

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 @ $V_{OL} = 0.5$ V and $V_{DD} = 10$ 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 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



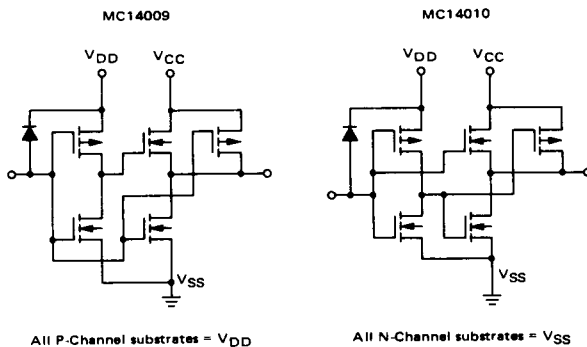
P SUFFIX
PLASTIC PACKAGE
CASE 648

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

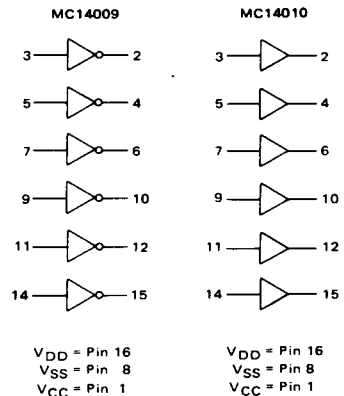
Rating	Symbol	Value	Unit
DC Supply Voltage ($V_{CC} \leq V_{DD}$) –AL Version CL,CP Version	V_{DD}	+18 to -0.5 +16 to -0.5	Vdc
Input Voltage, All Inputs	V_{in}	V_{DD} to -0.5	Vdc
DC Current Drain per Pin*	I	10	mAdc
Operating Temperature Range –AL Version CL,CP Version	T_A	-55 to +125 -40 to +85	$^{\circ}$ C
Storage Temperature Range	T_{stg}	-65 to +150	$^{\circ}$ 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		Min	Max								
Output Voltage	1,2,3	V _{out}			MC14009												Vdc										
(V _{in} = 5.0 Vdc)					5.0	5.0	-	0.01	-	0	0.01	-	0.05	-	0.01	-		0	0.01	-	0.05						
(V _{in} = 10 Vdc)					10	10	-	0.01	-	0	0.01	-	0.05	-	0.01	-		0	0.01	-	0.05						
(V _{in} = 15 Vdc)					15	-	-	-	-	0	-	-	-	-	-	-		0	-	-	-						
MC14010																											
(V _{in} = 0 Vdc)					5.0	5.0	-	0.01	-	0	0.01	-	0.05	-	0.01	-		0	0.01	-	0.05						
(V _{in} = 0 Vdc)		10	10	-	0.01	-	0	0.01	-	0.05	-	0.01	-	0	0.01	-	0.05										
(V _{in} = 0 Vdc)		15	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-										
MC14009																											
(V _{in} = 0 Vdc)		5.0	5.0	4.99	-	4.99	5.0	-	4.95	-	4.99	-	4.99	5.0	-	4.95	-	-									
(V _{in} = 0 Vdc)		10	10	9.99	-	9.99	10	-	9.95	-	9.99	-	9.99	10	-	9.95	-	-									
(V _{in} = 0 Vdc)		15	-	-	-	-	15	-	-	-	-	-	-	15	-	-	-	-									
MC14010																											
(V _{in} = 5.0 Vdc)	5.0	5.0	4.99	-	4.99	5.0	-	4.95	-	4.99	-	4.99	5.0	-	4.95	-	-										
(V _{in} = 10 Vdc)	10	10	9.99	-	9.99	10	-	9.95	-	9.99	-	9.99	10	-	9.95	-	-										
(V _{in} = 15 Vdc)	15	-	-	-	-	15	-	-	-	-	-	-	15	-	-	-	-										
Noise Immunity*	-	V _{NL}			MC14009												Vdc										
(V _{out} ≥ 3.5 Vdc)					5.0	5.0	1.0	-	1.0	2.0	-	0.9	-	1.0	-	1.0		2.0	-	0.9	-						
(V _{out} ≥ 7.0 Vdc)					10	10	2.0	-	2.0	3.0	-	1.2	-	2.0	-	2.0		3.0	-	1.9	-						
(V _{out} ≥ 10.5 Vdc)					15	15	-	-	-	4.5	-	-	-	-	-	-		4.5	-	-	-						
