

## CD4009M/CD4009C Hex Buffers (Inverting) CD4010M/CD4010C Hex Buffers (Non-Inverting)

### General Description

These hex buffers are monolithic complementary MOS (CMOS) integrated circuits. The N- and P-channel enhancement mode transistors provide a symmetrical circuit with output swings essentially equal to the supply voltage. This results in high noise immunity over a wide supply voltage range. No DC power other than that caused by leakage current is consumed during static conditions. All inputs are protected against static discharge. These gates may be used as hex buffers, CMOS to DTL or TTL interface or as CMOS current drivers. Conversion ranges are from 3V to 15V providing  $V_{CC} \leq V_{DD}$ .

### Features

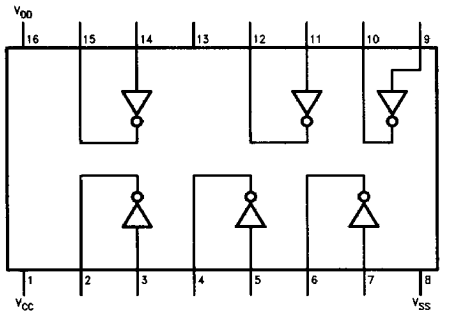
- Wide supply voltage range 3.0V to 15V
- Low power 100 nW (typ.)
- High noise immunity 0.45  $V_{DD}$  (typ.)
- High current sinking capability 8 mA (min.) at  $V_O = 0.5V$  and  $V_{DD} = 10V$

### Applications

- Automotive
- Data terminals
- Instrumentation
- Medical electronics
- Alarm system
- Industrial controls
- Remote metering
- Computers

### Schematic and Connection Diagrams

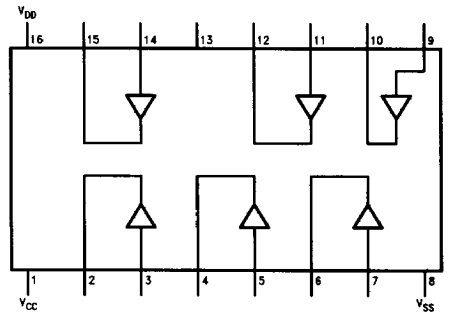
Dual-In-Line Package



Top View

TL/F/5945-2

Dual-In-Line Package



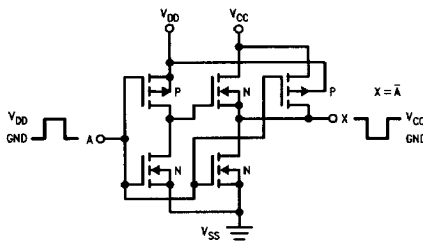
Top View

TL/F/5945-4

Order Number CD4009\* or CD4010\*

\*Please look into Section 8, Appendix D for availability of various package types.

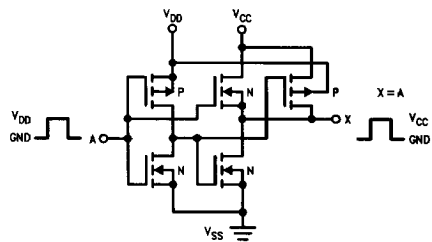
CD4009M/CD4009C



Hex COS/MOS to DTL or TTL converter (non-inverting).  
Connect  $V_{CC}$  to DTL or TTL supply.  
Connect  $V_{DD}$  to COS/MOS supply.

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CD4010M/CD4010C



Hex COS/MOS to DTL or TTL converter (inverting).  
Connect  $V_{CC}$  to DTL or TTL supply.  
Connect  $V_{DD}$  to COS/MOS supply.

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### Absolute Maximum Ratings

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/Distributors for availability and specifications.  
 Voltage at Any Pin (Note 1)  $V_{SS} - 0.3V$  to  $V_{SS} + 15.5V$   
 Operating Temperature Range  
 CD40XXM  $-55^{\circ}C$  to  $+125^{\circ}C$   
 CD40XXC  $-45^{\circ}C$  to  $+85^{\circ}C$

Storage Temperature Range ( $T_S$ )  $-65^{\circ}C$  to  $+150^{\circ}C$   
 Power Dissipation ( $P_D$ )  
 Dual-In-Line 700 mW  
 Small Outline 500 mW  
 Lead Temperature ( $T_L$ )  
 (Soldering, 10 seconds)  $260^{\circ}C$   
 Operating Range ( $V_{DD}$ )  $V_{SS} + 3V$  to  $V_{SS} + 15V$

