

SWITCHING
N-CHANNEL POWER MOS FET

DESCRIPTION

The 2SK3221 is N-channel DMOS FET device that features a low gate charge and excellent switching characteristics, and designed for high voltage applications such as switching power supply, AC adapter.

FEATURES

- Low gate charge
 $Q_G = 9 \text{ nC TYP. (} V_{DD} = 450 \text{ V, } V_{GS} = 10 \text{ V, } I_D = 2.0 \text{ A)}$
- Gate voltage rating $\pm 30 \text{ V}$
- Low on-state resistance
 $R_{DS(on)} = 4.4 \text{ } \Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 1.0 \text{ A)}$
- Avalanche capability ratings
- Isolated TO-220 package

ORDERING INFORMATION

| PART NUMBER | PACKAGE |
|-------------|-----------------|
| 2SK3211 | Isolated TO-220 |

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

| | | | |
|--|----------------|-------------|------------------|
| Drain to Source Voltage ($V_{GS} = 0 \text{ V}$) | V_{DSS} | 600 | V |
| Gate to Source Voltage ($V_{DS} = 0 \text{ V}$) | V_{GSS} | ± 30 | V |
| Drain Current (DC) ($T_C = 25^\circ\text{C}$) | $I_{D(DC)}$ | ± 2.0 | A |
| Drain Current (pulse) ^{Note1} | $I_{D(pulse)}$ | ± 8.0 | A |
| Total Power Dissipation ($T_A = 25^\circ\text{C}$) | P_{T1} | 2.0 | W |
| Total Power Dissipation ($T_C = 25^\circ\text{C}$) | P_{T2} | 25 | W |
| Channel Temperature | T_{ch} | 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -55 to +150 | $^\circ\text{C}$ |
| Single Avalanche Current ^{Note2} | I_{AS} | 2.0 | A |
| Single Avalanche Energy ^{Note2} | E_{AS} | 2.7 | mJ |
| Diode Recovery dv/dt ^{Note3} | dv/dt | 3.5 | V/ns |

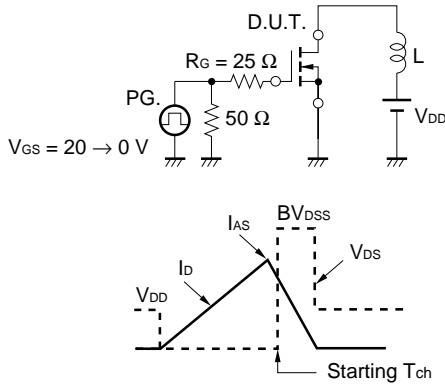
- Notes**
1. $PW \leq 10 \text{ } \mu\text{s}$, Duty Cycle $\leq 1\%$
 2. Starting $T_{ch} = 25^\circ\text{C}$, $V_{DD} = 150 \text{ V}$, $R_G = 25 \text{ } \Omega$, $V_{GS} = 20 \rightarrow 0 \text{ V}$
 3. $I_F \leq 1.0 \text{ A}$, $V_{clamp} = 600 \text{ V}$, $di/dt \leq 100 \text{ A/ } \mu\text{s}$, $T_A = 25^\circ\text{C}$

