



CD4510BM/CD4510BC BCD Up/Down Counter CD4516BM/CD4516BC Binary Up/Down Counter

General Description

The CD4510BM/CD4510BC and CD4516BM/CD4516BC are monolithic CMOS up/down counters which count in BCD and binary, respectively.

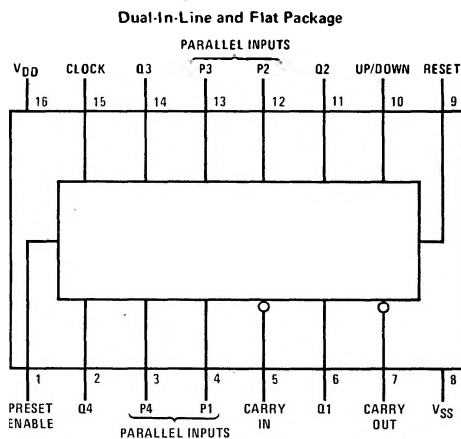
The counters count up when the up/down input is at logical "1" and vice versa. A logical "1" preset enable signal allows information at the parallel inputs to preset the counters to any state synchronously with the clock. The counters are advanced one count at the positive-going edge of the clock if the carry in, preset enable, and reset inputs are at logical "0". Advancement is inhibited when any of these three inputs are at logical "1". The carry out signal is normally at logical "1" state and goes to logical "0" when the counter reaches its maximum count in the "up" mode or its minimum count in the "down" mode, provided the carry input is at logical "0" state. The counters are cleared asynchronously by applying a logical "1" voltage level at the reset input.

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 compatibility fan out of 2 driving 74L or 1 driving 74LS
- Parallel load "jam" inputs
- Low quiescent power dissipation 0.25 μ W/package (typ.) @ $V_{CC} = 5.0V$
- Motorola MC14510, MC14516 second source

Connection Diagram



Truth Table

TOP VIEW

CLOCK	RESET	PRESET ENABLE	CARRY IN	UP/DOWN	OUTPUT FUNCTION
X	1	X	X	X	Reset to zero
X	0	1	X	X	Set to P1, P2, P3, P4
	0	0	0	1	Count up
	0	0	0	0	Count down
	0	0	X	X	No change
X	0	0	1	X	No change

= positive transition
 = negative transition
 X = don't care

Absolute Maximum Ratings

(Notes 1 and 2)

V_{DD} dc 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} dc Supply Voltage	3V to 15V
V_{IN} Input Voltage	0 to V_{DD}
T_A Operating Temperature Range	-55°C to +125°C
CD4510BM, CD4516BM	-40°C to +85°C
CD4510BC, CD4516BC	

DC Electrical Characteristics CD4510BM/CD4516BM (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		0.05	5		150	μA
	$V_{DD} = 10V$		10		0.1	10		300	μA
	$V_{DD} = 15V$		20		0.15	20		600	μA
V_{OL} Low Level Output Voltage	$V_{IH} = V_{DD}, V_{IL} = 0V, I_{O} < 1 \mu A$								
	$V_{DD} = 5V$		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	$V_{IH} = V_{DD}, V_{IL} = 0V, I_{O} < 1 \mu A$								
	$V_{DD} = 5V$	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$								
	$V_{DD} = 5V, V_O = 0.5V \text{ or } 4.5V$		1.5		2.25	1.5		1.5	V
	$V_{DD} = 10V, V_O = 1V \text{ or } 9V$		3.0		4.5	3.0		3.0	V
	$V_{DD} = 15V, V_O = 1.5V \text{ or } 13.5V$		4.0		6.75	4.0		4.0	V
V_{IH} High Level Input Voltage	$ I_{O} < 1 \mu A$								
	$V_{DD} = 5V, V_O = 0.5V \text{ or } 4.5V$	3.5		3.5	2.75		3.5		V
	$V_{DD} = 10V, V_O = 1V \text{ or } 9V$	7.0		7.0	5.5		7.0		V
	$V_{DD} = 15V, V_O = 1.5V \text{ or } 13.5V$	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	0.8		0.36		mA
	$V_{DD} = 10V, V_O = 0.5V$	1.6		1.3	2.0		0.9		mA
	$V_{DD} = 15V, V_O = 1.5V$	4.2		3.4	7.8		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	-0.8		-0.36		mA
	$V_{DD} = 10V, V_O = 9.5V$	-1.6		-1.3	-2.0		-0.9		mA
	$V_{DD} = 15V, V_O = 13.5V$	-4.2		-3.4	-7.8		-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 CD4510BC/CD4516BC (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		0.05	20		150	μA
	$V_{DD} = 10V$		40		0.1	40		300	μA
	$V_{DD} = 15V$		80		0.15	80		600	μA
V_{OL} Low Level Output Voltage	$V_{IH} = V_{DD}, V_{IL} = 0V, I_{O} < 1 \mu A$								
	$V_{DD} = 5V$		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	$V_{IH} = V_{DD}, V_{IL} = 0V, I_{O} < 1 \mu A$								
	$V_{DD} = 5V$	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.) CD4510BC/CD4516BC (Note 2)

