

### KK4516B

## Presettable Up/Down Counter High-Voltage Silicon-Gate CMOS

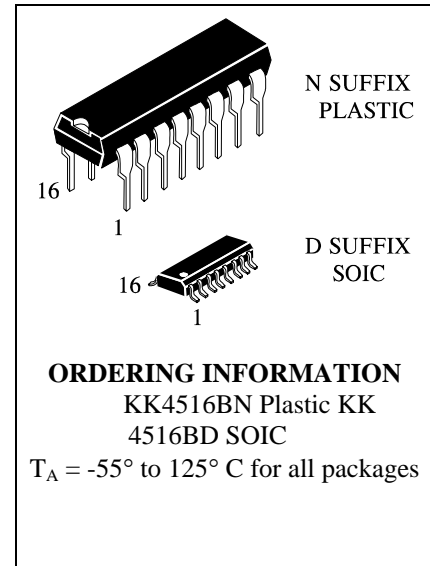
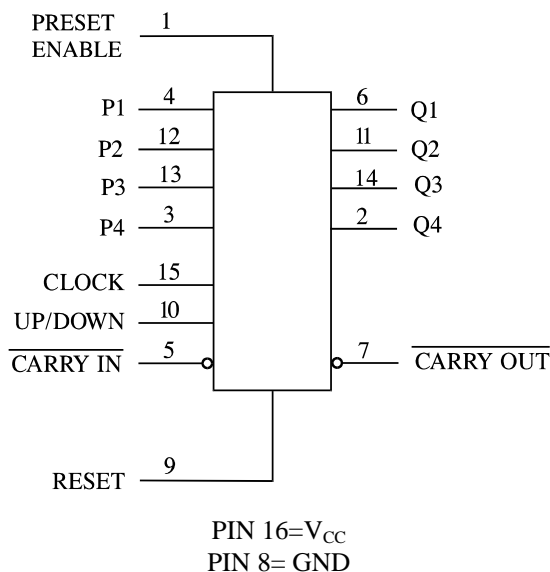
The KK4516B Presettable Binary Up/Down Counter consists of four synchronously clocked D-type flip-flops (with a gating structure to provide T-type flip-flop capability) connected as counters. This counter can be cleared by a high level on the RESET line, and can be preset to any binary number present on the jam inputs by a high level on the PRESET ENABLE line.

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.

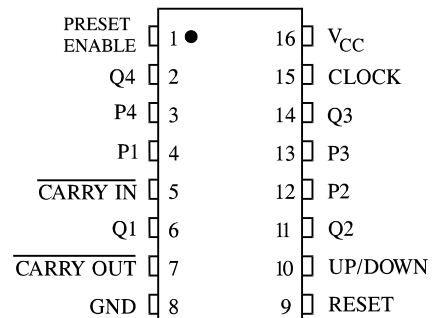
The KK4516B can be cascaded in the ripple mode by connecting the CARRY-OUT to the clock of the next stage. If the UP/DOWN input changes during a terminal count, the CARRY-OUT must be gated with the clock, and the UP/DOWN input must change while the clock is high. This method provides a clean clock signal to the subsequent counting stage.

- Operating Voltage Range: 3.0 to 18 V
- Maximum input current of 1  $\mu$ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (over full package temperature range):
  - 1.0 V min @ 5.0 V supply
  - 2.0 V min @ 10.0 V supply
  - 2.5 V min @ 15.0 V supply

### LOGIC DIAGRAM



### PIN ASSIGNMENT



### FUNCTION TABLE

Inputs					Outputs
CL	$\overline{CI}$	U/D	PE	R	Mode
X	H	X	L	L	NO COUNT
	L	H	L	L	COUNT UP
	L	L	L	L	COUNT DOWN
X	X	X	H	L	PRESET
X	X	X	X	H	RESET

X = don't care

**MAXIMUM RATINGS\***

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	-0.5 to +20	V
V <sub>IN</sub>	DC Input Voltage (Referenced to GND)	-0.5 to V <sub>CC</sub> +0.5	V
V <sub>OUT</sub>	DC Output Voltage (Referenced to GND)	-0.5 to V <sub>CC</sub> +0.5	V
I <sub>IN</sub>	DC Input Current, per Pin	±10	mA
P <sub>D</sub>	Power Dissipation in Still Air, Plastic DIP+ SOIC Package+	750 500	mW
P <sub>D</sub>	Power Dissipation per Output Transistor	100	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds (Plastic DIP or SOIC Package)	260	°C

