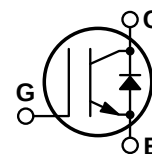
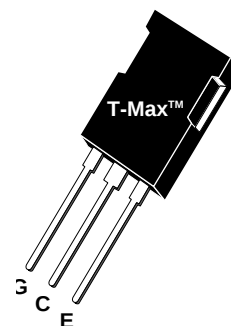


POWER MOS 7® IGBT

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
- 100 kHz operation @ 800V, 12A
- 50 kHz operation @ 800V, 20A
- RBSOA rated



MAXIMUM RATINGS

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

Symbol	Parameter	APT35GP120B2D2	UNIT
V_{CES}	Collector-Emitter Voltage	1200	Volts
V_{GE}	Gate-Emitter Voltage	± 20	
V_{GEM}	Gate-Emitter Voltage Transient	± 30	
I_{C1}	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	96	Amps
I_{C2}	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	46	
I_{CM}	Pulsed Collector Current ^① @ $T_C = 25^\circ\text{C}$	140	
RBSOA	Reverse Bias Safe Operating Area @ $T_J = 150^\circ\text{C}$	140A @ 960V	
P_D	Total Power Dissipation	540	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	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage ($V_{GE} = 0V, I_C = 500\mu A$)	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 1mA, T_J = 25^\circ\text{C}$)	3	4.5	6	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = 35A, T_J = 25^\circ\text{C}$)		2.9	3.9	
	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = 35A, T_J = 125^\circ\text{C}$)		2.8		
I_{CES}	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_J = 25^\circ\text{C}$) ^②			500	μA
	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_J = 125^\circ\text{C}$) ^②			3000	
I_{GES}	Gate-Emitter Leakage Current ($V_{GE} = \pm 20V$)			± 100	nA



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

DYNAMIC CHARACTERISTICS

APT35GP120B2D2

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		3423		pF
C_{oes}	Output Capacitance			252		
C_{res}	Reverse Transfer Capacitance			30		
V_{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 35A$		7		V
Q_g	Total Gate Charge ^③			150		nC
Q_{ge}	Gate-Emitter Charge			21		
Q_{gc}	Gate-Collector ("Miller") Charge			62		
RBSOA	Reverse Bias Safe Operating Area	$T_J = 150^\circ C, R_G = 5\Omega, V_{GE} = 15V, L = 100\mu H, V_{CE} = 960V$	140			A
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 35A$ $R_G = 5\Omega$ $T_J = +25^\circ C$		14		ns
t_r	Current Rise Time			25		
$t_{d(off)}$	Turn-off Delay Time			99		
t_f	Current Fall Time			77		
E_{on1}	Turn-on Switching Energy ^④			1000		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			2262		
E_{off}	Turn-off Switching Energy ^⑥			1185		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 35A$ $R_G = 5\Omega$ $T_J = +125^\circ C$		14		ns
t_r	Current Rise Time			25		
$t_{d(off)}$	Turn-off Delay Time			155		
t_f	Current Fall Time			128		
E_{on1}	Turn-on Switching Energy ^④			1000		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			4027		
E_{off}	Turn-off Switching Energy ^⑥			3016		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.23	$^\circ C/W$
$R_{\theta JC}$	Junction to Case (DIODE)			.90	
W_T	Package Weight			5.90	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. A Combi device is used for the clamping diode as shown in the E_{on2} test circuit. (See Figures 21, 22.)

⑥ E_{off} is the clamped inductive turn-off energy. (See Figures 21, 23.)

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

TYPICAL PERFORMANCE CURVES

APT35GP120B2D2

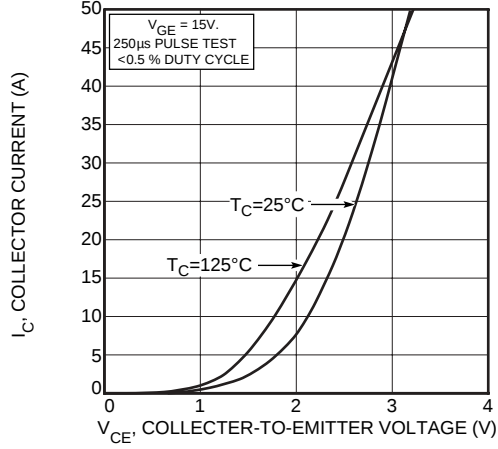


FIGURE 1, Output Characteristics ($V_{GE} = 15V$)

