

## CD4001BM/CD4001BC Quad 2-Input NOR Buffered B Series Gate

## CD4011BM/CD4011BC Quad 2-Input NAND Buffered B Series Gate

### General Description

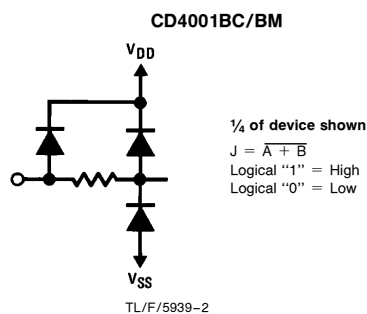
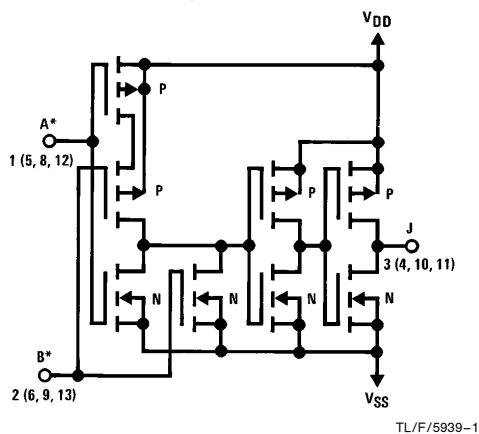
These quad gates are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. They have equal source and sink current capabilities and conform to standard B series output drive. The devices also have buffered outputs which improve transfer characteristics by providing very high gain.

All inputs are protected against static discharge with diodes to  $V_{DD}$  and  $V_{SS}$ .

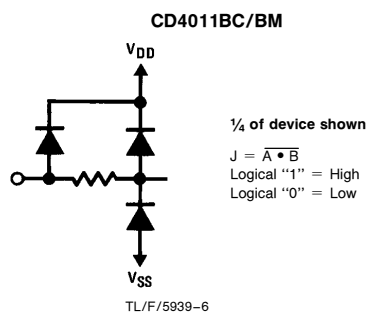
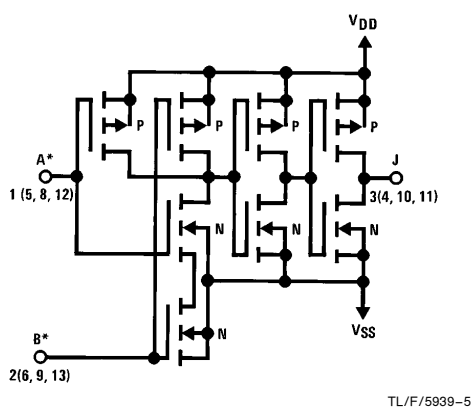
### Features

- Low power TTL compatibility
  - 5V–10V–15V parametric ratings
  - Symmetrical output characteristics
  - Maximum input leakage 1  $\mu$ A at 15V over full temperature range
- Fan out of 2 driving 74L  
or 1 driving 74LS

### Schematic Diagrams



\*All inputs protected by standard CMOS protection circuit.



\*All inputs protected by standard CMOS protection circuit.

## Absolute Maximum Ratings (Notes 1 and 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                               |                               |
|-------------------------------|-------------------------------|
| Voltage at any Pin            | -0.5V to $V_{DD} + 0.5V$      |
| Power Dissipation ( $P_D$ )   |                               |
| Dual-In-Line                  | 700 mW                        |
| Small Outline                 | 500 mW                        |
| $V_{DD}$ Range                | -0.5 $V_{DC}$ to +18 $V_{DC}$ |
| Storage Temperature ( $T_S$ ) | -65°C to +150°C               |
| Lead Temperature ( $T_L$ )    |                               |
| (Soldering, 10 seconds)       | 260°C                         |

