

# HD74AC112/HD74ACT112

## Dual JK Negative Edge-Triggered Flip-Flop

REJ03D0244-0200Z  
 (Previous ADE-205-364 (Z))  
 Rev.2.00  
 Jul.16.2004

### Description

The HD74AC112/HD74ACT112 features individual J, K, Clock and asynchronous Set and Clear inputs to each flip-flop. When the clock goes High, the inputs are enabled and data will be accepted. The logic level of the J and K inputs may change when the clock is High and the bistable will perform according to the Truth Table as long as minimum setup and hold times are observed. Input data is transferred to the outputs on the falling edge of the clock pulse.

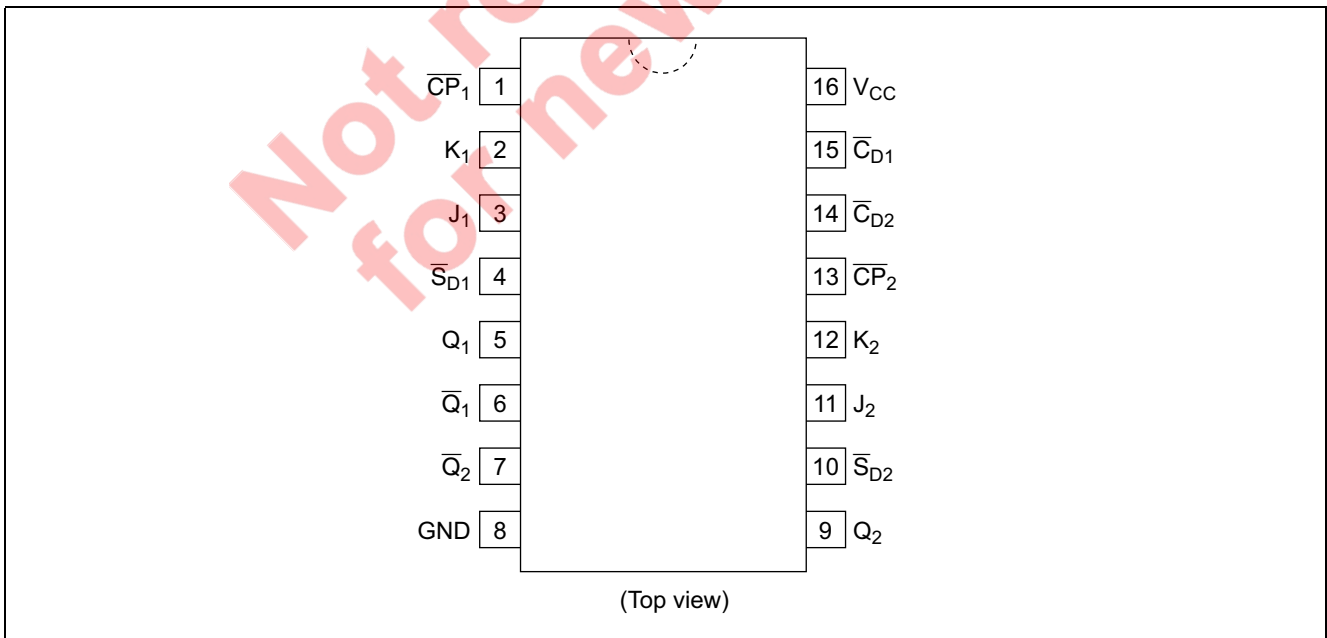
### Features

- Outputs Source/Sink 24 mA
- HD74ACT112 has TTL-Compatible Inputs
- Ordering Information: Ex. HD74AC112

