

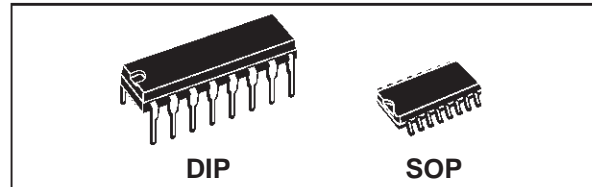


PRESETTABLE UP/DOWN COUNTERS

- MEDIUM SPEED OPERATION $f_{CL} = 8\text{MHz}$ TYP. AT 10V
- SYNCHRONOUS INTERNAL CARRY PROPAGATION
- RESET AND PRESET CAPABILITY
- QUIESCENT CURRENT SPECIFIED TO 15V
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 15V AND 25°C
- 100% TESTED FOR QUIESCENT CURRENT MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD No. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

DESCRIPTION

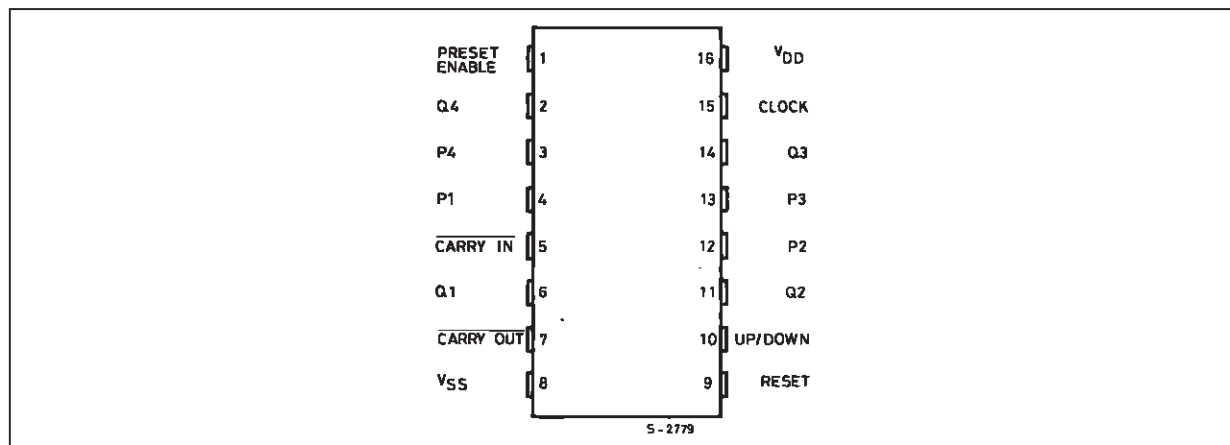
The HCF4510B and HCF4516B are monolithic integrated circuits available in 16-lead dual in-line plastic and plastic micro package. The HCF4510B Presettable BCD Up/Down Counter and the HCF4516B Presettable Binary Up/Down Counter consist of four synchronously clocked D-type flip-flops (with a gating structure to provide T-type flip-flop capability) connected as counters. These counters can be cleared by a high level on the RESET line, and can be preset to any binary number present on the jam inputs by a high level on the PRESET ENABLE line. The HCF4510B will count out of non-BCD counter states in a maximum of two clock pulses in the up mode,



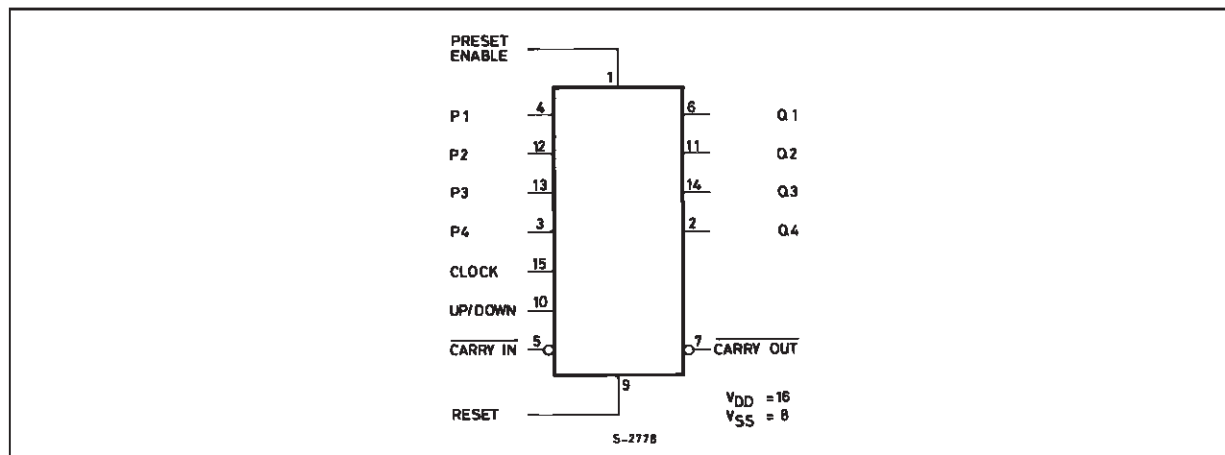
| ORDER CODES | | |
|-------------|------------|---------------|
| PACKAGE | TUBE | T & R |
| DIP | HCF45XXBEY | |
| SOP | HCF45XXBM1 | HCF45XXM013TR |

and a maximum of four clock pulses in the down mode. If the CARRY-IN input is held low, the counter advances up or down on each positive-going clock transition. Synchronous cascading is accomplished by connecting all clock inputs in parallel and connecting the CARRY-OUT of a less significant stage to the CARRY-IN of a more significant stage. The HCF4510B and HCF4516B can be loaded in the ripple mode by connecting the CARRY-OUT to the clock of the next stage. If the UP/DOWN input changes during a terminal count, the CARRY-OUT must be gated with the clock, and the UP/DOWN input must change while the clock is high. This method provides a clean clock signal to the subsequent counting stage.

