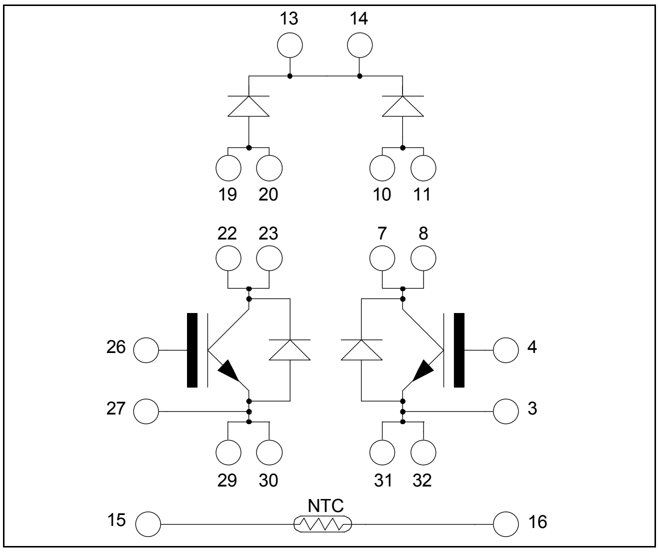
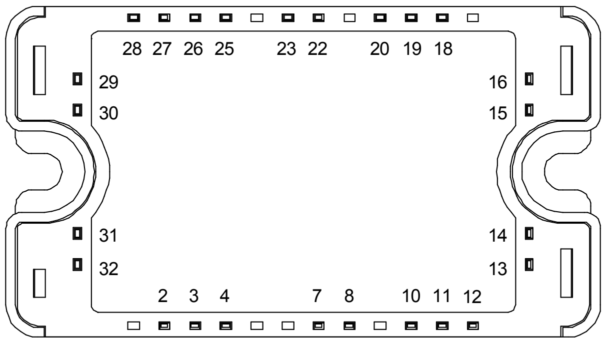
Dual Boost chopper NPT IGBT Power Module

V_{CES} = 1200V
I_C = 50A @ Tc = 80°C





All multiple inputs and outputs must be shorted together
Example: 13/14 ; 29/30 ; 22/23 …

Application
- AC and DC motor control
- Switched Mode Power Supplies
- Power Factor Correction (PFC)
- Interleaved PFC

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

Benefits
- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- Easy paralleling due to positive TC of VCEsat
- Each leg can be easily paralleled to achieve a single boost of twice the current capability
- 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	70	A
		T_c = 80°C	50	
I_{CM}	Pulsed Collector Current	T_c = 25°C	150	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_c = 25°C	312	W
RBSOA	Reverse Bias Safe Operating Area	T_j = 150°C	100A @ 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			250	µA
			T_j = 125°C			500	
$V_{CE(sat)}$	Collector Emitter saturation Voltage	V_{GE} =15V I_C = 50A	T_j = 25°C		3.2	3.7	V
			T_j = 125°C		4.0		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE}, I_C = 1 mA		4.5		6.5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20 V, V_{CE} = 0V				100	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{ies}	Input Capacitance	V_{GE} = 0V V_{CE} = 25V f = 1MHz			3450		pF
C_{oes}	Output Capacitance				330		
C_{res}	Reverse Transfer Capacitance				220		
Q_g	Total gate Charge	V_{GS} = 15V V_{Bus} = 600V I_C = 50A			330		nC
Q_{ge}	Gate – Emitter Charge				35		
Q_{gc}	Gate – Collector Charge				200		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = 15V V_{Bus} = 600V I_C = 50A R_G = 5 Ω			35		ns
T_r	Rise Time				65		
$T_{d(off)}$	Turn-off Delay Time				320		
T_f	Fall Time				30		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = ±15V V_{Bus} = 600V I_C = 50A R_G = 5 Ω			35		ns
T_r	Rise Time				65		
$T_{d(off)}$	Turn-off Delay Time				360		
T_f	Fall Time				40		
E_{on}	Turn-on Switching Energy	V_{GE} = ±15V V_{Bus} = 600V I_C = 50A R_G = 5 Ω	T_j = 125°C		6.9		mJ
E_{off}	Turn-off Switching Energy		T_j = 125°C		3.05		
I_{sc}	Short Circuit data	V_{GE} ≤15V ; V_{Bus} = 900V t_p ≤ 10µs ; T_j = 125°C			300		A

