

## CMOS Hex Inverter

High-Voltage Types (20-Volt Rating)

■ CD4069UB types consist of six CMOS inverter circuits. These devices are intended for all general-purpose inverter applications where the medium-power TTL-drive and logic-level-conversion capabilities of circuits such as the CD4009 and CD4049 Hex Inverter/Buffers are not required.

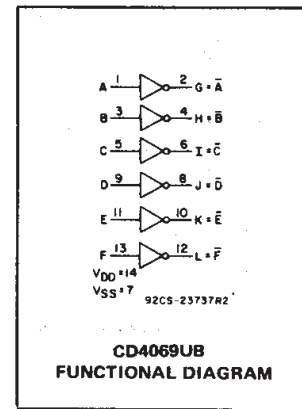
The CD4069UB-Series types are supplied in 14-lead hermetic dual-in-line ceramic packages (D and F suffixes), 14-lead dual-in-line plastic package (E suffix), and in chip form (H suffix).

### Features:

- Standardized symmetrical output characteristics
- Medium Speed Operation— $t_{PHL}, t_{PLH}=30$  ns (typ.) at 10 V
- 100% tested for quiescent current at 20 V
- Maximum input current of 1  $\mu$ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

### Applications:

- Logic inversion
- Pulse shaping
- Oscillators
- High-input-impedance amplifiers



### 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

### 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 $V_{DD} + 0.5V$
DC INPUT CURRENT, ANY ONE INPUT	..... $\pm 10$ mA
POWER DISSIPATION PER PACKAGE ( $P_D$ ):	
For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$	..... 500 mW
For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$	..... Derate Linearly at 12 mW/°C to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (All Package Types)	..... 100 mW
OPERATING-TEMPERATURE RANGE ( $T_A$ )	..... $-55^\circ\text{C}$ to $+125^\circ\text{C}$
STORAGE TEMPERATURE RANGE ( $T_{stg}$ )	..... $-65^\circ\text{C}$ to $+150^\circ\text{C}$
LEAD TEMPERATURE (DURING SOLDERING):	
At distance 1/16 $\pm$ 1/32 inch (1.59 $\pm$ 0.79 mm) from case for 10s max	..... $+265^\circ\text{C}$

### DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$ ; Input $t_r, t_f = 20$ ns,

$C_L = 50$  pF,  $R_L = 200$  K $\Omega$

CHARACTERISTIC	CONDITIONS	LIMITS		UNITS	
		$V_{DD}$ V	Typ.		Max.
Propagation Delay Time; $t_{PLH}, t_{PHL}$	$V_{DD} = 5$	55	110	ns	
	$V_{DD} = 10$	30	60		
	$V_{DD} = 15$	25	50		
Transition Time; $t_{THL}, t_{TLH}$	$V_{DD} = 5$	100	200	ns	
	$V_{DD} = 10$	50	100		
	$V_{DD} = 15$	40	80		
Input Capacitance; $C_{IN}$	Any Input	10	15	pF	

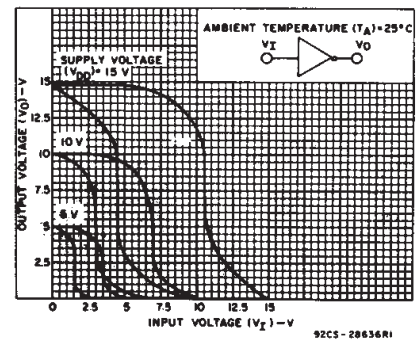


Fig. 1 — Minimum and maximum voltage transfer characteristics.

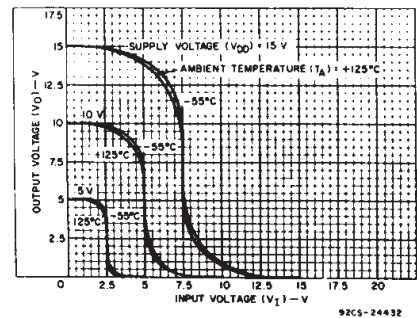


Fig. 2 — Typical voltage transfer characteristics as a function of temperature.