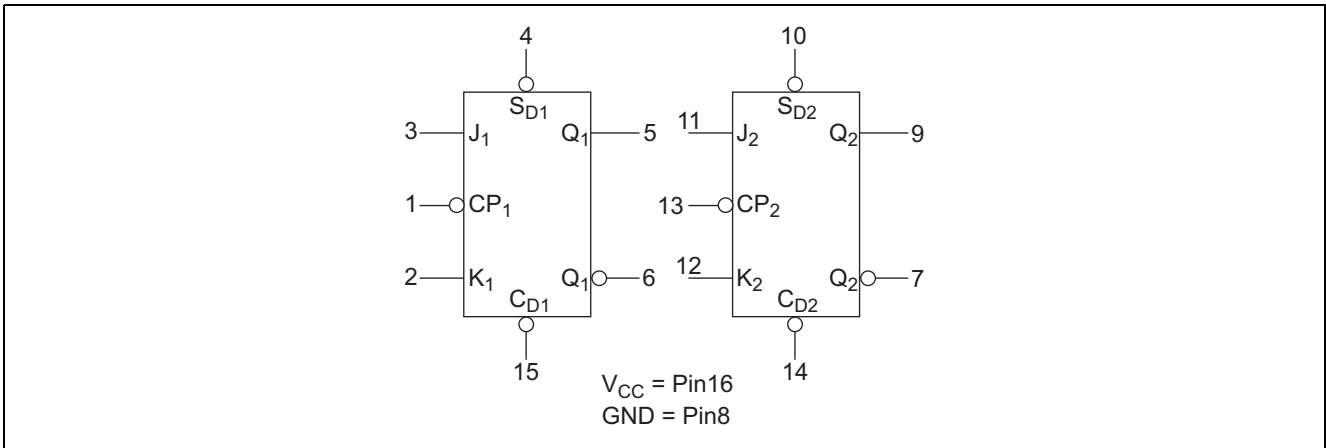
Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD74AC112FPEL	SOP-16 pin (JEITA)	FP-16DAV	FP	EL (2,000 pcs/reel)
HD74AC112RPEL	SOP-16 pin (JEDEC)	FP-16DNV	RP	EL (2,500 pcs/reel)

- Notes: 1. Please consult the sales office for the above package availability.  
 2. The packages with lead-free pins are distinguished from the conventional products by adding V at the end of the package code.

### Pin Arrangement



**Logic Symbol**



**Pin Names**

- $J_1, J_2, K_1, K_2$  Data Inputs
- $\overline{CP}_1, \overline{CP}_2$  Clock Pulse Inputs (Active Falling Edge)
- $\overline{C}_{D1}, \overline{C}_{D2}$  Direct Clear Inputs (Active Low)
- $\overline{S}_{D1}, \overline{S}_{D2}$  Direct Set Inputs (Active Low)
- $Q_1, Q_2, \overline{Q}_1, \overline{Q}_2$  Outputs

**Asynchronous Inputs:**

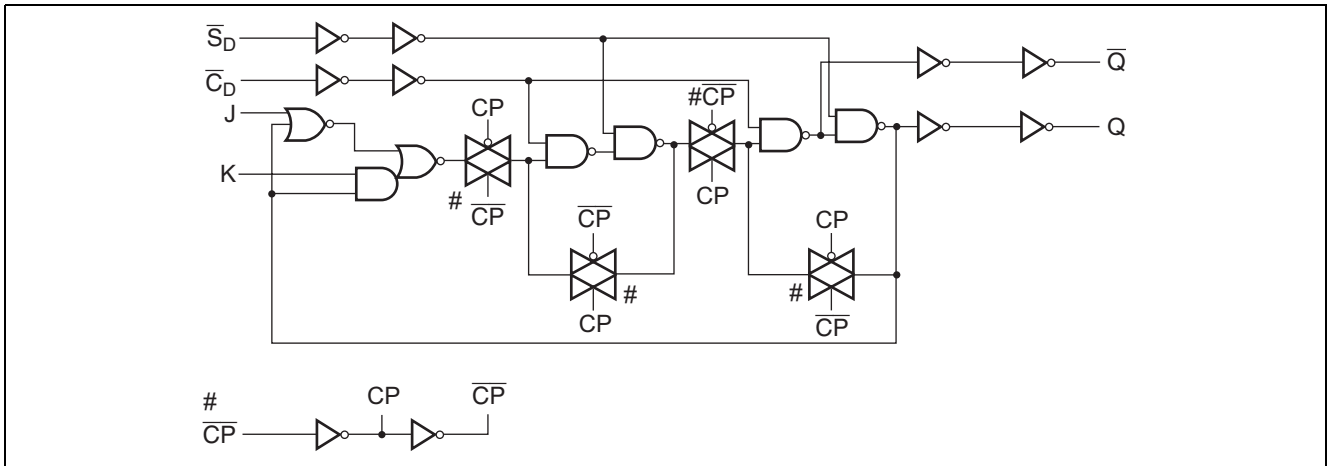
- Low input to  $\overline{S}_D$  sets Q to High level
- Low input to  $\overline{C}_D$  sets Q to Low level
- Clear and Set are independent of clock
- Simultaneous Low on  $\overline{C}_D$  and  $\overline{S}_D$  makes both Q and  $\overline{Q}$  High

