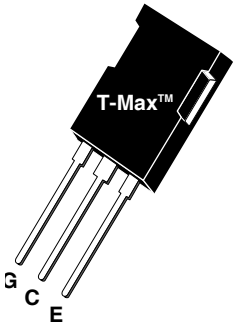
APT40GP90B2DF2

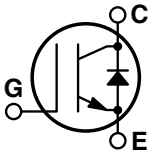
900V

POWER MOS 7® IGBT



The POWER MOS 7® IGBT is a new generation of high voltage power IGBTs. Using Punch Through Technology this IGBT is ideal for many high frequency, high voltage switching applications and has been optimized for high frequency switchmode power supplies.

- **Low Conduction Loss**
- **Low Gate Charge**
- **Ultrafast Tail Current shutoff**
- **SSOA Rated**



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

Symbol	Parameter	APT40GP90B2DF2	UNIT
V_{CES}	Collector-Emitter Voltage	900	Volts
V_{GE}	Gate-Emitter Voltage	±20	
V_{GEM}	Gate-Emitter Voltage Transient	±30	
I_{C1}	Continuous Collector Current ⑦ @ T_C = 25°C	100	Amps
I_{C2}	Continuous Collector Current @ T_C = 110°C	50	
I_{CM}	Pulsed Collector Current ① @ T_C = 150°C	160	
SSOA	Switching Safe Operating Area @ T_J = 150°C	160A @ 900V	
P_D	Total Power Dissipation	543	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	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 500µA)	900			Volts
$V_{GE(TH)}$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 1mA, T_j = 25°C)	3	4.5	6	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 40A, T_j = 25°C)		3.2	3.9	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 40A, T_j = 125°C)		2.7		
I_{CES}	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25°C) ②			500	µA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125°C) ②			1500	
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			±100	nA

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

APT Website - http://www.advancedpower.com

050-7480 Rev B 8-2004

DYNAMIC CHARACTERISTICS

APT40GP90B2DF2

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance**		3300		pF
C_{oes}	Output Capacitance	V_{GE} = 0V, V_{CE} = 25V		325		
C_{res}	Reverse Transfer Capacitance	f = 1 MHz		35		
V_{GEP}	Gate-to-Emitter Plateau Voltage	**Gate Charge**		7.5		V
Q_g	Total Gate Charge ③	V_{GE} = 15V		145		nC
Q_{ge}	Gate-Emitter Charge	V_{CE} = 450V		22		
Q_{gc}	Gate-Collector ("Miller") Charge	I_C = 40A		55		
SSOA	Switching Safe Operating Area	T_J = 150°C, R_G = 5Ω, V_{GE} = 15V, L = 100µH, V_{CE} = 900V	160			A
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (25°C)**		16		ns
t_r	Current Rise Time	V_{CC} = 600V		27		
$t_{d(off)}$	Turn-off Delay Time	V_{GE} = 15V		75		
t_f	Current Fall Time	I_C = 40A		60		
E_{on1}	Turn-on Switching Energy ④	R_G = 5Ω		TBD		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤	T_J = +25°C		1415		
E_{off}	Turn-off Switching Energy ⑥			825		
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)**		16		ns
t_r	Current Rise Time	V_{CC} = 600V		27		
$t_{d(off)}$	Turn-off Delay Time	V_{GE} = 15V		110		
t_f	Current Fall Time	I_C = 40A		105		
E_{on1}	Turn-on Switching Energy ④	R_G = 5Ω		TBD		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤	T_J = +125°C		2370		
E_{off}	Turn-off Switching Energy ⑥			1505		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\Theta JC}$	Junction to Case (IGBT)			.23	°C/W
$R_{\Theta JC}$	Junction to Case (DIODE)			.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.)

⑦ Continuous current limited by package lead temperature.

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

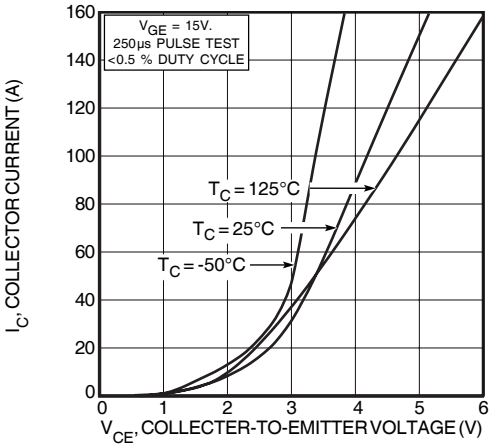


FIGURE 1, Output Characteristics(V_{GE} = 15V)

