

# HD74HC78

## Dual J-K Flip-Flops

### (with Preset, Common Clear and Common Clock)

REJ03D0553-0200  
 (Previous ADE-205-425)  
 Rev.2.00  
 Oct 06, 2005

### 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 ( $T_a = 25^\circ\text{C}$ )
- Ordering Information

| Part Name    | Package Type       | Package Code (Previous Code) | Package Abbreviation | Taping Abbreviation (Quantity) |
|--------------|--------------------|------------------------------|----------------------|--------------------------------|
| HD74HC78FPEL | SOP-14 pin (JEITA) | PRSP0014DF-B (FP-14DAV)      | FP                   | EL (2,000 pcs/reel)            |
| HD74HC78RPEL | SOP-14 pin (JEDEC) | PRSP0014DE-A (FP-14DNV)      | RP                   | EL (2,500 pcs/reel)            |

Note: Please consult the sales office for the above package availability.

### Function Table

|        |       | Inputs  |   |   | Outputs   |           |
|--------|-------|---|---|---|-----------|-----------|
| Preset | Clear | Clock   | J | K | Q         | $\bar{Q}$ |
| L      | H     | X   | X | X | H         | L         |
| H      | L     | X   | X | X | L         | H         |
| L      | L     | X   | X | X | $H^{*1}$  | $H^{*1}$  |
| 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 |           |

