



**MOTOROLA**

# Bi-Quinary Counter

## ELECTRICALLY TESTED PER:

**MPG 1678 (– 30°C to + 85°C)**

The 1678 is a 4-bit counter capable of divide-by-two, divide-by-five, or divide-by-10 function. When used independently, the divide-by-two section will toggle at 350 MHz typically, while the divide-by-five section will toggle at 325 MHz typically. Clock inputs trigger on the positive going edge of the clock pulse.

Set and Reset inputs override the clock, allowing asynchronous "set" or "clear". Individual Set and common Reset inputs are provided, as well as complementary outputs for the first and fourth bits. True outputs are available at all bits.

- DC Input Factor
 

|     |      |
|-----|------|
| R   | 2.40 |
| Clk | 0.77 |
| C2  | 1.23 |
| S   | 1.00 |
- Power Dissipation = 750 mW typ
- $t_{Tog}$  = 350 MHz typ

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| ABSOLUTE MAXIMUM RATINGS:             | Symbol    | Min   | Max      | Unit |
|---------------------------------------|-----------|-------|----------|------|
| Power Supply Voltage ( $V_{CC} = 0$ ) | $V_{CC}$  | – 8.0 | 0        | Vdc  |
| Base Input Voltage ( $V_{CC} = 0$ )   | $V_{IN}$  | 0     | $V_{EE}$ | Vdc  |
| Storage Temperature Range             | $T_{stg}$ | – 55  | + 125    | °C   |
| Operating Temperature Range           | $T_A$     | – 30  | + 85     | °C   |

## PIN ASSIGNMENTS

| FUNCTION         | DIL | BURN-IN<br>(CONDITION C) |
|------------------|-----|--------------------------|
| $V_{CC1}$        | 1   | GND                      |
| C2               | 2   | OPEN                     |
| $S_2$            | 3   | GND                      |
| $Q_2$            | 4   | 51 $\Omega$ to $V_{TT}$  |
| $\overline{Q}_3$ | 5   | 51 $\Omega$ to $V_{TT}$  |
| $Q_3$            | 6   | 51 $\Omega$ to $V_{TT}$  |
| $S_3$            | 7   | GND                      |
| $V_{EE}$         | 8   | $V_{EE}$                 |
| Reset            | 9   | OPEN                     |
| $S_1$            | 10  | GND                      |
| $Q_1$            | 11  | 51 $\Omega$ to $V_{TT}$  |
| $Q_0$            | 12  | 51 $\Omega$ to $V_{TT}$  |
| $\overline{Q}_0$ | 13  | 51 $\Omega$ to $V_{TT}$  |
| $S_0$            | 14  | GND                      |
| Clock            | 15  | OPEN                     |
| $V_{CC2}$        | 16  | GND                      |

## BURN - IN CONDITIONS:

$V_{TT} = -2.0$  V MAX/ – 2.2 V MIN

$V_{EE} = -5.7$  V MAX/ – 5.2 V MIN

**Military 1678**

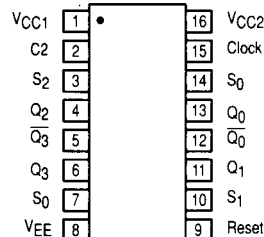


## AVAILABLE AS

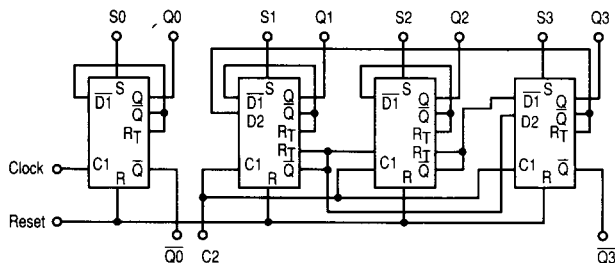
- 1) JAN: N/A
  - 2) SMD: N/A
  - 3) 883: N/A
  - 4) 1678/BXA \*
- X = CASE OUTLINE AS FOLLOWS:

PACKAGE: Cerdip: E

\* 883 Processing (Non-Compliant)



## LOGIC DIAGRAM



TRUTH TABLE

| $\bar{D}$ | C | S | R | Q         | $\bar{Q}$       |
|-----------|---|---|---|-----------|-----------------|
| 0         | 0 | 0 | 0 | $Q_n + 1$ | $\bar{Q}_n + 1$ |
| 0         | 0 | 0 | 1 | 0         | 1               |
| 0         | 0 | 1 | 0 | 1         | 0               |
| 0         | 0 | 1 | 1 | •         | •               |
| 0         | 1 | 0 | 0 | 1         | 0               |
| 0         | 1 | 0 | 1 | 0         | 1               |
| 0         | 1 | 1 | 0 | 1         | 0               |
| 0         | 1 | 1 | 1 | •         | •               |
| 1         | 0 | 0 | 0 | $Q_n + 1$ | $\bar{Q}_n + 1$ |
| 1         | 0 | 0 | 1 | 0         | 1               |
| 1         | 0 | 1 | 0 | 1         | 0               |
| 1         | 0 | 1 | 1 | •         | •               |
| 1         | 1 | 0 | 0 | 0         | 1               |
| 1         | 1 | 0 | 1 | 0         | 1               |
| 1         | 1 | 1 | 0 | 1         | 0               |
| 1         | 1 | 1 | 1 | •         | •               |

