

### SWITCHING N-CHANNEL POWER MOSFET

#### DESCRIPTION

The 2SK4057 is N-channel MOSFET 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

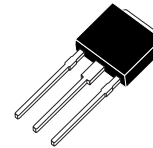
- Low on-state resistance  
 $R_{DS(on)1} = 15.0 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 15 \text{ A)}$
- Low  $Q_{GD}$ :  $Q_{GD} = 2.8 \text{ nC TYP.}$
- 4.5 V drive available

#### ORDERING INFORMATION

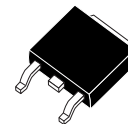
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PART NUMBER	PACKAGE
2SK4057(1)-S27-AY <sup>Note</sup>	TO-251 (MP-3-b)
2SK4057-ZK-E1-AY <sup>Note</sup>	TO-252 (MP-3ZK)
2SK4057-ZK-E2-AY <sup>Note</sup>	TO-252 (MP-3ZK)

(TO-251)



(TO-252)



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

#### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C)

Drain to Source Voltage (V <sub>GS</sub> = 0 V)	V <sub>DSS</sub>	25	V
Gate to Source Voltage (V <sub>DS</sub> = 0 V)	V <sub>GSS</sub>	±20	V
Drain Current (DC) (T <sub>C</sub> = 25°C)	I <sub>D(DC)</sub>	±30	A
Drain Current (pulse) <sup>Note1</sup>	I <sub>D(pulse)</sub>	±100	A
Total Power Dissipation (T <sub>C</sub> = 25°C)	P <sub>T1</sub>	19	W
Total Power Dissipation	P <sub>T2</sub>	1.0	W
Channel Temperature	T <sub>ch</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-55 to +150	°C
Single Avalanche Current <sup>Note2</sup>	I <sub>AS</sub>	17	A
Single Avalanche Energy <sup>Note2</sup>	E <sub>AS</sub>	28.9	mJ

**Notes** 1. PW ≤ 10 μs, Duty Cycle ≤ 1%

2. Starting T<sub>ch</sub> = 25°C, V<sub>DD</sub> = 12 V, R<sub>G</sub> = 25 Ω, V<sub>GS</sub> = 20 → 0 V, L = 100 μH

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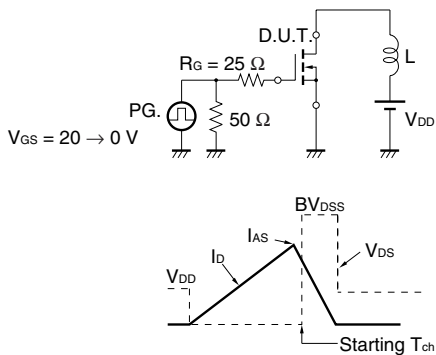
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**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)**

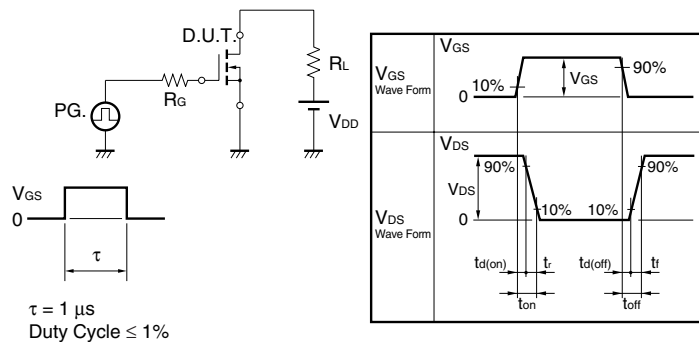
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>bss</sub>	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V			10	μA
Gate Leakage Current	I <sub>gss</sub>	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±100	nA
Gate Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	1.5	2.1	2.5	V
Forward Transfer Admittance <sup>Note</sup>	y <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 7.5 A	5	9.4		S
Drain to Source On-state Resistance <sup>Note</sup>	R <sub>DS(on)1</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 15 A		11.4	15.0	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 15 A		18.5	25.0	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 10 V		720		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V		210		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		90		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 12 V, I <sub>D</sub> = 15 A		7.1		ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = 10 V		3.3		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 3 Ω		23		ns
Fall Time	t <sub>f</sub>			5.1		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 12 V		14.5		nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 12 V		1.9		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 30 A		2.8		nC
Gate Resistance	R <sub>G</sub>			3.4		Ω
Body Diode Forward Voltage <sup>Note</sup>	V <sub>F(S-D)</sub>	I <sub>F</sub> = 30 A, V <sub>GS</sub> = 0 V		0.95	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 30 A, V <sub>GS</sub> = 0 V		26		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		22		nC

