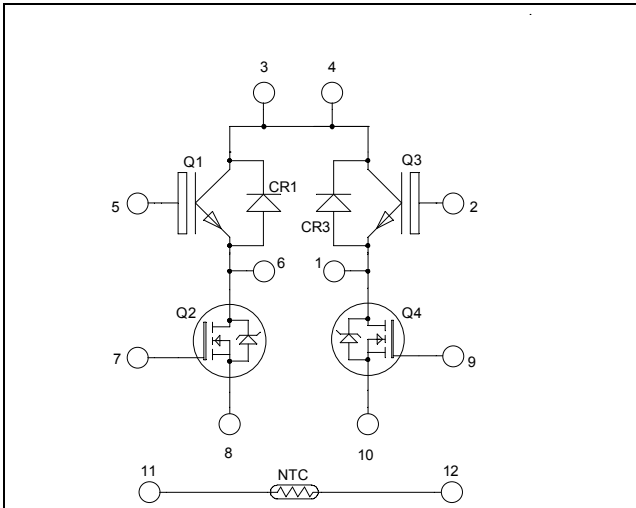


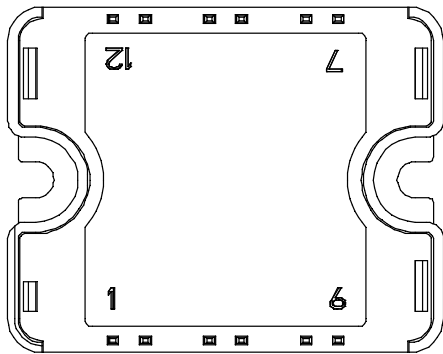
*Full - Bridge
CoolMOS & Trench + Field Stop[®] IGBT
Power module*

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°C	80
		T _C = 80°C	50
I _{CM}	Pulsed Collector Current	T _C = 25°C	100
V _{GE}	Gate - Emitter Voltage	±20	V
P _D	Maximum Power Dissipation	T _C = 25°C	176
RBSOA	Reverse Bias Safe Operating Area	T _J = 150°C	100A @ 550V

Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I _{CES}	Zero Gate Voltage Collector Current	V _{GE} = 0V, V _{CE} = 600V			250	µA
V _{CE(sat)}	Collector Emitter Saturation Voltage	V _{GE} = 15V I _C = 50A	T _J = 25°C	1.5	1.9	V
			T _J = 150°C	1.7		
V _{GE(th)}	Gate Threshold Voltage	V _{GE} = V _{CE} , I _C = 600µA	5.0	5.8	6.5	V
I _{GES}	Gate - Emitter Leakage Current	V _{GE} = 20V, V _{CE} = 0V			600	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C _{ies}	Input Capacitance	V _{GE} = 0V V _{CE} = 25V f = 1MHz		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} = ±15V V _{Bus} = 300V I _C = 50A R _G = 8.2Ω		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} = ±15V V _{Bus} = 300V I _C = 50A R _G = 8.2Ω		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} = ±15V V _{Bus} = 300V I _C = 50A	T _J = 25°C	0.3		mJ
			T _J = 150°C	0.43		
E _{off}	Turn-off Switching Energy	R _G = 8.2Ω	T _J = 25°C	1.35		mJ
			T _J = 150°C	1.75		
R _{thJC}	Junction to Case Thermal resistance				0.85	°C/W

1.2 Top SiC diode characteristics (CR1, CR3)

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
V _{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I _{RM}	Maximum Reverse Leakage Current	V _R =600V	T _j = 25°C		50	200	μA
			T _j = 125°C		100	1000	
I _{F(AV)}	Maximum Average Forward Current	50% duty cycle	T _c = 100°C		10		A
V _F	Diode Forward Voltage	I _F = 10A	T _j = 25°C		1.6	1.8	V
			T _j = 175°C		2	2.4	
Q _C	Total Capacitive Charge	I _F = 10A, V _R = 300V di/dt = 500A/μs			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	°C/W

