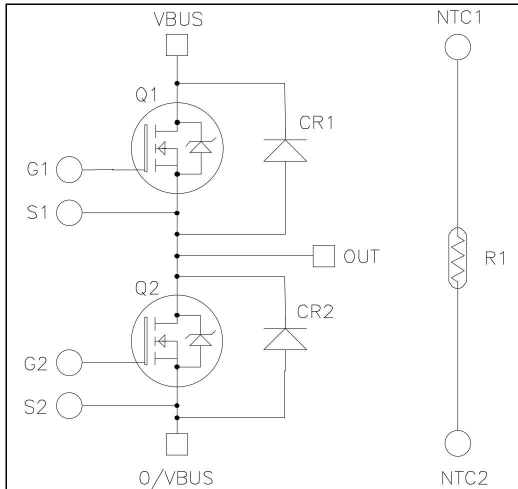
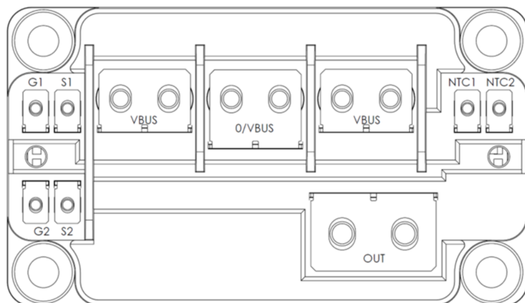
MSCSM170AM029CT6LIAG
Preliminary data

Very low stray inductance
Phase leg SiC MOSFET Power Module

V_{DSS} = 1700V
R_{DSon} = 2.9mΩ typ @ Tj = 25°C
I_D = 676A @ Tc = 25°C





Application
- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- EV motor and traction drive

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
- M4 & M5 power connectors
- M2.5 signals connectors
- AlN substrate for improved thermal performance

Benefits
- High efficiency converter
- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Low profile
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

Absolute maximum ratings (per SiC MOSFET)

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Voltage		1700	V
I_D	Continuous Drain Current	T_c = 25°C	676	A
		T_c = 80°C	538	A
I_{DM}	Pulsed Drain current		1350	A
V_{GS}	Gate - Source Voltage		-10/23	V
R_{DSon}	Drain - Source ON Resistance		3.75	mΩ
P_D	Power Dissipation	T_c = 25°C	3000	W

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

Electrical Characteristics (Per SiC MOSFET)

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V$, $V_{DS} = 1700V$			120	1200	µA
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 20V$ $I_D = 360A$	$T_j = 25°C$		2.9	3.75	mΩ
			$T_j = 175°C$		5.1		
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 30$ mA		1.8	3.3		V
I_{GSS}	Gate – Source Leakage Current	$V_{GS} = 20$ V, $V_{DS} = 0V$				1200	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			39.6		nF
C_{oss}	Output Capacitance				1.8		
C_{rss}	Reverse Transfer Capacitance				0.12		
Q_g	Total gate Charge	$V_{GS} = -5/20V$ $V_{Bus} = 850V$ $I_D = 360A$			2136		nC
Q_{gs}	Gate – Source Charge				588		
Q_{gd}	Gate – Drain Charge				324		
$T_{d(on)}$	Turn-on Delay Time	$V_{GS} = -5/20V$; $V_{Bus} = 900V$ $I_D = 600A$; $T_J = 150°C$ $R_G = 0.25Ω$			65		ns
T_r	Rise Time				52		
$T_{d(off)}$	Turn-off Delay Time				148		
T_f	Fall Time				44		
E_{on}	Turn on Energy	$V_{GS} = -5/+20V$ $V_{Bus} = 900V$; $I_D = 600A$ $R_G = 0.25Ω$	$T_j = 150°C$		23		mJ
E_{off}	Turn off Energy		$T_j = 150°C$		10.7		
R_{Gint}	Internal gate resistance				0.79		Ω
R_{thJC}	Junction to Case Thermal Resistance					0.05	°C/W

Body diode ratings and characteristics (Per SiC MOSFET)

Symbol	*Characteristic*	*Test Conditions*	*Min*	*Typ*	*Max*	*Unit*
V_{SD}	Diode Forward Voltage	$V_{GS} = 0V$, $I_{SD} = 360A$		3.7		V
		$V_{GS} = -5V$, $I_{SD} = 360A$		3.9		
t_{rr}	Reverse Recovery Time	$I_{SD} = 360A$; $V_{GS} = -5V$ $V_R = 900V$; $di_F/dt = 1200A/µs$		27		ns
Q_{rr}	Reverse Recovery Charge			7.8		µC
I_{rr}	Reverse Recovery Current			552		A

