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# HD74HC78

Dual J-K Flip-Flops (with Preset, Common Clear and  
Common Clock)

# HITACHI

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## Description

This flip-flop is edge sensitive to the clock input and change state on the negative transition of the clock pulse. Each flip-flop has independent J, K, and preset inputs and Q and  $\bar{Q}$  outputs. Two flip-flops are controlled by a common clear and a common clock. Preset and clear are independent of the clock and accomplished by a low logic level on the corresponding input.

## Features

- High Speed Operation:  $t_{pd}$  (Clock to Q) = 20 ns typ ( $C_L = 50$  pF)
- High Output Current: Fanout of 10 LSTTL Loads
- Wide Operating Voltage:  $V_{CC} = 2$  to 6 V
- Low Input Current: 1  $\mu$ A max
- Low Quiescent Supply Current:  $I_{CC}$  (static) = 2  $\mu$ A max ( $T_a = 25^\circ\text{C}$ )

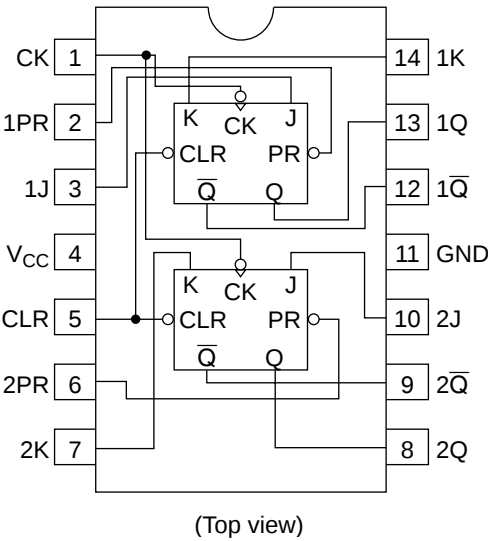
# HD74HC78

## Function Table

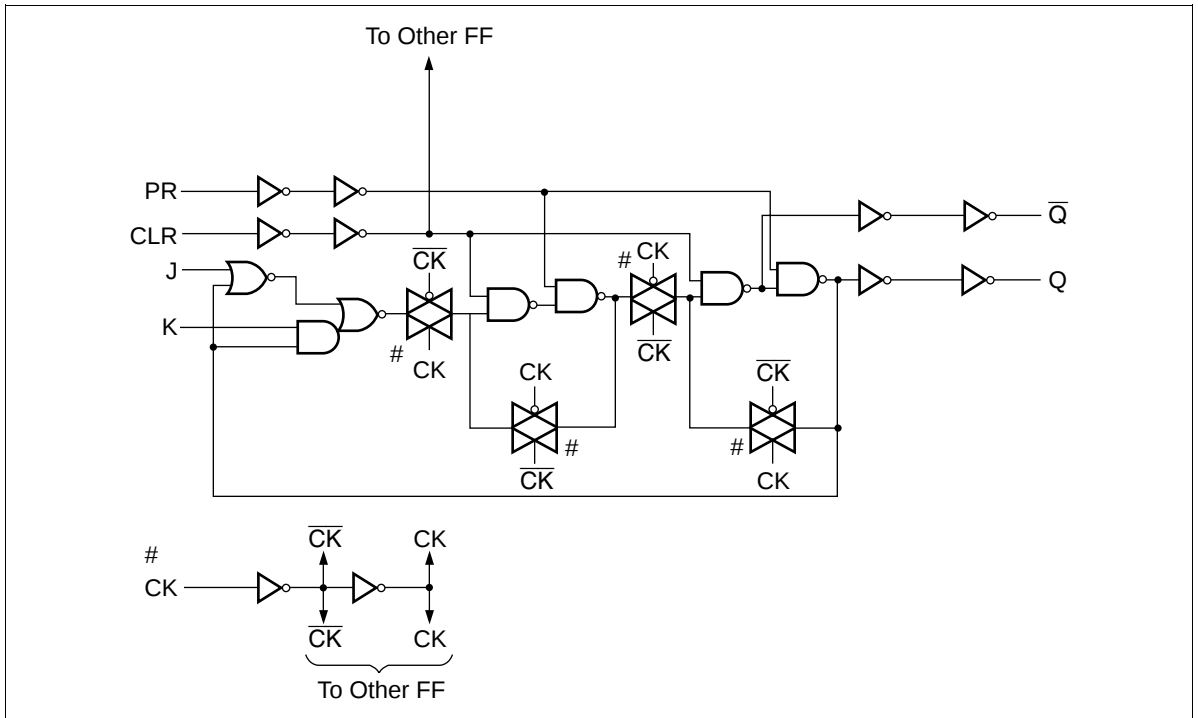
| Inputs |       |                                                                                   |   |   | Outputs         |                 |
|--------|-------|-----------------------------------------------------------------------------------|---|---|-----------------|-----------------|
| Preset | Clear | Clock                                                                             | J | K | Q               | $\overline{Q}$  |
| L      | H     | X                                                                                 | X | X | H               | L               |
| H      | L     | X                                                                                 | X | X | L               | H               |
| L      | L     | X                                                                                 | X | X | H <sup>*1</sup> | H <sup>*1</sup> |
| H      | H     |  | L | L | No change       |                 |
| H      | H     |  | L | H | L               | H               |
| H      | H     |  | H | L | H               | L               |
| H      | H     |  | H | H | Toggle          |                 |
| H      | H     | L                                                                                 | X | X | No change       |                 |
| H      | H     | H                                                                                 | X | X | No change       |                 |
| H      | H     |  | X | X | No change       |                 |

