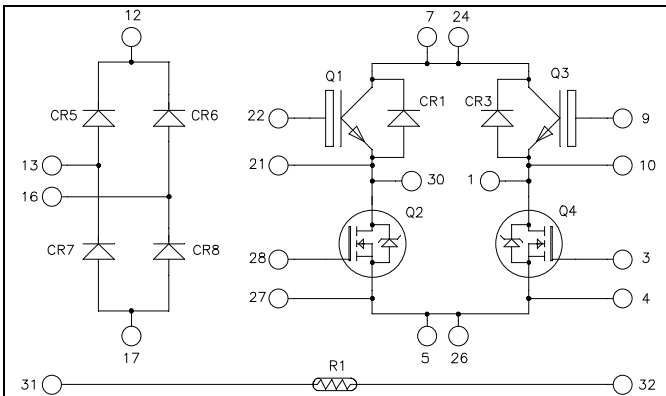
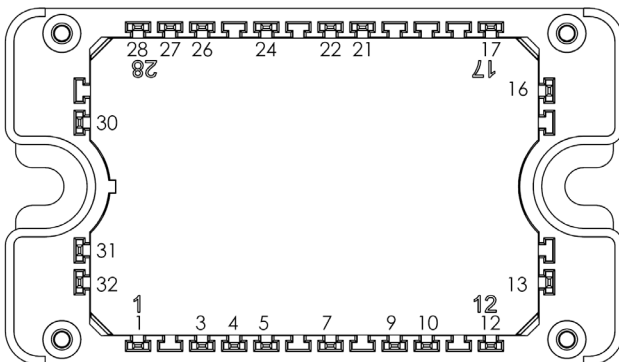


**Full bridge + rectifier bridge
CoolMOS™ & Trench + Field Stop IGBT3
Power Module**



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

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	μA
$V_{CE(sat)}$	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		μC
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ($25^\circ C$) $V_{GE} = \pm 15V$ $V_{Bus} = 300V$ $I_C = 50A$ $R_G = 8.2\Omega$		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 ($150^\circ C$) $V_{GE} = \pm 15V$ $V_{Bus} = 300V$ $I_C = 50A$ $R_G = 8.2\Omega$		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 _{RRM}	Maximum Peak Repetitive Reverse Voltage		600			V
I _{RM}	Maximum Reverse Leakage Current	V _R =600V		T _j = 25°C 20 T _j = 175°C 40	120 600	μA
I _F	DC Forward Current			T _c = 100°C 20		A
V _F	Diode Forward Voltage	I _F = 20A		T _j = 25°C 1.6 T _j = 175°C 2	1.8 2.4	V
Q _C	Total Capacitive Charge	I _F = 20A, V _R = 300V di/dt = 800A/μs		28		nC
C	Total Capacitance	f = 1MHz, V _R = 200V f = 1MHz, V _R = 400V		130 100		pF
R _{thJC}	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 _{DSS}	Drain - Source Breakdown Voltage	600	V
I _D	Continuous Drain Current	T _c = 25°C 49 T _c = 80°C 38	A
I _{DM}	Pulsed Drain current	130	
V _{GS}	Gate - Source Voltage	±20	V
R _{DS(on)}	Drain - Source ON Resistance	45	mΩ
P _D	Maximum Power Dissipation	T _c = 25°C 250	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

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
I _{DSS}	Zero Gate Voltage Drain Current	V _{GS} = 0V, V _{DS} = 600V T _j = 25°C V _{GS} = 0V, V _{DS} = 600V T _j = 125°C			250 500	μA
R _{DS(on)}	Drain – Source on Resistance	V _{GS} = 10V, I _D = 24.5A		40	45	mΩ
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} = ±20 V, 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 = 5Ω		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 = 5Ω		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 = 5Ω		658		μJ
E _{off}	Turn-off Switching Energy			635		
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		49		A
		T _c = 80°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 _S /dt = 100A/μs	T _j = 25°C		600	ns
Q _{rr}	Reverse Recovery Charge		T _j = 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 _R	Maximum DC reverse Voltage	600	V
V _{RRM}	Maximum Peak Repetitive Reverse Voltage		
I _{F(AV)}	Maximum Average Forward Current	40	A
I _{FSM}	Non-Repetitive Forward Surge Current		
		8.3ms	T _j = 45°C

Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V _F	Diode Forward Voltage	I _F = 30A		1.8	2.2	V
		I _F = 60A		2.2		
		I _F = 30A	T _j = 125°C		1.5	
I _{RM}	Maximum Reverse Leakage Current	V _R = 600V	T _j = 25°C		250	μA
			T _j = 125°C		500	

Dynamic Characteristics

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
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		μC
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).