SiC diode characteristics (Per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					1700	V
I_{RRM}	Reverse Leakage Current	V_R=1700V	T_j = 25°C		300	1200	µA
			T_j = 175°C		1500		
I_F	Forward Current		Tc = 125°C		300		A
V_F	Diode Forward Voltage	I_F = 300A	T_j = 25°C		1.5	1.8	V
			T_j = 175°C		2		
Q_C	Total Capacitive Charge	V_R = 900V			2460		nC
C	Total Capacitance	f = 1MHz, V_R = 600V			1800		pF
		f = 1MHz, V_R = 900V			1500		
R_{thJC}	Junction to Case Thermal Resistance					0.062	°C/W

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	For terminals	M2.5	0.4	0.6	N.m
			M4	2	3	
			M5	2	3.5	
		To heatsink	M6	3	5	
L_{DC}	Module stray inductance between VBUS & 0/VBUS				3	nH
Wt	Package Weight				320	g

Temperature sensor NTC (see application note APT0406).

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
$\Delta B/B$		T_C=100°C		4		%

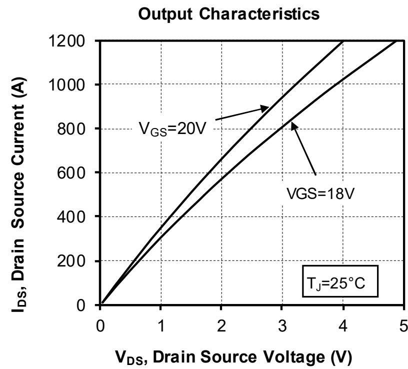
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

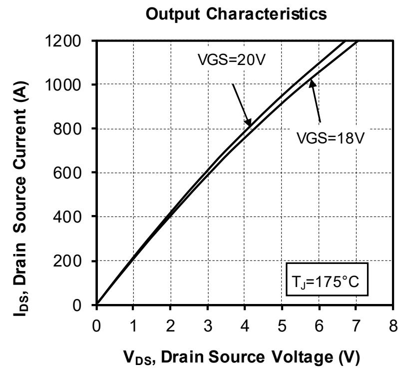
T: Thermistor temperature
R_T: Thermistor value at T

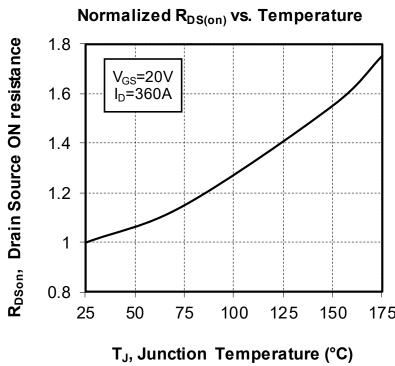
Package outline (dimensions in mm)

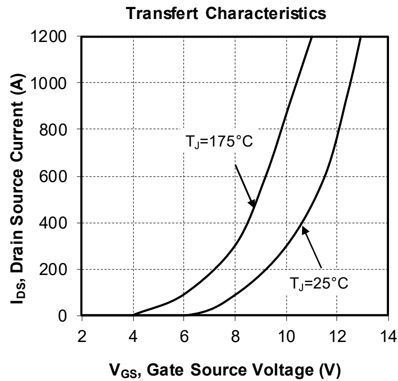
See application note AN1911 - Mounting instructions for SP6 Low inductance Power Module

