

# HD74HC85

## 4-bit Magnitude Comparator

REJ03D0555-0200  
(Previous ADE-205-427)  
Rev.2.00  
Oct 06, 2005

### Description

The HD74HC85 is designed for high speed comparison of two four bit words. This circuit has eight comparison input, 4 for each word; three cascade inputs ( $A < B$ ,  $A > B$ ,  $A = B$ ); and three decision outputs ( $A < B$ ,  $A > B$ ,  $A = B$ ). The result of a comparison is indicated by a high level on one of the decision outputs. Thus it may be determined whether one word is "greater than," "less than," or "equal to" the other word. By connecting the outputs of the least significant stage to the cascade inputs of the next stage, words of greater than four bits can be compared. In addition the least significant stage must have a high level applied to the  $A = B$  input, and a low level to the  $A < B$ , and  $A > B$  inputs.

### Features

- High Speed Operation:  $t_{pd}$  (Data Word Input to Output) = 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) = 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) |
|--------------|--------------------|------------------------------|----------------------|--------------------------------|
| HD74HC85P    | DILP-16 pin        | PRDP0016AE-B (DP-16FV)       | P                    | —                              |
| HD74HC85FPEL | SOP-16 pin (JEITA) | PRSP0016DH-B (FP-16DAV)      | FP                   | EL (2,000 pcs/reel)            |
| HD74HC85RPEL | SOP-16 pin (JEDEC) | PRSP0016DG-A (FP-16DNV)      | RP                   | EL (2,500 pcs/reel)            |

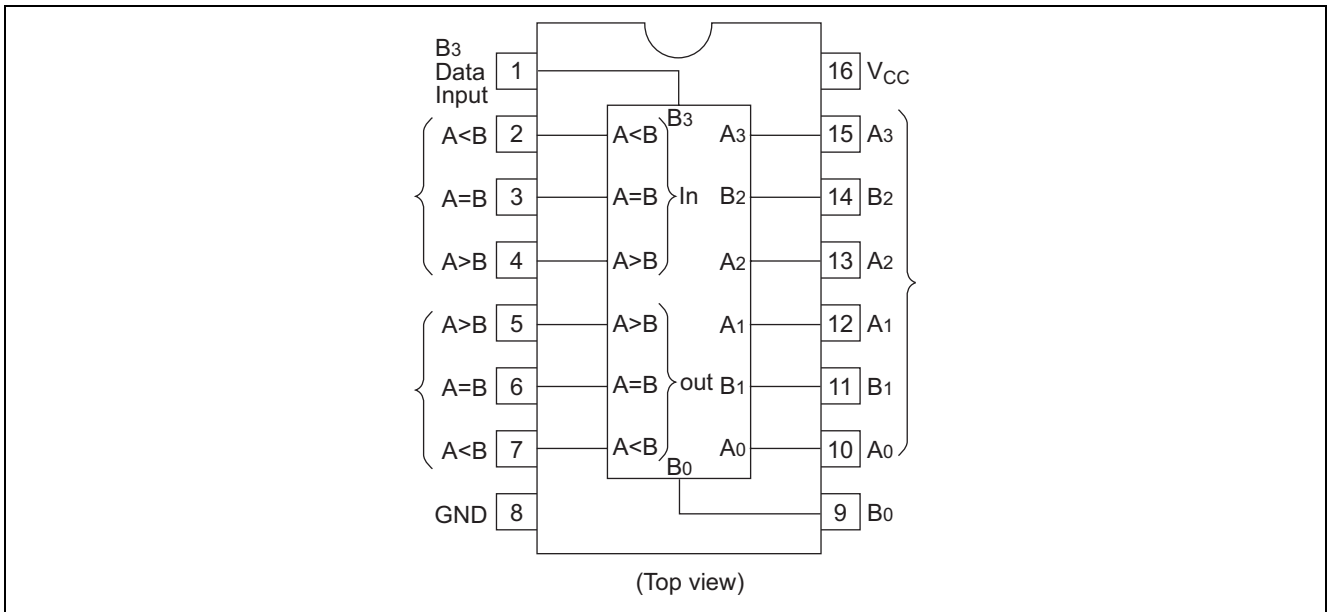
Note: Please consult the sales office for the above package availability.

