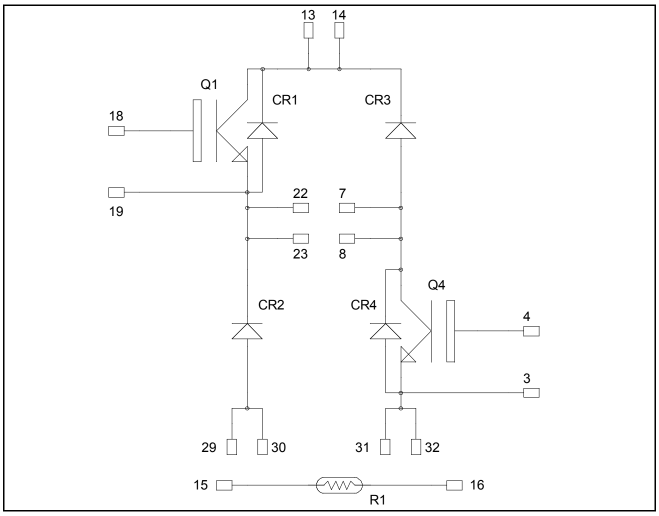
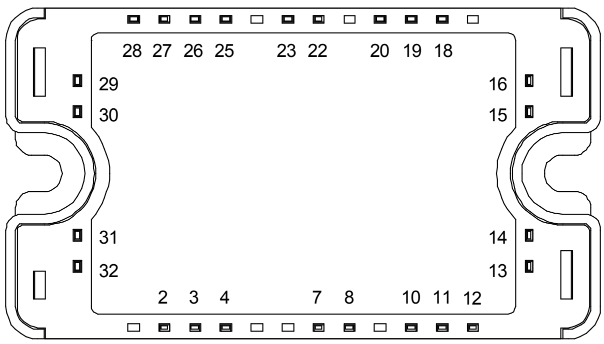
Microsemi POWER PRODUCTS GROUP

APTGF50DH120T3G

Asymmetrical - Bridge 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

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
- 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

Diode ratings and characteristics (CR2 & CR3)

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		

CR1 & CR4 are IGBT protection diodes only

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance		IGBT			0.4	°C/W
			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

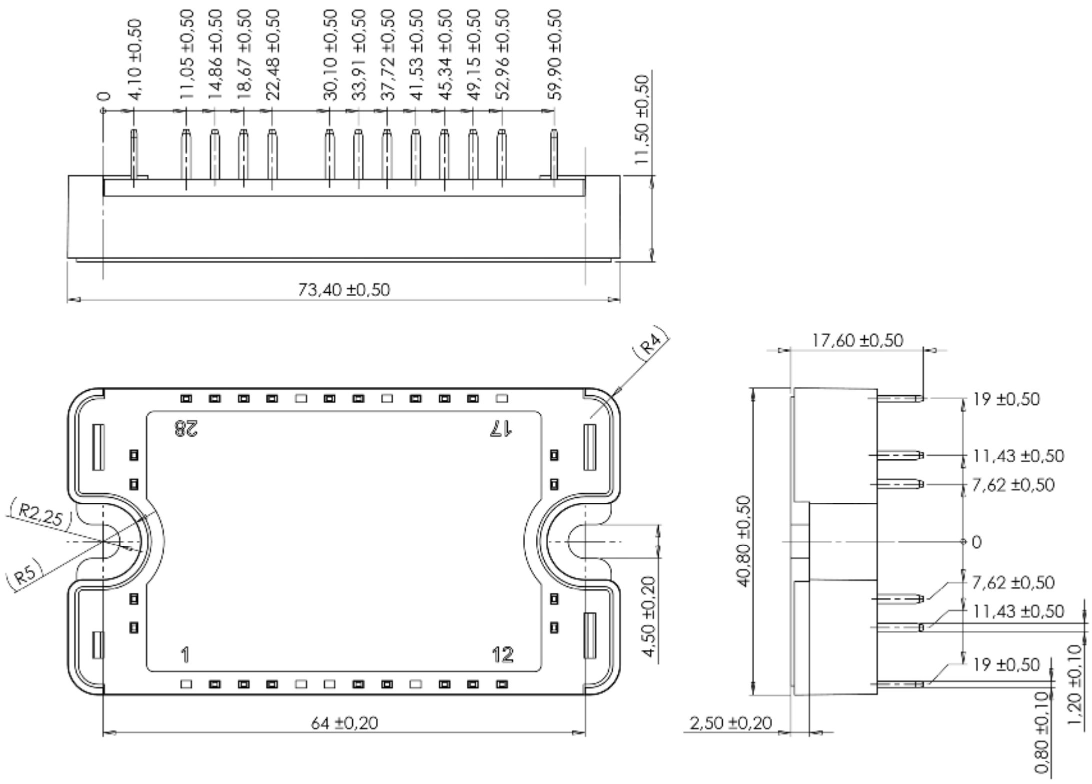
Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

