

Resonant Mode IGBT®

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

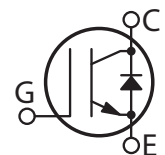
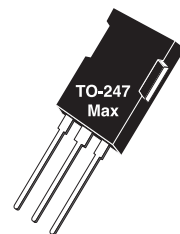
Features

- Low Conduction Loss
- Low Gate Charge
- Ultrafast Tail Current shutoff
- Low forward Diode Voltage (V_F)
- Ultrasoft Recovery Diode

- SSOA Rated
- RoHS Compliant 

Typical Applications

- Induction Heating
- Welding
- Medical
- High Power Telecom
- Resonant Mode Phase Shifted Bridge



MAXIMUM RATINGS

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

Symbol	Parameter	APT50GT120B2RDL(G)	UNIT
V_{CES}	Collector-Emitter Voltage	1200	Volts
V_{GE}	Gate-Emitter Voltage	± 30	
I_{C1}	Continuous Collector Current ⁽³⁾ @ $T_C = 25^\circ\text{C}$	106	Amps
I_{C2}	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	50	
I_{CM}	Pulsed Collector Current ⁽¹⁾ @ $T_C = 150^\circ\text{C}$	150	
SSOA	Switching Safe Operating Area @ $T_J = 150^\circ\text{C}$	150A @ 1200V	
P_D	Total Power Dissipation	694	Watts
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ\text{C}$
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	Units
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ($V_{GE} = 0V, I_C = 3mA$)	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 2mA, T_J = 25^\circ\text{C}$)	4.5	5.5	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = 50A, T_J = 25^\circ\text{C}$)	2.7	3.2	3.7	
	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = 50A, T_J = 125^\circ\text{C}$)		4.0		
I_{CES}	Collector Cut-off Current ($V_{CE} = 1200V, V_{GE} = 0V, T_J = 25^\circ\text{C}$) ⁽²⁾			300	μA
	Collector Cut-off Current ($V_{CE} = 1200V, V_{GE} = 0V, T_J = 125^\circ\text{C}$) ⁽²⁾			1500	
I_{GES}	Gate-Emitter Leakage Current ($V_{GE} = \pm 20V$)			300	nA
$R_{G(int)}$	Integrated Gate Resistor		5		Ω



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

DYNAMIC CHARACTERISTICS

APT50GT120B2RDL(G)

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		2500		pF
C_{oes}	Output Capacitance			250		
C_{res}	Reverse Transfer Capacitance			155		
V_{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 50A$		7.5		V
Q_g	Total Gate Charge ^③			240		nC
Q_{ge}	Gate-Emitter Charge			20		
Q_{gc}	Gate-Collector ("Miller") Charge			110		
SSOA	Switching Safe Operating Area	$T_J = 150^\circ\text{C}, R_G = 1.0\Omega^{\text{⑦}}, V_{GE} = 15V, L = 100\mu\text{H}, V_{CE} = 1200V$	150			A
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 4.7\Omega^{\text{⑦}}$ $T_J = +25^\circ\text{C}$		23		ns
t_r	Current Rise Time			50		
$t_{d(off)}$	Turn-off Delay Time			215		
t_f	Current Fall Time			26		
E_{on1}	Turn-on Switching Energy ^④			3585		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			4835		
E_{off}	Turn-off Switching Energy ^⑥			1910		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 4.7\Omega^{\text{⑦}}$ $T_J = +125^\circ\text{C}$		23		ns
t_r	Current Rise Time			50		
$t_{d(off)}$	Turn-off Delay Time			255		
t_f	Current Fall Time			50		
E_{on1}	Turn-on Switching Energy ^④			3580		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			6970		
E_{off}	Turn-off Switching Energy ^⑥			2750		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.18	$^\circ\text{C/W}$
$R_{\theta JC}$	Junction to Case (DIODE)			.61	
W_T	Package Weight		5.9		gm

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 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.)