2. Bottom switches

2.1 Bottom CoolMOS™ characteristics

Absolute maximum ratings

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>	<i>Unit</i>
V _{DSS}	Drain - Source Breakdown Voltage	600	V
I _D	Continuous Drain Current	T _c = 25°C	36
		T _c = 80°C	27
I _{DM}	Pulsed Drain current	115	A
V _{GS}	Gate - Source Voltage	±20	V
R _{DS(on)}	Drain - Source ON Resistance	83	mΩ
P _D	Maximum Power Dissipation	T _c = 25°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

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
I _{DSS}	Zero Gate Voltage Drain Current	V _{GS} = 0V, V _{DS} = 600V	T _j = 25°C			100	μA
		V _{GS} = 0V, V _{DS} = 600V	T _j = 125°C			5000	
R _{DS(on)}	Drain - Source on Resistance	V _{GS} = 10V, I _D = 24.5A				83	mΩ
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} = ±20 V, 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	$I_S = -36A$ $V_R = 350V$ $di/dt = 100A/\mu s$	$T_j = 25^\circ C$		210		ns
			$T_j = 125^\circ C$		350		
Q_{rr}	Reverse Recovery Charge	$I_S = -36A$ $V_R = 350V$ $di/dt = 100A/\mu s$	$T_j = 25^\circ C$		2		μC
			$T_j = 125^\circ C$		5.4		

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

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

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

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

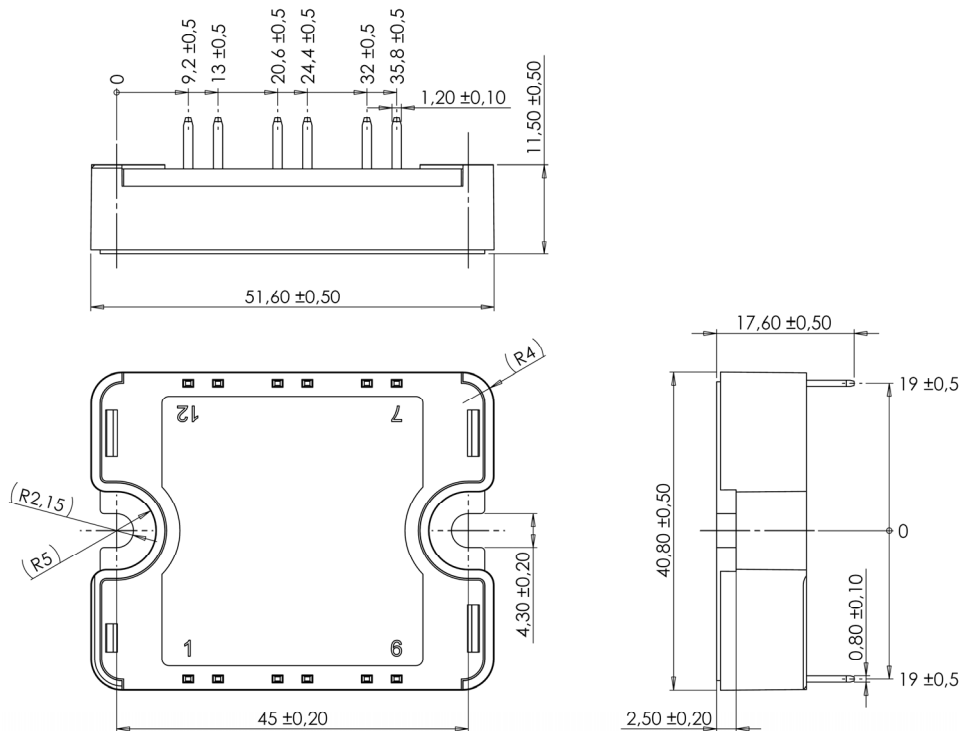
T: Thermistor temperature
 R_T: Thermistor value at T

4. Package characteristics

Symbol	Characteristic	Min	Typ	Max	Unit	
V _{ISOL}	RMS Isolation Voltage, any terminal to case t=1 min, 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	M4	2	3	N.m
Wt	Package Weight				80	g

