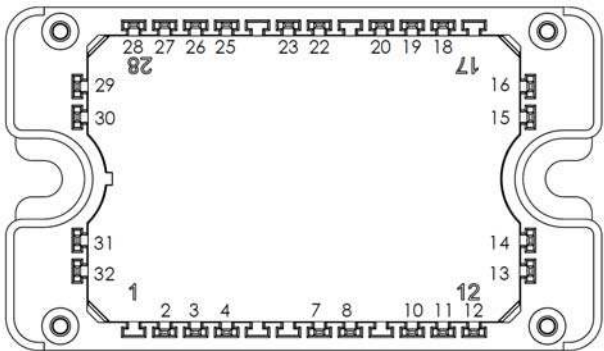
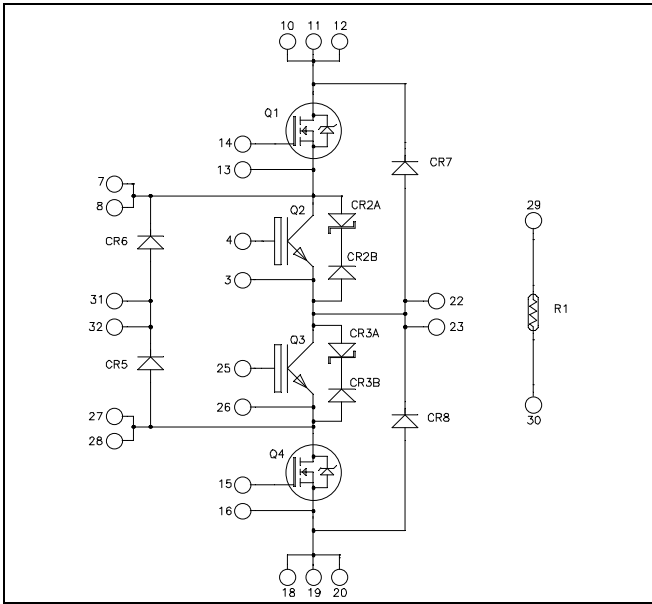


Three level inverter Power Module

Trench & Field Stop IGBT3 Q2, Q3:
 $V_{CES} = 600V$; $I_C = 30A @ T_c = 80^\circ C$

Super junction MOSFET Q1, Q4:
 $V_{DSS} = 600V$; $I_D = 17A @ T_c = 80^\circ C$



All multiple inputs and outputs must be shorted together
 Example: 10/11/12 ; 7/8 ...

Application

- Solar converter
- Uninterruptible Power Supplies

Features

- **Q2, Q3 Trench + Field Stop IGBT3**
 - Low voltage drop
 - Low tail current
 - Switching frequency up to 20 kHz
 - Low leakage current
 - RBSOA and SCSOA rated
- **Q1, Q4 Super junction MOSFET**
 - Ultra low R_{DSon}
 - Low Miller capacitance
 - Ultra low gate charge
 - Avalanche energy rated
 - Very rugged
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

Benefits

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- 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.

Q1 & Q4 Absolute maximum ratings (per Super junction MOSFET)

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>	<i>Unit</i>
V _{DSS}	Drain - Source Voltage	600	V
I _D	Continuous Drain Current	T _c = 25°C	22
		T _c = 80°C	17
I _{DM}	Pulsed Drain current	75	A
V _{GS}	Gate - Source Voltage	±20	V
R _{DS(on)}	Drain - Source ON Resistance	99	mΩ
P _D	Power Dissipation	T _c = 25°C	110
I _{AR}	Avalanche current (repetitive and non repetitive)	11	A
E _{AR}	Repetitive Avalanche Energy	1.2	mJ
E _{AS}	Single Pulse Avalanche Energy	800	

Q1 & Q4 Electrical Characteristics (per Super junction MOSFET)

<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			50	μA
R _{DS(on)}	Drain - Source on Resistance	V _{GS} = 10V, I _D = 18A			99	mΩ
V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 1.2 mA	2.5	3	3.5	V
I _{GSS}	Gate - Source Leakage Current	V _{GS} = ±20 V, V _{DS} = 0V			100	nA

Q1 & Q4 Dynamic Characteristics (per Super junction MOSFET)

