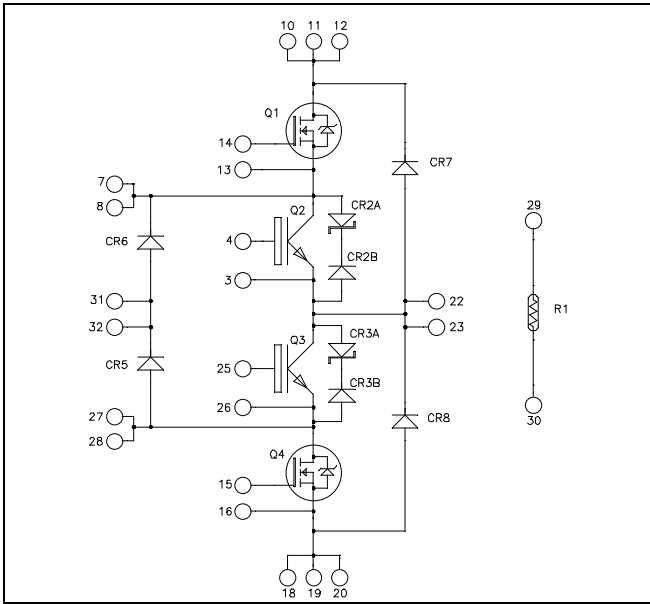


*Three level inverter*  
*CoolMOS & Trench + Field Stop IGBT4*  
*Power Module*

**Trench & Field Stop IGBT4 Q2, Q3:**  
 $V_{CES} = 1200V$  ;  $I_C = 40A$  @  $T_c = 80^\circ C$

**CoolMOS™ Q1, Q4:**  
 $V_{DSS} = 900V$  ;  $I_D = 23A$  @  $T_c = 80^\circ C$

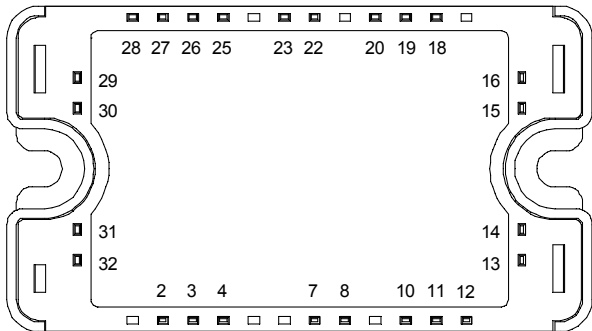


**Application**

- Solar converter
- Uninterruptible Power Supplies

**Features**

- **Q2, Q3 Trench + Field Stop IGBT 4 Technology**
  - Low voltage drop
  - Low leakage current
  - Low switching losses
- **Q1, Q4 CoolMOS™**
  - 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



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

**Benefits**

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive TC of  $V_{CEsat}$
- 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.  
See application note APT0502 on [www.microsemi.com](http://www.microsemi.com)

**Q1 & Q4 Absolute maximum ratings** (per CoolMOS™)

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>	<i>Unit</i>
V <sub>DSS</sub>	Drain - Source Breakdown Voltage	900	V
I <sub>D</sub>	Continuous Drain Current	T <sub>c</sub> = 25°C	30
		T <sub>c</sub> = 80°C	23
I <sub>DM</sub>	Pulsed Drain current	75	A
V <sub>GS</sub>	Gate - Source Voltage	±20	V
R <sub>DS(on)</sub>	Drain - Source ON Resistance	120	mΩ
P <sub>D</sub>	Maximum Power Dissipation	T <sub>c</sub> = 25°C	250
I <sub>AR</sub>	Avalanche current (repetitive and non repetitive)	8.8	A
E <sub>AR</sub>	Repetitive Avalanche Energy	2.9	mJ
E <sub>AS</sub>	Single Pulse Avalanche Energy	1940	