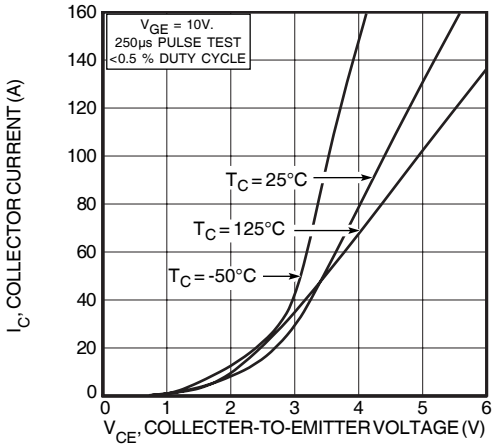


FIGURE 2, Output Characteristics (V_{GE} = 10V)

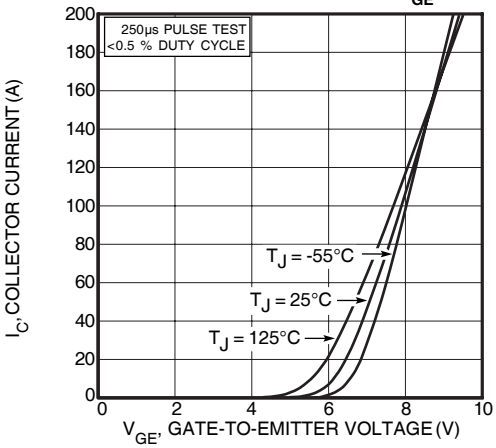


FIGURE 3, Transfer Characteristics

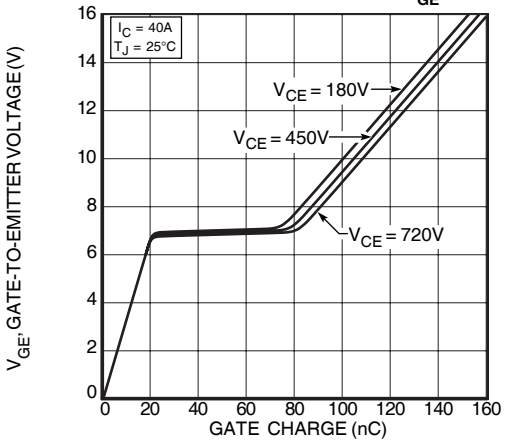


FIGURE 4, Gate Charge

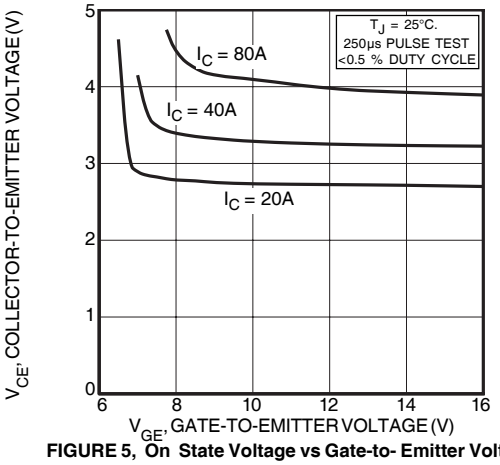


FIGURE 5, On State Voltage vs Gate-to- Emitter Voltage

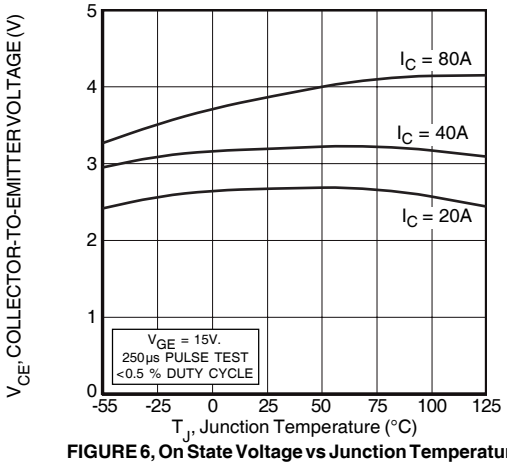


FIGURE 6, On State Voltage vs Junction Temperature

