

To all our customers

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Renesas Technology Corp.  
Customer Support Dept.  
April 1, 2003

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Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

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# 2SK2938(L),2SK2938(S)

Silicon N Channel MOS FET  
High Speed Power Switching

**RENESAS**

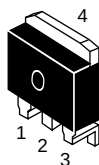
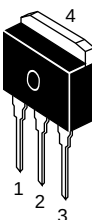
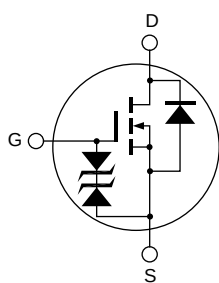
ADE-208-561B (Z)  
3rd. Edition  
Jul. 1998

## Features

- Low on-resistance  
 $R_{DS} = 0.026 \Omega$  typ.
- High speed switching
- 4V gate drive device can be driven from 5V source

## Outline

LDBPAK



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

Absolute Maximum Ratings (Ta = 25°C)

| Item                                   | Symbol                                 | Ratings     | Unit |
|----------------------------------------|----------------------------------------|-------------|------|
| Drain to source voltage                | V <sub>DSS</sub>                       | 60          | V    |
| Gate to source voltage                 | V <sub>GSS</sub>                       | ±20         | V    |
| Drain current                          | I <sub>D</sub>                         | 25          | A    |
| Drain peak current                     | I <sub>D(pulse)</sub> <sup>Note1</sup> | 100         | A    |
| Body-drain diode reverse drain current | I <sub>DR</sub>                        | 25          | A    |
| Avalanche current                      | I <sub>AP</sub> <sup>Note3</sup>       | 20          | A    |
| Avalanche energy                       | E <sub>AR</sub> <sup>Note3</sup>       | 34          | mJ   |
| Channel dissipation                    | Pch <sup>Note2</sup>                   | 50          | W    |
| Channel temperature                    | Tch                                    | 150         | °C   |
| Storage temperature                    | Tstg                                   | –55 to +150 | °C   |

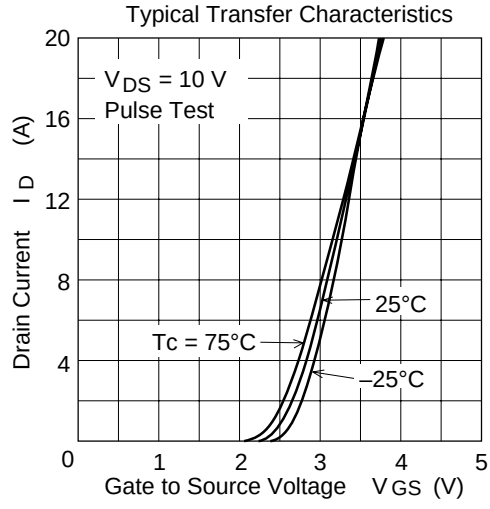
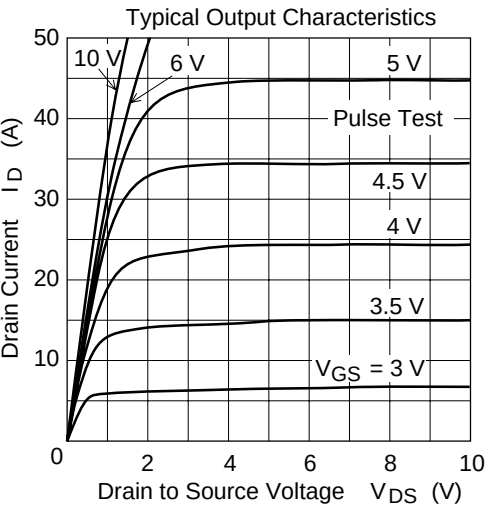
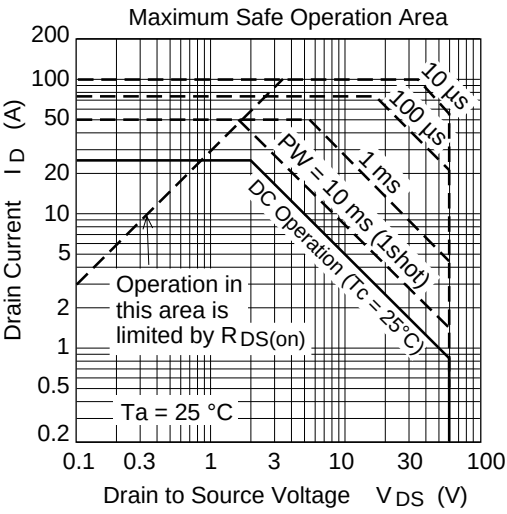
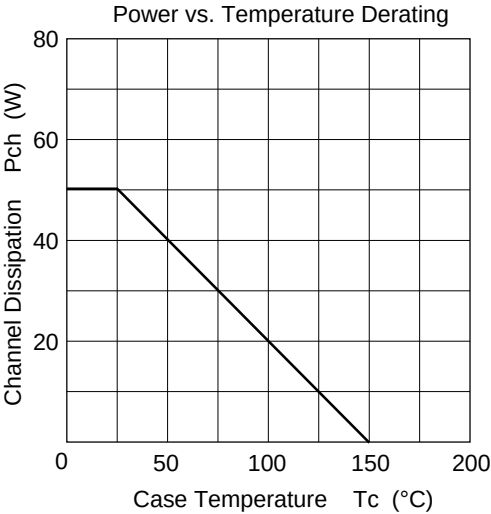
Note: 1. PW ≤ 10μs, duty cycle ≤ 1 %  
2. Value at Tc = 25°C  
3. Value at Tch = 25°C, Rg 50Ω

