

Phase leg Series & SiC parallel diodes MOSFET Power Module

$$V_{DSS} = 500V$$

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

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

Application

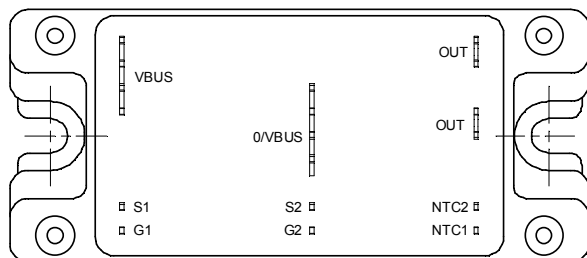
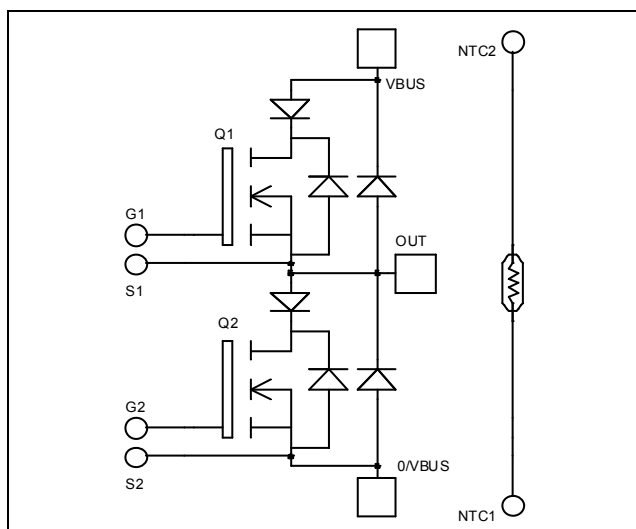
- Motor control
- Switched Mode Power Supplies
- Uninterruptible Power Supplies

Features

- **Power MOS 7[®] MOSFETs**
 - Low R_{DSon}
 - Low input and Miller capacitance
 - 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



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	± 30	V
R_{DSon}	Drain - Source ON Resistance	38	m Ω
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.

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

Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
BV_{DSS}	Drain - Source Breakdown Voltage	$V_{GS} = 0V, I_D = 375\mu A$	500			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 500V, T_j = 25^\circ\text{C}$			150	μA
		$V_{GS} = 0V, V_{DS} = 400V, T_j = 125^\circ\text{C}$			750	
$R_{DS(on)}$	Drain - Source on Resistance	$V_{GS} = 10V, I_D = 45A$			38	$m\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 5mA$	3		5	V
I_{GSS}	Gate - Source Leakage Current	$V_{GS} = \pm 30V, V_{DS} = 0V$			± 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	$V_{DS} = 25V$		2.36		
C_{rss}	Reverse Transfer Capacitance	$f = 1MHz$		0.17		
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	Inductive switching @ 125°C $V_{GS} = 15V$ $V_{Bus} = 333V$ $I_D = 90A$ $R_G = 2\Omega$		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	Inductive switching @ 25°C $V_{GS} = 15V, V_{Bus} = 333V$ $I_D = 90A, R_G = 2\Omega$		906		μJ
E_{off}	Turn-off Switching Energy ❶			1452		
E_{on}	Turn-on Switching Energy	Inductive switching @ 125°C $V_{GS} = 15V, V_{Bus} = 333V$ $I_D = 90A, R_G = 2\Omega$		1491		μJ
E_{off}	Turn-off Switching Energy ❶			1692		

❶ In accordance with JEDEC standard JESD24-1.

Series diode ratings and characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_{F(AV)}$	Maximum Average Forward Current	50% duty cycle, $T_c = 85^\circ\text{C}$		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	$I_F = 90A, V_R = 133V, di/dt = 600A/\mu s, T_j = 25^\circ\text{C}$		24		ns
		$T_j = 125^\circ\text{C}$		48		
Q_{rr}	Reverse Recovery Charge	$I_F = 90A, V_R = 133V, di/dt = 600A/\mu s, T_j = 25^\circ\text{C}$		99		nC
		$T_j = 125^\circ\text{C}$		450		

