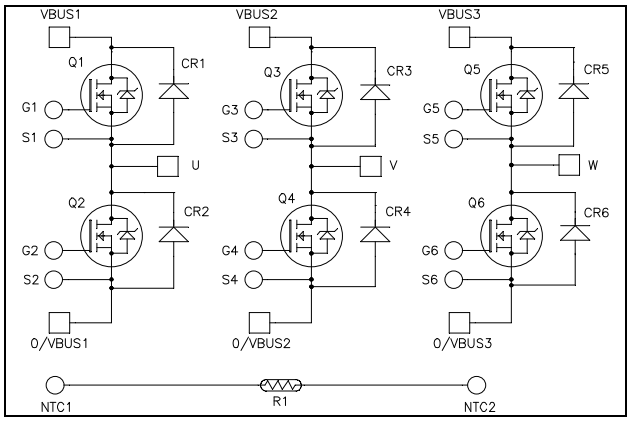
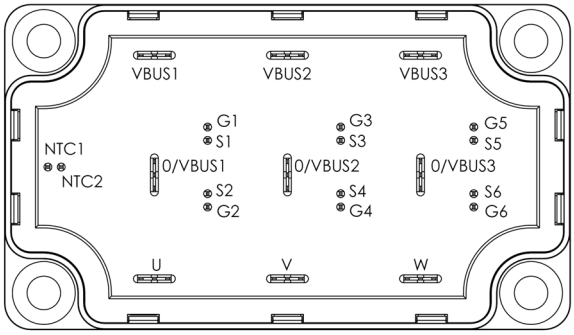
Triple phase leg SiC MOSFET Power Module

V_{DSS} = 1200V
R_{DSon} = 33mΩ max @ Tj = 25°C
I_D = 112A @ Tc = 25°C





Application

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

Features

- ***SiC Power MOSFET***
  - High speed switching
  - Low $R_{DS(on)}$
  - Ultra low loss
- ***SiC Schottky Diode***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Very low stray inductance
- Kelvin source for easy drive
- Internal thermistor for temperature monitoring
- AlN substrate for improved thermal performance

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

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

Absolute maximum ratings (per SiC MOSFET)

Symbol	Parameter		Max ratings	Unit
V_{DSS}	Drain - Source Voltage		1200	V
I_D	Continuous Drain Current	T_c = 25°C	112	A
		T_c = 80°C	89	
I_{DM}	Pulsed Drain current		225	
V_{GS}	Gate - Source Voltage		-10/25V	V
R_{DSon}	Drain - Source ON Resistance		33	mΩ
P_D	Power Dissipation	T_c = 25°C	714	W

Electrical Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0V , V_{DS} = 1200V			30	300	µA
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 20V, I_D = 60A	T_j = 25°C		27	33	mΩ
			T_j = 175°C		46		
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 3mA		1.7	3		V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = 20 V, V_{DS} = 0V				300	nA

Dynamic Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 1000V f = 1MHz			7680		pF
C_{oss}	Output Capacitance				360		
C_{rss}	Reverse Transfer Capacitance				60		
Q_g	Total gate Charge	V_{GS} = -5/20V V_{Bus} = 600V I_D = 60A			408		nC
Q_{gs}	Gate – Source Charge				120		
Q_{gd}	Gate – Drain Charge				120		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching V_{GS} = -5/20V ; V_{Bus} = 800V I_D = 60A ; T_J =150°C R_G = 1.7Ω			10		ns
T_r	Rise Time				10		
$T_{d(off)}$	Turn-off Delay Time				45		
T_f	Fall Time				30		
E_{on}	Turn on Energy	Inductive Switching V_{GS} = -5/+20V V_{Bus} = 600V I_D = 60A R_G = 1.7Ω	T_j = 150°C		1.3		mJ
E_{off}	Turn off Energy		T_j = 150°C		0.7		
R_{Gint}	Internal gate resistance				1.1		Ω
R_{thJC}	Junction to Case Thermal Resistance					0.21	°C/W

