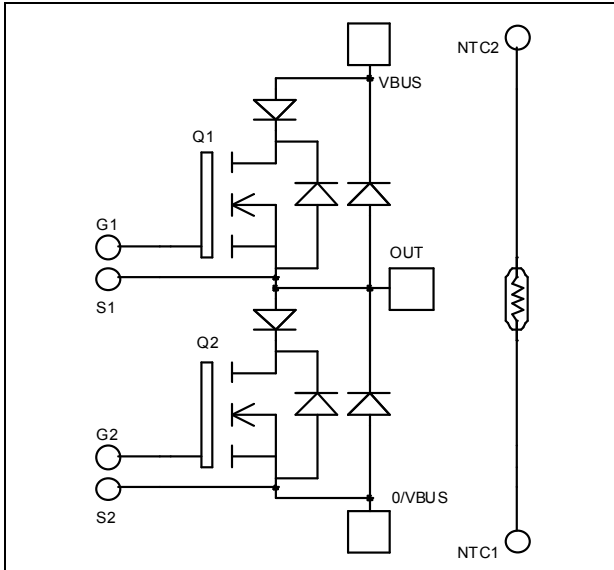


**Phase Serie & SiC parallel diodes  
Super Junction MOSFET Power Module**

$V_{DSS} = 800V$   
 $R_{DSon} = 150m\Omega \text{ max @ } T_j = 25^\circ C$   
 $I_D = 28A \text{ @ } T_c = 25^\circ C$

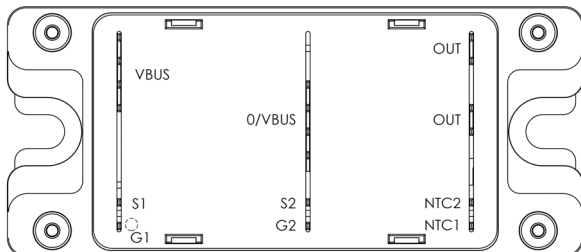


**Application**

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

**Features**

- **CoolMOST™**
  - 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

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

**Absolute maximum ratings**

Symbol	Parameter	Max ratings	Unit
$V_{DSS}$	Drain - Source Breakdown Voltage	800	V
$I_D$	Continuous Drain Current	$T_c = 25^\circ C$	28
		$T_c = 80^\circ C$	21
$I_{DM}$	Pulsed Drain current	112	A
$V_{GS}$	Gate - Source Voltage	$\pm 30$	V
$R_{DSon}$	Drain - Source ON Resistance	150	$m\Omega$
$P_D$	Maximum Power Dissipation	$T_c = 25^\circ C$	277
$I_{AR}$	Avalanche current (repetitive and non repetitive)	17	A
$E_{AR}$	Repetitive Avalanche Energy	0.5	mJ
$E_{AS}$	Single Pulse Avalanche Energy	670	

**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> = 800V			50	μA
		T <sub>j</sub> = 25°C				
		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 800V			375	
R <sub>DS(on)</sub>	Drain – Source on Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 14A			150	mΩ
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 2mA	2.1	3	3.9	V
I <sub>GSS</sub>	Gate – Source Leakage Current	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0V			±150	nA

**Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V		4507		pF
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> = 25V		2092		
C <sub>rss</sub>	Reverse Transfer Capacitance	f = 1MHz		108		
Q <sub>g</sub>	Total gate Charge	V <sub>GS</sub> = 10V		180		nC
Q <sub>gs</sub>	Gate – Source Charge	V <sub>Bus</sub> = 400V		22		
Q <sub>gd</sub>	Gate – Drain Charge	I <sub>D</sub> = 28A		90		
T <sub>d(on)</sub>	Turn-on Delay Time	<b>Inductive switching @125°C</b> V <sub>GS</sub> = 15V V <sub>Bus</sub> = 533V I <sub>D</sub> = 28A R <sub>G</sub> = 2.5Ω		10		ns
T <sub>r</sub>	Rise Time			13		
T <sub>d(off)</sub>	Turn-off Delay Time			83		
T <sub>f</sub>	Fall Time			35		
E <sub>on</sub>	Turn-on Switching Energy	<b>Inductive switching @ 25°C</b> V <sub>GS</sub> = 15V, V <sub>Bus</sub> = 533V I <sub>D</sub> = 28A, R <sub>G</sub> = 2.5Ω		291		μJ
E <sub>off</sub>	Turn-off Switching Energy			278		
E <sub>on</sub>	Turn-on Switching Energy	<b>Inductive switching @ 125°C</b> V <sub>GS</sub> = 15V, V <sub>Bus</sub> = 533V I <sub>D</sub> = 28A, R <sub>G</sub> = 2.5Ω		510		μJ
E <sub>off</sub>	Turn-off Switching Energy			342		
R <sub>thJC</sub>	Junction to Case Thermal Resistance				0.45	°C/W

