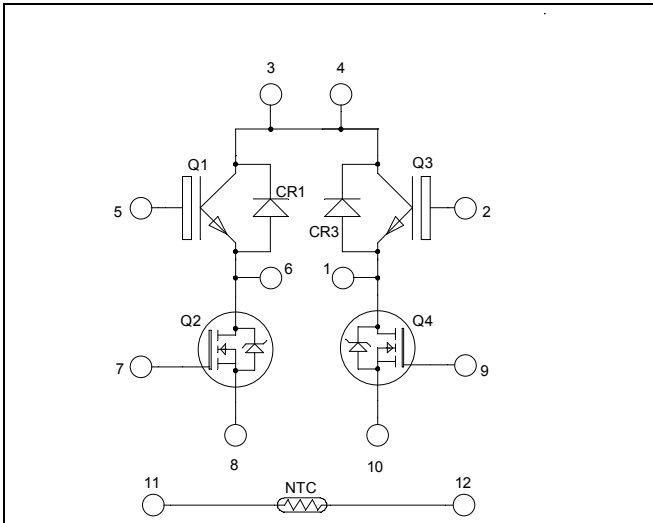


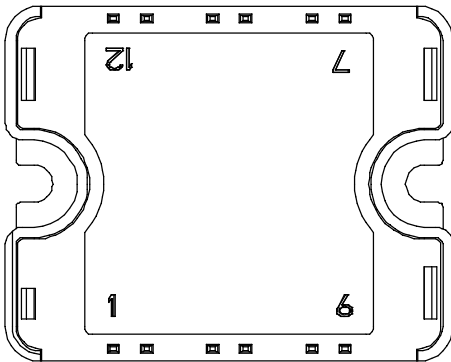
**Full - Bridge
CoolMOS & Trench + Field Stop[®] IGBT
Power module**

Trench & Field Stop[®] IGBT Q1, Q3:
 $V_{CES} = 600V$; $I_C = 50A$ @ $T_c = 80^\circ C$

CoolMOS[™] Q2, Q4:
 $V_{DSS} = 600V$; $I_D = 36A$ @ $T_c = 25^\circ C$



Top switches : Trench + Field Stop IGBT[®]
 Bottom switches : CoolMOS[™]



Pins 3/4 must be shorted together

Application

- Solar converter

Features

- **Q2, Q4 CoolMOS[™]**
 - Ultra low R_{DSon}
 - Low Miller capacitance
 - Ultra low gate charge
 - Avalanche energy rated
 - Very rugged
 - Fast intrinsic diode
- **Q1, Q3 Trench & Field Stop IGBT[®]**
 - Low voltage drop
 - Switching frequency up to 20 kHz
 - RBSOA & SCSOA rated
 - Low tail current
- **SiC Schottky Diode (CR1, CR3)**
 - 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

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

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

All ratings @ $T_j = 25^\circ C$ unless otherwise specified

1. Top switches
1.1 Top Trench + Field Stop IGBT® characteristics
Absolute maximum ratings

Symbol	Parameter	Max ratings	Unit
V_{CES}	Collector - Emitter Breakdown Voltage	600	V
I_C	Continuous Collector Current	$T_C = 25^\circ\text{C}$	80
		$T_C = 80^\circ\text{C}$	50
I_{CM}	Pulsed Collector Current	$T_C = 25^\circ\text{C}$	100
V_{GE}	Gate - Emitter Voltage	± 20	V
P_D	Maximum Power Dissipation	$T_C = 25^\circ\text{C}$	176
RBSOA	Reverse Bias Safe Operating Area	$T_J = 150^\circ\text{C}$	100A @ 550V

Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I_{CES}	Zero Gate Voltage Collector Current	$V_{GE} = 0\text{V}, V_{CE} = 600\text{V}$			250	μA
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	$V_{GE} = 15\text{V}$ $I_C = 50\text{A}$	$T_J = 25^\circ\text{C}$	1.5	1.9	V
			$T_J = 150^\circ\text{C}$	1.7		
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 600\mu\text{A}$	5.0	5.8	6.5	V
I_{GES}	Gate - Emitter Leakage Current	$V_{GE} = 20\text{V}, V_{CE} = 0\text{V}$			600	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{ies}	Input Capacitance	$V_{GE} = 0\text{V}$ $V_{CE} = 25\text{V}$ $f = 1\text{MHz}$		3150		pF
C_{oes}	Output Capacitance			200		
C_{res}	Reverse Transfer Capacitance			95		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$ $R_G = 8.2\Omega$		110		ns
T_r	Rise Time			45		
$T_{d(off)}$	Turn-off Delay Time			200		
T_f	Fall Time			40		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (150°C) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$ $R_G = 8.2\Omega$		120		ns
T_r	Rise Time			50		
$T_{d(off)}$	Turn-off Delay Time			250		
T_f	Fall Time			60		
E_{on}	Turn-on Switching Energy	$V_{GE} = \pm 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$ $R_G = 8.2\Omega$	$T_J = 25^\circ\text{C}$	0.3		mJ
			$T_J = 150^\circ\text{C}$	0.43		
E_{off}	Turn-off Switching Energy	$I_C = 50\text{A}$ $R_G = 8.2\Omega$	$T_J = 25^\circ\text{C}$	1.35		mJ
			$T_J = 150^\circ\text{C}$	1.75		
R_{thJC}	Junction to Case Thermal resistance				0.85	$^\circ\text{C/W}$

1.2 Top SiC diode characteristics (CR1, CR3)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	$V_R=600V$	$T_j = 25^\circ C$		50	200	μA
			$T_j = 125^\circ C$		100	1000	
$I_{F(AV)}$	Maximum Average Forward Current	50% duty cycle	$T_c = 100^\circ C$		10		A
V_F	Diode Forward Voltage	$I_F = 10A$	$T_j = 25^\circ C$		1.6	1.8	V
			$T_j = 175^\circ C$		2	2.4	
Q_C	Total Capacitive Charge	$I_F = 10A, V_R = 300V$ $di/dt = 500A/\mu s$			14		nC
C	Total Capacitance	$f = 1MHz, V_R = 200V$			65		pF
		$f = 1MHz, V_R = 400V$			50		
R_{thJC}	Junction to Case Thermal resistance					2.5	$^\circ C/W$

2. Bottom switches

2.1 Bottom CoolMOS™ characteristics

Absolute maximum ratings

Symbol	Parameter	Max ratings	Unit
V_{DSS}	Drain - Source Breakdown Voltage	600	V
I_D	Continuous Drain Current	$T_c = 25^\circ C$	36
		$T_c = 80^\circ C$	27
I_{DM}	Pulsed Drain current	115	A
V_{GS}	Gate - Source Voltage	± 20	V
R_{DSon}	Drain - Source ON Resistance	83	$m\Omega$
P_D	Maximum Power Dissipation	$T_c = 25^\circ C$	250
I_{AR}	Avalanche current (repetitive and non repetitive)	20	A
E_{AR}	Repetitive Avalanche Energy	1	mJ
E_{AS}	Single Pulse Avalanche Energy	1800	

Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 600V$	$T_j = 25^\circ C$			100	μA
		$V_{GS} = 0V, V_{DS} = 600V$	$T_j = 125^\circ C$			5000	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 24.5A$				83	$m\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 3mA$		3	4	5	V
I_{GSS}	Gate – Source Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$				100	nA

Dynamic Characteristics

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
C_{iss}	Input Capacitance	$V_{GS} = 0V$; $V_{DS} = 25V$ $f = 1MHz$		7.2		nF
C_{rss}	Reverse Transfer Capacitance			0.041		
Q_g	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 300V$ $I_D = 36A$		250		nC
Q_{gs}	Gate – Source Charge			43		
Q_{gd}	Gate – Drain Charge			135		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 36A$ $R_G = 5\Omega$		21		ns
T_r	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			240		
T_f	Fall Time			52		
E_{on}	Turn-on Switching Energy	Inductive switching @ 25°C $V_{GS} = 10V$; $V_{Bus} = 400V$ $I_D = 36A$; $R_G = 5\Omega$		531		μJ
E_{off}	Turn-off Switching Energy			590		
E_{on}	Turn-on Switching Energy	Inductive switching @ 125°C $V_{GS} = 10V$; $V_{Bus} = 400V$ $I_D = 36A$; $R_G = 5\Omega$		762		μJ
E_{off}	Turn-off Switching Energy			725		
R_{thJC}	Junction to Case Thermal resistance				0.5	°C/W

