# HAF2021(L), HAF2021(S)

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

REJ03G0179-0200Z
(Previous ADE-208-1459A(Z))
Rev.2.00
Mar.05.2004

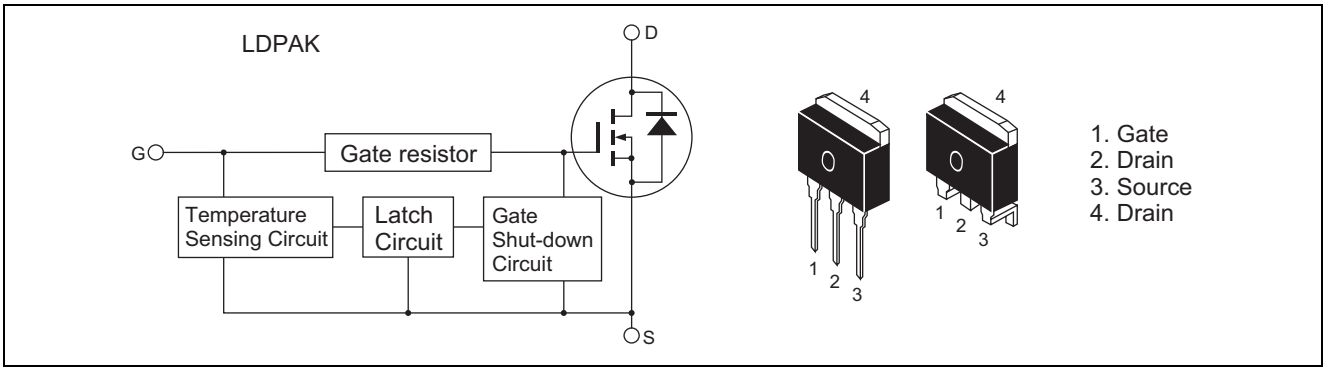
### Description

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 (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



## Absolute Maximum Ratings

(Ta = 25°C)

| Item | Symbol | Ratings | Unit |
|---|---|---|---|
| Drain to source voltage | $V_{DSS}$ | 60 | V |
| Gate to source voltage | $V_{GSS}$ | 16 | V |
| Gate to source voltage | $V_{GSS}$ | –2.5 | V |
| Drain current | $I_D$ | 50 | A |
| Drain peak current | $I_{D(pulse)}$ Note1 | 100 | A |
| Body-drain diode reverse drain current | $I_{DR}$ | 50 | A |
| Channel dissipation | Pch Note2 | 100 | W |
| Channel temperature | Tch | 150 | °C |
| Storage temperature | Tstg | –55 to +150 | °C |

Notes: 1. PW ≤ 10µs, duty cycle ≤ 1 %
2. Value at Ta = 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 | $I_{IH1}$ | — | — | 100 | µA | Vi = 6 V, $V_{DS}$ = 0 |
| (Gate non shut down) | $I_{IH2}$ | — | — | 50 | µA | Vi = 3.5 V, $V_{DS}$ = 0 |
| | $I_{IL}$ | — | — | 1 | µA | Vi = 1.2 V, $V_{DS}$ = 0 |
| Input current | $I_{IH(sd)1}$ | — | 0.6 | — | mA | Vi = 6 V, $V_{DS}$ = 0 |
| (Gate shut down) | $I_{IH(sd)2}$ | — | 0.35 | — | mA | Vi = 3.5 V, $V_{DS}$ = 0 |
| Shut down temperature | $T_{sd}$ | — | 175 | — | °C | Channel temperature |
| Gate operation voltage | $V_{OP}$ | 3.5 | — | 12 | V | |

## Electrical Characteristics

(Ta = 25°C)

