# HD74LS93

## 4-bit Binary Counter

REJ03D0423–0200
Rev.2.00
Feb.18.2005

The HD74LS93 contains four master-slave flip-flops and additional gating to provide a divide-by-two counter and three-state binary counter for divide-by-eight. To use this maximum count length of this counter, the B input is connected to the $Q_A$ output. The input count pulses are applied to input A and the outputs are described in the appropriate function table.

### Features

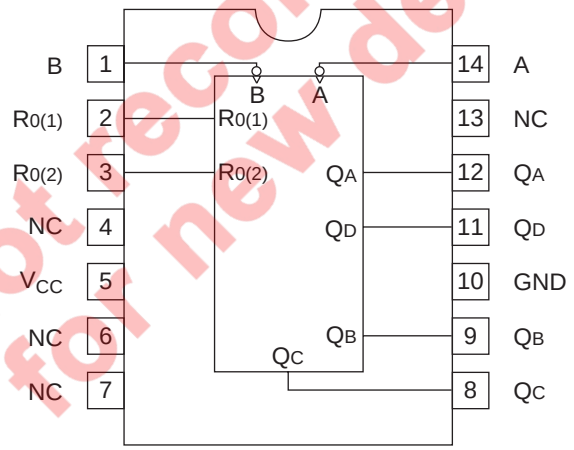
- Ordering Information

| Part Name | Package Type | Package Code (Previous Code) | Package Abbreviation | Taping Abbreviation (Quantity) |
|---|---|---|---|---|
| HD74LS93P | DILP-14 pin | PRDP0014AB-B (DP-14AV) | P | — |
| HD74LS93FPEL | SOP-14 pin (JEITA) | PRSP0014DF-B (FP-14DAV) | FP | EL (2,000 pcs/reel) |

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



### Pin Arrangement




(Top view)

## Function Table

### • Reset / Count Function Table

| Reset inputs | | Outputs | | | |
|---|---|---|---|---|---|
| $R_{0(1)}$ | $R_{0(2)}$ | $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
| H | H | L | L | L | L |
| L | X | Count | | | |
| X | L | Count | | | |

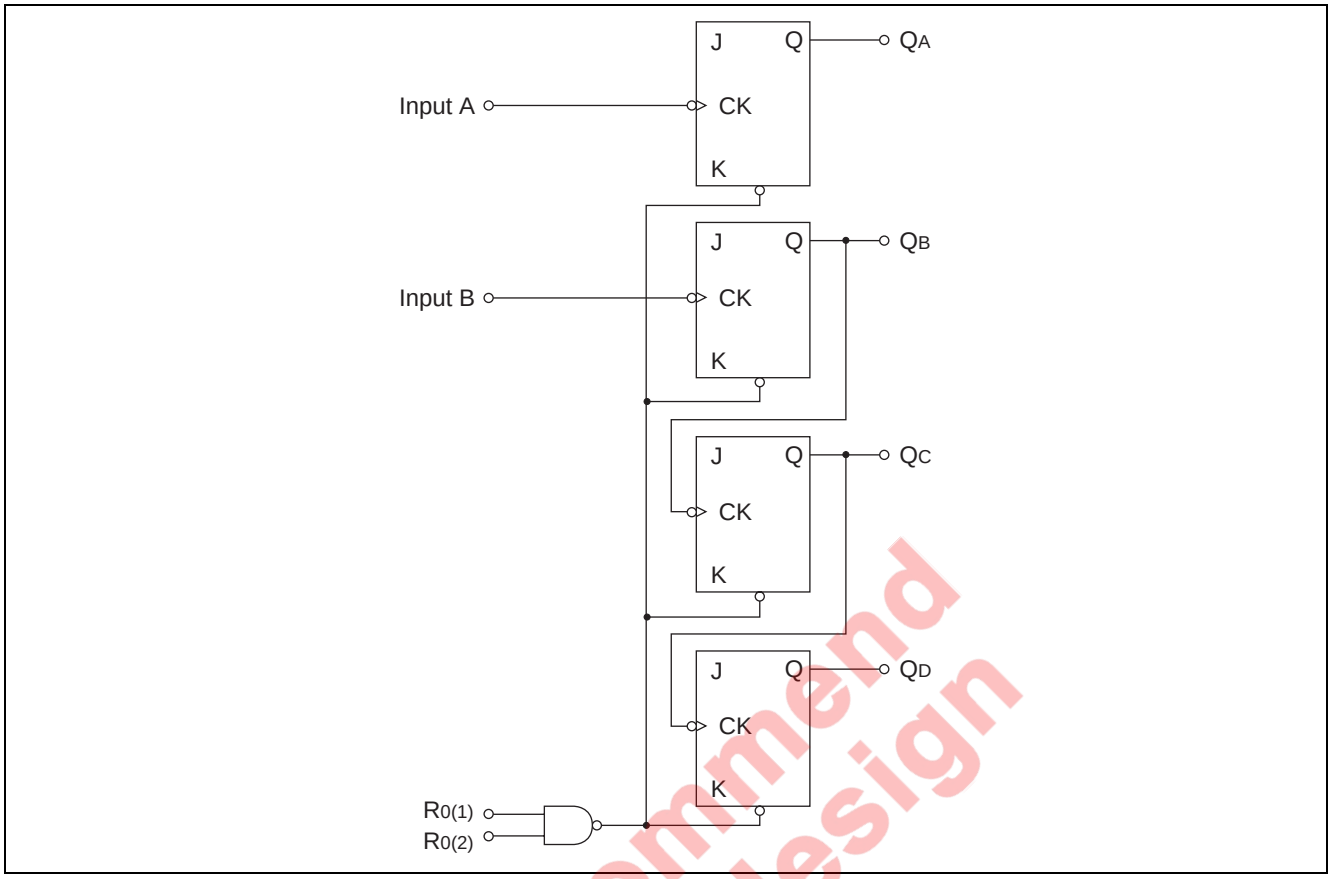
Note: H; high level, L; low level, X; irrelevant

