HD14510B

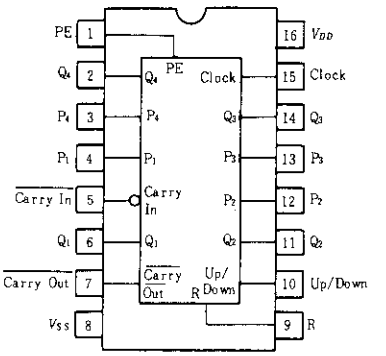
BCD Up/Down Counter

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

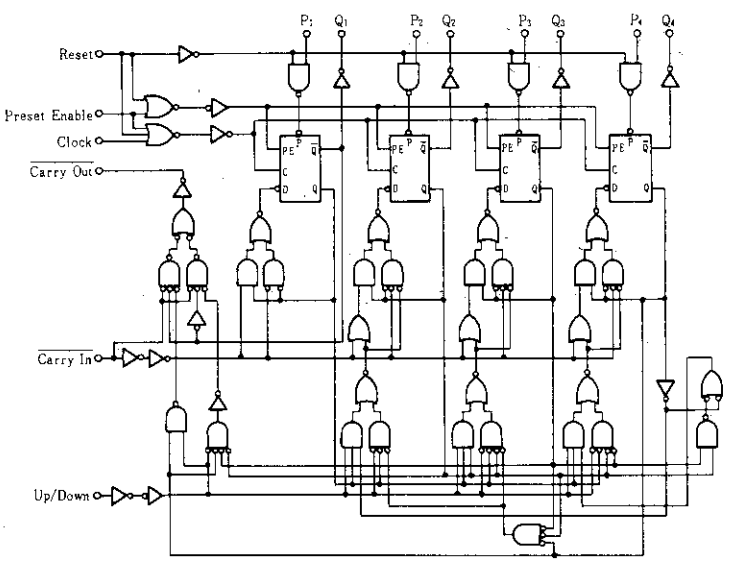
- Quiescent Current = 5nA/pkg typ. @5V
- Noise Immunity = 45% of V_{DD} typ.
- Supply Voltage Range = 3 to 18V
- Low Input Capacitance = 5pF typ.
- Internally Synchronous for High Speed
- Logic Edge-clocked Design ... Count Occurs on Positive Going Edge of Clock
- 5MHz Counting Rate
- Asynchronous Preset 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

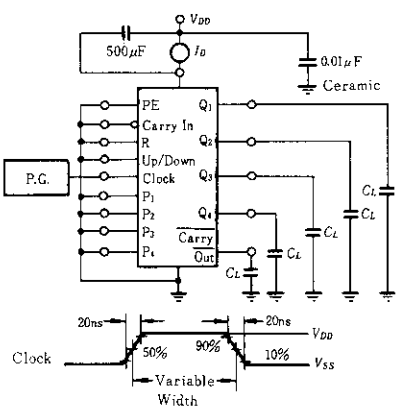
×=Don't Care

■ ELECTRICAL CHARACTERISTICS

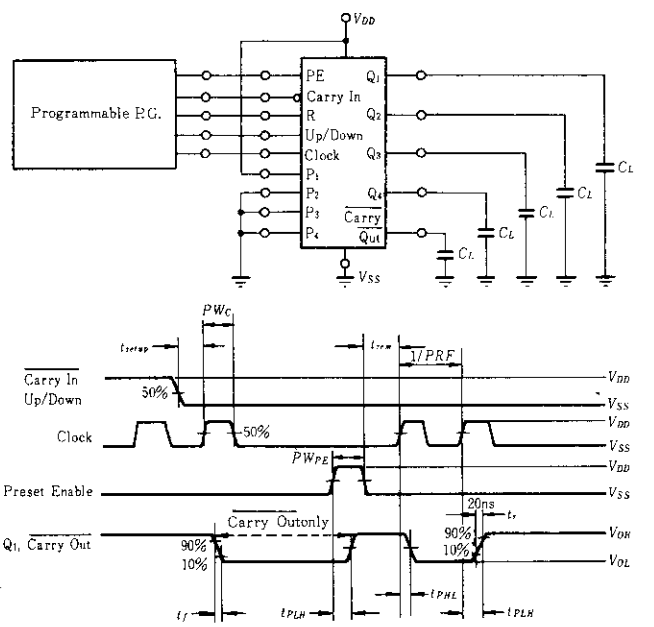
Characteristic	Symbol	V_{DD}(V)	Test Conditions	−40°C min	−40°C max	25°C min	25°C typ	25°C max	85°C min	85°C max	Unit
Output Voltage	V_{OL}	5.0	$V_{in}=V_{DD}$ or 0	—	0.05	—	0	0.05	—	0.05	V
		10		—	0.05	—	0	0.05	—	0.05	
		15		—	0.05	—	0	0.05	—	0.05	
	V_{OH}	5.0	$V_{in}=0$ or V_{DD}	4.95	—	4.95	5.0	—	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

