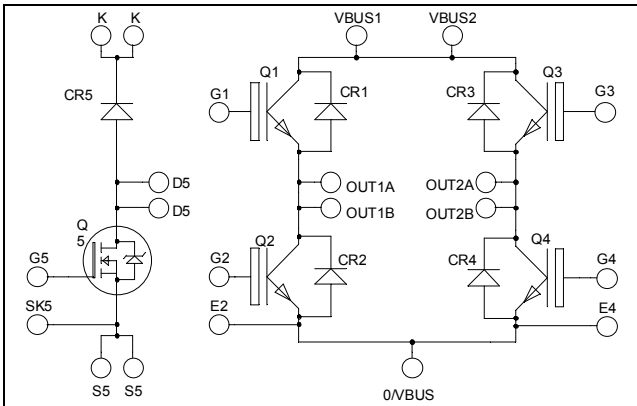
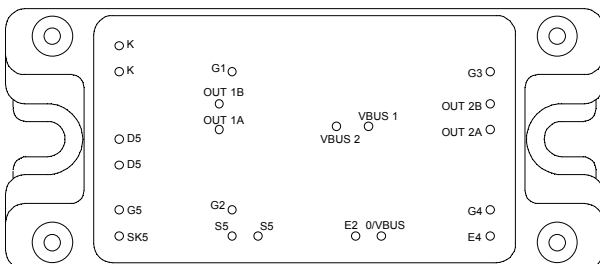


**Boost chopper CoolMos™
+ full bridge
NPT & Trench + Field Stop IGBT
Power module**



Full bridge top switches : Trench + Field Stop IGBT
 Full bridge bottom switches : FAST NPT IGBT
 Q5 boost chopper : CoolMOS™



All multiple inputs and outputs must be shorted together
 OUT1A/OUT1B ; VBUS1/VBUS2 ; K/K ; ...

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

Fast NPT IGBT Q2, Q4:
 $V_{CES} = 600V$; $I_C = 50A$ @ $T_c = 80^\circ C$

CoolMOS™ Q5:
 $V_{CES} = 600V$; $I_C = 49A$ @ $T_c = 25^\circ C$

Application

- Solar converter

Features

- **Q2, Q4 (FAST Non Punch Through (NPT) IGBT)**
 - Switching frequency up to 100 kHz
 - RBSOA & SCSOA rated
 - Low tail current
- **Q1, Q3 (Trench & Field Stop IGBT)**
 - Low voltage drop
 - Switching frequency up to 20 kHz
 - RBSOA & SCSOA rated
 - Low tail current

Q5 (CoolMOS™)

- Ultra low R_{DSon}
- Low Miller capacitance
- Ultra low gate charge
- Avalanche energy rated

- Kelvin emitter for easy drive
- Very low stray inductance
- 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

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

All ratings @ $T_j = 25^\circ\text{C}$ unless otherwise specified

1. Full bridge top switches
1.1 Top Trench + Field Stop IGBT[®] characteristics
Absolute maximum ratings

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>	<i>Unit</i>
V_{CES}	Collector - Emitter Breakdown Voltage	600	V
I_C	Continuous Collector Current	$T_C = 25^\circ\text{C}$	80
		$T_C = 80^\circ\text{C}$	50
I_{CM}	Pulsed Collector Current	$T_C = 25^\circ\text{C}$	100
V_{GE}	Gate - Emitter Voltage	± 20	V
P_D	Maximum Power Dissipation	$T_C = 25^\circ\text{C}$	176
RBSOA	Reverse Bias Safe Operating Area	$T_j = 150^\circ\text{C}$	100A @ 550V

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_{CES}	Zero Gate Voltage Collector Current	$V_{GE} = 0\text{V}, V_{CE} = 600\text{V}$			250	μA
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	$V_{GE} = 15\text{V}$ $I_C = 50\text{A}$	$T_j = 25^\circ\text{C}$	1.5	1.9	V
			$T_j = 150^\circ\text{C}$	1.7		
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 600\mu\text{A}$	5.0	5.8	6.5	V
I_{GES}	Gate - Emitter Leakage Current	$V_{GE} = 20\text{V}, V_{CE} = 0\text{V}$			600	nA

Dynamic Characteristics

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
C_{ies}	Input Capacitance	$V_{GE} = 0\text{V}$ $V_{CE} = 25\text{V}$ $f = 1\text{MHz}$		3150		pF
C_{oes}	Output Capacitance			200		
C_{res}	Reverse Transfer Capacitance			95		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$ $R_G = 8.2\Omega$		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) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$ $R_G = 8.2\Omega$		120		ns
T_r	Rise Time			50		
$T_{d(off)}$	Turn-off Delay Time			250		
T_f	Fall Time			60		
E_{on}	Turn-on Switching Energy	$V_{GE} = \pm 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$ $R_G = 8.2\Omega$	$T_j = 25^\circ\text{C}$	0.3		mJ
			$T_j = 150^\circ\text{C}$	0.43		
E_{off}	Turn-off Switching Energy	$I_C = 50\text{A}$ $R_G = 8.2\Omega$	$T_j = 25^\circ\text{C}$	1.35		mJ
			$T_j = 150^\circ\text{C}$	1.75		
R_{thJC}	Junction to Case Thermal resistance				0.85	$^\circ\text{C/W}$

1.2 Top fast diode characteristics

<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	$V_R=600V$	$T_j = 25^\circ C$			25	μA
			$T_j = 125^\circ C$			500	
I_F	DC Forward Current	$T_c = 80^\circ C$			30		A
V_F	Diode Forward Voltage	$I_F = 30A$			1.8	2.3	V
		$I_F = 60A$			2.1		
		$I_F = 30A$	$T_j = 125^\circ C$		1.5		
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	$I_F = 30A$	$V_R = 400V$	$di/dt = 200A/\mu s$	$T_j = 25^\circ C$	35	nC
					$T_j = 125^\circ C$	480	
R_{thJC}	Junction to Case Thermal resistance					1.2	$^\circ C/W$

