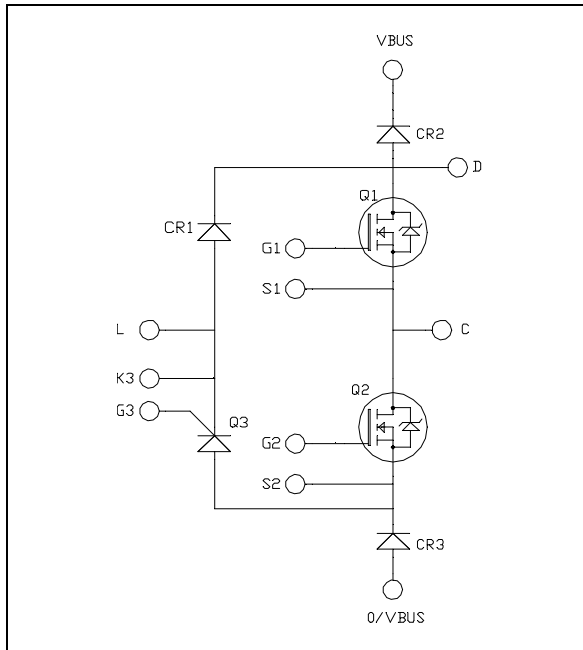


## Phase leg Power Module

**Super junction MOSFET Q1 & Q2:**  
 $V_{DS} = 600V$  ;  $I_D = 108A$  @  $T_J = 25^\circ C$



### Application

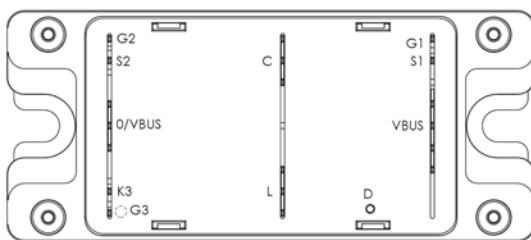
- Plasma & Induction heating
- Uninterruptible Power Supplies

### Features


- **Super junction MOSFET**
  - Ultra low  $R_{DS(on)}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
  - Very rugged
- **SiC Schottky Diode (CR2, CR3)**
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- 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 @  $T_J = 25^\circ C$  unless otherwise specified**

 **CAUTION:** These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

## 1. Absolute maximum ratings

### Diode (CR1)

Symbol	Parameter	Max ratings	Unit
$V_{RRM}$	Peak Repetitive Reverse Voltage	1600	V
$I_F$	DC Forward Current	$T_C = 80^\circ\text{C}$ 200	A
$I_{FSM}$	Non-Repetitive Forward Surge Current	$t = 10\text{ms}$ $T_J = 25^\circ\text{C}$ 1600	
$P_D$	Power Dissipation	$T_C = 25^\circ\text{C}$ 390	W

### Thyristor (Q3)

Symbol	Parameter	Max ratings	Unit
$V_{DRM}$	Repetitive Peak Reverse Voltage	1600	V
$I_{DRM}$	Repetitive Peak Reverse Current	3	mA
$I_{TRMS}$	RMS on – state current	$T_J = 100^\circ\text{C}$ 60	A
$I_{TSM}$	Surge on – state current	$t = 10\text{ms}$ $T_C = 45^\circ\text{C}$ 520	A
$V_{RGM}$	Peak Reverse Gate Voltage	10	V
$P_D$	Power Dissipation	$T_C = 25^\circ\text{C}$ 357	W

### Super junction MOSFET (Q1 & Q2)

Symbol	Parameter	Max ratings	Unit
$V_{DSS}$	Drain - Source Voltage	600	V
$I_D$	Continuous Drain Current	$T_c = 25^\circ\text{C}$ 108	A
		$T_c = 80^\circ\text{C}$ 81	
$I_{DM}$	Pulsed Drain current	260	
$V_{GS}$	Gate - Source Voltage	$\pm 20$	V
$R_{DSon}$	Drain - Source ON Resistance	24	m $\Omega$
$P_D$	Power Dissipation	$T_c = 25^\circ\text{C}$ 647	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	

### SiC Diodes (CR2 & CR3)

Symbol	Parameter	Max ratings	Unit
$V_{RRM}$	Peak Repetitive Reverse Voltage	650	V
$I_F$	DC Forward Current	$T_C = 70^\circ\text{C}$ 50	A
$P_D$	Power Dissipation	$T_C = 25^\circ\text{C}$ 170	W

