

# HAF2015RJ

## Silicon N Channel MOS FET Series Power Switching

# HITACHI

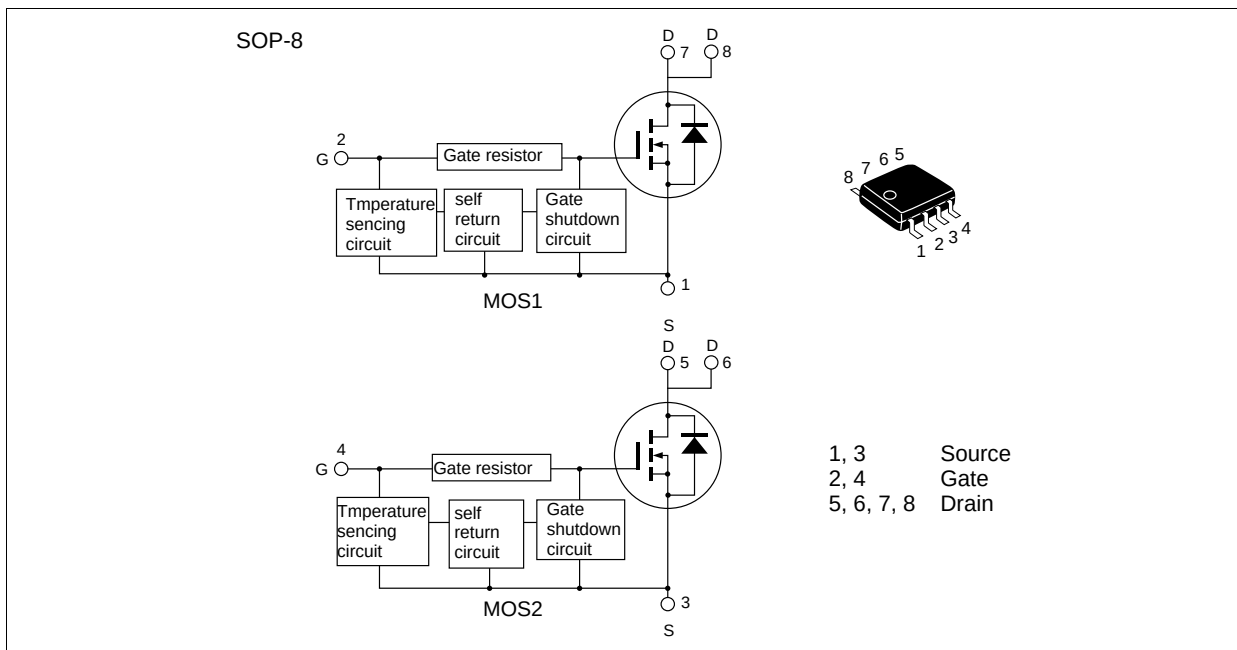
ADE-208-933 (Z)  
1st. Edition  
Dec. 2000

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 (5 to 6 V Gate drive)
- High endurance capability against to the short circuit
- Built-in the over temperature shut-down circuit
- Temperature hysteresis type.
- High density mounting.

### Outline



**Absolute Maximum Ratings** ( $T_a = 25^{\circ}\text{C}$ )

| Item                                   | Symbol                                 | Ratings     | Unit               |
|----------------------------------------|----------------------------------------|-------------|--------------------|
| Drain to source voltage                | $V_{\text{DSS}}$                       | 60          | V                  |
| Gate to source voltage                 | $V_{\text{GSS}}$                       | 16          | V                  |
| Gate to source voltage                 | $V_{\text{GSS}}$                       | -2.5        | V                  |
| Drain current                          | $I_{\text{D}}$                         | 2           | A                  |
| Drain peak current                     | $I_{\text{D(pulse)}}$ <sup>Note1</sup> | 4           | A                  |
| Body-drain diode reverse drain current | $I_{\text{DR}}$                        | 2           | A                  |
| Avalanche current                      | $I_{\text{AP}}$ <sup>Note4</sup>       | 0.54        | A                  |
| Avalanche energy                       | $E_{\text{AR}}$ <sup>Note4</sup>       | 25          | mJ                 |
| Channel dissipation                    | $P_{\text{ch}}$ <sup>Note2</sup>       | 2           | W                  |
| Channel dissipation                    | $P_{\text{ch}}$ <sup>Note3</sup>       | 1.5         | W                  |
| Channel temperature                    | $T_{\text{ch}}$                        | 150         | $^{\circ}\text{C}$ |
| Storage temperature                    | $T_{\text{stg}}$                       | -55 to +150 | $^{\circ}\text{C}$ |