2. Full bridge bottom switches

2.1 Bottom Fast NPT IGBT characteristics

Absolute maximum ratings

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>		<i>Unit</i>
V_{CES}	Collector - Emitter Breakdown Voltage	600		V
I_C	Continuous Collector Current	$T_c = 25^\circ C$	65	A
		$T_c = 80^\circ C$	50	
I_{CM}	Pulsed Collector Current	$T_c = 25^\circ C$	230	
V_{GE}	Gate - Emitter Voltage	± 20		V
P_D	Maximum Power Dissipation	$T_c = 25^\circ C$	250	W
RBSOA	Reverse Bias Safe Operating Area	$T_j = 125^\circ C$	100A @ 500V	

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_{CES}	Zero Gate Voltage Collector Current	$V_{GE} = 0V$	$V_{CE} = 600V$	$T_j = 25^\circ C$		250	μA
				$T_j = 125^\circ C$		500	
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	$V_{GE} = 15V$	$I_C = 50A$	$T_j = 25^\circ C$	1.7	2.0	V
				$T_j = 125^\circ C$		2.2	
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1mA$		4		6	V
I_{GES}	Gate - Emitter Leakage Current	$V_{GE} = 20V, V_{CE} = 0V$				400	nA

Dynamic Characteristics

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
C_{ies}	Input Capacitance	$V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1MHz$		2200		pF
C_{oes}	Output Capacitance			323		
C_{res}	Reverse Transfer Capacitance			200		
Q_g	Total gate Charge	$V_{GE} = 15V$ $V_{Bus} = 300V$ $I_C = 50A$		166		nC
Q_{ge}	Gate – Emitter Charge			20		
Q_{gc}	Gate – Collector Charge			100		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{GE} = 15V$ $V_{Bus} = 400V$ $I_C = 50A$ $R_G = 2.7\Omega$		40		ns
T_r	Rise Time			9		
$T_{d(off)}$	Turn-off Delay Time			120		
T_f	Fall Time			12		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{GE} = 15V$ $V_{Bus} = 400V$ $I_C = 50A$ $R_G = 2.7\Omega$		42		ns
T_r	Rise Time			10		
$T_{d(off)}$	Turn-off Delay Time			130		
T_f	Fall Time			21		
E_{on}	Turn-on Switching Energy	$V_{GE} = 15V$ $V_{Bus} = 400V$ $I_C = 50A$ $R_G = 2.7\Omega$	$T_j = 125^\circ C$	0.5		mJ
E_{off}	Turn-off Switching Energy			$T_j = 125^\circ C$	1	
R_{thJC}	Junction to Case Thermal resistance				0.5	°C/W

2.2 Bottom diode characteristics

<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	$V_R = 600V$	$T_j = 25^\circ C$		25	μA
			$T_j = 125^\circ C$		500	
I_F	DC Forward Current			30		A
V_F	Diode Forward Voltage	$I_F = 30A$		1.8	2.3	V
		$I_F = 60A$		2.1		
		$I_F = 30A$	$T_j = 125^\circ C$	1.5		
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	$I_F = 30A$ $V_R = 400V$ $di/dt = 200A/\mu s$	$T_j = 25^\circ C$	35		nC
			$T_j = 125^\circ C$	480		
R_{thJC}	Junction to Case Thermal resistance				1.2	°C/W

3. Boost chopper switch

3.1 CoolMOS™ characteristics

Absolute maximum ratings

Symbol	Parameter	Max ratings	Unit
V _{DSS}	Drain - Source Breakdown Voltage	600	V
I _D	Continuous Drain Current	T _c = 25°C	49
		T _c = 80°C	38
I _{DM}	Pulsed Drain current	130	A
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	290
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°C		250	μA
		V _{GS} = 0V, V _{DS} = 600V	T _j = 125°C		500	
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			0.29		
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 = 4.7Ω		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 = 4.7Ω		675		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 = 4.7Ω		1100		μJ
E _{off}	Turn-off Switching Energy			635		
R _{thJC}	Junction to Case Thermal resistance				0.5	°C/W

3.2 Chopper diode characteristics

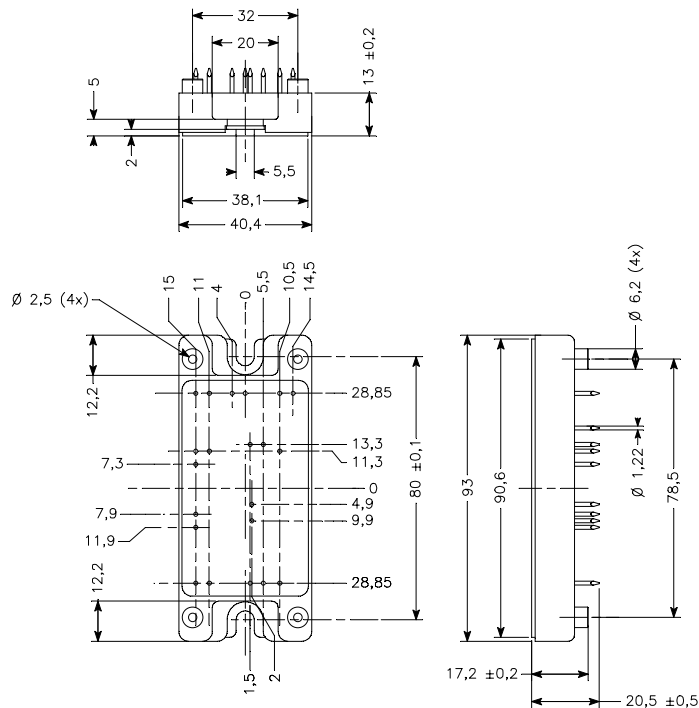
Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V _{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I _{RM}	Maximum Reverse Leakage Current	V _R =600V	T _j = 25°C			25	μA
			T _j = 125°C			500	
I _F	DC Forward Current	T _c = 80°C			60		A
V _F	Diode Forward Voltage	I _F = 60A			1.7	2.3	V
		I _F = 120A			2		
		I _F = 60A	T _j = 125°C		1.4		
t _{rr}	Reverse Recovery Time	I _F = 60A V _R = 400V di/dt = 200A/μs	T _j = 25°C		70		ns
	T _j = 125°C			140			
Q _{rr}	Reverse Recovery Charge	I _F = 60A V _R = 400V di/dt = 200A/μs	T _j = 25°C		100		nC
	T _j = 125°C			690			
R _{thJC}	Junction to Case Thermal resistance					0.85	°C/W