### DC Electrical Characteristics

Symbol	Characteristics	Test Conditions (Volts)		Limits												Units		
				CD40XXM						CD40XXC								
				$-55^{\circ}C$		$+25^{\circ}C$		$+125^{\circ}C$		$-40^{\circ}C$		$+25^{\circ}C$		$+85^{\circ}C$				
$V_O$	$V_{DD}$	Min	Max	Min	Typ	Max	Min	Max	Min	Max	Min	Typ	Max	Min	Max			
$I_{CC}$	Quiescent Device Current		5		0.3		0.01	0.3		20		3		0.03	3		42	$\mu A$
			10		0.5		0.01	0.5		30		5		0.05	5		70	$\mu A$
$P_D$	Quiescent Device Dissipation/Package		5		1.5		0.05	1.5		100		15		0.15	15		210	$\mu W$
			10		5		0.1	5		300		50		0.5	50		700	$\mu W$
$V_{OL}$	Output Voltage Low Level		5		0.01		0	0.01		0.05		0.01		0	0.01		0.05	V
			10		0.01		0	0.01		0.05		0.01		0	0.01		0.05	V
$V_{OH}$	Output Voltage High Level		5	4.99		4.99		5		4.95		4.99		4.99	5		4.95	V
			10	9.99		9.99		10		9.95		9.99		9.99	10		9.95	V
$V_{NL}$	Noise Immunity (All Inputs)	CD4009M	$V_O \geq 4.0$	5	1		1	2.25		0.9		1		1	2.25		0.9	V
			$V_O \geq 8.0$	10	2		2	4.5		1.9		2		2	4.5		1.9	V
$V_{NL}$	Noise Immunity (All Inputs)	CD4010M	$V_O \geq 1.5$	5	1.6		1.5	2.25		1.4		1.6		1.5	2.25		1.4	V
			$V_O \geq 3.0$	10	3.2		3	4.5		2.9		3.2		3	4.5		2.9	V
$V_{NH}$	Noise Immunity (All Inputs)	CD4010M	$V_O \geq 3.5$	5	1.4		1.5	2.25		1.5		1.4		1.5	2.25		1.5	V
			$V_O \geq 7.0$	10	2.9		3	4.5		3		2.9		3	4.5		3	V
$I_{DN}$	Output Drive Current N-Channel (Note 2)		0.4	5	3.75		3	4		2.1		3.6		3			2.4	mA
			0.5	10	10		8	10		5.6		9.6		8			6.4	mA
$I_{DP}$	Output Drive Current P-Channel (Note 2)		2.5	5	-1.85		-1.25	-1.75		-0.9		-1.5		-1.25			-1	mA
			9.5	10	-0.9		-0.6	-0.8		-0.4		-0.72		-0.6			-0.48	mA
$I_{IN}$	Input Current													10			pA	

Note 1: This device should not be connected to circuits with the power on because high transient voltage may cause permanent damage.  
 Note 2:  $I_{DN}$  and  $I_{DP}$  are tested one output at a time.

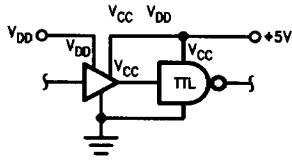
### AC Electrical Characteristics\*

$T_A = 25^{\circ}C$ ,  $C_L = 15$  pF, unless otherwise noted. Typical Temperature coefficient for all values of  $V_{DD} = 0.3\%/^{\circ}C$

Characteristics	Test Conditions	Limits							Units
		CD40XXM			CD40XXC				
		$V_{DD}$ (Volts)	Min	Typ	Max	Min	Typ	Max	
Propagation Delay Time: High-to-Low Level ( $t_{PHL}$ )	$V_{CC} = V_{DD}$	5	—	15	55	—	15	70	ns
		10	—	10	30	—	10	40	
Low-to-High Level ( $t_{PLH}$ )	$V_{DD} = 10V$ $V_{CC} = 5V$	5	—	10	25	—	10	35	ns
		10	—	50	80	—	50	100	
Transition Time: High-to-Low Level ( $t_{THL}$ )	$V_{CC} = V_{DD}$	5	—	20	45	—	20	60	ns
		10	—	16	40	—	16	50	
Low-to-High Level ( $t_{TLH}$ )	$V_{CC} = V_{DD}$	5	—	80	125	—	80	160	ns
		10	—	50	100	—	50	120	
Input Capacitance ( $C_i$ )	Any Input		—	5	—	—	5	—	pF

\*AC Parameters are guaranteed by DC correlated testing.

### Typical Application



TL/F/5945-5