

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.

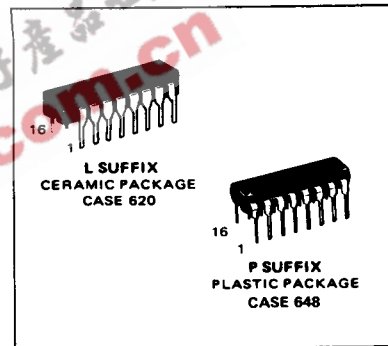
- Quiescent Power Dissipation = 50 nW/package typical
- High Current Sinking Capability
8.0 mA minimum @ $V_{OL} = 0.5\text{ V}$ and $V_{DD} = 10\text{ V}$
- Supply Voltage Range = 3.0 Vdc to 18 Vdc (MC14009/10 AL)
3.0 Vdc to 16 Vdc (MC14009/10CL/CP)
- Wide CMOS-to-Bipolar Conversion Range –
From MCMOS 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 $> 6.0\text{ V}$ is permitted if $V_{CC} \leq V_{DD}$.
- Pin for Pin Replacement for CD4009A – MC14009
CD4010A – MC14010

McMOS

(LOW-POWER COMPLEMENTARY MOS)

HEX BUFFERS

Inverting – MC14009AL/CL/CP
 Noninverting – MC14010AL/CL/CP

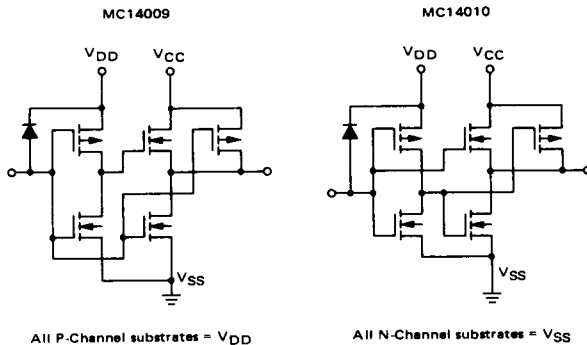


MAXIMUM RATINGS (Voltages referenced to V_{SS} , Pin 8)

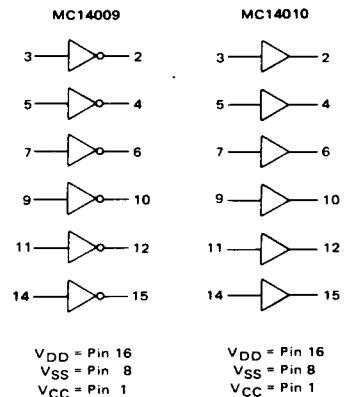
Rating	Symbol	Value	Unit
DC Supply Voltage ($V_{CC} \leq V_{DD}$) –AL Version CL,CP Version	V_{DD}	+18 to -0.5 +16 to -0.5	Vdc
Input Voltage, All Inputs	V_{in}	V_{DD} to -0.5	Vdc
DC Current Drain per Pin*	I	10	mAdc
Operating Temperature Range –AL Version CL,CP Version	T_A	-55 to +125 -40 to +85	$^{\circ}\text{C}$
Storage Temperature Range	T_{stg}	-65 to +150	$^{\circ}\text{C}$

*Buffered Outputs may supply higher current.

CIRCUIT SCHEMATIC
(1/6 OF CIRCUIT SHOWN)



LOGIC DIAGRAMS



See Mechanical Data Section for package dimensions.

MC14009, MC14010 (continued)