Note: 1.  $PW \leq 10 \mu\text{s}$ , duty cycle  $\leq 1\%$

2. 1 Drive operation : When using the glass epoxy board (FR4  $40 \times 40 \times 1.6\text{mm}$ ),  $PW \leq 10\text{s}$

3. 2 Drive operation : When using the glass epoxy board (FR4  $40 \times 40 \times 1.6\text{mm}$ ),  $PW \leq 10\text{s}$

4.  $T_{\text{ch}} = 25^{\circ}\text{C}$ ,  $R_g > 50 \Omega$

**Typical Operation Characteristics**

| Item                                  | Symbol               | Min | Typ  | Max | Unit               | Test Conditions                           |
|---------------------------------------|----------------------|-----|------|-----|--------------------|-------------------------------------------|
| Input voltage                         | $V_{\text{IH}}$      | 3.5 | —    | —   | V                  |                                           |
|                                       | $V_{\text{IL}}$      | —   | —    | 1.2 | V                  |                                           |
| Input current<br>(Gate non shut down) | $I_{\text{IH1}}$     | —   | —    | 100 | $\mu\text{A}$      | $V_i = 5\text{V}$ , $V_{\text{DS}} = 0$   |
|                                       | $I_{\text{IH2}}$     | —   | —    | 50  | $\mu\text{A}$      | $V_i = 3.5\text{V}$ , $V_{\text{DS}} = 0$ |
|                                       | $I_{\text{IL}}$      | —   | —    | 1   | $\mu\text{A}$      | $V_i = 1.2\text{V}$ , $V_{\text{DS}} = 0$ |
| Input current<br>(Gate shut down)     | $I_{\text{IH(sd)1}}$ | —   | 0.53 | —   | mA                 | $V_i = 8\text{V}$ , $V_{\text{DS}} = 0$   |
|                                       | $I_{\text{IH(sd)2}}$ | —   | 0.2  | —   | mA                 | $V_i = 3.5\text{V}$ , $V_{\text{DS}} = 0$ |
| Shut down temperature                 | $T_{\text{sd}}$      | —   | 175  | —   | $^{\circ}\text{C}$ | Channel temperature                       |
| Hysteresis temperature                | $T_{\text{thr}}$     | —   | 120  | —   | $^{\circ}\text{C}$ | Channel temperature                       |
| Gate operation voltage                | $V_{\text{op}}$      | 3.5 | —    | 12  | V                  |                                           |

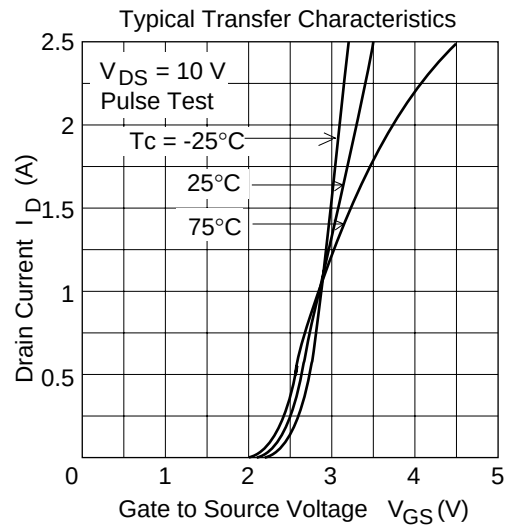
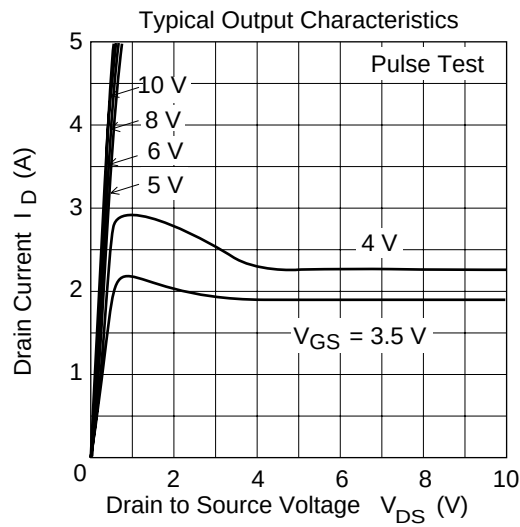
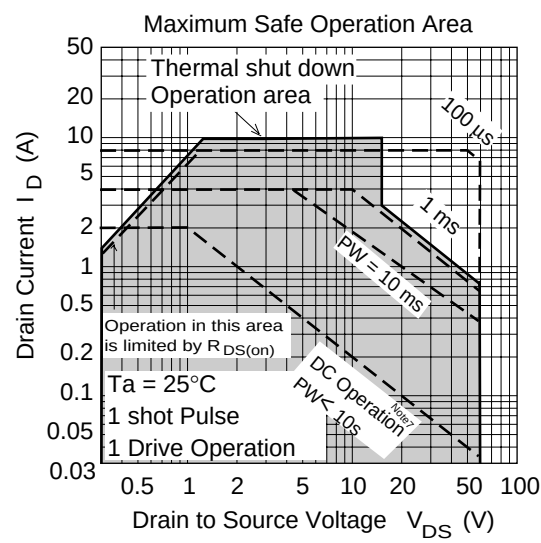
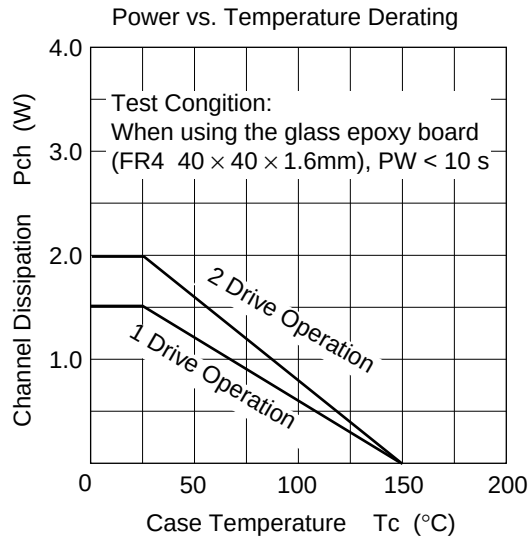
## Electrical Characteristics (Ta = 25°C)