## 2. Electrical Characteristics

### Diode (CR1)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_R$	Reverse Current	$V_R = 1600\text{V}$			50	$\mu\text{A}$
$V_F$	Forward Voltage	$I_F = 77\text{A}$		$T_J = 25^\circ\text{C}$ 1	1.21	V
				$T_J = 125^\circ\text{C}$ 0.9	1.1	
$V_T$	On – state Voltage				0.83	V
$r_T$	On – state Slope resistance				2.2	m $\Omega$
$R_{thJC}$	Junction to Case Thermal Resistance				0.32	$^\circ\text{C/W}$

**Thyristor (Q3)**

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
$V_T$	On – state Voltage	$I_T = 60A$	$T_J = 25^\circ C$		1.41		V
$V_{TO}$	Direct On state threshold Voltage		$T_J = 125^\circ C$		0.85		
$r_T$	On – state Slope resistance		$T_J = 125^\circ C$		10		m $\Omega$
$V_{GT}$	Gate Trigger Voltage		$T_J = 25^\circ C$		1.5		V
$I_{GT}$	Gate Trigger Current				50		mA
$R_{thJC}$	Junction to Case Thermal Resistance					0.35	$^\circ C/W$

**Super junction MOSFET (Q1 & Q2)**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 600V$			350	$\mu A$
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 47.5A$			24	m $\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 5mA$	2.1	3	3.9	V
$I_{GSS}$	Gate – Source Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$			200	nA
$C_{iss}$	Input Capacitance	$V_{GS} = 0V ; V_{DS} = 25V$		14.4		nF
$C_{oss}$	Output Capacitance	$f = 1MHz$		17		
$Q_g$	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 300V$ $I_D = 95A$		300		nC
$Q_{gs}$	Gate – Source Charge			68		
$Q_{gd}$	Gate – Drain Charge			102		
$T_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (125<math>^\circ C</math>)</b> $V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 95A$ $R_G = 2.5\Omega$		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	<b>Inductive switching @ 125<math>^\circ C</math></b> $V_{GS} = 10V ; V_{Bus} = 400V$ $I_D = 95A ; R_G = 2.5\Omega$		2200		$\mu J$
$E_{off}$	Turn-off Switching Energy			1270		
$R_{Gint}$	Internal gate resistance			2.5		$\Omega$
$R_{thJC}$	Junction to Case Thermal Resistance				0.193	$^\circ C/W$

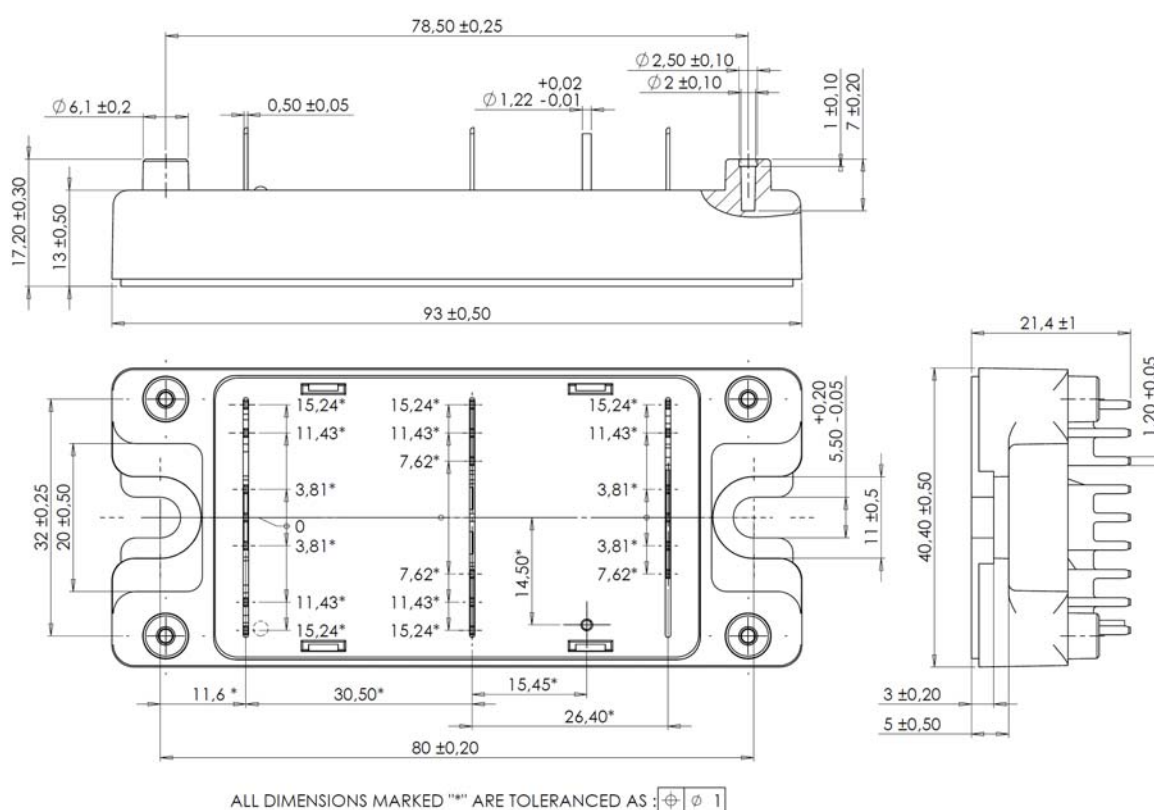
**SiC Diodes (CR2 & CR3)**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_{RM}$	Reverse Leakage Current	$V_R = 650V$	$T_J = 25^\circ C$	50	500	$\mu A$
			$T_J = 175^\circ C$	200	1000	
$V_F$	Diode Forward Voltage	$I_F = 50A$	$T_J = 25^\circ C$	1.5	1.8	V
			$T_J = 175^\circ C$	1.8	2.2	
$Q_C$	Total Capacitive Charge	$I_F = 50A, V_R = 400V$		110		nC
C	Total Capacitance	$f = 1MHz, V_R = 200V$		200		pF
		$f = 1MHz, V_R = 400V$		180		
$R_{thJC}$	Junction to Case Thermal Resistance				0.94	$^\circ C/W$