**Series diode ratings and characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage		1000			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> = 1000V			250	μA
I <sub>F</sub>	DC Forward Current	T <sub>c</sub> = 80°C		60		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 60A		1.9	2.3	V
		I <sub>F</sub> = 120A		2.2		
		I <sub>F</sub> = 60A	T <sub>j</sub> = 125°C		1.7	
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 60A V <sub>R</sub> = 667V di/dt = 400A/μs	T <sub>j</sub> = 25°C		290	ns
			T <sub>j</sub> = 125°C		390	
Q <sub>rr</sub>	Reverse Recovery Charge	di/dt = 400A/μs	T <sub>j</sub> = 25°C		1.34	μC
			T <sub>j</sub> = 125°C		4.7	
R <sub>thJC</sub>	Junction to Case Thermal Resistance				0.65	°C/W

**Parallel diode ratings and characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage		1200			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> =1200V		64	400	μA
				112	2000	
I <sub>F</sub>	DC Forward Current			20		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 20A		1.6	1.8	V
				2.3		
Q <sub>C</sub>	Total Capacitive Charge	I <sub>F</sub> = 20A, V <sub>R</sub> = 1200V di/dt = 1000A/μs		160		nC
Q	Total Capacitance	f = 1MHz, V <sub>R</sub> = 200V		192		pF
		f = 1MHz, V <sub>R</sub> = 400V		138		
R <sub>thJC</sub>	Junction to Case Thermal Resistance				1	°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>Jmax</sub> -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

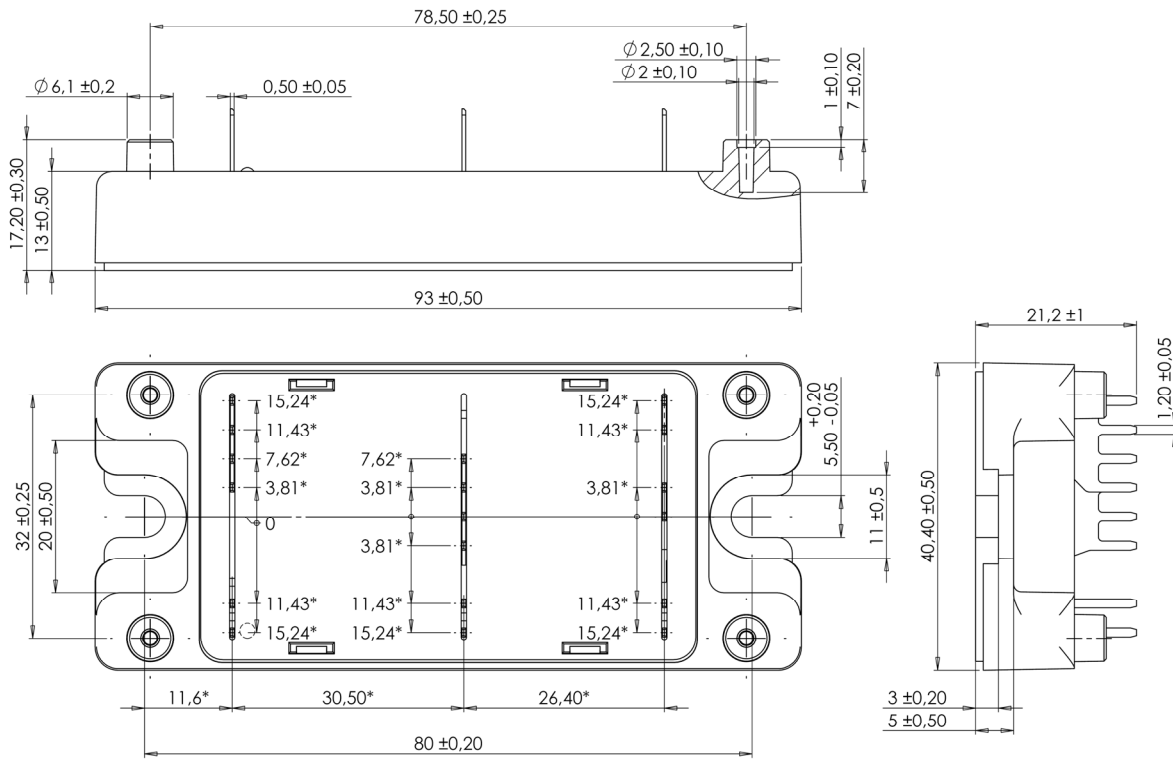
**Temperature sensor NTC** (see application note APT0406 on www.microsemi.com).