\*Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

+Derating - Plastic DIP: - 10 mW/°C from 65° to 125°C

SOIC Package: - 7 mW/°C from 65° to 125°C

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	3.0	18	V
V <sub>IN</sub> , V <sub>OUT</sub>	DC Input Voltage, Output Voltage (Referenced to GND)	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature, All Package Types	-55	+125	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V<sub>IN</sub> and V<sub>OUT</sub> should be constrained to the range GND ≤ (V<sub>IN</sub> or V<sub>OUT</sub>) ≤ V<sub>CC</sub>.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

**DC ELECTRICAL CHARACTERISTICS** (Voltages Referenced to GND)

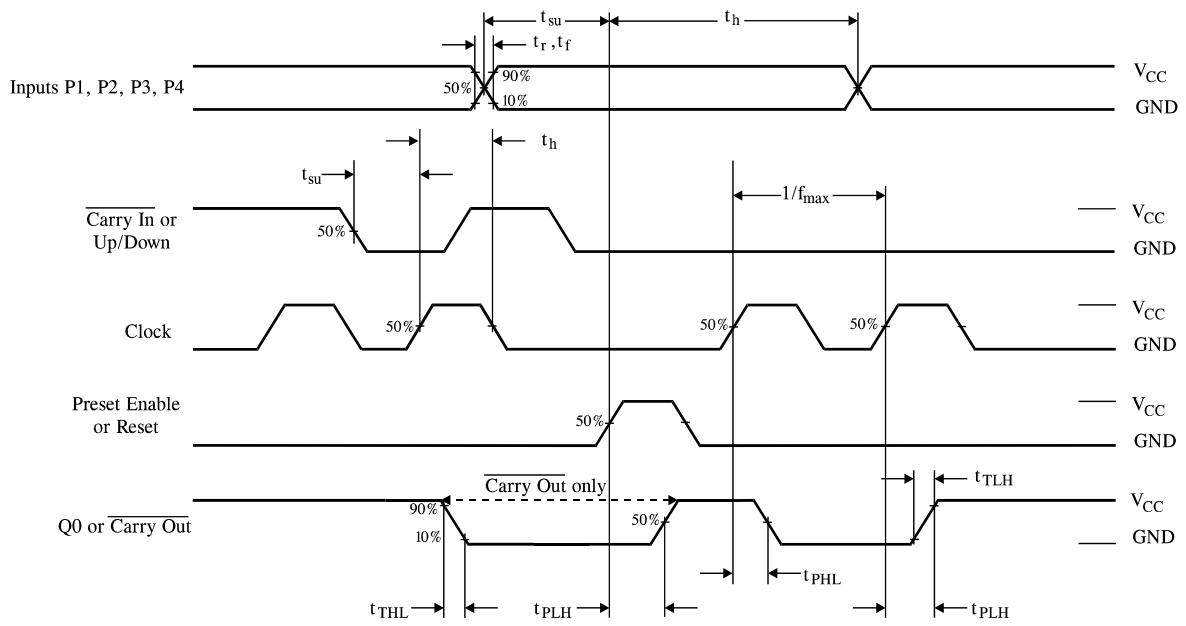
Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				≥-55°C	25°C	≤125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>OUT</sub> = 0.5 V or V <sub>CC</sub> - 0.5V V <sub>OUT</sub> = 1.0 V or V <sub>CC</sub> - 1.0 V V <sub>OUT</sub> = 1.5 V or V <sub>CC</sub> - 1.5V	5.0	3.5	3.5	3.5	V
			10	7	7	7	
			15	11	11	11	
V <sub>IL</sub>	Maximum Low - Level Input Voltage	V <sub>OUT</sub> = 0.5 V or V <sub>CC</sub> - 0.5V V <sub>OUT</sub> = 1.0 V or V <sub>CC</sub> - 1.0 V V <sub>OUT</sub> = 1.5 V or V <sub>CC</sub> - 1.5V	5.0	1.5	1.5	1.5	V
			10	3	3	3	
			15	4	4	4	
V <sub>OH</sub>	Minimum High-Level Output Voltage	V <sub>IN</sub> =GND or V <sub>CC</sub>	5.0	4.95	4.95	4.95	V
			10	9.95	9.95	9.95	
			15	14.95	14.95	14.95	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>IN</sub> =GND or V <sub>CC</sub>	5.0	0.05	0.05	0.05	V
			10	0.05	0.05	0.05	
			15	0.05	0.05	0.05	
I <sub>IN</sub>	Maximum Input Leakage Current	V <sub>IN</sub> = GND or V <sub>CC</sub>	18	±0.1	±0.1	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>IN</sub> = GND or V <sub>CC</sub>	5.0	5	5	150	μA
			10	10	10	300	
			15	20	20	600	
			20	100	100	3000	
I <sub>OL</sub>	Minimum Output Low (Sink) Current	V <sub>IN</sub> = GND or V <sub>CC</sub> U <sub>OL</sub> =0.4 V U <sub>OL</sub> =0.5 V U <sub>OL</sub> =1.5 V	5.0	0.64	0.51	0.36	mA
			10	1.6	1.3	0.9	
			15	4.2	3.4	2.4	
I <sub>OH</sub>	Minimum Output High (Source) Current	V <sub>IN</sub> = GND or V <sub>CC</sub> U <sub>OH</sub> =2.5 V U <sub>OH</sub> =4.6 V U <sub>OH</sub> =9.5 V U <sub>OH</sub> =13.5 V	5.0	-2	-1.6	-1.15	mA
			5.0	-0.64	-0.51	-0.36	
			10	-1.6	-1.3	-0.9	
			15	-4.2	-3.4	-2.4	

