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

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HAF1001

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

RENESAS

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

Features

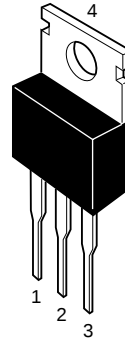
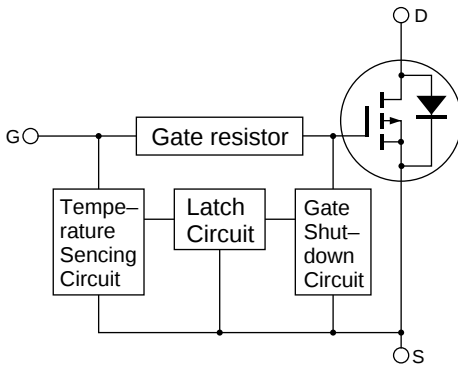
This FET has the over temperature shut-down capability sensing to the junction temperature.

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 (Ta = 25°C)

Item	Symbol	Ratings	Unit
Drain to source voltage	V_{DS}	−60	V
Gate to source voltage	V_{GS}	−16	V
Gate to source voltage	V_{GS}	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	°C
Storage temperature	T_{stg}	−55 to +150	°C

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

2. Value at $T_c = 25^\circ C$

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 (Gate non shut down)	I_{IH1}	—	—	−100	μA	$V_i = -8V, V_{DS} = 0$
	I_{IH2}	—	—	−50	μA	$V_i = -3.5V, V_{DS} = 0$
	I_{IL}	—	—	−1	μA	$V_i = -1.2V, V_{DS} = 0$
Input current (Gate shut down)	$I_{IH(sd)1}$	—	−0.8	—	mA	$V_i = -8V, V_{DS} = 0$
	$I_{IH(sd)2}$	—	−0.35	—	mA	$V_i = -3.5V, V_{DS} = 0$
Shut down temperature	T_{sd}	—	175	—	°C	Channel temperature
Gate operation voltage	V_{OP}	−3.5	—	−13	V	

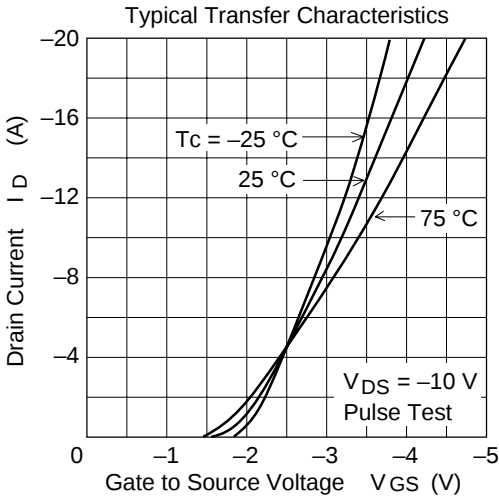
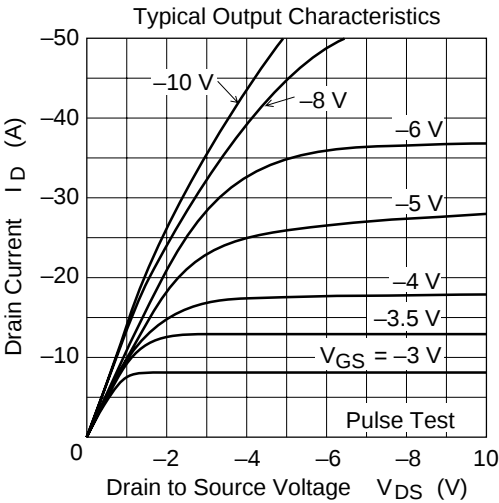
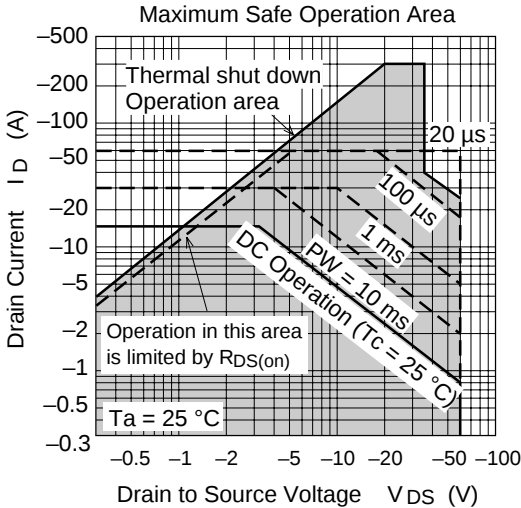
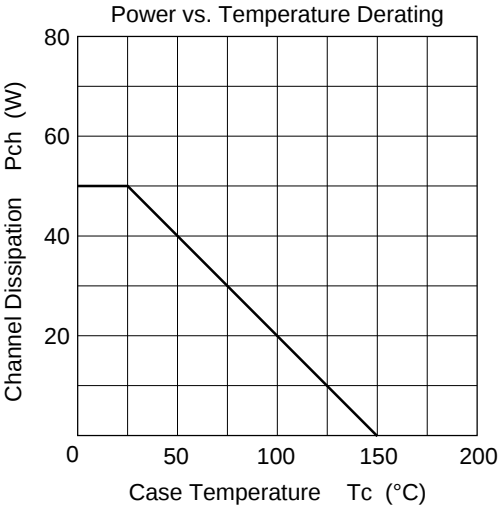
Electrical Characteristics (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain current	I_{D1}	-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_{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 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	$I_F = -15A$, $V_{GS} = 0$ $di_F/dt = 50A/\mu s$
Over load shut down	t_{os1}	—	3.7	—	ms	$V_{GS} = -5V$, $V_{DD} = -12V$
operation time ^{Note4}	t_{os2}	—	1	—	ms	$V_{GS} = -5V$, $V_{DD} = -24V$

