

DYNAMIC CHARACTERISTICS

APT33GF120B2_LRDQ2(G)

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		1855		pF
C_{oes}	Output Capacitance			230		
C_{res}	Reverse Transfer Capacitance			110		
V_{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 25A$		10		V
Q_g	Total Gate Charge ^③			170		nC
Q_{ge}	Gate-Emitter Charge			19		
Q_{gc}	Gate-Collector ("Miller") Charge			100		
SSOA	Switching Safe Operating Area	$T_J = 150^\circ C, R_G = 4.3\Omega, V_{GE} = 15V, L = 100\mu H, V_{CE} = 1200V$	75			A
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 25A$ $R_G = 4.3\Omega$ $T_J = +25^\circ C$		14		ns
t_r	Current Rise Time			17		
$t_{d(off)}$	Turn-off Delay Time			185		
t_f	Current Fall Time			110		
E_{on1}	Turn-on Switching Energy ^④			1315		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			1930		
E_{off}	Turn-off Switching Energy ^⑥			1515		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 25A$ $R_G = 4.3\Omega$ $T_J = +125^\circ C$		14		ns
t_r	Current Rise Time			17		
$t_{d(off)}$	Turn-off Delay Time			220		
t_f	Current Fall Time			135		
E_{on1}	Turn-on Switching Energy ^④			1325		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			3325		
E_{off}	Turn-off Switching Energy ^⑥			2145		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.35	°C/W
$R_{\theta JC}$	Junction to Case (DIODE)			0.61	
W_T	Package Weight		6.10		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. (See Figure 24.)

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.)

APT Reserves the right to change, without notice, the specifications and information contained herein.

TYPICAL PERFORMANCE CURVES

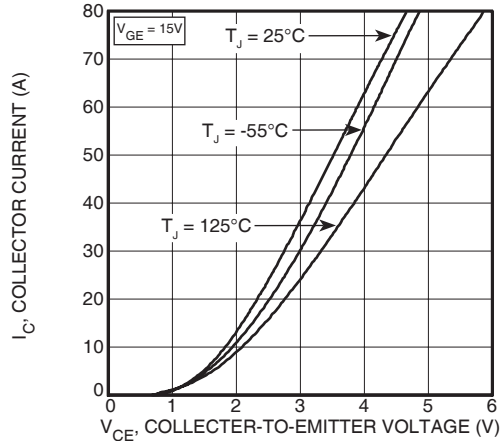


FIGURE 1, Output Characteristics($T_J = 25^\circ\text{C}$)

