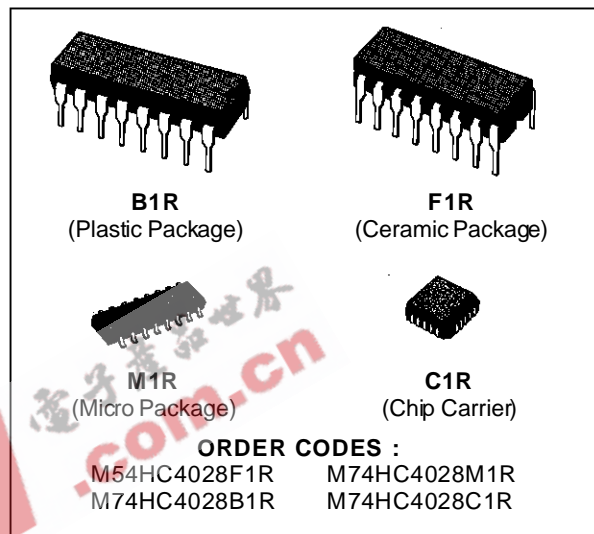


BCD TO DECIMAL DECODER

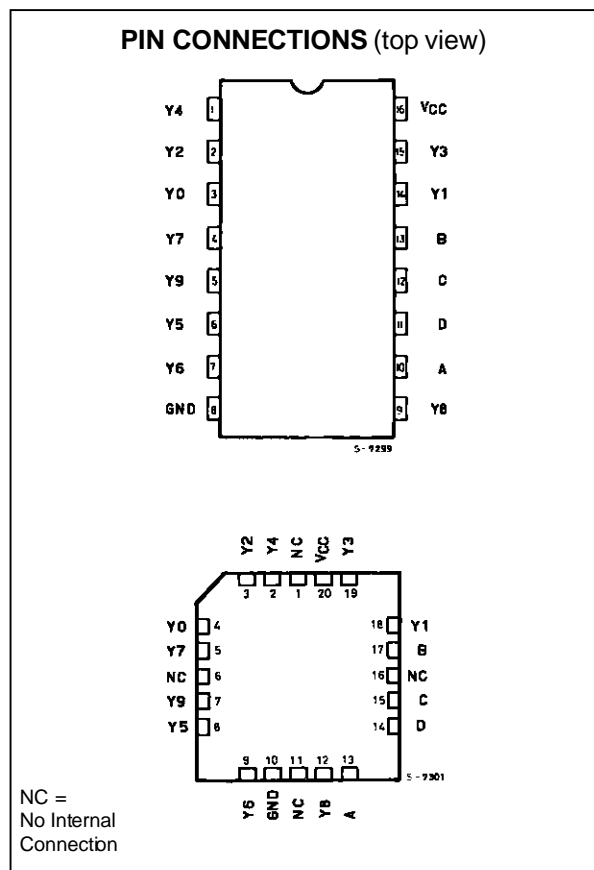
- HIGH SPEED
 $t_{PD} = 18 \text{ ns (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION
 $I_{CC} = 4 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- HIGH NOISE IMMUNITY
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- OUTPUT DRIVE CAPABILITY
 10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.)}$
- BALANCED PROPAGATION DELAYS
 $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 6 \text{ V}$
- PIN AND FUNCTION COMPATIBLE WITH 4028B



DESCRIPTION

The M54/74HC4028 is a high speed CMOS BCD-TO-DECIMAL DECODER fabricated in silicon gate C²MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. A BCD code applied to the four inputs (A to D) provides a high level at the selected one of the decimal decoded outputs. An illegal BCD code such as eleven to fifteen gives a low level at all outputs. The device also can be used as 3-TO-8-LINE DECODER, when D input is assigned as a disable input. The device is useful for code conversion, address decoding, memory selection, demultiplexing, or read out decoding.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.