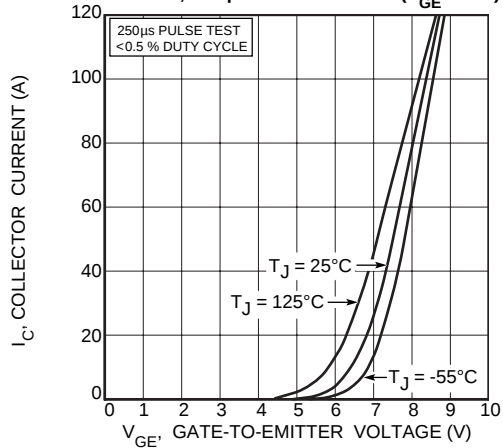


FIGURE 3, Transfer Characteristics

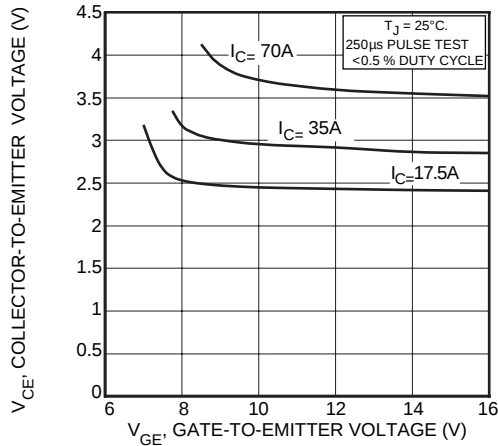


FIGURE 5, On State Voltage vs. Gate-to-Emitter Voltage

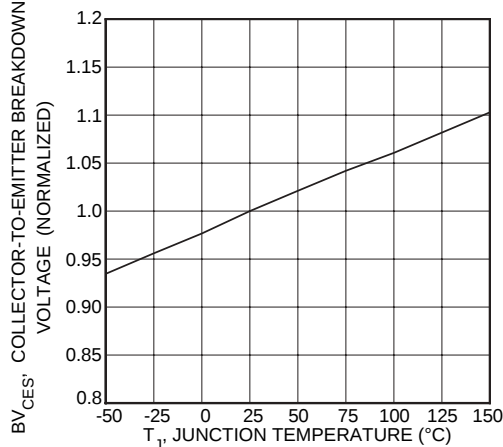


FIGURE 7, Breakdown Voltage vs. Junction Temperature

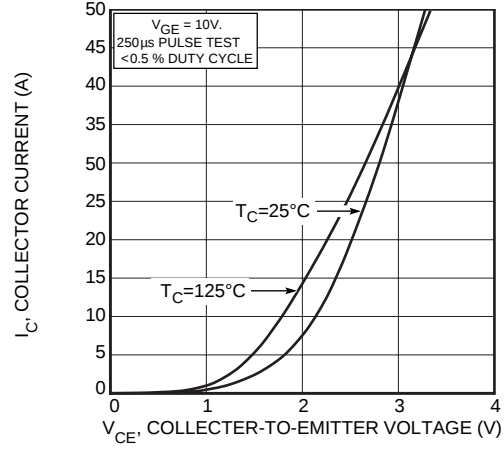


FIGURE 2, Output Characteristics ($V_{GE} = 10V$)