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
$\Delta B/B$		T_C=100°C		4		%

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

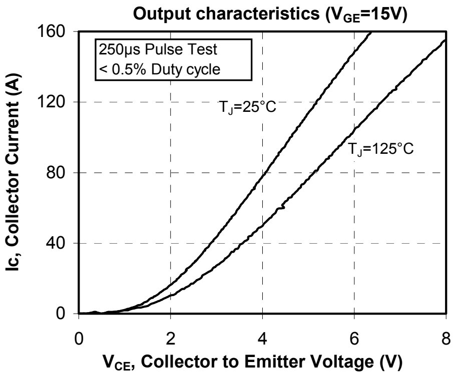
T: Thermistor temperature
R_T: Thermistor value at T

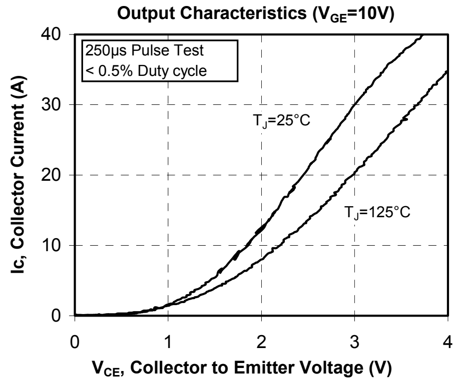
SP3 Package outline (dimensions in mm)

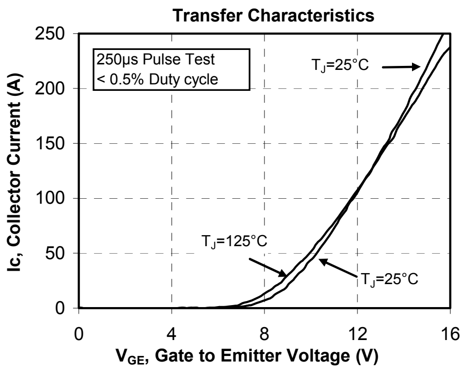


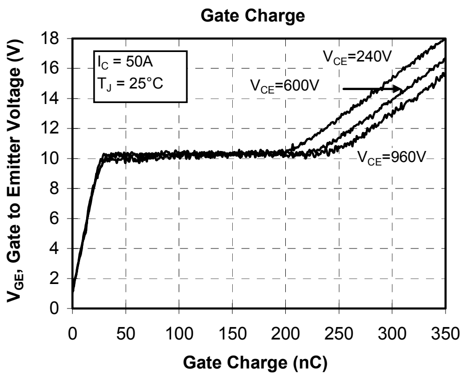
See application note 1901 - Mounting Instructions for SP3 Power Modules on www.microsemi.com

