Old Company Name in Catalogs and Other Documents

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April 1st, 2010 Renesas Electronics Corporation

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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

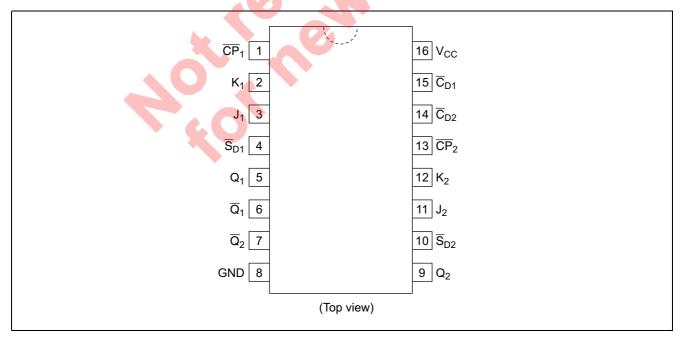
- Outputs Source/Sink 24 mA
- HD74ACT112 has TTL-Compatible Inputs
- Ordering Information: Ex. HD74AC112

| 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) |

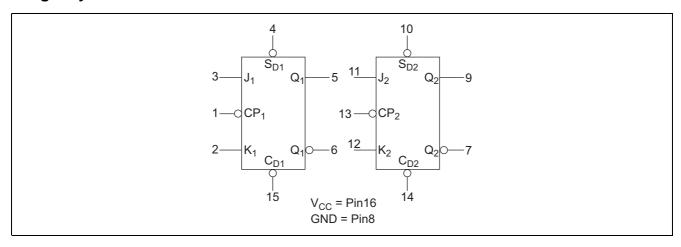
Notes: 1. Please consult the sales office for the above package availability.

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

J₁, J₂, K₁, K₂ Data Inputs

 $\overline{\overline{CP}}_1, \overline{\overline{CP}}_2$ Clock Pulse Inputs (Active Falling Edge)

 $\begin{array}{ll} \overline{C}_{D1}, \, \overline{C}_{D2} & \quad \text{Direct Clear Inputs (Active Low)} \\ \overline{S}_{D1}, \, \overline{S}_{D2} & \quad \text{Direct Set Inputs (Active Low)} \end{array}$

 $Q_1, Q_2, \overline{Q}_1, \overline{Q}_2$ 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

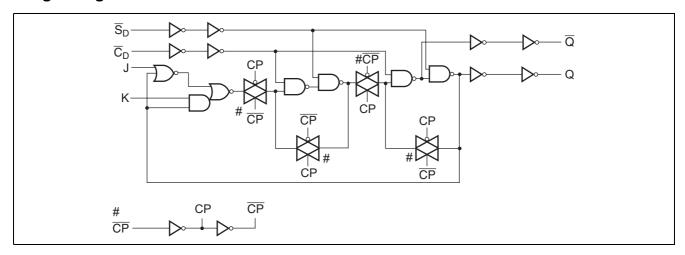
Simultaneous Low on \overline{C}_D and \overline{S}_D makes both Q and \overline{Q} High

Truth Table

| Inputs | 10 11 | Outputs |
|------------------|-------|--------------------|
| @ t _n | | @ t _{n+1} |
| J | K | Q |
| L | L | Qn |
| L | Н | L |
| Н | L | Н |
| Н | Н | <u>Q</u> n |

 $\begin{array}{lll} t_n & : & \text{Bit time before clock } \textcolor{red}{\textbf{pulse.}} \\ t_{n+1} & : & \text{Bit time after clock pulse.} \\ \textbf{H} & : & \text{High Voltage Level} \\ \textbf{L} & : & \text{Low Voltage Level} \end{array}$

Logic Diagram



Absolute Maximum Ratings

| Item | Symbol | Ratings | Unit | Condition |
|---|------------------------------------|-----------------|------|---------------------------|
| Supply voltage | V _{cc} | -0.5 to 7 | ٧ | |
| DC input diode current | I _{IK} | -20 | mA | $V_1 = -0.5V$ |
| | | 20 | mA | V _I = Vcc+0.5V |
| DC input voltage | V _I | -0.5 to Vcc+0.5 | V | |
| DC output diode current | I _{OK} | -50 | mA | $V_{O} = -0.5V$ |
| | | 50 | mA | $V_O = Vcc+0.5V$ |
| DC output voltage | Vo | -0.5 to Vcc+0.5 | V | |
| DC output source or sink current | Io | ±50 | mA | |
| DC V _{CC} or ground current per output pin | I _{CC} , I _{GND} | ±50 | mA | |
| Storage temperature | Tstg | -65 to +150 | °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 | Та | -40 to +85 | °C | |
| Input rise and fall time | tr, tf | 8 | ns/V | $V_{CC} = 3.0V$ |
| (except Schmitt inputs) | | | | V _{CC} = 4.5 V |
| V_{IN} 30% to 70% V_{CC} | | | | V _{CC} = 5.5 V |

