

# 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,

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

•Low gate charge,

Qg = 32 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)	D(DC)	±65	А
Drain current (pulse) Note1	D(pulse)	±260	А
Total power dissipation (T <sub>A</sub> = 25°C)	P <sub>T1</sub>	2.0	W
Total power dissipation (Tc = 25°C)	P <sub>T2</sub>	25	W
Channel temperature	Tch	150	°C
Storage temperature	Tstg	-55 to +150	°C
Single Avalanche Current Note2	las	35	А
Single Avalanche Energy Note2	Eas	122	mJ

#### Note 1. PW $\leq$ 10 $\mu s,$ Duty Cycle $\leq$ 1%

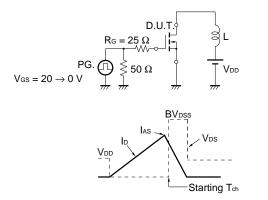
2. Starting  $T_{ch}$  = 25°C,  $V_{DD}$  = 10 V,  $R_{G}$  = 25  $\Omega,$   $V_{GS}$  = 20  $\rightarrow$  0 V

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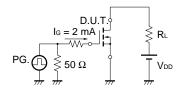
ELECTRICAL CHARACTERISTICS (TA = 25°C)

Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Zero Gate Voltage Drain Current	IDSS	Vds = 20 V, Vgs = 0 V			10	μA
Gate Leakage Current	lgss	$V_{GS} = \pm 20 \text{ V}, \text{ V}_{DS} = 0 \text{ V}$			±10	μA
Gate Cut-off Voltage	VGS(off)	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	1.5		2.5	V
Forward Transfer Admittance	y <sub>fs</sub>	Vds = 10 V, Id = 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 <sub>DS</sub> = 10 V		1700		pF
Output Capacitance	Coss	V <sub>GS</sub> = 0 V		700		pF
Reverse Transfer Capacitance	Crss	f = 1 MHz		250		pF
Turn-on Delay Time	td(on)	Vdd = 10 V, Id = 40 A		16		ns
Rise Time	tr	Vgs = 10 V		14		ns
Turn-off Delay Time	td(off)	R <sub>G</sub> = 10 Ω		50		ns
Fall Time	tr			12		ns
Total Gate Charge	QG	Vdd = 16 V		32		nC
Gate to Source Charge	Q <sub>GS</sub>	Vgs = 10 V		6.0		nC
Gate to Drain Charge	Qgd	ID = 65 A		8.3		nC
Body Diode Forward Voltage	VF(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

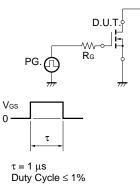
#### TEST CIRCUIT 1 AVALANCHE CAPABILITY