Parallel diode ratings and characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
$I_{F(AV)}$	Maximum Average Forward Current	50% duty cycle	$T_c = 125^\circ\text{C}$		50		A
V_F	Diode Forward Voltage	$I_F = 50\text{A}$	$T_j = 25^\circ\text{C}$		1.6	1.8	V
			$T_j = 175^\circ\text{C}$		2.0	2.4	
Q_C	Total Capacitive Charge	$I_F = 50\text{A}, V_R = 300\text{V}$ $di/dt = 1400\text{A}/\mu\text{s}$			70		nC
Q	Total Capacitance	$f = 1\text{MHz}, V_R = 200\text{V}$			325		pF
		$f = 1\text{MHz}, V_R = 400\text{V}$			250		

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
R _{thJC}	Junction to Case		Transistor			0.18	°C/W
			Series diode			0.45	
			Parallel diode			0.5	
V _{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz			2500			V
T _J	Operating junction temperature range			-40		150	°C
T _{STG}	Storage Temperature Range			-40		125	
T _C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To heatsink	M5			4.7	N.m
Wt	Package Weight					160	g

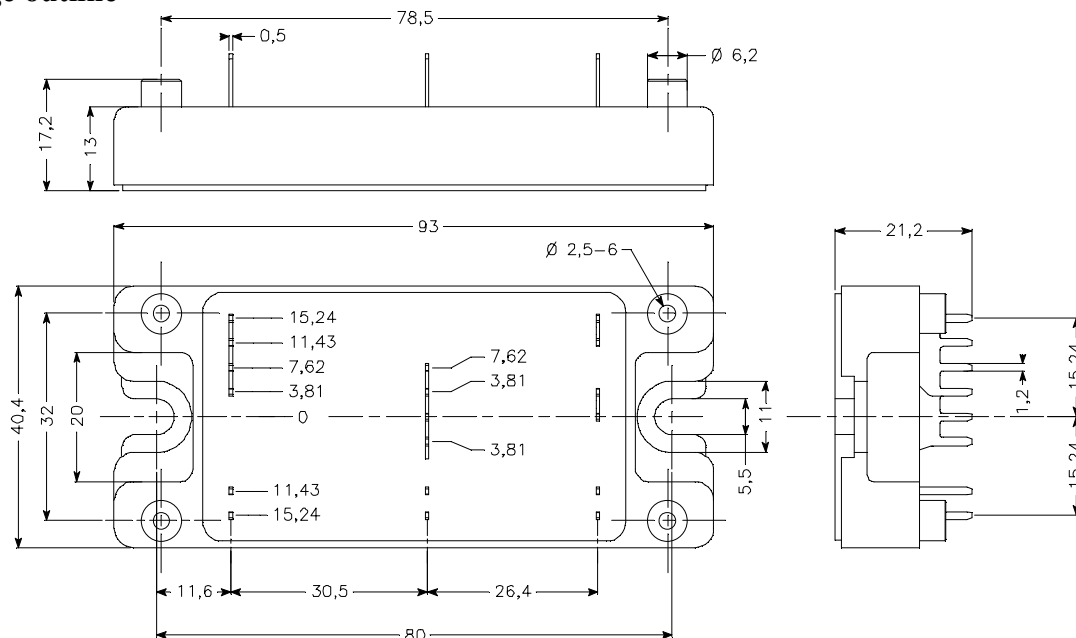
Temperature sensor NTC

Symbol	Characteristic	Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C		68		$\text{k}\Omega$
$B_{25/85}$	$T_{25} = 298.16\text{ K}$		4080		K

