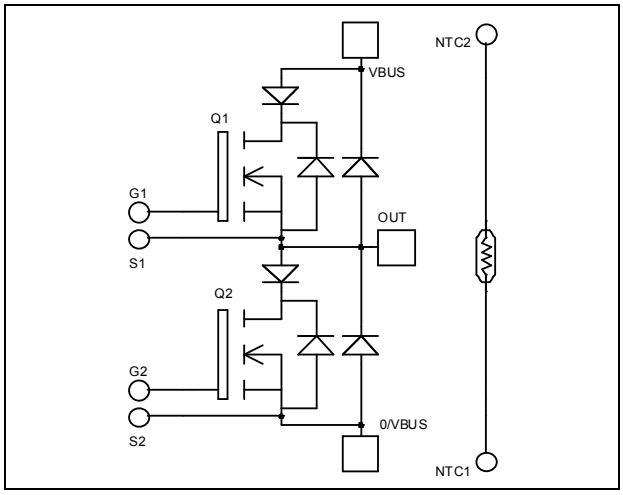
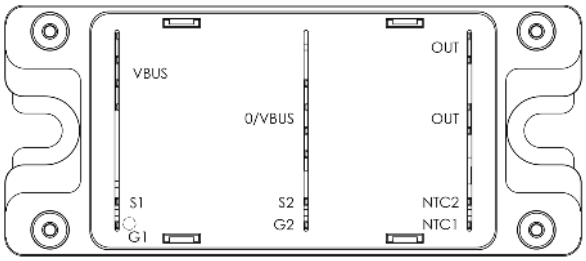
# APTC60AM35SCTG

***Phase leg Series & SiC parallel diodes***
***Super Junction MOSFET Power Module***

**$V_{DSS}$ = 600V**
**$R_{DSon}$ = 35mΩ max @ Tj = 25°C**
**$I_D$ = 72A @ Tc = 25°C**




**Application**

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

**Features**

- ***CoolMOS™***
  - Ultra low $R_{DSon}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
- ***Parallel SiC Schottky Diode***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Kelvin source for easy drive
- Very low stray inductance
- 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

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

## Absolute maximum ratings

| *Symbol* | *Parameter* | | *Max ratings* | *Unit* |
|---|---|---|---|---|
| $V_{DSS}$ | Drain - Source Breakdown Voltage | | 600 | V |
| $I_D$ | Continuous Drain Current | $T_c$ = 25°C | 72 | A |
| | | $T_c$ = 80°C | 54 | |
| $I_{DM}$ | Pulsed Drain current | | 288 | |
| $V_{GS}$ | Gate - Source Voltage | | ±30 | V |
| $R_{DSon}$ | Drain - Source ON Resistance | | 35 | mΩ |
| $P_D$ | Maximum Power Dissipation | $T_c$ = 25°C | 416 | W |
| $I_{AR}$ | Avalanche current (repetitive and non repetitive) | | 20 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | 1 | mJ |
| $E_{AS}$ | Single Pulse Avalanche Energy | | 1800 | |

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

## Electrical Characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{GS}$ = 0V,$V_{DS}$ = 600V | $T_j$ = 25°C | | | 50 | µA |
| | | $V_{GS}$ = 0V,$V_{DS}$ = 600V | $T_j$ = 125°C | | | 500 | |
| $R_{DS(on)}$ | Drain – Source on Resistance | $V_{GS}$ = 10V, $I_D$ = 36A | | | | 35 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 2mA | | 2.1 | 3 | 3.9 | V |
| $I_{GSS}$ | Gate – Source Leakage Current | $V_{GS}$ = ±20 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 | | 14 | | nF |
| $C_{oss}$ | Output Capacitance | | | 5.13 | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 0.42 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 10V<br>$V_{Bus}$ = 300V<br>$I_D$ = 72A | | 518 | | nC |
| $Q_{gs}$ | Gate – Source Charge | | | 58 | | |
| $Q_{gd}$ | Gate – Drain Charge | | | 222 | | |
| $T_{d(on)}$ | Turn-on Delay Time | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V<br>$V_{Bus}$ = 400V<br>$I_D$ = 72A<br>$R_G$ = 2.5Ω | | 21 | | ns |
| $T_r$ | Rise Time | | | 30 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 283 | | |
| $T_f$ | Fall Time | | | 84 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 25°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 400V<br>$I_D$ = 72A, $R_G$ = 2.5Ω | | 804 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 1960 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 400V<br>$I_D$ = 72A, $R_G$ = 2.5Ω | | 1315 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 2412 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | 0.3 | °C/W |

