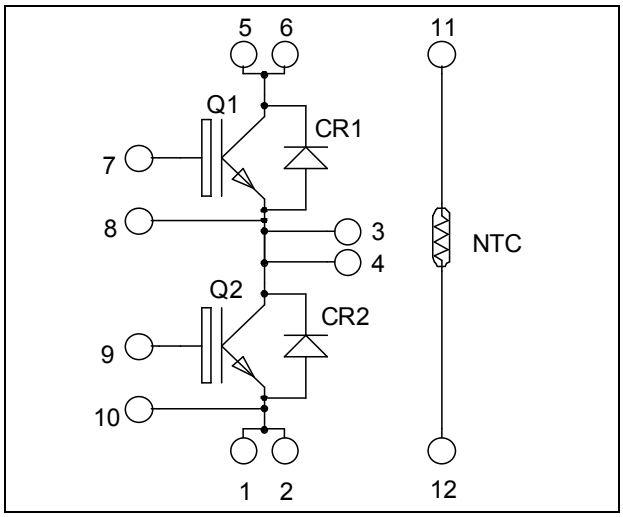
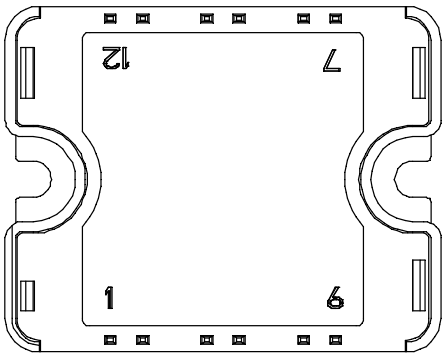
Microsemi
POWER PRODUCTS GROUP

APTGF90A60T1G

Phase leg NPT IGBT Power Module

V_{CES} = 600V
I_C = 90A @ Tc = 80°C





Pins 1/2 ; 3/4 ; 5/6 must be shorted together

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 100 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
- Very low stray inductance
  - Symmetrical design
- Internal thermistor for temperature monitoring
- High level of integration

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
- RoHS Compliant

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{CES}	Collector - Emitter Breakdown Voltage		600	V
I_C	Continuous Collector Current	T_c = 25°C	110	A
		T_c = 80°C	90	
I_{CM}	Pulsed Collector Current	T_c = 25°C	315	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_c = 25°C	416	W
RBSOA	Reverse Bias Safe Operating Area	T_j = 150°C	200A @ 600V	

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} = 600V	T_j = 25°C			250	µA
			T_j = 125°C			500	
$V_{CE(sat)}$	Collector Emitter saturation Voltage	V_{GE} =15V I_C = 90A	T_j = 25°C		2.0	2.5	V
			T_j = 125°C		2.2		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE}, I_C = 1mA		3		5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20 V, V_{CE} = 0V				±150	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{ies}	Input Capacitance	V_{GE} = 0V V_{CE} = 25V f = 1MHz			4300		pF
C_{oes}	Output Capacitance				470		
C_{res}	Reverse Transfer Capacitance				400		
Q_g	Total gate Charge	V_{GE} = 15V V_{Bus} = 300V I_C = 90A			330		nC
Q_{ge}	Gate – Emitter Charge				290		
Q_{gc}	Gate – Collector Charge				200		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = 15V V_{Bus} = 400V I_C = 90A R_G = 5 Ω			26		ns
T_r	Rise Time				25		
$T_{d(off)}$	Turn-off Delay Time				150		
T_f	Fall Time				30		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = 15V V_{Bus} = 400V I_C = 90A R_G = 5 Ω			26		ns
T_r	Rise Time				25		
$T_{d(off)}$	Turn-off Delay Time				170		
T_f	Fall Time				40		
E_{on}	Turn-on Switching Energy	V_{GE} = 15V V_{Bus} = 400V I_C = 90A R_G = 5 Ω	T_j = 125°C		4.3		mJ
E_{off}	Turn-off Switching Energy		T_j = 125°C		3.5		

