

CD4518BM/CD4518BC, CD4520BM/CD4520BC Dual Synchronous Up Counters

General Description

The CD4518BM/CD4518BC dual BCD counter and the CD4520BM/CD4520BC dual binary counter are implemented with complementary MOS (CMOS) circuits constructed with N- and P-channel enhancement mode transistors.







Each counter consists of two identical, independent, synchronous, 4-stage counters. The counter stages are toggle flip-flops which increment on either the positive-edge of CLOCK or negative-edge of ENABLE, simplifying cascading of multiple stages. Each counter can be asynchronously

cleared by a high level on the RESET line. All inputs are protected against static discharge by diode clamps to both V_{DD} and V_{SS} .

Features

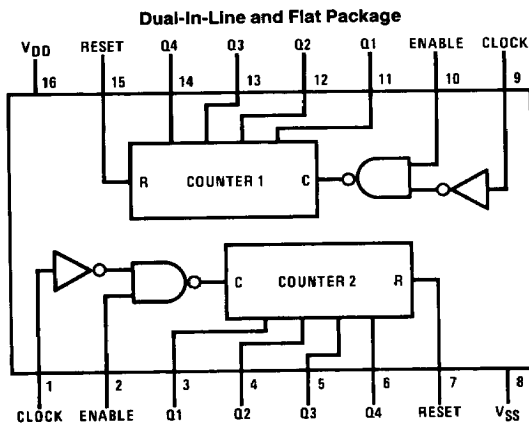
- Wide supply voltage range 3.0V to 15V
- High noise immunity 0.45 V_{DD} (typ.)
- Low power TTL fan out of 2 driving 74L compatibility or 1 driving 74LS
- 6 MHz counting rate (typ.) at $V_{DD} = 10V$

Truth Table

Clock	Enable	Reset	Action
	1	0	Increment Counter
0		0	Increment Counter
	X	0	No Change
X		0	No Change
	0	0	No Change
1		0	No Change
X	X	1	Q1 thru Q4 = 0

X = Don't Care

Connection Diagram



Top View

TL/F/5995-1

**Order Number CD4518B* or
CD4520B***

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

Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, 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 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 V_{DD}
Operating Temperature Range (T_A)	
CD4518BM, CD4520BM	-55°C to +125°C
CD4518BC, CD4520BC	-40°C to +85°C

DC Electrical Characteristics CD4518BM/CD4520BM (Note 2)

Symbol	Parameter	Conditions	-55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	$V_{DD} = 5V$		5		0.01	5		150	μA
		$V_{DD} = 10V$		10		0.01	10		300	μA
		$V_{DD} = 15V$		20		0.01	20		600	μA
V_{OL}	Low Level Output Voltage	$ I_O < 1\mu A, V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$ I_O < 1\mu A, V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
V_{IL}	Low Level Input Voltage	$ I_O < 1\mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or 4.5V		1.5		2.25	1.5		1.5	V
		$V_{DD} = 10V, V_O = 1V$ or 9V		3.0		4.5	3.0		3.0	V
V_{IH}	High Level Input Voltage	$ I_O < 1\mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or 4.5V	3.5		3.5	2.75		3.5		V
		$V_{DD} = 10V, V_O = 1V$ or 9V	7.0		7.0	5.5		7.0		V
I_{OL}	Low Level Output Current (Note 3)	$V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V, V_O = 0.4V$	0.64		0.51	0.88		0.36		mA
		$V_{DD} = 10V, V_O = 0.5V$	1.6		1.3	2.25		0.9		mA
I_{OH}	High Level Output Current (Note 3)	$V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V, V_O = 4.6V$	-0.64		-0.51	-0.88		-0.36		mA
		$V_{DD} = 10V, V_O = 9.5V$	-1.6		-1.3	-2.25		-0.9		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

DC Electrical Characteristics CD4518BC/CD4520BC (Note 2)

Symbol	Parameter	Conditions	-40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	$V_{DD} = 5V$		20		0.01	20		150	μA
		$V_{DD} = 10V$		40		0.01	40		300	μA
		$V_{DD} = 15V$		80		0.01	80		600	μA
V_{OL}	Low Level Output Voltage	$ I_O < 1\mu A, V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$ I_O < 1\mu A, V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
V_{OH}	High Level Output Voltage	$ I_O < 1\mu A, V_{IH} = V_{DD}, V_{IL} = 0V$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V

