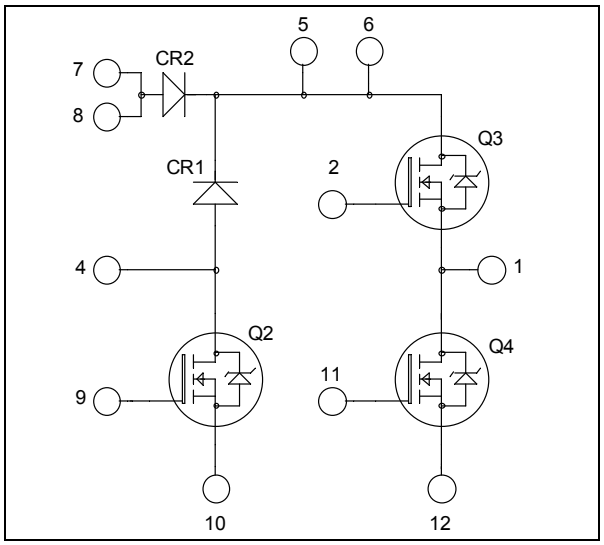
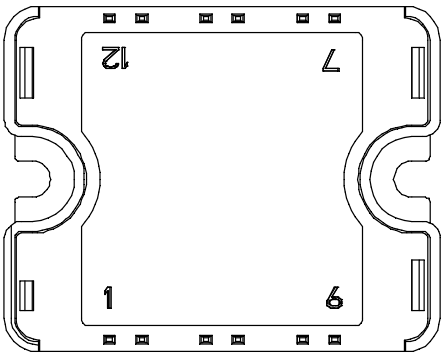
APTC60AM45BC1G

Boost chopper & Phase Leg Super Junction MOSFET Power Module

V_{DSS} = 600V
R_{DSon} = 45mΩ max @ Tj = 25°C
I_D = 49A @ Tc = 25°C





Pins 7/8 ; 5/6 must be shorted together

Application

- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Solar converter

Features

- ***CoolMOS™***
  - Ultra low R_{DSon}
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
  - Very rugged
- ***SiC Schottky Diode (CR1)***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- ***By pass FRED diode (CR2)***

Benefits

- Very low stray inductance
- High level of integration
- 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

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed. See application note APT0502 on www.microsemi.com

1. Phase leg (Q3 & Q4)

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Breakdown Voltage		600	V
I_D	Continuous Drain Current	T_c = 25°C	49	A
		T_c = 80°C	38	
I_{DM}	Pulsed Drain current		130	
V_{GS}	Gate - Source Voltage		±20	V
R_{DSon}	Drain - Source ON Resistance		45	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	250	W
I_{AR}	Avalanche current (repetitive and non repetitive)		15	A
E_{AR}	Repetitive Avalanche Energy		3	mJ
E_{AS}	Single Pulse Avalanche Energy		1900	

Electrical Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V, V_{DS} = 600V	T_j = 25°C			250	µA
		V_{GS} = 0V, V_{DS} = 600V	T_j = 125°C			500	
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 24.5A			40	45	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 3mA		2.1	3	3.9	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±20 V, V_{DS} = 0V				100	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*	*Min*	*Typ*	*Max*	*Unit*
C_{iss}	Input Capacitance	V_{GS} = 0V ; V_{DS} = 25V f = 1MHz		7.2		nF
C_{oss}	Output Capacitance			8.5		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 300V I_D = 49A		150		nC
Q_{gs}	Gate – Source Charge			34		
Q_{gd}	Gate – Drain Charge			51		
$T_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)** V_{GS} = 10V V_{Bus} = 400V I_D = 49A R_G = 5Ω		21		ns
T_r	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			100		
T_f	Fall Time			45		
R_{thJC}	Junction to Case Thermal Resistance				0.5	°C/W

Source - Drain diode ratings and characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_S	Continuous Source current (Body diode)		Tc = 25°C		49		A
			Tc = 80°C		38		
V_{SD}	Diode Forward Voltage	V_{GS} = 0V, I_S = - 49A				1.2	V
dv/dt	Peak Diode Recovery ❶					4	V/ns
t_{rr}	Reverse Recovery Time	I_S = - 49A V_R = 350V di_S/dt = 100A/µs	T_j = 25°C		600		ns
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		17		µC

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.
$I_S \leq$ - 49A di/dt ≤ 100A/µs $V_R \leq V_{DSS}$ $T_j \leq$ 150°C

