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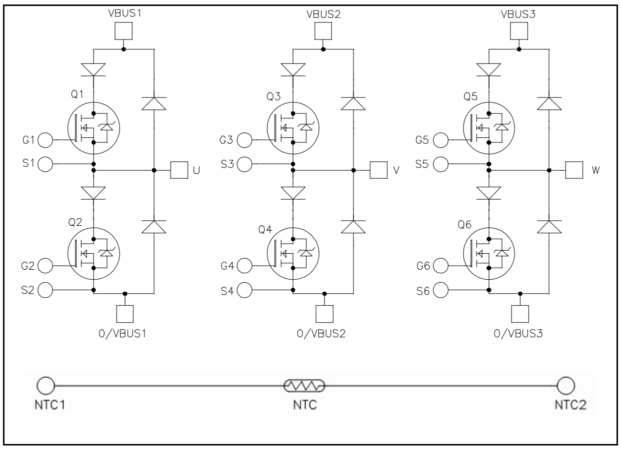
Triple phase leg CoolMOS™ Power Module

V_{DSS} = 600V
R_{DSon} = 21mΩ typ @ Tj = 25°C
I_D = 116A @ Tc = 25°C

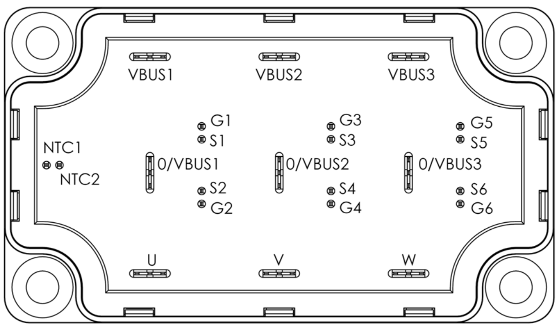


Application

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

Features

- ***CoolMOS™***
  - Ultra low R_{DSon}
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
  - Very rugged
- ***SiC Parallel 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
- High level of integration
- 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
- Very low (12mm) profile
- Each leg can be easily paralleled to achieve a phase leg of three times the current capability
- Module can be configured as a three phase bridge
- 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 CoolMOS™)

Symbol	Parameter		Max ratings	Unit
V_{DSS}	Drain - Source Breakdown Voltage		600	V
I_D	Continuous Drain Current	$T_c = 25°C$	116	A
		$T_c = 80°C$	87	
I_{DM}	Pulsed Drain current		400	
V_{GS}	Gate - Source Voltage		±20	V
R_{DSon}	Drain - Source ON Resistance		21	mΩ
P_D	Maximum Power Dissipation	$T_c = 25°C$	625	W
I_{AR}	Avalanche current (repetitive and non repetitive)		13	A
E_{AR}	Repetitive Avalanche Energy		3	mJ
E_{AS}	Single Pulse Avalanche Energy		1950	

Electrical Characteristics (Per CoolMOS™)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 600V$			200	µA
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 88A$		18.5	21	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 6mA$	2.4	3	3.6	V
I_{GSS}	Gate – Source Leakage Current	$V_{GS} = ±20\ V, V_{DS} = 0V$			200	nA

Dynamic Characteristics (Per CoolMOS™)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{GS} = 0V$; $V_{DS} = 100V$ f = 1MHz		13		nF
C_{oss}	Output Capacitance			0.72		
Q_g	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 480V$ $I_D = 88A$		580		nC
Q_{gs}	Gate – Source Charge			72		
Q_{gd}	Gate – Drain Charge			300		
$T_{d(on)}$	Turn-on Delay Time	**Inductive Switching @ 25°C** $V_{GS} = 13V$ $V_{Bus} = 400V$ $I_D = 88A$ $R_G = 0.8Ω$		23		ns
T_r	Rise Time			10		
$T_{d(off)}$	Turn-off Delay Time			130		
T_f	Fall Time			7		
E_{on}	Turn-on Switching Energy	**Inductive switching @ 125°C** $V_{GS} = 13V, V_{Bus} = 400V$ $I_D = 88A, R_G = 0.8Ω$		1.2		mJ
E_{off}	Turn-off Switching Energy			2.8		
R_{thJC}	Junction to Case Thermal Resistance				0.20	°C/W

