

# HD74HC112

## Dual J-K Flip-Flops (with Preset and Clear)

REJ03D0562-0200  
(Previous ADE-205-435)  
Rev.2.00  
Oct 11, 2005

### Description

Each flip-flop has independent J, K, preset, clear and clock inputs and Q and  $\bar{Q}$  outputs. This device is edge sensitive to the clock input and change state on the negative going transition of the clock pulse. Clear and preset 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) = 17 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) |
|---------------|--------------------|------------------------------|----------------------|--------------------------------|
| HD74HC112P    | DILP-16 pin        | PRDP0016AE-B (DP-16FV)       | P                    | —                              |
| HD74HC112FPEL | SOP-16 pin (JEITA) | PRSP0016DH-B (FP-16DAV)      | FP                   | EL (2,000 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 |           |

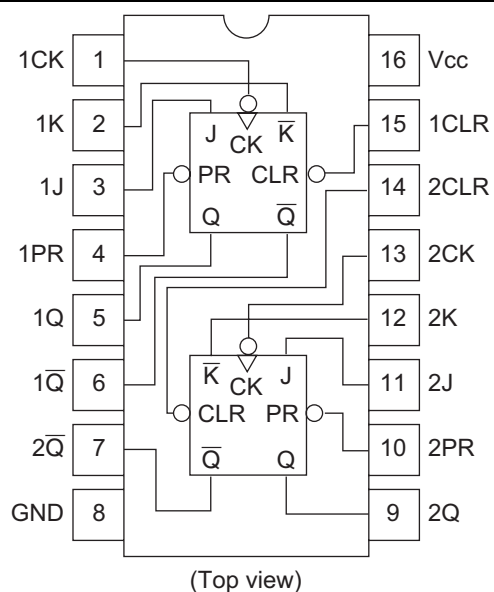
H : High level

L : Low level

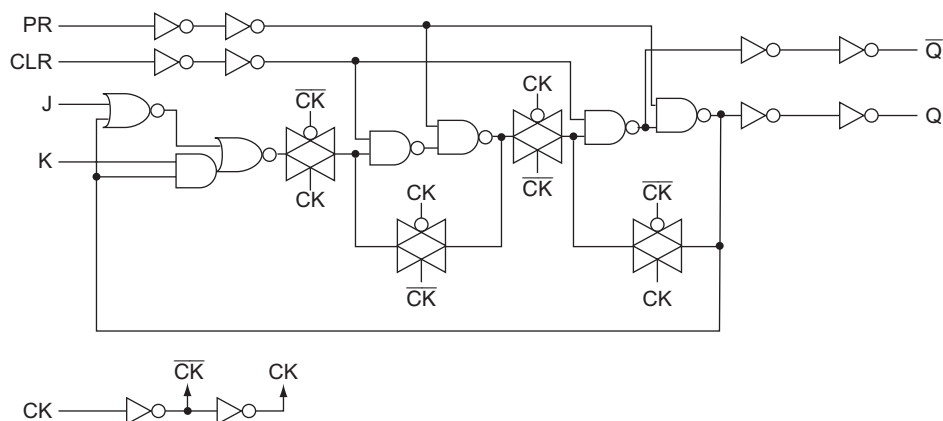
X : Irrelevant

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

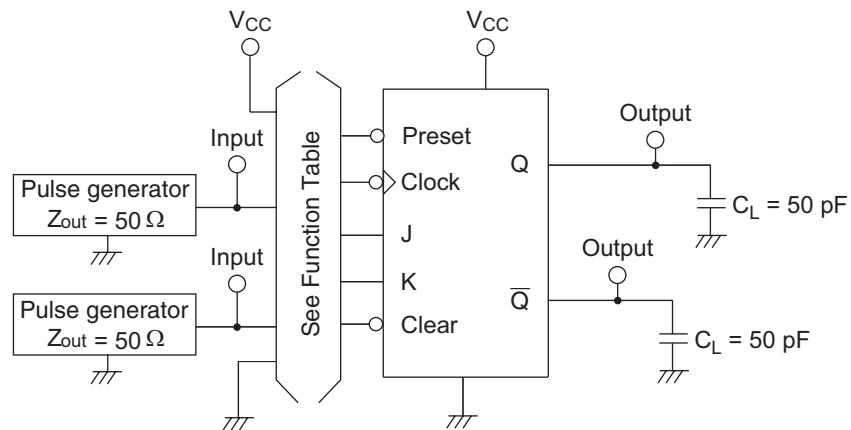
| Item                     | Symbol   | $V_{CC}$ (V) | $T_a = 25^\circ\text{C}$ |     |           | $T_a = -40\text{ to }+85^\circ\text{C}$ |           | Unit          | Test Conditions                                                 |                                   |
|--------------------------|----------|--------------|--------------------------|-----|-----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

