

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

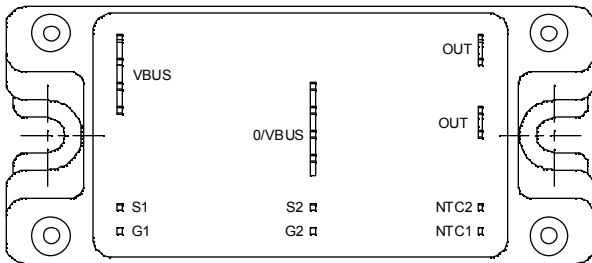
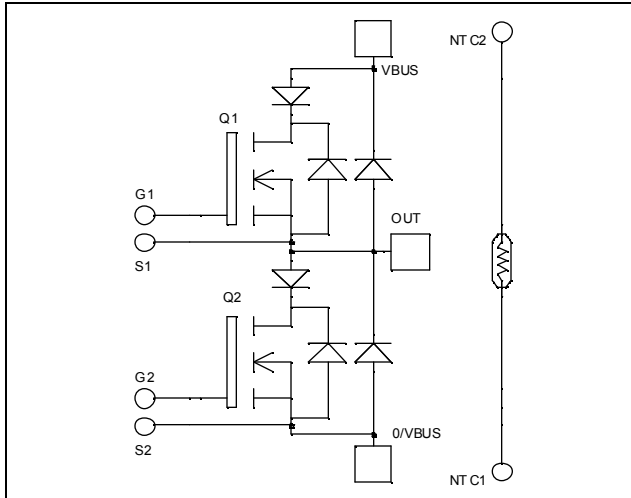
**$V_{DSS} = 600V$**   
 **$R_{DSon} = 35m\Omega \text{ max @ } T_j = 25^\circ C$**   
 **$I_D = 72A \text{ @ } T_c = 25^\circ C$**

### Application

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

### Features

- **COOLMOS**  
Power Semiconductors
  - 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
  - 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	600	V
$I_D$	Continuous Drain Current	$T_c = 25^\circ C$	72
		$T_c = 80^\circ C$	54
$I_{DM}$	Pulsed Drain current	288	
$V_{GS}$	Gate - Source Voltage	$\pm 30$	V
$R_{DSon}$	Drain - Source ON Resistance	35	$m\Omega$
$P_D$	Maximum Power Dissipation	$T_c = 25^\circ C$	416
$I_{AR}$	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](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	$V_{GS} = 0\text{V}, V_{DS} = 600\text{V}$	$T_j = 25^\circ\text{C}$			50	$\mu\text{A}$
		$V_{GS} = 0\text{V}, V_{DS} = 600\text{V}$	$T_j = 125^\circ\text{C}$			500	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10\text{V}, I_D = 36\text{A}$				35	$\text{m}\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 2\text{mA}$		2.1	3	3.9	V
$I_{GSS}$	Gate – Source Leakage Current	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$				$\pm 150$	nA

**Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$C_{iss}$	Input Capacitance	$V_{GS} = 0\text{V}$ $V_{DS} = 25\text{V}$ $f = 1\text{MHz}$		14		nF
$C_{oss}$	Output Capacitance			5.13		
$C_{rss}$	Reverse Transfer Capacitance			0.42		
$Q_g$	Total gate Charge	$V_{GS} = 10\text{V}$ $V_{Bus} = 300\text{V}$ $I_D = 72\text{A}$		518		nC
$Q_{gs}$	Gate – Source Charge			58		
$Q_{gd}$	Gate – Drain Charge			222		
$T_{d(on)}$	Turn-on Delay Time	<b>Inductive switching @ <math>125^\circ\text{C}</math></b>		21		ns
$T_r$	Rise Time	$V_{GS} = 15\text{V}$		30		
$T_{d(off)}$	Turn-off Delay Time	$V_{Bus} = 400\text{V}$		283		
$T_f$	Fall Time	$I_D = 72\text{A}$ $R_G = 2.5\Omega$		84		
$E_{on}$	Turn-on Switching Energy	<b>Inductive switching @ <math>25^\circ\text{C}</math></b>		804		$\mu\text{J}$
$E_{off}$	Turn-off Switching Energy	$V_{GS} = 15\text{V}, V_{Bus} = 400\text{V}$ $I_D = 72\text{A}, R_G = 2.5\Omega$		1960		
$E_{on}$	Turn-on Switching Energy	<b>Inductive switching @ <math>125^\circ\text{C}</math></b>		1315		$\mu\text{J}$
$E_{off}$	Turn-off Switching Energy	$V_{GS} = 15\text{V}, V_{Bus} = 400\text{V}$ $I_D = 72\text{A}, R_G = 2.5\Omega$		2412		

