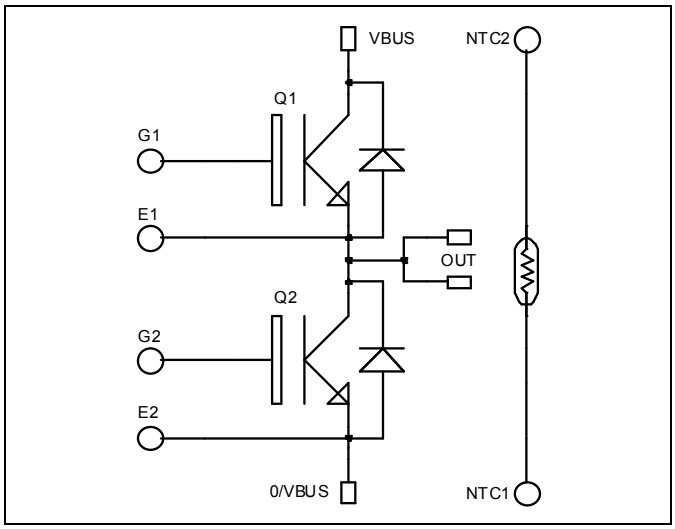
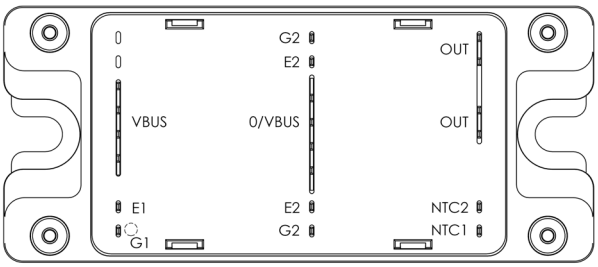
Phase leg
NPT IGBT Power Module

V_{CES} = 1200V
I_C = 150A @ Tc = 80°C





Application

- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Motor control

Features

- Non Punch Through (NPT) Fast IGBT
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 50 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
- Kelvin emitter for easy drive
- Very low stray inductance
  - Symmetrical design
  - Lead frames for power connections
- Internal thermistor for temperature monitoring
- High level of integration

Benefits

- Outstanding performance at high frequency operation
- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Easy paralleling due to positive TC of VCEsat
- Low profile
- RoHS compliant

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{CES}	Collector - Emitter Breakdown Voltage		1200	V
I_C	Continuous Collector Current	T_c = 25°C	200	A
		T_c = 80°C	150	
I_{CM}	Pulsed Collector Current	T_c = 25°C	300	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_c = 25°C	961	W
RBSOA	Reverse Bias Safe Operating Area	T_j = 150°C	300A @ 1200V	

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed. See application note APT0502 on www.microsemi.com

All ratings @ T_j = 25°C unless otherwise specified

Electrical Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
I_{CES}	Zero Gate Voltage Collector Current	V_{GE} = 0V, V_{CE} = 1200V	T_j = 25°C			350	µA
			T_j = 125°C			600	
$V_{CE(sat)}$	Collector Emitter saturation Voltage	V_{GE} =15V, I_C = 150A	T_j = 25°C		3.2	3.7	V
			T_j = 125°C		3.9		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE}, I_C = 5 mA		4.5		6.5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = ±20V, V_{CE} = 0V				±500	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
C_{ies}	Input Capacitance	V_{GE} = 0V, V_{CE} = 25V, f = 1MHz			10.2		nF
C_{oes}	Output Capacitance				1.4		
C_{res}	Reverse Transfer Capacitance				0.75		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = 15V, V_{Bus} = 600V, I_C = 150A, R_G = 5.6Ω			120		ns
T_r	Rise Time				50		
$T_{d(off)}$	Turn-off Delay Time				310		
T_f	Fall Time				20		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = 15V, V_{Bus} = 600V, I_C = 150A, R_G = 5.6Ω			130		ns
T_r	Rise Time				60		
$T_{d(off)}$	Turn-off Delay Time				360		
T_f	Fall Time				30		
E_{on}	Turn-on Switching Energy	V_{GE} = 15V, V_{Bus} = 600V, I_C = 150A, R_G = 5.6Ω	T_j = 125°C		18		mJ
E_{off}	Turn-off Switching Energy		T_j = 125°C		8		

