

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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SWITCHING
N-CHANNEL POWER MOSFET

DESCRIPTION

The 2SK3993 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
 $R_{DS(on)1} = 3.8 \text{ m}\Omega \text{ MAX. (}V_{GS} = 10 \text{ V, } I_D = 32 \text{ A}\text{)}$
- Low C_{iss} : $C_{iss} = 4770 \text{ pF TYP.}$
- 5 V drive available

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

Drain to Source Voltage ($V_{GS} = 0 \text{ V}$)	V_{DSS}	25	V
Gate to Source Voltage ($V_{DS} = 0 \text{ V}$)	V_{GS}	± 20	V
Drain Current (DC) ($T_c = 25^\circ\text{C}$)	$I_{D(DC)}$	± 64	A
Drain Current (pulse) ^{Note1}	$I_{D(pulse)}$	± 256	A
Total Power Dissipation ($T_c = 25^\circ\text{C}$)	P_{T1}	40	W
Total Power Dissipation	P_{T2}	1.0	W
Channel Temperature	T_{ch}	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$
Single Avalanche Current ^{Note2}	I_{AS}	41	A
Single Avalanche Energy ^{Note2}	E_{AS}	168	mJ

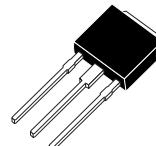
Notes 1. PW $\leq 10 \mu\text{s}$, Duty Cycle $\leq 1\%$

2. Starting $T_{ch} = 25^\circ\text{C}$, $V_{DD} = 12.5 \text{ V}$, $R_G = 25 \Omega$, $V_{GS} = 20 \rightarrow 0 \text{ V}$

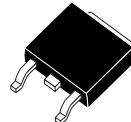
ORDERING INFORMATION

PART NUMBER	PACKAGE
2SK3993	TO-251 (MP-3)
2SK3993-ZK	TO-252 (MP-3ZK)

(TO-251)



(TO-252)



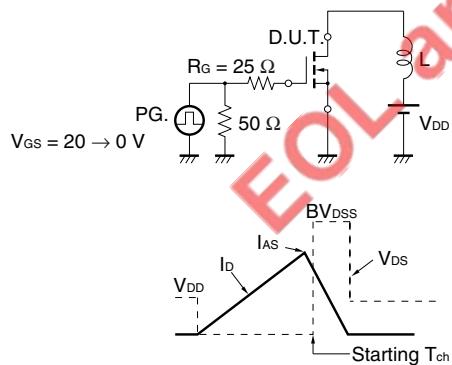
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ELECTRICAL CHARACTERISTICS (TA = 25°C)

