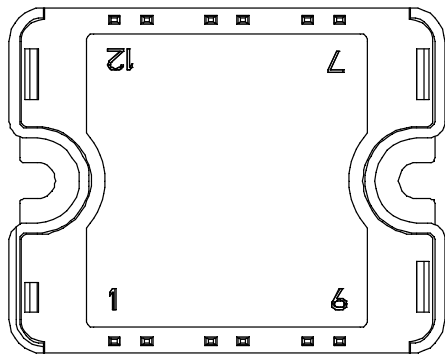
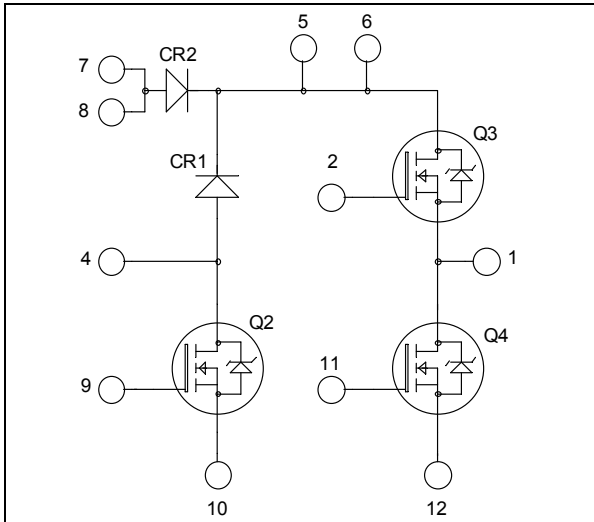


**Boost chopper & Phase Leg  
Super Junction MOSFET  
Power Module**

**Boost chopper:  $V_{DSS} = 600V$   
 $R_{DSon} = 45m\Omega \text{ max @ } T_j = 25^\circ C$   
 $I_D = 49A \text{ @ } T_c = 25^\circ C$**

**Phase leg:  $V_{DSS} = 600V$   
 $R_{DSon} = 83m\Omega \text{ max @ } T_j = 25^\circ C$   
 $I_D = 36A \text{ @ } T_c = 25^\circ C$**



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
- **By pass 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](http://www.microsemi.com)

**1. Phase leg (Q3 & Q4)**
**Absolute maximum ratings**

Symbol	Parameter	Max ratings	Unit
V <sub>DSS</sub>	Drain - Source Breakdown Voltage	600	V
I <sub>D</sub>	Continuous Drain Current	T <sub>c</sub> = 25°C	36
		T <sub>c</sub> = 80°C	27
I <sub>DM</sub>	Pulsed Drain current	115	A
V <sub>GS</sub>	Gate - Source Voltage	±20	V
R <sub>DS(on)</sub>	Drain - Source ON Resistance	83	mΩ
P <sub>D</sub>	Maximum Power Dissipation	T <sub>c</sub> = 25°C	250
I <sub>AR</sub>	Avalanche current (repetitive and non repetitive)	20	A
E <sub>AR</sub>	Repetitive Avalanche Energy	1	mJ
E <sub>AS</sub>	Single Pulse Avalanche Energy	1800	

**Electrical Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 600V   T <sub>j</sub> = 25°C			100	μA
		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 600V   T <sub>j</sub> = 125°C			5000	
R <sub>DS(on)</sub>	Drain - Source on Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 24.5A			83	mΩ
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 3mA	3	4	5	V
I <sub>GSS</sub>	Gate - Source Leakage Current	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0V			100	nA

**Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V ; V <sub>DS</sub> = 25V f = 1MHz		7.2		nF
C <sub>rss</sub>	Reverse Transfer Capacitance			0.041		
Q <sub>g</sub>	Total gate Charge	V <sub>GS</sub> = 10V V <sub>Bus</sub> = 300V I <sub>D</sub> = 36A		250		nC
Q <sub>gs</sub>	Gate - Source Charge			43		
Q <sub>gd</sub>	Gate - Drain Charge			135		
T <sub>d(on)</sub>	Turn-on Delay Time	<b>Inductive Switching (125°C)</b> V <sub>GS</sub> = 10V V <sub>Bus</sub> = 400V I <sub>D</sub> = 36A R <sub>G</sub> = 5Ω		21		ns
T <sub>r</sub>	Rise Time			30		
T <sub>d(off)</sub>	Turn-off Delay Time			240		
T <sub>f</sub>	Fall Time			52		
R <sub>thJC</sub>	Junction to Case Thermal resistance				0.5	°C/W

