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P1 98.2

DATA SHEET

NEC

MOS FIELD EFFECT POWER TRANSISTORS
2SK2136, 2SK2136-Z

SWITCHING
N-CHANNEL POWER MOS FET
INDUSTRIAL USE

DESCRIPTION

The 2SK2136, 2SK2136-Z are N-channel Power MOS Field Effect Transistors designed for high voltage switching applications.

FEATURES

- Low On-state Resistance
  $R_{DS(on)}$ = 0.18 Ω MAX. (V_{GS} = 10 V, I_D = 10 A)
- Low C_{iss} C_{iss} = 1 100 pF TYP.
- 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.

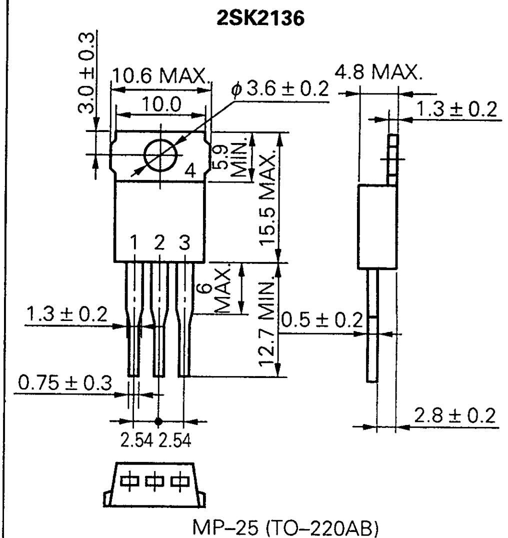
ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

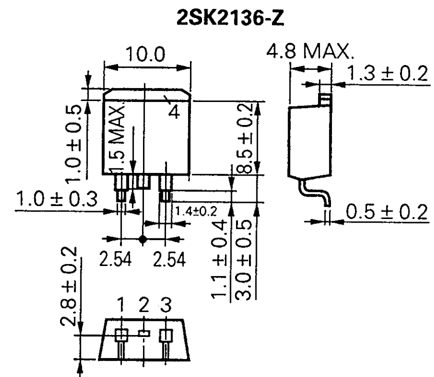
Parameter	Symbol	Rating	Unit
Drain to Source Voltage	V_{DSS}	200	V
Gate to Source Voltage	V_{GSS}	±30	V
Drain Current (DC)	$I_{D(DS)}$	±20	A
Drain Current (pulse)	$I_{D(pulse)}$*	±80	A
Total Power Dissipation (T_c = 25 °C)	P_{T1}	75	W
Total Power Dissipation (T_a = 25 °C)	P_{T2}	1.5	W
Channel Temperature	T_{ch}	150	°C
Storage Temperature	T_{stg}	−55 to +150	°C
Single Avalanche Current	I_{AS}**	20	A
Single Avalanche Energy	E_{AS}**	80	mJ

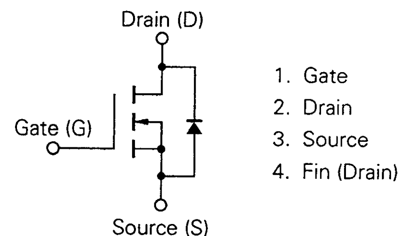
* PW ≦ 10 μs, Duty Cycle ≦ 1 %

** Starting T_{ch} = 25 °C, R_G = 25 Ω, V_{GS} = 20 V → 0

PACKAGE DIMENSIONS
(Unit : mm)







(Diode in the figure is the parasitic diode)