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
C _{iss}	Input Capacitance	V _{GS} = 0V ; V _{DS} = 100V f = 1MHz		2800		pF
C _{oss}	Output Capacitance			130		
Q _g	Total gate Charge	V _{GS} = 10V V _{Bus} = 400V I _D = 18A		14		nC
Q _{gs}	Gate - Source Charge			20		
Q _{gd}	Gate - Drain Charge			60		
T _{d(on)}	Turn-on Delay Time	V _{GS} = 10V V _{Bus} = 400V I _D = 18A R _G = 3.3Ω		10		ns
T _r	Rise Time			5		
T _{d(off)}	Turn-off Delay Time			60		
T _f	Fall Time			5		
R _{thJC}	Junction to Case Thermal Resistance				1.15	°C/W

Q2 & Q3 Absolute maximum ratings (per IGBT)

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>	<i>Unit</i>
V _{CES}	Collector - Emitter Voltage	600	V
I _C	Continuous Collector Current	T _c = 25°C	50
		T _c = 80°C	30
I _{CM}	Pulsed Collector Current	T _c = 25°C	60
V _{GE}	Gate - Emitter Voltage	±20	V
P _D	Power Dissipation	T _c = 25°C	90
RBSOA	Reverse Bias Safe Operating Area	T _J = 150°C	60A @ 550V

Q2 & Q3 Electrical Characteristics (per IGBT)

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		1.5	1.9	V
		I _C = 30A	T _j = 25°C			
V _{GE(th)}	Gate Threshold Voltage	V _{GE} = V _{CE} , I _C = 400μA	5.0	5.8	6.5	V
I _{GES}	Gate – Emitter Leakage Current	V _{GE} = 20V, V _{CE} = 0V			300	nA

Q2 & Q3 Dynamic Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C _{ies}	Input Capacitance	V _{GE} = 0V V _{CE} = 25V f = 1MHz		1600		pF
C _{oes}	Output Capacitance			110		
C _{res}	Reverse Transfer Capacitance			50		
Q _G	Gate charge	V _{GE} = ±15V, I _C = 30A V _{CE} = 300V		0.3		μC
T _{d(on)}	Turn-on Delay Time	Inductive Switching (25°C) V _{GE} = ±15V V _{Bus} = 300V I _C = 30A R _G = 10Ω		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} = ±15V V _{Bus} = 300V I _C = 30A R _G = 10Ω		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} = ±15V V _{Bus} = 300V I _C = 30A R _G = 10Ω	T _j = 25°C	0.16		mJ
			T _j = 150°C	0.3		
E _{off}	Turn-off Switching Energy	I _C = 30A R _G = 10Ω	T _j = 25°C	0.7		mJ
			T _j = 150°C	1.05		
I _{sc}	Short Circuit data	V _{GE} ≤ 15V ; V _{Bus} = 360V t _p ≤ 6μs ; T _j = 150°C		150		A
R _{thJC}	Junction to Case Thermal Resistance				1.6	°C/W

CR2 & CR3 diode ratings and characteristics (per device)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V _F	Diode + tranzorb Forward Voltage	I _F = 10A		10		V
R _{thJC}	Junction to Case Thermal Resistance				8	°C/W

CR5 & CR6 diode ratings and characteristics (per diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V _{RRM}	Peak Repetitive Reverse Voltage					600	V
I _{RM}	Reverse Leakage Current	V _R =600V				25	μA
I _F	DC Forward Current		T _c = 80°C		30		A
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		
t _{rr}	Reverse Recovery Time	I _F = 30A V _R = 400V di/dt = 200A/μs	T _j = 25°C		25		ns
			T _j = 125°C		160		
Q _{rr}	Reverse Recovery Charge	I _F = 30A V _R = 400V di/dt = 200A/μs	T _j = 25°C		35		nC
			T _j = 125°C		480		
E _{rr}	Reverse Recovery Energy	I _F = 30A V _R = 400V di/dt = 1000A/μs	T _j = 125°C		0.6		mJ
R _{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

