CD4518B, CD4520B Types

CMOS Dual Up-Counters

High-Voltage Types (20-Volt Rating)

CD4518B Dual BCD Up-Counter
CD4520B Dual Binary Up-Counter

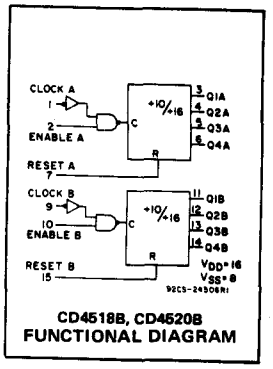
The RCA-CD4518 Dual BCD Up-Counter and CD4520 Dual Binary Up-Counter each consist of two identical, internally synchronous 4-stage counters. The counter stages are D-type flip-flops having interchangeable CLOCK and ENABLE lines for incrementing on either the positive-going or negative-going transition. For single-unit operation the ENABLE input is maintained high and the counter advances on each positive-going transition of the CLOCK. The counters are cleared by high levels on their RESET lines.

The counter can be cascaded in the ripple mode by connecting Q4 to the enable input of the subsequent counter while the CLOCK input of the latter is held low.

The CD4518B and CD4520B types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), 16-lead ceramic flat packages (K suffix), and in chip form (H suffix).

Features:

- **Medium-speed operation — 6-MHz typical clock frequency at 10 V**
- **Positive- or negative-edge triggering**
- **Synchronous internal carry propagation**
- **100% tested for quiescent current at 20 V**
- **Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C**
- **Noise margin(over full package-temperature range): 1 V at V_{DD} = 5 V; 2 V at V_{DD} = 10 V; 2.5 V at V_{DD} = 15 V**
- **5-V, 10-V, and 15-V parametric ratings**
- **Standardized, symmetrical output characteristics**
- **Meets all requirements of JEDEC Tentative Standard No. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices"**



CD4518B, CD4520B FUNCTIONAL DIAGRAM

Applications:

- **Multistage synchronous counting**
- **Multistage ripple counting**
- **Frequency dividers**

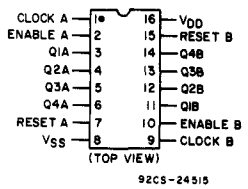
TRUTH TABLE

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 1 ≡ High State 0 ≡ Low State

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_{DD})
(Voltages referenced to V_{SS} Terminal) . . . . . −0.5 to +20 V
INPUT VOLTAGE RANGE, ALL INPUTS . . . . . −0.5 to V_{DD} +0.5 V
DC INPUT CURRENT, ANY ONE INPUT . . . . . ±10 mA
POWER DISSIPATION PER PACKAGE (P_D):
For T_A = −40 to +60°C (PACKAGE TYPE E) . . . . . 500 mW
For T_A = +60 to +85°C (PACKAGE TYPE E) . . . . . Derate Linearly at 12 mW/°C to 200 mW
For T_A = -55 to +100°C (PACKAGE TYPES D, F, K) . . . . . 500 mW
For T_A = +100 to +125°C (PACKAGE TYPES D, F, K) . . . Derate Linearly at 12 mW/°C to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR
FOR T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) . . . . . 100 mW
OPERATING-TEMPERATURE RANGE (T_A):
PACKAGE TYPES D, F, K, H . . . . . −55 to +125°C
PACKAGE TYPE E . . . . . −40 to +85°C
STORAGE TEMPERATURE RANGE (T_{stg}) . . . . . −65 to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max. . . . . +265°C



CD4518B, CD4520B TERMINAL ASSIGNMENT

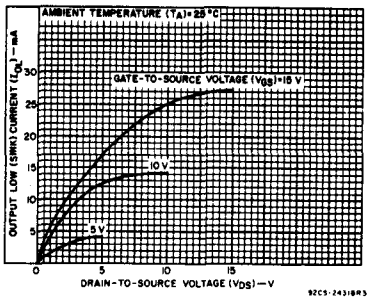


Fig. 1 – Typical output low (sink) current characteristics.