### • BCD Count Sequence (Notes 1)

| Count | Outputs | | | |
|---|---|---|---|---|
| | $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
| 0 | L | L | L | L |
| 1 | L | L | L | H |
| 2 | L | L | H | L |
| 3 | L | L | H | H |
| 4 | L | H | L | H |
| 5 | L | H | L | H |
| 6 | L | H | H | L |
| 7 | L | H | H | H |
| 8 | H | L | L | L |
| 9 | H | L | L | H |
| 10 | H | L | H | L |
| 11 | H | L | H | H |
| 12 | H | H | L | L |
| 13 | H | H | L | H |
| 14 | H | H | H | L |
| 15 | H | H | H | H |

Notes: 1. Output QA is connected to input B for BCD count.
2. H; high level, L; low level

## Block Diagram






## Absolute Maximum Ratings

| Item | | Symbol | Ratings | Unit |
|---|---|---|---|---|
| Supply voltage | | $V_{CC}$ | 7 | V |
| Input voltage | R Inputs | $V_{IN}$ | 7 | V |
| | A, B Inputs | $V_{IN}$ | 5.5 | V |
| Power dissipation | | $P_T$ | 400 | mW |
| Storage temperature | | Tstg | –65 to +150 | °C |

Note: Voltage value, unless otherwise noted, are with respect to network ground terminal.

## Recommended Operating Conditions

| Item | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Supply voltage | | $V_{CC}$ | 4.75 | 5.00 | 5.25 | V |
| Output current | | $I_{OH}$ | — | — | –400 | µA |
| | | $I_{OL}$ | — | — | 8 | mA |
| Operating temperature | | Topr | –20 | 25 | 75 | °C |
| Count frequency | A input | $f_{count}$ | 0 | — | 32 | MHz |
| | B input | | 0 | — | 16 | |
| Pulse width | A input | $t_w$ | 15 | — | — | ns |
| | B input | | 30 | — | — | |
| | Reset input | | 15 | — | — | |
| Setup time | | $t_{su}$ | 25 | — | — | ns |

