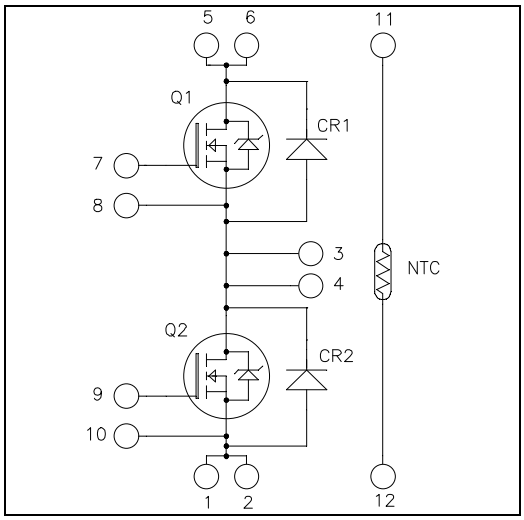
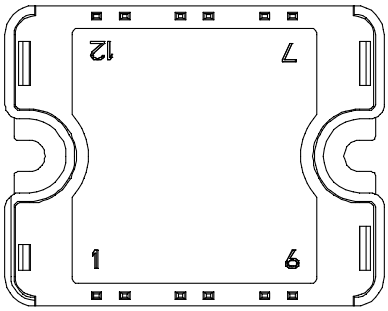
APTMC120AM20CT1AG

Phase leg
SiC MOSFET Power Module

V_{DSS} = 1200V
R_{DSon} = 17mΩ max @ Tj = 25°C
I_D = 143A @ Tc = 25°C





Pins 1/2 ; 3/4 ; 5/6 must be shorted together

Application

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

Features

- ***SiC Power MOSFET***
  - Low $R_{DS(on)}$
  - High temperature performance
- ***SiC Schottky Diode***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Very low stray inductance
- Internal thermistor for temperature monitoring
- 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°C unless otherwise specified

1. SiC MOSFET characteristics (Per MOSFET)

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Breakdown Voltage		1200	V
I_D	Continuous Drain Current	T_c = 25°C	143	A
		T_c = 80°C	108	
I_{DM}	Pulsed Drain current		280	
V_{GS}	Gate - Source Voltage		-10/+25	V
R_{DSon}	Drain - Source ON Resistance		17	mΩ
P_D	Maximum Power Dissipation	T_c = 25°C	600	W

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} = 1200V			20	200	µA
$R_{DS(on)}$	Drain – Source on Resistance	V_{GS} = 20V I_D = 100A	T_j = 25°C		12.5	17	mΩ
			T_j = 150°C		22	32	
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 2mA		1.9	2.3		V
I_{GSS}	Gate – Source Leakage Current	V_{GS} = 20 V, V_{DS} = 0V				1	µA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 1000V f = 1MHz			5960		pF
C_{oss}	Output Capacitance				440		
C_{rss}	Reverse Transfer Capacitance				46		
Q_g	Total gate Charge	V_{GS} = -2/+20V V_{Bus} = 800V I_D =100A			360		nC
Q_{gs}	Gate – Source Charge				64		
Q_{gd}	Gate – Drain Charge				126		
$T_{d(on)}$	Turn-on Delay Time	V_{GS} = -2/+20V V_{Bus} = 800V I_D = 100A R_L = 8Ω ; R_G = 10Ω			21		ns
T_r	Rise Time				19		
$T_{d(off)}$	Turn-off Delay Time				50		
T_f	Fall Time				30		
E_{on}	Turn on Energy	Inductive Switching V_{GS} = -5/+20V V_{Bus} = 600V I_D = 100A R_G = 10Ω	T_j = 150°C		2.2		mJ
E_{off}	Turn off Energy		T_j = 150°C		1.2		
R_{thJC}	Junction to Case Thermal Resistance					0.21	°C/W

