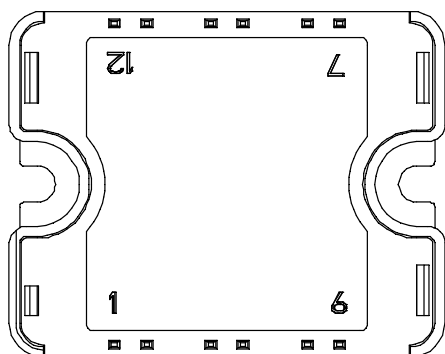
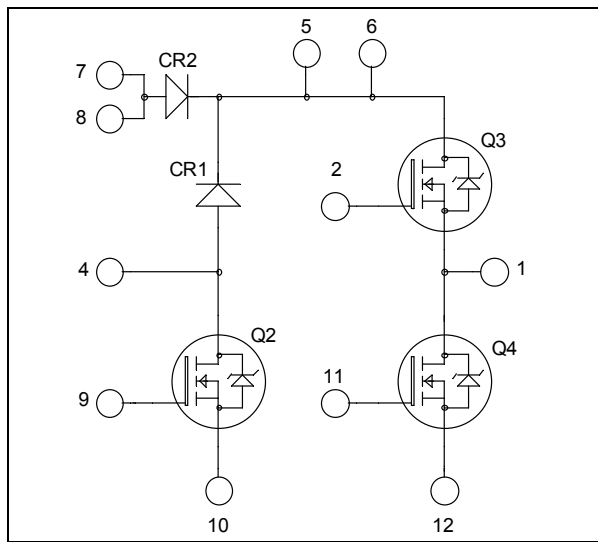


Boost chopper & Phase Leg Super Junction MOSFET Power Module

$$V_{DSS} = 600V$$

$$R_{DSon} = 45m\Omega \text{ max @ } T_j = 25^\circ C$$

$$I_D = 49A \text{ @ } T_c = 25^\circ C$$



Pins 7/8 ; 5/6 must be shorted together

Application

- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Solar converter

Features

- **CoolMOS™**
 - Ultra low R_{DSon}
 - Low Miller capacitance
 - Ultra low gate charge
 - Avalanche energy rated
 - Very rugged
- **SiC Schottky Diode (CR1)**
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature Independent switching behavior
 - Positive temperature coefficient on VF
- **Bypass FRED diode (CR2)**

Benefits

- Very low stray inductance
- High level of integration
- 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 @ $T_j = 25^\circ C$ unless otherwise specified

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

1. Phase leg (Q3 & Q4)

Absolute maximum ratings

Symbol	Parameter	Max ratings	Unit
V_{DSS}	Drain - Source Breakdown Voltage	600	V
I_D	Continuous Drain Current	$T_c = 25^\circ\text{C}$	49
		$T_c = 80^\circ\text{C}$	38
I_{DM}	Pulsed Drain current	130	A
V_{GS}	Gate - Source Voltage	± 20	V
$R_{DS(on)}$	Drain - Source ON Resistance	45	m Ω
P_D	Maximum Power Dissipation	$T_c = 25^\circ\text{C}$	250
I_{AR}	Avalanche current (repetitive and non repetitive)	15	A
E_{AR}	Repetitive Avalanche Energy	3	mJ
E_{AS}	Single Pulse Avalanche Energy	1900	

Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 600V, T_j = 25^\circ\text{C}$			250	μA
		$V_{GS} = 0V, V_{DS} = 600V, T_j = 125^\circ\text{C}$			500	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 24.5A$		40	45	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 3mA$	2.1	3	3.9	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_{oss}	Output Capacitance			8.5		
Q_g	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 300V$ $I_D = 49A$		150		nC
Q_{gs}	Gate – Source Charge			34		
Q_{gd}	Gate – Drain Charge			51		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 49A$ $R_G = 5\Omega$		21		ns
T_r	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			100		
T_f	Fall Time			45		
R_{thJC}	Junction to Case Thermal Resistance				0.5	$^\circ\text{C/W}$

Source - Drain diode ratings and characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I_S	Continuous Source current (Body diode)	$T_c = 25^\circ\text{C}$		49		A
		$T_c = 80^\circ\text{C}$		38		
V_{SD}	Diode Forward Voltage	$V_{GS} = 0V, I_S = -49A$			1.2	V
dv/dt	Peak Diode Recovery ❶				4	V/ns
t_{rr}	Reverse Recovery Time	$I_S = -49A$ $V_R = 350V$ $di/dt = 100A/\mu s$	$T_j = 25^\circ\text{C}$	600		ns
Q_{rr}	Reverse Recovery Charge		$T_j = 25^\circ\text{C}$	17		μC

