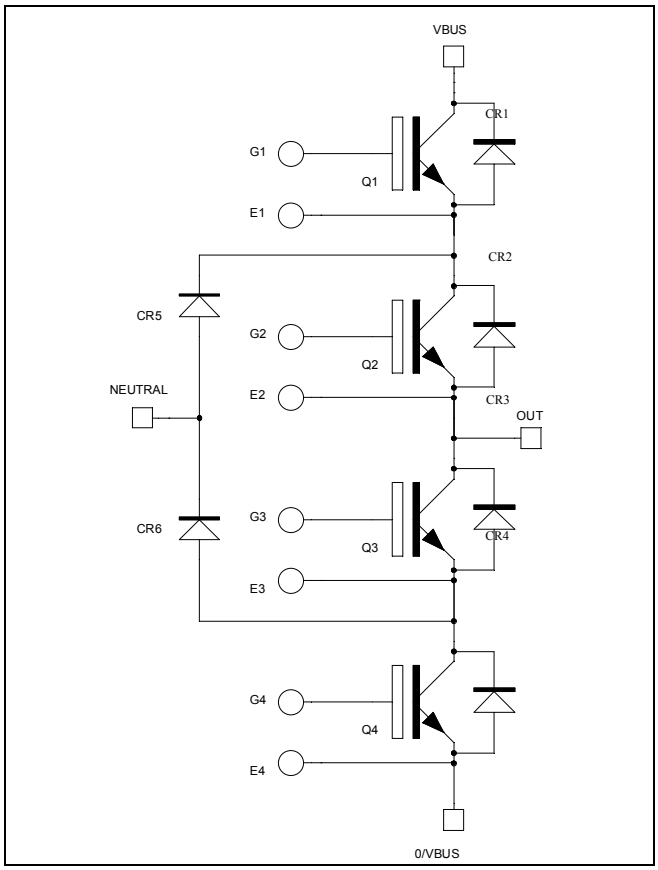
Three level inverter Trench + Field Stop IGBT3 Power Module

V_{CES} = 650V
I_C = 400A @ Tc = 80°C



Application

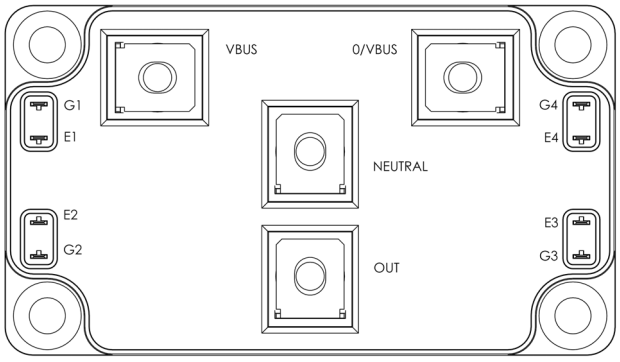
- Solar converter
- Uninterruptible Power Supplies

Features

- Trench + Field Stop IGBT3 Technology
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 20 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
- Kelvin emitter for easy drive
- Very low stray inductance
- M5 power connectors
- High level of integration

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 VCEsat
- Low profile
- RoHS Compliant



All ratings @ T_j = 25°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

Q1 to Q4 Absolute maximum ratings (per IGBT)

Symbol	Parameter		Max ratings	Unit
V_{CES}	Collector - Emitter Voltage		650	V
I_C	Continuous Collector Current	T_C = 25°C	500	A
		T_C = 80°C	400	
I_{CM}	Pulsed Collector Current	T_C = 25°C	800	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_C = 25°C	1150	W
RBSOA	Reverse Bias Safe Operating Area	T_j = 125°C	800A @ 600V	

Q1 to Q4 Electrical Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{CES}	Zero Gate Voltage Collector Current	V_{GE} = 0V, V_{CE} = 650V				250	µA
$V_{CE(sat)}$	Collector Emitter saturation Voltage	V_{GE} = 15V, I_C = 400A	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 = 6.4 mA		5.1	5.8	6.4	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20V, V_{CE} = 0V				1.2	µA