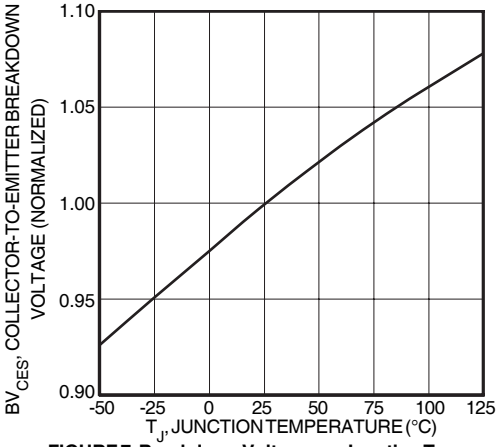


FIGURE 7, Breakdown Voltage vs. Junction Temperature

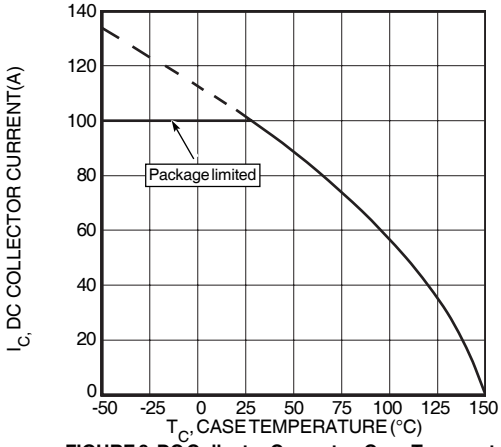


FIGURE 8, DC Collector Current vs Case Temperature

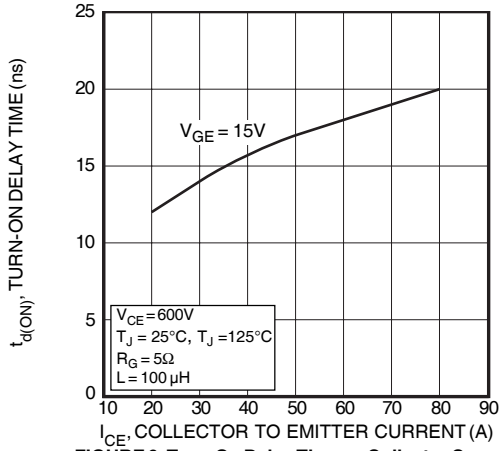


FIGURE 9, Turn-On Delay Time vs Collector Current

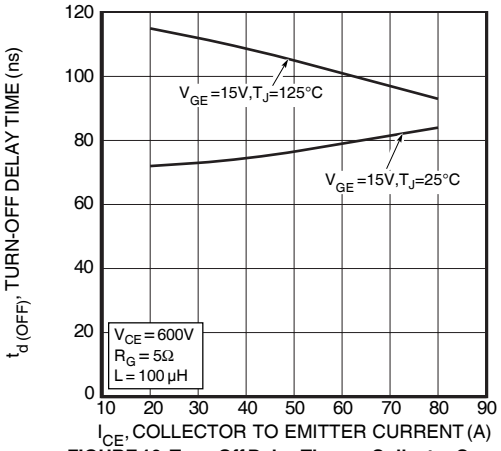


FIGURE 10, Turn-Off Delay Time vs Collector Current

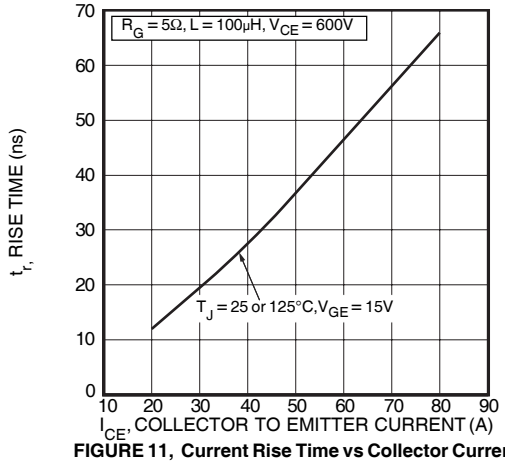


FIGURE 11, Current Rise Time vs Collector Current