| Item                                                | Symbol        | Min  | Typ  | Max  | Unit             | Test Conditions                                                            |
|-----------------------------------------------------|---------------|------|------|------|------------------|----------------------------------------------------------------------------|
| Drain current                                       | $I_{D1}$      | 0.7  | —    | —    | A                | $V_{GS} = 3.5 \text{ V}$ , $V_{DS} = 2 \text{ V}$                          |
| Drain current                                       | $I_{D2}$      | —    | —    | 10   | mA               | $V_{GS} = 1.2 \text{ V}$ , $V_{DS} = 2 \text{ V}$                          |
| Drain to source breakdown voltage                   | $V_{(BR)DSS}$ | 60   | —    | —    | V                | $I_D = 10 \text{ mA}$ , $V_{GS} = 0$                                       |
| Gate to source breakdown voltage                    | $V_{(BR)GSS}$ | 16   | —    | —    | V                | $I_G = 300 \mu\text{A}$ , $V_{DS} = 0$                                     |
| Gate to source breakdown voltage                    | $V_{(BR)GSS}$ | -2.5 | —    | —    | V                | $I_G = -100 \mu\text{A}$ , $V_{DS} = 0$                                    |
| Gate to source leak current                         | $I_{GSS1}$    | —    | —    | 100  | $\mu\text{A}$    | $V_{GS} = 5 \text{ V}$ , $V_{DS} = 0$                                      |
|                                                     | $I_{GSS2}$    | —    | —    | 50   | $\mu\text{A}$    | $V_{GS} = 3.5 \text{ V}$ , $V_{DS} = 0$                                    |
|                                                     | $I_{GSS3}$    | —    | —    | 1    | $\mu\text{A}$    | $V_{GS} = 1.2 \text{ V}$ , $V_{DS} = 0$                                    |
|                                                     | $I_{GSS4}$    | —    | —    | -100 | $\mu\text{A}$    | $V_{GS} = -2.4 \text{ V}$ , $V_{DS} = 0$                                   |
| Input current (shut down)                           | $I_{GS(op)1}$ | —    | 0.53 | —    | mA               | $V_{GS} = 8 \text{ V}$ , $V_{DS} = 0$                                      |
|                                                     | $I_{GS(op)2}$ | —    | 0.2  | —    | mA               | $V_{GS} = 3.5 \text{ V}$ , $V_{DS} = 0$                                    |
| Zero gate voltage drain current                     | $I_{DSS1}$    | —    | —    | 10   | $\mu\text{A}$    | $V_{DS} = 60 \text{ V}$ , $V_{GS} = 0$                                     |
| Zero gate voltage drain current                     | $I_{DSS2}$    | —    | —    | 10   | mA               | $V_{DS} = 48 \text{ V}$ , $V_{GS} = 0$<br>$T_a = 125^\circ\text{C}$        |
| Gate to source cutoff voltage                       | $V_{GS(off)}$ | 1.4  | —    | 2.5  | V                | $I_D = 1 \text{ mA}$ , $V_{DS} = 10 \text{ V}$                             |
| Static drain to source on state resistance          | $R_{DS(on)}$  | —    | 130  | 200  | $\text{m}\Omega$ | $I_D = 1 \text{ A}$ , $V_{GS} = 5 \text{ V}$ <sup>Note5</sup>              |
| Static drain to source on state resistance          | $R_{DS(on)}$  | —    | 110  | 160  | $\text{m}\Omega$ | $I_D = 1 \text{ A}$ , $V_{GS} = 10 \text{ V}$ <sup>Note5</sup>             |
| Forward transfer admittance                         | $ y_{fs} $    | 0.5  | 2.5  | —    | S                | $I_D = 1 \text{ A}$ , $V_{DS} = 10 \text{ V}$ <sup>Note5</sup>             |
| Output capacitance                                  | $C_{oss}$     | —    | 139  | —    | pF               | $V_{DS} = 10 \text{ V}$ , $V_{GS} = 0$<br>$f = 1 \text{ MHz}$              |
| Turn-on delay time                                  | $t_{d(on)}$   | —    | 4.2  | —    | $\mu\text{s}$    | $I_D = 1 \text{ A}$ , $V_{GS} = 5 \text{ V}$                               |
| Rise time                                           | $t_r$         | —    | 20   | —    | $\mu\text{s}$    | $R_L = 30 \Omega$                                                          |
| Turn-off delay time                                 | $t_{d(off)}$  | —    | 1    | —    | $\mu\text{s}$    |                                                                            |
| Fall time                                           | $t_f$         | —    | 1    | —    | $\mu\text{s}$    |                                                                            |
| Body-drain diode forward voltage                    | $V_{DF}$      | —    | 0.82 | —    | V                | $I_F = 2 \text{ A}$ , $V_{GS} = 0$                                         |
| Body-drain diode reverse recovery time              | $t_{rr}$      | —    | 55   | —    | ns               | $I_F = 2 \text{ A}$ , $V_{GS} = 0$<br>$di_F/dt = 50 \text{ A}/\mu\text{s}$ |
| Over load shut down operation time <sup>Note6</sup> | $t_{os1}$     | —    | 15   | —    | ms               | $V_{GS} = 5 \text{ V}$ , $V_{DD} = 16 \text{ V}$                           |