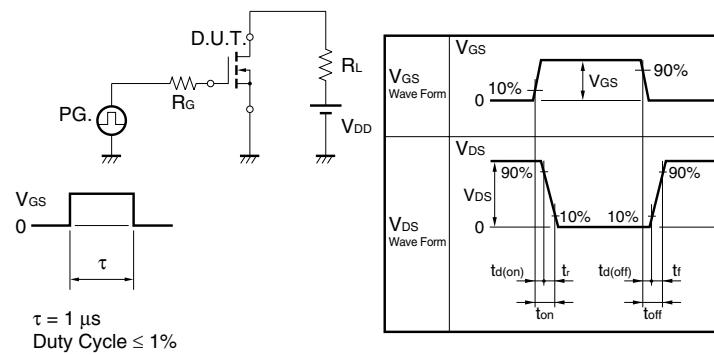
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 25 \text{ V}$, $V_{GS} = 0 \text{ V}$			10	μA
Gate Leakage Current	I_{GSS}	$V_{GS} = \pm 20 \text{ V}$, $V_{DS} = 0 \text{ V}$			± 100	nA
Gate Cut-off Voltage	$V_{GS(\text{off})}$	$V_{DS} = 10 \text{ V}$, $I_D = 1 \text{ mA}$	2.0	2.4	3.0	V
Forward Transfer Admittance ^{Note}	$ y_{fs} $	$V_{DS} = 10 \text{ V}$, $I_D = 16 \text{ A}$	15			S
Drain to Source On-state Resistance ^{Note}	$R_{DS(\text{on})1}$	$V_{GS} = 10 \text{ V}$, $I_D = 32 \text{ A}$		2.7	3.8	$\text{m}\Omega$
	$R_{DS(\text{on})2}$	$V_{GS} = 5.0 \text{ V}$, $I_D = 16 \text{ A}$		4.1	7.8	$\text{m}\Omega$
Input Capacitance	C_{iss}	$V_{DS} = 10 \text{ V}$		4770		pF
Output Capacitance	C_{oss}	$V_{GS} = 0 \text{ V}$		1000		pF
Reverse Transfer Capacitance	C_{rss}	$f = 1 \text{ MHz}$		690		pF
Turn-on Delay Time	$t_{d(\text{on})}$	$V_{DD} = 12.5 \text{ V}$, $I_D = 32 \text{ A}$		27		ns
Rise Time	t_r	$V_{GS} = 10 \text{ V}$		38		ns
Turn-off Delay Time	$t_{d(\text{off})}$	$R_G = 10 \Omega$		107		ns
Fall Time	t_f			54		ns
Total Gate Charge	Q_G	$V_{DD} = 20 \text{ V}$		88		nC
Gate to Source Charge	Q_{GS}	$V_{GS} = 10 \text{ V}$		16		nC
Gate to Drain Charge	Q_{GD}	$I_D = 64 \text{ A}$		30		nC
Body Diode Forward Voltage ^{Note}	$V_{F(S-D)}$	$I_F = 64 \text{ A}$, $V_{GS} = 0 \text{ V}$		0.91		V
Reverse Recovery Time	t_{rr}	$I_F = 64 \text{ A}$, $V_{GS} = 0 \text{ V}$		43		ns
Reverse Recovery Charge	Q_{rr}	$di/dt = 100 \text{ A}/\mu\text{s}$		52		nC

Note Pulsed

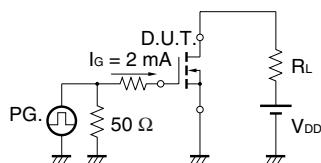
TEST CIRCUIT 1 AVALANCHE CAPABILITY

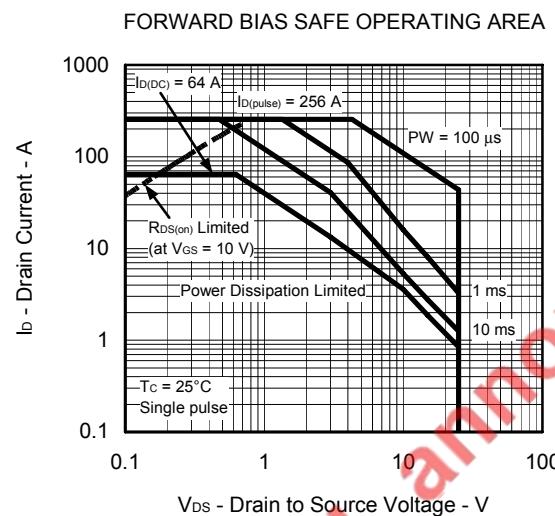
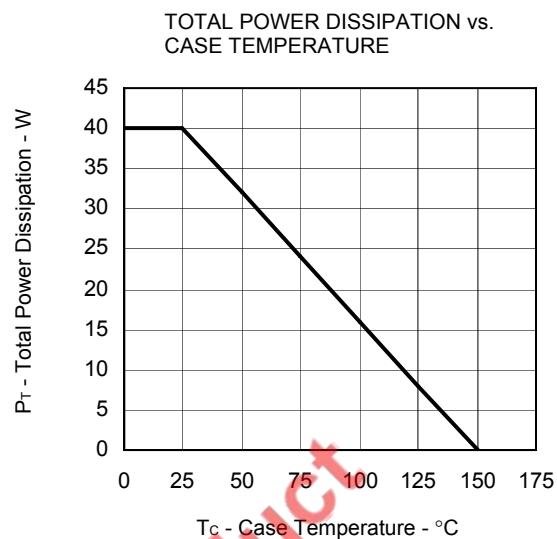
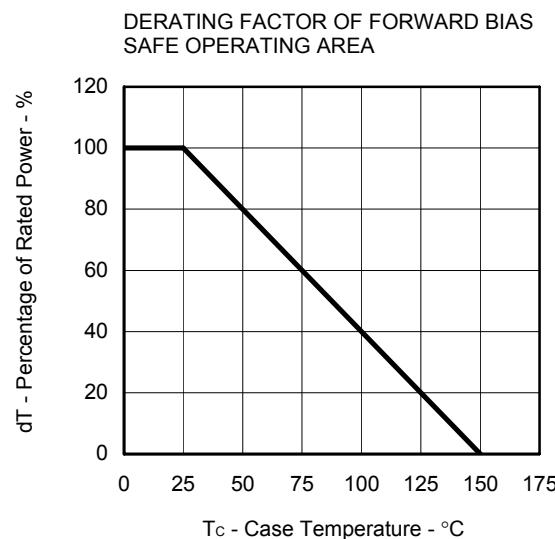