Chopper 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			100	µA
			T_j = 125°C			500	
I_F	DC Forward Current		Tc = 80°C		60		A
V_F	Diode Forward Voltage	I_F = 60A			2.5	3	V
		I_F = 120A			3		
		I_F = 60A	T_j = 125°C		1.8		
t_{rr}	Reverse Recovery Time	I_F = 60A V_R = 800V di/dt =200A/µs	T_j = 25°C		265		ns
			T_j = 125°C		350		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		560		nC
			T_j = 125°C		2890		

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance	IGBT				0.4	°C/W
		Chopper diode				0.9	
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	M4	2		3	N.m
Wt	Package Weight					110	g

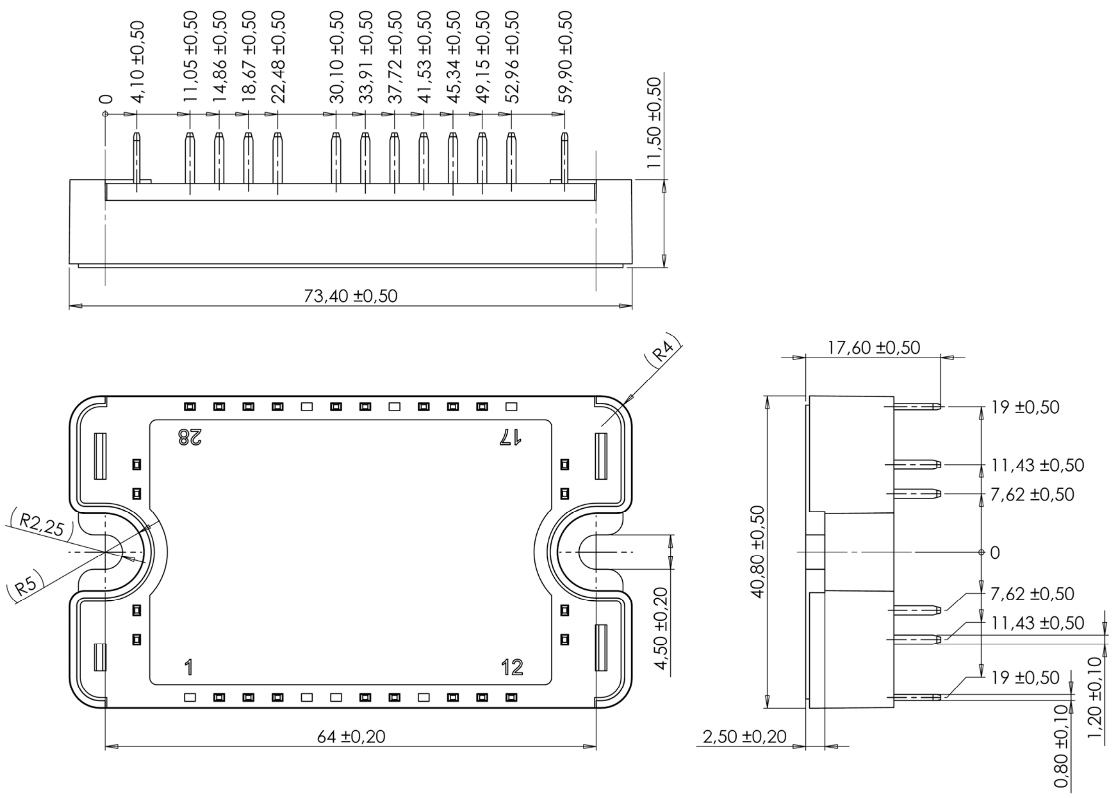
Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

Symbol	Characteristic		Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C			50		kΩ
$\Delta R_{25}/R_{25}$				5		%
$B_{25/85}$	T_{25} = 298.15 K			3952		K
ΔB/B		T_C=100°C		4		%

