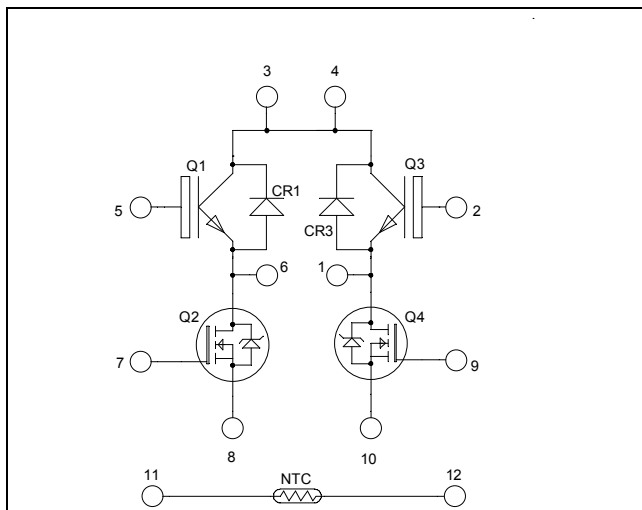


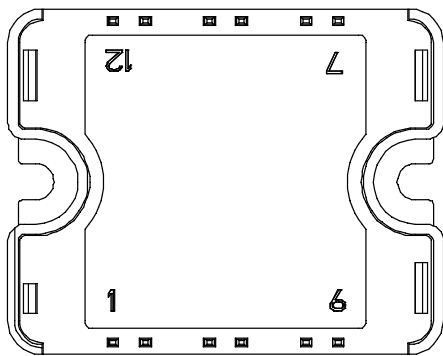
**Full - Bridge
CoolMOS & Trench + Field Stop[®] IGBT
Power module**

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 $R_{DS(on)}$
 - 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	$T_C = 25^\circ\text{C}$	A
		$T_C = 80^\circ\text{C}$	
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	$V_{GE} = 0\text{V}$		3150		pF
C_{oes}	Output Capacitance	$V_{CE} = 25\text{V}$		200		
C_{res}	Reverse Transfer Capacitance	$f = 1\text{MHz}$		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		$T_J = 25^\circ\text{C}$	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°C	36	A
		T _c = 80°C	27	
I _{DM}	Pulsed Drain current		115	
V _{GS}	Gate - Source Voltage		±20	V
R _{DSon}	Drain - Source ON Resistance		83	mΩ
P _D	Maximum Power Dissipation	T _c = 25°C	250	W
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 Ω
$V_{GS(th)}$	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

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
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

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I _S	Continuous Source current (Body diode)		T _C = 25°C		36		A
			T _C = 80°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/μs	T _j = 25°C		210		ns
			T _j = 125°C		350		
Q _{rr}	Reverse Recovery Charge		T _j = 25°C		2		μC
			T _j = 125°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

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

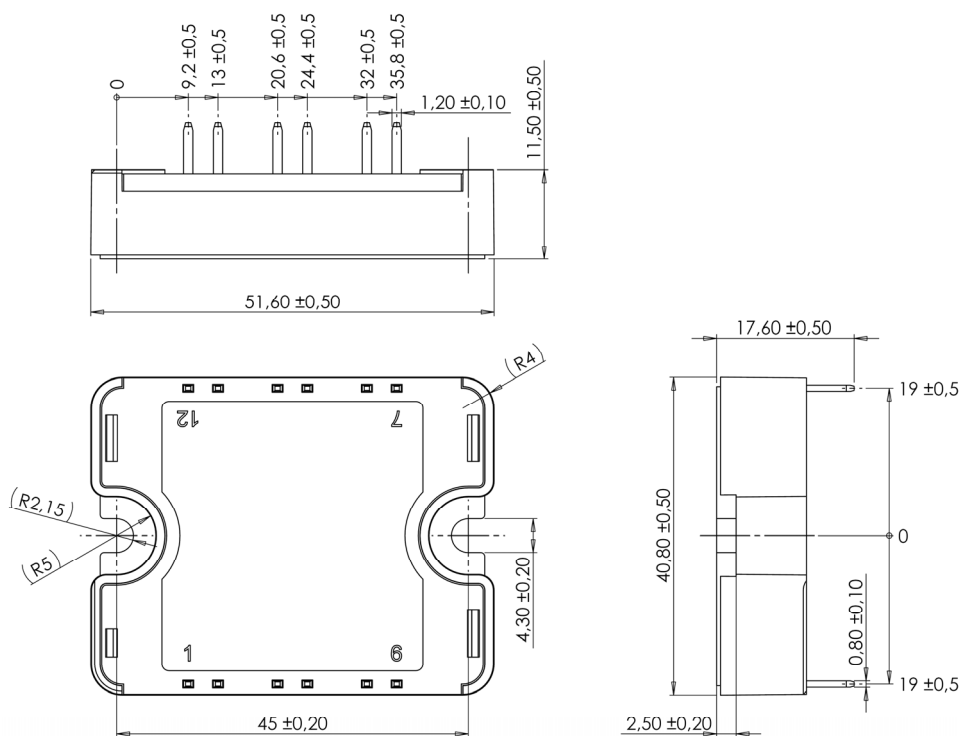
T: Thermistor temperature
R_T: Thermistor value at T

