



# **AiP74HC/HCT190**

## **Presettable Synchronous BCD Decade up/down Counter**

### **Product Specification**

**Specification Revision History:**

<b>Version</b>	<b>Date</b>	<b>Description</b>
2012-06-A1	2012-06	New
2023-04-B1	2023-04	Update the template



# Contents

<b>1、 General Description.....</b>	<b>3</b>
<b>2、 Block Diagram And Pin Description .....</b>	<b>6</b>
2.1、 Block Diagram .....	6
2.2、 Pin Configurations.....	9
2.3、 Pin Description .....	9
2.4、 Function Table.....	9
<b>3、 Electrical Parameter .....</b>	<b>10</b>
3.1、 Absolute Maximum Ratings.....	10
3.2、 Recommended Operating Conditions .....	11
3.3、 Electrical Characteristics .....	11
3.3.1、 DC Characteristics 1 .....	11
3.3.2、 DC Characteristics 2 .....	12
3.3.3、 DC Characteristics 3 .....	13
3.3.4、 AC Characteristics 1 .....	14
3.3.5、 AC Characteristics 2 .....	16
3.3.6、 AC Characteristics 3 .....	18
<b>4、 Testing Circuit .....</b>	<b>21</b>
4.1、 AC Testing Circuit .....	21
4.2、 AC Testing Waveforms.....	21
4.3、 Measurement Points .....	24
4.4、 Test Data .....	24
<b>5、 Package Information .....</b>	<b>25</b>
5.1、 DIP16 .....	25
5.2、 SOP16 .....	26
5.3、 TSSOP16.....	27
<b>6、 Statements And Notes .....</b>	<b>28</b>
6.1、 The name and content of Hazardous substances or Elements in the product .....	28
6.2、 Notes .....	28



## 1、 General Description

The AiP74HC/HCT190 are asynchronously presettable up/down BCD decade counters. They contain four master/slave flip-flops with internal gating and steering logic to provide asynchronous preset and synchronous count-up and count-down operation.

Asynchronous parallel load capability permits the counter to be preset to any desired number. Information present on the parallel data inputs (D0 to D3) is loaded into the counter and appears on the outputs when the parallel load ( $\overline{PL}$ ) input is LOW. As indicated in the function table, this operation overrides the counting function.

Counting is inhibited by a HIGH level on the count enable ( $\overline{CE}$ ) input. When  $\overline{CE}$  is LOW internal state changes are initiated synchronously by the LOW-to-HIGH transition of the clock input. The up/down ( $\overline{U/D}$ ) input signal determines the direction of counting as indicated in the function table. The  $\overline{CE}$  input may go LOW when the clock is in either state, however, the LOW-to-HIGH  $\overline{CE}$  transition must occur only when the clock is HIGH. Also, the  $\overline{U/D}$  input should be changed only when either  $\overline{CE}$  or CP is HIGH.

Overflow/underflow indications are provided by two types of outputs, the terminal count (TC) and ripple clock ( $\overline{RC}$ ). The TC output is normally LOW and goes HIGH when a circuit reaches zero in the count-down mode or reaches “9” in the count-up-mode. The TC output will remain HIGH until a state change occurs, either by counting or presetting, or until  $\overline{U/D}$  is changed. Do not use the TC output as a clock signal because it is subject to decoding spikes. The TC signal is used internally to enable the  $\overline{RC}$  output. When TC is HIGH and  $\overline{CE}$  is LOW, the  $\overline{RC}$  output follows the clock pulse (CP). This feature simplifies the design of multistage counters as shown in Figure 5 and 6.

In Figure 5, each  $\overline{RC}$  output is used as the clock input to the next higher stage. It is only necessary to inhibit the first stage to prevent counting in all stages, since a HIGH on  $\overline{CE}$  inhibits the  $\overline{RC}$  output pulse as indicated in the function table. The timing skew between state changes in the first and last stages is represented by the cumulative delay of the clock as it ripples through the preceding stages. This can be a disadvantage of this configuration in some applications.

Figure 6 shows a method of causing state changes to occur simultaneously in all stages. The  $\overline{RC}$  outputs propagate the carry/borrow signals in ripple fashion and all clock inputs are driven in parallel. In this configuration the duration of the clock LOW state must be long enough to allow the negative-going edge of the carry/borrow signal to ripple through to the last stage before the clock goes HIGH. Since the  $\overline{RC}$  output of any package goes HIGH shortly after its CP input goes HIGH there is no such restriction on the HIGH-state duration of the clock.

In Figure.7, the configuration shown avoids ripple delays and their associated restrictions. Combining the TC signals from all the preceding stages forms the  $\overline{CE}$  input for a given stage. An enable must be included in each carry gate in order to inhibit counting. The TC output of a given stage is not affected by its own  $\overline{CE}$  signal therefore the simple inhibit scheme of Figure 5 and 6 does not apply.

**Features:**

- Input levels:
  - For AiP74HC190: CMOS level
  - For AiP74HCT190: TTL level
- Synchronous reversible counting
- Asynchronous parallel load
- Count enable control for synchronous expansion
- Single up/down control input
- Specified from -40°C to +125°C
- Packaging information: DIP16/SOP16/TSSOP16

**Ordering Information:****Tube packing specifications:**

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP74HC190DA16.TB	DIP16	74HC190	25 PCS/tube	40 tube/box	1000 PCS/box	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing: 2.54mm
AiP74HCT190DA16.TB	DIP16	74HCT190	25 PCS/tube	40 tube/box	1000 PCS/box	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing: 2.54mm
AiP74HC190SA16.TB	SOP16	74HC190	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing: 1.27mm
AiP74HCT190SA16.TB	SOP16	74HCT190	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing: 1.27mm
AiP74HC190TA16.TB	TSSOP16	74HC190	96 PCS/tube	200 tube/box	19200 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing: 0.65mm
AiP74HCT190TA16.TB	TSSOP16	74HCT190	96 PCS/tube	200 tube/box	19200 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing: 0.65mm

**Reel packing specifications:**

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP74HC190SA16.TR	SOP16	74HC190	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
AiP74HCT190SA16.TR	SOP16	74HCT190	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
AiP74HC190TA16.TR	TSSOP16	74HC190	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing:0.65mm
AiP74HCT190TA16.TR	TSSOP16	74HCT190	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing:0.65mm

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.