<i>Symbol</i>	<i>Characteristic</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
R_{25}	Resistance @ 25°C		50		k Ω
$\Delta R_{25}/R_{25}$			5		%
$B_{25/85}$	$T_{25} = 298.15 K$		3952		K
$\Delta B/B$	$T_C = 100^\circ C$		4		%

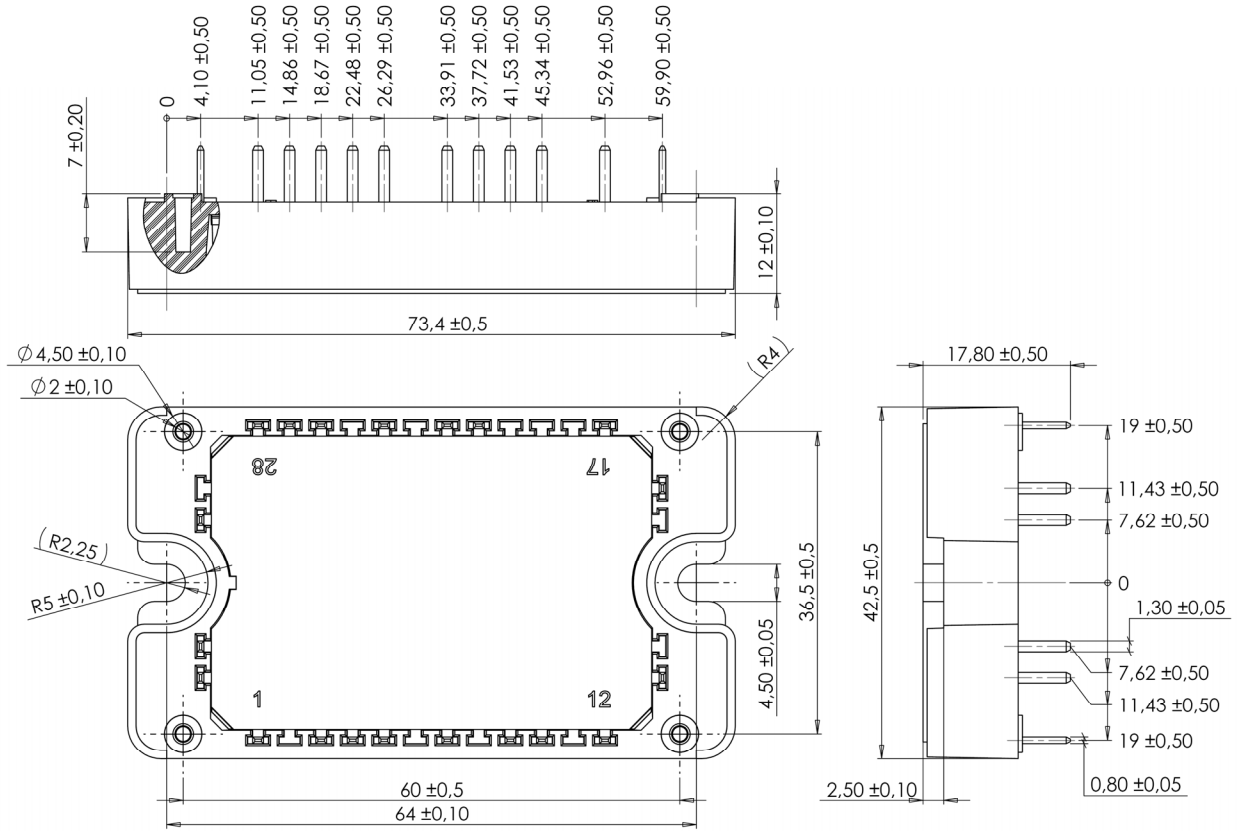
$$R_T = \frac{R_{25}}{\exp \left[B_{25/85} \left(\frac{1}{T_{25}} - \frac{1}{T} \right) \right]}$$

