

# MC14049UB

## Hex Buffers

The MC14049UB hex inverter/buffer is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. This complementary MOS device finds primary use where low power dissipation and/or high noise immunity is desired. This device provides logic-level conversion using only one supply voltage,  $V_{DD}$ . The input-signal high level ( $V_{IH}$ ) can exceed the  $V_{DD}$  supply voltage for logic-level conversions. Two TTL/DTL Loads can be driven when the device is used as CMOS-to-TTL/DTL converters ( $V_{DD} = 5.0\text{ V}$ ,  $V_{OL} \leq 0.4\text{ V}$ ,  $I_{OL} \geq 3.2\text{ mA}$ ). Note that pins 13 and 16 are not connected internally on this device; consequently connections to these terminals will not affect circuit operation.

### Features

- High Source and Sink Currents
- High-to-Low Level Converter
- Supply Voltage Range = 3.0 V to 18 V
- Meets JEDEC UB Specifications
- $V_{IN}$  can exceed  $V_{DD}$
- Improved ESD Protection on All Inputs
- Pb-Free Packages are Available\*

### MAXIMUM RATINGS (Voltages Referenced to $V_{SS}$ )

Symbol	Parameter	Value	Unit
$V_{DD}$	DC Supply Voltage Range	-0.5 to +18.0	V
$V_{in}$	Input Voltage Range (DC or Transient)	-0.5 to +18.0	V
$V_{out}$	Output Voltage Range (DC or Transient)	-0.5 to $V_{DD}$ +0.5	V
$I_{in}$	Input Current (DC or Transient) per Pin	$\pm 10$	mA
$I_{out}$	Output Current (DC or Transient) per Pin	+45	mA
$P_D$	Power Dissipation, per Package (Note 14) Plastic SOIC	825 740	mW
$T_A$	Ambient Temperature Range	-55 to +125	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature Range	-65 to +150	$^{\circ}\text{C}$
$T_L$	Lead Temperature (8-Second Soldering)	260	$^{\circ}\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

14. Temperature Derating: All Packages: See Figure 4.

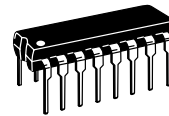
This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields referenced to the  $V_{SS}$  pin, only. Extra precautions must be taken to avoid applications of any voltage higher than the maximum rated voltages to this high-impedance circuit. For proper operation, the ranges  $V_{SS} \leq V_{in} \leq 18\text{ V}$  and  $V_{SS} \leq V_{out} \leq V_{DD}$  are recommended.



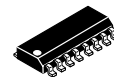
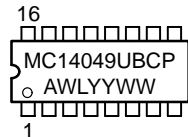
ON Semiconductor®

<http://onsemi.com>

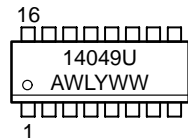
### MARKING DIAGRAMS



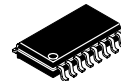
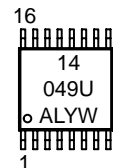
PDIP-16  
P SUFFIX  
CASE 648



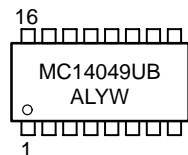
SOIC-16  
D SUFFIX  
CASE 751B



TSSOP-16  
DT SUFFIX  
CASE 948F



SOEIAJ-16  
F SUFFIX  
CASE 966



A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 145 of this data sheet.

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# MC14049UB

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.

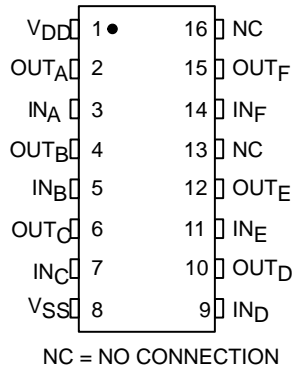


Figure 1. Pin Assignment

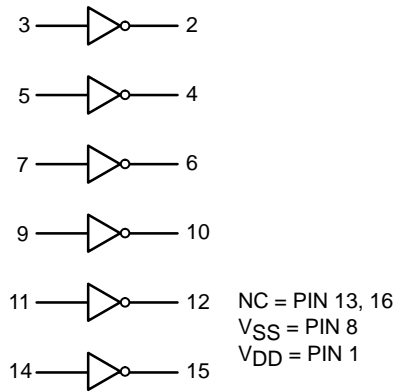


Figure 2. Logic Diagram  
MC14049UB

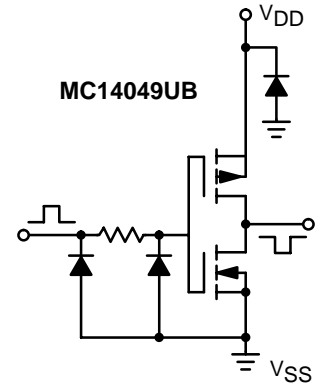


Figure 3. Circuit Schematic  
(1/6 of circuit shown)

