

## SWITCHING N-CHANNEL POWER MOS FET INDUSTRIAL USE

### DESCRIPTION

The 2SK2141 is N-channel Power MOS Field Effect Transistor designed for high voltage switching applications.

### FEATURES

- Low On-state Resistance  
 $R_{DS(on)} = 1.1 \Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 3.0 \text{ A)}$
- Low  $C_{iss}$   $C_{iss} = 1150 \text{ pF TYP.}$
- High Avalanche Capability Ratings
- Isolated TO-220 (MP-45F) Package

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

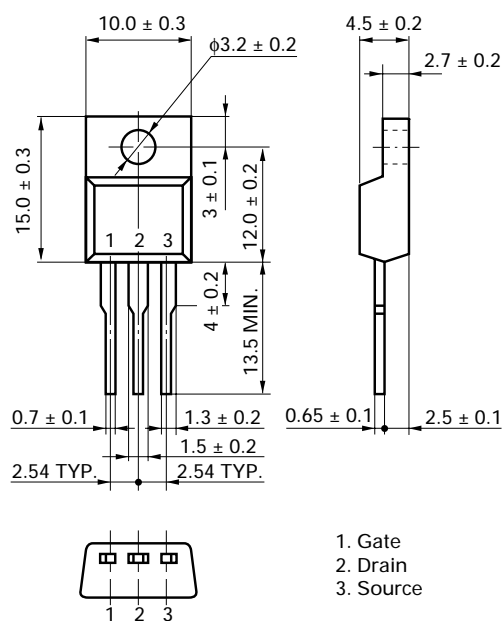
Drain to Source Voltage	$V_{DSS}$	600	V
Gate to Source Voltage	$V_{GSS}$	$\pm 30$	V
Drain Current (DC)	$I_D \text{ (DC)}$	$\pm 6.0$	A
Drain Current (pulse)	$I_D \text{ (pulse)}^*$	$\pm 24$	A
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{T1}$	35	W
Total Power Dissipation ( $T_A = 25^\circ\text{C}$ )	$P_{T2}$	2.0	W
Storage Temperature	$T_{stg}$	$-55 \text{ to } +150$	$^\circ\text{C}$
Channel Temperature	$T_{ch}$	150	$^\circ\text{C}$
Single Avalanche Current	$I_{AS}^{**}$	6.0	A
Single Avalanche Energy	$E_{AS}^{**}$	12	mJ

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

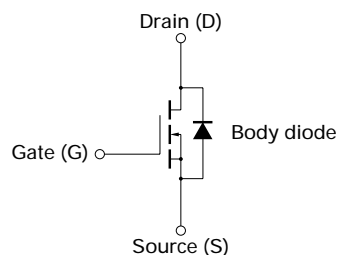
\*\*Starting  $T_{ch} = 25^\circ\text{C}$ ,  $R_G = 25 \Omega$ ,  $V_{GS} = 20 \text{ V} \rightarrow 0$

The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device is actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.

### PACKAGE DIMENSIONS (in millimeters)



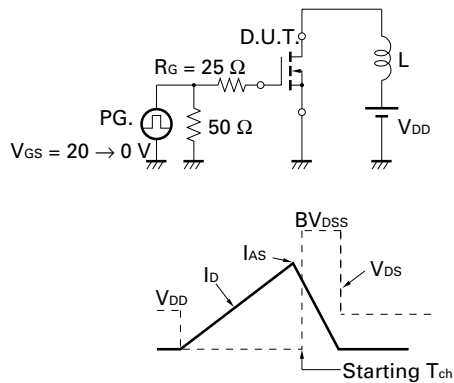
### ISOLATED TO-220 (MP-45F)