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

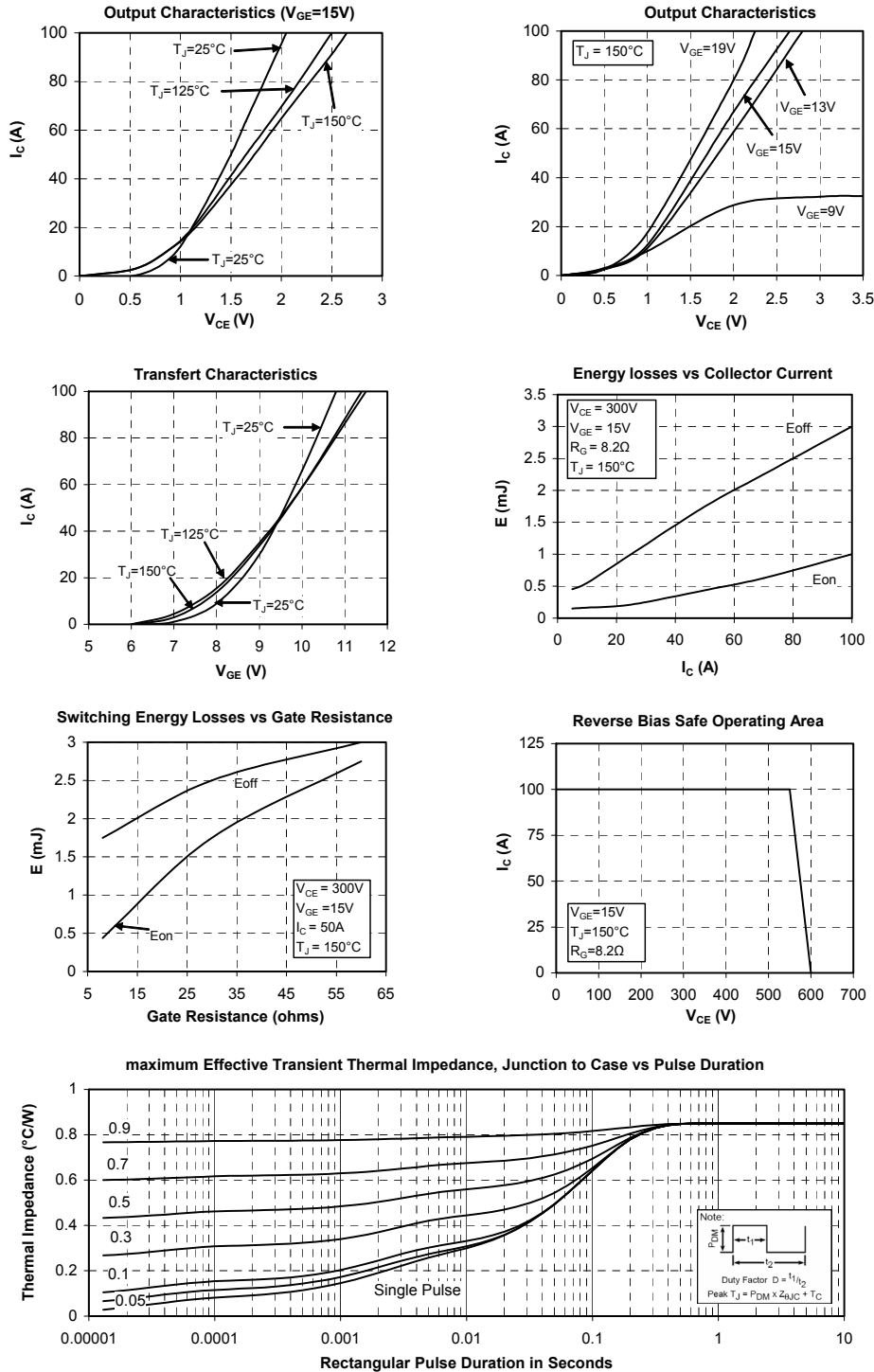
5. SP1 Package outline (dimensions in mm)