**Note** Pulsed

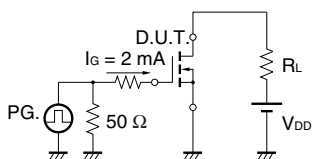
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



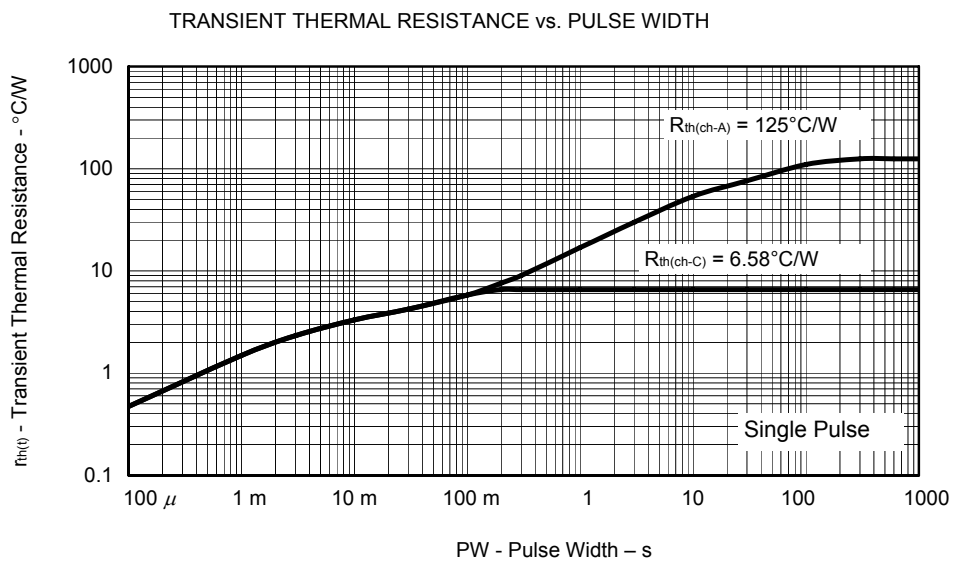
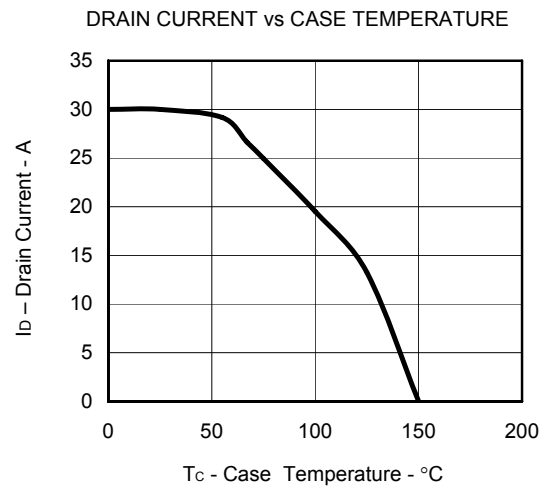
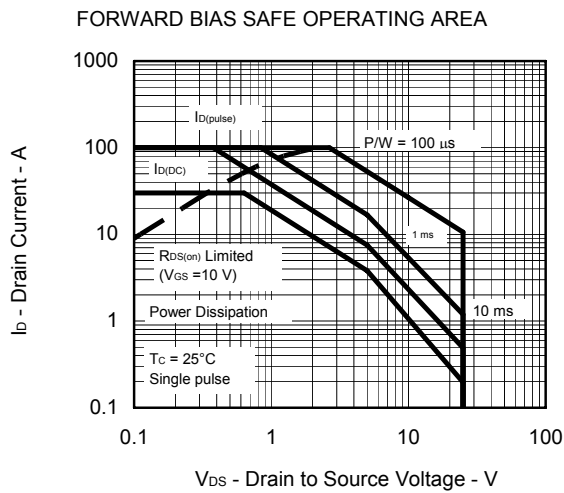
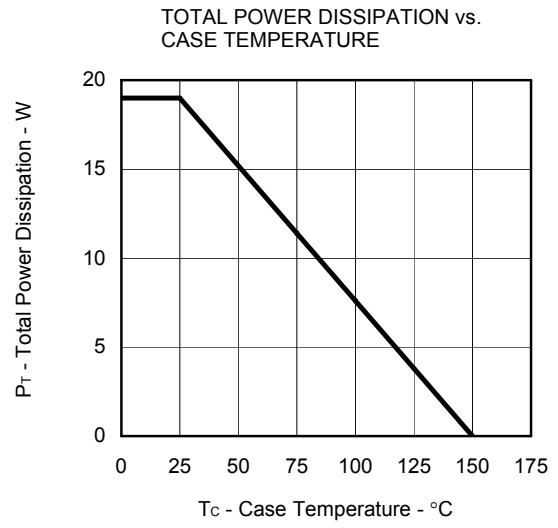
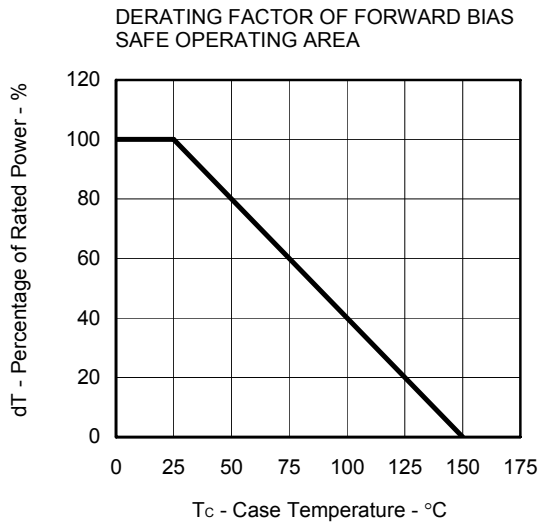
**TEST CIRCUIT 2 SWITCHING TIME**