CR7 & CR8 diode ratings and characteristics (per diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V _{RRM}	Peak Repetitive Reverse Voltage					1200	V
I _{RM}	Reverse Leakage Current	V _R =1200V				100	μA
I _F	DC Forward Current		T _c = 80°C		30		A
V _F	Diode Forward Voltage	I _F = 30A			2.6	3.1	V
		I _F = 60A			3.2		
		I _F = 30A	T _j = 125°C		1.8		
t _{rr}	Reverse Recovery Time	I _F = 30A V _R = 800V di/dt = 200A/μs	T _j = 25°C		300		ns
			T _j = 125°C		380		
Q _{rr}	Reverse Recovery Charge	I _F = 30A V _R = 800V di/dt = 200A/μs	T _j = 25°C		360		nC
			T _j = 125°C		1700		
E _{rr}	Reverse Recovery Energy	I _F = 30A V _R = 800V di/dt = 1000A/μs	T _j = 125°C		1.6		mJ
R _{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

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		kΩ
ΔR ₂₅ /R ₂₅			5		%
B _{25/85}	T ₂₅ = 298.15 K		3952		K
ΔB/B			4		%

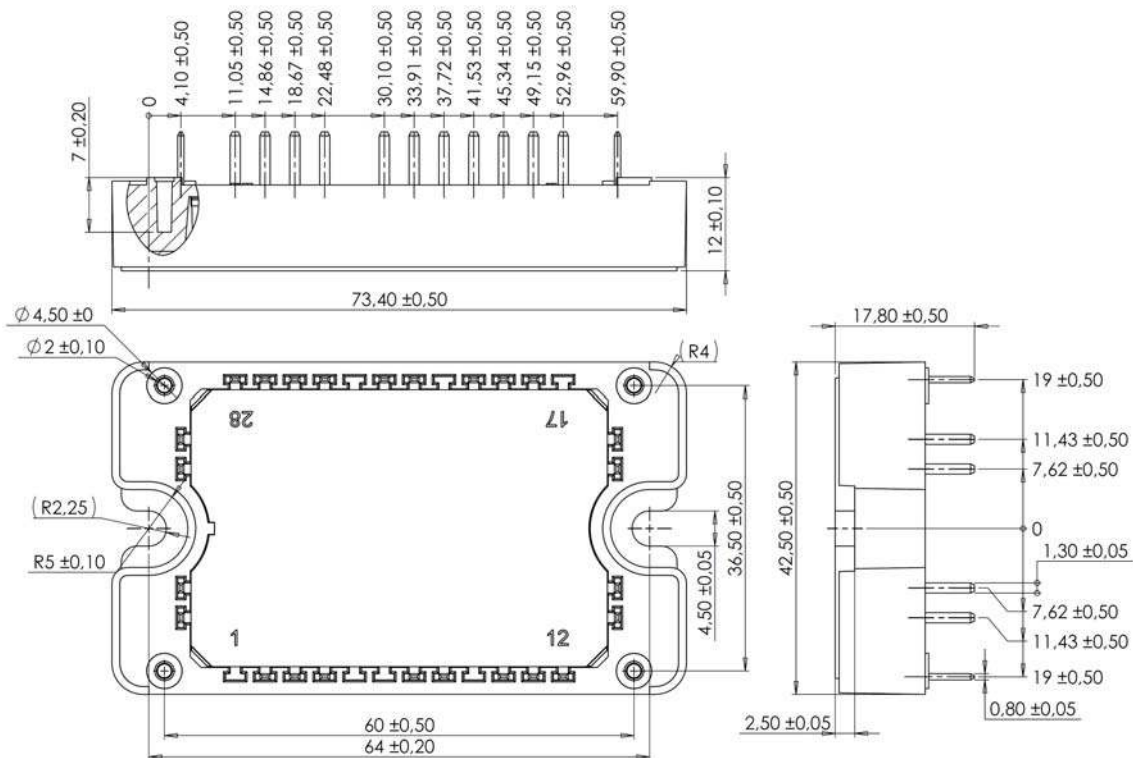
$$R_T = \frac{R_{25}}{\exp \left[B_{25/85} \left(\frac{1}{T_{25}} - \frac{1}{T} \right) \right]}$$

