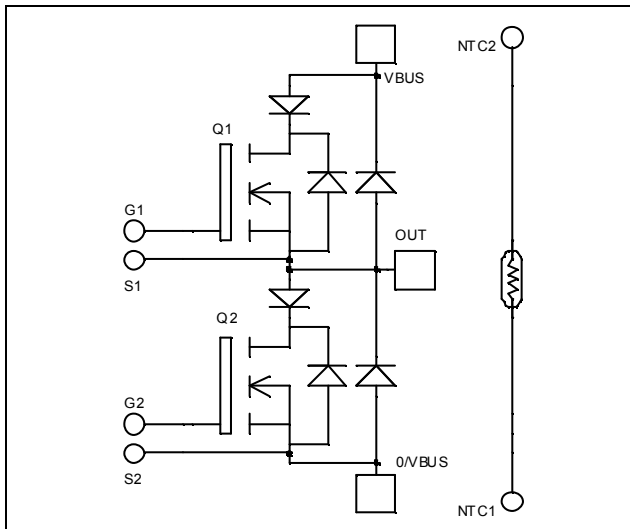


## Phase leg Series & parallel diodes MOSFET Power Module

$$V_{DSS} = 500V$$

$$R_{DSon} = 38m\Omega \text{ typ @ } T_j = 25^\circ C$$

$$I_D = 90A \text{ @ } T_c = 25^\circ C$$

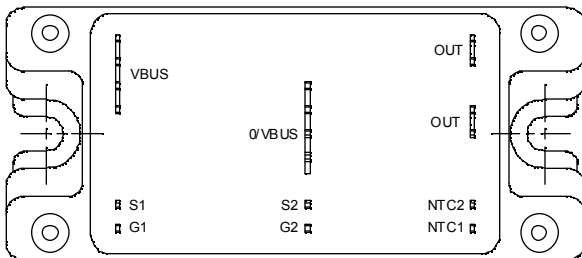


### Application

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

### Features

- Power MOS 7<sup>®</sup> 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                  | 500                | V          |
| $I_D$      | Continuous Drain Current                          | $T_c = 25^\circ C$ | 90         |
|            |                                                   | $T_c = 80^\circ C$ | 67         |
| $I_{DM}$   | Pulsed Drain current                              | 360                | A          |
| $V_{GS}$   | Gate - Source Voltage                             | $\pm 30$           | V          |
| $R_{DSon}$ | Drain - Source ON Resistance                      | 45                 | m $\Omega$ |
| $P_D$      | Maximum Power Dissipation                         | $T_c = 25^\circ C$ | 694        |
| $I_{AR}$   | Avalanche current (repetitive and non repetitive) | 46                 | A          |
| $E_{AR}$   | Repetitive Avalanche Energy                       | 50                 | mJ         |
| $E_{AS}$   | Single Pulse Avalanche Energy                     | 2500               |            |



CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed. See application note APT0502 on [www.microsemi.com](http://www.microsemi.com)

All ratings @  $T_j = 25^\circ\text{C}$  unless otherwise specified

## Electrical Characteristics

| Symbol       | Characteristic                  | Test Conditions                 | Min | Typ | Max       | Unit      |
|--------------|---------------------------------|---------------------------------|-----|-----|-----------|-----------|
| $I_{DSS}$    | Zero Gate Voltage Drain Current | $V_{GS} = 0V, V_{DS} = 500V$    |     |     | 200       | $\mu A$   |
|              |                                 | $V_{GS} = 0V, V_{DS} = 400V$    |     |     | 1000      |           |
| $R_{DS(on)}$ | Drain – Source on Resistance    | $V_{GS} = 10V, I_D = 45A$       |     | 38  | 45        | $m\Omega$ |
| $V_{GS(th)}$ | Gate Threshold Voltage          | $V_{GS} = V_{DS}, I_D = 5mA$    | 3   |     | 5         | V         |
| $I_{GSS}$    | Gate – Source Leakage Current   | $V_{GS} = \pm 30V, V_{DS} = 0V$ |     |     | $\pm 150$ | nA        |