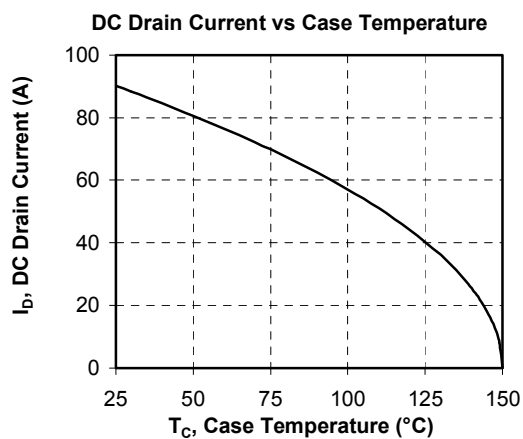
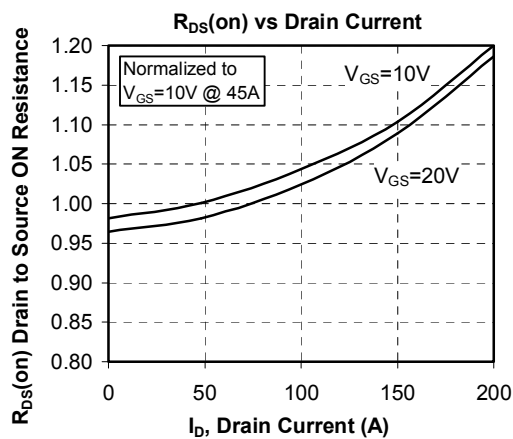
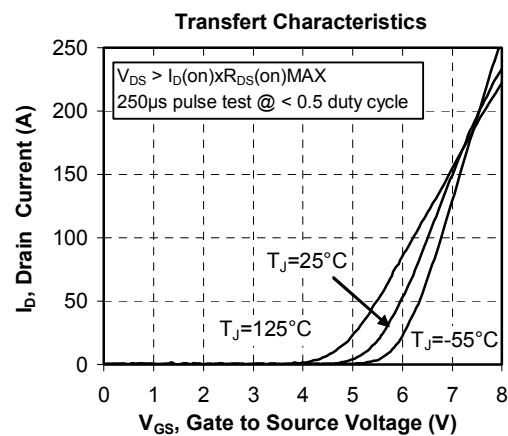
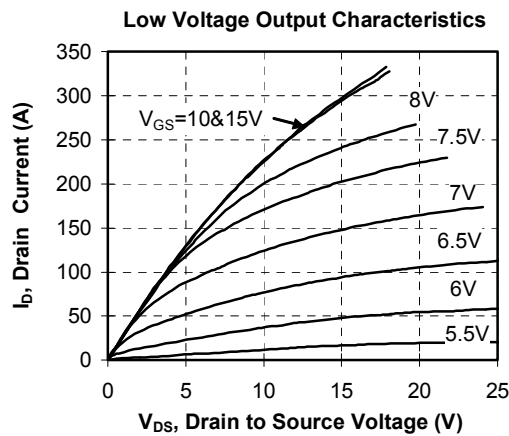
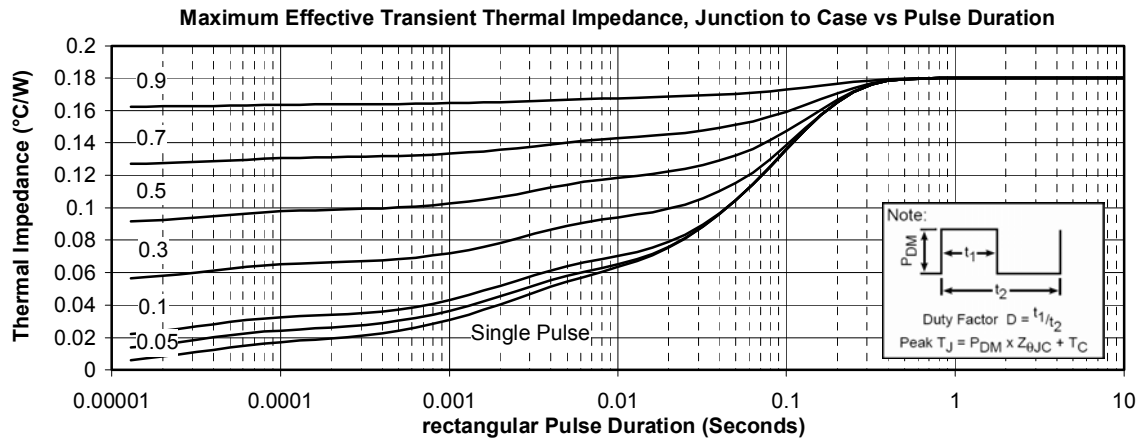
$$R_T = \frac{R_{25}}{\exp \left[B_{25/85} \left(\frac{1}{T_{25}} - \frac{1}{T} \right) \right]}$$

