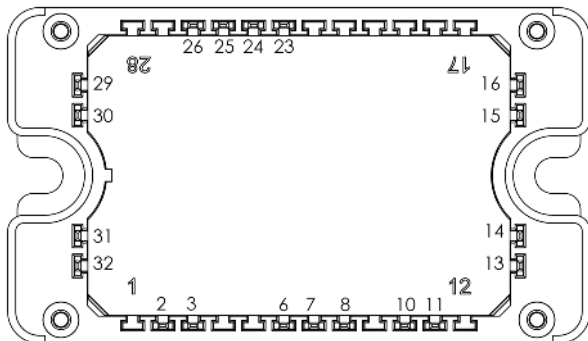
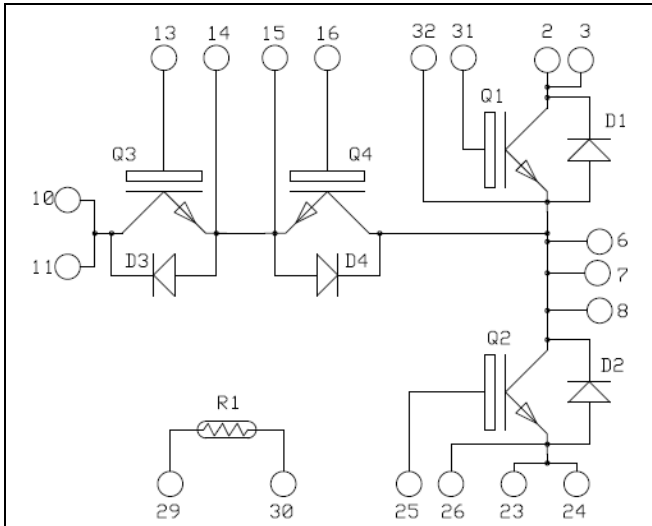


**Phase Leg & Dual Common Emitter
Power Module**



All multiple inputs and outputs must be shorted together
10/11 ; 23/24 ; 2/3 ; ...

High speed Trench & Field Stop IGBT4 (Q1, Q2):
 $V_{CES} = 1200V$; $I_C = 40A$ @ $T_c = 80^\circ C$

Trench & Field Stop IGBT3 (Q3, Q4):
 $V_{CES} = 600V$; $I_C = 50A$ @ $T_c = 80^\circ C$

Application

- Solar converter
- Uninterruptible Power Supplies

Features

- **Q1, Q2 High speed Trench + field Stop IGBT4**
 - Low voltage drop
 - Low tail current
- **Q3, Q4 Trench + field Stop IGBT3**
 - Low voltage drop
 - Low tail current
 - Switching frequency up to 20 kHz
- **SiC Schottky Diode (D3, D4)**
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature Independent switching behavior
 - Positive temperature coefficient on VF

- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

Benefits

- Stable temperature behavior
- Very rugged
- Solderable terminals for easy PCB mounting
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive T_C 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

1. High speed Trench & Field Stop IGBT4 Phase Leg Q1&Q2 (per IGBT)
Absolute maximum ratings (per IGBT)

Symbol	Parameter	Max ratings	Unit
V_{CES}	Collector - Emitter Breakdown Voltage	1200	V
I_C	Continuous Collector Current	$T_C = 25^\circ\text{C}$	75
		$T_C = 80^\circ\text{C}$	40
I_{CM}	Pulsed Collector Current	$T_C = 25^\circ\text{C}$	160
V_{GE}	Gate - Emitter Voltage	± 20	V
P_D	Maximum Power Dissipation	250	W
RBSOA	Reverse Bias Safe Operating Area	$T_j = 150^\circ\text{C}$	80A @ 1100V

Electrical Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit	
I_{CES}	Zero Gate Voltage Collector Current	$V_{GE} = 0\text{V}, V_{CE} = 1200\text{V}$			100	μA	
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	$V_{GE} = 15\text{V}$ $I_C = 40\text{A}$	$T_j = 25^\circ\text{C}$	1.7	2.05	2.4	V
			$T_j = 150^\circ\text{C}$		2.6		
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1\text{mA}$	5.0	5.8	6.5	V	
I_{GES}	Gate - Emitter Leakage Current	$V_{GE} = 20\text{V}, V_{CE} = 0\text{V}$			120	nA	

