

# HD74HC4020

## 14-stage Binary Counter

REJ03D0645-0200  
 (Previous ADE-205-531)  
 Rev.2.00  
 Mar 30, 2006

### Description

The HD74HC4020 is a 14 stage counter. This device is incremented on the falling edge (negative transition) of the input clock, and all its output is reset to a low level by applying a logical high on its reset input.



### Features

- High Speed Operation:  $t_{pd}$  (Clock to  $Q_1$ ) = 14 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) = 4  $\mu$ A max ( $T_a = 25^\circ\text{C}$ )
- Ordering Information

| Part Name      | Package Type       | Package Code (Previous Code) | Package Abbreviation | Taping Abbreviation (Quantity) |
|----------------|--------------------|------------------------------|----------------------|--------------------------------|
| HD74HC4020P    | DILP-16 pin        | PRDP0016AE-B (DP-16FV)       | P                    | —                              |
| HD74HC4020FPEL | SOP-16 pin (JEITA) | PRSP0016DH-B (FP-16DAV)      | FP                   | EL (2,000 pcs/reel)            |

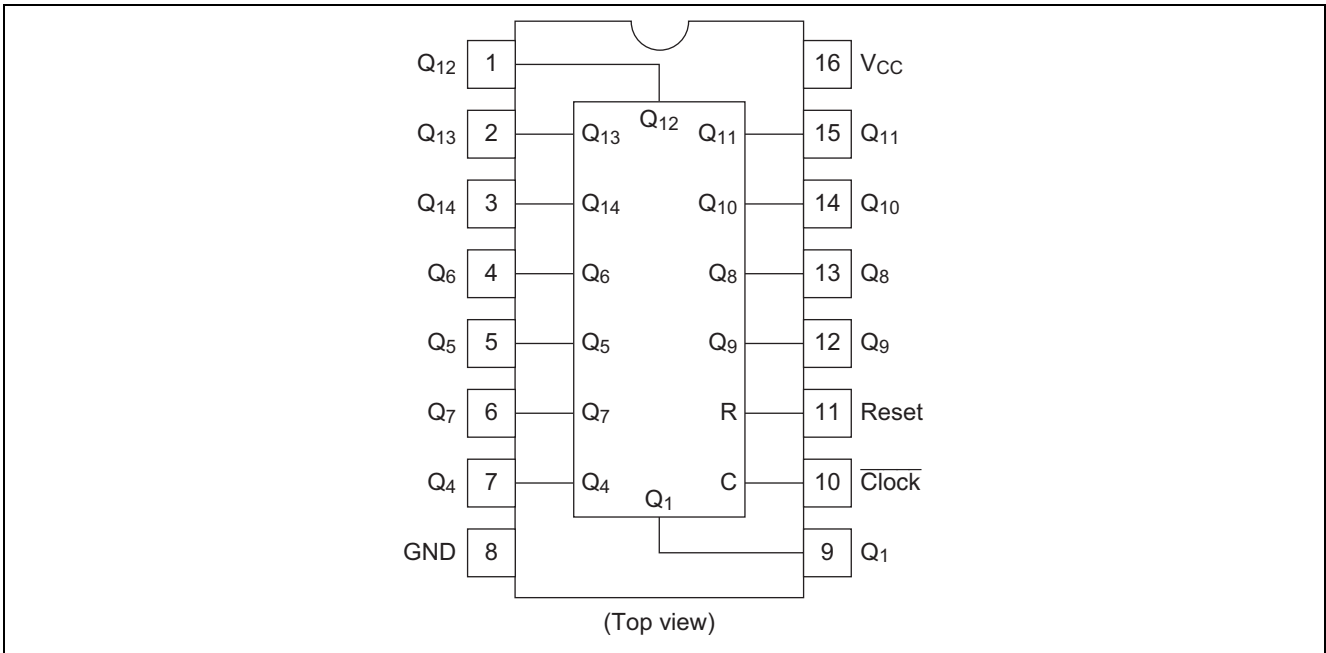
Note: Please consult the sales office for the above package availability.