TEST CIRCUIT 2 SWITCHING TIME

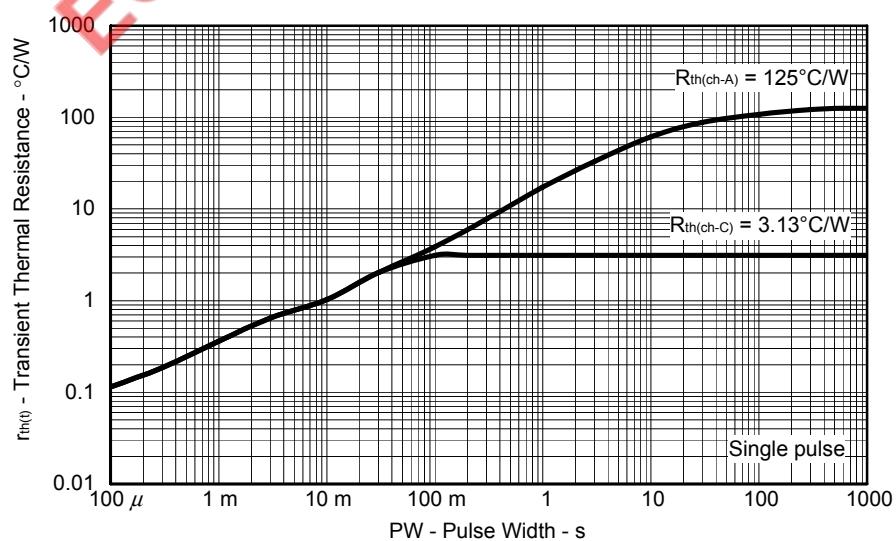


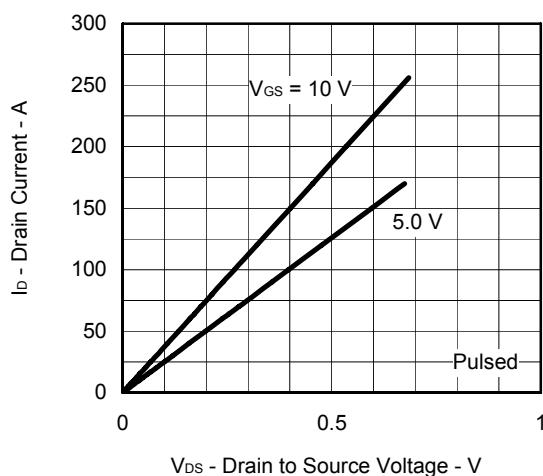
TEST CIRCUIT 3 GATE CHARGE



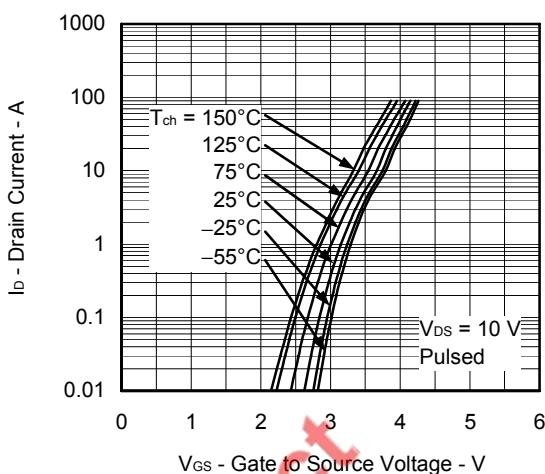
