To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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DATA SHEET

MOS FIELD EFFECT TRANSISTOR

2SK4091

SWITCHING
N-CHANNEL POWER MOS FET

DESCRIPTION

The 2SK4091 is N-channel MOS FET device that features a low on-state resistance and excellent switching characteristics, and designed for low voltage high current applications such as DC/DC converter with synchronous rectifier.

FEATURES

- Low on-state resistance
  $R_{DS(on)1}$ = 13.0 mΩ MAX. (V_{GS} = 10 V, I_D = 15 A)
  $R_{DS(on)2}$ = 21 mΩ MAX. (V_{GS} = 4.5 V, I_D = 15 A)
- Low gate to drain charge
  Q_{GD} = 2.2 nC TYP. (V_{DD} = 15 V, I_D = 30 A)
- 4.5 V drive available
- Avalanche capability ratings

ORDERING INFORMATION

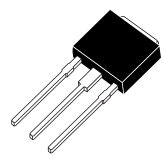
PART NUMBER	LEAD PLATING	PACKING	PACKAGE
2SK4091(1)-S27-AY Note	Pure Sn (Tin)	Tube 75 p/tube	TO-251 (MP-3-b) typ. 0.34 g
2SK4091-ZK-E1-AY Note		Tape 2500 p/reel	TO-252 (MP-3ZK) typ. 0.27 g
2SK4091-ZK-E2-AY Note			

Note Pb-free (This product does not contain Pb in external electrode).

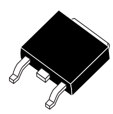
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

Drain to Source Voltage (V_{GS} = 0 V)	V_{DSS}	30	V
Gate to Source Voltage (V_{DS} = 0 V)	V_{GSS}	±20	V
Drain Current (DC) (T_C = 25°C)	$I_{D(DC)}$	±30	A
Drain Current (pulse) Note1	$I_{D(pulse)}$	±110	A
Total Power Dissipation (T_C = 25°C)	P_{T1}	21	W
Total Power Dissipation (T_A = 25°C)	P_{T2}	1.0	W
Channel Temperature	T_{ch}	150	°C
Storage Temperature	T_{stg}	−55 to +150	°C
Single Avalanche Current Note2	I_{AS}	18	A
Single Avalanche Energy Note2	E_{AS}	32.4	mJ

(TO-251)



(TO-252)



Notes 1. PW ≤ 10 μs, Duty Cycle ≤ 1%

2. Starting T_{ch} = 25°C, V_{DD} = 15 V, R_G = 25 Ω, V_{GS} = 20 → 0 V, L = 0.1 mH

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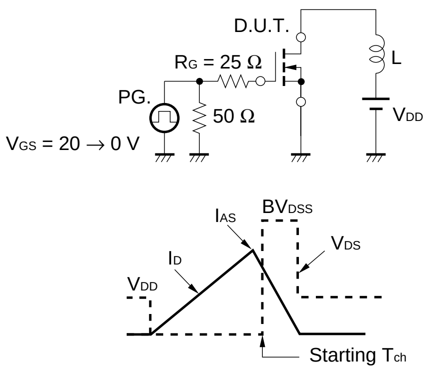
Document No. D18635EJ1V0DS00 (1st edition)
Date Published February 2007 NS CP(K)
Printed in Japan

