To our customers,

# Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation



Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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# HAF1002(L), HAF1002(S)

## Silicon P Channel MOS FET Series
## Power Switching

REJ03G1133-0200
(Previous: ADE-208-586)
Rev.2.00
Sep 07, 2005



### Description

This FET has the over temperature shut-down capability sensing to the junction temperature.

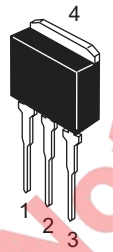
This FET has the built-in over temperature shut-down circuit in the gate area. And this circuit operation to shut-down the gate voltage in case of high junction temperature like applying over power consumption, over current etc.

### Features

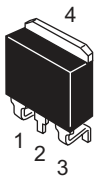
- Logic level operation (–4 to –6 V Gate drive)
- High endurance capability against to the short circuit
- Built-in the over temperature shut-down circuit
- Latch type shut-down operation (Need 0 voltage recovery)

### Outline

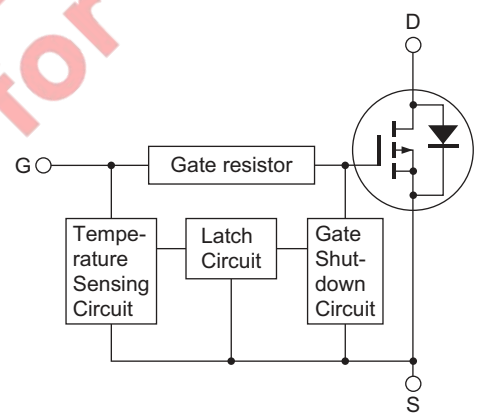
RENESAS Package code: PRSS0004AE-A
(Package name: LDPAK (L) )




RENESAS Package code: PRSS0004AE-B
(Package name: LDPAK (S)-(1) )




1. Gate
2. Drain
3. Source
4. Drain



## Absolute Maximum Ratings

(Ta = 25°C)

| Item | Symbol | Value | Unit |
|---|---|---|---|
| Drain to source voltage | $V_{DSS}$ | –60 | V |
| Gate to source voltage | $V_{GSS}$ | –16 | V |
| | $V_{GSS}$ | 3 | V |
| Drain current | $I_D$ | –15 | A |
| Drain peak current | $I_{D\ (pulse)}$ Note 1 | –30 | A |
| Body-drain diode reverse drain current | $I_{DR}$ | –15 | A |
| Channel dissipation | Pch Note 2 | 50 | W |
| Channel temperature | Tch | 150 | °C |
| Storage temperature | Tstg | –55 to +150 | °C |

Notes: 1. PW ≤ 10 ∝s, duty cycle ≤ 1%
2. Value at Tc = 25°C

## Typical Operation Characteristics

| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Input voltage | $V_{IH}$ | –3.5 | — | — | V | |
| | $V_{IL}$ | — | — | –1.2 | V | |
| Input current (Gate non shut down) | $I_{IH1}$ | — | — | –100 | ∝A | Vi = –8 V, $V_{DS}$ = 0 |
| | $I_{IH2}$ | — | — | –50 | ∝A | Vi = –3.5 V, $V_{DS}$ = 0 |
| | $I_{IL}$ | — | — | –1 | ∝A | Vi = –1.2 V, $V_{DS}$ = 0 |
| Input current (Gate shut down) | $I_{IH\ (sd)\ 1}$ | — | –0.8 | — | mA | Vi = –8 V, $V_{DS}$ = 0 |
| | $I_{IH\ (sd)\ 2}$ | — | –0.35 | — | mA | Vi = –3.5 V, $V_{DS}$ = 0 |
| Shut down temperature | Tsd | — | 175 | — | °C | Channel temperature |
| Gate operation voltage | $V_{OP}$ | –3.5 | — | –13 | V | |

## Electrical Characteristics

(Ta = 25°C)

