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

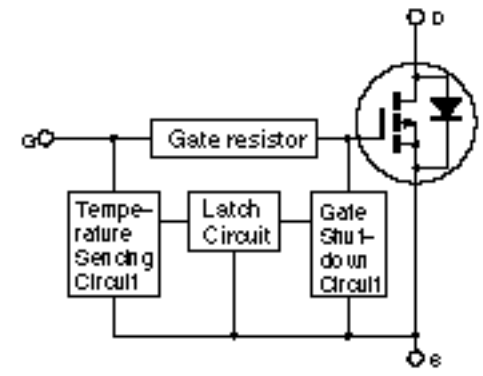
This FET has the over temperature shut–down capability sensing to the junction temperature.

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 (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}	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	Pch Note2	50	W
Channel temperature	Tch	150	°C
Storage temperature	Tstg	–55 to +150	°C

Note: 1. PW ≤ 10µs, duty cycle ≤ 1 %
2. Value at Tc = 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	

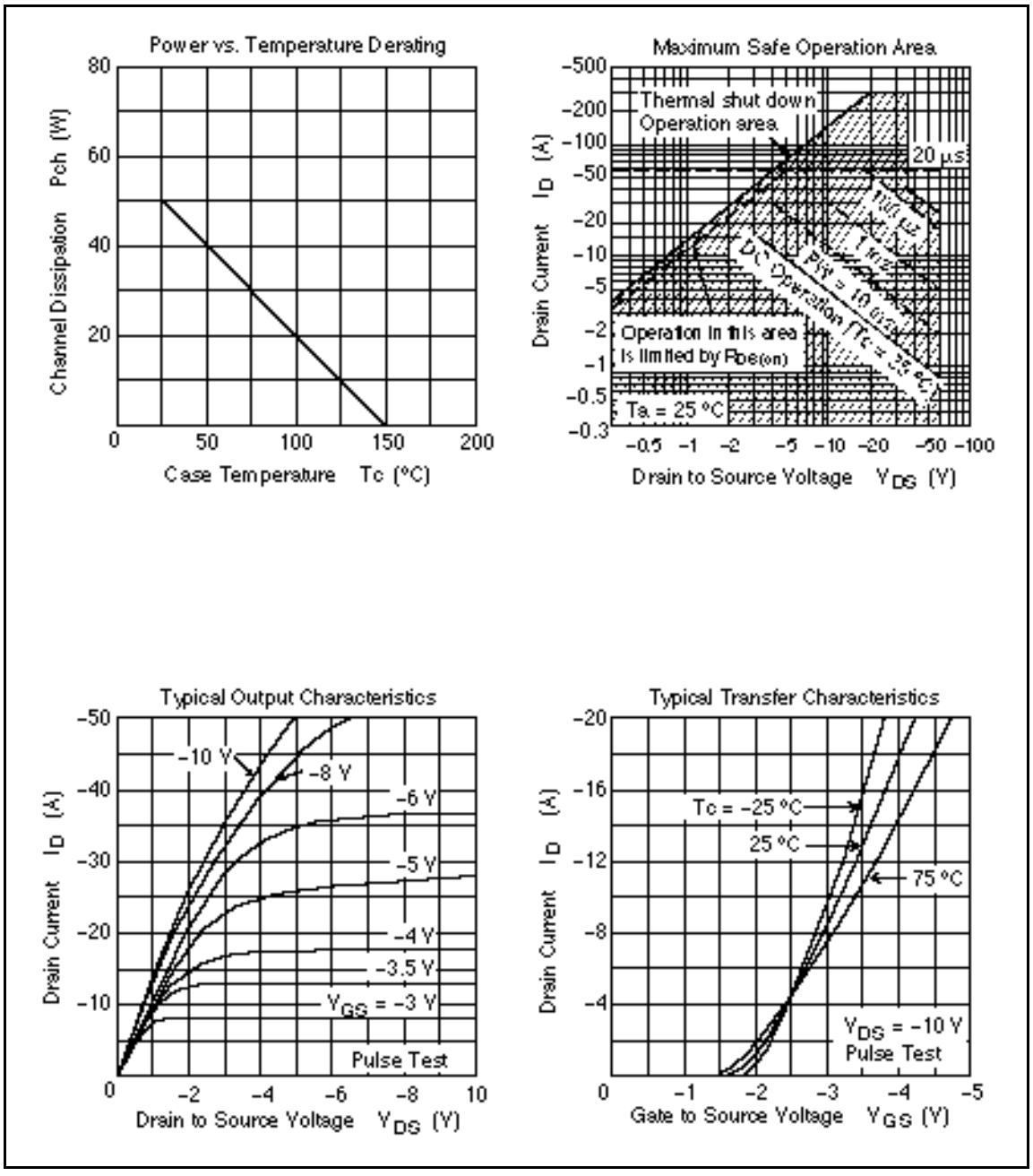
Electrical Characteristics (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain current	I_{D1}	–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 = –100µA, V_{DS} = 0
Gate to source breakdown voltage	$V_{(BR)GSS}$	3	—	—	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	$V_{GS(off)}$	–1.1	—	–2.25	V	I_D = –1mA, V_{DS} = –10V
Static drain to source on state resistance	$R_{DS(on)}$	—	100	130	mΩ	I_D = –7.5A, V_{GS} = –4V [Note3]
Static drain to source on state resistance	$R_{DS(on)}$	—	70	90	mΩ	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	Coss	—	610	—	pF	V_{DS} = –10V , V_{GS} = 0 f = 1 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 = 4Ω
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/µs
Over load shut down operation time [Note4]	t_{os1}	—	3.7	—	ms	V_{GS} = –5V, V_{DD} = –12V
	t_{os2}	—	1	—	ms	V_{GS} = –5V, V_{DD} = –24V