DC Characteristics: HD74AC112

| Item | Sym- bol | Vcc (V) | 7 | Γa = 25°(| C | +85°C | | Unit | Condition |
|--------------------------|------------------|------------|------|-----------|------|-------|------|------|--|
| | | | min. | typ. | max. | min. | max. | | |
| Input Voltage | V _{IH} | 3.0 | 2.1 | 1.5 | — | 2.1 | — | V | $V_{OUT} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$ |
| | | 4.5 | 3.15 | 2.25 | _ | 3.15 | _ | | |
| | | 5.5 | 3.85 | 2.75 | — | 3.85 | — | | |
| | V_{IL} | 3.0 | _ | 1.50 | 0.9 | — | 0.9 | | $V_{OUT} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$ |
| | | 4.5 | _ | 2.25 | 1.35 | — | 1.35 | | |
| | | 5.5 | _ | 2.75 | 1.65 | — | 1.65 | | |
| Output voltage | V _{OH} | 3.0 | 2.9 | 2.99 | — | 2.9 | — | V | $V_{IN} = V_{IL}$ or V_{IH} |
| | | 4.5 | 4.4 | 4.49 | _ | 4.4 | _ | | $I_{OUT} = -50 \mu A$ |
| | | 5.5 | 5.4 | 5.49 | _ | 5.4 | _ | | |
| | | 3.0 | 2.58 | _ | _ | 2.48 | _ | | $V_{IN} = V_{IL} \text{ or } V_{IH}$ $I_{OH} = -12 \text{ mA}$ |
| | | 4.5 | 3.94 | _ | _ | 3.80 | _ | | $I_{OH} = -24 \text{ mA}$ |
| | | 5.5 | 4.94 | | _ | 4.80 | _ | | $I_{OH} = -24 \text{ mA}$ |
| | V_{OL} | 3.0 | _ | 0.002 | 0.1 | — | 0.1 | | $V_{IN} = V_{IL}$ or V_{IH} |
| | | 4.5 | _ | 0.001 | 0.1 | _ | 0.1 | | I _{OUT} = 50 μA |
| | | 5.5 | _ | 0.001 | 0.1 | — | 0.1 | | |
| | | 3.0 | _ | _ | 0.32 | _ | 0.37 | | $V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 12 \text{ mA}$ |
| | | 4.5 | _ | | 0.32 | - 4 | 0.37 | | $I_{OL} = 24 \text{ mA}$ |
| | | 5.5 | _ | _ | 0.32 | - | 0.37 | | $I_{OL} = 24 \text{ mA}$ |
| Input leakage current | I _{IN} | 5.5 | _ | _ | ±0.1 | - | ±1.0 | μΑ | $V_{IN} = V_{CC}$ or GND |
| Dynamic output | I _{OLD} | 5.5 | _ | _ | 4 | 86 | | mΑ | V _{OLD} = 1.1 V |
| current* | I _{OHD} | 5.5 | _ | _ | | -75 | V | mA | V _{OHD} = 3.85 V |
| Quiescent supply current | I _{cc} | 5.5 | | 7 | 4.0 | -0 | 40 | μΑ | $V_{IN} = V_{CC}$ 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 _{CC} | 2 to 6 | V | |
| Input and output voltage | V _I , V _O | 0 to V _{CC} | V | |
| Operating temperature | Та | -40 to +85 | °C | |
| Input rise and fall time (except Schmitt inputs) V _{IN} 0.8 to 2.0 V | tr, tf | 8 | ns/V | $V_{CC} = 4.5V$ $V_{CC} = 5.5V$ |