Dynamic Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{ies}	Input Capacitance	$V_{GE} = 0\text{V}$ $V_{CE} = 25\text{V}$ $f = 1\text{MHz}$		2300		pF
C_{oes}	Output Capacitance			150		
C_{res}	Reverse Transfer Capacitance			135		
Q_G	Gate charge	$V_{GE} = 15\text{V}, I_C = 40\text{A}$ $V_{CE} = 960\text{V}$		185		nC
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 600\text{V}$ $I_C = 40\text{A}$ $R_G = 12\Omega$		30		ns
T_r	Rise Time			57		
$T_{d(off)}$	Turn-off Delay Time			290		
T_f	Fall Time			16		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (150°C) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 600\text{V}$ $I_C = 40\text{A}$ $R_G = 12\Omega$		30		ns
T_r	Rise Time			49		
$T_{d(off)}$	Turn-off Delay Time			366		
T_f	Fall Time			48		
E_{on}	Turn on Energy	$V_{GE} = \pm 15\text{V}$ $V_{Bus} = 600\text{V}$ $I_C = 40\text{A}$ $R_G = 12\Omega$	$T_j = 25^\circ\text{C}$	3.2		mJ
			$T_j = 150^\circ\text{C}$	3.75		
E_{off}	Turn off Energy	$I_C = 40\text{A}$ $R_G = 12\Omega$	$T_j = 25^\circ\text{C}$	1.2		
			$T_j = 150^\circ\text{C}$	2.25		
I_{sc}	Short Circuit data	$V_{GE} \leq 15\text{V}; V_{Bus} = 600\text{V}$ $t_p \leq 10\mu\text{s}; T_j = 150^\circ\text{C}$		150		A
R_{thJC}	Junction to Case Thermal Resistance				0.6	$^\circ\text{C/W}$

Diode ratings and characteristics (D1 & D2) (per diode)

<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			1200			V
I _{RM}	Maximum Reverse Leakage Current	V _R =1200V				100	μA
I _F	DC Forward Current		T _c = 80°C		25		A
V _F	Diode Forward Voltage	I _F = 25A			2.6	3.1	V
		I _F = 50A			3.2		
		I _F = 25A	T _j = 125°C		1.8		
t _{rr}	Reverse Recovery Time	I _F = 25A V _R = 667V di/dt = 200A/μs	T _j = 25°C		320		ns
			T _j = 125°C		360		
Q _{rr}	Reverse Recovery Charge	I _F = 25A V _R = 667V di/dt = 200A/μs	T _j = 25°C		480		nC
			T _j = 125°C		1800		
R _{thJC}	Junction to Case Thermal Resistance					1.4	°C/W

2. Trench & Field Stop IGBT3 Dual common emitter Q3&Q4 (per IGBT)
Absolute maximum ratings (per IGBT)

<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°C	80	A
		T _C = 80°C	50	
I _{CM}	Pulsed Collector Current	T _C = 25°C	100	
V _{GE}	Gate - Emitter Voltage	±20		V
P _D	Maximum Power Dissipation	T _C = 25°C	176	W
RBSOA	Reverse Bias Safe Operating Area	T _j = 150°C	100A @ 550V	

Electrical Characteristics (per IGBT)

<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				250	μA
V _{CE(sat)}	Collector Emitter Saturation Voltage	V _{GE} = 15V I _C = 50A	T _j = 25°C		1.5	1.9	V
			T _j = 150°C		1.7		
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

Dynamic Characteristics (per IGBT)

<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	$V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1MHz$		3150		pF
C_{oes}	Output Capacitance			200		
C_{res}	Reverse Transfer Capacitance			95		
Q_G	Gate charge	$V_{GE} = \pm 15V$, $I_C = 50A$ $V_{CE} = 300V$		500		nC
$T_{d(on)}$	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	$V_{GE} = \pm 15V$ $V_{Bus} = 300V$ $I_C = 50A$ $R_G = 8.2\Omega$	$T_j = 25^\circ C$	0.2		mJ
			$T_j = 150^\circ C$	0.26		
E_{off}	Turn-off Switching Energy		$T_j = 25^\circ C$	1.35		mJ
			$T_j = 150^\circ C$	1.75		
I_{sc}	Short Circuit data	$V_{GE} \leq 15V$; $V_{Bus} = 360V$ $t_p \leq 10\mu s$; $T_j = 150^\circ C$		250		A
R_{thJC}	Junction to Case Thermal Resistance				0.85	°C/W

