To all our customers

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

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# HAF2002

Silicon N Channel MOS FET Series
Power Switching

ADE-208-503A (Z)
2nd. Edition
Nov. 1997

## Features

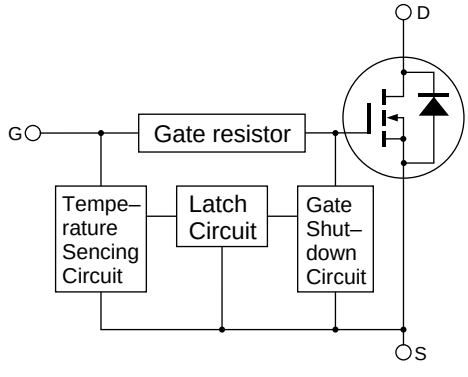
This FET has the over temperature shut–down capability sensing to the junction temperature.

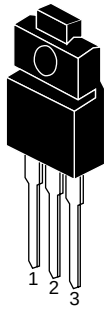
This FET has the built–in over temperature shut–down circuit in the gate area. And this circuit operation to shut–down the gate voltage in case of high junction temperature like applying over power consumption, over current etc.

- 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

TO–220FM




1. Gate
2. Drain
3. Source

## 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 | $V_{GSS}$ | –2.8 | V |
| Drain current | $I_D$ | 20 | A |
| Drain peak current | $I_{D(pulse)}$ Note1 | 40 | A |
| Body-drain diode reverse drain current | $I_{DR}$ | 20 | A |
| Channel dissipation | Pch Note2 | 30 | W |
| Channel temperature | Tch | 150 | °C |
| Storage temperature | Tstg | –55 to +150 | °C |

Note: 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 = 8V, $V_{DS}$ = 0 |
| (Gate non shut down) | $I_{IH2}$ | — | — | 50 | µA | Vi = 3.5V, $V_{DS}$ = 0 |
| | $I_{IL}$ | — | — | 1 | µA | Vi = 1.2V, $V_{DS}$ = 0 |
| Input current | $I_{IH(sd)1}$ | — | 0.8 | — | mA | Vi = 8V, $V_{DS}$ = 0 |
| (Gate shut down) | $I_{IH(sd)2}$ | — | 0.35 | — | mA | Vi = 3.5V, $V_{DS}$ = 0 |
| Shut down temperature | $T_{sd}$ | — | 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 | $I_{D1}$ | 10 | — | — | A | $V_{GS}$ = 3.5V, $V_{DS}$ = 2V |
| Drain current | $I_{D2}$ | — | — | 10 | mA | $V_{GS}$ = 1.2V, $V_{DS}$ = 2V |
| Drain to source breakdown voltage | $V_{(BR)DSS}$ | 60 | — | — | V | $I_D$ = 10mA, $V_{GS}$ = 0 |
| Gate to source breakdown voltage | $V_{(BR)GSS}$ | 16 | — | — | V | $I_G$ = 100µA, $V_{DS}$ = 0 |
| Gate to source breakdown voltage | $V_{(BR)GSS}$ | –2.8 | — | — | V | $I_G$ = –100µA, $V_{DS}$ = 0 |
| Gate to source leak current | $I_{GSS1}$ | — | — | 100 | µA | $V_{GS}$ = 8V, $V_{DS}$ = 0 |
| | $I_{GSS2}$ | — | — | 50 | µA | $V_{GS}$ = 3.5V, $V_{DS}$ = 0 |
| | $I_{GSS3}$ | — | — | 1 | µA | $V_{GS}$ = 1.2V, $V_{DS}$ = 0 |
| | $I_{GSS4}$ | — | — | –100 | µA | $V_{GS}$ = –2.4V, $V_{DS}$ = 0 |
| Input current (shut down) | $I_{GS(op)1}$ | — | 0.8 | — | mA | $V_{GS}$ = 8V, $V_{DS}$ = 0 |
| | $I_{GS(op)2}$ | — | 0.35 | — | mA | $V_{GS}$ = 3.5V, $V_{DS}$ = 0 |
| Zero gate voltege drain current | $I_{DSS}$ | — | — | 250 | µA | $V_{DS}$ = 50 V, $V_{GS}$ = 0 |
| Gate to source cutoff voltage | $V_{GS(off)}$ | 1.0 | — | 2.25 | V | $I_D$ = 1mA, $V_{DS}$ = 10V |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 50 | 65 | mΩ | $I_D$ = 10A, $V_{GS}$ = 4V [Note3] |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 30 | 43 | mΩ | $I_D$ = 10A, $V_{GS}$ = 10V [Note3] |
| Forward transfer admittance | $\|y_{fs}\|$ | 6 | 12 | — | S | $I_D$ = 10A, $V_{DS}$ = 10V [Note3] |
| Output capacitance | Coss | — | 630 | — | pF | $V_{DS}$ = 10V , $V_{GS}$ = 0<br>f = 1 MHz |
| Turn-on delay time | $t_{d(on)}$ | — | 7.5 | — | µs | $I_D$ = 5A, $V_{GS}$ = 5V |
| Rise time | $t_r$ | — | 29 | — | µs | $R_L$ = 6Ω |
| Turn-off delay time | $t_{d(off)}$ | — | 34 | — | µs | |
| Fall time | $t_f$ | — | 26 | — | µs | |
| Body–drain diode forward voltage | $V_{DF}$ | — | 1.0 | — | V | $I_F$ = 20A, $V_{GS}$ = 0 |
| Body–drain diode reverse recovery time | $t_{rr}$ | — | 110 | — | ns | $I_F$ = 20A, $V_{GS}$ = 0<br>diF/ dt =50A/µs |
| Over load shut down operation time [Note4] | $t_{os1}$ | — | 1.8 | — | ms | $V_{GS}$ = 5V, $V_{DD}$ = 12V |
| | $t_{os2}$ | — | 0.7 | — | ms | $V_{GS}$ = 5V, $V_{DD}$ = 24V |

