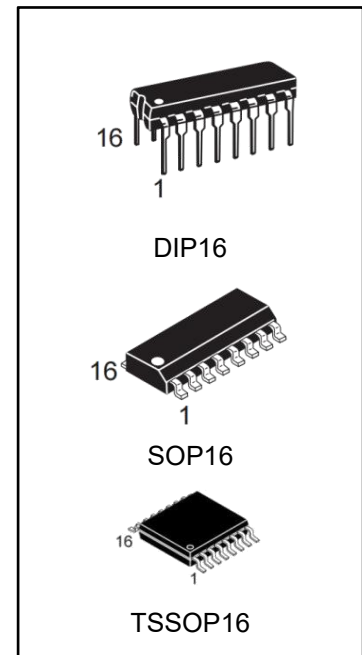


## Features

- High Voltage Types (20V Rating)
- CD4518B Dual BCD Up Counter
- CD4520B Dual Binary Up Counter
- Medium Speed Operation: 6MHz Typical Clock Frequency at 10V
- Positive or Negative Edge Triggering
- Synchronous Internal Carry Propagation
- 100% Tested for Quiescent Current at 20V
- 5V, 10V and 15V Parametric Ratings
- Maximum Input Current of 1 $\mu$ A at 18V Over Full Package Temperature Range; 100nA at 18V and +25°C
- Noise Margin (Over Full Package/Temperature Range)
  - 1V at VDD = 5V
  - 2V at VDD = 10V
  - 2.5V at VDD = 15V
- Standardized Symmetrical Output Characteristics
- Meets All Requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"



## Ordering Information

| DEVICE       | Package Type | MARKING | Packing | Packing Qty  |
|--------------|--------------|---------|---------|--------------|
| CD4518BE     | DIP-16       | CD4518B | TUBE    | 1000pcs/box  |
| CD4520BE     | DIP-16       | CD4520B | TUBE    | 1000pcs/box  |
| CD4518BM/TR  | SOP-16       | CD4518B | REEL    | 2500pcs/reel |
| CD4520BM/TR  | SOP-16       | CD4520B | REEL    | 2500pcs/reel |
| CD4518BMT/TR | TSSOP-16     | CD4518B | REEL    | 2500pcs/reel |
| CD4520BMT/TR | TSSOP-16     | CD4520B | REEL    | 2500pcs/reel |

## Description

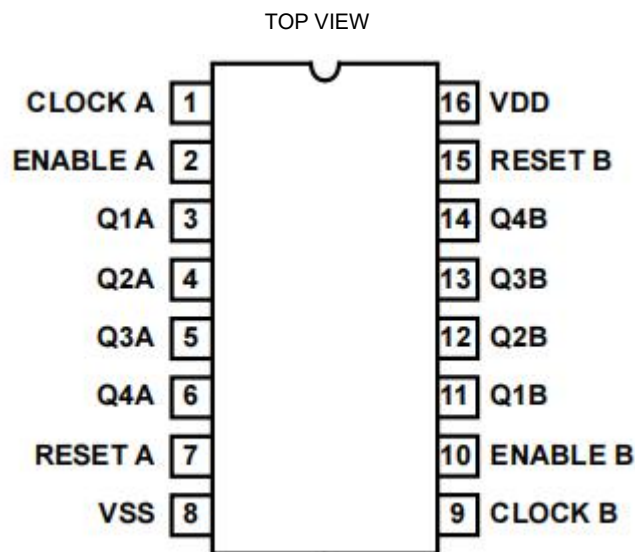
CD4518B Dual BCD Up Counter and CD4520B Dual Binary Up Counter each consist of two identical, internally synchronous 4-stage counters. The counter stages are D-type flip-flops having interchangeable CLOCK and ENABLE lines for incrementing on either the positive-going or negative-going transition. For 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.

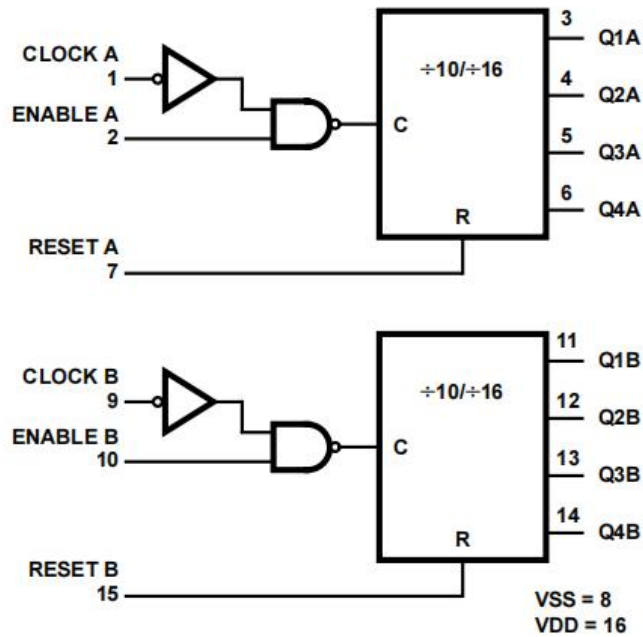
## Applications

- Multistage Synchronous Counting
- Multistage Ripple Counting
- Frequency Dividers

## Pinout



CD4518B/CD4520B

**Functional Diagram**

**Absolute Maximum Ratings**

| Condition   | Min  | Max     | UNITS |
|---|------|---------|-------|
| DC Supply Voltage Range, (VDD)<br>(Voltage Referenced to VSS Terminals)                     | -0.5 | +20     | V     |
| Input Voltage Range, All Inputs   | -0.5 | Vdd+0.5 | V     |
| DC Input Current, Any One Input   | -10  | +10     | mA    |
| Operating Temperature Range   | -40  | +85     | °C    |
| Storage Temperature Range (TSTG)  | -65  | +150    | °C    |
| Lead Temperature (During Soldering) At Distance (1.59mm ± 0.79mm) from case for 10s Maximum | -    | +265    | °C    |

**DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

| PARAMETER                      | SYMBOL | CONDITIONS (NOTE 1)                   |           | GROUP A<br>SUBGROUPS | TEMPERATURE         | LIMITS         |                | UNITS |
|--------------------------------|--------|---------------------------------------|-----------|----------------------|---------------------|----------------|----------------|-------|
|                                |        |                                       |           |                      |                     | MIN            | MAX            |       |
| Supply Current                 | IDD    | VDD = 20V, VIN = VDD or GND           |           | 1                    | +25°C               | -              | 10             | A     |
|                                |        |                                       |           | 2                    | +85°C               | -              | 1000           | A     |
|                                |        | VDD = 18V, VIN = VDD or GND           |           | 3                    | -40°C               | -              | 10             | A     |
| Input Leakage Current          | IIL    | VIN = VDD or GND                      | VDD = 20  | 1                    | +25°C               | -100           | -              | nA    |
|                                |        |                                       | VDD = 18V | 2                    | +85°C               | -1000          | -              | nA    |
|                                |        |                                       |           | 3                    | -40°C               | -100           | -              | nA    |
| Input Leakage Current          | IIH    | VIN = VDD or GND                      | VDD = 20  | 1                    | +25°C               | -              | 100            | nA    |
|                                |        |                                       | VDD = 18V | 2                    | +85°C               | -              | 1000           | nA    |
|                                |        |                                       |           | 3                    | -40°C               | -              | 100            | nA    |
| Output Voltage                 | VOL15  | VDD = 15V, No Load                    |           | 1, 2, 3              | +25°C, +85°C, -40°C | -              | 50             | mV    |
| Output Voltage                 | VOH15  | VDD = 15V, No Load (Note 3)           |           | 1, 2, 3              | +25°C, +85°C, -40°C | 14.95          | -              | V     |
| Output Current (Sink)          | IOL5   | VDD = 5V, VOUT = 0.4V                 |           | 1                    | +25°C               | 0.53           | -              | mA    |
| Output Current (Sink)          | IOL10  | VDD = 10V, VOUT = 0.5V                |           | 1                    | +25°C               | 1.4            | -              | mA    |
| Output Current (Sink)          | IOL15  | VDD = 15V, VOUT = 1.5V                |           | 1                    | +25°C               | 3.5            | -              | mA    |
| Output Current (Source)        | IOH5A  | VDD = 5V, VOUT = 4.6V                 |           | 1                    | +25°C               | -              | -0.53          | mA    |
| Output Current (Source)        | IOH5B  | VDD = 5V, VOUT = 2.5V                 |           | 1                    | +25°C               | -              | -1.8           | mA    |
| Output Current (Source)        | IOH10  | VDD = 10V, VOUT = 9.5V                |           | 1                    | +25°C               | -              | -1.4           | mA    |
| Output Current (Source)        | IOH15  | VDD = 15V, VOUT = 13.5V               |           | 1                    | +25°C               | -              | -3.5           | mA    |
| N Threshold Voltage            | VNTH   | VDD = 10V, ISS = -10μA                |           | 1                    | +25°C               | -2.8           | -0.7           | V     |
| P Threshold Voltage            | VPTH   | VSS = 0V, IDD = 10μA                  |           | 1                    | +25°C               | 0.7            | 2.8            | V     |
| Functional                     | F      | VDD = 2.8V, VIN = VDD or GND          |           | 7                    | +25°C               | VOH ><br>VDD/2 | VOL <<br>VDD/2 | V     |
|                                |        | VDD = 20V, VIN = VDD or GND           |           | 7                    | +25°C               |                |                |       |
|                                |        | VDD = 18V, VIN = VDD or GND           |           | 8A                   | +85°C               |                |                |       |
|                                |        | VDD = 3V, VIN = VDD or GND            |           | 8B                   | -40°C               |                |                |       |
| Input Voltage Low<br>(Note 2)  | VIL    | VDD = 5V, VOH > 4.5V,<br>VOL < 0.5V   |           | 1, 2, 3              | +25°C, +85°C, -40°C | -              | 1.5            | V     |
| Input Voltage High<br>(Note 2) | VIH    | VDD = 5V, VOH > 4.5V,<br>VOL < 0.5V   |           | 1, 2, 3              | +25°C, +85°C, -40°C | 3.5            | -              | V     |
| Input Voltage Low<br>(Note 2)  | VIL    | VDD = 15V, VOH > 13.5V,<br>VOL < 1.5V |           | 1, 2, 3              | +25°C, +85°C, -40°C | -              | 4              | V     |
| Input Voltage High<br>(Note 2) | VIH    | VDD = 15V, VOH > 13.5V,<br>VOL < 1.5V |           | 1, 2, 3              | +25°C, +85°C, -40°C | 11             | -              | V     |

**NOTES:**

1. All voltages referenced to device GND, 100% testing being implemented.
2. Go/No Go test with limits applied to inputs.
3. For accuracy, voltage is measured differentially to VDD. Limit is 0.050V max.

