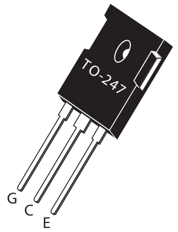
1200V

APT25GT120BRDL(G)

***G Denotes RoHS Compliant, Pb Free Terminal Finish.**

Resonant Mode IGBT®



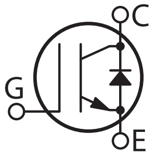
The Thunderbolt IGBT® used in this Resonant Mode Combi is a new generation of high voltage power IGBTs. Using Non- Punch Through Technology, the Thunderblot IGBT® offers superior ruggedness and ultrafast switching speed.

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°C unless otherwise specified.

Symbol	Parameter	APT25GT120BRDL(G)	UNIT
V_{CES}	Collector-Emitter Voltage	1200	Volts
V_{GE}	Gate-Emitter Voltage	±30	
I_{C1}	Continuous Collector Current @ T_C = 25°C	54	Amps
I_{C2}	Continuous Collector Current @ T_C = 110°C	25	
I_{CM}	Pulsed Collector Current ①	75	
SSOA	Switching Safe Operating Area @ T_J = 150°C	75A @ 1200V	
P_D	Total Power Dissipation	347	Watts
T_J,T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°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 = 1.5mA)	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 1mA, T_j = 25°C)	4.5	5.5	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 25A, T_j = 25°C)	2.7	3.2	3.7	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 25A, T_j = 125°C)		3.9		
I_{CES}	Collector Cut-off Current (V_{CE} = 1200V, V_{GE} = 0V, T_j = 25°C) ②			200	μA
	Collector Cut-off Current (V_{CE} = 1200V, V_{GE} = 0V, T_j = 125°C) ②			1250	
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			120	nA

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

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance** V_{GE} = 0V, V_{CE} = 25V f = 1 MHz		1845		pF
C_{oes}	Output Capacitance			170		
C_{res}	Reverse Transfer Capacitance			110		
V_{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge V_{GE} = 15V V_{CE} = 600V I_C = 25A		10.0		V
Q_g	Total Gate Charge ③			170		nC
Q_{ge}	Gate-Emitter Charge			20		
Q_{gc}	Gate-Collector ("Miller") Charge			100		
SSOA	Switching Safe Operating Area	T_J = 150°C, R_G = 5Ω, V_{GE} = 15V, L = 100µH, V_{CE} = 1200V	75			A
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (25℃)** V_{CC} = 800V V_{GE} = 15V I_C = 25A R_G = 5Ω T_J = +25°C		14		ns
t_r	Current Rise Time			27		
$t_{d(off)}$	Turn-off Delay Time			150		
t_f	Current Fall Time			36		
E_{on1}	Turn-on Switching Energy ④			930		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤			1860		
E_{off}	Turn-off Switching Energy ⑥			720		
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125℃)** V_{CC} = 800V V_{GE} = 15V I_C = 25A R_G = 5Ω T_J = +125°C		14		ns
t_r	Current Rise Time			27		
$t_{d(off)}$	Turn-off Delay Time			175		
t_f	Current Fall Time			45		
E_{on1}	Turn-on Switching Energy ④			925		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤			3265		
E_{off}	Turn-off Switching Energy ⑥			965		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case **(IGBT)**			.36	°C/W
$R_{\theta JC}$	Junction to Case **(DIODE)**			1.4	
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.)

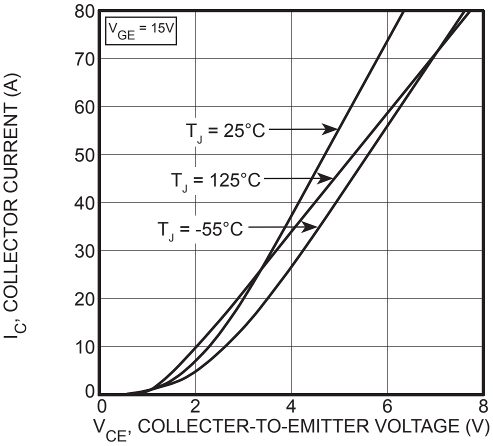


FIGURE 1, Output Characteristics(T_J = 25℃)

