

## CD4049UBC • CD4050BC

### Hex Inverting Buffer • Hex Non-Inverting Buffer

#### General Description

The CD4049UBC and CD4050BC hex buffers are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. These devices feature logic level conversion using only one supply voltage ( $V_{DD}$ ). The input signal high level ( $V_{IH}$ ) can exceed the  $V_{DD}$  supply voltage when these devices are used for logic level conversions. These devices are intended for use as hex buffers, CMOS to DTL/TTL converters, or as CMOS current drivers, and at  $V_{DD} = 5.0V$ , they can drive directly two DTL/TTL loads over the full operating temperature range.

#### Features

- Wide supply voltage range: 3.0V to 15V
- Direct drive to 2 TTL loads at 5.0V over full temperature range
- High source and sink current capability
- Special input protection permits input voltages greater than  $V_{DD}$

#### Applications

- CMOS hex inverter/buffer
- CMOS to DTL/TTL hex converter
- CMOS current "sink" or "source" driver
- CMOS HIGH-to-LOW logic level converter

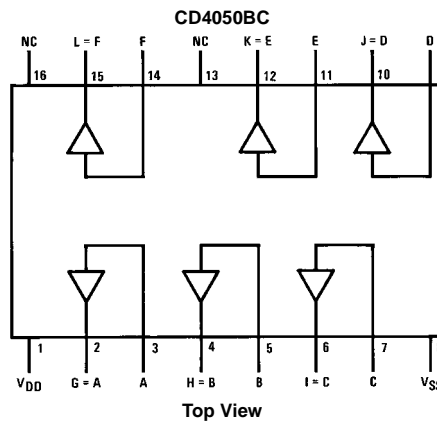
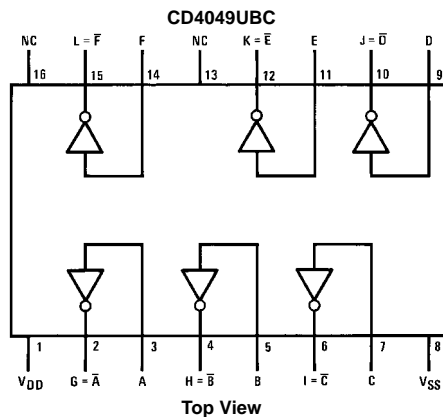
#### Ordering Code:

| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| CD4049UBCM   | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| CD4049UBCN   | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |
| CD4050BCM    | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| CD4050BCN    | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

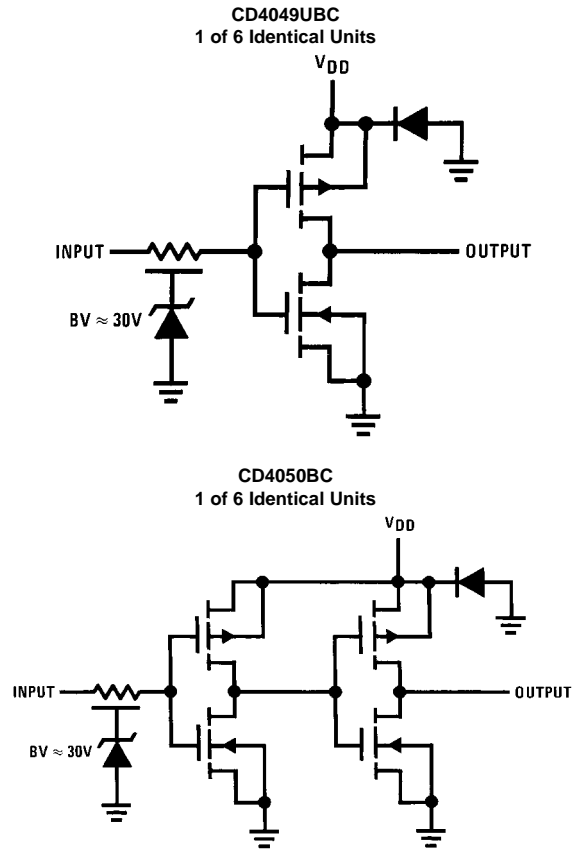
Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

