CD4008BM/CD4008BC 4-Bit Full Adder

General Description

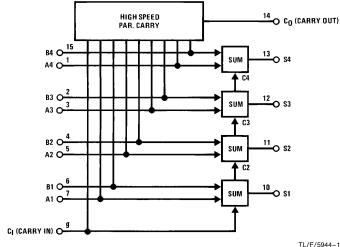
The CD4008B types consist of four full-adder stages with fast look-ahead carry provision from stage to stage. Circuitry is included to provide a fast "parallel-carry-out" bit to permit high-speed operation in arithmetic sections using several CD4008B's. CD4008B inputs include the four sets of bits to be added, A1 to A4 and B1 to B4, in addition to the "Carry in" bit from a previous section. CD4008B outputs include the four sum bits, S1 and S4, in addition to the high-speed "parallel-carry-out" which may be utilized at a succeeding CD4008B section.

All inputs are protected from damage due to static discharge by diode clamps to V_{DD} and GND.

Features

- 3.0V to 15V ■ Wide supply voltage range
- High noise immunity 0.45 V_{CC} (typ.)
- Fan out of 2 driving 74L ■ Low power TTL compatibility or 1 driving 74LS
- 4 sum outputs plus parallel look-ahead carry-output
- Quiescent current specified to 15V
- Maximum input leakage of 1 µA at 15V (full package temperature range)

Block Diagram



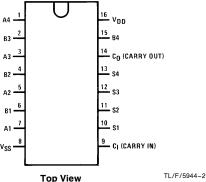
Truth Table

Ai	Bi	Ci	CO	SUM
0	0	0	0	0
1	0	0	0	1
0	1	0	0	1
1	1	0	1	0
0	0	1	0	1
1	0	1	1	0
0	1	1	1	0
1	1	1	1	1

TL/F/5944-1

Connection Diagram

Dual-In-Line Package



Order Number CD4008B

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.

DC Supply Voltage (V_{DD}) $-0.5 \text{V to } + 18 \text{ V}_{DC}$ Input Voltage (V_{IN}) $-0.5 \text{V to V}_{DD} + 0.5 \text{ V}_{DC}$ Storage Temperature Range (T_S) $-65 ^{\circ}\text{C to } + 150 ^{\circ}\text{C}$

Power Dissipation (PD)

Dual-In-Line 700 mW Small Outline 500 mW

Lead Temperature, (T_L) (Soldering, 10 seconds)

Recommended Operating

Conditions (Note 2)

DC Supply Voltage (V_{DD}) 3 to 15 V_{DC} Input Voltage (V_{IN}) 0 to V_{DD} V_{DC}

Operating Temperature Range (T_A) CD4008BM

DC Electrical Characteristics CD4008BM (Note 2)

Symbol	Parameter	Conditions	−55°C		+ 25°C			+ 125°C		Units
Symbol	rarameter	Conditions	Min	Max	Min	Тур	Max	Min	Max	Omis
I _{DD}	Quiescent Device Current	$ \begin{aligned} &V_{DD} = 5 \text{V, } V_{IN} = V_{DD} \text{ or } V_{SS} \\ &V_{DD} = 10 \text{V, } V_{IN} = V_{DD} \text{ or } V_{SS} \\ &V_{DD} = 15 \text{V, } V_{IN} = V_{DD} \text{ or } V_{SS} \end{aligned} $		5 10 20		0.3 0.5 1.0	5 10 20		150 300 600	μΑ μΑ μΑ
V _{OL}	Low Level Output Voltage	$\begin{aligned} & I_{O} \!<\! 1 \mu A \\ &V_{DD} = 5 V \\ &V_{DD} = 10 V \\ &V_{DD} = 15 V \end{aligned}$		0.05 0.05 0.05		0 0	0.05 0.05 0.05		0.05 0.05 0.05	V V V
V _{OH}	High Level Output Voltage	$ \begin{aligned} & I_O < 1 \; \mu A \\ & V_{DD} = 5V \\ & V_{DD} = 10V \\ & V_{DD} = 15V \end{aligned} $	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	$\begin{array}{l} I_O < 1 \; \mu A \\ V_{DD} = 5 V, \; V_O = 0.5 V \; \text{or} \; 4.5 V \\ V_{DD} = 10 V, \; V_O = 1 V \; \text{or} \; 9 V \\ V_{DD} = 15 V, \; V_O = 1.5 V \; \text{or} \; 13.5 V \end{array}$		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V
V _{IH}	High Level Input Voltage	$\begin{split} & I_O < 1~\mu\text{A} \\ &V_{DD} \! = \! 5\text{V}, V_O \! = \! 0.5\text{V} \text{ or } 4.5\text{V} \\ &V_{DD} \! = \! 10\text{V}, V_O \! = \! 1\text{V or } 9\text{V} \\ &V_{DD} \! = \! 15\text{V}, V_O \! = \! 1.5\text{V or } 13.5\text{V} \end{split}$	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
l _{OL}	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_{O} = 0.4V$ $V_{DD} = 10V, V_{O} = 0.5V$ $V_{DD} = 15V, V_{O} = 1.5V$	0.64 1.6 4.2		0.51 1.3 3.4	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
ГОН	High Level Output Current (Note 3)	$V_{DD} = 5V, V_{O} = 4.6V$ $V_{DD} = 10V, V_{O} = 9.5V$ $V_{DD} = 15V, V_{O} = 13.5V$	-0.25 -0.62 -1.8		-0.2 -0.5 -1.5	-0.35 -0.8 -3.5		-0.14 -0.35 -1.1		mA mA mA
I _{IN}	Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		-0.1 0.1		-10 ⁻⁵	-0.1 0.1		-1.0 1.0	μA μA