## AC ELECTRICAL PERFORMANCE CHARACTERISTICS

| PARAMETER                            | SYMBOL         | CONDITIONS (NOTE 1, 2)     | GROUP A<br>SUBGROUPS | TEMPERATURE  | LIMITS |     | UNITS |
|--------------------------------------|----------------|----------------------------|----------------------|--------------|--------|-----|-------|
|                                      |                |                            |                      |              | MIN    | MAX |       |
| Propagation Delay<br>Clock to Output | TPHL1<br>TPLH1 | VDD = 5V, VIN = VDD or GND | 9                    | +25°C        | -      | 560 | ns    |
|                                      |                |                            | 10, 11               | +85°C, -40°C | -      | 756 | ns    |
| Propagation Delay<br>Reset to Output | TPHL2          | VDD = 5V, VIN = VDD or GND | 9                    | +25°C        | -      | 650 | ns    |
|                                      |                |                            | 10, 11               | +85°C, -40°C | -      | 878 | ns    |
| Transition Time (Note 2)             | TTHL<br>TTLH   | VDD = 5V, VIN = VDD or GND | 9                    | +25°C        | -      | 200 | ns    |
|                                      |                |                            | 10, 11               | +85°C, -40°C | -      | 270 | ns    |
| Maximum Clock<br>Input Frequency     | FCL            | VDD = 5V, VIN = VDD or GND | 9                    | +25°C        | 1.5    | -   | MHz   |
|                                      |                |                            | 10, 11               | +85°C, -40°C | 1.11   | -   | MHz   |

### NOTES:

1. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
2. -40°C and +85°C limits guaranteed, 100% testing being implemented.

## ELECTRICAL PERFORMANCE CHARACTERISTICS

| PARAMETER               | SYMBOL | CONDITIONS                  | NOTES | TEMPERATURE         | LIMITS |       | UNITS |
|-------------------------|--------|-----------------------------|-------|---------------------|--------|-------|-------|
|                         |        |                             |       |                     | MIN    | MAX   |       |
| Supply Current          | IDD    | VDD = 5V, VIN = VDD or GND  | 1, 2  | -40°C, +25°C        | -      | 5     | A     |
|                         |        |                             |       | +85°C               | -      | 150   | A     |
|                         |        | VDD = 10V, VIN = VDD or GND | 1, 2  | -40°C, +25°C        | -      | 10    | A     |
|                         |        |                             |       | +85°C               | -      | 300   | A     |
|                         |        | VDD = 15V, VIN = VDD or GND | 1, 2  | -40°C, +25°C        | -      | 10    | A     |
|                         |        |                             |       | +85°C               | -      | 600   | A     |
| Output Voltage          | VOL    | VDD = 5V, No Load           | 1, 2  | +25°C, +85°C, -40°C | -      | 50    | mV    |
| Output Voltage          | VOL    | VDD = 10V, No Load          | 1, 2  | +25°C, +85°C, -40°C | -      | 50    | mV    |
| Output Voltage          | VOH    | VDD = 5V, No Load           | 1, 2  | +25°C, +85°C, -40°C | 4.95   | -     | V     |
| Output Voltage          | VOH    | VDD = 10V, No Load          | 1, 2  | +25°C, +85°C, -40°C | 9.95   | -     | V     |
| Output Current (Sink)   | IOL5   | VDD = 5V, VOUT = 0.4V       | 1, 2  | +85°C               | 0.36   | -     | mA    |
|                         |        |                             |       | -40°C               | 0.64   | -     | mA    |
| Output Current (Sink)   | IOL10  | VDD = 10V, VOUT = 0.5V      | 1, 2  | +85°C               | 0.9    | -     | mA    |
|                         |        |                             |       | -40°C               | 1.6    | -     | mA    |
| Output Current (Sink)   | IOL15  | VDD = 15V, VOUT = 1.5V      | 1, 2  | +85°C               | 2.4    | -     | mA    |
|                         |        |                             |       | -40°C               | 4.2    | -     | mA    |
| Output Current (Source) | IOH5A  | VDD = 5V, VOUT = 4.6V       | 1, 2  | +85°C               | -      | -0.36 | mA    |
|                         |        |                             |       | -40°C               | -      | -0.64 | mA    |
| Output Current (Source) | IOH5B  | VDD = 5V, VOUT = 2.5V       | 1, 2  | +85°C               | -      | -1.15 | mA    |
|                         |        |                             |       | -40°C               | -      | -2.0  | mA    |
| Output Current (Source) | IOH10  | VDD = 10V, VOUT = 9.5V      | 1, 2  | +85°C               | -      | -0.9  | mA    |
|                         |        |                             |       | -40°C               | -      | -1.6  | mA    |
| Output Current (Source) | IOH15  | VDD = 15V, VOUT = 13.5V     | 1, 2  | +85°C               | -      | -2.4  | mA    |
|                         |        |                             |       | -40°C               | -      | -4.2  | mA    |
| Input Voltage Low       | VIL    | VDD=10V, VOH>9V, VOL<1V     | 1, 2  | +25°C, +85°C, -40°C | -      | 3     | V     |
| Input Voltage High      | VIH    | VDD=10V, VOH>9V, VOL<1V     | 1, 2  | +25°C, +85°C, -40°C | +7     | -     | V     |

**ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

| PARAMETER                            | SYMBOL         | CONDITIONS             | NOTES              | TEMPERATURE    | LIMITS |            | UNITS    |
|--------------------------------------|----------------|------------------------|--------------------|----------------|--------|------------|----------|
|                                      |                |                        |                    |                | MIN    | MAX        |          |
| Propagation Delay<br>Clock to Output | TPHL1<br>TPLH1 | VDD = 10V<br>VDD = 15V | 1, 2, 3<br>1, 2, 3 | +25°C<br>+25°C | -<br>- | 230<br>160 | ns<br>ns |
| Propagation Delay<br>Reset to Output | TPHL2          | VDD = 10V<br>VDD = 15V | 1, 2, 3<br>1, 2, 3 | +25°C<br>+25°C | -<br>- | 225<br>170 | ns<br>ns |
| Transition Time                      | TTHL           | VDD = 10V              | 1, 2, 3            | +25°C          | -      | 100        | ns       |
|                                      | TTLH           | VDD = 15V              | 1, 2, 3            | +25°C          | -      | 80         | ns       |
| Maximum Clock Input<br>Frequency     | FCL            | VDD = 10V              | 1, 2, 3            | +25°C          | 3      | -          | MHz      |
|                                      |                | VDD = 15V              | 1, 2, 3            | +25°C          | 4      | -          | MHz      |
| Maximum Clock Rise<br>and Fall Time  | TRCL<br>TFCL   | VDD = 5V               | 1, 2, 3, 4         | +25°C          | -      | 15         | s        |
|                                      |                | VDD = 10V              | 1, 2, 3, 4         | +25°C          | -      | 5          | s        |
|                                      |                | VDD = 15V              | 1, 2, 3, 4         | +25°C          | -      | 5          | s        |
| Minimum Enable<br>Pulse Width        | TW             | VDD = 5V               | 1, 2, 3            | +25°C          | -      | 400        | ns       |
|                                      |                | VDD = 10V              | 1, 2, 3            | +25°C          | -      | 200        | ns       |
|                                      |                | VDD = 15V              | 1, 2, 3            | +25°C          | -      | 140        | ns       |
| Minimum Reset<br>Pulse Width         | TW             | VDD = 5V               | 1, 2, 3            | +25°C          | -      | 250        | ns       |
|                                      |                | VDD = 10V              | 1, 2, 3            | +25°C          | -      | 110        | ns       |
|                                      |                | VDD = 15V              | 1, 2, 3            | +25°C          | -      | 80         | ns       |
| Minimum Clock<br>Pulse Width         | TW             | VDD = 5V               | 1, 2, 3            | +25°C          | -      | 200        | ns       |
|                                      |                | VDD = 10V              | 1, 2, 3            | +25°C          | -      | 100        | ns       |
|                                      |                | VDD = 15V              | 1, 2, 3            | +25°C          | -      | 70         | ns       |
| Input Capacitance                    | CIN            | Any Input              | 1, 2               | +25°C          | -      | 7.5        | pF       |

**NOTES:**

1. All voltages referenced to device GND.
2. The parameters listed on Table 3 are controlled via design or process and are not directly tested. These parameters are characterized on initial design release and upon design changes which would affect these characteristics.
3. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
4. If more than one unit is cascaded, TRCL should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage for the estimated capacitive load.

**Post Irradiation Electrical Performance Characteristics**

| PARAMETER                    | SYMBOL       | CONDITIONS                  | NOTES      | TEMPERATURE | LIMITS |                          | UNITS |
|------------------------------|--------------|-----------------------------|------------|-------------|--------|--------------------------|-------|
|                              |              |                             |            |             | MIN    | MAX                      |       |
| Supply Current               | IDD          | VDD = 20V, VIN = VDD or GND | 1, 4       | +25°C       | -      | 25                       | μA    |
| N Threshold Voltage          | VNTH         | VDD = 10V, ISS = -10μA      | 1, 4       | +25°C       | -2.8   | -0.2                     | V     |
| N Threshold Voltage<br>Delta | ΔVTN         | VDD = 10V, ISS = -10μA      | 1, 4       | +25°C       | -      | 1                        | V     |
| P Threshold Voltage          | VTP          | VSS = 0V, IDD = 10μA        | 1, 4       | +25°C       | 0.2    | 2.8                      | V     |
| P Threshold Voltage Delta    | ΔVTP         | VSS = 0V, IDD = 10μA        | 1, 4       | +25°C       | -      | 1                        | V     |
| Functional                   | F            | VDD = 18V, VIN = VDD or GND | 1          | +25°C       | VOH >  | VOL <                    | V     |
|                              |              | VDD = 3V, VIN = VDD or GND  |            | +25°C       | VDD/2  | VDD/2                    |       |
| Propagation Delay Time       | TPHL<br>TPLH | VDD = 5V                    | 1, 2, 3, 4 | +25°C       | -      | 1.35 x<br>+25°C<br>Limit | ns    |