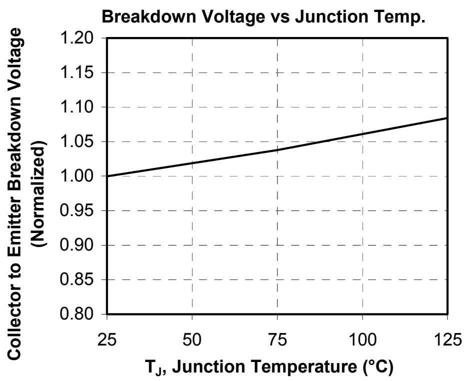
Typical IGBT Performance Curve

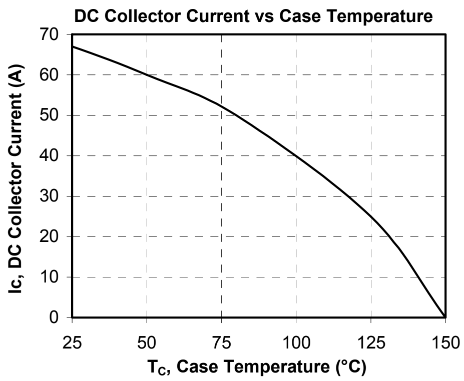


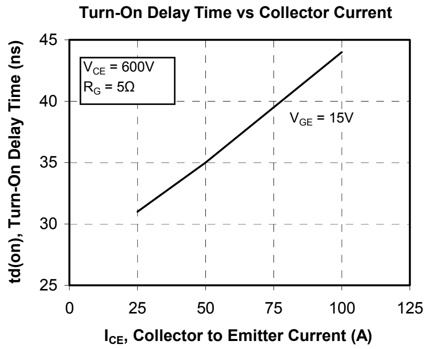


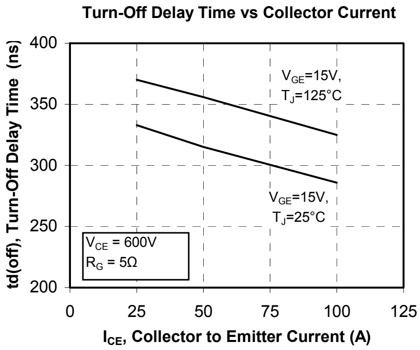


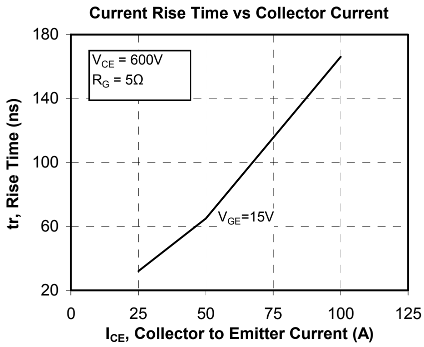


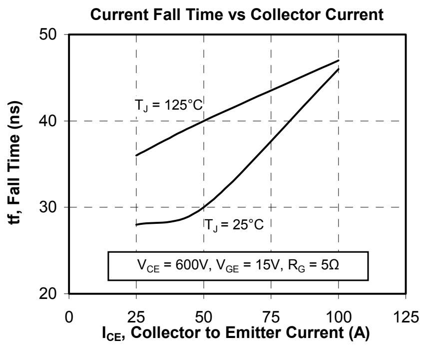


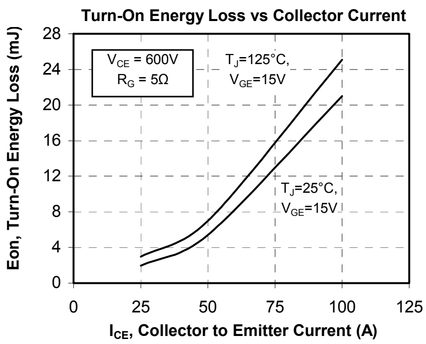


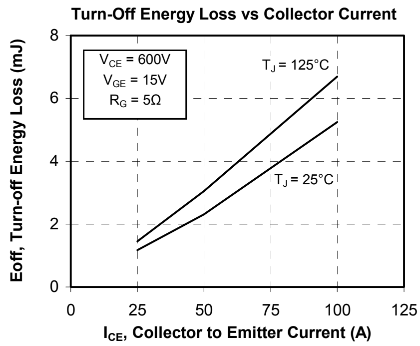

Turn-On Delay Time vs Collector Current
V_{CE} = 600V
R_G = 5Ω
V_{GE} = 15V
td(on), Turn-On Delay Time (ns)
I_{CE}, Collector to Emitter Current (A)
45
40
35
30
25
0
25
50
75
100
125