3. SiC diode ratings and characteristics (D3 & D4) (per diode)

<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	$V_R = 600V$	$T_j = 25^\circ C$	10	60	μA
			$T_j = 175^\circ C$	20	300	
I_F	DC Forward Current	$T_c = 100^\circ C$		10		A
V_F	Diode Forward Voltage	$I_F = 10A$	$T_j = 25^\circ C$	1.6	1.8	V
			$T_j = 175^\circ C$	2	2.4	
Q_C	Total Capacitive Charge	$I_F = 10A$, $V_R = 600V$ $di/dt = 500A/\mu s$		28		nC
C	Total Capacitance	$f = 1MHz$, $V_R = 200V$		65		pF
		$f = 1MHz$, $V_R = 400V$		50		
R_{thJC}	Junction to Case Thermal Resistance				2.5	°C/W

4. Thermal & package characteristics

Temperature sensor NTC

Symbol	Characteristic	Min	Typ	Max	Unit
R ₂₅	Resistance @ 25°C		22		kΩ
ΔR ₂₅ /R ₂₅	Resistance tolerance			5	%
ΔB/B	Beta tolerance			3	
B _{25/100}	T ₂₅ = 298.16 K		3980		K

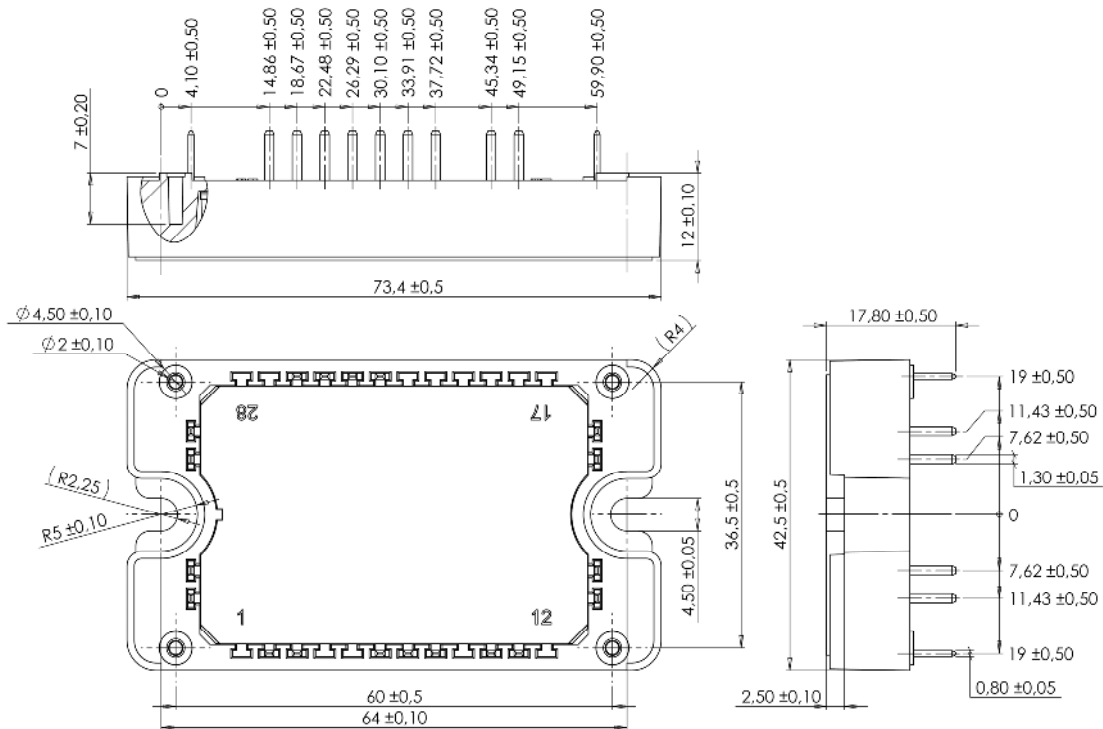
$$R_T = \frac{R_{25}}{\exp \left[B_{25/100} \left(\frac{1}{T_{25}} - \frac{1}{T} \right) \right]}$$

