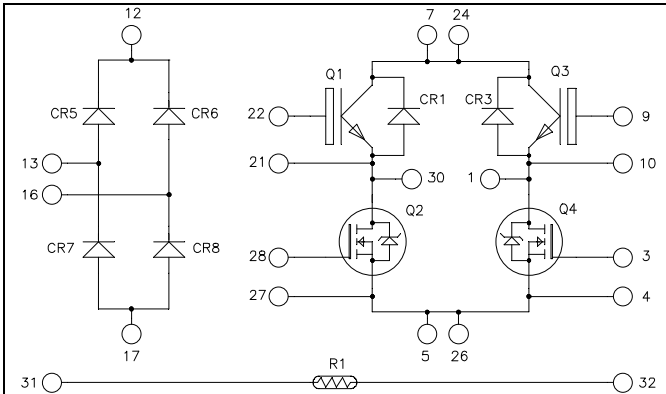
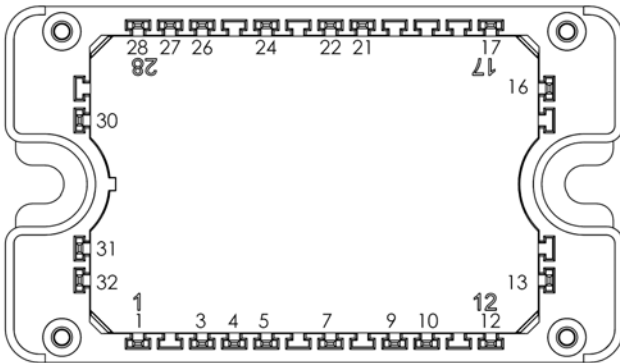


**Full bridge + rectifier bridge  
CoolMOS™ & Trench + Field Stop IGBT3  
Power Module**



Top switches : Trench + Field Stop IGBT3  
Bottom switches : CoolMOS™



All multiple inputs and outputs must be shorted together  
7/24 ; 5/26

**Trench & Field Stop IGBT3 Q1, Q3:**  
 $V_{CES} = 600V$  ;  $I_C = 50A$  @  $T_c = 80^\circ C$

**CoolMOS™ Q2, Q4:**  
 $V_{DSS} = 600V$

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

### Application

- Solar converter

### Features

- **Q2, Q4 CoolMOS™**
  - Ultra low  $R_{DSon}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
- **Q1, Q3 Trench & Field Stop IGBT3**
  - 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
- Very low stray inductance
- Kelvin source for easy drive
- Internal thermistor for temperature monitoring
- High level of integration

### Benefits

- Optimized conduction & switching losses
- 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
- Easy paralleling due to positive  $T_C$  of  $V_{CEsat}$
- 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. Top switches**
**1.1 Top Trench + Field Stop IGBT3 characteristics (per IGBT)**
**Electrical Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{GE} = 0V, V_{CE} = 600V$			250	$\mu A$
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	$V_{GE} = 15V$ $I_C = 50A$		1.5 1.7	1.9	V
		$T_j = 25^\circ C$ $T_j = 150^\circ C$				
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 600\mu A$	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	$V_{GE} = 0V$		3150		pF
$C_{oes}$	Output Capacitance	$V_{CE} = 25V$		200		
$C_{res}$	Reverse Transfer Capacitance	$f = 1MHz$		95		
$Q_G$	Gate charge	$V_{GE} = \pm 15V, I_C = 50A$ $V_{CE} = 300V$		0.5		$\mu C$
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{GE} = \pm 15V$ $V_{Bus} = 300V$ $I_C = 50A$ $R_G = 8.2\Omega$		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) $V_{GE} = \pm 15V$ $V_{Bus} = 300V$ $I_C = 50A$ $R_G = 8.2\Omega$		120		ns
$T_r$	Rise Time			50		
$T_{d(off)}$	Turn-off Delay Time			250		
$T_f$	Fall Time			60		
$E_{off}$	Turn-off Switching Energy	$V_{GE} = \pm 15V$ $V_{Bus} = 300V$ $I_C = 50A$ $R_G = 8.2\Omega$		1.35 1.75		mJ
		$T_j = 25^\circ C$ $T_j = 150^\circ C$				
$I_{sc}$	Short Circuit data	$V_{GE} \leq 15V; V_{Bus} = 360V$ $t_p \leq 6\mu s; T_j = 150^\circ C$		250		A
$R_{thJC}$	Junction to Case Thermal resistance				0.85	$^\circ C/W$

