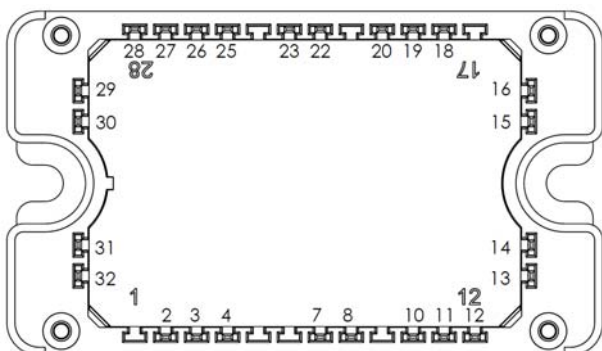
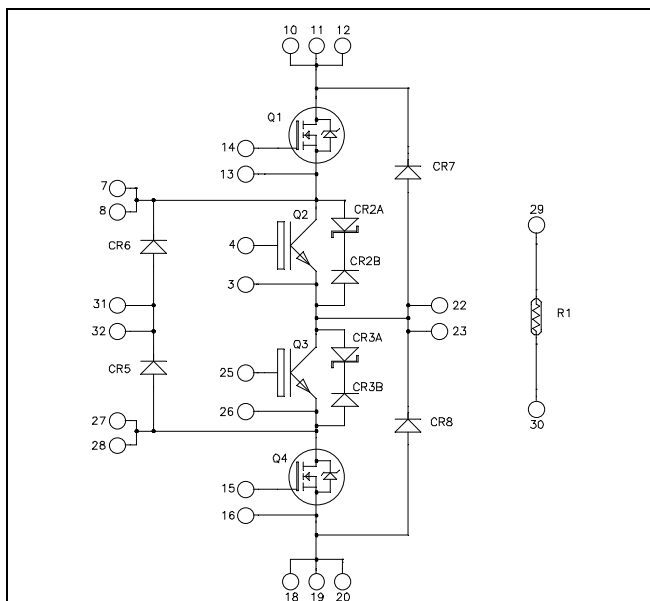


Three level inverter Power Module

Trench & Field Stop IGBT3 Q2, Q3:
 $V_{CES} = 600V$; $I_C = 50A$ @ $T_c = 80^\circ C$

Super junction MOSFET Q1, Q4:
 $V_{DSS} = 600V$; $I_D = 29A$ @ $T_c = 80^\circ C$



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 $R_{DS(on)}$
 - 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)

Symbol	Parameter	Max ratings	Unit
V_{DS}	Drain - Source Voltage	600	V
I_D	Continuous Drain Current	$T_c = 25^\circ\text{C}$ 39	A
		$T_c = 80^\circ\text{C}$ 29	
I_{DM}	Pulsed Drain current	160	
V_{GS}	Gate - Source Voltage	± 20	V
$R_{DS(on)}$	Drain - Source ON Resistance	70	m Ω
P_D	Power Dissipation	$T_c = 25^\circ\text{C}$ 250	W
I_{AR}	Avalanche current (repetitive and non repetitive)	20	A
E_{AR}	Repetitive Avalanche Energy	1	mJ
E_{AS}	Single Pulse Avalanche Energy	1800	

Q1 & Q4 Electrical Characteristics (per Super junction MOSFET)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 600V$			25	μA
$R_{DS(on)}$	Drain - Source on Resistance	$V_{GS} = 10V, I_D = 39A$			70	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 2.7mA$	2.1	3	3.9	V
I_{GSS}	Gate - Source Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$			± 100	nA

Q1 & Q4 Dynamic Characteristics (per Super junction MOSFET)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1MHz$		7		nF
C_{oss}	Output Capacitance			2.56		
C_{rss}	Reverse Transfer Capacitance			0.21		
Q_g	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 300V$ $I_D = 39A$		259		nC
Q_{gs}	Gate - Source Charge			29		
Q_{gd}	Gate - Drain Charge			111		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching @ 125°C $V_{GS} = 15V$ $V_{Bus} = 400V$ $I_D = 39A$ $R_G = 5\Omega$		21		ns
T_r	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			283		
T_f	Fall Time			84		
E_{on}	Turn-on Switching Energy	Inductive switching @ 25°C $V_{GS} = 15V, V_{Bus} = 400V$ $I_D = 39A, R_G = 5\Omega$		670		μJ
E_{off}	Turn-off Switching Energy			980		
E_{on}	Turn-on Switching Energy	Inductive switching @ 125°C $V_{GS} = 15V, V_{Bus} = 400V$ $I_D = 39A, R_G = 5\Omega$		1096		μJ
E_{off}	Turn-off Switching Energy			1206		
R_{thJC}	Junction to Case Thermal Resistance				0.5	$^\circ\text{C/W}$

