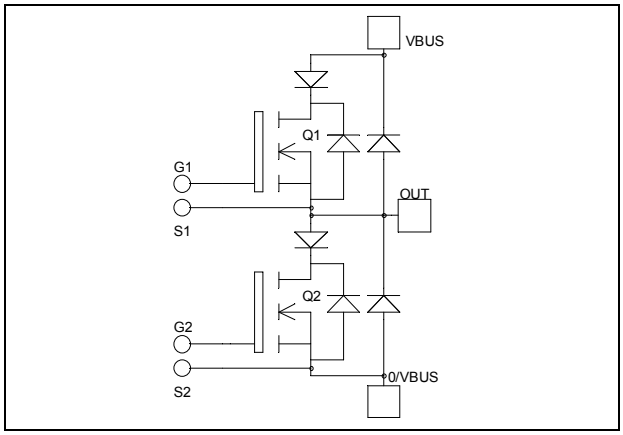
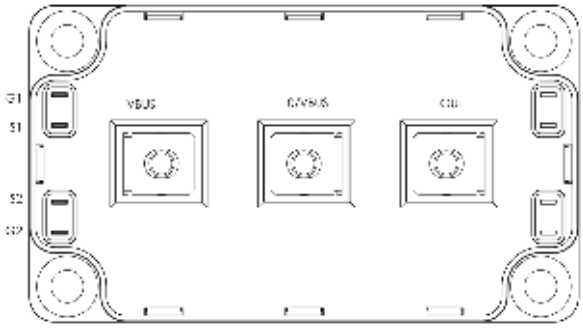
APTM50AM24SCG

Phase leg
Series & SiC parallel diodes
MOSFET Power Module

V_{DSS} = 500V
R_{DSon} = 24mΩ typ @ Tj = 25°C
I_D = 150A @ 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
  - Very rugged
- ***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
  - M5 power connectors
- High level of integration

Benefits

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- 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	150	A
		T_c = 80°C	110	
I_{DM}	Pulsed Drain current		600	
V_{GS}	Gate - Source Voltage		±30	V
R_{DSon}	Drain - Source ON Resistance		28	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	1250	W
I_{AR}	Avalanche current (repetitive and non repetitive)		24	A
E_{AR}	Repetitive Avalanche Energy		30	mJ
E_{AS}	Single Pulse Avalanche Energy		1300	

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			500	µA
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 75A		24	28	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 6mA	3		5	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±30 V, V_{DS} = 0V			±600	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 25V f = 1MHz		19.6		nF
C_{oss}	Output Capacitance			4.2		
C_{rss}	Reverse Transfer Capacitance			0.3		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 250V I_D = 150A		434		nC
Q_{gs}	Gate – Source Charge			120		
Q_{gd}	Gate – Drain Charge			216		
$T_{d(on)}$	Turn-on Delay Time	**Inductive switching @ 125°C** V_{GS} = 15V V_{Bus} = 333V I_D = 150A R_G = 0.8Ω		10		ns
T_r	Rise Time			17		
$T_{d(off)}$	Turn-off Delay Time			50		
T_f	Fall Time			41		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 25°C** V_{GS} = 15V, V_{Bus} = 333V I_D = 150A, R_G = 0.8Ω		1.15		mJ
E_{off}	Turn-off Switching Energy			1.5		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** V_{GS} = 15V, V_{Bus} = 333V I_D = 150A, R_G = 0.8Ω		1.97		mJ
E_{off}	Turn-off Switching Energy			1.7		
R_{thJC}	Junction to Case Thermal Resistance				0.1	°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				150	µA
I_F	DC Forward Current		Tc = 80°C		200		A
V_F	Diode Forward Voltage	I_F = 200A V_{GE} = 0V	T_j = 25°C		1.6	2	V
			T_j = 150°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 200A V_R = 300V di/dt =2800A/µs	T_j = 25°C		125		ns
			T_j = 150°C		220		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		9.4		µC
			T_j = 150°C		19.8		
E_r	Reverse Recovery Energy		T_j = 25°C		2.2		mJ
			T_j = 150°C		4.8		
R_{thJC}	Junction to Case Thermal Resistance					0.39	°C/W

