HD14516B

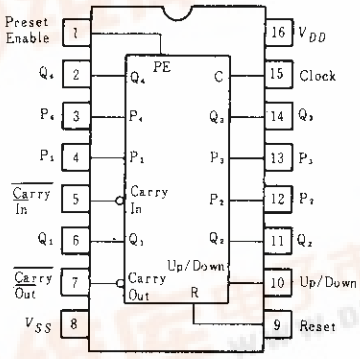
Binary Up/Down Counter

The HD14516B finds primary use where low power dissipation and/or high noise immunity is desired. This binary presettable up/down counter may be used as a counting/frequency synthesizer, in A/D and D/A conversion, for up/down counting, for magnitude and sign generation, and for difference counting.

■ FEATURES

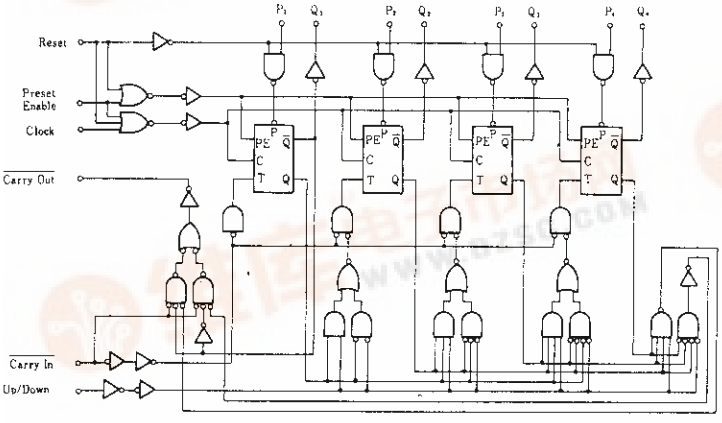
- Quiescent Current = 5nA/pkg typ. @5V
- Supply Voltage Range = 3 to 18V
  Internally Synchronous for High Speed
- Logic Edge-clocked Design ... Count Occurs on Positive Going Edge of Clock
- 6MHz Counting Rate (@10V)
- Single Pin Reset
- Asynchronous Preset Enable Operation
- Capable of Driving One Low-power Schottky TTL Load Over the Rated Temperature Range

■ PIN ARRANGEMENT

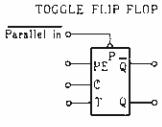


(Top View)

■ LOGIC DIAGRAM



TOGGLE FLIP FLOP



■ Flip-flop Functional Truth Table

Preset Enable	Clock	Toggle Enable	Q_{n+1}
1	×	×	Parallel in
0	↑	0	Q_n
0	↑	1	$\overline{Q_n}$
0	↓	×	Q_n

x = Don't Care

■ TRUTH TABLE

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

x = Don't Care

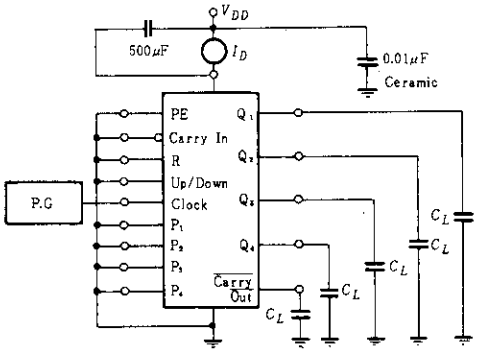
■ ELECTRICAL CHARACTERISTICS

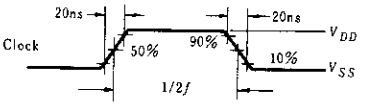
Characteristic	Symbol	V_{DD}(V)	Test Conditions	−40°C min	−40°C max	25°C min	25°C typ	25°C max	85°C min	85°C max	Unit
Output Voltage	V_{OL}	5.0	$V_{in}=V_{DD}$ or 0	—	0.05	—	0	0.05	—	0.05	V
		10		—	0.05	—	0	0.05	—	0.05	
		15		—	0.05	—	0	0.05	—	0.05	
	V_{OH}	5.0	$V_{in}=0$ or V_{DD}	4.95	—	4.95	5.0	—	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}, C_L=50pF, f=1kHz, per Gate	—	—	—	0.58	—	—	—	μA
		10		—	—	—	1.2	—	—	—	
		15		—	—	—	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



