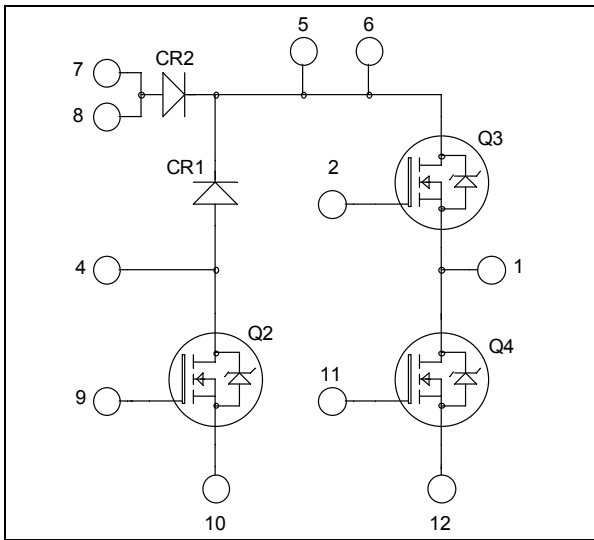


**Boost chopper & Phase Leg  
Super Junction MOSFET  
Power Module**

$V_{DSS} = 600V$

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

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



### Application

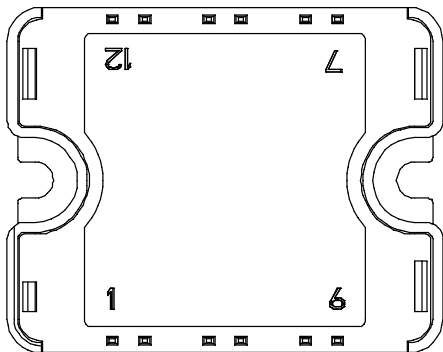
- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Solar converter

### Features

- **CoolMOS™**
  - Ultra low  $R_{DSon}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
  - Very rugged
- **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



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

**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
$V_{DSS}$	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	$\pm 20$	V
$R_{DS(on)}$	Drain - Source ON Resistance	45	m $\Omega$
$P_D$	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	$\mu\text{A}$
		$V_{GS} = 0V, V_{DS} = 600V$   $T_j = 125^\circ\text{C}$			500	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 24.5A$		40	45	m $\Omega$
$V_{GS(th)}$	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	<b>Inductive Switching (125°C)</b> $V_{GS} = 10V$ $V_{Bus} = 400V$ $I_D = 49A$ $R_G = 5\Omega$		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 <sup>①</sup>				4	V/ns
$t_{rr}$	Reverse Recovery Time	$I_S = -49A$ $V_R = 350V$ $di_S/dt = 100A/\mu s$	$T_j = 25^\circ\text{C}$		600	ns
$Q_{rr}$	Reverse Recovery Charge		$T_j = 25^\circ\text{C}$		17	

① dv/dt numbers reflect the limitations of the circuit rather than the device itself.

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

**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
E <sub>AR</sub>	Repetitive Avalanche Energy		3
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			250	μA
		T <sub>j</sub> = 25°C				
		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 600V			500	
		T <sub>j</sub> = 125°C				
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		675		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		1100		μJ
E <sub>off</sub>	Turn-off Switching Energy			635		
R <sub>thJC</sub>	Junction to Case Thermal Resistance				0.5	°C/W

**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			25	μA
			T <sub>j</sub> = 125°C			500	
I <sub>F</sub>	DC Forward Current	T <sub>c</sub> = 80°C			60		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 60A			1.7	2.3	V
		I <sub>F</sub> = 120A			2		
		I <sub>F</sub> = 60A	T <sub>j</sub> = 125°C		1.4		
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 600A V <sub>R</sub> = 400V di/dt = 200A/μs	T <sub>j</sub> = 25°C		70		ns
			T <sub>j</sub> = 125°C			140	
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>F</sub> = 600A V <sub>R</sub> = 400V di/dt = 200A/μs	T <sub>j</sub> = 25°C		100		nC
			T <sub>j</sub> = 125°C			690	
R <sub>thJC</sub>	Junction to Case Thermal Resistance					0.85	°C/W