### 3. Package characteristics

Symbol	Characteristic			Min	Max	Unit
V <sub>ISOL</sub>	RMS Isolation Voltage, any terminal to case t=1 min, 50/60Hz			4000		V
T <sub>J</sub>	Operating junction temperature range		Q1, Q2, Q3, CR1	-40	150	°C
			CR2, CR3	-40	175	
T <sub>JOP</sub>	Recommended junction temperature under switching conditions			-40	T <sub>Jmax</sub> -25	
T <sub>STG</sub>	Storage Temperature Range			-40	125	
T <sub>C</sub>	Operating Case Temperature			-40	125	
Torque	Mounting torque	To Heatsink	M5	2.5	4.7	N.m
Wt	Package Weight				160	g

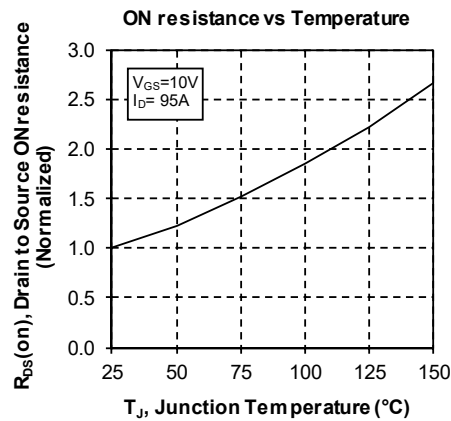
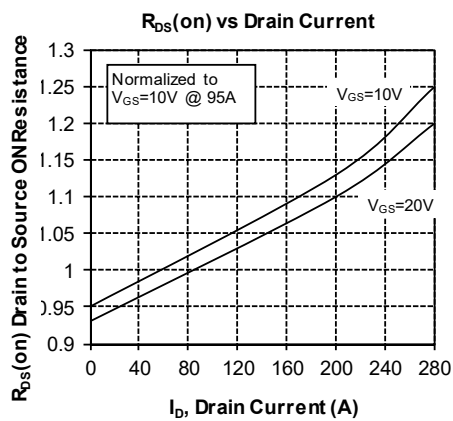
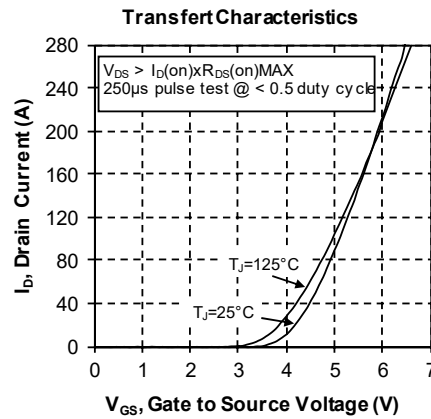
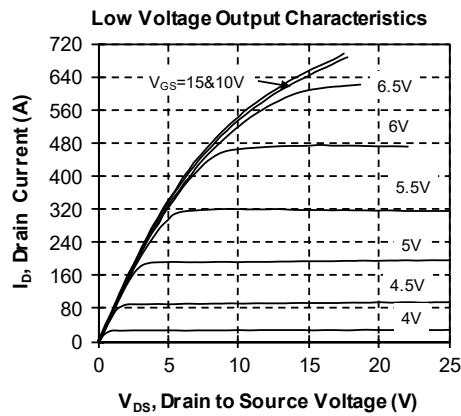
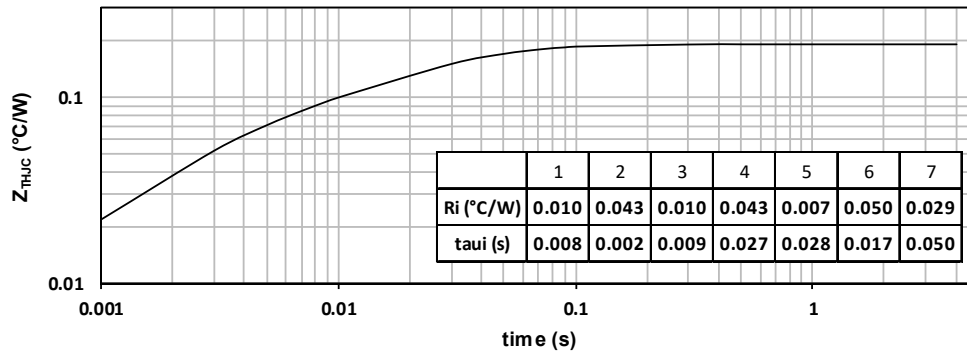
### Package outline (dimensions in mm)