Body diode ratings and characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	V_{GS} = 0V, I_{SD} = 60A		3.9		V
t_{rr}	Reverse Recovery Time	I_{SD} = 60A ; V_{GS} = -2V V_R = 800V ; di_F/dt = 300A/µs		140		ns
Q_{rr}	Reverse Recovery Charge			345		nC
I_{rr}	Reverse Recovery Current			6		A

SiC schottky diode ratings and characteristics (per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					1200	V
I_{RRM}	Reverse Leakage Current	V_R=1200V	T_j = 25°C		30	600	µA
			T_j = 175°C		1500		
I_F	DC Forward Current		Tc = 125°C		30		A
V_F	Diode Forward Voltage	I_F = 30A	T_j = 25°C		1.5	1.8	V
			T_j = 175°C		2.3		
Q_C	Total Capacitive Charge	I_F = 30A, V_R = 600V di/dt =1500A/µs			360		nC
C	Total Capacitance	f = 1MHz, V_R = 200V			345		pF
		f = 1MHz, V_R = 400V			255		
R_{thJC}	Junction to Case Thermal Resistance					0.37	°C/W

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

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		%

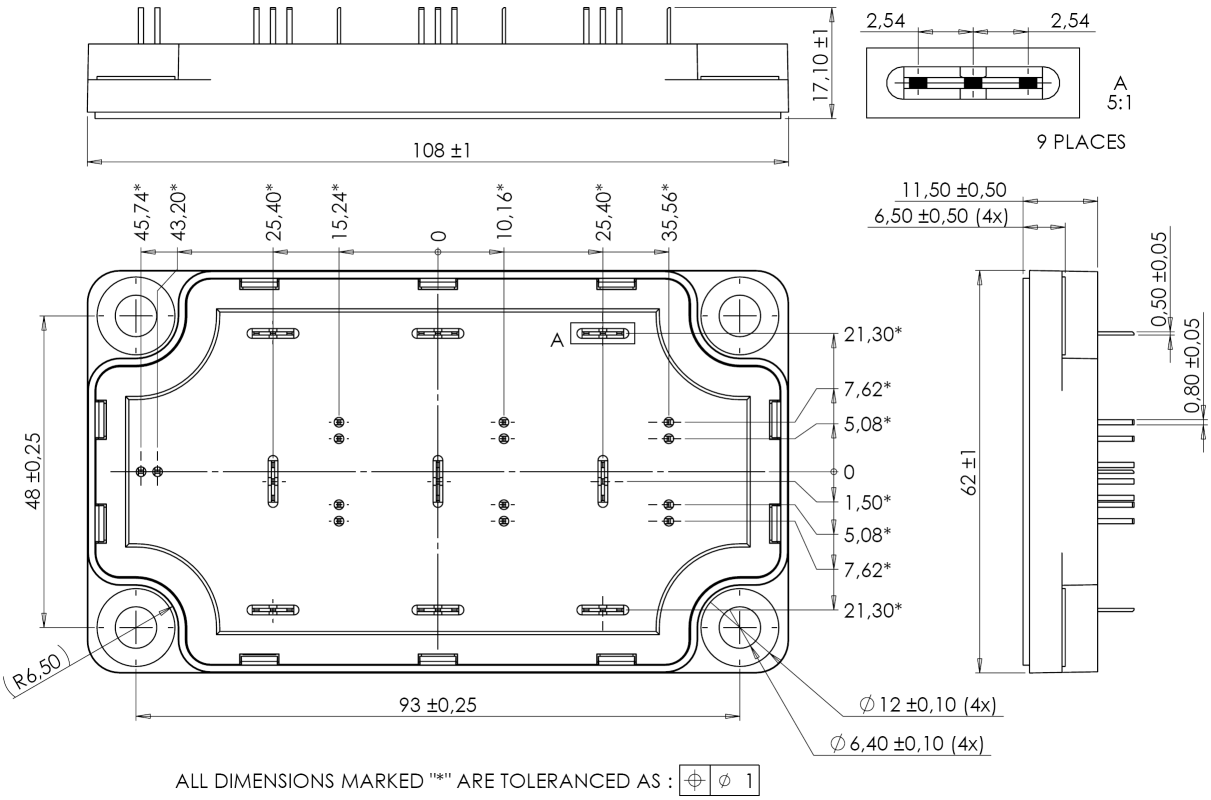
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
R_T: Thermistor value at T

