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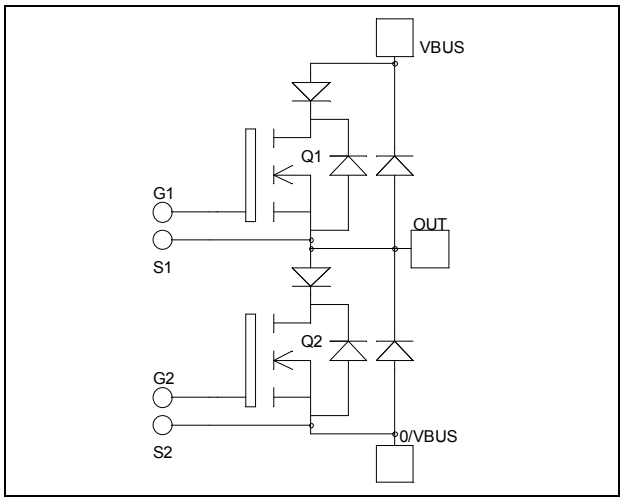
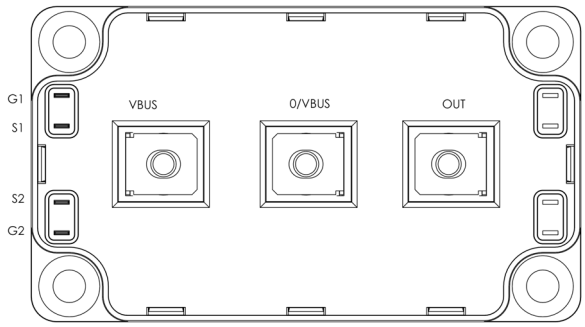
# APTM50AM24SG

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

$V_{DSS}$ = 500V
$R_{DSon}$ = 24mΩ typ @ Tj = 25°C
$I_D$ = 150A @ 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
  - Fast intrinsic reverse diode
  - Avalanche energy rated
  - Very rugged
- Kelvin source for easy drive
- Very low stray inductance
  - Symmetrical design
  - M5 power connectors
- High level of integration

**Benefits**

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- 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 | | 500 | V |
| $I_D$ | Continuous Drain Current | $T_c$ = 25°C | 150 | A |
| | | $T_c$ = 80°C | 110 | |
| $I_{DM}$ | Pulsed Drain current | | 600 | |
| $V_{GS}$ | Gate - Source Voltage | | ±30 | V |
| $R_{DSon}$ | Drain - Source ON Resistance | | 28 | mΩ |
| $P_D$ | Maximum Power Dissipation | $T_c$ = 25°C | 1250 | W |
| $I_{AR}$ | Avalanche current (repetitive and non repetitive) | | 24 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | 30 | mJ |
| $E_{AS}$ | Single Pulse Avalanche Energy | | 1300 | |

**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, $V_{DS}$ = 500V | | | 500 | µA |
| $R_{DS(on)}$ | Drain – Source on Resistance | $V_{GS}$ = 10V, $I_D$ = 75A | | 24 | 28 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 6mA | 3 | | 5 | V |
| $I_{GSS}$ | Gate – Source Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0V | | | ±600 | 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 | | 19.6 | | nF |
| $C_{oss}$ | Output Capacitance | | | 4.2 | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 0.3 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 10V<br>$V_{Bus}$ = 250V<br>$I_D$ = 150A | | 434 | | nC |
| $Q_{gs}$ | Gate – Source Charge | | | 120 | | |
| $Q_{gd}$ | Gate – Drain Charge | | | 216 | | |
| $T_{d(on)}$ | Turn-on Delay Time | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V<br>$V_{Bus}$ = 333V<br>$I_D$ = 150A<br>$R_G$ = 0.8Ω | | 10 | | ns |
| $T_r$ | Rise Time | | | 17 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 50 | | |
| $T_f$ | Fall Time | | | 41 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 25°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 333V<br>$I_D$ = 150A, $R_G$ = 0.8Ω | | 1.9 | | mJ |
| $E_{off}$ | Turn-off Switching Energy | | | 1.5 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 125°C**<br>$V_{GS}$ = 15V, $V_{Bus}$ = 333V<br>$I_D$ = 150A, $R_G$ = 0.8Ω | | 3.3 | | mJ |
| $E_{off}$ | Turn-off Switching Energy | | | 1.7 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | 0.1 | °C/W |