## Electrical Characteristics

(Ta = –20 to +75 °C)

| Item | | Symbol | min. | typ.* | max. | Unit | Condition | |
|---|---|---|---|---|---|---|---|---|
| Input voltage | | $V_{IH}$ | 2.0 | — | — | V | | |
| | | $V_{IL}$ | — | — | 0.8 | V | | |
| Output voltage | | $V_{OH}$ | 2.7 | — | — | V | $V_{CC}$ = 4.75 V, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $I_{OH}$ = –400 µA | |
| | | $V_{OL}$ | — | — | 0.4 | V | $I_{OL}$ = 4 mA** | $V_{CC}$ = 4.75 V, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V |
| | | | — | — | 0.5 | | $I_{OL}$ = 8 mA** | |
| Input current | Any reset | $I_{IL}$ | — | — | –0.4 | mA | $V_{CC}$ = 5.25 V, $V_I$ = 0.4 V | |
| | A input | | — | — | –2.4 | | | |
| | B input | | — | — | –1.6 | | | |
| | Any reset | $I_{IH}$ | — | — | 20 | µA | $V_{CC}$ = 5.25 V, $V_I$ = 2.7 V | |
| | A input | | — | — | 40 | | | |
| | B input | | — | — | 40 | | | |
| | Any reset | $I_I$ | — | — | 0.1 | mA | $V_I$ = 7 V | $V_{CC}$ = 5.25 V |
| | A input | | — | — | 0.2 | | $V_I$ = 5.5 V | |
| | B input | | — | — | 0.2 | | $V_I$ = 5.5 V | |
| Short-circuit output current | | $I_{OS}$ | –20 | — | –100 | mA | $V_{CC}$ = 5.25 V | |
| Supply current | | $I_{CC}$*** | — | 9 | 15 | mA | $V_{CC}$ = 5.25 V | |
| Input clamp voltage | | $V_{IK}$ | — | — | –1.5 | V | $V_{CC}$ = 4.75 V, $I_{IN}$ = –18 mA | |

Notes: * $V_{CC}$ = 5 V, Ta = 25°C

** $Q_A$ output is tested at specified $I_{OL}$ plus the limit value of IIL for the B input. This permits driving the B input while maintaining full fan-out capability.

*** $I_{CC}$ is measured with all outputs open, both $R_0$ inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.

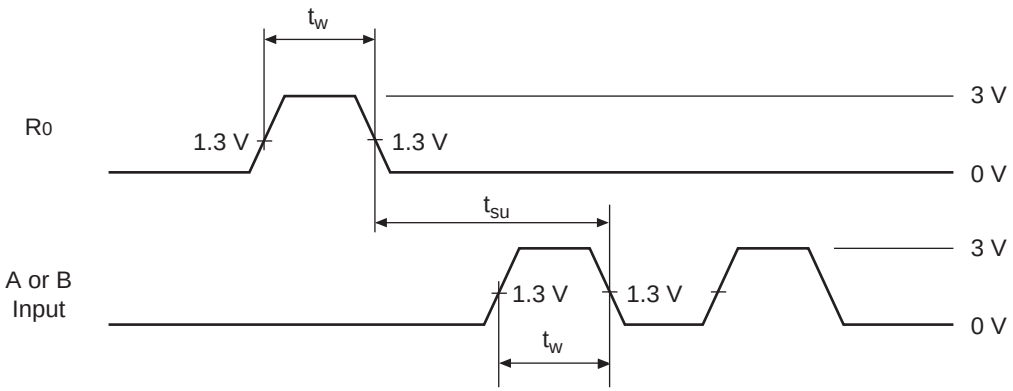
## Switching Characteristics

($V_{CC}$ = 5 V, Ta = 25°C)

| Item | Symbol | Inputs | Outputs | min. | typ. | max. | Unit | Condition |
|---|---|---|---|---|---|---|---|---|
| Maximum count frequency | $f_{max}$ | A | $Q_A$ | 32 | 42 | — | MHz | $C_L$ = 15 pF, $R_L$ = 2 kΩ |
| | | B | $Q_B$ | 16 | — | — | | |
| Propagation delay time | $t_{PLH}$ | A | $Q_A$ | — | 10 | 16 | ns | |
| | $t_{PHL}$ | | | — | 12 | 18 | | |
| | $t_{PLH}$ | A | $Q_D$ | — | 46 | 70 | | |
| | $t_{PHL}$ | | | — | 46 | 70 | | |
| | $t_{PLH}$ | B | $Q_B$ | — | 10 | 16 | | |
| | $t_{PHL}$ | | | — | 14 | 21 | | |
| | $t_{PLH}$ | B | $Q_C$ | — | 21 | 32 | | |
| | $t_{PHL}$ | | | — | 23 | 35 | | |
| | $t_{PLH}$ | B | $Q_D$ | — | 34 | 51 | | |
| | $t_{PHL}$ | | | — | 34 | 51 | | |
| | $t_{PHL}$ | Set-to-0 | $Q_A$ to $Q_D$ | — | 26 | 40 | | |