Source - Drain diode ratings and characteristics

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>	
I_S	Continuous Source current (Body diode)	$T_c = 25^\circ C$		36		A	
		$T_c = 80^\circ C$		27			
V_{SD}	Diode Forward Voltage	$V_{GS} = 0V$, $I_S = -36A$			1.2	V	
dv/dt	Peak Diode Recovery ❶				40	V/ns	
t_{rr}	Reverse Recovery Time	$I_S = -36A$ $V_R = 350V$ $di_s/dt = 100A/\mu s$	$T_j = 25^\circ C$		210		ns
			$T_j = 125^\circ C$		350		
Q_{rr}	Reverse Recovery Charge		$T_j = 25^\circ C$		2		μC
			$T_j = 125^\circ C$		5.4		

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.

$I_S \leq -36A$ $di/dt \leq 100A/\mu s$ $V_R \leq V_{DSS}$ $T_j \leq 150^\circ C$

3. Temperature sensor

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

Symbol	Characteristic	Min	Typ	Max	Unit
R ₂₅	Resistance @ 25°C		50		kΩ
B _{25/85}	T ₂₅ = 298.15 K		3952		K

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

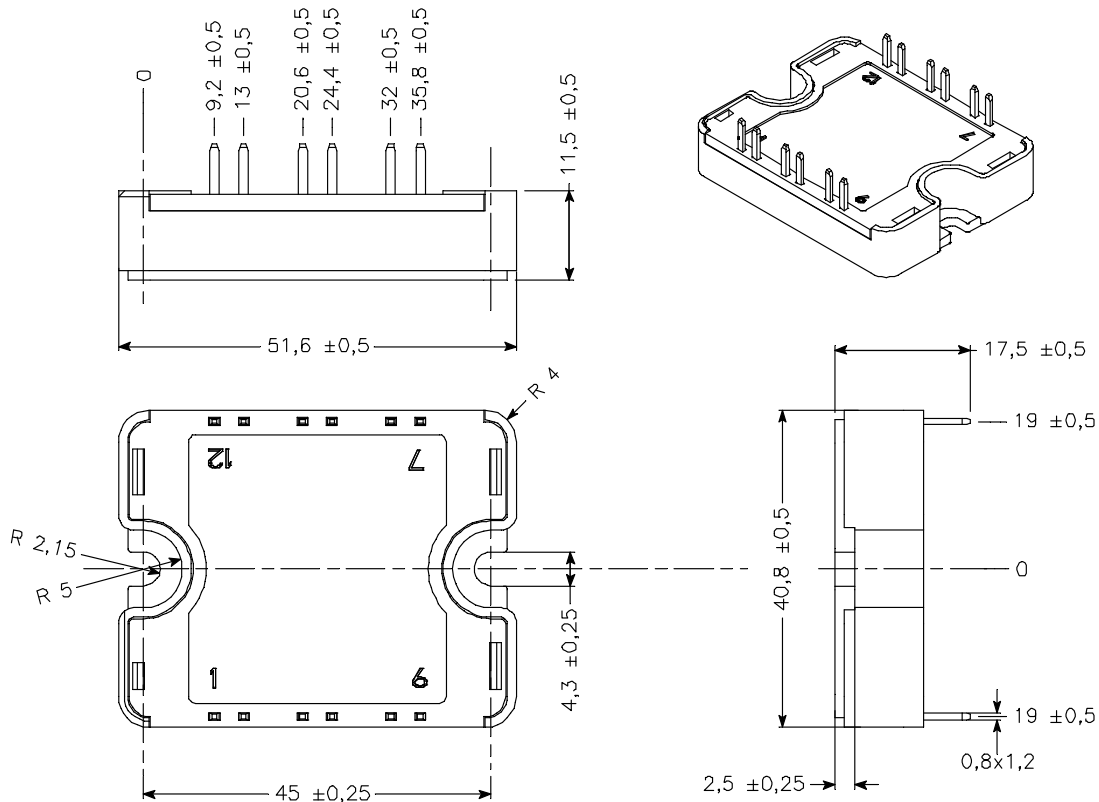
T: Thermistor temperature
 R_T: Thermistor value at T

4. Package characteristics

Symbol	Characteristic	Min	Typ	Max	Unit	
V _{ISOL}	RMS Isolation Voltage, any terminal to case t = 1 min, I _{isol} < 1mA, 50/60Hz	2500			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	M4	2.5	4.7	N.m
Wt	Package Weight				80	g

