DATA SHEET

NEC

# MOS FIELD EFFECT TRANSISTOR
# 2SK3902

## SWITCHING
## N-CHANNEL POWER MOS FET

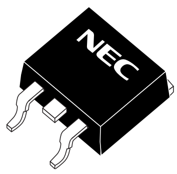
## DESCRIPTION

The 2SK3902 is N-channel MOS Field Effect Transistor designed for high current switching applications.

## ORDERING INFORMATION

| PART NUMBER | PACKAGE |
|---|---|
| 2SK3902-ZK | TO-263 (MP-25ZK) |

(TO-263)



## FEATURES

- Super low On-state resistance
  $R_{DS(on)1}$ = 21 mΩ MAX. ($V_{GS}$ = 10 V, $I_D$ = 15 A)
  $R_{DS(on)2}$ = 26 mΩ MAX. ($V_{GS}$ = 4.5 V, $I_D$ = 15 A)
- Low $C_{iss}$: $C_{iss}$ = 1200 pF TYP.
- Built-in gate protection diode

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C)

| | | | |
|---|---|---|---|
| Drain to Source Voltage ($V_{GS}$ = 0 V) | $V_{DSS}$ | 60 | V |
| Gate to Source Voltage ($V_{DS}$ = 0 V) | $V_{GSS}$ | ±20 | V |
| Drain Current (DC) ($T_C$ = 25°C) | $I_{D(DC)}$ | ±30 | A |
| Drain Current (pulse) Note1 | $I_{D(pulse)}$ | ±90 | A |
| Total Power Dissipation ($T_C$ = 25°C) | $P_{T1}$ | 45 | 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 Energy Note2 | $E_{AS}$ | 40 | mJ |
| Repetitive Avalanche Current Note3 | $I_{AR}$ | 20 | A |
| Repetitive Avalanche Energy Note3 | $E_{AR}$ | 40 | mJ |

**Notes 1.** PW ≤ 10 $\mu$s, Duty Cycle ≤ 1%

**2.** Starting $T_{ch}$ = 25°C, $V_{DD}$ = 30 V, $R_G$ = 25 Ω, $V_{GS}$ = 20 → 0 V, L = 100 $\mu$H

**3.** $R_G$ = 25 Ω, $T_{ch(peak)}$ ≤ 150°C

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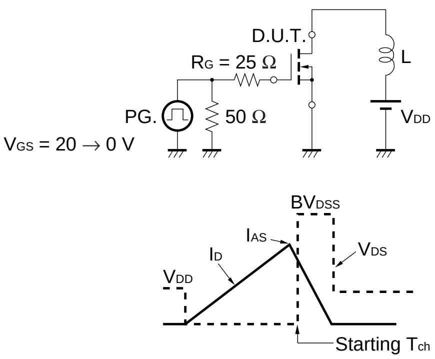
## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