**Truth Table**

Inputs		Outputs
@ $t_n$		@ $t_{n+1}$
J	K	Q
L	L	Qn
L	H	L
H	L	H
H	H	$\overline{Q}_n$

- $t_n$  : Bit time before clock pulse.
- $t_{n+1}$  : Bit time after clock pulse.
- H : High Voltage Level
- L : Low Voltage Level

Logic Diagram



Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	-0.5 to 7	V	
DC input diode current	$I_{IK}$	-20	mA	$V_I = -0.5V$
		20	mA	$V_I = V_{CC}+0.5V$
DC input voltage	$V_I$	-0.5 to $V_{CC}+0.5$	V	
DC output diode current	$I_{OK}$	-50	mA	$V_O = -0.5V$
		50	mA	$V_O = V_{CC}+0.5V$
DC output voltage	$V_O$	-0.5 to $V_{CC}+0.5$	V	
DC output source or sink current	$I_O$	$\pm 50$	mA	
DC $V_{CC}$ or ground current per output pin	$I_{CC}, I_{GND}$	$\pm 50$	mA	
Storage temperature	$T_{stg}$	-65 to +150	$^{\circ}C$	

Recommended Operating Conditions: HD74AC112

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	2 to 6	V	
Input and output voltage	$V_I, V_O$	0 to $V_{CC}$	V	
Operating temperature	$T_a$	-40 to +85	$^{\circ}C$	
Input rise and fall time (except Schmitt inputs) $V_{IN}$ 30% to 70% $V_{CC}$	$t_r, t_f$	8	ns/V	$V_{CC} = 3.0V$
				$V_{CC} = 4.5 V$
				$V_{CC} = 5.5 V$

**DC Characteristics: HD74AC112**

Item	Symbol	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to +85°C		Unit	Condition		
			min.	typ.	max.	min.	max.				
Input Voltage	V <sub>IH</sub>	3.0	2.1	1.5	—	2.1	—	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V		
		4.5	3.15	2.25	—	3.15	—				
		5.5	3.85	2.75	—	3.85	—				
	V <sub>IL</sub>	3.0	—	1.50	0.9	—	0.9		V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V		
		4.5	—	2.25	1.35	—	1.35				
		5.5	—	2.75	1.65	—	1.65				
Output voltage	V <sub>OH</sub>	3.0	2.9	2.99	—	2.9	—	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = -50 μA		
		4.5	4.4	4.49	—	4.4	—				
		5.5	5.4	5.49	—	5.4	—				
		3.0	2.58	—	—	2.48	—			V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = -12 mA	
		4.5	3.94	—	—	3.80	—				I <sub>OH</sub> = -24 mA
		5.5	4.94	—	—	4.80	—				I <sub>OH</sub> = -24 mA
	V <sub>OL</sub>	3.0	—	0.002	0.1	—	0.1	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = 50 μA		
		4.5	—	0.001	0.1	—	0.1				
		5.5	—	0.001	0.1	—	0.1				
		3.0	—	—	0.32	—	0.37			V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OL</sub> = 12 mA	
		4.5	—	—	0.32	—	0.37				I <sub>OL</sub> = 24 mA
		5.5	—	—	0.32	—	0.37				I <sub>OL</sub> = 24 mA
	Input leakage current	I <sub>IN</sub>	5.5	—	—	±0.1	—	±1.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND	
	Dynamic output current*	I <sub>OLD</sub>	5.5	—	—	—	86	—	mA	V <sub>OLD</sub> = 1.1 V	
		I <sub>OHD</sub>	5.5	—	—	—	-75	—	mA	V <sub>OHD</sub> = 3.85 V	
Quiescent supply current	I <sub>CC</sub>	5.5	—	—	4.0	—	40	μA	V <sub>IN</sub> = V <sub>CC</sub> or ground		

\*Maximum test duration 2.0 ms, one output loaded at a time.