PIN CONNECTION



FUNCTIONAL DIAGRAM



TRUTH TABLE

| CL | CI | U/D | PE | R | Action |
|----|----|-----|----|---|------------|
| X | 1 | X | 0 | 0 | No Count |
| | 0 | 1 | 0 | 0 | Count Up |
| | 0 | 0 | 0 | 0 | Count Down |
| X | X | X | 1 | 0 | Preset |
| X | X | X | X | 1 | Reset |

X=Don't care

ABSOLUTE MAXIMUM RATING

| Symbol | Parameter | Value | Unit |
|-------------------|--|-------------------------------|----------|
| V _{DD} * | Supply Voltage | -0.5 to +18 | V |
| V _i | Input Voltage | -0.5 to V _{DD} + 0.5 | V |
| I _i | DC Input Current (any one input) | ± 10 | mA |
| P _{tot} | Total Power Dissipation (per package) Dissipation per Output Transistor for Top = Full Package Temperature Range | 200 100 | mW mW |
| T _{op} | Operating Temperature | -40 to +85 | °C |
| T _{stg} | Storage Temperature | -65 to +150 | °C |

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

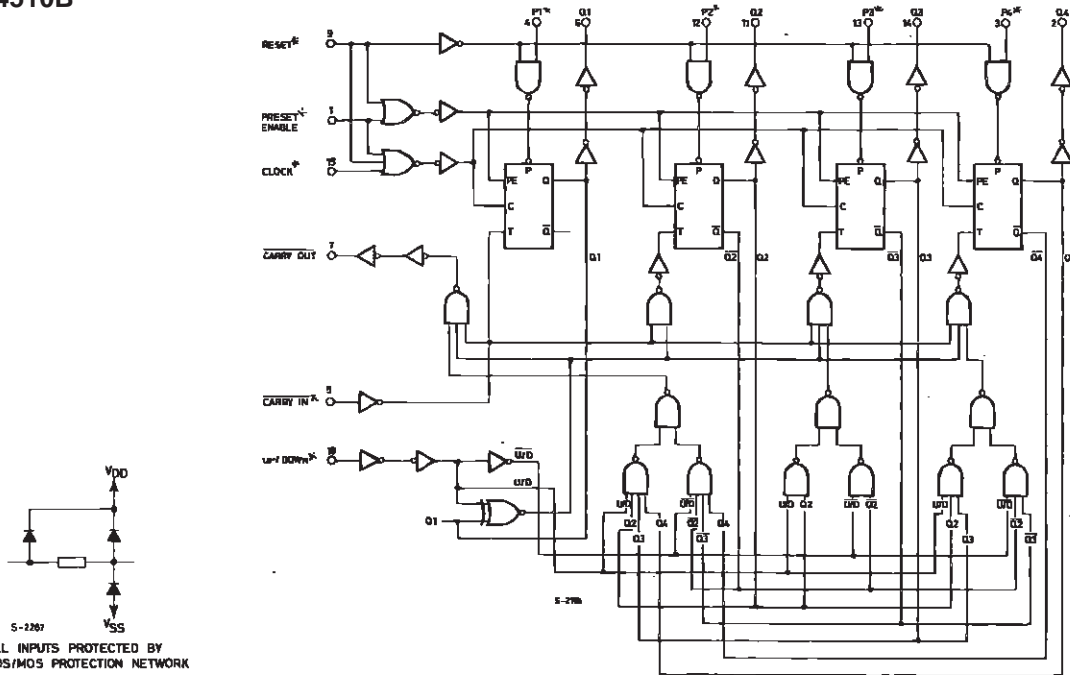
* All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

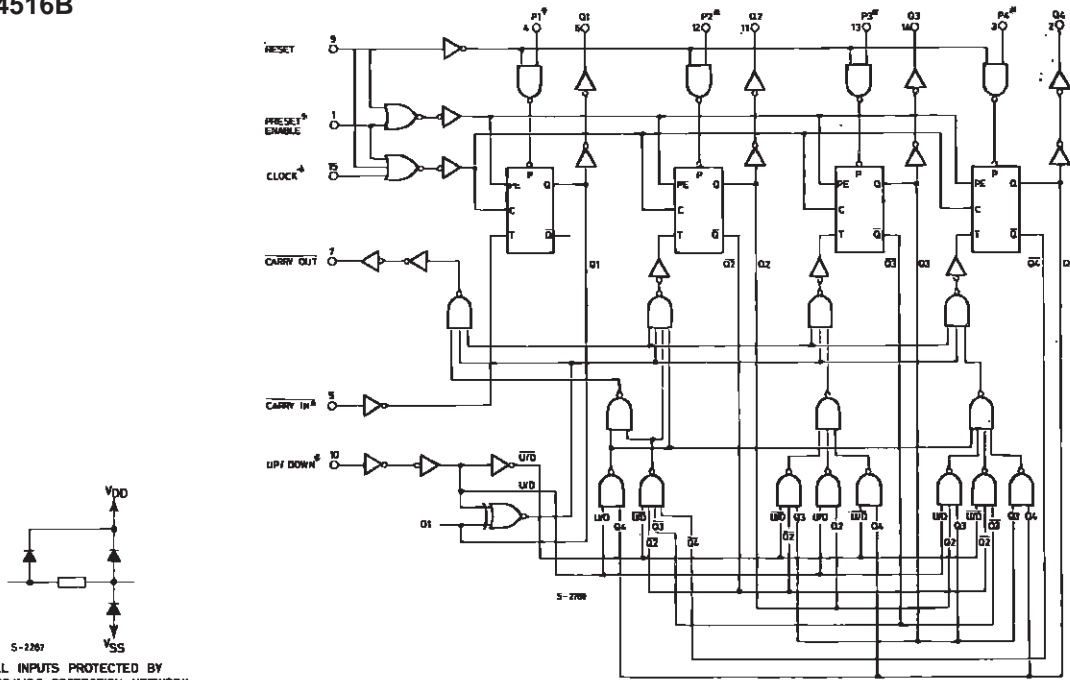
| Symbol | Parameter | Value | Unit |
|-----------------|-----------------------|----------------------|------|
| V _{DD} | Supply Voltage | 3 to 15 | V |
| V _I | Input Voltage | 0 to V _{DD} | V |
| T _{op} | Operating Temperature | -40 to +85 | °C |