**1.2 Top SiC diode characteristics (CR1, CR3) (per diode)**

<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		20	120	μA
			T <sub>j</sub> = 175°C		40	600	
I <sub>F</sub>	DC Forward Current	T <sub>c</sub> = 100°C			20		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 20A	T <sub>j</sub> = 25°C		1.6	1.8	V
			T <sub>j</sub> = 175°C		2	2.4	
Q <sub>C</sub>	Total Capacitive Charge	I <sub>F</sub> = 20A, V <sub>R</sub> = 300V di/dt = 800A/μs			28		nC
C	Total Capacitance	f = 1MHz, V <sub>R</sub> = 200V			130		pF
		f = 1MHz, V <sub>R</sub> = 400V			100		
R <sub>thJC</sub>	Junction to Case Thermal resistance					1.5	°C/W

**2. Bottom switches**
**2.1 Bottom CoolMOS™ characteristics (Per CoolMOS™)**
**Absolute maximum ratings**

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>	<i>Unit</i>
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>DSon</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**

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
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		658		μJ
E <sub>off</sub>	Turn-off Switching Energy			635		
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		49		A
		T <sub>c</sub> = 80°C		38		
V <sub>SD</sub>	Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>S</sub> = - 49A			1.2	V
dv/dt	Peak Diode Recovery <sup>❶</sup>				4	V/ns
t <sub>rr</sub>	Reverse Recovery Time	I <sub>S</sub> = - 49A V <sub>R</sub> = 350V di <sub>S</sub> /dt = 100A/μs	T <sub>j</sub> = 25°C		600	ns
Q <sub>rr</sub>	Reverse Recovery Charge		T <sub>j</sub> = 25°C		17	μC

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

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

**3. Rectifier bridge (per diode)**
**Absolute maximum ratings**

Symbol	Parameter	Max ratings	Unit
V <sub>R</sub>	Maximum DC reverse Voltage	600	V
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage		
I <sub>F(AV)</sub>	Maximum Average Forward Current	40	A
I <sub>FSM</sub>	Non-Repetitive Forward Surge Current		
		8.3ms	T <sub>j</sub> = 45°C

**Electrical Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 30A		1.8	2.2	V
		I <sub>F</sub> = 60A		2.2		
		I <sub>F</sub> = 30A	T <sub>j</sub> = 125°C		1.5	
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> = 600V	T <sub>j</sub> = 25°C		250	μA
			T <sub>j</sub> = 125°C		500	

**Dynamic Characteristics**

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
$t_{rr}$	Reverse Recovery Time	$I_F=1A, V_R=30V$ $di/dt = 100A/\mu s$	$T_j = 25^\circ C$		22		ns
$t_{rr}$	Reverse Recovery Time	$I_F = 30A$ $V_R = 400V$ $di/dt = 200A/\mu s$	$T_j = 25^\circ C$		25		ns
			$T_j = 125^\circ C$		160		
$Q_{rr}$	Reverse Recovery Charge		$T_j = 25^\circ C$		35		nC
			$T_j = 125^\circ C$		480		
$I_{RRM}$	Reverse Recovery Current		$T_j = 25^\circ C$		3		A
		$T_j = 125^\circ C$		6			
$t_{rr}$	Reverse Recovery Time	$I_F = 30A$ $V_R = 400V$ $di/dt = 1000A/\mu s$	$T_j = 125^\circ C$		85		ns
$Q_{rr}$	Reverse Recovery Charge				920		$\mu C$
$I_{RRM}$	Reverse Recovery Current				20		A
$R_{thJC}$	Junction to Case Thermal Resistance					1.2	$^\circ C/W$

**4. Thermal and package characteristics**
**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		k $\Omega$
$\Delta R_{25}/R_{25}$			5		%
$B_{25/85}$	$T_{25} = 298.15 K$		3952		K
$\Delta B/B$	$T_C = 100^\circ C$		4		%

