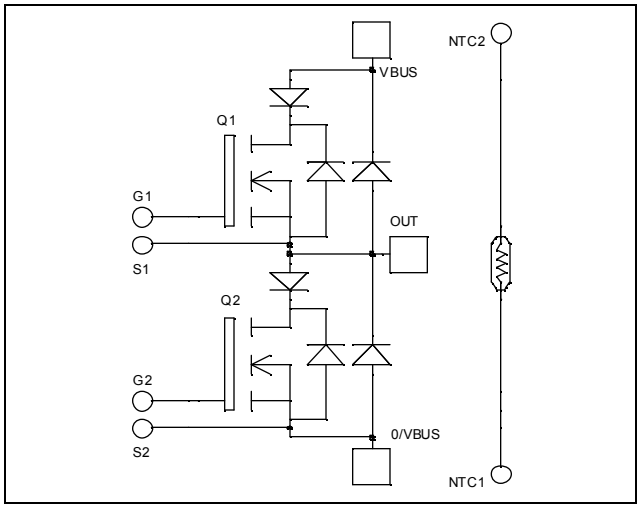
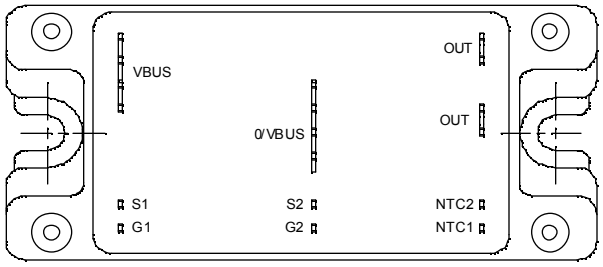
# Phase leg
# Series & parallel diodes
# MOSFET Power Module

$V_{DSS}$ = 1000V
$R_{DSon}$ = 230mΩ typ @ Tj = 25°C
$I_D$ = 36A @ Tc = 25°C




**Application**

- Motor control
- Switched Mode Power Supplies
- Uninterruptible Power Supplies

**Features**

- Power MOS 7® MOSFETs
  - Low $R_{DSon}$
  - Low input and Miller capacitance
  - Low gate charge
  - Avalanche energy rated
  - Very rugged
- Kelvin source for easy drive
- Very low stray inductance
  - Symmetrical design
  - Lead frames for power connections
- Internal thermistor for temperature monitoring
- High level of integration

**Benefits**

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- RoHS Compliant

## Absolute maximum ratings

| *Symbol* | *Parameter* | | *Max ratings* | *Unit* |
|---|---|---|---|---|
| $V_{DSS}$ | Drain - Source Breakdown Voltage | | 1000 | V |
| $I_D$ | Continuous Drain Current | $T_c$ = 25°C | 36 | A |
| | | $T_c$ = 80°C | 27 | |
| $I_{DM}$ | Pulsed Drain current | | 144 | |
| $V_{GS}$ | Gate - Source Voltage | | ±30 | V |
| $R_{DSon}$ | Drain - Source ON Resistance | | 270 | mΩ |
| $P_D$ | Maximum Power Dissipation | $T_c$ = 25°C | 694 | W |
| $I_{AR}$ | Avalanche current (repetitive and non repetitive) | | 18 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | 50 | mJ |
| $E_{AS}$ | Single Pulse Avalanche Energy | | 2500 | |

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handing Procedures Should Be Followed. See application note APT0502 on www.microsemi.com

**All ratings @ $T_j$ = 25°C unless otherwise specified**

## Electrical Characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{GS}$ = 0V, $V_{DS}$= 1000V | $T_j$ = 25°C | | | 200 | µA |
| | | $V_{GS}$ = 0V, $V_{DS}$= 800V | $T_j$ = 125°C | | | 1000 | |
| $R_{DS(on)}$ | Drain – Source on Resistance | $V_{GS}$ = 10V, $I_D$ = 18A | | | 230 | 270 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 5mA | | 3 | | 5 | V |
| $I_{GSS}$ | Gate – Source Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0V | | | | ±150 | nA |

## Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V<br>$V_{DS}$ = 25V<br>f = 1MHz | | 8700 | | pF |
| $C_{oss}$ | Output Capacitance | | | 1430 | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 240 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 10V<br>$V_{Bus}$ = 500V<br>$I_D$ = 36A | | 308 | | nC |
| $Q_{gs}$ | Gate – Source Charge | | | 52 | | |
| $Q_{gd}$ | Gate – Drain Charge | | | 194 | | |
| $T_{d(on)}$ | Turn-on Delay Time | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V<br>$V_{Bus}$ = 667V<br>$I_D$ = 36A<br>$R_G$ = 2.5Ω | | 10 | | ns |
| $T_r$ | Rise Time | | | 12 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 121 | | |
| $T_f$ | Fall Time | | | 35 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 25°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 667V<br>$I_D$ = 36A, $R_G$ = 2.5Ω | | 1278 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 760 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 667V<br>$I_D$ = 36A, $R_G$ = 2.5Ω | | 2092 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 902 | | |

## Series diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Maximum Peak Repetitive Reverse Voltage | | | 200 | | | V |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$=200V | $T_j$ = 25°C | | | 350 | µA |
| | | | $T_j$ = 125°C | | | 600 | |
| $I_F$ | DC Forward Current | | $T_c$ = 85°C | | 60 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 60A | | | 1.1 | 1.15 | V |
| | | $I_F$ = 120A | | | 1.4 | | |
| | | $I_F$ = 60A | $T_j$ = 125°C | | 0.9 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 60A<br>$V_R$ = 133V<br>di/dt = 400A/µs | $T_j$ = 25°C | | 24 | | ns |
| | | | $T_j$ = 125°C | | 48 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 66 | | nC |
| | | | $T_j$ = 125°C | | 300 | | |

## Parallel diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Maximum Peak Repetitive Reverse Voltage | | | 1000 | | | V |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$=1000V | $T_j$ = 25°C | | | 350 | µA |
| | | | $T_j$ = 125°C | | | 600 | |
| $I_F$ | DC Forward Current | | $T_c$ = 65°C | | 60 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 60A | | | 1.9 | 2.3 | V |
| | | $I_F$ = 120A | | | 2.2 | | |
| | | $I_F$ = 60A | $T_j$ = 125°C | | 1.7 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 60A<br>$V_R$ = 667V<br>di/dt = 400A/µs | $T_j$ = 25°C | | 290 | | ns |
| | | | $T_j$ = 125°C | | 390 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 1340 | | nC |
| | | | $T_j$ = 125°C | | 4700 | | |

## Thermal and package characteristics

| Symbol | Characteristic | | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction to Case Thermal Resistance | | Transistor | | | 0.18 | °C/W |
| | | | Diode | | | 0.65 | |
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz | | | 2500 | | | V |
| $T_J$ | Operating junction temperature range | | | -40 | | 150 | °C |
| $T_{STG}$ | Storage Temperature Range | | | -40 | | 125 | |
| $T_C$ | Operating Case Temperature | | | -40 | | 100 | |
| Torque | Mounting torque | To Heatsink | M5 | 2.5 | | 4.7 | N.m |
| Wt | Package Weight | | | | | 160 | g |