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

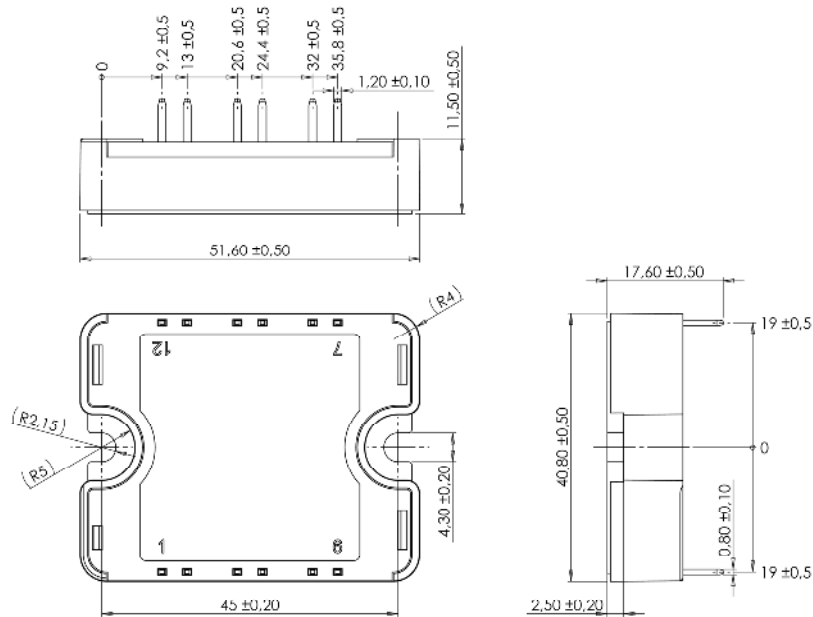
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V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage			600			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> =600V	T <sub>j</sub> = 25°C			100	μA
			T <sub>j</sub> = 150°C			350	
I <sub>F</sub>	DC Forward Current	T <sub>c</sub> = 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		1.6	2	V
			T <sub>j</sub> = 150°C			1.5	
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 30A V <sub>R</sub> = 300V di/dt = 1800A/μs	T <sub>j</sub> = 25°C		100		ns
			T <sub>j</sub> = 150°C			150	
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		1.5		μC
			T <sub>j</sub> = 150°C			3.1	
E <sub>rr</sub>	Reverse Recovery Energy	I <sub>F</sub> = 30A V <sub>R</sub> = 300V di/dt = 1800A/μs	T <sub>j</sub> = 25°C		0.34		mJ
			T <sub>j</sub> = 150°C			0.75	
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

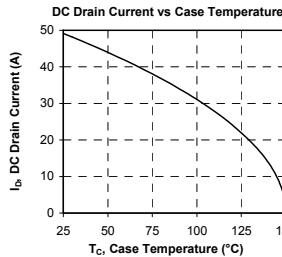
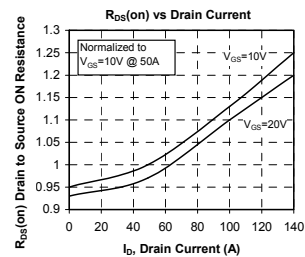
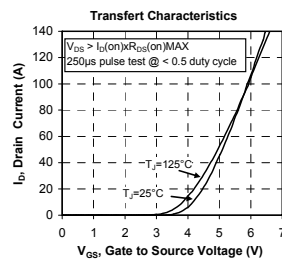
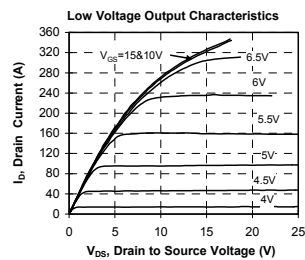
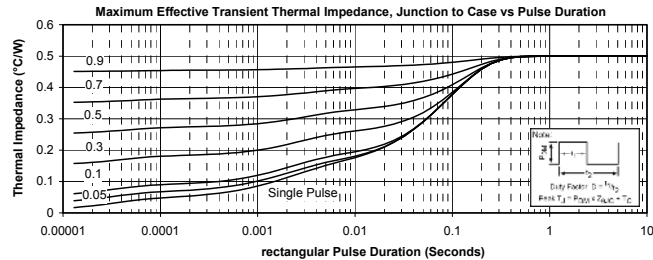
\* T<sub>jmax</sub> = 175°C for by pass diode