• Output State Undefined

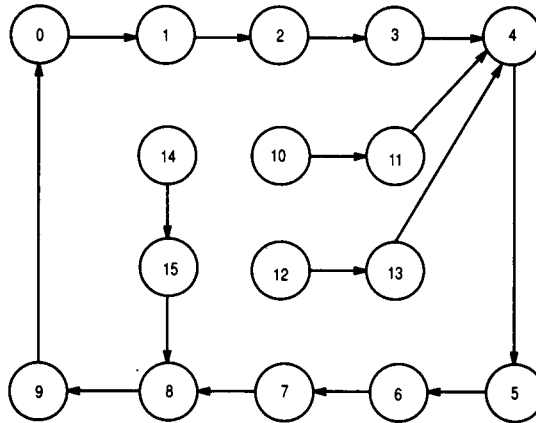


Figure 1. State Diagram



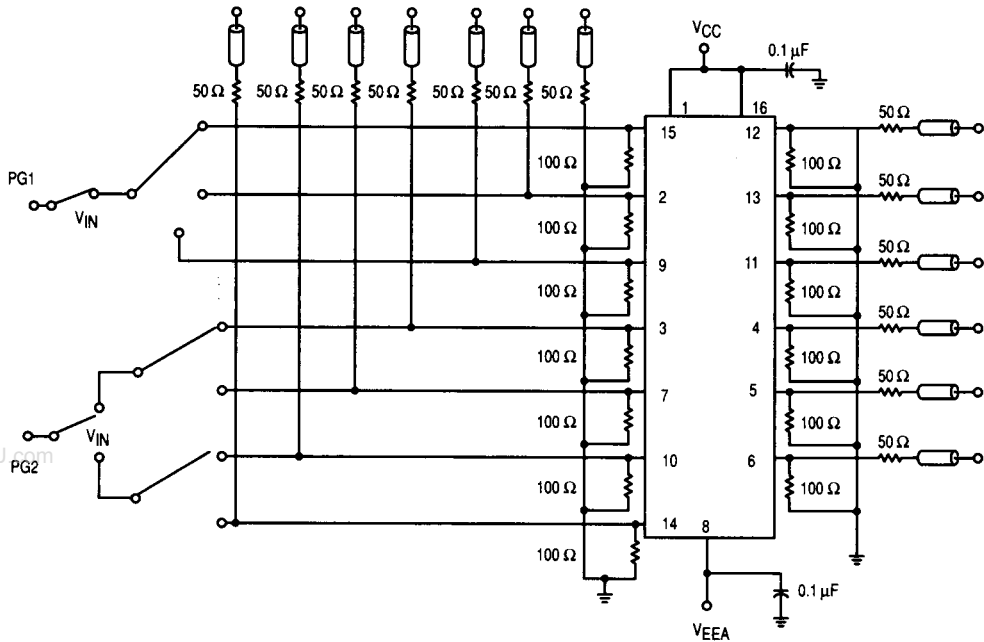
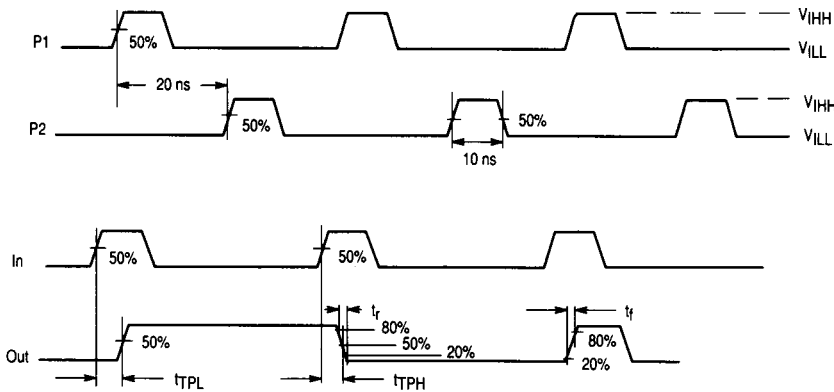


Figure 4. Switching Test Circuit

**NOTES**

1.  $t_r = t_f = 1.5 \text{ ns} \pm 0.2 \text{ ns}$ .
2.  $f_{\text{req}} = 25 \text{ MHz}$ .

Figure 5. Setup and Hold Waveforms

| Temp.            | 25°C   | 85°C    | -30°C   |
|------------------|--------|---------|---------|
| $V_{\text{IHH}}$ | 1.11 V | 1.185 V | 1.041 V |
| $V_{\text{ILL}}$ | 0.31 V | 0.337 V | 0.285 V |

# 1678 QUIESCENT LIMIT TABLE

| Test Temperature        | Test Voltage Values (Volts) |                 |                  |                  |                 |                  |
|-------------------------|-----------------------------|-----------------|------------------|------------------|-----------------|------------------|
|                         | V <sub>IH</sub>             | V <sub>IL</sub> | V <sub>IHA</sub> | V <sub>ILA</sub> | V <sub>EE</sub> | V <sub>EEA</sub> |
| T <sub>A</sub> = 25 °C  | -0.81                       | -1.85           | -1.095           | -1.485           | -5.2            | -3.2             |
| T <sub>A</sub> = 85 °C  | -0.70                       | -1.83           | -1.025           | -1.440           | -5.2            | -3.2             |
| T <sub>A</sub> = -30 °C | -0.875                      | -1.89           | -1.180           | -1.515           | -5.2            | -3.2             |

