

To our customers,

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## Old Company Name in Catalogs and Other Documents

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

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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

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## SWITCHING

### N-CHANNEL POWER MOS FET

#### DESCRIPTION

The 2SK3813 is N-channel MOS Field Effect Transistor designed for high current switching applications.

#### FEATURES

- Super low on-state resistance  
 $R_{DS(on)1} = 5.3 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 30 \text{ A)}$   
 $R_{DS(on)2} = 7.1 \text{ m}\Omega \text{ MAX. (} V_{GS} = 4.5 \text{ V, } I_D = 30 \text{ A)}$
- Low  $C_{iss}$ :  $C_{iss} = 5500 \text{ pF TYP.}$

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

Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )	$V_{DSS}$	40	V
Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )	$V_{GSS}$	$\pm 20$	V
Drain Current (DC) ( $T_C = 25^\circ\text{C}$ )	$I_{D(DC)}$	$\pm 60$	A
Drain Current (pulse) <sup>Note1</sup>	$I_{D(pulse)}$	$\pm 240$	A
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{T1}$	84	W
Total Power Dissipation ( $T_A = 25^\circ\text{C}$ )	$P_{T2}$	1.0	W
Channel Temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Avalanche Energy <sup>Note2</sup>	$E_{AS}$	137	mJ
Repetitive Avalanche Current <sup>Note3</sup>	$I_{AR}$	37	A
Repetitive Avalanche Energy <sup>Note3</sup>	$E_{AR}$	137	mJ

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

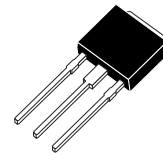
**2.** Starting  $T_{ch} = 25^\circ\text{C}$ ,  $V_{DD} = 20 \text{ V}$ ,  $R_G = 25 \Omega$ ,  $V_{GS} = 20 \rightarrow 0 \text{ V}$ ,  $L = 100 \mu\text{H}$

**3.**  $T_{ch(peak)} \leq 150^\circ\text{C}$ ,  $R_G = 25 \Omega$

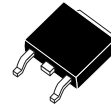
#### ORDERING INFORMATION

PART NUMBER	PACKAGE
2SK3813	TO-251 (MP-3)
2SK3813-Z	TO-252 (MP-3Z)

(TO-251)



(TO-252)



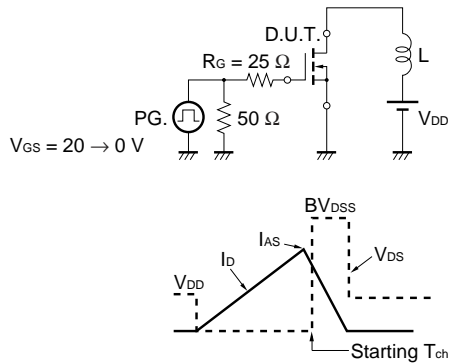
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**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)**

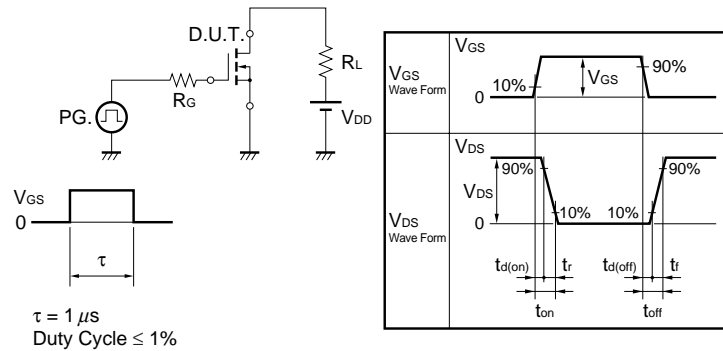
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 40 V, V <sub>GS</sub> = 0 V			10	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±100	nA
Gate Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	1.5	2.0	2.5	V
Forward Transfer Admittance <b>Note</b>	y <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 30 A	21	42		S
Drain to Source On-state Resistance <b>Note</b>	R <sub>DS(on)1</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 30 A		4.2	5.3	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 30 A		5.3	7.1	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 10 V		5500		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V		740		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		490		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 20 V, I <sub>D</sub> = 30 A		25		ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = 10 V		8.5		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		81		ns
Fall Time	t <sub>f</sub>			10		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 32 V		96		nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 10 V		18		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 60 A		23.5		nC
Body Diode Forward Voltage <b>Note</b>	V <sub>F(S-D)</sub>	I <sub>F</sub> = 60 A, V <sub>GS</sub> = 0 V		0.94	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 60 A, V <sub>GS</sub> = 0 V		35		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		31		nC