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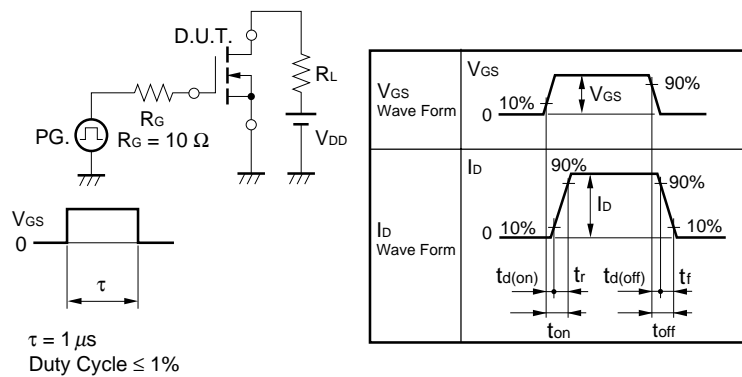
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------|----------------------|---|------|------|------|------|
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 600 V, V _{GS} = 0 V | | | 100 | μA |
| Gate Leakage Current | I _{GSS} | V _{GS} = ±30 V, V _{DS} = 0 V | | | ±10 | μA |
| Gate Cut-off Voltage | V _{GS(off)} | V _{DS} = 10 V, I _D = 1 mA | 2.5 | | 3.5 | V |
| Forward Transfer Admittance | y _{fs} | V _{DS} = 10 V, I _D = 1.0 A | 0.5 | | | S |
| Drain to Source On-state Resistance | R _{DS(on)} | V _{GS} = 10 V, I _D = 1.0 A | | 3.3 | 4.4 | Ω |
| Input Capacitance | C _{iSS} | V _{DS} = 10 V | | 290 | | pF |
| Output Capacitance | C _{oSS} | V _{GS} = 0 V | | 60 | | pF |
| Reverse Transfer Capacitance | C _{rSS} | f = 1 MHz | | 5 | | pF |
| Turn-on Delay Time | t _{d(on)} | V _{DD} = 150 V, I _D = 1.0 A | | 7 | | ns |
| Rise Time | t _r | V _{GS} = 10 V | | 2 | | ns |
| Turn-off Delay Time | t _{d(off)} | R _G = 10 Ω | | 20 | | ns |
| Fall Time | t _f | | | 10 | | ns |
| Total Gate Charge | Q _G | V _{DD} = 450 V | | 9 | | nC |
| Gate to Source Charge | Q _{GS} | V _{GS} = 10 V | | 2.4 | | nC |
| Gate to Drain Charge | Q _{GD} | I _D = 2.0 A | | 2 | | nC |
| Body Diode Forward Voltage | V _{F(S-D)} | I _F = 2.0 A, V _{GS} = 0 V | | 0.9 | | V |
| Reverse Recovery Time | t _{rr} | I _F = 2.0 A, V _{GS} = 0 V | | 0.9 | | μs |
| Reverse Recovery Charge | Q _{rr} | di/dt = 50 A/μs | | 2.0 | | μC |

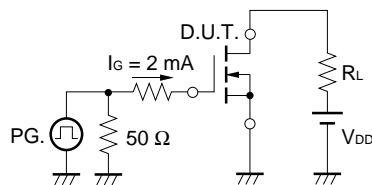
TEST CIRCUIT 1 AVALANCHE CAPABILITY



TEST CIRCUIT 2 SWITCHING TIME

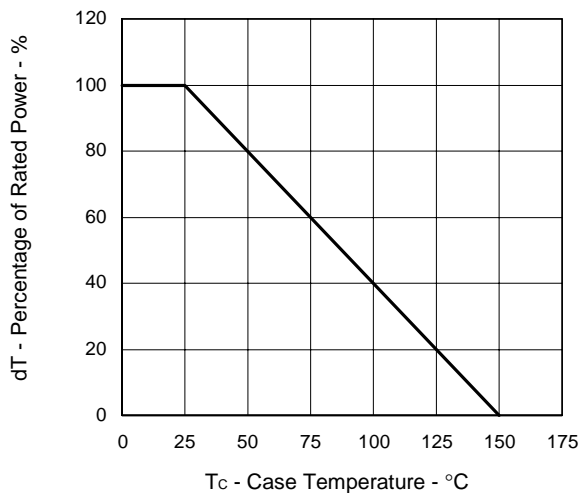


TEST CIRCUIT 3 GATE CHARGE

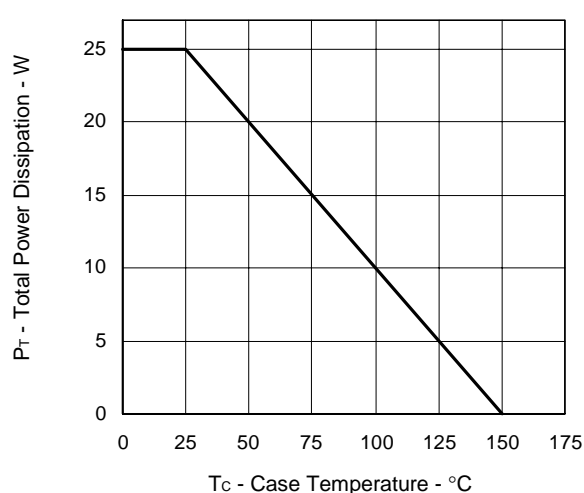


TYPICAL CHARACTERISTICS (T_A = 25°C)