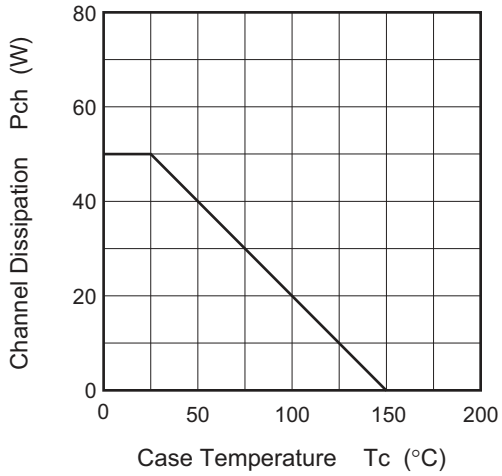
| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Drain current | $I_{D1}$ | –7 | — | — | A | $V_{GS}$ = –3.5 V, $V_{DS}$ = –2 V |
| | $I_{D2}$ | — | — | –10 | mA | $V_{GS}$ = –1.2 V, $V_{DS}$ = –2 V |
| Drain to source breakdown voltage | $V_{(BR)\ DSS}$ | –60 | — | — | V | $I_D$ = –10 mA, $V_{GS}$ = 0 |
| Gate to source breakdown voltage | $V_{(BR)\ GSS}$ | –16 | — | — | V | $I_G$ = –100 ∝A, $V_{DS}$ = 0 |
| | $V_{(BR)\ GSS}$ | 3 | — | — | V | $I_G$ = 100 ∝A, $V_{DS}$ = 0 |
| Gate to source leak current | $I_{GSS1}$ | — | — | –100 | ∝A | $V_{GS}$ = –8 V, $V_{DS}$ = 0 |
| | $I_{GSS2}$ | — | — | –50 | ∝A | $V_{GS}$ = –3.5 V, $V_{DS}$ = 0 |
| | $I_{GSS3}$ | — | — | –1 | ∝A | $V_{GS}$ = –1.2 V, $V_{DS}$ = 0 |
| | $I_{GSS4}$ | — | — | 100 | ∝A | $V_{GS}$ = 2.4 V, $V_{DS}$ = 0 |
| Input current (shut down) | $I_{GS\ (op)\ 1}$ | — | –0.8 | — | mA | $V_{GS}$ = –8 V, $V_{DS}$ = 0 |
| | $I_{GS\ (op)\ 2}$ | — | –0.35 | — | mA | $V_{GS}$ = –3.5 V, $V_{DS}$ = 0 |
| Zero gate voltage drain current | $I_{DSS}$ | — | — | –250 | ∝A | $V_{DS}$ = –50 V, $V_{GS}$ = 0 |
| Gate to source cutoff voltage | $V_{GS\ (off)}$ | –1.1 | — | –2.25 | V | $I_D$ = –1 mA, $V_{DS}$ = –10 V |
| Static drain to source on state resistance | $R_{DS\ (on)}$ | — | 100 | 130 | mΩ | $I_D$ = –7.5 A, $V_{GS}$ = –4 V Note 3 |
| | $R_{DS\ (on)}$ | — | 70 | 90 | mΩ | $I_D$ = –7.5 A, $V_{GS}$ = –10 V Note 3 |
| Forward transfer admittance | $\|y_{fs}\|$ | 5 | 10 | — | S | $I_D$ = –7.5 A, $V_{DS}$ = –10 V Note 3 |
| Output capacitance | Coss | — | 610 | — | pF | $V_{DS}$ = –10 V, $V_{GS}$ = 0<br>f = 1 MHz |
| Turn-on delay time | $t_{d\ (on)}$ | — | 7.5 | — | ∝s | $I_D$ = –7.5 A<br>$V_{GS}$ = –5 V<br>$R_L$ = 4 Ω |
| Rise time | $t_r$ | — | 36 | — | ∝s | |
| Turn-off delay time | $t_{d\ (off)}$ | — | 32 | — | ∝s | |
| Fall time | $t_f$ | — | 29 | — | ∝s | |
| Body-drain diode forward voltage | $V_{DF}$ | — | –1.0 | — | V | $I_F$ = –15 A, $V_{GS}$ = 0 |
| Body-drain diode reverse recovery time | $t_{rr}$ | — | 200 | — | ns | $I_F$ = –15 A, $V_{GS}$ = 0<br>$di_F/dt$ = 50 A/∝s |
| Over load shut down operation time Note4 | $t_{os1}$ | — | 3.7 | — | ms | $V_{GS}$ = –5 V, $V_{DD}$ = –12 V |
| | $t_{os2}$ | — | 1 | — | ms | $V_{GS}$ = –5 V, $V_{DD}$ = –24 V |

