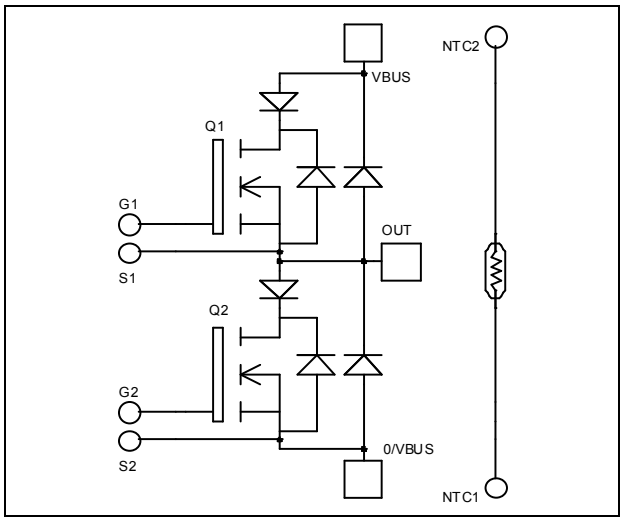
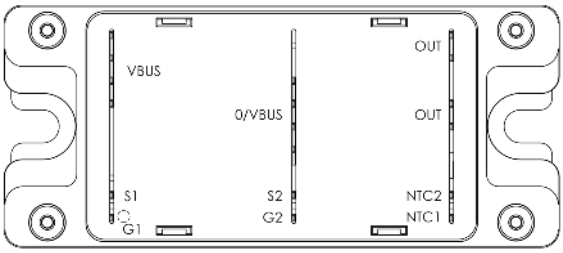
APTM50AM38SCTG

Phase leg Series & SiC parallel diodes
MOSFET Power Module

V_{DSS} = 500V
R_{DSon} = 38mΩ typ @ Tj = 25°C
I_D = 90A @ Tc = 25°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
- RoHS Compliant

All ratings @ T_j = 25°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°C	90	A
		T_c = 80°C	67	
I_{DM}	Pulsed Drain current		360	
V_{GS}	Gate - Source Voltage		±30	V
R_{DSon}	Drain - Source ON Resistance		45	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	694	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

Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V, V_{DS} = 500V	T_j = 25°C			200	µA
		V_{GS} = 0V, V_{DS} = 400V	T_j = 125°C			1000	
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 45A			38	45	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 5mA		3		5	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±30 V, V_{DS} = 0V				±150	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 25V f = 1MHz		11.2		nF
C_{oss}	Output Capacitance			2.36		
C_{rss}	Reverse Transfer Capacitance			0.18		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 250V I_D = 90A		246		nC
Q_{gs}	Gate – Source Charge			66		
Q_{gd}	Gate – Drain Charge			130		
$T_{d(on)}$	Turn-on Delay Time	**Inductive switching @ 125°C** V_{GS} = 15V V_{Bus} = 333V I_D = 90A R_G = 2Ω		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 = 2Ω		906		µJ
E_{off}	Turn-off Switching Energy			1452		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** V_{GS} = 15V, V_{Bus} = 333V I_D = 90A, R_G = 2Ω		1490		µJ
E_{off}	Turn-off Switching Energy			1692		
R_{thJC}	Junction to Case Thermal Resistance				0.18	°C/W

Series diode ratings and characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	V_R = 600V				250	µA
I_F	DC Forward Current		T_c = 85°C		90		A
V_F	Diode Forward Voltage	I_F = 90A			1.6	1.8	V
		I_F = 180A			1.9		
		I_F = 90A	T_j = 125°C		1.4		
t_{rr}	Reverse Recovery Time	I_F = 90A V_R = 400V di/dt = 600A/µs	T_j = 25°C		85		ns
			T_j = 125°C		160		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		390		nC
			T_j = 125°C		2100		
R_{thJC}	Junction to Case Thermal Resistance					0.45	°C/W

