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P1 98.2

# MOS FIELD EFFECT POWER TRANSISTOR 2SK2040, 2SK2040-Z

## SWITCHING N-CHANNEL POWER MOS FET INDUSTRIAL USE

### DESCRIPTION

The 2SK2040 is N-channel MOS Field Effect Transistor designed for high voltage switching applications.

### FEATURES

- Low On-state Resistance  
 $R_{DS(on)} \leq 5.0 \Omega$  ( $V_{GS} = 10 V, I_D = 1.0 A$ )
- Low  $C_{iss}$   $C_{iss} = 275 pF$  TYP.
- Built-in G-S Gate Protection Diode
- High Avalanche Capability Ratings

### QUALITY GRADE

Standard

Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

### ABSOLUTE MAXIMUM RATINGS ( $T_a = 25^\circ C$ )

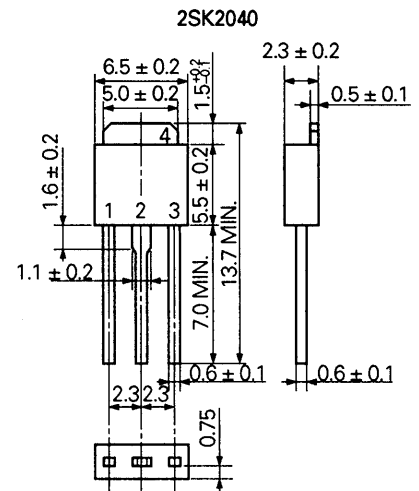
Drain to Source Voltage	$V_{DSS}$	600	V
Gate to Source Voltage	$V_{GSS}$	$\pm 30$	V
Drain Current (DC)	$I_{D(DC)}$	$\pm 2.0$	A
Drain Current (pulse)	$I_{D(pulse)^*}$	$\pm 6.0$	A
Total Power Dissipation ( $T_c = 25^\circ C$ )	$P_{T1}$	20	W
Total Power Dissipation ( $T_a = 25^\circ C$ )	$P_{T2}$	1.0	W
Channel Temperature	$T_{ch}$	150	$^\circ C$
Storage Temperature	$T_{stg}$	-55 to +150	$^\circ C$
Single Avalanche Current	$I_{AS}^{**}$	3.0	A
Single Avalanche Energy	$E_{AS}^{**}$	78	mJ

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

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

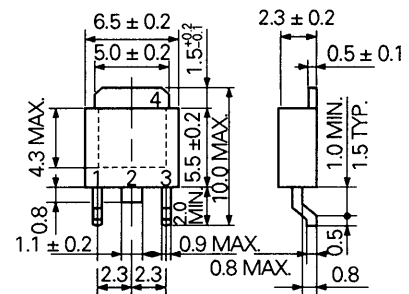
### PACKAGE DIMENSIONS

(in millimeters)



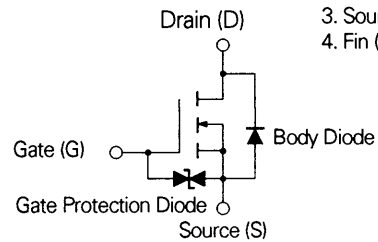
MP-3

2SK2040-Z



MP-3Z

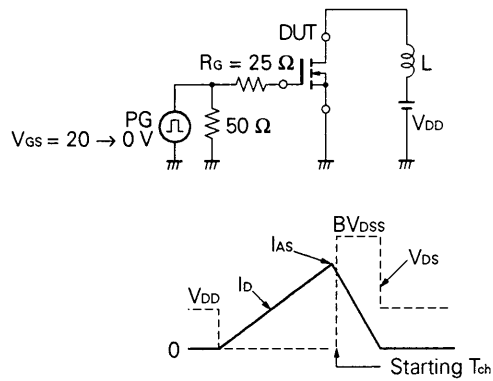
1. Gate
2. Drain
3. Source
4. Fin (Drain)



