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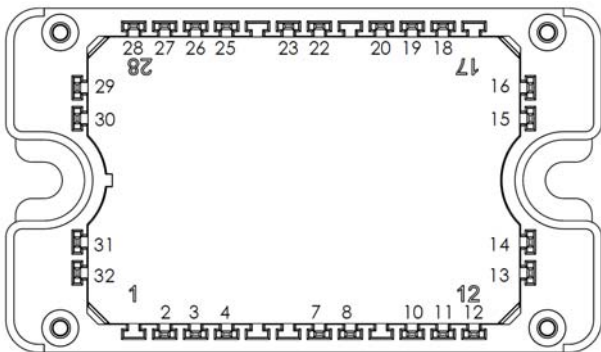
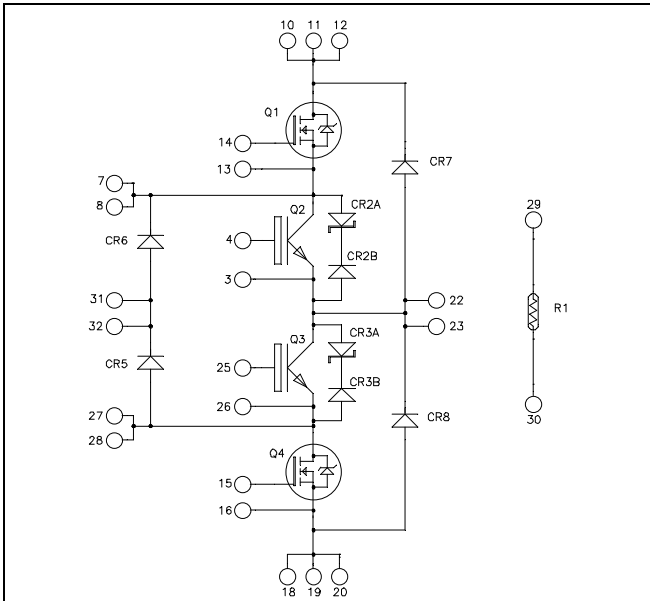
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Three level inverter Power Module

Trench & Field Stop IGBT3 Q2, Q3:
 $V_{CES} = 600V$; $I_C = 75A @ T_c = 80^\circ C$

Super junction MOSFET Q1, Q4:
 $V_{DSS} = 600V$; $I_D = 70A @ T_c = 80^\circ C$



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)

Symbol	Parameter	Max ratings	Unit
V _{DSS}	Drain - Source Voltage	600	V
I _D	Continuous Drain Current	T _c = 25°C	95
		T _c = 80°C	70
I _{DM}	Pulsed Drain current	260	A
V _{GS}	Gate - Source Voltage	±20	V
R _{DS(on)}	Drain - Source ON Resistance	24	mΩ
P _D	Power Dissipation	T _c = 25°C	462
I _{AR}	Avalanche current (repetitive and non repetitive)	15	A
E _{AR}	Repetitive Avalanche Energy	3	mJ
E _{AS}	Single Pulse Avalanche Energy	1900	