T: Thermistor temperature
 R_T: Thermistor value at T

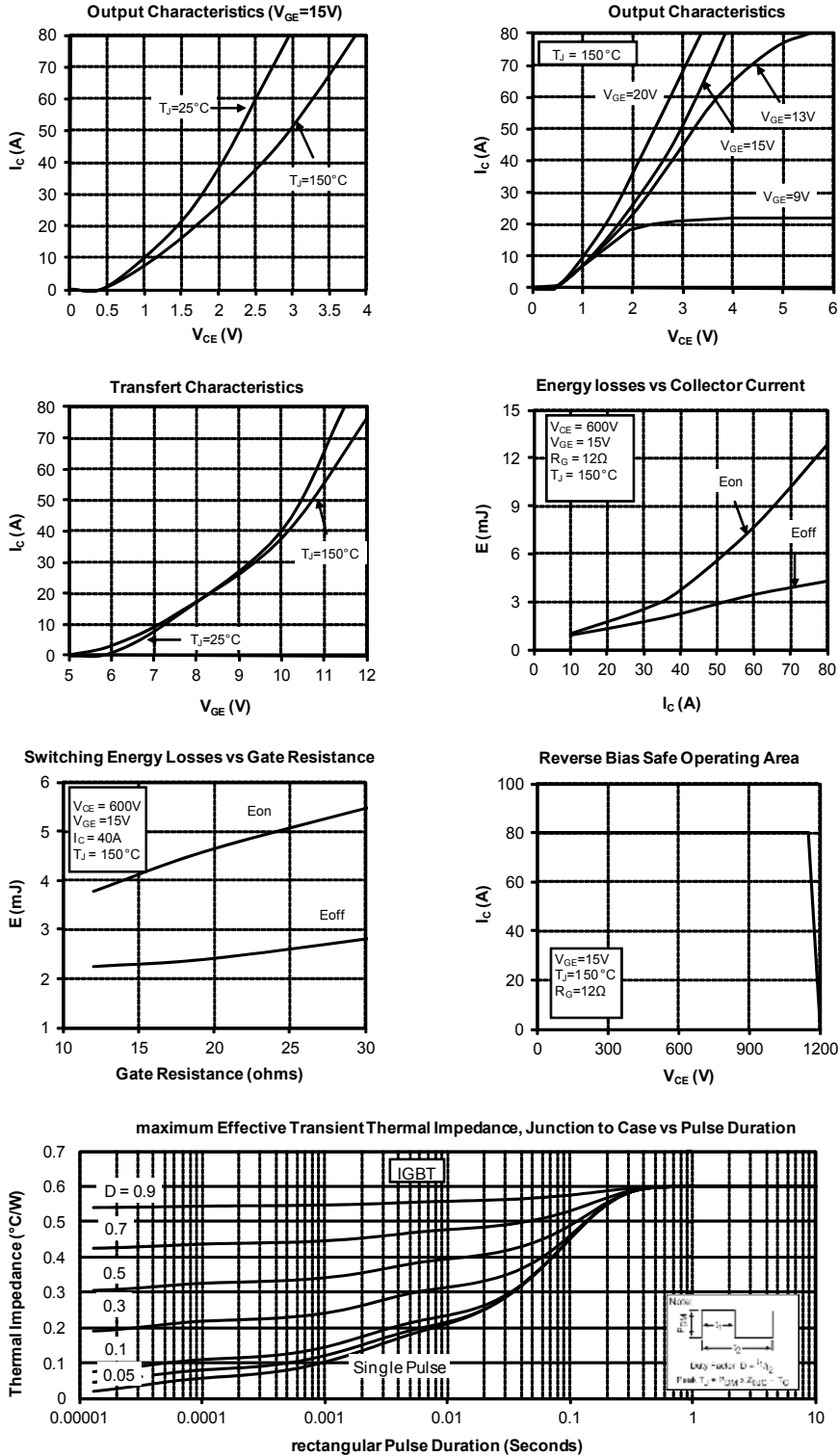
Thermal and package characteristics

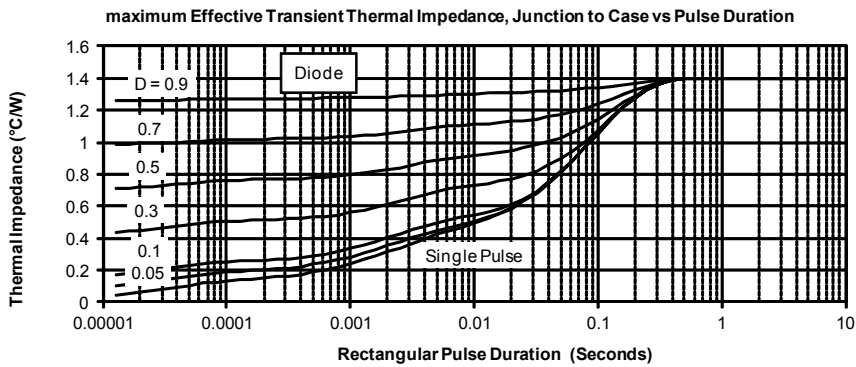
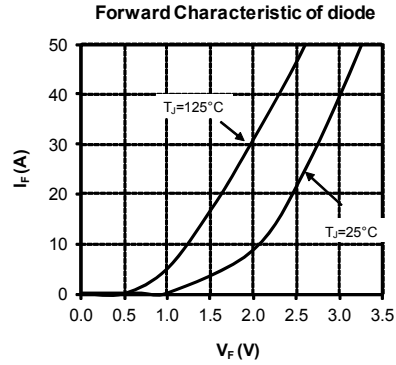
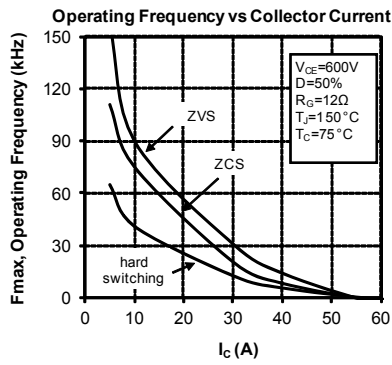
Symbol	Characteristic	Min	Typ	Max	Unit		
V _{ISOL}	RMS Isolation Voltage, any terminal to case t=1 min, 50/60Hz	4000			V		
