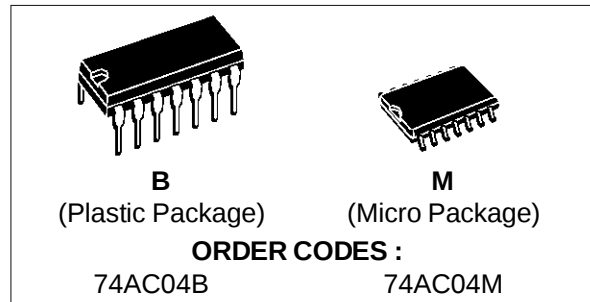


## HEX INVERTER

- HIGH SPEED:  $t_{PD} = 4 \text{ ns}$  (TYP.) at  $V_{CC} = 5V$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu A$  (MAX.) at  $T_A = 25^\circ C$
- HIGH NOISE IMMUNITY:  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- $50\Omega$  TRANSMISSION LINE DRIVING CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 24 \text{ mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}$  (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 04
- IMPROVED LATCH-UP IMMUNITY

### DESCRIPTION

The AC04 is an advanced high-speed CMOS HEX INVERTER fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS

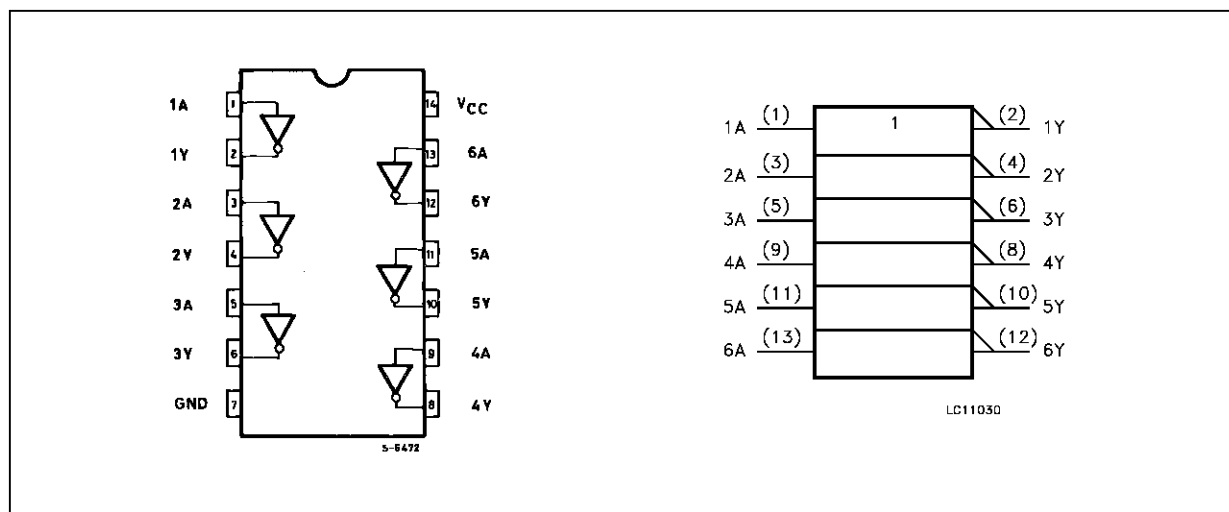


technology. It is ideal for low power applications maintaining high speed operation similar to equivalent Bipolar Schottky TTL.

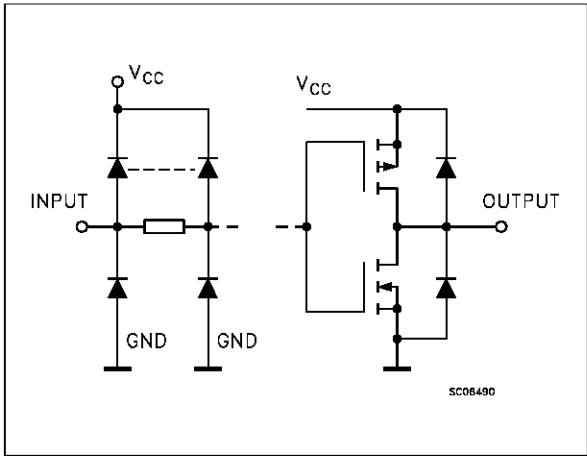
The internal circuit is composed of 3 stages including buffer output, which enables high noise immunity and stable output.