## Dynamic Characteristics

| Symbol       | Characteristic               | Test Conditions                                                                                                                     | Min | Typ  | Max | Unit    |
|--------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|---------|
| $C_{iss}$    | Input Capacitance            | $V_{GS} = 0V$                                                                                                                       |     | 11.2 |     | nF      |
| $C_{oss}$    | Output Capacitance           | $V_{DS} = 25V$                                                                                                                      |     | 2.4  |     |         |
| $C_{rss}$    | Reverse Transfer Capacitance | $f = 1MHz$                                                                                                                          |     | 0.18 |     |         |
| $Q_g$        | Total gate Charge            | $V_{GS} = 10V$                                                                                                                      |     | 246  |     | nC      |
| $Q_{gs}$     | Gate – Source Charge         | $V_{Bus} = 250V$                                                                                                                    |     | 66   |     |         |
| $Q_{gd}$     | Gate – Drain Charge          | $I_D = 90A$                                                                                                                         |     | 130  |     |         |
| $T_{d(on)}$  | Turn-on Delay Time           | <b>Inductive switching @ <math>125^\circ\text{C}</math></b><br>$V_{GS} = 15V$<br>$V_{Bus} = 333V$<br>$I_D = 90A$<br>$R_G = 2\Omega$ |     | 18   |     | ns      |
| $T_r$        | Rise Time                    |                                                                                                                                     |     | 35   |     |         |
| $T_{d(off)}$ | Turn-off Delay Time          |                                                                                                                                     |     | 87   |     |         |
| $T_f$        | Fall Time                    |                                                                                                                                     |     | 77   |     |         |
| $E_{on}$     | Turn-on Switching Energy     | <b>Inductive switching @ <math>25^\circ\text{C}</math></b><br>$V_{GS} = 15V, V_{Bus} = 333V$<br>$I_D = 90A, R_G = 2\Omega$          |     | 1510 |     | $\mu J$ |
| $E_{off}$    | Turn-off Switching Energy    |                                                                                                                                     |     | 1452 |     |         |
| $E_{on}$     | Turn-on Switching Energy     | <b>Inductive switching @ <math>125^\circ\text{C}</math></b><br>$V_{GS} = 15V, V_{Bus} = 333V$<br>$I_D = 90A, R_G = 2\Omega$         |     | 2482 |     | $\mu J$ |
| $E_{off}$    | Turn-off Switching Energy    |                                                                                                                                     |     | 1692 |     |         |

## 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         | $V_R = 200V$                                        | $T_j = 25^\circ\text{C}$  |     | 500  | $\mu A$ |
|           |                                         |                                                     | $T_j = 125^\circ\text{C}$ |     | 750  |         |
| $I_F$     | DC Forward Current                      | $T_c = 85^\circ\text{C}$                            |                           | 90  |      | A       |
| $V_F$     | Diode Forward Voltage                   | $I_F = 90A$                                         |                           | 1.1 | 1.15 | V       |
|           |                                         | $I_F = 180A$                                        |                           | 1.4 |      |         |
|           |                                         | $I_F = 90A$                                         | $T_j = 125^\circ\text{C}$ | 0.9 |      |         |
| $t_{rr}$  | Reverse Recovery Time                   | $I_F = 90A$<br>$V_R = 133V$<br>$di/dt = 600A/\mu s$ | $T_j = 25^\circ\text{C}$  | 24  |      | ns      |
|           |                                         |                                                     | $T_j = 125^\circ\text{C}$ | 48  |      |         |
| $Q_{rr}$  | Reverse Recovery Charge                 | $I_F = 90A$<br>$V_R = 133V$<br>$di/dt = 600A/\mu s$ | $T_j = 25^\circ\text{C}$  | 99  |      | nC      |
|           |                                         |                                                     | $T_j = 125^\circ\text{C}$ | 450 |      |         |