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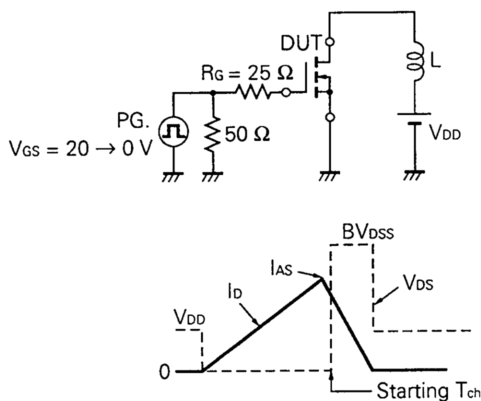
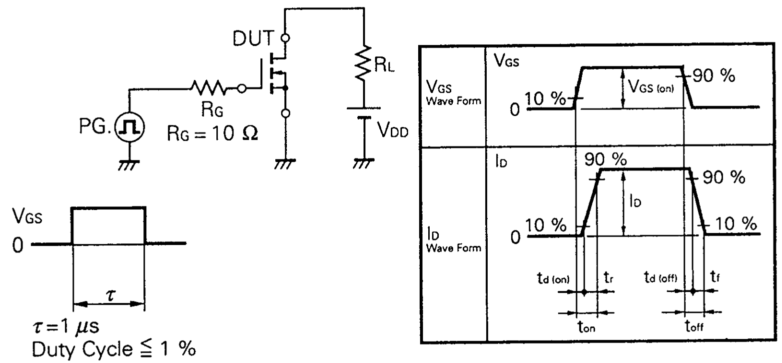
ELECTRICAL CHARACTERISTICS (T_a = 25 °C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Drain to Source On-state Resistance	$R_{DS(on)}$			0.18	Ω	V_{GS} = 10 V, I_D = 10 A
Gate to Source Cutoff Voltage	$V_{GS(off)}$	2.0		4.0	V	V_{DS} = 10 V, I_D = 1 mA
Forward Transfer Admittance	$\|y_{fs}\|$	4.0			S	V_{DS} = 10 V, I_D = 10 A
Drain Leakage Current	I_{DSS}			100	μA	V_{DS} = 200 V, V_{GS} = 0
Gate to Source Leakage Current	I_{GSS}			±100	nA	V_{GS} = ±30 V, V_{DS} = 0
Input Capacitance	C_{iss}		1 100		pF	V_{DS} = 10 V V_{GS} = 0 f = 1 MHz
Output Capacitance	C_{oss}		540		pF	
Reverse Transfer Capacitance	C_{rss}		190		pF	
Turn-On Delay Time	$t_{d(on)}$		20		ns	V_{GS} = 10 V V_{DD} = 100 V I_D = 10 A, R_G = 10 Ω R_L = 10 Ω
Rise Time	t_r		85		ns	
Turn-Off Delay Time	$t_{d(off)}$		60		ns	
Fall Time	t_f		25		ns	
Total Gate Charge	Q_G		30		nC	V_{GS} = 10 V I_D = 20 A V_{DD} = 160 V
Gate to Source Charge	Q_{GS}		7.0		nC	
Gate to Drain Charge	Q_{GD}		15		nC	
Diode Forward Voltage	$V_{F(S-D)}$		1.0		V	I_F = 20 A, V_{GS} = 0
Reverse Recovery Time	t_{rr}		210		ns	I_F = 20 A di/dt = 50 A/μs
Reverse Recovery Charge	Q_{rr}		1.0		μC	