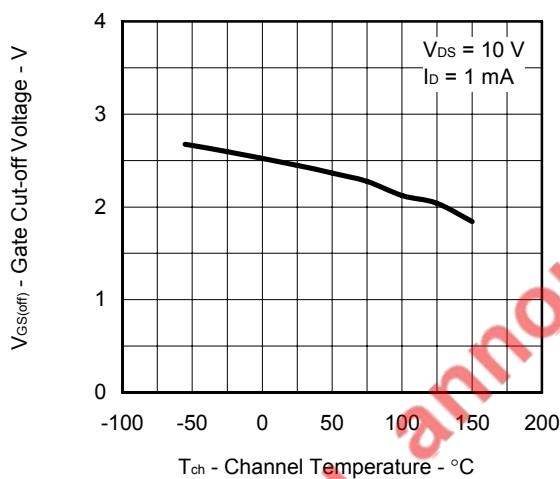
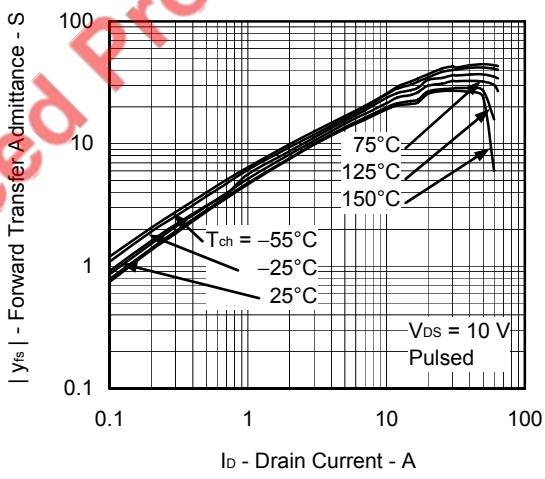
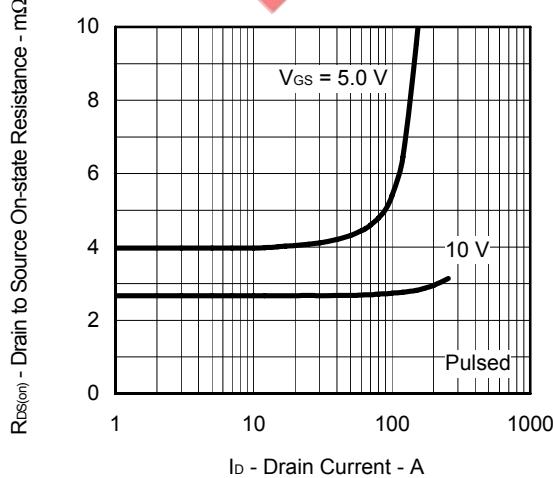
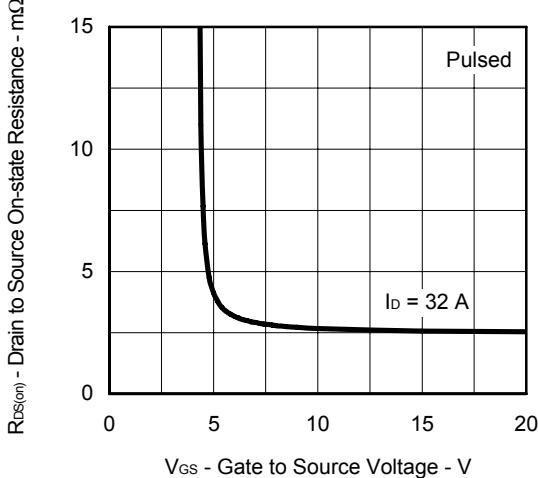
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