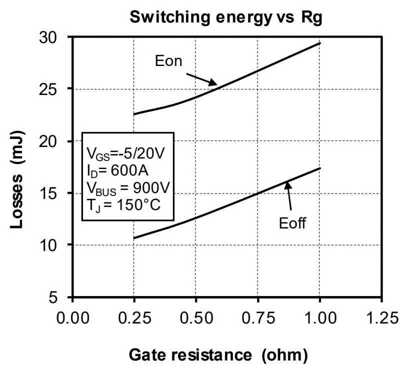
Typical SiC MOSFET Performance Curve

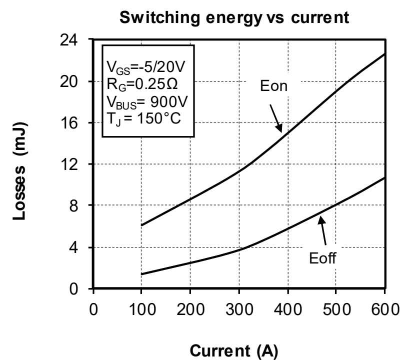


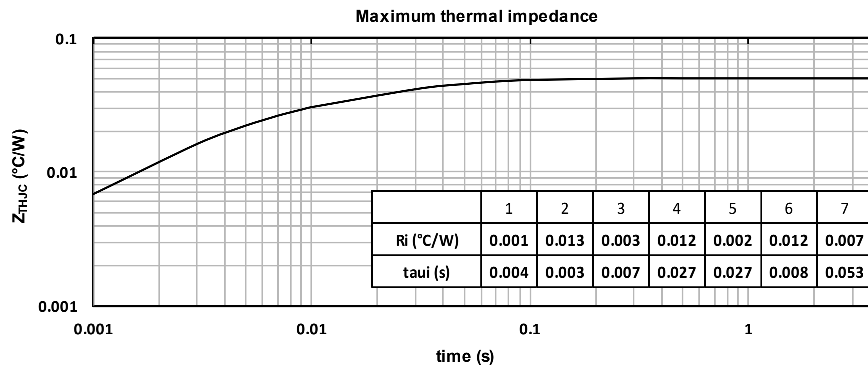




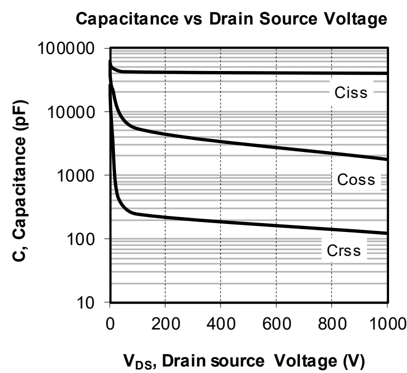


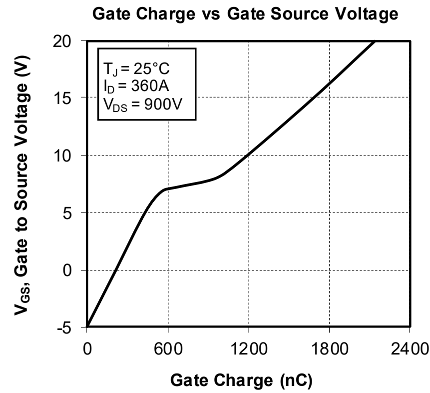


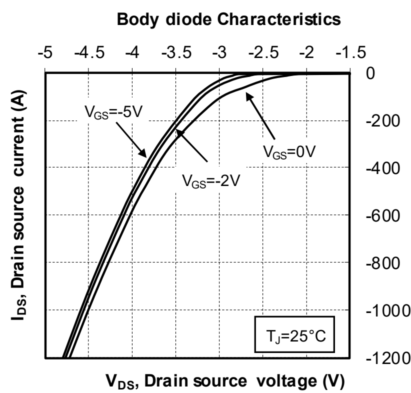


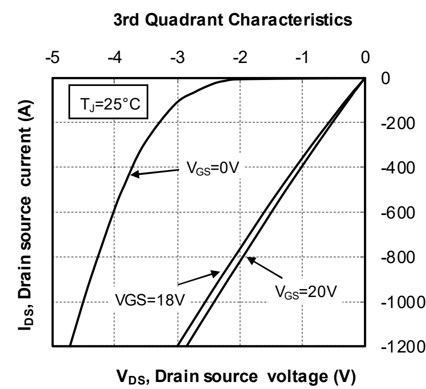


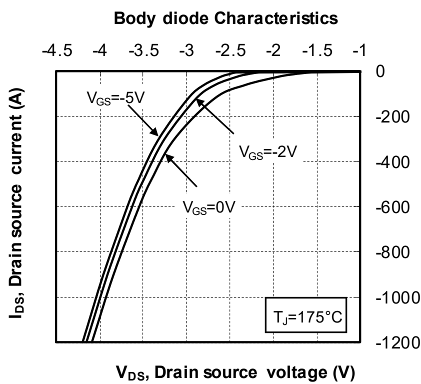
	1	2	3	4	5	6	7
Ri (°C/W)	0.001	0.013	0.003	0.012	0.002	0.012	0.007
taui (s)	0.004	0.003	0.007	0.027	0.027	0.008	0.053

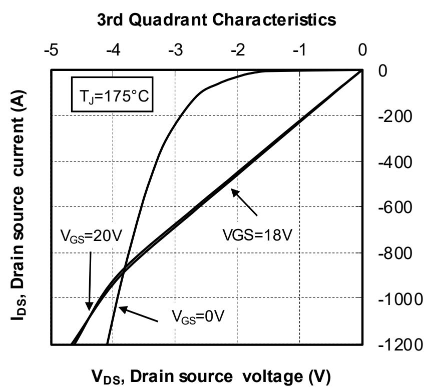

Capacitance vs Drain Source Voltage
C, Capacitance (pF)
100000
10000
1000
100
10
0
200
400
600
800
1000
Ciss
Coss
Crss
V_{DS}, Drain source Voltage (V)