260°C

DC Electrical Characteristics CD4008BC (Note 2)

Symbol	Parameter	Conditions	−40°C		+ 25°C			+ 85°C		Units
Cymbol	i didilictor	Min		Max	Min	Тур	Max	Min	Max	
I _{DD}	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD} \text{ or } V_{SS}$		20		0.5	20		150	μΑ
		$V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS}		40		1	40		300	μΑ
		$V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS}		80		5	80		600	μΑ
V _{OL}	Low Level Output Voltage	I _O < 1 μA								
02		$V_{DD} = 5V$		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	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

DC Electrical Characteristics CD4008BC (Note 2) (Continued)

Symbol	Parameter	Conditions	-40°C		+ 25°C			+ 85°C		Units
Symbol	Farameter	Conditions	Min	Max	Min	Тур	Max	Min	Max	Oilles
V _{IL}	Low Level Input Voltage	$\begin{split} & I_O < 1~\mu\text{A} \\ &V_{DD} \! = \! 5\text{V}, V_O \! = \! 0.5\text{V} \text{ or } 4.5\text{V} \\ &V_{DD} \! = \! 10\text{V}, V_O \! = \! 1\text{V or } 9\text{V} \\ &V_{DD} \! = \! 15\text{V}, V_O \! = \! 1.5\text{V or } 13.5\text{V} \end{split}$		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V
V _{IH}	High Level Input Voltage	$\begin{split} & I_O < 1~\mu\text{A} \\ &V_{DD} = 5\text{V}, ~V_O = 0.5\text{V or } 4.5\text{V} \\ &V_{DD} = 10\text{V}, ~V_O = 1\text{V or } 9\text{V} \\ &V_{DD} = 15\text{V}, ~V_O = 1.5\text{V or } 13.5\text{V} \end{split}$	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
l _{OL}	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_{O} = 0.4V$ $V_{DD} = 10V, V_{O} = 0.5V$ $V_{DD} = 15V, V_{O} = 1.5V$	0.52 1.3 3.6		0.44 1.1 3.0	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I _{OH}	High Level Output Current (Note 3)	$V_{DD} = 5V, V_{O} = 4.6V$ $V_{DD} = 10V, V_{O} = 9.5V$ $V_{DD} = 15V, V_{O} = 13.5V$	-0.2 -0.5 -1.4		-0.16 -0.4 -1.2	-0.35 -0.8 -3.5		-0.12 -0.3 -1.0		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		-1.0 1.0	μA μA