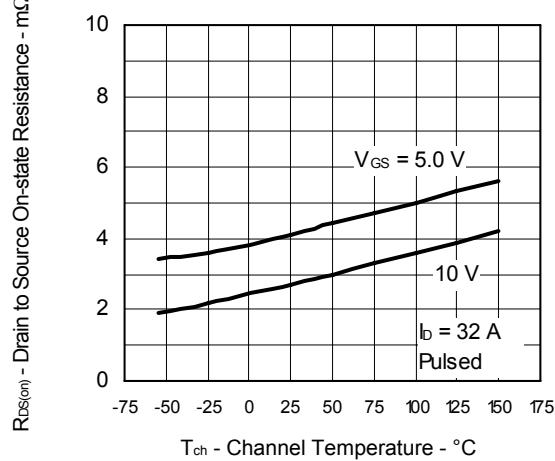


DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE

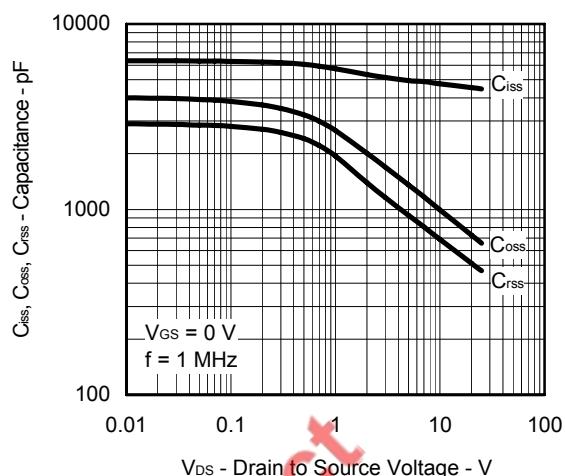
FORWARD TRANSFER CHARACTERISTICS

GATE CUT-OFF VOLTAGE vs.
CHANNEL TEMPERATUREFORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENTDRAIN TO SOURCE ON-STATE RESISTANCE vs.
DRAIN CURRENTDRAIN TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE

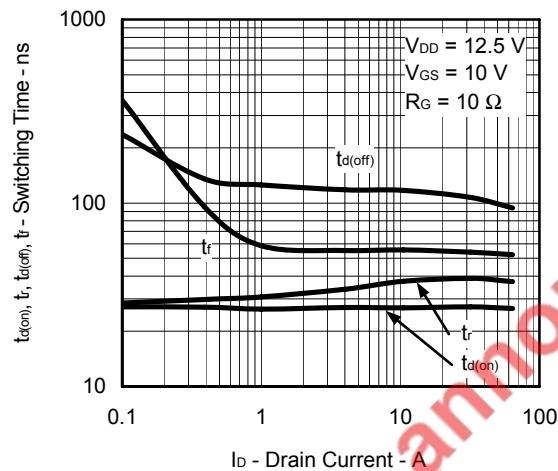
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
CHANNEL TEMPERATURE



