

# CD4011B, CD4012B, CD4023B Types

## CMOS NAND GATES

### High-Voltage Types (20-Volt Rating)

Quad 2 Input – CD4011B  
Dual 4 Input – CD4012B  
Triple 3 Input – CD4023B

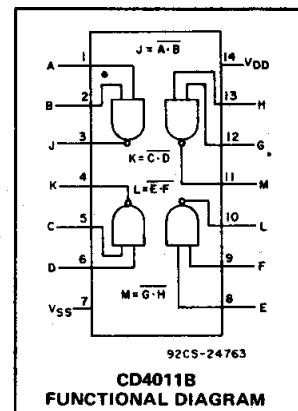
■ CD4011B, CD4012B, and CD4023B NAND gates provide the system designer with direct implementation of the NAND function and supplement the existing family of CMOS gates. All inputs and outputs are buffered.

The CD4011B, CD4012B, and CD4023B types are supplied in 14-lead hermetic dual-in-line ceramic packages (D and F suffixes), 14-lead dual-in-line plastic packages (E suffix), 14-lead dual-in-line small-outline plastic package (M suffix), thin shrink small-outline package (PWR suffix), 14-lead small-outline package (NSR suffix), and in chip form (H suffix).

### Features:

- Propagation delay time = 60 ns (typ.) at  $C_L = 50$  pF,  $V_{DD} = 10$  V
- Buffered inputs and outputs
- Standardized symmetrical output characteristics
- Maximum input current of  $1 \mu A$  at 18 V over full package temperature range; 100 nA at 18 V and 25°C
- 100% tested for quiescent current at 20 V
- 5-V, 10-V, and 15-V parametric ratings
- Noise margin (over full package temperature range):
  - 1 V at  $V_{DD} = 5$  V
  - 2 V at  $V_{DD} = 10$  V
  - 2.5 V at  $V_{DD} = 15$  V

- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of "B" Series CMOS Devices"



### MAXIMUM RATINGS, Absolute-Maximum Values:

#### DC SUPPLY-VOLTAGE RANGE, ( $V_{DD}$ )

Voltages referenced to  $V_{SS}$  Terminal) ..... -0.5V to +20V

INPUT VOLTAGE RANGE, ALL INPUTS ..... -0.5V to  $V_{DD} + 0.5$  V

DC INPUT CURRENT, ANY ONE INPUT .....  $\pm 10$  mA

#### POWER DISSIPATION PER PACKAGE ( $P_D$ ):

For  $T_A = -55^\circ C$  to  $+100^\circ C$  ..... 500 mW

For  $T_A = +100^\circ C$  to  $+125^\circ C$  ..... Derate Linearly at 12 mW/ $^\circ C$  to 200 mW

#### DEVICE DISSIPATION PER OUTPUT TRANSISTOR

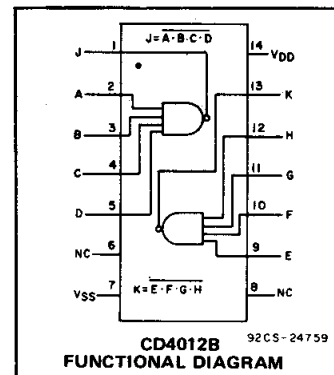
For  $T_A =$  FULL PACKAGE-TEMPERATURE RANGE (All Package Types) ..... 100 mW

OPERATING-TEMPERATURE RANGE ( $T_A$ ) .....  $-55^\circ C$  to  $+125^\circ C$

STORAGE TEMPERATURE RANGE ( $T_{stg}$ ) .....  $-65^\circ C$  to  $+150^\circ C$

#### LEAD TEMPERATURE (DURING SOLDERING):

At distance  $1/16 \pm 1/32$  inch (1.59  $\pm$  0.79 mm) from case for 10s max .....  $+265^\circ C$