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

$I_S \leq -49A$ $di/dt \leq 100A/\mu s$ $V_R \leq V_{DSS}$ $T_j \leq 150^\circ\text{C}$

2. Boost chopper (CR1 & Q2)

Absolute maximum ratings

Symbol	Parameter	Max ratings	Unit
V_{DSS}	Drain - Source Breakdown Voltage	600	V
I_D	Continuous Drain Current	$T_c = 25^\circ\text{C}$	A
		$T_c = 80^\circ\text{C}$	
I_{DM}	Pulsed Drain current	130	
V_{GS}	Gate - Source Voltage	± 20	V
$R_{DS(on)}$	Drain - Source ON Resistance	45	m Ω
P_D	Maximum Power Dissipation	$T_c = 25^\circ\text{C}$	W
I_{AR}	Avalanche current (repetitive and non repetitive)	15	A
E_{AR}	Repetitive Avalanche Energy	3	mJ
E_{AS}	Single Pulse Avalanche Energy	1900	

Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 600V, T_j = 25^\circ\text{C}$			250	μA
		$V_{GS} = 0V, V_{DS} = 600V, T_j = 125^\circ\text{C}$			500	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 24.5A$		40	45	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 3mA$	2.1	3	3.9	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_{oss}	Output Capacitance			8.5		
Q_g	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 300V$ $I_D = 49A$		150		nC
Q_{gs}	Gate – Source Charge			34		
Q_{gd}	Gate – Drain Charge			51		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 49A$ $R_G = 5\Omega$		21		ns
T_r	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			100		
T_f	Fall Time			45		
E_{on}	Turn-on Switching Energy	Inductive switching @ 25°C $V_{GS} = 10V; V_{Bus} = 400V$ $I_D = 49A; R_G = 5\Omega$		405		μJ
E_{off}	Turn-off Switching Energy			520		
E_{on}	Turn-on Switching Energy	Inductive switching @ 125°C $V_{GS} = 10V; V_{Bus} = 400V$ $I_D = 49A; R_G = 5\Omega$		660		μJ
E_{off}	Turn-off Switching Energy			635		
R_{thJC}	Junction to Case Thermal Resistance				0.5	$^\circ\text{C/W}$

SiC schottky diode ratings and characteristics (CR1)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	$V_R=600V$	$T_j = 25^{\circ}C$		10	60	μA
			$T_j = 175^{\circ}C$		20	300	
$I_{F(AV)}$	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	$^{\circ}C/W$

3. By pass FRED diode (CR2)
Diode ratings and characteristics

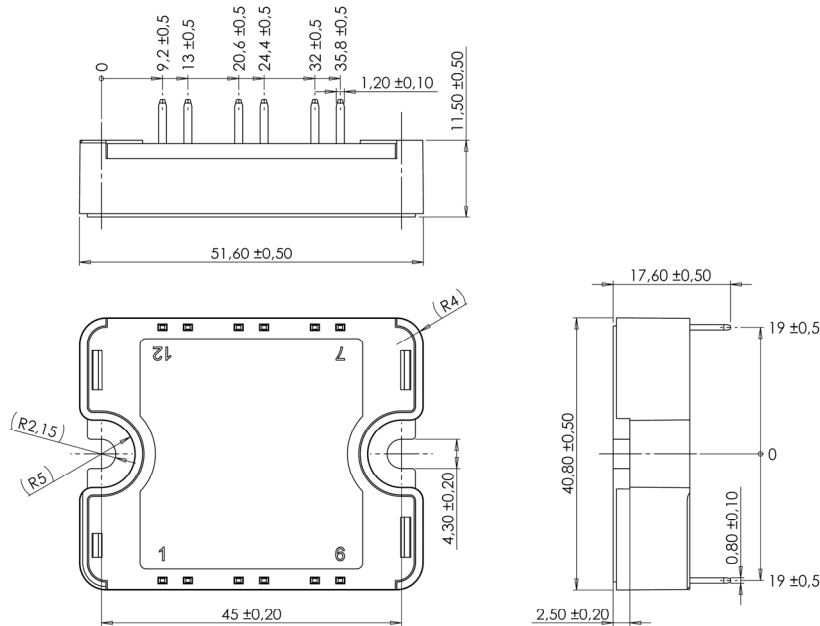
Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	$V_R=600V$	$T_j = 25^{\circ}C$			100	μA
			$T_j = 150^{\circ}C$			350	
I_F	DC Forward Current		$T_c = 80^{\circ}C$		30		A
V_F	Diode Forward Voltage	$I_F = 30A$ $V_{GE} = 0V$	$T_j = 25^{\circ}C$		1.6	2	V
			$T_j = 150^{\circ}C$		1.5		
t_{rr}	Reverse Recovery Time	$I_F = 30A$ $V_R = 300V$ $di/dt = 1800A/\mu s$	$T_j = 25^{\circ}C$		100		ns
			$T_j = 150^{\circ}C$		150		
Q_{rr}	Reverse Recovery Charge		$T_j = 25^{\circ}C$		1.5		μC
			$T_j = 150^{\circ}C$		3.1		
E_{rr}	Reverse Recovery Energy		$T_j = 25^{\circ}C$		0.34		mJ
			$T_j = 150^{\circ}C$		0.75		
R_{thJC}	Junction to Case Thermal Resistance					2.45	$^{\circ}C/W$