DC Characteristics: HD74ACT112

| Item | Sym- bol | V _{cc} (V) | 1 | Ta = 25°0 | C | +85°C | | Unit | Condition |
|--------------------------------|------------------|---------------------|------|-----------|------|-------|------|------|---|
| | | | min. | typ. | max. | min. | max. | | |
| Input voltage | V _{IH} | 4.5 | 2.0 | 1.5 | _ | 2.0 | _ | V | V _{OUT} = 0.1 V or Vcc-0.1 V |
| | | 5.5 | 2.0 | 1.5 | _ | 2.0 | _ | | |
| | V _{IL} | 4.5 | _ | 1.5 | 0.8 | _ | 0.8 | | V _{OUT} = 0.1 V or Vcc–0.1 V |
| | | 5.5 | _ | 1.5 | 0.8 | _ | 0.8 | | |
| Output voltage | V _{OH} | 4.5 | 4.4 | 4.49 | _ | 4.4 | _ | V | $V_{IN} = V_{IL}$ or V_{IH} |
| | | 5.5 | 5.4 | 5.49 | _ | 5.4 | _ | | $I_{OUT} = -50 \mu A$ |
| | | 4.5 | 3.94 | _ | _ | 3.80 | _ | | $V_{IN} = V_{IL}$ $I_{OH} = -24 \text{ mA}$ |
| | | 5.5 | 4.94 | _ | _ | 4.80 | _ | | $I_{OH} = -24 \text{ mA}$ |
| | V _{OL} | 4.5 | _ | 0.001 | 0.1 | _ | 0.1 | | $V_{IN} = V_{IL}$ or V_{IH} |
| | | 5.5 | _ | 0.001 | 0.1 | _ | 0.1 | | $I_{OUT} = 50 \mu A$ |
| | | 4.5 | _ | _ | 0.32 | _ | 0.37 | | $V_{IN} = V_{IL}$ $I_{OL} = 24 \text{ mA}$ |
| | | 5.5 | _ | _ | 0.32 | _ | 0.37 | | $I_{OL} = 24 \text{ mA}$ |
| Input current | I _{IN} | 5.5 | _ | _ | ±0.1 | _ | ±1.0 | μΑ | $V_{IN} = V_{CC}$ or GND |
| I _{cc} /input current | I _{CCT} | 5.5 | _ | 0.6 | _ | _ | 1.5 | mΑ | $V_{IN} = V_{CC} - 2.1 \text{ V}$ |
| Dynamic output | I _{OLD} | 5.5 | _ | _ | _ | 86 | _ | mA | V _{OLD} = 1.1 V |
| current* | I _{OHD} | 5.5 | _ | _ | | -75 | | mΑ | V _{OHD} = 3.85 V |
| Quiescent supply current | I _{cc} | 5.5 | _ | _ | 4.0 | - | 40 | μΑ | $V_{IN} = V_{CC}$ or ground |

^{*}Maximum test duration 2.0 ms, one output loaded at a time.

AC Characteristics: HD74AC112

| | | | Ta = +25°C | | | Ta = -40°0 | C to +85°C | |
|--|------------------|-----------------------|------------|-----------------------|------|---------------|------------|------|
| | | | V | C _L = 50 p | F | $C_L = 50 pF$ | | |
| Item | Symbol | V _{cc} (V)*1 | Min | Тур | Max | Min | Max | Unit |
| Maximum clock | f _{max} | 3.3 | 125 | | _ | 100 | | MHz |
| frequency | | 5.0 | 150 | | _ | 125 | _ | |
| Propagation delay | t _{PLH} | 3.3 | 1.0 | 11.0 | 14.0 | 1.0 | 15.0 | ns |
| \overline{C}_P to Q or \overline{Q} | | 5.0 | 1.0 | 8.5 | 11.0 | 1.0 | 12.0 | |
| Propagation delay | t _{PHL} | 3.3 | 1.0 | 11.0 | 14.0 | 1.0 | 15.0 | |
| $\overline{\mathbb{C}}_{\mathbb{P}}$ to Q or $\overline{\mathbb{Q}}$ | | 5.0 | 1.0 | 8.5 | 11.0 | 1.0 | 12.0 | |
| Propagation delay | t _{PLH} | 3.3 | 1.0 | 9.5 | 12.5 | 1.0 | 13.5 | |
| \overline{C}_D , \overline{S}_D to Q or \overline{Q} | | 5.0 | 1.0 | 7.0 | 9.5 | 1.0 | 10.5 | |
| Propagation delay | t _{PHL} | 3.3 | 1.0 | 11.5 | 14.5 | 1.0 | 15.5 | |
| \overline{C}_D , \overline{S}_D to Q or \overline{Q} | , | 5.0 | 1.0 | 9.0 | 11.0 | 1.0 | 12.5 | |

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

AC Operating Requirements: HD74AC112

| | | | Ta = +25°C C _∟ = 50 pF | | Ta = -40°C to +85°C C _L = 50 pF | |
|--|------------------|-----------------------|--------------------------------------|-----------|--|------|
| Item | Symbol | V _{cc} (V)*1 | Тур | Guarantee | d Minimum | Unit |
| Setup time | t _{su} | 3.3 | 3.0 | 5.5 | 6.0 | ns |
| J or K to \overline{C}_P | | 5.0 | 2.0 | 4.5 | 4.5 | |
| Hold time | t _h | 3.3 | -1.5 | 0.0 | 0.0 | |
| \overline{C}_{P} to J or K | | 5.0 | -0.5 | 0.0 | 0.0 | |
| Pulse width | t _w | 3.3 | 2.0 | 5.5 | 7.0 | |
| \overline{C}_P or \overline{C}_D or \overline{S}_D | | 5.0 | 2.0 | 4.5 | 5.0 | |
| Recovery time | t _{rec} | 3.3 | 1.5 | 3.5 | 3.5 | |
| \overline{C}_D or \overline{S}_D to \overline{C}_P | | 5.0 | 1.0 | 3.0 | 3.0 | |

