

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



L SUFFIX
CERAMIC PACKAGE
CASE 620



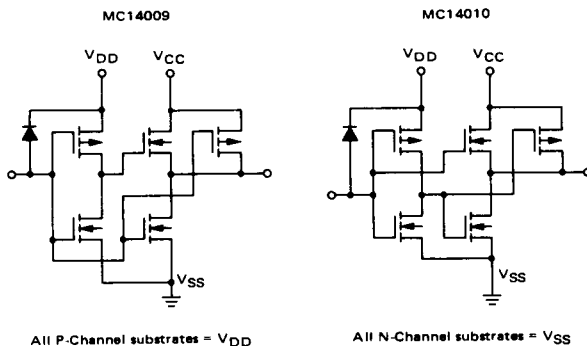
P SUFFIX
PLASTIC PACKAGE
CASE 648

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

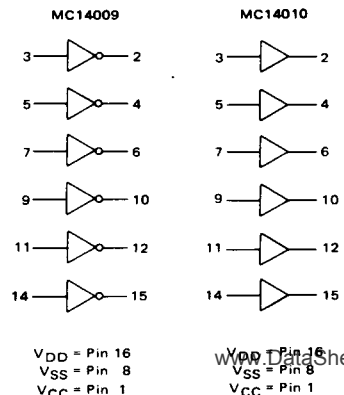
Rating	Symbol	Value	Unit
DC Supply Voltage ($V_{CC} \leq V_{DD}$) –AL Version CL,CP Version	V_{DD}	+18 to -0.5 +16 to -0.5	Vdc
Input Voltage, All Inputs	V_{in}	V_{DD} to -0.5	Vdc
DC Current Drain per Pin*	I	10	mAdc
Operating Temperature Range –AL Version CL,CP Version	T_A	-55 to +125 -40 to +85	$^{\circ}\text{C}$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



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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		Min
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	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		Vdc	
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Typ		Typ		Typ		Typ		Typ		Typ			
	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	V _{out}	5.0 10 15	5.0 10 15	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		Vdc
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Typ		Typ		Typ		Typ		Typ		Typ		
Noise Immunity* MC14009 (V _{out} ≥ 3.5 Vdc) (V _{out} ≥ 7.0 Vdc) (V _{out} ≥ 10.5 Vdc) (V _{out} ≤ 1.5 Vdc) (V _{out} ≤ 3.0 Vdc) (V _{out} ≤ 4.5 Vdc) MC14010 (V _{out} ≤ 1.5 Vdc) (V _{out} ≤ 3.0 Vdc) (V _{out} ≤ 4.5 Vdc) (V _{out} ≥ 3.5 Vdc) (V _{out} ≥ 7.0 Vdc) (V _{out} ≥ 10.5 Vdc)	-	V _{NL}	5.0 10 15	5.0 10 15	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		Vdc	
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Typ		Typ		Typ		Typ		Typ		Typ			
	MC14009 (V _{out} ≤ 1.5 Vdc) (V _{out} ≤ 3.0 Vdc) (V _{out} ≤ 4.5 Vdc) (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	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		Vdc
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Typ		Typ		Typ		Typ		Typ		Typ		
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	I _{OH}	5.0 10 15	5.0 10 15	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		mA _{dc}	
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Typ		Typ		Typ		Typ		Typ		Typ			
	Sink (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	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		mA _{dc}
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Typ		Typ		Typ		Typ		Typ		Typ		
Input Current	-	I _{in}	-	-	-	-	-	-	-	-	-	-	-	-	-	pA _{dc}		
Input Capacitance (V _{in} = 0)	MC14009	C _{in}	-	-	-	-	10	-	-	-	-	-	10	-	-	pF		
	MC14010	C _{in}	-	-	-	-	5.0	-	-	-	-	-	5.0	-	-	pF		
Quiescent Dissipation	7	P _D	5.0	-	-	1.5	-	0.06	1.5	-	100	-	15	-	210	μW		
			10	-	-	5.0	-	0.1	5.0	-	300	-	50	-	700	μW		
			15	-	-	5.0	-	0.15	5.0	-	50	-	0.85	-	-	μW		
Turn-On Delay Time** (C _L = 15 pF) MC14009 t _{PHL} = (0.16 ns/pF) C _L + 12 ns t _{PHL} = (0.10 ns/pF) C _L + 8.0 ns t _{PHL} = (0.08 ns/pF) C _L + 6.0 ns t _{PHL} = (0.05 ns/pF) C _L + 7.0 ns t _{PHL} = (0.03 ns/pF) C _L + 5.0 ns MC14010 t _{PHL} = (0.38 ns/pF) C _L + 19 ns t _{PHL} = (0.08 ns/pF) C _L + 19 ns t _{PHL} = (0.06 ns/pF) C _L + 14 ns t _{PHL} = (0.08 ns/pF) C _L + 14 ns t _{PHL} = (0.09 ns/pF) C _L + 9.0 ns	4	t _{PHL}	5.0 10 15	5.0 10 15	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		ns	
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Typ		Typ		Typ		Typ		Typ		Typ			
	MC14009/10 t _{PLH} = (1.0 ns/pF) C _L + 35 ns t _{PLH} = (0.40 ns/pF) C _L + 19 ns t _{PLH} = (0.34 ns/pF) C _L + 15 ns t _{PLH} = (0.36 ns/pF) C _L + 20 ns t _{PLH} = (0.16 ns/pF) C _L + 18 ns	4	t _{PLH}	5.0 10 15	5.0 10 15	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		ns
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Typ		Typ		Typ		Typ		Typ		Typ		
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	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		ns	
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Min		Min		Min		Min		Min		Min			
					Max		Max		Max		Max		Max		Max			
					Typ		Typ		Typ		Typ		Typ		Typ			
	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	-55°C		+25°C		+125°C		-40°C		+25°C		+85°C		ns
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Min		Min		Min		Min		Min		Min		
						Max		Max		Max		Max		Max		Max		
						Typ		Typ		Typ		Typ		Typ		Typ		