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			350	μA
R _{DS(on)}	Drain - Source on Resistance	V _{GS} = 10V, I _D = 47.5A			24	mΩ
V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 5mA	2.1	3	3.9	V
I _{GSS}	Gate - Source Leakage Current	V _{GS} = ±20 V, V _{DS} = 0V			200	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		14.4		nF
C _{oss}	Output Capacitance			17		
Q _g	Total gate Charge	V _{GS} = 10V V _{Bus} = 300V I _D = 95A		300		nC
Q _{gs}	Gate - Source Charge			68		
Q _{gd}	Gate - Drain Charge			102		
T _{d(on)}	Turn-on Delay Time	Inductive Switching (125°C) V _{GS} = 10V V _{Bus} = 400V I _D = 95A R _G = 2.5Ω		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 = 95A ; R _G = 2.5Ω		1350		μJ
E _{off}	Turn-off Switching Energy			1040		
E _{on}	Turn-on Switching Energy	Inductive switching @ 125°C V _{GS} = 10V ; V _{Bus} = 400V I _D = 95A ; R _G = 2.5Ω		2200		μJ
E _{off}	Turn-off Switching Energy			1270		
R _{thJC}	Junction to Case Thermal Resistance				0.27	°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°C	100
		T _C = 80°C	75
I _{CM}	Pulsed Collector Current	T _C = 25°C	140
V _{GE}	Gate - Emitter Voltage	±20	V
P _D	Power Dissipation	T _C = 25°C	250
RBSOA	Reverse Bias Safe Operating Area	T _J = 150°C	150A @ 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 = 75A	T _J = 25°C			
V _{GE(th)}	Gate Threshold Voltage	V _{GE} = V _{CE} , I _C = 600μA	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 = 1MHz		4620		pF
C _{oes}	Output Capacitance			300		
C _{res}	Reverse Transfer Capacitance			140		
Q _G	Gate charge	V _{GE} = ±15V, I _C = 75A V _{CE} = 300V		0.8		μC
T _{d(on)}	Turn-on Delay Time	Inductive Switching (25°C) V _{GE} = ±15V V _{Bus} = 300V I _C = 75A R _G = 4.7Ω		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 = 75A R _G = 4.7Ω		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		0.35		mJ
E _{off}	Turn-off Switching Energy	I _C = 75A	T _J = 25°C		0.6	
		R _G = 4.7Ω	T _J = 150°C		2.2	
I _{sc}	Short Circuit data	V _{GE} ≤ 15V ; V _{Bus} = 360V t _p ≤ 6μs ; T _J = 150°C		380		A
R _{thJC}	Junction to Case Thermal Resistance				0.60	°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		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		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		%
				T _C =100°C	

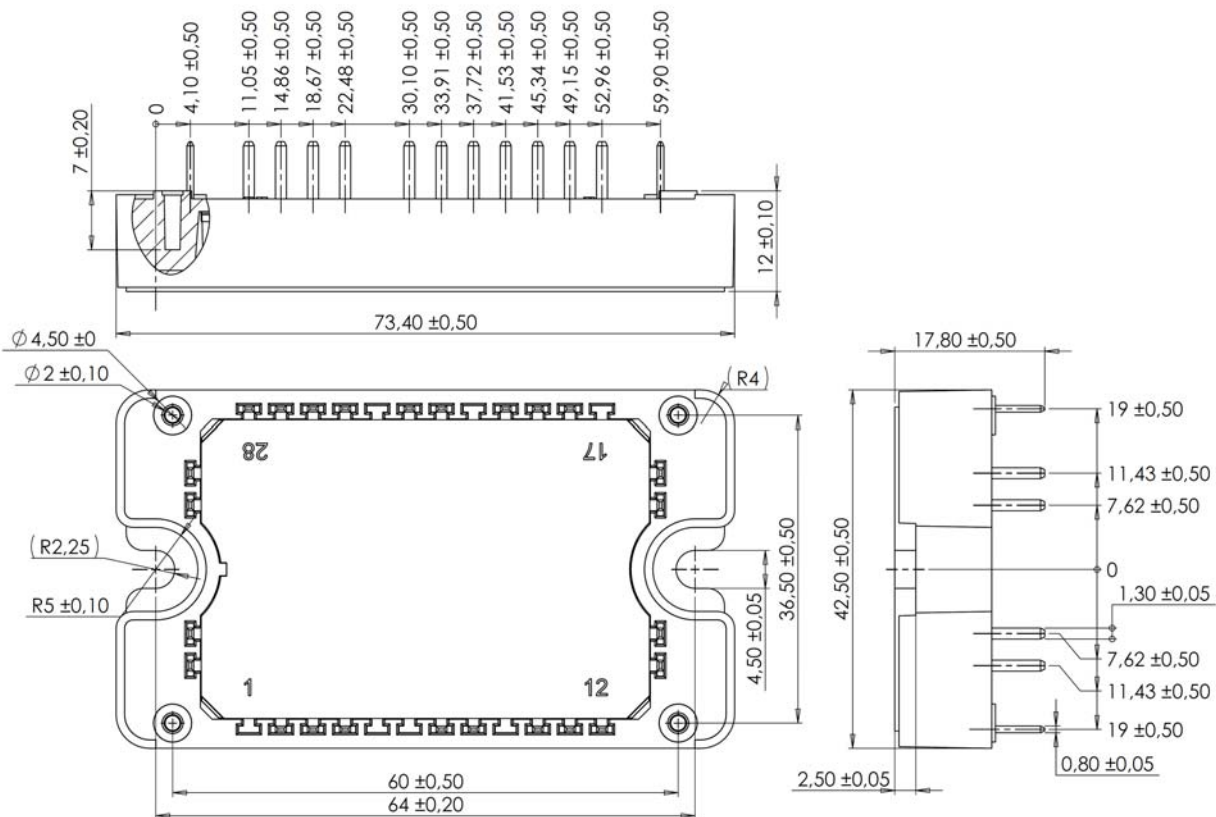
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
 R_T: Thermistor value at T