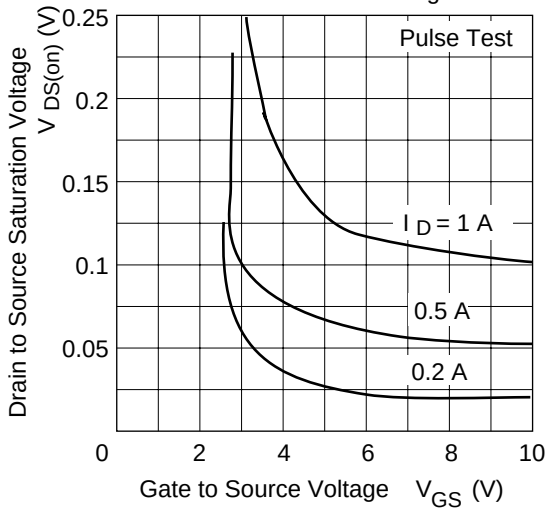
Note: 5. Pulse test

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

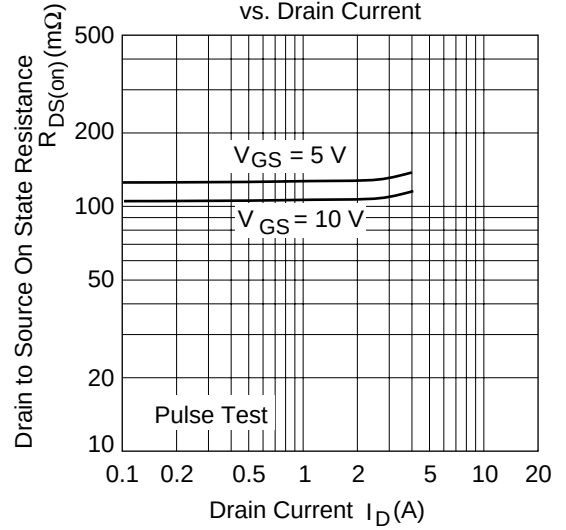
Main Characteristics



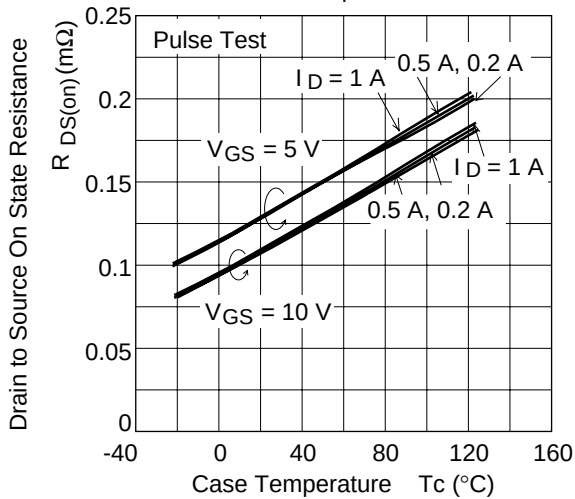
Drain to Source Saturation Voltage vs.  
Gate to Source Voltage



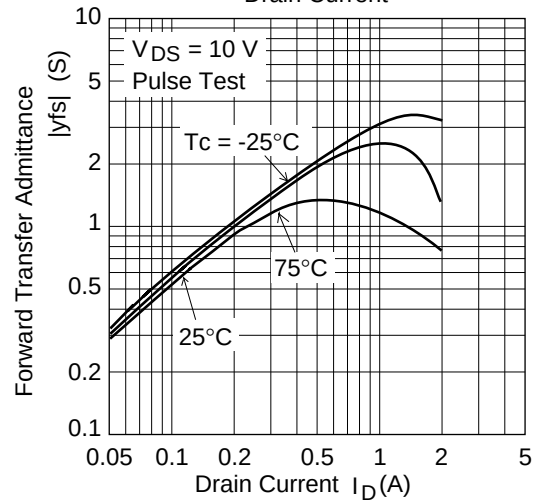
