# HD74HC589

## 8-bit Serial or Parallel-input/Serial-output Shift Register (with 3-state outputs)

REJ03D0631-0200
(Previous ADE-205-511)
Rev.2.00
Mar 30, 2006

## Description

The HD74HC589 is similar in function to the HD74HC597, which is not a 3-state device.

This device consists of an 8-bit storage latch which feeds parallel data to an 8-bit shift register. Data can also be loaded serially (see Function Table). The shift register output, $O_H$, is a three-state output, allowing this device to be used in bus-oriented systems.

## Features

- High Speed Operation: $t_{pd}$ (Shift Clock to $Q_H$) = 15 ns typ ($C_L$ = 50 pF)
- High Output Current: Fanout of 15 LSTTL Loads
- Wide Operating Voltage: $V_{CC}$ = 2 to 6 V
- Low Input Current: 1 µA max
- Low Quiescent Supply Current: $I_{CC}$ (static) = 4 µA max (Ta = 25°C)
- Ordering Information

| Part Name | Package Type | Package Code (Previous Code) | Package Abbreviation | Taping Abbreviation (Quantity) |
|---|---|---|---|---|
| HD74HC589FPEL | SOP-16 pin (JEITA) | PRSP0016DH-B (FP-16DAV) | FP | EL (2,000 pcs/reel) |
| HD74HC589RPEL | 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.

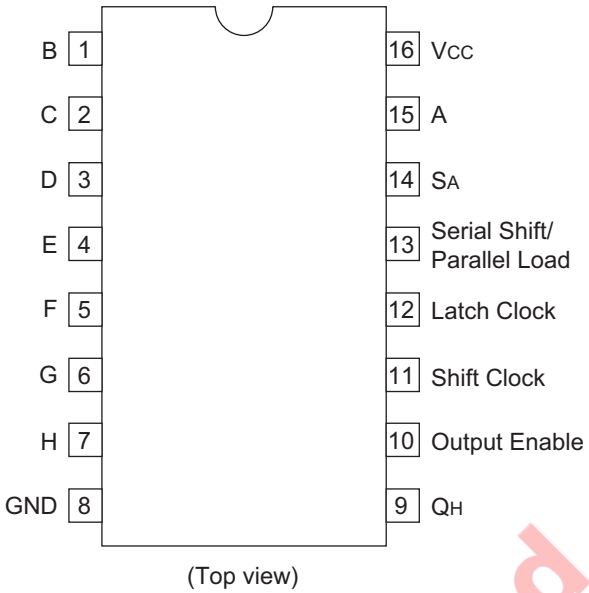


## Function Table

| Latch Clock LCK | Shift Clock SCK | Serial Shift/ Parallel Load | Output Enable $\overline{OE}$ | Function |
|---|---|---|---|---|
| ↑ | X | X | X | Data are loaded into input latches |
| ↑ | X | L | L | Data are loaded from input into shift registers |
| X | X | L | L | Data are transferred from input latches to shift registers |
| L, H, ↓ | L, H, ↓ | X | H | Outputs are disabled |
| X | ↑ | H | L | Serial shift $Q_n = Q_{n-1}$, $Q_0$ = SER |