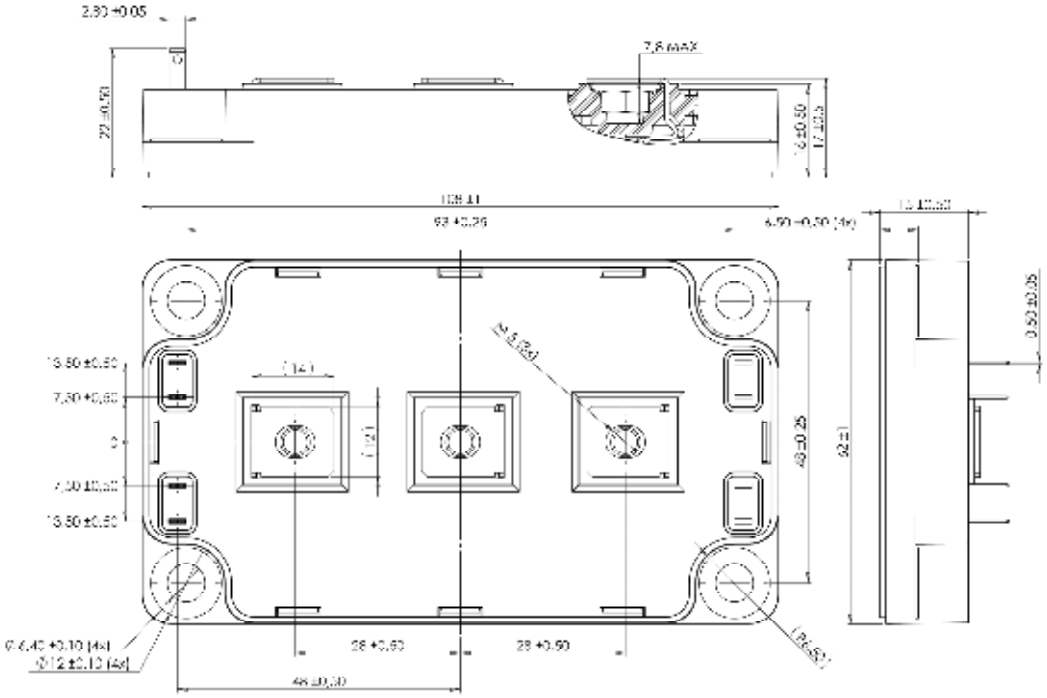
SiC Parallel diode ratings and characteristics

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		400	1600	µA
			T_j = 175°C		800	8000	
I_F	DC Forward Current		Tc = 100°C		80		A
V_F	Diode Forward Voltage	I_F = 80A	T_j = 25°C		1.6	1.8	V
			T_j = 175°C		2.0	2.4	
Q_C	Total Capacitive Charge	I_F = 80A, V_R = 600V di/dt =2000A/µs			224		nC
Q	Total Capacitance	f = 1MHz, V_R = 200V			520		pF
		f = 1MHz, V_R = 400V			400		
R_{thJC}	Junction to Case Thermal Resistance					0.35	°C/W

Thermal and package characteristics

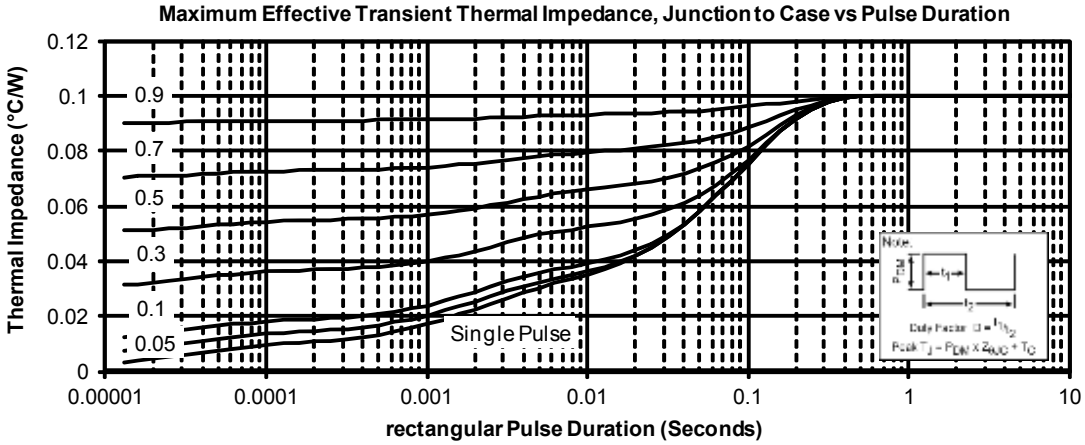
Symbol	*Characteristic*			*Min*	*Max*	*Unit*
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000		V
T_J	Operating junction temperature range			-40	150	°C
T_{JOP}	Recommended junction temperature under switching conditions			-40	$T_J$max -25	
T_{STG}	Storage Temperature Range			-40	125	
T_C	Operating Case Temperature			-40	100	
Torque	Mounting torque	To heatsink	M6	3	5	N.m
		For terminals	M5	2	3.5	
Wt	Package Weight				300	g