MC14010																											
(V _{out} ≤ 1.5 Vdc)					5.0	5.0	1.4	-	1.5	2.25	-	1.5	-	1.4	-	1.5		2.25	-	1.5	-						
(V _{out} ≤ 3.0 Vdc)		10	10	2.9	-	3.0	4.5	-	3.0	-	2.9	-	3.0	4.5	-	3.0	-										
(V _{out} ≤ 4.5 Vdc)		15	15	-	-	-	6.75	-	-	-	-	-	-	6.75	-	-	-										
MC14010																											
(V _{out} ≤ 1.5 Vdc)		5.0	5.0	1.5	-	1.5	2.25	-	1.4	-	1.5	-	1.5	2.25	-	1.4	-										
(V _{out} ≤ 3.0 Vdc)		10	10	3.0	-	3.0	4.5	-	2.9	-	3.0	-	3.0	4.5	-	2.9	-										
(V _{out} ≤ 4.5 Vdc)		15	15	-	-	-	6.75	-	-	-	-	-	-	6.75	-	-	-										
MC14010																											
(V _{out} ≥ 3.5 Vdc)	5.0	5.0	1.4	-	1.5	2.25	-	1.5	-	1.4	-	1.5	2.25	-	1.5	-											
(V _{out} ≥ 7.0 Vdc)	10	10	2.9	-	3.0	4.5	-	3.0	-	2.9	-	3.0	4.5	-	3.0	-											
(V _{out} ≥ 10.5 Vdc)	15	15	-	-	-	6.75	-	-	-	-	-	-	6.75	-	-	-											
Output Drive Current	5	Source	I _{OH}			MC14009												mA _{dc}									
(V _{OH} = 2.5 Vdc)						5.0	5.0	-1.85	-	-1.25	-1.75	-	-0.9	-	-1.5	-	-1.25		-1.75	-	-1.0	-					
(V _{OH} = 9.5 Vdc)						10	10	-0.9	-	-0.6	-0.8	-	-0.4	-	-0.72	-	-0.6		-0.8	-	-0.48	-					
(V _{OH} = 13.5 Vdc)		15				15	-	-	-	-5.0	-	-	-	-	-	-	-5.0		-	-	-						
MC14010																											
(V _{OL} = 0.4 Vdc)		5.0				5.0	3.75	-	3.0	4.0	-	2.1	-	3.6	-	3.0	4.0		-	2.4	-						
(V _{OL} = 0.5 Vdc)	10	10	10	-	8.0	10	-	5.6	-	9.6	-	8.0	10	-	6.4	-											
(V _{OL} = 1.5 Vdc)	15	15	-	-	-	35	-	-	-	-	-	-	35	-	-	-											
Input Current	-	-	I _{in}	-	-	-	-	-	-	-	-	-	-	-	-	-	pA _{dc}										
Input Capacitance (V _{in} = 0)	MC14009	-	C _{in}	-	-	-	-	10	-	-	-	-	-	10	-	-	pF										
	MC14010	-	-	-	-	-	-	5.0	-	-	-	-	-	5.0	-	-	-										
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	-										
				15	-	-	-	-	0.15	-	-	-	-	0.85	-	-	-										
Turn-On Delay Time** (C _L = 15 pF)	4	I _{PHL}				MC14009												ns									
I _{PHL} = (0.16 ns/pF) C _L + 12 ns						5.0	5.0	-	-	15	55	-	-	-	-	-	-		15	70	-	-					
I _{PHL} = (0.10 ns/pF) C _L + 8.0 ns						10	10	-	-	9.0	30	-	-	-	-	-	-		9.0	40	-	-					
I _{PHL} = (0.08 ns/pF) C _L + 6.0 ns						15	15	-	-	7.0	-	-	-	-	-	-	-		7.0	-	-	-					
I _{PHL} = (0.05 ns/pF) C _L + 7.0 ns						10	10	5.0	-	8.0	25	-	-	-	-	-	-		8.0	35	-	-					