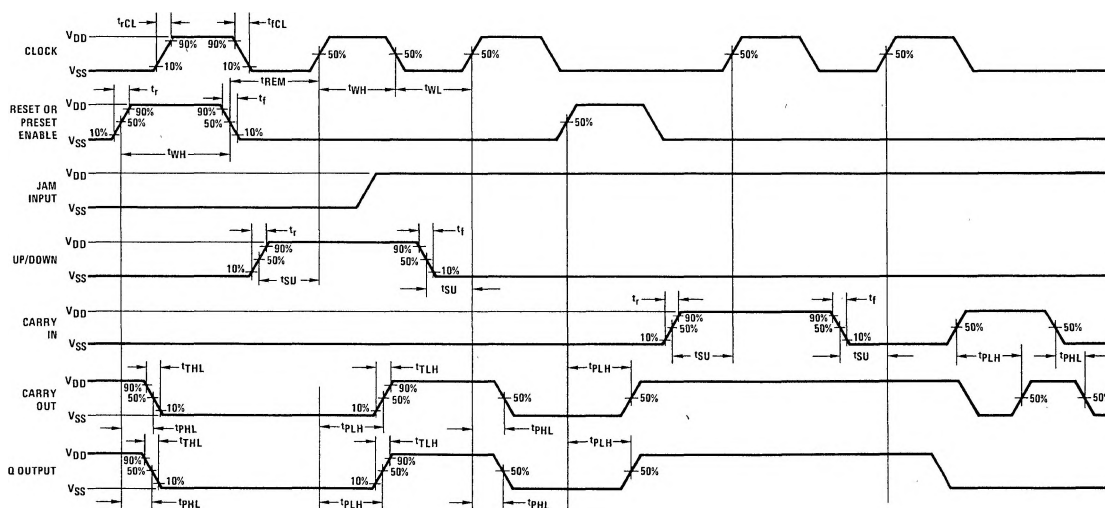
PARAMETER	CONDITIONS	-40°C		25°C			85°C		UNITS
		MIN	MAX	MIN	TYP	MAX	MIN	MAX	
V _{IL} Low Level Input Voltage	$I_{IQ} < 1 \mu A$								
	V _{DD} = 5V, V _O = 0.5V or 4.5V		1.5		2.25	1.5		1.5	V
	V _{DD} = 10V, V _O = 1V or 9V		3.0		4.5	3.0		3.0	V
	V _{DD} = 15V, V _O = 1.5V or 13.5V		4.0		6.75	4.0		4.0	V
V _{IH} High Level Input Voltage	$I_{IQ} < 1 \mu A$								
	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	0.8		0.36		mA
	V _{DD} = 10V, V _O = 0.5V	1.3		1.1	2.0		0.9		mA
	V _{DD} = 15V, V _O = 1.5V	3.6		3.0	7.8		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	-0.8		-0.36		mA
	V _{DD} = 10V, V _O = 9.5V	-1.3		-1.1	-2.0		-0.9		mA
	V _{DD} = 15V, V _O = 13.5V	-3.6		-3.0	-7.8		-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

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: Devices should not be connected while power is "ON."

