


**Thunderbolt IGBT®**

The Thunderbolt IGBT® is a new generation of high voltage power IGBTs. Using Non-Punch-Through Technology, the Thunderbolt IGBT® offers superior ruggedness and ultrafast switching speed.


**Features**

- Low Forward Voltage Drop
- Low Tail Current
- RoHS Compliant 
- RBSOA and SCSOA Rated
- High Frequency Switching to 50KHz
- Ultra Low Leakage Current

Unless stated otherwise, Microsemi discrete IGBTs contain a single IGBT die. This device is made with two parallel IGBT die. It is intended for switch-mode operation. It is not suitable for linear mode operation.

**Maximum Ratings**

 All Ratings:  $T_C = 25^\circ C$  unless otherwise specified.

Symbol	Parameter	Ratings	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	Volts
$V_{GE}$	Gate-Emitter Voltage	$\pm 30$	
$I_{C1}$	Continuous Collector Current @ $T_C = 25^\circ C$	94	Amps
$I_{C2}$	Continuous Collector Current @ $T_C = 100^\circ C$	50	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	150	
SSOA	Switching Safe Operating Area @ $T_J = 150^\circ C$	150A @ 1200V	
$P_D$	Total Power Dissipation	625	Watts
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ C$
$T_L$	Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec.	300	

**Static Electrical Characteristics**

Symbol	Characteristic / Test Conditions	Min	Typ	Max	Unit
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V, I_C = 3mA$ )	1200	-	-	Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 2mA, T_J = 25^\circ C$ )	4.5	5.5	6.5	
$V_{CE(ON)}$	Collector Emitter On Voltage ( $V_{GE} = 15V, I_C = 50A, T_J = 25^\circ C$ )	2.7	3.2	3.7	
	Collector Emitter On Voltage ( $V_{GE} = 15V, I_C = 50A, T_J = 125^\circ C$ )	-	4.0	-	
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 25^\circ C$ ) <sup>②</sup>	-	-	300	$\mu A$
	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 125^\circ C$ ) <sup>②</sup>	-	-	TBD	
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )	-	-	300	nA



CAUTION: These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

## Dynamic Characteristic

APT50GT120B2RDQ2R

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	$V_{GE} = 0V, V_{CE} = 25V$ $f = 1MHz$	-	3700	-	pF
$C_{oes}$	Output Capacitance		-	380	-	
$C_{res}$	Reverse Transfer Capacitance		-	225	-	
$V_{GEP}$	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 50A$	-	10.5	-	V
$Q_g$	Total Gate Charge		-	340	-	nC
$Q_{ge}$	Gate-Emitter Charge		-	40	-	
$Q_{gc}$	Gate-Collector Charge		-	210	-	
SSOA	Switching Safe Operating Area	$T_J = 150^\circ C, R_G = 1.0\Omega^{(2)}, V_{GE} = 15V,$ $L = 100\mu H, V_{CE} = 1200V$	150			A
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 4.7\Omega$ $T_J = +25^\circ C$	-	24	-	ns
$t_r$	Current Rise Time		-	53	-	
$t_{d(off)}$	Turn-Off Delay Time		-	230	-	
$t_f$	Current Fall Time		-	26	-	μJ
$E_{on1}$	Turn-On Switching Energy <sup>(4)</sup>		-	TBD	-	
$E_{on2}$	Turn-On Switching Energy <sup>(5)</sup>		-	5330	-	
$E_{off}$	Turn-Off Switching Energy <sup>(6)</sup>	-	2033	-		
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 4.7\Omega$ $T_J = 125^\circ C$	-	24	-	ns
$t_r$	Current Rise Time		-	53	-	
$t_{d(off)}$	Turn-Off Delay Time		-	255	-	
$t_f$	Current Fall Time		-	48	-	μJ
$E_{on1}$	Turn-On Switching Energy <sup>(4)</sup>		-	TBD	-	
$E_{on2}$	Turn-On Switching Energy <sup>(5)</sup>		-	5670	-	
$E_{off}$	Turn-Off Switching Energy <sup>(6)</sup>	-	2850	-		

## Thermal and Mechanical Characteristics

Symbol	Characteristic / Test Conditions	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case (IGBT)			0.20	°C/W
$R_{\theta JC}$	Junction to Case (DIODE)			0.80	
$W_T$	Package Weight		6.2		g

① Repetitive Rating: Pulse width limited by maximum junction temperature.

② For Combi devices,  $I_{ces}$  includes both IGBT and FRED leakages.

③ See MIL-STD-750 Method 3471.

④  $E_{on1}$  is the clamped inductive turn-on energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to  $z$  a the IGBT turn-on loss. Tested in inductive switching test circuit shown in figure 21, but with a Silicon Carbide diode.

⑤  $E_{on2}$  is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22.)

⑥  $E_{off}$  is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See Figures 21, 23.)

⑦  $R_G$  is external gate resistance not including gate driver impedance.

