

# CD4518B, CD4520B Types

## CMOS Dual Up-Counters

High-Voltage Types (20-Volt Rating)

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

■ 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.

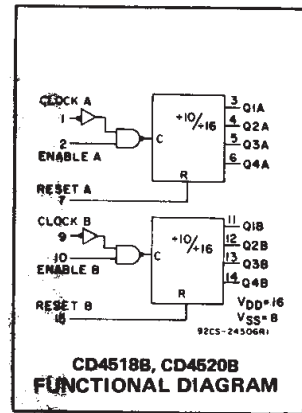
The CD4518B and CD4520B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, and NSR suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

**MAXIMUM RATINGS, Absolute-Maximum Values:**

DC SUPPLY-VOLTAGE RANGE, (V <sub>DD</sub> )	
Voltages referenced to V <sub>SS</sub> Terminal)	..... -0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS	..... -0.5V to V <sub>DD</sub> +0.5V
DC INPUT CURRENT, ANY ONE INPUT	..... ±10mA
POWER DISSIPATION PER PACKAGE (P <sub>D</sub> ):	
For T <sub>A</sub> = -55°C to +100°C	..... 500mW
For T <sub>A</sub> = +100°C to +125°C	..... Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR T <sub>A</sub> = FULL PACKAGE-TEMPERATURE RANGE (All Package Types)	..... 100mW
OPERATING-TEMPERATURE RANGE (T <sub>A</sub> )	..... -55°C to +125°C
STORAGE TEMPERATURE RANGE (T <sub>stg</sub> )	..... -65°C to +150°C
LEAD TEMPERATURE (DURING SOLDERING):	
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max	..... +265°C

**Features:**

- Medium-speed operation – 6-MHz typical clock frequency at 10 V<sub>DD</sub>
- 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<sub>DD</sub> = 5 V  
2 V at V<sub>DD</sub> = 10 V  
2.5 V at V<sub>DD</sub> = 15 V
- 5-V, 10-V, and 15-V parametric ratings
- Standardized, symmetrical output characteristics
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"



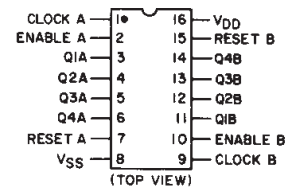
**Applications:**

- 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



**CD4518B, CD4520B  
TERMINAL ASSIGNMENT**

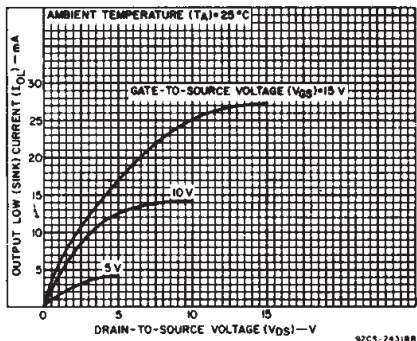


Fig. 1 – Typical output low (sink) current characteristics.

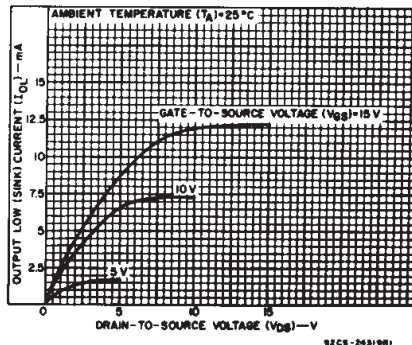


Fig. 2 – Minimum output low (sink) current characteristics.

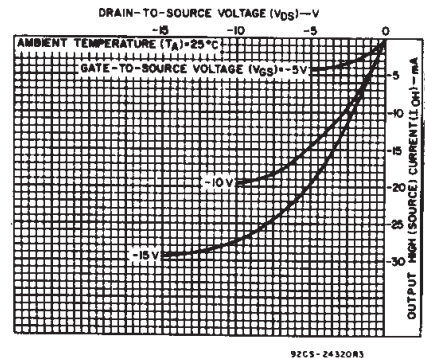


Fig. 3 – Typical output high (source) current characteristics.