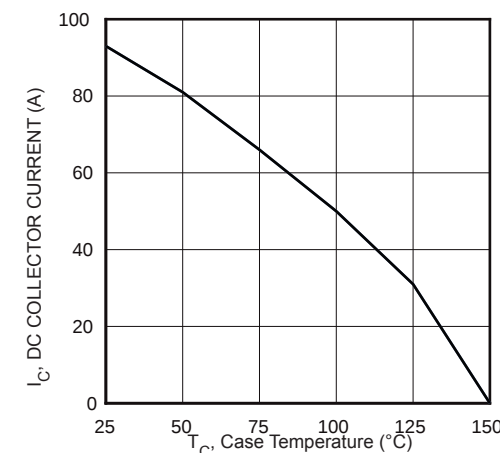
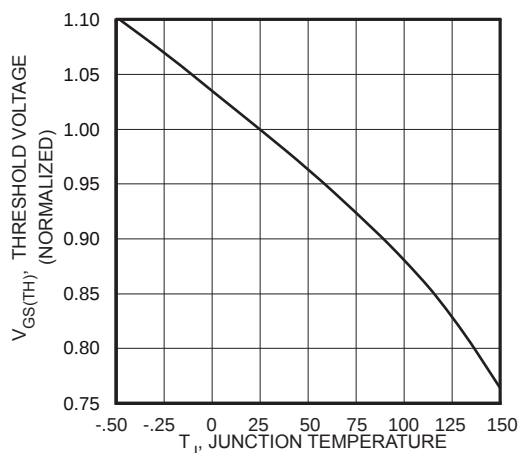
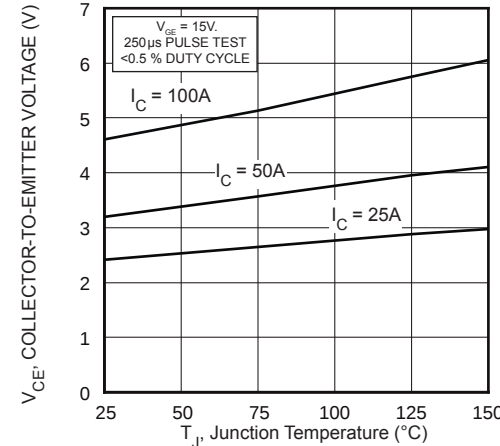
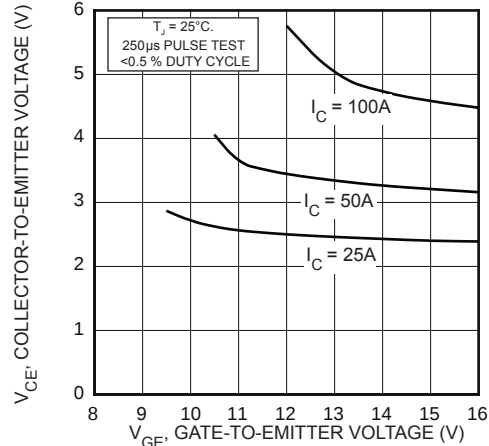
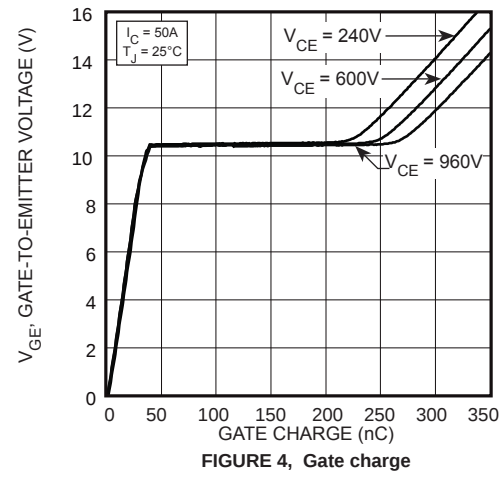
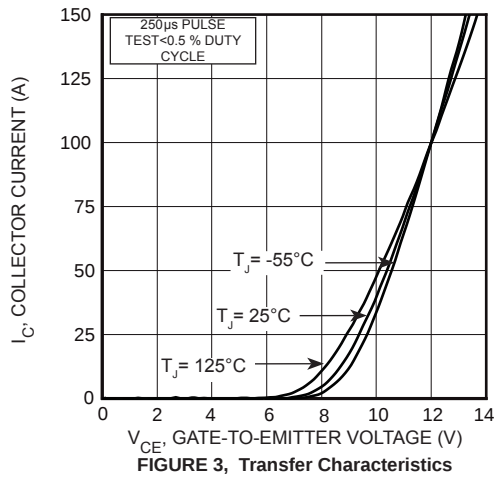
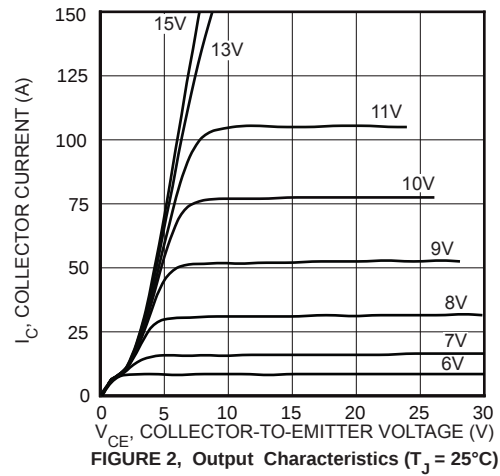
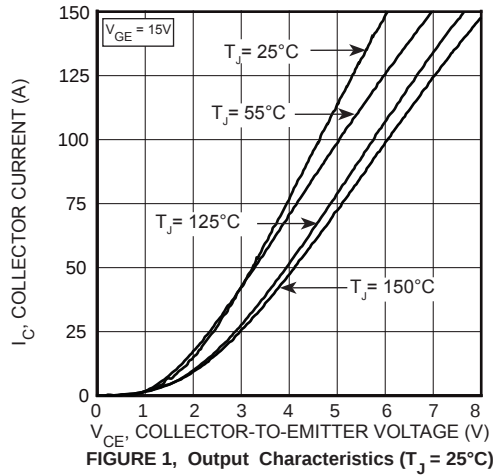
⑦ R_G is external gate resistance, not including $R_{G(int)}$ nor gate driver impedance.