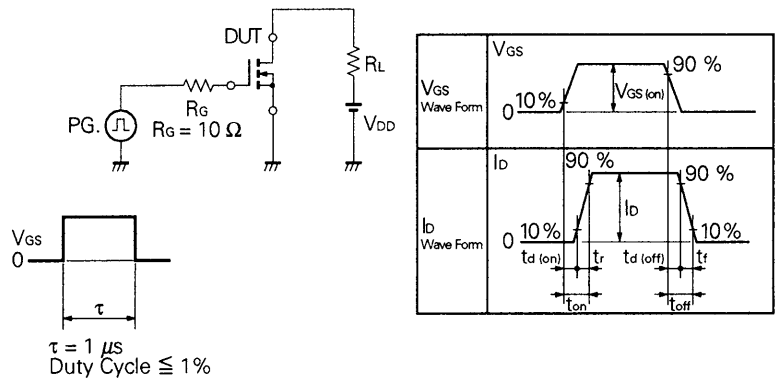
**ELECTRICAL CHARACTERISTICS (T<sub>a</sub> = 25 °C)**

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Drain to Source On-state Resistance	R <sub>DS(on)</sub>		4.2	5.0	Ω	V <sub>GS</sub> = 10 V, I <sub>b</sub> = 1 A
Gate to Source Cutoff Voltage	V <sub>GS(off)</sub>	2.0		4.0	V	V <sub>DS</sub> = 10 V, I <sub>b</sub> = 1 mA
Forward Transfer Admittance	y <sub>fs</sub>	0.5			S	V <sub>DS</sub> = 20 V, I <sub>b</sub> = 1 A
Drain Leakage Current	I <sub>DSS</sub>			100	μA	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0
Gate to Source Leakage Current	I <sub>GSS</sub>			±10	μA	V <sub>GS</sub> = ±25 V, V <sub>DS</sub> = 0
Input Capacitance	C <sub>iss</sub>		275		pF	V <sub>DS</sub> = 10 V
Output Capacitance	C <sub>oss</sub>		68		pF	V <sub>GS</sub> = 0
Reverse Transfer Capacitance	C <sub>rss</sub>		23		pF	f = 1 MHz
Turn-On Delay Time	t <sub>d(on)</sub>		7		ns	V <sub>GS</sub> = 10 V V <sub>DD</sub> = 150 V I <sub>b</sub> = 1.0 A, R <sub>G</sub> = 10 Ω R <sub>L</sub> = 150 Ω
Rise Time	t <sub>r</sub>		4		ns	
Turn-Off Delay Time	t <sub>d(off)</sub>		37		ns	
Fall Time	t <sub>f</sub>		8		ns	
Total Gate Charge	Q <sub>G</sub>		12		nC	V <sub>GS</sub> = 10 V I <sub>b</sub> = 2 A V <sub>DD</sub> = 450 V
Gate to Source Charge	Q <sub>GS</sub>		2.2		nC	
Gate to Drain Charge	Q <sub>GD</sub>		6.2		nC	
Diode Forward Voltage	V <sub>F(S-D)</sub>		0.9		V	I <sub>F</sub> = 2 A, V <sub>GS</sub> = 0
Reverse Recovery Time	t <sub>rr</sub>		340		ns	I <sub>F</sub> = 2 A
Reverse Recovery Charge	Q <sub>rr</sub>		1.1		μC	di/dt = 50 A/μs

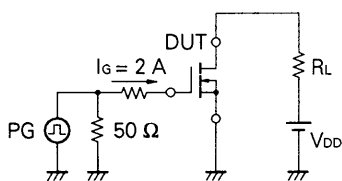
**Test Circuit 1: Avalanche Capability**



