National Semiconductor

CD4069M/CD4069C Inverter Circuits

General Description

The CD4069B 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.

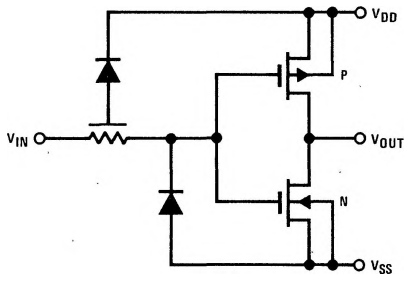
This device is intended for all general purpose inverter applications where the special characteristics of the MM74C901, MM74C903, MM74C907, and CD4049A Hex Inverter/Buffers are not required. In those applications requiring larger noise immunity the MM74C14 or MM74C914 Hex Schmitt Trigger is suggested.

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

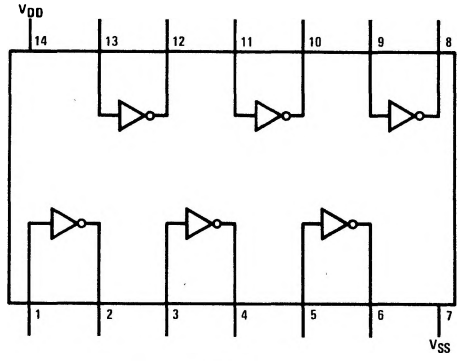
Features

- 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 Diagrams

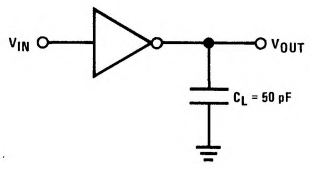


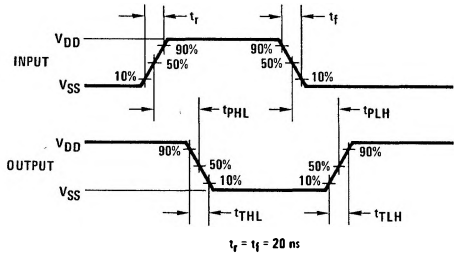
Dual-In-Line Package



TOP VIEW

AC Test Circuits and Switching Time Waveforms





$t_r = t_f = 20$ ns

Absolute Maximum Ratings

(Notes 1 and 2)

V_{DD} dc Supply Voltage	−0.5 to +18 V_{DC}
V_{IN} Input Voltage	−0.5 to V_{DD} +0.5 V_{DC}
T_S Storage Temperature Range	−65°C to +150°C
P_D Package Dissipation	500 mW
T_L Lead Temperature (Soldering, 10 seconds)	300°C

Recommended Operating Conditions

(Note 2)

V_{DD} dc Supply Voltage	3 to 15 V_{DC}
V_{IN} Input Voltage	0 to V_{DD} V_{DC}
T_A Operating Temperature Range	
CD4069M	−55°C to +125°C
CD4069C	−40°C to +85°C

DC Electrical Characteristics

CD4069M (Note 2)

PARAMETER		CONDITIONS	−55°C		25°C			125°C		UNITS
			MIN	MAX	MIN	TYP	MAX	MIN	MAX	
I_{DD}	Quiescent Device Current	V_{DD} = 5V		0.25			0.25		7.5	μA
		V_{DD} = 10V		0.5			0.5		15	μA
		V_{DD} = 15V		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		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 9V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$\|I_O\| < 1\mu A$								
		V_{DD} = 5V, V_O = 0.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current	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	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

DC Electrical Characteristics CD4069C (Note 2)

PARAMETER		CONDITIONS	−40°C		25°C			85°C		UNITS
			MIN	MAX	MIN	TYP	MAX	MIN	MAX	
I_{DD}	Quiescent Device Current	V_{DD} = 5V		1.0			1.0		7.5	μA
		V_{DD} = 10V		2.0			2.0		15	μA
		V_{DD} = 15V		4.0			4.0		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			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	$\|I_O\| < 1\mu A$								
		V_{DD} = 5V, V_O = 4.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 9V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 13.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$\|I_O\| < 1\mu A$								
		V_{DD} = 5V, V_O = 0.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current	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		8.0	8.8		2.4		mA
I_{OH}	High Level Output Current	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		−8.0	−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 $T_A = 25°C$, $C_L = 50\,pF$, $R_L = 200\,k\Omega$, t_r and $t_f \leq 20\,ns$, unless otherwise specified

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	7.5	pF
C_{PD}	Power Dissipation Capacitance	Any Gate (Note 3)		12		pF

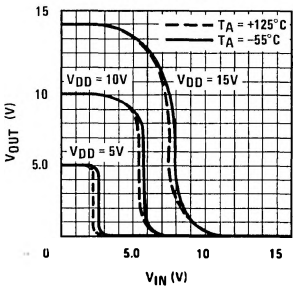
Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual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

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

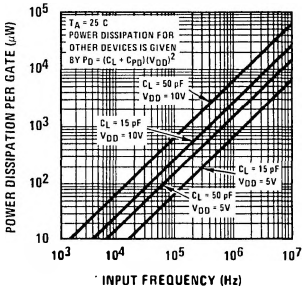
Note 3: C_{PD} determines the no load ac power consumption of any CMOS device. For complete explanation, see 54C/74C Family Characteristics application note—AN-90.

Typical Performance Characteristics

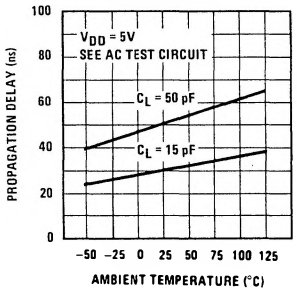
Gate Transfer Characteristics



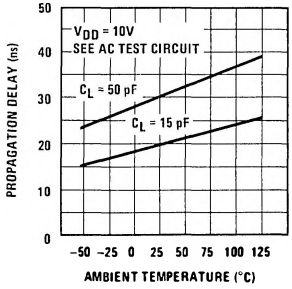
Power Dissipation vs Frequency



Propagation Delay vs Ambient Temperature



Propagation Delay vs Ambient Temperature



Propagation Delay Time vs Load Capacitance