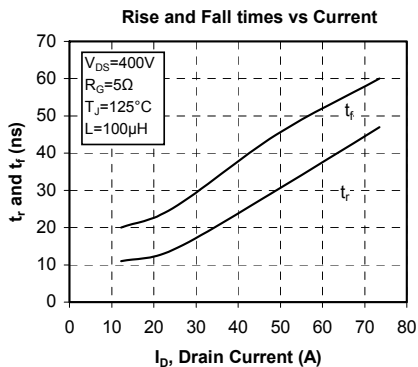
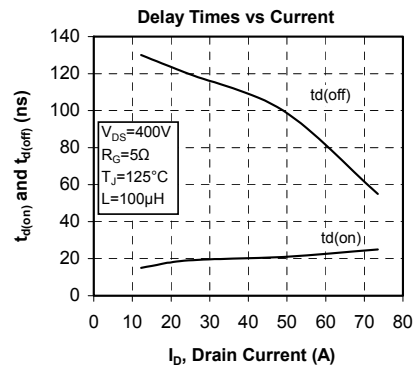
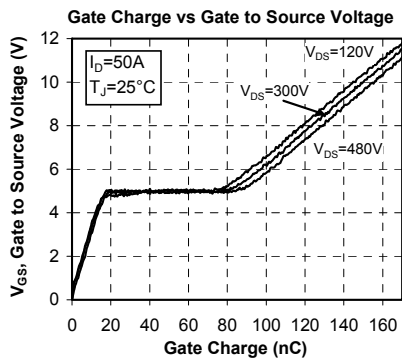
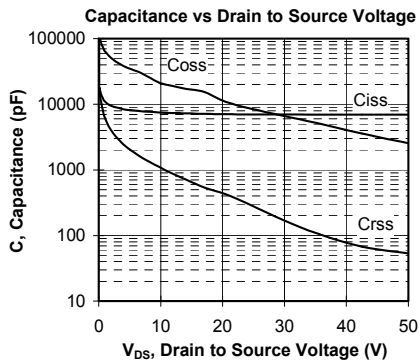
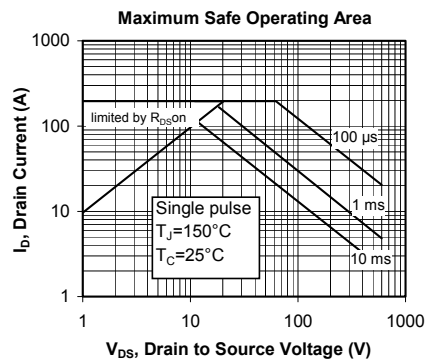
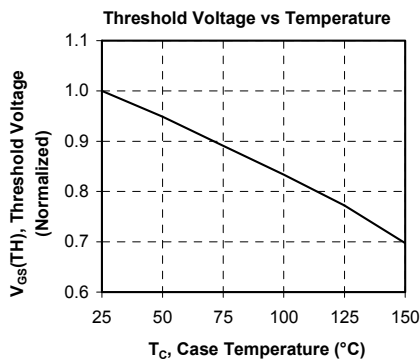
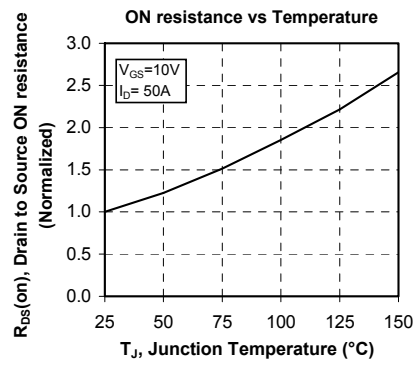
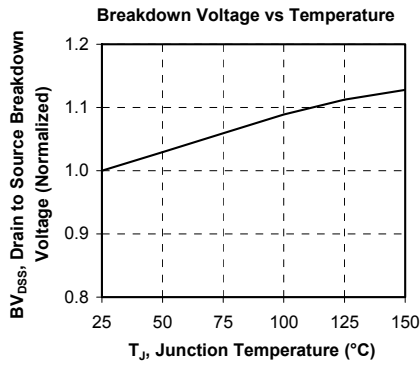
## SP1 Package outline (dimensions in mm)