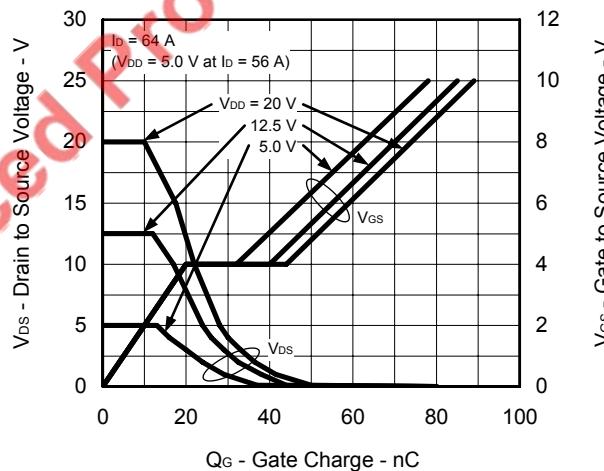
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



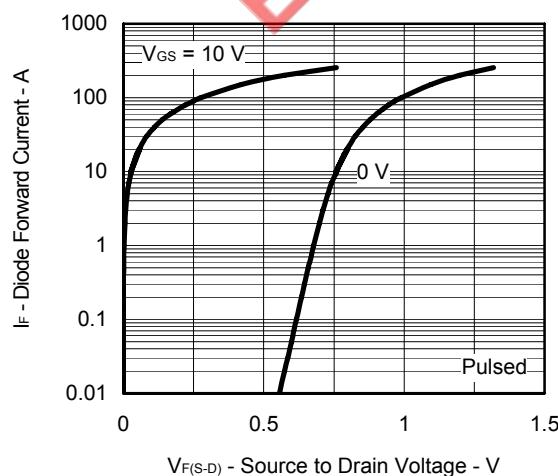
SWITCHING CHARACTERISTICS



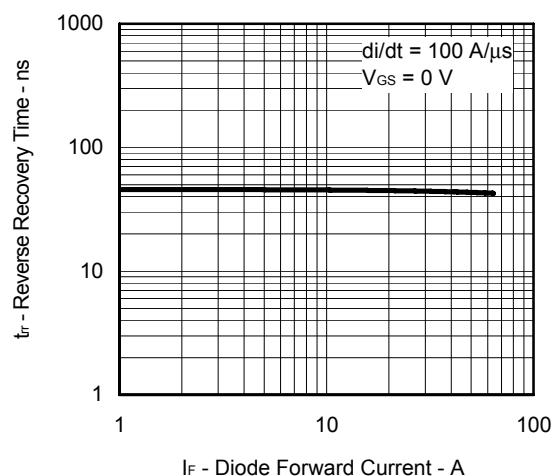
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