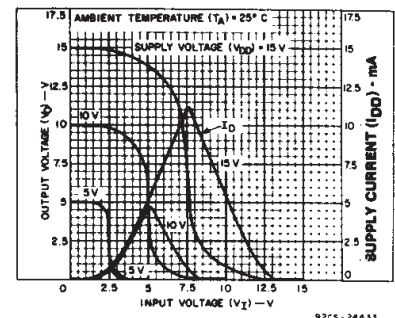


Fig. 3 — Typical current and voltage transfer characteristics.

# CD4069UB Types

## STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)	-55	-40	+85	+125	+25			
								Min.	Typ.	Max.	
Quiescent Device Current, 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 (Sink) Current 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 (Source) Current, 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: Low-Level, V <sub>OL</sub> Max.	-	5	5	0.05			-	0	0.05	-	V
	-	10	10	0.05			-	0	0.05	-	
	-	15	15	0.05			-	0	0.05	-	
Output Voltage: High-Level, V <sub>OH</sub> Min.	-	0	5	4.95			4.95	5	-	-	V
	-	0	10	9.95			9.95	10	-	-	
	-	0	15	14.95			14.95	15	-	-	
Input Low Voltage, V <sub>IL</sub> Max.	4.5	-	5	1			-	-	1	-	V
	9	-	10	2			-	-	2	-	
	13.5	-	15	2.5			-	-	2.5	-	
Input High Voltage, V <sub>IH</sub> Min.	0.5	-	5	4			4	-	-	-	V
	1	-	10	8			8	-	-	-	
	1.5	-	15	12.5			12.5	-	-	-	
Input Current I <sub>IN</sub> Max.		0,18	18	±0.1	±0.1	±1	±1	-	±10 <sup>-5</sup>	±0.1	μA

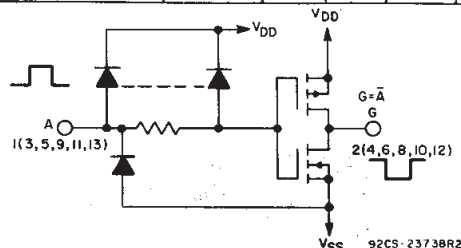


Fig. 6 - Schematic diagram of one of six identical inverters.

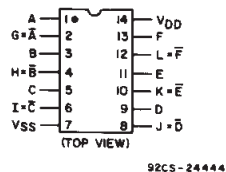


Fig. 7 - CD4069UB terminal assignment.

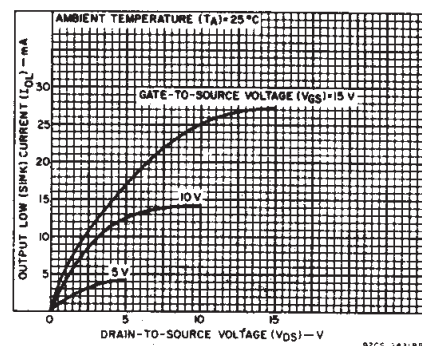


Fig. 4 - Typical output low (sink) current characteristics.

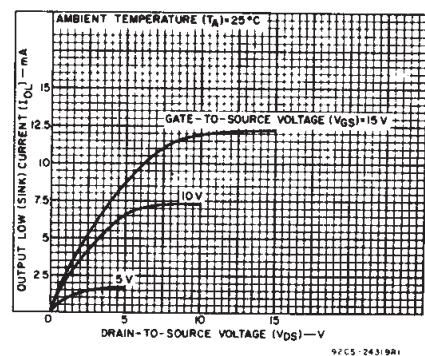


Fig. 5 - Minimum output low (sink) current characteristics.