Q2 & Q3 Absolute maximum ratings (per IGBT)

Symbol	Parameter	Max ratings	Unit
V_{CES}	Collector - Emitter Voltage	600	V
I_C	Continuous Collector Current	$T_C = 25^\circ\text{C}$ 80 $T_C = 80^\circ\text{C}$ 50	A
I_{CM}	Pulsed Collector Current	$T_C = 25^\circ\text{C}$ 100	
V_{GE}	Gate – Emitter Voltage	± 20	V
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$ 176	W
RBSOA	Reverse Bias Safe Operating Area	$T_J = 150^\circ\text{C}$ 100A @ 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	$V_{GE} = 15V$ $I_C = 50A$ $T_J = 25^\circ\text{C}$ $T_J = 150^\circ\text{C}$		1.5 1.7	1.9	V
$V_{GE(th)}$	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	$V_{GE} = 20V, V_{CE} = 0V$			600	nA

Q2 & Q3 Dynamic Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{ies}	Input Capacitance	$V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{MHz}$		3150		pF
C_{oes}	Output Capacitance			200		
C_{res}	Reverse Transfer Capacitance			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°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_{on}	Turn-on Switching Energy	$V_{GE} = \pm 15V$ $V_{Bus} = 300V$ $I_C = 50A$ $R_G = 8.2\Omega$ $T_J = 25^\circ\text{C}$ $T_J = 150^\circ\text{C}$		0.3 0.43		mJ
E_{off}	Turn-off Switching Energy	$T_J = 25^\circ\text{C}$ $T_J = 150^\circ\text{C}$		1.35 1.75		
I_{sc}	Short Circuit data	$V_{GE} \leq 15V; V_{Bus} = 360V$ $t_p \leq 6\mu\text{s}; T_J = 150^\circ\text{C}$		250		A
R_{thJC}	Junction to Case Thermal Resistance				0.85	$^\circ\text{C/W}$

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 T _j = 125°C	25 160		ns
Q _{rr}	Reverse Recovery Charge		T _j = 25°C T _j = 125°C	35 480		nC
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 T _j = 125°C	300 380		ns
Q _{rr}	Reverse Recovery Charge		T _j = 25°C T _j = 125°C	360 1700		nC
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	T _C =100°C		4		%

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

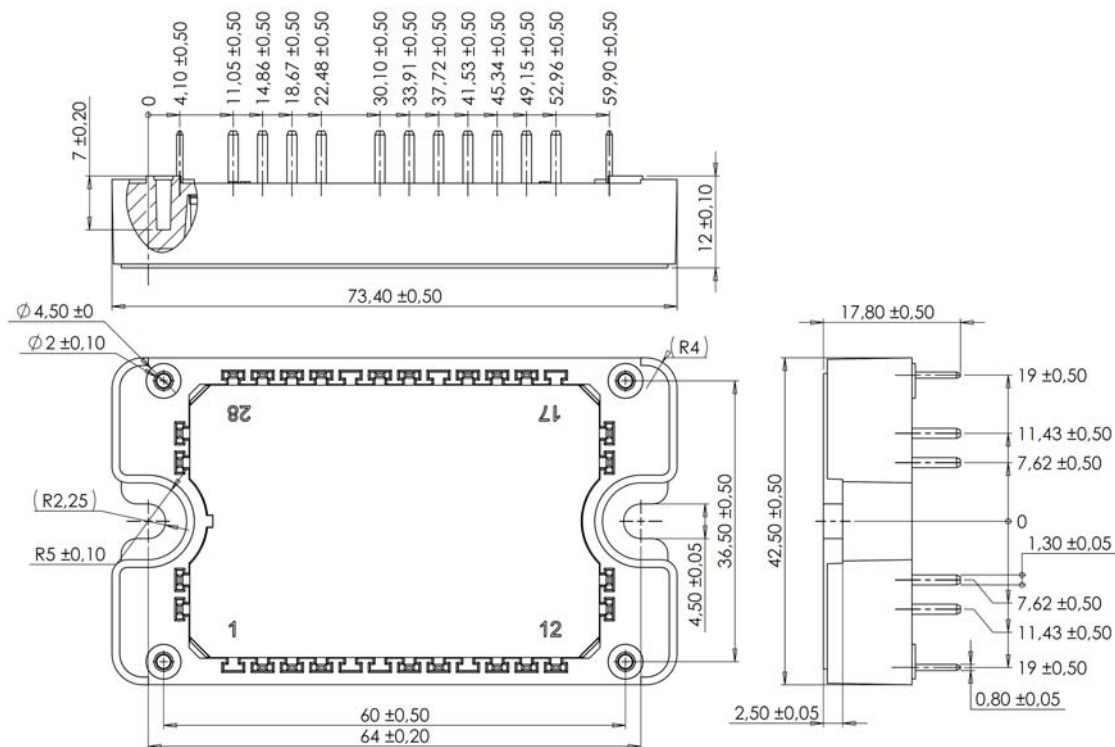
T: Thermistor temperature
R_T: Thermistor value at T