ELECTRICAL CHARACTERISTICS

Characteristic	Figure	Symbol	V _{DD} Vdc	V _{CC} Vdc	MC14009/10AL						MC14009/10CL/CP						Unit
					-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		
					Min	Max	Min	Typ	Max	Min	Max	Min	Max	Min	Typ	Max	
Output Voltage MC14009 (V _{in} = 5.0 Vdc) (V _{in} = 10 Vdc) (V _{in} = 15 Vdc) MC14010 (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) MC14009 (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) MC14010 (V _{in} = 5.0 Vdc) (V _{in} = 10 Vdc) (V _{in} = 15 Vdc)	1,2,3	V _{out}	5.0 10 15	5.0 10 15	- 0.01 -	- 0 0	0.01 0.01 -	- 0.05 -	- 0.01 -	- 0 0	0.01 0.01 -	- 0.01 -	- 0 0	0.01 0.01 -	- 0.05 -	Vdc	
MC14009 (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) MC14010 (V _{in} = 5.0 Vdc) (V _{in} = 10 Vdc) (V _{in} = 15 Vdc)	"0" Level		5.0 10 15	5.0 10 15	- 0.01 -	- 0 0	0.01 0.01 -	- 0.05 -	- 0.01 -	- 0 0	0.01 0.01 -	- 0.01 -	- 0 0	0.01 0.01 -	- 0.05 -	Vdc	
MC14009 (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) (V _{in} = 0 Vdc) MC14010 (V _{in} = 5.0 Vdc) (V _{in} = 10 Vdc) (V _{in} = 15 Vdc)	"1" Level		5.0 10 15	5.0 10 15	4.99 9.99 -	4.99 9.99 15	5.0 10 15	- 4.95 -	4.99 9.95 -	4.99 9.99 -	4.99 9.99 15	5.0 10 15	- 4.95 -	4.95 9.95 -	Vdc		
Noise Immunity* MC14009 (V _{out} ≥ 3.5 Vdc) (V _{out} ≥ 7.0 Vdc) (V _{out} ≥ 10.5 Vdc) MC14010 (V _{out} ≤ 1.5 Vdc) (V _{out} ≤ 3.0 Vdc) (V _{out} ≤ 4.5 Vdc) MC14009 (V _{out} ≤ 1.5 Vdc) (V _{out} ≤ 3.0 Vdc) (V _{out} ≤ 4.5 Vdc) MC14010 (V _{out} ≥ 3.5 Vdc) (V _{out} ≥ 7.0 Vdc) (V _{out} ≥ 10.5 Vdc)	-	V _{NL} V _{NH} V _{NL} V _{NH}	5.0 10 15	5.0 10 15	1.0 2.0 -	1.0 2.0 4.5	2.0 3.0 4.5	- 0.9 -	- 1.2 -	- 1.0 -	- 2.0 4.5	2.0 3.0 4.5	- 0.9 -	- 1.9 -	Vdc		
MC14009 (V _{out} ≤ 1.5 Vdc) (V _{out} ≤ 3.0 Vdc) (V _{out} ≤ 4.5 Vdc) MC14010 (V _{out} ≥ 3.5 Vdc) (V _{out} ≥ 7.0 Vdc) (V _{out} ≥ 10.5 Vdc)		V _{NL} V _{NH}	5.0 10 15	5.0 10 15	1.5 3.0 -	1.5 3.0 6.75	2.25 4.5 6.75	- 1.4 -	- 2.9 -	- 1.5 -	- 3.0 6.75	2.25 4.5 6.75	- 1.4 -	- 2.9 -	Vdc		
MC14009 (V _{out} ≥ 3.5 Vdc) (V _{out} ≥ 7.0 Vdc) (V _{out} ≥ 10.5 Vdc)		V _{NH}	5.0 10 15	5.0 10 15	1.4 2.9 -	1.5 3.0 6.75	2.25 4.5 6.75	- 1.5 -	- 1.4 -	- 2.9 -	- 3.0 6.75	2.25 4.5 6.75	- 1.5 -	- 3.0 -	Vdc		
Output Drive Current (V _{OH} = 2.5 Vdc) (V _{OH} = 9.5 Vdc) (V _{OH} = 13.5 Vdc) (V _{OL} = 0.4 Vdc) (V _{OL} = 0.5 Vdc) (V _{OL} = 1.5 Vdc)	Source Sink	I _{OH} I _{OL}	5.0 10 15	5.0 10 15	-1.85 -0.9 -	-1.25 -0.6 -5.0	-1.75 -0.8 -	- -0.9 -	- -0.4 -	- -1.5 -	- -0.6 -	- -1.75 -	- -0.8 -	- -1.0 -4.48	mAdc		
