

# HD74AC74

## Dual D-Type Positive Edge-Triggered Flip-Flop

REJ03D0277-0200Z  
 (Previous ADE-205-361 (Z))  
 Rev.2.00  
 Jul.16.2004

### Description

The HD74AC74 is a dual D-type flip-flop with Asynchronous Clear and Set inputs and complementary (Q,  $\bar{Q}$ ) outputs. Information at the input is transferred to the outputs on the positive edge of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive-going pulse. After the Clock Pulse input threshold voltage has been passed, the Data input is locked out and information present will not be transferred to the outputs until the next rising edge of the Clock Pulse input.

### Features

Asynchronous Inputs:

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

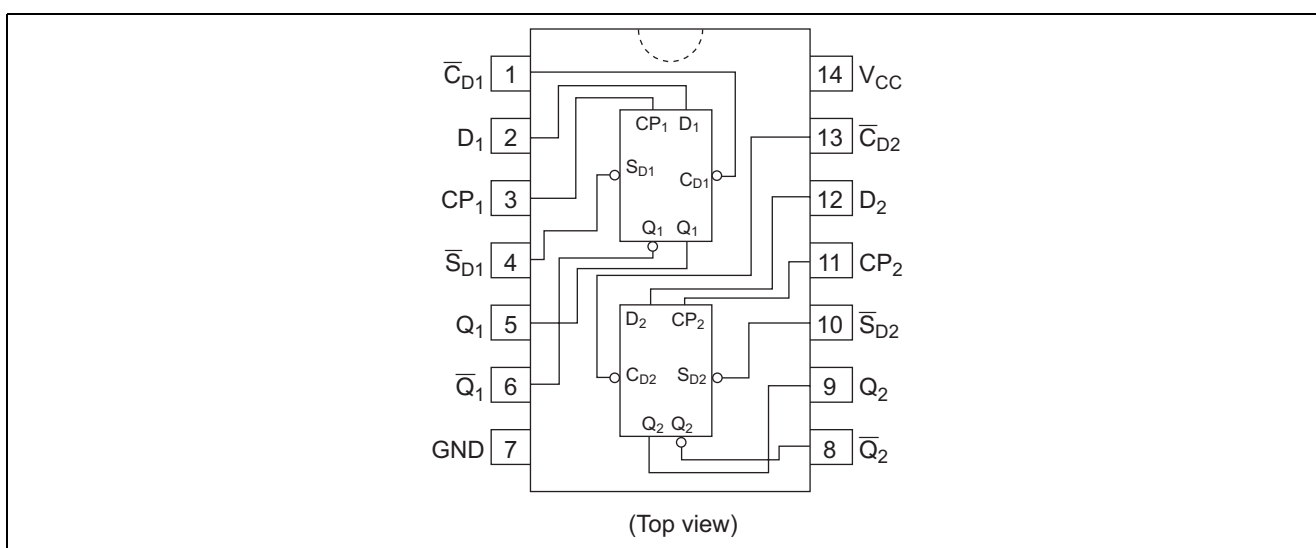
- Outputs Source/Sink 24 mA
- Ordering Information

| Part Name    | Package Type       | Package Code | Package Abbreviation | Taping Abbreviation (Quantity) |
|--------------|--------------------|--------------|----------------------|--------------------------------|
| HD74AC74P    | DIP-14 pin         | DP-14, -14AV | P                    | —                              |
| HD74AC74FPEL | SOP-14 pin (JEITA) | FP-14DAV     | FP                   | EL (2,000 pcs/reel)            |
| HD74AC74RPEL | SOP-14 pin (JEDEC) | FP-14DNV     | RP                   | EL (2,500 pcs/reel)            |
| HD74AC74TELL | TSSOP-14 pin       | TTP-14DV     | T                    | ELL (2,000 pcs/reel)           |