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	175	°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	125	
Torque	Mounting torque	To heatsink	M6	3	5	N.m
Wt	Package Weight				250	g

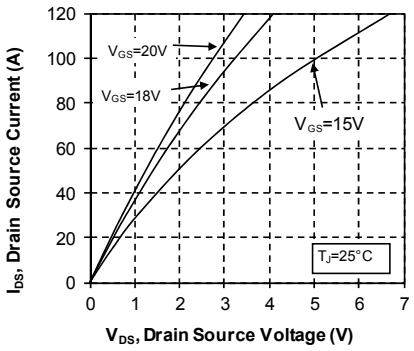
Package outline (dimensions in mm)



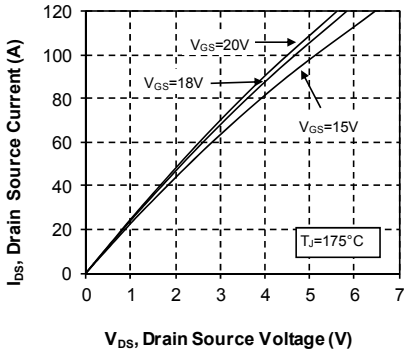
See application note 1902 - Mounting Instructions for SP6-P (12mm) Power Modules on www.microsemi.com

Typical SiC MOSFET Performance Curve

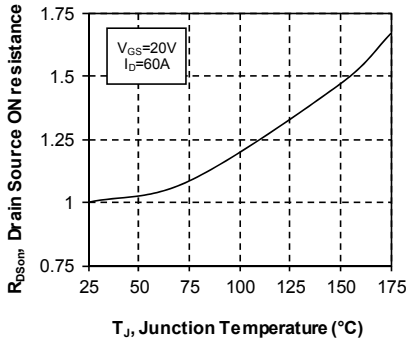
Output Characteristics



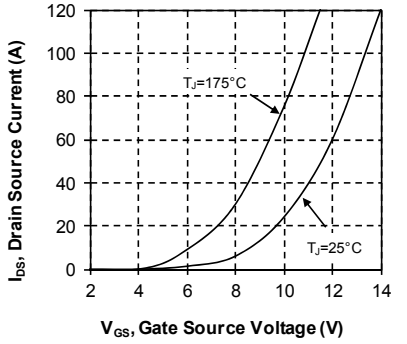
Output Characteristics



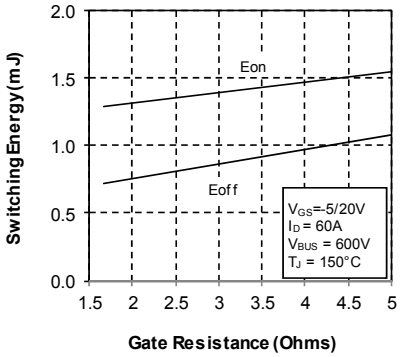
Normalized $R_{DS(on)}$ vs. Temperature



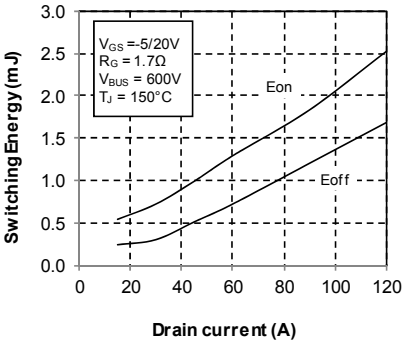
Transfert Characteristics



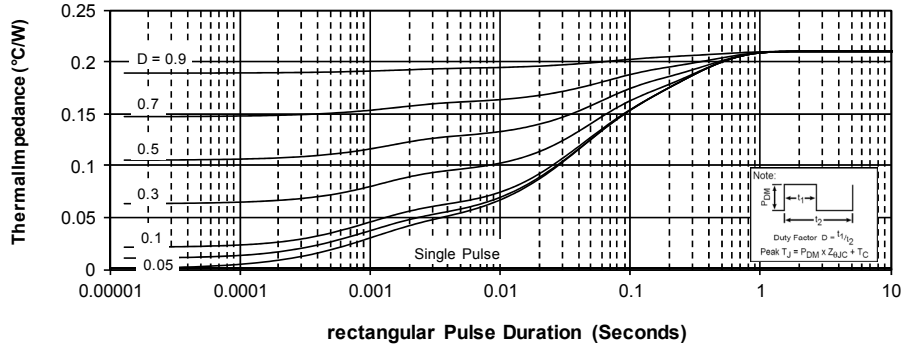
inductive switching energy vs RG



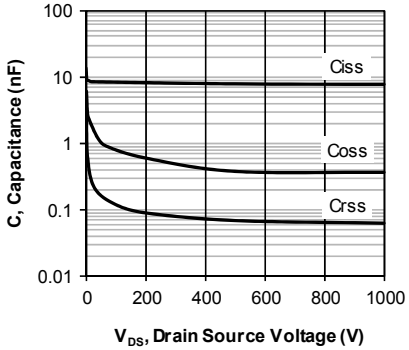
Inductive switching energy vs current



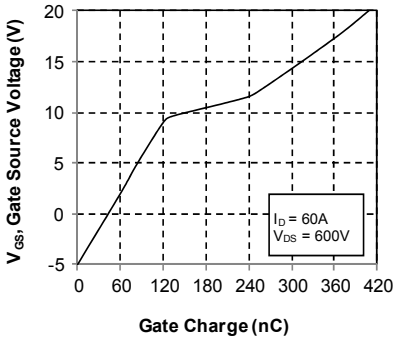
Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