MC14009 (V _{OL} = 0.4 Vdc) (V _{OL} = 0.5 Vdc) (V _{OL} = 1.5 Vdc)	Sink	I _{OL}	5.0 10 15	5.0 10 15	3.75 10 35	3.0 8.0 35	4.0 10 35	- 2.1 -	- 5.6 -	- 3.6 -	- 3.0 35	4.0 10 35	- 2.4 -	- 6.4 -	mAdc		
Input Current (V _{in} = 0)	-	I _{in}	-	-	-	-	-	-	-	-	-	-	-	-	pAdc		
Input Capacitance (V _{in} = 0)	MC14009 MC14010	C _{in}	-	-	-	-	10 5.0	-	-	-	-	10 5.0	-	-	pF		
Quiescent Dissipation	7	P _D	5.0 10 15	-	- 5.0 -	0.06 0.1 0.15	1.5 5.0 -	-	100 300 -	-	15 50 -	-	0.15 0.5 0.85	15 50 700	210 700	μW	
Turn-On Delay Time** (C _L = 15 pF) MC14009 I _{PHL} = (0.16 ns/pF) C _L + 12 ns I _{PHL} = (0.10 ns/pF) C _L + 8.0 ns I _{PHL} = (0.08 ns/pF) C _L + 6.0 ns I _{PHL} = (0.05 ns/pF) C _L + 7.0 ns I _{PHL} = (0.03 ns/pF) C _L + 5.0 ns MC14010 I _{PHL} = (0.38 ns/pF) C _L + 19 ns I _{PHL} = (0.08 ns/pF) C _L + 19 ns I _{PHL} = (0.06 ns/pF) C _L + 14 ns I _{PHL} = (0.08 ns/pF) C _L + 14 ns I _{PHL} = (0.09 ns/pF) C _L + 9.0 ns	4	t _{PHL}	5.0 10 15 15	5.0 10 15 5.0	- - - -	15 9.0 7.0 8.0 5.0	55 30 25 25 5.0	- - - -	- - -	- - -	- - -	15 9.0 7.0 8.0 5.0	70 40 35 35 5.0	- - - - -	ns		
Turn-Off Delay Time** (C _L = 15 pF) MC14009/10 I _{PLH} = (1.0 ns/pF) C _L + 35 ns I _{PLH} = (0.40 ns/pF) C _L + 19 ns I _{PLH} = (0.34 ns/pF) C _L + 15 ns I _{PLH} = (0.35 ns/pF) C _L + 20 ns I _{PLH} = (0.16 ns/pF) C _L + 18 ns	4	t _{PLH}	5.0 10 15 10 5.0 15	5.0 10 15 10 5.0 5.0	- - - -	50 25 25 25 20	80 55 25 30 -	- -	- -	- -	- -	50 25 25 25 20	100 70 20 25 40	- - - - -	ns		
Output Rise Time** (C _L = 15 pF) MC14009 t _r = (2.4 ns/pF) C _L + 44 ns t _r = (1.0 ns/pF) C _L + 20 ns t _r = (0.62 ns/pF) C _L + 20 ns MC14010 t _r = (1.6 ns/pF) C _L + 56 ns t _r = (0.76 ns/pF) C _L + 39 ns t _r = (0.6 ns/pF) C _L + 21 ns	4	t _r	5.0 10 15	5.0 10 15	- - -	80 35 30	125 100 -	- -	- -	- -	- -	80 35 30	160 120 -	- -	ns		
Output Fall Time** (C _L = 15 pF) MC14009 t _f = (0.22 ns/pF) C _L + 9.0 ns t _f = (0.10 ns/pF) C _L + 7.0 ns t _f = (0.07 ns/pF) C _L + 6.0 ns MC14010 t _f = (0.20 ns/pF) C _L + 22 ns t _f = (0.07 ns/pF) C _L + 15 ns t _f = (0.07 ns/pF) C _L + 9.0 ns	4	t _f	5.0 10 15	5.0 10 15	- - -	13 9.0 7.0	45 40 -	- -	- -	- -	- -	13 9.0 7.0	60 50 -	- -	ns		
MC14010 t _f = (0.20 ns/pF) C _L + 22 ns t _f = (0.07 ns/pF) C _L + 15 ns t _f = (0.07 ns/pF) C _L + 9.0 ns			5.0 10 15	5.0 10 15	- - -	25 16 10	45 40 -	- -	- -	- -	- -	25 16 10	60 50 -	- -	ns		