## Series diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Maximum Peak Repetitive Reverse Voltage | | | 600 | | | V |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$=600V | | | | 150 | µA |
| $I_F$ | DC Forward Current | | Tc = 80°C | | 200 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 200A<br>$V_{GE}$ = 0V | $T_j$ = 25°C | | 1.6 | 2 | V |
| | | | $T_j$ = 150°C | | 1.5 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 200A<br>$V_R$ = 300V<br>di/dt =2800A/µs | $T_j$ = 25°C | | 125 | | ns |
| | | | $T_j$ = 150°C | | 220 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 9.4 | | µC |
| | | | $T_j$ = 150°C | | 19.8 | | |
| $E_r$ | Reverse Recovery Energy | | $T_j$ = 25°C | | 2.2 | | mJ |
| | | | $T_j$ = 150°C | | 4.8 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 0.39 | °C/W |

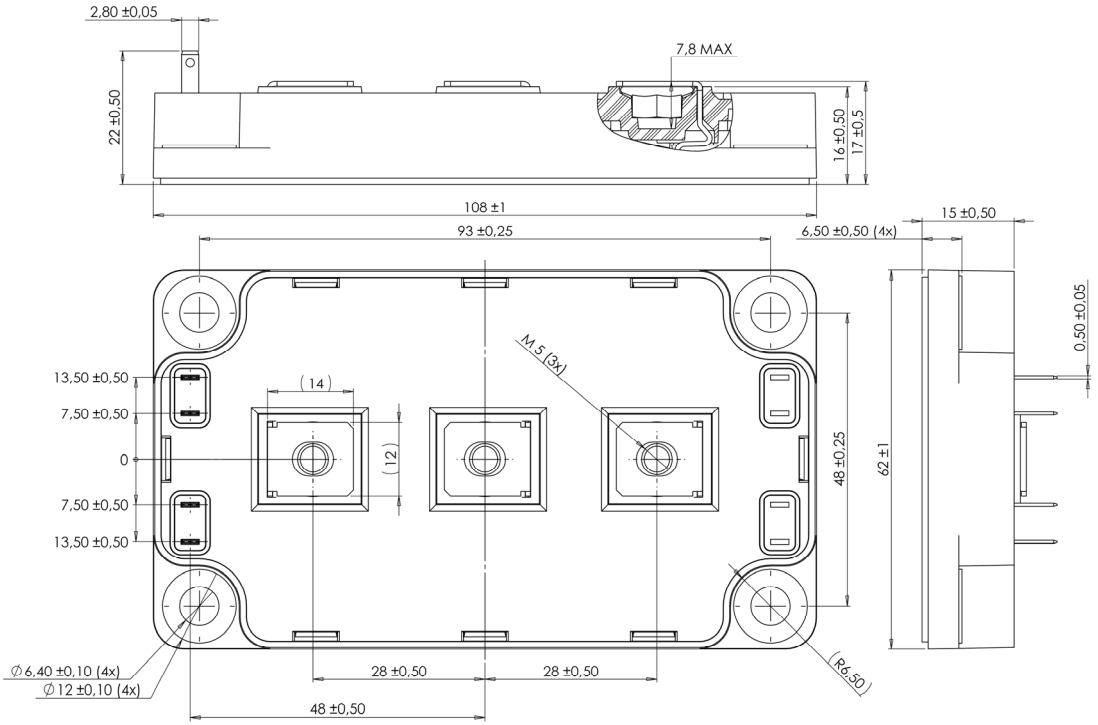
## Parallel diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Maximum Repetitive Reverse Voltage | | | 600 | | | V |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$ = 600V | | | | 350 | µA |
| $I_F$ | DC Forward Current | | $T_c$ = 70°C | | 120 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 120A | | | 1.6 | 1.8 | V |
| | | $I_F$ = 240A | | | 1.9 | | |
| | | $I_F$ = 120A | $T_j$ = 125°C | | 1.4 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 120A<br>$V_R$ = 400V<br>di/dt = 400A/µs | $T_j$ = 25°C | | 130 | | ns |
| | | | $T_j$ = 125°C | | 170 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 440 | | nC |
| | | | $T_j$ = 125°C | | 1840 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 0.46 | °C/W |