### Function Table

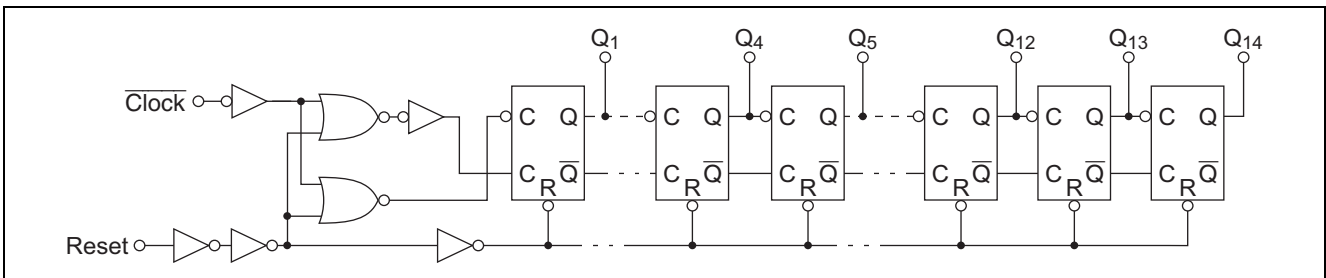
| Clock                                                                               | Reset | Outputs State         |
|-------------------------------------------------------------------------------------|-------|-----------------------|
|  | L     | No change             |
|  | L     | Advance to next state |
| X                                                                                   | H     | All output are low    |

Note: 1. X: Don't care

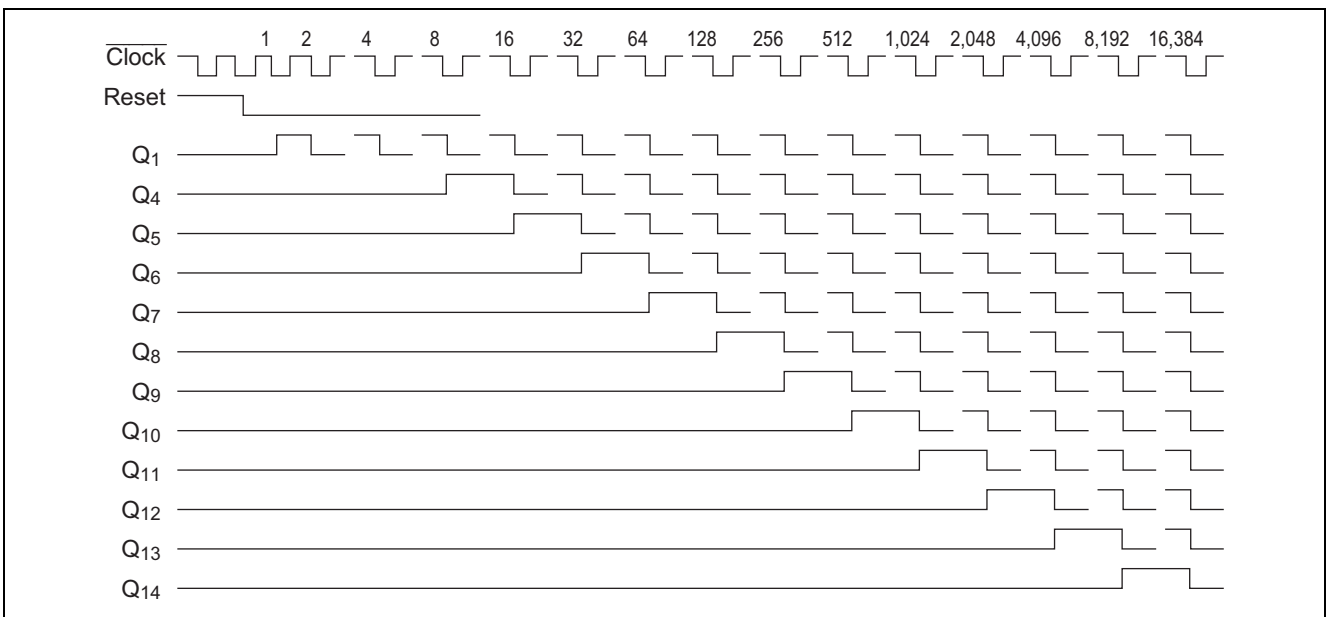
### Pin Arrangement



### Block Diagram



### Timing Diagram



### 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               | $I_{OUT}$             | $\pm 25$               | 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   | $V_{CC} = 2.0$ V |
|                                      |                   | 0 to 500      |      | $V_{CC} = 4.5$ V |
|                                      |                   | 0 to 400      |      | $V_{CC} = 6.0$ V |