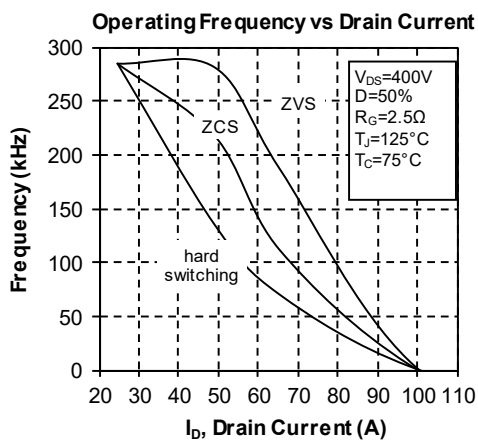
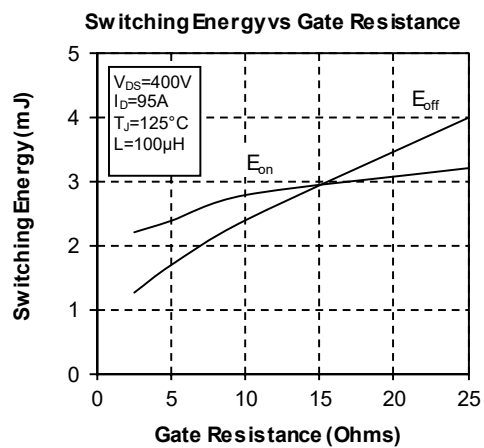
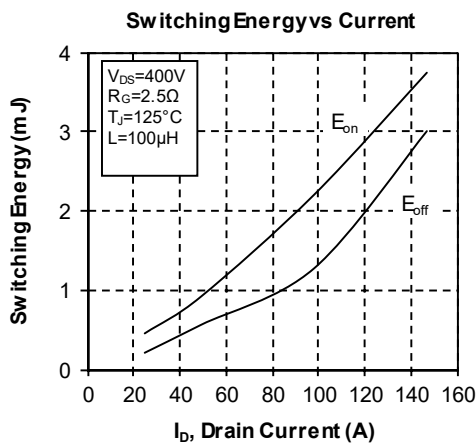
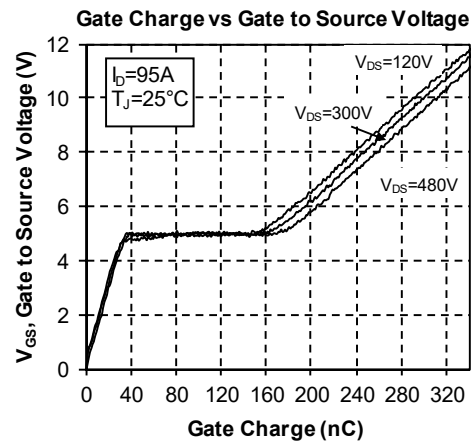
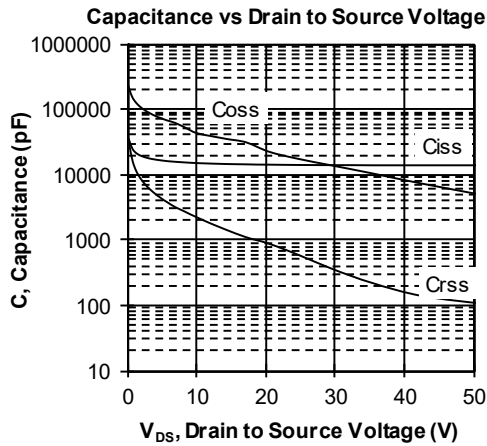