**Source - Drain diode ratings and characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I <sub>S</sub>	Continuous Source current (Body diode)	T <sub>c</sub> = 25°C			36	A
		T <sub>c</sub> = 80°C			27	
V <sub>SD</sub>	Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>S</sub> = - 36A			1.2	V
dv/dt	Peak Diode Recovery ①				40	V/ns
t <sub>rr</sub>	Reverse Recovery Time	I <sub>S</sub> = - 36A V <sub>R</sub> = 350V di/dt = 100A/μs	T <sub>j</sub> = 25°C		210	ns
			T <sub>j</sub> = 125°C		350	
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>S</sub> = - 36A V <sub>R</sub> = 350V di/dt = 100A/μs	T <sub>j</sub> = 25°C		2	μC
			T <sub>j</sub> = 125°C		5.4	

① dv/dt numbers reflect the limitations of the circuit rather than the device itself. I<sub>S</sub> ≤ - 36A di/dt ≤ 100A/μs V<sub>R</sub> ≤ V<sub>DSS</sub> T<sub>j</sub> ≤ 150°C

## 2. Boost chopper (CR1 & Q2)

### Absolute maximum ratings

Symbol	Parameter	Max ratings	Unit
V <sub>DSS</sub>	Drain - Source Breakdown Voltage	600	V
I <sub>D</sub>	Continuous Drain Current	T <sub>c</sub> = 25°C	49
		T <sub>c</sub> = 80°C	38
I <sub>DM</sub>	Pulsed Drain current	130	A
V <sub>GS</sub>	Gate - Source Voltage	±20	V
R <sub>DS(on)</sub>	Drain - Source ON Resistance	45	mΩ
P <sub>D</sub>	Maximum Power Dissipation	T <sub>c</sub> = 25°C	250
I <sub>AR</sub>	Avalanche current (repetitive and non repetitive)	15	A
E <sub>AR</sub>	Repetitive Avalanche Energy	3	mJ
E <sub>AS</sub>	Single Pulse Avalanche Energy	1900	

### Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 600V   T <sub>j</sub> = 25°C			250	μA
		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 600V   T <sub>j</sub> = 125°C			500	
R <sub>DS(on)</sub>	Drain – Source on Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 24.5A		40	45	mΩ
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 3mA	2.1	3	3.9	V
I <sub>GSS</sub>	Gate – Source Leakage Current	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0V			100	nA

### Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V ; V <sub>DS</sub> = 25V f = 1MHz		7.2		nF
C <sub>oss</sub>	Output Capacitance			8.5		
Q <sub>g</sub>	Total gate Charge	V <sub>GS</sub> = 10V V <sub>Bus</sub> = 300V I <sub>D</sub> = 49A		150		nC
Q <sub>gs</sub>	Gate – Source Charge			34		
Q <sub>gd</sub>	Gate – Drain Charge			51		
T <sub>d(on)</sub>	Turn-on Delay Time	<b>Inductive Switching (125°C)</b> V <sub>GS</sub> = 10V V <sub>Bus</sub> = 400V I <sub>D</sub> = 49A R <sub>G</sub> = 5Ω		21		ns
T <sub>r</sub>	Rise Time			30		
T <sub>d(off)</sub>	Turn-off Delay Time			100		
T <sub>f</sub>	Fall Time			45		
E <sub>on</sub>	Turn-on Switching Energy	<b>Inductive switching @ 25°C</b> V <sub>GS</sub> = 10V ; V <sub>Bus</sub> = 400V I <sub>D</sub> = 49A ; R <sub>G</sub> = 5Ω		405		μJ
E <sub>off</sub>	Turn-off Switching Energy			520		
E <sub>on</sub>	Turn-on Switching Energy	<b>Inductive switching @ 125°C</b> V <sub>GS</sub> = 10V ; V <sub>Bus</sub> = 400V I <sub>D</sub> = 49A ; R <sub>G</sub> = 5Ω		660		μJ
E <sub>off</sub>	Turn-off Switching Energy			635		
R <sub>thJC</sub>	Junction to Case Thermal resistance				0.5	°C/W