## ELECTRICAL CHARACTERISTICS (Voltages Referenced to $V_{SS}$ )

Characteristic	Symbol	$V_{DD}$ Vdc	- 55°C		25°C			125°C		Unit	
			Min	Max	Min	Typ (Note 15)	Max	Min	Max		
Output Voltage $V_{in} = V_{DD}$ or 0	"0" Level	$V_{OL}$	5.0	-	0.05	-	0	0.05	-	0.05	Vdc
			10	-	0.05	-	0	0.05	-	0.05	
			15	-	0.05	-	0	0.05	-	0.05	
	"1" Level $V_{in} = 0$ or $V_{DD}$	$V_{OH}$	5.0	4.95	-	4.95	5.0	-	4.95	-	Vdc
			10	9.95	-	9.95	10	-	9.95	-	
			15	14.95	-	14.95	15	-	14.95	-	
Input Voltage ( $V_O = 4.5$ Vdc) ( $V_O = 9.0$ Vdc) ( $V_O = 13.5$ Vdc)	"0" Level	$V_{IL}$	5.0	-	1.0	-	2.25	1.0	-	1.0	Vdc
			10	-	2.0	-	4.50	2.0	-	2.0	
			15	-	2.5	-	6.75	2.5	-	2.5	
	"1" Level ( $V_O = 0.5$ Vdc) ( $V_O = 1.0$ Vdc) ( $V_O = 1.5$ Vdc)	$V_{IH}$	5.0	4.0	-	4.0	2.75	-	4.0	-	Vdc
			10	8.0	-	8.0	5.50	-	8.0	-	
			15	12.5	-	12.5	8.25	-	12.5	-	
Output Drive Current ( $V_{OH} = 2.5$ Vdc) ( $V_{OH} = 9.5$ Vdc) ( $V_{OH} = 13.5$ Vdc)	Source	$I_{OH}$	5.0	-1.6	-	-1.25	-2.5	-	-1.0	-	mAdc
			10	-1.6	-	-1.3	-2.6	-	-1.0	-	
			15	-4.7	-	-3.75	-10	-	-3.0	-	
	Sink ( $V_{OL} = 0.4$ Vdc) ( $V_{OL} = 0.5$ Vdc) ( $V_{OL} = 1.5$ Vdc)	$I_{OL}$	5.0	3.75	-	3.2	6.0	-	2.6	-	mAdc
			10	10	-	8.0	16	-	6.6	-	
			15	30	-	24	40	-	19	-	
Input Current	$I_{in}$	15	-	$\pm 0.1$	-	$\pm 0.000$ 01	$\pm 0.1$	-	$\pm 1.0$	$\mu$ Adc	
Input Capacitance ( $V_{in} = 0$ )	$C_{in}$	-	-	-	-	10	20	-	-	pF	
Quiescent Current (Per Package)	$I_{DD}$	5.0	-	1.0	-	0.002	1.0	-	30	$\mu$ Adc	
		10	-	2.0	-	0.004	2.0	-	60		
		15	-	4.0	-	0.006	4.0	-	120		
Total Supply Current (Note 16 and 17) (Dynamic plus Quiescent, Per Package) ( $C_L = 50$ pF on all outputs, all buffers switching)	$I_T$	5.0	$I_T = (1.8 \mu\text{A/kHz}) f + I_{DD}$							$\mu$ Adc	
		10	$I_T = (3.5 \mu\text{A/kHz}) f + I_{DD}$								
		15	$I_T = (5.3 \mu\text{A/kHz}) f + I_{DD}$								

15. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

16. The formulas given are for the typical characteristics only at 25°C.

17. To calculate total supply current at loads other than 50 pF:

## MC14049UB

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) Vfk$$

where:  $I_T$  is in  $\mu\text{A}$  (per package),  $C_L$  in pF,  $V = (V_{DD} - V_{SS})$  in volts,  $f$  in kHz is input frequency, and  $k = 0.002$ .