T_j=175°C for Trench & Field Stop IGBT

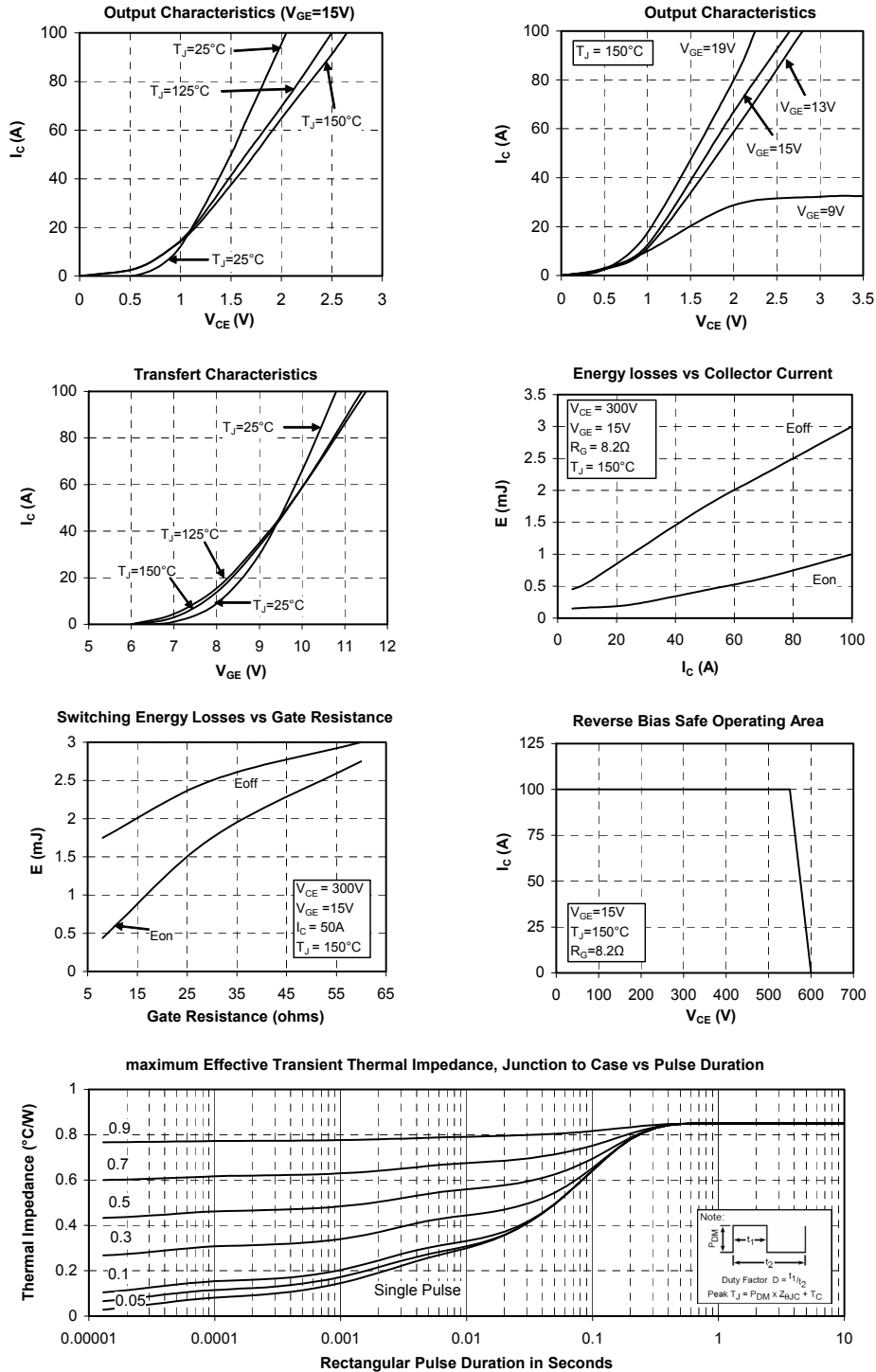
5. SP1 Package outline (dimensions in mm)