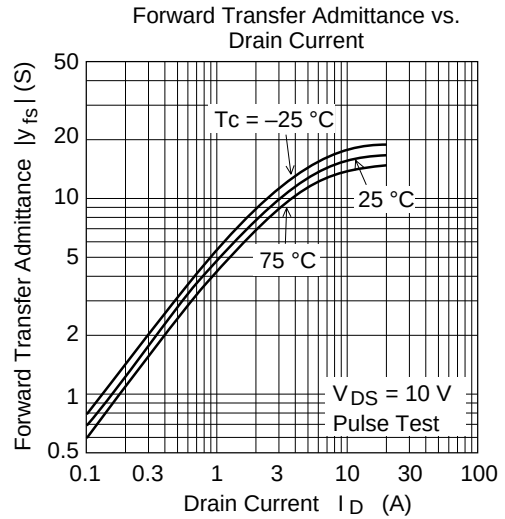
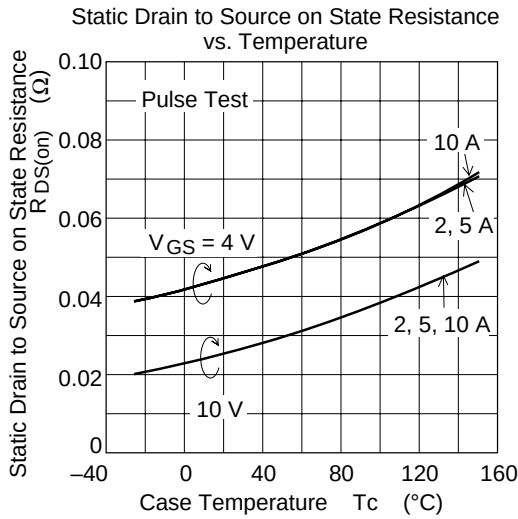
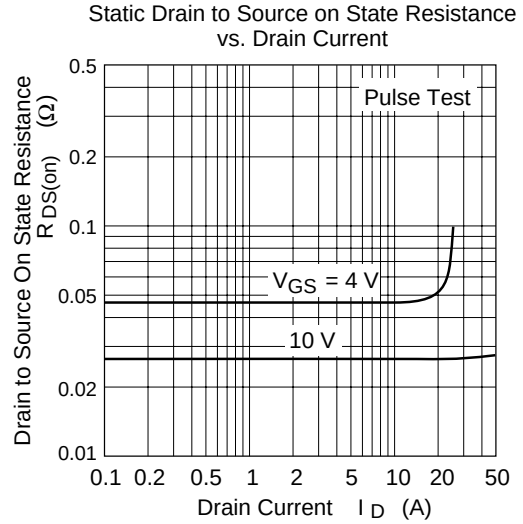
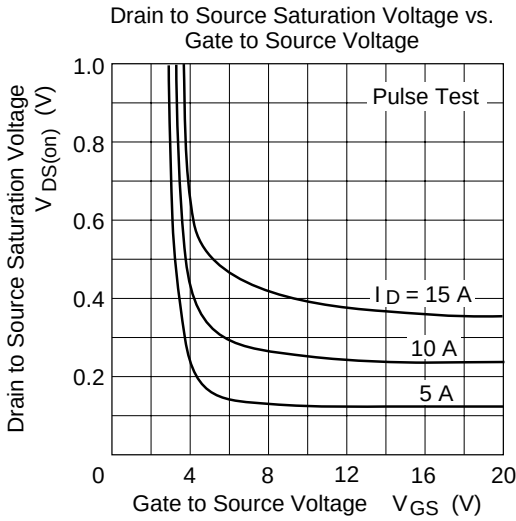
## Electrical Characteristics (Ta = 25°C)