LOGIC DIAGRAMS

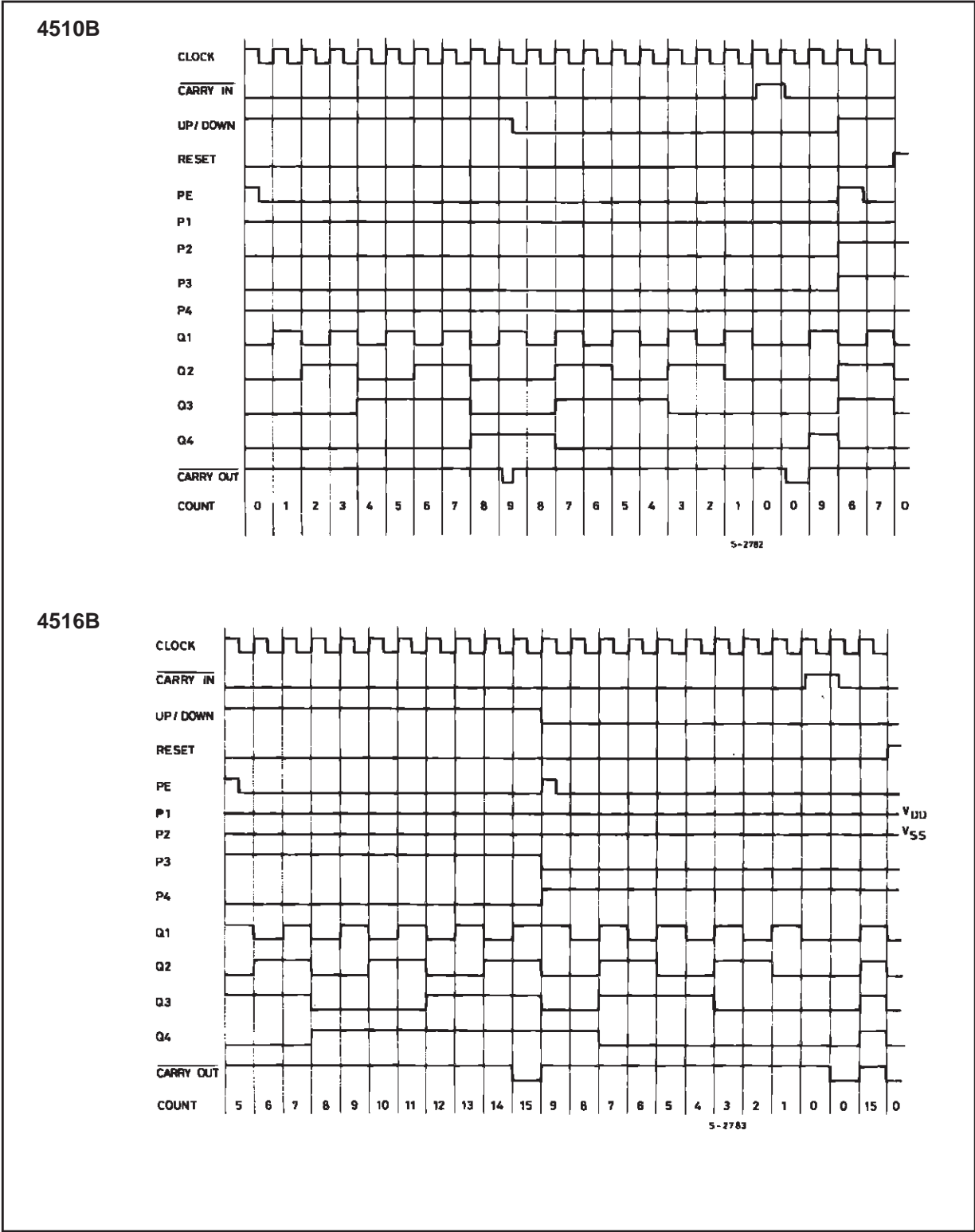
4510B



4516B



TIMING DIAGRAMS



STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

| Symbol | Parameter | Test Conditions | | | | Value | | | | | | Unit | |
|-----------------------------------|-----------------------|-----------------------|-----------------------|--------------------------------|------------------------|--------|-----------|-------|---------------|-----------|-------|---------|---------|
| | | V _I (V) | V _O (V) | I _O (μ A) | V _{DD} (V) | -40 °C | | 25 °C | | | 85 °C | | |
| | | | | | | Min. | Max. | Min. | Typ. | Max. | Min. | | Max. |
| I _L | Quiescent Current | 0/5 | | | 5 | | 20 | | 0.02 | 20 | | 150 | μ A |
| | | 0/10 | | | 10 | | 40 | | 0.02 | 40 | | 300 | |
| | | 0/15 | | | 15 | | 80 | | 0.02 | 80 | | 600 | |
| V _{OH} | Output High Voltage | 0/5 | | < 1 | 5 | 4.95 | | 4.95 | | | 4.95 | | V |
| | | 0/10 | | < 1 | 10 | 9.95 | | 9.95 | | | 9.95 | | |
| | | 0/15 | | < 1 | 15 | 14.95 | | 14.95 | | | 14.95 | | |
| V _{OL} | Output Low Voltage | 5/0 | | < 1 | 5 | | 0.05 | | | 0.05 | | 0.05 | V |
| | | 10/0 | | < 1 | 10 | | 0.05 | | | 0.05 | | 0.05 | |
| | | 15/0 | | < 1 | 15 | | 0.05 | | | 0.05 | | 0.05 | |
| V _{IH} | Input High Voltage | | 0.5/4.5 | < 1 | 5 | 3.5 | | 3.5 | | | 3.5 | | V |
| | | | 1/9 | < 1 | 10 | 7 | | 7 | | | 7 | | |
| | | | 1.5/13.5 | < 1 | 15 | 11 | | 11 | | | 11 | | |
| V _{IL} | Input Low Voltage | | 4.5/0.5 | < 1 | 5 | | 1.5 | | | 1.5 | | 1.5 | V |
| | | | 9/1 | < 1 | 10 | | 3 | | | 3 | | 3 | |
| | | | 13.5/1.5 | < 1 | 15 | | 4 | | | 4 | | 4 | |
| I _{OH} | Output Drive Current | 0/5 | 2.5 | | 5 | -1.53 | | -1.36 | -3.2 | | -1.1 | | mA |
| | | 0/5 | 4.6 | | 5 | -0.52 | | -0.44 | -1 | | -0.36 | | |
| | | 0/10 | 9.5 | | 10 | -1.3 | | -1.1 | -2.6 | | -0.9 | | |
| | | 0/15 | 13.5 | | 15 | -3.6 | | -3.0 | -6.8 | | -2.4 | | |
| I _{OL} | Output Sink Current | 0/5 | 0.4 | | 5 | 0.52 | | 0.44 | 1 | | 0.36 | | mA |
| | | 0/10 | 0.5 | | 10 | 1.3 | | 1.1 | 2.6 | | 0.9 | | |
| | | 0/15 | 1.5 | | 15 | 3.6 | | 3.0 | 6.8 | | 2.4 | | |
| I _{IH} , I _{IL} | Input Leakage Current | 0/15 | Any Input | | 15 | | ± 0.3 | | $\pm 10^{-5}$ | ± 0.3 | | ± 1 | μ A |
| C _I | Input Capacitance | | Any Input | | | | | | 5 | 7.5 | | | pF |