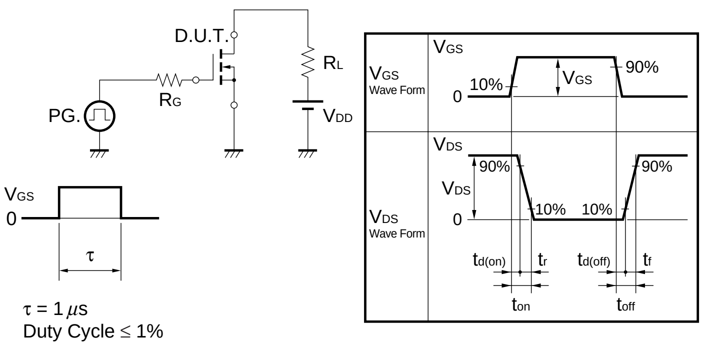
| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | | | 10 | μA |
| Gate Leakage Current | $I_{GSS}$ | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | | | ±10 | μA |
| Gate Cut-off Voltage | $V_{GS(off)}$ | $V_{DS}$ = 10 V, $I_D$ = 1 mA | 1.5 | 2.0 | 2.5 | V |
| Forward Transfer Admittance Note | $\|y_{fs}\|$ | $V_{DS}$ = 10 V, $I_D$ = 15 A | 9.5 | 19 | | S |
| Drain to Source On-state Resistance Note | $R_{DS(on)1}$ | $V_{GS}$ = 10 V, $I_D$ = 15 A | | 16.8 | 21 | mΩ |
| | $R_{DS(on)2}$ | $V_{GS}$ = 4.5 V, $I_D$ = 15 A | | 19.5 | 26 | mΩ |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 10 V | | 1200 | | pF |
| Output Capacitance | $C_{oss}$ | $V_{GS}$ = 0 V | | 250 | | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | f = 1 MHz | | 85 | | pF |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$ = 30 V, $I_D$ = 15 A | | 10 | | ns |
| Rise Time | $t_r$ | $V_{GS}$ = 10 V | | 4 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | $R_G$ = 0 Ω | | 37 | | ns |
| Fall Time | $t_f$ | | | 4 | | ns |
| Total Gate Charge | $Q_G$ | $V_{DD}$ = 48 V | | 25 | | nC |
| Gate to Source Charge | $Q_{GS}$ | $V_{GS}$ = 10 V | | 4.5 | | nC |
| Gate to Drain Charge | $Q_{GD}$ | $I_D$ = 30 A | | 6.0 | | nC |
| Body Diode Forward Voltage Note | $V_{F(S-D)}$ | $I_F$ = 30 A, $V_{GS}$ = 0 V | | 0.92 | 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 30 A, $V_{GS}$ = 0 V | | 31 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | di/dt = 100 A/μs | | 34 | | nC |

**Note** Pulsed

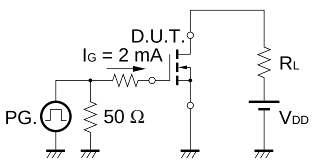
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**




**TEST CIRCUIT 2 SWITCHING TIME**

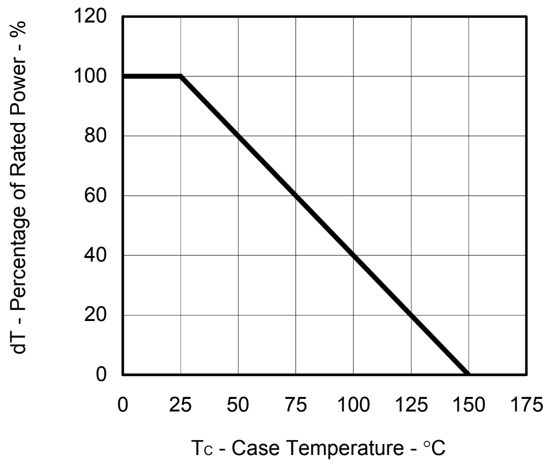



**TEST CIRCUIT 3 GATE CHARGE**

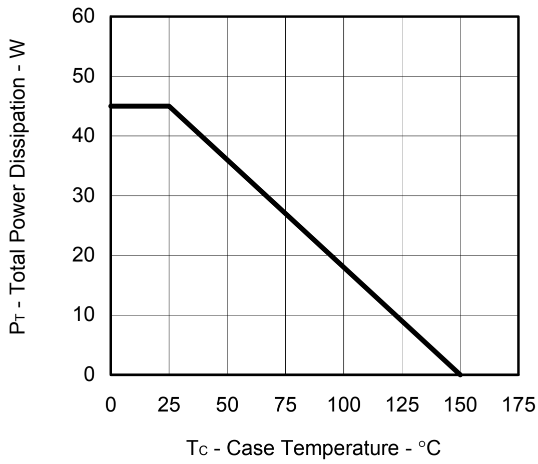


**TYPICAL CHARACTERISTICS ($T_A$ = 25°C)**

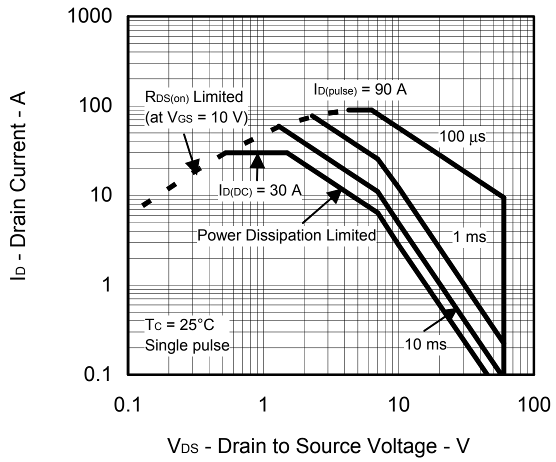
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