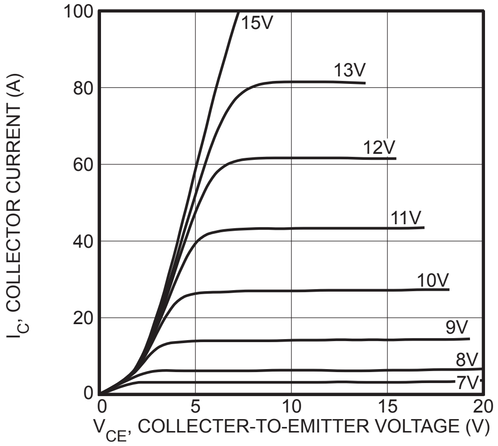


FIGURE 2, Output Characteristics (T_J = 125℃)

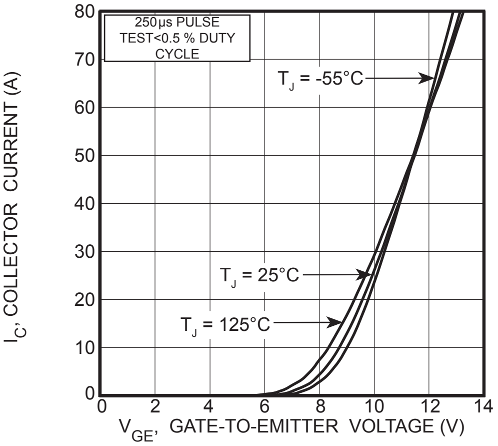


FIGURE 3, Transfer Characteristics

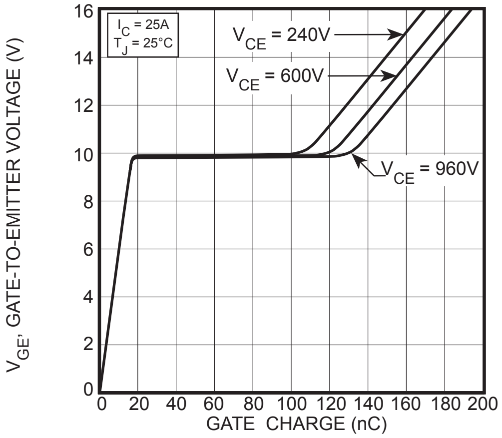


FIGURE 4, Gate Charge

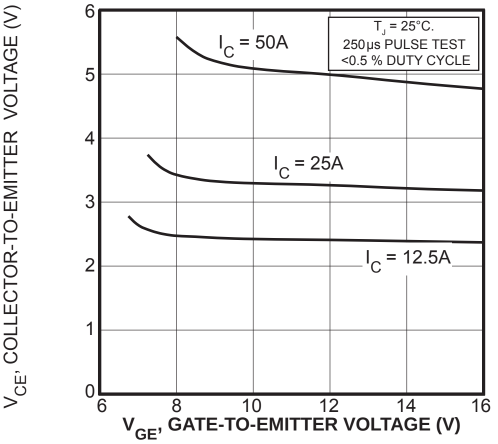


FIGURE 5, On State Voltage vs Gate-to- Emitter Voltage

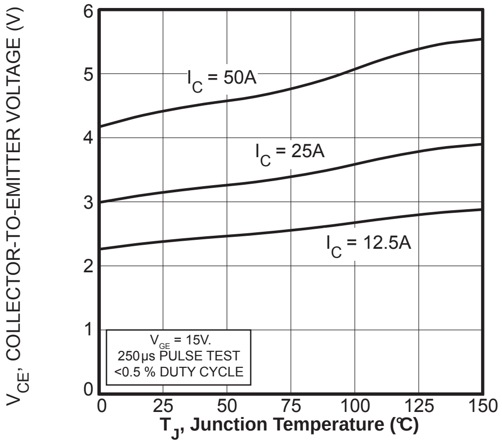


FIGURE 6, On State Voltage vs Junction Temperature