I _{PHL} = (0.03 ns/pF) C _L + 5.0 ns						15	15	5.0	-	5.0	-	-	-	-	-	-	-		5.0	-	-	-					
MC14010																											
I _{PHL} = (0.38 ns/pF) C _L + 19 ns						5.0	5.0	-	-	25	55	-	-	-	-	-	-		25	70	-	-					
I _{PHL} = (0.08 ns/pF) C _L + 19 ns						10	10	-	-	20	30	-	-	-	-	-	-		20	40	-	-					
I _{PHL} = (0.06 ns/pF) C _L + 14 ns						15	15	-	-	15	-	-	-	-	-	-	-		15	-	-	-					
I _{PHL} = (0.08 ns/pF) C _L + 14 ns						10	10	5.0	-	15	25	-	-	-	-	-	-		15	35	-	-					
I _{PHL} = (0.08 ns/pF) C _L + 9.0 ns						15	15	5.0	-	10	-	-	-	-	-	-	-		10	-	-	-					
Turn-Off Delay Time** (C _L = 15 pF)	4	I _{PLH}				MC14009/10												ns									
I _{PLH} = (1.0 ns/pF) C _L + 35 ns						5.0	5.0	-	-	50	80	-	-	-	-	-	50		100	-	-						
I _{PLH} = (0.40 ns/pF) C _L + 19 ns						10	10	-	-	25	55	-	-	-	-	-	25		70	-	-						
I _{PLH} = (0.34 ns/pF) C _L + 15 ns						15	15	-	-	20	-	-	-	-	-	-	20		-	-	-	-					
I _{PLH} = (0.36 ns/pF) C _L + 20 ns						10	10	5.0	-	25	30	-	-	-	-	-	25		40	-	-						
I _{PLH} = (0.16 ns/pF) C _L + 18 ns						15	15	5.0	-	20	-	-	-	-	-	-	20		-	-	-						
Output Rise Time** (C _L = 15 pF)	4	t _r				MC14009												ns									
t _r = (2.4 ns/pF) C _L + 44 ns						5.0	5.0	-	-	80	125	-	-	-	-	-	80		160	-	-						
t _r = (1.0 ns/pF) C _L + 20 ns						10	10	-	-	35	100	-	-	-	-	-	35		120	-	-						
t _r = (0.62 ns/pF) C _L + 20 ns						15	15	-	-	30	-	-	-	-	-	-	30		-	-	-						
MC14010																											
t _r = (1.6 ns/pF) C _L + 56 ns						5.0	5.0	-	-	80	125	-	-	-	-	-	80		160	-	-						
t _r = (0.76 ns/pF) C _L + 39 ns						10	10	-	-	50	100	-	-	-	-	-	50		120	-	-						
t _r = (0.6 ns/pF) C _L + 21 ns						15	15	-	-	30	-	-	-	-	-	-	30		-	-	-						
Output Fall Time** (C _L = 15 pF)						4	t _f				MC14009												ns				
t _f = (0.22 ns/pF) C _L + 9.0 ns											5.0	5.0	-	-	13	45	-		-	-	-	-		13	60	-	-
t _f = (0.10 ns/pF) C _L + 7.0 ns											10	10	-	-	9.0	40	-		-	-	-	-		9.0	50	-	-
t _f = (0.07 ns/pF) C _L + 6.0 ns											15	15	-	-	7.0	-	-		-	-	-	-		7.0	-	-	-
MC14010																											
t _f = (0.20 ns/pF) C _L + 22 ns	5.0	5.0	-	-	25						45	-	-	-	-	-	25	60	-	-							
t _f = (0.07 ns/pF) C _L + 15 ns	10	10	-	-	16						40	-	-	-	-	-	16	50	-	-							
t _f = (0.07 ns/pF) C _L + 9.0 ns	15	15	-	-	10						-	-	-	-	-	-	10	-	-	-							

