MC14009AL MC14009CL MC14009CP MC14010AL MC14010CL MC14010CP

HEX BUFFERS

The MC14009 hex inverter/buffer and MC14010 noninverting hex buffer are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These complementary MOS devices find primary use where low power dissipation and/or high noise immunity is desired. Both devices can be used as current "sink" or "source" drivers, as CMOS-to-CMOS or CMOS-to-bipolar (TTL or DTL) logic level converters, or as multiplexers (1-to-6). The MC14009 also provides the invert function.

- Quiescent Power Dissipation = 50 nW/package typical
- High Current Sinking Capability
 8.0 mA minimum @ VOL = 0.5 V and VDD = 10 V
- Supply Voltage Range = 3.0 Vdc to 18 Vdc (MC14009/10 AL)
- Supply Voltage Range = 3.0 Vdc to 18 Vdc (MC14009/10 AL)
 3.0 Vdc to 16 Vdc (MC14009/10CL/CP)
- Wide CMOS-to-Bipolar Conversion Range -

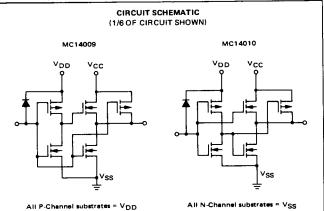
From MCMOS operating with specified supply voltage range to TTL or DTL operating with ± 3.0 V to ± 6.0 V supply. Conversion with logic output levels ≥ 6.0 V is permitted if VCC \leq VDD.

Pin for Pin Replacement for CD4009A -- MC14009
 CD4010A -- MC14010

MAXIMUM RATINGS (Voltages referenced to V_{SS}, Pin8)

Rating	Symbol	Value	Unit
DC Supply Voltage (V _{CC} ≤V _{DD}) -AL Version CL,CP Version	V _{DD}	+18 to -0.5 +16 to -0.5	Vdc
Input Voltage, All Inputs	Vin	V _{DD} to -0.5	Vdc
DC Current Drain per Pin*	ı	10	mAdc
Operating Temperature Range —AL Version CL,CP Version	TA	-55 to +125 -40 to +85	°C
Storage Temperature Range	T _{stg}	-65 to +150	°c

^{*}Buffered Outputs may supply higher current.

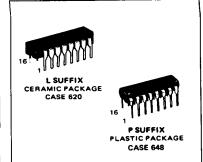


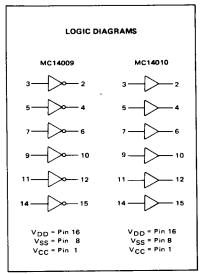
McMOS

(LOW-POWER COMPLEMENTARY MOS)

HEX BUFFERS

Inverting — MC14009A L/CL/CP Noninverting — MC14010A L/CL/CP





See Mechanical Data Section for package dimensions

MC14009, MC14010 (continued)

