

# HD74AC107/HD74ACT107

## Dual JK Flip-Flop (with Separate Clear and Clock)

REJ03D0243-0200Z  
(Previous ADE-205-363 (Z))  
Rev.2.00  
Jul.16.2004

### Description

The HD74AC107/HD74ACT107 dual JK master/slave flip-flops have a separate clock for each flip-flop. Inputs to the master section are controlled by the clock pulse. The clock pulse also regulates the state of the coupling transistors which connect the master and slave sections. The sequence of operation is as follows: 1) isolate slave from master; 2) enter information from J and K inputs to master; 3) disable J and K inputs; 4) transfer information from master to slave.

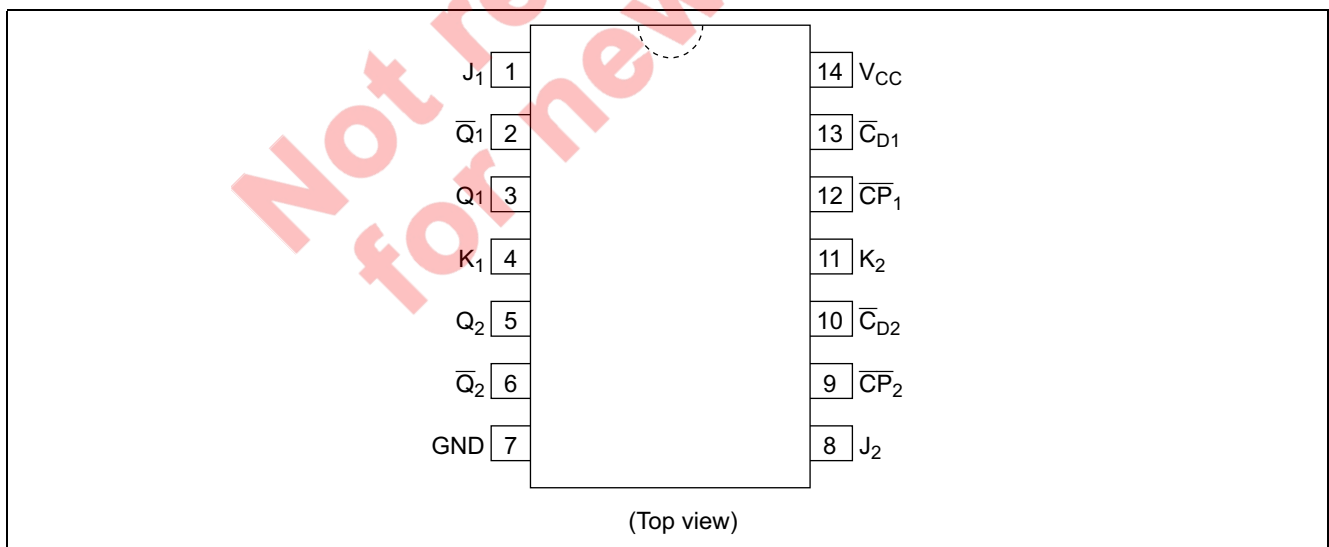
### Features

- Outputs Source/Sink 24 mA
- HD74ACT107 has TTL-Compatible Inputs
- Ordering Information: Ex. HD74AC107

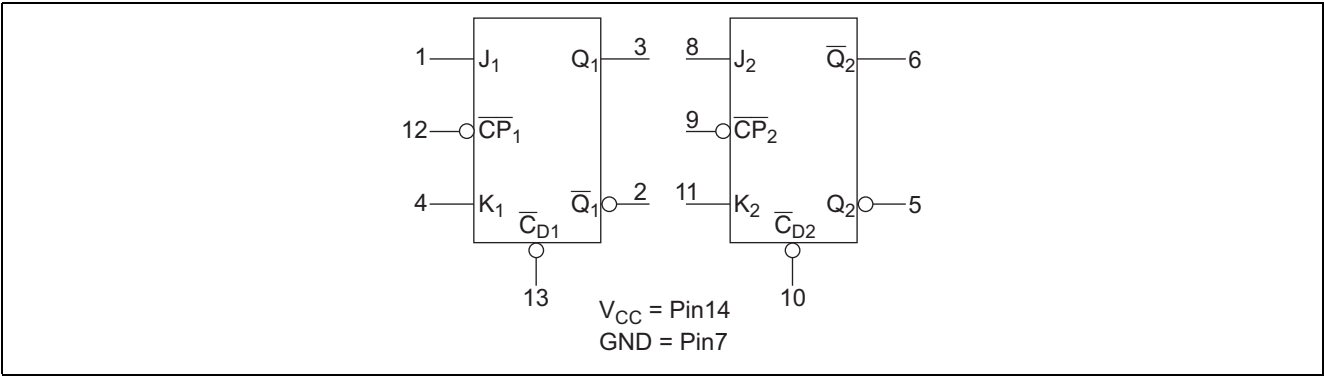
| Part Name     | Package Type       | Package Code | Package Abbreviation | Taping Abbreviation (Quantity) |
|---------------|--------------------|--------------|----------------------|--------------------------------|
| HD74AC107FPEL | SOP-14 pin (JEITA) | FP-14DAV     | FP                   | EL (2,000 pcs/reel)            |
| HD74AC107RPEL | SOP-14 pin (JEDEC) | FP-14DNV     | 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