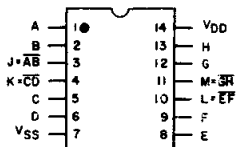


### RECOMMENDED OPERATING CONDITIONS

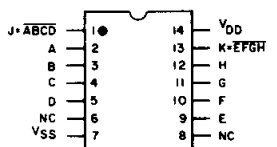
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

| CHARACTERISTIC                                                    | LIMITS |      | UNITS |
|-------------------------------------------------------------------|--------|------|-------|
|                                                                   | MIN.   | MAX. |       |
| Supply-Voltage Range (For $T_A =$ Full Package Temperature Range) | 3      | 18   | V     |

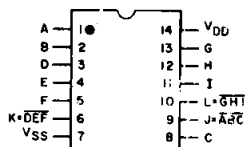
### TERMINAL ASSIGNMENTS



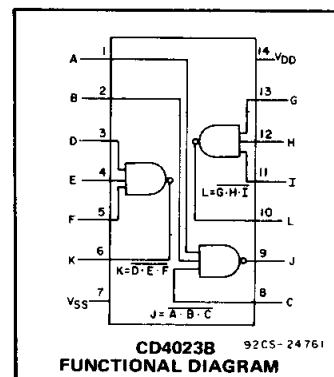
**CD4011B**



**CD4012B**



**CD4023B**



# CD4011B, CD4012B, CD4023B Types

## STATIC ELECTRICAL CHARACTERISTICS

| CHARACTER-<br>ISTIC                                         | CONDITIONS            |                        |                        | LIMITS AT INDICATED TEMPERATURES (°C) |       |       |       |       |                   |      | UNITS |
|-------------------------------------------------------------|-----------------------|------------------------|------------------------|---------------------------------------|-------|-------|-------|-------|-------------------|------|-------|
|                                                             | V <sub>O</sub><br>(V) | V <sub>IN</sub><br>(V) | V <sub>DD</sub><br>(V) |                                       |       |       |       | +25   |                   |      |       |
|                                                             |                       |                        |                        | -55                                   | -40   | +85   | +125  | Min.  | Typ.              | Max. |       |
| Quiescent Device<br>Current,<br>I <sub>DD</sub> Max.        | —                     | 0,5                    | 5                      | 0.25                                  | 0.25  | 7.5   | 7.5   | —     | 0.01              | 0.25 | μA    |
|                                                             | —                     | 0,10                   | 10                     | 0.5                                   | 0.5   | 15    | 15    | —     | 0.01              | 0.5  |       |
|                                                             | —                     | 0,15                   | 15                     | 1                                     | 1     | 30    | 30    | —     | 0.01              | 1    |       |
|                                                             | —                     | 0,20                   | 20                     | 5                                     | 5     | 150   | 150   | —     | 0.02              | 5    |       |
| Output Low<br>(Sink) Current<br>I <sub>OL</sub> Min.        | 0.4                   | 0,5                    | 5                      | 0.64                                  | 0.61  | 0.42  | 0.36  | 0.51  | 1                 | —    | mA    |
|                                                             | 0.5                   | 0,10                   | 10                     | 1.6                                   | 1.5   | 1.1   | 0.9   | 1.3   | 2.6               | —    |       |
|                                                             | 1.5                   | 0,15                   | 15                     | 4.2                                   | 4     | 2.8   | 2.4   | 3.4   | 6.8               | —    |       |
| Output High<br>(Source)<br>Current,<br>I <sub>OH</sub> Min. | 4.6                   | 0,5                    | 5                      | -0.64                                 | -0.61 | -0.42 | -0.36 | -0.51 | -1                | —    | mA    |
|                                                             | 2.5                   | 0,5                    | 5                      | -2                                    | -1.8  | -1.3  | -1.15 | -1.6  | -3.2              | —    |       |
|                                                             | 9.5                   | 0,10                   | 10                     | -1.6                                  | -1.5  | -1.1  | -0.9  | -1.3  | -2.6              | —    |       |
|                                                             | 13.5                  | 0,15                   | 15                     | -4.2                                  | -4    | -2.8  | -2.4  | -3.4  | -6.8              | —    |       |
| Output Voltage:<br>Low-Level,<br>V <sub>OL</sub> Max.       | —                     | 0,5                    | 5                      | 0.05                                  |       |       |       | —     | 0                 | 0.05 | V     |
|                                                             | —                     | 0,10                   | 10                     | 0.05                                  |       |       |       | —     | 0                 | 0.05 |       |
|                                                             | —                     | 0,15                   | 15                     | 0.05                                  |       |       |       | —     | 0                 | 0.05 |       |
| Output Voltage:<br>High-Level,<br>V <sub>OH</sub> Min.      | —                     | 0,5                    | 5                      | 4.95                                  |       |       |       | 4.95  | 5                 | —    | V     |
|                                                             | —                     | 0,10                   | 10                     | 9.95                                  |       |       |       | 9.95  | 10                | —    |       |
|                                                             | —                     | 0,15                   | 15                     | 14.95                                 |       |       |       | 14.95 | 15                | —    |       |
| Input Low<br>Voltage,<br>V <sub>IL</sub> Max.               | 4.5                   | —                      | 5                      | 1.5                                   |       |       |       | —     | —                 | 1.5  | V     |
|                                                             | 9                     | —                      | 10                     | 3                                     |       |       |       | —     | —                 | 3    |       |
|                                                             | 13.5                  | —                      | 15                     | 4                                     |       |       |       | —     | —                 | 4    |       |
| Input High<br>Voltage,<br>V <sub>IH</sub> Min.              | 0.5,4.5               | —                      | 5                      | 3.5                                   |       |       |       | 3.5   | —                 | —    | V     |
|                                                             | 1,9                   | —                      | 10                     | 7                                     |       |       |       | 7     | —                 | —    |       |
|                                                             | 1.5,13.5              | —                      | 15                     | 11                                    |       |       |       | 11    | —                 | —    |       |
| Input Current<br>I <sub>IN</sub> Max.                       |                       | 0,18                   | 18                     | ±0.1                                  | ±0.1  | ±1    | ±1    | —     | ±10 <sup>-5</sup> | ±0.1 | μA    |