Logic Diagrams

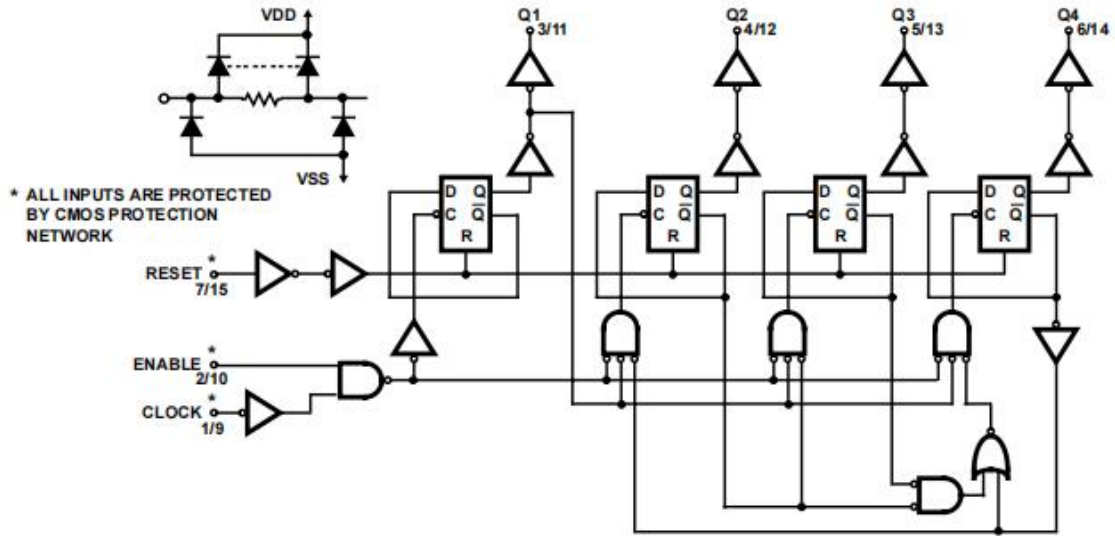


FIGURE 1. DECADE COUNTER (CD4518B) LOGIC DIAGRAM FOR ONE OF TWO IDENTICAL COUNTERS

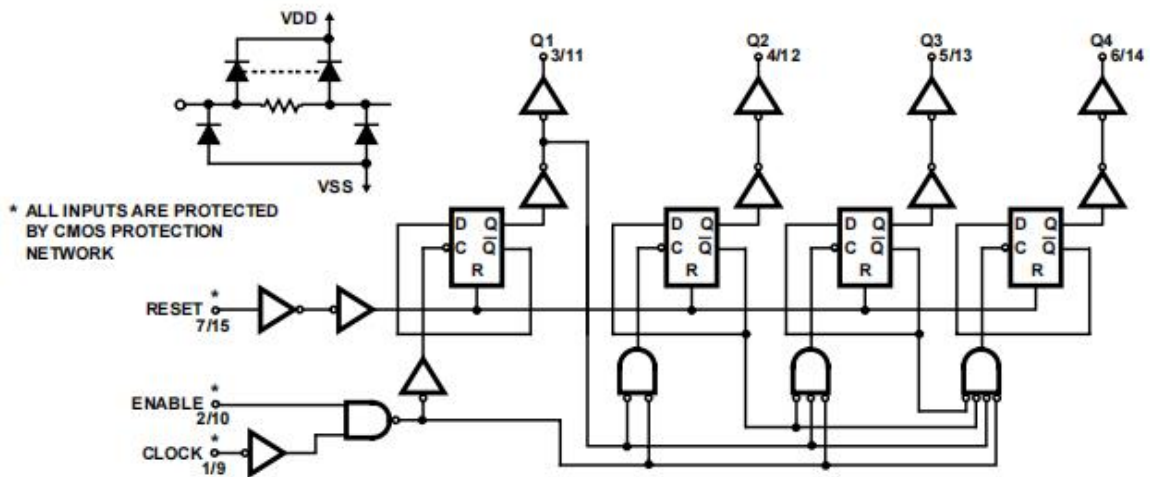


FIGURE 2. BINARY COUNTER (CD4520B) LOGIC DIAGRAM FOR ONE OF TWO IDENTICAL COUNTERS

TRUTH TABLE

| CLOCK      | ENABLE     | RESET | ACTION            |
|------------|------------|-------|-------------------|
| $\nearrow$ | 1          | 0     | Increment Counter |
| 0          | $\searrow$ | 0     | Increment Counter |
| $\searrow$ | X          | 0     | No Change         |
| X          | $\nearrow$ | 0     | No Change         |
| $\nearrow$ | 0          | 0     | No Change         |
| 1          | $\searrow$ | 0     | No Change         |
| X          | X          | 1     | Q1 thru Q4 = 0    |