**Note** Pulsed

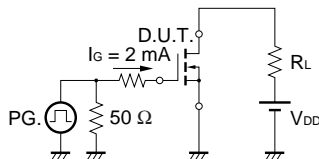
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



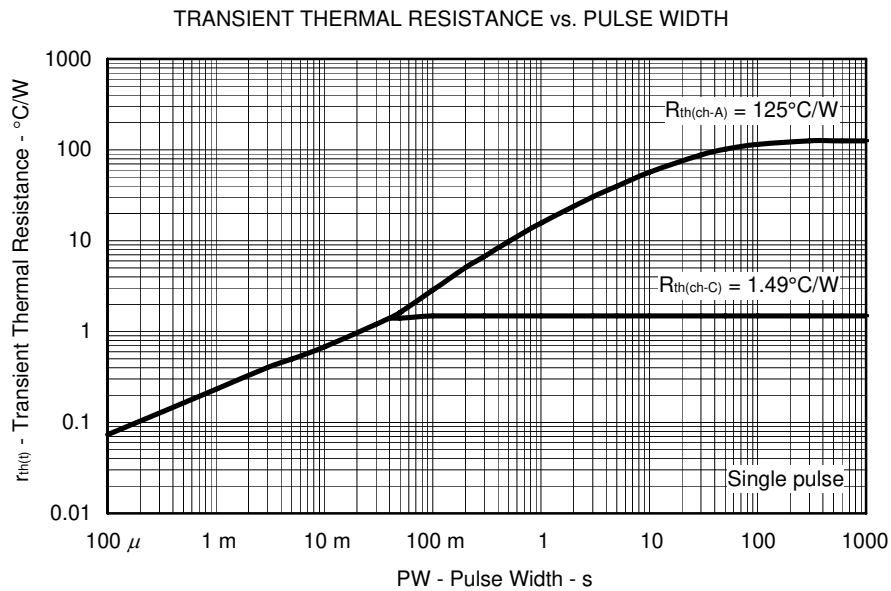
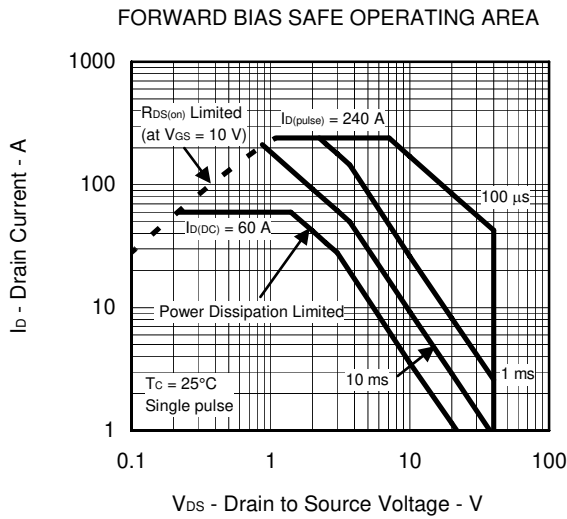
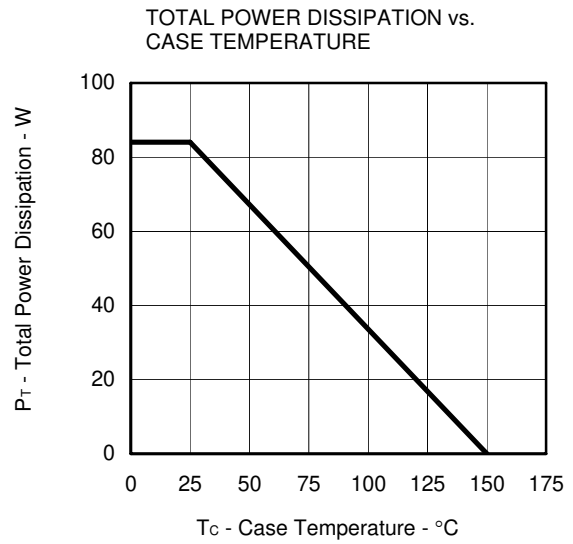
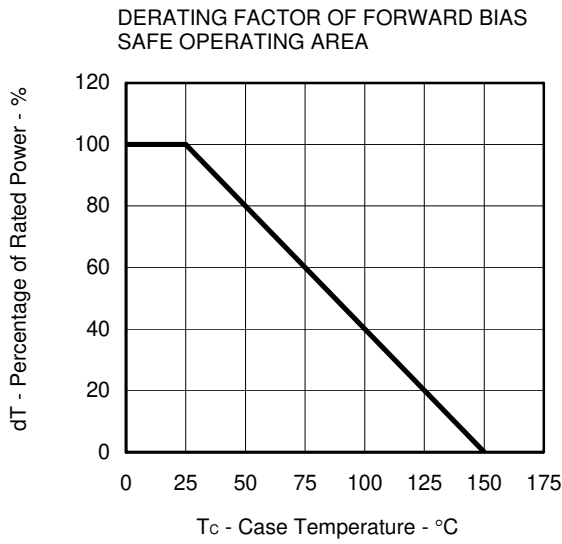
**TEST CIRCUIT 2 SWITCHING TIME**