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

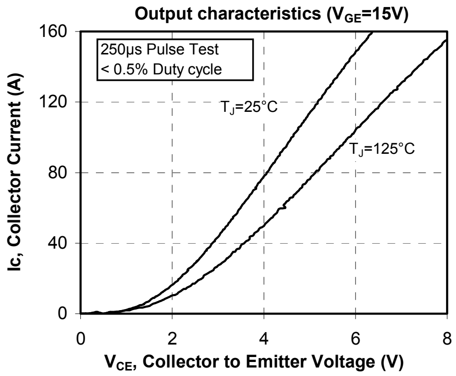
T: Thermistor temperature
R_T: Thermistor value at T

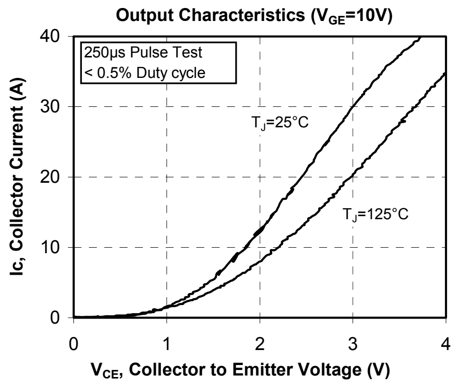
SP3 Package outline (dimensions in mm)

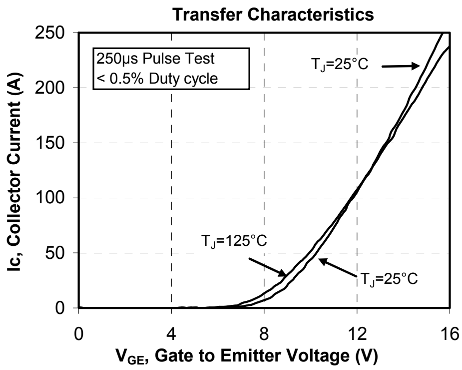


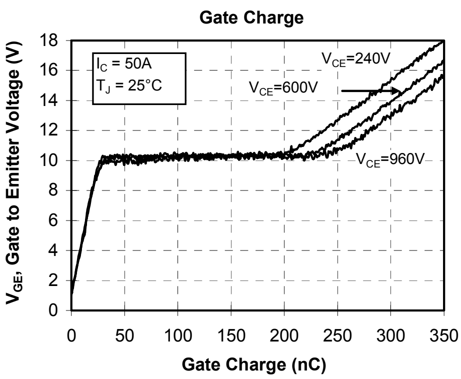
See application note 1901 - Mounting Instructions for SP3 Power Modules on www.microsemi.com