T _J	Operating junction temperature range	-40		175	°C		
T _{STG}	Storage Temperature Range	-40		125			
T _C	Operating Case Temperature	-40		100			
Torque	Mounting torque		To heatsink	M4	2	3	N.m
Wt	Package Weight					110	g

SP3F Package outline (dimensions in mm)

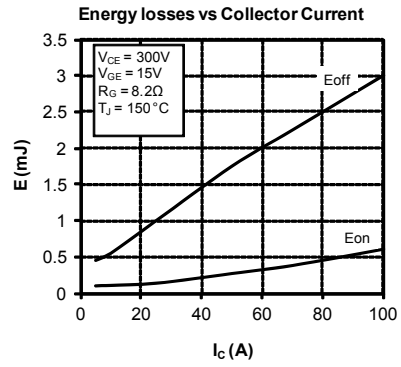
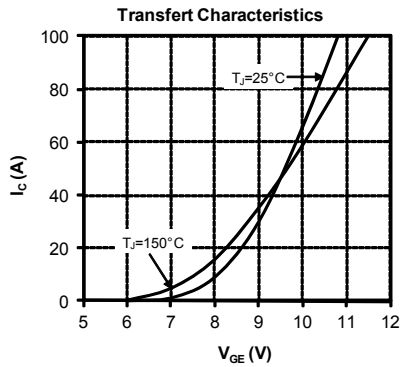
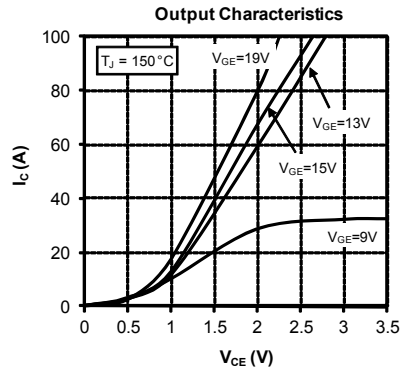
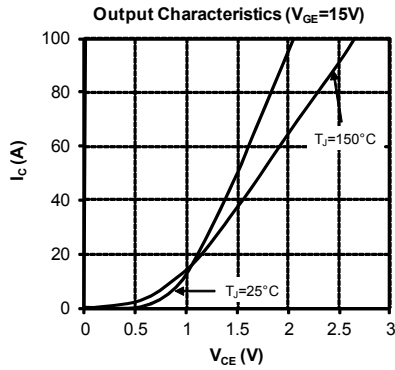