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

T: Thermistor temperature  
 $R_T$ : Thermistor value at T

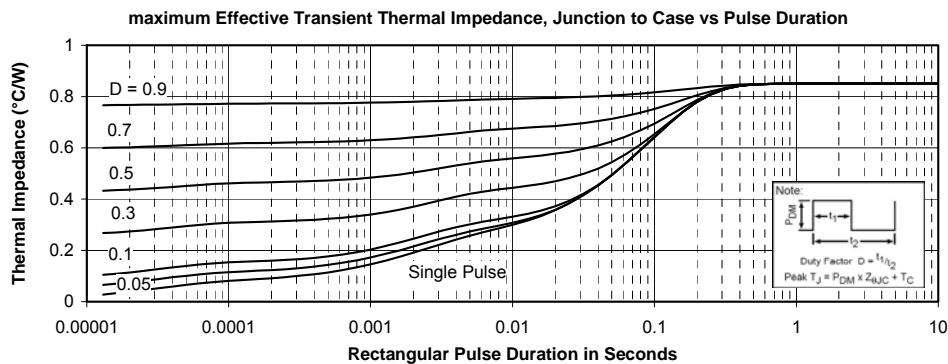
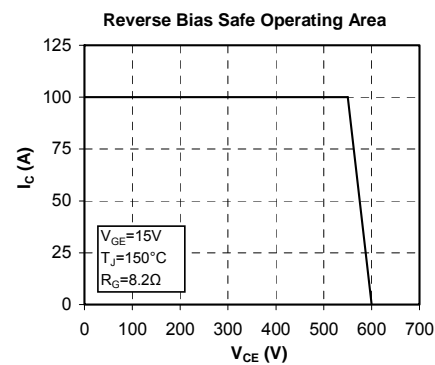
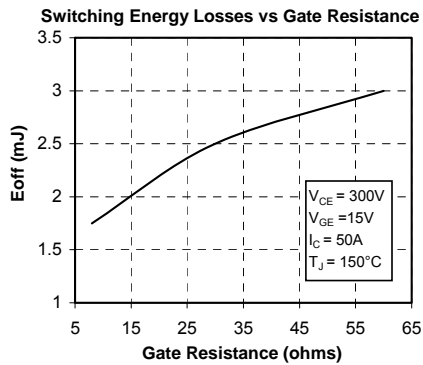
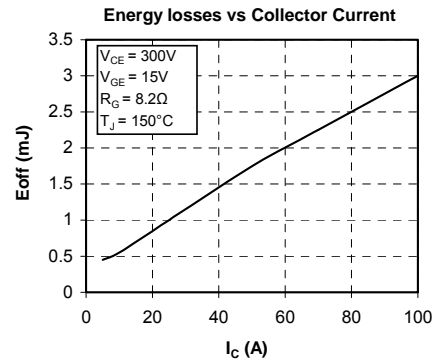
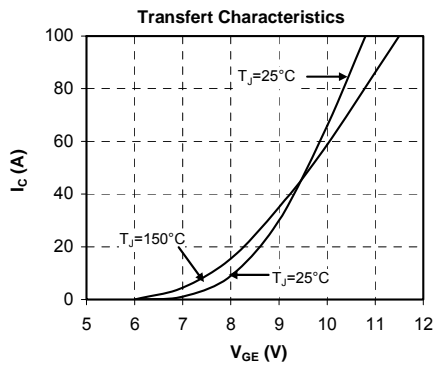
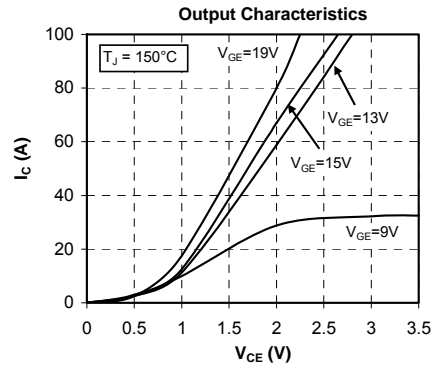
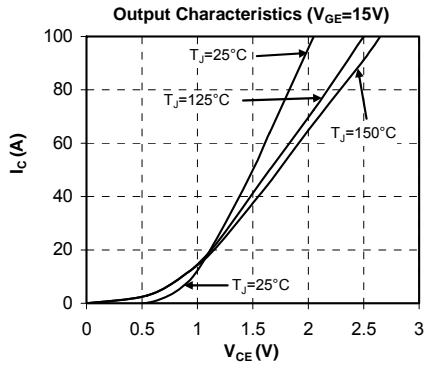
**Package characteristics**