## 2、Block Diagram And Pin Description

### 2.1、Block Diagram

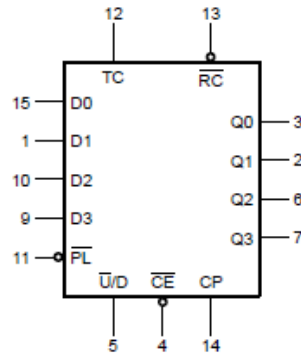


Figure 1. Logic symbol

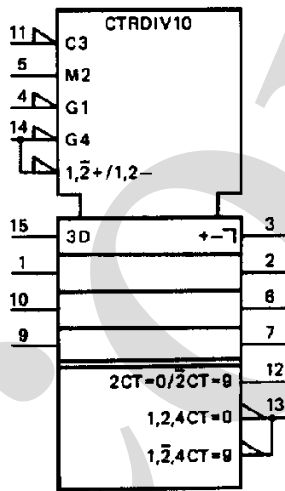


Figure 2. IEC logic symbol

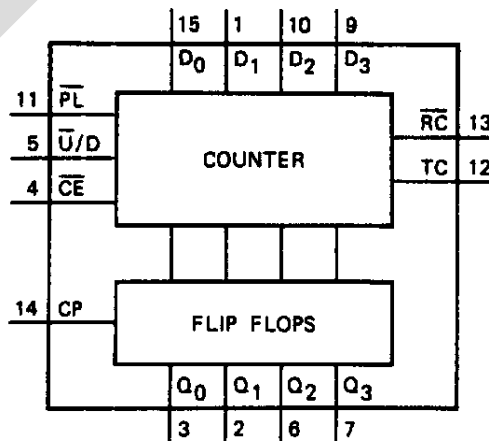


Figure 3. Functional diagram

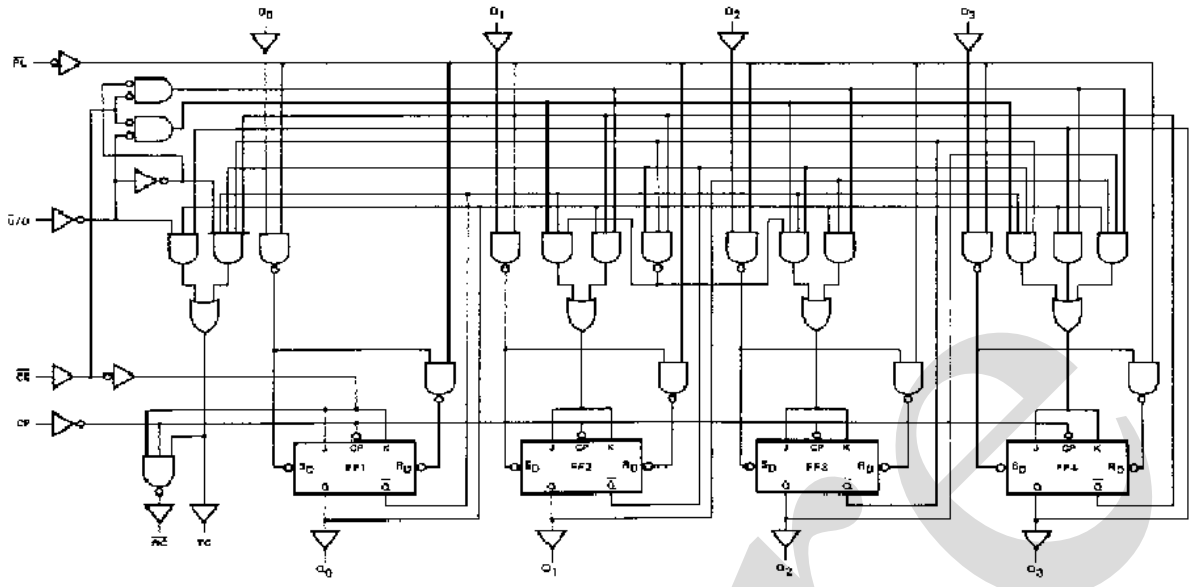


Figure 4. Logic diagram

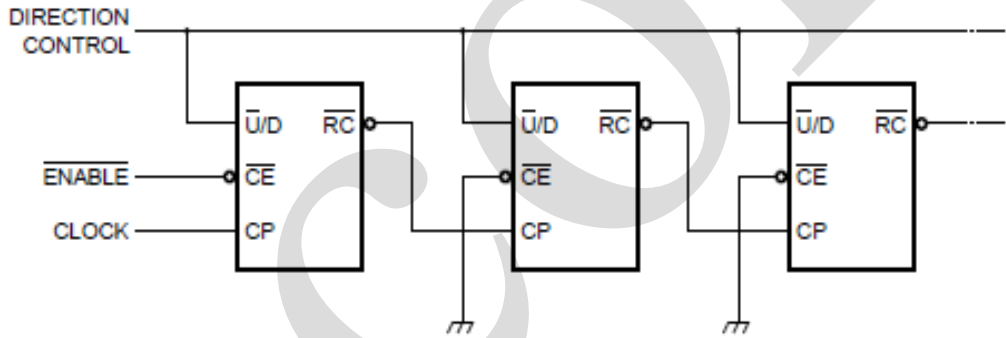


Figure 5. N-stage ripple counter using ripple clock

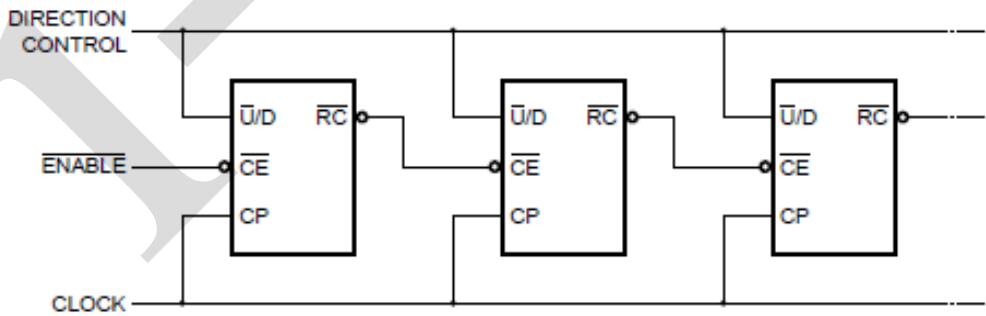


Figure 6. Synchronous n-stage counter using ripple carry/borrow

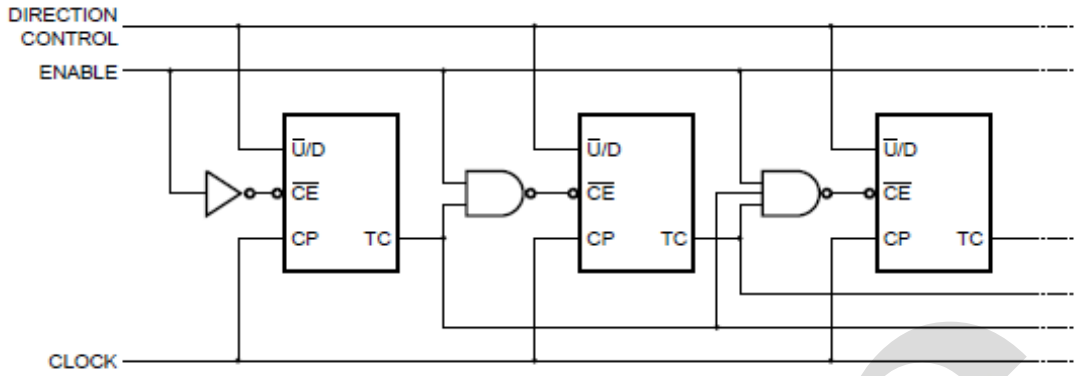


Figure 7. Synchronous n-stage counter with parallel gated carry/borrow

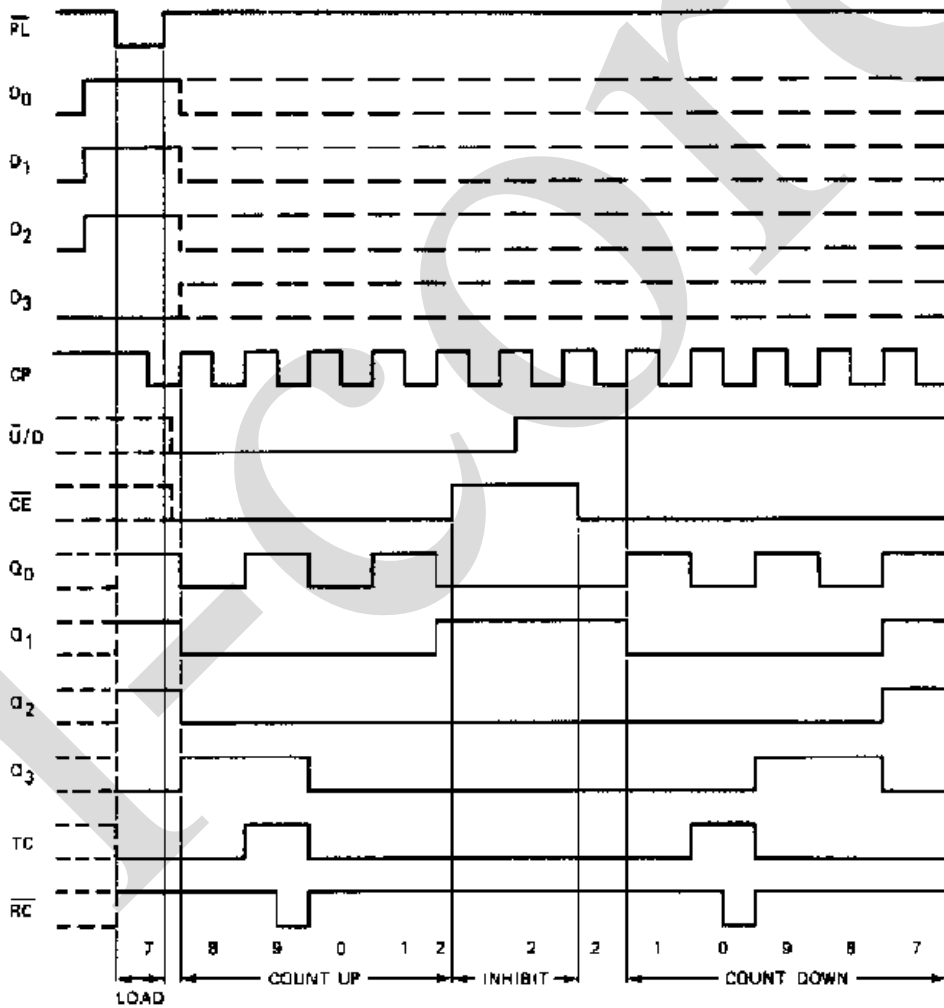
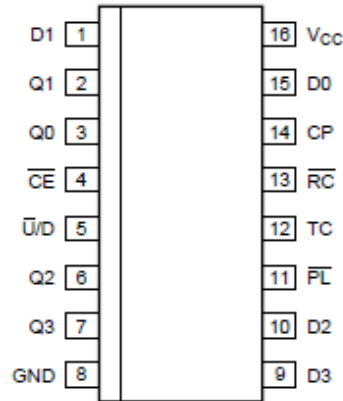


Figure 8. Typical timing sequence





## 2.2、Pin Configurations



## 2.3、Pin Description

Pin No.	Pin Name	Description
1	D1	data input
2	Q1	flip-flop output
3	Q0	flip-flop output
4	$\overline{\text{CE}}$	count enable input (active LOW)
5	$\overline{\text{U/D}}$	up/down input
6	Q2	flip-flop output
7	Q3	flip-flop output
8	GND	ground (0V)
9	D3	data input
10	D2	data input
11	$\overline{\text{PL}}$	parallel load input (active LOW)
12	TC	terminal count output
13	$\overline{\text{RC}}$	ripple clock output (active LOW)
14	CP	clock input (LOW-to-HIGH, edge-triggered)
15	D0	data input
16	V <sub>CC</sub>	supply voltage

## 2.4、Function Table

Operating mode	Input					Output
	$\overline{\text{PL}}$	$\overline{\text{U/D}}$	$\overline{\text{CE}}$	CP	D <sub>n</sub>	Q <sub>n</sub>
parallel load	L	X	X	X	L	L
	L	X	X	X	H	H
count up	H	L	1	↑	X	count up
count down	H	H	1	↑	X	count down
hold (do nothing)	H	X	H	X	X	no change

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care; ↑=LOW-to-HIGH clock transition;  
 1=LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition.