**SiC schottky diode ratings and characteristics (CR1)**

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage			600			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> =600V	T <sub>j</sub> = 25°C T <sub>j</sub> = 175°C		10 20	60 300	μA
I <sub>F(AV)</sub>	Maximum Average Forward Current	50% duty cycle	T <sub>c</sub> = 100°C		10		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 10A	T <sub>j</sub> = 25°C T <sub>j</sub> = 175°C		1.6 2	1.8 2.4	V
Q <sub>C</sub>	Total Capacitive Charge	I <sub>F</sub> = 10A, V <sub>R</sub> = 300V di/dt = 500A/μs			14		nC
C	Total Capacitance	f = 1MHz, V <sub>R</sub> = 200V f = 1MHz, V <sub>R</sub> = 400V			65 50		pF
R <sub>thJC</sub>	Junction to Case Thermal resistance					2.5	°C/W

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

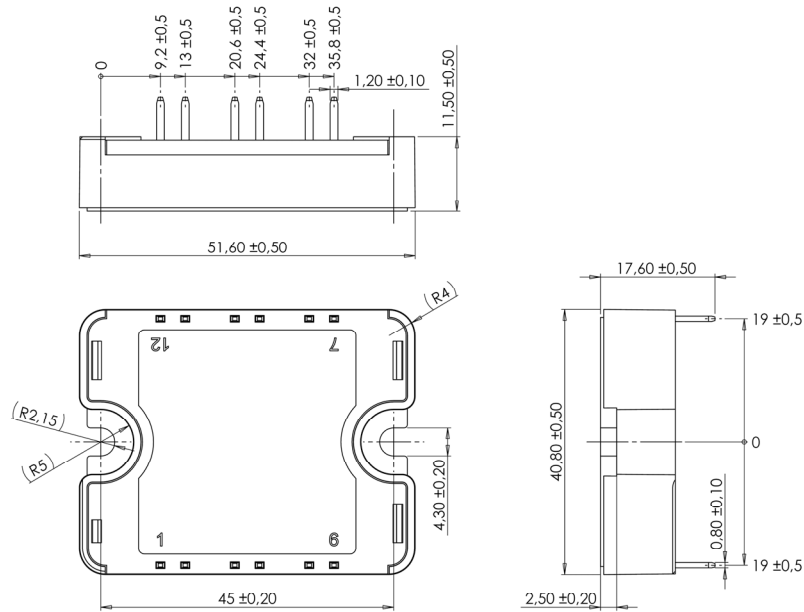
<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage			600			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> =600V	T <sub>j</sub> = 25°C T <sub>j</sub> = 150°C			100 350	μA
I <sub>F</sub>	DC Forward Current		T <sub>c</sub> = 80°C		30		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 30A V <sub>GE</sub> = 0V	T <sub>j</sub> = 25°C T <sub>j</sub> = 150°C		1.6 1.5	2	V
t <sub>rr</sub>	Reverse Recovery Time		T <sub>j</sub> = 25°C T <sub>j</sub> = 150°C		100 150		ns
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>F</sub> = 30A V <sub>R</sub> = 300V di/dt = 1800A/μs	T <sub>j</sub> = 25°C T <sub>j</sub> = 150°C		1.5 3.1		μC
E <sub>rr</sub>	Reverse Recovery Energy		T <sub>j</sub> = 25°C T <sub>j</sub> = 150°C		0.34 0.75		mJ
R <sub>thJC</sub>	Junction to Case Thermal Resistance					2.45	°C/W