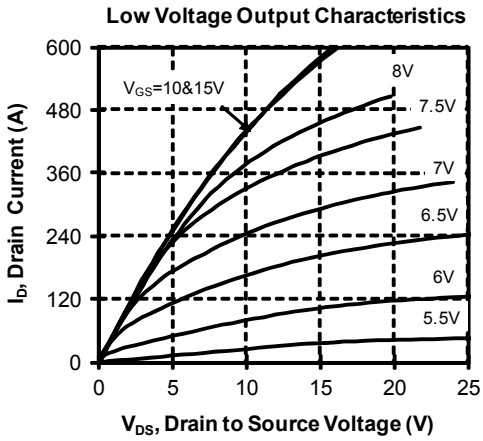
SP6 Package outline (dimensions in mm)

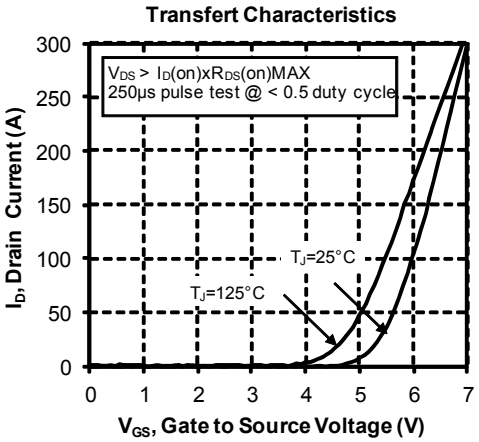


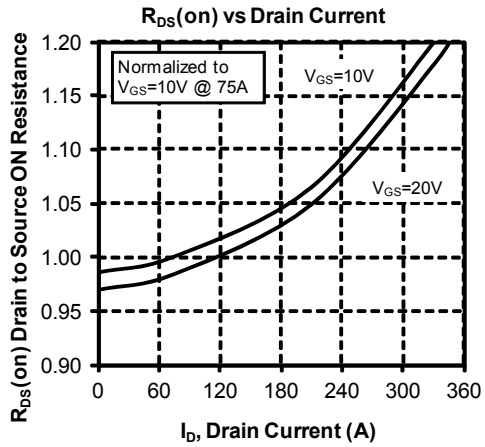
See application note APT0601 - Mounting Instructions for SP6 Power Modules on www.microsemi.com