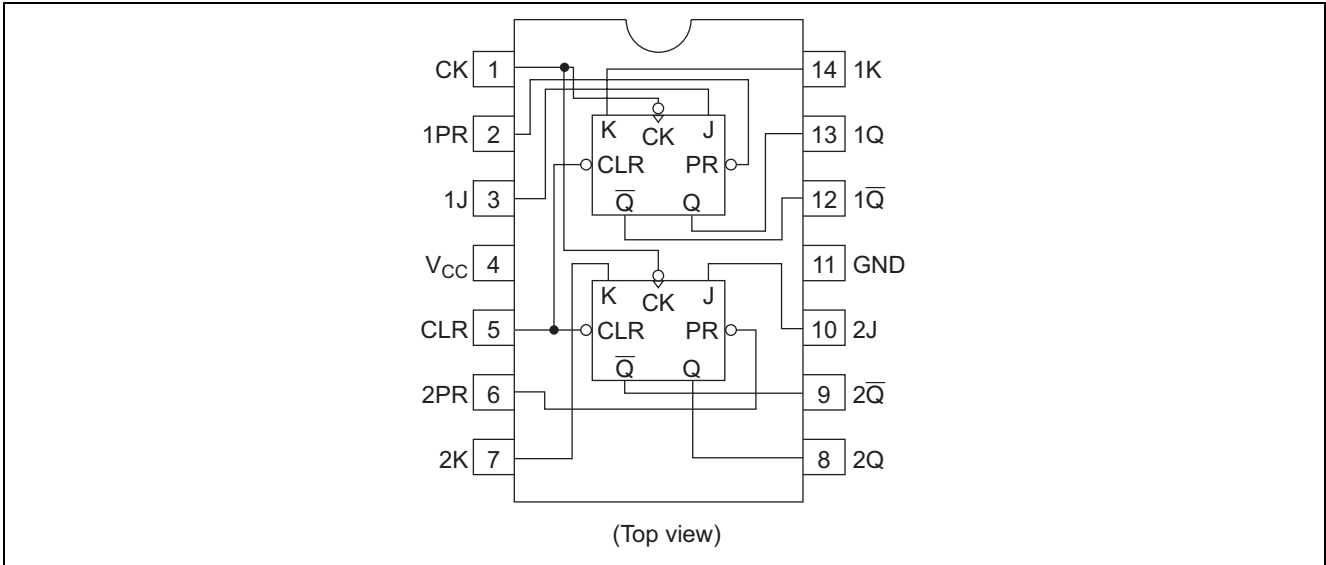
H: High level

L: Low level

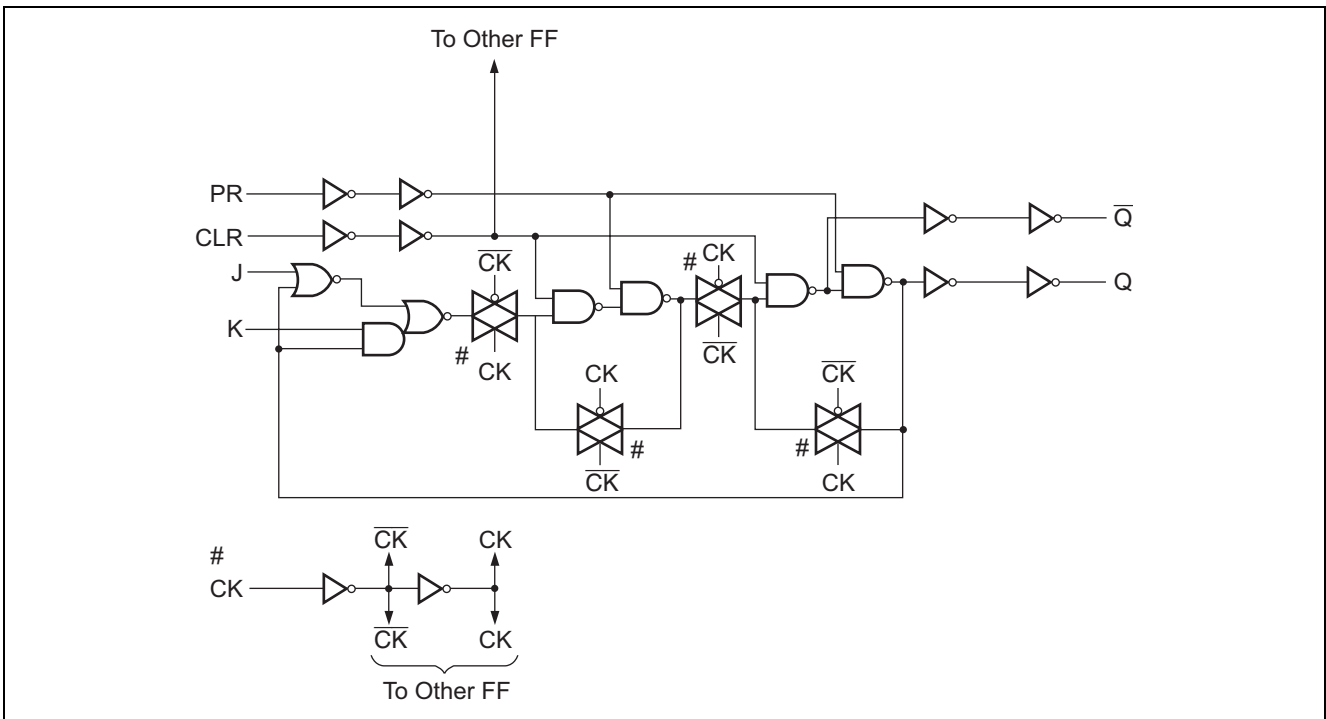
X: Irrelevant

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

### Pin Arrangement



### Logic Diagram (1/2)



### Absolute Maximum Ratings

| Item                         | Symbol                | Ratings                | Unit |
|------------------------------|-----------------------|------------------------|------|
| Supply voltage range         | $V_{CC}$              | -0.5 to 7.0            | V    |
| Input / Output voltage       | $V_{in}, V_{out}$     | -0.5 to $V_{CC} + 0.5$ | V    |
| Input / Output diode current | $I_{IK}, I_{OK}$      | $\pm 20$               | mA   |
| Output current               | $I_O$                 | $\pm 25$               | mA   |
| $V_{CC}$ , GND current       | $I_{CC}$ or $I_{GND}$ | $\pm 50$               | mA   |
| Power dissipation            | $P_T$                 | 500                    | mW   |
| Storage temperature          | $T_{stg}$             | -65 to +150            | °C   |

Note: The absolute maximum ratings are values, which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