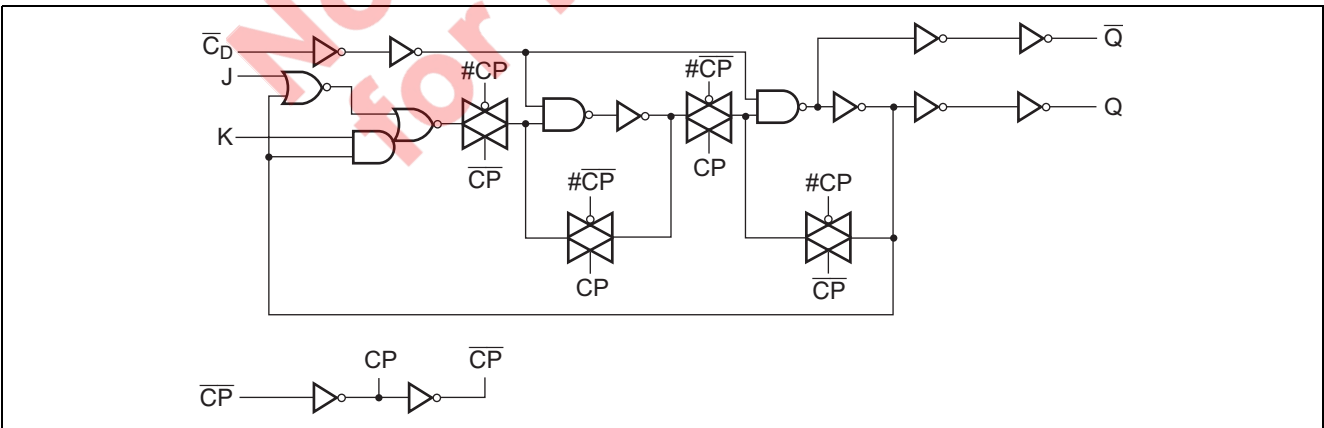
|                                            |                                          |
|--------------------------------------------|------------------------------------------|
| $J_1, J_2, K_1, K_2$                       | Data Inputs                              |
| $\overline{CP}_1, \overline{CP}_2$         | Clock Pulse Inputs (Active Falling Edge) |
| $\overline{CD}_1, \overline{CD}_2$         | Direct Clear Inputs (Active Low)         |
| $Q_1, Q_2, \overline{Q}_1, \overline{Q}_2$ | Outputs                                  |

## Truth Table

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

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

## 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          | °C   |                     |

## Recommended Operating Conditions: HD74AC107

| 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    | °C   |                 |
| Input rise and fall time<br>(except Schmitt inputs)<br>$V_{IN}$ 30% to 70% $V_{CC}$ | $t_r, t_f$ | 8             | ns/V | $V_{CC} = 3.0V$ |
|                                                                                     |            |               |      | $V_{CC} = 4.5V$ |
|                                                                                     |            |               |      | $V_{CC} = 5.5V$ |