⑧ Continuous current limited by package lead temperature.

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

TYPICAL PERFORMANCE CURVES

APT50GT120B2RDL(G)



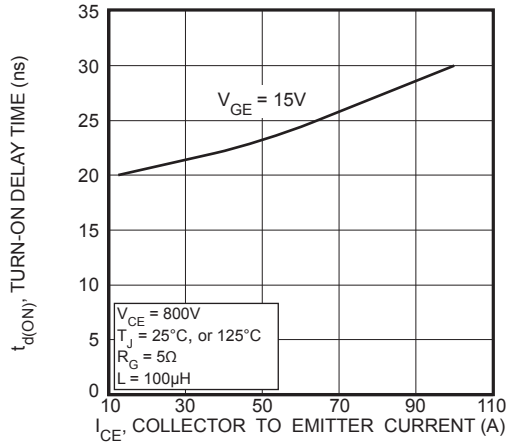


FIGURE 9, Turn-On Delay Time vs Collector Current

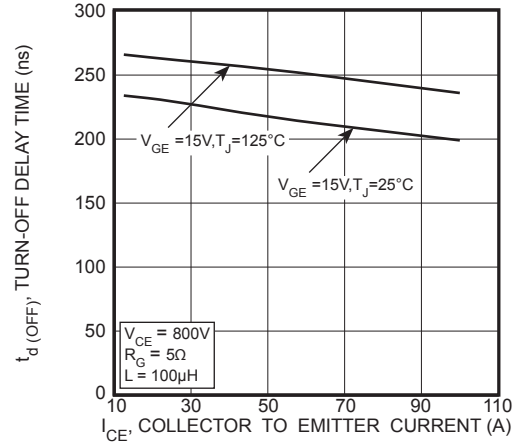


FIGURE 10, Turn-Off Delay Time vs Collector Current

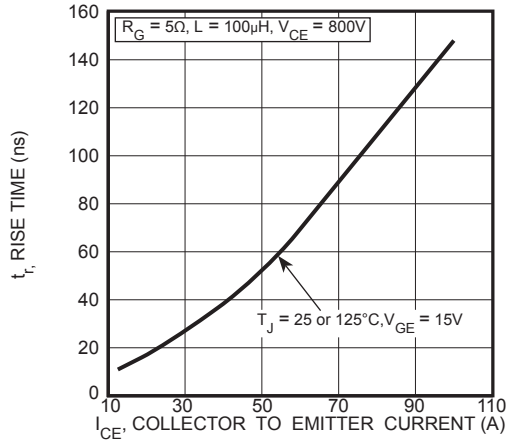


FIGURE 11, Current Rise Time vs Collector Current

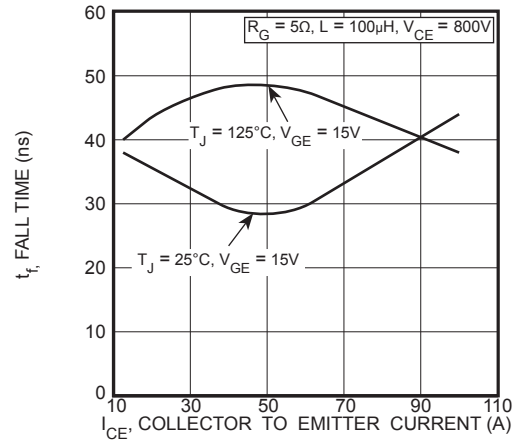