Parallel diode ratings and characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	V_R=600V	T_j = 25°C		250	1000	µA
			T_j = 175°C		500	5000	
I_F	DC Forward Current		Tc = 125°C		50		A
V_F	Diode Forward Voltage	I_F = 50A	T_j = 25°C		1.6	1.8	V
			T_j = 175°C		2.0	2.4	
Q_C	Total Capacitive Charge	I_F = 50A, V_R = 300V di/dt =1400A/µs			70		nC
Q	Total Capacitance	f = 1MHz, V_R = 200V			325		pF
		f = 1MHz, V_R = 400V			250		
R_{thJC}	Junction to Case Thermal Resistance					0.5	°C/W

Thermal and package characteristics

Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000		V
T_J	Operating junction temperature range			-40	150	°C
T_{JOP}	Recommended junction temperature under switching conditions			-40	$T_J$max -25	
T_{STG}	Storage Temperature Range			-40	125	
T_C	Operating Case Temperature			-40	100	
Torque	Mounting torque	To heatsink	M5	2.5	4.7	N.m
Wt	Package Weight				160	g

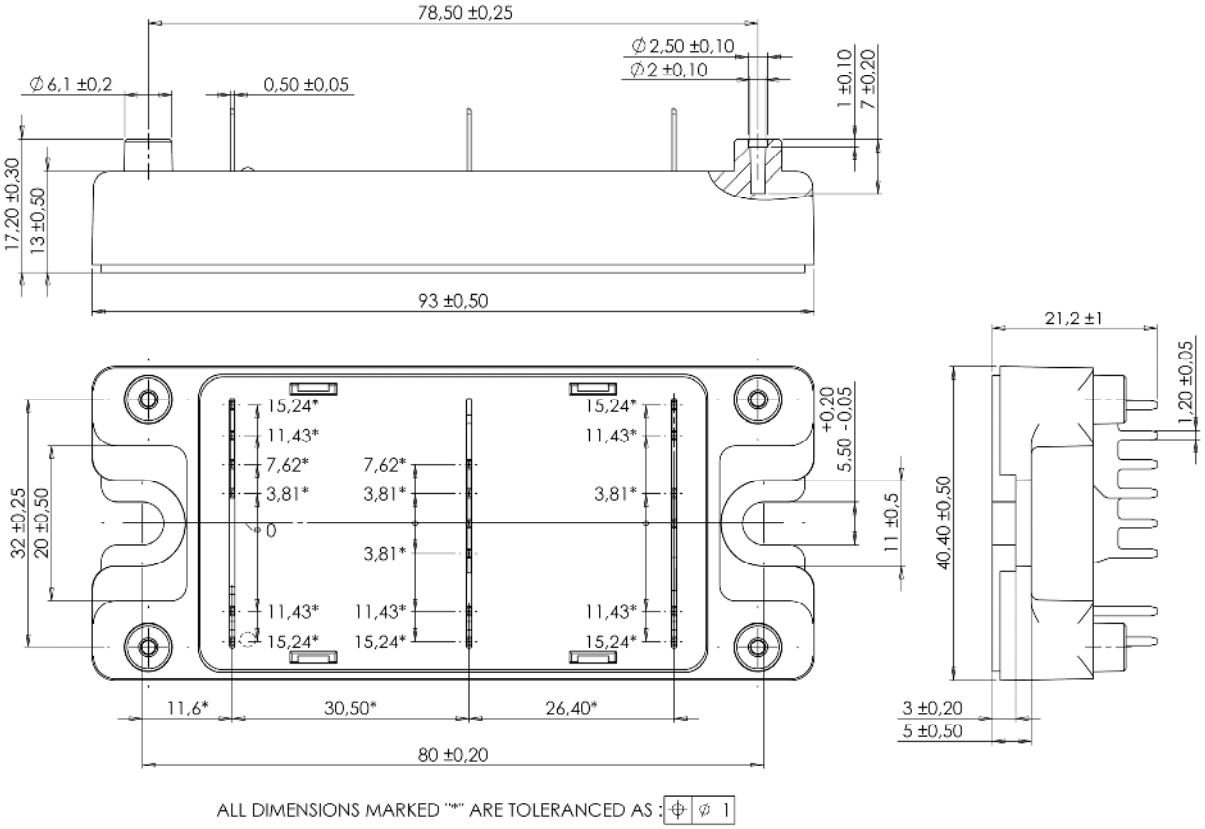
Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