Notes: 3. Pulse test

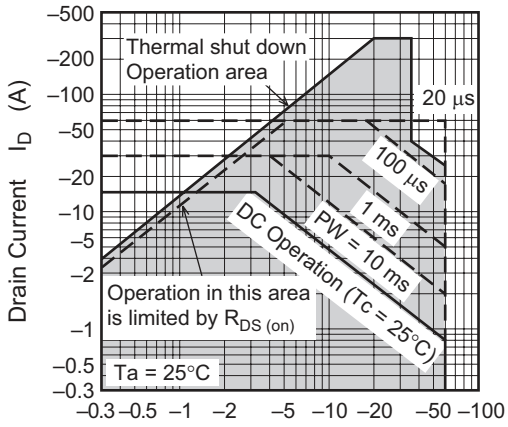
4. Include the time shift based on increasing of channel temperature when operate under over load condition.

## Main Characteristics

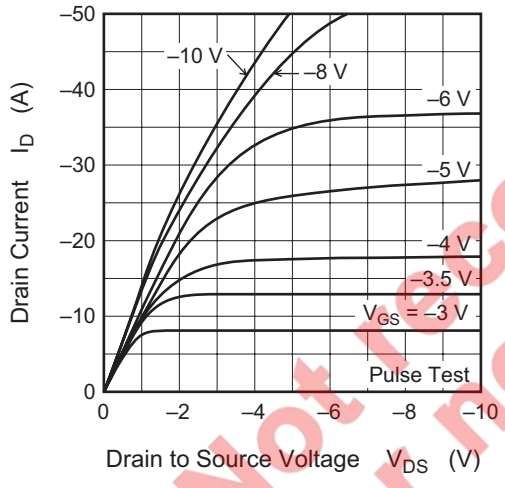
Power vs. Temperature Derating



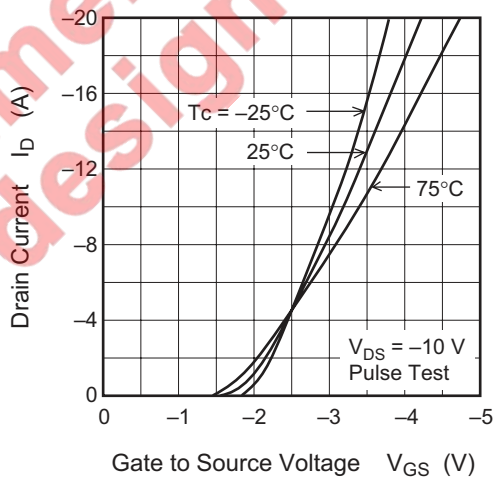

Maximum Safe Operation Area



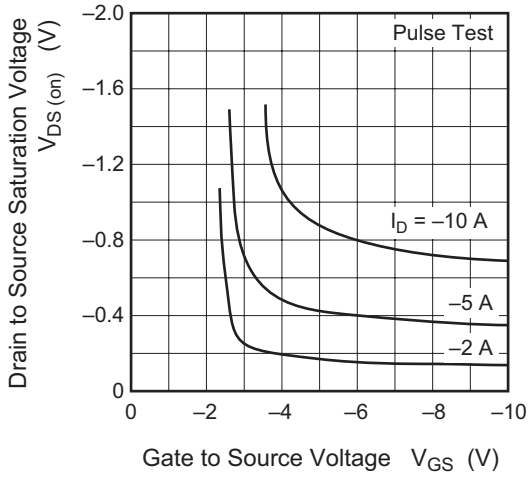

Typical Output Characteristics