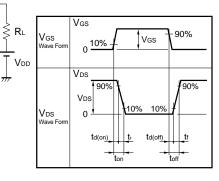


# **TEST CIRCUIT 3 GATE CHARGE**

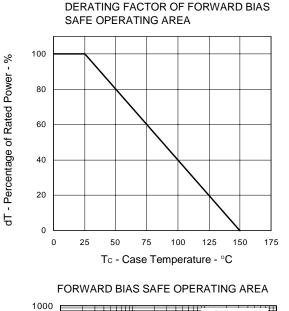


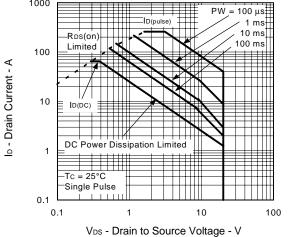
#### **TEST CIRCUIT 2 SWITCHING TIME**

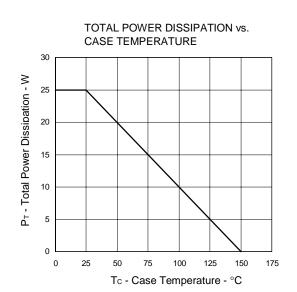




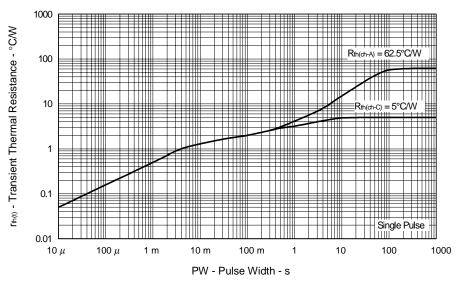




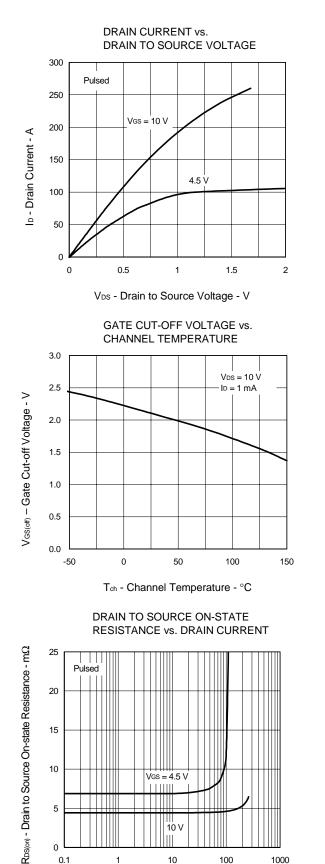




TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



Data Sheet D16251EJ2V0DS



VGS = 4.5 V

10 V

10

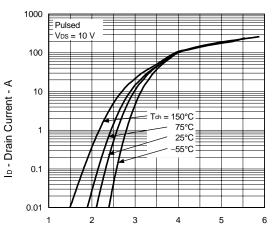
ID - Drain Current - A

100

1000

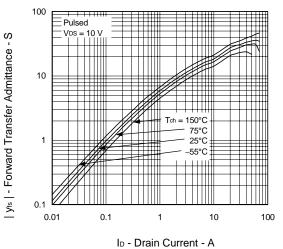
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#### FORWARD TRANSFER CHARACTERISTICS

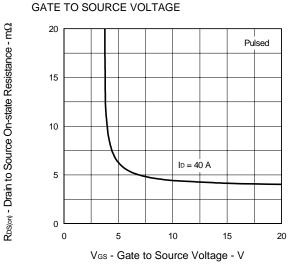


VGS - Gate to Source Voltage - V

FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



DRAIN TO SOURCE ON-STATE RESISTANCE vs.



Data Sheet D16251EJ2V0DS

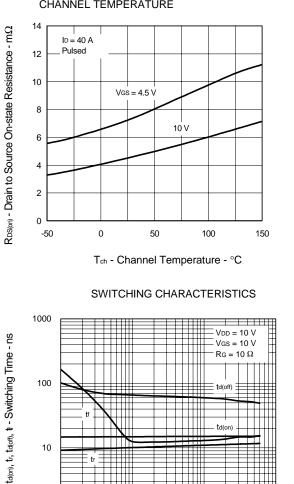
10

5

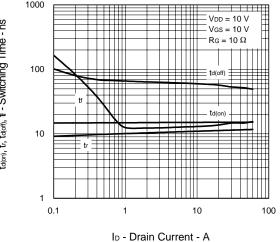
0

0.1

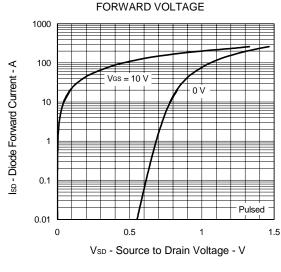
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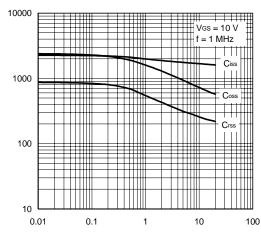
#### DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE





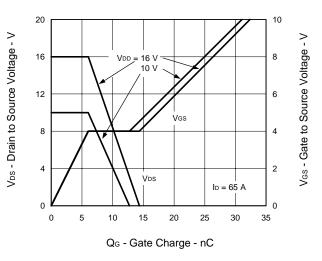


#### CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE

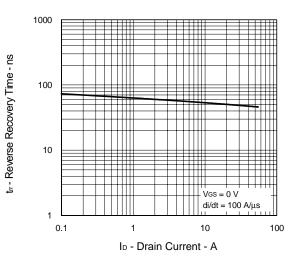


VDS - Drain to Source Voltage - V

DYNAMIC INPUT/OUTPUT CHARACTERISTICS

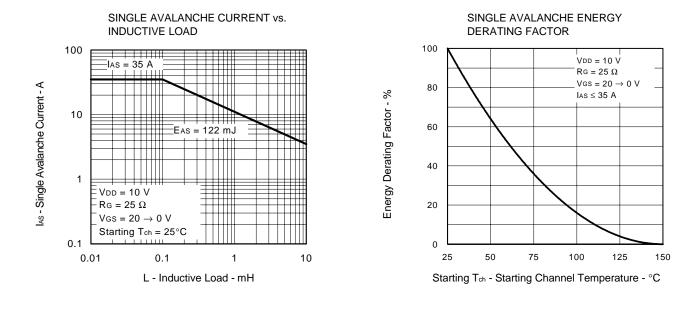


#### **REVERSE RECOVERY TIME vs. DRAIN CURRENT**



Data Sheet D16251EJ2V0DS

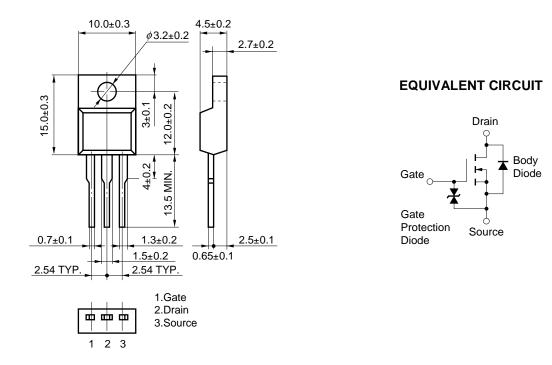
Ciss, Coss, Crss - Capacitance - pF



Data Sheet D16251EJ2V0DS

# PACKAGE DRAWING (Unit: mm)

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



**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. • The information in this document is current as of June, 2002. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.

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