

March 1988

CD4049UBM/CD4049UBC Hex Inverting Buffer CD4050BM/CD4050BC Hex Non-Inverting Buffer

General Description

These hex buffers are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. These devices feature logic level conversion using only one supply voltage (V_{DD}). The input signal high level (V_{IH}) can exceed the V_{DD} supply voltage when these devices are used for logic level conversions. These devices are intended for use as hex buffers, CMOS to DTL/TTL converters, or as CMOS current drivers, and at $V_{DD} = 5.0V$, they can drive directly two DTL/TTL loads over the full operating temperature range.

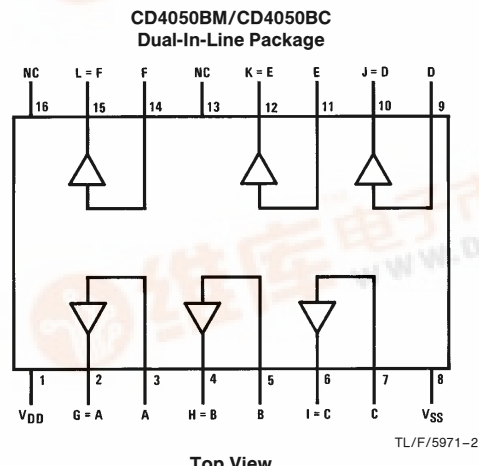
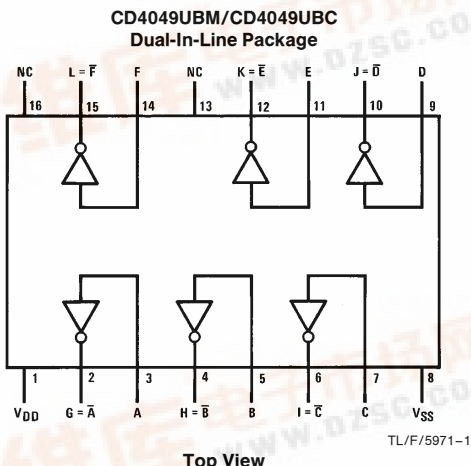
Features

- Wide supply voltage range 3.0V to 15V
- Direct drive to 2 TTL loads at 5.0V over full temperature range
- High source and sink current capability
- Special input protection permits input voltages greater than V_{DD}

Applications

- CMOS hex inverter/buffer
- CMOS to DTL/TTL hex converter
- CMOS current "sink" or "source" driver
- CMOS high-to-low logic level converter

Connection Diagrams



CD4049UBM/CD4049UBC Hex Inverting Buffer
CD4050BM/CD4050BC Hex Non-Inverting Buffer



Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{DD})	– 0.5V to + 18V
Input Voltage (V_{IN})	– 0.5V to + 18V
Voltage at Any Output Pin (V_{OUT})	– 0.5V to V_{DD} + 0.5V
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

Recommended Operating Conditions (Note 2)

Supply Voltage (V_{DD})	3V to 15V
Input Voltage (V_{IN})	0V to 15V
Voltage at Any Output Pin (V_{OUT})	0 to V_{DD}
Operating Temperature Range (T_A)	
CD4049UBM, CD4050BM	– 55°C to + 125°C
CD4049UBC, CD4050BC	– 40°C to + 85°C

DC Electrical Characteristics CD4049M/CD4050BM (Note 2)