Input			Terminal count state				Output	
$\bar{U}/D$	$\bar{CE}$	CP	Q0	Q1	Q2	Q3	TC	$\bar{RC}$
H	H	X	H	X	X	H	L	H
L	H	X	H	X	X	H	H	H
L	L		H	X	X	H		
L	H	X	L	L	L	L	L	H
H	H	X	L	L	L	L	H	H
H	L		L	L	L	L		

Note:

[1] H=HIGH voltage level; L=LOW voltage level; X=don't care.

[2] =one LOW level output pulse.

[3] =TC goes LOW on a LOW-to-HIGH clock transition.

### 3、Electrical Parameter

#### 3.1、Absolute Maximum Ratings

(Voltages are referenced to GND(ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Max.	Unit
supply voltage	$V_{CC}$	-	-0.5	+7.0	V
input clamping current	$I_{IK}$	$V_I < -0.5V$ or $V_I > V_{CC}+0.5V$	-	$\pm 20$	mA
output clamping current	$I_{OK}$	$V_O < -0.5V$ or $V_O > V_{CC}+0.5V$	-	$\pm 20$	mA
output current	$I_O$	$V_O = -0.5V$ to $V_{CC}+0.5V$	-	$\pm 25$	mA
supply current	$I_{CC}$	-	-	+50	mA
ground current	$I_{GND}$	-	-50	-	mA
storage temperature	$T_{stg}$	-	-65	+150	°C
total power dissipation	$P_{tot}$	-	-	500	mW
Soldering temperature	$T_L$	10s	DIP		°C
			SOP/TSSOP		
			245		
			260		



### 3.2、Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>AiP74HC190</b>						
supply voltage	$V_{CC}$	-	2.0	5.0	6.0	V
input voltage	$V_I$	-	0	-	$V_{CC}$	V
output voltage	$V_O$	-	0	-	$V_{CC}$	V
input transition rise and fall rate	$\Delta t/\Delta V$	$V_{CC}=2.0V$	-	-	625	ns/V
		$V_{CC}=4.5V$	-	1.67	139	ns/V
		$V_{CC}=6.0V$	-	-	83	ns/V
ambient temperature	$T_{amb}$	-	-40	-	+125	°C
<b>AiP74HCT190</b>						
supply voltage	$V_{CC}$	-	4.5	5.0	5.5	V
input voltage	$V_I$	-	0	-	$V_{CC}$	V
output voltage	$V_O$	-	0	-	$V_{CC}$	V
input transition rise and fall rate	$\Delta t/\Delta V$	$V_{CC}=2.0V$	-	-	-	ns/V
		$V_{CC}=4.5V$	-	1.67	139	ns/V
		$V_{CC}=6.0V$	-	-	-	ns/V
ambient temperature	$T_{amb}$	-	-40	-	+125	°C

### 3.3、Electrical Characteristics

#### 3.3.1、DC Characteristics 1

( $T_{amb}=25^{\circ}C$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
<b>AiP74HC190</b>							
HIGH-level input voltage	$V_{IH}$	$V_{CC}=2.0V$	1.5	1.2	-	V	
		$V_{CC}=4.5V$	3.15	2.4	-	V	
		$V_{CC}=6.0V$	4.2	3.2	-	V	
LOW-level input voltage	$V_{IL}$	$V_{CC}=2.0V$	-	0.8	0.5	V	
		$V_{CC}=4.5V$	-	2.1	1.35	V	
		$V_{CC}=6.0V$	-	2.8	1.8	V	
HIGH-level output voltage	$V_{OH}$	$V_I = V_{IH} \text{ or } V_{IL}$	$I_O=-20\mu A; V_{CC}=2.0V$	1.9	2.0	-	V
			$I_O=-20\mu A; V_{CC}=4.5V$	4.4	4.5	-	V
			$I_O=-20\mu A; V_{CC}=6.0V$	5.9	6.0	-	V
			$I_O=-4.0mA; V_{CC}=4.5V$	3.98	4.32	-	V
			$I_O=-5.2mA; V_{CC}=6.0V$	5.48	5.81	-	V
LOW-level output voltage	$V_{OL}$	$V_I = V_{IH} \text{ or } V_{IL}$	$I_O=20\mu A; V_{CC}=2.0V$	-	0	0.1	V
			$I_O=20\mu A; V_{CC}=4.5V$	-	0	0.1	V
			$I_O=20\mu A; V_{CC}=6.0V$	-	0	0.1	V
			$I_O=4.0mA; V_{CC}=4.5V$	-	0.15	0.26	V
			$I_O=5.2mA; V_{CC}=6.0V$	-	0.16	0.26	V
input leakage current	$I_I$	$V_I=V_{CC} \text{ or } GND; V_{CC}=6.0V$	-	-	$\pm 1.0$	$\mu A$	
supply current	$I_{CC}$	$V_I=V_{CC} \text{ or } GND; I_O=0A; V_{CC}=6.0V$	-	-	8.0	$\mu A$	
input	$C_I$	-	-	3.5	-	pF	



capacitance							
<b>AiP74HCT190</b>							
HIGH-level input voltage	$V_{IH}$	$V_{CC}=4.5V$ to $5.5V$	2.0	1.6	-	V	
LOW-level input voltage	$V_{IL}$	$V_{CC}=4.5V$ to $5.5V$	-	1.2	0.8	V	
HIGH-level output voltage	$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}; V_{CC}=4.5V$	$I_O=-20\mu A$	4.4	4.5	-	V
			$I_O=-4.0mA$	3.98	4.32	-	V
LOW-level output voltage	$V_{OL}$	$V_I = V_{IH}$ or $V_{IL}; V_{CC}=4.5V$	$I_O=20\mu A$	-	0	0.1	V
			$I_O=4.0mA$	-	0.16	0.26	V
input leakage current	$I_I$	$V_I=V_{CC}$ or GND; $V_{CC}=5.5V$	-	-	$\pm 1.0$	$\mu A$	
supply current	$I_{CC}$	$V_I=V_{CC}$ or GND; $I_O=0A; V_{CC}=5.5V$	-	-	8.0	$\mu A$	
additional supply current	$\Delta I_{CC}$	$V_I=V_{CC}-2.1V;$ other inputs at $V_{CC}$ or GND; $I_O=0A;$ $V_{CC}=4.5V$ to $5.5V$	-	-	360	$\mu A$	
input capacitance	$C_I$	-	-	3.5	-	pF	

### 3.3.2、DC Characteristics 2

( $T_{amb}=-40^{\circ}C$  to  $+85^{\circ}C$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
<b>AiP74HC190</b>							
HIGH-level input voltage	$V_{IH}$	$V_{CC}=2.0V$	1.5	-	-	V	
		$V_{CC}=4.5V$	3.15	-	-	V	
		$V_{CC}=6.0V$	4.2	-	-	V	
LOW-level input voltage	$V_{IL}$	$V_{CC}=2.0V$	-	-	0.5	V	
		$V_{CC}=4.5V$	-	-	1.35	V	
		$V_{CC}=6.0V$	-	-	1.8	V	
HIGH-level output voltage	$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}$	$I_O=-20\mu A; V_{CC}=2.0V$	1.9	-	-	V
			$I_O=-20\mu A; V_{CC}=4.5V$	4.4	-	-	V
			$I_O=-20\mu A; V_{CC}=6.0V$	5.9	-	-	V
			$I_O=-4.0mA; V_{CC}=4.5V$	3.84	-	-	V
			$I_O=-5.2mA; V_{CC}=6.0V$	5.34	-	-	V
LOW-level output voltage	$V_{OL}$	$V_I = V_{IH}$ or $V_{IL}$	$I_O=20\mu A; V_{CC}=2.0V$	-	-	0.1	V
			$I_O=20\mu A; V_{CC}=4.5V$	-	-	0.1	V
			$I_O=20\mu A; V_{CC}=6.0V$	-	-	0.1	V
			$I_O=4.0mA; V_{CC}=4.5V$	-	-	0.33	V
			$I_O=5.2mA; V_{CC}=6.0V$	-	-	0.33	V
input leakage current	$I_I$	$V_I=V_{CC}$ or GND; $V_{CC}=6.0V$	-	-	$\pm 1.0$	$\mu A$	
supply current	$I_{CC}$	$V_I=V_{CC}$ or GND; $I_O=0A; V_{CC}=6.0V$	-	-	80	$\mu A$	
<b>AiP74HCT190</b>							
HIGH-level input voltage	$V_{IH}$	$V_{CC}=4.5V$ to $5.5V$	2.0	-	-	V	
LOW-level input voltage	$V_{IL}$	$V_{CC}=4.5V$ to $5.5V$	-	-	0.8	V	



