

MOS FIELD EFFECT TRANSISTOR **2SK3659**

SWITCHING N-CHANNEL POWER MOS FET

DESCRIPTION

The 2SK3659 is N-channel MOS FET device that features a low on-state resistance and excellent switching characteristics, designed for low voltage high current applications such as DC/DC converter with synchronous rectifier.

ORDERING INFORMATION

PART NUMBER	PACKAGE
2SK3659	Isolated TO-220

FEATURES

- •4.5V drive available.
- •Low on-state resistance,

 $R_{DS(on)1} = 5.7 \text{ m}\Omega \text{ MAX.} \text{ (Vgs} = 10 \text{ V, ID} = 40 \text{ A)}$

·Low gate charge,

 $Q_G = 32 \text{ nC TYP.}$ (VDD = 16 V, VGS = 10 V, ID = 65 A)

- •Built-in gate protection diode.
- •Avalanche capability ratings.
- •Isolated TO-220 package.

ABSOLUTE MAXIMUM RATING (TA = 25°C)

Drain to source voltage (Vgs = 0 V)	VDSS	20	V
Gate to source voltage (V _{DS} = 0 V)	Vgss	±20	V
Drain current (DC) (Tc = 25°C)	25°C) I _{D(DC)} ±65		
Drain current (pulse) Note1	ID(pulse)	±260	Α
Total power dissipation (T _A = 25°C)	P _{T1}	2.0	W
Total power dissipation (Tc = 25°C)	P _{T2}	25	W
Channel temperature	Tch	150	°C
Storage temperature	T _{stg}	-55 to +150	°C
Single Avalanche Current Note2	IAS	35	Α
Single Avalanche Energy Note2	Eas	122	mJ

Note 1. PW \leq 10 μ s, Duty Cycle \leq 1%

2. Starting T_{ch} = 25°C, V_{DD} = 10 V, R_{G} = 25 $\Omega,\,V_{GS}$ = 20 \rightarrow 0 V

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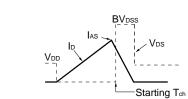


ELECTRICAL CHARACTERISTICS (TA = 25°C)

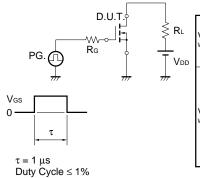
Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Zero Gate Voltage Drain Current	Ipss	V _{DS} = 20 V, V _{GS} = 0 V			10	μΑ
Gate Leakage Current	Igss	V _{GS} = ±20 V, V _{DS} = 0 V			±10	μΑ
Gate Cut-off Voltage	V _{GS(off)}	V _{DS} = 10 V, I _D = 1 mA	1.5		2.5	V
Forward Transfer Admittance	yfs	V _{DS} = 10 V, I _D = 40 A	15			S
Drain to Source On-state Resistance	RDS(on)1	Vgs = 10 V, ID = 40 A		4.6	5.7	mΩ
	RDS(on)2	Vgs = 4.5 V, ID = 40 A		7.1	9.9	mΩ
Input Capacitance	Ciss	V _{DS} = 10 V		1700		pF
Output Capacitance	Coss	V _G S = 0 V		700		pF
Reverse Transfer Capacitance	Crss	f = 1 MHz		250		pF
Turn-on Delay Time	t _{d(on)}	V _{DD} = 10 V, I _D = 40 A		16		ns
Rise Time	tr	Vgs = 10 V		14		ns
Turn-off Delay Time	t _{d(off)}	R _G = 10 Ω		50		ns
Fall Time	t _f			12		ns
Total Gate Charge	Q _G	VDD = 16 V		32		nC
Gate to Source Charge	Qgs	V _G S = 10 V		6.0		nC
Gate to Drain Charge	Q _{GD}	ID = 65 A		8.3		nC
Body Diode Forward Voltage	V _{F(S-D)}	IF = 65 A, VGS = 0 V		1.0		V
Reverse Recovery Time	trr	IF = 65 A, VGS = 0 V		45		ns
Reverse Recovery Charge	Qrr	di/dt = 100 A/μs		34		nC

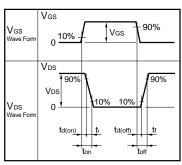
TEST CIRCUIT 1 AVALANCHE CAPABILITY

$\begin{array}{c} \text{D.U.T.} \\ \text{RG} = 25 \, \Omega \\ \text{VGS} = 20 \rightarrow 0 \, \text{V} \end{array} \begin{array}{c} \text{PG.} \\ \text{PS.} \\ \text{M. M.} \end{array} \begin{array}{c} \text{D.U.T.} \\ \text{VDD} \\ \text{M.} \end{array}$

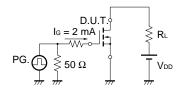


TEST CIRCUIT 2 SWITCHING TIME



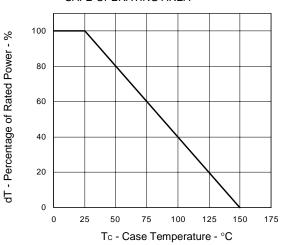


TEST CIRCUIT 3 GATE CHARGE

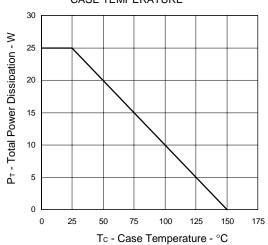


TYPICAL CHARACTERISTICS (TA = 25°C)

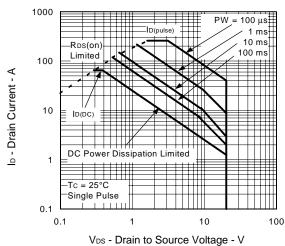
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