Q1 to Q4 Dynamic Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{ies}	Input Capacitance	V_{GE} = 0V V_{CE} = 25V f = 1MHz			24		nF
C_{oes}	Output Capacitance				1.5		
C_{res}	Reverse Transfer Capacitance				0.75		
Q_G	Gate charge	V_{GE}=±15V, I_C=400A V_{CE}=300V			4.2		µC
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = ±15V V_{Bus} = 300V I_C = 400A R_G = 1.8Ω			115		ns
T_r	Rise Time				45		
$T_{d(off)}$	Turn-off Delay Time				225		
T_f	Fall Time				55		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (150°C) V_{GE} = ±15V V_{Bus} = 300V I_C = 400A R_G = 1.8Ω			130		ns
T_r	Rise Time				50		
$T_{d(off)}$	Turn-off Delay Time				300		
T_f	Fall Time				70		
E_{on}	Turn on Energy	V_{GE} = ±15V V_{Bus} = 300V I_C = 400A R_G = 1.8Ω	T_j = 25°C		2		mJ
			T_j = 150°C		3.6		
E_{off}	Turn off Energy		T_j = 25°C		11.5		
			T_j = 150°C		14		
I_{sc}	Short Circuit data	V_{GE} ≤15V ; V_{Bus} = 360V t_p ≤ 6µs ; T_j = 150°C			2000		A
R_{thJC}	Junction to Case Thermal Resistance					0.13	°C/W

CR1 to CR4 diode ratings and characteristics (per diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					650	V
I_{RM}	Reverse Leakage Current	V_R=650V				150	µA
I_F	DC Forward Current		Tc = 80°C		300		A
V_F	Diode Forward Voltage	I_F = 300A V_{GE} = 0V	T_j = 25°C		1.6	2	V
			T_j = 150°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 300A V_R = 300V di/dt =4000A/µs	T_j = 25°C		130		ns
			T_j = 150°C		225		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		13.7		µC
			T_j = 150°C		29		
E_{rr}	Reverse Recovery Energy		T_j = 25°C		3.2		mJ
			T_j = 150°C		7		
R_{thJC}	Junction to Case Thermal Resistance					0.29	°C/W