Reverse diode ratings and characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	V_R=600V	T_j = 25°C			35	µA
			T_j = 125°C			600	
I_F	DC Forward Current		Tc = 80°C		60		A
V_F	Diode Forward Voltage	I_F = 60A			1.8	2.2	V
		I_F = 120A			2.2		
		I_F = 60A	T_j = 125°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 60A V_R = 400V di/dt =400A/µs	T_j = 25°C		25		ns
			T_j = 125°C		160		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		70		nC
			T_j = 125°C		960		

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance	IGBT				0.3	°C/W
		Diode				0.65	
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					80	g

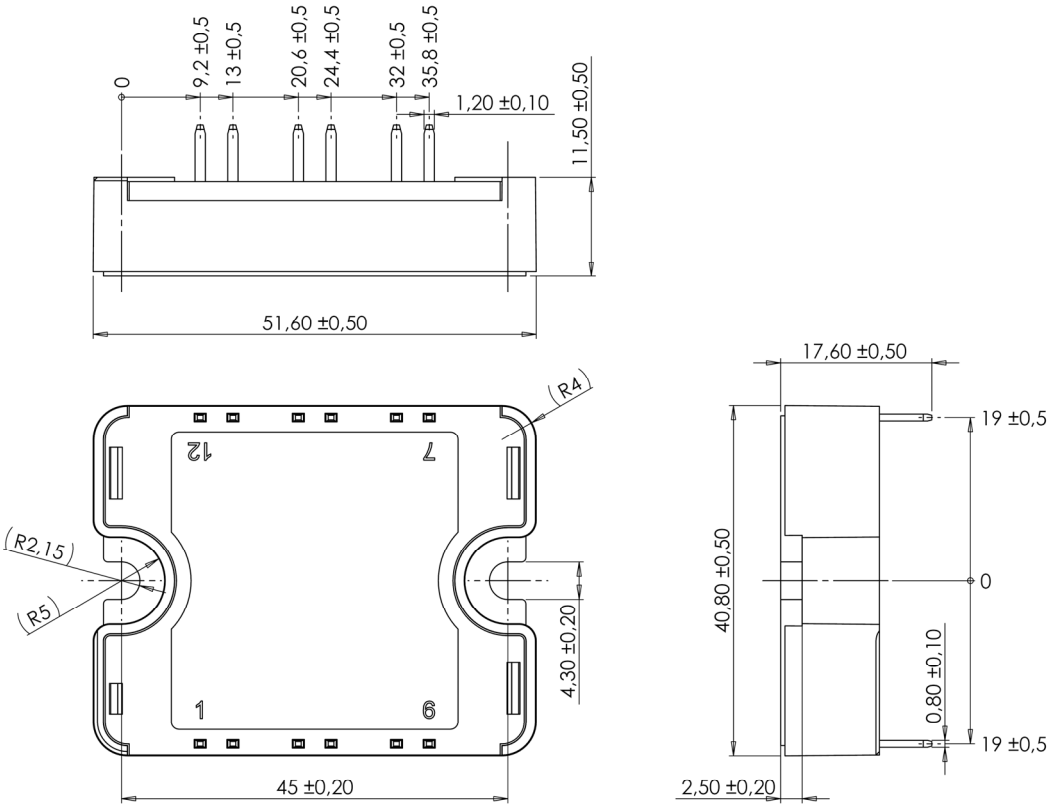
Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

Symbol	Characteristic	Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C		50		kΩ
$B_{25/85}$	T_{25} = 298.15 K		3952		K

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

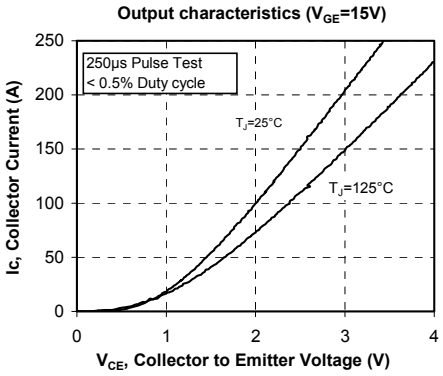
T: Thermistor temperature
R_T: Thermistor value at T

