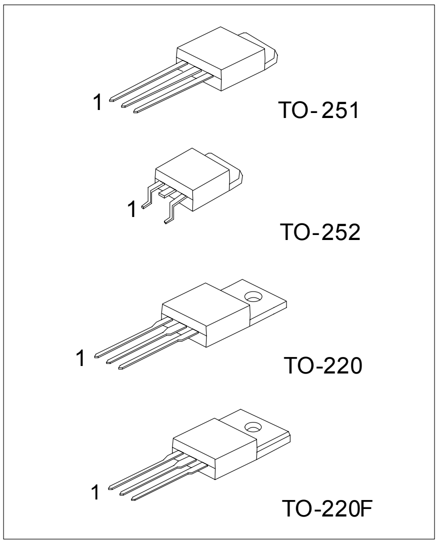
# 1.8Amps, 650 Volts
# N-CHANNEL MOSFET




*Pb-free plating product number: 2N60

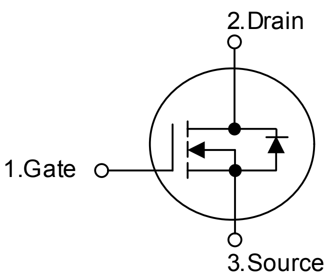
## ■ DESCRIPTION

The YR 2N65 is a high voltage MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

## ■ FEATURES

* $R_{DS(ON)}$ = 7.0Ω@$V_{GS}$ = 10V.
* Ultra Low gate charge (typical 9.0nC)
* Low reverse transfer capacitance (Crss = typical 5.0 pF)
* Fast switching capability
* Avalanche energy specified
* Improved dv/dt capability, high ruggedness

## ■ SYMBOL



## ■ ABSOLUTE MAXIMUM RATINGS ($T_C$ = 25°C, unless otherwise specified)

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 650 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±20 | V |
| Avalanche Current (Note 2) | | $I_{AR}$ | 1.8 | A |
| Drain Current Continuous | $T_C$ = 25°C | $I_D$ | 1.8 | A |
| | $T_C$ = 100°C | | 1.26 | A |
| Drain Current Pulsed (Note 2) | | $I_{DP}$ | 7.2 | A |
| Avalanche Energy | Repetitive(Note 2) | $E_{AR}$ | 4.5 | mJ |
| | Single Pulse(Note 3) | $E_{AS}$ | 140 | mJ |
| Peak Diode Recovery dv/dt (Note 4) | | dv/dt | 4.5 | V/ns |
| Total Power Dissipation | $T_C$ = 25°C | $P_D$ | 45 | W |
| | Derate above 25°C | | 0.36 | W/℃ |
| Junction Temperature | | $T_J$ | +150 | ℃ |
| Storage Temperature | | $T_{STG}$ | -55 ~ +150 | ℃ |

Note:1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3. L=64mH, $I_{AS}$=2.0A, $V_{DD}$=50V, $R_G$=25 Ω, Starting $T_J$ = 25°C
4. $I_{SD}$≤ 2.4A, di/dt ≤ 200A/μs, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C

## ■ THERMAL DATA

| PARAMETER | PACKAGE | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Thermal Resistance Junction-Ambient | TO-251 | $\theta_{JA}$ | 112 | ℃/W |
| | TO-252 | | 112 | |
| | TO-220 | | 54 | |
| | TO-220F | | 54 | |
| Thermal Resistance Junction-Case | TO-251 | $\theta_{Jc}$ | 12 | |
| | TO-252 | | 12 | |
| | TO-220 | | 4 | |
| | TO-220F | | 4 | |