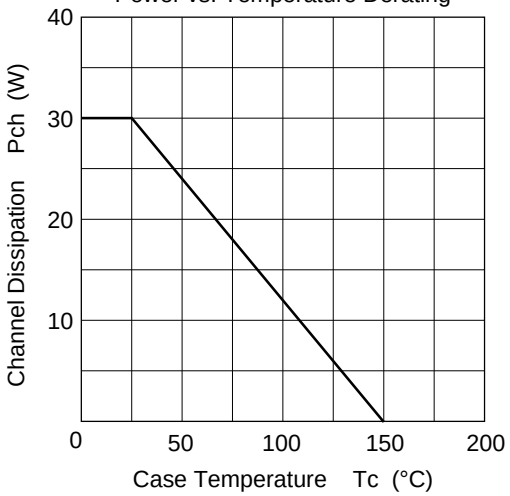
Note: 3. Pulse test

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

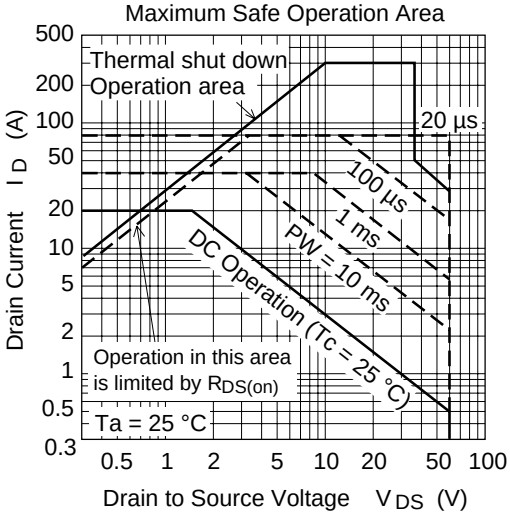
See characteristic curve of HAF2001.