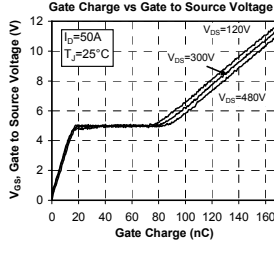
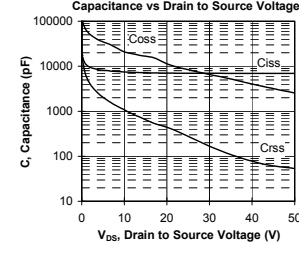
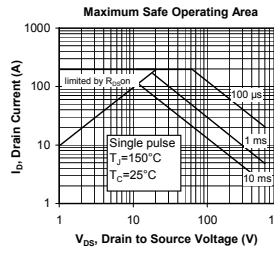
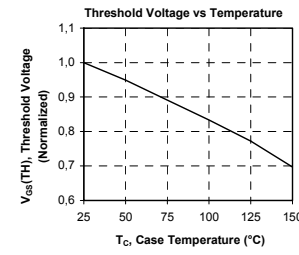
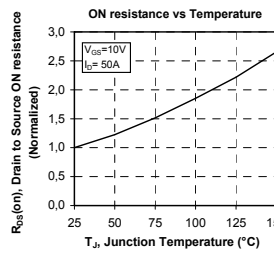
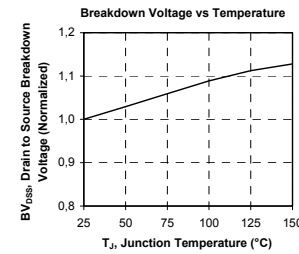
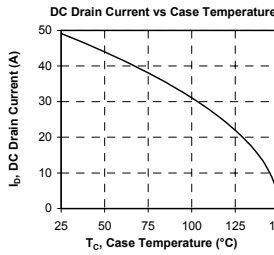
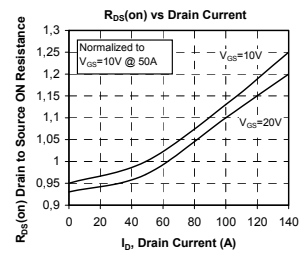
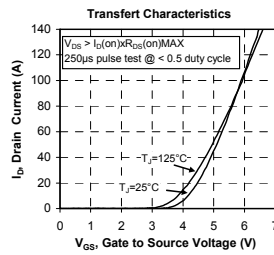
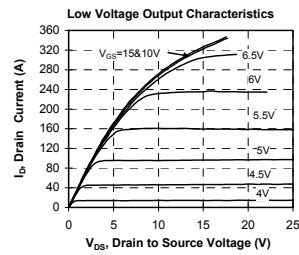
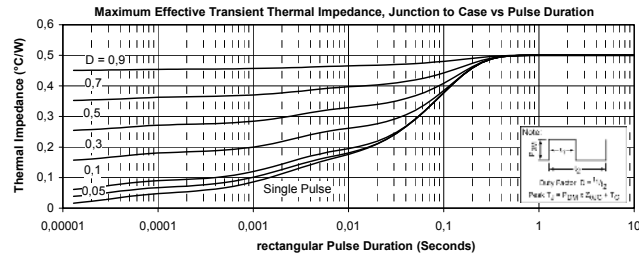
See application note 1904 - Mounting Instructions for SP1 Power Modules on [www.microsemi.com](http://www.microsemi.com)