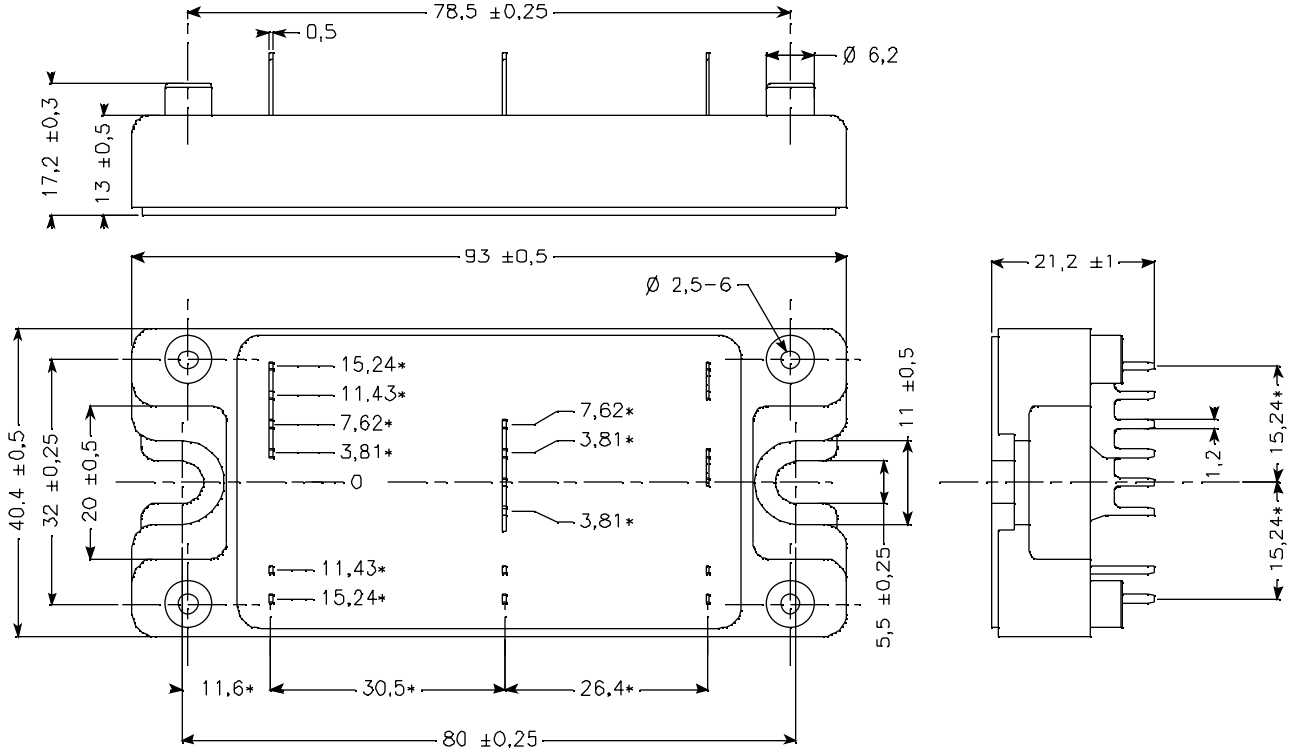
## Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{25}$ | Resistance @ 25°C | | 50 | | kΩ |
| $B_{25/85}$ | $T_{25}$ = 298.15 K | | 3952 | | K |

$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

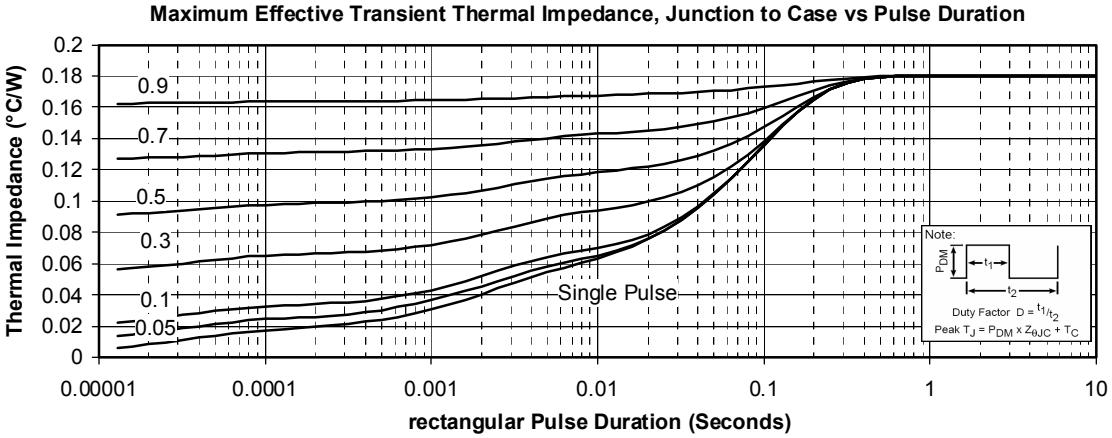
T: Thermistor temperature
$R_T$: Thermistor value at T