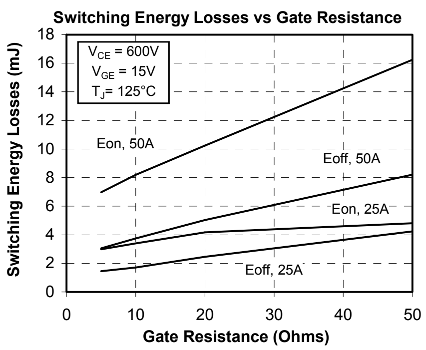

Turn-Off Delay Time vs Collector Current
V_{GE}=15V,
T_J=125°C
V_{GE}=15V,
T_J=25°C
V_{CE} = 600V
R_G = 5Ω
td(off), Turn-Off Delay Time (ns)
I_{CE}, Collector to Emitter Current (A)
400
350
300
250
200
0
25
50
75
100
125

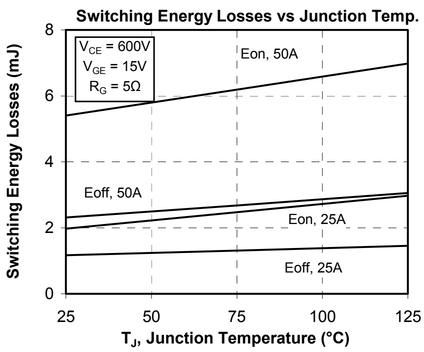

Current Rise Time vs Collector Current
V_{CE} = 600V
R_G = 5Ω
V_{GE}=15V
tr, Rise Time (ns)
I_{CE}, Collector to Emitter Current (A)
180
140
100
60
20
0
25
50
75
100
125

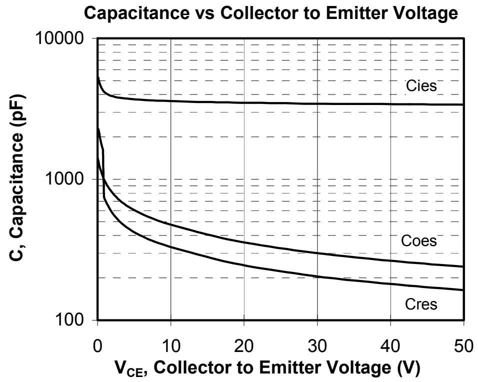

Current Fall Time vs Collector Current
T_J = 125°C
T_J = 25°C
V_{CE} = 600V, V_{GE} = 15V, R_G = 5Ω
tf, Fall Time (ns)
I_{CE}, Collector to Emitter Current (A)
50
40
30
20
0
25
50
75
100
125

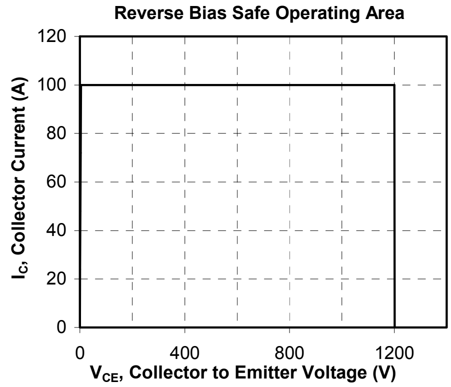

Turn-On Energy Loss vs Collector Current
V_{CE} = 600V
R_G = 5Ω
T_J=125°C,
V_{GE}=15V
T_J=25°C,
V_{GE}=15V
Eon, Turn-On Energy Loss (mJ)
I_{CE}, Collector to Emitter Current (A)
28
24
20
16
12
8
4
0
0
25
50
75
100
125