Series diode ratings and characteristics (Per series diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	V_R = 600V				100	µA
I_F	DC Forward Current		T_c = 80°C		75		A
V_F	Diode Forward Voltage	I_F = 75A	T_j = 25°C		1.6	2	V
			T_j = 150°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 75A, V_R = 300V, di/dt = 2000A/µs	T_j = 25°C		100		ns
			T_j = 150°C		150		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		3.6		nC
			T_j = 150°C		7.6		
R_{thJC}	Junction to Case Thermal Resistance					0.80	°C/W

SiC Parallel diode ratings and characteristics (Per parallel diode)

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		30	180	µA
			T_j = 175°C		60	900	
I_F	DC Forward Current		Tc = 100°C		30		A
V_F	Diode Forward Voltage	I_F = 30A	T_j = 25°C		1.6	1.8	V
			T_j = 175°C		2	2.4	
Q_C	Total Capacitive Charge	I_F = 30A, V_R = 600V, di/dt = 1000A/µs			84		nC
C	Total Capacitance	f = 1MHz, V_R = 200V			195		pF
		f = 1MHz, V_R = 400V			150		
R_{thJC}	Junction to Case Thermal Resistance					0.80	°C/W

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	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_{STG}	Storage Temperature Range			-40		125	
T_C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To heatsink	M6	3		5	N.m
Wt	Package Weight					250	g

* T_J = 175°C for series and parallel diodes

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

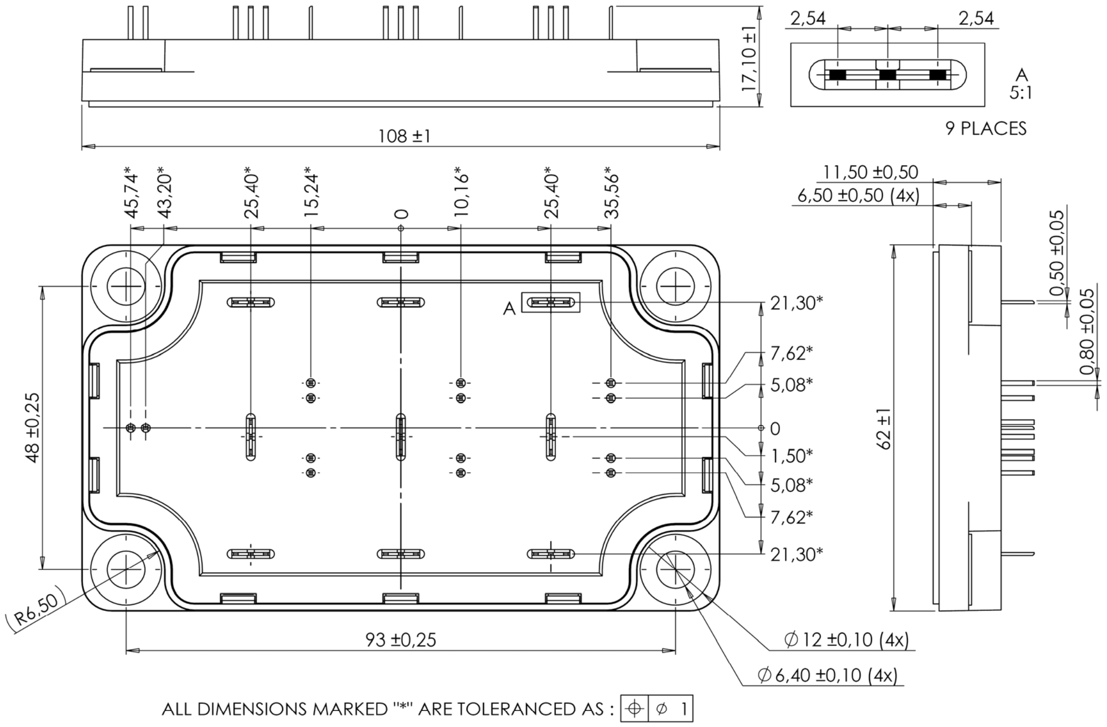
Pins NTC1 & NTC2 are only mounted on APTM100TA35SCTPG power module.