4. Thermal & 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*	$^{\circ}C$
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

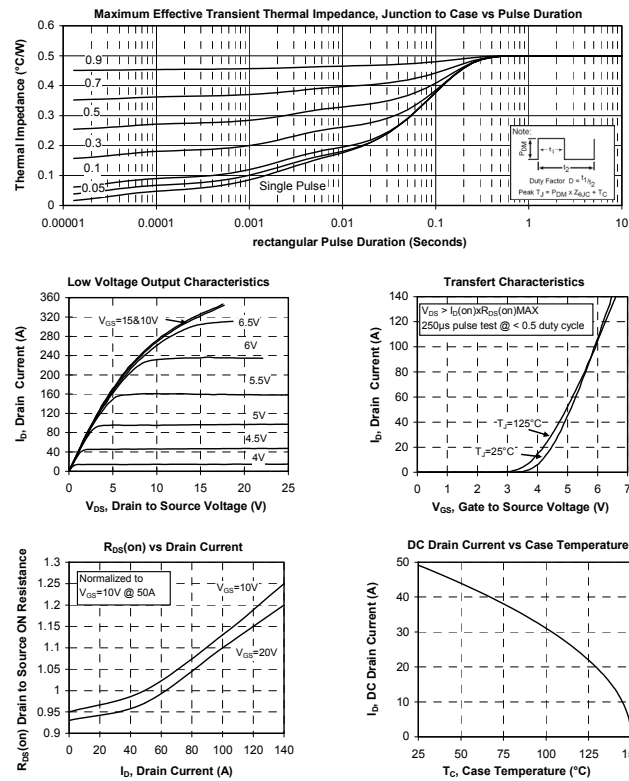
* $T_{jmax} = 175^{\circ}C$ for by pass and SiC diode