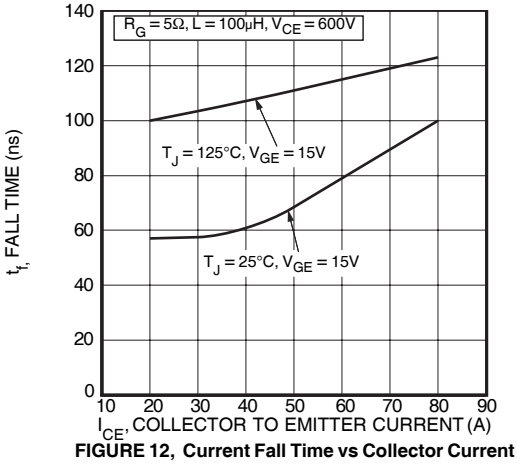


FIGURE 12, Current Fall Time vs Collector Current

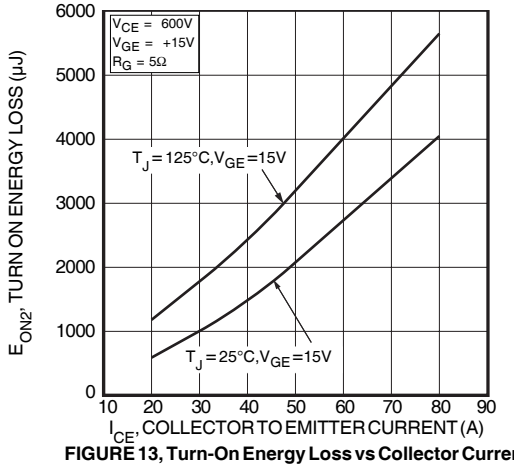


FIGURE 13, Turn-On Energy Loss vs Collector Current

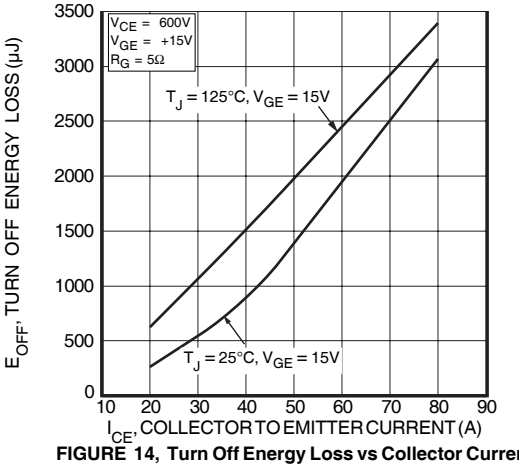


FIGURE 14, Turn Off Energy Loss vs Collector Current

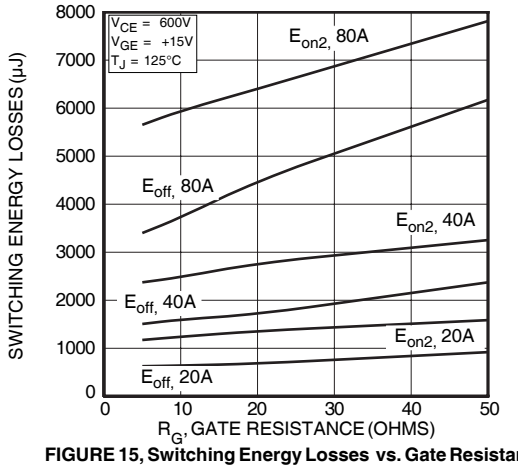


FIGURE 15, Switching Energy Losses vs. Gate Resistance

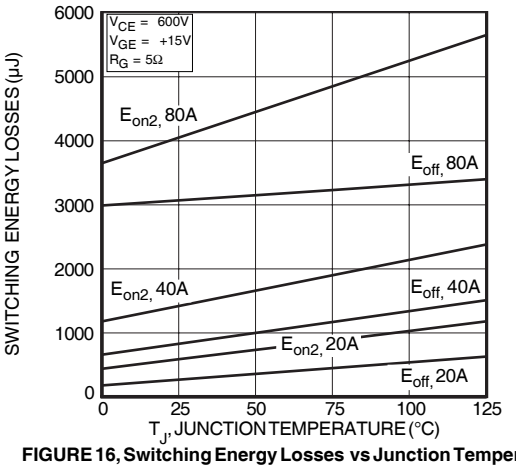