T: Thermistor temperature
 R_T: Thermistor value at T

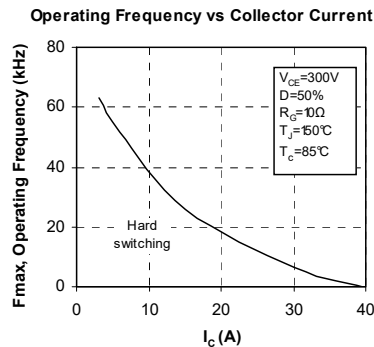
Thermal and package characteristics

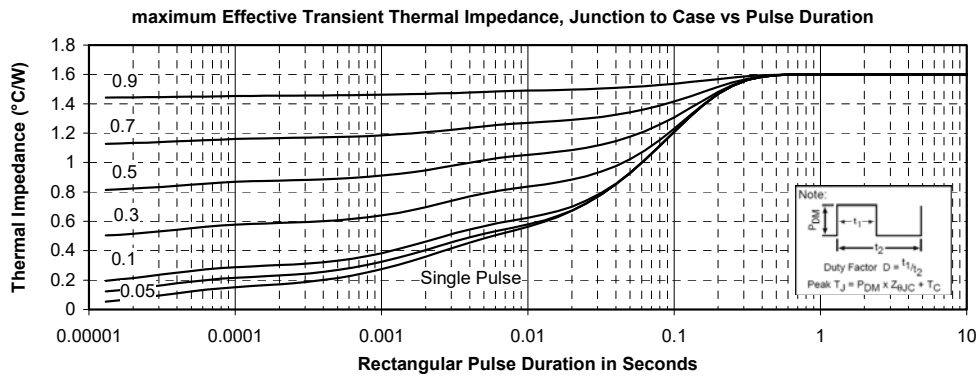
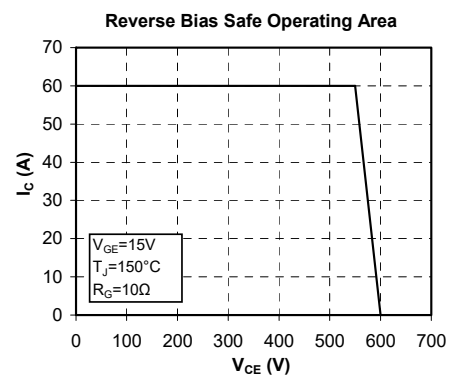
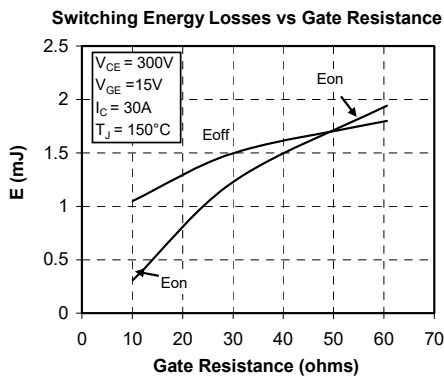
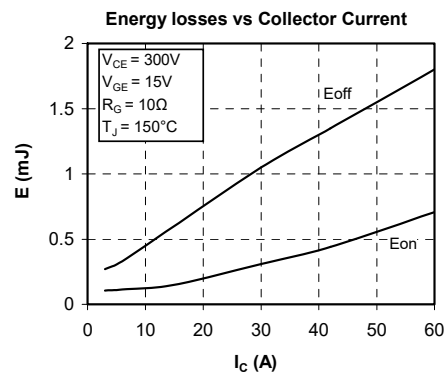
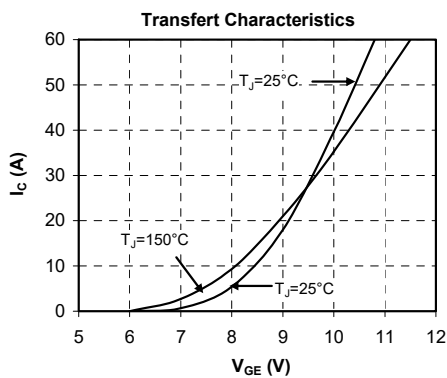
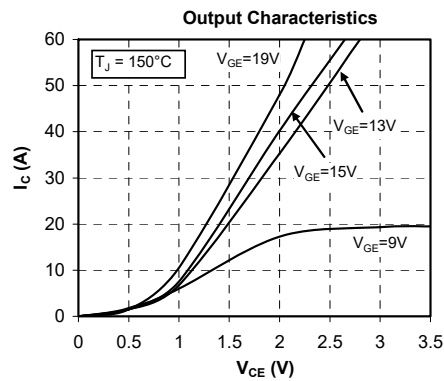
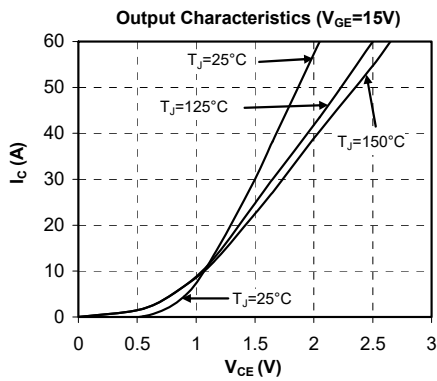
Symbol	Characteristic	Min	Max	Unit		
V _{ISOL}	RMS Isolation Voltage, any terminal to case t=1 min, 50/60Hz	4000		V		
T _J	Operating junction temperature range	-40	175*	°C		
T _{JOP}	Recommended junction temperature under switching conditions	-40	T _{Jmax} -25			
T _{STG}	Storage Temperature Range	-40	125			
T _C	Operating Case Temperature	-40	125			
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package Weight				110	g