T: Thermistor temperature
 R_T : Thermistor value at T

Package characteristics

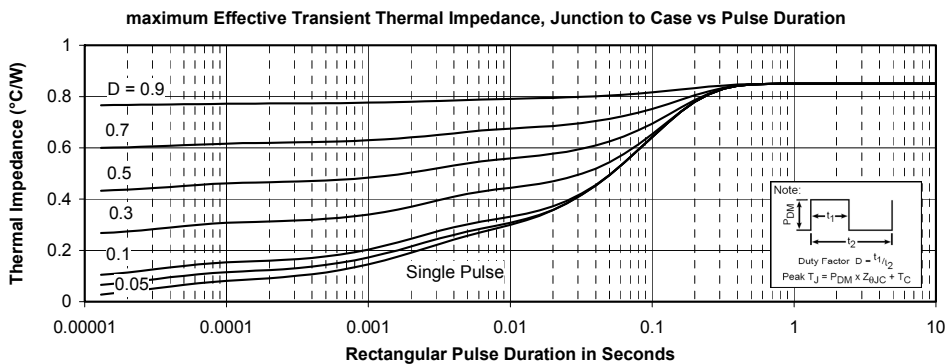
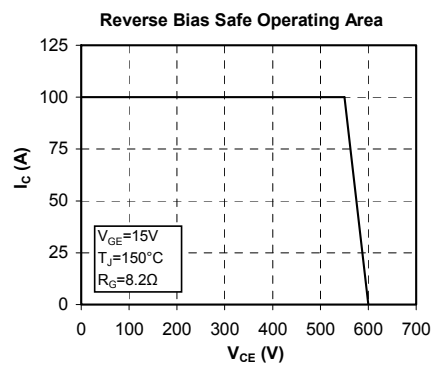
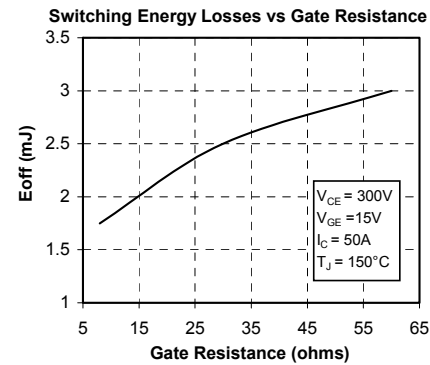
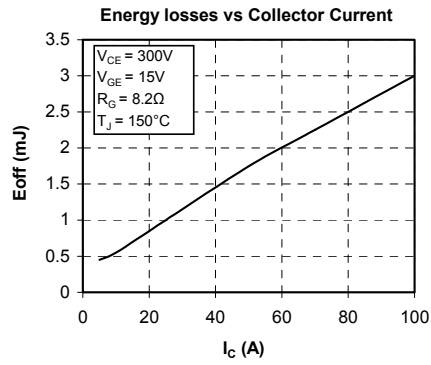
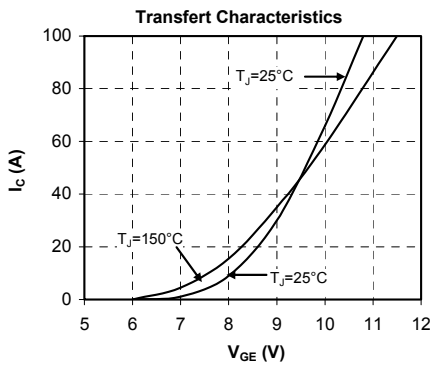
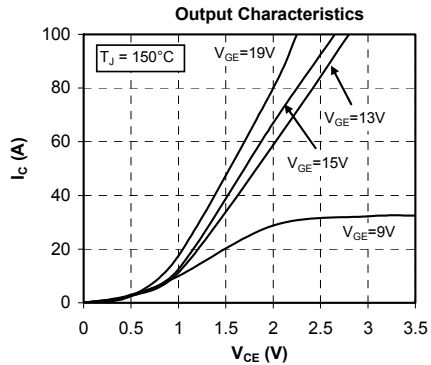
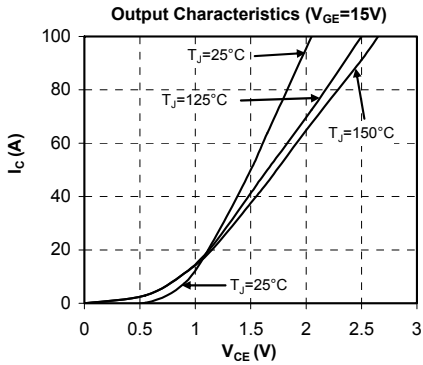
<i>Symbol</i>	<i>Characteristic</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>	
V_{ISOL}	RMS Isolation Voltage, any terminal to case t=1 min, 50/60Hz	4000			V	
T_J	Operating junction temperature range	-40		175	$^\circ C$	
T_{STG}	Storage Temperature Range	-40		125		
T_C	Operating Case Temperature	-40		100		
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package Weight				110	g