Symbol	Characteristic	Min	Typ	Max	Unit	
$V_{ISOL}$	RMS Isolation Voltage, any terminal to case t=1 min, I isol<1mA, 50/60Hz	4000			V	
$T_j$	Operating junction temperature range	-40		175	$^\circ C$	
$T_{STG}$	Storage Temperature Range	-40		125		
$T_C$	Operating Case Temperature	-40		100		
Torque	Mounting torque	To heatsink	M4	2.5	4.7	N.m
Wt	Package Weight				110	g



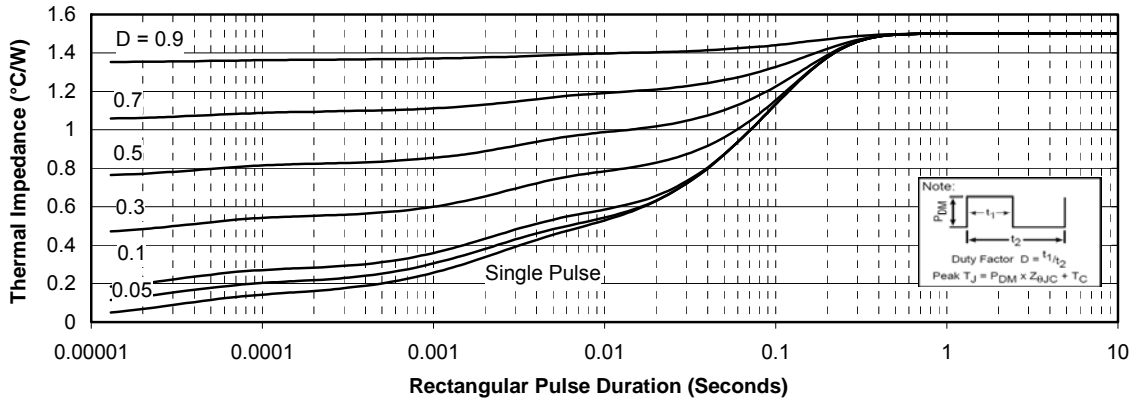
## 5. Top switches curves

### 5.1 Top Trench + Field Stop IGBT3 typical performance curves (per IGBT)

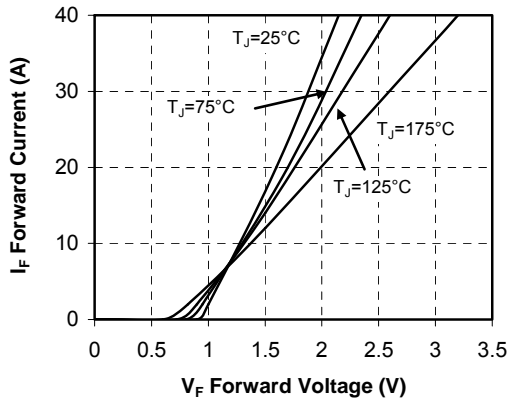


## 5.2 Top SiC diode characteristics (per diode)

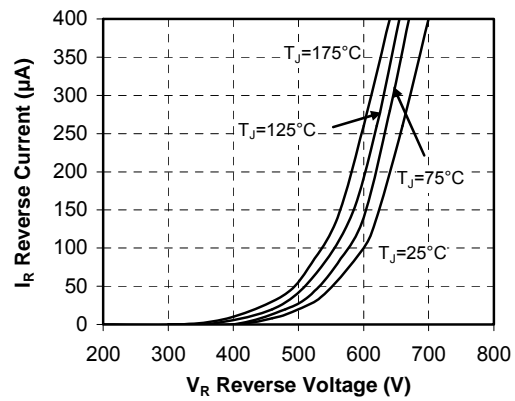
Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