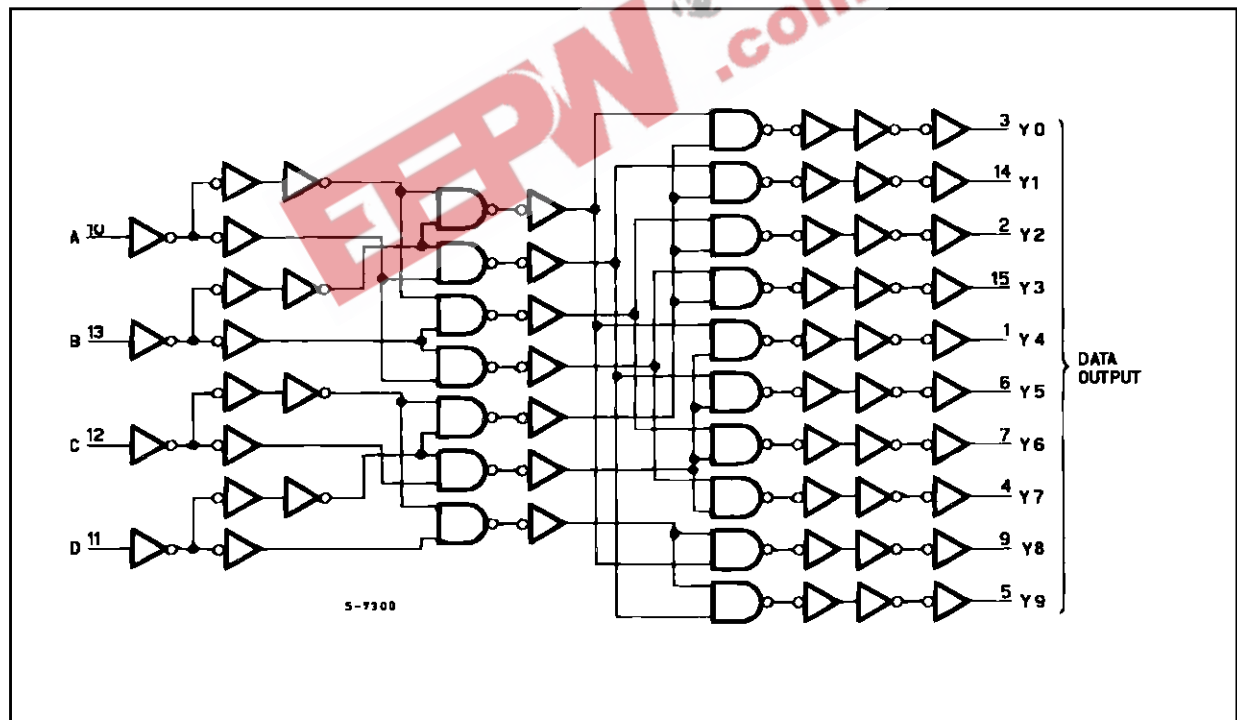
M54/M74HC4028

TRUTH TABLE

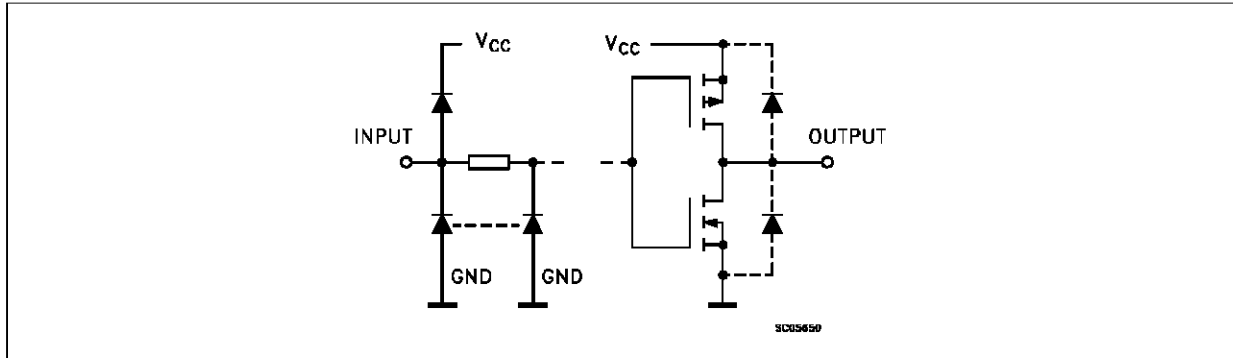
| INPUTS | | | | OUTPUTS | | | | | | | | | | SELECTED OUTPUTT |
|--------|---|---|---|---------|----|----|----|----|----|----|----|----|----|------------------|
| D | C | B | A | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y8 | Y9 | |
| L | L | L | L | H | L | L | L | L | L | L | L | L | L | Y0 |
| L | L | L | H | L | H | L | L | L | L | L | L | L | L | Y1 |
| L | L | H | L | L | L | H | L | L | L | L | L | L | L | Y2 |
| L | L | H | H | L | L | L | H | L | L | L | L | L | L | Y3 |
| L | H | L | L | L | L | L | L | H | L | L | L | L | L | Y4 |
| L | H | L | H | L | L | L | L | L | H | L | L | L | L | Y5 |
| L | H | H | L | L | L | L | L | L | L | H | L | L | L | Y6 |
| L | H | H | H | L | L | L | L | L | L | L | H | L | L | Y7 |
| H | L | L | L | L | L | L | L | L | L | L | L | H | L | Y8 |
| H | L | L | H | L | L | L | L | L | L | L | L | L | H | Y9 |
| H | X | H | X | L | L | L | L | L | L | L | L | L | L | NOTE |
| H | H | X | X | L | L | L | L | L | L | L | L | L | L | NOTE |