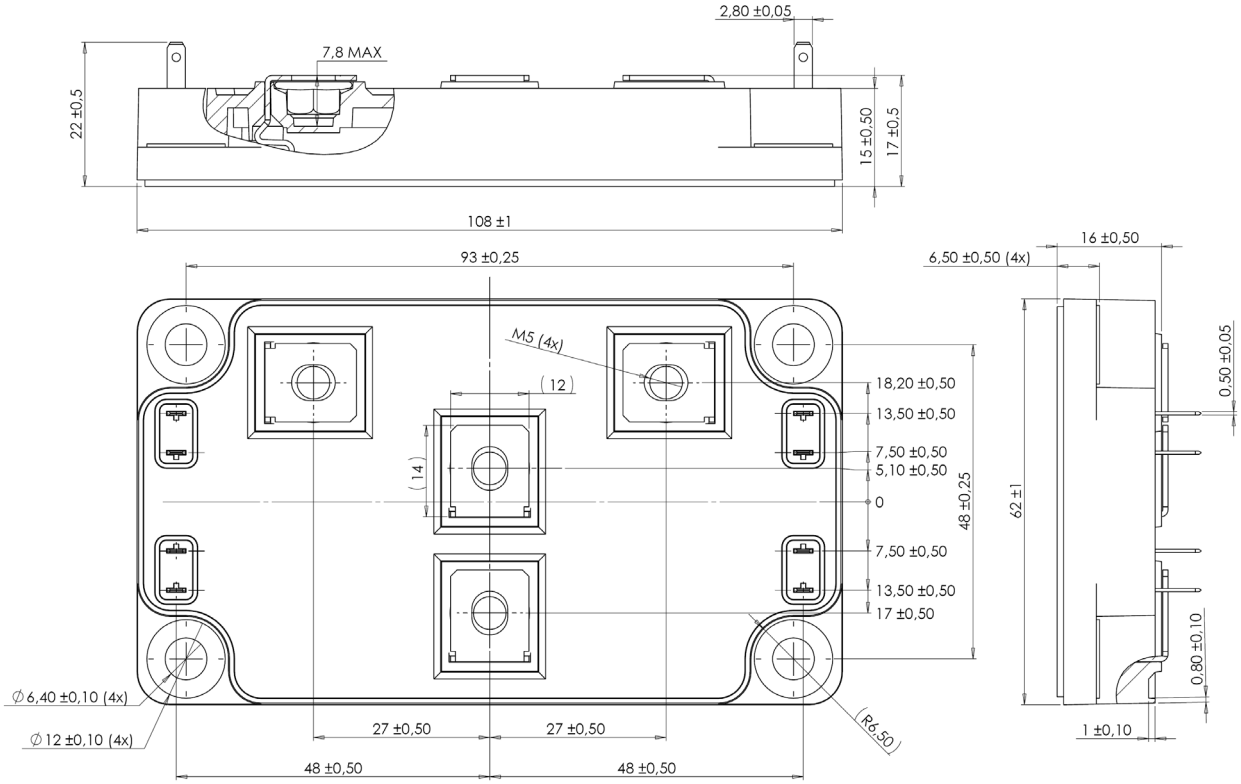
CR5 & CR6 diode ratings and characteristics (per diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					650	V
I_{RM}	Reverse Leakage Current	V_R=650V				150	µA
I_F	DC Forward Current		Tc = 80°C		400		A
V_F	Diode Forward Voltage	I_F = 400A V_{GE} = 0V	T_j = 25°C		1.6	2.0	V
			T_j = 150°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 400A V_R = 300V di/dt =4800A/µs	T_j = 25°C		125		ns
			T_j = 150°C		220		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		19		µC
			T_j = 150°C		40		
E_{rr}	Reverse Recovery Energy		T_j = 25°C		4.4		mJ
			T_j = 150°C		9.6		
R_{thJC}	Junction to Case Thermal Resistance					0.2	°C/W

Thermal and package characteristics

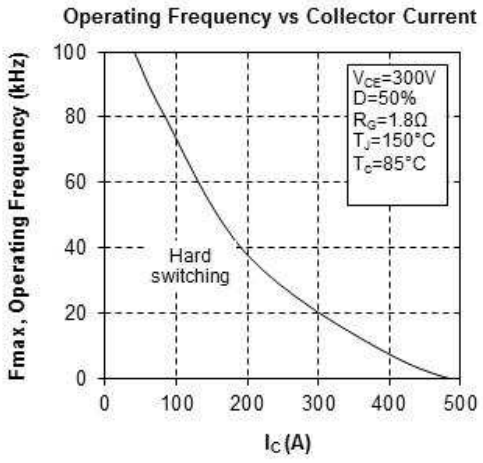
Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000		V
T_J	Operating junction temperature range			-40	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			-40	$T_J$max -25	
T_{STG}	Storage Temperature Range			-40	125	
T_C	Operating Case Temperature			-40	100	
Torque	Mounting torque	To heatsink	M6	3	5	N.m
		For terminals	M5	2	3.5	
Wt	Package Weight				300	g

SP6 Package outline (dimensions in mm)

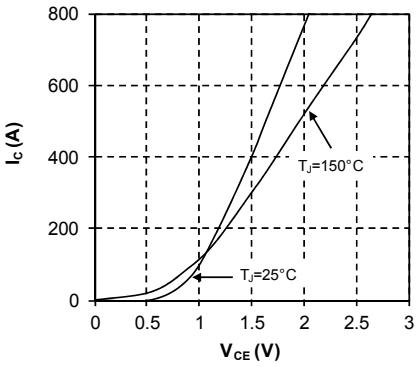


See application note APT0601 - Mounting Instructions for SP6 Power Modules on www.microsemi.com