# CD4518B, CD4520B Types

## STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)	-55			+25				
				Min.	Typ.	Max.	Min.	Typ.	Max.		
Quiescent Device Current, I <sub>DD</sub> 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 <sub>OL</sub> 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 <sub>OH</sub> Min.	4,6	0,5	5	-0,64	-0,61	-0,42	-0,36	-0,51	-1	—	mA
	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 <sub>OL</sub> Max.	—	0,5	5	0,05			—			0	V
	—	0,10	10	0,05			—			0	
	—	0,15	15	0,05			—			0	
Output Voltage: High-Level, V <sub>OH</sub> Min.	—	0,5	5	4,95			4,95			5	V
	—	0,10	10	9,95			9,95			10	
	—	0,15	15	14,95			14,95			15	
Input Low Voltage, V <sub>IL</sub> 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 <sub>IH</sub> Min.	0,5, 4,5	—	5	3,5			3,5			—	V
	1,9	—	10	7			7			—	
	1,5, 13,5	—	15	11			11			—	
Input Current I <sub>IN</sub> Max.	—	0,18	18	±0,1	±0,1	±1	±1	—	±10 <sup>-5</sup>	±0,1	μA

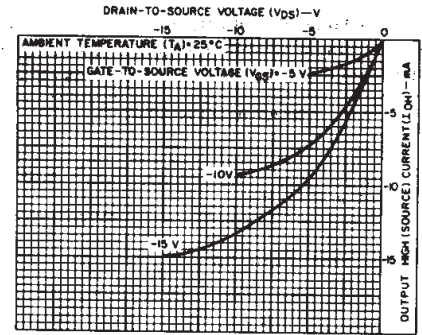


Fig. 4 — Minimum output high (source) current characteristics.

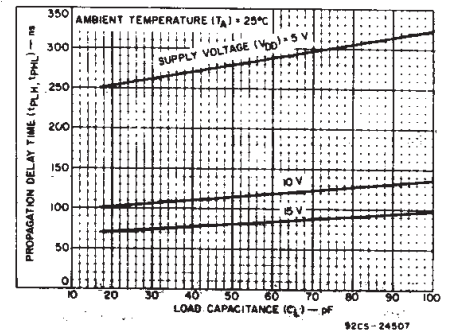


Fig. 5 — Typical propagation delay vs. load capacitance, clock or enable to output.

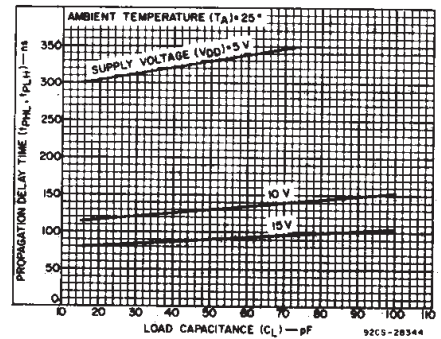


Fig. 6 — Typical propagation delay time vs. load capacitance, reset to output.



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

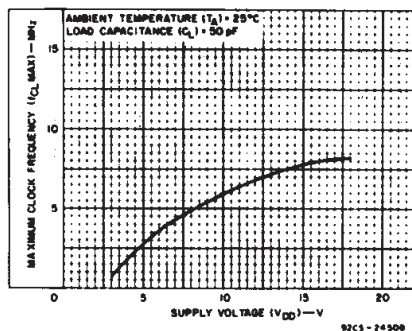


Fig. 8 — Typical maximum-clock-frequency vs. supply voltage.

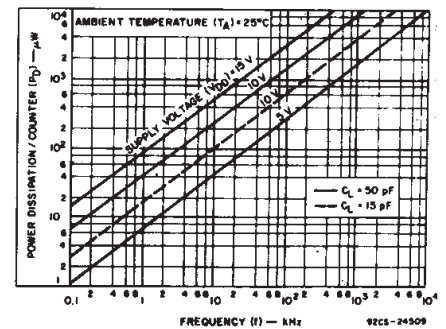


Fig. 9 — Typical power dissipation characteristics.