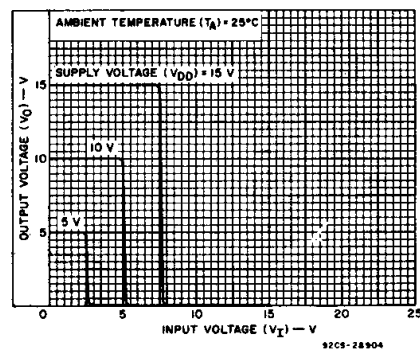


Fig. 1 — Typical voltage transfer characteristics.

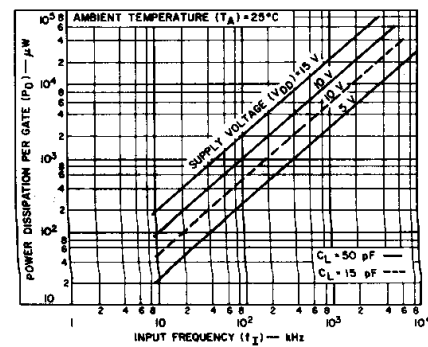


Fig. 2 — Typical power dissipation characteristics.

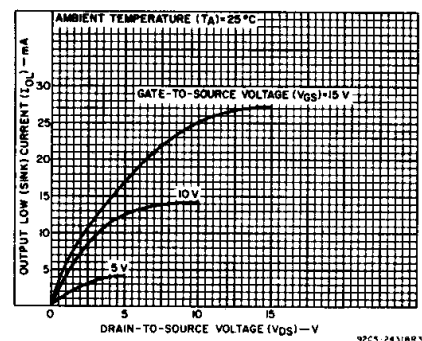


Fig. 3 — Typical output low (sink) current characteristics.

