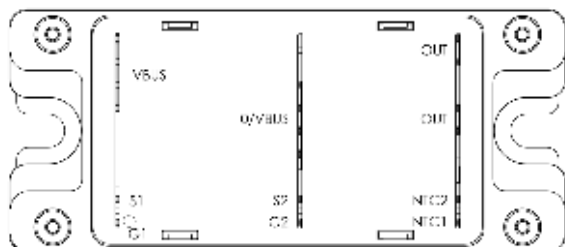
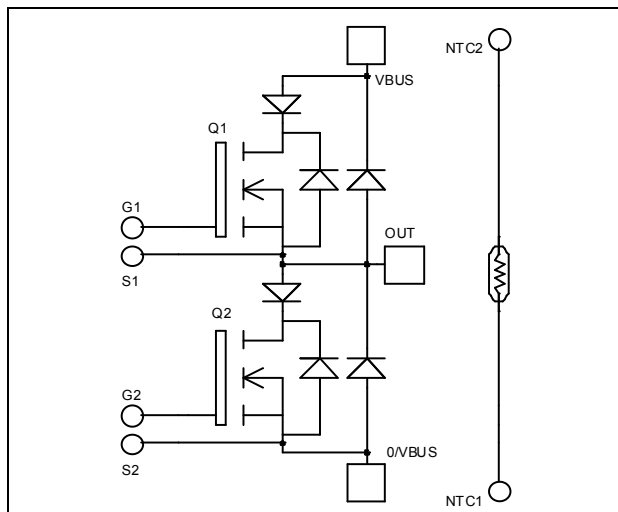


## Phase leg Series & parallel diodes MOSFET Power Module

**$V_{DSS} = 500V$**

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

**$I_D = 90A$  @  $T_c = 25^\circ C$**



### 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

**All ratings @  $T_j = 25^\circ C$  unless otherwise specified**

### Absolute maximum ratings

| Symbol     | Parameter                                         | Max ratings        | Unit       |
|------------|---------------------------------------------------|--------------------|------------|
| $V_{DSS}$  | Drain - Source Breakdown Voltage                  | 500                | V          |
| $I_D$      | Continuous Drain Current                          | $T_c = 25^\circ C$ | A          |
|            |                                                   | $T_c = 80^\circ C$ |            |
| $I_{DM}$   | Pulsed Drain current                              | 360                |            |
| $V_{GS}$   | Gate - Source Voltage                             | $\pm 30$           | V          |
| $R_{DSon}$ | Drain - Source ON Resistance                      | 45                 | m $\Omega$ |
| $P_D$      | Maximum Power Dissipation                         | $T_c = 25^\circ C$ | W          |
| $I_{AR}$   | 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)

**Electrical Characteristics**

| Symbol              | Characteristic                  | Test Conditions                                                     | Min | Typ | Max  | Unit |
|---------------------|---------------------------------|---------------------------------------------------------------------|-----|-----|------|------|
| I <sub>DSS</sub>    | Zero Gate Voltage Drain Current | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 500V T <sub>j</sub> = 25°C  |     |     | 200  | μA   |
|                     |                                 | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 400V T <sub>j</sub> = 125°C |     |     | 1000 |      |
| R <sub>DS(on)</sub> | Drain – Source on Resistance    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 45A                         |     | 38  | 45   | mΩ   |
| V <sub>GS(th)</sub> | Gate Threshold Voltage          | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 5mA            | 3   |     | 5    | V    |
| I <sub>GSS</sub>    | Gate – Source Leakage Current   | V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0V                       |     |     | ±200 | nA   |