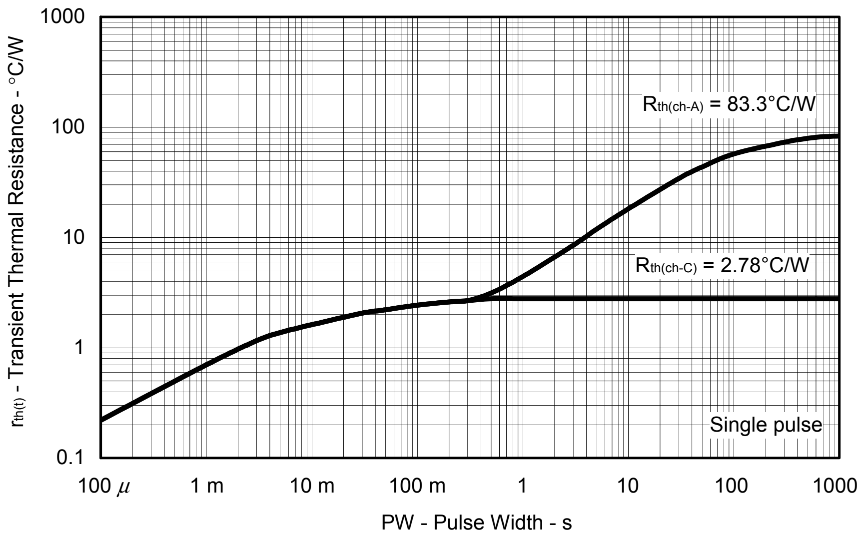

TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



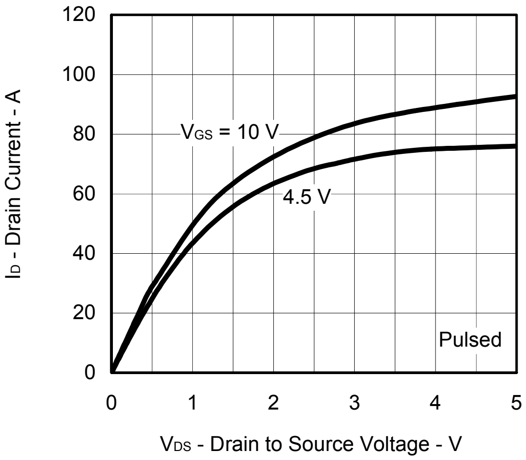

FORWARD BIAS SAFE OPERATING AREA



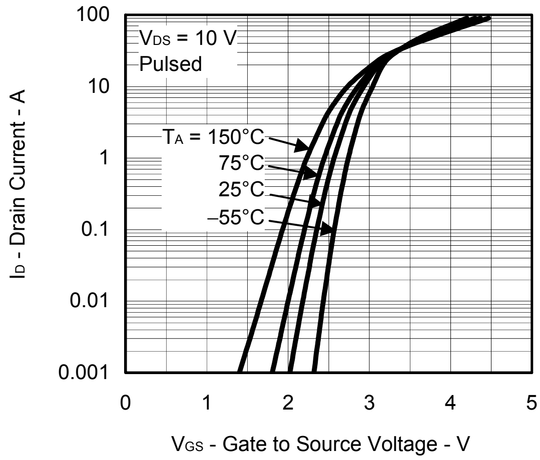

TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



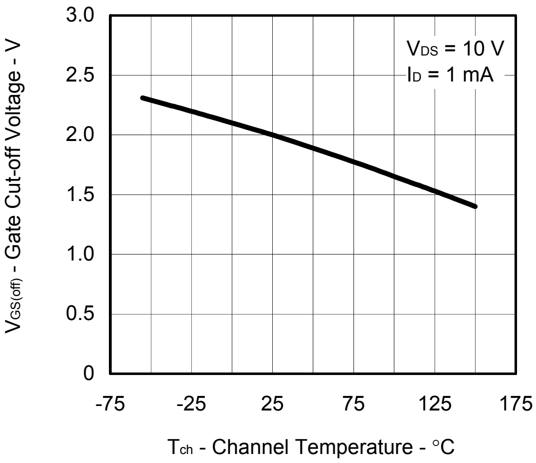
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



