

# MC10H016

## 4-Bit Binary Counter

### Description

The MC10H016 is a high-speed synchronous, presettable, cascadable 4-bit binary counter. It is useful for a large number of conversion, counting and digital integration applications.

### Features

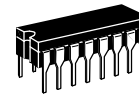
- Counting Frequency, 200 MHz Minimum
- Improved Noise Margin 150 mV (Over Operating Voltage and Temperature Range)
- Voltage Compensated
- MECL 10K™ – Compatible
- Positive Edge Triggered
- Pb-Free Packages are Available\*



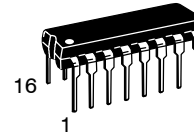
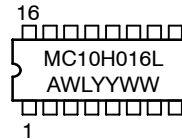
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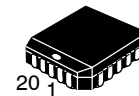
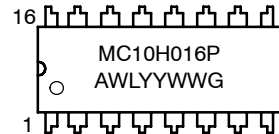
### MARKING DIAGRAMS\*



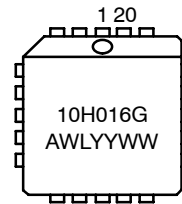
**CDIP-16  
L SUFFIX  
CASE 620**



**PDIP-16  
P SUFFIX  
CASE 648**



**PLLC-20  
FN SUFFIX  
CASE 775**



A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

(Note: Microdot may be in either location)

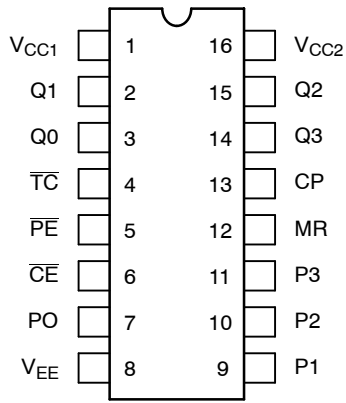
\*For additional marking information, refer to Application Note AND8002/D.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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Pin assignment is for Dual-in-Line Package

**Figure 1. Pin Assignment**

**Table 1. TRUTH TABLE**

| CE | PE | MR | CP | Function                                                      |
|----|----|----|----|---------------------------------------------------------------|
| L  | L  | L  | Z  | Load Parallel ( $P_n$ to $Q_n$ )                              |
| H  | L  | L  | Z  | Load Parallel ( $P_n$ to $Q_n$ )                              |
| L  | H  | L  | Z  | Count                                                         |
| H  | H  | L  | Z  | Hold                                                          |
| X  | X  | L  | ZZ | Masters Respond; Slaves Hold                                  |
| X  | X  | H  | X  | Reset ( $Q_n = \text{LOW}$ , $\overline{T_C} = \text{HIGH}$ ) |

Z = Clock Pulse (Low to High); ZZ = Clock Pulse (High to Low)

Features include assertion inputs and outputs on each of the four master/slave counting flip-flops. Terminal count is generated internally in a manner that allows synchronous loading at nearly the speed of the basic counter.

**Table 2. MAXIMUM RATINGS**

| Symbol    | Characteristic                 | Rating                                           | Unit |
|-----------|--------------------------------|--------------------------------------------------|------|
| $V_{EE}$  | Power Supply ( $V_{CC} = 0$ )  | -8.0 to 0                                        | Vdc  |
| $V_I$     | Input Voltage ( $V_{CC} = 0$ ) | 0 to $V_{EE}$                                    | Vdc  |
| $I_{out}$ | Output Current                 | Continuous<br>Surge<br>50<br>100                 | mA   |
| $T_A$     | Operating Temperature Range    | 0 to +75                                         | °C   |
| $T_{stg}$ | Storage Temperature Range      | Plastic<br>Ceramic<br>-55 to +150<br>-55 to +165 | °C   |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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**Table 3. ELECTRICAL CHARACTERISTICS** ( $V_{EE} = -5.2\text{ V} \pm 5\%$ ) (Note 1)