**Q1 & Q4 Electrical Characteristics** (per CoolMOS™)

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 900V	T <sub>j</sub> = 25°C		100	μA
		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 900V	T <sub>j</sub> = 125°C		500	
R <sub>DS(on)</sub>	Drain – Source on Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 26A		100	120	mΩ
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> ; I <sub>D</sub> = 3mA	2.5	3	3.5	V
I <sub>GSS</sub>	Gate – Source Leakage Current	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0V			100	nA

**Q1 & Q4 Dynamic Characteristics** (per CoolMOS™)

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V ; V <sub>DS</sub> = 100V f = 1MHz		6800		pF
C <sub>oss</sub>	Output Capacitance			330		
Q <sub>g</sub>	Total gate Charge	V <sub>GS</sub> = 10V V <sub>Bus</sub> = 400V I <sub>D</sub> = 26A		270		nC
Q <sub>gs</sub>	Gate – Source Charge			32		
Q <sub>gd</sub>	Gate – Drain Charge			115		
T <sub>d(on)</sub>	Turn-on Delay Time	<b>Inductive Switching (125°C)</b> V <sub>GS</sub> = 10V V <sub>Bus</sub> = 400V I <sub>D</sub> = 26A R <sub>G</sub> = 7.5Ω		70		ns
T <sub>r</sub>	Rise Time			20		
T <sub>d(off)</sub>	Turn-off Delay Time			400		
T <sub>f</sub>	Fall Time			25		
R <sub>thJC</sub>	Junction to Case Thermal resistance				0.5	°C/W

**Q2 & Q3 Absolute maximum ratings** (per IGBT)

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>	<i>Unit</i>
V <sub>CES</sub>	Collector - Emitter Breakdown Voltage	1200	V
I <sub>C</sub>	Continuous Collector Current	T <sub>C</sub> = 25°C	60
		T <sub>C</sub> = 80°C	40
I <sub>CM</sub>	Pulsed Collector Current	T <sub>C</sub> = 25°C	70
V <sub>GE</sub>	Gate – Emitter Voltage	±20	V
P <sub>D</sub>	Maximum Power Dissipation	T <sub>C</sub> = 25°C	220
RBSOA	Reverse Bias Safe Operating Area	T <sub>j</sub> = 150°C	70A @ 1100V

**Q2 & Q3 Electrical Characteristics (per IGBT)**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{GE} = 0V, V_{CE} = 1200V$			250	$\mu A$
$V_{CE(sat)}$	Collector Emitter saturation Voltage	$V_{GE} = 15V$ $I_C = 35A$		1.85 2.25	2.25	V
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1.2mA$	5.0	5.8	6.5	V
$I_{GES}$	Gate – Emitter Leakage Current	$V_{GE} = 20V, V_{CE} = 0V$			400	nA

**Q2 & Q3 Dynamic Characteristics (per IGBT)**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	$V_{GE} = 0V$		1950		pF
$C_{oes}$	Output Capacitance	$V_{CE} = 25V$		155		
$C_{res}$	Reverse Transfer Capacitance	$f = 1MHz$		115		
$Q_G$	Gate charge	$V_{GE} = \pm 15V ; V_{CE} = 600V$ $I_C = 35A$		0.27		$\mu C$
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{GE} = \pm 15V$ $V_{CE} = 600V$ $I_C = 35A$ $R_G = 12\Omega$		130		ns
$T_r$	Rise Time			20		
$T_{d(off)}$	Turn-off Delay Time			300		
$T_f$	Fall Time			45		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (150°C) $V_{GE} = \pm 15V$ $V_{CE} = 600V$ $I_C = 35A$ $R_G = 12\Omega$		150		ns
$T_r$	Rise Time			35		
$T_{d(off)}$	Turn-off Delay Time			350		
$T_f$	Fall Time			80		
$E_{on}$	Turn-on Switching Energy	$V_{GE} = \pm 15V$ $V_{CE} = 600V$		2.6 4		mJ
$E_{off}$	Turn-off Switching Energy	$I_C = 35A$ $R_G = 12\Omega$		2 3		
$I_{sc}$	Short Circuit data	$V_{GE} \leq 15V ; V_{Bus} = 900V$ $t_p \leq 10\mu s ; T_j = 150^\circ C$		140		A
$R_{thJC}$	Junction to Case Thermal Resistance				0.68	$^\circ C/W$