The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD} = 5V, 2V min. with V_{DD} = 10V, 2.5V min. with V_{DD} = 15V

HCF4510B/4515B

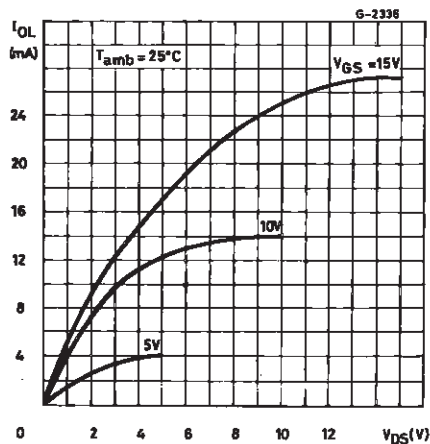
DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ K}\Omega$, typical temperature coefficient for all V_{DD} values is $03\text{ }^{\circ}\text{C}$, all input rise and fall times = 20 ns)

| Symbol | Parameter | Test Conditions | | Value | | | Unit |
|------------------------|---|-----------------|-----------------|-------|------|------|---------------|
| | | | V_{DD} (V) | Min. | Typ. | Max. | |
| t_{PHL} t_{PLH} | Propagation Delay Time Clock to Q Output | | 5 | | 200 | 400 | ns |
| | | | 10 | | 100 | 200 | |
| | | | 15 | | 75 | 150 | |
| t_{PHL} t_{PLH} | Propagation Delay Time Preset or Reset to Q Output | | 5 | | 210 | 420 | ns |
| | | | 10 | | 105 | 210 | |
| | | | 15 | | 80 | 160 | |
| t_{PHL} t_{PLH} | Propagation Delay Time Clock to Carry Out | | 5 | | 240 | 480 | ns |
| | | | 10 | | 120 | 240 | |
| | | | 15 | | 90 | 180 | |
| t_{PHL} t_{PLH} | Propagation Delay Time Carry In to Carry Out | | 5 | | 125 | 250 | ns |
| | | | 10 | | 60 | 120 | |
| | | | 15 | | 50 | 100 | |
| t_{PHL} t_{PLH} | Propagation Delay Time Preset or Reset to Carry Out | | 5 | | 320 | 640 | ns |
| | | | 10 | | 160 | 320 | |
| | | | 15 | | 125 | 250 | |
| t_{THL} t_{TLH} | Transition Time | | 5 | | 100 | 200 | ns |
| | | | 10 | | 50 | 100 | |
| | | | 15 | | 40 | 80 | |
| f_{MAX} | Max Clock Frequency | | 5 | 2 | 4 | | MHz |
| | | | 10 | 4 | 8 | | |
| | | | 15 | 5.5 | 11 | | |
| t_w | Clock Pulse Width | | 5 | 150 | | | ns |
| | | | 10 | 75 | | | |
| | | | 15 | 60 | | | |
| | Preset Enable or Reset Removal Time (1) | | 5 | 150 | | | ns |
| | | | 10 | 80 | | | |
| | | | 15 | 60 | | | |
| t_r, t_f | Clock Rise and Fall Time (2) | | 5 | | | 15 | μs |
| | | | 10 | | | 5 | |
| | | | 15 | | | 5 | |
| t_{setup} | Carry In Setup Time | | 5 | 130 | | | ns |
| | | | 10 | 60 | | | |
| | | | 15 | 45 | | | |
| t_{setup} | Up Down Setup Time | | 5 | 360 | | | ns |
| | | | 10 | 160 | | | |
| | | | 15 | 110 | | | |
| t_w | Preset Enable or Reset Pulse Width | | 5 | 220 | | | ns |
| | | | 10 | 100 | | | |
| | | | 15 | 75 | | | |