#### Connection Diagrams

##### Pin Assignments for DIP



### Schematic Diagrams



| Absolute Maximum Ratings (Note 1)       |                          | Recommended Operating Conditions (Note 2)                                                                                                                                                                                                                                                                                                 |                |
|-----------------------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Supply Voltage ( $V_{DD}$ )             | -0.5V to +18V            | Supply Voltage ( $V_{DD}$ )                                                                                                                                                                                                                                                                                                               | 3V to 15V      |
| Input Voltage ( $V_{IN}$ )              | -0.5V to +18V            | Input Voltage ( $V_{IN}$ )                                                                                                                                                                                                                                                                                                                | 0V to 15V      |
| Voltage at Any Output Pin ( $V_{OUT}$ ) | -0.5V to $V_{DD} + 0.5V$ | Voltage at Any Output Pin ( $V_{OUT}$ )                                                                                                                                                                                                                                                                                                   | 0 to $V_{DD}$  |
| Storage Temperature Range ( $T_S$ )     | -65°C to +150°C          | Operating Temperature Range ( $T_A$ )                                                                                                                                                                                                                                                                                                     |                |
| Power Dissipation ( $P_D$ )             |                          | CD4049UBC, CD4050BC                                                                                                                                                                                                                                                                                                                       | -40°C to +85°C |
| Dual-In-Line                            | 700 mW                   | <b>Note 1:</b> "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed; they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation. |                |
| Small Outline                           | 500 mW                   | <b>Note 2:</b> $V_{SS} = 0V$ unless otherwise specified.                                                                                                                                                                                                                                                                                  |                |
| Lead Temperature ( $T_L$ )              |                          |                                                                                                                                                                                                                                                                                                                                           |                |
| (Soldering, 10 seconds)                 | 260°C                    |                                                                                                                                                                                                                                                                                                                                           |                |