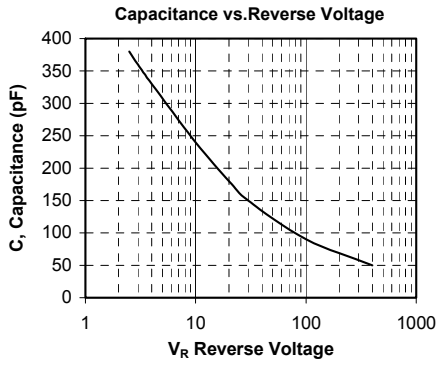
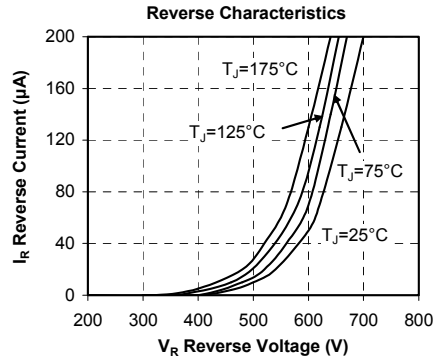
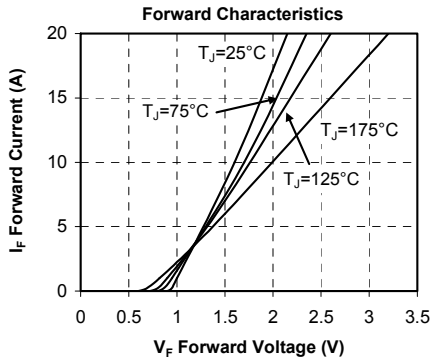
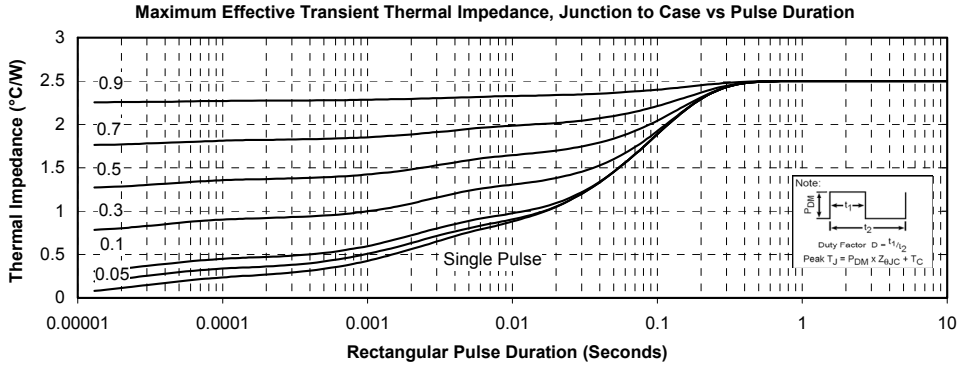
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