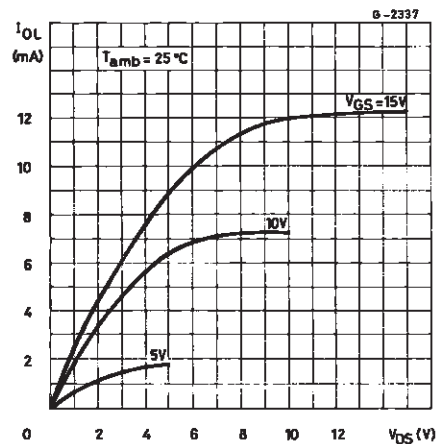
(1) Time required after the falling edge of the reset or preset enable inputs before the rising edge of the clock will trigger the counter (similar to setup time).

(2) If more than unit is cascaded in the parallel clocked application, t_{rCL} should be made less than or equal to the sum of the fixed propagation delay at 15 pF and the transition time of the carry output driving stage of the estimated capacitive load.

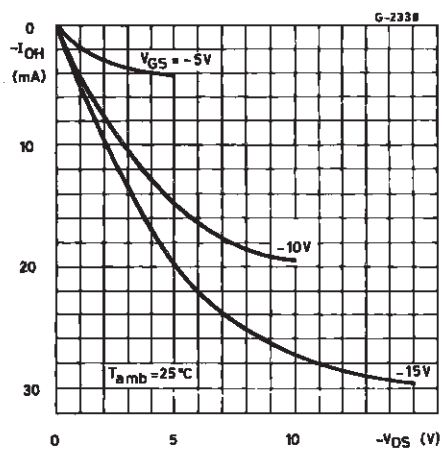
Typical Output Low (sink) Current Characteristics.



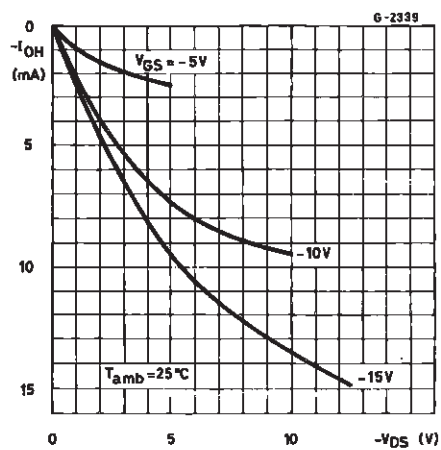
Minimum Output Low (sink) Current Characteristics.



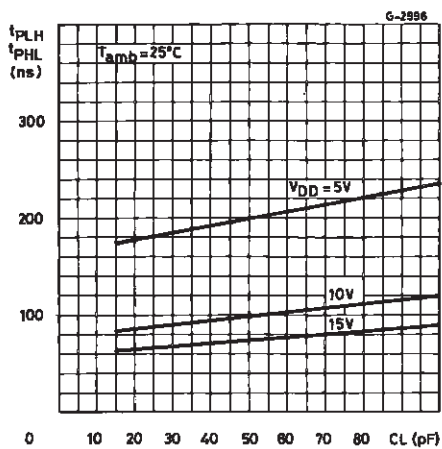
Typical Output High (source) Current Characteristics.



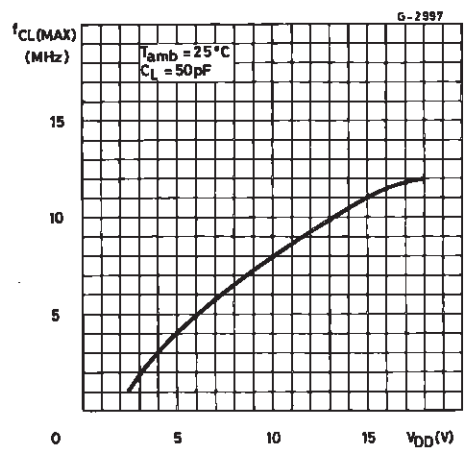
Minimum Output High (source) Current Characteristics.



Typical Propagation Delay Time vs. Load Capacitance for Clock to Q Output.

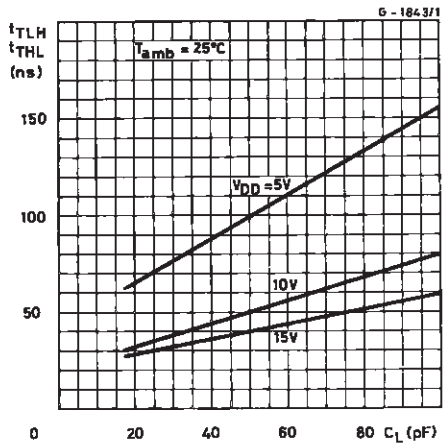


Typical Maximum Clock Input Frequency vs. Supply Voltage.