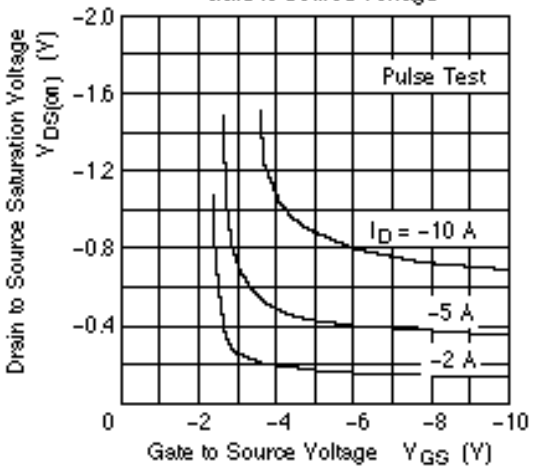
Note: 3. Pulse test

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

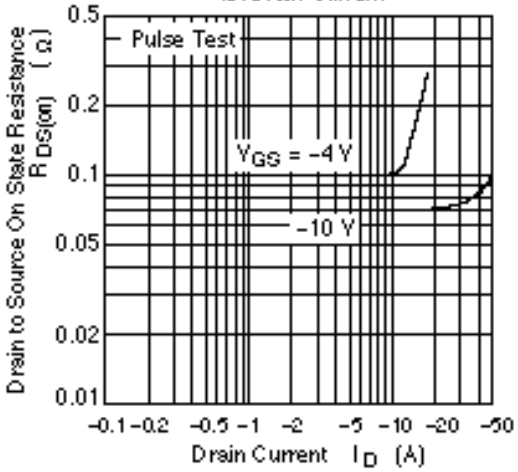
Main Characteristics



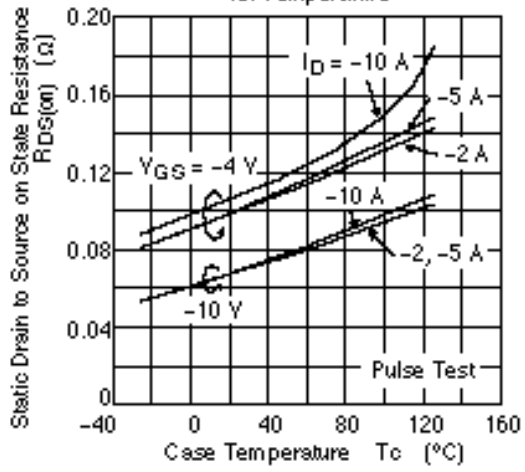
Drain to Source Saturation Voltage vs. Gate to Source Voltage



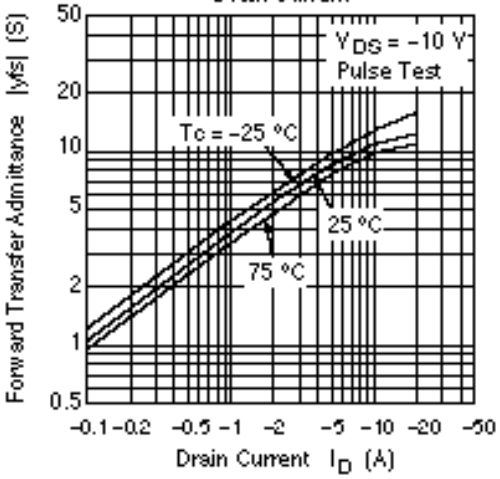
Static Drain to Source State Resistance vs. Drain Current