Symbol	Characteristic		Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C			50		kΩ
$\Delta R_{25}/R_{25}$				5		%
$B_{25/85}$	T_{25} = 298.15 K			3952		K
ΔB/B		T_C=100°C		4		%

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

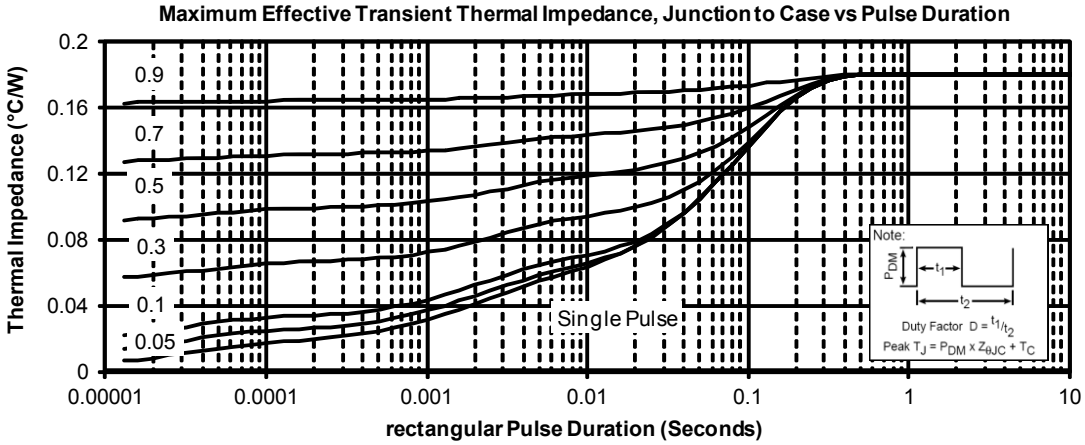
T: Thermistor temperature
R_T: Thermistor value at T

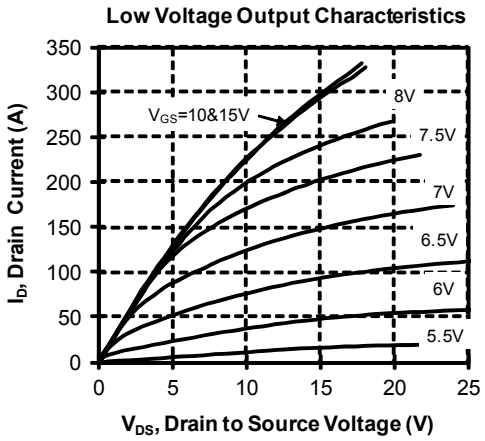
SP4 Package outline (dimensions in mm)