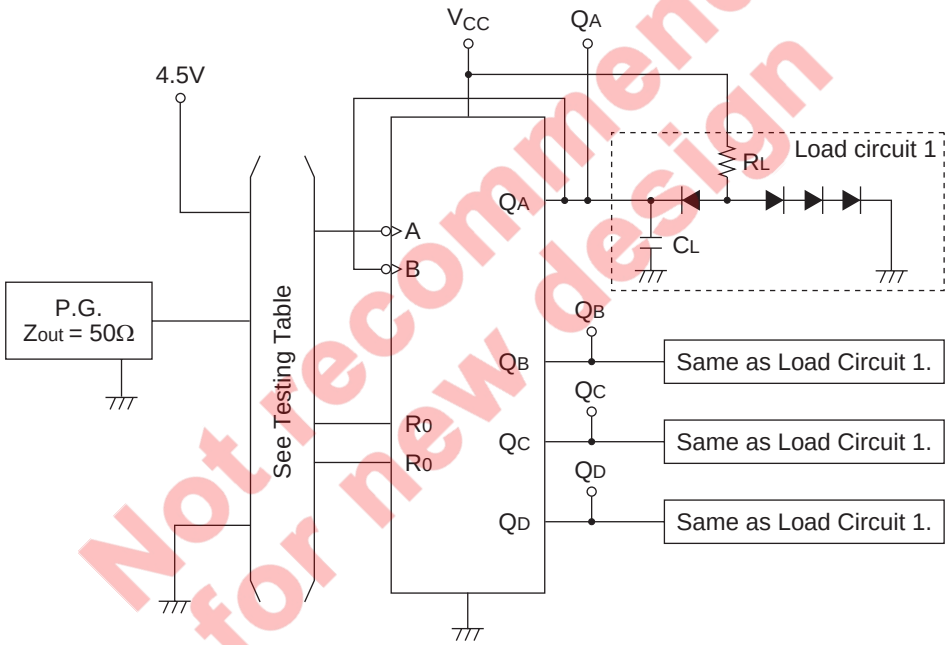
Note: Refer to Test Circuit and Waveform of the Common Item "TTL Common Matter (Document No.: REJ27D0005-0100)".

## Timing Definition




## Testing Method

### Test Circuit






Notes: 1. $C_L$ includes probe and jig capacitance.
2. All diodes are 1S2074(H).