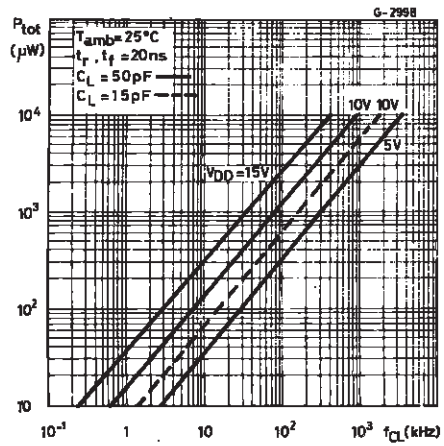


HCF4510B/4515B

Typical Transition Time vs. Load Capacitance.

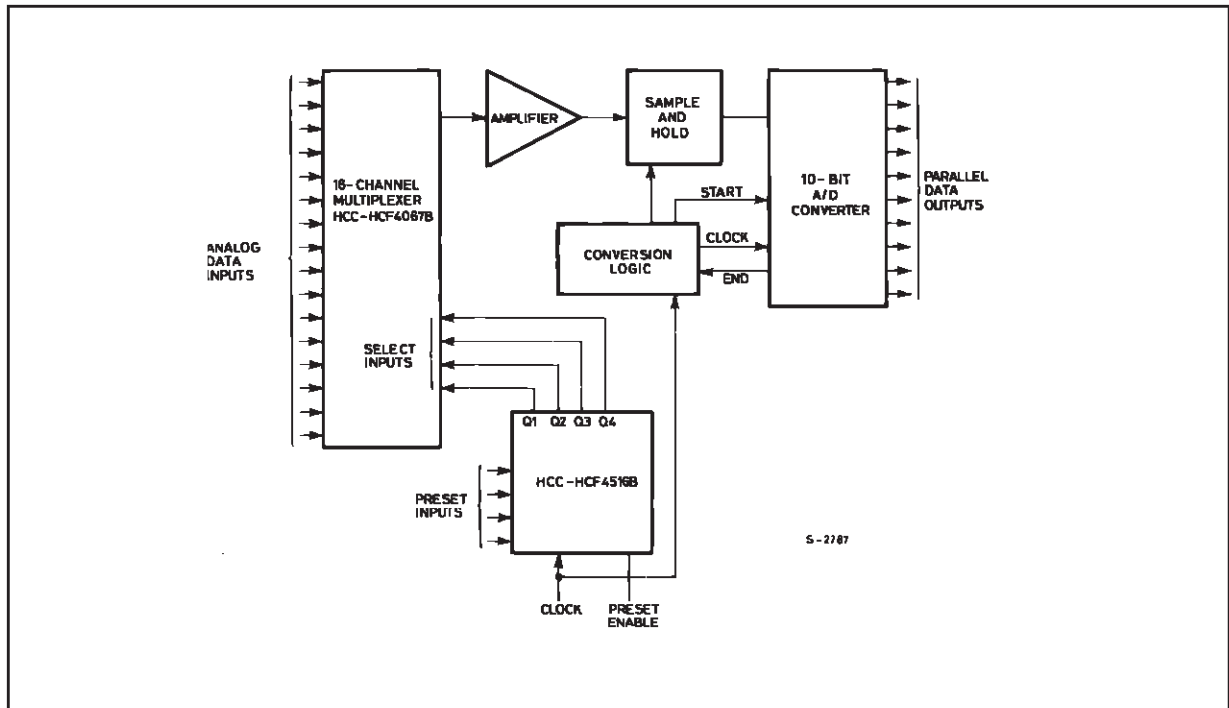


Typical Dynamic Power Dissipation vs. Frequency.