## Series diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Peak Repetitive Reverse Voltage | | | | | 600 | V |
| $I_{RM}$ | Reverse Leakage Current | $V_R$=600V | | | | 150 | µA |
| $I_F$ | DC Forward current | | Tc = 80°C | | 100 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 100A<br>$V_{GE}$ = 0V | $T_j$ = 25°C | | 1.6 | 2 | V |
| | | | $T_j$ = 150°C | | 1.5 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 100A<br>$V_R$ = 300V<br>di/dt =2500A/µs | $T_j$ = 25°C | | 100 | | ns |
| | | | $T_j$ = 150°C | | 150 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 5.1 | | µC |
| | | | $T_j$ = 150°C | | 10.7 | | |
| $E_{rr}$ | Reverse Recovery Energy | | $T_j$ = 25°C | | 1.2 | | mJ |
| | | | $T_j$ = 150°C | | 2.4 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 0.71 | °C/W |

## Parallel SiC diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Peak Repetitive Reverse Voltage | | | | | 600 | V |
| $I_{RM}$ | Reverse Leakage Current | $V_R$=600V | $T_j$ = 25°C | | 200 | 800 | µA |
| | | | $T_j$ = 175°C | | 400 | 4000 | |
| $I_F$ | DC Forward Current | | Tc = 125°C | | 40 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 40A | $T_j$ = 25°C | | 1.6 | 1.8 | V |
| | | | $T_j$ = 175°C | | 2.0 | 2.4 | |
| $Q_C$ | Total Capacitive Charge | $I_F$ = 40A, $V_R$ = 600V<br>di/dt =1200A/µs | | | 112 | | nC |
| C | Total Capacitance | f = 1MHz, $V_R$ = 200V | | | 260 | | pF |
| | | f = 1MHz, $V_R$ = 400V | | | 200 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 0.8 | °C/W |

## Thermal and package characteristics

| Symbol | Characteristic | | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz | | | 4000 | | V |
| $T_J$ | Operating junction temperature range | | | -40 | 150 | °C |
| $T_{JOP}$ | Recommended junction temperature under switching conditions | | | -40 | $T_J$max -25 | |
| $T_{STG}$ | 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 |