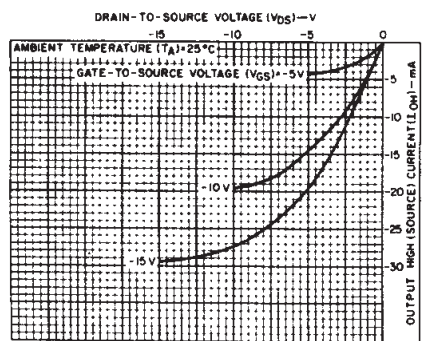


Fig. 8 - Typical output high (source) current characteristics.

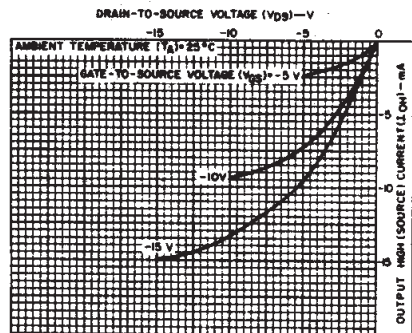


Fig. 9 - Minimum output high (source) current characteristics.

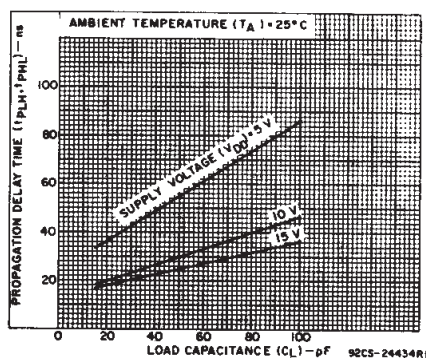


Fig. 10 - Typical propagation delay time vs. load capacitance.

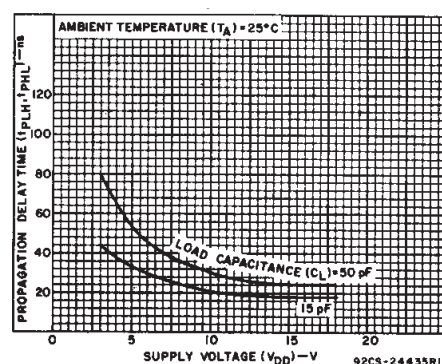


Fig. 11 - Typical propagation delay time vs. supply voltage.

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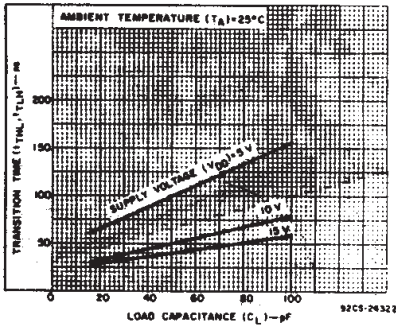


Fig. 12 - Typical transition time vs. load capacitance.

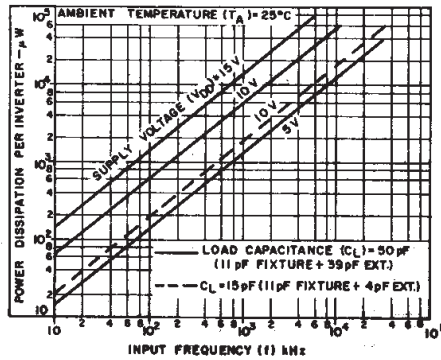


Fig. 13 - Typical dynamic power dissipation vs. frequency.

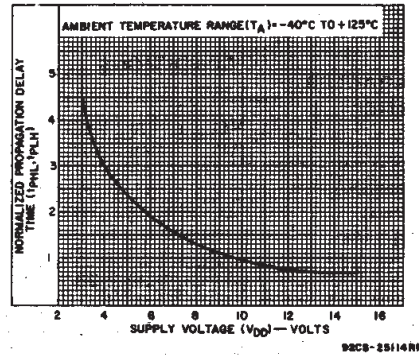


Fig. 14 - Variation of normalized propagation delay time (t<sub>PHL</sub> and t<sub>PLH</sub>) with supply voltage.

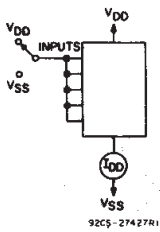


Fig. 15 - Quiescent device current test circuit.