**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	$V_R = 200\text{V}$	$T_j = 25^\circ\text{C}$		350	$\mu\text{A}$
			$T_j = 125^\circ\text{C}$		600	
$I_F$	DC Forward Current			60		A
$V_F$	Diode Forward Voltage	$I_F = 60\text{A}$		1.1	1.15	V
		$I_F = 120\text{A}$		1.4		
		$I_F = 60\text{A}$	$T_j = 125^\circ\text{C}$	0.9		
$t_{rr}$	Reverse Recovery Time	$I_F = 60\text{A}$ $V_R = 133\text{V}$ $di/dt = 400\text{A}/\mu\text{s}$	$T_j = 25^\circ\text{C}$	24		ns
			$T_j = 125^\circ\text{C}$	48		
$Q_{rr}$	Reverse Recovery Charge	$I_F = 60\text{A}$ $V_R = 133\text{V}$ $di/dt = 400\text{A}/\mu\text{s}$	$T_j = 25^\circ\text{C}$	66		nC
			$T_j = 125^\circ\text{C}$	300		

**Parallel SiC diode ratings and characteristics**

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
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		200	800	μA
			T <sub>j</sub> = 175°C		400	4000	
I <sub>F</sub>	DC Forward Current		T <sub>c</sub> = 125°C		40		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 40A	T <sub>j</sub> = 25°C		1.6	1.8	V
			T <sub>j</sub> = 175°C		2.0	2.4	
Q <sub>C</sub>	Total Capacitive Charge	I <sub>F</sub> = 40A, V <sub>R</sub> = 300V di/dt = 1200A/μs			56		nC
C	Total Capacitance	f = 1MHz, V <sub>R</sub> = 200V			260		pF
		f = 1MHz, V <sub>R</sub> = 400V			200		

**Thermal and package characteristics**

<i>Symbol</i>	<i>Characteristic</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
R <sub>thJC</sub>	Junction to Case Thermal Resistance	Transistor			0.3	°C/W
		Series diode			0.65	
		Parallel diode			0.8	
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	
Wt	Package Weight				160	g