4. 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	2500			V	
T _J	Operating junction temperature range	-40		150*	°C	
T _{STG}	Storage Temperature Range	-40		125		
T _C	Operating Case Temperature	-40		100		
Torque	Mounting torque	To heatsink	M5	2.5	4.7	N.m
Wt	Package Weight				160	g

* T_J=175°C for Trench & Field Stop IGBT

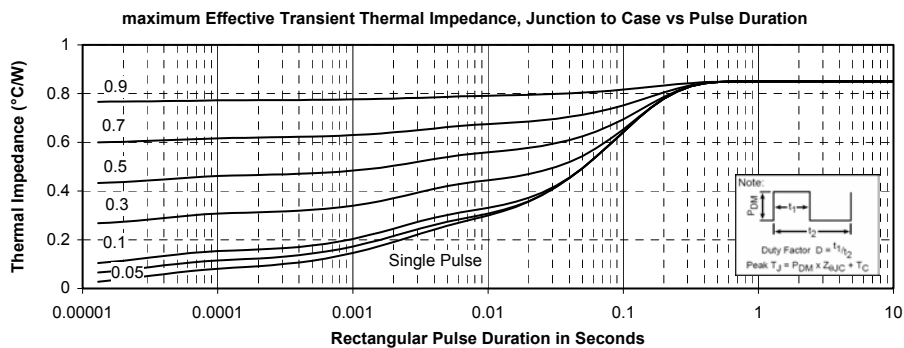
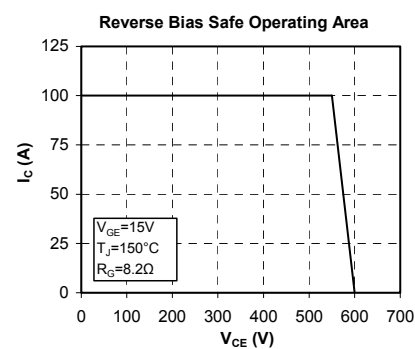
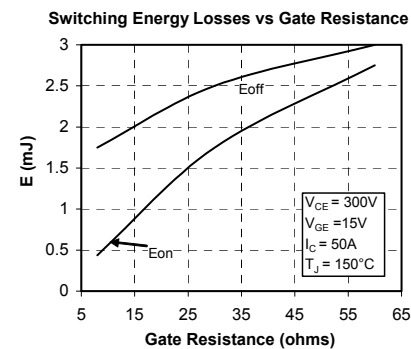
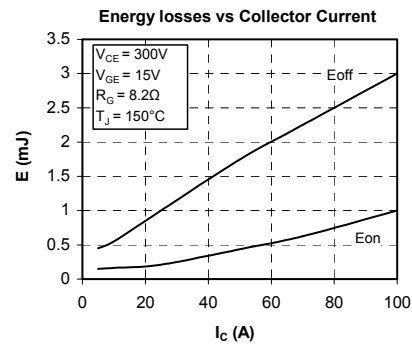
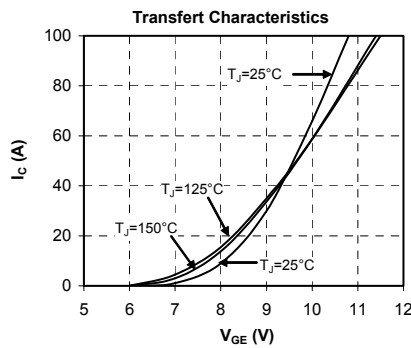
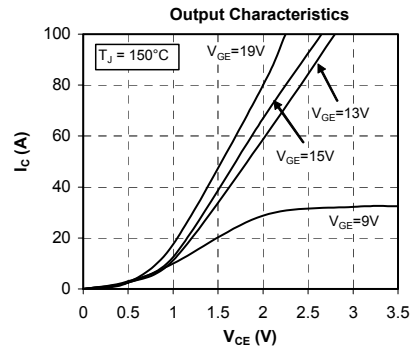
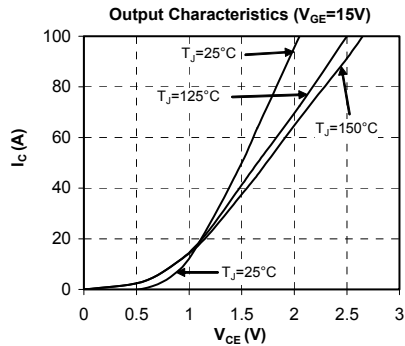
5. SP4 Package outline (dimensions in mm)



