

CD4069UBM/CD4069UBC Inverter Circuits

General Description

The CD4069UB consists of six inverter circuits and is manufactured using complementary MOS (CMOS) to achieve wide power supply operating range, low power consumption, high noise immunity, and symmetric controlled rise and fall times.

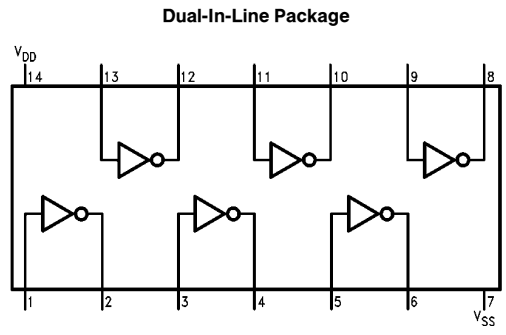
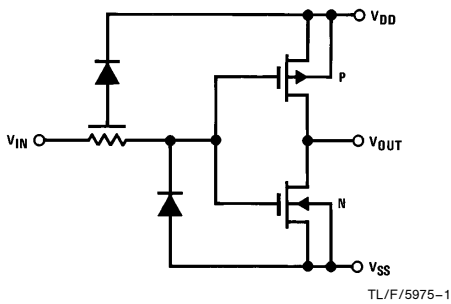
This device is intended for all general purpose inverter applications where the special characteristics of the MM74C901, MM74C903, MM74C907, and CD4049A Hex Inverter/Buffers are not required. In those applications requiring larger noise immunity the MM74C14 or MM74C914 Hex Schmitt Trigger is suggested.

All inputs are protected from damage due to static discharge by diode clamps to V_{DD} and V_{SS} .

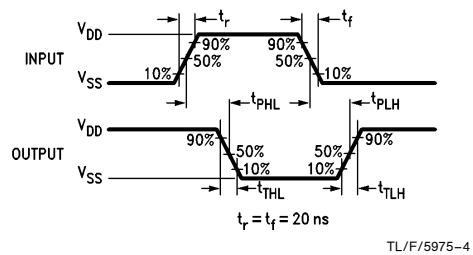
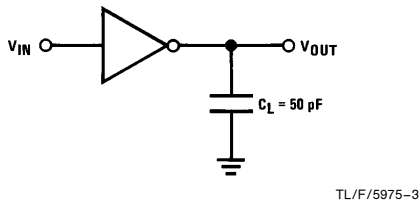
Features

- Wide supply voltage range 3.0V to 15V
- High noise immunity 0.45 V_{DD} typ.
- Low power TTL compatibility Fan out of 2 driving 74L or 1 driving 74LS
- Equivalent to MM54C04/MM74C04

Schematic and Connection Diagram



AC Test Circuits and Switching Time Waveforms



Absolute Maximum Ratings (Notes 1 & 2)

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

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

Recommended Operating Conditions (Note 2)

| | |
|---------------------------------------|-------------------------|
| DC Supply Voltage (V_{DD}) | 3V to 15 V_{DC} |
| Input Voltage (V_{IN}) | 0V to V_{DD} V_{DC} |
| Operating Temperature Range (T_A) | |
| CD4069UBM | -55°C to +125°C |
| CD4069UBC | -40°C to +85°C |

DC Electrical Characteristics CD4069UBM (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 | | | 0.25 | | 7.5 | μA |
| | | $V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS} | | 0.5 | | | 0.5 | | 15 | μA |
| | | $V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS} | | 1.0 | | | 1.0 | | 30 | μA |
| V_{OL} | Low Level Output Voltage | $ I_O < 1 \mu A$ $V_{DD} = 5V$ | | 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 | $ I_O < 1 \mu A$ $V_{DD} = 5V$ | 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 | $ I_O < 1 \mu A$ $V_{DD} = 5V$, $V_O = 4.5V$ | | 1.0 | | | 1.0 | | 1.0 | V |
| | | $V_{DD} = 10V$, $V_O = 9V$ | | 2.0 | | | 2.0 | | 2.0 | V |
| | | $V_{DD} = 15V$, $V_O = 13.5V$ | | 3.0 | | | 3.0 | | 3.0 | V |
| V_{IH} | High Level Input Voltage | $ I_O < 1 \mu A$ $V_{DD} = 5V$, $V_O = 0.5V$ | 4.0 | | 4.0 | | | 4.0 | | V |
| | | $V_{DD} = 10V$, $V_O = 1V$ | 8.0 | | 8.0 | | | 8.0 | | V |
| | | $V_{DD} = 15V$, $V_O = 1.5V$ | 12.0 | | 12.0 | | | 12.0 | | 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 | μA |
| | | $V_{DD} = 15V$, $V_{IN} = 15V$ | | 0.10 | | 10^{-5} | 0.10 | | 1.0 | μA |

Note 1: "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.

