

TC4510BP/BF

C²MOS DIGITAL INTEGRATED CIRCUIT
SILICON MONOLITHIC

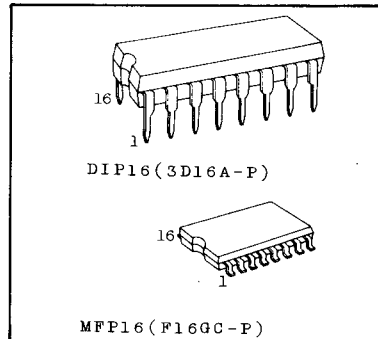
TC4510BP/TC4510BF PRESETTABLE BCD UP/DOWN COUNTER

TC4510BP/BF is UP/DOWN decade counter having asynchronous RESET and PRESET functions. When RESET input is set to "H" level, the content of counter is reset to "0" and when RESET is set to "L" and P.E. to "H", inputs A_{IN} through D_{IN} are preset to the counter.

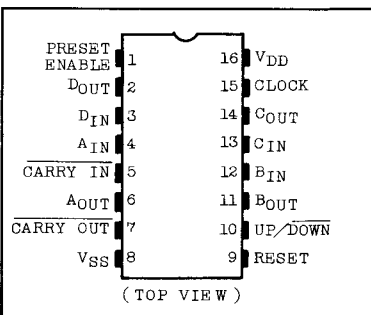
If TC4510BP/BF's are connected in cascade using CARRY INPUT and CARRY OUTPUT, decimal counter of N digits with the parallel carry capability can be composed. Switching of counting up or down is achieved by UP/DOWN INPUT. The counter advances its counting condition at the rising edge of CLOCK.

ABSOLUTE MAXIMUM RATINGS

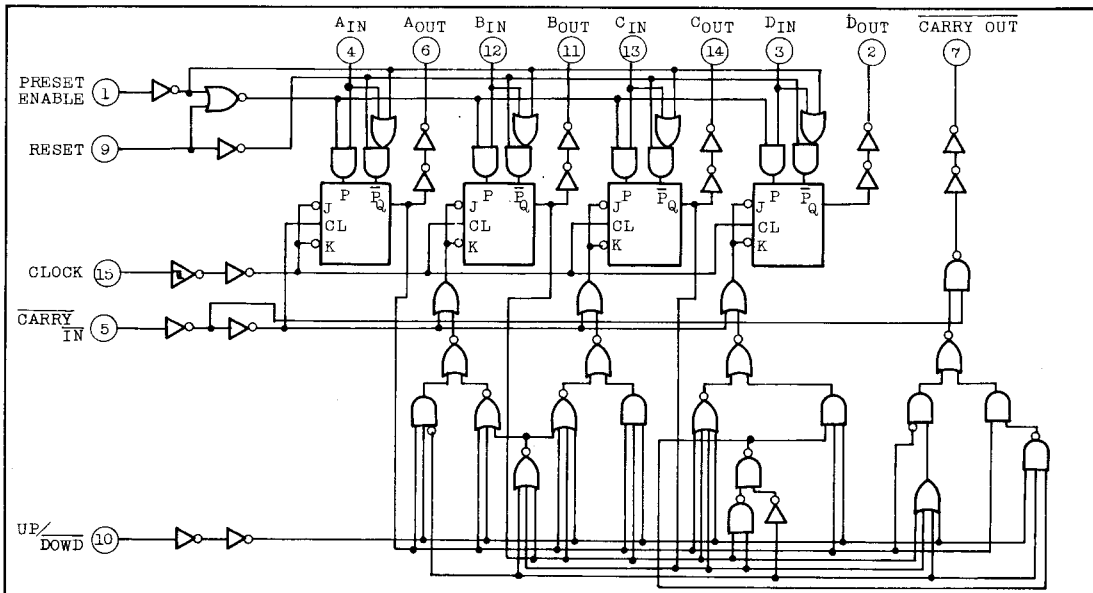
| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|-----------------------------|------------------|---|------|
| DC Supply Voltage | V _{DD} | V _{SS} -0.5 ~ V _{SS} +20 | V |
| Input Voltage | V _{IN} | V _{SS} -0.5 ~ V _{DD} +0.5 | V |
| Output Voltage | V _{OUT} | V _{SS} -0.5 ~ V _{DD} +0.5 | V |
| DC Input Current | I _{IN} | ±10 | mA |
| Power Dissipation | P _D | 300(DIP)/180(MFP) | mW |
| Operating Temperature Range | T _A | -40 ~ 85 | °C |
| Storage Temperature Range | T _{stg} | -65 ~ 150 | °C |
| Lead Temp./Time | T _{sol} | 260 • 10 sec | |