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

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

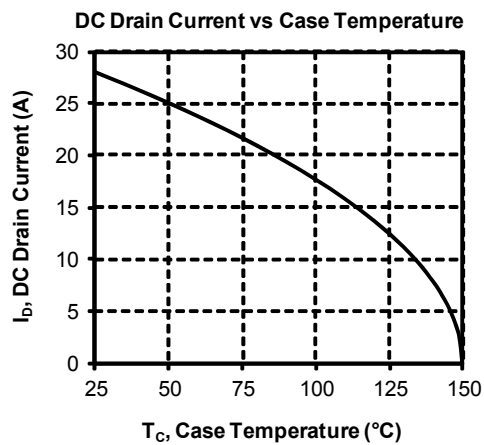
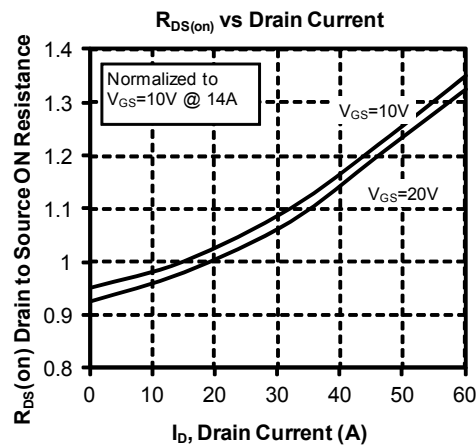
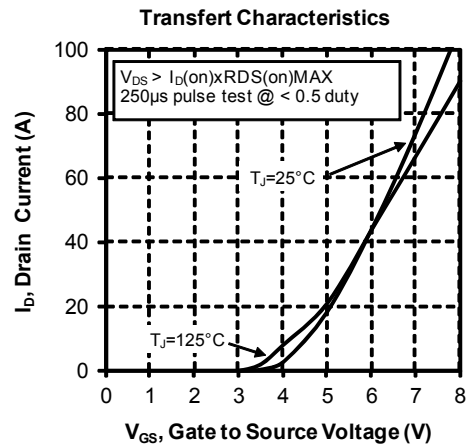
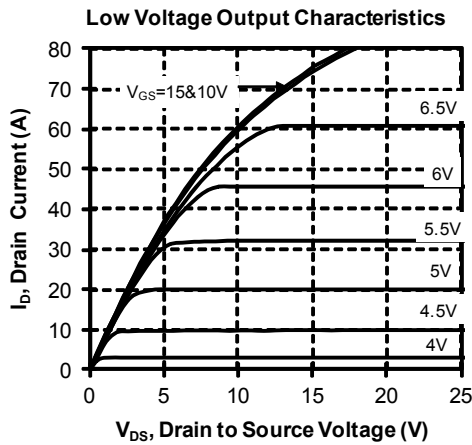
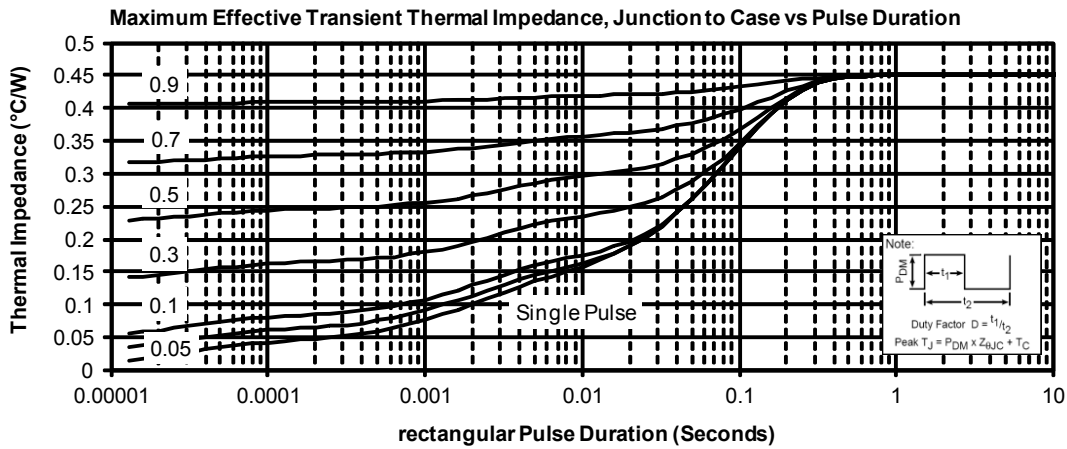
T: Thermistor temperature  
 R<sub>T</sub>: Thermistor value at T