Typical Performance Curves

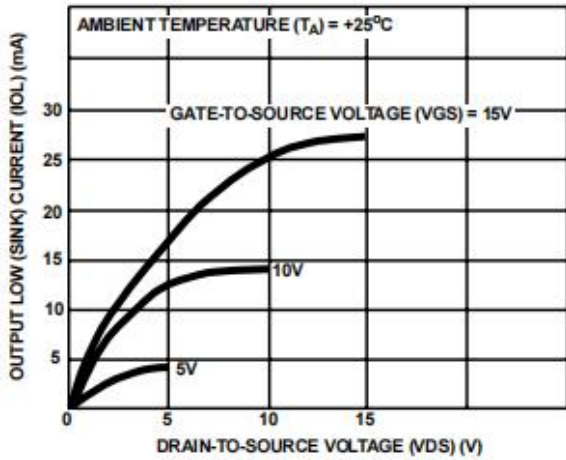


FIGURE 3. TYPICAL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

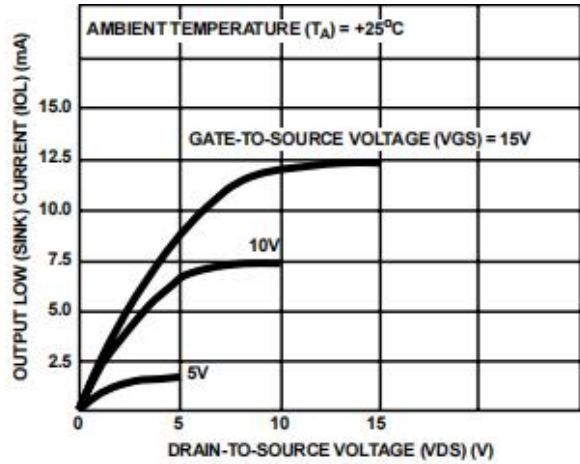


FIGURE 4. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

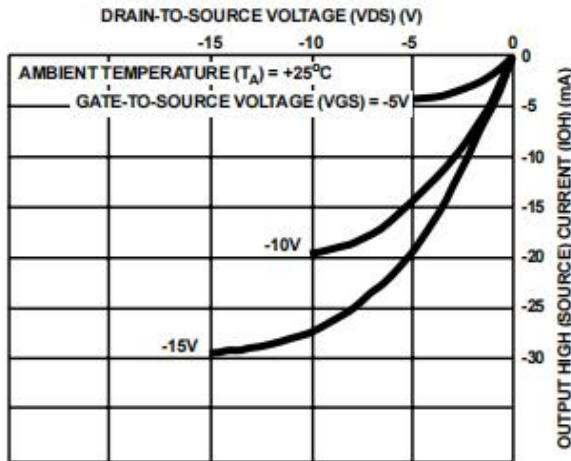


FIGURE 5. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

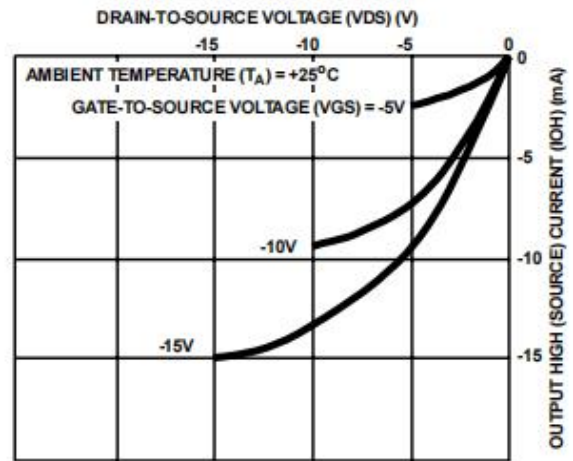


FIGURE 6. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

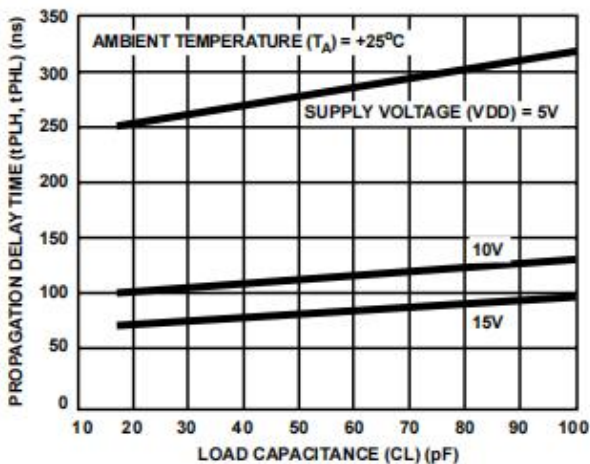


FIGURE 7. TYPICAL PROPAGATION DELAY vs LOAD CAPACITANCE, CLOCK OR ENABLE TO OUTPUT

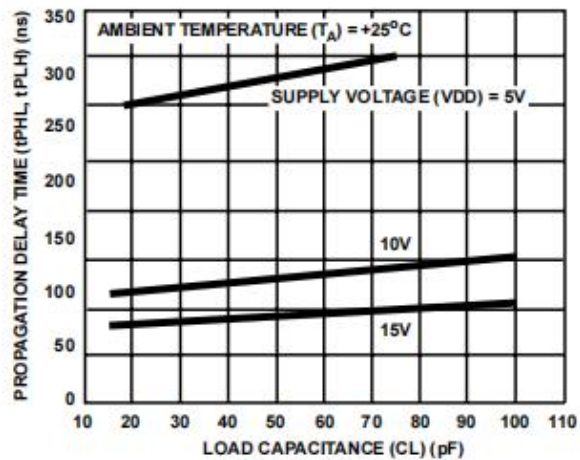