DC Electrical Characteristics CD4518BC/CD4520BC (Note 2) (Continued)

Symbol	Parameter	Conditions	-40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
V _{IL}	Low Level Input Voltage	I _O < 1μA V _{DD} = 5V, V _O = 0.5V or 4.5V V _{DD} = 10V, V _O = 1V or 9V V _{DD} = 15V, V _O = 1.5V or 13.5V		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 _{IH}	High Level Input Voltage	I _O < 1μA V _{DD} = 5V, V _O = 0.5V or 4.5V V _{DD} = 10V, V _O = 1V or 9V V _{DD} = 15V, V _O = 1.5V or 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
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	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 _{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	-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 _{IN}	Input Current	V _{DD} = 15V, V _{IN} = 0V V _{DD} = 15V, V _{IN} = 15V		-0.3 0.3		-10 ⁻⁵ 10 ⁻⁵	-0.3 0.3		-1.0 1.0	μA μA

AC Electrical Characteristics*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t _{PHL} , t _{PLH}	Propagation Delay Time Clock → Q	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		325 110 85	650 225 170	ns ns ns
t _{PHL}	Propagation Delay Time Reset → Q	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		220 90 65	560 230 160	ns ns ns
t _{rHL} , t _{rLH}	Transition Time	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		100 50 40	200 100 80	ns ns ns
f _{CL}	Maximum Clock Input Frequency	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	1.5 3.0 4.0	3 6 8		MHz MHz MHz
t _{WL} , t _{WH}	Minimum Clock Pulse Width	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		10 50 35	200 100 70	ns ns ns
t _{rCL} , t _{rFC}	Maximum Clock or Enable Rise and Fall Time	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	15 10 5			μs μs μs
t _{WH} , t _{WL}	Minimum Enable Pulse Width	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		125 55 40	250 110 80	ns ns ns
t _{WH}	Minimum Reset Pulse Width	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		180 80 65	375 160 130	ns ns ns
C _{IN}	Input Capacitance	Any Input		5	7.5	pF
C _{PD}	Power Dissipation Capacity	Either Counter (Note 4)		50		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 tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

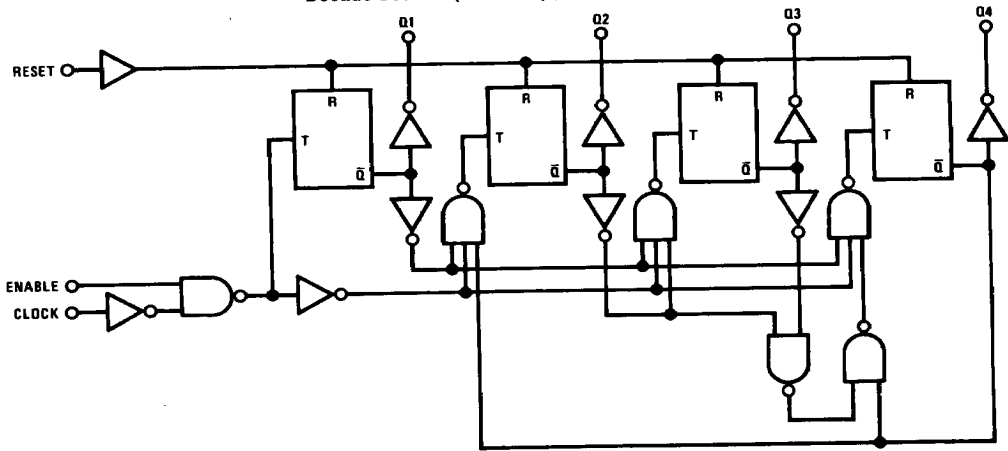
Note 2: V_{SS} = 0V unless otherwise specified.