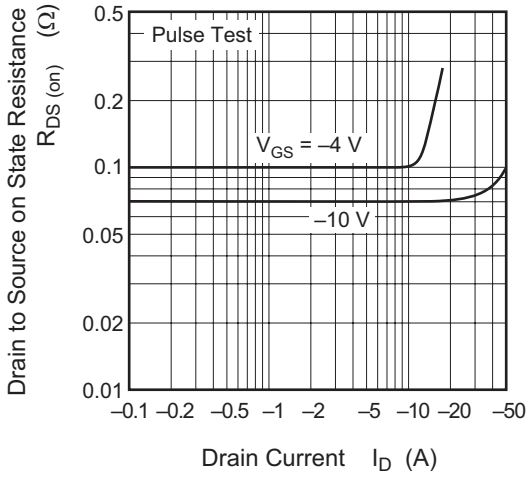

Typical Transfer Characteristics



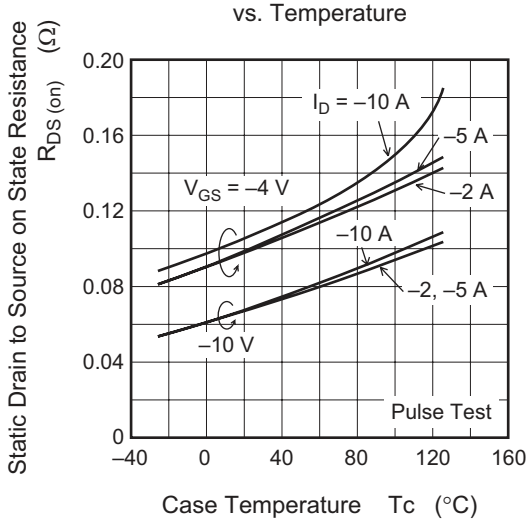

Drain to Source Saturation Voltage vs. Gate to Source Voltage



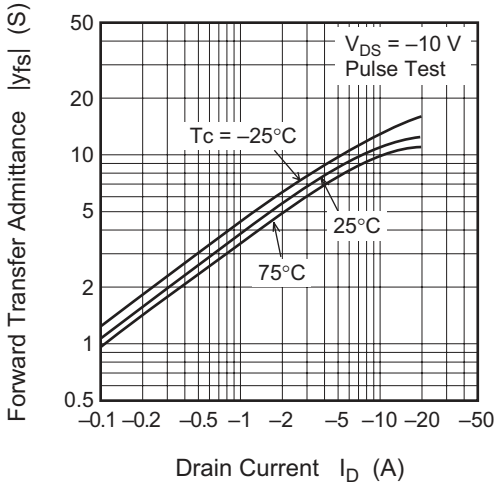

Static Drain to Source on State Resistance vs. Drain Current



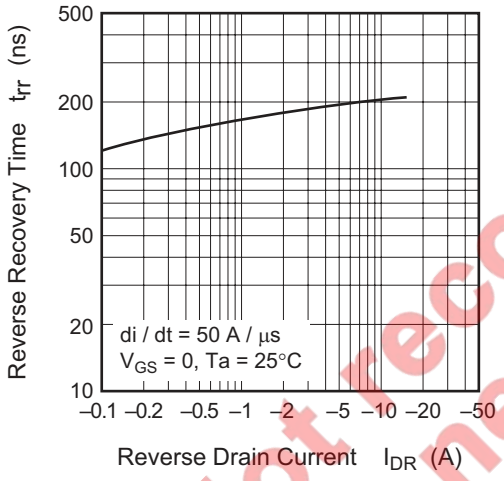
Static Drain to Source on State Resistance vs. Temperature