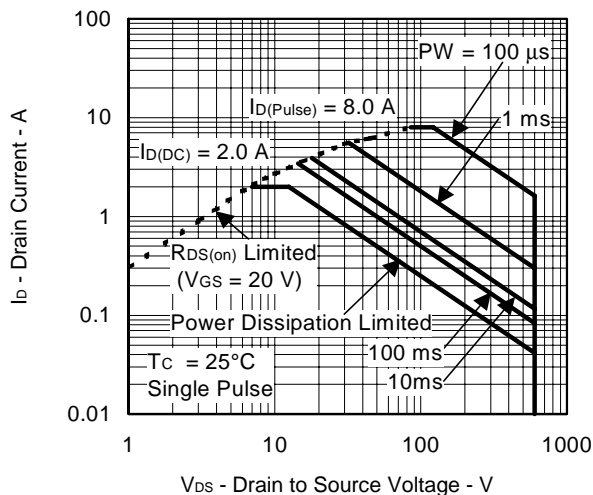
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



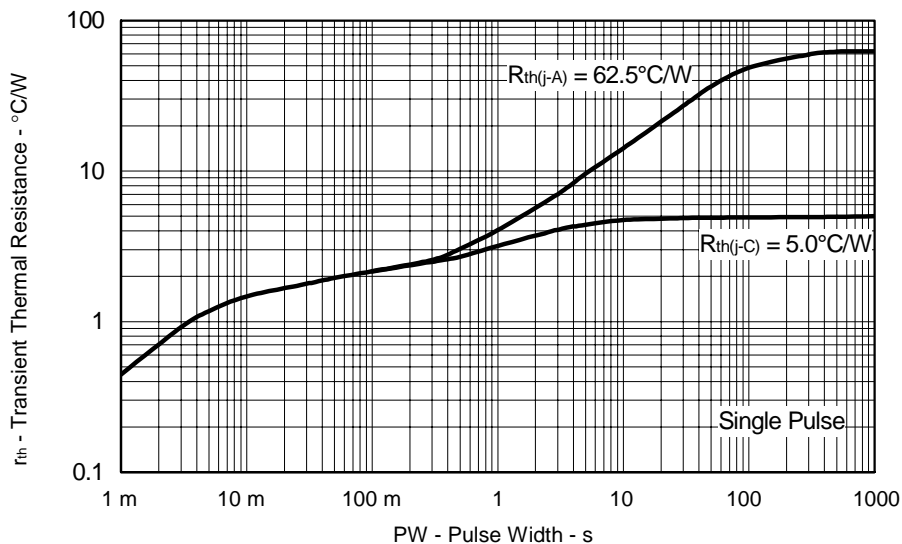
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



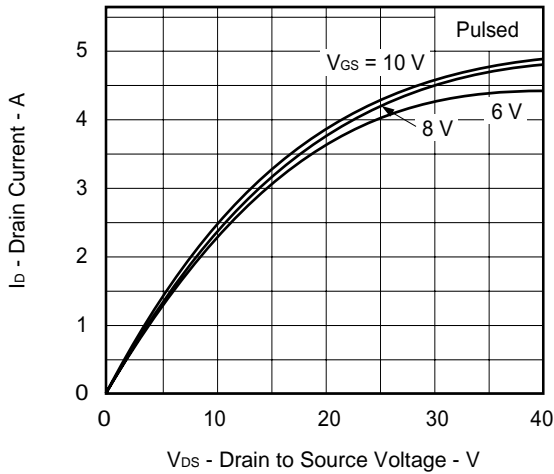
FORWARD BIAS SAFE OPERATING AREA



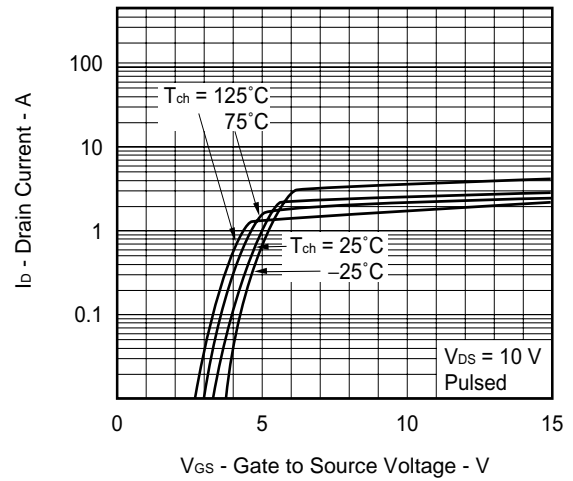
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