All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

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

TRUTH TABLE

| A | Y |
|---|---|
| L | H |
| H | L |

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        | $\pm 20$               | mA                 |
| $I_{OK}$              | DC Output Diode Current       | $\pm 20$               | mA                 |
| $I_O$                 | DC Output Current             | $\pm 50$               | mA                 |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | $\pm 300$              | mA                 |
| $T_{stg}$             | Storage Temperature           | -65 to +150            | $^{\circ}\text{C}$ |
| $T_L$                 | Lead Temperature (10 sec)     | 300                    | $^{\circ}\text{C}$ |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

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:                                          | -40 to +85    | $^{\circ}\text{C}$ |
| dt/dv    | Input Rise and Fall Time $V_{CC} = 3.0, 4.5$ or $5.5$ V(note 1) | 8             | ns/V               |

1)  $V_{IN}$  from 30% to 70% of  $V_{CC}$

## DC SPECIFICATIONS

| Symbol           | Parameter                             | Test Conditions        |                                                                          |                        | Value |       |              |      |    | Unit |
|------------------|---------------------------------------|------------------------|--------------------------------------------------------------------------|------------------------|-------|-------|--------------|------|----|------|
|                  |                                       | V <sub>CC</sub><br>(V) |                                                                          | T <sub>A</sub> = 25 °C |       |       | -40 to 85 °C |      |    |      |
|                  |                                       |                        |                                                                          | Min.                   | Typ.  | Max.  | Min.         | Max. |    |      |
| V <sub>IH</sub>  | High Level Input Voltage              | 3.0                    | V <sub>O</sub> = 0.1 V or<br>V <sub>CC</sub> - 0.1 V                     | 2.1                    | 1.5   |       | 2.1          |      | V  |      |
|                  |                                       | 4.5                    |                                                                          | 3.15                   | 2.25  |       | 3.15         |      |    |      |
|                  |                                       | 5.5                    |                                                                          | 3.85                   | 2.75  |       | 3.85         |      |    |      |
| V <sub>IL</sub>  | Low Level Input Voltage               | 3.0                    | V <sub>O</sub> = 0.1 V or<br>V <sub>CC</sub> - 0.1 V                     |                        | 1.5   | 0.9   |              | 0.9  | V  |      |
|                  |                                       | 4.5                    |                                                                          |                        | 2.25  | 1.35  |              | 1.35 |    |      |
|                  |                                       | 5.5                    |                                                                          |                        | 2.75  | 1.65  |              | 1.65 |    |      |
| V <sub>OH</sub>  | High Level Output Voltage             | 3.0                    | V <sub>I</sub> <sup>(*)</sup> =<br>V <sub>IH</sub> or<br>V <sub>IL</sub> | I <sub>O</sub> =-50 μA | 2.9   | 2.99  |              | 2.9  | V  |      |
|                  |                                       | 4.5                    |                                                                          | I <sub>O</sub> =-50 μA | 4.4   | 4.49  |              | 4.4  |    |      |
|                  |                                       | 5.5                    |                                                                          | I <sub>O</sub> =-50 μA | 5.4   | 5.49  |              | 5.4  |    |      |
|                  |                                       | 3.0                    |                                                                          | I <sub>O</sub> =-12 mA | 2.56  |       |              | 2.46 |    |      |
|                  |                                       | 4.5                    |                                                                          | I <sub>O</sub> =-24 mA | 3.86  |       |              | 3.76 |    |      |
|                  |                                       | 5.5                    |                                                                          | I <sub>O</sub> =-24 mA | 4.86  |       |              | 4.76 |    |      |
| V <sub>OL</sub>  | Low Level Output Voltage              | 3.0                    | V <sub>I</sub> <sup>(*)</sup> =<br>V <sub>IH</sub> or<br>V <sub>IL</sub> | I <sub>O</sub> =50 μA  |       | 0.002 | 0.1          | 0.1  | V  |      |
|                  |                                       | 4.5                    |                                                                          | I <sub>O</sub> =50 μA  |       | 0.001 | 0.1          | 0.1  |    |      |
|                  |                                       | 5.5                    |                                                                          | I <sub>O</sub> =50 μA  |       | 0.001 | 0.1          | 0.1  |    |      |
|                  |                                       | 3.0                    |                                                                          | I <sub>O</sub> =12 mA  |       | 0.36  |              | 0.44 |    |      |
|                  |                                       | 4.5                    |                                                                          | I <sub>O</sub> =24 mA  |       | 0.36  |              | 0.44 |    |      |
|                  |                                       | 5.5                    |                                                                          | I <sub>O</sub> =24 mA  |       | 0.36  |              | 0.44 |    |      |
| I <sub>I</sub>   | Input Leakage Current                 | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                  |                        |       | ±0.1  |              | ±1   | μA |      |
| I <sub>CC</sub>  | Quiescent Supply Current              | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                  |                        |       | 4     |              | 40   | μA |      |
| I <sub>OLD</sub> | Dynamic Output Current<br>(note 1, 2) | 5.5                    | V <sub>OLD</sub> = 1.65 V max                                            |                        |       |       |              | 75   | mA |      |
| I <sub>OHD</sub> |                                       |                        | V <sub>OHD</sub> = 3.85 V min                                            |                        |       |       |              | -75  | mA |      |

