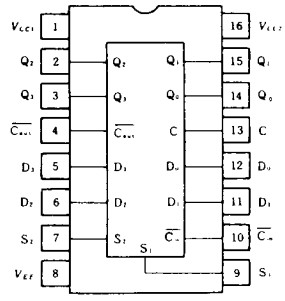
Universal Hexadecimal Counter

The HD10136 is a high speed synchronous counter that can count up, count down, preset, or stop count at frequencies exceeding 100MHz. The flexibility of this device allows the designer to use one basic counter for most applications, and the synchronous counter feature makes the HD10136 suitable for either computers or instrumentation.

Three control lines (S1, S2, and $\overline{\text{Carry In}}$) determine the operation mode of the counter. Lines S1 and S2 determine one of four operations; preset (program), increment (count up), decrement (count down), or hold (stop count). Note that in the preset mode a clock pulse is necessary to load the counter, and the information present on the data inputs(D0, D1, D2, and D3) will be entered into the counter. $\overline{\text{Carry Out}}$ goes low on the terminal count, or when the counter is being preset.

This device is not designed for use with gated clocks. Control is via S1 and S2.

■PIN ARRANGEMENT



(Top View)

■FUNCTION SELECT TABLE

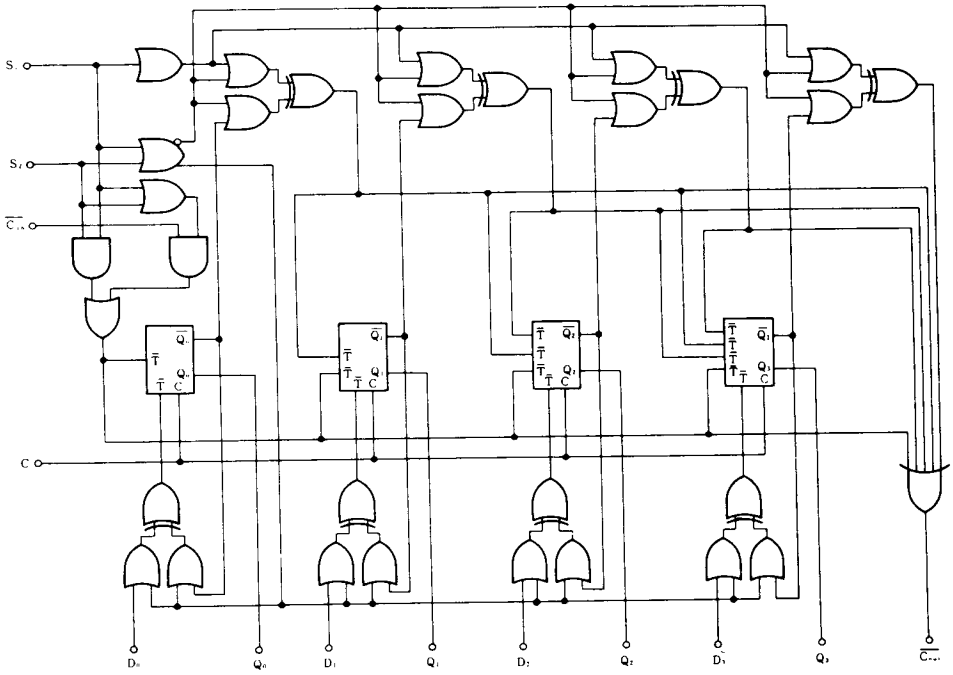
S_1	S_2	Operating Mode
L	L	Preset (Program)
L	H	Increment (Count Up)
H	L	Decrement (Count Down)
H	H	Hold (Stop Count)

■TRUTH TABLE

Inputs								Outputs				
S_1	S_2	D_0	D_1	D_2	D_3	$\overline{Cin}$	C	Q_0	Q_1	Q_2	Q_3	$\overline{Cout}$
L	L	L	L	H	H	×	↑	L	L	H	H	L
L	H	×	×	×	×	L	↑	H	L	H	H	H
L	H	×	×	×	×	L	↑	L	H	H	H	H
L	H	×	×	×	×	L	↑	H	H	H	H	L
L	H	×	×	×	×	H	L	H	H	H	H	H
L	H	×	×	×	×	H	↑	H	H	H	H	H
H	H	×	×	×	×	×	↑	H	H	H	H	H
L	L	H	H	L	L	×	↑	H	H	L	L	L
H	L	×	×	×	×	L	↑	L	H	L	L	H
H	L	×	×	×	×	L	↑	H	L	L	L	H
H	L	×	×	×	×	L	↑	L	L	L	L	L
H	L	×	×	×	×	L	↑	H	H	H	H	H

Notes) 1. × : Don't care.
2. A ↑ is defined as a clock input transition from a low to a high logic level.