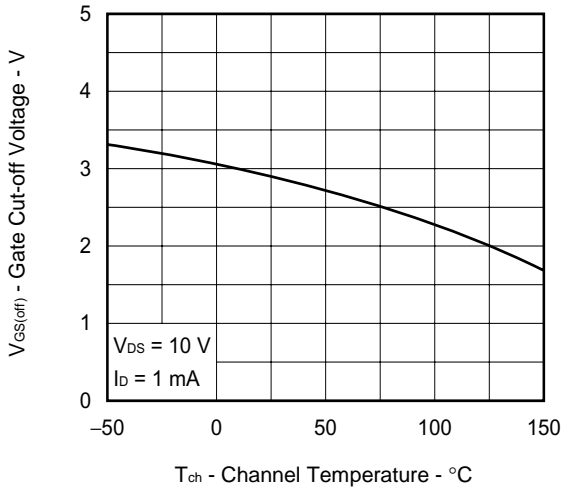
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



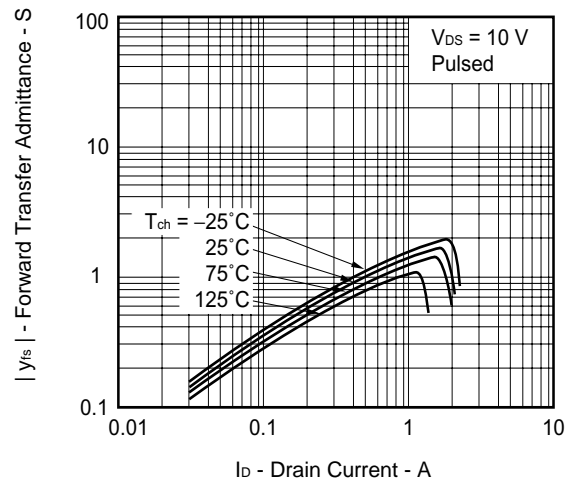
FORWARD TRANSFER CHARACTERISTICS



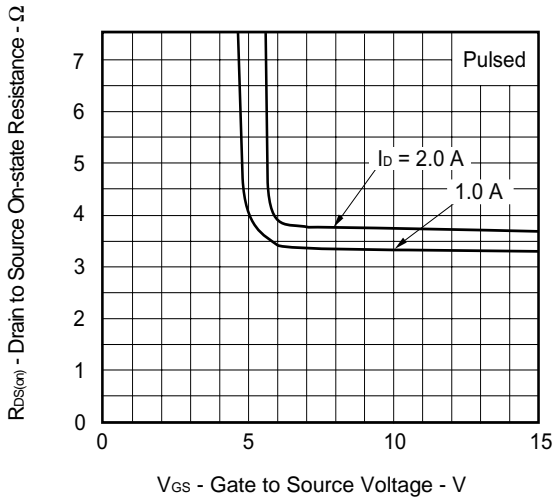
GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



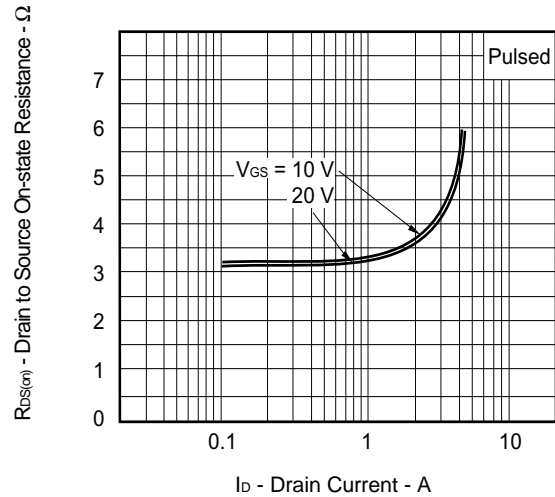
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



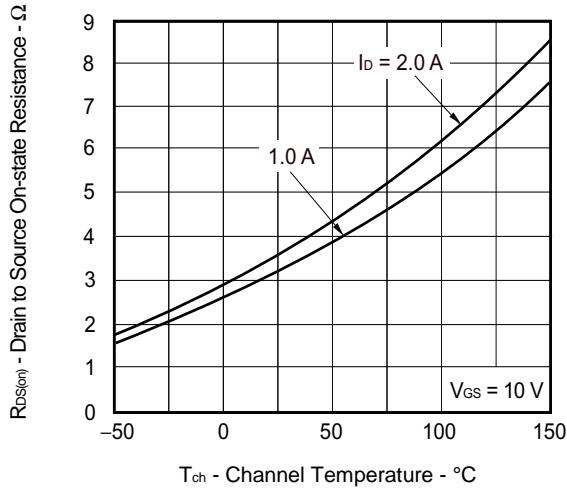
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