| Symbol            | Parameter                  | Limits     |       |            |        |            |        | Units | TEST VOLTAGE APPLIED TO PINS BELOW                                                                          |                 |                        |                  |                  |                |                 |                 |                        |
|-------------------|----------------------------|------------|-------|------------|--------|------------|--------|-------|-------------------------------------------------------------------------------------------------------------|-----------------|------------------------|------------------|------------------|----------------|-----------------|-----------------|------------------------|
|                   | Functional Parameters:     | + 25 °C    |       | + 85 °C    |        | - 30 °C    |        |       | Pinouts referenced are for DIL package, check Pin Assignments<br>VCC = 0.0 V, Output Load = 50 Ω to - 2.0 V |                 |                        |                  |                  |                |                 |                 |                        |
|                   |                            | Subgroup 1 |       | Subgroup 2 |        | Subgroup 3 |        |       |                                                                                                             |                 |                        |                  |                  |                |                 |                 |                        |
|                   |                            | Min        | Max   | Min        | Max    | Min        | Max    |       |                                                                                                             |                 |                        |                  |                  |                |                 |                 |                        |
| VOH               | High Output Voltage        | -0.96      | -0.81 | -0.89      | -0.7   | -1.045     | -0.875 | V     | V <sub>IH</sub>                                                                                             | 3, 7, 9, 10, 14 | V <sub>IL</sub>        | V <sub>IHA</sub> | V <sub>ILA</sub> | V <sub>R</sub> | V <sub>CC</sub> | V <sub>EE</sub> | P.U.T.                 |
| VOL               | Low Output Voltage         | -1.85      | -1.62 | -1.83      | -1.575 | -1.89      | -1.65  | V     |                                                                                                             | 7, 9, 10, 14    |                        |                  |                  | 4 - 6, 11 - 13 | 1, 16           | 8               | 4 - 6, 11 - 13         |
| VOHA              | High Output Voltage        | -0.98      | -0.81 | -0.91      | -0.7   | -1.065     | -0.875 | V     |                                                                                                             | 10              |                        |                  |                  | 4 - 6, 11 - 13 | 1, 16           | 8               | 4 - 6, 11 - 13         |
| VOLA              | Low Output Voltage         | -1.85      | -1.60 | -1.83      | -1.555 | -1.89      | -1.63  | V     |                                                                                                             | 10              |                        |                  |                  | 4 - 6          | 1, 16           | 8               | 4 - 6                  |
| I <sub>EE</sub>   | Power Supply Drain Current | -200       |       |            |        |            |        | mA    | 2, 3, 7, 9, 10, 14, 15                                                                                      |                 |                        |                  |                  |                | 1, 16           | 8               | 8                      |
| I <sub>INH1</sub> | Input Current High         |            | 450   |            |        |            |        | μA    | 3, 7, 10, 14, 15                                                                                            |                 |                        |                  |                  |                | 1, 16           | 8               | 3, 7, 9, 10, 14, 15    |
| I <sub>INH2</sub> | Input Current High         |            | 700   |            |        |            |        | μA    | 2                                                                                                           |                 |                        |                  |                  |                | 1, 16           | 8               | 2                      |
| I <sub>INH3</sub> | Input Current High         |            | 1.0   |            |        |            |        | mA    | 9                                                                                                           |                 |                        |                  |                  |                | 1, 16           | 8               | 9                      |
| I <sub>INL</sub>  | Input Current Low          | 0.5        |       |            |        |            |        | μA    |                                                                                                             |                 | 2, 3, 7, 9, 10, 14, 15 |                  |                  |                | 1, 16           | 8               | 2, 3, 7, 9, 10, 14, 15 |

**CAUTION:** This device dissipates 750 to 900 mW of power. Use heat sink if operating over 50 seconds at T<sub>A</sub> ≥ 25°C.

# 1678 QUIESCENT LIMIT TABLE

| Test Temperature        | Test Voltage Values (Volts) |                 |                  |                  |                 |                  |                 |                  |
|-------------------------|-----------------------------|-----------------|------------------|------------------|-----------------|------------------|-----------------|------------------|
|                         | V <sub>IH</sub>             | V <sub>IL</sub> | V <sub>IHA</sub> | V <sub>ILA</sub> | V <sub>EE</sub> | V <sub>EEA</sub> | V <sub>CC</sub> | V <sub>CCA</sub> |
| T <sub>A</sub> = 25 °C  | -0.81                       | -1.85           | -1.095           | -1.485           | -5.2            | -3.2             | +5.0            | +5.0             |
| T <sub>A</sub> = 85 °C  | -0.70                       | -1.83           | -1.025           | -1.440           | -5.2            | -3.2             | +5.0            | +5.0             |
| T <sub>A</sub> = -30 °C | -0.875                      | -1.89           | -1.180           | -1.515           | -5.2            | -3.2             | +5.0            | +5.0             |

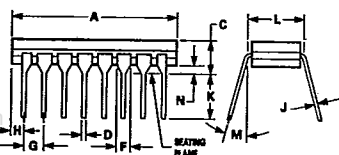
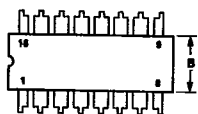
| Symbol             | Parameter                      | Limits     |     |             |     |             |     | Units | TEST VOLTAGE APPLIED TO PINS BELOW                                                         |               |       |      |       |               |
|--------------------|--------------------------------|------------|-----|-------------|-----|-------------|-----|-------|--------------------------------------------------------------------------------------------|---------------|-------|------|-------|---------------|
|                    | Functional Parameters:         | + 25 °C    |     | + 85 °C     |     | - 30 °C     |     |       | Pinouts referenced are for DIL package, check Pin Assignments<br>Output Load = 50 Ω to GND |               |       |      |       |               |
|                    |                                | Subgroup 9 |     | Subgroup 10 |     | Subgroup 11 |     |       |                                                                                            |               |       |      |       |               |
|                    |                                | Min        | Max | Min         | Max | Min         | Max |       |                                                                                            |               |       |      |       |               |
| t <sub>TLH</sub>   | Rise Time                      |            | 2.7 |             | 3.1 |             | 2.9 | ns    | VIN                                                                                        | VOUT          | VCC   | VEEA | CP1-2 | P.U.T.        |
| t <sub>THL</sub>   | Fall Time                      |            | 2.6 |             | 3.0 |             | 2.8 | ns    | 14                                                                                         | 12, 13        | 1, 16 | 8    |       | 12, 13        |
| t <sub>pd</sub>    | Propagation Delay<br>C1 Limits |            | 2.7 |             | 3.1 |             | 2.9 | ns    | 14                                                                                         | 12, 13        | 1, 16 | 8    |       | 12, 13        |
| t <sub>pd</sub>    | Propagation Delay<br>C2 Limits |            | 3.0 |             | 3.4 |             | 3.2 | ns    | 2                                                                                          | 4, 5, 6, 11   | 1, 16 | 8    |       | 4, 5, 6, 11   |
| t <sub>Set</sub>   | Set Limits                     |            | 3.7 |             | 4.1 |             | 3.9 | ns    | 3, 7, 9, 10, 14                                                                            | 4 - 6, 6 - 13 | 1, 16 | 8    |       | 4 - 6, 6 - 13 |
| t <sub>Reset</sub> | Reset Limits                   |            | 4.5 |             | 4.9 |             | 3.9 | ns    | 3, 7, 9, 10, 14                                                                            | 4 - 6, 6 - 13 | 1, 16 | 8    |       | 4 - 6, 6 - 13 |
| t <sub>Tog1</sub>  | Toggle Frequency<br>+by 2      | 300        |     | 270         |     | 260         |     | MHz   |                                                                                            |               | 1, 16 | 8    | 15    |               |
| t <sub>Tog2</sub>  | Toggle Frequency<br>+bv 5      | 275        |     | 250         |     | 250         |     | MHz   |                                                                                            |               | 1, 16 | 8    | 3     |               |

\* Temperature limits are guaranteed but not tested.