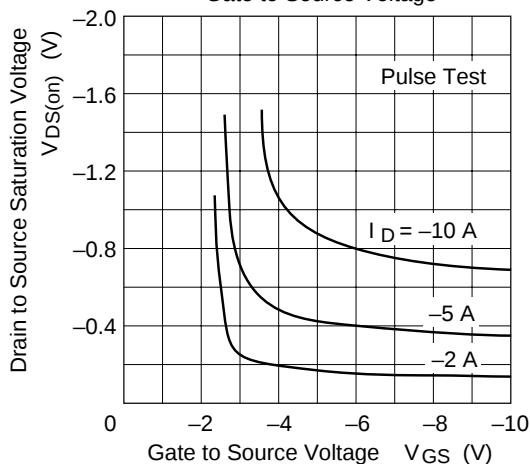
Note: 3. Pulse test

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

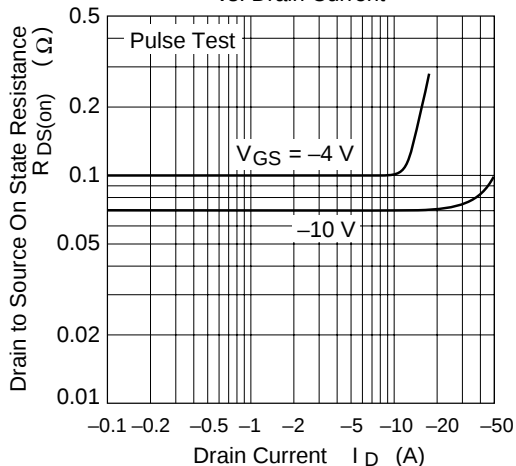
Main Characteristics



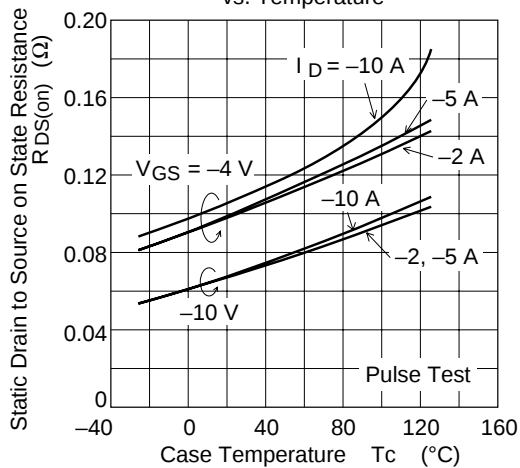
Drain to Source Saturation Voltage vs.
Gate to Source Voltage