X: DON'T CARE

LOGIC DIAGRAM



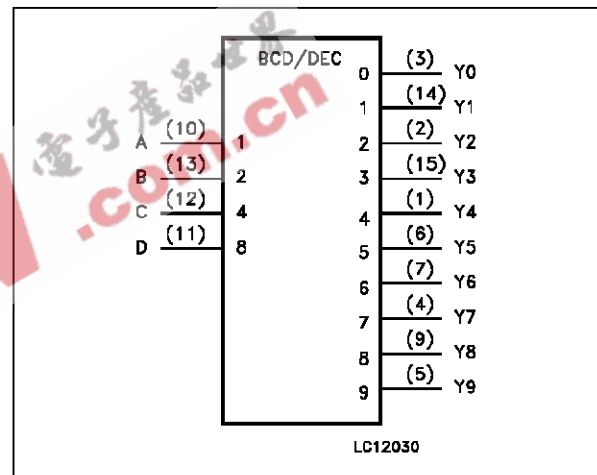
INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|--------------------------------|-----------------|-------------------------|
| 1, 2, 3, 4, 5, 6, 7, 9, 14, 15 | Y0 to Y9 | Decoder Outputs |
| 10, 11, 13, 12 | A to D | Data Inputs |
| 8 | GND | Ground (0V) |
| 16 | V _{CC} | Positive Supply Voltage |

IEC LOGIC SYMBOL



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-------------------------------------|--|-------------------------------|------|
| V _{CC} | Supply Voltage | -0.5 to +7 | V |
| V _I | DC Input Voltage | -0.5 to V _{CC} + 0.5 | V |
| V _O | DC Output Voltage | -0.5 to V _{CC} + 0.5 | V |
| I _{IK} | DC Input Diode Current | ± 20 | mA |
| I _{OK} | DC Output Diode Current | ± 20 | mA |
| I _O | DC Output Source Sink Current Per Output Pin | ± 25 | mA |
| I _{CC} or I _{GND} | DC V _{CC} or Ground Current | ± 50 | mA |
| P _D | Power Dissipation | 500 (*) | mW |
| T _{stg} | Storage Temperature | -65 to +150 | °C |
| T _L | Lead Temperature (10 sec) | 300 | °C |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.
 (*) 500 mW: ≅ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

M54/M74HC4028

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|------------|---|---------------------------|-----------|
| V_{CC} | Supply Voltage | 2 to 6 | V |
| V_I | Input Voltage | 0 to V_{CC} | V |
| V_O | Output Voltage | 0 to V_{CC} | V |
| T_{op} | Operating Temperature: M54HC Series M74HC Series | -55 to +125 -40 to +85 | °C °C |
| t_r, t_f | Input Rise and Fall Time | $V_{CC} = 2\text{ V}$ | 0 to 1000 |
| | | $V_{CC} = 4.5\text{ V}$ | 0 to 500 |
| | | $V_{CC} = 6\text{ V}$ | 0 to 400 |