SP3 Package outline (dimensions in mm)



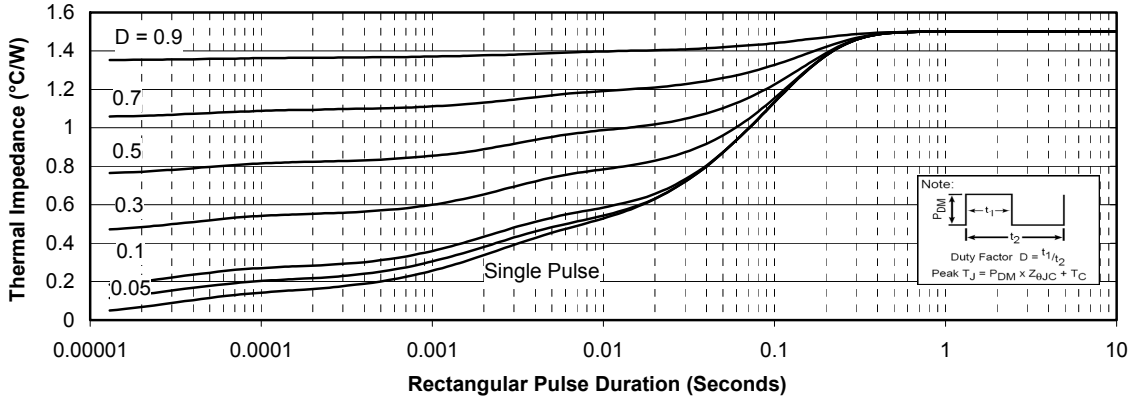
5. Top switches curves

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

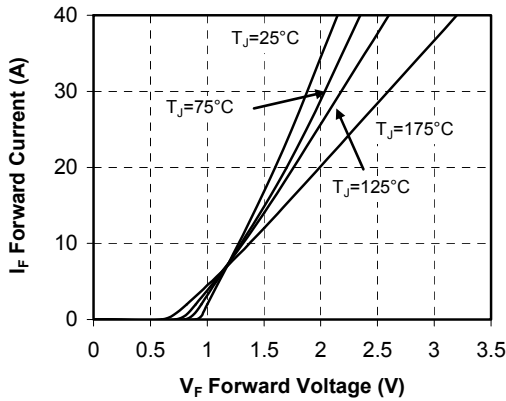


5.2 Top SiC diode characteristics (per diode)

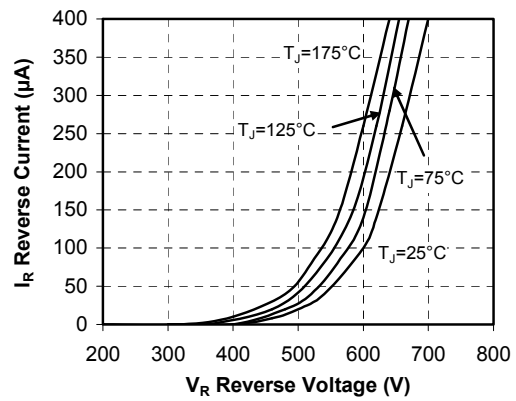
Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