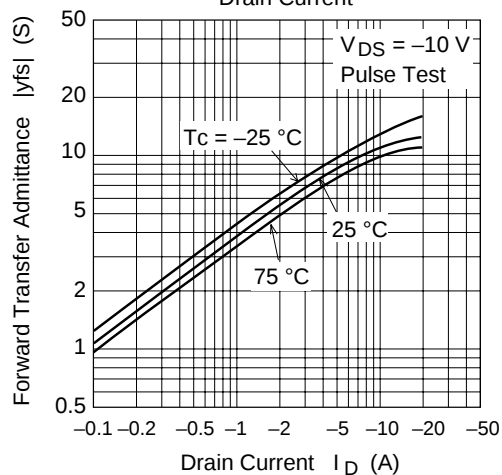
Static Drain to Source State Resistance
vs. Drain Current



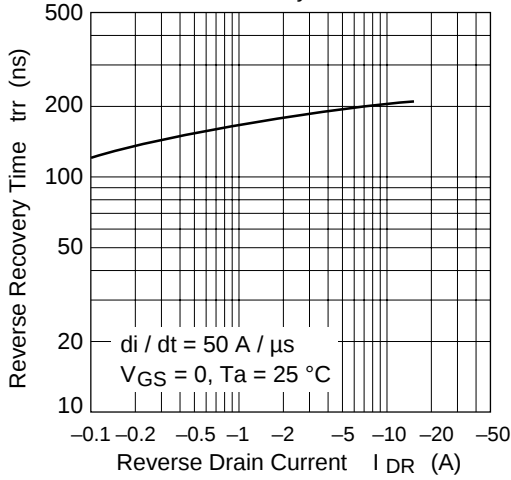
Static Drain to Source on State Resistance
vs. Temperature



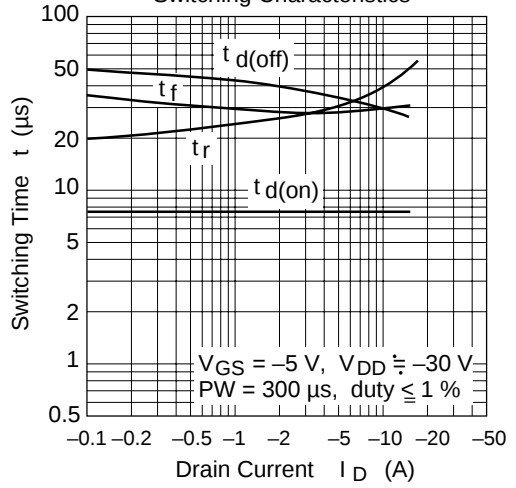
Forward Transfer Admittance vs.
Drain Current



