

HAF1001

Silicon P Channel MOS FET Series
Power Switching / Over Temperature Shut-down Capability

HITACHI

ADE-208-583 A (Z)
2nd Edition
October 1997

Features

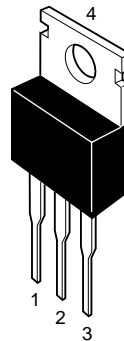
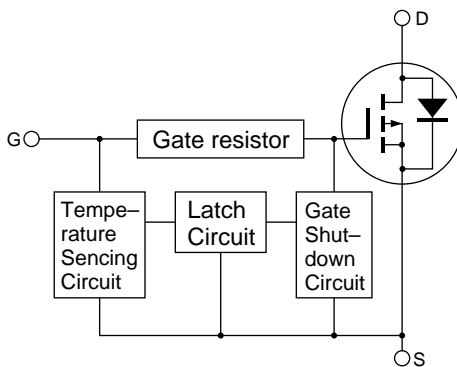
This FET has the over temperature shut-down capability sensing to the junction temperature.

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-220AB



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

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

| 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-} | 3 | V |
| Drain current | I_D | -15 | A |
| Drain peak current | $I_{D(pulse)}$ ^{Note1} | -30 | A |
| Body-drain diode reverse drain current | I_{DR} | -15 | A |
| Channel dissipation | P_{ch} ^{Note2} | 50 | W |
| Channel temperature | T_{ch} | 150 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | -55 to +150 | $^\circ\text{C}$ |

Note: 1. $PW \leq 10\mu\text{s}$, duty cycle $\leq 1\%$
 2. Value at $T_c = 25^\circ\text{C}$

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 | $V_i = -8\text{V}$, $V_{DS} = 0$ |
| (Gate non shut down) | I_{IH2} | — | — | -50 | μA | $V_i = -3.5\text{V}$, $V_{DS} = 0$ |
| | I_{IL} | — | — | -1 | μA | $V_i = -1.2\text{V}$, $V_{DS} = 0$ |
| Input current | $I_{IH(sd)1}$ | — | -0.8 | — | mA | $V_i = -8\text{V}$, $V_{DS} = 0$ |
| (Gate shut down) | $I_{IH(sd)2}$ | — | -0.35 | — | mA | $V_i = -3.5\text{V}$, $V_{DS} = 0$ |
| Shut down temperature | T_{sd} | — | 175 | — | $^\circ\text{C}$ | Channel temperature |
| Gate operation voltage | V_{OP} | -3.5 | — | -13 | V | |