*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

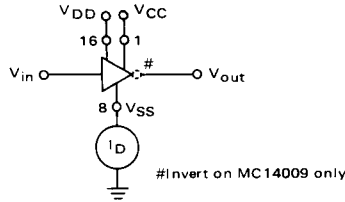


FIGURE 2 – TYPICAL VOLTAGE AND CURRENT TRANSFER CHARACTERISTICS versus TEMPERATURE

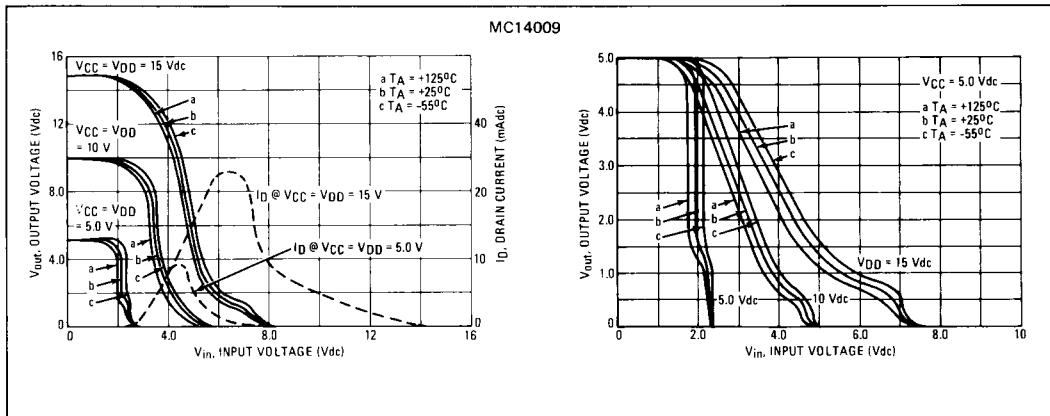


FIGURE 3 – TYPICAL VOLTAGE TRANSFER CHARACTERISTICS versus TEMPERATURE