**Recommended Operating Conditions: HD74ACT112**

Item	Symbol	Ratings	Unit	Condition
Supply voltage	V <sub>CC</sub>	2 to 6	V	
Input and output voltage	V <sub>I</sub> , V <sub>O</sub>	0 to V <sub>CC</sub>	V	
Operating temperature	Ta	-40 to +85	°C	
Input rise and fall time (except Schmitt inputs) V <sub>IN</sub> 0.8 to 2.0 V	tr, tf	8	ns/V	V <sub>CC</sub> = 4.5V V <sub>CC</sub> = 5.5V

**DC Characteristics: HD74ACT112**

Item	Symbol	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to +85°C		Unit	Condition				
			min.	typ.	max.	min.	max.						
Input voltage	V <sub>IH</sub>	4.5	2.0	1.5	—	2.0	—	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V				
		5.5	2.0	1.5	—	2.0	—						
	V <sub>IL</sub>	4.5	—	1.5	0.8	—	0.8		V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> -0.1 V				
		5.5	—	1.5	0.8	—	0.8						
Output voltage	V <sub>OH</sub>	4.5	4.4	4.49	—	4.4	—	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = -50 μA				
		5.5	5.4	5.49	—	5.4	—						
		4.5	3.94	—	—	3.80	—			V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -24 mA		
		5.5	4.94	—	—	4.80	—				I <sub>OH</sub> = -24 mA		
	V <sub>OL</sub>	4.5	—	0.001	0.1	—	0.1		V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OUT</sub> = 50 μA				
		5.5	—	0.001	0.1	—	0.1						
		4.5	—	—	0.32	—	0.37			V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OL</sub> = 24 mA		
		5.5	—	—	0.32	—	0.37				I <sub>OL</sub> = 24 mA		
		Input current	I <sub>IN</sub>	5.5	—	—	±0.1			—	±1.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND
		I <sub>CC</sub> /input current	I <sub>CCT</sub>	5.5	—	0.6	—			—	1.5	mA	V <sub>IN</sub> = V <sub>CC</sub> -2.1 V
Dynamic output current*	I <sub>OLD</sub>	5.5	—	—	—	86	—	mA	V <sub>OLD</sub> = 1.1 V				
	I <sub>OHD</sub>	5.5	—	—	—	-75	—	mA	V <sub>OHD</sub> = 3.85 V				
Quiescent supply current	I <sub>CC</sub>	5.5	—	—	4.0	—	40	μA	V <sub>IN</sub> = V <sub>CC</sub> or ground				

\*Maximum test duration 2.0 ms, one output loaded at a time.

**AC Characteristics: HD74AC112**

Item	Symbol	V <sub>CC</sub> (V)*1	Ta = +25°C C <sub>L</sub> = 50 pF			Ta = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Maximum clock frequency	f <sub>max</sub>	3.3	125	—	—	100	—	MHz
		5.0	150	—	—	125	—	
Propagation delay C <sub>P</sub> to Q or Q̄	t <sub>PLH</sub>	3.3	1.0	11.0	14.0	1.0	15.0	ns
		5.0	1.0	8.5	11.0	1.0	12.0	
Propagation delay C <sub>P</sub> to Q or Q̄	t <sub>PHL</sub>	3.3	1.0	11.0	14.0	1.0	15.0	
		5.0	1.0	8.5	11.0	1.0	12.0	
Propagation delay C <sub>D</sub> , S <sub>D</sub> to Q or Q̄	t <sub>PLH</sub>	3.3	1.0	9.5	12.5	1.0	13.5	
		5.0	1.0	7.0	9.5	1.0	10.5	
Propagation delay C <sub>D</sub> , S <sub>D</sub> to Q or Q̄	t <sub>PHL</sub>	3.3	1.0	11.5	14.5	1.0	15.5	
		5.0	1.0	9.0	11.0	1.0	12.5	

Note: 1. Voltage Range 3.3 is 3.3 V ± 0.3 V  
Voltage Range 5.0 is 5.0 V ± 0.5 V

**AC Operating Requirements: HD74AC112**

Item	Symbol	V <sub>CC</sub> (V)*1	Ta = +25°C C <sub>L</sub> = 50 pF		Ta = -40°C to +85°C C <sub>L</sub> = 50 pF	Unit
			Typ	Guaranteed Minimum		
Setup time J or K to $\overline{C}_P$	t <sub>su</sub>	3.3	3.0	5.5	6.0	ns
			5.0	2.0	4.5	
Hold time $\overline{C}_P$ to J or K	t <sub>h</sub>	3.3	-1.5	0.0	0.0	
			5.0	-0.5	0.0	
Pulse width $\overline{C}_P$ or $\overline{C}_D$ or $\overline{S}_D$	t <sub>w</sub>	3.3	2.0	5.5	7.0	
			5.0	2.0	4.5	
Recovery time $\overline{C}_D$ or $\overline{S}_D$ to $\overline{C}_P$	t <sub>rec</sub>	3.3	1.5	3.5	3.5	
			5.0	1.0	3.0	3.0