**AC ELECTRICAL CHARACTERISTICS** ( $C_L=50\text{pF}$ ,  $R_L=200\text{k}\Omega$ , Input  $t_r=t_f=20\text{ ns}$ )

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			≥-55°C	25°C	≤125°C	
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay, Clock to Q (Figure 1)	5.0	400	400	800	ns
		10	200	200	400	
		15	150	150	300	
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay, Preset or Reset to Q (Figure 1)	5.0	420	420	840	ns
		10	210	210	420	
		15	160	160	320	
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay, Clock to Carry Out (Figure 1)	5.0	480	480	960	ns
		10	240	240	480	
		15	180	180	360	
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay, Carry In to Carry Out (Figure 1)	5.0	250	250	500	ns
		10	120	120	240	
		15	100	100	200	
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay, Preset or Reset to Carry Out (Figure 1)	5.0	640	640	1280	ns
		10	320	320	640	
		15	250	250	500	
t <sub>THL</sub> , t <sub>TLH</sub>	Maximum Output Transition Time, Any Output (Figure 1)	5.0	200	200	400	ns
		10	100	100	200	
		15	80	80	160	
C <sub>IN</sub>	Maximum Input Capacitance	-		7.5		pF

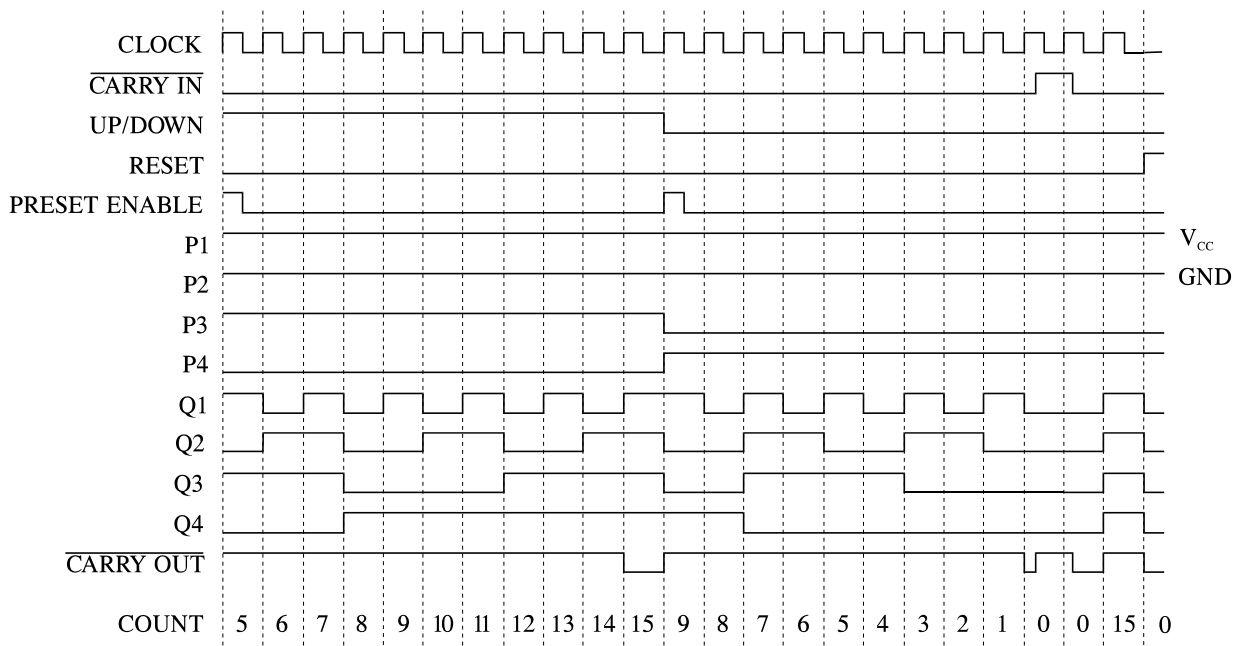
**TIMING REQUIREMENTS**( $C_L=50\text{pF}$ ,  $R_L=200\text{ k}\Omega$ , Input  $t_r=t_f=20\text{ ns}$ )