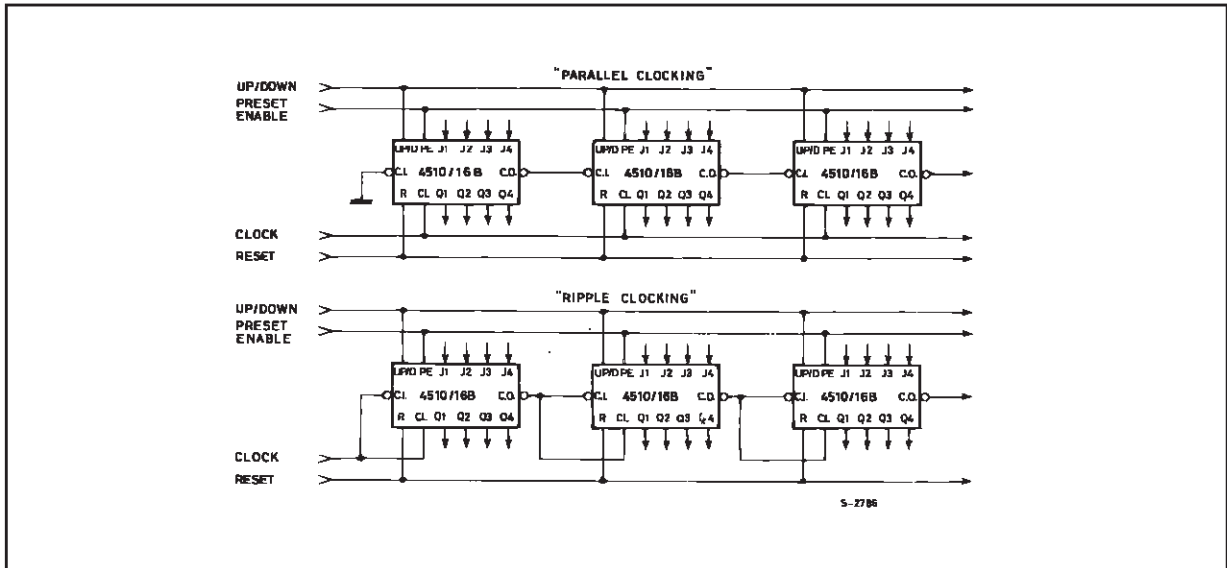
TYPICAL APPLICATIONS

TYPICAL 16-CHANNEL, 10 BIT DATA ACQUISITION SYSTEM



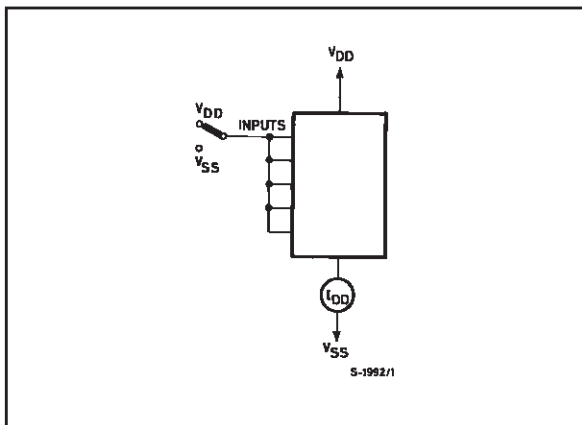
This acquisition system can be operated in the random access mode by jamming in the channel number at the present inputs, or in the sequential mode by clocking the HCF4516B.

CASCADING COUNTER PACKAGES

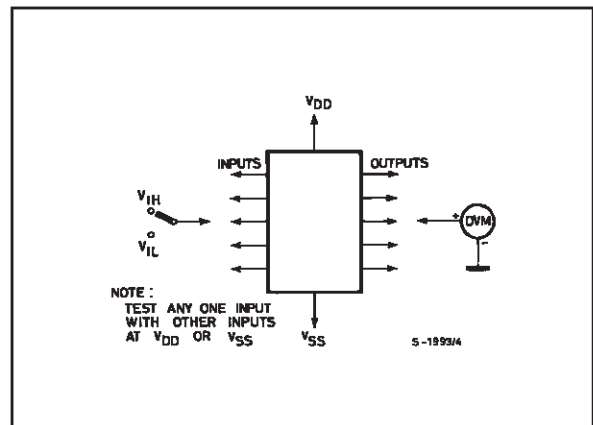


TEST CIRCUITS

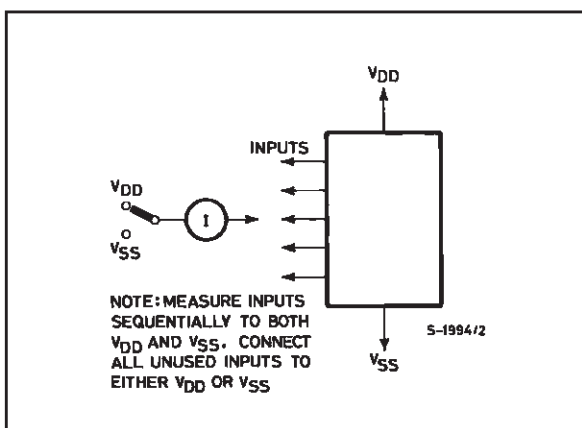
Quiescent Device Current.



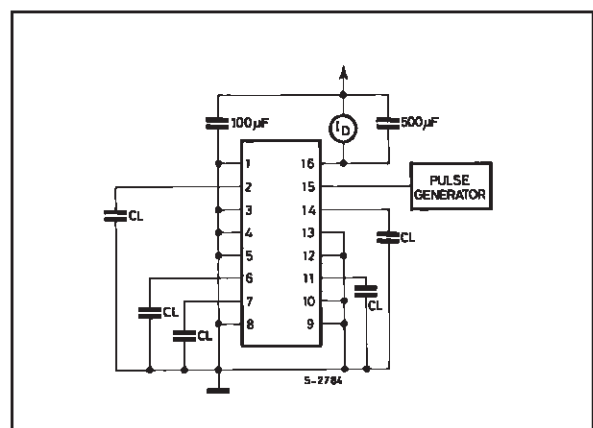
Noise Immunity.



Input Leakage Current.