Static Drain to Source State Resistance  
vs. Drain Current



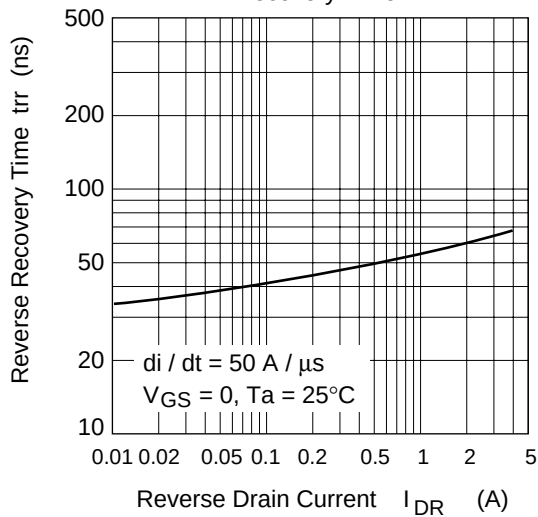
Static Drain to Source on State Resistance  
vs. Temperature



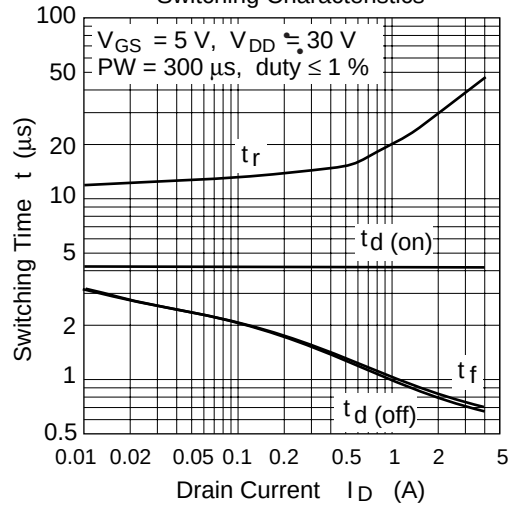
Forward Transfer Admittance vs.  
Drain Current



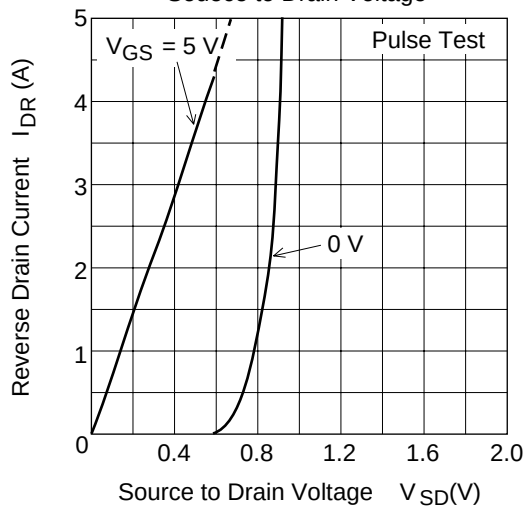
Body to Drain Diode Reverse Recovery Time