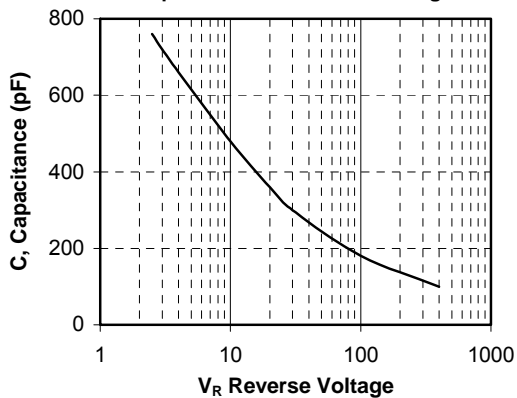
Forward Characteristics



Reverse Characteristics

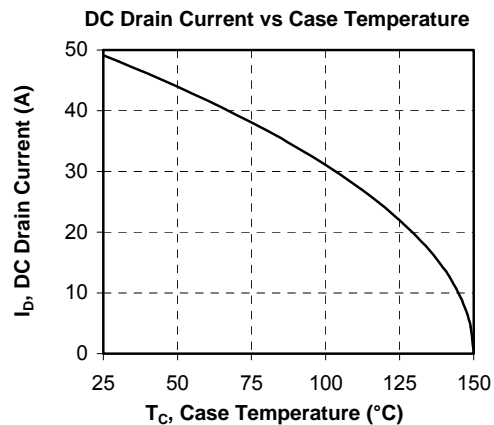
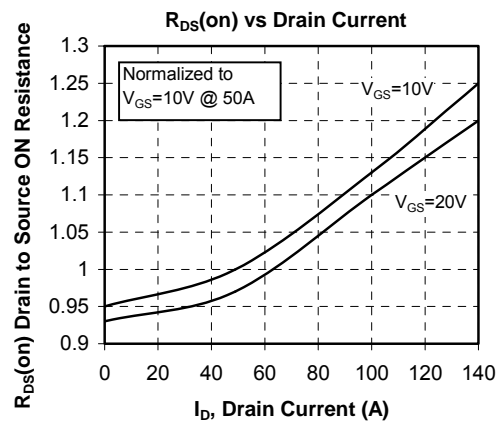
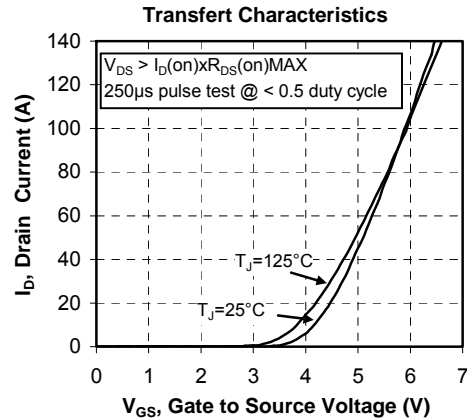
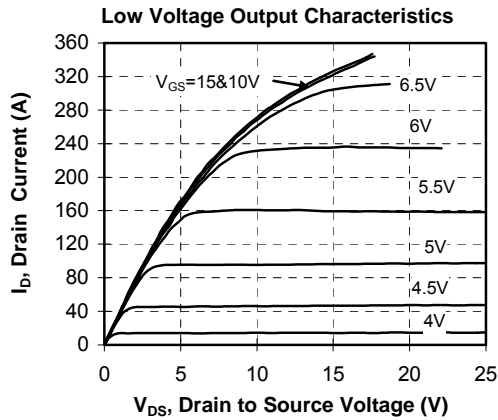
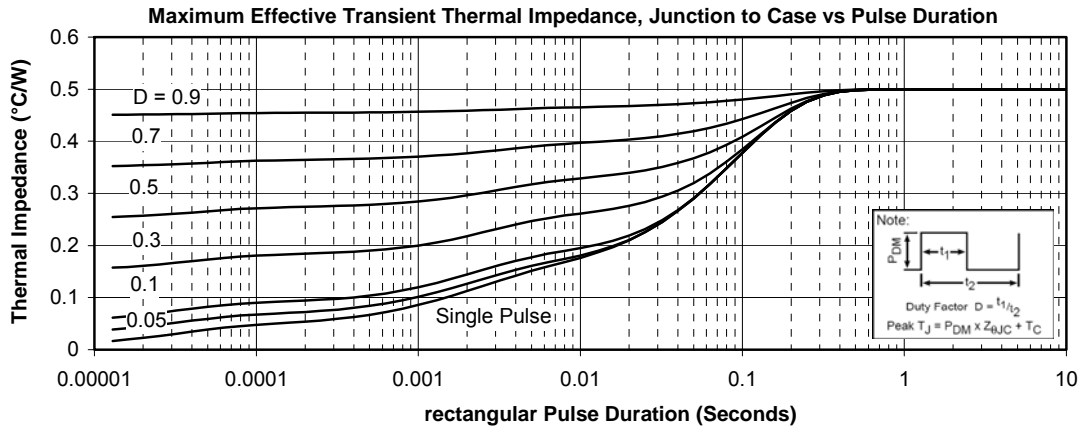