| Item                                       | Symbol        | Min      | Typ   | Max      | Unit          | Test Conditions                                                         |
|--------------------------------------------|---------------|----------|-------|----------|---------------|-------------------------------------------------------------------------|
| Drain to source breakdown voltage          | $V_{(BR)DSS}$ | 60       | —     | —        | V             | $I_D = 10\text{mA}$ , $V_{GS} = 0$                                      |
| Gate to source breakdown voltage           | $V_{(BR)GSS}$ | $\pm 20$ | —     | —        | V             | $I_G = \pm 100\mu\text{A}$ , $V_{DS} = 0$                               |
| Gate to source leak current                | $I_{GSS}$     | —        | —     | $\pm 10$ | $\mu\text{A}$ | $V_{GS} = \pm 16\text{V}$ , $V_{DS} = 0$                                |
| Zero gate voltage drain current            | $I_{DSS}$     | —        | —     | 10       | $\mu\text{A}$ | $V_{DS} = 60\text{V}$ , $V_{GS} = 0$                                    |
| Gate to source cutoff voltage              | $V_{GS(off)}$ | 1.5      | —     | 2.5      | V             | $I_D = 1\text{mA}$ , $V_{DS} = 10\text{V}$                              |
| Static drain to source on state resistance | $R_{DS(on)}$  | —        | 0.026 | 0.034    | $\Omega$      | $I_D = 15\text{A}$ , $V_{GS} = 10\text{V}$ <sup>Note4</sup>             |
|                                            | $R_{DS(on)}$  | —        | 0.045 | 0.07     | $\Omega$      | $I_D = 15\text{A}$ , $V_{GS} = 4\text{V}$ <sup>Note4</sup>              |
| Forward transfer admittance                | $ y_{fs} $    | 11       | 17    | —        | S             | $I_D = 15\text{A}$ , $V_{DS} = 10\text{V}$ <sup>Note4</sup>             |
| Input capacitance                          | $C_{iss}$     | —        | 740   | —        | pF            | $V_{DS} = 10\text{V}$                                                   |
| Output capacitance                         | $C_{oss}$     | —        | 380   | —        | pF            | $V_{GS} = 0$                                                            |
| Reverse transfer capacitance               | $C_{rss}$     | —        | 140   | —        | pF            | $f = 1\text{MHz}$                                                       |
| Turn-on delay time                         | $t_{d(on)}$   | —        | 10    | —        | ns            | $I_D = 15\text{A}$ , $V_{GS} = 10\text{V}$                              |
| Rise time                                  | $t_r$         | —        | 160   | —        | ns            | $R_L = 2\Omega$                                                         |
| Turn-off delay time                        | $t_{d(off)}$  | —        | 100   | —        | ns            |                                                                         |
| Fall time                                  | $t_f$         | —        | 150   | —        | ns            |                                                                         |
| Body-drain diode forward voltage           | $V_{DF}$      | —        | 0.95  | —        | V             | $I_F = 25\text{A}$ , $V_{GS} = 0$                                       |
| Body-drain diode reverse recovery time     | $t_{rr}$      | —        | 40    | —        | ns            | $I_F = 25\text{A}$ , $V_{GS} = 0$<br>$di_F/dt = 50\text{A}/\mu\text{s}$ |