PIN ASSIGNMENT



LOGIC DIAGRAM

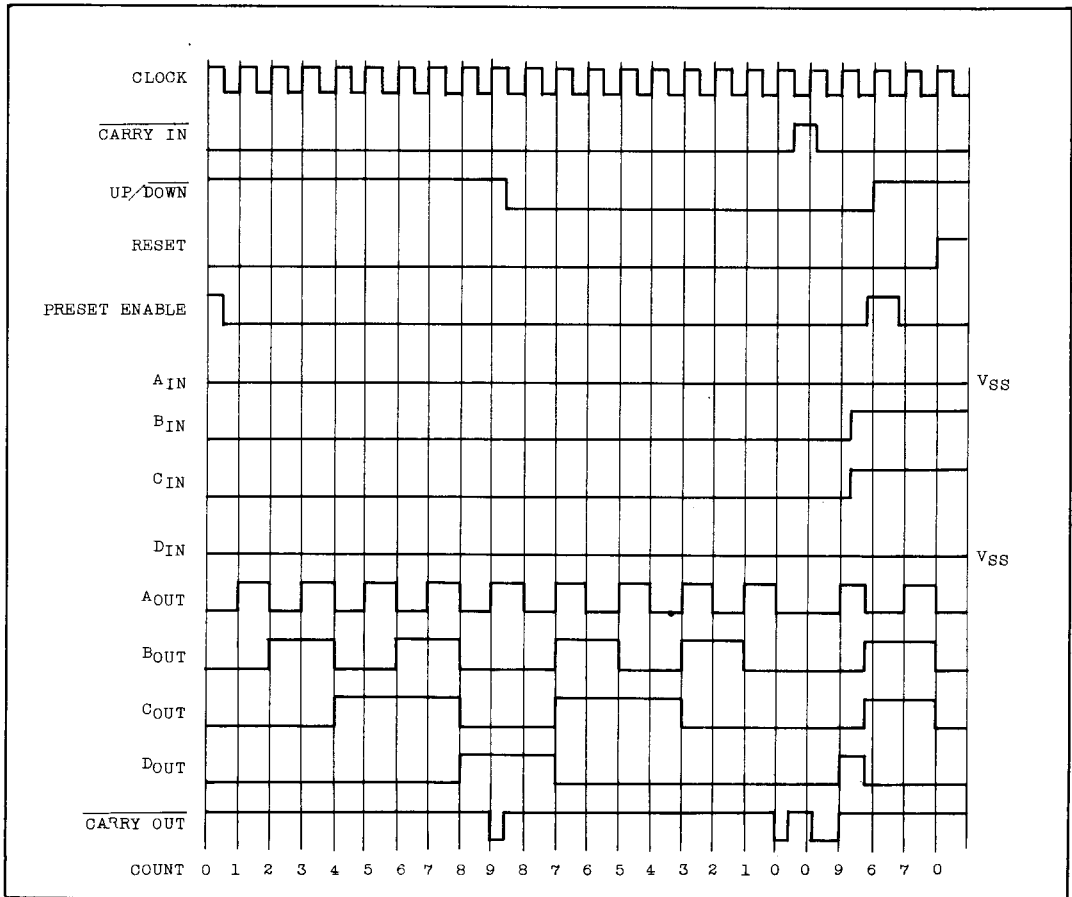


TRUTH TABLE

| CARRY IN | UP/DOWN | PRESET ENABLE | RESET | FUNCTION |
|----------|---------|---------------|-------|------------|
| H | * | L | L | NO COUNT |
| L | H | L | L | UP COUNT |
| L | L | L | L | DOWN COUNT |
| * | * | H | L | PRESET |
| * | * | * | H | RESET |

* Don't care

TIMING DIAGRAM



TC4510BP/BF

RECOMMENDED OPERATING CONDITIONS (V_{SS}=0V)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-------------------|-----------------|------|------|-----------------|------|
| DC Supply Voltage | V _{DD} | 3 | - | 18 | V |
| Input Voltage | V _{IN} | 0 | - | V _{DD} | |

