National Semiconductor

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

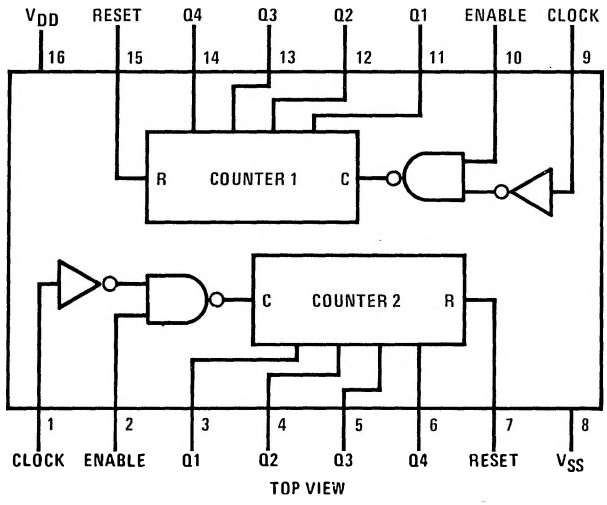
Truth Table

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

Dual-In-Line and Flat Package



TOP VIEW

Absolute Maximum Ratings

(Notes 1 and 2)

V_{DD} Supply Voltage	−0.5V to +18V
V_{IN} Input Voltage	−0.5V to V_{DD} + 0.5V
T_S Storage Temperature Range	−65°C to +150°C
P_D Package Dissipation	500 mW
T_L Lead Temperature (Soldering, 10 seconds)	300°C

Recommended Operating Conditions

(Note 2)

V_{DD} Supply Voltage	3V to 15V
V_{IN} Input Voltage	0V to V_{DD}
T_A Operating Temperature Range	
CD4518BM, CD4520BM	−55°C to +125°C
CD4518BC, CD4520BC	−40°C to +85°C

DC Electrical Characteristics CD4518BM/CD4520BM (Note 2)

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_{DD} = 15V		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_{DD} = 15V	14.95		14.95	15		14.95		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_{DD} = 15V, V_O = 1.5V or 13.5V		4.0		6.75	4.0		4.0	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
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0	8.25		11.0		V
I_{OL}	Low Level Output Current	$V_{IH} = V_{DD}$, 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
		V_{DD} = 15V, V_O = 1.5V	4.2		3.4	8.8		2.4		mA
I_{OH}	High Level Output Current	$V_{IH} = V_{DD}$, 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
		V_{DD} = 15V, V_O = 13.5V	−4.2		−3.4	−8.8		−2.4		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)

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_{DD} = 15V		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_{DD} = 15V	14.95		14.95	15		14.95		V

DC Electrical Characteristics (Cont'd.) CD4518BC/CD4520BC (Note 2)

PARAMETER		CONDITIONS	−40 C		25 C			85 C		UNITS
			MIN	MAX	MIN	TYP	MAX	MIN	MAX	
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_{DD} = 15V, V_O = 1.5V or 13.5V		4.0		6.75	4.0		4.0	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
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0	8.25		11.0		V
I_{OL}	Low Level Output Current	$V_{IH} = V_{DD}$, V_{IL} = 0V								
		V_{DD} = 5V, V_O = 0.4V	0.52		0.44	0.88		0.36		mA
		V_{DD} = 10V, V_O = 0.5V	1.3		1.1	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	3.6		3.0	8.8		2.4		mA
I_{OH}	High Level Output Current	$V_{IH} = V_{DD}$, V_{IL} = 0V								
		V_{DD} = 5V, V_O = 4.6V	−0.52		−0.44	−0.88		−0.36		mA
		V_{DD} = 10V, V_O = 9.5V	−1.3		−1.1	−2.25		−0.9		mA
		V_{DD} = 15V, V_O = 13.5V	−3.6		−3.0	−8.8		−2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.3		-10^{-5}	−0.3		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.3		10^{-5}	0.3		1.0	μA

AC Electrical Characteristics $T_A = 25°C$, $C_L = 50\,pF$, $R_L = 200\,k\Omega$, $t_r = t_f = 20\,ns$, unless otherwise specified.

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
t_{PHL}, t_{PLH}	Propagation Delay Time, Clock → Q	V_{DD} = 5V		325	650	ns
		V_{DD} = 10V		110	225	ns
		V_{DD} = 15V		85	170	ns
t_{PHL}	Propagation Delay Time Reset → Q	V_{DD} = 5V		220	560	ns
		V_{DD} = 10V		90	230	ns
		V_{DD} = 15V		65	160	ns
t_{THL}, t_{TLH}	Transition Time	V_{DD} = 5V		100	200	ns
		V_{DD} = 10V		50	100	ns
		V_{DD} = 15V		40	80	ns
f_{CL}	Maximum Clock Input Frequency	V_{DD} = 5V	1.5	3		MHz
		V_{DD} = 10V	3.0	6		MHz
		V_{DD} = 15V	4.0	8		MHz
t_{WL}, t_{WH}	Minimum Clock Pulse Width	V_{DD} = 5V		100	200	ns
		V_{DD} = 10V		50	100	ns
		V_{DD} = 15V		35	70	ns
t_{RCL}, t_{FC}	Maximum Clock or Enable Rise and Fall Time	V_{DD} = 5V	15			μs
		V_{DD} = 10V	10			μs
		V_{DD} = 15V	5			μs
t_{WH}, t_{WL}	Minimum Enable Pulse Width	V_{DD} = 5V		125	250	ns
		V_{DD} = 10V		55	110	ns
		V_{DD} = 15V		40	80	ns
t_{WH}	Minimum Reset Pulse Width	V_{DD} = 5V		180	375	ns
		V_{DD} = 10V		80	160	ns
		V_{DD} = 15V		65	130	ns
C_{IN}	Input Capacitance	Any Input		5	7.5	pF
C_{PD}	Power Dissipation Capacity	Either Counter, (Note 3)		50		pF

