National Semiconductor

February 1988

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

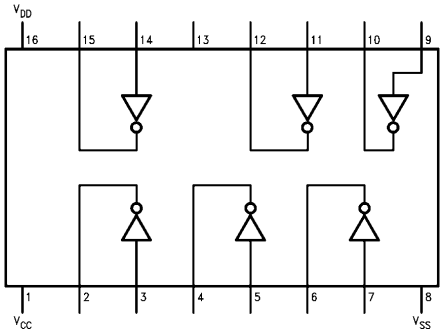
■ Wide supply voltage range	3.0V to 15V
■ Low power	100 nW (typ.)
■ High noise immunity	0.45 V_{DD} (typ.)
■ High current sinking capability	8 mA (min.) at $V_O = 0.5V$ and $V_{DD} = 10V$

Applications

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

Schematic and Connection Diagrams

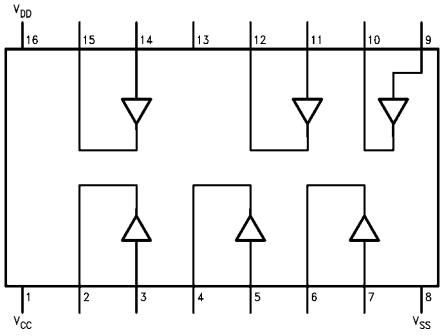
Dual-In-Line Package



TL/F/5945–2

Top View

Dual-In-Line Package

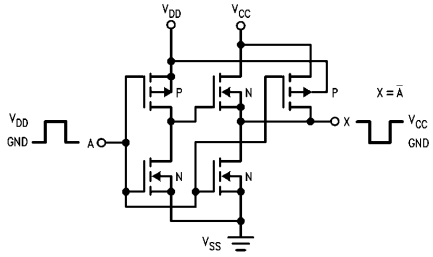


TL/F/5945–4

Top View

Order Number CD4009 or CD4010

CD4009M/CD4009C



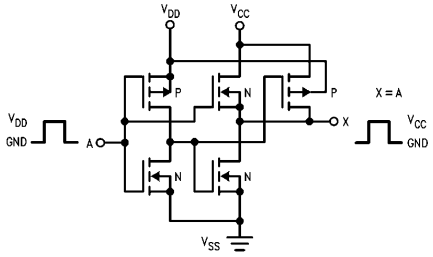
Hex COS/MOS to DTL or TTL converter (non-inverting).

TL/F/5945–1

Connect V_{CC} to DTL or TTL supply.

Connect V_{DD} to COS/MOS supply.

CD4010M/CD4010C



Hex COS/MOS to DTL or TTL converter (inverting).

TL/F/5945–3

Connect V_{CC} to DTL or TTL supply.

Connect V_{DD} to COS/MOS supply.

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please 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 $-55°C$ to $+125°C$
- CD40XXC $-45°C$ to $+85°C$

Storage Temperature Range (T_S) $-65°C$ to $+150°C$

Power Dissipation (P_D)
- Dual-In-Line 700 mW
- Small Outline 500 mW

Lead Temperature (T_L) (Soldering, 10 seconds) 260°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°C		+25°C			+125°C		−40°C		+25°C			+85°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	μA
			10		0.5		0.01	0.5		30		5		0.05	5		70	μA
P_D	Quiescent Device Dissipation/Package		5		1.5		0.05	1.5		100		15		0.15	15		210	μW
			10		5		0.1	5		300		50		0.5	50		700	μW
	Output Voltage		5		0.01		0	0.01		0.05		0.01		0	0.01		0.05	V
V_{OL}	Low Level		10		0.01		0	0.01		0.05		0.01		0	0.01		0.05	V
V_{OH}	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
	Noise Immunity (All Inputs)																	
V_{NL}	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}	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}		$V_O \geq 3.5$	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
	Output Drive Current	0.4	5	3.75		3	4		2.1		3.6		3			2.4		mA
I_DN	N-Channel (Note 2)	0.5	10	10		8	10		5.6		9.6		8			6.4		mA
I_DP	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							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.