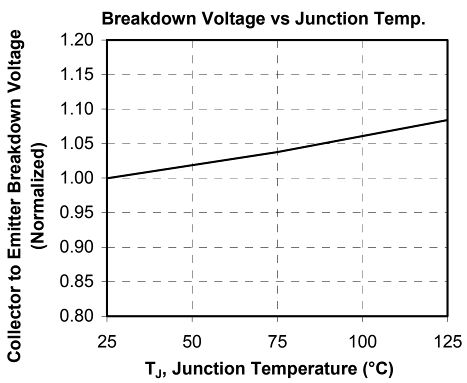
Typical IGBT Performance Curve

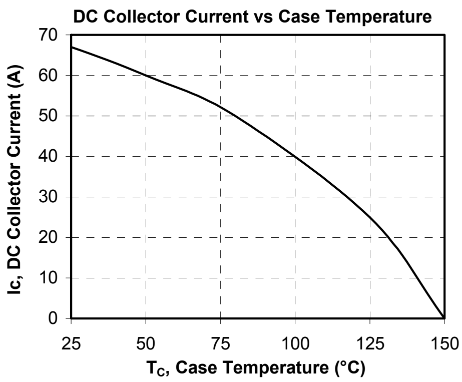




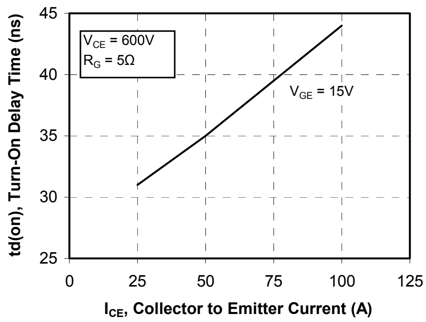




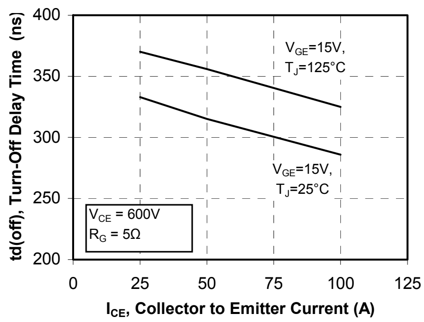




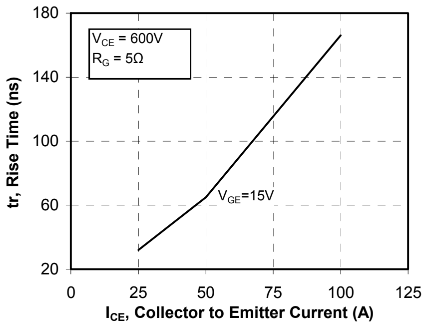
Turn-On Delay Time vs Collector Current



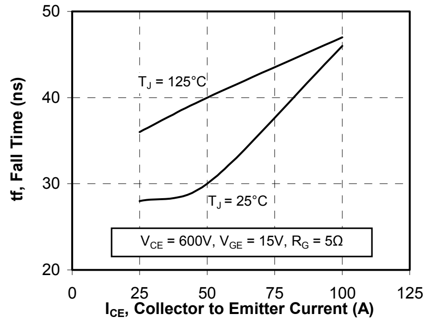
Turn-Off Delay Time vs Collector Current



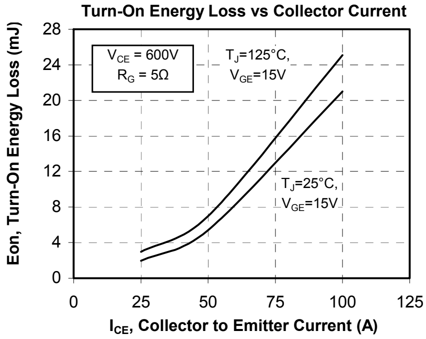
Current Rise Time vs Collector Current



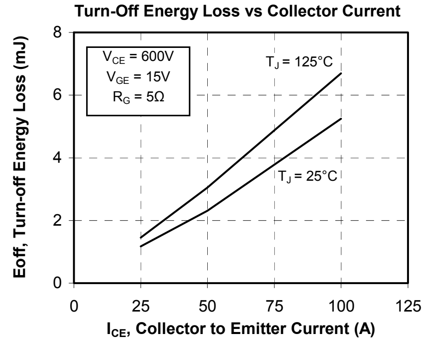
Current Fall Time vs Collector Current



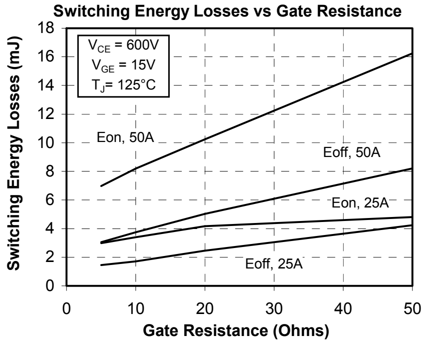
Turn-On Energy Loss vs Collector Current



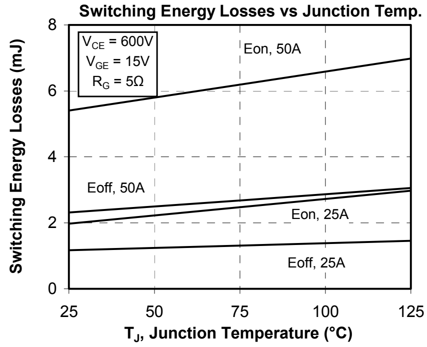
Turn-Off Energy Loss vs Collector Current