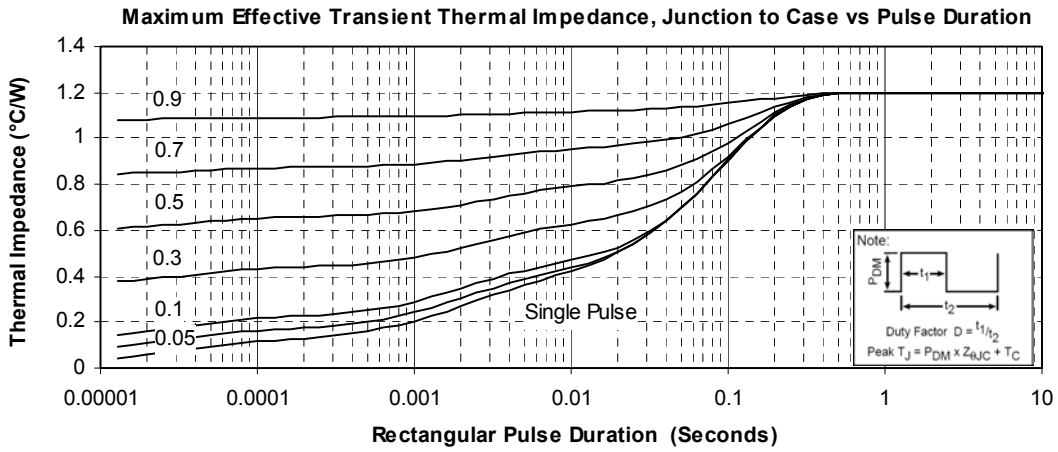
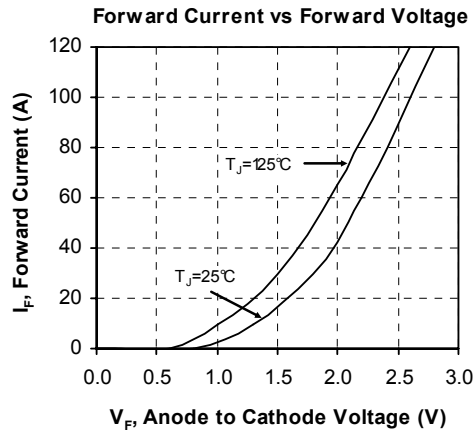
See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

6. Full bridge top switches curves

6.1 Top Trench + Field Stop IGBT typical performance curves

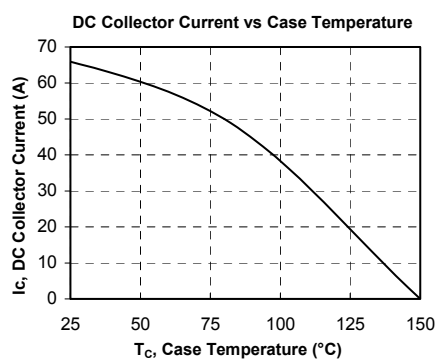
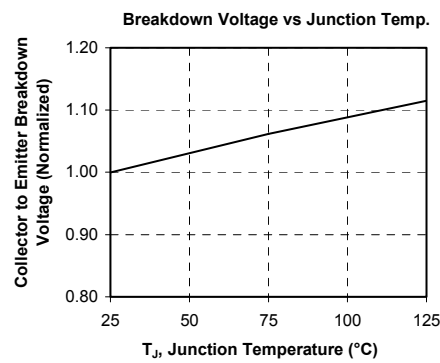
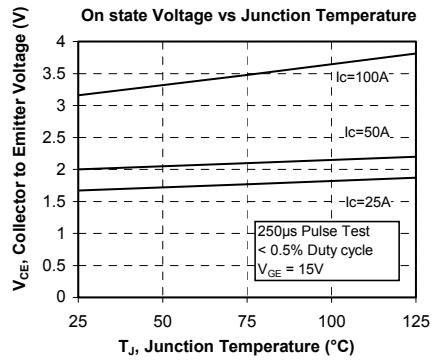
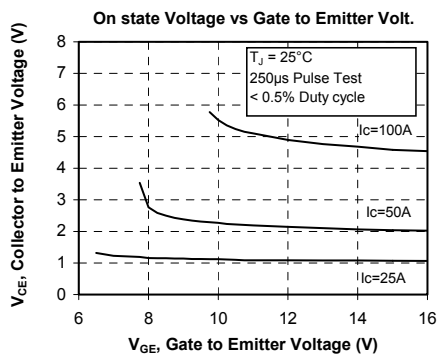
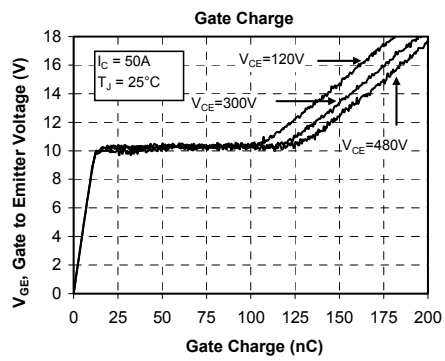
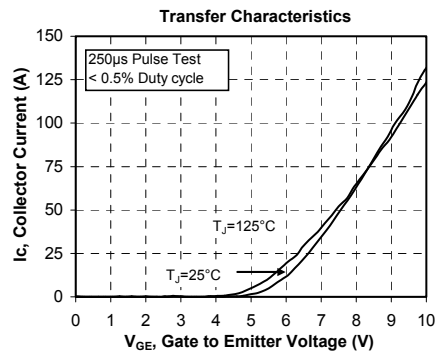
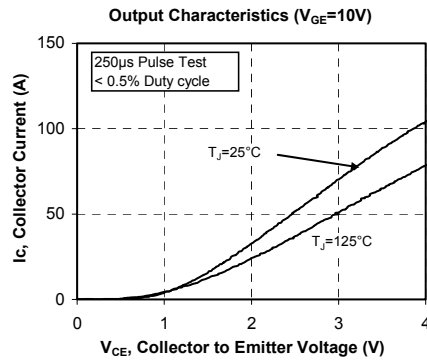
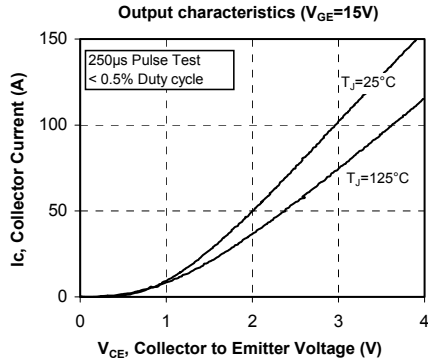