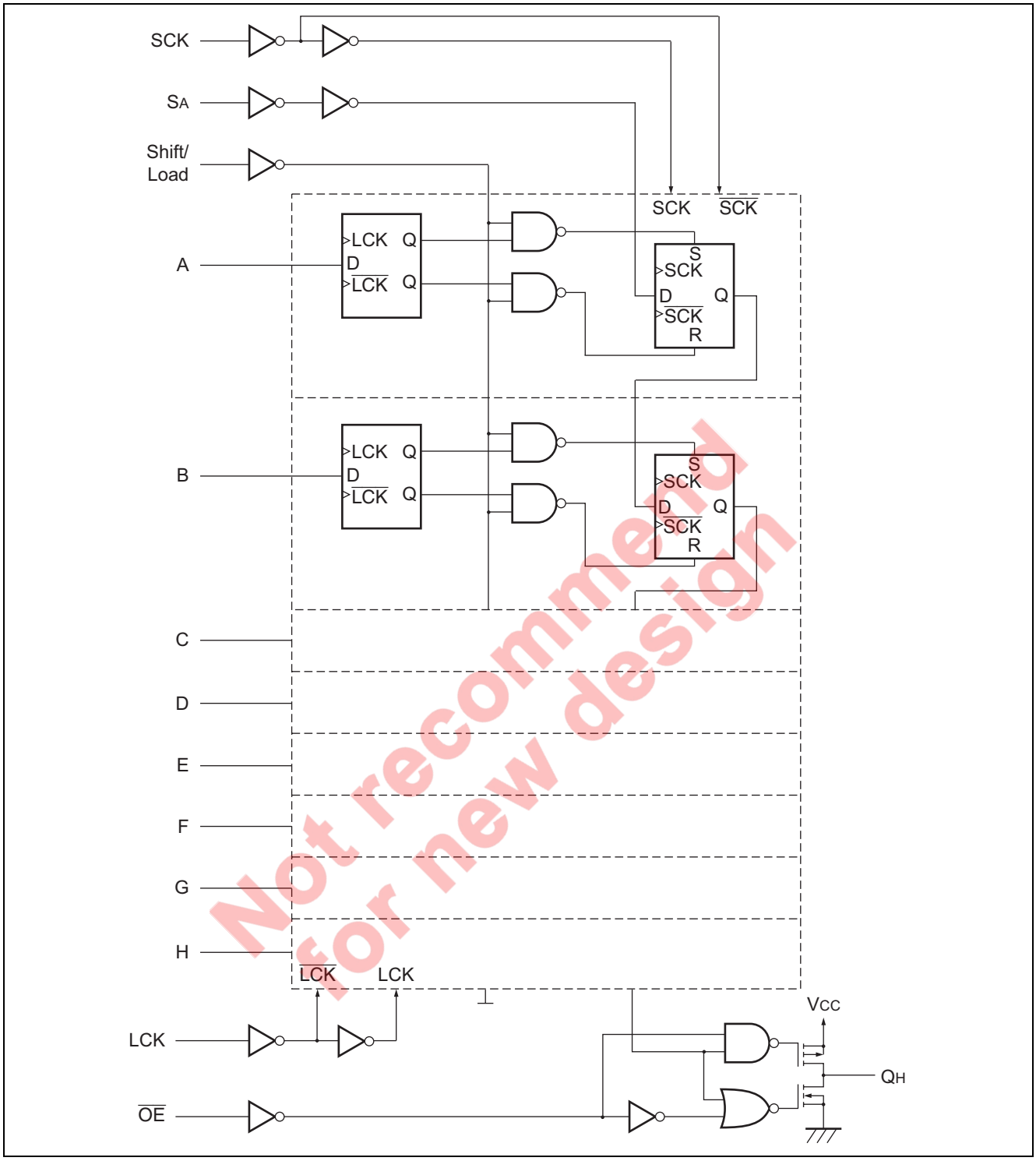
Note: 1. H; High level, L; Low level, X; Irrelevant

## Pin Arrangement




(Top view)

## 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 | $I_{IK}$, $I_{OK}$ | ±20 | mA |
| Output current | $I_{OUT}$ | ±35 | mA |
| $V_{CC}$, GND current | $I_{CC}$ or $I_{GND}$ | ±75 | mA |
| Power dissipation | $P_T$ | 500 | mW |
| Storage temperature | Tstg | –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 | Ta | –40 to 85 | °C | |
| Input rise / fall time*1 | $t_r$, $t_f$ | 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.