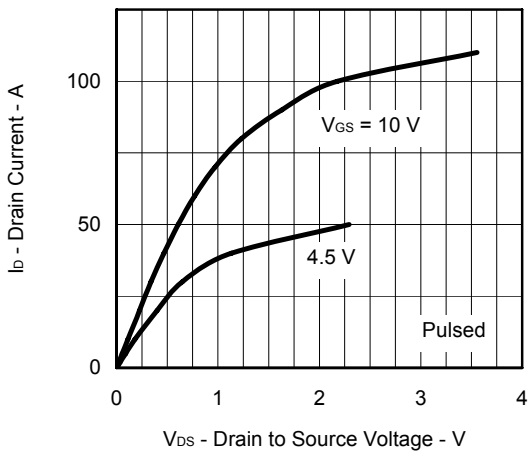
**TEST CIRCUIT 3 GATE CHARGE**



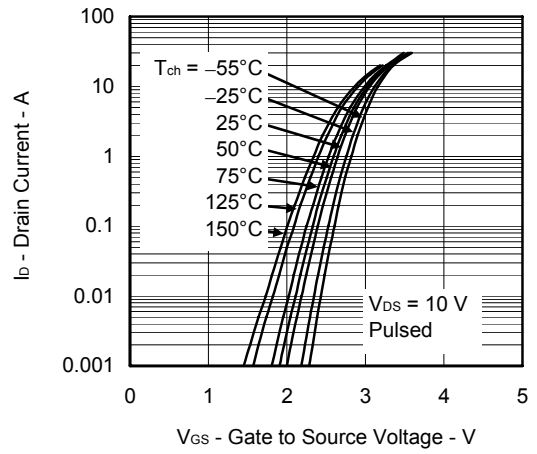
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



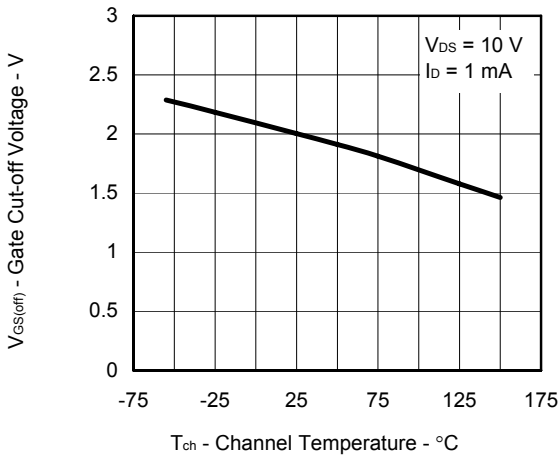
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