6. Top switches curves

6.1 Top Trench + Field Stop IGBT® typical performance curves

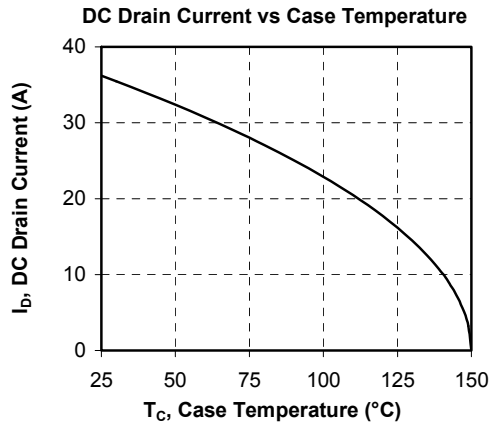
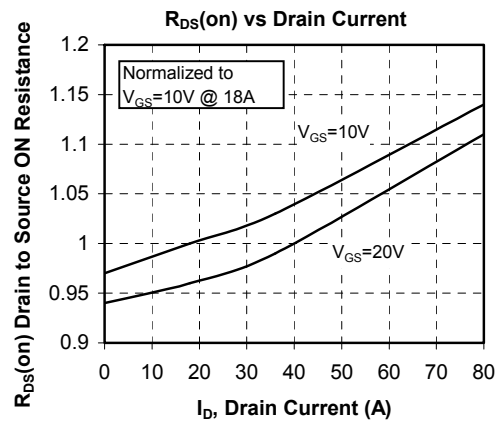
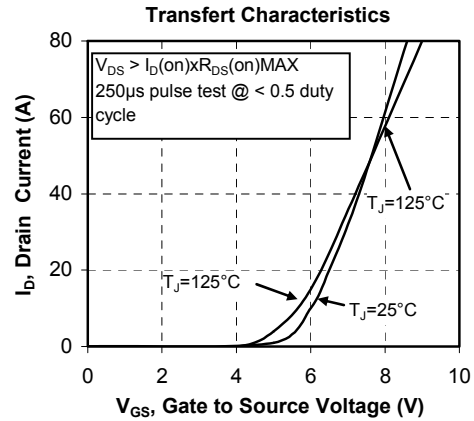
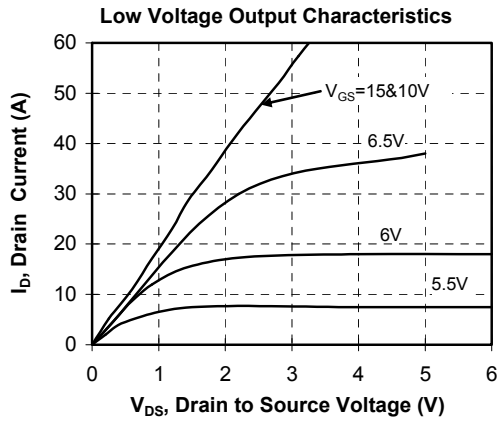
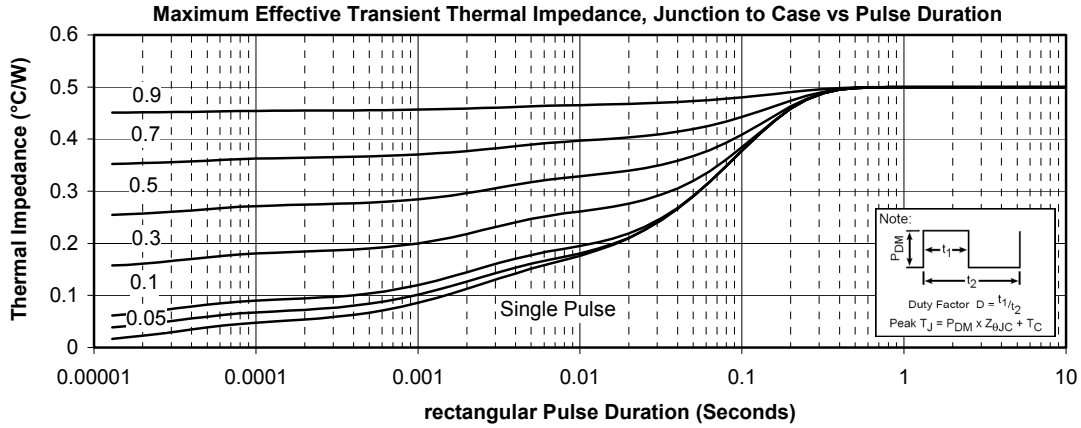