## Thermal and package characteristics

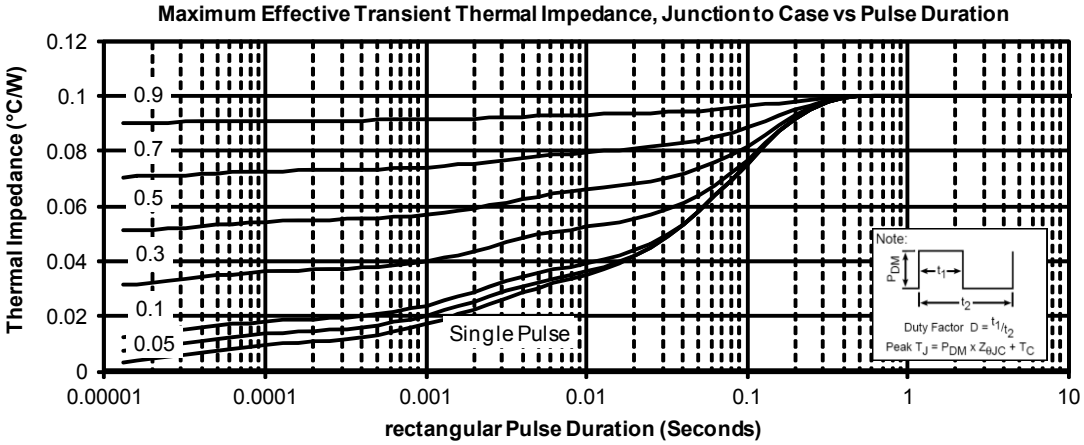
| Symbol | Characteristic | | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz | | | 4000 | | V |
| $T_J$ | Operating junction temperature range | | | -40 | 150 | °C |
| $T_{JOP}$ | Recommended junction temperature under switching 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 | M6 | 3 | 5 | N.m |
| | | For terminals | M5 | 2 | 3.5 | |
| Wt | Package Weight | | | | 300 | g |

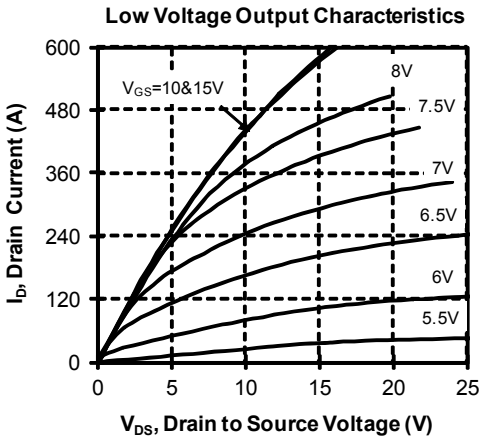
## SP6 Package outline (dimensions in mm)

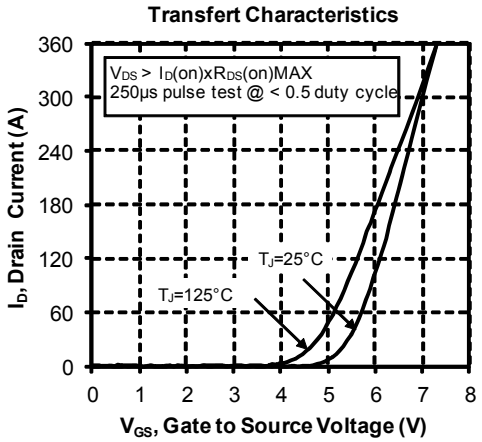


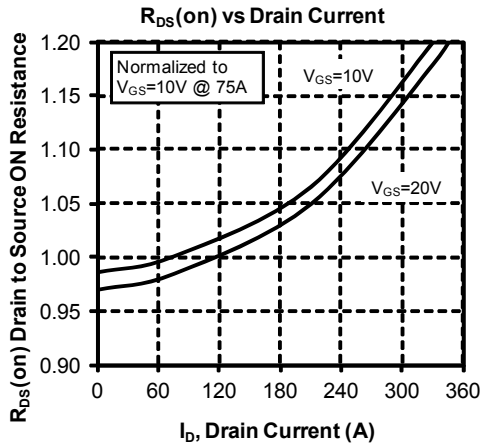

See application note APT0601 - Mounting Instructions for SP6 Power Modules on www.microsemi.com