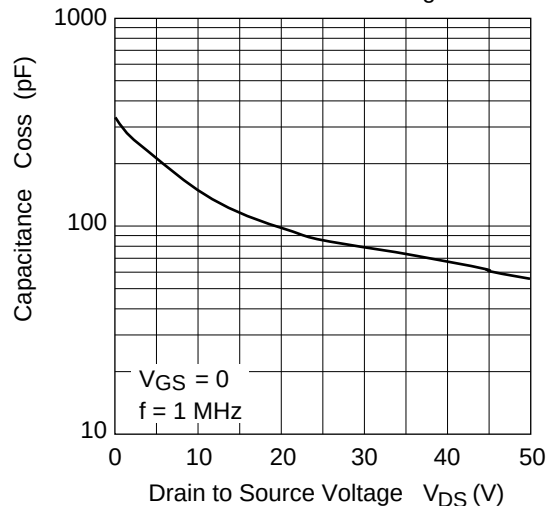
Switching Characteristics



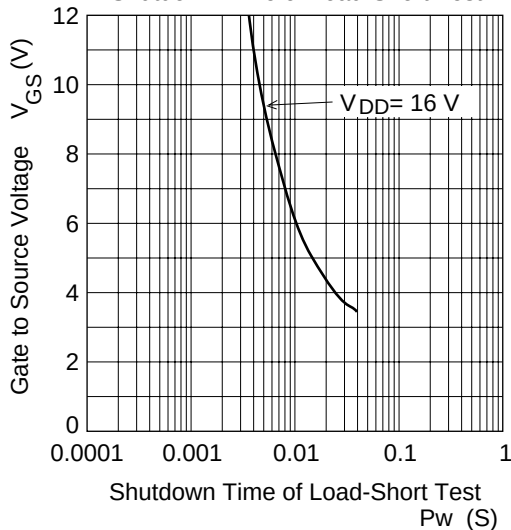
Reverse Drain Current vs. Source to Drain Voltage



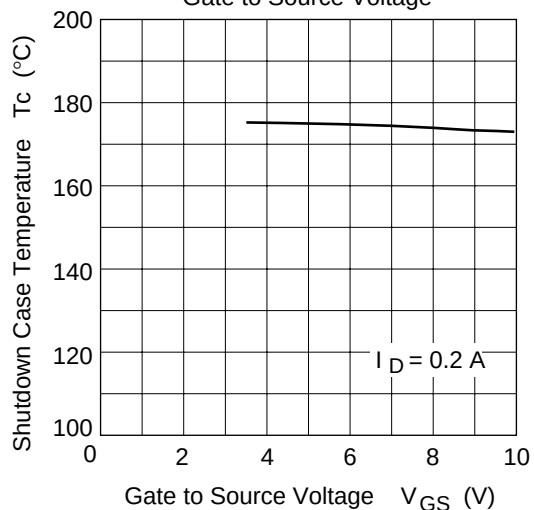
Typical Capacitance vs. Drain to Source Voltage



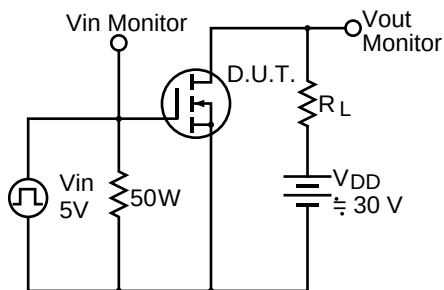
Gate to Source Voltage vs.  
Shutdown Time of Load-Short Test



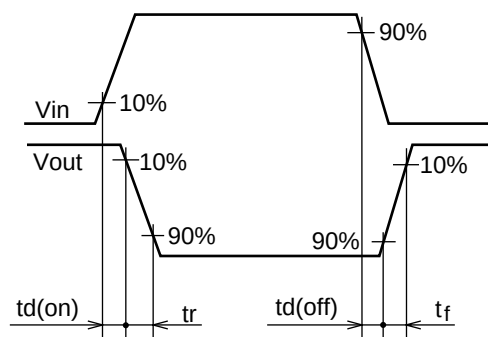
Shutdown Case Temperature vs.  
Gate to Source Voltage