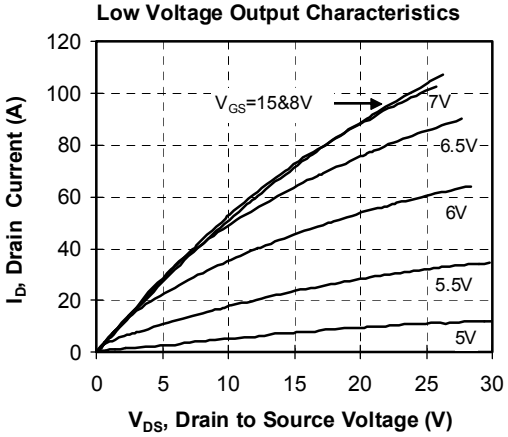
**SP4 Package outline** (dimensions in mm)

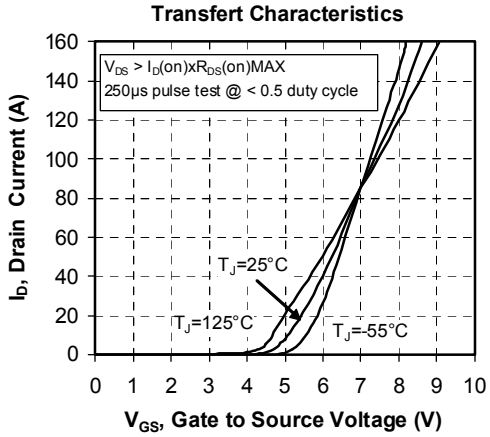


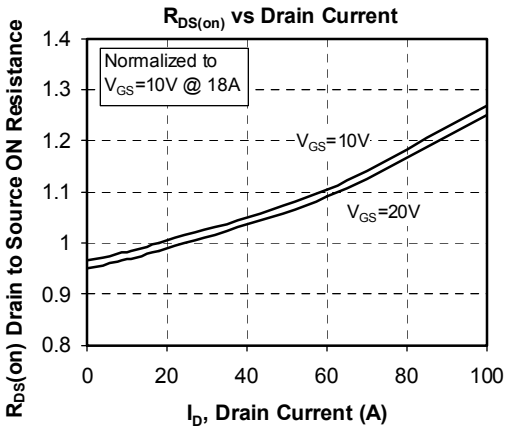

See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

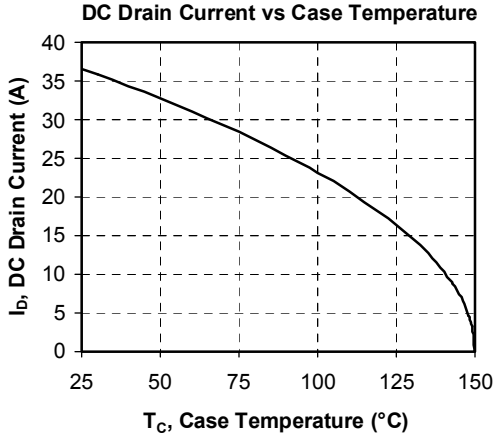
## Typical Performance Curve



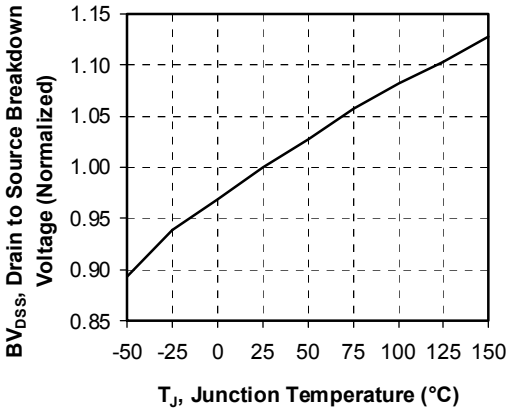



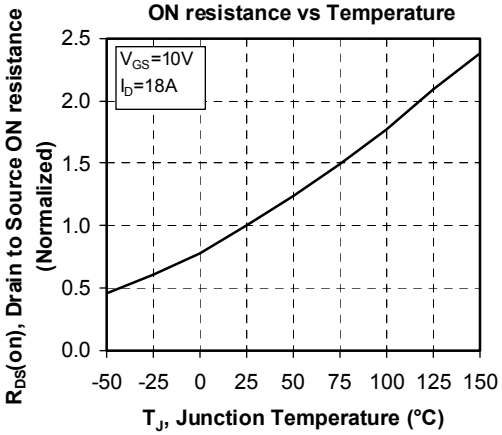



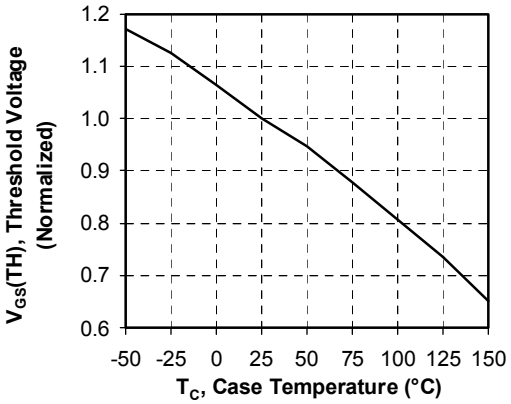