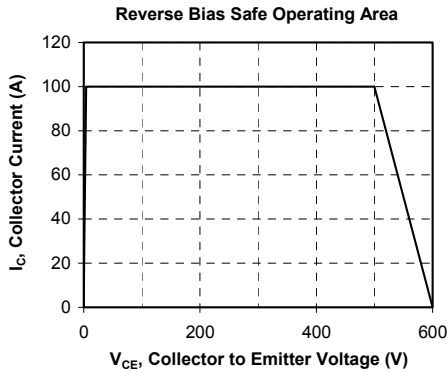
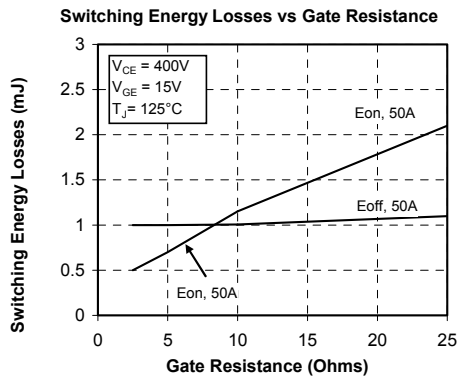
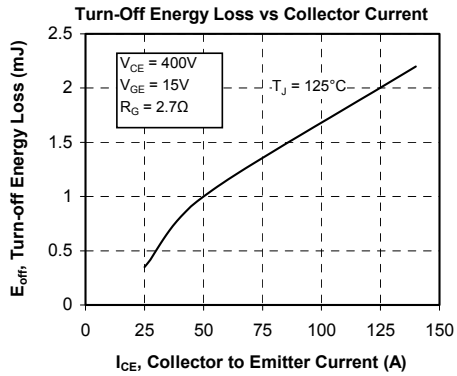
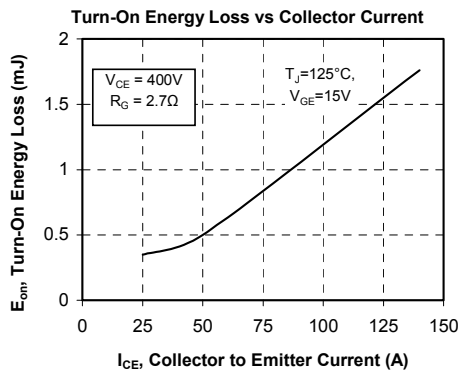
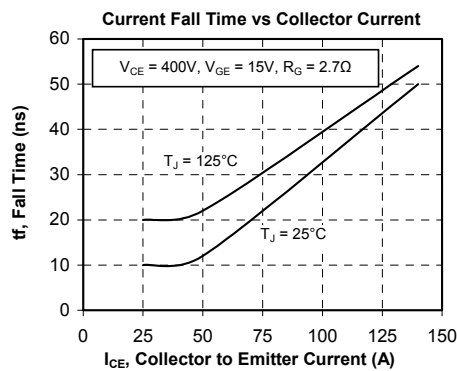
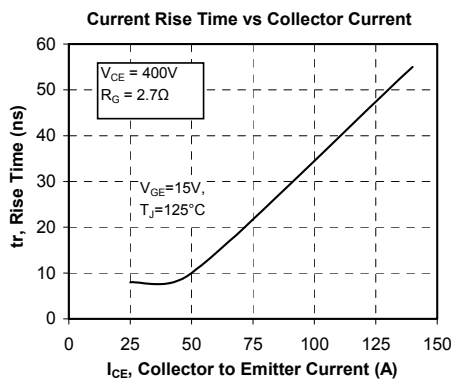
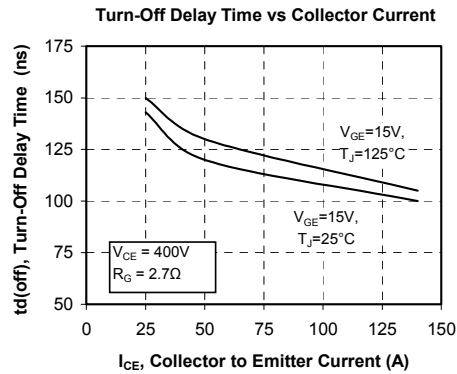
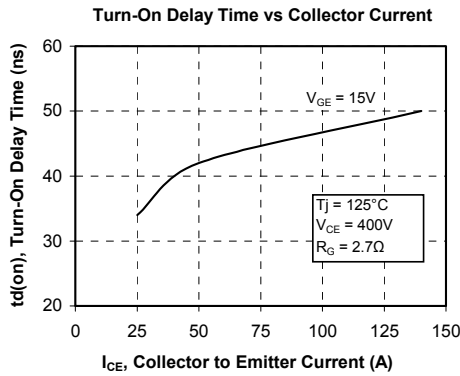
6.2 Top Fast diode typical performance curves