DC SPECIFICATIONS

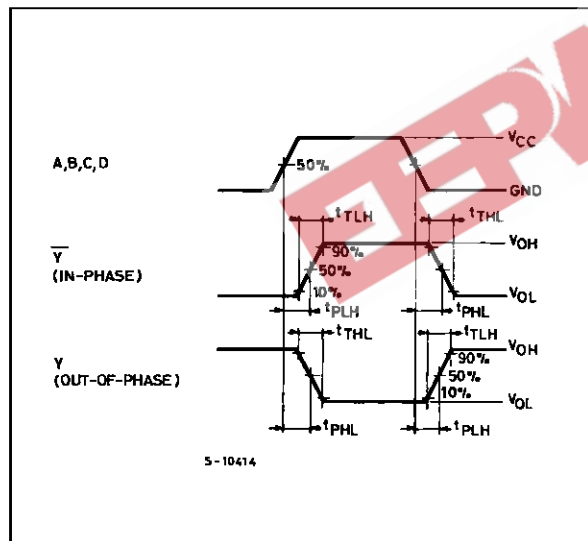
| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | |
|----------|---------------------------|-----------------|----------------------------------|---------------------------------------|------|-----------|--------------------------------------|---------|---------------------------------------|---------------|------|
| | | V_{CC} (V) | | $T_A = 25\text{ °C}$ 54HC and 74HC | | | $-40\text{ to }85\text{ °C}$ 74HC | | $-55\text{ to }125\text{ °C}$ 54HC | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| V_{IH} | High Level Input Voltage | 2.0 | | 1.5 | | | 1.5 | | 1.5 | V | |
| | | 4.5 | | 3.15 | | | 3.15 | | 3.15 | | |
| | | 6.0 | | 4.2 | | | 4.2 | | 4.2 | | |
| V_{IL} | Low Level Input Voltage | 2.0 | | | | 0.5 | | 0.5 | 0.5 | V | |
| | | 4.5 | | | | 1.35 | | 1.35 | 1.35 | | |
| | | 6.0 | | | | 1.8 | | 1.8 | 1.8 | | |
| V_{OH} | High Level Output Voltage | 2.0 | $V_I = V_{IH}$ or V_{IL} | $I_O = -20\text{ }\mu\text{A}$ | 1.9 | 2.0 | | 1.9 | | 1.9 | V |
| | | 4.5 | | | 4.4 | 4.5 | | 4.4 | | 4.4 | |
| | | 6.0 | | | 5.9 | 6.0 | | 5.9 | | 5.9 | |
| | | 4.5 | | | 4.18 | 4.31 | | 4.13 | | 4.10 | |
| | | 6.0 | | | 5.68 | 5.8 | | 5.63 | | 5.60 | |
| V_{OL} | Low Level Output Voltage | 2.0 | $V_I = V_{IH}$ or V_{IL} | $I_O = 20\text{ }\mu\text{A}$ | | 0.0 | 0.1 | | 0.1 | 0.1 | V |
| | | 4.5 | | | | 0.0 | 0.1 | | 0.1 | 0.1 | |
| | | 6.0 | | | | 0.0 | 0.1 | | 0.1 | 0.1 | |
| | | 4.5 | | | | 0.17 | 0.26 | | 0.33 | 0.40 | |
| | | 6.0 | | | | 0.18 | 0.26 | | 0.33 | 0.40 | |
| I_I | Input Leakage Current | 6.0 | $V_I = V_{CC}$ or GND | | | ± 0.1 | | ± 1 | ± 1 | μA | |
| I_{CC} | Quiescent Supply Current | 6.0 | $V_I = V_{CC}$ or GND | | | 4 | | 40 | 80 | μA | |

AC ELECTRICAL CHARACTERISTICS ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6 \text{ ns}$)