## Operating Conditions

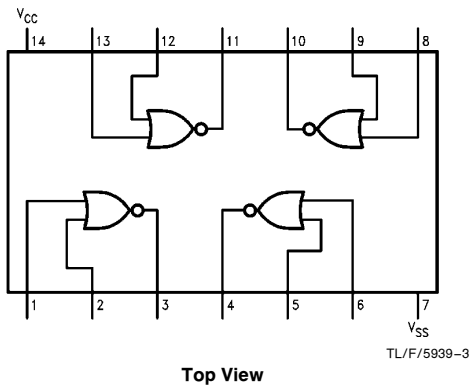
|                              |                           |
|------------------------------|---------------------------|
| Operating Range ( $V_{DD}$ ) | 3 $V_{DC}$ to 15 $V_{DC}$ |
| Operating Temperature Range  |                           |
| CD4001BM, CD4011BM           | -55°C to +125°C           |
| CD4001BC, CD4011BC           | -40°C to +85°C            |

## DC Electrical Characteristics CD4001BM, CD4011BM (Note 2)

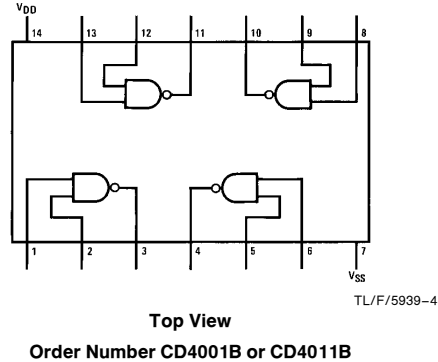
| Symbol   | Parameter                          | Conditions                                  | -55°C |       | +25°C |            |       | +125°C |      | Units   |
|----------|------------------------------------|---|-------|-------|-------|------------|-------|--------|------|---------|
|          |                                    |   | Min   | Max   | Min   | Typ        | Max   | Min    | Max  |         |
| $I_{DD}$ | Quiescent Device Current           | $V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$  |       | 0.25  |       | 0.004      | 0.25  |        | 7.5  | $\mu A$ |
|          |                                    | $V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 0.50  |       | 0.005      | 0.50  |        | 15   | $\mu A$ |
|          |                                    | $V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 1.0   |       | 0.006      | 1.0   |        | 30   | $\mu A$ |
| $V_{OL}$ | Low Level Output Voltage           | $V_{DD} = 5V$                               |       | 0.05  |       | 0          | 0.05  |        | 0.05 | V       |
|          |                                    | $V_{DD} = 10V$                              |       | 0.05  |       | 0          | 0.05  |        | 0.05 | V       |
|          |                                    | $V_{DD} = 15V$                              |       | 0.05  |       | 0          | 0.05  |        | 0.05 | V       |
| $V_{OH}$ | High Level Output Voltage          | $V_{DD} = 5V$                               | 4.95  |       | 4.95  | 5          |       | 4.95   |      | V       |
|          |                                    | $V_{DD} = 10V$                              | 9.95  |       | 9.95  | 10         |       | 9.95   |      | V       |
|          |                                    | $V_{DD} = 15V$                              | 14.95 |       | 14.95 | 15         |       | 14.95  |      | V       |
| $V_{IL}$ | Low Level Input Voltage            | $V_{DD} = 5V, V_O = 4.5V$                   |       | 1.5   |       | 2          | 1.5   |        | 1.5  | V       |
|          |                                    | $V_{DD} = 10V, V_O = 9.0V$                  |       | 3.0   |       | 4          | 3.0   |        | 3.0  | V       |
|          |                                    | $V_{DD} = 15V, V_O = 13.5V$                 |       | 4.0   |       | 6          | 4.0   |        | 4.0  | V       |
| $V_{IH}$ | High Level Input Voltage           | $V_{DD} = 5V, V_O = 0.5V$                   | 3.5   |       | 3.5   | 3          |       | 3.5    |      | V       |
|          |                                    | $V_{DD} = 10V, V_O = 1.0V$                  | 7.0   |       | 7.0   | 6          |       | 7.0    |      | V       |
|          |                                    | $V_{DD} = 15V, V_O = 1.5V$                  | 11.0  |       | 11.0  | 9          |       | 11.0   |      | V       |
| $I_{OL}$ | Low Level Output Current (Note 3)  | $V_{DD} = 5V, V_O = 0.4V$                   | 0.64  |       | 0.51  | 0.88       |       | 0.36   |      | mA      |
|          |                                    | $V_{DD} = 10V, V_O = 0.5V$                  | 1.6   |       | 1.3   | 2.25       |       | 0.9    |      | mA      |
|          |                                    | $V_{DD} = 15V, V_O = 1.5V$                  | 4.2   |       | 3.4   | 8.8        |       | 2.4    |      | mA      |
| $I_{OH}$ | High Level Output Current (Note 3) | $V_{DD} = 5V, V_O = 4.6V$                   | -0.64 |       | -0.51 | -0.88      |       | -0.36  |      | mA      |
|          |                                    | $V_{DD} = 10V, V_O = 9.5V$                  | -1.6  |       | -1.3  | -2.25      |       | -0.9   |      | mA      |
|          |                                    | $V_{DD} = 15V, V_O = 13.5V$                 | -4.2  |       | -3.4  | -8.8       |       | -2.4   |      | mA      |
| $I_{IN}$ | Input Current                      | $V_{DD} = 15V, V_{IN} = 0V$                 |       | -0.10 |       | $-10^{-5}$ | -0.10 |        | -1.0 | $\mu A$ |
|          |                                    | $V_{DD} = 15V, V_{IN} = 15V$                |       | 0.10  |       | $10^{-5}$  | 0.10  |        | 1.0  | $\mu A$ |