Symbol	Parameter	Conditions	– 55°C		+ 25°C			+ 125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		1.0 2.0 4.0		0.01 0.01 0.03	1.0 2.0 4.0		30 60 120	μA μA μA
V_{OL}	Low Level Output Voltage	$V_{IH} = V_{DD}$, $V_{IL} = 0V$, $ I_O < 1 \mu A$ $V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		0.05 0.05 0.05		0 0 0	0.05 0.05 0.05		0.05 0.05 0.05	V V V
V_{OH}	High Level Output Voltage	$V_{IH} = V_{DD}$, $V_{IL} = 0V$, $ I_O < 1 \mu A$ $V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	4.95 9.95 14.95		4.95 9.95 14.95	5 10 15		4.95 9.95 14.95		V V V
V_{IL}	Low Level Input Voltage (CD4050BM Only)	$ I_O < 1 \mu A$ $V_{DD} = 5V$, $V_O = 0.5V$ $V_{DD} = 10V$, $V_O = 1V$ $V_{DD} = 15V$, $V_O = 1.5V$		1.5 3.0 4.0		2.25 4.5 6.75	1.5 3.0 4.0		1.5 3.0 4.0	V V V
V_{IL}	Low Level Input Voltage (CD4049UBM Only)	$ I_O < 1 \mu A$ $V_{DD} = 5V$, $V_O = 4.5V$ $V_{DD} = 10V$, $V_O = 9V$ $V_{DD} = 15V$, $V_O = 13.5V$		1.0 2.0 3.0		1.5 2.5 3.5	1.0 2.0 3.0		1.0 2.0 3.0	V V V
V_{IH}	High Level Input Voltage (CD4050BM Only)	$ I_O < 1 \mu A$ $V_{DD} = 5V$, $V_O = 4.5V$ $V_{DD} = 10V$, $V_O = 9V$ $V_{DD} = 15V$, $V_O = 13.5V$	3.5 7.0 11.0		3.5 7.0 11.0	2.75 5.5 8.25		3.5 7.0 11.0		V V V
V_{IH}	High Level Input Voltage (CD4049UBM Only)	$ I_O < 1 \mu A$ $V_{DD} = 5V$, $V_O = 0.5V$ $V_{DD} = 10V$, $V_O = 1V$ $V_{DD} = 15V$, $V_O = 1.5V$	4.0 8.0 12.0		4.0 8.0 12.0	3.5 7.5 11.5		4.0 8.0 12.0		V V V
I_{OL}	Low Level Output Current (Note 3)	$V_{IH} = V_{DD}$, $V_{IL} = 0V$ $V_{DD} = 5V$, $V_O = 0.4V$ $V_{DD} = 10V$, $V_O = 0.5V$ $V_{DD} = 15V$, $V_O = 1.5V$	5.6 12 35		4.6 9.8 29	5 12 40		3.2 6.8 20		mA mA mA

Note 1: “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed; they are not meant to imply that the devices should be operated at these limits. The table of “Recommended Operating Conditions” and “Electrical Characteristics” provides conditions for actual device operation.

Note 2: $V_{SS} = 0V$ unless otherwise specified.

Note 3: These are *peak* output current capabilities. Continuous output current is rated at 12 mA maximum. The output current should not be allowed to exceed this value for extended periods of time. I_{OL} and I_{OH} are tested one output at a time.

DC Electrical Characteristics CD4049M/CD4050BM (Note 2) (Continued)

Symbol	Parameter	Conditions	−55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I _{OH}	High Level Output Current (Note 3)	V _{IH} = V _{DD} , V _{IL} = 0V								
		V _{DD} = 5V, V _O = 4.6V	−1.3		−1.1	−1.6		−0.72		mA
		V _{DD} = 10V, V _O = 9.5V	−2.6		−2.2	−3.6		−1.5		mA
		V _{DD} = 15V, V _O = 13.5V	−8.0		−7.2	−12		−5.0		mA
I _{IN}	Input Current	V _{DD} = 15V, V _{IN} = 0V		−0.1		−10 ^{−5}	−0.1		−1.0	μA
		V _{DD} = 15V, V _{IN} = 15V		0.1		10 ^{−5}	0.1		1.0	μA

Note 1: “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed; they are not meant to imply that the devices should be operated at these limits. The table of “Recommended Operating Conditions” and “Electrical Characteristics” provides conditions for actual device operation.

Note 2: V_{SS} = 0V unless otherwise specified.

Note 3: These are *peak* output current capabilities. Continuous output current is rated at 12 mA maximum. The output current should not be allowed to exceed this value for extended periods of time. I_{OL} and I_{OH} are tested one output at a time.