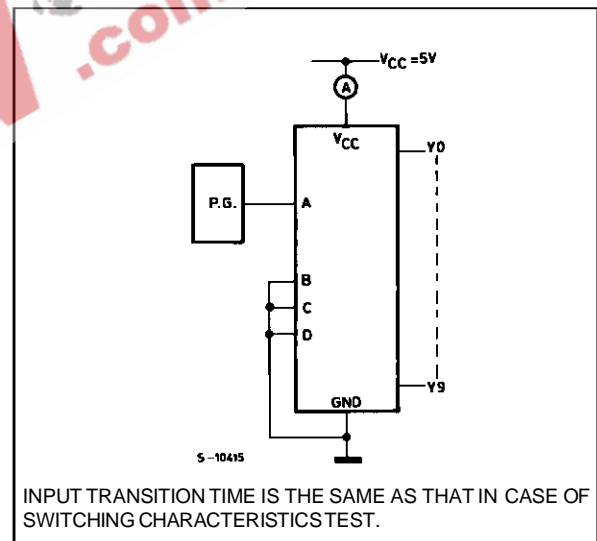
| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | |
|------------------------|-------------------------------|-----------------|--|--|------|------|---|------|--|------|------|
| | | V_{CC} (V) | | $T_A = 25 \text{ }^\circ\text{C}$ 54HC and 74HC | | | $-40 \text{ to } 85 \text{ }^\circ\text{C}$ 74HC | | $-55 \text{ to } 125 \text{ }^\circ\text{C}$ 54HC | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t_{TLH} t_{THL} | Output Transition Time | 2.0 | | | 30 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 8 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 7 | 13 | | 16 | | 19 | |
| t_{PLH} t_{PHL} | Propagation Delay Time | 2.0 | | | 96 | 185 | | 230 | | 280 | ns |
| | | 4.5 | | | 24 | 37 | | 46 | | 56 | |
| | | 6.0 | | | 20 | 31 | | 39 | | 48 | |
| C_{IN} | Input Capacitance | | | | 5 | 10 | | 10 | | 10 | pF |
| $C_{PD} (*)$ | Power Dissipation Capacitance | | | | 39 | | | | | | pF |

(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

SWITCHING CHARACTERISTICS TEST WAVEFORM



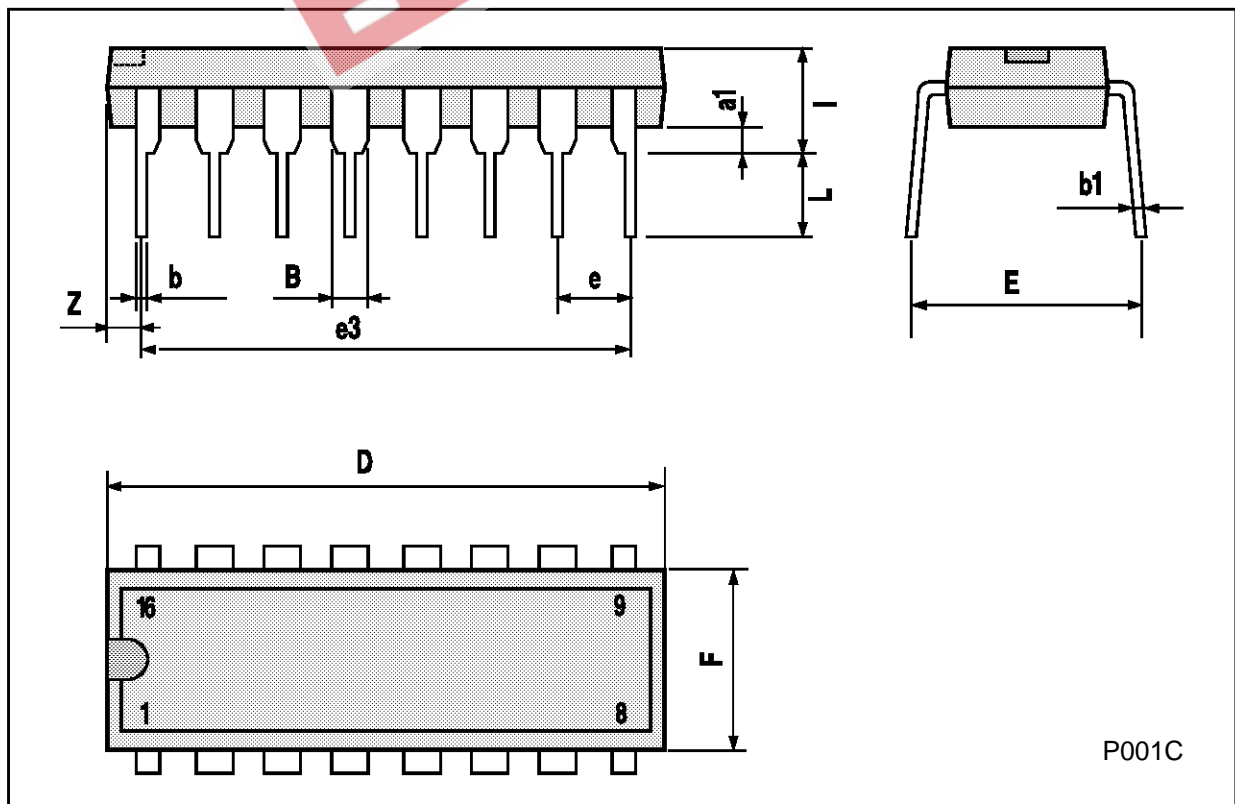
TEST CIRCUIT I_{CC} (Opr.)