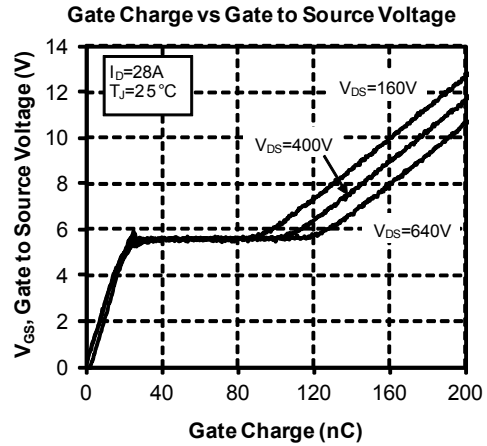
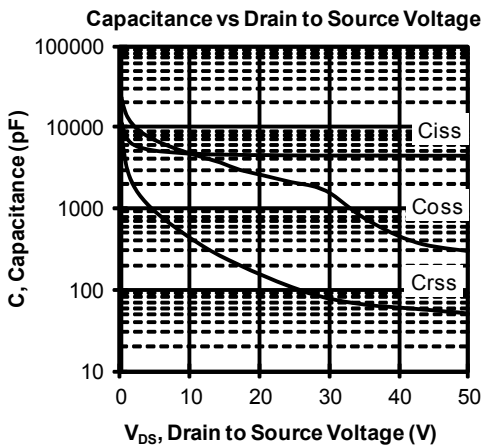
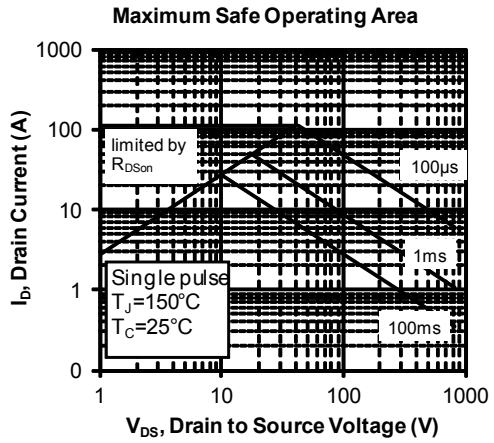
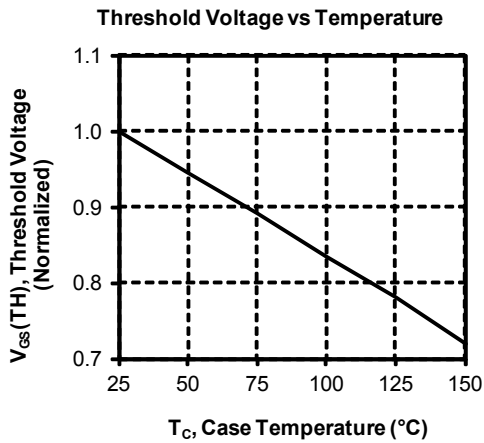
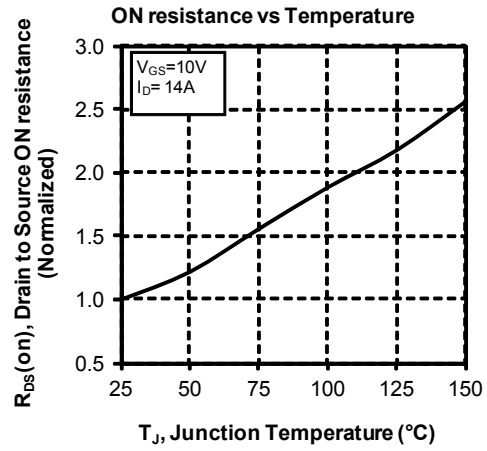
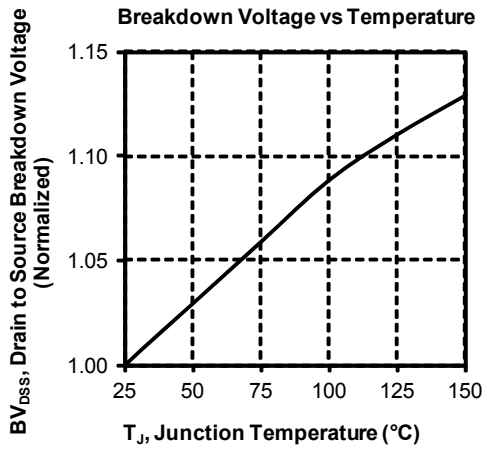
## SP4 Package outline (dimensions in mm)



