# HD14510B

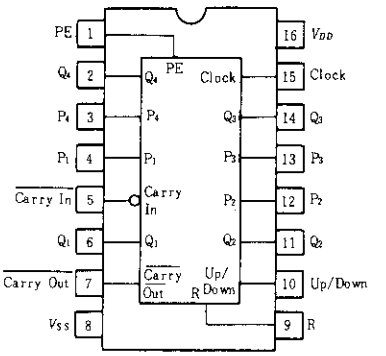
## BCD Up/Down Counter

The HD14510B BCD up/down counter consists of type D flip-flop stages with a gating structure to provide type T flip-flop capability. The counter can be cleared by applying a high level on the Reset line. This complementary MOS counter finds primary use in up/down and difference counting and frequency synthesizer applications where low power dissipation and/or high noise immunity is desired. It is also useful in A/D andD/A conversion and for magnitude and sign generation.

## ■ FEATURES

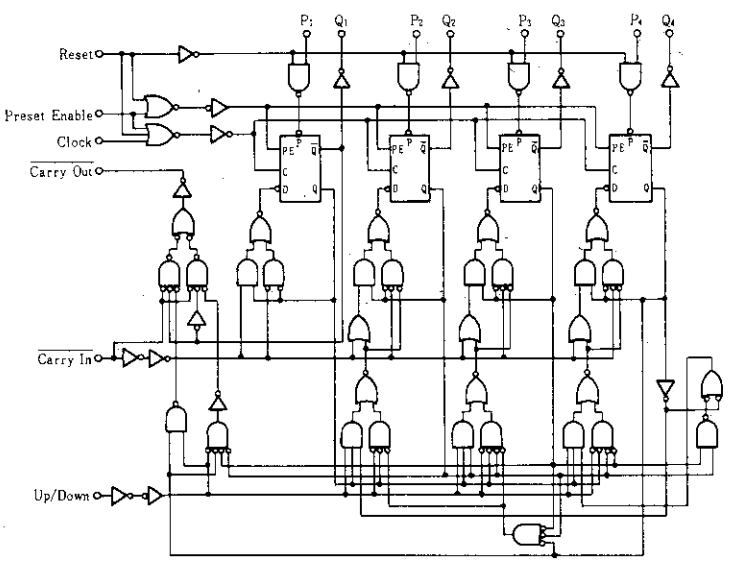
- Quiescent Current = 5nA/pkg typ. @5V
- Noise Immunity = 45% of $V_{DD}$ typ.
- Supply Voltage Range = 3 to 18V
- Low Input Capacitance = 5pF typ.
- Internally Synchronous for High Speed
- Logic Edge-clocked Design ... Count Occurs on Positive Going Edge of Clock
- 5MHz Counting Rate
- Asynchronous Preset Enable Operation
- Capable of Driving One Low-power Schottky TTL Load Over the Rated Temperature Range

## ■ PIN ARRANGEMENT




(Top View)

## ■ LOGIC DIAGRAM




## ■ TRUTH TABLE

| $\overline{\text{Carry In}}$ | Up/Down | Preset Enable | Reset | Action |
|---|---|---|---|---|
| 1 | × | 0 | 0 | No Count |
| 0 | 1 | 0 | 0 | Count Up |
| 0 | 0 | 0 | 0 | Count Down |
| × | × | 1 | 0 | Preset |
| × | × | × | 1 | Reset |

