NEC

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 mΩ MAX. (V_{GS} = 10 V, I_D = 40 A)
- Low gate charge,
  Q_G = 32 nC TYP. (V_{DD} = 16 V, V_{GS} = 10 V, I_D = 65 A)
- Built-in gate protection diode.
- Avalanche capability ratings.
- Isolated TO-220 package.

ABSOLUTE MAXIMUM RATING (T_A = 25°C)

Drain to source voltage (V_{GS} = 0 V)	V_{DSS}	20	V
Gate to source voltage (V_{DS} = 0 V)	V_{GSS}	±20	V
Drain current (DC) (T_C = 25°C)	$I_{D(DC)}$	±65	A
Drain current (pulse) Note1	$I_{D(pulse)}$	±260	A
Total power dissipation (T_A = 25°C)	P_{T1}	2.0	W
Total power dissipation (T_C = 25°C)	P_{T2}	25	W
Channel temperature	T_{ch}	150	°C
Storage temperature	T_{stg}	–55 to +150	°C
Single Avalanche Current Note2	I_{AS}	35	A
Single Avalanche Energy Note2	E_{AS}	122	mJ

Note 1. PW ≤ 10 μs, Duty Cycle ≤ 1%

2. Starting T_{ch} = 25°C, V_{DD} = 10 V, R_G = 25 Ω, V_{GS} = 20 → 0 V

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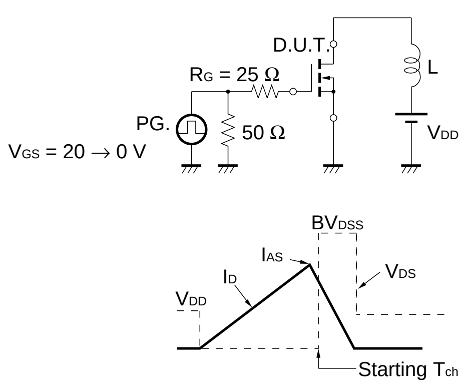
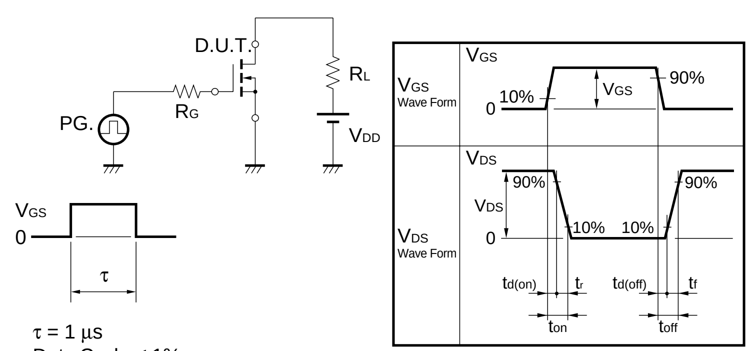
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V			10	µA
Gate Leakage Current	I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V			±10	µA
Gate Cut-off Voltage	$V_{GS(off)}$	V_{DS} = 10 V, I_D = 1 mA	1.5		2.5	V
Forward Transfer Admittance	$\lvert y_{fs} \rvert$	V_{DS} = 10 V, I_D = 40 A	15			S
Drain to Source On-state Resistance	$R_{DS(on)1}$	V_{GS} = 10 V, I_D = 40 A		4.6	5.7	mΩ
	$R_{DS(on)2}$	V_{GS} = 4.5 V, I_D = 40 A		7.1	9.9	mΩ
Input Capacitance	C_{iss}	V_{DS} = 10 V		1700		pF
Output Capacitance	C_{oss}	V_{GS} = 0 V		700		pF
Reverse Transfer Capacitance	C_{rss}	f = 1 MHz		250		pF
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 10 V, I_D = 40 A		16		ns
Rise Time	t_r	V_{GS} = 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	V_{DD} = 16 V		32		nC
Gate to Source Charge	Q_{GS}	V_{GS} = 10 V		6.0		nC
Gate to Drain Charge	Q_{GD}	I_D = 65 A		8.3		nC
Body Diode Forward Voltage	$V_{F(S-D)}$	I_F = 65 A, V_{GS} = 0 V		1.0		V
Reverse Recovery Time	t_{rr}	I_F = 65 A, V_{GS} = 0 V		45		ns
Reverse Recovery Charge	Q_{rr}	di/dt = 100 A/µs		34		nC