**CR2 & CR3 diode ratings and characteristics (per device)**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$V_F$	Diode + tranzorb Forward Voltage	$I_F = 10A$		10.5		V
$R_{thJC}$	Junction to Case Thermal Resistance				8	$^\circ C/W$

**CR5 & CR6 diode ratings and characteristics (per diode)**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage		1000			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> =1000V			100	μA
I <sub>F</sub>	DC Forward Current	T <sub>c</sub> = 80°C		40		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 40A		2.5	3	V
		I <sub>F</sub> = 80A		3.1		
		I <sub>F</sub> = 40A	T <sub>j</sub> = 125°C	2		
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 40A V <sub>R</sub> = 667V di/dt = 200A/μs	T <sub>j</sub> = 25°C	250		ns
	T <sub>j</sub> = 125°C		315			
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>F</sub> = 40A V <sub>R</sub> = 667V di/dt = 200A/μs	T <sub>j</sub> = 25°C	415		nC
	T <sub>j</sub> = 125°C		1650			
E <sub>rr</sub>	Reverse Recovery Energy	I <sub>F</sub> = 40A V <sub>R</sub> = 667V di/dt = 1000A/μs	T <sub>j</sub> = 125°C	1.3		mJ
R <sub>thJC</sub>	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 <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage		1200			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> =1200V			100	μA
I <sub>F</sub>	DC Forward Current	T <sub>c</sub> = 80°C		40		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 30A		2.6	3.1	V
		I <sub>F</sub> = 60A		3.2		
		I <sub>F</sub> = 30A	T <sub>j</sub> = 125°C	1.8		
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 30A V <sub>R</sub> = 800V di/dt = 200A/μs	T <sub>j</sub> = 25°C	300		ns
	T <sub>j</sub> = 125°C		380			
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>F</sub> = 30A V <sub>R</sub> = 800V di/dt = 200A/μs	T <sub>j</sub> = 25°C	360		nC
	T <sub>j</sub> = 125°C		1700			
E <sub>rr</sub>	Reverse Recovery Energy	I <sub>F</sub> = 30A V <sub>R</sub> = 800V di/dt = 1000A/μs	T <sub>j</sub> = 125°C	1.6		mJ
R <sub>thJC</sub>	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 <sub>25</sub>	Resistance @ 25°C		50		kΩ
ΔR <sub>25</sub> /R <sub>25</sub>			5		%
B <sub>25/85</sub>	T <sub>25</sub> = 298.15 K		3952		K
ΔB/B		T <sub>C</sub> =100°C	4		%