FIGURE 12, Current Fall Time vs Collector Current

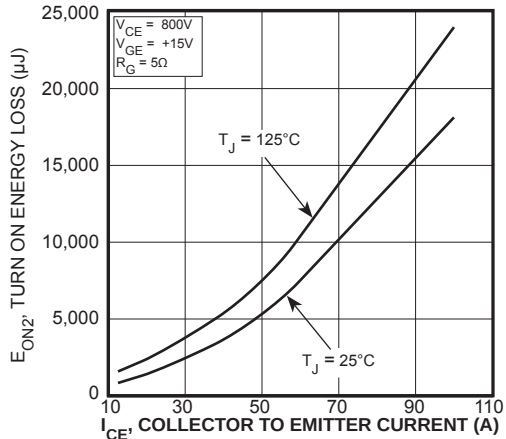


FIGURE 13, Turn-On Energy Loss vs Collector Current

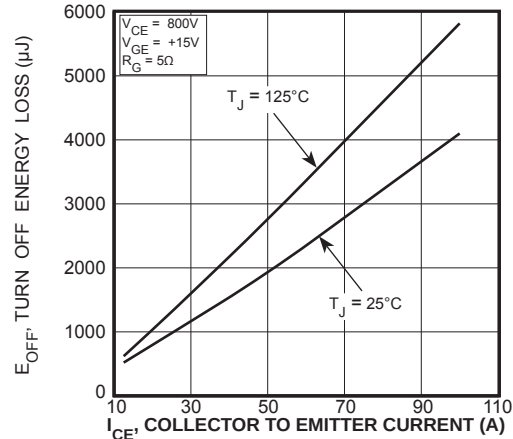


FIGURE 14, Turn Off Energy Loss vs Collector Current

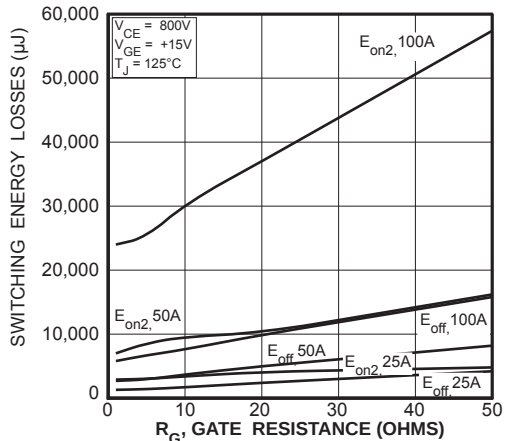


FIGURE 15, Switching Energy Losses vs. Gate Resistance

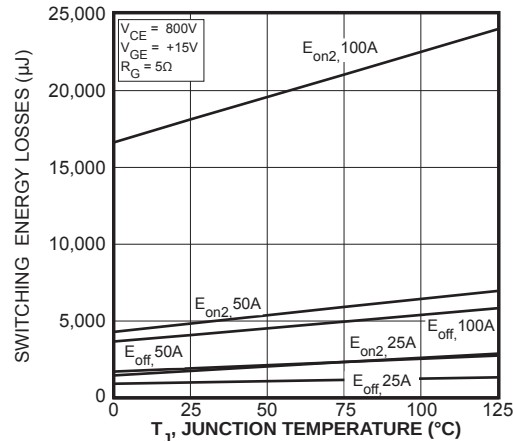


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