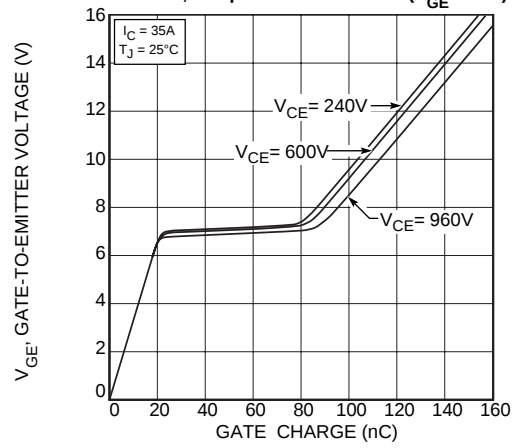


FIGURE 4, Gate Charge

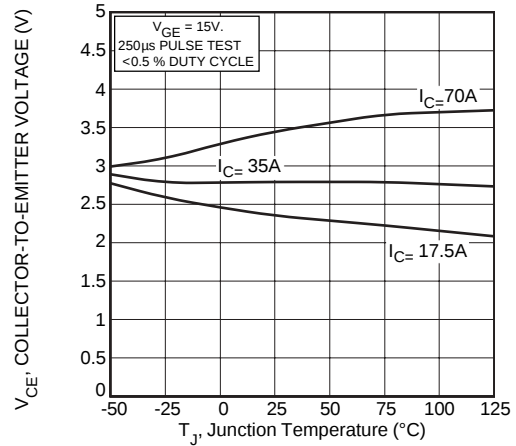


FIGURE 6, On State Voltage vs. Junction Temperature

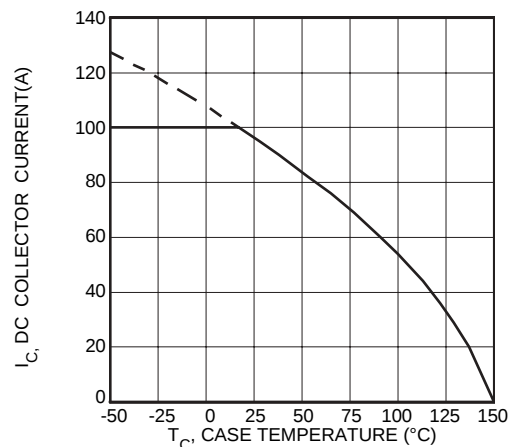


FIGURE 8, DC Collector Current vs. Case Temperature

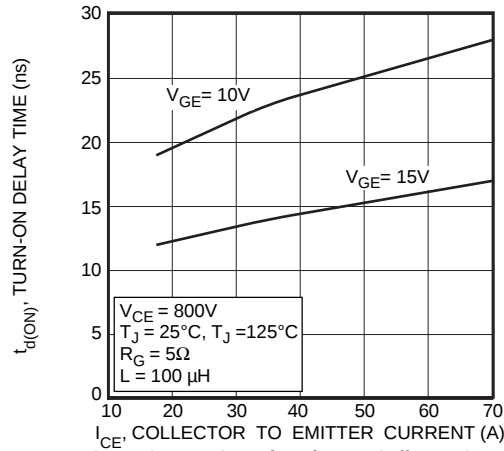


FIGURE 9, Turn-On Delay Time vs Collector Current

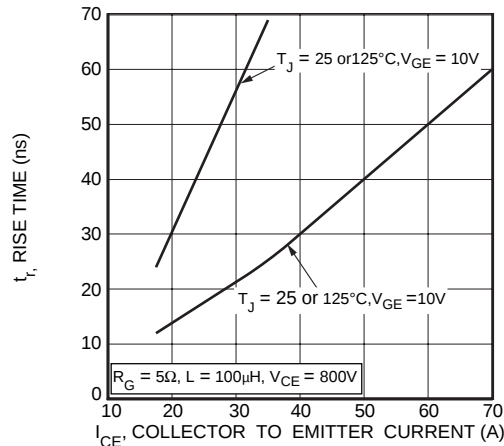


FIGURE 11, Current Rise Time vs Collector Current

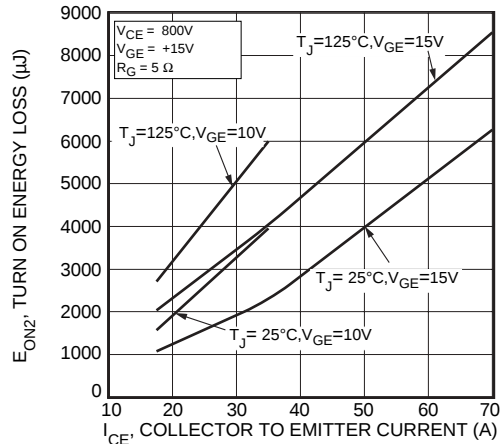


FIGURE 13, Turn-On Energy Loss vs Collector Current