T_J = 175°C for Trench & Field Stop IGBT

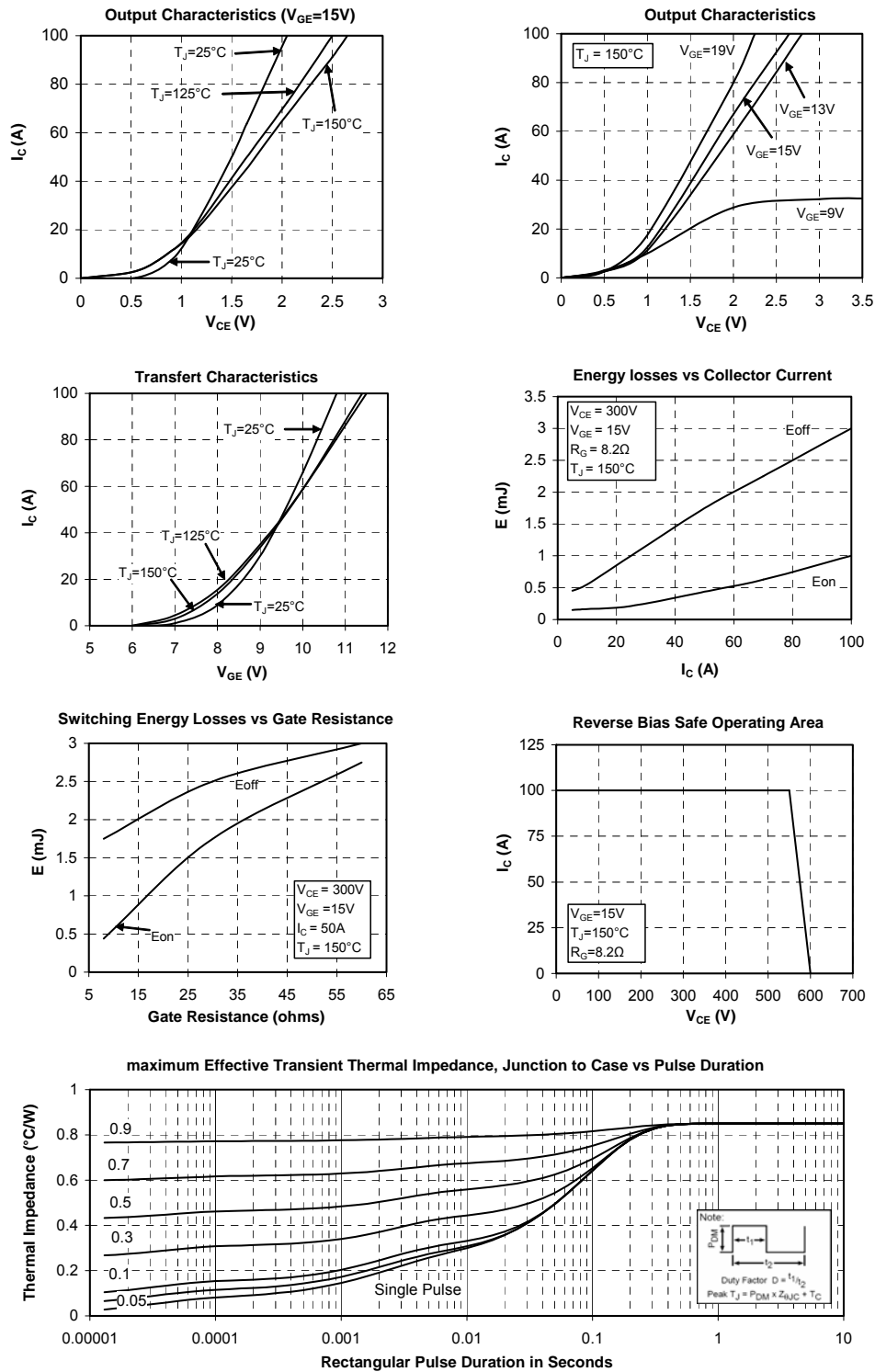
5. SP1 Package outline (dimensions in mm)