Microsemi reserves the right to change, without notice, the specifications and information contained herein.

Typical Performance Curves

APT50GT120B2RDQ2G

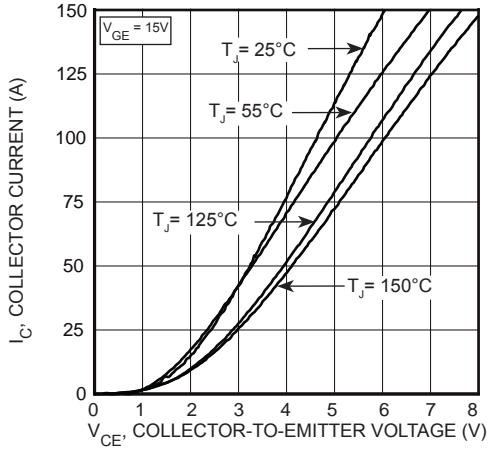


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

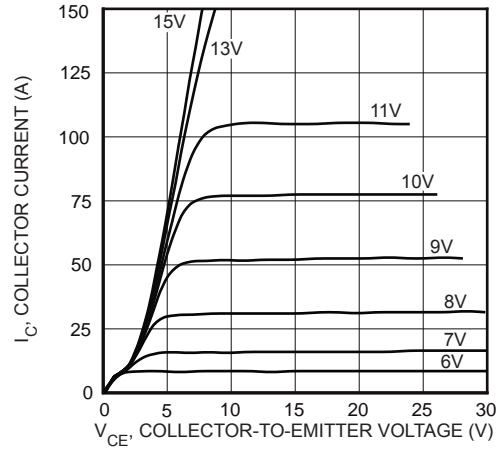


FIGURE 2, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

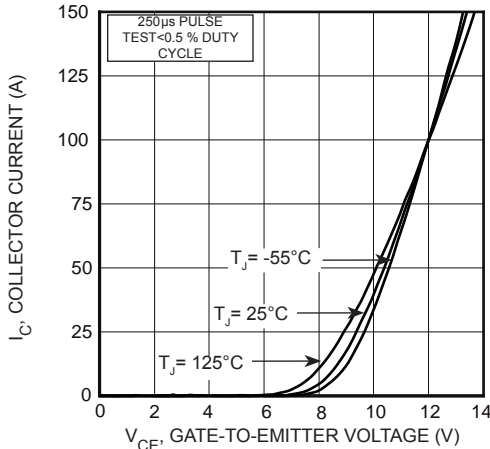


FIGURE 3, Transfer Characteristics

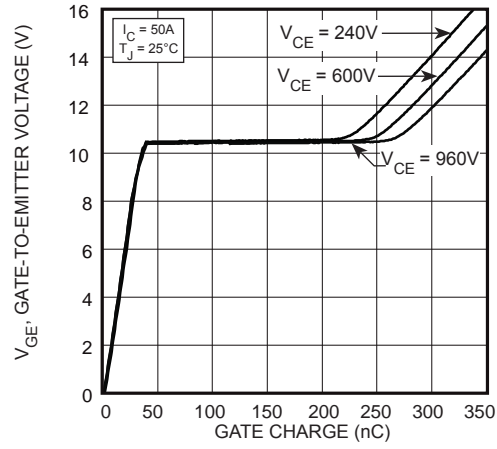


FIGURE 4, Gate charge

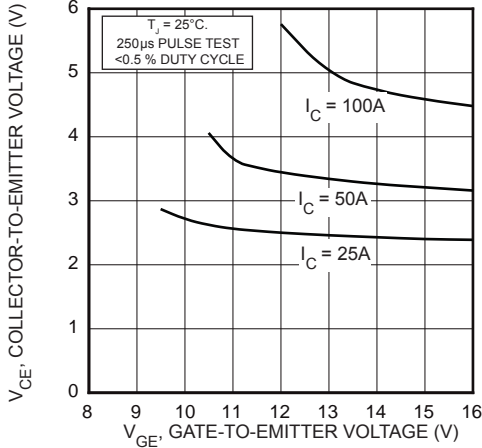


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

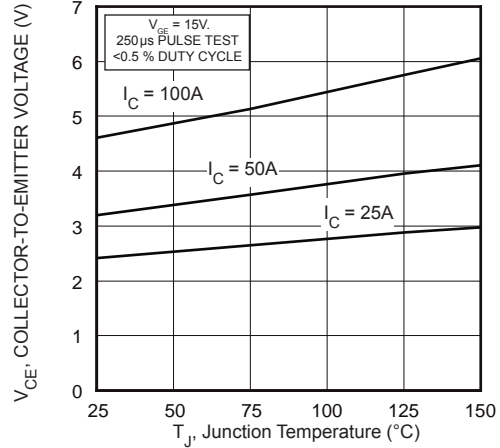


FIGURE 6, On State Voltage vs Junction Temperature

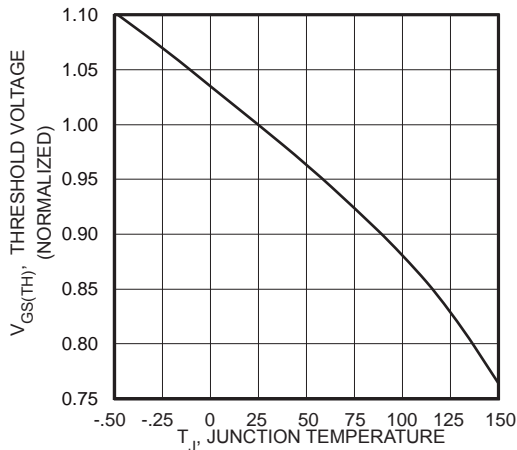


FIGURE 7, Threshold Voltage vs Junction Temperature