Thermal and package characteristics

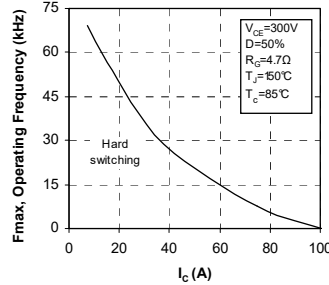
Symbol	Characteristic	Min	Max	Unit		
V _{ISOL}	RMS Isolation Voltage, any terminal to case t=1 min, 50/60Hz	4000		V		
T _J	Operating junction temperature range	-40	175*	°C		
T _{JOP}	Recommended junction temperature under switching conditions	-40	T _{Jmax} -25			
T _{STG}	Storage Temperature Range	-40	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

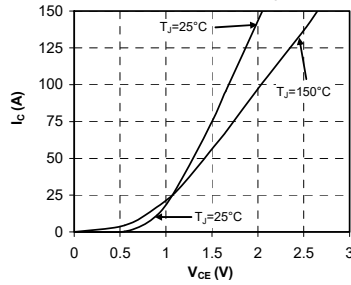
Package outline (dimensions in mm)

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

Q2 & Q3 Typical performance curve

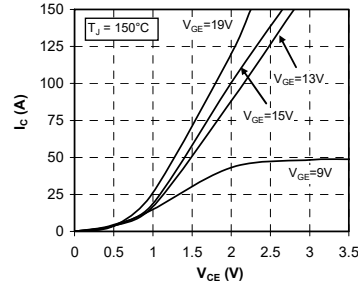
Operating Frequency vs Collector Current



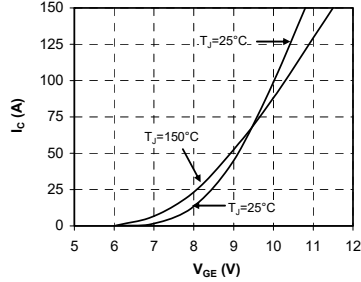
Output Characteristics ($V_{GE}=15V$)



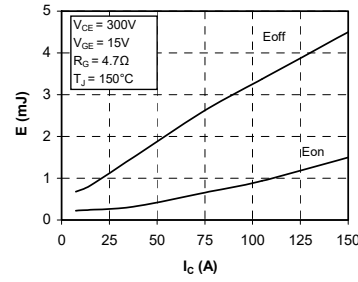
Output Characteristics



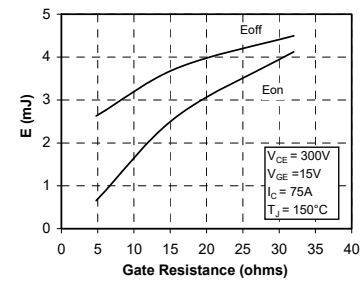
Transfer Characteristics



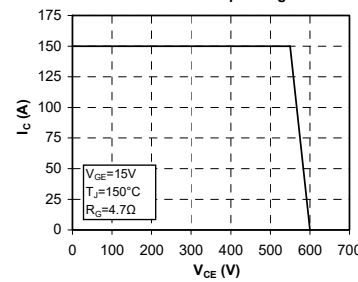
Energy losses vs Collector Current



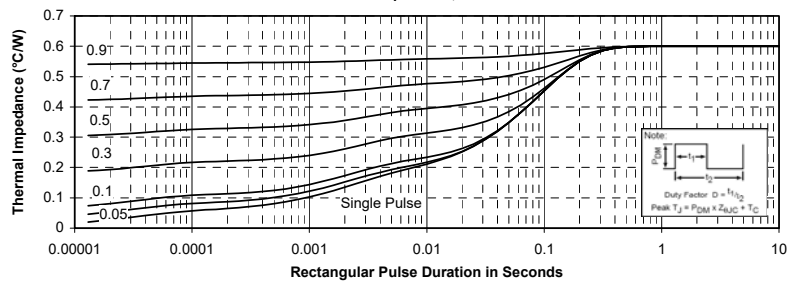
Switching Energy Losses vs Gate Resistance