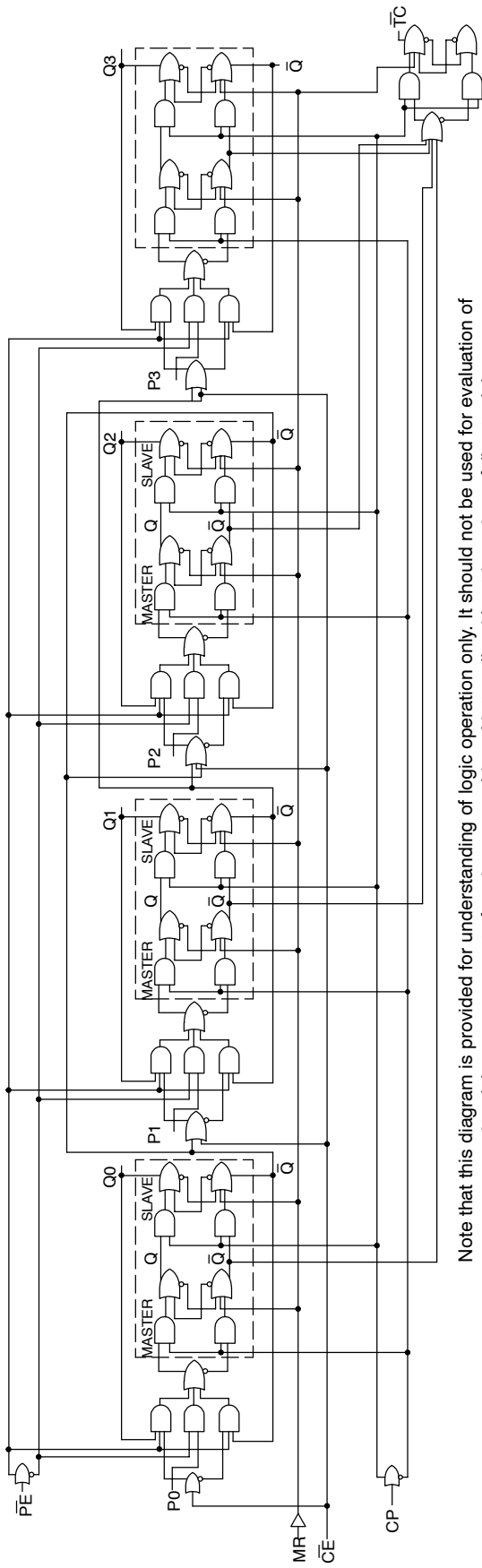
| Symbol    | Characteristic             | 0°    |       | 25°   |       | 75°   |        | Unit          |
|-----------|----------------------------|-------|-------|-------|-------|-------|--------|---------------|
|           |                            | Min   | Max   | Min   | Max   | Min   | Max    |               |
| $I_E$     | Power Supply Current       | -     | 126   | -     | 115   | -     | 126    | mA            |
| $I_{inH}$ | Input Current High         | -     | 450   | -     | 265   | -     | 265    | $\mu\text{A}$ |
|           | All Except MR<br>Pin 12 MR | -     | 1190  | -     | 700   | -     | 700    |               |
| $I_{inL}$ | Input Current Low          | 0.5   | -     | 0.5   | -     | 0.3   | -      | $\mu\text{A}$ |
| $V_{OH}$  | High Output Voltage        | -1.02 | -0.84 | -0.98 | -0.81 | -0.92 | -0.735 | Vdc           |
| $V_{OL}$  | Low Output Voltage         | -1.95 | -1.63 | -1.95 | -1.63 | -1.95 | -1.60  | Vdc           |
| $V_{IH}$  | High Input Voltage         | -1.17 | -0.84 | -1.13 | -0.81 | -1.07 | -0.735 | Vdc           |
| $V_{IL}$  | Low Input Voltage          | -1.95 | -1.48 | -1.95 | -1.48 | -1.95 | -1.45  | Vdc           |

1. Each MECL 10H™ series circuit has been designed to meet the dc specifications shown in the test table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse air flow greater than 500 lfpm is maintained. Outputs are terminated through a 50  $\Omega$  resistor to -2.0 V.