HIGH-level output voltage	$V_{OH}$	$V_I = V_{IH} \text{ or } V_{IL}; V_{CC}=4.5V$	$I_O=-20\mu A$	4.4	-	-	V
			$I_O=-4.0mA$	3.84	-	-	V
LOW-level output voltage	$V_{OL}$	$V_I = V_{IH} \text{ or } V_{IL}; V_{CC}=4.5V$	$I_O=20\mu A$	-	-	0.1	V
			$I_O=4.0mA$	-	-	0.33	V
input leakage current	$I_I$	$V_I=V_{CC} \text{ or } GND; V_{CC}=5.5V$		-	-	$\pm 1.0$	$\mu A$
supply current	$I_{CC}$	$V_I=V_{CC} \text{ or } GND; I_O=0A; V_{CC}=5.5V$		-	-	80	$\mu A$
additional supply current	$\Delta I_{CC}$	$V_I=V_{CC}-2.1V;$ other inputs at $V_{CC} \text{ or } GND; I_O=0A;$ $V_{CC}=4.5V \text{ to } 5.5V$		-	-	450	$\mu A$

### 3.3.3、DC Characteristics 3

( $T_{amb}=-40^{\circ}C$  to  $+125^{\circ}C$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
<b>AiP74HC190</b>							
HIGH-level input voltage	$V_{IH}$	$V_{CC}=2.0V$	1.5	-	-	V	
		$V_{CC}=4.5V$	3.15	-	-	V	
		$V_{CC}=6.0V$	4.2	-	-	V	
LOW-level input voltage	$V_{IL}$	$V_{CC}=2.0V$	-	-	0.5	V	
		$V_{CC}=4.5V$	-	-	1.35	V	
		$V_{CC}=6.0V$	-	-	1.8	V	
HIGH-level output voltage	$V_{OH}$	$V_I = V_{IH} \text{ or } V_{IL}$	$I_O=-20\mu A; V_{CC}=2.0V$	1.9	-	-	V
			$I_O=-20\mu A; V_{CC}=4.5V$	4.4	-	-	V
			$I_O=-20\mu A; V_{CC}=6.0V$	5.9	-	-	V
			$I_O=-4.0mA; V_{CC}=4.5V$	3.7	-	-	V
			$I_O=-5.2mA; V_{CC}=6.0V$	5.2	-	-	V
LOW-level output voltage	$V_{OL}$	$V_I = V_{IH} \text{ or } V_{IL}$	$I_O=20\mu A; V_{CC}=2.0V$	-	-	0.1	V
			$I_O=20\mu A; V_{CC}=4.5V$	-	-	0.1	V
			$I_O=20\mu A; V_{CC}=6.0V$	-	-	0.1	V
			$I_O=4.0mA; V_{CC}=4.5V$	-	-	0.4	V
			$I_O=5.2mA; V_{CC}=6.0V$	-	-	0.4	V
input leakage current	$I_I$	$V_I=V_{CC} \text{ or } GND; V_{CC}=6.0V$		-	-	$\pm 1.0$	$\mu A$
supply current	$I_{CC}$	$V_I=V_{CC} \text{ or } GND; I_O=0A; V_{CC}=6.0V$		-	-	160	$\mu A$
<b>AiP74HCT190</b>							
HIGH-level input voltage	$V_{IH}$	$V_{CC}=4.5V \text{ to } 5.5V$		2.0	-	-	V
LOW-level input voltage	$V_{IL}$	$V_{CC}=4.5V \text{ to } 5.5V$		-	-	0.8	V
HIGH-level output voltage	$V_{OH}$	$V_I = V_{IH} \text{ or } V_{IL}; V_{CC}=4.5V$	$I_O=-20\mu A$	4.4	-	-	V
			$I_O=-4.0mA$	3.7	-	-	V
LOW-level output voltage	$V_{OL}$	$V_I = V_{IH} \text{ or } V_{IL}; V_{CC}=4.5V$	$I_O=20\mu A$	-	-	0.1	V
			$I_O=4.0mA$	-	-	0.4	V
input leakage current	$I_I$	$V_I=V_{CC} \text{ or } GND; V_{CC}=5.5V$		-	-	$\pm 1.0$	$\mu A$
supply current	$I_{CC}$	$V_I=V_{CC} \text{ or } GND; I_O=0A; V_{CC}=5.5V$		-	-	160	$\mu A$
additional	$\Delta I_{CC}$	$V_I=V_{CC}-2.1V;$		-	-	490	$\mu A$



supply current		other inputs at $V_{CC}$ or GND; $I_O=0A$ ; $V_{CC}=4.5V$ to $5.5V$			
----------------	--	--	--	--	--

### 3.3.4、AC Characteristics 1

( $T_{amb}=25^{\circ}C$ , GND=0V;  $t_r=t_f=6ns$ ;  $C_L=50pF$ , unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
<b>AiP74HC190</b>							
propagation delay	$t_{pd}$	CP to Qn; see Figure 10	$V_{CC}=2.0V$	-	72	220	ns
			$V_{CC}=4.5V$	-	26	44	ns
			$V_{CC}=5.0V$ ; $C_L=15pF$	-	22	-	ns
		CP to TC; see Figure 10	$V_{CC}=2.0V$	-	83	255	ns
			$V_{CC}=4.5V$	-	30	51	ns
			$V_{CC}=6.0V$	-	24	43	ns
		CP to $\bar{RC}$ ; see Figure 11	$V_{CC}=2.0V$	-	44	150	ns
			$V_{CC}=4.5V$	-	16	30	ns
			$V_{CC}=6.0V$	-	13	26	ns
		$\bar{CE}$ to $\bar{RC}$ ; see Figure 11	$V_{CC}=2.0V$	-	33	130	ns
			$V_{CC}=4.5V$	-	12	26	ns
			$V_{CC}=6.0V$	-	10	22	ns
		Dn to Qn; see Figure 12	$V_{CC}=2.0V$	-	63	220	ns
			$V_{CC}=4.5V$	-	23	44	ns
			$V_{CC}=6.0V$	-	18	37	ns
		$\bar{PL}$ to Qn; see Figure 13	$V_{CC}=2.0V$	-	63	220	ns
			$V_{CC}=4.5V$	-	23	44	ns
			$V_{CC}=6.0V$	-	18	37	ns
		$\bar{U/D}$ to TC; see Figure 14	$V_{CC}=2.0V$	-	44	190	ns
			$V_{CC}=4.5V$	-	16	38	ns
			$V_{CC}=6.0V$	-	13	32	ns
		$\bar{U/D}$ to $\bar{RC}$ ; see Figure 14	$V_{CC}=2.0V$	-	50	210	ns
			$V_{CC}=4.5V$	-	18	42	ns
			$V_{CC}=6.0V$	-	14	36	ns
transition time	$t_t$	see Figure 15	$V_{CC}=2.0V$	-	19	75	ns
			$V_{CC}=4.5V$	-	7	15	ns
			$V_{CC}=6.0V$	-	6	13	ns
pulse width	$t_w$	CP; HIGH or LOW; see Figure 10	$V_{CC}=2.0V$	155	28	-	ns
			$V_{CC}=4.5V$	31	10	-	ns
			$V_{CC}=6.0V$	26	8	-	ns
		$\bar{PL}$ ; LOW; see Figure 15	$V_{CC}=2.0V$	100	25	-	ns
			$V_{CC}=4.5V$	20	9	-	ns
recovery time	$t_{rec}$	$\bar{PL}$ to CP; see Figure 15	$V_{CC}=2.0V$	35	8	-	ns
			$V_{CC}=4.5V$	7	3	-	ns
			$V_{CC}=6.0V$	6	2	-	ns
set-up time	$t_{su}$	$\bar{U/D}$ to CP;	$V_{CC}=2.0V$	205	61	-	ns