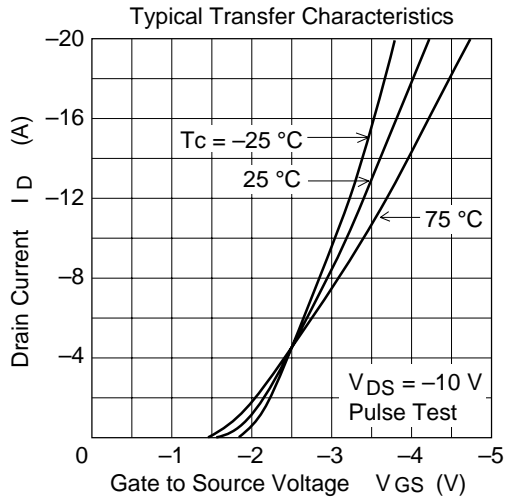
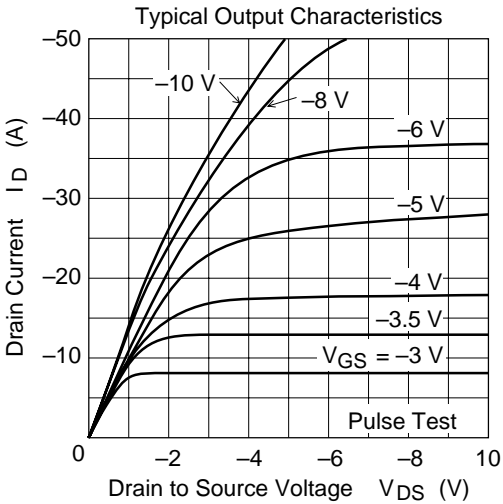
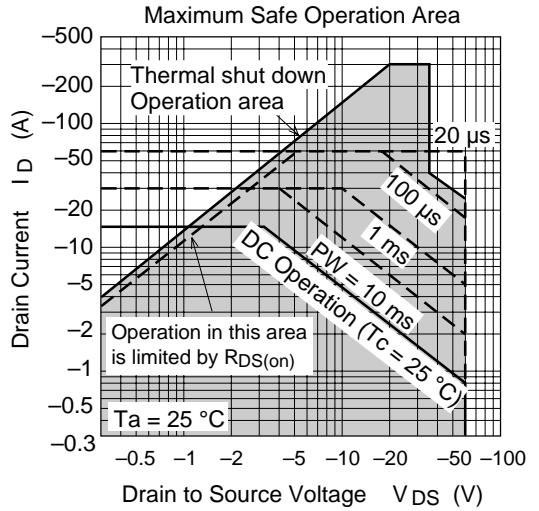
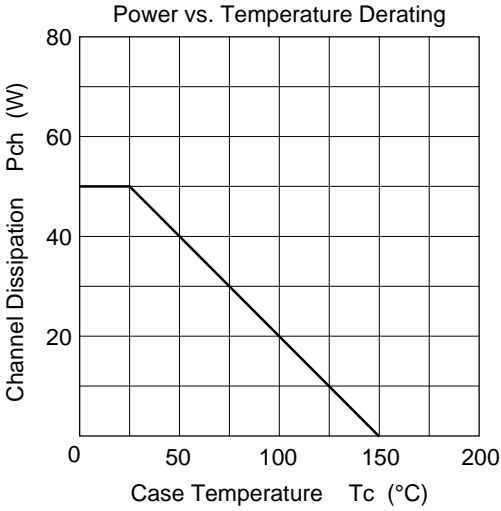
Electrical Characteristics (Ta = 25°C)

| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|--|----------------|------|-------|-------|------------|---|
| Drain current | I_{D1} | -7 | — | — | A | $V_{GS} = -3.5V, V_{DS} = -2V$ |
| 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 | $I_G = -100\mu A, V_{DS} = 0$ |
| Gate to source breakdown voltage | $V_{(BR)GSS-}$ | 3 | — | — | V | $I_G = 100\mu A, V_{DS} = 0$ |
| Gate to source leak current | I_{GSS+1} | — | — | -100 | μA | $V_{GS} = -8V, V_{DS} = 0$ |
| | I_{GSS+2} | — | — | -50 | μA | $V_{GS} = -3.5V, V_{DS} = 0$ |
| | I_{GSS+3} | — | — | -1 | μA | $V_{GS} = -1.2V, V_{DS} = 0$ |
| | I_{GSS-} | — | — | 100 | μA | $V_{GS} = 2.4V, V_{DS} = 0$ |
| Input current (shut down) | $I_{GS(op)1}$ | — | -0.8 | — | mA | $V_{GS} = -8V, V_{DS} = 0$ |
| | $I_{GS(op)1}$ | — | -0.35 | — | mA | $V_{GS} = -3.5V, V_{DS} = 0$ |
| Zero gate voltage drain current | I_{DSS} | — | — | -250 | μA | $V_{DS} = -50V, V_{GS} = 0$ |
| Gate to source cutoff voltage | $V_{GS(off)}$ | -1.1 | — | -2.25 | V | $I_D = -1mA, V_{DS} = -10V$ |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 100 | 130 | m Ω | $I_D = -7.5A, V_{GS} = -4V$ ^{Note3} |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 70 | 90 | m Ω | $I_D = -7.5A$ $V_{GS} = -10V$ ^{Note3} |
| Forward transfer admittance | $ y_{fs} $ | 5 | 10 | — | S | $I_D = -7.5A, V_{DS} = -10V$ ^{Note3} |
| Output capacitance | C_{oss} | — | 610 | — | pF | $V_{DS} = -10V, V_{GS} = 0$ $f = 1\text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | — | 7.5 | — | μs | $I_D = -7.5A, V_{GS} = -5V$ |
| Rise time | t_r | — | 36 | — | μs | $R_L = 4\Omega$ |
| Turn-off delay time | $t_{d(off)}$ | — | 32 | — | μs | |
| Fall time | t_f | — | 29 | — | μs | |
| Body-drain diode forward voltage | V_{DF} | — | -1.0 | — | V | $I_F = -15A, V_{GS} = 0$ |
| Body-drain diode reverse recovery time | t_{rr} | — | 200 | — | ns | $I_F = -15A, V_{GS} = 0$ $diF/dt = 50A/\mu s$ |
| Over load shut down operation time | t_{os1} | — | 3.7 | — | ms | $V_{GS} = -5V, V_{DD} = -12V$ |
| | t_{os2} | — | 1 | — | ms | $V_{GS} = -5V, V_{DD} = -24V$ |