**Table 4. AC CHARACTERISTICS**

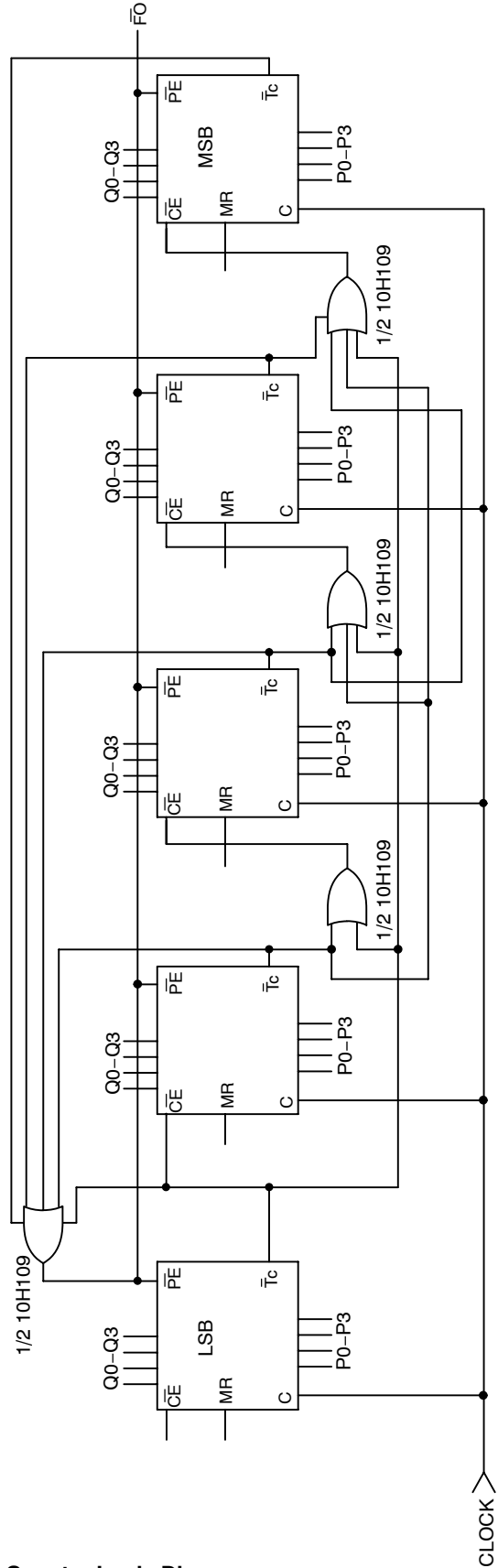
| Symbol      | Characteristic     | 0°                                          |     | 25° |     | 75° |     | Unit |    |
|-------------|--------------------|---------------------------------------------|-----|-----|-----|-----|-----|------|----|
|             |                    | Min                                         | Max | Min | Max | Min | Max |      |    |
| $t_{pd}$    | Propagation Delay  | Clock to Q                                  | 1.0 | 2.4 | 1.0 | 2.5 | 1.0 | 2.7  | ns |
|             |                    | Clock to $\overline{TC}$                    | 0.7 | 2.4 | 0.7 | 2.5 | 0.7 | 2.6  |    |
|             |                    | MR to Q                                     | 0.7 | 2.4 | 0.7 | 2.5 | 0.7 | 2.6  |    |
| $t_{set}$   | Set-up Time        | $P_n$ to Clock                              | 2.0 | -   | 2.0 | -   | 2.0 | -    | ns |
|             |                    | $\overline{CE}$ or $\overline{PE}$ to Clock | 2.5 | -   | 2.5 | -   | 2.5 | -    |    |
| $t_{hold}$  | Hold Time          | Clock to $P_n$                              | 1.0 | -   | 1.0 | -   | 1.0 | -    | ns |
|             |                    | Clock to $\overline{CE}$ or $\overline{PE}$ | 0.5 | -   | 0.5 | -   | 0.5 | -    |    |
| $f_{count}$ | Counting Frequency | 200                                         | -   | 200 | -   | 200 | -   | MHz  |    |
| $t_r$       | Rise Time          | 0.5                                         | 2.0 | 0.5 | 2.1 | 0.5 | 2.2 | ns   |    |
| $t_f$       | Fall Time          | 0.5                                         | 2.0 | 0.5 | 2.1 | 0.5 | 2.2 | ns   |    |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.



Note that this diagram is provided for understanding of logic operation only. It should not be used for evaluation of propagation delays as many gate functions are achieved internally without incurring a full gate delay.