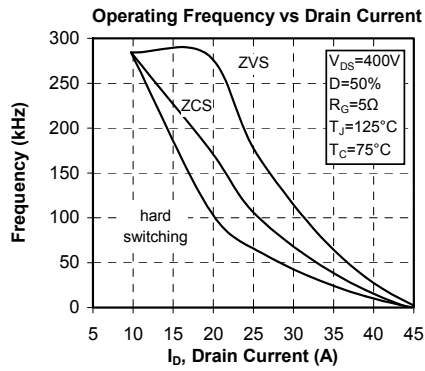
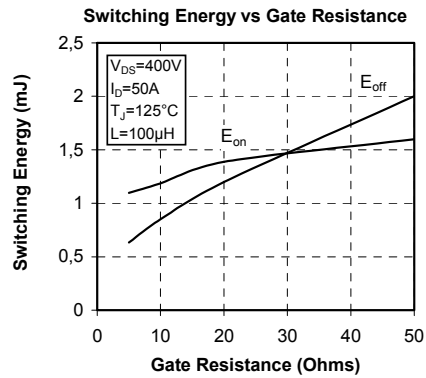
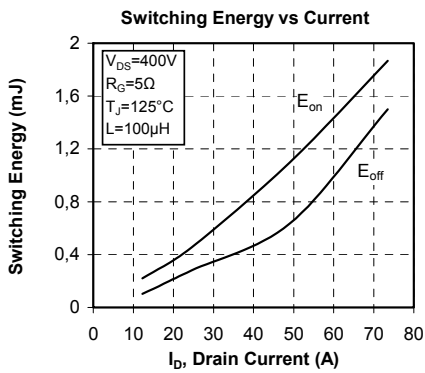
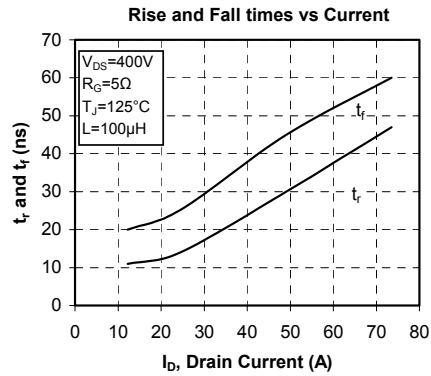
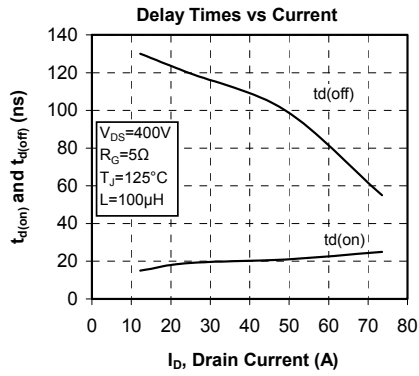
## 5. Typical CoolMOS Performance Curve (Phase leg)





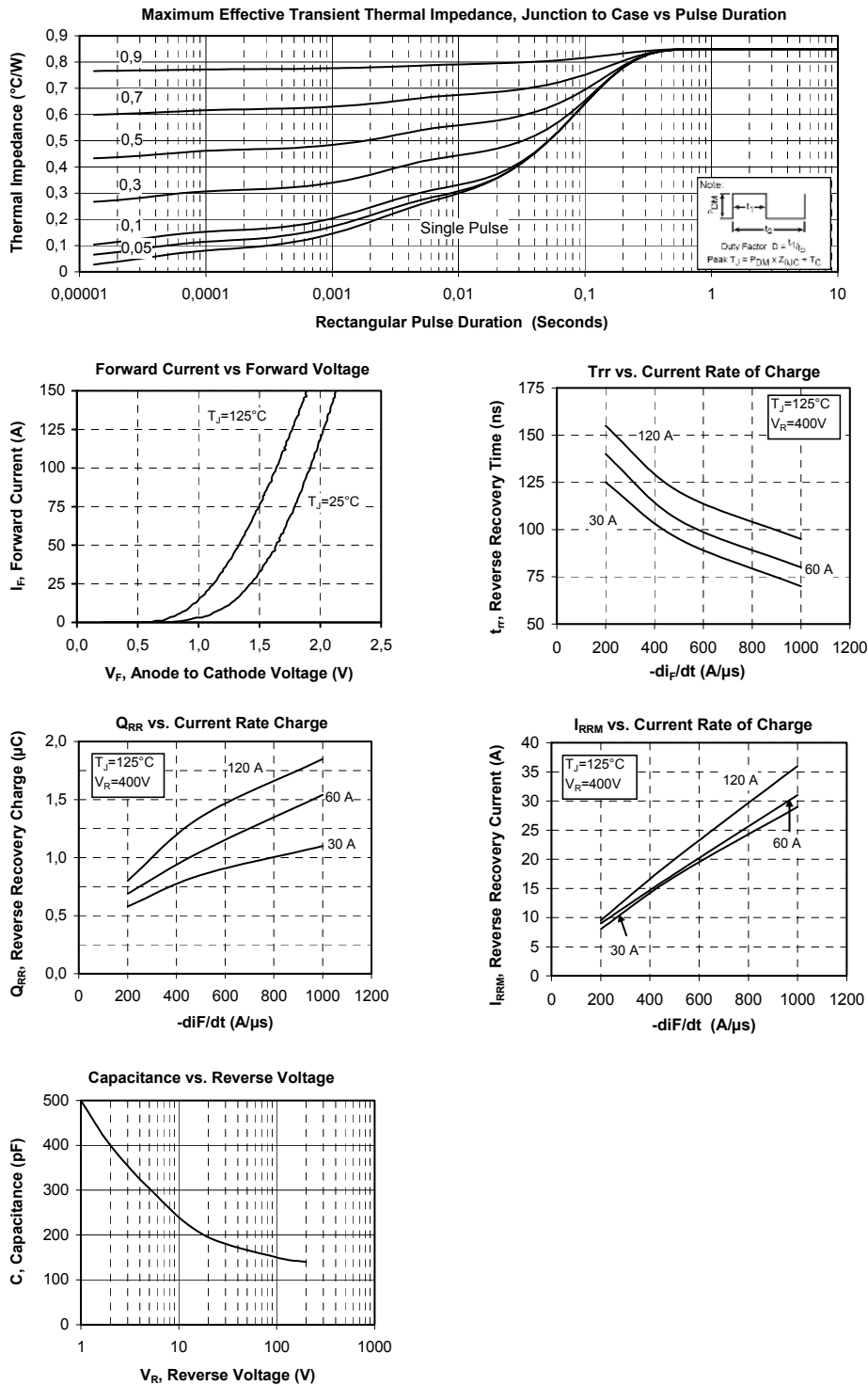
## 6. Typical CoolMOS Performance Curve (Boost chopper)