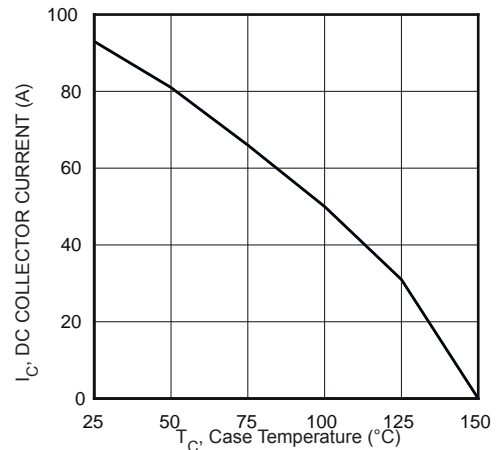


FIGURE 8, DC Collector Current vs Case Temperature

# Typical Performance Curves

APT50GT120B2RDQ2G

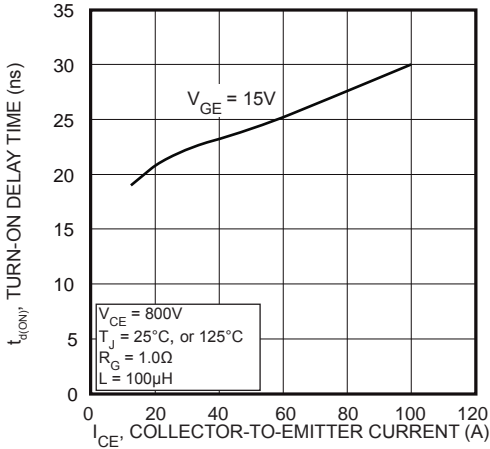


FIGURE 9, Turn-On Delay Time vs Collector Current

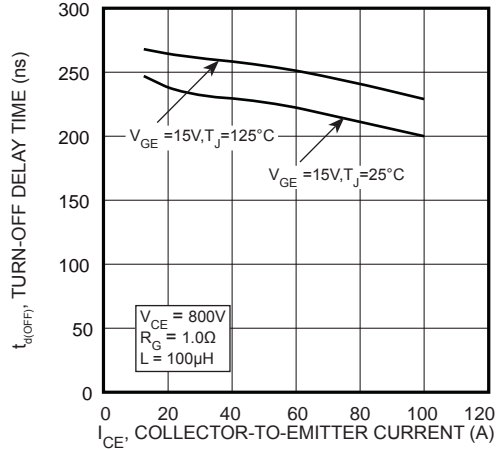


FIGURE 10, Turn-Off Delay Time vs Collector Current

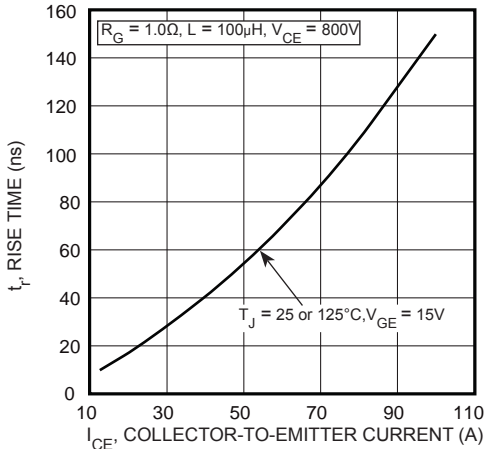


FIGURE 11, Current Rise Time vs Collector Current

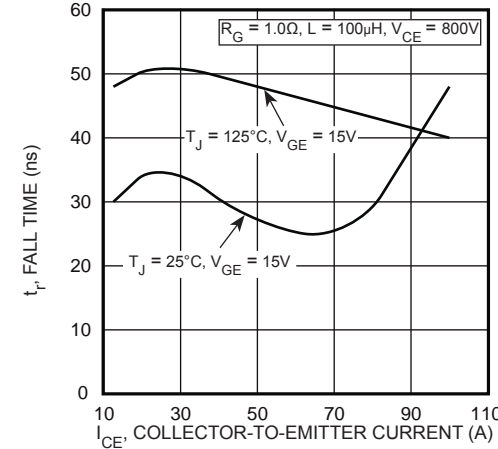


FIGURE 12, Current Fall Time vs Collector Current

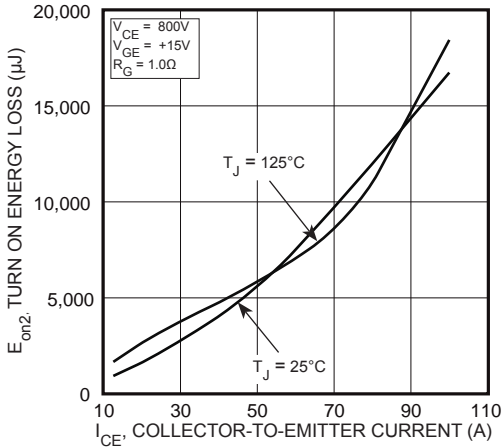


FIGURE 13, Turn-On Energy Loss vs Collector Current

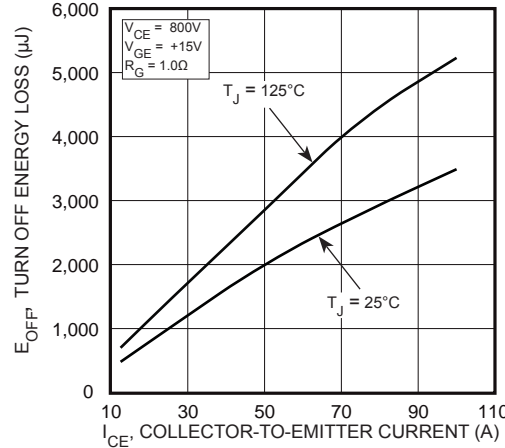


FIGURE 14, Turn-Off Energy Loss vs Collector Current

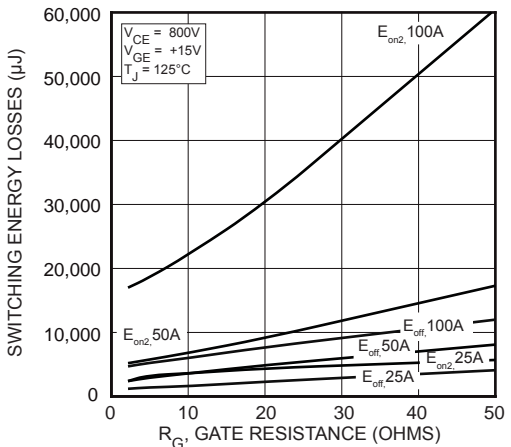


FIGURE 15, Switching Energy Losses vs Gate Resistance