## PACKAGE OUTLINE DIMENSIONS

A letter suffix to the MECL logic function part number is used to specify the package style (see drawings below). See appropriate selector guide for specific packaging available for a given device type.

**L SUFFIX  
CERAMIC PACKAGE  
CASE 620-09**



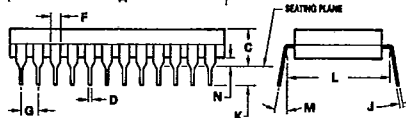
| DIM | MIN      | MAX   | MIN       | MAX   |
|-----|----------|-------|-----------|-------|
| A   | 19.05    | 19.81 | 0.750     | 0.780 |
| B   | 6.32     | 6.59  | 0.245     | 0.275 |
| C   | 4.06     | 5.08  | 0.160     | 0.200 |
| D   | 0.30     | 0.51  | 0.015     | 0.020 |
| F   | 1.40     | 1.65  | 0.055     | 0.065 |
| 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     | 4.06  | 0.125     | 0.160 |
| L   | 2.27     | 2.87  | 0.290     | 0.310 |
| M   | —        | 10°   | —         | 15°   |
| N   | 0.51     | 1.02  | 0.020     | 0.040 |

## NOTES:

- LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- PACKAGE INDEX: NOTCH IN LEAD NOTCH IN CERAMIC OR INK DOT.
- DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.

**L SUFFIX  
CERAMIC PACKAGE  
CASE 623-05**

**(LW SUFFIX  
FOR  
MC10H181  
ONLY)**

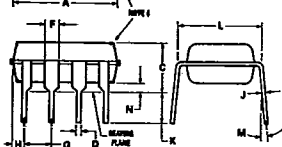
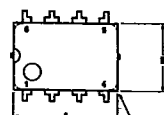


| DIM | MIN       | MAX   | MIN       | MAX   |
|-----|-----------|-------|-----------|-------|
| A   | 31.24     | 32.77 | 1.230     | 1.290 |
| B   | 12.70     | 15.49 | 0.500     | 0.610 |
| C   | 4.06      | 5.59  | 0.160     | 0.220 |
| D   | 0.41      | 0.51  | 0.016     | 0.020 |
| F   | 1.27      | 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 |

## NOTES:

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

**P SUFFIX  
PLASTIC PACKAGE  
CASE 626-04**

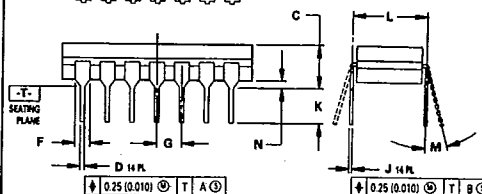
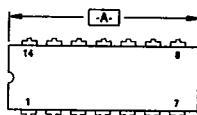


| DIM | MIN      | MAX   | MIN       | MAX   |
|-----|----------|-------|-----------|-------|
| A   | 9.40     | 10.16 | 0.370     | 0.400 |
| B   | 6.10     | 6.60  | 0.240     | 0.260 |
| C   | 3.94     | 4.45  | 0.155     | 0.175 |
| D   | 0.30     | 0.51  | 0.015     | 0.020 |
| F   | 1.02     | 1.52  | 0.040     | 0.060 |
| G   | 2.54 BSC |       | 0.100 BSC |       |
| H   | 0.76     | 1.27  | 0.030     | 0.050 |
| 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   | —        | 10°   | —         | 15°   |
| N   | 0.51     | 0.76  | 0.020     | 0.030 |

## NOTES:

- LEAD POSITIONAL TOLERANCE:  
 $\phi 0.13 (0.005) \text{ T } A \text{ B } \text{C}$
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
- DIMENSIONS A AND B ARE DATUMS.
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

**L SUFFIX  
CERAMIC PACKAGE  
CASE 632-08**



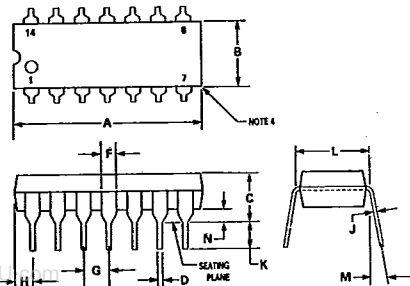
| DIM | MIN      | MAX   | MIN       | MAX   |
|-----|----------|-------|-----------|-------|
| A   | 19.05    | 19.94 | 0.750     | 0.785 |
| B   | 6.23     | 7.11  | 0.245     | 0.280 |
| C   | 3.94     | 5.08  | 0.155     | 0.200 |
| D   | 0.30     | 0.50  | 0.015     | 0.020 |
| F   | 1.40     | 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 |

## NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
- DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

## PACKAGE OUTLINE DIMENSIONS (continued)

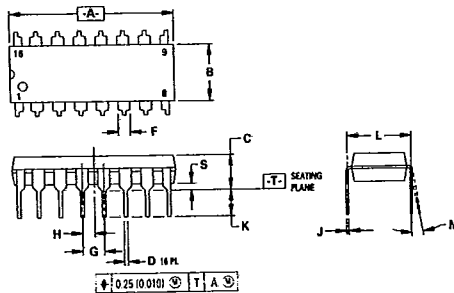
T-90-20

P SUFFIX  
PLASTIC PACKAGE  
CASE 646-06

| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | 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 |
| E   | 1.02        | 1.78  | 0.040  | 0.070 |
| F   | 2.54        | BSC   | 0.100  | BSC   |
| G   | 1.32        | 2.41  | 0.052  | 0.095 |
| H   | 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   | 0.29        | 1.01  | 0.015  | 0.039 |