FIGURE 16, Switching Energy Losses vs Junction Temperature

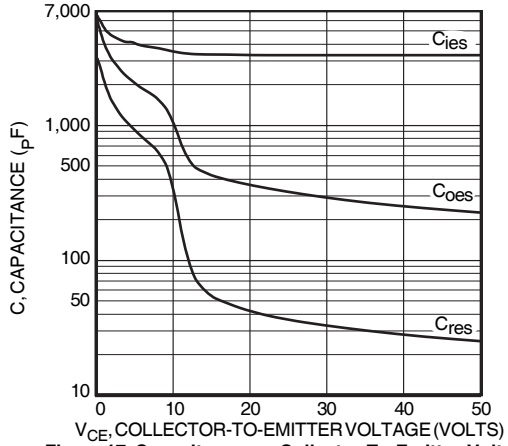


Figure 17, Capacitance vs Collector-To-Emitter Voltage

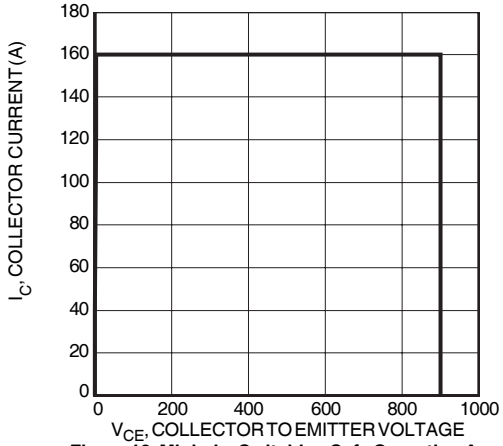


Figure 18, Minimim Switching Safe Operating Area

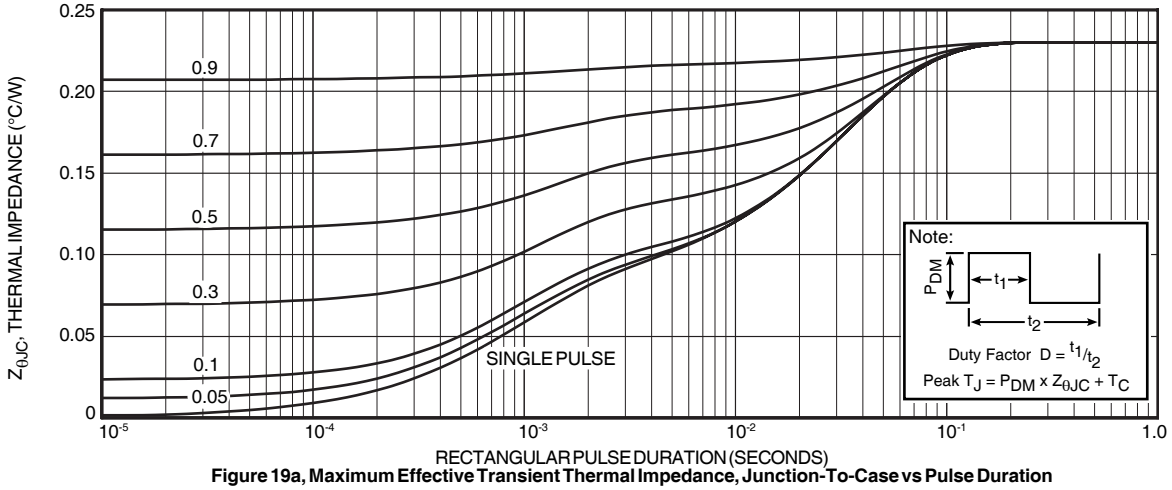


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

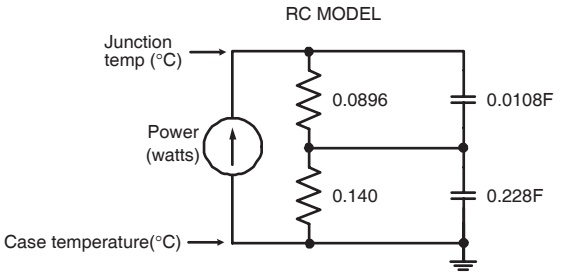
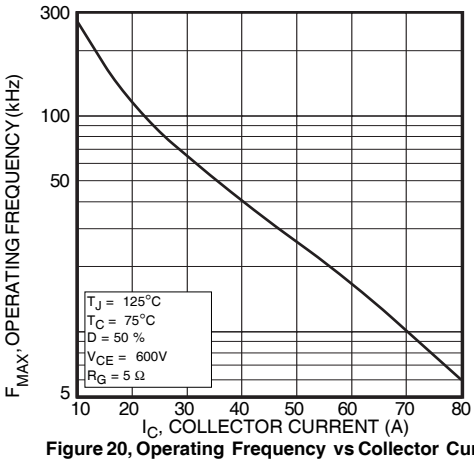