**Test Circuit 2: Switching Time**

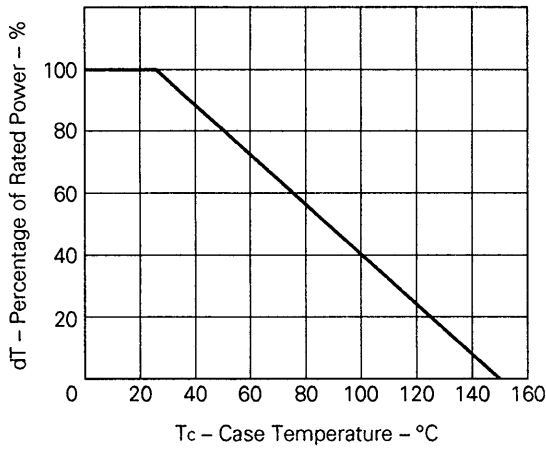


**Test Circuit 3: Gate Charge**

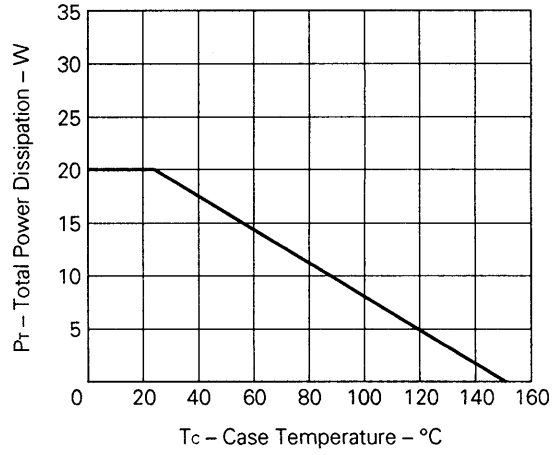


TYPICAL CHARACTERISTICS ( $T_a = 25^\circ\text{C}$ )

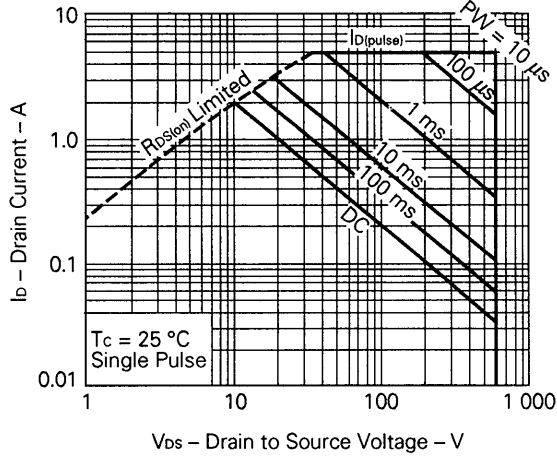
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



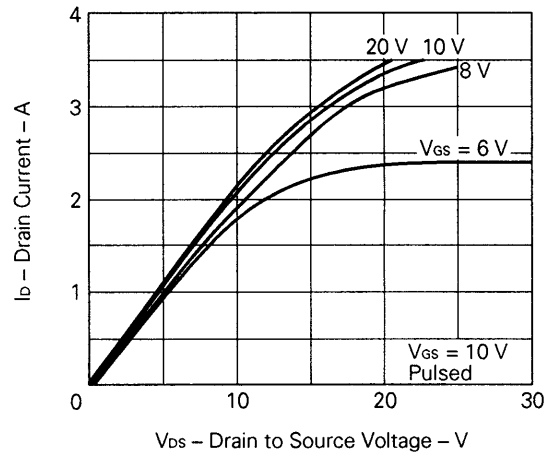
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