### Recommended Operating Conditions

| Item                                 | Symbol            | Ratings       | Unit | Conditions              |
|--------------------------------------|-------------------|---------------|------|-------------------------|
| Supply voltage                       | $V_{CC}$          | 2 to 6        | V    |                         |
| Input / Output voltage               | $V_{IN}, V_{OUT}$ | 0 to $V_{CC}$ | V    |                         |
| Operating temperature                | $T_a$             | -40 to 85     | °C   |                         |
| Input rise / fall time <sup>*1</sup> | $t_r, t_f$        | 0 to 1000     | ns   | $V_{CC} = 2.0\text{ V}$ |
|                                      |                   | 0 to 500      |      | $V_{CC} = 4.5\text{ V}$ |
|                                      |                   | 0 to 400      |      | $V_{CC} = 6.0\text{ V}$ |

Note: 1. This item guarantees maximum limit when one input switches.  
Waveform: Refer to test circuit of switching characteristics.

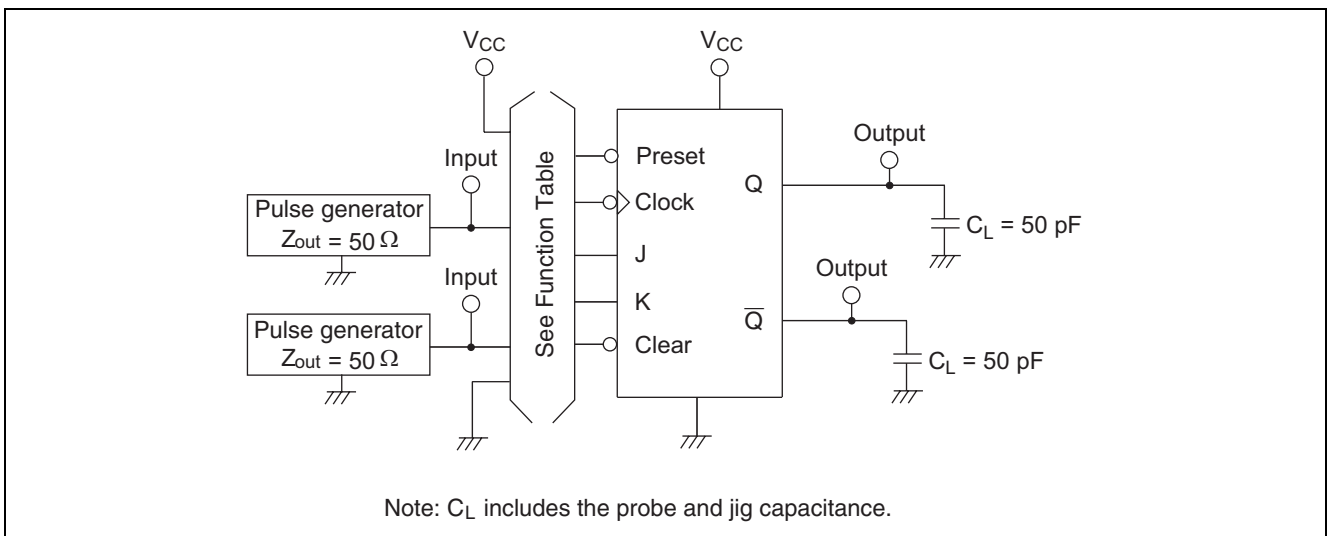
### Electrical Characteristics

| Item                     | Symbol   | $V_{CC}$ (V) | $T_a = 25^\circ\text{C}$ |     |           | $T_a = -40\text{ to }+85^\circ\text{C}$ |           | Unit          | Test Conditions                                      |                             |
|--------------------------|----------|--------------|--------------------------|-----|-----------|---|-----------|---------------|--|-----------------------------|
|                          |          |              | Min                      | Typ | Max       | Min                                     | Max       |               |  |                             |
| Input voltage            | $V_{IH}$ | 2.0          | 1.5                      | —   | —         | 1.5                                     | —         | V             |  |                             |
|                          |          | 4.5          | 3.15                     | —   | —         | 3.15                                    | —         |               |  |                             |
|                          |          | 6.0          | 4.2                      | —   | —         | 4.2                                     | —         |               |  |                             |
|                          | $V_{IL}$ | 2.0          | —                        | —   | 0.5       | —                                       | 0.5       | V             |  |                             |
|                          |          | 4.5          | —                        | —   | 1.35      | —                                       | 1.35      |               |  |                             |