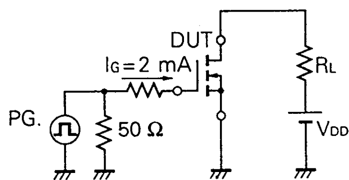
Test Circuit 1 : Avalanche Capability



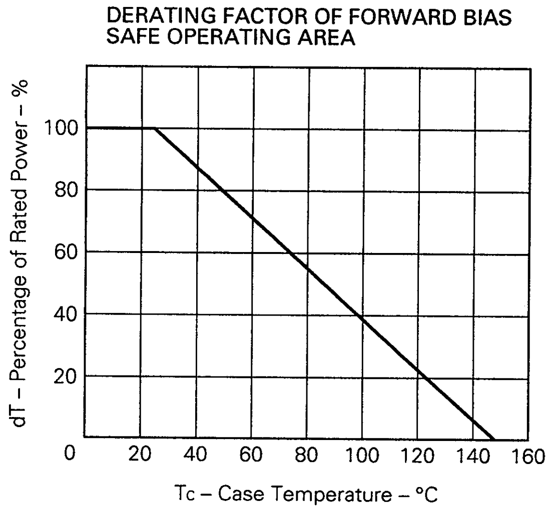
Test Circuit 2 : Switching Time

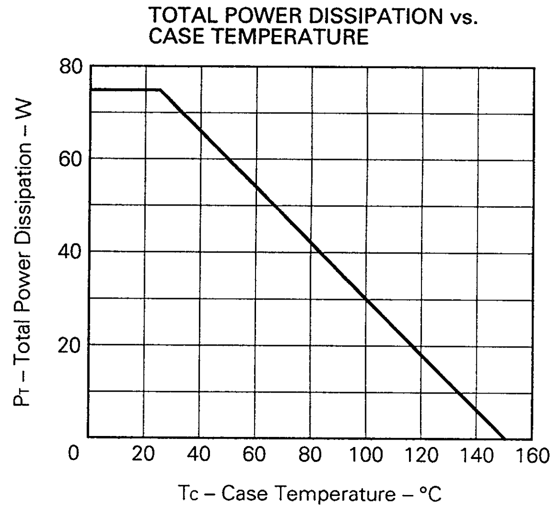


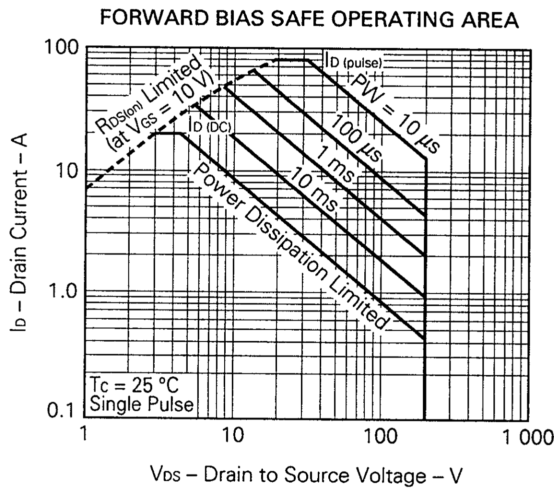
Test Circuit 3 : Gate Charge

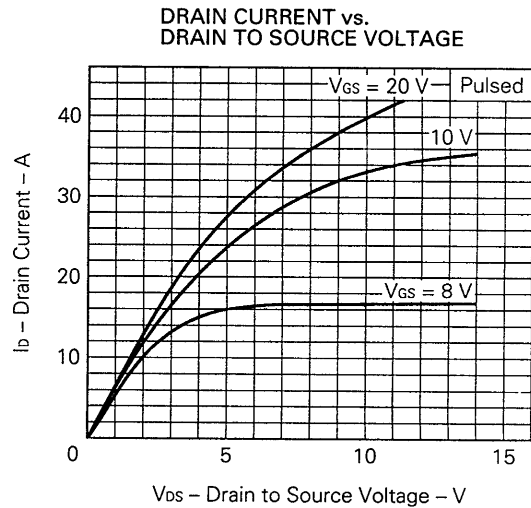


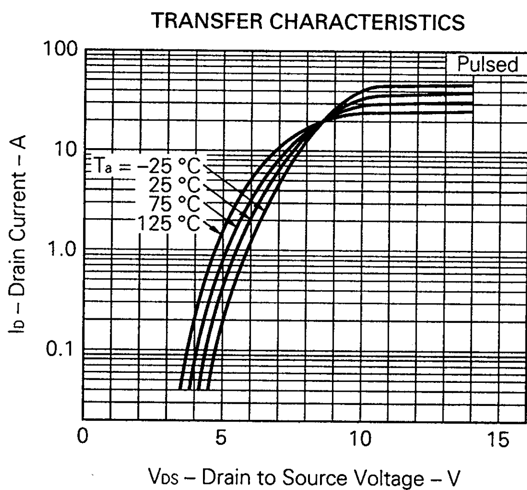
TYPICAL CHARACTERISTICS (T_a = 25 °C)