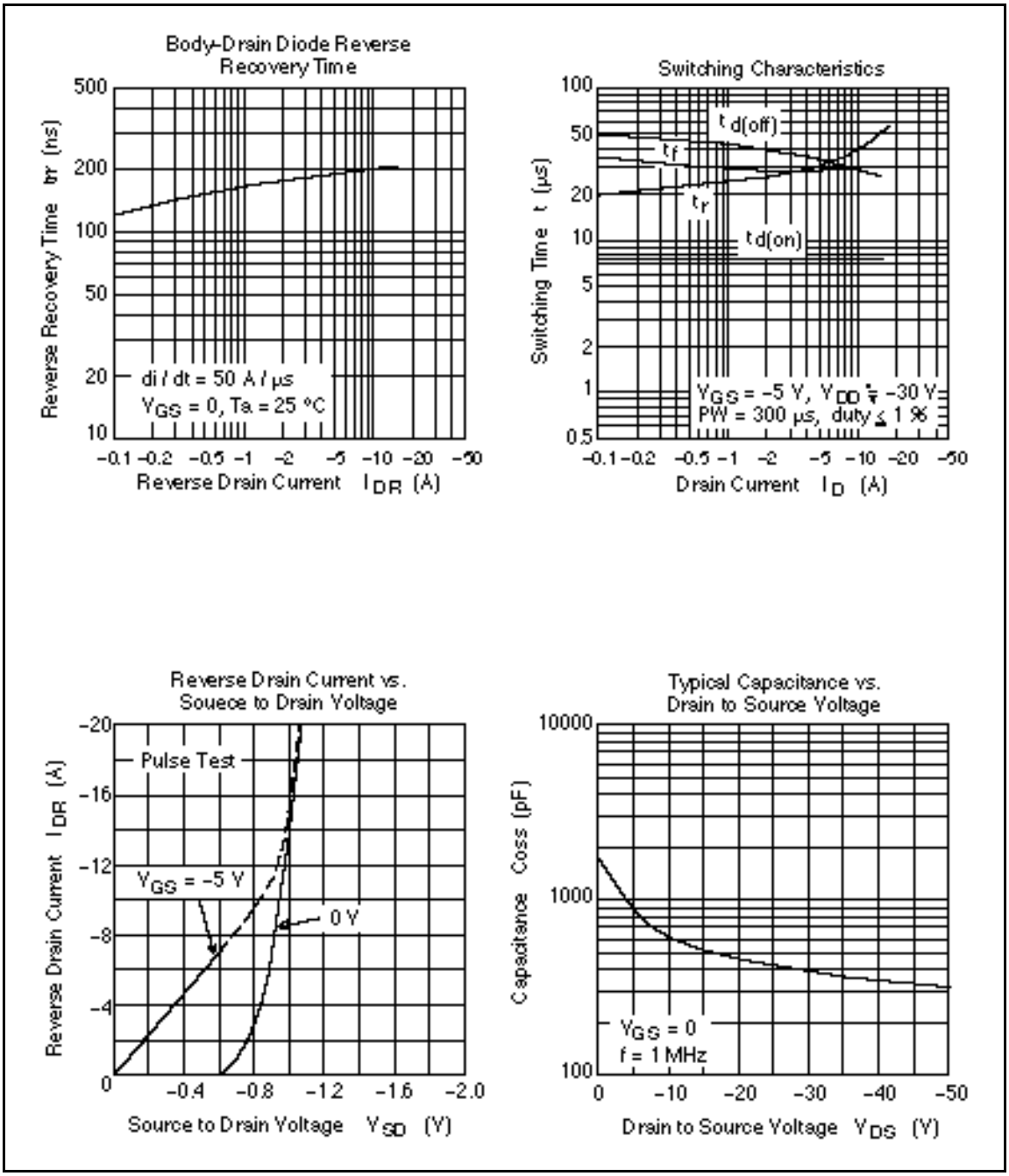


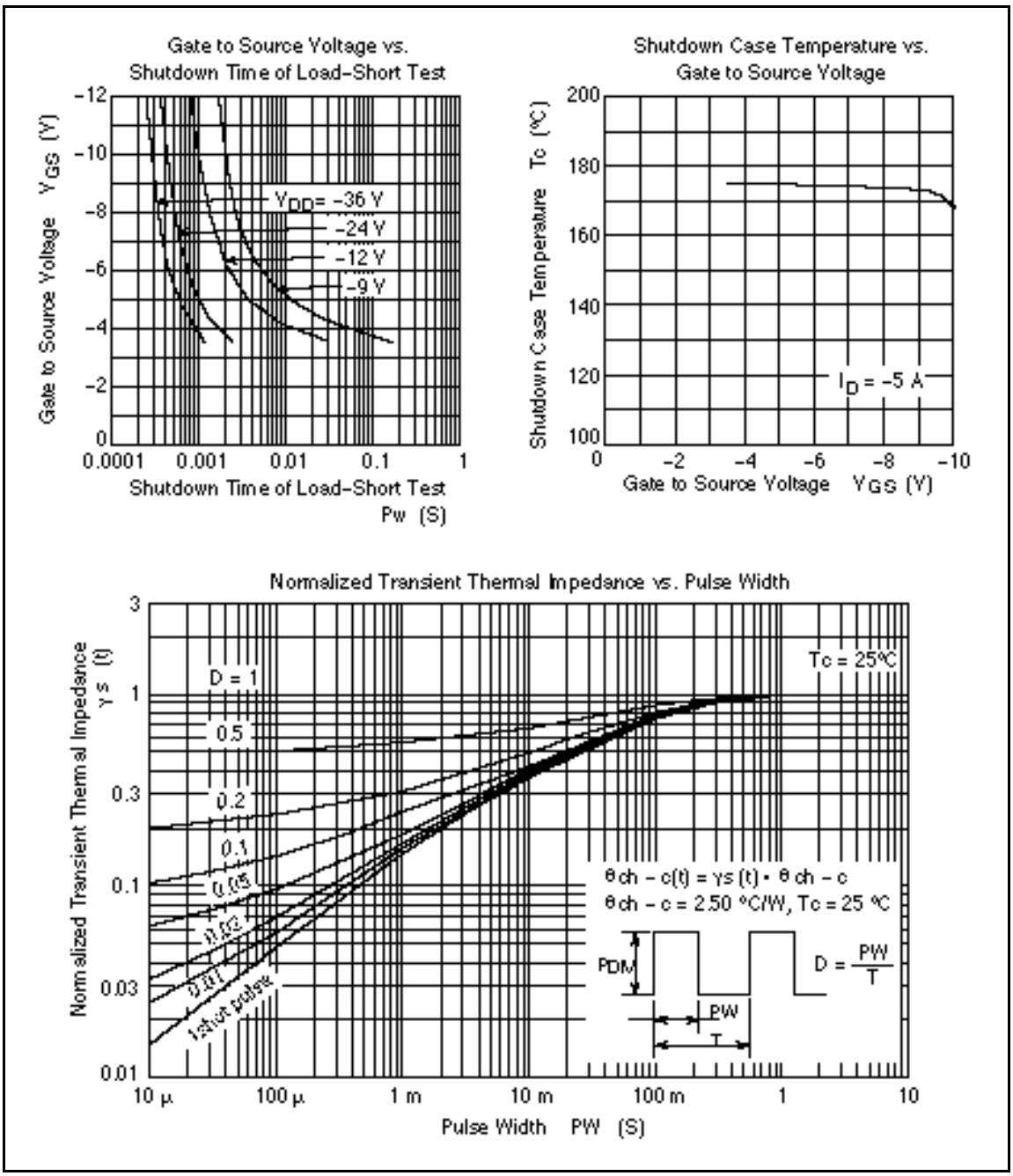
Static Drain to Source on State Resistance vs. Temperature