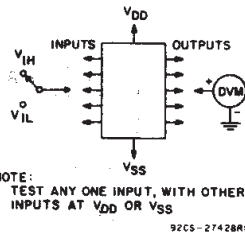


Fig. 16 - Noise immunity test circuit.

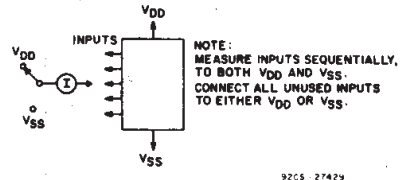


Fig. 17 - Input leakage current test circuit.

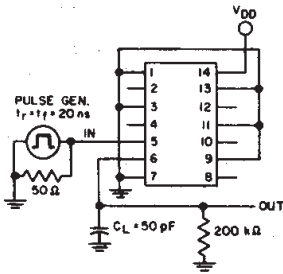
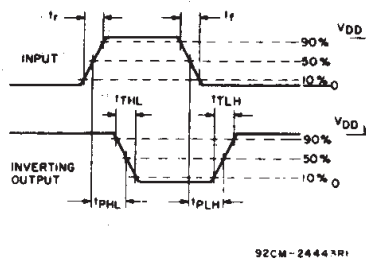


Fig. 18 - Dynamic electrical characteristics test circuit and waveforms.



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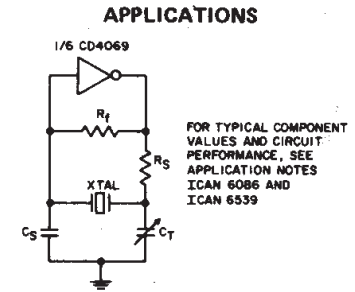


Fig. 19 - Typical crystal oscillator circuit.

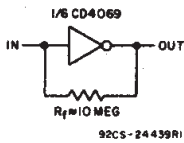


Fig. 20 - High-input impedance amplifier.

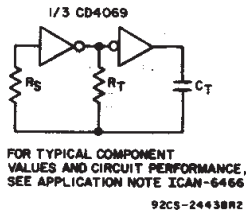
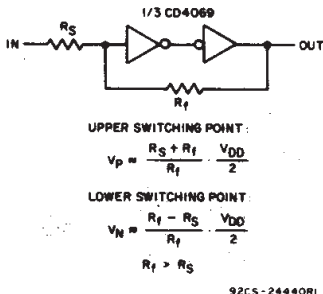


Fig. 21 - Typical RC oscillator circuit.



UPPER SWITCHING POINT:  

$$V_p = \frac{R_S + R_f}{R_f} \frac{V_{DD}}{2}$$
 LOWER SWITCHING POINT:  

$$V_N = \frac{R_f - R_S}{R_f} \frac{V_{DD}}{2}$$

$$R_f > R_S$$

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Fig. 22 - Input pulse shaping circuit (Schmitt trigger).

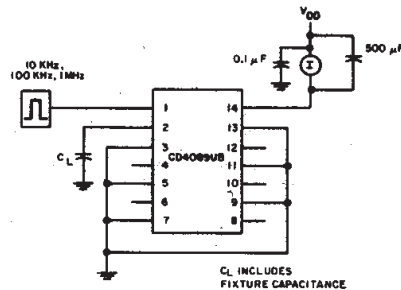
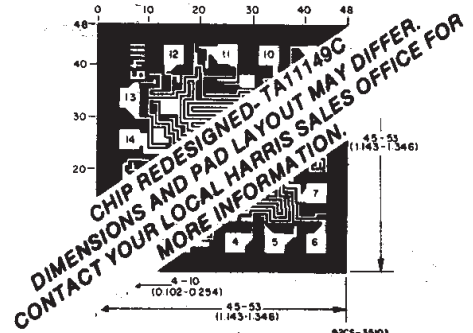


Fig. 23 - Dynamic power dissipation test circuit.



Dimensions and pad layout for CD4069UBH.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10<sup>-3</sup> inch).

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