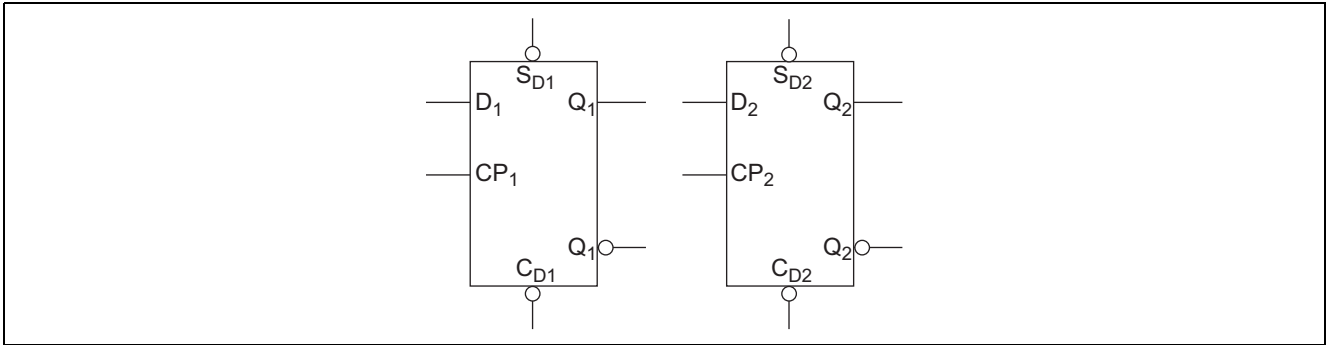
Notes: 1. Please consult the sales office for the above package availability.

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**

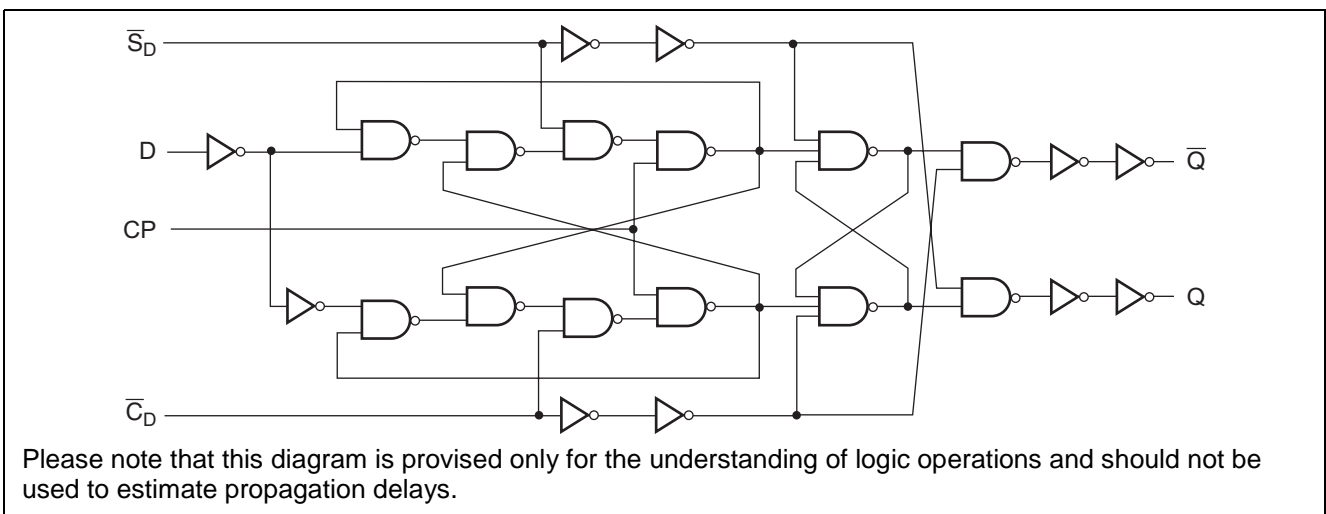
- $D_1, D_2$  Data Inputs
- $CP_1, CP_2$  Clock Pulse Inputs
- $\overline{C}_{D1}, \overline{C}_{D2}$  Direct Clear Inputs
- $\overline{S}_{D1}, \overline{S}_{D2}$  Direct Set Inputs
- $Q_1, \overline{Q}_1, Q_2, \overline{Q}_2$  Outputs

**Truth Table (Each Half)**

| Inputs           |                  |    |   | Outputs |                  |
|------------------|------------------|----|---|---------|------------------|
| $\overline{S}_D$ | $\overline{C}_D$ | CP | D | Q       | $\overline{Q}$   |
| L                | H                | X  | X | H       | L                |
| H                | L                | X  | X | L       | H                |
| L                | L                | X  | X | H       | H                |
| H                | H                |    | H | H       | L                |
| H                | H                |    | L | L       | H                |
| H                | H                | L  | X | $Q_0$   | $\overline{Q}_0$ |