M54/M74HC4028

Plastic DIP16 (0.25) MECHANICAL DATA

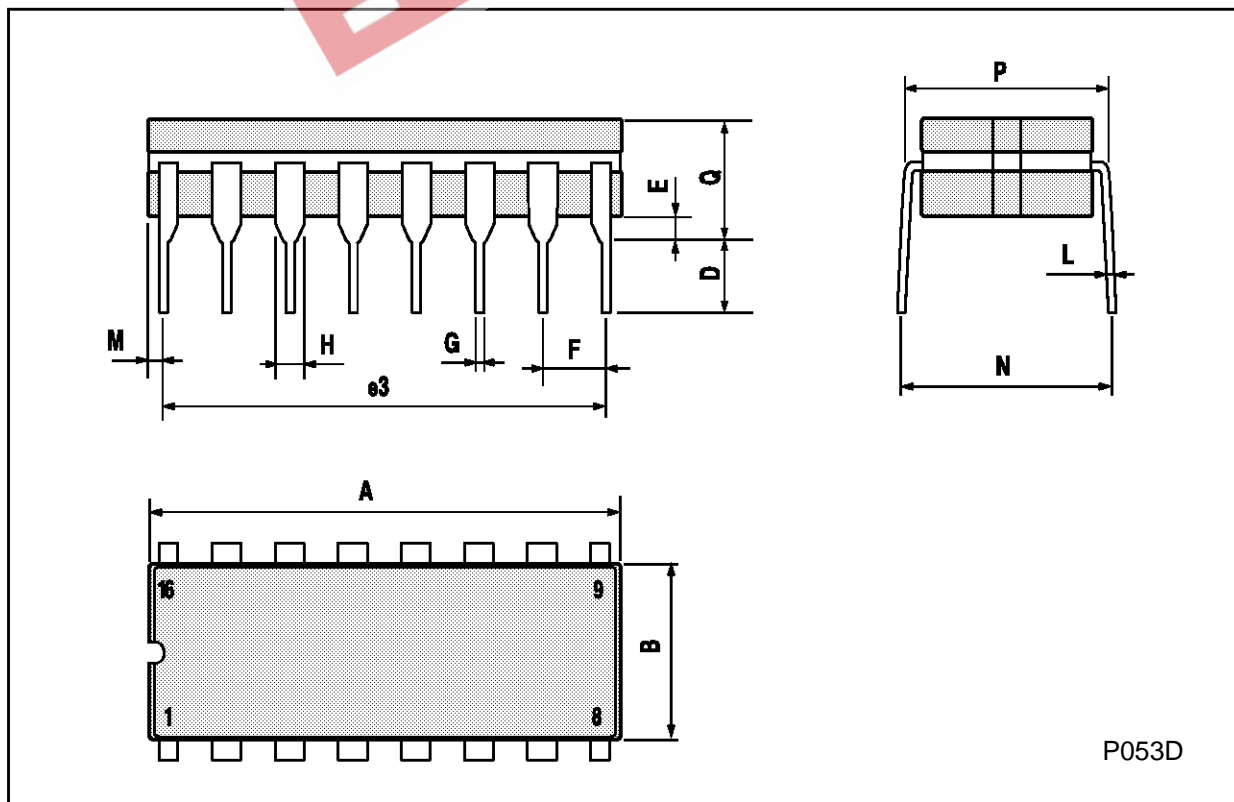
| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 17.78 | | | 0.700 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.27 | | | 0.050 |