ELECTRICAL CHARACTERISTICS

Charterwine Page Symbol Wish								<u></u>	MC14009/10AL MC14009/10CL/CP										1			
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TPHL * (10.05 nt/pF) CL + 5.0 ns 10	10 5.0 - - - 8.0 25 - - - - 8.0 35 - - - 8.0 35 - - - - 8.0 35 - - - - 8.0 35 - - - - - 8.0 35 - - - - - 8.0 35 - - - - - - - - -	tput = (0.08 ns/oF) Cr + 6.0 ns	1										1 1									1
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Tept. = (0.38 ns/pF) CL + 19 ns 10	10	tpHL = (0.03 ns/pF) CL + 5.0 ns			1	15	5.0		-	-	5.0	•	- 1			-						1
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TepH_ = (10.06 m/gF) C_t + 14 ns	15	tpHL = (0.38 ns/pF) CL + 19 ns						- 1		-			-	- [-					-	-	ı
tent (10.08 ni/6F) Ct + 14 ns	10 5.0 - - 15 25 - - - 15 35 - -	tens = (0.06 or/oF) C; + 14																			-	ı
TPH_ = (0.09 nr/6F) C_t + 9.0 ns	19 Ansigh C L + 9.0 ms 4	tpH = (0.08 ns/nF) Cr + 14 ns														- 1						l
Un-OHD Delay Time** (C_ = 15 pc) MC14009/10 1p_L + (1.0 ns/pc) C_ + 35 ns 1p_L + (0.34 ns/pc) C_ + 19 ns 1p_L + (0.34 ns/pc) C_ + 18 ns 15	#** 4	tPHL = (0.09 ns/pF) CL + 9.0 ns	ļ					-		-		-	-	_	<u> </u>	_ [ء ا			1
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tpt_H * (1.0 n/s)F i C_t * 35 ns 50 50 - - - 50 80 - - - - 50 100 tpt_H * (0.04 m/s)F i C_t * 15 ns 10 0 - - 25 55 - - - - 25 70 tpt_H * (0.34 m/s)F i C_t * 15 ns 15 15 15 - - 20 - - - - 25 40 tpt_H * (0.16 m/s)F i C_t * 18 ns 15 5.0 - - 20 - - - - 20 MC14009 1 1 5.0 5.0 - - - 20 - - - - - 20 - - - - - 20 - - - - - 20 - <td> 40 ns/pF C_1 + 19 ns 10 10 - - 25 55 - - - - 25 70 - - 28 18 18 18 19 19 19 19 1</td> <td>(C_L = 15 pF)</td> <td>Ì</td> <td></td> <td> </td> <td>l</td> <td>l</td> <td></td> <td>1</td> <td> </td> <td> </td> <td>ļ</td> <td>] </td> <td> </td> <td></td> <td></td> <td> </td> <td></td> <td>l i</td> <td>1 1</td> <td></td> <td>Ι ຶ</td>	40 ns/pF C_1 + 19 ns 10 10 - - 25 55 - - - - 25 70 - - 28 18 18 18 19 19 19 19 1	(C _L = 15 pF)	Ì			l	l		1			ļ]						l i	1 1		Ι ຶ
tpt, # 10.40 nt/pF1 Ct + 19 ns tpt, # 10.40 nt/pF1 Ct + 19 ns tpt, # 10.34 nt/pF1 Ct + 15 ns tpt, # 10.34 nt/pF1 Ct + 20 ns tpt, # 10.36 nt/pF1 Ct + 18 ns tpt, # 10.36 nt/pF1 Ct + 18 ns tpt, # 10.36 nt/pF1 Ct + 18 ns tpt, # 10.36 nt/pF1 Ct + 20 ns tpt, # 10.40 nt/pF1 Ct + 44 ns tpt, # 10.40 nt/pF1 Ct + 20 ns tpt, # 10.50 nt/pF1 Ct + 20 ns	40 ns/pF C_1 + 19 ns 10 10 - - 25 55 - - - - 25 70 - - 28 18 18 18 19 19 19 19 1						١			i .					ŀ					1 1		1
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utput Rise Trime** (2 - 15 pF) MC14009 1; + (2.4 ns/pF) CL + 24 ns 1; + (1.0 ns/pF) CL + 20 ns 10 10 38 100 38 120 1; + (1.0 ns/pF) CL + 20 ns 10 10 38 100 38 120 1; + (1.8 ns/pF) CL + 20 ns 15 15 30 30 120 1; + (1.8 ns/pF) CL + 56 ns 1; + (0.76 ns/pF) CL + 29 ns 10 10 50 100 50 120 1; + (0.6 ns/pF) CL + 21 ns 15 15 30 30	A	tPLH = (0.16 ns/pF) CL + 18 ns	J			15				-												l