3  
COMMERCIAL CMOS  
HIGH VOLTAGE ICs

## CD4518B, CD4520B Types

**RECOMMENDED OPERATING CONDITIONS** at  $T_A = 25^\circ\text{C}$ , Except as Noted.  
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	V <sub>DD</sub> (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	$\mu\text{s}$
	10	—	5	
	15	—	5	
Reset Pulse Width, $t_W$	5	250	—	ns
	10	110	—	
	15	80	—	

### DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$ ; Input $t_r, t_f = 20 \text{ ns}$ , $C_L = 50 \text{ pF}$ , $R_L = 200 \text{ k}\Omega$

CHARACTERISTIC	TEST CONDITIONS	LIMITS			UNITS	
		V <sub>DD</sub> V	Min.	Typ.		Max.
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	ns
		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	$\mu\text{s}$
		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

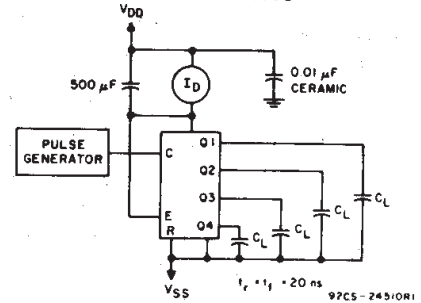


Fig. 10 — Dynamic power dissipation.

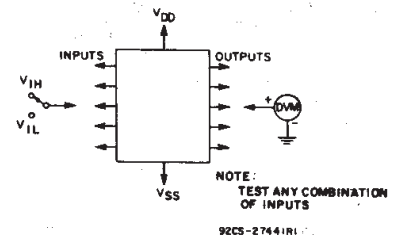


Fig. 11 — Input voltage.

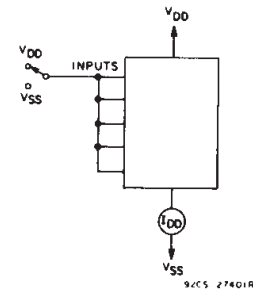


Fig. 12 — Quiescent device current test circuit.

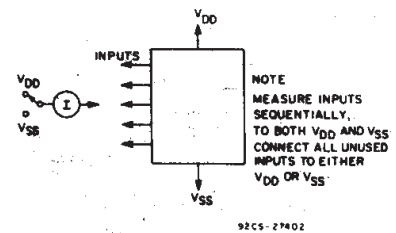


Fig. 13 — Input leakage-current test circuit.