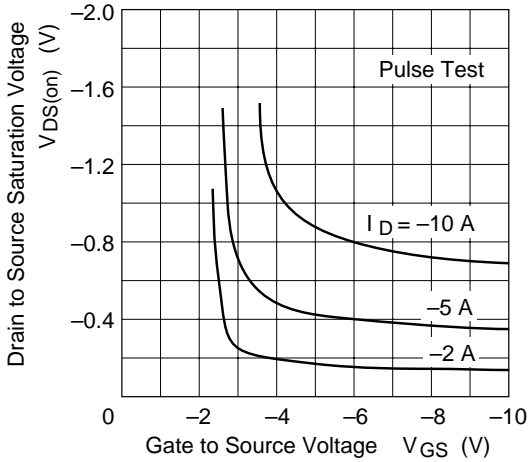
Note: 3. Pulse test

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

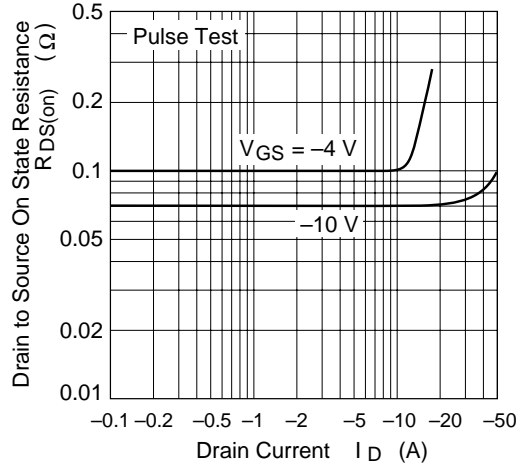
Main Characteristics



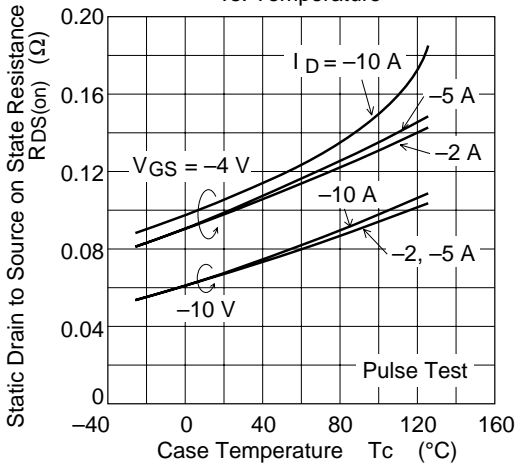
Drain to Source Saturation Voltage vs. Gate to Source Voltage