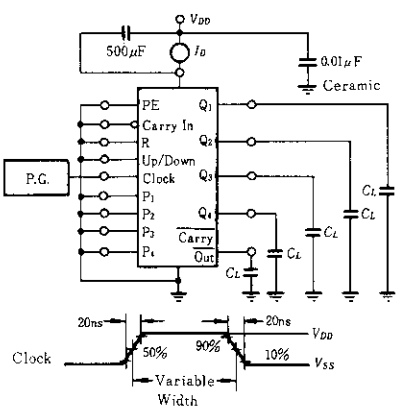
×=Don't Care

## ■ ELECTRICAL CHARACTERISTICS

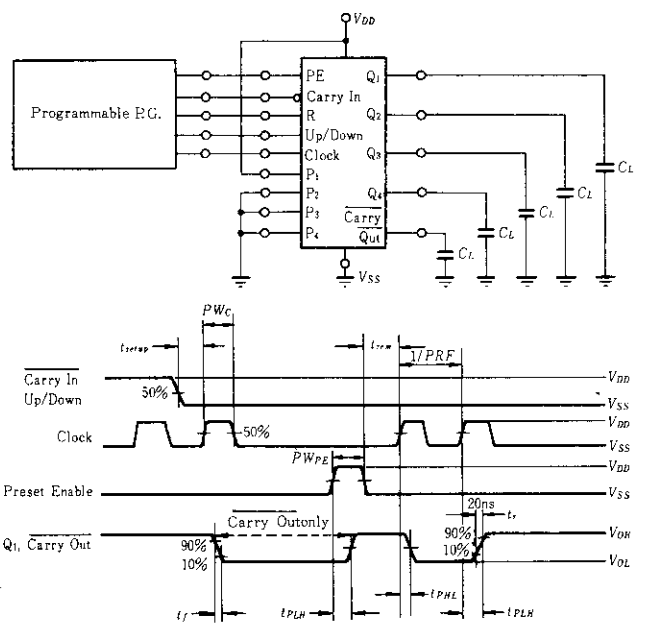
| Characteristic | Symbol | $V_{DD}$(V) | Test Conditions | −40°C min | −40°C max | 25°C min | 25°C typ | 25°C max | 85°C min | 85°C max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Output Voltage | $V_{OL}$ | 5.0 | $V_{in}=V_{DD}$ or 0 | — | 0.05 | — | 0 | 0.05 | — | 0.05 | V |
| | | 10 | | — | 0.05 | — | 0 | 0.05 | — | 0.05 | |
| | | 15 | | — | 0.05 | — | 0 | 0.05 | — | 0.05 | |
| | $V_{OH}$ | 5.0 | $V_{in}=0$ or $V_{DD}$ | 4.95 | — | 4.95 | 5.0 | — | 4.95 | — | V |
| | | 10 | | 9.95 | — | 9.95 | 10 | — | 9.95 | — | |
| | | 15 | | 14.95 | — | 14.95 | 15 | — | 14.95 | — | |
| Input Voltage | $V_{IL}$ | 5.0 | $V_{out}=4.5$ or 0.5V | — | 1.5 | — | 2.25 | 1.5 | — | 1.5 | V |
| | | 10 | $V_{out}=9.0$ or 1.0V | — | 3.0 | — | 4.50 | 3.0 | — | 3.0 | |
| | | 15 | $V_{out}=13.5$ or 1.5V | — | 4.0 | — | 6.75 | 4.0 | — | 4.0 | |
| | $V_{IH}$ | 5.0 | $V_{out}=0.5$ or 4.5V | 3.5 | — | 3.5 | 2.75 | — | 3.5 | — | V |
| | | 10 | $V_{out}=1.0$ or 9.0V | 7.0 | — | 7.0 | 5.50 | — | 7.0 | — | |
| | | 15 | $V_{out}=1.5$ or 13.5V | 11.0 | — | 11.0 | 8.25 | — | 11.0 | — | |
| Output Drive Current | $I_{OH}$ | 5.0 | $V_{OH}=2.5$V | −1.0 | — | −0.8 | −1.7 | — | −0.6 | — | mA |
| | | 5.0 | $V_{OH}=4.6$V | −0.2 | — | −0.16 | −0.36 | — | −0.12 | — | |
| | | 10 | $V_{OH}=9.5$V | −0.5 | — | −0.4 | −0.9 | — | −0.3 | — | |
| | | 15 | $V_{OH}=13.5$V | −1.4 | — | −1.2 | −3.5 | — | −1.0 | — | |
| | $I_{OL}$ | 5.0 | $V_{OL}=0.4$V | 0.52 | — | 0.44 | 0.88 | — | 0.36 | — | mA |
| | | 10 | $V_{OL}=0.5$V | 1.3 | — | 1.1 | 2.25 | — | 0.9 | — | |
| | | 15 | $V_{OL}=1.5$V | 3.6 | — | 3.0 | 8.8 | — | 2.4 | — | |
| Input Current | $I_{in}$ | 15 | | — | ±0.3 | — | ±0.00001 | ±0.3 | — | ±1.0 | μA |
| Input Capacitance | $C_{in}$ | | $V_{in}=0$ | — | — | — | 5.0 | 7.5 | — | — | pF |
| Quiescent Current | $I_{DD}$ | 5.0 | Zero Signal, per Package | — | 20 | — | 0.005 | 20 | — | 150 | μA |
| | | 10 | | — | 40 | — | 0.010 | 40 | — | 300 | |
| | | 15 | | — | 80 | — | 0.015 | 80 | — | 600 | |
| Total Supply Current* | $I_T$ | 5.0 | Dynamic+$I_{DD}$, | — | — | — | 0.58 | — | — | — | μA |
| | | 10 | per Gate | — | — | — | 1.2 | — | — | — | |
| | | 15 | $C_L=50$pF, $f=1$kHz | — | — | — | 1.7 | — | — | — | |