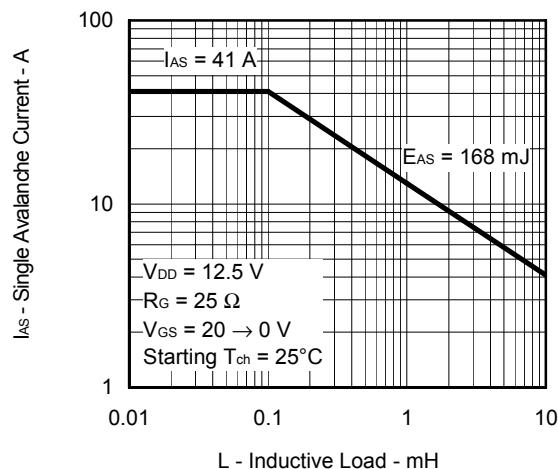
SOURCE TO DRAIN DIODE FORWARD VOLTAGE



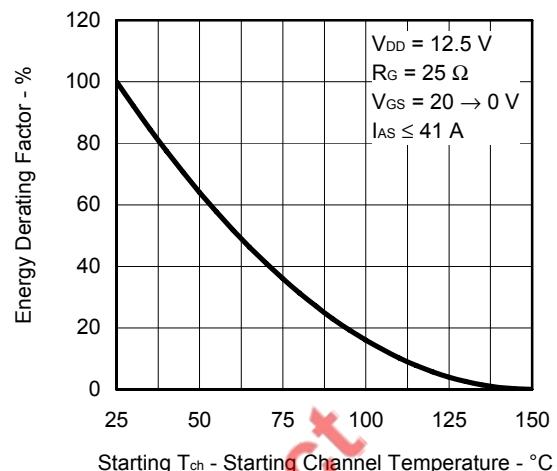
REVERSE RECOVERY TIME vs.
DIODE FORWARD CURRENT



SINGLE AVALANCHE CURRENT vs.
INDUCTIVE LOAD

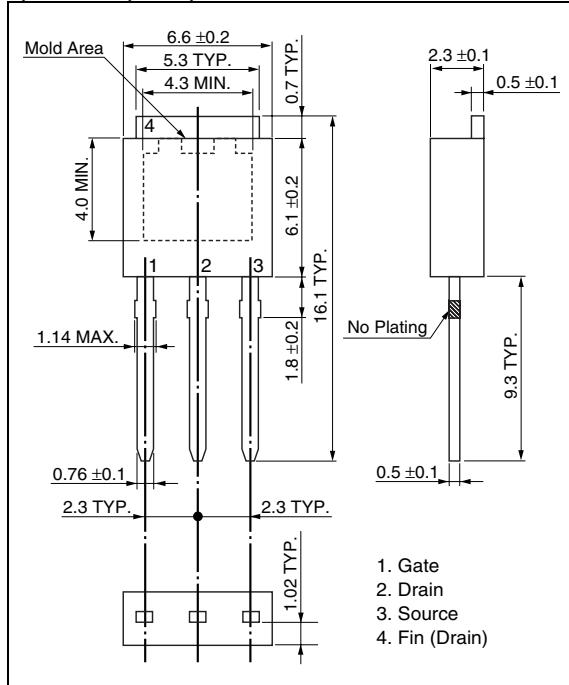


SINGLE AVALANCHE ENERGY
DERATING FACTOR

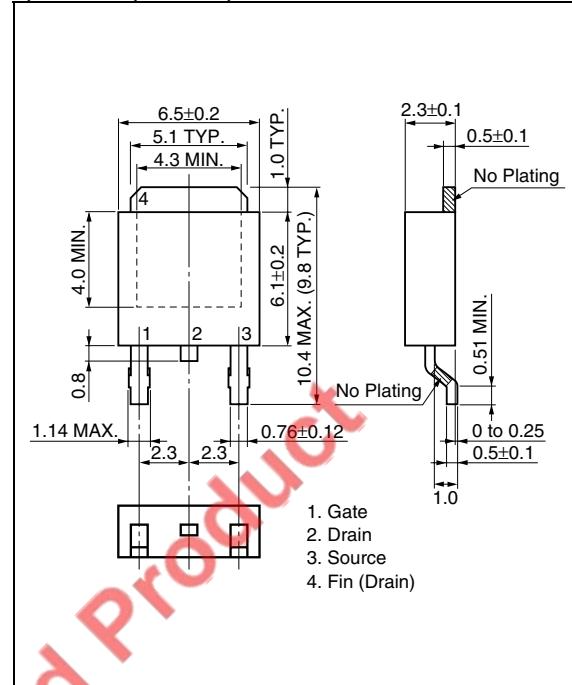


PACKAGE DRAWINGS (Unit: mm)

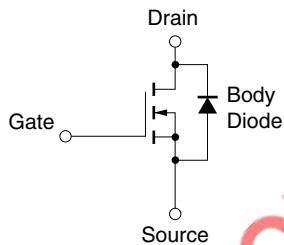
1) TO-251 (MP-3)



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.

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