P001C

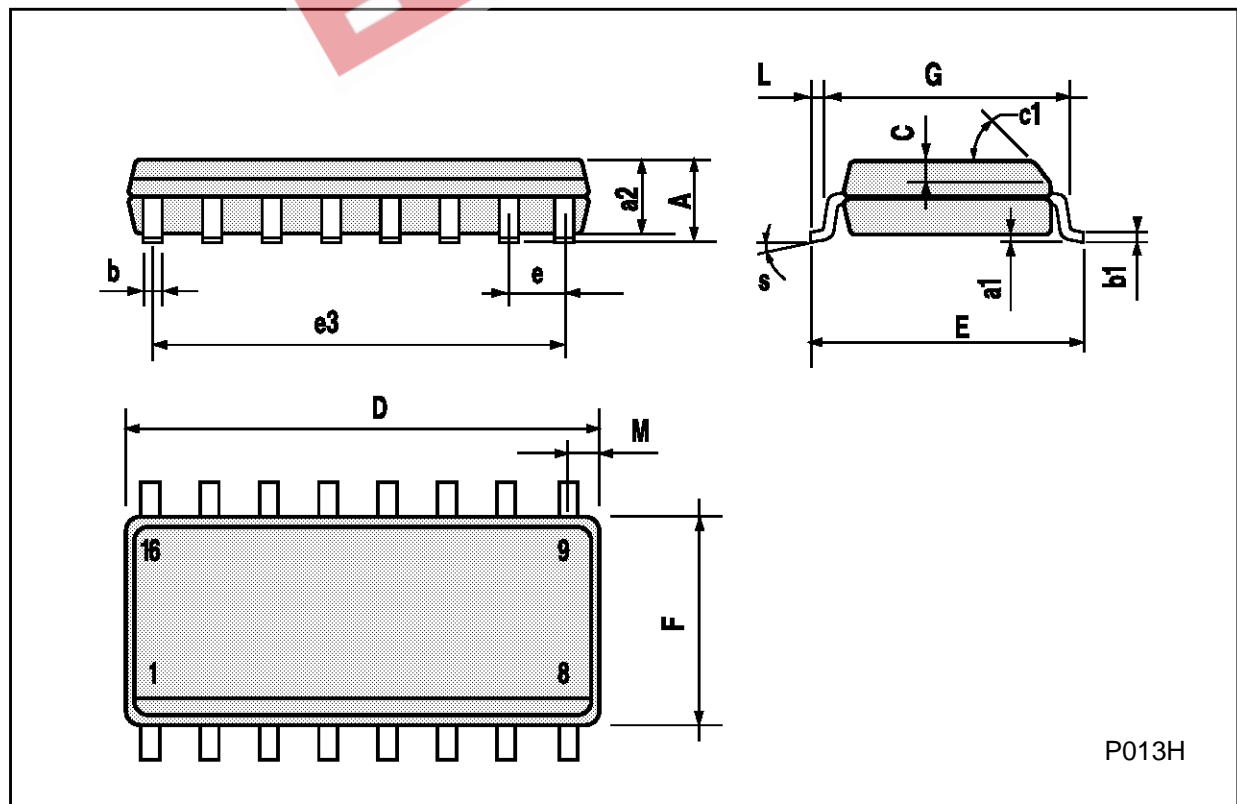
Ceramic DIP16/1 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 20 | | | 0.787 |
| B | | | 7 | | | 0.276 |
| D | | 3.3 | | | 0.130 | |
| E | 0.38 | | | 0.015 | | |
| e3 | | 17.78 | | | 0.700 | |
| F | 2.29 | | 2.79 | 0.090 | | 0.110 |
| G | 0.4 | | 0.55 | 0.016 | | 0.022 |
| H | 1.17 | | 1.52 | 0.046 | | 0.060 |
| L | 0.22 | | 0.31 | 0.009 | | 0.012 |
| M | 0.51 | | 1.27 | 0.020 | | 0.050 |
| N | | | 10.3 | | | 0.406 |
| P | 7.8 | | 8.05 | 0.307 | | 0.317 |
| Q | | | 5.08 | | | 0.200 |