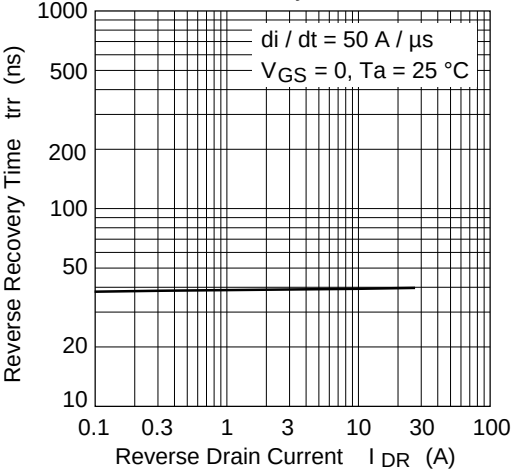
Note: 4. Pulse test

Main Characteristics

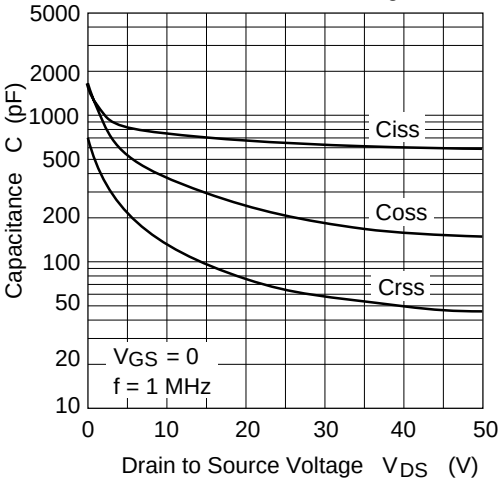




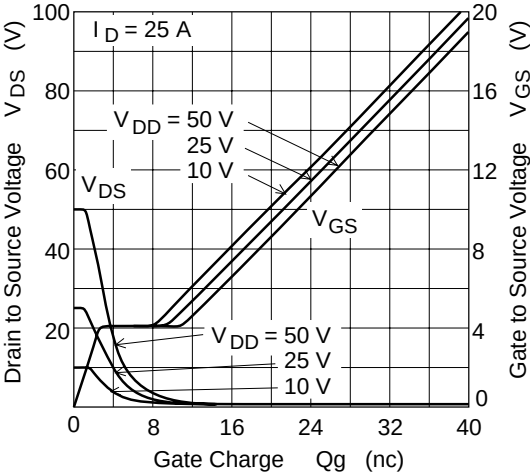
Body-Drain Diode Reverse Recovery Time



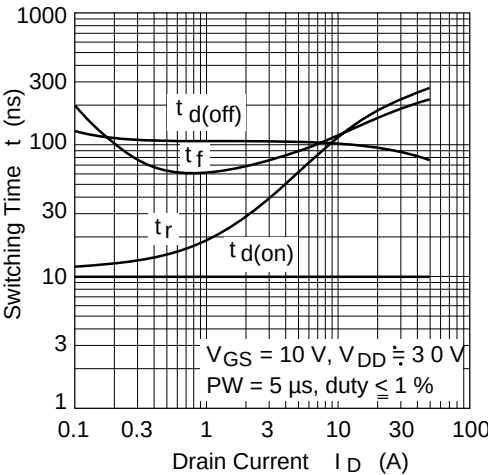
Typical Capacitance vs. Drain to Source Voltage