## ■ ELECTRICAL CHARACTERISTICS ($T_J$ =25℃, unless Otherwise specified.)

| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $V_{GS}$ = 0V, $I_D$ = 250μA | 650 | | | V |
| Zero Gate Voltage Drain Current | | $I_{DSS}$ | $V_{DS}$ = 650V, $V_{GS}$ = 0V | | | 10 | μA |
| | | | $V_{DS}$ = 520V, $T_C$ = 125°C | | | 100 | μA |
| Gate-Body Leakage Current | Forward | $I_{GSS}$ | $V_{GS}$ = 20V, $V_{DS}$ = 0V | | | 100 | nA |
| | Reverse | | $V_{GS}$ = -20V, $V_{DS}$ = 0V | | | -100 | nA |
| Breakdown Voltage Temperature Coefficient | | $\triangle BV_{DSS}/\triangle T_J$ | $I_D$ = 250 μA | | 0.4 | | V/℃ |
| **On Characteristics** | | | | | | | |
| Gate Threshold Voltage | | $V_{GS(TH)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 2.0 | | 4.0 | V |
| Static Drain-Source On-Resistance | | $R_{DS(ON)}$ | $V_{GS}$ = 10V, $I_D$ =0.9A | | 6.0 | 7.0 | Ω |
| Forward Transconductance | | $g_{FS}$ | $V_{DS}$ = 50V, $I_D$ = 0.9A (Note 1) | | 2.25 | | S |
| **Dynamic Characteristics** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | $V_{DS}$ =25V, $V_{GS}$ =0V, f =1MHz | | 270 | 350 | pF |
| Output Capacitance | | $C_{OSS}$ | | | 40 | 50 | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 5 | 7 | pF |

## ■ ELECTRICAL CHARACTERISTICS(Cont.)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **Switching Characteristics** | | | | | | |
| Turn-On Delay Time | $t_{D\ (ON)}$ | $V_{DD}$ =300V, $I_D$ =1.8A, $R_G$=25Ω (Note 1,2) | | 10 | 30 | ns |
| Rise Time | $t_R$ | | | 25 | 60 | ns |
| Turn-Off Delay Time | $t_{D(OFF)}$ | | | 20 | 50 | ns |
| Fall Time | $t_F$ | | | 25 | 60 | ns |
| Total Gate Charge | $Q_G$ | $V_{DS}$=480V, $V_{GS}$=10V, $I_D$=1.8A (Note 1, 2) | | 9.0 | 11 | nC |
| Gate-Source Charge | $Q_{GS}$ | | | 1.6 | | nC |
| Gate-Drain Charge | $Q_{GD}$ | | | 4.3 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Drain-Source Diode Forward Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_{SD}$ = 1.8 A | | | 1.4 | V |
| Continuous Drain-Source Current | $I_{SD}$ | | | | 1.8 | A |
| Pulsed Drain-Source Current | $I_{SM}$ | | | | 7.2 | A |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, $I_{SD}$ = 1.8A, di/dt = 100 A/μs (Note1) | | 180 | | ns |
| Reverse Recovery Charge | $Q_{RR}$ | | | 0.72 | | μC |

Note: 1. Pulse Test: Pulse Width ≤300μs, Duty Cycle≤2%
2. Essentially Independent of Operating Temperature