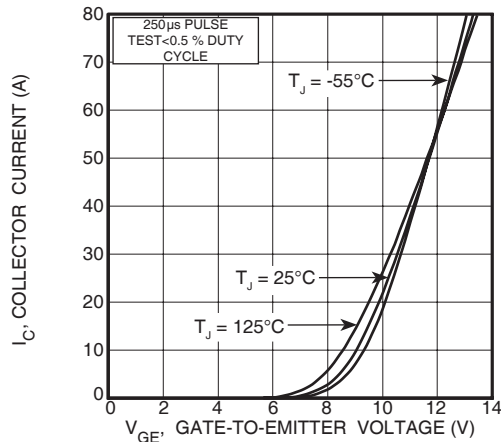


FIGURE 3, Transfer Characteristics

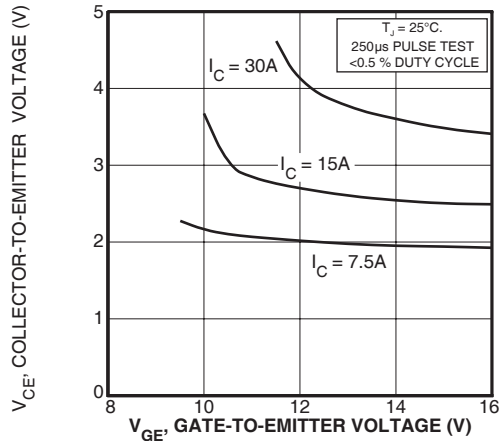


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

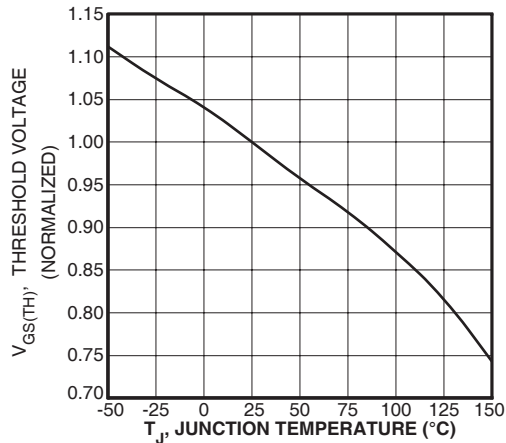


FIGURE 7, Threshold Voltage vs. Junction Temperature

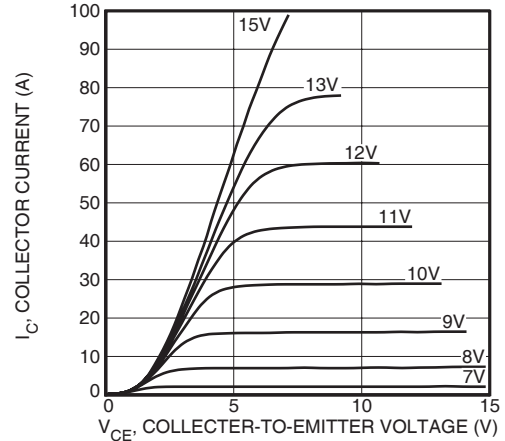


FIGURE 2, Output Characteristics ($T_J = 125^\circ\text{C}$)

