FAIRCHILD SEMICONDUCTOR™

October 1987
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# CD4001BC/CD4011BC
# Quad 2-Input NOR Buffered B Series Gate • Quad 2-Input NAND Buffered B Series Gate

## General Description

The CD4001BC and CD4011BC 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:
  Fan out of 2 driving 74L compatibility: or 1 driving 74LS
- 5V–10V–15V parametric ratings
- Symmetrical output characteristics
- Maximum input leakage 1 µA at 15V over full temperature range

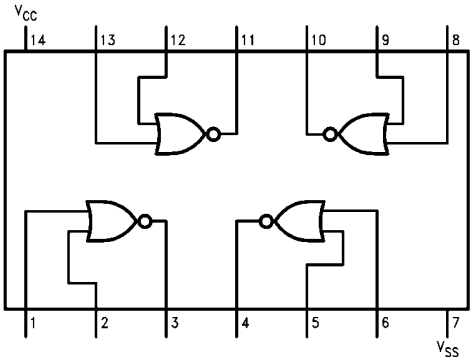
## Ordering Code:

| Order Number | Package Number | Package Description |
|---|---|---|
| CD4001BCM | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150” Narrow |
| CD4001BCSJ | M14D | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide |
| CD4001BCN | N14A | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300” Wide |
| CD4011BCM | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150” Narrow |
| CD4011BCN | N14A | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300” Wide |

Devices also available in Tape and Reel. Specify by appending the suffix letter “X” to the ordering code.

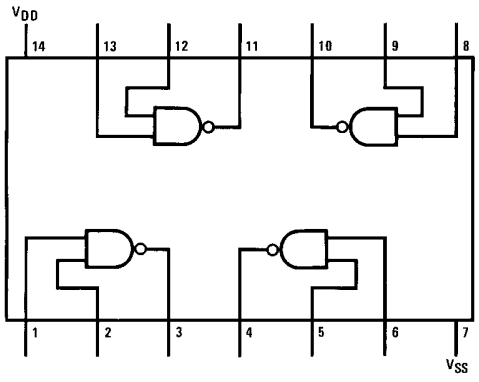
## Connection Diagrams

**Pin Assignments for DIP, SOIC and SOP**
**CD4001BC**




**Top View**

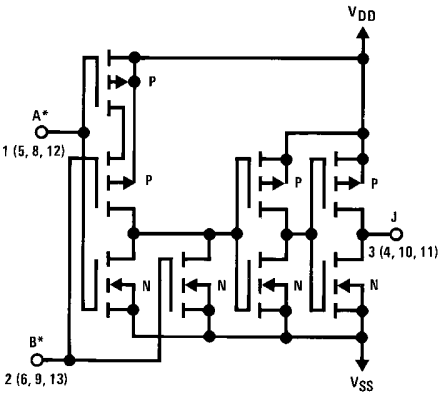
**Pin Assignments for DIP and SOIC**
**CD4011BC**



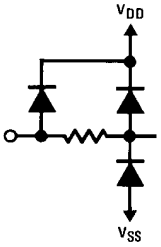

**Top View**

## Schematic Diagrams




**CD4001BC**



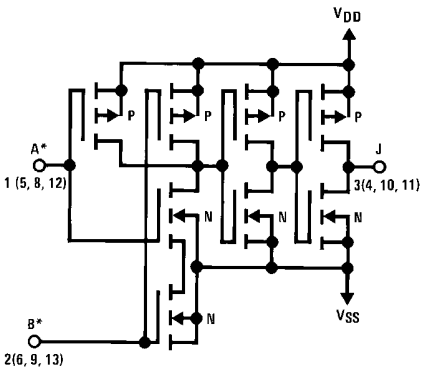

**1/4 of device shown**

$J = \overline{A + B}$

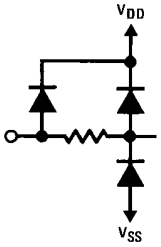
Logical "1" = HIGH

Logical "0" = LOW

All inputs protected by standard CMOS protection circuit.




**CD4011BC**




**1/4 of device shown**

$J = \overline{A \cdot B}$

Logical "1" = HIGH

Logical "0" = LOW

All inputs protected by standard CMOS protection circuit.

## Absolute Maximum Ratings(Note 1)

(Note 2)

| | |
|---|---|
| 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 |

## Recommended Operating Conditions

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

**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 Electrical Characteristics tables provide conditions for actual device operation.