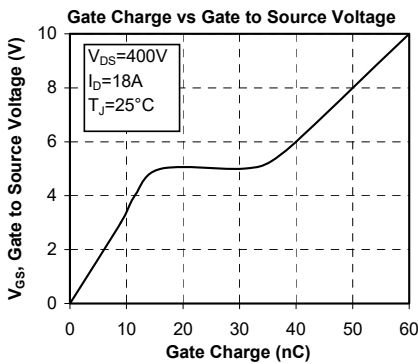
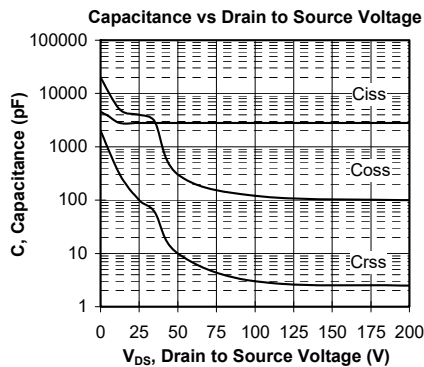
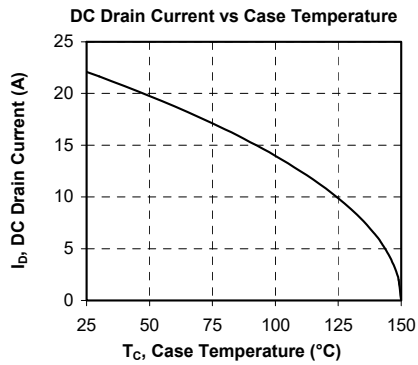
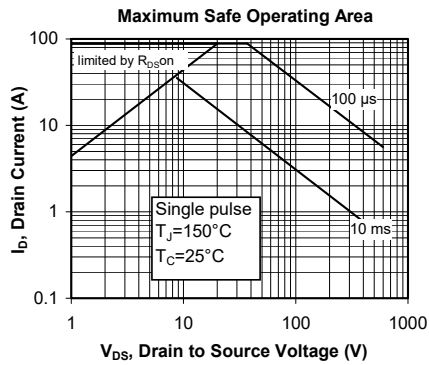
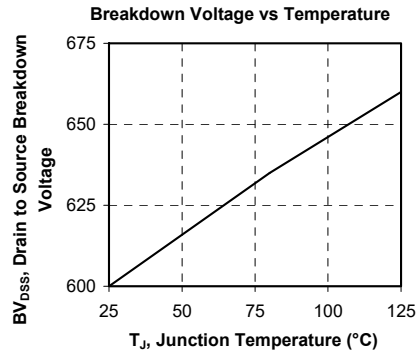
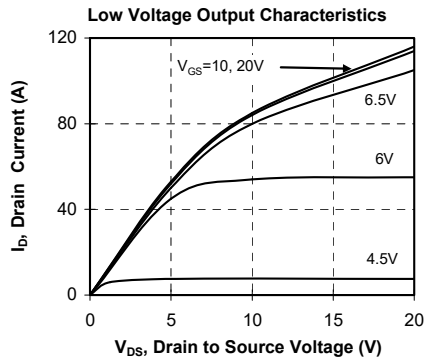
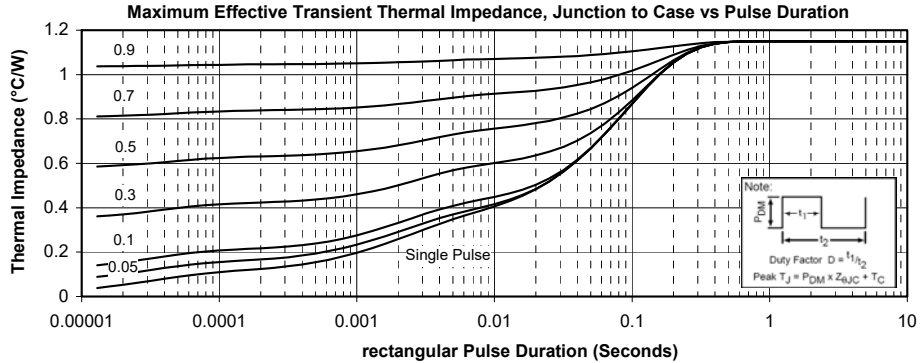
* T_{Jmax} = 150°C for Q1 & Q4