### DC Electrical Characteristics (Note 3)

| Symbol   | Parameter                                    | Conditions                                                               | -40°C |      | +25°C |            |      | +85°C |      | Units   |
|----------|----------------------------------------------|--------------------------------------------------------------------------|-------|------|-------|------------|------|-------|------|---------|
|          |                                              |                                                                          | Min   | Max  | Min   | Typ        | Max  | Min   | Max  |         |
| $I_{DD}$ | Quiescent Device Current                     | $V_{DD} = 5V$                                                            |       | 4    |       | 0.03       | 4.0  |       | 30   | $\mu A$ |
|          |                                              | $V_{DD} = 10V$                                                           |       | 8    |       | 0.05       | 8.0  |       | 60   | $\mu A$ |
|          |                                              | $V_{DD} = 15V$                                                           |       | 16   |       | 0.07       | 16.0 |       | 120  | $\mu A$ |
| $V_{OL}$ | LOW Level Output Voltage                     | $V_{IH} = V_{DD}, V_{IL} = 0V,$<br>$ I_{OL}  < 1 \mu A$<br>$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                    | $V_{IH} = V_{DD}, V_{IL} = 0V,$<br>$ I_{OL}  < 1 \mu A$<br>$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<br>(CD4050BC Only)   | $ I_{OL}  < 1 \mu A$<br>$V_{DD} = 5V, V_O = 0.5V$                        |       | 1.5  |       | 2.25       | 1.5  |       | 1.5  | V       |
|          |                                              | $V_{DD} = 10V, V_O = 1V$                                                 |       | 3.0  |       | 4.5        | 3.0  |       | 3.0  | V       |
|          |                                              | $V_{DD} = 15V, V_O = 1.5V$                                               |       | 4.0  |       | 6.75       | 4.0  |       | 4.0  | V       |
| $V_{IL}$ | LOW Level Input Voltage<br>(CD4049UBC Only)  | $ I_{OL}  < 1 \mu A$<br>$V_{DD} = 5V, V_O = 4.5V$                        |       | 1.0  |       | 1.5        | 1.0  |       | 1.0  | V       |
|          |                                              | $V_{DD} = 10V, V_O = 9V$                                                 |       | 2.0  |       | 2.5        | 2.0  |       | 2.0  | V       |
|          |                                              | $V_{DD} = 15V, V_O = 13.5V$                                              |       | 3.0  |       | 3.5        | 3.0  |       | 3.0  | V       |
| $V_{IH}$ | HIGH Level Input Voltage<br>(CD4050BC Only)  | $ I_{OL}  < 1 \mu A$<br>$V_{DD} = 5V, V_O = 4.5V$                        | 3.5   |      | 3.5   | 2.75       |      | 3.5   |      | V       |
|          |                                              | $V_{DD} = 10V, V_O = 9V$                                                 | 7.0   |      | 7.0   | 5.5        |      | 7.0   |      | V       |
|          |                                              | $V_{DD} = 15V, V_O = 13.5V$                                              | 11.0  |      | 11.0  | 8.25       |      | 11.0  |      | V       |
| $V_{IH}$ | HIGH Level Input Voltage<br>(CD4049UBC Only) | $ I_{OL}  < 1 \mu A$<br>$V_{DD} = 5V, V_O = 0.5V$                        | 4.0   |      | 4.0   | 3.5        |      | 4.0   |      | V       |
|          |                                              | $V_{DD} = 10V, V_O = 1V$                                                 | 8.0   |      | 8.0   | 7.5        |      | 8.0   |      | V       |
|          |                                              | $V_{DD} = 15V, V_O = 1.5V$                                               | 12.0  |      | 12.0  | 11.5       |      | 12.0  |      | V       |
| $I_{OL}$ | LOW Level Output Current<br>(Note 4)         | $V_{IH} = V_{DD}, V_{IL} = 0V$<br>$V_{DD} = 5V, V_O = 0.4V$              | 4.6   |      | 4.0   | 5          |      | 3.2   |      | mA      |
|          |                                              | $V_{DD} = 10V, V_O = 0.5V$                                               | 9.8   |      | 8.5   | 12         |      | 6.8   |      | mA      |
|          |                                              | $V_{DD} = 15V, V_O = 1.5V$                                               | 29    |      | 25    | 40         |      | 20    |      | mA      |
| $I_{OH}$ | HIGH Level Output Current<br>(Note 4)        | $V_{IH} = V_{DD}, V_{IL} = 0V$<br>$V_{DD} = 5V, V_O = 4.6V$              | -1.0  |      | -0.9  | -1.6       |      | -0.72 |      | mA      |
|          |                                              | $V_{DD} = 10V, V_O = 9.5V$                                               | -2.1  |      | -1.9  | -3.6       |      | -1.5  |      | mA      |
|          |                                              | $V_{DD} = 15V, V_O = 13.5V$                                              | -7.1  |      | -6.2  | -12        |      | -5    |      | mA      |
| $I_{IN}$ | Input Current                                | $V_{DD} = 15V, V_{IN} = 0V$                                              | -0.3  |      | -0.3  | $-10^{-5}$ |      |       | -1.0 | $\mu A$ |
|          |                                              | $V_{DD} = 15V, V_{IN} = 15V$                                             | 0.3   |      | 0.3   | $10^{-5}$  |      |       | 1.0  | $\mu A$ |

**Note 3:**  $V_{SS} = 0V$  unless otherwise specified.

**DC Electrical Characteristics** (Continued)

**Note 4:** These are peak output current capabilities. Continuous output current is rated at 12 mA maximum. The output current should not be allowed to exceed this value for extended periods of time.  $I_{OL}$  and  $I_{OH}$  are tested one output at a time.

**AC Electrical Characteristics** (Note 5)

CD4049UBC

$T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ , unless otherwise specified

| Symbol    | Parameter                                   | Conditions            | Min | Typ | Max  | Units |
|-----------|---------------------------------------------|-----------------------|-----|-----|------|-------|
| $t_{PHL}$ | Propagation Delay Time<br>HIGH-to-LOW Level | $V_{DD} = 5\text{V}$  |     | 30  | 65   | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 20  | 40   | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 15  | 30   | ns    |
| $t_{PLH}$ | Propagation Delay Time<br>LOW-to-HIGH Level | $V_{DD} = 5\text{V}$  |     | 45  | 85   | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 25  | 45   | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 20  | 35   | ns    |
| $t_{THL}$ | Transition Time<br>HIGH-to-LOW Level        | $V_{DD} = 5\text{V}$  |     | 30  | 60   | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 20  | 40   | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 15  | 30   | ns    |
| $t_{TLH}$ | Transition Time<br>LOW-to-HIGH Level        | $V_{DD} = 5\text{V}$  |     | 60  | 120  | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 30  | 55   | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 25  | 45   | ns    |
| $C_{IN}$  | Input Capacitance                           | Any Input             |     | 15  | 22.5 | pF    |