## 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          | —                        | 17  | 30  | —                                       | 38  |      |                          |  |
|                         |                    | 6.0          | —                        | —   | 26  | —                                       | 33  |      |                          |  |
|                         |                    | 2.0          | —                        | —   | 140 | —                                       | 175 | ns   | Clear to Q or $\bar{Q}$  |  |
|                         |                    | 4.5          | —                        | 15  | 28  | —                                       | 35  |      |                          |  |
|                         |                    | 6.0          | —                        | —   | 24  | —                                       | 30  |      |                          |  |
|                         |                    | 2.0          | —                        | —   | 140 | —                                       | 175 | ns   | Preset to Q or $\bar{Q}$ |  |
|                         |                    | 4.5          | —                        | 16  | 28  | —                                       | 35  |      |                          |  |
|                         |                    | 6.0          | —                        | —   | 24  | —                                       | 30  |      |                          |  |

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

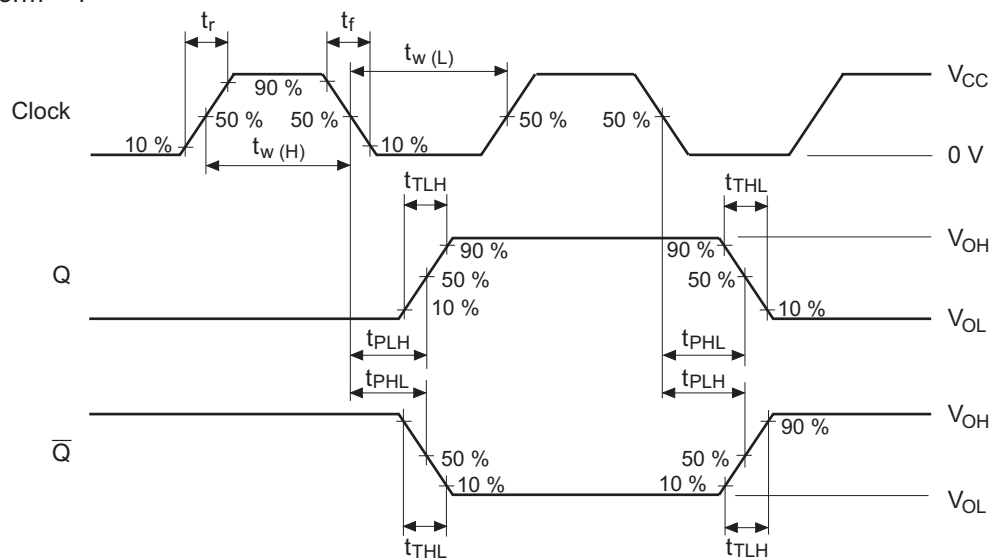
| Item                  | Symbol             | $V_{CC} \text{ (V)}$ | $T_a = 25^\circ\text{C}$ |     |     | $T_a = -40 \text{ to } +85^\circ\text{C}$ |     | Unit | Test Conditions |
|-----------------------|--------------------|----------------------|--------------------------|-----|-----|-------------------------------------------|-----|------|-----------------|
|                       |                    |                      | Min                      | Typ | Max | Min                                       | Max |      |                 |
| Pulse width           | $t_w$              | 2.0                  | 80                       | —   | —   | 100                                       | —   | ns   | Clear, Clock    |
|                       |                    | 4.5                  | 16                       | 9   | —   | 20                                        | —   |      |                 |
|                       |                    | 6.0                  | 14                       | —   | —   | 17                                        | —   |      |                 |
| Setup time            | $t_{su}$           | 2.0                  | 100                      | —   | —   | 125                                       | —   | ns   | J or K to Clock |
|                       |                    | 4.5                  | 20                       | 3   | —   | 25                                        | —   |      |                 |
|                       |                    | 6.0                  | 17                       | —   | —   | 21                                        | —   |      |                 |
| Hold time             | $t_h$              | 2.0                  | 5                        | —   | —   | 5                                         | —   | ns   | Clock to J or K |
|                       |                    | 4.5                  | 5                        | -2  | —   | 5                                         | —   |      |                 |
|                       |                    | 6.0                  | 5                        | —   | —   | 5                                         | —   |      |                 |
| Removal time          | $t_{rem}$          | 2.0                  | 100                      | —   | —   | 125                                       | —   | ns   | Clear to Clock  |
|                       |                    | 4.5                  | 20                       | 2   | —   | 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**