## ■ TEST CIRCUITS AND WAVEFORMS

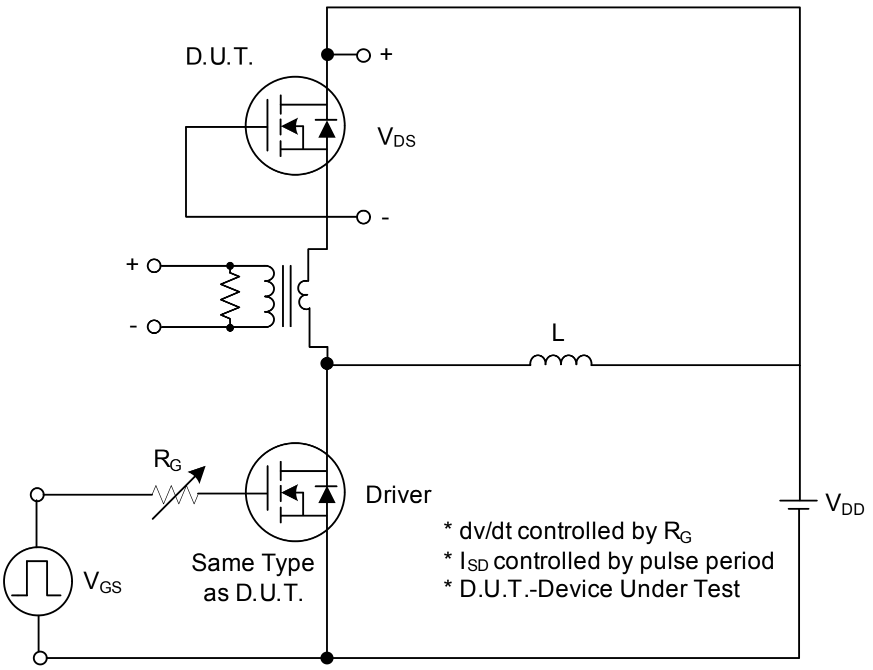



**Fig. 1A Peak Diode Recovery dv/dt Test Circuit**

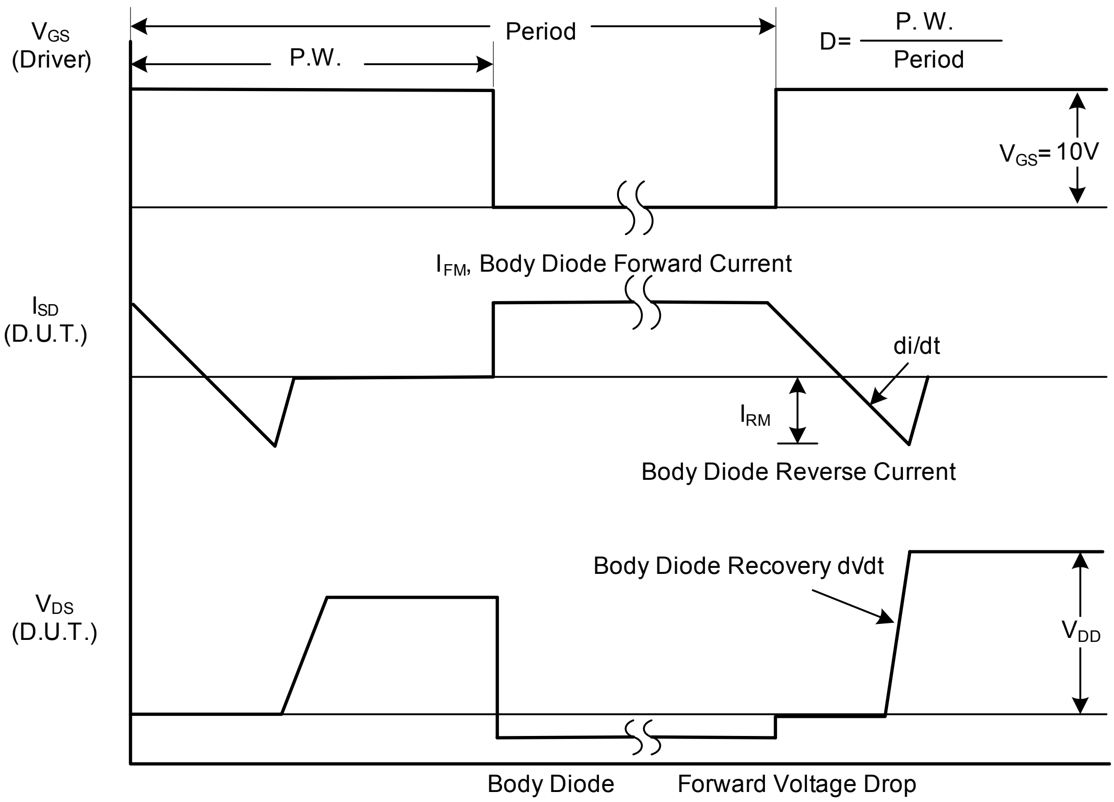



**Fig. 1B Peak Diode Recovery dv/dt Waveforms**

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

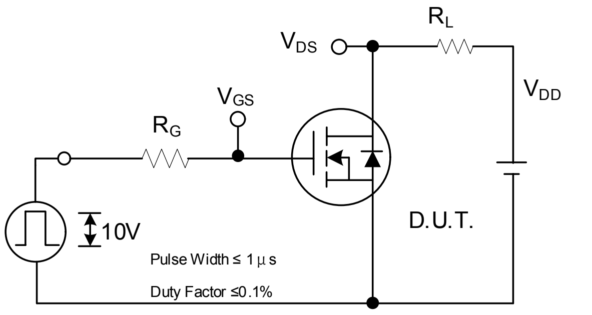



**Fig. 2A Switching Test Circuit**

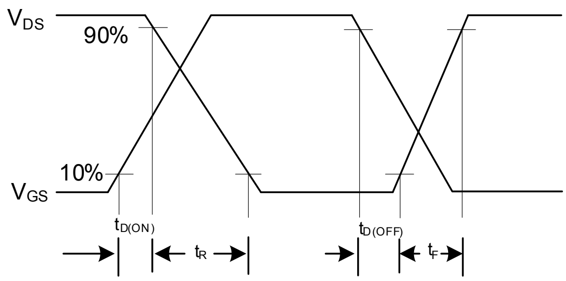