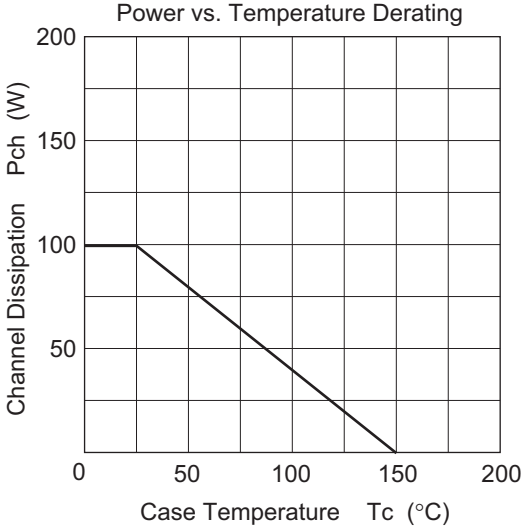
| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Drain current | $I_{D1}$ | 90 | — | — | A | $V_{GS}$ = 6 V, $V_{DS}$ = 10 V |
| Drain current | $I_{D2}$ | — | — | 10 | mA | $V_{GS}$ = 1.2 V, $V_{DS}$ = 10 V |
| Drain to source breakdown voltage | $V_{(BR)DSS}$ | 60 | — | — | V | $I_D$ = 10 mA, $V_{GS}$ = 0 |
| Gate to source breakdown voltage | $V_{(BR)GSS}$ | 16 | — | — | V | $I_G$ = 300 µA, $V_{DS}$ = 0 |
| Gate to source breakdown voltage | $V_{(BR)GSS}$ | –2.5 | — | — | V | $I_G$ = –100 µA, $V_{DS}$ = 0 |
| Gate to source leak current | $I_{GSS1}$ | — | — | 100 | µA | $V_{GS}$ = 6 V, $V_{DS}$ = 0 |
| | $I_{GSS2}$ | — | — | 50 | µA | $V_{GS}$ = 3.5 V, $V_{DS}$ = 0 |
| | $I_{GSS3}$ | — | — | 1 | µA | $V_{GS}$ = 1.2 V, $V_{DS}$ = 0 |
| | $I_{GSS4}$ | — | — | –100 | µA | $V_{GS}$ = –2.4 V, $V_{DS}$ = 0 |
| Input current (shut down) | $I_{GS(op)1}$ | — | 0.6 | — | mA | $V_{GS}$ = 6 V, $V_{DS}$ = 0 |
| | $I_{GS(op)2}$ | — | 0.35 | — | mA | $V_{GS}$ = 3.5 V, $V_{DS}$ = 0 |
| Zero gate voltage drain current | $I_{DSS}$ | — | — | 10 | µA | $V_{DS}$ = 60 V, $V_{GS}$ = 0 |
| Gate to source cutoff voltage | $V_{GS(off)}$ | 2.2 | — | 3.4 | V | $I_D$ = 1 mA, $V_{DS}$ = 10 V |
| Forward transfer admittance | $\|y_{fs}\|$ | 15 | 50 | — | S | $I_D$ = 25 A, $V_{DS}$ = 10 V [Note3] |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 8 | 12 | mΩ | $I_D$ = 25 A, $V_{GS}$ = 10 V [Note3] |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 9.5 | 15 | mΩ | $I_D$ = 25 A, $V_{GS}$ = 6 V [Note3] |
| Output capacitance | Coss | — | 1450 | — | pF | $V_{DS}$ = 10 V , $V_{GS}$ = 0, f = 1 MHz |
| Turn-on delay time | $t_{d(on)}$ | — | 20 | — | µs | $I_D$ = 25 A, $V_{GS}$ = 10 V |
| Rise time | $t_r$ | — | 75 | — | µs | $R_L$ = 1.2 Ω |
| Turn-off delay time | $t_{d(off)}$ | — | 3 | — | µs | |
| Fall time | $t_f$ | — | 2.6 | — | µs | |
| Body–drain diode forward voltage | $V_{DF}$ | — | 0.9 | — | V | $I_F$ = 50 A, $V_{GS}$ = 0 |
| Body–drain diode reverse recovery time | $t_{rr}$ | — | 110 | — | ns | $I_F$ = 50 A, $V_{GS}$ = 0<br>diF/ dt =50 A/µs |
| Over load shut down operation time [Note4] | $t_{os}$ | — | 0.8 | — | ms | $V_{GS}$ = 6 V, $V_{DD}$ = 16 V |