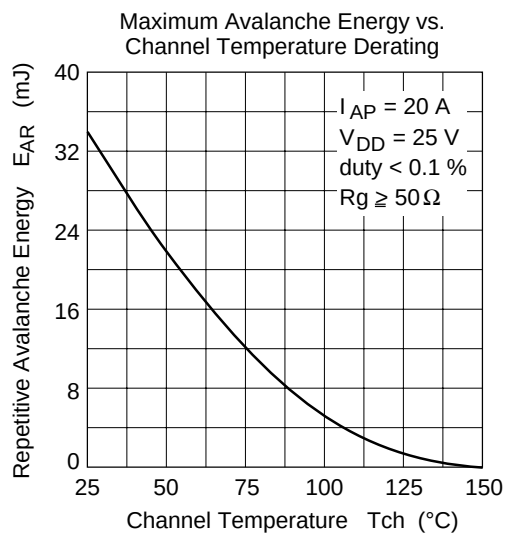
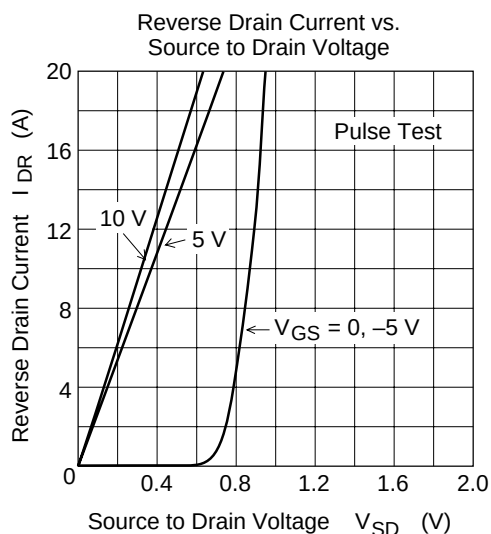
Dynamic Input Characteristics