DC Electrical Characteristics CD4049UBC/CD4050BC (Note 2)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I _{DD}	Quiescent Device Current	V _{DD} = 5V		4		0.03	4.0		30	μA
		V _{DD} = 10V		8		0.05	8.0		60	μA
		V _{DD} = 15V		16		0.07	16.0		120	μA
V _{OL}	Low Level Output Voltage	V _{IH} = V _{DD} , V _{IL} = 0V, I _O < 1 μA								
		V _{DD} = 5V		0.05		0	0.05		0.05	V
		V _{DD} = 10V		0.05		0	0.05		0.05	V
		V _{DD} = 15V		0.05		0	0.05		0.05	V
V _{OH}	High Level Output Voltage	V _{IH} = V _{DD} , V _{IL} = 0V, I _O < 1 μA								
		V _{DD} = 5V	4.95		4.95	5		4.95		V
		V _{DD} = 10V	9.95		9.95	10		9.95		V
		V _{DD} = 15V	14.95		14.95	15		14.95		V
V _{IL}	Low Level Input Voltage (CD4050BC Only)	I _O < 1 μA								
		V _{DD} = 5V, V _O = 0.5V		1.5		2.25	1.5		1.5	V
		V _{DD} = 10V, V _O = 1V		3.0		4.5	3.0		3.0	V
		V _{DD} = 15V, V _O = 1.5V		4.0		6.75	4.0		4.0	V
V _{IL}	Low Level Input Voltage (CD4049UBC Only)	I _O < 1 μA								
		V _{DD} = 5V, V _O = 4.5V		1.0		1.5	1.0		1.0	V
		V _{DD} = 10V, V _O = 9V		2.0		2.5	2.0		2.0	V
		V _{DD} = 15V, V _O = 13.5V		3.0		3.5	3.0		3.0	V
V _{IH}	High Level Input Voltage (CD4050BC Only)	I _O < 1 μA								
		V _{DD} = 5V, V _O = 4.5V	3.5		3.5	2.75		3.5		V
		V _{DD} = 10V, V _O = 9V	7.0		7.0	5.5		7.0		V
		V _{DD} = 15V, V _O = 13.5V	11.0		11.0	8.25		11.0		V
V _{IH}	High Level Input Voltage (CD4049UBC Only)	I _O < 1 μA								
		V _{DD} = 5V, V _O = 0.5V	4.0		4.0	3.5		4.0		V
		V _{DD} = 10V, V _O = 1V	8.0		8.0	7.5		8.0		V
		V _{DD} = 15V, V _O = 1.5V	12.0		12.0	11.5		12.0		V

Note 1: “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed; they are not meant to imply that the devices should be operated at these limits. The table of “Recommended Operating Conditions” and “Electrical Characteristics” provides conditions for actual device operation.

Note 2: V_{SS} = 0V unless otherwise specified.

Note 3: These are *peak* output current capabilities. Continuous output current is rated at 12 mA maximum. The output current should not be allowed to exceed this value for extended periods of time. I_{OL} and I_{OH} are tested one output at a time.

DC Electrical Characteristics CD4049UBC/CD4050BC (Note 2) (Continued)										
Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I _{OL}	Low Level Output Current (Note 3)	V _{IH} = V _{DD} , V _{IL} = 0V V _{DD} = 5V, V _O = 0.4V V _{DD} = 10V, V _O = 0.5V V _{DD} = 15V, V _O = 1.5V	4.6 9.8 29		4.0 8.5 25	5 12 40		3.2 6.8 20		mA mA mA
I _{OH}	High Level Output Current (Note 3)	V _{IH} = V _{DD} , V _{IL} = 0V V _{DD} = 5V, V _O = 4.6V V _{DD} = 10V, V _O = 9.5V V _{DD} = 15V, V _O = 13.5V	−1.0 −2.1 −7.1		−0.9 −1.9 −6.2	−1.6 −3.6 −12		−0.72 −1.5 −5		mA mA mA
I _{IN}	Input Current	V _{DD} = 15V, V _{IN} = 0V V _{DD} = 15V, V _{IN} = 15V	−0.3 0.3		−0.3 0.3	10 ^{−5} 10 ^{−5}			−1.0 1.0	μA μA