Figure 2. 4-Bit Binary Counter Logic Diagram



PN Counter 1 to 165  
**MC10H016 Cascaded for 5 Stage Presettable Counter**  
 Max freq. is only OR gate delay below max when counting alone.

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### ORDERING INFORMATION

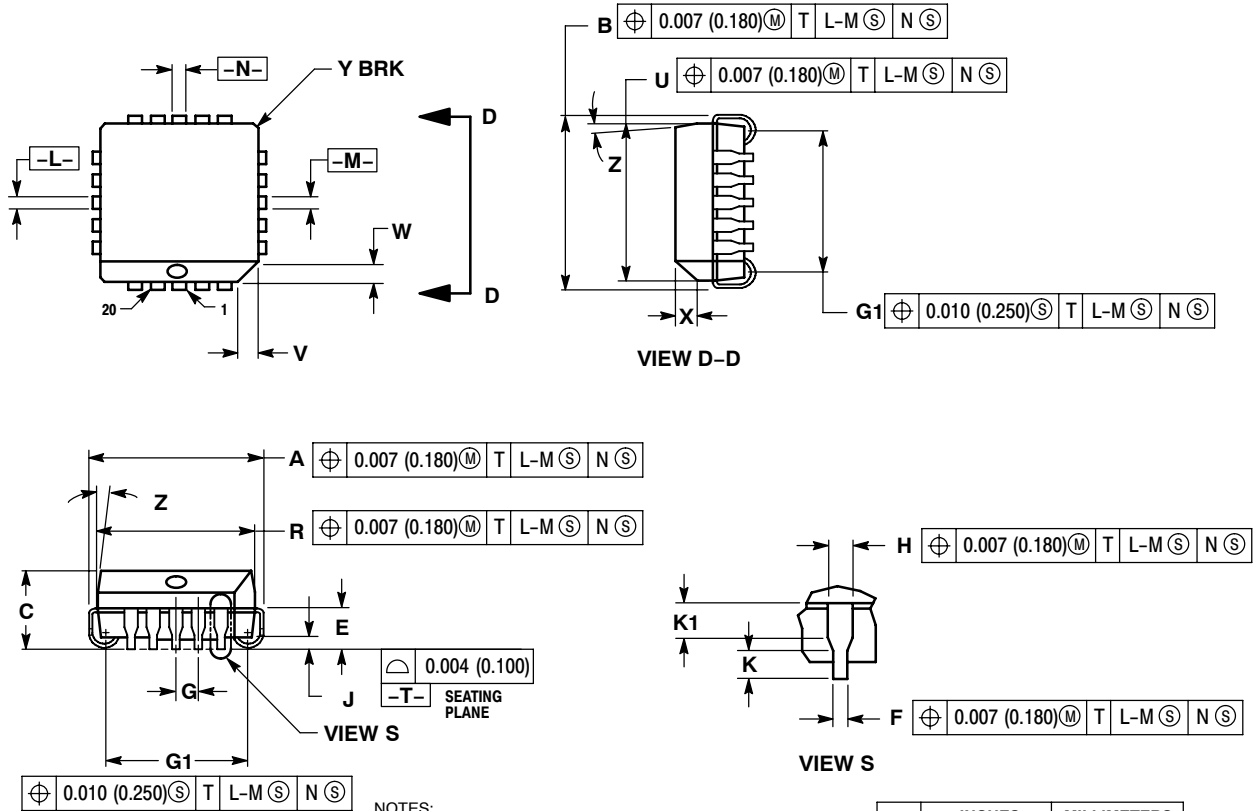
| Device        | Package              | Shipping†         |
|---------------|----------------------|-------------------|
| MC10H016FN    | PLLC-20              | 46 Unit / Rail    |
| MC10H016FNG   | PLLC-20<br>(Pb-Free) | 46 Unit / Rail    |
| MC10H016FNR2  | PLLC-20              | 500 / Tape & Reel |
| MC10H016FNR2G | PLLC-20<br>(Pb-Free) | 500 / Tape & Reel |
| MC10H016L     | CDIP-16              | 25 Unit / Rail    |
| MC10H016P     | PDIP-16              | 25 Unit / Rail    |
| MC10H016PG    | PDIP-16<br>(Pb-Free) | 25 Unit / Rail    |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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## PACKAGE DIMENSIONS