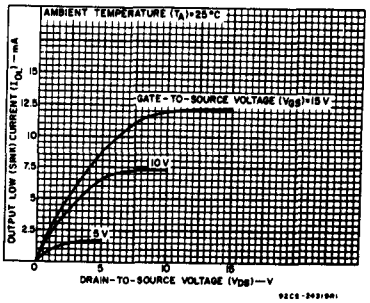


Fig. 2 – Minimum output low (sink) current characteristics.

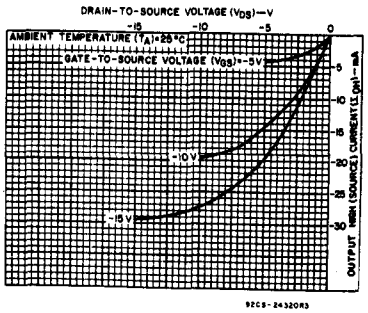


Fig. 3 – Typical output high (source) current characteristics.

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C) Values at -55, +25, +125 Apply to D, F, K, H Packages Values at −40, +25, +85 Apply to E Package							UNITS
								+25			
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	−40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current, I_{DD} Max.	–	0,5	5	5	5	150	150	–	0.04	5	μA
	–	0,10	10	10	10	300	300	–	0.04	10	
	–	0,15	15	20	20	600	600	–	0.04	20	
	–	0,20	20	100	100	3000	3000	–	0.08	100	
Output Low (Sink) Current I_{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	–	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	–	
	1.5	0,15	15	4.2	4	2.8	2.4	3 4	6.8	–	
Output High (Source) Current, I_{OH} Min.	4.6	0,5	5	−0.64	−0.61	−0.42	−0.36	−0.51	−1	–	
	2.5	0,5	5	−2	−1.8	−1.3	−1.15	−1.6	−3.2	–	
	9.5	0,10	10	−1.6	−1.5	−1.1	−0.9	−1.3	−2.6	–	
	13.5	0,15	15	−4.2	−4	−2.8	−2.4	−3.4	−6.8	–	
Output Voltage: Low-Level, V_{OL} Max.	–	0,5	5	0.05				–	0	0.05	V
	–	0,10	10	0.05				–	0	0.05	
	–	0,15	15	0.05				–	0	0.05	
Output Voltage: High-Level, V_{OH} Min.	–	0,5	5	4.95				4.95	5	–	
	–	0,10	10	9.95				9.95	10	–	
	–	0,15	15	14.95				14.95	15	–	
Input Low Voltage, V_{IL} Max.	0.5, 4.5	–	5	1.5				—	—	1.5	V
	1, 9	–	10	3				—	—	3	
	1.5,13.5	–	15	4				—	—	4	
Input High Voltage, V_{IH} Min.	0.5, 4.5	–	5	3.5				3.5	—	—	
	1, 9	–	10	7				7	—	—	
	1.5,13.5	-	15	11				11	—	—	
Input Current I_{IN} Max.	–	0,18	18	±0.1	±0.1	±1	±1	–	$±10^{-5}$	±0.1	μA

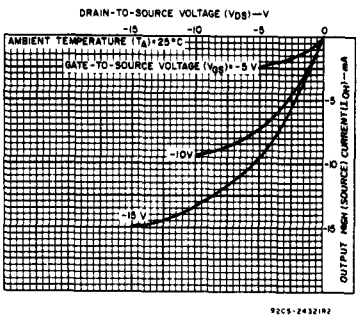


Fig. 4 — Minimum output high (source) current characteristics.

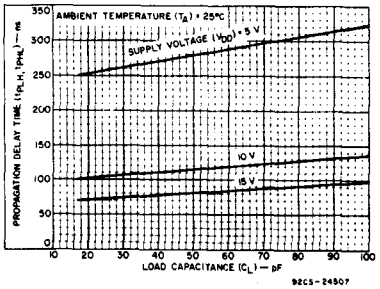


Fig. 5 — Typical propagation delay vs. load capacitance, clock or enable to output.

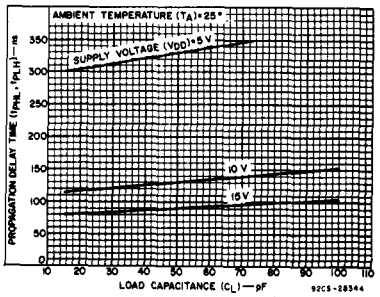


Fig. 6 — Typical propagation delay time vs. load capacitance, reset to output.