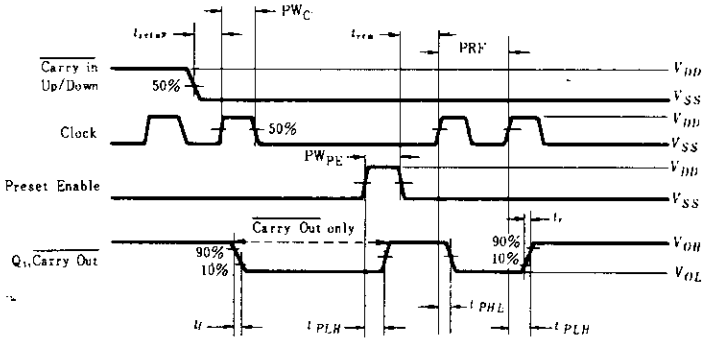


■SWITCHING CHARACTERISTICS (C_L=50pF, Ta=25°C)

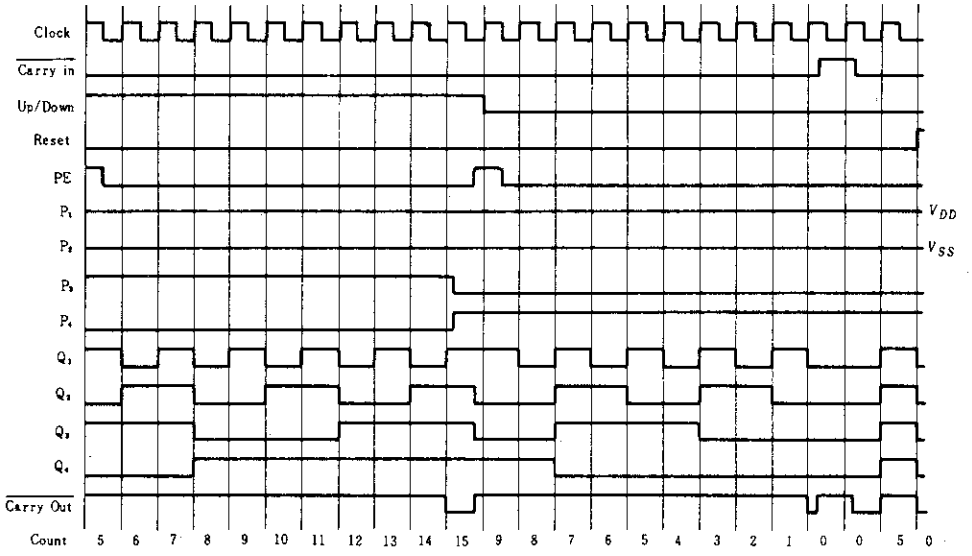
Characteristic		Symbol	V_{DD} (V)	min	typ	max	Unit
Output Rise Time		t_r	5.0	–	180	360	ns
			10	–	90	180	
			15	–	65	130	
Output Fall Time		t_f	5.0	–	100	200	ns
			10	–	50	100	
			15	–	40	80	
Propagation Delay Time	Clock-to-Q	t_{PLH} t_{PHL}	5.0	–	315	630	ns
			10	–	130	260	
			15	–	100	200	
	Clock-to-Carry Out		5.0	–	315	630	
			10	–	130	260	
			15	–	100	200	
	Carry In-to-Carry Out		5.0	–	180	360	
			10	–	80	160	
			15	–	60	120	
	Preset or Reset-to-Q		5.0	–	315	630	
			10	–	130	360	
			15	–	100	300	
	Preset or Reset-to-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	
Carry In Setup Time		t_{setup}	5.0	260	130	–	ns
			10	120	60	–	
			15	100	50	–	
Up/Down Setup Time			5.0	500	250	–	
			10	200	100	–	
			15	150	75	–	
Preset Enable Pulse Width		PW_{PE}	5.0	200	100	–	ns
			10	100	50	–	
			15	80	40	–	