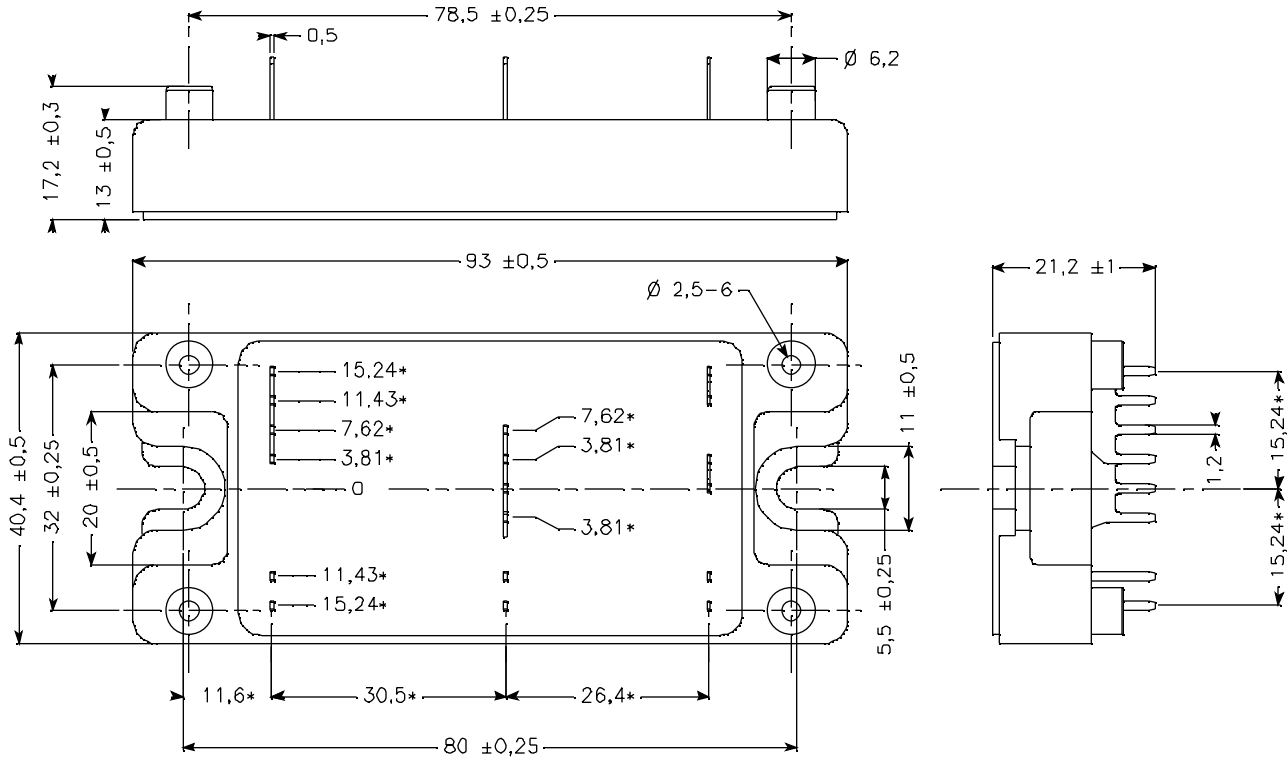
**Temperature sensor NTC** (see application note APT0406 on www.microsemi.com for more information).

<i>Symbol</i>	<i>Characteristic</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
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