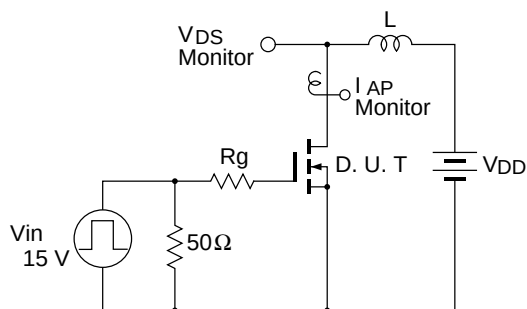
Switching Characteristics





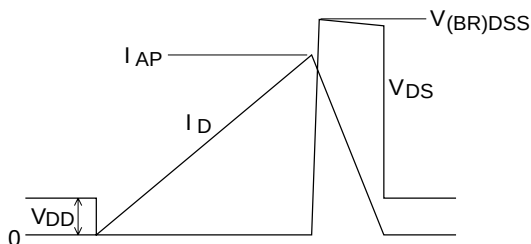


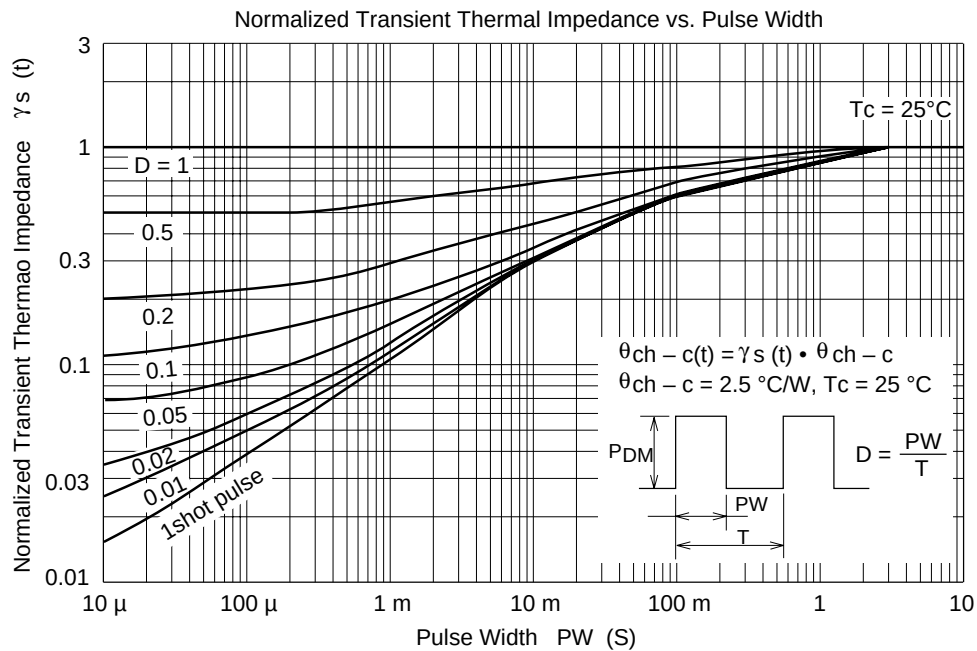
Avalanche Test Circuit



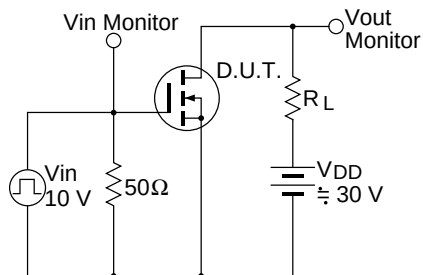
Avalanche Waveform

$$E_{AR} = \frac{1}{2} \cdot L \cdot I_{AP}^2 \cdot \frac{V_{DSS}}{V_{DSS} - V_{DD}}$$

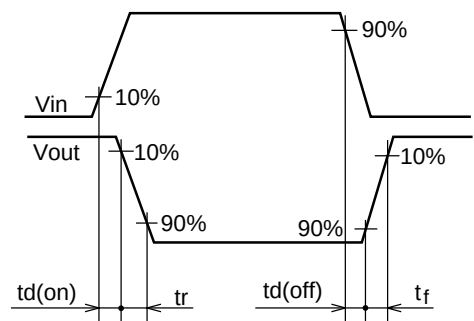




Switching Time Test Circuit



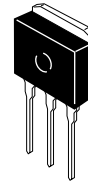
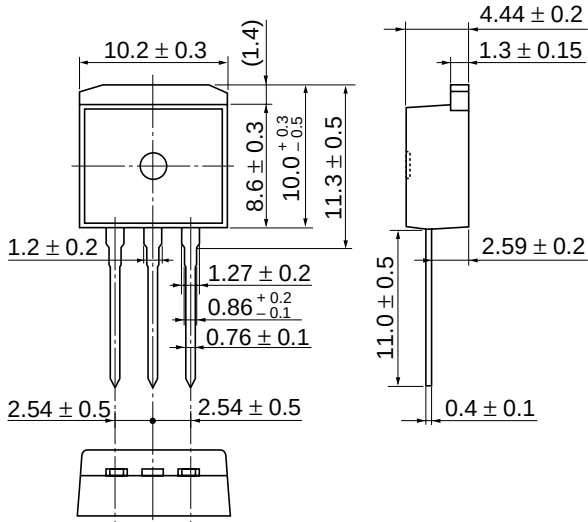
Waveform