**Function Table**

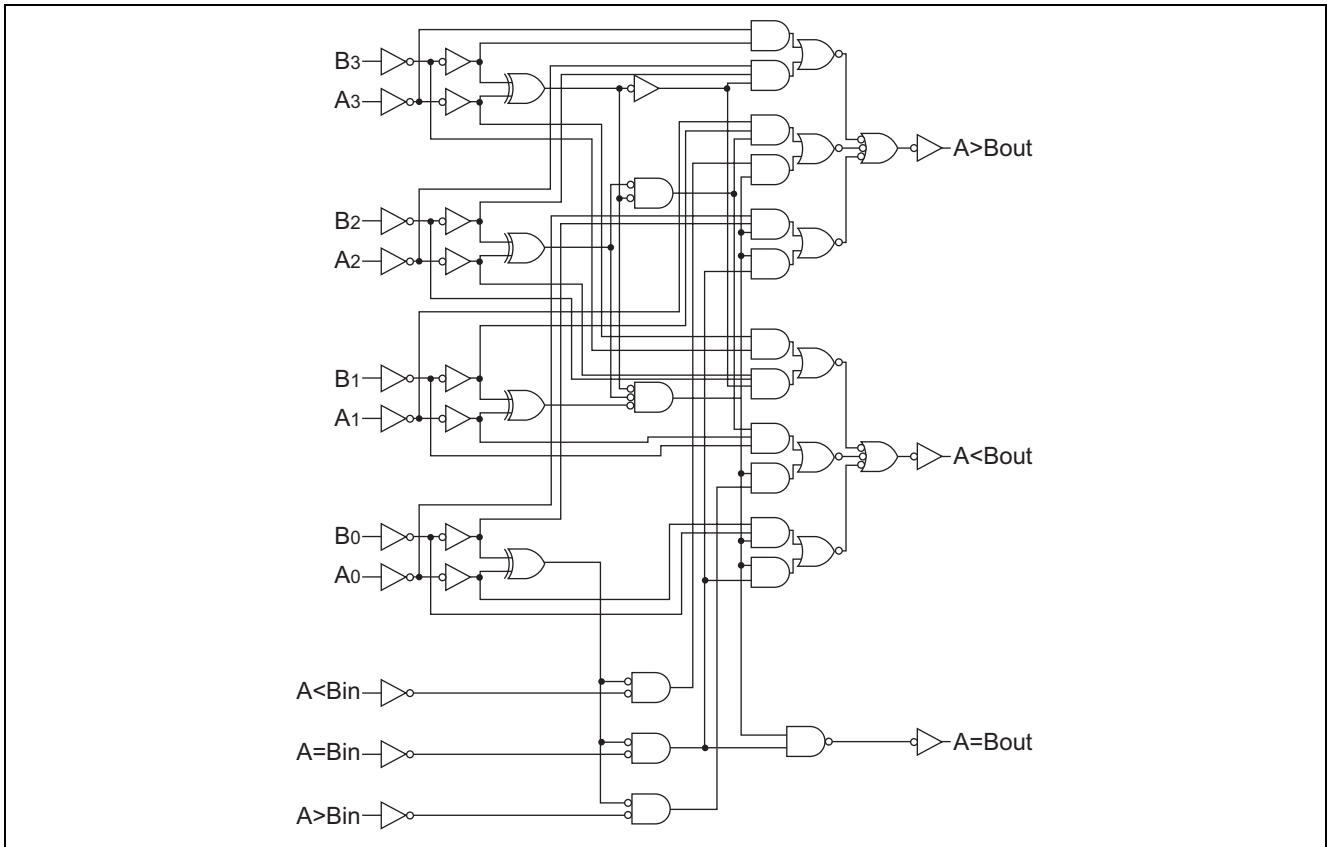
| Data Word Inputs                |                                 |                                 |                                 | Cascading Inputs |         |         | Outputs  |          |          |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|------------------|---------|---------|----------|----------|----------|
| A <sub>3</sub> , B <sub>3</sub> | A <sub>2</sub> , B <sub>2</sub> | A <sub>1</sub> , B <sub>1</sub> | A <sub>0</sub> , B <sub>0</sub> | A > Bin          | A = Bin | A < Bin | A > Bout | A = Bout | A < Bout |
| A <sub>3</sub> > B <sub>3</sub> | X                               | X                               | X                               | X                | X       | X       | H        | L        | L        |
| A <sub>3</sub> < B <sub>3</sub> | X                               | X                               | X                               | X                | X       | X       | L        | L        | H        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> > B <sub>2</sub> | X                               | X                               | X                | X       | X       | H        | L        | L        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> < B <sub>2</sub> | X                               | X                               | X                | X       | X       | L        | L        | H        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> > B <sub>1</sub> | X                               | X                | X       | X       | H        | L        | L        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> < B <sub>1</sub> | X                               | X                | X       | X       | L        | L        | H        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> = B <sub>1</sub> | A <sub>0</sub> > B <sub>0</sub> | X                | X       | X       | H        | L        | L        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> = B <sub>1</sub> | A <sub>0</sub> < B <sub>0</sub> | X                | X       | X       | L        | L        | H        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> = B <sub>1</sub> | A <sub>0</sub> = B <sub>0</sub> | L                | L       | L       | H        | L        | H        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> = B <sub>1</sub> | A <sub>0</sub> = B <sub>0</sub> | L                | L       | H       | L        | L        | H        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> = B <sub>1</sub> | A <sub>0</sub> = B <sub>0</sub> | H                | L       | L       | H        | L        | L        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> = B <sub>1</sub> | A <sub>0</sub> = B <sub>0</sub> | H                | L       | H       | L        | L        | L        |
| A <sub>3</sub> = B <sub>3</sub> | A <sub>2</sub> = B <sub>2</sub> | A <sub>1</sub> = B <sub>1</sub> | A <sub>0</sub> = B <sub>0</sub> | X                | H       | X       | L        | H        | L        |