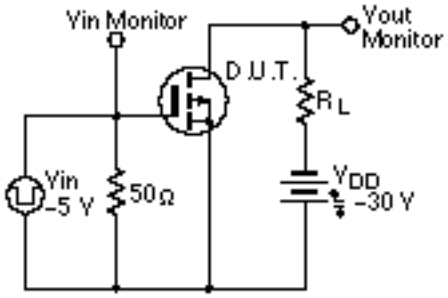
Forward Transfer Admittance vs. Drain Current



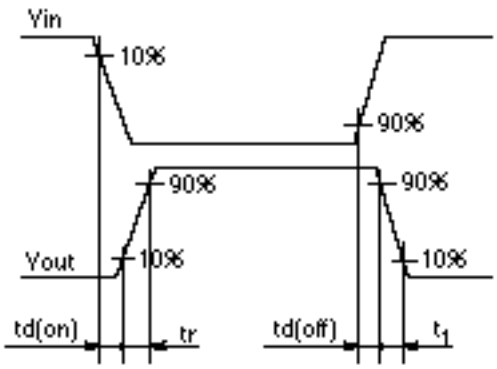

Body-Drain Diode Reverse Recovery Time
Reverse Recovery Time trr (ns)
500
200
100
50
20
10
di / dt = 50 A / µs
VGS = 0, Ta = 25 °C
−0.1 −0.2 −0.5 −1 −2 −5 −10 −20 −50
Reverse Drain Current IDR (A)
Switching Characteristics
Switching Time t (µs)
100
50
20
10
5
2
1
0.5
td(off)
tf
tr
td(on)
VGS = −5 V, VDD ≒ −30 V
PW = 300 µs, duty ≦ 1 %
−0.1 −0.2 −0.5 −1 −2 −5 −10 −20 −50
Drain Current ID (A)
Reverse Drain Current vs. Souece to Drain Voltage
Reverse Drain Current IDR (A)
−20
−16
−12
−8
−4
0
Pulse Test
VGS = −5 V
0 V
−0.4 −0.8 −1.2 −1.6 −2.0
Source to Drain Voltage VSD (V)
Typical Capacitance vs. Drain to Source Voltage
Capacitance Coss (pF)
10000
1000
100
VGS = 0
f = 1 MHz
0 −10 −20 −30 −40 −50
Drain to Source Voltage VDS (V)