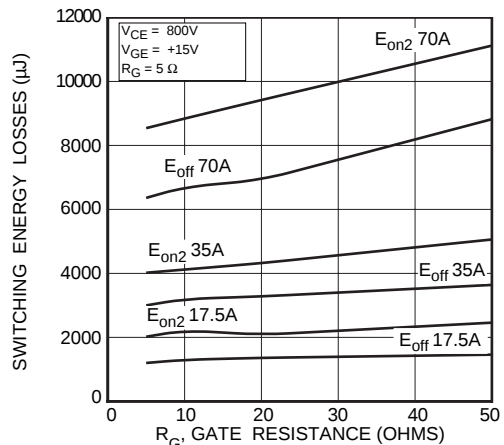


FIGURE 15, Switching Energy Losses vs. Gate Resistance

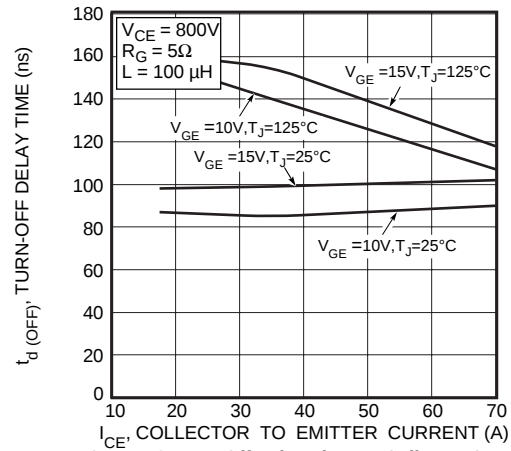


FIGURE 10, Turn-Off Delay Time vs Collector Current

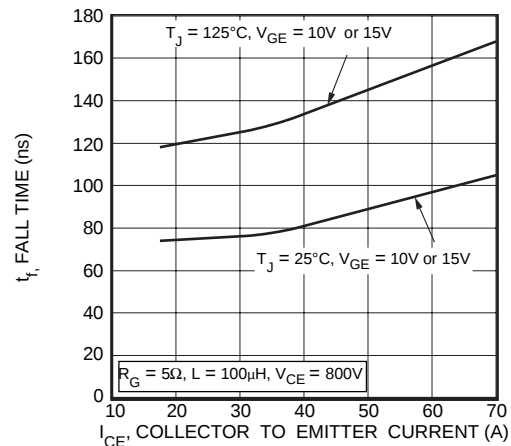


FIGURE 12, Current Fall Time vs Collector Current

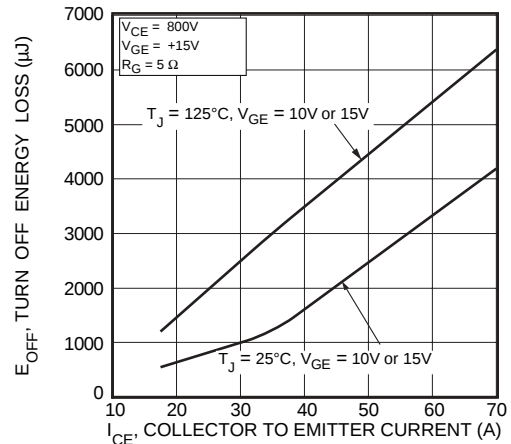


FIGURE 14, Turn Off Energy Loss vs Collector Current

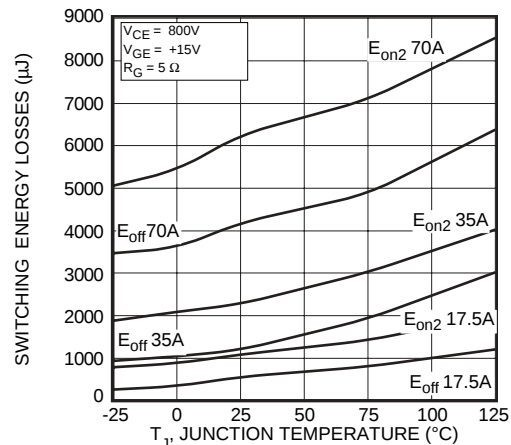


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

APT35GP120B2D2

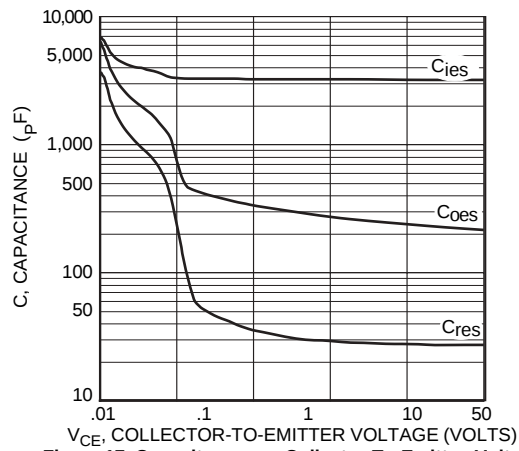