**Fig. 2B Switching Waveforms**

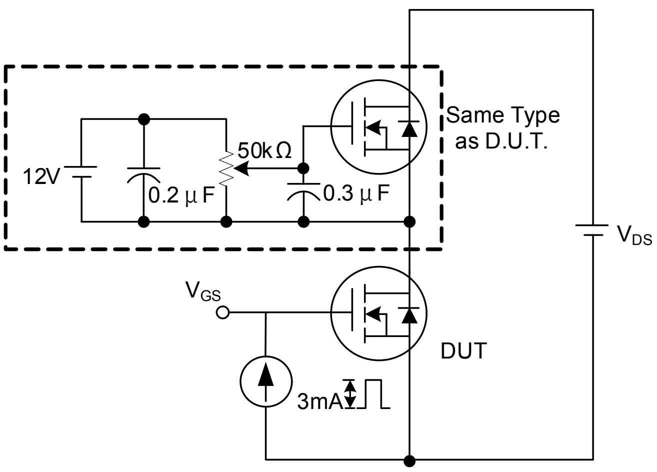



**Fig. 3A Gate Charge Test Circuit**

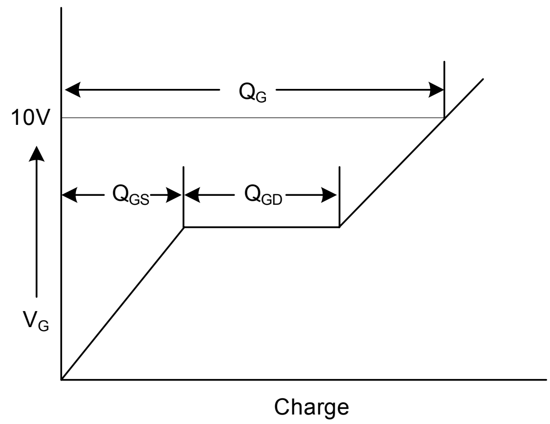



**Fig. 3B Gate Charge Waveform**

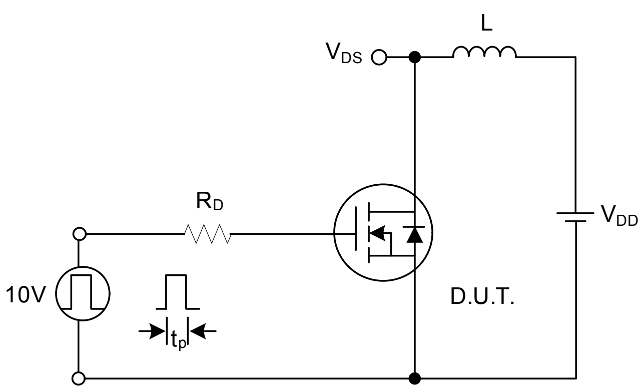



**Fig. 4A Unclamped Inductive Switching Test Circuit**

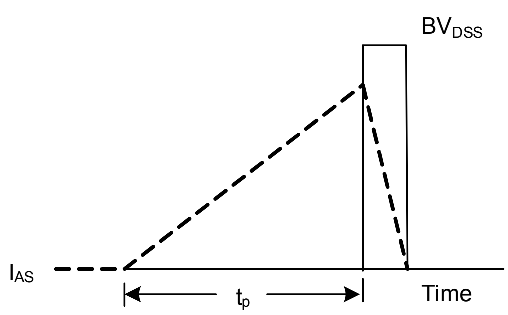
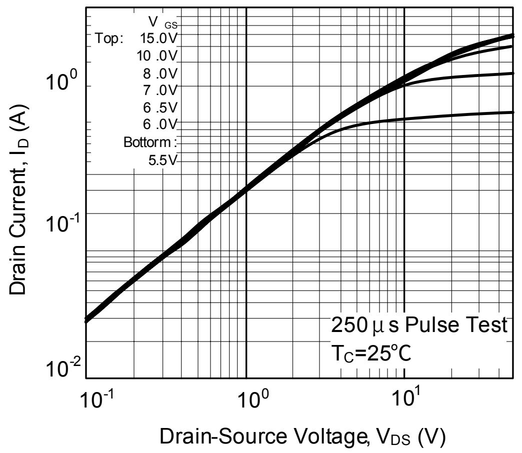