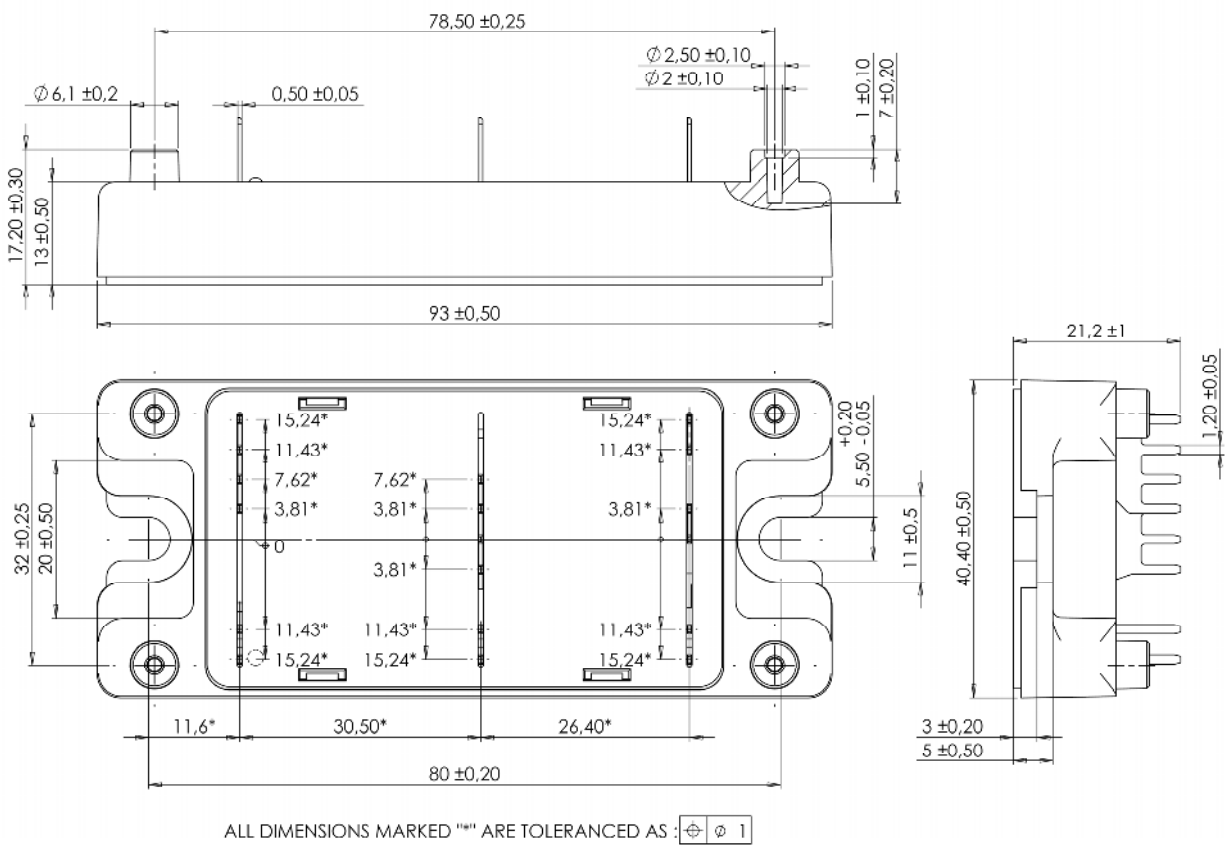
## Temperature sensor NTC (see application note APT0406 on www.microsemi.com).

| Symbol | Characteristic | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{25}$ | Resistance @ 25°C | | | 50 | | kΩ |
| $\Delta R_{25}/R_{25}$ | | | | 5 | | % |
| $B_{25/85}$ | $T_{25}$ = 298.15 K | | | 3952 | | K |
| ΔB/B | | $T_C$=100°C | | 4 | | % |

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

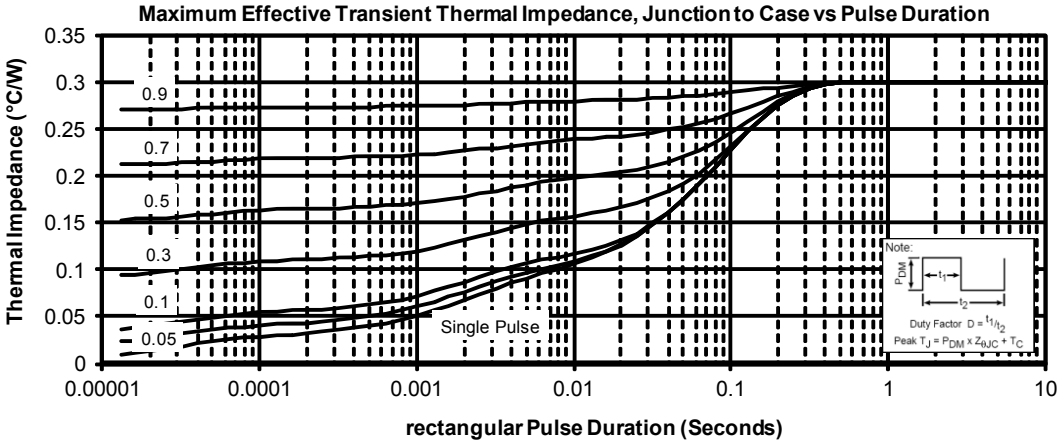
T: Thermistor temperature
$R_T$: Thermistor value at T