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

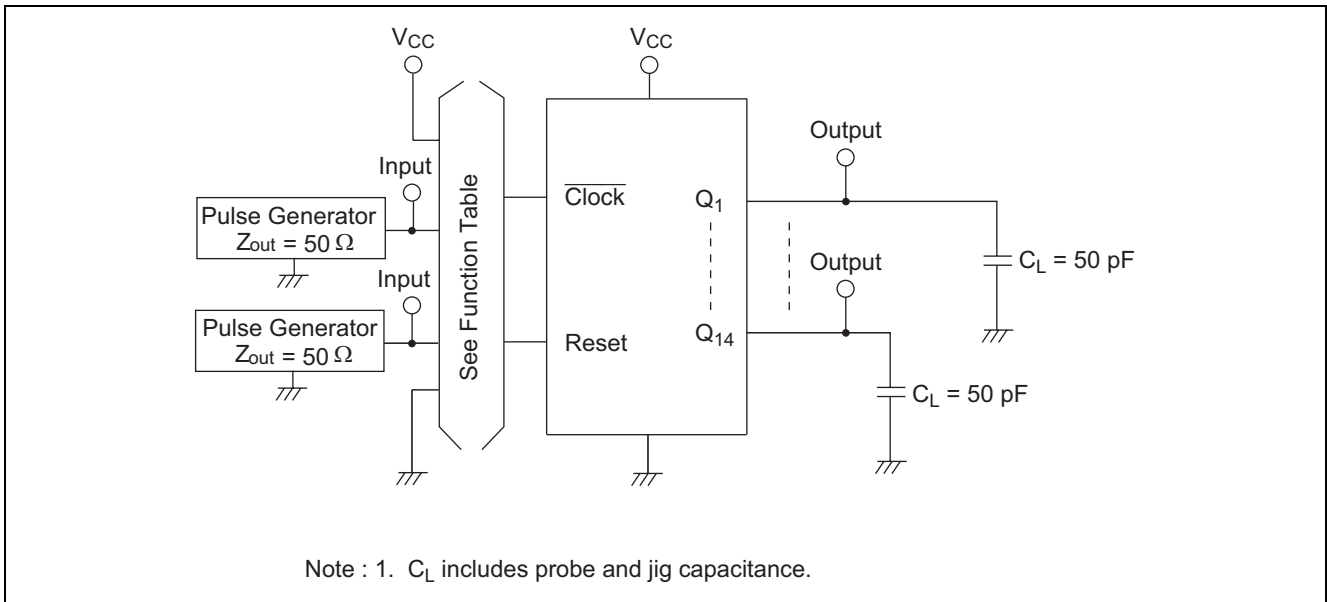
### Electrical Characteristics

| Item                     | Symbol   | $V_{CC}$ (V) | $T_a = 25^\circ\text{C}$ |     |           | $T_a = -40$ 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                                | —         |               |                                                       | $I_{OH} = -4$ mA             |                   |
|                          |          | 6.0          | 5.9                      | 6.0 | —         | 5.9                                | —         |               |                                                       | $I_{OH} = -5.2$ 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      |               |                                                       |                              | $I_{OH} = 4$ mA   |
|                          |          | 6.0          | —                        | —   | 0.26      | —                                  | 0.33      |               |                                                       |                              | $I_{OH} = 5.2$ 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          | —                        | —   | 4.0       | —                                  | 40        | $\mu\text{A}$ | $V_{in} = V_{CC}$ or GND, $I_{out} = 0$ $\mu\text{A}$ |                              |                   |