* To calculate total supply current at frequency other than 1kHz.
@$V_{DD}=5.0$V $I_T=(0.58\mu A/kHz)f+I_{DD}$, @$V_{DD}=10$V $I_T=(1.2\mu A/kHz)f+I_{DD}$, @$V_{DD}=15$V $I_T=(1.7\mu A/kHz)f+I_{DD}$

## ■ POWER DISSIPATION TEST CIRCUIT AND WAVEFORM




## ■ SWITCHING TIME TEST CIRCUIT

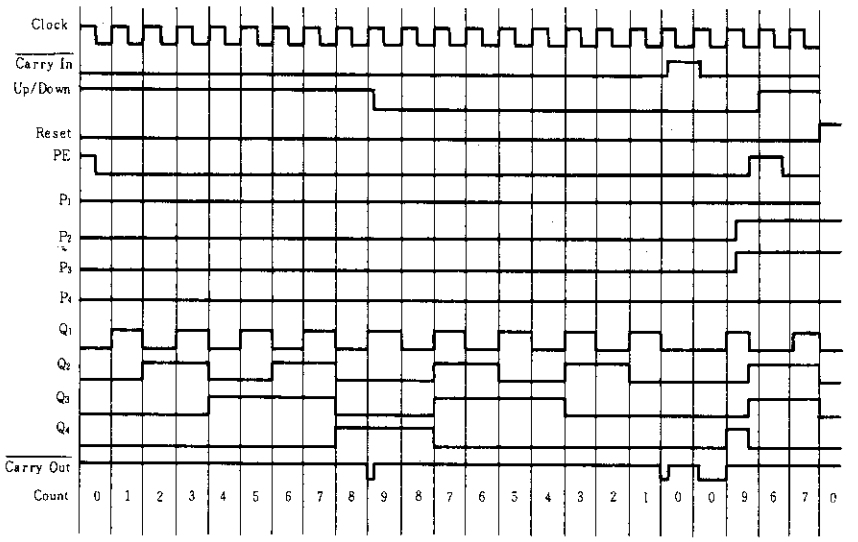


## ■ SWITCHING CHARACTERISTICS ($C_L$=50pF, $Ta$=25°C)

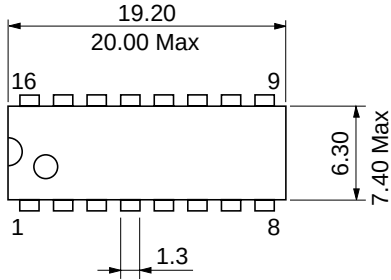
| Characteristic | | Symbol | $V_{DD}$ (V) | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| Output Rise Time | | $t_r$ | 5.0 | — | 180 | 360 | ns |
| | | | 10 | — | 90 | 180 | |
| | | | 15 | — | 65 | 130 | |
| Output Fall Time | | $t_f$ | 5.0 | — | 120 | 250 | ns |
| | | | 10 | — | 60 | 125 | |
| | | | 15 | — | 40 | 100 | |
| Propagation Delay Time | Clock to Q | $t_{PLH}$, $t_{PHL}$ | 5.0 | — | 315 | 630 | ns |
| | | | 10 | — | 130 | 260 | |
| | | | 15 | — | 100 | 200 | |
| | Clock to $\overline{\text{Carry Out}}$ | | 5.0 | — | 315 | 630 | |
| | | | 10 | — | 130 | 260 | |
| | | | 15 | — | 100 | 200 | |
| | $\overline{\text{Carry In}}$ to $\overline{\text{Carry Out}}$ | | 5.0 | — | 180 | 360 | |
| | | | 10 | — | 80 | 160 | |
| | | | 15 | — | 60 | 120 | |
| | Preset, Reset to Q | | 5.0 | — | 315 | 630 | |
| | | | 10 | — | 130 | 260 | |
| | | | 15 | — | 100 | 200 | |
| | Preset, Reset to $\overline{\text{Carry Out}}$ | | 5.0 | — | 550 | 1100 | |