## NOTES:

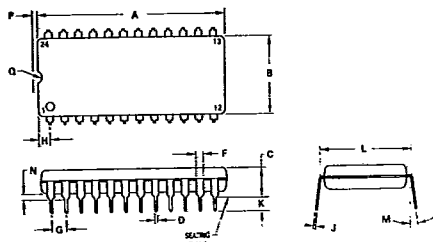
- LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

P SUFFIX  
PLASTIC PACKAGE  
CASE 648-08

| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 18.80       | 19.55 | 0.740  | 0.770 |
| B   | 6.35        | 6.85  | 0.250  | 0.270 |
| C   | 3.69        | 4.44  | 0.145  | 0.175 |
| D   | 0.39        | 0.53  | 0.015  | 0.021 |
| E   | 1.02        | 1.77  | 0.040  | 0.070 |
| F   | 2.54        | BSC   | 0.100  | BSC   |
| G   | 1.27        | BSC   | 0.050  | BSC   |
| H   | 0.21        | 0.38  | 0.008  | 0.015 |
| K   | 2.80        | 3.30  | 0.110  | 0.130 |
| L   | 7.50        | 7.74  | 0.295  | 0.305 |
| M   | 0°          | 10°   | 0°     | 10°   |
| N   | 0.51        | 1.01  | 0.020  | 0.040 |

## NOTES:

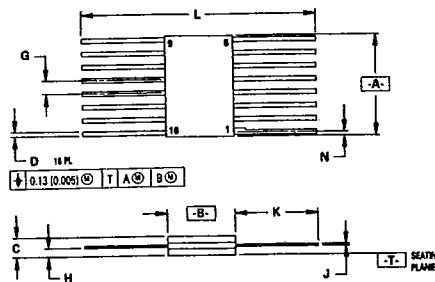
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

P SUFFIX  
PLASTIC PACKAGE  
CASE 649-03(PW SUFFIX  
FOR MC10H181  
ONLY)

| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 31.50       | 32.13 | 1.240  | 1.265 |
| B   | 13.21       | 13.72 | 0.520  | 0.540 |
| C   | 4.70        | 5.21  | 0.185  | 0.205 |
| D   | 0.38        | 0.51  | 0.015  | 0.020 |
| E   | 1.02        | 1.52  | 0.040  | 0.060 |
| F   | 2.54        | BSC   | 0.100  | BSC   |
| G   | 1.65        | 2.15  | 0.065  | 0.085 |
| H   | 0.20        | 0.30  | 0.008  | 0.012 |
| K   | 2.92        | 3.43  | 0.115  | 0.135 |
| L   | 14.99       | 15.49 | 0.590  | 0.610 |
| M   | —           | 10°   | —      | 10°   |
| N   | 0.51        | 1.02  | 0.020  | 0.040 |
| P   | 0.13        | 0.38  | 0.005  | 0.015 |
| Q   | 0.51        | 0.76  | 0.020  | 0.030 |

## NOTES:

- LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.

F SUFFIX  
CERAMIC PACKAGE  
CASE 650-05

| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 9.40        | 9.90 | 0.370  | 0.390 |
| B   | 6.73        | 6.80 | 0.265  | 0.269 |
| C   | 1.53        | 2.15 | 0.060  | 0.085 |
| D   | 0.38        | 0.48 | 0.014  | 0.019 |
| E   | 1.27        | BSC  | 0.050  | BSC   |
| F   | 0.64        | 0.01 | 0.025  | 0.040 |
| G   | 0.11        | 0.17 | 0.004  | 0.007 |
| K   | 6.35        | 9.39 | 0.250  | 0.370 |
| L   | 18.93       | —    | 0.745  | —     |
| N   | —           | 0.50 | —      | 0.020 |

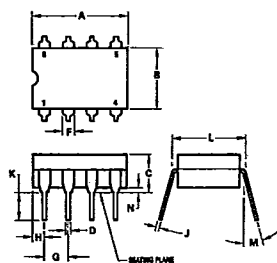
## NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- DIMENSION "A" AND "B" ALLOW FOR LID MISALIGNMENT, AND GLASS MENISCUS.
- DIMENSION "H" SHALL BE MEASURED AT THE POINT OF EXIT OF THE LEAD FROM THE BODY.
- LEAD NUMBER 1 IDENTIFIED BY TAB ON LEAD OR DOT ON COVER.
- DIMENSION "J" INCLUDES SOLDER LEAD FINISH.
- LEAD NUMBERS SHOWN FOR REFERENCE ONLY.



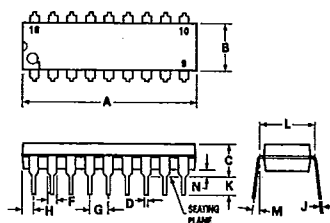
## PACKAGE OUTLINE DIMENSIONS (continued)

T-90-20

**L SUFFIX**  
**CERAMIC PACKAGE**  
**CASE 693-02**


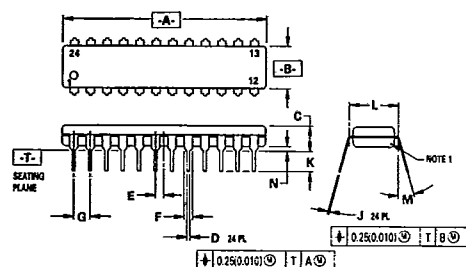
| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.91        | 10.92 | 0.390     | 0.430 |
| B   | 6.22        | 6.99  | 0.245     | 0.275 |
| C   | 4.32        | 5.08  | 0.170     | 0.200 |
| D   | 0.41        | 0.51  | 0.016     | 0.020 |
| E   | 1.40        | 1.65  | 0.055     | 0.065 |
| F   | 2.54 BSC    |       | 0.100 BSC |       |
| G   | 1.14        | 1.65  | 0.045     | 0.065 |
| H   | 0.20        | 0.30  | 0.008     | 0.012 |
| I   | 3.18        | 4.08  | 0.125     | 0.160 |
| J   | 7.37        | 7.87  | 0.290     | 0.310 |
| K   | —           | 15°   | —         | 15°   |
| L   | 0.51        | 1.02  | 0.020     | 0.040 |

- NOTES:
- LEADS WITHIN 0.13 mm (0.005) RAD OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
  - DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.