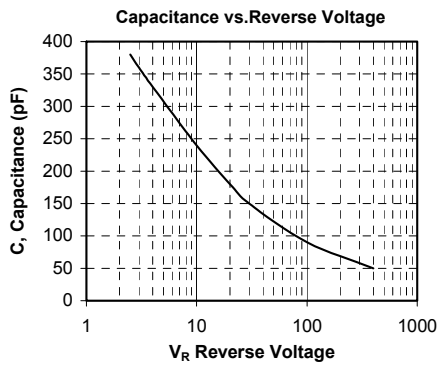
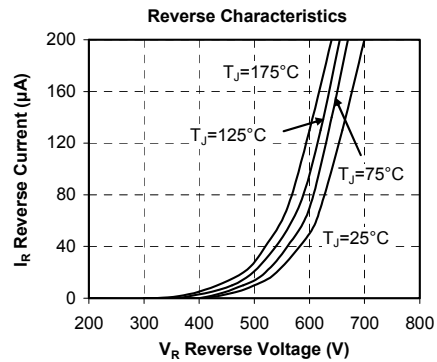
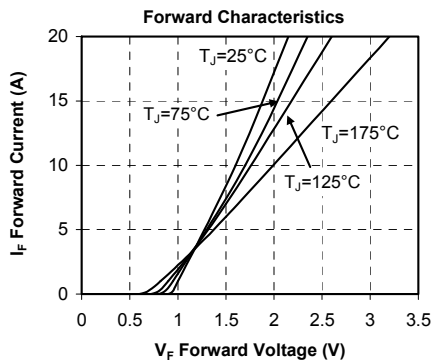
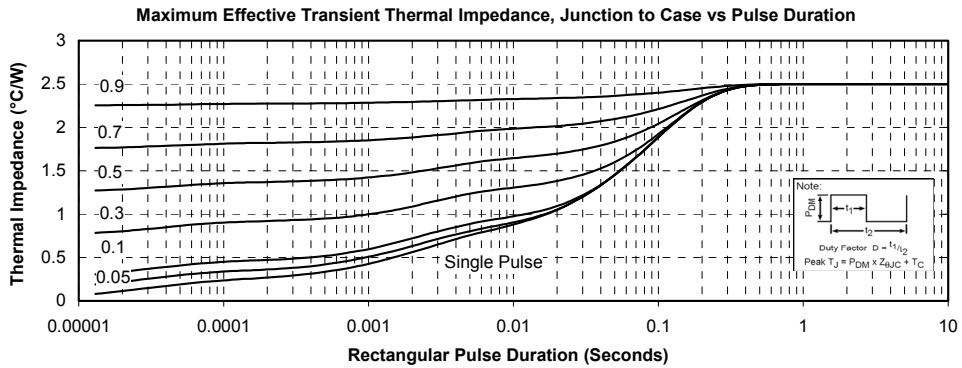
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