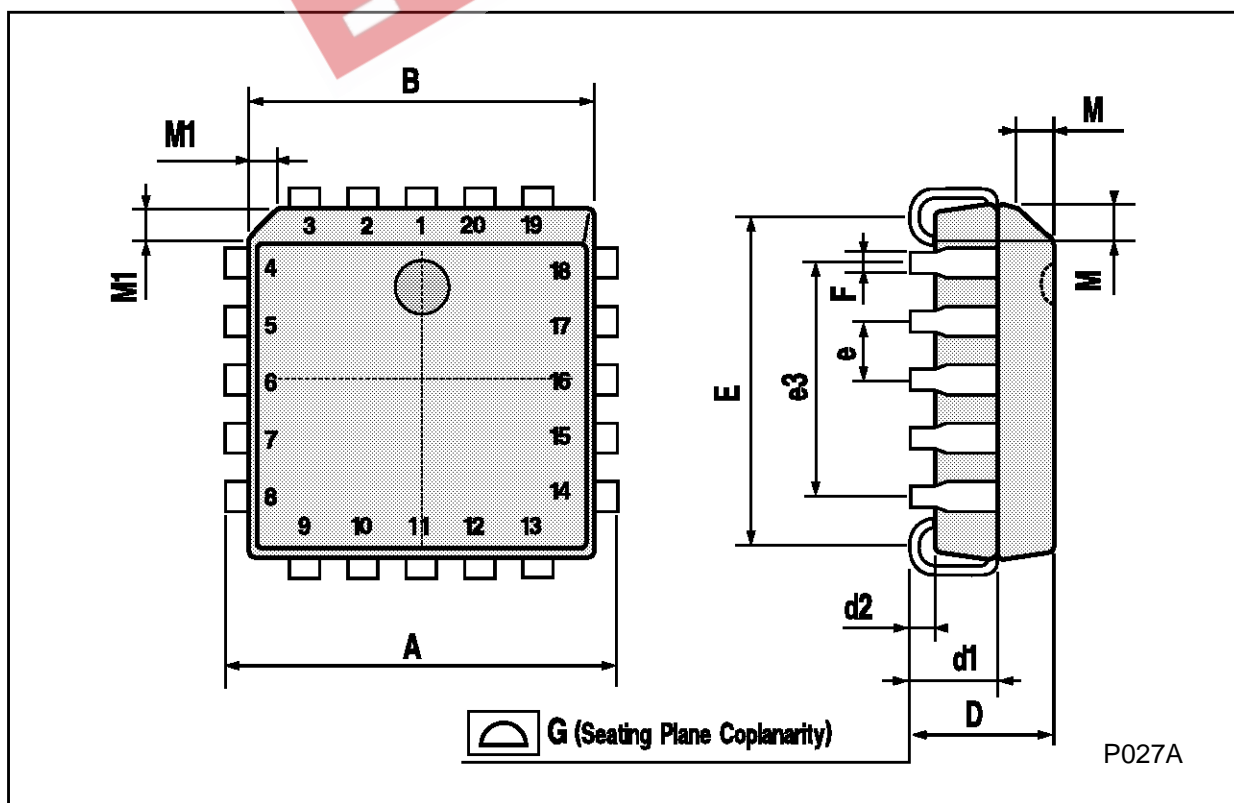
SO16 (Narrow) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | 45° (typ.) | | | | | |
| D | 9.8 | | 10 | 0.385 | | 0.393 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 8.89 | | | 0.350 | |
| F | 3.8 | | 4.0 | 0.149 | | 0.157 |
| G | 4.6 | | 5.3 | 0.181 | | 0.208 |
| L | 0.5 | | 1.27 | 0.019 | | 0.050 |
| M | | | 0.62 | | | 0.024 |
| S | 8° (max.) | | | | | |



PLCC20 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 9.78 | | 10.03 | 0.385 | | 0.395 |
| B | 8.89 | | 9.04 | 0.350 | | 0.356 |
| D | 4.2 | | 4.57 | 0.165 | | 0.180 |
| d1 | | 2.54 | | | 0.100 | |
| d2 | | 0.56 | | | 0.022 | |
| E | 7.37 | | 8.38 | 0.290 | | 0.330 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 5.08 | | | 0.200 | |
| F | | 0.38 | | | 0.015 | |
| G | | | 0.101 | | | 0.004 |
| M | | 1.27 | | | 0.050 | |
| M1 | | 1.14 | | | 0.045 | |



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