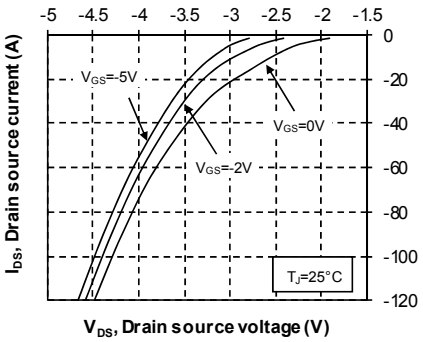
Capacitance vs Drain Source Voltage



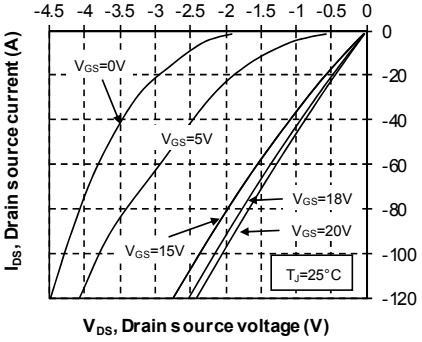
Gate Charge vs Gate Source Voltage



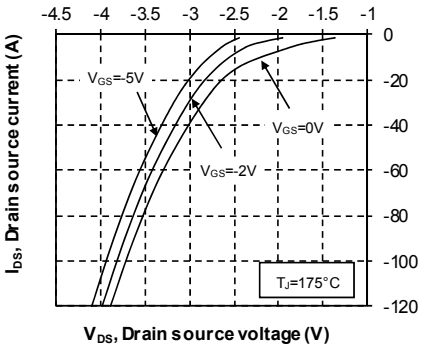
Body diode Characteristics



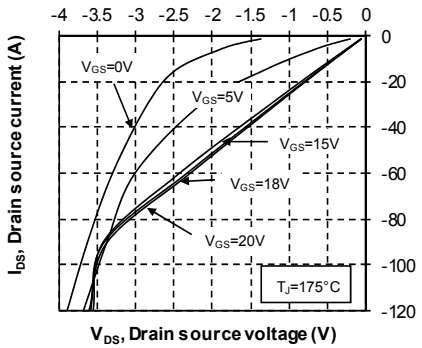
3rd quadrant Characteristics



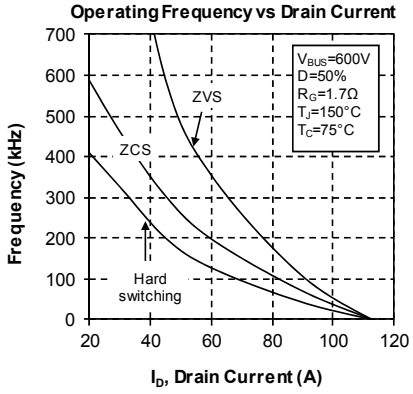