Note: 1. Q and  $\overline{Q}$  will remain HIGH as long as Preset and Clear are Low, but Q and  $\overline{Q}$  are unpredictable, if Preset and Clear go HIGH simultaneously.

## Pin Arrangement



Block Diagram (1//2)

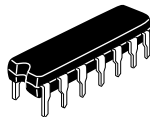
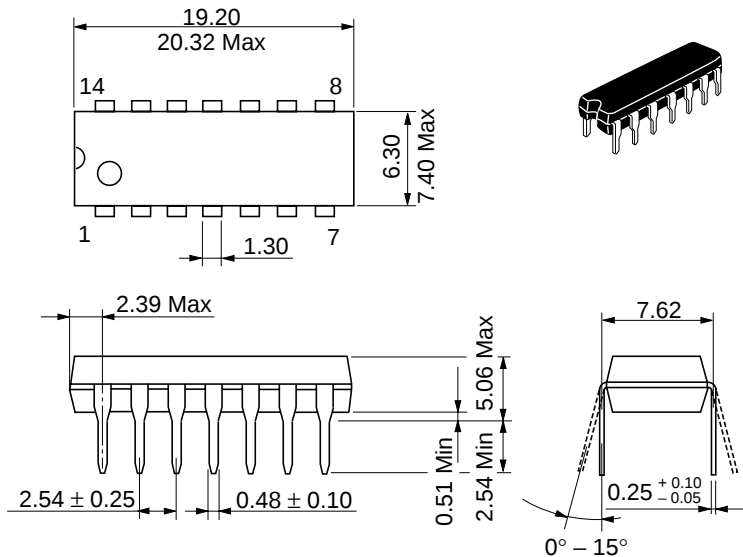