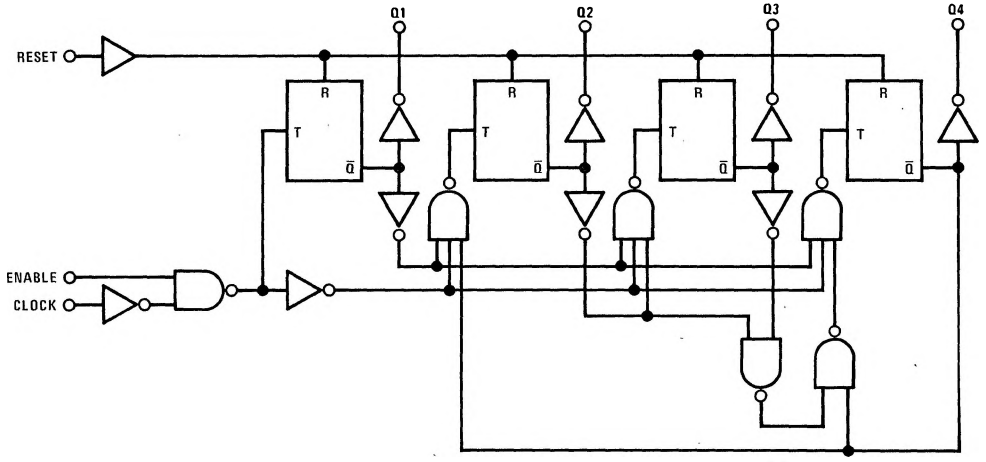
Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual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

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

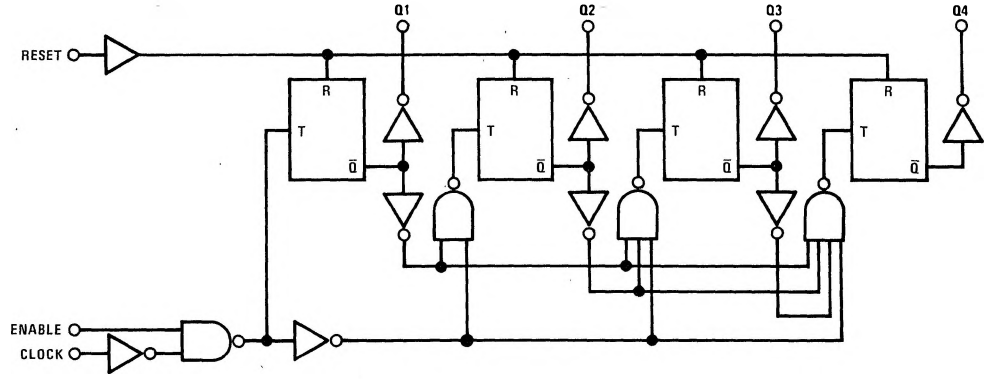
Note 3: C_{PD} determines the no load ac power consumption of a CMOS device. For a complete explanation, see "54C/74C Family Characteristics," application note AN-90.

Logic Diagrams

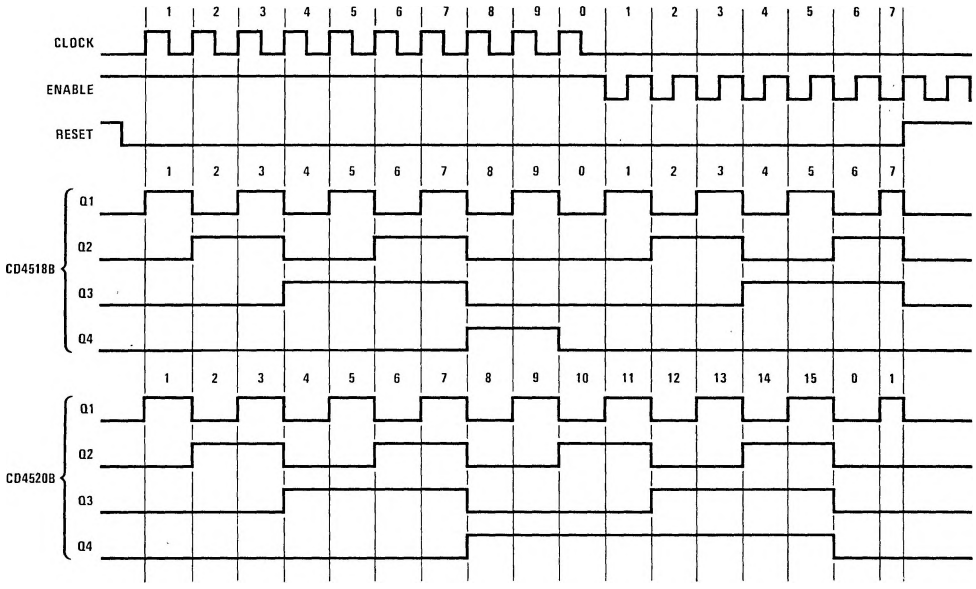
Decade Counter (CD4518B) 1/2 Device Shown



Binary Counter (CD4520B) 1/2 Device Shown



Timing Diagrams



Switching Time Waveforms