# MC14049UB

## SWITCHING CHARACTERISTICS (Note 18) ( $C_L = 50 \text{ pF}$ , $T_A = 25^\circ\text{C}$ )

Characteristic	Symbol	$V_{DD}$ Vdc	Min	Typ (Note 19)	Max	Unit
Output Rise Time $t_{TLH} = (0.8 \text{ ns/pF}) C_L + 60 \text{ ns}$ $t_{TLH} = (0.3 \text{ ns/pF}) C_L + 35 \text{ ns}$ $t_{TLH} = (0.27 \text{ ns/pF}) C_L + 26.5 \text{ ns}$	$t_{TLH}$	5.0 10 15	- - -	100 50 40	160 100 60	ns
Output Fall Time $t_{THL} = (0.3 \text{ ns/pF}) C_L + 25 \text{ ns}$ $t_{THL} = (0.12 \text{ ns/pF}) C_L + 14 \text{ ns}$ $t_{THL} = (0.1 \text{ ns/pF}) C_L + 10 \text{ ns}$	$t_{THL}$	5.0 10 15	- - -	40 20 15	60 40 30	ns
Propagation Delay Time $t_{PLH} = (0.38 \text{ ns/pF}) C_L + 61 \text{ ns}$ $t_{PLH} = (0.20 \text{ ns/pF}) C_L + 30 \text{ ns}$ $t_{PLH} = (0.11 \text{ ns/pF}) C_L + 24.5 \text{ ns}$	$t_{PLH}$	5.0 10 15	- - -	80 40 30	120 65 50	ns
Propagation Delay Time $t_{PHL} = (0.38 \text{ ns/pF}) C_L + 11 \text{ ns}$ $t_{PHL} = (0.12 \text{ ns/pF}) C_L + 9 \text{ ns}$ $t_{PHL} = (0.11 \text{ ns/pF}) C_L + 4.5 \text{ ns}$	$t_{PHL}$	5.0 10 15	- - -	30 15 10	60 30 20	ns

18. The formulas given are for the typical characteristics only at  $25^\circ\text{C}$ .

19. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

## ORDERING INFORMATION

Device	Package	Shipping†
MC14049UBCP	PDIP-16	2,000 Units / Box
MC14049UBCPG	PDIP-16 (Pb-Free)	2,000 Units / Box
MC14049UBD	SOIC-16	2,400 Units / Box
MC14049UBDG	SOIC-16 (Pb-Free)	2,400 Units / Box
MC14049UBDR2	SOIC-16	2,500 / Tape & Reel
MC14049UBDR2G	SOIC-16 (Pb-Free)	2,500 / Tape & Reel
MC14049UBDT	TSSOP-16	96 Units / Rail
MC14049UBDTEL	TSSOP-16*	96 Units / Rail
MC14049UBDTR2	TSSOP-16*	2,500 / Tape & Reel
MC14049UBF	SOEIAJ-16	See Note 20
MC14049UBFEL	SOEIAJ-16	See Note 20

20. For ordering information on the EIAJ version of the SOIC packages, please contact your local ON Semiconductor representative.

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*This package is inherently Pb-Free.