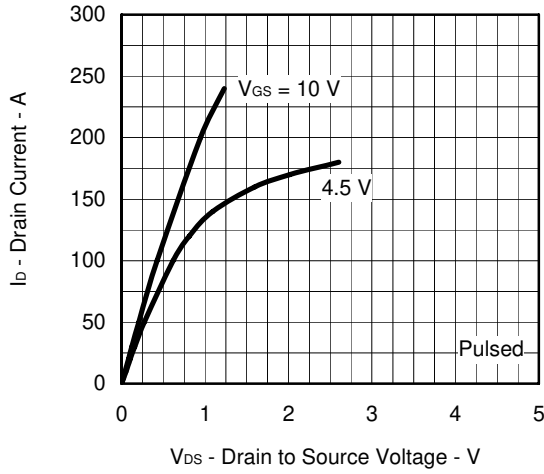
**TEST CIRCUIT 3 GATE CHARGE**



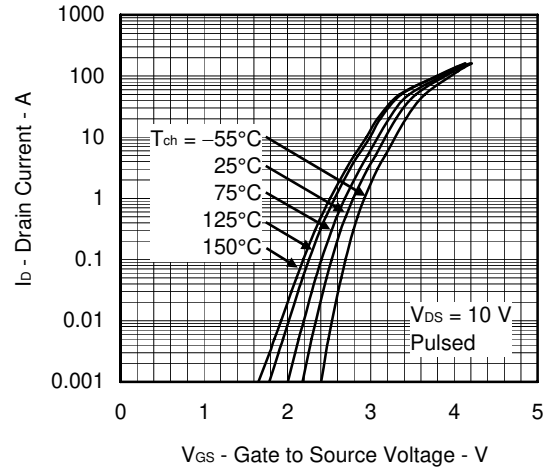
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



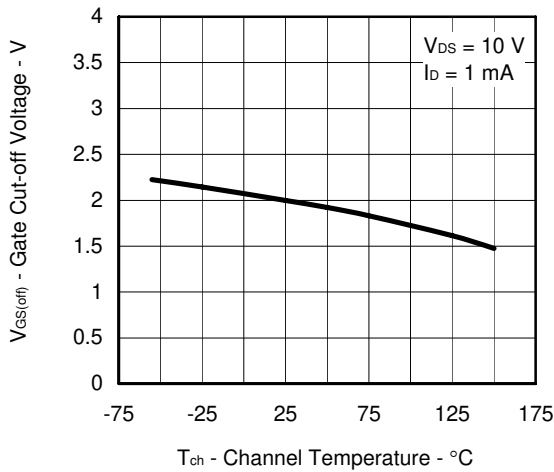
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