Reverse diode ratings and characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			1200			V
I_{RM}	Maximum Reverse Leakage Current	V_R=1200V	T_j = 25°C			500	µA
			T_j = 125°C			750	
I_F	DC Forward Current		Tc = 80°C		100		A
V_F	Diode Forward Voltage	I_F = 100A	T_j = 25°C		2.1		V
			T_j = 125°C		1.9		
t_{rr}	Reverse Recovery Time	I_F = 100A, V_R = 600V, di/dt =2500A/µs	T_j = 25°C		95		ns
			T_j = 125°C		190		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		8.4		µC
			T_j = 125°C		18		
E_r	Reverse Recovery Energy		T_j = 25°C		3		mJ
			T_j = 125°C		6		

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
$B_{25/85}$	T_{25} = 298.15 K		3952		K

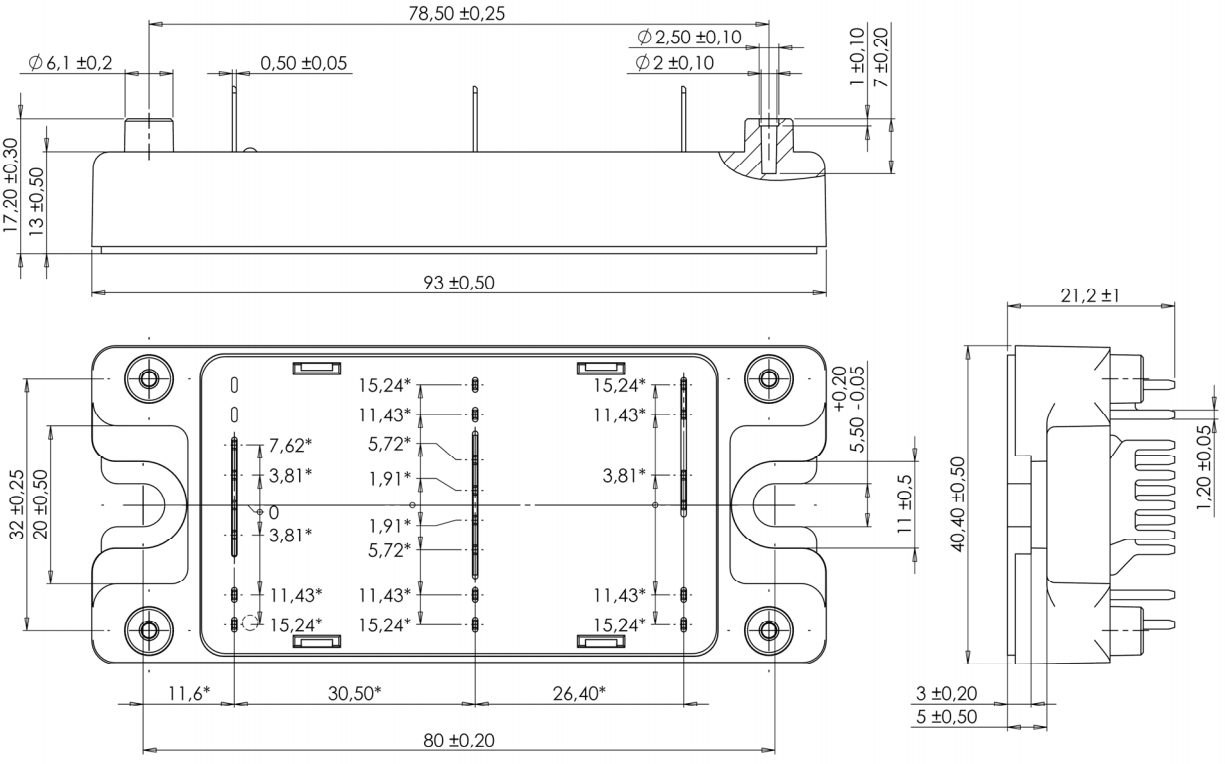
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
R_T: Thermistor value at T