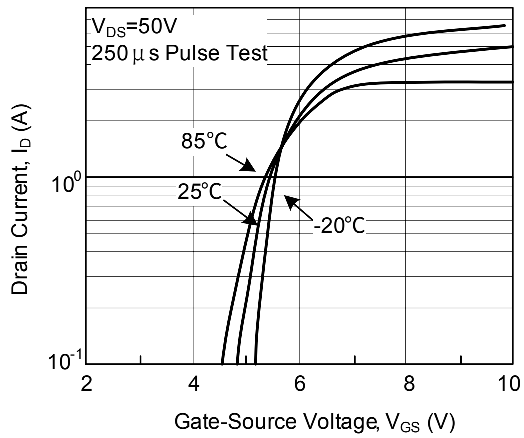

**Fig. 4B Unclamped Inductive Switching Waveforms**

## ■ TYPICAL CHARACTERISTICS

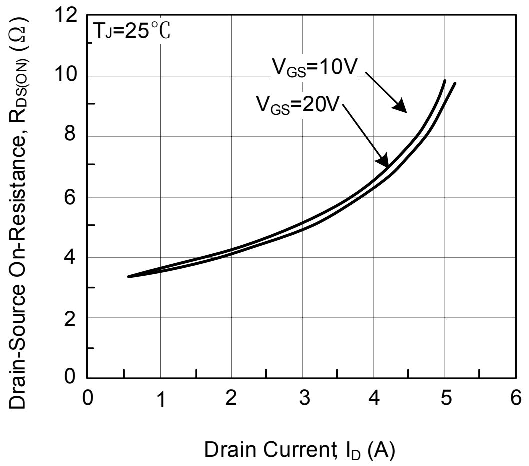
On-Region Characteristics



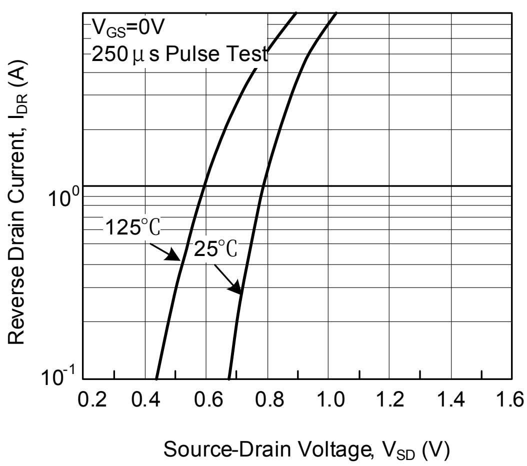

Transfer Characteristics



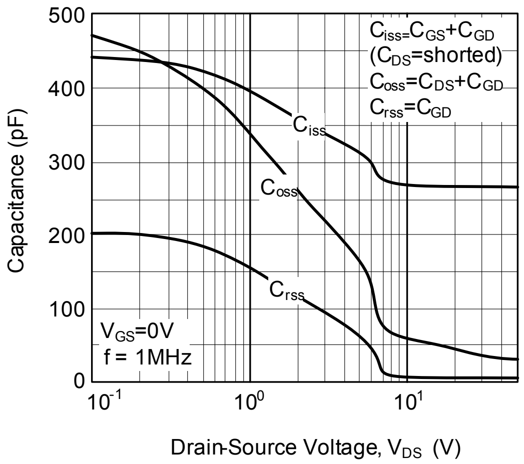

On-Resistance Variation vs Drain Current and Gate Voltage



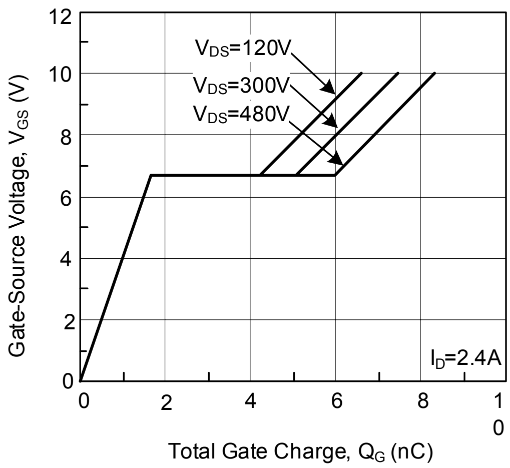

Body Diode Forward Voltage Variationvs. Source Current and Temperature