Switching Time Waveforms

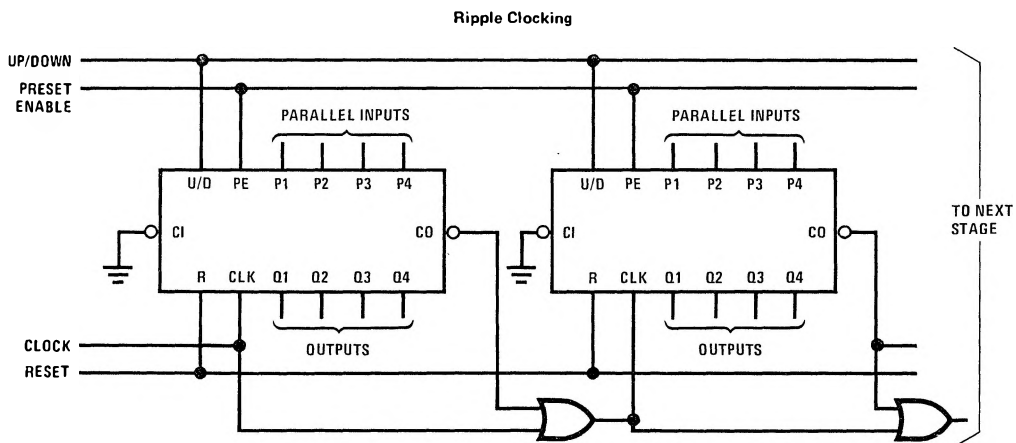
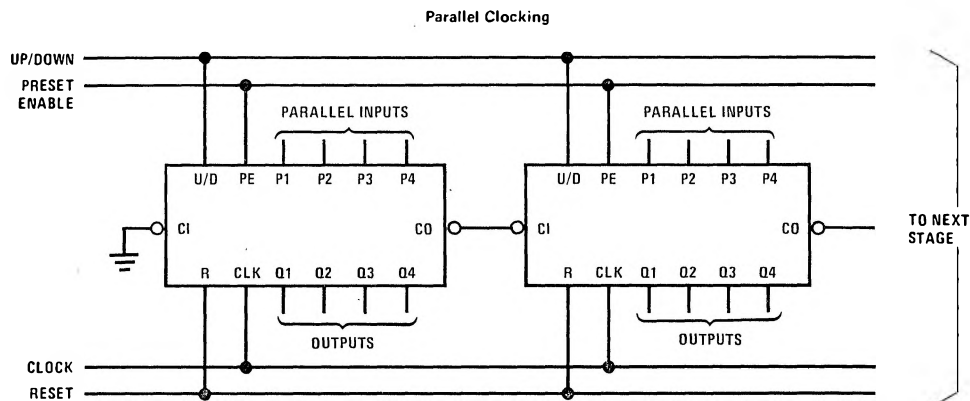


AC Electrical Characteristics CD4510BM/CD4510BC, CD4516BM/CD4516BC $T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}\Omega$, $t_{rCL} = t_{fCL} = t_r = t_f = 20\text{ ns}$, unless otherwise specified.

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
CLOCKED OPERATION						
t _{PHL} , t _{PLH}	Propagation Delay Time Clock to Q Outputs	V _{DD} = 5V		220	500	ns
		V _{DD} = 10V		100	200	ns
		V _{DD} = 15V		80	180	ns
t _{PHL} , t _{PLH}	Propagation Delay Time Clock to Carry Output	V _{DD} = 5V		315	630	ns
		V _{DD} = 10V		130	260	ns
		V _{DD} = 15V		100	200	ns
t _{THL} , t _{TLH}	Transition Time Q and Carry Outputs	V _{DD} = 5V		100	200	ns
		V _{DD} = 10V		50	100	ns
		V _{DD} = 15V		40	80	ns
t _{WL} , t _{WH}	Minimum Clock Pulse Width	V _{DD} = 5V		160	315	ns
		V _{DD} = 10V		65	130	ns
		V _{DD} = 15V		50	100	ns
t _{rCL} , t _{fCL}	Maximum Clock Rise and Fall Time	V _{DD} = 5V	15			μs
		V _{DD} = 10V	15			μs
		V _{DD} = 15V	15			μs
t _{SU}	Minimum Carry, In Set-Up Time	V _{DD} = 5V		100	220	ns
		V _{DD} = 10V		40	80	ns
		V _{DD} = 15V		35	70	ns
t _{SU}	Minimum Up/Down Set-Up Time	V _{DD} = 5V		200	420	ns
		V _{DD} = 10V		70	170	ns
		V _{DD} = 15V		60	150	ns
f _{CL}	Maximum Clock Frequency	V _{DD} = 5V	1.5	3.1		MHz
		V _{DD} = 10V	3.8	7.6		MHz
		V _{DD} = 15V	5.0	10.0		MHz
C _{IN}	Input Capacitance	Any Input		5	7.5	pF
C _{PD}	Power Dissipation Capacitance (Note 4)	Per Package,		65		pF
RESET/PRESET ENABLE OPERATION						
t _{PHL} , t _{PLH}	Propagation Delay Time Reset/ Preset Enable to Q Output	V _{DD} = 5V		285	570	ns
		V _{DD} = 10V		115	230	ns
		V _{DD} = 15V		95	195	ns
t _{PHL} , t _{PLH}	Propagation Delay Time Reset/ Preset Enable to Carry Output	V _{DD} = 5V		420	860	ns
		V _{DD} = 10V		170	350	ns
		V _{DD} = 15V		140	290	ns
t _{WH}	Minimum Reset/Preset Enable Pulse Width	V _{DD} = 5V		90	200	ns
		V _{DD} = 10V		40	100	ns
		V _{DD} = 15V		35	80	ns
t _{REM}	Minimum Reset/Preset Enable Removal Time	V _{DD} = 5V		170	330	ns
		V _{DD} = 10V		70	140	ns
		V _{DD} = 15V		60	120	ns
CARRY INPUT OPERATION						
t _{PHL} , t _{PLH}	Propagation Delay Time Carry In to Carry Output	V _{DD} = 5V		260	500	ns
		V _{DD} = 10V		110	220	ns
		V _{DD} = 15V		90	180	ns

Note 4: Dynamic power dissipation (P_D) is given by: $P_D = (C_{PD} + C_L)V_{DD}^2f + P_Q$; where C_L = load capacitance; f = frequency of operation; P_Q = Quiescent Power Dissipation. For further details, see application note AN-90, "54C/74C Family characteristics."