Thermal and package characteristics

Symbol	*Characteristic*			*Min*	*Typ*	*Max*	*Unit*
R_{thJC}	Junction to Case Thermal Resistance		IGBT			0.13	°C/W
			Diode			0.32	
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000			V
T_J	Operating junction temperature range			-40		150	°C
T_{STG}	Storage Temperature Range			-40		125	
T_C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To heatsink	M5	2.5		4.7	N.m
Wt	Package Weight					160	g

SP4 Package outline (dimensions in mm)

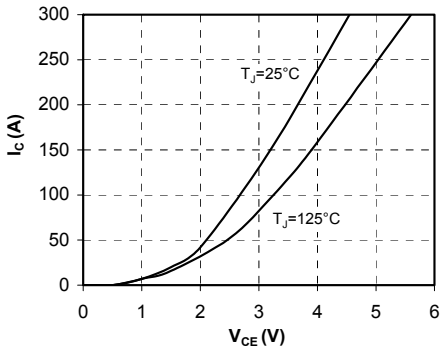


ALL DIMENSIONS MARKED "*" ARE TOLERANCED AS : ⌖ ∅ 1

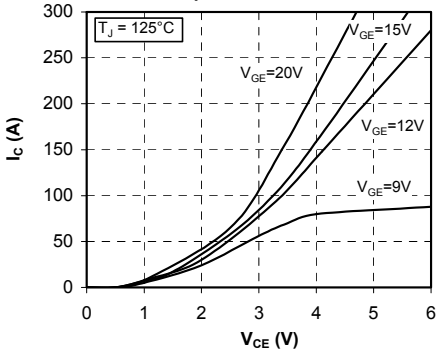
See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

Typical Performance Curve

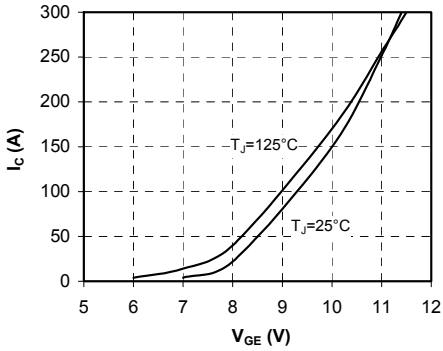
Output Characteristics (V_{GE}=15V)



