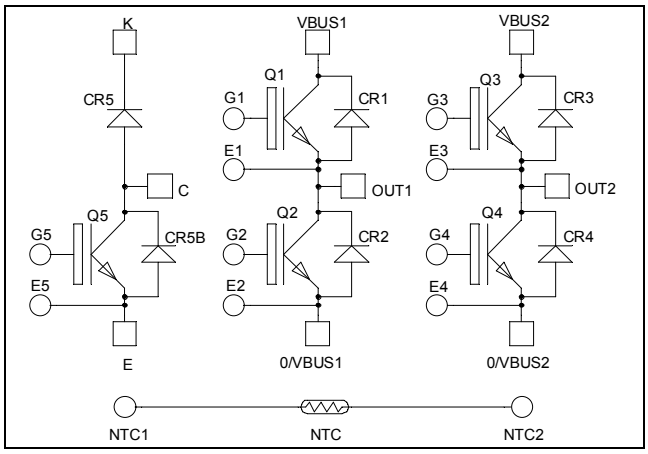
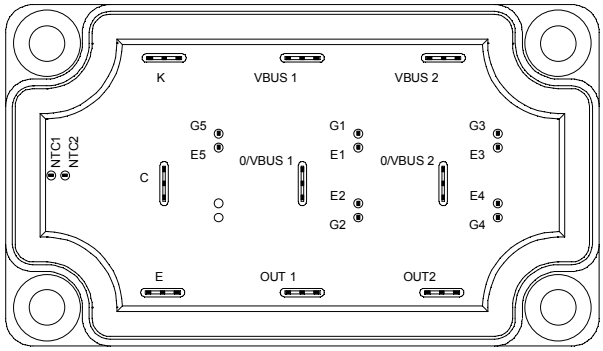
APTGV50H120BTPG

Boost chopper + full bridge
NPT & Trench + Field Stop IGBT
Power module



Full bridge top switches : Trench + Field Stop IGBT
Full bridge bottom switches : FAST NPT IGBT
Q5 boost chopper : FAST NPT IGBT



Trench & Field Stop IGBT Q1, Q3:
V_{CES} = 1200V ; I_C = 50A @ Tc = 80°C

Fast NPT IGBT Q2, Q4:
V_{CES} = 1200V ; I_C = 50A @ Tc = 80°C

Fast NPT IGBT Q5:
V_{CES} = 1200V ; I_C = 100A @ Tc = 80°C

Application

- Solar converter

Features

- ***Q2, Q4, Q5 (FAST Non Punch Through (NPT) IGBT)***
  - Switching frequency up to 100 kHz
  - RBSOA & SCSOA rated
  - Low tail current
- ***Q1, Q3 (Trench & Field Stop IGBT)***
  - Low voltage drop
  - Switching frequency up to 20 kHz
  - RBSOA & SCSOA rated
  - Low tail current
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

Benefits

- Optimized conduction & switching losses
- 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 T_C of V_{CEsat}
- RoHS Compliant

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

All ratings @ T_j = 25°C unless otherwise specified

1. Full bridge top switches

1.1 Top Trench + Field Stop IGBT characteristics

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	75	A
		T_C = 80°C	50	
I_{CM}	Pulsed Collector Current	T_C = 25°C	100	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_C = 25°C	270	W
RBSOA	Reverse Bias Safe Operating Area	T_J = 125°C	100A @ 1150V	

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	1.4	1.7	2.1	V
			T_j = 125°C		2.0		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE} , I_C = 2mA		5.0	5.8	6.5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20V, V_{CE} = 0V				400	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
C_{ies}	Input Capacitance	V_{GE} = 0V,V_{CE} = 25V f = 1MHz			3600		pF
C_{rss}	Reverse Transfer Capacitance				160		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = ±15V V_{Bus} = 600V I_C = 50A R_G = 18Ω			90		ns
T_r	Rise Time				30		
$T_{d(off)}$	Turn-off Delay Time				420		
T_f	Fall Time				70		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = ±15V V_{Bus} = 600V I_C = 50A R_G = 18Ω			90		ns
T_r	Rise Time				50		
$T_{d(off)}$	Turn-off Delay Time				520		
T_f	Fall Time				90		
E_{on}	Turn-on Switching Energy	V_{GE} = ±15V V_{Bus} = 600V I_C = 50A R_G = 18Ω	T_j = 125°C		5		mJ
E_{off}	Turn-off Switching Energy		T_j = 125°C		5.5		
R_{thJC}	Junction to Case Thermal resistance					0.45	°C/W