Notes: 3. Pulse test

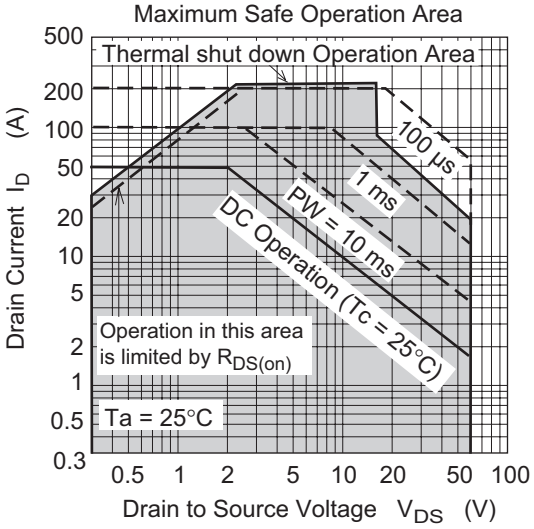
4. Including the junction temperature rise of the over loaded condition.

## Main Characteristics

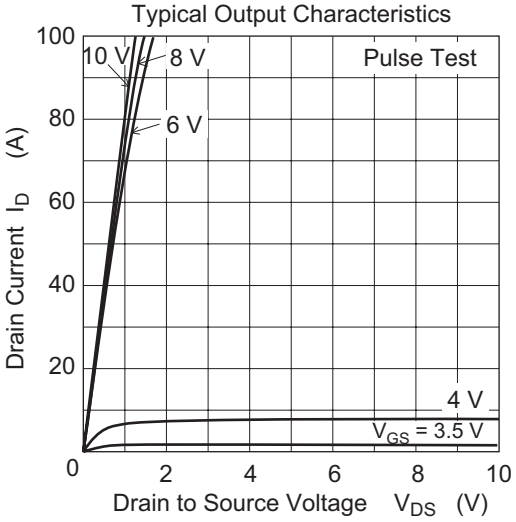
Power vs. Temperature Derating



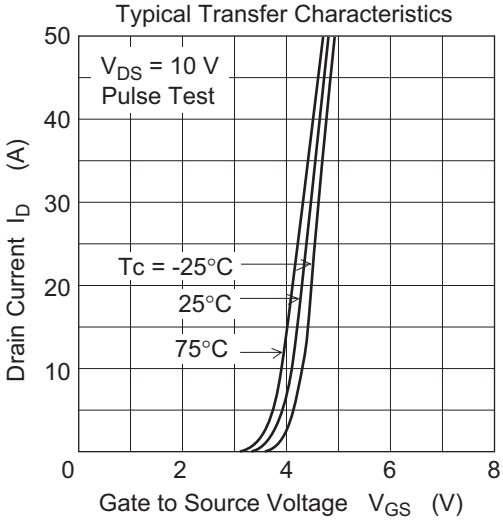

Maximum Safe Operation Area



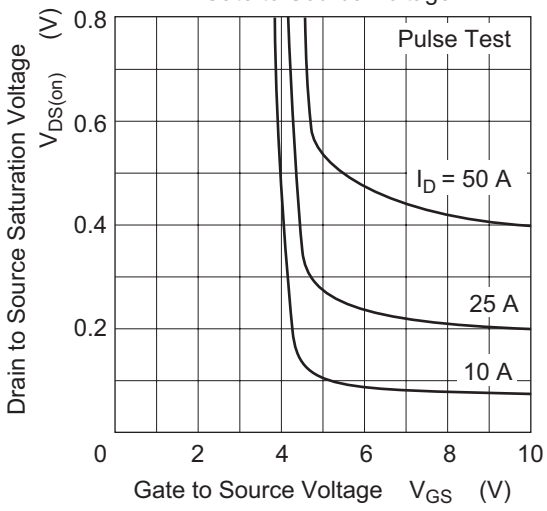

Typical Output Characteristics