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	N.m
Wt	Package Weight		110	g

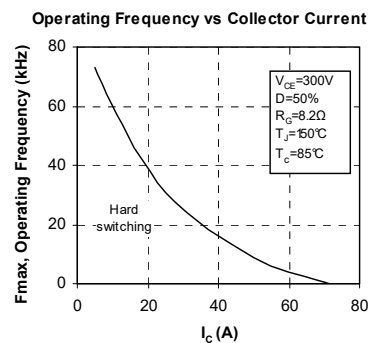
* $T_{Jmax} = 150^{\circ}\text{C}$ for Q1 & Q4

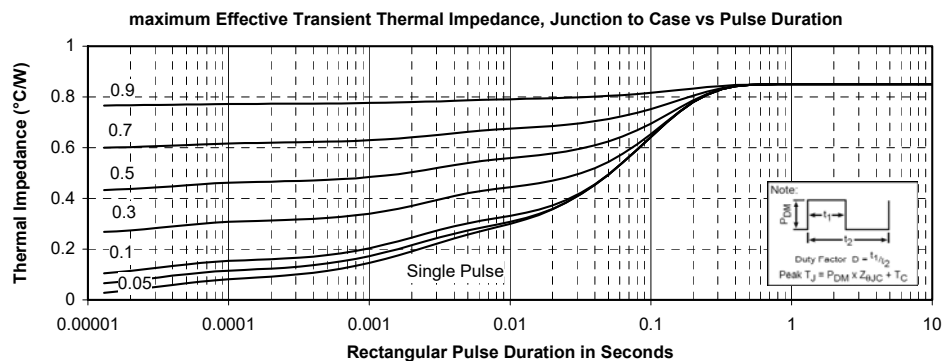
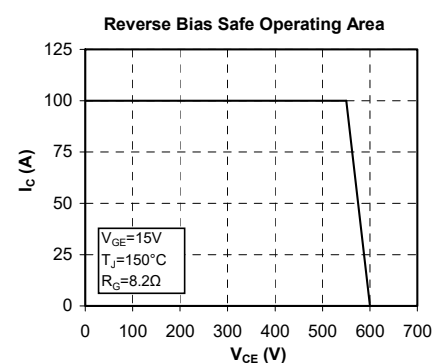
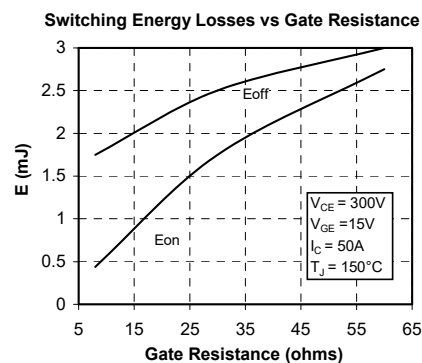
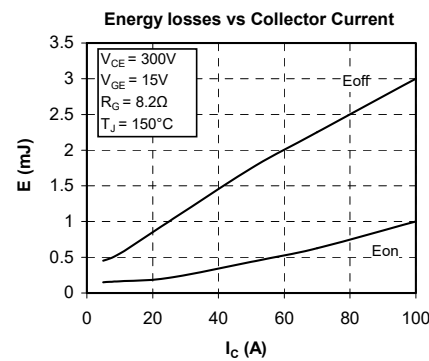
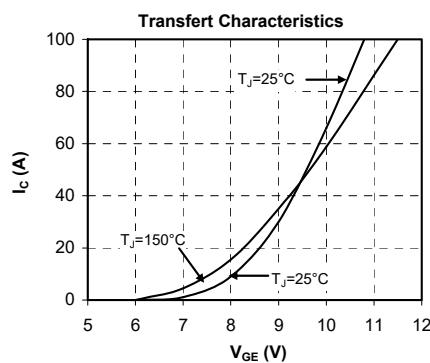
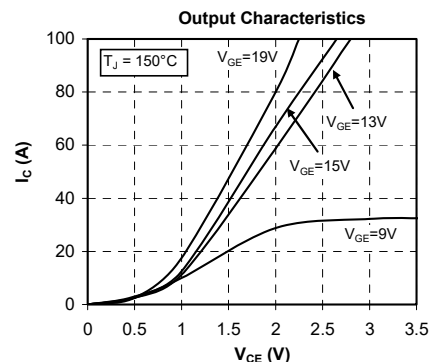
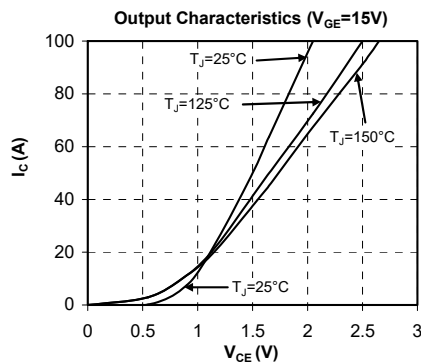
Package outline (dimensions in mm)