## Main Characteristics

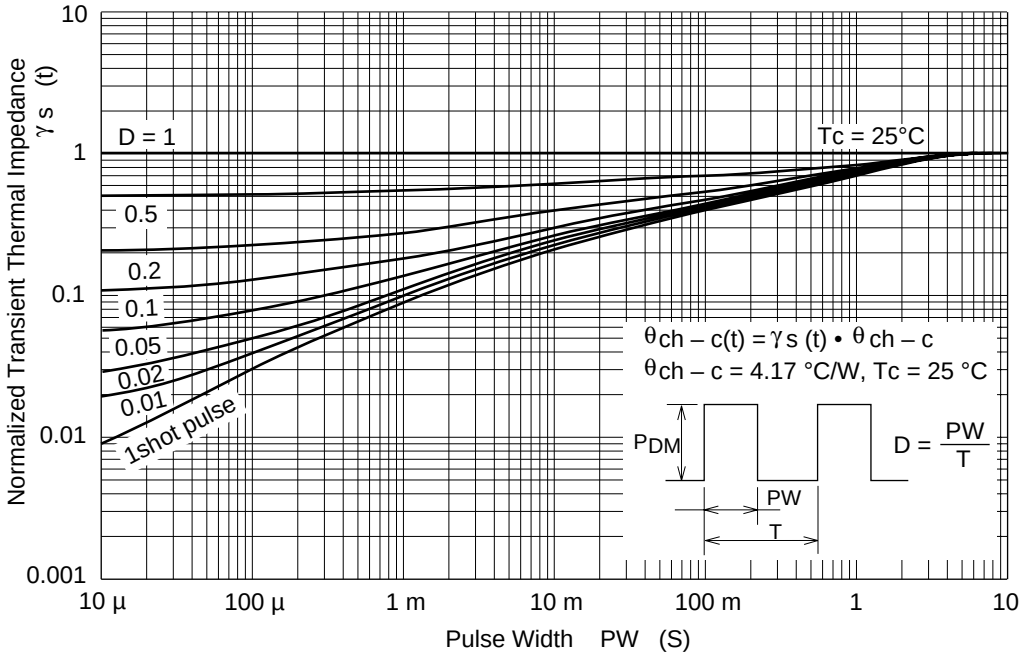
Power vs. Temperature Derating



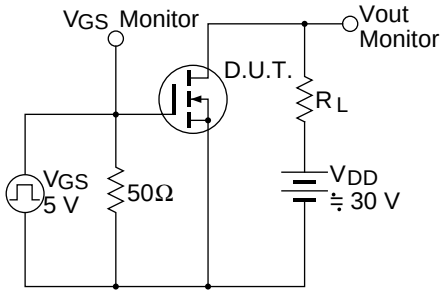

Maximum Safe Operation Area



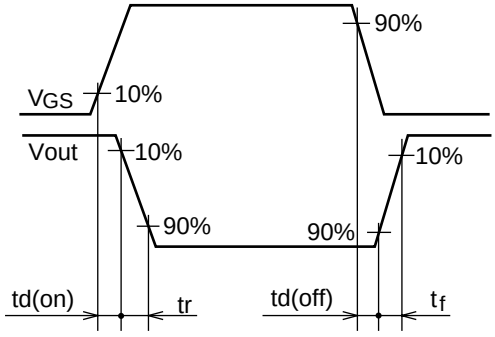
Normalized Transient Thermal Impedance vs. Pulse Width




Switching Time Test Circuit



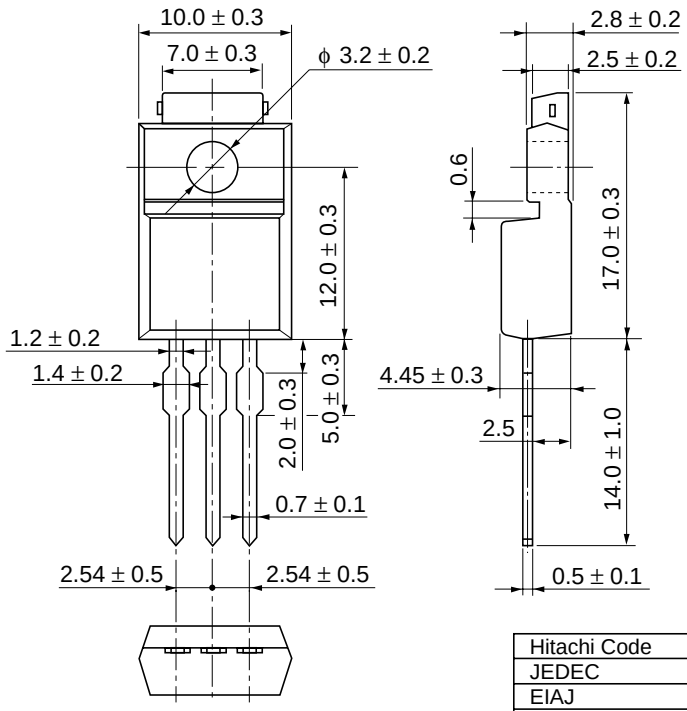

Waveform

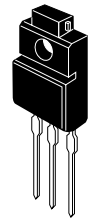


## Package Dimensions

As of January, 2001

Unit: mm



| | |
|---|---|
| Hitachi Code | TO-220FM |
| JEDEC | — |
| EIAJ | Conforms |
| Mass (reference value) | 1.8 g |

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