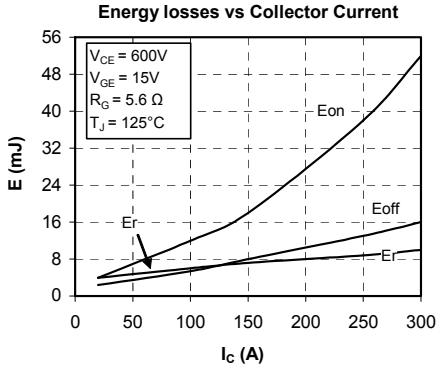
Output Characteristics



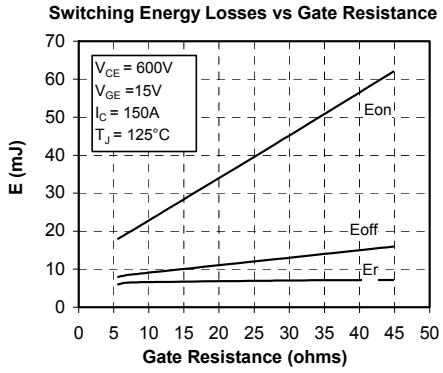
Transfert Characteristics



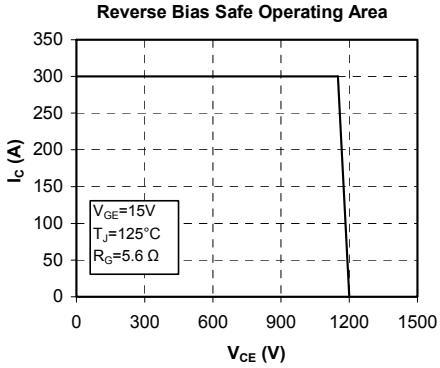
Energy losses vs Collector Current



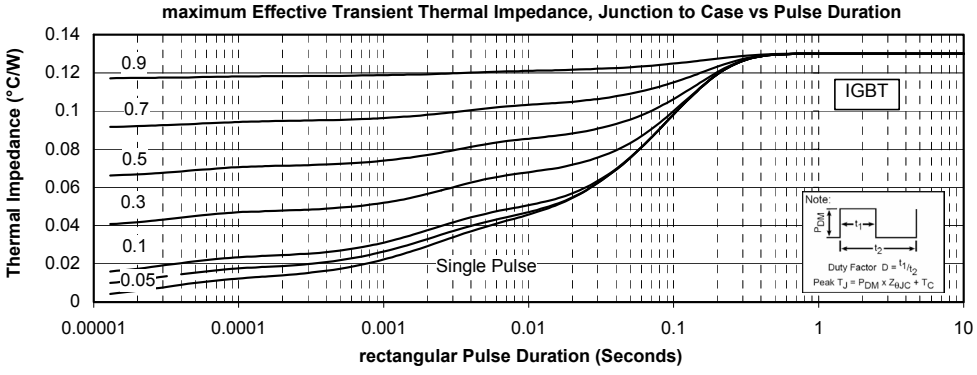
Switching Energy Losses vs Gate Resistance

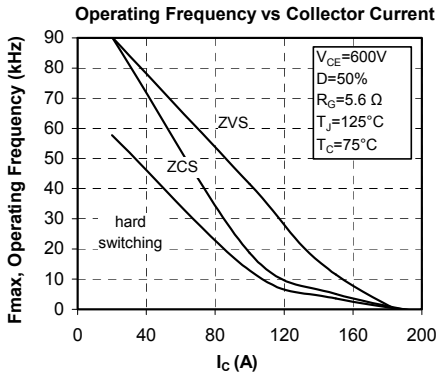


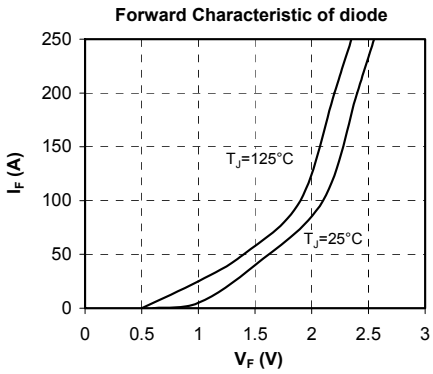
Reverse Bias Safe Operating Area

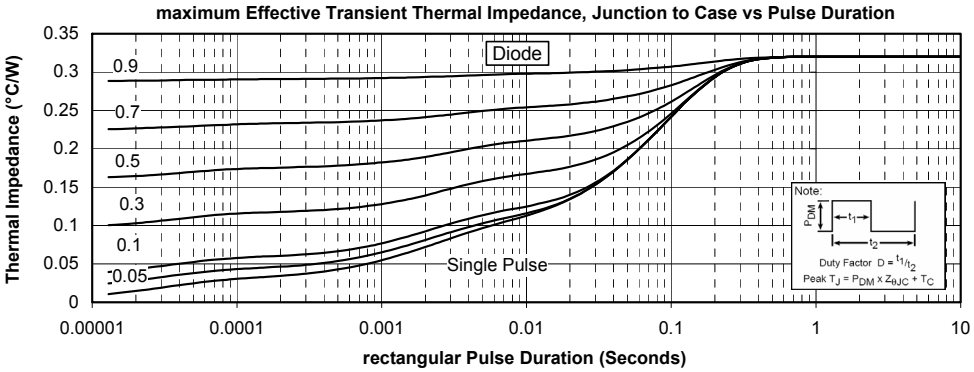


maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration




Operating Frequency vs Collector Current
Fmax, Operating Frequency (kHz)
I_C (A)
V_{CE}=600V
D=50%
R_G=5.6 Ω
T_J=125°C
T_C=75°C
ZVS
ZCS
hard
switching


Forward Characteristic of diode
I_F (A)
V_F (V)
T_J=125°C
T_J=25°C


maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
rectangular Pulse Duration (Seconds)
Diode
0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
Note:
Duty Factor D = t_1/t_2
Peak T_J = P_{DM} x $Z_{\theta JC}$ + T_C

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