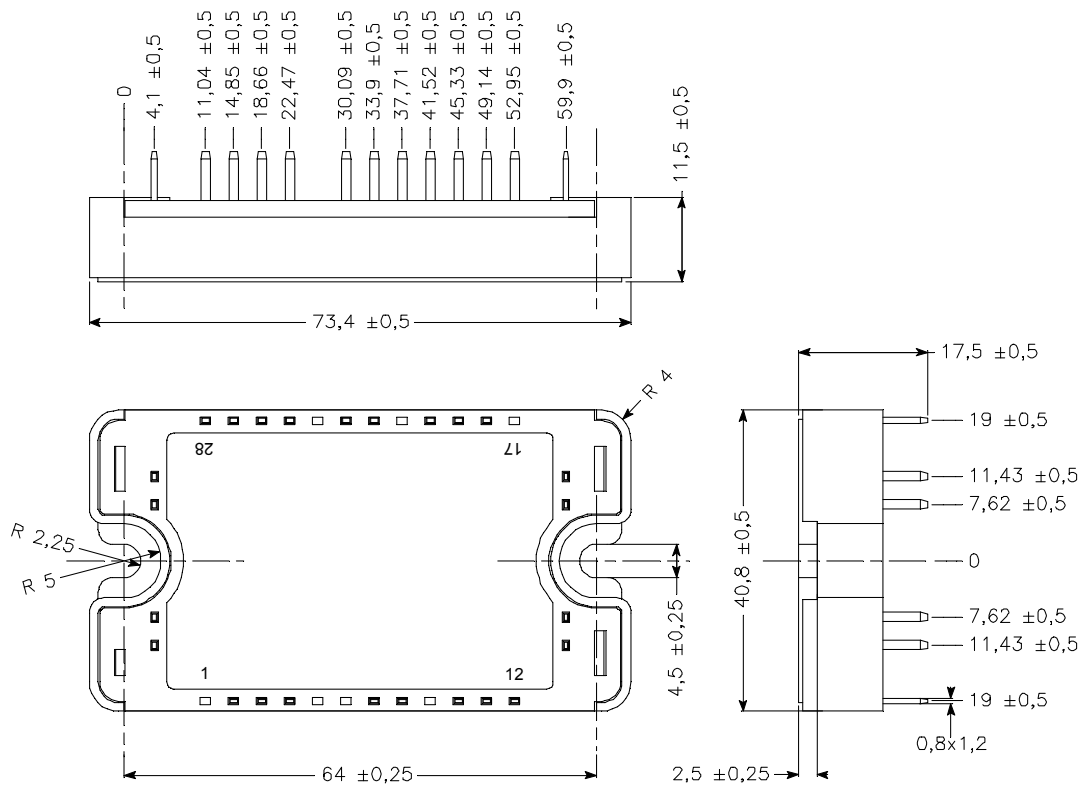
$$R_T = \frac{R_{25}}{\exp \left[ B_{25/85} \left( \frac{1}{T} - \frac{1}{T_{25}} \right) \right]}$$