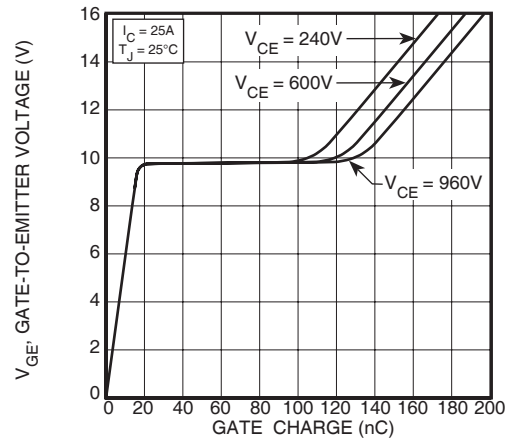


FIGURE 4, Gate Charge

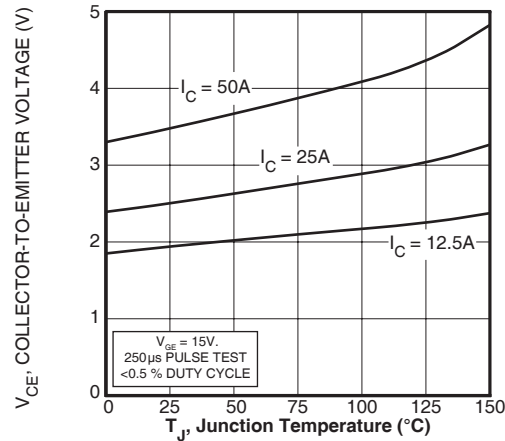


FIGURE 6, On State Voltage vs Junction Temperature

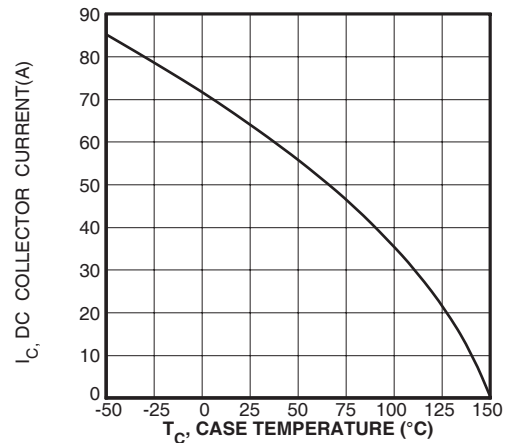


FIGURE 8, DC Collector Current vs Case Temperature

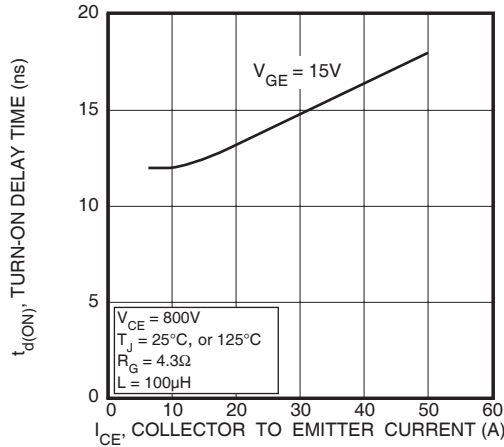


FIGURE 9, Turn-On Delay Time vs Collector Current

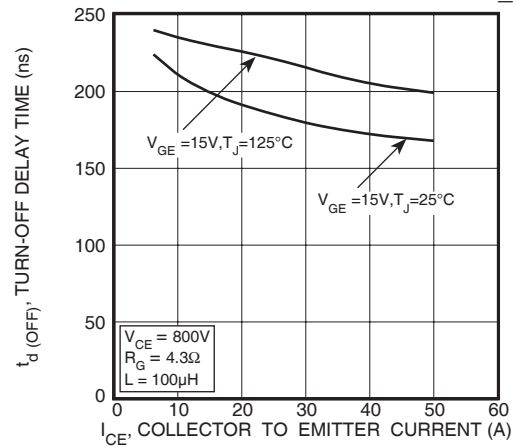


FIGURE 10, Turn-Off Delay Time vs Collector Current

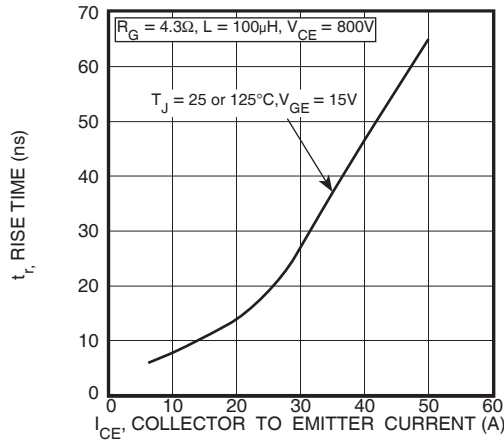


FIGURE 11, Current Rise Time vs Collector Current

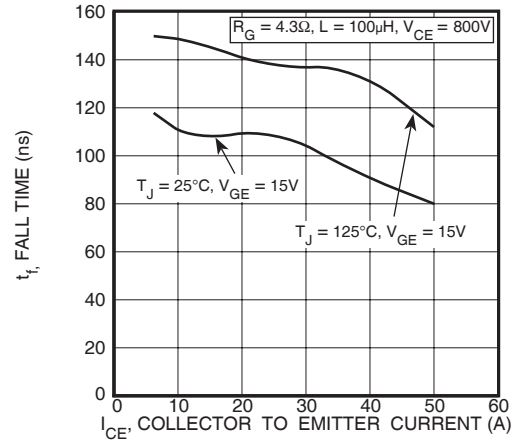


FIGURE 12, Current Fall Time vs Collector Current

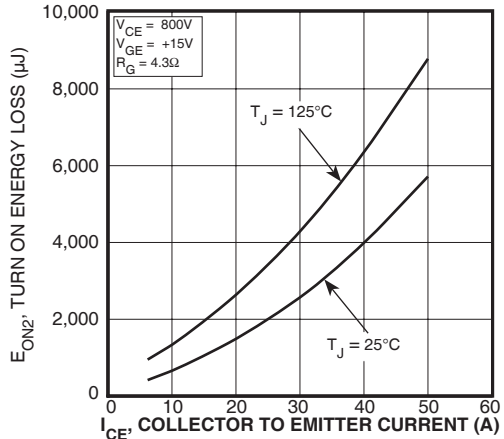


FIGURE 13, Turn-On Energy Loss vs Collector Current

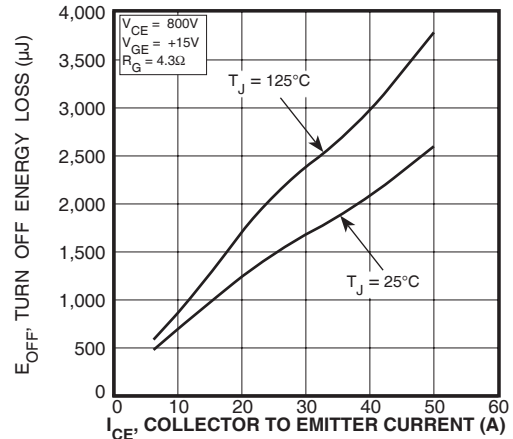


FIGURE 14, Turn Off Energy Loss vs Collector Current

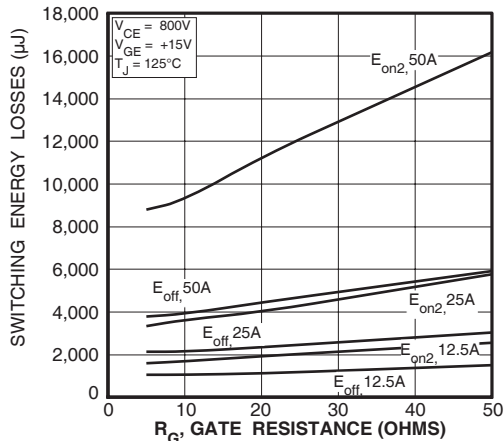