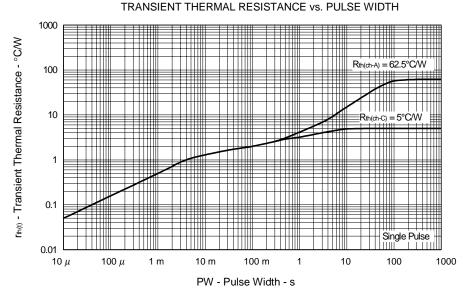
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



FORWARD BIAS SAFE OPERATING AREA

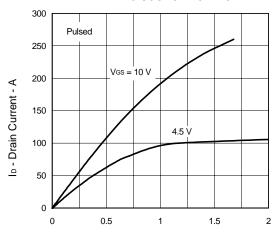


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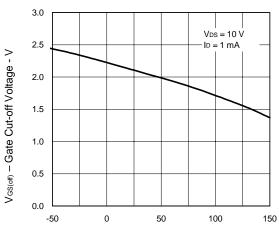
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DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



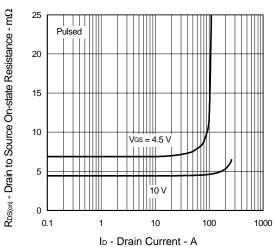
V_{DS} - Drain to Source Voltage - V

GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE

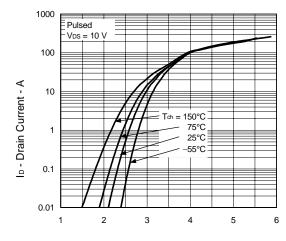


Tch - Channel Temperature - °C

DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

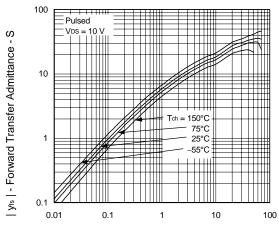


FORWARD TRANSFER CHARACTERISTICS



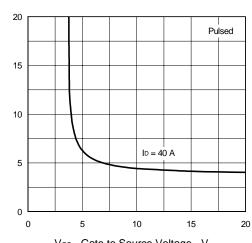
V_{GS} - Gate to Source Voltage - V

FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



ID - Drain Current - A

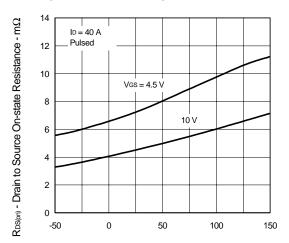
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



V_{GS} - Gate to Source Voltage - V

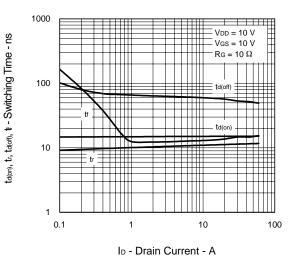
R_{DS(on)} - Drain to Source On-state Resistance - mΩ

DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE

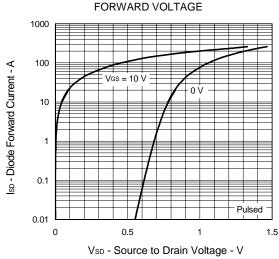


Tch - Channel Temperature - °C

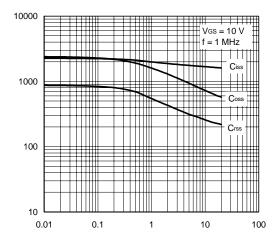
SWITCHING CHARACTERISTICS



SOURCE TO DRAIN DIODE

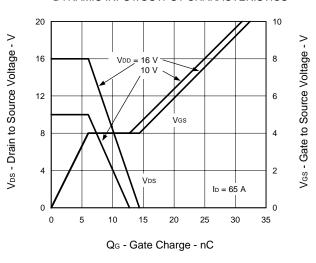


CAPACITANCE vs.
DRAIN TO SOURCE VOLTAGE

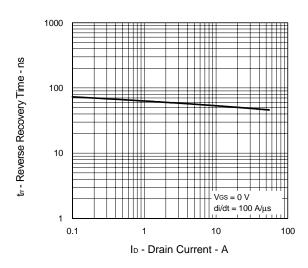


V_{DS} - Drain to Source Voltage - V

DYNAMIC INPUT/OUTPUT CHARACTERISTICS

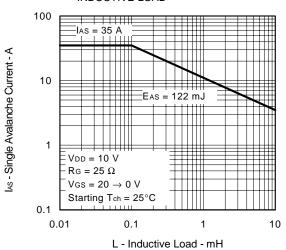


REVERSE RECOVERY TIME vs. DRAIN CURRENT

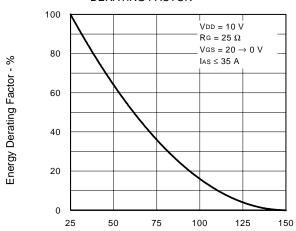


Ciss, Coss, Crss - Capacitance - pF

SINGLE AVALANCHE CURRENT vs. INDUCTIVE LOAD



SINGLE AVALANCHE ENERGY DERATING FACTOR

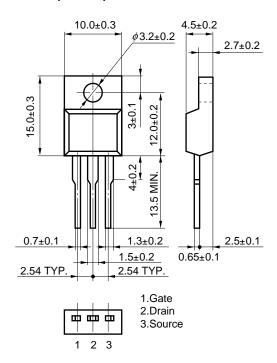


Starting Tch - Starting Channel Temperature - °C

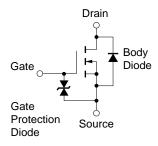


PACKAGE DRAWING (Unit: mm)

Isolated TO-220 (MP-45F)



EQUIVALENT CIRCUIT



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

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