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

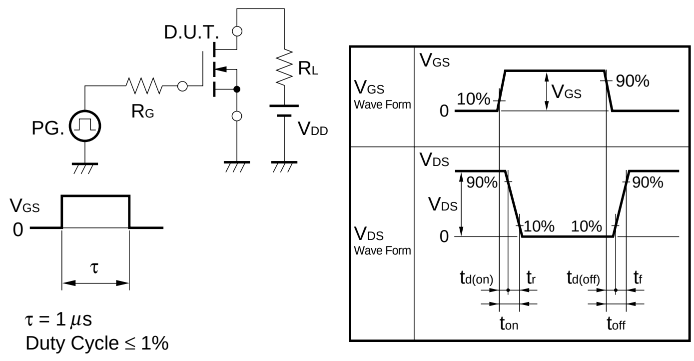
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 30 V, V_{GS} = 0 V			10	μA
Gate Leakage Current	I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V			±100	nA
Gate to Source Cut-off Voltage	$V_{GS(off)}$	V_{DS} = V_{GS}, I_D = 250 μA	1.5	2.0	2.5	V
Forward Transfer Admittance Note	$\| y_{fs} \|$	V_{DS} = 10 V, I_D = 15 A	7	14		S
Drain to Source On-state Resistance Note	$R_{DS(on)1}$	V_{GS} = 10 V, I_D = 15 A		9.8	13.0	mΩ
	$R_{DS(on)2}$	V_{GS} = 4.5 V, I_D = 15 A		13.6	21	mΩ
Input Capacitance	C_{iss}	V_{DS} = 10 V,		920		pF
Output Capacitance	C_{oss}	V_{GS} = 0 V,		240		pF
Reverse Transfer Capacitance	C_{rss}	f = 1 MHz		78		pF
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 15 V, I_D = 30 A,		7.5		ns
Rise Time	t_r	V_{GS} = 10 V,		3.9		ns
Turn-off Delay Time	$t_{d(off)}$	R_G = 3 Ω		26		ns
Fall Time	t_f			4.8		ns
Total Gate Charge	Q_{G1}	V_{DD} = 15 V, V_{GS} = 10 V, I_D = 30 A		15		nC
	Q_{G2}	V_{DD} = 15 V, V_{GS} = 4.5 V, I_D = 30 A		6.7		nC
Gate to Source Charge	Q_{GS}	V_{DD} = 15 V, I_D = 30 A		2.6		nC
Gate to Drain Charge	Q_{GD}			2.2		nC
Gate Resistance	R_G			1.6		Ω
Body Diode Forward Voltage Note	$V_{F(S-D)}$	I_F = 30 A, V_{GS} = 0 V		0.9	1.5	V
Reverse Recovery Time	t_{rr}	I_F = 30 A, V_{GS} = 0 V,		25		ns
Reverse Recovery Charge	Q_{rr}	di/dt = 100 A/μs		16		nC

Note Pulsed

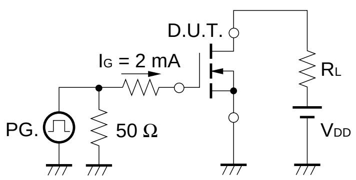
TEST CIRCUIT 1 AVALANCHE CAPABILITY



TEST CIRCUIT 2 SWITCHING TIME

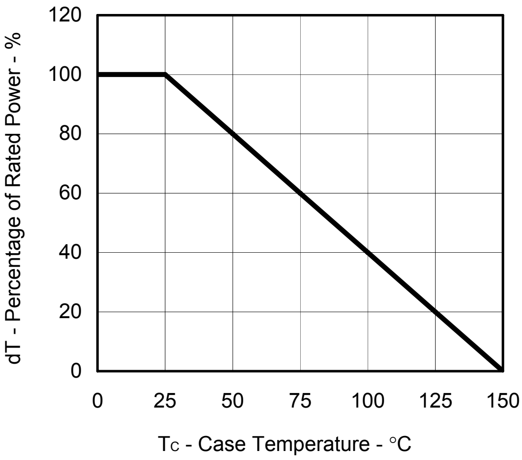


TEST CIRCUIT 3 GATE CHARGE

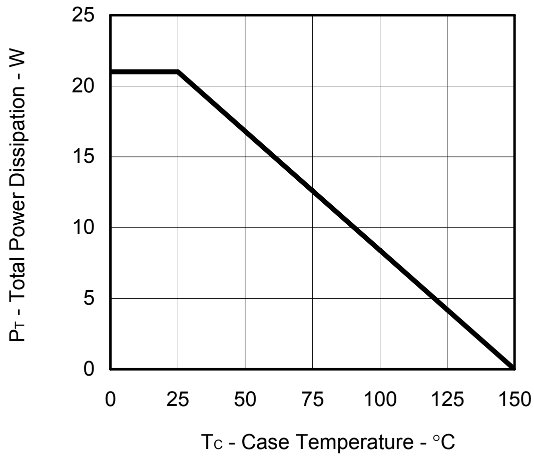


TYPICAL CHARACTERISTICS (T_A = 25°C)