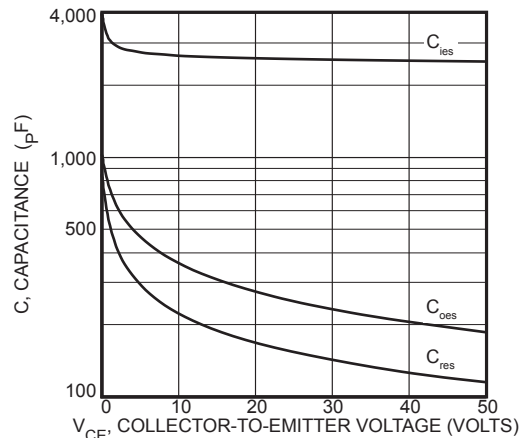


Figure 17, Capacitance vs Collector-To-Emitter Voltage

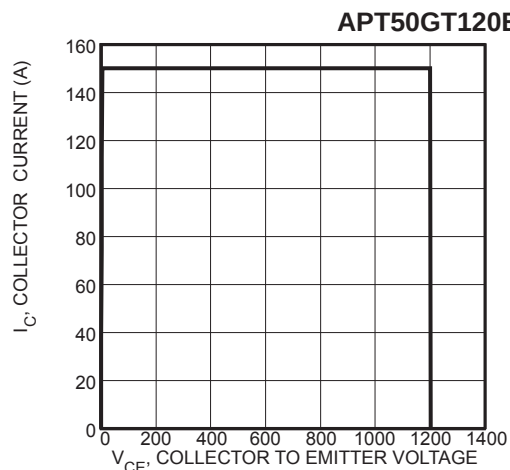


Figure 18, Minimum Switching Safe Operating Area

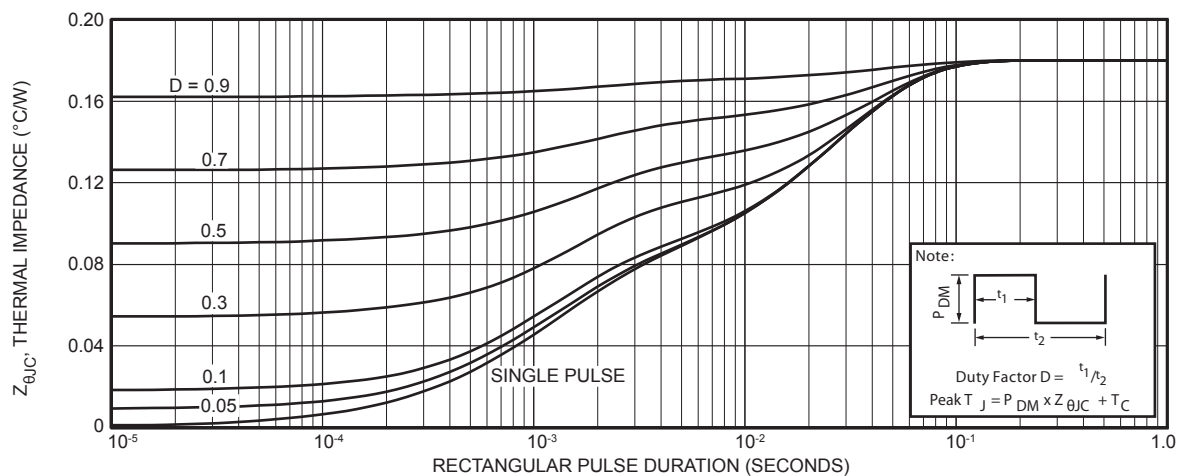


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

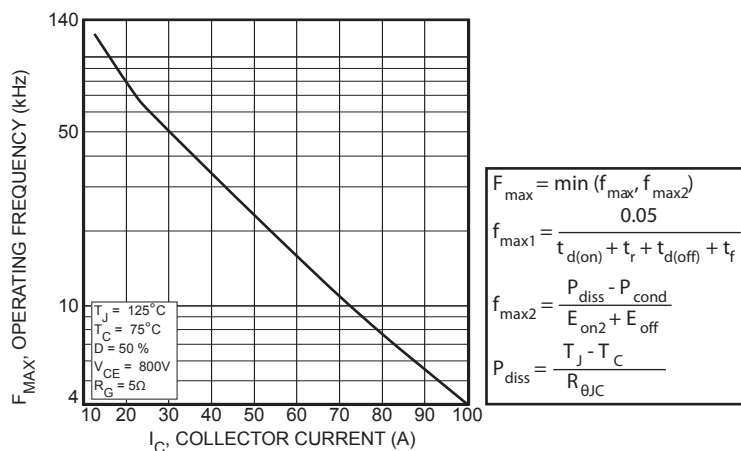


Figure 20, Operating Frequency vs Collector Current

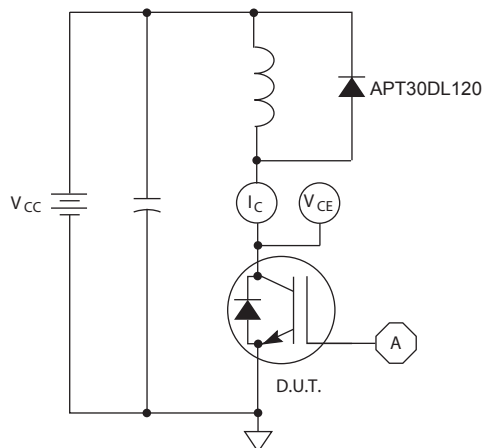


Figure 21, Inductive Switching Test Circuit

APT50GT120B2RDL(G)