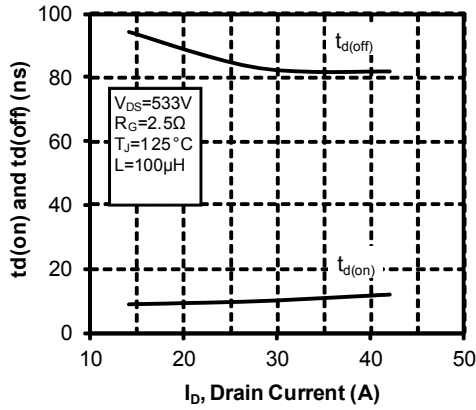
ALL DIMENSIONS MARKED "\*" ARE TOLERANCED AS:  $\pm \phi 1$

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

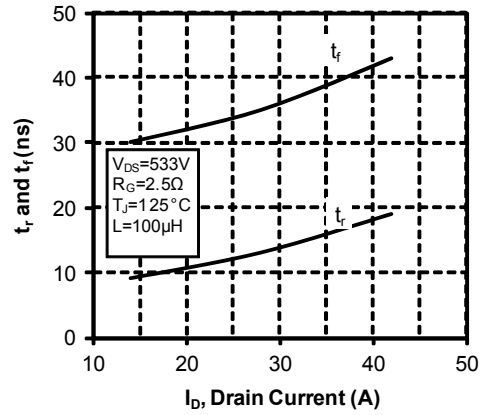
**Typical CoolMOS Performance Curve**




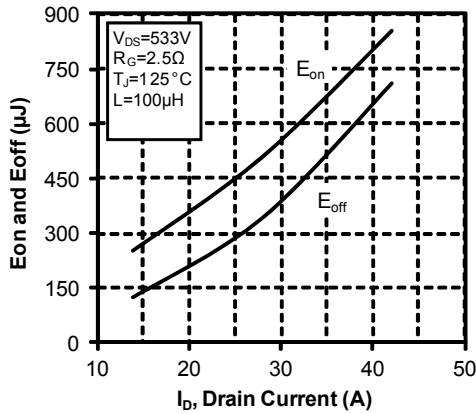
**Delay Times vs Current**



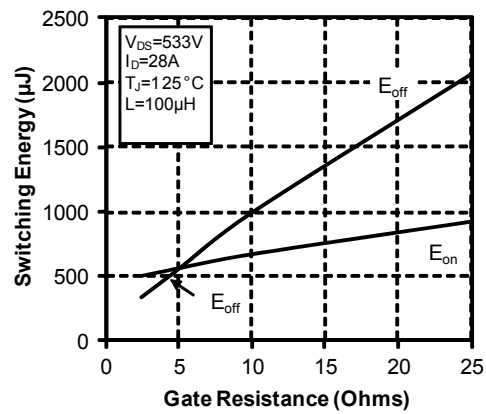
**Rise and Fall times vs Current**



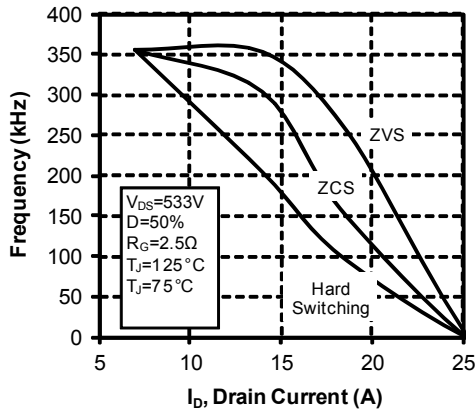