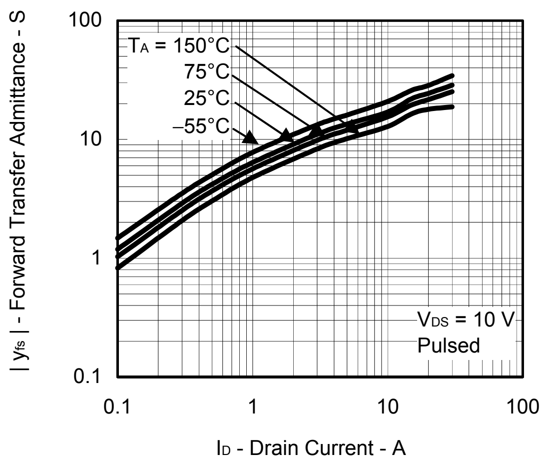

FORWARD TRANSFER CHARACTERISTICS



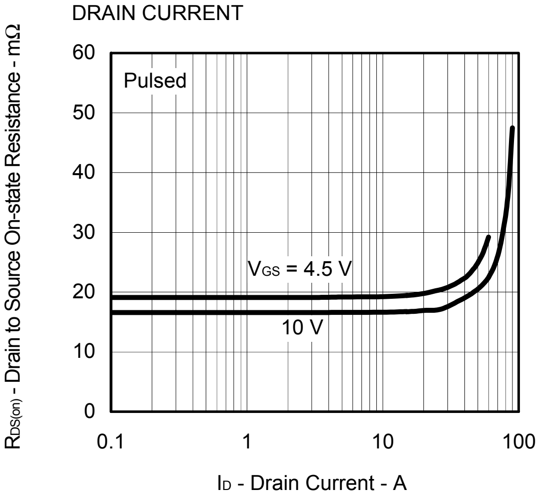

GATE CUT-OFF VOLTAGE vs.
CHANNEL TEMPERATURE



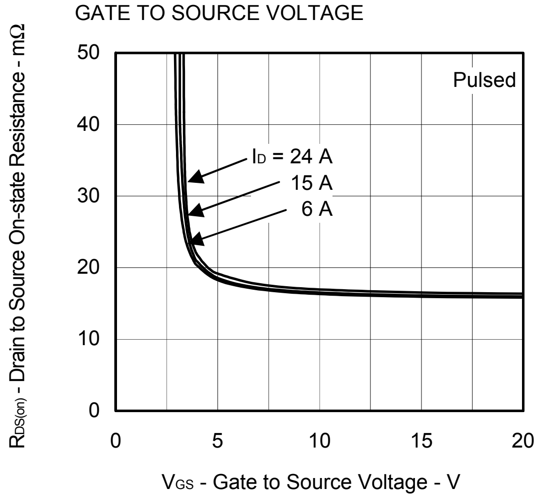

FORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENT



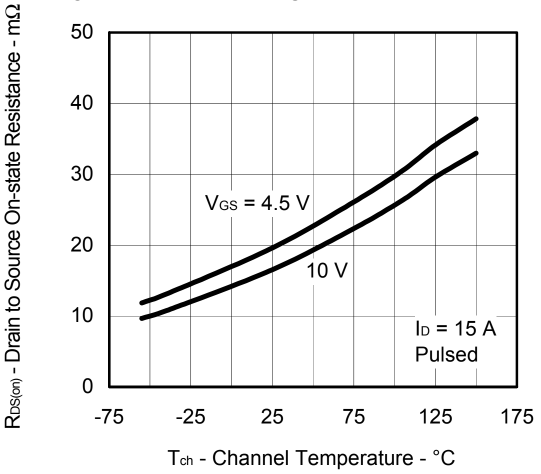

DRAIN TO SOURCE ON-STATE RESISTANCE vs.
DRAIN CURRENT



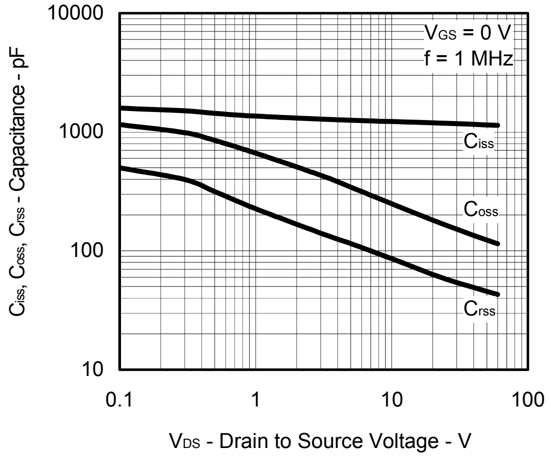

DRAIN TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE



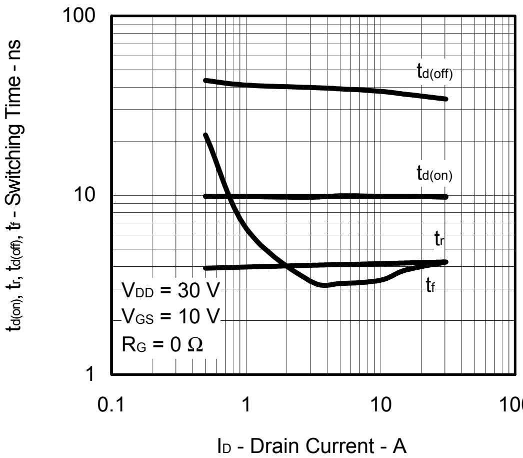
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