2. Boost chopper (CR1 & Q2)

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Breakdown Voltage		600	V
I_D	Continuous Drain Current	T_c = 25°C	49	A
		T_c = 80°C	38	
I_{DM}	Pulsed Drain current		130	
V_{GS}	Gate - Source Voltage		±20	V
R_{DSon}	Drain - Source ON Resistance		45	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	250	W
I_{AR}	Avalanche current (repetitive and non repetitive)		15	A
E_{AR}	Repetitive Avalanche Energy		3	mJ
E_{AS}	Single Pulse Avalanche Energy		1900	

Electrical Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V, V_{DS} = 600V	T_j = 25°C			250	µA
		V_{GS} = 0V, V_{DS} = 600V	T_j = 125°C			500	
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 10V, I_D = 24.5A			40	45	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 3mA		2.1	3	3.9	V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = ±20 V, V_{DS} = 0V				100	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*	*Min*	*Typ*	*Max*	*Unit*
C_{iss}	Input Capacitance	V_{GS} = 0V ; V_{DS} = 25V f = 1MHz		7.2		nF
C_{oss}	Output Capacitance			8.5		
Q_g	Total gate Charge	V_{GS} = 10V V_{Bus} = 300V I_D = 49A		150		nC
Q_{gs}	Gate – Source Charge			34		
Q_{gd}	Gate – Drain Charge			51		
$T_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)** V_{GS} = 10V V_{Bus} = 400V I_D = 49A R_G = 5Ω		21		ns
T_r	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			100		
T_f	Fall Time			45		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 25°C** V_{GS} = 10V ; V_{Bus} = 400V I_D = 49A ; R_G = 5Ω		405		µJ
E_{off}	Turn-off Switching Energy			520		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** V_{GS} = 10V ; V_{Bus} = 400V I_D = 49A ; R_G = 5Ω		660		µJ
E_{off}	Turn-off Switching Energy			635		
R_{thJC}	Junction to Case Thermal Resistance				0.5	°C/W

SiC schottky diode ratings and characteristics (CR1)

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		10	60	µA
			T_j = 175°C		20	300	
$I_{F(AV)}$	Maximum Average Forward Current	50% duty cycle	Tc = 100°C		10		A
V_F	Diode Forward Voltage	I_F = 10A	T_j = 25°C		1.6	1.8	V
			T_j = 175°C		2	2.4	
Q_C	Total Capacitive Charge	I_F = 10A, V_R = 300V di/dt =500A/µs			14		nC
C	Total Capacitance	f = 1MHz, V_R = 200V			65		pF
		f = 1MHz, V_R = 400V			50		
R_{thJC}	Junction to Case Thermal Resistance					2.5	°C/W

3. By pass FRED diode (CR2)

Diode ratings and characteristics

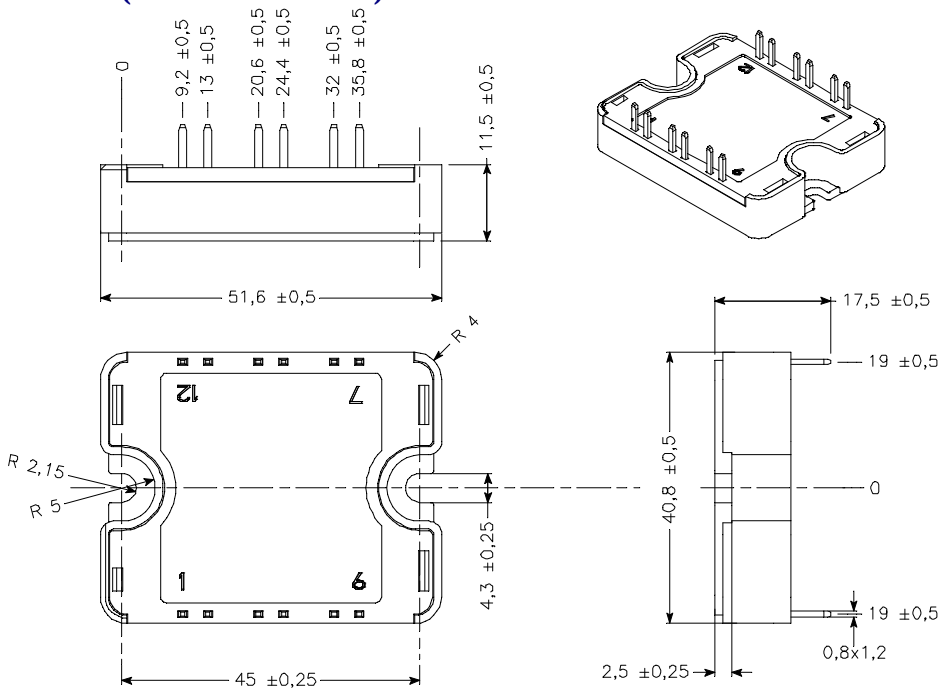
Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	V_R=600V	T_j = 25°C			100	µA
			T_j = 150°C			350	
I_F	DC Forward Current		Tc = 80°C		30		A
V_F	Diode Forward Voltage	I_F = 30A V_{GE} = 0V	T_j = 25°C		1.6	2	V
			T_j = 150°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 30A V_R = 300V di/dt =1800A/µs	T_j = 25°C		100		ns
			T_j = 150°C		150		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		1.5		µC
			T_j = 150°C		3.1		
E_{rr}	Reverse Recovery Energy		T_j = 25°C		0.34		mJ
			T_j = 150°C		0.75		
R_{thJC}	Junction to Case Thermal Resistance					2.45	°C/W