FIGURE 15, Switching Energy Losses vs. Gate Resistance

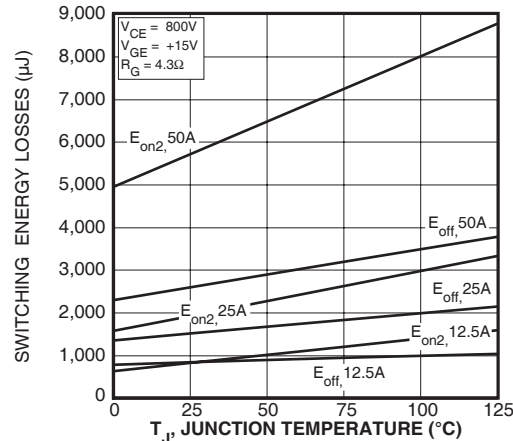


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

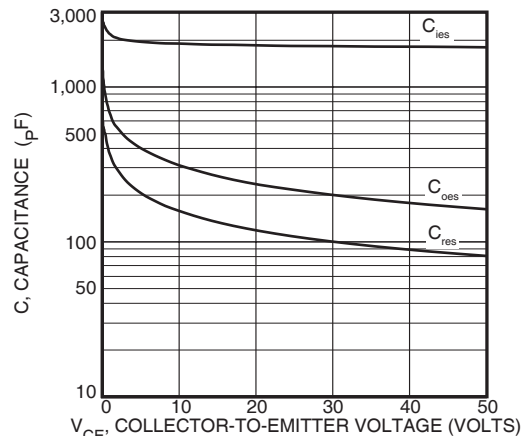


Figure 17, Capacitance vs Collector-To-Emitter Voltage

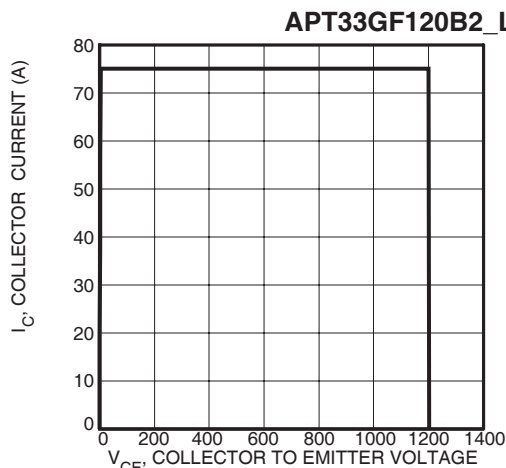


Figure 18, Minimum Switching Safe Operating Area

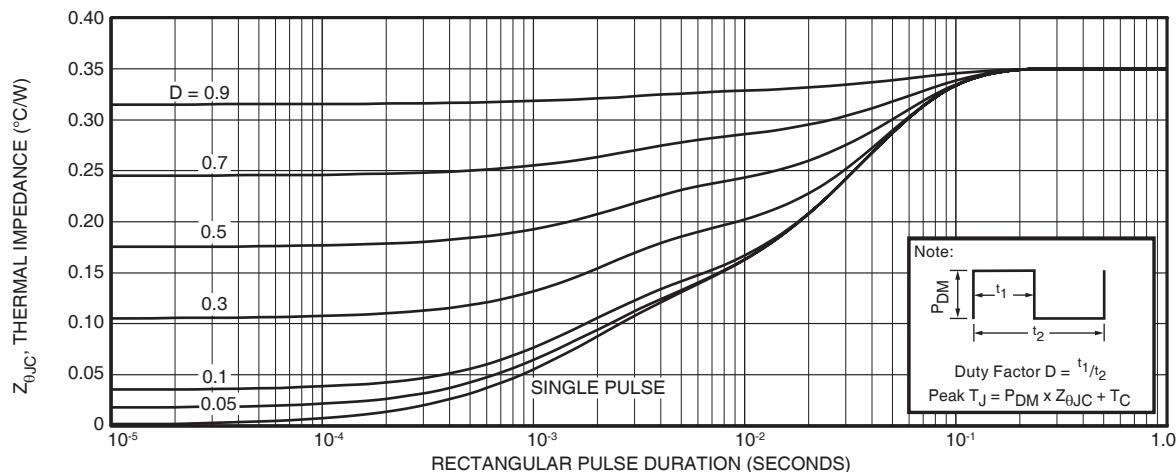


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

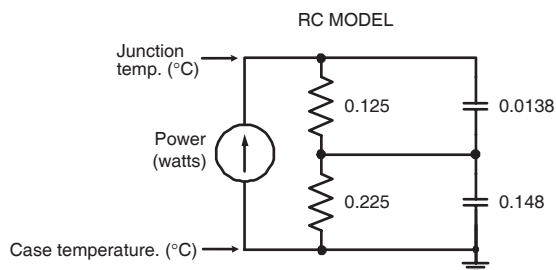


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

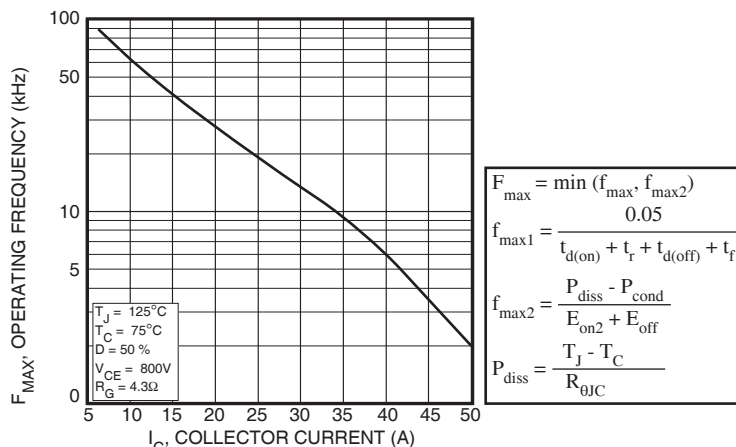


Figure 20, Operating Frequency vs Collector Current

$$F_{\max} = \min(f_{\max1}, f_{\max2})$$

$$f_{\max1} = \frac{0.05}{t_{d(\text{on})} + t_r + t_{d(\text{off})} + t_f}$$

$$f_{\max2} = \frac{P_{\text{diss}} - P_{\text{cond}}}{E_{\text{on2}} + E_{\text{off}}}$$

$$P_{\text{diss}} = \frac{T_J - T_C}{R_{\theta JC}}$$