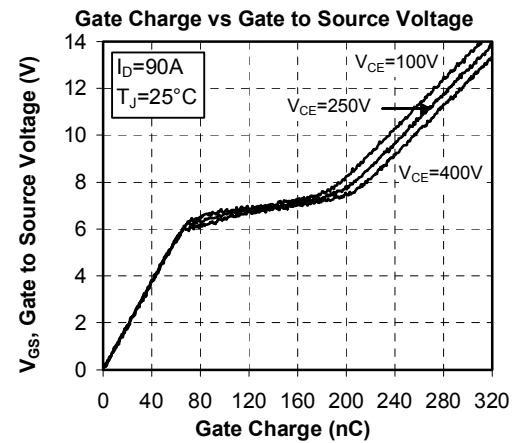
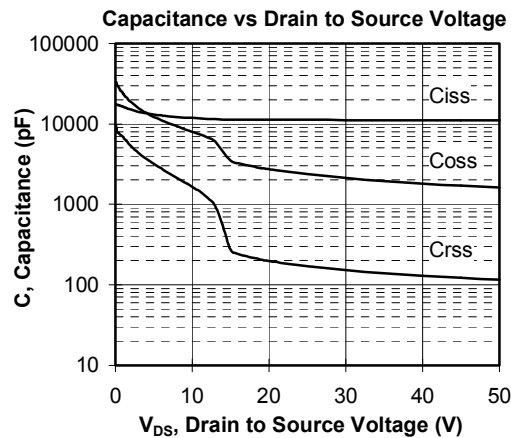
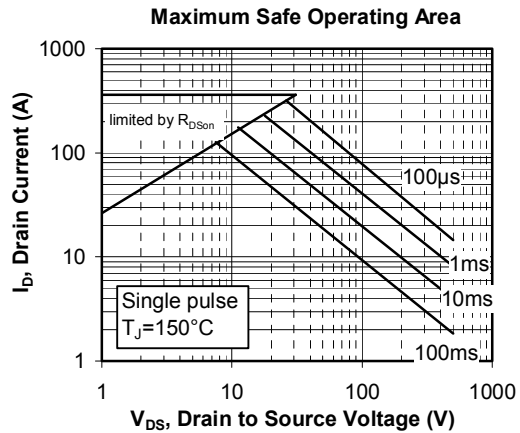
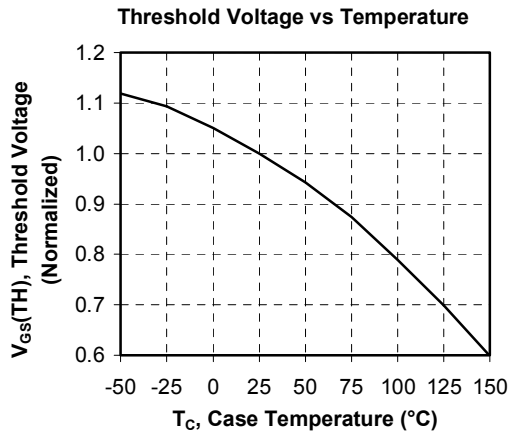
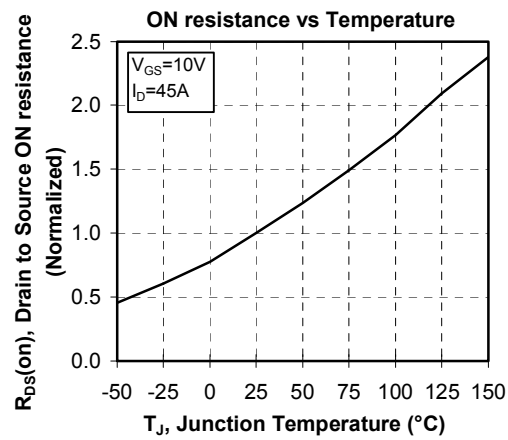
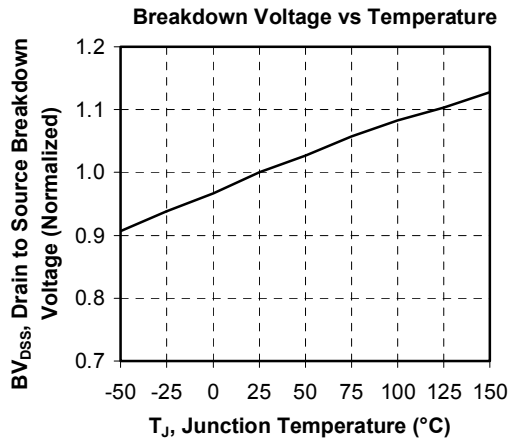
T: Thermistor temperature
R_T: Thermistor value at T