# CD4518B, CD4520B Types

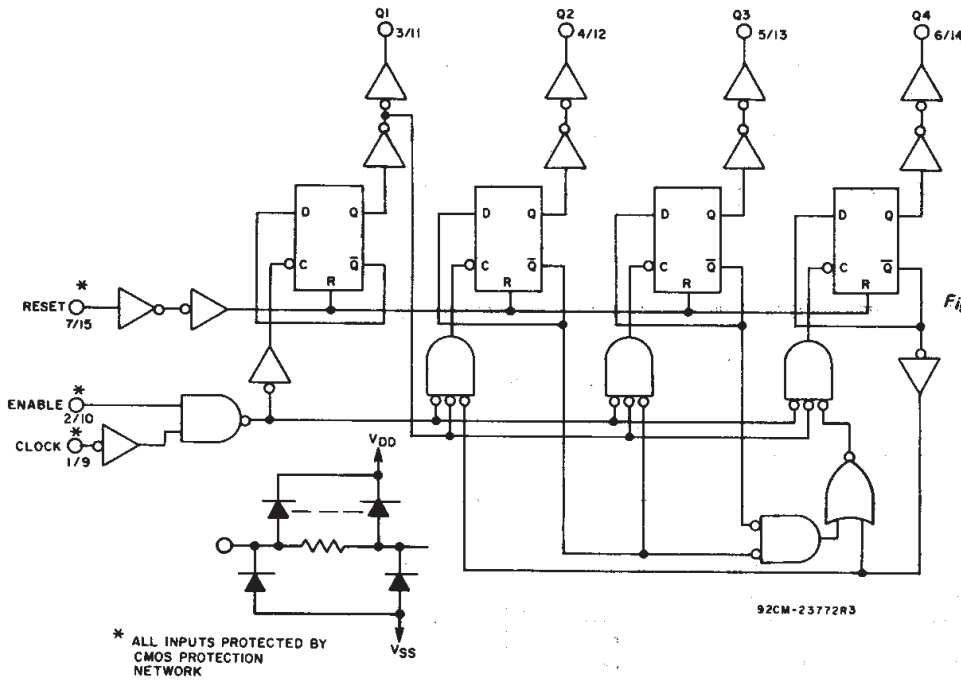


Fig. 14 — Decade counter (CD4518B) logic diagram for one of two identical counters.

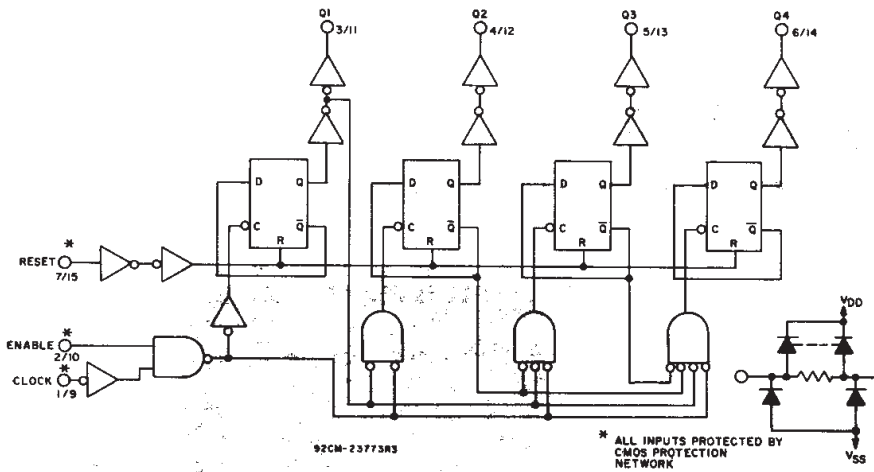


Fig. 15 — Binary counter (CD4520B) logic diagram for one of two identical counters.

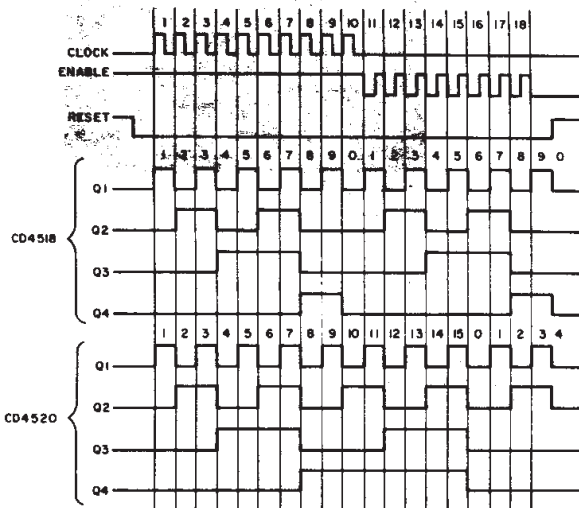


Fig. 16 — Timing diagrams for CD4518B and CD4520B.

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## CD4518B, CD4520B Types

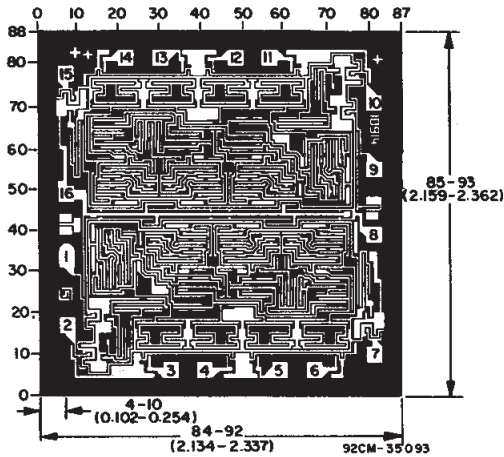


Fig. 17 — Ripple cascading of four counters with positive edge triggering.