*DC Noise Margin (V_{NH}, V_{NL}) 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

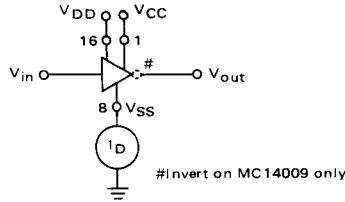


FIGURE 2 – TYPICAL VOLTAGE AND CURRENT TRANSFER CHARACTERISTICS versus TEMPERATURE

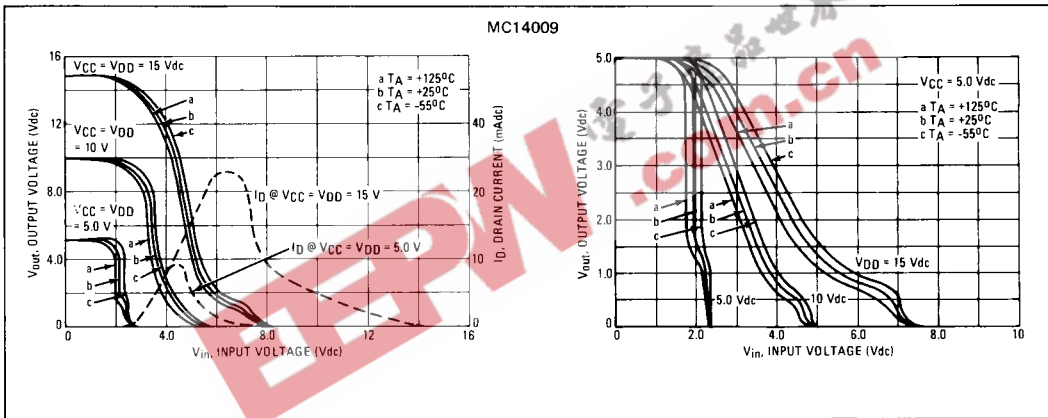


FIGURE 3 – TYPICAL VOLTAGE TRANSFER CHARACTERISTICS versus TEMPERATURE

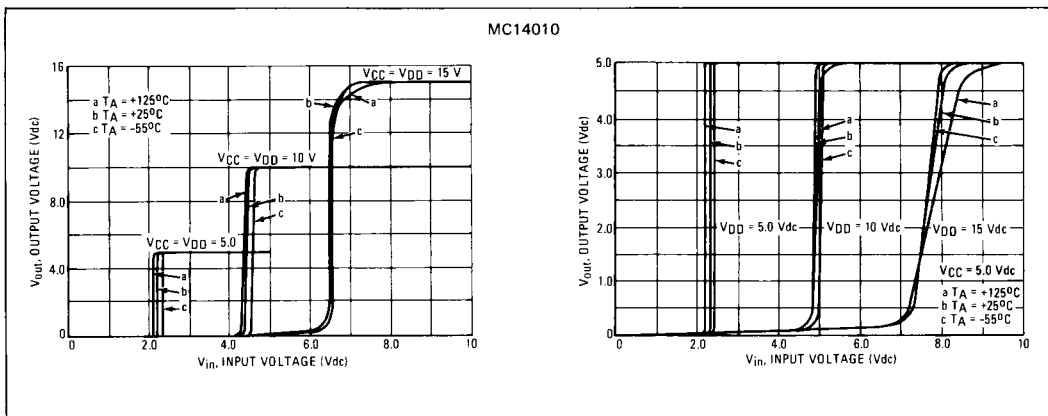


FIGURE 4 – SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

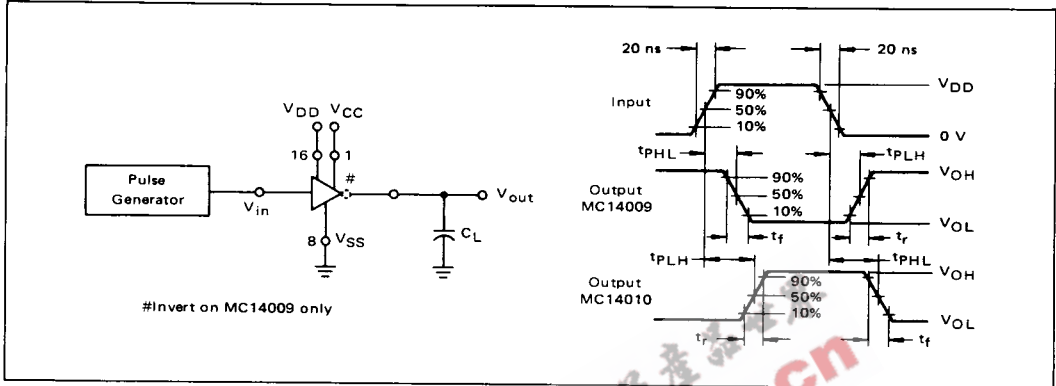


FIGURE 5 – TYPICAL OUTPUT SOURCE CHARACTERISTICS

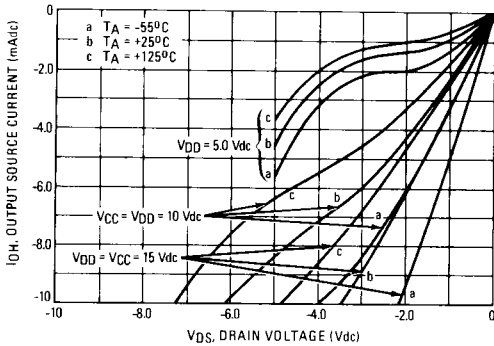
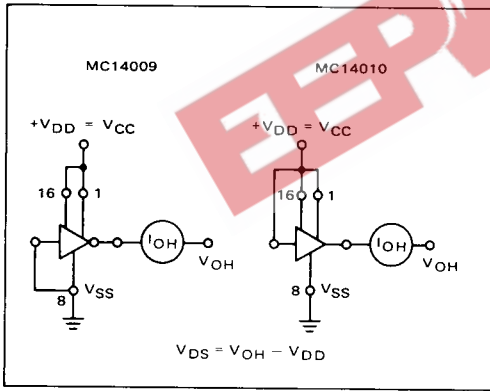