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL



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

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

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

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

Figure 20, Operating Frequency vs Collector Current

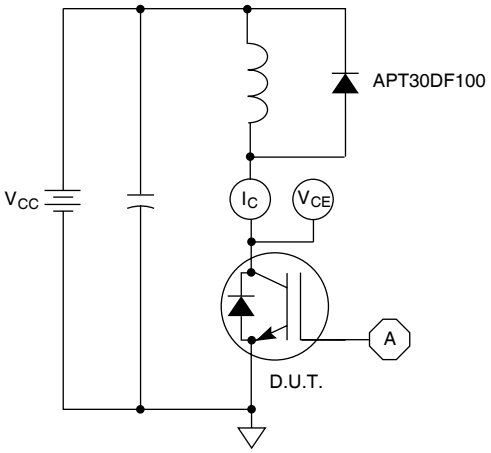


Figure 21, Inductive Switching Test Circuit

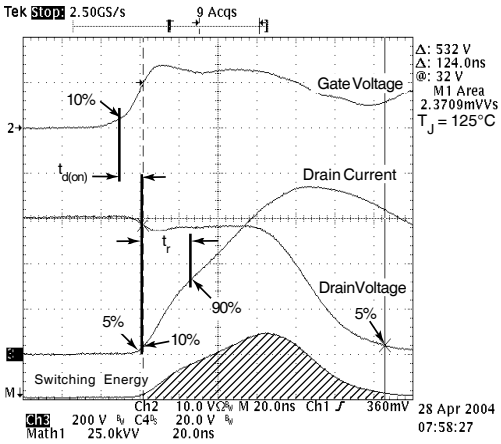


Figure 22, Turn-on Switching Waveforms and Definitions

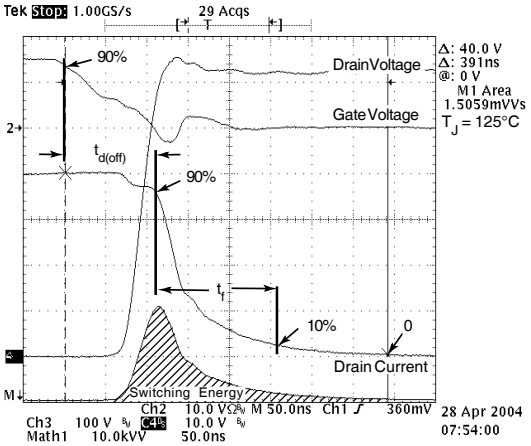


Figure 23, Turn-off Switching Waveforms and Definitions

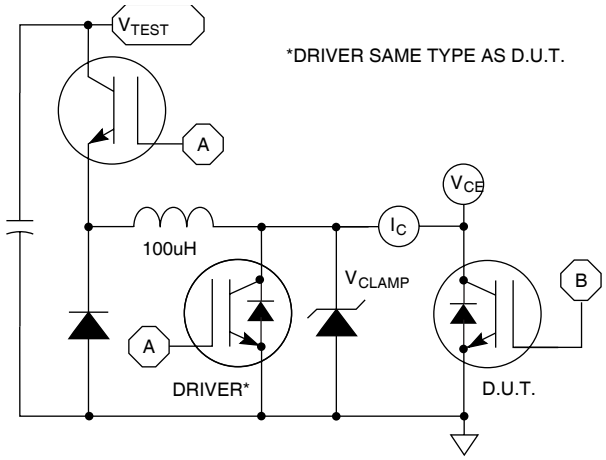


Figure 24, E_{ON1} Test Circuit

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

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

Symbol	Characteristic / Test Conditions	APT40GP90B2DF2			UNIT
$I_F(AV)$	Maximum Average Forward Current (T_C = 82°C, Duty Cycle = 0.5)		30		Amps
$I_F(RMS)$	RMS Forward Current (Square wave, 50% duty)		40		
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 45°C, 8.3ms)		210		

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Forward Voltage	I_F = 40A		3.5		Volts
		I_F = 80A		4.4		
		I_F = 40A, T_J = 125°C		2.5		

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	-	40		ns
t_{rr}	Reverse Recovery Time	I_F = 30A, di_F/dt = -200A/µs V_R = 667V, T_C = 25°C	-	260		ns
Q_{rr}	Reverse Recovery Charge		-	325		nC
I_{RRM}	Maximum Reverse Recovery Current		-	4	-	Amps
t_{rr}	Reverse Recovery Time	I_F = 30A, di_F/dt = -200A/µs V_R = 667V, T_C = 125°C	-	315		ns
Q_{rr}	Reverse Recovery Charge		-	1450		nC
I_{RRM}	Maximum Reverse Recovery Current		-	9	-	Amps
t_{rr}	Reverse Recovery Time	I_F = 30A, di_F/dt = -1000A/µs V_R = 667V, T_C = 125°C	-	125		ns
Q_{rr}	Reverse Recovery Charge		-	2160		nC
I_{RRM}	Maximum Reverse Recovery Current		-	28		Amps