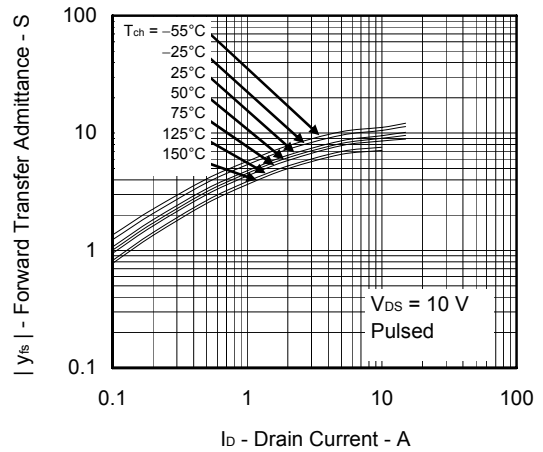
FORWARD TRANSFER CHARACTERISTICS



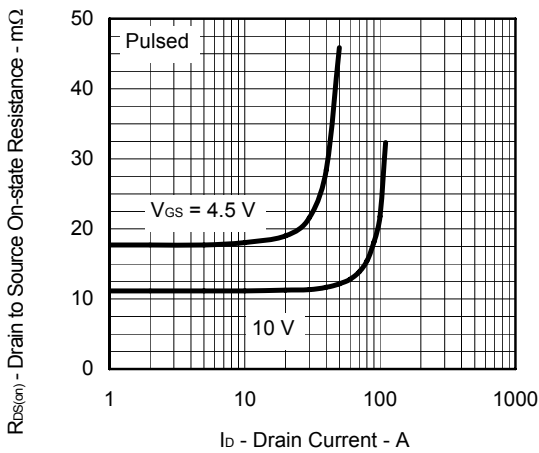
GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



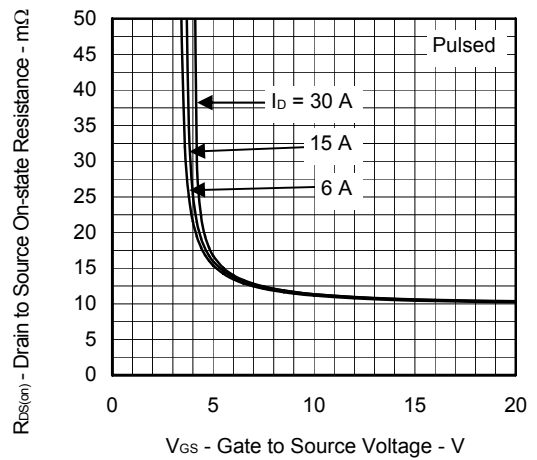
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT