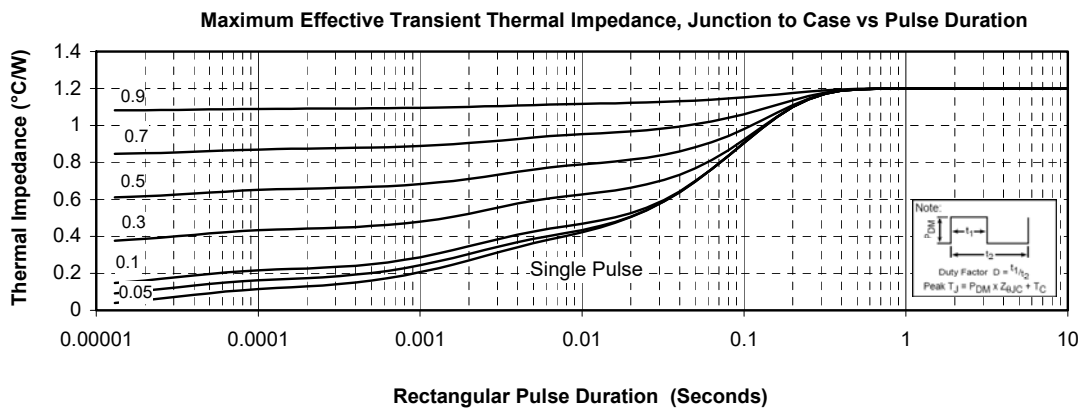
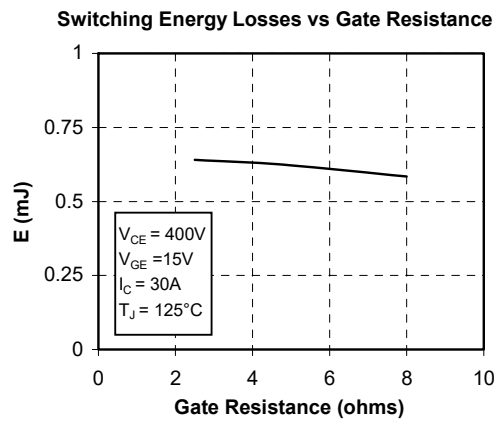
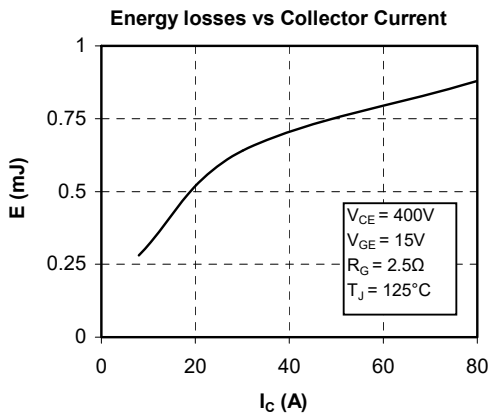
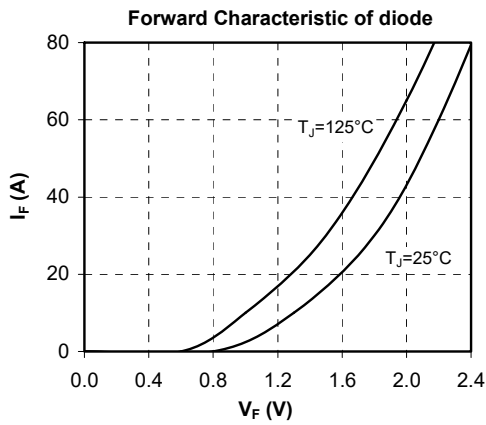
Package outline (dimensions in mm)