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

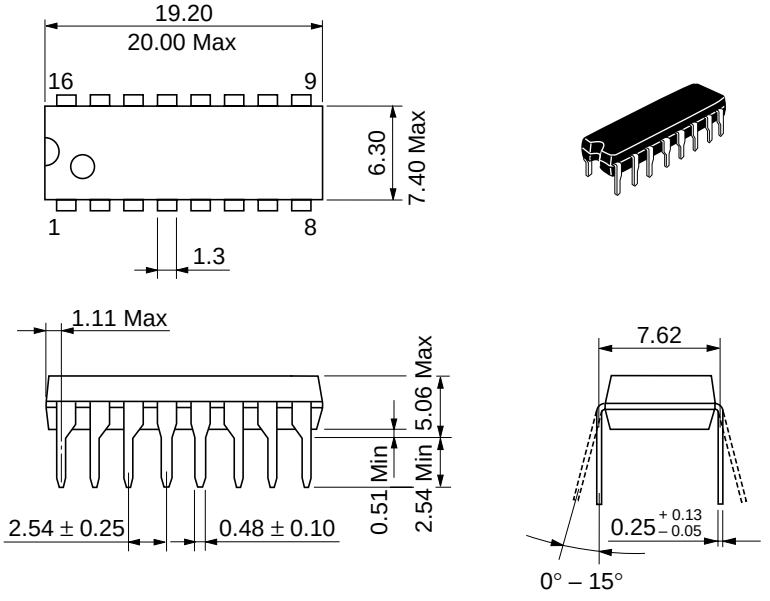
■DYNAMIC SIGNAL WAVEFORMS



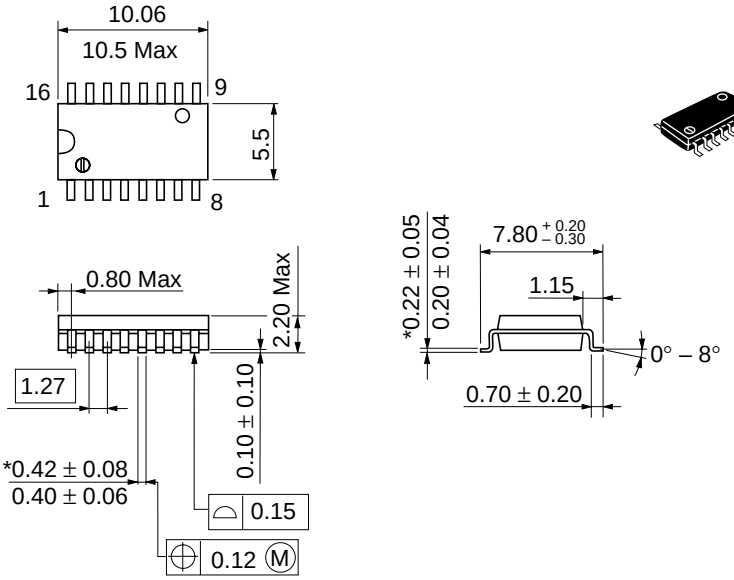
■TIMING DIAGRAM



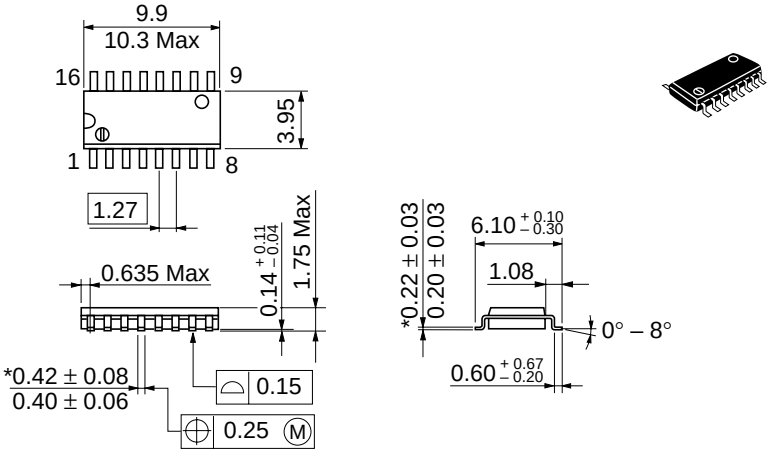
Unit: mm


19.20
20.00 Max
16
9
6.30
7.40 Max
1
8
1.3
1.11 Max
5.06 Max
0.51 Min
2.54 Min
2.54 ± 0.25
0.48 ± 0.10
7.62
0.25 + 0.13 − 0.05
0° – 15°

Unit: mm


10.06
10.5 Max
16
9
1
8
5.5
0.80 Max
2.20 Max
1.27
*0.42 ± 0.08
0.40 ± 0.06
0.10 ± 0.10
0.15
0.12 M
*0.22 ± 0.05
0.20 ± 0.04
7.80 +0.20 −0.30
1.15
0° – 8°
0.70 ± 0.20

Unit: mm


9.9
10.3 Max
16
9
1
8
3.95
1.27
0.635 Max
0.14 +0.11 −0.04
1.75 Max
*0.42 ± 0.08
0.40 ± 0.06
0.15
0.25 M
*0.22 ± 0.03
0.20 ± 0.03
6.10 +0.10 −0.30
1.08
0° – 8°
0.60 +0.67 −0.20

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