**Dynamic Characteristics**

| Symbol              | Characteristic                      | Test Conditions                                                                                                                       | Min | Typ  | Max  | Unit |
|---------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| C <sub>iss</sub>    | Input Capacitance                   | V <sub>GS</sub> = 0V                                                                                                                  |     | 11.2 |      | nF   |
| C <sub>oss</sub>    | Output Capacitance                  | V <sub>DS</sub> = 25V                                                                                                                 |     | 2.4  |      |      |
| C <sub>rss</sub>    | Reverse Transfer Capacitance        | f = 1MHz                                                                                                                              |     | 0.18 |      |      |
| Q <sub>g</sub>      | Total gate Charge                   | V <sub>GS</sub> = 10V                                                                                                                 |     | 246  |      | nC   |
| Q <sub>gs</sub>     | Gate – Source Charge                | V <sub>Bus</sub> = 250V                                                                                                               |     | 66   |      |      |
| Q <sub>gd</sub>     | Gate – Drain Charge                 | I <sub>D</sub> = 90A                                                                                                                  |     | 130  |      |      |
| T <sub>d(on)</sub>  | Turn-on Delay Time                  | <b>Inductive switching @ 125°C</b><br>V <sub>GS</sub> = 15V<br>V <sub>Bus</sub> = 333V<br>I <sub>D</sub> = 90A<br>R <sub>G</sub> = 2Ω |     | 18   |      | ns   |
| T <sub>r</sub>      | Rise Time                           |                                                                                                                                       |     | 35   |      |      |
| T <sub>d(off)</sub> | Turn-off Delay Time                 |                                                                                                                                       |     | 87   |      |      |
| T <sub>f</sub>      | Fall Time                           |                                                                                                                                       |     | 77   |      |      |
| E <sub>on</sub>     | Turn-on Switching Energy            | <b>Inductive switching @ 25°C</b><br>V <sub>GS</sub> = 15V, V <sub>Bus</sub> = 333V<br>I <sub>D</sub> = 90A, R <sub>G</sub> = 2Ω      |     | 1510 |      | μJ   |
| E <sub>off</sub>    | Turn-off Switching Energy           |                                                                                                                                       |     | 1452 |      |      |
| E <sub>on</sub>     | Turn-on Switching Energy            | <b>Inductive switching @ 125°C</b><br>V <sub>GS</sub> = 15V, V <sub>Bus</sub> = 333V<br>I <sub>D</sub> = 90A, R <sub>G</sub> = 2Ω     |     | 2482 |      | μJ   |
| E <sub>off</sub>    | Turn-off Switching Energy           |                                                                                                                                       |     | 1692 |      |      |
| R <sub>thJC</sub>   | Junction to Case Thermal Resistance |                                                                                                                                       |     |      | 0.18 | °C/W |

**Series 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                                            |                        |      | 250  | μA   |
| I <sub>F</sub>    | DC Forward Current                      | T <sub>c</sub> = 80°C                                            |                        | 90   |      | A    |
| V <sub>F</sub>    | Diode Forward Voltage                   | I <sub>F</sub> = 90A                                             |                        | 1.6  | 1.8  | V    |
|                   |                                         | I <sub>F</sub> = 180A                                            |                        | 1.9  |      |      |
|                   |                                         | I <sub>F</sub> = 90A T <sub>j</sub> = 125°C                      |                        | 1.4  |      |      |
| 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                 | I <sub>F</sub> = 90A<br>V <sub>R</sub> = 400V<br>di/dt = 600A/μs | T <sub>j</sub> = 25°C  | 390  |      | nC   |
|                   |                                         |                                                                  | T <sub>j</sub> = 125°C | 2100 |      |      |
| R <sub>thJC</sub> | Junction to Case Thermal Resistance     |                                                                  |                        |      | 0.45 | °C/W |

## 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                                             |                        |     |      | 250  | μA   |
| I <sub>F</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  |     | 25   |      | ns   |
|                   |                                         |                                                                  | T <sub>j</sub> = 125°C |     | 160  |      |      |
| Q <sub>rr</sub>   | Reverse Recovery Charge                 |                                                                  | T <sub>j</sub> = 25°C  |     | 105  |      | nC   |
|                   |                                         |                                                                  | T <sub>j</sub> = 125°C |     | 1440 |      |      |
| R <sub>thJC</sub> | Junction to Case Thermal Resistance     |                                                                  |                        |     |      | 0.45 | °C/W |

## Thermal and package characteristics

| Symbol            | Characteristic                                                |             |    | Min  | Max                    | Unit |
|-------------------|---------------------------------------------------------------|-------------|----|------|------------------------|------|
| V <sub>ISOL</sub> | RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz |             |    | 4000 |                        | V    |
| T <sub>J</sub>    | Operating junction temperature range                          |             |    | -40  | 150                    | °C   |
| T <sub>JOP</sub>  | Recommended junction temperature under switching conditions   |             |    | -40  | T <sub>J</sub> max -25 |      |
| 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    |