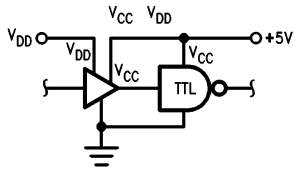
AC Electrical Characteristics*

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

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	
	$V_{DD} = 10V$, $V_{CC} = 5V$		—	10	25	—	10	35	
Low-to-High Level (t_{PLH})	$V_{CC} = V_{DD}$	5	—	50	80	—	50	100	ns
		10	—	25	55	—	25	70	
	$V_{DD} = 10V$, $V_{CC} = 5V$		—	15	30	—	15	40	
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

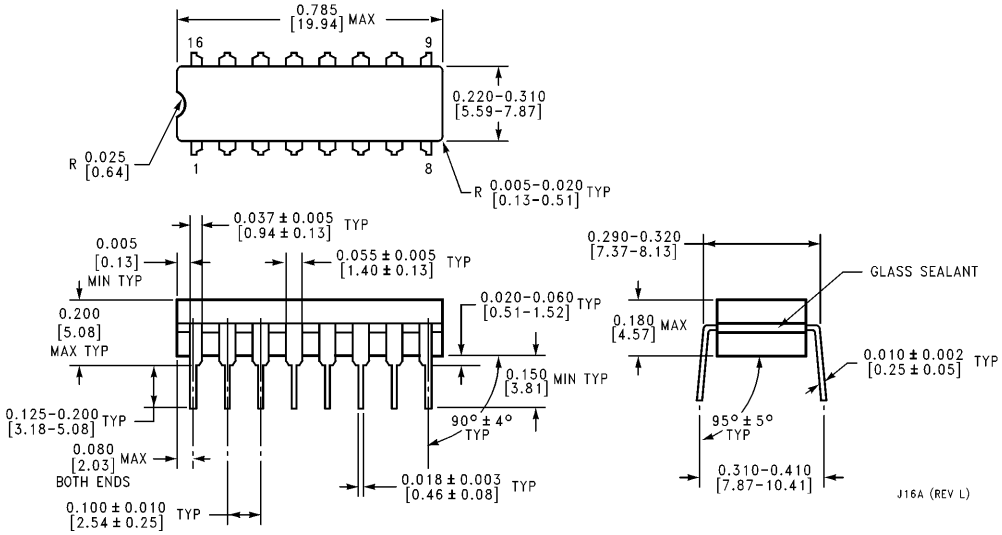
*AC Parameters are guaranteed by DC correlated testing.

Typical Application



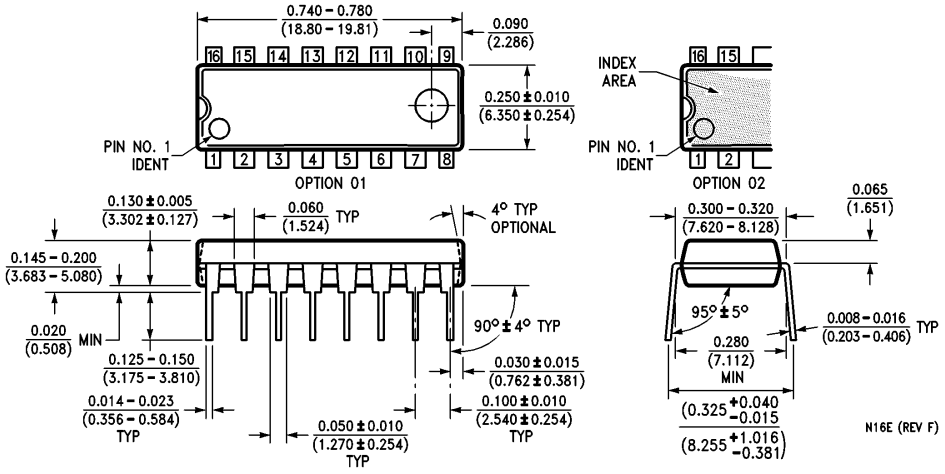
TL/F/5945–5

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4009MJ, CD4009CJ, CD4010MJ or CD4010CJ
NS Package Number J16A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4009MN, CD4009CN, CD4010MN or CD4010CN
NS Package Number N16E

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
Tel: 81-043-299-2309
Fax: 81-043-299-2408