- H : High Voltage Level
- L : Low Voltage Level
- X : Immaterial
- : Low-to-High Clock Transition
- $Q_0 (\overline{Q}_0)$  : Previous Q ( $\overline{Q}$ ) before Low-to-High Transition of Clock

**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

| 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<br>(except Schmitt inputs)<br>$V_{IN}$ 30% to 70% $V_{CC}$ | tr, tf     | 8             | ns/V        | $V_{CC} = 3.0V$ |
|   |            |               |             | $V_{CC} = 4.5V$ |
|   |            |               |             | $V_{CC} = 5.5V$ |

## DC Characteristics

| Item                     | Sym-<br>bol | Vcc<br>(V) | $T_a = 25^{\circ}C$ |       |           | $T_a = -40$ to<br>$+85^{\circ}C$ |           | Unit    | Condition  |  |  |  |
|--------------------------|-------------|------------|---------------------|-------|-----------|----------------------------------|-----------|---------|--|--|--|--|
|                          |             |            | min.                | typ.  | max.      | min.                             | max.      |         |  |  |  |  |
| Input Voltage            | $V_{IH}$    | 3.0        | 2.1                 | 1.5   | —         | 2.1                              | —         | V       | $V_{OUT} = 0.1V$ 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       |         |  |  | $V_{OUT} = 0.1V$ 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       | $V_{IN} = V_{IL}$ 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                             | —         |         |  |  | $V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OH} = -12 \text{ mA}$<br>$I_{OH} = -24 \text{ mA}$<br>$I_{OH} = -24 \text{ mA}$ |  |
|                          |             | 4.5        | 3.94                | —     | —         | 3.80                             | —         |         |  |  |  |  |
|                          |             | 5.5        | 4.94                | —     | —         | 4.80                             | —         |         |  |  |  |  |
|                          | $V_{OL}$    | 3.0        | —                   | 0.002 | 0.1       | —                                | 0.1       |         | $V_{IN} = V_{IL}$ 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      |         |  |  | $V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OL} = 12 \text{ mA}$<br>$I_{OL} = 24 \text{ mA}$<br>$I_{OL} = 24 \text{ mA}$    |  |
|                          |             | 4.5        | —                   | —     | 0.32      | —                                | 0.37      |         |  |  |  |  |
|                          |             | 5.5        | —                   | —     | 0.32      | —                                | 0.37      |         |  |  |  |  |
| Input leakage current    | $I_{IN}$    | 5.5        | —                   | —     | $\pm 0.1$ | —                                | $\pm 1.0$ | $\mu A$ | $V_{IN} = V_{CC}$ or GND                               |  |  |  |
| 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        | $\mu A$ | $V_{IN} = V_{CC}$ or ground                            |  |  |  |

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

## AC Characteristics

| Item  | Symbol           | V <sub>CC</sub> (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 <sub>max</sub> | 3.3                   | 100                                  | 125  | —    | 95  | —    | MHz  |
|   |                  | 5.0                   | 140                                  | 160  | —    | 125   | —    |      |
| Propagation delay<br>C <sub>Dn</sub> or S <sub>Dn</sub> to Q <sub>n</sub> or Q <sub>n</sub> | t <sub>PLH</sub> | 3.3                   | 1.0                                  | 8.0  | 12.0 | 1.0   | 13.0 | ns   |
|   |                  | 5.0                   | 1.0                                  | 6.0  | 9.0  | 1.0   | 10.0 |      |
| Propagation delay<br>C <sub>Dn</sub> or S <sub>Dn</sub> to Q <sub>n</sub> or Q <sub>n</sub> | t <sub>PHL</sub> | 3.3                   | 1.0                                  | 10.5 | 12.0 | 1.0   | 13.5 | ns   |
|   |                  | 5.0                   | 1.0                                  | 8.0  | 9.5  | 1.0   | 10.5 |      |
| Propagation delay<br>CP <sub>n</sub> to Q <sub>n</sub> or Q <sub>n</sub>                    | t <sub>PLH</sub> | 3.3                   | 1.0                                  | 8.0  | 13.5 | 1.0   | 16.0 | ns   |
|   |                  | 5.0                   | 1.0                                  | 6.0  | 10.0 | 1.0   | 10.5 |      |
| Propagation delay<br>CP <sub>n</sub> to Q <sub>n</sub> or Q <sub>n</sub>                    | t <sub>PHL</sub> | 3.3                   | 1.0                                  | 8.0  | 14.0 | 1.0   | 14.5 | ns   |
|   |                  | 5.0                   | 1.0                                  | 6.0  | 10.0 | 1.0   | 10.5 |      |