FIGURE 8. TYPICAL PROPAGATION DELAY TIME vs LOAD CAPACITANCE, RESET TO OUTPUT



**Typical Performance Curves**

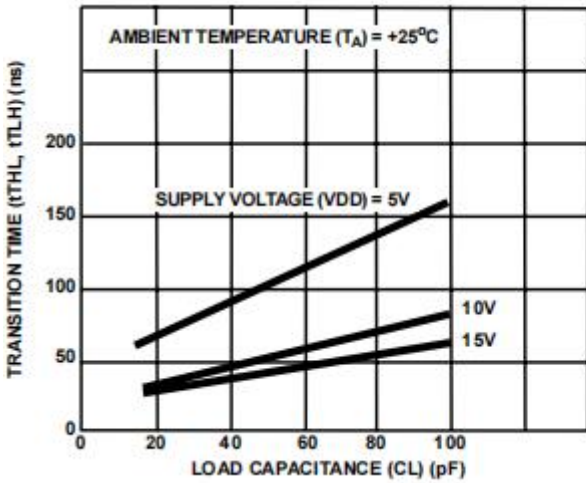


FIGURE 9. TYPICAL TRANSITION TIME vs LOAD CAPACITANCE

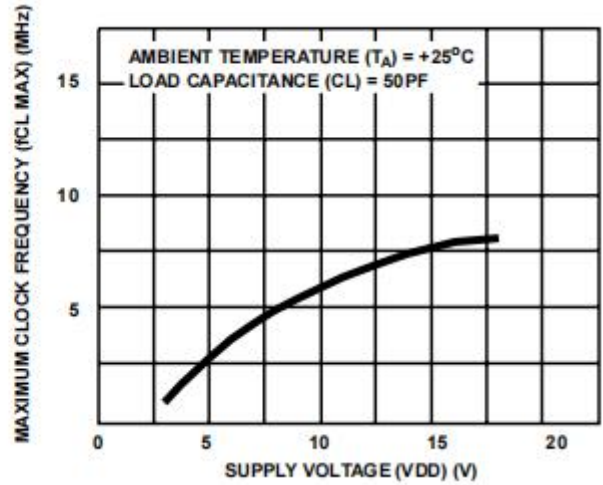


FIGURE 10. TYPICAL MAXIMUM CLOCK FREQUENCY vs SUPPLY VOLTAGE

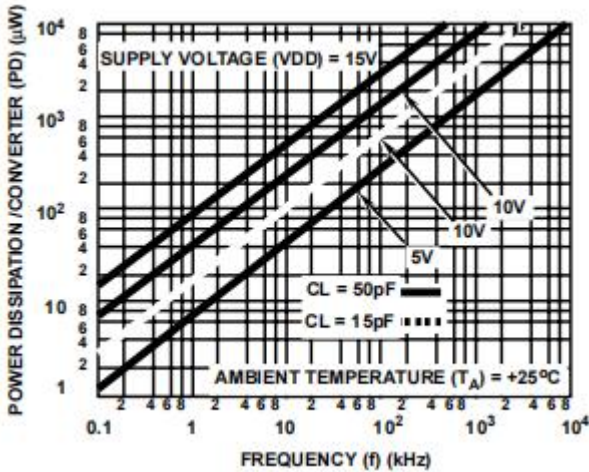


FIGURE 11. TYPICAL POWER DISSIPATION CHARACTERISTICS

**Timing Diagrams**

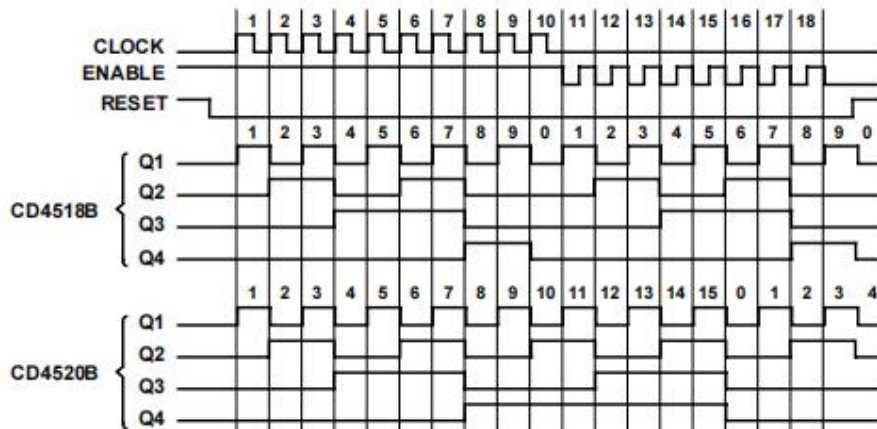


FIGURE 12. TIMING DIAGRAMS FOR CD4518B AND CD4520B

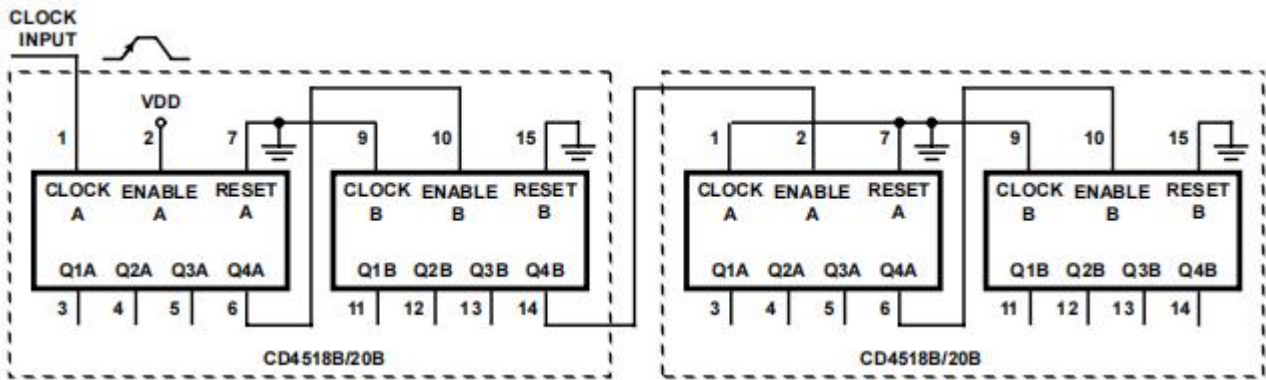
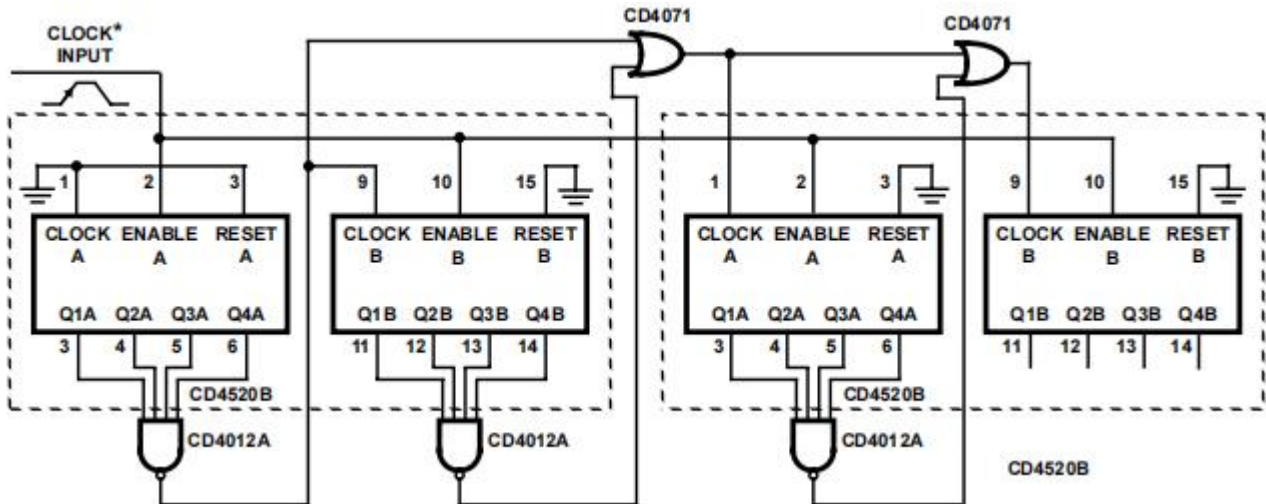
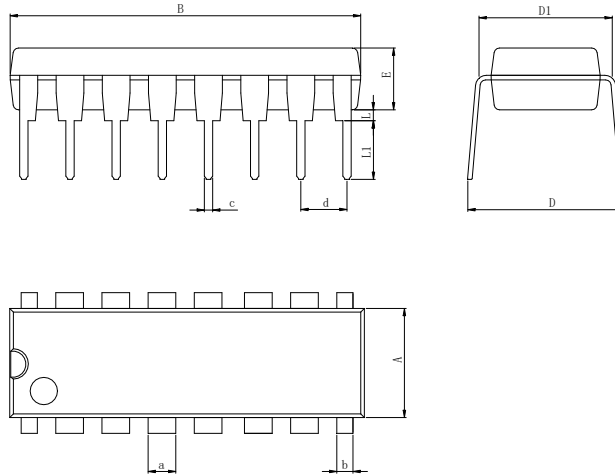