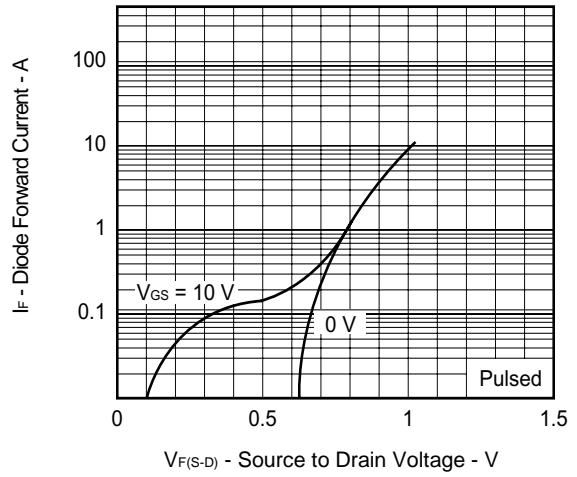
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



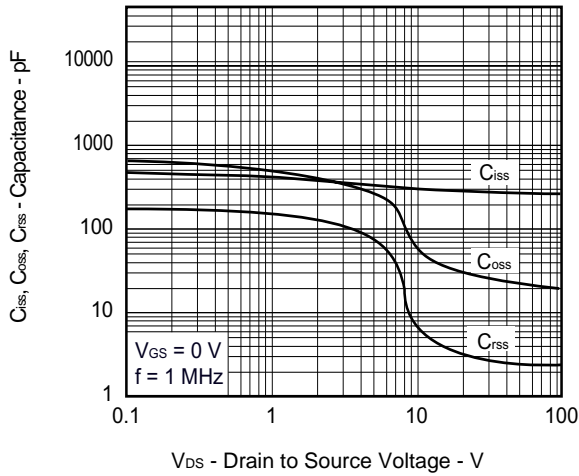
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



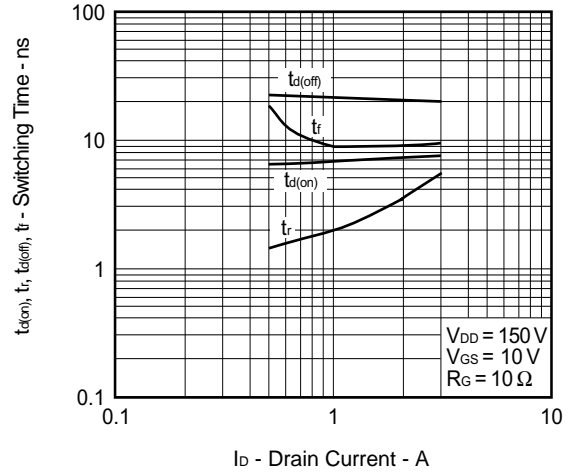
SOURCE TO DRAIN DIODE FORWARD VOLTAGE



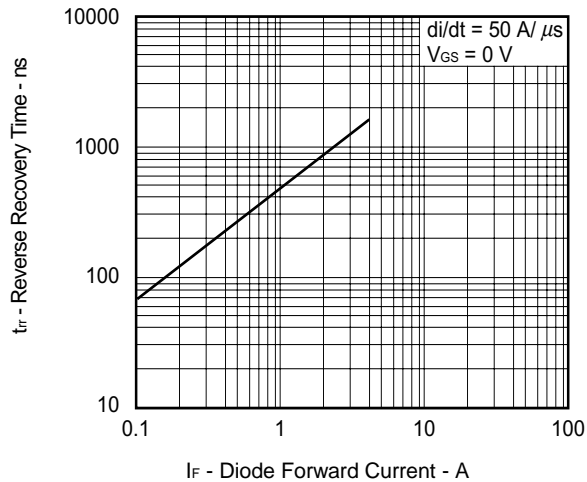
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