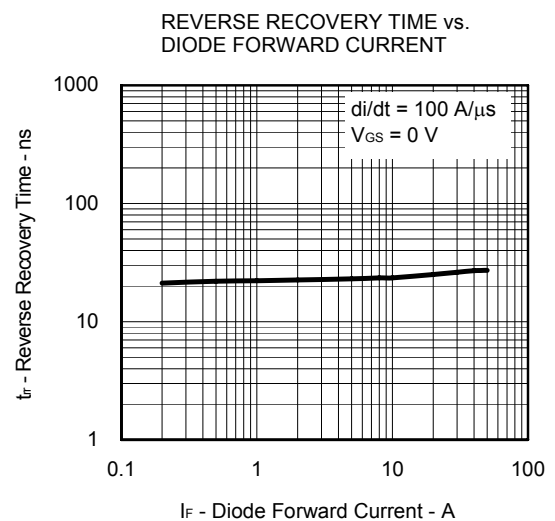
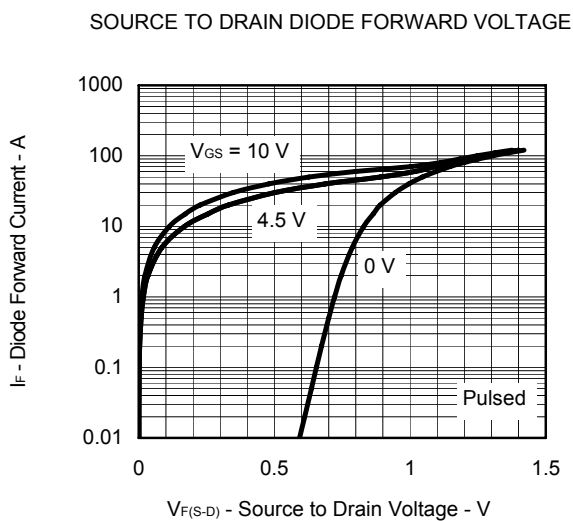
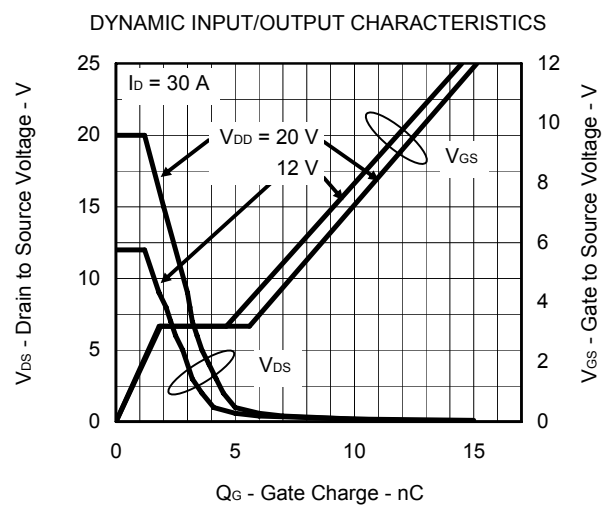
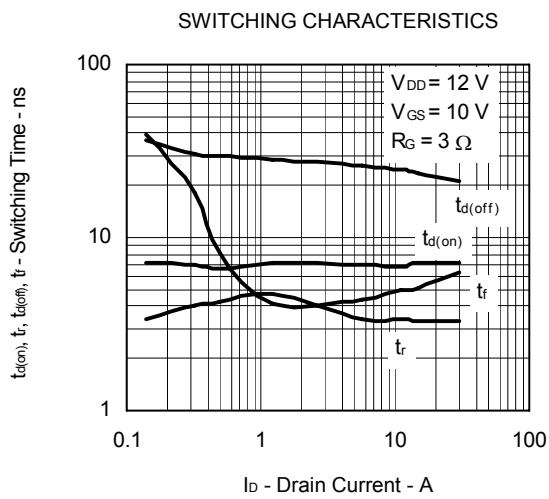
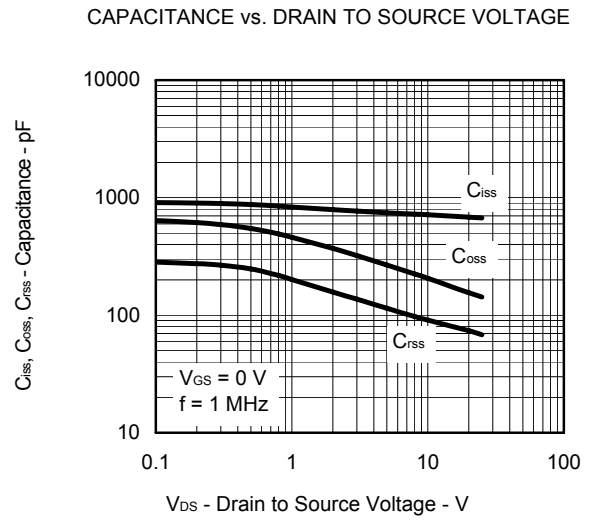
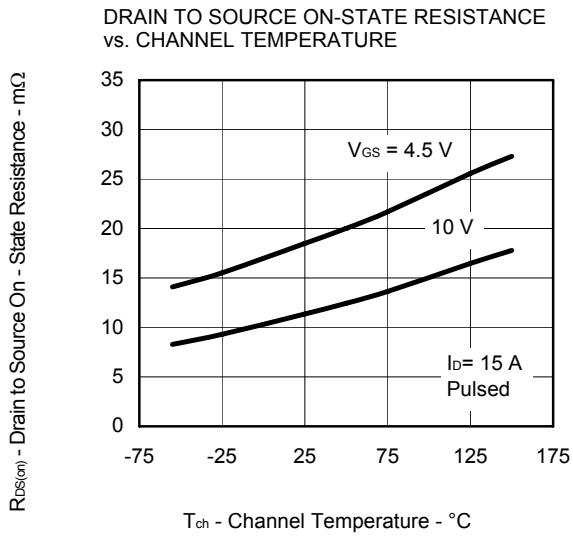


DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

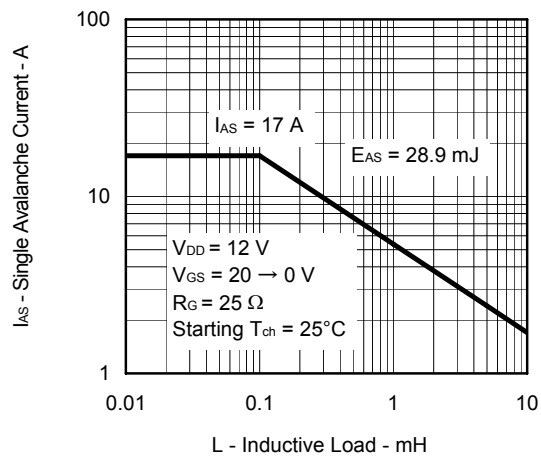


DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE

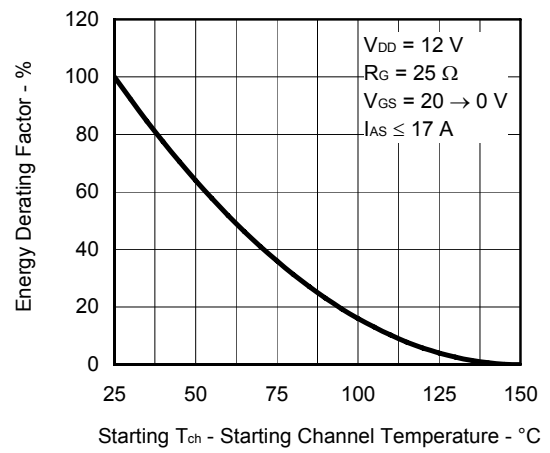




SINGLE AVALANCHE CURRENT vs. INDUCTIVE LOAD



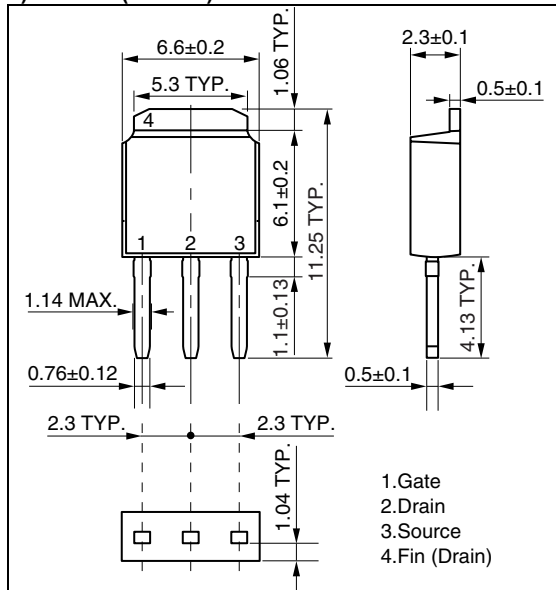
SINGLE AVALANCHE ENERGY DERATING FACTOR



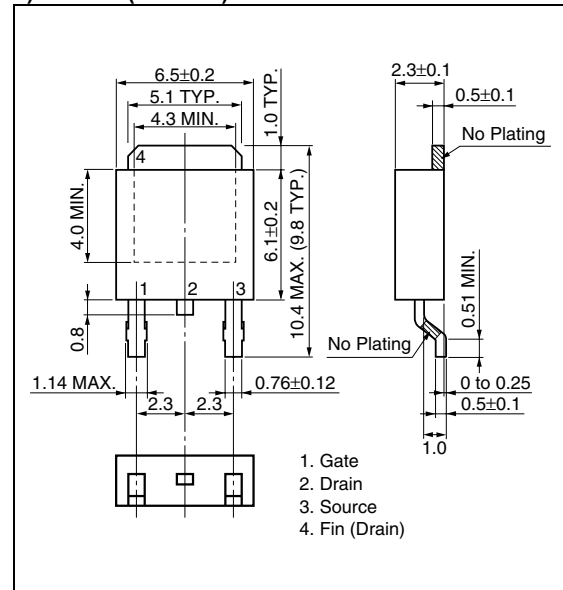
PACKAGE DRAWINGS (Unit: mm)

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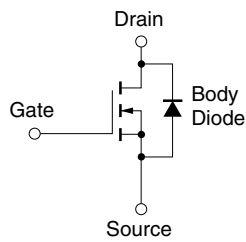
1) TO-251 (MP-3-b)



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.

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