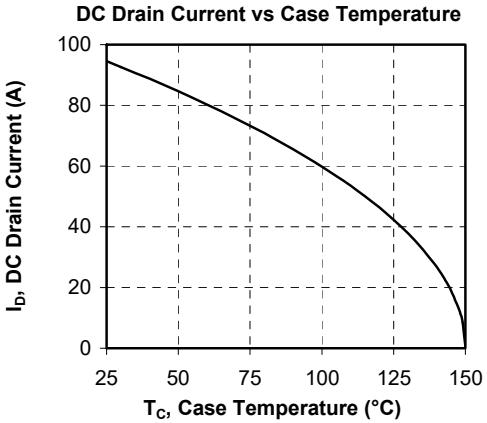
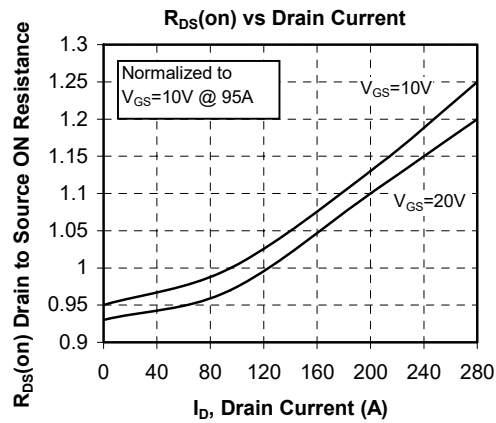
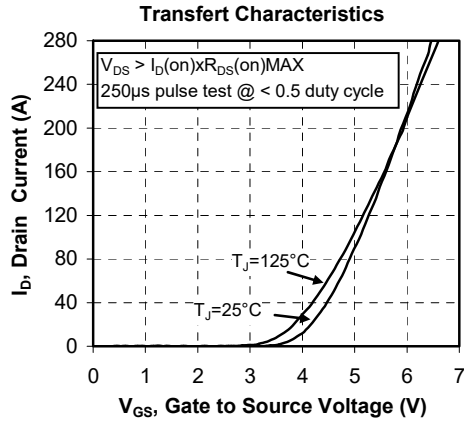
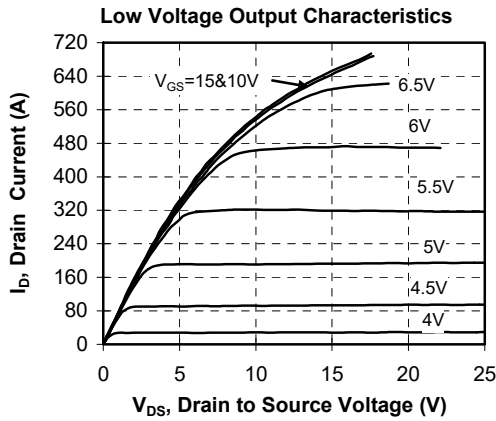
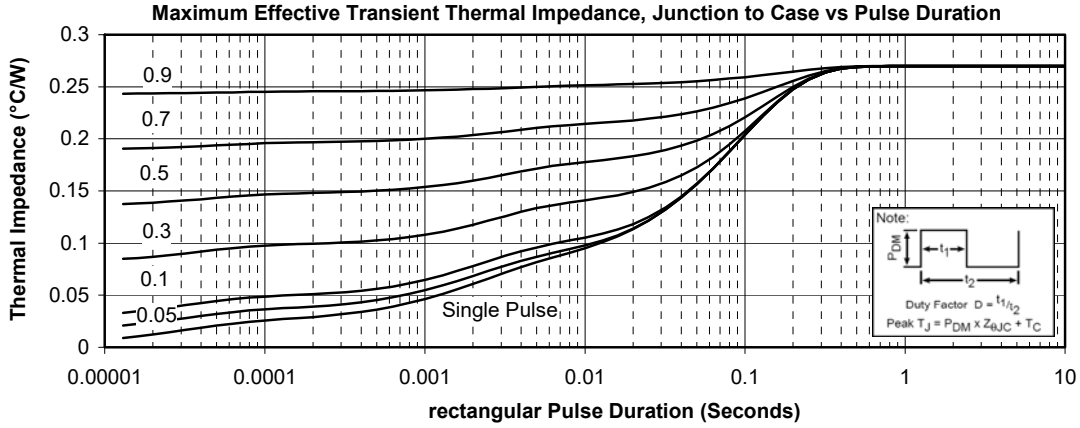