H : High level  
 L : Low level  
 X : Irrelevant

**Pin Arrangement**



Logic 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               | $I_O$                 | $\pm 25$               | 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            | $^{\circ}C$ |

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     | $^{\circ}C$ |                  |
| 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.

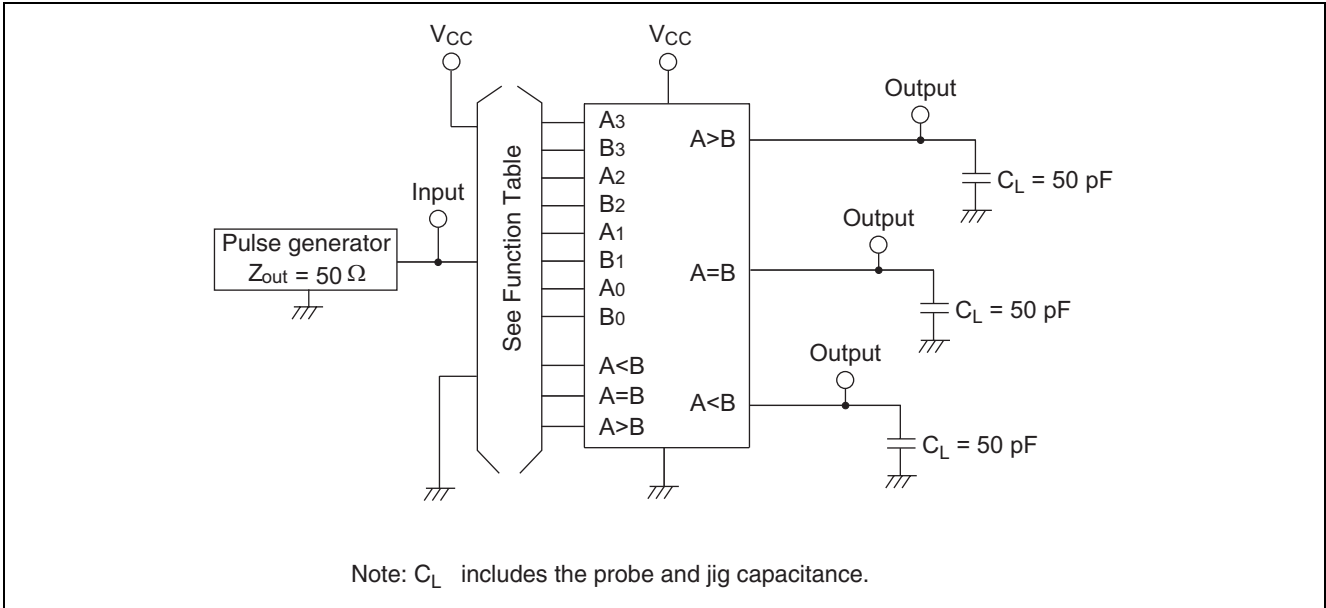
**Electrical Characteristics**

| Item                     | Symbol          | V <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    |   |                           |
|                          |                 | 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    | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>              | I <sub>OH</sub> = -20 μA  |
|                          |                 | 4.5                 | 4.4       | 4.5 | —    | 4.4               | —    |      |   | I <sub>OH</sub> = -4 mA   |
|                          |                 | 6.0                 | 5.9       | 6.0 | —    | 5.9               | —    |      |   | I <sub>OH</sub> = -5.2 mA |
|                          |                 | 4.5                 | 4.18      | —   | —    | 4.13              | —    |      |   |                           |
|                          |                 | 6.0                 | 5.68      | —   | —    | 5.63              | —    |      |   |                           |
|                          |                 | 6.0                 | 5.68      | —   | —    | 5.63              | —    |      |   |                           |
|                          | V <sub>OL</sub> | 2.0                 | —         | 0.0 | 0.1  | —                 | 0.1  | V    | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>              | 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 |      |   | I <sub>OL</sub> = 4 mA    |
|                          |                 | 6.0                 | —         | —   | 0.26 | —                 | 0.33 |      |   | I <sub>OL</sub> = 5.2 mA  |
|                          |                 | 6.0                 | —         | —   | 0.26 | —                 | 0.33 |      |   |                           |
| Input current            | I <sub>in</sub> | 6.0                 | —         | —   | ±0.1 | —                 | ±1.0 | μA   | V <sub>in</sub> = V <sub>CC</sub> or GND                          |                           |
| Quiescent supply current | I <sub>CC</sub> | 6.0                 | —         | —   | 4.0  | —                 | 40   | μA   | V <sub>in</sub> = V <sub>CC</sub> or GND, I <sub>out</sub> = 0 μA |                           |