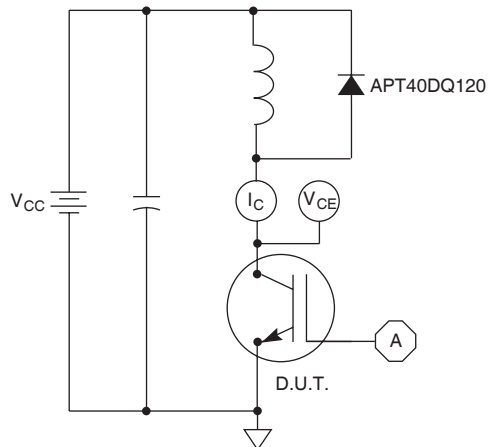


Figure 21, Inductive Switching Test Circuit

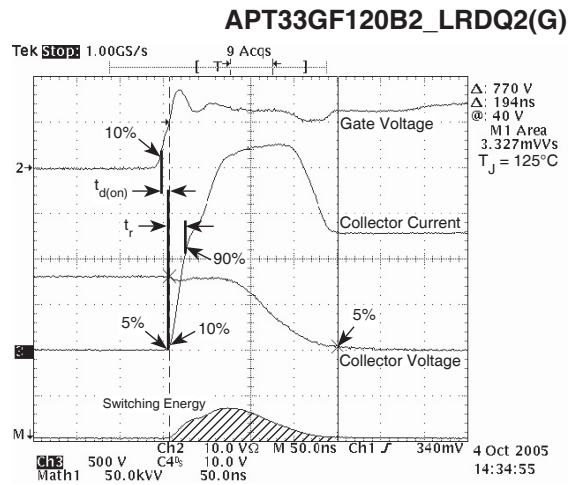


Figure 22, Turn-on Switching Waveforms and Definitions

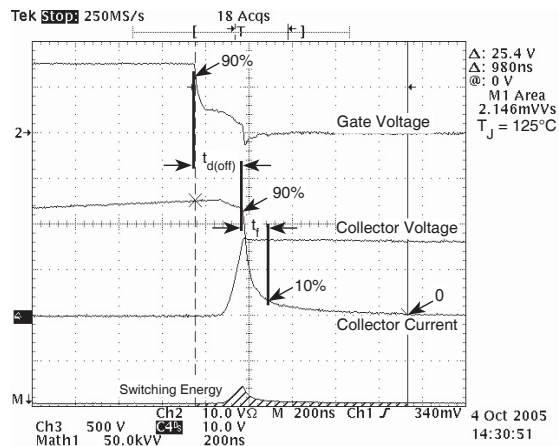


Figure 23, Turn-off Switching Waveforms and Definitions

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

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

Symbol	Characteristic / Test Conditions	APT33GF120B2_LRDQ2(G)			UNIT
$I_{F(AV)}$	Maximum Average Forward Current ($T_C = 112^\circ\text{C}$, Duty Cycle = 0.5)		40		Amps
$I_{F(RMS)}$	RMS Forward Current (Square wave, 50% duty)		63		
I_{FSM}	Non-Repetitive Forward Surge Current ($T_J = 45^\circ\text{C}$, 8.3ms)		210		

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Forward Voltage	$I_F = 25\text{A}$		2.46		Volts
		$I_F = 50\text{A}$		2.95		
		$I_F = 25\text{A}$, $T_J = 125^\circ\text{C}$		1.83		