T: Thermistor temperature  
 R<sub>T</sub>: Thermistor value at T

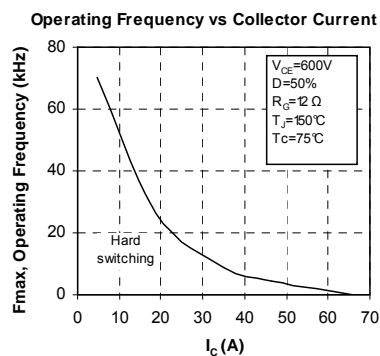
**Thermal and package characteristics**

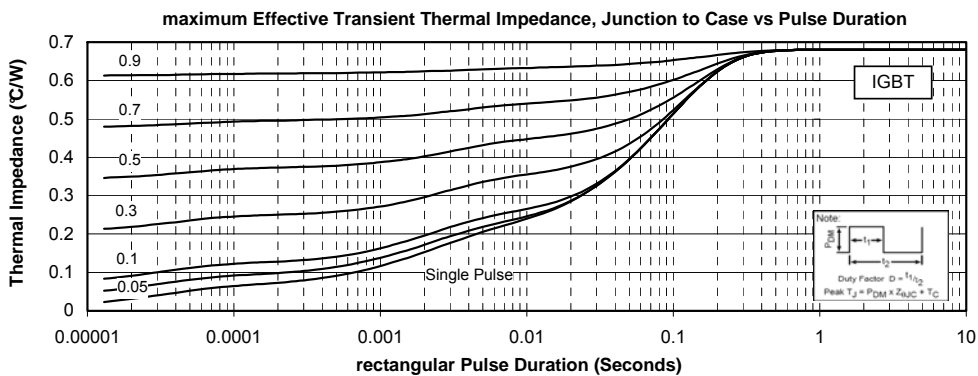
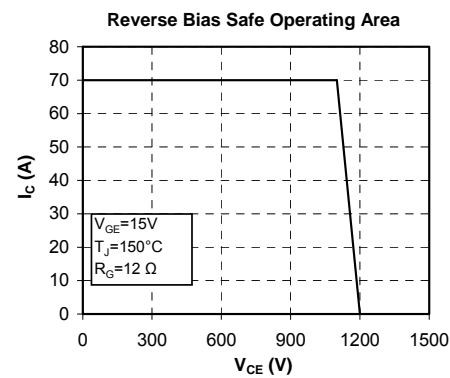
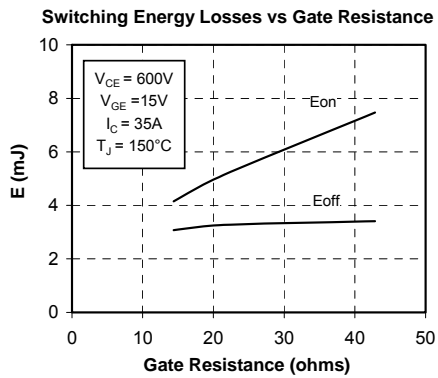
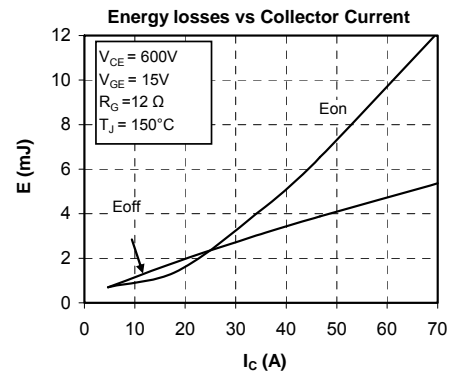
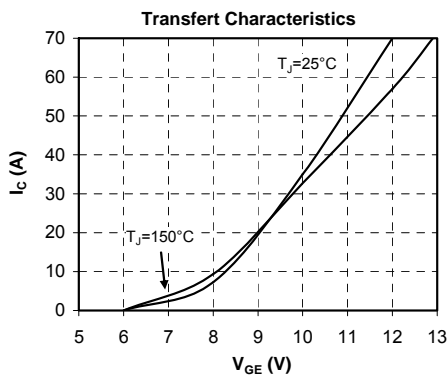
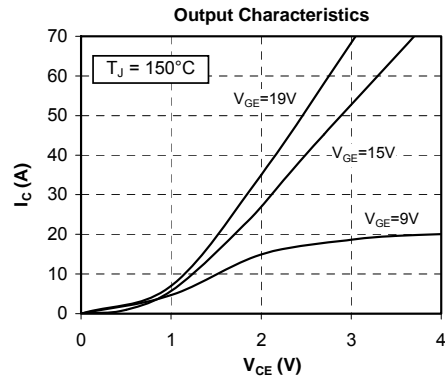
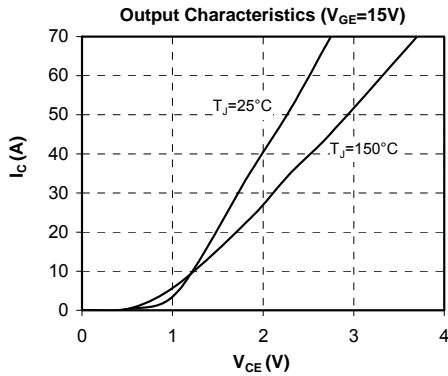
Symbol	Characteristic	Min	Typ	Max	Unit
V <sub>ISOL</sub>	RMS Isolation Voltage, any terminal to case t=1 min, I <sub>isol</sub> <1mA, 50/60Hz	4000			V
T <sub>J</sub>	Operating junction temperature range	-40		175*	°C
T <sub>STG</sub>	Storage Temperature Range	-40		125	
T <sub>C</sub>	Operating Case Temperature	-40		100	
Torque	Mounting torque	To heatsink M4		4.7	N.m
Wt	Package Weight			110	g