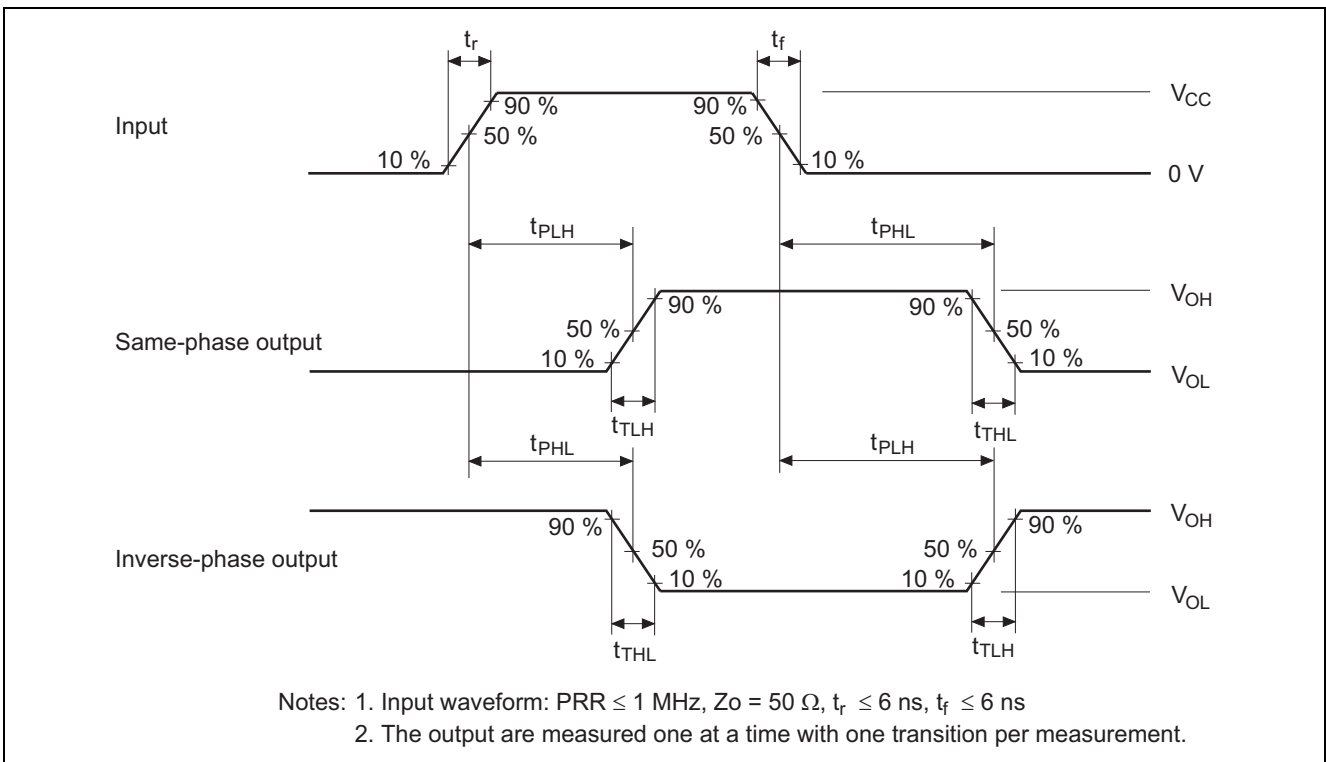
**Switching Characteristics (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6 ns)**

| Item                   | Symbol                              | V <sub>CC</sub> (V) | Ta = 25°C |     |     | Ta = -40 to +85°C |     | Unit | Test Conditions                                    |  |
|------------------------|-------------------------------------|---------------------|-----------|-----|-----|-------------------|-----|------|--|--|
|                        |                                     |                     | Min       | Typ | Max | Min               | Max |      |  |  |
| Propagation delay time | t <sub>PLH</sub> , t <sub>PHL</sub> | 2.0                 | —         | —   | 210 | —                 | 265 | ns   | C <sub>0</sub> to Σ <sub>1</sub>                   |  |
|                        |                                     | 4.5                 | —         | 20  | 42  | —                 | 53  |      |  |  |
|                        |                                     | 6.0                 | —         | —   | 36  | —                 | 45  |      |  |  |
|                        | t <sub>PLH</sub> , t <sub>PHL</sub> | 2.0                 | —         | —   | 175 | —                 | 220 | ns   | A <sub>1</sub> or B <sub>1</sub> to Σ <sub>1</sub> |  |
|                        |                                     | 4.5                 | —         | 20  | 35  | —                 | 44  |      |  |  |
|                        |                                     | 6.0                 | —         | —   | 30  | —                 | 37  |      |  |  |