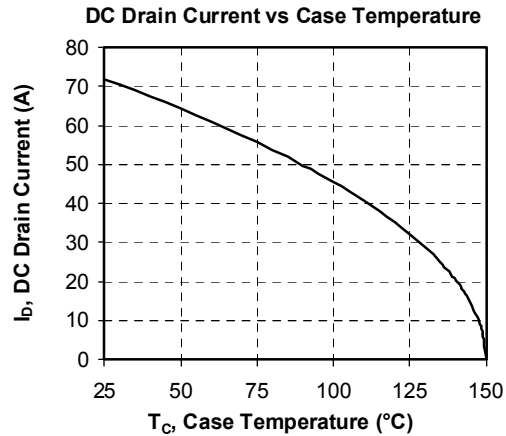
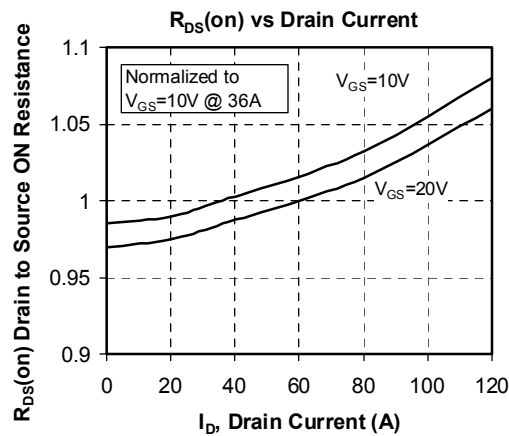
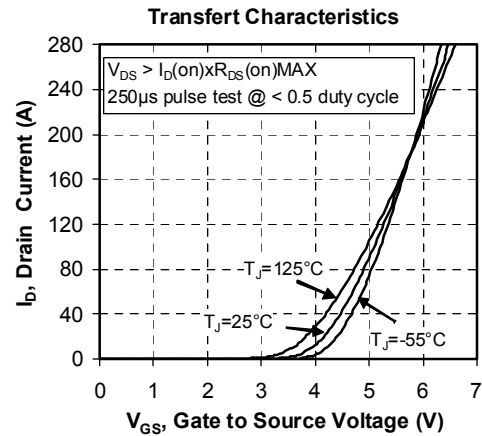
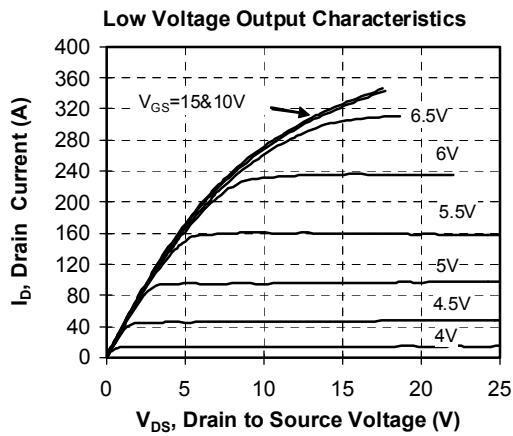
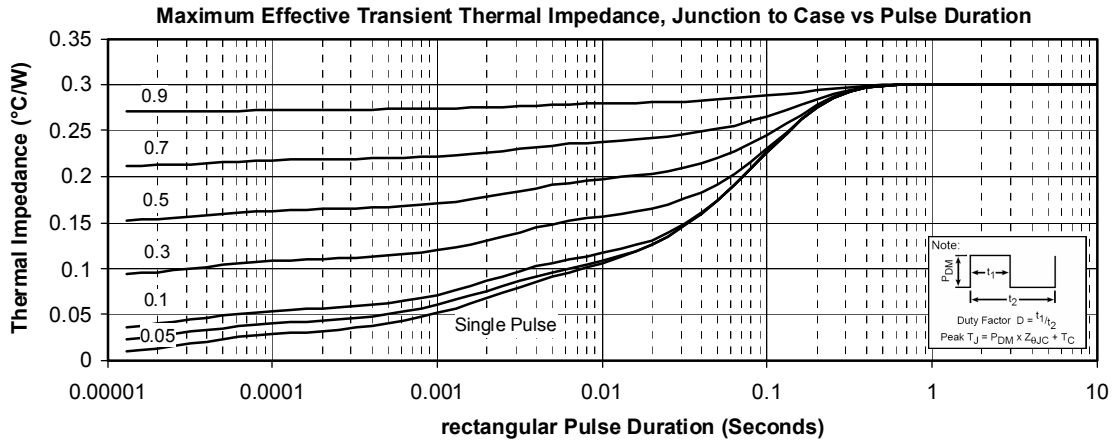
## SP4 Package outline (dimensions in mm)