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

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

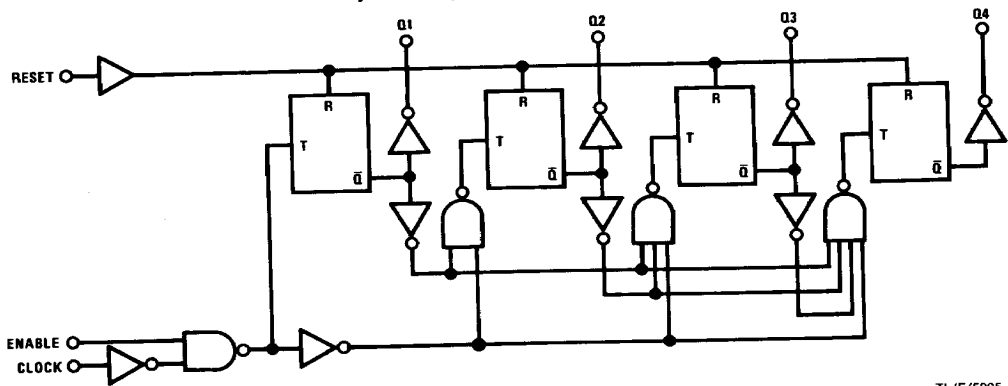
Logic Diagrams

Decade Counter (CD4518B) 1/2 Device Shown



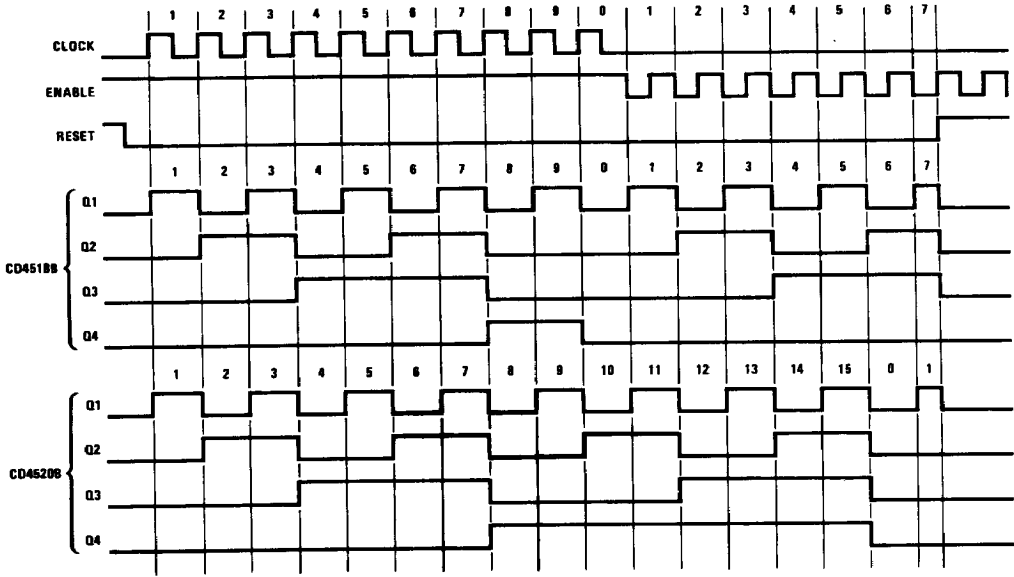
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Binary Counter (CD4520B) 1/2 Device Shown



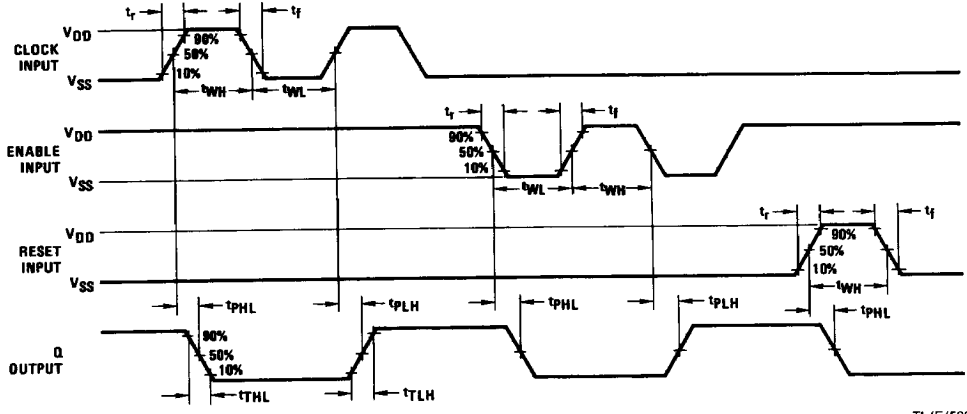
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Timing Diagrams



TL/F/5995-4

Switching Time Waveforms



TL/F/5995-5