See application note APT0501 - Mounting Instructions for SP4 Power Modules on [www.microsemi.com](http://www.microsemi.com)

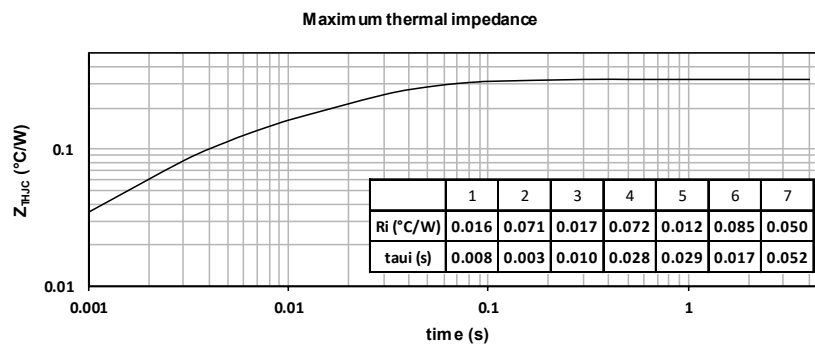
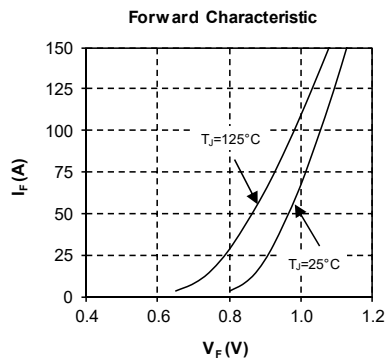
## 4. Typical performance curves Super junction MOSFET (Q1 & Q2)

Maximum thermal impedance

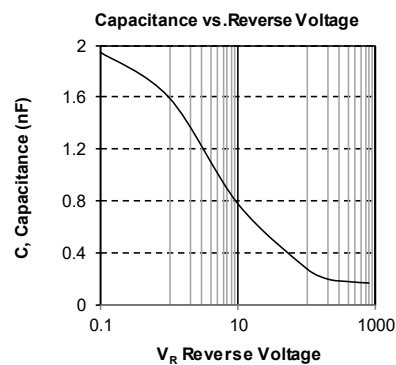
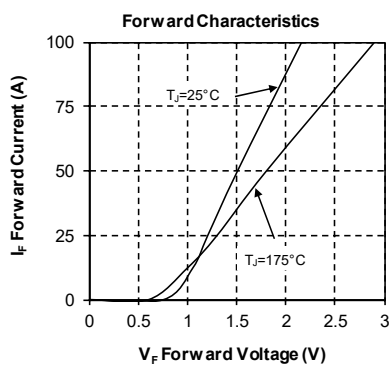
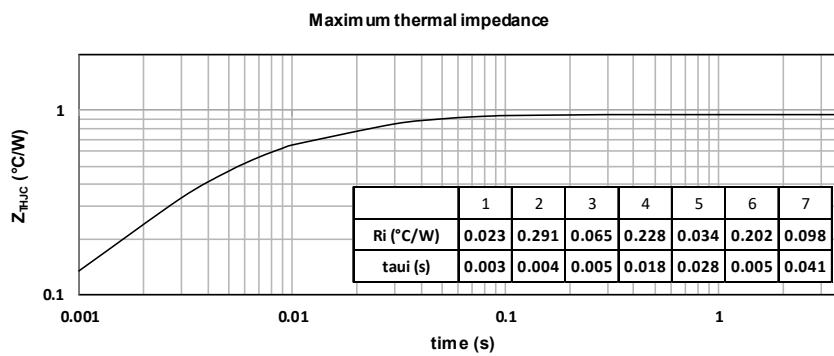




## Diode (CR1)



## SiC diode (CR2 & CR3)



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