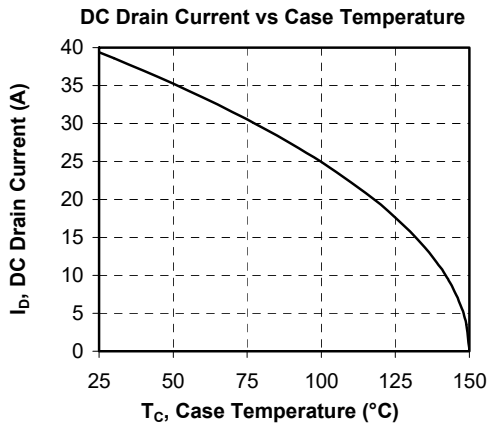
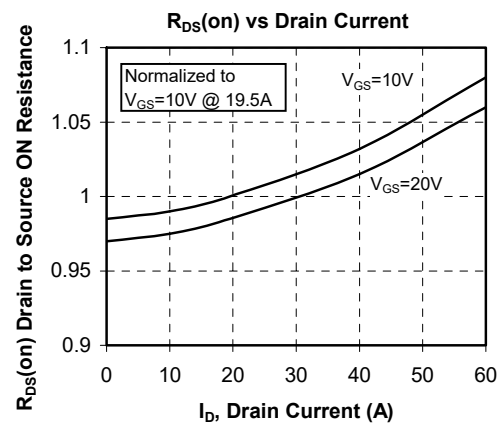
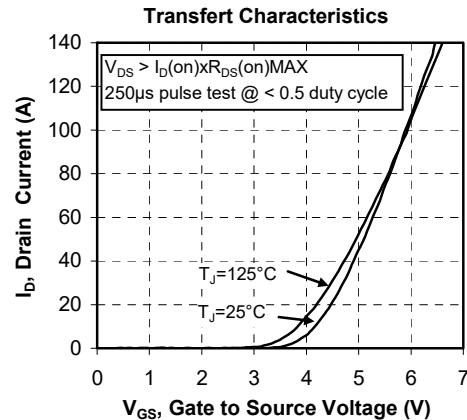
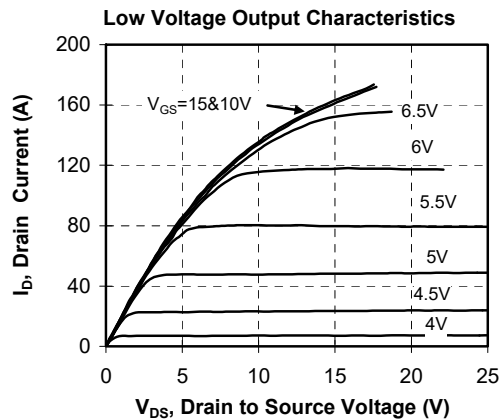
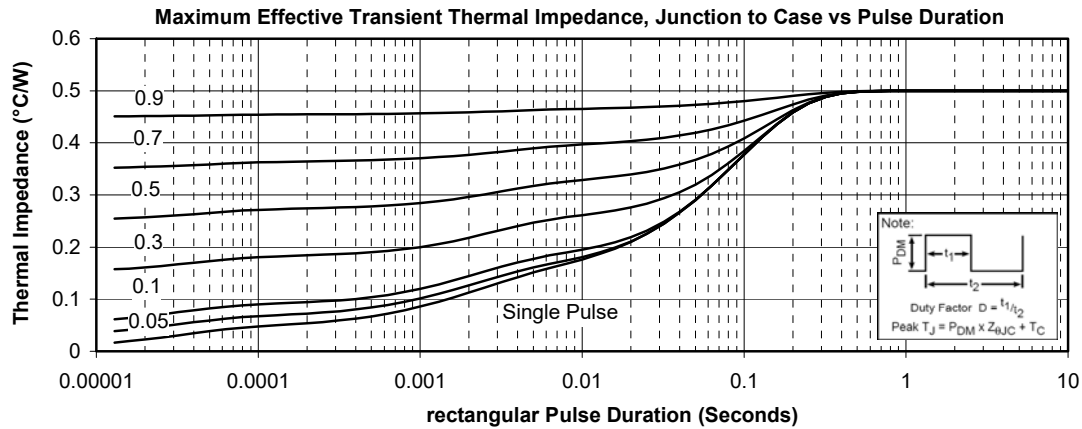
See application note 1906 - Mounting Instructions for SP3F Power Modules on www.microsemi.com