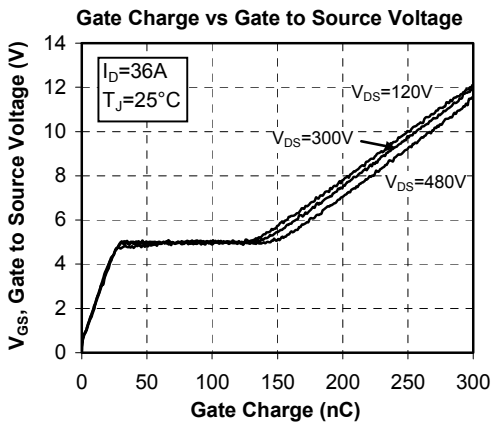
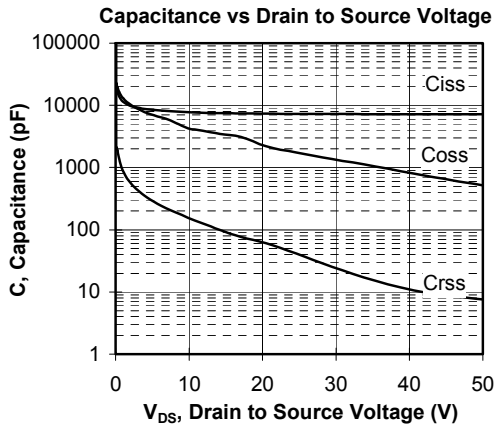
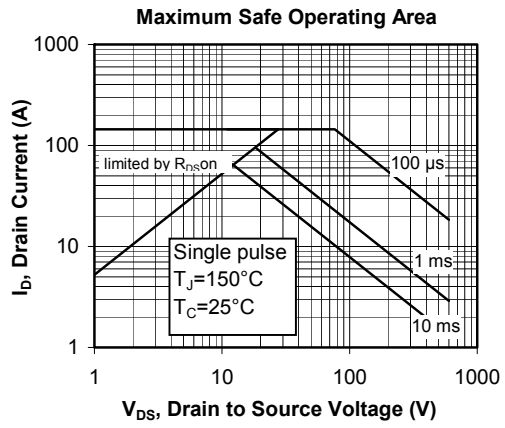
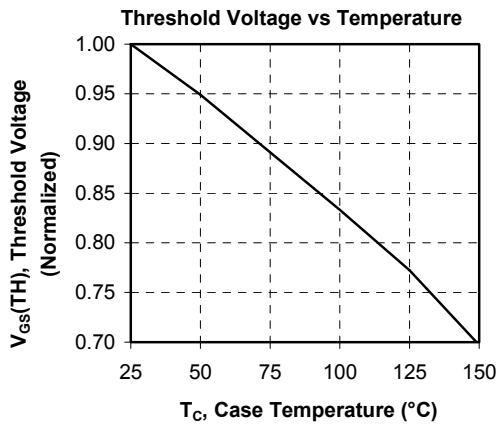
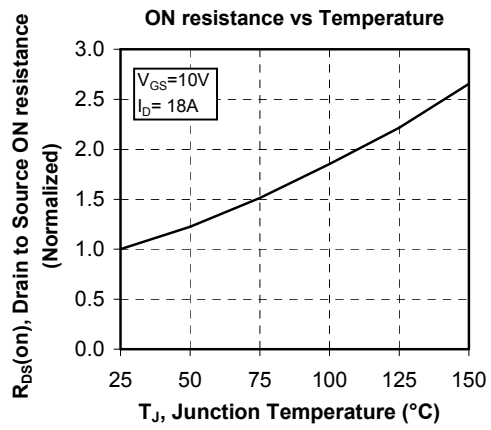
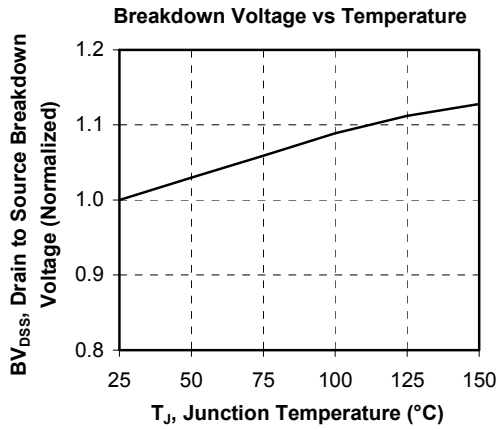
6.2 Top SiC diode typical performance curves