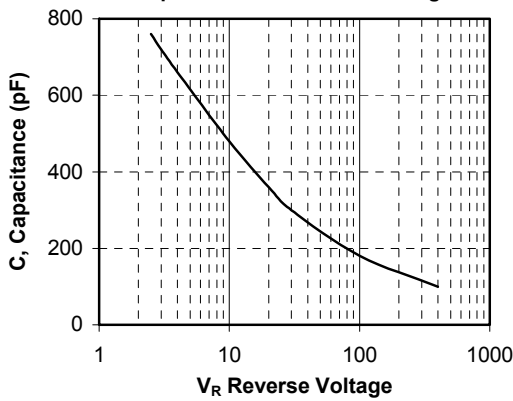
Forward Characteristics



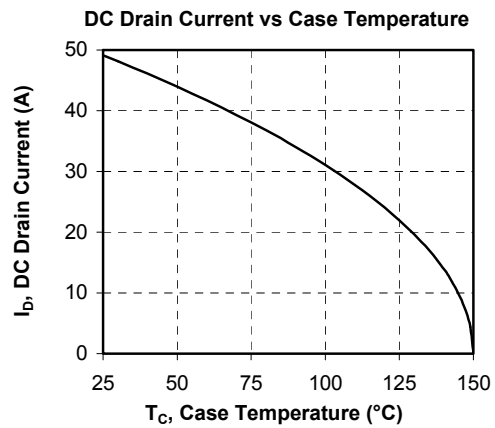
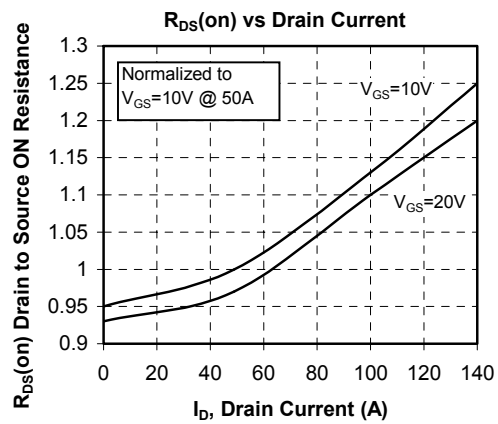
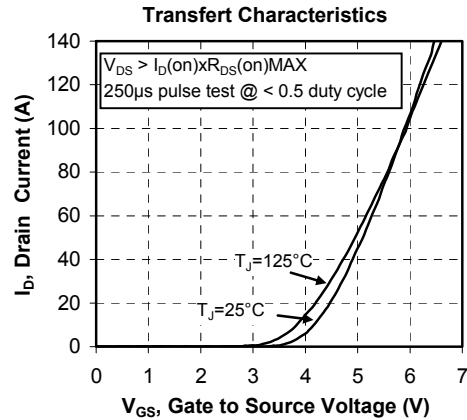
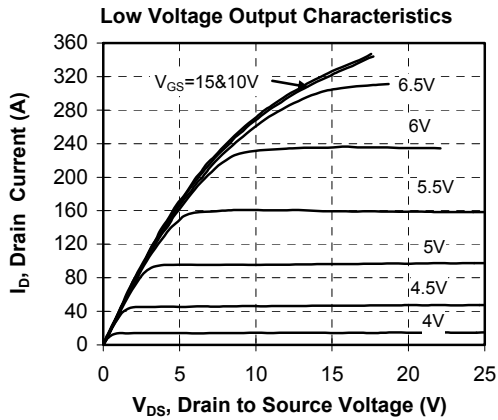
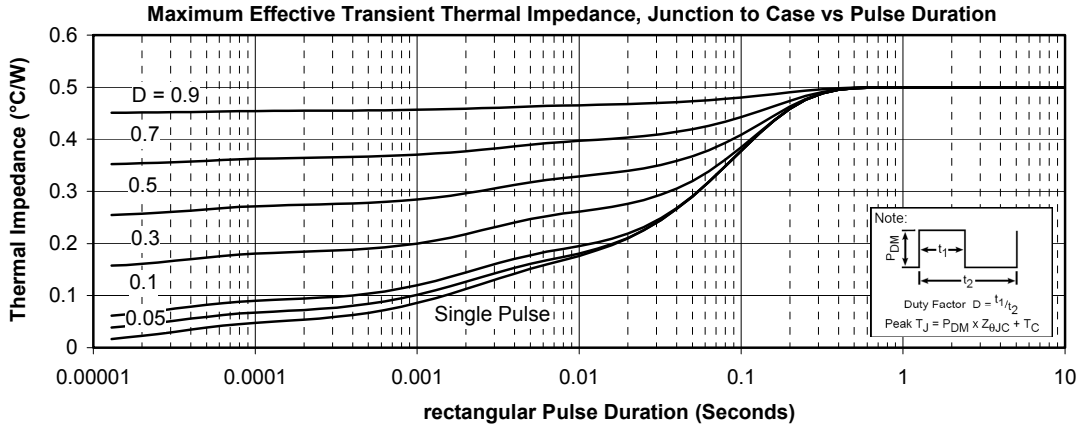
Reverse Characteristics