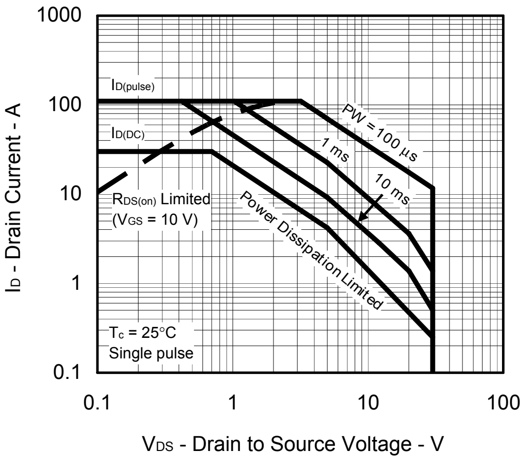
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



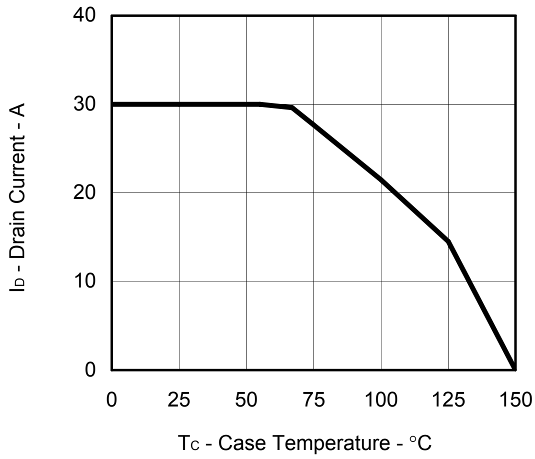
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