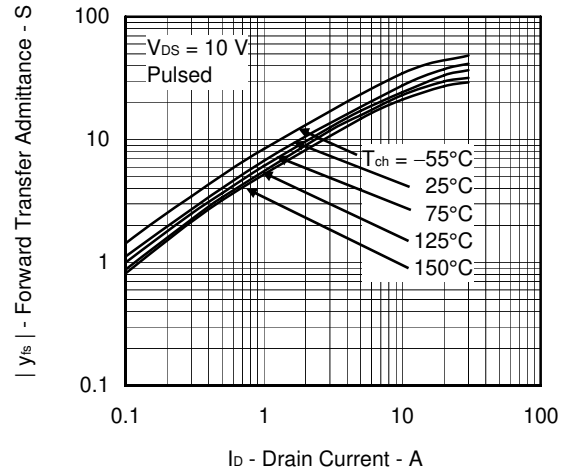
FORWARD TRANSFER CHARACTERISTICS



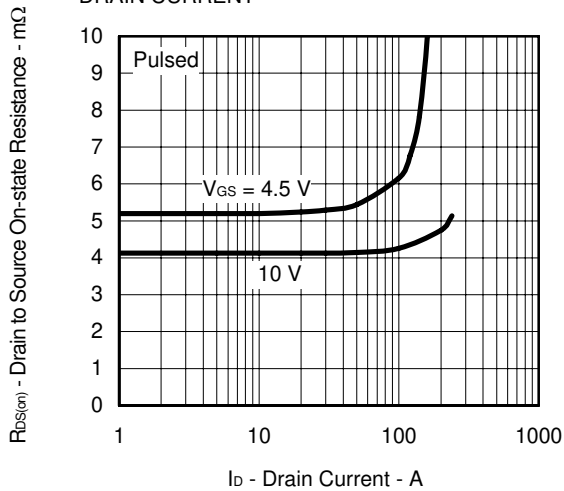
GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



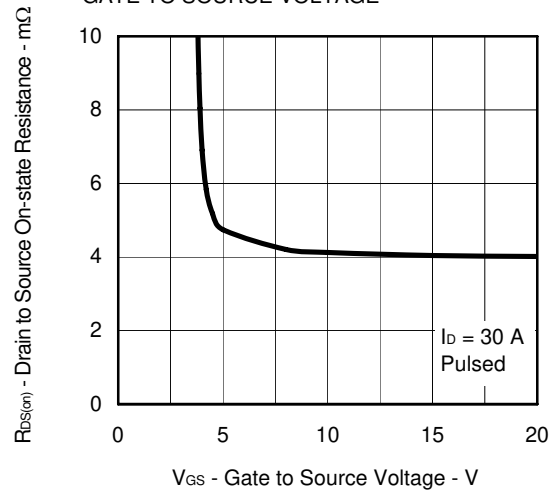
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



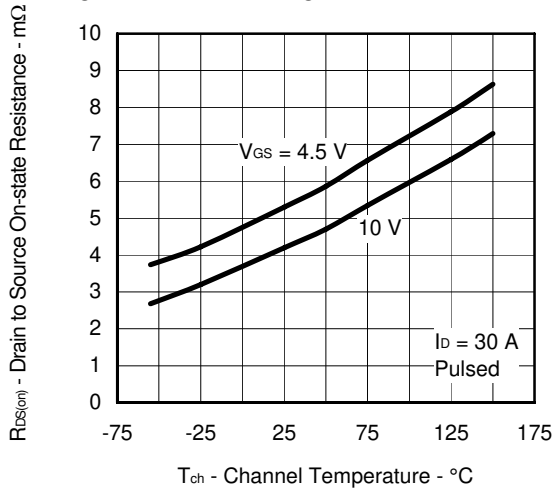
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



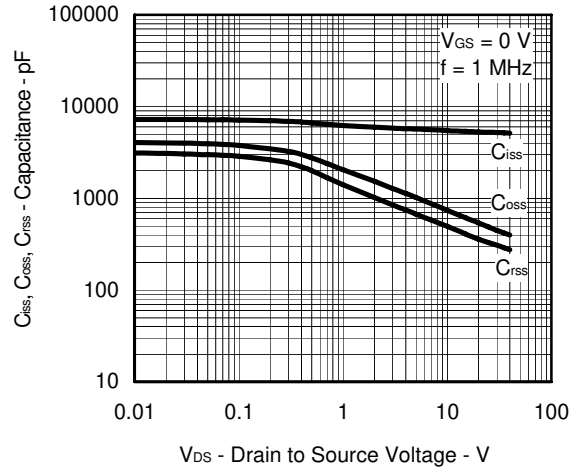
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