**P SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 707-02**


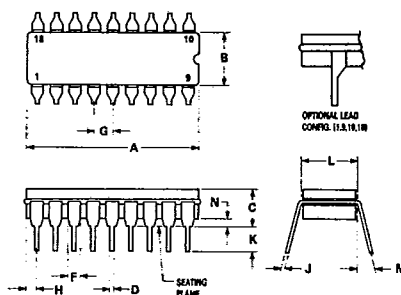
| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 22.22       | 23.24 | 0.875     | 0.915 |
| B   | 6.10        | 6.60  | 0.240     | 0.260 |
| C   | 3.56        | 4.57  | 0.140     | 0.180 |
|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

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

**P SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 724-03**


| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 31.25       | 32.13 | 1.230     | 1.265 |
| B   | 6.35        | 6.85  | 0.250     | 0.270 |
| C   | 3.68        | 4.44  | 0.145     | 0.175 |
| D   | 0.38        | 0.51  | 0.015     | 0.020 |
| E   | 1.27 BSC    |       | 0.050 BSC |       |
| F   | 1.02        | 1.52  | 0.040     | 0.060 |
| G   | 2.54 BSC    |       | 0.100 BSC |       |
| H   | 0.18        | 0.30  | 0.007     | 0.012 |
| I   | 2.80        | 3.55  | 0.110     | 0.140 |
| J   | 7.62 BSC    |       | 0.300 BSC |       |
| K   | 0°          | 15°   | 0°        | 15°   |
| L   | 0.51        | 1.01  | 0.020     | 0.040 |

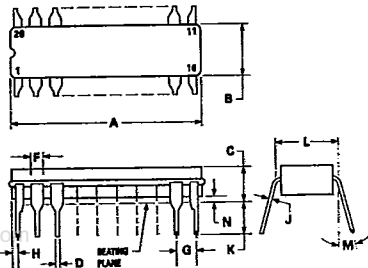
- NOTES:
- CHAMFERED CONTOUR OPTIONAL.
  - DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
  - DIMENSIONS AND TOLERANCES PER ANSI Y14.3M, 1982.
  - CONTROLLING DIMENSION: INCH.

**L SUFFIX**  
**CERAMIC PACKAGE**  
**CASE 726-04**


| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | 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 |
| E   | 1.40        | 1.78  | 0.055     | 0.070 |
| F   | 2.54 BSC    |       | 0.100 BSC |       |
| G   | 0.51        | 1.14  | 0.020     | 0.045 |
| H   | 0.20        | 0.30  | 0.008     | 0.012 |
| I   | 3.18        | 4.32  | 0.125     | 0.170 |
| J   | 7.62 BSC    |       | 0.300 BSC |       |
| K   | 0°          | 15°   | 0°        | 15°   |
| L   | 0.51        | 1.02  | 0.020     | 0.040 |

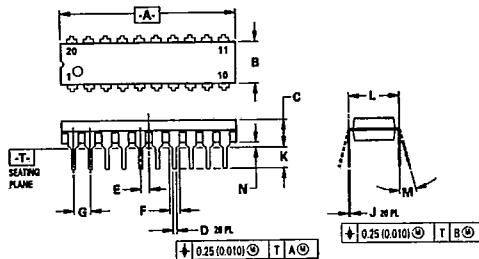
- NOTES:
- LEADS, TRUE POSITIONED WITHIN 0.25 mm (0.010) DIA. AT SEATING PLANE, AT MAXIMUM MATERIAL CONDITION.
  - DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
  - DIM "A" & "B" INCLUDES MENISCUS.
  - "F" DIMENSION IS FOR FULL LEADS. "HALF" LEADS ARE OPTIONAL AT LEAD POSITIONS 1, 9, 10, AND 18.

## PACKAGE OUTLINE DIMENSIONS (continued)

L SUFFIX  
CERAMIC PACKAGE  
CASE 732-03

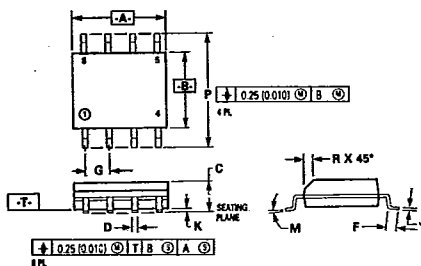
| DIM | MIN      | MAX   | MIN       | MAX   |
|-----|----------|-------|-----------|-------|
| A   | 23.88    | 25.15 | 0.940     | 0.990 |
| B   | 6.80     | 7.43  | 0.260     | 0.295 |
| C   | 3.81     | 5.08  | 0.150     | 0.200 |
| D   | 0.38     | 0.56  | 0.015     | 0.022 |
| E   | 1.40     | 1.65  | 0.055     | 0.065 |
| F   | 2.54 BSC |       | 0.100 BSC |       |
| G   | 0.51     | 1.27  | 0.020     | 0.050 |
| H   | 0.20     | 0.30  | 0.008     | 0.012 |
| J   | 3.18     | 4.06  | 0.125     | 0.160 |
| K   | 7.62 BSC |       | 0.300 BSC |       |
| L   | 0°       | 15°   | 0°        | 15°   |
| M   | 0.25     | 1.02  | 0.010     | 0.040 |

- 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.