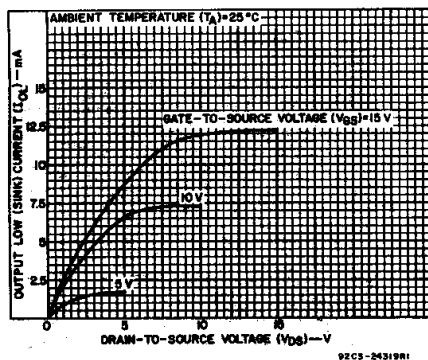


Fig. 4 — Minimum output low (sink) current characteristics.

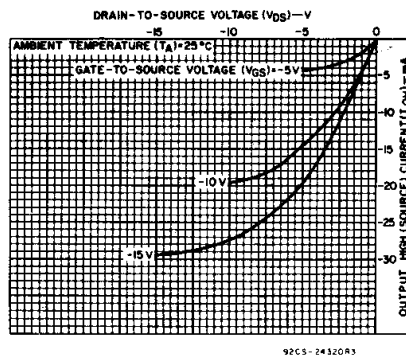


Fig. 5 — Typical output high (source) current characteristics.

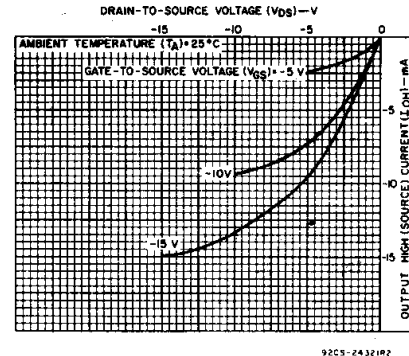


Fig. 6 — Minimum output high (source) current characteristics.

## CD4011B, CD4012B, CD4023B Types

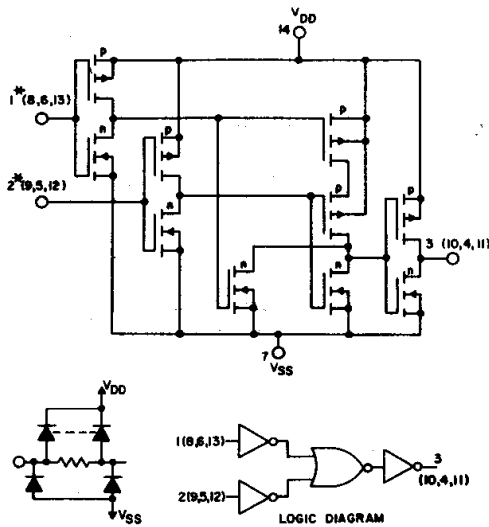


Fig. 7 – Schematic and logic diagrams for CD4011B.

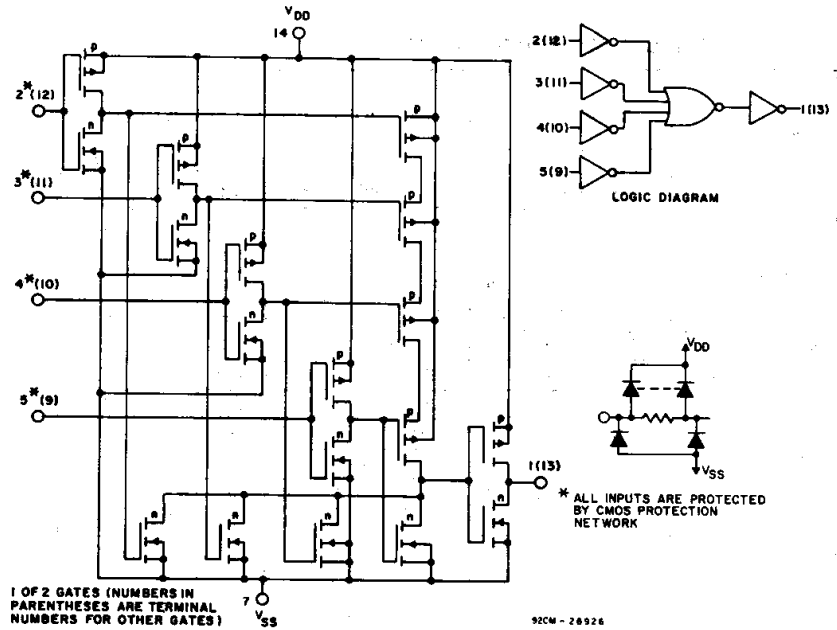


Fig. 8 – Schematic and logic diagrams for CD4012B.