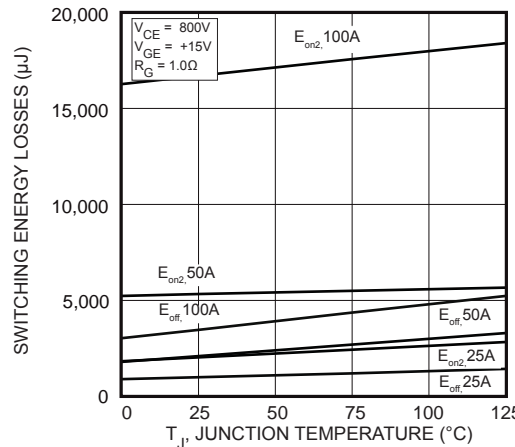


FIGURE 16, Switching Energy Losses vs Junction Temperature

Typical Performance Curves

APT50GT120B2RDQ2G

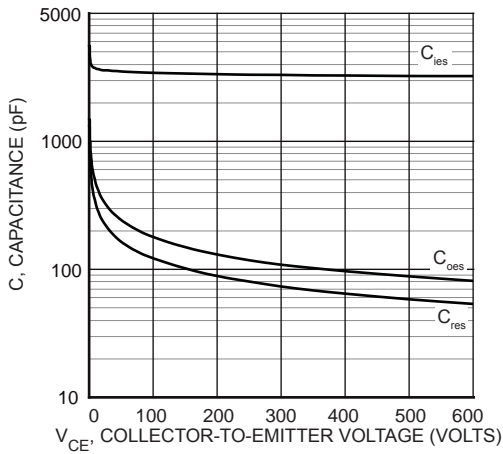


FIGURE 17, Capacitance vs Collector-To-Emitter Voltage

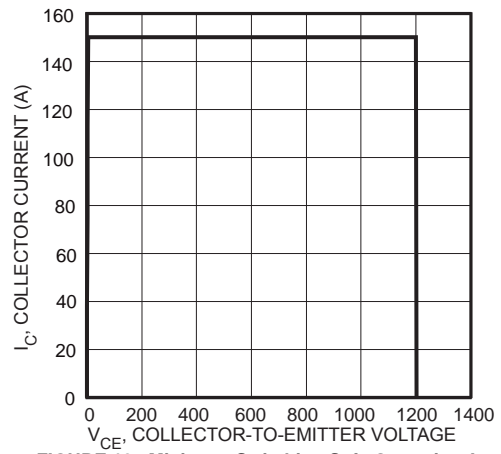


FIGURE 18, Minimum Switching Safe Operating Area

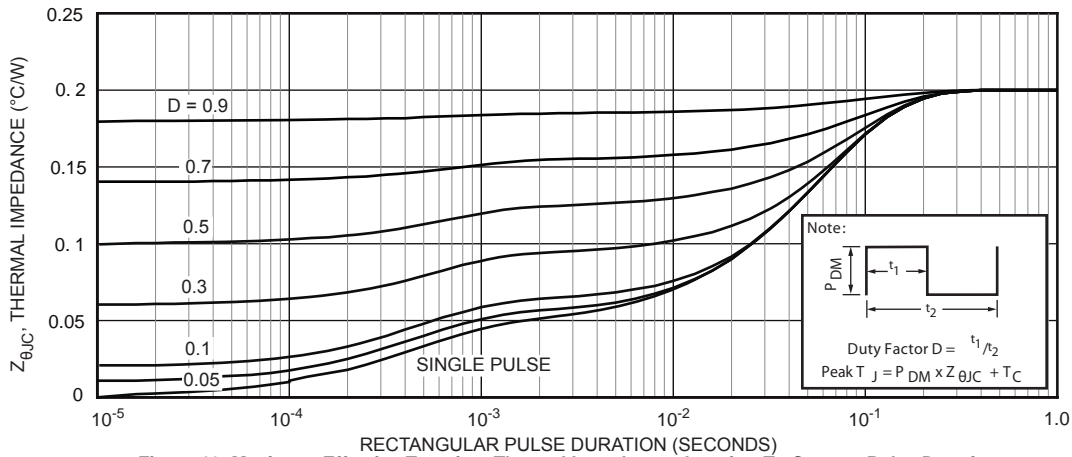


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

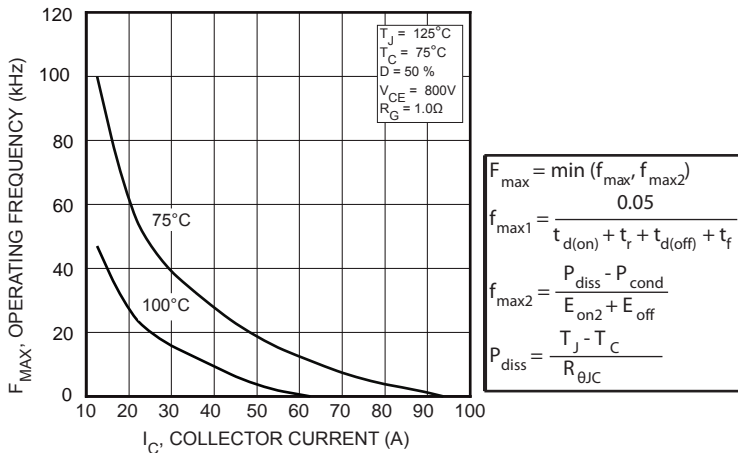


Figure 20, Operating Frequency vs Collector Current

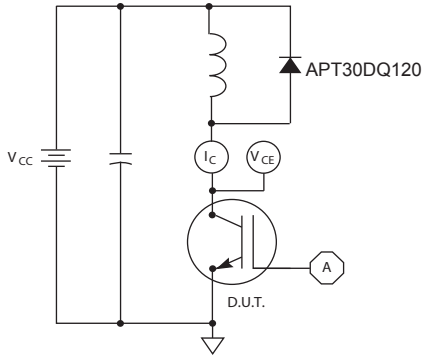


Figure 21, Inductive Switching Test Circuit

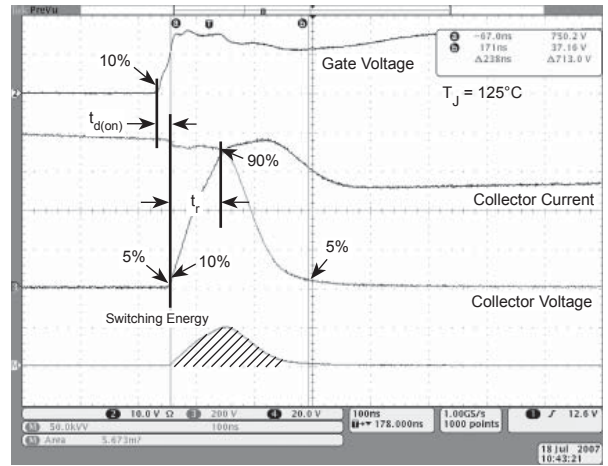


Figure 22, Turn-on Switching Waveforms and Definitions

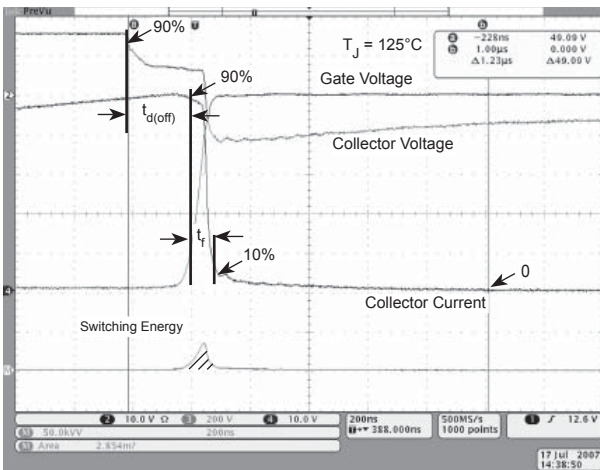


Figure 23, Turn-off Switching Waveforms and Definitions