FIGURE 6 – TYPICAL OUTPUT SINK CHARACTERISTICS

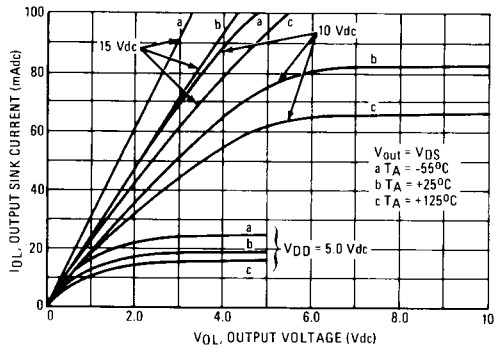
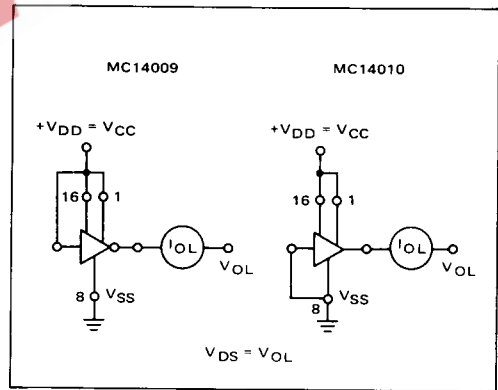
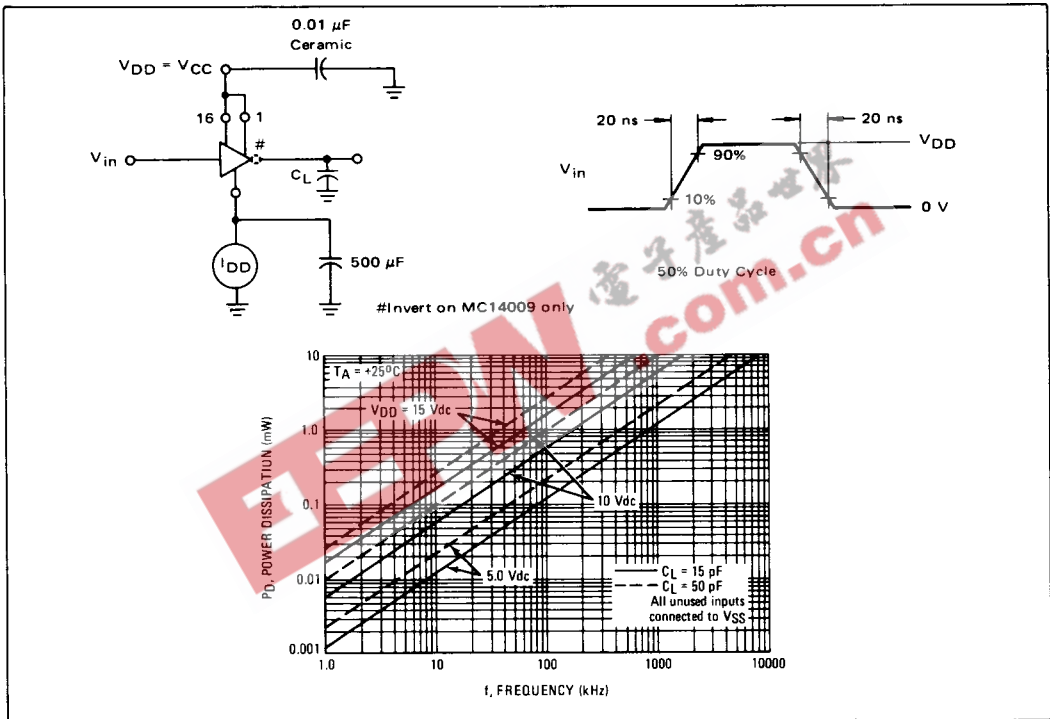


FIGURE 7 – TYPICAL DYNAMIC POWER DISSIPATION CHARACTERISTICS



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 $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

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