\* T<sub>jmax</sub> = 150°C for Q1 & Q4

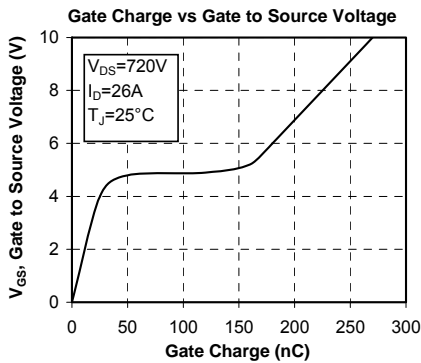
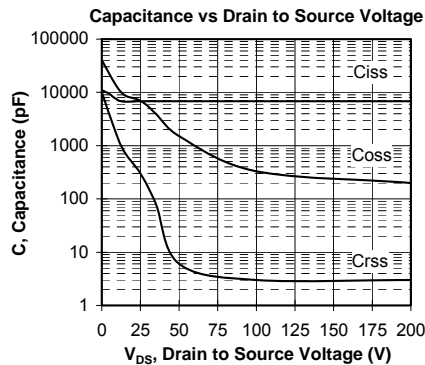
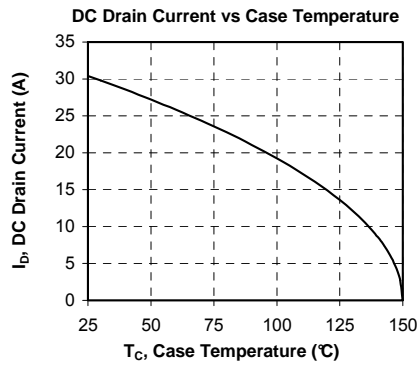
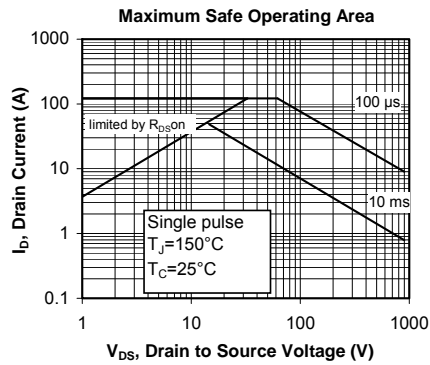
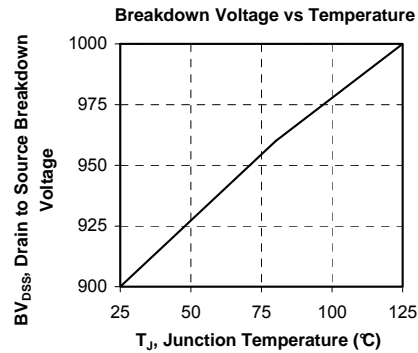
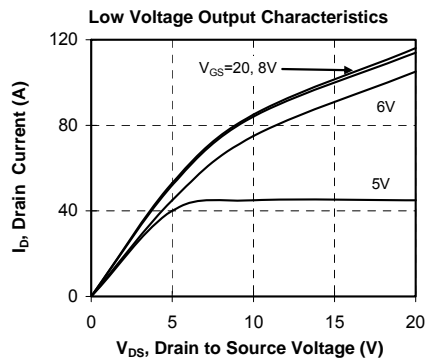
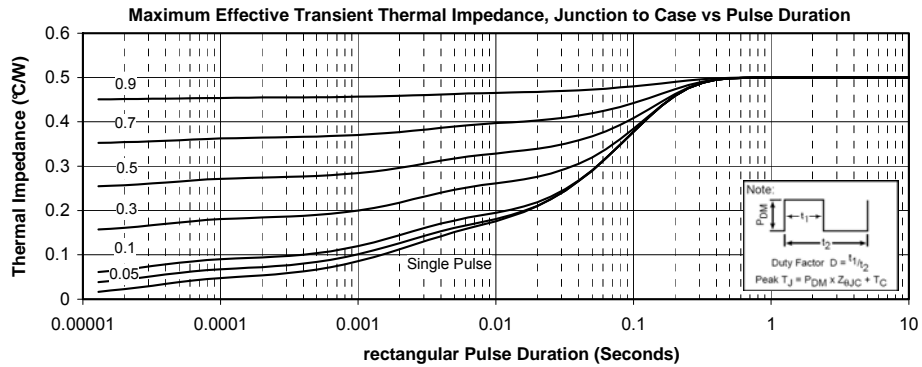
**SP3 Package outline (dimensions in mm)**