Gate to Source Voltage vs.
Shutdown Time of Load-Short Test
Gate to Source Voltage VGS (V)
VDD = -36 V
-24 V
-12 V
-9 V
Shutdown Time of Load-Short Test
Pw (S)
Shutdown Case Temperature vs.
Gate to Source Voltage
Shutdown Case Temperature Tc (°C)
ID = -5 A
Gate to Source Voltage VGS (V)
Normalized Transient Thermal Impedance vs. Pulse Width
Normalized Transient Thermal Impedance γs (t)
D = 1
0.5
0.2
0.1
0.05
0.02
0.01
1shot pulse
Tc = 25°C
θch - c(t) = γs (t) • θch - c
θch - c = 2.50 °C/W, Tc = 25 °C
PDM
D = PW/T
PW
T
Pulse Width PW (S)

Switching Time Test Circuit

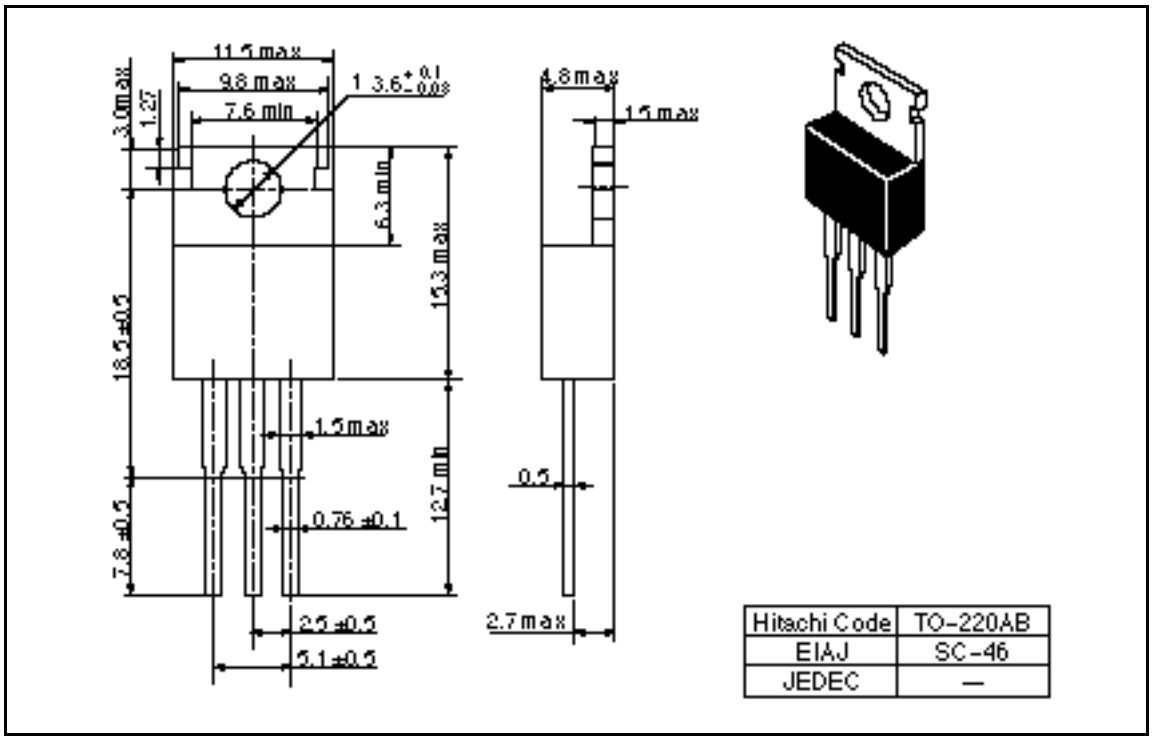


Waveform



Package Dimensions

Unit: mm



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