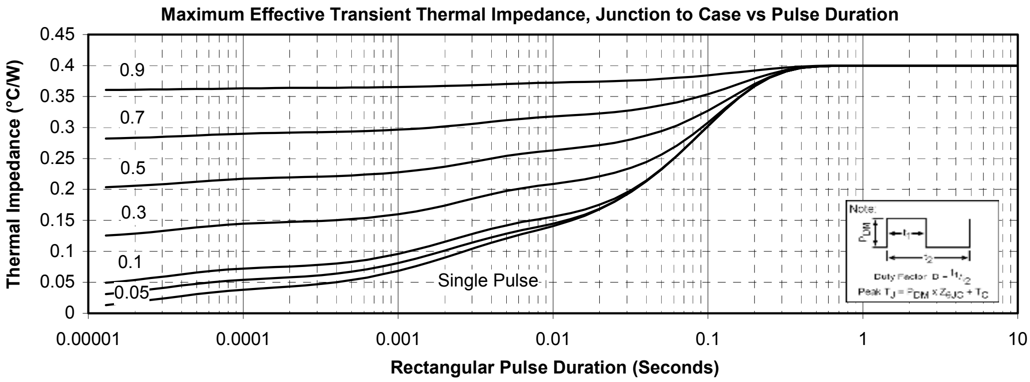

Turn-Off Energy Loss vs Collector Current
V_{CE} = 600V
V_{GE} = 15V
R_G = 5Ω
T_J = 125°C
T_J = 25°C
Eoff, Turn-off Energy Loss (mJ)
I_{CE}, Collector to Emitter Current (A)
8
6
4
2
0
0
25
50
75
100
125

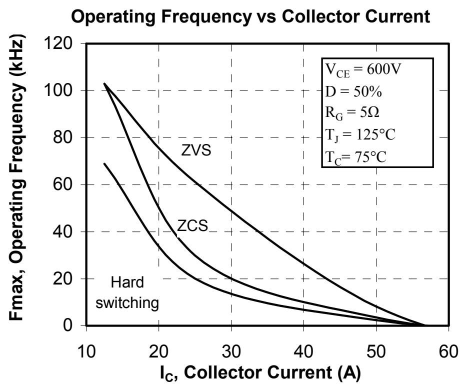

Switching Energy Losses vs Gate Resistance
V_{CE} = 600V
V_{GE} = 15V
T_J= 125°C
Eon, 50A
Eoff, 50A
Eon, 25A
Eoff, 25A
Switching Energy Losses (mJ)
Gate Resistance (Ohms)
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50


Switching Energy Losses vs Junction Temp.
V_{CE} = 600V
V_{GE} = 15V
R_G = 5Ω
Eon, 50A
Eoff, 50A
Eon, 25A
Eoff, 25A
Switching Energy Losses (mJ)
T_J, Junction Temperature (°C)
8
6
4
2
0
25
50
75
100
125

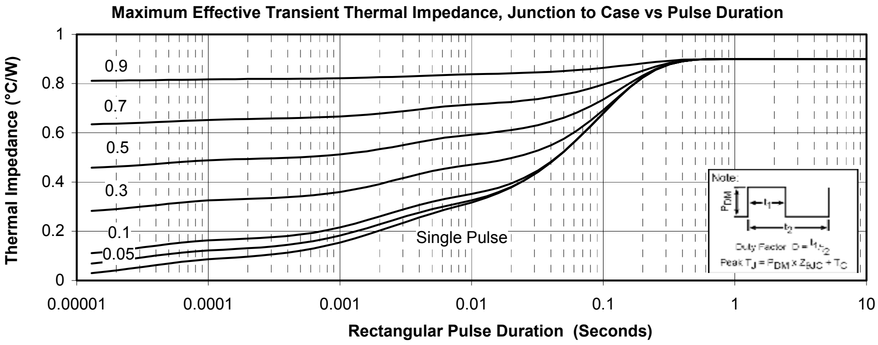

Capacitance vs Collector to Emitter Voltage
C, Capacitance (pF)
10000
1000
100
Cies
Coes
Cres
0
10
20
30
40
50
VCE, Collector to Emitter Voltage (V)