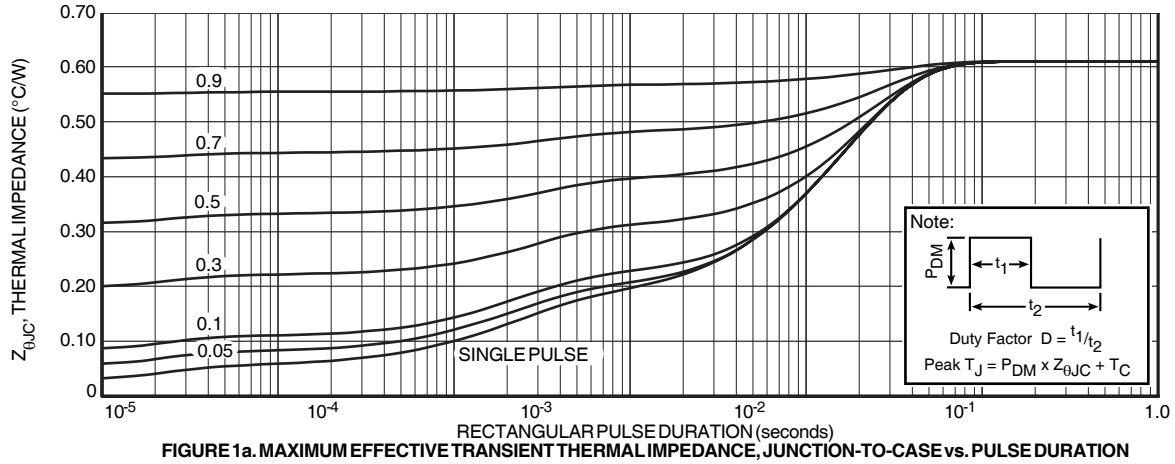


FIGURE 1a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

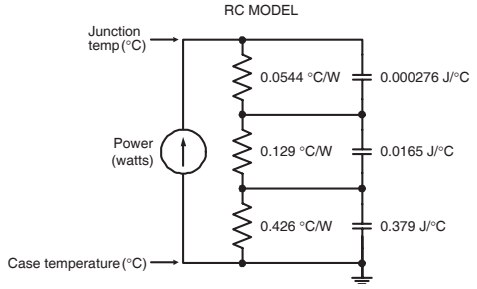


FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

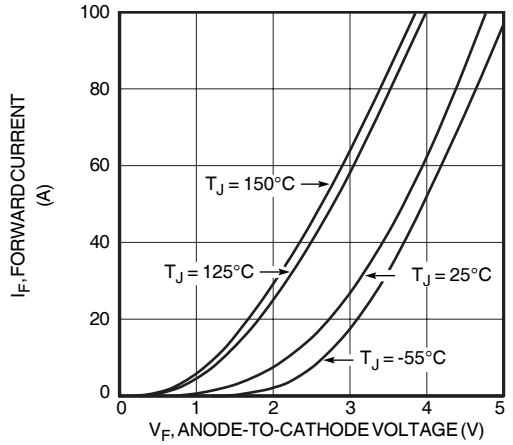


Figure 2. Forward Current *vs.* Forward Voltage

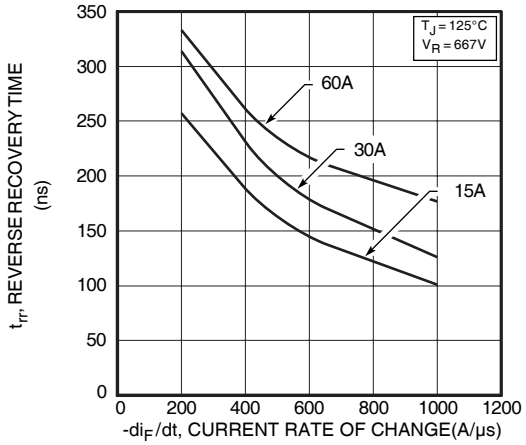


Figure 3. Reverse Recovery Time *vs.* Current Rate of Change

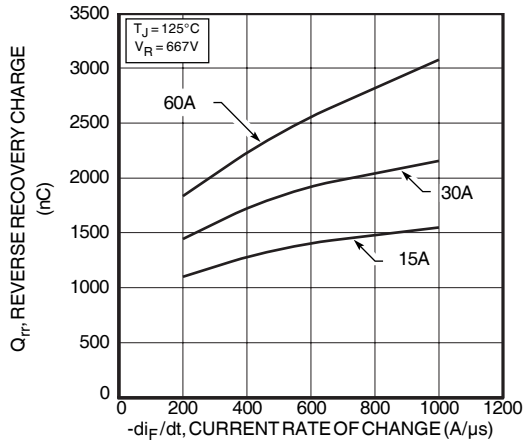


Figure 4. Reverse Recovery Charge *vs.* Current Rate of Change

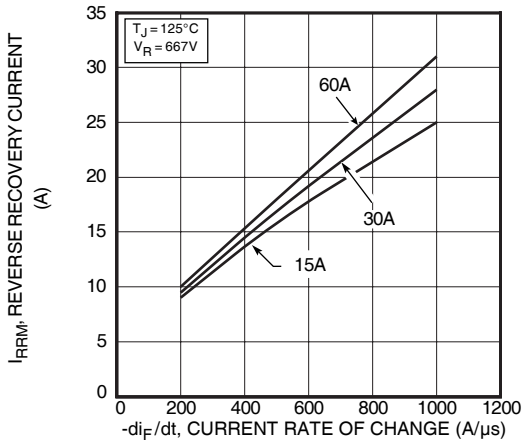


Figure 5. Reverse Recovery Current *vs.* Current Rate of Change

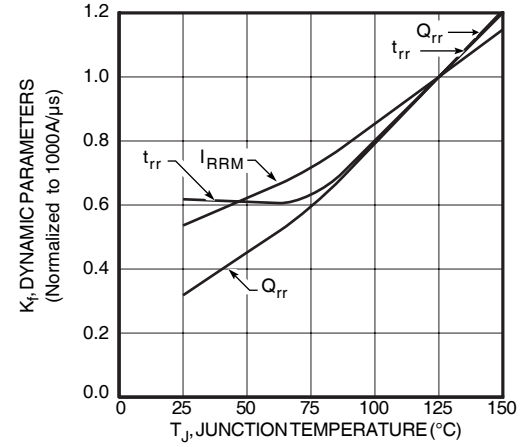


Figure 6. Dynamic Parameters *vs.* Junction Temperature

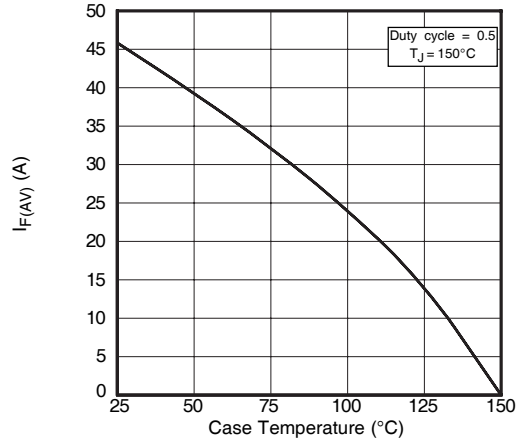


Figure 7. Maximum Average Forward Current *vs.* CaseTemperature