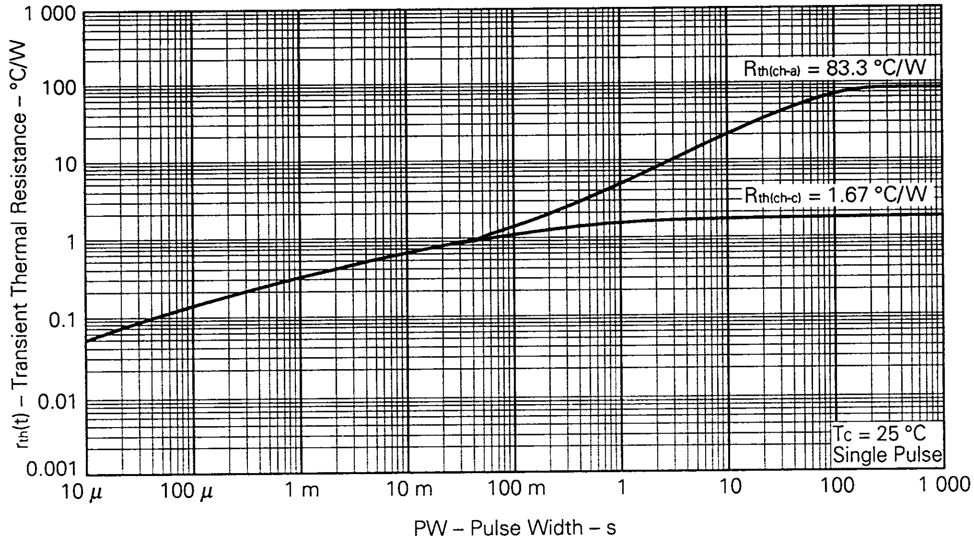


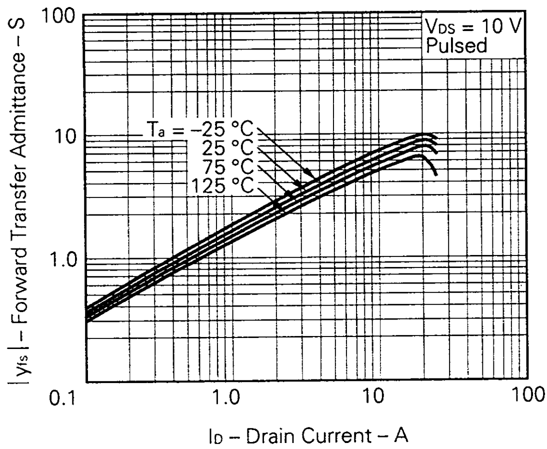


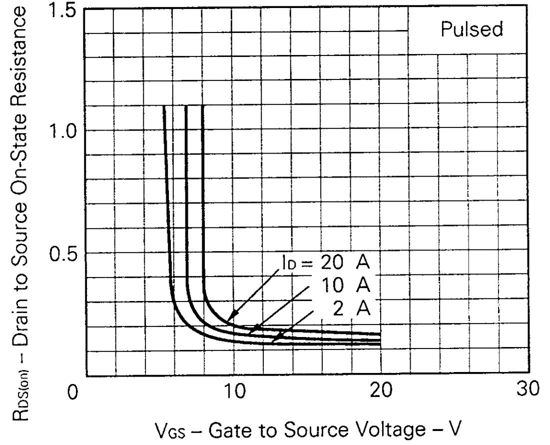


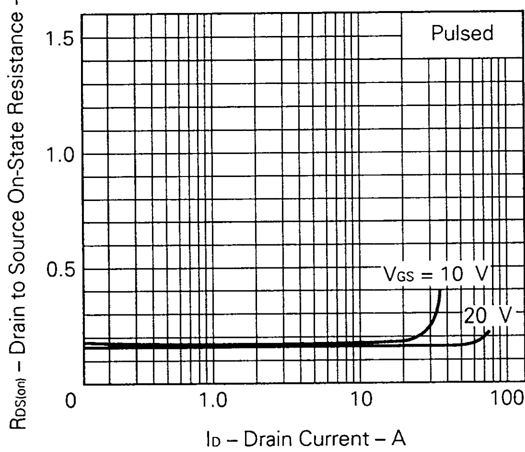


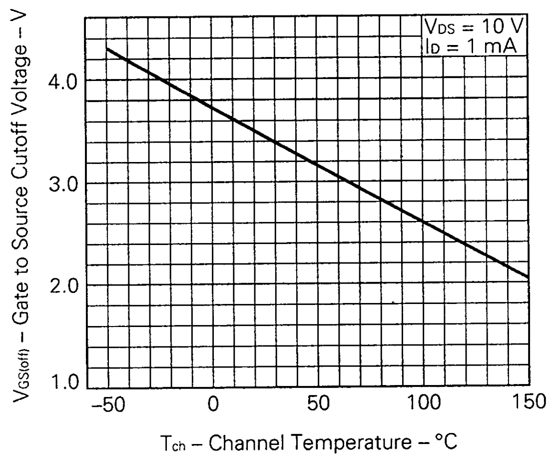


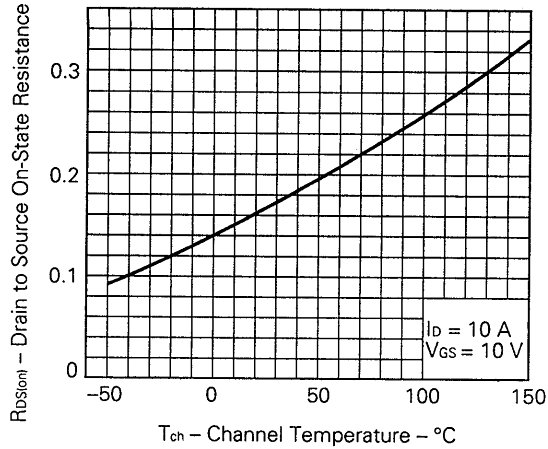

TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH
$r_{th}(t)$ – Transient Thermal Resistance – °C/W
1 000
100
10
1
0.1
0.01
0.001