## DC Characteristics: HD74AC107

| Item                     | Sym-<br>bol | $V_{CC}$<br>(V) | $T_a = 25^\circ C$ |       |           | $T_a = -40 \text{ to } +85^\circ C$ |           | Unit    | Condition                                                     |                           |
|--------------------------|-------------|-----------------|--------------------|-------|-----------|-------------------------------------|-----------|---------|---------------------------------------------------------------|---------------------------|
|                          |             |                 | min.               | typ.  | max.      | min.                                | max.      |         |                                                               |                           |
| Input Voltage            | $V_{IH}$    | 3.0             | 2.1                | 1.5   | —         | 2.1                                 | —         | V       | $V_{OUT} = 0.1V \text{ or } V_{CC} - 0.1V$                    |                           |
|                          |             | 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       |         | $V_{OUT} = 0.1V \text{ or } V_{CC} - 0.1V$                    |                           |
|                          |             | 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       | $V_{IN} = V_{IL} \text{ or } V_{IH}$<br>$I_{OUT} = -50 \mu A$ |                           |
|                          |             | 4.5             | 4.4                | 4.49  | —         | 4.4                                 | —         |         |                                                               |                           |
|                          |             | 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       |         | $V_{IN} = V_{IL} \text{ or } V_{IH}$<br>$I_{OUT} = 50 \mu A$  |                           |
|                          |             | 4.5             | —                  | 0.001 | 0.1       | —                                   | 0.1       |         |                                                               |                           |
|                          |             | 5.5             | —                  | 0.001 | 0.1       | —                                   | 0.1       |         |                                                               |                           |
|                          |             | 3.0             | —                  | —     | 0.32      | —                                   | 0.37      |         | $V_{IN} = V_{IL} \text{ or } V_{IH}$                          | $I_{OL} = 12 \text{ mA}$  |
|                          |             | 4.5             | —                  | —     | 0.32      | —                                   | 0.37      |         |                                                               | $I_{OL} = 24 \text{ mA}$  |
|                          |             | 5.5             | —                  | —     | 0.32      | —                                   | 0.37      |         |                                                               | $I_{OL} = 24 \text{ mA}$  |
|                          |             | 3.0             | —                  | —     | —         | —                                   | —         |         | $V_{IN} = V_{CC} \text{ or GND}$                              |                           |
|                          |             | 4.5             | —                  | —     | —         | —                                   | —         |         |                                                               |                           |
| Input leakage current    | $I_{IN}$    | 5.5             | —                  | —     | $\pm 0.1$ | —                                   | $\pm 1.0$ | $\mu A$ |                                                               |                           |
| Dynamic output current*  | $I_{OLD}$   | 5.5             | —                  | —     | —         | 86                                  | —         | mA      | $V_{OLD} = 1.1V$                                              |                           |
|                          | $I_{OHD}$   | 5.5             | —                  | —     | —         | -75                                 | —         | mA      | $V_{OHD} = 3.85V$                                             |                           |
| Quiescent supply current | $I_{CC}$    | 5.5             | —                  | —     | 4.0       | —                                   | 40        | $\mu A$ | $V_{IN} = V_{CC} \text{ or ground}$                           |                           |

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

## Recommended Operating Conditions: HD74ACT107

| 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    | °C   |                                    |
| Input rise and fall time<br>(except Schmitt inputs)<br>$V_{IN}$ 0.8 to 2.0 V | $t_r, t_f$ | 8             | ns/V | $V_{CC} = 4.5V$<br>$V_{CC} = 5.5V$ |

## DC Characteristics: HD74ACT107

| Item                     | Symbol    | $V_{CC}$<br>(V) | $T_a = 25^\circ C$ |       |           | $T_a = -40$ to<br>+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 $V_{CC}-0.1 V$                    |
|                          |           | 5.5             | 2.0                | 1.5   | —         | 2.0                     | —         |         |                                                        |
|                          | $V_{IL}$  | 4.5             | —                  | 1.5   | 0.8       | —                       | 0.8       |         | $V_{OUT} = 0.1 V$ or $V_{CC}-0.1 V$                    |
|                          |           | 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 $V_{IH}$<br>$I_{OUT} = -50 \mu A$ |
|                          |           | 5.5             | 5.4                | 5.49  | —         | 5.4                     | —         |         |                                                        |
|                          |           | 4.5             | 3.94               | —     | —         | 3.80                    | —         |         |                                                        |
|                          |           | 5.5             | 4.94               | —     | —         | 4.80                    | —         |         |                                                        |
|                          | $V_{OL}$  | 4.5             | —                  | 0.001 | 0.1       | —                       | 0.1       |         | $V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OUT} = 50 \mu A$  |
|                          |           | 5.5             | —                  | 0.001 | 0.1       | —                       | 0.1       |         |                                                        |
|                          |           | 4.5             | —                  | —     | 0.32      | —                       | 0.37      |         |                                                        |
|                          |           | 5.5             | —                  | —     | 0.32      | —                       | 0.37      |         |                                                        |
|                          |           | 4.5             | —                  | —     | —         | —                       | —         |         | $V_{IN} = V_{IL}$<br>$I_{OL} = 24 mA$                  |
|                          |           | 5.5             | —                  | —     | —         | —                       | —         |         |                                                        |
|                          |           | 4.5             | —                  | —     | —         | —                       | —         |         | $V_{IN} = V_{IL}$<br>$I_{OL} = 24 mA$                  |
|                          |           | 5.5             | —                  | —     | —         | —                       | —         |         |                                                        |
| Input current            | $I_{IN}$  | 5.5             | —                  | —     | $\pm 0.1$ | —                       | $\pm 1.0$ | $\mu A$ | $V_{IN} = V_{CC}$ or GND                               |
| $I_{CC}$ /input current  | $I_{CCT}$ | 5.5             | —                  | 0.6   | —         | —                       | 1.5       | mA      | $V_{IN} = V_{CC}-2.1 V$                                |
| Dynamic output current*  | $I_{OLD}$ | 5.5             | —                  | —     | —         | 86                      | —         | mA      | $V_{OLD} = 1.1 V$                                      |
|                          | $I_{OHD}$ | 5.5             | —                  | —     | —         | -75                     | —         | mA      | $V_{OHD} = 3.85 V$                                     |
| Quiescent supply current | $I_{CC}$  | 5.5             | —                  | —     | 4.0       | —                       | 40        | $\mu A$ | $V_{IN} = V_{CC}$ or ground                            |