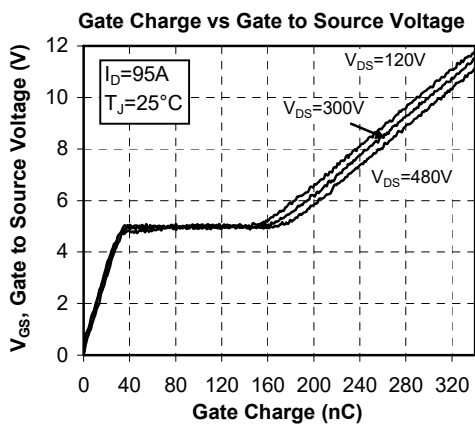
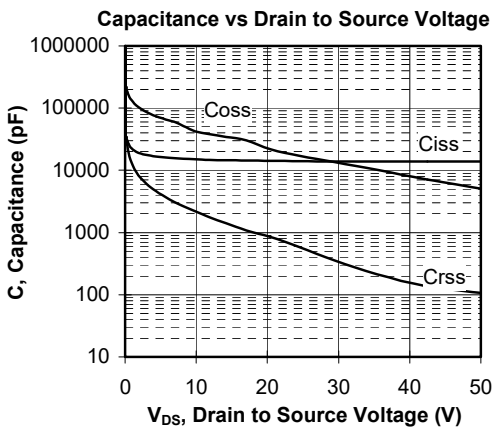
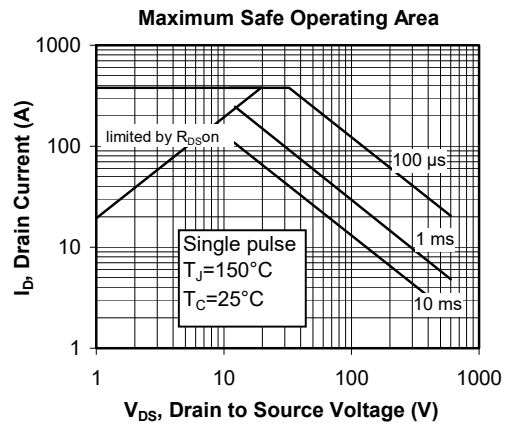
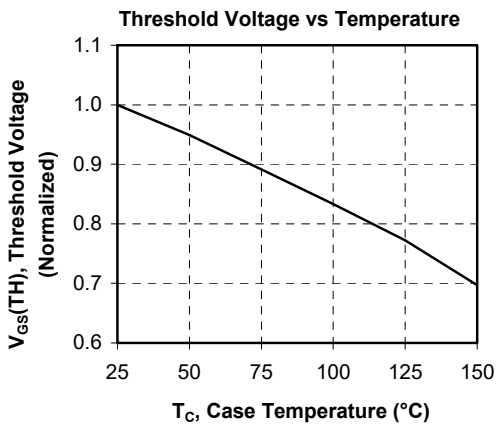
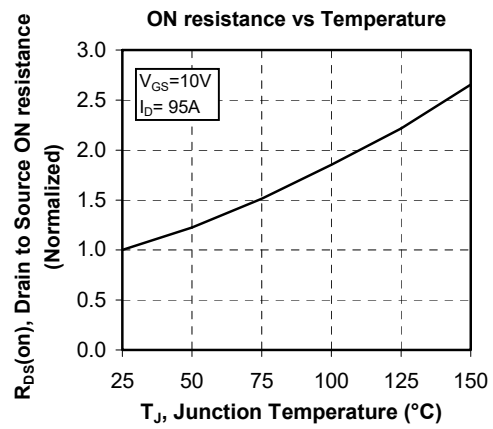
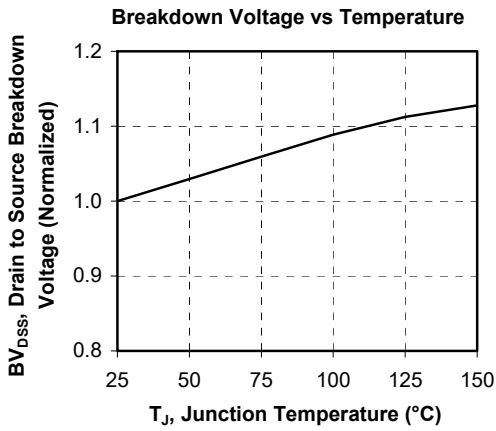
Reverse Bias Safe Operating Area