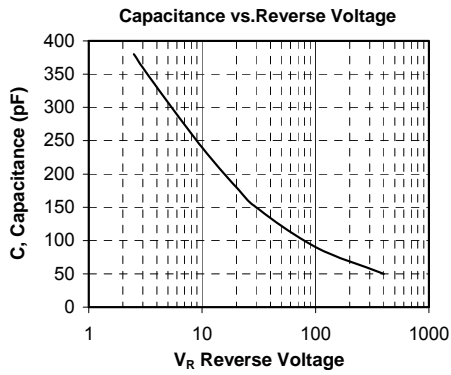
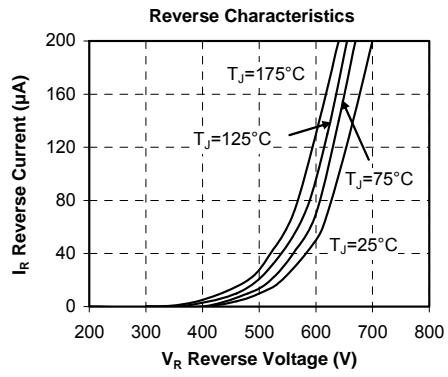
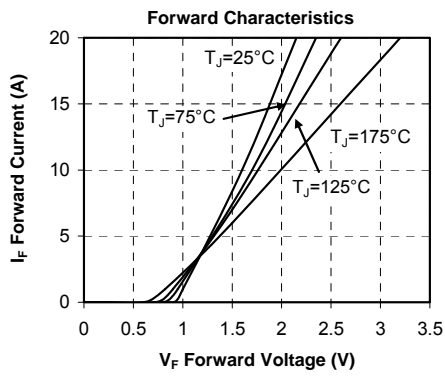
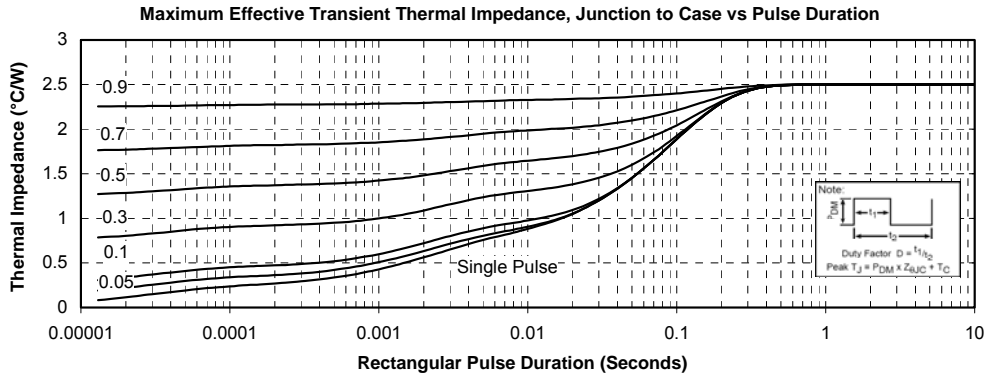
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