TEST CIRCUIT 1 AVALANCHE CAPABILITY

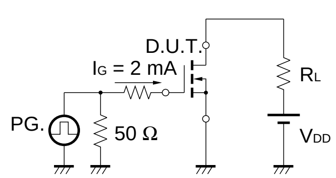


TEST CIRCUIT 2 SWITCHING TIME



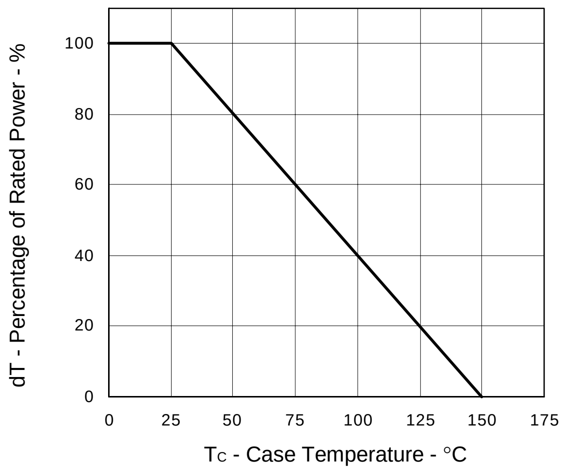
τ = 1 µs
Duty Cycle ≤ 1%

TEST CIRCUIT 3 GATE CHARGE

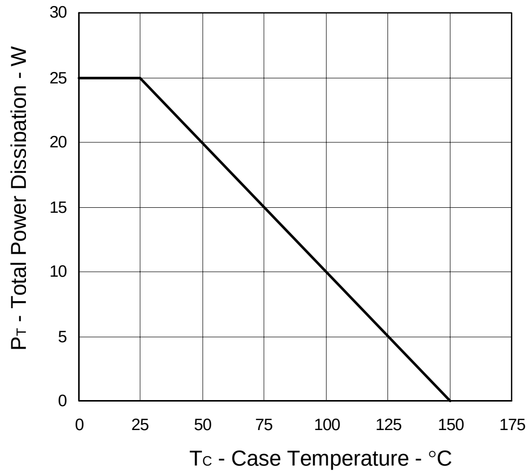


TYPICAL CHARACTERISTICS (T_A = 25°C)

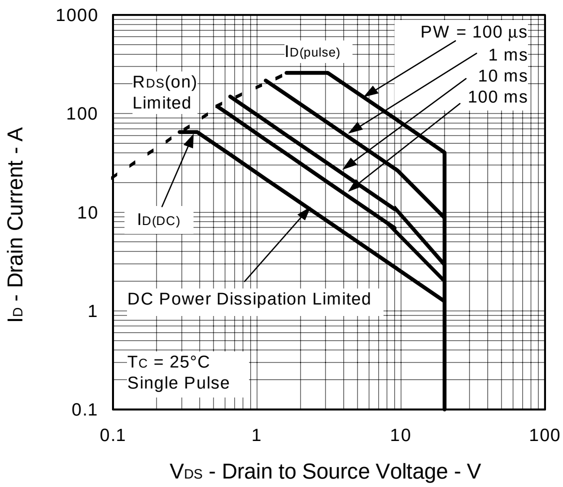
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