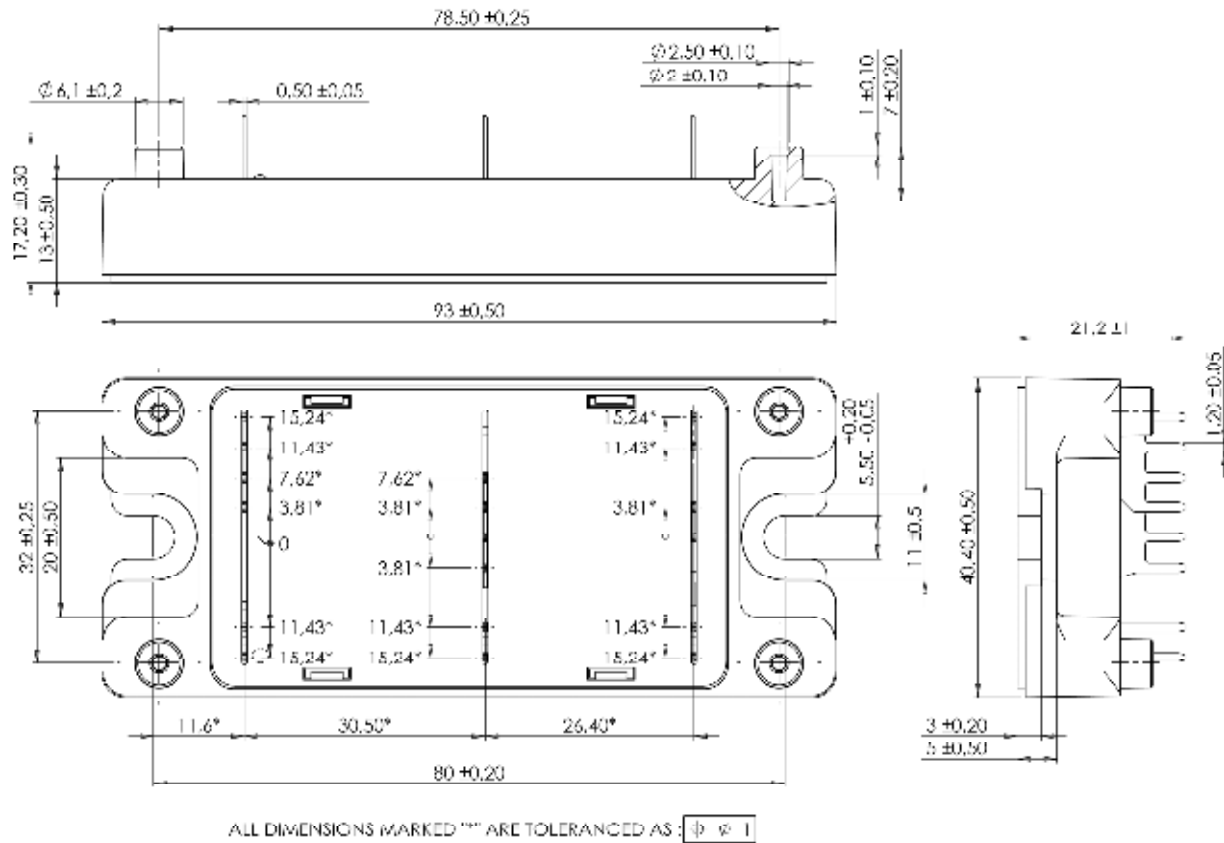
## Temperature sensor NTC (see application note APT0406 on www.microsemi.com).

| Symbol                            | Characteristic             | Min | Typ  | Max | Unit |
|-----------------------------------|----------------------------|-----|------|-----|------|
| R <sub>25</sub>                   | Resistance @ 25°C          |     | 50   |     | kΩ   |
| ΔR <sub>25</sub> /R <sub>25</sub> |                            |     | 5    |     | %    |
| B <sub>25/85</sub>                | T <sub>25</sub> = 298.15 K |     | 3952 |     | K    |
| ΔB/B                              |                            |     | 4    |     | %    |