■BLOCK DIAGRAM



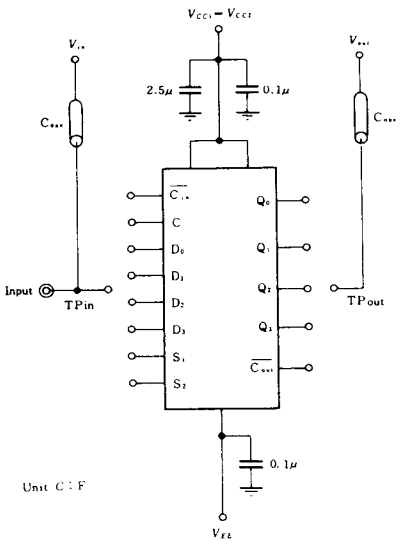
■DC CHARACTERISTICS ($V_{EE}=-5.2$V, $Ta=0\sim60$℃)

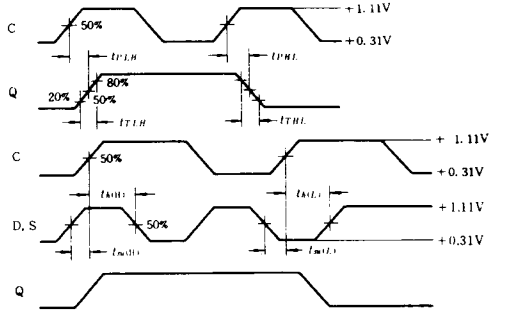
Item	Symbol	Test Condition			min	typ	max	Unit
Supply Current	I_{EE}			25℃	—	120	150	mA
Input Current	I_{IH}	$V_{IH}=-0.810$	D	25℃	—	—	220	μA
			S_2		—	—	265	
			S_1, $\overline{Cin}$		—	—	245	
			C		—	—	290	
	I_{IL}	$V_{IL}=-1.850$V		25℃	0.5	—	—	μA
Output Voltage	V_{OH}	$V_{IH}=-0.850$V or $V_{IL}=-1.870$V		0℃	−1.010	—	−0.850	V
		$V_{IH}=-0.810$V or $V_{IL}=-1.850$V		25℃	−0.960	—	−0.810	
		$V_{IH}=-0.750$V or $V_{IL}=-1.835$V		60℃	−0.920	—	−0.750	
	V_{OL}	$V_{IL}=-1.870$V or $V_{IH}=-0.850$V		0℃	−1.870	—	−1.660	V
		$V_{IL}=-1.850$V or $V_{IH}=-0.810$V		25℃	−1.850	—	−1.650	
		$V_{IL}=-1.835$V or $V_{IH}=-0.750$V		60℃	−1.835	—	−1.625	
Output Threshold Voltage	V_{OHA}	$V_{IHA}=-1.150$V or $V_{ILA}=-1.485$V		0℃	−1.025	—	—	V
		$V_{IHA}=-1.105$V or $V_{ILA}=-1.475$V		25℃	−0.980	—	—	
		$V_{IHA}=-1.065$V or $V_{ILA}=-1.455$V		60℃	−0.940	—	—	
	V_{OLA}	$V_{ILA}=-1.485$V or $V_{IHA}=-1.150$V		0℃	—	—	−1.640	V
		$V_{ILA}=-1.475$V or $V_{IHA}=-1.105$V		25℃	—	—	−1.630	
		$V_{ILA}=-1.455$V or $V_{IHA}=-1.065$V		60℃	—	—	−1.610	

■AC CHARACTERISTICS ($V_{EE}=-3.2V$, $V_{CC}=+2.0V$, $Ta=0\sim60℃$)