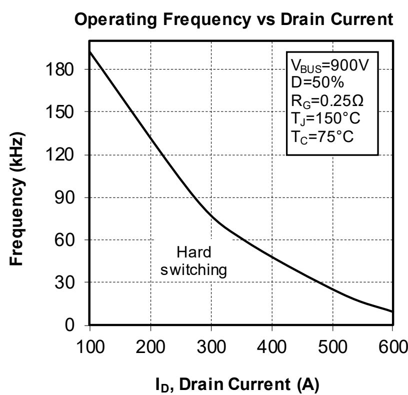

Gate Charge vs Gate Source Voltage
V_{GS}, Gate to Source Voltage (V)
T_J = 25°C
I_D = 360A
V_{DS} = 900V
20
15
10
5
0
-5
0
600
1200
1800
2400
Gate Charge (nC)


Body diode Characteristics
I_{DS}, Drain source current (A)
-5
-4.5
-4
-3.5
-3
-2.5
-2
-1.5
0
-200
-400
-600
-800
-1000
-1200
V_{GS}=-5V
V_{GS}=0V
V_{GS}=-2V
T_J=25°C
V_{DS}, Drain source voltage (V)

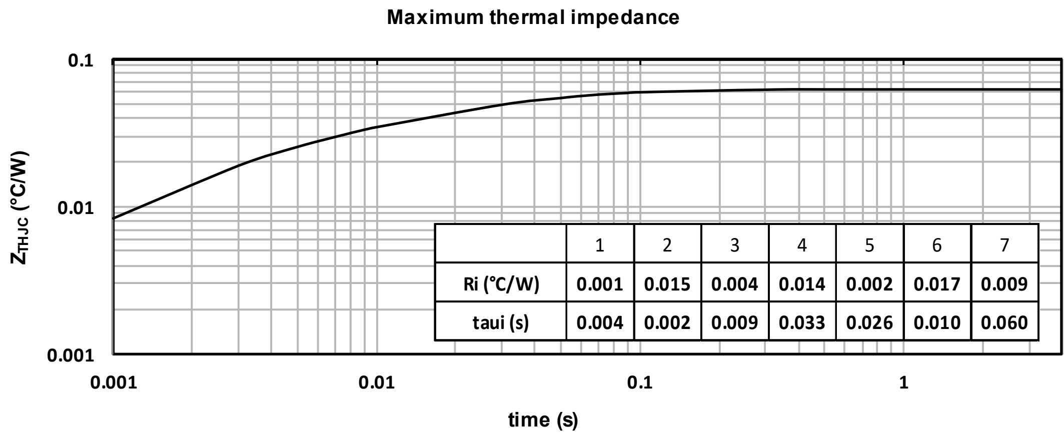

3rd Quadrant Characteristics
I_{DS}, Drain source current (A)
-5
-4
-3
-2
-1
0
0
-200
-400
-600
-800
-1000
-1200
T_J=25°C
V_{GS}=0V
VGS=18V
V_{GS}=20V
V_{DS}, Drain source voltage (V)


Body diode Characteristics
I_{DS}, Drain source current (A)
-4.5
-4
-3.5
-3
-2.5
-2
-1.5
-1
0
-200
-400
-600
-800
-1000
-1200
V_{GS}=-5V
V_{GS}=-2V
V_{GS}=0V
T_J=175°C
V_{DS}, Drain source voltage (V)


3rd Quadrant Characteristics
I_{DS}, Drain source current (A)
-5
-4
-3
-2
-1
0
0
-200
-400
-600
-800
-1000
-1200
T_J=175°C
V_{GS}=20V
VGS=18V
V_{GS}=0V
V_{DS}, Drain source voltage (V)


Operating Frequency vs Drain Current
Frequency (kHz)
180
150
120
90
60
30
0
100
200
300
400
500
600
V_{BUS}=900V
D=50%
R_G=0.25Ω
T_J=150°C
T_C=75°C
Hard switching
I_D, Drain Current (A)

Typical SiC diode Performance Curve



	1	2	3	4	5	6	7
Ri (°C/W)	0.001	0.015	0.004	0.014	0.002	0.017	0.009
taui (s)	0.004	0.002	0.009	0.033	0.026	0.010	0.060