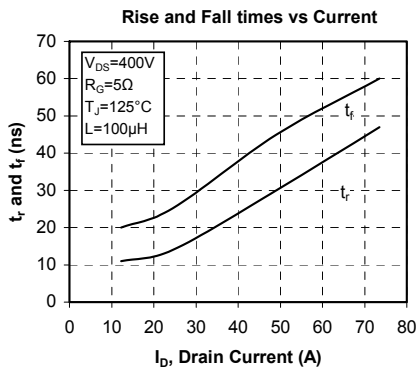
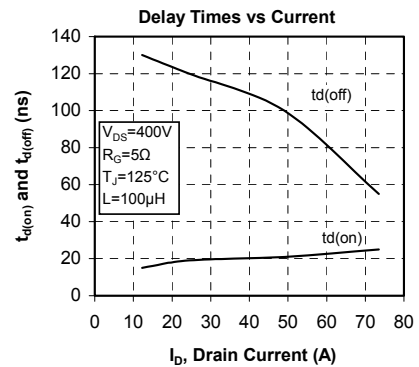
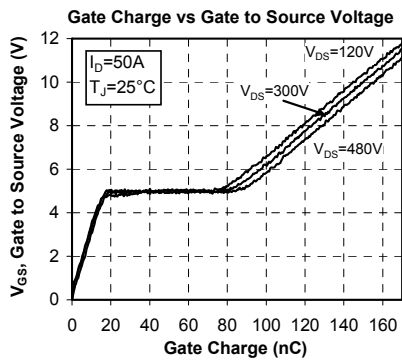
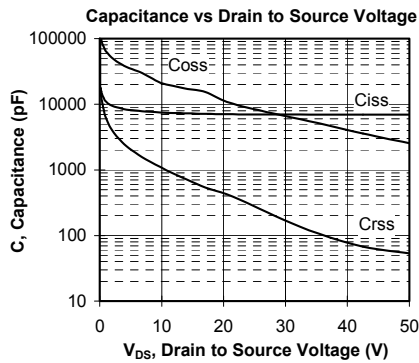
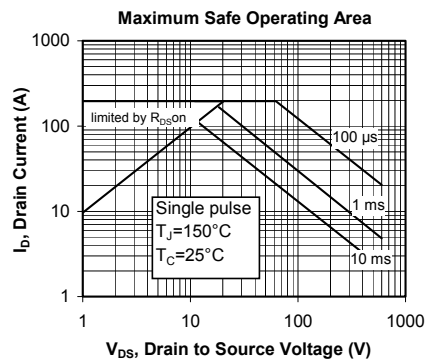
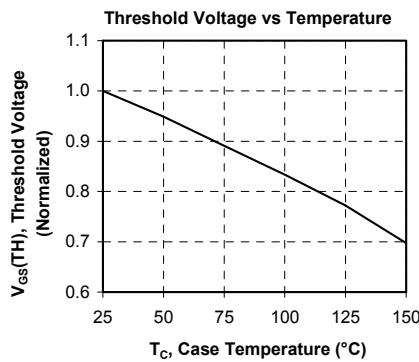
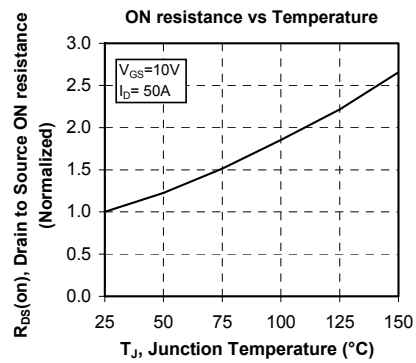
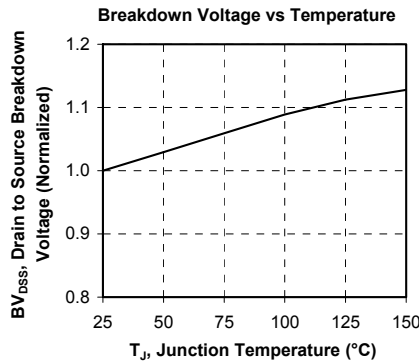
SP1 Package outline (dimensions in mm)