6. Top switches curves

6.1 Top Trench + Field Stop IGBT® typical performance curves

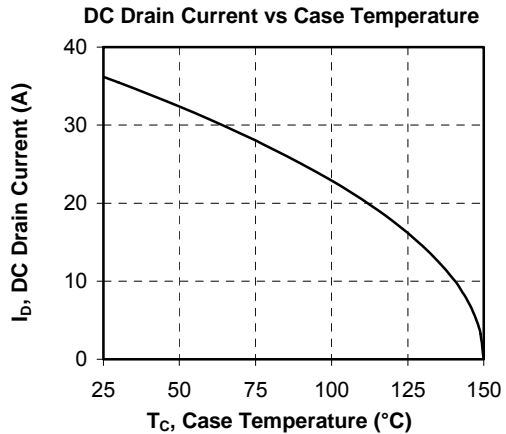
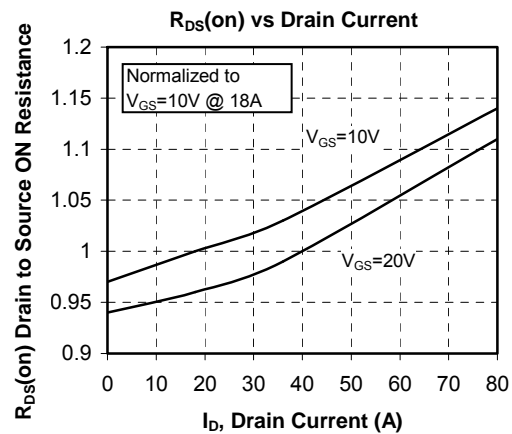
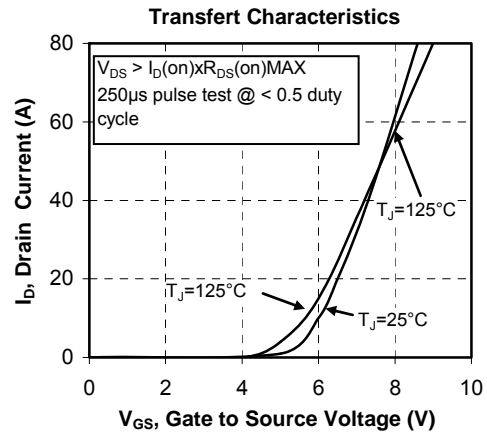
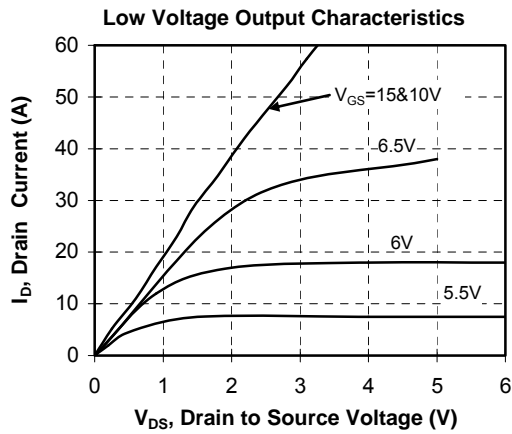
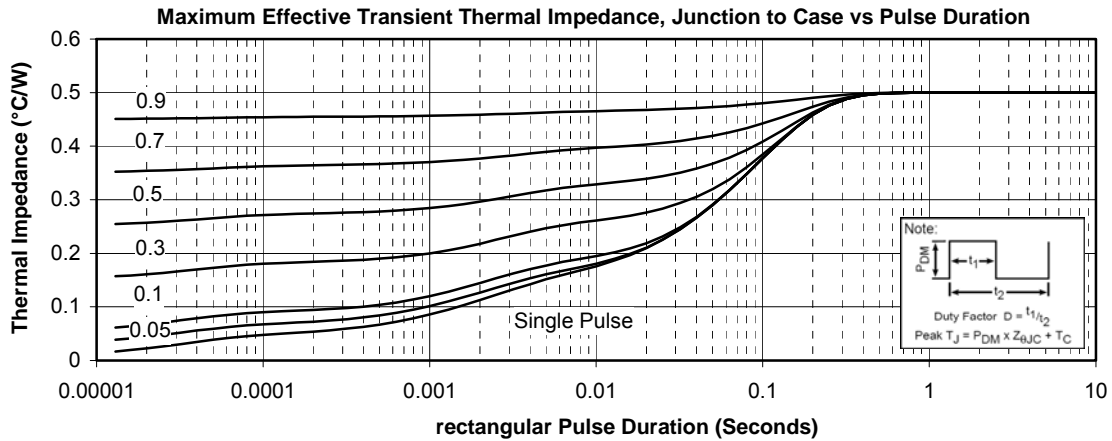