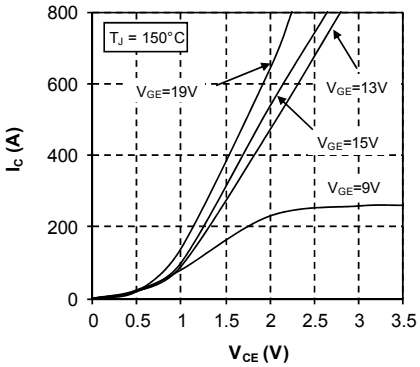
Q1 to Q4 Typical performance curve



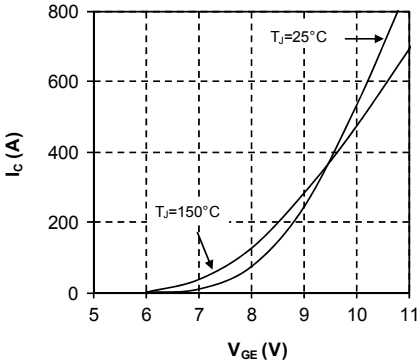
Output Characteristics (V_{GE}=15V)



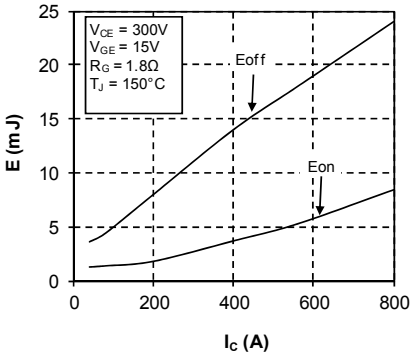
Output Characteristics



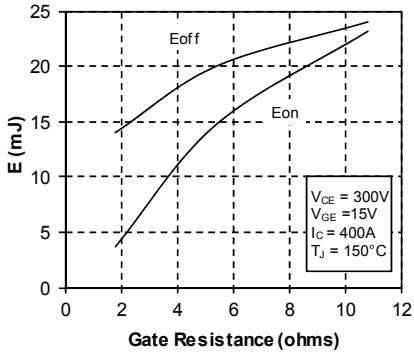
Transfert Characteristics



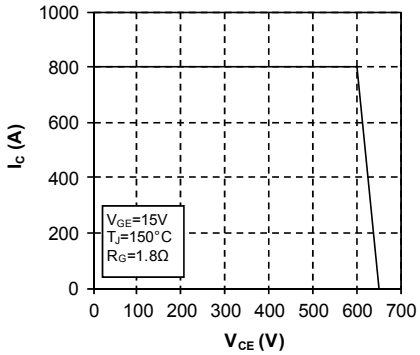
Energy losses vs Collector Current



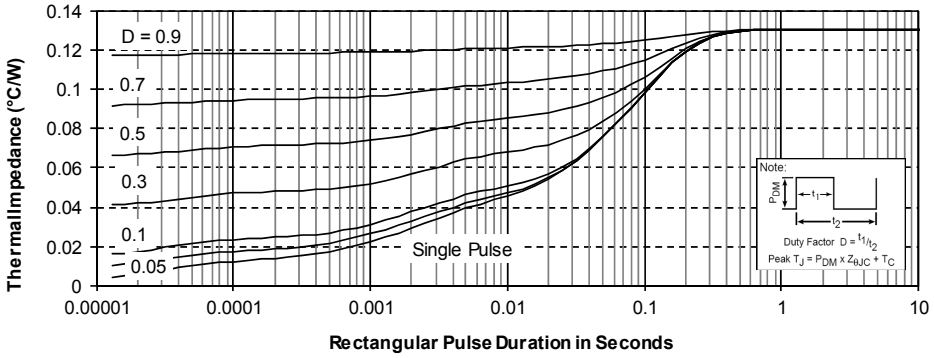
Switching Energy Losses vs Gate Resistance