**Note 2:** All voltages measured with respect to $V_{SS}$ unless otherwise specified.

## DC Electrical Characteristics (Note 2)

| Symbol | Parameter | Conditions | −40°C | | +25°C | | | +85°C | | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Typ | Max | Min | Max | |
| $I_{DD}$ | Quiescent Device | $V_{DD}$ = 5V, $V_{IN}$ = $V_{DD}$ or $V_{SS}$ | | 1 | | 0.004 | 1 | | 7.5 | µA |
| | Current | $V_{DD}$ = 10V, $V_{IN}$ = $V_{DD}$ or $V_{SS}$ | | 2 | | 0.005 | 2 | | 15 | µA |
| | | $V_{DD}$ = 15V, $V_{IN}$ = $V_{DD}$ or $V_{SS}$ | | 4 | | 0.006 | 4 | | 30 | µA |
| $V_{OL}$ | LOW Level | $V_{DD}$ = 5V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | Output Voltage | $V_{DD}$ = 10V $\quad$ $\lvert I_O \rvert$ < 1 µA | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | | $V_{DD}$ = 15V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| $V_{OH}$ | HIGH Level | $V_{DD}$ = 5V | 4.95 | | 4.95 | 5 | | 4.95 | | V |
| | Output Voltage | $V_{DD}$ = 10V $\quad$ $\lvert I_O \rvert$ < 1 µA | 9.95 | | 9.95 | 10 | | 9.95 | | V |
| | | $V_{DD}$ = 15V | 14.95 | | 14.95 | 15 | | 14.95 | | V |
| $V_{IL}$ | LOW Level | $V_{DD}$ = 5V, $V_O$ = 4.5V | | 1.5 | | 2 | 1.5 | | 1.5 | V |
| | Input Voltage | $V_{DD}$ = 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 | $V_{DD}$ = 5V, $V_O$ = 0.5V | 3.5 | | 3.5 | 3 | | 3.5 | | V |
| | Input Voltage | $V_{DD}$ = 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 | $V_{DD}$ = 5V, $V_O$ = 0.4V | 0.52 | | 0.44 | 0.88 | | 0.36 | | mA |
| | Current | $V_{DD}$ = 10V, $V_O$ = 0.5V | 1.3 | | 1.1 | 2.25 | | 0.9 | | mA |
| | (Note 3) | $V_{DD}$ = 15V, $V_O$ = 1.5V | 3.6 | | 3.0 | 8.8 | | 2.4 | | mA |
| $I_{OH}$ | HIGH Level Output | $V_{DD}$ = 5V, $V_O$ = 4.6V | −0.52 | | −0.44 | −0.88 | | −0.36 | | mA |
| | Current | $V_{DD}$ = 10V, $V_O$ = 9.5V | −1.3 | | −1.1 | −2.25 | | −0.9 | | mA |
| | (Note 3) | $V_{DD}$ = 15V, $V_O$ = 13.5V | −3.6 | | −3.0 | −8.8 | | −2.4 | | mA |
| $I_{IN}$ | Input Current | $V_{DD}$ = 15V, $V_{IN}$ = 0V | | −0.30 | | $-10^{-5}$ | −0.30 | | −1.0 | µA |
| | | $V_{DD}$ = 15V, $V_{IN}$ = 15V | | 0.30 | | $10^{-5}$ | 0.30 | | 1.0 | µA |

**Note 3:** $I_{OL}$ and $I_{OH}$ are tested one output at a time.

## AC Electrical Characteristics (Note 4)

CD4001BC: $T_A$ = 25°C, Input $t_r$; $t_f$ = 20 ns. $C_L$ = 50 pF, $R_L$ = 200k. Typical temperature coefficient is 0.3%/°C.

| Symbol | Parameter | Conditions | Typ | Max | Units |
|---|---|---|---|---|---|
| $t_{PHL}$ | Propagation Delay Time, | $V_{DD}$ = 5V | 120 | 250 | ns |
| | HIGH-to-LOW Level | $V_{DD}$ = 10V | 50 | 100 | ns |
| | | $V_{DD}$ = 15V | 35 | 70 | ns |
| $t_{PLH}$ | Propagation Delay Time, | $V_{DD}$ = 5V | 110 | 250 | ns |
| | LOW-to-HIGH Level | $V_{DD}$ = 10V | 50 | 100 | ns |
| | | $V_{DD}$ = 15V | 35 | 70 | ns |
| $t_{THL}$, $t_{TLH}$ | Transition Time | $V_{DD}$ = 5V | 90 | 200 | ns |
| | | $V_{DD}$ = 10V | 50 | 100 | ns |
| | | $V_{DD}$ = 15V | 40 | 80 | ns |
| $C_{IN}$ | Average Input Capacitance | Any Input | 5 | 7.5 | pF |
| $C_{PD}$ | Power Dissipation Capacity | Any Gate | 14 | | pF |