**Breakdown Voltage vs Temperature**



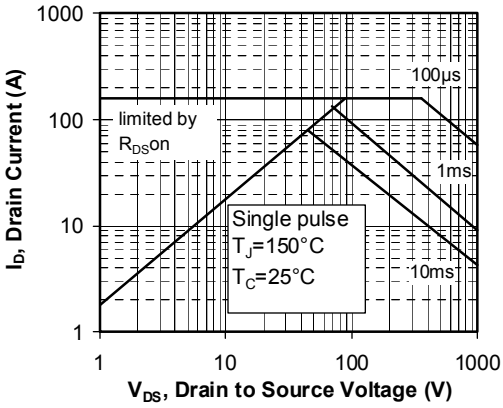

**ON resistance vs Temperature**



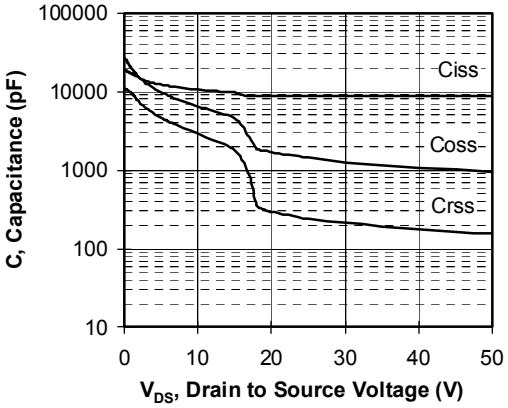

**Threshold Voltage vs Temperature**



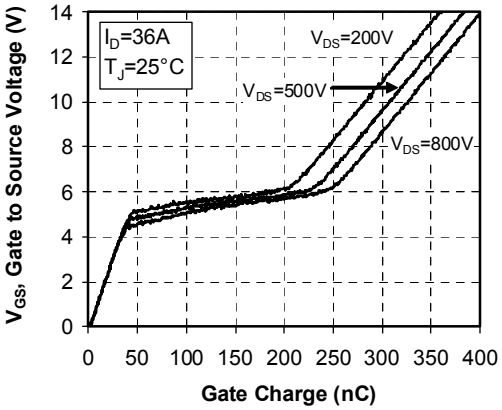

**Maximum Safe Operating Area**



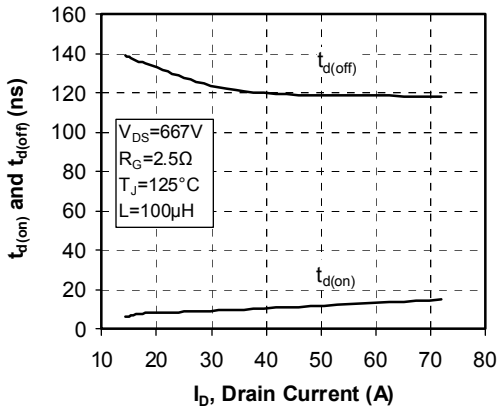

**Capacitance vs Drain to Source Voltage**



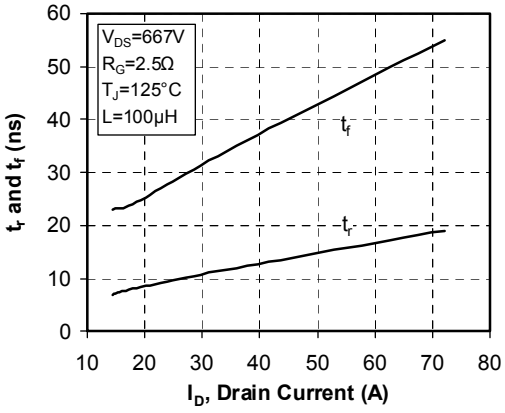