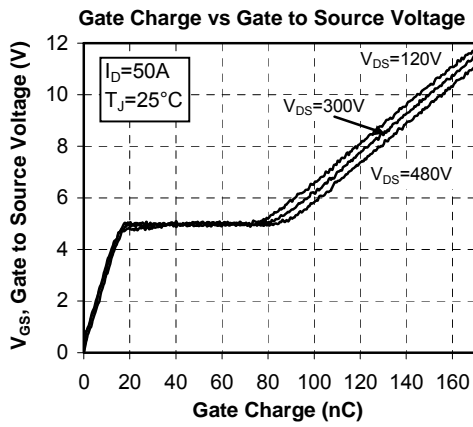
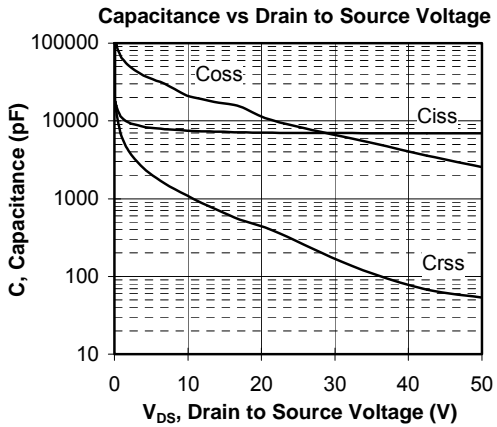
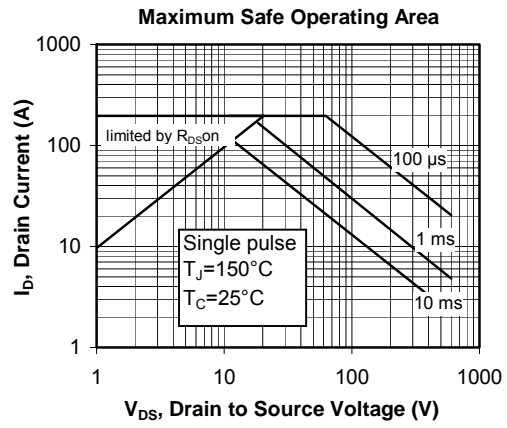
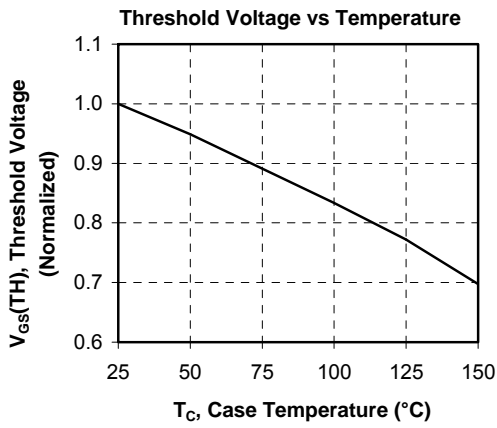
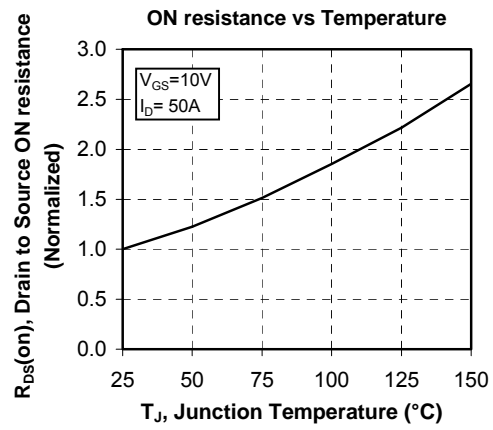
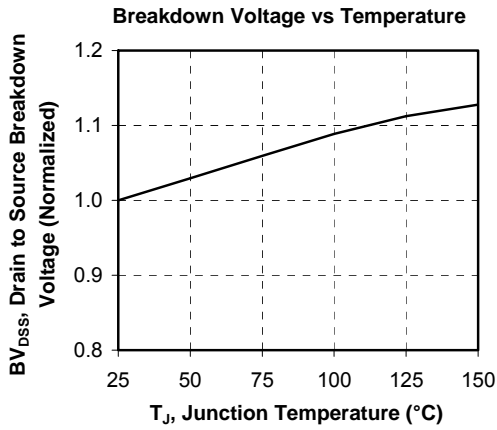
Capacitance vs. Reverse Voltage