## Connection Diagrams

CD4001BC/CD4001BM  
Dual-In-Line Package



CD4011BC/CD4011BM  
Dual-In-Line Package



## DC Electrical Characteristics CD4001BC, CD4011BC (Note 2)

| Symbol          | Parameter                          | Conditions  | -40°C |       | +25°C |                   |       | +85°C |      | Units |
|-----------------|------------------------------------|---|-------|-------|-------|-------------------|-------|-------|------|-------|
|                 |                                    |   | Min   | Max   | Min   | Typ               | Max   | Min   | Max  |       |
| I <sub>DD</sub> | Quiescent Device Current           | V <sub>DD</sub> = 5V, V <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub>  |       | 1     |       | 0.004             | 1     |       | 7.5  | μA    |
|                 |                                    | V <sub>DD</sub> = 10V, V <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub> |       | 2     |       | 0.005             | 2     |       | 15   | μA    |
|                 |                                    | V <sub>DD</sub> = 15V, V <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub> |       | 4     |       | 0.006             | 4     |       | 30   | μA    |
| V <sub>OL</sub> | Low Level Output Voltage           | V <sub>DD</sub> = 5V }  I <sub>O</sub>   < 1 μA                             |       | 0.05  |       | 0                 | 0.05  |       | 0.05 | V     |
|                 |                                    | V <sub>DD</sub> = 10V }   |       | 0.05  |       | 0                 | 0.05  |       | 0.05 | V     |
|                 |                                    | V <sub>DD</sub> = 15V }   |       | 0.05  |       | 0                 | 0.05  |       | 0.05 | V     |
| V <sub>OH</sub> | High Level Output Voltage          | V <sub>DD</sub> = 5V }  I <sub>O</sub>   < 1 μA                             | 4.95  |       | 4.95  | 5                 |       | 4.95  |      | V     |
|                 |                                    | V <sub>DD</sub> = 10V }   | 9.95  |       | 9.95  | 10                |       | 9.95  |      | V     |
|                 |                                    | V <sub>DD</sub> = 15V }   | 14.95 |       | 14.95 | 15                |       | 14.95 |      | V     |
| V <sub>IL</sub> | Low Level Input Voltage            | V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.5V                                 |       | 1.5   |       | 2                 | 1.5   |       | 1.5  | V     |
|                 |                                    | V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.0V                                |       | 3.0   |       | 4                 | 3.0   |       | 3.0  | V     |
|                 |                                    | V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V                               |       | 4.0   |       | 6                 | 4.0   |       | 4.0  | V     |
| V <sub>IH</sub> | High Level Input Voltage           | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V                                 | 3.5   |       | 3.5   | 3                 |       | 3.5   |      | V     |
|                 |                                    | V <sub>DD</sub> = 10V, V <sub>O</sub> = 1.0V                                | 7.0   |       | 7.0   | 6                 |       | 7.0   |      | V     |
|                 |                                    | V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V                                | 11.0  |       | 11.0  | 9                 |       | 11.0  |      | V     |
| I <sub>OL</sub> | Low Level Output Current (Note 3)  | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V                                 | 0.52  |       | 0.44  | 0.88              |       | 0.36  |      | mA    |
|                 |                                    | V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V                                | 1.3   |       | 1.1   | 2.25              |       | 0.9   |      | mA    |
|                 |                                    | V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V                                | 3.6   |       | 3.0   | 8.8               |       | 2.4   |      | mA    |
| I <sub>OH</sub> | High Level Output Current (Note 3) | V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V                                 | -0.52 |       | -0.44 | -0.88             |       | -0.36 |      | mA    |
|                 |                                    | V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V                                | -1.3  |       | -1.1  | -2.25             |       | -0.9  |      | mA    |
|                 |                                    | V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V                               | -3.6  |       | -3.0  | -8.8              |       | -2.4  |      | mA    |
| I <sub>IN</sub> | Input Current                      | V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V                                 |       | -0.30 |       | -10 <sup>-5</sup> | -0.30 |       | -1.0 | μA    |
|                 |                                    | V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V                                |       | 0.30  |       | 10 <sup>-5</sup>  | 0.30  |       | 1.0  | μA    |