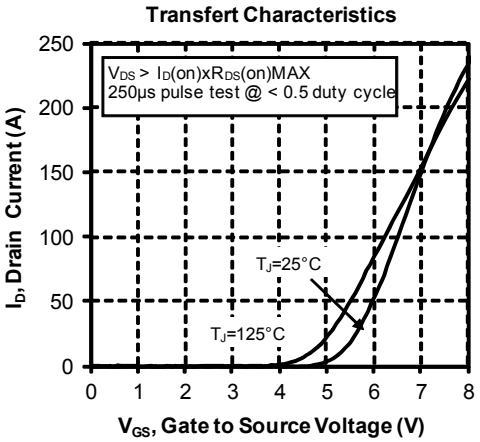


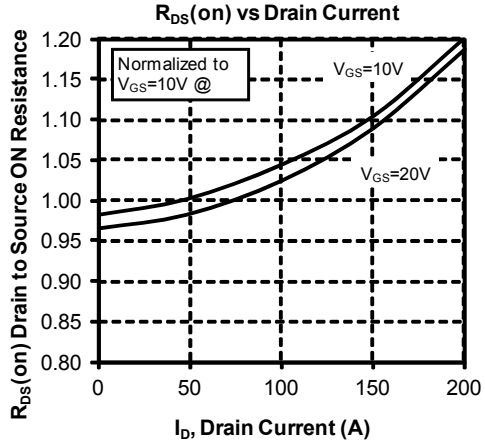
See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