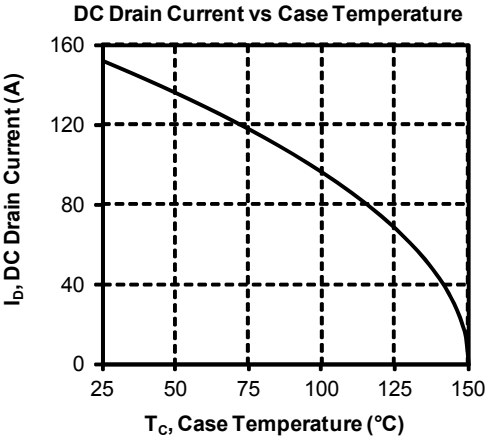
Typical MOSFET Performance Curve

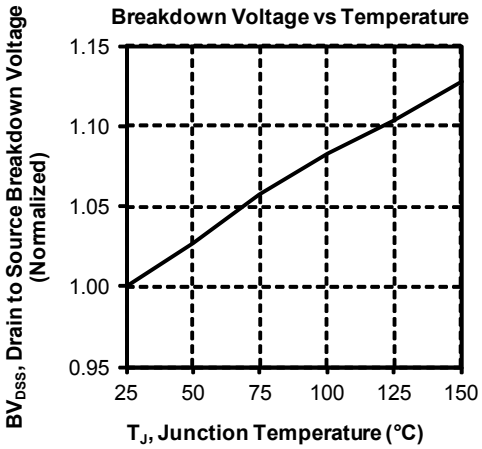


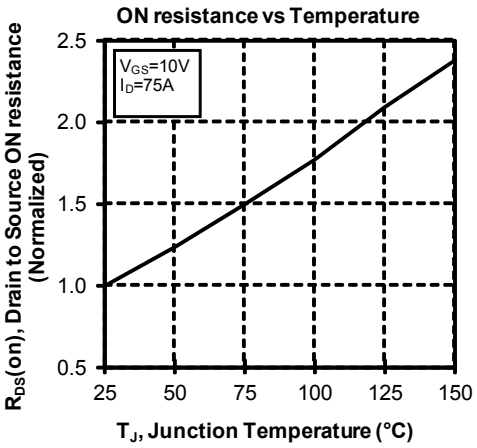


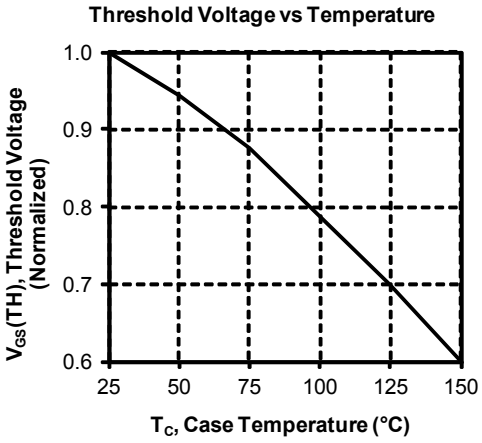


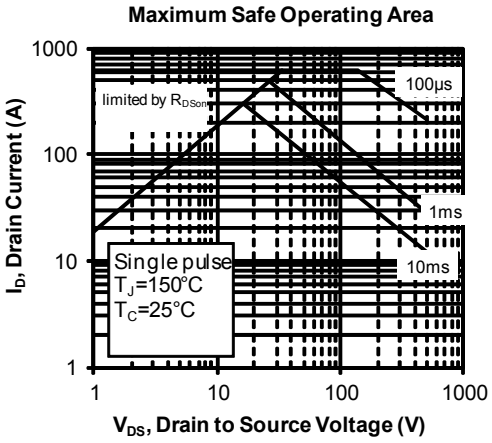


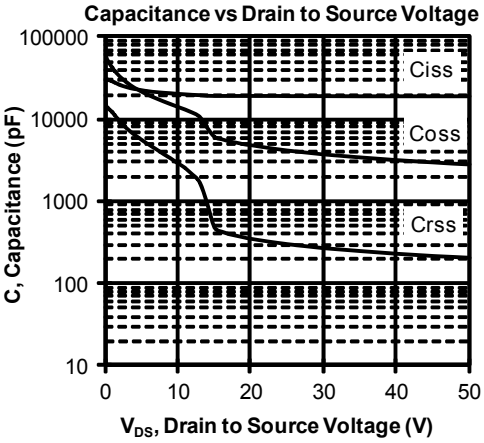


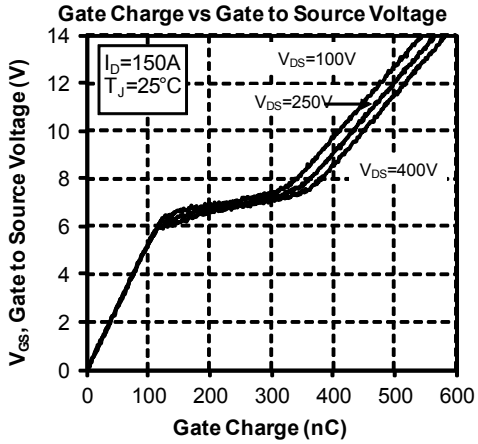

Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage (Normalized)
1.15
1.10
1.05
1.00
0.95
25
50
75
100
125
150
TJ, Junction Temperature (°C)

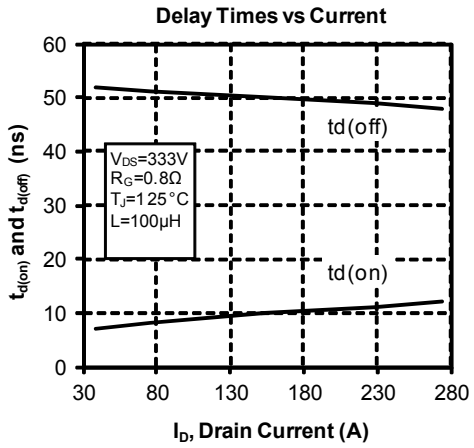

ON resistance vs Temperature
RDS(on), Drain to Source ON resistance (Normalized)
VGS=10V
ID=75A
2.5
2.0
1.5
1.0
0.5
25
50
75
100
125
150
TJ, Junction Temperature (°C)