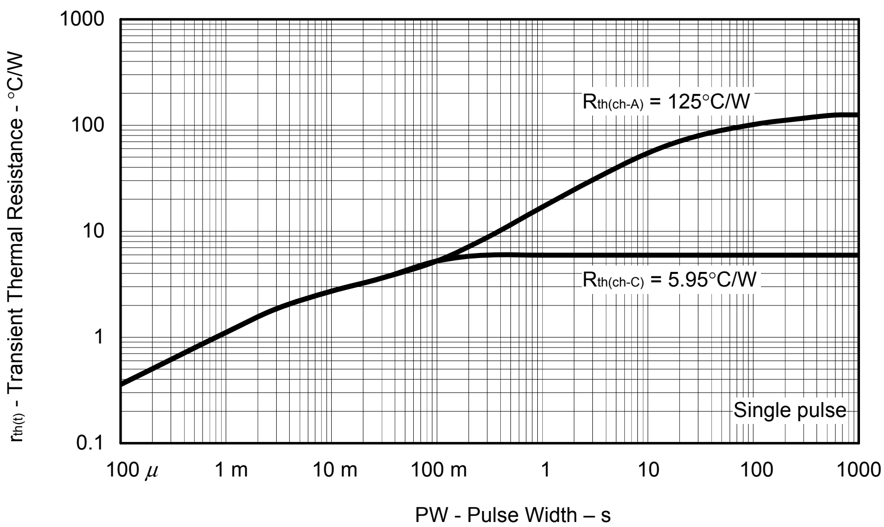
FORWARD BIAS SAFE OPERATING AREA



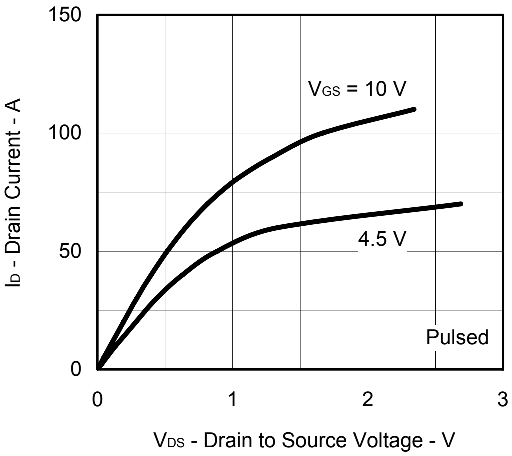
DRAIN CURRENT vs. CASE TEMPERATURE



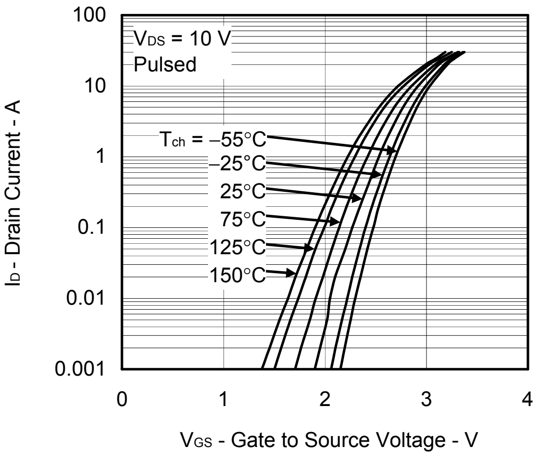
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



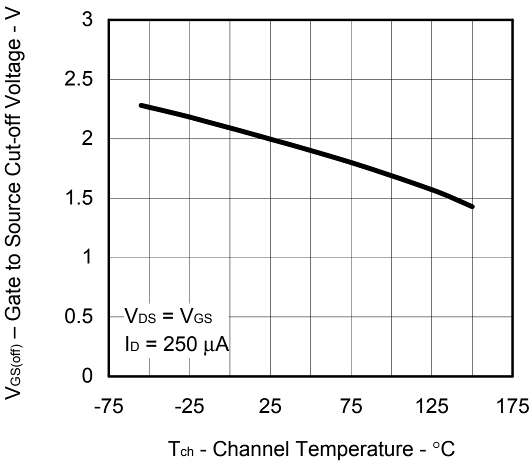
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



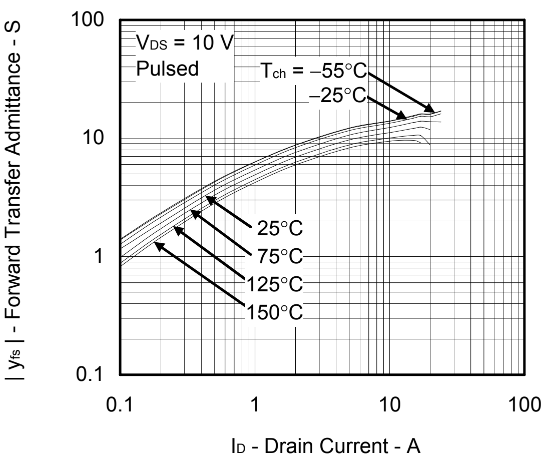
FORWARD TRANSFER CHARACTERISTICS



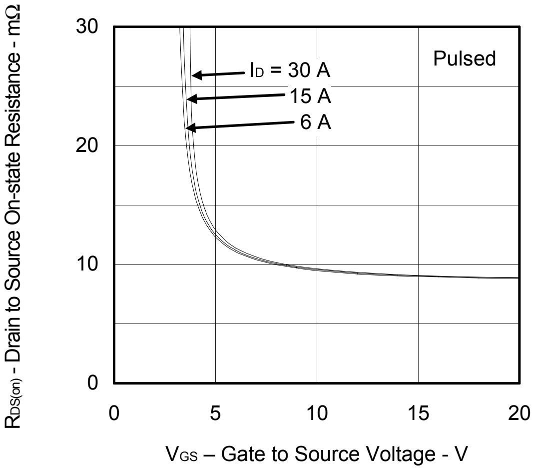
GATE TO SOURCE CUT-OFF VOLTAGE vs.
CHANNEL TEMPERATURE