|                        | t <sub>PLH</sub> , t <sub>PHL</sub> | 2.0                 | —         | —   | 125 | —                 | 155 | ns   | C <sub>0</sub> to C <sub>4</sub>                   |  |
|                        |                                     | 4.5                 | —         | 12  | 25  | —                 | 31  |      |  |  |
|                        |                                     | 6.0                 | —         | —   | 21  | —                 | 26  |      |  |  |
|                        | t <sub>PLH</sub> , t <sub>PHL</sub> | 2.0                 | —         | —   | 155 | —                 | 195 | ns   | A <sub>1</sub> or B <sub>1</sub> to C <sub>4</sub> |  |
|                        |                                     | 4.5                 | —         | 14  | 31  | —                 | 39  |      |  |  |
|                        |                                     | 6.0                 | —         | —   | 26  | —                 | 33  |      |  |  |
| Output fall time       | t <sub>THL</sub>                    | 2.0                 | —         | —   | 75  | —                 | 95  | ns   |  |  |
|                        |                                     | 4.5                 | —         | 5   | 15  | —                 | 19  |      |  |  |
|                        |                                     | 6.0                 | —         | —   | 13  | —                 | 16  |      |  |  |
| Input capacitance      | C <sub>in</sub>                     | —                   | —         | 5   | 10  | —                 | 10  | pF   |  |  |