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		%

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

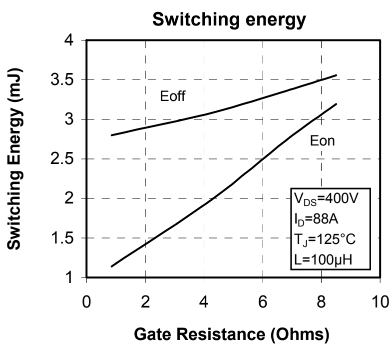
T: Thermistor temperature
R_T: Thermistor value at T

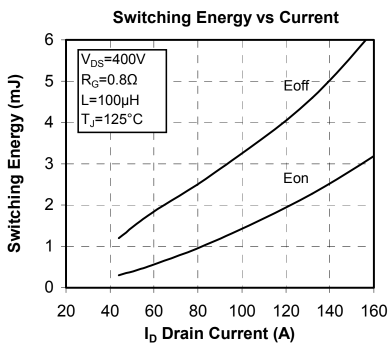
SP6-P Package outline (dimensions in mm)

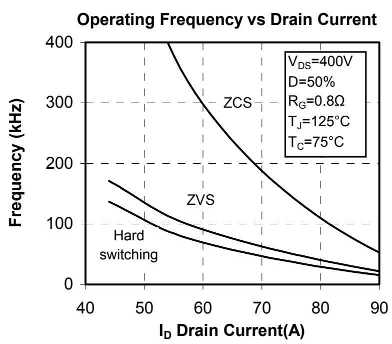


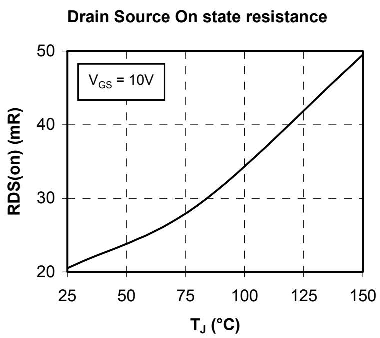
See application note 1902 - Mounting Instructions for SP6-P (12mm) Power Modules on www.microsemi.com