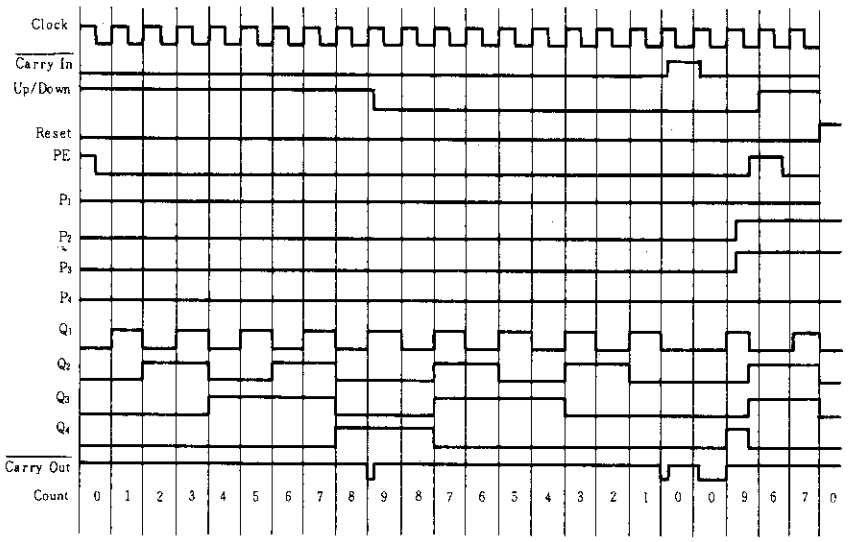


■ SWITCHING CHARACTERISTICS (C_L=50pF, Ta=25°C)

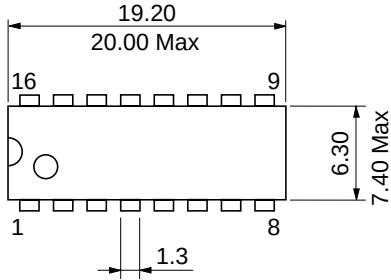
Characteristic		Symbol	V_{DD} (V)	min	typ	max	Unit
Output Rise Time		t_r	5.0	—	180	360	ns
			10	—	90	180	
			15	—	65	130	
Output Fall Time		t_f	5.0	—	120	250	ns
			10	—	60	125	
			15	—	40	100	
Propagation Delay Time	Clock to Q	t_{PLH}, t_{PHL}	5.0	—	315	630	ns
			10	—	130	260	
			15	—	100	200	
	Clock 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	

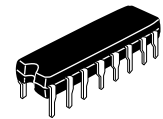
*The Preset or Reset Signal must be low prior to a positive-going transition of the clock.

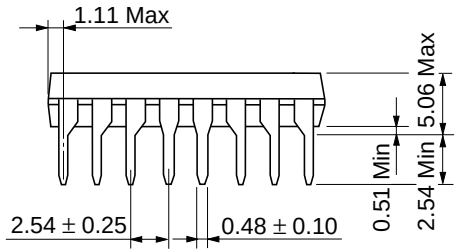
● TIMING DIAGRAM

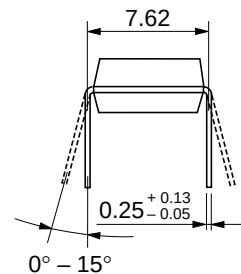


Unit: mm









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Weight (reference value)	1.07 g

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