		see Figure 16	$V_{CC}=4.5V$	41	22	-	ns
			$V_{CC}=6.0V$	35	18	-	ns
		Dn to $\overline{PL}$ ; see Figure 17	$V_{CC}=2.0V$	100	19	-	ns
			$V_{CC}=4.5V$	20	7	-	ns
			$V_{CC}=6.0V$	17	6	-	ns
		$\overline{CE}$ to CP; see Figure 16	$V_{CC}=2.0V$	140	39	-	ns
			$V_{CC}=4.5V$	28	14	-	ns
			$V_{CC}=6.0V$	24	11	-	ns
		hold time	$t_h$	$\overline{U/D}$ to CP; see Figure 16	$V_{CC}=2.0V$	0	-44
$V_{CC}=4.5V$	0				-16	-	ns
$V_{CC}=6.0V$	0				-13	-	ns
Dn to $\overline{PL}$ ; see Figure 17	$V_{CC}=2.0V$			0	-14	-	ns
	$V_{CC}=4.5V$			0	-5	-	ns
	$V_{CC}=6.0V$			0	-4	-	ns
$\overline{CE}$ to CP; see Figure 16	$V_{CC}=2.0V$			0	-19	-	ns
	$V_{CC}=4.5V$			0	-7	-	ns
	$V_{CC}=6.0V$			0	-6	-	ns
maximum frequency	$f_{max}$	CP; see Figure 10	$V_{CC}=2.0V$	3.0	8.3	-	MHz
			$V_{CC}=4.5V$	15	25	-	MHz
			$V_{CC}=5.0V; C_L=15pF$	-	28	-	MHz
			$V_{CC}=6.0V$	18	30	-	MHz
power dissipation capacitance	$C_{PD}$	$V_I=GND$ to $V_{CC}$		-	36	-	pF
<b>AiP74HCT190</b>							
propagation delay	$t_{pd}$	CP to Qn; see Figure 10	$V_{CC}=4.5V$	-	28	48	ns
			$V_{CC}=5.0V; C_L=15pF$	-	24	-	ns
		CP to TC; see Figure 10	$V_{CC}=4.5V$	-	34	58	ns
		CP to RC; see Figure 11	$V_{CC}=4.5V$	-	20	35	ns
		$\overline{CE}$ to RC; see Figure 11	$V_{CC}=4.5V$	-	18	33	ns
		Dn to Qn; see Figure 12	$V_{CC}=4.5V$	-	24	44	ns
		$\overline{PL}$ to Qn; see Figure 13	$V_{CC}=4.5V$	-	29	49	ns
		$\overline{U/D}$ to TC; see Figure 14	$V_{CC}=4.5V$	-	24	45	ns
$\overline{U/D}$ to RC; see Figure 14	$V_{CC}=4.5V$	-	26	45	ns		
transition time	$t_t$	$V_{CC}=4.5V$ ; see Figure 15		-	7	15	ns
pulse width	$t_w$	CP; HIGH or LOW; $V_{CC}=4.5V$ see Figure 10		25	10	-	ns
		PL; LOW; $V_{CC}=4.5V$ ; see Figure 15		22	12	-	ns
recovery time	$t_{rec}$	$\overline{PL}$ to CP; $V_{CC}=4.5V$ ; see Figure 15		7	1	-	ns



set-up time	$t_{su}$	$\bar{U}/D$ to CP; $V_{CC}=4.5V$ ; see Figure 16	42	25	-	ns	
		Dn to $\bar{P}L$ ; $V_{CC}=4.5V$ ; see Figure 17	20	10	-	ns	
		$\bar{C}E$ to CP; $V_{CC}=4.5V$ ; see Figure 16	31	18	-	ns	
hold time	$t_h$	$\bar{U}/D$ to CP; $V_{CC}=4.5V$ ; see Figure 16	0	-18	-	ns	
		Dn to $\bar{P}L$ ; $V_{CC}=4.5V$ ; see Figure 17	0	-6	-	ns	
		$\bar{C}E$ to CP; $V_{CC}=4.5V$ ; see Figure 16	0	-10	-	ns	
maximum frequency	$f_{max}$	CP; see Figure 10	$V_{CC}=4.5V$	16	27	-	MHz
			$V_{CC}=5.0V$ ; $C_L=15pF$	-	30	-	MHz
power dissipation capacitance	$C_{PD}$	$V_I=GND$ to $V_{CC}-1.5V$	-	38	-	pF	

Note:

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

[2]  $t_i$  is the same as  $t_{THL}$  and  $t_{TLH}$ .

[3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in uW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

$f_i$ =input frequency in MHz;

$f_o$ =output frequency in MHz;

$C_L$ =output load capacitance in pF;

$V_{CC}$ =supply voltage in V;

$\sum (C_L \times V_{CC}^2 \times f_o)$ =sum of outputs.

### 3.3.5、 AC Characteristics 2

( $T_{amb}=-40^{\circ}C$  to  $+85^{\circ}C$ ,  $GND=0V$ ;  $t_r=t_f=6ns$ ;  $C_L=50pF$ , unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
<b>AiP74HC190</b>							
propagation delay	$t_{pd}$	CP to Qn; see Figure 10	$V_{CC}=2.0V$	-	-	275	ns
			$V_{CC}=4.5V$	-	-	55	ns
			$V_{CC}=6.0V$	-	-	47	ns
		CP to TC; see Figure 10	$V_{CC}=2.0V$	-	-	320	ns
			$V_{CC}=4.5V$	-	-	64	ns
			$V_{CC}=6.0V$	-	-	54	ns
		CP to $\bar{R}C$ ; see Figure 11	$V_{CC}=2.0V$	-	-	190	ns
			$V_{CC}=4.5V$	-	-	38	ns
			$V_{CC}=6.0V$	-	-	33	ns
		$\bar{C}E$ to $\bar{R}C$ ; see Figure 11	$V_{CC}=2.0V$	-	-	165	ns
			$V_{CC}=4.5V$	-	-	33	ns
			$V_{CC}=6.0V$	-	-	28	ns
		Dn to Qn; see Figure 12	$V_{CC}=2.0V$	-	-	275	ns
			$V_{CC}=4.5V$	-	-	55	ns
			$V_{CC}=6.0V$	-	-	47	ns
$\bar{P}L$ to Qn; see Figure 13	$V_{CC}=2.0V$	-	-	275	ns		
	$V_{CC}=4.5V$	-	-	55	ns		
	$V_{CC}=6.0V$	-	-	47	ns		





		$\bar{U}/D$ to TC; see Figure 14	$V_{CC}=2.0V$	-	-	240	ns
			$V_{CC}=4.5V$	-	-	48	ns
			$V_{CC}=6.0V$	-	-	41	ns
		$\bar{U}/D$ to $\bar{RC}$ ; see Figure 14	$V_{CC}=2.0V$	-	-	265	ns
			$V_{CC}=4.5V$	-	-	53	ns
			$V_{CC}=6.0V$	-	-	45	ns
transition time	$t_t$	see Figure 15	$V_{CC}=2.0V$	-	-	95	ns
			$V_{CC}=4.5V$	-	-	19	ns
			$V_{CC}=6.0V$	-	-	16	ns
pulse width	$t_w$	CP; HIGH or LOW; see Figure 10	$V_{CC}=2.0V$	195	-	-	ns
			$V_{CC}=4.5V$	39	-	-	ns
			$V_{CC}=6.0V$	33	-	-	ns
		$\bar{PL}$ ; LOW; see Figure 15	$V_{CC}=2.0V$	125	-	-	ns
			$V_{CC}=4.5V$	25	-	-	ns
			$V_{CC}=6.0V$	21	-	-	ns
recovery time	$t_{rec}$	$\bar{PL}$ to CP; see Figure 15	$V_{CC}=2.0V$	45	-	-	ns
			$V_{CC}=4.5V$	9	-	-	ns
			$V_{CC}=6.0V$	8	-	-	ns
set-up time	$t_{su}$	$\bar{U}/D$ to CP; see Figure 16	$V_{CC}=2.0V$	255	-	-	ns
			$V_{CC}=4.5V$	51	-	-	ns
			$V_{CC}=6.0V$	43	-	-	ns
		Dn to $\bar{PL}$ ; see Figure 17	$V_{CC}=2.0V$	125	-	-	ns
			$V_{CC}=4.5V$	25	-	-	ns
			$V_{CC}=6.0V$	21	-	-	ns
		$\bar{CE}$ to CP; see Figure 16	$V_{CC}=2.0V$	175	-	-	ns
			$V_{CC}=4.5V$	35	-	-	ns
			$V_{CC}=6.0V$	30	-	-	ns
hold time	$t_h$	$\bar{U}/D$ to CP; see Figure 16	$V_{CC}=2.0V$	0	-	-	ns
			$V_{CC}=4.5V$	0	-	-	ns
			$V_{CC}=6.0V$	0	-	-	ns
		Dn to $\bar{PL}$ ; see Figure 17	$V_{CC}=2.0V$	0	-	-	ns
			$V_{CC}=4.5V$	0	-	-	ns
			$V_{CC}=6.0V$	0	-	-	ns
		$\bar{CE}$ to CP; see Figure 16	$V_{CC}=2.0V$	0	-	-	ns
			$V_{CC}=4.5V$	0	-	-	ns
			$V_{CC}=6.0V$	0	-	-	ns
maximum frequency	$f_{max}$	CP; see Figure 10	$V_{CC}=2.0V$	2.4	-	-	MHz
			$V_{CC}=4.5V$	12	-	-	MHz
			$V_{CC}=6.0V$	14	-	-	MHz
<b>AiP74HCT190</b>							
propagation delay	$t_{pd}$	CP to Qn; see Figure 10	$V_{CC}=4.5V$	-	-	60	ns
		CP to TC; see Figure 10	$V_{CC}=4.5V$	-	-	73	ns
		CP to $\bar{RC}$ ; see Figure 11	$V_{CC}=4.5V$	-	-	44	ns