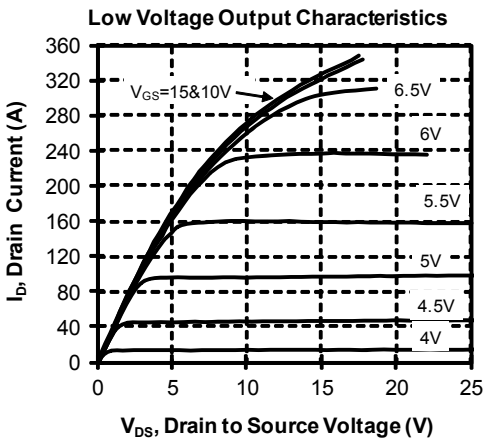
**SP4 Package outline** (dimensions in mm)

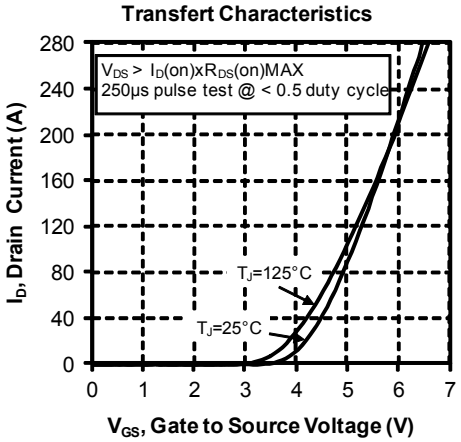


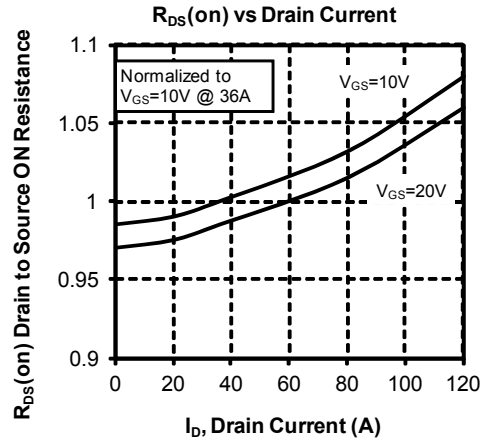

See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

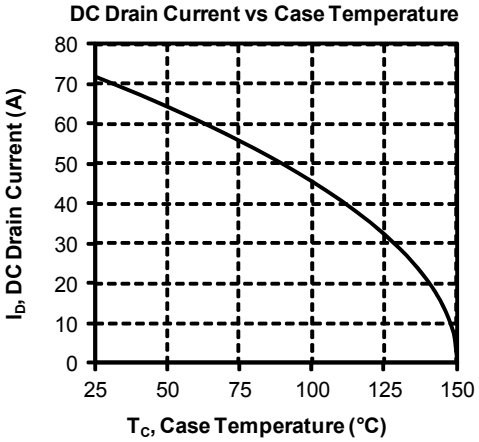
## Typical CoolMOS Performance Curve



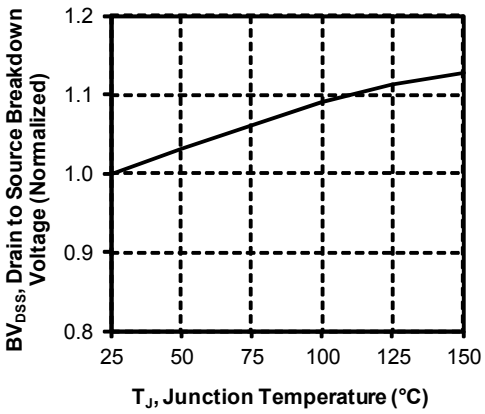