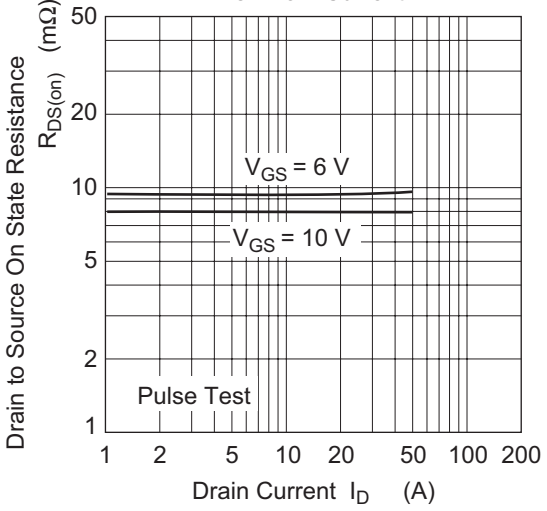

Typical Transfer Characteristics



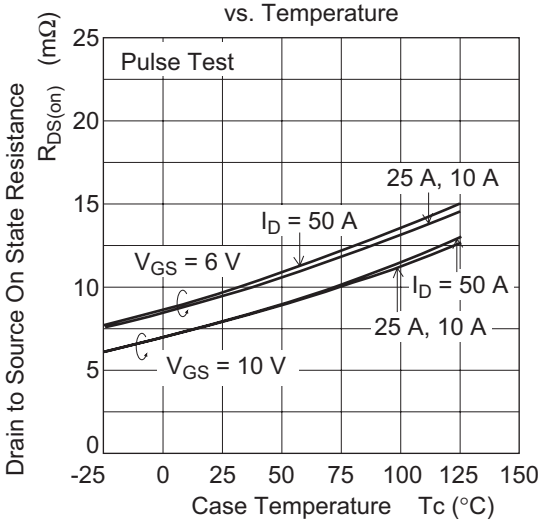

Drain to Source Saturation Voltage vs. Gate to Source Voltage



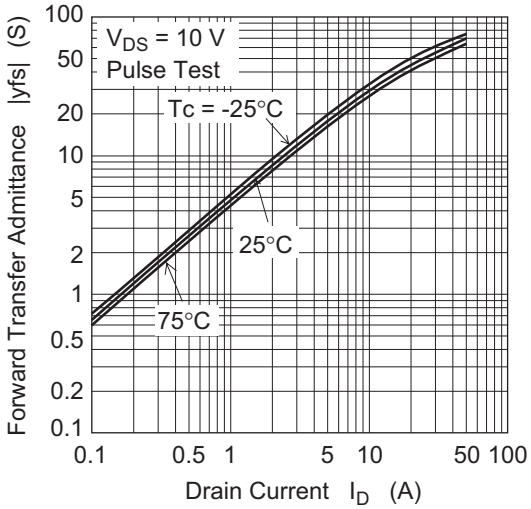

Static Drain to Source State Resistance vs. Drain Current



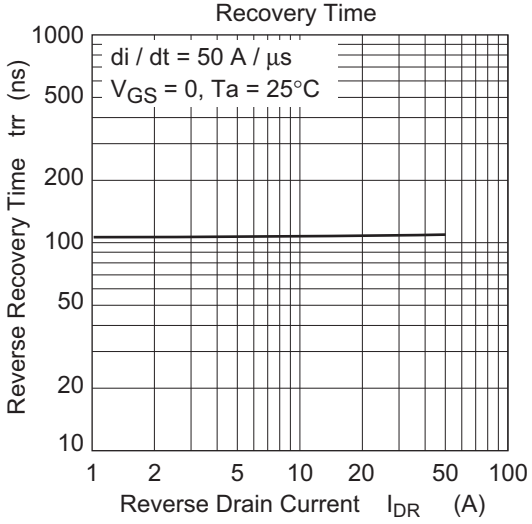
Static Drain to Source State Resistance vs. Temperature