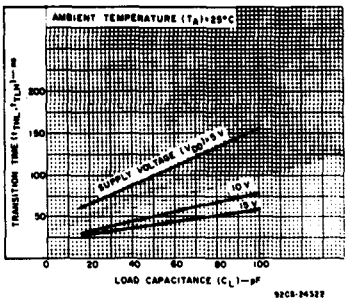


Fig. 7 — Typical transition time vs. load capacitance.

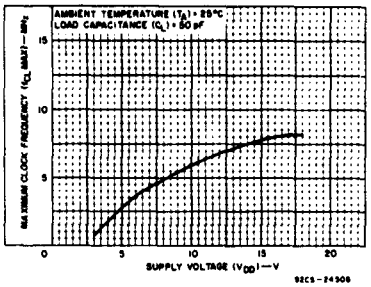


Fig. 8 — Typical maximum-clock-frequency vs. supply voltage.

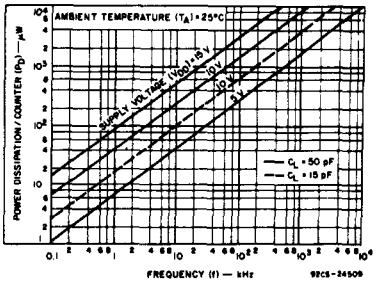


Fig. 9 — Typical power dissipation characteristics.

RECOMMENDED OPERATING CONDITIONS at T_A = 25°C, Except as Noted.
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	V_{DD} (V)	LIMITS		UNITS
		Min.	Max.	
Supply-Voltage Range (For T_A=Full Package-Temperature Range)		3	18	V
Enable Pulse Width, t_W	5	400	–	ns
	10	200	–	
	15	140	–	
Clock Pulse Width, t_W	5	200	–	ns
	10	100	–	
	15	70	–	
Clock Input Frequency, f_{CL}	5		1.5	MHz
	10	dc	3	
	15		4	
Clock Rise or Fall Time, t_rCL or t_fCL:	5	–	15	μs
	10	–	5	
	15	–	5	
Reset Pulse Width, t_W	5	250	–	ns
	10	110	–	
	15	80	–	

DYNAMIC ELECTRICAL CHARACTERISTICS at T_A=25°C;
Input t_r,t_f=20 ns, C_L=50 pF, R_L=200 KΩ

CHARACTERISTIC	TEST CONDITIONS	V_{DD} V	LIMITS Min.	Typ.	Max.	UNITS
Propagation Delay Time, t_{PHL}, t_{PLH}: Clock or Enable to Output		5	–	280	560	ns
		10	–	115	230	
		15	–	80	160	
Reset to Output		5	–	330	650	
		10	–	130	225	
		15	–	90	170	
Transition Time, t_{THL}, t_{TLH}		5	–	100	200	ns
		10	–	50	100	
		15	–	40	80	
Maximum Clock Input Frequency, f_{CL}		5	1.5	3	–	MHz
		10	3	6	–	
		15	4	8	–	
Minimum Clock Pulse Width, t_W		5		100	200	ns
		10		50	100	
		15		35	70	
Clock Rise or Fall Time, t_r or t_f:		5	–	–	15	μs
		10, 15	–	–	5	
Minimum Reset Pulse Width, t_W		5	–	125	250	ns
		10	–	55	110	
		15	–	40	80	
Minimum Enable Pulse Width, t_W		5	–	200	400	ns
		10	–	100	200	
		15	–	70	140	
Input Capacitance, C_{IN}	Any Input		–	5	7.5	pF

TEST CIRCUITS

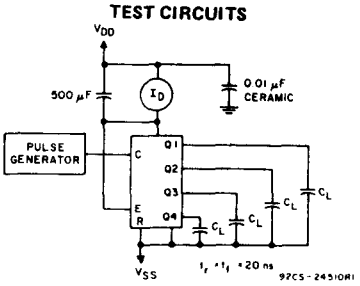


Fig. 10 – Dynamic power dissipation.