Figure 17, Capacitance vs Collector-To-Emitter Voltage

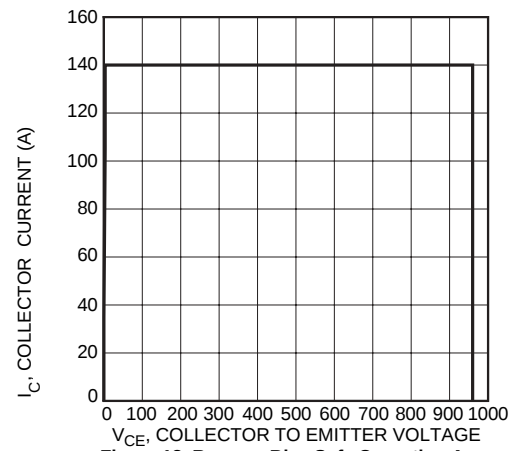


Figure 18, Reverse Bias Safe Operating Area

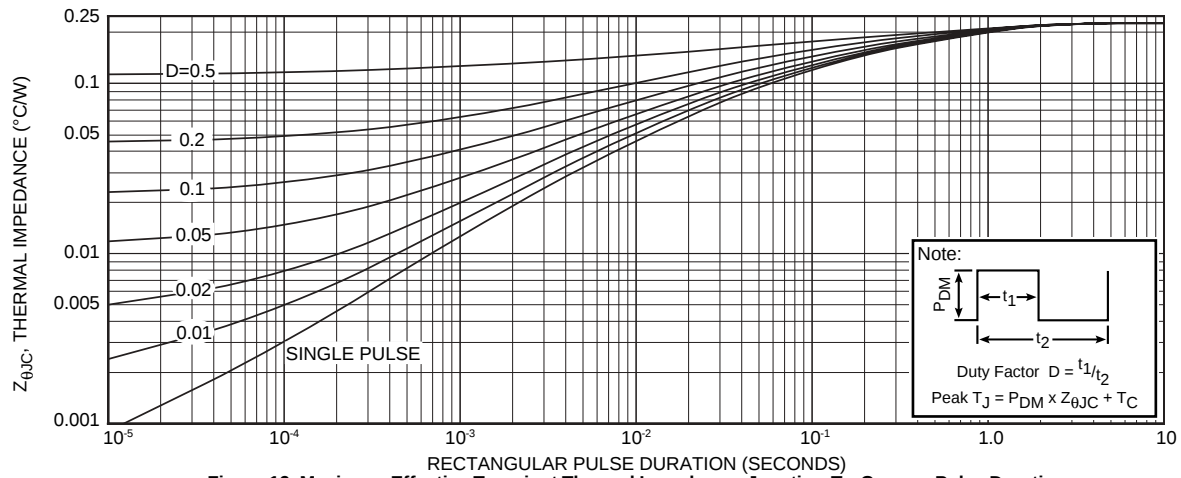


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

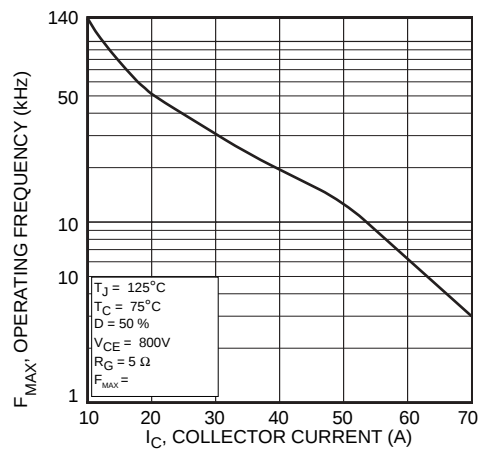


Figure 20, Operating Frequency vs Collector Current

$$F_{\max} = \min(f_{\max 1}, f_{\max 2})$$

$$f_{\max 1} = \frac{0.05}{t_{d(\text{on})} + t_r + t_{d(\text{off})} + t_f}$$

$$f_{\max 2} = \frac{P_{\text{diss}} - P_{\text{cond}}}{E_{\text{on2}} + E_{\text{off}}}$$