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

All Ratings:  $T_C = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic / Test Conditions	APT50GT120B2RDQ2G	Unit
$I_{F(AV)}$	Maximum Average Forward Current ( $T_C = 103^\circ\text{C}$ , Duty Cycle = 0.5)	30	Amps
$I_{F(RMS)}$	RMS Forward Current (Square wave, 50% duty)	43	
$I_{FSM}$	Non-Repetitive Forward Surge Current ( $T_J = 45^\circ\text{C}$ , 8.3 ms)	210	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	Min	Type	Max	Unit	
$V_F$	Forward Voltage				Volts	
		$I_F = 30\text{A}$		2.8		3.3
		$I_F = 60\text{A}$		3.4		
	$I_F = 30\text{A}, T_J = 125^\circ\text{C}$		2.1			

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$t_{rr}$	Reverse Recovery Time	$I_F = 1\text{A}, di_F/dt = -100\text{A}/\mu\text{s}, V_R = 30\text{V}, T_J = 25^\circ\text{C}$	-	26	-	ns
$t_{rr}$	Reverse Recovery Time	$I_F = 30\text{A}, di_F/dt = -200\text{A}/\mu\text{s}, V_R = 667\text{V}, T_C = 25^\circ\text{C}$	-	320	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	545	-	nC
$I_{RRM}$	Maximum Reverse Recovery Current		-	4	-	Amps
$t_{rr}$	Reverse Recovery Time	$I_F = 30\text{A}, di_F/dt = -200\text{A}/\mu\text{s}, V_R = 667\text{V}, T_C = 125^\circ\text{C}$	-	435	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	2100	-	nC
$I_{RRM}$	Maximum Reverse Recovery Current		-	9	-	Amps
$t_{rr}$	Reverse Recovery Time	$I_F = 30\text{A}, di_F/dt = -1000\text{A}/\mu\text{s}, V_R = 800\text{V}, T_C = 125^\circ\text{C}$	-	180	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	2975	-	nC
$I_{RRM}$	Maximum Reverse Recovery Current		-	28	-	Amps