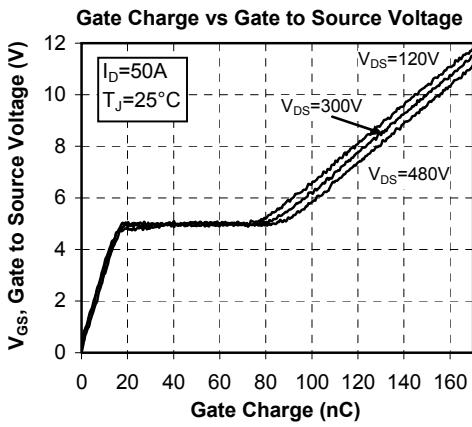
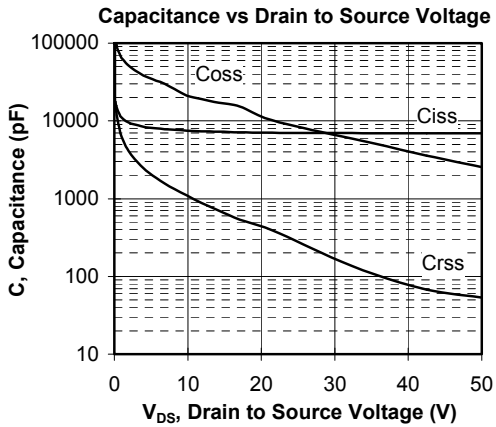
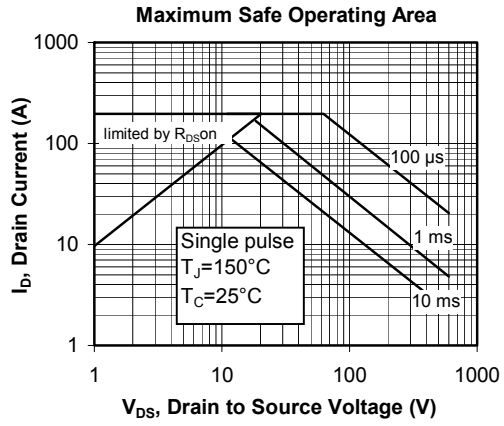
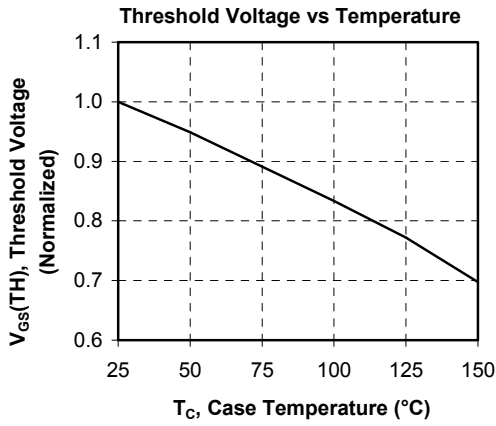
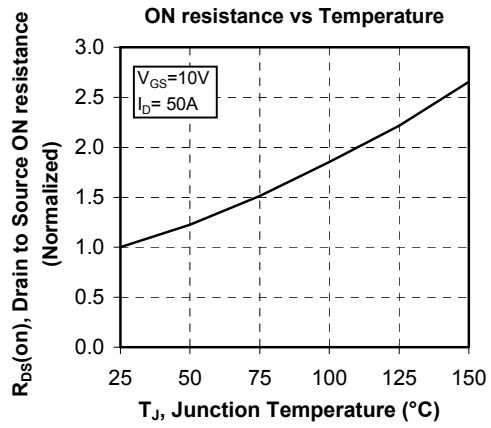
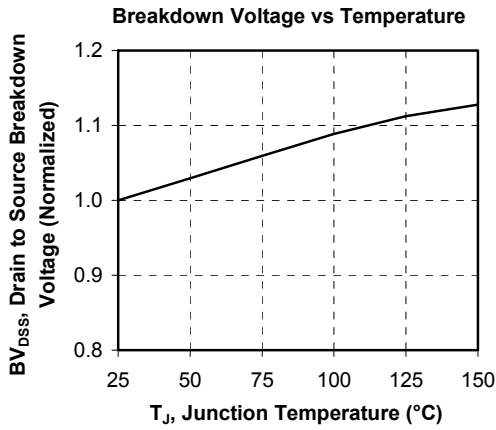