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	$I_F = 40\text{A}$, $di_F/dt = -200\text{A}/\mu\text{s}$ $V_R = 800\text{V}$, $T_C = 25^\circ\text{C}$	-	350		
Q_{rr}	Reverse Recovery Charge		-	570		nC
I_{RRM}	Maximum Reverse Recovery Current		-	4	-	Amps
t_{rr}	Reverse Recovery Time	$I_F = 40\text{A}$, $di_F/dt = -200\text{A}/\mu\text{s}$ $V_R = 800\text{V}$, $T_C = 125^\circ\text{C}$	-	430		ns
Q_{rr}	Reverse Recovery Charge		-	2200		nC
I_{RRM}	Maximum Reverse Recovery Current		-	9	-	Amps
t_{rr}	Reverse Recovery Time	$I_F = 40\text{A}$, $di_F/dt = -1000\text{A}/\mu\text{s}$ $V_R = 800\text{V}$, $T_C = 125^\circ\text{C}$	-	210		ns
Q_{rr}	Reverse Recovery Charge		-	3400		nC
I_{RRM}	Maximum Reverse Recovery Current		-	29		Amps

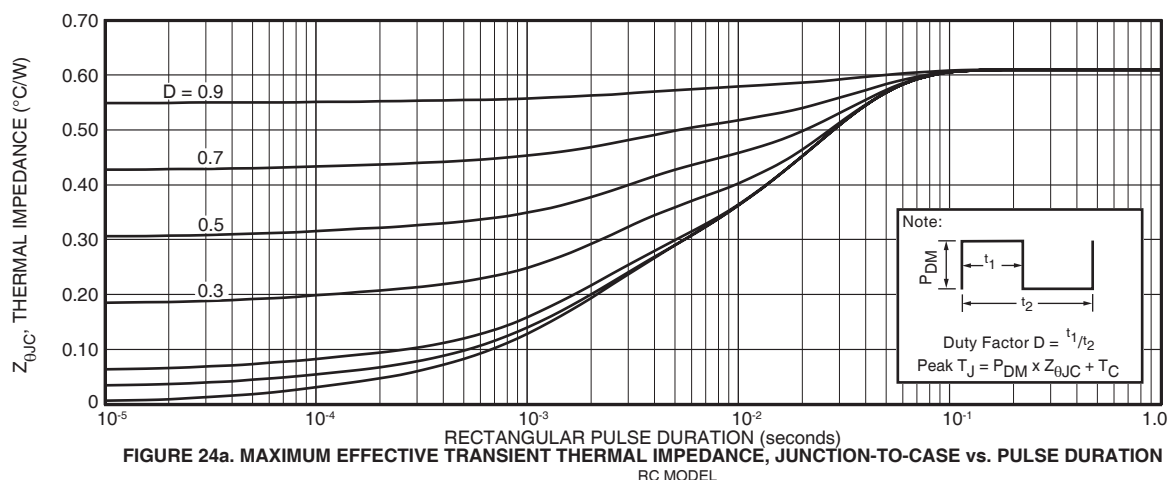