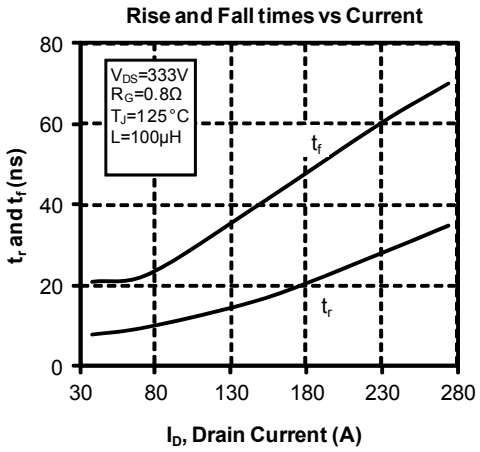

Threshold Voltage vs Temperature
VGS(TH), Threshold Voltage (Normalized)
1.0
0.9
0.8
0.7
0.6
25
50
75
100
125
150
TC, Case Temperature (°C)

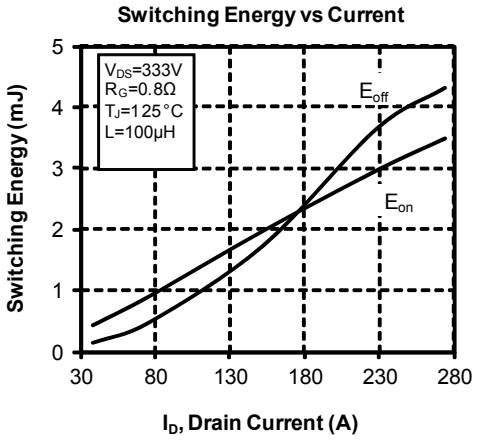

Maximum Safe Operating Area
ID, Drain Current (A)
1000
100
10
1
limited by RDSon
100µs
1ms
10ms
Single pulse
TJ=150°C
TC=25°C
1
10
100
1000
VDS, Drain to Source Voltage (V)

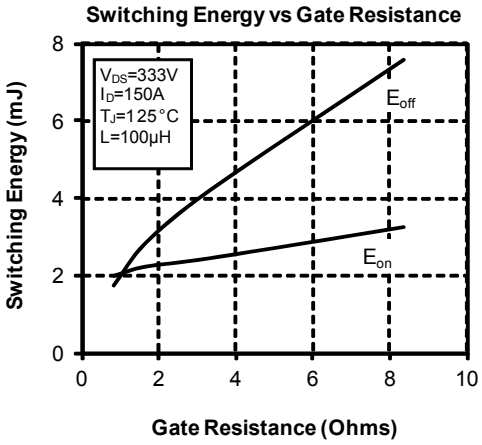

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
100000
10000
1000
100
10
Ciss
Coss
Crss
0
10
20
30
40
50
VDS, Drain to Source Voltage (V)

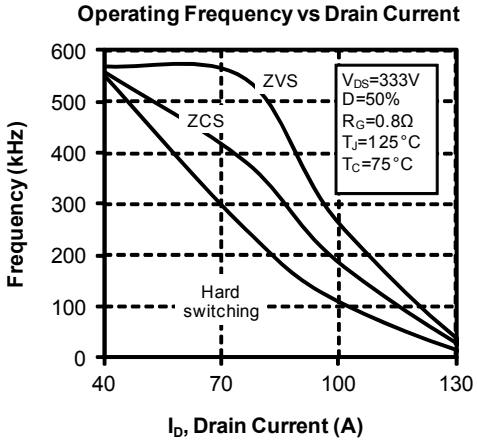

Gate Charge vs Gate to Source Voltage
VGS, Gate to Source Voltage (V)
ID=150A
TJ=25°C
VDS=100V
VDS=250V
VDS=400V
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
Gate Charge (nC)


Delay Times vs Current
td(off)
td(on)
VDS=333V
RG=0.8Ω
TJ=125°C
L=100µH
td(on) and td(off) (ns)
ID, Drain Current (A)