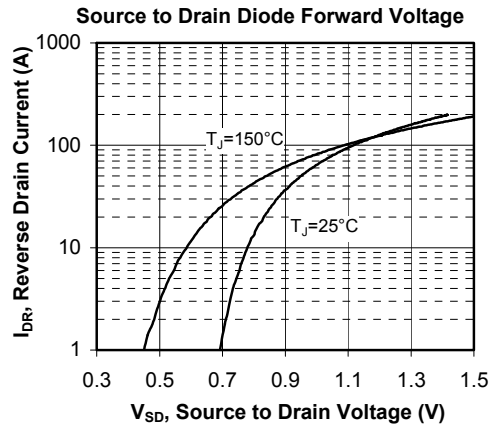
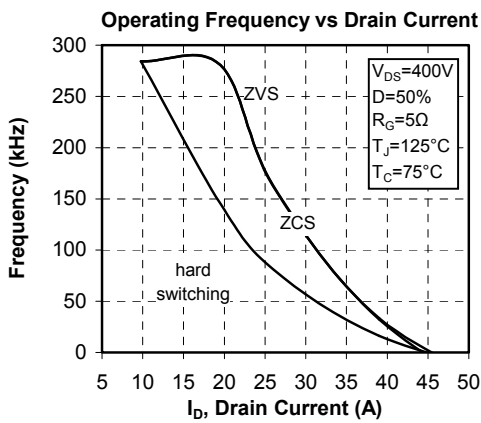
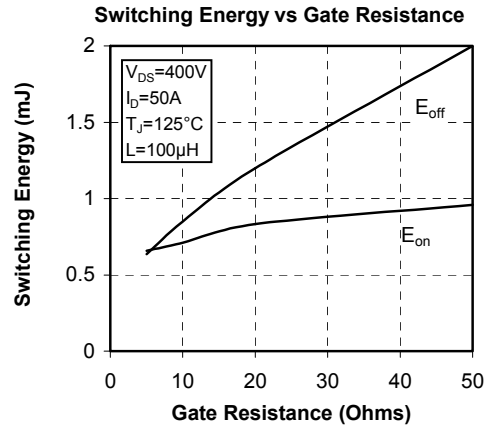
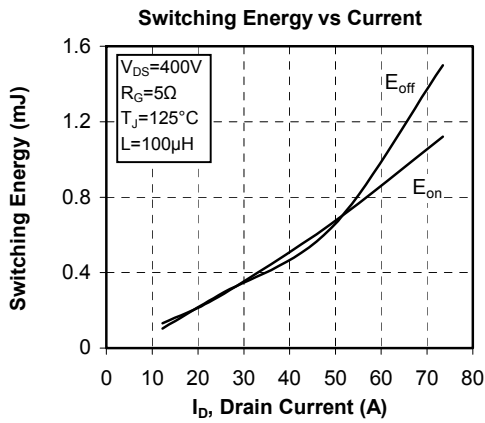
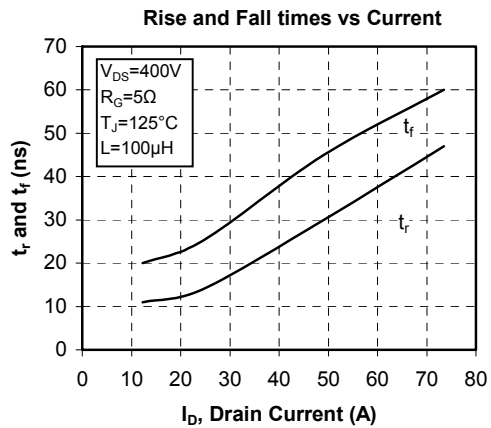
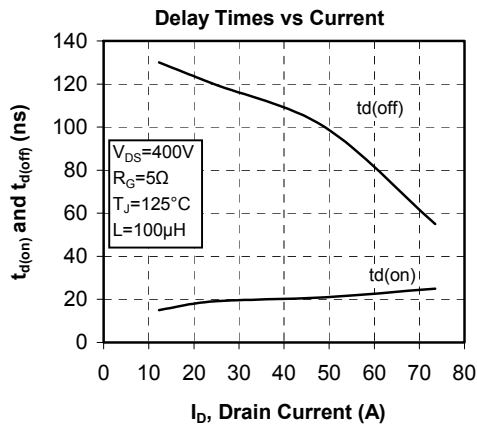
Capacitance vs. Reverse Voltage