12 15. pF) MC14029 1y + (12. ns/pF) C_1 + 44 ns 1y + (10. ns/pF) C_2 + 20 ns 10 10 35 100 30 180 1y + (10.82 ns/pF) C_2 + 20 ns 15 15 30 30 30 120 1y + (10.82 ns/pF) C_1 + 36 ns 1y + (0.76 ns/pF) C_2 + 39 ns 10 10 50 100 50 120 1y + (0.6 ns/pF) C_2 + 21 ns 15 15 30 30 120 1y + (0.6 ns/pF) C_2 + 21 ns 15 15 30 30 120 1y + (0.6 ns/pF) C_2 + 21 ns 15 15 30		utput Rise Time**		4	tr		1	П	_	П	\vdash		\vdash	-	\dashv		\dashv		$\overline{}$	Н		,
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t, * (0.62 ns/pF) C_t + 20 ns 15 15 - - 30 - - - 30 - MC14010 t, * (1.6 ns/pF) C_t + 56 ns 5.0 5.0 - - - 80 125 -	15 15 30 30 10 160 - 10 160 10 160 - 10 160 10 160 - 10 160 10 160 - 10 160 10 160 - 10 160 - 10 160 10 160 - 1	tr = (1 0 ns/nF) Cr + 20 ns	1		l .								-	-	- [-	- 			-		ı
MC14010 t; *16 nt/pF) Ct; *56 ns t; *(0.76 nt/pF) Ct; *56 ns t; *(0.76 nt/pF) Ct; *21 ns 10 10 50 100 50 120 t; *(0.8 nt/pF) Ct; *21 ns 15 15 30 30 120 utout Fall True** (Ct; *15 pF) MC14029 t; *(0.20 nt/pF) Ct; *9.0 ns t; *(0.10 nt/pF) Ct; *7.0 ns 10 10 9.0 40 13 80 10 10 9.0 40 13 80	10 C1 + 56 ns	t _r = (0.62 ns/pF) C ₁ + 20 ns						_		🗓		.00	_ 1	_ []	: I		<u>-</u>		120	-	<u>-</u>	l
t, = 11.6 nst/pFi C _L + 26 ns t, = (0.76 nst/pFi C _L + 29 ns t, = (0.6 nst/pFi C _L + 21 ns 15 15 30 30 30 30	10 10 50 100 50 100 50 120 120 120 150 120		ļ			<u> </u>	ــــــــــــــــــــــــــــــــــــــ	ш		\sqcup							لللل	~~	لئا	لبتط		
t ₇ = (0.76 nt/pF) C ₄ = 39 ns t ₇ = (0.8 nt/pF) C ₄ = 21 ns 15	10 10 50 100 50 120 120 120 150 120		ŀ			5.0	5.0	_	_	ا ۔ ا	80	125	_ I	_ I	_ [_ 1	_ 1	an l	160			İ
t _T = (0.6 ns/pF) C _L + 21 ns	15 15 - - 30 - - - 30 - - - 30 - -	$t_r = (0.76 \text{ ns/pF}) C_1 + 39 \text{ ns}$	ļ					-		-			_		_ [I			- I	1	ı
Upot Fall Time ** (C _L * 15 pF) MC14009 1* * (0.22 ns/pF) C _L * 9.0 ns 1* * (0.10 ns/pF) C _L * 7.0 ns 10 10 9.0 40 13 60	14 ty	t _r = (0.6 ns/pF) C _L + 21 ns			L	15		ᄓ		~			-	- 1	-	- 1	-		-	-	-	1
(C ₄ • 15 pF) MC14009 (+ (0.22 nt/pF) C ₄ • 90 ns (+ (0.10 nt/pF) C ₄ • 70 ns	11/0F1 CL + 90 ns 15.0	utput Fall Time **		4	ч									\neg				$\neg \neg$		П		,
ty * (0.22 ns/pF) C _L * 9 0 ns 50 50 13 45 13 60 14 * (0.10 ns/pF) C _L * 7 0 ns 10 10 10 9 0 40 1 - 1 2 0 50 50 15 € (0.10 ns/pF) C _L * 7 0 ns 10 10 10 9 0 40 1 - 1 2 0 50 50 15 € (0.10 ns/pF) C _L * 7 0 ns 10 10 10 10 10 10 10 10 10 10 10 10 10	10 10 9.0 40 9.0 50 15 15 70 25 45 25 60 15 15 25 45 25 60	(CL * 15 pF)					l	ı i					I	ŀ	- [- 1	l					
14 • (0.10 ns/pF) C ₁ + 7.0 ns	10 10 9.0 40 9.0 50 15 15 70 25 45 25 60 15 15 25 45 25 60	MC14009					٠,	ļ ļ			ا ا	ا ـ ا	ļļ	ŀ	- 1	ı	ļ	_ 1	ا ا			ı
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	st/oFI CL + 22 ns	ty = (0.22 ns/pF) C _L + 9.0 ns										**	-	_ []					50		-	l
		ty = (0.22 ns/pF) C _L + 9.0 ns ty = (0.10 ns/pF) C _L + 7.0 ns																				
		$t_f = (0.22 \text{ ns/pF}) \text{ C}_L + 9.0 \text{ ns}$ $t_f = (0.10 \text{ ns/pF}) \text{ C}_L + 7.0 \text{ ns}$ $t_f = (0.07 \text{ ns/pF}) \text{ C}_L + 6.0 \text{ ns}$	1				'"			_	, ° I	1	-	_ 1	_ [-	- 1	′ ′ 1	-	- 1	-	
		ty = (0.22 ns/pF) C _L + 9.0 ns ty = (0.10 ns/pF) C _L + 7.0 ns	:					Ш		H		45	-		-	_	-	\dashv	- FC	H	\dashv	