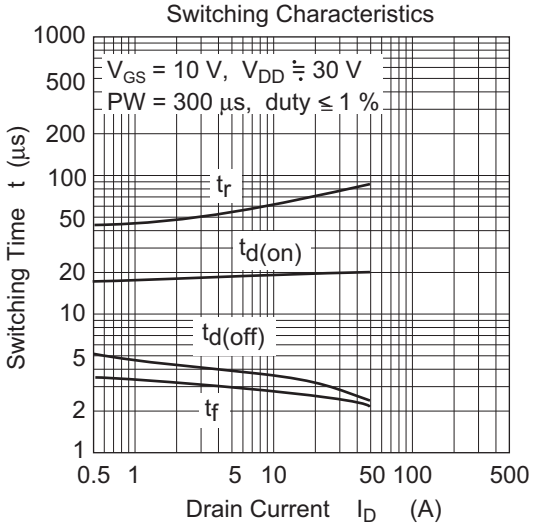

Forward Transfer Admittance vs. Drain Current



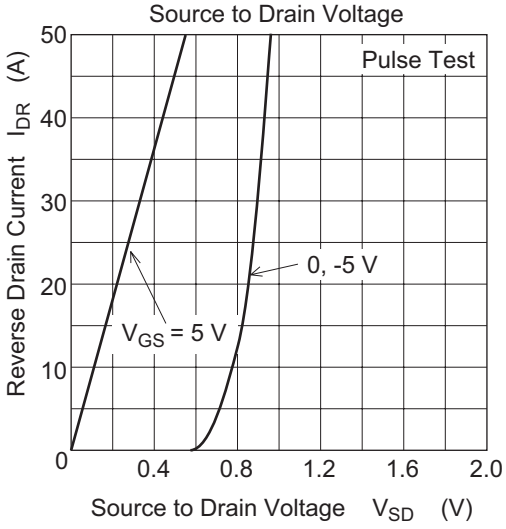

Body to Drain Diode Reverse Recovery Time



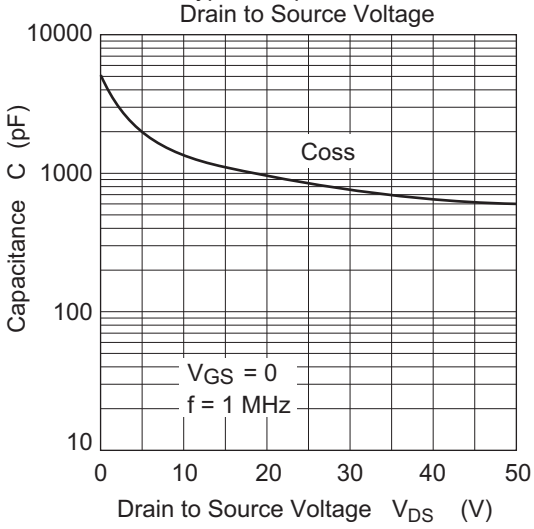

Switching Characteristics



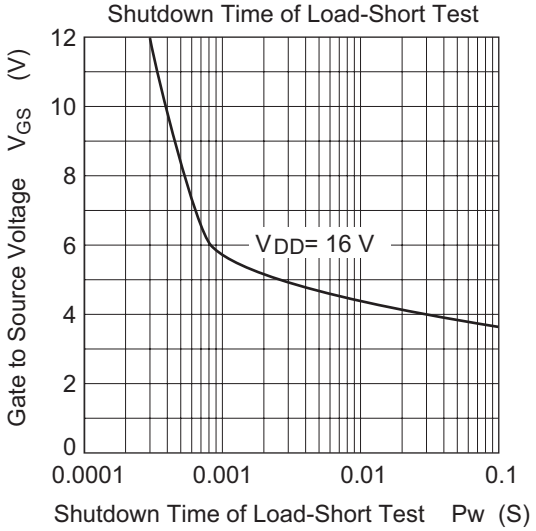