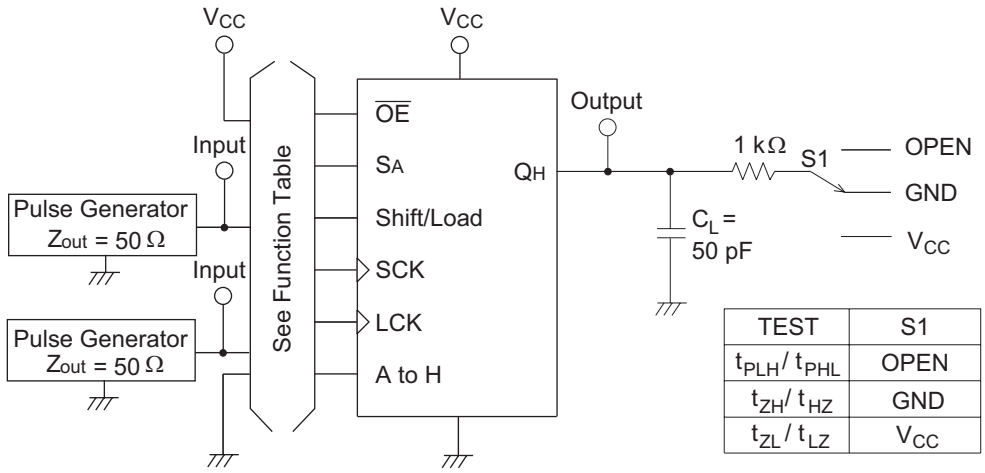
## Electrical Characteristics

| Item | Symbol | $V_{CC}$ (V) | Ta = 25°C | | | Ta = –40 to+85°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 | Vin = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –20 µA |
| | | 4.5 | 4.4 | 4.5 | — | 4.4 | — | | | |
| | | 6.0 | 5.9 | 6.0 | — | 5.9 | — | | | |
| | | 4.5 | 4.18 | — | — | 4.13 | — | | | $I_{OH}$ = –6 mA |
| | | 6.0 | 5.68 | — | — | 5.63 | — | | | $I_{OH}$ = –7.8 mA |
| | $V_{OL}$ | 2.0 | — | 0.0 | 0.1 | — | 0.1 | V | Vin = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 20 µA |
| | | 4.5 | — | 0.0 | 0.1 | — | 0.1 | | | |
| | | 6.0 | — | 0.0 | 0.1 | — | 0.1 | | | |
| | | 4.5 | — | — | 0.26 | — | 0.33 | | | $I_{OH}$ = 6 mA |
| | | 6.0 | — | — | 0.26 | — | 0.33 | | | $I_{OH}$ = 7.8 mA |
| Off-state output current | $I_{OZ}$ | 6.0 | — | — | ±0.5 | — | ±5.0 | µA | Vin = $V_{IH}$ or $V_{IL}$<br>Vout = $V_{CC}$ or GND | |
| Input current | Iin | 6.0 | — | — | ±0.1 | — | ±1.0 | µA | Vin = $V_{CC}$ or GND | |
| Quiescent supply current | $I_{CC}$ | 6.0 | — | — | 4.0 | — | 40 | µA | Vin = $V_{CC}$ or GND, Iout = 0 µA | |