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

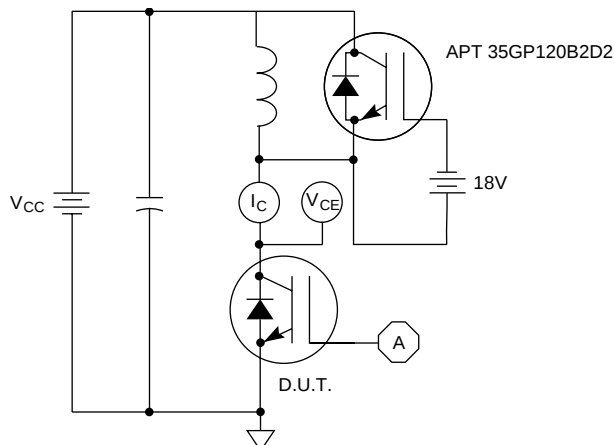


Figure 21, Inductive Switching Test Circuit

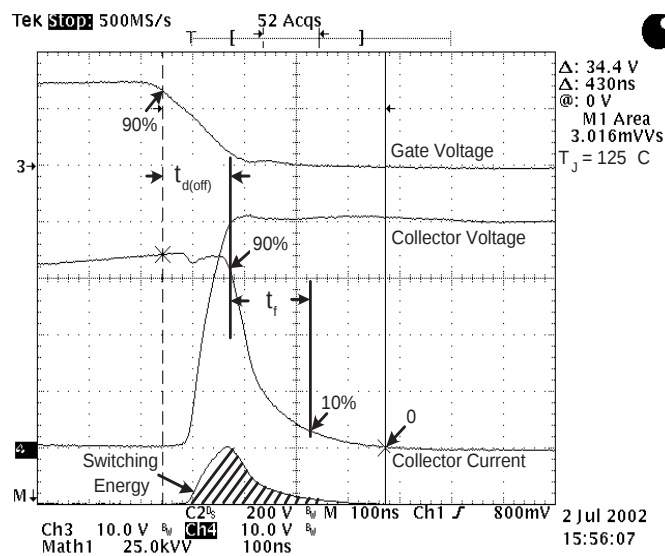


Figure 23, Turn-off Switching Waveforms and Definitions

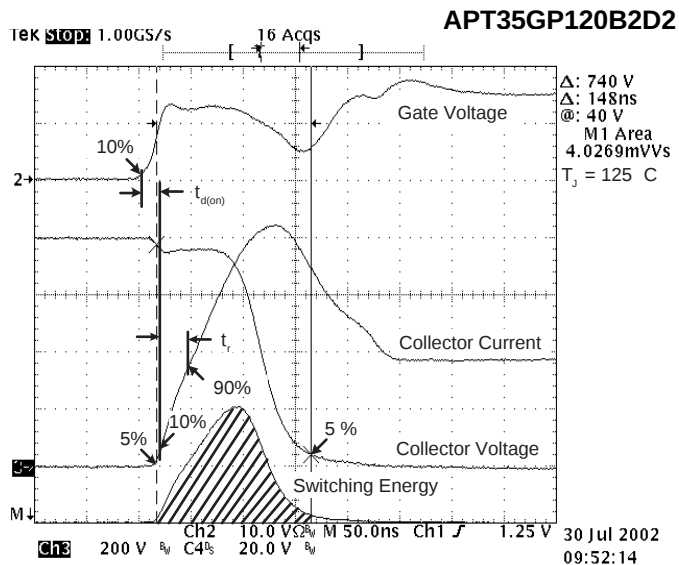


Figure 22, Turn-on Switching Waveforms and Definitions

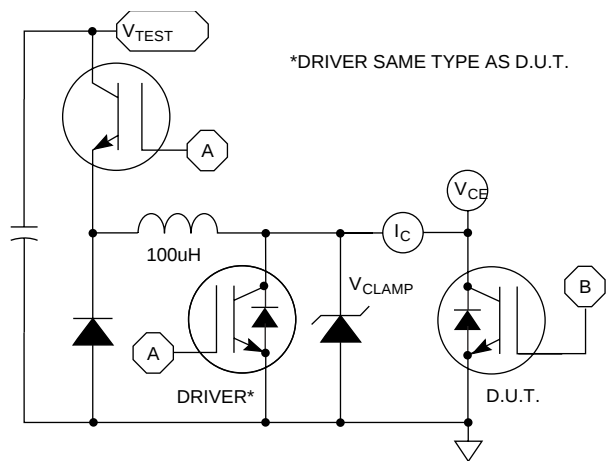


Figure 24, E_{ON1} Test Circuit

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

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

Symbol	Characteristic / Test Conditions	APT35GP120B2D2			UNIT
$I_F(\text{AV})$	Maximum Average Forward Current ($T_C = 80^\circ\text{C}$, Duty Cycle = 0.5)		35		Amps
$I_F(\text{RMS})$	RMS Forward Current		70		
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	Maximum Forward Voltage	$I_F = 35\text{A}$		2.5	Volts
		$I_F = 60\text{A}$		2.0	
		$I_F = 35\text{A}$, $T_J = 150^\circ\text{C}$		2.0	

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
t_{rr1}	Reverse Recovery Time, $I_F = 1.0\text{A}$, $di_F/dt = -15\text{A}/\mu\text{s}$, $V_R = 30\text{V}$, $T_J = 25^\circ\text{C}$		70	85	ns
t_{rr2}	Reverse Recovery Time	$T_J = 25^\circ\text{C}$		70	
t_{rr3}	$I_F = 35\text{A}$, $di_F/dt = -240\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$		160	
t_{fr1}	Forward Recovery Time	$T_J = 25^\circ\text{C}$		255	
t_{fr2}	$I_F = 35\text{A}$, $di_F/dt = 240\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$		255	
I_{RRM1}	Reverse Recovery Current	$T_J = 25^\circ\text{C}$		7	Amps
I_{RRM2}	$I_F = 35\text{A}$, $di_F/dt = -240\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$		12	
Q_{rr1}	Recovery Charge	$T_J = 25^\circ\text{C}$		660	nC
Q_{rr2}	$I_F = 35\text{A}$, $di_F/dt = -240\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$		1640	
V_{fr1}	Forward Recovery Voltage	$T_J = 25^\circ\text{C}$		15	Volts
V_{fr2}	$I_F = 35\text{A}$, $di_F/dt = 240\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$		20	
di_M/dt	Rate of Fall of Recovery Current	$T_J = 25^\circ\text{C}$		245	A/ μs
	$I_F = 35\text{A}$, $di_F/dt = -240\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ (See Figure 33)	$T_J = 100^\circ\text{C}$		160	