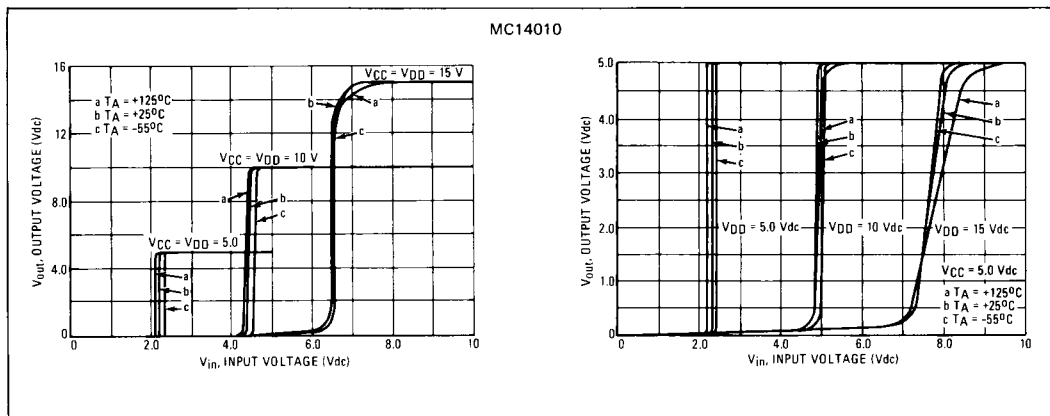


FIGURE 4 – SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

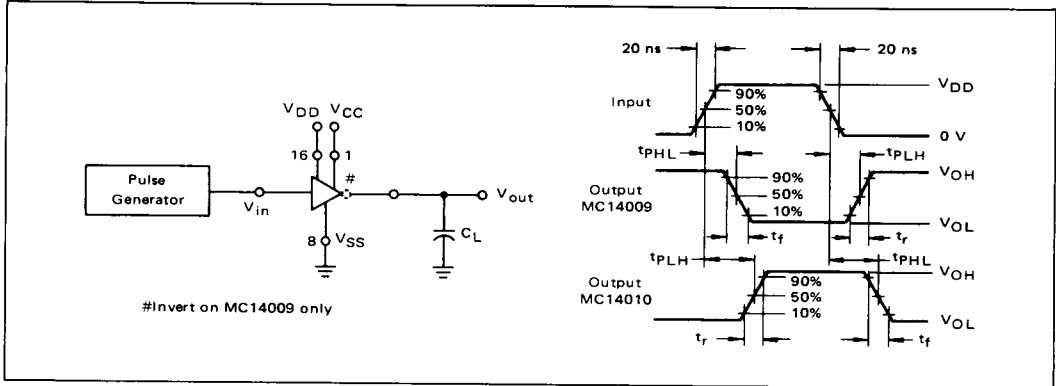


FIGURE 5 – TYPICAL OUTPUT SOURCE CHARACTERISTICS

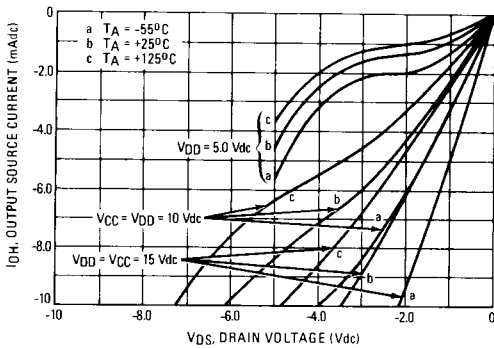
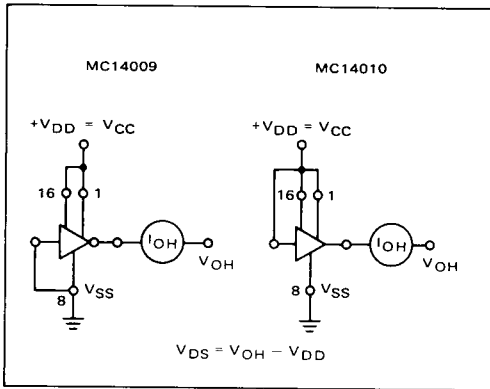