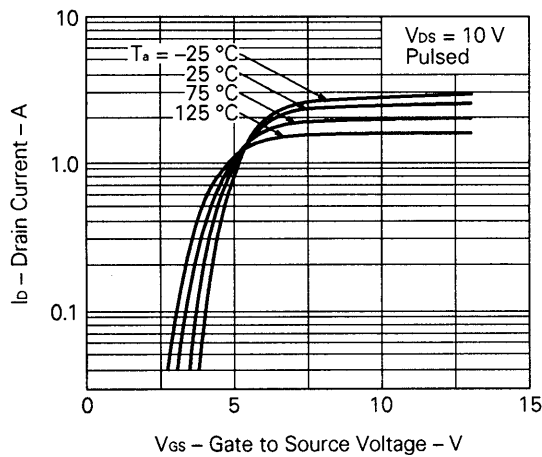
FORWARD BIAS SAFE OPERATING AREA

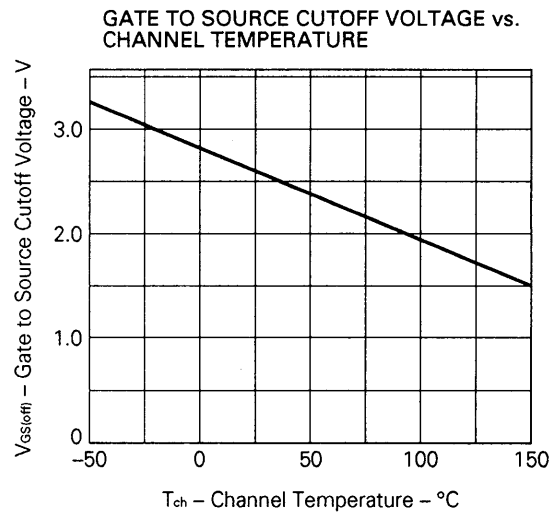
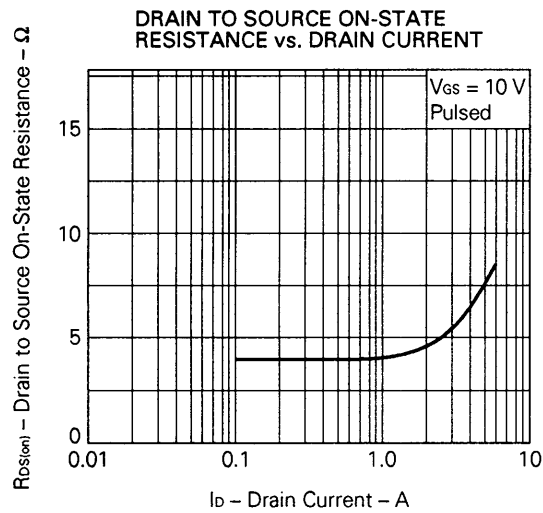
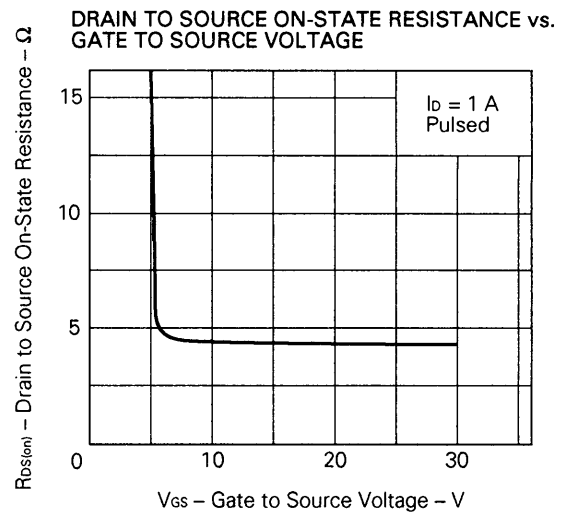
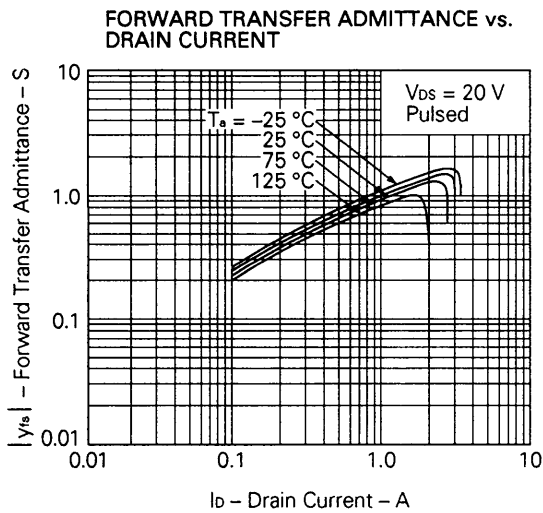
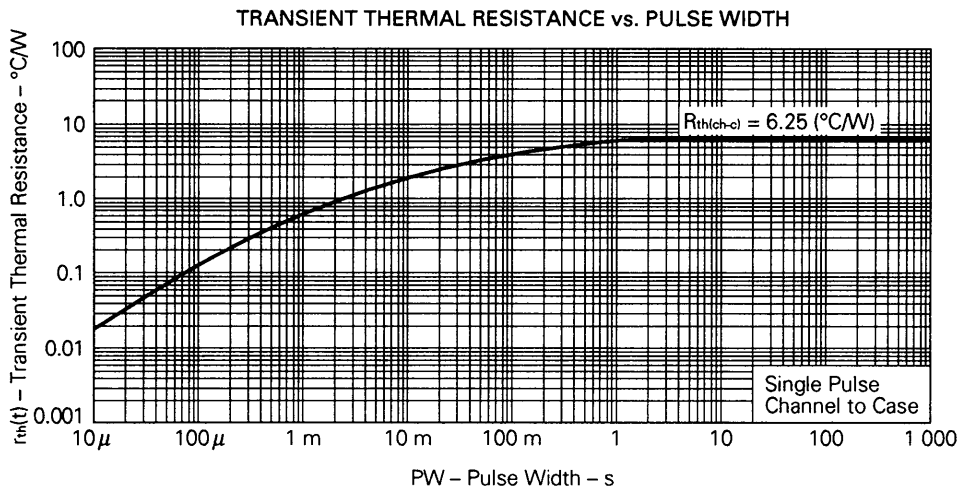