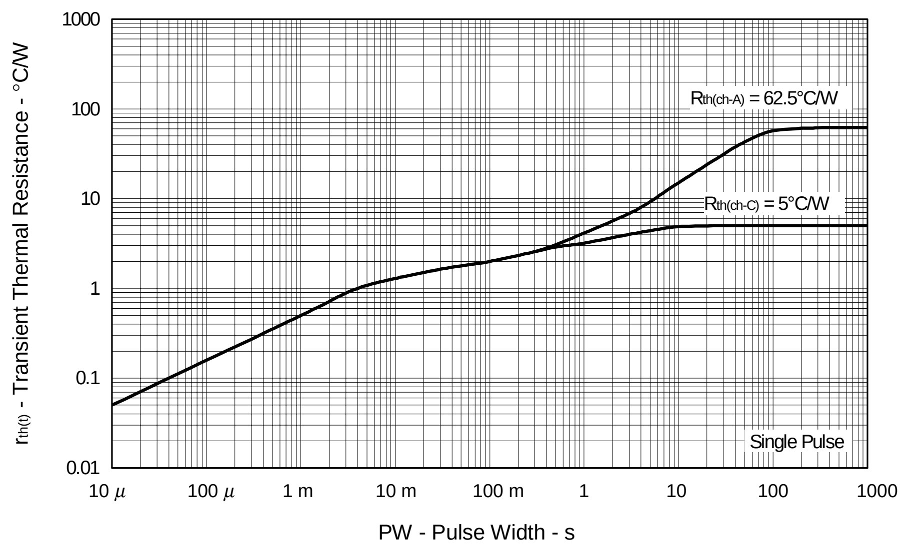
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



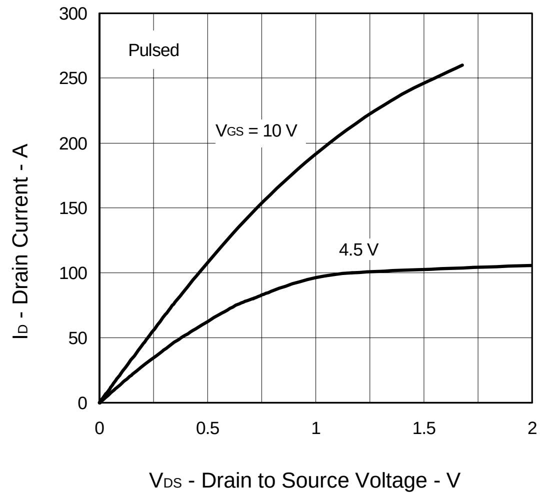
FORWARD BIAS SAFE OPERATING AREA



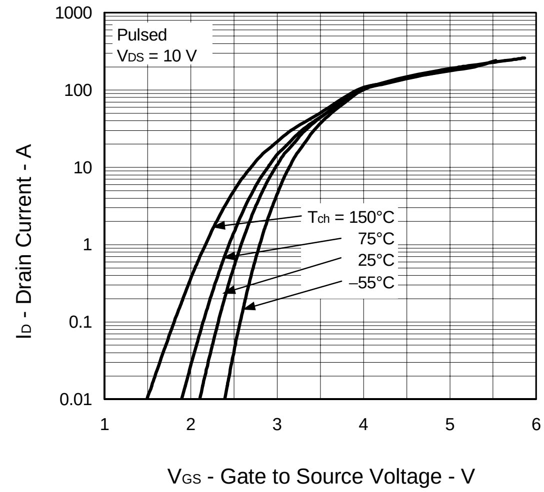
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



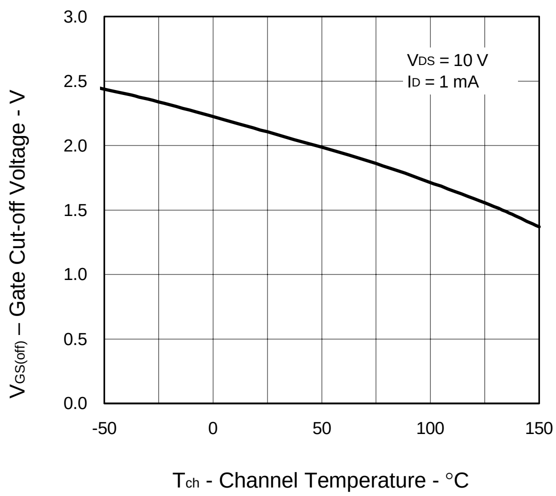
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