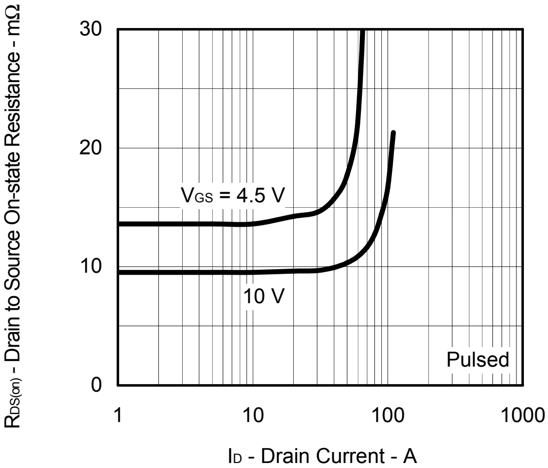
FORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENT



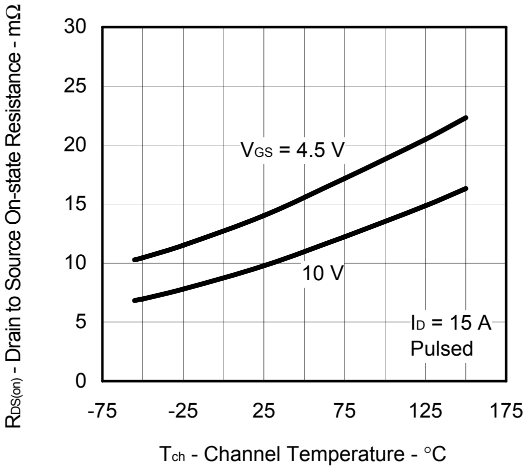
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE



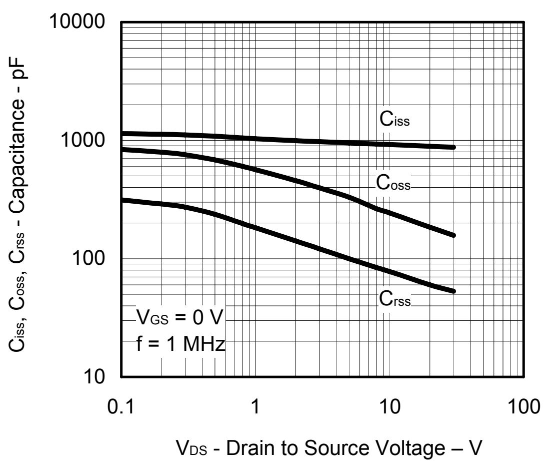
DRAIN TO SOURCE ON-STATE
RESISTANCE vs. DRAIN CURRENT



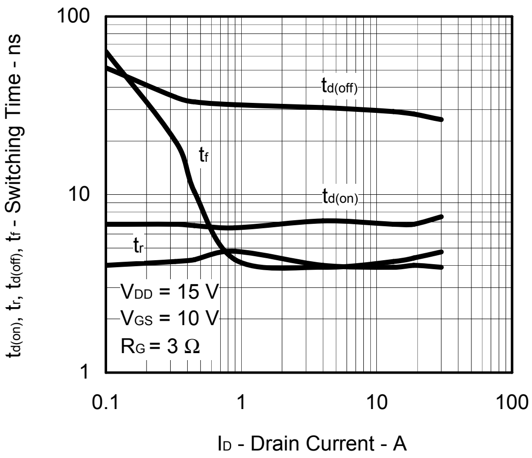
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
CHANNEL TEMPERATURE