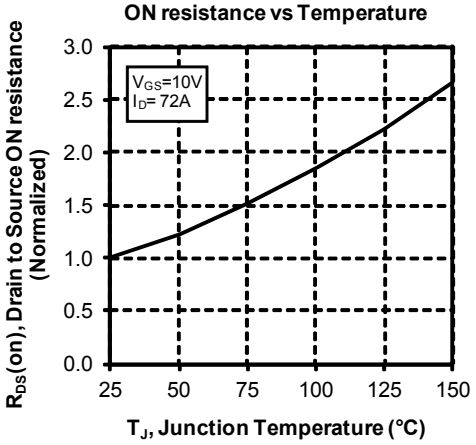



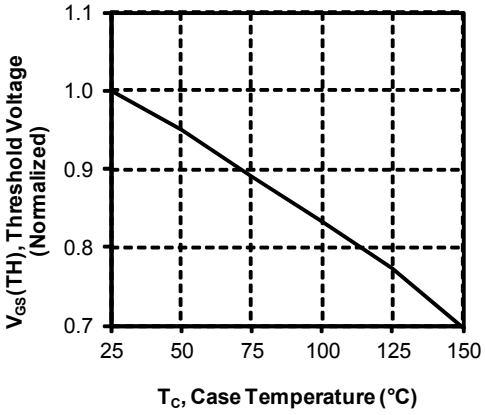
**Breakdown Voltage vs Temperature**



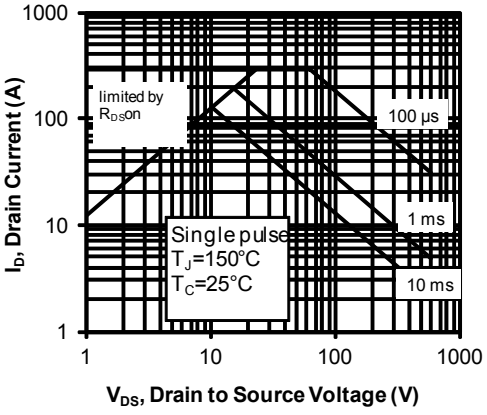

**ON resistance vs Temperature**



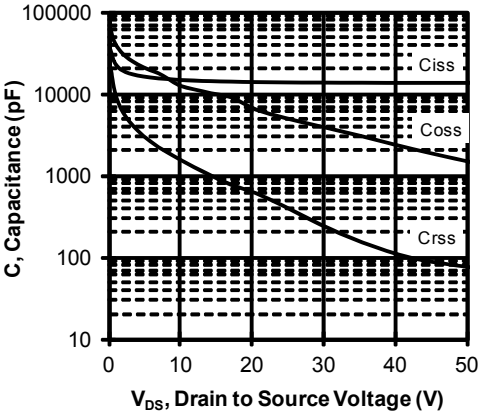

**Threshold Voltage vs Temperature**



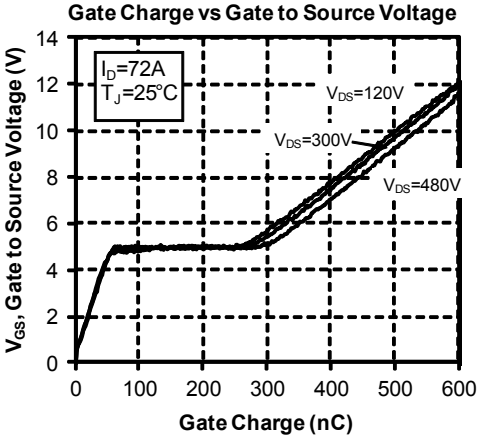

**Maximum Safe Operating Area**



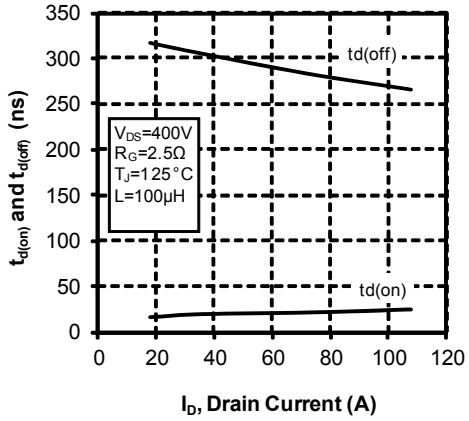