FIGURE 6 – TYPICAL OUTPUT SINK CHARACTERISTICS

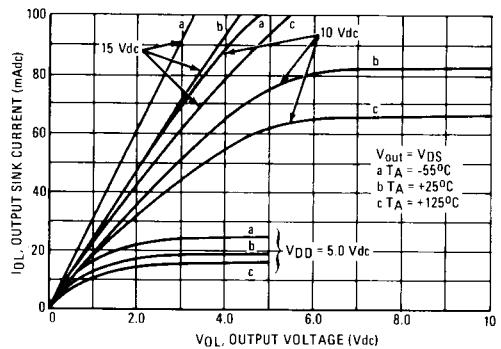
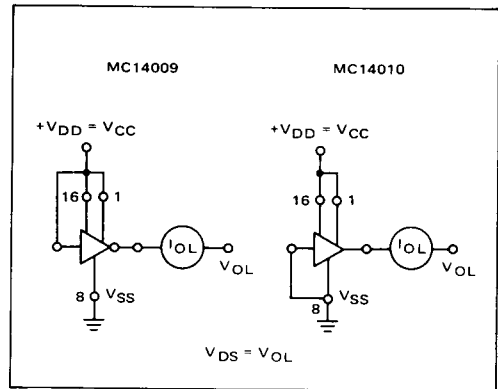
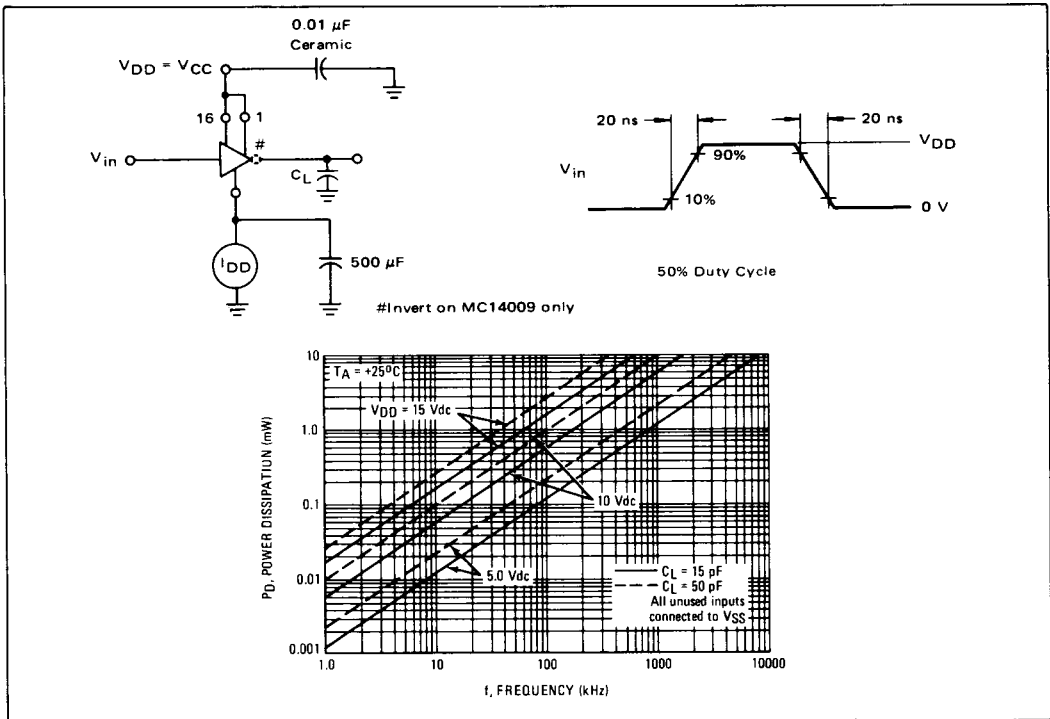


FIGURE 7 – TYPICAL DYNAMIC POWER DISSIPATION CHARACTERISTICS



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}).