Note: 1. Voltage Range 3.3 is $3.3 \text{ V} \pm 0.3 \text{ V}$ Voltage Range 5.0 is $5.0 \text{ V} \pm 0.5 \text{ V}$

AC Characteristics: HD74ACT112

| | | | Ta = +25°C C _L = 50 pF | | | | C to +85°C 50 pF | |
|--|------------------|-----------------------|--------------------------------------|------|------|-----|---------------------|------|
| Item | Symbol | V _{cc} (V)*1 | Min | Тур | Max | Min | Max | Unit |
| Maximum clock frequency | f _{max} | 5.0 | 100 | _ | | 80 | 2 | MHz |
| Propagation delay \overline{C}_P to Q or \overline{Q} | t _{PLH} | 5.0 | 1.0 | 10.5 | 13.0 | 1.0 | 14.0 | ns |
| Propagation delay \overline{C}_P to Q or \overline{Q} | t _{PHL} | 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 _{PLH} | 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 _{PHL} | 5.0 | 1.0 | 10.5 | 12.5 | 1.0 | 13.5 | |

Note: 1. Voltage Range 5.0 is 5.0 V \pm 0.5 V

AC Operating Requirements: HD74ACT112

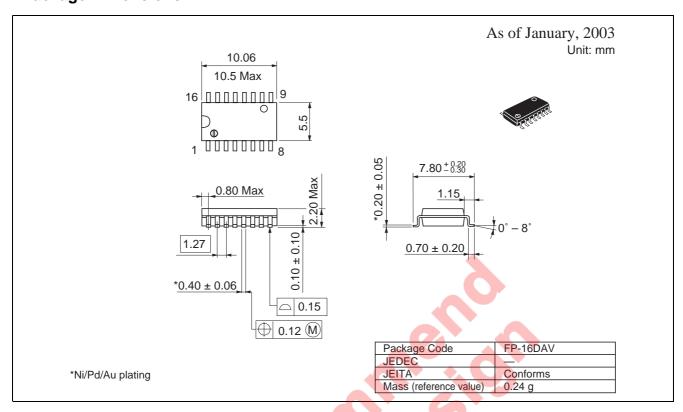
| 4 | .0 | | Ta = +25°C C _L = 50 pF | | Ta = -40°C to +85°C C _L = 50 pF | |
|---|------------------|-----------------------|--------------------------------------|-----------|--|------|
| Item | Symbol | V _{cc} (V)*1 | Тур | Guarantee | d Minimum | Unit |
| Setup time J or K to $\overline{\mathbb{C}}_{P}$ | t _{su} | 5.0 | 2.5 | 7.0 | 8.0 | ns |
| Hold time $\overline{\mathbb{C}}_{P}$ to J or K | t _h | 5.0 | 0.0 | 1.5 | 1.5 | |
| Pulse width \overline{C}_P or \overline{C}_D or \overline{S}_D | t _w | 5.0 | 4.5 | 7.0 | 8.0 | |
| Recovery time \overline{C}_D , \overline{S}_D to \overline{C}_P | t _{rec} | 5.0 | -2.5 | 3.0 | 3.0 | |

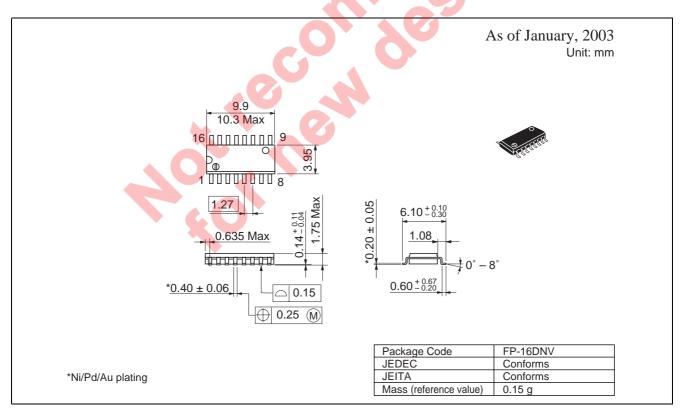
Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

Capacitance

| Item | Symbol | Тур | Unit | Condition |
|-------------------------------|-----------------|------|------|-------------------------|
| Input capacitance | C _{IN} | 4.5 | pF | V _{CC} = 5.5 V |
| Power dissipation capacitance | C_{PD} | 35.0 | pF | V _{CC} = 5.0 V |

Package Dimensions





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