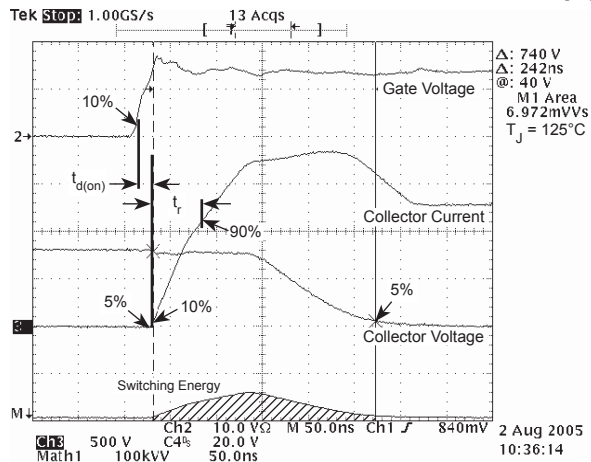


Figure 22, Turn-on Switching Waveforms and Definitions

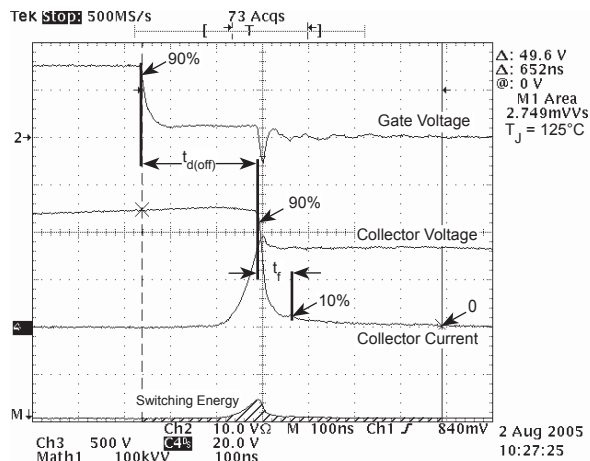


Figure 23, Turn-off Switching Waveforms and Definitions

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

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

Symbol	Characteristic / Test Conditions	APT50GT120B2RDL(G)			UNIT
$I_F(\text{AV})$	Maximum Average Forward Current ($T_C = 145^\circ\text{C}$, Duty Cycle = 0.5)		30		Amps
$I_F(\text{RMS})$	RMS Forward Current (Square wave, 50% duty)		81		
I_{FSM}	Non-Repetitive Forward Surge Current ($T_J = 45^\circ\text{C}$, 8.3ms)		60		

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Forward Voltage	$I_F = 30\text{A}$		1.6	2.1	Volts
		$I_F = 60\text{A}$		2.0		
		$I_F = 30\text{A}$, $T_J = 125^\circ\text{C}$		1.6		

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
t_{rr}	Reverse Recovery Time	$I_F = 1\text{A}$, $di_F/dt = -100\text{A}/\mu\text{s}$, $V_R = 30\text{V}$, $T_J = 25^\circ\text{C}$	-	61		ns
t_{rr}	Reverse Recovery Time	$I_F = 30\text{A}$, $di_F/dt = -200\text{A}/\mu\text{s}$ $V_R = 800\text{V}$, $T_C = 25^\circ\text{C}$	-	592		
Q_{rr}	Reverse Recovery Charge		-	2694		nC
I_{RRM}	Maximum Reverse Recovery Current		-	9	-	Amps
t_{rr}	Reverse Recovery Time	$I_F = 30\text{A}$, $di_F/dt = -200\text{A}/\mu\text{s}$ $V_R = 800\text{V}$, $T_C = 125^\circ\text{C}$	-	389		ns
Q_{rr}	Reverse Recovery Charge		-	3459		nC
I_{RRM}	Maximum Reverse Recovery Current		-	15	-	Amps
t_{rr}	Reverse Recovery Time	$I_F = 30\text{A}$, $di_F/dt = -1000\text{A}/\mu\text{s}$ $V_R = 800\text{V}$, $T_C = 125^\circ\text{C}$	-	165		ns
Q_{rr}	Reverse Recovery Charge		-	4646		nC
I_{RRM}	Maximum Reverse Recovery Current		-	44		Amps