AC Electrical Characteristics* CD4049UBM/CD4049UBC

T_A = 25°C, C_L = 50 pF, R_L = 200k, t_r = t_f = 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t _{PHL}	Propagation Delay Time High-to-Low Level	V _{DD} = 5V		30	65	ns
		V _{DD} = 10V		20	40	ns
		V _{DD} = 15V		15	30	ns
t _{PLH}	Propagation Delay Time Low-to-High Level	V _{DD} = 5V		45	85	ns
		V _{DD} = 10V		25	45	ns
		V _{DD} = 15V		20	35	ns
t _{THL}	Transition Time High-to-Low Level	V _{DD} = 5V		30	60	ns
		V _{DD} = 10V		20	40	ns
		V _{DD} = 15V		15	30	ns
t _{TLH}	Transition Time Low-to-High Level	V _{DD} = 5V		60	120	ns
		V _{DD} = 10V		30	55	ns
		V _{DD} = 15V		25	45	ns
C _{IN}	Input Capacitance	Any Input		15	22.5	pF

*AC Parameters are guaranteed by DC correlated testing.

AC Electrical Characteristics* CD4050BM/CD4050BC

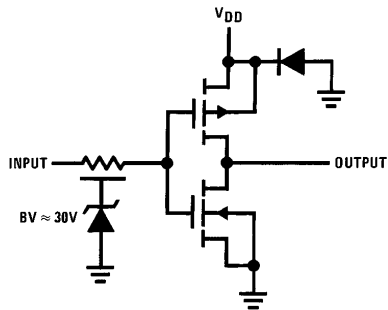
T_A = 25°C, C_L = 50 pF, R_L = 200k, t_r = t_f = 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t _{PHL}	Propagation Delay Time High-to-Low Level	V _{DD} = 5V		60	110	ns
		V _{DD} = 10V		25	55	ns
		V _{DD} = 15V		20	30	ns
t _{PLH}	Propagation Delay Time Low-to-High Level	V _{DD} = 5V		60	120	ns
		V _{DD} = 10V		30	55	ns
		V _{DD} = 15V		25	45	ns
t _{THL}	Transition Time High-to-Low Level	V _{DD} = 5V		30	60	ns
		V _{DD} = 10V		20	40	ns
		V _{DD} = 15V		15	30	ns
t _{TLH}	Transition Time Low-to-High Level	V _{DD} = 5V		60	120	ns
		V _{DD} = 10V		30	55	ns
		V _{DD} = 15V		25	45	ns
C _{IN}	Input Capacitance	Any Input		5	7.5	pF

*AC Parameters are guaranteed by DC correlated testing.