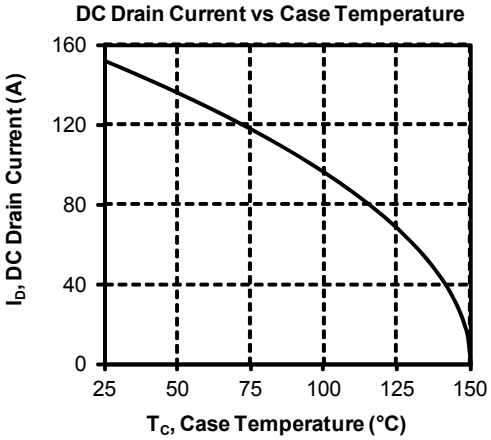
## Typical Performance Curve



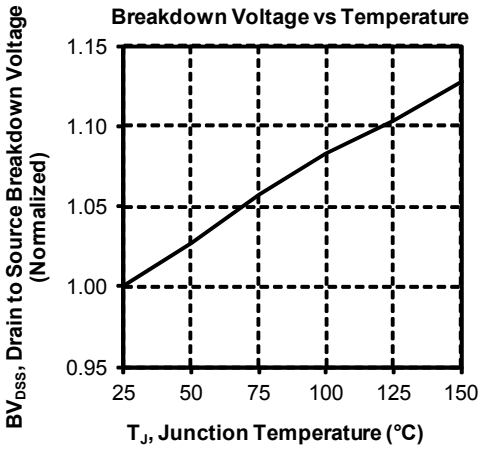



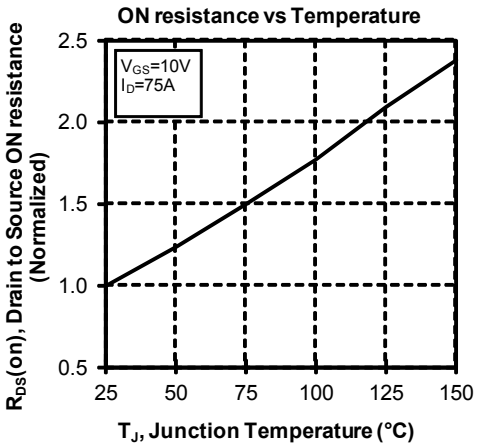



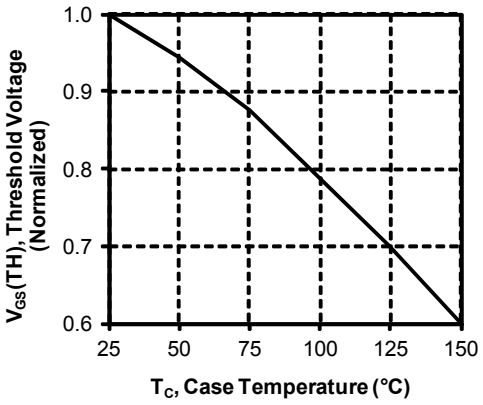
**Breakdown Voltage vs Temperature**



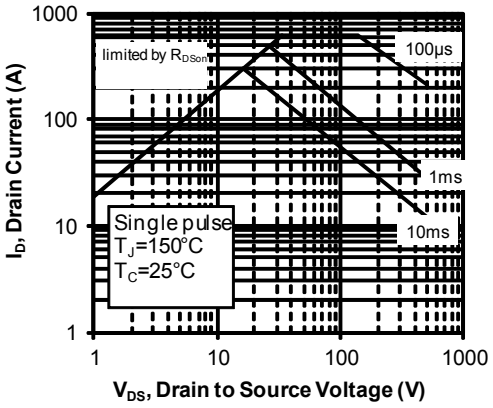

**ON resistance vs Temperature**



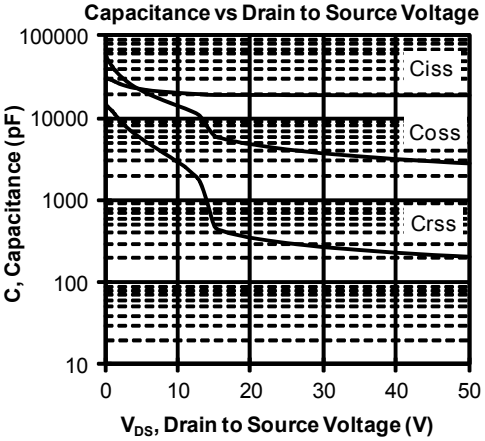

**Threshold Voltage vs Temperature**



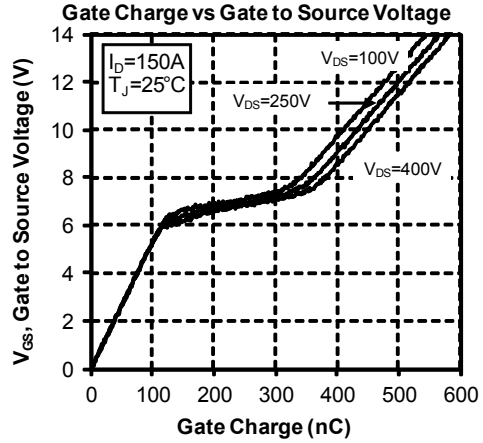

**Maximum Safe Operating Area**



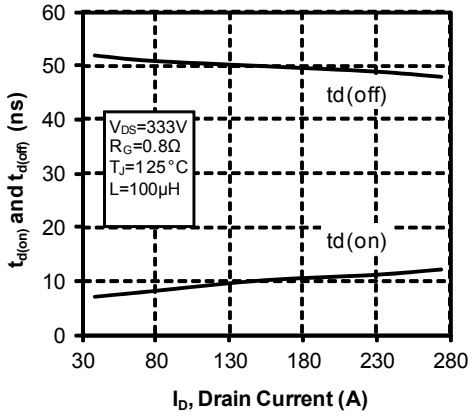