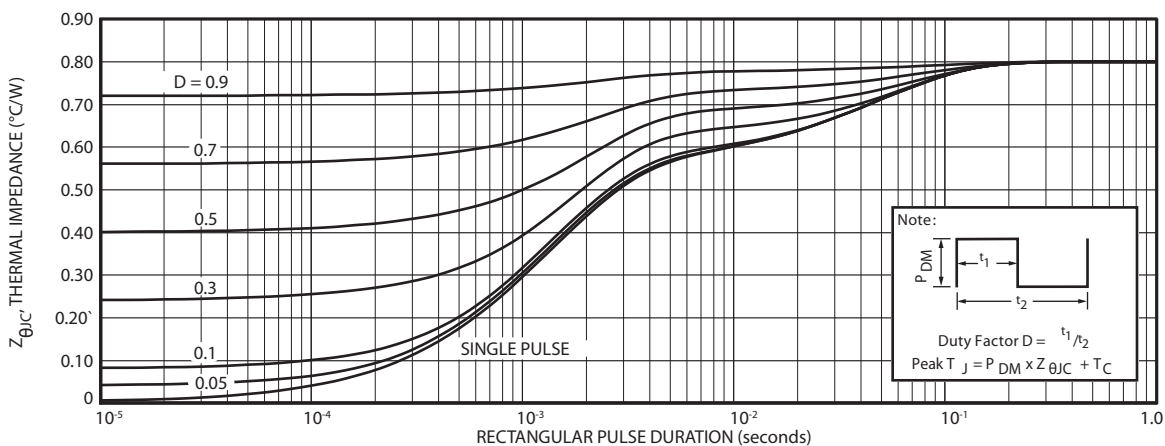


FIGURE 24. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

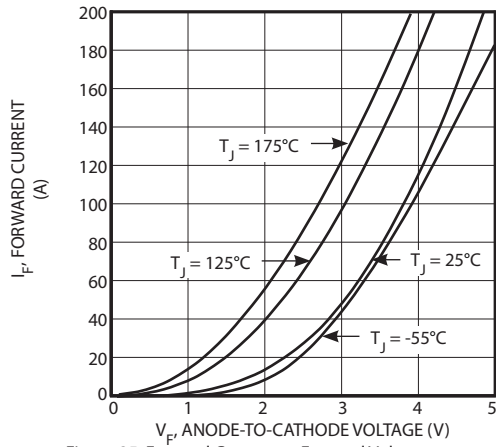


Figure 25. Forward Current vs. Forward Voltage

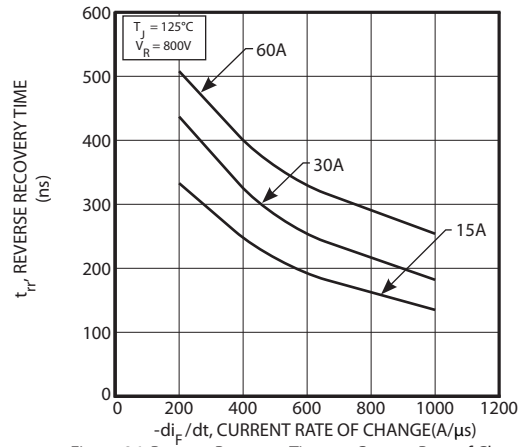


Figure 26. Reverse Recovery Time vs. Current Rate of Change

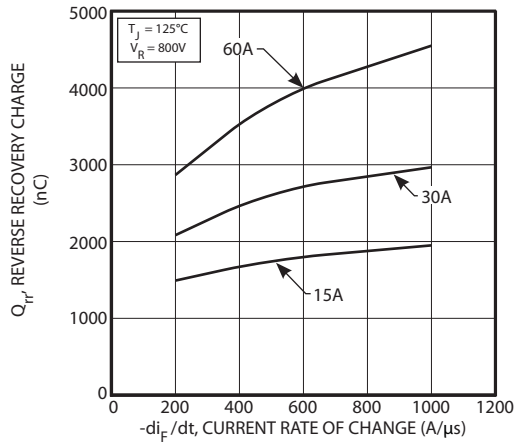


Figure 27. Reverse Recovery Charge vs. Current Rate of Change

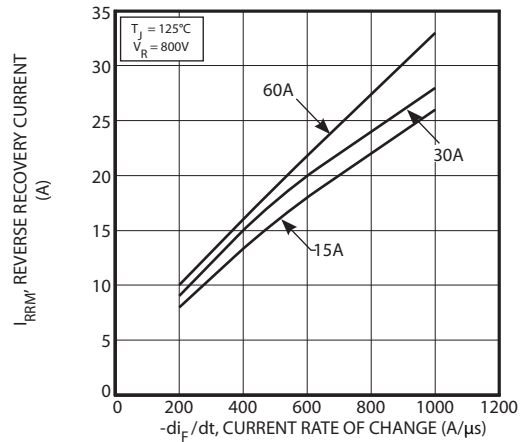


Figure 28. Reverse Recovery Current vs. Current Rate of Change

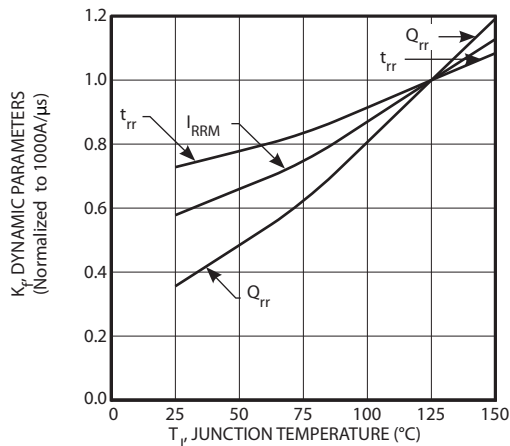


Figure 29. Dynamic Parameters vs. Junction Temperature

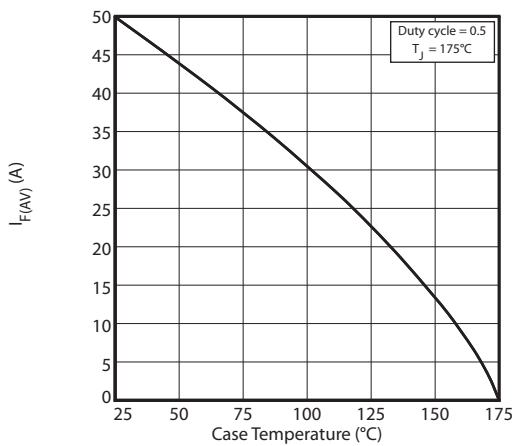


Figure 30. Maximum Average Forward Current vs. Case Temperature

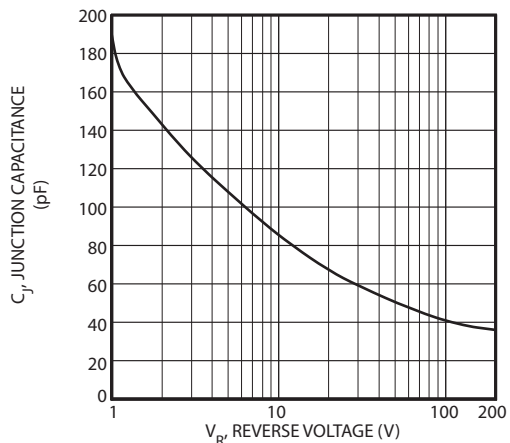


Figure 31. Junction Capacitance vs. Reverse Voltage