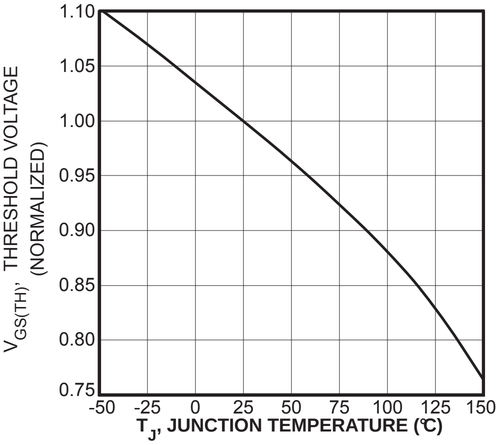


FIGURE 7, Threshold Voltage vs. Junction Temperature

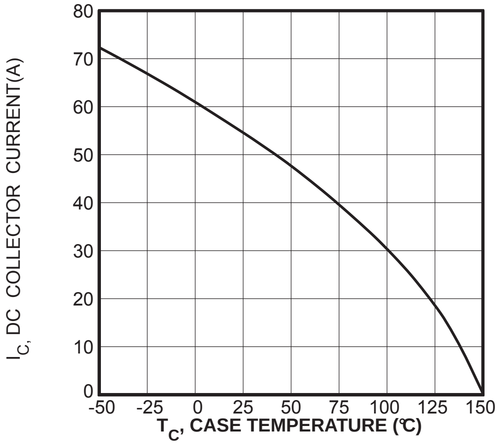


FIGURE 8, DC Collector Current vs Case Temperature

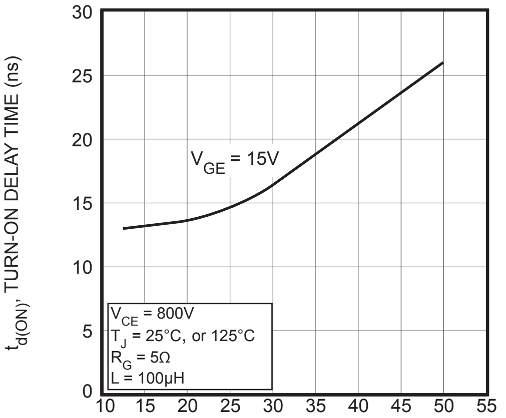


FIGURE 9, Turn-On Delay Time vs Collector Current

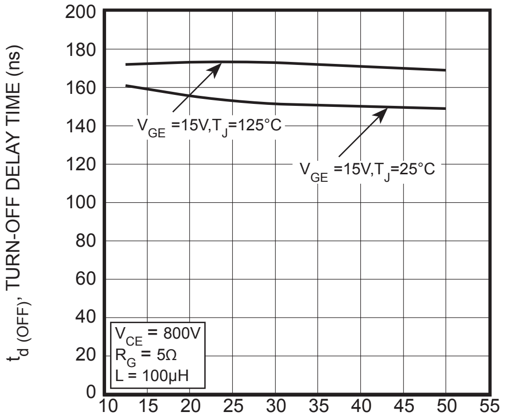


FIGURE 10, Turn-Off Delay Time vs Collector Current

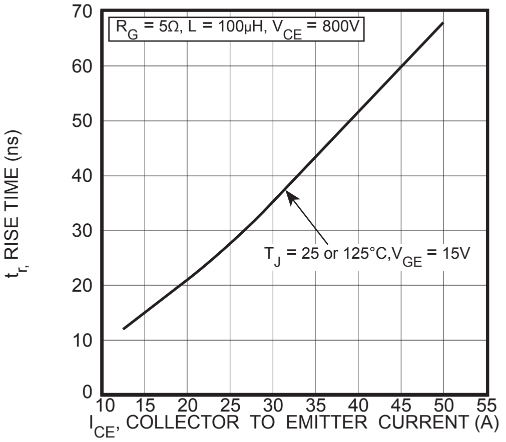