## Parallel diode ratings and characteristics

| Symbol             | Characteristic                          | Test Conditions                                                  |                        | Min | Typ  | Max | Unit |
|--------------------|-----------------------------------------|------------------------------------------------------------------|------------------------|-----|------|-----|------|
| V <sub>RRM</sub>   | Maximum Peak Repetitive Reverse Voltage |                                                                  |                        | 600 |      |     | V    |
| I <sub>RM</sub>    | Maximum Reverse Leakage Current         | V <sub>R</sub> =600V                                             | T <sub>j</sub> = 25°C  |     |      | 500 | μA   |
|                    |                                         |                                                                  | T <sub>j</sub> = 125°C |     |      | 750 |      |
| I <sub>F(AV)</sub> | DC Forward Current                      |                                                                  | T <sub>c</sub> = 90°C  |     | 90   |     | A    |
| V <sub>F</sub>     | Diode Forward Voltage                   | I <sub>F</sub> = 90A                                             |                        |     | 1.8  | 2.2 | V    |
|                    |                                         | I <sub>F</sub> = 180A                                            |                        |     | 2    |     |      |
|                    |                                         | I <sub>F</sub> = 90A                                             | T <sub>j</sub> = 125°C |     | 1.3  |     |      |
| t <sub>rr</sub>    | Reverse Recovery Time                   | I <sub>F</sub> = 90A<br>V <sub>R</sub> = 400V<br>di/dt = 600A/μs | T <sub>j</sub> = 25°C  |     | 85   |     | ns   |
|                    |                                         |                                                                  | T <sub>j</sub> = 125°C |     | 160  |     |      |
| Q <sub>rr</sub>    | Reverse Recovery Charge                 |                                                                  | T <sub>j</sub> = 25°C  |     | 390  |     | nC   |
|                    |                                         |                                                                  | T <sub>j</sub> = 125°C |     | 2100 |     |      |

## Thermal and package characteristics

| Symbol            | Characteristic                                                                          | Test Conditions |    | Min  | Typ | Max  | Unit |
|-------------------|-----------------------------------------------------------------------------------------|-----------------|----|------|-----|------|------|
| R <sub>thJC</sub> | Junction to Case Thermal Resistance                                                     | Transistor      |    |      |     | 0.18 | °C/W |
|                   |                                                                                         | Diode           |    |      |     | 0.45 |      |
| V <sub>ISOL</sub> | RMS Isolation Voltage, any terminal to case t = 1 min, I <sub>isol</sub> < 1mA, 50/60Hz |                 |    | 2500 |     |      | V    |
| T <sub>J</sub>    | Operating junction temperature range                                                    |                 |    | -40  |     | 150  | °C   |
| T <sub>STG</sub>  | Storage Temperature Range                                                               |                 |    | -40  |     | 125  |      |
| T <sub>C</sub>    | Operating Case Temperature                                                              |                 |    | -40  |     | 100  |      |
| Torque            | Mounting torque                                                                         | To Heatsink     | M5 | 2.5  |     | 4.7  | N.m  |
| Wt                | Package Weight                                                                          |                 |    |      |     | 160  | g    |