|                          |          | 6.0          | —                        | —   | 1.8       | —                                       | 1.8       |               |  |                             |
| Output voltage           | $V_{OH}$ | 2.0          | 1.9                      | 2.0 | —         | 1.9                                     | —         | V             | $V_{in} = V_{IH}$ or $V_{IL}$                        | $I_{OH} = -20\ \mu\text{A}$ |
|                          |          | 4.5          | 4.4                      | 4.5 | —         | 4.4                                     | —         |               |  | $I_{OH} = -4\ \text{mA}$    |
|                          |          | 6.0          | 5.9                      | 6.0 | —         | 5.9                                     | —         |               |  | $I_{OH} = -5.2\ \text{mA}$  |
|                          |          | 4.5          | 4.18                     | —   | —         | 4.13                                    | —         |               |  |                             |
|                          |          | 6.0          | 5.68                     | —   | —         | 5.63                                    | —         |               |  |                             |
|                          | $V_{OL}$ | 2.0          | —                        | 0.0 | 0.1       | —                                       | 0.1       | V             | $V_{in} = V_{IH}$ or $V_{IL}$                        | $I_{OL} = 20\ \mu\text{A}$  |
|                          |          | 4.5          | —                        | 0.0 | 0.1       | —                                       | 0.1       |               |  |                             |
|                          |          | 6.0          | —                        | 0.0 | 0.1       | —                                       | 0.1       |               |  |                             |
|                          |          | 4.5          | —                        | —   | 0.26      | —                                       | 0.33      |               |  | $I_{OL} = 4\ \text{mA}$     |
|                          |          | 6.0          | —                        | —   | 0.26      | —                                       | 0.33      |               |  | $I_{OL} = 5.2\ \text{mA}$   |
| Input current            | $I_{in}$ | 6.0          | —                        | —   | $\pm 0.1$ | —                                       | $\pm 1.0$ | $\mu\text{A}$ | $V_{in} = V_{CC}$ or GND                             |                             |
| Quiescent supply current | $I_{CC}$ | 6.0          | —                        | —   | 2.0       | —                                       | 20        | $\mu\text{A}$ | $V_{in} = V_{CC}$ or GND, $I_{out} = 0\ \mu\text{A}$ |                             |