FIGURE 11, Current Rise Time vs Collector Current

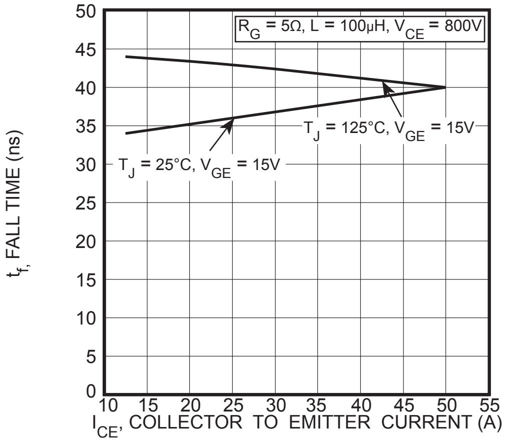


FIGURE 12, Current Fall Time vs Collector Current

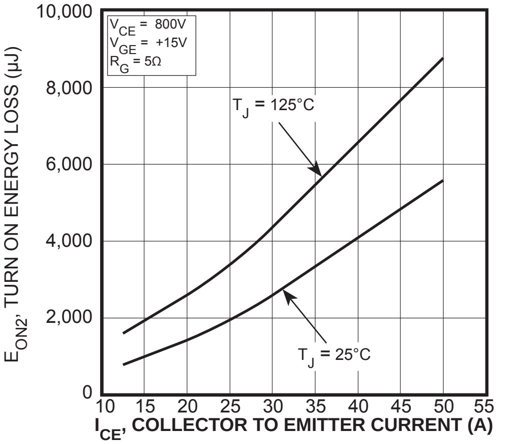


FIGURE 13, Turn-On Energy Loss vs Collector Current

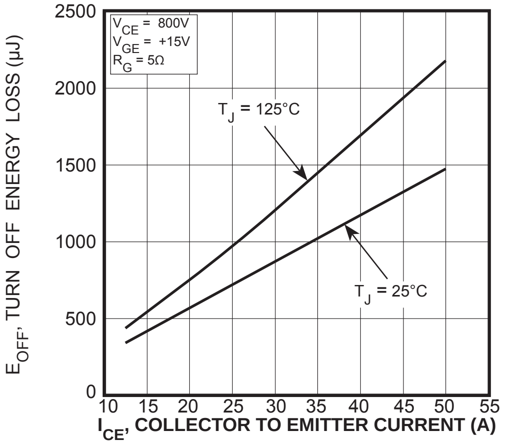


FIGURE 14, Turn Off Energy Loss vs Collector Current

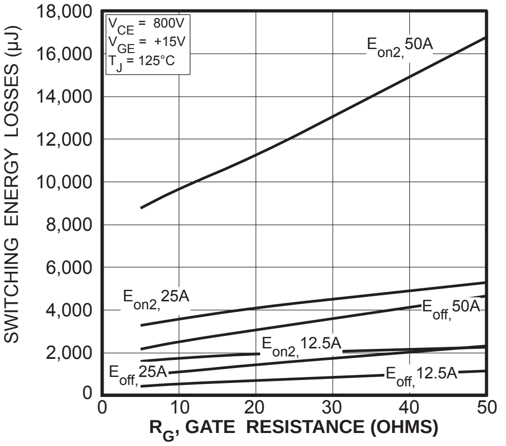