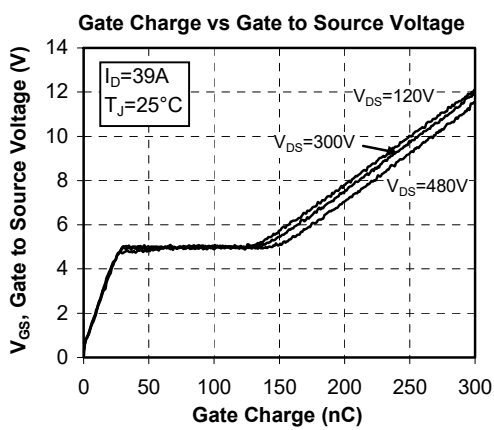
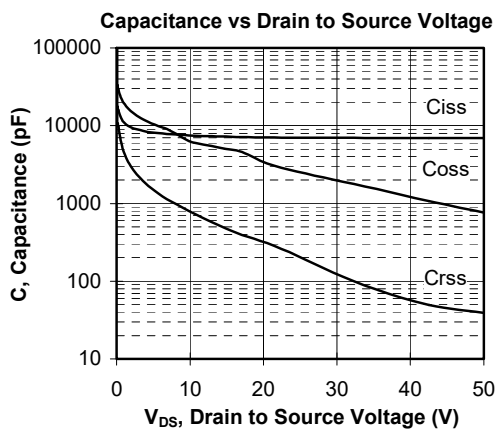
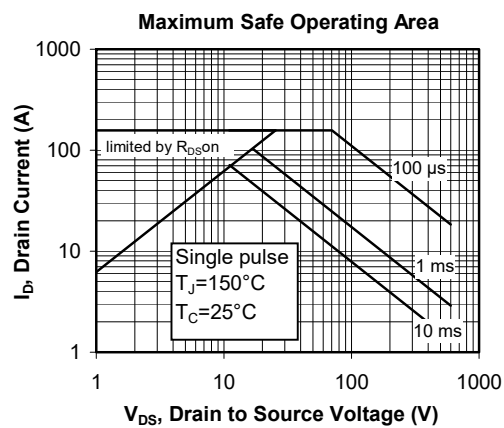
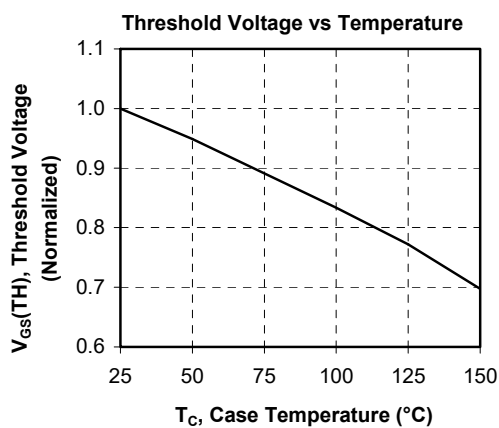
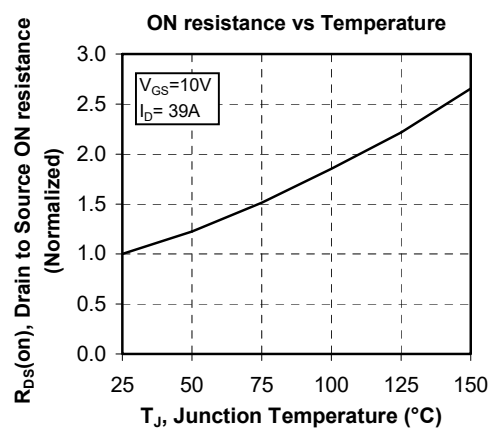
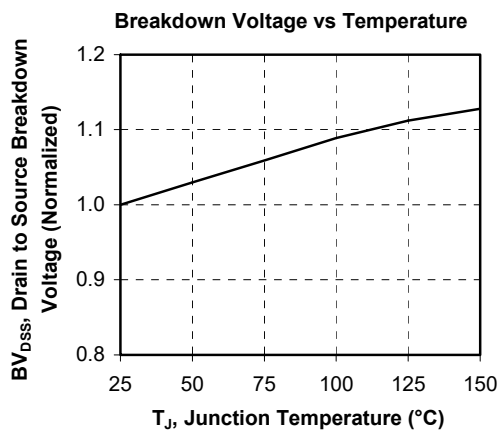
Q2 & Q3 Typical performance curve