1) Maximum test duration 2ms, one output loaded at time

2) Incident wave switching is guaranteed on transmission lines with impedances as low as 50 Ω.

(\*) All outputs loaded.

AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω, Input t<sub>r</sub> = t<sub>f</sub> = 3 ns)

| Symbol           | Parameter              | Test Condition         |  | Value                  |      |      |              |      | Unit |
|------------------|------------------------|------------------------|--|------------------------|------|------|--------------|------|------|
|                  |                        | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25 °C |      |      | -40 to 85 °C |      |      |
|                  |                        |                        |  | Min.                   | Typ. | Max. | Min.         | Max. |      |
| t <sub>PLH</sub> | Propagation Delay Time | 3.3 <sup>(*)</sup>     |  | 1.5                    | 5.0  | 9.0  | 1.0          | 10.0 | ns   |
| t <sub>PHL</sub> |                        | 5.0 <sup>(**)</sup>    |  | 1.5                    | 4.0  | 7.0  | 1.0          | 8.0  |      |

(\*) Voltage range is 3.3V ± 0.3V

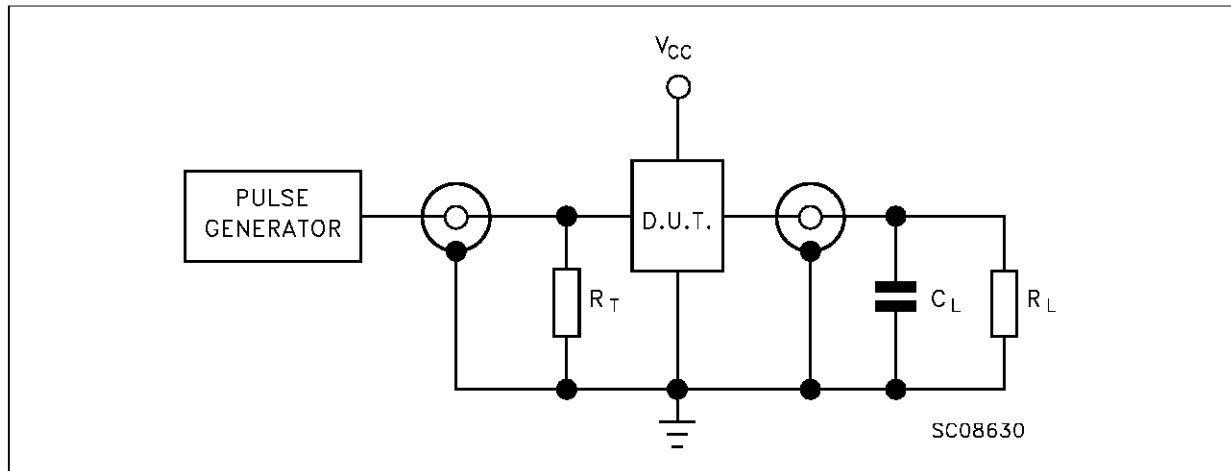
(\*\*) Voltage range is 5V ± 0.5V