4. Thermal & Package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz			4000			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	M4	2.5		4.7	N.m
Wt	Package Weight					80	g

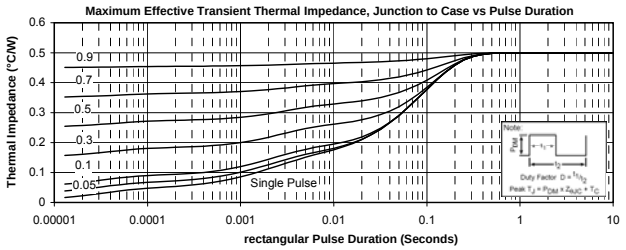
* T_{jmax} = 175°C for by pass and SiC diode

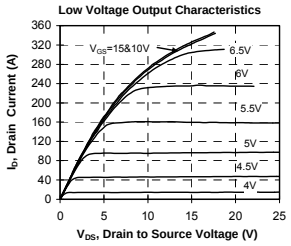
SP1 Package outline (dimensions in mm)

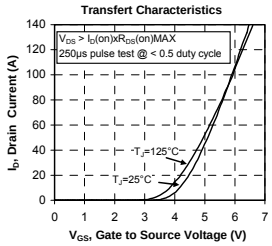


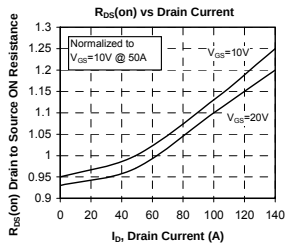
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

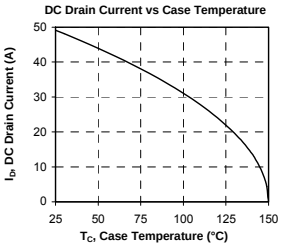
5. Typical CoolMOS Performance Curve (Phase leg)