**4. Thermal & Package characteristics**

<i>Symbol</i>	<i>Characteristic</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>	
V <sub>ISOL</sub>	RMS Isolation Voltage, any terminal to case t = 1 min, 50/60Hz	4000			V	
T <sub>J</sub>	Operating junction temperature range	-40		150*	°C	
T <sub>STG</sub>	Storage Temperature Range	-40		125		
T <sub>C</sub>	Operating Case Temperature	-40		100		
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package Weight				80	g

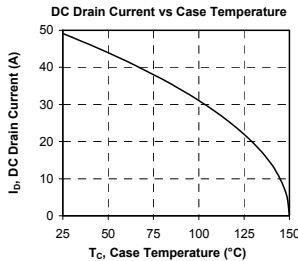
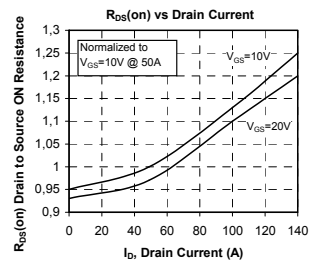
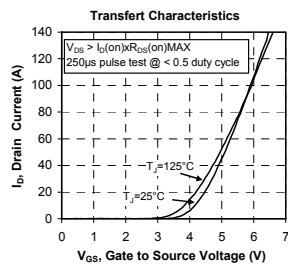
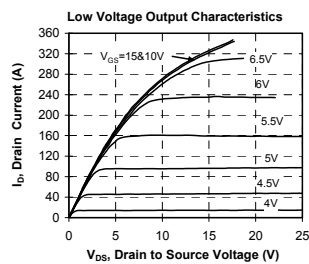
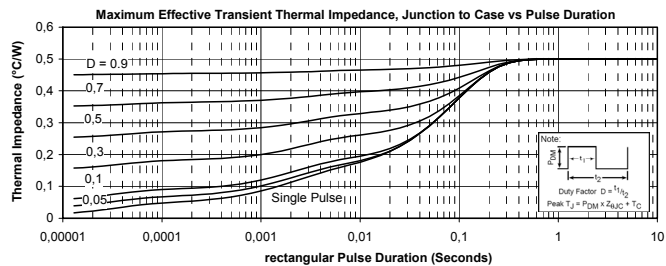
\* T<sub>jmax</sub> = 175°C for by pass and SiC diode

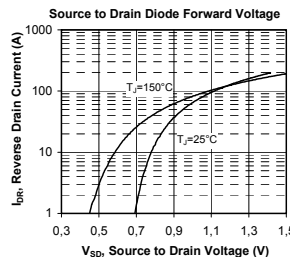
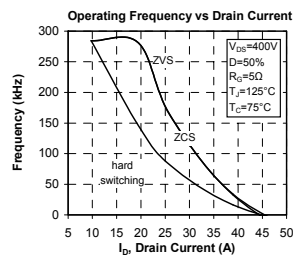
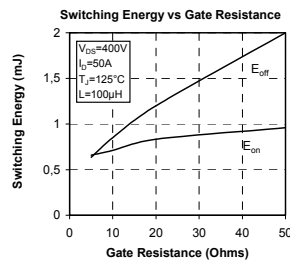
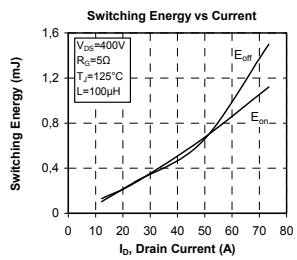
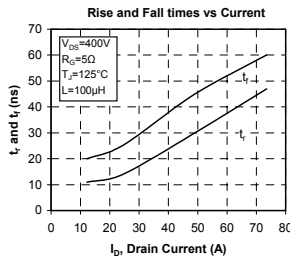
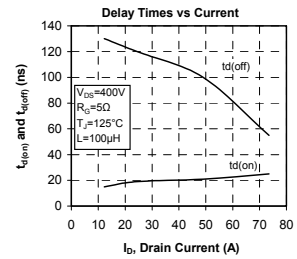
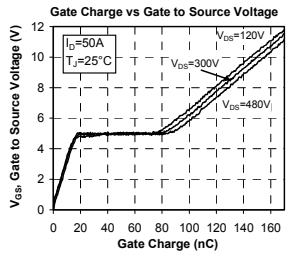
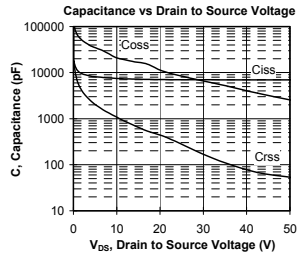
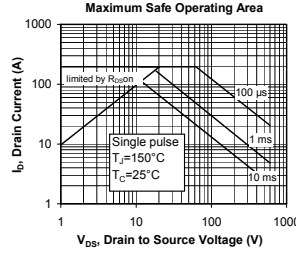
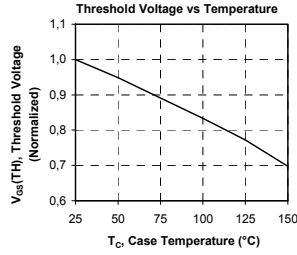
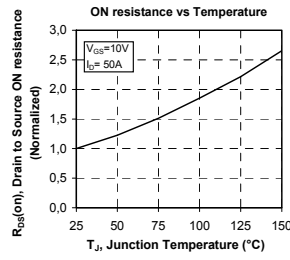
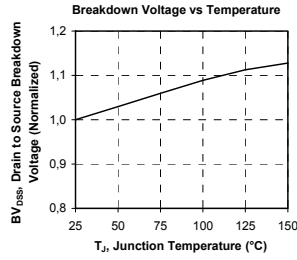
## SP1 Package outline (dimensions in mm)