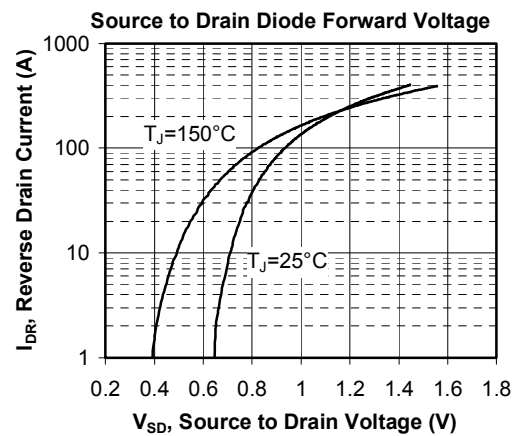
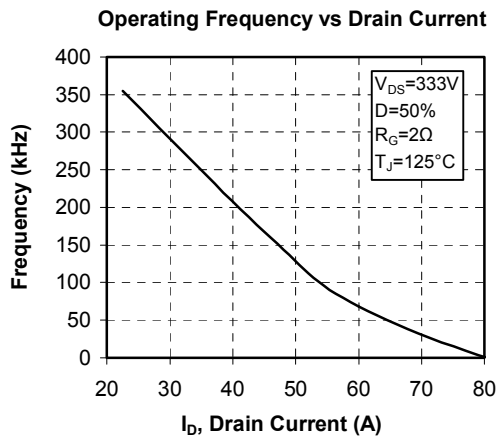
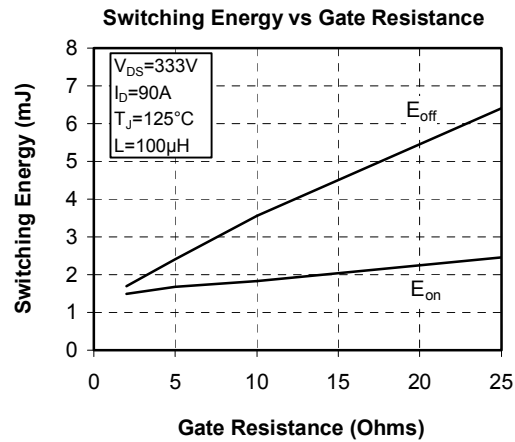
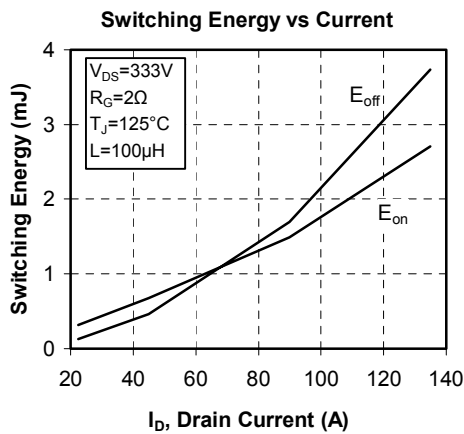
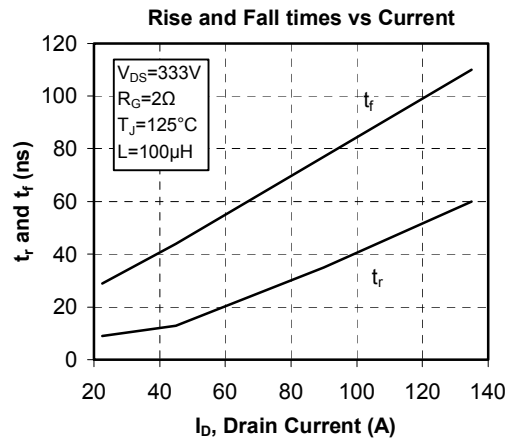
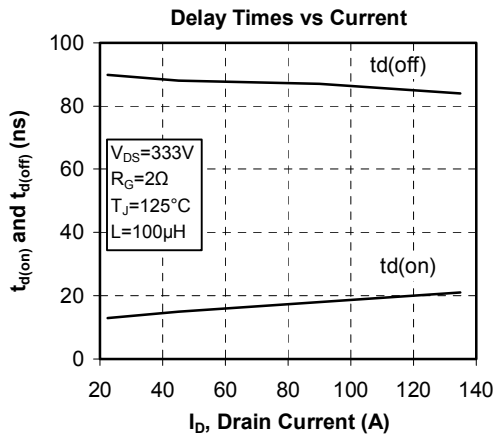
Package outline