## CAPACITIVE CHARACTERISTICS

| Symbol          | Parameter                              | Test Conditions        |  | Value                  |      |      |              |      | Unit |
|-----------------|----------------------------------------|------------------------|--|------------------------|------|------|--------------|------|------|
|                 |                                        | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25 °C |      |      | -40 to 85 °C |      |      |
|                 |                                        |                        |  | Min.                   | Typ. | Max. | Min.         | Max. |      |
| C <sub>IN</sub> | Input Capacitance                      | 5.0                    |  |                        | 4    |      |              |      | pF   |
| C <sub>PD</sub> | Power Dissipation Capacitance (note 1) | 5.0                    |  |                        | 33   |      |              |      | pF   |

1) C<sub>PD</sub> 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<sub>CC(opr)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>IN</sub> + I<sub>CC</sub>/n (per circuit)

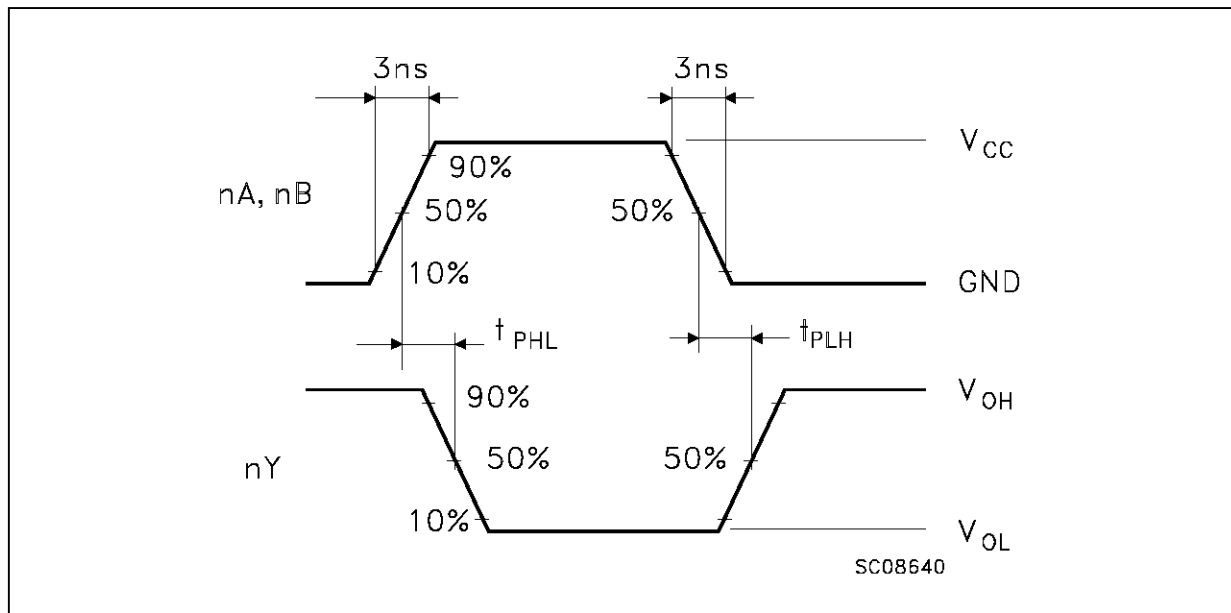
## TEST CIRCUIT



$C_L = 50 \text{ pF}$  or equivalent (includes jig and probe capacitance)