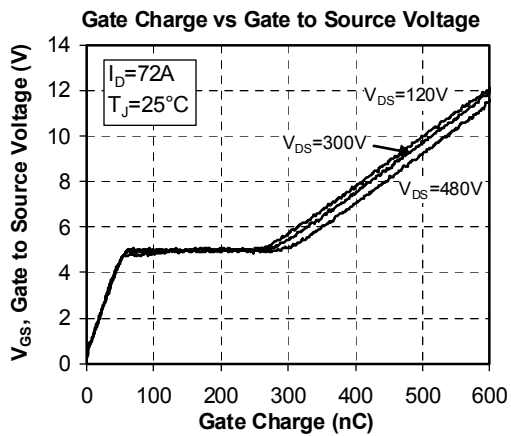
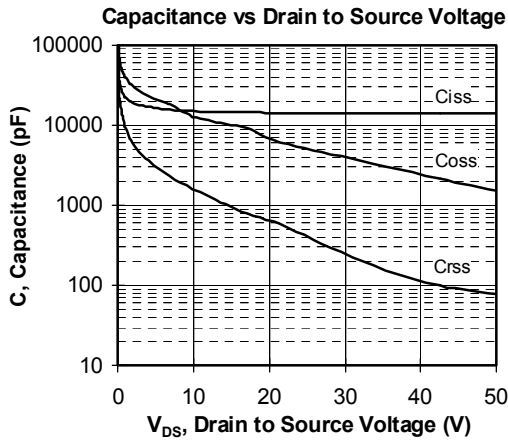
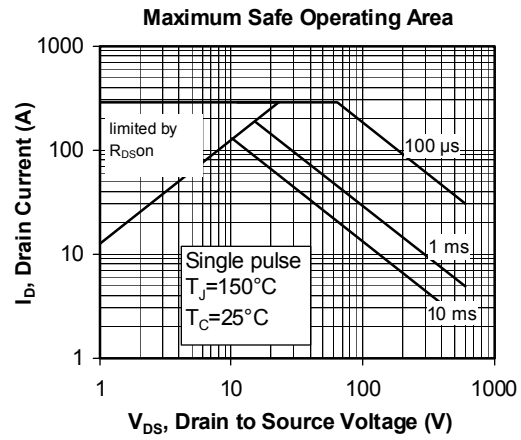
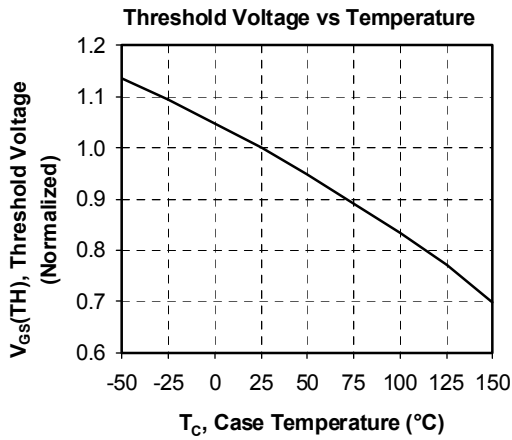
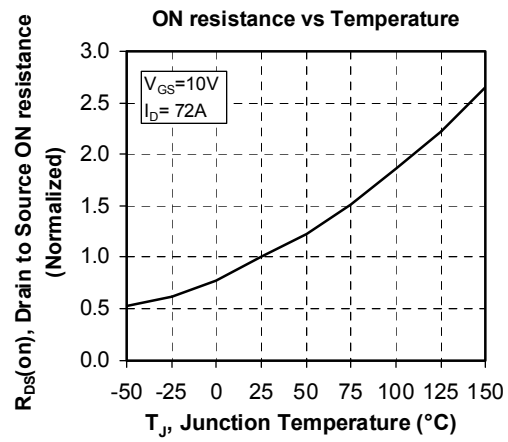
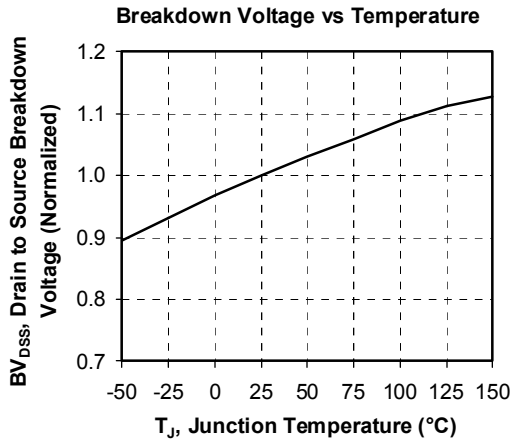