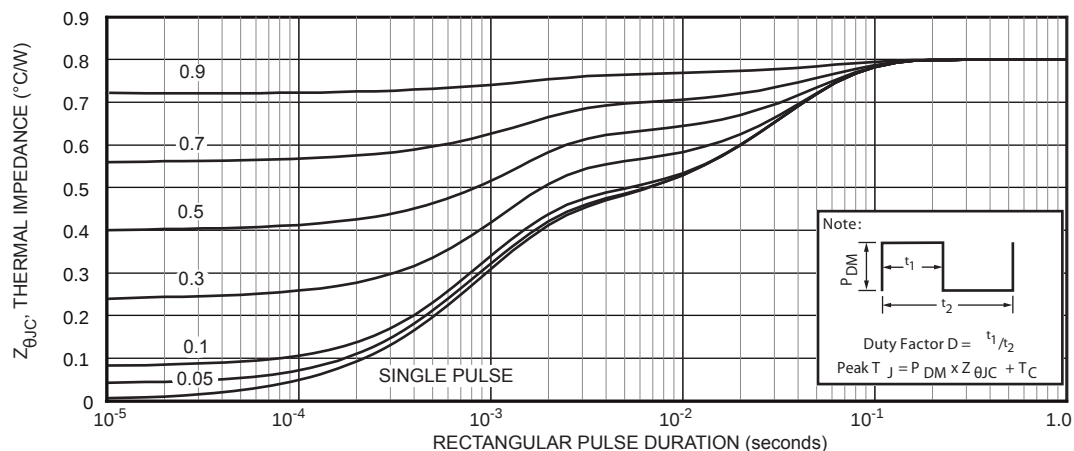


FIGURE 24a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

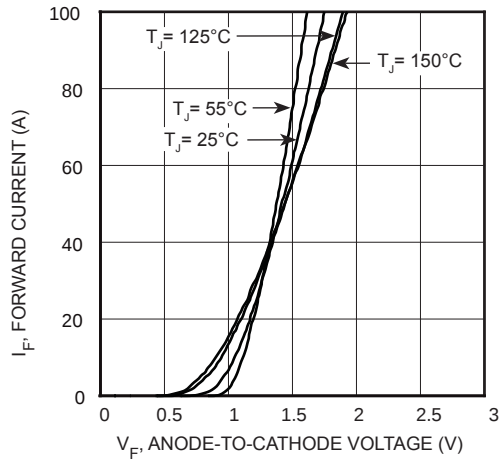


FIGURE 2, Forward Current vs. Forward Voltage

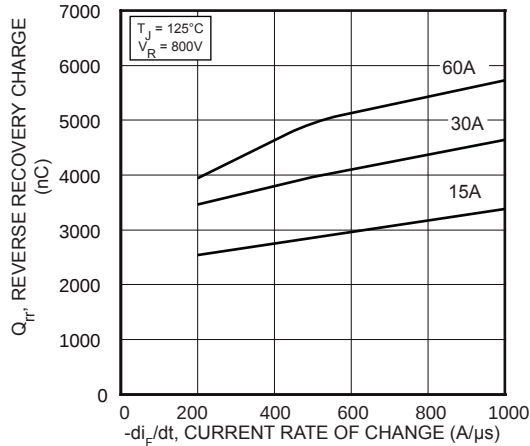


FIGURE 4, Reverse Recovery Charge vs. Current Rate of Change

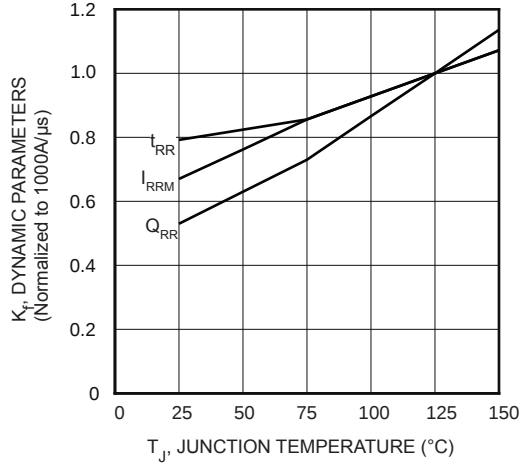


FIGURE 6, Dynamic Parameters vs. Junction Temperature

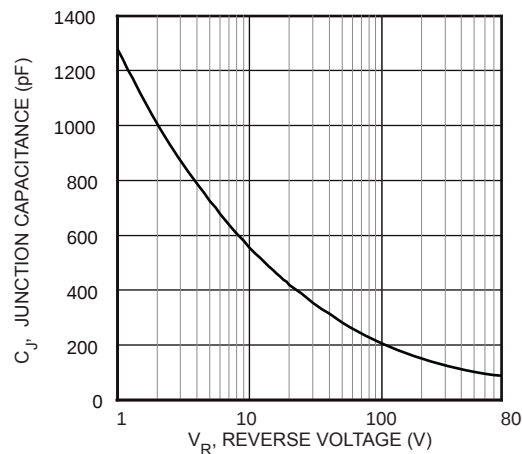


FIGURE 8, Junction Capacitance vs. Reverse Voltage

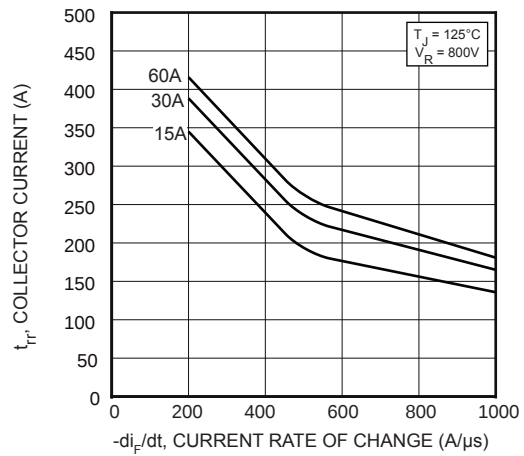


FIGURE 3, Reverse Recovery Time vs. Current Rate of Change