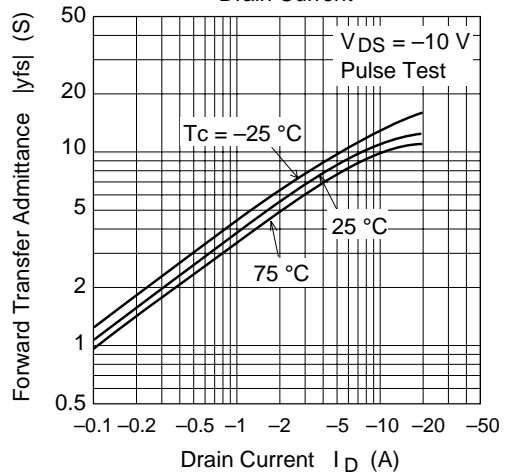
Static Drain to Source State Resistance vs. Drain Current

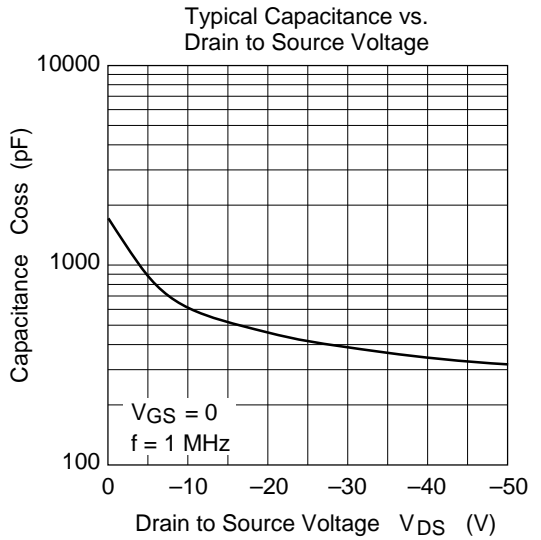
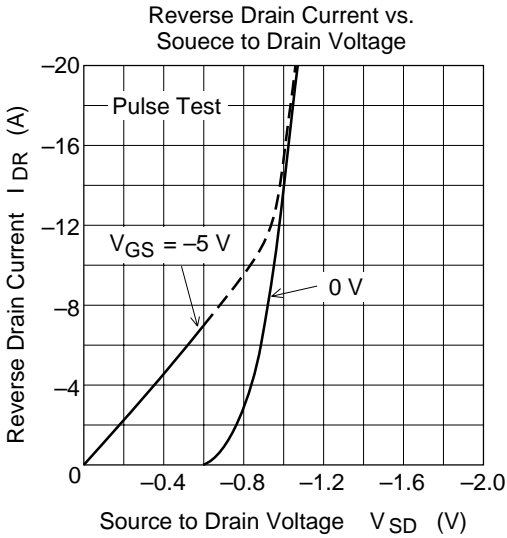
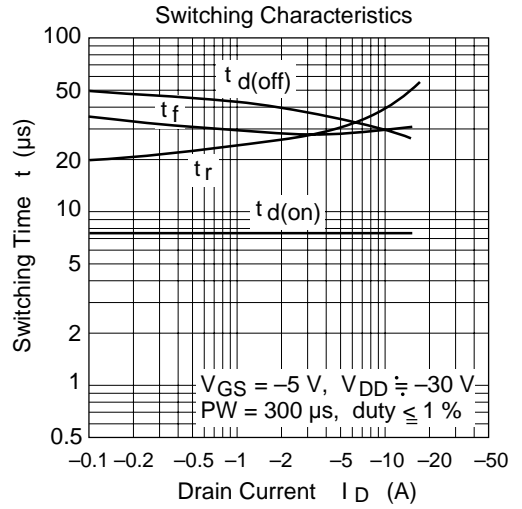
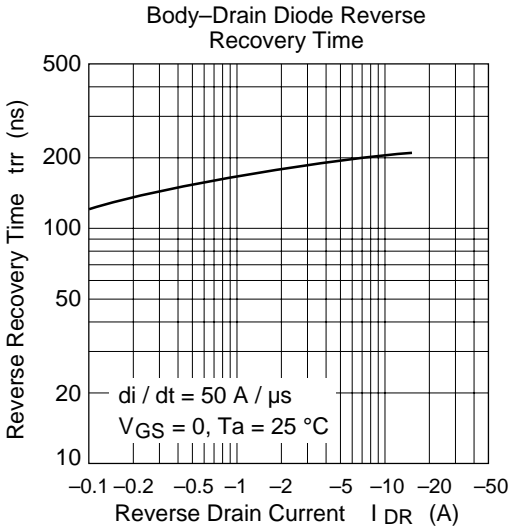