DC Characteristics

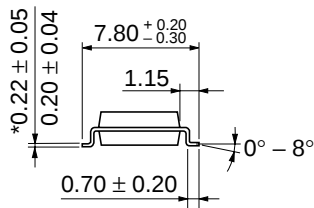
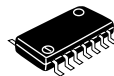
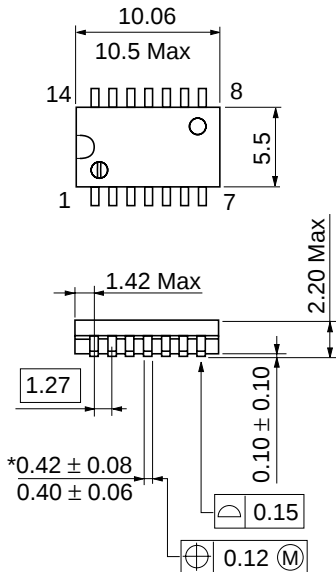
| Item                     | Symbol          | V <sub>CC</sub> (V) | Ta = 25°C |     |      | Ta = -40 to +85°C |      | Unit | Test Conditions                                                   |
|--------------------------|-----------------|---------------------|-----------|-----|------|-------------------|------|------|-------------------------------------------------------------------|
|                          |                 |                     | Min       | Typ | Max  | Min               | Max  |      |                                                                   |
| Input voltage            | V <sub>IH</sub> | 2.0                 | 1.5       | —   | —    | 1.5               | —    | V    | Vin = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -20 μA |
|                          |                 | 4.5                 | 3.15      | —   | —    | 3.15              | —    |      |                                                                   |
|                          |                 | 6.0                 | 4.2       | —   | —    | 4.2               | —    |      |                                                                   |
|                          | V <sub>IL</sub> | 2.0                 | —         | —   | 0.5  | —                 | 0.5  | V    |                                                                   |
|                          |                 | 4.5                 | —         | —   | 1.35 | —                 | 1.35 |      |                                                                   |
|                          |                 | 6.0                 | —         | —   | 1.8  | —                 | 1.8  |      |                                                                   |
| Output voltage           | V <sub>OH</sub> | 2.0                 | 1.9       | 2.0 | —    | 1.9               | —    | V    | I <sub>OH</sub> = -4 mA                                           |
|                          |                 | 4.5                 | 4.4       | 4.5 | —    | 4.4               | —    |      |                                                                   |
|                          |                 | 6.0                 | 5.9       | 6.0 | —    | 5.9               | —    |      |                                                                   |
|                          |                 | 4.5                 | 4.18      | —   | —    | 4.13              | —    |      |                                                                   |
|                          |                 | 6.0                 | 5.68      | —   | —    | 5.63              | —    |      |                                                                   |
|                          | V <sub>OL</sub> | 2.0                 | —         | 0.0 | 0.1  | —                 | 0.1  | V    | I <sub>OL</sub> = 20 μA                                           |
|                          |                 | 4.5                 | —         | 0.0 | 0.1  | —                 | 0.1  |      |                                                                   |
|                          |                 | 6.0                 | —         | 0.0 | 0.1  | —                 | 0.1  |      |                                                                   |
|                          |                 | 4.5                 | —         | —   | 0.26 | —                 | 0.33 |      |                                                                   |
|                          |                 | 6.0                 | —         | —   | 0.26 | —                 | 0.33 |      |                                                                   |
| Input current            | I <sub>in</sub> | 6.0                 | —         | —   | ±0.1 | —                 | ±1.0 | μA   | Vin = V <sub>CC</sub> or GND                                      |
| Quiescent supply current | I <sub>CC</sub> | 6.0                 | —         | —   | 2.0  | —                 | 20   | μA   | Vin = V <sub>CC</sub> or GND, I <sub>out</sub> = 0 μA             |