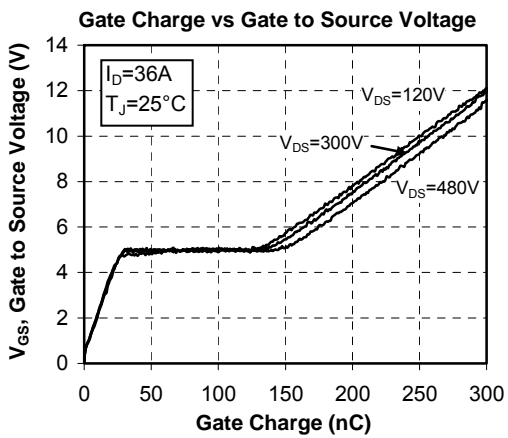
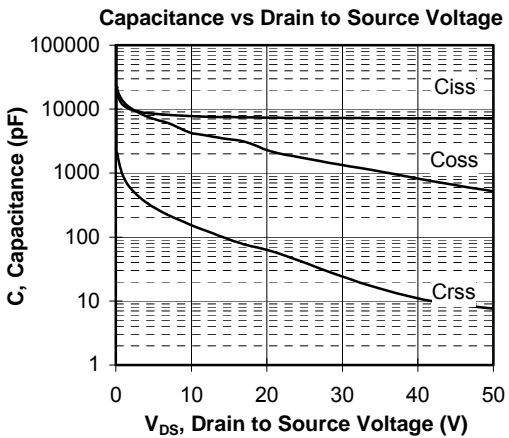
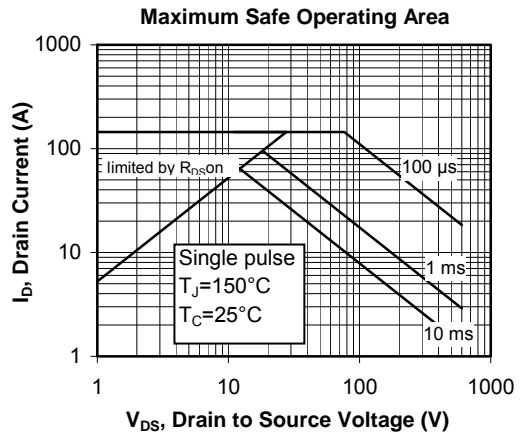
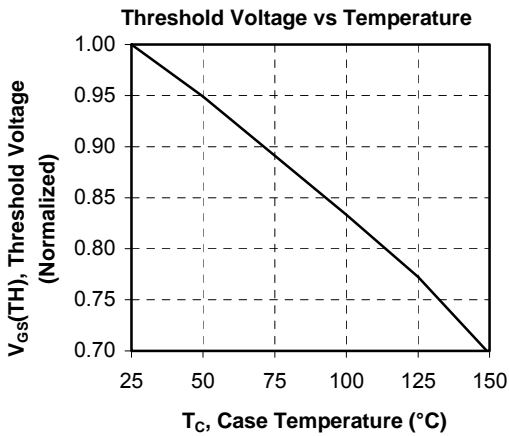
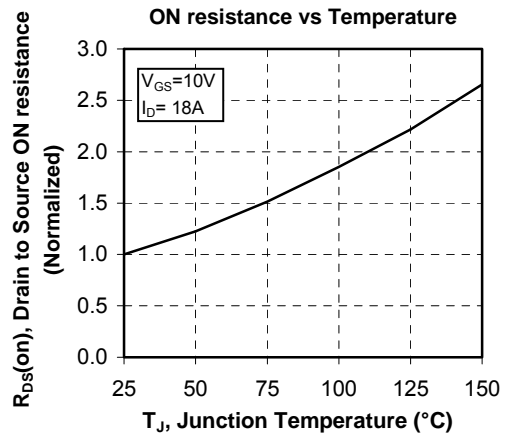
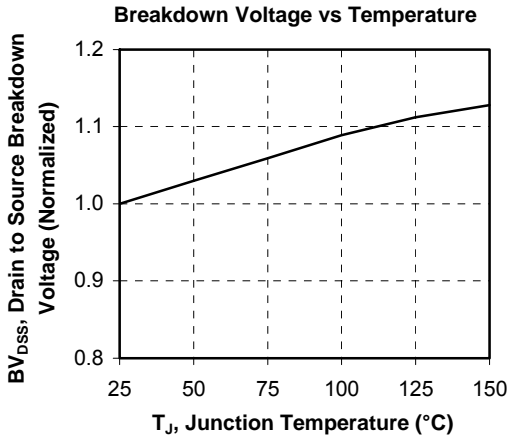
6.2 Top SiC diode typical performance curves