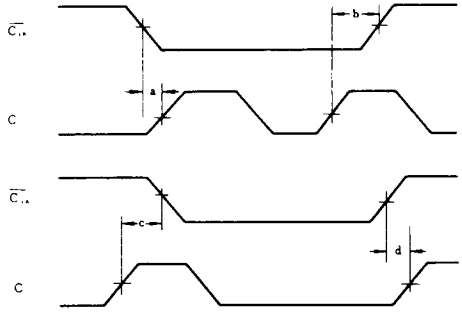
Item		Symbol	Input	Output	Test Condition		min	typ	max	Unit
Propagation Delay Time		t_{PLH}	C	Q	$R_L=50\Omega$	0℃	0.8	—	4.8	ns
						25℃	1.0	3.3	4.5	
						60℃	1.4	—	5.0	
		t_{PHL}				0℃	0.8	—	4.8	ns
						25℃	1.0	3.3	4.5	
						60℃	1.4	—	5.0	
		t_{PLH}	C	$\overline{Cout}$		0℃	2.0	—	10.9	ns
						25℃	2.5	7.0	10.5	
						60℃	2.4	—	11.5	
		t_{PHL}				0℃	2.0	—	10.9	ns
						25℃	2.5	7.0	10.5	
						60℃	2.4	—	11.5	
		t_{PLH}	$\overline{Cin}$	$\overline{Cout}$		0℃	1.6	—	7.4	ns
						25℃	1.6	5.0	6.9	
						60℃	1.9	—	7.5	
		t_{PHL}				0℃	1.6	—	7.4	ns
						25℃	1.6	5.0	6.9	
						60℃	1.9	—	7.5	
Setup Time		$t_{su(H)}$	D, C	Q		25℃	—	—	3.5	ns
		$t_{su(L)}$					—	—	3.5	ns
		t_{su}	S_1, C	Q			—	—	7.5	ns
			S_2, C	Q			—	—	7.5	
			$\overline{Cin}$, C	Q			—	—	3.7	
			C, $\overline{Cin}$	Q			—	—	−1.0	
Hold Time		$t_{h(H)}$	C, D	Q		25℃	—	—	−0.3	ns
		$t_{h(L)}$					—	—	−0.3	ns
		t_h	C, S_1	Q			—	—	−1.4	ns
			C, S_2	Q			—	—	−1.4	
			C, $\overline{Cin}$	Q			—	—	−1.1	
			$\overline{Cin}$, C	Q			—	—	3.1	
Count Frequency	Count Up	f_{count}	C	Q		0℃	125	—	—	MHz
						25℃	125	150	—	
						60℃	125	—	—	
	Count Down					0℃	125	—	—	
						25℃	125	150	—	
						60℃	125	—	—	
Rise Time		t_{TLH}	C	$\overline{Cout}$		0℃	0.9	—	3.3	ns
						25℃	1.1	2.0	3.3	
						60℃	1.1	—	3.5	
			C	Q		0℃	0.9	—	3.3	
						25℃	1.1	2.0	3.3	
						60℃	1.1	—	3.5	
Fall Time		t_{THL}	C	$\overline{Cout}$		0℃	0.9	—	3.3	ns
						25℃	1.1	2.0	3.3	
						60℃	1.1	—	3.5	
			C	Q		0℃	0.9	—	3.3	
						25℃	1.1	2.0	3.3	
						60℃	1.1	—	3.5	

■SWITCHING TIME TEST CIRCUIT





Notes)
1. 50Ω termination to ground located in each scope channel input. All input and output cables to the scope are equal lengths of 50Ω coaxial cable.
2. Wire length should be <6.35mm (1/4 inch) from TPin to input pin and TPout to output pin.
3. Unused outputs connected to a 50Ω resistor to ground.
4. t_{su} is the minimum time before the positive transition of the clock pulse that information must present at the data.
5. t_h is the minimum time after the positive transition of the clock pulse that information must remain unchanged at the data.



Notes)
1. (a) is the minimum time to wait after the counter has been enabled to clock it.
2. (b) is the minimum time before the counter has been disabled that it may be clocked.
3. (c) is the minimum time before the counter is enabled that a clock pulse may be applied with no effect on the state of the counter.
4. (d) is the minimum time to wait after the counter is disabled that a clock pulse may be applied with no effect in the state of the counter.
5. (b) and (c) may be negative numbers.