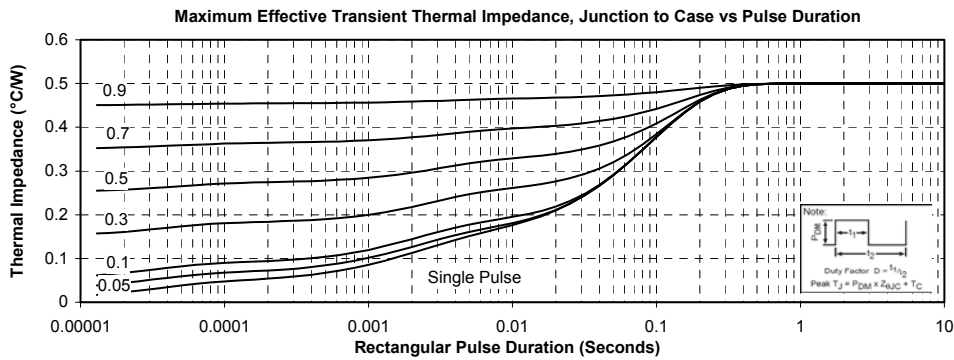
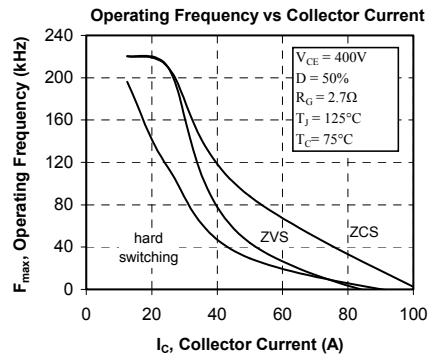
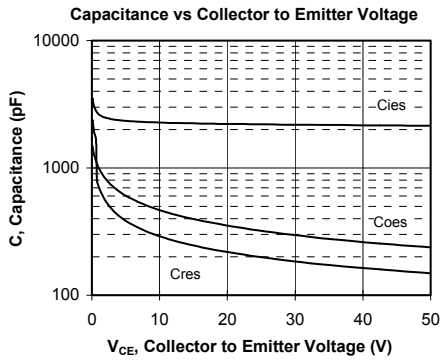


7. Full bridge bottom switches curves

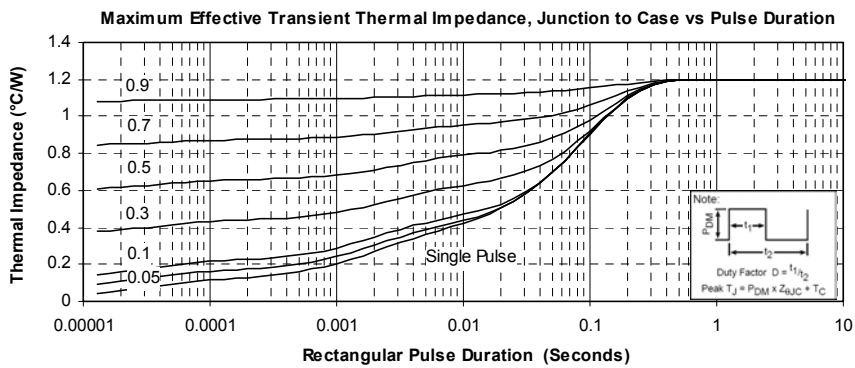
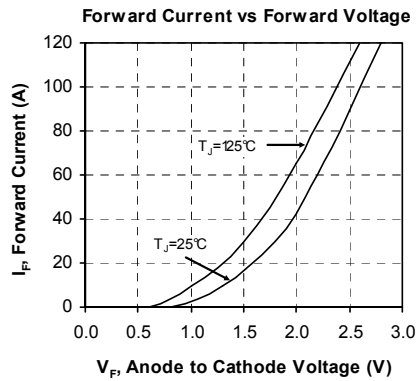
7.1 Bottom fast NPT IGBT typical performance curves





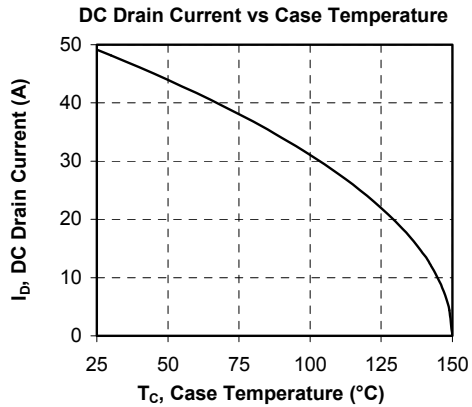
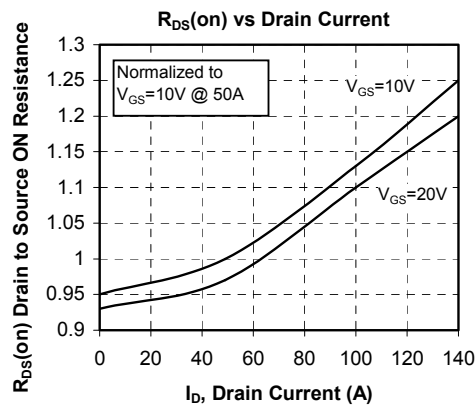
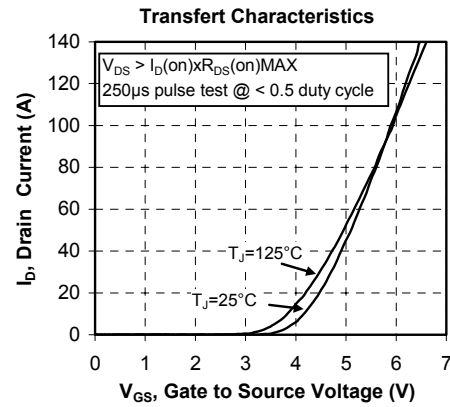
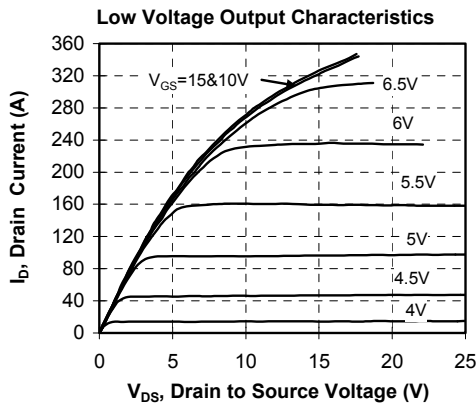
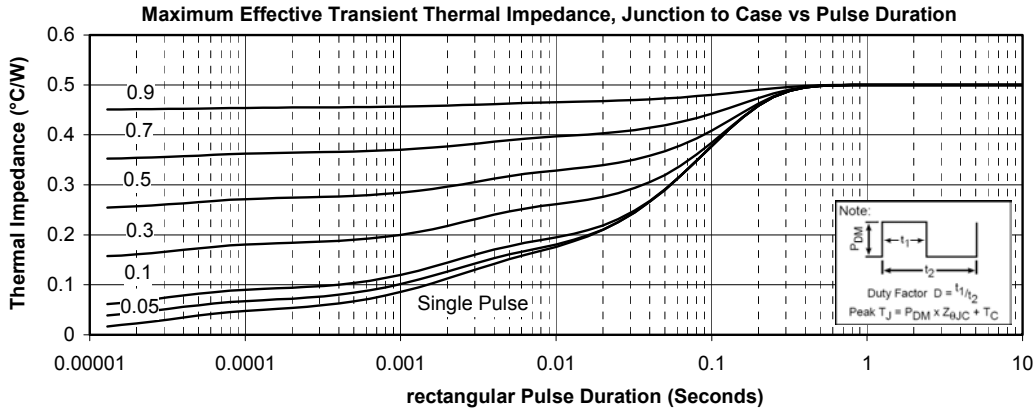