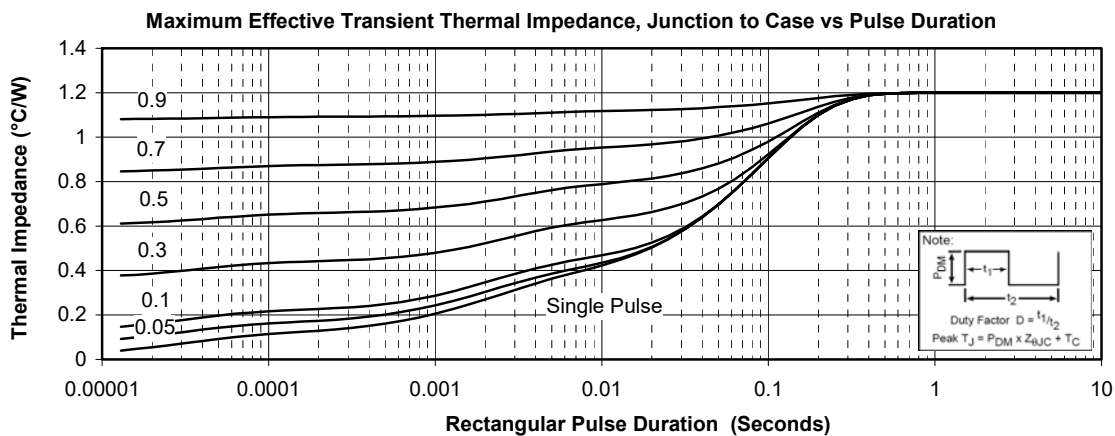
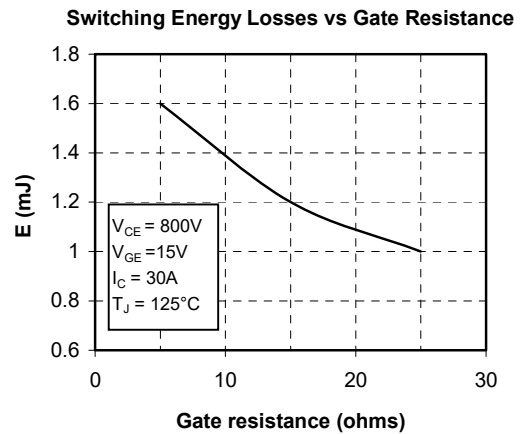
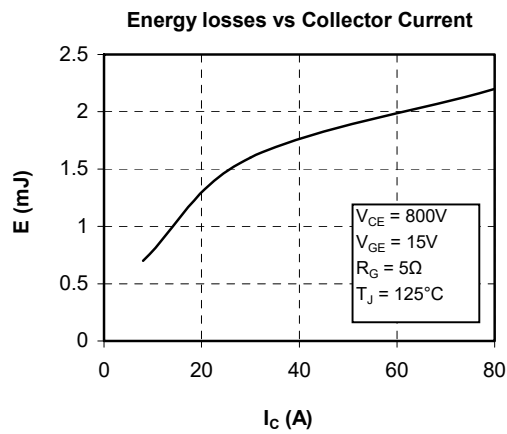
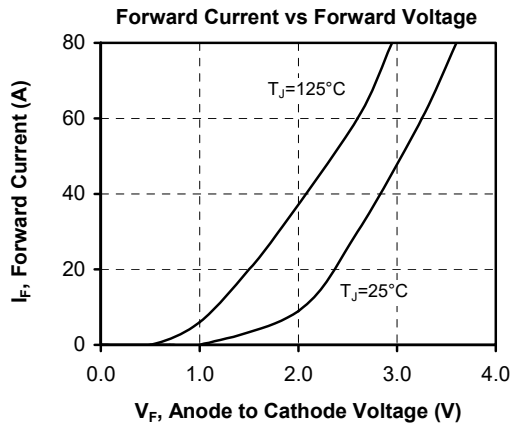
See application note 1906 - Mounting Instructions for SP3F Power Modules on www.microsemi.com

Q2 & Q3 Typical performance curve




Q1 & Q4 Typical performance curve


CR5 & CR6 Typical performance curve


CR7 & CR8 Typical performance curve


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