| | | | 10 | — | 225 | 450 | |
| | | | 15 | — | 150 | 300 | |
| Clock Pulse Width | | $PW_C$ | 5.0 | 400 | 200 | — | ns |
| | | | 10 | 200 | 100 | — | |
| | | | 15 | 150 | 75 | — | |
| Clock Frequency | | $PRF$ | 5.0 | — | 3.0 | 1.5 | MHz |
| | | | 10 | — | 6.0 | 3.0 | |
| | | | 15 | — | 8.0 | 4.0 | |
| Preset or Reset Removal Time* | | $t_{rem}$ | 5.0 | 650 | 325 | — | ns |
| | | | 10 | 230 | 115 | — | |
| | | | 15 | 180 | 90 | — | |
| Clock Pulse Rise and Fall Time | | $t_r$, $t_f$ | 5.0 | — | — | 15 | μs |
| | | | 10 | — | — | 15 | |
| | | | 15 | — | — | 15 | |
| Setup Time | Carry In | $t_{setup}$ | 5.0 | 260 | 130 | — | ns |
| | | | 10 | 120 | 60 | — | |
| | | | 15 | 100 | 50 | — | |
| | Up/Down | | 5.0 | 500 | 250 | — | |
| | | | 10 | 200 | 100 | — | |
| | | | 15 | 150 | 75 | — | |
| Preset Enable Pulse Width | | $PW_{PE}$ | 5.0 | — | 100 | 200 | ns |
| | | | 10 | — | 50 | 100 | |
| | | | 15 | — | 40 | 80 | |

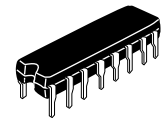
*The Preset or Reset Signal must be low prior to a positive-going transition of the clock.

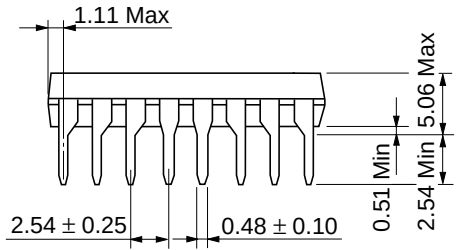
● TIMING DIAGRAM

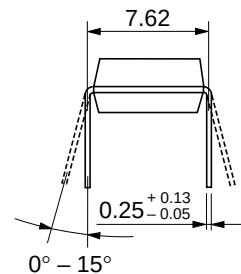


Unit: mm






| | |
|---|---|
| Hitachi Code | DP-16 |
| JEDEC | Conforms |
| EIAJ | Conforms |
| Weight (reference value) | 1.07 g |

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