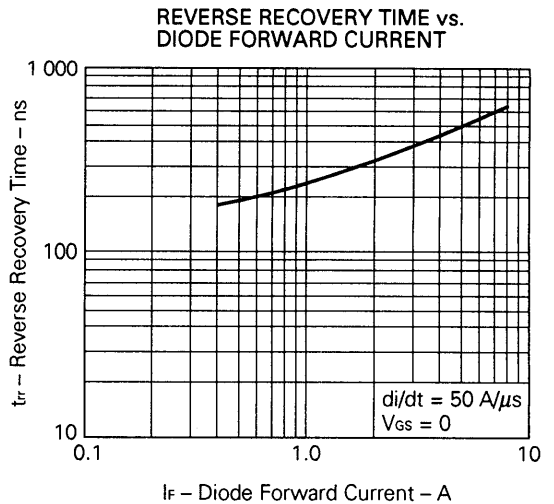
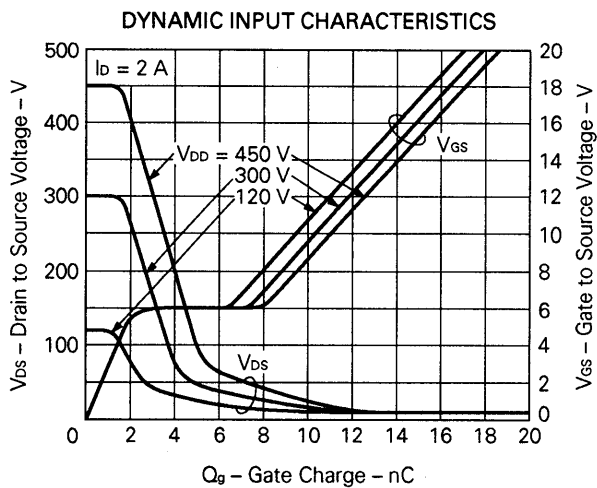
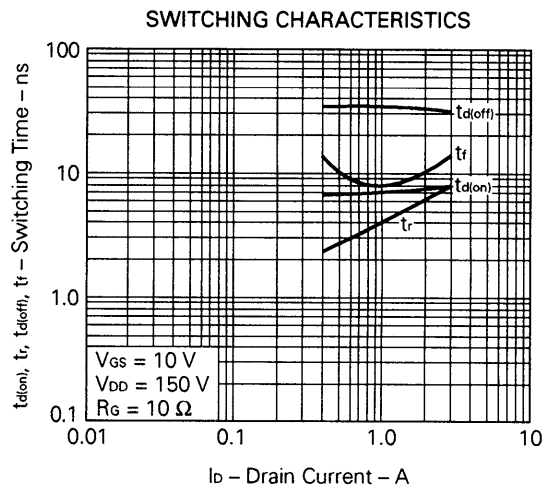
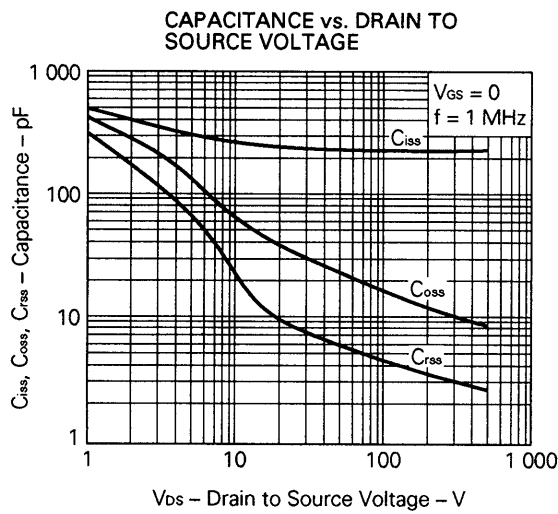
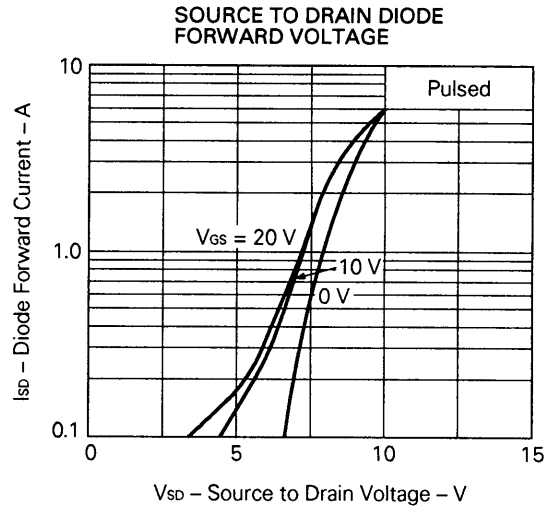
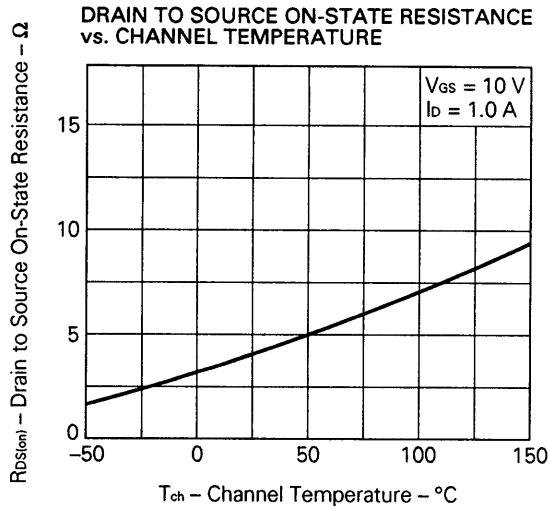
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