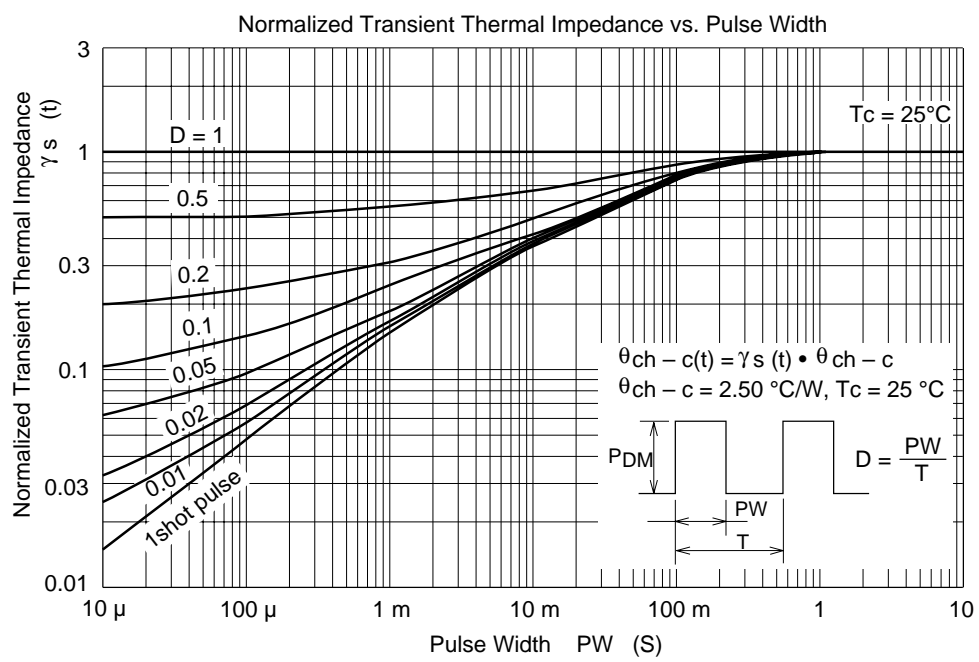
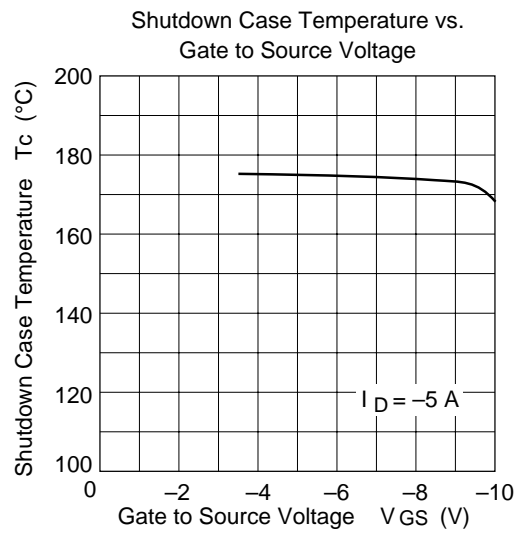
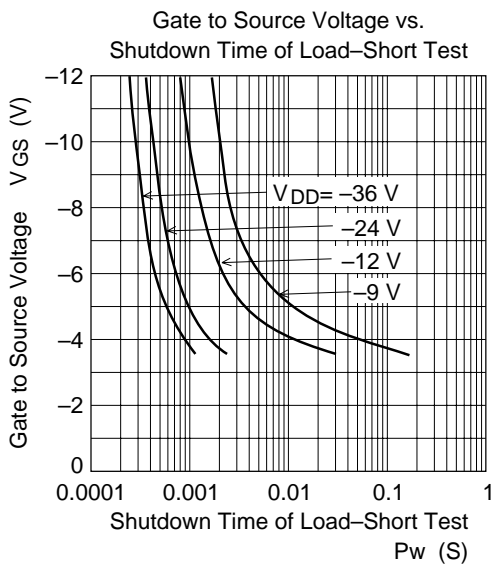
Static Drain to Source on State Resistance vs. Temperature