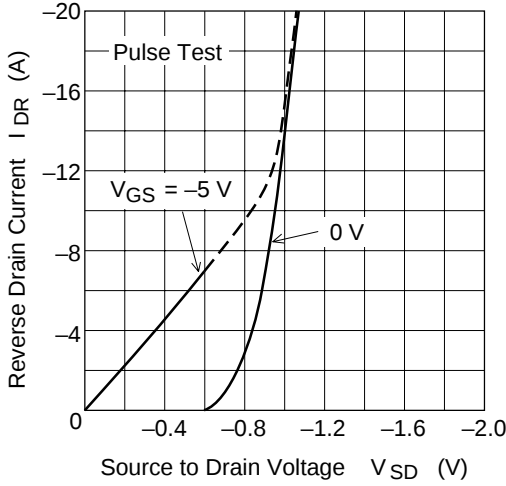
Body-Drain Diode Reverse Recovery Time



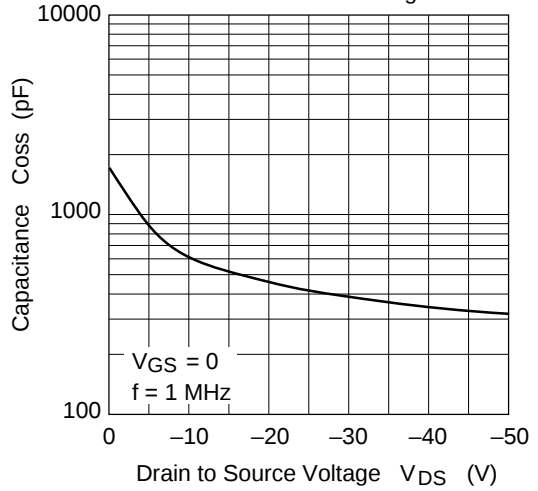
Switching Characteristics

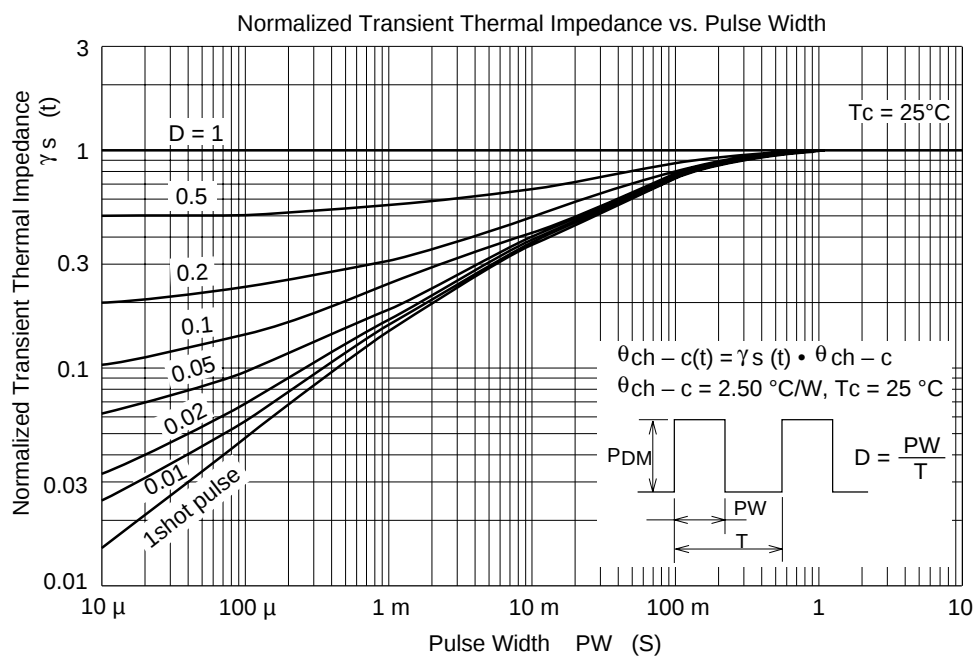
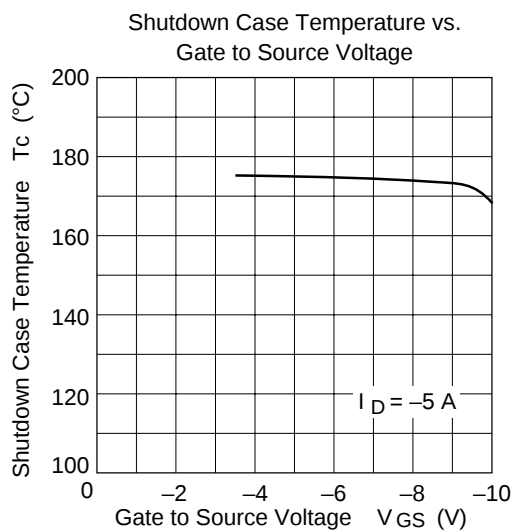
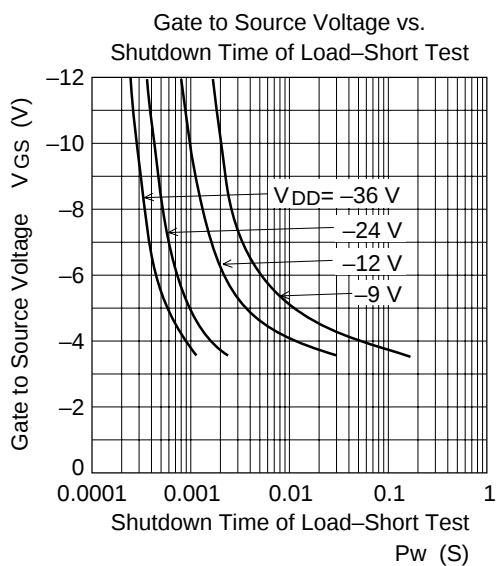