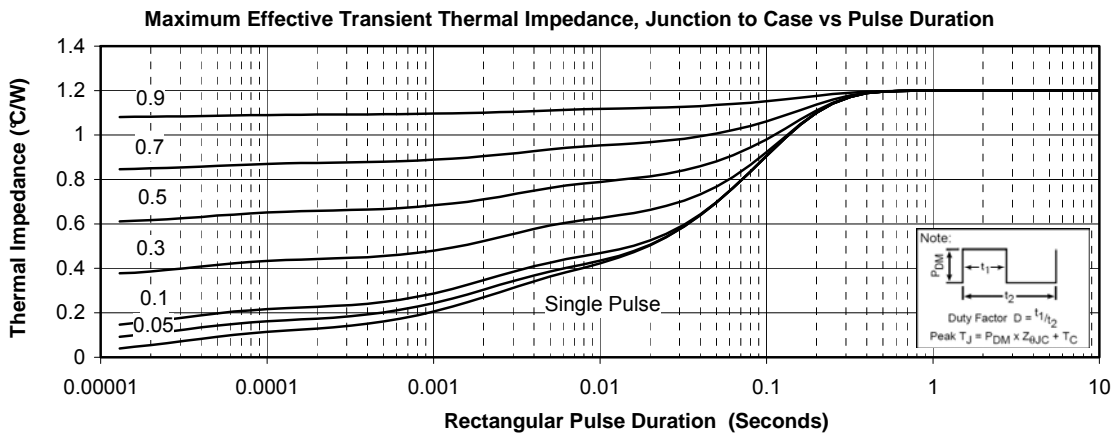
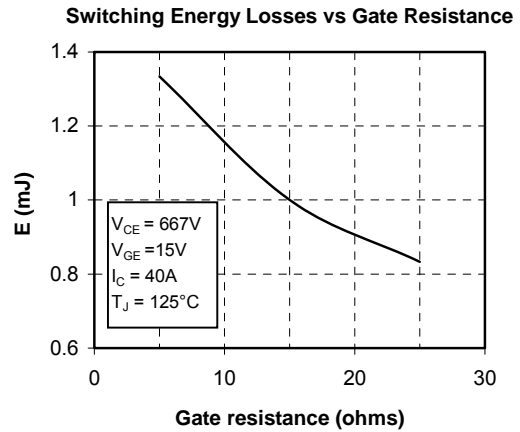
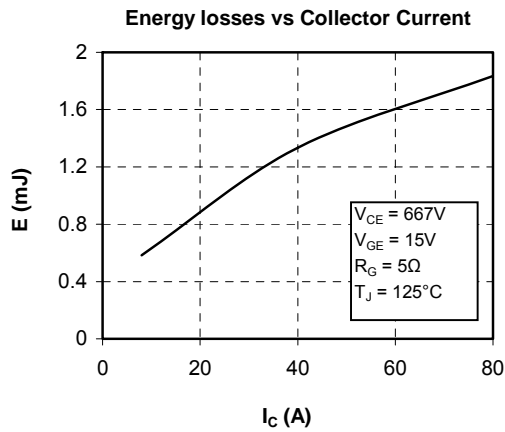
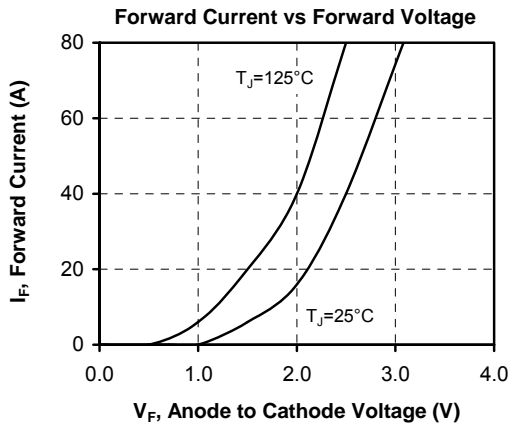
See application note 1901 - Mounting Instructions for SP3 Power Modules on [www.microsemi.com](http://www.microsemi.com)