6. Top switches curves

6.1 Top Trench + Field Stop IGBT® typical performance curves

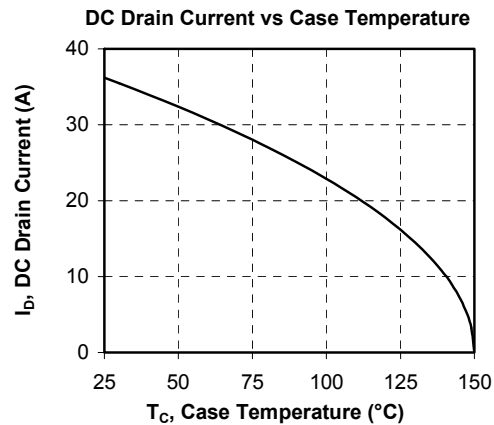
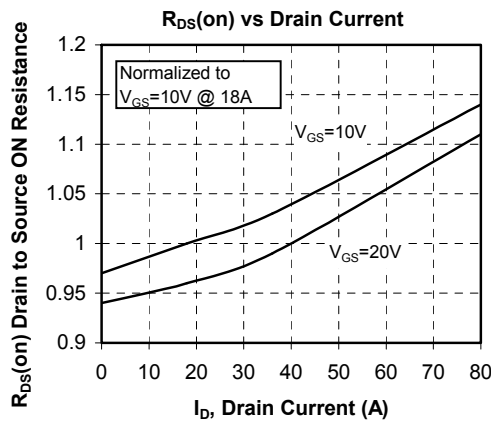
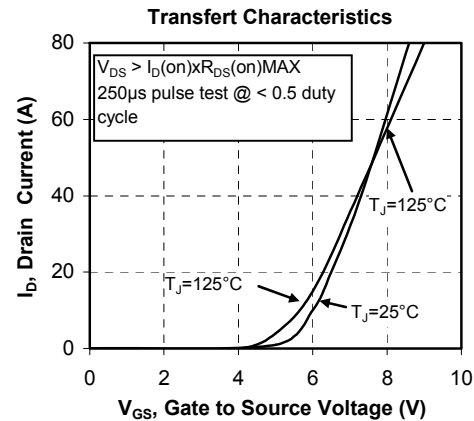
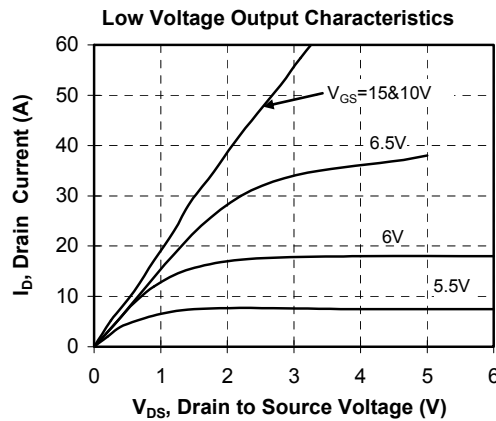
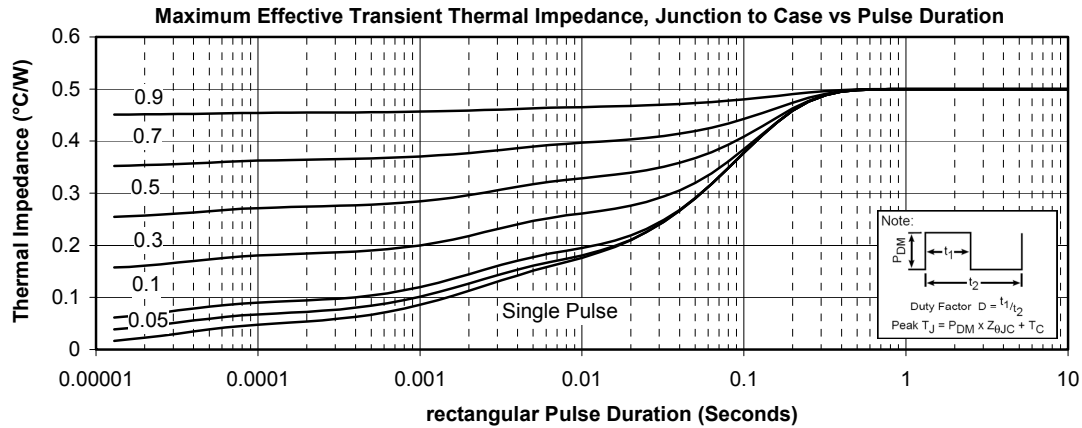