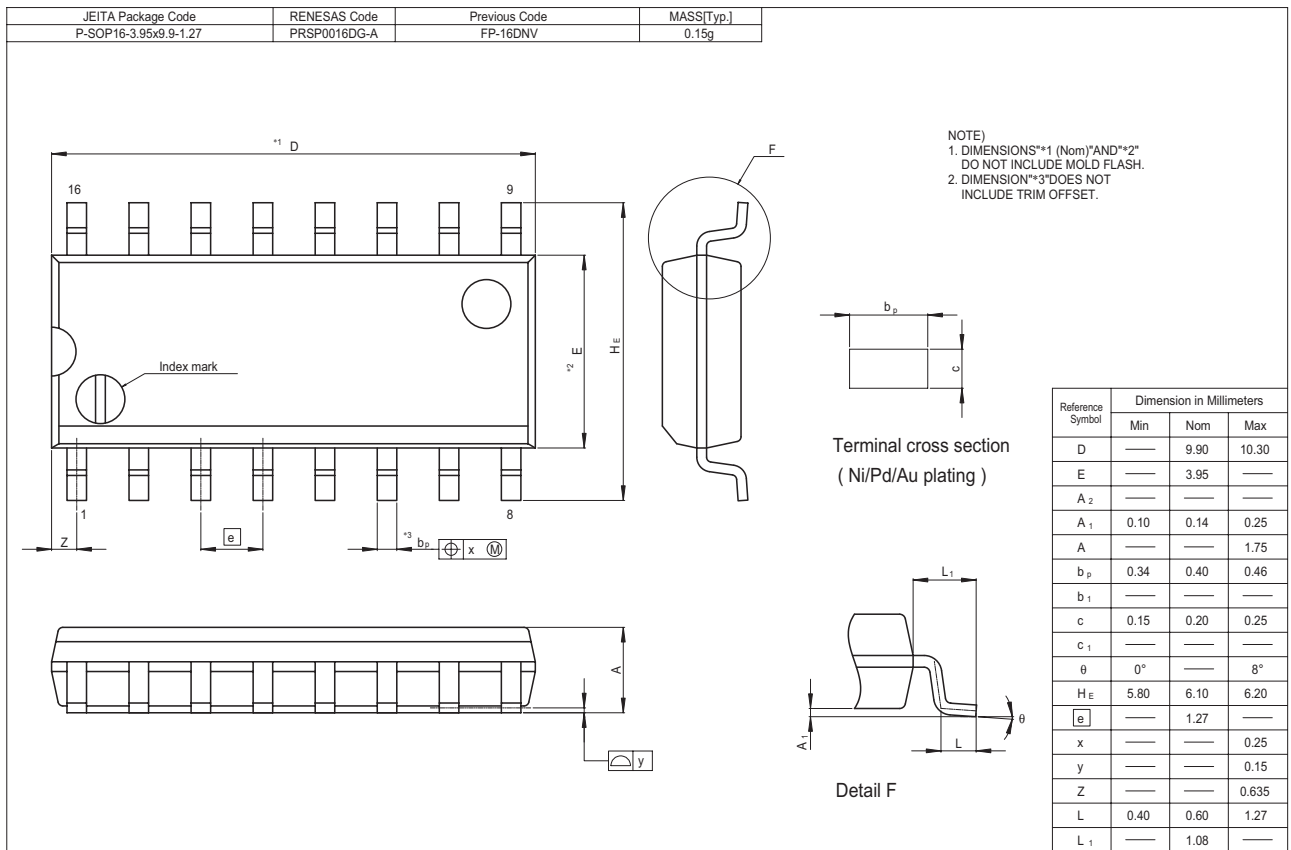