STATIC ELECTRICAL CHARACTERISTICS (V_{SS}=0V)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | V _{DD} (V) | -40°C | | 25°C | | | 85°C | | UNIT | |
|---------------------------|-----------------|---|------------------------|-------|------|-------|-------|-------------------|-------|------|------|----|
| | | | | MIN. | MAX. | MIN. | TYP. | MAX. | MIN. | MAX. | | |
| High-Level Output Voltage | V _{OH} | I _{OUT} < 1μA V _{IN} =V _{SS} , V _{DD} | 5 | 4.95 | - | 4.95 | 5.00 | - | 4.95 | - | V | |
| | | | 10 | 9.95 | - | 9.95 | 10.00 | - | 9.95 | - | | |
| | | | 15 | 14.95 | - | 14.95 | 15.00 | - | 14.95 | - | | |
| Low-Level Output Voltage | V _{OL} | I _{OUT} < 1μA V _{IN} =V _{SS} , V _{DD} | 5 | - | 0.05 | - | 0.00 | 0.05 | - | 0.05 | V | |
| | | | 10 | - | 0.05 | - | 0.00 | 0.05 | - | 0.05 | | |
| | | | 15 | - | 0.05 | - | 0.00 | 0.05 | - | 0.05 | | |
| Output High Current | I _{OH} | V _{OH} =4.6V V _{OH} =2.5V V _{OH} =9.5V V _{OH} =13.5V V _{IN} =V _{SS} , V _{DD} | 5 | -0.61 | - | -0.51 | -1.0 | - | -0.42 | - | mA | |
| | | | 5 | -2.5 | - | -2.1 | -4.0 | - | -1.7 | - | | |
| | | | 10 | -1.5 | - | -1.3 | -2.2 | - | -1.1 | - | | |
| | | | 15 | -4.0 | - | -3.4 | -9.0 | - | -2.8 | - | | |
| | | | 15 | -4.0 | - | -3.4 | -9.0 | - | -2.8 | - | | |
| Output Low Current | I _{OL} | V _{OL} =0.4V V _{OL} =0.5V V _{OL} =1.5V V _{IN} =V _{SS} , V _{DD} | 5 | 0.61 | - | 0.51 | 1.2 | - | 0.42 | - | mA | |
| | | | 10 | 1.5 | - | 1.3 | 3.2 | - | 1.1 | - | | |
| | | | 15 | 4.0 | - | 3.4 | 12.0 | - | 2.8 | - | | |
| | | | 15 | 4.0 | - | 3.4 | 12.0 | - | 2.8 | - | | |
| Input High Voltage | V _{IH} | V _{OUT} =0.5V, 4.5V V _{OUT} =1.0V, 9.0V V _{OUT} =1.5V, 13.5V I _{OUT} < 1μA | 5 | 3.5 | - | 3.5 | 2.75 | - | 3.5 | - | V | |
| | | | 10 | 7.0 | - | 7.0 | 5.5 | - | 7.0 | - | | |
| | | | 15 | 11.0 | - | 11.0 | 8.25 | - | 11.0 | - | | |
| | | | 15 | 11.0 | - | 11.0 | 8.25 | - | 11.0 | - | | |
| Input Low Voltage | V _{IL} | V _{OUT} =0.5V, 4.5V V _{OUT} =1.0V, 9.0V V _{OUT} =1.5V, 13.5V I _{OUT} < 1μA | 5 | - | 1.5 | - | 2.25 | 1.5 | - | 1.5 | V | |
| | | | 10 | - | 3.0 | - | 4.5 | 3.0 | - | 3.0 | | |
| | | | 15 | - | 4.0 | - | 6.75 | 4.0 | - | 4.0 | | |
| | | | 15 | - | 4.0 | - | 6.75 | 4.0 | - | 4.0 | | |
| Input Current | "H" Level | I _{IH} | V _{IH} =18V | 18 | - | 0.1 | - | 10 ⁻⁵ | 0.1 | - | 1.0 | μA |
| | "L" Level | I _{IL} | V _{IL} =0V | 18 | - | -0.1 | - | -10 ⁻⁵ | -0.1 | - | -1.0 | |
| Quiescent Device Current | I _{DD} | V _{IN} =V _{SS} , V _{DD} * | 5 | - | 5 | - | 0.005 | 5 | - | 150 | μA | |
| | | | 10 | - | 10 | - | 0.010 | 10 | - | 300 | | |
| | | | 15 | - | 20 | - | 0.015 | 20 | - | 600 | | |

* All valid input combinations.