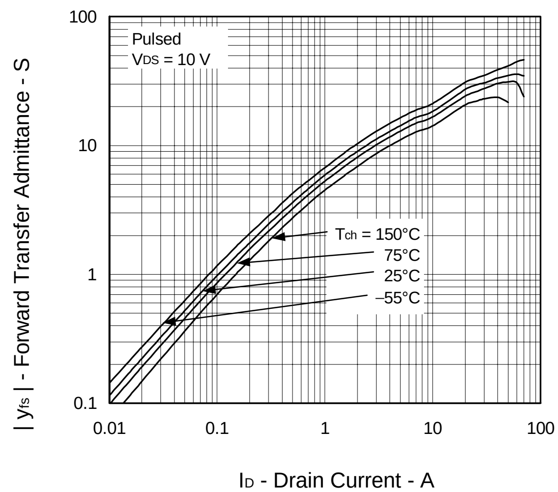
FORWARD TRANSFER CHARACTERISTICS



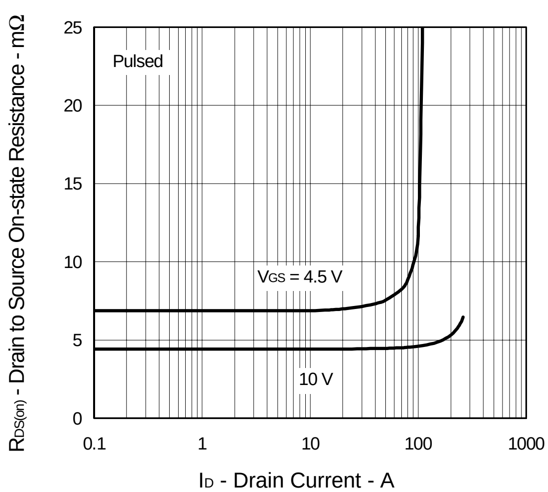
GATE CUT-OFF VOLTAGE vs.
CHANNEL TEMPERATURE



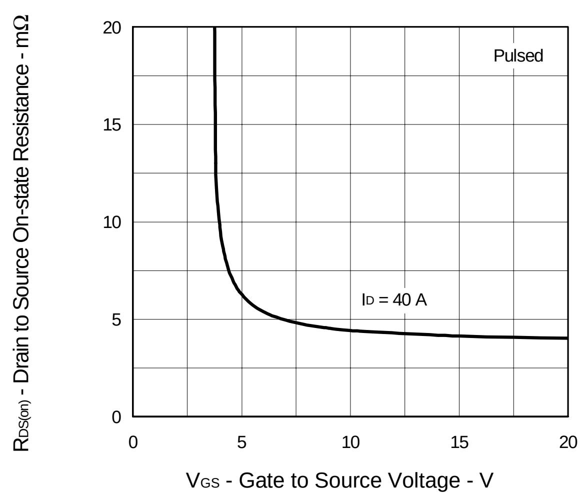
FORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENT



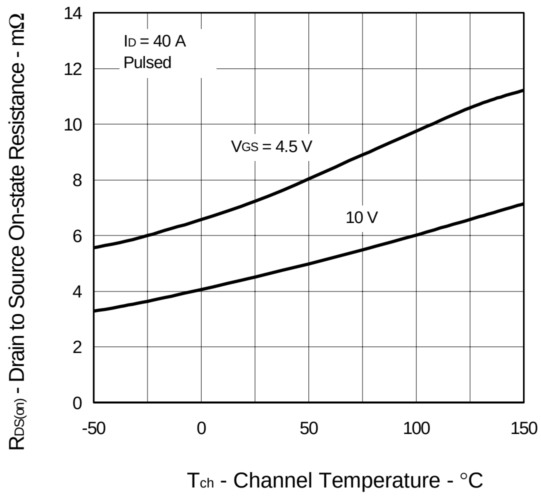
DRAIN TO SOURCE ON-STATE
RESISTANCE vs. DRAIN CURRENT