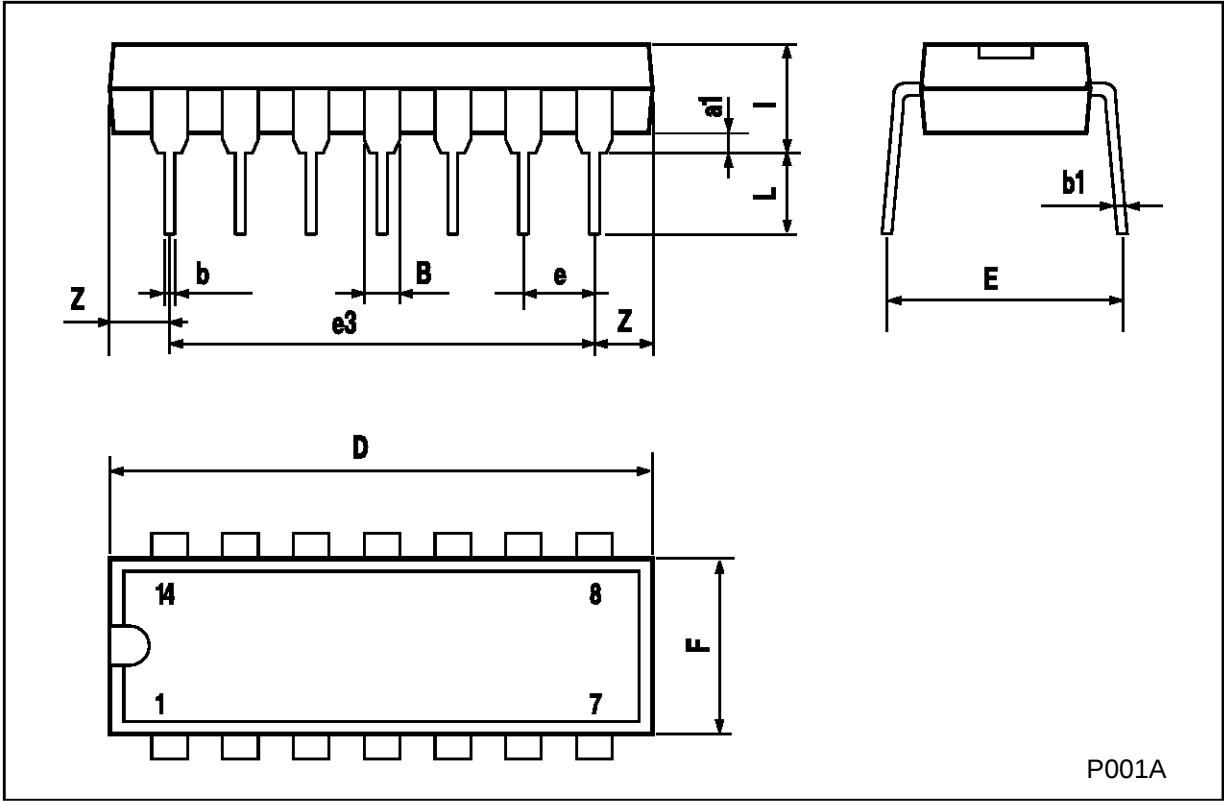
$R_L = R_1 = 500\Omega$  or equivalent

$R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

WAVEFORM: PROPAGATION DELAYS ( $f=1\text{MHz}$ ; 50% duty cycle)