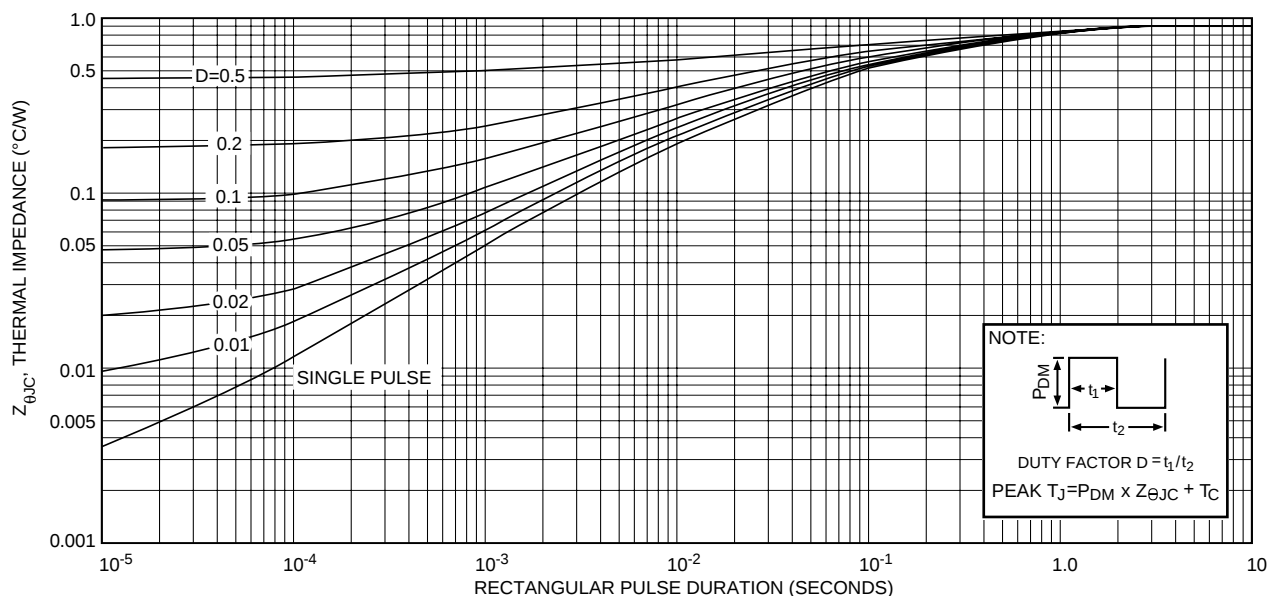


FIGURE 25, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

TYPICAL PERFORMANCE CURVES

APT35GP120B2D2

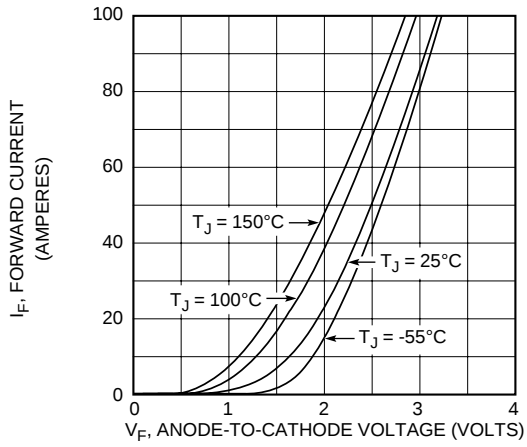


Figure 26, Forward Voltage Drop vs Forward Current

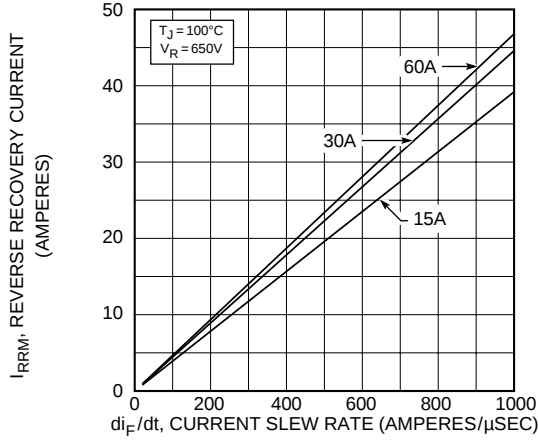


Figure 28, Reverse Recovery Current vs Current Slew Rate

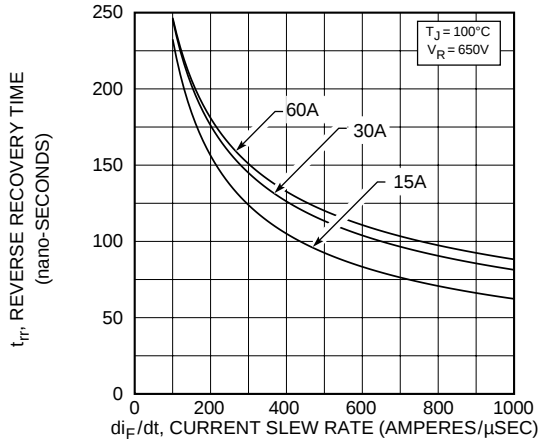


Figure 30, Reverse Recovery Time vs Current Slew Rate

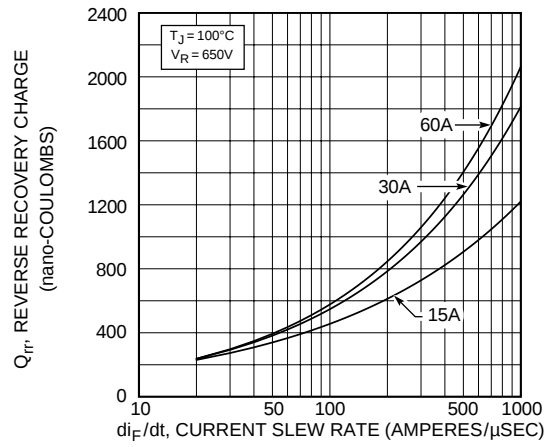


Figure 27, Reverse Recovery Charge vs Current Slew Rate

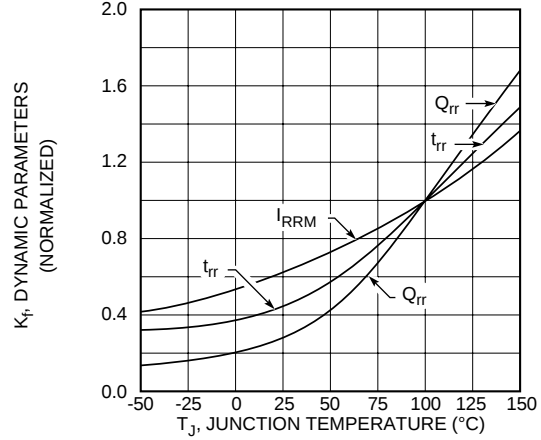


Figure 29, Dynamic Parameters vs Junction Temperature

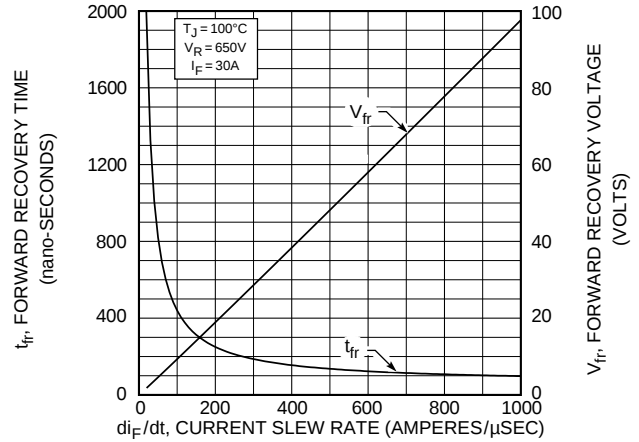


Figure 31, Forward Recovery Voltage/Time vs Current Slew Rate

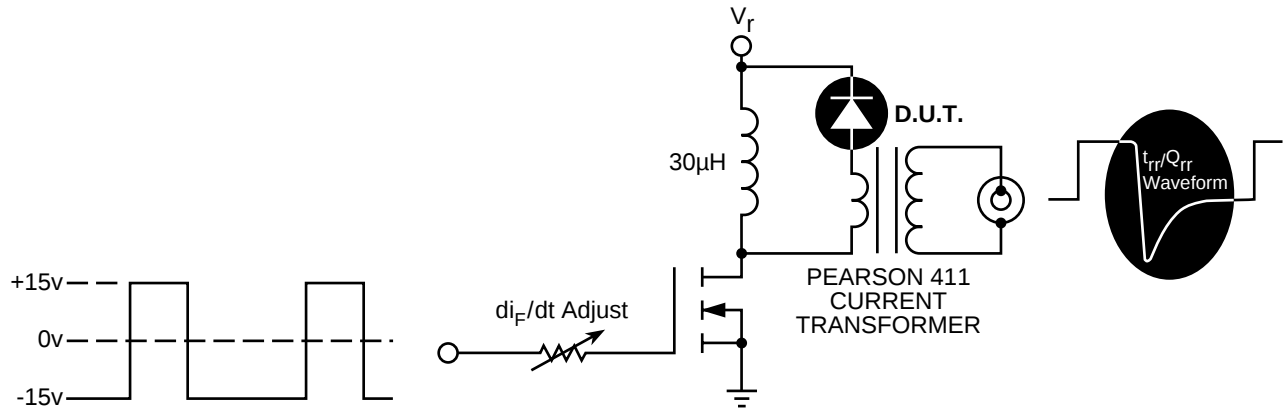


Figure 32, Diode Reverse Recovery Test Circuit and Wave Forms

1 I_F - Forward Conduction Current