P SUFFIX  
PLASTIC PACKAGE  
CASE 738-03

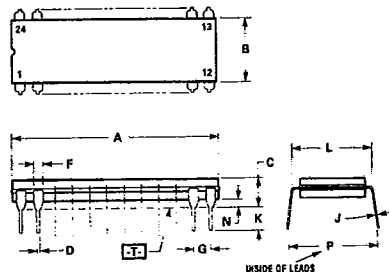
| DIM | MIN      | MAX   | MIN       | MAX   |
|-----|----------|-------|-----------|-------|
| A   | 25.55    | 27.17 | 1.010     | 1.070 |
| B   | 6.10     | 6.60  | 0.240     | 0.260 |
| C   | 3.81     | 4.57  | 0.150     | 0.180 |
| D   | 0.38     | 0.55  | 0.015     | 0.022 |
| E   | 1.27 BSC |       | 0.050 BSC |       |
| F   | 1.27     | 1.77  | 0.050     | 0.070 |
| 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 |

- 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.

D SUFFIX  
PLASTIC SOIC PACKAGE  
CASE 751-03

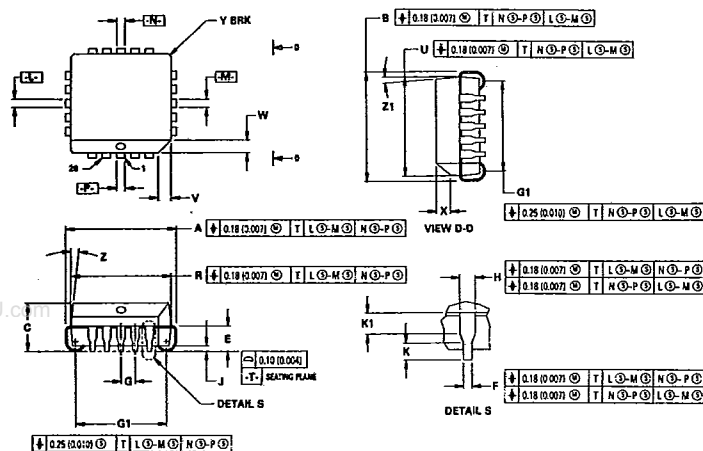
| DIM | MIN      | MAX  | MIN       | MAX   |
|-----|----------|------|-----------|-------|
| A   | 4.80     | 5.00 | 0.189     | 0.196 |
| B   | 3.80     | 4.00 | 0.150     | 0.157 |
| C   | 1.35     | 1.75 | 0.054     | 0.068 |
| D   | 0.35     | 0.49 | 0.014     | 0.019 |
| E   | 0.40     | 1.25 | 0.015     | 0.049 |
| F   | 1.27 BSC |      | 0.050 BSC |       |
| G   | 0.18     | 0.25 | 0.007     | 0.009 |
| H   | 0.10     | 0.25 | 0.004     | 0.009 |
| J   | 0°       | 7°   | 0°        | 7°    |
| K   | 5.80     | 6.20 | 0.229     | 0.244 |
| L   | 0.25     | 0.50 | 0.010     | 0.019 |

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

L SUFFIX  
CERAMIC PACKAGE  
CASE 758-01

| DIM | MIN      | MAX   | MIN       | MAX   |
|-----|----------|-------|-----------|-------|
| A   | 31.50    | 32.64 | 1.240     | 1.285 |
| B   | 7.24     | 7.75  | 0.285     | 0.305 |
| C   | 3.68     | 4.44  | 0.145     | 0.175 |
| D   | 0.38     | 0.53  | 0.015     | 0.021 |
| E   | 1.14     | 1.57  | 0.045     | 0.062 |
| F   | 2.54 BSC |       | 0.100 BSC |       |
| G   | 0.20     | 0.33  | 0.008     | 0.013 |
| H   | 2.54     | 4.19  | 0.100     | 0.165 |
| J   | 7.62     | 7.87  | 0.300     | 0.310 |
| K   | 0.51     | 1.27  | 0.020     | 0.050 |
| L   | 9.14     | 10.16 | 0.360     | 0.400 |

- NOTES:
- DIMENSION A IS DATUM.
  - POSITIONAL TOLERANCE FOR LEADS: 24 PLACES  $\pm 0.25 (0.010) \text{ TIA } \text{M}$ .
  - $\text{T}$  IS SEATING PLANE.
  - DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  - DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

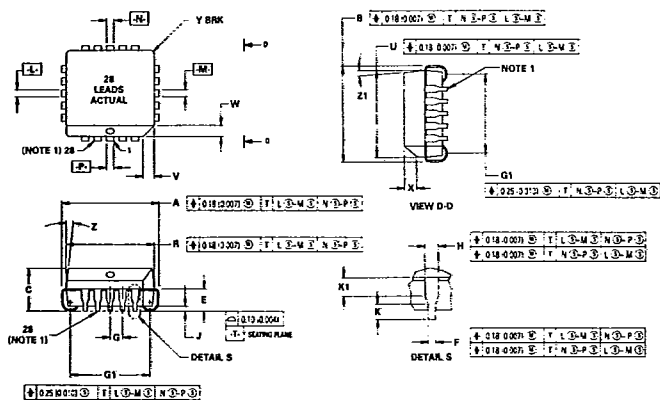


FN SUFFIX  
PLASTIC PACKAGE  
CASE 775-02

## NOTES:

1. DATUMS -L-, -M-, -N-, AND -P- DETERMINED WHERE TOP OF LEAD SHOULDER EXIT PLASTIC BODY AT MOLD PARTING LINE.
2. DIM G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
3. DIM R AND U DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION IS 0.25 (0.010) PER SIDE.
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
5. CONTROLLING DIMENSION: INCH.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.78        | 10.03 | 0.385     | 0.395 |
| B   | 9.78        | 10.03 | 0.385     | 0.395 |
| C   | 4.20        | 4.57  | 0.165     | 0.180 |
| E   | 2.29        | 2.79  | 0.090     | 0.110 |
| F   | 0.33        | 0.48  | 0.013     | 0.019 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| H   | 0.66        | 0.81  | 0.026     | 0.032 |
| J   | 0.51        | —     | 0.020     | —     |
| K   | 0.64        | —     | 0.025     | —     |
| R   | 8.89        | 9.04  | 0.350     | 0.356 |
| U   | 8.89        | 9.04  | 0.350     | 0.356 |
| V   | 1.07        | 1.21  | 0.042     | 0.048 |
| W   | 1.07        | 1.21  | 0.042     | 0.048 |
| X   | 1.07        | 1.42  | 0.042     | 0.056 |
| Y   | —           | 0.50  | —         | 0.020 |
| Z   | 2°          | 10°   | 2°        | 10°   |
| G1  | 7.88        | 8.38  | 0.310     | 0.330 |
| K1  | 1.02        | —     | 0.040     | —     |
| Z1  | 2°          | 10°   | 2°        | 10°   |