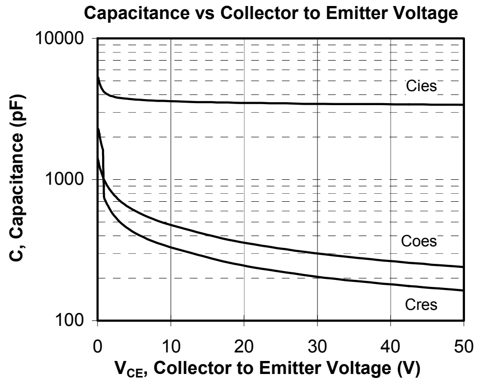


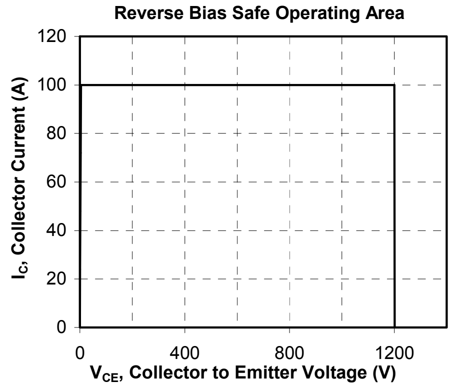
Switching Energy Losses vs Gate Resistance

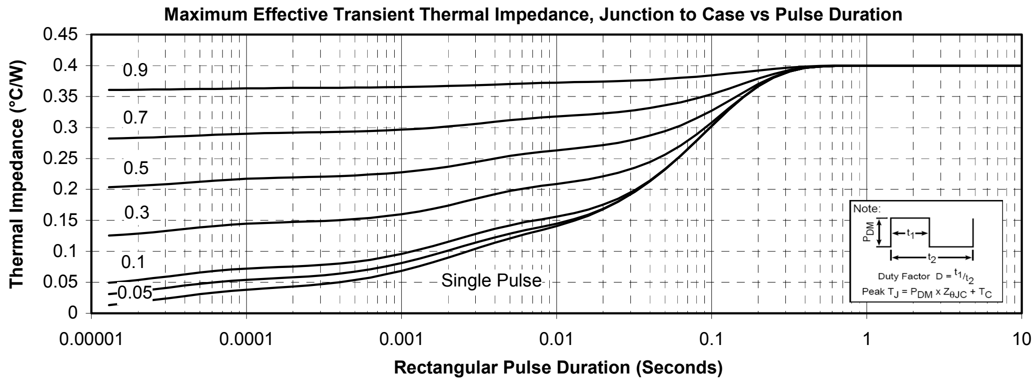


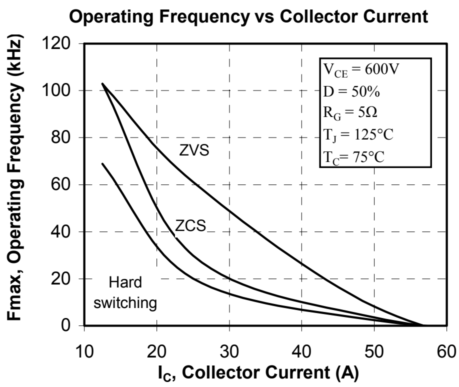
Switching Energy Losses vs Junction Temp.




Capacitance vs Collector to Emitter Voltage
C, Capacitance (pF)
10000
1000
100
Cies
Coes
Cres
0
10
20
30
40
50
VCE, Collector to Emitter Voltage (V)

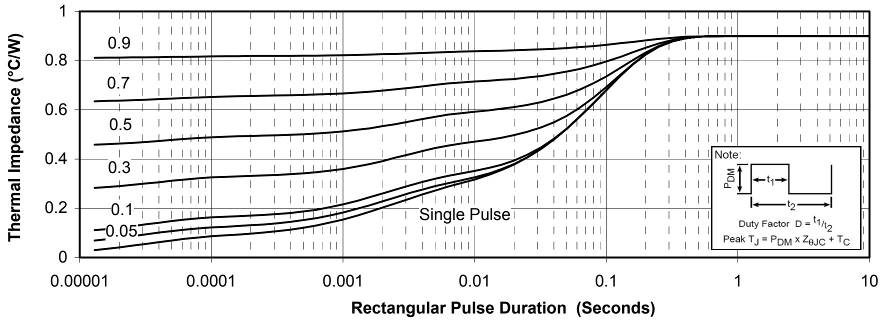

Reverse Bias Safe Operating Area
IC, Collector Current (A)
120
100
80
60
40
20
0
400
800
1200
VCE, Collector to Emitter Voltage (V)


Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
Note:
PDM
t1
t2
Duty Factor D = t1/t2
Peak TJ = PDM x ZθJC + TC
0.00001
0.0001
0.001
0.01
0.1
1
10
Rectangular Pulse Duration (Seconds)

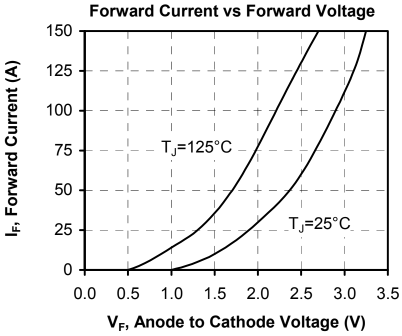

Operating Frequency vs Collector Current
Fmax, Operating Frequency (kHz)
120
100
80
60
40
20
0
VCE = 600V
D = 50%
RG = 5Ω
TJ = 125°C
TC= 75°C
ZVS
ZCS
Hard
switching
10
20
30
40
50
60
IC, Collector Current (A)

Typical chopper diode Performance Curve

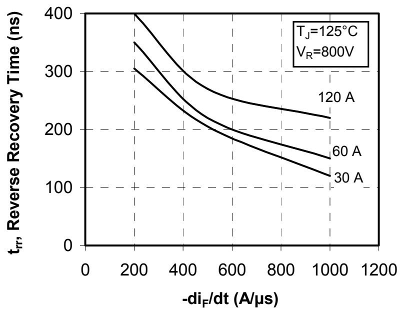
Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



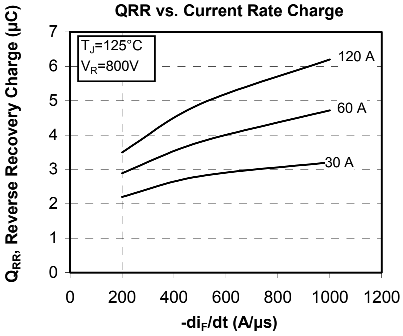
Forward Current vs Forward Voltage



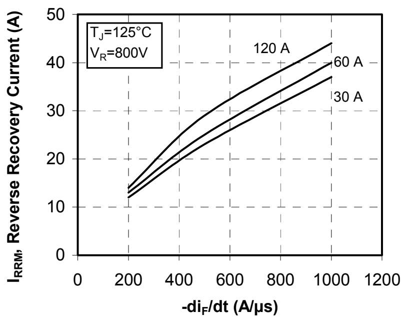
Trr vs. Current Rate of Charge



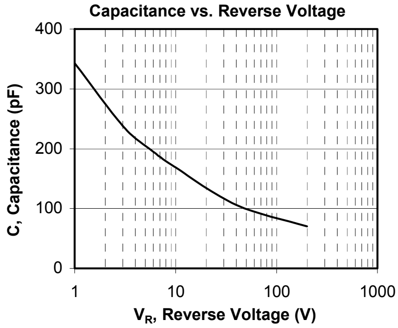
QRR vs. Current Rate Charge



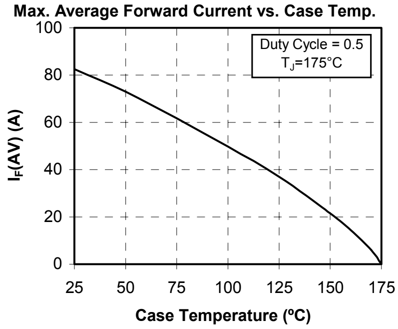
IRRM vs. Current Rate of Charge



Capacitance vs. Reverse Voltage



Max. Average Forward Current vs. Case Temp.



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