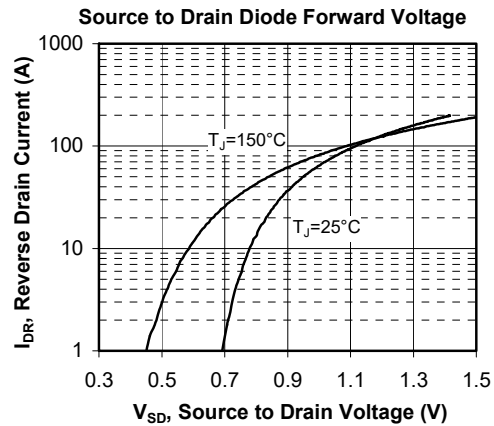
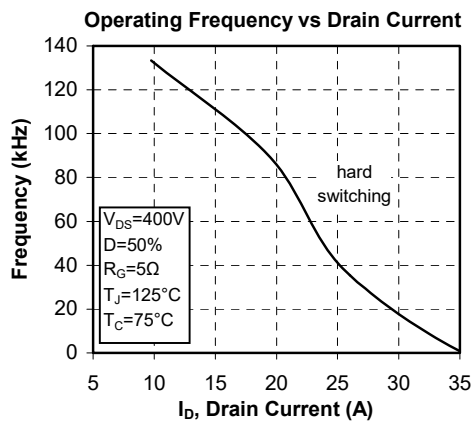
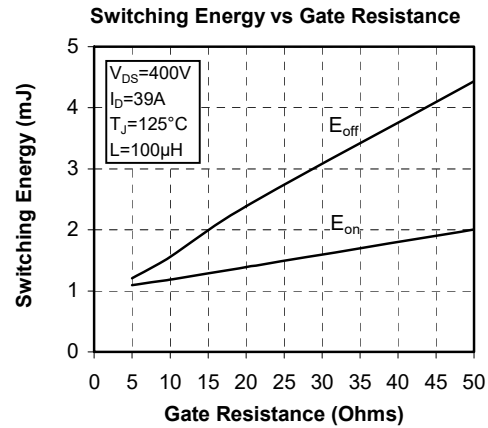
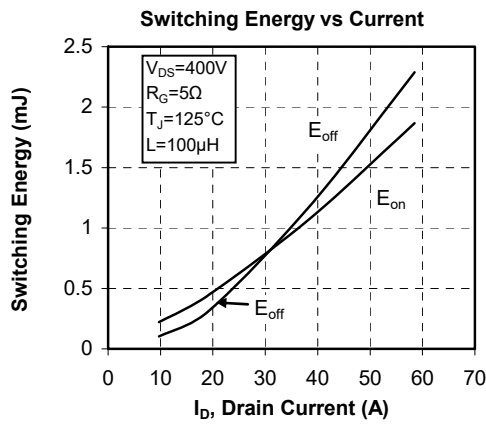
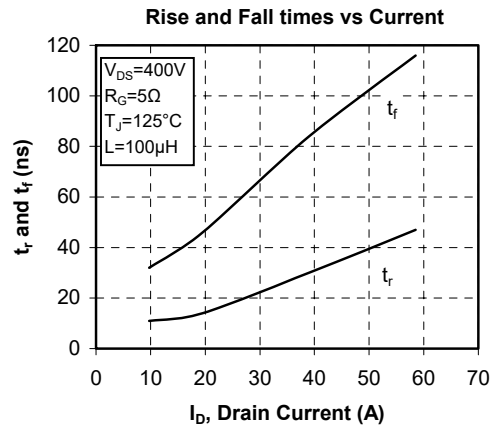
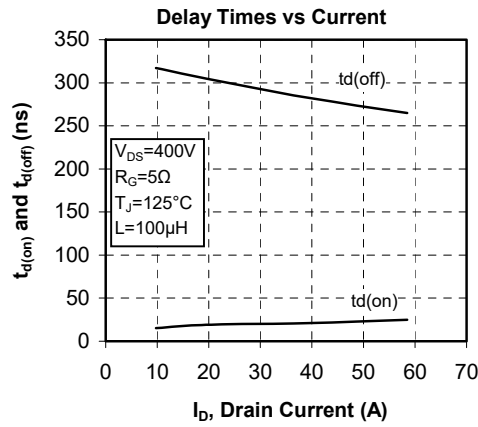