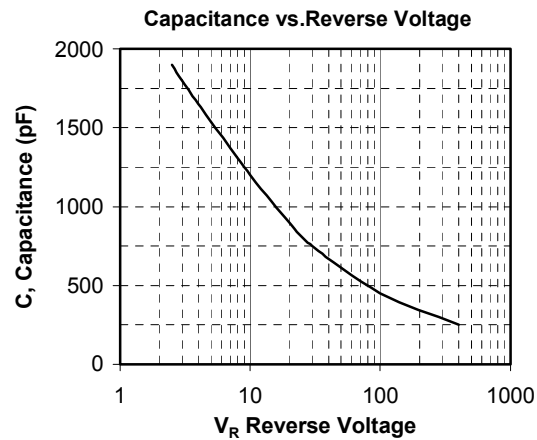
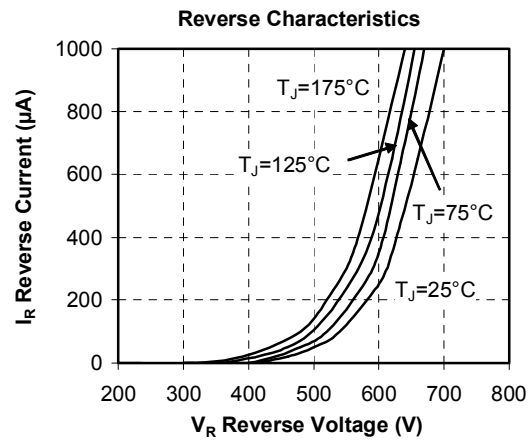
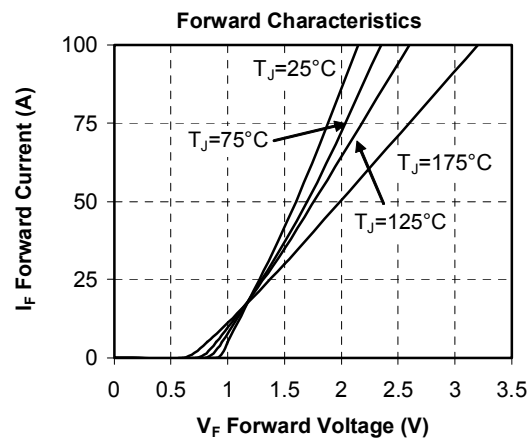
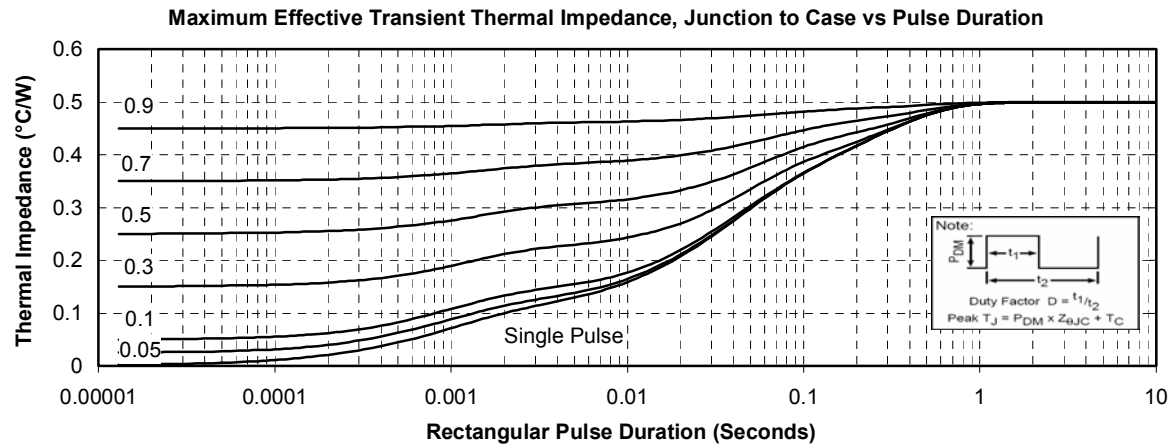
Typical MOSFET Performance Curve







Typical SiC Diode Performance Curve



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APT's products are covered by one or more of U.S. patents 4,895,810 5,045,903 5,089,434 5,182,234 5,019,522 5,262,336 6,503,786 5,256,583 4,748,103 5,283,202 5,231,474 5,434,095 5,528,058 and foreign patents. U.S. and Foreign patents pending. All Rights Reserved.