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			≥-55°C	25°C	≤125°C	
t <sub>su</sub>	Minimum Setup Time, P to Preset Enable (Figure 1)	5.0	25	25	50	ns
		10	10	10	20	
		15	10	10	20	
t <sub>su</sub>	Minimum Setup Time, Up/Down to Clock (Figure 1)	5.0				ns
		10				
		15				
t <sub>su</sub>	Minimum Setup Time, Carry In to Clock (Figure 1)	5.0				ns
		10				
		15				
t <sub>h</sub>	Minimum Hold Time, Clock to Carry In (Figure 1)	5.0	60	60	120	ns
		10	30	30	60	
		15	30	30	60	
t <sub>h</sub>	Minimum Hold Time, Clock to Up/Down (Figure 1)	5.0	30	30	60	ns
		10	30	30	60	
		15	30	30	60	
t <sub>h</sub>	Minimum Hold Time, Preset enable to P (Figure 1)	5.0	70	70	140	ns
		10	40	40	80	
		15	40	40	80	

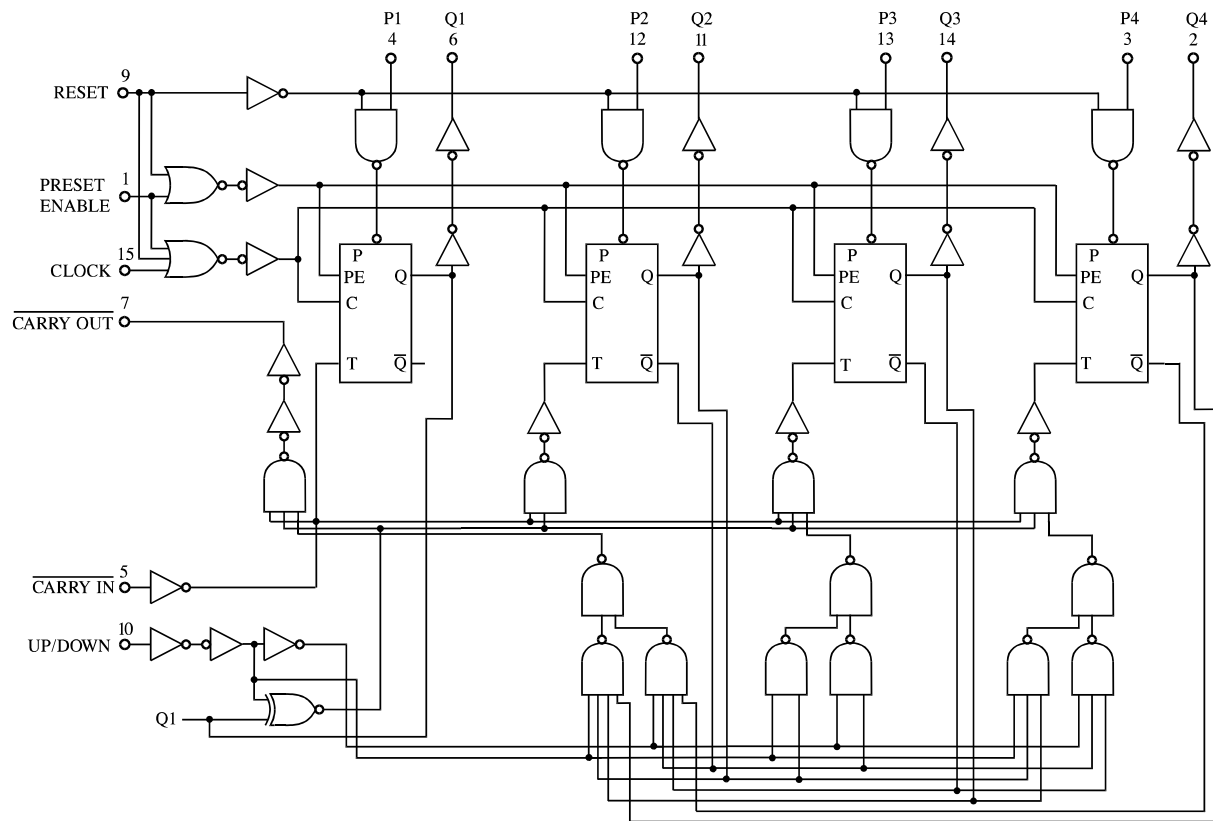


**Figure 1. Switching Waveforms**

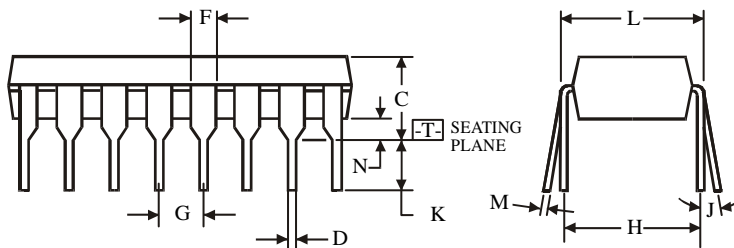
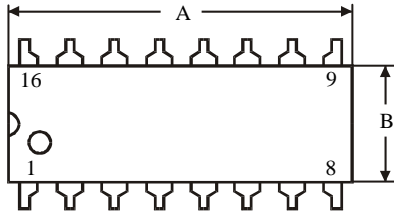