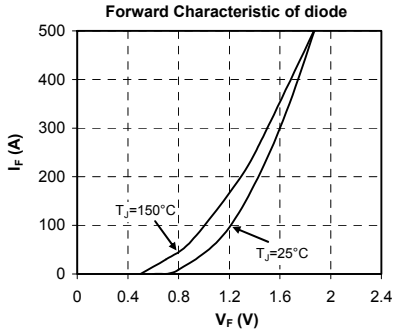
Reverse Bias Safe Operating Area

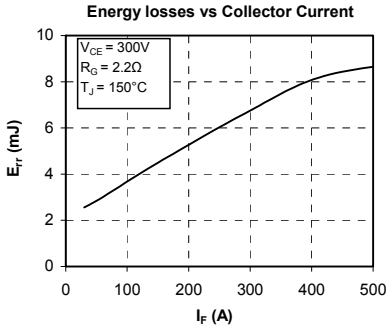


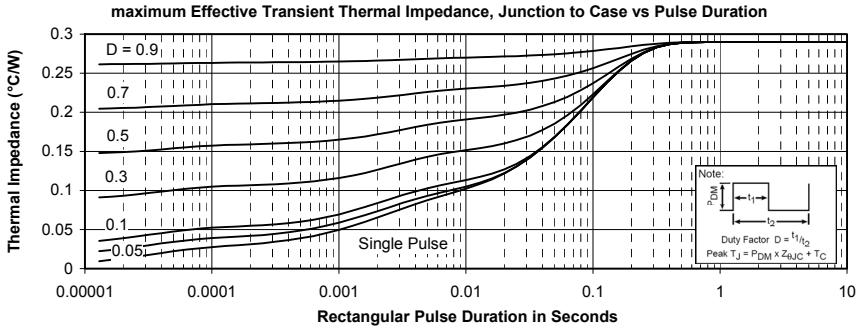
maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



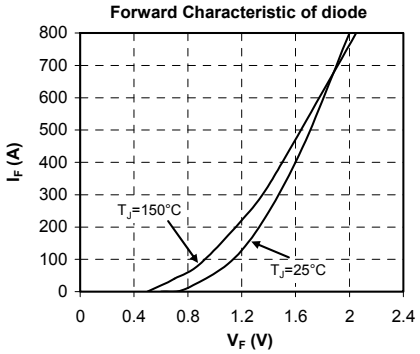
CR1 to CR4 Typical performance curve

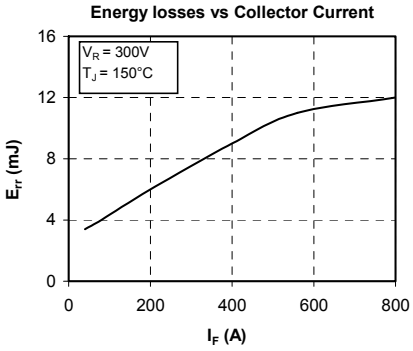


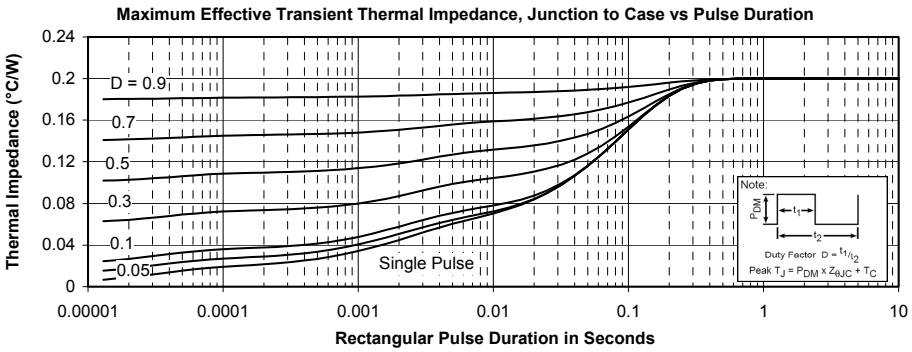




CR5 & CR6 Typical performance curve







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