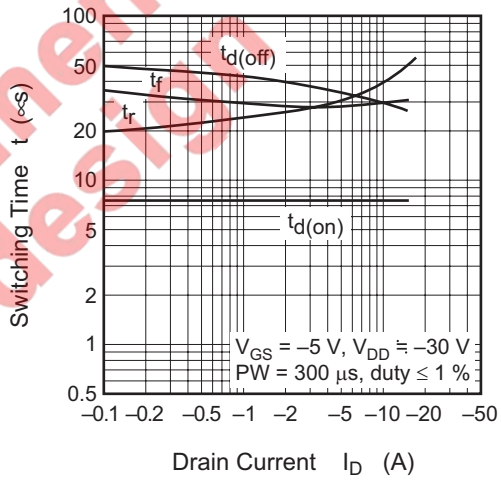

Forward Transfer Admittance vs. Drain Current



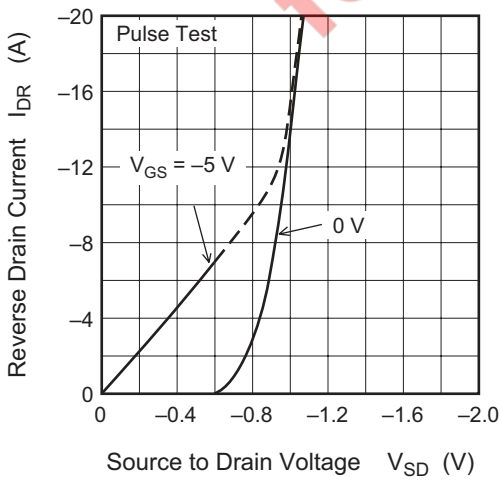

Body-Drain Diode Reverse Recovery Time



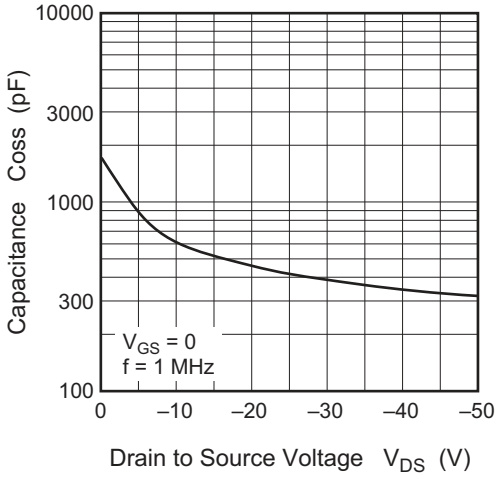

Switching Characteristics



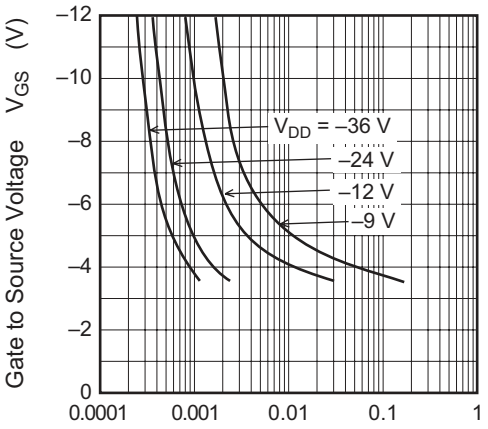

Reverse Drain Current vs. Source to Drain Voltage



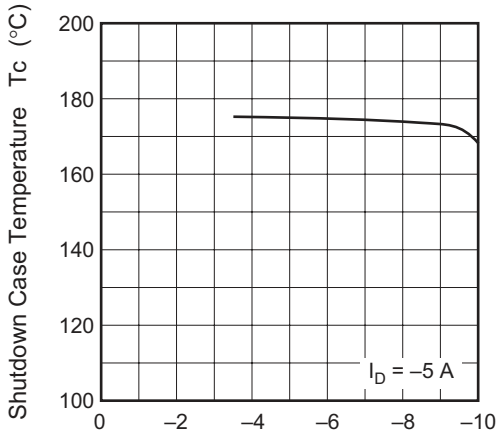

Typical Capacitance vs. Drain to Source Voltage



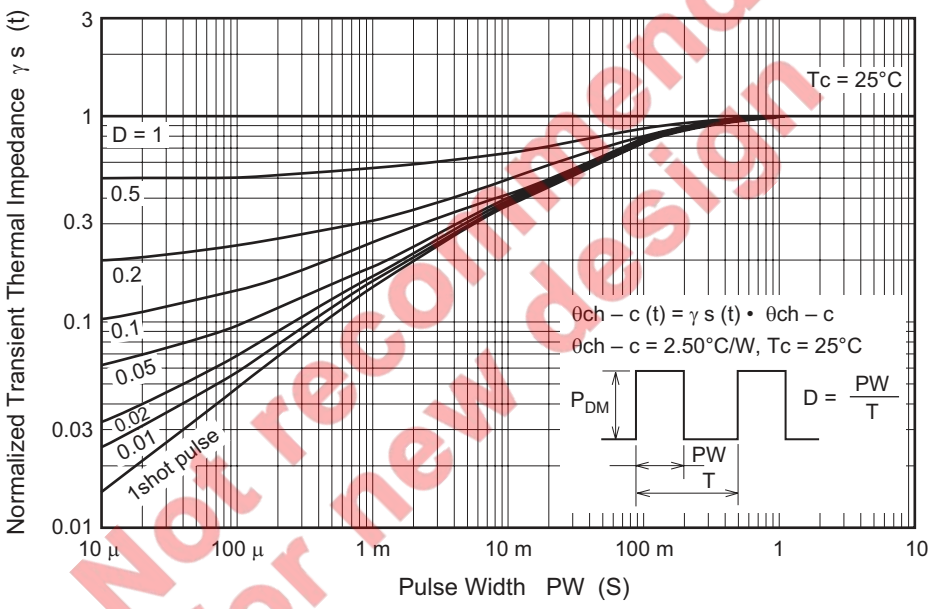
Gate to Source Voltage vs.
Shutdown Time of Load-Short Test