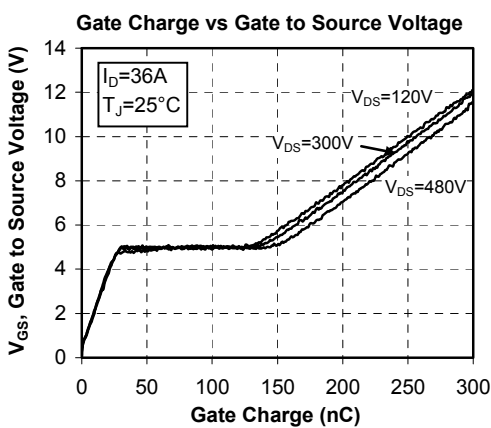
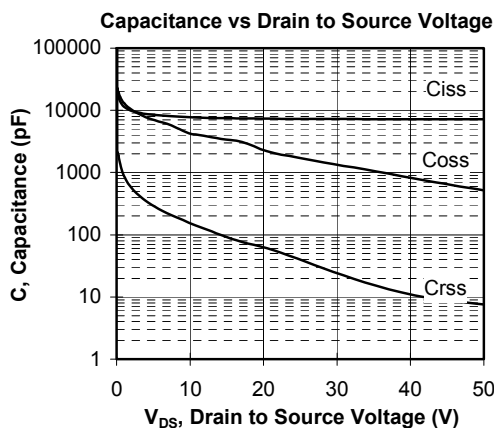
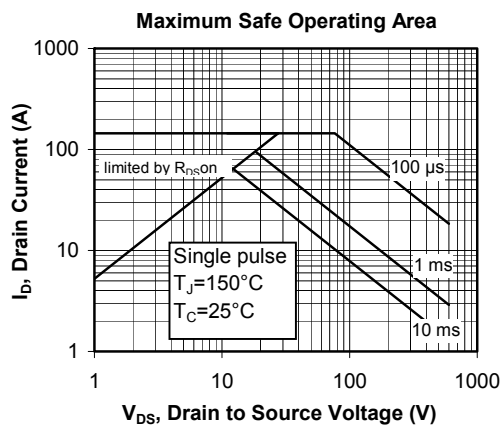
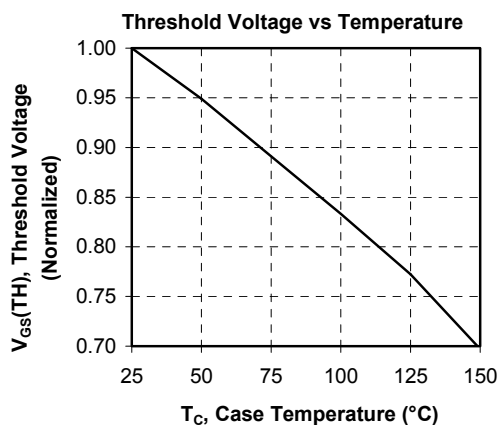
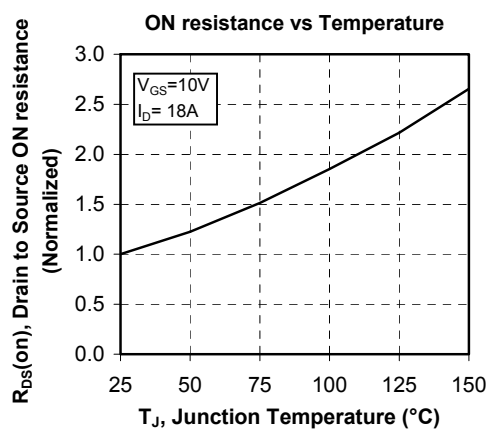
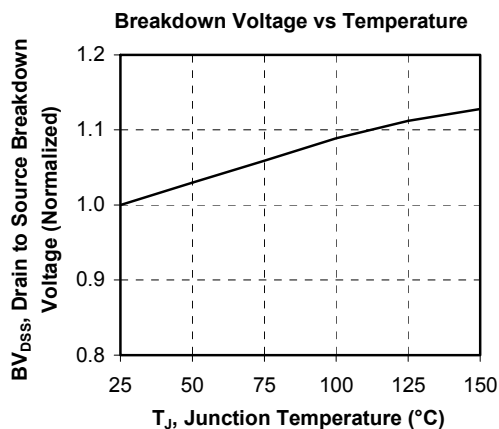
6.2 Top SiC diode typical performance curves