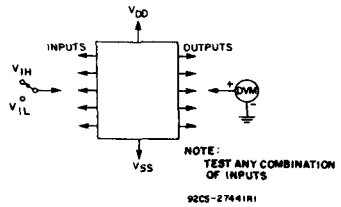


Fig. 11 – Input voltage.

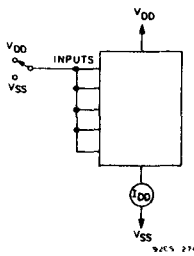


Fig. 12 – Quiescent device current test circuit.

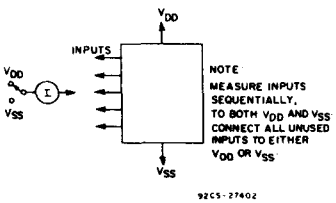


Fig. 13 – Input leakage-current test circuit.

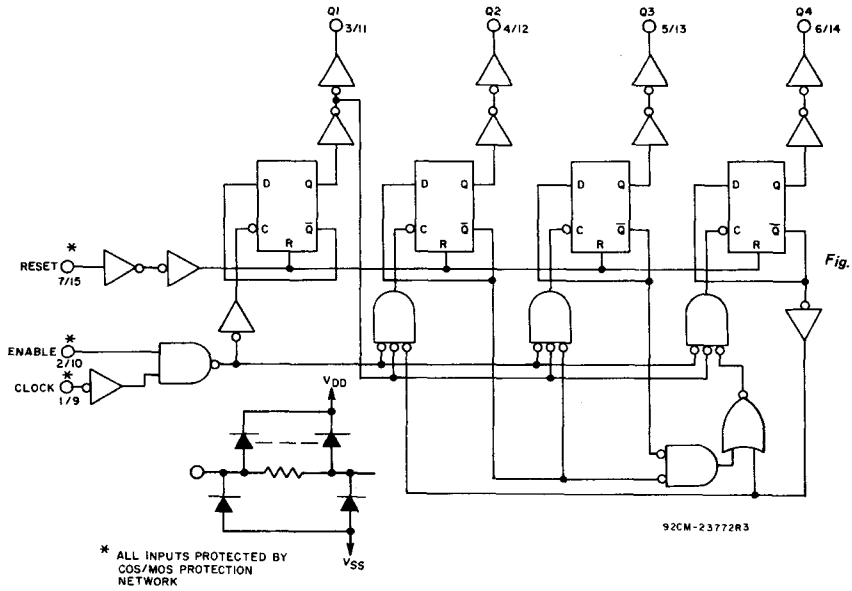


Fig. 14 — Decade counter (CD4518B) logic diagram for one of two identical counters.

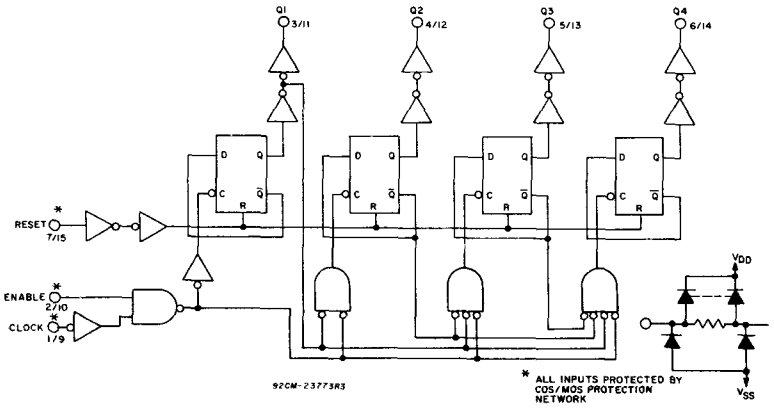


Fig. 15 — Binary counter (CD4520B) logic diagram for one of two identical counters.