$R_{th(ch-a)}$ = 83.3 °C/W
$R_{th(ch-c)}$ = 1.67 °C/W
T_C = 25 °C
Single Pulse
10 μ
100 μ
1 m
10 m
100 m
1
10
100
1 000
PW – Pulse Width – s

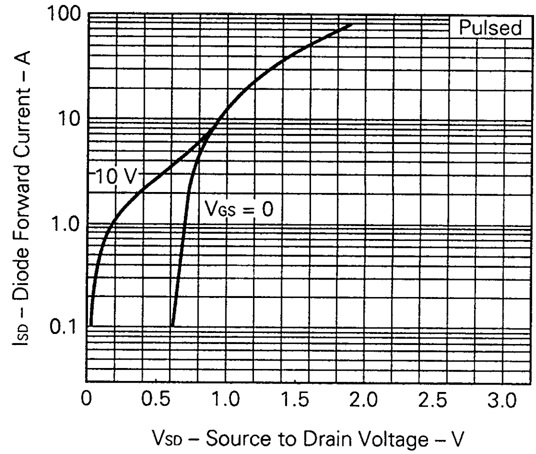

FORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENT
| yfs | – Forward Transfer Admittance – S
100
10
1.0
0.1
V_{DS} = 10 V
Pulsed
T_a = −25 °C
25 °C
75 °C
125 °C
1.0
10
100
I_D – Drain Current – A