AC Characteristics ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

| Item                    | Symbol                 | $V_{CC} \text{ (V)}$ | $T_a = 25^\circ\text{C}$ |     |     | $T_a = -40 \text{ to } +85^\circ\text{C}$ |     | Unit | Test Conditions          |
|-------------------------|------------------------|----------------------|--------------------------|-----|-----|-------------------------------------------|-----|------|--------------------------|
|                         |                        |                      | Min                      | Typ | Max | Min                                       | Max |      |                          |
| Maximum clock frequency | $f_{\max}$             | 2.0                  | —                        | —   | 6   | —                                         | 5   | MHz  |                          |
|                         |                        | 4.5                  | —                        | —   | 30  | —                                         | 24  |      |                          |
|                         |                        | 6.0                  | —                        | —   | 35  | —                                         | 28  |      |                          |
| Propagation delay time  | $t_{PLH}$              | 2.0                  | —                        | —   | 150 | —                                         | 190 | ns   | Clock to Q or $\bar{Q}$  |
|                         |                        | 4.5                  | —                        | 20  | 30  | —                                         | 38  |      |                          |
|                         |                        | 6.0                  | —                        | —   | 26  | —                                         | 33  |      |                          |
|                         | $t_{PHL}$              | 2.0                  | —                        | —   | 140 | —                                         | 175 |      | Clear to Q or $\bar{Q}$  |
|                         |                        | 4.5                  | —                        | 18  | 28  | —                                         | 35  |      |                          |
|                         |                        | 6.0                  | —                        | —   | 24  | —                                         | 30  |      |                          |
|                         | $t_{PHL}$              | 2.0                  | —                        | —   | 140 | —                                         | 175 |      | Preset to Q or $\bar{Q}$ |
|                         |                        | 4.5                  | —                        | 18  | 28  | —                                         | 35  |      |                          |
|                         |                        | 6.0                  | —                        | —   | 24  | —                                         | 30  |      |                          |
| Pulse width             | $t_w$                  | 2.0                  | 80                       | —   | —   | 100                                       | —   | ns   | Clock, Preset, Clear     |
|                         |                        | 4.5                  | 16                       | 8   | —   | 20                                        | —   |      |                          |
|                         |                        | 6.0                  | 14                       | —   | —   | 17                                        | —   |      |                          |
| Setup time              | $t_{su}$               | 2.0                  | 100                      | —   | —   | 125                                       | —   | ns   | J or K to Clock          |
|                         |                        | 4.5                  | 20                       | 2   | —   | 25                                        | —   |      |                          |
|                         |                        | 6.0                  | 17                       | —   | —   | 21                                        | —   |      |                          |
| Hold time               | $t_h$                  | 2.0                  | 5                        | —   | —   | 5                                         | —   | ns   | Clock to J or K          |
|                         |                        | 4.5                  | 5                        | -1  | —   | 5                                         | —   |      |                          |
|                         |                        | 6.0                  | 5                        | —   | —   | 5                                         | —   |      |                          |
| Removal time            | $t_{rem}$              | 2.0                  | 100                      | —   | —   | 125                                       | —   | ns   | Preset or Clear to Clock |
|                         |                        | 4.5                  | 20                       | 0   | —   | 25                                        | —   |      |                          |
|                         |                        | 6.0                  | 17                       | —   | —   | 21                                        | —   |      |                          |
| Output rise/fall time   | $t_{TLH}$<br>$t_{THL}$ | 2.0                  | —                        | —   | 75  | —                                         | 95  | ns   |                          |
|                         |                        | 4.5                  | —                        | 5   | 15  | —                                         | 19  |      |                          |
|                         |                        | 6.0                  | —                        | —   | 13  | —                                         | 16  |      |                          |
| Input capacitance       | $C_{in}$               | —                    | —                        | 5   | 10  | —                                         | 10  | pF   |                          |

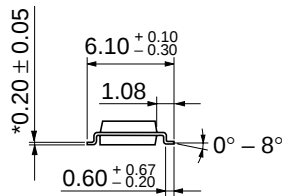
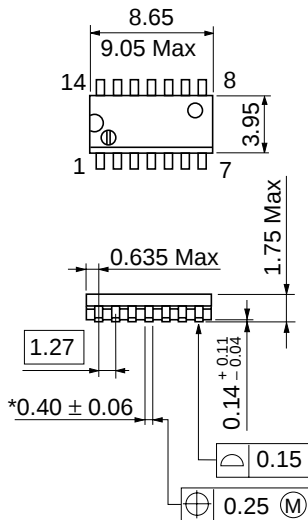


|                          |          |
|--------------------------|----------|
| Hitachi Code             | DP-14    |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.97 g   |

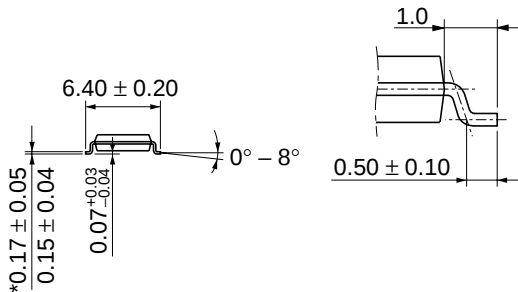
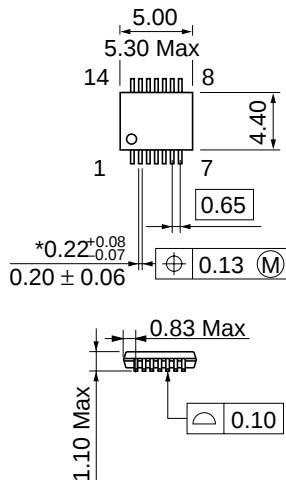


\*Dimension including the plating thickness  
Base material dimension

|                          |          |
|--------------------------|----------|
| Hitachi Code             | FP-14DA  |
| JEDEC                    | —        |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.23 g   |



|                          |          |
|--------------------------|----------|
| Hitachi Code             | FP-14DN  |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.13 g   |



\*Dimension including the plating thickness  
Base material dimension

|                          |         |
|--------------------------|---------|
| Hitachi Code             | TTP-14D |
| JEDEC                    | —       |
| EIAJ                     | —       |
| Weight (reference value) | 0.05 g  |

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