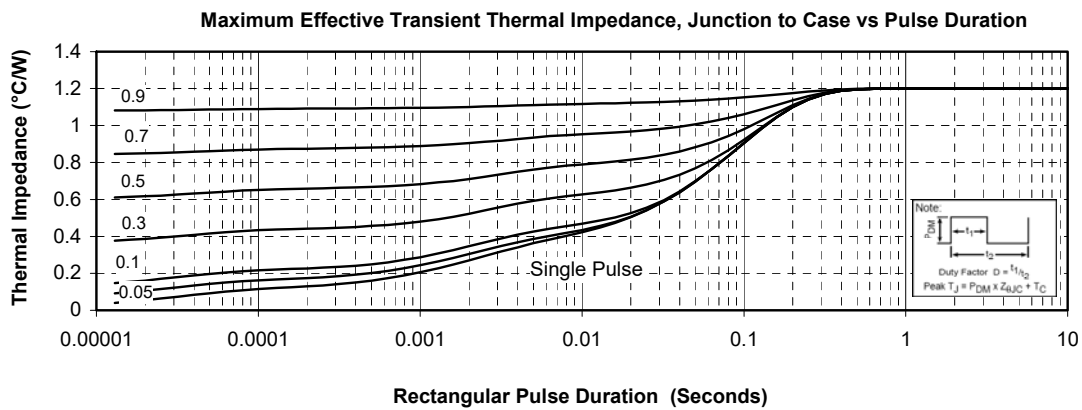
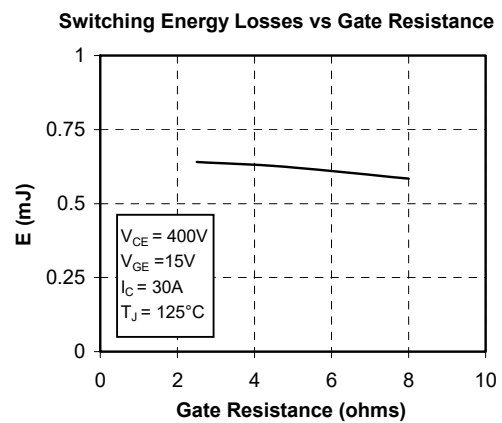
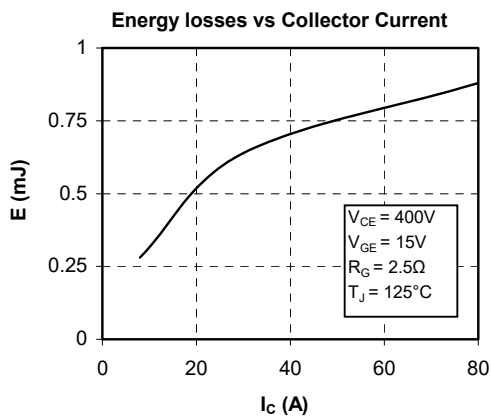
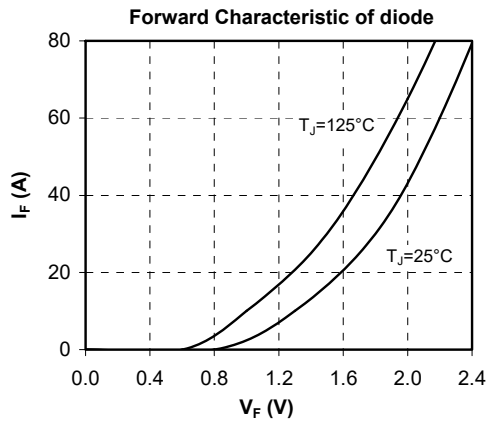
Q1 & Q4 Typical performance curve