## Switching Characteristics ($C_L$ = 50 pF, Input $t_r$ = $t_f$ = 6 ns)

| Item | Symbol | $V_{CC}$ (V) | Ta = 25°C | | | Ta = –40 to +85°C | | Unit | Test Conditions |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | | |
| Maximum clock frequency | $f_{max}$ | 2.0 | — | — | 5 | — | 4 | MHz | |
| | | 4.5 | — | — | 27 | — | 21 | | |
| | | 6.0 | — | — | 32 | — | 25 | | |
| Propagation delay time | $t_{PLH}$ $t_{PHL}$ | 2.0 | — | — | 200 | — | 250 | ns | Latch clock to $Q_H$ |
| | | 4.5 | — | 20 | 40 | — | 50 | | |
| | | 6.0 | — | — | 34 | — | 43 | | |
| | $t_{PLH}$ $t_{PHL}$ | 2.0 | — | — | 175 | — | 220 | ns | Shift clock to $Q_H$ |
| | | 4.5 | — | 15 | 35 | — | 44 | | |
| | | 6.0 | — | — | 30 | — | 37 | | |
| | $t_{PLH}$ $t_{PHL}$ | 2.0 | — | — | 175 | — | 220 | ns | Serial shift/parallel load to $Q_H$ |
| | | 4.5 | — | 16 | 35 | — | 44 | | |
| | | 6.0 | — | — | 30 | — | 37 | | |
| Output enable time | $t_{ZL}$ $t_{ZH}$ | 2.0 | — | — | 150 | — | 190 | ns | |
| | | 4.5 | — | 9 | 30 | — | 38 | | |
| | | 6.0 | — | — | 26 | — | 33 | | |
| Output disable time | $t_{LZ}$ $t_{HZ}$ | 2.0 | — | — | 150 | — | 190 | ns | |
| | | 4.5 | — | 14 | 30 | — | 38 | | |
| | | 6.0 | — | — | 26 | — | 33 | | |
| Pulse width | $t_w$ | 2.0 | 80 | — | — | 100 | — | ns | |
| | | 4.5 | 16 | 8 | — | 20 | — | | |
| | | 6.0 | 14 | — | — | 17 | — | | |
| Setup time | $t_{su}$ | 2.0 | 100 | — | — | 125 | — | ns | Data to latch clock |
| | | 4.5 | 20 | 1 | — | 25 | — | | |
| | | 6.0 | 17 | — | — | 21 | — | | |
| | $t_{su}$ | 2.0 | 100 | — | — | 125 | — | ns | $S_A$ to shift clock |
| | | 4.5 | 20 | — | — | 25 | — | | |
| | | 6.0 | 17 | — | — | 21 | — | | |
| | $t_{su}$ | 2.0 | 100 | — | — | 125 | — | ns | Serial shift/parallel load to shift clock |
| | | 4.5 | 20 | — | — | 25 | — | | |
| | | 6.0 | 17 | — | — | 21 | — | | |
| Hold time | $t_h$ | 2.0 | 5 | — | — | 5 | — | ns | Latch clock to data |
| | | 4.5 | 5 | 0 | — | 5 | — | | |
| | | 6.0 | 5 | — | — | 5 | — | | |
| | $t_h$ | 2.0 | 5 | — | — | 5 | — | ns | Shift clock to $S_A$ |
| | | 4.5 | 5 | — | — | 5 | — | | |
| | | 6.0 | 5 | — | — | 5 | — | | |
| | $t_h$ | 2.0 | 5 | — | — | 5 | — | ns | Shift clock to serial shift/ parallel load |
| | | 4.5 | 5 | — | — | 5 | — | | |
| | | 6.0 | 5 | — | — | 5 | — | | |
| Output rise/fall time | $t_{TLH}$ $t_{THL}$ | 2.0 | — | — | 75 | — | 95 | ns | |
| | | 4.5 | — | 5 | 15 | — | 19 | | |
| | | 6.0 | — | — | 13 | — | 16 | | |
| Input capacitance | Cin | — | — | 5 | 10 | — | 10 | pF | |

## Test Circuit

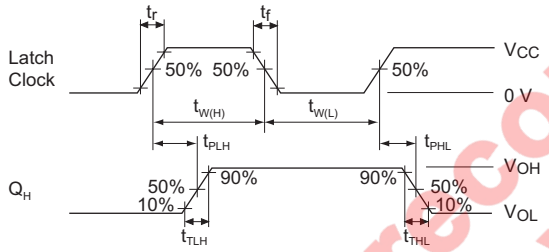



| TEST | S1 |
|---|---|
| $t_{PLH}$/ $t_{PHL}$ | OPEN |
| $t_{ZH}$/ $t_{HZ}$ | GND |
| $t_{ZL}$ / $t_{LZ}$ | VCC |

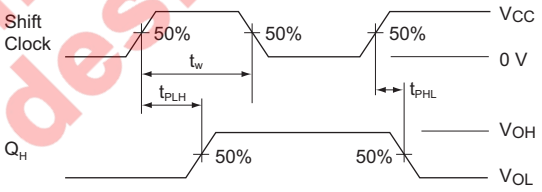
Note : 1. $C_L$ includes probe and jig capacitance.