Capacitance vs. Drain-Source Voltage

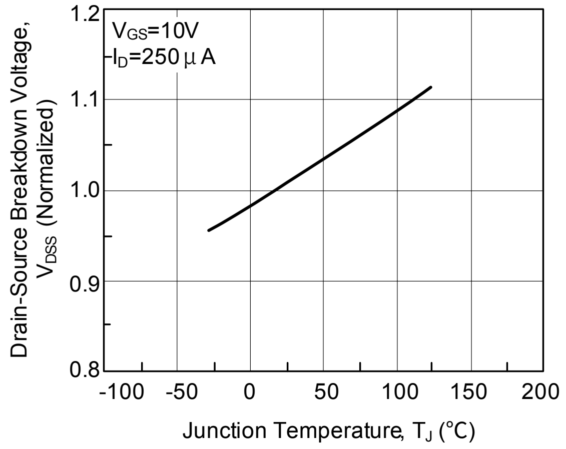



Gate Charge vs. Gate Charge Voltage

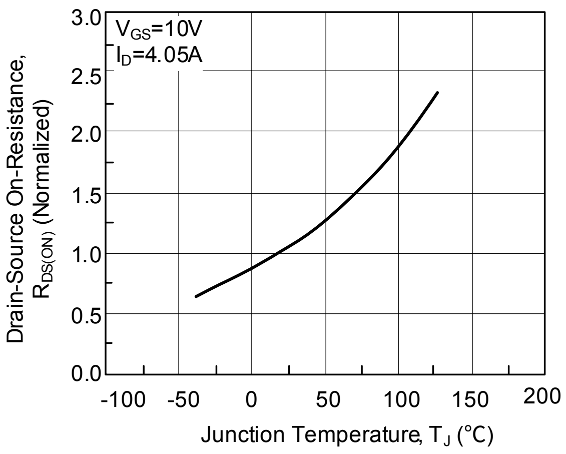


## ■ TYPICAL CHARACTERISTICS(Cont.)

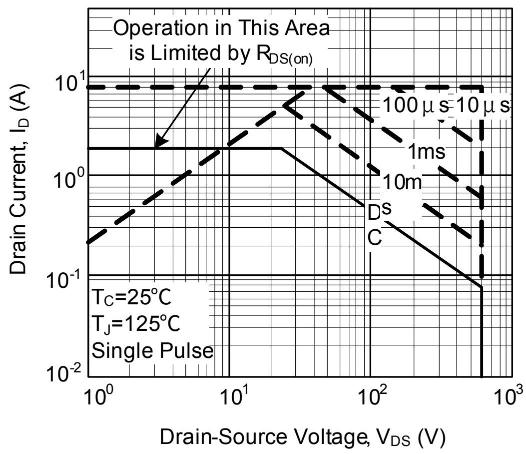
Breakdown Voltage vs Temperature



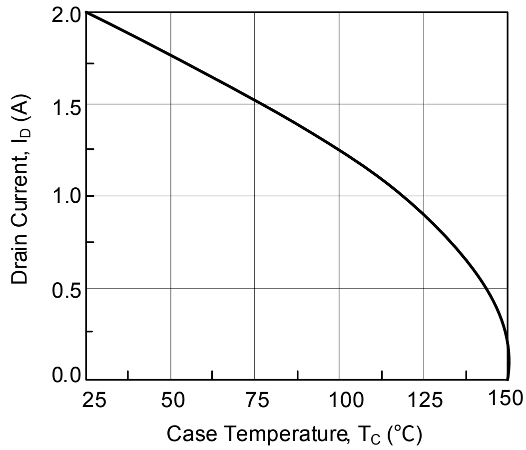

On-Resistance vs. Temperature




Max. Safe Operating Area




Max. Drain Current vs. Case Temperature




Thermal Response