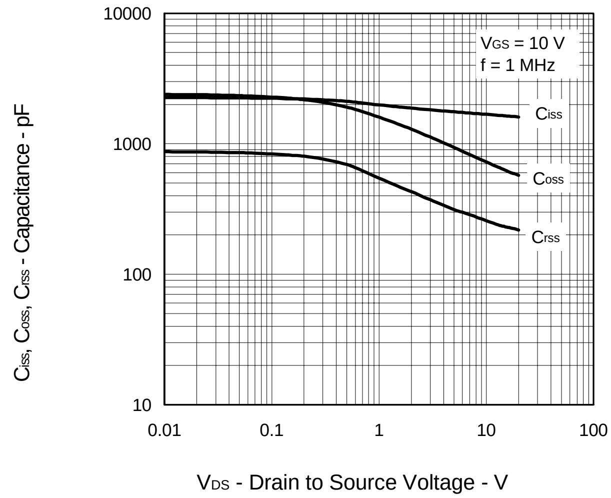
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE



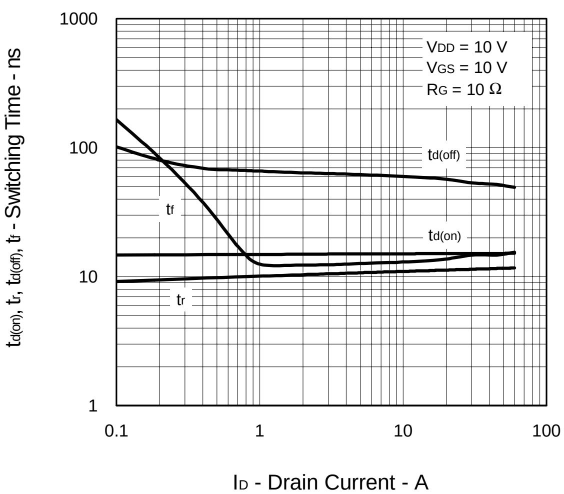
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
CHANNEL TEMPERATURE



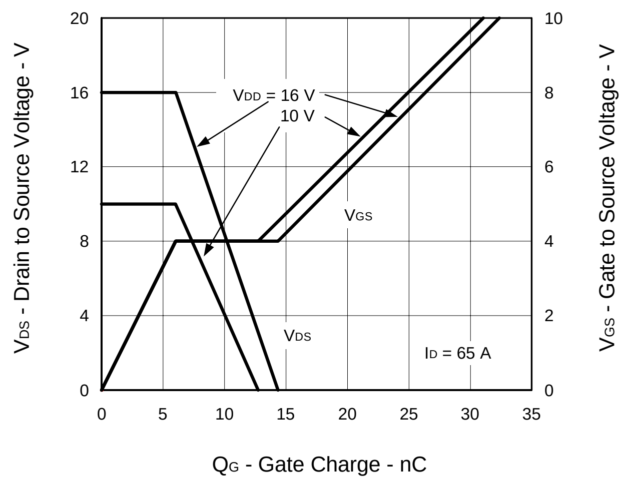
CAPACITANCE vs.
DRAIN TO SOURCE VOLTAGE



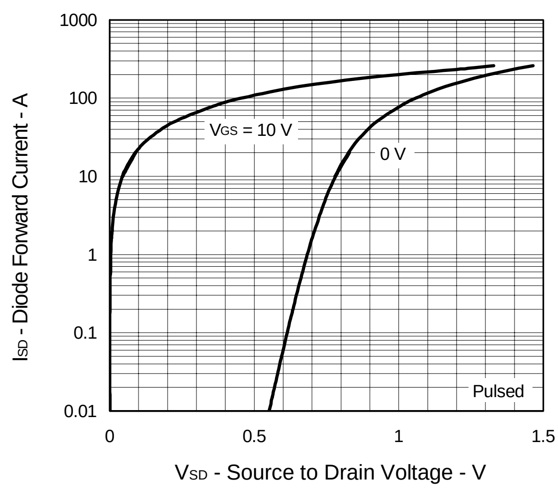
SWITCHING CHARACTERISTICS



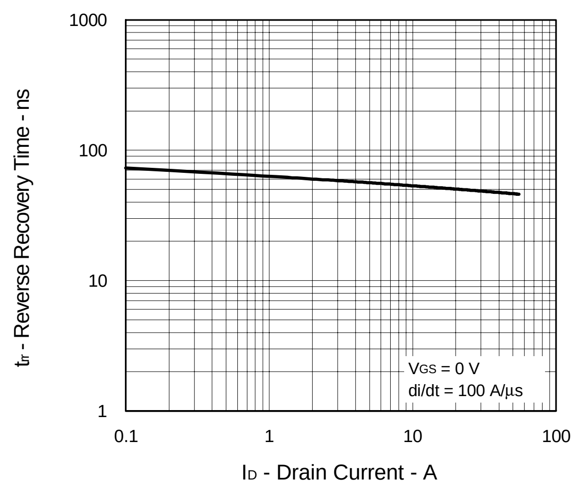
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