DYNAMIC ELECTRICAL CHARACTERISTICS (Ta=25°C, VSS=0V, CL=50pF)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | VDD(V) | MIN. | TYP. | MAX. | UNIT |
|--|--------------------------------------|----------------|--------|----------|------|------|------|
| | | | | | | | |
| Output Transition Time (Low to High) | t _{TLH} | | 5 | - | 70 | 200 | ns |
| | | | 10 | - | 35 | 100 | |
| | | | 15 | - | 30 | 80 | |
| Output Transition Time (High to Low) | t _{THL} | | 5 | - | 70 | 200 | |
| | | | 10 | - | 35 | 100 | |
| | | | 15 | - | 30 | 80 | |
| Propagation Delay Time (CLOCK-A, B, C, D _{OUT}) | t _{pLH} t _{pHL} | | 5 | - | 180 | 400 | |
| | | | 10 | - | 85 | 200 | |
| | | | 15 | - | 60 | 150 | |
| Propagation Delay Time (CLOCK-CARRY OUT) | t _{pLH} t _{pHL} | | 5 | - | 220 | 480 | |
| | | | 10 | - | 100 | 240 | |
| | | | 15 | - | 75 | 180 | |
| Propagation Delay Time (PRESET ENABLE, RESET-A, B, C, D _{OUT}) | t _{pLH} t _{pHL} | | 5 | - | 180 | 420 | |
| | | | 10 | - | 85 | 210 | |
| | | | 15 | - | 65 | 160 | |
| Propagation Delay Time (PRESET ENABLE, RESET-CARRY OUT) | t _{pLH} t _{pHL} | | 5 | - | 240 | 640 | |
| | | | 10 | - | 110 | 320 | |
| | | | 15 | - | 80 | 250 | |
| Propagation Delay Time (CARRY IN - CARRY OUT) | t _{pLH} t _{pHL} | | 5 | - | 85 | 250 | |
| | | | 10 | - | 45 | 120 | |
| | | | 15 | - | 35 | 100 | |
| Max. Clock Frequency | f _{CL} | | 5 | 2 | 5 | - | MHz |
| | | | 10 | 4 | 10 | - | |
| | | | 15 | 5.5 | 14 | - | |
| Max. Clock Input Rise Time Max. Clock Input Fall Time | t _{rCL} t _{fCL} | | 5 | NO Limit | | | μs |
| | | | 10 | | | | |
| | | | 15 | | | | |
| Min. Clock Pulse Width | t _w | | 5 | - | 40 | 150 | ns |
| | | | 10 | - | 20 | 75 | |
| | | | 15 | - | 15 | 60 | |

TC4510BP/BF

DYNAMIC ELECTRICAL CHARACTERISTICS ($T_a=25^\circ\text{C}$, $V_{SS}=0\text{V}$, $C_L=50\text{pF}$)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | V_{DD} (V) | MIN. | TYP. | MAX. | UNIT |
|--|-----------|----------------|--------------|------|------|------|------|
| Min. Pulse Width (PRESET ENABLE, RESET) | t_{WH} | | 5 | - | 55 | 200 | ns |
| | | | 10 | - | 25 | 100 | |
| | | | 15 | - | 20 | 75 | |
| Min. Set-up Time (UP/ $\overline{\text{DOWN}}$ -CLOCK) | t_{SU} | | 5 | - | 95 | 360 | |
| | | | 10 | - | 45 | 160 | |
| | | | 15 | - | 30 | 110 | |
| Min. Hold Time (UP/ $\overline{\text{DOWN}}$ -CLOCK) | t_H | | 5 | - | - | 30 | |
| | | | 10 | - | - | 30 | |
| | | | 15 | - | - | 30 | |
| Min. Set-up Time ($\overline{\text{CARRY IN}}$ -CLOCK) | t_{SU} | | 5 | - | 75 | 150 | |
| | | | 10 | - | 35 | 60 | |
| | | | 15 | - | 25 | 45 | |
| Min. Hold Time ($\overline{\text{CARRY IN}}$ -CLOCK) | t_H | | 5 | - | - | 60 | |
| | | | 10 | - | - | 30 | |
| | | | 15 | - | - | 30 | |
| Min. Set-up Time (A,B,C,D-PRESET ENABLE) | t_{SU} | | 5 | - | 35 | 70 | |
| | | | 10 | - | 15 | 30 | |
| | | | 15 | - | 10 | 20 | |
| Min. Hold Time (A,B,C,D-PRESET ENABLE) | t_H | | 5 | - | 15 | 70 | |
| | | | 10 | - | 10 | 40 | |
| | | | 15 | - | 5 | 40 | |
| Min. Removal Time (PRESET ENABLE, RESET-CLOCK) | t_{rem} | | 5 | - | 40 | 150 | |
| | | | 10 | - | 20 | 80 | |
| | | | 15 | - | 15 | 60 | |
| Input Capacitance | C_{IN} | | | | 5 | 7.5 | pF |

WAVEFORMS FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