20 LEAD PLLC  
CASE 775-02  
ISSUE E



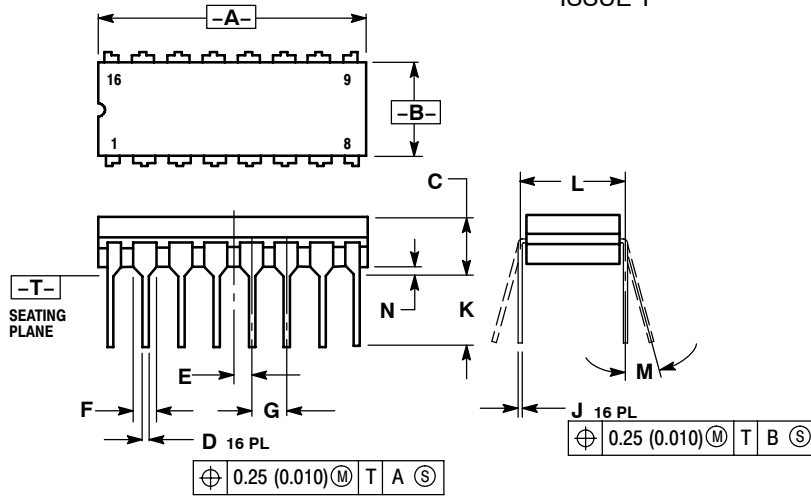
- NOTES:
1. DIMENSIONS AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. DIMENSIONS IN INCHES.
  3. DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
  4. DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
  5. DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.
  6. DIMENSIONS IN THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
  7. DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

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

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## PACKAGE DIMENSIONS

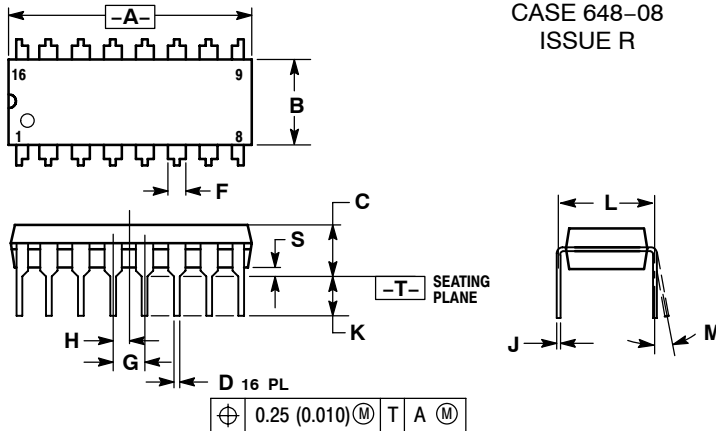
### CDIP-16 L SUFFIX CERAMIC DIP PACKAGE CASE 620-10 ISSUE T



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

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.750     | 0.785 | 19.05       | 19.93 |
| B   | 0.240     | 0.295 | 6.10        | 7.49  |
| C   | ---       | 0.200 | ---         | 5.08  |
| D   | 0.015     | 0.020 | 0.39        | 0.50  |
| E   | 0.050 BSC |       | 1.27 BSC    |       |
| F   | 0.055     | 0.065 | 1.40        | 1.65  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.125     | 0.170 | 3.18        | 4.31  |
| L   | 0.300 BSC |       | 7.62 BSC    |       |
| M   | 0°        | 15°   | 0°          | 15°   |
| N   | 0.020     | 0.040 | 0.51        | 1.01  |

### PDIP-16 P SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R



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

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.740     | 0.770 | 18.80       | 19.55 |
| B   | 0.250     | 0.270 | 6.35        | 6.85  |
| C   | 0.145     | 0.175 | 3.69        | 4.44  |
| D   | 0.015     | 0.021 | 0.39        | 0.53  |
| F   | 0.040     | 0.70  | 1.02        | 1.77  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.050 BSC |       | 1.27 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.110     | 0.130 | 2.80        | 3.30  |
| L   | 0.295     | 0.305 | 7.50        | 7.74  |
| M   | 0°        | 10°   | 0°          | 10°   |
| S   | 0.020     | 0.040 | 0.51        | 1.01  |

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