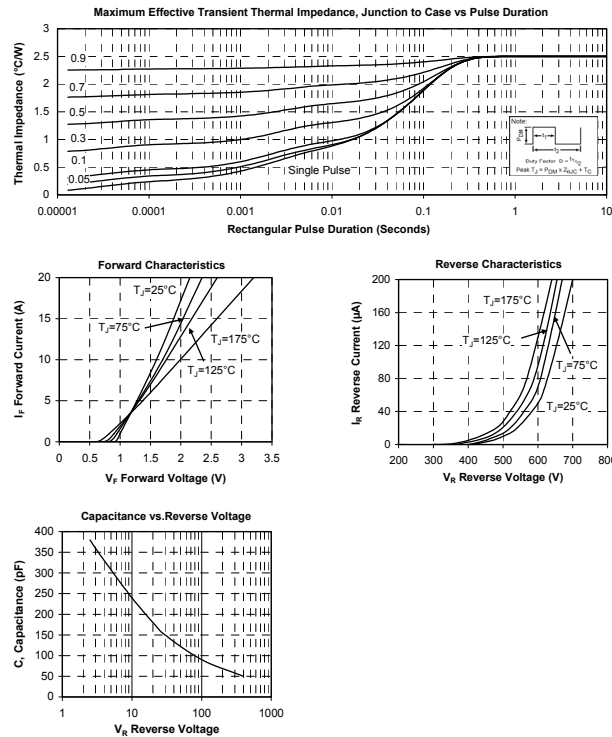
See application note 1904 - Mounting Instructions for SP1 Power Modules on [www.microsemi.com](http://www.microsemi.com)