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

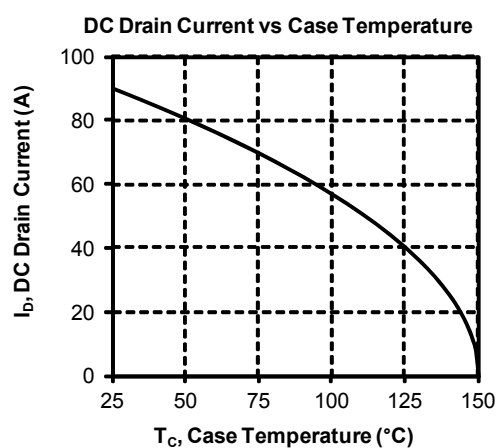
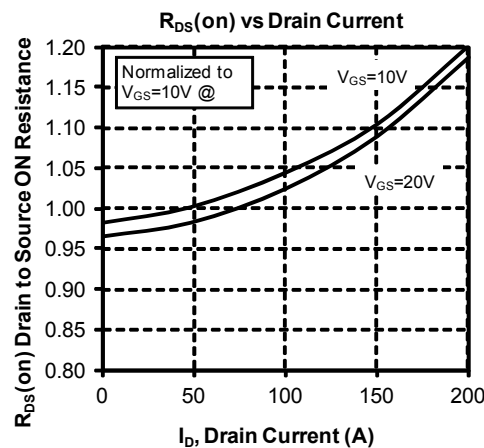
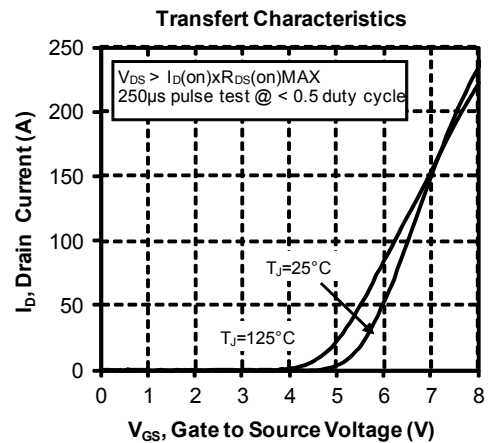
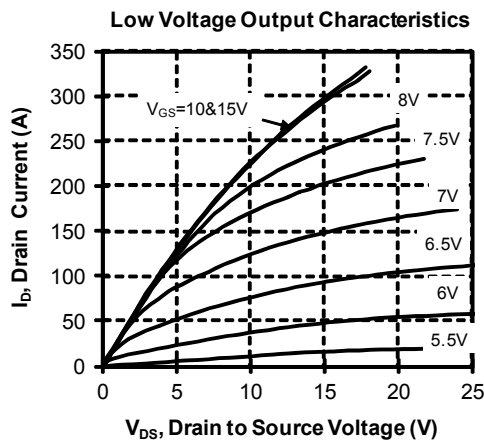
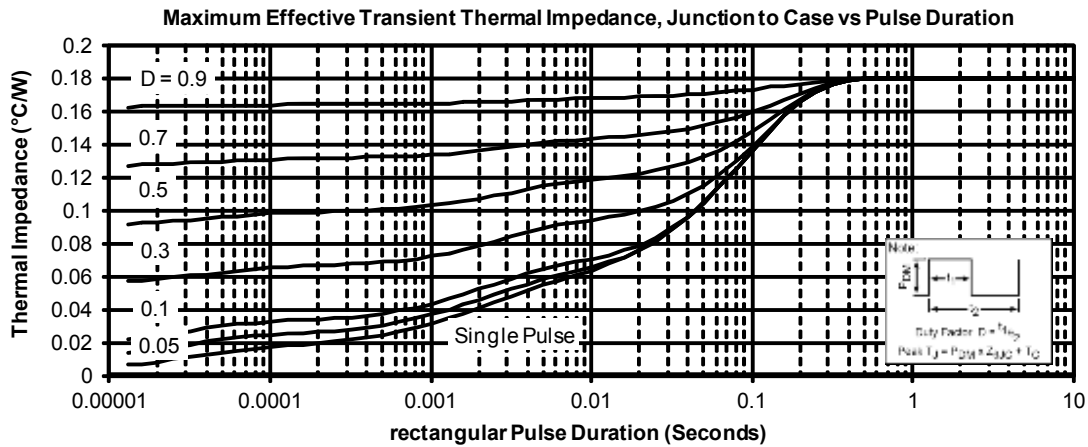
T: Thermistor temperature  
R<sub>T</sub>: Thermistor value at T