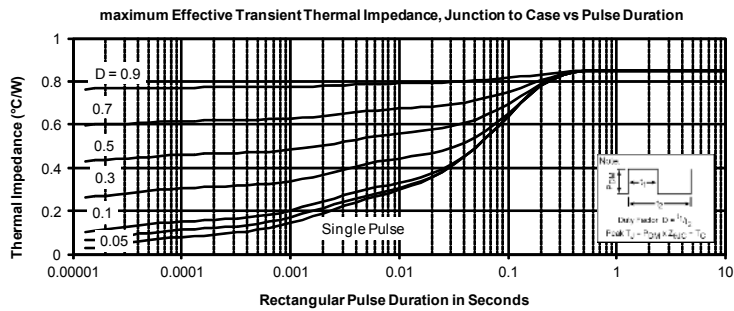
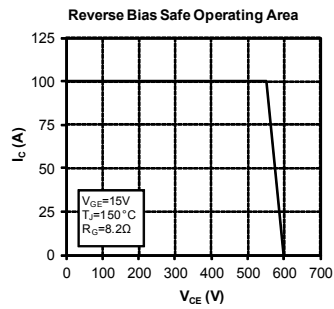
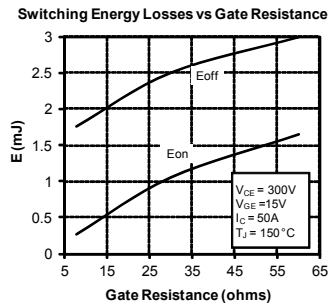
See application note 1906 - Mounting Instructions for SP3F Power Modules on www.microsemi.com

5. Typical performance curve
Q1, Q2 High speed Trench + field stop IGBT4 + CR1 & CR2 diode characteristics


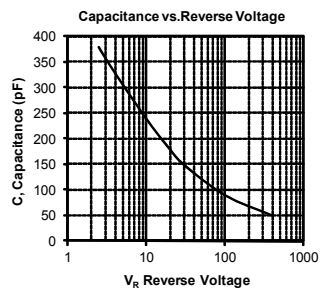
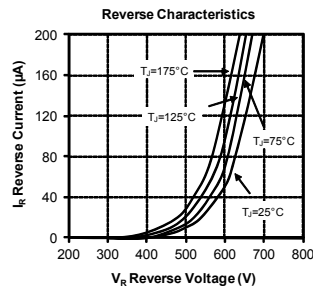
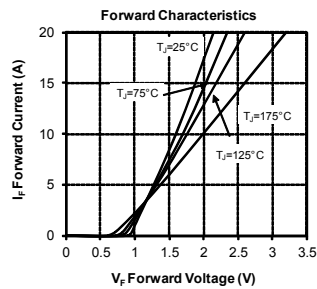
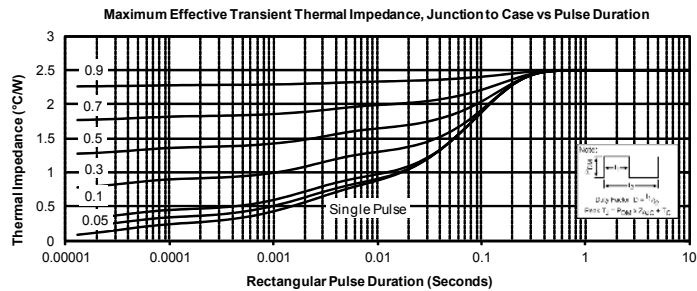


Q3, Q4 Trench + field stop IGBT3





CR3 & CR4 SiC diode characteristics



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