**Switching Energy vs Current**



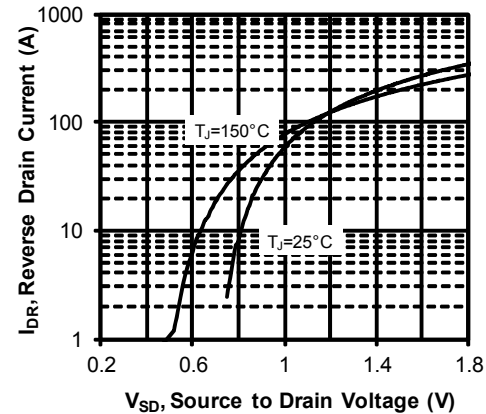
**Switching Energy vs Gate Resistance**



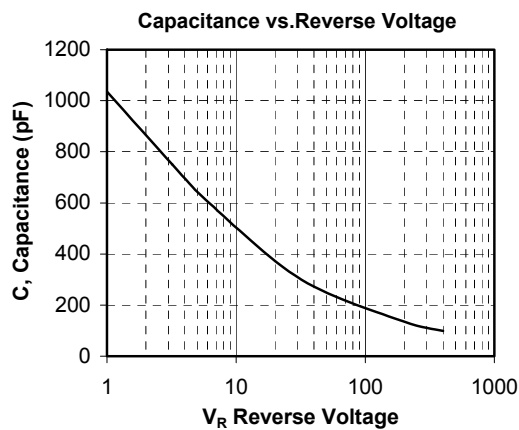
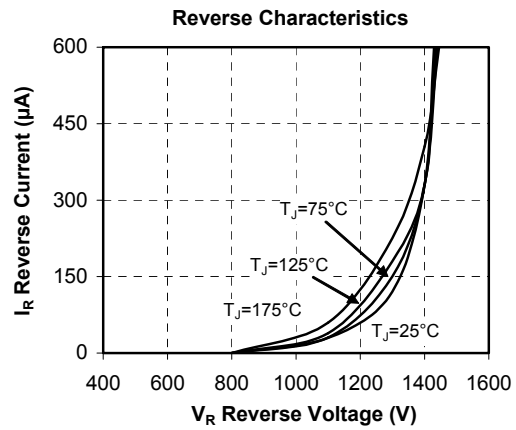
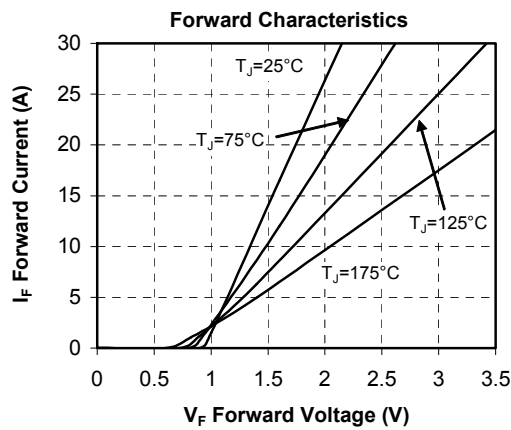
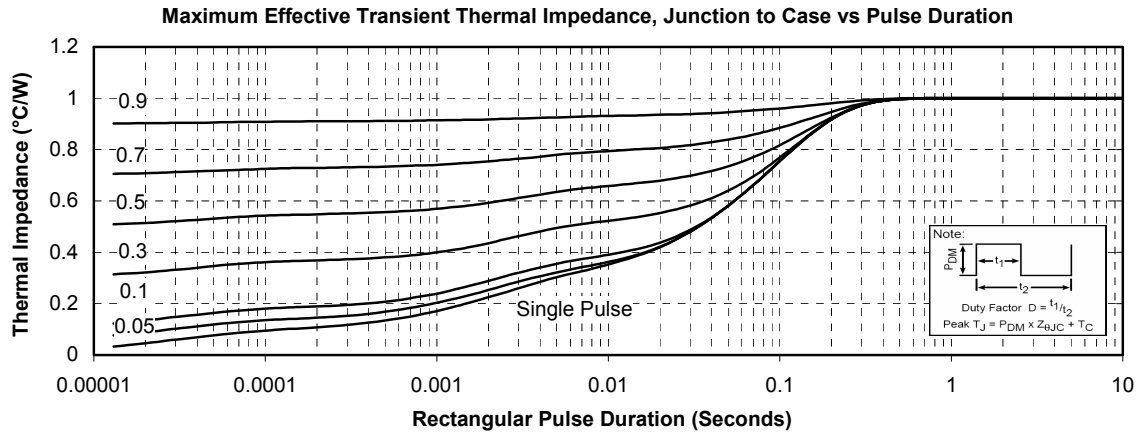
**Operating Frequency vs Drain Current**



**Source to Drain Diode Forward Voltage**



**Typical SiC Diode Performance Curve**



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