*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

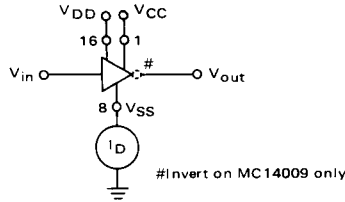


FIGURE 2 – TYPICAL VOLTAGE AND CURRENT TRANSFER CHARACTERISTICS versus TEMPERATURE

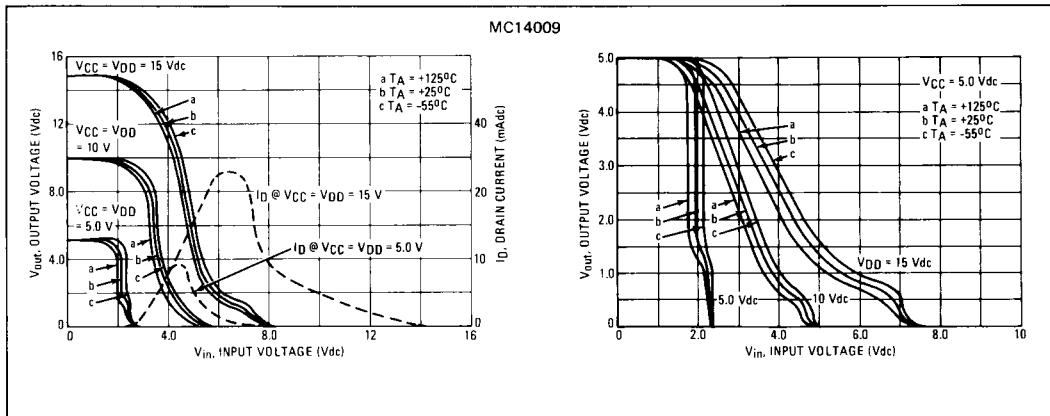


FIGURE 3 – TYPICAL VOLTAGE TRANSFER CHARACTERISTICS versus TEMPERATURE

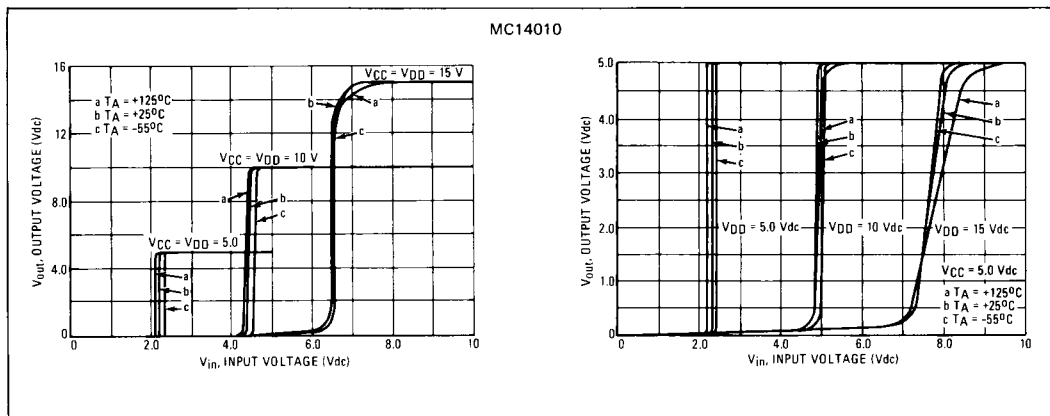


FIGURE 4 – SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

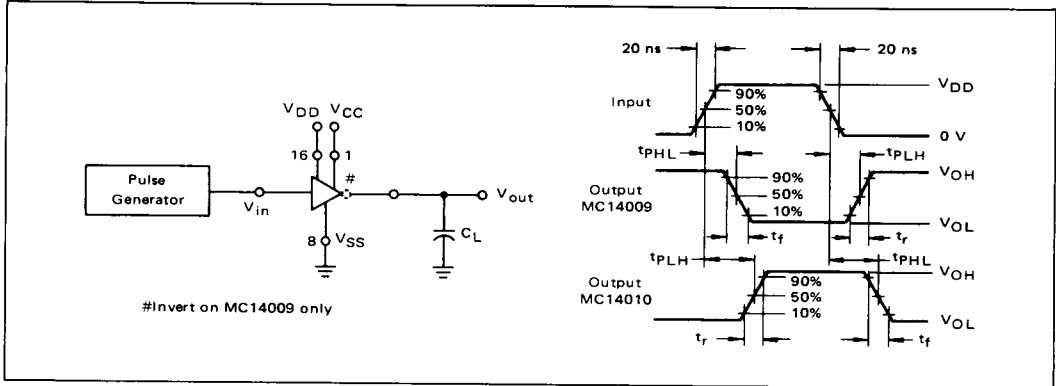