**Note 4:** AC Parameters are guaranteed by DC correlated testing.

## AC Electrical Characteristics (Note 5)

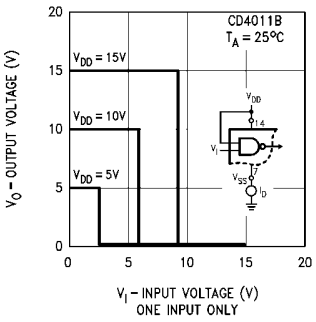
CD4011BC: $T_A$= 25°C, Input $t_r$; $t_f$ = 20 ns. $C_L$ = 50 pF, $R_L$ = 200k. Typical Temperature Coefficient is 0.3%/°C.

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

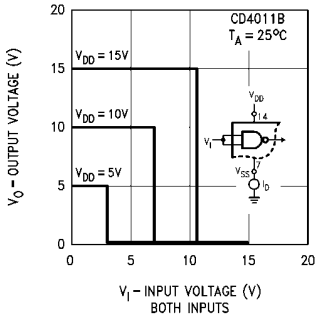
**Note 5:** AC Parameters are guaranteed by DC correlated testing.

## Typical Performance Characteristics

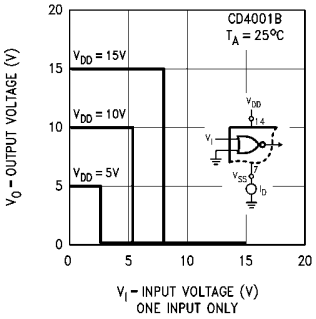
**Typical Transfer Characteristics**



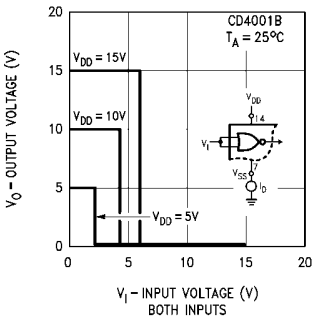

**Typical Transfer Characteristics**

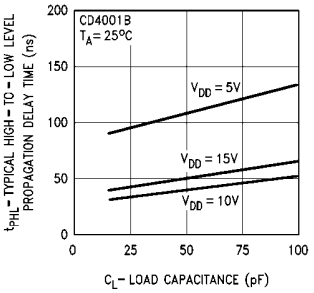


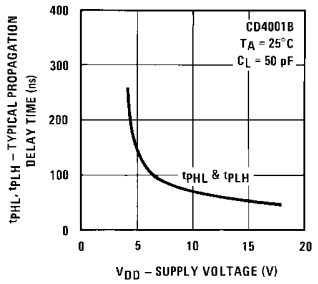

**Typical Transfer Characteristics**

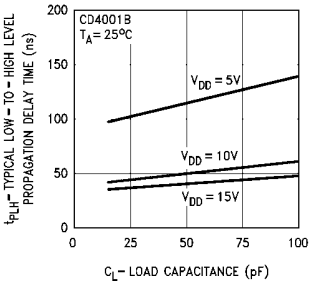