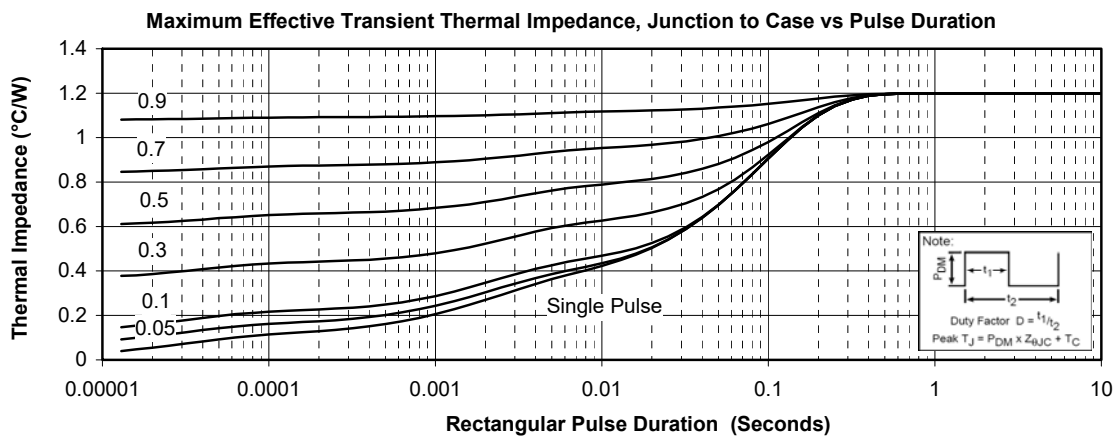
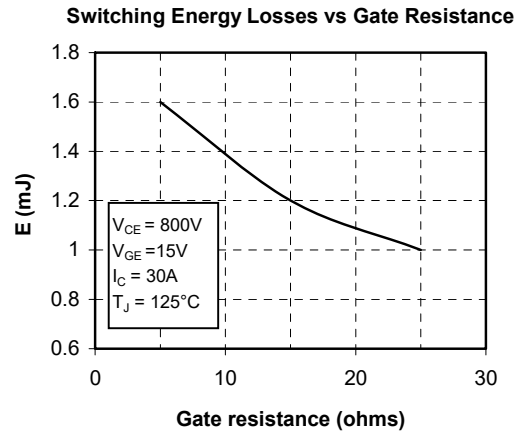
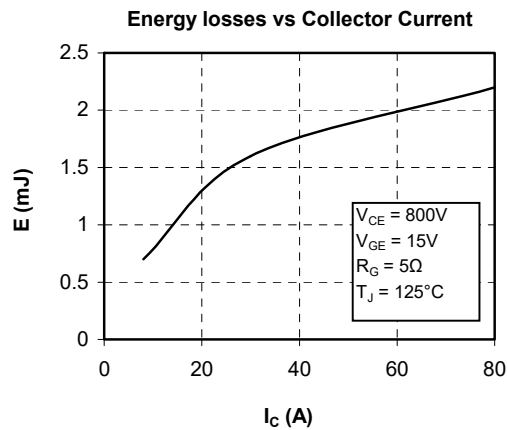
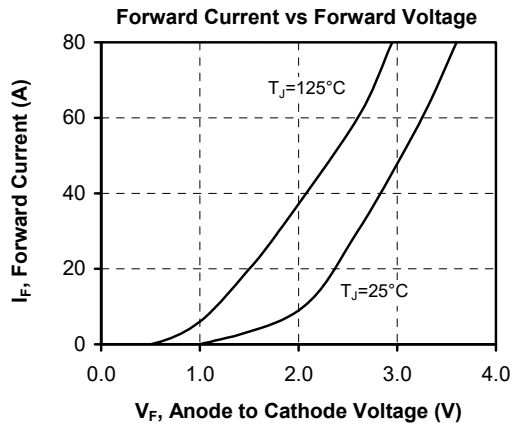




CR5 & CR6 Typical performance curve



CR7 & CR8 Typical performance curve



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