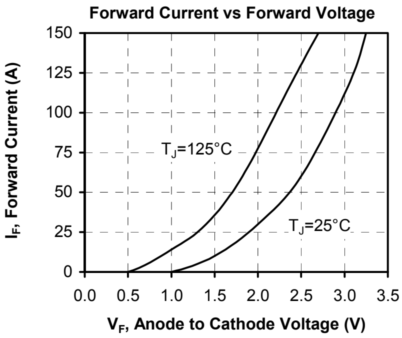

Reverse Bias Safe Operating Area
IC, Collector Current (A)
120
100
80
60
40
20
0
400
800
1200
VCE, Collector to Emitter Voltage (V)

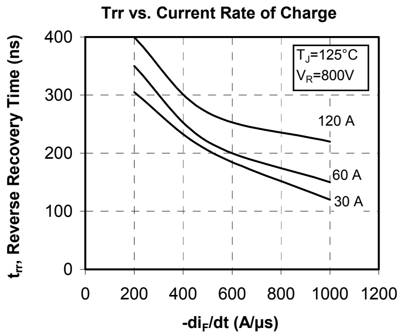

Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
0.00001
0.0001
0.001
0.01
0.1
1
10
Rectangular Pulse Duration (Seconds)

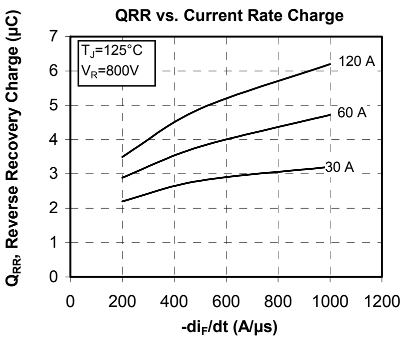

Operating Frequency vs Collector Current
Fmax, Operating Frequency (kHz)
120
100
80
60
40
20
0
VCE = 600V
D = 50%
RG = 5Ω
TJ = 125°C
TC= 75°C
ZVS
ZCS
Hard switching
10
20
30
40
50
60
IC, Collector Current (A)

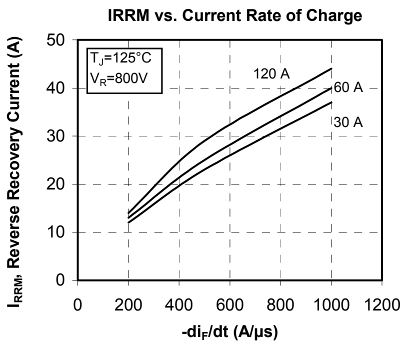
Typical diode Performance Curve

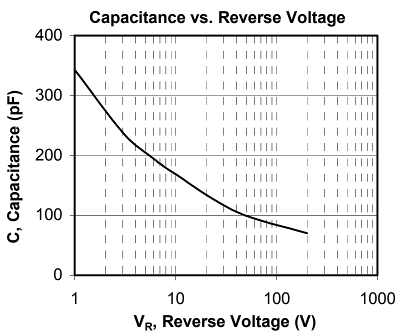


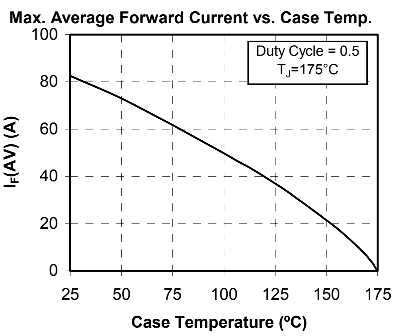












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