1.2 Top fast diode 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		
R_{thJC}	Junction to Case Thermal resistance					0.9	°C/W

2. Full bridge bottom switches

2.1 Bottom Fast NPT IGBT characteristics

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	

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		
R_{thJC}	Junction to Case Thermal resistance					0.4	°C/W

2.2 Bottom diode 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			250	µA
			T_j = 125°C			500	
I_F	DC Forward Current		Tc = 80°C		30		A
V_F	Diode Forward Voltage	I_F = 30A			2	2.5	V
		I_F = 60A			2.3		
		I_F = 30A	T_j = 125°C		1.8		
t_{rr}	Reverse Recovery Time	I_F = 30A V_R = 800V di/dt =200A/µs	T_j = 25°C		370		ns
			T_j = 125°C		500		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		660		nC
			T_j = 125°C		3450		
R_{thJC}	Junction to Case Thermal resistance					1.2	°C/W

3. Boost chopper switches

3.1 Fast NPT IGBT characteristics

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	130	A
		T_c = 80°C	100	
I_{CM}	Pulsed Collector Current	T_c = 25°C	200	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_c = 25°C	650	W
RBSOA	Reverse Bias Safe Operating Area	T_j = 150°C	200A @ 1150V	

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 = 100A	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 = 4 mA		4.5		6.5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20 V, V_{CE} = 0V				400	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
C_{ies}	Input Capacitance	V_{GE} = 0V ; V_{CE} = 25V f = 1MHz			6.8		nF
C_{res}	Reverse Transfer Capacitance				0.42		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = 15V, V_{Bus} = 600V, I_C = 100A, R_G = 5.6 Ω			120		ns
T_r	Rise Time				50		
$T_{d(off)}$	Turn-off Delay Time				310		
T_f	Fall Time				31		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = ±15V, V_{Bus} = 600V, I_C = 100A, R_G = 5.6 Ω			130		ns
T_r	Rise Time				60		
$T_{d(off)}$	Turn-off Delay Time				360		
T_f	Fall Time				36		
E_{on}	Turn-on Switching Energy	V_{GE} = ±15V, V_{Bus} = 600V, I_C = 100A, R_G = 5.6 Ω	T_j = 125°C		12		mJ
E_{off}	Turn-off Switching Energy		T_j = 125°C		5		
R_{thJC}	Junction to Case Thermal resistance					0.19	°C/W

3.2 Chopper diode 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		
R_{thJC}	Junction to Case Thermal resistance					0.9	°C/W

4. 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

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

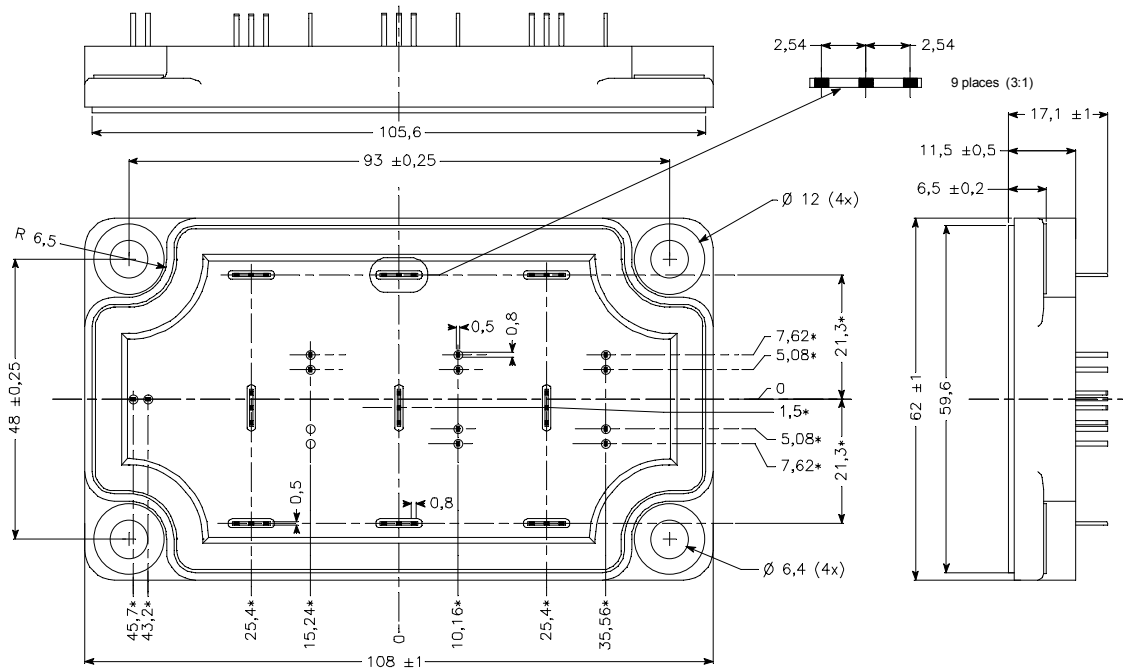
T: Thermistor temperature
R_T: Thermistor value at T