2. SiC diode characteristics (Per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			1200			V
I_{RM}	Maximum Reverse Leakage Current	V_R=1200V	T_j = 25°C		70	400	µA
			T_j = 175°C		130	800	
I_F	DC Forward Current		Tc = 125°C		40		A
V_F	Diode Forward Voltage	I_F = 40A	T_j = 25°C		1.5	1.8	V
			T_j = 175°C		2.2	3	
Q_C	Total Capacitive Charge	I_F = 40A, V_R = 1200V di/dt = 1000A/µs			260		nC
C	Total Capacitance	f = 1MHz, V_R = 200V			186		pF
		f = 1MHz, V_R = 400V			134		
R_{thJC}	Junction to Case Thermal Resistance					0.7	°C/W

3. Thermal and package characteristics

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	SiC MOSFET		-40		150	°C
		SiC diode		-40		175	
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	M4	2		3	N.m
Wt	Package Weight					80	g

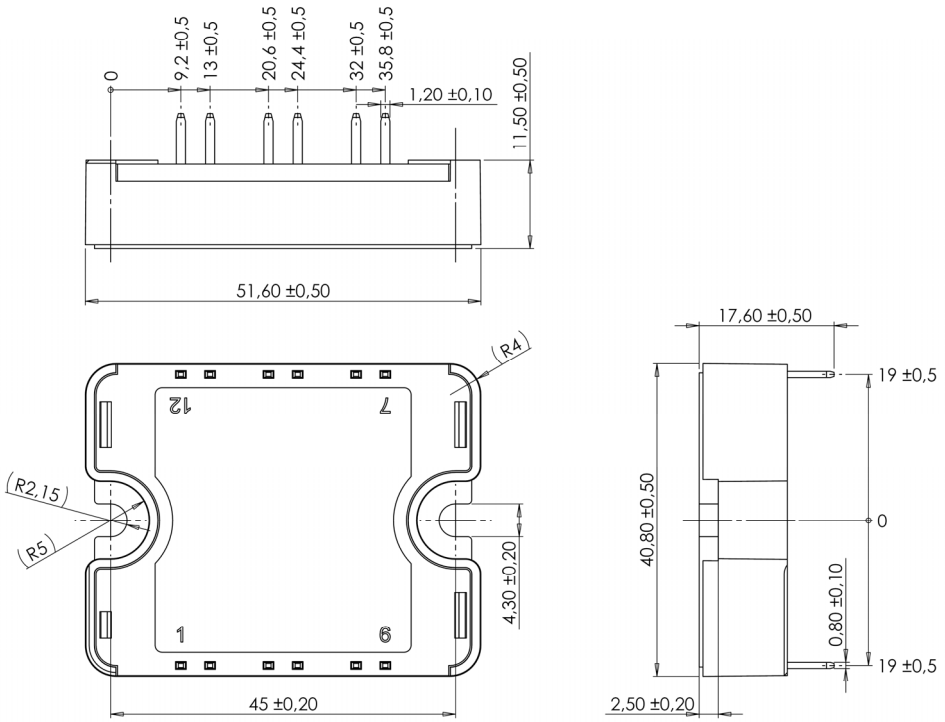
Temperature sensor NTC (see application note APT0406 on www.microsemi.com).

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

SP1 Package outline (dimensions in mm)