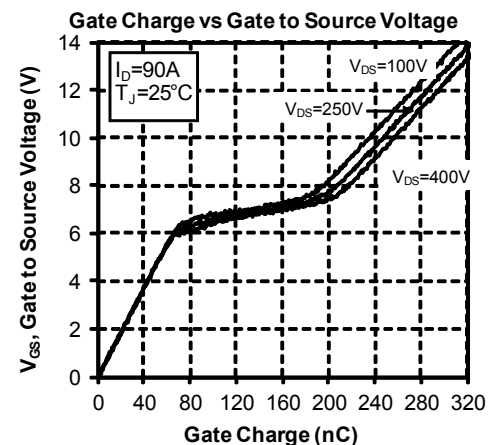
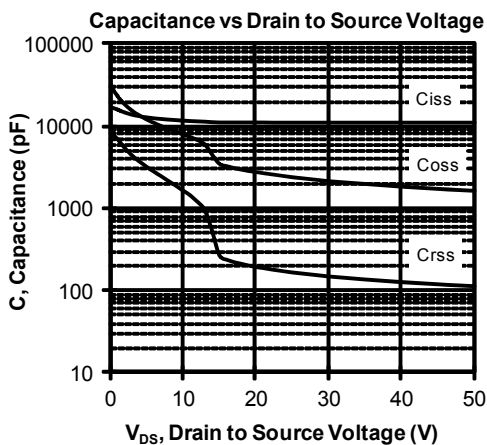
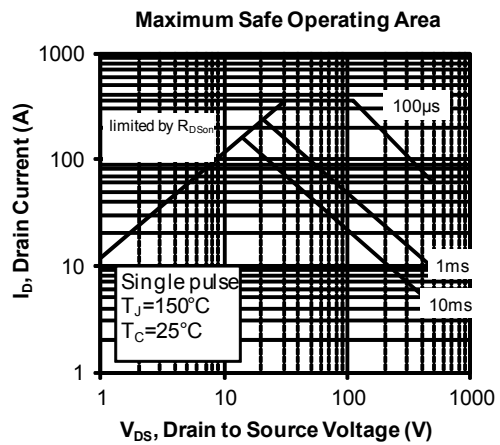
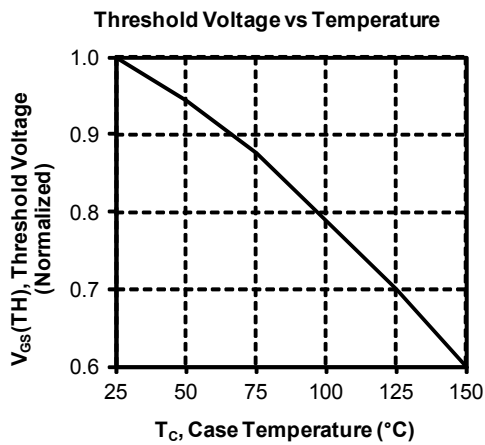
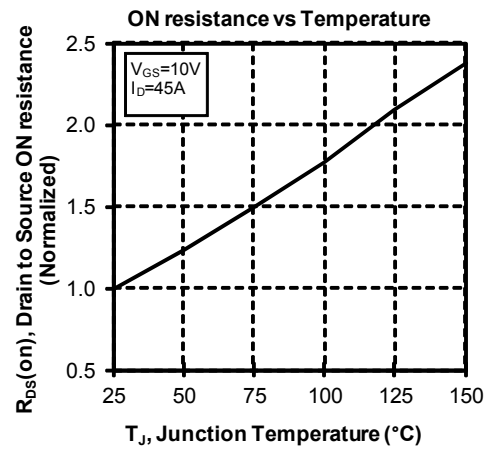
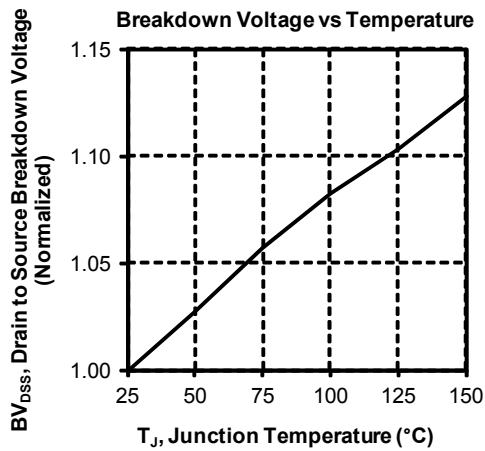
## SP4 Package outline (dimensions in mm)