5. Package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz			2500			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	M6	2.5		4.7	N.m
Wt	Package Weight					250	g

* Tj=175°C for Trench & Field Stop IGBT

6. SP6-P Package outline (dimensions in mm)

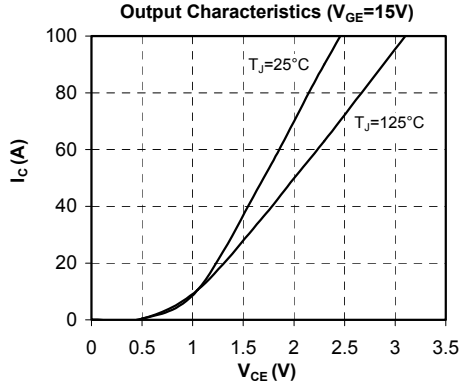


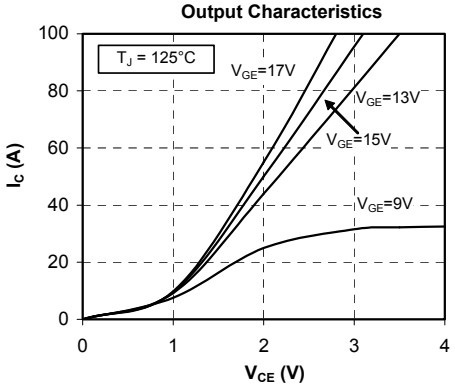
ALL DIMENSIONS MARKED " * " ARE TOLERENCED AS : ⊕ Ø1

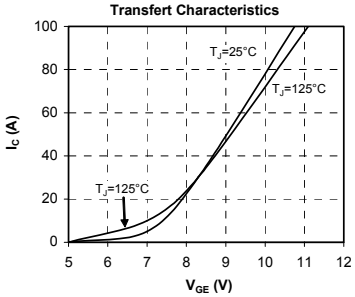
See application note 1902 - Mounting Instructions for SP6-P (12mm) Power Modules on www.microsemi.com

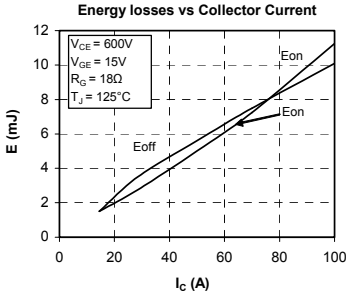
7. Full bridge top switches curves

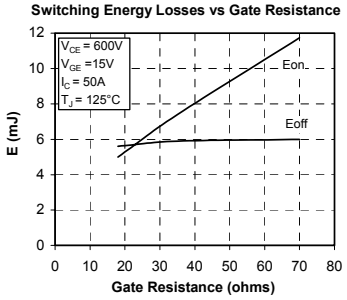
7.1 Top Trench + Field Stop IGBT typical performance curves