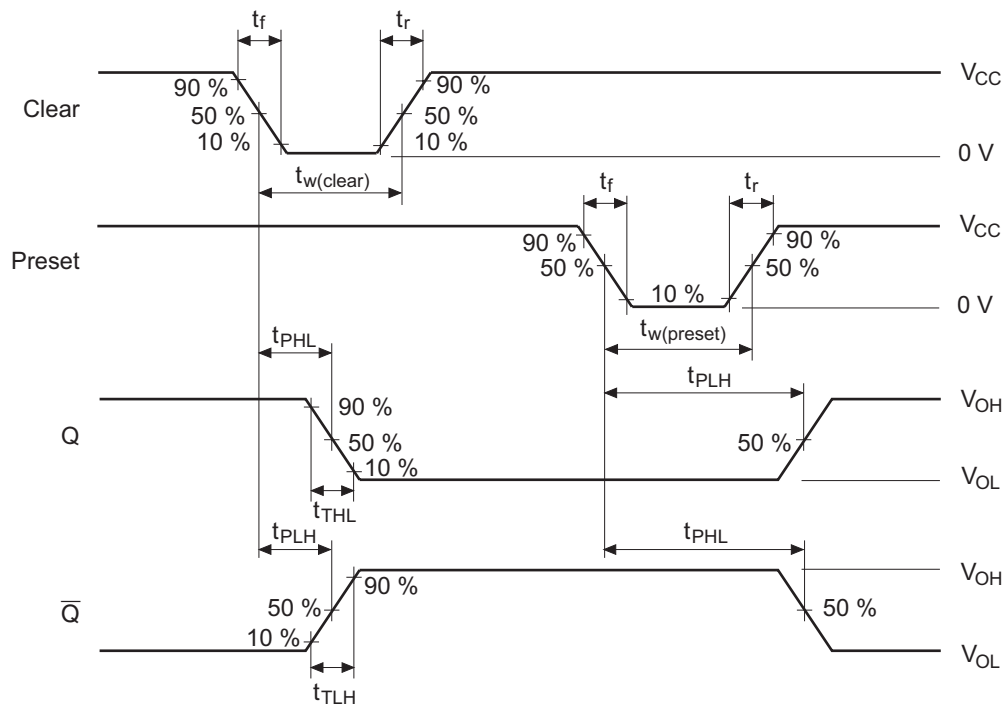
Note:  $C_L$  includes the probe and jig capacitance.