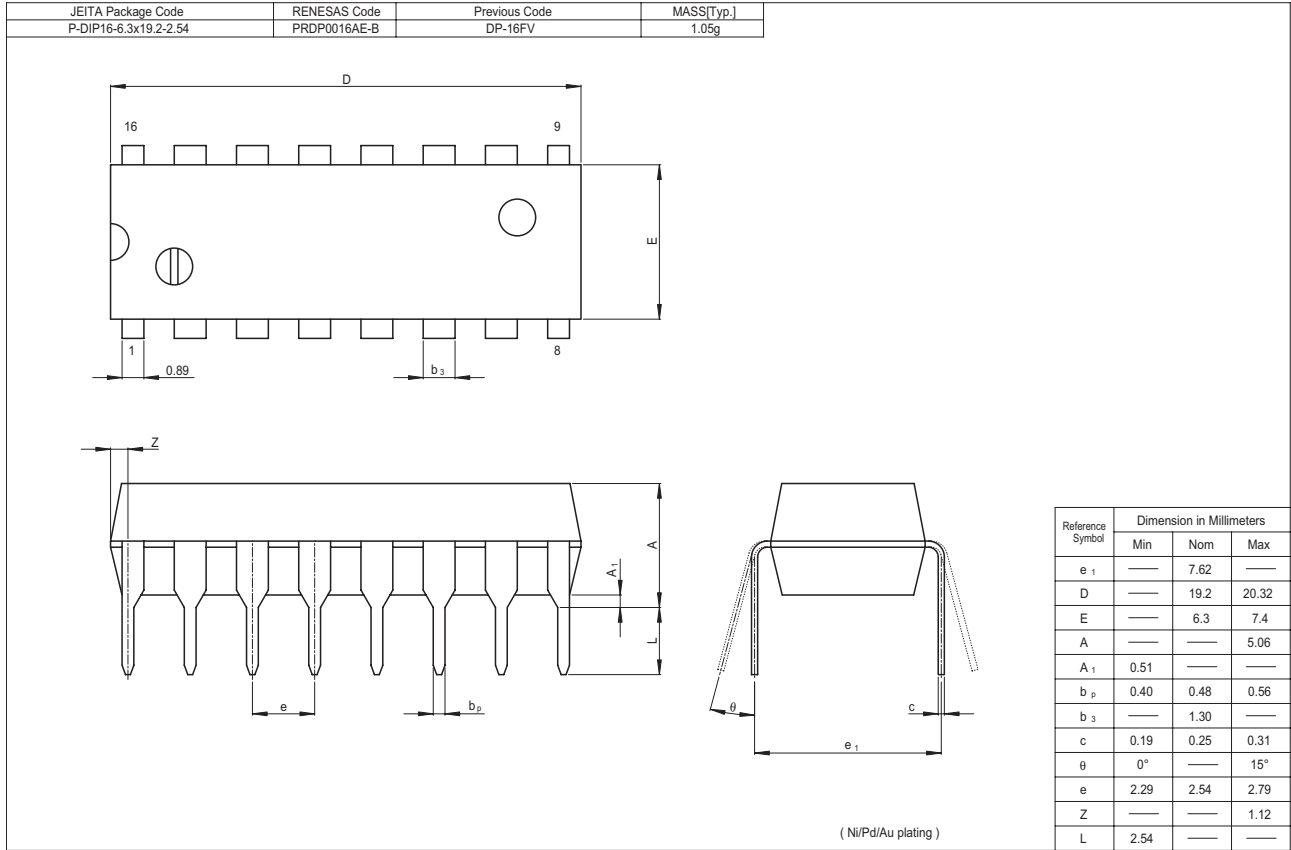
Test Circuit