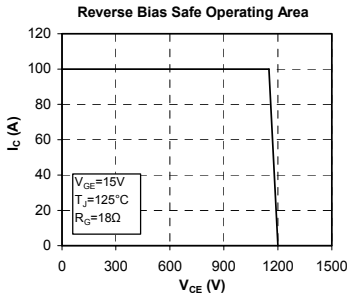


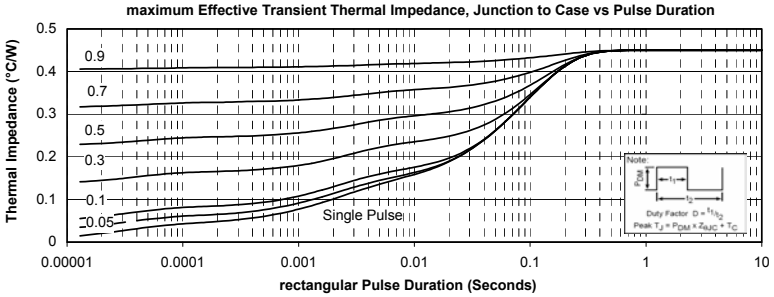




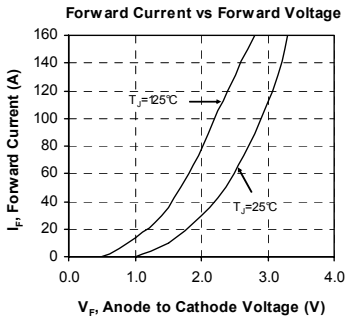


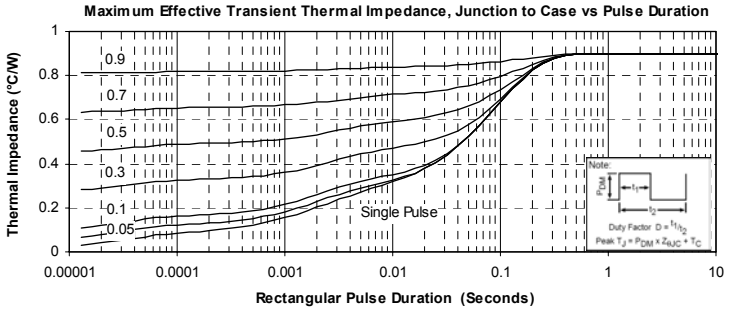






7.2 Top Fast diode typical performance curves

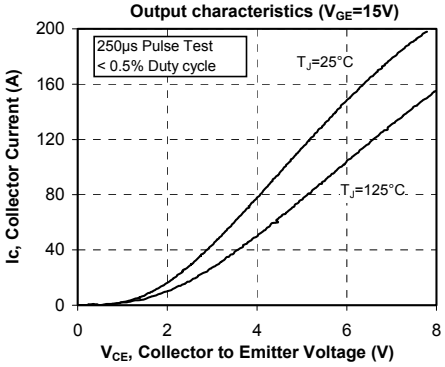




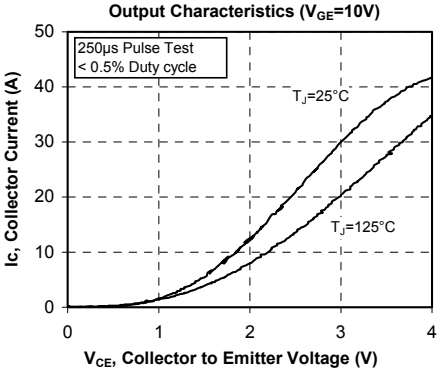
8. Full bridge bottom switches curves

8.1 Bottom fast NPT IGBT typical performance curves

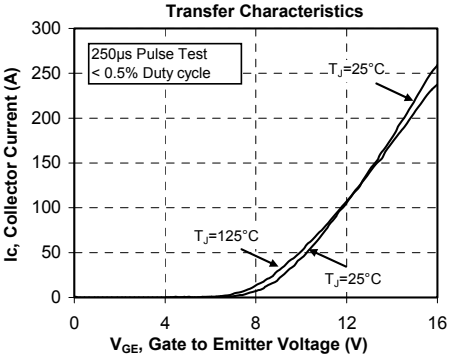
Output characteristics (V_{GE}=15V)