## AC Electrical Characteristics\* CD4001BC, CD4001BM

T<sub>A</sub> = 25°C, Input t<sub>r</sub>, t<sub>f</sub> = 20 ns, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200k. Typical temperature coefficient is 0.3%/°C.

| Symbol                              | Parameter                                 | Conditions            | Typ | Max | Units |
|-------------------------------------|---|-----------------------|-----|-----|-------|
| t <sub>PHL</sub>                    | Propagation Delay Time, High-to-Low Level | V <sub>DD</sub> = 5V  | 120 | 250 | ns    |
|                                     |   | V <sub>DD</sub> = 10V | 50  | 100 | ns    |
|                                     |   | V <sub>DD</sub> = 15V | 35  | 70  | ns    |
| t <sub>PLH</sub>                    | Propagation Delay Time, Low-to-High Level | V <sub>DD</sub> = 5V  | 110 | 250 | ns    |
|                                     |   | V <sub>DD</sub> = 10V | 50  | 100 | ns    |
|                                     |   | V <sub>DD</sub> = 15V | 35  | 70  | ns    |
| t <sub>THL</sub> , t <sub>TLH</sub> | Transition Time                           | V <sub>DD</sub> = 5V  | 90  | 200 | ns    |
|                                     |   | V <sub>DD</sub> = 10V | 50  | 100 | ns    |
|                                     |   | V <sub>DD</sub> = 15V | 40  | 80  | ns    |
| C <sub>IN</sub>                     | Average Input Capacitance                 | Any Input             | 5   | 7.5 | pF    |
| C <sub>PD</sub>                     | Power Dissipation Capacity                | Any Gate              | 14  |     | pF    |

\*AC Parameters are guaranteed by DC correlated testing.

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** All voltages measured with respect to V<sub>SS</sub> unless otherwise specified.

**Note 3:** I<sub>OL</sub> and I<sub>OH</sub> are tested one output at a time.

## AC Electrical Characteristics\* CD4011BC, CD4011BM

$T_A = 25^\circ\text{C}$ , Input  $t_r$ ;  $t_f = 20$  ns.  $C_L = 50$  pF,  $R_L = 200\text{k}$ . Typical Temperature Coefficient is  $0.3\%/^\circ\text{C}$ .

| Symbol             | Parameter                               | Conditions            | Typ | Max | Units |
|--------------------|---|-----------------------|-----|-----|-------|
| $t_{PHL}$          | Propagation Delay,<br>High-to-Low Level | $V_{DD} = 5\text{V}$  | 120 | 250 | ns    |
|                    |   | $V_{DD} = 10\text{V}$ | 50  | 100 | ns    |
|                    |   | $V_{DD} = 15\text{V}$ | 35  | 70  | ns    |
| $t_{PLH}$          | Propagation Delay,<br>Low-to-High Level | $V_{DD} = 5\text{V}$  | 85  | 250 | ns    |
|                    |   | $V_{DD} = 10\text{V}$ | 40  | 100 | ns    |
|                    |   | $V_{DD} = 15\text{V}$ | 30  | 70  | ns    |
| $t_{THL}, t_{TLH}$ | Transition Time                         | $V_{DD} = 5\text{V}$  | 90  | 200 | ns    |
|                    |   | $V_{DD} = 10\text{V}$ | 50  | 100 | ns    |
|                    |   | $V_{DD} = 15\text{V}$ | 40  | 80  | ns    |
| $C_{IN}$           | Average Input Capacitance               | Any Input             | 5   | 7.5 | pF    |
| $C_{PD}$           | Power Dissipation Capacity              | Any Gate              | 14  |     | pF    |

\*AC Parameters are guaranteed by DC correlated testing.