		$\overline{CE}$ to $\overline{RC}$ ; see Figure 11	$V_{CC}=4.5V$	-	-	41	ns
		Dn to Qn; see Figure 12	$V_{CC}=4.5V$	-	-	55	ns
		$\overline{PL}$ to Qn; see Figure 13	$V_{CC}=4.5V$	-	-	61	ns
		$\overline{U/D}$ to TC; see Figure 14	$V_{CC}=4.5V$	-	-	56	ns
		$\overline{U/D}$ to $\overline{RC}$ ; see Figure 14	$V_{CC}=4.5V$	-	-	56	ns
transition time	$t_t$	$V_{CC}=4.5V$ ; see Figure 15		-	-	19	ns
pulse width	$t_w$	CP; HIGH or LOW; $V_{CC}=4.5V$ see Figure 10		31	-	-	ns
		$\overline{PL}$ ; LOW; $V_{CC}=4.5V$ ; see Figure 15		28	-	-	ns
recovery time	$t_{rec}$	$\overline{PL}$ to CP; $V_{CC}=4.5V$ ; see Figure 15		9	-	-	ns
set-up time	$t_{su}$	$\overline{U/D}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		53	-	-	ns
		Dn to $\overline{PL}$ ; $V_{CC}=4.5V$ ; see Figure 17		25	-	-	ns
		$\overline{CE}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		39	-	-	ns
hold time	$t_h$	$\overline{U/D}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		0	-	-	ns
		Dn to $\overline{PL}$ ; $V_{CC}=4.5V$ ; see Figure 17		0	-	-	ns
		$\overline{CE}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		0	-	-	ns
maximum frequency	$f_{max}$	CP; see Figure 10	$V_{CC}=4.5V$	13	-	-	MHz

Note:

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .[2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .

### 3.3.6. AC Characteristics 3

(T<sub>amb</sub> = -40°C to +125°C, GND = 0V;  $t_r = t_f = 6ns$ ;  $C_L = 50pF$ , unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
<b>AiP74HC190</b>							
propagation delay	$t_{pd}$	CP to Qn; see Figure 10	$V_{CC}=2.0V$	-	-	330	ns
			$V_{CC}=4.5V$	-	-	66	ns
			$V_{CC}=6.0V$	-	-	56	ns
		CP to TC; see Figure 10	$V_{CC}=2.0V$	-	-	384	ns
			$V_{CC}=4.5V$	-	-	77	ns
			$V_{CC}=6.0V$	-	-	65	ns
		CP to $\overline{RC}$ ; see Figure 11	$V_{CC}=2.0V$	-	-	228	ns
			$V_{CC}=4.5V$	-	-	46	ns
			$V_{CC}=6.0V$	-	-	40	ns
		$\overline{CE}$ to $\overline{RC}$ ; see Figure 11	$V_{CC}=2.0V$	-	-	198	ns
			$V_{CC}=4.5V$	-	-	40	ns
			$V_{CC}=6.0V$	-	-	34	ns
		Dn to Qn; see Figure 12	$V_{CC}=2.0V$	-	-	330	ns
			$V_{CC}=4.5V$	-	-	66	ns



		$\bar{P}L$ to Qn; see Figure 13	$V_{CC}=6.0V$	-	-	56	ns		
			$V_{CC}=2.0V$	-	-	330	ns		
			$V_{CC}=4.5V$	-	-	66	ns		
			$V_{CC}=6.0V$	-	-	56	ns		
		$\bar{U}/D$ to TC; see Figure 14	$V_{CC}=2.0V$	-	-	288	ns		
			$V_{CC}=4.5V$	-	-	58	ns		
			$V_{CC}=6.0V$	-	-	49	ns		
		$\bar{U}/D$ to $\bar{R}C$ ; see Figure 14	$V_{CC}=2.0V$	-	-	318	ns		
			$V_{CC}=4.5V$	-	-	64	ns		
			$V_{CC}=6.0V$	-	-	54	ns		
		transition time	$t_t$	see Figure 15	$V_{CC}=2.0V$	-	-	114	ns
					$V_{CC}=4.5V$	-	-	23	ns
$V_{CC}=6.0V$	-				-	19	ns		
pulse width	$t_w$	CP; HIGH or LOW; see Figure 10	$V_{CC}=2.0V$	234	-	-	ns		
			$V_{CC}=4.5V$	47	-	-	ns		
			$V_{CC}=6.0V$	40	-	-	ns		
		$\bar{P}L$ ; LOW; see Figure 15	$V_{CC}=2.0V$	150	-	-	ns		
			$V_{CC}=4.5V$	30	-	-	ns		
			$V_{CC}=6.0V$	25	-	-	ns		
recovery time	$t_{rec}$	$\bar{P}L$ to CP; see Figure 15	$V_{CC}=2.0V$	54	-	-	ns		
			$V_{CC}=4.5V$	11	-	-	ns		
			$V_{CC}=6.0V$	10	-	-	ns		
set-up time	$t_{su}$	$\bar{U}/D$ to CP; see Figure 16	$V_{CC}=2.0V$	306	-	-	ns		
			$V_{CC}=4.5V$	61	-	-	ns		
			$V_{CC}=6.0V$	52	-	-	ns		
		Dn to $\bar{P}L$ ; see Figure 17	$V_{CC}=2.0V$	150	-	-	ns		
			$V_{CC}=4.5V$	30	-	-	ns		
			$V_{CC}=6.0V$	25	-	-	ns		
		$\bar{C}E$ to CP; see Figure 16	$V_{CC}=2.0V$	210	-	-	ns		
			$V_{CC}=4.5V$	42	-	-	ns		
			$V_{CC}=6.0V$	36	-	-	ns		
hold time	$t_h$	$\bar{U}/D$ to CP; see Figure 16	$V_{CC}=2.0V$	0	-	-	ns		
			$V_{CC}=4.5V$	0	-	-	ns		
			$V_{CC}=6.0V$	0	-	-	ns		
		Dn to $\bar{P}L$ ; see Figure 17	$V_{CC}=2.0V$	0	-	-	ns		
			$V_{CC}=4.5V$	0	-	-	ns		
			$V_{CC}=6.0V$	0	-	-	ns		
		$\bar{C}E$ to CP; see Figure 16	$V_{CC}=2.0V$	0	-	-	ns		
			$V_{CC}=4.5V$	0	-	-	ns		
			$V_{CC}=6.0V$	0	-	-	ns		
maximum frequency	$f_{max}$	CP; see Figure 10	$V_{CC}=2.0V$	2	-	-	MHz		
			$V_{CC}=4.5V$	10	-	-	MHz		
			$V_{CC}=6.0V$	12	-	-	MHz		
<b>AiP74HCT190</b>									
propagation	$t_{pd}$	CP to Qn;	$V_{CC}=4.5V$	-	-	72	ns		



delay		see Figure 10					
		CP to TC; see Figure 10	$V_{CC}=4.5V$	-	-	88	ns
		CP to RC; see Figure 11	$V_{CC}=4.5V$	-	-	53	ns
		$\overline{CE}$ to $\overline{RC}$ ; see Figure 11	$V_{CC}=4.5V$	-	-	49	ns
		Dn to Qn; see Figure 12	$V_{CC}=4.5V$	-	-	66	ns
		$\overline{PL}$ to Qn; see Figure 13	$V_{CC}=4.5V$	-	-	73	ns
		$\overline{U/D}$ to TC; see Figure 14	$V_{CC}=4.5V$	-	-	67	ns
		$\overline{U/D}$ to $\overline{RC}$ ; see Figure 14	$V_{CC}=4.5V$	-	-	67	ns
transition time	$t_t$	$V_{CC}=4.5V$ ; see Figure 15		-	-	23	ns
pulse width	$t_w$	CP; HIGH or LOW; $V_{CC}=4.5V$ see Figure 10		37	-	-	ns
		$\overline{PL}$ ; LOW; $V_{CC}=4.5V$ ; see Figure 15		34	-	-	ns
recovery time	$t_{rec}$	$\overline{PL}$ to CP; $V_{CC}=4.5V$ ; see Figure 15		11	-	-	ns
set-up time	$t_{su}$	$\overline{U/D}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		64	-	-	ns
		Dn to $\overline{PL}$ ; $V_{CC}=4.5V$ ; see Figure 17		30	-	-	ns
		$\overline{CE}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		47	-	-	ns
hold time	$t_h$	$\overline{U/D}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		0	-	-	ns
		Dn to $\overline{PL}$ ; $V_{CC}=4.5V$ ; see Figure 17		0	-	-	ns
		$\overline{CE}$ to CP; $V_{CC}=4.5V$ ; see Figure 16		0	-	-	ns
maximum frequency	$f_{max}$	CP; see Figure 10	$V_{CC}=4.5V$	11	-	-	MHz

Note:

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

[2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .



### 4、 Testing Circuit

#### 4.1、 AC Testing Circuit

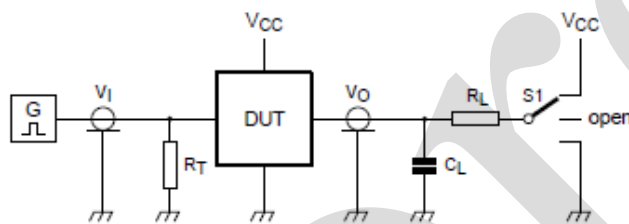
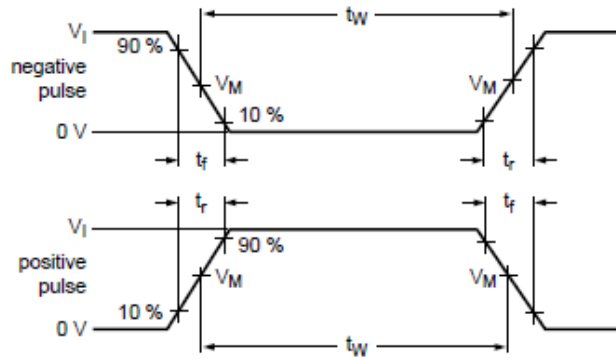


Figure 9. Test circuit for measuring switching times

Definitions for test circuit:

$C_L$ =Load capacitance including jig and probe capacitance.

$R_T$ =Termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator.

$R_L$ =Load resistance.

S1=Test selection switch

#### 4.2、 AC Testing Waveforms

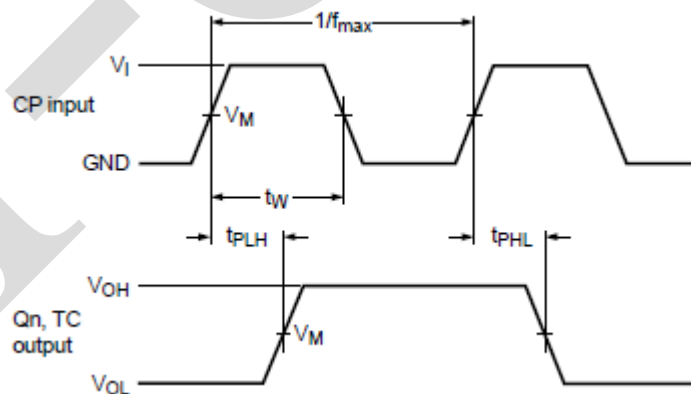


Figure 10. The clock input (CP) to outputs (Qn, TC) propagation delays, clock pulse width and maximum clock frequency

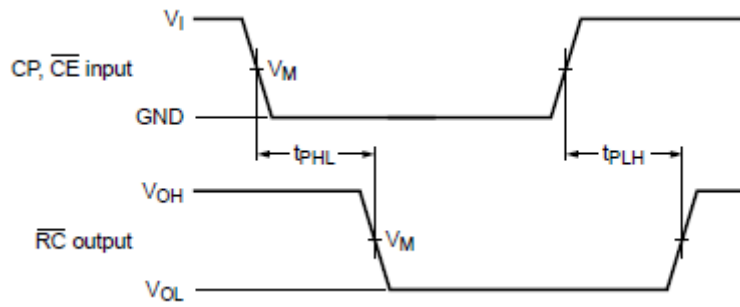


Figure 11. The clock and count enable inputs (CP,  $\overline{CE}$ ) to ripple clock output ( $\overline{RC}$ ) propagation delays

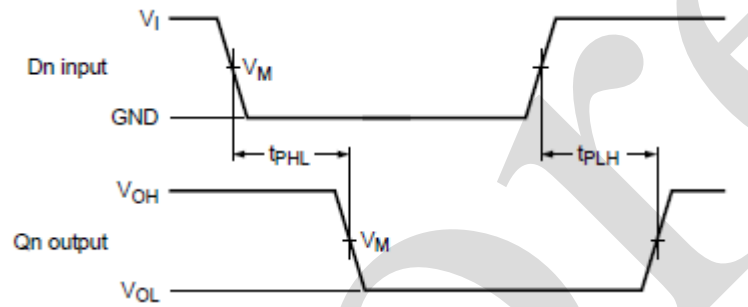


Figure 12. The input (Dn) to output (Qn) propagation delays

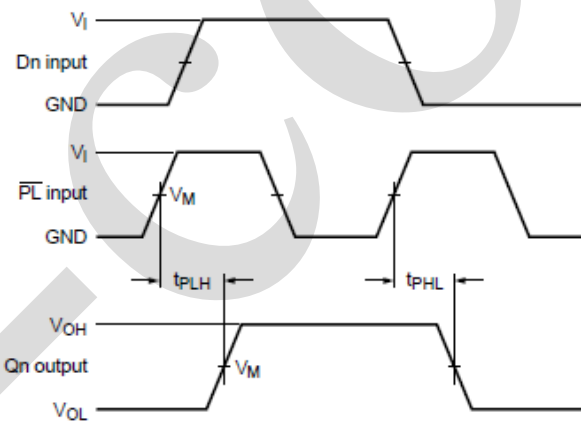


Figure 13. The parallel load input ( $\overline{PL}$ ) to output (Qn) propagation delays

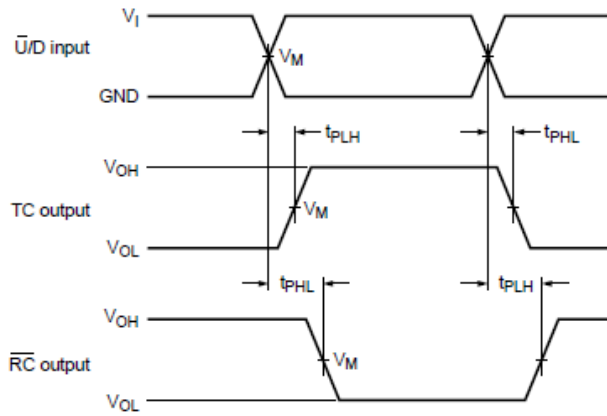


Figure 14. The up/down count input ( $\bar{U}/D$ ) to terminal count and ripple clock output (TC,  $\bar{RC}$ ) propagation delays

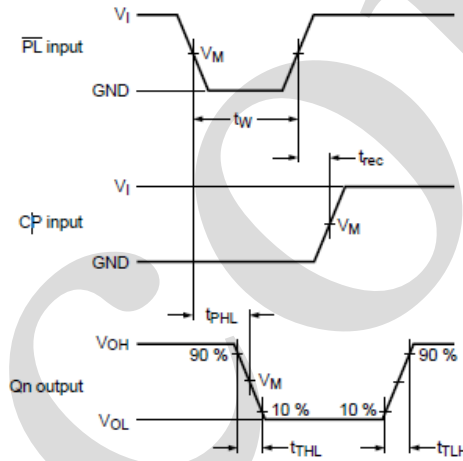


Figure 15. The parallel load input ( $\bar{PL}$ ) to clock (CP) recovery times, parallel load pulse width and output (Qn) transition times

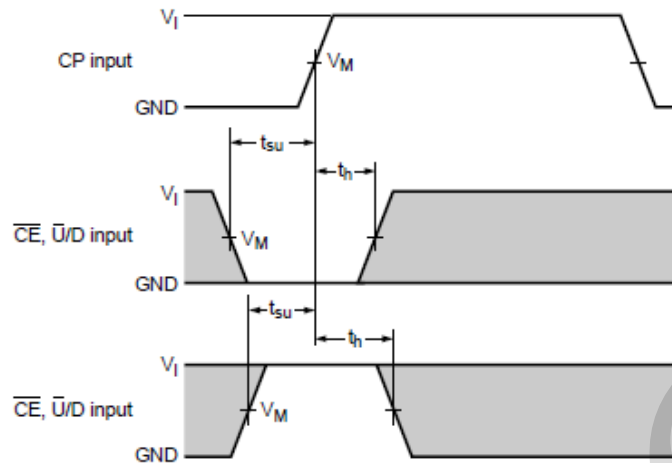


Figure 16. The count enable and up/down count inputs ( $\overline{CE}$ ,  $\overline{U/D}$ ) to clock input (CP) set-up and hold times