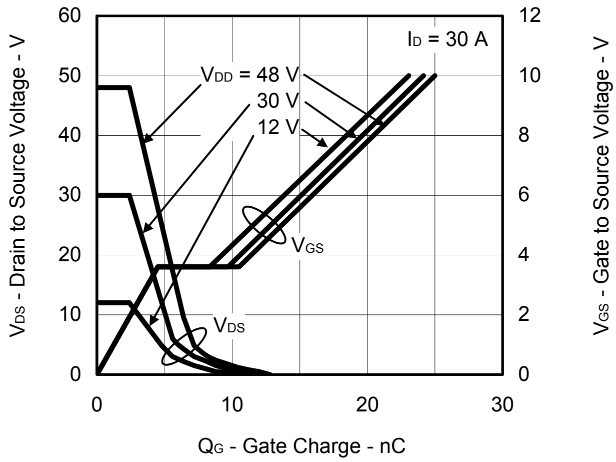

CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



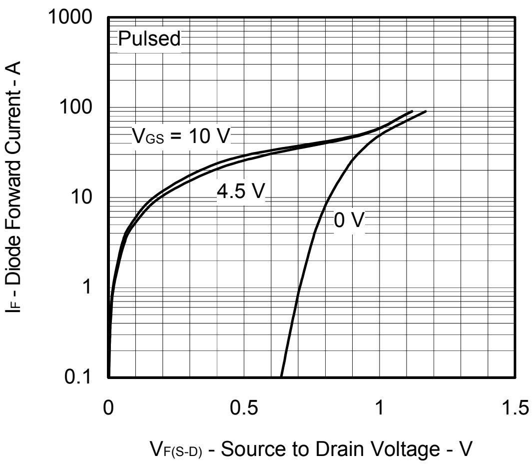

SWITCHING CHARACTERISTICS



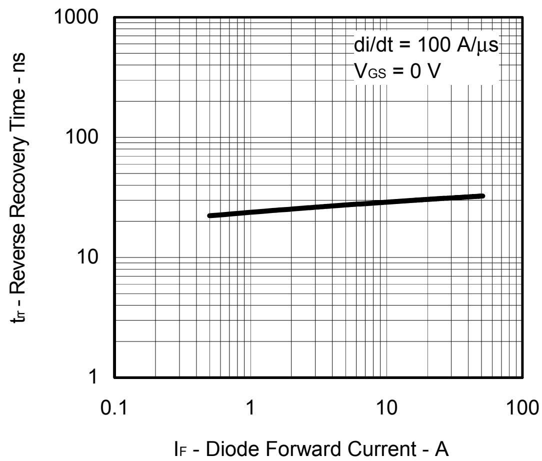

DYNAMIC INPUT/OUTPUT CHARACTERISTICS



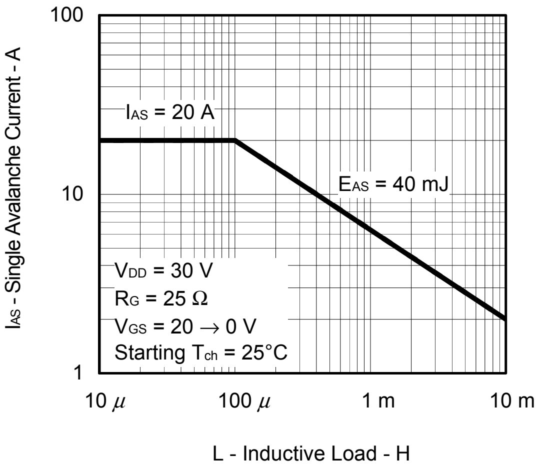

SOURCE TO DRAIN DIODE FORWARD VOLTAGE



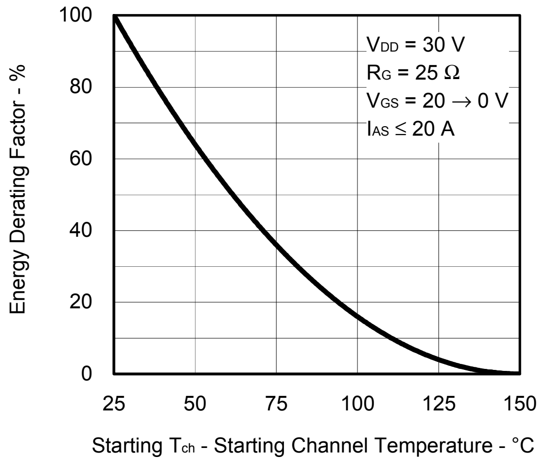

REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



SINGLE AVALANCHE CURRENT vs.
INDUCTIVE LOAD

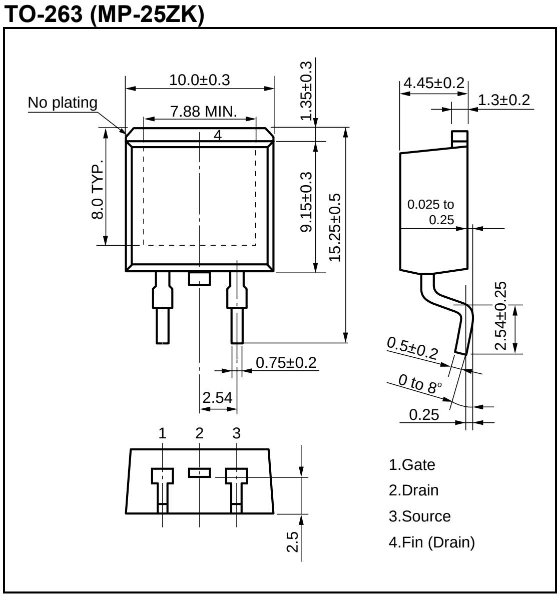



SINGLE AVALANCHE ENERGY
DERATING FACTOR

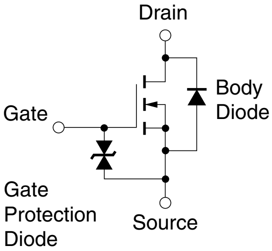


## PACKAGE DRAWING (Unit: mm)

**TO-263 (MP-25ZK)**




## 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.