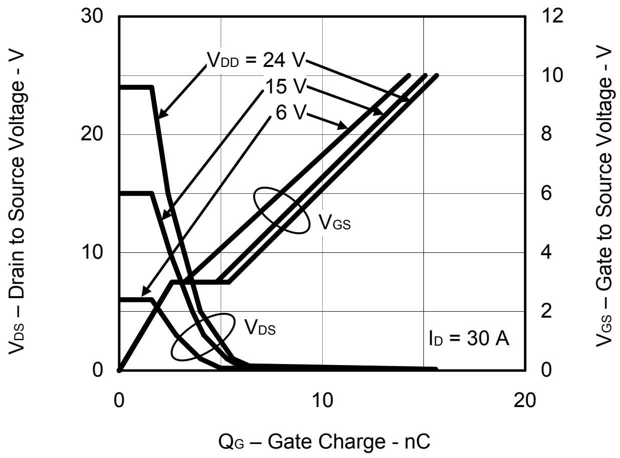
CAPACITANCE vs. DRAIN TO
SOURCE VOLTAGE



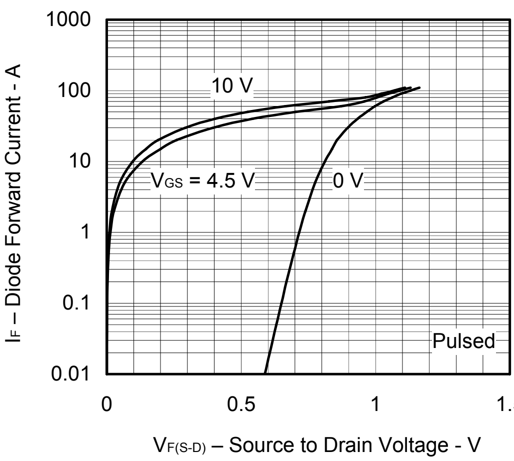
SWITCHING CHARACTERISTICS



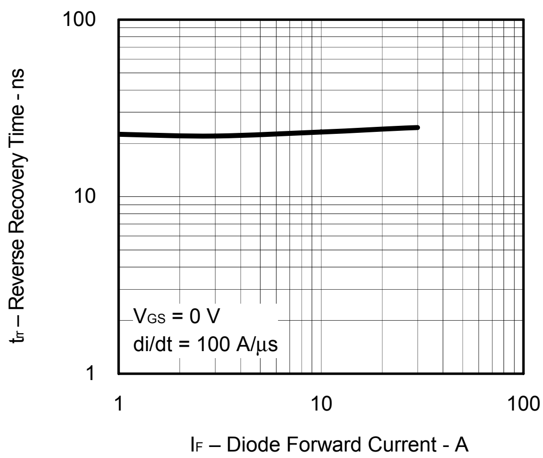
DYNAMIC INPUT/OUTPUT CHARACTERISTICS

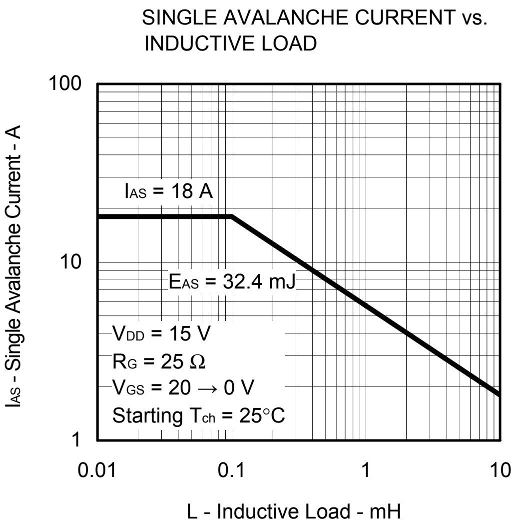


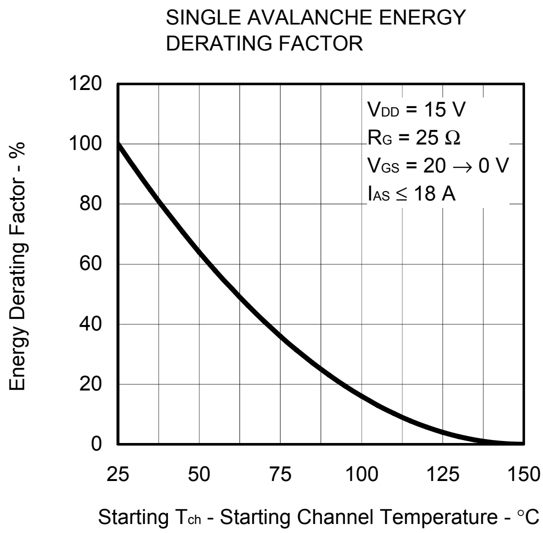
SOURCE TO DRAIN DIODE
FORWARD VOLTAGE



REVERSE RECOVERY TIME vs.
DIODE FORWARD CURRENT

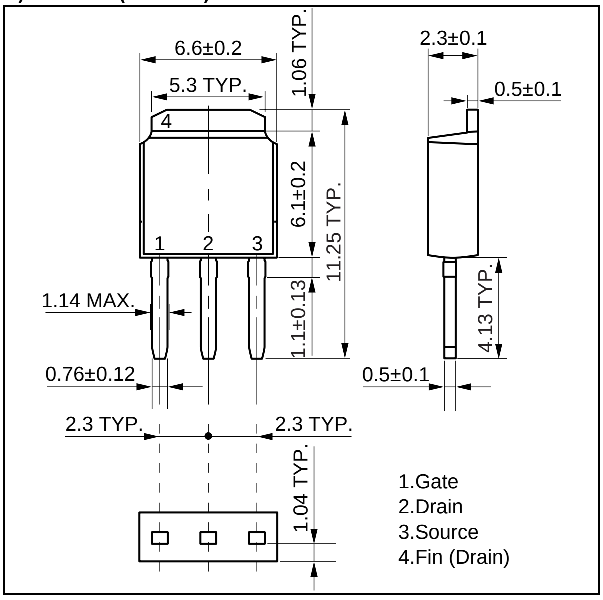



SINGLE AVALANCHE CURRENT vs.
INDUCTIVE LOAD
100
10
1
0.01
0.1
1
10
IAS - Single Avalanche Current - A