Note 2: $V_{SS} = 0V$ unless otherwise specified.

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

DC Electrical Characteristics CD4069UBC (Note 2)

| 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, V _{IN} = V _{DD} or V _{SS} | | 1.0 | | | 1.0 | | 7.5 | μA |
| | | V _{DD} = 10V, V _{IN} = V _{DD} or V _{SS} | | 2.0 | | | 2.0 | | 15 | μA |
| | | V _{DD} = 15V, V _{IN} = V _{DD} or V _{SS} | | 4.0 | | | 4.0 | | 30 | μA |
| V _{OL} | Low Level Output Voltage | I _O < 1 μA 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 | I _O < 1 μA V _{DD} = 5V | 4.95 | | 4.95 | | | 4.95 | | V |
| | | V _{DD} = 10V | 9.95 | | 9.95 | | | 9.95 | | V |
| | | V _{DD} = 15V | 14.95 | | 14.95 | | | 14.95 | | V |
| V _{IL} | Low Level Input Voltage | I _O < 1 μA V _{DD} = 5V, V _O = 4.5V | | 1.0 | | | 1.0 | | 1.0 | V |
| | | V _{DD} = 10V, V _O = 9V | | 2.0 | | | 2.0 | | 2.0 | V |
| | | V _{DD} = 15V, V _O = 13.5V | | 3.0 | | | 3.0 | | 3.0 | V |
| V _{IH} | High Level Input Voltage | I _O < 1 μA V _{DD} = 5V, V _O = 0.5V | 4.0 | | 4.0 | | | 4.0 | | V |
| | | V _{DD} = 10V, V _O = 1V | 8.0 | | 8.0 | | | 8.0 | | V |
| | | V _{DD} = 15V, V _O = 1.5V | 12.0 | | 12.0 | | | 12.0 | | V |
| I _{OL} | Low Level Output Current (Note 3) | V _{DD} = 5V, V _O = 0.4V | 0.52 | | 0.44 | 0.88 | | 0.36 | | mA |
| | | V _{DD} = 10V, V _O = 0.5V | 1.3 | | 1.1 | 2.25 | | 0.9 | | mA |
| | | V _{DD} = 15V, V _O = 1.5V | 3.6 | | 3.0 | 8.8 | | 2.4 | | mA |
| I _{OH} | High Level Output Current (Note 3) | V _{DD} = 5V, V _O = 4.6V | -0.52 | | -0.44 | -0.88 | | -0.36 | | mA |
| | | V _{DD} = 10V, V _O = 9.5V | -1.3 | | -1.1 | -2.25 | | -0.9 | | mA |
| | | 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 |

AC Electrical Characteristics*

T_A = 25°C, C_L = 50 pF, R_L = 200 kΩ, t_r and t_f ≤ 20 ns, unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|--------------------------------------|--|-----------------------|-----|-----|-----|-------|
| t _{PHL} or t _{PLH} | Propagation Delay Time from Input to Output | V _{DD} = 5V | | 50 | 90 | ns |
| | | V _{DD} = 10V | | 30 | 60 | ns |
| | | V _{DD} = 15V | | 25 | 50 | ns |
| t _{THL} or t _{TLH} | Transition Time | V _{DD} = 5V | | 80 | 150 | ns |
| | | V _{DD} = 10V | | 50 | 100 | ns |
| | | V _{DD} = 15V | | 40 | 80 | ns |
| C _{IN} | Average Input Capacitance | Any Gate | | 6 | 15 | pF |
| C _{PD} | Power Dissipation Capacitance | Any Gate (Note 4) | | 12 | | pF |

*AC Parameters are guaranteed by DC correlated testing.

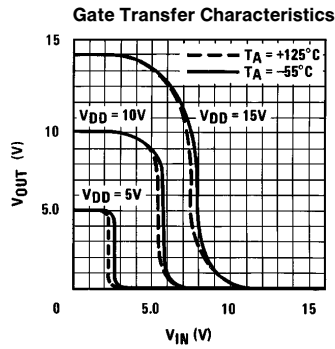
Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual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

Note 2: V_{SS} = 0V unless otherwise specified.

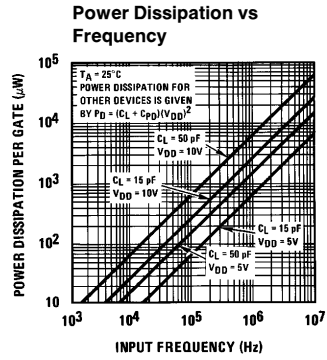
Note 3: I_{OH} and I_{OL} are tested one output at a time.

Note 4: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation, see 54C/74C Family Characteristics application note—AN-90.