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

## AC Characteristics: HD74AC107

| Item                                               | Symbol    | $V_{CC}$ (V)* <sup>1</sup> | $T_a = +25^\circ C$<br>$C_L = 50 pF$ |      |      | $T_a = -40^\circ C$ to +85°C<br>$C_L = 50 pF$ |      | Unit |
|----------------------------------------------------|-----------|----------------------------|--------------------------------------|------|------|-----------------------------------------------|------|------|
|                                                    |           |                            | Min                                  | Typ  | Max  | Min                                           | Max  |      |
| Maximum clock frequency                            | $f_{max}$ | 3.3                        | 125                                  | —    | —    | 100                                           | —    | MHz  |
|                                                    |           | 5.0                        | 150                                  | —    | —    | 125                                           | —    |      |
| Propagation delay<br>$\bar{C}_P$ to Q or $\bar{Q}$ | $t_{PLH}$ | 3.3                        | 1.0                                  | 9.5  | 13.0 | 1.0                                           | 14.0 | ns   |
|                                                    |           | 5.0                        | 1.0                                  | 7.5  | 10.0 | 1.0                                           | 11.0 |      |
| Propagation delay<br>$\bar{C}_P$ to Q or $\bar{Q}$ | $t_{PHL}$ | 3.3                        | 1.0                                  | 10.0 | 13.5 | 1.0                                           | 14.5 | ns   |
|                                                    |           | 5.0                        | 1.0                                  | 8.0  | 10.5 | 1.0                                           | 11.5 |      |
| Propagation delay<br>$\bar{C}_D$ to $\bar{Q}$      | $t_{PLH}$ | 3.3                        | 1.0                                  | 9.5  | 13.0 | 1.0                                           | 14.0 | ns   |
|                                                    |           | 5.0                        | 1.0                                  | 7.5  | 10.0 | 1.0                                           | 11.0 |      |
| Propagation delay<br>$\bar{C}_D$ to $\bar{Q}$      | $t_{PHL}$ | 3.3                        | 1.0                                  | 9.5  | 13.0 | 1.0                                           | 14.0 | ns   |
|                                                    |           | 5.0                        | 1.0                                  | 7.5  | 10.0 | 1.0                                           | 11.0 |      |

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

## Operating Requirements: HD74AC107

| Item                                                  | Symbol           | V <sub>CC</sub> (V)*1 | Ta = +25°C<br>C <sub>L</sub> = 50 pF |                    | Ta = −40°C<br>to +85°C<br>C <sub>L</sub> = 50 pF | Unit |
|-------------------------------------------------------|------------------|-----------------------|--------------------------------------|--------------------|--------------------------------------------------|------|
|                                                       |                  |                       | Typ                                  | Guaranteed Minimum |                                                  |      |
| Setup time<br>J or k to $\overline{C}_p$              | t <sub>su</sub>  | 3.3                   | 3.0                                  | 5.5                | 6.0                                              | ns   |
|                                                       |                  | 5.0                   | 2.0                                  | 4.0                | 4.5                                              |      |
| Hold time<br>$\overline{C}_p$ to J or k               | t <sub>h</sub>   | 3.3                   | −1.5                                 | 0.0                | 0.0                                              |      |
|                                                       |                  | 5.0                   | −0.5                                 | 0.0                | 0.0                                              |      |
| Pulse width<br>$\overline{C}_p$ or $\overline{C}_D$   | t <sub>w</sub>   | 3.3                   | 2.0                                  | 5.5                | 7.0                                              |      |
|                                                       |                  | 5.0                   | 2.0                                  | 4.5                | 5.0                                              |      |
| Recovery time<br>$\overline{C}_D$ to $\overline{C}_p$ | t <sub>rec</sub> | 3.3                   | 1.5                                  | 3.0                | 3.0                                              |      |
|                                                       |                  | 5.0                   | 1.0                                  | 3.0                | 3.0                                              |      |