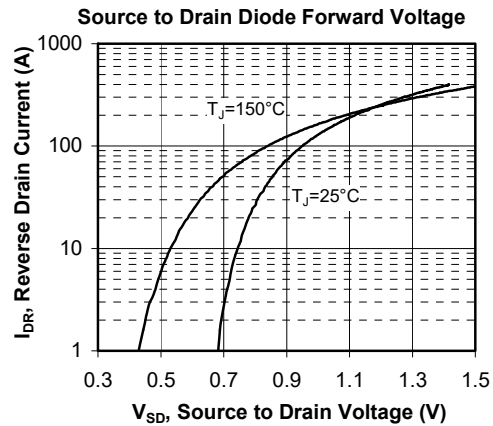
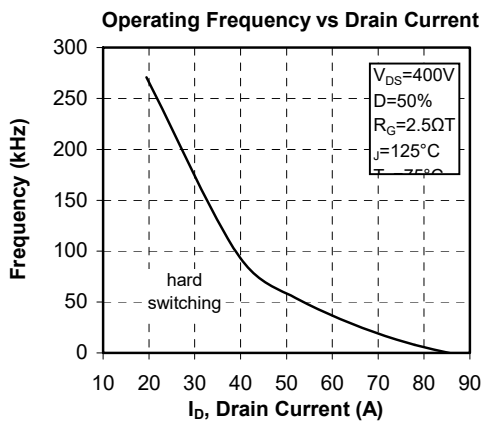
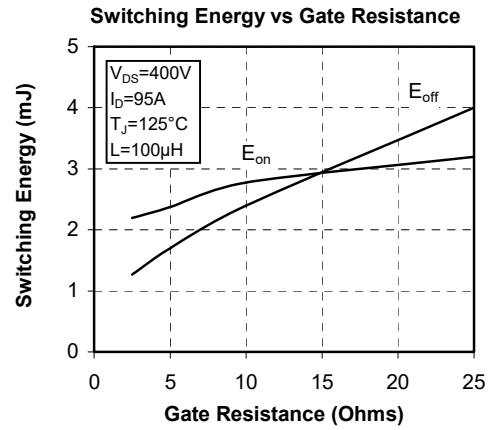
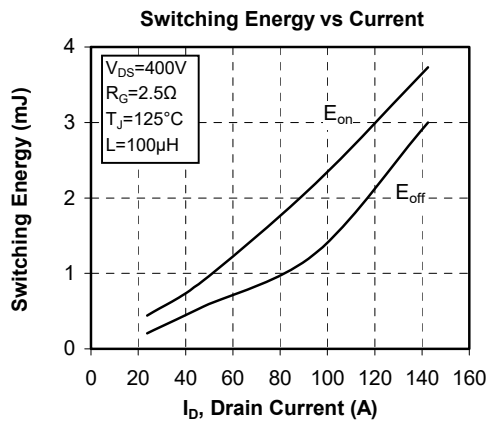
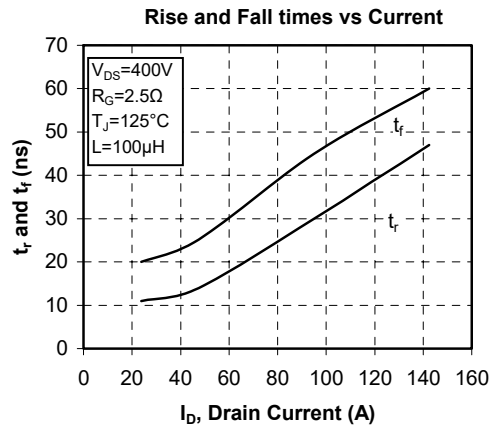
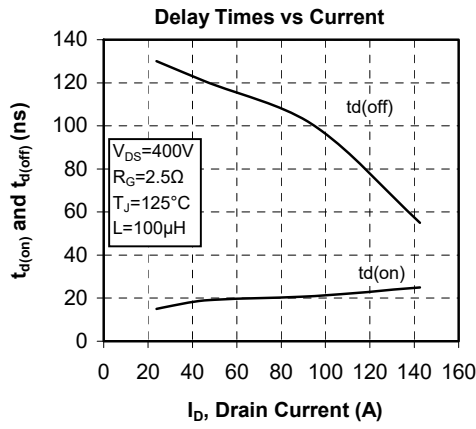