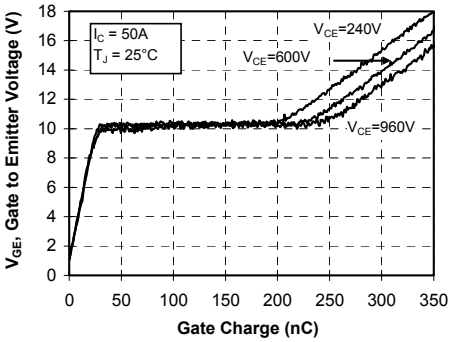
Output Characteristics (V_{GE}=10V)



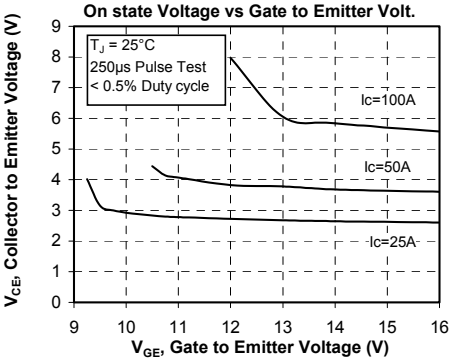
Transfer Characteristics



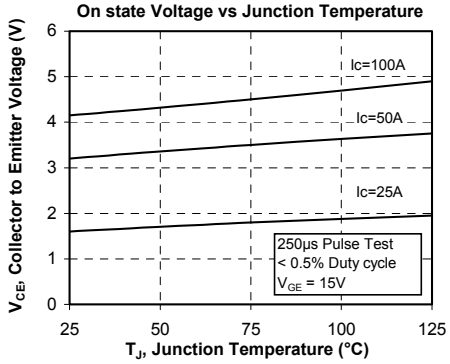
Gate Charge



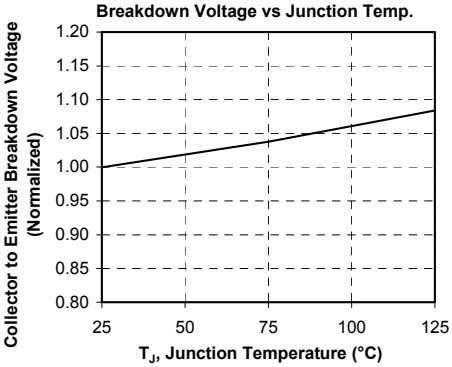
On state Voltage vs Gate to Emitter Volt.



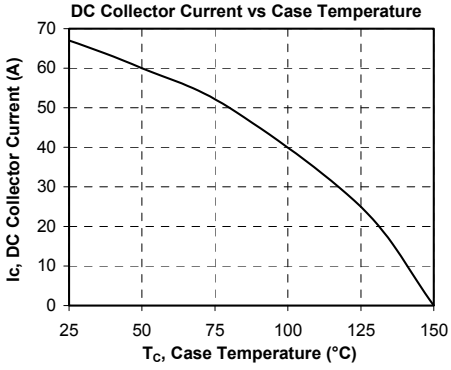
On state Voltage vs Junction Temperature



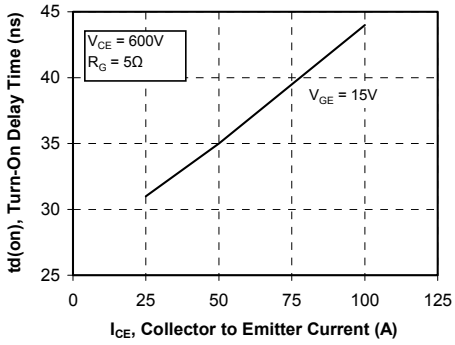
Breakdown Voltage vs Junction Temp.