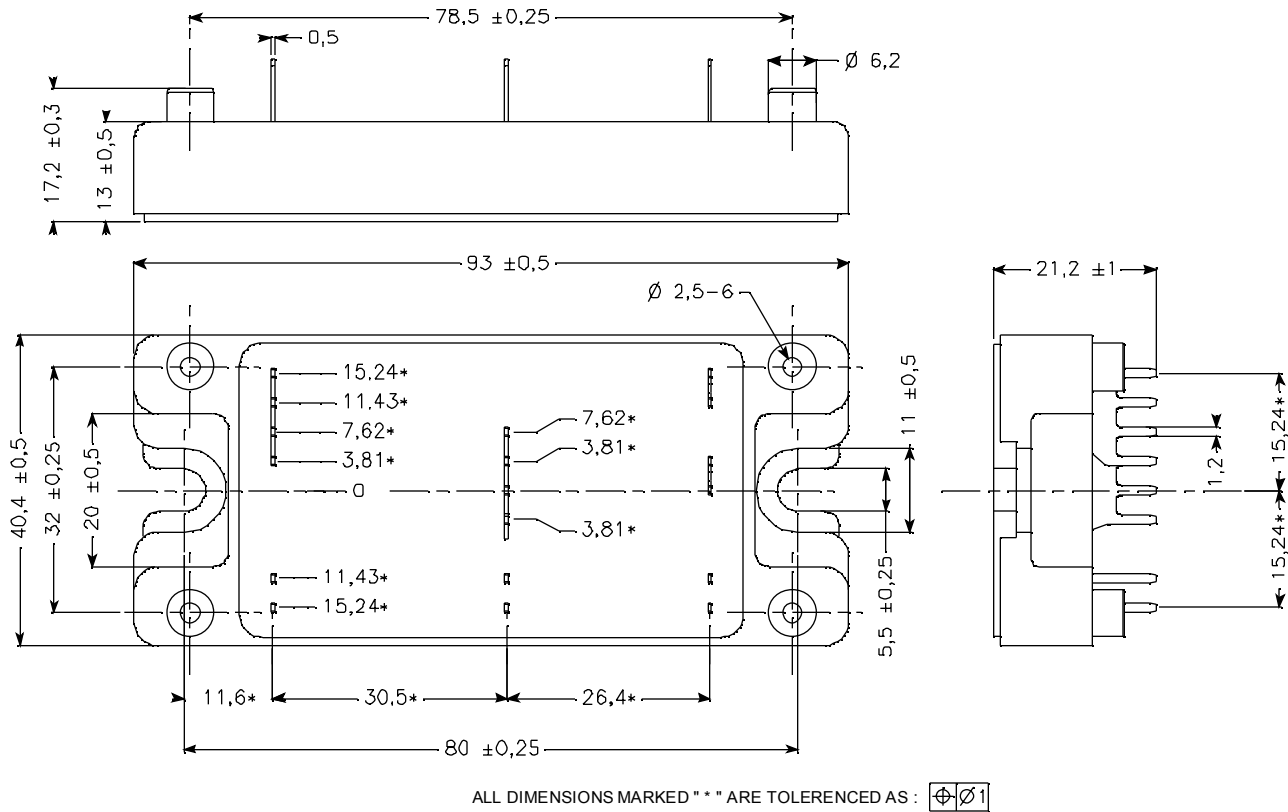
## Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

| Symbol             | Characteristic             | Min | Typ  | Max | Unit |
|--------------------|----------------------------|-----|------|-----|------|
| R <sub>25</sub>    | Resistance @ 25°C          |     | 50   |     | kΩ   |
| B <sub>25/85</sub> | T <sub>25</sub> = 298.15 K |     | 3952 |     | K    |