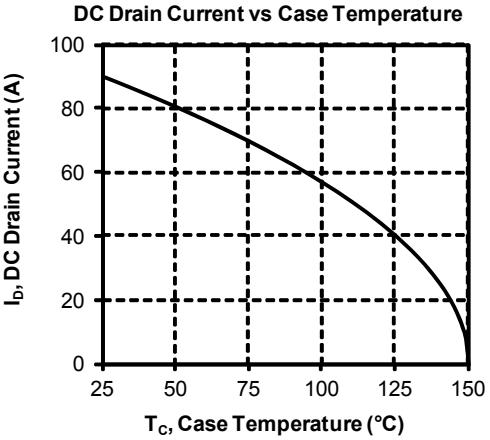
Typical MOSFET Performance Curve

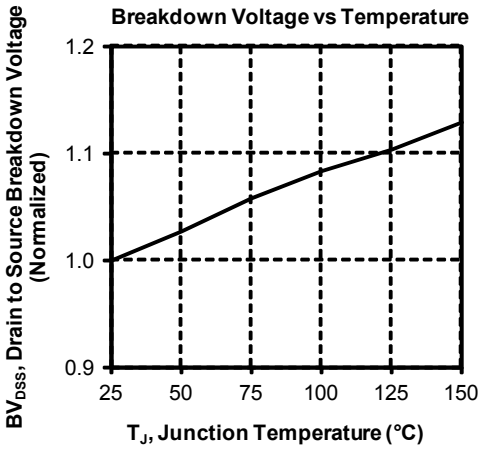


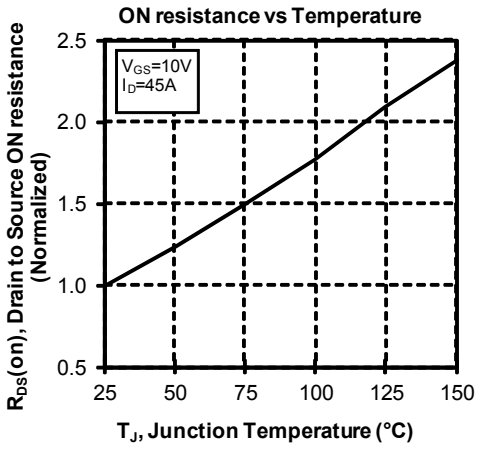


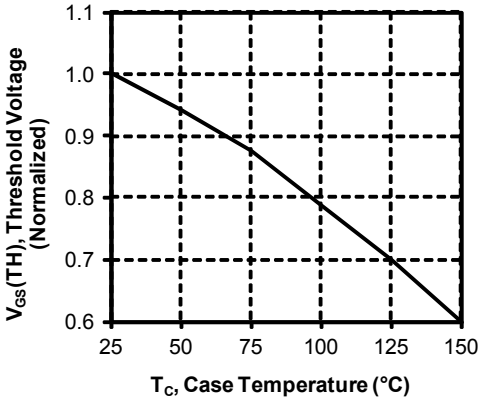


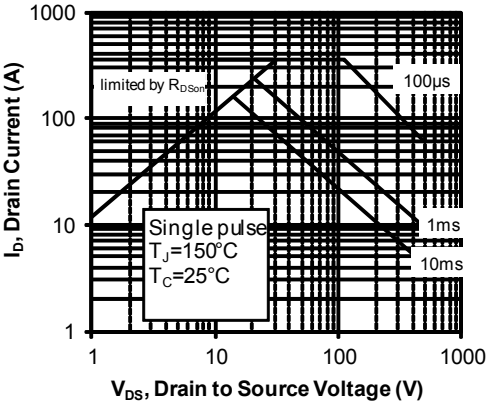


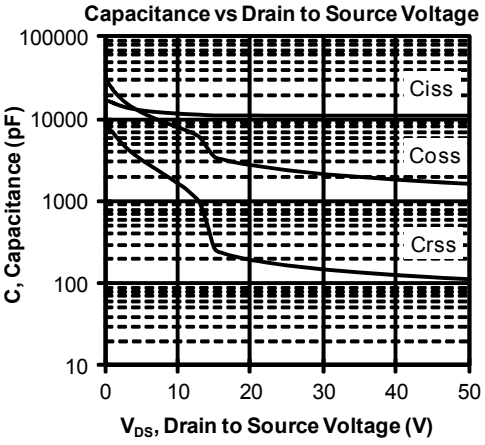


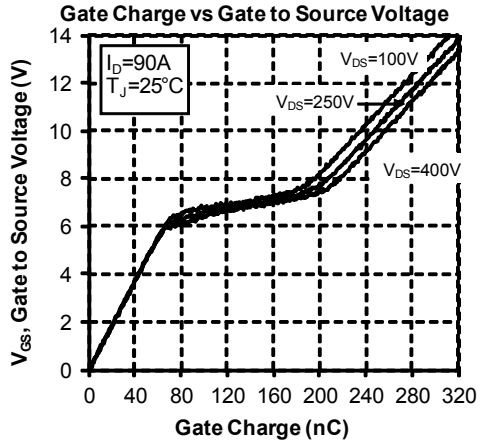

Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage (Normalized)
1.2
1.1
1.0
0.9
25
50
75
100
125
150
TJ, Junction Temperature (°C)


ON resistance vs Temperature
RDS(on), Drain to Source ON resistance (Normalized)
VGS=10V
ID=45A
2.5
2.0
1.5
1.0
0.5
25
50
75
100
125
150
TJ, Junction Temperature (°C)

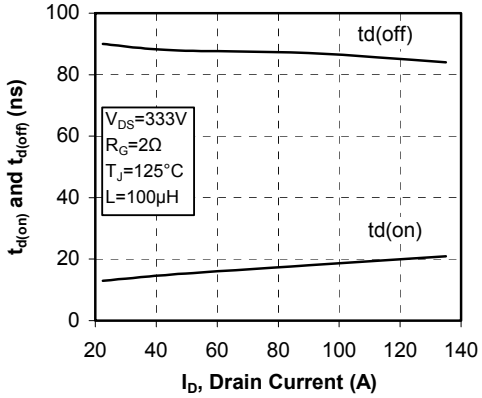

Threshold Voltage vs Temperature
VGS(TH), Threshold Voltage (Normalized)
1.1
1.0
0.9
0.8
0.7
0.6
25
50
75
100
125
150
TC, Case Temperature (°C)


Maximum Safe Operating Area
ID, Drain Current (A)
1000
100
10
1
limited by RDSon
100µs
1ms
10ms
Single pulse
TJ=150°C
TC=25°C
1
10
100
1000
VDS, Drain to Source Voltage (V)