Reverse Drain Current vs. Source to Drain Voltage



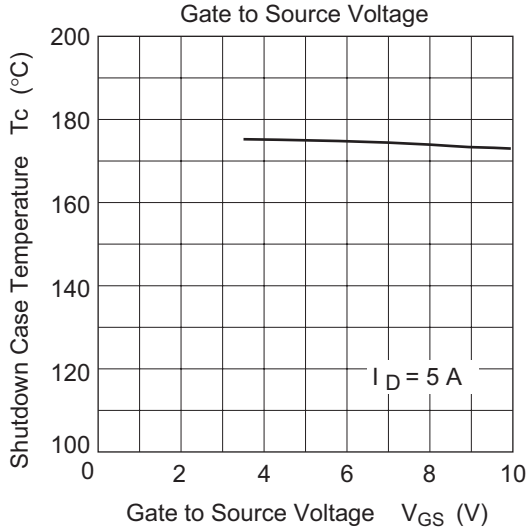

Typical Capacitance vs. Drain to Source Voltage



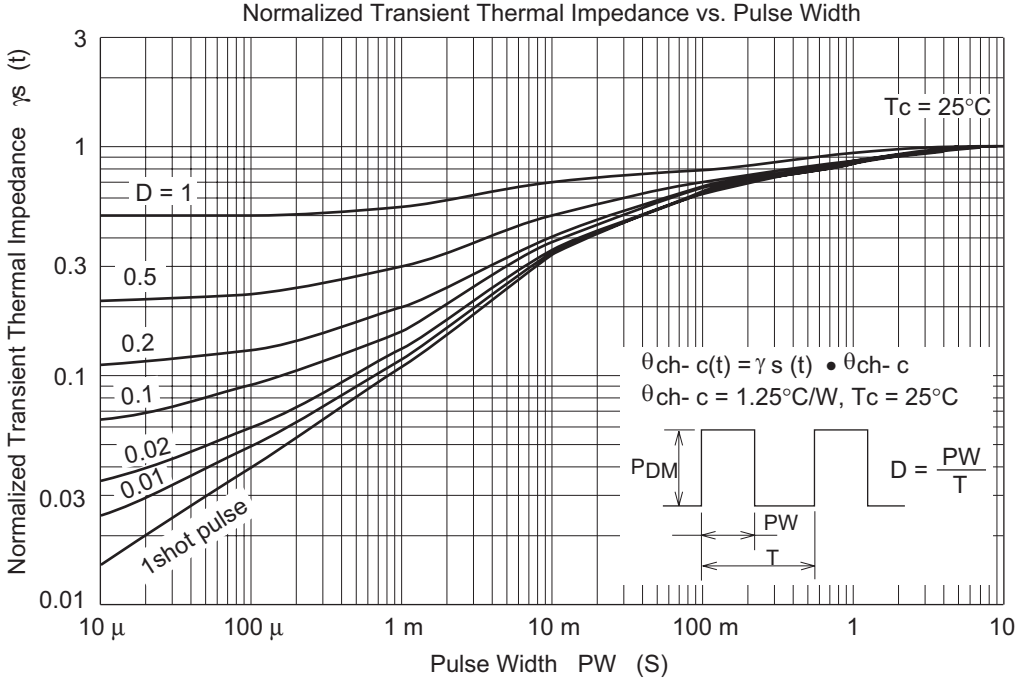
Gate to Source Voltage vs.
Shutdown Time of Load-Short Test