## Testing Table

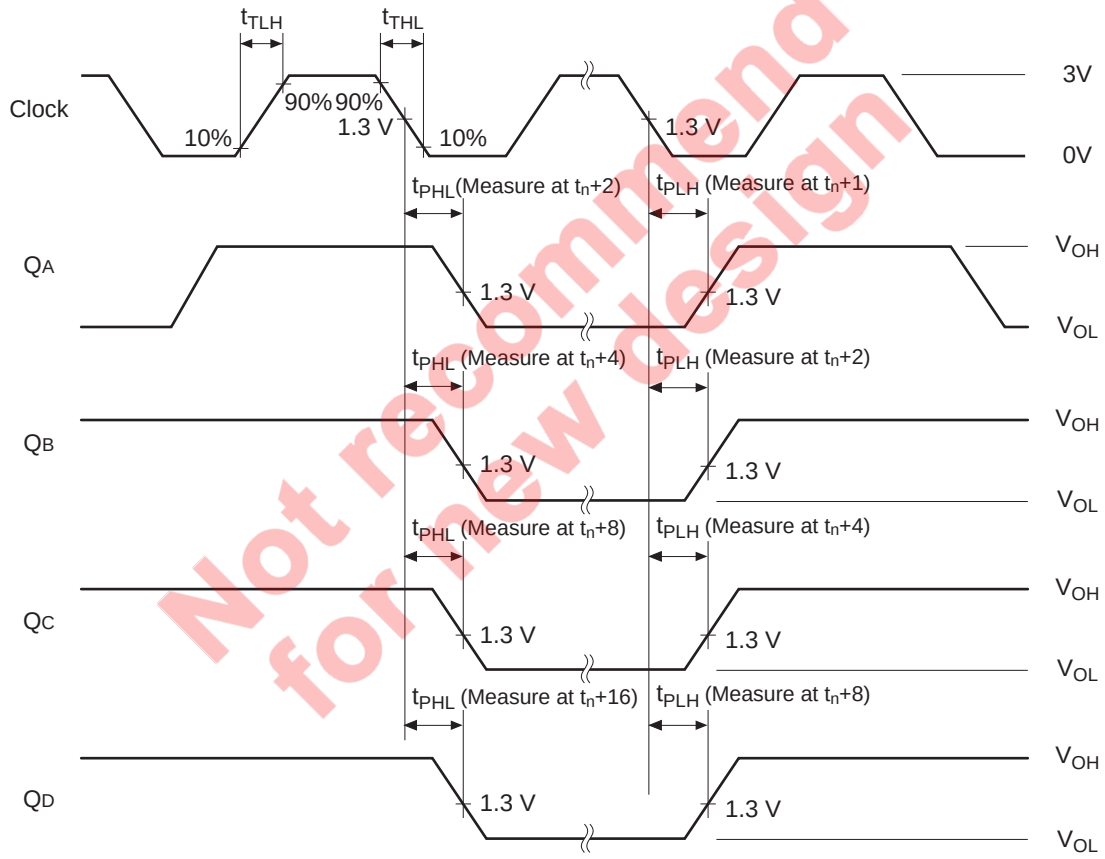
| Item | From input to output | Inputs | | | Outputs | | | |
|---|---|---|---|---|---|---|---|---|
| | | A | B | $R_0$ | $Q_A$ | $Q_B$ | $Q_C$ | $Q_D$ |
| $f_{max}$ | A → Q | IN | to $Q_A$ | GND | Out | Out | Out | Out |
| | B → Q | 4.5 V | IN | GND | — | Out | Out | Out |
| $t_{PLH}$ $t_{PHL}$ | A → $Q_A$ | IN | to $Q_A$ | GND | Out | — | — | — |
| | A → $Q_D$ | IN | to $Q_A$ | GND | — | — | — | Out |
| | B → $Q_B$ | 4.5 V | IN | GND | — | Out | — | — |
| | B → $Q_C$ | 4.5 V | IN | GND | — | — | Out | — |
| | B → $Q_D$ | 4.5 V | IN | GND | — | — | — | Out |
| | $R_0$** → Q | IN* | to $Q_A$ | IN | Out | Out | Out | Out |

* For initialized.

** Measured with each input and unused inputs at 4.5 V.

## Waveform

1. $f_{max}$, $t_{PLH}$, $t_{PHL}$ (Clock → Q)

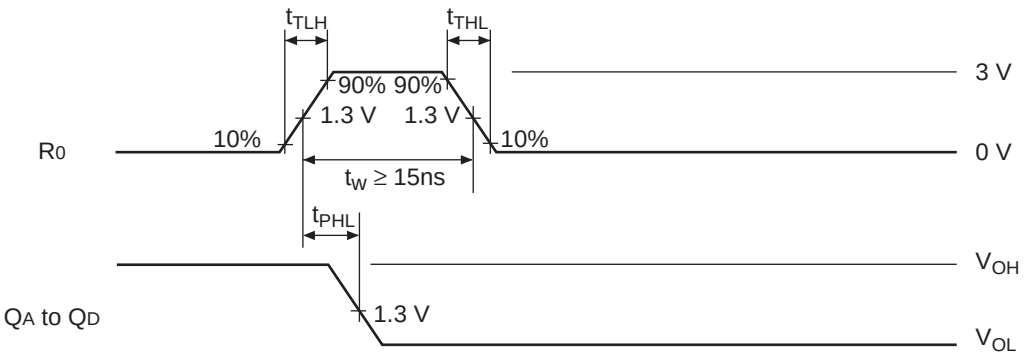





Notes: 1. Input pulse; $t_{TLH} \leq 15$ ns, $t_{THL} \leq 5$ ns, PRR = 1 MHz, duty cycle = 50% and for fmax., $t_{TLH} = t_{THL} \leq 2.5$ ns

2. $t_n$ is reference bit time when all outputs are low.