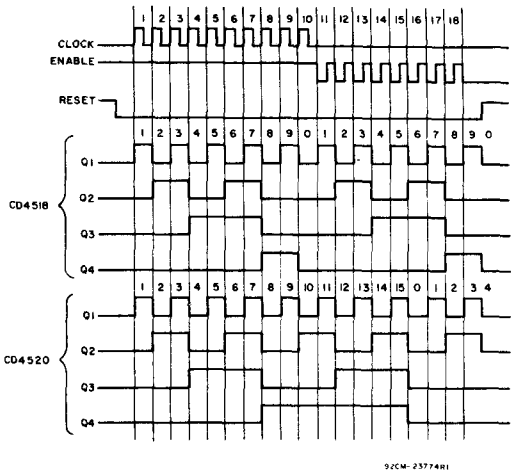


Fig. 16 — Timing diagrams for CD4518B and CD4520B.

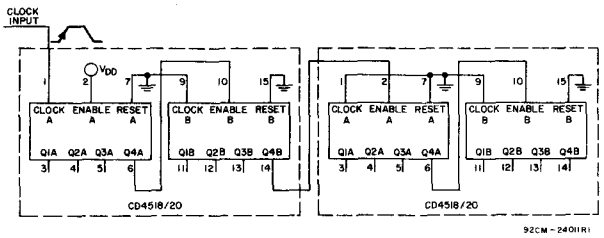
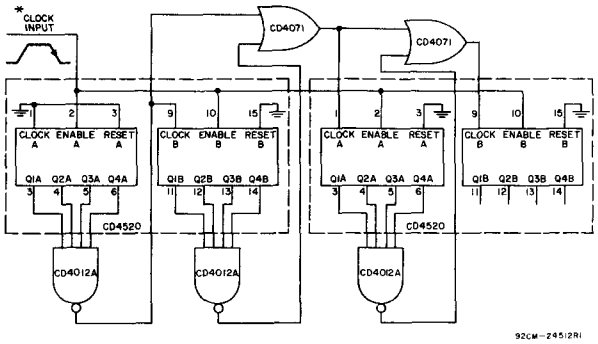
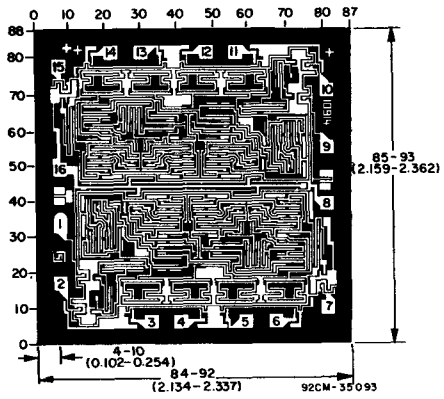


Fig. 17 – Ripple cascading of four counters with positive edge triggering.

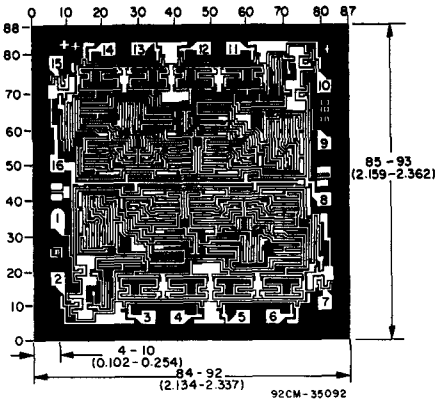


*NOTE: FOR SYNCHRONOUS CASCADING, THE CLOCK TRANSITION TIME SHOULD BE MADE LESS THAN OR EQUAL TO THE SUM OF THE FIXED PROPAGATION DELAY AT 15 pF AND THE TRANSITION TIME OF THE OUTPUT DRIVER STAGE FOR THE ESTIMATED CAPACITATIVE LOAD.

Fig. 18 – Synchronous cascading of four binary counters with negative edge triggering.



Dimensions and pad layout for CD4518BH chip.



Dimensions and pad layout for CD4520BH chip.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

The photographs and dimensions of each CMOS chip represent a chip when it is part of the wafer. When the wafer is separated into individual chips, the angle of cleavage may vary with respect to the chip face for different chips. The actual dimensions of the isolated chip, therefore, may differ slightly from the nominal dimensions shown. The user should consider a tolerance of −3 mils to +16 mils applicable to the nominal dimensions shown.