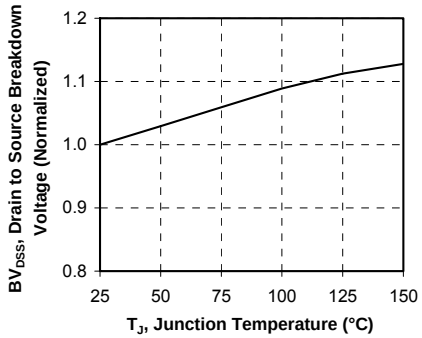




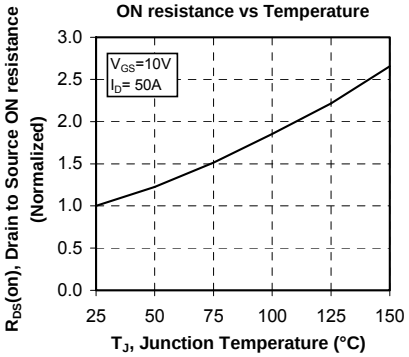




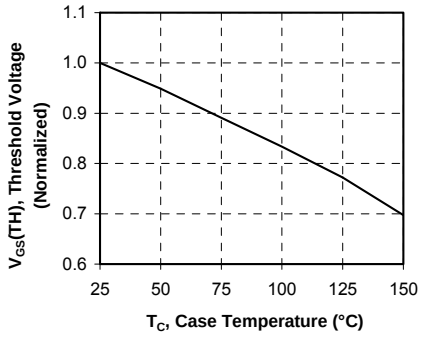
Breakdown Voltage vs Temperature



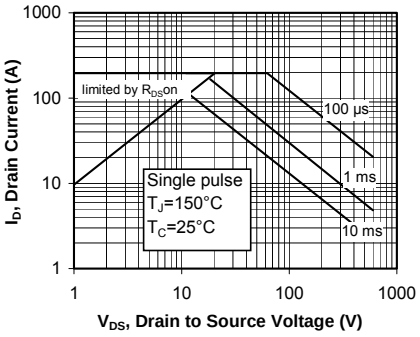
ON resistance vs Temperature



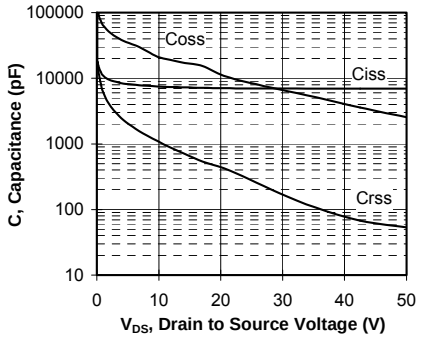
Threshold Voltage vs Temperature



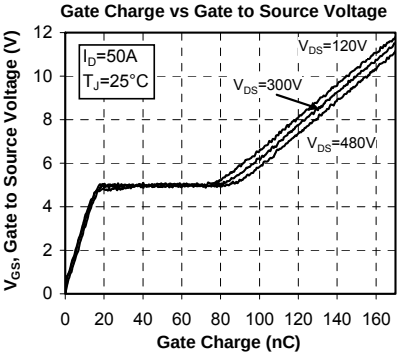
Maximum Safe Operating Area



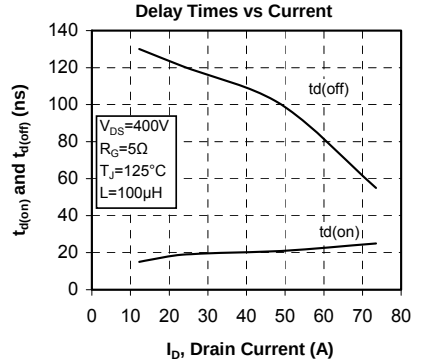
Capacitance vs Drain to Source Voltage



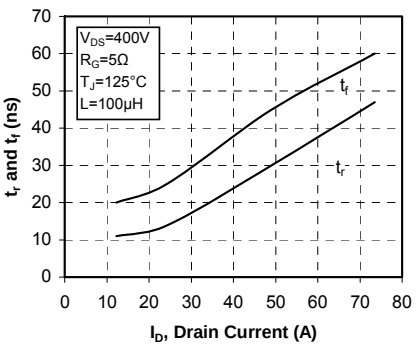
Gate Charge vs Gate to Source Voltage



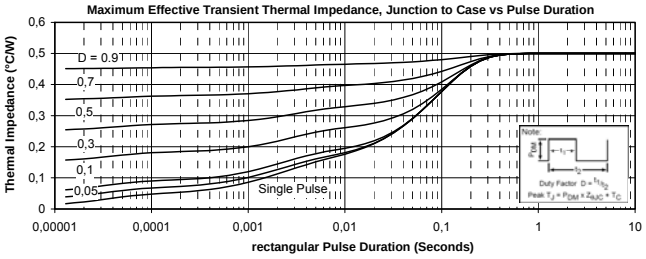
Delay Times vs Current

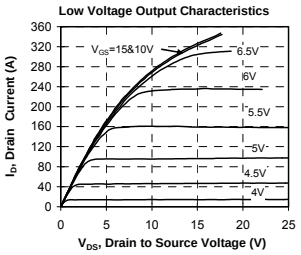


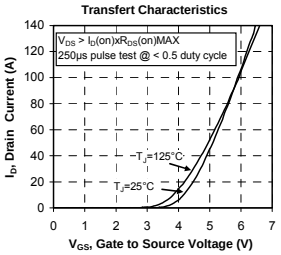
Rise and Fall times vs Current

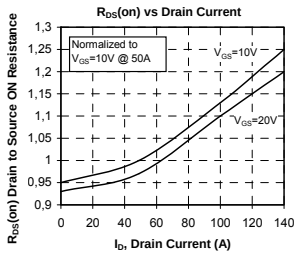


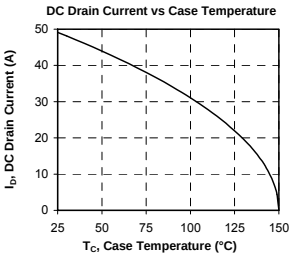
6. Typical CoolMOS Performance Curve (Boost chopper)