FIGURE 15, Switching Energy Losses vs. Gate Resistance

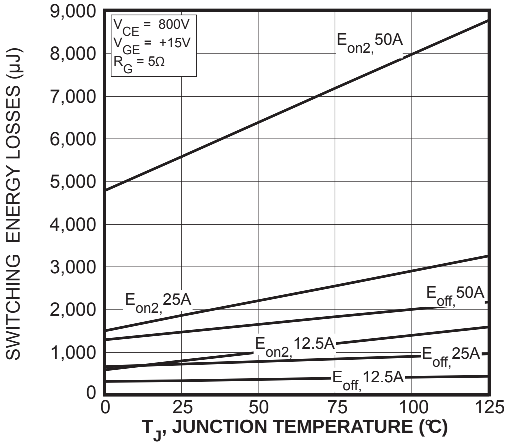


FIGURE 16, Switching Energy Losses vs Junction Temperature

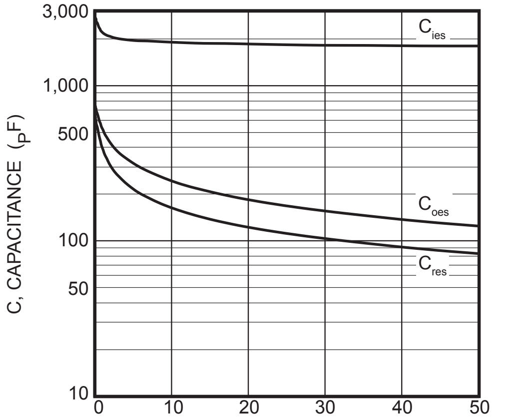


Figure 17, Capacitance vs Collector-To-Emitter Voltage

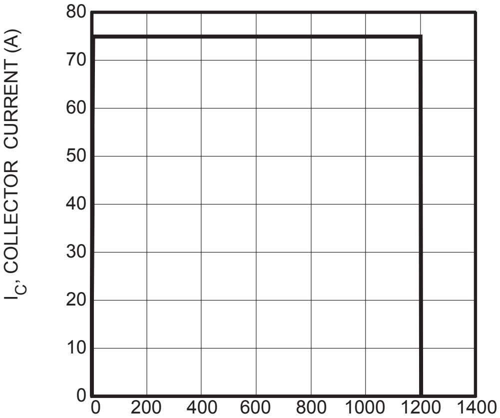


Figure 18,Minimim Switching Safe Operating Area

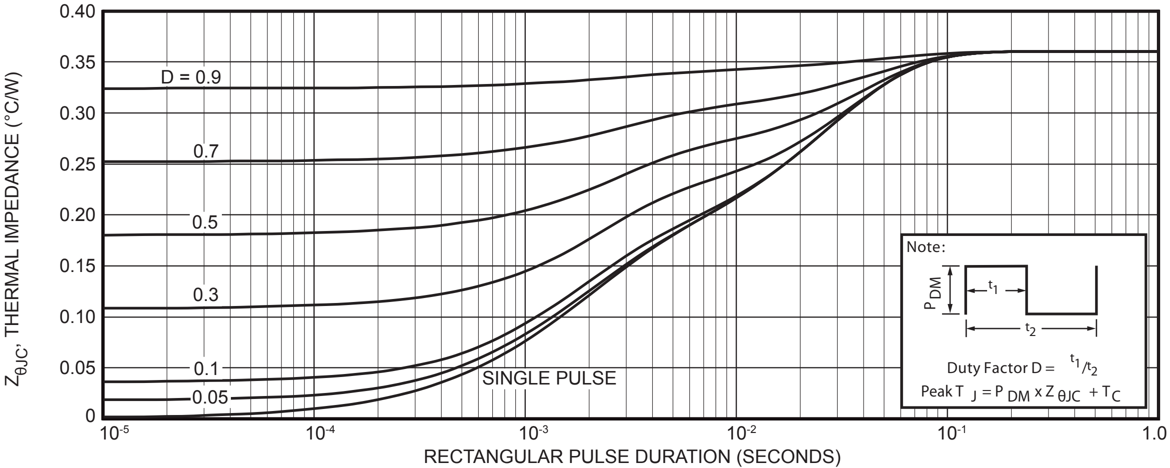
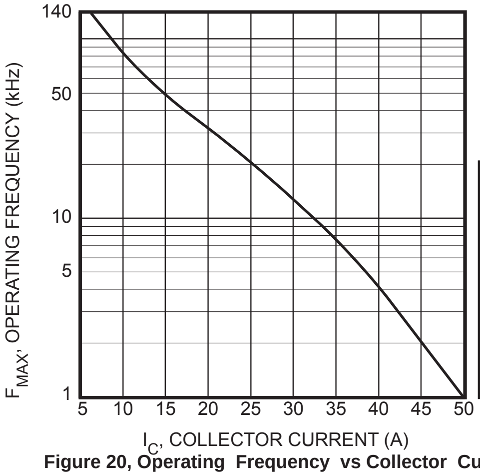