AC Electrical Characteristics*

 $T_A = 25^{\circ}C,\, C_L = 50$ pF, $R_L = 200$ k, input $t_r,\, t_f = 20$ ns, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Тур	Max	Units
t _{PHL} or t _{PLH}	Propagation Delay Time	$V_{DD} = 5V$		425	750	ns
	Sum In to Sum Out	$V_{DD} = 10V$		170	250	ns
		$V_{DD} = 15V$		125	190	ns
	Carry In to Sum Out	$V_{DD} = 5V$		320	650	ns
		$V_{DD} = 10V$		125	225	ns
		$V_{DD} = 15V$		95	175	ns
	Sum In to Carry Out	$V_{DD} = 5V$		250	500	ns
		$V_{DD} = 10V$		115	200	ns
		$V_{DD} = 15V$		90	160	ns
	Carry In to Carry Out	$V_{DD} = 5V$		130	245	ns
		$V_{DD} = 10V$		60	105	ns
		$V_{DD} = 15V$		45	80	ns
	Carry In to Carry Out	$C_L = 15 pF$				
		$V_{DD} = 5V$		100	175	ns
		$V_{DD} = 10V$		45	75	ns
		$V_{DD} = 15V$		35	60	ns
t_{THL}	High-to-Low Transition Time	$V_{DD} = 5V$		100	200	ns
		$V_{DD} = 10V$		50	100	ns
		$V_{DD} = 15V$		40	80	ns
t _{TLH}	Low-to-High Transition Time	$V_{DD} = 5V$		200	400	ns
	_	$V_{DD} = 10V$		100	200	ns
		$V_{DD} = 15V$		80	160	ns
C _{IN}	Average Input Capacitance			5	7.5	pF
C _{PD}	Power Dissipation Capacitance	(Note 4)		100		pF

^{*}AC Parameters are guaranteed by DC correlated testing.

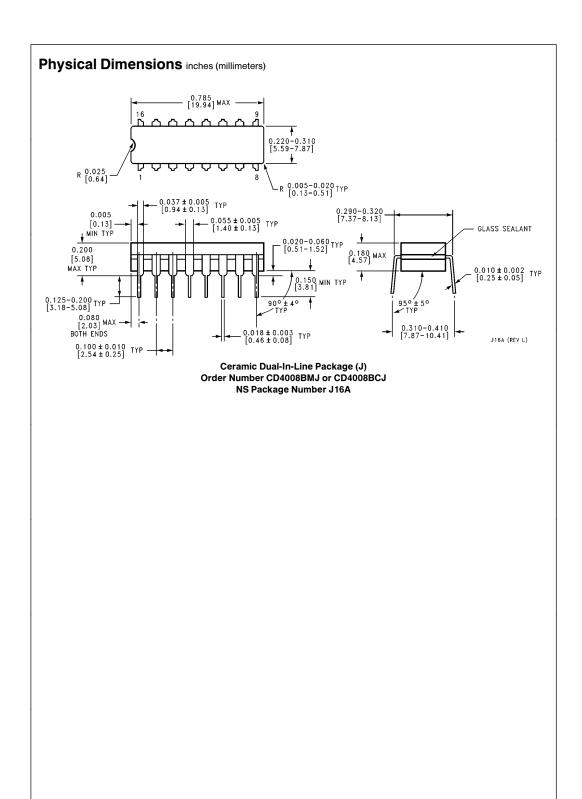
Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed; they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual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

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

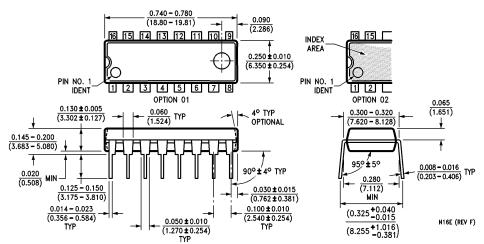
Note 3: $I_{\mbox{\scriptsize OH}}$ and $I_{\mbox{\scriptsize OL}}$ are tested one output at a time.

Note 4: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation, see 54C/74C Family Characteristics application note, AN-90.

AC Test Circuit and Switching Time Waveforms PULSE GENERATOR COUT CIN $C_L = 50 \ pF$ TL/F/5944-3 VDD c_{IN} ^tPLH S1-S4 voH COUT TL/F/5944-4



Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4008BMN or CD4008BCN
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:

- 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.
- 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: (652) 2737-1600 Fax: (652) 2736-9960 National Semiconductor Japan Ltd. Tel: 81-043-299-2309 Fax: 81-043-299-2408