FN SUFFIX  
PLASTIC PACKAGE  
CASE 776-02

## NOTES:

1. DUE TO SPACE LIMITATION, CASE 776-02 SHALL BE REPRESENTED BY A GENERAL (SMALLER) CASE OUTLINE DRAWING RATHER THAN SHOWING ALL 28 LEADS.
2. DATUMS -L-, -M-, -N-, AND -P- DETERMINED WHERE TOP OF LEAD SHOULDER EXIT PLASTIC BODY AT MOLD PARTING LINE.
3. DIM G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
4. DIM R AND U DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION IS 0.25 (0.010) PER SIDE.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
6. CONTROLLING DIMENSION: INCH.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 12.32       | 12.57 | 0.485     | 0.495 |
| B   | 12.32       | 12.57 | 0.485     | 0.495 |
| C   | 4.20        | 4.57  | 0.165     | 0.180 |
| E   | 2.29        | 2.79  | 0.090     | 0.110 |
| F   | 0.33        | 0.48  | 0.013     | 0.019 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| H   | 0.66        | 0.81  | 0.026     | 0.032 |
| J   | 0.51        | —     | 0.020     | —     |
| K   | 0.64        | —     | 0.025     | —     |
| R   | 11.43       | 11.58 | 0.450     | 0.456 |
| U   | 11.43       | 11.58 | 0.450     | 0.456 |
| V   | 1.07        | 1.21  | 0.042     | 0.048 |
| W   | 1.07        | 1.21  | 0.042     | 0.048 |
| X   | 1.07        | 1.42  | 0.042     | 0.056 |
| Y   | —           | 0.50  | —         | 0.020 |
| Z   | 2°          | 10°   | 2°        | 10°   |
| G1  | 10.42       | 10.92 | 0.410     | 0.430 |
| K1  | 1.02        | —     | 0.040     | —     |
| Z1  | 2°          | 10°   | 2°        | 10°   |

## MECL Logic Surface Mount

### WHY SURFACE MOUNT?

Surface Mount Technology is now being utilized to offer answers to many problems that have been created in the use of insertion technology.

Limitations have been reached with insertion packages and PC board technology. Surface Mount Technology offers the opportunity to continue to advance the State-of-the-Art designs that cannot be accomplished with Insertion Technology.

Surface Mount Packages allow more optimum device performance with the smaller Surface Mount configuration. Internal lead lengths, parasitic capacitance and inductance that placed limitations on chip performance have been reduced.

The lower profile of Surface Mount Packages allows more boards to be utilized in a given amount of space. They are stacked closer together and utilize less total volume than insertion populated PC boards.

Printed circuit costs are lowered with the reduction of the number of board layers required. The elimination or reduction of the number of plated through holes in the board, contribute significantly to lower PC board prices.

Surface Mount assembly does not require the preparation of components that are common on insertion technology lines. Surface Mount components are sent directly to the assembly line, eliminating an intermediate step.

Automatic placement equipment is available that can place Surface Mount components at the rate of a few thousand per hour to hundreds of thousands of components per hour.

Surface Mount Technology is cost effective, allowing the manufacturer the opportunity to produce smaller units and offer increased functions with the same size product.

### MECL AVAILABILITY IN SURFACE MOUNT

Motorola is now offering MECL 10K and MECL 10KH in the PLCC (Plastic Leaded Chip Carrier) packages.

MECL in PLCC may be ordered in conventional plastic rails or on Tape and Reel. Refer to the Tape and Reel section for ordering details.

### TAPE AND REEL

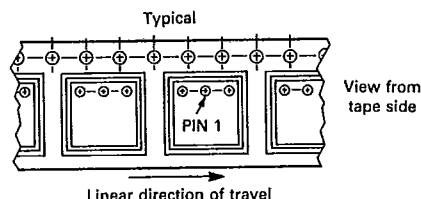
Motorola has now added the convenience of Tape and Reel packaging for our growing family of standard Integrated Circuit products. The packaging fully conforms to

the latest EIA RS-481A specification. The antistatic embossed tape provides a secure cavity sealed with a peel-back cover tape.

### GENERAL INFORMATION

- Reel Size 13 inch (330 mm) Suffix: R2
- Tape Width 16 mm
- Units/Reel 1000

### MECHANICAL POLARIZATION



### ORDERING INFORMATION

- Minimum Lot Size/Device Type = 3000 Pieces.
- No Partial Reel Counts Available.
- To order devices which are to be delivered in Tape and Reel, add the appropriate suffix to the device number being ordered.

#### EXAMPLE:

#### ORDERING CODE

MC10100FN  
MC10100FNR2  
MC10H100FN  
MC10H100FNR2  
MC12015D  
MC12015DR2

#### SHIPMENT METHOD

Magazines (Rails)  
13 inch Tape and Reel  
Magazines (Rails)  
13 inch Tape and Reel  
Magazines (Rails)  
13 inch Tape and Reel

### DUAL-IN-LINE PACKAGE TO PLCC PIN CONVERSION DATA

The following tables give the equivalent I/O pinouts of Dual-In-Line (DIL) packages and Plastic Leaded Chip Carrier (PLCC) packages.

Conversion Tables

|             |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |
|-------------|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|
| 16 PIN DIL  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 20 PIN PLCC | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 12 | 13 | 14 | 15 | 17 | 18 | 19 | 20 |

|             |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
|-------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|
| 20 PIN DIL  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 20 PIN PLCC | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |

|             |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 24 PIN DIL  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 28 PIN PLCC | 2 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 17 | 18 | 19 | 20 | 21 | 23 | 24 | 25 | 26 | 27 | 28 |