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

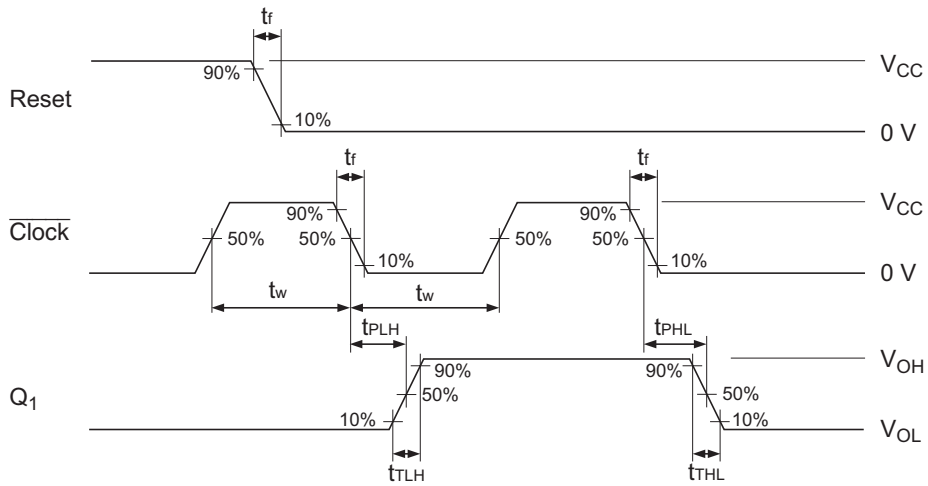
| Item                    | Symbol                 | $V_{CC}$ (V) | $T_a = 25^\circ\text{C}$ |     |     | $T_a = -40 \text{ to } +85^\circ\text{C}$ |     | Unit | Test Conditions |                    |
|-------------------------|------------------------|--------------|--------------------------|-----|-----|-------------------------------------------|-----|------|-----------------|--------------------|
|                         |                        |              | Min                      | Typ | Max | Min                                       | Max |      |                 |                    |
| Maximum clock frequency | $f_{max}$              | 2.0          | —                        | —   | 5   | —                                         | 4   | MHz  |                 |                    |
|                         |                        | 4.5          | —                        | —   | 25  | —                                         | 20  |      |                 |                    |
|                         |                        | 6.0          | —                        | —   | 29  | —                                         | 24  |      |                 |                    |
| Propagation delay time  | $t_{PLH}$              | 2.0          | —                        | —   | 175 | —                                         | 220 | ns   | Clock to $Q_1$  |                    |
|                         |                        | 4.5          | —                        | 14  | 35  | —                                         | 44  |      |                 |                    |
|                         |                        | 6.0          | —                        | —   | 30  | —                                         | 37  |      |                 |                    |
|                         | $t_{PHL}$              | 2.0          | —                        | —   | 175 | —                                         | 220 | ns   | Clock to $Q_1$  |                    |
|                         |                        | 4.5          | —                        | 14  | 35  | —                                         | 44  |      |                 |                    |
|                         |                        | 6.0          | —                        | —   | 30  | —                                         | 37  |      |                 |                    |
|                         | $t_{PLH}$              | $t_{PHL}$    | 2.0                      | —   | —   | 200                                       | —   | 250  | ns              | Reset to output    |
|                         |                        |              | 4.5                      | —   | 18  | 40                                        | —   | 50   |                 |                    |
|                         |                        |              | 6.0                      | —   | —   | 34                                        | —   | 43   |                 |                    |
|                         | $t_{PLH}$              | $t_{PHL}$    | 2.0                      | —   | —   | 100                                       | —   | 125  | ns              | $Q_n$ to $Q_{n-1}$ |
|                         |                        |              | 4.5                      | —   | —   | 20                                        | —   | 25   |                 |                    |
|                         |                        |              | 6.0                      | —   | —   | 17                                        | —   | 21   |                 |                    |
| Removal time            | $t_{rem}$              | 2.0          | 100                      | —   | —   | 125                                       | —   | ns   |                 |                    |
|                         |                        | 4.5          | 20                       | 6   | —   | 25                                        | —   |      |                 |                    |
|                         |                        | 6.0          | 17                       | —   | —   | 21                                        | —   |      |                 |                    |
| Pulse width             | $t_w$                  | 2.0          | 80                       | —   | —   | 100                                       | —   | ns   |                 |                    |
|                         |                        | 4.5          | 16                       | 4   | —   | 20                                        | —   |      |                 |                    |
|                         |                        | 6.0          | 14                       | —   | —   | 17                                        | —   |      |                 |                    |
| 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   |                 |                    |