Reverse Drain Current vs. Source to Drain Voltage

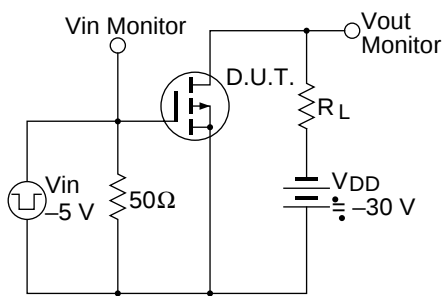


Typical Capacitance vs. Drain to Source Voltage

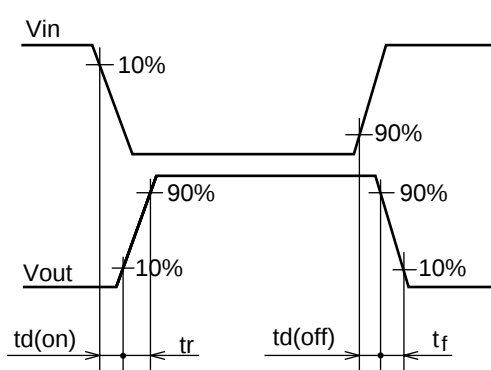




Switching Time Test Circuit



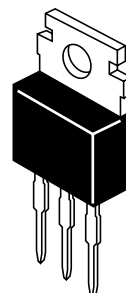
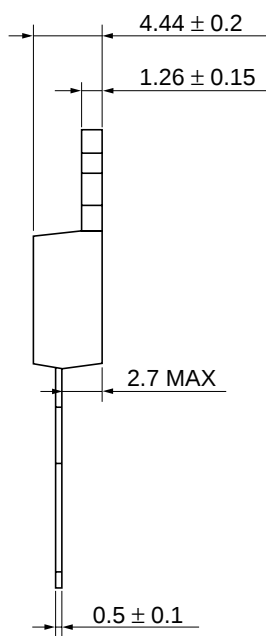
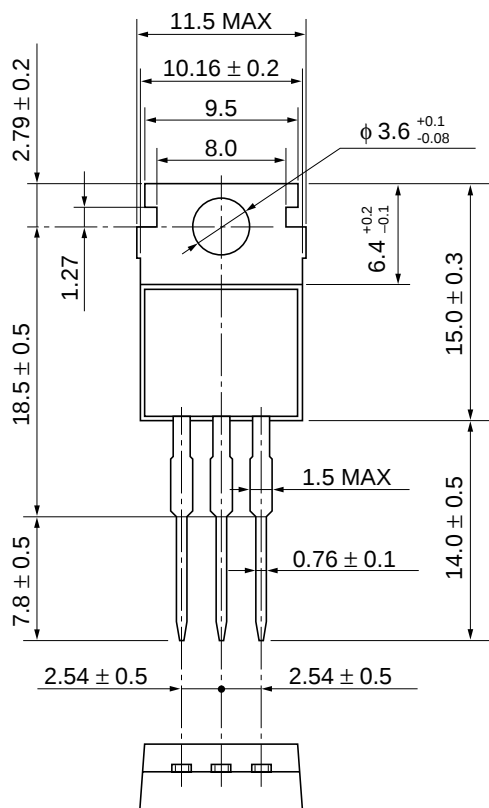
Waveform



Package Dimensions

As of January, 2001

Unit: mm



Hitachi Code	TO-220AB
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	1.8 g

Cautions

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