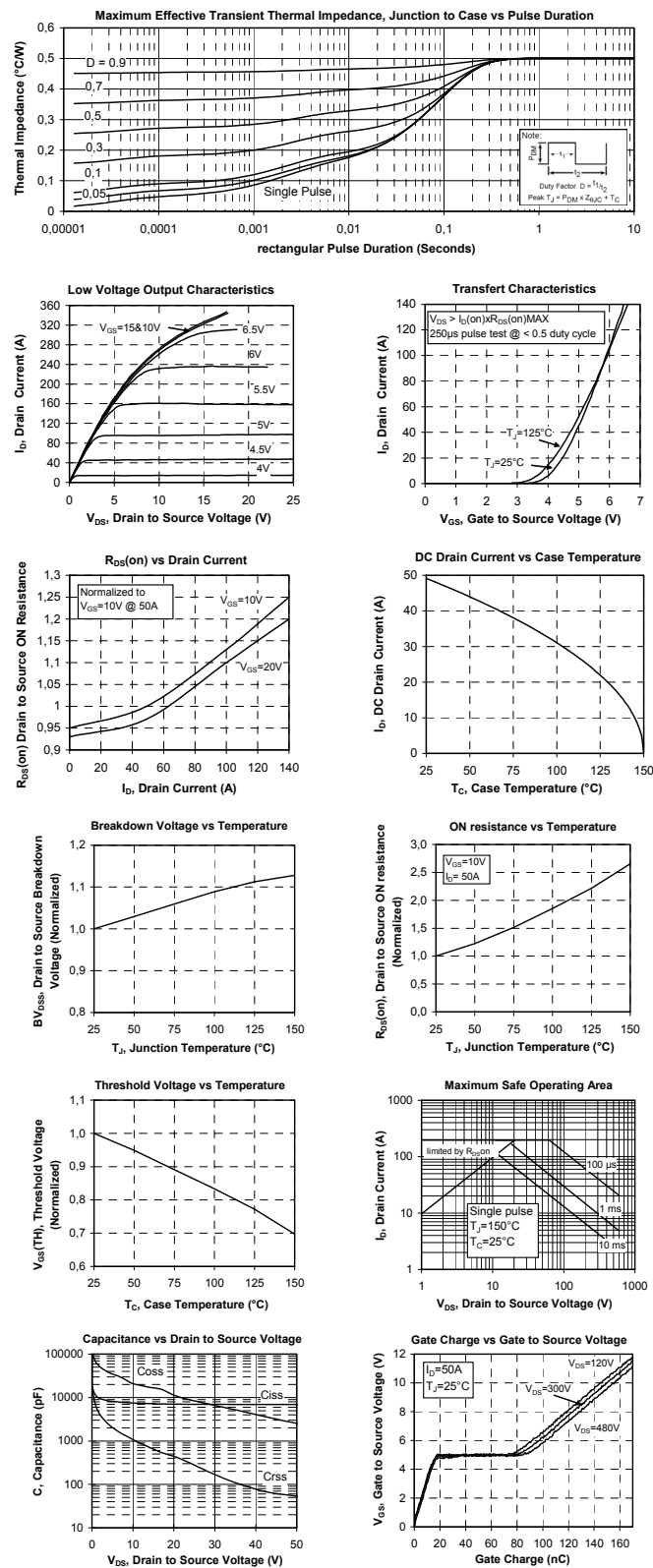
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

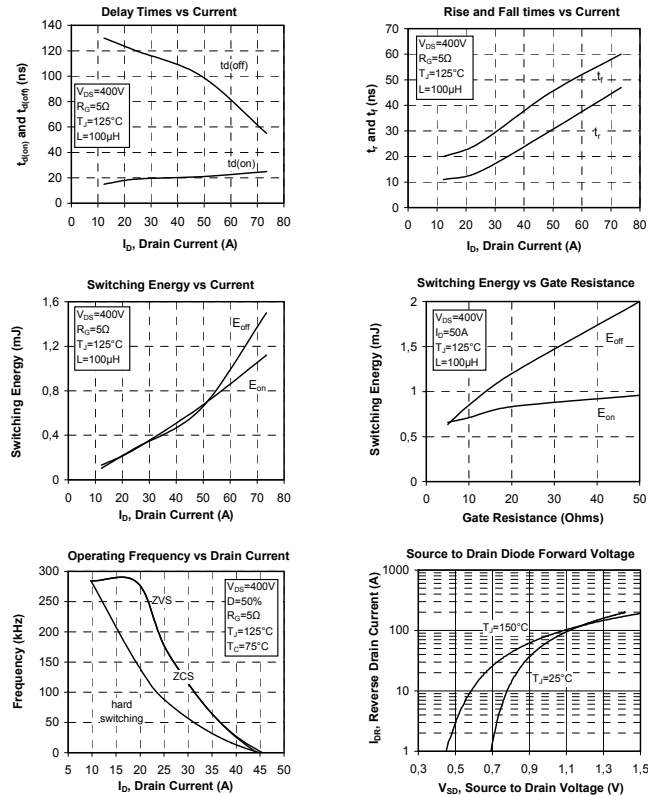
5. Typical CoolMOS Performance Curve (Phase leg)