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

| 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 |  |      |
| Set-up time, HIGH or LOW<br>D <sub>n</sub> to CP <sub>n</sub>        | t <sub>su</sub>  | 3.3                   | 1.5                                  | 4.0                | 4.5  | ns   |
|  |                  | 5.0                   | 1.0                                  | 3.0                | 3.0  |      |
| Hold time, HIGH or LOW<br>D <sub>n</sub> to CP <sub>n</sub>          | t <sub>h</sub>   | 3.3                   | -2.0                                 | 0                  | 0  | ns   |
|  |                  | 5.0                   | -1.5                                 | 0                  | 0  |      |
| CP <sub>n</sub> or C <sub>Dn</sub> or S <sub>Dn</sub><br>Pulse width | t <sub>w</sub>   | 3.3                   | 3.0                                  | 5.5                | 7.0  | ns   |
|  |                  | 5.0                   | 2.5                                  | 4.5                | 5.0  |      |
| Recovery time<br>C <sub>Dn</sub> or S <sub>Dn</sub> to CP            | t <sub>rec</sub> | 3.3                   | -2.5                                 | 0                  | 0  | ns   |
|  |                  | 5.0                   | -2.0                                 | 0                  | 0  |      |

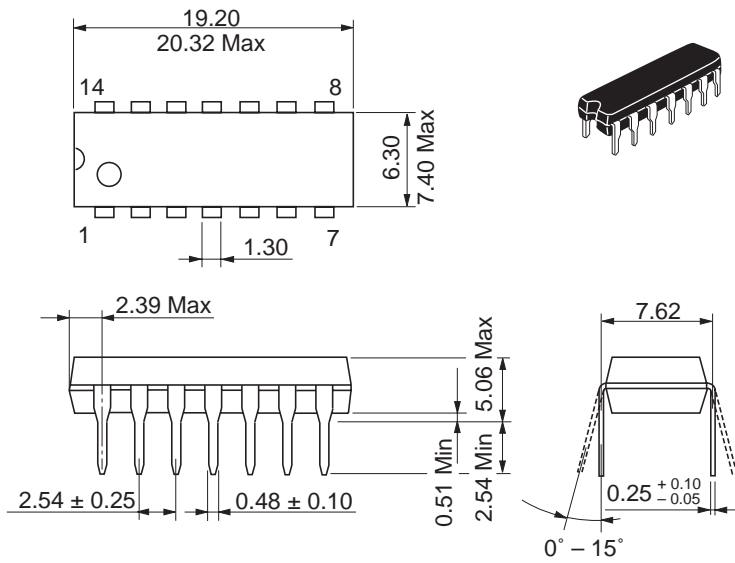
Note: 1. Voltage Range 3.3 is 3.3 V ± 0.3 V  
Voltage Range 5.0 is 5.0 V ± 0.5 V

## 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 |

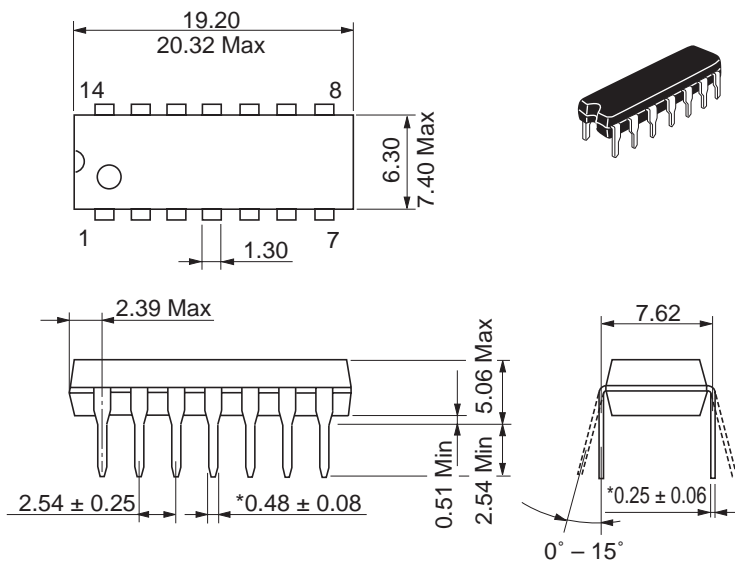
Package Dimensions

As of January, 2003  
Unit: mm



|                        |          |
|------------------------|----------|
| Package Code           | DP-14    |
| JEDEC                  | Conforms |
| JEITA                  | Conforms |
| Mass (reference value) | 0.97 g   |