**Capacitance vs Drain to Source Voltage**



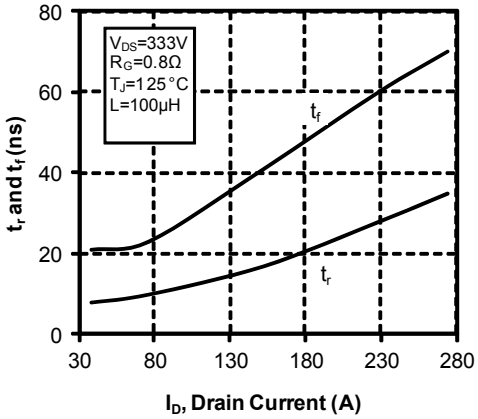

**Gate Charge vs Gate to Source Voltage**



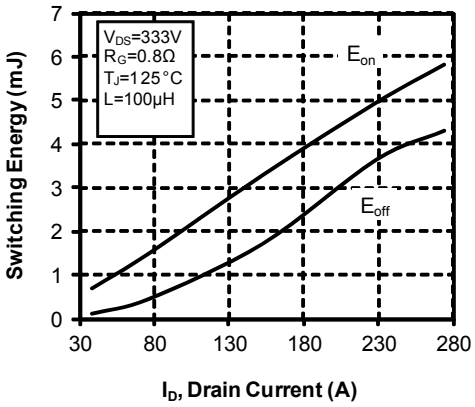
**Delay Times vs Current**



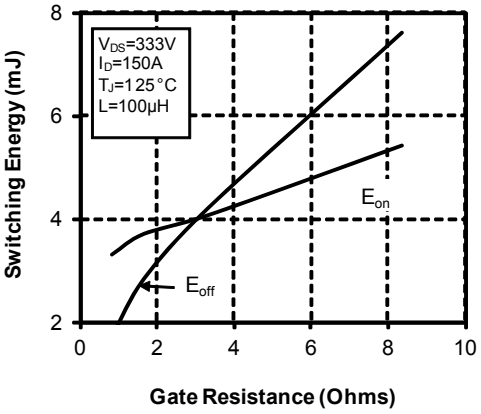

**Rise and Fall times vs Current**



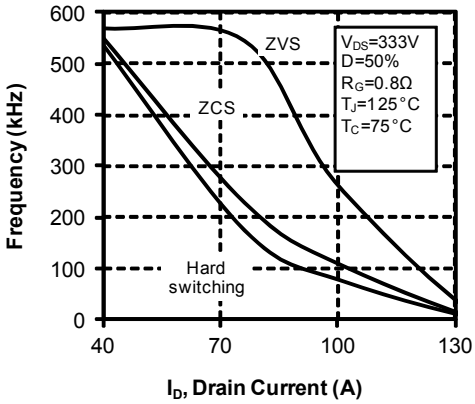

**Switching Energy vs Current**




**Switching Energy vs Gate Resistance**




**Operating Frequency vs Drain Current**



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