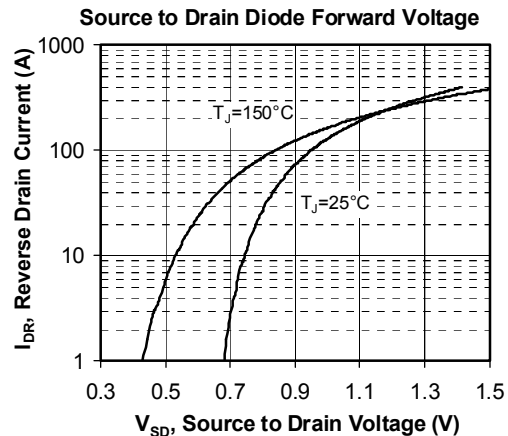
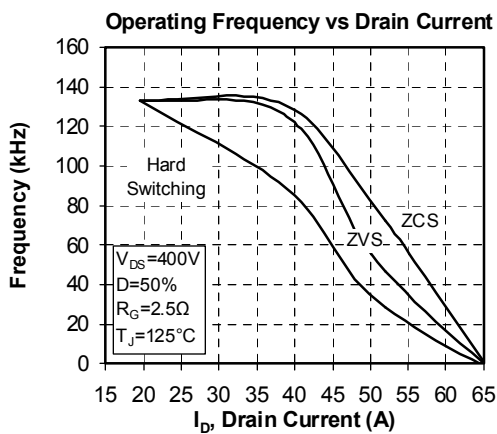
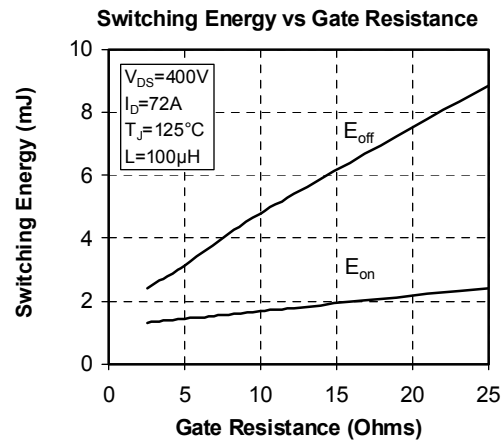
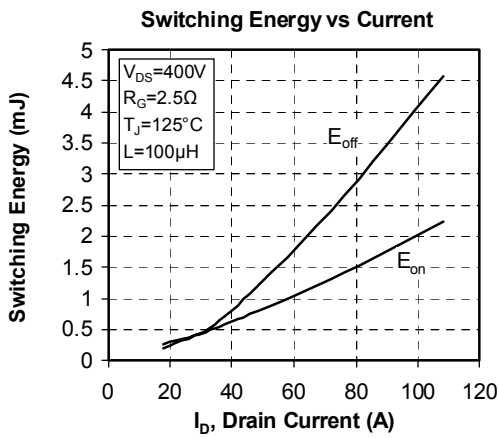
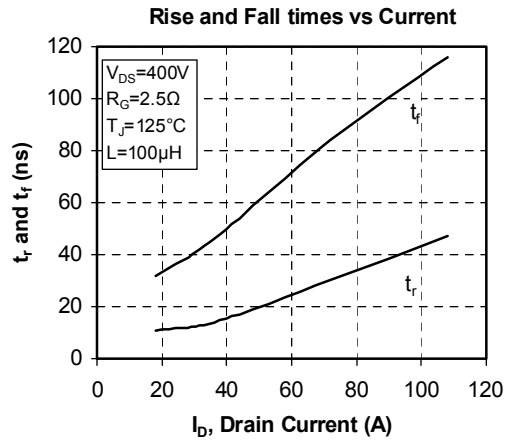
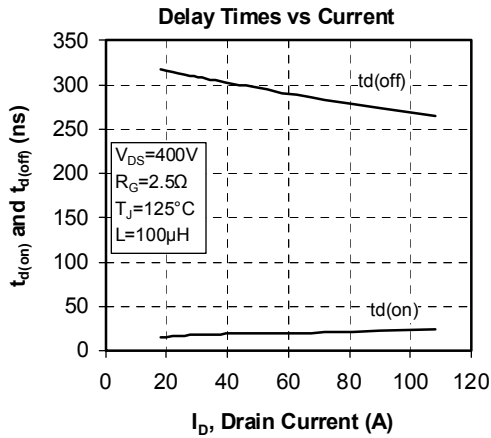
ALL DIMENSIONS MARKED "\*" ARE TOLERANCED AS :  $\varnothing 1$