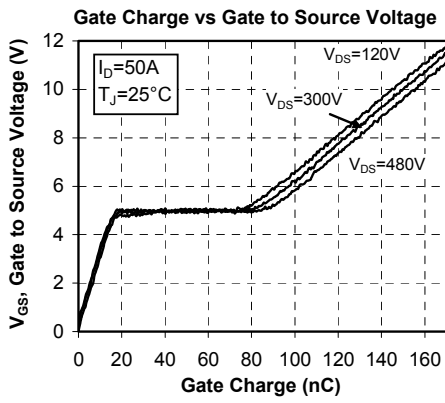
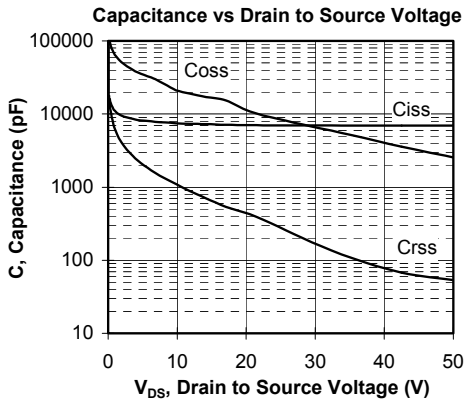
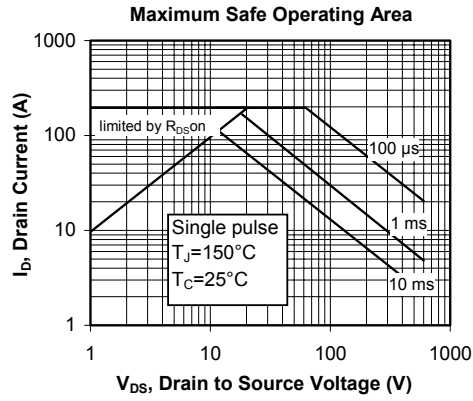
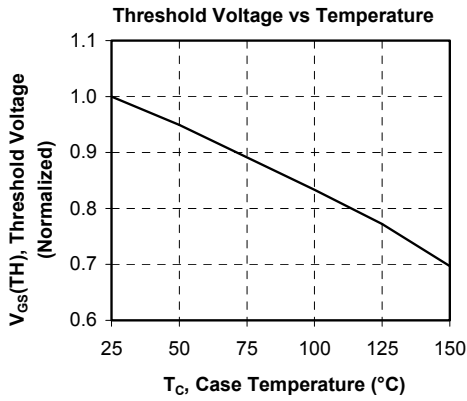
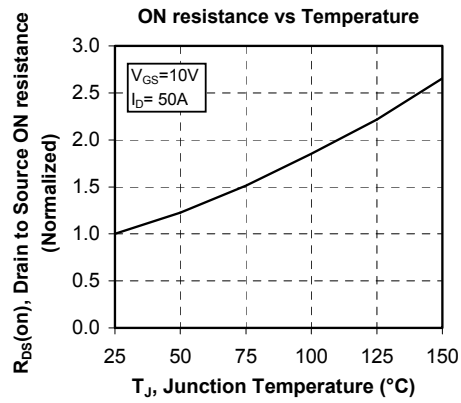
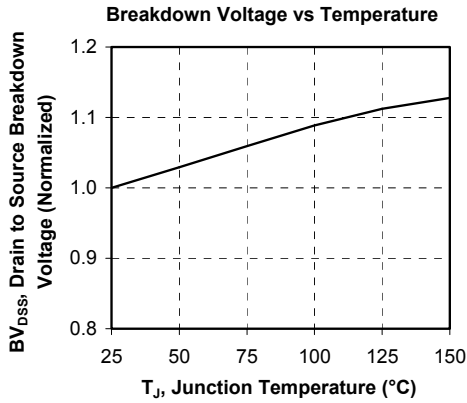
7.2 Bottom diode typical performance curves