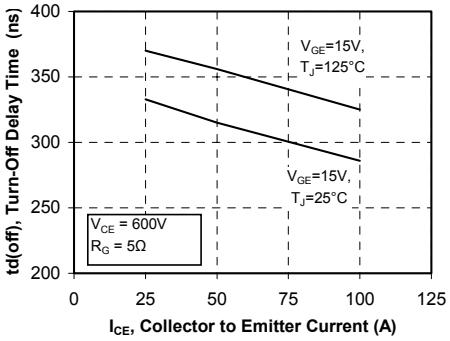
DC Collector Current vs Case Temperature



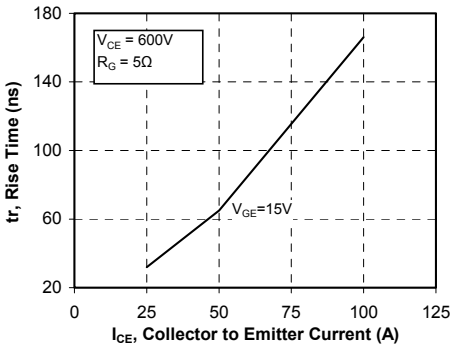
Turn-On Delay Time vs Collector Current



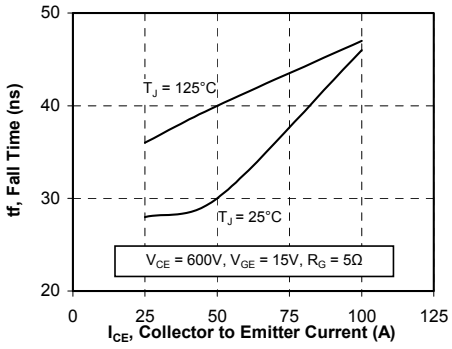
Turn-Off Delay Time vs Collector Current



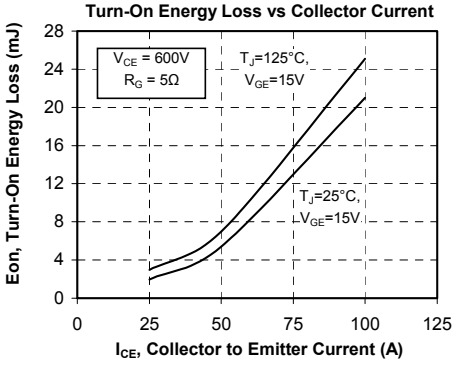
Current Rise Time vs Collector Current



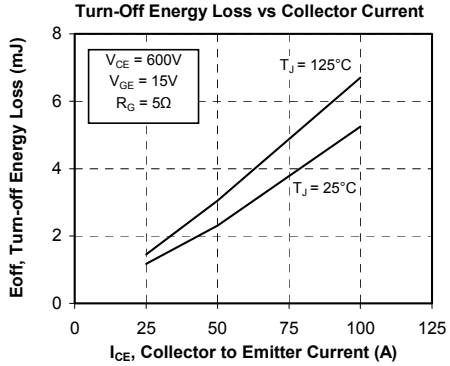
Current Fall Time vs Collector Current



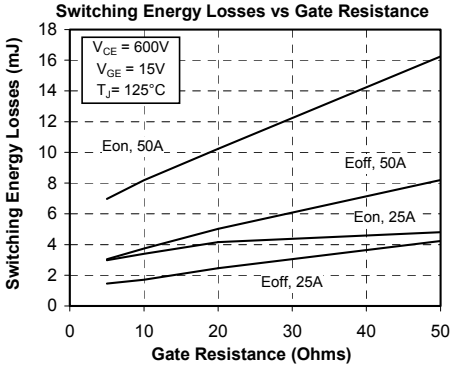
Turn-On Energy Loss vs Collector Current



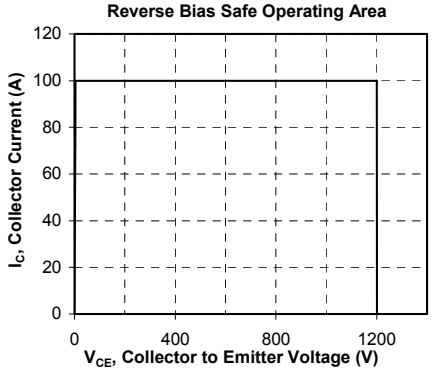
Turn-Off Energy Loss vs Collector Current