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration



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

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

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

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

Figure 20, Operating Frequency vs Collector Current

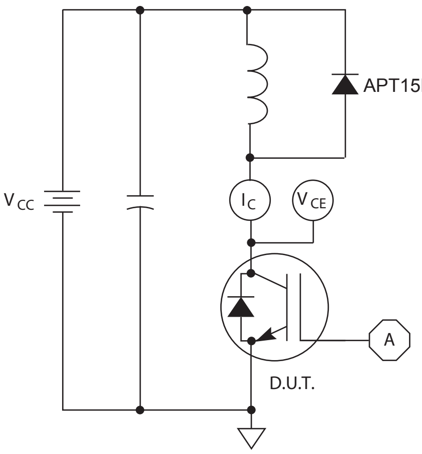


Figure 21, Inductive Switching Test Circuit

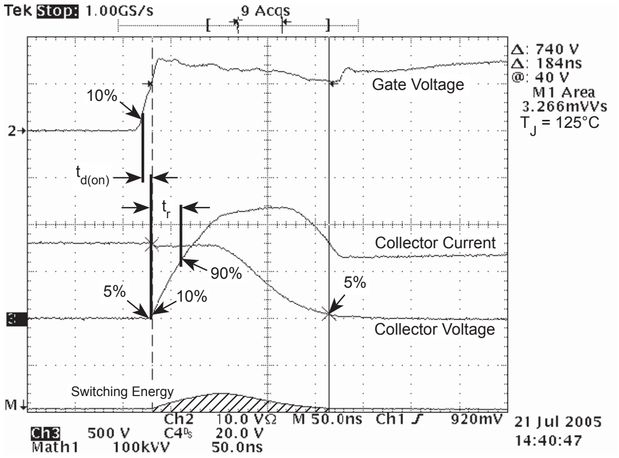


Figure 22, Turn-on Switching Waveforms and Definitions

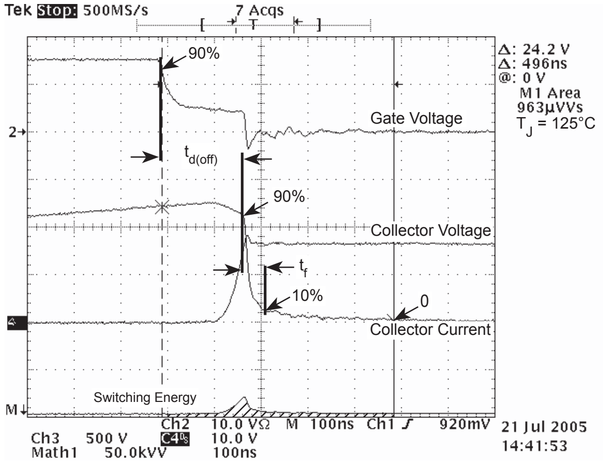


Figure 23, Turn-off Switching Waveforms and Definitions

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Characteristic / Test Conditions	APT25GT120BRDL(G)			UNIT
I_F(AV)	Maximum Average Forward Current (T_C = 115°C, Duty Cycle = 0.5)		15		Amps
I_F(RMS)	RMS Forward Current (Square wave, 50% duty)		30		
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 45°C, 8.3ms)		60		

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Forward Voltage	I_F = 15A		1.6	2.1	Volts
		I_F = 30A		2.0		
		I_F = 15A, T_J = 125°C		1.6		

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
t_{rr}	Reverse Recovery Time	I_F = 1A, di_F/dt = -100A/µs, V_R = 30V, T_J = 25°C	-	51		ns
t_{rr}	Reverse Recovery Time	I_F = 15A, di_F/dt = -200A/µs V_R = 800V, T_C = 25°C	-	523		
Q_{rr}	Reverse Recovery Charge		-	1492		nC
I_{RRM}	Maximum Reverse Recovery Current		-	7	-	Amps
t_{rr}	Reverse Recovery Time	I_F = 15A, di_F/dt = -200A/µs V_R = 800V, T_C = 125°C	-	716		ns
Q_{rr}	Reverse Recovery Charge		-	2886		nC
I_{RRM}	Maximum Reverse Recovery Current		-	8	-	Amps
t_{rr}	Reverse Recovery Time	I_F = 15A, di_F/dt = -1000A/µs V_R = 800V, T_C = 125°C	-	233		ns
Q_{rr}	Reverse Recovery Charge		-	2873		nC
I_{RRM}	Maximum Reverse Recovery Current		-	25		Amps