**Gate Charge vs Gate to Source Voltage**



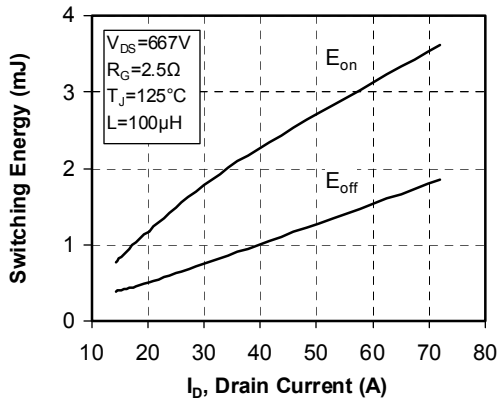
**Delay Times vs Current**



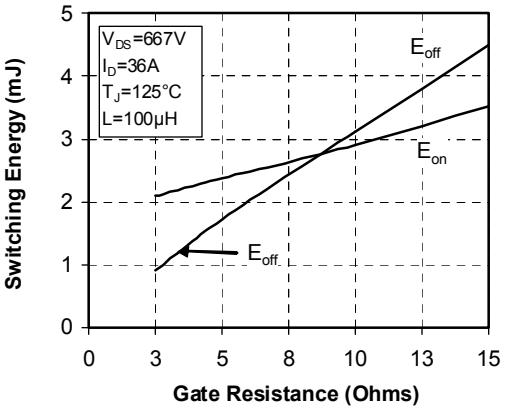

**Rise and Fall times vs Current**



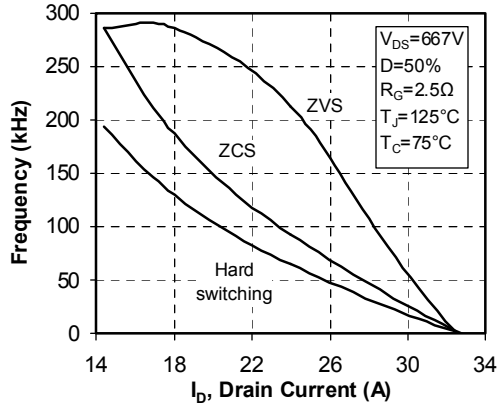

**Switching Energy vs Current**




**Switching Energy vs Gate Resistance**




**Operating Frequency vs Drain Current**




**Source to Drain Diode Forward Voltage**