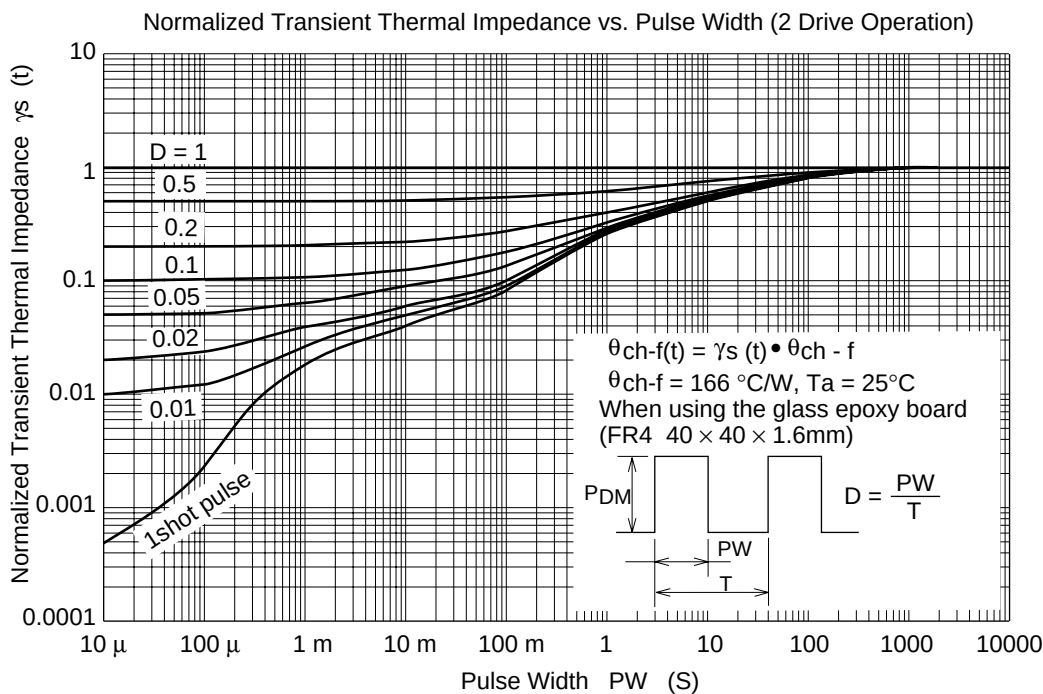
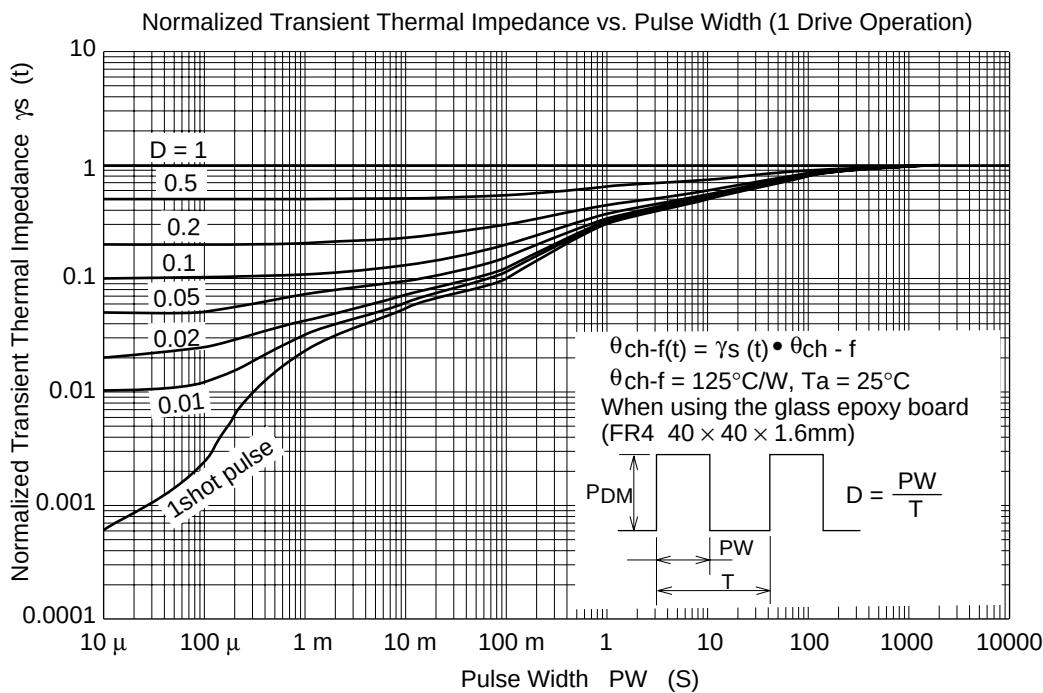