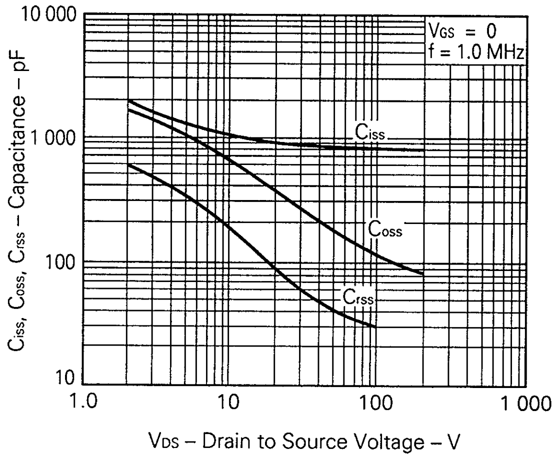

DRAIN TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE
$R_{DS(on)}$ – Drain to Source On-State Resistance – Ω
1.5
1.0
0.5
0
Pulsed
I_D = 20 A
10 A
2 A
10
20
30
V_{GS} – Gate to Source Voltage – V

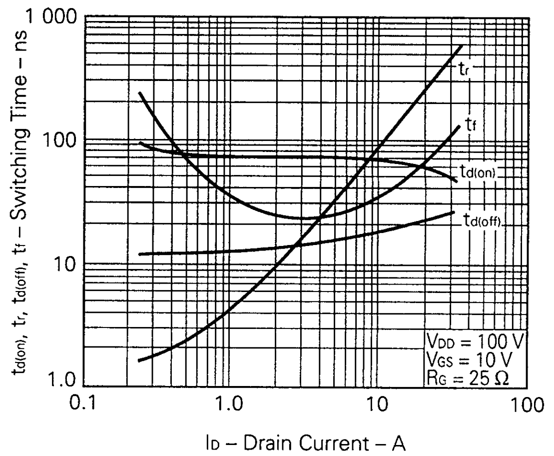

DRAIN TO SOURCE ON-STATE RESISTANCE vs.
DRAIN CURRENT
$R_{DS(on)}$ – Drain to Source On-State Resistance – Ω
1.5
1.0
0.5
0
Pulsed
V_{GS} = 10 V
20 V
1.0
10
100
I_D – Drain Current – A

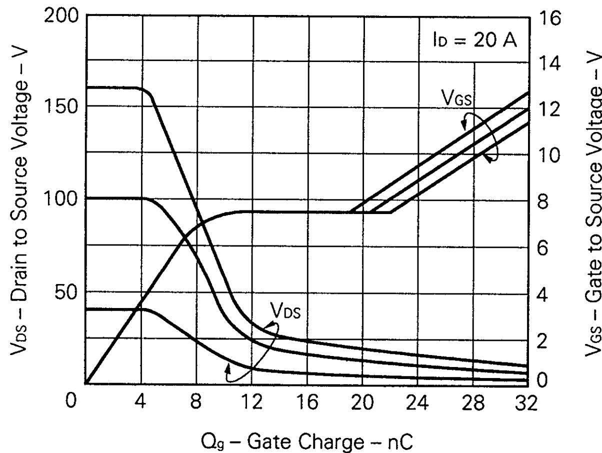

GATE TO SOURCE CUTOFF VOLTAGE vs.
CHANNEL TEMPERATURE
$V_{GS(off)}$ – Gate to Source Cutoff Voltage – V
4.0
3.0
2.0
1.0
V_{DS} = 10 V
I_D = 1 mA
-50
0
50
100
150
T_{ch} – Channel Temperature – °C