FIGURE 24a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION
RC MODEL

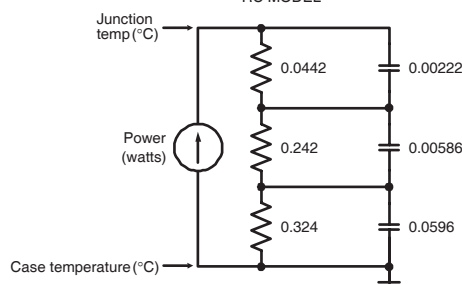


FIGURE 24b. TRANSIENT THERMAL IMPEDANCE MODEL

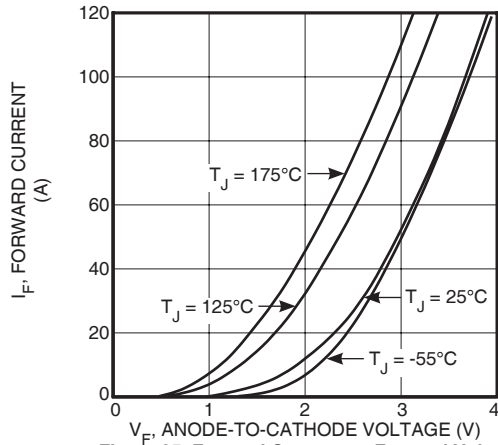


Figure 25. Forward Current vs. Forward Voltage

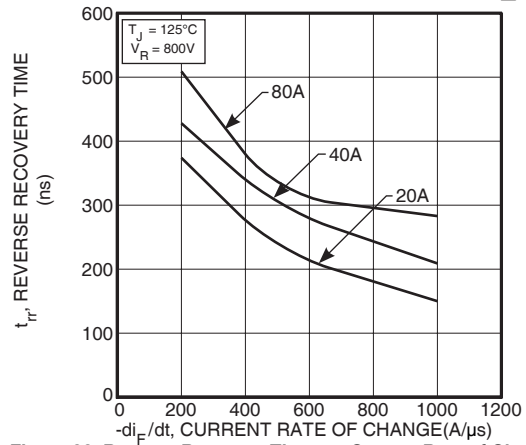


Figure 26. Reverse Recovery Time vs. Current Rate of Change

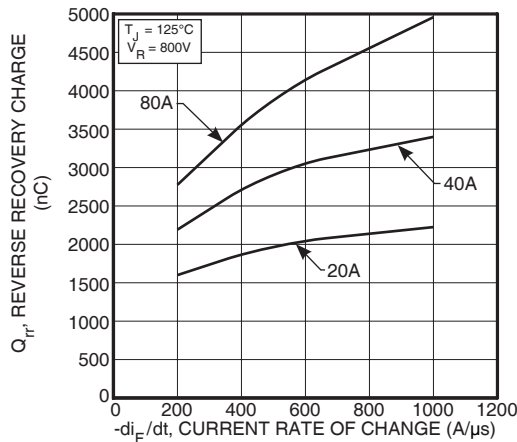


Figure 27. Reverse Recovery Charge vs. Current Rate of Change

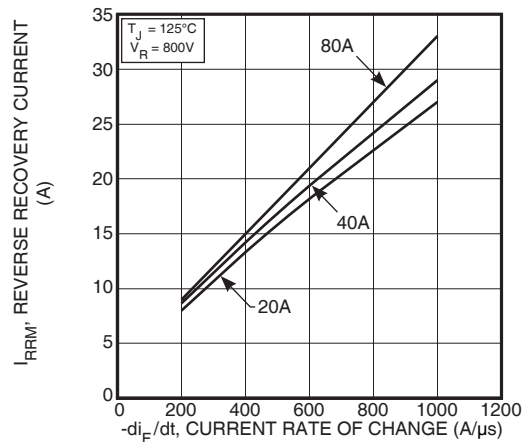


Figure 28. Reverse Recovery Current vs. Current Rate of Change

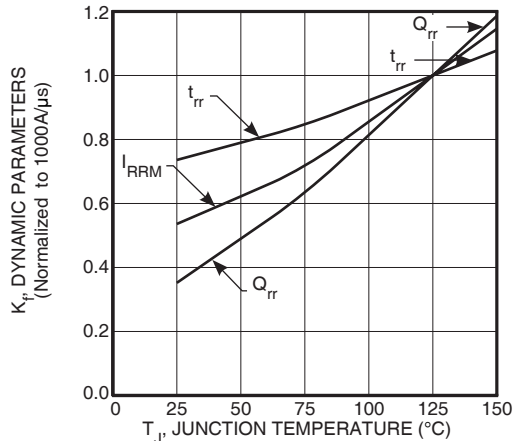


Figure 29. Dynamic Parameters vs. Junction Temperature

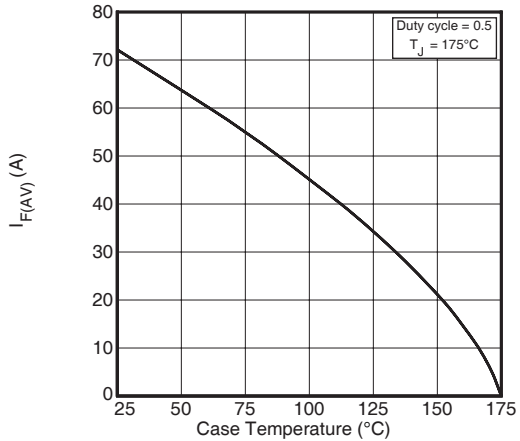


Figure 30. Maximum Average Forward Current vs. Case Temperature