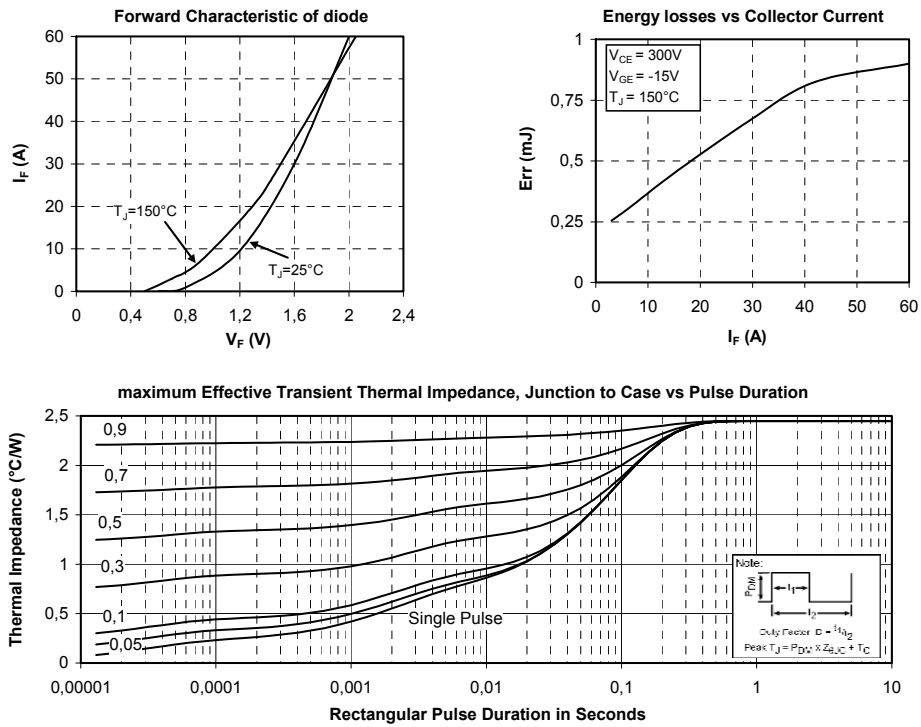




## 7. Typical Performance Curve (CRI)



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



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