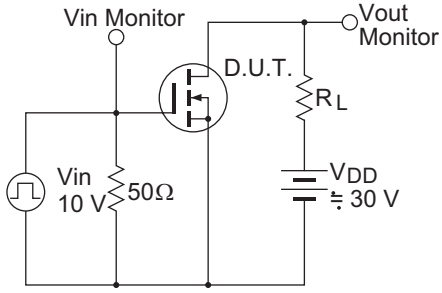

Shutdown Case Temperature vs.
Gate to Source Voltage



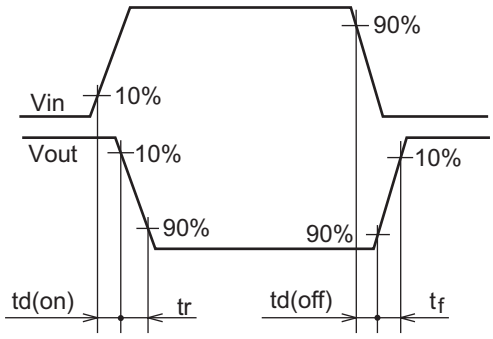

Normalized Transient Thermal Impedance vs. Pulse Width




Switching Time Test Circuit

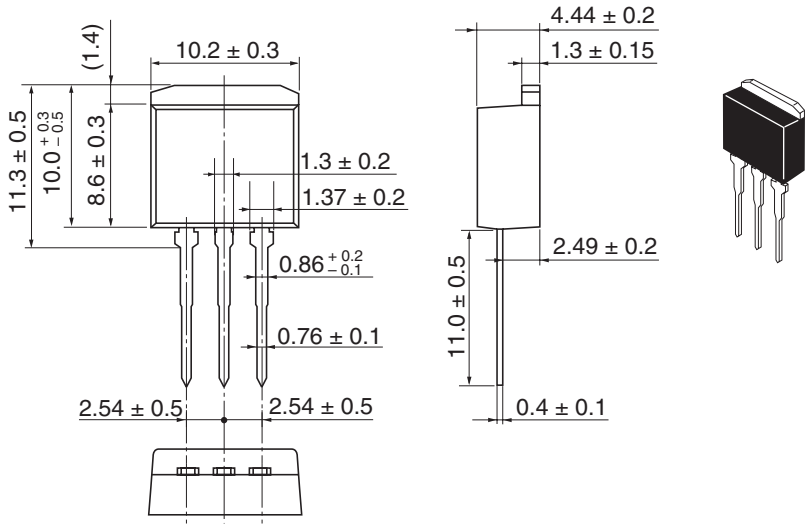



Waveform



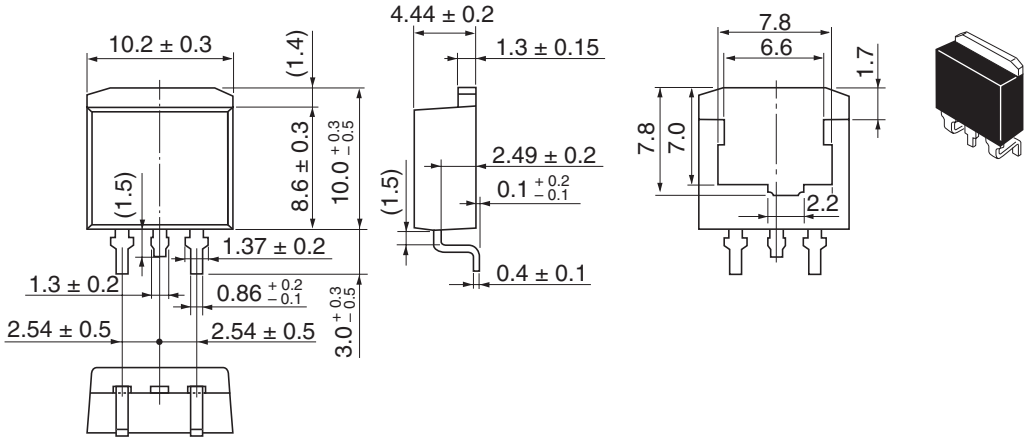
## Package Dimensions

As of January, 2003
Unit: mm




| Package Code | LDPAK (L) |
|---|---|
| JEDEC | — |
| JEITA | — |
| Mass (reference value) | 1.40 g |

As of January, 2003
Unit: mm




| Package Code | LDPAK (S)-(1) |
|---|---|
| JEDEC | — |
| JEITA | — |
| Mass (reference value) | 1.30 g |

## Ordering Information

| Part Name | Quantity | Shipping Container |
|---|---|---|
| HAF2021-90L | Max:50pcs/sack | sack |
| HAF2021-90S | Max:50pcs/sack | sack |
| HAF2021-90STL | 1000pcs/Reel | Embossed tape |
| HAF2021-90STR | 1000pcs/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



## RENESAS SALES OFFICES

http://www.renesas.com

**Renesas Technology America, Inc.**
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500 Fax: <1> (408) 382-7501

**Renesas Technology Europe Limited.**
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, United Kingdom
Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

**Renesas Technology Europe GmbH**
Dornacher Str. 3, D-85622 Feldkirchen, Germany
Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

**Renesas Technology Hong Kong Ltd.**
7/F., North Tower, World Finance Centre, Harbour City, Canton Road, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2375-6836

**Renesas Technology Taiwan Co., Ltd.**
FL 10, #99, Fu-Hsing N. Rd., Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

**Renesas Technology (Shanghai) Co., Ltd.**
26/F., Ruijin 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



Colophon .1.0