Body diode Characteristics



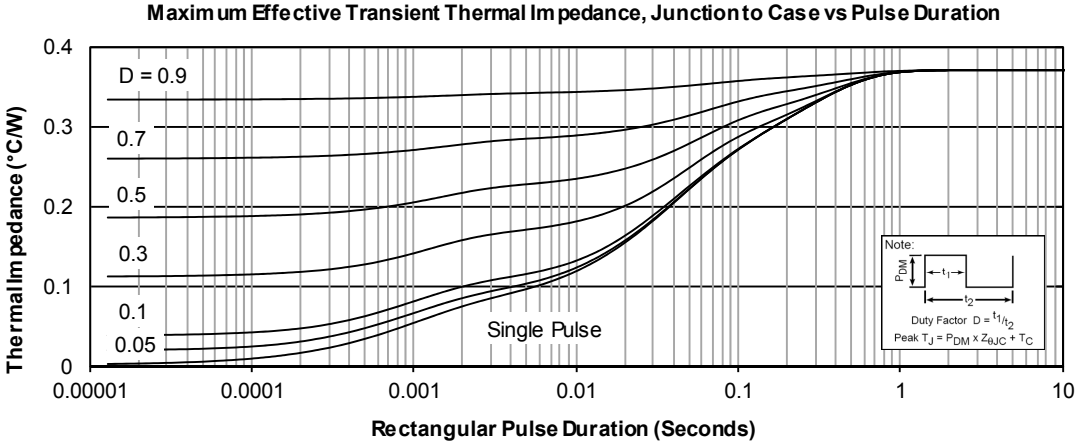
3rd quadrant Characteristics

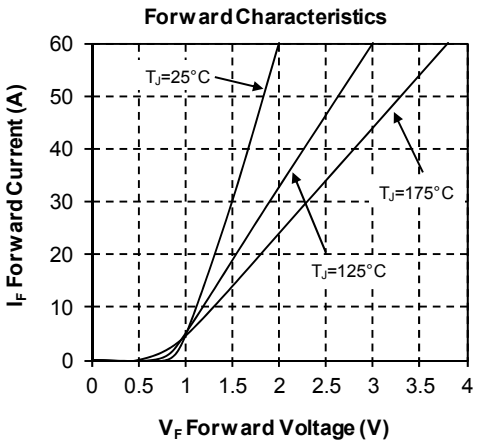


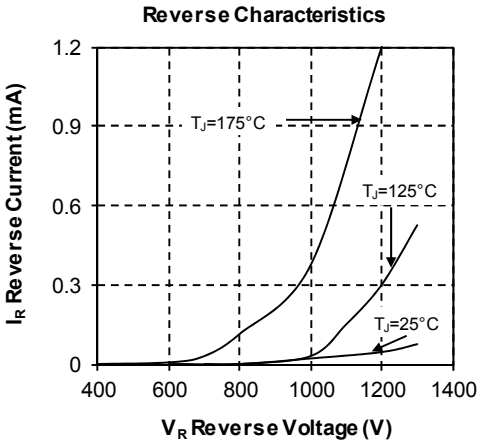
Operating Frequency vs Drain Current

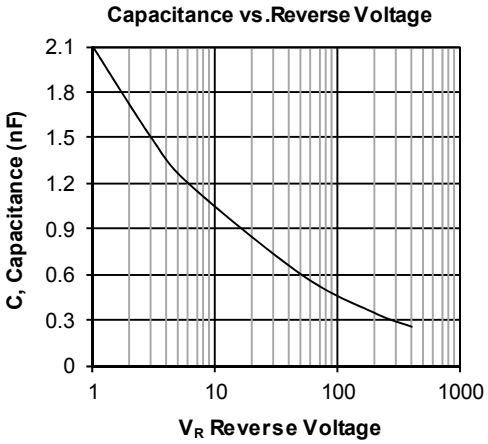


Typical SiC diode Performance Curve









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