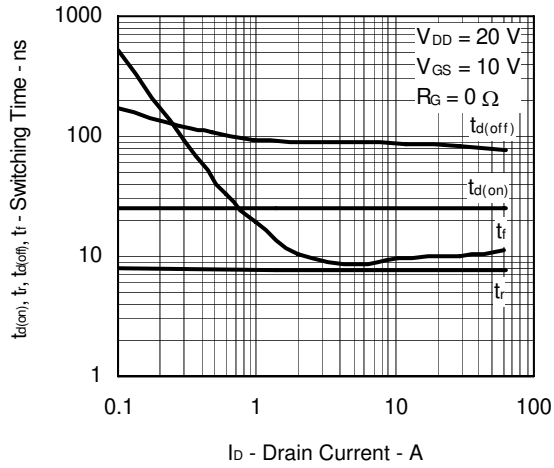
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



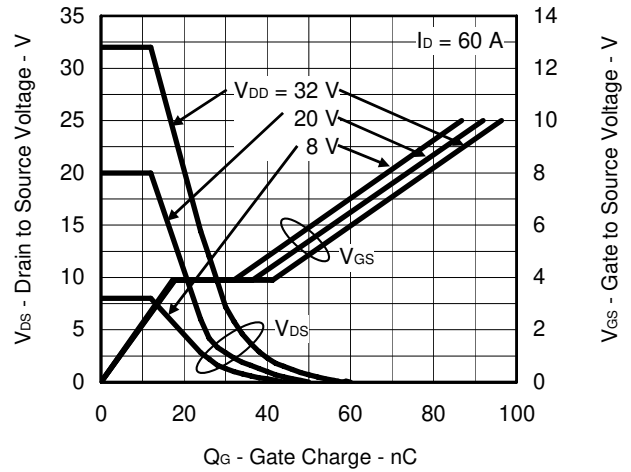
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



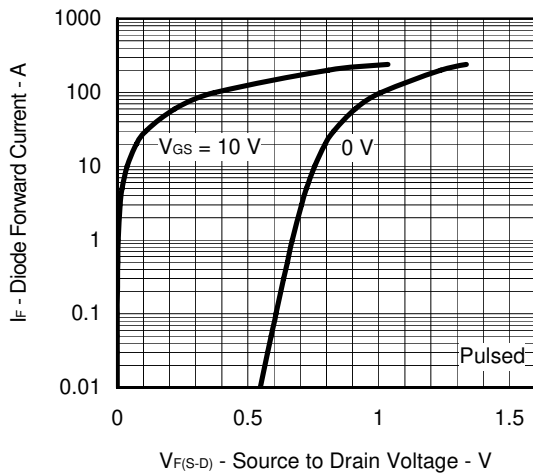
SWITCHING CHARACTERISTICS



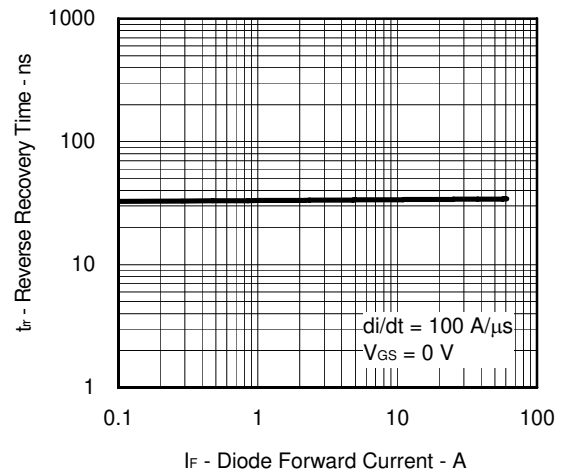
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