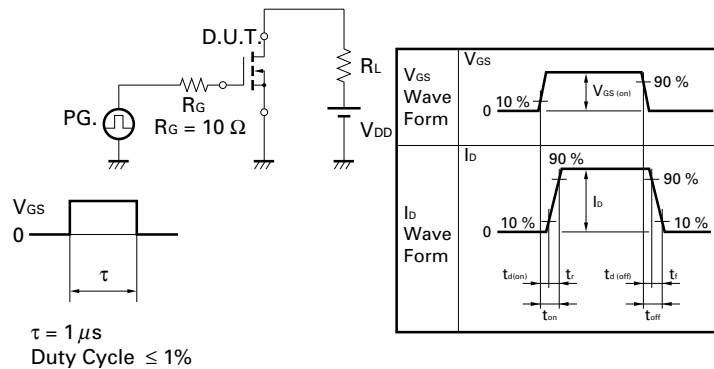
ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Drain to Source On-state Resistance	R <sub>DS(on)</sub>		0.8	1.1	Ω	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3.0 A
Gate to Source Cutoff Voltage	V <sub>GS(off)</sub>	2.5		3.5	V	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA
Forward Transfer Admittance	y <sub>fs</sub>	2.0			S	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 3.0 A
Drain Leakage Current	I <sub>DSS</sub>			100	μA	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0
Gate to Source Leakage Current	I <sub>GSS</sub>			±100	nA	V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0
Input Capacitance	C <sub>iss</sub>		1150		pF	V <sub>DS</sub> = 10 V V <sub>GS</sub> = 0 f = 1 MHz
Output Capacitance	C <sub>oss</sub>		260		pF	
Reverse Transfer Capacitance	C <sub>rss</sub>		60		pF	
Turn-On Delay Time	t <sub>d(on)</sub>		15		ns	V <sub>GS</sub> = 10 V V <sub>DD</sub> = 150 V I <sub>D</sub> = 3.0 A, R <sub>G</sub> = 10 Ω R <sub>L</sub> = 37.5 Ω
Rise Time	t <sub>r</sub>		15		ns	
Turn-Off Delay Time	t <sub>d(off)</sub>		75		ns	
Fall Time	t <sub>f</sub>		13		ns	
Total Gate Charge	Q <sub>G</sub>		40		nC	V <sub>GS</sub> = 10 V I <sub>D</sub> = 6.0 A V <sub>DD</sub> = 480 V
Gate to Source Charge	Q <sub>GS</sub>		6.0		nC	
Gate to Drain Charge	Q <sub>GD</sub>		20		nC	
Diode Forward Voltage	V <sub>F(S-D)</sub>		1.0		V	I <sub>F</sub> = 6.0 A, V <sub>GS</sub> = 0
Reverse Recovery Time	t <sub>rr</sub>		370		ns	I <sub>F</sub> = 6.0 A di/dt = 50 A/μs
Reverse Recovery Charge	Q <sub>rr</sub>		1.5		μC	

