (1,9,10,18)

**NOTES:**
1. LEADS, TRUE POSITIONED WITHIN 0.25 mm (0.010) DIA. AT SEATING PLANE, AT MAXIMUM MATERIAL CONDITION.
2. DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIM "A" & "B" INCLUDES MENISCUS.
4. "F" DIMENSION IS FOR FULL LEADS. "HALF" LEADS ARE OPTIONAL AT LEAD POSITIONS 1, 9, 10, AND 18.
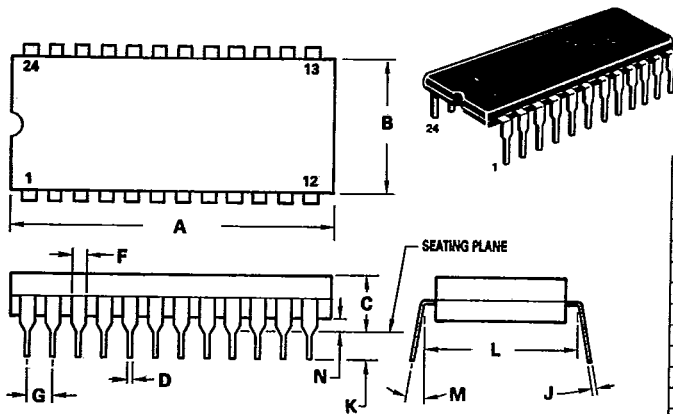
| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|---|---|---|---|---|
| A | 22.35 | 23.11 | 0.880 | 0.910 |
| B | 6.10 | 7.49 | 0.240 | 0.295 |
| C | — | 5.08 | — | 0.200 |
| D | 0.38 | 0.53 | 0.015 | 0.021 |
| F | 1.40 | 1.78 | 0.055 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 0.51 | 1.14 | 0.020 | 0.045 |
| J | 0.20 | 0.30 | 0.008 | 0.012 |
| K | 3.18 | 4.32 | 0.125 | 0.170 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.51 | 1.02 | 0.020 | 0.040 |

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## PACKAGE DIMENSIONS (Continued)
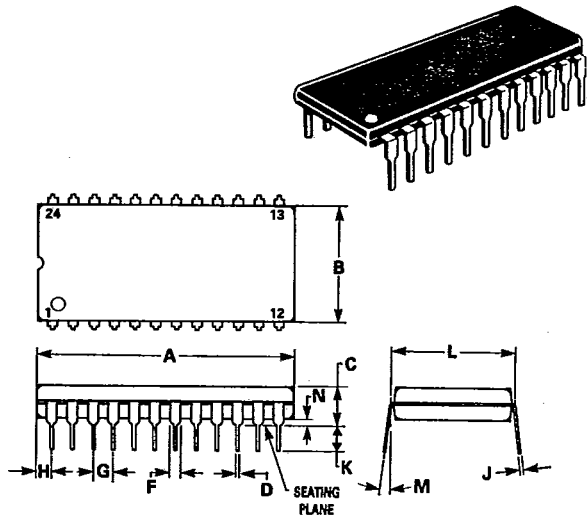
━━━━━━━━━━ 24-PIN PACKAGE ━━━━━━━━━━

**CERAMIC PACKAGE**
**CASE 623-05**



NOTES:
1. DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
2. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION. (WHEN FORMED PARALLEL).

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 31.24 | 32.77 | 1.230 | 1.290 |
| B | 12.70 | 15.49 | 0.500 | 0.610 |
| C | 4.06 | 5.59 | 0.160 | 0.220 |
| D | 0.41 | 0.51 | 0.016 | 0.020 |
| F | 1.27 | 1.52 | 0.050 | 0.060 |
| G | 2.54 BSC | | 0.100 BSC | |
| J | 0.20 | 0.30 | 0.008 | 0.012 |
| K | 3.18 | 4.06 | 0.125 | 0.160 |
| L | 15.24 BSC | | 0.600 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.51 | 1.27 | 0.020 | 0.050 |

**PLASTIC PACKAGE**
**CASE 709-02**



NOTES:
1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 mm (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 31.37 | 32.13 | 1.235 | 1.265 |
| B | 13.72 | 14.22 | 0.540 | 0.560 |
| C | 3.94 | 5.08 | 0.155 | 0.200 |
| D | 0.36 | 0.56 | 0.014 | 0.022 |
| F | 1.02 | 1.52 | 0.040 | 0.060 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 1.65 | 2.03 | 0.065 | 0.080 |
| J | 0.20 | 0.38 | 0.008 | 0.015 |
| K | 2.92 | 3.43 | 0.115 | 0.135 |
| L | 15.24 BSC | | 0.600 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.51 | 1.02 | 0.020 | 0.040 |

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