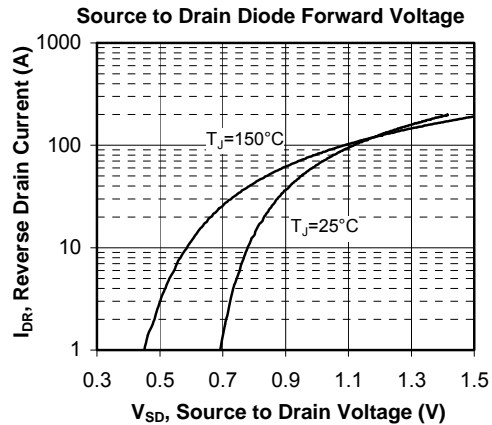
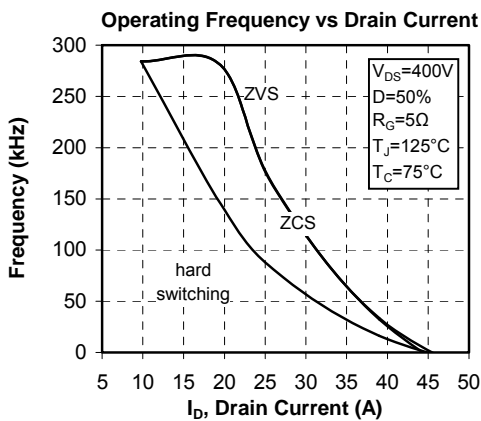
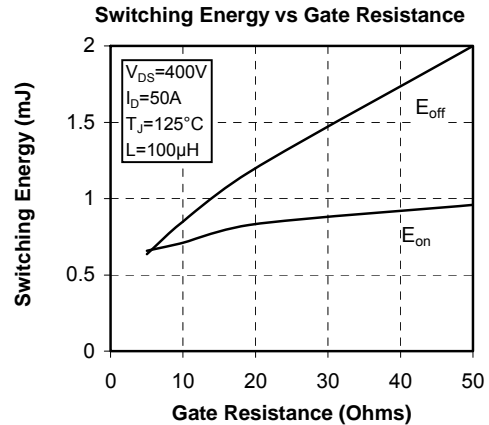
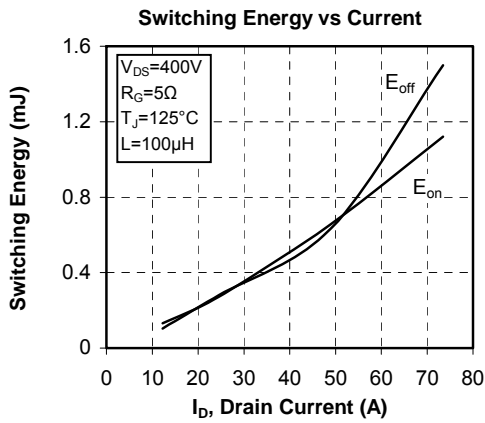
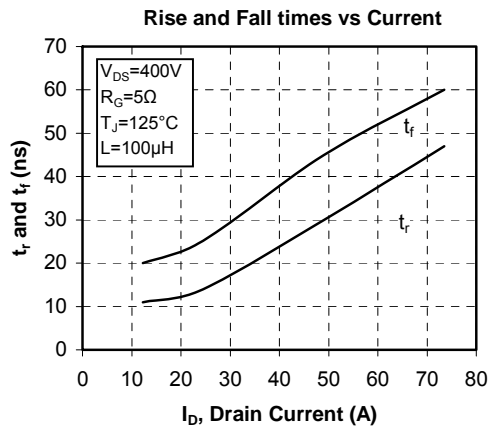
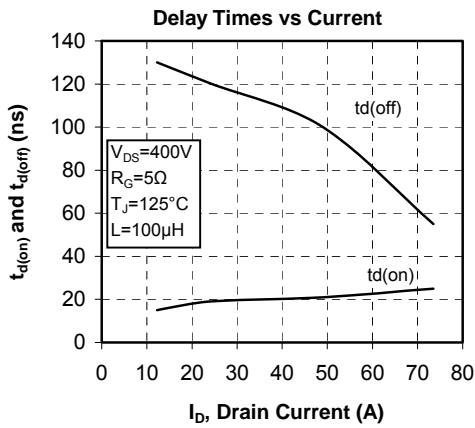