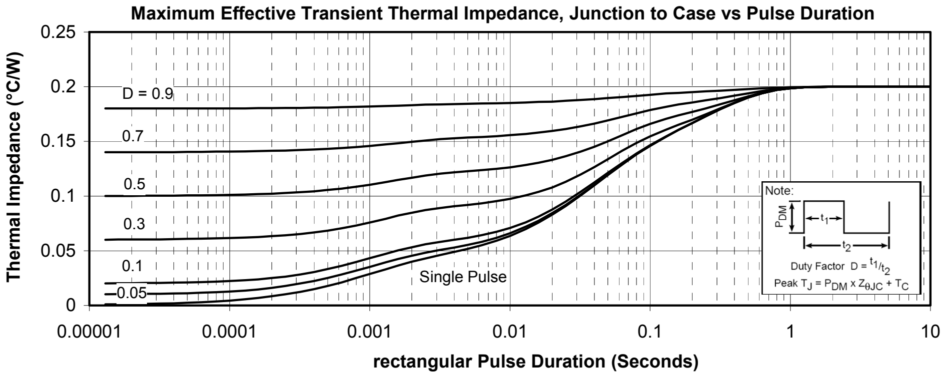
Typical CoolMOS™ Performance Curve

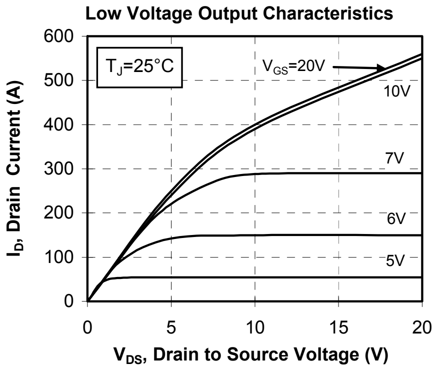


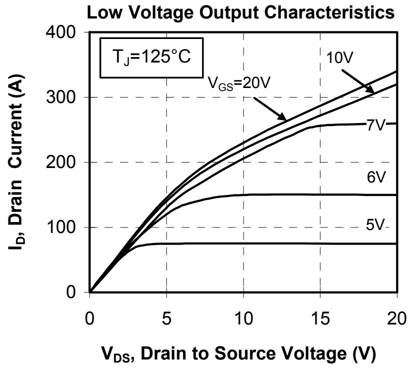


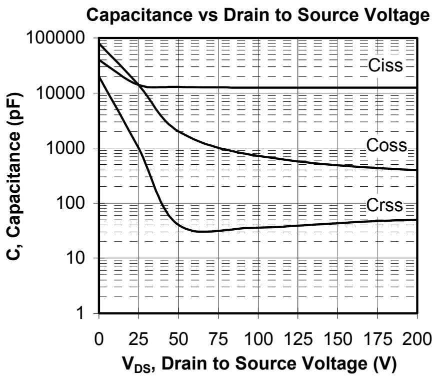


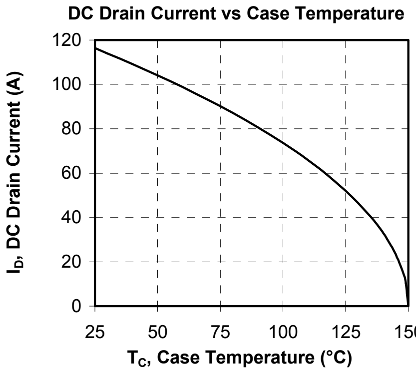


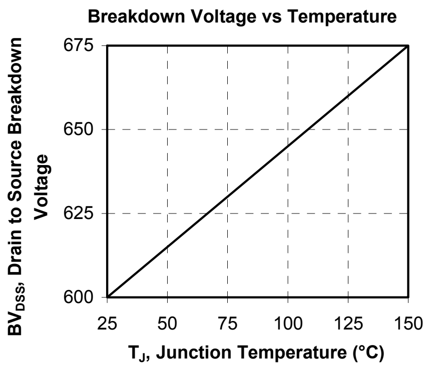

Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
rectangular Pulse Duration (Seconds)
D = 0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
Note:
Duty Factor D = t1/t2
Peak TJ = PDM x ZθJC + TC

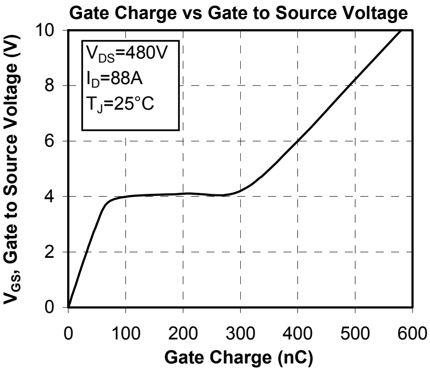

Low Voltage Output Characteristics
TJ=25°C
VGS=20V
10V
7V
6V
5V
ID, Drain Current (A)
VDS, Drain to Source Voltage (V)


Low Voltage Output Characteristics
TJ=125°C
VGS=20V
10V
7V
6V
5V
ID, Drain Current (A)
VDS, Drain to Source Voltage (V)

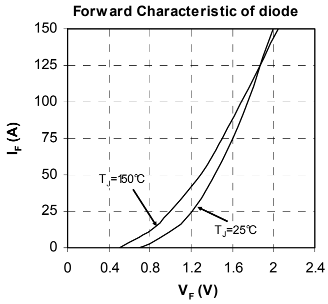

Capacitance vs Drain to Source Voltage
Ciss
Coss
Crss
C, Capacitance (pF)
VDS, Drain to Source Voltage (V)