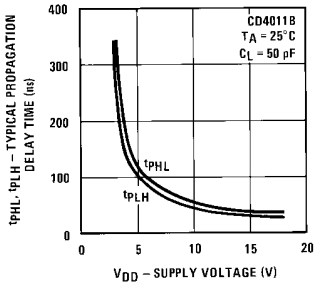
## Typical Transfer Characteristics

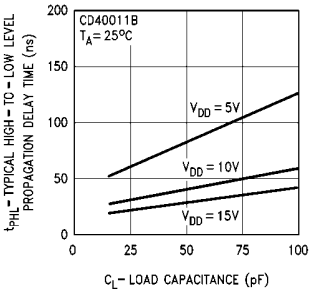


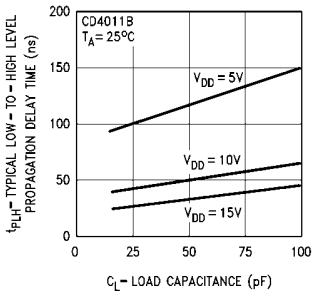



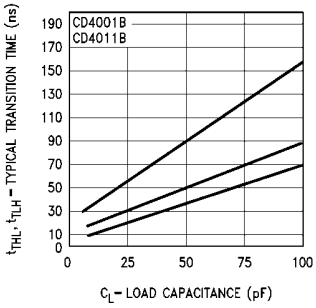



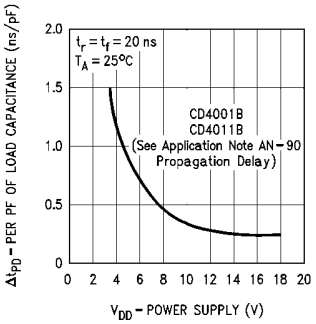



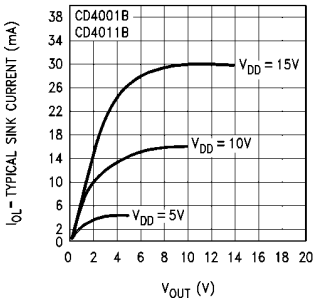



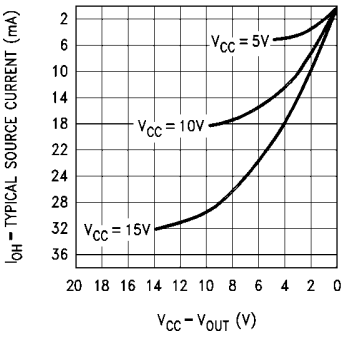




CD4011B
$T_A$ = 25°C
$V_{DD}$ = 5V
$V_{DD}$ = 10V
$V_{DD}$ = 15V
$t_{PLH}$ – TYPICAL LOW – TO – HIGH LEVEL PROPAGATION DELAY TIME (ns)
$C_L$ – LOAD CAPACITANCE (pF)

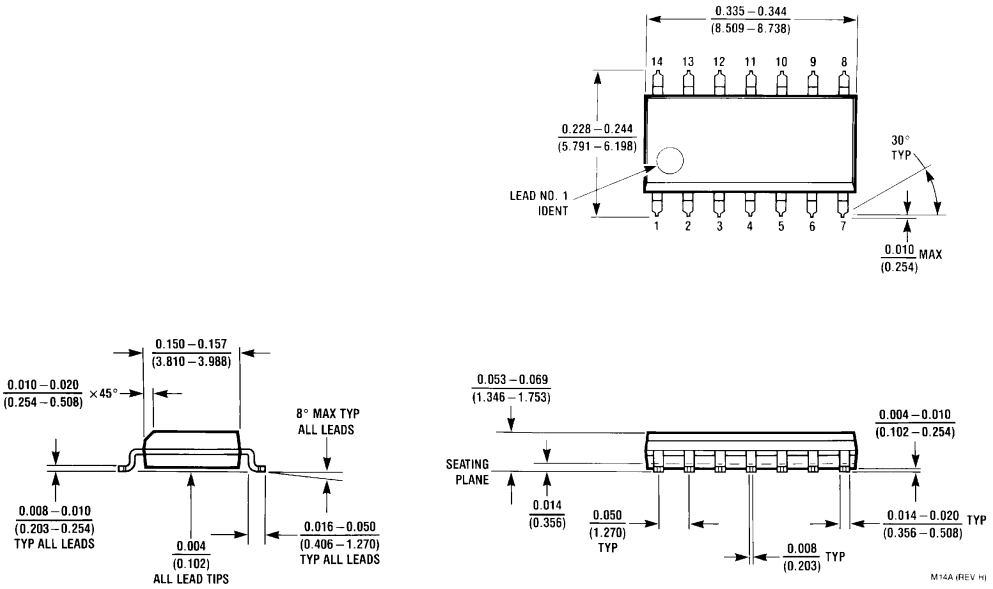

CD4001B
CD4011B
$t_{THL}$, $t_{TLH}$ – TYPICAL TRANSITION TIME (ns)
$C_L$ – LOAD CAPACITANCE (pF)


$t_r = t_f$ = 20 ns
$T_A$ = 25°C
CD4001B
CD4011B
(See Application Note AN – 90
Propagation Delay)
$\Delta t_{PD}$ – PER PF OF LOAD CAPACITANCE (ns/pF)
$V_{DD}$ – POWER SUPPLY (V)