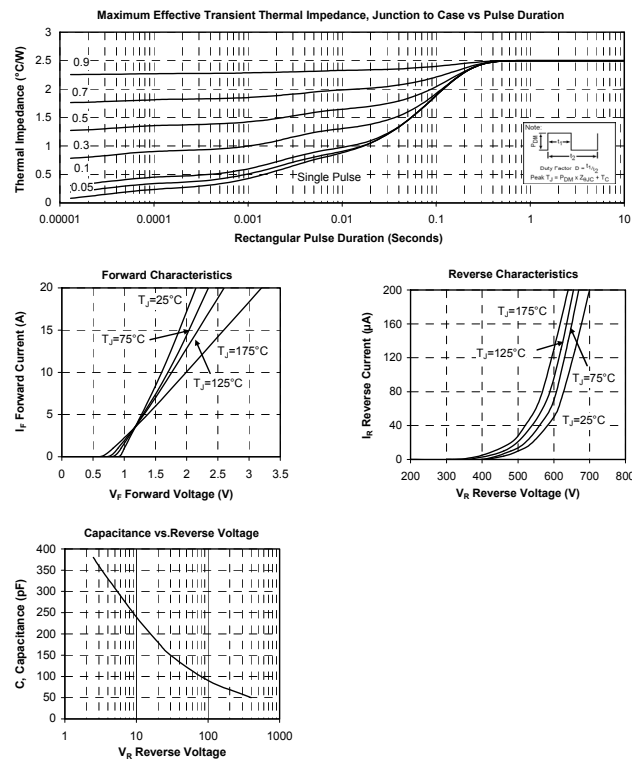


6. Typical CoolMOS Performance Curve (Boost chopper)

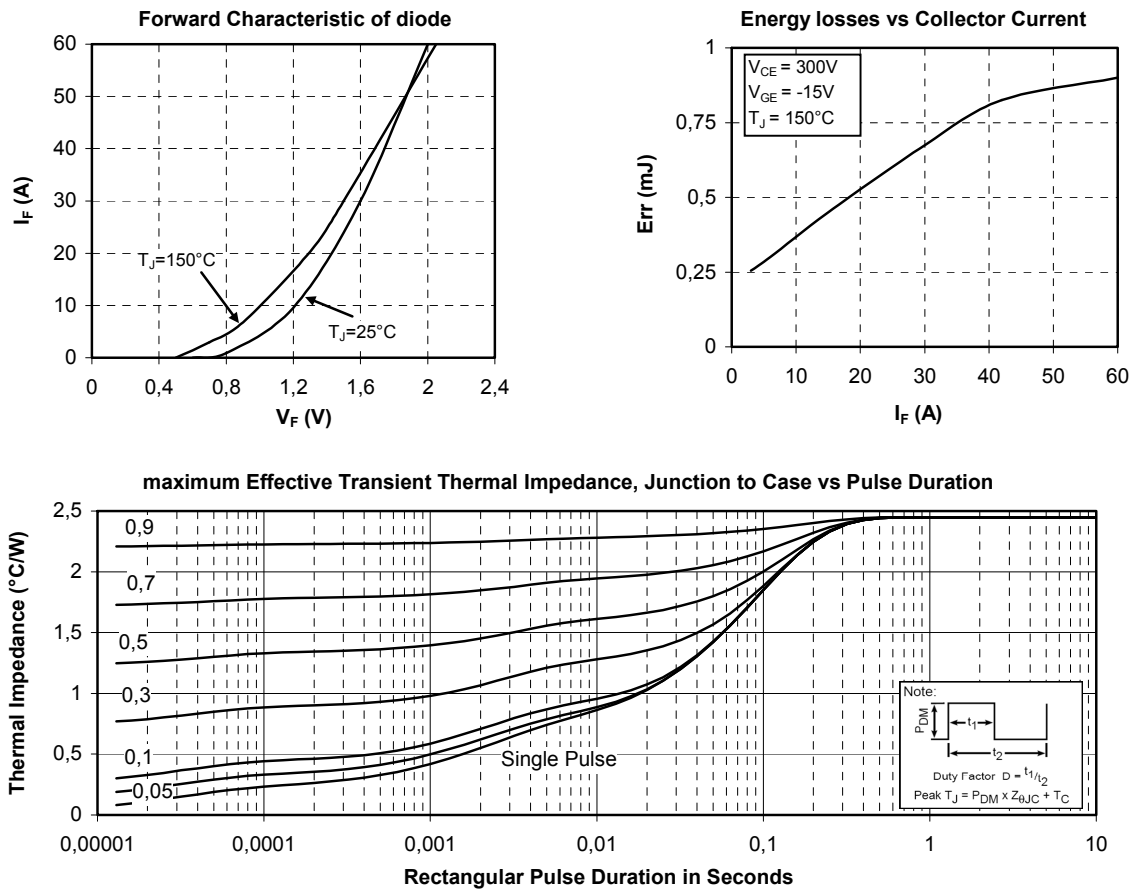




7. SiC Typical Performance Curve (CR1)



8. Typical By pass Performance Curve (CR2)



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