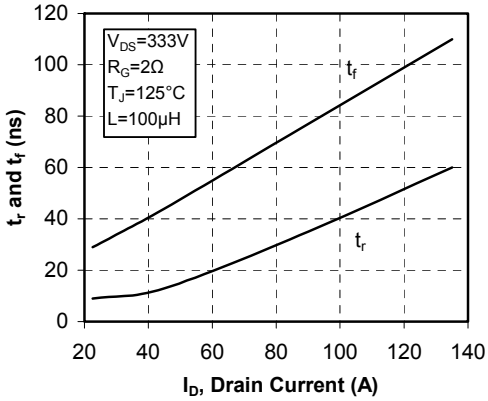

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
100000
10000
1000
100
10
Ciss
Coss
Crss
0
10
20
30
40
50
VDS, Drain to Source Voltage (V)


Gate Charge vs Gate to Source Voltage
VGS, Gate to Source Voltage (V)
14
12
10
8
6
4
2
0
ID=90A
TJ=25°C
VDS=100V
VDS=250V
VDS=400V
0
40
80
120
160
200
240
280
320
Gate Charge (nC)

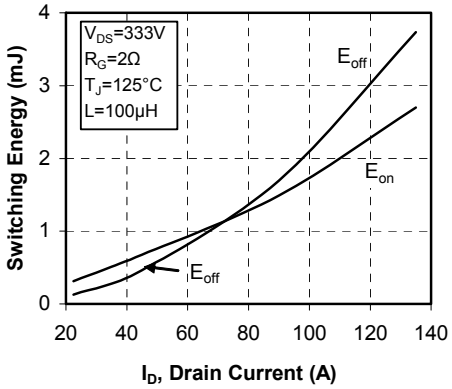
Delay Times vs Current



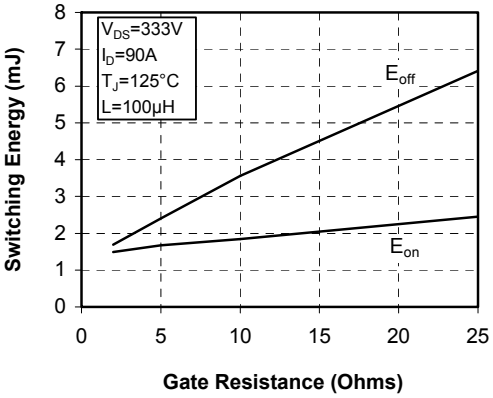
Rise and Fall times vs Current