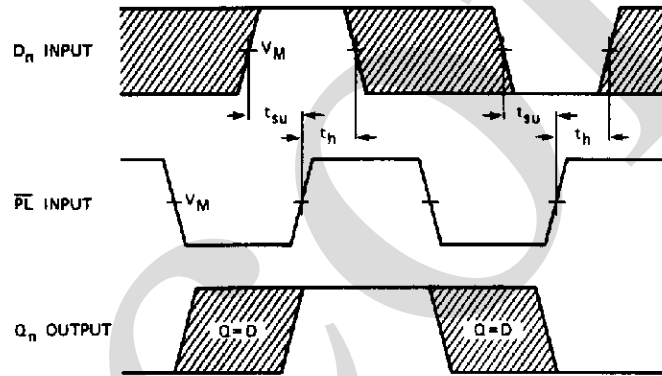


Figure 17. Waveforms showing the set-up and hold times from the parallel load input ( $\overline{PL}$ ) to the data input ( $D_n$ )

### 4.3. Measurement Points

Type	Input	Output
	$V_M$	$V_M$
AiP74HC190	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
AiP74HCT190	1.3V	1.3V

### 4.4. Test Data

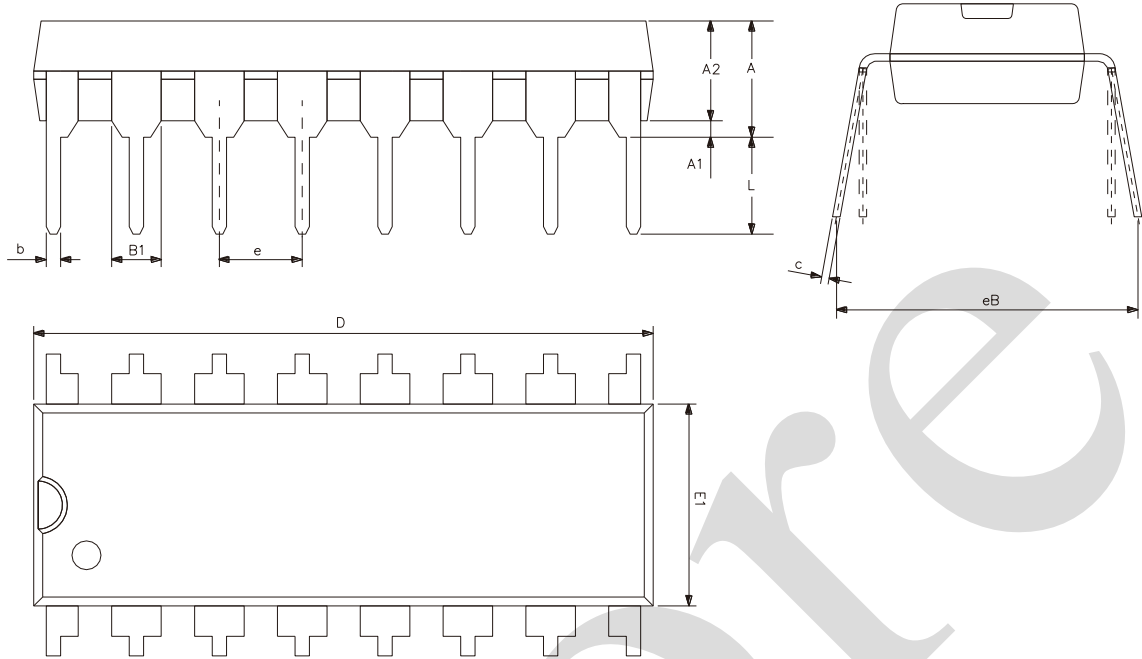
Type	Input		Load		S1 position
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$
AiP74HC190	$V_{CC}$	6ns	15pF, 50pF	1k $\Omega$	open
AiP74HCT190	3V	6ns	15pF, 50pF	1k $\Omega$	open





### 5、 Package Information

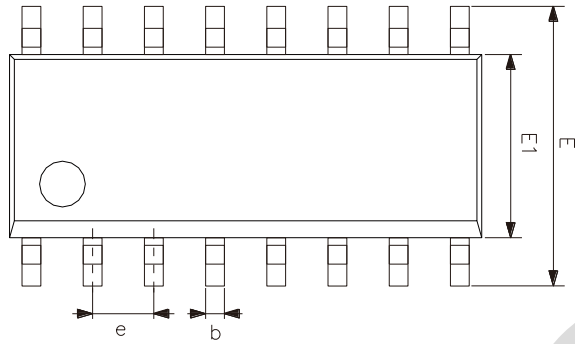
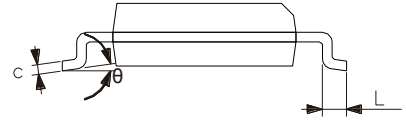
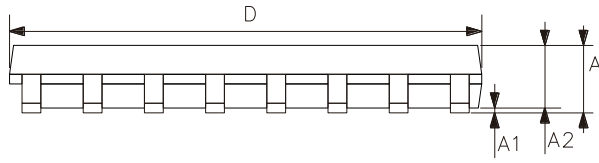
#### 5.1、 DIP16



Symbol	Dimensions (mm)	
	Min.	Max.
A2	3.20	3.60
A1	0.51	-
A	3.60	5.33
L	3.00	3.60
b	0.36	0.56
B1	1.52	
D	18.80	19.94
E1	6.20	6.60
e	2.54	
c	0.20	0.36
eB	7.62	9.30



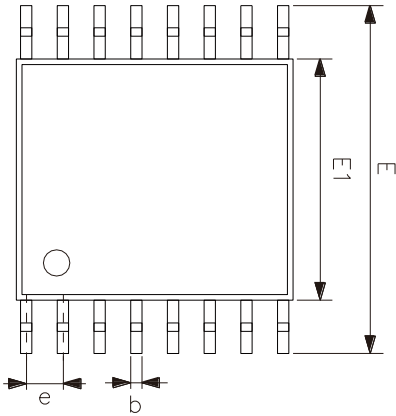
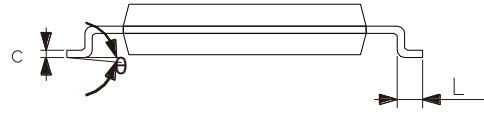
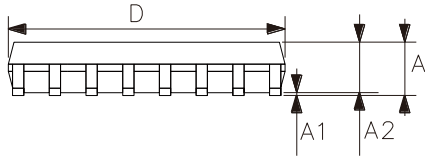
## 5.2、SOP16



Symbol	Dimensions (mm)	
	Min.	Max.
A	1.35	1.80
A1	0.10	0.25
A2	1.25	1.55
b	0.33	0.51
c	0.19	0.25
D	9.50	10.10
E	5.80	6.30
E1	3.70	4.10
e	1.27	
L	0.35	0.89
$\theta$	0°	8°



## 5.3. TSSOP16



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E1	4.30	4.50
E	6.20	6.60
e	0.65	
L	0.45	0.75
$\theta$	0°	8°



## 6、 Statements And Notes

### 6.1、 The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements									
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers	Dibutyl phthalate	Butylbenzyl phthalate	Di-2-ethylhexyl phthalate	Diisobutyl phthalate
Lead frame	○	○	○	○	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
The lead	○	○	○	○	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○	○	○	○	○
explanation	○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.									

### 6.2、 Notes

We Recommend you to read this chapter carefully before using this product.

The information in this chapter is provided for reference only and i-Core disclaims any express or implied warranties, including but not limited to applicability, special application or non-infringement of third party rights.

This product is not suitable for critical equipment such as life-saving, life-sustaining or safety equipment. It is also not suitable for applications that may result in personal injury, death, or serious property or environmental damage due to product malfunction or failure. I-Core will not be liable for any damages incurred by the customers at their own risk for such applications.

The customer is responsible for conducting all necessary tests i-Core's application to avoid failure in the application or the application of the customer's third party users. I-Core does not accept any liability.

The Company reserves the right to change or improve the information published in this chapter at any time.

The information in this chapter are subject to change without notice. We recommend the customer to consult our sales staff before purchasing.

Please obtain related materials form i-Core's regular channels and we are not responsible for its content if it is provided by sources other than our company.

In case of any conflict between the Chinese and English version, the version is subject to the Chinese one.