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

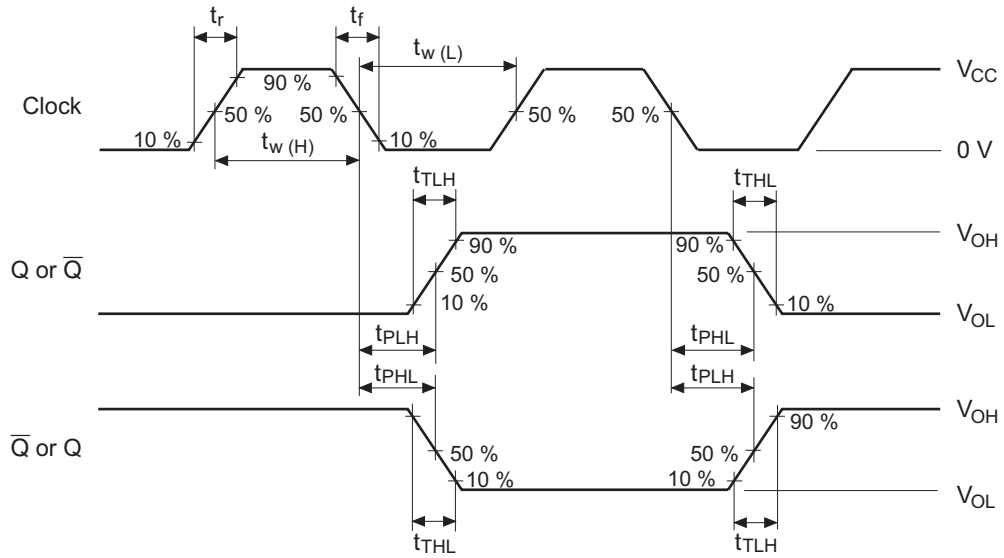
| Item                    | Symbol             | $V_{CC}$ (V) | $T_a = 25^\circ\text{C}$ |     |     | $T_a = -40 \text{ to } +85^\circ\text{C}$ |     | Unit | Test Conditions          |    |                          |
|-------------------------|--------------------|--------------|--------------------------|-----|-----|---|-----|------|--------------------------|----|--------------------------|
|                         |                    |              | 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  | $t_{PLH}, t_{PHL}$ | 2.0          | —                        | —   | 150 | —   | 190 | ns   | Clock to Q or $\bar{Q}$  |    |                          |
|                         |                    | 4.5          | —                        | 20  | 30  | —   | 38  |      |                          |    |                          |
|                         |                    | 6.0          | —                        | —   | 26  | —   | 33  |      |                          |    |                          |
|                         |                    |              |                          | 2.0 | —   | —   | 140 | —    | 175                      | ns | Clear to Q or $\bar{Q}$  |
|                         |                    |              |                          | 4.5 | —   | 18  | 28  | —    | 35                       |    |                          |
|                         |                    |              |                          | 6.0 | —   | —   | 24  | —    | 30                       |    |                          |
|                         |                    |              |                          | 2.0 | —   | —   | 140 | —    | 175                      | ns | Preset to Q or $\bar{Q}$ |
|                         |                    |              |                          | 4.5 | —   | 18  | 28  | —    | 35                       |    |                          |
|                         |                    |              |                          | 6.0 | —   | —   | 24  | —    | 30                       |    |                          |
| Pulse width             | $t_w$              | 2.0          | 80                       | —   | —   | 100                                       | —   | ns   | Preset, Clear, Clock     |    |                          |
|                         |                    | 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   | $t_{TLH}, t_{THL}$ | 2.0          | —                        | —   | 75  | —   | 95  | ns   |                          |    |                          |
|                         |                    | 4.5          | —                        | 5   | 15  | —   | 19  |      |                          |    |                          |
|                         |                    | 6.0          | —                        | —   | 13  | —   | 16  |      |                          |    |                          |
| Input capacitance       | $C_{in}$           | —            | —                        | 5   | 10  | —   | 10  | pF   |                          |    |                          |