Shutdown Case Temperature vs.
Gate to Source Voltage

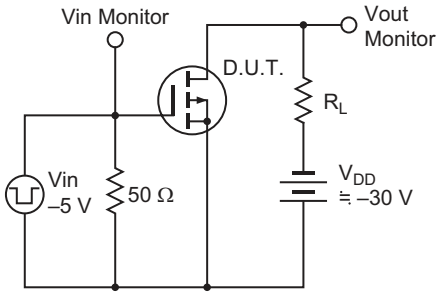



Normalized Transient Thermal Impedance vs. Pulse Width

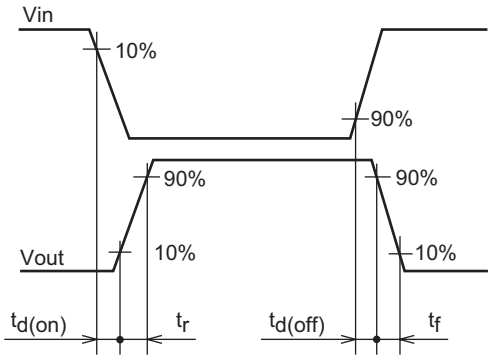





Switching Time Test Circuit



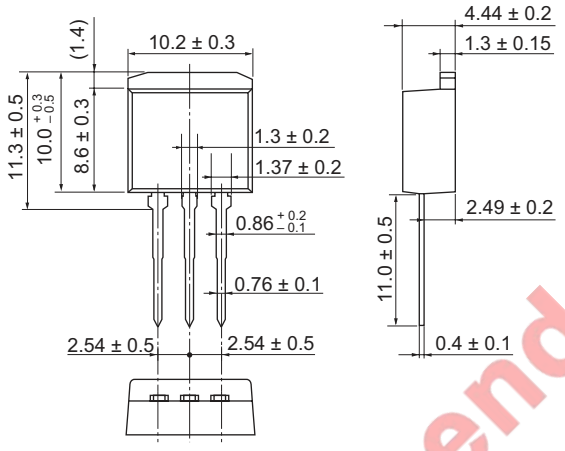

Waveform



## Package Dimensions

| JEITA Package Code | RENESAS Code | Package Name | MASS[Typ.] |
|---|---|---|---|
| — | PRSS0004AE-A | LDPAK(L) / LDPAK(L)V | 1.40g |

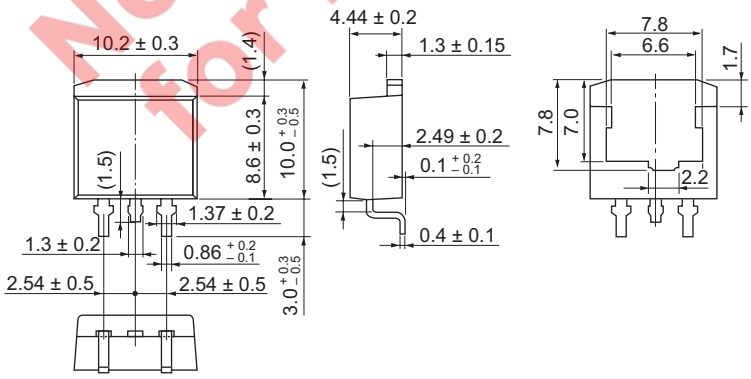
Unit: mm






| JEITA Package Code | RENESAS Code | Package Name | MASS[Typ.] |
|---|---|---|---|
| SC-83 | PRSS0004AE-B | LDPAK(S)-(1) / LDPAK(S)-(1)V | 1.30g |

Unit: mm



## Ordering Information

| Part Name | Quantity | Shipping Container |
|---|---|---|
| HAF1002-90L | Max: 50 pcs/sack | Sack |
| HAF1002-90S | Max: 50 pcs/sack | Sack |
| HAF1002-90STL | 1000 pcs/Reel | Embossed tape |
| HAF1002-90STR | 1000 pcs/Reel | Embossed tape |

Note: For some grades, production may be terminated. Please contact the Renesas sales office to check the state of production before ordering the product.

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan





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