# Package Dimensions

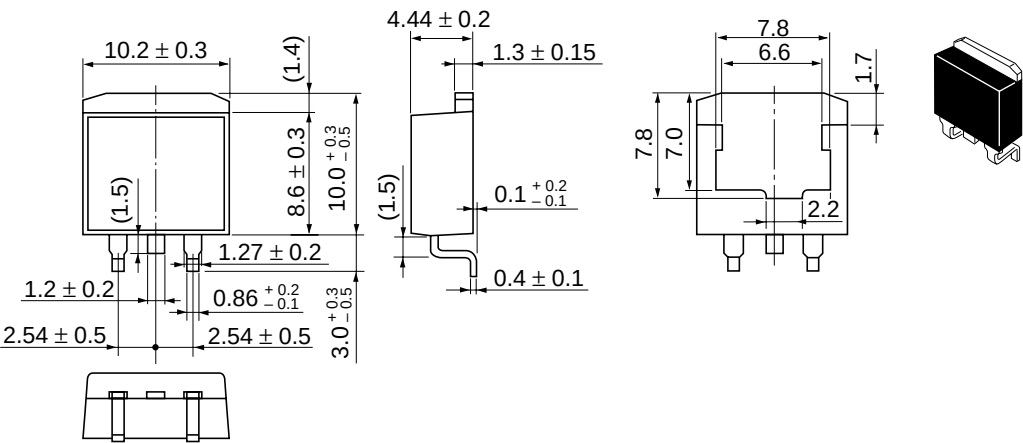
As of January, 2001

Unit: mm



|                        |           |
|------------------------|-----------|
| Hitachi Code           | LDBAK (L) |
| JEDEC                  | —         |
| EIAJ                   | —         |
| Mass (reference value) | 1.4 g     |

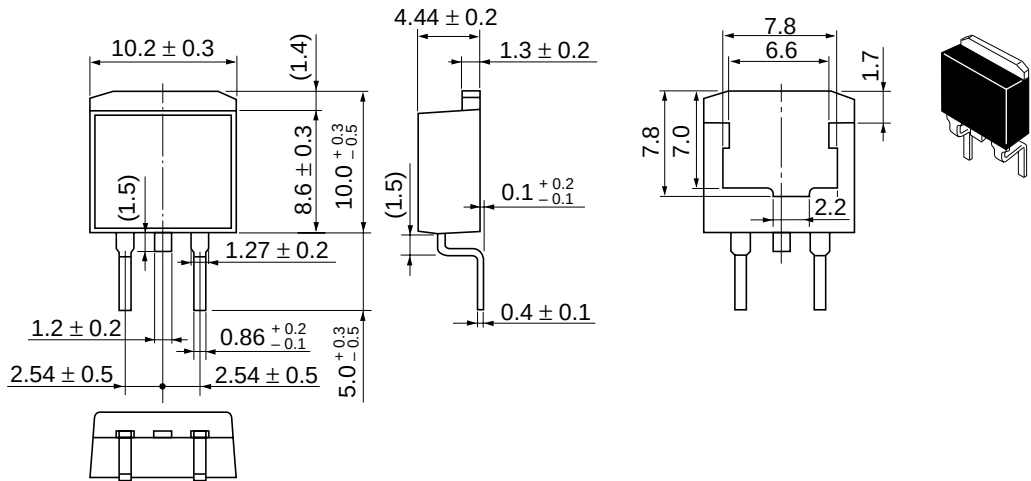
As of January, 2001  
Unit: mm



|                        |               |
|------------------------|---------------|
| Hitachi Code           | LDPAK (S)-(1) |
| JEDEC                  | —             |
| EIAJ                   | —             |
| Mass (reference value) | 1.3 g         |

As of January, 2001

Unit: mm



|                        |               |
|------------------------|---------------|
| Hitachi Code           | LDPAK (S)-(2) |
| JEDEC                  | —             |
| EIAJ                   | —             |
| Mass (reference value) | 1.35 g        |

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