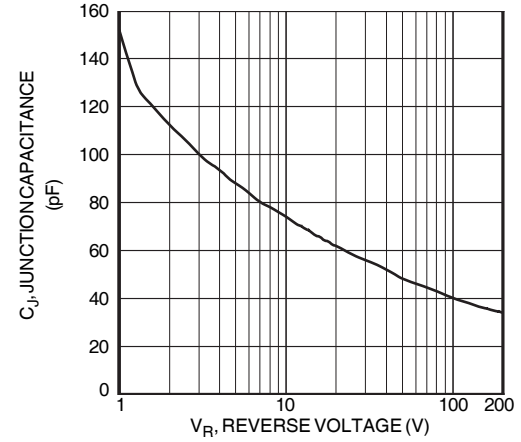


Figure 8. Junction Capacitance *vs.* Reverse Voltage

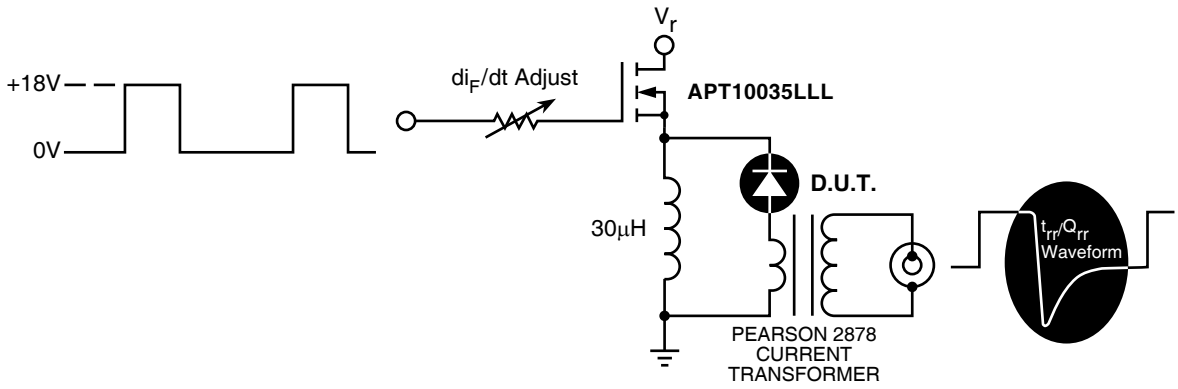
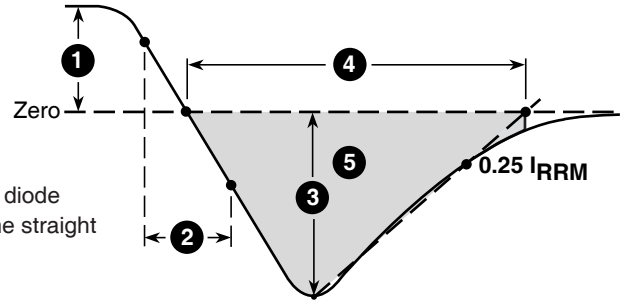


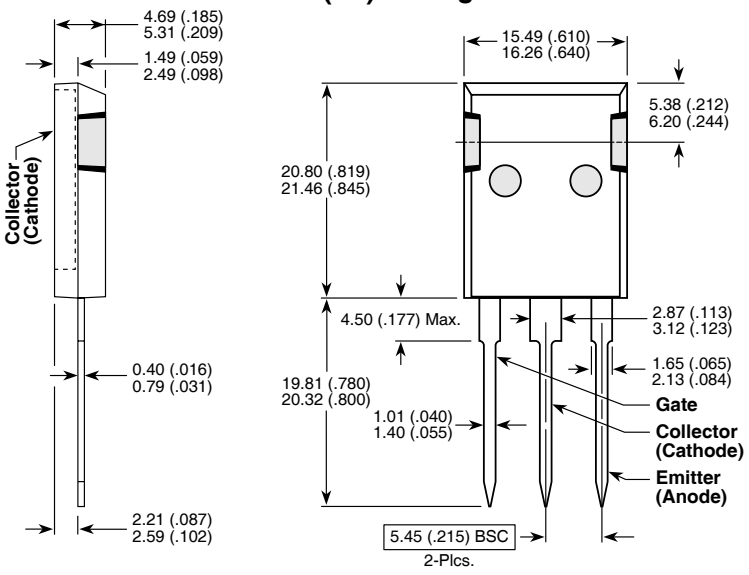
Figure 33. Diode Test Circuit



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 $0.25 \bullet I_{RRM}$ passes through zero.
5. Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{rr}.

Figure 34, Diode Reverse Recovery Waveform and Definitions

T-Max™ (B2) Package Outline



Dimensions in Millimeters and (Inches)

APT's products are covered by one or more of U.S.patents 4,895,810 5,045,903 5,089,434 5,182,234 5,019,522
5,262,336 6,503,786 5,256,583 4,748,103 5,283,202 5,231,474 5,434,095 5,528,058 and foreign patents. US and Foreign patents pending. All Rights Reserved.