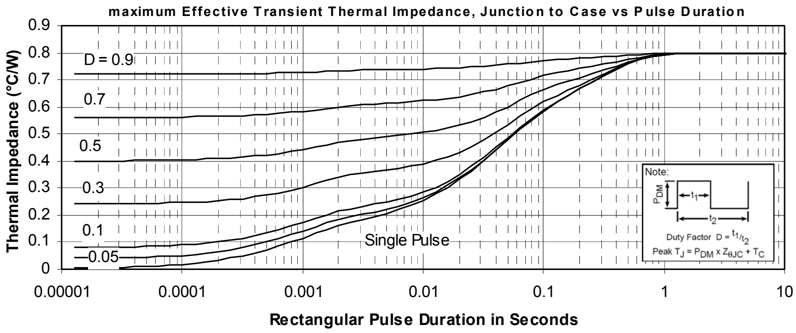

DC Drain Current vs Case Temperature
ID, DC Drain Current (A)
TC, Case Temperature (°C)


Breakdown Voltage vs Temperature
BVDSS, Drain to Source Breakdown Voltage
TJ, Junction Temperature (°C)

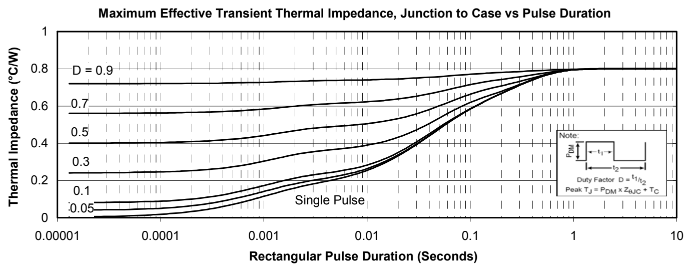

Gate Charge vs Gate to Source Voltage
VDS=480V
ID=88A
TJ=25°C
VGS, Gate to Source Voltage (V)
Gate Charge (nC)

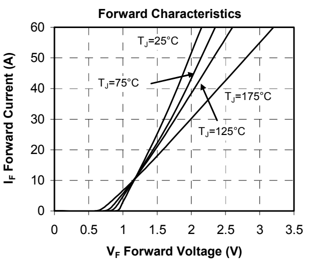
Typical series diode Performance Curve

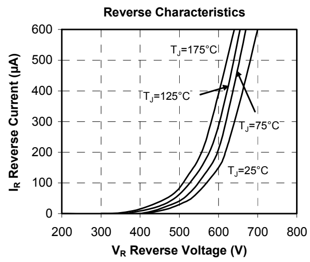


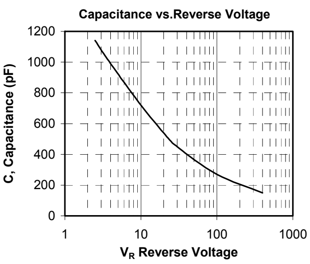


Typical SiC parallel diode Performance Curve

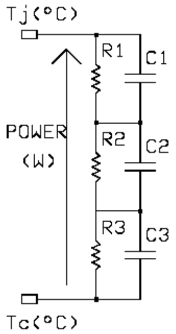






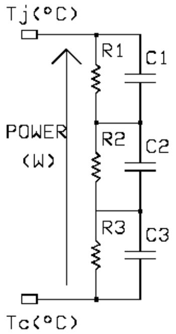


Thermal impedance ; CoolMOS™



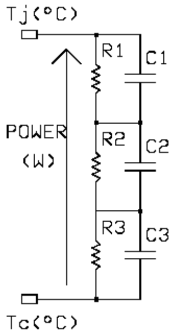
RC Final Model
R1 = 0.044 Ω
R2 = 0.103 Ω
R3 = 0.053 Ω
C1 = 0.022 F
C2 = 0.347 F
C3 = 4.31 F

Thermal impedance ; Series diode



RC Final Model
R1 = 0.176 Ω
R2 = 0.413 Ω
R3 = 0.211 Ω
C1 = 0.0055 F
C2 = 0.086 F
C3 = 1.07 F

Thermal impedance ; SiC Parallel diode



RC Final Model
R1 = 0.176 Ω
R2 = 0.413 Ω
R3 = 0.211 Ω
C1 = 0.0055 F
C2 = 0.086 F
C3 = 1.07 F

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