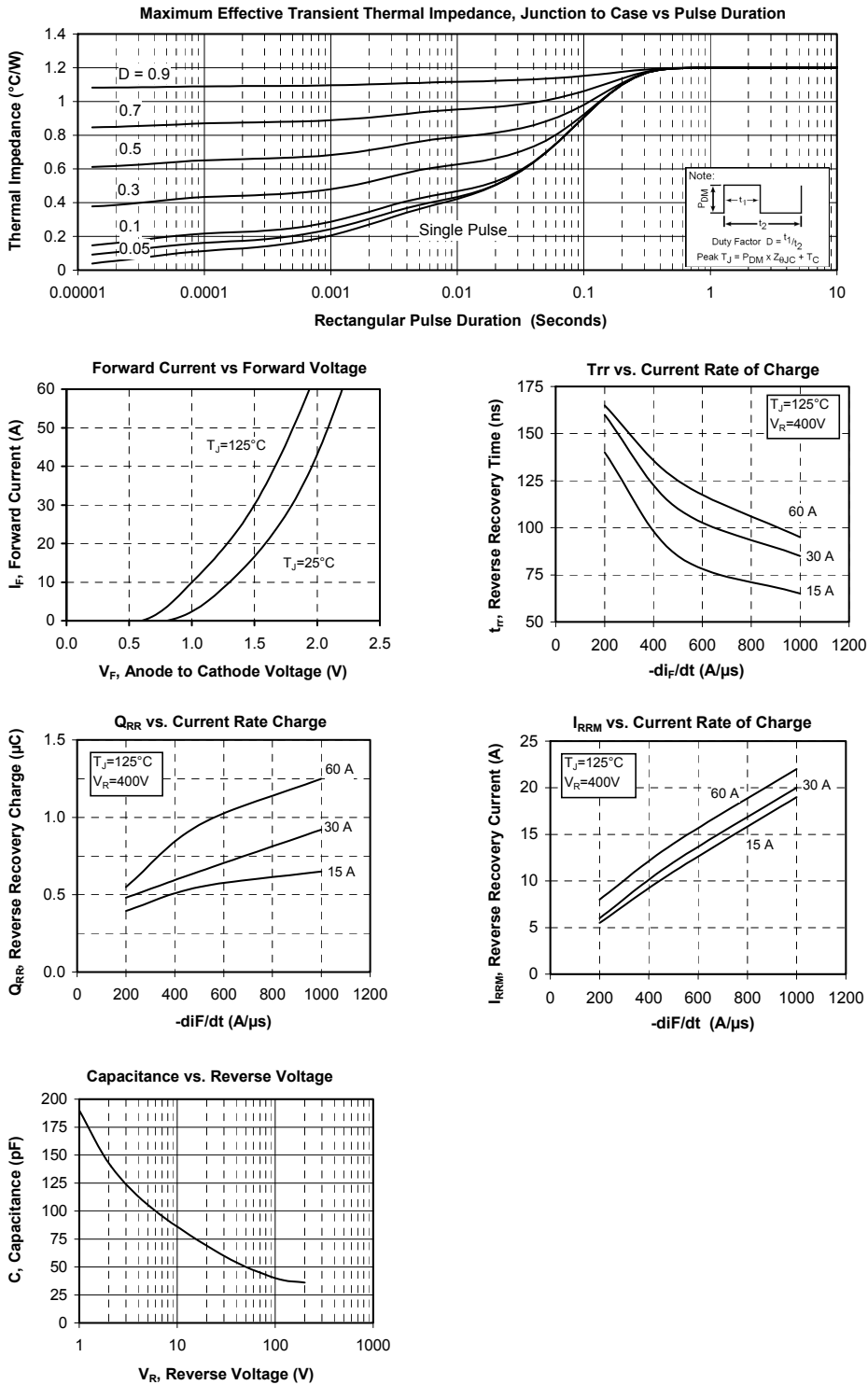
6. Bottom switches curves (per CoolMOST™)







7. Typical rectifier bridge Performance Curve (per diode)



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