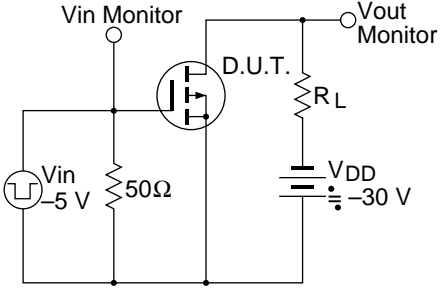
Forward Transfer Admittance vs. Drain Current



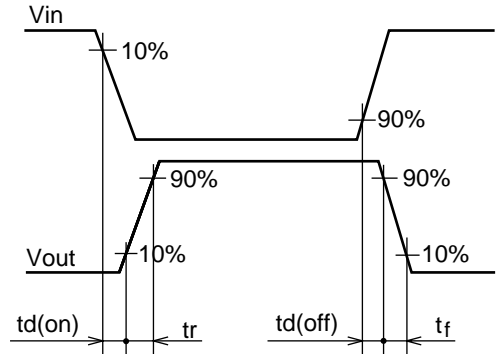




Switching Time Test Circuit

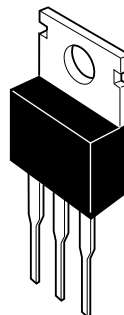
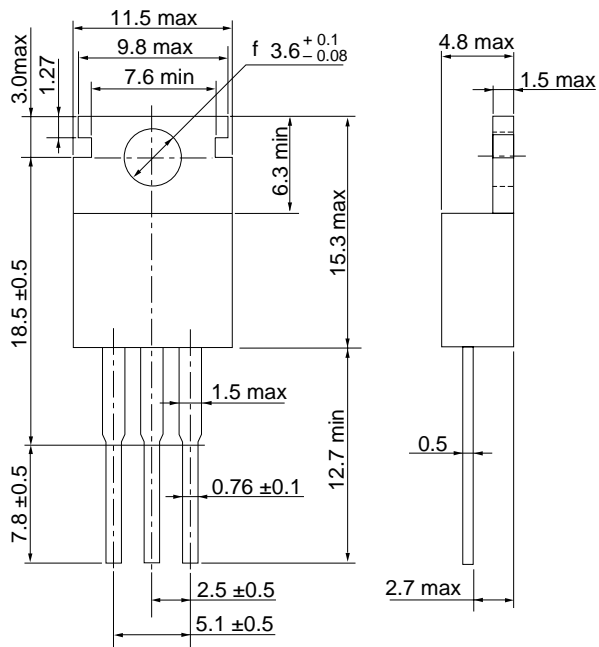


Waveform



Package Dimensions

Unit: mm



| | |
|--------------|----------|
| Hitachi Code | TO-220AB |
| EIAJ | SC-46 |
| JEDEC | — |

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