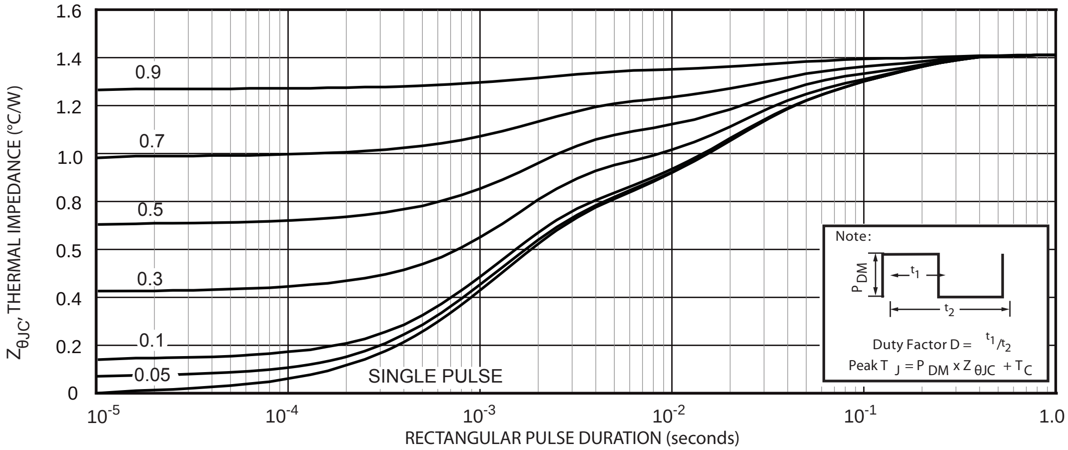


FIGURE 1. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

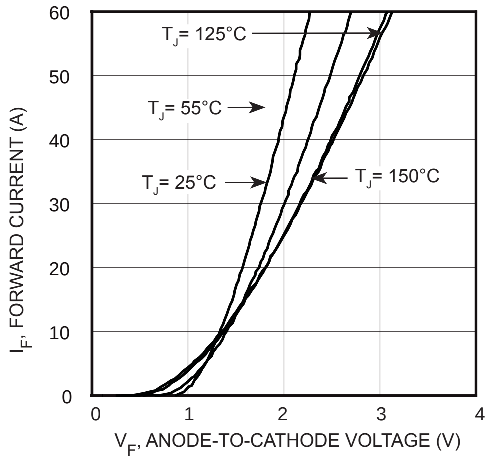


FIGURE 2, Forward Current vs. Forward Voltage

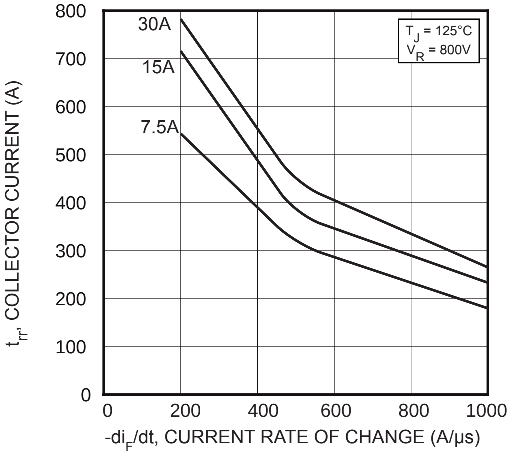


FIGURE 3, Reverse Recovery Time vs. Current Rate of Change

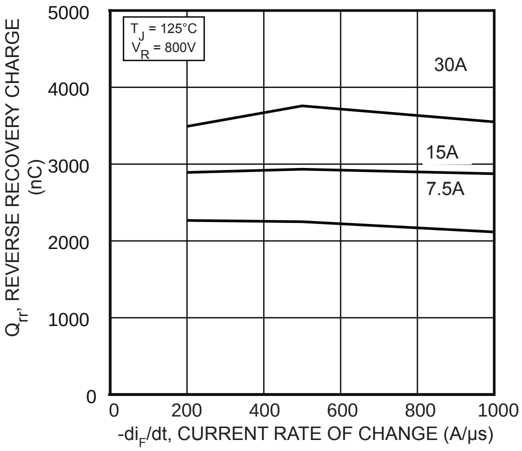


FIGURE 4, Reverse Recovery Charge vs. Current Rate of Change

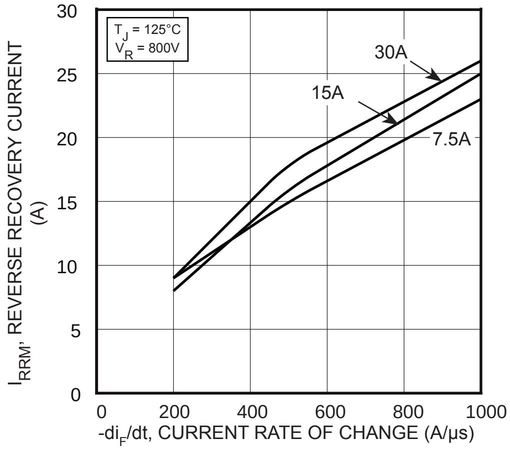


FIGURE 5, Reverse Recovery Current vs. Current Rate of Change

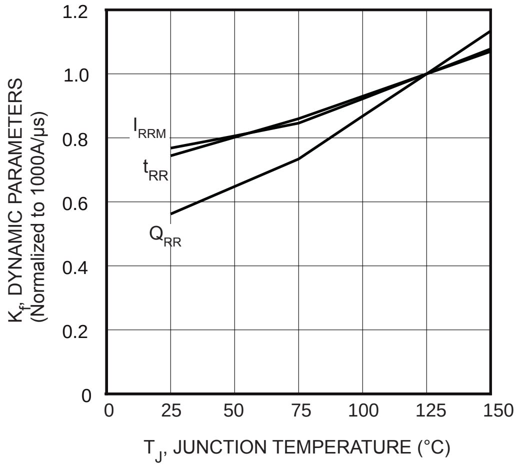


FIGURE 6, Dynamic Parameters vs Junction Temperature

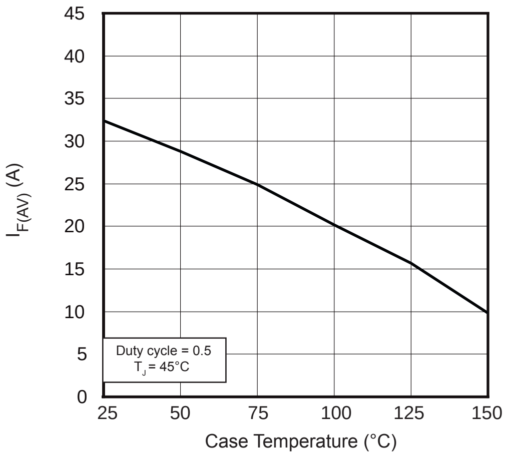


FIGURE 7, Maximum Average Forward Current vs. Case Temperature