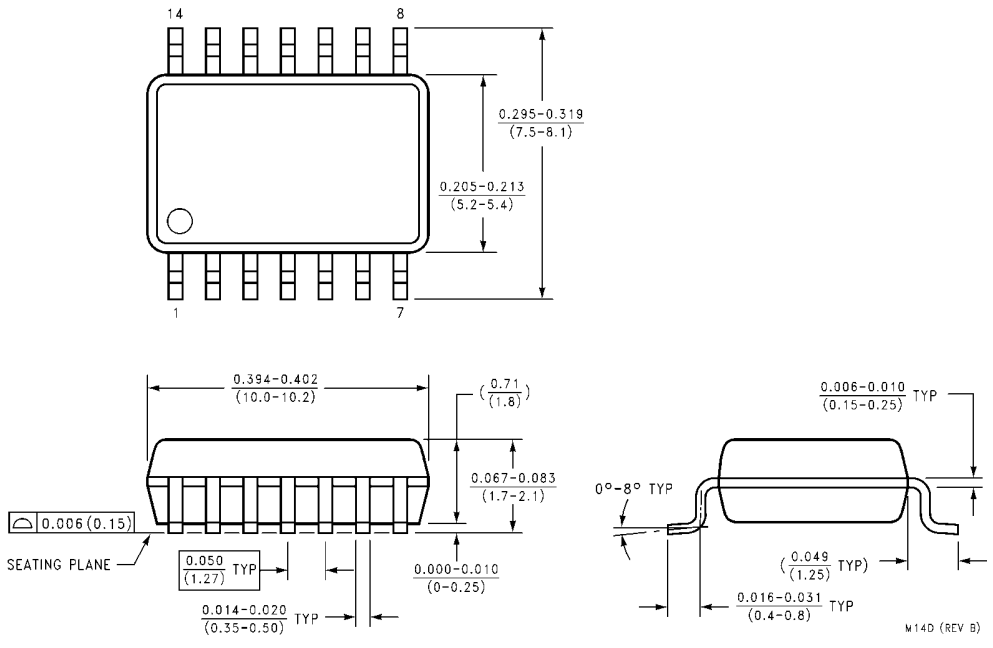

CD4001B
CD4011B
$V_{DD}$ = 15V
$V_{DD}$ = 10V
$V_{DD}$ = 5V
$I_{OL}$ – TYPICAL SINK CURRENT (mA)
$V_{OUT}$ (V)


$V_{CC}$ = 5V
$V_{CC}$ = 10V
$V_{CC}$ = 15V
$I_{OH}$ – TYPICAL SOURCE CURRENT (mA)
$V_{CC} - V_{OUT}$ (V)

## Physical Dimensions inches (millimeters) unless otherwise noted

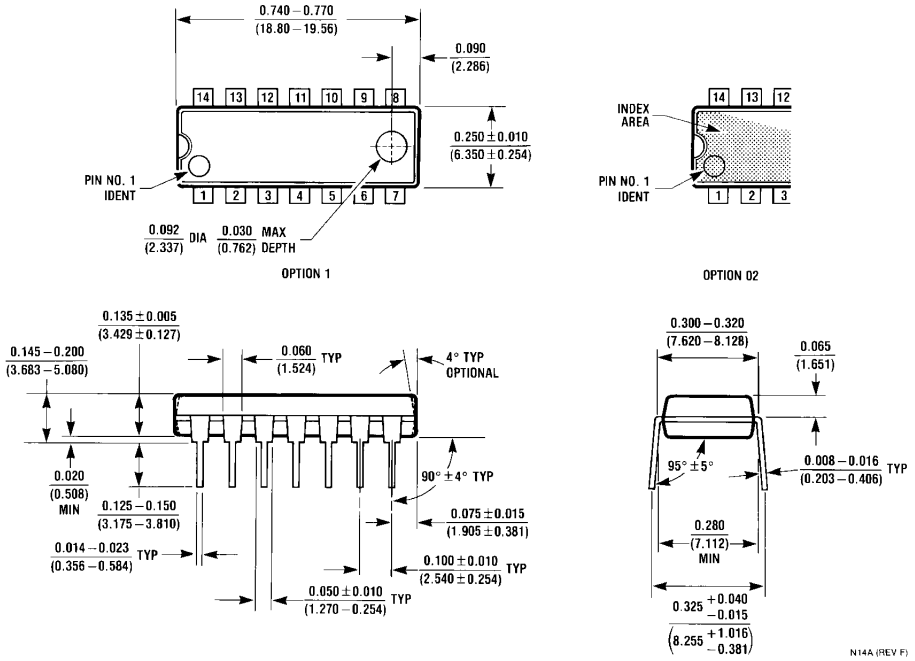



**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow**
**Package Number M14A**




**14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide**
**Package Number M14D**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)




**14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide**
**Package Number N14A**

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