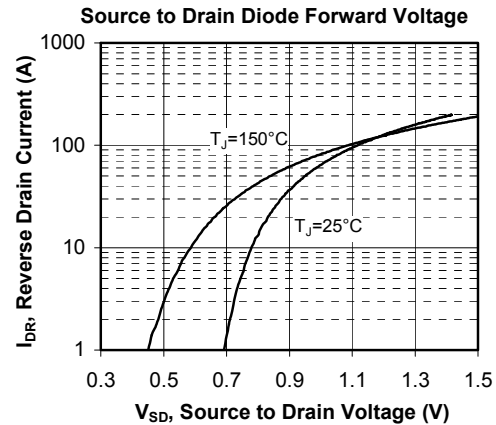
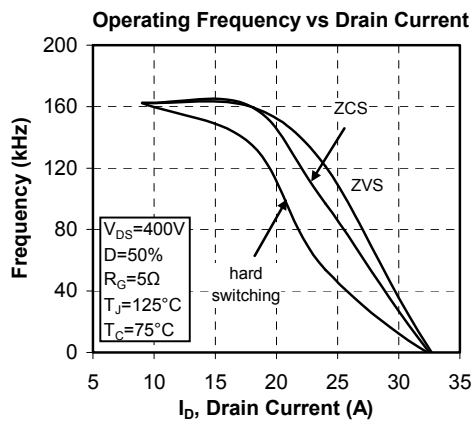
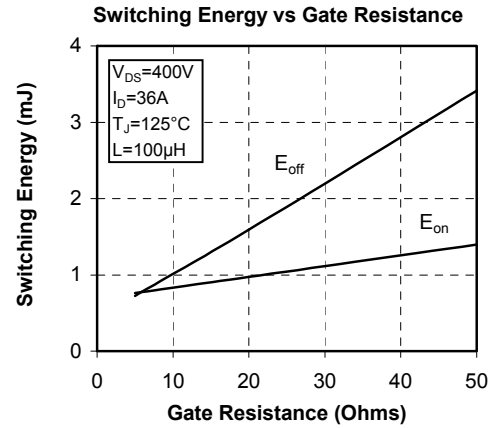
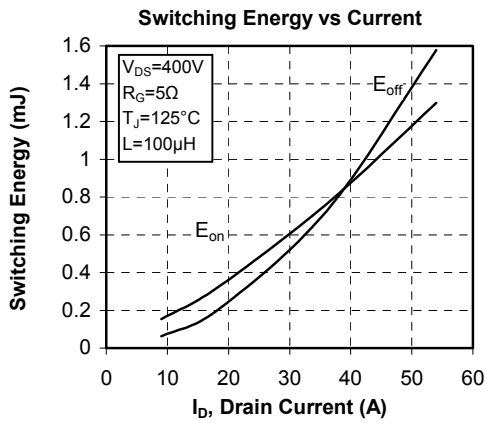
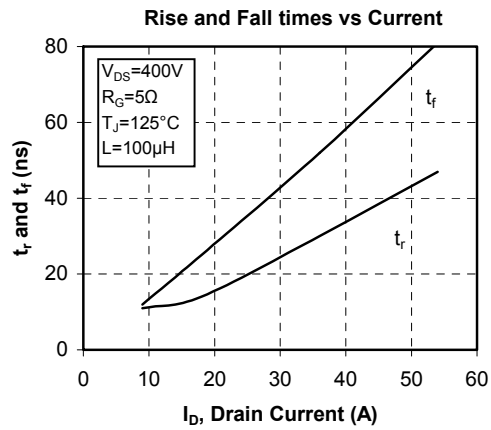
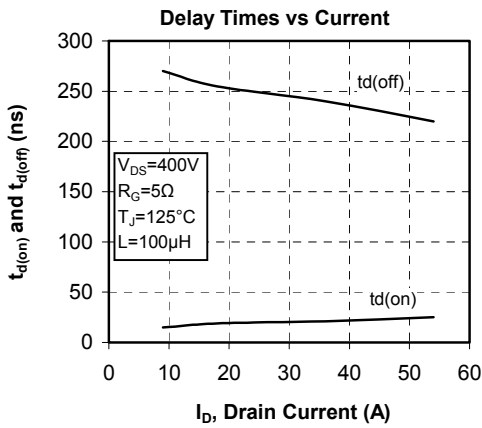


7. Bottom switches curves

7.1 Bottom CoolMOS™ typical performance curves







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