**Capacitance vs Drain to Source Voltage**



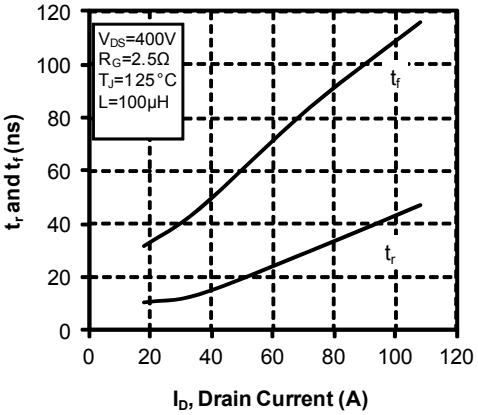

**Gate Charge vs Gate to Source Voltage**



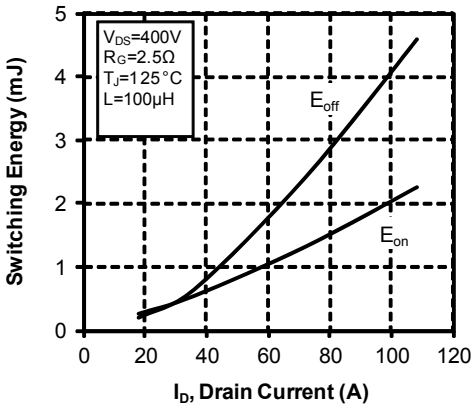
**Delay Times vs Current**



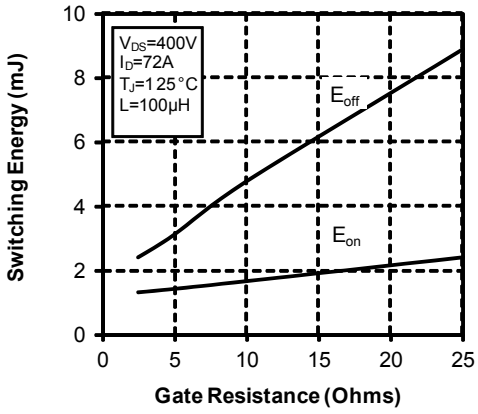

**Rise and Fall times vs Current**



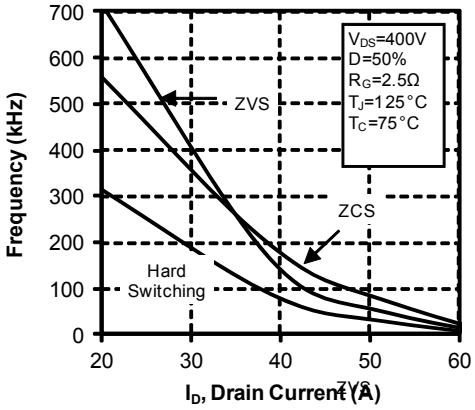