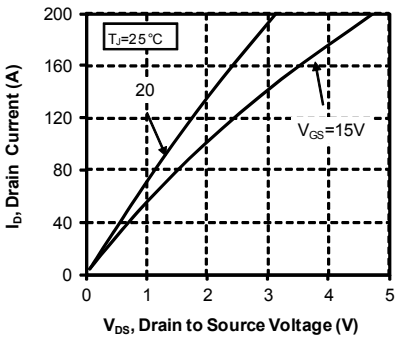


See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

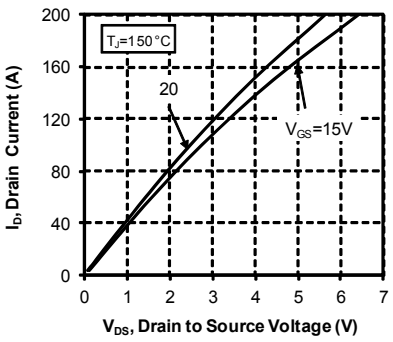
4. Typical Performance Curves

SiC MOSFET

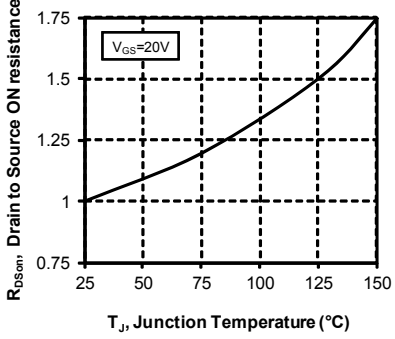
Output Characteristics



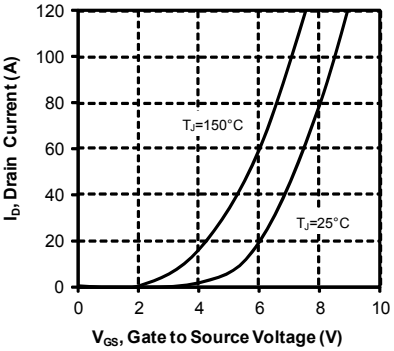
Output Characteristics



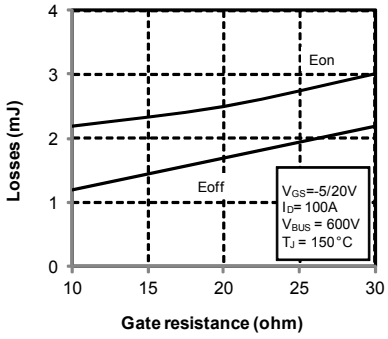
Normalized $R_{DS(on)}$ vs. Temperature



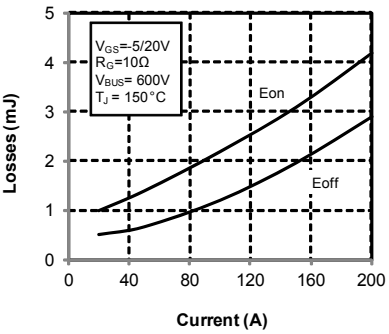
Transfert Characteristics



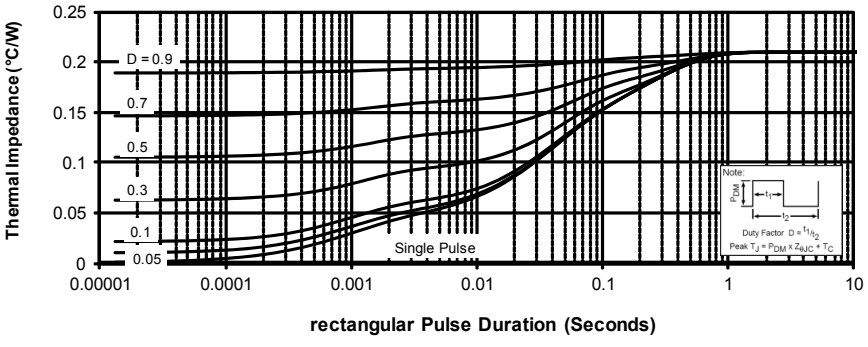
Switching energy vs Rg

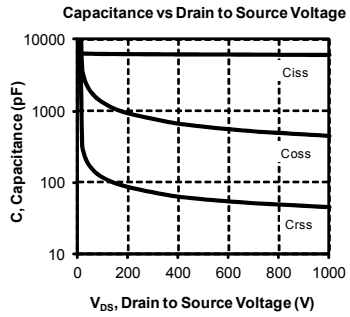


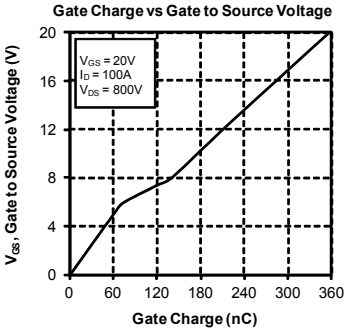
switching energy vs current

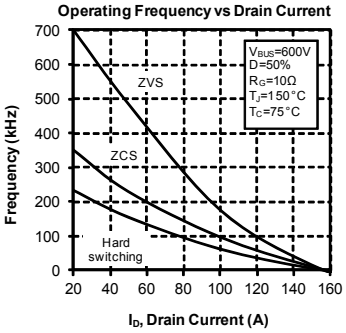


Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration

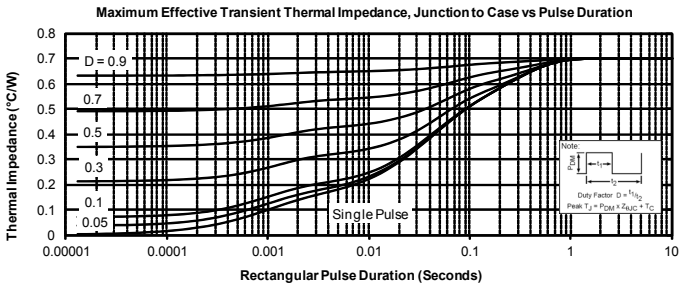


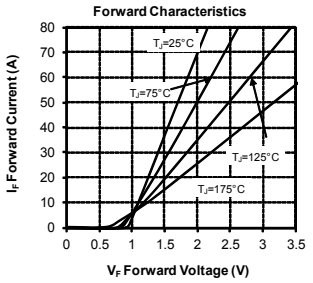

Capacitance vs Drain to Source Voltage
C, Capacitance (pF)
10000
1000
100
10
Ciss
Coss
Crss
0
200
400
600
800
1000
VDS, Drain to Source Voltage (V)

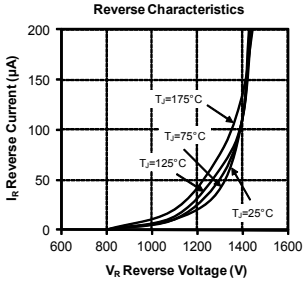