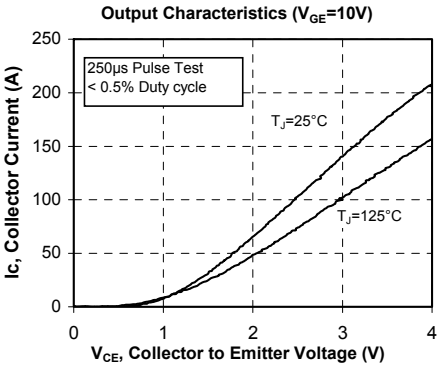
SP1 Package outline (dimensions in mm)

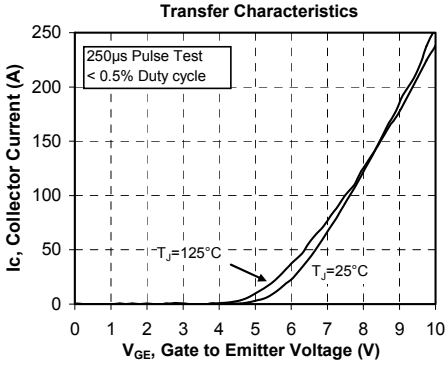


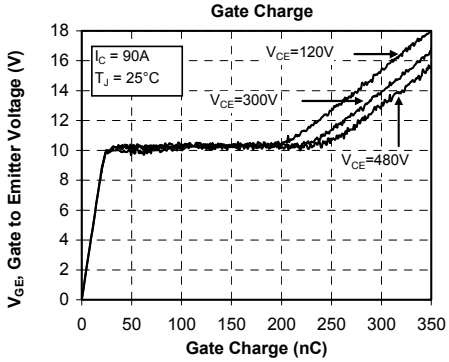
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