**Q2 & Q3 Typical performance curve**


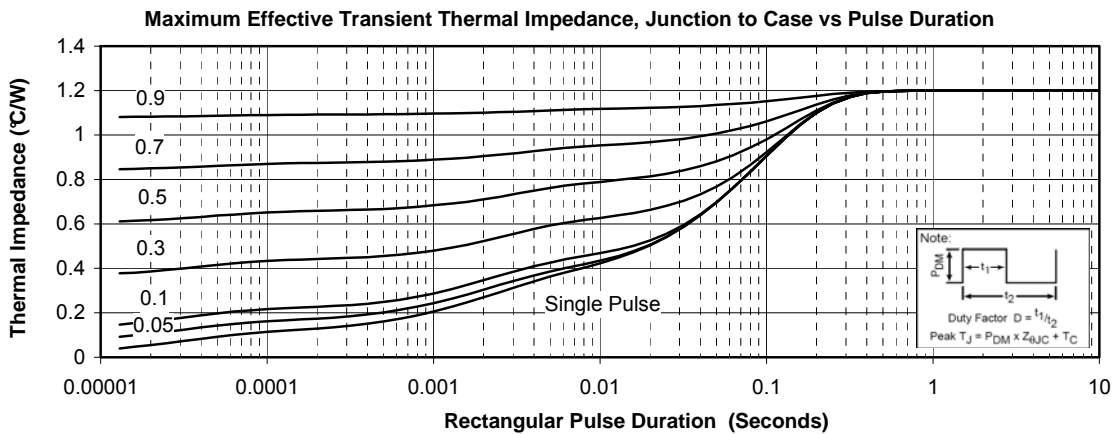
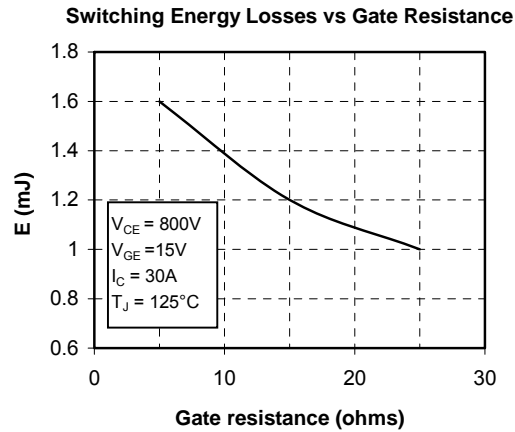
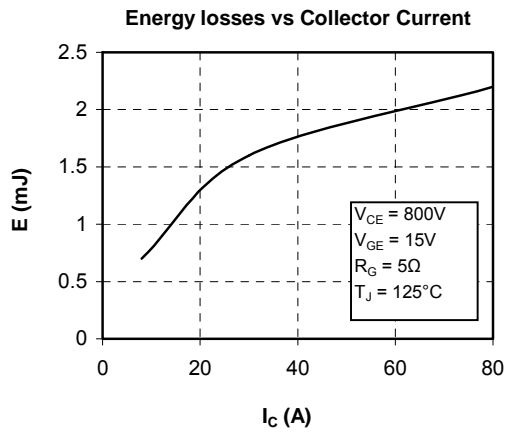
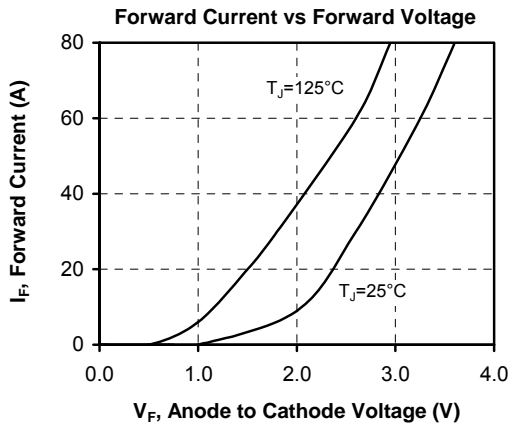


## Q1 & Q4 Typical performance curve



**CR5 & CR6 Typical performance curve**




**CR7 & CR8 Typical performance curve**


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