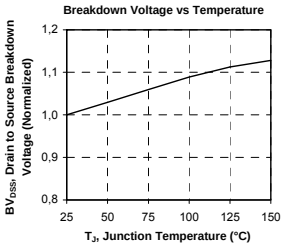


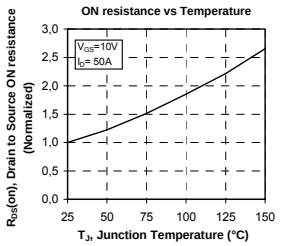


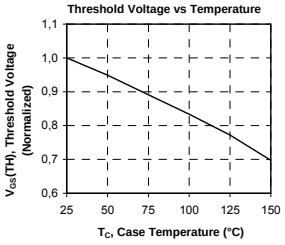


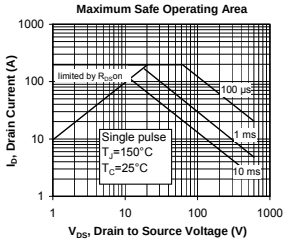


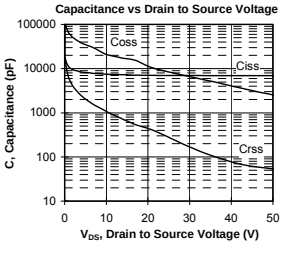


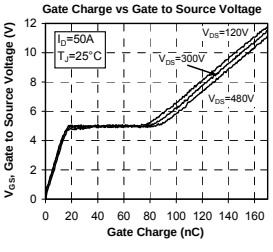


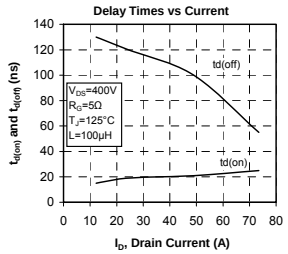


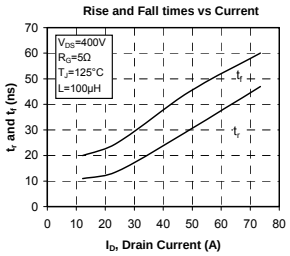


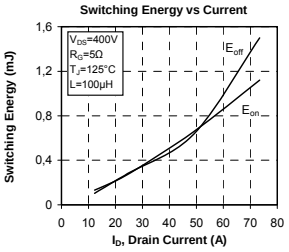


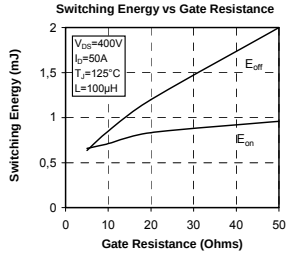


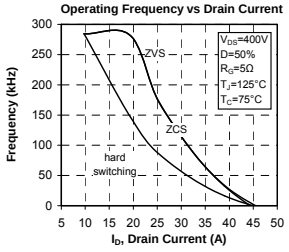


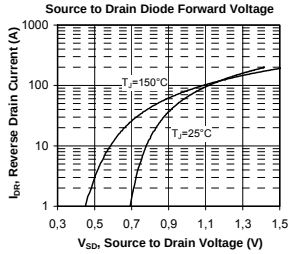




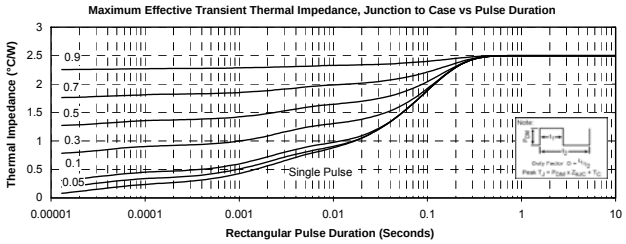


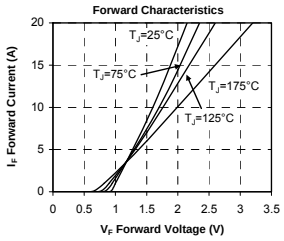


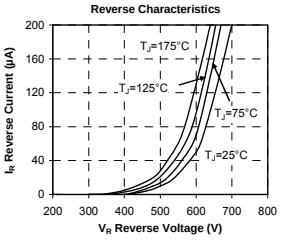


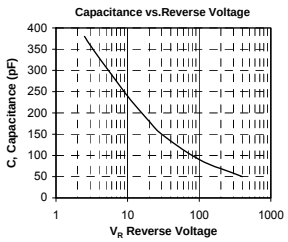


7. SiC Typical Performance Curve (CR1)









8. Typical By pass Performance Curve (CR2)