*DC Noise Margin (VNH, VNL) is defined as the maximum voltage change, from an ideal "1" or "0" input level, before producing an output state change.
**The formula given is for the typical characteristics only.

FIGURE 1 - CURRENT AND VOLTAGE TRANSFER CHARACTERISTICS TEST CIRCUIT

FIGURE 2 - TYPICAL VOLTAGE AND CURRENT TRANSFER CHARACTERISTICS versus TEMPERATURE

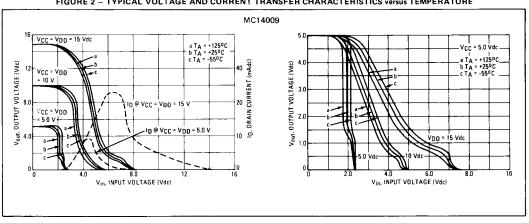


FIGURE 3 — TYPICAL VOLTAGE TRANSFER CHARACTERISTICS versus TEMPERATURE

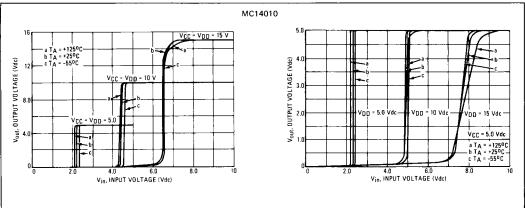
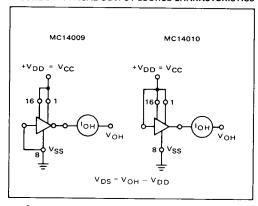


FIGURE 4 - SWITCHING TIME TEST CIRCUIT AND WAVEFORMS 20 ns ~ - 20 ns V_{DD} Input VDD VCC 50% - 10% tPHL. Voн Pulse 90% Output MC14009 50% Generator 10% VOL Output MC14010 #Invert on MC14009 only

FIGURE 5 - TYPICAL OUTPUT SOURCE CHARACTERISTICS



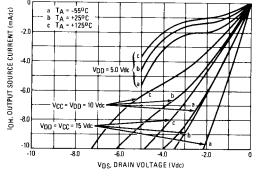
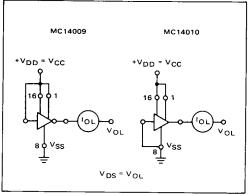
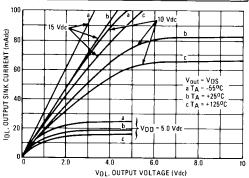


FIGURE 6 - TYPICAL OUTPUT SINK CHARACTERISTICS





This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that V_{in} and V_{out} be constrained to the range $V_{SS} \leqslant (V_{in} \text{ or } V_{out}) \leqslant V_{DD}.$

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either VSS or VDD)

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