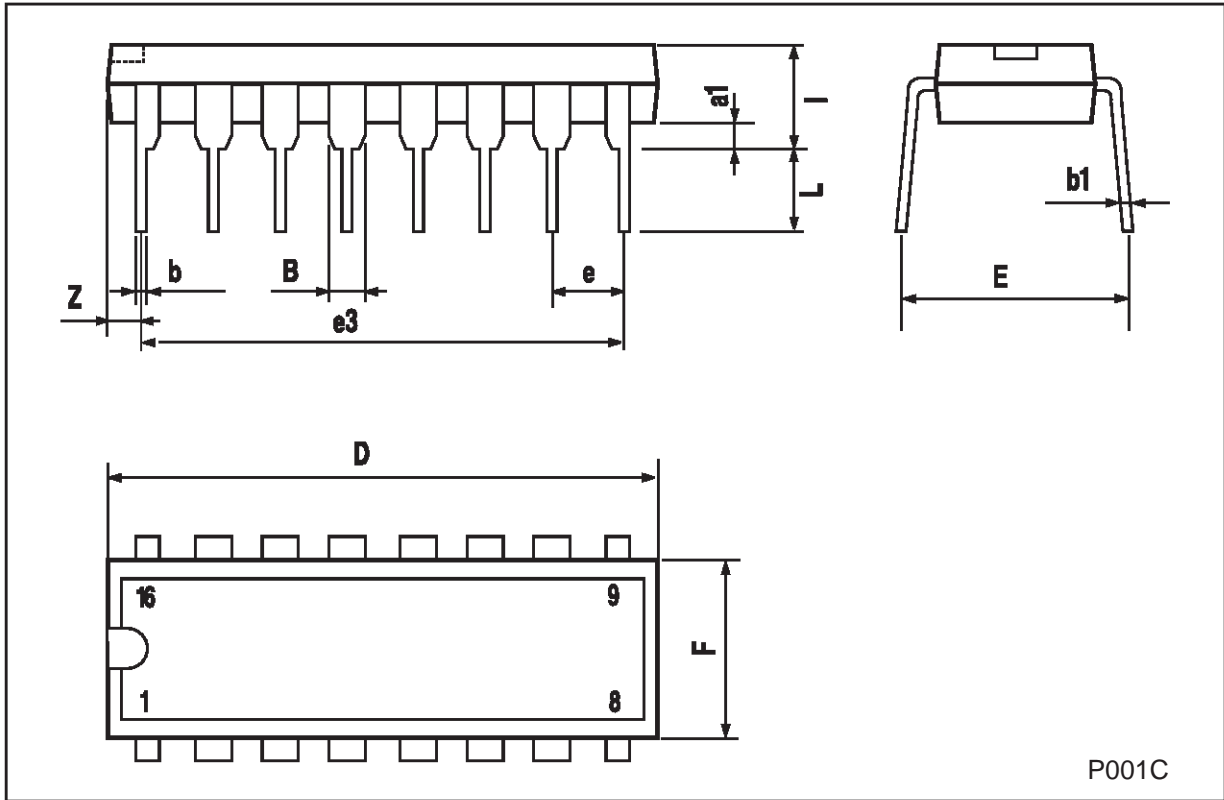


Power Dissipation and Input Waveform.



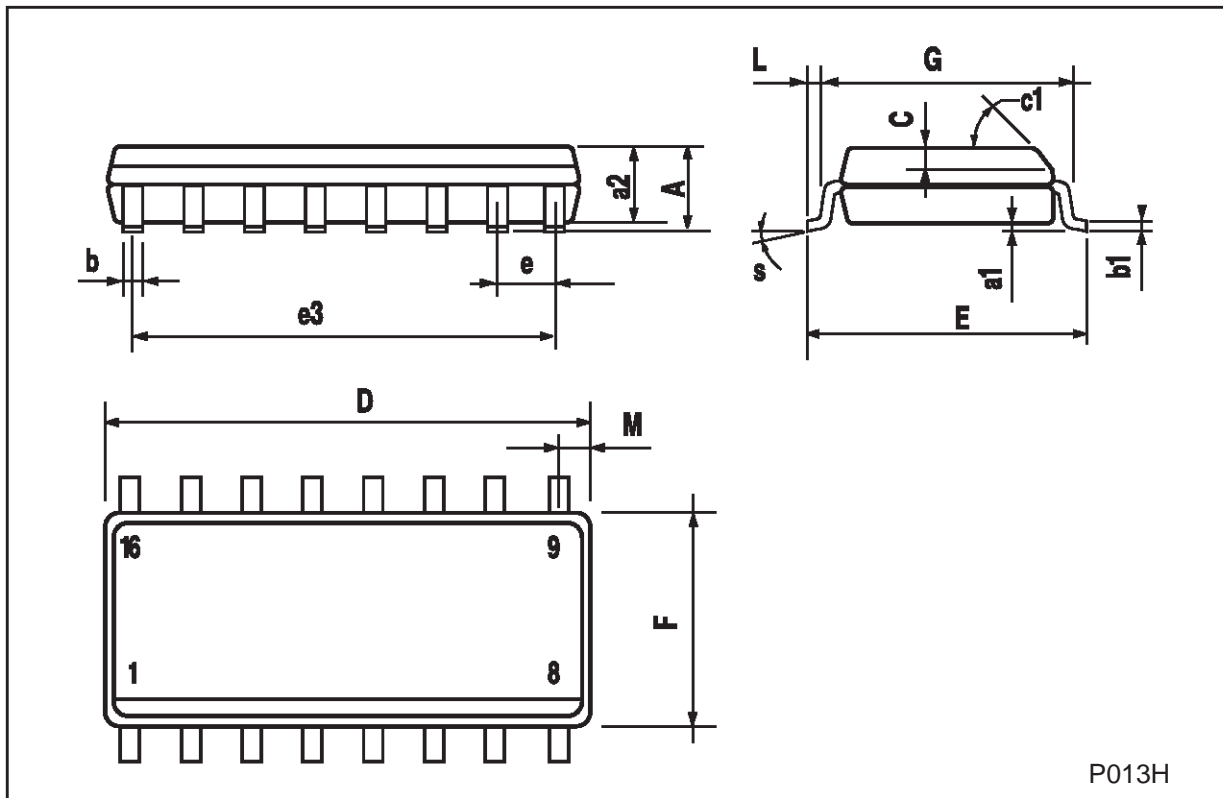
Plastic DIP-16 (0.25) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 17.78 | | | 0.700 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.27 | | | 0.050 |



SO-16 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|-----------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | 45 (typ.) | | | | | |
| D | 9.8 | | 10 | 0.385 | | 0.393 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 8.89 | | | 0.350 | |
| F | 3.8 | | 4.0 | 0.149 | | 0.157 |
| G | 4.6 | | 5.3 | 0.181 | | 0.208 |
| L | 0.5 | | 1.27 | 0.019 | | 0.050 |
| M | | | 0.62 | | | 0.024 |
| S | 8 (max.) | | | | | |



P013H

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