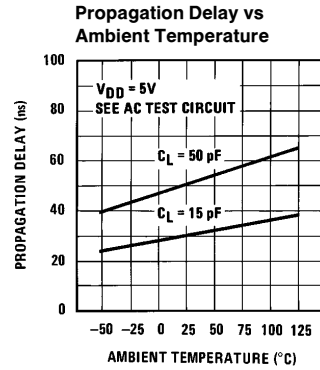
Typical Performance Characteristics



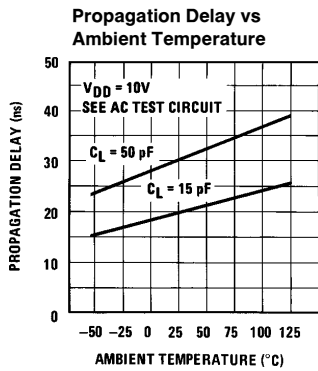
TL/F/5975-5



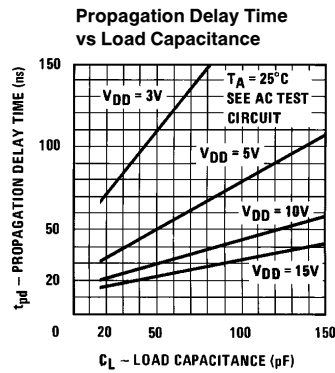
TL/F/5975-6



TL/F/5975-7

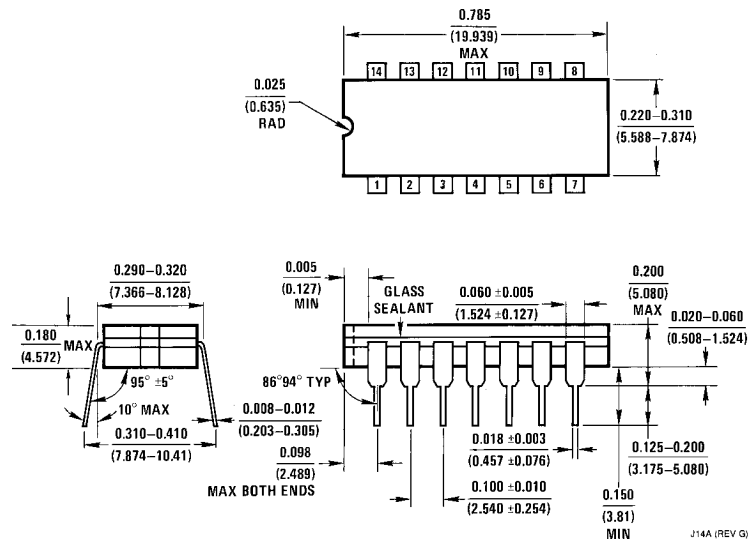


TL/F/5975-8



TL/F/5975-9

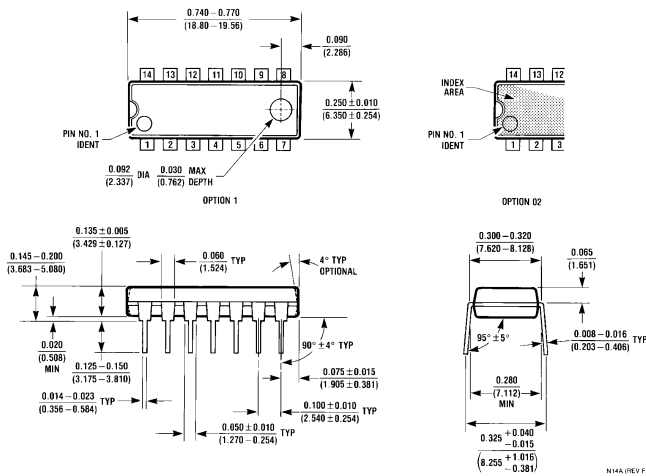
Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4069UBMJ or CD4069UBCJ
NS Package Number J14A

J14A (REV G)

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4069UBMN or CD4069UBCN
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.

| | | | |
|--|--|---|---|
|  <p>National Semiconductor Corporation 1111 West Bardin Road Arlington, TX 76017 Tel: 1(800) 272-9959 Fax: 1(800) 737-7018</p> | <p>National Semiconductor Europe Fax: (+49) 0-180-530 85 86 Email: cnjwge@tevm2.nsc.com Deutsch Tel: (+49) 0-180-530 85 85 English Tel: (+49) 0-180-532 78 32 Français Tel: (+49) 0-180-532 93 58 Italiano Tel: (+49) 0-180-534 16 80</p> | <p>National Semiconductor Hong Kong Ltd. 19th Floor, Straight Block, Ocean Centre, 5 Canton Rd. Tsimshatsui, Kowloon Hong Kong Tel: (852) 2737-1600 Fax: (852) 2736-9960</p> | <p>National Semiconductor Japan Ltd. Tel: 81-043-299-2309 Fax: 81-043-299-2408</p> |
|--|--|---|---|

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.