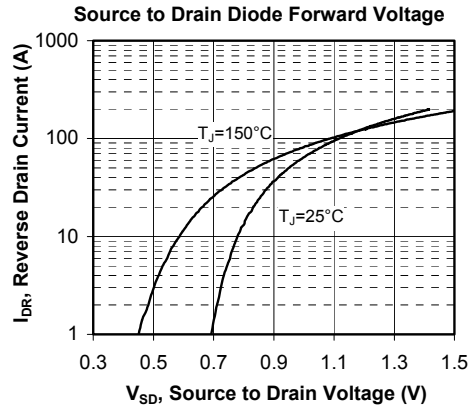
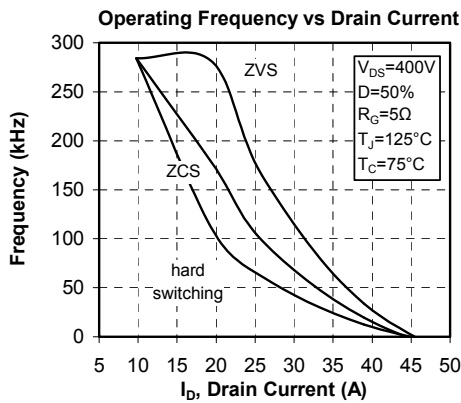
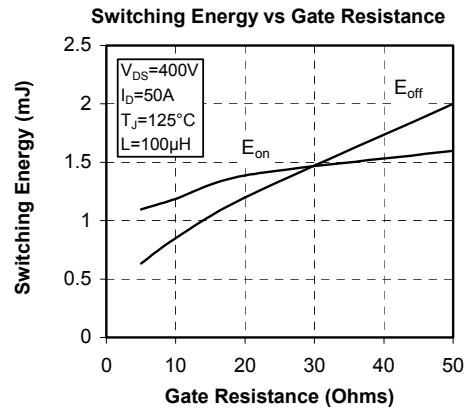
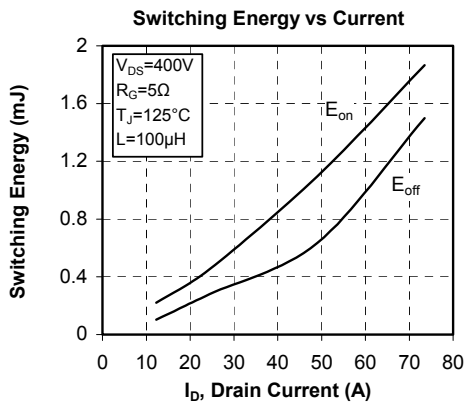
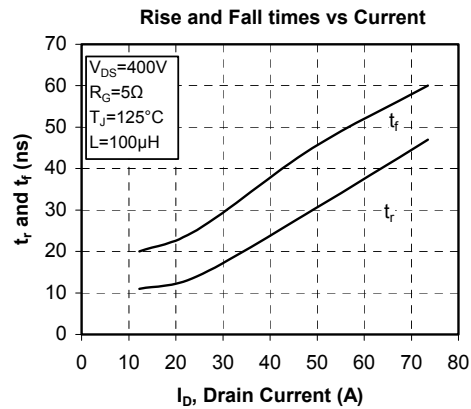
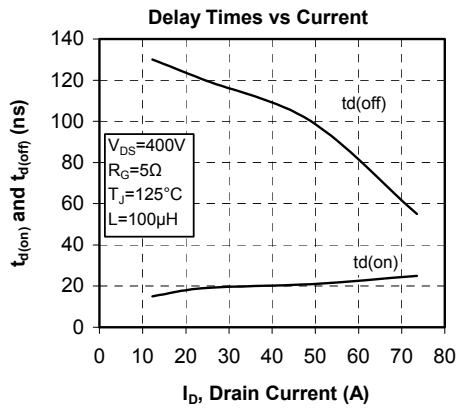


8. Boost chopper switch curves

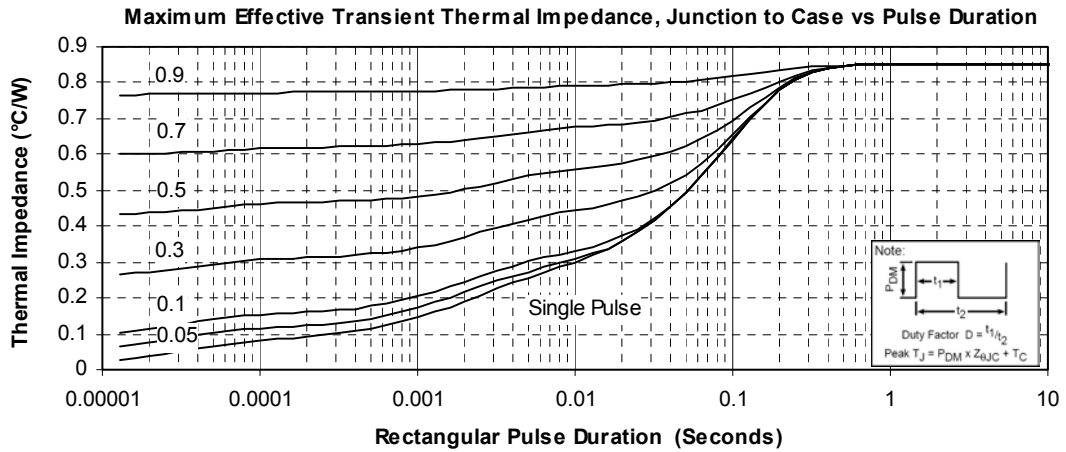
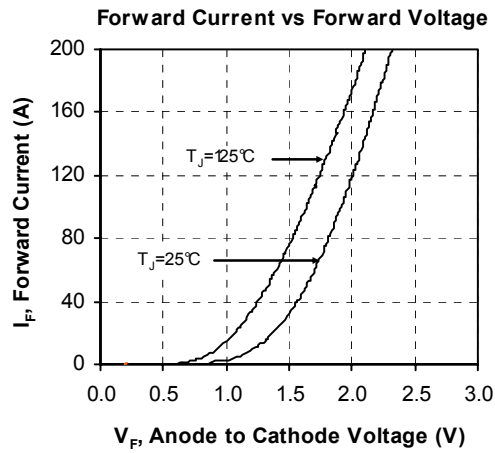
8.1 CoolMOS™ typical performance curves







8.2 Chopper diode typical performance curves



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