## Typical Performance Characteristics

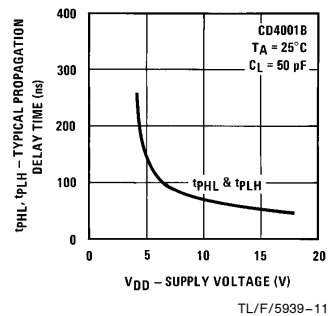
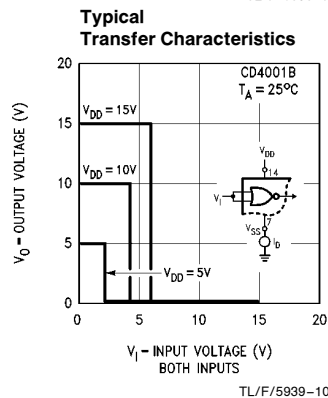
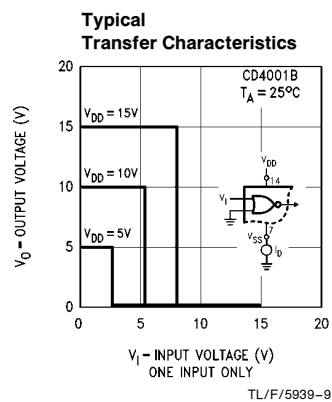
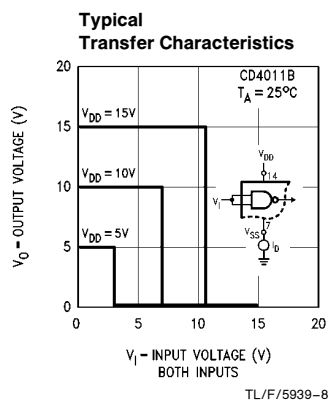
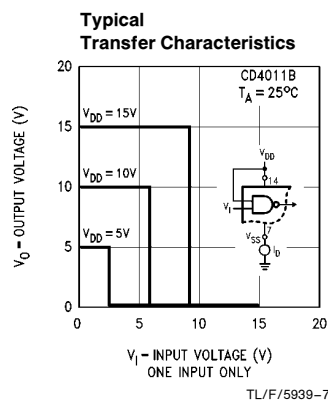