FIGURE 13. RIPPLE CASCADING OF FOUR COUNTERS WITH POSITIVE EDGE TRIGGERING

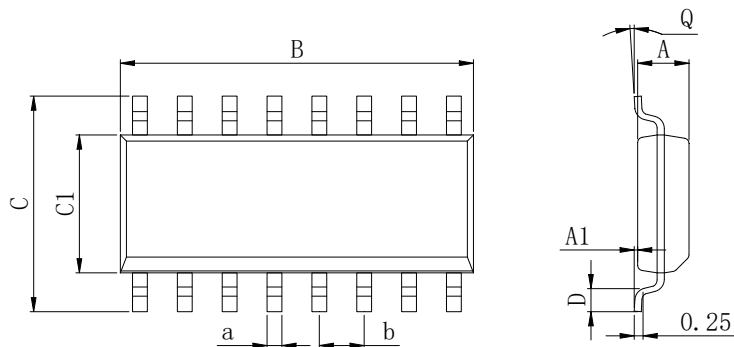


\*For synchronous cascading, the clock transition time should be made less than or equal to the sum of the fixed propagation delay at 15pF and the transition time of the output driver stage for the estimated capacitive load.

FIGURE 14. SYNCHRONOUS CASCADING OF FOUR BINARY COUNTERS WITH NEGATIVE EDGE TRIGGERING

**Physical Dimensions**
**DIP16**


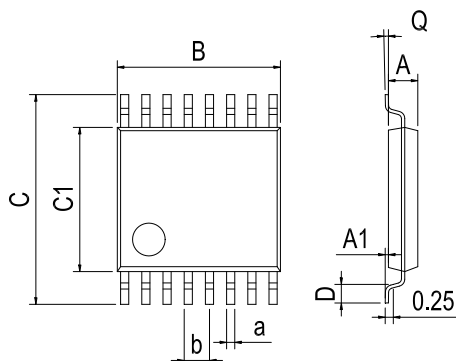
| Dimensions In Millimeters(DIP16) |      |       |      |      |      |      |      |      |      |      |          |
|----------------------------------|------|-------|------|------|------|------|------|------|------|------|----------|
| Symbol:                          | A    | B     | D    | D1   | E    | L    | L1   | a    | b    | c    | d        |
| Min:                             | 6.10 | 18.94 | 8.40 | 7.42 | 3.10 | 0.50 | 300  | 1.50 | 0.85 | 0.40 | 2.54 BSC |
| Max:                             | 6.68 | 19.56 | 9.00 | 7.82 | 3.55 | 0.70 | 3.60 | 1.55 | 0.90 | 0.50 |          |

**SOP16**


| Dimensions In Millimeters(SOP16) |      |      |      |      |      |      |    |      |          |
|----------------------------------|------|------|------|------|------|------|----|------|----------|
| Symbol:                          | A    | A1   | B    | C    | C1   | D    | Q  | a    | b        |
| Min:                             | 1.35 | 0.05 | 9.80 | 5.80 | 3.80 | 0.40 | 0° | 0.35 | 1.27 BSC |
| Max:                             | 1.55 | 0.20 | 10.0 | 6.20 | 4.00 | 0.80 | 8° | 0.45 |          |

**Physical Dimensions**

TSSOP16



| Dimensions In Millimeters(TSSOP16) |      |      |      |      |      |      |    |      |          |
|------------------------------------|------|------|------|------|------|------|----|------|----------|
| Symbol:                            | A    | A1   | B    | C    | C1   | D    | Q  | a    | b        |
| Min:                               | 0.85 | 0.05 | 4.90 | 6.20 | 4.30 | 0.40 | 0° | 0.20 | 0.65 BSC |
| Max:                               | 0.95 | 0.20 | 5.10 | 6.60 | 4.50 | 0.80 | 8° | 0.25 |          |

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