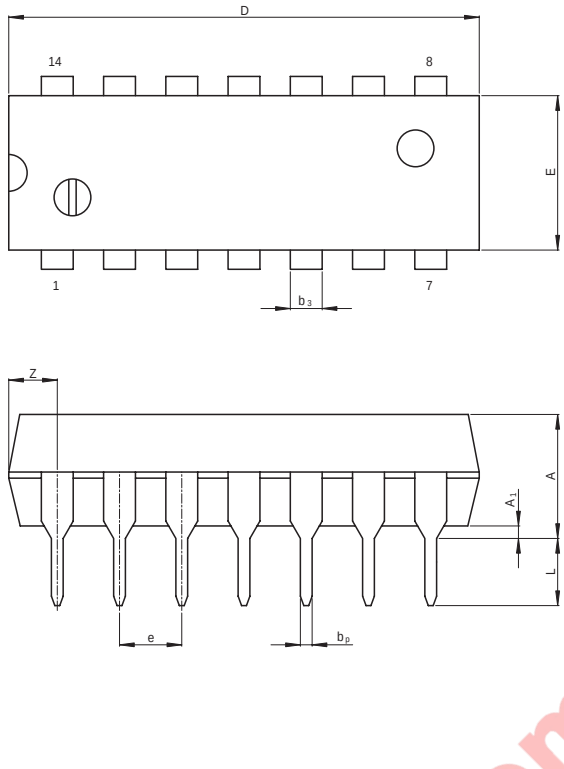
2. $t_{PHL}$ ($R_0 \rightarrow Q$)




Notes: $t_{TLH} \leq 15$ ns, $t_{THL} \leq 5$ ns

# Package Dimensions

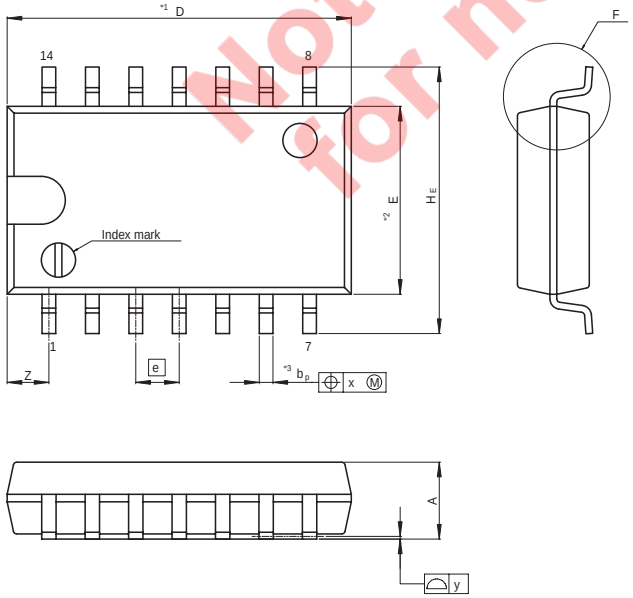
| JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|---|---|---|---|
| P-DIP14-6.3x19.2-2.54 | PRDP0014AB-B | DP-14AV | 0.97g |



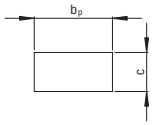

| Reference Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| e 1 | —— | 7.62 | —— |
| D | —— | 19.2 | 20.32 |
| E | —— | 6.3 | 7.4 |
| A | —— | —— | 5.06 |
| A 1 | 0.51 | —— | —— |
| b p | 0.40 | 0.48 | 0.56 |
| b 3 | —— | 1.30 | —— |
| c | 0.19 | 0.25 | 0.31 |
| θ | 0° | —— | 15° |
| e | 2.29 | 2.54 | 2.79 |
| Z | —— | —— | 2.39 |
| L | 2.54 | —— | —— |



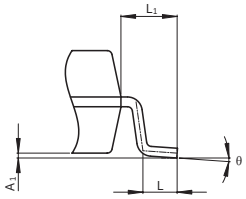
| JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|---|---|---|---|
| P-SOP14-5.5x10.06-1.27 | PRSP0014DF-B | FP-14DAV | 0.23g |




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




Terminal cross section
( Ni/Pd/Au plating )




Detail F

| 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 | —— | —— | 1.42 |
| L | 0.50 | 0.70 | 0.90 |
| L 1 | —— | 1.15 | —— |

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