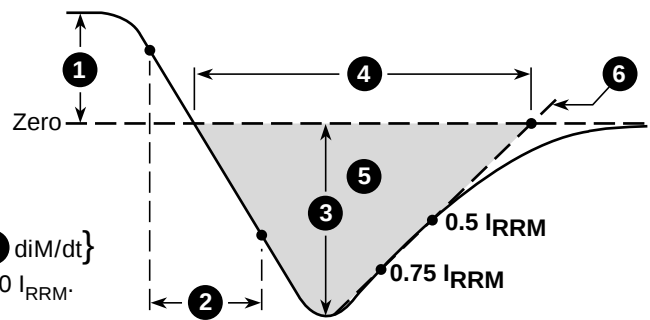
2 di_F/dt - Current Slew Rate, Rate of Forward Current Change Through Zero Crossing.

3 I_{RRM} - Peak Reverse Recovery Current.

4 t_{rr} - Reverse Recovery Time Measured from Point of I_F Current Falling Through Zero to a Tangent Line {6 di_M/dt } Extrapolated Through Zero Defined by 0.75 and 0.50 I_{RRM} .

5 Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{rr} .

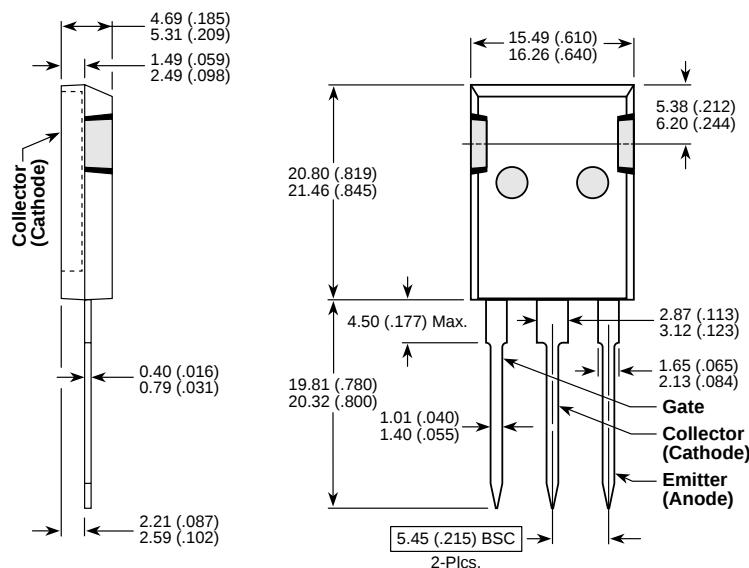
6 di_M/dt - Maximum Rate of Current Change During the Trailing Portion of t_{rr} .



$$Q_{rr} = \frac{1}{2} (t_{rr} \cdot I_{RRM})$$

Figure 33, Diode Reverse Recovery Wave Forms and Definitions

T-Max™ (B2) Package Outline



Dimensions in Millimeters and (Inches)

APT's devices are covered by one or more of the following U.S.patents:

4,895,810	5,045,903	5,089,434	5,182,234	5,019,522	5,262,336
5,256,583	4,748,103	5,283,202	5,231,474	5,434,095	5,528,058