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

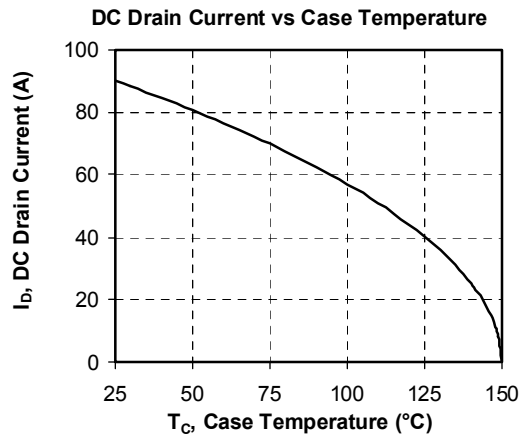
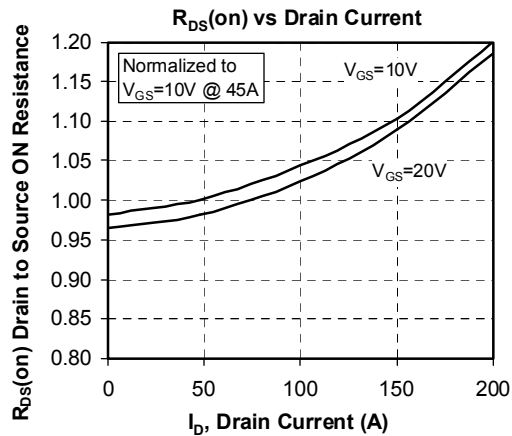
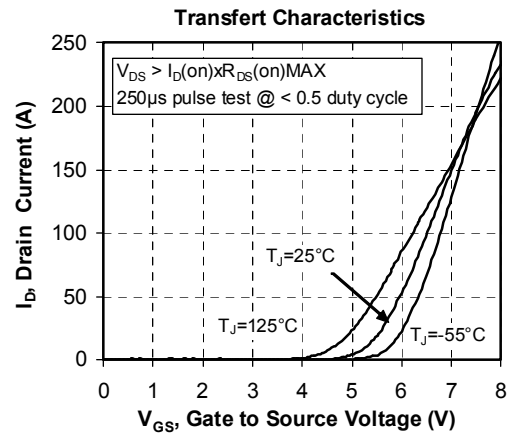
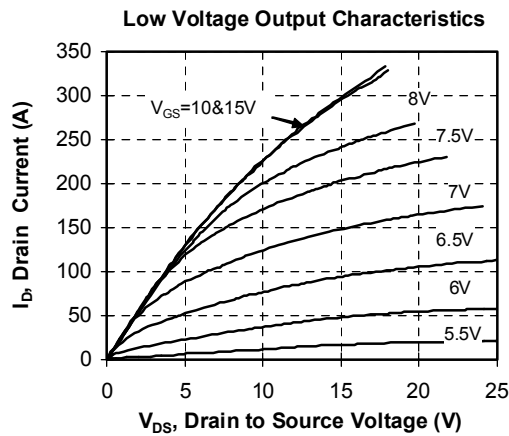
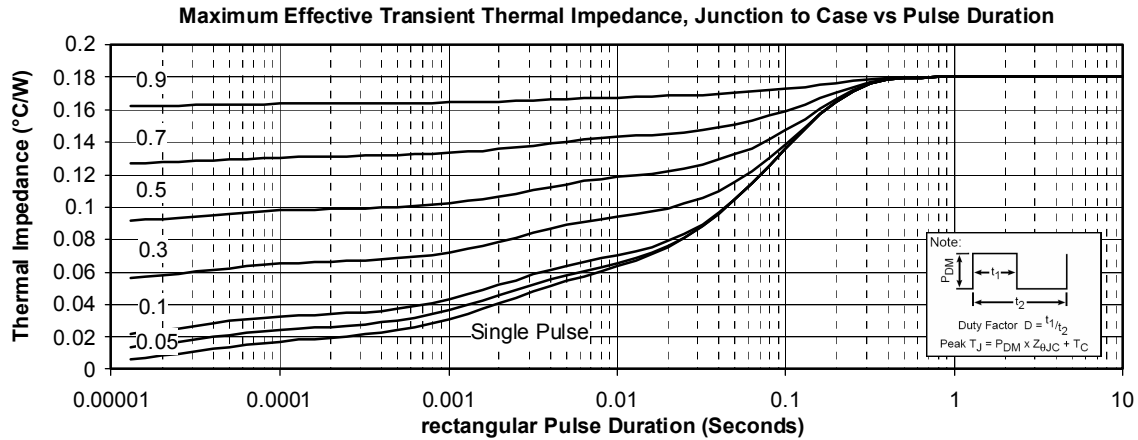
T: Thermistor temperature  
R<sub>T</sub>: Thermistor value at T