FIGURE 5 – TYPICAL OUTPUT SOURCE CHARACTERISTICS

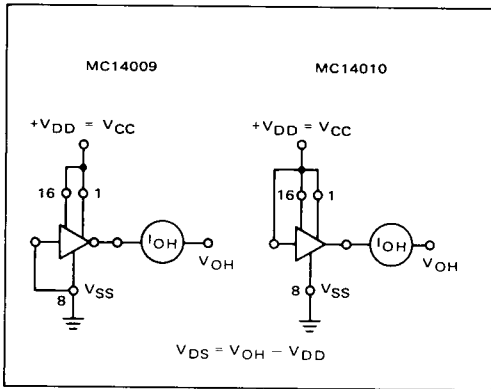


FIGURE 6 – TYPICAL OUTPUT SINK CHARACTERISTICS

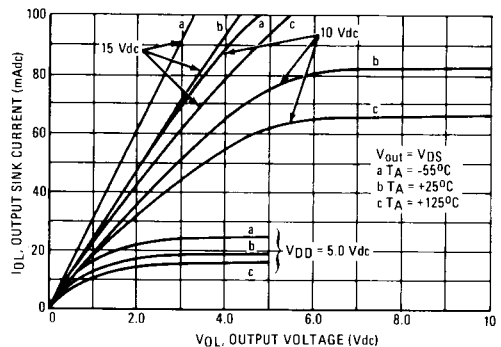
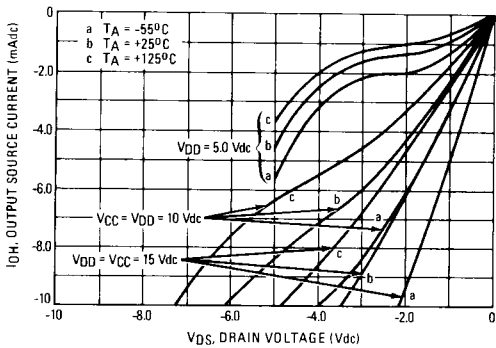
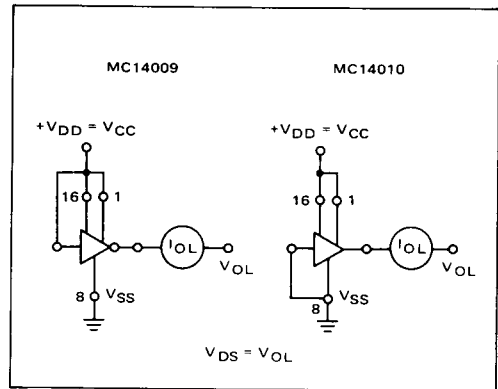
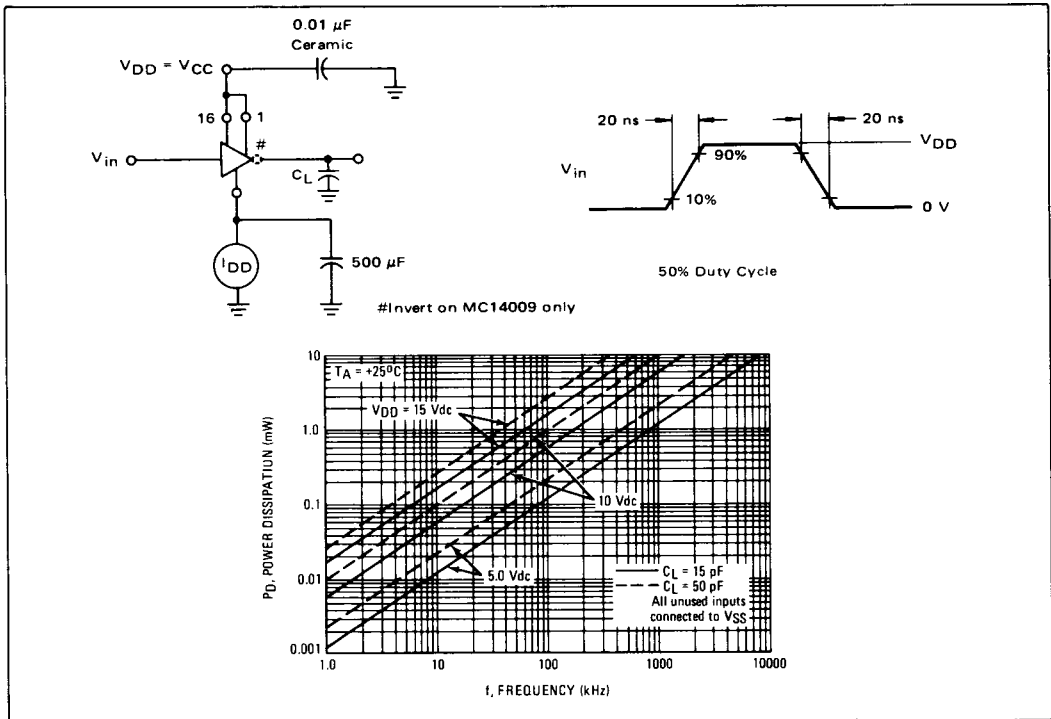


FIGURE 7 – TYPICAL DYNAMIC POWER DISSIPATION CHARACTERISTICS



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}).