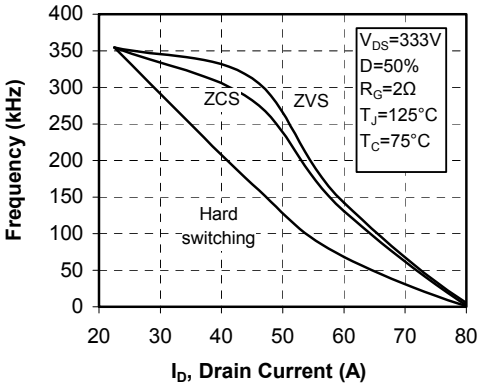
Switching Energy vs Current



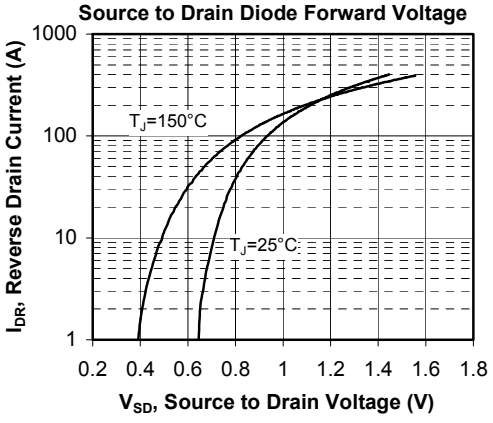
Switching Energy vs Gate Resistance



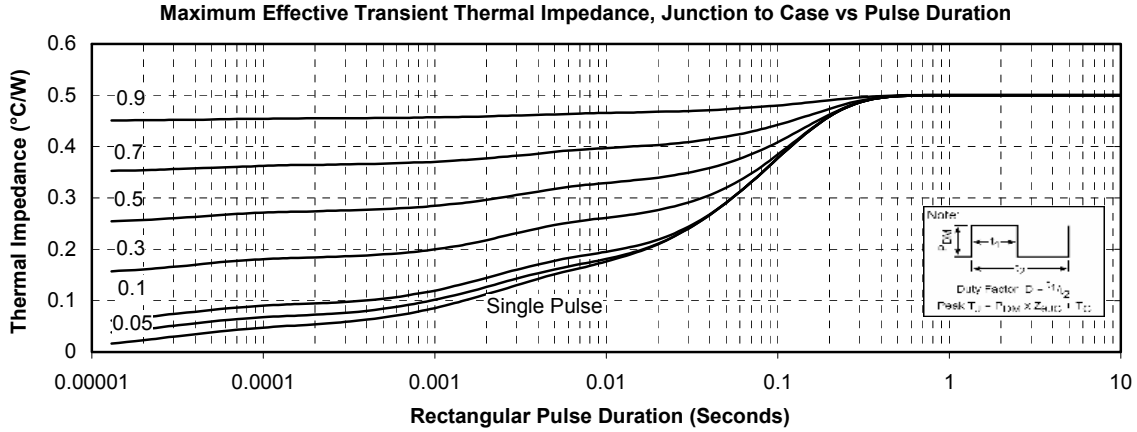
Operating Frequency vs Drain Current

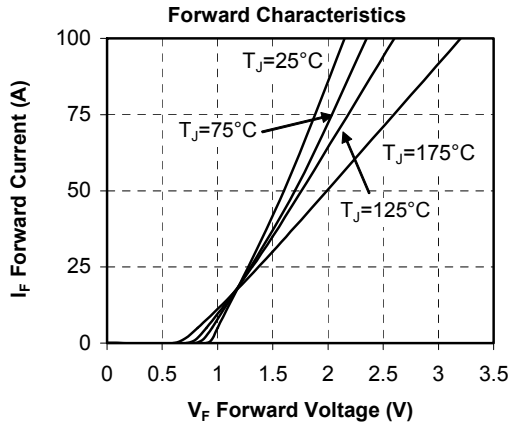


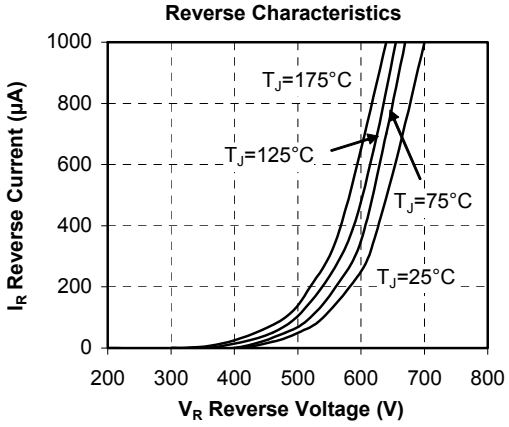
Source to Drain Diode Forward Voltage

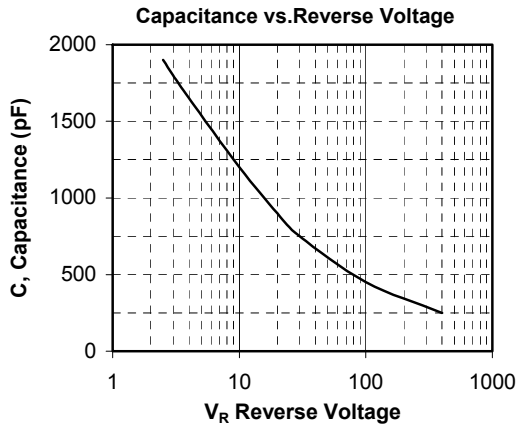


Typical SiC Diode Performance Curve









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