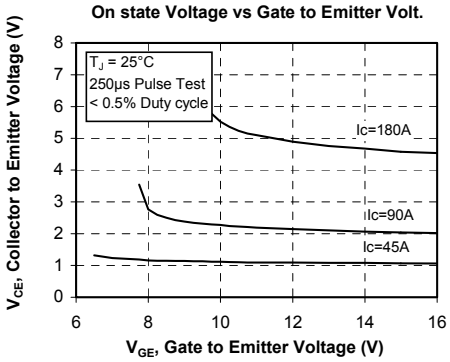
Typical Performance Curve

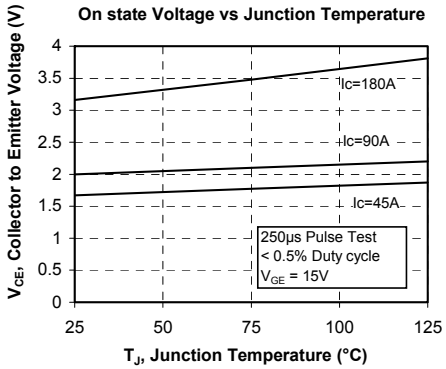


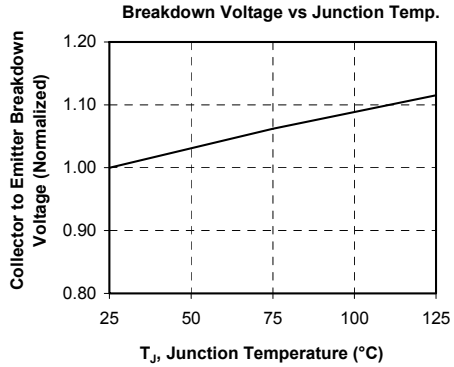


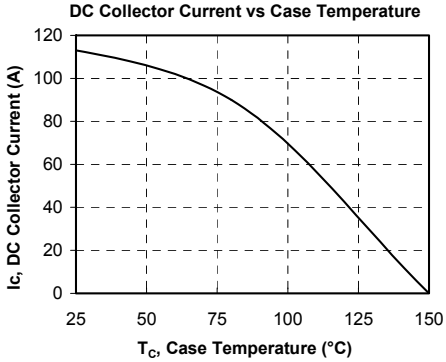




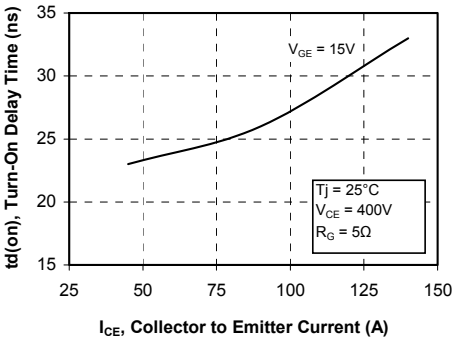




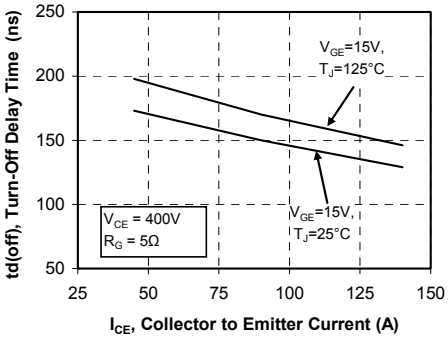




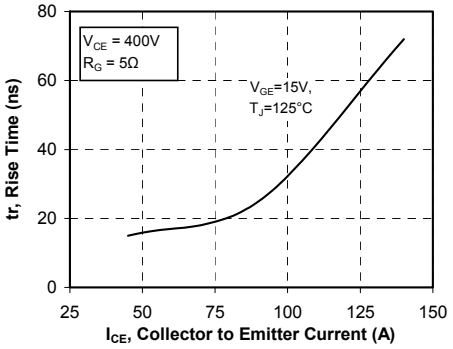
Turn-On Delay Time vs Collector Current



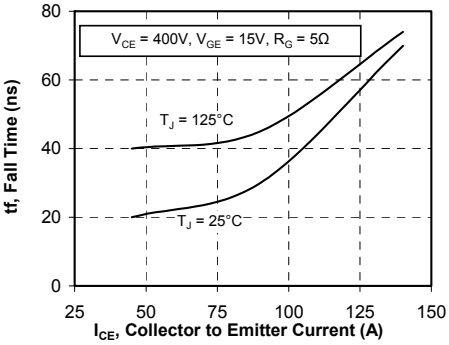
Turn-Off Delay Time vs Collector Current



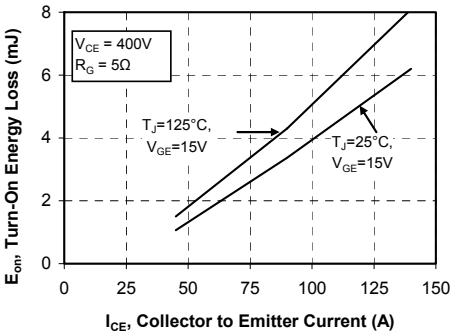
Current Rise Time vs Collector Current



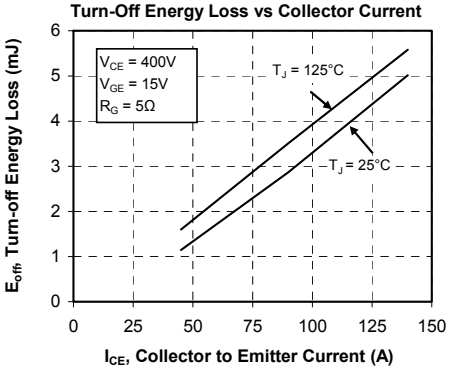
Current Fall Time vs Collector Current



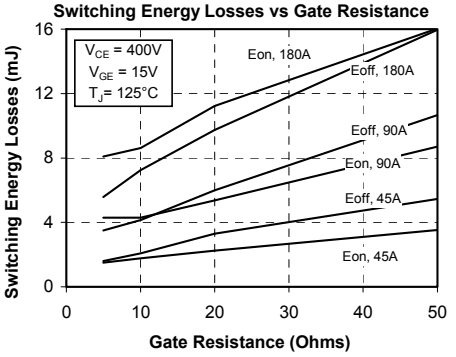
Turn-On Energy Loss vs Collector Current