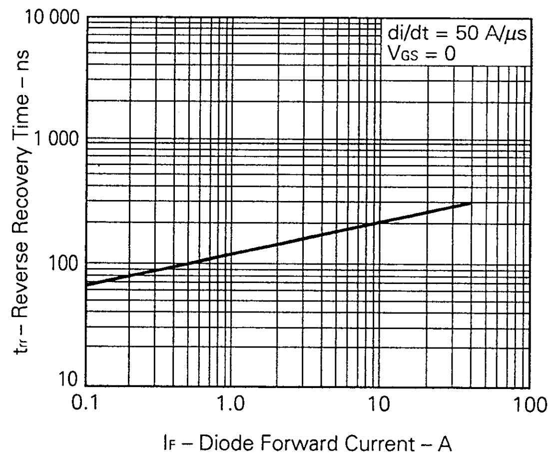

DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE
RDS(on) – Drain to Source On-State Resistance – Ω
0.3
0.2
0.1
0
ID = 10 A
VGS = 10 V
−50
0
50
100
150
Tch – Channel Temperature – °C


SOURCE TO DRAIN DIODE FORWARD VOLTAGE
Pulsed
ISD – Diode Forward Current – A
100
10
1.0
0.1
10 V
VGS = 0
0
0.5
1.0
1.5
2.0
2.5
3.0
VSD – Source to Drain Voltage – V

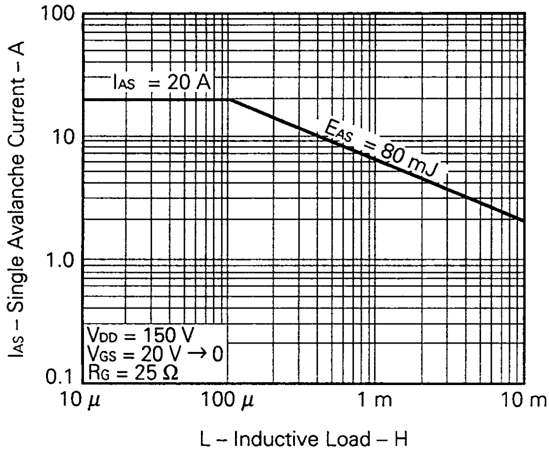

CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE
Ciss, Coss, Crss – Capacitance – pF
10 000
1 000
100
10
VGS = 0
f = 1.0 MHz
Ciss
Coss
Crss
1.0
10
100
1 000
VDS – Drain to Source Voltage – V


SWITCHING CHARACTERISTICS
td(on), tr, td(off), tf – Switching Time – ns
1 000
100
10
1.0
tr
tf
td(on)
td(off)
VDD = 100 V
VGS = 10 V
RG = 25 Ω
0.1
1.0
10
100
ID – Drain Current – A

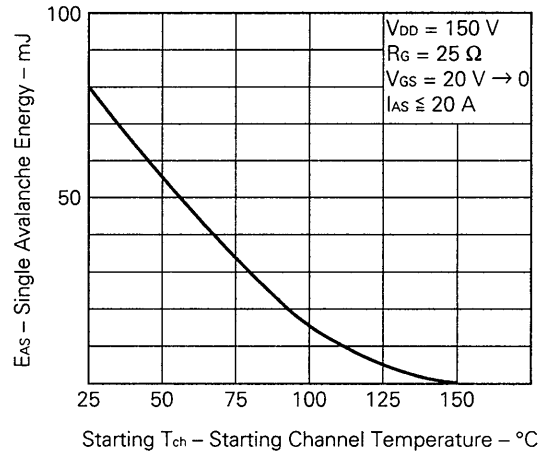

DYNAMIC INPUT/OUTPUT CHARACTERISTICS
VDS – Drain to Source Voltage – V
VGS – Gate to Source Voltage – V
ID = 20 A
VGS
VDS
200
150
100
50
0
16
14
12
10
8
6
4
2
0
4
8
12
16
20
24
28
32
Qg – Gate Charge – nC


REVERSE RECOVERY TIME vs. REVERSE DRAIN CURRENT
trr – Reverse Recovery Time – ns
di/dt = 50 A/μs
VGS = 0
10 000
1 000
100
10
0.1
1.0
10
100
IF – Diode Forward Current – A

SINGLE AVALANCHE CURRENT vs. INDUCTIVE LOAD



SINGLE AVALANCHE ENERGY vs. STARTING CHANNEL TEMPERATURE



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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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M4 92.6