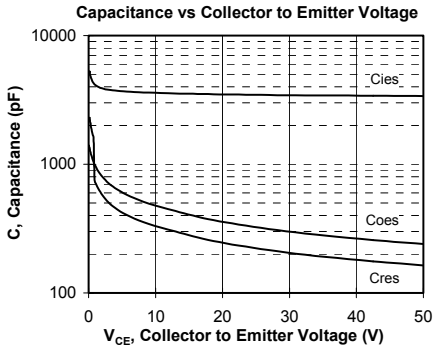


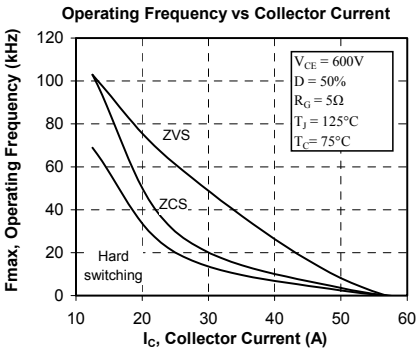
Switching Energy Losses vs Gate Resistance

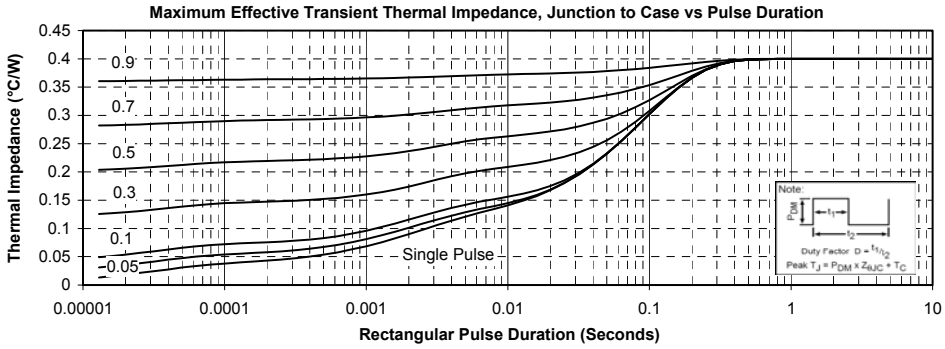


Reverse Bias Safe Operating Area

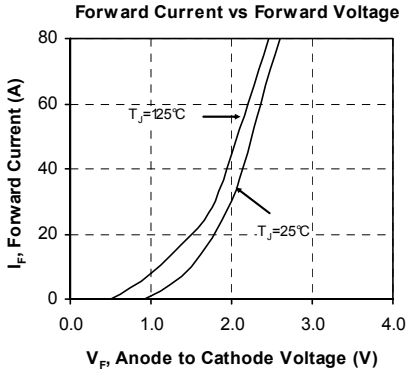


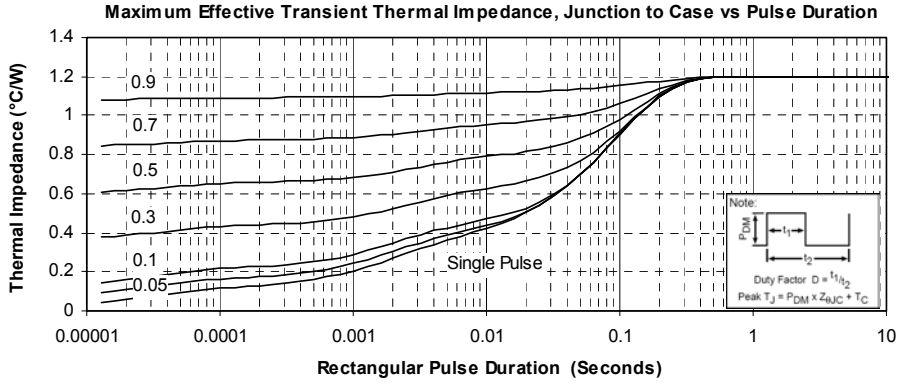






8.2 Bottom diode typical performance curves

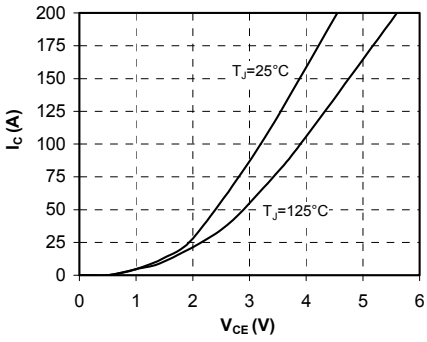




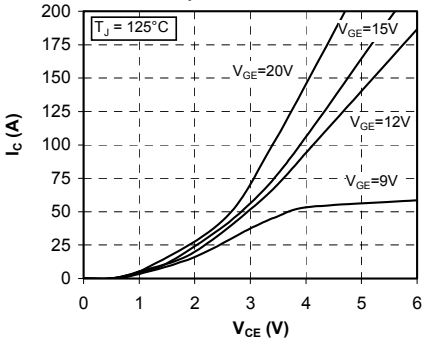
9. Boost chopper switches curves

9.1 Fast NPT IGBT typical performance curves