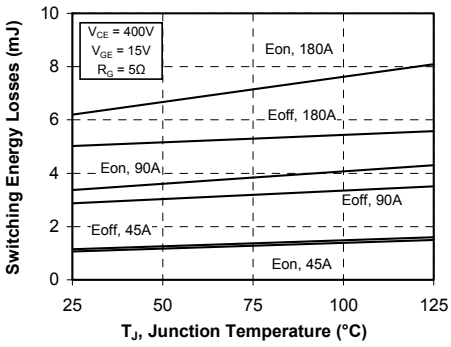
Turn-Off Energy Loss vs Collector Current

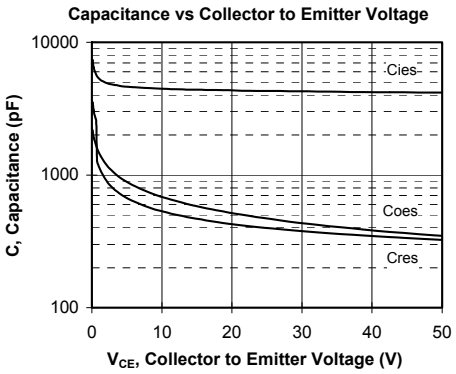


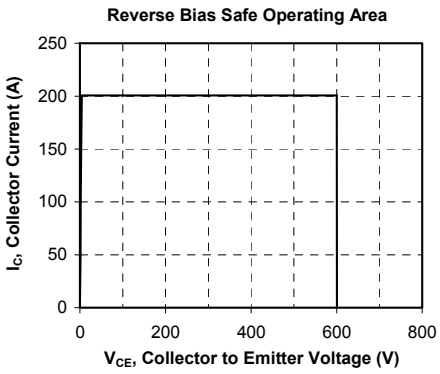
Switching Energy Losses vs Gate Resistance

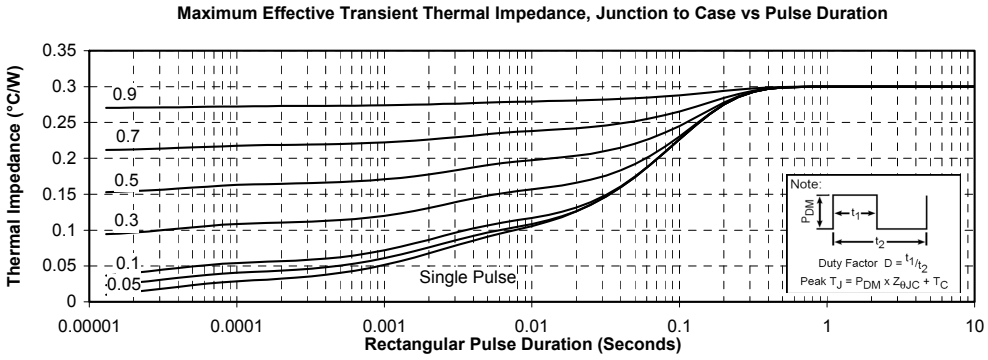


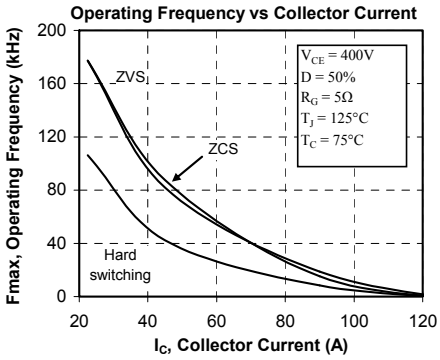
Switching Energy Losses vs Junction Temp.




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)
250
200
150
100
50
0
0
200
400
600
800
VCE, Collector to Emitter Voltage (V)


Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
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)
200
160
120
80
40
0
ZVS
ZCS
Hard
switching
VCE = 400V
D = 50%
RG = 5Ω
TJ = 125°C
TC = 75°C
20
40
60
80
100
120
IC, Collector Current (A)

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