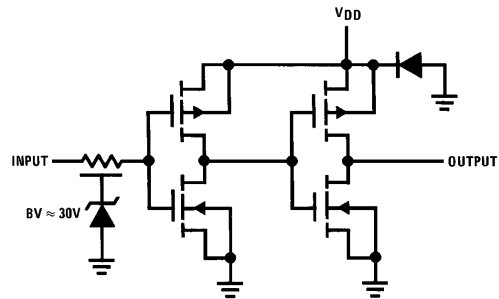
Schematic Diagrams

CD4049UBM/CD4049UBC
1 of 6 Identical Units



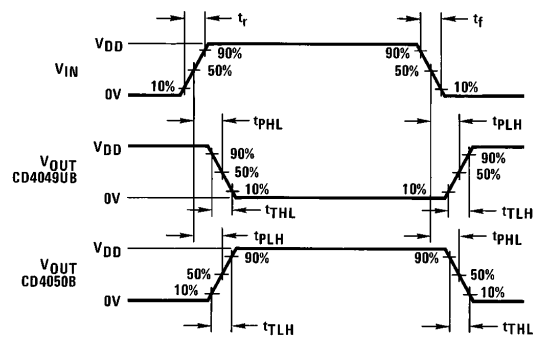
TL/F/5971-3

CD4050BM/CD4050BC
1 of 6 Identical Units



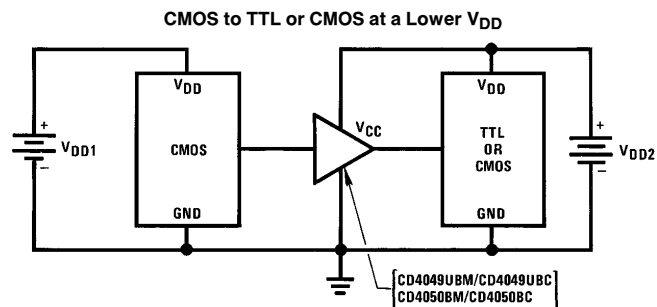
TL/F/5971-4

Switching Time Waveforms



TL/F/5971-5

Typical Applications

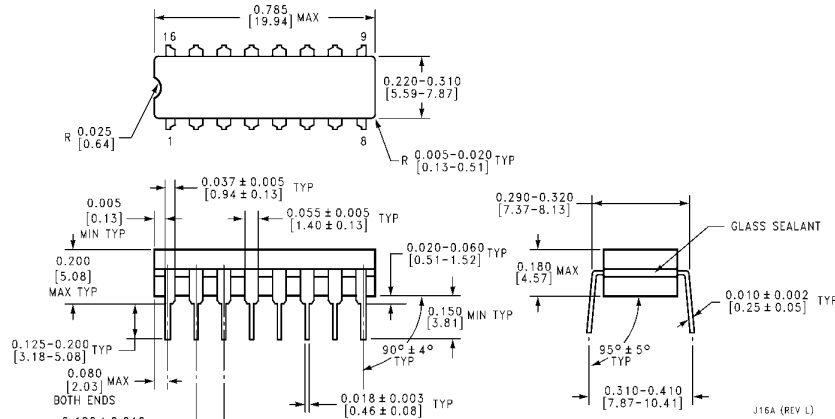


Note: $V_{DD1} \geq V_{DD2}$

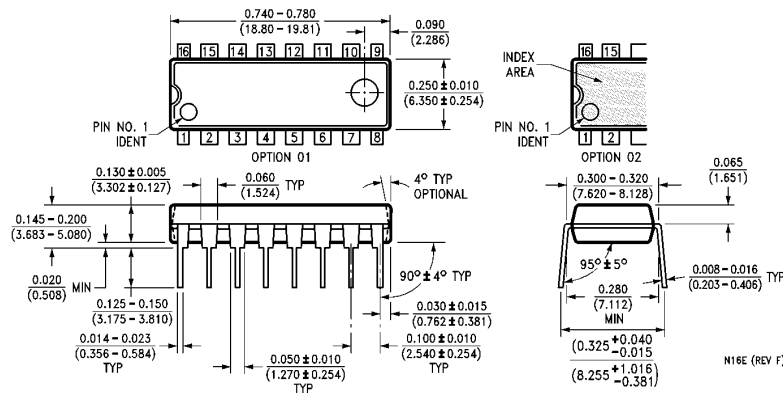
Note: In the case of the CD4049UBM/CD4049UBC the output drive capability increases with increasing input voltage. E.g., If $V_{DD1} = 10V$ the CD4049UBM/CD4049UBC could drive 4 TTL loads.

TL/F/5971-6

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4049UBMJ, CD4049UBCJ, CD4049BMJ or CD4049BCJ
NS Package Number J16A



Molded Dual-In-Line Package (N)
Order Number CD4050BMN, CD4050BCN, CD4050BMN or CD4050BCN
NS Package Number N16E

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