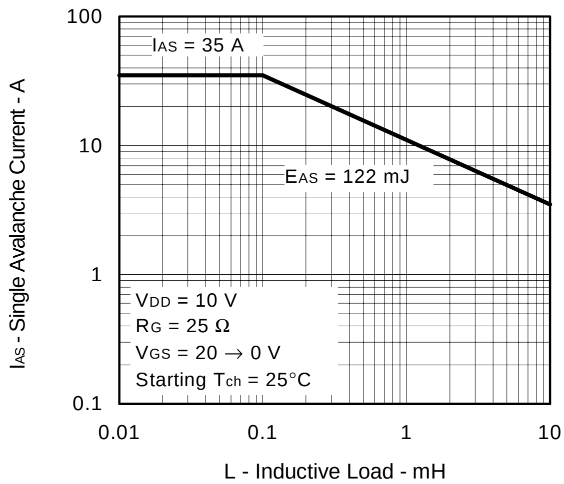
SOURCE TO DRAIN DIODE
FORWARD VOLTAGE



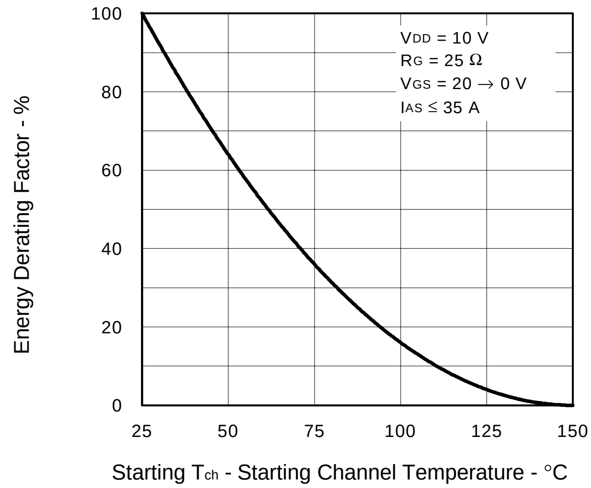
REVERSE RECOVERY TIME vs. DRAIN CURRENT



SINGLE AVALANCHE CURRENT vs.
INDUCTIVE LOAD

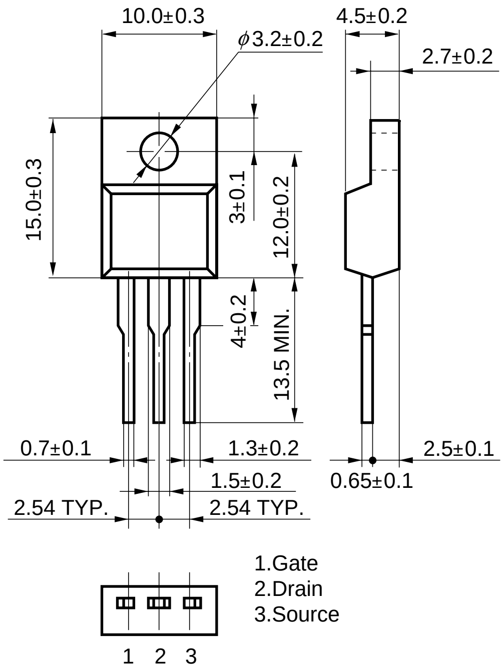


SINGLE AVALANCHE ENERGY
DERATING FACTOR

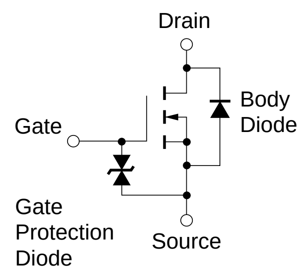


PACKAGE DRAWING (Unit: mm)

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.