**Test Circuit**

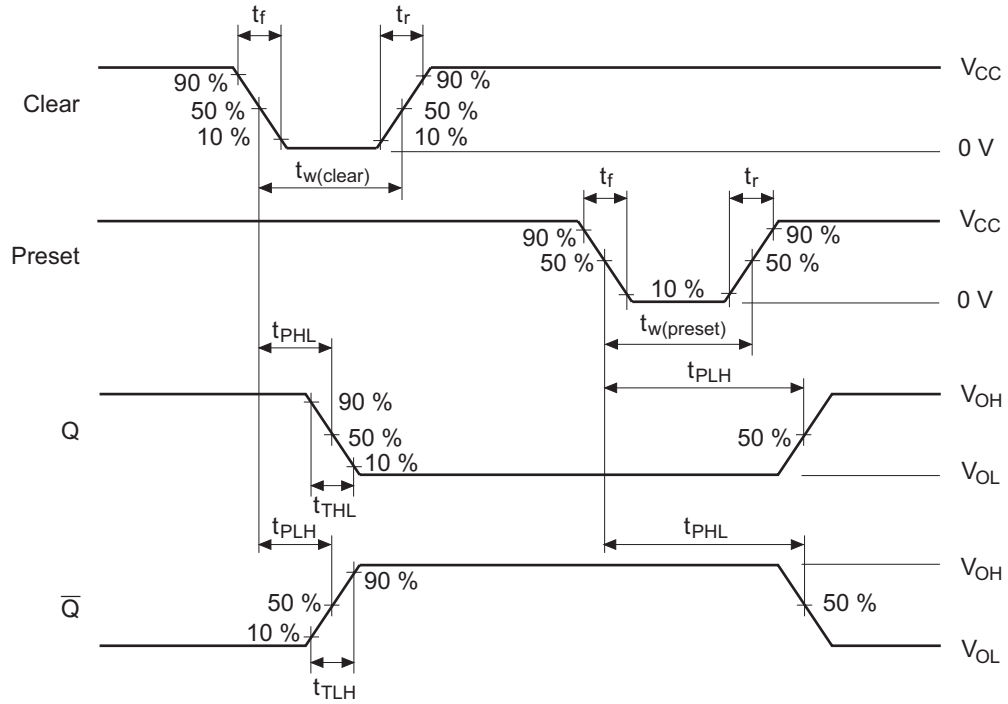


Waveforms

• Waveform – 1

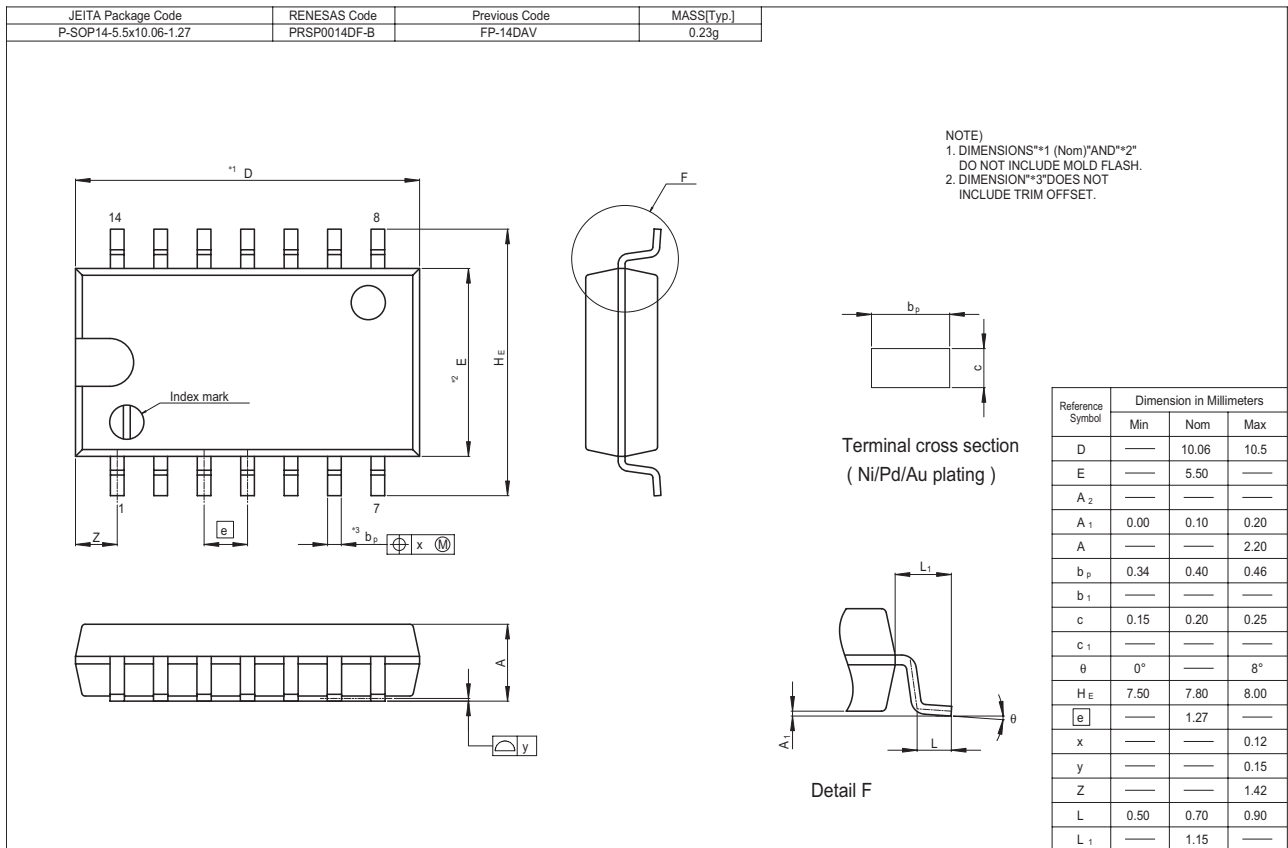
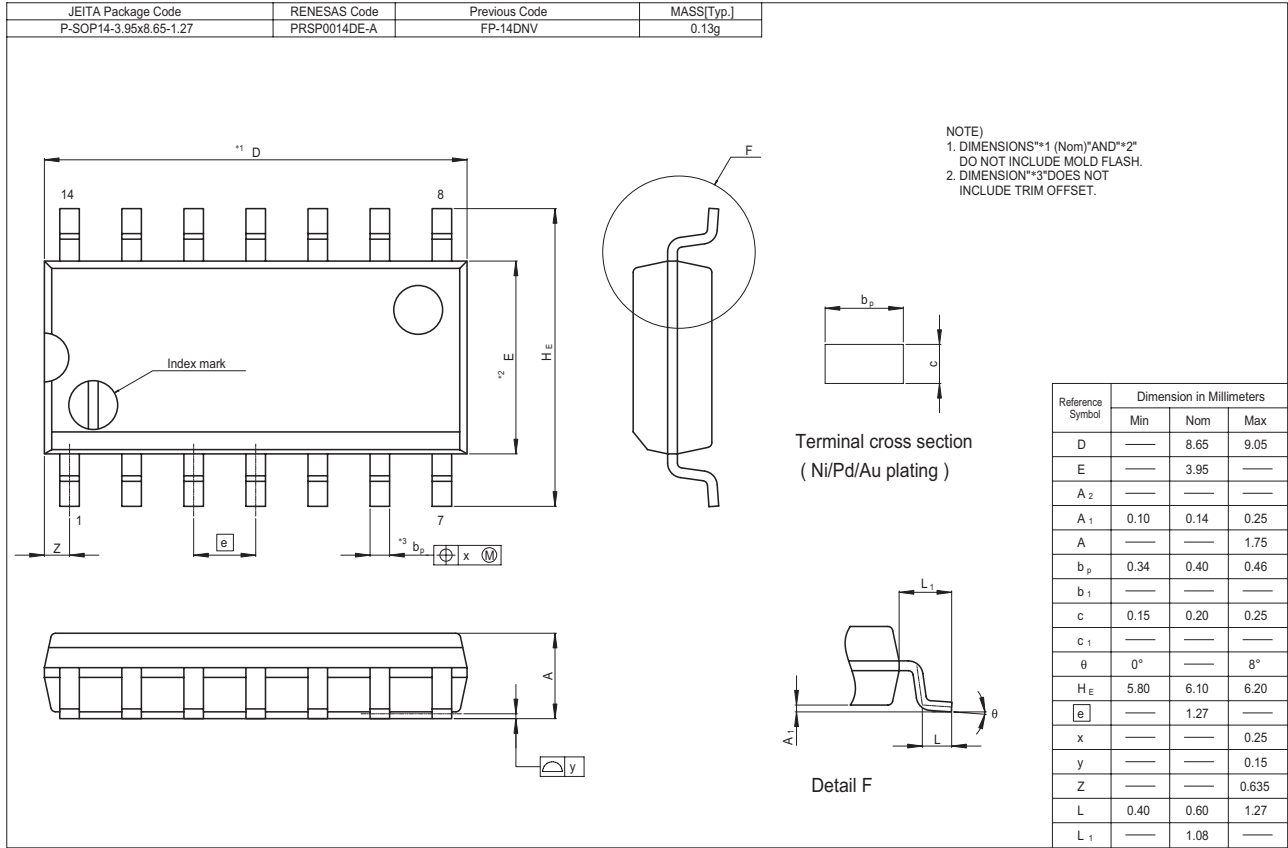


• Waveform – 2



- Notes: 1. Input waveform:  $PRR \leq 1 \text{ MHz}$ ,  $Z_o = 50 \Omega$ ,  $t_r \leq 6 \text{ ns}$ ,  $t_f \leq 6 \text{ ns}$   
 2. The output are measured one at a time with one transition per measurement.

Package Dimensions



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