Note: 1. Voltage Range 3.3 is 3.3 V ± 0.3 V  
Voltage Range 5.0 is 5.0 V ± 0.5 V

**AC Characteristics: HD74ACT112**

Item	Symbol	V <sub>CC</sub> (V)*1	Ta = +25°C C <sub>L</sub> = 50 pF			Ta = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Maximum clock frequency	f <sub>max</sub>	5.0	100	—	—	80	—	MHz
Propagation delay $\overline{C}_P$ to Q or $\overline{Q}$	t <sub>PLH</sub>	5.0	1.0	10.5	13.0	1.0	14.0	ns
Propagation delay $\overline{C}_P$ to Q or $\overline{Q}$	t <sub>PHL</sub>	5.0	1.0	10.5	13.0	1.0	14.0	
Propagation delay $\overline{C}_D$ , $\overline{S}_D$ to Q or $\overline{Q}$	t <sub>PLH</sub>	5.0	1.0	8.0	10.0	1.0	11.0	
Propagation delay $\overline{C}_D$ , $\overline{S}_D$ to Q or $\overline{Q}$	t <sub>PHL</sub>	5.0	1.0	10.5	12.5	1.0	13.5	

Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

**AC Operating Requirements: HD74ACT112**

Item	Symbol	V <sub>CC</sub> (V)*1	Ta = +25°C C <sub>L</sub> = 50 pF		Ta = -40°C to +85°C C <sub>L</sub> = 50 pF	Unit
			Typ	Guaranteed Minimum		
Setup time J or K to $\overline{C}_P$	t <sub>su</sub>	5.0	2.5	7.0	8.0	ns
Hold time $\overline{C}_P$ to J or K	t <sub>h</sub>	5.0	0.0	1.5	1.5	
Pulse width $\overline{C}_P$ or $\overline{C}_D$ or $\overline{S}_D$	t <sub>w</sub>	5.0	4.5	7.0	8.0	
Recovery time $\overline{C}_D$ , $\overline{S}_D$ to $\overline{C}_P$	t <sub>rec</sub>	5.0	-2.5	3.0	3.0	

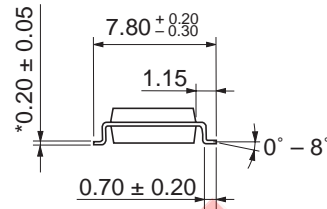
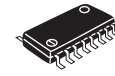
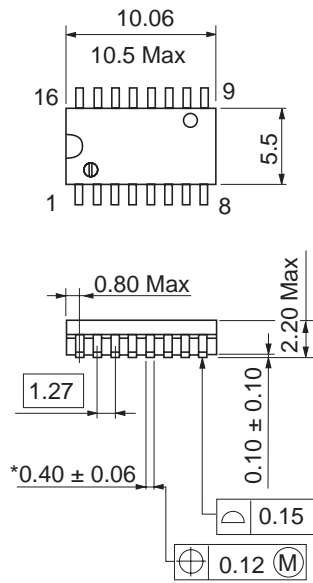
Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

**Capacitance**

Item	Symbol	Typ	Unit	Condition
Input capacitance	C <sub>IN</sub>	4.5	pF	V <sub>CC</sub> = 5.5 V
Power dissipation capacitance	C <sub>PD</sub>	35.0	pF	V <sub>CC</sub> = 5.0 V

Package Dimensions

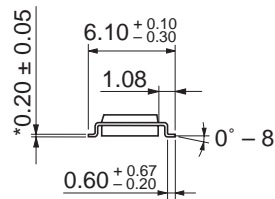
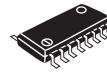
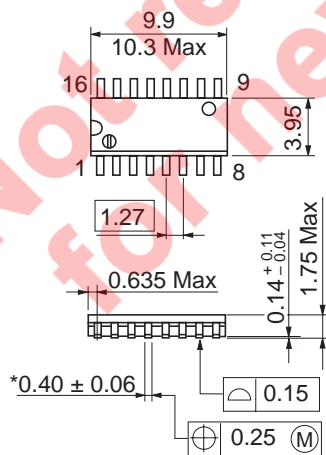
As of January, 2003  
Unit: mm



\*Ni/Pd/Au plating

Package Code	FP-16DAV
JEDEC	—
JEITA	Conforms
Mass (reference value)	0.24 g

As of January, 2003  
Unit: mm



\*Ni/Pd/Au plating

Package Code	FP-16DNV
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	0.15 g

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