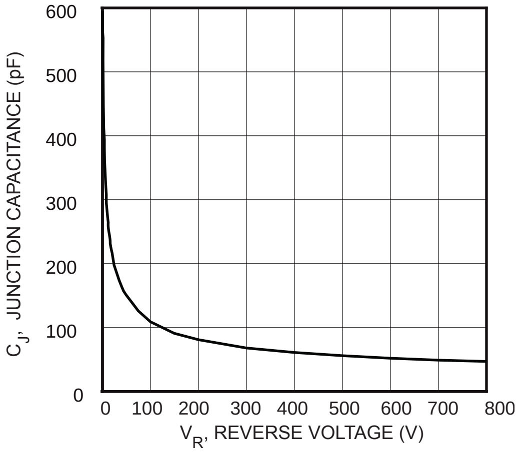


FIGURE 8, Junction Capacitance vs. Reverse Voltage

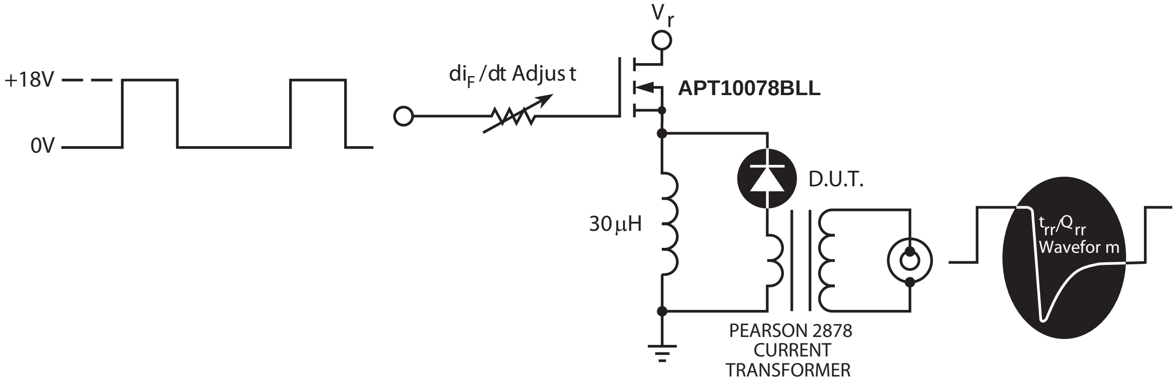
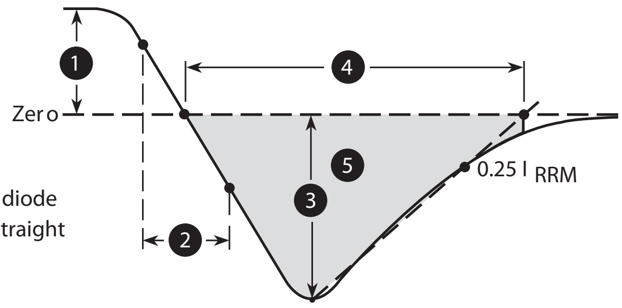


Figure 32. Diode Test Circuit

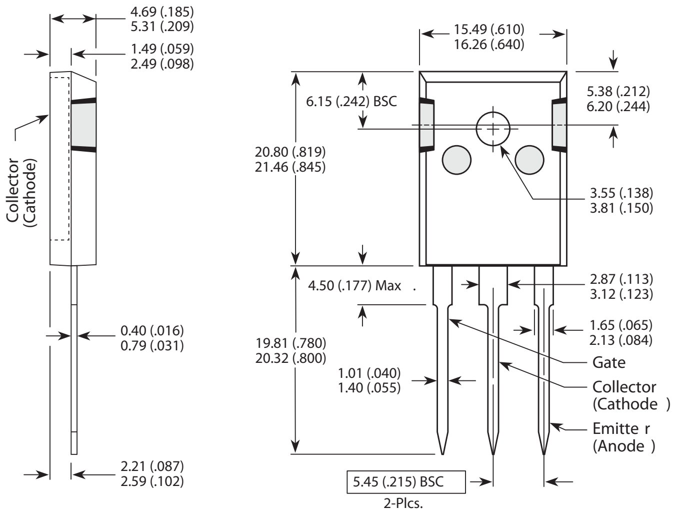


1. I_F - Forward Conduction Current
2. di_F/dt - Rate of Diode Current Change Through Zero Crossing.
3. I_{RRM} - Maximum Reverse Recovery Current.
4. t_{rr} - Reverse Recovery Time, measured from zero crossing where the diode current goes from positive to negative, to the point at which the straight 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

TO-247 Package Outline

e1 SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)