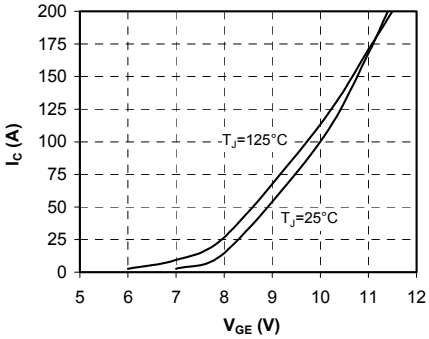
Output Characteristics (V_{GE}=15V)



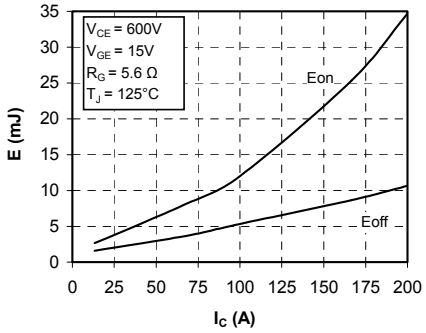
Output Characteristics



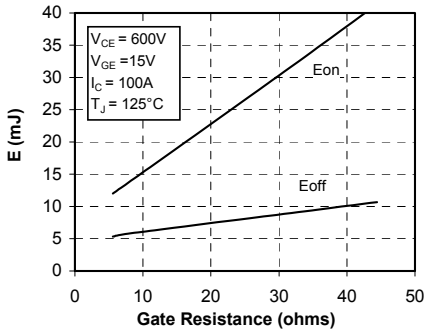
Transfert Characteristics



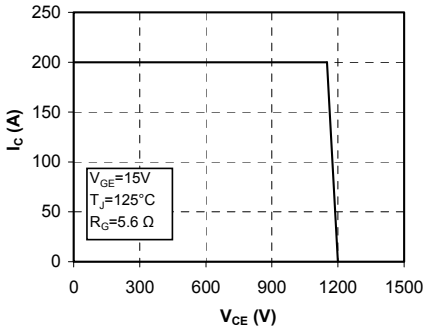
Energy losses vs Collector Current



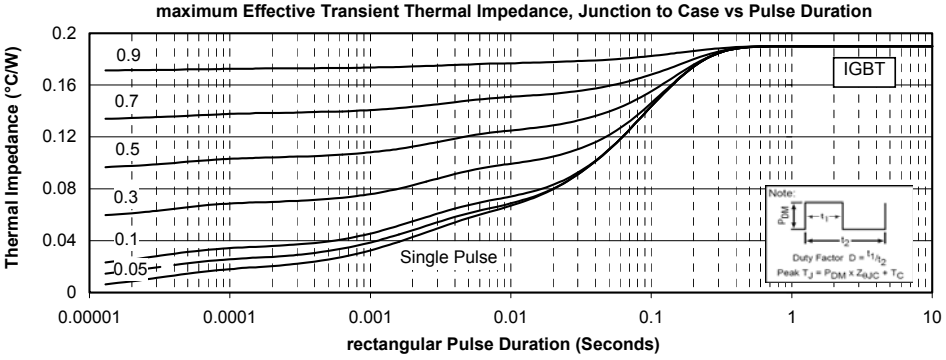
Switching Energy Losses vs Gate Resistance



Reverse Bias Safe Operating Area



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



9.2 Chopper diode typical performance curves