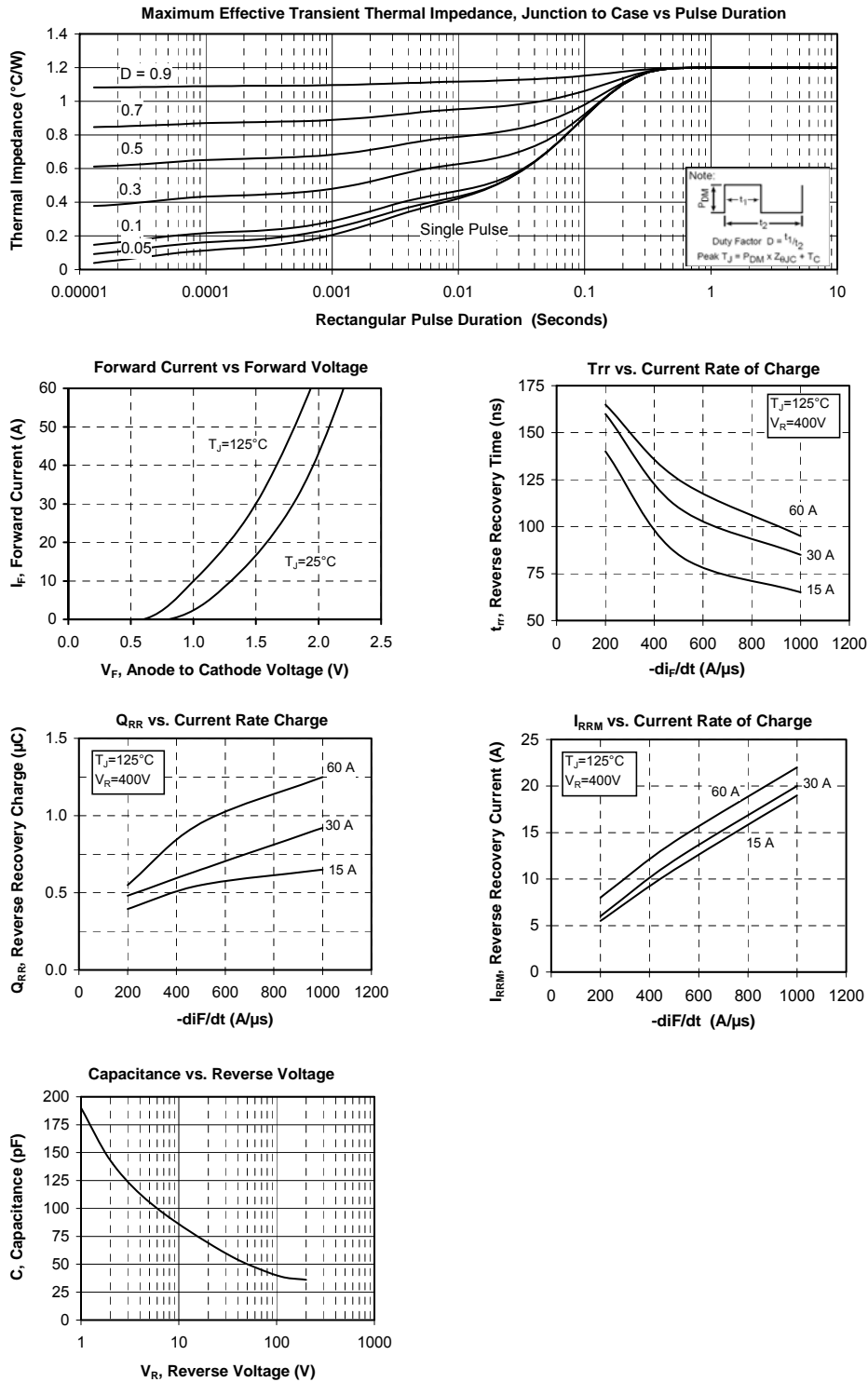
## 6. Bottom switches curves (per CoolMOST™)







## 7. Typical rectifier bridge Performance Curve (per diode)



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

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