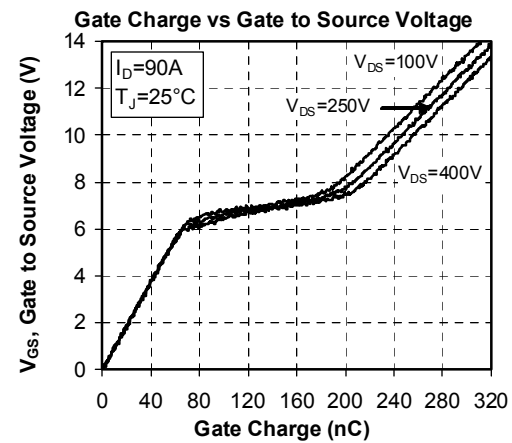
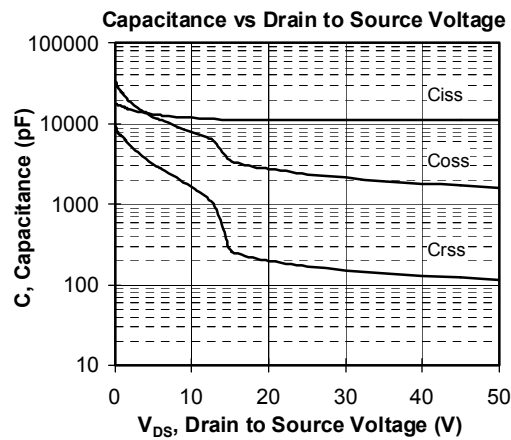
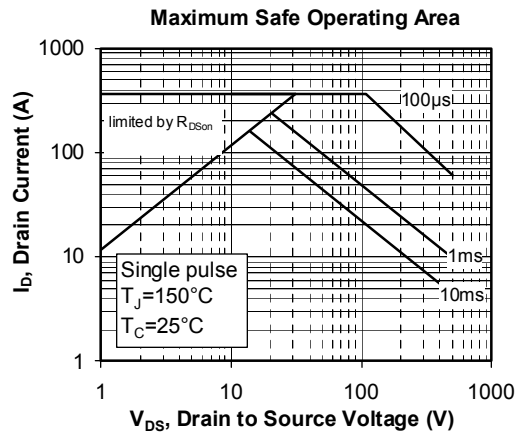
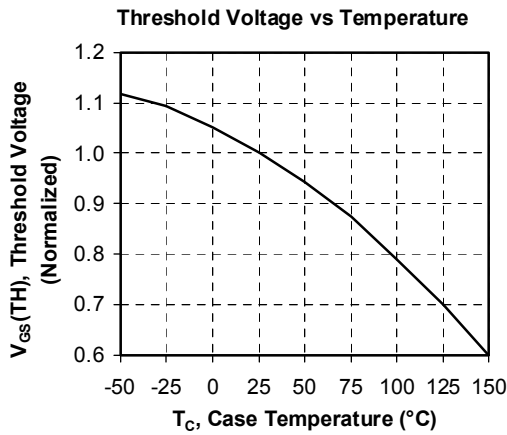
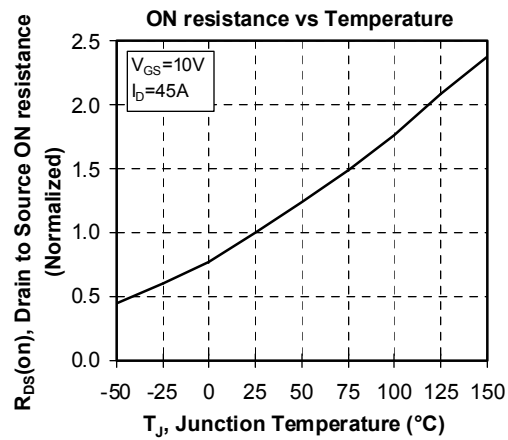
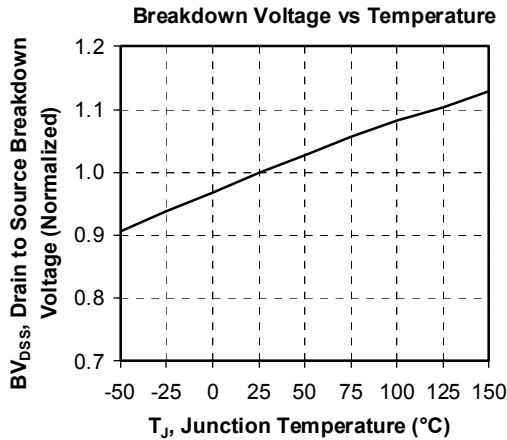
## SP4 Package outline (dimensions in mm)