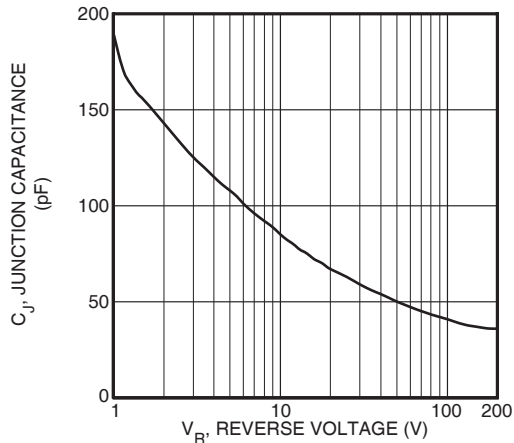


Figure 31. Junction Capacitance vs. Reverse Voltage

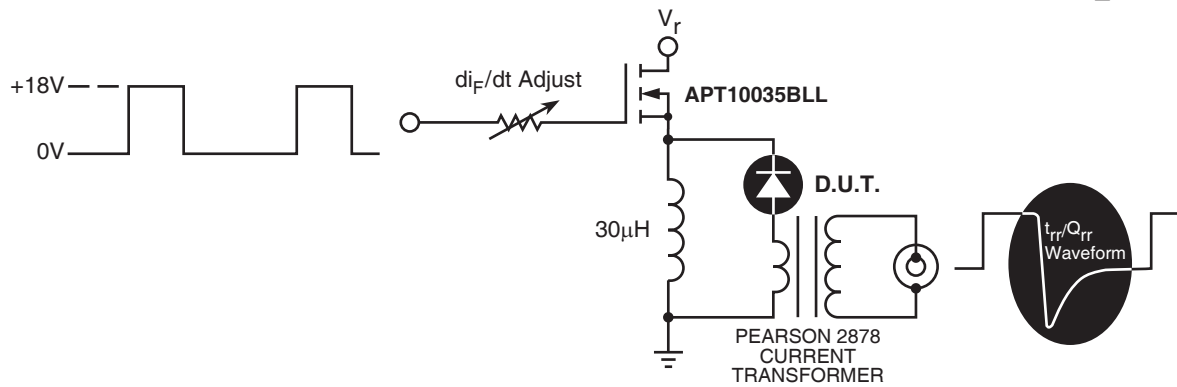


Figure 32. Diode Test Circuit

- 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 diode current goes from positive to negative, to the point at which the straight line through I_{RRM} and $0.25 \cdot I_{RRM}$ passes through zero.
- 5 Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{rr} .

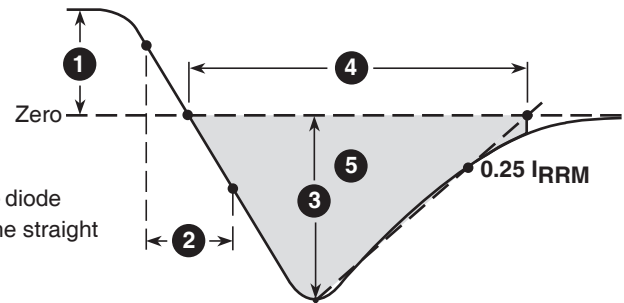
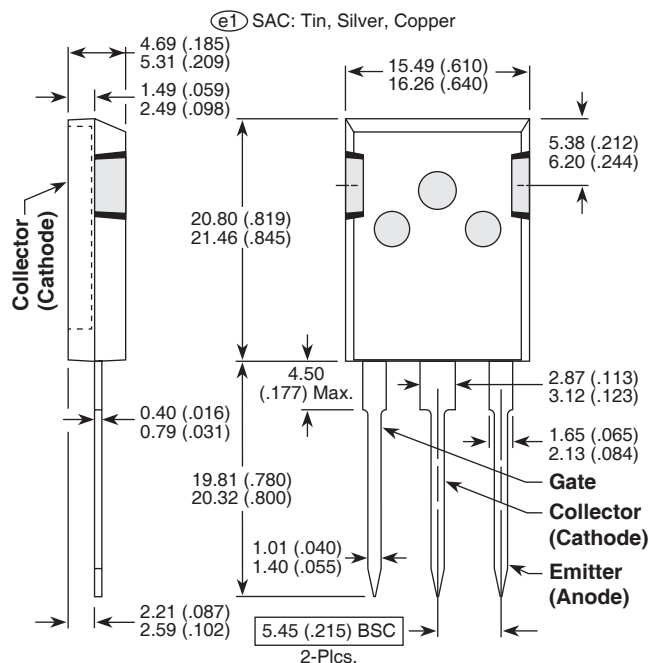


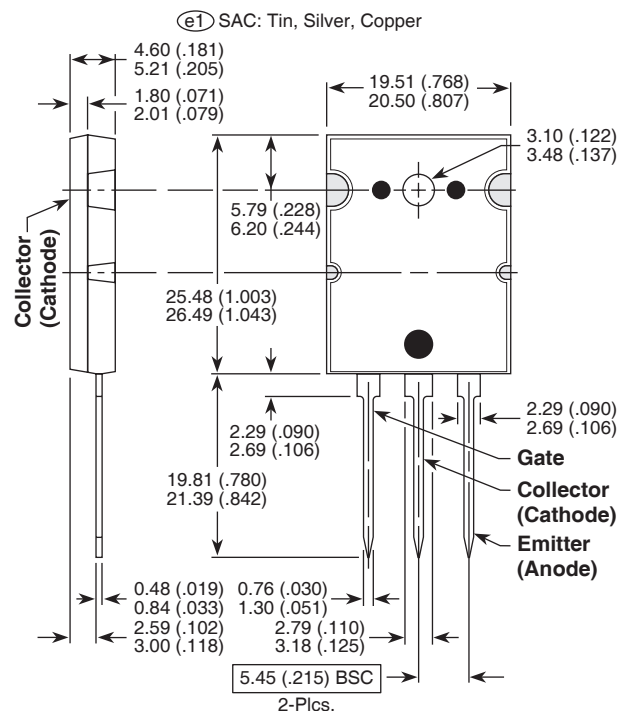
Figure 33. Diode Reverse Recovery Waveform and Definitions

T-MAX® (B2) Package Outline



Dimensions in Millimeters and (Inches)

TO-264 (L) Package Outline



Dimensions in Millimeters and (Inches)