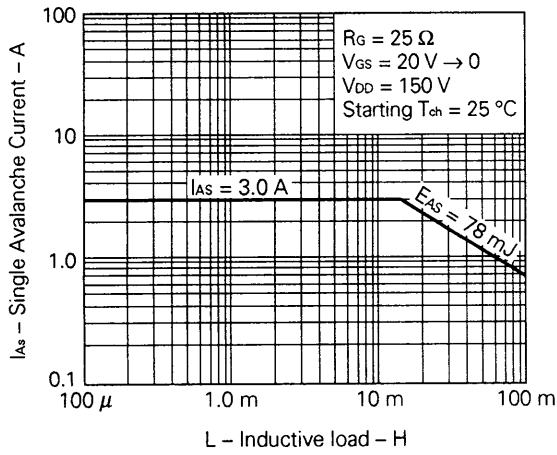
TRANSFER CHARACTERISTICS



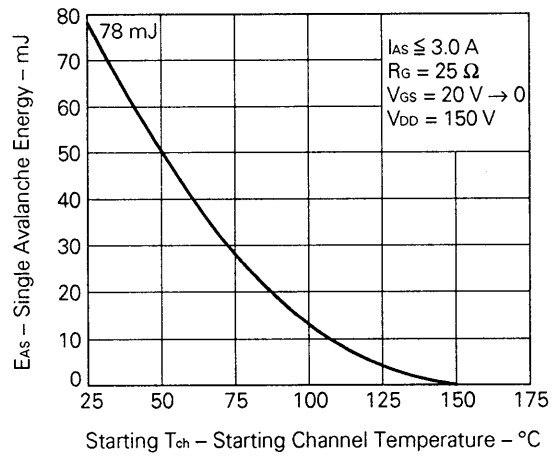




SINGLE AVALANCHE CURRENT vs. INDUCTIVE LOAD



SINGLE AVALANCHE ENERGY vs. STARTING CHANNEL TEMPERATURE



**Reference**

Application note name	No.
Safe operating area of Power MOS FET.	TEA-1034
Application circuit using Power MOS FET.	TEA-1035
Quality control of NEC semiconductors devices.	TEI-1202
Quality control guide of semiconductors devices.	MEI-1202
Assembly manual of semiconductors devices.	IEI-1207



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