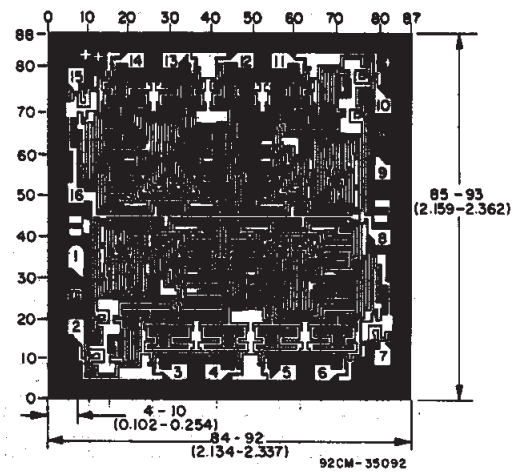


\*NOTE:  
FOR SYNCHRONOUS CASCADING, THE CLOCK TRANSITION TIME SHOULD BE MADE LESS THAN OR EQUAL TO THE SUM OF THE FIXED PROPAGATION DELAY AT 15 pF AND THE TRANSITION TIME OF THE OUTPUT DRIVER STAGE FOR THE ESTIMATED CAPACITATIVE LOAD.

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).

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
7702301EA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	7702301EA CD4520BF3A	<a href="#">Samples</a>
CD4518BE	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD4518BE	<a href="#">Samples</a>
CD4518BEE4	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD4518BE	<a href="#">Samples</a>
CD4518BF	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	CD4518BF	<a href="#">Samples</a>
CD4518BF3A	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	CD4518BF3A	<a href="#">Samples</a>
CD4518BM	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4518BM	<a href="#">Samples</a>
CD4518BM96	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4518BM	<a href="#">Samples</a>
CD4518BNSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4518B	<a href="#">Samples</a>
CD4518BPW	ACTIVE	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM518B	<a href="#">Samples</a>
CD4518BPWE4	ACTIVE	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM518B	<a href="#">Samples</a>
CD4518BPWG4	ACTIVE	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM518B	<a href="#">Samples</a>
CD4518BPWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM518B	<a href="#">Samples</a>
CD4520BE	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD4520BE	<a href="#">Samples</a>
CD4520BEE4	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD4520BE	<a href="#">Samples</a>
CD4520BF	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	CD4520BF	<a href="#">Samples</a>
CD4520BF3A	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	7702301EA CD4520BF3A	<a href="#">Samples</a>
CD4520BM	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4520BM	<a href="#">Samples</a>
CD4520BM96	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4520BM	<a href="#">Samples</a>
CD4520BME4	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4520BM	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD4520BMG4	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4520BM	<a href="#">Samples</a>
CD4520BNSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4520B	<a href="#">Samples</a>
CD4520BPW	ACTIVE	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM520B	<a href="#">Samples</a>
CD4520BPWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM520B	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF CD4518B, CD4518B-MIL, CD4520B, CD4520B-MIL :**

- Catalog: [CD4518B](#), [CD4520B](#)
- Military: [CD4518B-MIL](#), [CD4520B-MIL](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications



**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD4518BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4518BNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
CD4518BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD4520BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4520BNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
CD4520BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4518BM96	SOIC	D	16	2500	333.2	345.9	28.6
CD4518BNSR	SO	NS	16	2000	853.0	449.0	35.0
CD4518BPWR	TSSOP	PW	16	2000	853.0	449.0	35.0
CD4520BM96	SOIC	D	16	2500	333.2	345.9	28.6
CD4520BNSR	SO	NS	16	2000	853.0	449.0	35.0
CD4520BPWR	TSSOP	PW	16	2000	853.0	449.0	35.0

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - D The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002



D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



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NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

## MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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