**Switching Energy vs Current**



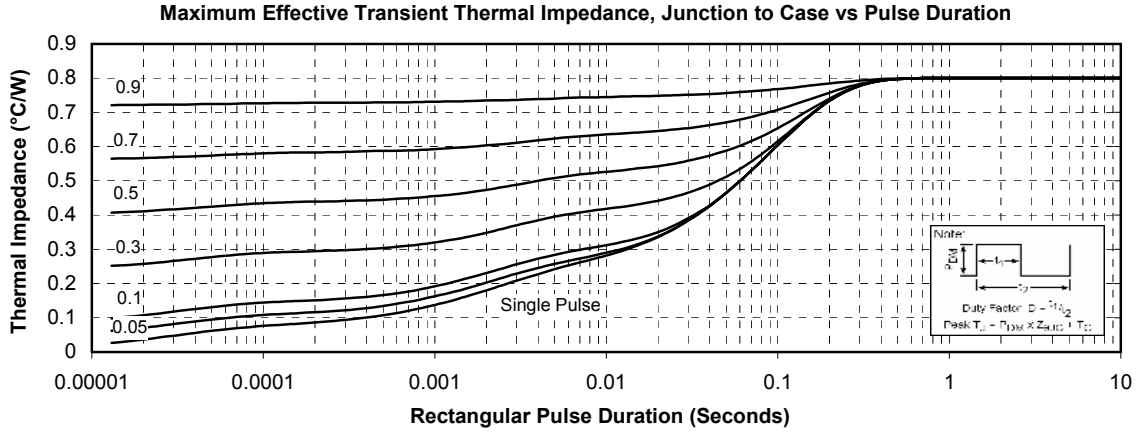

**Switching Energy vs Gate Resistance**

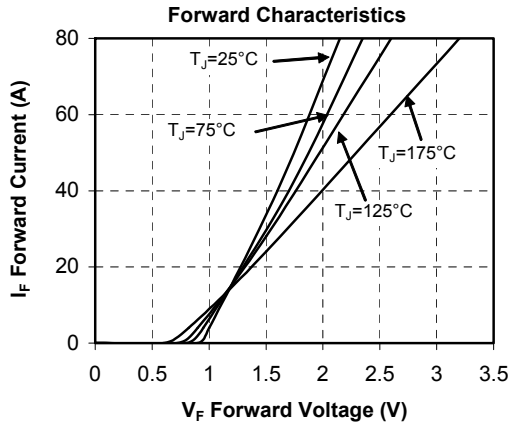


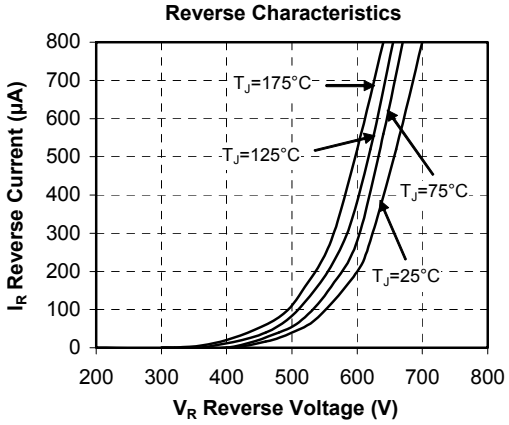

**Operating Frequency vs Drain Current**

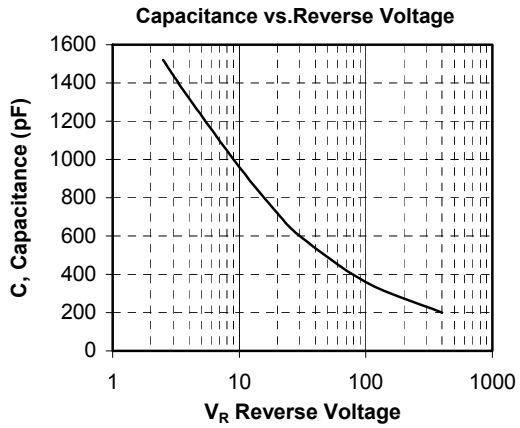


## Typical SiC Diode Performance Curve

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