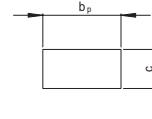
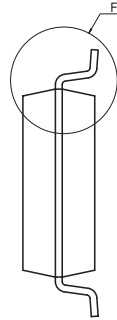
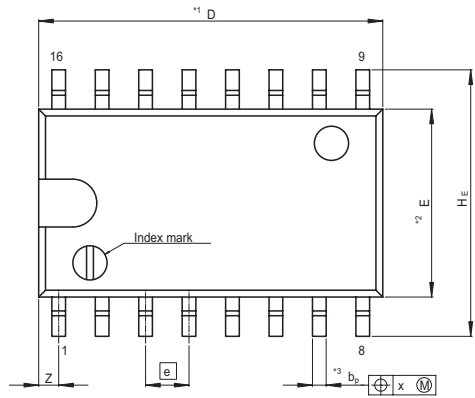
Waveforms



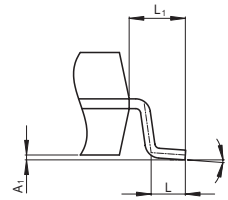
Package Dimensions



|  |                              |                           |                     |
|--|------------------------------|---------------------------|---------------------|
| JEITA Package Code<br>P-SOP16-5.5x10.06-1.27 | RENESAS Code<br>PRSP0016DH-B | Previous Code<br>FP-16DAV | MASS[Typ.]<br>0.24g |
|--|------------------------------|---------------------------|---------------------|



Terminal cross section  
( Ni/Pd/Au plating )



Detail F

NOTE)  
1. DIMENSIONS\*1 (Nom)\*AND\*2\*  
DO NOT INCLUDE MOLD FLASH.  
2. DIMENSION\*3\*DOES NOT  
INCLUDE TRIM OFFSET.

| Reference Symbol | Dimension in Millimeters |       |      |
|------------------|--------------------------|-------|------|
|                  | Min                      | Nom   | Max  |
| D                | —                        | 10.06 | 10.5 |
| E                | —                        | 5.50  | —    |
| A <sub>2</sub>   | —                        | —     | —    |
| A <sub>1</sub>   | 0.00                     | 0.10  | 0.20 |
| A                | —                        | —     | 2.20 |
| b <sub>p</sub>   | 0.34                     | 0.40  | 0.46 |
| b <sub>1</sub>   | —                        | —     | —    |
| c                | 0.15                     | 0.20  | 0.25 |
| c <sub>1</sub>   | —                        | —     | —    |
| $\theta$         | 0°                       | —     | 8°   |
| H <sub>E</sub>   | 7.50                     | 7.80  | 8.00 |
| e                | —                        | 1.27  | —    |
| x                | —                        | —     | 0.12 |
| y                | —                        | —     | 0.15 |
| Z                | —                        | —     | 0.80 |
| L                | 0.50                     | 0.70  | 0.90 |
| L <sub>1</sub>   | —                        | 1.15  | —    |

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Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

#### **Renesas Technology (Shanghai) Co., Ltd.**

Unit2607 Ruijing Building, No.205 Maoming Road (S), Shanghai 200020, China  
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

#### **Renesas Technology Singapore Pte. Ltd.**

1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001

#### **Renesas Technology Korea Co., Ltd.**

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Tel: <82> 2-796-3115, Fax: <82> 2-796-2145

#### **Renesas Technology Malaysia Sdn. Bhd.**

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