L - Inductive Load - mH
IAS = 18 A
EAS = 32.4 mJ
VDD = 15 V
RG = 25 Ω
VGS = 20 → 0 V
Starting Tch = 25°C

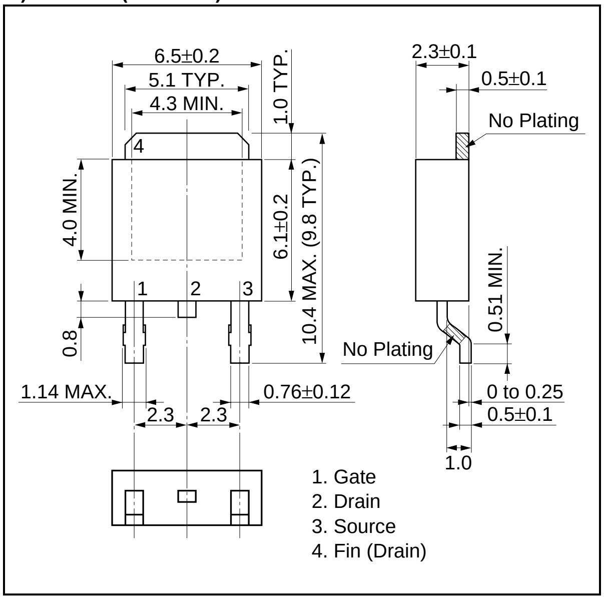

SINGLE AVALANCHE ENERGY
DERATING FACTOR
120
100
80
60
40
20
0
25
50
75
100
125
150
Energy Derating Factor - %
Starting Tch - Starting Channel Temperature - °C
VDD = 15 V
RG = 25 Ω
VGS = 20 → 0 V
IAS ≤ 18 A

PACKAGE DRAWINGS (Unit: mm)

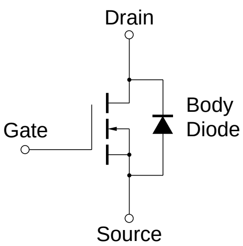
1) TO-251 (MP-3-b)



2) TO-252 (MP-3ZK)



EQUIVALENT CIRCUIT



Remark Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.