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

**AC Electrical Characteristics** (Note 6)

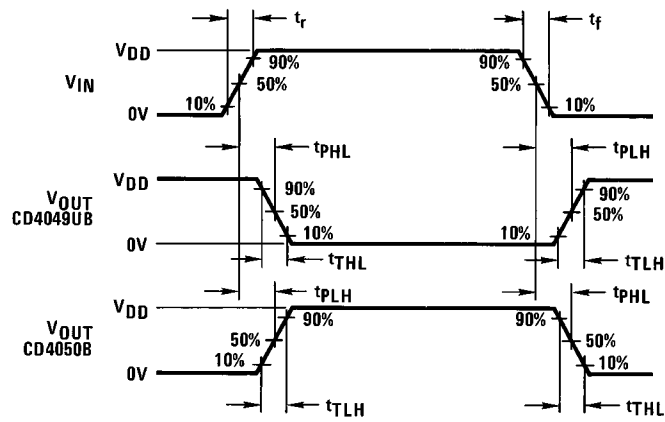
CD4050BC

$T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ , unless otherwise specified

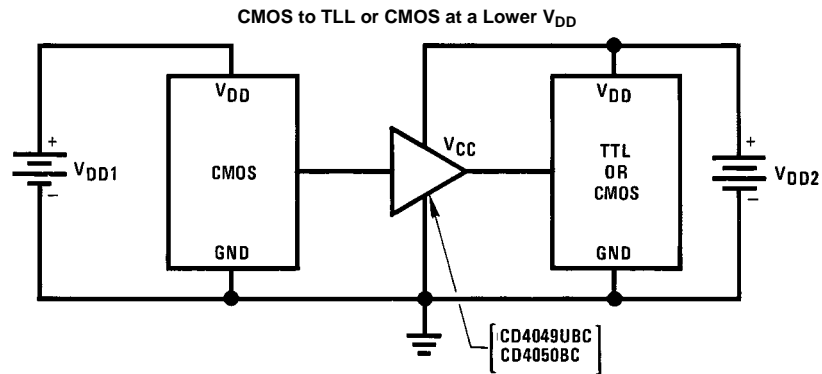
| Symbol    | Parameter                                   | Conditions            | Min | Typ | Max | Units |
|-----------|---------------------------------------------|-----------------------|-----|-----|-----|-------|
| $t_{PHL}$ | Propagation Delay Time<br>HIGH-to-LOW Level | $V_{DD} = 5\text{V}$  |     | 60  | 110 | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 25  | 55  | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 20  | 30  | ns    |
| $t_{PLH}$ | Propagation Delay Time<br>LOW-to-HIGH Level | $V_{DD} = 5\text{V}$  |     | 60  | 120 | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 30  | 55  | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 25  | 45  | ns    |
| $t_{THL}$ | Transition Time<br>HIGH-to-LOW Level        | $V_{DD} = 5\text{V}$  |     | 30  | 60  | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 20  | 40  | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 15  | 30  | ns    |
| $t_{TLH}$ | Transition Time<br>LOW-to-HIGH Level        | $V_{DD} = 5\text{V}$  |     | 60  | 120 | ns    |
|           |                                             | $V_{DD} = 10\text{V}$ |     | 30  | 55  | ns    |
|           |                                             | $V_{DD} = 15\text{V}$ |     | 25  | 45  | ns    |
| $C_{IN}$  | Input Capacitance                           | Any Input             |     | 5   | 7.5 | pF    |