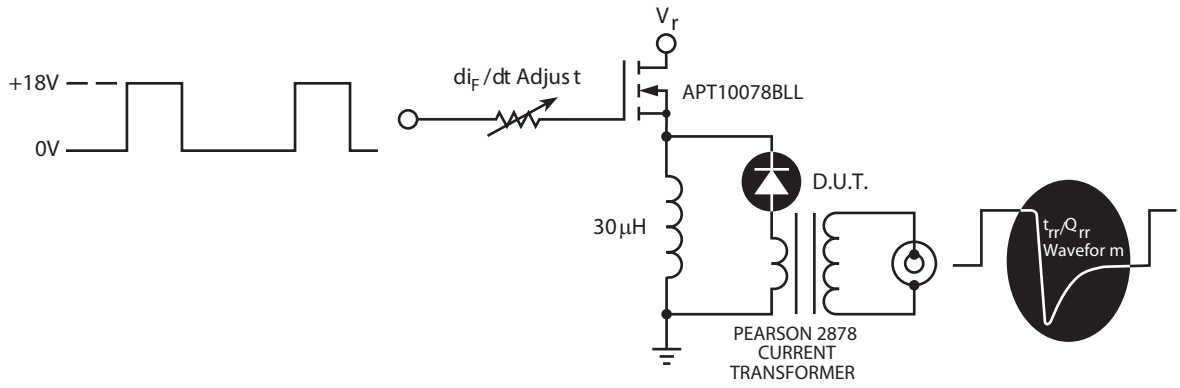


Figure 32. Diode Test Circuit

- 1  $I_F$  - Forward Conduction Current
- 2  $di_F/dt$  - Rate of Diode Current Change Through Zero Crossing.
- 3  $I_{RRM}$  - Maximum Reverse Recovery Current
- 4  $t_{rr}$  - Reverse Recovery Time, measured from zero crossing where the diode current goes from positive to negative, to the point at which the straight line through  $I_{RRM}$  and  $0.25 I_{RRM}$  passes through zero.
- 5  $Q_{rr}$  - Area Under the Curve Defined by  $I_{RRM}$  and  $t_{rr}$ .

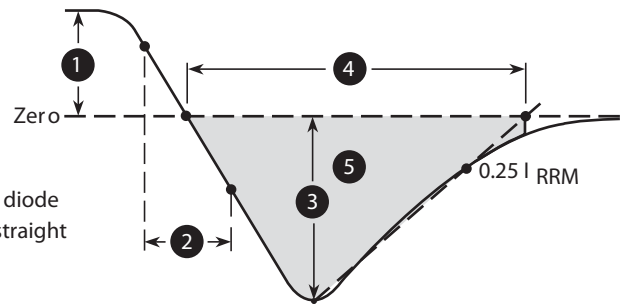
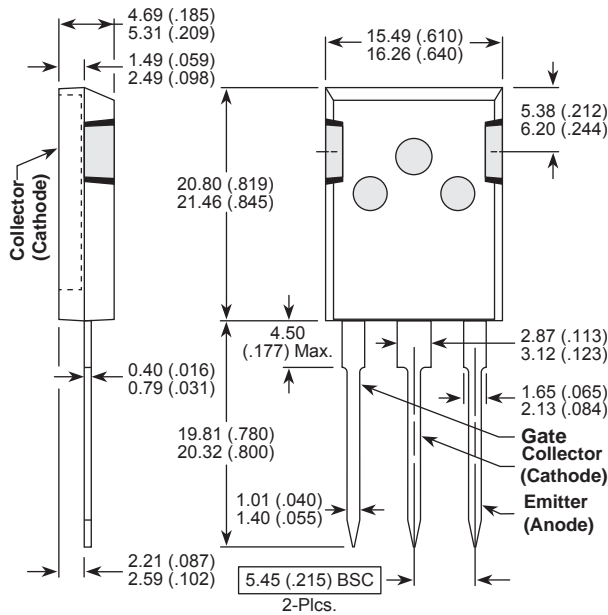


Figure 33, Diode Reverse Recovery Waveform and Definitions

T-MAX® Package Outline

e1 SAC: Tin, Silver, Copper  
e3 100% Sn



Dimensions in Millimeters and (Inches)



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.