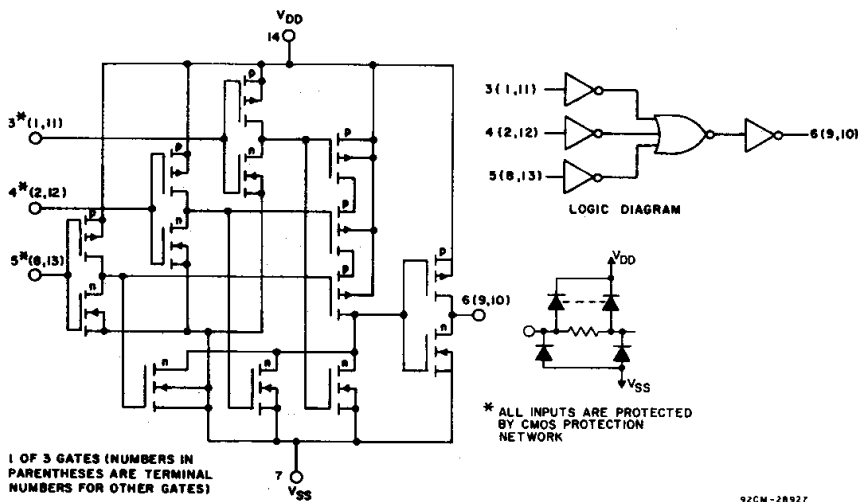


Fig. 9 – Schematic and logic diagrams for CD4023B.

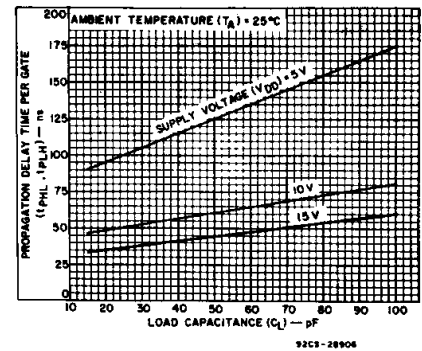


Fig. 10 – Typical propagation delay time per gate as a function of load capacitance.

### DYNAMIC ELECTRICAL CHARACTERISTICS

At  $T_A = 25^\circ\text{C}$ : Input  $t_r, t_f = 20\text{ ns}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$

| CHARACTERISTIC                                              | TEST CONDITIONS | LIMITS                |      | UNITS |
|-------------------------------------------------------------|-----------------|-----------------------|------|-------|
|                                                             |                 | V <sub>DD</sub> VOLTS | TYP. | MAX.  |
| Propagation Delay Time, t <sub>PHL</sub> , t <sub>PLH</sub> |                 | 5                     | 125  | 250   |
|                                                             |                 | 10                    | 60   | 120   |
|                                                             |                 | 15                    | 45   | 90    |
| Transition Time, t <sub>THL</sub> , t <sub>TLH</sub>        |                 | 5                     | 100  | 200   |
|                                                             |                 | 10                    | 50   | 100   |
|                                                             |                 | 15                    | 40   | 80    |
| Input Capacitance, C <sub>IN</sub>                          | Any Input       |                       | 5    | 7.5   |
|                                                             |                 |                       |      | pF    |

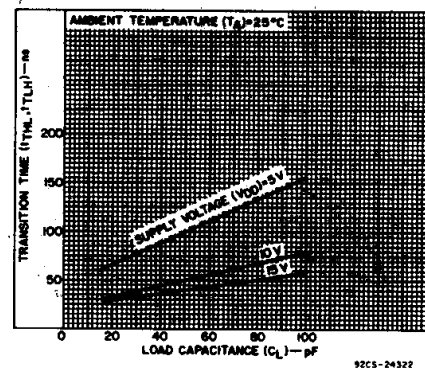


Fig. 11 – Typical transition time as a function of load capacitance.