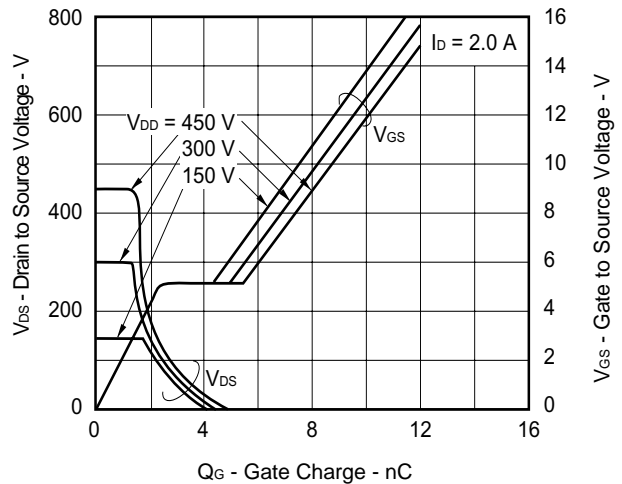
SWITCHING CHARACTERISTICS



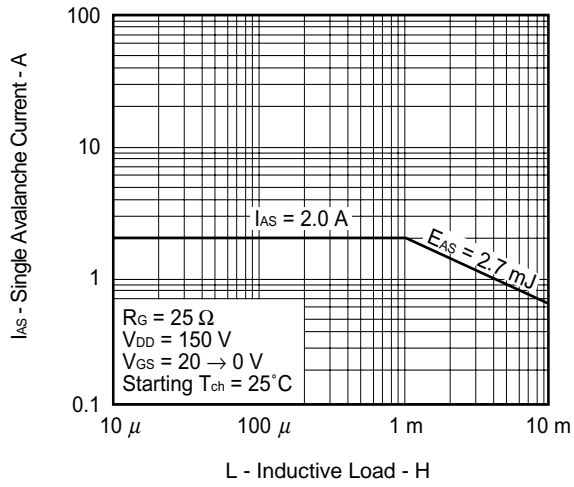
REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



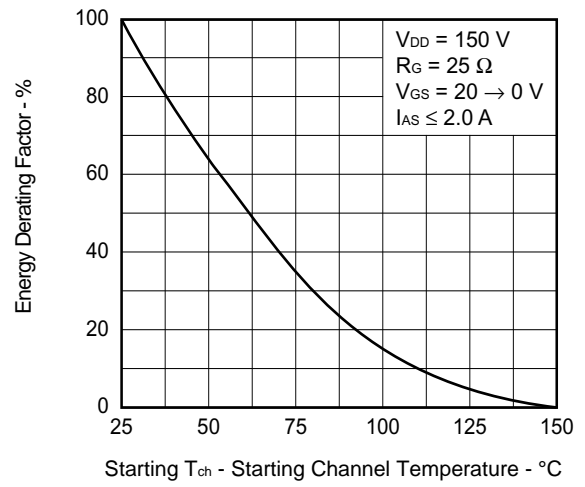
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SINGLE AVALANCHE CURRENT vs. INDUCTIVE LOAD

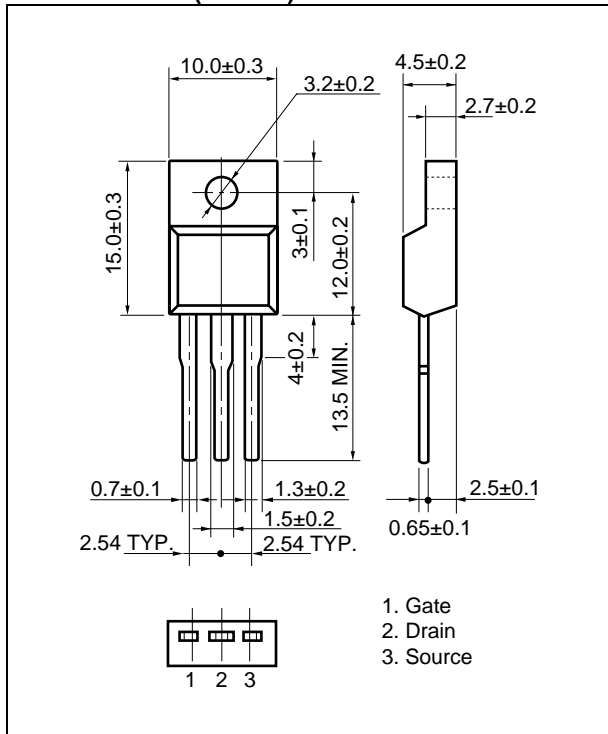


SINGLE AVALANCHE ENERGY DERATING FACTOR

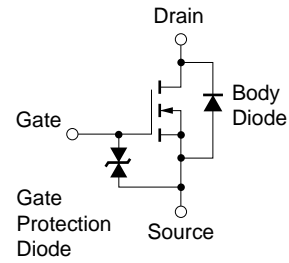


PACKAGE DRAWING (Unit: mm)

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.

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