## Waveforms

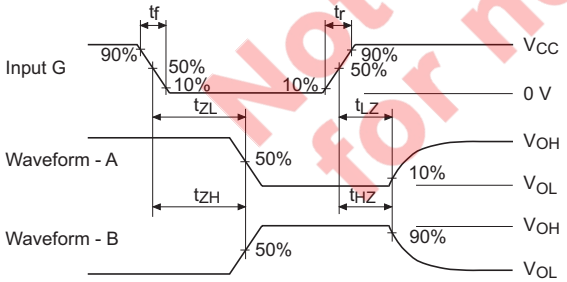
**1. (SERIAL SHIFT / PARALLEL LOAD = "L")**



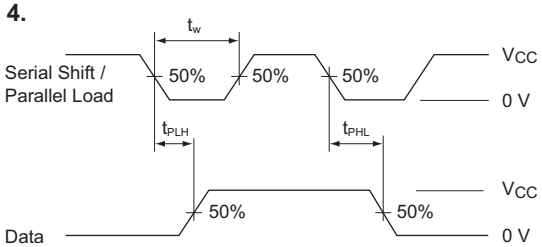

**2. (SERIAL SHIFT / PARALLEL LOAD = "H")**




**3.**

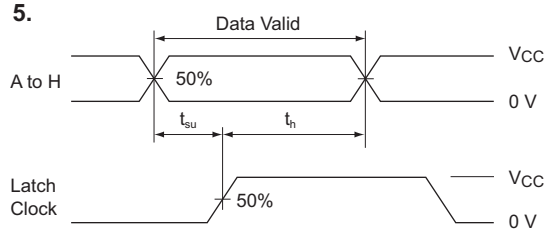



**4.**

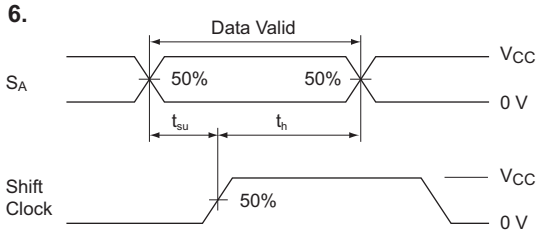



Notes : 1. Input waveform : PRR ≤ 1 MHz, duty cycle 50%, $t_r \leq 6$ ns, $t_f \leq 6$ ns
2. Waveform - A is for an output with internal conditions such that the output is low except when disabled by the output control.
3. Waveform - B is for an output with internal conditions such that the output is high except when disabled by the output control.
4. The output are measured one at a time with one transition per measurement.