## CD4011B, CD4012B, CD4023B Types

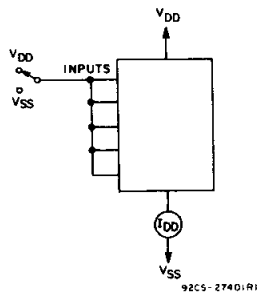


Fig. 12 - Quiescent-device-current test circuit.

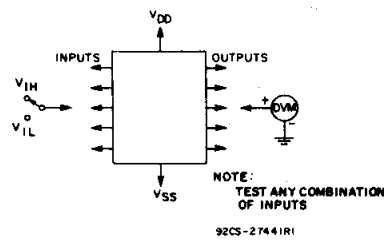


Fig. 13 - Input-voltage test circuit.

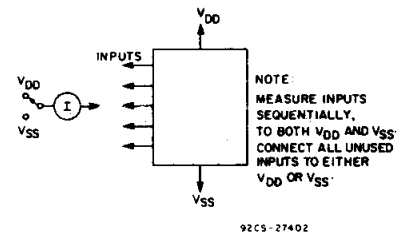
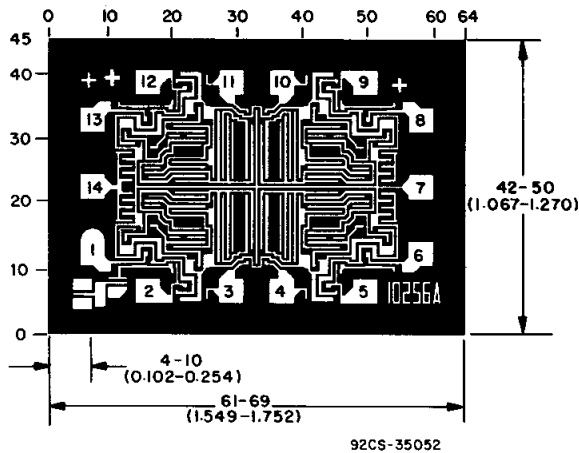
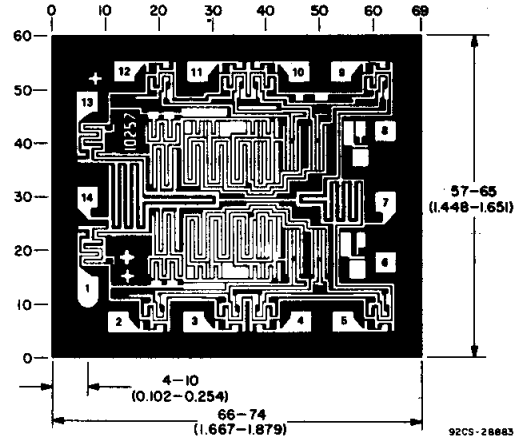


Fig. 14 - Input-current test circuit.

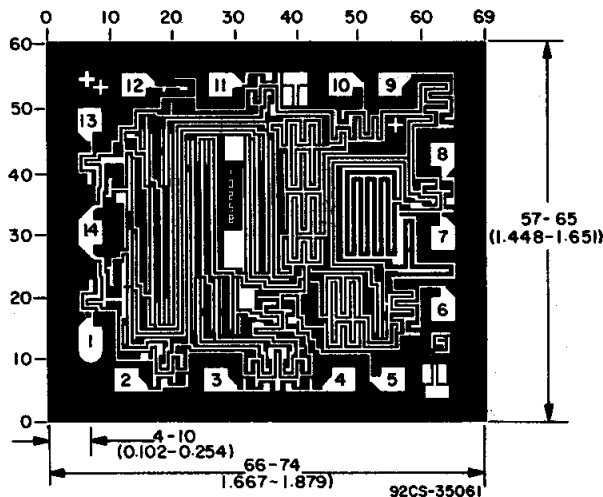
### Chip Dimensions and Pad Layouts



CD4011BH



CD4012BH



CD4023BH

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).

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