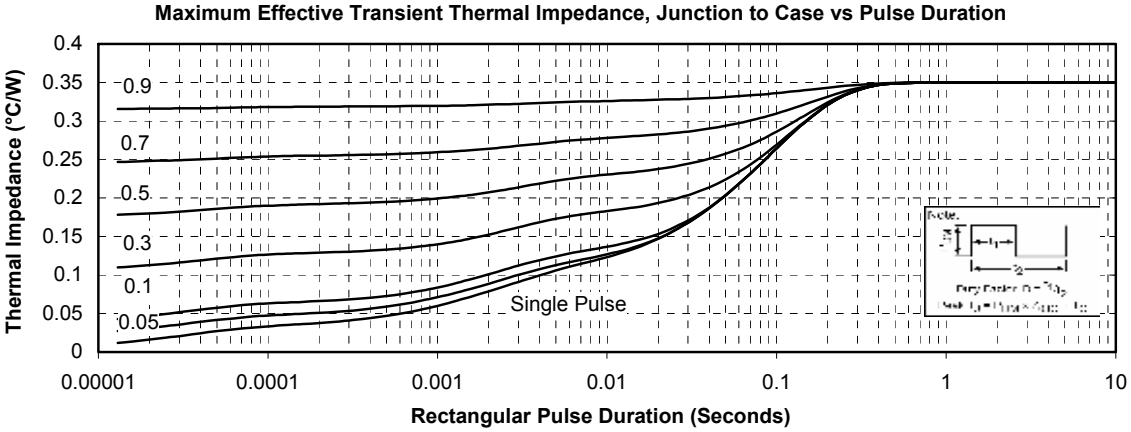

Rise and Fall times vs Current
VDS=333V
RG=0.8Ω
TJ=125°C
L=100µH
tf
tr
tr and tf (ns)
ID, Drain Current (A)

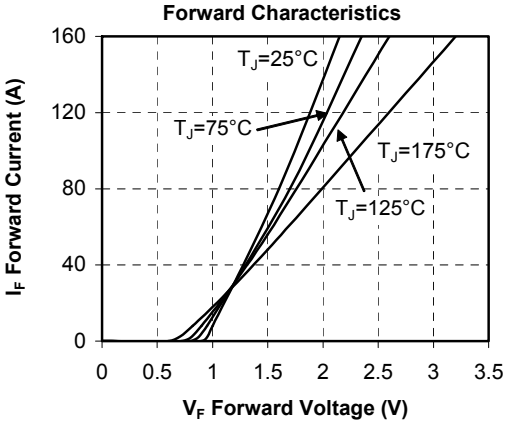

Switching Energy vs Current
VDS=333V
RG=0.8Ω
TJ=125°C
L=100µH
Eoff
Eon
Switching Energy (mJ)
ID, Drain Current (A)

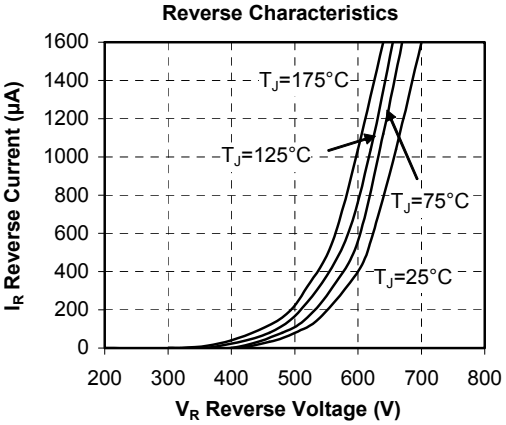

Switching Energy vs Gate Resistance
VDS=333V
ID=150A
TJ=125°C
L=100µH
Eoff
Eon
Switching Energy (mJ)
Gate Resistance (Ohms)

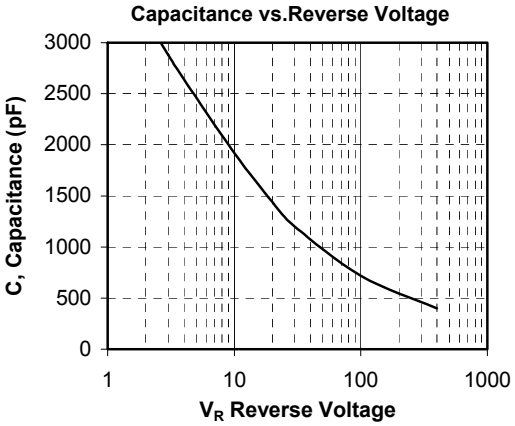

Operating Frequency vs Drain Current
ZVS
ZCS
Hard switching
VDS=333V
D=50%
RG=0.8Ω
TJ=125°C
TC=75°C
Frequency (kHz)
ID, Drain Current (A)

Typical SiC Diode Performance Curve









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