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 Characteristics: HD74ACT107

| Item                                                         | Symbol    | $V_{CC} (V)^{*1}$ | Ta = +25°C<br>C <sub>L</sub> = 50 pF |      |      | Ta = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Unit |
|--------------------------------------------------------------|-----------|-------------------|--------------------------------------|------|------|-----------------------------------------------|------|------|
|                                                              |           |                   | Min                                  | Typ  | Max  | Min                                           | Max  |      |
| Maximum clock frequency                                      | $f_{max}$ | 5.0               | 100                                  | —    | —    | 80                                            | —    | MHz  |
| Propagation delay<br>$\overline{C}_P$ to Q or $\overline{Q}$ | $t_{PLH}$ | 5.0               | 1.0                                  | 9.5  | 12.5 | 1.0                                           | 13.5 | ns   |
| Propagation delay<br>$\overline{C}_P$ to Q or $\overline{Q}$ | $t_{PHL}$ | 5.0               | 1.0                                  | 10.5 | 13.0 | 1.0                                           | 14.0 |      |
| Propagation delay<br>$\overline{C}_D$ to Q                   | $t_{PLH}$ | 5.0               | 1.0                                  | 8.5  | 11.0 | 1.0                                           | 12.0 |      |
| Propagation delay<br>$\overline{C}_D$ to Q                   | $t_{PHL}$ | 5.0               | 1.0                                  | 8.5  | 11.0 | 1.0                                           | 12.0 |      |

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

## Operating Requirements: HD74ACT107

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

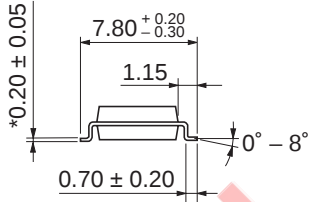
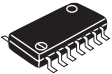
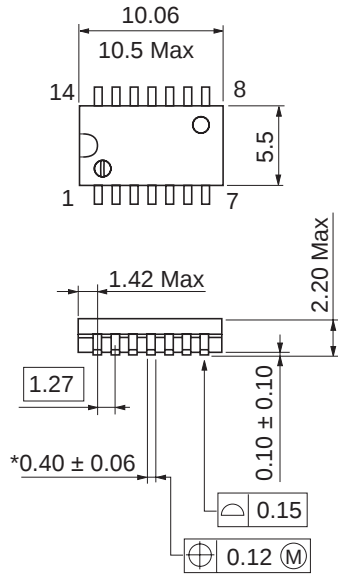
Note: 1. Voltage Range 5.0 is 5.0 V  $\pm$  0.5 V

## Capacitance

| Item                          | Symbol   | Typ  | 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

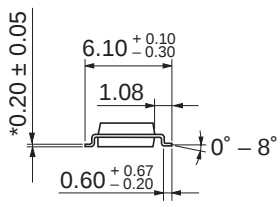
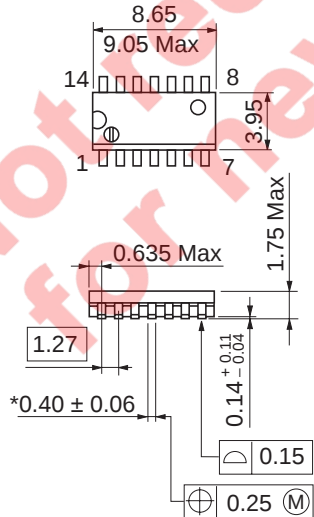
As of January, 2003  
Unit: mm



|                        |          |
|------------------------|----------|
| Package Code           | FP-14DAV |
| JEDEC                  | —        |
| JEITA                  | Conforms |
| Mass (reference value) | 0.23 g   |

\*Ni/Pd/Au plating

As of January, 2003  
Unit: mm



|                        |          |
|------------------------|----------|
| Package Code           | FP-14DNV |
| JEDEC                  | Conforms |
| JEITA                  | Conforms |
| Mass (reference value) | 0.13 g   |

\*Ni/Pd/Au plating

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