Gate Charge vs Gate to Source Voltage
VGS = 20V
ID = 100A
VDS = 800V
VGS, Gate to Source Voltage (V)
20
16
12
8
4
0
0
60
120
180
240
300
360
Gate Charge (nC)

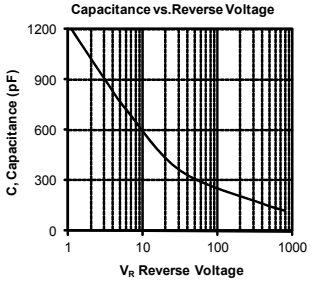

Operating Frequency vs Drain Current
VBUS=600V
D=50%
RG=10Ω
TJ=150°C
TC=75°C
ZVS
ZCS
Hard switching
Frequency (kHz)
700
600
500
400
300
200
100
0
20
40
60
80
100
120
140
160
ID, Drain Current (A)

SiC diode


Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
D = 0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
0.00001
0.0001
0.001
0.01
0.1
1
10
Rectangular Pulse Duration (Seconds)


Forward Characteristics
IF Forward Current (A)
80
70
60
50
40
30
20
10
0
TJ=25°C
TJ=75°C
TJ=125°C
TJ=175°C
0
0.5
1
1.5
2
2.5
3
3.5
VF Forward Voltage (V)


Reverse Characteristics
IR Reverse Current (µA)
200
150
100
50
0
TJ=175°C
TJ=75°C
TJ=125°C
TJ=25°C
600
800
1000
1200
1400
1600
VR Reverse Voltage (V)


Capacitance vs.Reverse Voltage
C, Capacitance (pF)
1200
900
600
300
0
1
10
100
1000
VR Reverse Voltage

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