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

## Typical CoolMOS Performance Curve

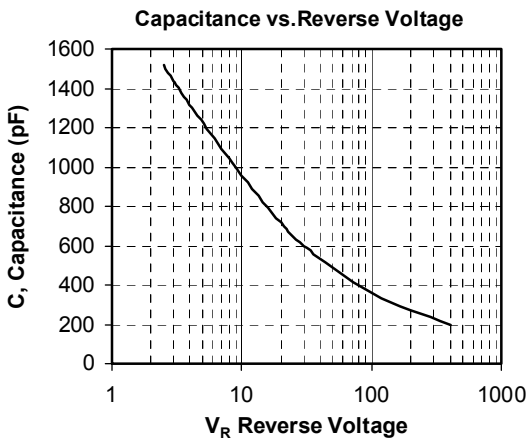
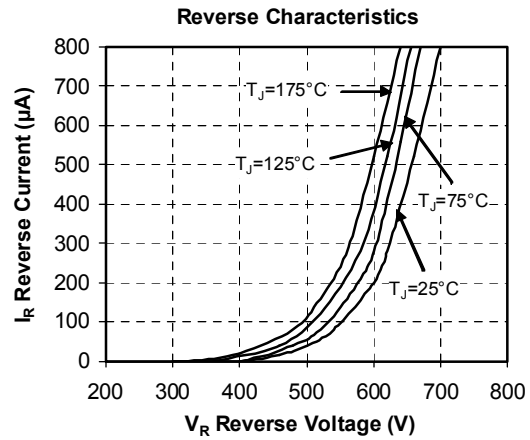
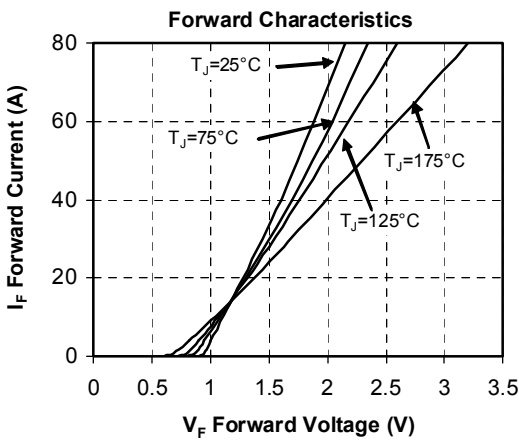
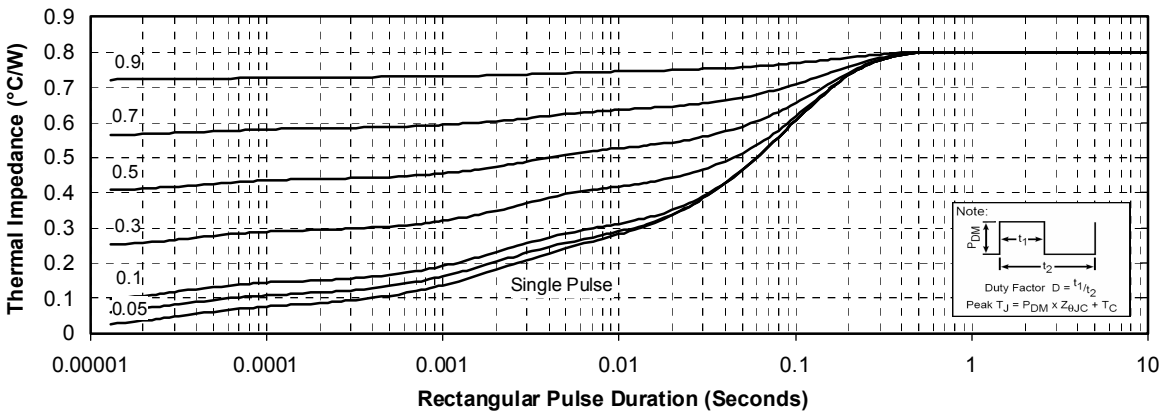






## Typical SiC Diode Performance Curve

Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



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