Cascading Packages



Schematic Diagrams

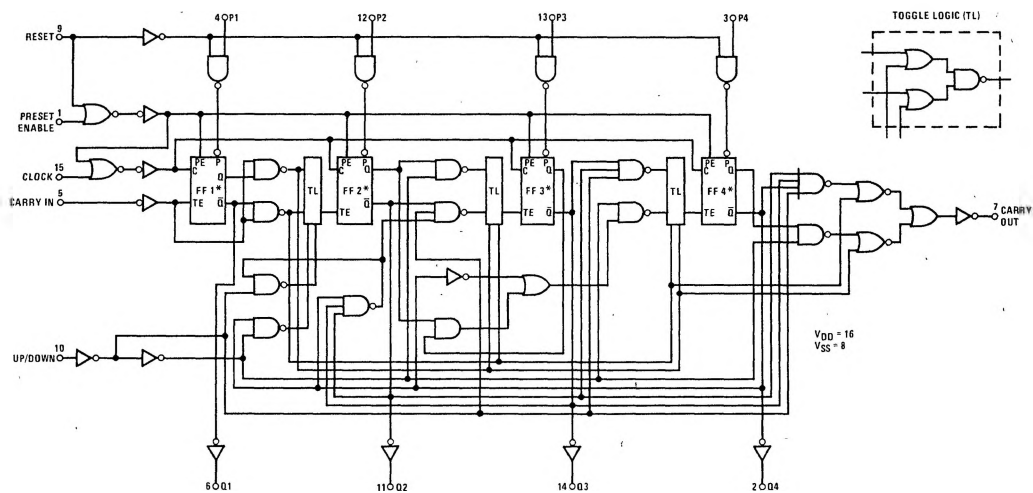
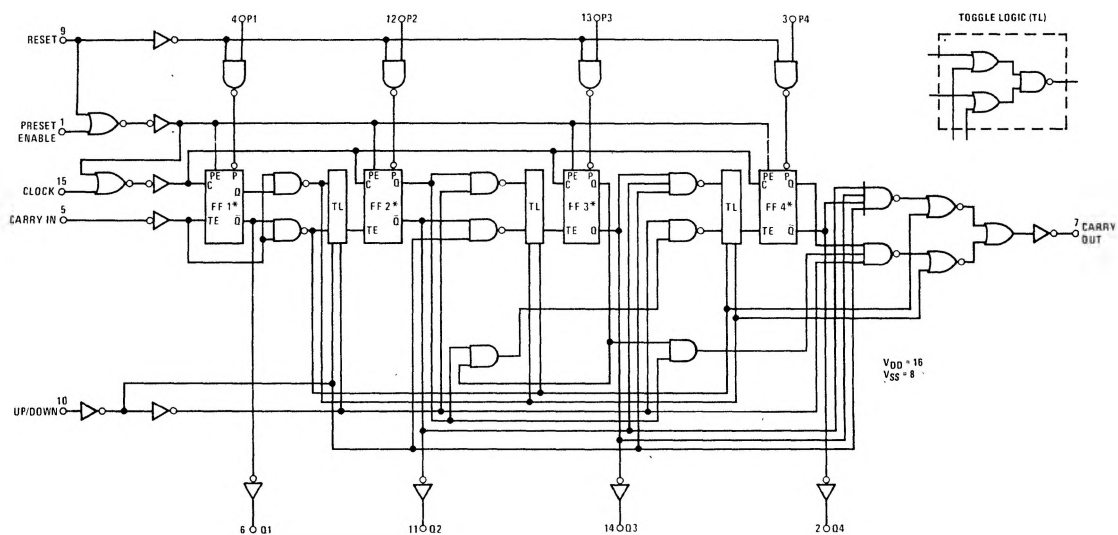


FIGURE 1. CD4510



*Flip-flop toggles at the positive-going edge of clock (C) if Toggle Enable (TE) is at logical "1" and Preset Enable (PE) is at logical "0"

FIGURE 2. CD4516

Logic Waveforms

CD4510BM/CD4510BC, CD4516BM/CD4516BC

CD4510BM/CD4510BC