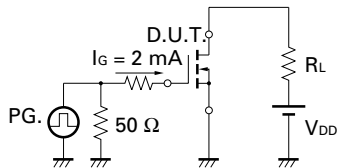
Test Circuit 1: Avalanche Capability



Test Circuit 2: Switching Time

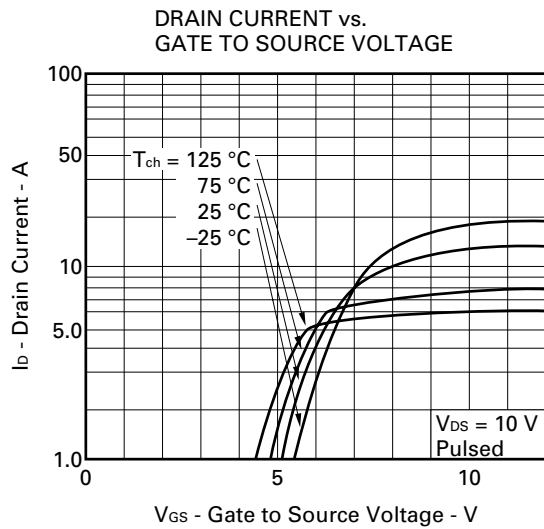
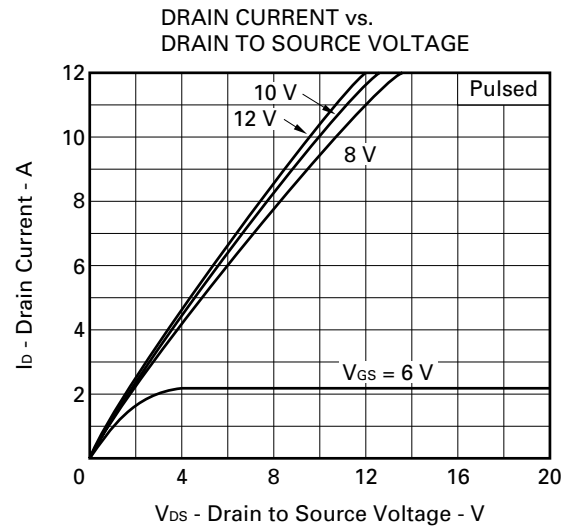
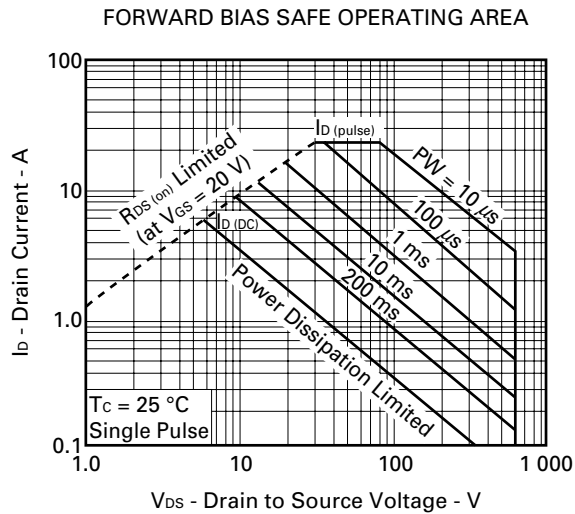
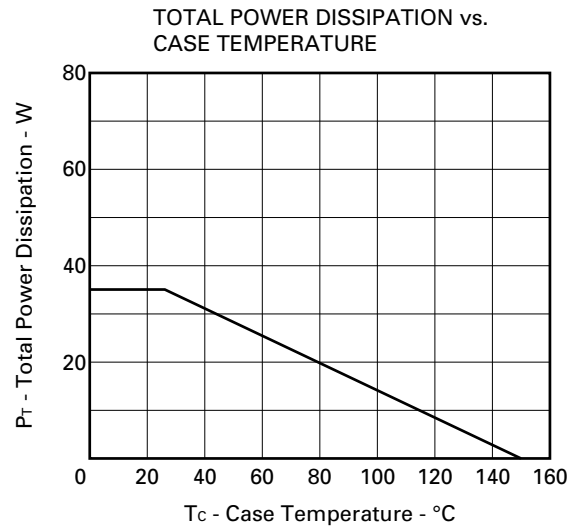
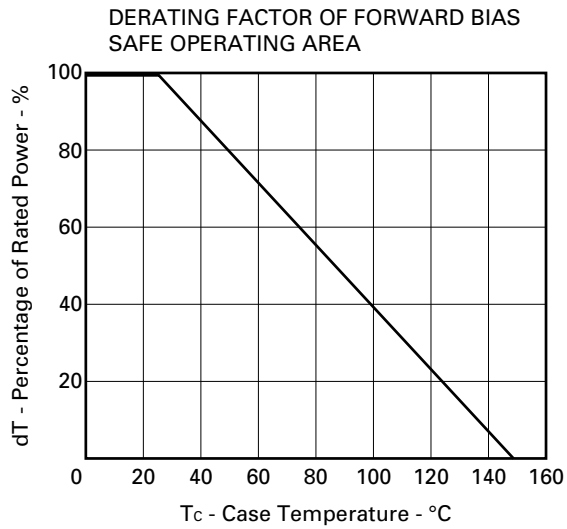


Test Circuit 3: Gate Charge

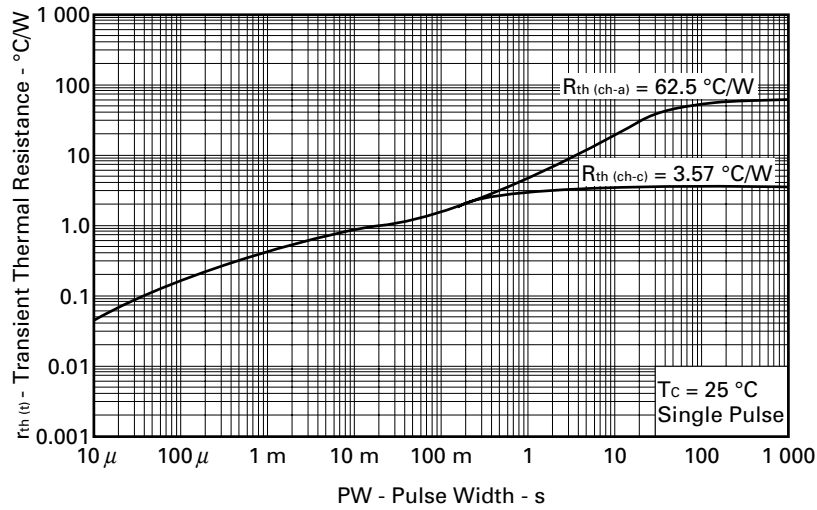


The application circuits and their parameters are for references only and are not intended for use in actual design-in's.