Unit: mm

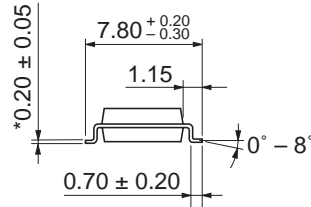
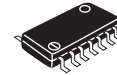
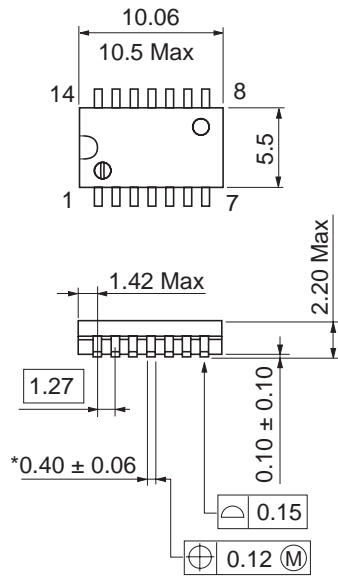


\*Ni/Pd/AU Plating

|                        |          |
|------------------------|----------|
| Package Code           | DP-14AV  |
| JEDEC                  | Conforms |
| JEITA                  | Conforms |
| Mass (reference value) | 0.97 g   |

As of January, 2003

Unit: mm

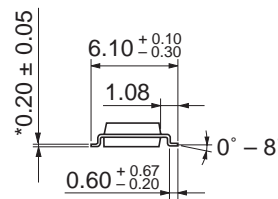
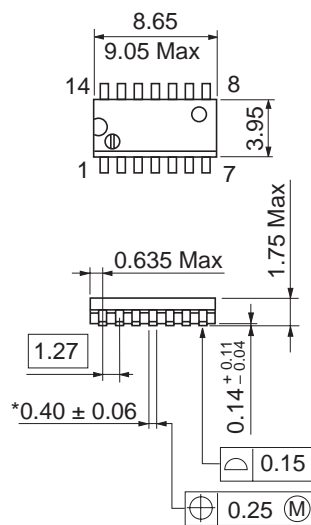


\*Ni/Pd/Au plating

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

As of January, 2003

Unit: mm

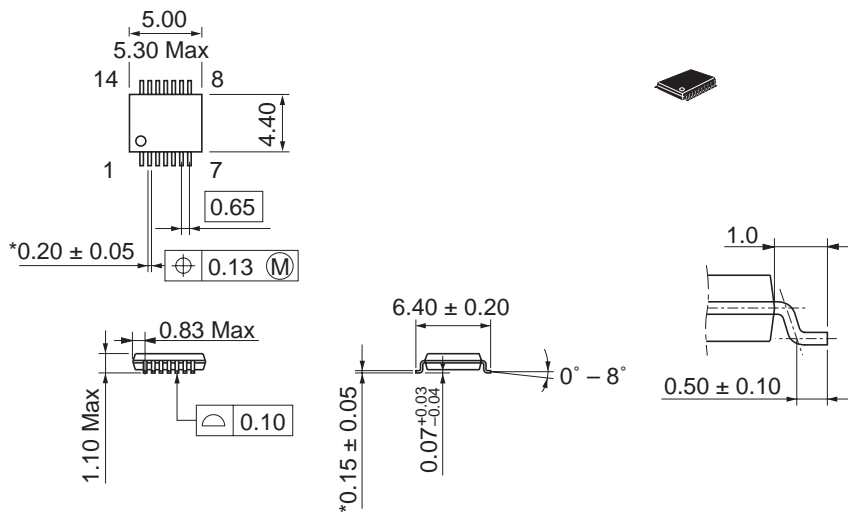


\*Ni/Pd/Au plating

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

As of January, 2003

Unit: mm



\*Ni/Pd/Au plating

|                        |          |
|------------------------|----------|
| Package Code           | TTP-14DV |
| JEDEC                  | —        |
| JEITA                  | —        |
| Mass (reference value) | 0.05 g   |

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