**Note 6:** AC Parameters are guaranteed by DC correlated testing.

### Switching Time Waveforms



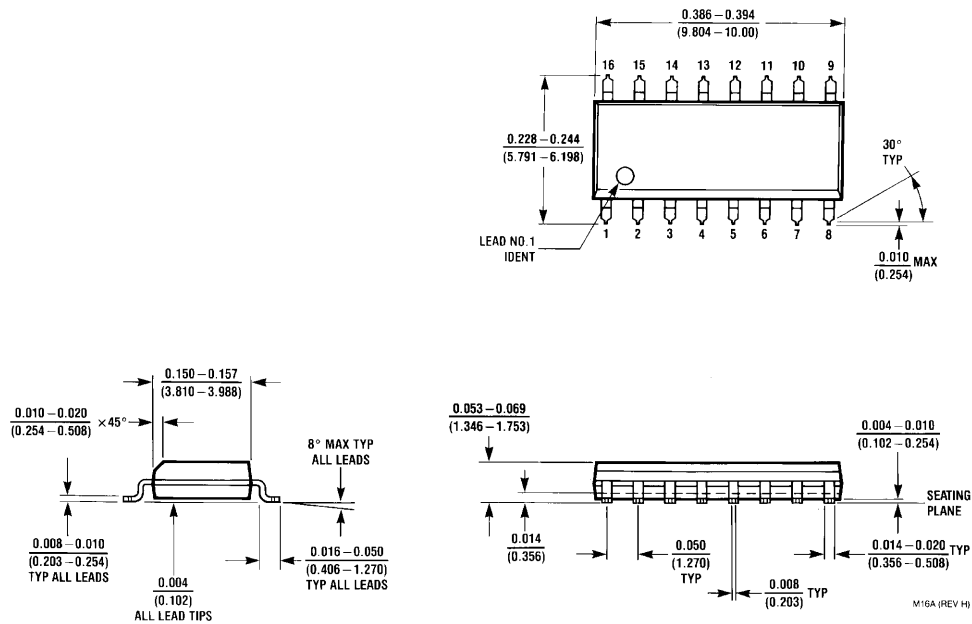
### Typical Applications



$$V_{DD1} \geq V_{DD2}$$

In the case of the CD4049UBC the output drive capability increases with increasing input voltage.  
E.g., if  $V_{DD1} = 10V$  the CD4049UBC could drive 4 TTL loads.

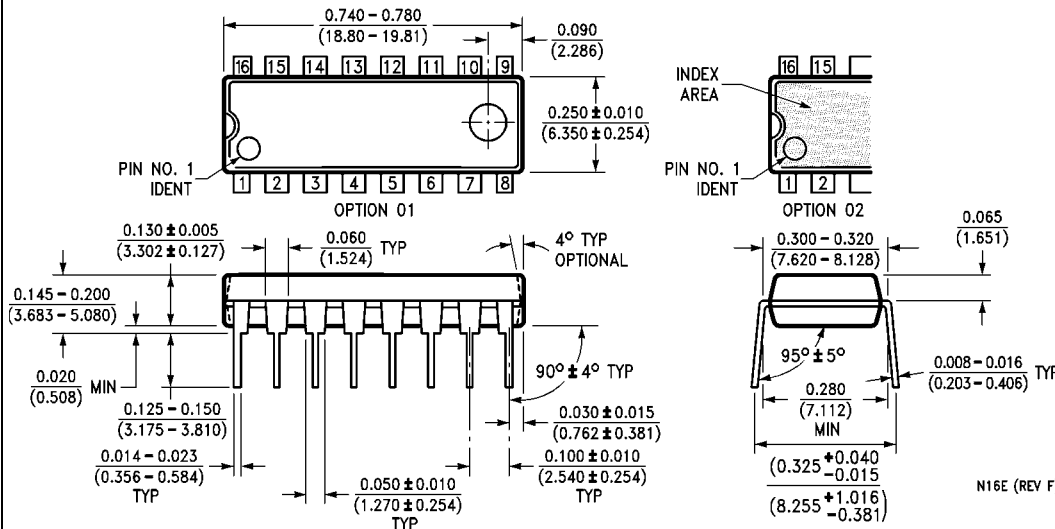
**Physical Dimensions** inches (millimeters) unless otherwise noted



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M16A**

M16A (REV H)

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



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N16E

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