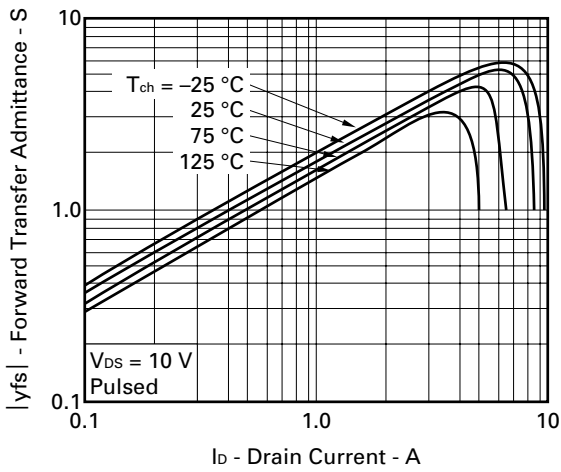
TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$ )



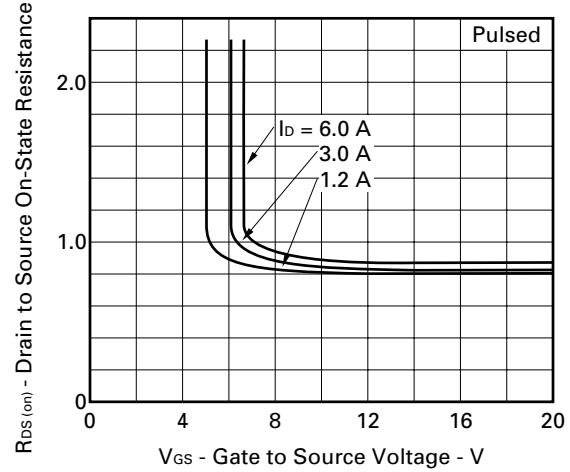
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



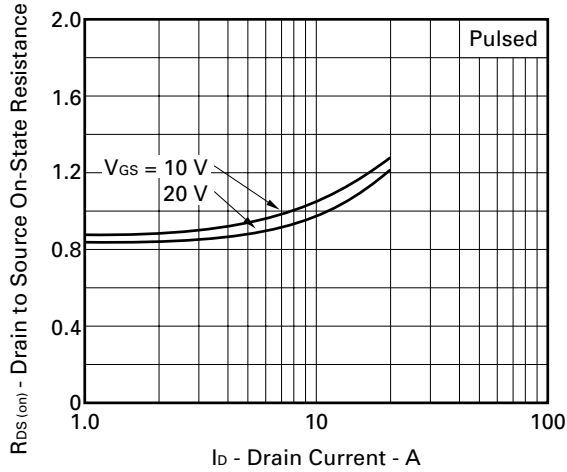
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



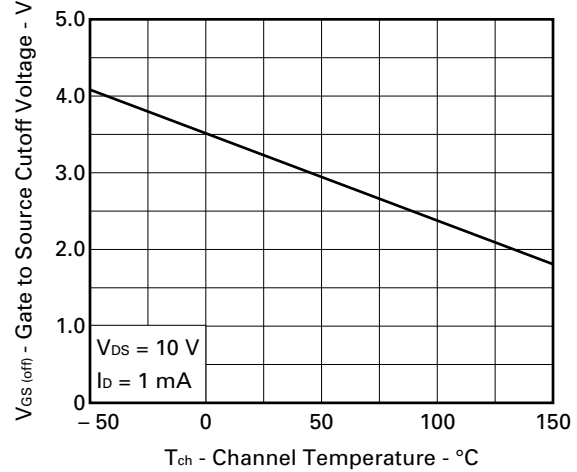
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE

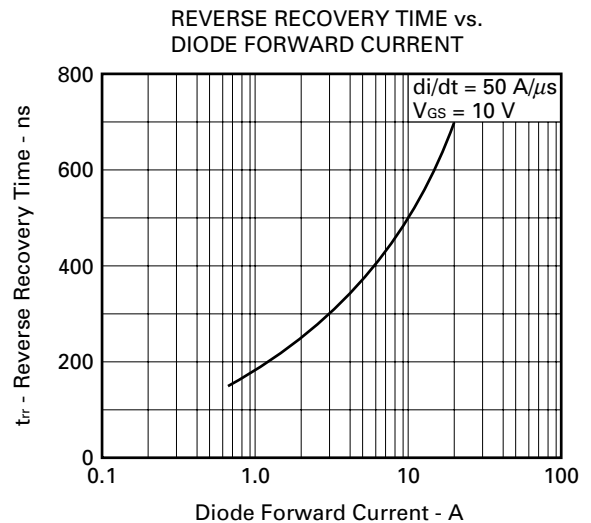
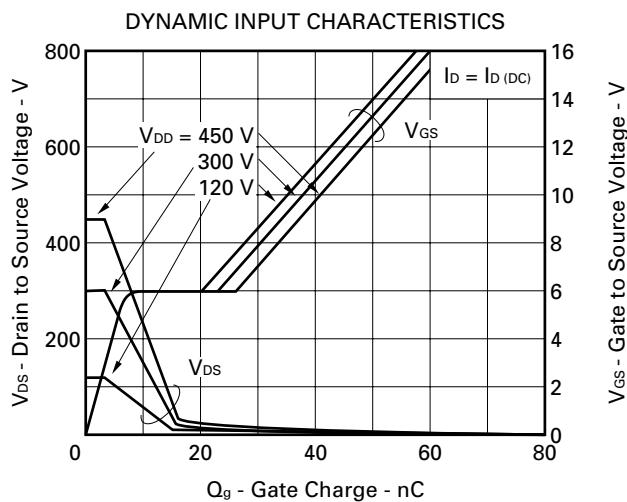
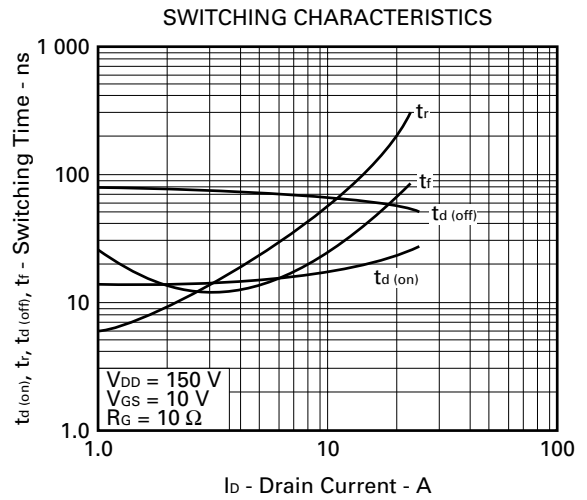
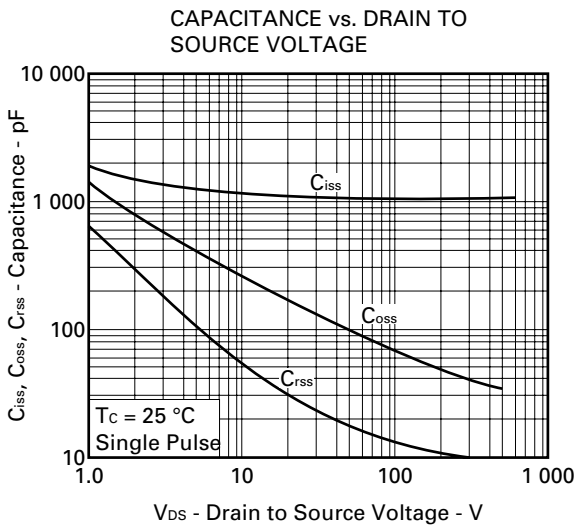
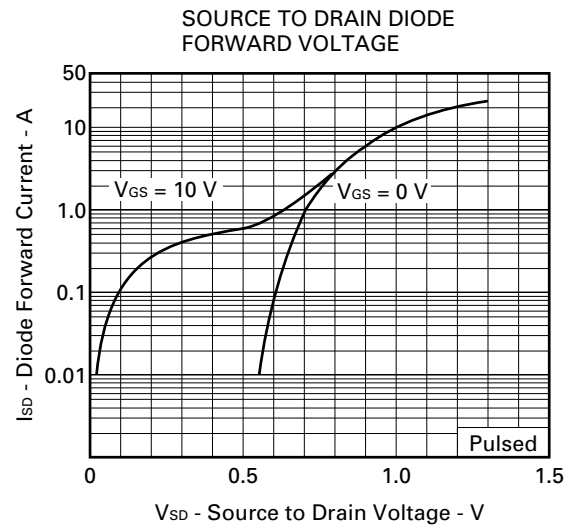
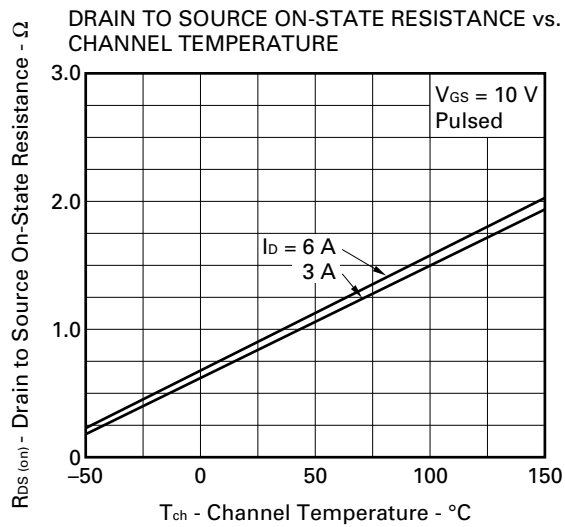


DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

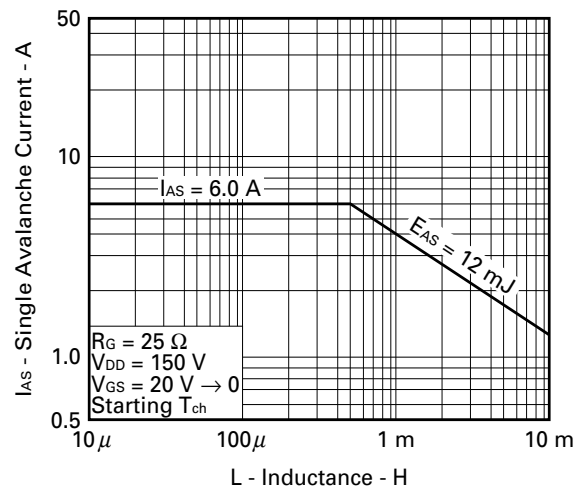


GATE TO SOURCE CUTOFF VOLTAGE vs. CHANNEL TEMPERATURE

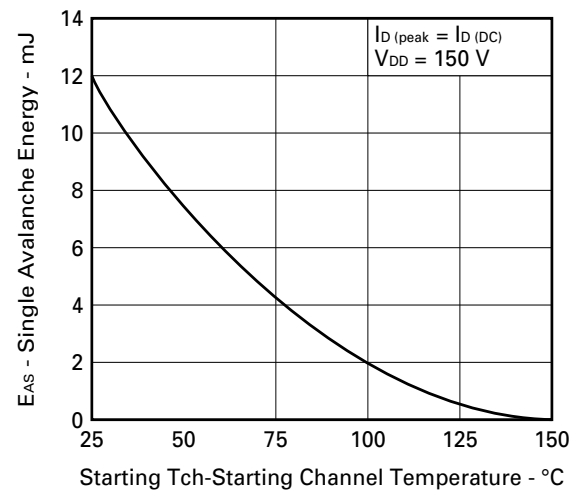




SINGLE AVALANCHE CURRENT vs.  
INDUCTIVE LOAD



SINGLE AVALANCHE ENERGY vs.  
STARTING CHANNEL TEMPERATURE



## REFERENCE

Document Name	Document No.
NEC semiconductor device reliability/quality control system.	TEI-1202
Quality grade on NEC semiconductor devices.	IEI-1209
Semiconductor device mounting technology manual.	IEI-1207
Semiconductor device package manual.	IEI-1213
Guide to quality assurance for semiconductor devices.	MEI-1202
Semiconductor selection guide.	MF-1134
Power MOS FET features and application switching power supply.	TEA-1034
Application circuits using Power MOS FET.	TEA-1035
Safe operating area of Power MOS FET.	TEA-1037

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