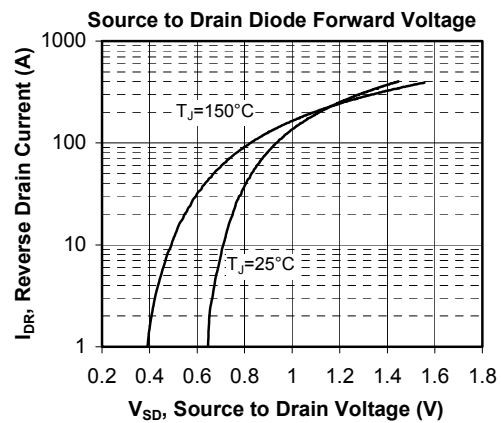
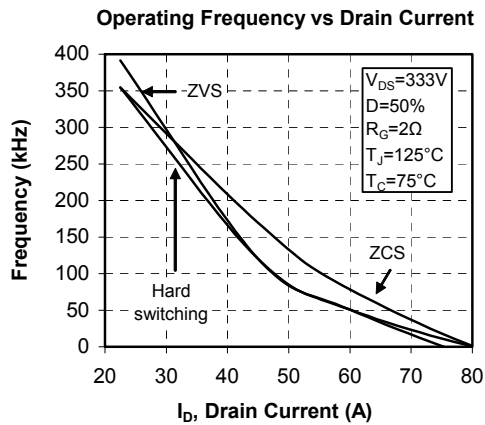
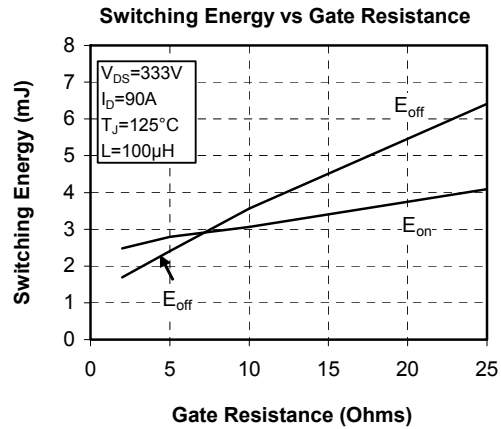
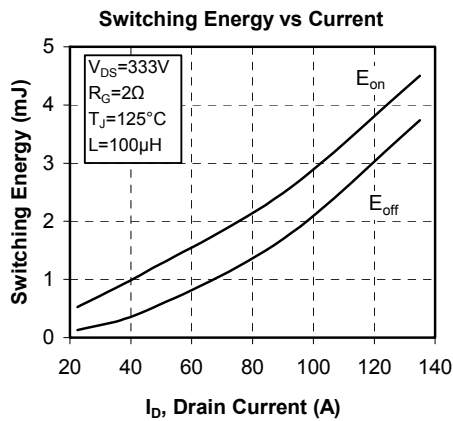
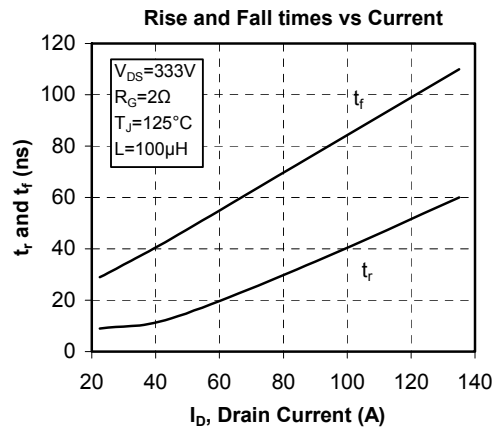
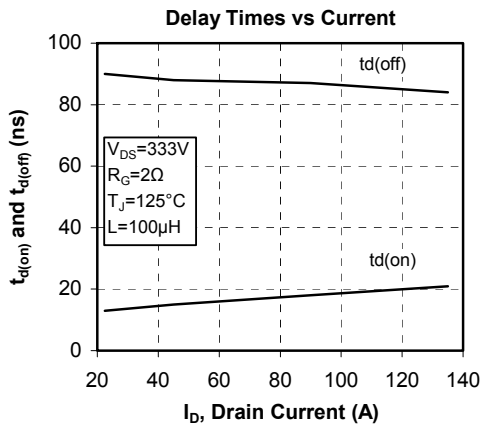


See application note APT0501 - Mounting Instructions for SP4 Power Modules on [www.microsemi.com](http://www.microsemi.com)

## Typical Performance Curve







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