Test Circuit



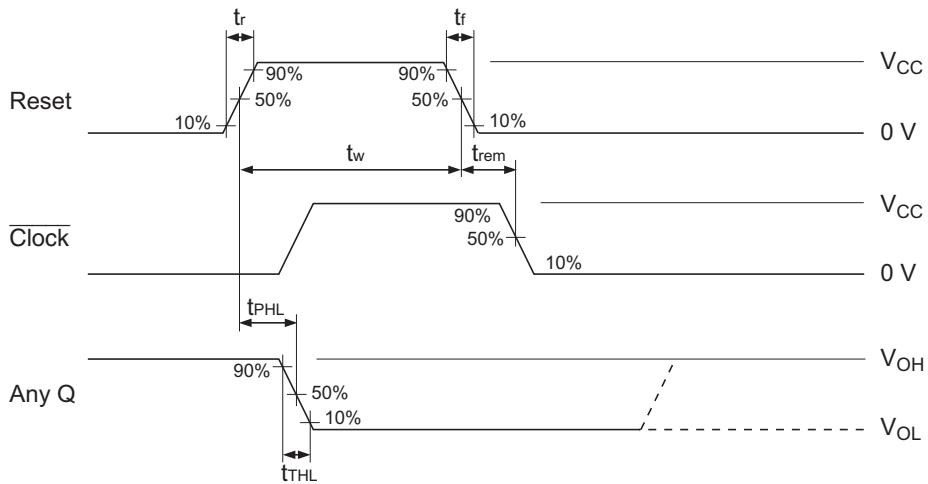
Waveforms

• Waveform – 1



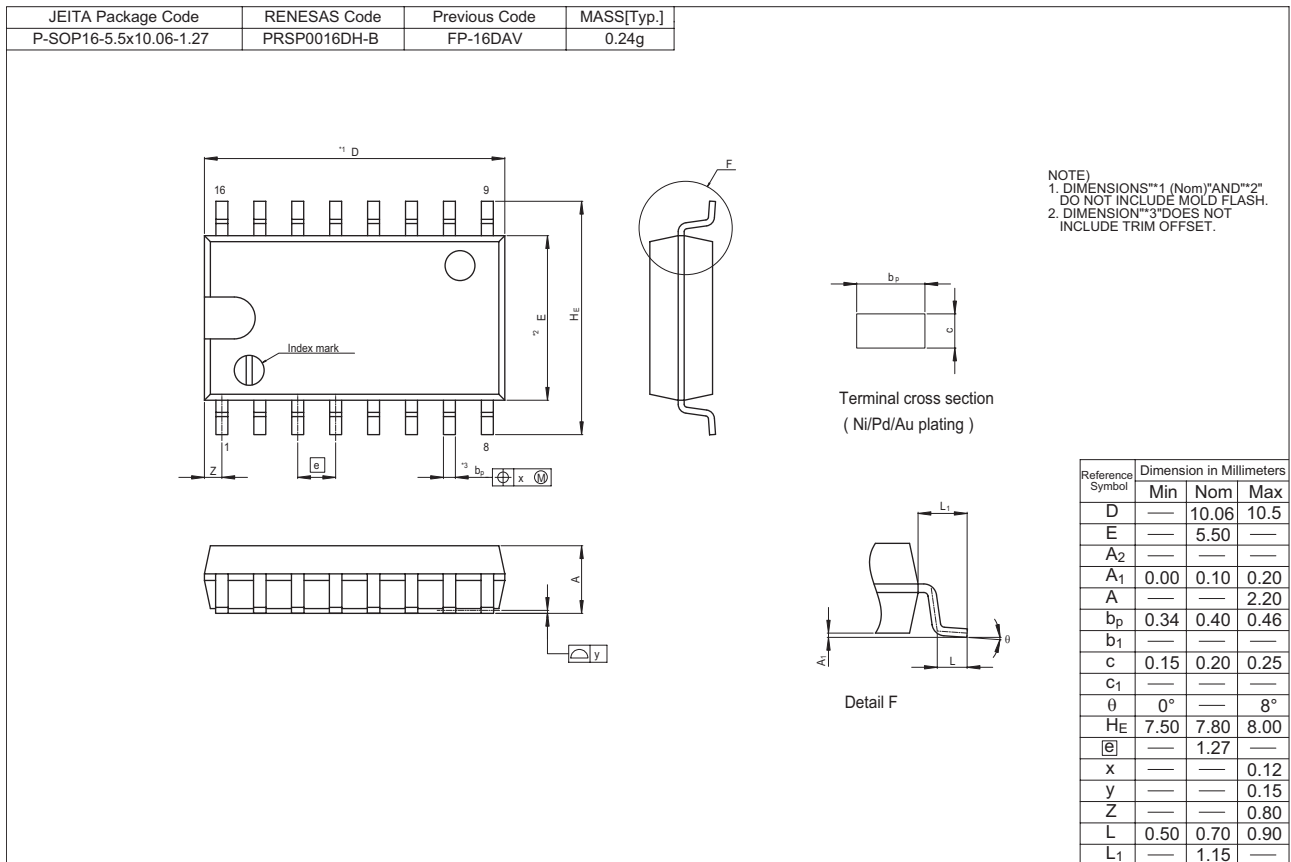
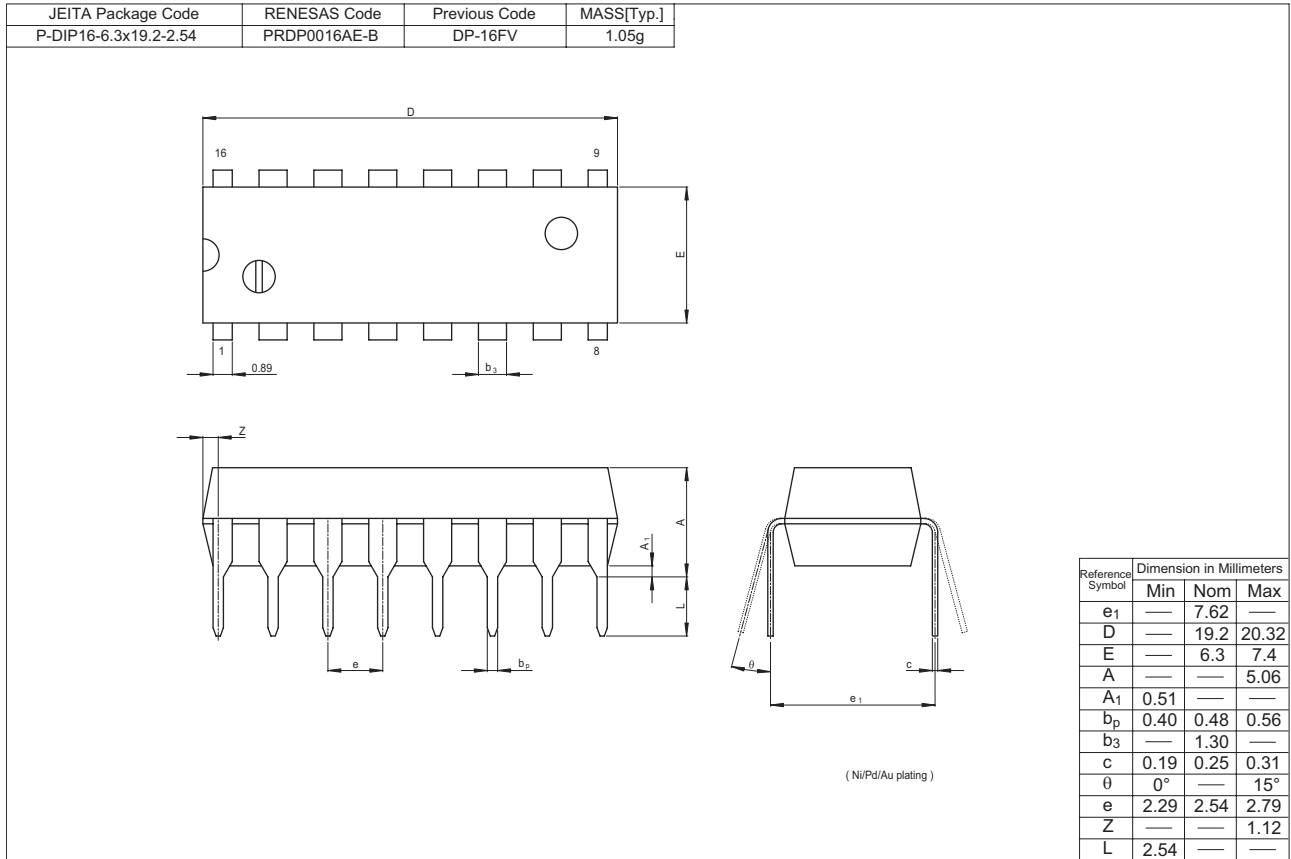
Note : 1. Waveform : PRR ≤ 1 MHz, Z<sub>o</sub> = 50 Ω, t<sub>r</sub> ≤ 6 ns, t<sub>f</sub> ≤ 6 ns

• Waveform – 2



Note : 1. Waveform : PRR ≤ 1 MHz, Z<sub>o</sub> = 50 Ω, t<sub>r</sub> ≤ 6 ns, t<sub>f</sub> ≤ 6 ns

Package Dimensions



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