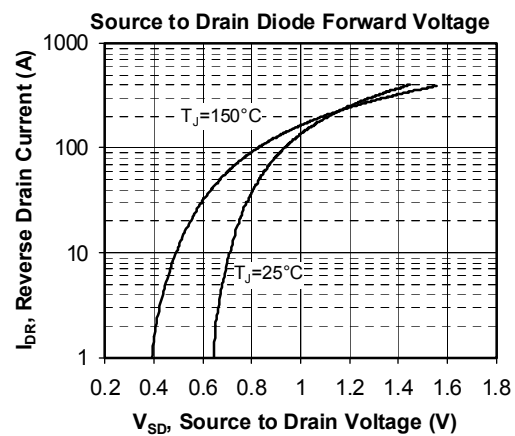
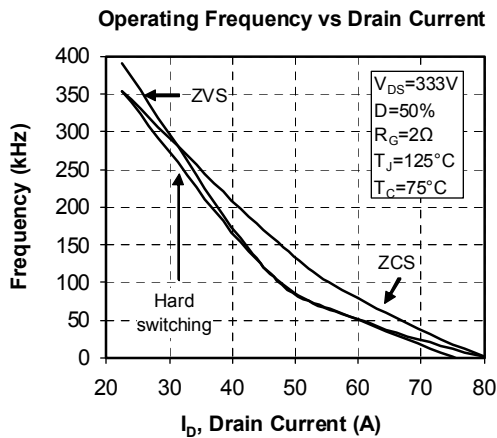
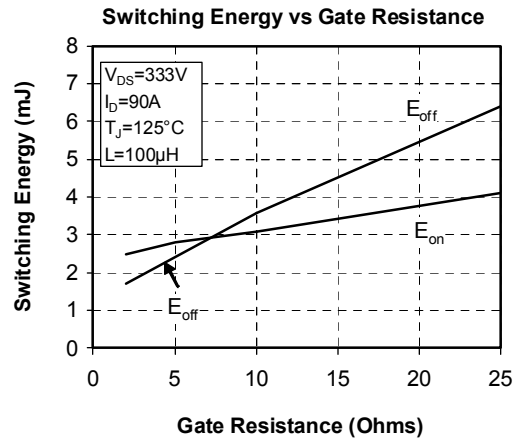
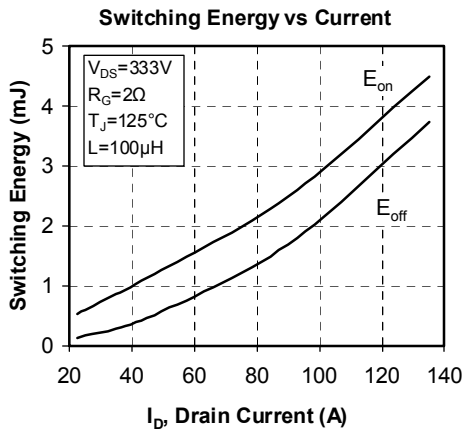
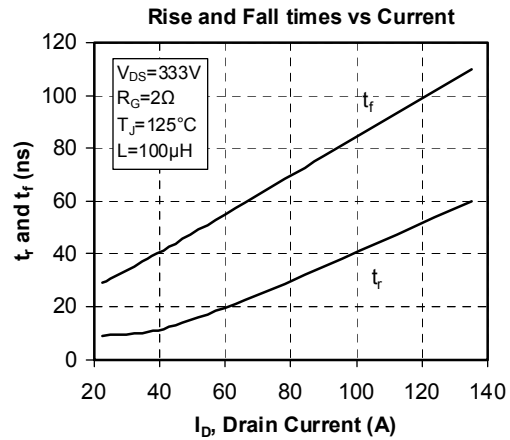
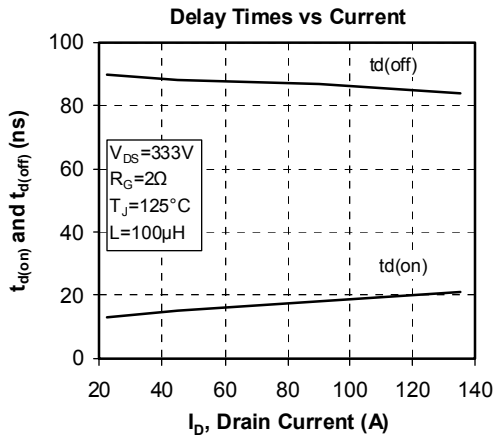


See application note APT0501 - Mounting Instructions for SP4 Power Modules on [www.microsemi.com](http://www.microsemi.com)

## Typical Performance Curve







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