FIGURE 5

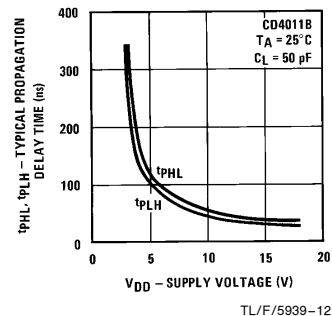


FIGURE 6

## Typical Performance Characteristics (Continued)

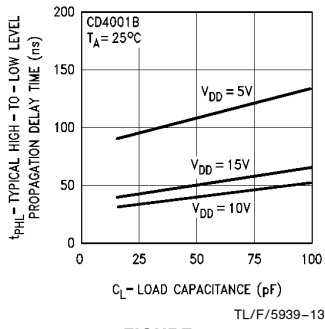


FIGURE 7

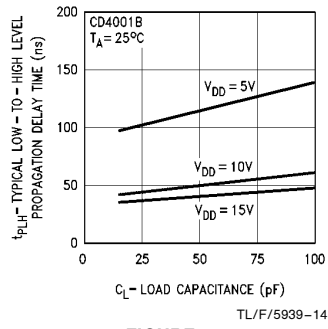


FIGURE 8

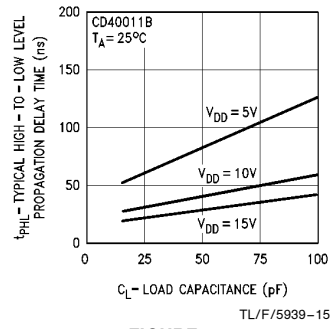


FIGURE 9

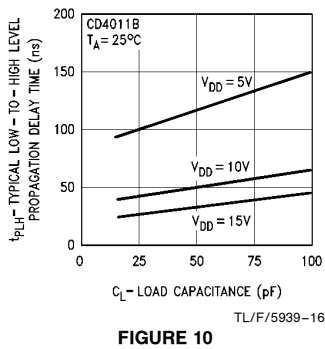


FIGURE 10

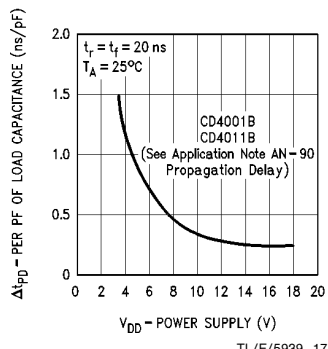


FIGURE 11

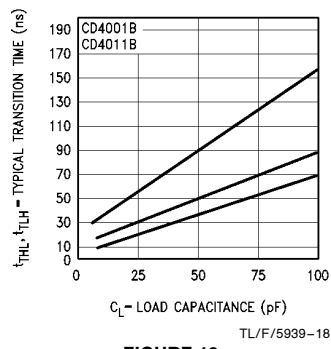


FIGURE 12

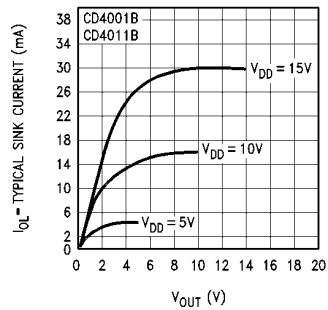


FIGURE 13

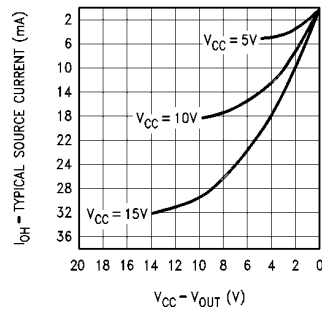
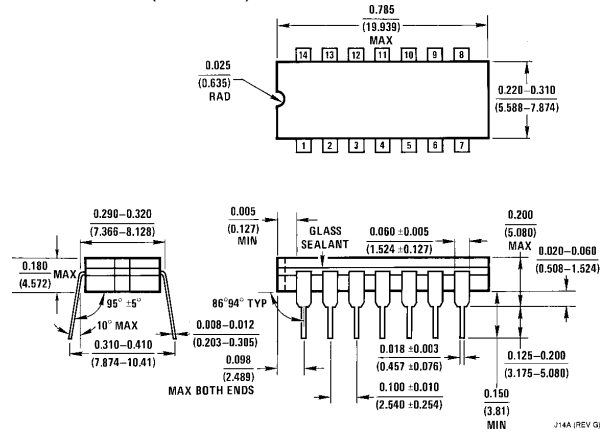
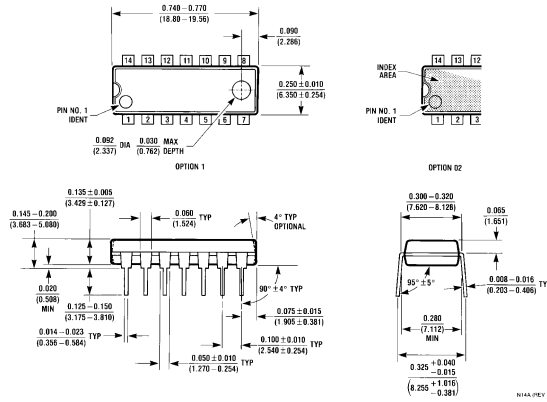


FIGURE 14

**Physical Dimensions** inches (millimeters)



**Ceramic Dual-In-Line Package (J)**  
**Order Number CD4001BMJ, CD4001BCJ, CD4011BMJ or CD4011BCJ**  
**NS Package Number J14A**



**Molded Dual-In-Line Package (N)**  
**Order Number CD4001BMN, CD4001BCN, CD4011BMN or CD4011BCN**  
**NS Package Number N14A**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.