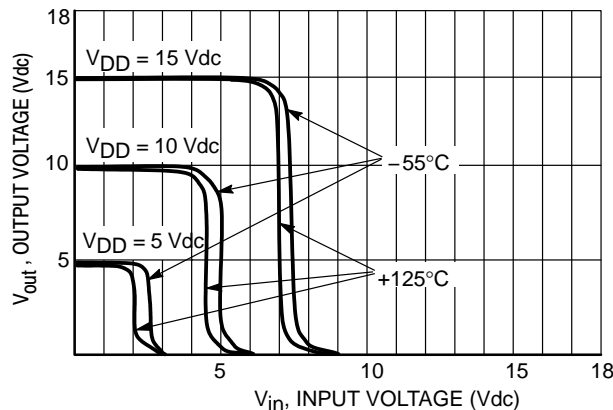


Figure 4. Typical Voltage Transfer Characteristics versus Temperature

# MC14049UB

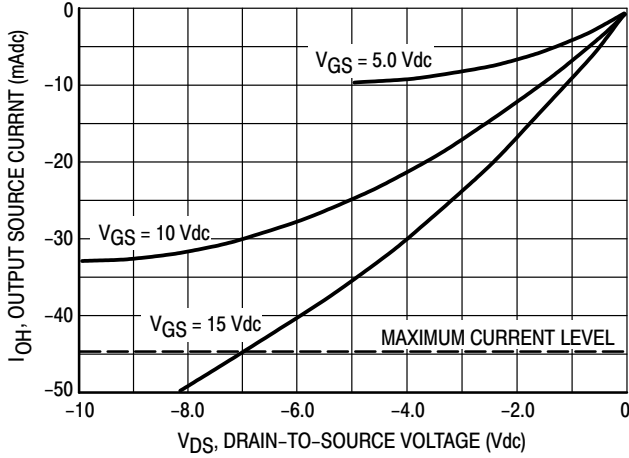
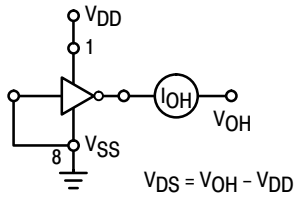


Figure 5. Typical Output Source Characteristics

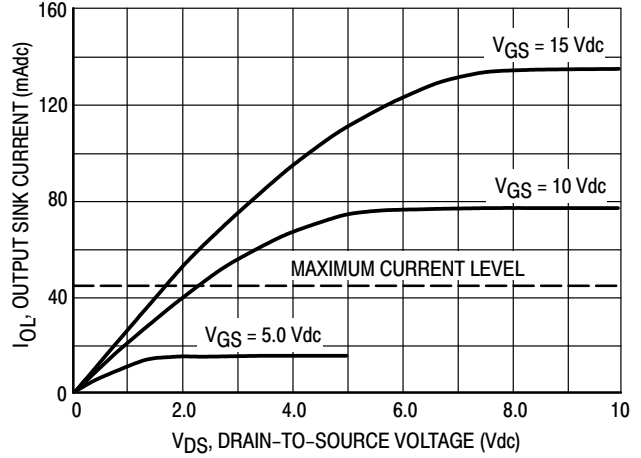
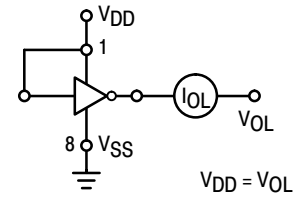


Figure 6. Typical Output Sink Characteristics

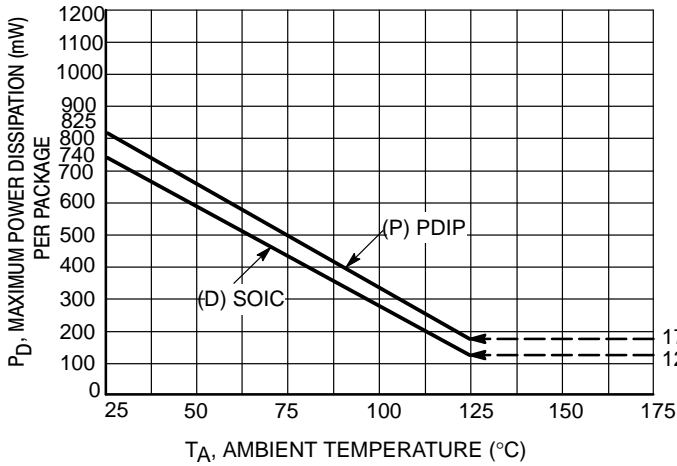


Figure 7. Ambient Temperature Power Derating

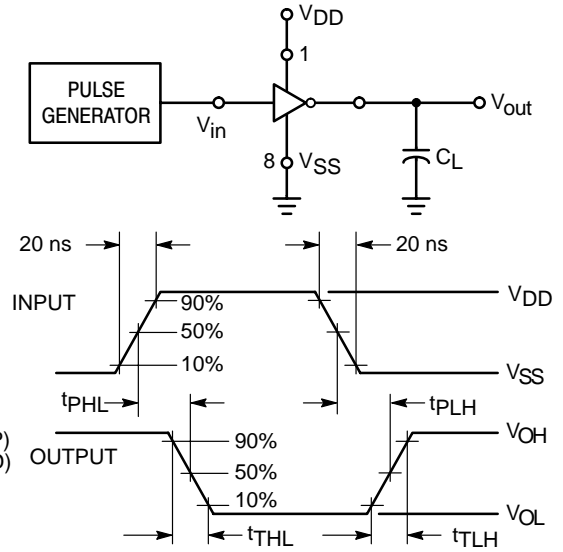


Figure 8. Switching Time Test Circuit and Waveforms