Switching Time Test Circuit



Waveform



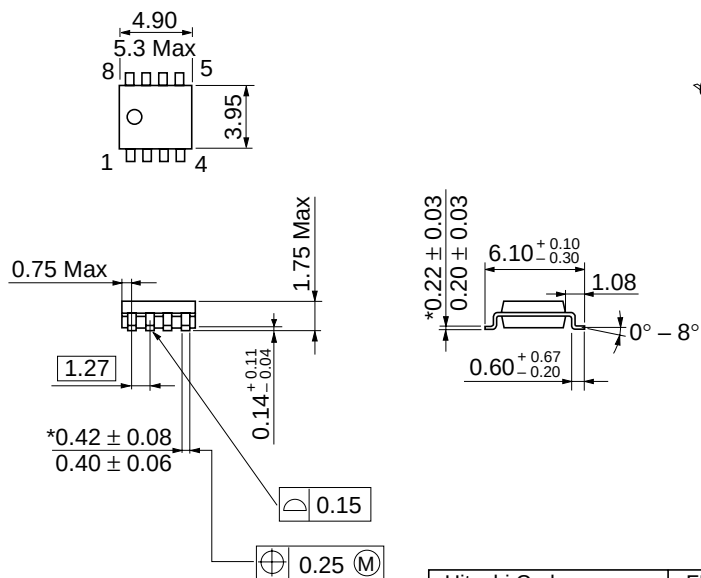




## Package Dimensions

As of January, 2001

Unit: mm



\*Dimension including the plating thickness  
Base material dimension

|                        |          |
|------------------------|----------|
| Hitachi Code           | FP-8DA   |
| JEDEC                  | Conforms |
| EIAJ                   | —        |
| Mass (reference value) | 0.085 g  |

**Cautions**

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

---

---

# HITACHI

**Hitachi, Ltd.**

Semiconductor &amp; Integrated Circuits.

Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

|     |              |                                                                                               |
|-----|--------------|-----------------------------------------------------------------------------------------------|
| URL | NorthAmerica | : <a href="http://semiconductor.hitachi.com/">http://semiconductor.hitachi.com/</a>           |
|     | Europe       | : <a href="http://www.hitachi-eu.com/hel/ecg">http://www.hitachi-eu.com/hel/ecg</a>           |
|     | Asia         | : <a href="http://sicapac.hitachi-asia.com">http://sicapac.hitachi-asia.com</a>               |
|     | Japan        | : <a href="http://www.hitachi.co.jp/Sicd/indx.htm">http://www.hitachi.co.jp/Sicd/indx.htm</a> |

**For further information write to:**

Hitachi Semiconductor  
(America) Inc.  
179 East Tasman Drive,  
San Jose, CA 95134  
Tel: <1> (408) 433-1990  
Fax: <1> (408) 433-0223

Hitachi Europe GmbH  
Electronic Components Group  
Dornacher Straße 3  
D-85622 Feldkirchen, Munich  
Germany  
Tel: <49> (89) 9 9180-0  
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.  
Electronic Components Group.  
Whitebrook Park  
Lower Cookham Road  
Maidenhead  
Berkshire SL6 8YA, United Kingdom  
Tel: <44> (1628) 585000  
Fax: <44> (1628) 585160

Hitachi Asia Ltd.  
Hitachi Tower  
16 Collyer Quay #20-00,  
Singapore 049318  
Tel: <65>-538-6533/538-8577  
Fax: <65>-538-6933/538-3877  
URL: <http://www.hitachi.com.sg>

Hitachi Asia Ltd.  
(Taipei Branch Office)  
4/F, No. 167, Tun Hwa North Road,  
Hung-Kuo Building,  
Taipei (105), Taiwan  
Tel: <886>-(2)-2718-3666  
Fax: <886>-(2)-2718-8180  
Telex: 23222 HAS-TP  
URL: <http://www.hitachi.com.tw>

Hitachi Asia (Hong Kong) Ltd.  
Group III (Electronic Components)  
7/F., North Tower,  
World Finance Centre,  
Harbour City, Canton Road  
Tsim Sha Tsui, Kowloon,  
Hong Kong  
Tel: <852>-(2)-735-9218  
Fax: <852>-(2)-730-0281  
URL: <http://www.hitachi.com.hk>

Copyright © Hitachi, Ltd., 2000. All rights reserved. Printed in Japan.  
Colophon 2.0