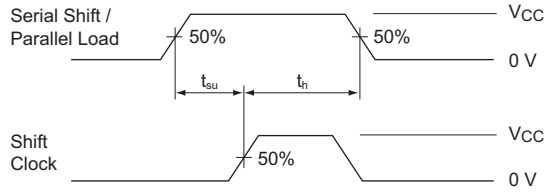
**5.**




**6.**



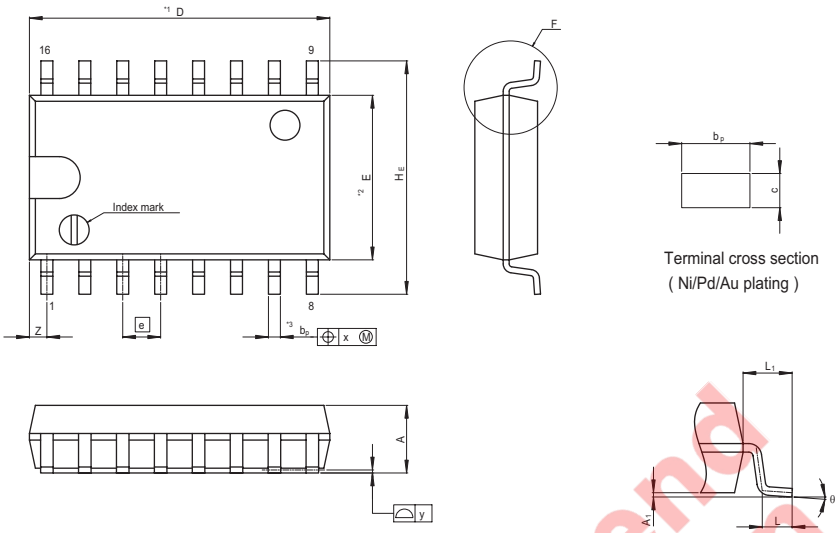

**7.**




Notes : 1. Input waveform : PRR ≤ 1 MHz, duty cycle 50%, $t_r$ ≤ 6 ns, $t_f$ ≤ 6 ns
2. The output are measured one at a time with one transition per measurement.

## Package Dimensions

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

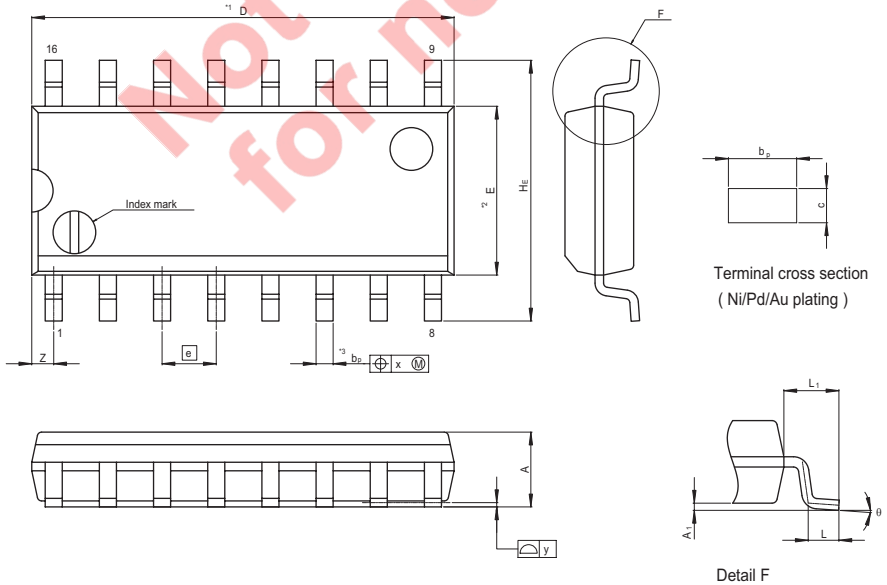



NOTE)
1. DIMENSIONS"*1 (Nom)"AND"*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION"*3"DOES NOT INCLUDE TRIM OFFSET.

| Reference Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| D | — | 10.06 | 10.5 |
| E | — | 5.50 | — |
| $A_2$ | — | — | — |
| $A_1$ | 0.00 | 0.10 | 0.20 |
| A | — | — | 2.20 |
| $b_p$ | 0.34 | 0.40 | 0.46 |
| $b_1$ | — | — | — |
| c | 0.15 | 0.20 | 0.25 |
| $c_1$ | — | — | — |
| θ | 0° | — | 8° |
| $H_E$ | 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 |
| $L_1$ | — | 1.15 | — |



| JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|---|---|---|---|
| P-SOP16-3.95x9.9-1.27 | PRSP0016DG-A | FP-16DNV | 0.15g |




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 | — | 9.90 | 10.30 |
| E | — | 3.95 | — |
| $A_2$ | — | — | — |
| $A_1$ | 0.10 | 0.14 | 0.25 |
| A | — | — | 1.75 |
| $b_p$ | 0.34 | 0.40 | 0.46 |
| $b_1$ | — | — | — |
| c | 0.15 | 0.20 | 0.25 |
| $c_1$ | — | — | — |
| θ | 0° | — | 8° |
| $H_E$ | 5.80 | 6.10 | 6.20 |
| e | — | 1.27 | — |
| x | — | — | 0.25 |
| y | — | — | 0.15 |
| Z | — | — | 0.635 |
| L | 0.40 | 0.60 | 1.27 |
| $L_1$ | — | 1.08 | — |

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