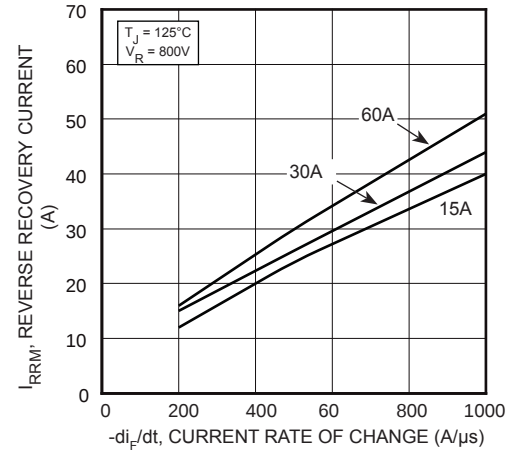


FIGURE 5, Reverse Recovery Current vs. Current Rate of Change

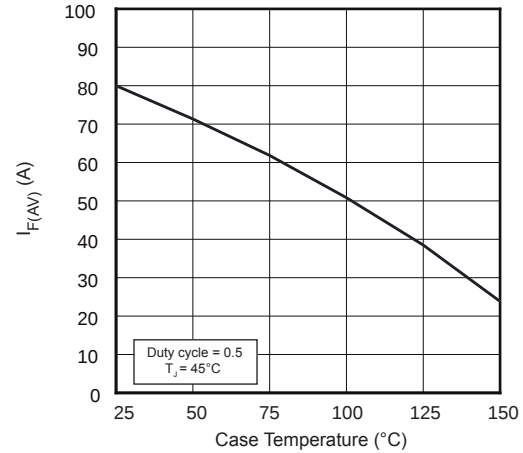


FIGURE 7, Maximum Average Forward Current vs. Case Temperature

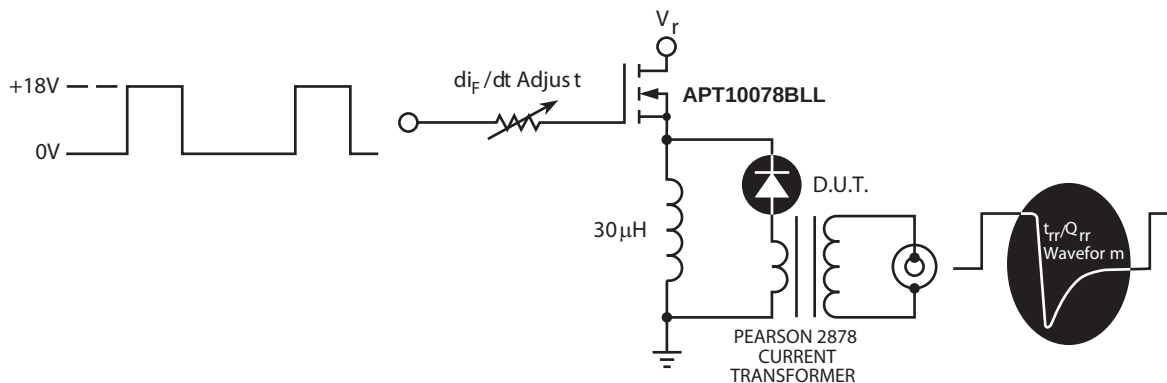


Figure 32. Diode Test Circuit

- 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} .

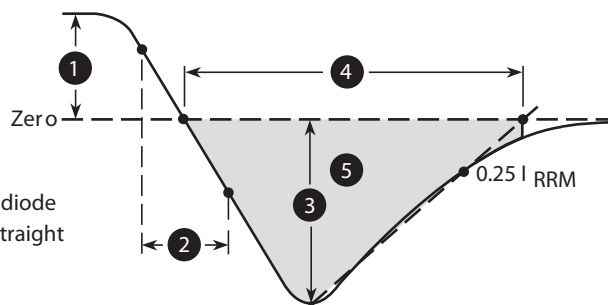
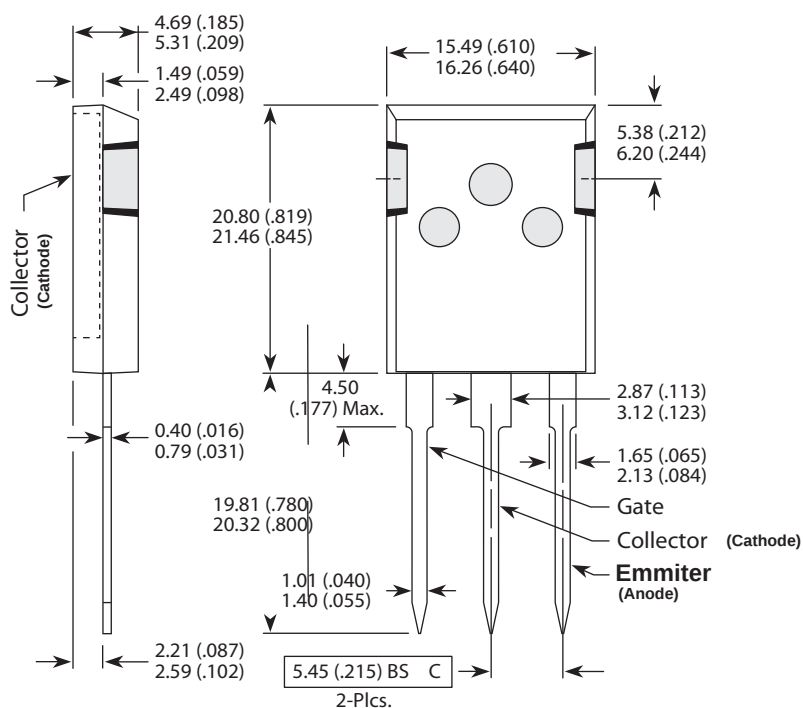


Figure 33. Diode Reverse Recovery Waveform and Definitions

T-MAX® (B2) Package Outline

e1 SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)