## 5. Typical CoolMOS Performance Curve (Boost chopper)

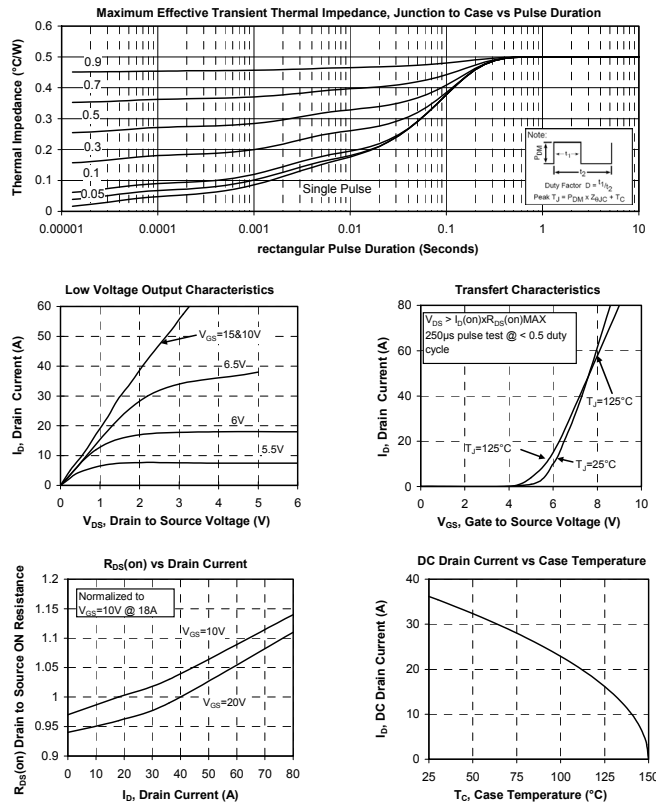


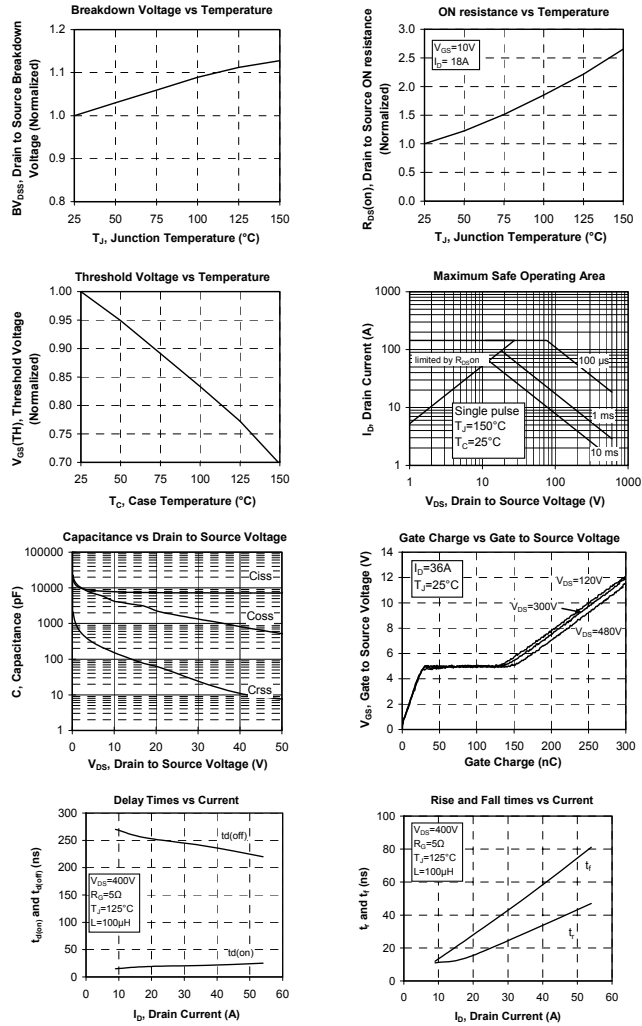


## 6. SiC Typical Performance Curve (CR1)

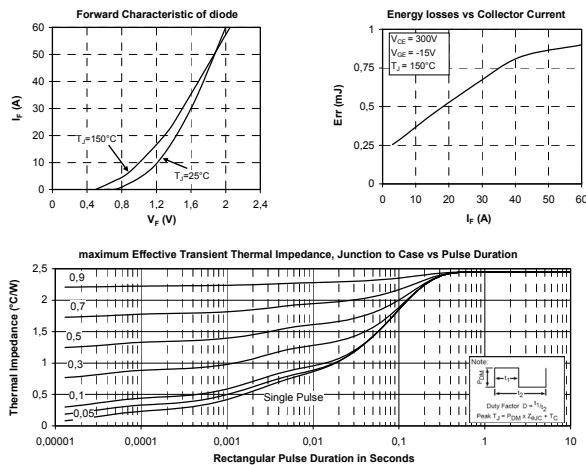


## 7. Typical CoolMOS Performance Curve (Phase leg)





## 8. Typical By pass Performance Curve (CR2)



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