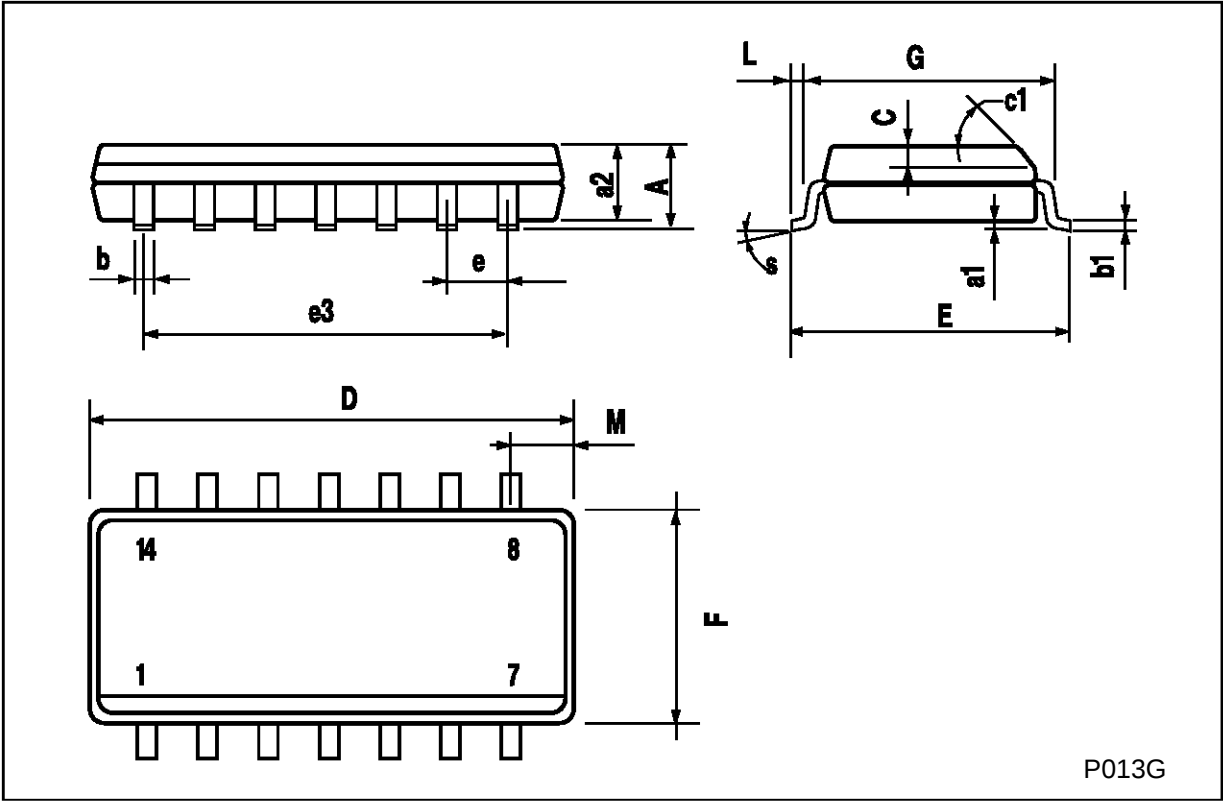
Plastic DIP14 MECHANICAL DATA

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 1.39 |       | 1.65 | 0.055 |       | 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   |      | 15.24 |      |       | 0.600 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| l    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    | 1.27 |       | 2.54 | 0.050 |       | 0.100 |



SO14 MECHANICAL DATA

| DIM. | mm        |      |      | inch  |       |       |
|------|-----------|------|------|-------|-------|-------|
|      | MIN.      | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |           |      | 1.75 |       |       | 0.068 |
| a1   | 0.1       |      | 0.2  | 0.003 |       | 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    | 8.55      |      | 8.75 | 0.336 |       | 0.344 |
| E    | 5.8       |      | 6.2  | 0.228 |       | 0.244 |
| e    |           | 1.27 |      |       | 0.050 |       |
| e3   |           | 7.62 |      |       | 0.300 |       |
| 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    |           |      | 0.68 |       |       | 0.026 |
| S    | 8 (max.)  |      |      |       |       |       |



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