## Waveforms

## • Waveform – 1

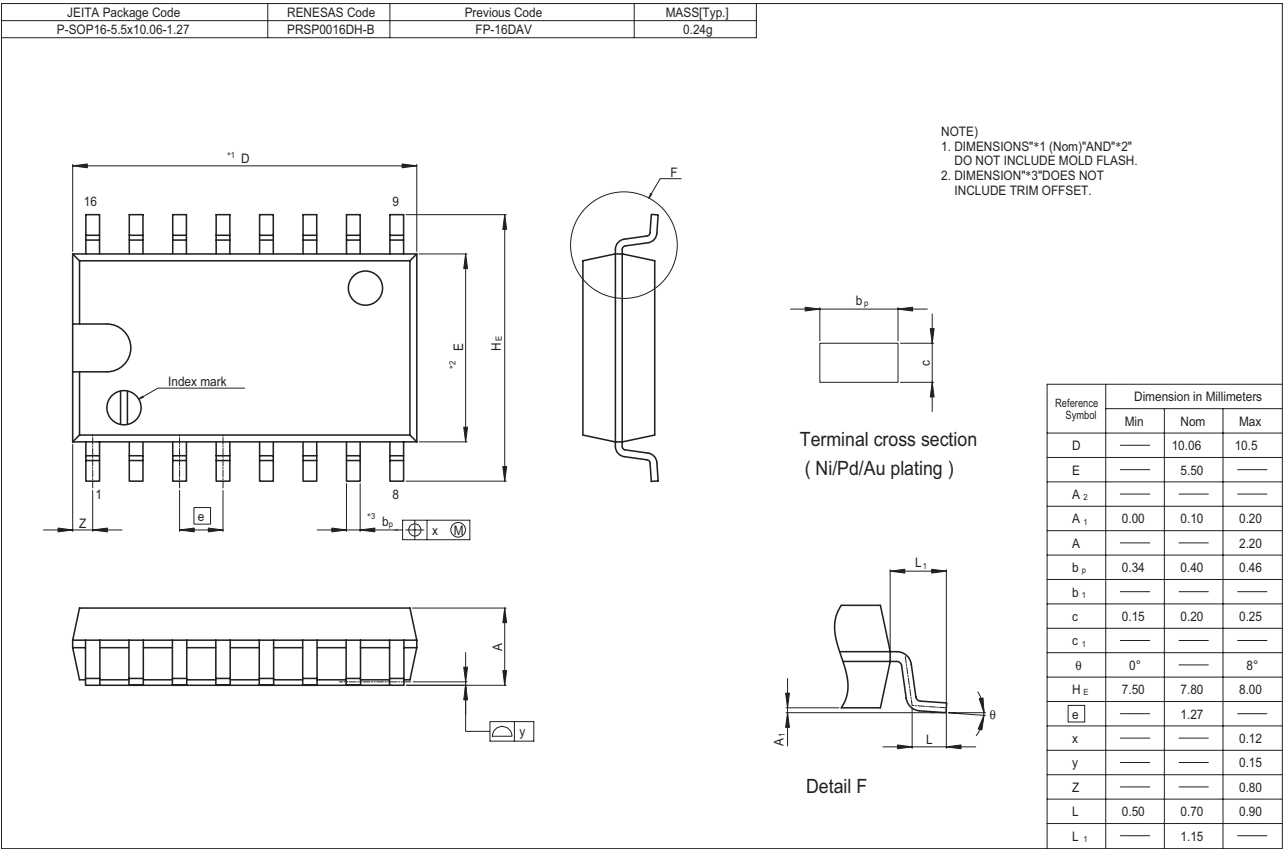
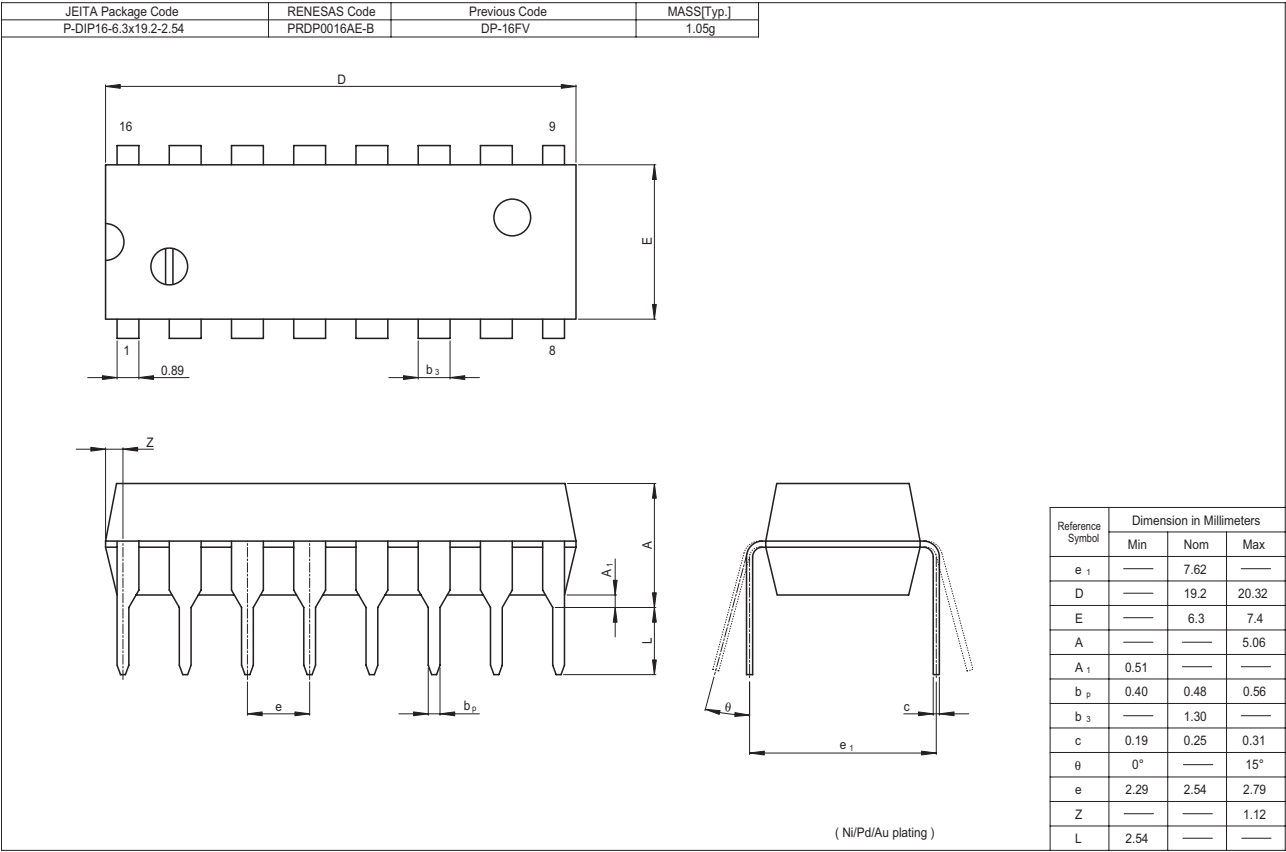


## • Waveform – 2



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

Package Dimensions



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