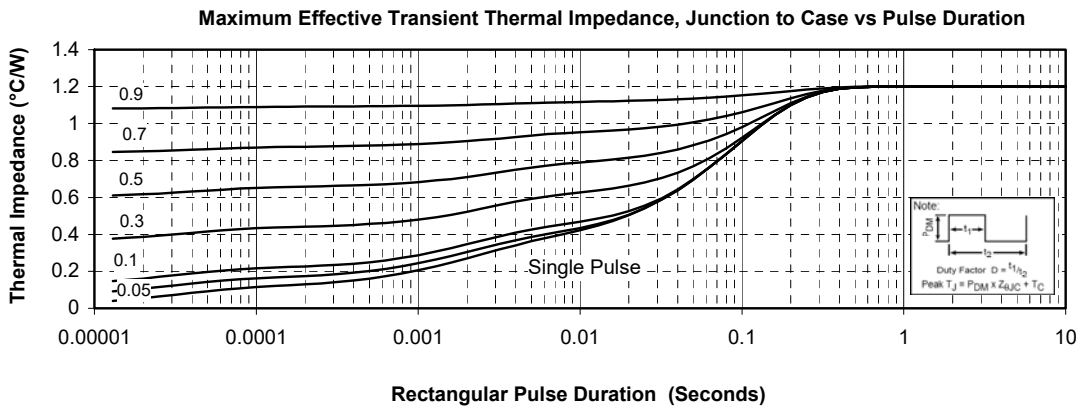
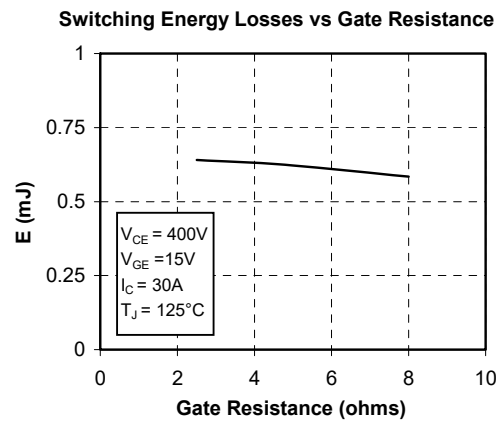
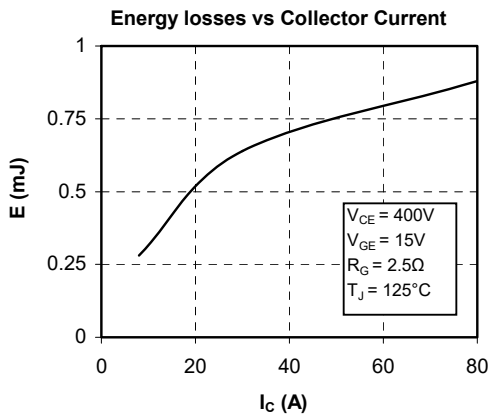
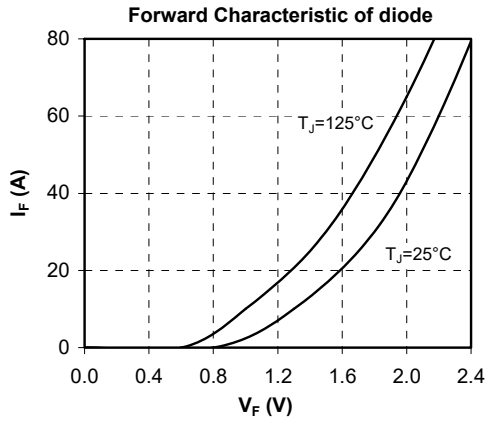
maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration