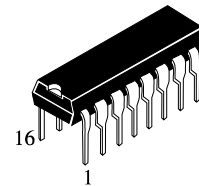
**TIMING DIAGRAM**



**EXPANDED LOGIC DIAGRAM**



### N SUFFIX PLASTIC DIP (MS - 001BB)



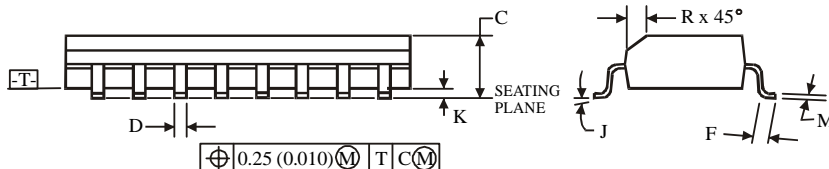
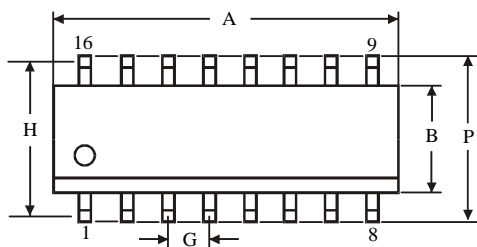
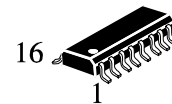
$\oplus 0.25 (0.010) \text{M} \text{T}$

#### NOTES:

- Dimensions "A", "B" do not include mold flash or protrusions.  
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

Symbol	Dimension, mm	
	MIN	MAX
A	18.67	19.69
B	6.1	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.2	0.36
N	0.38	

### D SUFFIX SOIC (MS - 012AC)



$\oplus 0.25 (0.010) \text{M} \text{T} \text{C} \text{M}$

#### NOTES:

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.

Symbol	Dimension, mm	
	MIN	MAX
A	9.8	10
B	3.8	4
C	1.35	1.75
D	0.33	0.51
F	0.4	1.27
G	1.27	
H	5.72	
J	0°	8°
K	0.1	0.25
M	0.19	0.25
P	5.8	6.2
R	0.25	0.5