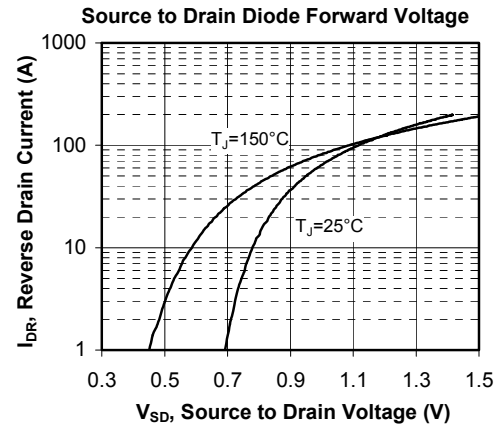
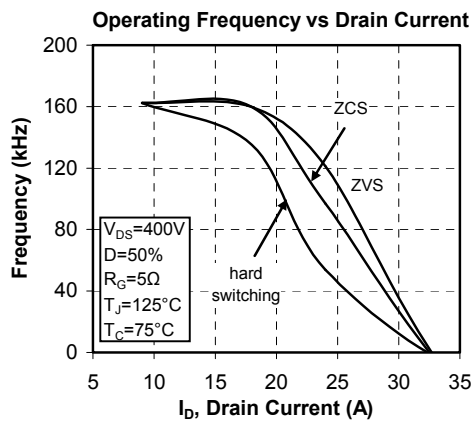
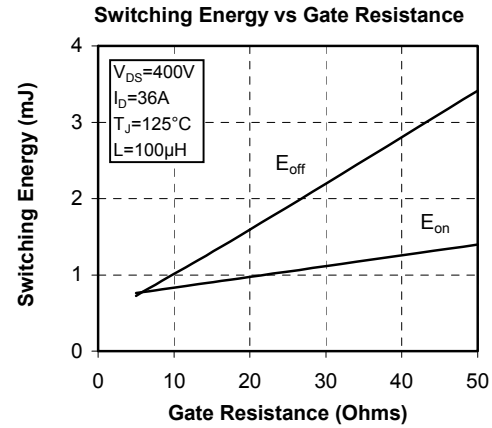
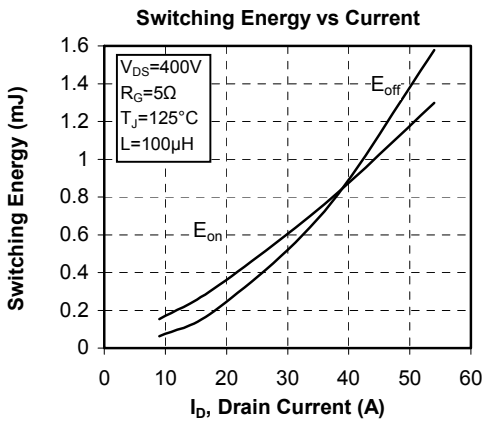
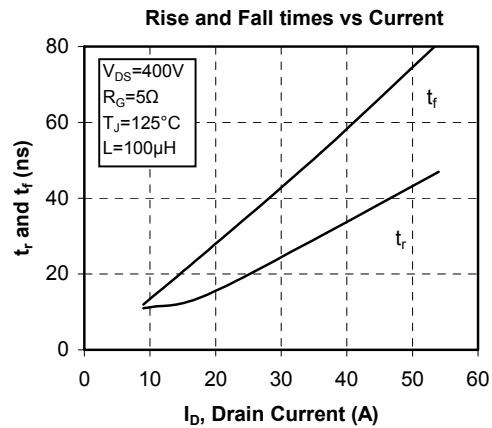
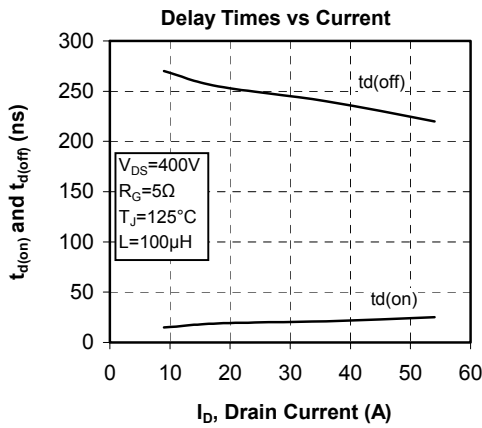


7. Bottom switches curves

7.1 Bottom CoolMOST™ typical performance curves







“COOLMOS™” comprise a new family of transistors developed by Infineon Technologies AG. “COOLMOS” is a trademark of Infineon Technologies AG.

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