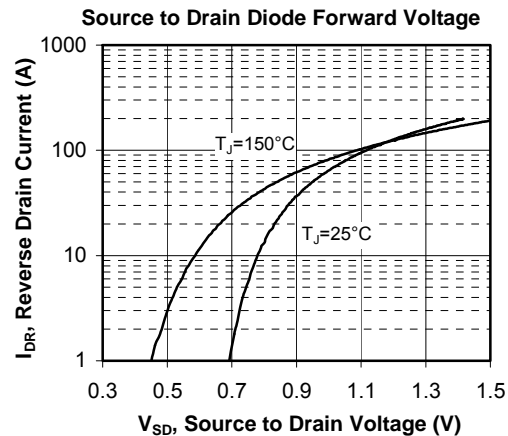
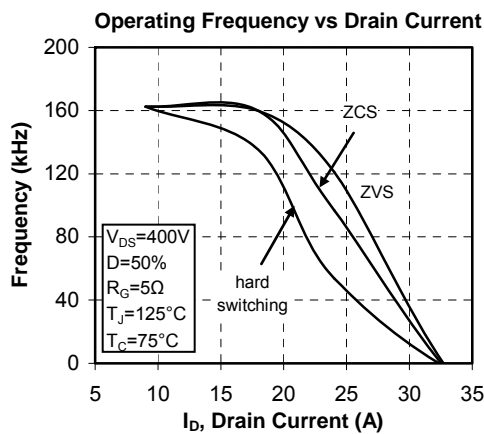
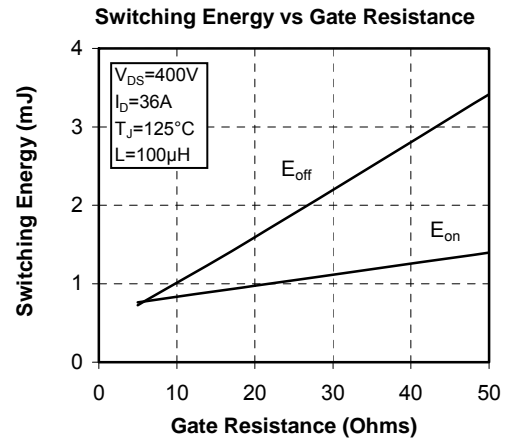
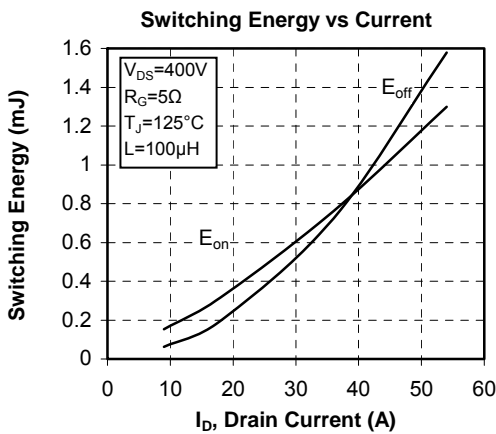
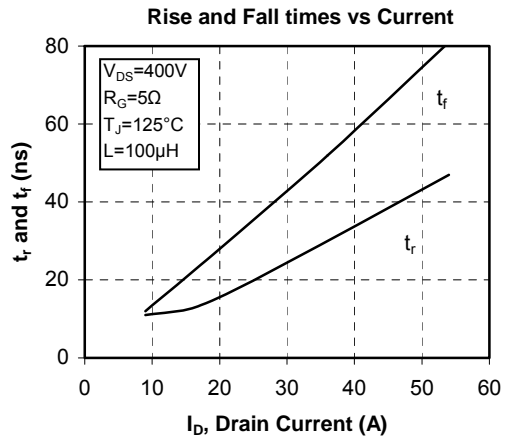
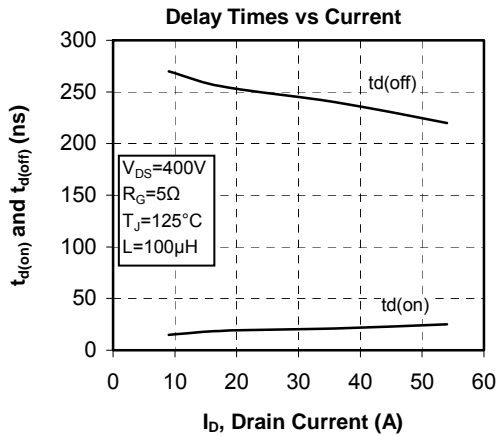


7. Bottom switches curves

7.1 Bottom CoolMOS™ typical performance curves







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Microsemi's products are covered by one or more of U.S. patents 4,895,810 5,045,903 5,089,434 5,182,234 5,019,522 5,262,336 6,503,786 5,256,583 4,748,103 5,283,202 5,231,474 5,434,095 5,528,058 and foreign patents. U.S and Foreign patents pending. All Rights Reserved.