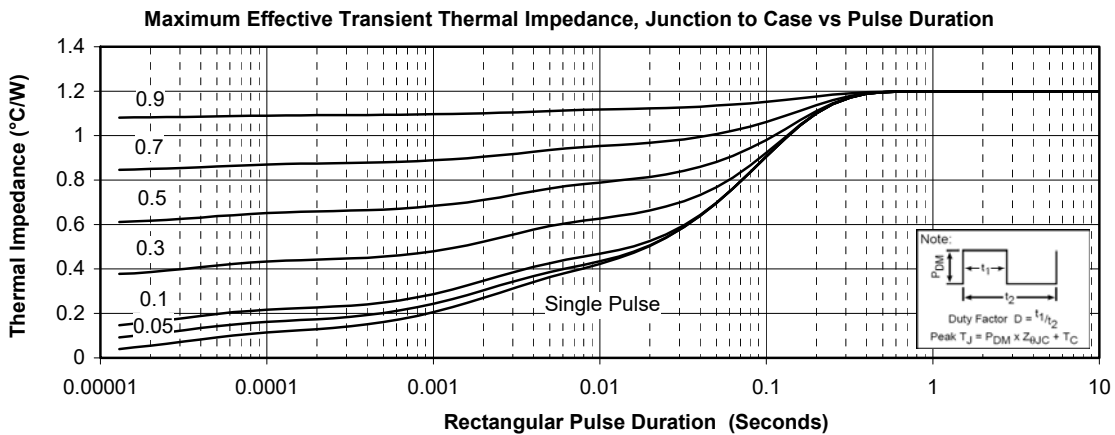
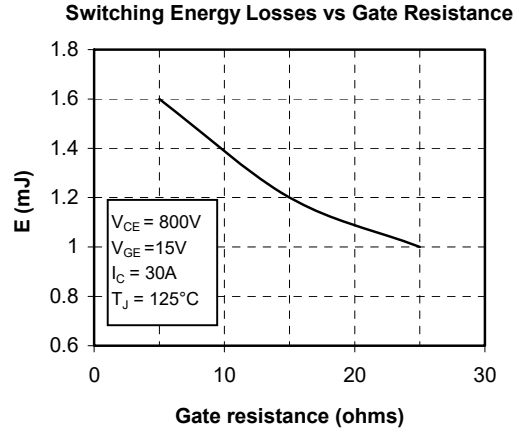
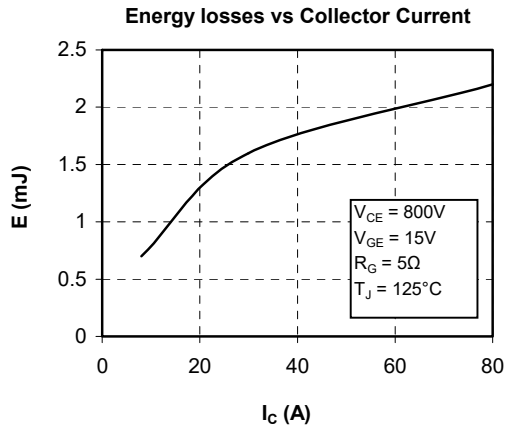
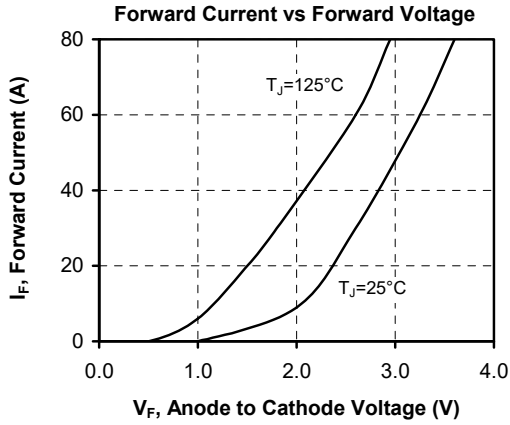


Q1 & Q4 Typical performance curve






CR5 & CR6 Typical performance curve


CR7 & CR8 Typical performance curve


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