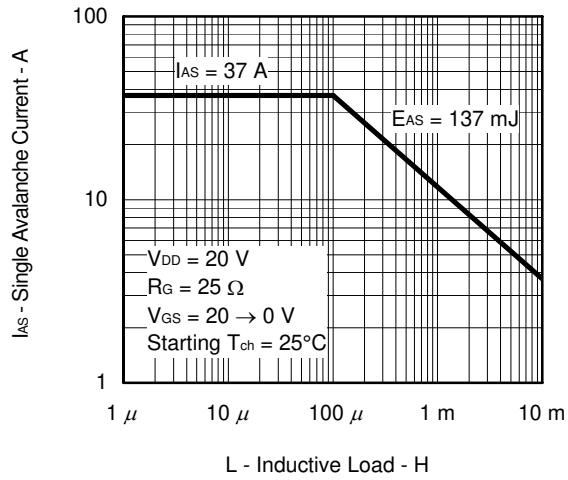
SOURCE TO DRAIN DIODE FORWARD VOLTAGE



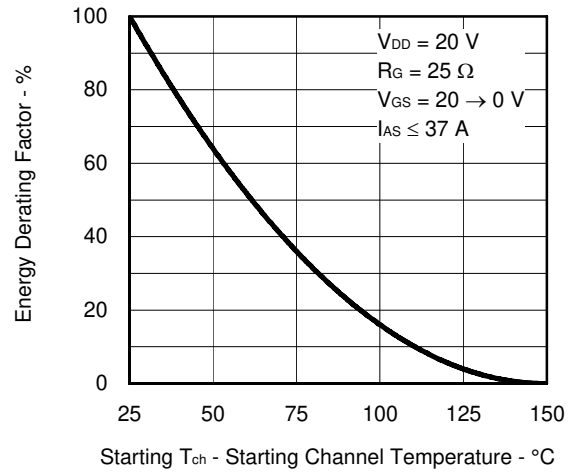
REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



SINGLE AVALANCHE CURRENT vs. INDUCTIVE LOAD



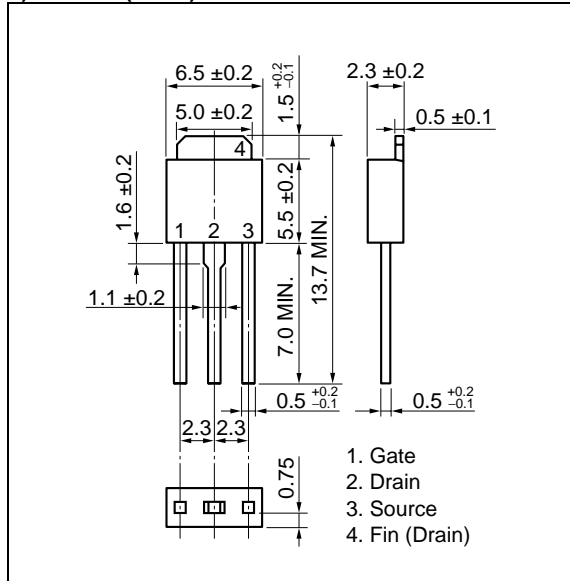
SINGLE AVALANCHE ENERGY DERATING FACTOR



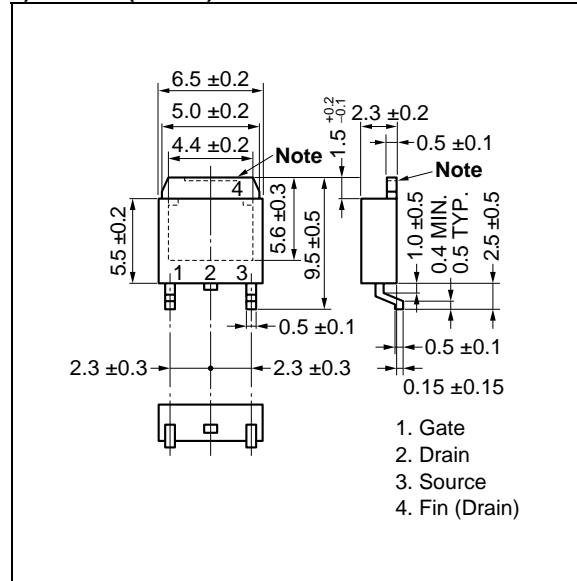


PACKAGE DRAWINGS (Unit: mm)

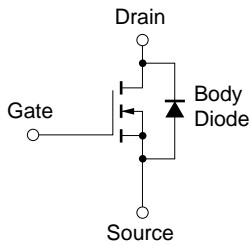
1) TO-251 (MP-3)



<R> 2) TO-252 (MP-3Z)



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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